

# TMS320F2837xS Delfino Microcontrollers

## Technical Reference Manual



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<b>Preface</b> .....	<b>78</b>
<b>1 C28x Processor</b> .....	<b>79</b>
1.1 Overview.....	80
1.1.1 Floating-Point Unit .....	80
1.1.2 Trigonometric Math Unit .....	80
1.1.3 Viterbi, Complex Math, and CRC Unit II (VCU-II) .....	81
<b>2 System Control</b> .....	<b>82</b>
2.1 Introduction.....	83
2.2 System Control Functional Description.....	83
2.2.1 Device Identification .....	83
2.2.2 Device Configuration Registers .....	83
2.3 Resets .....	84
2.3.1 Reset Sources .....	84
2.3.2 External Reset (XRS).....	84
2.3.3 Power-On Reset (POR) .....	84
2.3.4 Debugger Reset (SYSRS) .....	85
2.3.5 Watchdog Reset (WDRS).....	85
2.3.6 NMI Watchdog Reset (NMIWDRS) .....	85
2.3.7 DCSM Safe Code Copy Reset (SCCRESET).....	85
2.3.8 Hibernate Reset (HIBRESET) .....	85
2.3.9 Hardware BIST Reset (HWBISTR).....	85
2.3.10 Test Reset (TRST) .....	86
2.4 Peripheral Interrupts .....	86
2.4.1 Interrupt Concepts.....	86
2.4.2 Interrupt Architecture.....	86
2.4.3 Interrupt Entry Sequence.....	87
2.4.4 Configuring and Using Interrupts.....	88
2.4.5 PIE Channel Mapping .....	90
2.4.6 Vector Tables .....	91
2.5 Exceptions and Non-Maskable Interrupts.....	97
2.5.1 Configuring and Using NMIs.....	97
2.5.2 Emulation Considerations .....	97
2.5.3 NMI Sources .....	98
2.5.4 Illegal Instruction Trap (ITRAP).....	98
2.6 Safety Features.....	98
2.6.1 Write Protection on Registers.....	98
2.6.2 Missing Clock Detection Logic.....	99
2.6.3 PLLSLIP Detection .....	100
2.6.4 CPU1 Vector Address Validity Check.....	100
2.6.5 NMIWDs .....	101
2.6.6 ECC and Parity Enabled RAMs, Shared RAMs Protection .....	101
2.6.7 ECC Enabled Flash Memory .....	101
2.6.8 ERRORSTS Pin.....	101
2.7 Clocking .....	101
2.7.1 Clock Sources.....	102

2.7.2	Derived Clocks .....	104
2.7.3	Device Clock Domains .....	105
2.7.4	XCLKOUT.....	106
2.7.5	Clock Connectivity .....	107
2.7.6	Clock Source and PLL Setup .....	108
2.8	32-Bit CPU Timers 0/1/2.....	111
2.9	Watchdog Timers .....	113
2.9.1	Servicing the Watchdog Timer .....	113
2.9.2	Minimum Window Check .....	114
2.9.3	Watchdog Reset or Watchdog Interrupt Mode.....	114
2.9.4	Watchdog Operation in Low Power Modes .....	115
2.9.5	Emulation Considerations .....	115
2.10	Low Power Modes .....	116
2.10.1	IDLE .....	116
2.10.2	STANDBY .....	116
2.10.3	HALT .....	116
2.10.4	HIB.....	117
2.11	Memory Controller Module .....	119
2.11.1	Functional Description .....	119
2.12	Flash and OTP Memory .....	126
2.12.1	Features.....	126
2.12.2	Flash Tools .....	126
2.12.3	Default Flash Configuration .....	127
2.12.4	Flash Bank, OTP and Pump .....	127
2.12.5	Flash Module Controller (FMC) .....	127
2.12.6	Flash and OTP Power-Down Modes and Wakeup.....	128
2.12.7	Flash and OTP Performance.....	129
2.12.8	Flash Read Interface .....	130
2.12.9	Erase/Program Flash.....	132
2.12.10	Error Correction Code (ECC) Protection .....	133
2.12.11	Reserved Locations Within Flash and OTP .....	137
2.12.12	Procedure to Change the Flash Control Registers .....	137
2.12.13	Flash Pump Ownership Control .....	137
2.13	Dual Code Security Module (DCSM).....	139
2.13.1	Functional Description .....	139
2.13.2	CSM Impact on Other On-Chip Resources .....	145
2.13.3	Incorporating Code Security in User Applications .....	146
2.14	JTAG .....	150
2.15	Registers.....	152
2.15.1	Base Addresses .....	152
2.15.2	CPUTIMER_REGS Registers.....	153
2.15.3	PIE_CTRL_REGS Registers .....	160
2.15.4	WD_REGS Registers .....	212
2.15.5	NMI_INTRUPT_REGS Registers.....	218
2.15.6	XINT_REGS Registers.....	229
2.15.7	DMA_CLA_SRC_SEL_REGS Registers .....	238
2.15.8	FLASH_PUMP_SEMAPHORE_REGS Registers .....	245
2.15.9	DEV_CFG_REGS Registers .....	247
2.15.10	CLK_CFG_REGS Registers.....	292
2.15.11	CPU_SYS_REGS Registers.....	314
2.15.12	ROM_PREFETCH_REGS Registers .....	354
2.15.13	DCSM_COMMON_REGS Registers .....	356
2.15.14	DCSM_Z1_OTP Registers.....	363

2.15.15	DCSM_Z1_REGS Registers .....	370
2.15.16	DCSM_Z2_OTP Registers .....	390
2.15.17	DCSM_Z2_REGS Registers .....	397
2.15.18	MEM_CFG_REGS Registers .....	417
2.15.19	ACCESS_PROTECTION_REGS Registers .....	463
2.15.20	MEMORY_ERROR_REGS Registers .....	486
2.15.21	ROM_WAIT_STATE_REGS Registers .....	503
2.15.22	FLASH_CTRL_REGS Registers .....	505
2.15.23	FLASH_ECC_REGS Registers .....	514
2.15.24	UID_REGS Registers .....	537
<b>3</b>	<b>ROM Code and Peripheral Booting .....</b>	<b>546</b>
3.1	Introduction .....	547
3.2	Device Boot Philosophy .....	547
3.3	Device Boot Modes .....	547
3.4	Configuring Boot Mode Pins .....	548
3.5	Configuring Get Boot Options .....	549
3.6	Configuring Emulation Boot Options .....	550
3.7	Device Boot Flow Diagrams .....	551
3.7.1	Emulation Boot Flow Diagrams .....	551
3.7.2	Standalone and Hibernate Boot Flow Diagrams .....	552
3.8	Device Reset and Exception Handling .....	553
3.8.1	Reset Causes and Handling .....	553
3.8.2	Exceptions and Interrupts Handling .....	554
3.9	Boot ROM Description .....	554
3.9.1	Entry Points .....	554
3.9.2	Wait Points .....	555
3.9.3	Memory Maps .....	555
3.9.4	Boot Modes .....	557
3.9.5	Boot Data Stream Structure .....	570
3.9.6	GPIO Assignments .....	572
3.9.7	Clock Initializations .....	574
3.9.8	Wait State Configuration .....	574
3.9.9	Boot Status information .....	574
3.9.10	ROM Version .....	575
<b>4</b>	<b>Direct Memory Access (DMA) .....</b>	<b>576</b>
4.1	Introduction .....	577
4.2	Architecture .....	578
4.2.1	Block Diagram .....	578
4.2.2	Common Peripheral Architecture .....	578
4.2.3	Peripheral Interrupt Event Trigger Sources .....	579
4.2.4	DMA Bus .....	584
4.3	Pipeline Timing and Throughput .....	584
4.4	CPU Arbitration .....	585
4.5	Channel Priority .....	586
4.5.1	Round-Robin Mode .....	586
4.5.2	Channel 1 High Priority Mode .....	587
4.6	Address Pointer and Transfer Control .....	588
4.7	Overrun Detection Feature .....	592
4.8	Register Descriptions .....	594
4.8.1	DMA Control Register (DMACTRL) — EALLOW Protected .....	595
4.8.2	Debug Control Register (DEBUGCTRL) — EALLOW Protected .....	596
4.8.3	Revision Register (REVISION) .....	596
4.8.4	Priority Control Register 1 (PRIORITYCTRL1) — EALLOW Protected .....	597



4.8.5	Priority Status Register (PRIORITYSTAT) .....	598
4.8.6	Mode Register (MODE) — EALLOW Protected .....	599
4.8.7	Control Register (CONTROL) — EALLOW Protected .....	601
4.8.8	Burst Size Register (BURST_SIZE) — EALLOW Protected .....	603
4.8.9	BURST_COUNT Register .....	603
4.8.10	Source Burst Step Register Size (SRC_BURST_STEP) — EALLOW Protected .....	604
4.8.11	Destination Burst Step Register Size (DST_BURST_STEP) — EALLOW Protected .....	605
4.8.12	Transfer Size Register (TRANSFER_SIZE) — EALLOW Protected .....	605
4.8.13	Transfer Count Register (TRANSFER_COUNT) .....	606
4.8.14	Source Transfer Step Size Register (SRC_TRANSFER_STEP) — EALLOW Protected .....	606
4.8.15	Destination Transfer Step Size Register (DST_TRANSFER_STEP) — EALLOW Protected .....	607
4.8.16	Source/Destination Wrap Size Register (SRC/DST_WRAP_SIZE) — EALLOW protected) .....	607
4.8.17	Source/Destination Wrap Count Register (SCR/DST_WRAP_COUNT) .....	608
4.8.18	Source/Destination Wrap Step Size Registers (SRC/DST_WRAP_STEP) — EALLOW Protected .....	608
4.8.19	Shadow Source Begin and Current Address Pointer Registers (SRC_BEG_ADDR_SHADOW/DST_BEG_ADDR_SHADOW) — All EALLOW Protected .....	609
4.8.20	Active Source Begin and Current Address Pointer Registers (SRC_BEG_ADDR/DST_BEG_ADDR) .....	609
4.8.21	Shadow Destination Begin and Current Address Pointer Registers (SRC_ADDR_SHADOW/DST_ADDR_SHADOW) — All EALLOW Protected .....	610
4.8.22	Active Destination Begin and Current Address Pointer Registers (SRC_ADDR/DST_ADDR) .....	610
<b>5</b>	<b>Control Law Accelerator (CLA) .....</b>	<b>611</b>
5.1	Control Law Accelerator (CLA) Overview .....	612
5.2	CLA Interface .....	614
5.2.1	CLA Memory .....	614
5.2.2	CLA Memory Bus .....	615
5.2.3	Shared Peripherals and EALLOW Protection .....	615
5.2.4	CLA Tasks and Interrupt Vectors .....	616
5.2.5	CLA Software Interrupt to CPU .....	618
5.3	CLA and CPU Arbitration .....	618
5.3.1	CLA and CPU Arbitration .....	618
5.3.2	CLA Message RAM .....	618
5.4	CLA Configuration and Debug .....	620
5.4.1	Building a CLA Application .....	620
5.4.2	Typical CLA Initialization Sequence .....	620
5.4.3	Debugging CLA Code .....	622
5.4.4	CLA Illegal Opcode Behavior .....	623
5.4.5	Resetting the CLA .....	623
5.5	Pipeline .....	624
5.5.1	Pipeline Overview .....	624
5.5.2	CLA Pipeline Alignment .....	624
5.5.3	Parallel Instructions .....	627
5.6	Instruction Set .....	629
5.6.1	Instruction Descriptions .....	629
5.6.2	Addressing Modes and Encoding .....	631
5.6.3	Instructions .....	633
5.7	Registers .....	744
5.7.1	CLA Base Addresses .....	744
5.7.2	CLA_REGS Registers .....	745
5.7.3	CLA_SOFTINT_REGS Registers .....	780
<b>6</b>	<b>General-Purpose Input/Output (GPIO) .....</b>	<b>785</b>
6.1	GPIO Overview .....	786
6.2	Configuration Overview .....	787

6.3	Digital General-Purpose I/O Control.....	787
6.4	Input Qualification.....	789
6.4.1	No Synchronization (Asynchronous Input) .....	789
6.4.2	Synchronization to SYSCLKOUT Only.....	789
6.4.3	Qualification Using a Sampling Window .....	789
6.5	USB Signals .....	792
6.6	SPI Signals .....	792
6.7	GPIO and Peripheral Muxing.....	794
6.8	Internal Pullup Configuration Requirements.....	795
6.9	Registers .....	797
6.9.1	GPIO Base Addresses .....	797
6.9.2	GPIO_CTRL_REGS Registers.....	798
6.9.3	GPIO_DATA_REGS Registers .....	963
<b>7</b>	<b>Crossbar (X-BAR).....</b>	<b>1013</b>
7.1	GPIO Input X-BAR .....	1014
7.2	ePWM and GPIO Output X-BAR .....	1015
7.2.1	ePWM X-BAR.....	1015
7.2.2	GPIO Output X-BAR .....	1018
7.2.3	X-BAR Flags .....	1019
7.3	X-BAR Registers .....	1021
7.3.1	X-BAR Base Addresses .....	1021
7.3.2	INPUT_XBAR_REGS Registers .....	1022
7.3.3	XBAR_REGS Registers .....	1041
7.3.4	EPWM_XBAR_REGS Registers .....	1054
7.3.5	OUTPUT_XBAR_REGS Registers .....	1147
<b>8</b>	<b>Analog Subsystem .....</b>	<b>1248</b>
8.1	Analog Subsystem .....	1249
8.1.1	Features .....	1249
8.1.2	Block Diagram .....	1249
8.1.3	Lock Registers .....	1252
8.2	Registers .....	1253
8.2.1	Analog Subsystem Base Addresses.....	1253
8.2.2	ANALOG_SUBSYS_REGS Registers.....	1254
<b>9</b>	<b>Analog-to-Digital Converter (ADC).....</b>	<b>1263</b>
9.1	Analog-to-Digital Converter (ADC).....	1264
9.1.1	Features .....	1264
9.1.2	ADC Block Diagram.....	1264
9.1.3	ADC Configurability .....	1265
9.1.4	SOC Principle of Operation .....	1269
9.1.5	SOC Configuration Examples .....	1272
9.1.6	ADC Conversion Priority .....	1274
9.1.7	Burst Mode .....	1277
9.1.8	EOC and Interrupt Operation .....	1279
9.1.9	Post-Processing Blocks .....	1279
9.1.10	Opens/Shorts Detection Circuit (OSDETECT) .....	1282
9.1.11	Power-Up Sequence.....	1283
9.1.12	ADC Calibration .....	1283
9.2	ADC Timings.....	1284
9.2.1	ADC Timing Diagrams.....	1284
9.3	Additional Information.....	1289
9.3.1	Ensuring Synchronous Operation .....	1289
9.3.2	Choosing an Acquisition Window Duration .....	1293
9.3.3	Achieving Simultaneous Sampling .....	1294

9.3.4	Designing an External Reference Circuit.....	1294
9.3.5	Internal Temperature Sensor .....	1296
9.4	Registers .....	1297
9.4.1	ADC Base Addresses.....	1297
9.4.2	ADC_REGS Registers.....	1298
9.4.3	ADC_RESULT_REGS Registers.....	1436
<b>10</b>	<b>Buffered Digital to Analog Converter (DAC) .....</b>	<b>1457</b>
10.1	Buffered Digital to Analog Converter (DAC) Overview .....	1458
10.1.1	Features .....	1458
10.1.2	Block Diagram .....	1458
10.2	Using the DAC.....	1458
10.3	Lock Registers.....	1459
10.4	Registers .....	1459
10.4.1	DAC Base Addresses .....	1459
10.4.2	DAC_REGS Registers.....	1460
<b>11</b>	<b>Comparator Subsystem (CMPSS).....</b>	<b>1468</b>
11.1	CMPSS Overview .....	1469
11.1.1	Features .....	1469
11.1.2	Block Diagram .....	1469
11.2	Comparator.....	1470
11.3	Internal DAC .....	1470
11.4	Ramp Generator.....	1471
11.5	Digital Filter .....	1472
11.6	Registers .....	1474
11.6.1	CMPSS Base Addresses.....	1474
11.6.2	CMPSS_REGS Registers.....	1475
<b>12</b>	<b>Sigma Delta Filter Module (SDFM).....</b>	<b>1500</b>
12.1	SDFM Module Overview .....	1501
12.1.1	SDFM Features.....	1501
12.1.2	Block Diagram .....	1501
12.2	Configuring Device Pins.....	1503
12.3	Input Control Unit.....	1504
12.4	Comparator Unit .....	1505
12.5	Data Filter Unit.....	1506
12.5.1	32-bit or 16-bit Data Filter Output Representation.....	1508
12.5.2	Data Rate and Latency of the Sinc Filter .....	1509
12.6	Interrupt Unit .....	1510
12.7	Register Descriptions .....	1512
12.8	Registers .....	1513
12.8.1	SDFM Base Addresses.....	1513
12.8.2	SDFM_REGS Registers.....	1514
<b>13</b>	<b>Enhanced Pulse Width Modulator (ePWM) .....</b>	<b>1550</b>
13.1	Introduction.....	1551
13.1.1	Submodule Overview .....	1553
13.2	Configuring Device Pins .....	1558
13.3	Overview.....	1558
13.4	Time-Base (TB) Submodule .....	1560
13.4.1	Purpose of the Time-Base Submodule.....	1560
13.4.2	Controlling and Monitoring the Time-Base Submodule .....	1561
13.4.3	Calculating PWM Period and Frequency .....	1562
13.4.4	Phase Locking the Time-Base Clocks of Multiple ePWM Modules.....	1566
13.4.5	Simultaneous Writes to TBPRD and CMPx Registers Between ePWM Modules .....	1566

13.4.6	Time-Base Counter Modes and Timing Waveforms.....	1567
13.4.7	Global Load .....	1569
13.5	Counter-Compare (CC) Submodule .....	1571
13.5.1	Purpose of the Counter-Compare Submodule .....	1571
13.5.2	Controlling and Monitoring the Counter-Compare Submodule.....	1571
13.5.3	Operational Highlights for the Counter-Compare Submodule.....	1572
13.5.4	Count Mode Timing Waveforms .....	1574
13.6	Action-Qualifier (AQ) Submodule .....	1577
13.6.1	Purpose of the Action-Qualifier Submodule .....	1578
13.6.2	Action-Qualifier Submodule Control and Status Register Definitions .....	1578
13.6.3	Action-Qualifier Event Priority .....	1581
13.6.4	AQCTLA and AQCTLB Shadow Mode Operations .....	1582
13.6.5	Waveforms for Common Configurations .....	1584
13.7	Dead-Band Generator (DB) Submodule .....	1590
13.7.1	Purpose of the Dead-Band Submodule .....	1591
13.7.2	Dead-band Submodule Additional Operating Modes.....	1591
13.7.3	Operational Highlights for the Dead-Band Submodule.....	1592
13.8	PWM Chopper (PC) Submodule .....	1597
13.8.1	Purpose of the PWM Chopper Submodule .....	1597
13.8.2	Operational Highlights for the PWM Chopper Submodule.....	1597
13.8.3	Waveforms .....	1598
13.9	Trip-Zone (TZ) Submodule.....	1601
13.9.1	Purpose of the Trip-Zone Submodule .....	1601
13.9.2	Operational Highlights for the Trip-Zone Submodule.....	1601
13.9.3	Generating Trip Event Interrupts .....	1604
13.10	Event-Trigger (ET) Submodule.....	1606
13.10.1	Operational Overview of the ePWM Type 4 Event-Trigger Submodule .....	1607
13.11	Digital Compare (DC) Submodule .....	1612
13.11.1	Purpose of the Digital Compare Submodule .....	1613
13.11.2	Enhanced Trip Action .....	1614
13.11.3	Using CMPSS to Trip the ePWM on a Cycle-by-Cycle Basis .....	1614
13.11.4	Operation Highlights of the Digital Compare Submodule .....	1614
13.12	EPWM X-BAR .....	1620
13.13	Applications to Power Topologies .....	1621
13.13.1	Overview of Multiple Modules .....	1621
13.13.2	Key Configuration Capabilities .....	1622
13.13.3	Controlling Multiple Buck Converters With Independent Frequencies.....	1623
13.13.4	Controlling Multiple Buck Converters With Same Frequencies.....	1626
13.13.5	Controlling Multiple Half H-Bridge (HHB) Converters .....	1627
13.13.6	Controlling Dual 3-Phase Inverters for Motors (ACI and PMSM) .....	1629
13.13.7	Practical Applications Using Phase Control Between PWM Modules .....	1631
13.13.8	Controlling a 3-Phase Interleaved DC/DC Converter .....	1632
13.13.9	Controlling Zero Voltage Switched Full Bridge (ZVSFB) Converter.....	1635
13.13.10	Controlling a Peak Current Mode Controlled Buck Module.....	1636
13.13.11	Controlling H-Bridge LLC Resonant Converter.....	1637
13.14	Registers .....	1639
13.14.1	EPWM Base Addresses .....	1639
13.14.2	EPWM_REGS Registers .....	1640
13.14.3	EPWM_XBAR_REGS Registers.....	1776
13.14.4	SYNC_SOC_REGS Registers .....	1869
<b>14</b>	<b>High-Resolution Pulse Width Modulator (HRPWM).....</b>	<b>1877</b>
14.1	Introduction.....	1878
14.2	Operational Description of HRPWM .....	1880

14.2.1	Controlling the HRPWM Capabilities .....	1880
14.2.2	Configuring the HRPWM .....	1883
14.2.3	Configuring Hi-Res in Deadband Rising Edge and Falling Edge Delay .....	1884
14.2.4	Principle of Operation.....	1884
14.2.5	Deadband High Resolution Operation .....	1894
14.2.6	Scale Factor Optimizing Software (SFO) .....	1895
14.2.7	HRPWM Examples Using Optimized Assembly Code .....	1895
14.3	Appendix A: SFO Library Software - SFO_TI_Build_V7.lib.....	1901
14.3.1	Scale Factor Optimizer Function - int SFO() .....	1901
14.3.2	Software Usage .....	1902
<b>15</b>	<b>Enhanced Capture (eCAP).....</b>	<b>1904</b>
15.1	Introduction.....	1905
15.2	Description .....	1905
15.3	Configuring Device Pins for the eCAP .....	1905
15.4	Capture and APWM Operating Mode .....	1906
15.5	Capture Mode Description .....	1907
15.5.1	Event Prescaler.....	1908
15.5.2	Edge Polarity Select and Qualifier .....	1909
15.5.3	Continuous/One-Shot Control .....	1909
15.5.4	32-Bit Counter and Phase Control .....	1910
15.5.5	CAP1-CAP4 Registers .....	1911
15.5.6	Using SWSYNC with the ECAP Module .....	1911
15.5.7	Interrupt Control .....	1912
15.5.8	Shadow Load and Lockout Control .....	1914
15.5.9	APWM Mode Operation .....	1914
15.6	Application of the ECAP Module .....	1915
15.6.1	Example 1 - Absolute Time-Stamp Operation Rising Edge Trigger.....	1915
15.6.2	Example 2 - Absolute Time-Stamp Operation Rising and Falling Edge Trigger.....	1918
15.6.3	Example 3 - Time Difference (Delta) Operation Rising Edge Trigger.....	1920
15.6.4	Example 4 - Time Difference (Delta) Operation Rising and Falling Edge Trigger.....	1922
15.7	Application of the APWM Mode .....	1924
15.7.1	Example 1 - Simple PWM Generation (Independent Channel/s).....	1924
15.8	Registers .....	1926
15.8.1	eCAP Base Addresses .....	1926
15.8.2	ECAP_REGS Registers .....	1927
<b>16</b>	<b>Enhanced QEP (eQEP).....</b>	<b>1944</b>
16.1	Introduction.....	1945
16.2	Configuring Device Pins .....	1947
16.3	Description .....	1947
16.3.1	EQEP Inputs .....	1947
16.3.2	Functional Description .....	1948
16.3.3	eQEP Memory Map.....	1949
16.4	Quadrature Decoder Unit (QDU) .....	1950
16.4.1	Position Counter Input Modes .....	1950
16.4.2	eQEP Input Polarity Selection .....	1953
16.4.3	Position-Compare Sync Output .....	1953
16.5	Position Counter and Control Unit (PCCU) .....	1953
16.5.1	Position Counter Operating Modes .....	1953
16.5.2	Position Counter Latch .....	1955
16.5.3	Position Counter Initialization.....	1957
16.5.4	eQEP Position-compare Unit.....	1958
16.6	eQEP Edge Capture Unit .....	1959
16.7	eQEP Watchdog.....	1963

16.8	Unit Timer Base .....	1963
16.9	eQEP Interrupt Structure .....	1964
16.10	Registers .....	1965
16.10.1	eQEP Base Addresses .....	1965
16.10.2	EQEP_REGS Registers .....	1966
<b>17</b>	<b>Serial Peripheral Interface (SPI) .....</b>	<b>2000</b>
17.1	SPI Module Overview .....	2001
17.1.1	Features .....	2001
17.1.2	CPU Interface .....	2001
17.2	System-Level Integration .....	2002
17.2.1	SPI Module Signals .....	2002
17.2.2	Configuring Device Pins .....	2003
17.2.3	SPI Interrupts .....	2003
17.2.4	DMA Support .....	2005
17.3	SPI Operation .....	2006
17.3.1	Introduction to Operation .....	2006
17.3.2	Master Mode .....	2007
17.3.3	Slave Mode .....	2008
17.3.4	Data Format .....	2009
17.3.5	Baud Rate Selection .....	2010
17.3.6	SPI Clocking Schemes .....	2011
17.3.7	SPI FIFO Description .....	2012
17.3.8	SPI DMA Transfers .....	2013
17.3.9	SPI High-Speed Mode .....	2014
17.3.10	SPI 3-Wire Mode Description .....	2014
17.4	Programming Procedure .....	2015
17.4.1	Initialization Upon Reset .....	2015
17.4.2	Configuring the SPI .....	2016
17.4.3	Configuring the SPI for High-Speed Mode .....	2016
17.4.4	Data Transfer Example .....	2017
17.4.5	SPI STEINV Bit in Digital Audio Transfers .....	2018
17.5	Registers .....	2020
17.5.1	SPI Base Addresses .....	2020
17.5.2	SPI_REGS Registers .....	2021
<b>18</b>	<b>Serial Communications Interface (SCI) .....</b>	<b>2040</b>
18.1	Enhanced SCI Module Overview .....	2041
18.2	Architecture .....	2042
18.3	SCI Module Signal Summary .....	2043
18.4	Configuring Device Pins .....	2043
18.5	Multiprocessor and Asynchronous Communication Modes .....	2043
18.6	SCI Programmable Data Format .....	2044
18.7	SCI Multiprocessor Communication .....	2044
18.7.1	Recognizing the Address Byte .....	2045
18.7.2	Controlling the SCI TX and RX Features .....	2045
18.7.3	Receipt Sequence .....	2045
18.8	Idle-Line Multiprocessor Mode .....	2045
18.8.1	Idle-Line Mode Steps .....	2046
18.8.2	Block Start Signal .....	2046
18.8.3	Wake-UP Temporary (WUT) Flag .....	2046
18.8.4	Receiver Operation .....	2047
18.9	Address-Bit Multiprocessor Mode .....	2047
18.9.1	Sending an Address .....	2047
18.10	SCI Communication Format .....	2048

18.10.1	Receiver Signals in Communication Modes.....	2049
18.10.2	Transmitter Signals in Communication Modes.....	2049
18.11	SCI Port Interrupts .....	2050
18.12	SCI Baud Rate Calculations.....	2050
18.13	SCI Enhanced Features.....	2051
18.13.1	SCI FIFO Description .....	2051
18.13.2	SCI Auto-Baud .....	2052
18.13.3	Autobaud-Detect Sequence .....	2053
18.14	Registers .....	2054
18.14.1	SCI Base Addresses .....	2054
18.14.2	SCI_REGS Registers .....	2055
<b>19</b>	<b>Inter-Integrated Circuit Module (I2C).....</b>	<b>2075</b>
19.1	Introduction to the I2C Module .....	2076
19.1.1	Features .....	2076
19.1.2	Features Not Supported.....	2076
19.1.3	Functional Overview .....	2077
19.1.4	Clock Generation.....	2078
19.1.5	I2C Clock Divider Registers (I2CCLKL and I2CCLKH) .....	2079
19.2	Configuring Device Pins .....	2080
19.3	I2C Module Operational Details .....	2080
19.3.1	Input and Output Voltage Levels .....	2080
19.3.2	Data Validity .....	2080
19.3.3	Operating Modes .....	2080
19.3.4	I2C Module START and STOP Conditions .....	2081
19.3.5	Serial Data Formats.....	2082
19.3.6	NACK Bit Generation .....	2084
19.3.7	Clock Synchronization .....	2085
19.3.8	Arbitration .....	2085
19.3.9	Digital Loopback Mode .....	2086
19.4	Interrupt Requests Generated by the I2C Module .....	2087
19.4.1	Basic I2C Interrupt Requests .....	2087
19.4.2	I2C FIFO Interrupts .....	2088
19.5	Resetting or Disabling the I2C Module .....	2089
19.6	Registers .....	2090
19.6.1	I2C Base Addresses .....	2090
19.6.2	I2C_REGS Registers .....	2091
<b>20</b>	<b>Multichannel Buffered Serial Port (McBSP) .....</b>	<b>2115</b>
20.1	Overview.....	2116
20.1.1	Features of the McBSPs .....	2116
20.1.2	McBSP Pins/Signals .....	2117
20.2	Configuring Device Pins .....	2118
20.3	McBSP Operation .....	2118
20.3.1	Data Transfer Process of McBSPs .....	2119
20.3.2	Companding (Compressing and Expanding) Data.....	2120
20.3.3	Clocking and Framing Data .....	2121
20.3.4	Frame Phases .....	2124
20.3.5	McBSP Reception.....	2126
20.3.6	McBSP Transmission.....	2127
20.3.7	Interrupts and DMA Events Generated by a McBSP .....	2128
20.4	McBSP Sample Rate Generator .....	2128
20.4.1	Block Diagram .....	2129
20.4.2	Frame Synchronization Generation in the Sample Rate Generator.....	2132
20.4.3	Synchronizing Sample Rate Generator Outputs to an External Clock .....	2132



20.4.4	Reset and Initialization Procedure for the Sample Rate Generator .....	2134
20.5	McBSP Exception/Error Conditions .....	2135
20.5.1	Types of Errors .....	2135
20.5.2	Overrun in the Receiver .....	2135
20.5.3	Unexpected Receive Frame-Synchronization Pulse .....	2137
20.5.4	Overwrite in the Transmitter .....	2139
20.5.5	Underflow in the Transmitter.....	2140
20.5.6	Unexpected Transmit Frame-Synchronization Pulse.....	2141
20.6	Multichannel Selection Modes.....	2143
20.6.1	Channels, Blocks, and Partitions.....	2143
20.6.2	Multichannel Selection.....	2144
20.6.3	Configuring a Frame for Multichannel Selection .....	2144
20.6.4	Using Two Partitions .....	2144
20.6.5	Using Eight Partitions .....	2146
20.6.6	Receive Multichannel Selection Mode.....	2147
20.6.7	Transmit Multichannel Selection Modes .....	2147
20.6.8	Using Interrupts Between Block Transfers.....	2149
20.7	SPI Operation Using the Clock Stop Mode .....	2150
20.7.1	SPI Protocol.....	2150
20.7.2	Clock Stop Mode .....	2151
20.7.3	Bits Used to Enable and Configure the Clock Stop Mode .....	2151
20.7.4	Clock Stop Mode Timing Diagrams.....	2152
20.7.5	Procedure for Configuring a McBSP for SPI Operation .....	2154
20.7.6	McBSP as the SPI Master .....	2154
20.7.7	McBSP as an SPI Slave.....	2156
20.8	Receiver Configuration .....	2157
20.8.1	Programming the McBSP Registers for the Desired Receiver Operation .....	2157
20.8.2	Resetting and Enabling the Receiver.....	2158
20.8.3	Set the Receiver Pins to Operate as McBSP Pins .....	2158
20.8.4	Enable/Disable the Digital Loopback Mode.....	2159
20.8.5	Enable/Disable the Clock Stop Mode.....	2159
20.8.6	Enable/Disable the Receive Multichannel Selection Mode .....	2160
20.8.7	Choose One or Two Phases for the Receive Frame .....	2160
20.8.8	Set the Receive Word Length(s) .....	2161
20.8.9	Set the Receive Frame Length .....	2161
20.8.10	Enable/Disable the Receive Frame-Synchronization Ignore Function.....	2162
20.8.11	Set the Receive Companding Mode .....	2163
20.8.12	Set the Receive Data Delay .....	2164
20.8.13	Set the Receive Sign-Extension and Justification Mode .....	2166
20.8.14	Set the Receive Interrupt Mode.....	2167
20.8.15	Set the Receive Frame-Synchronization Mode.....	2167
20.8.16	Set the Receive Frame-Synchronization Polarity.....	2169
20.8.17	Set the Receive Clock Mode .....	2171
20.8.18	Set the Receive Clock Polarity.....	2172
20.8.19	Set the SRG Clock Divide-Down Value.....	2174
20.8.20	Set the SRG Clock Synchronization Mode .....	2174
20.8.21	Set the SRG Clock Mode (Choose an Input Clock).....	2175
20.8.22	Set the SRG Input Clock Polarity .....	2176
20.9	Transmitter Configuration .....	2176
20.9.1	Programming the McBSP Registers for the Desired Transmitter Operation .....	2176
20.9.2	Resetting and Enabling the Transmitter.....	2177
20.9.3	Set the Transmitter Pins to Operate as McBSP Pins .....	2178
20.9.4	Enable/Disable the Digital Loopback Mode.....	2178



20.9.5	Enable/Disable the Clock Stop Mode.....	2178
20.9.6	Enable/Disable Transmit Multichannel Selection .....	2179
20.9.7	Choose One or Two Phases for the Transmit Frame .....	2181
20.9.8	Set the Transmit Word Length(s) .....	2181
20.9.9	Set the Transmit Frame Length .....	2182
20.9.10	Enable/Disable the Transmit Frame-Synchronization Ignore Function.....	2183
20.9.11	Set the Transmit Companding Mode.....	2184
20.9.12	Set the Transmit Data Delay .....	2185
20.9.13	Set the Transmit DXENA Mode.....	2187
20.9.14	Set the Transmit Interrupt Mode .....	2187
20.9.15	Set the Transmit Frame-Synchronization Mode .....	2188
20.9.16	Set the Transmit Frame-Synchronization Polarity.....	2189
20.9.17	Set the SRG Frame-Synchronization Period and Pulse Width .....	2190
20.9.18	Set the Transmit Clock Mode .....	2191
20.9.19	Set the Transmit Clock Polarity .....	2191
20.10	Emulation and Reset Considerations .....	2192
20.10.1	McBSP Emulation Mode.....	2193
20.10.2	Resetting and Initializing McBSPs.....	2193
20.11	Data Packing Examples.....	2195
20.11.1	Data Packing Using Frame Length and Word Length .....	2195
20.11.2	Data Packing Using Word Length and the Frame-Synchronization Ignore Function .....	2197
20.12	Interrupt Generation .....	2197
20.12.1	McBSP Receive Interrupt Generation.....	2198
20.12.2	McBSP Transmit Interrupt Generation .....	2198
20.12.3	Error Flags .....	2199
20.13	McBSP Modes.....	2199
20.14	McBSP Registers .....	2201
20.14.1	McBSP Base Addresses.....	2201
20.14.2	Data Receive Registers (DRR[1,2]) .....	2202
20.14.3	Data Transmit Registers (DXR[1,2]) .....	2202
20.14.4	Serial Port Control Registers (SPCR[1,2]) .....	2203
20.14.5	Receive Control Registers (RCR[1, 2]) .....	2208
20.14.6	Transmit Control Registers (XCR1 and XCR2) .....	2210
20.14.7	Sample Rate Generator Registers (SRGR1 and SRGR2) .....	2213
20.14.8	Multichannel Control Registers (MCR[1,2]) .....	2215
20.14.9	Pin Control Register (PCR).....	2220
20.14.10	Receive Channel Enable Registers (RCERA, RCERB, RCERC, RCERD, RCERE, RCERF, RCERG, RCERH) .....	2222
20.14.11	Transmit Channel Enable Registers (XCERA, XCERB, XCERC, XCERD, XCERE, XCERF, XCERG, XCERH) .....	2224
20.14.12	McBSP Interrupt Enable Register.....	2226
<b>21</b>	<b>Controller Area Network (CAN) .....</b>	<b>2227</b>
21.1	Overview.....	2228
21.1.1	Features .....	2228
21.1.2	Functional Description .....	2228
21.1.3	Block Diagram .....	2229
21.2	Configuring Device Pins .....	2230
21.3	Address/Data Bus Bridge .....	2230
21.4	Operating Modes .....	2231
21.4.1	Initialization .....	2231
21.4.2	CAN Message Transfer (Normal Operation) .....	2232
21.4.3	Test Modes .....	2233
21.5	Multiple Clock Source .....	2236
21.6	Interrupt Functionality .....	2236

21.6.1	Message Object Interrupts .....	2236
21.6.2	Status Change Interrupts .....	2236
21.6.3	Error Interrupts .....	2236
21.6.4	PIE Nomenclature for DCAN Interrupts .....	2237
21.7	Parity Check Mechanism .....	2237
21.7.1	Behavior on Parity Error .....	2237
21.8	Debug Mode .....	2237
21.9	Module Initialization .....	2238
21.10	Configuration of Message Objects .....	2238
21.10.1	Configuration of a Transmit Object for Data Frames .....	2238
21.10.2	Configuration of a Transmit Object for Remote Frames .....	2239
21.10.3	Configuration of a Single Receive Object for Data Frames .....	2239
21.10.4	Configuration of a Single Receive Object for Remote Frames .....	2239
21.10.5	Configuration of a FIFO Buffer .....	2240
21.11	Message Handling .....	2240
21.11.1	Message Handler Overview .....	2240
21.11.2	Receive/Transmit Priority .....	2240
21.11.3	Transmission of Messages in Event Driven CAN Communication .....	2241
21.11.4	Updating a Transmit Object .....	2241
21.11.5	Changing a Transmit Object .....	2241
21.11.6	Acceptance Filtering of Received Messages .....	2242
21.11.7	Reception of Data Frames .....	2242
21.11.8	Reception of Remote Frames .....	2242
21.11.9	Reading Received Messages .....	2243
21.11.10	Requesting New Data for a Receive Object .....	2243
21.11.11	Storing Received Messages in FIFO Buffers .....	2243
21.11.12	Reading from a FIFO Buffer .....	2243
21.12	CAN Bit Timing .....	2244
21.12.1	Bit Time and Bit Rate .....	2245
21.12.2	Configuration of the CAN Bit Timing .....	2249
21.13	Message Interface Register Sets .....	2252
21.13.1	Message Interface Register Sets 1 and 2 .....	2253
21.13.2	IF3 Register Set .....	2254
21.14	Message RAM .....	2254
21.14.1	Structure of Message Objects .....	2254
21.14.2	Addressing Message Objects in RAM .....	2256
21.14.3	Message RAM Representation in Debug Mode .....	2257
21.15	Registers .....	2259
21.15.1	CAN Base Addresses .....	2259
21.15.2	CAN_REGS Registers .....	2260
<b>22</b>	<b>Universal Serial Bus (USB) Controller .....</b>	<b>2321</b>
22.1	Introduction .....	2322
22.2	Features .....	2322
22.2.1	Block Diagram .....	2322
22.2.2	Signal Description .....	2323
22.2.3	VBus Recommendations .....	2323
22.3	Functional Description .....	2324
22.3.1	Operation as a Device .....	2324
22.3.2	Operation as a Host .....	2328
22.3.3	DMA Operation .....	2331
22.3.4	Address/Data Bus Bridge .....	2331
22.4	Initialization and Configuration .....	2333
22.4.1	Pin Configuration .....	2333

22.4.2	Endpoint Configuration .....	2333
22.5	Register Map .....	2334
22.6	Register Descriptions .....	2349
22.6.1	USB Device Functional Address Register (USBFADDR), offset 0x000.....	2349
22.6.2	USB Power Management Register (USBPOWER), offset 0x001.....	2350
22.6.3	USB Transmit Interrupt Status Register (USBTXIS), offset 0x002 .....	2352
22.6.4	USB Receive Interrupt Status Register (USBRXIS), offset 0x004.....	2354
22.6.5	USB Transmit Interrupt Enable Register (USBTXIE), offset 0x006 .....	2356
22.6.6	USB Receive Interrupt Enable Register (USBRXIE), offset 0x008 .....	2358
22.6.7	USB General Interrupt Status Register (USBIS), offset 0x00A .....	2360
22.6.8	USB Interrupt Enable Register (USBIE), offset 0x00B .....	2362
22.6.9	USB Frame Value Register (USBFRAME), offset 0x00C.....	2364
22.6.10	USB Endpoint Index Register (USBEPIDX), offset 0x00E .....	2364
22.6.11	USB Test Mode Register (USBTEST), offset 0x00F.....	2365
22.6.12	USB FIFO Endpoint n Register (USBFIFO[0]-USBFIFO[15]).....	2367
22.6.13	USB Device Control Register (USBDEVCTL), offset 0x060 .....	2368
22.6.14	USB Transmit Dynamic FIFO Sizing Register (USBTXFIFOSZ), offset 0x062.....	2370
22.6.15	USB Receive Dynamic FIFO Sizing Register (USBRXFIFOSZ), offset 0x063 .....	2371
22.6.16	USB Transmit FIFO Start Address Register (USBTXFIFOADD), offset 0x064.....	2372
22.6.17	USB Receive FIFO Start Address Register (USBRXFIFOADD), offset 0x066 .....	2373
22.6.18	USB Connect Timing Register (USBCONTIM), offset 0x07A.....	2374
22.6.19	USB Full-Speed Last Transaction to End of Frame Timing Register (USBFSEOF), offset 0x07D .....	2375
22.6.20	USB Low-Speed Last Transaction to End of Frame Timing Register (USBLSEOF), offset 0x07E .....	2375
22.6.21	USB Transmit Functional Address Endpoint n Registers (USBTXFUNCADDR[0]- USBTXFUNCADDR[15]) .....	2376
22.6.22	USB Transmit Hub Address Endpoint n Registers (USBTXHUBADDR[0]- USBTXHUBADDR[15]) .....	2377
22.6.23	USB Transmit Hub Port Endpoint n Registers (USBTXHUBPORT[0]-USBTXHUBPORT[15]) ...	2378
22.6.24	USB Receive Functional Address Endpoint n Registers (USBRXFUNCADDR[1]- USBRXFUNCADDR[15]) .....	2379
22.6.25	USB Receive Hub Address Endpoint n Registers (USBRXHUBADDR[1]- USBRXHUBADDR[15]).....	2380
22.6.26	USB Receive Hub Port Endpoint n Registers (USBRXHUBPORT[1]-USBRXHUBPORT[15])....	2381
22.6.27	USB Maximum Transmit Data Endpoint n Registers (USBTXMAXP[1]-USBTXMAXP[15]) .....	2382
22.6.28	USB Control and Status Endpoint 0 Low Register (USBCSRL0), offset 0x102 .....	2383
22.6.29	USB Control and Status Endpoint 0 High Register (USBCSRH0), offset 0x103.....	2385
22.6.30	USB Receive Byte Count Endpoint 0 Register (USBCOUNT0), offset 0x108.....	2386
22.6.31	USB Type Endpoint 0 Register (USBTYPE0), offset 0x10A .....	2386
22.6.32	USB NAK Limit Register (USBNAKLMT), offset 0x10B .....	2387
22.6.33	USB Transmit Control and Status Endpoint n Low Register (USBTXCSSL[1]- USBTXCSSL[15]) .....	2388
22.6.34	USB Transmit Control and Status Endpoint n High Register (USBTXCSRH[1]- USBTXCSRH[15]).....	2391
22.6.35	USB Maximum Receive Data Endpoint n Registers (USBRXMAXP[1]-USBRXMAXP[15]) .....	2393
22.6.36	USB Receive Control and Status Endpoint n Low Register (USBRXCSSL[1]- USBRXCSSL[15]).....	2394
22.6.37	USB Receive Control and Status Endpoint n High Register (USBRXCSRH[1]- USBRXCSRH[15]) .....	2396
22.6.38	USB Receive Byte Count Endpoint n Registers (USBRXCOUNT[1]-USBRXCOUNT[15]) .....	2398
22.6.39	USB Host Transmit Configure Type Endpoint n Register (USBTXTYPE[1]-USBTXTYPE[15]) ...	2399
22.6.40	USB Host Transmit Interval Endpoint n Register (USBTXINTERVAL[1]USBTXINTERVAL[15]) .	2400
22.6.41	USB Host Configure Receive Type Endpoint n Register (USBRXTYPE[1]-USBRXTYPE[15]) ...	2401
22.6.42	USB Host Receive Polling Interval Endpoint n Register (USBRXINTERVAL[1]- USBRXINTERVAL[15]) .....	2402

22.6.43	USB Request Packet Count in Block Transfer Endpoint n Registers (USBRQPKTCOUNT[1]-USBRQPKTCOUNT[15]) .....	2403
22.6.44	USB Receive Double Packet Buffer Disable Register (USBRXDPKTBUFDIS), offset 0x340 .....	2404
22.6.45	USB Transmit Double Packet Buffer Disable Register (USBTXDPKTBUFDIS), offset 0x342 .....	2406
22.6.46	USB External Power Control Register (USBEPCC), offset 0x400 .....	2407
22.6.47	USB External Power Control Raw Interrupt Status Register (USBEPCCRIS), offset 0x404 .....	2409
22.6.48	USB External Power Control Interrupt Mask Register (USBEPCCIM), offset 0x408 .....	2410
22.6.49	USB External Power Control Interrupt Status and Clear Register (USBEPCCISC), offset 0x40C .....	2411
22.6.50	USB Device RESUME Raw Interrupt Status Register (USBDRRIS), offset 0x410 .....	2412
22.6.51	USB Device RESUME Raw Interrupt Mask Register (USBDRIM), offset 0x414 .....	2413
22.6.52	USB Device RESUME Interrupt Status and Clear Register (USBDRISC), offset 0x418 .....	2414
22.6.53	USB General-Purpose Control and Status Register (USBGPCS), offset 0x41C .....	2415
22.6.54	USB DMA Select Register (USBDMASEL), offset 0x450 .....	2416
<b>23</b>	<b>Universal Parallel Port (uPP) .....</b>	<b>2418</b>
23.1	Introduction .....	2419
23.1.1	Features Supported .....	2419
23.2	Configuring Device Pins .....	2420
23.3	Functional Description .....	2420
23.3.1	Functional Block Diagram .....	2420
23.3.2	Data Flow .....	2420
23.3.3	Clock Generation and Control .....	2421
23.4	IO Interface and System Requirements .....	2423
23.4.1	Pin Multiplexing .....	2423
23.4.2	Internal DMA Controller Description .....	2423
23.4.3	Protocol Description .....	2425
23.4.4	Data Format .....	2428
23.4.5	Reset Considerations .....	2428
23.4.6	Interrupt Support .....	2429
23.4.7	Emulation Considerations .....	2430
23.4.8	Transmit and Receive FIFOs .....	2430
23.4.9	Transmit and Receive Data (MSG) RAM .....	2430
23.4.10	Initialization and Operation .....	2431
23.5	Registers .....	2433
23.5.1	UPP Base Addresses .....	2433
23.5.2	UPP_REGS Registers .....	2434
<b>24</b>	<b>External Memory Interface (EMIF) .....</b>	<b>2469</b>
24.1	Introduction .....	2470
24.1.1	Purpose of the Peripheral .....	2470
24.1.2	Features .....	2470
24.1.3	Functional Block Diagram .....	2471
24.2	Configuring Device Pins .....	2472
24.3	EMIF Module Architecture .....	2472
24.3.1	EMIF Clock Control .....	2472
24.3.2	EMIF Requests .....	2472
24.3.3	EMIF Signal Descriptions .....	2472
24.3.4	EMIF Signal Multiplexing Control .....	2474
24.3.5	SDRAM Controller and Interface .....	2474
24.3.6	Asynchronous Controller and Interface .....	2486
24.3.7	Data Bus Parking .....	2498
24.3.8	Reset and Initialization Considerations .....	2498
24.3.9	Interrupt Support .....	2498
24.3.10	DMA Event Support .....	2499
24.3.11	EMIF Signal Multiplexing .....	2499

24.3.12	Memory Map .....	2499
24.3.13	Priority and Arbitration .....	2500
24.3.14	System Considerations .....	2501
24.3.15	Power Management .....	2502
24.3.16	Emulation Considerations .....	2502
24.4	Example Configuration .....	2503
24.4.1	Hardware Interface.....	2503
24.4.2	Software Configuration .....	2503
24.5	Registers .....	2511
24.5.1	EMIF Base Addresses.....	2511
24.5.2	EMIF_REGS Registers .....	2512
24.5.3	EMIF1_CONFIG_REGS Registers .....	2532
<b>Revision History .....</b>		<b>2536</b>

## List of Figures

2-1.	Device Interrupt Architecture .....	86
2-2.	Interrupt Propagation Path .....	87
2-3.	Missing Clock Detection Logic .....	100
2-4.	ERRORSTS Pin Diagram .....	101
2-5.	Clocking System .....	102
2-6.	Single-ended 3.3V External Clock.....	103
2-7.	External Crystal .....	103
2-8.	External Resonator .....	104
2-9.	AUXCLKIN .....	104
2-10.	CPU-Timers .....	111
2-11.	CPU-Timer Interrupts Signals and Output Signal .....	112
2-12.	CPU Watchdog Timer Module .....	113
2-13.	Memory Architecture .....	119
2-14.	Arbitration Scheme on Global Shared Memories.....	121
2-15.	Arbitration Scheme on Local Shared Memories .....	121
2-16.	FMC Interface with Core, Bank and Pump .....	128
2-17.	Flash Prefetch Mode .....	131
2-18.	ECC Logic Inputs and Outputs.....	134
2-19.	PUMP_OWNERSHIP Configuration .....	138
2-20.	Storage of Zone-Select Bits in OTP .....	142
2-21.	Location of Zone-Select Block Based on Link-Pointer .....	143
2-22.	CSM Password Match Flow (PMF).....	147
2-23.	ECSL Password Match Flow (PMF).....	149
2-24.	TIM Register .....	154
2-25.	PRD Register .....	155
2-26.	TCR Register .....	156
2-27.	TPR Register .....	158
2-28.	TPRH Register .....	159
2-29.	PIECTRL Register .....	162
2-30.	PIEACK Register.....	163
2-31.	PIEIER1 Register .....	164
2-32.	PIEIFR1 Register .....	166
2-33.	PIEIER2 Register .....	168
2-34.	PIEIFR2 Register .....	170
2-35.	PIEIER3 Register .....	172
2-36.	PIEIFR3 Register .....	174
2-37.	PIEIER4 Register .....	176
2-38.	PIEIFR4 Register .....	178
2-39.	PIEIER5 Register .....	180
2-40.	PIEIFR5 Register .....	182
2-41.	PIEIER6 Register .....	184
2-42.	PIEIFR6 Register .....	186
2-43.	PIEIER7 Register .....	188
2-44.	PIEIFR7 Register .....	190
2-45.	PIEIER8 Register .....	192
2-46.	PIEIFR8 Register .....	194
2-47.	PIEIER9 Register .....	196

2-48.	PIEIFR9 Register .....	198
2-49.	PIEIER10 Register.....	200
2-50.	PIEIFR10 Register.....	202
2-51.	PIEIER11 Register.....	204
2-52.	PIEIFR11 Register.....	206
2-53.	PIEIER12 Register.....	208
2-54.	PIEIFR12 Register .....	210
2-55.	SCSR Register .....	213
2-56.	WDCNTR Register .....	214
2-57.	WDKEY Register.....	215
2-58.	WDCR Register .....	216
2-59.	WDWCR Register .....	217
2-60.	NMICFG Register.....	219
2-61.	NMIFLG Register .....	220
2-62.	NMIFLGCLR Register .....	222
2-63.	NMIFLGFRC Register.....	224
2-64.	NMIWDCNT Register .....	225
2-65.	NMIWDPRD Register .....	226
2-66.	NMISHDFLG Register.....	227
2-67.	XINT1CR Register.....	230
2-68.	XINT2CR Register .....	231
2-69.	XINT3CR Register .....	232
2-70.	XINT4CR Register.....	233
2-71.	XINT5CR Register.....	234
2-72.	XINT1CTR Register .....	235
2-73.	XINT2CTR Register .....	236
2-74.	XINT3CTR Register .....	237
2-75.	CLA1TASKSRCSELLOCK Register .....	239
2-76.	DMACHSRCSELLOCK Register .....	240
2-77.	CLA1TASKSRCSEL1 Register .....	241
2-78.	CLA1TASKSRCSEL2 Register .....	242
2-79.	DMACHSRCSEL1 Register .....	243
2-80.	DMACHSRCSEL2 Register .....	244
2-81.	PUMPREQUEST Register.....	246
2-82.	PARTIDL_1 Register .....	249
2-83.	PARTIDH_1 Register.....	251
2-84.	REVID Register .....	252
2-85.	DC0_1 Register .....	253
2-86.	DC1_1 Register .....	254
2-87.	DC2_1 Register .....	255
2-88.	DC3_1 Register .....	256
2-89.	DC4_1 Register .....	258
2-90.	DC5_1 Register .....	259
2-91.	DC6_1 Register .....	260
2-92.	DC7_1 Register .....	261
2-93.	DC8_1 Register .....	262
2-94.	DC9_1 Register .....	263
2-95.	DC10_1 Register.....	264
2-96.	DC11_1 Register.....	265



2-97.	DC12_1 Register.....	266
2-98.	DC13_1 Register.....	267
2-99.	DC14_1 Register.....	268
2-100.	DC15_1 Register.....	269
2-101.	DC17_1 Register.....	271
2-102.	DC18_1 Register.....	272
2-103.	DC20_1 Register.....	273
2-104.	PERCNF1_1 Register .....	275
2-105.	FUSEERR Register.....	276
2-106.	SOFTPRES0 Register .....	277
2-107.	SOFTPRES1 Register .....	278
2-108.	SOFTPRES2 Register .....	279
2-109.	SOFTPRES3 Register .....	281
2-110.	SOFTPRES4 Register .....	282
2-111.	SOFTPRES6 Register .....	283
2-112.	SOFTPRES7 Register .....	284
2-113.	SOFTPRES8 Register .....	285
2-114.	SOFTPRES9 Register .....	286
2-115.	SOFTPRES11 Register .....	287
2-116.	SOFTPRES13 Register .....	288
2-117.	SOFTPRES14 Register .....	289
2-118.	SOFTPRES16 Register .....	290
2-119.	SYSDBGCTL Register .....	291
2-120.	CLKCFGLOCK1 Register.....	294
2-121.	CLKSRCCTL1 Register .....	296
2-122.	CLKSRCCTL2 Register .....	298
2-123.	CLKSRCCTL3 Register .....	300
2-124.	SYSPLLCTL1 Register.....	301
2-125.	SYSPLLMULT Register .....	302
2-126.	SYSPLLSTS Register .....	303
2-127.	AUXPLLCTL1 Register .....	304
2-128.	AUXPLLMULT Register.....	305
2-129.	AUXPLLSTS Register .....	306
2-130.	SYSCLKDIVSEL Register .....	307
2-131.	AUXCLKDIVSEL Register .....	308
2-132.	PERCLKDIVSEL Register .....	309
2-133.	XCLKOUTDIVSEL Register .....	310
2-134.	LOSPCP Register .....	311
2-135.	MCDCCR Register .....	312
2-136.	X1CNT Register.....	313
2-137.	CPUSYSLOCK1 Register .....	316
2-138.	HIBBOOTMODE Register .....	319
2-139.	IORESTOREADDR Register .....	320
2-140.	PIEVERRADDR Register .....	321
2-141.	PCLKCR0 Register .....	322
2-142.	PCLKCR1 Register .....	324
2-143.	PCLKCR2 Register .....	325
2-144.	PCLKCR3 Register .....	327
2-145.	PCLKCR4 Register .....	329



2-146. PCLKCR6 Register .....	330
2-147. PCLKCR7 Register .....	331
2-148. PCLKCR8 Register .....	332
2-149. PCLKCR9 Register .....	333
2-150. PCLKCR10 Register .....	334
2-151. PCLKCR11 Register .....	335
2-152. PCLKCR12 Register .....	336
2-153. PCLKCR13 Register .....	337
2-154. PCLKCR14 Register .....	338
2-155. PCLKCR16 Register .....	340
2-156. SECMSEL_1 Register.....	341
2-157. LPMCR Register .....	342
2-158. GPIOLPMSEL0 Register.....	344
2-159. GPIOLPMSEL1 Register.....	347
2-160. TMR2CLKCTL Register.....	350
2-161. RESC Register .....	352
2-162. ROMPREFETCH Register.....	355
2-163. FLSEM Register .....	357
2-164. SECTSTAT Register .....	358
2-165. RAMSTAT Register.....	361
2-166. Z1OTP_LINKPOINTER1 Register.....	364
2-167. Z1OTP_LINKPOINTER2 Register.....	365
2-168. Z1OTP_LINKPOINTER3 Register.....	366
2-169. Z1OTP_PSWDLOCK Register .....	367
2-170. Z1OTP_CRCLOCK Register .....	368
2-171. Z1OTP_BOOTCTRL Register.....	369
2-172. Z1_LINKPOINTER Register .....	371
2-173. Z1_OTPSECCLOCK Register .....	372
2-174. Z1_BOOTCTRL Register .....	373
2-175. Z1_LINKPOINTERERR Register .....	374
2-176. Z1_CSMKEY0 Register .....	375
2-177. Z1_CSMKEY1 Register .....	376
2-178. Z1_CSMKEY2 Register .....	377
2-179. Z1_CSMKEY3 Register .....	378
2-180. Z1_CR Register .....	379
2-181. Z1_GRABSECTR Register .....	380
2-182. Z1_GRABRAMR Register .....	383
2-183. Z1_EXEONLYSECTR Register .....	385
2-184. Z1_EXEONLYRAMR Register .....	388
2-185. Z2OTP_LINKPOINTER1 Register.....	391
2-186. Z2OTP_LINKPOINTER2 Register.....	392
2-187. Z2OTP_LINKPOINTER3 Register.....	393
2-188. Z2OTP_PSWDLOCK Register .....	394
2-189. Z2OTP_CRCLOCK Register .....	395
2-190. Z2OTP_BOOTCTRL Register.....	396
2-191. Z2_LINKPOINTER Register .....	398
2-192. Z2_OTPSECCLOCK Register .....	399
2-193. Z2_BOOTCTRL Register .....	400
2-194. Z2_LINKPOINTERERR Register .....	401

2-195. Z2_CSMKEY0 Register .....	402
2-196. Z2_CSMKEY1 Register .....	403
2-197. Z2_CSMKEY2 Register .....	404
2-198. Z2_CSMKEY3 Register .....	405
2-199. Z2_CR Register .....	406
2-200. Z2_GRABSECTR Register .....	407
2-201. Z2_GRABRAMR Register .....	410
2-202. Z2_EXEONLYSECTR Register .....	412
2-203. Z2_EXEONLYRAMR Register .....	415
2-204. DxLOCK Register .....	419
2-205. DxCOMMIT Register .....	420
2-206. DxACCPROT0 Register .....	421
2-207. DxTEST Register .....	422
2-208. DxINIT Register .....	423
2-209. DxINITDONE Register .....	424
2-210. LSxLOCK Register .....	425
2-211. LSxCOMMIT Register .....	427
2-212. LSxMSEL Register .....	429
2-213. LSxCLAPGM Register .....	431
2-214. LSxACCPROT0 Register .....	432
2-215. LSxACCPROT1 Register .....	434
2-216. LSxTEST Register .....	435
2-217. LSxINIT Register .....	437
2-218. LSxINITDONE Register .....	438
2-219. GSxLOCK Register .....	439
2-220. GSxCOMMIT Register .....	442
2-221. GSxACCPROT0 Register .....	445
2-222. GSxACCPROT1 Register .....	447
2-223. GSxACCPROT2 Register .....	449
2-224. GSxACCPROT3 Register .....	451
2-225. GSxTEST Register .....	453
2-226. GSxINIT Register .....	456
2-227. GSxINITDONE Register .....	458
2-228. MSGxTEST Register .....	460
2-229. MSGxINIT Register .....	461
2-230. MSGxINITDONE Register .....	462
2-231. NMAVFLG Register .....	465
2-232. NMAVSET Register .....	467
2-233. NMAVCLR Register .....	469
2-234. NMAVINTEN Register .....	471
2-235. NMCPURDAVADDR Register .....	472
2-236. NMCPUWRAVADDR Register .....	473
2-237. NMCPUFAVADDR Register .....	474
2-238. NMDMAWRAVADDR Register .....	475
2-239. NMCLA1RDAVADDR Register .....	476
2-240. NMCLA1WRAVADDR Register .....	477
2-241. NMCLA1FAVADDR Register .....	478
2-242. MAVFLG Register .....	479
2-243. MAVSET Register .....	480

2-244. MAVCLR Register .....	481
2-245. MAVINTEN Register .....	482
2-246. MCPUFAVADDR Register.....	483
2-247. MCPUWRAVADDR Register.....	484
2-248. MDMAWRAVADDR Register .....	485
2-249. UCERRFLG Register.....	487
2-250. UCERRSET Register.....	488
2-251. UCERRCLR Register .....	489
2-252. UCCPUREADDR Register .....	490
2-253. UCDMAREADDR Register .....	491
2-254. UCCLA1READDR Register .....	492
2-255. CERRFLG Register.....	493
2-256. CERRSET Register.....	494
2-257. CERRCLR Register .....	495
2-258. CCPUREADDR Register .....	496
2-259. CERRCNT Register .....	497
2-260. CERRTHRES Register.....	498
2-261. CEINTFLG Register .....	499
2-262. CEINTCLR Register .....	500
2-263. CEINTSET Register .....	501
2-264. CEINTEN Register.....	502
2-265. ROMWAITSTATE Register.....	504
2-266. FRDCNTL Register.....	506
2-267. FBAC Register .....	507
2-268. FBFALLBACK Register .....	508
2-269. FBPRDY Register .....	509
2-270. FPAC1 Register.....	510
2-271. FMSTAT Register.....	511
2-272. FRD_INTF_CTRL Register.....	513
2-273. ECC_ENABLE Register.....	516
2-274. SINGLE_ERR_ADDR_LOW Register.....	517
2-275. SINGLE_ERR_ADDR_HIGH Register .....	518
2-276. UNC_ERR_ADDR_LOW Register.....	519
2-277. UNC_ERR_ADDR_HIGH Register .....	520
2-278. ERR_STATUS Register.....	521
2-279. ERR_POS Register.....	523
2-280. ERR_STATUS_CLR Register .....	524
2-281. ERR_CNT Register.....	525
2-282. ERR_THRESHOLD Register.....	526
2-283. ERR_INTFLG Register.....	527
2-284. ERR_INTCLR Register .....	528
2-285. FDATAH_TEST Register .....	529
2-286. FDATAL_TEST Register.....	530
2-287. FADDR_TEST Register.....	531
2-288. FECC_TEST Register.....	532
2-289. FECC_CTRL Register.....	533
2-290. FOUTH_TEST Register.....	534
2-291. FOUTL_TEST Register .....	535
2-292. FECC_STATUS Register.....	536

2-293. UID_PSRAND0 Register.....	538
2-294. UID_PSRAND1 Register.....	539
2-295. UID_PSRAND2 Register.....	540
2-296. UID_PSRAND3 Register.....	541
2-297. UID_PSRAND4 Register.....	542
2-298. UID_PSRAND5 Register.....	543
2-299. UID_UNIQUE Register .....	544
2-300. UID_CHECKSUM Register .....	545
3-1. Z1 and Z2 BOOTCTRL Selection .....	549
3-2. CPU1 Device Boot Flow .....	551
3-3. CPU1 Emulation Boot Flow .....	552
3-4. CPU1 Standalone and Hibernate Boot Flow .....	553
3-5. Overview of SCI Bootloader Operation .....	558
3-6. Overview of SCI Boot Function .....	559
3-7. SPI Loader.....	559
3-8. Data Transfer From EEPROM Flow.....	561
3-9. EEPROM Device at Address 0x50 .....	561
3-10. Overview of I2C Boot Function .....	562
3-11. Random Read .....	563
3-12. Sequential Read .....	564
3-13. Overview of Parallel GPIO Bootloader Operation .....	564
3-14. Parallel GPIO Bootloader Handshake Protocol.....	565
3-15. Parallel GPIO Mode Overview .....	565
3-16. Parallel GPIO Mode - Host Transfer Flow.....	566
3-17. 8-Bit Parallel GetWord Function .....	567
3-18. Overview of CAN-A Bootloader Operation .....	568
3-19. USB Boot Flow .....	569
4-1. DMA Block Diagram .....	578
4-2. Common Peripheral Architecture .....	579
4-3. DMA Trigger Architecture.....	580
4-4. Peripheral Interrupt Trigger Input Diagram .....	581
4-5. 4-Stage Pipeline DMA Transfer.....	585
4-6. 4-Stage Pipeline With One Read Stall (McBSP as source).....	585
4-7. DMA State Diagram .....	591
4-8. Overrun Detection Logic .....	593
4-9. DMA Control Register (DMACTRL) .....	595
4-10. Debug Control Register (DEBUGCTRL) .....	596
4-11. Revision Register (REVISION).....	596
4-12. Priority Control Register 1 (PRIORITYCTRL1) .....	597
4-13. Priority Status Register (PRIORITYSTAT) .....	598
4-14. Mode Register (MODE) .....	599
4-15. Control Register (CONTROL) .....	601
4-16. Burst Size Register (BURST_SIZE).....	603
4-17. Burst Size Register (BURST_COUNT) .....	603
4-18. Source Burst Step Size Register (SRC_BURST_STEP).....	604
4-19. Destination Burst Step Register Size (DST_BURST_STEP) .....	605
4-20. Transfer Size Register (TRANSFER_SIZE).....	605
4-21. Transfer Count Register (TRANSFER_COUNT) .....	606
4-22. Source Transfer Step Size Register (SRC_TRANSFER_STEP) .....	606

4-23.	Destination Transfer Step Size Register (DST_TRANSFER_STEP) .....	607
4-24.	Source/Destination Wrap Size Register (SRC/DST_WRAP_SIZE) .....	607
4-25.	Source/Destination Wrap Count Register (SCR/DST_WRAP_COUNT) .....	608
4-26.	Source/Destination Wrap Step Size Registers (SRC/DST_WRAP_STEP) .....	608
4-27.	Shadow Source Begin and Current Address Pointer Registers (SRC_BEG_ADDR_SHADOW/DST_BEG_ADDR_SHADOW).....	609
4-28.	Active Source Begin and Current Address Pointer Registers (SRC_BEG_ADDR/DST_BEG_ADDR) .....	609
4-29.	Shadow Destination Begin and Current Address Pointer Registers (SRC_ADDR_SHADOW/DST_ADDR_SHADOW) .....	610
4-30.	Active Destination Begin and Current Address Pointer Registers (SRC_ADDR/DST_ADDR).....	610
5-1.	CLA Block Diagram.....	613
5-2.	MVECT1 Register .....	747
5-3.	MVECT2 Register .....	748
5-4.	MVECT3 Register .....	749
5-5.	MVECT4 Register .....	750
5-6.	MVECT5 Register .....	751
5-7.	MVECT6 Register .....	752
5-8.	MVECT7 Register .....	753
5-9.	MVECT8 Register .....	754
5-10.	MCTL Register .....	755
5-11.	MIFR Register .....	756
5-12.	MIOVF Register .....	758
5-13.	MIFRC Register .....	760
5-14.	MICLR Register .....	762
5-15.	MICLROVF Register .....	764
5-16.	MIER Register .....	766
5-17.	MIRUN Register.....	768
5-18.	_MPC Register .....	770
5-19.	_MAR0 Register .....	771
5-20.	_MAR1 Register .....	772
5-21.	_MSTF Register.....	773
5-22.	_MR0 Register .....	776
5-23.	_MR1 Register .....	777
5-24.	_MR2 Register .....	778
5-25.	_MR3 Register .....	779
5-26.	SOFTINTEN Register .....	781
5-27.	SOFTINTFRC Register .....	783
6-1.	GPIO Logic for a Single Pin .....	786
6-2.	Input Qualification Using a Sampling Window .....	789
6-3.	Input Qualifier Clock Cycles .....	792
6-4.	GPACTRL Register.....	802
6-5.	GPAQSEL1 Register .....	803
6-6.	GPAQSEL2 Register .....	805
6-7.	GPAMUX1 Register .....	807
6-8.	GPAMUX2 Register .....	809
6-9.	GPADIR Register .....	811
6-10.	GPAPUD Register .....	813
6-11.	GPAINV Register .....	815
6-12.	GPAODR Register.....	817

6-13.	GPAGMUX1 Register .....	819
6-14.	GPAGMUX2 Register .....	820
6-15.	GPACSEL1 Register .....	821
6-16.	GPACSEL2 Register .....	822
6-17.	GPACSEL3 Register .....	823
6-18.	GPACSEL4 Register .....	824
6-19.	GPALOCK Register .....	825
6-20.	GPACR Register .....	827
6-21.	GPBCTRL Register .....	829
6-22.	GPBQSEL1 Register .....	830
6-23.	GPBQSEL2 Register .....	832
6-24.	GPBMUX1 Register .....	834
6-25.	GPBMUX2 Register .....	836
6-26.	GPBDIR Register .....	838
6-27.	GPBPUD Register .....	840
6-28.	GPBINV Register .....	842
6-29.	GPBODR Register .....	844
6-30.	GPBAMSEL Register .....	846
6-31.	GPBGMUX1 Register .....	848
6-32.	GPBGMUX2 Register .....	849
6-33.	GPBCSEL1 Register .....	850
6-34.	GPBCSEL2 Register .....	851
6-35.	GPBCSEL3 Register .....	852
6-36.	GPBCSEL4 Register .....	853
6-37.	GPBLOCK Register .....	854
6-38.	GPBCR Register .....	856
6-39.	GPCCTRL Register .....	858
6-40.	GPCQSEL1 Register .....	859
6-41.	GPCQSEL2 Register .....	861
6-42.	GPCMUX1 Register .....	863
6-43.	GPCMUX2 Register .....	865
6-44.	GPCDIR Register .....	867
6-45.	GPCPUD Register .....	869
6-46.	GPCINV Register .....	871
6-47.	GPCODR Register .....	873
6-48.	GPCGMUX1 Register .....	875
6-49.	GPCGMUX2 Register .....	876
6-50.	GPCCSEL1 Register .....	877
6-51.	GPCCSEL2 Register .....	878
6-52.	GPCCSEL3 Register .....	879
6-53.	GPCCSEL4 Register .....	880
6-54.	GPCLOCK Register .....	881
6-55.	GPCCR Register .....	883
6-56.	GPDCTRL Register .....	885
6-57.	GPDQSEL1 Register .....	886
6-58.	GPDQSEL2 Register .....	888
6-59.	GPDMUX1 Register .....	890
6-60.	GPDMUX2 Register .....	892
6-61.	GPDDIR Register .....	894

6-62.	GPDPUD Register .....	896
6-63.	GPDIR Register .....	898
6-64.	GPDIR Register .....	900
6-65.	GPDIRMUX1 Register .....	902
6-66.	GPDIRMUX2 Register .....	904
6-67.	GPDIRSEL1 Register .....	906
6-68.	GPDIRSEL2 Register .....	907
6-69.	GPDIRSEL3 Register .....	908
6-70.	GPDIRSEL4 Register .....	909
6-71.	GPDIRLOCK Register .....	910
6-72.	GPDIRCR Register .....	912
6-73.	GPDIRCTRL Register .....	914
6-74.	GPDIRQSEL1 Register .....	915
6-75.	GPDIRQSEL2 Register .....	917
6-76.	GPDIRMUX1 Register .....	919
6-77.	GPDIRMUX2 Register .....	921
6-78.	GPDIRDIR Register .....	923
6-79.	GPDIRPUD Register .....	925
6-80.	GPDIRINV Register .....	927
6-81.	GPDIRODR Register .....	929
6-82.	GPDIRGMUX1 Register .....	931
6-83.	GPDIRGMUX2 Register .....	933
6-84.	GPDIRSEL1 Register .....	935
6-85.	GPDIRSEL2 Register .....	936
6-86.	GPDIRSEL3 Register .....	937
6-87.	GPDIRSEL4 Register .....	938
6-88.	GPDIRLOCK Register .....	939
6-89.	GPDIRCR Register .....	941
6-90.	GPDIRCTRL Register .....	943
6-91.	GPDIRQSEL1 Register .....	944
6-92.	GPDIRMUX1 Register .....	946
6-93.	GPDIRDIR Register .....	948
6-94.	GPDIRPUD Register .....	950
6-95.	GPDIRINV Register .....	952
6-96.	GPDIRODR Register .....	954
6-97.	GPDIRGMUX1 Register .....	956
6-98.	GPDIRSEL1 Register .....	957
6-99.	GPDIRSEL2 Register .....	958
6-100.	GPDIRFLOCK Register .....	959
6-101.	GPDIRFCR Register .....	961
6-102.	GPDIRDAT Register .....	965
6-103.	GPDIRASET Register .....	967
6-104.	GPDIRACLEAR Register .....	969
6-105.	GPDIRATOGGLE Register .....	971
6-106.	GPDIRBDAT Register .....	973
6-107.	GPDIRBSET Register .....	975
6-108.	GPDIRBCLEAR Register .....	977
6-109.	GPDIRBTOGGLE Register .....	979
6-110.	GPDIRCDAT Register .....	981



6-111. GPCSET Register .....	983
6-112. GPCCLEAR Register.....	985
6-113. GPCTOGGLE Register .....	987
6-114. GPDDAT Register .....	989
6-115. GPDSET Register .....	991
6-116. GPD CLEAR Register.....	993
6-117. GPDTOGGLE Register .....	995
6-118. GPEDAT Register .....	997
6-119. GPESET Register .....	999
6-120. GPECLEAR Register .....	1001
6-121. GPETOGGLE Register.....	1003
6-122. GPFDAT Register .....	1005
6-123. GPFSET Register .....	1007
6-124. GPFCLEAR Register .....	1009
6-125. GPFTOGGLE Register .....	1011
7-1. Input X-BAR.....	1014
7-2. ePWM Architecture - Single Output.....	1016
7-3. GPIO Output X-BAR Architecture .....	1018
7-4. ePWM and Output X-BARs Architectures .....	1020
7-5. INPUT1SELECT Register .....	1023
7-6. INPUT2SELECT Register .....	1024
7-7. INPUT3SELECT Register .....	1025
7-8. INPUT4SELECT Register .....	1026
7-9. INPUT5SELECT Register .....	1027
7-10. INPUT6SELECT Register .....	1028
7-11. INPUT7SELECT Register .....	1029
7-12. INPUT8SELECT Register .....	1030
7-13. INPUT9SELECT Register .....	1031
7-14. INPUT10SELECT Register .....	1032
7-15. INPUT11SELECT Register .....	1033
7-16. INPUT12SELECT Register .....	1034
7-17. INPUT13SELECT Register .....	1035
7-18. INPUT14SELECT Register .....	1036
7-19. INPUTSELECTLOCK Register .....	1037
7-20. XBARFLG1 Register .....	1042
7-21. XBARFLG2 Register .....	1044
7-22. XBARFLG3 Register .....	1046
7-23. XBARCLR1 Register.....	1048
7-24. XBARCLR2 Register.....	1050
7-25. XBARCLR3 Register.....	1052
7-26. TRIP4MUX0TO15CFG Register .....	1056
7-27. TRIP4MUX16TO31CFG Register .....	1059
7-28. TRIP5MUX0TO15CFG Register .....	1062
7-29. TRIP5MUX16TO31CFG Register .....	1065
7-30. TRIP7MUX0TO15CFG Register .....	1068
7-31. TRIP7MUX16TO31CFG Register .....	1071
7-32. TRIP8MUX0TO15CFG Register .....	1074
7-33. TRIP8MUX16TO31CFG Register .....	1077
7-34. TRIP9MUX0TO15CFG Register .....	1080



7-35.	TRIP9MUX16TO31CFG Register .....	1083
7-36.	TRIP10MUX0TO15CFG Register .....	1086
7-37.	TRIP10MUX16TO31CFG Register .....	1089
7-38.	TRIP11MUX0TO15CFG Register .....	1092
7-39.	TRIP11MUX16TO31CFG Register .....	1095
7-40.	TRIP12MUX0TO15CFG Register .....	1098
7-41.	TRIP12MUX16TO31CFG Register .....	1101
7-42.	TRIP4MUXENABLE Register.....	1104
7-43.	TRIP5MUXENABLE Register.....	1109
7-44.	TRIP7MUXENABLE Register.....	1114
7-45.	TRIP8MUXENABLE Register.....	1119
7-46.	TRIP9MUXENABLE Register.....	1124
7-47.	TRIP10MUXENABLE Register .....	1129
7-48.	TRIP11MUXENABLE Register .....	1134
7-49.	TRIP12MUXENABLE Register .....	1139
7-50.	TRIPOUTINV Register.....	1144
7-51.	TRIPLOCK Register .....	1146
7-52.	OUTPUT1MUX0TO15CFG Register .....	1149
7-53.	OUTPUT1MUX16TO31CFG Register.....	1152
7-54.	OUTPUT2MUX0TO15CFG Register .....	1155
7-55.	OUTPUT2MUX16TO31CFG Register .....	1158
7-56.	OUTPUT3MUX0TO15CFG Register .....	1161
7-57.	OUTPUT3MUX16TO31CFG Register.....	1164
7-58.	OUTPUT4MUX0TO15CFG Register .....	1167
7-59.	OUTPUT4MUX16TO31CFG Register .....	1170
7-60.	OUTPUT5MUX0TO15CFG Register .....	1173
7-61.	OUTPUT5MUX16TO31CFG Register.....	1176
7-62.	OUTPUT6MUX0TO15CFG Register .....	1179
7-63.	OUTPUT6MUX16TO31CFG Register.....	1182
7-64.	OUTPUT7MUX0TO15CFG Register .....	1185
7-65.	OUTPUT7MUX16TO31CFG Register.....	1188
7-66.	OUTPUT8MUX0TO15CFG Register .....	1191
7-67.	OUTPUT8MUX16TO31CFG Register.....	1194
7-68.	OUTPUT1MUXENABLE Register.....	1197
7-69.	OUTPUT2MUXENABLE Register.....	1202
7-70.	OUTPUT3MUXENABLE Register.....	1207
7-71.	OUTPUT4MUXENABLE Register.....	1212
7-72.	OUTPUT5MUXENABLE Register.....	1217
7-73.	OUTPUT6MUXENABLE Register.....	1222
7-74.	OUTPUT7MUXENABLE Register.....	1227
7-75.	OUTPUT8MUXENABLE Register.....	1232
7-76.	OUTPUTLATCH Register .....	1237
7-77.	OUTPUTLATCHCLR Register.....	1239
7-78.	OUTPUTLATCHFRC Register .....	1241
7-79.	OUTPUTLATCHENABLE Register .....	1243
7-80.	OUTPUTINV Register .....	1245
7-81.	OUTPUTLOCK Register .....	1247
8-1.	Analog Subsystem Block Diagram (337-Ball ZWT).....	1250
8-2.	Analog Subsystem Block Diagram (176-Pin PTP).....	1251

8-3.	Analog Subsystem Block Diagram (100-Pin PZP) .....	1252
8-4.	INTOSC1TRIM Register .....	1255
8-5.	INTOSC2TRIM Register .....	1256
8-6.	TSNSCTL Register .....	1257
8-7.	LOCK Register .....	1258
8-8.	ANAREFTRIMA Register .....	1259
8-9.	ANAREFTRIMB Register .....	1260
8-10.	ANAREFTRIMC Register .....	1261
8-11.	ANAREFTRIMD Register .....	1262
9-1.	ADC Module Block Diagram .....	1265
9-2.	SOC Block Diagram .....	1269
9-3.	Single-Ended Input Model .....	1270
9-4.	Differential Input Model .....	1270
9-5.	Round Robin Priority Example .....	1275
9-6.	High Priority Example .....	1276
9-7.	Burst Priority Example .....	1278
9-8.	ADC EOC Interrupts .....	1279
9-9.	ADC PPB Block Diagram .....	1280
9-10.	ADC PPB Interrupt Event .....	1281
9-11.	Opens/Shorts Detection Circuit .....	1282
9-12.	ADC Timings for 12-bit Mode in Early Interrupt Mode .....	1285
9-13.	ADC Timings for 12-bit Mode in Late Interrupt Mode .....	1286
9-14.	ADC Timings for 16-bit Mode in Early Interrupt Mode .....	1287
9-15.	ADC Timings for 16-bit Mode in Late Interrupt Mode (SYSCLK Cycles) .....	1288
9-16.	Example: Basic Synchronous Operation .....	1290
9-17.	Example: Synchronous Operation with Multiple Trigger Sources .....	1291
9-18.	Example: Synchronous Operation with Uneven SOC Numbers .....	1292
9-19.	Example: Asynchronous Operation with Uneven SOC Numbers – Trigger Overflow .....	1292
9-20.	Example: Asynchronous Operation with Different Resolutions .....	1292
9-21.	Example: Synchronous Operation with Different Resolutions .....	1293
9-22.	Example: Synchronous Equivalent Operation with Non-Overlapping Conversions .....	1293
9-23.	ADC Reference System .....	1295
9-24.	ADC Shared Reference System .....	1296
9-25.	ADCCTL1 Register .....	1301
9-26.	ADCCTL2 Register .....	1303
9-27.	ADCBURSTCTL_1 Register .....	1304
9-28.	ADCINTFLG Register .....	1306
9-29.	ADCINTFLGCLR Register .....	1308
9-30.	ADCINTOVF Register .....	1310
9-31.	ADCINTOVFCLR Register .....	1312
9-32.	ADCINTSEL1N2 Register .....	1313
9-33.	ADCINTSEL3N4 Register .....	1315
9-34.	ADCSOCPRCTL Register .....	1317
9-35.	ADCINTSOCSEL1 Register .....	1320
9-36.	ADCINTSOCSEL2 Register .....	1322
9-37.	ADCSOCFLG1 Register .....	1324
9-38.	ADCSOCFRC1 Register .....	1329
9-39.	ADCSOCOVF1 Register .....	1334
9-40.	ADCSOCOVFCLR1 Register .....	1338

9-41. ADCSOC0CTL_1 Register .....	1342
9-42. ADCSOC1CTL_1 Register .....	1345
9-43. ADCSOC2CTL_1 Register .....	1348
9-44. ADCSOC3CTL_1 Register .....	1351
9-45. ADCSOC4CTL_1 Register .....	1354
9-46. ADCSOC5CTL_1 Register .....	1357
9-47. ADCSOC6CTL_1 Register .....	1360
9-48. ADCSOC7CTL_1 Register .....	1363
9-49. ADCSOC8CTL_1 Register .....	1366
9-50. ADCSOC9CTL_1 Register .....	1369
9-51. ADCSOC10CTL_1 Register .....	1372
9-52. ADCSOC11CTL_1 Register .....	1375
9-53. ADCSOC12CTL_1 Register .....	1378
9-54. ADCSOC13CTL_1 Register .....	1381
9-55. ADCSOC14CTL_1 Register .....	1384
9-56. ADCSOC15CTL_1 Register .....	1387
9-57. ADCEVTSTAT Register .....	1390
9-58. ADCEVTCLR Register.....	1392
9-59. ADCEVTSEL Register.....	1394
9-60. ADCEVTINTSEL Register.....	1396
9-61. ADCCOUNTER Register .....	1398
9-62. ADCREV Register.....	1399
9-63. ADCOFFTRIM Register .....	1400
9-64. ADCPPB1CONFIG Register.....	1401
9-65. ADCPPB1STAMP Register .....	1403
9-66. ADCPPB1OFFCAL Register.....	1404
9-67. ADCPPB1OFFREF Register.....	1405
9-68. ADCPPB1TRIPHI Register .....	1406
9-69. ADCPPB1TRIPLO Register.....	1407
9-70. ADCPPB2CONFIG Register.....	1408
9-71. ADCPPB2STAMP Register .....	1410
9-72. ADCPPB2OFFCAL Register.....	1411
9-73. ADCPPB2OFFREF Register.....	1412
9-74. ADCPPB2TRIPHI Register .....	1413
9-75. ADCPPB2TRIPLO Register.....	1414
9-76. ADCPPB3CONFIG Register.....	1415
9-77. ADCPPB3STAMP Register .....	1417
9-78. ADCPPB3OFFCAL Register.....	1418
9-79. ADCPPB3OFFREF Register.....	1419
9-80. ADCPPB3TRIPHI Register .....	1420
9-81. ADCPPB3TRIPLO Register.....	1421
9-82. ADCPPB4CONFIG Register.....	1422
9-83. ADCPPB4STAMP Register .....	1424
9-84. ADCPPB4OFFCAL Register.....	1425
9-85. ADCPPB4OFFREF Register.....	1426
9-86. ADCPPB4TRIPHI Register .....	1427
9-87. ADCPPB4TRIPLO Register.....	1428
9-88. ADCINLTRIM1 Register .....	1429
9-89. ADCINLTRIM2 Register .....	1430

9-90. ADCINLTRIM3 Register .....	1431
9-91. ADCINLTRIM4 Register .....	1432
9-92. ADCINLTRIM5 Register .....	1433
9-93. ADCINLTRIM6 Register .....	1434
9-94. ADCRESULT0 Register .....	1437
9-95. ADCRESULT1 Register .....	1438
9-96. ADCRESULT2 Register .....	1439
9-97. ADCRESULT3 Register .....	1440
9-98. ADCRESULT4 Register .....	1441
9-99. ADCRESULT5 Register .....	1442
9-100. ADCRESULT6 Register .....	1443
9-101. ADCRESULT7 Register .....	1444
9-102. ADCRESULT8 Register .....	1445
9-103. ADCRESULT9 Register .....	1446
9-104. ADCRESULT10 Register.....	1447
9-105. ADCRESULT11 Register.....	1448
9-106. ADCRESULT12 Register.....	1449
9-107. ADCRESULT13 Register.....	1450
9-108. ADCRESULT14 Register.....	1451
9-109. ADCRESULT15 Register.....	1452
9-110. ADCPPB1RESULT Register.....	1453
9-111. ADCPPB2RESULT Register.....	1454
9-112. ADCPPB3RESULT Register.....	1455
9-113. ADCPPB4RESULT Register.....	1456
10-1. DAC Module Block Diagram .....	1458
10-2. DACREV Register.....	1461
10-3. DACCTL Register .....	1462
10-4. DACVALA Register .....	1463
10-5. DACVALS Register .....	1464
10-6. DACOUTEN Register.....	1465
10-7. DACLOCK Register .....	1466
10-8. DACTRIM Register.....	1467
11-1. CMPSS Module Block Diagram .....	1469
11-2. Comparator Digital Output .....	1470
11-3. DAC Reference Select.....	1470
11-4. Output Voltage Calculation.....	1470
11-5. Ramp Generator.....	1471
11-6. Ramp Generator Behavior .....	1472
11-7. Digital Filter Behavior .....	1472
11-8. COMPCTL Register.....	1477
11-9. COMPHYSCTL Register .....	1479
11-10. COMPSTS Register.....	1480
11-11. COMPSTSCLR Register .....	1481
11-12. COMPDACCTL Register .....	1482
11-13. DACHVALS Register .....	1484
11-14. DACHVALA Register .....	1485
11-15. RAMPMAXREFA Register .....	1486
11-16. RAMPMAXREFS Register .....	1487
11-17. RAMPDECVALA Register.....	1488

11-18. RAMPDECVALS Register.....	1489
11-19. RAMPSTS Register.....	1490
11-20. DACLVALS Register.....	1491
11-21. DACLVALA Register.....	1492
11-22. RAMPDLYA Register.....	1493
11-23. RAMPDLYS Register.....	1494
11-24. CTRIPLFILCTL Register.....	1495
11-25. CTRIPLFILCLKCTL Register.....	1496
11-26. CTRIPHFILCTL Register.....	1497
11-27. CTRIPHFILCLKCTL Register.....	1498
11-28. COMPLOCK Register.....	1499
12-1. Sigma Delta Filter Module (SDFM) Block Diagram.....	1502
12-2. Block Diagram of One Filter Module.....	1503
12-3. Typical PWM Interface to Sigma Delta Filter Module.....	1503
12-4. Operation Diagrams.....	1505
12-5. Comparator Filter Resolution.....	1506
12-6. Frequency Response of Various Sinc Filters.....	1507
12-7. Data Filter Resolution.....	1508
12-8. SDFM Interrupt Unit.....	1511
12-9. SDIFLG Register.....	1516
12-10. SDIFLGCLR Register.....	1518
12-11. SDCTL Register.....	1520
12-12. SDMFILEN Register.....	1521
12-13. SDCTLPARM1 Register.....	1522
12-14. SDDFPARM1 Register.....	1523
12-15. SDDPARAM1 Register.....	1524
12-16. SDCMPH1 Register.....	1525
12-17. SDCMPL1 Register.....	1526
12-18. SDCPARAM1 Register.....	1527
12-19. SDDATA1 Register.....	1528
12-20. SDCTLPARM2 Register.....	1529
12-21. SDDFPARM2 Register.....	1530
12-22. SDDPARAM2 Register.....	1531
12-23. SDCMPH2 Register.....	1532
12-24. SDCMPL2 Register.....	1533
12-25. SDCPARAM2 Register.....	1534
12-26. SDDATA2 Register.....	1535
12-27. SDCTLPARM3 Register.....	1536
12-28. SDDFPARM3 Register.....	1537
12-29. SDDPARAM3 Register.....	1538
12-30. SDCMPH3 Register.....	1539
12-31. SDCMPL3 Register.....	1540
12-32. SDCPARAM3 Register.....	1541
12-33. SDDATA3 Register.....	1542
12-34. SDCTLPARM4 Register.....	1543
12-35. SDDFPARM4 Register.....	1544
12-36. SDDPARAM4 Register.....	1545
12-37. SDCMPH4 Register.....	1546
12-38. SDCMPL4 Register.....	1547

12-39. SDCPARAM4 Register .....	1548
12-40. SDDATA4 Register .....	1549
13-1. Multiple ePWM Modules.....	1554
13-2. Submodules and Signal Connections for an ePWM Module .....	1555
13-3. ePWM Submodules and Critical Internal Signal Interconnects .....	1557
13-4. Time-Base Submodule .....	1560
13-5. Time-Base Submodule Signals and Registers .....	1561
13-6. Time-Base Frequency and Period .....	1563
13-7. Time-Base Counter Synchronization Scheme.....	1565
13-8. Time-Base Up-Count Mode Waveforms .....	1567
13-9. Time-Base Down-Count Mode Waveforms .....	1568
13-10. Time-Base Up-Down-Count Waveforms, TBCTL[PHSDIR = 0] Count Down On Synchronization Event ...	1568
13-11. Time-Base Up-Down Count Waveforms, TBCTL[PHSDIR = 1] Count Up On Synchronization Event .....	1569
13-12. Global Load: Signals and Registers .....	1570
13-13. Counter-Compare Submodule.....	1571
13-14. Detailed View of the Counter-Compare Submodule.....	1572
13-15. Counter-Compare Event Waveforms in Up-Count Mode .....	1575
13-16. Counter-Compare Events in Down-Count Mode .....	1576
13-17. Counter-Compare Events In Up-Down-Count Mode, TBCTL[PHSDIR = 0] Count Down On Synchronization Event .....	1577
13-18. Counter-Compare Events In Up-Down-Count Mode, TBCTL[PHSDIR = 1] Count Up On Synchronization Event .....	1577
13-19. Action-Qualifier Submodule .....	1578
13-20. Action-Qualifier Submodule Inputs and Outputs .....	1579
13-21. Possible Action-Qualifier Actions for EPWMxA and EPWMxB Outputs .....	1580
13-22. AQCTLR[SHDWAQAMODE] .....	1583
13-23. AQCTLR[SHDWAQBMODE] .....	1583
13-24. Up-Down-Count Mode Symmetrical Waveform .....	1585
13-25. Up, Single Edge Asymmetric Waveform, With Independent Modulation on EPWMxA and EPWMxB—Active High .....	1586
13-26. Up, Single Edge Asymmetric Waveform With Independent Modulation on EPWMxA and EPWMxB—Active Low .....	1587
13-27. Up-Count, Pulse Placement Asymmetric Waveform With Independent Modulation on EPWMxA .....	1588
13-28. Up-Down-Count, Dual Edge Symmetric Waveform, With Independent Modulation on EPWMxA and EPWMxB — Active Low .....	1588
13-29. Up-Down-Count, Dual Edge Symmetric Waveform, With Independent Modulation on EPWMxA and EPWMxB — Complementary.....	1589
13-30. Up-Down-Count, Dual Edge Asymmetric Waveform, With Independent Modulation on EPWMxA—Active Low .....	1589
13-31. Up-Down-Count, PWM Waveform Generation Utilizing T1 and T2 Events .....	1590
13-32. Dead_Band Submodule .....	1590
13-33. Configuration Options for the Dead-Band Submodule .....	1593
13-34. Dead-Band Waveforms for Typical Cases (0% < Duty < 100%).....	1595
13-35. PWM Chopper Submodule.....	1597
13-36. PWM Chopper Submodule Operational Details.....	1598
13-37. Simple PWM Chopper Submodule Waveforms Showing Chopping Action Only .....	1598
13-38. PWM Chopper Submodule Waveforms Showing the First Pulse and Subsequent Sustaining Pulses .....	1599
13-39. PWM Chopper Submodule Waveforms Showing the Pulse Width (Duty Cycle) Control of Sustaining Pulses.....	1600
13-40. Trip-Zone Submodule.....	1601
13-41. Trip-Zone Submodule Mode Control Logic .....	1605

13-42. Trip-Zone Submodule Interrupt Logic.....	1606
13-43. Event-Trigger Submodule .....	1607
13-44. Event-Trigger Submodule Showing Event Inputs and Prescaled Outputs.....	1608
13-45. Event-Trigger Interrupt Generator.....	1610
13-46. Event-Trigger SOCA Pulse Generator .....	1611
13-47. Event-Trigger SOCB Pulse Generator .....	1611
13-48. Digital-Compare Submodule High-Level Block Diagram .....	1612
13-49. ePWM Trip Input Connectivity .....	1613
13-50. DCAEVT1 Event Triggering.....	1616
13-51. DCAEVT2 Event Triggering.....	1616
13-52. DCBEVT1 Event Triggering.....	1617
13-53. DCBEVT2 Event Triggering.....	1617
13-54. Event Filtering .....	1618
13-55. Blanking Window Timing Diagram .....	1618
13-56. Valley Switching .....	1620
13-57. EPWM X-BAR .....	1621
13-58. Simplified ePWM Module.....	1622
13-59. EPWM1 Configured as a Typical Master, EPWM2 Configured as a Slave .....	1623
13-60. Control of Four Buck Stages. Here $F_{P_{PWM1}} \neq F_{P_{PWM2}} \neq F_{P_{PWM3}} \neq F_{P_{PWM4}}$ .....	1624
13-61. Buck Waveforms for (Note: Only three bucks shown here) .....	1625
13-62. Control of Four Buck Stages. (Note: $F_{P_{PWM2}} = N \times F_{P_{PWM1}}$ ).....	1626
13-63. Buck Waveforms for (Note: $F_{P_{PWM2}} = F_{P_{PWM1}}$ ).....	1627
13-64. Control of Two Half-H Bridge Stages ( $F_{P_{PWM2}} = N \times F_{P_{PWM1}}$ ).....	1628
13-65. Half-H Bridge Waveforms for (Note: Here $F_{P_{PWM2}} = F_{P_{PWM1}}$ ).....	1629
13-66. 3-Phase Inverter Waveforms (Only One Inverter Shown) .....	1630
13-67. Configuring Two PWM Modules for Phase Control.....	1631
13-68. Timing Waveforms Associated With Phase Control Between Two Modules .....	1632
13-69. Control of a 3-Phase Interleaved DC/DC Converter.....	1633
13-70. 3-Phase Interleaved DC/DC Converter Waveforms for .....	1634
13-71. Controlling a Full-H Bridge Stage ( $F_{P_{PWM2}} = F_{P_{PWM1}}$ ) .....	1635
13-72. ZVS Full-H Bridge Waveforms .....	1636
13-73. Peak Current Mode Control of a Buck Converter .....	1636
13-74. Peak Current Mode Control Waveforms for .....	1637
13-75. Control of Two Resonant Converter Stages.....	1637
13-76. H-Bridge LLC Resonant Converter PWM Waveforms.....	1638
13-77. TBCTL Register .....	1643
13-78. TBCTL2 Register .....	1646
13-79. EPWMSYNCINSEL Register .....	1647
13-80. TBCTR Register .....	1648
13-81. TBSTS Register .....	1649
13-82. EPWMSYNCOUTEN Register.....	1650
13-83. CMPCTL Register .....	1652
13-84. CMPCTL2 Register .....	1654
13-85. DBCTL Register .....	1656
13-86. DBCTL2 Register.....	1659
13-87. AQCTL Register .....	1660
13-88. AQTSRCSEL Register.....	1662
13-89. PCCTL Register .....	1663
13-90. VCAPCTL Register .....	1665



13-91. VCNTCFG Register .....	1667
13-92. HRCNFG Register .....	1669
13-93. HRPWR Register .....	1671
13-94. HRMSTEP Register .....	1672
13-95. HRCNFG2 Register .....	1673
13-96. HRPCTL Register .....	1674
13-97. TRREM Register .....	1676
13-98. GLDCTL Register .....	1677
13-99. GLDCFG Register .....	1679
13-100. EPWMXLINK Register .....	1681
13-101. EPWMREV Register .....	1685
13-102. AQCTLA Register .....	1686
13-103. AQCTLA2 Register .....	1688
13-104. AQCTLB Register .....	1690
13-105. AQCTLB2 Register .....	1692
13-106. AQSFRC Register .....	1694
13-107. AQCSFRC Register .....	1696
13-108. DBREDHR Register .....	1697
13-109. DBRED Register .....	1698
13-110. DBFEDHR Register .....	1699
13-111. DBFED Register .....	1700
13-112. TBPHS Register .....	1701
13-113. TBPRDHR Register .....	1702
13-114. TBPRD Register .....	1703
13-115. CMPA Register .....	1704
13-116. CMPB Register .....	1705
13-117. CMPC Register .....	1706
13-118. CMPD Register .....	1707
13-119. GLDCTL2 Register .....	1708
13-120. SWVDELVAL Register .....	1709
13-121. TZSEL Register .....	1710
13-122. TZDCSEL Register .....	1712
13-123. TZCTL Register .....	1714
13-124. TZCTL2 Register .....	1716
13-125. TZCTLDCA Register .....	1718
13-126. TZCTLDCA Register .....	1720
13-127. TZEINT Register .....	1722
13-128. TZFLG Register .....	1723
13-129. TZCBCFLG Register .....	1725
13-130. TZOSTFLG Register .....	1727
13-131. TZCLR Register .....	1729
13-132. TZCBCCLR Register .....	1731
13-133. TZOSTCLR Register .....	1733
13-134. TZFRC Register .....	1735
13-135. ETSEL Register .....	1736
13-136. ETPS Register .....	1739
13-137. ETFLG Register .....	1742
13-138. ETCLR Register .....	1743
13-139. ETFRC Register .....	1744



13-140. ETINTPS Register .....	1745
13-141. ETSOCPs Register.....	1746
13-142. ETCNTINITCTL Register .....	1748
13-143. ETCNTINIT Register .....	1749
13-144. DCTRIPSEL Register .....	1750
13-145. DCACTL Register.....	1752
13-146. DCBCTL Register.....	1754
13-147. DCFCTL Register.....	1756
13-148. DCCAPCTL Register.....	1757
13-149. DCFOFFSET Register .....	1759
13-150. DCFOFFSETCNT Register.....	1760
13-151. DCFWINDOW Register .....	1761
13-152. DCFWINDOWCNT Register.....	1762
13-153. DCCAP Register .....	1763
13-154. DCAHTRIPSEL Register.....	1764
13-155. DCALTRIPSEL Register .....	1766
13-156. DCBHTRIPSEL Register.....	1768
13-157. DCBLTRIPSEL Register .....	1770
13-158. EPWMLOCK Register.....	1772
13-159. HWVDELVAL Register .....	1774
13-160. VCNTVAL Register .....	1775
13-161. TRIP4MUX0TO15CFG Register .....	1778
13-162. TRIP4MUX16TO31CFG Register .....	1781
13-163. TRIP5MUX0TO15CFG Register .....	1784
13-164. TRIP5MUX16TO31CFG Register .....	1787
13-165. TRIP7MUX0TO15CFG Register .....	1790
13-166. TRIP7MUX16TO31CFG Register .....	1793
13-167. TRIP8MUX0TO15CFG Register .....	1796
13-168. TRIP8MUX16TO31CFG Register .....	1799
13-169. TRIP9MUX0TO15CFG Register .....	1802
13-170. TRIP9MUX16TO31CFG Register .....	1805
13-171. TRIP10MUX0TO15CFG Register .....	1808
13-172. TRIP10MUX16TO31CFG Register .....	1811
13-173. TRIP11MUX0TO15CFG Register .....	1814
13-174. TRIP11MUX16TO31CFG Register .....	1817
13-175. TRIP12MUX0TO15CFG Register .....	1820
13-176. TRIP12MUX16TO31CFG Register .....	1823
13-177. TRIP4MUXENABLE Register .....	1826
13-178. TRIP5MUXENABLE Register .....	1831
13-179. TRIP7MUXENABLE Register .....	1836
13-180. TRIP8MUXENABLE Register .....	1841
13-181. TRIP9MUXENABLE Register .....	1846
13-182. TRIP10MUXENABLE Register.....	1851
13-183. TRIP11MUXENABLE Register.....	1856
13-184. TRIP12MUXENABLE Register.....	1861
13-185. TRIPOUTINV Register .....	1866
13-186. TRIPLOCK Register .....	1868
13-187. SYNCSELECT Register.....	1870
13-188. ADCSOCOUTSELECT Register.....	1873

13-189. SYNCLOCK Register .....	1876
14-1. Resolution Calculations for Conventionally Generated PWM .....	1878
14-2. Operating Logic Using MEP .....	1880
14-3. HRPWM Extension Registers and Memory Configuration .....	1881
14-4. HRPWM System Interface .....	1882
14-5. HRPWM Block Diagram .....	1883
14-6. Required PWM Waveform for a Requested Duty = 40.5% .....	1885
14-7. Low % Duty Cycle Range Limitation Example (HRPCTL[HRPE] = 0) .....	1888
14-8. High % Duty Cycle Range Limitation Example (HRPCTL[HRPE] = 0) .....	1890
14-9. Up-Count Duty Cycle Range Limitation Example (HRPCTL[HRPE]=1) .....	1890
14-10. Up-Down Count Duty Cycle Range Limitation Example (HRPCTL[HRPE]=1) .....	1891
14-11. Simple Buck Controlled Converter Using a Single PWM .....	1896
14-12. PWM Waveform Generated for Simple Buck Controlled Converter .....	1896
14-13. Simple Reconstruction Filter for a PWM-based DAC .....	1898
14-14. PWM Waveform Generated for the PWM DAC Function .....	1898
15-1. Capture and APWM Modes of Operation .....	1906
15-2. Counter Compare and PRD Effects on the eCAP Output in APWM Mode.....	1907
15-3. Capture Function Diagram .....	1908
15-4. Event Prescale Control .....	1909
15-5. Prescale Function Waveforms.....	1909
15-6. Details of the Continuous/One-shot Block .....	1910
15-7. Details of the Counter and Synchronization Block.....	1911
15-8. Time-Base Counter Synchronization Scheme 4 .....	1912
15-9. Interrupts in eCAP Module .....	1913
15-10. PWM Waveform Details Of APWM Mode Operation .....	1914
15-11. Time-Base Frequency and Period Calculation .....	1915
15-12. Capture Sequence for Absolute Time-stamp and Rising Edge Detect.....	1916
15-13. Capture Sequence for Absolute Time-stamp With Rising and Falling Edge Detect.....	1918
15-14. Capture Sequence for Delta Mode Time-stamp and Rising Edge Detect .....	1920
15-15. Capture Sequence for Delta Mode Time-stamp With Rising and Falling Edge Detect .....	1922
15-16. PWM Waveform Details of APWM Mode Operation.....	1924
15-17. TSCTR Register .....	1928
15-18. CTRPHS Register .....	1929
15-19. CAP1 Register .....	1930
15-20. CAP2 Register .....	1931
15-21. CAP3 Register .....	1932
15-22. CAP4 Register .....	1933
15-23. ECCTL1 Register.....	1934
15-24. ECCTL2 Register.....	1936
15-25. ECEINT Register .....	1938
15-26. ECFLG Register .....	1940
15-27. ECCLR Register.....	1942
15-28. ECFRC Register.....	1943
16-1. Optical Encoder Disk .....	1945
16-2. QEP Encoder Output Signal for Forward/Reverse Movement .....	1945
16-3. Index Pulse Example .....	1946
16-4. Functional Block Diagram of the eQEP Peripheral .....	1948
16-5. Functional Block Diagram of Decoder Unit .....	1950
16-6. Quadrature Decoder State Machine .....	1951

16-7. Quadrature-clock and Direction Decoding .....	1952
16-8. Position Counter Reset by Index Pulse for 1000 Line Encoder (QPOSMAX = 3999 or 0xF9F).....	1954
16-9. Position Counter Underflow/Overflow (QPOSMAX = 4) .....	1955
16-10. Software Index Marker for 1000-line Encoder (QEPCTL[IEL] = 1) .....	1956
16-11. Strobe Event Latch (QEPCTL[SEL] = 1) .....	1957
16-12. eQEP Position-compare Unit .....	1958
16-13. eQEP Position-compare Event Generation Points.....	1959
16-14. eQEP Position-compare Sync Output Pulse Stretcher.....	1959
16-15. eQEP Edge Capture Unit .....	1961
16-16. Unit Position Event for Low Speed Measurement (QCAPCTL[UPPS] = 0010).....	1961
16-17. eQEP Edge Capture Unit - Timing Details.....	1962
16-18. eQEP Watchdog Timer.....	1963
16-19. eQEP Unit Time Base .....	1964
16-20. EQEP Interrupt Generation .....	1964
16-21. QPOSCNT Register.....	1968
16-22. QPOSINIT Register .....	1969
16-23. QPOSMAX Register .....	1970
16-24. QPOSCMP Register .....	1971
16-25. QPOSILAT Register .....	1972
16-26. QPOSSLAT Register .....	1973
16-27. QPOSLAT Register .....	1974
16-28. QUTMR Register .....	1975
16-29. QUPRD Register .....	1976
16-30. QWDTMR Register .....	1977
16-31. QWDPRD Register.....	1978
16-32. QDECCTL Register .....	1979
16-33. QEPCTL Register .....	1981
16-34. QCAPCTL Register .....	1984
16-35. QPOSCTL Register .....	1985
16-36. QEINT Register.....	1986
16-37. QFLG Register.....	1988
16-38. QCLR Register .....	1990
16-39. QFRC Register .....	1992
16-40. QEPSTS Register .....	1994
16-41. QCTMR Register .....	1996
16-42. QCPRD Register .....	1997
16-43. QCTMRLAT Register .....	1998
16-44. QCPRDLAT Register .....	1999
17-1. SPI CPU Interface.....	2002
17-2. SPI Interrupt Flags and Enable Logic Generation .....	2005
17-3. SPI DMA Trigger Diagram .....	2006
17-4. SPI Master/Slave Connection .....	2007
17-5. SPI Module Master Configuration .....	2008
17-6. SPI Module Slave Configuration .....	2009
17-7. SPICLK Signal Options.....	2012
17-8. SPI: SPICLK-LSPCLK Characteristic When (BRR + 1) is Odd, BRR > 3, and CLKPOLARITY = 1 .....	2012
17-9. SPI 3-wire Master Mode.....	2015
17-10. SPI 3-wire Slave Mode .....	2015
17-11. Five Bits per Character .....	2018

17-12. SPI Digital Audio Receiver Configuration Using 2 SPIs.....	2019
17-13. Standard Right-Justified Digital Audio Data Format .....	2019
17-14. SPICCR Register .....	2022
17-15. SPICTL Register .....	2024
17-16. SPISTS Register .....	2026
17-17. SPIBRR Register .....	2028
17-18. SPIRXEMU Register .....	2029
17-19. SPIRXBUF Register .....	2030
17-20. SPITXBUF Register.....	2031
17-21. SPIDAT Register .....	2032
17-22. SPIFFTX Register.....	2033
17-23. SPIFFRX Register.....	2035
17-24. SPIFFCT Register.....	2037
17-25. SPIPRI Register .....	2038
18-1. SCI CPU Interface .....	2041
18-2. Serial Communications Interface (SCI) Module Block Diagram .....	2042
18-3. Typical SCI Data Frame Formats .....	2044
18-4. Idle-Line Multiprocessor Communication Format .....	2046
18-5. Double-Buffered WUT and TXSHF .....	2046
18-6. Address-Bit Multiprocessor Communication Format.....	2048
18-7. SCI Asynchronous Communications Format .....	2048
18-8. SCI RX Signals in Communication Modes.....	2049
18-9. SCI TX Signals in Communications Mode .....	2049
18-10. SCI FIFO Interrupt Flags and Enable Logic .....	2052
18-11. SCICCR Register.....	2056
18-12. SCICTL1 Register .....	2058
18-13. SCIHBAUD Register .....	2060
18-14. SCILBAUD Register .....	2061
18-15. SCICTL2 Register .....	2062
18-16. SCIRXST Register .....	2064
18-17. SCIRXEMU Register.....	2066
18-18. SCIRXBUF Register .....	2067
18-19. SCITXBUF Register.....	2068
18-20. SCIFFTX Register.....	2069
18-21. SCIFFRX Register .....	2071
18-22. SCIFFCT Register.....	2073
18-23. SCIPRI Register .....	2074
19-1. Multiple I2C Modules Connected.....	2076
19-2. I2C Module Conceptual Block Diagram .....	2078
19-3. Clocking Diagram for the I2C Module .....	2078
19-4. The Roles of the Clock Divide-Down Values (ICCL and ICCH).....	2079
19-5. Bit Transfer on the I2C-Bus .....	2080
19-6. I2C Module START and STOP Conditions .....	2082
19-7. I2C Module Data Transfer (7-Bit Addressing with 8-bit Data Configuration Shown) .....	2082
19-8. I2C Module 7-Bit Addressing Format (FDF = 0, XA = 0 in I2CMDR) .....	2082
19-9. I2C Module 10-Bit Addressing Format (FDF = 0, XA = 1 in I2CMDR) .....	2083
19-10. I2C Module Free Data Format (FDF = 1 in I2CMDR) .....	2083
19-11. Repeated START Condition (in This Case, 7-Bit Addressing Format).....	2084
19-12. Synchronization of Two I2C Clock Generators During Arbitration .....	2085

19-13. Arbitration Procedure Between Two Master-Transmitters .....	2086
19-14. Pin Diagram Showing the Effects of the Digital Loopback Mode (DLB) Bit .....	2086
19-15. Enable Paths of the I2C Interrupt Requests .....	2088
19-16. I2COAR Register .....	2092
19-17. I2CIER Register .....	2093
19-18. I2CSTR Register .....	2094
19-19. I2CCLKL Register .....	2099
19-20. I2CCLKH Register.....	2100
19-21. I2CCNT Register .....	2101
19-22. I2CDRR Register .....	2102
19-23. I2CSAR Register .....	2103
19-24. I2CDXR Register .....	2104
19-25. I2CMDR Register.....	2105
19-26. I2CISRC Register .....	2109
19-27. I2CEMDR Register.....	2110
19-28. I2CPSC Register .....	2111
19-29. I2CFFTX Register .....	2112
19-30. I2CFFRX Register.....	2114
20-1. Conceptual Block Diagram of the McBSP .....	2118
20-2. McBSP Data Transfer Paths.....	2119
20-3. Companding Processes .....	2120
20-4. $\mu$ -Law Transmit Data Companding Format .....	2120
20-5. A-Law Transmit Data Companding Format.....	2120
20-6. Two Methods by Which the McBSP Can Compand Internal Data.....	2121
20-7. Example - Clock Signal Control of Bit Transfer Timing .....	2121
20-8. McBSP Operating at Maximum Packet Frequency .....	2123
20-9. Single-Phase Frame for a McBSP Data Transfer.....	2124
20-10. Dual-Phase Frame for a McBSP Data Transfer.....	2125
20-11. Implementing the AC97 Standard With a Dual-Phase Frame.....	2125
20-12. Timing of an AC97-Standard Data Transfer Near Frame Synchronization .....	2126
20-13. McBSP Reception Physical Data Path .....	2126
20-14. McBSP Reception Signal Activity .....	2126
20-15. McBSP Transmission Physical Data Path .....	2127
20-16. McBSP Transmission Signal Activity .....	2127
20-17. Conceptual Block Diagram of the Sample Rate Generator.....	2129
20-18. Possible Inputs to the Sample Rate Generator and the Polarity Bits .....	2131
20-19. CLKG Synchronization and FSG Generation When GSYNC = 1 and CLKGDV = 1.....	2133
20-20. CLKG Synchronization and FSG Generation When GSYNC = 1 and CLKGDV = 3.....	2134
20-21. Overrun in the McBSP Receiver .....	2136
20-22. Overrun Prevented in the McBSP Receiver .....	2137
20-23. Possible Responses to Receive Frame-Synchronization Pulses .....	2137
20-24. An Unexpected Frame-Synchronization Pulse During a McBSP Reception .....	2138
20-25. Proper Positioning of Frame-Synchronization Pulses .....	2139
20-26. Data in the McBSP Transmitter Overwritten and Thus Not Transmitted.....	2139
20-27. Underflow During McBSP Transmission .....	2140
20-28. Underflow Prevented in the McBSP Transmitter .....	2141
20-29. Possible Responses to Transmit Frame-Synchronization Pulses .....	2141
20-30. An Unexpected Frame-Synchronization Pulse During a McBSP Transmission .....	2142
20-31. Proper Positioning of Frame-Synchronization Pulses .....	2143

20-32. Alternating Between the Channels of Partition A and the Channels of Partition B .....	2145
20-33. Reassigning Channel Blocks Throughout a McBSP Data Transfer .....	2146
20-34. McBSP Data Transfer in the 8-Partition Mode .....	2147
20-35. Activity on McBSP Pins for the Possible Values of XMCM .....	2150
20-36. Typical SPI Interface .....	2151
20-37. SPI Transfer With CLKSTP = 10b (No Clock Delay), CLKXP = 0, and CLKRP = 0 .....	2153
20-38. SPI Transfer With CLKSTP = 11b (Clock Delay), CLKXP = 0, CLKRP = 1 .....	2153
20-39. SPI Transfer With CLKSTP = 10b (No Clock Delay), CLKXP = 1, and CLKRP = 0 .....	2153
20-40. SPI Transfer With CLKSTP = 11b (Clock Delay), CLKXP = 1, CLKRP = 1 .....	2153
20-41. SPI Interface with McBSP Used as Master .....	2155
20-42. SPI Interface With McBSP Used as Slave .....	2156
20-43. Unexpected Frame-Synchronization Pulse With (R/X)FIG = 0 .....	2163
20-44. Unexpected Frame-Synchronization Pulse With (R/X)FIG = 1 .....	2163
20-45. Companding Processes for Reception and for Transmission .....	2164
20-46. Range of Programmable Data Delay .....	2165
20-47. 2-Bit Data Delay Used to Skip a Framing Bit .....	2165
20-48. Data Clocked Externally Using a Rising Edge and Sampled by the McBSP Receiver on a Falling Edge ..	2170
20-49. Frame of Period 16 CLKG Periods and Active Width of 2 CLKG Periods .....	2171
20-50. Data Clocked Externally Using a Rising Edge and Sampled by the McBSP Receiver on a Falling Edge ..	2173
20-51. Unexpected Frame-Synchronization Pulse With (R/X) FIG = 0 .....	2183
20-52. Unexpected Frame-Synchronization Pulse With (R/X) FIG = 1 .....	2183
20-53. Companding Processes for Reception and for Transmission .....	2184
20-54. $\mu$ -Law Transmit Data Companding Format .....	2184
20-55. A-Law Transmit Data Companding Format .....	2185
20-56. Range of Programmable Data Delay .....	2186
20-57. 2-Bit Data Delay Used to Skip a Framing Bit .....	2186
20-58. Data Clocked Externally Using a Rising Edge and Sampled by the McBSP Receiver on a Falling Edge ..	2190
20-59. Frame of Period 16 CLKG Periods and Active Width of 2 CLKG Periods .....	2190
20-60. Data Clocked Externally Using a Rising Edge and Sampled by the McBSP Receiver on a Falling Edge ..	2192
20-61. Four 8-Bit Data Words Transferred To/From the McBSP .....	2196
20-62. One 32-Bit Data Word Transferred To/From the McBSP .....	2196
20-63. 8-Bit Data Words Transferred at Maximum Packet Frequency .....	2197
20-64. Configuring the Data Stream of as a Continuous 32-Bit Word .....	2197
20-65. Receive Interrupt Generation .....	2198
20-66. Transmit Interrupt Generation .....	2198
20-67. Data Receive Registers (DRR2 and DRR1) .....	2202
20-68. Data Transmit Registers (DXR2 and DXR1) .....	2202
20-69. Serial Port Control 1 Register (SPCR1) .....	2203
20-70. Serial Port Control 2 Register (SPCR2) .....	2206
20-71. Receive Control Register 1 (RCR1) .....	2208
20-72. Receive Control Register 2 (RCR2) .....	2209
20-73. Transmit Control 1 Register (XCR1) .....	2211
20-74. Transmit Control 2 Register (XCR2) .....	2212
20-75. Sample Rate Generator 1 Register (SRGR1) .....	2214
20-76. Sample Rate Generator 2 Register (SRGR2) .....	2214
20-77. Multichannel Control 1 Register (MCR1) .....	2216
20-78. Multichannel Control 2 Register (MCR2) .....	2218
20-79. Pin Control Register (PCR) .....	2220
20-80. Receive Channel Enable Registers (RCERA...RCERH) .....	2222



20-81. Transmit Channel Enable Registers (XCERA...XCERH) .....	2224
20-82. McBSP Interrupt Enable Register (MFFINT) .....	2226
21-1. CAN Block Diagram.....	2229
21-2. CAN Core in Silent Mode .....	2233
21-3. CAN Core in Loopback Mode .....	2234
21-4. CAN Core in External Loopback Mode.....	2235
21-5. CAN Core in Loopback Combined with Silent Mode .....	2235
21-6. Initialization of a Transmit Object .....	2238
21-7. Initialization of a single Receive Object for Data Frames .....	2239
21-8. Initialization of a single Receive Object for Remote Frames .....	2239
21-9. CPU Handling of a FIFO Buffer (Interrupt Driven) .....	2244
21-10. Bit Timing.....	2245
21-11. The Propagation Time Segment .....	2246
21-12. Synchronization on Late and Early Edges .....	2248
21-13. Filtering of Short Dominant Spikes.....	2249
21-14. Structure of the CAN Core's CAN Protocol Controller .....	2250
21-15. Data Transfer Between IF1 / IF2 Registers and Message RAM.....	2253
21-16. Structure of a Message Object .....	2254
21-17. Message RAM Representation in Debug Mode.....	2258
21-18. CAN_CTL Register.....	2262
21-19. CAN_ES Register .....	2265
21-20. CAN_ERRC Register .....	2267
21-21. CAN_BTR Register .....	2268
21-22. CAN_INT Register .....	2270
21-23. CAN_TEST Register.....	2271
21-24. CAN_PERR Register .....	2273
21-25. CAN_RAM_INIT Register .....	2274
21-26. CAN_GLB_INT_EN Register .....	2275
21-27. CAN_GLB_INT_FLG Register.....	2276
21-28. CAN_GLB_INT_CLR Register.....	2277
21-29. CAN_ABOTR Register .....	2278
21-30. CAN_TXRQ_X Register .....	2279
21-31. CAN_TXRQ_21 Register.....	2280
21-32. CAN_NDAT_X Register .....	2281
21-33. CAN_NDAT_21 Register .....	2282
21-34. CAN_IPEN_X Register .....	2283
21-35. CAN_IPEN_21 Register .....	2284
21-36. CAN_MVAL_X Register .....	2285
21-37. CAN_MVAL_21 Register.....	2286
21-38. CAN_IP_MUX21 Register.....	2287
21-39. CAN_IF1CMD Register.....	2288
21-40. CAN_IF1MSK Register .....	2292
21-41. CAN_IF1ARB Register .....	2293
21-42. CAN_IF1MCTL Register .....	2295
21-43. CAN_IF1DATA Register.....	2298
21-44. CAN_IF1DATB Register.....	2299
21-45. CAN_IF2CMD Register.....	2300
21-46. CAN_IF2MSK Register .....	2304
21-47. CAN_IF2ARB Register .....	2305



21-48. CAN_IF2MCTL Register .....	2307
21-49. CAN_IF2DATA Register.....	2310
21-50. CAN_IF2DATB Register.....	2311
21-51. CAN_IF3OBS Register .....	2312
21-52. CAN_IF3MSK Register .....	2314
21-53. CAN_IF3ARB Register .....	2315
21-54. CAN_IF3MCTL Register .....	2316
21-55. CAN_IF3DATA Register.....	2318
21-56. CAN_IF3DATB Register.....	2319
21-57. CAN_IF3UPD Register .....	2320
22-1. USB Block Diagram.....	2322
22-2. USB Scheme.....	2323
22-3. Function Address Register (USBFADDR) .....	2349
22-4. Power Management Register (USBPOWER) in Host Mode.....	2350
22-5. Power Management Register (USBPOWER) in Device Mode .....	2350
22-6. USB Transmit Interrupt Status Register (USBTXIS).....	2352
22-7. USB Transmit Interrupt Status Register (USBRXIS) .....	2354
22-8. USB Transmit Interrupt Status Enable Register (USBTXIE) .....	2356
22-9. USB Transmit Interrupt Status Enable Register (USBRXIE) .....	2358
22-10. USB General Interrupt Status Register (USBIS) in Host Mode .....	2360
22-11. USB General Interrupt Status Register (USBIS) in Device Mode .....	2361
22-12. USB Interrupt Enable Register (USBIE) in Host Mode .....	2362
22-13. USB Interrupt Enable Register (USBIE) in Device Mode .....	2363
22-14. Frame Number Register (FRAME).....	2364
22-15. USB Endpoint Index Register (USBEPIDX) .....	2364
22-16. USB Test Mode Register (USBTEST) in Host Mode .....	2365
22-17. USB Test Mode Register (USBTEST) in Device Mode .....	2365
22-18. USB FIFO Endpoint <i>n</i> Register (USBFIFO[ <i>n</i> ]) .....	2367
22-19. USB Device Control Register (USBDEVCTL) .....	2368
22-20. USB Transmit Dynamic FIFO Sizing Register (USBTXFIFOSZ) .....	2370
22-21. USB Receive Dynamic FIFO Sizing Register (USBRXFIFOSZ) .....	2371
22-22. USB Transmit FIFO Start Address Register (USBTXFIFOADDR).....	2372
22-23. USB Receive FIFO Start Address Register (USBRXFIFOADDR) .....	2373
22-24. USB Connect Timing Register (USBCONTIM).....	2374
22-25. USB Full-Speed Last Transaction to End of Frame Timing Register (USBFSEOF) .....	2375
22-26. USB Low-Speed Last Transaction to End of Frame Timing Register (USBLSEOF) .....	2375
22-27. USB Transmit Functional Address Endpoint <i>n</i> Registers (USBTXFUNCADDR[ <i>n</i> ]) .....	2376
22-28. USB Transmit Hub Address Endpoint <i>n</i> Registers (USBTXHUBADDR[ <i>n</i> ]).....	2377
22-29. USB Transmit Hub Port Endpoint <i>n</i> Registers (USBTXHUBPORT[ <i>n</i> ]).....	2378
22-30. USB Receive Functional Address Endpoint <i>n</i> Registers (USBFIFO[ <i>n</i> ]) .....	2379
22-31. USB Receive Hub Address Endpoint <i>n</i> Registers (USBRXHUBADDR[ <i>n</i> ]) .....	2380
22-32. USB Transmit Hub Port Endpoint <i>n</i> Registers (USBRXHUBPORT[ <i>n</i> ]) .....	2381
22-33. USB Maximum Transmit Data Endpoint <i>n</i> Registers (USBTXMAXP[ <i>n</i> ]).....	2382
22-34. USB Control and Status Endpoint 0 Low Register (USBCSRL0) in Host Mode .....	2383
22-35. USB Control and Status Endpoint 0 Low Register (USBCSRL0) in Device Mode .....	2384
22-36. USB Control and Status Endpoint 0 High Register (USBCSRH0) in Host Mode .....	2385
22-37. USB Control and Status Endpoint 0 High Register (USBCSRH0) in Device Mode .....	2385
22-38. USB Receive Byte Count Endpoint 0 Register (USBCOUNT0).....	2386
22-39. USB Type Endpoint 0 Register (USBTYP0) .....	2386

22-40. USB NAK Limit Register (USBNAKLMT) .....	2387
22-41. USB Transmit Control and Status Endpoint <i>n</i> Low Register (USBTXCSRL[ <i>n</i> ]) in Host Mode.....	2388
22-42. USB Transmit Control and Status Endpoint <i>n</i> Low Register (USBTXCSRL[ <i>n</i> ]) in Device Mode .....	2389
22-43. USB Transmit Control and Status Endpoint <i>n</i> High Register (USBTXCSRH[ <i>n</i> ]) in Host Mode.....	2391
22-44. USB Transmit Control and Status Endpoint <i>n</i> High Register (USBTXCSRH[ <i>n</i> ]) in Device Mode .....	2392
22-45. USB Maximum Receive Data Endpoint <i>n</i> Registers (USBRXMAXP[ <i>n</i> ]) .....	2393
22-46. USB Receive Control and Status Endpoint <i>n</i> Low Register (USBCSRL[ <i>n</i> ]) in Host Mode .....	2394
22-47. USB Control and Status Endpoint <i>n</i> Low Register (USBCSRL[ <i>n</i> ]) in Device Mode.....	2395
22-48. USB Receive Control and Status Endpoint <i>n</i> High Register (USBCSRH[ <i>n</i> ]) in Host Mode.....	2396
22-49. USB Control and Status Endpoint <i>n</i> High Register (USBCSRH[ <i>n</i> ]) in Device Mode.....	2397
22-50. USB Maximum Receive Data Endpoint <i>n</i> Registers (USBRXCOUNT[ <i>n</i> ]) .....	2398
22-51. USB Host Transmit Configure Type Endpoint <i>n</i> Register (USBTXTYPE[ <i>n</i> ]) .....	2399
22-52. USB Host Transmit Interval Endpoint <i>n</i> Register (USBTXINTERVAL[ <i>n</i> ]) .....	2400
22-53. USB Host Configure Receive Type Endpoint <i>n</i> Register (USBRXTYPE[ <i>n</i> ]) .....	2401
22-54. USB Host Receive Polling Interval Endpoint <i>n</i> Register (USBRXINTERVAL[ <i>n</i> ]) .....	2402
22-55. USB Request Packet Count in Block Transfer Endpoint <i>n</i> Registers (USBRQPKTCOUNT[ <i>n</i> ]) .....	2403
22-56. USB Receive Double Packet Buffer Disable Register (USBRXDPKTBUFDIS).....	2404
22-57. USB Transmit Double Packet Buffer Disable Register (USBTXDPKTBUFDIS) .....	2406
22-58. USB External Power Control Register (USBEPCC) .....	2407
22-59. USB External Power Control Raw Interrupt Status Register (USBEPCCRIS) .....	2409
22-60. USB External Power Control Interrupt Mask Register (USBEPCCIM) .....	2410
22-61. USB External Power Control Interrupt Status and Clear Register (USBEPCCISC).....	2411
22-62. USB Device RESUME Raw Interrupt Status Register (USBDRRIS) .....	2412
22-63. USB Device RESUME Raw Interrupt Status Register (USBDRRIS) .....	2413
22-64. USB Device RESUME Interrupt Status and Clear Register (USBDRISC).....	2414
22-65. USB General-Purpose Control and Status Register (USBGPCS) .....	2415
22-66. USB DMA Select Register (USBDMASEL) .....	2416
23-1. uPP Integration .....	2419
23-2. Functional Block Diagram .....	2420
23-3. RX in SDR or DDR (non-demux) Mode .....	2421
23-4. RX in DDR (demux) Mode .....	2421
23-5. TX in SDR (non-interleave) or DDR (non-demux) Mode.....	2421
23-6. TX in SDR (interleave) or DDR (demux) Mode .....	2421
23-7. IO Output Clock Generation for TX Mode.....	2422
23-8. IO Input clock for RX Mode .....	2422
23-9. Structure of DMA Window and Lines in Memory.....	2424
23-10. uPP Receive in SDR Mode .....	2426
23-11. uPP Transmit in SDR Mode .....	2427
23-12. uPP Transmit in SDR Mode – Interleaving .....	2427
23-13. uPP Receive DDR Case .....	2427
23-14. uPP Transmit DDR Case.....	2427
23-15. uPP Tx Data Pattern in Non-Interleaved Mode .....	2428
23-16. uPP Rx Data Pattern in Non-Interleaved Mode .....	2428
23-17. PID Register .....	2436
23-18. PERCTL Register .....	2437
23-19. CHCTL Register .....	2439
23-20. IFCFG Register.....	2440
23-21. IFIVAL Register.....	2442
23-22. THCFG Register.....	2443

23-23. RAWINTST Register .....	2445
23-24. ENINTST Register .....	2447
23-25. INTENSET Register.....	2449
23-26. INTENCLR Register .....	2451
23-27. CHIDESC0 Register .....	2453
23-28. CHIDESC1 Register .....	2454
23-29. CHIDESC2 Register .....	2455
23-30. CHIST0 Register .....	2456
23-31. CHIST1 Register .....	2457
23-32. CHIST2 Register .....	2458
23-33. CHQDESC0 Register .....	2459
23-34. CHQDESC1 Register .....	2460
23-35. CHQDESC2 Register .....	2461
23-36. CHQST0 Register .....	2462
23-37. CHQST1 Register .....	2463
23-38. CHQST2 Register .....	2464
23-39. GINTEN Register .....	2465
23-40. GINTFLG Register .....	2466
23-41. GINTCLR Register .....	2467
23-42. DLYCTL Register.....	2468
24-1. EMIF Module Overview.....	2470
24-2. EMIF Functional Block Diagram.....	2471
24-3. Timing Waveform of SDRAM PRE Command .....	2475
24-4. EMIF to 2M x 16 x 4 bank SDRAM Interface .....	2475
24-5. EMIF to 512K x 16 x 2 bank SDRAM Interface.....	2476
24-6. Timing Waveform for Basic SDRAM Read Operation.....	2483
24-7. Timing Waveform for Basic SDRAM Write Operation.....	2484
24-8. EMIF Asynchronous Interface .....	2486
24-9. EMIF to 8-bit/16-bit Memory Interface.....	2487
24-10. Common Asynchronous Interface.....	2487
24-11. Timing Waveform of an Asynchronous Read Cycle in Normal Mode .....	2491
24-12. Timing Waveform of an Asynchronous Write Cycle in Normal Mode .....	2493
24-13. Timing Waveform of an Asynchronous Read Cycle in Select Strobe Mode .....	2495
24-14. Timing Waveform of an Asynchronous Write Cycle in Select Strobe Mode.....	2497
24-15. Example Configuration Interface .....	2504
24-16. SDRAM Timing Register (SDRAM_TR).....	2505
24-17. SDRAM Self Refresh Exit Timing Register (SDR_EXT_TMNG).....	2506
24-18. SDRAM Refresh Control Register (SDRAM_RCR).....	2507
24-19. SDRAM Configuration Register (SDRAM_CR).....	2507
24-20. LH28F800BJE-PTTL90 to EMIF Read Timing Waveforms.....	2508
24-21. LH28F800BJE-PTTL90 to EMIF Write Timing Waveforms .....	2509
24-22. Asynchronous <i>m</i> Configuration Register ( <i>m</i> = 1, 2) (ASYNC_CS <sub><i>n</i></sub> _CR( <i>n</i> = 2, 3)) .....	2510
24-23. RCSR Register .....	2513
24-24. ASYNC_WCCR Register .....	2514
24-25. SDRAM_CR Register .....	2515
24-26. SDRAM_RCR Register .....	2517
24-27. ASYNC_CS2_CR Register .....	2518
24-28. ASYNC_CS3_CR Register .....	2520
24-29. ASYNC_CS4_CR Register .....	2522

24-30. SDRAM_TR Register .....	2524
24-31. TOTAL_SDRAM_AR Register .....	2525
24-32. TOTAL_SDRAM_ACTR Register .....	2526
24-33. SDR_EXT_TMNG Register .....	2527
24-34. INT_RAW Register .....	2528
24-35. INT_MSK Register .....	2529
24-36. INT_MSK_SET Register .....	2530
24-37. INT_MSK_CLR Register .....	2531
24-38. EMIF1LOCK Register.....	2533
24-39. EMIF1COMMIT Register .....	2534
24-40. EMIF1ACCPROT0 Register .....	2535

## List of Tables

1-1.	TMU Supported Instructions .....	80
1-2.	Viterbi Decode Performance .....	81
1-3.	Complex Math Performance .....	81
2-1.	Reset Signals .....	84
2-2.	PIE Channel Mapping .....	90
2-3.	CPU Interrupt Vectors .....	91
2-4.	PIE Interrupt Vectors.....	92
2-5.	Access to EALLOW-Protected Registers .....	98
2-6.	Clock Connections Sorted by Clock Domain.....	107
2-7.	Clock Connections Sorted by Module Name.....	108
2-8.	Example Watchdog Key Sequences .....	113
2-9.	Local Shared RAM.....	120
2-10.	Global Shared RAM .....	120
2-11.	Error Handling in Different Scenarios .....	124
2-12.	Mapping of ECC Bits in Read Data from ECC/Parity Address Map .....	125
2-13.	Mapping of Parity Bits in Read Data from ECC/Parity Address Map .....	125
2-14.	RAM Status .....	139
2-15.	Security Levels .....	140
2-16.	System Control Base Address Table.....	152
2-17.	CPUTIMER_REGS Registers .....	153
2-18.	CPUTIMER_REGS Access Type Codes .....	153
2-19.	TIM Register Field Descriptions .....	154
2-20.	PRD Register Field Descriptions .....	155
2-21.	TCR Register Field Descriptions.....	156
2-22.	TPR Register Field Descriptions.....	158
2-23.	TPRH Register Field Descriptions.....	159
2-24.	PIE_CTRL_REGS Registers .....	160
2-25.	PIE_CTRL_REGS Access Type Codes .....	160
2-26.	PIECTRL Register Field Descriptions.....	162
2-27.	PIEACK Register Field Descriptions .....	163
2-28.	PIEIER1 Register Field Descriptions.....	164
2-29.	PIEIFR1 Register Field Descriptions .....	166
2-30.	PIEIER2 Register Field Descriptions.....	168
2-31.	PIEIFR2 Register Field Descriptions .....	170
2-32.	PIEIER3 Register Field Descriptions.....	172
2-33.	PIEIFR3 Register Field Descriptions .....	174
2-34.	PIEIER4 Register Field Descriptions.....	176
2-35.	PIEIFR4 Register Field Descriptions .....	178
2-36.	PIEIER5 Register Field Descriptions.....	180
2-37.	PIEIFR5 Register Field Descriptions .....	182
2-38.	PIEIER6 Register Field Descriptions.....	184
2-39.	PIEIFR6 Register Field Descriptions .....	186
2-40.	PIEIER7 Register Field Descriptions.....	188
2-41.	PIEIFR7 Register Field Descriptions .....	190
2-42.	PIEIER8 Register Field Descriptions.....	192
2-43.	PIEIFR8 Register Field Descriptions .....	194
2-44.	PIEIER9 Register Field Descriptions.....	196

2-45.	PIEFR9 Register Field Descriptions .....	198
2-46.	PIEIER10 Register Field Descriptions .....	200
2-47.	PIEFR10 Register Field Descriptions .....	202
2-48.	PIEIER11 Register Field Descriptions .....	204
2-49.	PIEFR11 Register Field Descriptions .....	206
2-50.	PIEIER12 Register Field Descriptions .....	208
2-51.	PIEFR12 Register Field Descriptions .....	210
2-52.	WD_REGS Registers .....	212
2-53.	WD_REGS Access Type Codes .....	212
2-54.	SCSR Register Field Descriptions.....	213
2-55.	WDCNTR Register Field Descriptions .....	214
2-56.	WDKEY Register Field Descriptions .....	215
2-57.	WDCR Register Field Descriptions.....	216
2-58.	WDWCR Register Field Descriptions .....	217
2-59.	NMI_INTRUPT_REGS Registers.....	218
2-60.	NMI_INTRUPT_REGS Access Type Codes .....	218
2-61.	NMICFG Register Field Descriptions .....	219
2-62.	NMIFLG Register Field Descriptions .....	220
2-63.	NMIFLGCLR Register Field Descriptions.....	222
2-64.	NMIFLGFRC Register Field Descriptions .....	224
2-65.	NMIWDCNT Register Field Descriptions .....	225
2-66.	NMIWDPRD Register Field Descriptions .....	226
2-67.	NMISHDFLG Register Field Descriptions .....	227
2-68.	XINT_REGS Registers.....	229
2-69.	XINT_REGS Access Type Codes .....	229
2-70.	XINT1CR Register Field Descriptions.....	230
2-71.	XINT2CR Register Field Descriptions.....	231
2-72.	XINT3CR Register Field Descriptions.....	232
2-73.	XINT4CR Register Field Descriptions.....	233
2-74.	XINT5CR Register Field Descriptions.....	234
2-75.	XINT1CTR Register Field Descriptions .....	235
2-76.	XINT2CTR Register Field Descriptions .....	236
2-77.	XINT3CTR Register Field Descriptions .....	237
2-78.	DMA_CLA_SRC_SEL_REGS Registers .....	238
2-79.	DMA_CLA_SRC_SEL_REGS Access Type Codes.....	238
2-80.	CLA1TASKSRCSELLOCK Register Field Descriptions .....	239
2-81.	DMACHSRCSELLOCK Register Field Descriptions .....	240
2-82.	CLA1TASKSRCSEL1 Register Field Descriptions .....	241
2-83.	CLA1TASKSRCSEL2 Register Field Descriptions .....	242
2-84.	DMACHSRCSEL1 Register Field Descriptions .....	243
2-85.	DMACHSRCSEL2 Register Field Descriptions .....	244
2-86.	FLASH_PUMP_SEMAPHORE_REGS Registers .....	245
2-87.	FLASH_PUMP_SEMAPHORE_REGS Access Type Codes .....	245
2-88.	PUMPREQUEST Register Field Descriptions .....	246
2-89.	DEV_CFG_REGS Registers .....	247
2-90.	DEV_CFG_REGS Access Type Codes .....	248
2-91.	PARTIDL_1 Register Field Descriptions.....	249
2-92.	PARTIDH_1 Register Field Descriptions .....	251
2-93.	REVID Register Field Descriptions .....	252

2-94.	DC0_1 Register Field Descriptions.....	253
2-95.	DC1_1 Register Field Descriptions.....	254
2-96.	DC2_1 Register Field Descriptions.....	255
2-97.	DC3_1 Register Field Descriptions.....	256
2-98.	DC4_1 Register Field Descriptions.....	258
2-99.	DC5_1 Register Field Descriptions.....	259
2-100.	DC6_1 Register Field Descriptions.....	260
2-101.	DC7_1 Register Field Descriptions.....	261
2-102.	DC8_1 Register Field Descriptions.....	262
2-103.	DC9_1 Register Field Descriptions.....	263
2-104.	DC10_1 Register Field Descriptions.....	264
2-105.	DC11_1 Register Field Descriptions.....	265
2-106.	DC12_1 Register Field Descriptions.....	266
2-107.	DC13_1 Register Field Descriptions.....	267
2-108.	DC14_1 Register Field Descriptions.....	268
2-109.	DC15_1 Register Field Descriptions.....	269
2-110.	DC17_1 Register Field Descriptions.....	271
2-111.	DC18_1 Register Field Descriptions.....	272
2-112.	DC20_1 Register Field Descriptions.....	273
2-113.	PERCNF1_1 Register Field Descriptions.....	275
2-114.	FUSEERR Register Field Descriptions.....	276
2-115.	SOFTPRES0 Register Field Descriptions.....	277
2-116.	SOFTPRES1 Register Field Descriptions.....	278
2-117.	SOFTPRES2 Register Field Descriptions.....	279
2-118.	SOFTPRES3 Register Field Descriptions.....	281
2-119.	SOFTPRES4 Register Field Descriptions.....	282
2-120.	SOFTPRES6 Register Field Descriptions.....	283
2-121.	SOFTPRES7 Register Field Descriptions.....	284
2-122.	SOFTPRES8 Register Field Descriptions.....	285
2-123.	SOFTPRES9 Register Field Descriptions.....	286
2-124.	SOFTPRES11 Register Field Descriptions.....	287
2-125.	SOFTPRES13 Register Field Descriptions.....	288
2-126.	SOFTPRES14 Register Field Descriptions.....	289
2-127.	SOFTPRES16 Register Field Descriptions.....	290
2-128.	SYSDBGCTL Register Field Descriptions.....	291
2-129.	CLK_CFG_REGS Registers.....	292
2-130.	CLK_CFG_REGS Access Type Codes.....	292
2-131.	CLKCFGLOCK1 Register Field Descriptions.....	294
2-132.	CLKSRCCTL1 Register Field Descriptions.....	296
2-133.	CLKSRCCTL2 Register Field Descriptions.....	298
2-134.	CLKSRCCTL3 Register Field Descriptions.....	300
2-135.	SYSPLLCTL1 Register Field Descriptions.....	301
2-136.	SYSPLLMULT Register Field Descriptions.....	302
2-137.	SYSPLLSTS Register Field Descriptions.....	303
2-138.	AUXPLLCTL1 Register Field Descriptions.....	304
2-139.	AUXPLLMULT Register Field Descriptions.....	305
2-140.	AUXPLLSTS Register Field Descriptions.....	306
2-141.	SYSCLKDIVSEL Register Field Descriptions.....	307
2-142.	AUXCLKDIVSEL Register Field Descriptions.....	308



2-143. PERCLKDIVSEL Register Field Descriptions .....	309
2-144. XCLKOUTDIVSEL Register Field Descriptions .....	310
2-145. LOSPCP Register Field Descriptions .....	311
2-146. MCDCCR Register Field Descriptions .....	312
2-147. X1CNT Register Field Descriptions .....	313
2-148. CPU_SYS_REGS Registers .....	314
2-149. CPU_SYS_REGS Access Type Codes .....	314
2-150. CPUSYSLOCK1 Register Field Descriptions .....	316
2-151. HIBBOOTMODE Register Field Descriptions .....	319
2-152. IORESTOREADDR Register Field Descriptions .....	320
2-153. PIEVERRADDR Register Field Descriptions .....	321
2-154. PCLKCR0 Register Field Descriptions .....	322
2-155. PCLKCR1 Register Field Descriptions .....	324
2-156. PCLKCR2 Register Field Descriptions .....	325
2-157. PCLKCR3 Register Field Descriptions .....	327
2-158. PCLKCR4 Register Field Descriptions .....	329
2-159. PCLKCR6 Register Field Descriptions .....	330
2-160. PCLKCR7 Register Field Descriptions .....	331
2-161. PCLKCR8 Register Field Descriptions .....	332
2-162. PCLKCR9 Register Field Descriptions .....	333
2-163. PCLKCR10 Register Field Descriptions .....	334
2-164. PCLKCR11 Register Field Descriptions .....	335
2-165. PCLKCR12 Register Field Descriptions .....	336
2-166. PCLKCR13 Register Field Descriptions .....	337
2-167. PCLKCR14 Register Field Descriptions .....	338
2-168. PCLKCR16 Register Field Descriptions .....	340
2-169. SECMSEL_1 Register Field Descriptions .....	341
2-170. LPMCR Register Field Descriptions .....	342
2-171. GPIOLPMSSEL0 Register Field Descriptions .....	344
2-172. GPIOLPMSSEL1 Register Field Descriptions .....	347
2-173. TMR2CLKCTL Register Field Descriptions .....	350
2-174. RESC Register Field Descriptions .....	352
2-175. ROM_PREFETCH_REGS Registers .....	354
2-176. ROM_PREFETCH_REGS Access Type Codes .....	354
2-177. ROMPREFETCH Register Field Descriptions .....	355
2-178. DCSM_COMMON_REGS Registers .....	356
2-179. DCSM_COMMON_REGS Access Type Codes .....	356
2-180. FLSEM Register Field Descriptions .....	357
2-181. SECTSTAT Register Field Descriptions .....	358
2-182. RAMSTAT Register Field Descriptions .....	361
2-183. DCSM_Z1_OTP Registers .....	363
2-184. DCSM_Z1_OTP Access Type Codes .....	363
2-185. Z1OTP_LINKPOINTER1 Register Field Descriptions .....	364
2-186. Z1OTP_LINKPOINTER2 Register Field Descriptions .....	365
2-187. Z1OTP_LINKPOINTER3 Register Field Descriptions .....	366
2-188. Z1OTP_PSWDLOCK Register Field Descriptions .....	367
2-189. Z1OTP_CRCLOCK Register Field Descriptions .....	368
2-190. Z1OTP_BOOTCTRL Register Field Descriptions .....	369
2-191. DCSM_Z1_REGS Registers .....	370

2-192. DCSM_Z1_REGS Access Type Codes .....	370
2-193. Z1_LINKPOINTER Register Field Descriptions .....	371
2-194. Z1_OTPSECLOCK Register Field Descriptions .....	372
2-195. Z1_BOOTCTRL Register Field Descriptions .....	373
2-196. Z1_LINKPOINTERERR Register Field Descriptions .....	374
2-197. Z1_CSMKEY0 Register Field Descriptions .....	375
2-198. Z1_CSMKEY1 Register Field Descriptions .....	376
2-199. Z1_CSMKEY2 Register Field Descriptions .....	377
2-200. Z1_CSMKEY3 Register Field Descriptions .....	378
2-201. Z1_CR Register Field Descriptions .....	379
2-202. Z1_GRABSECTR Register Field Descriptions .....	380
2-203. Z1_GRABRAMR Register Field Descriptions .....	383
2-204. Z1_EXEONLYSECTR Register Field Descriptions .....	385
2-205. Z1_EXEONLYRAMR Register Field Descriptions .....	388
2-206. DCSM_Z2_OTP Registers .....	390
2-207. DCSM_Z2_OTP Access Type Codes .....	390
2-208. Z2OTP_LINKPOINTER1 Register Field Descriptions .....	391
2-209. Z2OTP_LINKPOINTER2 Register Field Descriptions .....	392
2-210. Z2OTP_LINKPOINTER3 Register Field Descriptions .....	393
2-211. Z2OTP_PSWDLOCK Register Field Descriptions .....	394
2-212. Z2OTP_CRCLOCK Register Field Descriptions .....	395
2-213. Z2OTP_BOOTCTRL Register Field Descriptions .....	396
2-214. DCSM_Z2_REGS Registers .....	397
2-215. DCSM_Z2_REGS Access Type Codes .....	397
2-216. Z2_LINKPOINTER Register Field Descriptions .....	398
2-217. Z2_OTPSECLOCK Register Field Descriptions .....	399
2-218. Z2_BOOTCTRL Register Field Descriptions .....	400
2-219. Z2_LINKPOINTERERR Register Field Descriptions .....	401
2-220. Z2_CSMKEY0 Register Field Descriptions .....	402
2-221. Z2_CSMKEY1 Register Field Descriptions .....	403
2-222. Z2_CSMKEY2 Register Field Descriptions .....	404
2-223. Z2_CSMKEY3 Register Field Descriptions .....	405
2-224. Z2_CR Register Field Descriptions .....	406
2-225. Z2_GRABSECTR Register Field Descriptions .....	407
2-226. Z2_GRABRAMR Register Field Descriptions .....	410
2-227. Z2_EXEONLYSECTR Register Field Descriptions .....	412
2-228. Z2_EXEONLYRAMR Register Field Descriptions .....	415
2-229. MEM_CFG_REGS Registers .....	417
2-230. MEM_CFG_REGS Access Type Codes .....	417
2-231. DxLOCK Register Field Descriptions .....	419
2-232. DxCOMMIT Register Field Descriptions .....	420
2-233. DxACCPROT0 Register Field Descriptions .....	421
2-234. DxTEST Register Field Descriptions .....	422
2-235. DxINIT Register Field Descriptions .....	423
2-236. DxINITDONE Register Field Descriptions .....	424
2-237. LSxLOCK Register Field Descriptions .....	425
2-238. LSxCOMMIT Register Field Descriptions .....	427
2-239. LSxMSEL Register Field Descriptions .....	429
2-240. LSxCLAPGM Register Field Descriptions .....	431

2-241. LSxACCPROT0 Register Field Descriptions .....	432
2-242. LSxACCPROT1 Register Field Descriptions .....	434
2-243. LSxTEST Register Field Descriptions .....	435
2-244. LSxINIT Register Field Descriptions .....	437
2-245. LSxINITDONE Register Field Descriptions.....	438
2-246. GSxLOCK Register Field Descriptions.....	439
2-247. GSxCOMMIT Register Field Descriptions .....	442
2-248. GSxACCPROT0 Register Field Descriptions .....	445
2-249. GSxACCPROT1 Register Field Descriptions .....	447
2-250. GSxACCPROT2 Register Field Descriptions .....	449
2-251. GSxACCPROT3 Register Field Descriptions .....	451
2-252. GSxTEST Register Field Descriptions .....	453
2-253. GSxINIT Register Field Descriptions .....	456
2-254. GSxINITDONE Register Field Descriptions .....	458
2-255. MSGxTEST Register Field Descriptions .....	460
2-256. MSGxINIT Register Field Descriptions.....	461
2-257. MSGxINITDONE Register Field Descriptions.....	462
2-258. ACCESS_PROTECTION_REGS Registers.....	463
2-259. ACCESS_PROTECTION_REGS Access Type Codes .....	463
2-260. NMAVFLG Register Field Descriptions .....	465
2-261. NMAVSET Register Field Descriptions .....	467
2-262. NMAVCLR Register Field Descriptions .....	469
2-263. NMAVINTEN Register Field Descriptions .....	471
2-264. NMCPURDAVADDR Register Field Descriptions .....	472
2-265. NMCPUWRAVADDR Register Field Descriptions .....	473
2-266. NMCPUFAVADDR Register Field Descriptions .....	474
2-267. NMDMAWRAVADDR Register Field Descriptions .....	475
2-268. NMCLA1RDAVADDR Register Field Descriptions .....	476
2-269. NMCLA1WRAVADDR Register Field Descriptions .....	477
2-270. NMCLA1FAVADDR Register Field Descriptions .....	478
2-271. MAVFLG Register Field Descriptions .....	479
2-272. MAVSET Register Field Descriptions .....	480
2-273. MAVCLR Register Field Descriptions .....	481
2-274. MAVINTEN Register Field Descriptions .....	482
2-275. MCPUFAVADDR Register Field Descriptions .....	483
2-276. MCPUWRAVADDR Register Field Descriptions .....	484
2-277. MDMAWRAVADDR Register Field Descriptions .....	485
2-278. MEMORY_ERROR_REGS Registers.....	486
2-279. MEMORY_ERROR_REGS Access Type Codes.....	486
2-280. UCERRFLG Register Field Descriptions .....	487
2-281. UCERRSET Register Field Descriptions .....	488
2-282. UCERRCLR Register Field Descriptions .....	489
2-283. UCCPUREADDR Register Field Descriptions .....	490
2-284. UCDMAREADDR Register Field Descriptions.....	491
2-285. UCCLA1READDR Register Field Descriptions .....	492
2-286. CERRFLG Register Field Descriptions .....	493
2-287. CERRSET Register Field Descriptions .....	494
2-288. CERRCLR Register Field Descriptions .....	495
2-289. CCPUREADDR Register Field Descriptions .....	496

2-290. CERRCNT Register Field Descriptions .....	497
2-291. CERRTHRES Register Field Descriptions .....	498
2-292. CEINTFLG Register Field Descriptions .....	499
2-293. CEINTCLR Register Field Descriptions .....	500
2-294. CEINTSET Register Field Descriptions .....	501
2-295. CEINTEN Register Field Descriptions .....	502
2-296. ROM_WAIT_STATE_REGS Registers .....	503
2-297. ROM_WAIT_STATE_REGS Access Type Codes .....	503
2-298. ROMWAITSTATE Register Field Descriptions .....	504
2-299. FLASH_CTRL_REGS Registers.....	505
2-300. FLASH_CTRL_REGS Access Type Codes .....	505
2-301. FRDCNTL Register Field Descriptions.....	506
2-302. FBAC Register Field Descriptions .....	507
2-303. FBFALLBACK Register Field Descriptions .....	508
2-304. FBPRDY Register Field Descriptions .....	509
2-305. FPAC1 Register Field Descriptions .....	510
2-306. FMSTAT Register Field Descriptions .....	511
2-307. FRD_INTF_CTRL Register Field Descriptions.....	513
2-308. FLASH_ECC_REGS Registers .....	514
2-309. FLASH_ECC_REGS Access Type Codes .....	514
2-310. ECC_ENABLE Register Field Descriptions .....	516
2-311. SINGLE_ERR_ADDR_LOW Register Field Descriptions .....	517
2-312. SINGLE_ERR_ADDR_HIGH Register Field Descriptions.....	518
2-313. UNC_ERR_ADDR_LOW Register Field Descriptions .....	519
2-314. UNC_ERR_ADDR_HIGH Register Field Descriptions.....	520
2-315. ERR_STATUS Register Field Descriptions .....	521
2-316. ERR_POS Register Field Descriptions .....	523
2-317. ERR_STATUS_CLR Register Field Descriptions .....	524
2-318. ERR_CNT Register Field Descriptions .....	525
2-319. ERR_THRESHOLD Register Field Descriptions .....	526
2-320. ERR_INTFLG Register Field Descriptions .....	527
2-321. ERR_INTCLR Register Field Descriptions .....	528
2-322. FDATAH_TEST Register Field Descriptions .....	529
2-323. FDATAL_TEST Register Field Descriptions .....	530
2-324. FADDR_TEST Register Field Descriptions .....	531
2-325. FECC_TEST Register Field Descriptions .....	532
2-326. FECC_CTRL Register Field Descriptions .....	533
2-327. FOUTH_TEST Register Field Descriptions .....	534
2-328. FOUTL_TEST Register Field Descriptions .....	535
2-329. FECC_STATUS Register Field Descriptions.....	536
2-330. UID_REGS Registers .....	537
2-331. UID_REGS Access Type Codes.....	537
2-332. UID_PSRAND0 Register Field Descriptions .....	538
2-333. UID_PSRAND1 Register Field Descriptions .....	539
2-334. UID_PSRAND2 Register Field Descriptions .....	540
2-335. UID_PSRAND3 Register Field Descriptions .....	541
2-336. UID_PSRAND4 Register Field Descriptions .....	542
2-337. UID_PSRAND5 Register Field Descriptions .....	543
2-338. UID_UNIQUE Register Field Descriptions .....	544

2-339. UID_CHECKSUM Register Field Descriptions.....	545
3-1. ROM Memory .....	547
3-2. Boot ROM Philosophy.....	547
3-3. Device Default Boot Modes .....	548
3-4. All Available Boot Modes .....	548
3-5. BOOTCTRL Register Bit Fields.....	548
3-6. Get Mode Decoding .....	549
3-7. Emulation Boot Options.....	550
3-8. Boot ROM Reset Causes and Actions.....	553
3-9. Boot ROM Exceptions and Actions.....	554
3-10. Entry Point Addresses .....	554
3-11. Wait Point Addresses for CPU1 .....	555
3-12. Boot ROM Memory Map .....	555
3-13. CLA Data ROM Memory Map.....	555
3-14. Reserved RAM and Flash Memory Map.....	556
3-15. CLA Data ROM Tables.....	556
3-16. SPI 8-Bit Data Stream .....	560
3-17. I2C 8-Bit Data Stream .....	563
3-18. Parallel GPIO Boot 8-Bit Data Stream .....	564
3-19. Bit-Rate Value for Internal Oscillators.....	568
3-20. CAN 8-Bit Data Stream .....	568
3-21. USB 8-Bit Data Stream .....	569
3-22. LSB/MSB Loading Sequence in 8-Bit Data Stream .....	571
3-23. SCI Boot Options .....	572
3-24. CAN Boot Options .....	573
3-25. I2C Boot Options.....	573
3-26. USB Boot Options .....	573
3-27. RAM Boot Options .....	573
3-28. Flash Boot Options .....	573
3-29. Wait Boot Options .....	573
3-30. SPI Boot Options .....	573
3-31. Parallel Boot Options.....	573
3-32. Boot Clock Sources .....	574
3-33. Clock State After Boot ROM .....	574
3-34. ROM Wait States .....	574
3-35. CPU1 Boot Status Address.....	575
3-36. CPU1 Boot Status Bit Fields .....	575
3-37. Boot ROM Version Information .....	575
4-1. Peripheral Interrupt Trigger Source Options .....	581
4-2. DMA Register Summary .....	594
4-3. DMA Control Register (DMACTRL) Field Descriptions .....	595
4-4. Debug Control Register (DEBUGCTRL) Field Descriptions .....	596
4-5. Revision Register (REVISION) Field Descriptions .....	596
4-6. Priority Control Register 1 (PRIORITYCTRL1) Field Descriptions .....	597
4-7. Priority Status Register (PRIORITYSTAT) Field Descriptions .....	598
4-8. Mode Register (MODE) Field Descriptions.....	599
4-9. Control Register (CONTROL) Field Descriptions.....	601
4-10. Burst Size Register (BURST_SIZE) Field Descriptions.....	603
4-11. Burst Count Register (BURST_COUNT) Field Descriptions .....	603

4-12.	Source Burst Step Size Register (SRC_BURST_STEP) Field Descriptions.....	604
4-13.	Destination Burst Step Register Size (DST_BURST_STEP) Field Descriptions.....	605
4-14.	Transfer Size Register (TRANSFER_SIZE) Field Descriptions .....	605
4-15.	Transfer Count Register (TRANSFER_COUNT) Field Descriptions.....	606
4-16.	Source Transfer Step Size Register (SRC_TRANSFER_STEP) Field Descriptions .....	606
4-17.	Destination Transfer Step Size Register (DST_TRANSFER_STEP) Field Descriptions.....	607
4-18.	Source/Destination Wrap Size Register (SRC/DST_WRAP_SIZE) Field Descriptions .....	607
4-19.	Source/Destination Wrap Count Register (SCR/DST_WRAP_COUNT) Field Descriptions .....	608
4-20.	Source/Destination Wrap Step Size Registers (SRC/DST_WRAP_STEP) Field Descriptions.....	608
4-21.	Shadow Source Begin and Current Address Pointer Registers (SRC_BEG_ADDR_SHADOW/DST_BEG_ADDR_SHADOW) Field Descriptions .....	609
4-22.	Active Source Begin and Current Address Pointer Registers (SRC_BEG_ADDR/DST_BEG_ADDR) Field Descriptions .....	609
4-23.	Shadow Destination Begin and Current Address Pointer Registers (SRC_ADDR_SHADOW/DST_ADDR_SHADOW) Field Descriptions.....	610
4-24.	Active Destination Begin and Current Address Pointer Registers (SRC_ADDR/DST_ADDR) Field Descriptions .....	610
5-1.	Configuration Options .....	616
5-2.	Write Followed by Read - Read Occurs First .....	625
5-3.	Write Followed by Read - Write Occurs First .....	625
5-4.	ADC to CLA Early Interrupt Response .....	627
5-5.	Operand Nomenclature .....	629
5-6.	INSTRUCTION dest, source1, source2 Short Description .....	630
5-7.	Addressing Modes .....	631
5-8.	Shift Field Encoding .....	632
5-9.	Operand Encoding.....	632
5-10.	Condition Field Encoding .....	632
5-11.	General Instructions .....	633
5-12.	Pipeline Activity For MBCNDD, Branch Not Taken .....	648
5-13.	Pipeline Activity For MBCNDD, Branch Taken .....	648
5-14.	Pipeline Activity For MCCNDD, Call Not Taken .....	654
5-15.	Pipeline Activity For MCCNDD, Call Taken .....	654
5-16.	Pipeline Activity For MMOV16 MARx, MRa , #16I .....	686
5-17.	Pipeline Activity For MMOV16 MAR0/MAR1, mem16 .....	689
5-18.	Pipeline Activity For MMOVI16 MAR0/MAR1, #16I .....	703
5-19.	Pipeline Activity For MRCNDD, Return Not Taken .....	725
5-20.	Pipeline Activity For MRCNDD, Return Taken .....	725
5-21.	Pipeline Activity For MSTOP .....	729
5-22.	CLA Base Address Table.....	744
5-23.	CLA_REGS Registers.....	745
5-24.	CLA_REGS Access Type Codes .....	745
5-25.	MVECT1 Register Field Descriptions .....	747
5-26.	MVECT2 Register Field Descriptions .....	748
5-27.	MVECT3 Register Field Descriptions .....	749
5-28.	MVECT4 Register Field Descriptions .....	750
5-29.	MVECT5 Register Field Descriptions .....	751
5-30.	MVECT6 Register Field Descriptions .....	752
5-31.	MVECT7 Register Field Descriptions .....	753
5-32.	MVECT8 Register Field Descriptions .....	754
5-33.	MCTL Register Field Descriptions.....	755



5-34.	MIFR Register Field Descriptions.....	756
5-35.	MIOVF Register Field Descriptions.....	758
5-36.	MIFRC Register Field Descriptions.....	760
5-37.	MICLR Register Field Descriptions.....	762
5-38.	MICLROVF Register Field Descriptions .....	764
5-39.	MIER Register Field Descriptions .....	766
5-40.	MIRUN Register Field Descriptions .....	768
5-41.	_MPC Register Field Descriptions.....	770
5-42.	_MAR0 Register Field Descriptions .....	771
5-43.	_MAR1 Register Field Descriptions .....	772
5-44.	_MSTF Register Field Descriptions .....	773
5-45.	_MR0 Register Field Descriptions .....	776
5-46.	_MR1 Register Field Descriptions .....	777
5-47.	_MR2 Register Field Descriptions .....	778
5-48.	_MR3 Register Field Descriptions .....	779
5-49.	CLA_SOFTINT_REGS Registers.....	780
5-50.	CLA_SOFTINT_REGS Access Type Codes .....	780
5-51.	SOFTINTEN Register Field Descriptions.....	781
5-52.	SOFTINTFRC Register Field Descriptions .....	783
6-1.	Sampling Period .....	790
6-2.	Sampling Frequency .....	790
6-3.	Case 1: Three-Sample Sampling Window Width.....	791
6-4.	Case 2: Six-Sample Sampling Window Width .....	791
6-5.	USB I/O Signal Muxing .....	792
6-6.	High-Speed SPI-Enabled GPIOs .....	792
6-7.	GPIO Configuration for High-Speed SPI .....	793
6-8.	GPIO and Peripheral Muxing.....	794
6-9.	Peripheral Muxing (multiple pins assigned) .....	795
6-10.	Pullup Resistors for 176-pin Packages .....	795
6-11.	Pullup Resistors for 100-pin Packages .....	796
6-12.	GPIO Base Address Table .....	797
6-13.	Specific vs Generic Terminology for Registers .....	797
6-14.	GPIO_CTRL_REGS Registers.....	798
6-15.	GPIO_CTRL_REGS Access Type Codes .....	800
6-16.	GPACTRL Register Field Descriptions .....	802
6-17.	GPAQSEL1 Register Field Descriptions.....	803
6-18.	GPAQSEL2 Register Field Descriptions.....	805
6-19.	GPAMUX1 Register Field Descriptions .....	807
6-20.	GPAMUX2 Register Field Descriptions .....	809
6-21.	GPADIR Register Field Descriptions.....	811
6-22.	GPAPUD Register Field Descriptions.....	813
6-23.	GPAINV Register Field Descriptions .....	815
6-24.	GPAODR Register Field Descriptions .....	817
6-25.	GPAGMUX1 Register Field Descriptions.....	819
6-26.	GPAGMUX2 Register Field Descriptions.....	820
6-27.	GPACSEL1 Register Field Descriptions .....	821
6-28.	GPACSEL2 Register Field Descriptions.....	822
6-29.	GPACSEL3 Register Field Descriptions .....	823
6-30.	GPACSEL4 Register Field Descriptions .....	824



6-31.	GPALOCK Register Field Descriptions .....	825
6-32.	GPACR Register Field Descriptions.....	827
6-33.	GPBCTRL Register Field Descriptions .....	829
6-34.	GPBQSEL1 Register Field Descriptions.....	830
6-35.	GPBQSEL2 Register Field Descriptions.....	832
6-36.	GPBMUX1 Register Field Descriptions .....	834
6-37.	GPBMUX2 Register Field Descriptions .....	836
6-38.	GPBDIR Register Field Descriptions.....	838
6-39.	GPBPUD Register Field Descriptions.....	840
6-40.	GPBINV Register Field Descriptions .....	842
6-41.	GPBODR Register Field Descriptions .....	844
6-42.	GPBAMSEL Register Field Descriptions .....	846
6-43.	GPBGMUX1 Register Field Descriptions.....	848
6-44.	GPBGMUX2 Register Field Descriptions.....	849
6-45.	GPBCSEL1 Register Field Descriptions .....	850
6-46.	GPBCSEL2 Register Field Descriptions .....	851
6-47.	GPBCSEL3 Register Field Descriptions .....	852
6-48.	GPBCSEL4 Register Field Descriptions .....	853
6-49.	GPBLOCK Register Field Descriptions .....	854
6-50.	GPBCR Register Field Descriptions.....	856
6-51.	GPCCTRL Register Field Descriptions .....	858
6-52.	GPCQSEL1 Register Field Descriptions.....	859
6-53.	GPCQSEL2 Register Field Descriptions.....	861
6-54.	GPCMUX1 Register Field Descriptions.....	863
6-55.	GPCMUX2 Register Field Descriptions.....	865
6-56.	GPCDIR Register Field Descriptions.....	867
6-57.	GPCPUD Register Field Descriptions.....	869
6-58.	GPCINV Register Field Descriptions .....	871
6-59.	GPCODR Register Field Descriptions .....	873
6-60.	GPCGMUX1 Register Field Descriptions.....	875
6-61.	GPCGMUX2 Register Field Descriptions.....	876
6-62.	GPCCSEL1 Register Field Descriptions.....	877
6-63.	GPCCSEL2 Register Field Descriptions.....	878
6-64.	GPCCSEL3 Register Field Descriptions.....	879
6-65.	GPCCSEL4 Register Field Descriptions.....	880
6-66.	GPCLOCK Register Field Descriptions .....	881
6-67.	GPCCR Register Field Descriptions .....	883
6-68.	GPDCTRL Register Field Descriptions .....	885
6-69.	GPDQSEL1 Register Field Descriptions.....	886
6-70.	GPDQSEL2 Register Field Descriptions.....	888
6-71.	GPDMUX1 Register Field Descriptions.....	890
6-72.	GPDMUX2 Register Field Descriptions.....	892
6-73.	GPDDIR Register Field Descriptions.....	894
6-74.	GPDPUUD Register Field Descriptions.....	896
6-75.	GPDINV Register Field Descriptions.....	898
6-76.	GPDODR Register Field Descriptions .....	900
6-77.	GPDGMUX1 Register Field Descriptions.....	902
6-78.	GPDGMUX2 Register Field Descriptions.....	904
6-79.	GPDCSEL1 Register Field Descriptions.....	906

6-80.	GPDCSEL2 Register Field Descriptions .....	907
6-81.	GPDCSEL3 Register Field Descriptions .....	908
6-82.	GPDCSEL4 Register Field Descriptions .....	909
6-83.	GPDLCK Register Field Descriptions .....	910
6-84.	GPDCR Register Field Descriptions .....	912
6-85.	GPECTRL Register Field Descriptions .....	914
6-86.	GPEQSEL1 Register Field Descriptions .....	915
6-87.	GPEQSEL2 Register Field Descriptions .....	917
6-88.	GPEMUX1 Register Field Descriptions .....	919
6-89.	GPEMUX2 Register Field Descriptions .....	921
6-90.	GPEDIR Register Field Descriptions .....	923
6-91.	GPEPUD Register Field Descriptions .....	925
6-92.	GPEINV Register Field Descriptions .....	927
6-93.	GPEODR Register Field Descriptions .....	929
6-94.	GPEGMUX1 Register Field Descriptions .....	931
6-95.	GPEGMUX2 Register Field Descriptions .....	933
6-96.	GPECSEL1 Register Field Descriptions .....	935
6-97.	GPECSEL2 Register Field Descriptions .....	936
6-98.	GPECSEL3 Register Field Descriptions .....	937
6-99.	GPECSEL4 Register Field Descriptions .....	938
6-100.	GPELOCK Register Field Descriptions .....	939
6-101.	GPECR Register Field Descriptions .....	941
6-102.	GPFCTRL Register Field Descriptions .....	943
6-103.	GPFQSEL1 Register Field Descriptions .....	944
6-104.	GPFMUX1 Register Field Descriptions .....	946
6-105.	GPFDIR Register Field Descriptions .....	948
6-106.	GPFPUUD Register Field Descriptions .....	950
6-107.	GPFINV Register Field Descriptions .....	952
6-108.	GPFODR Register Field Descriptions .....	954
6-109.	GPFGMUX1 Register Field Descriptions .....	956
6-110.	GPFSEL1 Register Field Descriptions .....	957
6-111.	GPFSEL2 Register Field Descriptions .....	958
6-112.	GPFLOCK Register Field Descriptions .....	959
6-113.	GPFGR Register Field Descriptions .....	961
6-114.	GPIO_DATA_REGS Registers .....	963
6-115.	GPIO_DATA_REGS Access Type Codes .....	963
6-116.	GPADAT Register Field Descriptions .....	965
6-117.	GPASET Register Field Descriptions .....	967
6-118.	GPACLEAR Register Field Descriptions .....	969
6-119.	GPATOGGLE Register Field Descriptions .....	971
6-120.	GPBDAT Register Field Descriptions .....	973
6-121.	GPBSET Register Field Descriptions .....	975
6-122.	GPBCLEAR Register Field Descriptions .....	977
6-123.	GPBTOGGLE Register Field Descriptions .....	979
6-124.	GPCDAT Register Field Descriptions .....	981
6-125.	GPCSET Register Field Descriptions .....	983
6-126.	GPCCLEAR Register Field Descriptions .....	985
6-127.	GPCTOGGLE Register Field Descriptions .....	987
6-128.	GPDDAT Register Field Descriptions .....	989

6-129. GPDSET Register Field Descriptions .....	991
6-130. GPDCLEAR Register Field Descriptions .....	993
6-131. GPDTOGGLE Register Field Descriptions .....	995
6-132. GPEDAT Register Field Descriptions .....	997
6-133. GPESET Register Field Descriptions .....	999
6-134. GPECLEAR Register Field Descriptions .....	1001
6-135. GPETOGGLE Register Field Descriptions .....	1003
6-136. GPFDAT Register Field Descriptions .....	1005
6-137. GPFSET Register Field Descriptions .....	1007
6-138. GPFCLEAR Register Field Descriptions .....	1009
6-139. GPFTOGGLE Register Field Descriptions .....	1011
7-1. Input X-BAR Destinations .....	1015
7-2. ePWM X-BAR Mux Configuration Table .....	1017
7-3. Output X-Bar Mux Configuration Table .....	1019
7-4. X-BAR Base Address Table .....	1021
7-5. INPUT_XBAR_REGS Registers .....	1022
7-6. INPUT_XBAR_REGS Access Type Codes .....	1022
7-7. INPUT1SELECT Register Field Descriptions .....	1023
7-8. INPUT2SELECT Register Field Descriptions .....	1024
7-9. INPUT3SELECT Register Field Descriptions .....	1025
7-10. INPUT4SELECT Register Field Descriptions .....	1026
7-11. INPUT5SELECT Register Field Descriptions .....	1027
7-12. INPUT6SELECT Register Field Descriptions .....	1028
7-13. INPUT7SELECT Register Field Descriptions .....	1029
7-14. INPUT8SELECT Register Field Descriptions .....	1030
7-15. INPUT9SELECT Register Field Descriptions .....	1031
7-16. INPUT10SELECT Register Field Descriptions .....	1032
7-17. INPUT11SELECT Register Field Descriptions .....	1033
7-18. INPUT12SELECT Register Field Descriptions .....	1034
7-19. INPUT13SELECT Register Field Descriptions .....	1035
7-20. INPUT14SELECT Register Field Descriptions .....	1036
7-21. INPUTSELECTLOCK Register Field Descriptions .....	1037
7-22. XBAR_REGS Registers .....	1041
7-23. XBAR_REGS Access Type Codes .....	1041
7-24. XBARFLG1 Register Field Descriptions .....	1042
7-25. XBARFLG2 Register Field Descriptions .....	1044
7-26. XBARFLG3 Register Field Descriptions .....	1046
7-27. XBARCLR1 Register Field Descriptions .....	1048
7-28. XBARCLR2 Register Field Descriptions .....	1050
7-29. XBARCLR3 Register Field Descriptions .....	1052
7-30. EPWM_XBAR_REGS Registers .....	1054
7-31. EPWM_XBAR_REGS Access Type Codes .....	1054
7-32. TRIP4MUX0TO15CFG Register Field Descriptions .....	1056
7-33. TRIP4MUX16TO31CFG Register Field Descriptions .....	1059
7-34. TRIP5MUX0TO15CFG Register Field Descriptions .....	1062
7-35. TRIP5MUX16TO31CFG Register Field Descriptions .....	1065
7-36. TRIP7MUX0TO15CFG Register Field Descriptions .....	1068
7-37. TRIP7MUX16TO31CFG Register Field Descriptions .....	1071
7-38. TRIP8MUX0TO15CFG Register Field Descriptions .....	1074

7-39.	TRIP8MUX16TO31CFG Register Field Descriptions.....	1077
7-40.	TRIP9MUX0TO15CFG Register Field Descriptions .....	1080
7-41.	TRIP9MUX16TO31CFG Register Field Descriptions.....	1083
7-42.	TRIP10MUX0TO15CFG Register Field Descriptions.....	1086
7-43.	TRIP10MUX16TO31CFG Register Field Descriptions .....	1089
7-44.	TRIP11MUX0TO15CFG Register Field Descriptions.....	1092
7-45.	TRIP11MUX16TO31CFG Register Field Descriptions .....	1095
7-46.	TRIP12MUX0TO15CFG Register Field Descriptions.....	1098
7-47.	TRIP12MUX16TO31CFG Register Field Descriptions .....	1101
7-48.	TRIP4MUXENABLE Register Field Descriptions .....	1104
7-49.	TRIP5MUXENABLE Register Field Descriptions .....	1109
7-50.	TRIP7MUXENABLE Register Field Descriptions .....	1114
7-51.	TRIP8MUXENABLE Register Field Descriptions .....	1119
7-52.	TRIP9MUXENABLE Register Field Descriptions .....	1124
7-53.	TRIP10MUXENABLE Register Field Descriptions .....	1129
7-54.	TRIP11MUXENABLE Register Field Descriptions .....	1134
7-55.	TRIP12MUXENABLE Register Field Descriptions .....	1139
7-56.	TRIPOUTINV Register Field Descriptions .....	1144
7-57.	TRIPLOCK Register Field Descriptions .....	1146
7-58.	OUTPUT_XBAR_REGS Registers .....	1147
7-59.	OUTPUT_XBAR_REGS Access Type Codes.....	1147
7-60.	OUTPUT1MUX0TO15CFG Register Field Descriptions .....	1149
7-61.	OUTPUT1MUX16TO31CFG Register Field Descriptions.....	1152
7-62.	OUTPUT2MUX0TO15CFG Register Field Descriptions .....	1155
7-63.	OUTPUT2MUX16TO31CFG Register Field Descriptions.....	1158
7-64.	OUTPUT3MUX0TO15CFG Register Field Descriptions .....	1161
7-65.	OUTPUT3MUX16TO31CFG Register Field Descriptions.....	1164
7-66.	OUTPUT4MUX0TO15CFG Register Field Descriptions .....	1167
7-67.	OUTPUT4MUX16TO31CFG Register Field Descriptions.....	1170
7-68.	OUTPUT5MUX0TO15CFG Register Field Descriptions .....	1173
7-69.	OUTPUT5MUX16TO31CFG Register Field Descriptions.....	1176
7-70.	OUTPUT6MUX0TO15CFG Register Field Descriptions .....	1179
7-71.	OUTPUT6MUX16TO31CFG Register Field Descriptions.....	1182
7-72.	OUTPUT7MUX0TO15CFG Register Field Descriptions .....	1185
7-73.	OUTPUT7MUX16TO31CFG Register Field Descriptions.....	1188
7-74.	OUTPUT8MUX0TO15CFG Register Field Descriptions .....	1191
7-75.	OUTPUT8MUX16TO31CFG Register Field Descriptions.....	1194
7-76.	OUTPUT1MUXENABLE Register Field Descriptions .....	1197
7-77.	OUTPUT2MUXENABLE Register Field Descriptions .....	1202
7-78.	OUTPUT3MUXENABLE Register Field Descriptions .....	1207
7-79.	OUTPUT4MUXENABLE Register Field Descriptions .....	1212
7-80.	OUTPUT5MUXENABLE Register Field Descriptions .....	1217
7-81.	OUTPUT6MUXENABLE Register Field Descriptions .....	1222
7-82.	OUTPUT7MUXENABLE Register Field Descriptions .....	1227
7-83.	OUTPUT8MUXENABLE Register Field Descriptions .....	1232
7-84.	OUTPUTLATCH Register Field Descriptions.....	1237
7-85.	OUTPUTLATCHCLR Register Field Descriptions .....	1239
7-86.	OUTPUTLATCHFRC Register Field Descriptions .....	1241
7-87.	OUTPUTLATCHENABLE Register Field Descriptions .....	1243

7-88.	OUTPUTINV Register Field Descriptions .....	1245
7-89.	OUTPUTLOCK Register Field Descriptions .....	1247
8-1.	Analog Subsystem Base Address Table .....	1253
8-2.	ANALOG_SUBSYS_REGS Registers.....	1254
8-3.	ANALOG_SUBSYS_REGS Access Type Codes .....	1254
8-4.	INTOSC1TRIM Register Field Descriptions .....	1255
8-5.	INTOSC2TRIM Register Field Descriptions .....	1256
8-6.	TSNSCTL Register Field Descriptions .....	1257
8-7.	LOCK Register Field Descriptions .....	1258
8-8.	ANAREFTRIMA Register Field Descriptions .....	1259
8-9.	ANAREFTRIMB Register Field Descriptions .....	1260
8-10.	ANAREFTRIMC Register Field Descriptions .....	1261
8-11.	ANAREFTRIMD Register Field Descriptions .....	1262
9-1.	ADC Options and Configuration Levels .....	1265
9-2.	Analog to 12-bit Digital Formulas .....	1268
9-3.	Analog to 16-bit Digital Formulas .....	1268
9-4.	12-Bit Digital-to-Analog Formulas .....	1268
9-5.	16-Bit Digital-to-Analog Formulas .....	1268
9-6.	Channel Selection of Input Pins .....	1271
9-7.	Example Requirements for Multiple Signal Sampling .....	1273
9-8.	Example Connections for Multiple Signal Sampling .....	1273
9-9.	DETECTCFG Settings.....	1283
9-10.	ADC Timings in 12-bit Mode (SYSCLK Cycles).....	1288
9-11.	ADC Timings in 16-bit Mode.....	1289
9-12.	ADC Base Address Table .....	1297
9-13.	ADC_REGS Registers.....	1298
9-14.	ADC_REGS Access Type Codes .....	1299
9-15.	ADCCTL1 Register Field Descriptions .....	1301
9-16.	ADCCTL2 Register Field Descriptions .....	1303
9-17.	ADCBURSTCTL_1 Register Field Descriptions.....	1304
9-18.	ADCINTFLG Register Field Descriptions .....	1306
9-19.	ADCINTFLGCLR Register Field Descriptions .....	1308
9-20.	ADCINTOVF Register Field Descriptions .....	1310
9-21.	ADCINTOVFCLR Register Field Descriptions.....	1312
9-22.	ADCINTSEL1N2 Register Field Descriptions.....	1313
9-23.	ADCINTSEL3N4 Register Field Descriptions.....	1315
9-24.	ADCSOCPRCTL Register Field Descriptions .....	1317
9-25.	ADCINTSOCSEL1 Register Field Descriptions .....	1320
9-26.	ADCINTSOCSEL2 Register Field Descriptions .....	1322
9-27.	ADCSOCFLG1 Register Field Descriptions .....	1324
9-28.	ADCSOCFRC1 Register Field Descriptions .....	1329
9-29.	ADCSOCOVF1 Register Field Descriptions .....	1334
9-30.	ADCSOCOVFCLR1 Register Field Descriptions.....	1338
9-31.	ADCSOC0CTL_1 Register Field Descriptions .....	1342
9-32.	ADCSOC1CTL_1 Register Field Descriptions .....	1345
9-33.	ADCSOC2CTL_1 Register Field Descriptions .....	1348
9-34.	ADCSOC3CTL_1 Register Field Descriptions .....	1351
9-35.	ADCSOC4CTL_1 Register Field Descriptions .....	1354
9-36.	ADCSOC5CTL_1 Register Field Descriptions .....	1357

9-37.	ADCSOC6CTL_1 Register Field Descriptions .....	1360
9-38.	ADCSOC7CTL_1 Register Field Descriptions .....	1363
9-39.	ADCSOC8CTL_1 Register Field Descriptions .....	1366
9-40.	ADCSOC9CTL_1 Register Field Descriptions .....	1369
9-41.	ADCSOC10CTL_1 Register Field Descriptions .....	1372
9-42.	ADCSOC11CTL_1 Register Field Descriptions .....	1375
9-43.	ADCSOC12CTL_1 Register Field Descriptions .....	1378
9-44.	ADCSOC13CTL_1 Register Field Descriptions .....	1381
9-45.	ADCSOC14CTL_1 Register Field Descriptions .....	1384
9-46.	ADCSOC15CTL_1 Register Field Descriptions .....	1387
9-47.	ADCEVTSTAT Register Field Descriptions.....	1390
9-48.	ADCEVTCLR Register Field Descriptions .....	1392
9-49.	ADCEVTSEL Register Field Descriptions.....	1394
9-50.	ADCEVTINTSEL Register Field Descriptions .....	1396
9-51.	ADCCOUNTER Register Field Descriptions.....	1398
9-52.	ADCREV Register Field Descriptions .....	1399
9-53.	ADCOFFTRIM Register Field Descriptions .....	1400
9-54.	ADCPPB1CONFIG Register Field Descriptions.....	1401
9-55.	ADCPPB1STAMP Register Field Descriptions.....	1403
9-56.	ADCPPB1OFFCAL Register Field Descriptions .....	1404
9-57.	ADCPPB1OFFREF Register Field Descriptions .....	1405
9-58.	ADCPPB1TRIPHI Register Field Descriptions .....	1406
9-59.	ADCPPB1TRIPLO Register Field Descriptions .....	1407
9-60.	ADCPPB2CONFIG Register Field Descriptions.....	1408
9-61.	ADCPPB2STAMP Register Field Descriptions.....	1410
9-62.	ADCPPB2OFFCAL Register Field Descriptions .....	1411
9-63.	ADCPPB2OFFREF Register Field Descriptions .....	1412
9-64.	ADCPPB2TRIPHI Register Field Descriptions .....	1413
9-65.	ADCPPB2TRIPLO Register Field Descriptions .....	1414
9-66.	ADCPPB3CONFIG Register Field Descriptions.....	1415
9-67.	ADCPPB3STAMP Register Field Descriptions.....	1417
9-68.	ADCPPB3OFFCAL Register Field Descriptions .....	1418
9-69.	ADCPPB3OFFREF Register Field Descriptions .....	1419
9-70.	ADCPPB3TRIPHI Register Field Descriptions .....	1420
9-71.	ADCPPB3TRIPLO Register Field Descriptions .....	1421
9-72.	ADCPPB4CONFIG Register Field Descriptions.....	1422
9-73.	ADCPPB4STAMP Register Field Descriptions.....	1424
9-74.	ADCPPB4OFFCAL Register Field Descriptions .....	1425
9-75.	ADCPPB4OFFREF Register Field Descriptions .....	1426
9-76.	ADCPPB4TRIPHI Register Field Descriptions .....	1427
9-77.	ADCPPB4TRIPLO Register Field Descriptions .....	1428
9-78.	ADCINLTRIM1 Register Field Descriptions.....	1429
9-79.	ADCINLTRIM2 Register Field Descriptions.....	1430
9-80.	ADCINLTRIM3 Register Field Descriptions.....	1431
9-81.	ADCINLTRIM4 Register Field Descriptions.....	1432
9-82.	ADCINLTRIM5 Register Field Descriptions.....	1433
9-83.	ADCINLTRIM6 Register Field Descriptions.....	1434
9-84.	ADC_RESULT_REGS Registers.....	1436
9-85.	ADC_RESULT_REGS Access Type Codes.....	1436



9-86.	ADCRESULT0 Register Field Descriptions .....	1437
9-87.	ADCRESULT1 Register Field Descriptions .....	1438
9-88.	ADCRESULT2 Register Field Descriptions .....	1439
9-89.	ADCRESULT3 Register Field Descriptions .....	1440
9-90.	ADCRESULT4 Register Field Descriptions .....	1441
9-91.	ADCRESULT5 Register Field Descriptions .....	1442
9-92.	ADCRESULT6 Register Field Descriptions .....	1443
9-93.	ADCRESULT7 Register Field Descriptions .....	1444
9-94.	ADCRESULT8 Register Field Descriptions .....	1445
9-95.	ADCRESULT9 Register Field Descriptions .....	1446
9-96.	ADCRESULT10 Register Field Descriptions .....	1447
9-97.	ADCRESULT11 Register Field Descriptions .....	1448
9-98.	ADCRESULT12 Register Field Descriptions .....	1449
9-99.	ADCRESULT13 Register Field Descriptions .....	1450
9-100.	ADCRESULT14 Register Field Descriptions .....	1451
9-101.	ADCRESULT15 Register Field Descriptions .....	1452
9-102.	ADCPPB1RESULT Register Field Descriptions .....	1453
9-103.	ADCPPB2RESULT Register Field Descriptions .....	1454
9-104.	ADCPPB3RESULT Register Field Descriptions .....	1455
9-105.	ADCPPB4RESULT Register Field Descriptions .....	1456
10-1.	DAC Base Address Table .....	1459
10-2.	DAC_REGS Registers .....	1460
10-3.	DAC_REGS Access Type Codes .....	1460
10-4.	DACREV Register Field Descriptions .....	1461
10-5.	DACCTL Register Field Descriptions .....	1462
10-6.	DACVALA Register Field Descriptions .....	1463
10-7.	DACVALS Register Field Descriptions .....	1464
10-8.	DACOUTEN Register Field Descriptions .....	1465
10-9.	DACLOCK Register Field Descriptions .....	1466
10-10.	DACTRIM Register Field Descriptions .....	1467
11-1.	CMPSS Base Address Table .....	1474
11-2.	CMPSS_REGS Registers .....	1475
11-3.	CMPSS_REGS Access Type Codes .....	1475
11-4.	COMPCTL Register Field Descriptions .....	1477
11-5.	COMPYSCTL Register Field Descriptions .....	1479
11-6.	COMPSTS Register Field Descriptions .....	1480
11-7.	COMPSTSCLR Register Field Descriptions .....	1481
11-8.	COMPDACCTL Register Field Descriptions .....	1482
11-9.	DACHVALS Register Field Descriptions .....	1484
11-10.	DACHVALA Register Field Descriptions .....	1485
11-11.	RAMPMAXREFA Register Field Descriptions .....	1486
11-12.	RAMPMAXREFS Register Field Descriptions .....	1487
11-13.	RAMPDECVALA Register Field Descriptions .....	1488
11-14.	RAMPDECVALS Register Field Descriptions .....	1489
11-15.	RAMPSTS Register Field Descriptions .....	1490
11-16.	DACLVALS Register Field Descriptions .....	1491
11-17.	DACLVALA Register Field Descriptions .....	1492
11-18.	RAMPDLYA Register Field Descriptions .....	1493
11-19.	RAMPDLYS Register Field Descriptions .....	1494



11-20. CTRIPLFILCTL Register Field Descriptions .....	1495
11-21. CTRIPLFILCLKCTL Register Field Descriptions .....	1496
11-22. CTRIPHFILCTL Register Field Descriptions.....	1497
11-23. CTRIPHFILCLKCTL Register Field Descriptions .....	1498
11-24. COMPLOCK Register Field Descriptions .....	1499
12-1. Modulator Clock Modes .....	1504
12-2. Peak Data Values for Different OSR/Filter Combinations .....	1506
12-3. Peak Data Values for Different DOSR/Filter Combinations .....	1507
12-4. Number of Incorrect Samples Tabulated.....	1508
12-5. Shift Control Bit Configuration Settings .....	1509
12-6. General Registers .....	1512
12-7. Filter 1 Registers .....	1512
12-8. Filter 2 Registers .....	1512
12-9. Filter 3 Registers .....	1512
12-10. Filter 4 Registers .....	1513
12-11. SDFM Base Address Table .....	1513
12-12. SDFM_REGS Registers.....	1514
12-13. SDFM_REGS Access Type Codes .....	1514
12-14. SDIFLG Register Field Descriptions .....	1516
12-15. SDIFLGCLR Register Field Descriptions .....	1518
12-16. SDCTL Register Field Descriptions.....	1520
12-17. SDMFILEN Register Field Descriptions .....	1521
12-18. SDCTLPARM1 Register Field Descriptions .....	1522
12-19. SDDFPARM1 Register Field Descriptions .....	1523
12-20. SDDPARAM1 Register Field Descriptions.....	1524
12-21. SDCMPH1 Register Field Descriptions .....	1525
12-22. SDCMPL1 Register Field Descriptions .....	1526
12-23. SDCPARAM1 Register Field Descriptions.....	1527
12-24. SDDATA1 Register Field Descriptions .....	1528
12-25. SDCTLPARM2 Register Field Descriptions .....	1529
12-26. SDDFPARM2 Register Field Descriptions .....	1530
12-27. SDDPARAM2 Register Field Descriptions.....	1531
12-28. SDCMPH2 Register Field Descriptions .....	1532
12-29. SDCMPL2 Register Field Descriptions .....	1533
12-30. SDCPARAM2 Register Field Descriptions.....	1534
12-31. SDDATA2 Register Field Descriptions .....	1535
12-32. SDCTLPARM3 Register Field Descriptions .....	1536
12-33. SDDFPARM3 Register Field Descriptions .....	1537
12-34. SDDPARAM3 Register Field Descriptions.....	1538
12-35. SDCMPH3 Register Field Descriptions .....	1539
12-36. SDCMPL3 Register Field Descriptions .....	1540
12-37. SDCPARAM3 Register Field Descriptions.....	1541
12-38. SDDATA3 Register Field Descriptions .....	1542
12-39. SDCTLPARM4 Register Field Descriptions .....	1543
12-40. SDDFPARM4 Register Field Descriptions .....	1544
12-41. SDDPARAM4 Register Field Descriptions.....	1545
12-42. SDCMPH4 Register Field Descriptions .....	1546
12-43. SDCMPL4 Register Field Descriptions .....	1547
12-44. SDCPARAM4 Register Field Descriptions.....	1548

12-45. SDDATA4 Register Field Descriptions .....	1549
13-1. Submodule Configuration Parameters.....	1558
13-2. Key Time-Base Signals.....	1561
13-3. Action-Qualifier Submodule Possible Input Events .....	1579
13-4. Action-Qualifier Event Priority for Up-Down-Count Mode .....	1581
13-5. Action-Qualifier Event Priority for Up-Count Mode.....	1581
13-6. Action-Qualifier Event Priority for Down-Count Mode .....	1581
13-7. Behavior if CMPA/CMPB is Greater than the Period .....	1582
13-8. Classical Dead-Band Operating Modes .....	1594
13-9. Additional Dead-Band Operating Modes .....	1594
13-10. Dead-Band Delay Values in $\mu$ S as a Function of DBFED and DBRED .....	1596
13-11. Possible Pulse Width Values for EPWMCLK = 80 MHz .....	1599
13-12. Possible Actions On a Trip Event .....	1603
13-13. EPWM Base Address Table .....	1639
13-14. EPWM_REGS Registers .....	1640
13-15. EPWM_REGS Access Type Codes .....	1642
13-16. TBCTL Register Field Descriptions .....	1643
13-17. TBCTL2 Register Field Descriptions.....	1646
13-18. EPWMSYNCINSEL Register Field Descriptions .....	1647
13-19. TBCTR Register Field Descriptions.....	1648
13-20. TBSTS Register Field Descriptions .....	1649
13-21. EPWMSYNCOUTEN Register Field Descriptions .....	1650
13-22. CMPCTL Register Field Descriptions.....	1652
13-23. CMPCTL2 Register Field Descriptions .....	1654
13-24. DBCTL Register Field Descriptions.....	1656
13-25. DBCTL2 Register Field Descriptions .....	1659
13-26. AQCTL Register Field Descriptions.....	1660
13-27. AQTSRCSEL Register Field Descriptions .....	1662
13-28. PCCTL Register Field Descriptions.....	1663
13-29. VCAPCTL Register Field Descriptions .....	1665
13-30. VCNTCFG Register Field Descriptions.....	1667
13-31. HRCNFG Register Field Descriptions .....	1669
13-32. HRPWR Register Field Descriptions .....	1671
13-33. HRMSTEP Register Field Descriptions .....	1672
13-34. HRCNFG2 Register Field Descriptions.....	1673
13-35. HRPCTL Register Field Descriptions .....	1674
13-36. TRREM Register Field Descriptions .....	1676
13-37. GLDCTL Register Field Descriptions .....	1677
13-38. GLDCFG Register Field Descriptions .....	1679
13-39. EPWMLINK Register Field Descriptions .....	1681
13-40. EPWMREV Register Field Descriptions.....	1685
13-41. AQCTLA Register Field Descriptions.....	1686
13-42. AQCTLA2 Register Field Descriptions .....	1688
13-43. AQCTLB Register Field Descriptions.....	1690
13-44. AQCTLB2 Register Field Descriptions .....	1692
13-45. AQSFRM Register Field Descriptions .....	1694
13-46. AQCSFRM Register Field Descriptions .....	1696
13-47. DBREDHR Register Field Descriptions .....	1697
13-48. DBRED Register Field Descriptions .....	1698

13-49. DBFEDHR Register Field Descriptions.....	1699
13-50. DBFED Register Field Descriptions .....	1700
13-51. TBPHS Register Field Descriptions.....	1701
13-52. TBPRDHR Register Field Descriptions.....	1702
13-53. TBPRD Register Field Descriptions .....	1703
13-54. CMPA Register Field Descriptions .....	1704
13-55. CMPB Register Field Descriptions .....	1705
13-56. CMPC Register Field Descriptions.....	1706
13-57. CMPD Register Field Descriptions.....	1707
13-58. GLDCTL2 Register Field Descriptions .....	1708
13-59. SWVDELVAL Register Field Descriptions .....	1709
13-60. TZSEL Register Field Descriptions .....	1710
13-61. TZDCSEL Register Field Descriptions .....	1712
13-62. TZCTL Register Field Descriptions .....	1714
13-63. TZCTL2 Register Field Descriptions.....	1716
13-64. TZCTLDCA Register Field Descriptions.....	1718
13-65. TZCTLDCB Register Field Descriptions.....	1720
13-66. TZEINT Register Field Descriptions .....	1722
13-67. TZFLG Register Field Descriptions .....	1723
13-68. TZCBCFLG Register Field Descriptions .....	1725
13-69. TZOSTFLG Register Field Descriptions.....	1727
13-70. TZCLR Register Field Descriptions .....	1729
13-71. TZCBCCLR Register Field Descriptions .....	1731
13-72. TZOSTCLR Register Field Descriptions .....	1733
13-73. TZFRC Register Field Descriptions.....	1735
13-74. ETSEL Register Field Descriptions .....	1736
13-75. ETPS Register Field Descriptions.....	1739
13-76. ETFLG Register Field Descriptions .....	1742
13-77. ETCLR Register Field Descriptions.....	1743
13-78. ETFRC Register Field Descriptions.....	1744
13-79. ETINTPS Register Field Descriptions .....	1745
13-80. ETSOCPS Register Field Descriptions.....	1746
13-81. ETCNTINITCTL Register Field Descriptions .....	1748
13-82. ETCNTINIT Register Field Descriptions.....	1749
13-83. DCTRIPESEL Register Field Descriptions .....	1750
13-84. DCACTL Register Field Descriptions .....	1752
13-85. DCBCTL Register Field Descriptions .....	1754
13-86. DCFCTL Register Field Descriptions .....	1756
13-87. DCCAPCTL Register Field Descriptions .....	1757
13-88. DCFOFFSET Register Field Descriptions .....	1759
13-89. DCFOFFSETCNT Register Field Descriptions.....	1760
13-90. DCFWINDOW Register Field Descriptions .....	1761
13-91. DCFWINDOWCNT Register Field Descriptions.....	1762
13-92. DCCAP Register Field Descriptions .....	1763
13-93. DCAHTRIPSEL Register Field Descriptions.....	1764
13-94. DCALTRIPSEL Register Field Descriptions .....	1766
13-95. DCBHTRIPSEL Register Field Descriptions.....	1768
13-96. DCBLTRIPSEL Register Field Descriptions .....	1770
13-97. EPWMLOCK Register Field Descriptions .....	1772

13-98. HWVDELVAL Register Field Descriptions .....	1774
13-99. VCNTVAL Register Field Descriptions .....	1775
13-100. EPWM_XBAR_REGS Registers .....	1776
13-101. EPWM_XBAR_REGS Access Type Codes .....	1776
13-102. TRIP4MUX0TO15CFG Register Field Descriptions.....	1778
13-103. TRIP4MUX16TO31CFG Register Field Descriptions .....	1781
13-104. TRIP5MUX0TO15CFG Register Field Descriptions.....	1784
13-105. TRIP5MUX16TO31CFG Register Field Descriptions .....	1787
13-106. TRIP7MUX0TO15CFG Register Field Descriptions.....	1790
13-107. TRIP7MUX16TO31CFG Register Field Descriptions .....	1793
13-108. TRIP8MUX0TO15CFG Register Field Descriptions.....	1796
13-109. TRIP8MUX16TO31CFG Register Field Descriptions .....	1799
13-110. TRIP9MUX0TO15CFG Register Field Descriptions.....	1802
13-111. TRIP9MUX16TO31CFG Register Field Descriptions .....	1805
13-112. TRIP10MUX0TO15CFG Register Field Descriptions .....	1808
13-113. TRIP10MUX16TO31CFG Register Field Descriptions.....	1811
13-114. TRIP11MUX0TO15CFG Register Field Descriptions .....	1814
13-115. TRIP11MUX16TO31CFG Register Field Descriptions.....	1817
13-116. TRIP12MUX0TO15CFG Register Field Descriptions .....	1820
13-117. TRIP12MUX16TO31CFG Register Field Descriptions.....	1823
13-118. TRIP4MUXENABLE Register Field Descriptions .....	1826
13-119. TRIP5MUXENABLE Register Field Descriptions .....	1831
13-120. TRIP7MUXENABLE Register Field Descriptions .....	1836
13-121. TRIP8MUXENABLE Register Field Descriptions .....	1841
13-122. TRIP9MUXENABLE Register Field Descriptions .....	1846
13-123. TRIP10MUXENABLE Register Field Descriptions .....	1851
13-124. TRIP11MUXENABLE Register Field Descriptions .....	1856
13-125. TRIP12MUXENABLE Register Field Descriptions .....	1861
13-126. TRIPOUTINV Register Field Descriptions .....	1866
13-127. TRIPLOCK Register Field Descriptions .....	1868
13-128. SYNC_SOC_REGS Registers .....	1869
13-129. SYNC_SOC_REGS Access Type Codes .....	1869
13-130. SYNCSELECT Register Field Descriptions .....	1870
13-131. ADCSOCOUTSELECT Register Field Descriptions .....	1873
13-132. SYNCSOCLOCK Register Field Descriptions.....	1876
14-1. Resolution for PWM and HRPWM .....	1879
14-2. Relationship Between MEP Steps, PWM Frequency and Resolution.....	1885
14-3. CMPA vs Duty (left), and [CMPA:CMPAHR] vs Duty (right).....	1886
14-4. Duty Cycle Range Limitation for Three EPWMCLK/TBCLK Cycles .....	1889
14-5. SFO Library Features.....	1901
14-6. Factor Values .....	1902
15-1. eCAP Base Address Table .....	1926
15-2. ECAP_REGS Registers .....	1927
15-3. ECAP_REGS Access Type Codes .....	1927
15-4. TSCTR Register Field Descriptions.....	1928
15-5. CTRPHS Register Field Descriptions.....	1929
15-6. CAP1 Register Field Descriptions.....	1930
15-7. CAP2 Register Field Descriptions.....	1931
15-8. CAP3 Register Field Descriptions.....	1932

15-9. CAP4 Register Field Descriptions.....	1933
15-10. ECCTL1 Register Field Descriptions .....	1934
15-11. ECCTL2 Register Field Descriptions .....	1936
15-12. ECEINT Register Field Descriptions.....	1938
15-13. ECFLG Register Field Descriptions.....	1940
15-14. ECCLR Register Field Descriptions .....	1942
15-15. ECFRC Register Field Descriptions .....	1943
16-1. EQEP Memory Map .....	1949
16-2. Quadrature Decoder Truth Table .....	1951
16-3. eQEP Base Address Table .....	1965
16-4. EQEP_REGS Registers .....	1966
16-5. EQEP_REGS Access Type Codes .....	1966
16-6. QPOSCNT Register Field Descriptions .....	1968
16-7. QPOSINIT Register Field Descriptions.....	1969
16-8. QPOSMAX Register Field Descriptions .....	1970
16-9. QPOSCMP Register Field Descriptions.....	1971
16-10. QPOSILAT Register Field Descriptions .....	1972
16-11. QPOSSLAT Register Field Descriptions .....	1973
16-12. QPOSLAT Register Field Descriptions .....	1974
16-13. QUTMR Register Field Descriptions.....	1975
16-14. QUPRD Register Field Descriptions .....	1976
16-15. QWDTMR Register Field Descriptions .....	1977
16-16. QWDPRD Register Field Descriptions .....	1978
16-17. QDECCTL Register Field Descriptions.....	1979
16-18. QEPCTL Register Field Descriptions.....	1981
16-19. QCAPCTL Register Field Descriptions .....	1984
16-20. QPOSCTL Register Field Descriptions.....	1985
16-21. QEINT Register Field Descriptions .....	1986
16-22. QFLG Register Field Descriptions .....	1988
16-23. QCLR Register Field Descriptions .....	1990
16-24. QFRC Register Field Descriptions .....	1992
16-25. QEPSTS Register Field Descriptions.....	1994
16-26. QCTMR Register Field Descriptions.....	1996
16-27. QCPRD Register Field Descriptions .....	1997
16-28. QCTMRLAT Register Field Descriptions.....	1998
16-29. QCPRDLAT Register Field Descriptions .....	1999
17-1. SPI Module Signal Summary .....	2002
17-2. High-Speed SPI Capable GPIOs.....	2003
17-3. SPI Interrupt Flag Modes.....	2005
17-4. SPI Clocking Scheme Selection Guide.....	2011
17-5. 4-wire vs. 3-wire SPI Pin Functions.....	2014
17-6. 3-Wire SPI Pin Configuration .....	2015
17-7. SPI Base Address Table .....	2020
17-8. SPI_REGS Registers .....	2021
17-9. SPI_REGS Access Type Codes .....	2021
17-10. SPICCR Register Field Descriptions .....	2022
17-11. SPICTL Register Field Descriptions .....	2024
17-12. SPISTS Register Field Descriptions .....	2026
17-13. SPIBRR Register Field Descriptions.....	2028

17-14. SPIRXEMU Register Field Descriptions.....	2029
17-15. SPIRXBUF Register Field Descriptions .....	2030
17-16. SPITXBUF Register Field Descriptions .....	2031
17-17. SPIDAT Register Field Descriptions .....	2032
17-18. SPIFFTX Register Field Descriptions.....	2033
17-19. SPIFFRX Register Field Descriptions .....	2035
17-20. SPIFFCT Register Field Descriptions .....	2037
17-21. SPIPRI Register Field Descriptions.....	2038
18-1. SCI Module Signal Summary .....	2043
18-2. Programming the Data Format Using SCICCR .....	2044
18-3. Asynchronous Baud Register Values for Common SCI Bit Rates .....	2050
18-4. SCI Interrupt Flags .....	2052
18-5. SCI Base Address Table .....	2054
18-6. SCI_REGS Registers .....	2055
18-7. SCI_REGS Access Type Codes .....	2055
18-8. SCICCR Register Field Descriptions .....	2056
18-9. SCICTL1 Register Field Descriptions.....	2058
18-10. SCIHBAUD Register Field Descriptions.....	2060
18-11. SCILBAUD Register Field Descriptions .....	2061
18-12. SCICTL2 Register Field Descriptions.....	2062
18-13. SCIRXST Register Field Descriptions .....	2064
18-14. SCIRXEMU Register Field Descriptions .....	2066
18-15. SCIRXBUF Register Field Descriptions .....	2067
18-16. SCITXBUF Register Field Descriptions .....	2068
18-17. SCIFFTX Register Field Descriptions .....	2069
18-18. SCIFFRX Register Field Descriptions .....	2071
18-19. SCIFFCT Register Field Descriptions .....	2073
18-20. SCIPRI Register Field Descriptions.....	2074
19-1. Dependency of Delay d on the Divide-Down Value IPSC .....	2079
19-2. Operating Modes of the I2C Module.....	2081
19-3. Master-Transmitter/Receiver Bus Activity Defined by the RM, STT, and STP Bits of I2CMDR .....	2081
19-4. How the MST and FDF Bits of I2CMDR Affect the Role of the TRX Bit of I2CMDR .....	2083
19-5. Ways to Generate a NACK Bit .....	2084
19-6. Descriptions of the Basic I2C Interrupt Requests .....	2087
19-7. I2C Base Address Table .....	2090
19-8. I2C_REGS Registers .....	2091
19-9. I2C_REGS Access Type Codes.....	2091
19-10. I2COAR Register Field Descriptions.....	2092
19-11. I2CIER Register Field Descriptions .....	2093
19-12. I2CSTR Register Field Descriptions .....	2094
19-13. I2CCLKL Register Field Descriptions.....	2099
19-14. I2CCLKH Register Field Descriptions .....	2100
19-15. I2CCNT Register Field Descriptions .....	2101
19-16. I2CDRR Register Field Descriptions.....	2102
19-17. I2CSAR Register Field Descriptions .....	2103
19-18. I2CDXR Register Field Descriptions .....	2104
19-19. I2CMDR Register Field Descriptions .....	2105
19-20. I2CISRC Register Field Descriptions .....	2109
19-21. I2CEMDR Register Field Descriptions .....	2110



19-22. I2CPSC Register Field Descriptions .....	2111
19-23. I2CFFTX Register Field Descriptions.....	2112
19-24. I2CFFRX Register Field Descriptions .....	2114
20-1. McBSP Interface Pins/Signals.....	2117
20-2. Register Bits That Determine the Number of Phases, Words, and Bits .....	2124
20-3. Interrupts and DMA Events Generated by a McBSP.....	2128
20-4. Effects of DLB and CLKSTP on Clock Modes.....	2130
20-5. Choosing an Input Clock for the Sample Rate Generator with the SCLKME and CLKSM Bits .....	2130
20-6. Polarity Options for the Input to the Sample Rate Generator .....	2131
20-7. Input Clock Selection for Sample Rate Generator .....	2134
20-8. Block - Channel Assignment.....	2143
20-9. 2-Partition Mode .....	2144
20-10. 8-Partition mode .....	2144
20-11. Receive Channel Assignment and Control With Eight Receive Partitions.....	2146
20-12. Transmit Channel Assignment and Control When Eight Transmit Partitions Are Used .....	2147
20-13. Selecting a Transmit Multichannel Selection Mode With the XMCM Bits.....	2148
20-14. Bits Used to Enable and Configure the Clock Stop Mode .....	2151
20-15. Effects of CLKSTP, CLKXP, and CLKRP on the Clock Scheme .....	2152
20-16. Bit Values Required to Configure the McBSP as an SPI Master .....	2155
20-17. Bit Values Required to Configure the McBSP as an SPI Slave.....	2156
20-18. Register Bits Used to Reset or Enable the McBSP Receiver Field Descriptions.....	2158
20-19. Reset State of Each McBSP Pin .....	2158
20-20. Register Bit Used to Enable/Disable the Digital Loopback Mode.....	2159
20-21. Receive Signals Connected to Transmit Signals in Digital Loopback Mode .....	2159
20-22. Register Bits Used to Enable/Disable the Clock Stop Mode .....	2159
20-23. Effects of CLKSTP, CLKXP, and CLKRP on the Clock Scheme .....	2160
20-24. Register Bit Used to Enable/Disable the Receive Multichannel Selection Mode .....	2160
20-25. Register Bit Used to Choose One or Two Phases for the Receive Frame .....	2160
20-26. Register Bits Used to Set the Receive Word Length(s).....	2161
20-27. Register Bits Used to Set the Receive Frame Length.....	2161
20-28. How to Calculate the Length of the Receive Frame .....	2162
20-29. Register Bit Used to Enable/Disable the Receive Frame-Synchronization Ignore Function .....	2162
20-30. Register Bits Used to Set the Receive Companding Mode.....	2163
20-31. Register Bits Used to Set the Receive Data Delay .....	2164
20-32. Register Bits Used to Set the Receive Sign-Extension and Justification Mode.....	2166
20-33. Example: Use of RJUST Field With 12-Bit Data Value ABCCh.....	2166
20-34. Example: Use of RJUST Field With 20-Bit Data Value ABCDEh.....	2166
20-35. Register Bits Used to Set the Receive Interrupt Mode .....	2167
20-36. Register Bits Used to Set the Receive Frame Synchronization Mode .....	2167
20-37. Select Sources to Provide the Receive Frame-Synchronization Signal and the Effect on the FSR Pin.....	2168
20-38. Register Bit Used to Set Receive Frame-Synchronization Polarity.....	2169
20-39. Register Bits Used to Set the SRG Frame-Synchronization Period and Pulse Width .....	2170
20-40. Register Bits Used to Set the Receive Clock Mode .....	2171
20-41. Receive Clock Signal Source Selection .....	2172
20-42. Register Bit Used to Set Receive Clock Polarity .....	2172
20-43. Register Bits Used to Set the Sample Rate Generator (SRG) Clock Divide-Down Value.....	2174
20-44. Register Bit Used to Set the SRG Clock Synchronization Mode .....	2174
20-45. Register Bits Used to Set the SRG Clock Mode (Choose an Input Clock) .....	2175
20-46. Register Bits Used to Set the SRG Input Clock Polarity .....	2176



20-47. Register Bits Used to Place Transmitter in Reset Field Descriptions .....	2177
20-48. Register Bit Used to Enable/Disable the Digital Loopback Mode.....	2178
20-49. Receive Signals Connected to Transmit Signals in Digital Loopback Mode .....	2178
20-50. Register Bits Used to Enable/Disable the Clock Stop Mode .....	2178
20-51. Effects of CLKSTP, CLKXP, and CLKRP on the Clock Scheme .....	2179
20-52. Register Bits Used to Enable/Disable Transmit Multichannel Selection .....	2180
20-53. Register Bit Used to Choose 1 or 2 Phases for the Transmit Frame .....	2181
20-54. Register Bits Used to Set the Transmit Word Length(s) .....	2181
20-55. Register Bits Used to Set the Transmit Frame Length .....	2182
20-56. How to Calculate Frame Length.....	2182
20-57. Register Bit Used to Enable/Disable the Transmit Frame-Synchronization Ignore Function .....	2183
20-58. Register Bits Used to Set the Transmit Companding Mode .....	2184
20-59. Register Bits Used to Set the Transmit Data Delay .....	2185
20-60. Register Bit Used to Set the Transmit DXENA (DX Delay Enabler) Mode .....	2187
20-61. Register Bits Used to Set the Transmit Interrupt Mode .....	2187
20-62. Register Bits Used to Set the Transmit Frame-Synchronization Mode .....	2188
20-63. How FSXM and FSGM Select the Source of Transmit Frame-Synchronization Pulses .....	2188
20-64. Register Bit Used to Set Transmit Frame-Synchronization Polarity .....	2189
20-65. Register Bits Used to Set SRG Frame-Synchronization Period and Pulse Width .....	2190
20-66. Register Bit Used to Set the Transmit Clock Mode.....	2191
20-67. How the CLKXM Bit Selects the Transmit Clock and the Corresponding Status of the MCLKX pin.....	2191
20-68. Register Bit Used to Set Transmit Clock Polarity .....	2191
20-69. McBSP Emulation Modes Selectable with FREE and SOFT Bits of SPCR2.....	2193
20-70. Reset State of Each McBSP Pin .....	2193
20-71. Receive Interrupt Sources and Signals .....	2198
20-72. Transmit Interrupt Sources and Signals.....	2198
20-73. Error Flags .....	2199
20-74. McBSP Mode Selection .....	2199
20-75. McBSP Base Address Table.....	2201
20-76. McBSP Register Summary.....	2201
20-77. Serial Port Control 1 Register (SPCR1) Field Descriptions .....	2203
20-78. Serial Port Control 2 Register (SPCR2) Field Descriptions.....	2206
20-79. Receive Control Register 1 (RCR1) Field Descriptions .....	2208
20-80. Frame Length Formula for Receive Control 1 Register (RCR1) .....	2209
20-81. Receive Control Register 2 (RCR2) Field Descriptions .....	2209
20-82. Frame Length Formula for Receive Control 2 Register (RCR2) .....	2210
20-83. Transmit Control 1 Register (XCR1) Field Descriptions .....	2211
20-84. Frame Length Formula for Transmit Control 1 Register (XCR1) .....	2211
20-85. Transmit Control 2 Register (XCR2) Field Descriptions .....	2212
20-86. Frame Length Formula for Transmit Control 2 Register (XCR2) .....	2213
20-87. Sample Rate Generator 1 Register (SRGR1) Field Descriptions.....	2214
20-88. Sample Rate Generator 2 Register (SRGR2) Field Descriptions.....	2215
20-89. Multichannel Control 1 Register (MCR1) Field Descriptions .....	2216
20-90. Multichannel Control 2 Register (MCR2) Field Descriptions .....	2218
20-91. Pin Control Register (PCR) Field Descriptions .....	2220
20-92. Pin Configuration .....	2222
20-93. Receive Channel Enable Registers (RCERA...RCERH) Field Descriptions.....	2222
20-94. Use of the Receive Channel Enable Registers .....	2223
20-95. Transmit Channel Enable Registers (XCERA...XCERH) Field Descriptions .....	2224

20-96. Use of the Transmit Channel Enable Registers .....	2225
20-97. McBSP Interrupt Enable Register (MFFINT) Field Descriptions .....	2226
21-1. CAN Register Access From Software .....	2230
21-2. CAN Register Access From CCS .....	2231
21-3. PIE Nomenclature for Interrupts.....	2237
21-4. Programmable Ranges Required by CAN Protocol .....	2245
21-5. Message Object Field Descriptions .....	2254
21-6. Message RAM Addressing in Debug Mode .....	2257
21-7. CAN Base Addresses Table .....	2259
21-8. CAN_REGS Registers.....	2260
21-9. CAN_REGS Access Type Codes .....	2261
21-10. CAN_CTL Register Field Descriptions .....	2262
21-11. CAN_ES Register Field Descriptions .....	2265
21-12. CAN_ERRC Register Field Descriptions .....	2267
21-13. CAN_BTR Register Field Descriptions .....	2268
21-14. CAN_INT Register Field Descriptions .....	2270
21-15. CAN_TEST Register Field Descriptions.....	2271
21-16. CAN_PERR Register Field Descriptions .....	2273
21-17. CAN_RAM_INIT Register Field Descriptions .....	2274
21-18. CAN_GLB_INT_EN Register Field Descriptions .....	2275
21-19. CAN_GLB_INT_FLG Register Field Descriptions .....	2276
21-20. CAN_GLB_INT_CLR Register Field Descriptions .....	2277
21-21. CAN_ABOTR Register Field Descriptions .....	2278
21-22. CAN_TXRQ_X Register Field Descriptions.....	2279
21-23. CAN_TXRQ_21 Register Field Descriptions .....	2280
21-24. CAN_NDAT_X Register Field Descriptions.....	2281
21-25. CAN_NDAT_21 Register Field Descriptions.....	2282
21-26. CAN_IPEN_X Register Field Descriptions .....	2283
21-27. CAN_IPEN_21 Register Field Descriptions.....	2284
21-28. CAN_MVAL_X Register Field Descriptions.....	2285
21-29. CAN_MVAL_21 Register Field Descriptions.....	2286
21-30. CAN_IP_MUX21 Register Field Descriptions .....	2287
21-31. CAN_IF1CMD Register Field Descriptions .....	2288
21-32. CAN_IF1MSK Register Field Descriptions.....	2292
21-33. CAN_IF1ARB Register Field Descriptions .....	2293
21-34. CAN_IF1MCTL Register Field Descriptions .....	2295
21-35. CAN_IF1DATA Register Field Descriptions .....	2298
21-36. CAN_IF1DATB Register Field Descriptions .....	2299
21-37. CAN_IF2CMD Register Field Descriptions .....	2300
21-38. CAN_IF2MSK Register Field Descriptions.....	2304
21-39. CAN_IF2ARB Register Field Descriptions .....	2305
21-40. CAN_IF2MCTL Register Field Descriptions .....	2307
21-41. CAN_IF2DATA Register Field Descriptions .....	2310
21-42. CAN_IF2DATB Register Field Descriptions .....	2311
21-43. CAN_IF3OBS Register Field Descriptions.....	2312
21-44. CAN_IF3MSK Register Field Descriptions.....	2314
21-45. CAN_IF3ARB Register Field Descriptions .....	2315
21-46. CAN_IF3MCTL Register Field Descriptions .....	2316
21-47. CAN_IF3DATA Register Field Descriptions .....	2318

21-48. CAN_IF3DATB Register Field Descriptions .....	2319
21-49. CAN_IF3UPD Register Field Descriptions .....	2320
22-1. USB Memory Access From Software.....	2331
22-2. USB Memory Access From CCS.....	2332
22-3. Universal Serial Bus (USB) Controller Register Map .....	2334
22-4. Function Address Register (USBFADDR) Field Descriptions .....	2349
22-5. Power Management Register (USBPOWER) in Host Mode Field Descriptions .....	2350
22-6. Power Management Register (USBPOWER) in Device Mode Field Descriptions.....	2350
22-7. USB Transmit Interrupt Status Register (USBTXIS) Field Descriptions .....	2352
22-8. USB Transmit Interrupt Status Register (USBRXIS) Field Descriptions .....	2354
22-9. USB Transmit Interrupt Status Register (USBTXIE) Field Descriptions .....	2356
22-10. USB Transmit Interrupt Status Register (USBRXIE) Field Descriptions .....	2358
22-11. USB General Interrupt Status Register (USBIS) in Host Mode Field Descriptions.....	2360
22-12. USB General Interrupt Status Register (USBIS) in Device Mode Field Descriptions .....	2361
22-13. USB Interrupt Enable Register (USBIE) in Host Mode Field Descriptions .....	2362
22-14. USB Interrupt Enable Register (USBIE) in Device Mode Field Descriptions.....	2363
22-15. Frame Number Register (FRAME) Field Descriptions .....	2364
22-16. USB Endpoint Index Register (USBEPIDX) Field Descriptions .....	2364
22-17. USB Test Mode Register (USBTEST) in Host Mode Field Descriptions.....	2365
22-18. USB Test Mode Register (USBTEST) in Device Mode Field Descriptions .....	2365
22-19. USB FIFO Endpoint <i>n</i> Register (USBFIFO[ <i>n</i> ]) Field Descriptions .....	2367
22-20. USB Device Control Register (USBDEVCTL) Field Descriptions.....	2368
22-21. USB Transmit Dynamic FIFO Sizing Register (USBTXFIFOSZ) Field Descriptions .....	2370
22-22. USB Receive Dynamic FIFO Sizing Register (USBRXFIFOSZ) Field Descriptions.....	2371
22-23. USB Transmit FIFO Start Address Register (USBTXFIFOADDR) Field Descriptions .....	2372
22-24. USB Receive FIFO Start Address Register (USBRXFIFOADDR) Field Descriptions.....	2373
22-25. USB Connect Timing Register (USBCONTIM) Field Descriptions.....	2374
22-26. USB Full-Speed Last Transaction to End of Frame Timing Register (USBFSEOF) Field Descriptions .....	2375
22-27. USB Low-Speed Last Transaction to End of Frame Timing Register (USBLSEOF) Field Descriptions.....	2375
22-28. USB Transmit Functional Address Endpoint <i>n</i> Registers (USBTXFUNCADDR[ <i>n</i> ]) Field Descriptions .....	2376
22-29. USB Transmit Hub Address Endpoint <i>n</i> Registers(USBTXHUBADDR[ <i>n</i> ]) Field Descriptions .....	2377
22-30. USB Transmit Hub Port Endpoint <i>n</i> Registers(USBTXHUBPORT[ <i>n</i> ]) Field Descriptions .....	2378
22-31. USB Recieve Functional Address Endpoint <i>n</i> Registers(USBFIFO[ <i>n</i> ]) Field Descriptions .....	2379
22-32. USB Receive Hub Address Endpoint <i>n</i> Registers(USBRXHUBADDR[ <i>n</i> ]) Field Descriptions .....	2380
22-33. USB Transmit Hub Port Endpoint <i>n</i> Registers(USBRXHUBPORT[ <i>n</i> ]) Field Descriptions .....	2381
22-34. USB Maximum Transmit Data Endpoint <i>n</i> Registers(USBTXMAXP[ <i>n</i> ]) Field Descriptions .....	2382
22-35. USB Control and Status Endpoint 0 Low Register(USBCSRL0) in Host Mode Field Descriptions .....	2383
22-36. USB Control and Status Endpoint 0 Low Register (USBCSRL0) in Device Mode Field Descriptions .....	2384
22-37. USB Control and Status Endpoint 0 High Register (USBCSRH0) in Host Mode Field Descriptions.....	2385
22-38. USB Control and Status Endpoint 0 High Register (USBCSRH0) in Device Mode Field Descriptions .....	2385
22-39. USB Receive Byte Count Endpoint 0 Register (USBCOUNT0) Field Descriptions .....	2386
22-40. USB Type Endpoint 0 Register (USBTTYPE0) Field Descriptions.....	2386
22-41. USB NAK Limit Register (USBNAKLMT) Field Descriptions .....	2387
22-42. USB Transmit Control and Status Endpoint <i>n</i> Low Register (USBTXCSRL[ <i>n</i> ]) in Host Mode Field Descriptions .....	2388
22-43. USB Transmit Control and Status Endpoint <i>n</i> Low Register (USBTXCSRL[ <i>n</i> ]) in Device Mode Field Descriptions .....	2389
22-44. USB Transmit Control and Status Endpoint <i>n</i> High Register (USBTXCSRH[ <i>n</i> ]) in Host Mode Field Descriptions .....	2391
22-45. USB Transmit Control and Status Endpoint <i>n</i> High Register (USBTXCSRH[ <i>n</i> ]) in Device Mode Field	

Descriptions .....	2392
22-46. USB Maximum Receive Data Endpoint <i>n</i> Registers (USBTXMAXP[ <i>n</i> ]) Field Descriptions .....	2393
22-47. USB Control and Status Endpoint <i>n</i> Low Register(USBCSRL[ <i>n</i> ]) in Host Mode Field Descriptions .....	2394
22-48. USB Control and Status Endpoint 0 Low Register(USBCSRL[ <i>n</i> ]) in Device Mode Field Descriptions .....	2395
22-49. USB Control and Status Endpoint <i>n</i> High Register (USBCSRH[ <i>n</i> ]) in Host Mode Field Descriptions .....	2396
22-50. USB Control and Status Endpoint 0 High Register(USBCSRH[ <i>n</i> ]) in Device Mode Field Descriptions .....	2397
22-51. USB Maximum Receive Data Endpoint <i>n</i> Registers (USBRXCOUNT[ <i>n</i> ]) Field Descriptions .....	2398
22-52. USB Host Transmit Configure Type Endpoint <i>n</i> Register(USBTXTYPE[ <i>n</i> ]) Field Descriptions .....	2399
22-53. USBTXINTERVAL[ <i>n</i> ] Frame Numbers .....	2400
22-54. USB Host Transmit Interval Endpoint <i>n</i> Register(USBTXINTERVAL[ <i>n</i> ]) Field Descriptions .....	2400
22-55. USB Host Configure Receive Type Endpoint <i>n</i> Register(USBRXTYPE[ <i>n</i> ]) Field Descriptions .....	2401
22-56. USBRXINTERVAL[ <i>n</i> ] Frame Numbers .....	2402
22-57. USB Host Receive Polling Interval Endpoint <i>n</i> Register(USBRXINTERVAL[ <i>n</i> ]) Field Descriptions.....	2402
22-58. USB Request Packet Count in Block Transfer Endpoint <i>n</i> Registers (USBRQPKTCOUNT[ <i>n</i> ]) Field Descriptions .....	2403
22-59. USB Receive Double Packet Buffer Disable Register (USBRXDPKTBUFDIS) Field Descriptions .....	2404
22-60. USB Transmit Double Packet Buffer Disable Register (USBTXDPKTBUFDIS) Field Descriptions .....	2406
22-61. USB External Power Control Register (USBEPCC) Field Descriptions.....	2407
22-62. USB External Power Control Raw Interrupt Status Register (USBEPCCRIS) Field Descriptions.....	2409
22-63. USB External Power Control Interrupt Mask Register (USBEPCCIM) Field Descriptions.....	2410
22-64. USB External Power Control Interrupt Status and Clear Register (USBEPCCISC) Field Descriptions .....	2411
22-65. USB Device RESUME Raw Interrupt Status Register (USBDRRIS) Field Descriptions.....	2412
22-66. USB Device RESUME Raw Interrupt Status Register (USBDRRIS) Field Descriptions.....	2413
22-67. USB Device RESUME Interrupt Status and Clear Register (USBDRISC) Field Descriptions .....	2414
22-68. USB General-Purpose Control and Status Register (USBGPCS) Field Descriptions.....	2415
22-69. USB DMA Select Register (USBDMASEL) Field Descriptions.....	2416
23-1. uPP Signal Description .....	2423
23-2. CPU/CLA/uPP-DMA Address Map.....	2430
23-3. CPU/CLA/uPP-DMA Address Map.....	2431
23-4. uPP Parameters Useful for System Tuning.....	2432
23-5. UPP Base Address Table .....	2433
23-6. UPP_REGS Registers .....	2434
23-7. UPP_REGS Access Type Codes .....	2434
23-8. PID Register Field Descriptions .....	2436
23-9. PERCTL Register Field Descriptions .....	2437
23-10. CHCTL Register Field Descriptions.....	2439
23-11. IFCFG Register Field Descriptions.....	2440
23-12. IFIVAL Register Field Descriptions .....	2442
23-13. THCFG Register Field Descriptions .....	2443
23-14. RAWINTST Register Field Descriptions.....	2445
23-15. ENINTST Register Field Descriptions .....	2447
23-16. INTENSET Register Field Descriptions .....	2449
23-17. INTENCLR Register Field Descriptions .....	2451
23-18. CHIDESC0 Register Field Descriptions .....	2453
23-19. CHIDESC1 Register Field Descriptions .....	2454
23-20. CHIDESC2 Register Field Descriptions .....	2455
23-21. CHIST0 Register Field Descriptions .....	2456
23-22. CHIST1 Register Field Descriptions .....	2457
23-23. CHIST2 Register Field Descriptions .....	2458

23-24. CHQDESC0 Register Field Descriptions.....	2459
23-25. CHQDESC1 Register Field Descriptions.....	2460
23-26. CHQDESC2 Register Field Descriptions.....	2461
23-27. CHQST0 Register Field Descriptions.....	2462
23-28. CHQST1 Register Field Descriptions.....	2463
23-29. CHQST2 Register Field Descriptions.....	2464
23-30. GINTEN Register Field Descriptions .....	2465
23-31. GINTFLG Register Field Descriptions .....	2466
23-32. GINTCLR Register Field Descriptions.....	2467
23-33. DLYCTL Register Field Descriptions .....	2468
24-1. Configuration for the EMIF1 Module.....	2470
24-2. EMIF Pins Used to Access Both SDRAM and Asynchronous Memories.....	2472
24-3. EMIF Pins Specific to SDRAM .....	2473
24-4. EMIF Pins Specific to Asynchronous Memory .....	2473
24-5. EMIF SDRAM Commands .....	2474
24-6. Truth Table for SDRAM Commands.....	2474
24-7. 16-bit EMIF Address Pin Connections.....	2476
24-8. Description of the SDRAM Configuration Register (SDRAM_CR).....	2477
24-9. Description of the SDRAM Refresh Control Register (SDRAM_RCR).....	2477
24-10. Description of the SDRAM Timing Register (SDRAM_TR).....	2478
24-11. Description of the SDRAM Self Refresh Exit Timing Register (SDR_EXT_TMNG).....	2478
24-12. SDRAM LOAD MODE REGISTER Command .....	2479
24-13. Refresh Urgency Levels .....	2480
24-14. Mapping from Logical Address to EMIF Pins for 32-bit SDRAM.....	2485
24-15. Mapping from Logical Address to EMIF Pins for 16-bit SDRAM.....	2485
24-16. Normal Mode vs. Select Strobe Mode.....	2486
24-17. Description of the Asynchronous <i>m</i> Configuration Register (ASYNC_CS <sub>n</sub> _CR).....	2488
24-18. Description of the Asynchronous Wait Cycle Configuration Register (ASYNC_WCCR) .....	2489
24-19. Description of EMIF Interrupt Mask Set Register (INT_MSK_SET) .....	2489
24-20. Description of EMIF Interrupt Mast Clear Register (INT_MSK_CLR) .....	2489
24-21. Asynchronous Read Operation in Normal Mode.....	2490
24-22. Asynchronous Write Operation in Normal Mode .....	2492
24-23. Asynchronous Read Operation in Select Strobe Mode .....	2494
24-24. Asynchronous Write Operation in Select Strobe Mode .....	2496
24-25. Interrupt Monitor and Control Bit Fields .....	2499
24-26. SR Field Value For EMIF to K4S641632H-TC(L)70 Interface.....	2503
24-27. SDRAM_TR Field Calculations for EMIF to K4S641632H-TC(L)70 Interface.....	2505
24-28. RR Calculation for EMIF to K4S641632H-TC(L)70 Interface .....	2506
24-29. RR Calculation for EMIF to K4S641632H-TC(L)70 Interface .....	2506
24-30. SDRAM_CR Field Values For EMIF to K4S641632H-TC(L)70 Interface.....	2507
24-31. AC Characteristics for a Read Access .....	2508
24-32. AC Characteristics for a Write Access .....	2508
24-33. EMIF Base Address Table .....	2511
24-34. EMIF_REGS Registers .....	2512
24-35. EMIF_REGS Access Type Codes .....	2512
24-36. RCSR Register Field Descriptions .....	2513
24-37. ASYNC_WCCR Register Field Descriptions .....	2514
24-38. SDRAM_CR Register Field Descriptions .....	2515
24-39. SDRAM_RCR Register Field Descriptions.....	2517

24-40. ASYNC_CS2_CR Register Field Descriptions .....	2518
24-41. ASYNC_CS3_CR Register Field Descriptions .....	2520
24-42. ASYNC_CS4_CR Register Field Descriptions .....	2522
24-43. SDRAM_TR Register Field Descriptions .....	2524
24-44. TOTAL_SDRAM_AR Register Field Descriptions .....	2525
24-45. TOTAL_SDRAM_ACTR Register Field Descriptions .....	2526
24-46. SDR_EXT_TMNG Register Field Descriptions .....	2527
24-47. INT_RAW Register Field Descriptions .....	2528
24-48. INT_MSK Register Field Descriptions .....	2529
24-49. INT_MSK_SET Register Field Descriptions .....	2530
24-50. INT_MSK_CLR Register Field Descriptions .....	2531
24-51. EMIF1_CONFIG_REGS Registers .....	2532
24-52. EMIF1_CONFIG_REGS Access Type Codes .....	2532
24-53. EMIF1LOCK Register Field Descriptions .....	2533
24-54. EMIF1COMMIT Register Field Descriptions .....	2534
24-55. EMIF1ACCPROT0 Register Field Descriptions .....	2535



## Read This First

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### About This Manual

This Technical Reference Manual (TRM) details the integration, the environment, the functional description, and the programming models for each peripheral and subsystem in the device.

The TRM should not be considered a substitute for the data manual, rather a companion guide that should be used alongside the device-specific data manual to understand the details to program the device. The primary purpose of the TRM is to abstract the programming details of the device from the data manual. This allows the data manual to outline the high-level features of the device without unnecessary information about register descriptions or programming models.

### Notational Conventions

This document uses the following conventions.

- Hexadecimal numbers may be shown with the suffix *h* or the prefix *0x*. For example, the following number is 40 hexadecimal (decimal 64): 40h or 0x40.
- Registers in this document are shown in figures and described in tables.
  - Each register figure shows a rectangle divided into fields that represent the fields of the register. Each field is labeled with its bit name, its beginning and ending bit numbers above, and its read/write properties with default reset value below. A legend explains the notation used for the properties.
  - Reserved bits in a register figure can have one of multiple meanings:
    - Not implemented on the device
    - Reserved for future device expansion
    - Reserved for TI testing
    - Reserved configurations of the device that are not supported
  - Writing nondefault values to the Reserved bits could cause unexpected behavior and should be avoided.

### Glossary

*TI Glossary* — This glossary lists and explains terms, acronyms, and definitions.

### Related Documentation From Texas Instruments

For a complete listing of related documentation and development-support tools for these devices, visit the Texas Instruments website at <http://www.ti.com>. Additionally, the *TMS320C28x CPU and Instruction Set Reference Guide (SPRU430)* and *TMS320C28x Floating Point Unit and Instruction Set Reference Guide (SPRUE02)* must be used in conjunction with this TRM.

### Trademarks

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## C28x Processor

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This chapter contains a modified description of the C28x Processor and provides links to access their respective references guides.

Topic	Page
1.1 Overview .....	80

## 1.1 Overview

The CPU is a 32-bit fixed-point processor. This device draws from the best features of digital signal processing; reduced instruction set computing (RISC); and microcontroller architectures, firmware, and tool sets.

The CPU features include a modified Harvard architecture and circular addressing. The RISC features are single-cycle instruction execution, register-to-register operations, and modified Harvard architecture. The microcontroller features include ease of use through an intuitive instruction set, byte packing and unpacking, and bit manipulation. The modified Harvard architecture of the CPU enables instruction and data fetches to be performed in parallel. The CPU can read instructions and data while it writes data simultaneously to maintain the single-cycle instruction operation across the pipeline. The CPU does this over six separate address/data buses.

For more information on CPU architecture and instruction set, see the *TMS320C28x CPU and Instruction Set Reference Guide* (literature number [SPRU430](#)). For more information on the C28x Floating Point Unit (FPU), Trigonometric Math Unit, and Viterbi, Complex Math, and CRC Unit II (VCU-II) instruction sets, see the *TMS320C28x Extended Instruction Sets Technical Reference Guide* (literature number [SPRUHS1](#)). A brief overview of the FPU, TMU, and VCU-II are provided here.

### 1.1.1 Floating-Point Unit

The C28x plus floating-point (C28x+FPU) processor extends the capabilities of the C28x fixed-point CPU by adding registers and instructions to support IEEE single-precision floating point operations.

Devices with the C28x+FPU include the standard C28x register set plus an additional set of floating-point unit registers. The additional floating-point unit registers are the following:

- Eight floating-point result registers, RnH (where n = 0–7)
- Floating-point Status Register (STF)
- Repeat Block Register (RB)

All of the floating-point registers, except the repeat block register, are shadowed. This shadowing can be used in high-priority interrupts for fast context save and restore of the floating-point registers.

### 1.1.2 Trigonometric Math Unit

The TMU extends the capabilities of a C28x+FPU by adding instructions and leveraging existing FPU instructions to speed up the execution of common trigonometric and arithmetic operations listed in [Table 1-1](#).

**Table 1-1. TMU Supported Instructions**

INSTRUCTIONS	C EQUIVALENT OPERATION	PIPELINE CYCLES
MPY2PIF32 RaH,RbH	$a = b * 2\pi$	2/3
DIV2PIF32 RaH,RbH	$a = b / 2\pi$	2/3
DIVF32 RaH,RbH,RcH	$a = b/c$	5
SQRTF32 RaH,RbH	$a = \text{sqrt}(b)$	5
SINPUF32 RaH,RbH	$a = \sin(b*2\pi)$	4
COSPUF32 RaH,RbH	$a = \cos(b*2\pi)$	4
ATANPUF32 RaH,RbH	$a = \text{atan}(b)/2\pi$	4
QUADF32 RaH,RbH,RcH,RdH	Operation to assist in calculating ATANPU2	5

No changes have been made to existing instructions, pipeline or memory bus architecture. All TMU instructions use the existing FPU register set (R0H to R7H) to carry out their operations.

### 1.1.3 Viterbi, Complex Math, and CRC Unit II (VCU-II)

The VCU-II is the second-generation Viterbi, Complex Math, and CRC extension to the C28x CPU. The VCU-II extends the capabilities of the C28x CPU by adding registers and instructions to accelerate the performance of FFTs and communications-based algorithms. The C28x+VCU-II supports the following algorithm types:

- **Viterbi Decoding**

Viterbi decoding is commonly used in baseband communications applications. The Viterbi decode algorithm consists of three main parts: branch metric calculations, compare-select (Viterbi butterfly), and a traceback operation. Table 1-2 shows a summary of the VCU performance for each of these operations.

**Table 1-2. Viterbi Decode Performance**

VITERBI OPERATION	VCU CYCLES
Branch Metric Calculation (code rate = 1/2)	1
Branch Metric Calculation (code rate = 1/3)	2p
Viterbi Butterfly (add-compare-select)	2 <sup>(1)</sup>
Traceback per Stage	3 <sup>(2)</sup>

<sup>(1)</sup> C28x CPU takes 15 cycles per butterfly.

<sup>(2)</sup> C28x CPU takes 22 cycles per stage.

- **Cyclic Redundancy Check**

Cyclic redundancy check (CRC) algorithms provide a straightforward method for verifying data integrity over large data blocks, communication packets, or code sections. The C28x+VCU can perform 8-bit, 16-bit, 24-bit, and 32-bit CRCs. For example, the VCU can compute the CRC for a block length of 10 bytes in 10 cycles. A CRC result register contains the current CRC, which is updated whenever a CRC instruction is executed.

- **Complex Math**

Complex math is used in many applications, a few of which are:

- Fast Fourier Transform (FFT)

The complex FFT is used in spread spectrum communications, as well as in many signal processing algorithms.

- Complex filters

Complex filters improve data reliability, transmission distance, and power efficiency. The C28x+VCU can perform a complex I and Q multiply with coefficients (four multiplies) in a single cycle. In addition, the C28x+VCU can read/write the real and imaginary parts of 16-bit complex data to memory in a single cycle.

**Table 1-3. Complex Math Performance**

COMPLEX MATH OPERATION	VCU CYCLES	NOTES
Add or Subtract	1	32 +/- 32 = 32-bit (Useful for filters)
Add or Subtract	1	16 +/- 32 = 15-bit (Useful for FFT)
Multiply	2p	16 x 16 = 32-bit
Multiply and Accumulate (MAC)	2p	32 + 32 = 32-bit, 16 x 16 = 32-bit
RPT MAC	2p+N	Repeat MAC. Single cycle after the first operation.

**NOTE:** Only the CRC-related VCU instructions will be supported in future devices. FFT algorithms are available for the C28x+FPU.

## System Control

This chapter explains system control and interrupts found on this MCU. The system control module configures and manages the overall operation of the device and provides information about the device status. Configurable features in system control include reset control, NMI operation, power control, clock control, and low-power modes.

Topic	Page
<b>2.1 Introduction</b> .....	<b>83</b>
<b>2.2 System Control Functional Description</b> .....	<b>83</b>
<b>2.3 Resets</b> .....	<b>84</b>
<b>2.4 Peripheral Interrupts</b> .....	<b>86</b>
<b>2.5 Exceptions and Non-Maskable Interrupts</b> .....	<b>97</b>
<b>2.6 Safety Features</b> .....	<b>98</b>
<b>2.7 Clocking</b> .....	<b>101</b>
<b>2.8 32-Bit CPU Timers 0/1/2</b> .....	<b>111</b>
<b>2.9 Watchdog Timers</b> .....	<b>113</b>
<b>2.10 Low Power Modes</b> .....	<b>116</b>
<b>2.11 Memory Controller Module</b> .....	<b>119</b>
<b>2.12 Flash and OTP Memory</b> .....	<b>126</b>
<b>2.13 Dual Code Security Module (DCSM)</b> .....	<b>139</b>
<b>2.14 JTAG</b> .....	<b>150</b>
<b>2.15 Registers</b> .....	<b>152</b>

## 2.1 Introduction

The register space of the device system control module is divided into three categories and will be explained further in this chapter. They are:

1. System Control Device Configuration Registers (DEV\_CFG\_REGS). The base address of these registers begins at 0x5D000.
2. System Control Clock Configuration Registers (CLK\_CFG\_REGS). The base address of these registers begins at 0x5D200.
3. System control CPU Subsystem Registers (CPU\_SYS\_REGS). The base address of these registers begins at 0x5D300.

## 2.2 System Control Functional Description

The system control module provides the following capabilities:

- Device identification and configuration registers
- Reset control
- Exceptions and Interrupt control
- Safety and error handling features of the device
- Power control
- Clock control
- Low Power modes
- Security module

### 2.2.1 Device Identification

Device identification registers provide information on device class, device family, revision, part number, pin count, operating temperature range, package type, pin count, and device qualification status.

All of the device information is part of the DEV\_CFG\_REGS space and is accessible only by the software running on the CPU1 subsystem.

The control subsystem device identification registers are: PARTIDL, PARTIDH, and REVID.

A 256-bit Unique ID (UID) is available in UID\_REGS. The 256 bits are separated into these registers:

- UID\_PSRAND0-5: 192 bits of pseudo-random data
- UID\_UNIQUE: 32-bit unique data, the value in this register will be unique across all devices with the same PARTIDH
- UID\_CHECKSUM: 32-bit fletcher checksum of UID\_PSRAND0-5 and UID\_UNIQUE
- CPU ID: 16-bit location in OTP. The value at this location provides the information about CPU (CPU1 or CPU20). Please refer to the device datasheet, for more detail.

### 2.2.2 Device Configuration Registers

Several registers provide users with configuration information for debug and identification purposes on this MCU. This information includes the features of the peripheral and how much RAM and FLASH memory is available on this part.

These registers are part of DEV\_CFG\_REGS space.

- DC0 – DC20: Device Configuration or Capabilities registers.  
If a particular bit in these registers is set to '1' then the associated/feature or module is available in the device.
- PERCNF: Peripheral configuration register.  
This register configures ADC capabilities, and enables or disables the USB internal PHY.
- CPUID: CPU identification register

## 2.3 Resets

This section explains the types and effects of the different resets on this device.

### 2.3.1 Reset Sources

Table 2-1 summarizes the various reset signals and their effect on the device.

**Table 2-1. Reset Signals**

Reset Source	CPU Core Reset (C28x, TMU, FPU, VCU)	Peripherals Reset	JTAG / Debug Logic Reset	IOs	$\overline{\text{XRS}}$ Output
POR	Yes	Yes	Yes	Hi-Z	Yes
$\overline{\text{XRS}}$ Pin	Yes	Yes	No	Hi-Z	-
$\overline{\text{WDRS}}$	Yes	Yes	No	Hi-Z	Yes
$\overline{\text{NMIWDRS}}$	Yes	Yes	No	Hi-Z	Yes
$\overline{\text{SYSRS}}$ (Debugger Reset)	Yes	Yes	No	Hi-Z	No
$\overline{\text{SCCRESET}}$	Yes	Yes	No	Hi-Z	No
$\overline{\text{HIBRESET}}$	Yes	Yes	Yes	Isolated	No
$\overline{\text{HWBISTR}}$	Yes	No	No	-	No
$\overline{\text{TRST}}$	No	No	Yes	-	No

The resets can be divided into a few groups:

- Chip-level resets ( $\overline{\text{XRS}}$ , POR,  $\overline{\text{WDRS}}$ , and  $\overline{\text{NMIWDRS}}$ ), which reset all or almost all of the device.
- System resets ( $\overline{\text{SYSRS}}$  and  $\overline{\text{SCCRESET}}$ ), which reset a large subset of the device but maintain some system-level configuration.
- Special resets ( $\overline{\text{HIBRESET}}$ ,  $\overline{\text{HWBISTR}}$ , and  $\overline{\text{TRST}}$ ), which enable specific device functions.

After a reset, the reset cause register (RESC) is updated with the reset cause. The bits in this register maintain their state across multiple resets. They can only be cleared by a power-on reset (POR) or by writing ones to the register.

Many peripheral modules have individual resets accessible through the system control registers. For information about a module's reset state, refer to the appropriate chapter for that module.

**Note:** After a POR,  $\overline{\text{XRS}}$ ,  $\overline{\text{WDRS}}$ ,  $\overline{\text{NMIWDRS}}$ , or  $\overline{\text{HIBRESET}}$ , the boot ROM will clear all of the system and message RAMs

### 2.3.2 External Reset ( $\overline{\text{XRS}}$ )

The external reset ( $\overline{\text{XRS}}$ ) is the main chip-level reset for the device. It resets the CPU, all peripherals and I/O pin configurations, and most of the system control registers. There is a dedicated open-drain pin for  $\overline{\text{XRS}}$ . This pin may be used to drive reset pins for other ICs in the application, and may itself be driven by an external source. The  $\overline{\text{XRS}}$  is driven internally during watchdog, NMI, and power-on resets. In hibernate mode, toggling  $\overline{\text{XRS}}$  will produce a  $\overline{\text{HIBRESET}}$ .

The  $\text{XRSn}$  bit in the RESC register will be set whenever  $\overline{\text{XRS}}$  is driven low for any reason. This bit is then cleared by the boot ROM.

### 2.3.3 Power-On Reset (POR)

The power-on reset (POR) circuit creates a clean reset throughout the device during power-up, suppressing glitches on the GPIOs. The  $\overline{\text{XRS}}$  pin is held low for the duration of the POR. In most applications,  $\overline{\text{XRS}}$  is held low long enough to reset other system ICs, but some applications may require a longer pulse. In these cases,  $\overline{\text{XRS}}$  can be driven low externally to provide the correct reset duration. A POR resets everything that  $\overline{\text{XRS}}$  does, along with a few other registers – the reset cause register (RESC), the NMI shadow flag register (NMISHDFLG), the X1 clock counter register (X1CNT), and the hibernate configuration registers (HIBBOOTMODE, IORESTOREADDR, and LPMCR.M0M1MODE).

After a POR, the POR and XRSn bits in RESC are set. These bits are then cleared by the boot ROM.

### 2.3.4 Debugger Reset ( $\overline{\text{SYSRS}}$ )

During development, it is sometimes necessary to reset the CPU and its peripherals without disconnecting the debugger or disrupting the system-level configuration. To facilitate this, the CPU has a subsystem reset, which can be triggered by a debugger using Code Composer Studio. This reset ( $\overline{\text{SYSRS}}$ ) resets the CPU, its peripherals, many system control registers (including its clock gating and LPM configuration), and all I/O pin configurations.

The  $\overline{\text{SYSRS}}$  does not reset the ICEPick debug module, the device capability registers, the clock source and PLL configurations, the missing clock detection state, the PIE vector fetch error handler address, the NMI flags, the analog trims, or anything reset only by a POR (see [Section 2.3.3](#)).

### 2.3.5 Watchdog Reset ( $\overline{\text{WDRS}}$ )

The device has a watchdog timer that can optionally trigger a reset that lasts for 512 INTOSC1 cycles. This watchdog reset ( $\overline{\text{WDRS}}$ ) produces an  $\overline{\text{XRS}}$ .

After a watchdog reset, the WDRSn bit in RESC is set.

### 2.3.6 NMI Watchdog Reset ( $\overline{\text{NMIWDRS}}$ )

The device has a non-maskable interrupt (NMI) module that detects hardware errors in the system. The NMI module has a watchdog timer that triggers a reset if the CPU does not respond to an error within a user-specified amount of time. This NMI watchdog reset ( $\overline{\text{NMIWDRS}}$ ) produces an  $\overline{\text{XRS}}$ .

After an NMI watchdog reset, the NMIWDRSn bit in RESC is set.

### 2.3.7 DCSM Safe Code Copy Reset ( $\overline{\text{SCCRESET}}$ )

The device has a dual-zone code security module (DCSM) that blocks read access to certain areas of the flash memory. To facilitate CRC checks and copying of CLA code, TI provides ROM functions to securely access those memory areas. To prevent security breaches, interrupts must be disabled before calling these functions. If a vector fetch occurs in a safe copy or CRC function, the DCSM triggers a reset. The security reset ( $\overline{\text{SCCRESET}}$ ) is similar to a  $\overline{\text{SYSRS}}$ . However, the security reset also resets the debug logic to deny access to a potential attacker.

After a security reset, the SCCRESETn bit in RESC is set.

### 2.3.8 Hibernate Reset ( $\overline{\text{HIBRESET}}$ )

Hibernate is a chip-level low-power mode that gates power to large portions of the device. Waking up from hibernate involves a special reset ( $\overline{\text{HIBRESET}}$ ). This reset is similar to a POR except that the I/O pins remain isolated and the  $\overline{\text{XRS}}$  pin is not toggled. (An external  $\overline{\text{XRS}}$  toggle during hibernate will trigger a  $\overline{\text{HIBRESET}}$ ). I/O isolation is disabled in software as part of a special boot ROM flow. For more information on hibernate, refer to [Section 2.10](#).

After a hibernate reset, the HIBRESETn bit in RESC is set. This bit is then cleared by the boot ROM.

### 2.3.9 Hardware BIST Reset ( $\overline{\text{HWBISTRs}}$ )

The Hardware Built-In Self-Test (HWBIST) module tests the functionality of the CPU. At the end of the test, it resets the CPU to return it to a working state. This reset ( $\overline{\text{HWBISTRs}}$ ) only affects the CPU itself. The peripherals and system control remain as previously configured. The CPU state is restored in software as part of a special boot ROM flow. For more information on the HWBIST flow, contact your local TI representative.

After a HWBIST reset, the HWBISTRn bit in RESC is set. This bit is then cleared by the boot ROM.



### 2.3.10 Test Reset ( $\overline{TRST}$ )

The ICEPick debug module and associated JTAG logic has its own reset ( $\overline{TRST}$ ) which is controlled by a dedicated pin. This reset is normally active unless the user connects a debugger to the device. For more information on the debug module, see the TI Processors Wiki page on ICEPick: <http://processors.wiki.ti.com/index.php/ICEPICK>.

The  $\overline{TRST}$  does not have a normal RESC bit, but the TRSTn\_pin\_status bit indicates the state of the pin.

## 2.4 Peripheral Interrupts

This section explains the peripheral interrupt handling on the device. Non-maskable interrupts are covered in Section 2.5. Software interrupts and emulation interrupts are not covered in this document. For information on those, see the *TMS320C28x CPU and Instruction Set Reference Guide (SPRU430)*.

### 2.4.1 Interrupt Concepts

An interrupt is a signal that causes the CPU to pause its current execution and branch to a different piece of code known as an interrupt service routine (ISR). This is a useful mechanism for handling peripheral events, and involves less CPU overhead or program complexity than register polling. However, because interrupts are asynchronous to the program flow, care must be taken to avoid conflicts over resources that are accessed both in interrupts and in the main program code.

Interrupts propagate to the CPU through a series of flag and enable registers. The flag registers store the interrupt until it is processed. The enable registers block the propagation of the interrupt. When an interrupt signal reaches the CPU, the CPU fetches the appropriate ISR address from a list called the vector table.

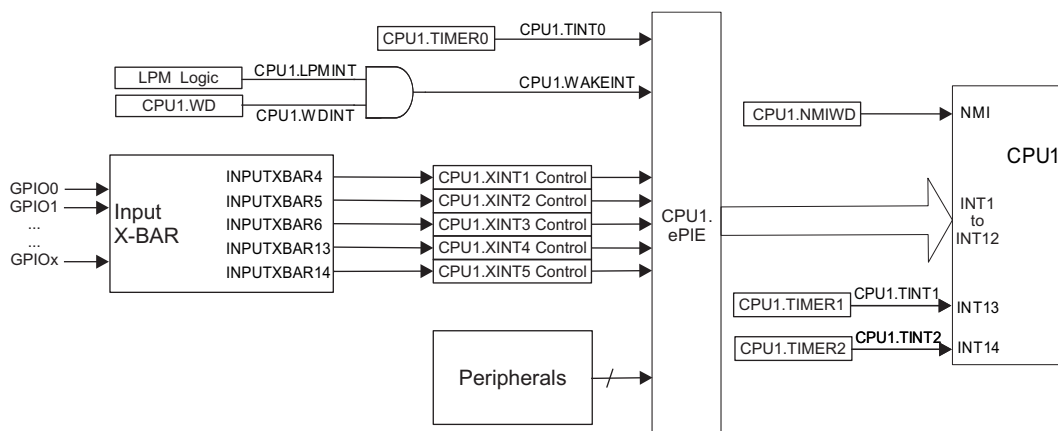
### 2.4.2 Interrupt Architecture

The C28x CPU has fourteen peripheral interrupt lines. Two of them (INT13 and INT14) are connected directly to CPU timers 1 and 2, respectively. The remaining twelve are connected to peripheral interrupt signals through the enhanced Peripheral Interrupt Expansion module (ePIE, or PIE as a shortened version). The PIE multiplexes up to sixteen peripheral interrupts into each CPU interrupt line. It also expands the vector table to allow each interrupt to have its own ISR. This allows the CPU to support a large number of peripherals.

An interrupt path is divided into three stages – the peripheral, the PIE, and the CPU. Each stage has its own enable and flag registers. This system allows the CPU to handle one interrupt while others are pending, implement and prioritize nested interrupts in software, and disable interrupts during certain critical tasks.

Figure 2-1 shows the interrupt architecture for this device.

**Figure 2-1. Device Interrupt Architecture**



### 2.4.2.1 Peripheral Stage

Each peripheral has its own unique interrupt configuration, which is described in that peripheral's chapter. Some peripherals allow multiple events to trigger the same interrupt signal. For example, a communications peripheral might use the same interrupt to indicate that data has been received or that there has been a transmission error. The cause of the interrupt can be determined by reading the peripheral's status register. Often, the bits in the status register must be cleared manually before another interrupt will be generated.

### 2.4.2.2 PIE Stage

The PIE provides individual flag and enable register bits for each of the peripheral interrupt signals, which are sometimes called PIE channels. These channels are grouped according to their associated CPU interrupt. Each PIE group has one 16-bit enable register (PIEIERx), one 16-bit flag register (PIEIFRx), and one bit in the PIE acknowledge register (PIEACK). The PIEACK register bit acts as a common interrupt mask for the entire PIE group.

When the CPU receives an interrupt, it fetches the address of the ISR from the PIE. The PIE returns the vector for the lowest-numbered channel in the group that is both flagged and enabled. This gives lower-numbered interrupts a higher priority when multiple interrupts are pending.

If no interrupt is both flagged and enabled, the PIE returns the vector for channel 1. This condition will not happen unless software changes the state of the PIE while an interrupt is propagating. [Section 2.4.4](#) contains procedures for safely modifying the PIE configuration once interrupts have been enabled.

### 2.4.2.3 CPU Stage

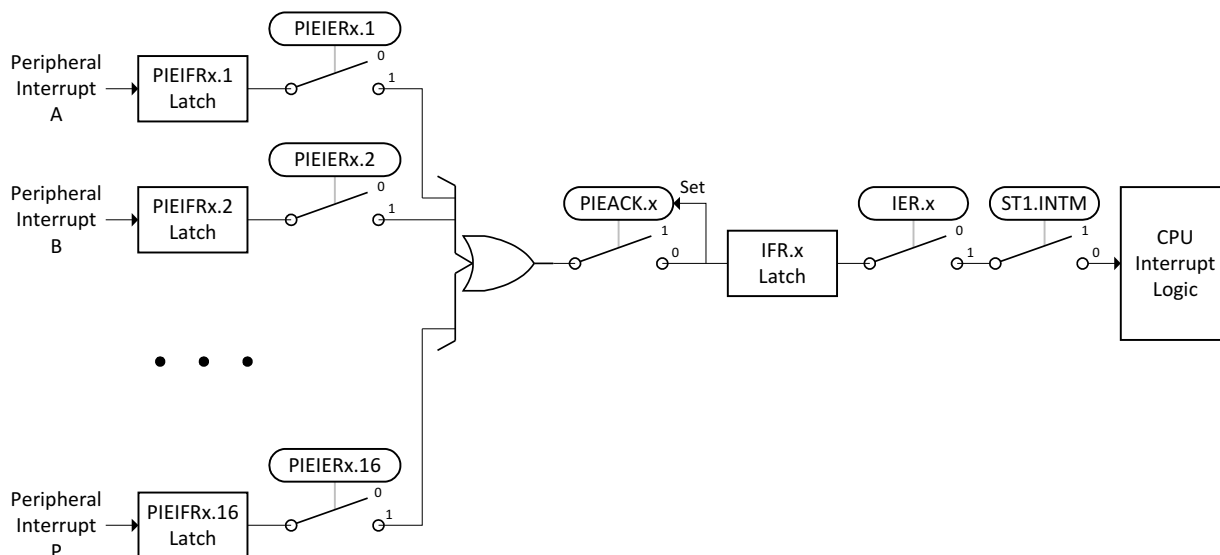
Like the PIE, the CPU provides flag and enable register bits for each of its interrupts. There is one enable register (IER) and one flag register (IFR), both of which are internal CPU registers. There is also a global interrupt mask, which is controlled by the INTM bit in the ST1 register. This mask can be set and cleared using the CPU's SETC instruction. In C code, controlSUITE's DINT and EINT macros can be used for this purpose.

Writes to IER and INTM are atomic operations. In particular, if INTM is cleared, the next instruction in the pipeline will run with interrupts disabled. No software delays are needed.

## 2.4.3 Interrupt Entry Sequence

Figure 2-2 shows how peripheral interrupts propagate to the CPU.

Figure 2-2. Interrupt Propagation Path



When a peripheral generates an interrupt (on PIE group x, channel y), it triggers the following sequence of events:

1. The interrupt is latched in PIEIFRx.y.
2. If PIEIERx.y is set, the interrupt propagates.
3. If PIEACK.x is clear, the interrupt propagates and PIEACK.x is set.
4. The interrupt is latched in IFR.x.
5. If IER.x is set, the interrupt propagates.
6. If INTM is clear, the CPU receives the interrupt.
7. Any instructions in the D2 or later stage of the pipeline are run to completion. Instructions in earlier stages are flushed.
8. The CPU saves its context on the stack.
9. IFR.x and IER.x are cleared. INTM is set. EALLOW is cleared.
10. The CPU fetches the ISR vector from the PIE. PIEIFRx.y is cleared.
11. The CPU branches to the ISR.

The interrupt latency is the time between PIEIFRx.y latching the interrupt and the first ISR instruction entering the execution stage of the CPU pipeline. The minimum interrupt latency is 14 SYSCLK cycles. Wait states on the ISR or stack memories will add to the latency. External interrupts add a minimum of two SYSCLK cycles for GPIO synchronization plus extra time for input qualification (if used). Loops created using the C28x RPT instruction cannot be interrupted.

## 2.4.4 Configuring and Using Interrupts

At power-up, no interrupts are enabled by default. The PIEIER and IER registers are cleared and INTM is set. The application code is responsible for configuring and enabling all peripheral interrupts.

### 2.4.4.1 Enabling Interrupts

To enable a peripheral interrupt, perform the following steps:

1. Disable interrupts globally (DINT or SETC INTM).
2. Enable the PIE by setting the ENPIE bit of the PIECTRL register.
3. Write the ISR vector for each interrupt to the appropriate location in the PIE vector table, which can be found in [Table 2-2](#).
4. Set the appropriate PIEIERx bit for each interrupt. The PIE group and channel assignments can be found in [Table 2-2](#).
5. Set the CPU IER bit for any PIE group containing enabled interrupts.
6. Enable the interrupt in the peripheral.
7. Enable interrupts globally (EINT or CLRC INTM).

Step 4 does not apply to the Timer1 and Timer2 interrupts, which connect directly to the CPU.

### 2.4.4.2 Handling Interrupts

ISRs are similar to normal functions, but must do the following:

1. Save and restore the state of certain CPU registers (if used).
2. Clear the PIEACK bit for the interrupt group.
3. Return using the IRET instruction.

Requirements 1 and 3 are handled automatically by the TMS320C28x C compiler if the function is defined using the `__interrupt` keyword. For information on this keyword, see the Keywords section of the *TMS320C28x Optimizing C/C++ Compiler v6.2.4 User's Guide* ([SPRU514](#)). For information on writing assembly code to handle interrupts, see the Standard Operation for Maskable Interrupts section of the *TMS320C28x CPU and Instruction Set Reference Guide* ([SPRU430](#)).

The PIEACK bit for the interrupt group must be cleared manually in user code. This is normally done at the end of the ISR. If the PIEACK bit is not cleared, the CPU will not receive any further interrupts from that group. This does not apply to the Timer1 and Timer2 interrupts, which do not go through the PIE.

#### 2.4.4.3 Disabling Interrupts

To disable all interrupts, set the CPU's global interrupt mask via DINT or SETC INTM. It is not necessary to add NOPs after setting INTM or modifying IER – the next instruction will execute with interrupts disabled.

Individual interrupts can be disabled using the PIEIERx registers, but care must be taken to avoid race conditions. If an interrupt signal is already propagating when the PIEIER write completes, it may reach the CPU and trigger a spurious interrupt condition. To avoid this, use the following procedure:

1. Disable interrupts globally (DINT or SETC INTM).
2. Clear the PIEIER bit for the interrupt.
3. Wait 5 cycles to make sure that any propagating interrupt has reached the CPU IFR register.
4. Clear the CPU IFR bit for the interrupt's PIE group.
5. Clear the PIEACK bit for the interrupt's PIE group.
6. Enable interrupts globally (EINT or CLRC INTM).

Interrupt groups can be disabled using the CPU IER register. This cannot cause a race condition, so no special procedure is needed.

PIEIFR bits must never be cleared in software since the read/modify/write operation may cause incoming interrupts to be lost. The only safe way to clear a PIEIFR bit is to have the CPU take the interrupt. The following procedure can be used to bypass the normal ISR:

1. Disable interrupts globally (DINT or SETC INTM).
2. Modify the PIE vector table to map the PIEIFR bit's interrupt vector to an empty ISR. This ISR will only contain a return from interrupt instruction (IRET).
3. Disable the interrupt in the peripheral registers.
4. Enable interrupts globally (EINT or CLRC INTM).
5. Wait for the pending interrupt to be serviced by the empty ISR.
6. Disable interrupts globally.
7. Modify the PIE vector table to map the interrupt vector back to its original ISR.
8. Clear the PIEACK bit for the interrupt's PIE group.
9. Enable interrupts globally.

#### 2.4.4.4 Nesting Interrupts

By default, interrupts do not nest. It is possible to nest and prioritize interrupts via software control of the IER and PIEIERx registers. Documentation and example code can be found in controlSUITE and on the TI Processors wiki:

[http://processors.wiki.ti.com/index.php/Interrupt\\_Nesting\\_on\\_C28x](http://processors.wiki.ti.com/index.php/Interrupt_Nesting_on_C28x)

## 2.4.5 PIE Channel Mapping

Table 2-2 shows the PIE group and channel assignments for each peripheral interrupt. Each row is a group, and each column is a channel within that group. When multiple interrupts are pending, the lowest-numbered channel is the lowest-numbered group is serviced first. Thus, the interrupts at the top of the table have the highest priority, and the interrupts at the bottom have the lowest priority.

**Table 2-2. PIE Channel Mapping**

	INTx.1	INTx.2	INTx.3	INTx.4	INTx.5	INTx.6	INTx.7	INTx.8	INTx.9	INTx.10	INTx.11	INTx.12	INTx.13	INTx.14	INTx.15	INTx.16
INT1.y	ADCA1	ADCB1	ADCC1	XINT1	XINT2	ADCD1	TIMER0	WAKE	-	-	-	-				
INT2.y	EPWM1_TZ	EPWM2_TZ	EPWM3_TZ	EPWM4_TZ	EPWM5_TZ	EPWM6_TZ	EPWM7_TZ	EPWM8_TZ	EPWM9_TZ	EPWM10_TZ	EPWM11_TZ	EPWM12_TZ	-	-	-	-
INT3.y	EPWM1	EPWM2	EPWM3	EPWM4	EPWM5	EPWM6	EPWM7	EPWM8	EPWM9	EPWM10	EPWM11	EPWM12	-	-	-	-
INT4.y	ECAP1	ECAP2	ECAP3	ECAP4	ECAP5	ECAP6	-	-	-	-	-	-	-	-	-	-
INT5.y	EQEP1	EQEP2	EQEP3	-	-	-	-	-	SD1	SD2	-	-	-	-	-	-
INT6.y	SPIA_RX	SPIA_TX	SPIB_RX	SPIB_TX	MCBSPA_RX	MCBSPA_TX	MCBSPB_RX	MCBSPB_TX	SPIC_RX	SPIC_TX	-	-	-	-	-	-
INT7.y	DMA_CH1	DMA_CH2	DMA_CH3	DMA_CH4	DMA_CH5	DMA_CH6	-	-	-	-	-	-	-	-	-	-
INT8.y	I2CA	I2CA_FIFO	I2CB	I2CB_FIFO	SCIC_RX	SCIC_TX	SCID_RX	SCID_TX	-	-	-	-	-	-	UPPA	-
INT9.y	SCIA_RX	SCIA_TX	SCIB_RX	SCIB_TX	CANA_0	CANA_1	CANB_0	CANB_1	-	-	-	-	-	-	USBA	-
INT10.y	ADCA_EVT	ADCA2	ADCA3	ADCA4	ADCB_EVT	ADCB2	ADCB3	ADCB4	ADCC_EVT	ADCC2	ADCC3	ADCC4	ADCD_EVT	ADCD2	ADCD3	ADCD4
INT11.y	CLA1_1	CLA1_2	CLA1_3	CLA1_4	CLA1_5	CLA1_6	CLA1_7	CLA1_8	-	-	-	-	-	-	-	-
INT12.y	XINT3	XINT4	XINT5	-	-	VCU	FPU_OVERFLOW	FPU_UNDERFLOW	EMIF_ERROR	RAM_CORRECTABLE_ERROR	FLASH_CORRECTABLE_ERROR	RAM_ACCESS_VIOLATION	SYS_PLL_SLIP	AUX_PLL_SLIP	CLA_OVERFLOW	CLA_UNDERFLOW

Note: Cells marked "-" are Reserved

## 2.4.6 Vector Tables

Table 2-3 shows the CPU interrupt vector table. The vectors for INT1 – INT12 are not used in this device. The reset vector is fetched from the boot ROM instead of from this table.

**Table 2-3. CPU Interrupt Vectors**

Name	Vector ID	Address	Size (x16)	Description	Core priority	ePIE group Priority
Reset	0	0x0000 0D00	2	Reset is always fetched from location 0x003F_FFC0 in Boot ROM	1 (Highest)	-
INT1	1	0x0000 0D02	2	Not used. See PIE Group 1	5	-
INT2	2	0x0000 0D04	2	Not used. See PIE Group 2	6	-
INT3	3	0x0000 0D06	2	Not used. See PIE Group 3	7	-
INT4	4	0x0000 0D08	2	Not used. See PIE Group 4	8	-
INT5	5	0x0000 0D0A	2	Not used. See PIE Group 5	9	-
INT6	6	0x0000 0D0C	2	Not used. See PIE Group 6	10	-
INT7	7	0x0000 0D0E	2	Not used. See PIE Group 7	11	-
INT8	8	0x0000 0D10	2	Not used. See PIE Group 8	12	-
INT9	9	0x0000 0D12	2	Not used. See PIE Group 9	13	-
INT10	10	0x0000 0D14	2	Not used. See PIE Group 10	14	-
INT11	11	0x0000 0D16	2	Not used. See PIE Group 11	15	-
INT12	12	0x0000 0D18	2	Not used. See PIE Group 12	16	-
INT13	13	0x0000 0D1A	2	CPU TIMER1 Interrupt	17	-
INT14	14	0x0000 0D1C	2	CPU TIMER2 Interrupt (for TI/RTOS use)	18	-
DATALOG	15	0x0000 0D1E	2	CPU Data Logging Interrupt	19 (lowest)	-
RTOSINT	16	0x0000 0D20	2	CPU Real-Time OS Interrupt	4	-
EMUINT	17	0x0000 0D22	2	CPU Emulation Interrupt	2	-
NMI	18	0x0000 0D24	2	Non-Maskable Interrupt	3	-
ILLEGAL	19	0x0000 0D26	2	Illegal Instruction (ITRAP)	-	-
USER 1	20	0x0000 0D28	2	User-Defined Trap	-	-
USER 2	21	0x0000 0D2A	2	User-Defined Trap	-	-
USER 3	22	0x0000 0D2C	2	User-Defined Trap	-	-
USER 4	23	0x0000 0D2E	2	User-Defined Trap	-	-
USER 5	24	0x0000 0D30	2	User-Defined Trap	-	-
USER 6	25	0x0000 0D32	2	User-Defined Trap	-	-
USER 7	26	0x0000 0D34	2	User-Defined Trap	-	-
USER 8	27	0x0000 0D36	2	User-Defined Trap	-	-
USER 9	28	0x0000 0D38	2	User-Defined Trap	-	-
USER 10	29	0x0000 0D3A	2	User-Defined Trap	-	-
USER 11	30	0x0000 0D3C	2	User-Defined Trap	-	-
USER 12	31	0x0000 0D3E	2	User-Defined Trap	-	-

Table 2-4 shows the Pie vector table.

**Table 2-4. PIE Interrupt Vectors**

Name	Vector ID	Address	Size (x16)	Description	Core priority	ePIE group Priority
<b>PIE Group 1 Vectors - Muxed into CPU INT1</b>						
INT1.1	32	0x0000 0D40	2	ADCA1 interrupt	5	1 (Highest)
INT1.2	33	0x0000 0D42	2	ADCB1 interrupt	5	2
INT1.3	34	0x0000 0D44	2	ADCC1 interrupt	5	3
INT1.4	35	0x0000 0D46	2	XINT1 interrupt	5	4
INT1.5	36	0x0000 0D48	2	XINT2 interrupt	5	5
INT1.6	37	0x0000 0D4A	2	ADCD1 interrupt	5	6
INT1.7	38	0x0000 0D4C	2	TIMER0 interrupt	5	7
INT1.8	39	0x0000 0D4E	2	WAKE interrupt	5	8
INT1.9	128	0x0000 0E00	2	Reserved	5	9
INT1.10	129	0x0000 0E02	2	Reserved	5	10
INT1.11	130	0x0000 0E04	2	Reserved	5	11
INT1.12	131	0x0000 0E06	2	Reserved	5	12
INT1.13	132	0x0000 0E08	2	IPC1 interrupt	5	13
INT1.14	133	0x0000 0E0A	2	IPC2 interrupt	5	14
INT1.15	134	0x0000 0E0C	2	IPC3 interrupt	5	15
INT1.16	135	0x0000 0E0E	2	IPC4 interrupt	5	16 (Lowest)
<b>PIE Group 2 Vectors - Muxed into CPU INT2</b>						
INT2.1	40	0x0000 0D50	2	EPWM1_TZ interrupt	6	1 (Highest)
INT2.2	41	0x0000 0D52	2	EPWM2_TZ interrupt	6	2
INT2.3	42	0x0000 0D54	2	EPWM3_TZ interrupt	6	3
INT2.4	43	0x0000 0D56	2	EPWM4_TZ interrupt	6	4
INT2.5	44	0x0000 0D58	2	EPWM5_TZ interrupt	6	5
INT2.6	45	0x0000 0D5A	2	EPWM6_TZ interrupt	6	6
INT2.7	46	0x0000 0D5C	2	EPWM7_TZ interrupt	6	7
INT2.8	47	0x0000 0D5E	2	EPWM8_TZ interrupt	6	8
INT2.9	136	0x0000 0E10	2	EPWM9_TZ interrupt	6	9
INT2.10	137	0x0000 0E12	2	EPWM10_TZ interrupt	6	10
INT2.11	138	0x0000 0E14	2	EPWM11_TZ interrupt	6	11
INT2.12	139	0x0000 0E16	2	EPWM12_TZ interrupt	6	12
INT2.13	140	0x0000 0E18	2	Reserved	6	13
INT2.14	141	0x0000 0E1A	2	Reserved	6	14
INT2.15	142	0x0000 0E1C	2	Reserved	6	15
INT2.16	143	0x0000 0E1E	2	Reserved	6	16 (Lowest)
<b>PIE Group 3 Vectors - Muxed into CPU INT3</b>						
INT3.1	48	0x0000 0D60	2	EPWM1 interrupt	7	1 (Highest)
INT3.2	49	0x0000 0D62	2	EPWM2 interrupt	7	2



**Table 2-4. PIE Interrupt Vectors (continued)**

Name	Vector ID	Address	Size (x16)	Description	Core priority	ePIE group Priority
INT3.3	50	0x0000 0D64	2	EPWM3 interrupt	7	3
INT3.4	51	0x0000 0D66	2	EPWM4 interrupt	7	4
INT3.5	52	0x0000 0D68	2	EPWM5 interrupt	7	5
INT3.6	53	0x0000 0D6A	2	EPWM6 interrupt	7	6
INT3.7	54	0x0000 0D6C	2	EPWM7 interrupt	7	7
INT3.8	55	0x0000 0D6E	2	EPWM8 interrupt	7	8
INT3.9	144	0x0000 0E20	2	EPWM9 interrupt	7	9
INT3.10	145	0x0000 0E22	2	EPWM10 interrupt	7	10
INT3.11	146	0x0000 0E24	2	EPWM11 interrupt	7	11
INT3.12	147	0x0000 0E26	2	EPWM12 interrupt	7	12
INT3.13	148	0x0000 0E28	2	Reserved	7	13
INT3.14	149	0x0000 0E2A	2	Reserved	7	14
INT3.15	150	0x0000 0E2C	2	Reserved	7	15
INT3.16	151	0x0000 0E2E	2	Reserved	7	16 (Lowest)
<b>PIE Group 4 Vectors - Muxed into CPU INT4</b>						
INT4.1	56	0x0000 0D70	2	ECAP1 interrupt	8	1 (Highest)
INT4.2	57	0x0000 0D72	2	ECAP2 interrupt	8	2
INT4.3	58	0x0000 0D74	2	ECAP3 interrupt	8	3
INT4.4	59	0x0000 0D76	2	ECAP4 interrupt	8	4
INT4.5	60	0x0000 0D78	2	ECAP5 interrupt	8	5
INT4.6	61	0x0000 0D7A	2	ECAP6 interrupt	8	6
INT4.7	62	0x0000 0D7C	2	Reserved	8	7
INT4.8	63	0x0000 0D7E	2	Reserved	8	8
INT4.9	152	0x0000 0E30	2	Reserved	8	9
INT4.10	153	0x0000 0E32	2	Reserved	8	10
INT4.11	154	0x0000 0E34	2	Reserved	8	11
INT4.12	155	0x0000 0E36	2	Reserved	8	12
INT4.13	156	0x0000 0E38	2	Reserved	8	13
INT4.14	157	0x0000 0E3A	2	Reserved	8	14
INT4.15	158	0x0000 0E3C	2	Reserved	8	15
INT4.16	159	0x0000 0E3E	2	Reserved	8	16 (Lowest)
<b>PIE Group 5 Vectors - Muxed into CPU INT5</b>						
INT5.1	64	0x0000 0D80	2	EQEP1 interrupt	9	1 (Highest)
INT5.2	65	0x0000 0D82	2	EQEP2 interrupt	9	2
INT5.3	66	0x0000 0D84	2	EQEP3 interrupt	9	3
INT5.4	67	0x0000 0D86	2	Reserved	9	4
INT5.5	68	0x0000 0D88	2	Reserved	9	5
INT5.6	69	0x0000 0D8A	2	Reserved	9	6
INT5.7	70	0x0000 0D8C	2	Reserved	9	7
INT5.8	71	0x0000 0D8E	2	Reserved	9	8
INT5.9	160	0x0000 0E40	2	SD1 interrupt	9	9
INT5.10	161	0x0000 0E42	2	SD2 interrupt	9	10
INT5.11	162	0x0000 0E44	2	Reserved	9	11
INT5.12	163	0x0000 0E46	2	Reserved	9	12
INT5.13	164	0x0000 0E48	2	Reserved	9	13

**Table 2-4. PIE Interrupt Vectors (continued)**

Name	Vector ID	Address	Size (x16)	Description	Core priority	ePIE group Priority
INT5.14	165	0x0000 0E4A	2	Reserved	9	14
INT5.15	166	0x0000 0E4C	2	Reserved	9	15
INT5.16	167	0x0000 0E4E	2	Reserved	9	16 (Lowest)
<b>PIE Group 6 Vectors - Muxed into CPU INT6</b>						
INT6.1	72	0x0000 0D90	2	SPIA_RX interrupt	10	1 (Highest)
INT6.2	73	0x0000 0D92	2	SPIA_TX interrupt	10	2
INT6.3	74	0x0000 0D94	2	SPIB_RX interrupt	10	3
INT6.4	75	0x0000 0D96	2	SPIB_TX interrupt	10	4
INT6.5	76	0x0000 0D98	2	MCBSPA_RX interrupt	10	5
INT6.6	77	0x0000 0D9A	2	MCBSPA_TX interrupt	10	6
INT6.7	78	0x0000 0D9C	2	MCBSPB_RX interrupt	10	7
INT6.8	79	0x0000 0D9E	2	MCBSPB_TX interrupt	10	8
INT6.9	168	0x0000 0E50	2	SPIC_RX interrupt	10	9
INT6.10	169	0x0000 0E52	2	SPIC_TX interrupt	10	10
INT6.11	170	0x0000 0E54	2	Reserved	10	11
INT6.12	171	0x0000 0E56	2	Reserved	10	12
INT6.13	172	0x0000 0E58	2	Reserved	10	13
INT6.14	173	0x0000 0E5A	2	Reserved	10	14
INT6.15	174	0x0000 0E5C	2	Reserved	10	15
INT6.16	175	0x0000 0E5E	2	Reserved	10	16 (Lowest)
<b>PIE Group 7 Vectors - Muxed into CPU INT7</b>						
INT7.1	80	0x0000 0DA0	2	DMA_CH1 interrupt	11	1 (Highest)
INT7.2	81	0x0000 0DA2	2	DMA_CH2 interrupt	11	2
INT7.3	82	0x0000 0DA4	2	DMA_CH3 interrupt	11	3
INT7.4	83	0x0000 0DA6	2	DMA_CH4 interrupt	11	4
INT7.5	84	0x0000 0DA8	2	DMA_CH5 interrupt	11	5
INT7.6	85	0x0000 0DAA	2	DMA_CH6 interrupt	11	6
INT7.7	86	0x0000 0DAC	2	Reserved	11	7
INT7.8	87	0x0000 0DAE	2	Reserved	11	8
INT7.9	176	0x0000 0E60	2	Reserved	11	9
INT7.10	177	0x0000 0E62	2	Reserved	11	10
INT7.11	178	0x0000 0E64	2	Reserved	11	11
INT7.12	179	0x0000 0E66	2	Reserved	11	12
INT7.13	180	0x0000 0E68	2	Reserved	11	13
INT7.14	181	0x0000 0E6A	2	Reserved	11	14
INT7.15	182	0x0000 0E6C	2	Reserved	11	15

**Table 2-4. PIE Interrupt Vectors (continued)**

Name	Vector ID	Address	Size (x16)	Description	Core priority	ePIE group Priority
INT7.16	183	0x0000 0E6E	2	Reserved	11	16 (Lowest)
<b>PIE Group 8 Vectors - Muxed into CPU INT8</b>						
INT8.1	88	0x0000 0DB0	2	I2CA interrupt	12	1 (Highest)
INT8.2	89	0x0000 0DB2	2	I2CA_FIFO interrupt	12	2
INT8.3	90	0x0000 0DB4	2	I2CB interrupt	12	3
INT8.4	91	0x0000 0DB6	2	I2CB_FIFO interrupt	12	4
INT8.5	92	0x0000 0DB8	2	SCIC_RX interrupt	12	5
INT8.6	93	0x0000 0DBA	2	SCIC_TX interrupt	12	6
INT8.7	94	0x0000 0DBC	2	SCID_RX interrupt	12	7
INT8.8	95	0x0000 0DBE	2	SCID_TX interrupt	12	8
INT8.9	184	0x0000 0E70	2	Reserved	12	9
INT8.10	185	0x0000 0E72	2	Reserved	12	10
INT8.11	186	0x0000 0E74	2	Reserved	12	11
INT8.12	187	0x0000 0E76	2	Reserved	12	12
INT8.13	188	0x0000 0E78	2	Reserved	12	13
INT8.14	189	0x0000 0E7A	2	Reserved	12	14
INT8.15	190	0x0000 0E7C	2	UPPA interrupt (CPU1 only)	12	15
INT8.16	191	0x0000 0E7E	2	Reserved	12	16 (Lowest)
<b>PIE Group 9 Vectors - Muxed into CPU INT9</b>						
INT9.1	96	0x0000 0DC0	2	SCIA_RX interrupt	13	1 (Highest)
INT9.2	97	0x0000 0DC2	2	SCIA_TX interrupt	13	2
INT9.3	98	0x0000 0DC4	2	SCIB_RX interrupt	13	3
INT9.4	99	0x0000 0DC6	2	SCIB_TX interrupt	13	4
INT9.5	100	0x0000 0DC8	2	CANA interrupt 0	13	5
INT9.6	101	0x0000 0DCA	2	CANA interrupt 1	13	6
INT9.7	102	0x0000 0DCC	2	CANB interrupt 0	13	7
INT9.8	103	0x0000 0DCE	2	CANB interrupt 1	13	8
INT9.9	192	0x0000 0E80	2	Reserved	13	9
INT9.10	193	0x0000 0E82	2	Reserved	13	10
INT9.11	194	0x0000 0E84	2	Reserved	13	11
INT9.12	195	0x0000 0E86	2	Reserved	13	12
INT9.13	196	0x0000 0E88	2	Reserved	13	13
INT9.14	197	0x0000 0E8A	2	Reserved	13	14
INT9.15	198	0x0000 0E8C	2	USBA interrupt (CPU1 only)	13	15
INT9.16	199	0x0000 0E8E	2	Reserved	13	16 (Lowest)
<b>PIE Group 10 Vectors - Muxed into CPU INT10</b>						
INT10.1	104	0x0000 0DD0	2	ADCA_EVT interrupt	14	1 (Highest)
INT10.2	105	0x0000 0DD2	2	ADCA2 interrupt	14	2

**Table 2-4. PIE Interrupt Vectors (continued)**

Name	Vector ID	Address	Size (x16)	Description	Core priority	ePIE group Priority
INT10.3	106	0x0000 0DD4	2	ADCA3 interrupt	14	3
INT10.4	107	0x0000 0DD6	2	ADCA4 interrupt	14	4
INT10.5	108	0x0000 0DD8	2	ADCB_EVT interrupt	14	5
INT10.6	109	0x0000 0DDA	2	ADCB2 interrupt	14	6
INT10.7	110	0x0000 0DDC	2	ADCB3 interrupt	14	7
INT10.8	111	0x0000 0DDE	2	ADCB4 interrupt	14	8
INT10.9	200	0x0000 0E90	2	ADCC_EVT interrupt	14	9
INT10.10	201	0x0000 0E92	2	ADCC2 interrupt	14	10
INT10.11	202	0x0000 0E94	2	ADCC3 interrupt	14	11
INT10.12	203	0x0000 0E96	2	ADCC4 interrupt	14	12
INT10.13	204	0x0000 0E98	2	ADCD_EVT interrupt	14	13
INT10.14	205	0x0000 0E9A	2	ADCD2 interrupt	14	14
INT10.15	206	0x0000 0E9C	2	ADCD3 interrupt	14	15
INT10.16	207	0x0000 0E9E	2	ADCD4 interrupt	14	16 (Lowest)
<b>PIE Group 11 Vectors - Muxed into CPU INT11</b>						
INT11.1	112	0x0000 0DE0	2	CLA1_1 interrupt	15	1 (Highest)
INT11.2	113	0x0000 0DE2	2	CLA1_2 interrupt	15	2
INT11.3	114	0x0000 0DE4	2	CLA1_3 interrupt	15	3
INT11.4	115	0x0000 0DE6	2	CLA1_4 interrupt	15	4
INT11.5	116	0x0000 0DE8	2	CLA1_5 interrupt	15	5
INT11.6	117	0x0000 0DEA	2	CLA1_6 interrupt	15	6
INT11.7	118	0x0000 0DEC	2	CLA1_7 interrupt	15	7
INT11.8	119	0x0000 0DEE	2	CLA1_8 interrupt	15	8
INT11.9	208	0x0000 0EA0	2	Reserved	15	9
INT11.10	209	0x0000 0EA2	2	Reserved	15	10
INT11.11	210	0x0000 0EA4	2	Reserved	15	11
INT11.12	211	0x0000 0EA6	2	Reserved	15	12
INT11.13	212	0x0000 0EA8	2	Reserved	15	13
INT11.14	213	0x0000 0EAA	2	Reserved	15	14
INT11.15	214	0x0000 0EAC	2	Reserved	15	15
INT11.16	215	0x0000 0EAE	2	Reserved	15	16 (Lowest)
<b>PIE Group 12 Vectors - Muxed into CPU INT12</b>						
INT12.1	120	0x0000 0DF0	2	XINT3 interrupt	16	1 (Highest)
INT12.2	121	0x0000 0DF2	2	XINT4 interrupt	16	2
INT12.3	122	0x0000 0DF4	2	XINT5 interrupt	16	3
INT12.4	123	0x0000 0DF6	2	Reserved	16	4
INT12.5	124	0x0000 0DF8	2	Reserved	16	5
INT12.6	125	0x0000 0DFA	2	VCU interrupt	16	6
INT12.7	126	0x0000 0DFC	2	FPU_OVERFLOW interrupt	16	7
INT12.8	127	0x0000 0DFE	2	FPU_UNDERFLOW interrupt	16	8
INT12.9	216	0x0000 0EB0	2	EMIF_ERROR interrupt	16	9

**Table 2-4. PIE Interrupt Vectors (continued)**

Name	Vector ID	Address	Size (x16)	Description	Core priority	ePIE group Priority
INT12.10	217	0x0000 0EB2	2	RAM_CORRECTABLE_ERROR interrupt	16	10
INT12.11	218	0x0000 0EB4	2	FLASH_CORRECTABLE_ERROR interrupt	16	11
INT12.12	219	0x0000 0EB6	2	RAM_ACCESS_VIOLATION interrupt	16	12
INT12.13	220	0x0000 0EB8	2	SYS_PLL_SLIP interrupt	16	13
INT12.14	221	0x0000 0EBA	2	AUX_PLL_SLIP interrupt	16	14
INT12.15	222	0x0000 0EBC	2	CLA_OVERFLOW interrupt	16	15
INT12.16	223	0x0000 0EBE	2	CLA_UNDERFLOW interrupt	16	16 (Lowest)

## 2.5 Exceptions and Non-Maskable Interrupts

This section describes system-level error conditions that can trigger a non-maskable interrupt (NMI). The interrupt allows the application to respond to the error.

### 2.5.1 Configuring and Using NMIs

An incoming NMI sets a status bit in the NMIFLG register and starts the NMI watchdog counter. This counter is clocked by the SYSCLK, and if it reaches the value in the NMIWDPRD register, it triggers an NMI watchdog reset (NMIWDRS). To prevent this, the NMI handler must clear the flag bit using the NMIFLGCLR register. Once all flag bits are clear, the NMIINT bit in the NMIFLG register may also be cleared to allow future NMIs to be taken.

The NMI module is enabled by the boot ROM during the startup process. To respond to NMIs, an NMI handler vector must be written to the PIE vector table.

### 2.5.2 Emulation Considerations

The NMI watchdog counter behaves as follows under debug conditions:

CPU Suspended	When the CPU is suspended, the NMI watchdog counter will be suspended.
Run-Free Mode	When the CPU is placed in run-free mode, the NMI watchdog counter will resume operation as normal.
Real-Time Single-Step Mode	When the CPU is in real-time single-step mode, the NMI watchdog counter will be suspended. The counter remains suspended even within real-time interrupts.
Real-Time Run-Free Mode	When the CPU is in real-time run-free mode, the NMI watchdog counter operates as normal.

### 2.5.3 NMI Sources

There are several types of hardware errors that can trigger an NMI. Additional information about the error is usually available from the module that detects it.

#### 2.5.3.1 Missing Clock Detection

The missing clock detection logic monitors OSCCLK for failure. If the OSCCLK source stops, the PLL is bypassed, OSCCLK is connected to INTOSC1, and an NMI is fired to the CPU. For more information on missing clock detection, see [Section 2.6.2](#).

#### 2.5.3.2 RAM Uncorrectable ECC Error

A single-bit parity error, double-bit ECC data error, or single-bit ECC address error in a RAM read will trigger an NMI. This applies to CPU, CLA, and DMA reads. Single-bit ECC data errors do not trigger an NMI, but can optionally trigger a normal peripheral interrupt. For more information on RAM error detection, see [Section 2.11.1.7](#).

#### 2.5.3.3 Flash Uncorrectable ECC Error

A double-bit ECC data error or single-bit ECC address error in a flash read will trigger an NMI. Single-bit ECC data errors do not trigger an NMI, but can optionally trigger a normal peripheral interrupt. For more information on flash error detection, see [Section 2.12.10](#).

### 2.5.4 Illegal Instruction Trap (ITRAP)

If the CPU tries to execute an illegal instruction, it generates a special interrupt called an illegal instruction trap (ITRAP). This interrupt is non-maskable and has its own vector in the PIE vector table. For more information about ITRAPs, see the Illegal-Instruction Trap section of the *TMS320C28x DSP CPU and Instruction Set Reference Guide (SPRU430)*.

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**NOTE:** A RAM fetch access violation will trigger an ITRAP in addition to the normal peripheral interrupt for RAM access violations. The CPU will handle the ITRAP first.

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## 2.6 Safety Features

This section gives details on features that monitor device operation during run-time to detect any error in operation.

### 2.6.1 Write Protection on Registers

#### 2.6.1.1 LOCK Protection on System Configuration Registers

Several system configuration registers are protected from spurious CPU writes by “LOCK” registers. Once these associated LOCK register bits are set the respective locked registers can no longer be modified by software. See specific register descriptions for details.

#### 2.6.1.2 EALLOW Protection

Several control registers are protected from spurious CPU writes by the EALLOW protection mechanism. The EALLOW bit in status register 1 (ST1) indicates the state of protection as shown in [Table 2-5](#).

**Table 2-5. Access to EALLOW-Protected Registers**

EALLOW Bit	CPU Writes	CPU Reads	JTAG Writes	JTAG Reads
0	Ignored	Allowed	Allowed <sup>(1)</sup>	Allowed
1	Allowed	Allowed	Allowed	Allowed

<sup>(1)</sup> The EALLOW bit is overridden via the JTAG port, allowing full access of protected registers during debug from the Code Composer Studio interface.

At reset, the EALLOW bit is cleared, enabling EALLOW protection. While protected, all writes to protected registers by the CPU are ignored and only CPU reads, JTAG reads, and JTAG writes are allowed. If this bit is set, by executing the EALLOW instruction, the CPU is allowed to write freely to protected registers. After modifying registers, they can once again be protected by executing the EDIS instruction to clear the EALLOW bit.

## 2.6.2 Missing Clock Detection Logic

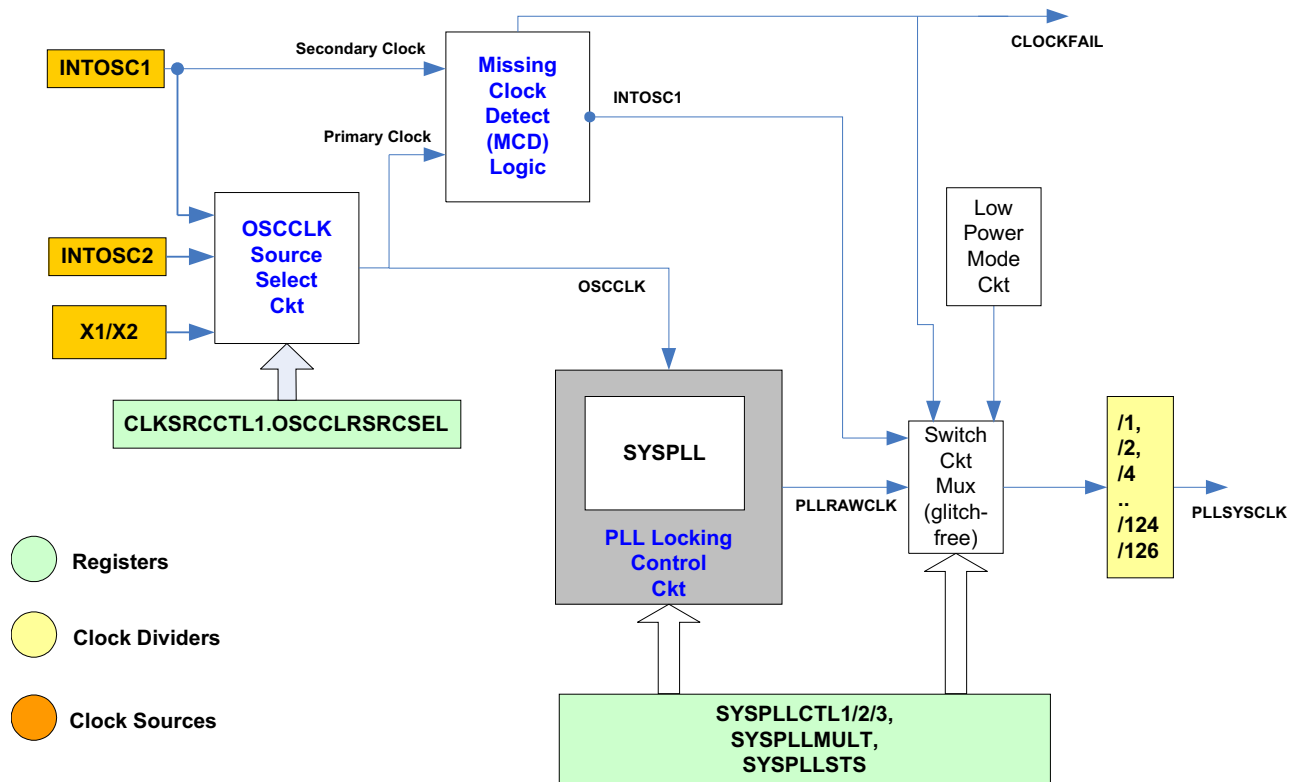
The missing clock detect (MCD) logic detects OSCCLK failure, using INTOSC1 as the reference clock source. This circuit only detects complete loss of OSCCLK and doesn't do any detection of frequency drift on the OSCCLK.

This circuit monitors the OSCCLK (primary clock) using the 10 MHz clock provided by the INTOSC1 (secondary clock) as a backup clock. This circuit functions as below:

1. The primary clock (OSCCLK) clock keeps ticking a 7-bit counter (named as MCDPCNT). This counter is asynchronously reset with  $\overline{XRS}$ .
2. The secondary clock (INTOSC1) clock keeps ticking a 13-bit counter (named as MCDSCNT). This counter is asynchronously reset with  $\overline{XRS}$ .
3. Each time MCDPCNT overflows, the MCDSCNT counter is reset. Thus, if OSCCLK is present or not slower than INTOSC1 by a factor of 64, MCDSCNT will never overflow.
4. If OSCCLK stops for some reason, or is slower than INTOSC1 by at least a factor of 64, the MCDSCNT will overflow and a missing clock condition will be detected on OSCCLK.
5. The above check is continuously active, unless the MCD is disabled using MCDPCR register (by making the MCLKOFF bit 1)
6. If the circuit ever detects a missing OSCCLK, the following occurs:
  - The MCDSTS flag is set
  - The MCDSCNT counter is frozen to prevent further missing clock detection
  - The CLOCKFAIL signal goes high, which generates TRIP events to PWM modules and fires NMIs to CPU1.NMIWD.
  - PLL is forcefully bypassed and OSCCLK is switched to INTOSC1 (after the PLLSYSCLK divider). PLLMULT is zeroed out automatically in this case.
  - While the MCDSTS bit is set, the OSCCLKSRCSEL bits have no effect and OSCCLK is forcefully connected to INTOSC1.
  - PLLRAWCLK going to the system is switched to INTOSC1 automatically
7. If the MCLKCLR bit is written (this is a W=1 bit), MCDSTS bit will be cleared and OSCCLK source will be decided by the OSCCLKSRCSEL bits. Writing to MCLKCLR will also clear the MCDPCNT and MCDSCNT counters to allow the circuit re-evaluate missing clock detection. If user wants to lock the PLL after missing clock detection, he needs to first switch the clock source to INTOSC1 (using OSCCLKSRCSEL register), do a MCLKCLR and re-lock the PLL.
8. The MCD is enabled at power up. There is no support for missing clock detection if INTOSC2 is failed from the device power-up.

Figure 2-3 shows the missing clock logic functional flow.



**Figure 2-3. Missing Clock Detection Logic**


### 2.6.3 PLLSLIP Detection

The PLL SLIP detection on this device can detect if the PLL reference clock goes too high or too slow while PLL is locked. An interrupt to both the CPUs is triggered as shown in the ePIE table in [Section 2.4](#). Apart from the interrupt to both the CPUs, the PLLSTS.SLIP bit is set for user software to check the error.

The SLIP detection is available on both SYSPLL and AUXPLL.

### 2.6.4 CPU1 Vector Address Validity Check

The ePIE vector table is duplicated into two parts:

- Main ePIE Vector Table mapped from 0xD00 to 0xEFF in the C28x memory space
- Redundant ePIE Vector Table mapped from 0x1000D00 to 0x1000EFF in the C28x memory space

Following is the behavior of accesses to the ePIE memories:

- Data Writes to Main Vector Table: Writes to both memories
- Data Writes to Redundant Vector Table: Writes only to the Redundant Vector Table
- Vector Fetch: Data from both the vector tables are compared
- Data Read: Can read the Main and Redundant vector table separately

On every vector fetch from the ePIE, a hardware comparison (no cycle penalty is incurred to do the comparison) of both the vector table outputs is performed and if there is a mismatch between the two vector table outputs, the following occurs:

1. If the PIEVERRADDR register (default value 0x3F FFFF) is not initialized, the default error handler at address 0x3FFFBE gets executed.  
But, when the PIEVERRADDR register is initialized to the address of the user-defined routine, the user-defined routine is executed instead of the default error handler.
2. Hardware also generates EPWM Trip signals which will trip the PWM outputs using TRIPIN15.
3. If there is no mismatch, the correct vector is jammed onto the C28 program control.

### 2.6.5 NMIWDs

CPU1 has a user-programmable NMIWD period register in which users can set a limit on how much time they want to allocate for the device to acknowledge the NMI. If the NMI is not acknowledged, it will cause a device reset.

### 2.6.6 ECC and Parity Enabled RAMs, Shared RAMs Protection

The CPU subsystem has different RAM blocks. Few RAM blocks are ECC-enabled and others are parity-enabled. All single-bit errors in ECC RAM are auto-corrected and an error counter is incremented every time a single bit error is detected. If the error counter reaches a predefined user configured limit, an interrupt is generated to the corresponding CPU. Refer to [Section 2.11](#) for more details on RAM errors.

All uncorrectable double-bit errors end up triggering an NMI to corresponding CPUs.

### 2.6.7 ECC Enabled Flash Memory

When ECC is programmed and enabled, flash single-bit errors are corrected automatically by ECC logic before giving data to CPU1, but they are not corrected in flash memory. Flash memory will still contain wrong data until another erase/program operation happens to correct the flash contents. Irrespective of whether the error interrupt is enabled or disabled, single-bit errors are always corrected before giving data to CPU1. When the interrupt is disabled, users can check the single-bit error counter register for any single-bit error occurrences. The error counter stops incrementing once its value is equal to the threshold+1. It is always suggested to set the threshold register to a non-zero value so that the error counter can increment. It is up to the user to decide the threshold value at which they have to reprogram the flash with the correct data.

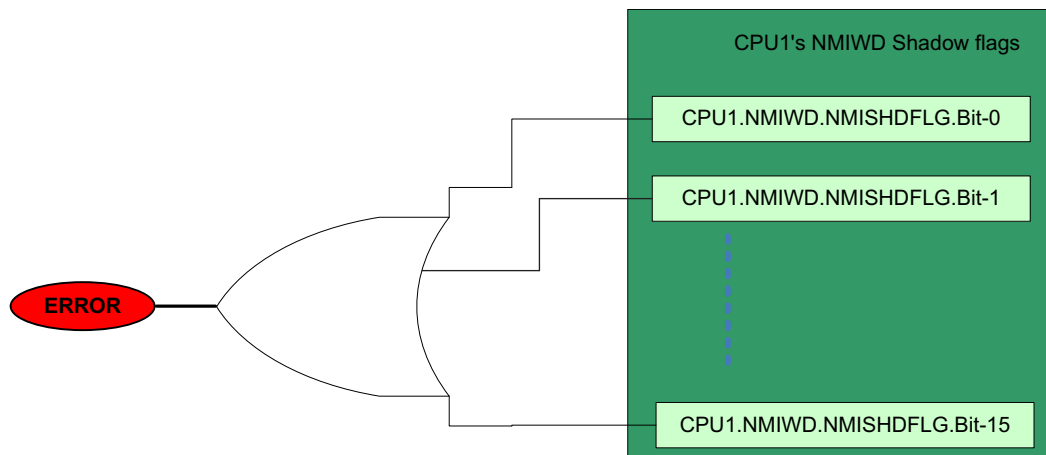
When ECC is programmed and enabled, flash uncorrectable errors end up triggering an NMI to CPU1. Please refer to [Section 2.11](#) for more details on flash error correction and error catching mechanisms.

### 2.6.8 ERRORSTS Pin

The ERRORSTS pin is an ‘always output’ pin and remains low until an error is detected inside the chip. On an error, the ERRORSTS pin goes high until the corresponding internal error status flag for that error source is cleared. [Figure 2-4](#) shows the functionality of the ERRORSTS pin.

The ERRORSTS pin will be tri-stated until the chip power rails ramp up to the lower operational limit. As the ERRORSTS pin is an active-high pin, users who care about the state of this pin during power-up should connect an external pull-down on this pin.

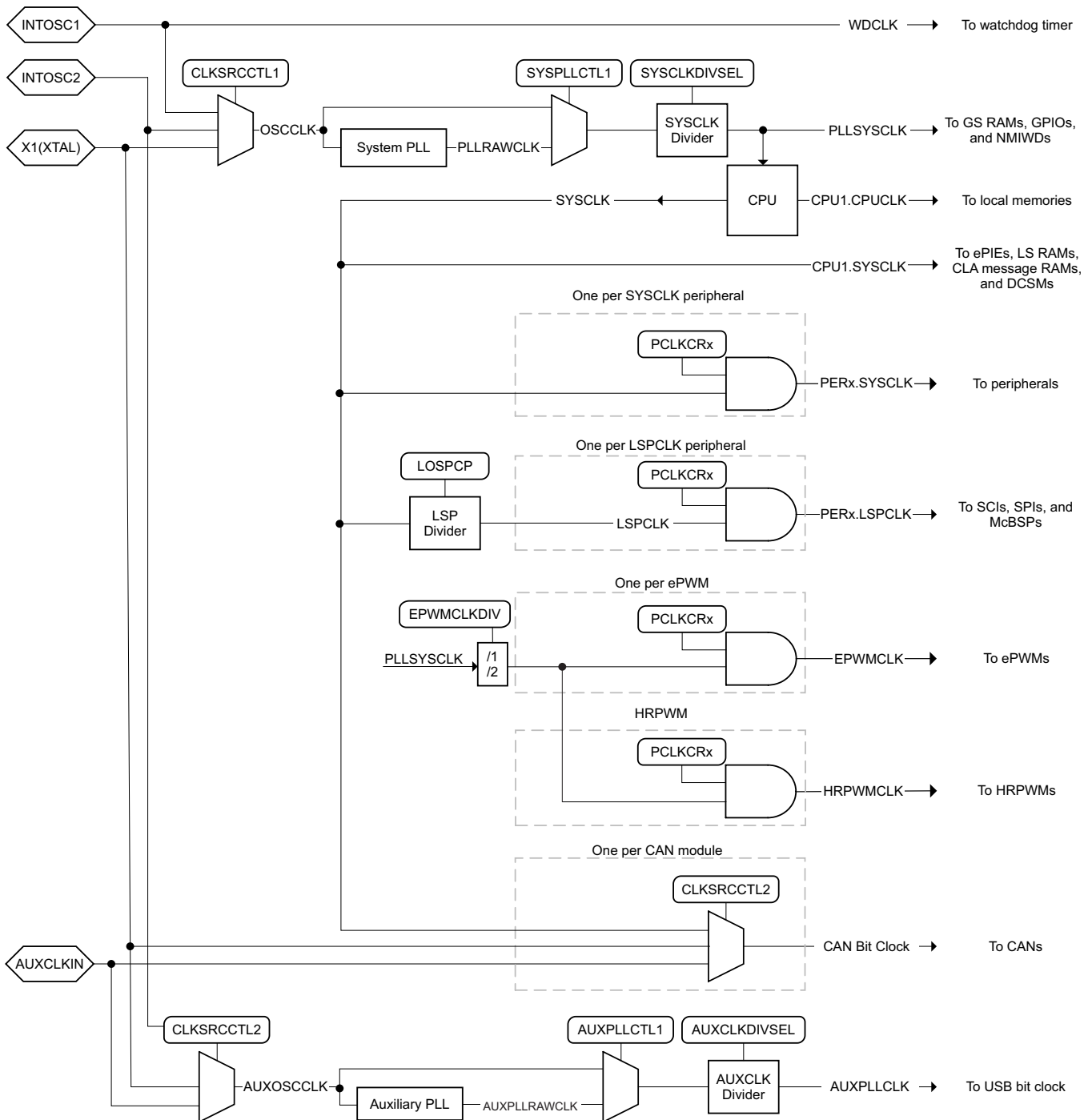
Figure 2-4. ERRORSTS Pin Diagram



## 2.7 Clocking

This section explains the clock sources and clock domains on this device, and how to configure them for application use. [Figure 2-5](#) provides an overview of the device's clocking system.

Figure 2-5. Clocking System



Note: The default/2 divider for ePWMs and EMIFs is not shown.

### 2.7.1 Clock Sources

All of the clocks in the device are derived from one of four clock sources.

### 2.7.1.1 Primary Internal Oscillator (INTOSC2)

At power-up, the device is clocked from an on-chip 10 MHz oscillator (INTOSC2). INTOSC2 is the primary internal clock source, and is the default system clock at reset. It is used to run the boot ROM and can be used as the system clock source for the application. Note that INTOSC2's frequency tolerance is too loose to meet the timing requirements for CAN and USB, so an external clock must be used to support those features.

### 2.7.1.2 Backup Internal Oscillator (INTOSC1)

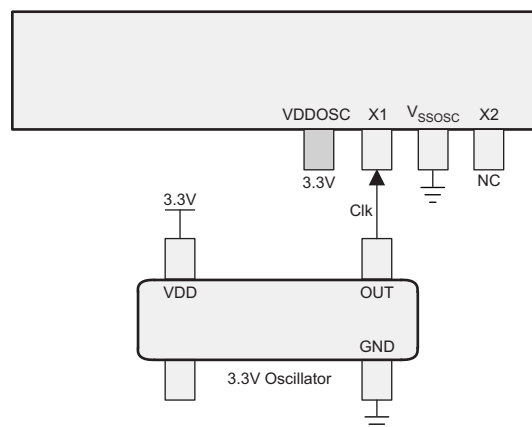
The device also includes a redundant on-chip 10 MHz oscillator (INTOSC1). INTOSC1 is a backup clock source that normally only clocks the watchdog timers and missing clock detection circuit (MCD). If MCD is enabled and a missing system clock is detected, the system PLL is bypassed and all system clocks are connected to INTOSC1 automatically. INTOSC1 may also be manually selected as the system and auxiliary clock source for debug purposes.

### 2.7.1.3 External Oscillator (XTAL)

The dedicated X1 and X2 pins support an external clock source (XTAL), which can be used as the main system and auxiliary clock source. Frequency limits and timing requirements can be found in the device datasheet. Three types of external clock sources are supported:

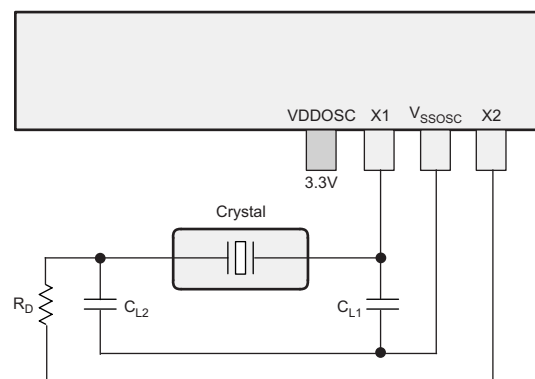
- A single-ended 3.3V external clock. The clock signal should be connected to X1 while X2 is left unconnected, as shown in [Figure 2-6](#).

**Figure 2-6. Single-ended 3.3V External Clock**



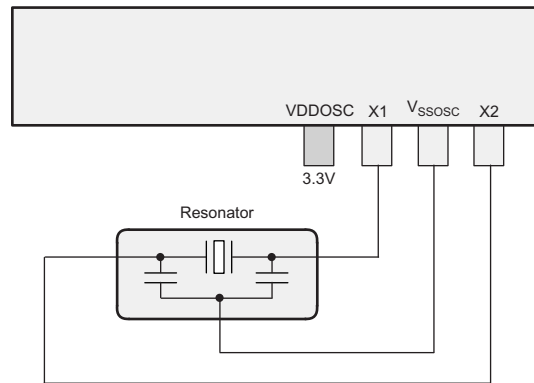
- An external crystal. The crystal should be connected across X1 and X2 with its load capacitors connected to VSSOSC as shown in [Figure 2-7](#).

**Figure 2-7. External Crystal**



- An external resonator. The resonator should be connected across X1 and X2 with its ground connected to VSSOSC as shown in [Figure 2-8](#).

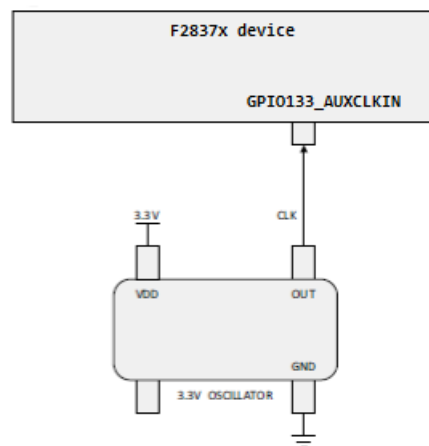
**Figure 2-8. External Resonator**



**2.7.1.4 Auxiliary Clock Input (AUXCLKIN)**

An additional external clock source is supported on GPIO133 (AUXCLKIN). This must be a single-ended 3.3V external clock. It can be used as the source for the USB and CAN bit clocks. Frequency limits and timing requirements can be found in the device datasheet. The external clock should be connected directly to the GPIO133 pin, as shown in [Figure 2-9](#).

**Figure 2-9. AUXCLKIN**



**2.7.2 Derived Clocks**

The clock sources discussed in the previous section can be multiplied (via PLL) and divided down to produce the desired clock frequencies for the application. This process produces a set of derived clocks, which are described in this section.

**2.7.2.1 Oscillator Clock (OSCCLK)**

One of INTOSC2, XTAL, or INTOSC1 must be chosen to be the master reference clock (OSCCLK) for the CPU and most of the peripherals. OSCCLK may be used directly or fed through the system PLL to reach a higher frequency. At reset, OSCCLK is the default system clock, and is connected to INTOSC2.

**2.7.2.2 System PLL Output Clock (PLLRAWCLK)**

The system PLL allows the device to run at its maximum rated operating frequency, and in most applications will generate the main system clock. This PLL uses OSCCLK as a reference, and features a fractional multiplier and slip detection. For configuration instructions, see [Section 2.7.6](#).

### 2.7.2.3 Auxiliary Oscillator Clock (AUXOSCCLK)

One of INTOSC2, XTAL, or AUXCLKIN may be chosen to be the auxiliary reference clock (AUXOSCCLK) for the USB module. (This selection does not affect the CAN bit clock, which uses AUXCLKIN directly). AUXOSCCLK may be used directly or fed through the auxiliary PLL to reach a higher frequency. At reset, AUXOSCCLK is connected to INTOSC2, but only an external oscillator can meet the USB timing requirements.

### 2.7.2.4 Auxiliary PLL Output Clock (AUXPLLRAWCLK)

The auxiliary PLL is used to generate a 60 MHz clock for the USB module. This PLL uses AUXOSCCLK as a reference, and features a fractional multiplier and slip detection. For configuration instructions, see [Section 2.7.6](#).

## 2.7.3 Device Clock Domains

The device clock domains feed the clock inputs of the various modules in the device. They are connected to the derived clocks, either directly or through an additional divider.

### 2.7.3.1 System Clock (PLLSYSCLK)

The system control registers, GS RAMs, GPIO qualification, and NMI watchdog timer have their own clock domain (PLLSYSCLK). Despite the name, PLLSYSCLK may be connected to the system PLL (PLLRAWCLK) or to OSCCLK. The chosen clock source is run through a frequency divider, which is configured via the SYSCLKDIVSEL register. PLLSYSCLK is gated in HALT mode.

### 2.7.3.2 CPU Clock (CPUCLK)

The CPU has its own clock (CPUCLK) which is used to clock the CPU, its coprocessors, its private RAMs (M0, M1, D0, and D1), and its boot ROM and flash wrapper. This clock is identical to PLLSYSCLK, but is gated when the CPU enters IDLE, STANDBY, or HALT mode.

### 2.7.3.3 CPU Subsystem Clock (SYSCLK and PERx.SYSCLK)

The CPU provides a clock (SYSCLK) to the CLA, DMA, and most peripherals. This clock is identical to PLLSYSCLK, but is gated when the CPU enters STANDBY or HALT mode.

Each peripheral clock has its own independent clock gating which is controlled by the PCLKCRx registers. By default, the ePWM, EMIF1, and EMIF2 clocks each have an additional /2 divider, which is required to support CPU frequencies over 100 MHz. At slower CPU frequencies, these dividers can be disabled via the PERCLKDIVSEL register.

### 2.7.3.4 Low-Speed Peripheral Clock (LSPCLK and PERx.LSPCLK)

The SCI, SPI, and McBSP modules can communicate at bit rates that are much slower than the CPU frequency. These modules are connected to a shared clock divider, which generates a low-speed peripheral clock (LSPCLK) derived from SYSCLK. LSPCLK uses a /4 divider by default, but the ratio can be changed via the LOSPCP register. Each SCI, SPI, and McBSP module's clock (PERx.LSPCLK) can be gated independently via the PCLKCRx registers.

### 2.7.3.5 USB Auxiliary Clock (AUXPLLCLK)

The USB module requires a fixed 60 MHz clock for bit sampling. Since the main system clock is usually not a multiple of 60 MHz, the correct frequency cannot be achieved with a simple divider. Instead, the USB clock is provided through an auxiliary clock path (AUXPLLCLK), which can use an independent clock source and PLL to generate the correct frequency.

USB clock tolerances are very tight. As stated in section 7.1.11 of the USB 2.0 specification, low-speed devices (1.50 Mb/s) have a tolerance of +/- 1.5%, while high-speed devices (12.000 Mb/s) have a tolerance of +/- 0.25%. Typically these tolerances are achieved by using an external crystal or resonator as the source for AUXOSCCLK.

### 2.7.3.6 CAN Bit Clock

The required frequency tolerance for the CAN bit clock depends on the bit timing setup and network configuration, and can be as tight as 0.1%. Since the main system clock (in the form of PERx.SYSCLK) may not be precise enough, the bit clock can also be connected to XTAL or AUXCLKIN via the CLKSRCCTL2 register. There is an independent selection for each CAN module.

### 2.7.3.7 CPU Timer2 Clock (TIMER2CLK)

CPU timers 0 and 1 are connected to PERx.SYSCLK. Timer 2 is connected to PERx.SYSCLK by default, but may also be connected to INTOSC1, INTOSC2, XTAL, or AUXPLLCLK via the TMR2CLKCTL register. This register also provides a separate prescale divider for timer 2. If a source other than SYSCLK is used, the SYSCLK frequency must be at least twice the source frequency to ensure correct sampling.

The main reason to use a non-SYSCLK source would be for internal frequency measurement. In most applications, timer 2 will run off of the SYSCLK.

### 2.7.4 XCLKOUT

It is sometimes necessary to observe a clock directly for debug and testing purposes. The external clock output (XCLKOUT) feature supports this by connecting a clock to an external pin, GPIO73. The available clock sources are PLLSYSCLK, PLLRAWCLK, SYSCLK, AUXPLLRAWCLK, INTOSC1, and INTOSC2.

To use XCLKOUT, first select the clock source via the CLKSRCCTL3 register. Next, select the desired output divider via the XCLKOUTDIVSEL register. Finally, connect GPIO73 to mux channel 3 using the GPIO configuration registers.



## 2.7.5 Clock Connectivity

The tables below provide details on the clock connections of every module present in the device.

**Table 2-6. Clock Connections Sorted by Clock Domain**

Clock Domain	Module Name
CPUCLK	CPU VCU FPU TMU Flash M0 - M1 RAMs D0 - D1 RAMs BootROM
SYSCLK	ePIE LS0 - LS5 RAMs CLA1 Message RAMs DCSM
PLLSYSCLK	NMIWD GS0 - GS15 RAMs GPIO Input Sync and Qual EMIF1
PERx.SYSCLK	CLA1 DMA Timer0 - 2 EMIF2 ADCA - D CMPSS1 - 8 DACA - C ePWM1 - 12 eCAP1 - 6 eQEP1 - 3 I2CA - B McBSPA - B SDFM1 - 8 uPP A
PERx.LSPCLK	McBSPA - B SCIA - D SPIA - C
CAN Bit Clock	CANA - B
AUXPLLCLK	USB
WDCLK (INTOSC1)	Watchdog Timer

**Table 2-7. Clock Connections Sorted by Module Name**

Module Name	Clock Domain
ADCA - D	PERx.SYSCLK
Boot ROM	CPUCLK
CANA - B	CAN Bit Clock
CLA	PERx.SYSCLK
CLA Message RAMs	SYSCLK
CMPSS1 - 8	PERx.SYSCLK
CPU	CPUCLK
CPU Timers	PERx.SYSCLK
D0 - D1 RAMs	CPUCLK
DACA - C	PERx.SYSCLK
DCSM	SYSCLK
DMA	PERx.SYSCLK
eCAP1 - 6	PERx.SYSCLK
EMIF1	PLLSYSCLK
EMIF2	PERx.SYSCLK
ePIE	SYSCLK
ePWM	PERx.SYSCLK
eQEP1 - 3	PERx.SYSCLK
Flash	CPUCLK
FPU	CPUCLK
GS0 - GS15 RAMs	PLLSYSCLK
I2CA - B	PERx.SYSCLK
LS0 - LS5 RAMs	SYSCLK
M0 - M1 RAMs	CPUCLK
McBSPA - B	PERx.LSPCLK
NMIWD	PLLSYSCLK
SCIA - D	PERx.LSPCLK
SDFM1 - 8	PERx.SYSCLK
SPIA - C	PERx.LSPCLK
TMU	CPUCLK
uPP	PERx.SYSCLK
USB	AUXPLLCLK
VCU	CPUCLK
Watchdog Timer	WDCLK (INTOSC1)

### 2.7.6 Clock Source and PLL Setup

The needs of the application are what ultimately determine the clock configuration. Specific concerns such as application performance, power consumption, total system cost, and EMC are beyond the scope of this document, but they should provide answers to the following questions:

1. What is the desired CPU frequency?
2. Is CAN required?
3. Is USB required?
4. What types of external oscillators or clock sources are available?

If CAN or USB is required, an external clock source with a precise frequency must be used as a reference clock. Otherwise, it may be possible to use only INTOSC2 and avoid the need for more external components.

### 2.7.6.1 Choosing PLL Settings

There are two settings to configure for each PLL – a multiplier and a divider. They obey the formulas:

$$f_{\text{PLLSYSCLK}} = f_{\text{OSCCLK}} * (\text{SYSPLLMULT.IMULT} + \text{SYSPLLMULT.FMULT}) / \text{SYSCLKDIVSEL.PLLSYSCLKDIV}$$

$$f_{\text{AUXPLLCLK}} = f_{\text{AUXOSCCLK}} * (\text{AUXPLLMULT.IMULT} + \text{AUXPLLMULT.FMULT}) / \text{AUXCLKDIVSEL.AUXPLLDIV}$$

where  $f_{\text{OSCCLK}}$  is the system oscillator clock frequency,  $f_{\text{AUXOSCCLK}}$  is the auxiliary oscillator clock frequency, IMULT and FMULT are the integral and fractional parts of the multipliers, PLLSYSCLKDIV is the system clock divider, and AUXPLLDIV is the auxiliary clock divider. For the permissible values of the multipliers and dividers, see the documentation for their respective registers.

Many combinations of multiplier and divider can produce the same output frequency. However, the product of the reference clock frequency and the multiplier (known as the VCO frequency) must be in the range specified in the data manual.

---

**NOTE:** The system clock frequency (PLLSYSCLK) may not exceed the limit specified in the datasheet. This limit does not allow for oscillator tolerance.

---

### 2.7.6.2 System Clock Setup

Once the application requirements are understood, a specific clock configuration can be determined. The default configuration is for INTOSC2 to be used as the system clock (PLLSYSCLK) with a divider of 1. The following procedure should be used to set up the desired application configuration:

1. Select the reference clock source (OSCCLK) by writing to CLKSRCCTL1.OSCCLKSRCSEL.
2. Set up the system PLL: (see the InitSysPll() function in your device's controlSUITE installation for an example):
  - a. Bypass the PLL by clearing SYSPLLCTL1[PLLCLKEN].
  - b. Set the system clock divider to /1 to ensure the fastest PLL configuration by clearing SYSCLKDIVSEL[PLLSYSCLKDIV].
  - c. Set the integral and fractional multipliers by simultaneously writing them both to SYSPLLMULT. This will automatically enable the PLL. Be sure that the product of OSCCLK and the multiplier is in the range specified in the data manual.
  - d. Lock the PLL five times (see your device errata for details). This number can be increased depending on application requirements. A higher number of lock attempts helps to ensure a successful PLL start.
  - e. Set the system clock divider one setting higher than the final desired value. For example ClkCfgRegs.SYSCLKDIVSEL.bit.PLLSYSCLKDIV = divsel + 1. This limits the current increase when switching to the PLL.
  - f. Set up the watchdog to reset the device. Note that the SCRS[WDOVERRIDE] bit should not be cleared prior to locking the PLL.
  - g. Set the SYSDBGCTL[BIT\_0] bit. This bit is only reset by a POR reset. If the watchdog has to reset the device due to an issue with switching to the PLL, this bit can be checked in the reset handler to determine the reset was caused by a PLL error.
  - h. Switch to the PLL as the system clock by setting SYSPLLCTL1[PLLCLKEN].
  - i. Clear the SYSDBGCTL[BIT\_0] bit.
  - j. Change the divider to the appropriate value.
  - k. Reconfigure the watchdog as needed for the application.

### 2.7.6.3 USB Auxiliary Clock Setup

See the InitAuxPll() function in your device's controlSUITE installation for an example.

If USB functionality is needed, the auxiliary clock (AUXPLLCLK) must be configured to produce 60 MHz. The procedure is similar to the system clock setup:

1. Select the reference clock source (AUXOSCCLK) by writing to CLKSRCCTL2.AUXOSCCLKSRCSEL.

2. Wait two AUXOSCCLK cycles.
3. Set up the auxiliary PLL. If the PLL is not needed, bypass it and power it down by writing a 0 to AUXPLLCTL1.PLEN. To use the PLL:
  - a. Set the desired auxiliary clock divider by writing to AUXCLKDIVSEL.AUXPLLDIV.
  - b. ) Configure CPU Timer 2 to be clocked from AUXPLL. Keep the counter frozen.
  - c. ) Power down the AUXPLL by clearing AUXPLLCTL1[PLEN].
  - d. Set the integral and fractional multipliers simultaneously. This will automatically enable the PLL. Be sure that the product of AUXOSCCLK and the multiplier is in the range specified in the data manual..
  - e. Wait for the PLL to lock by polling the AUXPLLSTS.LOCKS bit. This will take 16  $\mu$ s plus 1024 AUXOSCCLK cycles.
  - f. Connect the auxiliary PLL output clock (AUXPLLRAWCLK) to AUXPLLCLK by writing a 1 to AUXPLLCTL1.PLLCLKEN.
  - g. Start CPU Timer 2. In a large for() loop, continue polling the TCR[TIF] overflow flag. If it sets, the AUXPLL started correctly. If not, repeat steps (c) through (g). The auxiliary clock configuration can be changed at run time. Changing the AUXOSCCLK source will automatically bypass the PLL and set the multiplier to zero. Changing the multiplier from one non-zero value to another will temporarily bypass the PLL until it re-locks.

The auxiliary clock configuration can be changed at run time. Changing the AUXOSCCLK source will automatically bypass the PLL and set the multiplier to zero. Changing the multiplier from one non-zero value to another will temporarily bypass the PLL until it re-locks.

---

**NOTE:** If the AUXOSCCLK source is changed on the same AUXOSCCLK cycle as the multiplier, the PLL will be disabled but the AUXPLLMULT register will show the written value. This can happen when the system PLL is enabled before configuring the auxiliary PLL (CPUCLK >> AUXOSCCLK). To avoid this issue, wait two AUXOSCCLK cycles between changing the clock source and writing to AUXPLLMULT.

---

#### 2.7.6.4 Clock Configuration Examples

**Example 1:** Using a crystal (15 MHz) as a reference, generate a CPU frequency of 100 MHz and a USB clock of 60 MHz:

```

CLKSRCCTL1.OSCCLKSRCSEL = 0x1
SYSPLLMULT.IMULT = 26 (0x1A)
SYSPLLMULT.FMULT = .50 (0x2)
SYSCLKDIVSEL.PLLSYSCLKDIV = 4 (0x2)
SYSPLLCTL1.PLLCLKEN = 1

PERCLKDIVSEL.EPWMCLKDIV = 1 (0x0)
PERCLKDIVSEL.EMIF1CLKDIV = 1 (0x0)
PERCLKDIVSEL.EMIF2CLKDIV = 1 (0x0)

CLKSRCCTL2.AUXOSCCLKSRCSEL = 0x1
AUXPLLMULT.IMULT = 8 (0x08)
AUXPLLMULT.FMULT = .00 (0x0)
AUXCLKDIVSEL.AUXPLLDIV = 2 (0x1)
AUXPLLCTL1.PLLCLKEN = 1
    
```

This gives a PLLRAWCLK of 397.5 MHz and an AUXPLLRAWCLK of 120 MHz, both of which are in the acceptable range. The CPU frequency is 99.375 MHz. Crystals have tight frequency tolerances, which should keep the system clock from exceeding 100 MHz. The USB frequency is exactly 60 MHz. Since the CPU frequency is less than 100 MHz, the ePWM and EMIF clock dividers can be set to /1.

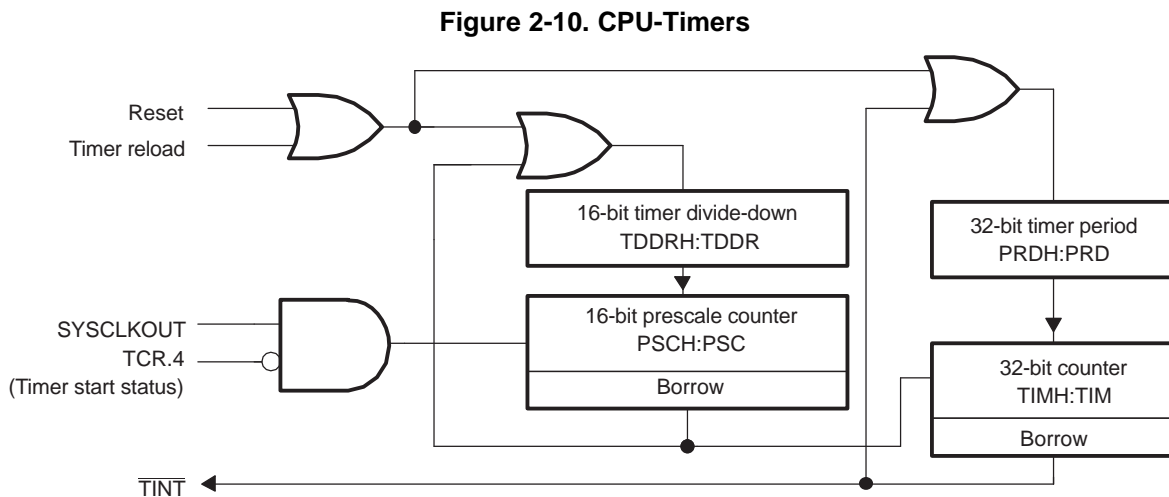
**Example 2:** Using INTOSC2 (10 MHz) as a reference, generate a CPU frequency of 200 MHz - 3%:

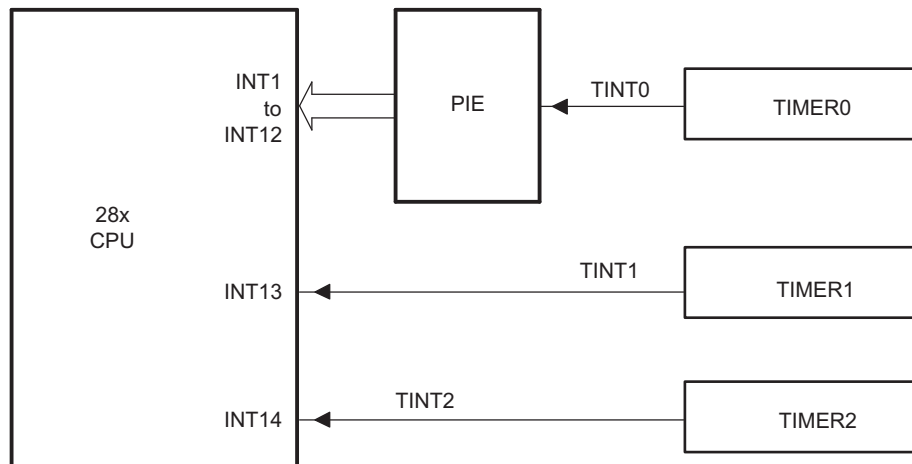
```
CLKSRCCTL1.OSCCLKSRCSEL = 0x0
SYSPLLMULT.IMULT = 38 (0x26)
SYSPLLMULT.FMULT = .75 (0x3)
SYSCLKDIVSEL.PLLSYSCLKDIV = 2 (0x1)
SYSPLLCTL1.PLLCLKEN = 1
```

## 2.8 32-Bit CPU Timers 0/1/2

This section describes the three 32-bit CPU-Timers (TIMER0/1/2) shown in [Figure 2-10](#).

CPU-Timer0 and CPU-Timer1 can be used in user applications. CPU-Timer2 is reserved for real-time operating system uses (for example, TI-RTOS). If the application is not using an operating system that utilizes this timer, then CPU-Timer2 can be used in the application. CPU-Timer0 and CPU-Timer1 run off of SYSCLK. CPU-Timer2 normally runs off of SYSCLK, but can also use INTOSC1, INTOSC2, XTAL, and AUXPLLCLK. The CPU-Timer interrupt signals (TINT0, TINT1, TINT2) are connected as shown in [Figure 2-11](#).



**Figure 2-11. CPU-Timer Interrupts Signals and Output Signal**


- A The timer registers are connected to the memory bus of the C28x processor.  
 B The CPU Timers are synchronized to SYSCLKOUT.

The general operation of the CPU-Timer is as follows:

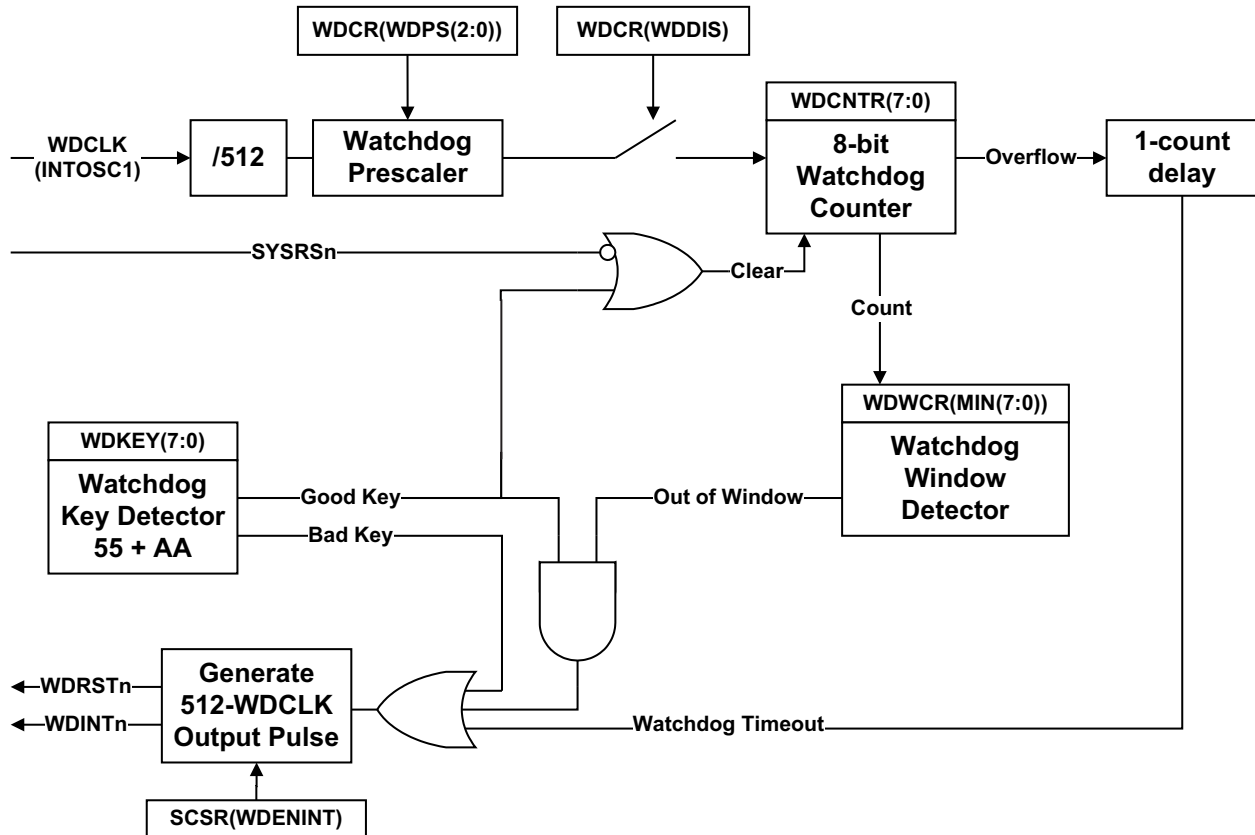
- The 32-bit counter register, TIMH:TIM, is loaded with the value in the period register PRDH:PRD
- The counter decrements once every  $(TPR[TDDRH:TDDR]+1)$  SYSCLKOUT cycles, where TDDRH:TDDR is the timer divider.
- When the counter reaches 0, a timer interrupt output signal generates an interrupt pulse.

The registers listed in [Section 2.15](#) are used to configure the timers.

## 2.9 Watchdog Timers

The watchdog module generates an output pulse 512 watchdog clocks (WDCLKs) wide whenever the 8-bit watchdog up counter has reached its maximum value. The watchdog clock source is INTOSC1. Software must periodically write a 0x55 + 0xAA sequence into the watchdog key register to reset the watchdog counter. The counter can also be disabled. Figure 2-12 shows the various functional blocks within the watchdog module.

Figure 2-12. CPU Watchdog Timer Module



### 2.9.1 Servicing the Watchdog Timer

The watchdog counter (WDCNTR) is reset when the proper sequence is written to the WDKEY register before the 8-bit watchdog counter overflows. The WDCNTR is reset-enabled when a value of 0x55 is written to the WDKEY. When the next value written to the WDKEY register is 0xAA, then the WDCNTR is reset. Any value written to the WDKEY other than 0x55 or 0xAA causes no action. Any sequence of 0x55 and 0xAA values can be written to the WDKEY without causing a system reset; only a write of 0x55 followed by a write of 0xAA to the WDKEY resets the WDCNTR.

Table 2-8. Example Watchdog Key Sequences

Step	Value Written to WDKEY	Result
1	0xAA	No action
2	0xAA	No action
3	0x55	WDCNTR is enabled to be reset if next value is 0xAA.
4	0x55	WDCNTR is enabled to be reset if next value is 0xAA.
5	0x55	WDCNTR is enabled to be reset if next value is 0xAA.
6	0xAA	WDCNTR is reset.
7	0xAA	No action
8	0x55	WDCNTR is enabled to be reset if next value is 0xAA.



**Table 2-8. Example Watchdog Key Sequences (continued)**

Step	Value Written to WDKEY	Result
9	0xAA	WDCNTR is reset.
10	0x55	WDCNTR is enabled to be reset if next value is 0xAA.
11	0x32	Improper value written to WDKEY. No action, WDCNTR no longer enabled to be reset by next 0xAA.
12	0xAA	No action due to previous invalid value.
13	0x55	WDCNTR is enabled to be reset if next value is 0xAA.
14	0xAA	WDCNTR is reset.

Step 3 in Table 2-8 is the first action that enables the WDCNTR to be reset. The WDCNTR is not actually reset until step 6. Step 8 again re-enables the WDCNTR to be reset and step 9 resets the WDCNTR. Step 10 again re-enables the WDCNTR to be reset. Writing the wrong key value to the WDKEY in step 11 causes no action, however the WDCNTR is no longer enabled to be reset and the 0xAA in step 12 now has no effect.

If the watchdog is configured to reset the device, then a WDCR overflow or writing the incorrect value to the WDCR[WDCHK] bits will reset the device and set the watchdog flag (WDRSn) in the reset cause register (RESC). After a reset, the program can read the state of this flag to determine whether the reset was caused by the watchdog. After doing this, the program should clear WDRSn to allow subsequent watchdog resets to be detected. Watchdog resets are not prevented when the flag is set.

### 2.9.2 Minimum Window Check

To complement the timeout mechanism, the watchdog also contains an optional "windowing" feature that requires a minimum delay between counter resets. This can help protect against error conditions that bypass large parts of the normal program flow but still include watchdog handling.

To set the window minimum, write the desired minimum watchdog count to the WDWCR register. This value will take effect after the next WDKEY sequence. From then on, any attempt to service the watchdog when WDCNTR is less than WDWCR will trigger a watchdog interrupt or reset. When WDCNTR is greater than or equal to WDWCR, the watchdog can be serviced normally.

At reset, the window minimum is zero, which disables the windowing feature.

### 2.9.3 Watchdog Reset or Watchdog Interrupt Mode

The watchdog can be configured in the SCSR register to either reset the device ( $\overline{\text{WDRST}}$ ) or assert an interrupt ( $\overline{\text{WDINT}}$ ) if the watchdog counter reaches its maximum value. The behavior of each condition is described below:

- **Reset mode:**

If the watchdog is configured to reset the device, then the  $\overline{\text{WDRST}}$  signal will pull the device reset ( $\overline{\text{XRS}}$ ) pin low for 512 OSCCLK cycles when the watchdog counter reaches its maximum value.

**Note:** After a watchdog reset, the boot ROM will clear all of the system and message RAMs.

- **Interrupt mode:**

When the watchdog counter expires, it will assert an interrupt by driving the  $\overline{\text{WDINT}}$  signal low for 512 OSCCLK cycles. The falling edge of  $\overline{\text{WDINT}}$  triggers a WAKEINT interrupt in the PIE if it is enabled. Because the PIE is edge-triggered, re-enabling the WAKEINT while  $\overline{\text{WDINT}}$  is active will not produce a duplicate interrupt.

To avoid unexpected behavior, software should not change the configuration of the watchdog while  $\overline{\text{WDINT}}$  is active. For example, changing from interrupt mode to reset mode while  $\overline{\text{WDINT}}$  is active will immediately reset the device. Disabling the watchdog while  $\overline{\text{WDINT}}$  is active will cause a duplicate interrupt if the watchdog is later re-enabled. If a debug reset is issued while  $\overline{\text{WDINT}}$  is active, the reset cause register (RESC) will show a watchdog reset. The WDINTS bit in the SCSR register can be read to determine the current state of  $\overline{\text{WDINT}}$ .

### 2.9.4 Watchdog Operation in Low Power Modes

In IDLE mode, the watchdog interrupt ( $\overline{\text{WDINT}}$ ) signal can generate an interrupt to the CPU to take the CPU out of IDLE mode. As with any other peripheral, the watchdog interrupt will trigger a WAKEINT interrupt in the PIE during IDLE mode. User software must determine which peripheral caused the interrupt.

In STANDBY mode, all of the clocks to the peripherals are turned off within the CPU subsystem. The only peripheral that remains functional is the watchdog since the watchdog module runs off the oscillator clock (OSCCLK). The  $\overline{\text{WDINT}}$  signal is fed to the Low Power Modes (LPM) block so that it can be used to wake the CPU from STANDBY low power mode. This feature is enabled by setting LPMCR.WDINTE = 1. See [Section 2.10](#) for details.

**Note:** If the watchdog interrupt is used to wake-up from an IDLE or STANDBY low power mode condition, software must make sure that the  $\overline{\text{WDINT}}$  signal goes back high before attempting to reenter the IDLE or STANDBY mode. The  $\overline{\text{WDINT}}$  signal will be held low for 512 OSCCLK cycles when the watchdog interrupt is generated. The current state of  $\overline{\text{WDINT}}$  can be determined by reading the watchdog interrupt status bit (WDINTS) bit in the SCSR register. WDINTS follows the state of  $\overline{\text{WDINT}}$  by two SYSCLKOUT cycles.

In HALT mode, the internal oscillators and CPU1 watchdog are kept active if the user sets CLKSRCCTL1.WDHALTI = 1. A watchdog reset can wake the system from HALT mode, but a watchdog interrupt cannot.

### 2.9.5 Emulation Considerations

The watchdog module behaves as follows under various debug conditions:

CPU Suspended:	When the CPU is suspended, the watchdog clock (WDCLK) is suspended
Run-Free Mode:	When the CPU is placed in run-free mode, then the watchdog module resumes operation as normal.
Real-Time Single-Step Mode:	When the CPU is in real-time single-step mode, the watchdog clock (WDCLK) is suspended. The watchdog remains suspended even within real-time interrupts.
Real-Time Run-Free Mode:	When the CPU is in real-time run-free mode, the watchdog operates as normal.

## 2.10 Low Power Modes

This device has three clock-gating, low-power modes and a special power-gating mode. All low-power modes are entered by setting the LPMCR register and executing the IDLE instruction. More information about this instruction can be found in the *TMS320C28x CPU and Instruction Set Reference Guide (SPRU430)*.

Low-power modes should not be entered into while a flash program or erase is ongoing.

The application should verify the following before entering STANDBY or HALT Mode:

1. Check the value of the GPIODAT register of the pin selected for STANDBY or HALT wake-up (GPIOLPMSEL0/1) prior to entering the Low-Power mode to ensure that the wake event has not already been asserted.
2. The LPMCR.QUALSTDBY register should be set to a value greater than the ratio of INTOSC1/PLLSYSCLK to ensure proper wake up. This is applicable to STANDBY only.

### 2.10.1 IDLE

IDLE is a standard feature of the C28x CPU. In this mode, the CPU clock is gated while all peripheral clocks are left running. IDLE can thus be used to conserve power while a CPU is waiting for peripheral events.

Any enabled interrupt will wake the CPU up from IDLE mode.

To enter IDLE mode, set LPMCR.LPM to 0x0 and execute the IDLE instruction.

### 2.10.2 STANDBY

STANDBY is a more aggressive low-power mode that gates both the CPU clock and any peripheral clocks derived from the CPU's SYSCLK. The watchdog however, is left active. STANDBY is best suited for an application where the wake-up signal will come from an external system rather than a peripheral input.

An NMI (or optionally) a watchdog interrupt or a configured GPIO can wake the CPU from STANDBY mode. Each GPIO from GPIO0-63 can be configured to wake the CPU when they are driven active low. Upon wakeup, the CPU receives the WAKEINT interrupt if configured.

#### To enter STANDBY mode:

1. Set LPMCR.LPM to 0x1.
2. Enable the WAKEINT interrupt in the PIE.
3. For watchdog interrupt wakeup, set LPMCR.WDINTE to 1 and configure the watchdog to generate interrupts.
4. For GPIO wakeup, set GPIOLPMSEL0 and GPIOLPMSEL1 to connect the chosen GPIOs to the LPM module, and set LPMCR.QUALSTDBY to select the number of OSCCLK cycles for input qualification.
5. Execute the IDLE instruction to enter STANDBY.

#### To wake up from Standby mode:

1. Configure the desired GPIO to trigger the wakeup.
2. Drive the selected GPIO signal low; it must remain low for the number of OSCCLK cycles specified in the QUALSTDBY bits in the LPMCR register. If the signal is sampled high during this period, the count restarts.

At the end of the qualification period, the PLL enables the CLKIN to the CPU and the WAKEINT interrupt is latched in the PIE block. The WAKEINT interrupt can also be triggered by a watchdog interrupt.

The CPU is now out of STANDBY mode and can resume normal execution.

### 2.10.3 HALT

HALT is a global low-power mode that gates almost all system clocks and allows for power-down of oscillators and analog blocks. HALT can be used for additional power savings over putting the CPU in STANDBY, although the options for wakeup are more limited.

Similar to STANDBY, any of GPIO0-63 can be configured to wake up the system from HALT. No other wakeup option is available. However, CPU1's watchdog may still be clocked, and can be configured to produce a watchdog reset if a timeout mechanism is needed. On wakeup, the CPU receives a WAKEINT interrupt.

**To enter HALT mode:**

1. Disable all interrupts with the exception of the WAKEINT interrupt. The other interrupts can be reenabled after the device is brought out of HALT mode.
2. Set LPMCR.LPM to 0x2. Set GPIOLPMSEL0 and GPIOLPMSEL1 to connect the chosen GPIOs to the LPM module.
3. Set CLKSRCCTL1.WDHALTI to 1 to keep the CPU1 watchdog active and INTOSC1 and INTOSC2 powered up in HALT.
4. Set CLKSRCCTL1.WDHALTI to 0 to disable the CPU1 watchdog and power down INTOSC1 and INTOSC2 in HALT.
5. Execute the IDLE instruction on CPU1 to enter HALT.

If an interrupt or NMI is received while the IDLE instruction is in the pipeline, the system will begin executing the WAKEINT ISR. After HALT wakeup, ISR execution will resume where it left off.

**NOTE:** Before entering HALT mode, if the system PLL is locked (SYSPLL.LOCKS = 1), it must also be connected to the system clock (PLLCTL1.PLLCLKEN = 1). Otherwise, the device will never wake up.

**To wake up from HALT mode:**

1. Drive the selected GPIO low for a minimum 5us. This will activate the CPU1.WAKEINT PIE interrupt.
2. Drive the wake-up GPIO high again to initiate the powering up of the SYSPLL and AUXPLL
3. Wait 16us plus 1024 OSCLK cycles to allow the PLLs to lock and the WAKEINT ISR to be latched.
4. Execute the WAKEINT ISR.

The device is now out of HALT mode and can resume normal execution.

## 2.10.4 HIB

Hibernate (HIB) is a global low-power mode that gates the supply voltages to most of the system. HIB is essentially a controlled power-down with remote wakeup capability, and can be used to save power during long periods of inactivity. Because gating the supply voltage corrupts the state of the logic, a reset is required to exit HIB. To prevent external systems from being affected by the reset, HIB provides isolation of the I/O pin states as well as low-power data retention via the M0 and M1 memories.

Unlike the clock-gating modes, HIB does not have a true wakeup. Instead, GPIO41 becomes HIBWAKE, an asynchronous reset signal. When the boot ROM detects a HIB wakeup, it will avoid clearing M0 and M1 and call a user-specified I/O restore function. To prevent glitches on internal and external signals, XRS will also generate a HIBWAKE signal during HIB. The I/O restore function should set up the GPIO control registers to match their pre-HIB state, then write a 1 to LPMCR.IOISODIS to deactivate I/O isolation. If the restore function does not disable isolation, the boot ROM will do it.

**To enter HIB mode:**

1. Save any necessary state to the M0 and M1 memories.
2. Put all I/Os in the desired state for isolation and deactivate any analog modules in use.
3. Write the address of the I/O restore function for the CPU to its IORESTOREADDR register.
4. Bypass the PLL by setting PLLCLKEN to 0.
5. Set CPU1's LPMCR.LPM to 0x3 and execute the IDLE instruction.

Any debugger connection will be lost on HIB entry since the JTAG logic is powered down.

Due to the loss of system state on HIB entry, it is possible for error information to be lost if an NMI is triggered while the IDLE instruction is in the pipeline. The ERRORSTS pin will be set and remain set until I/O isolation is disabled, but there will be no way to tell what caused the error.

**To wake the device from HIB mode:**

1. Assert the dedicated GPIOHIBWAKE pin (GPIO41) low to enable the power-up of the device clock

sources.

2. Assert `GPIOHIBWAKE` pin high again. This triggers the power-up of the rest of the device.
3. Boot ROM code will execute on HIB wake-up. Boot ROM will read `CPU1.RESC.HIBRESTn` bit to determine this is a wakeup from HIB.
4. Boot ROM calls the I/O context restore routine. This I/O restore function should reconfigure the I/O configuration and do any other necessary application setup.

Since waking up from HIB mode is a type of reset, the device will enter the main function. The device is now out of HIB mode and can normal execution.

---

**NOTE:** The bootROM uses locations 0x02-0x122 on CPU1's M0 RAM. To prevent losing any data during HIB wake-up, avoid saving any critical data to these locations.

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**NOTE:** The application must bypass the PLL before executing the IDLE instruction to enter HIB. If the PLL is not bypassed when entering HIB, there will be a brief current spike on the Vdd supply that may cause the device to reset.

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## 2.11 Memory Controller Module

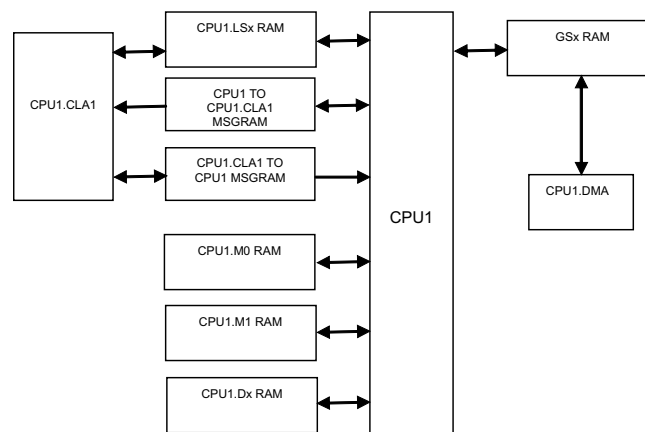
For these devices, the RAMs have different characteristics. Some are:

- dedicated to the CPU (M0, M1, and Dx RAMs),
- shared between the CPU and CLA (LSx RAM),
- shared between the CPU and DMA (GSx RAM), and
- used to send and receive messages between processors (MSGRAM).

All these RAMs are highly configurable to achieve control for write access and fetch access from different masters. All dedicated RAMs are enabled with the ECC feature (both data and address) and shared RAMs, are enabled with the PARITY (both data and address) feature. Some of the dedicated memories are secure memory as well. Refer to [Section 2.13](#) for more details. Each RAM has its own controller which takes care of the access protection/security related checks and ECC/Parity features for that RAM.

[Figure 2-13](#) shows the configuration of these RAMs.

**Figure 2-13. Memory Architecture**




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**NOTE:** All RAMs on these devices are SRAMs.

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### 2.11.1 Functional Description

This section further defines and discusses the dedicated RAMs, shared RAMs, and MSG RAMs on this device.

#### 2.11.1.1 Dedicated RAM (Dx RAM)

This device has four dedicated RAM blocks: M0, M1, D0, and D1. M0/M1 memories are small blocks of memory which are tightly coupled with the CPU. Only the CPU has access to these memories. No other masters (including DMA) have any access to these memories.

All dedicated RAMs have the ECC feature. All dedicated memories (except for M0/M1) are secure memory and also have the access protection (CPU write protection/CPU fetch protection) feature. Each type of access protection for each RAM block can be enabled/disabled by configuring the specific bit in the access protection register (DxACCPROT).

#### 2.11.1.2 Local Shared RAM (LSx RAM)

RAM blocks which are accessible to the CPU and CLA only, are called local shared RAMs (LSx RAMs). All such memories are secure memory and have the parity feature. By default, these memories are dedicated to the CPU only, and the user could choose to share these memories with the CLA by appropriately configuring the MSEL\_LSx bit field in the LSxMSEL register. Further, when these memories are shared between the CPU and CLA, the user could choose to use these memories as CLA program memory by configuring the CLAPGM\_LSx bit field in the LSxCLAPGM registers. CPU access to all memory blocks, which are programmed as CLA program memory, are blocked.

All these RAMs have the access protection (CPU write/CPU fetch) feature. Each type of access protection for each RAM block can be enabled or disabled by configuring the specific bit in the local shared RAM access protection registers. [Table 2-9](#) shows the LSx RAM features.

**Table 2-9. Local Shared RAM**

MSEL_LSx	CLAPGM_LSx	CPUx Allowed Access	CPUx.CLA1 Allowed Access	Comment
00	X	All	-	LSx memory is configured as CPU dedicated RAM
01	0	All	Data Read Data Write	LSx memory is shared between CPU and CLA1
01	1	Emulation Read Emulation Write	Fetch Only	LSx memory is CLA1 program memory

### 2.11.1.3 Global Shared RAM (GSx RAM)

RAM blocks which are accessible from the CPU and DMA are called global shared RAMs (GSx RAMs). [Table 2-10](#) shows the features of the GSx RAM.

**Table 2-10. Global Shared RAM**

CPU1	CPU1	CPU1	CPU1.DMA	CPU1.DMA
Fetch	Read	Write	Read	Write
Yes	Yes	Yes	Yes	Yes

Like other shared RAM, these RAMs also have a different levels of access protection which can be enabled or disabled by configuring specific bits in the GSxACCPROT registers.

Master select and access protection configuration for each GSx RAM block can be individually locked by the user to prevent further update to these bit fields. The user can also choose to permanently lock the configuration to individual bit fields by setting the specific bit fields in the GSxCOMMIT register (refer to the register description for more details). Once configuration is committed for a particular GSx RAM block, it can not be changed further until CPU1.SYSRS is issued.

### 2.11.1.4 Message RAM (CLA MSGRAM)

These RAM blocks are be used to share data between the CPU and CLA. The CLA has read and write access to the "CLA to CPU MSGRAM." The CPU has read and write access to the "CPU to CLA MSGRAM." The CPU and CLA both have read access to both MSGRAMs.

This RAM has parity.

### 2.11.1.5 Access Arbitration

For a shared RAM, multiple accesses can happen at a given time. The maximum number of accesses to any shared RAM at any given time depends on the type of shared RAM. On this device, a combination of a fixed and round robin scheme is followed to arbitrate multiple access at any given time.

The following is the order of fixed priority for CPU accesses:

1. Data Write/Program Write
2. Data Read
3. Program Read/Program Fetch

The following is the order of fixed priority for CLA accesses:

1. Data Write
2. Data Read/Program Fetch



Figure 2-14 represents the arbitration scheme on global shared memories:

**Figure 2-14. Arbitration Scheme on Global Shared Memories**

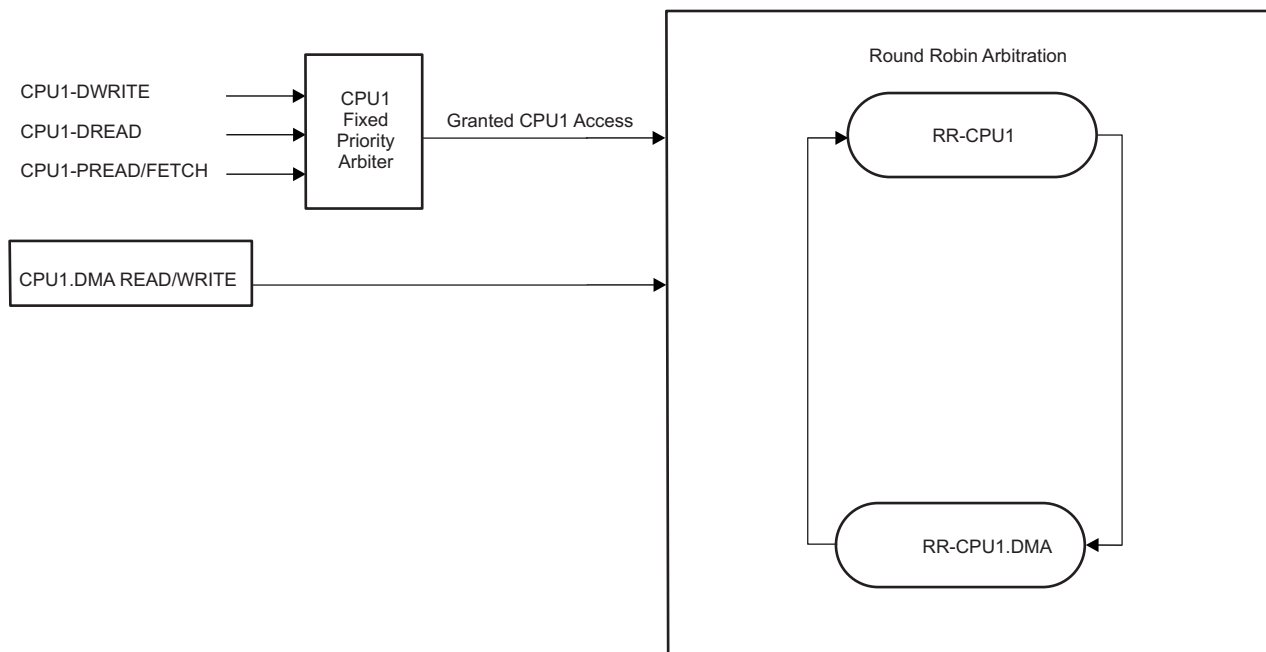
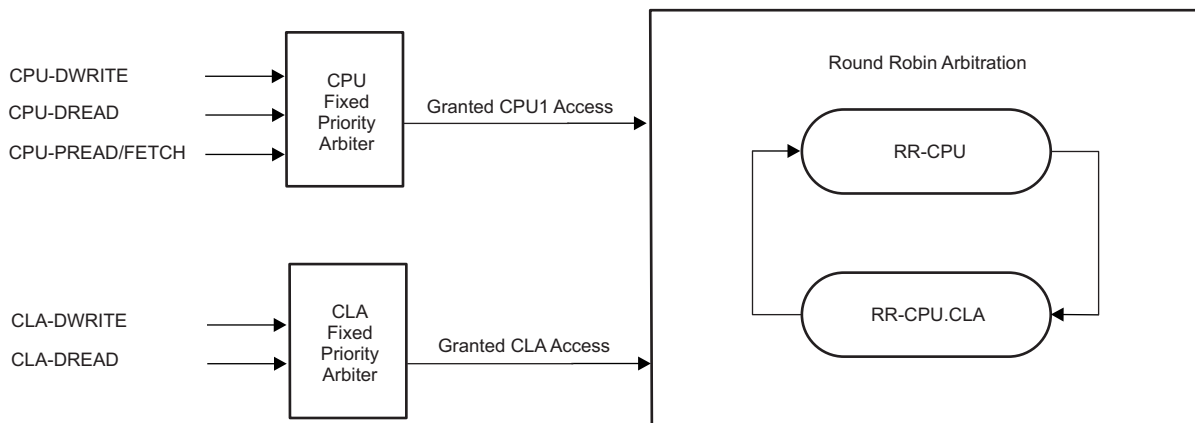


Figure 2-15 represents the arbitration scheme on local shared memories.

**Figure 2-15. Arbitration Scheme on Local Shared Memories**



### 2.11.1.6 Access Protection

All RAM blocks except for M0/M1 have different levels of protection. This feature allows the user to enable or disable specific access to individual RAM blocks from individual masters. There is no protection for read accesses, hence reads are always allowed from all the masters which have access to that RAM block.

The following sections describe the different kinds of protection available for RAM blocks on this device.

**Note:** For debug accesses, all the protections are disabled.

#### 2.11.1.6.1 CPU Fetch Protection

Fetch accesses from the CPU can be protected by setting the FETCHPROTx bit of the specific register to '1.' If fetch access is done by the CPU to a memory where CPU fetch protection is enabled, a fetch protection violation occurs.

If a fetch protection violation occurs, it results in an ITRAP for CPU. A flag gets set into the appropriate access violation flag register, and the memory address for which the access violation occurred, get latched into the appropriate CPU fetch access violation address register.

#### **2.11.1.6.2 CPU Write Protection**

Write accesses from the CPU can be protected by setting the CPUWRPROTx bit of the specific register to '1.' If write access is done by a CPU to memory where it is protected, a write protection violation occurs.

If a write protection violation occurs, write gets ignored, a flag gets set into the appropriate access violation flag register, and the memory address for which the access violation occurred, gets latched into the appropriate CPU write access violation address register. Also, an access violation interrupt is generated if enabled in the interrupt enable register.

#### **2.11.1.6.3 CPU Read Protection**

For local shared RAM, if memory is shared between the CPU and its CLA, the CPU will only have access if the memory is configured as data RAM for the CLA. If it is programmed as program RAM, all the access from the CPU, including a read, will be blocked and the violation will be considered as a non-master access violation.

If a read protection violation occurs, a flag gets set into the appropriate access violation flag register, and the memory address for which the access violation occurred, gets latched into the appropriate CPU read access violation address register. Also, an access violation interrupt is generated, if enabled in the interrupt enable register.

#### **2.11.1.6.4 CLA Fetch Protection**

If local shared RAM is configured as dedicated RAM for the CPU, or if it is configured as data RAM for the CLA, any fetch access from the CLA to that particular LSx RAM results in a CLA fetch protection violation, which is a non-master access violation.

If a CLA fetch protection violation occurs, it results in a MSTOP, a flag gets set into the appropriate access violation flag register, and the memory address for which the access violation occurred, gets latched into the appropriate CLA fetch access violation address register. Also, an access violation interrupt is generated to the master CPU if enabled in the interrupt enable register.

#### **2.11.1.6.5 CLA Write Protection**

If local shared RAM is configured as dedicated RAM for the CPU, or if it is configured as program RAM for the CLA, any data write access from the CLA to that particular LSx RAM results in a CLA write protection violation, which is a non-master access violation.

If a CLA write protection violation occurs, write gets ignored, a flag gets set into the appropriate access violation flag register, and the memory address for which the access violation occurred, gets latched into the appropriate CLA write access violation address register. Also, an access violation interrupt is generated to the master CPU if enabled in the interrupt enable register.

#### **2.11.1.6.6 CLA Read Protection**

If local shared RAM is configured as dedicated RAM for the CPU, or if it is configured as program RAM for the CLA, any data read access from the CLA to that particular LSx RAM results in a CLA read protection violation, which is a non-master access violation.

If a CLA read protection violation occurs, a flag gets set into the appropriate access violation flag register, and the memory address for which the access violation occurred, gets latched into the appropriate CLA read access violation address register. Also, an access violation interrupt is generated to the master CPU if enabled in the interrupt enable register.

#### **2.11.1.6.7 DMA Write Protection**

Write accesses from the DMA can be protected by setting the DMAWRPROTx bit of a specific register to '1.' If write access is done by the DMA to protected memory, a write protection violation occurs.

If a write access is made to GSx memory by a non-master DMA, it is called a non-master write protection violation. If a write access is made to a dedicated or shared memory by a master DMA, and DMAWRPROTx is set to '1' for that memory, it is called a master DMA write protection violation.

A flag gets set in the DMA access violation flag register, and the memory address where the violation happened gets latched in the DMA fetch access violation address register. These are dedicated registers for each subsystem.

- Note 1:** All access protections are ignored during debug accesses. Write access to a protected memory will go through when it is done via the debugger, irrespective of the write protection configuration for that memory.
- Note 2:** Access protection is not implemented for M0 and M1 memories.
- Note 3:** In the case of local shared RAM, if memory is shared between the CPU and its CLA, the CPU will only have access if the memory is configured as data RAM for the CLA. If it is programmed as program RAM, all the access from the CPU (including read) and data access from the CLA will be blocked, and violation will be considered as a non-master access violation. If the memory is configured as dedicated to the CPU, all access from the CLA will be blocked and the violation will be considered a non-master access violation.

### 2.11.1.7 Memory Error Detection, Correction and Error Handling

These devices have memory error detection and correction features to satisfy safety standards requirements. These requirements warrant the addition of detection mechanisms for finite dangerous failures.

In this device, all dedicated RAMs support error correction code (ECC) protection and the shared RAMs have parity protection. The ECC scheme used is Single Error Correction Double Error Detection (SECCDED). The parity scheme used is even parity. ECC/Parity will cover the data bits stored in memory as well as address.

ECC/Parity calculation is done inside the memory controller module and then calculated. ECC/Parity is written into the memory along with the data. ECC/Parity is computed for 16-bit data; hence, for each 32-bit data, there will be three 7-bit ECC codes (or 3-bit parity), two of which are for data and a third one for the address.

#### 2.11.1.7.1 Error Detection and Correction

Error detection is done while reading the data from memory. The error detection is performed for data as well as address. For parity memory, only a single-bit error gets detected, whereas in case of ECC memory, along with a single-bit error, a double-bit error also gets detected. These errors are called correctable error and uncorrectable errors. The following are characteristics of these errors:

- Parity errors are always uncorrectable errors
- Single-bit ECC errors are correctable errors
- Double-bit ECC errors are uncorrectable errors
- Address ECC errors are also uncorrectable errors

Correctable errors get corrected by the memory controller module and then correct data is given back as read data to the master. It is also written back into the memory to prevent double-bit error due to another single-bit error at the same memory address.

#### 2.11.1.7.2 Error Handling

For each correctable error, the count in the correctable error count register will increment by one. When the value in this count register becomes equal to the value configured into the correctable error threshold register, an interrupt is generated to the respective CPU, that is, if the interrupt is enabled in the correctable interrupt enable register. The user needs to configure the correctable error threshold register based on the system requirements. Also, the address for which the error occurred, gets latched into the master-specific status register and a flag gets set. Each of these registers are dedicated for each CPU subsystem.

If there are uncorrectable errors, an NMI gets generated for the respective CPU. In this case, the address for which the error occurred, also gets latched into the master-specific address status register, and a flag gets set.

Table 2-11 summarizes different error situations that can arise. These need to be handled appropriately in the software, using the status and interrupt indications provided.

**Table 2-11. Error Handling in Different Scenarios**

Access Type	Error Found In	Error Type	Status Indication	Error Notification
Reads	Data read from memory	Uncorrectable Error (Single-bit error for Parity RAMs OR Double bit Error for ECC RAMs)	Yes - CPU1/CPU1.DMA/CPU1.CLA1 CPU/DMA/CLA Read Error Address Register Data returned to CPU1/CPU1.DMA/CPU1.CLA1 is incorrect	NMI for CPU1 access NMI for CPU1.DMA access NMI to CPU for CPU1.CLA1 access
Reads	Data read from memory	Single-bit error for ECC RAMs	Yes - CPU1/CPU1.DMA CPU/DMA Read Error Address Register Increment single error counter	Interrupt when error counter reaches the user programmable threshold for single errors
Reads	Address	Address error	Yes - CPU1/CPU1.DMA/CPU1.CLA1 CPU/DMA/CLA Read Address Error Register Data returned to CPU1/CPU1.DMA/CPU1.CLA1 is incorrect	NMI to CPU for CPU1 access NMI to CPU for CPU1.DMA access NMI to CPU for CPU1.CLA1 access

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**NOTE:** In the case of an uncorrectable error during fetch on the CPU, there is the possibility of getting an ITRAP before an NMI exception, since garbage instructions enter into the CPU pipeline before the NMI gets generated.

During debug accesses, correctable as well as uncorrectable errors are masked.

---

#### 2.11.1.8 Application Test Hooks for Error Detection and Correction

Since error detection and correction logic is part of safety critical logic, safety applications may need to ensure that the logic is always working fine (during run time also). To enable this, a test mode is provided, in which a user can modify the data bits (without modifying the ECC/Parity bits) or ECC/Parity bits directly. Using this feature, an ECC/Parity error could be injected into data.

---

**NOTE:** The memory map for ECC/Parity bits and data bits are the same. The user must choose a different test mode to access ECC/Parity bits.

---

The following table shows the bit mapping for the ECC/Parity bits when they are read in RAMTEST mode using their respective addresses.

**Table 2-12. Mapping of ECC Bits in Read Data from ECC/Parity Address Map**

Data Bits Location in Read Data	Content (ECC Memory)
6:0	ECC Code for lower 16 bits of data
7	Not Used
14:8	ECC Code for upper 16 bits of data
15	Not Used
22:16	ECC Code for address
31:23	Not Used

**Table 2-13. Mapping of Parity Bits in Read Data from ECC/Parity Address Map**

Data Bits Location in Read Data	Content (Parity Memory)
0	Parity for lower 16 bits of data
7:1	Not Used
8	Parity for upper 16 bits of data
15:9	Not Used
16	Parity for address
31:17	Not Used

#### 2.11.1.9 RAM Initialization

To ensure that read/fetch from uninitialized RAM locations do not cause ECC or parity errors, the RAM\_INIT feature is provided for each memory block. Using this feature, any RAM block can be initialized with 0x0 data and respective ECC/Parity bits accordingly. This can be initiated by setting the INIT bit to '1' for the specific RAM block in INIT registers. To check the status of RAM initialization, SW should poll for the INITDONE bit for that RAM block in the INITDONE register to be set. Unless this bit gets set, no access should be made to that RAM memory block.

---

**NOTE:** None of the masters should access the memory while initialization is taking place. If memory is accessed before RAMINITDONE is set, the memory read/write as well as initialization will not happen correctly.

---

## 2.12 Flash and OTP Memory

Flash is an electrically erasable/programmable nonvolatile memory that can be programmed and erased many times to ease code development. Flash memory can be used primarily as a program memory for the core, and secondarily as static data memory.

This section describes the proper sequence to configure the wait states and operating mode of flash. It also includes information on flash and OTP power modes, how to improve flash performance by enabling the flash prefetch/cache mode, and the SECDED safety feature.

### 2.12.1 Features

Features of flash memory include:

- Two flash banks (Bank0 and Bank1) (refer to the device data manual for the size of the flash bank)
- Dedicated flash module controller (FMC) for each bank
- 128 bits (bank width) can be programmed at a time along with ECC
- Multiple sectors providing the option of leaving some sectors programmed and only erasing specific sectors
- User-programmable OTP locations (in USER OTP0) for configuring security, OTP boot-mode and boot-mode select pins (if the user is unable to use the factory-default boot-mode select pins)
- Flash pump shared by the two banks
- Hardware flash pump semaphore to control ownership of the pump between the two FMCs. The semaphore mechanism is not applicable during reads or program execution. It is also transparent when the CCS plugin/Uniflash is used for Flash programming. However, the semaphore must be managed when the API is used.
- Enhanced performance using the code-prefetch mechanism and data cache in FMC0 and FMC1
- Configurable wait states to give the best performance for a given execution speed
- Safety Features
  - SECDED-single error correction and double error detection is supported in the FMC
  - Address bits are included in ECC
  - Test mode to check the health of ECC logic
- Supports low-power modes for flash bank and pump for power savings
- Built-in power mode control logic
- Integrated flash program/erase state machine (FSM) in the FMC
  - Simple flash API algorithms
  - Fast erase and program times (refer to the device data manual for details)
- Code Security Module (CSM) to prevent access to the flash by unauthorized persons (refer to [Section 2.13](#) for details)
- Extra wait-state is encountered when code is fetched (or data is read) from Bank1, even for prefetched data

### 2.12.2 Flash Tools

Texas Instruments provides the following tools for flash:

- Code Composer Studio (CCS) - the development environment with integrated flash plugin
- F021 Flash API Library - a set of software peripheral functions to erase/program flash
- UniFlash - standalone tool to erase/program/verify the flash content through JTAG. No CCS is required.
- CCS On-Chip Flash Plugin and UniFlash tools developed for these devices support AutoEccGeneration (see *TMS320F2837xS Flash API Version 1.55 Reference Guide*, [SPNU630](#)). But they do not support the program of ECC generated by the linker -ecc options.
- Users must check and install available updates for CCS On-Chip Flash Plugin and UniFlash tools.

### 2.12.3 Default Flash Configuration

The following are flash module configuration settings at power-up :

- Both flash banks are in sleep power mode
- Shared pump is in sleep mode
- ECC is enabled
- Wait-states are set to the maximum (0xF)
- Code-prefetch mechanism and data cache are disabled in the FMC

During the boot process, the boot ROM performs a dummy read of the Code Security Module (CSM) password locations in the OTP. This read is performed to unlock a new (or erased) device that has no password stored in it, so that flash programming or loading of code into CSM-protected SARAM can be performed. On devices with a password, this read has no effect and the device remains locked. One effect of this read is that the flash will transition from the sleep (reset) state to the active state.

User application software must initialize wait-states using the FRDCNTL register, and configure cache/prefetch features using the RD\_INTF\_CTRL register, to achieve optimum system performance. Software that configures flash settings like wait-states, cache/prefetch features, and so on, must be executed only from RAM memory, **not** from flash memory.

---

**NOTE:** Before initializing wait-states, turn off the pre-fetch and data caching in the FRD\_INTF\_CTRL register.

---

### 2.12.4 Flash Bank, OTP and Pump

There are two flash banks, Bank0 and Bank1. Also, there is a one-time programmable (OTP) memory called USER OTP, which the user can program only once and cannot erase. Flash and OTP are uniformly mapped in both program and data memory space.

There is also a TI-OTP which contains manufacturing information like settings used by the flash state machine for erase and program operations, and so on. Users may read TI-OTP but it cannot be programmed or erased. For memory map and size information of the banks, TI-OTP, USER OTP and corresponding ECC locations, please refer to the device data manual.

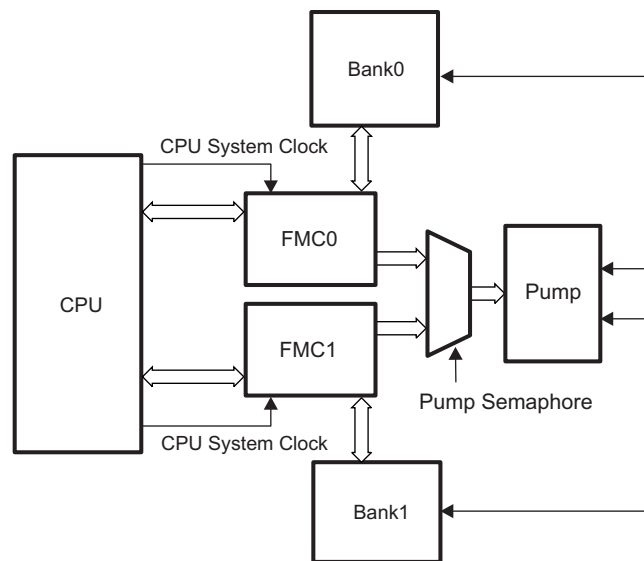
Bank0, Bank1 and OTP share a common flash pump. A hardware semaphore, called the flash pump semaphore, is provided to control the access of the flash pump between the FMCs of Bank0 and Bank1.

[Figure 2-21](#) depicts the user-programmable OTP locations in USER-OTP . For more information on the functionality of these fields, please refer to [Section 2.13](#) and the *ROM Code and Peripheral Booting* chapter.

### 2.12.5 Flash Module Controller (FMC)

There are dedicated flash module controllers, FMC0 and FMC1 for Bank0 and Bank1, respectively. The CPU interfaces with FMC0, which in turn interfaces with Bank0 and the shared pump to perform erase or program operations as well as to read data and execute code from the Bank0.



**Figure 2-16. FMC Interface with Core, Bank and Pump**


The CPU interfaces with FMC1 which in turn, interfaces with Bank1 and the shared pump to perform erase or program operations as well as to read data and execute code from Bank1. Control signals to the flash pump will be controlled by either FMC0 or FMC1, depending on who gains the flash pump semaphore.

There is a state machine in both FMC0 and FMC1 which generates the erase/program sequences in hardware. This simplifies the Flash API software which configures control registers in the FMC to perform flash erase and program operations (see [TMS320F2837xS Flash API Version 1.55 Reference Guide SPNU630](#), for details on Flash API).

[Section 2.12.6](#) through [Section 2.12.10](#) describe FMC in detail.

### 2.12.6 Flash and OTP Power-Down Modes and Wakeup

The flash bank and pump consume a significant amount of power when active. The flash module provides a mechanism to power-down flash banks and pump. Special timers automatically sequence the power-up of Bank0 and Bank1 independently of each other. The shared charge pump module has its own independent power-up timer as well.

The flash bank and OTP operate in three power modes: Sleep (lowest power), Standby, and Active (highest power)

- **Sleep State**  
This is the state after a device reset. In this state, a CPU data read or opcode fetch will automatically initiate a change in power mode to the standby state and then to the active state. During this transition time to the active state, the CPU will automatically be stalled.
- **Standby State**  
This state uses more power than the sleep state, but takes a shorter time to transition to the active or read state. In this state, a CPU data read or opcode fetch will automatically initiate a change in power mode to the active state. During this transition time to the active state, the CPU will automatically be stalled. Once the flash/OTP has reached the active state, the CPU access will complete as normal.
- **Active or Read State**  
In this state, the bank and pump are in active power mode state (highest power)

The charge pump operates in two power modes:

- Sleep (lowest power)
- Active (highest power)

Any access to any flash bank/OTP causes the charge pump to go into active mode, if it is in sleep mode. An erase or program command causes the charge pump and bank to become active. If any bank is in active or in standby mode, the charge pump will be in active mode, independent of the pump power mode control configuration (PMPPWR bit-field in FPAC1 register).

To power down the Flash pump, the CPU must power down the Flash Pump using below sequence without any Flash accesses in between. The Flash Pump will not enter low-power mode if below sequence is not followed.

1. Assign the Pump Semaphore for Bank 0.
2. Assign a value of 0x14 to FMC0 VREADST (refer to the FBAC register) to ensure the requisite delay needed for the flash pump/bank to come out of low-power mode later: FBAC.VREADST = 0x14
3. Change the FMC0 Flash Bank Fall Back power mode to Sleep: FBFALLBACK.BNKPWR = 0.
4. Change the FMC0 Flash Charge Pump Fall Back power mode to Sleep: FPAC1.PMPPWR = 0.
5. Assign the Pump Semaphore for Bank 1.
6. Assign a value of 0x14 to FMC1 VREADST (refer to FBAC register) to ensure the requisite delay needed for the flash pump/bank to come out of low-power mode later: FBAC.VREADST = 0x14.
7. Change the FMC1 Flash Bank Fall Back power mode to Sleep: FBFALLBACK.BNKPWR = 0.
8. Change the FMC1 Flash Charge Pump Fall Back power mode to Sleep: FPAC1.PMPPWR = 0.

The above listed procedure should be executed from RAM and not from Flash. Note that exclusive control of the Flash pump should be assigned to a FMC (using PUMPREQUEST, Flash pump ownership control register) before configuring the PMPPWR bit field of the FPAC1 register as shown in the above sequence. As the charge pump is shared between FMC0 and FMC1, the effective PMPPWR value used when powering down the pump will be of the FMC (out of FMC0 and FMC1) which owns the pump. The application software can check the current power mode of flash bank by reading the FBPRDY register. The PUMPRDY bit can be used by the application software to identify the current power mode status of the pump. A value of 0 in the PUMPRDY bit in both FMC0 and FMC1 indicates that the charge pump is in sleep mode. A value of 1 in PUMPRDY bit in either FMC0 or FMC1 or in both FMC0 and FMC1 indicates that the charge pump is in active mode. Refer to the register descriptions, [Section 2.15](#), for detailed information.

While the pump is in sleep state, a charge pump sleep down counter holds a user configurable value (PSLEEP bit field in the FPAC1 register) and when the charge pump exits sleep power mode, the down counter delays from 0 to PSLEEP prescaled SYSCLK clock cycles (prescaled clock is SYSCLK/2) before putting the charge pump into active power mode. Note that the configured PSLEEP value should yield at least a delay of 20us for the pump to go to active mode. Refer to the register descriptions, [Section 2.15](#), for detailed information

Below are the number of cycles it will take for the Bank and pump to wake up from low power modes.

1. Pump sleep to active = PSLEEP \* (SYSCLK/2) cycles
2. Bank sleep to standby = 425 Flash clock cycles
3. Bank standby to active = 90 Flash clock cycles

Where in Flash clock = SYSCLK/(RWAIT+1)

## 2.12.7 Flash and OTP Performance

Once the flash bank and pump are in the active power state, a read or fetch access can be classified as a flash access (access to an address location in flash) or an OTP access (access to an address location in OTP). Once the CPU throws an access to a flash memory address, data is returned after RWAIT+1 number of SYSCLK cycles. For a USER-OTP access, data is returned after 11 SYSCLK cycles.

RWAIT defines the number of random access wait-states and is configurable using the RWAIT bit-field in the FRDCNTL register. At reset, the RWAIT bit-field defaults to a worst-case wait-state count (15), and therefore needs to be initialized for the appropriate number of wait states to improve performance, based on the CPU clock rate and the access time of the flash. The flash supports 0-wait accesses when the RWAIT bits are set to zero. This assumes that the CPU speed is low enough to accommodate the access time.

For a given system clock frequency, RWAIT has to be configured using below formula:

$$\text{RWAIT} = \text{ceiling}[(\text{SYSCLK}/\text{FCLK})-1]$$

where SYSCLK is the system operating frequency

FCLK is flash clock frequency. FCLK should be  $\leq \text{FCLK}_{\text{max}}$ , allowed maximum flash clock frequency at RWAIT=0.

If RWAIT results in a fractional value when calculated using the above formula, RWAIT has to be rounded up to the nearest integer.

### 2.12.8 Flash Read Interface

This section provides details about the data read modes to access flash bank/OTP and the configuration registers which control the read interface. In addition to a standard read mode, the FMC has a built-in prefetch and cache mechanism to allow increased clock speeds and CPU throughput wherever applicable.

#### 2.12.8.1 FMC Flash Read Interface

##### 2.12.8.1.1 Standard Read Mode

Standard read mode is defined as the read mode in effect when code prefetch-mechanism and data cache are disabled. It is also the default read mode after reset. During this mode, each read access to flash is decoded by the flash wrapper to fetch the data from the addressed location and the data is returned after the RWAIT+1 number of cycles.

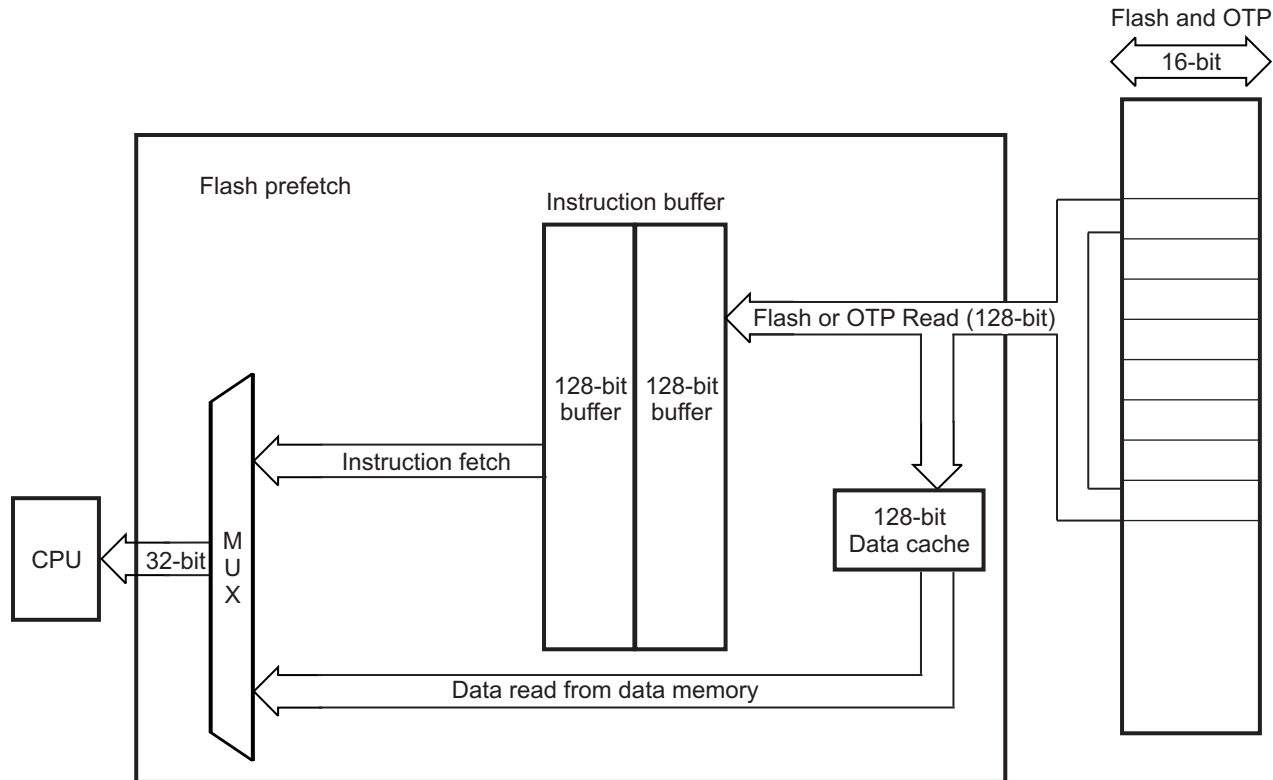
Prefetch buffers associated with prefetch mechanism and data cache are bypassed in standard read mode; therefore, every access to the flash/OTP is used by the CPU immediately, and every access creates a unique flash bank access.

Standard read mode is the recommended mode for lower system frequency operation in which RWAIT can be set to zero to provide single-cycle access operation. The FMC can operate at higher frequencies using standard read mode at the expense of adding wait states. At higher system frequencies, it is recommended to enable cache and prefetch mechanisms to improve performance. Refer to the device specific data manual to determine the maximum flash frequency allowed in standard read mode (that is, maximum flash clock frequency with RWAIT=0,  $\text{FCLK}_{\text{MAX}}$ ).

##### 2.12.8.1.2 Prefetch Mode

Flash memory is typically used to store application code. During code execution, instructions are fetched from sequential memory addresses, except when a discontinuity occurs. Usually the portion of the code that resides in sequential addresses makes up the majority of the application code and is referred to as linear code. To improve the performance of linear code execution, a flash prefetch-mechanism has been implemented in the FMC. [Figure 2-17](#) illustrates how this mode functions.

Figure 2-17. Flash Prefetch Mode



This prefetch mechanism does a look-ahead prefetch on linear address increments starting from the address of the last instruction fetch. The flash prefetch mechanism is disabled by default. Setting the PREFETCH\_EN bit in the FRD\_INTF\_CTRL register enables this prefetch mode.

An instruction fetch from the flash or OTP reads out 128 bits per access. The starting address of the access from flash is automatically aligned to a 128-bit boundary, such that the instruction location is within the 128 bits to be fetched. With the flash prefetch mode enabled, the 128 bits read from the instruction buffer are stored in a 128-bit wide by 2-level deep instruction prefetch buffer. The contents of this prefetch buffer are then sent to the CPU for processing as required.

Up to four 32-bit or eight 16-bit instructions can reside within a single 128-bit access. The majority of C28x instructions are 16 bits, so for every 128-bit instruction fetch from the flash bank, it is likely that there are up to eight instructions in the prefetch buffer ready to process through the CPU. During the time it takes to process these instructions, the flash prefetch mechanism automatically initiates another access to the flash bank to prefetch the next 128 bits. In this manner, the flash prefetch mechanism works in the background to keep the instruction prefetch buffers as full as possible. Using this technique, the overall efficiency of sequential code execution from flash or OTP is improved significantly. If the prefetch mechanism is enabled, then the last row of 128 bits in the bank should not be used, because the prefetch logic which does a look-ahead prefetch, will try to fetch from outside the bank and would result in an ECC error.

The flash prefetch is aborted only on a PC discontinuity caused by executing an instruction such as a branch, BANZ, call, or loop. When this occurs, the prefetch mechanism is aborted and the contents of the prefetch buffer are flushed. There are two possible scenarios when this occurs:

1. If the destination address is within the flash or OTP, the prefetch aborts and then resumes at the destination address.
2. If the destination address is outside of the flash and OTP, the prefetch is aborted and begins again only when a branch is made back into the flash or OTP. The flash prefetch mechanism only applies to instruction fetches from program space. Data reads from data memory and from program memory do not utilize the prefetch buffer capability and thus bypass the prefetch buffer. For example, instructions such as MAC, DMAC, and PREAD read a data value from program memory. When this read happens,

the prefetch buffer is bypassed but the buffer is not flushed. If an instruction prefetch is already in progress when a data read operation is initiated, then the data read will be stalled until the prefetch completes.

Note that the prefetch mechanism gets bypassed when RWAIT is configured as zero.

### 2.12.8.1.2.1 Data Cache

Along with the prefetch mechanism, a data cache of 128 bits wide is also implemented to improve data-space read performance. This data cache will not be filled by the prefetch mechanism. When any kind of data-space read is made by the CPU from an address in the bank, and if the data corresponding to the requested address is not in the data cache, then 128 bits of data will be read from the bank and loaded in the data cache. This data is eventually sent to the CPU for processing. The starting address of the access from flash is automatically aligned to a 128-bit boundary such that the requested address location is within the 128 bits to be read from the bank. By default, this data cache is disabled and can be enabled by setting DATA\_CACHE\_EN bit in the FRD\_INTF\_CTRL register. Note that the data cache gets bypassed when RWAIT is configured as zero.

Some other points to keep in mind when working with flash/ OTP:

- Reads of the USER OTP locations are hardwired for 10 wait states. The RWAIT bits have no effect on these locations.
- CPU writes to the flash or OTP memory map areas are ignored. They complete in a single cycle.
- If a security zone is in the locked state and the respective password lock bits are not all 1s, then,
  - Data reads to Zx-CSMPSWD will return 0
  - Program space reads to Zx-CSMPSWD will return 0
  - Program fetches to Zx-CSMPSWD will return 0
- When the Code Security Module (CSM) is secured, reads to the flash/OTP memory map area from outside the secure zone take the same number of cycles as a normal access. However, the read operation returns a zero.
- The arbitration scheme in FMC prioritizes CPU accesses in the fixed priority order of data read (highest priority), program space read and program fetches/program prefetches (lowest priority).
- When FSM interface is active for erase/program operations, data in the prefetch buffers and data cache in FMC will be flushed.
- When data cache is enabled, the debugger memory window open to Flash/OTP space will invoke data caching. Hence, debugger memory window should not be left open for Flash/OTP space when benchmarking the code for performance.

### 2.12.9 Erase/Program Flash

Flash memory may be programmed either by using the CCS Flash plugin or by using Uniflash. If these methods are not feasible in an application, the API may be used. The Flash memory should be programmed, erased, and verified only by using the F021 Flash API library. These functions are written, compiled and validated by Texas Instruments. The flash module contains a flash state machine (FSM) to perform program and erase operations. This section only provides a high level description for these operations, therefore, refer to the *TMS320F2837xS Flash API Version 1.55 Reference Guide (SPNU630)* for more information. Note that Flash API execution is interruptible. However, there should not be any read/fetch access from the Flash bank on which an erase/program operation is in progress. For dual bank devices, Flash API can be executed from one Flash bank to perform erase/program operations on the other Flash bank. For single flash bank devices, Flash API must be executed from RAM and not from Flash.

A typical flow to program flash is:

Erase → Program → Verify

Always refer to the device-specific support folder in controlSUITE™ for the latest Flash API library.

### 2.12.9.1 Erase

When the target flash is erased, it reads as all 1's. This state is called 'blank.' The erase function must be executed before programming. The user should NOT skip erase on sectors that read as 'blank' because these sectors may require additional erasing due to marginally erased bits columns. The FSM provides an "Erase Sector" command to erase the target sector. The erase function erases the data and the ECC together. This command is implemented by the following Flash API function:

```
Fapi_issueAsyncCommandWithAddress();
```

The Flash API provides the following function to determine if the flash bank is 'blank':

```
Fapi_doBlankCheck();
```

### 2.12.9.2 Program

The FSM provides a command to program the USER OTP and Flash. This command is also used to program ECC check bits.

This command is implemented by the following Flash API function:

```
Fapi_issueProgrammingCommand();
```

The Program function provides the options to program data without ECC, data along with user-provided ECC data, data along with ECC calculated by API software , and to program ECC only.

### 2.12.9.3 Verify

After programming, the user must perform verify using API function Fapi\_doVerify(). This function verifies the flash contents against supplied data.

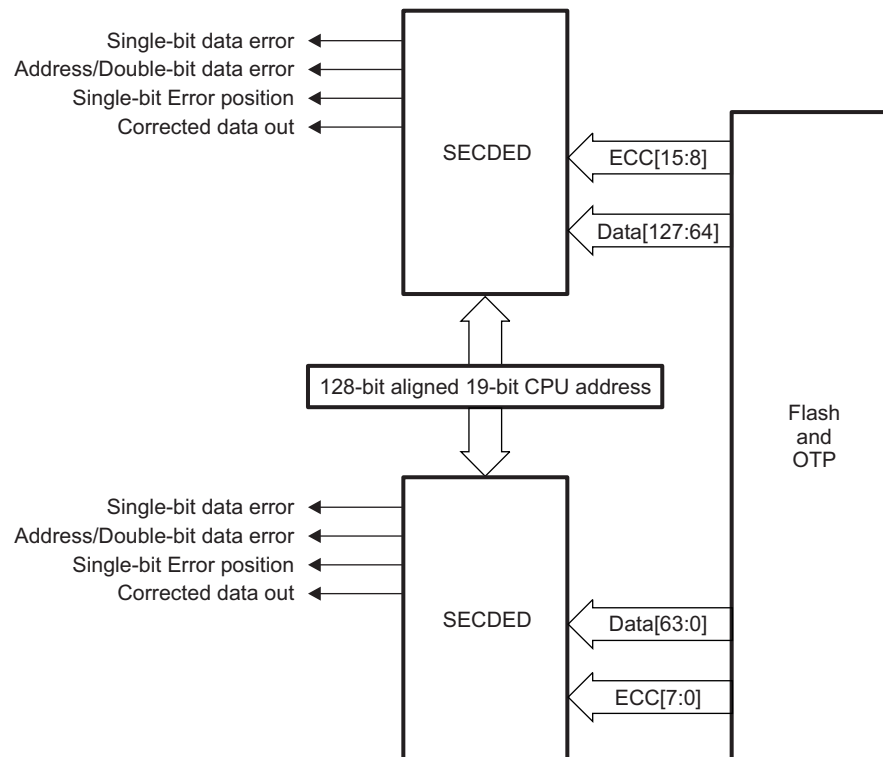
Application software typically perform a CRC check of the Flash memory contents during power-up and at regular intervals during runtime (as needed). Apart from this, ECC logic, when enabled (enabled by default), catches single-bit errors, double-bit errors, and address errors whenever the CPU reads/fetches from a Flash address.

## 2.12.10 Error Correction Code (ECC) Protection

FMC0 and FMC1 contain an embedded single error correction and double error detection (SECDDED) module. SECDDED, when enabled, provides the capability to screen out memory faults. SECDDED can detect and correct single-bit data errors and detect address errors/double-bit data errors. For every 64 bits of flash/OTP data (aligned on a 64-bit memory boundary) that is programmed, eight ECC check bits have to be calculated and programmed in ECC memory space. Refer to the device data manual for the Flash/OTP ECC memory map. SECDDED works with a total of eight user-calculated error correction code (ECC) check bits associated with each 64-bit wide data word and its corresponding 128-bit memory-aligned address. Users must program ECC check bits along with flash data. TI recommends using the AutoEccGeneration option available in Plugin/API to program ECC. Users can use the F021 Flash API to calculate and program ECC data along with flash data. Flash API uses hardware ECC logic in the device to generate the ECC data for the given Flash data. The Flash Plugin, the Flash programming tool integrated with Code Composer Studio, uses Flash API to generate and program ECC data).

[Figure 2-18](#) illustrates the ECC logic inputs and outputs.



**Figure 2-18. ECC Logic Inputs and Outputs**


During an instruction fetch or a data read operation, the 19 most significant address bits (three least significant bits of address are not considered), together with the 64-bit data/8-bit ECC read-out of flash banks/ECC memory map area, pass through the SECEDED logic and the eight checkbits are produced in FMC. These eight calculated ECC check bits are then XORed with the stored check bits (user programmed check bits) associated with the address and the read data. The 8-bit output is decoded inside the SECEDED module to determine one of three conditions:

- No error occurred
- A correctable error (single bit data error) occurred
- A non-correctable error (double bit data error or address error) occurred

If the SECEDED logic finds a single-bit error in the address field, then it is considered to be a non-correctable error.

---

**NOTE:** Since ECC is calculated for an entire 64-bit data, a non 64-bit read such as a byte read or a half-word read will still force the entire 64-bit data to be read and calculated, but only the byte or half-word will be actually used by the CPU.

---

This ECC (SECEDED) feature is enabled at reset. The ECC\_ENABLE register can be used to configure (enable/disable) the ECC feature. The ECC for the application code must be programmed. There are two SECEDED modules in each FMC. Out of the 128-bit data (aligned on a 128-bit memory boundary) read from the bank/OTP address, the lower 64-bits of data and corresponding 8 ECC bits (read from user programmable ECC memory area) are fed as inputs to one SECEDED module along with 128-bit aligned 19-bit address from where data has been read. The upper 64-bits of data and corresponding 8 ECC bits are fed as inputs to another SECEDED module in parallel, along with 128-bit aligned 19-bit address. Each of the SECEDED modules evaluate their inputs and determine if there is any single-bit data error or double-bit data error/address error.

ECC logic will be bypassed when the 64 data bits and the associated ECC bits fetched from the bank are either all ones or zeros.



### 2.12.10.1 Single-Bit Data Error

This section provides information for both single-bit data errors and single-bit ECC check bit errors. If there is a single bit flip (0 to 1 or 1 to 0) in flash data or in ECC data, then it is considered as a single-bit data error. The SECCDED module detects and corrects single-bit errors, if any, in the 64-bit flash data or eight ECC check bits read from the flash/ECC memory map before the read data is provided to the CPU.

When SECCDED finds and corrects single bit data errors, the following information is logged in the ECC registers if the ECC feature is enabled:

- Address where the error occurred – if the single-bit error occurs in the lower 64-bits of a 128-bit memory-aligned data, the lower 64-bit memory-aligned address will be captured in the SINGLE\_ERR\_ADDR\_LOW register. If the single-bit error occurs in the upper 64-bits of a 128-bit memory-aligned data, the upper 64-bit memory-aligned address will be captured in the SINGLE\_ERR\_ADDR\_HIGH register.
- Whether the error occurred in data bits or ECC bits – the ERR\_TYPE\_L and ERR\_TYPE\_H bit fields in the ERR\_POS register indicate whether the error occurred in data bits or ECC bits of the lower 64-bits, or the upper 64-bits respectively, of a 128-bit memory-aligned data.
- Bit position at which error occurred – the ERR\_POS\_L and ERR\_POS\_H bit fields in the ERR\_POS register indicate the bit position of the error in the lower 64-bits/lower 8-bit ECC, or the upper 64-bits/upper 8-bit ECC respectively, of a 128-bit memory-aligned data.
- Whether the corrected value is 0 (FAIL\_0\_L, FAIL\_0\_H flags in ERR\_STATUS register)
- Whether the corrected value is 1 (FAIL\_1\_L, FAIL\_1\_H flags in ERR\_STATUS register)
- A single bit error counter that increments on every single bit error occurrence (ERR\_CNT register) until a user-configurable threshold (see ERR\_THRESHOLD) is met
- A flag that gets set when one or more single-bit errors occurs after ERR\_CNT equals ERR\_THRESHOLD (SINGLE\_ERR\_INT\_FLG flag in the ERR\_INTFLG register)

When the ERR\_CNT value equals THRESHOLD+1 value and a single bit error occurs, the SINGLE\_ERR\_INT flag is set, and an interrupt (FLASH\_CORRECTABLE\_ERR on C28x PIE has to be enabled for interrupt, if needed) is fired. The SINGLE\_ERR interrupt will not be fired again until the SINGLE\_ERR\_INTFLG is cleared. If the single error interrupt flag is not cleared using the corresponding error interrupt clear bit in the ERR\_INTCLR register, the error interrupt will not come again, as this is an edge-based interrupt.

When multiple single-bit errors get caught by ECC logic, Flash ECC registers will hold the information related to the latest ECC error. When multiple single-bit errors get caught, both FAIL\_0\_L and FAIL\_1\_L (and/or FAIL\_0\_H and FAIL\_1\_H) might get set, indicating that single-bit fail0/fail1 occurred in different 64-bit aligned addresses.

Although ECC is calculated on 64-bit basis, a read of any address location within a 128-bit aligned Flash memory will cause the single-bit error flag to get set when there is a single-bit error in both or in either one of the lower 64 and upper 64 bits (or corresponding ECC check bits) of that 128-bit data.

### 2.12.10.2 Uncorrectable Error

Uncorrectable errors include address errors and double-bit errors in data/ECC. When SECCDED finds uncorrectable errors, the following information is logged in ECC registers if the ECC feature is enabled:

- Address where the error occurred – if the uncorrectable error occurs in the lower 64-bits of a 128-bit memory-aligned data, the lower 64-bit memory-aligned address will be captured in the UNC\_ERR\_ADDR\_LOW register. If the uncorrectable error occurs in the upper 64-bits of a 128-bit memory-aligned data, the upper 64-bit memory-aligned address will be captured in the UNC\_ERR\_ADDR\_HIGH register.
- A flag is set indicating that an uncorrectable error occurred – the UNC\_ERR\_L and UNC\_ERR\_H flags in the ERR\_STATUS register indicate the uncorrectable error occurrence in the lower 64-bits/lower 8-bit ECC, or the upper 64-bits/upper 8-bit ECC, respectively, of a 128-bit memory-aligned data.
- A flag is set indicating that an uncorrectable error interrupt is fired (UNC\_ERR\_INTFLG in ERR\_INTFLG register)

When an uncorrectable error occurs, the `UNC_ERR_INTFLG` bit is set and an uncorrectable error interrupt is fired. This uncorrectable error interrupt generates an NMI, if enabled. If an uncorrectable error interrupt flag is not cleared using the corresponding error interrupt clear bit in the `ERR_INTCLR` register, an error interrupt will not come again, as this is an edge based interrupt.

Although ECC is calculated on 64-bit basis, a read of any address location within a 128-bit aligned Flash memory will cause the uncorrectable error flag to get set when there is a uncorrectable error in both or in either one of the lower 64 and upper 64 bits (or corresponding ECC check bits) of that 128-bit data. NMI will occur on the CPU for a read of any address location within a 128-bit aligned Flash memory, when there is an uncorrectable error in both or in either one of the lower 64 and upper 64 bits (or corresponding ECC check bits) of that 128-bit data.

### 2.12.10.3 SECEDED Logic Correctness Check

Since error detection and correction logic are part of safety-critical logic, safety applications may need to ensure that the SECEDED logic is always working properly. For these safety concerns, in order to ensure the correctness of the SECEDED logic, an ECC test mode is provided to test the correctness of ECC logic periodically. In this ECC test mode, data/ECC and address inputs to the ECC logic are controlled by the ECC test mode registers `FDATAH_TEST`, `FDATAL_TEST`, `FECC_TEST`, and `FADDR_TEST`, respectively. Using this test mode, users can introduce single-bit errors, double-bit errors, or address errors and check whether or not SECEDED logic is catching those errors. Users can also check if SECEDED logic is reporting any false errors when no errors are introduced.

This ECC test mode can be enabled by setting the `ECC_TEST_EN` bit in the `FECC_CTRL` register. When ECC test mode is enabled, the CPU cannot read the data from flash and instead the CPU gets data from the ECC test mode registers (`FDATAH_TEST`/`FDATAL_TEST`). This is because ECC test mode registers (`FDATAH_TEST`, `FDATAL_TEST`, `FECC_TEST`) are multiplexed with data from the flash. Hence, the CPU should not read/fetch from Flash when ECC test mode is enabled. For this reason, ECC test mode code should be executed from RAM and not from flash.

Only one of the SECEDED modules (out of the two SECEDED modules that work on lower 64 bits and upper 64 bits of a read 128-bit data) at a time can be tested. The `ECC_SELECT` bit in the `FECC_CTRL` register can be configured by users to select one of the SECEDED modules for test.

To test the ECC logic using ECC test mode, users can follow the steps below:

1. Obtain the ECC for a given Flash address (128-bit aligned) and 64-bit data by using the Auto ECC generation option provided in Flash API .
2. Develop an application to test ECC logic using the above data. In this application
  - Write the 128-bit aligned 19-bit Flash address in `FADDR_TEST`
  - Write 64-bit data in `FDATAx_TEST` (`FDATAL_TEST` or `FDATAH_TEST` depending on which ECC logic the user wants to test) register
  - Write the corresponding 8-bit ECC in the `FECC_TEST` register
  - In any of the above three steps, users can insert errors (single-bit data error or double-bit data error or address error or single-bit ECC error or double-bit ECC error) so that they can check whether or not ECC logic is able to catch the errors
  - Select the ECC logic block (lower 64-bits or upper 64-bits) which needs to be tested using the `ECC_SELECT` bit in the `FECC_CTRL` register
  - Enable ECC test mode using the `ECC_TEST_EN` bit in `FECC_CTRL` register
  - Write a value of 1 in the `DO_ECC_CALC` bit in `FECC_CTRL` register to enable ECC test logic for a single cycle to evaluate the address, data, ECC in `FADDR_TEST`, `FDATAx_TEST` and `FECC_TEST` registers for ECC errors

Once the above ECC test mode registers are written by the user:

- The `FECC_OUTH` register holds the data output bits 63:32 from the SECEDED block under test
- The `FECC_OUTL` register holds the data output bits 31:0 from the SECEDED block under test
- The `FECC_STATUS` register holds the status of single-bit error occurrence, uncorrectable error occurrence, and error position of single-bit error in data/check bits

#### 2.12.10.4 Reading ECC Memory From a Higher Address Space

In these devices, ECC memory for Flash and OTP is allocated at a higher address space (address width more than 22 bits). C2000 Codegen tools (6.2 and onwards) are updated to include the below intrinsics to read ECC space.

For 16-bit read:

```
unsigned int variable = __addr32_read_uint16(unsigned long address);
```

For 32-bit read:

```
unsigned long variable = __addr32_read_uint32(unsigned long address);
```

#### 2.12.11 Reserved Locations Within Flash and OTP

When allocating code and data to flash and OTP memory, keep the following reserved locations in mind:

- The entire OTP has reserved user-configurable locations for security and boot process. For more details on the functionality of these fields, please refer to [Section 2.13](#), and the *ROM Code and Peripheral Booting* chapter.
- Refer to the *ROM Code and Peripheral Booting* chapter for reserved locations in flash for real-time operating system usage and a boot-to-flash entry point. A boot-to-flash entry point is reserved for an entry-into-flash branch instruction. When the boot-to-flash boot option is used, the boot ROM will jump to this address in flash. If the user programs a branch instruction here, that will then redirect code execution to the entry point of the application.

#### 2.12.12 Procedure to Change the Flash Control Registers

During flash configuration, no accesses to the flash or OTP can be in progress. This includes instructions still in the CPU pipeline, data reads, and instruction prefetch operations. To be sure that no access takes place during the configuration change, you should follow the procedure shown below for any code that modifies the flash control registers.

1. Start executing application code from RAM/Flash/OTP.
2. Branch to or call the flash configuration code (that writes to flash control registers) in RAM. This is required to properly flush the CPU pipeline before the configuration change. The function that changes the flash configuration cannot execute from the Flash or OTP. It must reside in RAM.
3. Execute the flash configuration code (should be located in RAM) that writes to flash control registers like FRDCNTL, FRD\_INTF\_CTRL, and so on.
4. At the end of the flash configuration code execution, wait eight cycles to let the write instructions propagate through the CPU pipeline. This must be done before the return-from-function call is made.
5. Return to the calling function which might reside in RAM or Flash/OTP and continue execution.

#### 2.12.13 Flash Pump Ownership Control

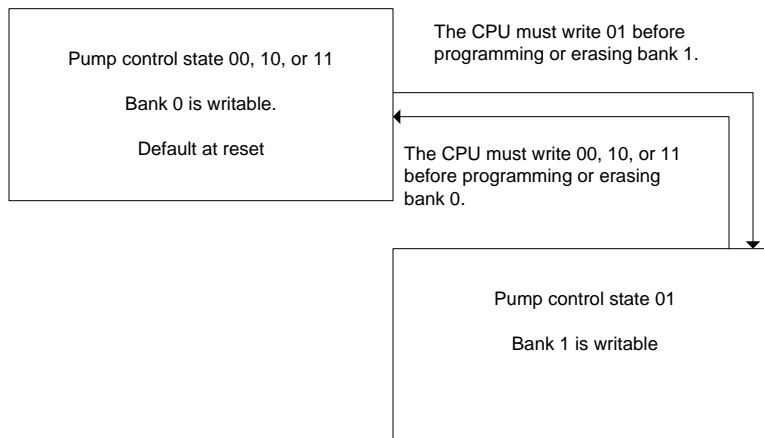
Both flash banks share a single charge pump for program and erase operations. However, only one flash bank can be programmed or erased at any given time. The CPU can read data and execute code from one bank while the other bank is being programmed or erased. The flash pump ownership setting allows pump access to only one bank at a time.

The pump ownership setting is implemented as a two-bit field in the PUMPREQUEST register with special write protections. This register requires a key field to be written at the same time as the control bits. Possible states for the PUMP\_OWNERSHIP bit field in the PUMPREQUEST register are:

00, 10, or 11	Bank 0 can be programmed or erased. 00 is the reset state.
01	Bank 1 can be programmed or erased.

Figure 2-19 shows the allowed states and state transitions.

**Figure 2-19. PUMP\_OWNERSHIP Configuration**



## 2.13 Dual Code Security Module (DCSM)

The dual code security module (DCSM) is a security feature incorporated in this device. It prevents access and visibility to on-chip secure memories (and other secure resources) to unauthorized persons. It also prevents duplication and reverse engineering of proprietary code. The term “secure” implies access to on-chip secure memories and resources are blocked. The term “unsecure” implies access is allowed (the contents of the memory could be read by any means); for example, through a debugging tool such as Code Composer Studio™.

The CPU subsystem's CSM has dual-zone security, zone1 and zone2.

### 2.13.1 Functional Description

The security module restricts the CPU access to on-chip secure memory and resources without interrupting or stalling CPU execution. When a read occurs to a secure memory location, the read returns a zero value and CPU execution continues with the next instruction. This, in effect, blocks read and write access to secure memories through the JTAG port or external peripherals.

The code security mechanism offers protection for two zones, Zone 1 (Z1) and Zone 2 (Z2). The security mechanism for both the zones is identical. Each zone has its own dedicated secure resource and allocated secure resource. The following are different secure resources available on this device:

- **OTP:** Each zone has its own dedicated secure OTP (USER OTP). This contains the security configurations for the individual zone. If a zone is secure, its USER OTP content (including CSM passwords) can be read (execution not allowed) only if the zone is unlocked using the password match flow (PMF).
- **CLA:** The CLA is a secure resource which can be allocated to either zone by configuring the GRABRAM location in the USER OTP. CLA configuration can only be performed by code running from the zone to which it has been allocated. The CLA message RAMs also belong to the same zone.
- **RAM:** All Dx and LSx RAMs can be secure RAM on this device. These RAMs can be allocated to either zone by configuring the respective GRABRAM location in the USER OTP.
- **Flash Sectors:** Flash Sectors can be secure on this device. Each Flash sector can be allocated to either zone by configuring the respective GRABSECT location in the USER OTP.
- **Secure ROM:** This device also has secure ROM which is EXEONLY-protected. This ROM contains specific function for the user, provided by TI.

Table 2-14 shows the status of a RAM block based on the configuration in GRABRAM register.

**Table 2-14. RAM Status**

GRAM_RAMx Bits in Z1_GRABRAMR Register	GRAM_RAMx Bits in Z2_GRABRAMR Register	Ownership
00	XX	GRAM_RAMx is inaccessible
XX	00	GRAM_RAMx is inaccessible
Differential Value (01/10)	Differential Value (01/10)	GRAM_RAMx is inaccessible
Differential Value (01/10)	11	GRAM_RAMx belongs to Z1
11	Differential Value (01/10)	GRAM_RAMx belongs to Z2
11	11	GRAM_RAMx is Non-Secure

The security of each zone is ensured by its own 128-bit (four 32-bit words) password (CSM password). The password for each zone is stored in its dedicated OTP location based on a zone-specific link pointer. A zone can be unsecured by executing the password match flow (PMF), described in [Section 2.13.3.3.2](#).

There are three types of accesses: data/program reads, JTAG access, and instruction fetches (calls, jumps, code executions, ISRs). Instruction fetches are never blocked. JTAG accesses are always blocked when a memory is secure. Data reads to a secure memory are always blocked unless the program is executing from a memory which belongs to the same zone. Data reads to unsecure memory are always allowed. [Table 2-15](#) shows the levels of security.

**Table 2-15. Security Levels**

PMF Executed With Correct Password?	Operating Mode of the Zone	Program Fetch Location	Security Description
No	Secure	Outside secure memory	Only instruction fetches by the CPU are allowed to secure memory. In other words, code can still be executed, but not read.
No	Secure	Inside secure memory	CPU has full access (except for EXEONLY memories where read is not allowed). JTAG port cannot read the secured memory contents.
Yes	Non-Secure	Anywhere	Full access for CPU and JTAG port to secure memory of that zone.

If the password locations of a zone have all 128 bits as ones, the zone is considered unsecure. Since new Flash devices have erased Flash (all ones), only a read of the password locations is required to bring any zone into unsecure mode. If the password locations of a zone have all 128 bits as zeros, the zone is secure, regardless of the contents of the CSMKEY registers. This means the zone can't be unlocked using PMF, the password match flow described in [Section 2.13.3.3.2](#). Therefore, the user should never use all zeros as a password. A password of all zeros will prevent debug of secure code or reprogramming the Flash.

CSMKEY registers are user-accessible registers that are used to unsecure the zones.

### 2.13.1.1 Emulation Code Security Logic (ECSL)

In addition to the CSM, the emulation code security logic (ECSL) has been implemented using a 64-bit password (part of existing CSM password) for each zone to prevent unauthorized users from stepping through secure code. A halt in secure code while the emulator is connected will trip the ECSL and break the emulation connection. To allow emulation of secure code, while maintaining the CSM protection against secure memory reads, the user must write the correct 64-bit password into the CSMKEY (0/1) registers, which matches the password value stored in the USER OTP of that zone. This will disable the ECSL for the specific zone.

When initially debugging a device with the password locations in OTP programmed (secured), the emulator takes some time to take control of the CPU. During this time, the CPU will start running and may execute an instruction that performs an access to a protected ECSL area and if the CPU is halted when the program counter (PC) is pointing to a secure location, the ECSL will trip and cause the emulator connection to be broken.

The solution to this problem is:

- Use the Wait Boot Mode boot option. In this mode, the CPU will be in a loop and hence will not jump to the user application code. Using this BOOTMODE, the user can connect to CCS and debug the code.

### 2.13.1.2 CPU Secure Logic

The CPU Secure Logic (CPUSL) on this device prevents a hacker from reading the CPU registers in a watch window while code is running in a secure zone. All accesses to CPU registers when the PC points to a secure location are blocked by this logic. The only exception to this is read access to the PC. It is highly recommended not to write into the CPU register in this case, because proper code execution may get affected. If the CSM is unlocked using the CSM password match flow, the CPUSL logic also gets disabled.



### 2.13.1.3 Execute-Only Protection

To achieve a higher level of security on secure Flash sectors and RAM blocks that store critical user code (instruction opcodes), the Execute-Only protection feature is provided. When the Execute-Only protection is turned on for any secure Flash sector or RAM block, data reads to that Flash sectors are disallowed from any code (even from secure code). Execute-only protection for a Flash sector and RAM block can be turned on by configuring the bit field associated for that particular sector/RAM block in the zone's (which has ownership of that sector/RAM block) EXEONLYSECT and EXEONLYRAM register, respectively.

### 2.13.1.4 Password Lock

The password locations for each zone can be locked by programming the zone's PSWDLOCK field with any value other than "1111" (0xF) at the PSWDLOCK location in OTP. Until the passwords of a zone are locked, password locations will not be secure and can be read from the debugger as well as code running from non-secure memory. This feature can be used by the user to avoid accidental locking of the zone while programming the Flash sectors during the software development phase. On a fresh device the value for password lock fields for all zones at the PSWDLOCK location in OTP will be "1111" which means the password for all zones will be unlocked.

---

**NOTE:** Password unlock only makes password locations non-secure. All other secure memories and other locations of Flash sectors, which contain a password, remains secure as per security settings. But since passwords are non-secure, anyone can read the password and make the zone non-secure by running through PMF.

---

### 2.13.1.5 Link Pointer and Zone Select

For each of the two security zones a dedicated OTP block exists that holds the configuration related to zone's security. The following are the available programmed configurations:

- Zx-LINKPOINTER1
- Zx-LINKPOINTER2
- Zx-LINKPOINTER3
- Zx-PSWDLOCK
- Zx-CRCLOCK
- Zx-BOOTCTRL
- Zx-EXEONLYRAM
- Zx-EXEONLYSECT
- Zx-GRABRAM
- Zx-GRABSECT
- Zx-CSMPASSWORD

Since OTP can't be erased, to provide flexibility of configuring some of the security settings like CSM passwords, allocation of RAM/Flash sectors and their attributes, multiple times by the user, the following configurations are placed in zone select regions of each zone's OTP Flash.

- Zx-EXEONLYRAM
- Zx-EXEONLYSECT
- Zx-GRABRAM
- Zx-GRABSECT
- Zx-CSMPASSWORD

The location of the zone select region in OTP is decided based on the value of three 29-bit link pointers (Zx-LINKPOINTERx) programmed in the OTP of each zone. All OTP locations except link pointer locations are protected with ECC. Since the link pointer locations are not protected with ECC, three link pointers are provided that need to be programmed with the same value. The final value of the link pointer is resolved in hardware when a dummy read is done to all the link pointers by comparing all the three values (bit-wise



voting logic). Since in OTP, a '1' can be flipped by the user to '0' but '0' can't be flipped to '1' (no erase operation for OTP), the most significant bit position in the resolved link pointer which is '0', defines the valid base address for the zone select region. While generating the final link pointer value, if the bit patterns is not one of those listed in [Figure 2-20](#), the final link pointer value becomes All\_1 (0xFFFF\_FFFF) which selects the Zone-Select-Block1 (also known as the default zone select block).

**Figure 2-20. Storage of Zone-Select Bits in OTP**

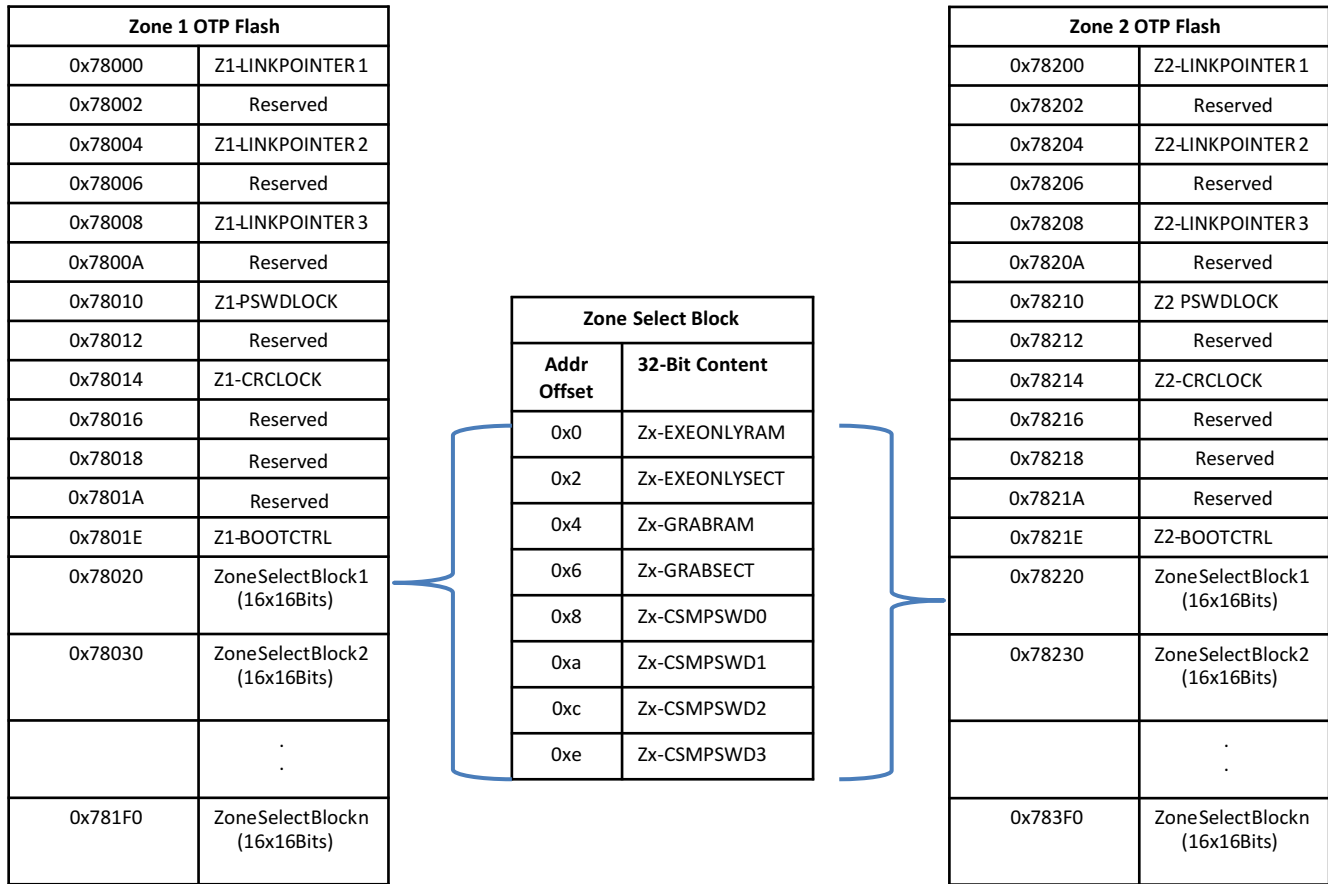
Zx-LINKPOINTER	Addr Offset Of Zone-Select Block
32'bxxx11111111111111111111111111111111	0x20
32'bxxx11111111111111111111111111111111 0	0x30
32'bxxx11111111111111111111111111111111 0x	0x40
32'bxxx11111111111111111111111111111111 0xx	0x50
32'bxxx11111111111111111111111111111111 0xxx	0x60
32'bxxx11111111111111111111111111111111 0xxxx	0x70
32'bxxx11111111111111111111111111111111 0xxxxx	0x80
32'bxxx11111111111111111111111111111111 0xxxxxx	0x90
32'bxxx11111111111111111111111111111111 0xxxxxxx	0xa0
32'bxxx11111111111111111111111111111111 0xxxxxxx	0xb0
32'bxxx11111111111111111111111111111111 0xxxxxxx	0xc0
32'bxxx11111111111111111111111111111111 0xxxxxxx	0xd0
32'bxxx11111111111111111111111111111111 0xxxxxxx	0xe0
32'bxxx11111111111111111111111111111111 0xxxxxxx	0xf0
32'bxxx11111111111111111111111111111111 0xxxxxxx	0x100
32'bxxx11111111111111111111111111111111 0xxxxxxx	0x110
32'bxxx11111111111111111111111111111111 0xxxxxxx	0x120
32'bxxx11111111111111111111111111111111 0xxxxxxx	0x130
32'bxxx11111111111111111111111111111111 0xxxxxxx	0x140
32'bxxx11111111111111111111111111111111 0xxxxxxx	0x150
32'bxxx11111111111111111111111111111111 0xxxxxxx	0x160
32'bxxx11111111111111111111111111111111 0xxxxxxx	0x170
32'bxxx11111111111111111111111111111111 0xxxxxxx	0x180
32'bxxx11111111111111111111111111111111 0xxxxxxx	0x190
32'bxxx11111111111111111111111111111111 0xxxxxxx	0x1a0
32'bxxx11111111111111111111111111111111 0xxxxxxx	0x1b0
32'bxxx11111111111111111111111111111111 0xxxxxxx	0x1c0
32'bxxx11111111111111111111111111111111 0xxxxxxx	0x1d0
32'bxxx10xxxxxxx11111111111111111111111111111111 0xxxxxxx	0x1e0
32'bxxx0xxxxxxx11111111111111111111111111111111 0xxxxxxx	0x1f0

Zone Select Block	
Addr Offset	32-Bit Content
0x0	Zx-EXEONLYRAM
0x2	Zx-EXEONLYSECT
0x4	Zx-GRABRAM
0x6	Zx-GRABSECT
0x8	Zx-CSMPSWD0
0xa	Zx-CSMPSWD1
0xc	Zx-CSMPSWD2
0xe	Zx-CSMPSWD3

**NOTE:** Address locations for other security settings (PSWDLOCK/CRCLOCK) that are not part of Zone Select blocks) can be programmed only once; therefore, the user should program them towards end of the development cycle.

Figure 2-21. Location of Zone-Select Block Based on Link-Pointer



2.13.1.5.1 C Code Example to get Zone Select Block Addr for Zone1

```

unsigned long LinkPointer;
unsigned long *ZoneSelBlockPtr;
int Bitpos = 28;
int ZeroFound = 0;

// Read Z1-Linkpointer register of DCSM module.
LinkPointer = *(unsigned long *)0x5F000;

// Bits 31 30 and 29 as most-sigificant 0 are reserved LinkPointer options

LinkPointer = LinkPointer << 2;

while ((ZeroFound == 0) && (bitpos > -1))
{
    if ((LinkPointer & 0x80000000) == 0)
    {
        ZeroFound = 1;
        ZoneSelBlockPtr = (unsigned long *) (0x78000 + ((bitpos + 3)*16));
    } else
    {
        bitpos--;
        LinkPointer = LinkPointer << 1;
    }
}
if (ZeroFound == 0)
{

```

```

//Default in case there is no zero found.
Zone1SelBlockPtr = (unsigned long *)0x78020;
}
    
```

### 2.13.1.6 Flash and OTP Erase/Program

On this device, OTP as well as normal Flash, are secure resources. Each zone has its own dedicated OTP, whereas normal Flash sectors can be allocated to any zone based on the value programmed in the GRABSECT location in OTP. Each zone has its own CSM passwords; read and write accesses are not allowed to resources owned by Z1 from code running from memory allocated to Z2 and vice versa. Before programming any secure Flash sector, the user must either unlock the zone to which that particular sector belongs, using PMF or execute the Flash programming code from secure memory which belongs to the same zone. The same is the case for erasing any secure Flash sector. To program the security settings in OTP Flash, the user must unlock the CSM of the respective zone. Unless the zone is unlocked, security settings in OTP Flash cannot be updated. The OTP content cannot be erased.

This device has only one Flash pump used for erase/program operation of normal Flash and OTP Flash. A semaphore mechanism is provided to avoid the conflict between Zone1 and Zone2. A zone needs to grab this semaphore to successfully complete the erase/program operation on the Flash sectors allocated to that zone. A semaphore can be grabbed by a zone by writing the appropriate value in the SEM field of the FLSEM register. For further details of this field, see the register description.

---

**NOTE:** If there is a loss of power or a reset of any nature during the flash programming operation, there is high probability of some (or possibly all) of the 128 bits in the corresponding 128-bit aligned address getting corrupted. If this happens while programming the password locations in USER OTP, the passwords may get corrupted.

---

### 2.13.1.7 Safe Copy Code

In some applications, the user may want to copy the code from secure Flash to secure RAM for better performance. The user cannot do this for EXEONLY flash sectors because EXEONLY secure memories cannot be read from anywhere. TI provides specific “Safe Copy Code” library functions for each zone to enable the user to copy content from EXEONLY secure flash sectors to EXEONLY RAM blocks. These functions do the copy-code operation in a highly secure environment and allow a copy to be performed only when the following conditions are met:

- The secure RAM block and the secure flash sector belong to the same zone.
- Both the secure RAM block and the secure flash sector have EXEONLY protection enabled.

For further usage of these library functions, see the device-specific Boot ROM documentation.

### 2.13.1.8 SafeCRC

Since reads from EXEONLY memories are not allowed, the user cannot calculate the CRC for content in EXEONLY memories using the VCU-II. But in some safety-critical applications, the user may have to calculate the CRC on these memories as well. To enable this without compromising on security, TI provides specific “SafeCRC” library functions for each zone. These functions do the CRC calculation in highly secure environment and allow a CRC calculation to be performed only when the following conditions are met:

- The source address should be modulo the number of words (based on length\_id) for which the CRC needs to be calculated.
- The destination address should belong to the same zone as the source address.

For further usage of these library functions, see the device-specific Boot ROM documentation.

---

**NOTE:** The user must disable all the interrupts before calling the safe copy code and the safeCRC function. If there is a vector fetch during copy code operation, the CPU gets reset immediately.

---

**Disclaimer: Code Security Module Disclaimer** The Code Security Module (CSM) included on this device was designed to password protect the data stored in the associated memory and is warranted by Texas Instruments (TI), in accordance with its standard terms and conditions, to conform to TI's published specifications for the warranty period applicable for this device. TI DOES NOT, HOWEVER, WARRANT OR REPRESENT THAT THE CSM CANNOT BE COMPROMISED OR BREACHED OR THAT THE DATA STORED IN THE ASSOCIATED MEMORY CANNOT BE ACCESSED THROUGH OTHER MEANS. MOREOVER, EXCEPT AS SET FORTH ABOVE, TI MAKES NO WARRANTIES OR REPRESENTATIONS CONCERNING THE CSM OR OPERATION OF THIS DEVICE, INCLUDING ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. IN NO EVENT SHALL TI BE LIABLE FOR ANY CONSEQUENTIAL, SPECIAL, INDIRECT, INCIDENTAL, OR PUNITIVE DAMAGES, HOWEVER CAUSED, ARISING IN ANY WAY OUT OF YOUR USE OF THE CSM OR THIS DEVICE, WHETHER OR NOT TI HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES. EXCLUDED DAMAGES INCLUDE, BUT ARE NOT LIMITED TO LOSS OF DATA, LOSS OF GOODWILL, LOSS OF USE OR INTERRUPTION OF BUSINESS OR OTHER ECONOMIC LOSS.

### **2.13.2 CSM Impact on Other On-Chip Resources**

On this device, M0/M1 and GSx memories are not secure. To avoid any potential hacking when the device is in the default state (post reset), accesses (all types) to all memories (secure as well as non-secure, except BOOT-ROM and OTP ) are disabled until proper security initialization is done. This means that after reset none of the memory resources except BOOT\_ROM and OTP is accessible to the user.

The following steps are required after reset (any type of reset) to initialize the security on each CPU subsystem.

- Dummy Read to address location of SECDC (0x703F0, TI-reserved register) in TI OTP
- Dummy Read to address location of Z1\_LINKPOINTER1 in Z1 OTP
- Dummy Read to address location of Z1\_LINKPOINTER2 in Z1 OTP
- Dummy Read to address location of Z1\_LINKPOINTER3 in Z1 OTP
- Dummy Read to address location of Z1\_PSWDLOCK in Z1 OTP
- Dummy Read to address location of Z1\_CRCLOCK in Z1 OTP
- Dummy Read to address location 0x78018 in Z1 OTP
- Dummy Read to address location of Z1\_BOOTCTRL in Z1 OTP
- Read to memory map register of Z1\_LINKPOINTER in DCSM module to calculate the address of zone select block for Z1
- Dummy read to address location of Z1\_EXEONLYRAM in Z1 OTP
- Dummy read to address location of Z1\_EXEONLYSECT in Z1 OTP
- Dummy read to address location of Z1\_GRABRAM in Z1 OTP
- Dummy read to address location of Z1\_GRABSECT in Z1 OTP
- Dummy Read to address location of Z2\_LINKPOINTER1 in Z2 OTP
- Dummy Read to address location of Z2\_LINKPOINTER2 in Z2 OTP
- Dummy Read to address location of Z2\_LINKPOINTER3 in Z2 OTP
- Dummy Read to address location of Z2\_PSWDLOCK in Z2 OTP
- Dummy Read to address location of Z2\_CRCLOCK in Z2 OTP
- Dummy Read to address location 0x78218 in Z2 OTP
- Dummy Read to address location of Z2\_BOOTCTRL in Z2 OTP
- Read to memory map register of Z2\_LINKPOINTER in DCSM module to calculate the address of zone select block for Z2
- Dummy read to address location of Z2\_EXEONLYRAM in Z2 OTP
- Dummy read to address location of Z2\_EXEONLYSECT in Z2 OTP
- Dummy read to address location of Z2\_GRABRAM in Z2 OTP
- Dummy read to address location of Z2\_GRABSECT in Z2 OTP

### 2.13.3 Incorporating Code Security in User Applications

Code security is typically not required in the development phase of a project. However, security is needed once a robust code is developed for a zone. Before such a code is programmed in the Flash memory, a CSM password should be chosen to secure the zone. Once a CSM password is in place for a zone, the zone is secured (programming a password at the appropriate locations and either performing a device reset or setting the FORCESEC bit (Zx\_CR.15) is the action that secures the device). From that time on, access to debug the contents of secure memory by any means (via JTAG, code running off external/on-chip memory, and so forth) requires a valid password. A password is not needed to run the code out of secure memory (such as in a typical end-user usage); however, access to secure memory contents for debug purposes, requires a password.

#### 2.13.3.1 Environments That Require Security Unlocking

The following are the typical situations under which unsecuring can be required:

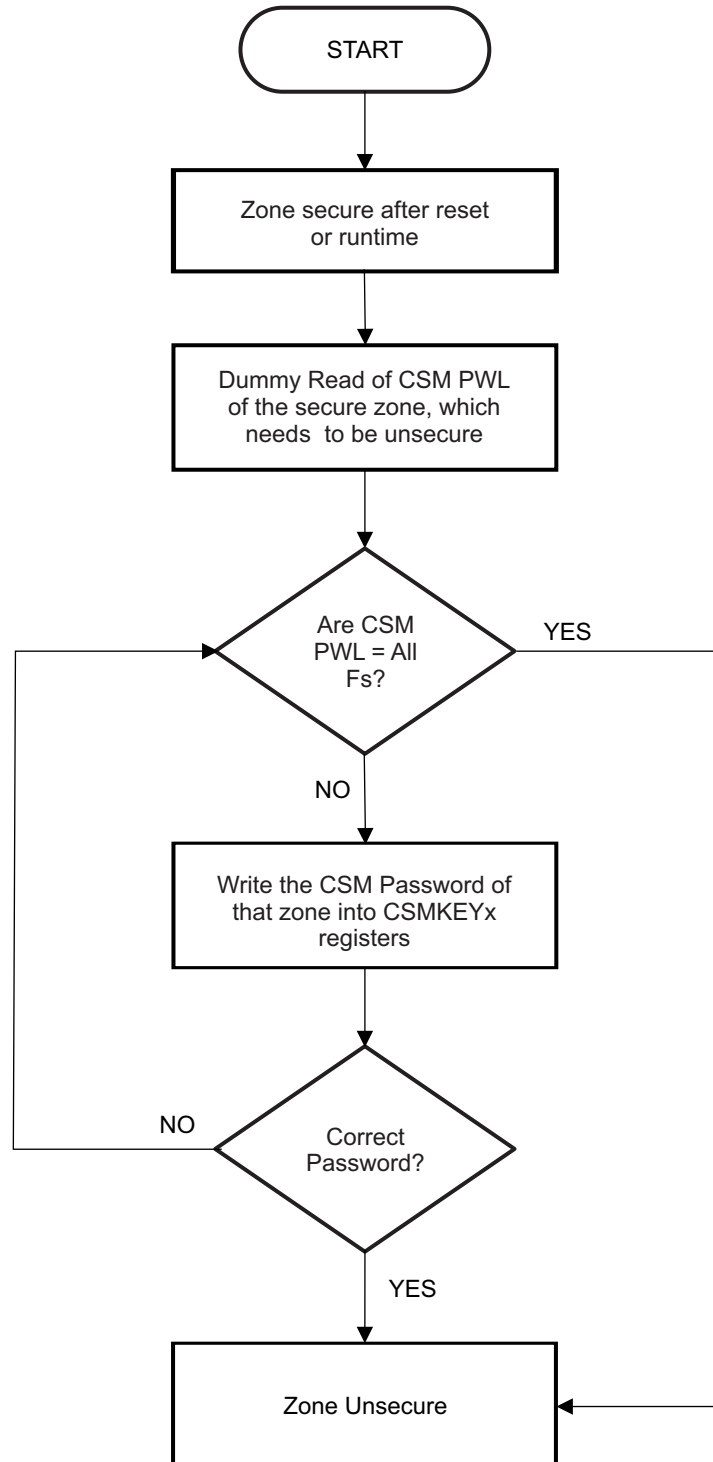
- Code development using debuggers (such as Code Composer Studio). This is the most common environment during the design phase of a product.
- Flash programming using TI's Flash utilities such as Code Composer Studio On-Chip Flash Programmer plug-in or the Uniflash tool. Flash programming is common during code development and testing. Once the user supplies the necessary password, the flash utilities disable the security logic before attempting to program the Flash. The flash utilities can disable the code security logic in new devices without any authorization, since new devices come with an erased Flash. However, reprogramming devices that already contain a custom password require the password to be supplied to the flash utilities in order to unlock the device to enable programming. In custom programming solutions that use the Flash API supplied by TI, unlocking the CSM can be avoided by executing the Flash programming algorithms from secure memory.
- Custom environment defined by the application
  - In addition to the above, access to secure memory contents can be required in situations such as:
    - Using the on-chip bootloader to load code or data into secure SARAM or to erase and program the Flash.
    - Executing code from on-chip unsecure memory and requiring access to secure memory for the lookup table. This is not a suggested operating condition as supplying the password from external code could compromise code security.

The unsecuring sequence is identical in all the above situations. This sequence is referred to as the password match flow (PMF) for simplicity. [Figure 2-22](#) explains the sequence of operation that is required every time the user attempts to unsecure a particular zone. A code example is listed for clarity.

#### 2.13.3.2 CSM Password Match Flow

Password match flow (PMF) is essentially a sequence of four dummy reads from password locations (PWL) followed by four writes (32-bit writes) to CSMKEY(0/1/2/3) registers. [Figure 2-22](#) shows how PMF helps to initialize the security logic registers and disable security logic.

Figure 2-22. CSM Password Match Flow (PMF)



2.13.3.3 Unsecuring Considerations for Zones With and Without Code Security

Case 1 and Case 2 provide unsecuring considerations for zones with and without code security.

- **Case 1: Zone With Code Security**

A zone with code security should have a predetermined password stored in the password locations of that zone. The following are steps to unsecure any secure zone:

1. Perform a dummy read of the password locations of that zone.
2. Write the password into the CSMKEY registers.
3. If the password is correct, the zone becomes unsecure; otherwise, it stays secure.

- **Case 2: Zone Without Code Security**

A zone without code security should have 0x FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF (128 bits of all ones) stored in the password locations. The following are steps to use this zone:

1. At reset, the CSM will lock memory regions protected by the CSM.
2. Perform a dummy read of the password locations.
3. Since the password is all ones, this alone will unlock the zone and all the secure memories dedicated to that zone are fully accessible immediately after this operation is completed.

---

**NOTE:** Even if a zone is not protected with a password (all password locations all ones), the CSM will lock at reset. Thus, a dummy read operation must still be performed on these zones prior to reading, writing, or programming secure memory if the code performing the access is executing from outside of the CSM protected memory region. The Boot ROM code does this dummy read for convenience.

---

### 2.13.3.3.1 C Code Example to Unsecure C28x Zone1

```
volatile long int *CSM = (volatile long int *)0x5F010; //CSM register file
volatile long int *CSMPWL = (volatile long int *)0x78028; //CSM Password location (assuming
default Zone sel block)

volatile int tmp;

int I;
// Read the 128-bits of the CSM password locations (PWL)
//
for (I=0;I<4; I++) tmp = *CSMPWL++;
// If the password locations (CSMPWL) are all = ones (0xFFFF),
// then the zone will now be unsecure. If the password
// is not all ones (0xFFFF), then the code below is required
// to unsecure the CSM.
// Write the 128-bit password to the CSMKEY registers
// If this password matches that stored in the
// CSLPWL then the CSM will become unsecure. If it does not
// match, then the zone will remain secure.
// An example password of:
// 0x11112222333344445555666677778888 is used.
*CSM++ = 0x22221111; // Register Z1_CSMKEY0 at 0x5F010
*CSM++ = 0x44443333; // Register Z1_CSMKEY1 at 0x5F012
*CSM++ = 0x66665555; // Register Z1_CSMKEY2 at 0x5F014
*CSM++ = 0x88887777; // Register Z1_CSMKEY3 at 0x5F016
```

### 2.13.3.3.2 C Code Example to Resecure C28x Zone1

```
volatile int *Z1_CR = 0x5F019; //CSMSCR register
//Set FORCESEC bit
*Z1_CR = 0x8000;
```

### 2.13.3.4 Environments That Require ECSL Unlocking

The following are the typical situations under which unsecuring can be required:

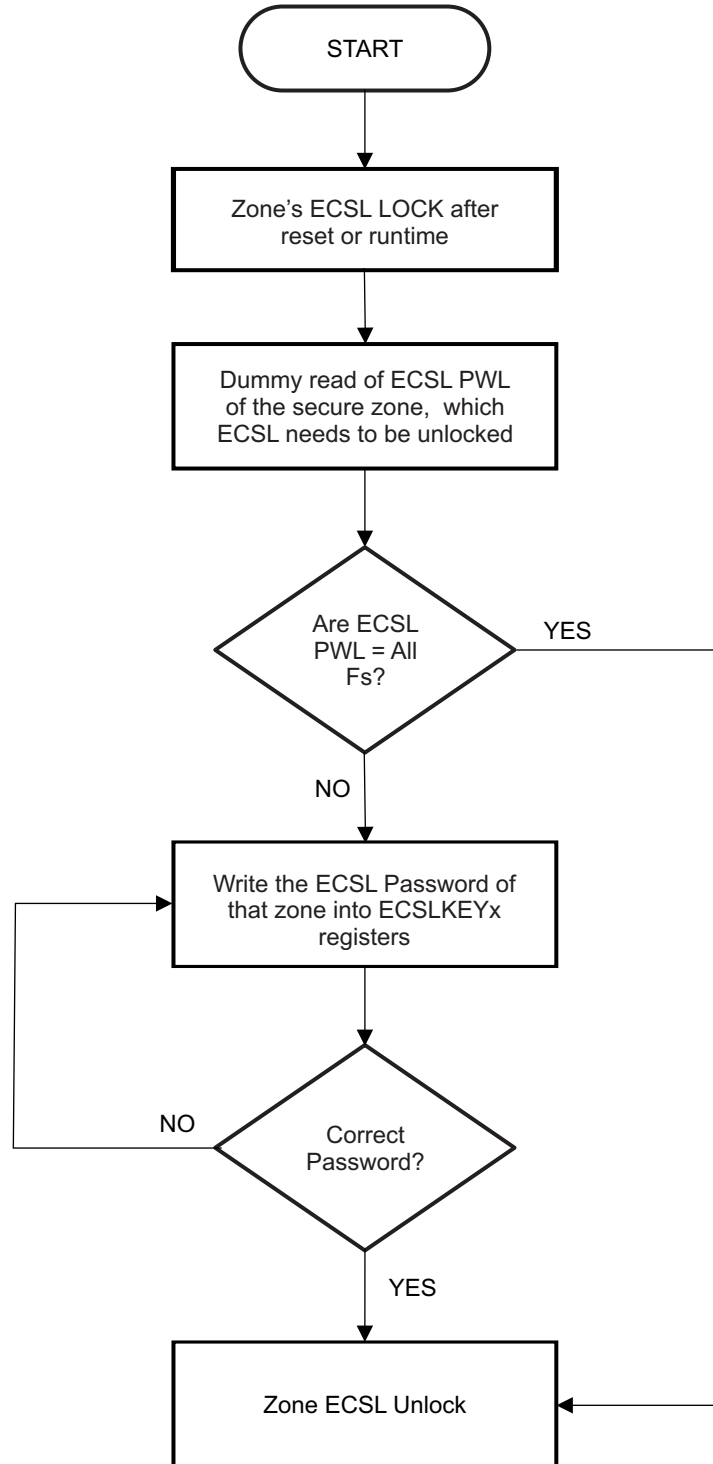
- The user develops some main IP, and then outsources peripheral functions to a subcontractor who must be able to run the user code during debug and may halt while main IP code is running. If ECSL is not unlocked, then Code Composer Studio connections will get disconnected, which can be inconvenient for the user. Note that unlocking ECSL doesn't enable access to secure code but only avoids disconnection of CCS (JTAG).



2.13.3.5 ECSL Password Match Flow

A password match flow (PMF) is essentially a sequence of eight dummy reads from password locations (PWL) followed by two writes to KEY registers. Figure 2-23 shows how the PMF helps to initialize the security logic registers and disable security logic.

Figure 2-23. ECSL Password Match Flow (PMF)



### 2.13.3.6 ECSL Disable Considerations for any Zone

A zone with ECSL enabled should have a predetermined ECSL password stored in the ECSL password locations in Flash (same as lower 64 bits of CSM passwords). The following are steps to disable the ECSL for any particular zone:

- Perform a dummy read of CAM password locations of that Zone
- Write the password into the CSMKEYx registers, corresponding to that Zone.
- If the password is correct, the ECSL gets disabled; otherwise, it stays enabled.

#### 2.13.3.6.1 C Code Example to Disable ECSL for C28x-Zone1

```
volatile long int *ECSL = (volatile int *)0x5F010; //ECSL register file
volatile long int *ECSLPWL = (volatile int *)0x78028; //ECSL Password location (assuming default
Zone sel block)

                                                                    volatile int tmp;

int I;
// Read the 64-bits of the password locations (PWL)
.
for (I=0;I<2; I++) tmp = *ECSLPWL++;
// If the ECSL password locations (ECSLPWL) are all = ones (0xFFFF),
// then the ECSL will now be disable. If the password
// is not all ones (0xFFFF), then the code below is required
// to disable the ECSL.
// Write the 64-bit password to the CSMKEYx registers
// If this password matches that stored in the
// CSMPWL then ECSL will get disable. If it does not
// match, then the zone will remain secure.
// An example password of:
// 0x1111222233334444 is used.
*ECSL++ = 0x22221111; // Register Z1_CSMKEY0 at 0x5F010
*ECSL++ = 0x44443333; // Register Z1_CSMKEY1 at 0x5F012
```

### 2.13.3.7 Device Unique ID

The bank 0 OTP contains a 256-bit value that is made up of both random and sequential parts. This value can be used as a seed for code encryption. The starting address of the value is 0x703C0. The first 192 bits are random, the next 32 bits are sequential, and the last 32 bits are a checksum value.

## 2.14 JTAG

Gel files perform certain initialization tasks. This helps the users in a debug environment. However, when executed standalone (without the emulator connected) the application may not work as expected, since there is no gel file to perform those initializations. For example, gel file disables watchdog. If user code does not service the watchdog in the application (or fails to disable it), there will be a difference in how the application behaves with the debugger and without.

Common tasks performed by the gel files (but not boot-ROM)

On Reset:

- Disable Flash ECC on some devices.
  - Disabling ECC only when using Flash API functions, see the Flash API User Guide for details. Otherwise, TI suggests to always program ECC and enable ECC-check.
- Disable Watchdog
- Enable CLA clock
- Select real-time mode or C28x mode

On Restart:

- Select real-time mode or C28x mode
- Clear IER and IFR

On Target Connect:

- Select real-time mode or C28x mode

## 2.15 Registers

### 2.15.1 Base Addresses

**Table 2-16. System Control Base Address Table**

Device Registers	Register Name	Start Address	End Address
CpuTimer0Regs	CPUTIMER_REGS	0x0000_0C00	0x0000_0C07
CpuTimer1Regs	CPUTIMER_REGS	0x0000_0C08	0x0000_0C0F
CpuTimer2Regs	CPUTIMER_REGS	0x0000_0C10	0x0000_0C17
PieCtrlRegs	PIE_CTRL_REGS	0x0000_0CE0	0x0000_0CFF
WdRegs	WD_REGS	0x0000_7000	0x0000_703F
NmiIntruptRegs	NMI_INTRUPT_REGS	0x0000_7060	0x0000_706F
XintRegs	XINT_REGS	0x0000_7070	0x0000_707F
DmaClaSrcSelRegs	DMA_CLA_SRC_SEL_REGS	0x0000_7980	0x0000_79BF
FlashPumpSemaphoreRegs	FLASH_PUMP_SEMAPHORE_REGS	0x0005_0024	0x0005_0025
DevCfgRegs	DEV_CFG_REGS	0x0005_D000	0x0005_D17F
ClkCfgRegs	CLK_CFG_REGS	0x0005_D200	0x0005_D2FF
CpuSysRegs	CPU_SYS_REGS	0x0005_D300	0x0005_D3FF
RomPrefetchRegs	ROM_PREFETCH_REGS	0x0005_E608	0x0005_E609
DcsmZ1Regs	DCSM_Z1_REGS	0x0005_F000	0x0005_F02F
DcsmZ2Regs	DCSM_Z2_REGS	0x0005_F040	0x0005_F05F
DcsmCommonRegs	DCSM_COMMON_REGS	0x0005_F070	0x0005_F07F
MemCfgRegs	MEM_CFG_REGS	0x0005_F400	0x0005_F47F
AccessProtectionRegs	ACCESS_PROTECTION_REGS	0x0005_F4C0	0x0005_F4FF
MemoryErrorRegs	MEMORY_ERROR_REGS	0x0005_F500	0x0005_F53F
RomWaitStateRegs	ROM_WAIT_STATE_REGS	0x0005_F540	0x0005_F541
Flash0CtrlRegs	FLASH_CTRL_REGS	0x0005_F800	0x0005_FAFF
Flash0EccRegs	FLASH_ECC_REGS	0x0005_FB00	0x0005_FB3F
Flash1CtrlRegs	FLASH_CTRL_REGS	0x0005_FC00	0x0005_FEFF
Flash1EccRegs	FLASH_ECC_REGS	0x0005_FF00	0x0005_FF3F

### 2.15.2 CPUTIMER\_REGS Registers

Table 2-17 lists the memory-mapped registers for the CPUTIMER\_REGS. All register offset addresses not listed in Table 2-17 should be considered as reserved locations and the register contents should not be modified.

**Table 2-17. CPUTIMER\_REGS Registers**

Offset	Acronym	Register Name	Write Protection	Section
0h	TIM	CPU-Timer, Counter Register		<a href="#">Go</a>
2h	PRD	CPU-Timer, Period Register		<a href="#">Go</a>
4h	TCR	CPU-Timer, Control Register		<a href="#">Go</a>
6h	TPR	CPU-Timer, Prescale Register		<a href="#">Go</a>
7h	TPRH	CPU-Timer, Prescale Register High		<a href="#">Go</a>

Complex bit access types are encoded to fit into small table cells. Table 2-18 shows the codes that are used for access types in this section.

**Table 2-18. CPUTIMER\_REGS Access Type Codes**

Access Type	Code	Description
<b>Read Type</b>		
R	R	Read
<b>Write Type</b>		
W	W	Write
W1C	1C W	1 to clear Write
<b>Reset or Default Value</b>		
-n		Value after reset or the default value
<b>Register Array Variables</b>		
i,j,k,l,m,n		When these variables are used in a register name, an offset, or an address, they refer to the value of a register array where the register is part of a group of repeating registers. The register groups form a hierarchical structure and the array is represented with a formula.
y		When this variable is used in a register name, an offset, or an address it refers to the value of a register array.

### 2.15.2.1 TIM Register (Offset = 0h) [reset = FFFFh]

TIM is shown in [Figure 2-24](#) and described in [Table 2-19](#).

Return to [Summary Table](#).

CPU-Timer, Counter Register

**Figure 2-24. TIM Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
MSW																LSW															
R/W-0h																R/W-FFFFh															

**Table 2-19. TIM Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	MSW	R/W	0h	CPU-Timer Counter Registers The TIMH register holds the high 16 bits of the current 32-bit count of the timer. The TIMH:TIM decrements by one every (TDDRH:TDDR+1) clock cycles, where TDDRH:TDDR is the timer prescale dividedown value. When the TIMH:TIM decrements to zero, the TIMH:TIM register is reloaded with the period value contained in the PRDH:PRD registers. The timer interrupt (TINT) signal is generated. Reset type: SYSRSn
15-0	LSW	R/W	FFFFh	CPU-Timer Counter Registers The TIM register holds the low 16 bits of the current 32-bit count of the timer. The TIMH:TIM decrements by one every (TDDRH:TDDR+1) clock cycles, where TDDRH:TDDR is the timer prescale dividedown value. When the TIMH:TIM decrements to zero, the TIMH:TIM register is reloaded with the period value contained in the PRDH:PRD registers. The timer interrupt (TINT) signal is generated. Reset type: SYSRSn

**2.15.2.2 PRD Register (Offset = 2h) [reset = 0001FFFFh]**

PRD is shown in [Figure 2-25](#) and described in [Table 2-20](#).

Return to [Summary Table](#).

CPU-Timer, Period Register

**Figure 2-25. PRD Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
MSW																LSW															
R/W-1h																R/W-FFFFh															

**Table 2-20. PRD Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	MSW	R/W	1h	<p>CPU-Timer Period Registers</p> <p>The PRDH register holds the high 16 bits of the 32-bit period. When the TIMH:TIM decrements to zero, the TIMH:TIM register is reloaded with the period value contained in the PRDH:PRD registers, at the start of the next timer input clock cycle (the output of the prescaler). The PRDH:PRD contents are also loaded into the TIMH:TIM when you set the timer reload bit (TRB) in the Timer Control Register (TCR).</p> <p>Reset type: SYSRSn</p>
15-0	LSW	R/W	FFFFh	<p>CPU-Timer Period Registers</p> <p>The PRD register holds the low 16 bits of the 32-bit period. When the TIMH:TIM decrements to zero, the TIMH:TIM register is reloaded with the period value contained in the PRDH:PRD registers, at the start of the next timer input clock cycle (the output of the prescaler). The PRDH:PRD contents are also loaded into the TIMH:TIM when you set the timer reload bit (TRB) in the Timer Control Register (TCR).</p> <p>Reset type: SYSRSn</p>



### 2.15.2.3 TCR Register (Offset = 4h) [reset = 1h]

TCR is shown in [Figure 2-26](#) and described in [Table 2-21](#).

Return to [Summary Table](#).

CPU-Timer, Control Register

**Figure 2-26. TCR Register**

15		14		13		12		11		10		9		8	
TIF		TIE		RESERVED				FREE		SOFT		RESERVED			
R/W1C-0h		R/W-0h		R-0h				R/W-0h		R/W-0h		R-0h			
7		6		5		4		3		2		1		0	
RESERVED				TRB		TSS		RESERVED							
R-0h				R/W-0h		R/W-0h		R-1h							

**Table 2-21. TCR Register Field Descriptions**

Bit	Field	Type	Reset	Description
15	TIF	R/W1C	0h	CPU-Timer Overflow Flag.  TIF indicates whether a timer overflow has happened since TIF was last cleared. TIF is not cleared automatically and does not need to be cleared to enable the next timer interrupt. Reset type: SYSRSn 0h (R/W) = The CPU-Timer has not decremented to zero. Writes of 0 are ignored. 1h (R/W) = This flag gets set when the CPU-timer decrements to zero. Writing a 1 to this bit clears the flag.
14	TIE	R/W	0h	CPU-Timer Interrupt Enable. Reset type: SYSRSn 0h (R/W) = The CPU-Timer interrupt is disabled. 1h (R/W) = The CPU-Timer interrupt is enabled. If the timer decrements to zero, and TIE is set, the timer asserts its interrupt request.
13-12	RESERVED	R	0h	Reserved
11	FREE	R/W	0h	If the FREE bit is set to 1, then, upon a software breakpoint, the timer continues to run. If FREE is 0, then the SOFT bit controls the emulation behavior. Reset type: SYSRSn 0h (R/W) = Stop after the next decrement of the TIMH:TIM (hard stop) 1h (R/W) = Stop after the TIMH:TIM decrements to 0 (soft stop)  In the SOFT STOP mode, the timer generates an interrupt before shutting down (since reaching 0 is the interrupt causing condition). 2h (R/W) = Free run 3h (R/W) = Free run
10	SOFT	R/W	0h	If the FREE bit is set to 1, then, upon a software breakpoint, the timer continues to run (that is, free runs). In this case, SOFT is a don't care. But if FREE is 0, then SOFT takes effect. In this case, if SOFT = 0, the timer halts the next time the TIMH:TIM decrements. If the SOFT bit is 1, then the timer halts when the TIMH:TIM has decremented to zero. Reset type: SYSRSn
9-6	RESERVED	R	0h	Reserved

**Table 2-21. TCR Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
5	TRB	R/W	0h	<p>Timer reload</p> <p>Reset type: SYSRStn</p> <p>0h (R/W) = The TRB bit is always read as zero. Writes of 0 are ignored.</p> <p>1h (R/W) = When you write a 1 to TRB, the TIMH:TIM is loaded with the value in the PRDH:PRD, and the prescaler counter (PSCH:PSC) is loaded with the value in the timer divideddown register (TDDR:DDR).</p>
4	TSS	R/W	0h	<p>CPU-Timer stop status bit.</p> <p>TSS is a 1-bit flag that stops or starts the CPU-timer.</p> <p>Reset type: SYSRStn</p> <p>0h (R/W) = Reads of 0 indicate the CPU-timer is running.</p> <p>To start or restart the CPU-timer, set TSS to 0. At reset, TSS is cleared to 0 and the CPU-timer immediately starts.</p> <p>1h (R/W) = Reads of 1 indicate that the CPU-timer is stopped.</p> <p>To stop the CPU-timer, set TSS to 1.</p>
3-0	RESERVED	R	1h	Reserved

### 2.15.2.4 TPR Register (Offset = 6h) [reset = 0h]

TPR is shown in [Figure 2-27](#) and described in [Table 2-22](#).

Return to [Summary Table](#).

CPU-Timer, Prescale Register

**Figure 2-27. TPR Register**

15	14	13	12	11	10	9	8
PSC							
R-0h							
7	6	5	4	3	2	1	0
TDDR							
R/W-0h							

**Table 2-22. TPR Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-8	PSC	R	0h	<p>CPU-Timer Prescale Counter.</p> <p>These bits hold the current prescale count for the timer. For every timer clock source cycle that the PSCH:PSC value is greater than 0, the PSCH:PSC decrements by one. One timer clock (output of the timer prescaler) cycle after the PSCH:PSC reaches 0, the PSCH:PSC is loaded with the contents of the TDDRH:TDDR, and the timer counter register (TIMH:TIM) decrements by one. The PSCH:PSC is also reloaded whenever the timer reload bit (TRB) is set by software. The PSCH:PSC can be checked by reading the register, but it cannot be set directly. It must get its value from the timer divide-down register (TDDRH:TDDR). At reset, the PSCH:PSC is set to 0.</p> <p>Reset type: SYSRSn</p>
7-0	TDDR	R/W	0h	<p>CPU-Timer Divide-Down.</p> <p>Every (TDDRH:TDDR + 1) timer clock source cycles, the timer counter register (TIMH:TIM) decrements by one. At reset, the TDDRH:TDDR bits are cleared to 0. To increase the overall timer count by an integer factor, write this factor minus one to the TDDRH:TDDR bits. When the prescaler counter (PSCH:PSC) value is 0, one timer clock source cycle later, the contents of the TDDRH:TDDR reload the PSCH:PSC, and the TIMH:TIM decrements by one. TDDRH:TDDR also reloads the PSCH:PSC whenever the timer reload bit (TRB) is set by software.</p> <p>Reset type: SYSRSn</p>

### 2.15.2.5 TPRH Register (Offset = 7h) [reset = 0h]

TPRH is shown in [Figure 2-28](#) and described in [Table 2-23](#).

Return to [Summary Table](#).

CPU-Timer, Prescale Register High

**Figure 2-28. TPRH Register**

15	14	13	12	11	10	9	8
PSCH							
R-0h							
7	6	5	4	3	2	1	0
TDDRH							
R/W-0h							

**Table 2-23. TPRH Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-8	PSCH	R	0h	See description of TIMERxTPR. Reset type: SYSRSn
7-0	TDDRH	R/W	0h	See description of TIMERxTPR. Reset type: SYSRSn

### 2.15.3 PIE\_CTRL\_REGS Registers

Table 2-24 lists the memory-mapped registers for the PIE\_CTRL\_REGS. All register offset addresses not listed in Table 2-24 should be considered as reserved locations and the register contents should not be modified.

**Table 2-24. PIE\_CTRL\_REGS Registers**

Offset	Acronym	Register Name	Write Protection	Section
0h	PIECTRL	ePIE Control Register		<a href="#">Go</a>
1h	PIEACK	Interrupt Acknowledge Register		<a href="#">Go</a>
2h	PIEIER1	Interrupt Group 1 Enable Register		<a href="#">Go</a>
3h	PIEIFR1	Interrupt Group 1 Flag Register		<a href="#">Go</a>
4h	PIEIER2	Interrupt Group 2 Enable Register		<a href="#">Go</a>
5h	PIEIFR2	Interrupt Group 2 Flag Register		<a href="#">Go</a>
6h	PIEIER3	Interrupt Group 3 Enable Register		<a href="#">Go</a>
7h	PIEIFR3	Interrupt Group 3 Flag Register		<a href="#">Go</a>
8h	PIEIER4	Interrupt Group 4 Enable Register		<a href="#">Go</a>
9h	PIEIFR4	Interrupt Group 4 Flag Register		<a href="#">Go</a>
Ah	PIEIER5	Interrupt Group 5 Enable Register		<a href="#">Go</a>
Bh	PIEIFR5	Interrupt Group 5 Flag Register		<a href="#">Go</a>
Ch	PIEIER6	Interrupt Group 6 Enable Register		<a href="#">Go</a>
Dh	PIEIFR6	Interrupt Group 6 Flag Register		<a href="#">Go</a>
Eh	PIEIER7	Interrupt Group 7 Enable Register		<a href="#">Go</a>
Fh	PIEIFR7	Interrupt Group 7 Flag Register		<a href="#">Go</a>
10h	PIEIER8	Interrupt Group 8 Enable Register		<a href="#">Go</a>
11h	PIEIFR8	Interrupt Group 8 Flag Register		<a href="#">Go</a>
12h	PIEIER9	Interrupt Group 9 Enable Register		<a href="#">Go</a>
13h	PIEIFR9	Interrupt Group 9 Flag Register		<a href="#">Go</a>
14h	PIEIER10	Interrupt Group 10 Enable Register		<a href="#">Go</a>
15h	PIEIFR10	Interrupt Group 10 Flag Register		<a href="#">Go</a>
16h	PIEIER11	Interrupt Group 11 Enable Register		<a href="#">Go</a>
17h	PIEIFR11	Interrupt Group 11 Flag Register		<a href="#">Go</a>
18h	PIEIER12	Interrupt Group 12 Enable Register		<a href="#">Go</a>
19h	PIEIFR12	Interrupt Group 12 Flag Register		<a href="#">Go</a>

Complex bit access types are encoded to fit into small table cells. Table 2-25 shows the codes that are used for access types in this section.

**Table 2-25. PIE\_CTRL\_REGS Access Type Codes**

Access Type	Code	Description
<b>Read Type</b>		
R	R	Read
R=0	R	Read
<b>Write Type</b>		
W	W	Write
W=1	W	Write
<b>Reset or Default Value</b>		
-n		Value after reset or the default value
<b>Register Array Variables</b>		

**Table 2-25. PIE\_CTRL\_REGS Access Type Codes (continued)**

Access Type	Code	Description
i,j,k,l,m,n		When these variables are used in a register name, an offset, or an address, they refer to the value of a register array where the register is part of a group of repeating registers. The register groups form a hierarchical structure and the array is represented with a formula.
y		When this variable is used in a register name, an offset, or an address it refers to the value of a register array.

### 2.15.3.1 PIECTRL Register (Offset = 0h) [reset = 0h]

PIECTRL is shown in [Figure 2-29](#) and described in [Table 2-26](#).

Return to [Summary Table](#).

ePIE Control Register

**Figure 2-29. PIECTRL Register**

15	14	13	12	11	10	9	8
PIEVECT							
R-0h							
7	6	5	4	3	2	1	0
PIEVECT							ENPIE
R-0h							R/W-0h

**Table 2-26. PIECTRL Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-1	PIEVECT	R	0h	These bits indicate the vector address of the vector fetched from the ePIE vector table. The least significant bit of the address is ignored and only bits 1 to 15 of the address are shown. The vector value can be read by the user to determine which interrupt generated the vector fetch.  Note: When a NMI is serviced, the PIEVECT bit-field does not reflect the vector as it does for other interrupts. Reset type: SYSRSn
0	ENPIE	R/W	0h	Enable vector fetching from ePIE block. This bit must be set to 1 for peripheral interrupts to work. All ePIE registers (PIEACK, PIEIFR, PIEIER) can be accessed even when the ePIE block is disabled. Reset type: SYSRSn



### 2.15.3.2 PIEACK Register (Offset = 1h) [reset = 0h]

PIEACK is shown in [Figure 2-30](#) and described in [Table 2-27](#).

Return to [Summary Table](#).

#### Acknowledge Register

When an interrupt propagates from the ePIE to a CPU interrupt line, the interrupt group's PIEACK bit is set. This prevents other interrupts in that group from propagating to the CPU while the first interrupt is handled. Writing a 1 to a PIEACK bit clears it and allows another interrupt from the corresponding group to propagate. ISRs for PIE interrupts should clear the group's PIEACK bit before returning from the interrupt.

Writes of 0 are ignored.

**Figure 2-30. PIEACK Register**

15	14	13	12	11	10	9	8
RESERVED				ACK12	ACK11	ACK10	ACK9
R=0-0h				R/W=1-0h	R/W=1-0h	R/W=1-0h	R/W=1-0h
7	6	5	4	3	2	1	0
ACK8	ACK7	ACK6	ACK5	ACK4	ACK3	ACK2	ACK1
R/W=1-0h	R/W=1-0h	R/W=1-0h	R/W=1-0h	R/W=1-0h	R/W=1-0h	R/W=1-0h	R/W=1-0h

**Table 2-27. PIEACK Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-12	RESERVED	R=0	0h	Reserved
11	ACK12	R/W=1	0h	Acknowledge PIE Interrupt Group 12 Reset type: SYSRSn
10	ACK11	R/W=1	0h	Acknowledge PIE Interrupt Group 11 Reset type: SYSRSn
9	ACK10	R/W=1	0h	Acknowledge PIE Interrupt Group 10 Reset type: SYSRSn
8	ACK9	R/W=1	0h	Acknowledge PIE Interrupt Group 9 Reset type: SYSRSn
7	ACK8	R/W=1	0h	Acknowledge PIE Interrupt Group 8 Reset type: SYSRSn
6	ACK7	R/W=1	0h	Acknowledge PIE Interrupt Group 7 Reset type: SYSRSn
5	ACK6	R/W=1	0h	Acknowledge PIE Interrupt Group 6 Reset type: SYSRSn
4	ACK5	R/W=1	0h	Acknowledge PIE Interrupt Group 5 Reset type: SYSRSn
3	ACK4	R/W=1	0h	Acknowledge PIE Interrupt Group 4 Reset type: SYSRSn
2	ACK3	R/W=1	0h	Acknowledge PIE Interrupt Group 3 Reset type: SYSRSn
1	ACK2	R/W=1	0h	Acknowledge PIE Interrupt Group 2 Reset type: SYSRSn
0	ACK1	R/W=1	0h	Acknowledge PIE Interrupt Group 1 Reset type: SYSRSn

### 2.15.3.3 PIEIER1 Register (Offset = 2h) [reset = 0h]

PIEIER1 is shown in [Figure 2-31](#) and described in [Table 2-28](#).

Return to [Summary Table](#).

Interrupt Group 1 Enable Register

These register bits individually enable an interrupt within a group. They behave very much like the bits in the CPU interrupt enable register (IER).

Setting a bit to 1 allows the corresponding interrupt to propagate to the CPU.

Setting a bit to 0 prevents the corresponding interrupt from propagating. Note that a peripheral interrupt signal can still set the PIEIFR bit for the disabled interrupt.

**Figure 2-31. PIEIER1 Register**

15		14		13		12		11		10		9		8	
INTx16		INTx15		INTx14		INTx13		INTx12		INTx11		INTx10		INTx9	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	
7		6		5		4		3		2		1		0	
INTx8		INTx7		INTx6		INTx5		INTx4		INTx3		INTx2		INTx1	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	

**Table 2-28. PIEIER1 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15	INTx16	R/W	0h	Enable for Interrupt 1.16 Reset type: SYSRSn
14	INTx15	R/W	0h	Enable for Interrupt 1.15 Reset type: SYSRSn
13	INTx14	R/W	0h	Enable for Interrupt 1.14 Reset type: SYSRSn
12	INTx13	R/W	0h	Enable for Interrupt 1.13 Reset type: SYSRSn
11	INTx12	R/W	0h	Enable for Interrupt 1.12 Reset type: SYSRSn
10	INTx11	R/W	0h	Enable for Interrupt 1.11 Reset type: SYSRSn
9	INTx10	R/W	0h	Enable for Interrupt 1.10 Reset type: SYSRSn
8	INTx9	R/W	0h	Enable for Interrupt 1.9 Reset type: SYSRSn
7	INTx8	R/W	0h	Enable for Interrupt 1.8 Reset type: SYSRSn
6	INTx7	R/W	0h	Enable for Interrupt 1.7 Reset type: SYSRSn
5	INTx6	R/W	0h	Enable for Interrupt 1.6 Reset type: SYSRSn
4	INTx5	R/W	0h	Enable for Interrupt 1.5 Reset type: SYSRSn
3	INTx4	R/W	0h	Enable for Interrupt 1.4 Reset type: SYSRSn
2	INTx3	R/W	0h	Enable for Interrupt 1.3 Reset type: SYSRSn

**Table 2-28. PIEIER1 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
1	INTx2	R/W	0h	Enable for Interrupt 1.2 Reset type: SYSRSn
0	INTx1	R/W	0h	Enable for Interrupt 1.1 Reset type: SYSRSn

### 2.15.3.4 PIEIFR1 Register (Offset = 3h) [reset = 0h]

PIEIFR1 is shown in [Figure 2-32](#) and described in [Table 2-29](#).

Return to [Summary Table](#).

#### Interrupt Group 1 Flag Register

These register bits indicate whether each interrupt in the group is currently pending. They behave very much like the bits in the CPU interrupt flag register (IFR).

When a peripheral sends an interrupt, the corresponding bit is set. This bit is cleared when the interrupt propagates to the CPU, at which point PIEACK is set.

NOTE: PIE IFR flags can be written to create software interrupts.

The IFR flag will be cleared on a write of zero. Hence, when the intent is to fire an interrupt it may cause inadvertent cancellation of other interrupts. It is recommended to use this only for testing or with extreme caution in the application code. Reading the PIE IFR registers is safe.

**Figure 2-32. PIEIFR1 Register**

15	14	13	12	11	10	9	8
INTx16	INTx15	INTx14	INTx13	INTx12	INTx11	INTx10	INTx9
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
7	6	5	4	3	2	1	0
INTx8	INTx7	INTx6	INTx5	INTx4	INTx3	INTx2	INTx1
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h

**Table 2-29. PIEIFR1 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15	INTx16	R/W	0h	Flag for Interrupt 1.16 Reset type: SYSRSn
14	INTx15	R/W	0h	Flag for Interrupt 1.15 Reset type: SYSRSn
13	INTx14	R/W	0h	Flag for Interrupt 1.14 Reset type: SYSRSn
12	INTx13	R/W	0h	Flag for Interrupt 1.13 Reset type: SYSRSn
11	INTx12	R/W	0h	Flag for Interrupt 1.12 Reset type: SYSRSn
10	INTx11	R/W	0h	Flag for Interrupt 1.11 Reset type: SYSRSn
9	INTx10	R/W	0h	Flag for Interrupt 1.10 Reset type: SYSRSn
8	INTx9	R/W	0h	Flag for Interrupt 1.9 Reset type: SYSRSn
7	INTx8	R/W	0h	Flag for Interrupt 1.8 Reset type: SYSRSn
6	INTx7	R/W	0h	Flag for Interrupt 1.7 Reset type: SYSRSn
5	INTx6	R/W	0h	Flag for Interrupt 1.6 Reset type: SYSRSn
4	INTx5	R/W	0h	Flag for Interrupt 1.5 Reset type: SYSRSn
3	INTx4	R/W	0h	Flag for Interrupt 1.4 Reset type: SYSRSn

**Table 2-29. PIEIFR1 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
2	INTx3	R/W	0h	Flag for Interrupt 1.3 Reset type: SYSRSn
1	INTx2	R/W	0h	Flag for Interrupt 1.2 Reset type: SYSRSn
0	INTx1	R/W	0h	Flag for Interrupt 1.1 Reset type: SYSRSn

### 2.15.3.5 PIEIER2 Register (Offset = 4h) [reset = 0h]

PIEIER2 is shown in [Figure 2-33](#) and described in [Table 2-30](#).

Return to [Summary Table](#).

Interrupt Group 2 Enable Register

These register bits individually enable an interrupt within a group. They behave very much like the bits in the CPU interrupt enable register (IER).

Setting a bit to 1 allows the corresponding interrupt to propagate to the CPU.

Setting a bit to 0 prevents the corresponding interrupt from propagating. Note that a peripheral interrupt signal can still set the PIEIFR bit for the disabled interrupt.

**Figure 2-33. PIEIER2 Register**

15		14		13		12		11		10		9		8	
INTx16		INTx15		INTx14		INTx13		INTx12		INTx11		INTx10		INTx9	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	
7		6		5		4		3		2		1		0	
INTx8		INTx7		INTx6		INTx5		INTx4		INTx3		INTx2		INTx1	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	

**Table 2-30. PIEIER2 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15	INTx16	R/W	0h	Enable for Interrupt 2.16 Reset type: SYSRSn
14	INTx15	R/W	0h	Enable for Interrupt 2.15 Reset type: SYSRSn
13	INTx14	R/W	0h	Enable for Interrupt 2.14 Reset type: SYSRSn
12	INTx13	R/W	0h	Enable for Interrupt 2.13 Reset type: SYSRSn
11	INTx12	R/W	0h	Enable for Interrupt 2.12 Reset type: SYSRSn
10	INTx11	R/W	0h	Enable for Interrupt 2.11 Reset type: SYSRSn
9	INTx10	R/W	0h	Enable for Interrupt 2.10 Reset type: SYSRSn
8	INTx9	R/W	0h	Enable for Interrupt 2.9 Reset type: SYSRSn
7	INTx8	R/W	0h	Enable for Interrupt 2.8 Reset type: SYSRSn
6	INTx7	R/W	0h	Enable for Interrupt 2.7 Reset type: SYSRSn
5	INTx6	R/W	0h	Enable for Interrupt 2.6 Reset type: SYSRSn
4	INTx5	R/W	0h	Enable for Interrupt 2.5 Reset type: SYSRSn
3	INTx4	R/W	0h	Enable for Interrupt 2.4 Reset type: SYSRSn
2	INTx3	R/W	0h	Enable for Interrupt 2.3 Reset type: SYSRSn

**Table 2-30. PIEIER2 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
1	INTx2	R/W	0h	Enable for Interrupt 2.2 Reset type: SYSRSn
0	INTx1	R/W	0h	Enable for Interrupt 2.1 Reset type: SYSRSn



### 2.15.3.6 PIEIFR2 Register (Offset = 5h) [reset = 0h]

PIEIFR2 is shown in [Figure 2-34](#) and described in [Table 2-31](#).

Return to [Summary Table](#).

#### Interrupt Group 2 Flag Register

These register bits indicate whether each interrupt in the group is currently pending. They behave very much like the bits in the CPU interrupt flag register (IFR).

When a peripheral sends an interrupt, the corresponding bit is set. This bit is cleared when the interrupt propagates to the CPU, at which point PIEACK is set.

NOTE: PIE IFR flags can be written to create software interrupts.

The IFR flag will be cleared on a write of zero. Hence, when the intent is to fire an interrupt it may cause inadvertent cancellation of other interrupts. It is recommended to use this only for testing or with extreme caution in the application code. Reading the PIE IFR registers is safe.

**Figure 2-34. PIEIFR2 Register**

15	14	13	12	11	10	9	8
INTx16	INTx15	INTx14	INTx13	INTx12	INTx11	INTx10	INTx9
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
7	6	5	4	3	2	1	0
INTx8	INTx7	INTx6	INTx5	INTx4	INTx3	INTx2	INTx1
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h

**Table 2-31. PIEIFR2 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15	INTx16	R/W	0h	Flag for Interrupt 2.16 Reset type: SYSRSn
14	INTx15	R/W	0h	Flag for Interrupt 2.15 Reset type: SYSRSn
13	INTx14	R/W	0h	Flag for Interrupt 2.14 Reset type: SYSRSn
12	INTx13	R/W	0h	Flag for Interrupt 2.13 Reset type: SYSRSn
11	INTx12	R/W	0h	Flag for Interrupt 2.12 Reset type: SYSRSn
10	INTx11	R/W	0h	Flag for Interrupt 2.11 Reset type: SYSRSn
9	INTx10	R/W	0h	Flag for Interrupt 2.10 Reset type: SYSRSn
8	INTx9	R/W	0h	Flag for Interrupt 2.9 Reset type: SYSRSn
7	INTx8	R/W	0h	Flag for Interrupt 2.8 Reset type: SYSRSn
6	INTx7	R/W	0h	Flag for Interrupt 2.7 Reset type: SYSRSn
5	INTx6	R/W	0h	Flag for Interrupt 2.6 Reset type: SYSRSn
4	INTx5	R/W	0h	Flag for Interrupt 2.5 Reset type: SYSRSn
3	INTx4	R/W	0h	Flag for Interrupt 2.4 Reset type: SYSRSn

**Table 2-31. PIEIFR2 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
2	INTx3	R/W	0h	Flag for Interrupt 2.3 Reset type: SYSRSn
1	INTx2	R/W	0h	Flag for Interrupt 2.2 Reset type: SYSRSn
0	INTx1	R/W	0h	Flag for Interrupt 2.1 Reset type: SYSRSn

### 2.15.3.7 PIEIER3 Register (Offset = 6h) [reset = 0h]

PIEIER3 is shown in [Figure 2-35](#) and described in [Table 2-32](#).

Return to [Summary Table](#).

Interrupt Group 3 Enable Register

These register bits individually enable an interrupt within a group. They behave very much like the bits in the CPU interrupt enable register (IER).

Setting a bit to 1 allows the corresponding interrupt to propagate to the CPU.

Setting a bit to 0 prevents the corresponding interrupt from propagating. Note that a peripheral interrupt signal can still set the PIEIFR bit for the disabled interrupt.

**Figure 2-35. PIEIER3 Register**

15		14		13		12		11		10		9		8	
INTx16		INTx15		INTx14		INTx13		INTx12		INTx11		INTx10		INTx9	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	
7		6		5		4		3		2		1		0	
INTx8		INTx7		INTx6		INTx5		INTx4		INTx3		INTx2		INTx1	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	

**Table 2-32. PIEIER3 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15	INTx16	R/W	0h	Enable for Interrupt 3.16 Reset type: SYSRSn
14	INTx15	R/W	0h	Enable for Interrupt 3.15 Reset type: SYSRSn
13	INTx14	R/W	0h	Enable for Interrupt 3.14 Reset type: SYSRSn
12	INTx13	R/W	0h	Enable for Interrupt 3.13 Reset type: SYSRSn
11	INTx12	R/W	0h	Enable for Interrupt 3.12 Reset type: SYSRSn
10	INTx11	R/W	0h	Enable for Interrupt 3.11 Reset type: SYSRSn
9	INTx10	R/W	0h	Enable for Interrupt 3.10 Reset type: SYSRSn
8	INTx9	R/W	0h	Enable for Interrupt 3.9 Reset type: SYSRSn
7	INTx8	R/W	0h	Enable for Interrupt 3.8 Reset type: SYSRSn
6	INTx7	R/W	0h	Enable for Interrupt 3.7 Reset type: SYSRSn
5	INTx6	R/W	0h	Enable for Interrupt 3.6 Reset type: SYSRSn
4	INTx5	R/W	0h	Enable for Interrupt 3.5 Reset type: SYSRSn
3	INTx4	R/W	0h	Enable for Interrupt 3.4 Reset type: SYSRSn
2	INTx3	R/W	0h	Enable for Interrupt 3.3 Reset type: SYSRSn

**Table 2-32. PIEIER3 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
1	INTx2	R/W	0h	Enable for Interrupt 3.2 Reset type: SYSRSn
0	INTx1	R/W	0h	Enable for Interrupt 3.1 Reset type: SYSRSn

### 2.15.3.8 PIEIFR3 Register (Offset = 7h) [reset = 0h]

PIEIFR3 is shown in [Figure 2-36](#) and described in [Table 2-33](#).

Return to [Summary Table](#).

#### Interrupt Group 3 Flag Register

These register bits indicate whether each interrupt in the group is currently pending. They behave very much like the bits in the CPU interrupt flag register (IFR).

When a peripheral sends an interrupt, the corresponding bit is set. This bit is cleared when the interrupt propagates to the CPU, at which point PIEACK is set.

NOTE: PIE IFR flags can be written to create software interrupts.

The IFR flag will be cleared on a write of zero. Hence, when the intent is to fire an interrupt it may cause inadvertent cancellation of other interrupts. It is recommended to use this only for testing or with extreme caution in the application code. Reading the PIE IFR registers is safe.

**Figure 2-36. PIEIFR3 Register**

15	14	13	12	11	10	9	8
INTx16	INTx15	INTx14	INTx13	INTx12	INTx11	INTx10	INTx9
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
7	6	5	4	3	2	1	0
INTx8	INTx7	INTx6	INTx5	INTx4	INTx3	INTx2	INTx1
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h

**Table 2-33. PIEIFR3 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15	INTx16	R/W	0h	Flag for Interrupt 3.16 Reset type: SYSRSn
14	INTx15	R/W	0h	Flag for Interrupt 3.15 Reset type: SYSRSn
13	INTx14	R/W	0h	Flag for Interrupt 3.14 Reset type: SYSRSn
12	INTx13	R/W	0h	Flag for Interrupt 3.13 Reset type: SYSRSn
11	INTx12	R/W	0h	Flag for Interrupt 3.12 Reset type: SYSRSn
10	INTx11	R/W	0h	Flag for Interrupt 3.11 Reset type: SYSRSn
9	INTx10	R/W	0h	Flag for Interrupt 3.10 Reset type: SYSRSn
8	INTx9	R/W	0h	Flag for Interrupt 3.9 Reset type: SYSRSn
7	INTx8	R/W	0h	Flag for Interrupt 3.8 Reset type: SYSRSn
6	INTx7	R/W	0h	Flag for Interrupt 3.7 Reset type: SYSRSn
5	INTx6	R/W	0h	Flag for Interrupt 3.6 Reset type: SYSRSn
4	INTx5	R/W	0h	Flag for Interrupt 3.5 Reset type: SYSRSn
3	INTx4	R/W	0h	Flag for Interrupt 3.4 Reset type: SYSRSn

**Table 2-33. PIEIFR3 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
2	INTx3	R/W	0h	Flag for Interrupt 3.3 Reset type: SYSRSn
1	INTx2	R/W	0h	Flag for Interrupt 3.2 Reset type: SYSRSn
0	INTx1	R/W	0h	Flag for Interrupt 3.1 Reset type: SYSRSn

### 2.15.3.9 PIEIER4 Register (Offset = 8h) [reset = 0h]

PIEIER4 is shown in [Figure 2-37](#) and described in [Table 2-34](#).

Return to [Summary Table](#).

Interrupt Group 4 Enable Register

These register bits individually enable an interrupt within a group. They behave very much like the bits in the CPU interrupt enable register (IER).

Setting a bit to 1 allows the corresponding interrupt to propagate to the CPU.

Setting a bit to 0 prevents the corresponding interrupt from propagating. Note that a peripheral interrupt signal can still set the PIEIFR bit for the disabled interrupt.

**Figure 2-37. PIEIER4 Register**

15		14		13		12		11		10		9		8	
INTx16		INTx15		INTx14		INTx13		INTx12		INTx11		INTx10		INTx9	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	
7		6		5		4		3		2		1		0	
INTx8		INTx7		INTx6		INTx5		INTx4		INTx3		INTx2		INTx1	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	

**Table 2-34. PIEIER4 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15	INTx16	R/W	0h	Enable for Interrupt 4.16 Reset type: SYSRSn
14	INTx15	R/W	0h	Enable for Interrupt 4.15 Reset type: SYSRSn
13	INTx14	R/W	0h	Enable for Interrupt 4.14 Reset type: SYSRSn
12	INTx13	R/W	0h	Enable for Interrupt 4.13 Reset type: SYSRSn
11	INTx12	R/W	0h	Enable for Interrupt 4.12 Reset type: SYSRSn
10	INTx11	R/W	0h	Enable for Interrupt 4.11 Reset type: SYSRSn
9	INTx10	R/W	0h	Enable for Interrupt 4.10 Reset type: SYSRSn
8	INTx9	R/W	0h	Enable for Interrupt 4.9 Reset type: SYSRSn
7	INTx8	R/W	0h	Enable for Interrupt 4.8 Reset type: SYSRSn
6	INTx7	R/W	0h	Enable for Interrupt 4.7 Reset type: SYSRSn
5	INTx6	R/W	0h	Enable for Interrupt 4.6 Reset type: SYSRSn
4	INTx5	R/W	0h	Enable for Interrupt 4.5 Reset type: SYSRSn
3	INTx4	R/W	0h	Enable for Interrupt 4.4 Reset type: SYSRSn
2	INTx3	R/W	0h	Enable for Interrupt 4.3 Reset type: SYSRSn



**Table 2-34. PIEIER4 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
1	INTx2	R/W	0h	Enable for Interrupt 4.2 Reset type: SYSRSn
0	INTx1	R/W	0h	Enable for Interrupt 4.1 Reset type: SYSRSn

### 2.15.3.10 PIEIFR4 Register (Offset = 9h) [reset = 0h]

PIEIFR4 is shown in [Figure 2-38](#) and described in [Table 2-35](#).

Return to [Summary Table](#).

#### Interrupt Group 4 Flag Register

These register bits indicate whether each interrupt in the group is currently pending. They behave very much like the bits in the CPU interrupt flag register (IFR).

When a peripheral sends an interrupt, the corresponding bit is set. This bit is cleared when the interrupt propagates to the CPU, at which point PIEACK is set.

NOTE: PIE IFR flags can be written to create software interrupts.

The IFR flag will be cleared on a write of zero. Hence, when the intent is to fire an interrupt it may cause inadvertent cancellation of other interrupts. It is recommended to use this only for testing or with extreme caution in the application code. Reading the PIE IFR registers is safe.

**Figure 2-38. PIEIFR4 Register**

15	14	13	12	11	10	9	8
INTx16	INTx15	INTx14	INTx13	INTx12	INTx11	INTx10	INTx9
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
7	6	5	4	3	2	1	0
INTx8	INTx7	INTx6	INTx5	INTx4	INTx3	INTx2	INTx1
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h

**Table 2-35. PIEIFR4 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15	INTx16	R/W	0h	Flag for Interrupt 4.16 Reset type: SYSRSn
14	INTx15	R/W	0h	Flag for Interrupt 4.15 Reset type: SYSRSn
13	INTx14	R/W	0h	Flag for Interrupt 4.14 Reset type: SYSRSn
12	INTx13	R/W	0h	Flag for Interrupt 4.13 Reset type: SYSRSn
11	INTx12	R/W	0h	Flag for Interrupt 4.12 Reset type: SYSRSn
10	INTx11	R/W	0h	Flag for Interrupt 4.11 Reset type: SYSRSn
9	INTx10	R/W	0h	Flag for Interrupt 4.10 Reset type: SYSRSn
8	INTx9	R/W	0h	Flag for Interrupt 4.9 Reset type: SYSRSn
7	INTx8	R/W	0h	Flag for Interrupt 4.8 Reset type: SYSRSn
6	INTx7	R/W	0h	Flag for Interrupt 4.7 Reset type: SYSRSn
5	INTx6	R/W	0h	Flag for Interrupt 4.6 Reset type: SYSRSn
4	INTx5	R/W	0h	Flag for Interrupt 4.5 Reset type: SYSRSn
3	INTx4	R/W	0h	Flag for Interrupt 4.4 Reset type: SYSRSn

**Table 2-35. PIEIFR4 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
2	INTx3	R/W	0h	Flag for Interrupt 4.3 Reset type: SYSRSn
1	INTx2	R/W	0h	Flag for Interrupt 4.2 Reset type: SYSRSn
0	INTx1	R/W	0h	Flag for Interrupt 4.1 Reset type: SYSRSn

### 2.15.3.11 PIEIER5 Register (Offset = Ah) [reset = 0h]

PIEIER5 is shown in [Figure 2-39](#) and described in [Table 2-36](#).

Return to [Summary Table](#).

Interrupt Group 5 Enable Register

These register bits individually enable an interrupt within a group. They behave very much like the bits in the CPU interrupt enable register (IER).

Setting a bit to 1 allows the corresponding interrupt to propagate to the CPU.

Setting a bit to 0 prevents the corresponding interrupt from propagating. Note that a peripheral interrupt signal can still set the PIEIFR bit for the disabled interrupt.

**Figure 2-39. PIEIER5 Register**

15		14		13		12		11		10		9		8	
INTx16		INTx15		INTx14		INTx13		INTx12		INTx11		INTx10		INTx9	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	
7		6		5		4		3		2		1		0	
INTx8		INTx7		INTx6		INTx5		INTx4		INTx3		INTx2		INTx1	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	

**Table 2-36. PIEIER5 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15	INTx16	R/W	0h	Enable for Interrupt 5.16 Reset type: SYSRSn
14	INTx15	R/W	0h	Enable for Interrupt 5.15 Reset type: SYSRSn
13	INTx14	R/W	0h	Enable for Interrupt 5.14 Reset type: SYSRSn
12	INTx13	R/W	0h	Enable for Interrupt 5.13 Reset type: SYSRSn
11	INTx12	R/W	0h	Enable for Interrupt 5.12 Reset type: SYSRSn
10	INTx11	R/W	0h	Enable for Interrupt 5.11 Reset type: SYSRSn
9	INTx10	R/W	0h	Enable for Interrupt 5.10 Reset type: SYSRSn
8	INTx9	R/W	0h	Enable for Interrupt 5.9 Reset type: SYSRSn
7	INTx8	R/W	0h	Enable for Interrupt 5.8 Reset type: SYSRSn
6	INTx7	R/W	0h	Enable for Interrupt 5.7 Reset type: SYSRSn
5	INTx6	R/W	0h	Enable for Interrupt 5.6 Reset type: SYSRSn
4	INTx5	R/W	0h	Enable for Interrupt 5.5 Reset type: SYSRSn
3	INTx4	R/W	0h	Enable for Interrupt 5.4 Reset type: SYSRSn
2	INTx3	R/W	0h	Enable for Interrupt 5.3 Reset type: SYSRSn

**Table 2-36. PIEIER5 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
1	INTx2	R/W	0h	Enable for Interrupt 5.2 Reset type: SYSRSn
0	INTx1	R/W	0h	Enable for Interrupt 5.1 Reset type: SYSRSn

### 2.15.3.12 PIEIFR5 Register (Offset = Bh) [reset = 0h]

PIEIFR5 is shown in [Figure 2-40](#) and described in [Table 2-37](#).

Return to [Summary Table](#).

#### Interrupt Group 5 Flag Register

These register bits indicate whether each interrupt in the group is currently pending. They behave very much like the bits in the CPU interrupt flag register (IFR).

When a peripheral sends an interrupt, the corresponding bit is set. This bit is cleared when the interrupt propagates to the CPU, at which point PIEACK is set.

NOTE: PIE IFR flags can be written to create software interrupts.

The IFR flag will be cleared on a write of zero. Hence, when the intent is to fire an interrupt it may cause inadvertent cancellation of other interrupts. It is recommended to use this only for testing or with extreme caution in the application code. Reading the PIE IFR registers is safe.

**Figure 2-40. PIEIFR5 Register**

15		14		13		12		11		10		9		8	
INTx16		INTx15		INTx14		INTx13		INTx12		INTx11		INTx10		INTx9	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	
7		6		5		4		3		2		1		0	
INTx8		INTx7		INTx6		INTx5		INTx4		INTx3		INTx2		INTx1	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	

**Table 2-37. PIEIFR5 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15	INTx16	R/W	0h	Flag for Interrupt 5.16 Reset type: SYSRSn
14	INTx15	R/W	0h	Flag for Interrupt 5.15 Reset type: SYSRSn
13	INTx14	R/W	0h	Flag for Interrupt 5.14 Reset type: SYSRSn
12	INTx13	R/W	0h	Flag for Interrupt 5.13 Reset type: SYSRSn
11	INTx12	R/W	0h	Flag for Interrupt 5.12 Reset type: SYSRSn
10	INTx11	R/W	0h	Flag for Interrupt 5.11 Reset type: SYSRSn
9	INTx10	R/W	0h	Flag for Interrupt 5.10 Reset type: SYSRSn
8	INTx9	R/W	0h	Flag for Interrupt 5.9 Reset type: SYSRSn
7	INTx8	R/W	0h	Flag for Interrupt 5.8 Reset type: SYSRSn
6	INTx7	R/W	0h	Flag for Interrupt 5.7 Reset type: SYSRSn
5	INTx6	R/W	0h	Flag for Interrupt 5.6 Reset type: SYSRSn
4	INTx5	R/W	0h	Flag for Interrupt 5.5 Reset type: SYSRSn
3	INTx4	R/W	0h	Flag for Interrupt 5.4 Reset type: SYSRSn

**Table 2-37. PIEIFR5 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
2	INTx3	R/W	0h	Flag for Interrupt 5.3 Reset type: SYSRSn
1	INTx2	R/W	0h	Flag for Interrupt 5.2 Reset type: SYSRSn
0	INTx1	R/W	0h	Flag for Interrupt 5.1 Reset type: SYSRSn

### 2.15.3.13 PIEIER6 Register (Offset = Ch) [reset = 0h]

PIEIER6 is shown in [Figure 2-41](#) and described in [Table 2-38](#).

Return to [Summary Table](#).

Interrupt Group 6 Enable Register

These register bits individually enable an interrupt within a group. They behave very much like the bits in the CPU interrupt enable register (IER).

Setting a bit to 1 allows the corresponding interrupt to propagate to the CPU.

Setting a bit to 0 prevents the corresponding interrupt from propagating. Note that a peripheral interrupt signal can still set the PIEIFR bit for the disabled interrupt.

**Figure 2-41. PIEIER6 Register**

15		14		13		12		11		10		9		8	
INTx16		INTx15		INTx14		INTx13		INTx12		INTx11		INTx10		INTx9	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	
7		6		5		4		3		2		1		0	
INTx8		INTx7		INTx6		INTx5		INTx4		INTx3		INTx2		INTx1	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	

**Table 2-38. PIEIER6 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15	INTx16	R/W	0h	Enable for Interrupt 6.16 Reset type: SYSRSn
14	INTx15	R/W	0h	Enable for Interrupt 6.15 Reset type: SYSRSn
13	INTx14	R/W	0h	Enable for Interrupt 6.14 Reset type: SYSRSn
12	INTx13	R/W	0h	Enable for Interrupt 6.13 Reset type: SYSRSn
11	INTx12	R/W	0h	Enable for Interrupt 6.12 Reset type: SYSRSn
10	INTx11	R/W	0h	Enable for Interrupt 6.11 Reset type: SYSRSn
9	INTx10	R/W	0h	Enable for Interrupt 6.10 Reset type: SYSRSn
8	INTx9	R/W	0h	Enable for Interrupt 6.9 Reset type: SYSRSn
7	INTx8	R/W	0h	Enable for Interrupt 6.8 Reset type: SYSRSn
6	INTx7	R/W	0h	Enable for Interrupt 6.7 Reset type: SYSRSn
5	INTx6	R/W	0h	Enable for Interrupt 6.6 Reset type: SYSRSn
4	INTx5	R/W	0h	Enable for Interrupt 6.5 Reset type: SYSRSn
3	INTx4	R/W	0h	Enable for Interrupt 6.4 Reset type: SYSRSn
2	INTx3	R/W	0h	Enable for Interrupt 6.3 Reset type: SYSRSn



**Table 2-38. PIEIER6 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
1	INTx2	R/W	0h	Enable for Interrupt 6.2 Reset type: SYSRSn
0	INTx1	R/W	0h	Enable for Interrupt 6.1 Reset type: SYSRSn

### 2.15.3.14 PIEIFR6 Register (Offset = Dh) [reset = 0h]

PIEIFR6 is shown in [Figure 2-42](#) and described in [Table 2-39](#).

Return to [Summary Table](#).

#### Interrupt Group 6 Flag Register

These register bits indicate whether each interrupt in the group is currently pending. They behave very much like the bits in the CPU interrupt flag register (IFR).

When a peripheral sends an interrupt, the corresponding bit is set. This bit is cleared when the interrupt propagates to the CPU, at which point PIEACK is set.

NOTE: PIE IFR flags can be written to create software interrupts.

The IFR flag will be cleared on a write of zero. Hence, when the intent is to fire an interrupt it may cause inadvertent cancellation of other interrupts. It is recommended to use this only for testing or with extreme caution in the application code. Reading the PIE IFR registers is safe.

**Figure 2-42. PIEIFR6 Register**

15	14	13	12	11	10	9	8
INTx16	INTx15	INTx14	INTx13	INTx12	INTx11	INTx10	INTx9
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
7	6	5	4	3	2	1	0
INTx8	INTx7	INTx6	INTx5	INTx4	INTx3	INTx2	INTx1
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h

**Table 2-39. PIEIFR6 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15	INTx16	R/W	0h	Flag for Interrupt 6.16 Reset type: SYSRSn
14	INTx15	R/W	0h	Flag for Interrupt 6.15 Reset type: SYSRSn
13	INTx14	R/W	0h	Flag for Interrupt 6.14 Reset type: SYSRSn
12	INTx13	R/W	0h	Flag for Interrupt 6.13 Reset type: SYSRSn
11	INTx12	R/W	0h	Flag for Interrupt 6.12 Reset type: SYSRSn
10	INTx11	R/W	0h	Flag for Interrupt 6.11 Reset type: SYSRSn
9	INTx10	R/W	0h	Flag for Interrupt 6.10 Reset type: SYSRSn
8	INTx9	R/W	0h	Flag for Interrupt 6.9 Reset type: SYSRSn
7	INTx8	R/W	0h	Flag for Interrupt 6.8 Reset type: SYSRSn
6	INTx7	R/W	0h	Flag for Interrupt 6.7 Reset type: SYSRSn
5	INTx6	R/W	0h	Flag for Interrupt 6.6 Reset type: SYSRSn
4	INTx5	R/W	0h	Flag for Interrupt 6.5 Reset type: SYSRSn
3	INTx4	R/W	0h	Flag for Interrupt 6.4 Reset type: SYSRSn

**Table 2-39. PIEIFR6 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
2	INTx3	R/W	0h	Flag for Interrupt 6.3 Reset type: SYSRSn
1	INTx2	R/W	0h	Flag for Interrupt 6.2 Reset type: SYSRSn
0	INTx1	R/W	0h	Flag for Interrupt 6.1 Reset type: SYSRSn

### 2.15.3.15 PIEIER7 Register (Offset = Eh) [reset = 0h]

PIEIER7 is shown in [Figure 2-43](#) and described in [Table 2-40](#).

Return to [Summary Table](#).

Interrupt Group 7 Enable Register

These register bits individually enable an interrupt within a group. They behave very much like the bits in the CPU interrupt enable register (IER).

Setting a bit to 1 allows the corresponding interrupt to propagate to the CPU.

Setting a bit to 0 prevents the corresponding interrupt from propagating. Note that a peripheral interrupt signal can still set the PIEIFR bit for the disabled interrupt.

**Figure 2-43. PIEIER7 Register**

15		14		13		12		11		10		9		8	
INTx16		INTx15		INTx14		INTx13		INTx12		INTx11		INTx10		INTx9	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	
7		6		5		4		3		2		1		0	
INTx8		INTx7		INTx6		INTx5		INTx4		INTx3		INTx2		INTx1	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	

**Table 2-40. PIEIER7 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15	INTx16	R/W	0h	Enable for Interrupt 7.16 Reset type: SYSRSn
14	INTx15	R/W	0h	Enable for Interrupt 7.15 Reset type: SYSRSn
13	INTx14	R/W	0h	Enable for Interrupt 7.14 Reset type: SYSRSn
12	INTx13	R/W	0h	Enable for Interrupt 7.13 Reset type: SYSRSn
11	INTx12	R/W	0h	Enable for Interrupt 7.12 Reset type: SYSRSn
10	INTx11	R/W	0h	Enable for Interrupt 7.11 Reset type: SYSRSn
9	INTx10	R/W	0h	Enable for Interrupt 7.10 Reset type: SYSRSn
8	INTx9	R/W	0h	Enable for Interrupt 7.9 Reset type: SYSRSn
7	INTx8	R/W	0h	Enable for Interrupt 7.8 Reset type: SYSRSn
6	INTx7	R/W	0h	Enable for Interrupt 7.7 Reset type: SYSRSn
5	INTx6	R/W	0h	Enable for Interrupt 7.6 Reset type: SYSRSn
4	INTx5	R/W	0h	Enable for Interrupt 7.5 Reset type: SYSRSn
3	INTx4	R/W	0h	Enable for Interrupt 7.4 Reset type: SYSRSn
2	INTx3	R/W	0h	Enable for Interrupt 7.3 Reset type: SYSRSn

**Table 2-40. PIEIER7 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
1	INTx2	R/W	0h	Enable for Interrupt 7.2 Reset type: SYSRSn
0	INTx1	R/W	0h	Enable for Interrupt 7.1 Reset type: SYSRSn

### 2.15.3.16 PIEIFR7 Register (Offset = Fh) [reset = 0h]

PIEIFR7 is shown in [Figure 2-44](#) and described in [Table 2-41](#).

Return to [Summary Table](#).

#### Interrupt Group 7 Flag Register

These register bits indicate whether each interrupt in the group is currently pending. They behave very much like the bits in the CPU interrupt flag register (IFR).

When a peripheral sends an interrupt, the corresponding bit is set. This bit is cleared when the interrupt propagates to the CPU, at which point PIEACK is set.

NOTE: PIE IFR flags can be written to create software interrupts.

The IFR flag will be cleared on a write of zero. Hence, when the intent is to fire an interrupt it may cause inadvertent cancellation of other interrupts. It is recommended to use this only for testing or with extreme caution in the application code. Reading the PIE IFR registers is safe.

**Figure 2-44. PIEIFR7 Register**

15	14	13	12	11	10	9	8
INTx16	INTx15	INTx14	INTx13	INTx12	INTx11	INTx10	INTx9
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
7	6	5	4	3	2	1	0
INTx8	INTx7	INTx6	INTx5	INTx4	INTx3	INTx2	INTx1
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h

**Table 2-41. PIEIFR7 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15	INTx16	R/W	0h	Flag for Interrupt 7.16 Reset type: SYSRSn
14	INTx15	R/W	0h	Flag for Interrupt 7.15 Reset type: SYSRSn
13	INTx14	R/W	0h	Flag for Interrupt 7.14 Reset type: SYSRSn
12	INTx13	R/W	0h	Flag for Interrupt 7.13 Reset type: SYSRSn
11	INTx12	R/W	0h	Flag for Interrupt 7.12 Reset type: SYSRSn
10	INTx11	R/W	0h	Flag for Interrupt 7.11 Reset type: SYSRSn
9	INTx10	R/W	0h	Flag for Interrupt 7.10 Reset type: SYSRSn
8	INTx9	R/W	0h	Flag for Interrupt 7.9 Reset type: SYSRSn
7	INTx8	R/W	0h	Flag for Interrupt 7.8 Reset type: SYSRSn
6	INTx7	R/W	0h	Flag for Interrupt 7.7 Reset type: SYSRSn
5	INTx6	R/W	0h	Flag for Interrupt 7.6 Reset type: SYSRSn
4	INTx5	R/W	0h	Flag for Interrupt 7.5 Reset type: SYSRSn
3	INTx4	R/W	0h	Flag for Interrupt 7.4 Reset type: SYSRSn

**Table 2-41. PIEIFR7 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
2	INTx3	R/W	0h	Flag for Interrupt 7.3 Reset type: SYSRSn
1	INTx2	R/W	0h	Flag for Interrupt 7.2 Reset type: SYSRSn
0	INTx1	R/W	0h	Flag for Interrupt 7.1 Reset type: SYSRSn

### 2.15.3.17 PIEIER8 Register (Offset = 10h) [reset = 0h]

PIEIER8 is shown in [Figure 2-45](#) and described in [Table 2-42](#).

Return to [Summary Table](#).

Interrupt Group 8 Enable Register

These register bits individually enable an interrupt within a group. They behave very much like the bits in the CPU interrupt enable register (IER).

Setting a bit to 1 allows the corresponding interrupt to propagate to the CPU.

Setting a bit to 0 prevents the corresponding interrupt from propagating. Note that a peripheral interrupt signal can still set the PIEIFR bit for the disabled interrupt.

**Figure 2-45. PIEIER8 Register**

15		14		13		12		11		10		9		8	
INTx16		INTx15		INTx14		INTx13		INTx12		INTx11		INTx10		INTx9	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	
7		6		5		4		3		2		1		0	
INTx8		INTx7		INTx6		INTx5		INTx4		INTx3		INTx2		INTx1	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	

**Table 2-42. PIEIER8 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15	INTx16	R/W	0h	Enable for Interrupt 8.16 Reset type: SYSRSn
14	INTx15	R/W	0h	Enable for Interrupt 8.15 Reset type: SYSRSn
13	INTx14	R/W	0h	Enable for Interrupt 8.14 Reset type: SYSRSn
12	INTx13	R/W	0h	Enable for Interrupt 8.13 Reset type: SYSRSn
11	INTx12	R/W	0h	Enable for Interrupt 8.12 Reset type: SYSRSn
10	INTx11	R/W	0h	Enable for Interrupt 8.11 Reset type: SYSRSn
9	INTx10	R/W	0h	Enable for Interrupt 8.10 Reset type: SYSRSn
8	INTx9	R/W	0h	Enable for Interrupt 8.9 Reset type: SYSRSn
7	INTx8	R/W	0h	Enable for Interrupt 8.8 Reset type: SYSRSn
6	INTx7	R/W	0h	Enable for Interrupt 8.7 Reset type: SYSRSn
5	INTx6	R/W	0h	Enable for Interrupt 8.6 Reset type: SYSRSn
4	INTx5	R/W	0h	Enable for Interrupt 8.5 Reset type: SYSRSn
3	INTx4	R/W	0h	Enable for Interrupt 8.4 Reset type: SYSRSn
2	INTx3	R/W	0h	Enable for Interrupt 8.3 Reset type: SYSRSn



**Table 2-42. PIEIER8 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
1	INTx2	R/W	0h	Enable for Interrupt 8.2 Reset type: SYSRSn
0	INTx1	R/W	0h	Enable for Interrupt 8.1 Reset type: SYSRSn

### 2.15.3.18 PIEIFR8 Register (Offset = 11h) [reset = 0h]

PIEIFR8 is shown in [Figure 2-46](#) and described in [Table 2-43](#).

Return to [Summary Table](#).

#### Interrupt Group 8 Flag Register

These register bits indicate whether each interrupt in the group is currently pending. They behave very much like the bits in the CPU interrupt flag register (IFR).

When a peripheral sends an interrupt, the corresponding bit is set. This bit is cleared when the interrupt propagates to the CPU, at which point PIEACK is set.

NOTE: PIE IFR flags can be written to create software interrupts.

The IFR flag will be cleared on a write of zero. Hence, when the intent is to fire an interrupt it may cause inadvertent cancellation of other interrupts. It is recommended to use this only for testing or with extreme caution in the application code. Reading the PIE IFR registers is safe.

**Figure 2-46. PIEIFR8 Register**

15	14	13	12	11	10	9	8
INTx16	INTx15	INTx14	INTx13	INTx12	INTx11	INTx10	INTx9
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
7	6	5	4	3	2	1	0
INTx8	INTx7	INTx6	INTx5	INTx4	INTx3	INTx2	INTx1
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h

**Table 2-43. PIEIFR8 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15	INTx16	R/W	0h	Flag for Interrupt 8.16 Reset type: SYSRSn
14	INTx15	R/W	0h	Flag for Interrupt 8.15 Reset type: SYSRSn
13	INTx14	R/W	0h	Flag for Interrupt 8.14 Reset type: SYSRSn
12	INTx13	R/W	0h	Flag for Interrupt 8.13 Reset type: SYSRSn
11	INTx12	R/W	0h	Flag for Interrupt 8.12 Reset type: SYSRSn
10	INTx11	R/W	0h	Flag for Interrupt 8.11 Reset type: SYSRSn
9	INTx10	R/W	0h	Flag for Interrupt 8.10 Reset type: SYSRSn
8	INTx9	R/W	0h	Flag for Interrupt 8.9 Reset type: SYSRSn
7	INTx8	R/W	0h	Flag for Interrupt 8.8 Reset type: SYSRSn
6	INTx7	R/W	0h	Flag for Interrupt 8.7 Reset type: SYSRSn
5	INTx6	R/W	0h	Flag for Interrupt 8.6 Reset type: SYSRSn
4	INTx5	R/W	0h	Flag for Interrupt 8.5 Reset type: SYSRSn
3	INTx4	R/W	0h	Flag for Interrupt 8.4 Reset type: SYSRSn

**Table 2-43. PIEIFR8 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
2	INTx3	R/W	0h	Flag for Interrupt 8.3 Reset type: SYSRSn
1	INTx2	R/W	0h	Flag for Interrupt 8.2 Reset type: SYSRSn
0	INTx1	R/W	0h	Flag for Interrupt 8.1 Reset type: SYSRSn

### 2.15.3.19 PIEIER9 Register (Offset = 12h) [reset = 0h]

PIEIER9 is shown in [Figure 2-47](#) and described in [Table 2-44](#).

Return to [Summary Table](#).

Interrupt Group 9 Enable Register

These register bits individually enable an interrupt within a group. They behave very much like the bits in the CPU interrupt enable register (IER).

Setting a bit to 1 allows the corresponding interrupt to propagate to the CPU.

Setting a bit to 0 prevents the corresponding interrupt from propagating. Note that a peripheral interrupt signal can still set the PIEIFR bit for the disabled interrupt.

**Figure 2-47. PIEIER9 Register**

15		14		13		12		11		10		9		8	
INTx16		INTx15		INTx14		INTx13		INTx12		INTx11		INTx10		INTx9	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	
7		6		5		4		3		2		1		0	
INTx8		INTx7		INTx6		INTx5		INTx4		INTx3		INTx2		INTx1	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	

**Table 2-44. PIEIER9 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15	INTx16	R/W	0h	Enable for Interrupt 9.16 Reset type: SYSRSn
14	INTx15	R/W	0h	Enable for Interrupt 9.15 Reset type: SYSRSn
13	INTx14	R/W	0h	Enable for Interrupt 9.14 Reset type: SYSRSn
12	INTx13	R/W	0h	Enable for Interrupt 9.13 Reset type: SYSRSn
11	INTx12	R/W	0h	Enable for Interrupt 9.12 Reset type: SYSRSn
10	INTx11	R/W	0h	Enable for Interrupt 9.11 Reset type: SYSRSn
9	INTx10	R/W	0h	Enable for Interrupt 9.10 Reset type: SYSRSn
8	INTx9	R/W	0h	Enable for Interrupt 9.9 Reset type: SYSRSn
7	INTx8	R/W	0h	Enable for Interrupt 9.8 Reset type: SYSRSn
6	INTx7	R/W	0h	Enable for Interrupt 9.7 Reset type: SYSRSn
5	INTx6	R/W	0h	Enable for Interrupt 9.6 Reset type: SYSRSn
4	INTx5	R/W	0h	Enable for Interrupt 9.5 Reset type: SYSRSn
3	INTx4	R/W	0h	Enable for Interrupt 9.4 Reset type: SYSRSn
2	INTx3	R/W	0h	Enable for Interrupt 9.3 Reset type: SYSRSn

**Table 2-44. PIEIER9 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
1	INTx2	R/W	0h	Enable for Interrupt 9.2 Reset type: SYSRSn
0	INTx1	R/W	0h	Enable for Interrupt 9.1 Reset type: SYSRSn

### 2.15.3.20 PIEIFR9 Register (Offset = 13h) [reset = 0h]

PIEIFR9 is shown in [Figure 2-48](#) and described in [Table 2-45](#).

Return to [Summary Table](#).

#### Interrupt Group 9 Flag Register

These register bits indicate whether each interrupt in the group is currently pending. They behave very much like the bits in the CPU interrupt flag register (IFR).

When a peripheral sends an interrupt, the corresponding bit is set. This bit is cleared when the interrupt propagates to the CPU, at which point PIEACK is set.

NOTE: PIE IFR flags can be written to create software interrupts.

The IFR flag will be cleared on a write of zero. Hence, when the intent is to fire an interrupt it may cause inadvertent cancellation of other interrupts. It is recommended to use this only for testing or with extreme caution in the application code. Reading the PIE IFR registers is safe.

**Figure 2-48. PIEIFR9 Register**

15		14		13		12		11		10		9		8	
INTx16		INTx15		INTx14		INTx13		INTx12		INTx11		INTx10		INTx9	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	
7		6		5		4		3		2		1		0	
INTx8		INTx7		INTx6		INTx5		INTx4		INTx3		INTx2		INTx1	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	

**Table 2-45. PIEIFR9 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15	INTx16	R/W	0h	Flag for Interrupt 9.16 Reset type: SYSRSn
14	INTx15	R/W	0h	Flag for Interrupt 9.15 Reset type: SYSRSn
13	INTx14	R/W	0h	Flag for Interrupt 9.14 Reset type: SYSRSn
12	INTx13	R/W	0h	Flag for Interrupt 9.13 Reset type: SYSRSn
11	INTx12	R/W	0h	Flag for Interrupt 9.12 Reset type: SYSRSn
10	INTx11	R/W	0h	Flag for Interrupt 9.11 Reset type: SYSRSn
9	INTx10	R/W	0h	Flag for Interrupt 9.10 Reset type: SYSRSn
8	INTx9	R/W	0h	Flag for Interrupt 9.9 Reset type: SYSRSn
7	INTx8	R/W	0h	Flag for Interrupt 9.8 Reset type: SYSRSn
6	INTx7	R/W	0h	Flag for Interrupt 9.7 Reset type: SYSRSn
5	INTx6	R/W	0h	Flag for Interrupt 9.6 Reset type: SYSRSn
4	INTx5	R/W	0h	Flag for Interrupt 9.5 Reset type: SYSRSn
3	INTx4	R/W	0h	Flag for Interrupt 9.4 Reset type: SYSRSn

**Table 2-45. PIEIFR9 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
2	INTx3	R/W	0h	Flag for Interrupt 9.3 Reset type: SYSRSn
1	INTx2	R/W	0h	Flag for Interrupt 9.2 Reset type: SYSRSn
0	INTx1	R/W	0h	Flag for Interrupt 9.1 Reset type: SYSRSn

### 2.15.3.21 PIEIER10 Register (Offset = 14h) [reset = 0h]

PIEIER10 is shown in [Figure 2-49](#) and described in [Table 2-46](#).

Return to [Summary Table](#).

Interrupt Group 10 Enable Register

These register bits individually enable an interrupt within a group. They behave very much like the bits in the CPU interrupt enable register (IER).

Setting a bit to 1 allows the corresponding interrupt to propagate to the CPU.

Setting a bit to 0 prevents the corresponding interrupt from propagating. Note that a peripheral interrupt signal can still set the PIEIFR bit for the disabled interrupt.

**Figure 2-49. PIEIER10 Register**

15		14		13		12		11		10		9		8	
INTx16		INTx15		INTx14		INTx13		INTx12		INTx11		INTx10		INTx9	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	
7		6		5		4		3		2		1		0	
INTx8		INTx7		INTx6		INTx5		INTx4		INTx3		INTx2		INTx1	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	

**Table 2-46. PIEIER10 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15	INTx16	R/W	0h	Enable for Interrupt 10.16 Reset type: SYSRSn
14	INTx15	R/W	0h	Enable for Interrupt 10.15 Reset type: SYSRSn
13	INTx14	R/W	0h	Enable for Interrupt 10.14 Reset type: SYSRSn
12	INTx13	R/W	0h	Enable for Interrupt 10.13 Reset type: SYSRSn
11	INTx12	R/W	0h	Enable for Interrupt 10.12 Reset type: SYSRSn
10	INTx11	R/W	0h	Enable for Interrupt 10.11 Reset type: SYSRSn
9	INTx10	R/W	0h	Enable for Interrupt 10.10 Reset type: SYSRSn
8	INTx9	R/W	0h	Enable for Interrupt 10.9 Reset type: SYSRSn
7	INTx8	R/W	0h	Enable for Interrupt 10.8 Reset type: SYSRSn
6	INTx7	R/W	0h	Enable for Interrupt 10.7 Reset type: SYSRSn
5	INTx6	R/W	0h	Enable for Interrupt 10.6 Reset type: SYSRSn
4	INTx5	R/W	0h	Enable for Interrupt 10.5 Reset type: SYSRSn
3	INTx4	R/W	0h	Enable for Interrupt 10.4 Reset type: SYSRSn
2	INTx3	R/W	0h	Enable for Interrupt 10.3 Reset type: SYSRSn



**Table 2-46. PIEIER10 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
1	INTx2	R/W	0h	Enable for Interrupt 10.2 Reset type: SYSRSn
0	INTx1	R/W	0h	Enable for Interrupt 10.1 Reset type: SYSRSn

### 2.15.3.22 PIEIFR10 Register (Offset = 15h) [reset = 0h]

PIEIFR10 is shown in [Figure 2-50](#) and described in [Table 2-47](#).

Return to [Summary Table](#).

#### Interrupt Group 10 Flag Register

These register bits indicate whether each interrupt in the group is currently pending. They behave very much like the bits in the CPU interrupt flag register (IFR).

When a peripheral sends an interrupt, the corresponding bit is set. This bit is cleared when the interrupt propagates to the CPU, at which point PIEACK is set.

NOTE: PIE IFR flags can be written to create software interrupts.

The IFR flag will be cleared on a write of zero. Hence, when the intent is to fire an interrupt it may cause inadvertent cancellation of other interrupts. It is recommended to use this only for testing or with extreme caution in the application code. Reading the PIE IFR registers is safe.

**Figure 2-50. PIEIFR10 Register**

15	14	13	12	11	10	9	8
INTx16	INTx15	INTx14	INTx13	INTx12	INTx11	INTx10	INTx9
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
7	6	5	4	3	2	1	0
INTx8	INTx7	INTx6	INTx5	INTx4	INTx3	INTx2	INTx1
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h

**Table 2-47. PIEIFR10 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15	INTx16	R/W	0h	Flag for Interrupt 10.16 Reset type: SYSRSn
14	INTx15	R/W	0h	Flag for Interrupt 10.15 Reset type: SYSRSn
13	INTx14	R/W	0h	Flag for Interrupt 10.14 Reset type: SYSRSn
12	INTx13	R/W	0h	Flag for Interrupt 10.13 Reset type: SYSRSn
11	INTx12	R/W	0h	Flag for Interrupt 10.12 Reset type: SYSRSn
10	INTx11	R/W	0h	Flag for Interrupt 10.11 Reset type: SYSRSn
9	INTx10	R/W	0h	Flag for Interrupt 10.10 Reset type: SYSRSn
8	INTx9	R/W	0h	Flag for Interrupt 10.9 Reset type: SYSRSn
7	INTx8	R/W	0h	Flag for Interrupt 10.8 Reset type: SYSRSn
6	INTx7	R/W	0h	Flag for Interrupt 10.7 Reset type: SYSRSn
5	INTx6	R/W	0h	Flag for Interrupt 10.6 Reset type: SYSRSn
4	INTx5	R/W	0h	Flag for Interrupt 10.5 Reset type: SYSRSn
3	INTx4	R/W	0h	Flag for Interrupt 10.4 Reset type: SYSRSn

**Table 2-47. PIEIFR10 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
2	INTx3	R/W	0h	Flag for Interrupt 10.3 Reset type: SYSRSn
1	INTx2	R/W	0h	Flag for Interrupt 10.2 Reset type: SYSRSn
0	INTx1	R/W	0h	Flag for Interrupt 10.1 Reset type: SYSRSn

### 2.15.3.23 PIEIER11 Register (Offset = 16h) [reset = 0h]

PIEIER11 is shown in [Figure 2-51](#) and described in [Table 2-48](#).

Return to [Summary Table](#).

Interrupt Group 11 Enable Register

These register bits individually enable an interrupt within a group. They behave very much like the bits in the CPU interrupt enable register (IER).

Setting a bit to 1 allows the corresponding interrupt to propagate to the CPU.

Setting a bit to 0 prevents the corresponding interrupt from propagating. Note that a peripheral interrupt signal can still set the PIEIFR bit for the disabled interrupt.

**Figure 2-51. PIEIER11 Register**

15		14		13		12		11		10		9		8	
INTx16		INTx15		INTx14		INTx13		INTx12		INTx11		INTx10		INTx9	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	
7		6		5		4		3		2		1		0	
INTx8		INTx7		INTx6		INTx5		INTx4		INTx3		INTx2		INTx1	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	

**Table 2-48. PIEIER11 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15	INTx16	R/W	0h	Enable for Interrupt 11.16 Reset type: SYSRSn
14	INTx15	R/W	0h	Enable for Interrupt 11.15 Reset type: SYSRSn
13	INTx14	R/W	0h	Enable for Interrupt 11.14 Reset type: SYSRSn
12	INTx13	R/W	0h	Enable for Interrupt 11.13 Reset type: SYSRSn
11	INTx12	R/W	0h	Enable for Interrupt 11.12 Reset type: SYSRSn
10	INTx11	R/W	0h	Enable for Interrupt 11.11 Reset type: SYSRSn
9	INTx10	R/W	0h	Enable for Interrupt 11.10 Reset type: SYSRSn
8	INTx9	R/W	0h	Enable for Interrupt 11.9 Reset type: SYSRSn
7	INTx8	R/W	0h	Enable for Interrupt 11.8 Reset type: SYSRSn
6	INTx7	R/W	0h	Enable for Interrupt 11.7 Reset type: SYSRSn
5	INTx6	R/W	0h	Enable for Interrupt 11.6 Reset type: SYSRSn
4	INTx5	R/W	0h	Enable for Interrupt 11.5 Reset type: SYSRSn
3	INTx4	R/W	0h	Enable for Interrupt 11.4 Reset type: SYSRSn
2	INTx3	R/W	0h	Enable for Interrupt 11.3 Reset type: SYSRSn

**Table 2-48. PIEIER11 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
1	INTx2	R/W	0h	Enable for Interrupt 11.2 Reset type: SYSRSn
0	INTx1	R/W	0h	Enable for Interrupt 11.1 Reset type: SYSRSn

### 2.15.3.24 PIEIFR11 Register (Offset = 17h) [reset = 0h]

PIEIFR11 is shown in [Figure 2-52](#) and described in [Table 2-49](#).

Return to [Summary Table](#).

#### Interrupt Group 11 Flag Register

These register bits indicate whether each interrupt in the group is currently pending. They behave very much like the bits in the CPU interrupt flag register (IFR).

When a peripheral sends an interrupt, the corresponding bit is set. This bit is cleared when the interrupt propagates to the CPU, at which point PIEACK is set.

NOTE: PIE IFR flags can be written to create software interrupts.

The IFR flag will be cleared on a write of zero. Hence, when the intent is to fire an interrupt it may cause inadvertent cancellation of other interrupts. It is recommended to use this only for testing or with extreme caution in the application code. Reading the PIE IFR registers is safe.

**Figure 2-52. PIEIFR11 Register**

15	14	13	12	11	10	9	8
INTx16	INTx15	INTx14	INTx13	INTx12	INTx11	INTx10	INTx9
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
7	6	5	4	3	2	1	0
INTx8	INTx7	INTx6	INTx5	INTx4	INTx3	INTx2	INTx1
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h

**Table 2-49. PIEIFR11 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15	INTx16	R/W	0h	Flag for Interrupt 11.16 Reset type: SYSRSn
14	INTx15	R/W	0h	Flag for Interrupt 11.15 Reset type: SYSRSn
13	INTx14	R/W	0h	Flag for Interrupt 11.14 Reset type: SYSRSn
12	INTx13	R/W	0h	Flag for Interrupt 11.13 Reset type: SYSRSn
11	INTx12	R/W	0h	Flag for Interrupt 11.12 Reset type: SYSRSn
10	INTx11	R/W	0h	Flag for Interrupt 11.11 Reset type: SYSRSn
9	INTx10	R/W	0h	Flag for Interrupt 11.10 Reset type: SYSRSn
8	INTx9	R/W	0h	Flag for Interrupt 11.9 Reset type: SYSRSn
7	INTx8	R/W	0h	Flag for Interrupt 11.8 Reset type: SYSRSn
6	INTx7	R/W	0h	Flag for Interrupt 11.7 Reset type: SYSRSn
5	INTx6	R/W	0h	Flag for Interrupt 11.6 Reset type: SYSRSn
4	INTx5	R/W	0h	Flag for Interrupt 11.5 Reset type: SYSRSn
3	INTx4	R/W	0h	Flag for Interrupt 11.4 Reset type: SYSRSn

**Table 2-49. PIEIFR11 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
2	INTx3	R/W	0h	Flag for Interrupt 11.3 Reset type: SYSRSn
1	INTx2	R/W	0h	Flag for Interrupt 11.2 Reset type: SYSRSn
0	INTx1	R/W	0h	Flag for Interrupt 11.1 Reset type: SYSRSn

### 2.15.3.25 PIEIER12 Register (Offset = 18h) [reset = 0h]

PIEIER12 is shown in [Figure 2-53](#) and described in [Table 2-50](#).

Return to [Summary Table](#).

Interrupt Group 12 Enable Register

These register bits individually enable an interrupt within a group. They behave very much like the bits in the CPU interrupt enable register (IER).

Setting a bit to 1 allows the corresponding interrupt to propagate to the CPU.

Setting a bit to 0 prevents the corresponding interrupt from propagating. Note that a peripheral interrupt signal can still set the PIEIFR bit for the disabled interrupt.

**Figure 2-53. PIEIER12 Register**

15		14		13		12		11		10		9		8	
INTx16		INTx15		INTx14		INTx13		INTx12		INTx11		INTx10		INTx9	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	
7		6		5		4		3		2		1		0	
INTx8		INTx7		INTx6		INTx5		INTx4		INTx3		INTx2		INTx1	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	

**Table 2-50. PIEIER12 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15	INTx16	R/W	0h	Enable for Interrupt 12.16 Reset type: SYSRSn
14	INTx15	R/W	0h	Enable for Interrupt 12.15 Reset type: SYSRSn
13	INTx14	R/W	0h	Enable for Interrupt 12.14 Reset type: SYSRSn
12	INTx13	R/W	0h	Enable for Interrupt 12.13 Reset type: SYSRSn
11	INTx12	R/W	0h	Enable for Interrupt 12.12 Reset type: SYSRSn
10	INTx11	R/W	0h	Enable for Interrupt 12.11 Reset type: SYSRSn
9	INTx10	R/W	0h	Enable for Interrupt 12.10 Reset type: SYSRSn
8	INTx9	R/W	0h	Enable for Interrupt 12.9 Reset type: SYSRSn
7	INTx8	R/W	0h	Enable for Interrupt 12.8 Reset type: SYSRSn
6	INTx7	R/W	0h	Enable for Interrupt 12.7 Reset type: SYSRSn
5	INTx6	R/W	0h	Enable for Interrupt 12.6 Reset type: SYSRSn
4	INTx5	R/W	0h	Enable for Interrupt 12.5 Reset type: SYSRSn
3	INTx4	R/W	0h	Enable for Interrupt 12.4 Reset type: SYSRSn
2	INTx3	R/W	0h	Enable for Interrupt 12.3 Reset type: SYSRSn



**Table 2-50. PIEIER12 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
1	INTx2	R/W	0h	Enable for Interrupt 12.2 Reset type: SYSRSn
0	INTx1	R/W	0h	Enable for Interrupt 12.1 Reset type: SYSRSn

### 2.15.3.26 PIEIFR12 Register (Offset = 19h) [reset = 0h]

PIEIFR12 is shown in [Figure 2-54](#) and described in [Table 2-51](#).

Return to [Summary Table](#).

#### Interrupt Group 12 Flag Register

These register bits indicate whether each interrupt in the group is currently pending. They behave very much like the bits in the CPU interrupt flag register (IFR).

When a peripheral sends an interrupt, the corresponding bit is set. This bit is cleared when the interrupt propagates to the CPU, at which point PIEACK is set.

NOTE: PIE IFR flags can be written to create software interrupts.

The IFR flag will be cleared on a write of zero. Hence, when the intent is to fire an interrupt it may cause inadvertent cancellation of other interrupts. It is recommended to use this only for testing or with extreme caution in the application code. Reading the PIE IFR registers is safe.

**Figure 2-54. PIEIFR12 Register**

15	14	13	12	11	10	9	8
INTx16	INTx15	INTx14	INTx13	INTx12	INTx11	INTx10	INTx9
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
7	6	5	4	3	2	1	0
INTx8	INTx7	INTx6	INTx5	INTx4	INTx3	INTx2	INTx1
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h

**Table 2-51. PIEIFR12 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15	INTx16	R/W	0h	Flag for Interrupt 12.16 Reset type: SYSRSn
14	INTx15	R/W	0h	Flag for Interrupt 12.15 Reset type: SYSRSn
13	INTx14	R/W	0h	Flag for Interrupt 12.14 Reset type: SYSRSn
12	INTx13	R/W	0h	Flag for Interrupt 12.13 Reset type: SYSRSn
11	INTx12	R/W	0h	Flag for Interrupt 12.12 Reset type: SYSRSn
10	INTx11	R/W	0h	Flag for Interrupt 12.11 Reset type: SYSRSn
9	INTx10	R/W	0h	Flag for Interrupt 12.10 Reset type: SYSRSn
8	INTx9	R/W	0h	Flag for Interrupt 12.9 Reset type: SYSRSn
7	INTx8	R/W	0h	Flag for Interrupt 12.8 Reset type: SYSRSn
6	INTx7	R/W	0h	Flag for Interrupt 12.7 Reset type: SYSRSn
5	INTx6	R/W	0h	Flag for Interrupt 12.6 Reset type: SYSRSn
4	INTx5	R/W	0h	Flag for Interrupt 12.5 Reset type: SYSRSn
3	INTx4	R/W	0h	Flag for Interrupt 12.4 Reset type: SYSRSn

**Table 2-51. PIEIFR12 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
2	INTx3	R/W	0h	Flag for Interrupt 12.3 Reset type: SYSRSn
1	INTx2	R/W	0h	Flag for Interrupt 12.2 Reset type: SYSRSn
0	INTx1	R/W	0h	Flag for Interrupt 12.1 Reset type: SYSRSn

### 2.15.4 WD\_REGS Registers

Table 2-52 lists the memory-mapped registers for the WD\_REGS. All register offset addresses not listed in Table 2-52 should be considered as reserved locations and the register contents should not be modified.

**Table 2-52. WD\_REGS Registers**

Offset	Acronym	Register Name	Write Protection	Section
22h	SCSR	System Control & Status Register	EALLOW	<a href="#">Go</a>
23h	WDCNTR	Watchdog Counter Register	EALLOW	<a href="#">Go</a>
25h	WDKEY	Watchdog Reset Key Register	EALLOW	<a href="#">Go</a>
29h	WDCR	Watchdog Control Register	EALLOW	<a href="#">Go</a>
2Ah	WDWCR	Watchdog Windowed Control Register	EALLOW	<a href="#">Go</a>

Complex bit access types are encoded to fit into small table cells. Table 2-53 shows the codes that are used for access types in this section.

**Table 2-53. WD\_REGS Access Type Codes**

Access Type	Code	Description
<b>Read Type</b>		
R	R	Read
R=0	R	Read
<b>Write Type</b>		
W	W	Write
W1C	1C W	1 to clear Write
W=1	W	Write
<b>Reset or Default Value</b>		
-n		Value after reset or the default value
<b>Register Array Variables</b>		
i,j,k,l,m,n		When these variables are used in a register name, an offset, or an address, they refer to the value of a register array where the register is part of a group of repeating registers. The register groups form a hierarchical structure and the array is represented with a formula.
y		When this variable is used in a register name, an offset, or an address it refers to the value of a register array.

### 2.15.4.1 SCSR Register (Offset = 22h) [reset = 5h]

SCSR is shown in [Figure 2-55](#) and described in [Table 2-54](#).

Return to [Summary Table](#).

It is recommended to only use 16 bit accesses to write to this register. Use a read-modify-write instruction may inadvertently clear other bits.

**Figure 2-55. SCSR Register**

15	14	13	12	11	10	9	8
RESERVED							
R=0-0h							
7	6	5	4	3	2	1	0
RESERVED					WDINTS	WDENINT	WDOVERRIDE
R=0-0h					R-1h	R/W-0h	R/W1C-1h

**Table 2-54. SCSR Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-3	RESERVED	R=0	0h	Reserved
2	WDINTS	R	1h	<p>Watchdog interrupt (WDINTn) status signal. This is a read only bit reflecting the current state of the WDINTn signal from the watchdog block (after synchronization with SYSCLOCKOUT). If this bit is 1, the watchdog interrupt is not active. If this bit is 0, then the watchdog interrupt is active.</p> <p>Note: ,If the WDINTn signal is used to wake up from IDLE or STANDBY condition, then the user should make sure that the WDINTn signal goes back high again before attempting to go back into IDLE or STANDBY mode. Reading this bit will tell the user the current state of this signal.</p> <p>Reset type: SYSRSn</p>
1	WDENINT	R/W	0h	<p>If this bit is set to 1, the watchdog reset (WDRSTn) output signal is disabled and the watchdog interrupt (WDINTn) output signal is enabled. If this bit is zero, then the WDRSTn output signal is enabled and the WDINTn output signal is disabled. This is the default state on system reset (SYSRSn).</p> <p>Reset type: SYSRSn</p>
0	WDOVERRIDE	R/W1C	1h	<p>If this bit is set to 1, the user is allowed to change the state of the Watchdog disable (WDDIS) bit in the Watchdog Control (WDCR) register. If the WDOVERRIDE bit is cleared, by writing a 1 the WDDIS bit cannot be modified by the user. Writing a 0 will have no effect. If this bit is cleared, then it will remain in this state until a reset occurs. The current state of this bit is readable by the user.</p> <p>Reset type: SYSRSn</p>

### 2.15.4.2 WDCNTR Register (Offset = 23h) [reset = 0h]

WDCNTR is shown in [Figure 2-56](#) and described in [Table 2-55](#).

Return to [Summary Table](#).

Watchdog Counter Register

**Figure 2-56. WDCNTR Register**

15	14	13	12	11	10	9	8
RESERVED							
R=0-0h							
7	6	5	4	3	2	1	0
WDCNTR							
R-0h							

**Table 2-55. WDCNTR Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-8	RESERVED	R=0	0h	Reserved
7-0	WDCNTR	R	0h	These bits contain the current value of the WD counter. The 8-bit counter continually increments at the WDCLK rate. If the counter overflows, then a watchdog output pulse (WDOUTn) is generated. If the WDKEY register is written with a valid combination, then the counter is reset to zero. Reset type: IORSn

### 2.15.4.3 WDKEY Register (Offset = 25h) [reset = 0h]

WDKEY is shown in [Figure 2-57](#) and described in [Table 2-56](#).

Return to [Summary Table](#).

Watchdog Reset Key Register

**Figure 2-57. WDKEY Register**

15	14	13	12	11	10	9	8
RESERVED							
R=0-0h							
7	6	5	4	3	2	1	0
WDKEY							
R/W-0h							

**Table 2-56. WDKEY Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-8	RESERVED	R=0	0h	Reserved
7-0	WDKEY	R/W	0h	Writing 0x55 followed by 0xAA will cause the WDCNTR bits to be cleared. Note: [1] Reads from the WDKEY return the value of WDCR register. Reset type: IORSn

#### 2.15.4.4 WDCR Register (Offset = 29h) [reset = 0h]

WDCR is shown in [Figure 2-58](#) and described in [Table 2-57](#).

Return to [Summary Table](#).

Watchdog Control Register

**Figure 2-58. WDCR Register**

15	14	13	12	11	10	9	8
RESERVED							
R=0-0h							
7	6	5	4	3	2	1	0
RESERVED	WDDIS	WDCHK			WDPS		
R-0h	R/W-0h	R=0/W-0h			R/W-0h		

**Table 2-57. WDCR Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-8	RESERVED	R=0	0h	Reserved
7	RESERVED	R	0h	Reserved
6	WDDIS	R/W	0h	Writing a 1 to this bit will disable the watchdog module. Writing a 0 will enable the module. This bit can only be modified if the WDOVERRIDE bit in the SCSR2 register is set to 1. On reset, the watchdog module is enabled. Reset type: IORSn
5-3	WDCHK	R=0/W	0h	The user must ALWAYS write 1,0,1 to these bits whenever a write to this register is performed. Writing any other value will cause an immediate reset to the core (if WD enabled). Reset type: IORSn
2-0	WDPS	R/W	0h	These bits configure the watchdog counter clock (WDCLK) rate relative to INTOSC1/512: 000 WDCLK = INTOSC1/512/1 001 WDCLK = INTOSC1/512/1 010 WDCLK = INTOSC1/512/2 011 WDCLK = INTOSC1/512/4 100 WDCLK = INTOSC1/512/8 101 WDCLK = INTOSC1/512/16 110 WDCLK = INTOSC1/512/32 111 WDCLK = INTOSC1/512/64 Reset type: IORSn



### 2.15.4.5 WDWCR Register (Offset = 2Ah) [reset = 0h]

WDWCR is shown in [Figure 2-59](#) and described in [Table 2-58](#).

Return to [Summary Table](#).

Watchdog Windowed Control Register

**Figure 2-59. WDWCR Register**

15	14	13	12	11	10	9	8
RESERVED							FIRSTKEY
R=0-0h							R-0h
7	6	5	4	3	2	1	0
MIN							
R/W-0h							

**Table 2-58. WDWCR Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-9	RESERVED	R=0	0h	Reserved
8	FIRSTKEY	R	0h	<p>This bit indicates if the 1st valid WDKEY (0x55 + 0xAA) got detected after MIN was configured to a non-zero value</p> <p>0: First Valid Key after non-zero MIN configuration has not happened yet</p> <p>1: First Valid key after non-zero MIN configuration got detected</p> <p>Notes:</p> <p>[1] If MIN = 0, this bit is never set</p> <p>[2] If MIN is changed back to 0x0 from a non-zero value, this bit is auto-cleared</p> <p>[3] This bit is added for debug purposes only</p> <p>Reset type: IORSn</p>
7-0	MIN	R/W	0h	<p>These bits define the lower limit of the Windowed functionality</p> <p>Reset type: IORSn</p>

### 2.15.5 NMI\_INTRUPT\_REGS Registers

Table 2-59 lists the memory-mapped registers for the NMI\_INTRUPT\_REGS. All register offset addresses not listed in Table 2-59 should be considered as reserved locations and the register contents should not be modified.

**Table 2-59. NMI\_INTRUPT\_REGS Registers**

Offset	Acronym	Register Name	Write Protection	Section
0h	NMICFG	NMI Configuration Register	EALLOW	<a href="#">Go</a>
1h	NMIFLG	NMI Flag Register (XRSn Clear)		<a href="#">Go</a>
2h	NMIFLGCLR	NMI Flag Clear Register	EALLOW	<a href="#">Go</a>
3h	NMIFLGFRC	NMI Flag Force Register	EALLOW	<a href="#">Go</a>
4h	NMIWDCNT	NMI Watchdog Counter Register		<a href="#">Go</a>
5h	NMIWDPRD	NMI Watchdog Period Register	EALLOW	<a href="#">Go</a>
6h	NMISHDFLG	NMI Shadow Flag Register		<a href="#">Go</a>

Complex bit access types are encoded to fit into small table cells. Table 2-60 shows the codes that are used for access types in this section.

**Table 2-60. NMI\_INTRUPT\_REGS Access Type Codes**

Access Type	Code	Description
<b>Read Type</b>		
R	R	Read
R=0	R	Read
<b>Write Type</b>		
W	W	Write
W=1	W	Write
<b>Reset or Default Value</b>		
-n		Value after reset or the default value
<b>Register Array Variables</b>		
i,j,k,l,m,n		When these variables are used in a register name, an offset, or an address, they refer to the value of a register array where the register is part of a group of repeating registers. The register groups form a hierarchical structure and the array is represented with a formula.
y		When this variable is used in a register name, an offset, or an address it refers to the value of a register array.

**2.15.5.1 NMICFG Register (Offset = 0h) [reset = 0h]**

NMICFG is shown in [Figure 2-60](#) and described in [Table 2-61](#).

Return to [Summary Table](#).

NMI Configuration Register

**Figure 2-60. NMICFG Register**

15	14	13	12	11	10	9	8
RESERVED							
R=0-0h							
7	6	5	4	3	2	1	0
RESERVED							NMIE
R=0-0h							R/W=1-0h

**Table 2-61. NMICFG Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-1	RESERVED	R=0	0h	Reserved
0	NMIE	R/W=1	0h	When set to 1 any condition will generate an NMI interrupt to the C28 CPU and kick off the NMI watchdog counter. As part of boot sequence this bit should be set after the device security related initialization is complete. 0 NMI disabled 1 NMI enabled Reset type: SYSRSn

### 2.15.5.2 NMIFLG Register (Offset = 1h) [reset = 0h]

NMIFLG is shown in [Figure 2-61](#) and described in [Table 2-62](#).

Return to [Summary Table](#).

NMI Flag Register (XRSn Clear)

**Figure 2-61. NMIFLG Register**

15	14	13	12	11	10	9	8
RESERVED				RESERVED	RESERVED	RESERVED	RESERVED
R=0-0h				R-0h	R-0h	R-0h	R-0h
7	6	5	4	3	2	1	0
RESERVED	RESERVED	RESERVED	CPU1HWBIST ERR	FLUNCERR	RAMUNCERR	CLOCKFAIL	NMIINT
R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h

**Table 2-62. NMIFLG Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-12	RESERVED	R=0	0h	Reserved
11	RESERVED	R	0h	Reserved
10	RESERVED	R	0h	Reserved
9	RESERVED	R	0h	Reserved
8	RESERVED	R	0h	Reserved
7	RESERVED	R	0h	Reserved
6	RESERVED	R	0h	Reserved
5	RESERVED	R	0h	Reserved
4	CPU1HWBISTERR	R	0h	HW BIST Error NMI Flag: This bit indicates if the time out error or a signature mismatch error condition during hardware BIST of C28 CPU1 occurred. This bit can only be cleared by the user writing to the corresponding clear bit in the NMIFLGCLR register or by an XRSn reset:  0, No C28 HWBIST error condition pending 1, C28 BIST error condition generated Reset type: XRSn
3	FLUNCERR	R	0h	Flash Uncorrectable Error NMI Flag: This bit indicates if an uncorrectable error occurred on a C28 Flash access and that condition is latched. This bit can only be cleared by the user writing to the corresponding clear bit in the NMIFLGCLR register or by an XRSn reset:  0, No C28 Flash uncorrectable error condition pending 1, C28 Flash uncorrectable error condition generated Reset type: XRSn
2	RAMUNCERR	R	0h	RAM Uncorrectable Error NMI Flag: This bit indicates if an uncorrectable error occurred on a RAM access (by any master) and that condition is latched. This bit can only be cleared by the user writing to the corresponding clear bit in the NMIFLGCLR register or by an XRSn reset:  0, No RAM uncorrectable error condition pending 1, RAM uncorrectable error condition generated Reset type: XRSn

**Table 2-62. NMIFLG Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
1	CLOCKFAIL	R	0h	<p>Clock Fail Interrupt Flag: These bits indicates if the CLOCKFAIL condition is latched. These bits can only be cleared by the user writing to the respective bit in the NMIFLGCLR register or by an XRSn reset:</p> <p>0, No CLOCKFAIL Condition Pending            1, CLOCKFAIL Condition Generated            Reset type: XRSn</p>
0	NMIINT	R	0h	<p>NMI Interrupt Flag: This bit indicates if an NMI interrupt was generated. This bit can only be cleared by the user writing to the respective bit in the NMIFLGCLR register or by an XRSn reset:</p> <p>0 No NMI Interrupt Generated            1 NMI Interrupt Generated            No further NMI interrupts pulses are generated until this flag is cleared by the user.            Reset type: XRSn</p>

### 2.15.5.3 NMIFLGCLR Register (Offset = 2h) [reset = 0h]

NMIFLGCLR is shown in [Figure 2-62](#) and described in [Table 2-63](#).

Return to [Summary Table](#).

NMI Flag Clear Register

**Figure 2-62. NMIFLGCLR Register**

15	14	13	12	11	10	9	8
RESERVED				OVF	RESERVED	RESERVED	RESERVED
R=0-0h				R=0/W=1-0h	R-0h	R-0h	R-0h
7	6	5	4	3	2	1	0
RESERVED	RESERVED	RESERVED	CPU1HWBISTERR	FLUNCERR	RAMUNCERR	CLOCKFAIL	NMIINT
R-0h	R-0h	R-0h	R=0/W=1-0h	R=0/W=1-0h	R=0/W=1-0h	R=0/W=1-0h	R=0/W=1-0h

**Table 2-63. NMIFLGCLR Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-12	RESERVED	R=0	0h	Reserved
11	OVF	R=0/W=1	0h	Writing a 1 to the respective bit clears the corresponding flag bit in the NMIFLG and NMISHDFLG registers. Writes of 0 are ignored. Always reads back 0.  Notes: [1] If hardware is trying to set a bit to 1 while software is trying to clear a bit to 0 on the same cycle, hardware has priority. [2] Users should clear the pending FAIL flag first and then clear the NMIINT flag. Reset type: SYSRSn
10	RESERVED	R	0h	Reserved
9	RESERVED	R	0h	Reserved
8	RESERVED	R	0h	Reserved
7	RESERVED	R	0h	Reserved
6	RESERVED	R	0h	Reserved
5	RESERVED	R	0h	Reserved
4	CPU1HWBISTERR	R=0/W=1	0h	Writing a 1 to the respective bit clears the corresponding flag bit in the NMIFLG and NMISHDFLG registers. Writes of 0 are ignored. Always reads back 0.  Notes: [1] If hardware is trying to set a bit to 1 while software is trying to clear a bit to 0 on the same cycle, hardware has priority. [2] Users should clear the pending FAIL flag first and then clear the NMIINT flag. Reset type: SYSRSn
3	FLUNCERR	R=0/W=1	0h	Writing a 1 to the respective bit clears the corresponding flag bit in the NMIFLG and NMISHDFLG registers. Writes of 0 are ignored. Always reads back 0.  Notes: [1] If hardware is trying to set a bit to 1 while software is trying to clear a bit to 0 on the same cycle, hardware has priority. [2] Users should clear the pending FAIL flag first and then clear the NMIINT flag. Reset type: SYSRSn

**Table 2-63. NMIFLGCLR Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
2	RAMUNCERR	R=0/W=1	0h	<p>Writing a 1 to the respective bit clears the corresponding flag bit in the NMIFLG and NMISHDFLG registers. Writes of 0 are ignored. Always reads back 0.</p> <p>Notes:</p> <p>[1] If hardware is trying to set a bit to 1 while software is trying to clear a bit to 0 on the same cycle, hardware has priority.</p> <p>[2] Users should clear the pending FAIL flag first and then clear the NMIINT flag.</p> <p>Reset type: SYSRSn</p>
1	CLOCKFAIL	R=0/W=1	0h	<p>Writing a 1 to the respective bit clears the corresponding flag bit in the NMIFLG and NMISHDFLG registers. Writes of 0 are ignored. Always reads back 0.</p> <p>Notes:</p> <p>[1] If hardware is trying to set a bit to 1 while software is trying to clear a bit to 0 on the same cycle, hardware has priority.</p> <p>[2] Users should clear the pending FAIL flag first and then clear the NMIINT flag.</p> <p>Reset type: SYSRSn</p>
0	NMIINT	R=0/W=1	0h	<p>Writing a 1 to the respective bit clears the corresponding flag bit in the NMIFLG and NMISHDFLG registers. Writes of 0 are ignored. Always reads back 0.</p> <p>Notes:</p> <p>[1] If hardware is trying to set a bit to 1 while software is trying to clear a bit to 0 on the same cycle, hardware has priority.</p> <p>[2] Users should clear the pending FAIL flag first and then clear the NMIINT flag.</p> <p>Reset type: SYSRSn</p>

### 2.15.5.4 NMIFLGFR Register (Offset = 3h) [reset = 0h]

NMIFLGFR is shown in [Figure 2-63](#) and described in [Table 2-64](#).

Return to [Summary Table](#).

NMI Flag Force Register

**Figure 2-63. NMIFLGFR Register**

15	14	13	12	11	10	9	8
RESERVED				OVF	RESERVED	RESERVED	RESERVED
R=0-0h				R=0/W=1-0h	R-0h	R-0h	R-0h
7	6	5	4	3	2	1	0
RESERVED	RESERVED	RESERVED	CPU1HWBIST ERR	FLUNCERR	RAMUNCERR	CLOCKFAIL	RESERVED
R-0h	R-0h	R-0h	R=0/W=1-0h	R=0/W=1-0h	R=0/W=1-0h	R=0/W=1-0h	R=0-0h

**Table 2-64. NMIFLGFR Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-12	RESERVED	R=0	0h	Reserved
11	OVF	R=0/W=1	0h	Writing a 1 to these bits will set the respective FAIL flag in the NMIFLG and NMISHDFLG registers. Writes of 0 are ignored. Always reads back 0. This can be used as a means to test the NMI mechanisms. Reset type: SYSRSn
10	RESERVED	R	0h	Reserved
9	RESERVED	R	0h	Reserved
8	RESERVED	R	0h	Reserved
7	RESERVED	R	0h	Reserved
6	RESERVED	R	0h	Reserved
5	RESERVED	R	0h	Reserved
4	CPU1HWBISTERR	R=0/W=1	0h	Writing a 1 to these bits will set the respective FAIL flag in the NMIFLG and NMISHDFLG registers. Writes of 0 are ignored. Always reads back 0. This can be used as a means to test the NMI mechanisms. Reset type: SYSRSn
3	FLUNCERR	R=0/W=1	0h	Writing a 1 to these bits will set the respective FAIL flag in the NMIFLG and NMISHDFLG registers. Writes of 0 are ignored. Always reads back 0. This can be used as a means to test the NMI mechanisms. Reset type: SYSRSn
2	RAMUNCERR	R=0/W=1	0h	Writing a 1 to these bits will set the respective FAIL flag in the NMIFLG and NMISHDFLG registers. Writes of 0 are ignored. Always reads back 0. This can be used as a means to test the NMI mechanisms. Reset type: SYSRSn
1	CLOCKFAIL	R=0/W=1	0h	Writing a 1 to these bits will set the respective FAIL flag in the NMIFLG and NMISHDFLG registers. Writes of 0 are ignored. Always reads back 0. This can be used as a means to test the NMI mechanisms. Reset type: SYSRSn
0	RESERVED	R=0	0h	Reserved



### 2.15.5.5 NMIWDCNT Register (Offset = 4h) [reset = 0h]

NMIWDCNT is shown in [Figure 2-64](#) and described in [Table 2-65](#).

Return to [Summary Table](#).

NMI Watchdog Counter Register

**Figure 2-64. NMIWDCNT Register**

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
NMIWDCNT															
R-0h															

**Table 2-65. NMIWDCNT Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-0	NMIWDCNT	R	0h	<p>NMI Watchdog Counter: This 16-bit incremental counter will start incrementing whenever any one of the enabled FAIL flags are set. If the counter reaches the period value, an NMIRSn signal is fired which will then resets the system. The counter will reset to zero when it reaches the period value and will then restart counting if any of the enabled FAIL flags are set.</p> <p>If no enabled FAIL flag is set, then the counter will reset to zero and remain at zero until an enabled FAIL flag is set.</p> <p>Normally, the software would respond to the NMI interrupt generated and clear the offending FLAG(s) before the NMI watchdog triggers a reset. In some situations, the software may decide to allow the watchdog to reset the device anyway.</p> <p>The counter is clocked at the SYCLKOUT rate. Reset type: SYSRSn</p>

### 2.15.5.6 NMIWDPRD Register (Offset = 5h) [reset = FFFFh]

NMIWDPRD is shown in [Figure 2-65](#) and described in [Table 2-66](#).

Return to [Summary Table](#).

NMI Watchdog Period Register

**Figure 2-65. NMIWDPRD Register**

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
NMIWDPRD															
R/W-FFFFh															

**Table 2-66. NMIWDPRD Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-0	NMIWDPRD	R/W	FFFFh	NMI Watchdog Period: This 16-bit value contains the period value at which a reset is generated when the watchdog counter matches. At reset this value is set at the maximum. The software can decrease the period value at initialization time.  Writing a PERIOD value that is smaller than the current counter value will automatically force an NMIRSn and hence reset the watchdog counter. Reset type: SYSRSn

### 2.15.5.7 NMISHDFLG Register (Offset = 6h) [reset = 0h]

NMISHDFLG is shown in [Figure 2-66](#) and described in [Table 2-67](#).

Return to [Summary Table](#).

NMI Shadow Flag Register

**Figure 2-66. NMISHDFLG Register**

15	14	13	12	11	10	9	8
RESERVED				OVF	RESERVED	RESERVED	RESERVED
R=0-0h				R-0h	R-0h	R-0h	R-0h
7	6	5	4	3	2	1	0
RESERVED	RESERVED	RESERVED	CPU1HWBIST ERR	FLUNCERR	RAMUNCERR	CLOCKFAIL	RESERVED
R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R=0-0h

**Table 2-67. NMISHDFLG Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-12	RESERVED	R=0	0h	Reserved
11	OVF	R	0h	Shadow NMI Flags: When an NMIFLG bit is set due to any of the possible NMI source in the device, the corresponding bit in this register is also set. Note that NMIFLGFRM and NMIFLGCLR register also affects the bits of this register in the same way as they do for the NMIFLG register. This register is resetted only by PORn.  Notes: [1] This register is added to keep the definition of System Control Reset Cause Register Clean. Reset type: PORn
10	RESERVED	R	0h	Reserved
9	RESERVED	R	0h	Reserved
8	RESERVED	R	0h	Reserved
7	RESERVED	R	0h	Reserved
6	RESERVED	R	0h	Reserved
5	RESERVED	R	0h	Reserved
4	CPU1HWBISTERR	R	0h	Shadow NMI Flags: When an NMIFLG bit is set due to any of the possible NMI source in the device, the corresponding bit in this register is also set. Note that NMIFLGFRM and NMIFLGCLR register also affects the bits of this register in the same way as they do for the NMIFLG register. This register is resetted only by PORn.  Notes: [1] This register is added to keep the definition of System Control Reset Cause Register Clean. Reset type: PORn
3	FLUNCERR	R	0h	Shadow NMI Flags: When an NMIFLG bit is set due to any of the possible NMI source in the device, the corresponding bit in this register is also set. Note that NMIFLGFRM and NMIFLGCLR register also affects the bits of this register in the same way as they do for the NMIFLG register. This register is resetted only by PORn.  Notes: [1] This register is added to keep the definition of System Control Reset Cause Register Clean. Reset type: PORn

**Table 2-67. NMISHDFLG Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
2	RAMUNCERR	R	0h	<p>Shadow NMI Flags: When an NMIFLG bit is set due to any of the possible NMI source in the device, the corresponding bit in this register is also set. Note that NMIFLGFRC and NMIFLGCLR register also affects the bits of this register in the same way as they do for the NMIFLG register. This register is resetted only by PORn.</p> <p>Notes: [1] This register is added to keep the definition of System Control Reset Cause Register Clean. Reset type: PORn</p>
1	CLOCKFAIL	R	0h	<p>Shadow NMI Flags: When an NMIFLG bit is set due to any of the possible NMI source in the device, the corresponding bit in this register is also set. Note that NMIFLGFRC and NMIFLGCLR register also affects the bits of this register in the same way as they do for the NMIFLG register. This register is resetted only by PORn.</p> <p>Notes: [1] This register is added to keep the definition of System Control Reset Cause Register Clean. Reset type: PORn</p>
0	RESERVED	R=0	0h	Reserved

### 2.15.6 XINT\_REGS Registers

Table 2-68 lists the memory-mapped registers for the XINT\_REGS. All register offset addresses not listed in Table 2-68 should be considered as reserved locations and the register contents should not be modified.

**Table 2-68. XINT\_REGS Registers**

Offset	Acronym	Register Name	Write Protection	Section
0h	XINT1CR	XINT1 configuration register		<a href="#">Go</a>
1h	XINT2CR	XINT2 configuration register		<a href="#">Go</a>
2h	XINT3CR	XINT3 configuration register		<a href="#">Go</a>
3h	XINT4CR	XINT4 configuration register		<a href="#">Go</a>
4h	XINT5CR	XINT5 configuration register		<a href="#">Go</a>
8h	XINT1CTR	XINT1 counter register		<a href="#">Go</a>
9h	XINT2CTR	XINT2 counter register		<a href="#">Go</a>
Ah	XINT3CTR	XINT3 counter register		<a href="#">Go</a>

Complex bit access types are encoded to fit into small table cells. Table 2-69 shows the codes that are used for access types in this section.

**Table 2-69. XINT\_REGS Access Type Codes**

Access Type	Code	Description
<b>Read Type</b>		
R	R	Read
R=0	R	Read
<b>Write Type</b>		
W	W	Write
<b>Reset or Default Value</b>		
-n		Value after reset or the default value
<b>Register Array Variables</b>		
i,j,k,l,m,n		When these variables are used in a register name, an offset, or an address, they refer to the value of a register array where the register is part of a group of repeating registers. The register groups form a hierarchical structure and the array is represented with a formula.
y		When this variable is used in a register name, an offset, or an address it refers to the value of a register array.

**2.15.6.1 XINT1CR Register (Offset = 0h) [reset = 0h]**

XINT1CR is shown in [Figure 2-67](#) and described in [Table 2-70](#).

Return to [Summary Table](#).

XINT1 configuration register

**Figure 2-67. XINT1CR Register**

15	14	13	12	11	10	9	8
RESERVED							
R=0-0h							
7	6	5	4	3	2	1	0
RESERVED				POLARITY		RESERVED	ENABLE
R=0-0h				R/W-0h		R=0-0h	R/W-0h

**Table 2-70. XINT1CR Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-4	RESERVED	R=0	0h	Reserved
3-2	POLARITY	R/W	0h	00: Interrupt is selected as negative edge triggered 01: Interrupt is selected as positive edge triggered 10: Interrupt is selected as negative edge triggered 11: Interrupt is selected as positive or negative edge triggered Reset type: SYSRSn
1	RESERVED	R=0	0h	Reserved
0	ENABLE	R/W	0h	0: Interrupt Disabled 1: Interrupt Enabled Reset type: SYSRSn

**2.15.6.2 XINT2CR Register (Offset = 1h) [reset = 0h]**

XINT2CR is shown in [Figure 2-68](#) and described in [Table 2-71](#).

Return to [Summary Table](#).

XINT2 configuration register

**Figure 2-68. XINT2CR Register**

15	14	13	12	11	10	9	8
RESERVED							
R=0-0h							
7	6	5	4	3	2	1	0
RESERVED				POLARITY		RESERVED	ENABLE
R=0-0h				R/W-0h		R=0-0h	R/W-0h

**Table 2-71. XINT2CR Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-4	RESERVED	R=0	0h	Reserved
3-2	POLARITY	R/W	0h	00: Interrupt is selected as negative edge triggered 01: Interrupt is selected as positive edge triggered 10: Interrupt is selected as negative edge triggered 11: Interrupt is selected as positive or negative edge triggered Reset type: SYSRSn
1	RESERVED	R=0	0h	Reserved
0	ENABLE	R/W	0h	0: Interrupt Disabled 1: Interrupt Enabled Reset type: SYSRSn

### 2.15.6.3 XINT3CR Register (Offset = 2h) [reset = 0h]

XINT3CR is shown in [Figure 2-69](#) and described in [Table 2-72](#).

Return to [Summary Table](#).

XINT3 configuration register

**Figure 2-69. XINT3CR Register**

15	14	13	12	11	10	9	8
RESERVED							
R=0-0h							
7	6	5	4	3	2	1	0
RESERVED				POLARITY		RESERVED	ENABLE
R=0-0h				R/W-0h		R=0-0h	R/W-0h

**Table 2-72. XINT3CR Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-4	RESERVED	R=0	0h	Reserved
3-2	POLARITY	R/W	0h	00: Interrupt is selected as negative edge triggered 01: Interrupt is selected as positive edge triggered 10: Interrupt is selected as negative edge triggered 11: Interrupt is selected as positive or negative edge triggered Reset type: SYSRSn
1	RESERVED	R=0	0h	Reserved
0	ENABLE	R/W	0h	0: Interrupt Disabled 1: Interrupt Enabled Reset type: SYSRSn



#### 2.15.6.4 XINT4CR Register (Offset = 3h) [reset = 0h]

XINT4CR is shown in [Figure 2-70](#) and described in [Table 2-73](#).

Return to [Summary Table](#).

XINT4 configuration register

**Figure 2-70. XINT4CR Register**

15	14	13	12	11	10	9	8
RESERVED							
R=0-0h							
7	6	5	4	3	2	1	0
RESERVED				POLARITY		RESERVED	ENABLE
R=0-0h				R/W-0h		R=0-0h	R/W-0h

**Table 2-73. XINT4CR Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-4	RESERVED	R=0	0h	Reserved
3-2	POLARITY	R/W	0h	00: Interrupt is selected as negative edge triggered 01: Interrupt is selected as positive edge triggered 10: Interrupt is selected as negative edge triggered 11: Interrupt is selected as positive or negative edge triggered Reset type: SYSRSn
1	RESERVED	R=0	0h	Reserved
0	ENABLE	R/W	0h	0: Interrupt Disabled 1: Interrupt Enabled Reset type: SYSRSn

### 2.15.6.5 XINT5CR Register (Offset = 4h) [reset = 0h]

XINT5CR is shown in [Figure 2-71](#) and described in [Table 2-74](#).

Return to [Summary Table](#).

XINT5 configuration register

**Figure 2-71. XINT5CR Register**

15	14	13	12	11	10	9	8
RESERVED							
R=0-0h							
7	6	5	4	3	2	1	0
RESERVED				POLARITY		RESERVED	ENABLE
R=0-0h				R/W-0h		R=0-0h	R/W-0h

**Table 2-74. XINT5CR Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-4	RESERVED	R=0	0h	Reserved
3-2	POLARITY	R/W	0h	00: Interrupt is selected as negative edge triggered 01: Interrupt is selected as positive edge triggered 10: Interrupt is selected as negative edge triggered 11: Interrupt is selected as positive or negative edge triggered Reset type: SYSRSn
1	RESERVED	R=0	0h	Reserved
0	ENABLE	R/W	0h	0: Interrupt Disabled 1: Interrupt Enabled Reset type: SYSRSn

**2.15.6.6 XINT1CTR Register (Offset = 8h) [reset = 0h]**

XINT1CTR is shown in [Figure 2-72](#) and described in [Table 2-75](#).

Return to [Summary Table](#).

XINT1 counter register

**Figure 2-72. XINT1CTR Register**

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
INTCTR															
R-0h															

**Table 2-75. XINT1CTR Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-0	INTCTR	R	0h	<p>This is a free running 16-bit up-counter that is clocked at the SYSCLKOUT rate. The counter value is reset to 0x0000 when a valid interrupt edge is detected and then continues counting until the next valid interrupt edge is detected. The counter must only be reset by the selected POLARITY edge as selected in the respective interrupt control register. When the interrupt is disabled, the counter will stop. The counter is a free-running counter and will wrap around to zero when the max value is reached. The counter is a read only register and can only be reset to zero by a valid interrupt edge or by reset.</p> <p>Reset type: SYSRSn</p>

### 2.15.6.7 XINT2CTR Register (Offset = 9h) [reset = 0h]

XINT2CTR is shown in [Figure 2-73](#) and described in [Table 2-76](#).

Return to [Summary Table](#).

XINT2 counter register

**Figure 2-73. XINT2CTR Register**

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
INTCTR															
R-0h															

**Table 2-76. XINT2CTR Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-0	INTCTR	R	0h	This is a free running 16-bit up-counter that is clocked at the SYSCLKOUT rate. The counter value is reset to 0x0000 when a valid interrupt edge is detected and then continues counting until the next valid interrupt edge is detected. The counter must only be reset by the selected POLARITY edge as selected in the respective interrupt control register. When the interrupt is disabled, the counter will stop. The counter is a free-running counter and will wrap around to zero when the max value is reached. The counter is a read only register and can only be reset to zero by a valid interrupt edge or by reset. Reset type: SYSRSn

**2.15.6.8 XINT3CTR Register (Offset = Ah) [reset = 0h]**

XINT3CTR is shown in [Figure 2-74](#) and described in [Table 2-77](#).

Return to [Summary Table](#).

XINT3 counter register

**Figure 2-74. XINT3CTR Register**

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
INTCTR															
R-0h															

**Table 2-77. XINT3CTR Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-0	INTCTR	R	0h	<p>This is a free running 16-bit up-counter that is clocked at the SYSCLKOUT rate. The counter value is reset to 0x0000 when a valid interrupt edge is detected and then continues counting until the next valid interrupt edge is detected. The counter must only be reset by the selected POLARITY edge as selected in the respective interrupt control register. When the interrupt is disabled, the counter will stop. The counter is a free-running counter and will wrap around to zero when the max value is reached. The counter is a read only register and can only be reset to zero by a valid interrupt edge or by reset.</p> <p>Reset type: SYSRSn</p>

### 2.15.7 DMA\_CLA\_SRC\_SEL\_REGS Registers

Table 2-78 lists the memory-mapped registers for the DMA\_CLA\_SRC\_SEL\_REGS. All register offset addresses not listed in Table 2-78 should be considered as reserved locations and the register contents should not be modified.

**Table 2-78. DMA\_CLA\_SRC\_SEL\_REGS Registers**

Offset	Acronym	Register Name	Write Protection	Section
0h	CLA1TASKSRCSELLOCK	CLA1 Task Trigger Source Select Lock Register	EALLOW	<a href="#">Go</a>
4h	DMACHSRCSELLOCK	DMA Channel Triger Source Select Lock Register	EALLOW	<a href="#">Go</a>
6h	CLA1TASKSRCSEL1	CLA1 Task Trigger Source Select Register-1	EALLOW	<a href="#">Go</a>
8h	CLA1TASKSRCSEL2	CLA1 Task Trigger Source Select Register-2	EALLOW	<a href="#">Go</a>
16h	DMACHSRCSEL1	DMA Channel Trigger Source Select Register-1	EALLOW	<a href="#">Go</a>
18h	DMACHSRCSEL2	DMA Channel Trigger Source Select Register-2	EALLOW	<a href="#">Go</a>

Complex bit access types are encoded to fit into small table cells. Table 2-79 shows the codes that are used for access types in this section.

**Table 2-79. DMA\_CLA\_SRC\_SEL\_REGS Access Type Codes**

Access Type	Code	Description
<b>Read Type</b>		
R	R	Read
R=0	R	Read
<b>Write Type</b>		
W	W	Write
WSOnce	SOnce W	Set once Write
<b>Reset or Default Value</b>		
-n		Value after reset or the default value
<b>Register Array Variables</b>		
i,j,k,l,m,n		When these variables are used in a register name, an offset, or an address, they refer to the value of a register array where the register is part of a group of repeating registers. The register groups form a hierarchical structure and the array is represented with a formula.
y		When this variable is used in a register name, an offset, or an address it refers to the value of a register array.

**2.15.7.1 CLA1TASKSRCSELLOCK Register (Offset = 0h) [reset = 0h]**

CLA1TASKSRCSELLOCK is shown in [Figure 2-75](#) and described in [Table 2-80](#).

Return to [Summary Table](#).

CLA1 Task Trigger Source Select Lock Register

**Figure 2-75. CLA1TASKSRCSELLOCK Register**

31	30	29	28	27	26	25	24
RESERVED							
R=0-0h							
23	22	21	20	19	18	17	16
RESERVED							
R=0-0h							
15	14	13	12	11	10	9	8
RESERVED							
R=0-0h							
7	6	5	4	3	2	1	0
RESERVED						CLA1TASKSR CSEL2	CLA1TASKSR CSEL1
R=0-0h						R/WSONce-0h	R/WSONce-0h

**Table 2-80. CLA1TASKSRCSELLOCK Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R=0	0h	Reserved
15-2	RESERVED	R=0	0h	Reserved
1	CLA1TASKSRCSEL2	R/WSONce	0h	CLA1TASKSRCSEL2 Register Lock bit: 0: Respective register is not locked 1: Respective register is locked. Notes: [1] Any SOnce bit in this register, once set can only be cleared through a SYSRSn. Write of 0 to any bit of this register has no effect [2] The locking mechanism applies to only writes. Reads to the registers which have LOCK protection are always allowed Reset type: SYSRSn
0	CLA1TASKSRCSEL1	R/WSONce	0h	CLA1TASKSRCSEL1 Register Lock bit: 0: Respective register is not locked 1: Respective register is locked. Notes: [1] Any SOnce bit in this register, once set can only be cleared through a SYSRSn. Write of 0 to any bit of this register has no effect [2] The locking mechanism applies to only writes. Reads to the registers which have LOCK protection are always allowed Reset type: SYSRSn

**2.15.7.2 DMACHSRCSELLOCK Register (Offset = 4h) [reset = 0h]**

 DMACHSRCSELLOCK is shown in [Figure 2-76](#) and described in [Table 2-81](#).

 Return to [Summary Table](#).

DMA Channel Trigger Source Select Lock Register

**Figure 2-76. DMACHSRCSELLOCK Register**

31	30	29	28	27	26	25	24
RESERVED							
R=0-0h							
23	22	21	20	19	18	17	16
RESERVED							
R=0-0h							
15	14	13	12	11	10	9	8
RESERVED							
R=0-0h							
7	6	5	4	3	2	1	0
RESERVED						DMACHSRCSE L2	DMACHSRCSE L1
R=0-0h						R/WSONce-0h	R/WSONce-0h

**Table 2-81. DMACHSRCSELLOCK Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R=0	0h	Reserved
15-2	RESERVED	R=0	0h	Reserved
1	DMACHSRCSEL2	R/WSONce	0h	DMACHSRCSEL2 Register Lock bit: 0: Respective register is not locked 1: Respective register is locked. Notes: [1] Any SOnce bit in this register, once set can only be cleared through a SYSRSn. Write of 0 to any bit of this register has no effect [2] The locking mechanism applies to only writes. Reads to the registers which have LOCK protection are always allowed Reset type: SYSRSn
0	DMACHSRCSEL1	R/WSONce	0h	DMACHSRCSEL1 Register Lock bit: 0: Respective register is not locked 1: Respective register is locked. Notes: [1] Any SOnce bit in this register, once set can only be cleared through a SYSRSn. Write of 0 to any bit of this register has no effect [2] The locking mechanism applies to only writes. Reads to the registers which have LOCK protection are always allowed Reset type: SYSRSn



### 2.15.7.3 CLA1TASKSRCSEL1 Register (Offset = 6h) [reset = 0h]

CLA1TASKSRCSEL1 is shown in [Figure 2-77](#) and described in [Table 2-82](#).

Return to [Summary Table](#).

CLA1 Task Trigger Source Select Register-1

**Figure 2-77. CLA1TASKSRCSEL1 Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
TASK4								TASK3								TASK2								TASK1							
R/W-0h								R/W-0h								R/W-0h								R/W-0h							

**Table 2-82. CLA1TASKSRCSEL1 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-24	TASK4	R/W	0h	Selects the Trigger Source for TASK4 of CLA1 Reset type: SYSRSn
23-16	TASK3	R/W	0h	Selects the Trigger Source for TASK3 of CLA1 Reset type: SYSRSn
15-8	TASK2	R/W	0h	Selects the Trigger Source for TASK2 of CLA1 Reset type: SYSRSn
7-0	TASK1	R/W	0h	Selects the Trigger Source for TASK1 of CLA1 Reset type: SYSRSn

### 2.15.7.4 CLA1TASKSRCSEL2 Register (Offset = 8h) [reset = 0h]

CLA1TASKSRCSEL2 is shown in [Figure 2-78](#) and described in [Table 2-83](#).

Return to [Summary Table](#).

CLA1 Task Trigger Source Select Register-2

**Figure 2-78. CLA1TASKSRCSEL2 Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
TASK8								TASK7								TASK6								TASK5							
R/W-0h								R/W-0h								R/W-0h								R/W-0h							

**Table 2-83. CLA1TASKSRCSEL2 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-24	TASK8	R/W	0h	Selects the Trigger Source for TASK8 of CLA1 Reset type: SYSRSn
23-16	TASK7	R/W	0h	Selects the Trigger Source for TASK7 of CLA1 Reset type: SYSRSn
15-8	TASK6	R/W	0h	Selects the Trigger Source for TASK6 of CLA1 Reset type: SYSRSn
7-0	TASK5	R/W	0h	Selects the Trigger Source for TASK5 of CLA1 Reset type: SYSRSn

### 2.15.7.5 DMACHSRCSEL1 Register (Offset = 16h) [reset = 0h]

DMACHSRCSEL1 is shown in [Figure 2-79](#) and described in [Table 2-84](#).

Return to [Summary Table](#).

DMA Channel Trigger Source Select Register-1

**Figure 2-79. DMACHSRCSEL1 Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
CH4								CH3								CH2								CH1							
R/W-0h								R/W-0h								R/W-0h								R/W-0h							

**Table 2-84. DMACHSRCSEL1 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-24	CH4	R/W	0h	Selects the Trigger and Sync Source CH4 of DMA Reset type: SYSRSn
23-16	CH3	R/W	0h	Selects the Trigger and Sync Source CH3 of DMA Reset type: SYSRSn
15-8	CH2	R/W	0h	Selects the Trigger and Sync Source CH2 of DMA Reset type: SYSRSn
7-0	CH1	R/W	0h	Selects the Trigger and Sync Source CH1 of DMA Reset type: SYSRSn

### 2.15.7.6 DMACHSRCSEL2 Register (Offset = 18h) [reset = 0h]

DMACHSRCSEL2 is shown in [Figure 2-80](#) and described in [Table 2-85](#).

Return to [Summary Table](#).

DMA Channel Trigger Source Select Register-2

**Figure 2-80. DMACHSRCSEL2 Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
RESERVED																CH6						CH5									
R=0-0h																R/W-0h						R/W-0h									

**Table 2-85. DMACHSRCSEL2 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R=0	0h	Reserved
15-8	CH6	R/W	0h	Selects the Trigger and Sync Source CH6 of DMA Reset type: SYSRSn
7-0	CH5	R/W	0h	Selects the Trigger and Sync Source CH5 of DMA Reset type: SYSRSn

### 2.15.8 FLASH\_PUMP\_SEMAPHORE\_REGS Registers

Table 2-86 lists the memory-mapped registers for the FLASH\_PUMP\_SEMAPHORE\_REGS. All register offset addresses not listed in Table 2-86 should be considered as reserved locations and the register contents should not be modified.

**Table 2-86. FLASH\_PUMP\_SEMAPHORE\_REGS Registers**

Offset	Acronym	Register Name	Write Protection	Section
0h	PUMPREQUEST	Flash programming semaphore PUMP request register	EALLOW	<a href="#">Go</a>

Complex bit access types are encoded to fit into small table cells. Table 2-87 shows the codes that are used for access types in this section.

**Table 2-87. FLASH\_PUMP\_SEMAPHORE\_REGS Access Type Codes**

Access Type	Code	Description
<b>Read Type</b>		
R	R	Read
R=0	R	Read
<b>Write Type</b>		
W	W	Write
<b>Reset or Default Value</b>		
-n		Value after reset or the default value
<b>Register Array Variables</b>		
i,j,k,l,m,n		When these variables are used in a register name, an offset, or an address, they refer to the value of a register array where the register is part of a group of repeating registers. The register groups form a hierarchical structure and the array is represented with a formula.
y		When this variable is used in a register name, an offset, or an address it refers to the value of a register array.

**2.15.8.1 PUMPREQUEST Register (Offset = 0h) [reset = 0h]**

PUMPREQUEST is shown in [Figure 2-81](#) and described in [Table 2-88](#).

Return to [Summary Table](#).

Flash programming semaphore PUMP request register

**Figure 2-81. PUMPREQUEST Register**

31	30	29	28	27	26	25	24
KEY							
R=0/W-0h							
23	22	21	20	19	18	17	16
KEY							
R=0/W-0h							
15	14	13	12	11	10	9	8
RESERVED							
R=0-0h							
7	6	5	4	3	2	1	0
RESERVED						PUMP_OWNERSHIP	
R=0-0h						R/W-0h	

**Table 2-88. PUMPREQUEST Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	KEY	R=0/W	0h	In order to write to the semaphore bits, 0x5a5a must be written to these key bits at the same time. Otherwise, writes are ignored. The key is cleared immediately after writing, so it must be written again for every semaphore change. Reset type: CPU1.SYSRSn
15-2	RESERVED	R=0	0h	Reserved
1-0	PUMP_OWNERSHIP	R/W	0h	These bits configure which FMC has control of the flash pump, which allows write access to the flash memory. The possible values are: 00, 10, 11: FMC0/BANK0 owns the flash pump for program/erase 01 : FMC1/BANK1 owns the flash pump for program/erase  The semaphore bits [1:0] must be written along with the correct key in bits [31:16]. Reset type: CPU1.SYSRSn

## 2.15.9 DEV\_CFG\_REGS Registers

Table 2-89 lists the memory-mapped registers for the DEV\_CFG\_REGS. All register offset addresses not listed in Table 2-89 should be considered as reserved locations and the register contents should not be modified.

**Table 2-89. DEV\_CFG\_REGS Registers**

Offset	Acronym	Register Name	Write Protection	Section
8h	PARTIDL_1	Lower 32-bit of Device PART Identification Number		<a href="#">Go</a>
Ah	PARTIDH_1	Upper 32-bit of Device PART Identification Number		<a href="#">Go</a>
Ch	REVID	Device Revision Number		<a href="#">Go</a>
10h	DC0_1	Device Capability: Device Information		<a href="#">Go</a>
12h	DC1_1	Device Capability: Processing Block Customization		<a href="#">Go</a>
14h	DC2_1	Device Capability: EMIF Customization		<a href="#">Go</a>
16h	DC3_1	Device Capability: Peripheral Customization		<a href="#">Go</a>
18h	DC4_1	Device Capability: Peripheral Customization		<a href="#">Go</a>
1Ah	DC5_1	Device Capability: Peripheral Customization		<a href="#">Go</a>
1Ch	DC6_1	Device Capability: Peripheral Customization		<a href="#">Go</a>
1Eh	DC7_1	Device Capability: Peripheral Customization		<a href="#">Go</a>
20h	DC8_1	Device Capability: Peripheral Customization		<a href="#">Go</a>
22h	DC9_1	Device Capability: Peripheral Customization		<a href="#">Go</a>
24h	DC10_1	Device Capability: Peripheral Customization		<a href="#">Go</a>
26h	DC11_1	Device Capability: Peripheral Customization		<a href="#">Go</a>
28h	DC12_1	Device Capability: Peripheral Customization		<a href="#">Go</a>
2Ah	DC13_1	Device Capability: Peripheral Customization		<a href="#">Go</a>
2Ch	DC14_1	Device Capability: Analog Modules Customization		<a href="#">Go</a>
2Eh	DC15_1	Device Capability: Analog Modules Customization		<a href="#">Go</a>
32h	DC17_1	Device Capability: Analog Modules Customization		<a href="#">Go</a>
34h	DC18_1	Device Capability: CPU1 Lx SRAM Customization		<a href="#">Go</a>
38h	DC20_1	Device Capability: GSx SRAM Customization		<a href="#">Go</a>
60h	PERCNF1_1	Peripheral Configuration register		<a href="#">Go</a>
74h	FUSEERR	e-Fuse error Status register		<a href="#">Go</a>
82h	SOFTPRES0	Processing Block Software Reset register	EALLOW	<a href="#">Go</a>
84h	SOFTPRES1	EMIF Software Reset register	EALLOW	<a href="#">Go</a>
86h	SOFTPRES2	Peripheral Software Reset register	EALLOW	<a href="#">Go</a>
88h	SOFTPRES3	Peripheral Software Reset register	EALLOW	<a href="#">Go</a>
8Ah	SOFTPRES4	Peripheral Software Reset register	EALLOW	<a href="#">Go</a>
8Eh	SOFTPRES6	Peripheral Software Reset register	EALLOW	<a href="#">Go</a>
90h	SOFTPRES7	Peripheral Software Reset register	EALLOW	<a href="#">Go</a>
92h	SOFTPRES8	Peripheral Software Reset register	EALLOW	<a href="#">Go</a>
94h	SOFTPRES9	Peripheral Software Reset register	EALLOW	<a href="#">Go</a>
98h	SOFTPRES11	Peripheral Software Reset register	EALLOW	<a href="#">Go</a>
9Ch	SOFTPRES13	Peripheral Software Reset register	EALLOW	<a href="#">Go</a>
9Eh	SOFTPRES14	Peripheral Software Reset register	EALLOW	<a href="#">Go</a>
A2h	SOFTPRES16	Peripheral Software Reset register	EALLOW	<a href="#">Go</a>
12Ch	SYDBGCTL	System Debug Control register	EALLOW	<a href="#">Go</a>

Complex bit access types are encoded to fit into small table cells. [Table 2-90](#) shows the codes that are used for access types in this section.

**Table 2-90. DEV\_CFG\_REGS Access Type Codes**

Access Type	Code	Description
<b>Read Type</b>		
R	R	Read
R=0	R	Read
<b>Write Type</b>		
W	W	Write
W=1	W	Write
WOnce	W	Write
WSOnce	SOnce W	Set once Write
<b>Reset or Default Value</b>		
-n		Value after reset or the default value
<b>Register Array Variables</b>		
i,j,k,l,m,n		When these variables are used in a register name, an offset, or an address, they refer to the value of a register array where the register is part of a group of repeating registers. The register groups form a hierarchical structure and the array is represented with a formula.
y		When this variable is used in a register name, an offset, or an address it refers to the value of a register array.



### 2.15.9.1 PARTIDL\_1 Register (Offset = 8h) [reset = X]

PARTIDL\_1 is shown in [Figure 2-82](#) and described in [Table 2-91](#).

Return to [Summary Table](#).

Lower 32-bit of Device PART Identification Number

**Figure 2-82. PARTIDL\_1 Register**

31	30	29	28	27	26	25	24
PARTID_FORMAT_REVISION				RESERVED			
R/WOnce-X				R/WOnce-X			
23	22	21	20	19	18	17	16
FLASH_SIZE							
R/WOnce-X							
15	14	13	12	11	10	9	8
RESERVED	INSTASPIN		RESERVED	RESERVED	PIN_COUNT		
R/WOnce-X	R/WOnce-X		R-0h	R-0h	R/WOnce-X		
7	6	5	4	3	2	1	0
QUAL		RESERVED	RESERVED		RESERVED		
R/WOnce-X		R/WOnce-X	R-0h		R-0h		

**Table 2-91. PARTIDL\_1 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-28	PARTID_FORMAT_REVISION	R/WOnce	X	Revision of the PARTID format Reset type: XRSn
27-24	RESERVED	R/WOnce	X	Reserved
23-16	FLASH_SIZE	R/WOnce	X	0x7 - 512KB 0x6 - 256KB  Note: This field shows flash size on CPU1 (see datasheet for flash size available) Reset type: XRSn
15	RESERVED	R/WOnce	X	Reserved
14-13	INSTASPIN	R/WOnce	X	0 = Reserved for future 1 = Reserved for future 2 = Reserved for future 3 = NONE Reset type: XRSn
12	RESERVED	R	0h	Reserved
11	RESERVED	R	0h	Reserved
10-8	PIN_COUNT	R/WOnce	X	0 = reserved for future 1 = reserved for future 2 = reserved for future 3 = reserved for future 4 = reserved for future 5 = 100 pin 6 = 176 pin 7 = 337 pin Reset type: XRSn

**Table 2-91. PARTIDL\_1 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
7-6	QUAL	R/WOnce	X	0 = Engineering sample.(TMX) 1 = Pilot production (TMP) 2 = Fully qualified (TMS) Reset type: XRSn
5	RESERVED	R/WOnce	X	Reserved
4-3	RESERVED	R	0h	Reserved
2-0	RESERVED	R	0h	Reserved

### 2.15.9.2 PARTIDH\_1 Register (Offset = Ah) [reset = X]

PARTIDH\_1 is shown in [Figure 2-83](#) and described in [Table 2-92](#).

Return to [Summary Table](#).

Upper 32-bit of Device PART Identification Number

**Figure 2-83. PARTIDH\_1 Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
DEVICE_CLASS_ID								PARTNO							
R/WOnce-X								R/WOnce-X							
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
FAMILY								RESERVED							
R/WOnce-X								R/WOnce-X							

**Table 2-92. PARTIDH\_1 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-24	DEVICE_CLASS_ID	R/WOnce	X	Reserved Reset type: XRSn
23-16	PARTNO	R/WOnce	X	Refer to Datasheet for Device Part Number Reset type: XRSn
15-8	FAMILY	R/WOnce	X	Device Family 0x3 - DELFINO DUAL CORE 0x4 - DELFINO SINGLE CORE 0x5 - PICCOLO SINGLE CORE Other values Reserved Reset type: XRSn
7-0	RESERVED	R/WOnce	X	Reserved

### 2.15.9.3 REVID Register (Offset = Ch) [reset = X]

REVID is shown in [Figure 2-84](#) and described in [Table 2-93](#).

Return to [Summary Table](#).

Device Revision Number

**Figure 2-84. REVID Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
REVID																															
R-X																															

**Table 2-93. REVID Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-0	REVID	R	X	These 32-bits specify the silicon revision. See your device specific datasheet for details. Reset type: N/A

**2.15.9.4 DC0\_1 Register (Offset = 10h) [reset = X]**

DC0\_1 is shown in [Figure 2-85](#) and described in [Table 2-94](#).

Return to [Summary Table](#).

Device Capability: Device Information

**Figure 2-85. DC0\_1 Register**

31	30	29	28	27	26	25	24
RESERVED							
R=0-0h							
23	22	21	20	19	18	17	16
RESERVED							
R=0-0h							
15	14	13	12	11	10	9	8
RESERVED							
R=0-0h							
7	6	5	4	3	2	1	0
RESERVED							SINGLE_CORE
R=0-0h							R/WOnce-X

**Table 2-94. DC0\_1 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R=0	0h	Reserved
15-1	RESERVED	R=0	0h	Reserved
0	SINGLE_CORE	R/WOnce	X	Single Core vs Dual Core 0: Single Core 1: Dual Core Reset type: XRSn

**2.15.9.5 DC1\_1 Register (Offset = 12h) [reset = X]**

DC1\_1 is shown in [Figure 2-86](#) and described in [Table 2-95](#).

Return to [Summary Table](#).

Device Capability: Processing Block Customization

**Figure 2-86. DC1\_1 Register**

31	30	29	28	27	26	25	24
RESERVED							
R=0-0h							
23	22	21	20	19	18	17	16
RESERVED							
R=0-0h							
15	14	13	12	11	10	9	8
RESERVED						RESERVED	RESERVED
R=0-0h						R-0h	R-0h
7	6	5	4	3	2	1	0
RESERVED	CPU1_CLA1	RESERVED		RESERVED	CPU1_VCU	RESERVED	CPU1_FPU_TMU
R-0h	R/WOnce-X	R=0-0h		R-0h	R/WOnce-X	R-0h	R/WOnce-X

**Table 2-95. DC1\_1 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R=0	0h	Reserved
15-10	RESERVED	R=0	0h	Reserved
9	RESERVED	R	0h	Reserved
8	RESERVED	R	0h	Reserved
7	RESERVED	R	0h	Reserved
6	CPU1_CLA1	R/WOnce	X	0 - feature is not present on this device 1 - feature is present on this device Reset type: XRSn
5-4	RESERVED	R=0	0h	Reserved
3	RESERVED	R	0h	Reserved
2	CPU1_VCU	R/WOnce	X	0 - feature is not present on this device 1 - feature is present on this device Reset type: XRSn
1	RESERVED	R	0h	Reserved
0	CPU1_FPU_TMU	R/WOnce	X	0 - feature is not present on this device 1 - feature is present on this device Reset type: XRSn

### 2.15.9.6 DC2\_1 Register (Offset = 14h) [reset = X]

DC2\_1 is shown in [Figure 2-87](#) and described in [Table 2-96](#).

Return to [Summary Table](#).

Device Capability: EMIF Customization

**Figure 2-87. DC2\_1 Register**

31	30	29	28	27	26	25	24
RESERVED							
R=0-0h							
23	22	21	20	19	18	17	16
RESERVED							
R=0-0h							
15	14	13	12	11	10	9	8
RESERVED							
R=0-0h							
7	6	5	4	3	2	1	0
RESERVED						EMIF2	EMIF1
R=0-0h						R/WOnce-X	R/WOnce-X

**Table 2-96. DC2\_1 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R=0	0h	Reserved
15-2	RESERVED	R=0	0h	Reserved
1	EMIF2	R/WOnce	X	EMIF2 : 0: Feature not present on the device 1: Feature present on the device Reset type: XRSn
0	EMIF1	R/WOnce	X	EMIF1 : 0: Feature not present on the device 1: Feature present on the device Reset type: XRSn

**2.15.9.7 DC3\_1 Register (Offset = 16h) [reset = X]**

DC3\_1 is shown in [Figure 2-88](#) and described in [Table 2-97](#).

Return to [Summary Table](#).

Device Capability: Peripheral Customization

**Figure 2-88. DC3\_1 Register**

31	30	29	28	27	26	25	24
RESERVED							
R=0-0h							
23	22	21	20	19	18	17	16
RESERVED							
R=0-0h							
15	14	13	12	11	10	9	8
RESERVED	RESERVED	RESERVED	RESERVED	EPWM12	EPWM11	EPWM10	EPWM9
R-0h	R-0h	R-0h	R-0h	R/WOnce-X	R/WOnce-X	R/WOnce-X	R/WOnce-X
7	6	5	4	3	2	1	0
EPWM8	EPWM7	EPWM6	EPWM5	EPWM4	EPWM3	EPWM2	EPWM1
R/WOnce-X	R/WOnce-X	R/WOnce-X	R/WOnce-X	R/WOnce-X	R/WOnce-X	R/WOnce-X	R/WOnce-X

**Table 2-97. DC3\_1 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R=0	0h	Reserved
15	RESERVED	R	0h	Reserved
14	RESERVED	R	0h	Reserved
13	RESERVED	R	0h	Reserved
12	RESERVED	R	0h	Reserved
11	EPWM12	R/WOnce	X	EPWM12 : 0: Feature not present on the device 1: Feature present on the device Reset type: XRSn
10	EPWM11	R/WOnce	X	EPWM11 : 0: Feature not present on the device 1: Feature present on the device Reset type: XRSn
9	EPWM10	R/WOnce	X	EPWM10 : 0: Feature not present on the device 1: Feature present on the device Reset type: XRSn
8	EPWM9	R/WOnce	X	EPWM9 : 0: Feature not present on the device 1: Feature present on the device Reset type: XRSn
7	EPWM8	R/WOnce	X	EPWM8 : 0: Feature not present on the device 1: Feature present on the device Reset type: XRSn



**Table 2-97. DC3\_1 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
6	EPWM7	R/WOnce	X	EPWM7 : 0: Feature not present on the device 1: Feature present on the device Reset type: XRSn
5	EPWM6	R/WOnce	X	EPWM6 : 0: Feature not present on the device 1: Feature present on the device Reset type: XRSn
4	EPWM5	R/WOnce	X	EPWM5 : 0: Feature not present on the device 1: Feature present on the device Reset type: XRSn
3	EPWM4	R/WOnce	X	EPWM4 : 0: Feature not present on the device 1: Feature present on the device Reset type: XRSn
2	EPWM3	R/WOnce	X	EPWM3 : 0: Feature not present on the device 1: Feature present on the device Reset type: XRSn
1	EPWM2	R/WOnce	X	EPWM2 : 0: Feature not present on the device 1: Feature present on the device Reset type: XRSn
0	EPWM1	R/WOnce	X	EPWM1 : 0: Feature not present on the device 1: Feature present on the device Reset type: XRSn

**2.15.9.8 DC4\_1 Register (Offset = 18h) [reset = X]**

 DC4\_1 is shown in [Figure 2-89](#) and described in [Table 2-98](#).

 Return to [Summary Table](#).

Device Capability: Peripheral Customization

**Figure 2-89. DC4\_1 Register**

31	30	29	28	27	26	25	24
RESERVED							
R=0-0h							
23	22	21	20	19	18	17	16
RESERVED							
R=0-0h							
15	14	13	12	11	10	9	8
RESERVED							
R=0-0h							
7	6	5	4	3	2	1	0
RESERVED	RESERVED	ECAP6	ECAP5	ECAP4	ECAP3	ECAP2	ECAP1
R-0h	R-0h	R/WOnce-X	R/WOnce-X	R/WOnce-X	R/WOnce-X	R/WOnce-X	R/WOnce-X

**Table 2-98. DC4\_1 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R=0	0h	Reserved
15-8	RESERVED	R=0	0h	Reserved
7	RESERVED	R	0h	Reserved
6	RESERVED	R	0h	Reserved
5	ECAP6	R/WOnce	X	ECAP6 : 0: Feature not present on the device 1: Feature present on the device Reset type: XRSn
4	ECAP5	R/WOnce	X	ECAP5 : 0: Feature not present on the device 1: Feature present on the device Reset type: XRSn
3	ECAP4	R/WOnce	X	ECAP4 : 0: Feature not present on the device 1: Feature present on the device Reset type: XRSn
2	ECAP3	R/WOnce	X	ECAP3 : 0: Feature not present on the device 1: Feature present on the device Reset type: XRSn
1	ECAP2	R/WOnce	X	ECAP2 : 0: Feature not present on the device 1: Feature present on the device Reset type: XRSn
0	ECAP1	R/WOnce	X	ECAP1 : 0: Feature not present on the device 1: Feature present on the device Reset type: XRSn

### 2.15.9.9 DC5\_1 Register (Offset = 1Ah) [reset = X]

DC5\_1 is shown in [Figure 2-90](#) and described in [Table 2-99](#).

Return to [Summary Table](#).

Device Capability: Peripheral Customization

**Figure 2-90. DC5\_1 Register**

31	30	29	28	27	26	25	24
RESERVED							
R=0-0h							
23	22	21	20	19	18	17	16
RESERVED							
R=0-0h							
15	14	13	12	11	10	9	8
RESERVED							
R=0-0h							
7	6	5	4	3	2	1	0
RESERVED				RESERVED	EQEP3	EQEP2	EQEP1
R=0-0h				R-0h	R/WOnce-X	R/WOnce-X	R/WOnce-X

**Table 2-99. DC5\_1 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R=0	0h	Reserved
15-4	RESERVED	R=0	0h	Reserved
3	RESERVED	R	0h	Reserved
2	EQEP3	R/WOnce	X	EQEP3 : 0: Feature not present on the device 1: Feature present on the device Reset type: XRSn
1	EQEP2	R/WOnce	X	EQEP2 : 0: Feature not present on the device 1: Feature present on the device Reset type: XRSn
0	EQEP1	R/WOnce	X	EQEP1 : 0: Feature not present on the device 1: Feature present on the device Reset type: XRSn

**2.15.9.10 DC6\_1 Register (Offset = 1Ch) [reset = X]**

DC6\_1 is shown in [Figure 2-91](#) and described in [Table 2-100](#).

Return to [Summary Table](#).

Device Capability: Peripheral Customization

**Figure 2-91. DC6\_1 Register**

31	30	29	28	27	26	25	24
RESERVED							
R=0-0h							
23	22	21	20	19	18	17	16
RESERVED							
R=0-0h							
15	14	13	12	11	10	9	8
RESERVED							
R=0-0h							
7	6	5	4	3	2	1	0
RESERVED	RESERVED	RESERVED	RESERVED	CLB4	CLB3	CLB2	CLB1
R-0h	R-0h	R-0h	R-0h	R/WOnce-X	R/WOnce-X	R/WOnce-X	R/WOnce-X

**Table 2-100. DC6\_1 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R=0	0h	Reserved
15-8	RESERVED	R=0	0h	Reserved
7	RESERVED	R	0h	Reserved
6	RESERVED	R	0h	Reserved
5	RESERVED	R	0h	Reserved
4	RESERVED	R	0h	Reserved
3	CLB4	R/WOnce	X	CLB4 : 0: Feature not present on the device 1: Feature present on the device Reset type: XRSn
2	CLB3	R/WOnce	X	CLB3 : 0: Feature not present on the device 1: Feature present on the device Reset type: XRSn
1	CLB2	R/WOnce	X	CLB2 : 0: Feature not present on the device 1: Feature present on the device Reset type: XRSn
0	CLB1	R/WOnce	X	CLB1 : 0: Feature not present on the device 1: Feature present on the device Reset type: XRSn

**2.15.9.11 DC7\_1 Register (Offset = 1Eh) [reset = X]**

DC7\_1 is shown in [Figure 2-92](#) and described in [Table 2-101](#).

Return to [Summary Table](#).

Device Capability: Peripheral Customization

**Figure 2-92. DC7\_1 Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
RESERVED															
R=0-0h															
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
RESERVED								RESE RVED	RESE RVED	RESE RVED	RESE RVED	RESE RVED	RESE RVED	SD2	SD1
R=0-0h								R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R/WO nce-X	R/WO nce-X

**Table 2-101. DC7\_1 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R=0	0h	Reserved
15-8	RESERVED	R=0	0h	Reserved
7	RESERVED	R	0h	Reserved
6	RESERVED	R	0h	Reserved
5	RESERVED	R	0h	Reserved
4	RESERVED	R	0h	Reserved
3	RESERVED	R	0h	Reserved
2	RESERVED	R	0h	Reserved
1	SD2	R/WOnce	X	SD2 : 0: Feature not present on the device 1: Feature present on the device Reset type: XRSn
0	SD1	R/WOnce	X	SD1 : 0: Feature not present on the device 1: Feature present on the device Reset type: XRSn

**2.15.9.12 DC8\_1 Register (Offset = 20h) [reset = X]**

 DC8\_1 is shown in [Figure 2-93](#) and described in [Table 2-102](#).

 Return to [Summary Table](#).

Device Capability: Peripheral Customization

**Figure 2-93. DC8\_1 Register**

31	30	29	28	27	26	25	24
RESERVED							
R=0-0h							
23	22	21	20	19	18	17	16
RESERVED							
R=0-0h							
15	14	13	12	11	10	9	8
RESERVED							
R=0-0h							
7	6	5	4	3	2	1	0
RESERVED				SCI_D	SCI_C	SCI_B	SCI_A
R=0-0h				R/WOnce-X	R/WOnce-X	R/WOnce-X	R/WOnce-X

**Table 2-102. DC8\_1 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R=0	0h	Reserved
15-4	RESERVED	R=0	0h	Reserved
3	SCI_D	R/WOnce	X	SCI_D : 0: Feature not present on the device 1: Feature present on the device Reset type: XRSn
2	SCI_C	R/WOnce	X	SCI_C : 0: Feature not present on the device 1: Feature present on the device Reset type: XRSn
1	SCI_B	R/WOnce	X	SCI_B : 0: Feature not present on the device 1: Feature present on the device Reset type: XRSn
0	SCI_A	R/WOnce	X	SCI_A : 0: Feature not present on the device 1: Feature present on the device Reset type: XRSn

**2.15.9.13 DC9\_1 Register (Offset = 22h) [reset = X]**

DC9\_1 is shown in [Figure 2-94](#) and described in [Table 2-103](#).

Return to [Summary Table](#).

Device Capability: Peripheral Customization

**Figure 2-94. DC9\_1 Register**

31	30	29	28	27	26	25	24
RESERVED							
R=0-0h							
23	22	21	20	19	18	17	16
RESERVED						RESERVED	RESERVED
R=0-0h						R-0h	R-0h
15	14	13	12	11	10	9	8
RESERVED							
R=0-0h							
7	6	5	4	3	2	1	0
RESERVED				RESERVED	SPI_C	SPI_B	SPI_A
R=0-0h				R-0h	R/WOnce-X	R/WOnce-X	R/WOnce-X

**Table 2-103. DC9\_1 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-18	RESERVED	R=0	0h	Reserved
17	RESERVED	R	0h	Reserved
16	RESERVED	R	0h	Reserved
15-4	RESERVED	R=0	0h	Reserved
3	RESERVED	R	0h	Reserved
2	SPI_C	R/WOnce	X	SPI_C : 0: Feature not present on the device 1: Feature present on the device Reset type: XRSn
1	SPI_B	R/WOnce	X	SPI_B : 0: Feature not present on the device 1: Feature present on the device Reset type: XRSn
0	SPI_A	R/WOnce	X	SPI_A : 0: Feature not present on the device 1: Feature present on the device Reset type: XRSn

**2.15.9.14 DC10\_1 Register (Offset = 24h) [reset = X]**

DC10\_1 is shown in [Figure 2-95](#) and described in [Table 2-104](#).

Return to [Summary Table](#).

Device Capability: Peripheral Customization

**Figure 2-95. DC10\_1 Register**

31	30	29	28	27	26	25	24
RESERVED							
R=0-0h							
23	22	21	20	19	18	17	16
RESERVED						RESERVED	RESERVED
R=0-0h						R-0h	R-0h
15	14	13	12	11	10	9	8
RESERVED							
R=0-0h							
7	6	5	4	3	2	1	0
RESERVED						I2C_B	I2C_A
R=0-0h						R/WOnce-X	R/WOnce-X

**Table 2-104. DC10\_1 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-18	RESERVED	R=0	0h	Reserved
17	RESERVED	R	0h	Reserved
16	RESERVED	R	0h	Reserved
15-2	RESERVED	R=0	0h	Reserved
1	I2C_B	R/WOnce	X	I2C_B : 0: Feature not present on the device 1: Feature present on the device Reset type: XRSn
0	I2C_A	R/WOnce	X	I2C_A : 0: Feature not present on the device 1: Feature present on the device Reset type: XRSn



**2.15.9.15 DC11\_1 Register (Offset = 26h) [reset = X]**

DC11\_1 is shown in [Figure 2-96](#) and described in [Table 2-105](#).

Return to [Summary Table](#).

Device Capability: Peripheral Customization

**Figure 2-96. DC11\_1 Register**

31	30	29	28	27	26	25	24
RESERVED							
R=0-0h							
23	22	21	20	19	18	17	16
RESERVED							
R=0-0h							
15	14	13	12	11	10	9	8
RESERVED							
R=0-0h							
7	6	5	4	3	2	1	0
RESERVED				RESERVED	RESERVED	CAN_B	CAN_A
R=0-0h				R-0h	R-0h	R/WOnce-X	R/WOnce-X

**Table 2-105. DC11\_1 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R=0	0h	Reserved
15-4	RESERVED	R=0	0h	Reserved
3	RESERVED	R	0h	Reserved
2	RESERVED	R	0h	Reserved
1	CAN_B	R/WOnce	X	CAN_B : 0: Feature not present on the device 1: Feature present on the device Reset type: XRSn
0	CAN_A	R/WOnce	X	CAN_A : 0: Feature not present on the device 1: Feature present on the device Reset type: XRSn

**2.15.9.16 DC12\_1 Register (Offset = 28h) [reset = X]**

 DC12\_1 is shown in [Figure 2-97](#) and described in [Table 2-106](#).

 Return to [Summary Table](#).

Device Capability: Peripheral Customization

**Figure 2-97. DC12\_1 Register**

31	30	29	28	27	26	25	24
RESERVED							
R=0-0h							
23	22	21	20	19	18	17	16
RESERVED				RESERVED		USB_A	
R=0-0h				R=0h		R/WOnce-X	
15	14	13	12	11	10	9	8
RESERVED							
R=0-0h							
7	6	5	4	3	2	1	0
RESERVED						McBSP_B	McBSP_A
R=0-0h						R/WOnce-X	R/WOnce-X

**Table 2-106. DC12\_1 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-20	RESERVED	R=0	0h	Reserved
19-18	RESERVED	R	0h	Reserved
17-16	USB_A	R/WOnce	X	Capability of the USB_A Module: 2'b00: No USB function 2'b01: Device Only 2'b10: Device or Host 2'b11: OTG Reset type: XRSn
15-2	RESERVED	R=0	0h	Reserved
1	McBSP_B	R/WOnce	X	McBSP_B : 0: Feature not present on the device 1: Feature present on the device Reset type: XRSn
0	McBSP_A	R/WOnce	X	McBSP_A : 0: Feature not present on the device 1: Feature present on the device Reset type: XRSn

**2.15.9.17 DC13\_1 Register (Offset = 2Ah) [reset = X]**

DC13\_1 is shown in [Figure 2-98](#) and described in [Table 2-107](#).

Return to [Summary Table](#).

Device Capability: Peripheral Customization

**Figure 2-98. DC13\_1 Register**

31	30	29	28	27	26	25	24
RESERVED							
R=0-0h							
23	22	21	20	19	18	17	16
RESERVED							
R=0-0h							
15	14	13	12	11	10	9	8
RESERVED							
R=0-0h							
7	6	5	4	3	2	1	0
RESERVED						RESERVED	uPP_A
R=0-0h						R-0h	R/WOnce-X

**Table 2-107. DC13\_1 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R=0	0h	Reserved
15-2	RESERVED	R=0	0h	Reserved
1	RESERVED	R	0h	Reserved
0	uPP_A	R/WOnce	X	uPP_A : 0: Feature not present on the device 1: Feature present on the device Reset type: XRSn

**2.15.9.18 DC14\_1 Register (Offset = 2Ch) [reset = X]**

DC14\_1 is shown in [Figure 2-99](#) and described in [Table 2-108](#).

Return to [Summary Table](#).

Device Capability: Analog Modules Customization

**Figure 2-99. DC14\_1 Register**

31	30	29	28	27	26	25	24
RESERVED							
R=0-0h							
23	22	21	20	19	18	17	16
RESERVED							
R=0-0h							
15	14	13	12	11	10	9	8
RESERVED							
R=0-0h							
7	6	5	4	3	2	1	0
RESERVED				ADC_D	ADC_C	ADC_B	ADC_A
R=0-0h				R/WOnce-X	R/WOnce-X	R/WOnce-X	R/WOnce-X

**Table 2-108. DC14\_1 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R=0	0h	Reserved
15-4	RESERVED	R=0	0h	Reserved
3	ADC_D	R/WOnce	X	ADC_D : 0: Feature not present on the device 1: Feature present on the device Reset type: XRSn
2	ADC_C	R/WOnce	X	ADC_C : 0: Feature not present on the device 1: Feature present on the device Reset type: XRSn
1	ADC_B	R/WOnce	X	ADC_B : 0: Feature not present on the device 1: Feature present on the device Reset type: XRSn
0	ADC_A	R/WOnce	X	ADC_A : 0: Feature not present on the device 1: Feature present on the device Reset type: XRSn

**2.15.9.19 DC15\_1 Register (Offset = 2Eh) [reset = X]**

 DC15\_1 is shown in [Figure 2-100](#) and described in [Table 2-109](#).

 Return to [Summary Table](#).

Device Capability: Analog Modules Customization

**Figure 2-100. DC15\_1 Register**

31	30	29	28	27	26	25	24
RESERVED							
R=0-0h							
23	22	21	20	19	18	17	16
RESERVED							
R=0-0h							
15	14	13	12	11	10	9	8
RESERVED							
R=0-0h							
7	6	5	4	3	2	1	0
CMPSS8	CMPSS7	CMPSS6	CMPSS5	CMPSS4	CMPSS3	CMPSS2	CMPSS1
R/WOnce-X	R/WOnce-X	R/WOnce-X	R/WOnce-X	R/WOnce-X	R/WOnce-X	R/WOnce-X	R/WOnce-X

**Table 2-109. DC15\_1 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R=0	0h	Reserved
15-8	RESERVED	R=0	0h	Reserved
7	CMPSS8	R/WOnce	X	CMPSS8 : 0: Feature not present on the device 1: Feature present on the device Reset type: XRSn
6	CMPSS7	R/WOnce	X	CMPSS7 : 0: Feature not present on the device 1: Feature present on the device Reset type: XRSn
5	CMPSS6	R/WOnce	X	CMPSS6 : 0: Feature not present on the device 1: Feature present on the device Reset type: XRSn
4	CMPSS5	R/WOnce	X	CMPSS5 : 0: Feature not present on the device 1: Feature present on the device Reset type: XRSn
3	CMPSS4	R/WOnce	X	CMPSS4 : 0: Feature not present on the device 1: Feature present on the device Reset type: XRSn
2	CMPSS3	R/WOnce	X	CMPSS3 : 0: Feature not present on the device 1: Feature present on the device Reset type: XRSn

**Table 2-109. DC15\_1 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
1	CMPSS2	R/WOnce	X	CMPSS2 : 0: Feature not present on the device 1: Feature present on the device Reset type: XRSn
0	CMPSS1	R/WOnce	X	CMPSS1 : 0: Feature not present on the device 1: Feature present on the device Reset type: XRSn

### 2.15.9.20 DC17\_1 Register (Offset = 32h) [reset = X]

DC17\_1 is shown in [Figure 2-101](#) and described in [Table 2-110](#).

Return to [Summary Table](#).

Device Capability: Analog Modules Customization

**Figure 2-101. DC17\_1 Register**

31	30	29	28	27	26	25	24
RESERVED							
R=0-0h							
23	22	21	20	19	18	17	16
RESERVED				RESERVED	DAC_C	DAC_B	DAC_A
R=0-0h				R-0h	R/WOnce-X	R/WOnce-X	R/WOnce-X
15	14	13	12	11	10	9	8
RESERVED							
R=0-0h							
7	6	5	4	3	2	1	0
RESERVED				RESERVED	RESERVED	RESERVED	RESERVED
R=0-0h				R-0h	R-0h	R-0h	R-0h

**Table 2-110. DC17\_1 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-20	RESERVED	R=0	0h	Reserved
19	RESERVED	R	0h	Reserved
18	DAC_C	R/WOnce	X	Buffered-DAC_C : 0: Feature not present on the device 1: Feature present on the device Reset type: XRSn
17	DAC_B	R/WOnce	X	Buffered-DAC_B : 0: Feature not present on the device 1: Feature present on the device Reset type: XRSn
16	DAC_A	R/WOnce	X	Buffered-DAC_A : 0: Feature not present on the device 1: Feature present on the device Reset type: XRSn
15-4	RESERVED	R=0	0h	Reserved
3	RESERVED	R	0h	Reserved
2	RESERVED	R	0h	Reserved
1	RESERVED	R	0h	Reserved
0	RESERVED	R	0h	Reserved

**2.15.9.21 DC18\_1 Register (Offset = 34h) [reset = X]**

 DC18\_1 is shown in [Figure 2-102](#) and described in [Table 2-111](#).

 Return to [Summary Table](#).

Device Capability: CPU1 Lx SRAM Customization

**Figure 2-102. DC18\_1 Register**

31	30	29	28	27	26	25	24
RESERVED							
R=0-0h							
23	22	21	20	19	18	17	16
RESERVED							
R=0-0h							
15	14	13	12	11	10	9	8
RESERVED							
R=0-0h							
7	6	5	4	3	2	1	0
RESERVED		LS5_1	LS4_1	LS3_1	LS2_1	LS1_1	LS0_1
R=0-0h		R/WOnce-X	R/WOnce-X	R/WOnce-X	R/WOnce-X	R/WOnce-X	R/WOnce-X

**Table 2-111. DC18\_1 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R=0	0h	Reserved
15-6	RESERVED	R=0	0h	Reserved
5	LS5_1	R/WOnce	X	LS5_1 : 0: Feature not present on the device 1: Feature present on the device Reset type: XRSn
4	LS4_1	R/WOnce	X	LS4_1 : 0: Feature not present on the device 1: Feature present on the device Reset type: XRSn
3	LS3_1	R/WOnce	X	LS3_1 : 0: Feature not present on the device 1: Feature present on the device Reset type: XRSn
2	LS2_1	R/WOnce	X	LS2_1 : 0: Feature not present on the device 1: Feature present on the device Reset type: XRSn
1	LS1_1	R/WOnce	X	LS1_1 : 0: Feature not present on the device 1: Feature present on the device Reset type: XRSn
0	LS0_1	R/WOnce	X	LS0_1 : 0: Feature not present on the device 1: Feature present on the device Reset type: XRSn



**2.15.9.22 DC20\_1 Register (Offset = 38h) [reset = X]**

DC20\_1 is shown in [Figure 2-103](#) and described in [Table 2-112](#).

Return to [Summary Table](#).

Device Capability: GSx SRAM Customization

**Figure 2-103. DC20\_1 Register**

31								30								29								28								27								26								25								24							
RESERVED																																																															
R=0-0h																																																															
23								22								21								20								19								18								17								16							
RESERVED																																																															
R=0-0h																																																															
15								14								13								12								11								10								9								8							
GS15								GS14								GS13								GS12								GS11								GS10								GS9								GS8							
R/WOnce-X								R/WOnce-X								R/WOnce-X								R/WOnce-X								R/WOnce-X								R/WOnce-X								R/WOnce-X															
7								6								5								4								3								2								1								0							
GS7								GS6								GS5								GS4								GS3								GS2								GS1								GS0							
R/WOnce-X								R/WOnce-X								R/WOnce-X								R/WOnce-X								R/WOnce-X								R/WOnce-X								R/WOnce-X															

**Table 2-112. DC20\_1 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R=0	0h	Reserved
15	GS15	R/WOnce	X	GS15 : 0: Feature not present on the device 1: Feature present on the device Reset type: XRSn
14	GS14	R/WOnce	X	GS14 : 0: Feature not present on the device 1: Feature present on the device Reset type: XRSn
13	GS13	R/WOnce	X	GS13 : 0: Feature not present on the device 1: Feature present on the device Reset type: XRSn
12	GS12	R/WOnce	X	GS12 : 0: Feature not present on the device 1: Feature present on the device Reset type: XRSn
11	GS11	R/WOnce	X	GS11 : 0: Feature not present on the device 1: Feature present on the device Reset type: XRSn
10	GS10	R/WOnce	X	GS10 : 0: Feature not present on the device 1: Feature present on the device Reset type: XRSn

**Table 2-112. DC20\_1 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
9	GS9	R/WOnce	X	GS9 : 0: Feature not present on the device 1: Feature present on the device Reset type: XRSn
8	GS8	R/WOnce	X	GS8 : 0: Feature not present on the device 1: Feature present on the device Reset type: XRSn
7	GS7	R/WOnce	X	GS7 : 0: Feature not present on the device 1: Feature present on the device Reset type: XRSn
6	GS6	R/WOnce	X	GS6 : 0: Feature not present on the device 1: Feature present on the device Reset type: XRSn
5	GS5	R/WOnce	X	GS5 : 0: Feature not present on the device 1: Feature present on the device Reset type: XRSn
4	GS4	R/WOnce	X	GS4 : 0: Feature not present on the device 1: Feature present on the device Reset type: XRSn
3	GS3	R/WOnce	X	GS3 : 0: Feature not present on the device 1: Feature present on the device Reset type: XRSn
2	GS2	R/WOnce	X	GS2 : 0: Feature not present on the device 1: Feature present on the device Reset type: XRSn
1	GS1	R/WOnce	X	GS1 : 0: Feature not present on the device 1: Feature present on the device Reset type: XRSn
0	GS0	R/WOnce	X	GS0 : 0: Feature not present on the device 1: Feature present on the device Reset type: XRSn

### 2.15.9.23 PERCNF1\_1 Register (Offset = 60h) [reset = X]

PERCNF1\_1 is shown in [Figure 2-104](#) and described in [Table 2-113](#).

Return to [Summary Table](#).

Peripheral Configuration register

**Figure 2-104. PERCNF1\_1 Register**

31	30	29	28	27	26	25	24
RESERVED							
R=0-0h							
23	22	21	20	19	18	17	16
RESERVED						RESERVED	USB_A_PHY
R=0-0h						R-0h	R/WOnce-X
15	14	13	12	11	10	9	8
RESERVED							
R=0-0h							
7	6	5	4	3	2	1	0
RESERVED				ADC_D_MODE	ADC_C_MODE	ADC_B_MODE	ADC_A_MODE
R=0-0h				R/WOnce-X	R/WOnce-X	R/WOnce-X	R/WOnce-X

**Table 2-113. PERCNF1\_1 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-18	RESERVED	R=0	0h	Reserved
17	RESERVED	R	0h	Reserved
16	USB_A_PHY	R/WOnce	X	Internal PHY is present present or not for the USB_A module: 0: Internal USB PHY Module is not present 1: Internal USB PHY Module is present. Reset type: XRSn
15-4	RESERVED	R=0	0h	Reserved
3	ADC_D_MODE	R/WOnce	X	0: 16-bit or 12-bit configurable in software 1: Only 12-bit operation available Reset type: XRSn
2	ADC_C_MODE	R/WOnce	X	0: 16-bit or 12-bit configurable in software 1: Only 12-bit operation available Reset type: XRSn
1	ADC_B_MODE	R/WOnce	X	0: 16-bit or 12-bit configurable in software 1: Only 12-bit operation available Reset type: XRSn
0	ADC_A_MODE	R/WOnce	X	0: 16-bit or 12-bit configurable in software 1: Only 12-bit operation available Reset type: XRSn

**2.15.9.24 FUSEERR Register (Offset = 74h) [reset = 0h]**

 FUSEERR is shown in [Figure 2-105](#) and described in [Table 2-114](#).

 Return to [Summary Table](#).

e-Fuse error Status register

**Figure 2-105. FUSEERR Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
RESERVED															
R=0-0h															
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
RESERVED										ERR		ALERR			
R=0-0h										R-0h		R-0h			

**Table 2-114. FUSEERR Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R=0	0h	Reserved
15-6	RESERVED	R=0	0h	Reserved
5	ERR	R	0h	Efuse Self Test Error Status set by hardware after fuse self test completes, in case of self test error  0: No error during fuse self test 1: Fuse self test error Reset type: XRSn
4-0	ALERR	R	0h	Efuse Autoload Error Status set by hardware after fuse auto load completes  00000: No error in auto load Other: Non zero value indicates error in autoload Reset type: XRSn

**2.15.9.25 SOFTPRES0 Register (Offset = 82h) [reset = 0h]**

SOFTPRES0 is shown in [Figure 2-106](#) and described in [Table 2-115](#).

Return to [Summary Table](#).

Processing Block Software Reset register

When bits in this register are set, the respective module is in reset. All design data is lost and the module registers are returned to their reset states. Bits must be manually cleared after being set.

**Figure 2-106. SOFTPRES0 Register**

31	30	29	28	27	26	25	24
RESERVED							
R=0-0h							
23	22	21	20	19	18	17	16
RESERVED							
R=0-0h							
15	14	13	12	11	10	9	8
RESERVED							
R=0-0h							
7	6	5	4	3	2	1	0
RESERVED				RESERVED	RESERVED	RESERVED	CPU1_CLA1
R=0-0h				R-0h	R-0h	R-0h	R/W-0h

**Table 2-115. SOFTPRES0 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R=0	0h	Reserved
15-4	RESERVED	R=0	0h	Reserved
3	RESERVED	R	0h	Reserved
2	RESERVED	R	0h	Reserved
1	RESERVED	R	0h	Reserved
0	CPU1_CLA1	R/W	0h	1: Module is under reset 0: Module reset is determined by the normal device reset structure Reset type: CPU1.SYSRSn

**2.15.9.26 SOFTPRES1 Register (Offset = 84h) [reset = 0h]**

SOFTPRES1 is shown in [Figure 2-107](#) and described in [Table 2-116](#).

Return to [Summary Table](#).

EMIF Software Reset register

**Figure 2-107. SOFTPRES1 Register**

31	30	29	28	27	26	25	24
RESERVED							
R=0-0h							
23	22	21	20	19	18	17	16
RESERVED							
R=0-0h							
15	14	13	12	11	10	9	8
RESERVED							
R=0-0h							
7	6	5	4	3	2	1	0
RESERVED						EMIF2	EMIF1
R=0-0h						R/W-0h	R/W-0h

**Table 2-116. SOFTPRES1 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R=0	0h	Reserved
15-2	RESERVED	R=0	0h	Reserved
1	EMIF2	R/W	0h	When this bit is set, only the control logic of the respective EMIF2 is reset. It does not reset the internal registers except the Total Access register and the Total Activate register.  This bit must be manually cleared after being set.  1: EMIF2 is under SOFTRESET 0: Module reset is determined by the device Reset Network Reset type: CPU1.SYSRSn
0	EMIF1	R/W	0h	When this bit is set, only the control logic of the respective EMIF1 is reset. It does not reset the internal registers except the Total Access register and the Total Activate register.  This bit must be manually cleared after being set.  1: EMIF1 is under SOFTRESET 0: Module reset is determined by the device Reset Network Reset type: CPU1.SYSRSn

### 2.15.9.27 SOFTPRES2 Register (Offset = 86h) [reset = 0h]

SOFTPRES2 is shown in [Figure 2-108](#) and described in [Table 2-117](#).

Return to [Summary Table](#).

Peripheral Software Reset register

When bits in this register are set, the respective peripheral is in reset. All data is lost and the peripheral registers are returned to their reset states. Bits must be manually cleared after being set.

**Figure 2-108. SOFTPRES2 Register**

31	30	29	28	27	26	25	24
RESERVED							
R=0-0h							
23	22	21	20	19	18	17	16
RESERVED							
R=0-0h							
15	14	13	12	11	10	9	8
RESERVED	RESERVED	RESERVED	RESERVED	EPWM12	EPWM11	EPWM10	EPWM9
R-0h	R-0h	R-0h	R-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
7	6	5	4	3	2	1	0
EPWM8	EPWM7	EPWM6	EPWM5	EPWM4	EPWM3	EPWM2	EPWM1
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h

**Table 2-117. SOFTPRES2 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R=0	0h	Reserved
15	RESERVED	R	0h	Reserved
14	RESERVED	R	0h	Reserved
13	RESERVED	R	0h	Reserved
12	RESERVED	R	0h	Reserved
11	EPWM12	R/W	0h	1: Module is under reset 0: Module reset is determined by the normal device reset structure Reset type: CPU1.SYSRSn
10	EPWM11	R/W	0h	1: Module is under reset 0: Module reset is determined by the normal device reset structure Reset type: CPU1.SYSRSn
9	EPWM10	R/W	0h	1: Module is under reset 0: Module reset is determined by the normal device reset structure Reset type: CPU1.SYSRSn
8	EPWM9	R/W	0h	1: Module is under reset 0: Module reset is determined by the normal device reset structure Reset type: CPU1.SYSRSn
7	EPWM8	R/W	0h	1: Module is under reset 0: Module reset is determined by the normal device reset structure Reset type: CPU1.SYSRSn
6	EPWM7	R/W	0h	1: Module is under reset 0: Module reset is determined by the normal device reset structure Reset type: CPU1.SYSRSn
5	EPWM6	R/W	0h	1: Module is under reset 0: Module reset is determined by the normal device reset structure Reset type: CPU1.SYSRSn

**Table 2-117. SOFTPRES2 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
4	EPWM5	R/W	0h	1: Module is under reset 0: Module reset is determined by the normal device reset structure Reset type: CPU1.SYSRSn
3	EPWM4	R/W	0h	1: Module is under reset 0: Module reset is determined by the normal device reset structure Reset type: CPU1.SYSRSn
2	EPWM3	R/W	0h	1: Module is under reset 0: Module reset is determined by the normal device reset structure Reset type: CPU1.SYSRSn
1	EPWM2	R/W	0h	1: Module is under reset 0: Module reset is determined by the normal device reset structure Reset type: CPU1.SYSRSn
0	EPWM1	R/W	0h	1: Module is under reset 0: Module reset is determined by the normal device reset structure Reset type: CPU1.SYSRSn



### 2.15.9.28 SOFTPRES3 Register (Offset = 88h) [reset = 0h]

SOFTPRES3 is shown in [Figure 2-109](#) and described in [Table 2-118](#).

Return to [Summary Table](#).

Peripheral Software Reset register

When bits in this register are set, the respective peripheral is in reset. All data is lost and the peripheral registers are returned to their reset states. Bits must be manually cleared after being set.

**Figure 2-109. SOFTPRES3 Register**

31	30	29	28	27	26	25	24
RESERVED							
R=0-0h							
23	22	21	20	19	18	17	16
RESERVED							
R=0-0h							
15	14	13	12	11	10	9	8
RESERVED							
R=0-0h							
7	6	5	4	3	2	1	0
RESERVED	RESERVED	ECAP6	ECAP5	ECAP4	ECAP3	ECAP2	ECAP1
R-0h	R-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h

**Table 2-118. SOFTPRES3 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R=0	0h	Reserved
15-8	RESERVED	R=0	0h	Reserved
7	RESERVED	R	0h	Reserved
6	RESERVED	R	0h	Reserved
5	ECAP6	R/W	0h	1: Module is under reset 0: Module reset is determined by the normal device reset structure Reset type: CPU1.SYSRSn
4	ECAP5	R/W	0h	1: Module is under reset 0: Module reset is determined by the normal device reset structure Reset type: CPU1.SYSRSn
3	ECAP4	R/W	0h	1: Module is under reset 0: Module reset is determined by the normal device reset structure Reset type: CPU1.SYSRSn
2	ECAP3	R/W	0h	1: Module is under reset 0: Module reset is determined by the normal device reset structure Reset type: CPU1.SYSRSn
1	ECAP2	R/W	0h	1: Module is under reset 0: Module reset is determined by the normal device reset structure Reset type: CPU1.SYSRSn
0	ECAP1	R/W	0h	1: Module is under reset 0: Module reset is determined by the normal device reset structure Reset type: CPU1.SYSRSn

**2.15.9.29 SOFTPRES4 Register (Offset = 8Ah) [reset = 0h]**

SOFTPRES4 is shown in [Figure 2-110](#) and described in [Table 2-119](#).

Return to [Summary Table](#).

Peripheral Software Reset register

When bits in this register are set, the respective peripheral is in reset. All data is lost and the peripheral registers are returned to their reset states. Bits must be manually cleared after being set.

**Figure 2-110. SOFTPRES4 Register**

31	30	29	28	27	26	25	24
RESERVED							
R=0-0h							
23	22	21	20	19	18	17	16
RESERVED							
R=0-0h							
15	14	13	12	11	10	9	8
RESERVED							
R=0-0h							
7	6	5	4	3	2	1	0
RESERVED				RESERVED	EQEP3	EQEP2	EQEP1
R=0-0h				R-0h	R/W-0h	R/W-0h	R/W-0h

**Table 2-119. SOFTPRES4 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R=0	0h	Reserved
15-4	RESERVED	R=0	0h	Reserved
3	RESERVED	R	0h	Reserved
2	EQEP3	R/W	0h	1: Module is under reset 0: Module reset is determined by the normal device reset structure Reset type: CPU1.SYSRSn
1	EQEP2	R/W	0h	1: Module is under reset 0: Module reset is determined by the normal device reset structure Reset type: CPU1.SYSRSn
0	EQEP1	R/W	0h	1: Module is under reset 0: Module reset is determined by the normal device reset structure Reset type: CPU1.SYSRSn

### 2.15.9.30 SOFTPRES6 Register (Offset = 8Eh) [reset = 0h]

SOFTPRES6 is shown in [Figure 2-111](#) and described in [Table 2-120](#).

Return to [Summary Table](#).

Peripheral Software Reset register

When bits in this register are set, the respective peripheral is in reset. All data is lost and the peripheral registers are returned to their reset states. Bits must be manually cleared after being set.

**Figure 2-111. SOFTPRES6 Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
RESERVED															
R=0-0h															
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
RESERVED								RESE RVED	RESE RVED	RESE RVED	RESE RVED	RESE RVED	RESE RVED	SD2	SD1
R=0-0h								R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R/W- 0h	R/W- 0h

**Table 2-120. SOFTPRES6 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R=0	0h	Reserved
15-8	RESERVED	R=0	0h	Reserved
7	RESERVED	R	0h	Reserved
6	RESERVED	R	0h	Reserved
5	RESERVED	R	0h	Reserved
4	RESERVED	R	0h	Reserved
3	RESERVED	R	0h	Reserved
2	RESERVED	R	0h	Reserved
1	SD2	R/W	0h	1: Module is under reset 0: Module reset is determined by the normal device reset structure Reset type: CPU1.SYSRSn
0	SD1	R/W	0h	1: Module is under reset 0: Module reset is determined by the normal device reset structure Reset type: CPU1.SYSRSn

**2.15.9.31 SOFTPRES7 Register (Offset = 90h) [reset = 0h]**

SOFTPRES7 is shown in [Figure 2-112](#) and described in [Table 2-121](#).

Return to [Summary Table](#).

Peripheral Software Reset register

When bits in this register are set, the respective peripheral is in reset. All data is lost and the peripheral registers are returned to their reset states. Bits must be manually cleared after being set.

**Figure 2-112. SOFTPRES7 Register**

31	30	29	28	27	26	25	24
RESERVED							
R=0-0h							
23	22	21	20	19	18	17	16
RESERVED							
R=0-0h							
15	14	13	12	11	10	9	8
RESERVED							
R=0-0h							
7	6	5	4	3	2	1	0
RESERVED				SCI_D	SCI_C	SCI_B	SCI_A
R=0-0h				R/W-0h	R/W-0h	R/W-0h	R/W-0h

**Table 2-121. SOFTPRES7 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R=0	0h	Reserved
15-4	RESERVED	R=0	0h	Reserved
3	SCI_D	R/W	0h	1: Module is under reset 0: Module reset is determined by the normal device reset structure Reset type: CPU1.SYSRSn
2	SCI_C	R/W	0h	1: Module is under reset 0: Module reset is determined by the normal device reset structure Reset type: CPU1.SYSRSn
1	SCI_B	R/W	0h	1: Module is under reset 0: Module reset is determined by the normal device reset structure Reset type: CPU1.SYSRSn
0	SCI_A	R/W	0h	1: Module is under reset 0: Module reset is determined by the normal device reset structure Reset type: CPU1.SYSRSn

### 2.15.9.32 SOFTPRES8 Register (Offset = 92h) [reset = 0h]

SOFTPRES8 is shown in [Figure 2-113](#) and described in [Table 2-122](#).

Return to [Summary Table](#).

Peripheral Software Reset register

When bits in this register are set, the respective peripheral is in reset. All data is lost and the peripheral registers are returned to their reset states. Bits must be manually cleared after being set.

**Figure 2-113. SOFTPRES8 Register**

31	30	29	28	27	26	25	24
RESERVED							
R=0-0h							
23	22	21	20	19	18	17	16
RESERVED						RESERVED	RESERVED
R=0-0h						R-0h	R-0h
15	14	13	12	11	10	9	8
RESERVED							
R=0-0h							
7	6	5	4	3	2	1	0
RESERVED				RESERVED	SPI_C	SPI_B	SPI_A
R=0-0h				R-0h	R/W-0h	R/W-0h	R/W-0h

**Table 2-122. SOFTPRES8 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-18	RESERVED	R=0	0h	Reserved
17	RESERVED	R	0h	Reserved
16	RESERVED	R	0h	Reserved
15-4	RESERVED	R=0	0h	Reserved
3	RESERVED	R	0h	Reserved
2	SPI_C	R/W	0h	1: Module is under reset 0: Module reset is determined by the normal device reset structure Reset type: CPU1.SYSRSn
1	SPI_B	R/W	0h	1: Module is under reset 0: Module reset is determined by the normal device reset structure Reset type: CPU1.SYSRSn
0	SPI_A	R/W	0h	1: Module is under reset 0: Module reset is determined by the normal device reset structure Reset type: CPU1.SYSRSn

**2.15.9.33 SOFTPRES9 Register (Offset = 94h) [reset = 0h]**

SOFTPRES9 is shown in [Figure 2-114](#) and described in [Table 2-123](#).

Return to [Summary Table](#).

Peripheral Software Reset register

When bits in this register are set, the respective peripheral is in reset. All data is lost and the peripheral registers are returned to their reset states. Bits must be manually cleared after being set.

**Figure 2-114. SOFTPRES9 Register**

31	30	29	28	27	26	25	24
RESERVED							
R=0-0h							
23	22	21	20	19	18	17	16
RESERVED						RESERVED	RESERVED
R=0-0h						R-0h	R-0h
15	14	13	12	11	10	9	8
RESERVED							
R=0-0h							
7	6	5	4	3	2	1	0
RESERVED						I2C_B	I2C_A
R=0-0h						R/W-0h	R/W-0h

**Table 2-123. SOFTPRES9 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-18	RESERVED	R=0	0h	Reserved
17	RESERVED	R	0h	Reserved
16	RESERVED	R	0h	Reserved
15-2	RESERVED	R=0	0h	Reserved
1	I2C_B	R/W	0h	1: Module is under reset 0: Module reset is determined by the normal device reset structure Reset type: CPU1.SYSRSn
0	I2C_A	R/W	0h	1: Module is under reset 0: Module reset is determined by the normal device reset structure Reset type: CPU1.SYSRSn

### 2.15.9.34 SOFTPRES11 Register (Offset = 98h) [reset = 0h]

SOFTPRES11 is shown in [Figure 2-115](#) and described in [Table 2-124](#).

Return to [Summary Table](#).

Peripheral Software Reset register

When bits in this register are set, the respective peripheral is in reset. All data is lost and the peripheral registers are returned to their reset states. Bits must be manually cleared after being set.

**Figure 2-115. SOFTPRES11 Register**

31	30	29	28	27	26	25	24
RESERVED							
R=0-0h							
23	22	21	20	19	18	17	16
RESERVED						RESERVED	USB_A
R=0-0h						R-0h	R/W-0h
15	14	13	12	11	10	9	8
RESERVED							
R=0-0h							
7	6	5	4	3	2	1	0
RESERVED						McBSP_B	McBSP_A
R=0-0h						R/W-0h	R/W-0h

**Table 2-124. SOFTPRES11 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-18	RESERVED	R=0	0h	Reserved
17	RESERVED	R	0h	Reserved
16	USB_A	R/W	0h	1: Module is under reset 0: Module reset is determined by the normal device reset structure Reset type: CPU1.SYSRSn
15-2	RESERVED	R=0	0h	Reserved
1	McBSP_B	R/W	0h	1: Module is under reset 0: Module reset is determined by the normal device reset structure Reset type: CPU1.SYSRSn
0	McBSP_A	R/W	0h	1: Module is under reset 0: Module reset is determined by the normal device reset structure Reset type: CPU1.SYSRSn

**2.15.9.35 SOFTPRES13 Register (Offset = 9Ch) [reset = 0h]**

SOFTPRES13 is shown in [Figure 2-116](#) and described in [Table 2-125](#).

Return to [Summary Table](#).

Peripheral Software Reset register

When bits in this register are set, the respective peripheral is in reset. All data is lost and the peripheral registers are returned to their reset states. Bits must be manually cleared after being set.

**Figure 2-116. SOFTPRES13 Register**

31	30	29	28	27	26	25	24
RESERVED							
R=0-0h							
23	22	21	20	19	18	17	16
RESERVED							
R=0-0h							
15	14	13	12	11	10	9	8
RESERVED							
R=0-0h							
7	6	5	4	3	2	1	0
RESERVED				ADC_D	ADC_C	ADC_B	ADC_A
R=0-0h				R/W-0h	R/W-0h	R/W-0h	R/W-0h

**Table 2-125. SOFTPRES13 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R=0	0h	Reserved
15-4	RESERVED	R=0	0h	Reserved
3	ADC_D	R/W	0h	1: Module is under reset 0: Module reset is determined by the normal device reset structure Reset type: CPU1.SYSRSn
2	ADC_C	R/W	0h	1: Module is under reset 0: Module reset is determined by the normal device reset structure Reset type: CPU1.SYSRSn
1	ADC_B	R/W	0h	1: Module is under reset 0: Module reset is determined by the normal device reset structure Reset type: CPU1.SYSRSn
0	ADC_A	R/W	0h	1: Module is under reset 0: Module reset is determined by the normal device reset structure Reset type: CPU1.SYSRSn



### 2.15.9.36 SOFTPRES14 Register (Offset = 9Eh) [reset = 0h]

SOFTPRES14 is shown in [Figure 2-117](#) and described in [Table 2-126](#).

Return to [Summary Table](#).

Peripheral Software Reset register

When bits in this register are set, the respective peripheral is in reset. All data is lost and the peripheral registers are returned to their reset states. Bits must be manually cleared after being set.

**Figure 2-117. SOFTPRES14 Register**

31	30	29	28	27	26	25	24
RESERVED							
R=0-0h							
23	22	21	20	19	18	17	16
RESERVED							
R=0-0h							
15	14	13	12	11	10	9	8
RESERVED							
R=0-0h							
7	6	5	4	3	2	1	0
CMPSS8	CMPSS7	CMPSS6	CMPSS5	CMPSS4	CMPSS3	CMPSS2	CMPSS1
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h

**Table 2-126. SOFTPRES14 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R=0	0h	Reserved
15-8	RESERVED	R=0	0h	Reserved
7	CMPSS8	R/W	0h	1: Module is under reset 0: Module reset is determined by the normal device reset structure Reset type: CPU1.SYSRSn
6	CMPSS7	R/W	0h	1: Module is under reset 0: Module reset is determined by the normal device reset structure Reset type: CPU1.SYSRSn
5	CMPSS6	R/W	0h	1: Module is under reset 0: Module reset is determined by the normal device reset structure Reset type: CPU1.SYSRSn
4	CMPSS5	R/W	0h	1: Module is under reset 0: Module reset is determined by the normal device reset structure Reset type: CPU1.SYSRSn
3	CMPSS4	R/W	0h	1: Module is under reset 0: Module reset is determined by the normal device reset structure Reset type: CPU1.SYSRSn
2	CMPSS3	R/W	0h	1: Module is under reset 0: Module reset is determined by the normal device reset structure Reset type: CPU1.SYSRSn
1	CMPSS2	R/W	0h	1: Module is under reset 0: Module reset is determined by the normal device reset structure Reset type: CPU1.SYSRSn
0	CMPSS1	R/W	0h	1: Module is under reset 0: Module reset is determined by the normal device reset structure Reset type: CPU1.SYSRSn

### 2.15.9.37 SOFTPRES16 Register (Offset = A2h) [reset = 0h]

SOFTPRES16 is shown in [Figure 2-118](#) and described in [Table 2-127](#).

Return to [Summary Table](#).

Peripheral Software Reset register

When bits in this register are set, the respective peripheral is in reset. All data is lost and the peripheral registers are returned to their reset states. Bits must be manually cleared after being set.

**Figure 2-118. SOFTPRES16 Register**

31	30	29	28	27	26	25	24
RESERVED							
R=0-0h							
23	22	21	20	19	18	17	16
RESERVED				RESERVED	DAC_C	DAC_B	DAC_A
R=0-0h				R-0h	R/W-0h	R/W-0h	R/W-0h
15	14	13	12	11	10	9	8
RESERVED							
R=0-0h							
7	6	5	4	3	2	1	0
RESERVED				RESERVED	RESERVED	RESERVED	RESERVED
R=0-0h				R-0h	R-0h	R-0h	R-0h

**Table 2-127. SOFTPRES16 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-20	RESERVED	R=0	0h	Reserved
19	RESERVED	R	0h	Reserved
18	DAC_C	R/W	0h	1: Module is under reset 0: Module reset is determined by the normal device reset structure Reset type: CPU1.SYSRSn
17	DAC_B	R/W	0h	1: Module is under reset 0: Module reset is determined by the normal device reset structure Reset type: CPU1.SYSRSn
16	DAC_A	R/W	0h	1: Module is under reset 0: Module reset is determined by the normal device reset structure Reset type: CPU1.SYSRSn
15-4	RESERVED	R=0	0h	Reserved
3	RESERVED	R	0h	Reserved
2	RESERVED	R	0h	Reserved
1	RESERVED	R	0h	Reserved
0	RESERVED	R	0h	Reserved

**2.15.9.38 SYSDBGCTL Register (Offset = 12Ch) [reset = 0h]**

SYSDBGCTL is shown in [Figure 2-119](#) and described in [Table 2-128](#).

Return to [Summary Table](#).

System Debug Control register

**Figure 2-119. SYSDBGCTL Register**

31	30	29	28	27	26	25	24
RESERVED							
R=0-0h							
23	22	21	20	19	18	17	16
RESERVED							
R=0-0h							
15	14	13	12	11	10	9	8
RESERVED							
R=0-0h							
7	6	5	4	3	2	1	0
RESERVED							BIT_0
R=0-0h							R/W-0h

**Table 2-128. SYSDBGCTL Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R=0	0h	Reserved
15-1	RESERVED	R=0	0h	Reserved
0	BIT_0	R/W	0h	This bit is for use in PLL startup and is only reset by POR. Reset type: PORn

## 2.15.10 CLK\_CFG\_REGS Registers

Table 2-129 lists the memory-mapped registers for the CLK\_CFG\_REGS. All register offset addresses not listed in Table 2-129 should be considered as reserved locations and the register contents should not be modified.

**Table 2-129. CLK\_CFG\_REGS Registers**

Offset	Acronym	Register Name	Write Protection	Section
2h	CLKCFGLOCK1	Lock bit for CLKCFG registers	EALLOW	<a href="#">Go</a>
8h	CLKSRCCTL1	Clock Source Control register-1	EALLOW	<a href="#">Go</a>
Ah	CLKSRCCTL2	Clock Source Control register-2	EALLOW	<a href="#">Go</a>
Ch	CLKSRCCTL3	Clock Source Control register-3	EALLOW	<a href="#">Go</a>
Eh	SYSPLLCTL1	SYSPLL Control register-1	EALLOW	<a href="#">Go</a>
14h	SYSPLLMULT	SYSPLL Multiplier register	EALLOW	<a href="#">Go</a>
16h	SYSPLLSTS	SYSPLL Status register		<a href="#">Go</a>
18h	AUXPLLCTL1	AUXPLL Control register-1	EALLOW	<a href="#">Go</a>
1Eh	AUXPLLMULT	AUXPLL Multiplier register	EALLOW	<a href="#">Go</a>
20h	AUXPLLSTS	AUXPLL Status register		<a href="#">Go</a>
22h	SYSCLKDIVSEL	System Clock Divider Select register	EALLOW	<a href="#">Go</a>
24h	AUXCLKDIVSEL	Auxillary Clock Divider Select register	EALLOW	<a href="#">Go</a>
26h	PERCLKDIVSEL	Peripheral Clock Divider Selet register	EALLOW	<a href="#">Go</a>
28h	XCLKOUTDIVSEL	XCLKOUT Divider Select register	EALLOW	<a href="#">Go</a>
2Ch	LOSPCP	Low Speed Clock Source Prescalar	EALLOW	<a href="#">Go</a>
2Eh	MCDCR	Missing Clock Detect Control Register	EALLOW	<a href="#">Go</a>
30h	X1CNT	10-bit Counter on X1 Clock		<a href="#">Go</a>

Complex bit access types are encoded to fit into small table cells. Table 2-130 shows the codes that are used for access types in this section.

**Table 2-130. CLK\_CFG\_REGS Access Type Codes**

Access Type	Code	Description
<b>Read Type</b>		
R	R	Read
R=0	R	Read
<b>Write Type</b>		
W	W	Write
W=1	W	Write
WSOnce	SOnce W	Set once Write
<b>Reset or Default Value</b>		
-n		Value after reset or the default value
<b>Register Array Variables</b>		
i,j,k,l,m,n		When these variables are used in a register name, an offset, or an address, they refer to the value of a register array where the register is part of a group of repeating registers. The register groups form a hierarchical structure and the array is represented with a formula.

**Table 2-130. CLK\_CFG\_REGS Access Type  
Codes (continued)**

Access Type	Code	Description
y		When this variable is used in a register name, an offset, or an address it refers to the value of a register array.

**2.15.10.1 CLKCFGLOCK1 Register (Offset = 2h) [reset = 0h]**

CLKCFGLOCK1 is shown in [Figure 2-120](#) and described in [Table 2-131](#).

Return to [Summary Table](#).

Lock bit for CLKCFG registers

Notes:

[1] Any bit in this register, once set can only be cleared through a CPU1.SYSRSn. Write of 0 to any bit of this register has no effect

[2] The locking mechanism applies to only writes. Reads to the registers which have LOCK protection are always allowed

**Figure 2-120. CLKCFGLOCK1 Register**

31	30	29	28	27	26	25	24
RESERVED							
R=0-0h							
23	22	21	20	19	18	17	16
RESERVED							
R=0-0h							
15	14	13	12	11	10	9	8
LOSPCP	RESERVED	PERCLKDIVSEL L	AUXCLKDIVSEL L	SYSCLKDIVSEL L	AUXPLLMULT	RESERVED	RESERVED
R/WSONce-0h	R=0-0h	R/WSONce-0h	R/WSONce-0h	R/WSONce-0h	R/WSONce-0h	R=0-0h	R=0-0h
7	6	5	4	3	2	1	0
AUXPLLCTL1	SYSPLLMULT	SYSPLLCTL3	SYSPLLCTL2	SYSPLLCTL1	CLKSRCCTL3	CLKSRCCTL2	CLKSRCCTL1
R/WSONce-0h	R/WSONce-0h	R/WSONce-0h	R/WSONce-0h	R/WSONce-0h	R/WSONce-0h	R/WSONce-0h	R/WSONce-0h

**Table 2-131. CLKCFGLOCK1 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R=0	0h	Reserved
15	LOSPCP	R/WSONce	0h	Lock bit for LOSPCP register: 0: Respective register is not locked 1: Respective register is locked. Reset type: CPU1.SYSRSn
14	RESERVED	R=0	0h	Reserved
13	PERCLKDIVSEL	R/WSONce	0h	Lock bit for PERCLKDIVSEL register: 0: Respective register is not locked 1: Respective register is locked. Reset type: CPU1.SYSRSn
12	AUXCLKDIVSEL	R/WSONce	0h	Lock bit for AUXCLKDIVSEL register: 0: Respective register is not locked 1: Respective register is locked. Reset type: CPU1.SYSRSn
11	SYSCLKDIVSEL	R/WSONce	0h	Lock bit for SYSCLKDIVSEL register: 0: Respective register is not locked 1: Respective register is locked. Reset type: CPU1.SYSRSn
10	AUXPLLMULT	R/WSONce	0h	Lock bit for AUXPLLMULT register: 0: Respective register is not locked 1: Respective register is locked. Reset type: CPU1.SYSRSn
9	RESERVED	R=0	0h	Reserved

**Table 2-131. CLKCFGLOCK1 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
8	RESERVED	R=0	0h	Reserved
7	AUXPLLCTL1	R/WOnce	0h	Lock bit for AUXPLLCTL1 register: 0: Respective register is not locked 1: Respective register is locked. Reset type: CPU1.SYSRSn
6	SYSPLLMULT	R/WOnce	0h	Lock bit for SYSPLLMULT register: 0: Respective register is not locked 1: Respective register is locked. Reset type: CPU1.SYSRSn
5	SYSPLLCTL3	R/WOnce	0h	Lock bit for SYSPLLCTL3 register: 0: Respective register is not locked 1: Respective register is locked. Reset type: CPU1.SYSRSn
4	SYSPLLCTL2	R/WOnce	0h	Lock bit for SYSPLLCTL2 register: 0: Respective register is not locked 1: Respective register is locked. Reset type: CPU1.SYSRSn
3	SYSPLLCTL1	R/WOnce	0h	Lock bit for SYSPLLCTL1 register: 0: Respective register is not locked 1: Respective register is locked. Reset type: CPU1.SYSRSn
2	CLKSRCCTL3	R/WOnce	0h	Lock bit for CLKSRCCTL3 register: 0: Respective register is not locked 1: Respective register is locked. Reset type: CPU1.SYSRSn
1	CLKSRCCTL2	R/WOnce	0h	Lock bit for CLKSRCCTL2 register: 0: Respective register is not locked 1: Respective register is locked. Reset type: CPU1.SYSRSn
0	CLKSRCCTL1	R/WOnce	0h	Lock bit for CLKSRCCTL1 register: 0: Respective register is not locked 1: Respective register is locked. Reset type: CPU1.SYSRSn

**2.15.10.2 CLKSRCCTL1 Register (Offset = 8h) [reset = 0h]**

 CLKSRCCTL1 is shown in [Figure 2-121](#) and described in [Table 2-132](#).

 Return to [Summary Table](#).

Clock Source Control register-1

**Figure 2-121. CLKSRCCTL1 Register**

31	30	29	28	27	26	25	24
RESERVED							
R=0-0h							
23	22	21	20	19	18	17	16
RESERVED							
R=0-0h							
15	14	13	12	11	10	9	8
RESERVED							
R=0-0h							
7	6	5	4	3	2	1	0
RESERVED		WDHALTI	XTALOFF	INTOSC2OFF	RESERVED	OSCCLKSRCSEL	
R=0-0h		R/W-0h	R/W-0h	R/W-0h	R=0-0h	R/W-0h	

**Table 2-132. CLKSRCCTL1 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R=0	0h	Reserved
15-6	RESERVED	R=0	0h	Reserved
5	WDHALTI	R/W	0h	Watchdog HALT Mode Ignore Bit: This bit determines if CPU1.WD is functional in the HALT mode or not.  0 = CPU1.WD is not functional in the HALT mode. Clock to CPU1.WD is gated when system enters HALT mode. Additionally, INTOSC1 and INTOSC2 are powered-down when system enters HALT mode  1 = CPU1.WD is functional in the HALT mode. Clock to CPU1.WD is not gated and INTOSC1/2 are not powered-down when system enters HALT mode  Reset type: XRSn
4	XTALOFF	R/W	0h	Crystal (External) Oscillator Off Bit: This bit turns external oscillator off:  0 = Crystal (External) Oscillator On (default on reset) 1 = Crystal (External) Oscillator Off  NOTE: Ensure no resources are using a clock source prior to disabling it. For example OSCCLKSRCSEL (SYSPLL), AUXOSCCLKSRCSEL (AUXPLL), CANxBCLKSEL (CAN Clock), TMR2CLKSRCSEL (CPUTIMER2) and XCLKOUTSEL(XCLKOUT).  Reset type: XRSn
3	INTOSC2OFF	R/W	0h	Internal Oscillator 2 Off Bit: This bit turns oscillator 2 off:  0 = Internal Oscillator 2 On (default on reset) 1 = Internal Oscillator 2 Off  This bit could be used by the user to turn off the internal oscillator 2 if it is not used.  NOTE: Ensure no resources are using a clock source prior to disabling it. For example OSCCLKSRCSEL (SYSPLL), AUXOSCCLKSRCSEL (AUXPLL), TMR2CLKSRCSEL (CPUTIMER2) and XCLOCKOUT (XCLKOUT).  Reset type: XRSn



**Table 2-132. CLKSRCCTL1 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
2	RESERVED	R=0	0h	Reserved
1-0	OSCCLKSRCSEL	R/W	0h	<p>Oscillator Clock Source Select Bit: This bit selects the source for OSCCLK.</p> <p>00 = INTOSC2 (default on reset)            01 = External Oscillator (XTAL)            10 = INTOSC1            11 = reserved (default to INTOSC1)</p> <p>At power-up or after an XRSn, INTOSC2 is selected by default. Whenever the user changes the clock source using these bits, the SYSPLLMULT register will be forced to zero and the PLL will be bypassed and powered down. This prevents potential PLL overshoot. The user will then have to write to the SYSPLLMULT register to configure the appropriate multiplier.</p> <p>The user must wait 10 OSCCLK cycles before writing to SYSPLLMULT or disabling the previous clock source to allow the change to complete..</p> <p>Notes:            [1] Reserved selection defaults to 00 configuration            [2] INTOSC1 is recommended to be used only after missing clock detection. If user wants to re-lock the PLL with INTOSC1 (the back-up clock source) after missing clock is detected, he can do a MCLKCLR and lock the PLL.</p> <p>Reset type: XRSn</p>

### 2.15.10.3 CLKSRCCTL2 Register (Offset = Ah) [reset = 0h]

CLKSRCCTL2 is shown in [Figure 2-122](#) and described in [Table 2-133](#).

Return to [Summary Table](#).

Clock Source Control register-2

**Figure 2-122. CLKSRCCTL2 Register**

31	30	29	28	27	26	25	24
RESERVED							
R=0-0h							
23	22	21	20	19	18	17	16
RESERVED							
R=0-0h							
15	14	13	12	11	10	9	8
RESERVED						RESERVED	
R=0-0h						R-0h	
7	6	5	4	3	2	1	0
RESERVED		CANBBCLKSEL		CANABCLKSEL		AUXOSCCLKSRCSEL	
R-0h		R/W-0h		R/W-0h		R/W-0h	

**Table 2-133. CLKSRCCTL2 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R=0	0h	Reserved
15-10	RESERVED	R=0	0h	Reserved
9-8	RESERVED	R	0h	Reserved
7-6	RESERVED	R	0h	Reserved
5-4	CANBBCLKSEL	R/W	0h	CANB Bit-Clock Source Select Bit: 00 = PERx.SYSCLK (default on reset) 01 = External Oscillator (XTAL) 10 = AUXCLKIN (from GPIO) 11 = Reserved  Missing clock detect circuit doesnt have any impact on these bits. Reset type: XRSn
3-2	CANABCLKSEL	R/W	0h	CANA Bit-Clock Source Select Bit: 00 = PERx.SYSCLK (default on reset) 01 = External Oscillator (XTAL) 10 = AUXCLKIN (from GPIO) 11 = Reserved  Missing clock detect circuit doesnt have any impact on these bits. Reset type: XRSn

**Table 2-133. CLKSRCCTL2 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
1-0	AUXOSCCLKSRCSEL	R/W	0h	<p>Oscillator Clock Source Select Bit: This bit selects the source for AUXOSCCLK:</p> <p>00 = INTOSC2 (default on reset)</p> <p>01 = External Oscillator (XTAL)</p> <p>10 = AUXCLKIN (from GPIO)</p> <p>11 = Reserved</p> <p>Whenever the user changes the clock source using these bits, the AUXPLLMULT register will be forced to zero and the PLL will be bypassed and powered down. This prevents potential PLL overshoot. The user will then have to write to the AUXPLLMULT register to configure the appropriate multiplier.</p> <p>The user must wait 10 OSCCLK cycles before writing to AUXPLLMULT or disabling the previous clock source to allow the change to complete.</p> <p>The missing clock detection circuit does not affect these bits. Reset type: XRSn</p>

**2.15.10.4 CLKSRCCTL3 Register (Offset = Ch) [reset = 0h]**

CLKSRCCTL3 is shown in [Figure 2-123](#) and described in [Table 2-134](#).

Return to [Summary Table](#).

Clock Source Control register-3

**Figure 2-123. CLKSRCCTL3 Register**

31	30	29	28	27	26	25	24
RESERVED							
R=0-0h							
23	22	21	20	19	18	17	16
RESERVED							
R=0-0h							
15	14	13	12	11	10	9	8
RESERVED							
R=0-0h							
7	6	5	4	3	2	1	0
RESERVED					XCLKOUTSEL		
R=0-0h					R/W-0h		

**Table 2-134. CLKSRCCTL3 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R=0	0h	Reserved
15-3	RESERVED	R=0	0h	Reserved
2-0	XCLKOUTSEL	R/W	0h	XCLKOUT Source Select Bit: This bit selects the source for XCLKOUT: 000 = PLLSYSCLK (default on reset) 001 = PLLRAWCLK 010 = CPU1.SYSCLK 011 = Reserved 100 = AUXPLLRAWCLK 101 = INTOSC1 110 = INTOSC2 111 = Reserved Reset type: CPU1.SYSRSn

**2.15.10.5 SYSPLLCTL1 Register (Offset = Eh) [reset = 0h]**

SYSPLLCTL1 is shown in [Figure 2-124](#) and described in [Table 2-135](#).

Return to [Summary Table](#).

SYSPLL Control register-1

**Figure 2-124. SYSPLLCTL1 Register**

31	30	29	28	27	26	25	24
RESERVED							
R=0-0h							
23	22	21	20	19	18	17	16
RESERVED							
R=0-0h							
15	14	13	12	11	10	9	8
RESERVED							
R=0-0h							
7	6	5	4	3	2	1	0
RESERVED						PLLCLKEN	PLLEN
R=0-0h						R/W-0h	R/W-0h

**Table 2-135. SYSPLLCTL1 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R=0	0h	Reserved
15-2	RESERVED	R=0	0h	Reserved
1	PLLCLKEN	R/W	0h	<p>SYSPLL bypassed or included in the PLLSYSCLK path: This bit decides if the SYSPLL is bypassed when PLLSYSCLK is generated</p> <p>1 = PLLSYSCLK is fed from the SYSPLL clock output. Users need to make sure that the PLL is locked before enabling this clock to the system.</p> <p>0 = SYSPLL is bypassed. Clock to system is direct feed from OSCCLK</p> <p>Reset type: XRSn</p>
0	PLLEN	R/W	0h	<p>SYSPLL enabled or disabled: This bit decides if the SYSPLL is enabled or not</p> <p>1 = SYSPLL is enabled</p> <p>0 = SYSPLL is powered off. Clock to system is direct feed from OSCCLK</p> <p>Reset type: XRSn</p>

**2.15.10.6 SYSPLLMULT Register (Offset = 14h) [reset = 0h]**

 SYSPLLMULT is shown in [Figure 2-125](#) and described in [Table 2-136](#).

 Return to [Summary Table](#).

SYSPLL Multiplier register

NOTE: FMULT and IMULT fields must be written at the same time for correct PLL operation.

**Figure 2-125. SYSPLLMULT Register**

31	30	29	28	27	26	25	24	
RESERVED								
R=0-0h								
23	22	21	20	19	18	17	16	
RESERVED								
R=0-0h								
15	14	13	12	11	10	9	8	
RESERVED						FMULT		
R=0-0h						R/W-0h		
7	6	5	4	3	2	1	0	
RESERVED							IMULT	
R=0-0h				R/W-0h				

**Table 2-136. SYSPLLMULT Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R=0	0h	Reserved
15-10	RESERVED	R=0	0h	Reserved
9-8	FMULT	R/W	0h	SYSPLL Fractional Multiplier: 00 Fractional Multiplier = 0 01 Fractional Multiplier = 0.25 10 Fractional Multiplier = 0.5 11 Fractional Multiplier = 0.75 Reset type: XRSn
7	RESERVED	R=0	0h	Reserved
6-0	IMULT	R/W	0h	SYSPLL Integer Multiplier: For 0000000 Fout = Fref (PLLBYPASS) Integer Multiplier = 1 0000001 Integer Multiplier = 1 0000010 Integer Multiplier = 2 0000011 Integer Multiplier = 3 ..... 1111111 Integer Multiplier = 127 Reset type: XRSn

**2.15.10.7 SYSPLLSTS Register (Offset = 16h) [reset = 0h]**

 SYSPLLSTS is shown in [Figure 2-126](#) and described in [Table 2-137](#).

[Return to Summary Table.](#)

SYSPLL Status register

**Figure 2-126. SYSPLLSTS Register**

31	30	29	28	27	26	25	24
RESERVED							
R=0-0h							
23	22	21	20	19	18	17	16
RESERVED							
R=0-0h							
15	14	13	12	11	10	9	8
RESERVED							
R=0-0h							
7	6	5	4	3	2	1	0
RESERVED						SLIPS	LOCKS
R=0-0h						R-0h	R-0h

**Table 2-137. SYSPLLSTS Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R=0	0h	Reserved
15-2	RESERVED	R=0	0h	Reserved
1	SLIPS	R	0h	SYSPLL Slip Status Bit: This bit indicates whether the SYSPLL is out of lock range 0 = SYSPLL is not out of lock 1 = SYSPLL is out of lock  Note: [1] If SYSPLL out of lock condition is detected then interrupts are fired to the ePIE. Software can decide to relock the PLL or switch to PLL bypass mode in the interrupt handler Reset type: XRSn
0	LOCKS	R	0h	SYSPLL Lock Status Bit: This bit indicates whether the SYSPLL is locked or not 0 = SYSPLL is not yet locked 1 = SYSPLL is locked Reset type: XRSn

**2.15.10.8 AUXPLLCTL1 Register (Offset = 18h) [reset = 0h]**

 AUXPLLCTL1 is shown in [Figure 2-127](#) and described in [Table 2-138](#).

 Return to [Summary Table](#).

AUXPLL Control register-1

**Figure 2-127. AUXPLLCTL1 Register**

31	30	29	28	27	26	25	24
RESERVED							
R=0-0h							
23	22	21	20	19	18	17	16
RESERVED							
R=0-0h							
15	14	13	12	11	10	9	8
RESERVED							
R=0-0h							
7	6	5	4	3	2	1	0
RESERVED						PLLCLKEN	PLEN
R=0-0h						R/W-0h	R/W-0h

**Table 2-138. AUXPLLCTL1 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R=0	0h	Reserved
15-2	RESERVED	R=0	0h	Reserved
1	PLLCLKEN	R/W	0h	AUXPLL bypassed or included in the AUXPLLCLK path: This bit decides if the AUXPLL is bypassed when AUXPLLCLK is generated  1 = AUXPLLCLK is fed from the AUXPLL clock output. Users need to make sure that the PLL is locked before enabling this clock to the AUXPLLCLK connected modules.  0 = AUXPLL is bypassed. Clock to modules connected to AUXPLLCLK is direct feed from AUXOSCCLK  Reset type: XRSn
0	PLEN	R/W	0h	AUXPLL enabled or disabled: This bit decides if the AUXPLL is enabled or not  1 = AUXPLL is enabled  0 = AUXPLL is powered off. Clock to system is direct feed from AUXOSCCLK  Reset type: XRSn



### 2.15.10.9 AUXPLLMULT Register (Offset = 1Eh) [reset = 0h]

AUXPLLMULT is shown in [Figure 2-128](#) and described in [Table 2-139](#).

Return to [Summary Table](#).

AUXPLL Multiplier register

NOTE: FMULT and IMULT fields must be written at the same time for correct PLL operation.

**Figure 2-128. AUXPLLMULT Register**

31	30	29	28	27	26	25	24
RESERVED							
R=0-0h							
23	22	21	20	19	18	17	16
RESERVED							
R=0-0h							
15	14	13	12	11	10	9	8
RESERVED						FMULT	
R=0-0h						R/W-0h	
7	6	5	4	3	2	1	0
RESERVED		IMULT					
R=0-0h		R/W-0h					

**Table 2-139. AUXPLLMULT Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R=0	0h	Reserved
15-10	RESERVED	R=0	0h	Reserved
9-8	FMULT	R/W	0h	AUXPLL Fractional Multiplier : 00 Fractional Multiplier = 0 01 Fractional Multiplier = 0.25 10 Fractional Multiplier = 0.5 11 Fractional Multiplier = 0.75 Reset type: XRSn
7	RESERVED	R=0	0h	Reserved
6-0	IMULT	R/W	0h	AUXPLL Integer Multiplier: For 0000000 Fout = Fref (PLLBYPASS) Integer Multiplier = 1 0000001 Integer Multiplier = 1 0000010 Integer Multiplier = 2 0000011 Integer Multiplier = 3 ..... 1111111 Integer Multiplier = 127 Reset type: XRSn

**2.15.10.10 AUXPLLSTS Register (Offset = 20h) [reset = 0h]**

AUXPLLSTS is shown in [Figure 2-129](#) and described in [Table 2-140](#).

Return to [Summary Table](#).

AUXPLL Status register

**Figure 2-129. AUXPLLSTS Register**

31	30	29	28	27	26	25	24
RESERVED							
R=0-0h							
23	22	21	20	19	18	17	16
RESERVED							
R=0-0h							
15	14	13	12	11	10	9	8
RESERVED							
R=0-0h							
7	6	5	4	3	2	1	0
RESERVED						SLIPS	LOCKS
R=0-0h						R-0h	R-0h

**Table 2-140. AUXPLLSTS Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R=0	0h	Reserved
15-2	RESERVED	R=0	0h	Reserved
1	SLIPS	R	0h	AUXPLL Slip Status Bit: This bit indicates whether the AUXPLL is out of lock range 0 = AUXPLL is not out of lock 1 = AUXPLL is out of lock  Note: [1] If AUXPLL out of lock condition is detected then interrupts are fired to the ePIE. Software can decide to relock the PLL or switch to PLL bypass mode in the interrupt handler Reset type: XRSn
0	LOCKS	R	0h	AUXPLL Lock Status Bit: This bit indicates whether the AUXPLL is locked or not 0 = AUXPLL is not yet locked 1 = AUXPLL is locked Reset type: XRSn

**2.15.10.11 SYCLKDIVSEL Register (Offset = 22h) [reset = 2h]**

 SYCLKDIVSEL is shown in [Figure 2-130](#) and described in [Table 2-141](#).

 Return to [Summary Table](#).

System Clock Divider Select register

**Figure 2-130. SYCLKDIVSEL Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
RESERVED															
R=0-0h															
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
RESERVED										PLLSYSCLKDIV					
R=0-0h										R/W-2h					

**Table 2-141. SYCLKDIVSEL Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R=0	0h	Reserved
15-6	RESERVED	R=0	0h	Reserved
5-0	PLLSYSCLKDIV	R/W	2h	PLLSYSCLK Divide Select: This bit selects the divider setting for the PLLSYSCLK. 000000 = /1 000001 = /2 000010 = /4 (default on reset) 000011 = /6 000100 = /8 ..... 111111 = /126 Reset type: XRSn

**2.15.10.12 AUXCLKDIVSEL Register (Offset = 24h) [reset = 1h]**

AUXCLKDIVSEL is shown in [Figure 2-131](#) and described in [Table 2-142](#).

Return to [Summary Table](#).

Auxillary Clock Divider Select register

**Figure 2-131. AUXCLKDIVSEL Register**

31	30	29	28	27	26	25	24
RESERVED							
R=0-0h							
23	22	21	20	19	18	17	16
RESERVED							
R=0-0h							
15	14	13	12	11	10	9	8
RESERVED							
R=0-0h							
7	6	5	4	3	2	1	0
RESERVED						AUXPLLDIV	
R=0-0h						R/W-1h	

**Table 2-142. AUXCLKDIVSEL Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R=0	0h	Reserved
15-2	RESERVED	R=0	0h	Reserved
1-0	AUXPLLDIV	R/W	1h	AUXPLLCLK Divide Select: This bit selects the divider setting for the AUXPLLCK. 00 = /1 01 = /2 (default on reset) 10 = /4 11 = /8 Reset type: XRSn

### 2.15.10.13 PERCLKDIVSEL Register (Offset = 26h) [reset = 51h]

PERCLKDIVSEL is shown in [Figure 2-132](#) and described in [Table 2-143](#).

Return to [Summary Table](#).

Peripheral Clock Divider Selet register

**Figure 2-132. PERCLKDIVSEL Register**

31	30	29	28	27	26	25	24
RESERVED							
R=0-0h							
23	22	21	20	19	18	17	16
RESERVED							
R=0-0h							
15	14	13	12	11	10	9	8
RESERVED							
R=0-0h							
7	6	5	4	3	2	1	0
RESERVED	EMIF2CLKDIV	RESERVED	EMIF1CLKDIV	RESERVED		EPWMCLKDIV	
R=0-0h	R/W-1h	R=0-0h	R/W-1h	R-0h		R/W-1h	

**Table 2-143. PERCLKDIVSEL Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R=0	0h	Reserved
15-7	RESERVED	R=0	0h	Reserved
6	EMIF2CLKDIV	R/W	1h	EMIF2 Clock Divide Select: This bit selects whether the EMIF2 module run with a /1 or /2 clock.  0: /1 of CPU1.SYSCLK is selected 1: /2 of CPU1.SYSCLK is selected Reset type: CPU1.SYSRSn
5	RESERVED	R=0	0h	Reserved
4	EMIF1CLKDIV	R/W	1h	EMIF1 Clock Divide Select: This bit selects whether the EMIF1 module run with a /1 or /2 clock.  For single core device 0: /1 of CPU1.SYSCLK is selected 1: /2 of CPU1.SYSCLK is selected For Dual core device 0: /1 of PLLSYSCLK is selected 1: /2 of PLLSYSCLK is selected Reset type: CPU1.SYSRSn
3-2	RESERVED	R	0h	Reserved
1-0	EPWMCLKDIV	R/W	1h	EPWM Clock Divide Select: This bit selects whether the EPWM modules run with a /1 or /2 clock. This divider sits in front of the PLLSYSCLK  x0 = /1 of PLLSYSCLK x1 = /2 of PLLSYSCLK (default on reset)  Note: Refer to the EPWM User Guide for maximum EPWM Frequency Reset type: CPU1.SYSRSn

**2.15.10.14 XCLKOUTDIVSEL Register (Offset = 28h) [reset = 3h]**

XCLKOUTDIVSEL is shown in [Figure 2-133](#) and described in [Table 2-144](#).

Return to [Summary Table](#).

XCLKOUT Divider Select register

**Figure 2-133. XCLKOUTDIVSEL Register**

31	30	29	28	27	26	25	24
RESERVED							
R=0-0h							
23	22	21	20	19	18	17	16
RESERVED							
R=0-0h							
15	14	13	12	11	10	9	8
RESERVED							
R=0-0h							
7	6	5	4	3	2	1	0
RESERVED						XCLKOUTDIV	
R=0-0h						R/W-3h	

**Table 2-144. XCLKOUTDIVSEL Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R=0	0h	Reserved
15-2	RESERVED	R=0	0h	Reserved
1-0	XCLKOUTDIV	R/W	3h	XCLKOUT Divide Select: This bit selects the divider setting for the XCLKOUT. 00 = /1 01 = /2 10 = /4 11 = /8 (default on reset) Reset type: CPU1.SYSRSn

**2.15.10.15 LOSPCP Register (Offset = 2Ch) [reset = 2h]**

LOSPCP is shown in [Figure 2-134](#) and described in [Table 2-145](#).

Return to [Summary Table](#).

Low Speed Clock Source Prescalar

**Figure 2-134. LOSPCP Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
RESERVED															
R=0-0h															
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
RESERVED												LSPCLKDIV			
R=0-0h												R/W-2h			

**Table 2-145. LOSPCP Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R=0	0h	Reserved
15-3	RESERVED	R=0	0h	Reserved
2-0	LSPCLKDIV	R/W	2h	<p>These bits configure the low-speed peripheral clock (LSPCLK) rate relative to SYCLK.</p> <p>000,LSPCLK = / 1            001,LSPCLK = / 2            010,LSPCLK = / 4 (default on reset)            011,LSPCLK = / 6            100,LSPCLK = / 8            101,LSPCLK = / 10            110,LSPCLK = / 12            111,LSPCLK = / 14</p> <p>Note:            [1] This clock is used as strobe for the SCI and SPI modules.            Reset type: CPU1.SYSRSn</p>

**2.15.10.16 MCDCR Register (Offset = 2Eh) [reset = 0h]**

 MCDCR is shown in [Figure 2-135](#) and described in [Table 2-146](#).

 Return to [Summary Table](#).

Missing Clock Detect Control Register

**Figure 2-135. MCDCR Register**

31	30	29	28	27	26	25	24
RESERVED							
R=0-0h							
23	22	21	20	19	18	17	16
RESERVED							
R=0-0h							
15	14	13	12	11	10	9	8
RESERVED							
R=0-0h							
7	6	5	4	3	2	1	0
RESERVED				OSCOFF	MCLKOFF	MCLKCLR	MCLKSTS
R=0-0h				R/W-0h	R/W-0h	R=0/W=1-0h	R-0h

**Table 2-146. MCDCR Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R=0	0h	Reserved
15-4	RESERVED	R=0	0h	Reserved
3	OSCOFF	R/W	0h	Oscillator Clock Off Bit: 0 = OSCCLK Connected to OSCCLK Counter in MCD module 1 = OSCCLK Disconnected to OSCCLK Counter in MCD module Reset type: XRSn
2	MCLKOFF	R/W	0h	Missing Clock Detect Off Bit: 0 = Missing Clock Detect Circuit Enabled 1 = Missing Clock Detect Circuit Disabled Reset type: XRSn
1	MCLKCLR	R=0/W=1	0h	Missing Clock Clear Bit: Write 1" to this bit to clear MCLKSTS bit and reset the missing clock detect circuit." Reset type: XRSn
0	MCLKSTS	R	0h	Missing Clock Status Bit: 0 = OSCCLK Is OK 1 = OSCCLK Detected Missing, CLOCKFAILn Generated Reset type: XRSn



**2.15.10.17 X1CNT Register (Offset = 30h) [reset = 0h]**

X1CNT is shown in [Figure 2-136](#) and described in [Table 2-147](#).

Return to [Summary Table](#).

10-bit Counter on X1 Clock

**Figure 2-136. X1CNT Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
RESERVED															
R=0-0h															
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
RESERVED						X1CNT									
R=0-0h						R-0h									

**Table 2-147. X1CNT Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R=0	0h	Reserved
15-10	RESERVED	R=0	0h	Reserved
9-0	X1CNT	R	0h	<p>X1 Counter:</p> <ul style="list-style-type: none"> <li>- This counter increments on every X1 CLOCKS positive-edge.</li> <li>- Once it reaches the values of 0x3ff, it freezes</li> <li>- Before switching from INTOSC2 to X1, application must check this counter and make sure that it has saturated. This will guarantee that the Crystal connected to X1/X2 is powered Up.</li> </ul> <p>Reset type: PORn</p>

## 2.15.11 CPU\_SYS\_REGS Registers

Table 2-148 lists the memory-mapped registers for the CPU\_SYS\_REGS. All register offset addresses not listed in Table 2-148 should be considered as reserved locations and the register contents should not be modified.

**Table 2-148. CPU\_SYS\_REGS Registers**

Offset	Acronym	Register Name	Write Protection	Section
0h	CPUSYSLOCK1	Lock bit for CPUSYS registers	EALLOW	<a href="#">Go</a>
6h	HIBBOOTMODE	HIB Boot Mode Register	EALLOW	<a href="#">Go</a>
8h	IORESTOREADDR	IORestore() routine Address Register	EALLOW	<a href="#">Go</a>
Ah	PIEVERRADDR	PIE Vector Fetch Error Address register	EALLOW	<a href="#">Go</a>
22h	PCLKCR0	Peripheral Clock Gating Registers	EALLOW	<a href="#">Go</a>
24h	PCLKCR1	Peripheral Clock Gating Registers	EALLOW	<a href="#">Go</a>
26h	PCLKCR2	Peripheral Clock Gating Registers	EALLOW	<a href="#">Go</a>
28h	PCLKCR3	Peripheral Clock Gating Registers	EALLOW	<a href="#">Go</a>
2Ah	PCLKCR4	Peripheral Clock Gating Registers	EALLOW	<a href="#">Go</a>
2Eh	PCLKCR6	Peripheral Clock Gating Registers	EALLOW	<a href="#">Go</a>
30h	PCLKCR7	Peripheral Clock Gating Registers	EALLOW	<a href="#">Go</a>
32h	PCLKCR8	Peripheral Clock Gating Registers	EALLOW	<a href="#">Go</a>
34h	PCLKCR9	Peripheral Clock Gating Registers	EALLOW	<a href="#">Go</a>
36h	PCLKCR10	Peripheral Clock Gating Registers	EALLOW	<a href="#">Go</a>
38h	PCLKCR11	Peripheral Clock Gating Registers	EALLOW	<a href="#">Go</a>
3Ah	PCLKCR12	Peripheral Clock Gating Registers	EALLOW	<a href="#">Go</a>
3Ch	PCLKCR13	Peripheral Clock Gating Registers	EALLOW	<a href="#">Go</a>
3Eh	PCLKCR14	Peripheral Clock Gating Registers	EALLOW	<a href="#">Go</a>
42h	PCLKCR16	Peripheral Clock Gating Registers	EALLOW	<a href="#">Go</a>
74h	SECMSEL_1	Secondary Master Select register for common peripherals: Selects between CLA & DMA	EALLOW	<a href="#">Go</a>
76h	LPMCR	LPM Control Register	EALLOW	<a href="#">Go</a>
78h	GPIO_LPMSEL0	GPIO LPM Wakeup select registers	EALLOW	<a href="#">Go</a>
7Ah	GPIO_LPMSEL1	GPIO LPM Wakeup select registers	EALLOW	<a href="#">Go</a>
7Ch	TMR2CLKCTL	Timer2 Clock Measurement functionality control register	EALLOW	<a href="#">Go</a>
80h	RESC	Reset Cause register		<a href="#">Go</a>

Complex bit access types are encoded to fit into small table cells. Table 2-149 shows the codes that are used for access types in this section.

**Table 2-149. CPU\_SYS\_REGS Access Type Codes**

Access Type	Code	Description
<b>Read Type</b>		
R	R	Read
R=0	R	Read
<b>Write Type</b>		
W	W	Write
W=1	W	Write
WSOnce	SOnce W	Set once Write
<b>Reset or Default Value</b>		
-n		Value after reset or the default value

**Table 2-149. CPU\_SYS\_REGS Access Type Codes (continued)**

Access Type	Code	Description
<b>Register Array Variables</b>		
i,j,k,l,m,n		When these variables are used in a register name, an offset, or an address, they refer to the value of a register array where the register is part of a group of repeating registers. The register groups form a hierarchical structure and the array is represented with a formula.
y		When this variable is used in a register name, an offset, or an address it refers to the value of a register array.

**2.15.11.1 CPUSYSLOCK1 Register (Offset = 0h) [reset = 0h]**

CPUSYSLOCK1 is shown in [Figure 2-137](#) and described in [Table 2-150](#).

Return to [Summary Table](#).

Lock bit for CPUSYS registers

Notes:

[1] Any bit in this register, once set can only be cleared through a CPU1.SYSRSn. Write of 0 to any bit of this register has no effect

[2] The locking mechanism applies to only writes. Reads to the registers which have LOCK protection are always allowed

**Figure 2-137. CPUSYSLOCK1 Register**

31								30								29								28								27								26								25								24							
RESERVED																																																															
R=0-0h																																																															
23								22								21								20								19								18								17								16							
GPIOLPMSEL1								GPIOLPMSEL0								LPMCR								SECMSEL								PCLKCR16								PCLKCR15								PCLKCR14								PCLKCR13							
R/WSONce-0h								R/WSONce-0h								R/WSONce-0h								R/WSONce-0h								R/WSONce-0h								R/WSONce-0h								R/WSONce-0h								R/WSONce-0h							
15								14								13								12								11								10								9								8							
PCLKCR12								PCLKCR11								PCLKCR10								PCLKCR9								PCLKCR8								PCLKCR7								PCLKCR6								PCLKCR5							
R/WSONce-0h								R/WSONce-0h								R/WSONce-0h								R/WSONce-0h								R/WSONce-0h								R/WSONce-0h								R/WSONce-0h								R/WSONce-0h							
7								6								5								4								3								2								1								0							
PCLKCR4								PCLKCR3								PCLKCR2								PCLKCR1								PCLKCR0								PIEVERRADD R								IORESTOREA DDR								HIBBOOTMOD E							
R/WSONce-0h								R/WSONce-0h								R/WSONce-0h								R/WSONce-0h								R/WSONce-0h								R/WSONce-0h								R/WSONce-0h								R/WSONce-0h							

**Table 2-150. CPUSYSLOCK1 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-24	RESERVED	R=0	0h	Reserved
23	GPIOLPMSEL1	R/WSONce	0h	Lock bit for GPIOLPMSEL1 Register: 0: Respective register is not locked 1: Respective register is locked.  Reset type: SYSRSn
22	GPIOLPMSEL0	R/WSONce	0h	Lock bit for GPIOLPMSEL0 Register: 0: Respective register is not locked 1: Respective register is locked.  Reset type: SYSRSn
21	LPMCR	R/WSONce	0h	Lock bit for LPMCR Register: 0: Respective register is not locked 1: Respective register is locked.  Reset type: SYSRSn
20	SECMSEL	R/WSONce	0h	Lock bit for SECMSEL Register: 0: Respective register is not locked 1: Respective register is locked.  Reset type: SYSRSn
19	PCLKCR16	R/WSONce	0h	Lock bit for PCLKCR16 Register: 0: Respective register is not locked 1: Respective register is locked.  Reset type: SYSRSn

**Table 2-150. CPUSYSLOCK1 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
18	PCLKCR15	R/WOnce	0h	Lock bit for PCLKCR15 Register: 0: Respective register is not locked 1: Respective register is locked.  Reset type: SYSRSn
17	PCLKCR14	R/WOnce	0h	Lock bit for PCLKCR14 Register: 0: Respective register is not locked 1: Respective register is locked.  Reset type: SYSRSn
16	PCLKCR13	R/WOnce	0h	Lock bit for PCLKCR13 Register: 0: Respective register is not locked 1: Respective register is locked.  Reset type: SYSRSn
15	PCLKCR12	R/WOnce	0h	Lock bit for PCLKCR12 Register: 0: Respective register is not locked 1: Respective register is locked.  Reset type: SYSRSn
14	PCLKCR11	R/WOnce	0h	Lock bit for PCLKCR11 Register: 0: Respective register is not locked 1: Respective register is locked.  Reset type: SYSRSn
13	PCLKCR10	R/WOnce	0h	Lock bit for PCLKCR10 Register: 0: Respective register is not locked 1: Respective register is locked.  Reset type: SYSRSn
12	PCLKCR9	R/WOnce	0h	Lock bit for PCLKCR9 Register: 0: Respective register is not locked 1: Respective register is locked.  Reset type: SYSRSn
11	PCLKCR8	R/WOnce	0h	Lock bit for PCLKCR8 Register: 0: Respective register is not locked 1: Respective register is locked.  Reset type: SYSRSn
10	PCLKCR7	R/WOnce	0h	Lock bit for PCLKCR7 Register: 0: Respective register is not locked 1: Respective register is locked.  Reset type: SYSRSn
9	PCLKCR6	R/WOnce	0h	Lock bit for PCLKCR6 Register: 0: Respective register is not locked 1: Respective register is locked.  Reset type: SYSRSn

**Table 2-150. CPUSYSLOCK1 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
8	PCLKCR5	R/WOnce	0h	Lock bit for PCLKCR5 Register: 0: Respective register is not locked 1: Respective register is locked.  Reset type: SYSRSn
7	PCLKCR4	R/WOnce	0h	Lock bit for PCLKCR4 Register: 0: Respective register is not locked 1: Respective register is locked.  Reset type: SYSRSn
6	PCLKCR3	R/WOnce	0h	Lock bit for PCLKCR3 Register: 0: Respective register is not locked 1: Respective register is locked.  Reset type: SYSRSn
5	PCLKCR2	R/WOnce	0h	Lock bit for PCLKCR2 Register: 0: Respective register is not locked 1: Respective register is locked.  Reset type: SYSRSn
4	PCLKCR1	R/WOnce	0h	Lock bit for PCLKCR1 Register: 0: Respective register is not locked 1: Respective register is locked.  Reset type: SYSRSn
3	PCLKCR0	R/WOnce	0h	Lock bit for PCLKCR0 Register: 0: Respective register is not locked 1: Respective register is locked. Reset type: SYSRSn
2	PIEVERRADDR	R/WOnce	0h	Lock bit for PIEVERRADDR Register: 0: Respective register is not locked 1: Respective register is locked. Reset type: SYSRSn
1	IORESTOREADDR	R/WOnce	0h	Lock bit for IORESTOREADDR Register: 0: Respective register is not locked 1: Respective register is locked. Reset type: SYSRSn
0	HIBBOOTMODE	R/WOnce	0h	Lock bit for HIBBOOTMODE register: 0: Respective register is not locked 1: Respective register is locked. Reset type: SYSRSn

**2.15.11.2 HIBBOOTMODE Register (Offset = 6h) [reset = Fh]**

HIBBOOTMODE is shown in [Figure 2-138](#) and described in [Table 2-151](#).

Return to [Summary Table](#).

HIB Boot Mode Register

**Figure 2-138. HIBBOOTMODE Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
																	BMODE														
R/W-Fh																															

**Table 2-151. HIBBOOTMODE Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-0	BMODE	R/W	Fh	This register defined the boot mode on a HIB Wakeup. Its the responsibility of user to initialize the appropriate boot mode before going into HIB mode. Refer to the Boot ROM Spec for more details on this register. Reset type: PORn

### 2.15.11.3 IORESTOREADDR Register (Offset = 8h) [reset = 003FFFFFFh]

IORESTOREADDR is shown in [Figure 2-139](#) and described in [Table 2-152](#).

Return to [Summary Table](#).

IORestore() routine Address Register

**Figure 2-139. IORESTOREADDR Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
RESERVED											ADDR																				
R=0-0h											R/W-003FFFFFFh																				

**Table 2-152. IORESTOREADDR Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-22	RESERVED	R=0	0h	Reserved
21-0	ADDR	R/W	003FFFFFFh	This register defines the address of the restoreIO() routine on a HIB wakeup. Its the responsibility of user to initialize this register with the restoreIO() routine address before going into HIB mode. Refer to the Boot ROM section for more details on this register. Reset type: PORn



**2.15.11.4 PIEVERRADDR Register (Offset = Ah) [reset = 003FFFFh]**

PIEVERRADDR is shown in [Figure 2-140](#) and described in [Table 2-153](#).

Return to [Summary Table](#).

PIE Vector Fetch Error Address register

**Figure 2-140. PIEVERRADDR Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
RESERVED											ADDR																				
R=0-0h											R/W-003FFFFh																				

**Table 2-153. PIEVERRADDR Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-22	RESERVED	R=0	0h	Reserved
21-0	ADDR	R/W	003FFFFh	This register defines the address of the PIE Vector Fetch Error handler routine. Its the responsibility of user to initialize this register. If this register is not initialized, a default error handler at address 0x3fffbe will get executed. Refer to the Boot ROM section for more details on this register. Reset type: XRSn

### 2.15.11.5 PCLKCR0 Register (Offset = 22h) [reset = 38h]

PCLKCR0 is shown in [Figure 2-141](#) and described in [Table 2-154](#).

Return to [Summary Table](#).

Peripheral Clock Gating Registers

**Figure 2-141. PCLKCR0 Register**

31	30	29	28	27	26	25	24
RESERVED							
R=0-0h							
23	22	21	20	19	18	17	16
RESERVED				RESERVED	TBCLKSYNC	RESERVED	HRPWM
R=0-0h				R-0h	R/W-0h	R=0-0h	R/W-0h
15	14	13	12	11	10	9	8
RESERVED							
R=0-0h							
7	6	5	4	3	2	1	0
RESERVED		CPUTIMER2	CPUTIMER1	CPUTIMER0	DMA	RESERVED	CLA1
R=0-0h		R/W-1h	R/W-1h	R/W-1h	R/W-0h	R-0h	R/W-0h

**Table 2-154. PCLKCR0 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-20	RESERVED	R=0	0h	Reserved
19	RESERVED	R	0h	Reserved
18	TBCLKSYNC	R/W	0h	EPWM Time Base Clock sync: When set PWM time bases of all the PWM modules start counting. Reset type: SYSRSn
17	RESERVED	R=0	0h	Reserved
16	HRPWM	R/W	0h	HRPWM Clock Enable Bit: When set, this enables the clock to the HRPWM module 1: HRPWM clock is enabled 0: HRPWM clock is disabled Reset type: SYSRSn
15-6	RESERVED	R=0	0h	Reserved
5	CPUTIMER2	R/W	1h	CPUTIMER2 Clock Enable bit: 0: Module clock is gated-off 1: Module clock is turned-on Reset type: SYSRSn
4	CPUTIMER1	R/W	1h	CPUTIMER1 Clock Enable bit: 0: Module clock is gated-off 1: Module clock is turned-on Reset type: SYSRSn
3	CPUTIMER0	R/W	1h	CPUTIMER0 Clock Enable bit: 0: Module clock is gated-off 1: Module clock is turned-on Reset type: SYSRSn

**Table 2-154. PCLKCR0 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
2	DMA	R/W	0h	DMA Clock Enable bit: 0: Module clock is gated-off 1: Module clock is turned-on  Reset type: SYSRSn
1	RESERVED	R	0h	Reserved
0	CLA1	R/W	0h	CLA1 Clock Enable Bit: 0: Module clock is gated-off 1: Module clock is turned-on  Reset type: SYSRSn

**2.15.11.6 PCLKCR1 Register (Offset = 24h) [reset = 0h]**

PCLKCR1 is shown in [Figure 2-142](#) and described in [Table 2-155](#).

Return to [Summary Table](#).

Peripheral Clock Gating Registers

**Figure 2-142. PCLKCR1 Register**

31	30	29	28	27	26	25	24
RESERVED							
R=0-0h							
23	22	21	20	19	18	17	16
RESERVED							
R=0-0h							
15	14	13	12	11	10	9	8
RESERVED							
R=0-0h							
7	6	5	4	3	2	1	0
RESERVED						EMIF2	EMIF1
R=0-0h						R/W-0h	R/W-0h

**Table 2-155. PCLKCR1 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R=0	0h	Reserved
15-2	RESERVED	R=0	0h	Reserved
1	EMIF2	R/W	0h	EMIF2 Clock Enable bit: 0: Module clock is gated-off 1: Module clock is turned-on Reset type: SYSRSn
0	EMIF1	R/W	0h	EMIF1 Clock Enable bit: 0: Module clock is gated-off 1: Module clock is turned-on Reset type: SYSRSn

### 2.15.11.7 PCLKCR2 Register (Offset = 26h) [reset = 0h]

PCLKCR2 is shown in [Figure 2-143](#) and described in [Table 2-156](#).

Return to [Summary Table](#).

Peripheral Clock Gating Registers

**Figure 2-143. PCLKCR2 Register**

31	30	29	28	27	26	25	24
RESERVED							
R=0-0h							
23	22	21	20	19	18	17	16
RESERVED							
R=0-0h							
15	14	13	12	11	10	9	8
RESERVED	RESERVED	RESERVED	RESERVED	EPWM12	EPWM11	EPWM10	EPWM9
R-0h	R-0h	R-0h	R-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
7	6	5	4	3	2	1	0
EPWM8	EPWM7	EPWM6	EPWM5	EPWM4	EPWM3	EPWM2	EPWM1
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h

**Table 2-156. PCLKCR2 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R=0	0h	Reserved
15	RESERVED	R	0h	Reserved
14	RESERVED	R	0h	Reserved
13	RESERVED	R	0h	Reserved
12	RESERVED	R	0h	Reserved
11	EPWM12	R/W	0h	EPWM12 Clock Enable bit: 0: Module clock is gated-off 1: Module clock is turned-on Reset type: SYSRSn
10	EPWM11	R/W	0h	EPWM11 Clock Enable bit: 0: Module clock is gated-off 1: Module clock is turned-on Reset type: SYSRSn
9	EPWM10	R/W	0h	EPWM10 Clock Enable bit: 0: Module clock is gated-off 1: Module clock is turned-on Reset type: SYSRSn
8	EPWM9	R/W	0h	EPWM9 Clock Enable bit: 0: Module clock is gated-off 1: Module clock is turned-on Reset type: SYSRSn
7	EPWM8	R/W	0h	EPWM8 Clock Enable bit: 0: Module clock is gated-off 1: Module clock is turned-on Reset type: SYSRSn

**Table 2-156. PCLKCR2 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
6	EPWM7	R/W	0h	EPWM7 Clock Enable bit: 0: Module clock is gated-off 1: Module clock is turned-on Reset type: SYSRSn
5	EPWM6	R/W	0h	EPWM6 Clock Enable bit: 0: Module clock is gated-off 1: Module clock is turned-on Reset type: SYSRSn
4	EPWM5	R/W	0h	EPWM5 Clock Enable bit: 0: Module clock is gated-off 1: Module clock is turned-on Reset type: SYSRSn
3	EPWM4	R/W	0h	EPWM4 Clock Enable bit: 0: Module clock is gated-off 1: Module clock is turned-on Reset type: SYSRSn
2	EPWM3	R/W	0h	EPWM3 Clock Enable bit: 0: Module clock is gated-off 1: Module clock is turned-on Reset type: SYSRSn
1	EPWM2	R/W	0h	EPWM2 Clock Enable bit: 0: Module clock is gated-off 1: Module clock is turned-on Reset type: SYSRSn
0	EPWM1	R/W	0h	EPWM1 Clock Enable bit: 0: Module clock is gated-off 1: Module clock is turned-on Reset type: SYSRSn

### 2.15.11.8 PCLKCR3 Register (Offset = 28h) [reset = 0h]

PCLKCR3 is shown in [Figure 2-144](#) and described in [Table 2-157](#).

Return to [Summary Table](#).

Peripheral Clock Gating Registers

**Figure 2-144. PCLKCR3 Register**

31	30	29	28	27	26	25	24
RESERVED							
R=0-0h							
23	22	21	20	19	18	17	16
RESERVED							
R=0-0h							
15	14	13	12	11	10	9	8
RESERVED							
R=0-0h							
7	6	5	4	3	2	1	0
RESERVED	RESERVED	ECAP6	ECAP5	ECAP4	ECAP3	ECAP2	ECAP1
R-0h	R-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h

**Table 2-157. PCLKCR3 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R=0	0h	Reserved
15-8	RESERVED	R=0	0h	Reserved
7	RESERVED	R	0h	Reserved
6	RESERVED	R	0h	Reserved
5	ECAP6	R/W	0h	ECAP6 Clock Enable bit: 0: Module clock is gated-off 1: Module clock is turned-on Reset type: SYSRSn
4	ECAP5	R/W	0h	ECAP5 Clock Enable bit: 0: Module clock is gated-off 1: Module clock is turned-on Reset type: SYSRSn
3	ECAP4	R/W	0h	ECAP4 Clock Enable bit: 0: Module clock is gated-off 1: Module clock is turned-on Reset type: SYSRSn
2	ECAP3	R/W	0h	ECAP3 Clock Enable bit: 0: Module clock is gated-off 1: Module clock is turned-on Reset type: SYSRSn
1	ECAP2	R/W	0h	ECAP2 Clock Enable bit: 0: Module clock is gated-off 1: Module clock is turned-on Reset type: SYSRSn

**Table 2-157. PCLKCR3 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
0	ECAP1	R/W	0h	ECAP1 Clock Enable bit: 0: Module clock is gated-off 1: Module clock is turned-on Reset type: SYSRSn



**2.15.11.9 PCLKCR4 Register (Offset = 2Ah) [reset = 0h]**

PCLKCR4 is shown in [Figure 2-145](#) and described in [Table 2-158](#).

Return to [Summary Table](#).

Peripheral Clock Gating Registers

**Figure 2-145. PCLKCR4 Register**

31	30	29	28	27	26	25	24
RESERVED							
R=0-0h							
23	22	21	20	19	18	17	16
RESERVED							
R=0-0h							
15	14	13	12	11	10	9	8
RESERVED							
R=0-0h							
7	6	5	4	3	2	1	0
RESERVED				RESERVED	EQEP3	EQEP2	EQEP1
R=0-0h				R-0h	R/W-0h	R/W-0h	R/W-0h

**Table 2-158. PCLKCR4 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R=0	0h	Reserved
15-4	RESERVED	R=0	0h	Reserved
3	RESERVED	R	0h	Reserved
2	EQEP3	R/W	0h	EQEP3 Clock Enable bit: 0: Module clock is gated-off 1: Module clock is turned-on Reset type: SYSRSn
1	EQEP2	R/W	0h	EQEP2 Clock Enable bit: 0: Module clock is gated-off 1: Module clock is turned-on Reset type: SYSRSn
0	EQEP1	R/W	0h	EQEP1 Clock Enable bit: 0: Module clock is gated-off 1: Module clock is turned-on Reset type: SYSRSn

**2.15.11.10 PCLKCR6 Register (Offset = 2Eh) [reset = 0h]**

PCLKCR6 is shown in [Figure 2-146](#) and described in [Table 2-159](#).

Return to [Summary Table](#).

Peripheral Clock Gating Registers

**Figure 2-146. PCLKCR6 Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
RESERVED															
R=0-0h															
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
RESERVED								RESE RVED	RESE RVED	RESE RVED	RESE RVED	RESE RVED	RESE RVED	SD2	SD1
R=0-0h								R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R/W- 0h	R/W- 0h

**Table 2-159. PCLKCR6 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R=0	0h	Reserved
15-8	RESERVED	R=0	0h	Reserved
7	RESERVED	R	0h	Reserved
6	RESERVED	R	0h	Reserved
5	RESERVED	R	0h	Reserved
4	RESERVED	R	0h	Reserved
3	RESERVED	R	0h	Reserved
2	RESERVED	R	0h	Reserved
1	SD2	R/W	0h	SD2 Clock Enable bit: 0: Module clock is gated-off 1: Module clock is turned-on Reset type: SYSRSn
0	SD1	R/W	0h	SD1 Clock Enable bit: 0: Module clock is gated-off 1: Module clock is turned-on Reset type: SYSRSn

**2.15.11.11 PCLKCR7 Register (Offset = 30h) [reset = 0h]**

PCLKCR7 is shown in [Figure 2-147](#) and described in [Table 2-160](#).

Return to [Summary Table](#).

Peripheral Clock Gating Registers

**Figure 2-147. PCLKCR7 Register**

31	30	29	28	27	26	25	24
RESERVED							
R=0-0h							
23	22	21	20	19	18	17	16
RESERVED							
R=0-0h							
15	14	13	12	11	10	9	8
RESERVED							
R=0-0h							
7	6	5	4	3	2	1	0
RESERVED				SCI_D	SCI_C	SCI_B	SCI_A
R=0-0h				R/W-0h	R/W-0h	R/W-0h	R/W-0h

**Table 2-160. PCLKCR7 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R=0	0h	Reserved
15-4	RESERVED	R=0	0h	Reserved
3	SCI_D	R/W	0h	SCI_D Clock Enable bit: 0: Module clock is gated-off 1: Module clock is turned-on Reset type: SYSRSn
2	SCI_C	R/W	0h	SCI_C Clock Enable bit: 0: Module clock is gated-off 1: Module clock is turned-on Reset type: SYSRSn
1	SCI_B	R/W	0h	SCI_B Clock Enable bit: 0: Module clock is gated-off 1: Module clock is turned-on Reset type: SYSRSn
0	SCI_A	R/W	0h	SCI_A Clock Enable bit: 0: Module clock is gated-off 1: Module clock is turned-on Reset type: SYSRSn

**2.15.11.12 PCLKCR8 Register (Offset = 32h) [reset = 0h]**

PCLKCR8 is shown in [Figure 2-148](#) and described in [Table 2-161](#).

Return to [Summary Table](#).

Peripheral Clock Gating Registers

**Figure 2-148. PCLKCR8 Register**

31	30	29	28	27	26	25	24
RESERVED							
R=0-0h							
23	22	21	20	19	18	17	16
RESERVED						RESERVED	RESERVED
R=0-0h						R-0h	R-0h
15	14	13	12	11	10	9	8
RESERVED							
R=0-0h							
7	6	5	4	3	2	1	0
RESERVED				RESERVED	SPI_C	SPI_B	SPI_A
R=0-0h				R-0h	R/W-0h	R/W-0h	R/W-0h

**Table 2-161. PCLKCR8 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-18	RESERVED	R=0	0h	Reserved
17	RESERVED	R	0h	Reserved
16	RESERVED	R	0h	Reserved
15-4	RESERVED	R=0	0h	Reserved
3	RESERVED	R	0h	Reserved
2	SPI_C	R/W	0h	SPI_C Clock Enable bit: 0: Module clock is gated-off 1: Module clock is turned-on Reset type: SYSRSn
1	SPI_B	R/W	0h	SPI_B Clock Enable bit: 0: Module clock is gated-off 1: Module clock is turned-on Reset type: SYSRSn
0	SPI_A	R/W	0h	SPI_A Clock Enable bit: 0: Module clock is gated-off 1: Module clock is turned-on Reset type: SYSRSn

**2.15.11.13 PCLKCR9 Register (Offset = 34h) [reset = 0h]**

PCLKCR9 is shown in [Figure 2-149](#) and described in [Table 2-162](#).

Return to [Summary Table](#).

Peripheral Clock Gating Registers

**Figure 2-149. PCLKCR9 Register**

31	30	29	28	27	26	25	24
RESERVED							
R=0-0h							
23	22	21	20	19	18	17	16
RESERVED						RESERVED	RESERVED
R=0-0h						R-0h	R-0h
15	14	13	12	11	10	9	8
RESERVED							
R=0-0h							
7	6	5	4	3	2	1	0
RESERVED						I2C_B	I2C_A
R=0-0h						R/W-0h	R/W-0h

**Table 2-162. PCLKCR9 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-18	RESERVED	R=0	0h	Reserved
17	RESERVED	R	0h	Reserved
16	RESERVED	R	0h	Reserved
15-2	RESERVED	R=0	0h	Reserved
1	I2C_B	R/W	0h	I2C_B Clock Enable bit: 0: Module clock is gated-off 1: Module clock is turned-on Reset type: SYSRSn
0	I2C_A	R/W	0h	I2C_A Clock Enable bit: 0: Module clock is gated-off 1: Module clock is turned-on Reset type: SYSRSn

**2.15.11.14 PCLKCR10 Register (Offset = 36h) [reset = 0h]**

PCLKCR10 is shown in [Figure 2-150](#) and described in [Table 2-163](#).

Return to [Summary Table](#).

Peripheral Clock Gating Registers

**Figure 2-150. PCLKCR10 Register**

31	30	29	28	27	26	25	24
RESERVED							
R=0-0h							
23	22	21	20	19	18	17	16
RESERVED							
R=0-0h							
15	14	13	12	11	10	9	8
RESERVED							
R=0-0h							
7	6	5	4	3	2	1	0
RESERVED				RESERVED	RESERVED	CAN_B	CAN_A
R=0-0h				R-0h	R-0h	R/W-0h	R/W-0h

**Table 2-163. PCLKCR10 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R=0	0h	Reserved
15-4	RESERVED	R=0	0h	Reserved
3	RESERVED	R	0h	Reserved
2	RESERVED	R	0h	Reserved
1	CAN_B	R/W	0h	CAN_B Clock Enable bit: 0: Module clock is gated-off 1: Module clock is turned-on Reset type: SYSRSn
0	CAN_A	R/W	0h	CAN_A Clock Enable bit: 0: Module clock is gated-off 1: Module clock is turned-on Reset type: SYSRSn

**2.15.11.15 PCLKCR11 Register (Offset = 38h) [reset = 0h]**

PCLKCR11 is shown in [Figure 2-151](#) and described in [Table 2-164](#).

Return to [Summary Table](#).

Peripheral Clock Gating Registers

**Figure 2-151. PCLKCR11 Register**

31	30	29	28	27	26	25	24
RESERVED							
R=0-0h							
23	22	21	20	19	18	17	16
RESERVED						RESERVED	USB_A
R=0-0h						R-0h	R/W-0h
15	14	13	12	11	10	9	8
RESERVED							
R=0-0h							
7	6	5	4	3	2	1	0
RESERVED						McBSP_B	McBSP_A
R=0-0h						R/W-0h	R/W-0h

**Table 2-164. PCLKCR11 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-18	RESERVED	R=0	0h	Reserved
17	RESERVED	R	0h	Reserved
16	USB_A	R/W	0h	USB_A Clock Enable bit: 0: Module clock is gated-off 1: Module clock is turned-on Reset type: SYSRSn
15-2	RESERVED	R=0	0h	Reserved
1	McBSP_B	R/W	0h	McBSP_B Clock Enable bit: 0: Module clock is gated-off 1: Module clock is turned-on Reset type: SYSRSn
0	McBSP_A	R/W	0h	McBSP_A Clock Enable bit: 0: Module clock is gated-off 1: Module clock is turned-on Reset type: SYSRSn

**2.15.11.16 PCLKCR12 Register (Offset = 3Ah) [reset = 0h]**

PCLKCR12 is shown in [Figure 2-152](#) and described in [Table 2-165](#).

Return to [Summary Table](#).

Peripheral Clock Gating Registers

**Figure 2-152. PCLKCR12 Register**

31	30	29	28	27	26	25	24
RESERVED							
R=0-0h							
23	22	21	20	19	18	17	16
RESERVED							
R=0-0h							
15	14	13	12	11	10	9	8
RESERVED							
R=0-0h							
7	6	5	4	3	2	1	0
RESERVED						RESERVED	uPP_A
R=0-0h						R-0h	R/W-0h

**Table 2-165. PCLKCR12 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R=0	0h	Reserved
15-2	RESERVED	R=0	0h	Reserved
1	RESERVED	R	0h	Reserved
0	uPP_A	R/W	0h	uPP_A Clock Enable bit: 0: Module clock is gated-off 1: Module clock is turned-on  Notes: [1] This bit also affects the uPP message RAM wrapper associated with the respective uPP module Reset type: SYSRSn



**2.15.11.17 PCLKCR13 Register (Offset = 3Ch) [reset = 0h]**

PCLKCR13 is shown in [Figure 2-153](#) and described in [Table 2-166](#).

Return to [Summary Table](#).

Peripheral Clock Gating Registers

**Figure 2-153. PCLKCR13 Register**

31	30	29	28	27	26	25	24
RESERVED							
R=0-0h							
23	22	21	20	19	18	17	16
RESERVED							
R=0-0h							
15	14	13	12	11	10	9	8
RESERVED							
R=0-0h							
7	6	5	4	3	2	1	0
RESERVED				ADC_D	ADC_C	ADC_B	ADC_A
R=0-0h				R/W-0h	R/W-0h	R/W-0h	R/W-0h

**Table 2-166. PCLKCR13 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R=0	0h	Reserved
15-4	RESERVED	R=0	0h	Reserved
3	ADC_D	R/W	0h	ADC_D Clock Enable bit: 0: Module clock is gated-off 1: Module clock is turned-on Reset type: SYSRSn
2	ADC_C	R/W	0h	ADC_C Clock Enable bit: 0: Module clock is gated-off 1: Module clock is turned-on Reset type: SYSRSn
1	ADC_B	R/W	0h	ADC_B Clock Enable bit: 0: Module clock is gated-off 1: Module clock is turned-on Reset type: SYSRSn
0	ADC_A	R/W	0h	ADC_A Clock Enable bit: 0: Module clock is gated-off 1: Module clock is turned-on Reset type: SYSRSn

**2.15.11.18 PCLKCR14 Register (Offset = 3Eh) [reset = 0h]**

PCLKCR14 is shown in [Figure 2-154](#) and described in [Table 2-167](#).

Return to [Summary Table](#).

Peripheral Clock Gating Registers

**Figure 2-154. PCLKCR14 Register**

31	30	29	28	27	26	25	24
RESERVED							
R=0-0h							
23	22	21	20	19	18	17	16
RESERVED							
R=0-0h							
15	14	13	12	11	10	9	8
RESERVED							
R=0-0h							
7	6	5	4	3	2	1	0
CMPSS8	CMPSS7	CMPSS6	CMPSS5	CMPSS4	CMPSS3	CMPSS2	CMPSS1
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h

**Table 2-167. PCLKCR14 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R=0	0h	Reserved
15-8	RESERVED	R=0	0h	Reserved
7	CMPSS8	R/W	0h	CMPSS8 Clock Enable bit: 0: Module clock is gated-off 1: Module clock is turned-on Reset type: SYSRSn
6	CMPSS7	R/W	0h	CMPSS7 Clock Enable bit: 0: Module clock is gated-off 1: Module clock is turned-on Reset type: SYSRSn
5	CMPSS6	R/W	0h	CMPSS6 Clock Enable bit: 0: Module clock is gated-off 1: Module clock is turned-on Reset type: SYSRSn
4	CMPSS5	R/W	0h	CMPSS5 Clock Enable bit: 0: Module clock is gated-off 1: Module clock is turned-on Reset type: SYSRSn
3	CMPSS4	R/W	0h	CMPSS4 Clock Enable bit: 0: Module clock is gated-off 1: Module clock is turned-on Reset type: SYSRSn
2	CMPSS3	R/W	0h	CMPSS3 Clock Enable bit: 0: Module clock is gated-off 1: Module clock is turned-on Reset type: SYSRSn

**Table 2-167. PCLKCR14 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
1	CMPSS2	R/W	0h	CMPSS2 Clock Enable bit: 0: Module clock is gated-off 1: Module clock is turned-on Reset type: SYSRSn
0	CMPSS1	R/W	0h	CMPSS1 Clock Enable bit: 0: Module clock is gated-off 1: Module clock is turned-on Reset type: SYSRSn

**2.15.11.19 PCLKCR16 Register (Offset = 42h) [reset = 0h]**

PCLKCR16 is shown in [Figure 2-155](#) and described in [Table 2-168](#).

Return to [Summary Table](#).

Peripheral Clock Gating Registers

**Figure 2-155. PCLKCR16 Register**

31	30	29	28	27	26	25	24
RESERVED							
R=0-0h							
23	22	21	20	19	18	17	16
RESERVED				RESERVED	DAC_C	DAC_B	DAC_A
R=0-0h				R-0h	R/W-0h	R/W-0h	R/W-0h
15	14	13	12	11	10	9	8
RESERVED							
R=0-0h							
7	6	5	4	3	2	1	0
RESERVED				RESERVED	RESERVED	RESERVED	RESERVED
R=0-0h				R-0h	R-0h	R-0h	R-0h

**Table 2-168. PCLKCR16 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-20	RESERVED	R=0	0h	Reserved
19	RESERVED	R	0h	Reserved
18	DAC_C	R/W	0h	Buffered_DAC_C Clock Enable Bit: 0: Module clock is gated-off 1: Module clock is turned-on Reset type: SYSRSn
17	DAC_B	R/W	0h	Buffered_DAC_B Clock Enable Bit: 0: Module clock is gated-off 1: Module clock is turned-on Reset type: SYSRSn
16	DAC_A	R/W	0h	Buffered_DAC_A Clock Enable Bit: 0: Module clock is gated-off 1: Module clock is turned-on Reset type: SYSRSn
15-4	RESERVED	R=0	0h	Reserved
3	RESERVED	R	0h	Reserved
2	RESERVED	R	0h	Reserved
1	RESERVED	R	0h	Reserved
0	RESERVED	R	0h	Reserved

### 2.15.11.20 SECMSEL\_1 Register (Offset = 74h) [reset = 0h]

SECMSEL\_1 is shown in [Figure 2-156](#) and described in [Table 2-169](#).

Return to [Summary Table](#).

Secondary Master Select register for common peripherals: Selects between CLA & DMA

**Figure 2-156. SECMSEL\_1 Register**

31	30	29	28	27	26	25	24
RESERVED							
R=0-0h							
23	22	21	20	19	18	17	16
RESERVED							
R=0-0h							
15	14	13	12	11	10	9	8
RESERVED		RESERVED		RESERVED		RESERVED	
R=0-0h		R-0h		R-0h		R-0h	
7	6	5	4	3	2	1	0
RESERVED		RESERVED		PF2SEL		PF1SEL	
R-0h		R-0h		R/W-0h		R/W-0h	

**Table 2-169. SECMSEL\_1 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R=0	0h	Reserved
15-14	RESERVED	R=0	0h	Reserved
13-12	RESERVED	R	0h	Reserved
11-10	RESERVED	R	0h	Reserved
9-8	RESERVED	R	0h	Reserved
7-6	RESERVED	R	0h	Reserved
5-4	RESERVED	R	0h	Reserved
3-2	PF2SEL	R/W	0h	This bit selects whether the dual ported bridge is connected with DMA or CLA as the secondary master (C28x is always connected as primary master)  x0: Bridge is connected to CLA x1: Bridge is connected to DMA Reset type: SYSRSn
1-0	PF1SEL	R/W	0h	This bit selects whether the dual ported bridge is connected with DMA or CLA as the secondary master (C28x is always connected as primary master)  x0: Bridge is connected to CLA x1: Bridge is connected to DMA Reset type: SYSRSn

**2.15.11.21 LPMCR Register (Offset = 76h) [reset = FCh]**

LPMCR is shown in [Figure 2-157](#) and described in [Table 2-170](#).

Return to [Summary Table](#).

LPM Control Register

**Figure 2-157. LPMCR Register**

31	30	29	28	27	26	25	24
IOISODIS	RESERVED						
R/W=1-0h				R=0-0h			
23	22	21	20	19	18	17	16
RESERVED						M0M1MODE	
R=0-0h						R/W-0h	
15	14	13	12	11	10	9	8
WDINTE	RESERVED						
R/W-0h				R=0-0h			
7	6	5	4	3	2	1	0
QUALSTDBY						LPM	
R/W-3Fh						R/W-0h	

**Table 2-170. LPMCR Register Field Descriptions**

Bit	Field	Type	Reset	Description
31	IOISODIS	R/W=1	0h	0: Indicates IO ISOLATION is not turned ON 1: Indicates IO ISOLATION is turned ON. This bit is set one by hardware ONLY during HIB. This bit cant be set to 1 by software  Writing 0 to this bit has not effect. Writing 1 to this bit deactivates IO ISOLATION Reset type: raw-XRSn
30-18	RESERVED	R=0	0h	Reserved
17-16	M0M1MODE	R/W	0h	These bit control the state of M0 & M1 memories when Device goes into HIB mode.  00: M0 & M1 memories ON with low-leakage mode 01: M0 & M1 memories OFF 1x: Reserved  Notes: [1] Low-leakage mode for M0 & M1 memories uses the "Retention" feature of the SRAMs.  [2] These bits take effect only when device goes into HIB mode. If the device is not in HIB mode, the value in this bit doesn't control the state of the M0 & M1 memories Reset type: PORn
15	WDINTE	R/W	0h	When this bit is set to 1, it enables the watchdog interrupt signal to wake the device from STANDBY mode.  Note: [1] To use this signal, the user must also enable the WDINTn signal using the WDENINT bit in the SCSR register. This signal will not wake the device from HALT mode because the clock to watchdog module is turned off Reset type: SYSRSn
14-8	RESERVED	R=0	0h	Reserved

**Table 2-170. LPMCR Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
7-2	QUALSTDBY	R/W	3Fh	<p>Select number of OSCCLK clock cycles to qualify the selected inputs when waking the from STANDBY mode:</p> <p>000000 = 2 OSCCLKs            000001 = 3 OSCCLKs            .....            111111 = 65 OSCCLKs</p> <p>Note: The LPMCR.QUALSTDBY register should be set to a value greater than the ratio of INTOSC1/PLLSYSCLK to ensure proper wake up.            Reset type: SYSRSn</p>
1-0	LPM	R/W	0h	<p>These bits set the low power mode for the device. Takes effect when CPU executes the IDLE instruction (when IDLE instruction is out of EXE Phase of the Pipeline)</p> <p>00: IDLE Mode            01: STANDBY Mode            10: HALT Mode            11: HIB Mode            Reset type: SYSRSn</p>

**2.15.11.22 GPIO\_LPMSEL0 Register (Offset = 78h) [reset = 0h]**

GPIO\_LPMSEL0 is shown in [Figure 2-158](#) and described in [Table 2-171](#).

Return to [Summary Table](#).

GPIO LPM Wakeup select registers

Connects the selected pin to the LPM circuit. Refer to LPM section of the TRM for the wakeup capabilities of the selected pin.

**Figure 2-158. GPIO\_LPMSEL0 Register**

31		30		29		28		27		26		25		24	
GPIO31	GPIO30	GPIO29	GPIO28	GPIO27	GPIO26	GPIO25	GPIO24	GPIO23	GPIO22	GPIO21	GPIO20	GPIO19	GPIO18	GPIO17	GPIO16
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
23		22		21		20		19		18		17		16	
GPIO23	GPIO22	GPIO21	GPIO20	GPIO19	GPIO18	GPIO17	GPIO16	GPIO15	GPIO14	GPIO13	GPIO12	GPIO11	GPIO10	GPIO9	GPIO8
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
15		14		13		12		11		10		9		8	
GPIO15	GPIO14	GPIO13	GPIO12	GPIO11	GPIO10	GPIO9	GPIO8	GPIO7	GPIO6	GPIO5	GPIO4	GPIO3	GPIO2	GPIO1	GPIO0
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
7		6		5		4		3		2		1		0	
GPIO7	GPIO6	GPIO5	GPIO4	GPIO3	GPIO2	GPIO1	GPIO0	GPIO7	GPIO6	GPIO5	GPIO4	GPIO3	GPIO2	GPIO1	GPIO0
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h

**Table 2-171. GPIO\_LPMSEL0 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31	GPIO31	R/W	0h	0 pin is dis-connected from LPM circuit 1 pin is connected to LPM circuit Reset type: SYSRSn
30	GPIO30	R/W	0h	0 pin is dis-connected from LPM circuit 1 pin is connected to LPM circuit Reset type: SYSRSn
29	GPIO29	R/W	0h	0 pin is dis-connected from LPM circuit 1 pin is connected to LPM circuit Reset type: SYSRSn
28	GPIO28	R/W	0h	0 pin is dis-connected from LPM circuit 1 pin is connected to LPM circuit Reset type: SYSRSn
27	GPIO27	R/W	0h	0 pin is dis-connected from LPM circuit 1 pin is connected to LPM circuit Reset type: SYSRSn
26	GPIO26	R/W	0h	0 pin is dis-connected from LPM circuit 1 pin is connected to LPM circuit Reset type: SYSRSn
25	GPIO25	R/W	0h	0 pin is dis-connected from LPM circuit 1 pin is connected to LPM circuit Reset type: SYSRSn
24	GPIO24	R/W	0h	0 pin is dis-connected from LPM circuit 1 pin is connected to LPM circuit Reset type: SYSRSn



**Table 2-171. GPIO\_LPMSEL0 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
23	GPIO23	R/W	0h	0 pin is dis-connected from LPM circuit 1 pin is connected to LPM circuit Reset type: SYSRSn
22	GPIO22	R/W	0h	0 pin is dis-connected from LPM circuit 1 pin is connected to LPM circuit Reset type: SYSRSn
21	GPIO21	R/W	0h	0 pin is dis-connected from LPM circuit 1 pin is connected to LPM circuit Reset type: SYSRSn
20	GPIO20	R/W	0h	0 pin is dis-connected from LPM circuit 1 pin is connected to LPM circuit Reset type: SYSRSn
19	GPIO19	R/W	0h	0 pin is dis-connected from LPM circuit 1 pin is connected to LPM circuit Reset type: SYSRSn
18	GPIO18	R/W	0h	0 pin is dis-connected from LPM circuit 1 pin is connected to LPM circuit Reset type: SYSRSn
17	GPIO17	R/W	0h	0 pin is dis-connected from LPM circuit 1 pin is connected to LPM circuit Reset type: SYSRSn
16	GPIO16	R/W	0h	0 pin is dis-connected from LPM circuit 1 pin is connected to LPM circuit Reset type: SYSRSn
15	GPIO15	R/W	0h	0 pin is dis-connected from LPM circuit 1 pin is connected to LPM circuit Reset type: SYSRSn
14	GPIO14	R/W	0h	0 pin is dis-connected from LPM circuit 1 pin is connected to LPM circuit Reset type: SYSRSn
13	GPIO13	R/W	0h	0 pin is dis-connected from LPM circuit 1 pin is connected to LPM circuit Reset type: SYSRSn
12	GPIO12	R/W	0h	0 pin is dis-connected from LPM circuit 1 pin is connected to LPM circuit Reset type: SYSRSn
11	GPIO11	R/W	0h	0 pin is dis-connected from LPM circuit 1 pin is connected to LPM circuit Reset type: SYSRSn
10	GPIO10	R/W	0h	0 pin is dis-connected from LPM circuit 1 pin is connected to LPM circuit Reset type: SYSRSn
9	GPIO9	R/W	0h	0 pin is dis-connected from LPM circuit 1 pin is connected to LPM circuit Reset type: SYSRSn
8	GPIO8	R/W	0h	0 pin is dis-connected from LPM circuit 1 pin is connected to LPM circuit Reset type: SYSRSn

**Table 2-171. GPIO\_LPMSEL0 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
7	GPIO7	R/W	0h	0 pin is dis-connected from LPM circuit 1 pin is connected to LPM circuit Reset type: SYSRSn
6	GPIO6	R/W	0h	0 pin is dis-connected from LPM circuit 1 pin is connected to LPM circuit Reset type: SYSRSn
5	GPIO5	R/W	0h	0 pin is dis-connected from LPM circuit 1 pin is connected to LPM circuit Reset type: SYSRSn
4	GPIO4	R/W	0h	0 pin is dis-connected from LPM circuit 1 pin is connected to LPM circuit Reset type: SYSRSn
3	GPIO3	R/W	0h	0 pin is dis-connected from LPM circuit 1 pin is connected to LPM circuit Reset type: SYSRSn
2	GPIO2	R/W	0h	0 pin is dis-connected from LPM circuit 1 pin is connected to LPM circuit Reset type: SYSRSn
1	GPIO1	R/W	0h	0 pin is dis-connected from LPM circuit 1 pin is connected to LPM circuit Reset type: SYSRSn
0	GPIO0	R/W	0h	0 pin is dis-connected from LPM circuit 1 pin is connected to LPM circuit Reset type: SYSRSn

### 2.15.11.23 GPIO\_LPMSEL1 Register (Offset = 7Ah) [reset = 0h]

GPIO\_LPMSEL1 is shown in [Figure 2-159](#) and described in [Table 2-172](#).

Return to [Summary Table](#).

GPIO LPM Wakeup select registers

Connects the selected pin to the LPM circuit. Refer to LPM section of the TRM for the wakeup capabilities of the selected pin.

**Figure 2-159. GPIO\_LPMSEL1 Register**

31		30		29		28		27		26		25		24	
GPIO63	GPIO62	GPIO61	GPIO60	GPIO59	GPIO58	GPIO57	GPIO56	GPIO55	GPIO54	GPIO53	GPIO52	GPIO51	GPIO50	GPIO49	GPIO48
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
23		22		21		20		19		18		17		16	
GPIO47	GPIO46	GPIO45	GPIO44	GPIO43	GPIO42	GPIO41	GPIO40	GPIO39	GPIO38	GPIO37	GPIO36	GPIO35	GPIO34	GPIO33	GPIO32
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
15		14		13		12		11		10		9		8	
GPIO7	GPIO6	GPIO5	GPIO4	GPIO3	GPIO2	GPIO1	GPIO0	GPIO39	GPIO38	GPIO37	GPIO36	GPIO35	GPIO34	GPIO33	GPIO32
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h

**Table 2-172. GPIO\_LPMSEL1 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31	GPIO63	R/W	0h	0 pin is dis-connected from LPM circuit 1 pin is connected to LPM circuit Reset type: SYSRSn
30	GPIO62	R/W	0h	0 pin is dis-connected from LPM circuit 1 pin is connected to LPM circuit Reset type: SYSRSn
29	GPIO61	R/W	0h	0 pin is dis-connected from LPM circuit 1 pin is connected to LPM circuit Reset type: SYSRSn
28	GPIO60	R/W	0h	0 pin is dis-connected from LPM circuit 1 pin is connected to LPM circuit Reset type: SYSRSn
27	GPIO59	R/W	0h	0 pin is dis-connected from LPM circuit 1 pin is connected to LPM circuit Reset type: SYSRSn
26	GPIO58	R/W	0h	0 pin is dis-connected from LPM circuit 1 pin is connected to LPM circuit Reset type: SYSRSn
25	GPIO57	R/W	0h	0 pin is dis-connected from LPM circuit 1 pin is connected to LPM circuit Reset type: SYSRSn
24	GPIO56	R/W	0h	0 pin is dis-connected from LPM circuit 1 pin is connected to LPM circuit Reset type: SYSRSn

**Table 2-172. GPIOLPMSEL1 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
23	GPIO55	R/W	0h	0 pin is dis-connected from LPM circuit 1 pin is connected to LPM circuit Reset type: SYSRSn
22	GPIO54	R/W	0h	0 pin is dis-connected from LPM circuit 1 pin is connected to LPM circuit Reset type: SYSRSn
21	GPIO53	R/W	0h	0 pin is dis-connected from LPM circuit 1 pin is connected to LPM circuit Reset type: SYSRSn
20	GPIO52	R/W	0h	0 pin is dis-connected from LPM circuit 1 pin is connected to LPM circuit Reset type: SYSRSn
19	GPIO51	R/W	0h	0 pin is dis-connected from LPM circuit 1 pin is connected to LPM circuit Reset type: SYSRSn
18	GPIO50	R/W	0h	0 pin is dis-connected from LPM circuit 1 pin is connected to LPM circuit Reset type: SYSRSn
17	GPIO49	R/W	0h	0 pin is dis-connected from LPM circuit 1 pin is connected to LPM circuit Reset type: SYSRSn
16	GPIO48	R/W	0h	0 pin is dis-connected from LPM circuit 1 pin is connected to LPM circuit Reset type: SYSRSn
15	GPIO47	R/W	0h	0 pin is dis-connected from LPM circuit 1 pin is connected to LPM circuit Reset type: SYSRSn
14	GPIO46	R/W	0h	0 pin is dis-connected from LPM circuit 1 pin is connected to LPM circuit Reset type: SYSRSn
13	GPIO45	R/W	0h	0 pin is dis-connected from LPM circuit 1 pin is connected to LPM circuit Reset type: SYSRSn
12	GPIO44	R/W	0h	0 pin is dis-connected from LPM circuit 1 pin is connected to LPM circuit Reset type: SYSRSn
11	GPIO43	R/W	0h	0 pin is dis-connected from LPM circuit 1 pin is connected to LPM circuit Reset type: SYSRSn
10	GPIO42	R/W	0h	0 pin is dis-connected from LPM circuit 1 pin is connected to LPM circuit Reset type: SYSRSn
9	GPIO41	R/W	0h	0 pin is dis-connected from LPM circuit 1 pin is connected to LPM circuit Reset type: SYSRSn
8	GPIO40	R/W	0h	0 pin is dis-connected from LPM circuit 1 pin is connected to LPM circuit Reset type: SYSRSn

**Table 2-172. GPIO\_LPMSEL1 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
7	GPIO39	R/W	0h	0 pin is dis-connected from LPM circuit 1 pin is connected to LPM circuit Reset type: SYSRSn
6	GPIO38	R/W	0h	0 pin is dis-connected from LPM circuit 1 pin is connected to LPM circuit Reset type: SYSRSn
5	GPIO37	R/W	0h	0 pin is dis-connected from LPM circuit 1 pin is connected to LPM circuit Reset type: SYSRSn
4	GPIO36	R/W	0h	0 pin is dis-connected from LPM circuit 1 pin is connected to LPM circuit Reset type: SYSRSn
3	GPIO35	R/W	0h	0 pin is dis-connected from LPM circuit 1 pin is connected to LPM circuit Reset type: SYSRSn
2	GPIO34	R/W	0h	0 pin is dis-connected from LPM circuit 1 pin is connected to LPM circuit Reset type: SYSRSn
1	GPIO33	R/W	0h	0 pin is dis-connected from LPM circuit 1 pin is connected to LPM circuit Reset type: SYSRSn
0	GPIO32	R/W	0h	0 pin is dis-connected from LPM circuit 1 pin is connected to LPM circuit Reset type: SYSRSn

**2.15.11.24 TMR2CLKCTL Register (Offset = 7Ch) [reset = 0h]**

TMR2CLKCTL is shown in [Figure 2-160](#) and described in [Table 2-173](#).

Return to [Summary Table](#).

Timer2 Clock Measurement functionality control register

**Figure 2-160. TMR2CLKCTL Register**

31	30	29	28	27	26	25	24
RESERVED							
R=0-0h							
23	22	21	20	19	18	17	16
RESERVED							
R=0-0h							
15	14	13	12	11	10	9	8
RESERVED							
R=0-0h							
7	6	5	4	3	2	1	0
RESERVED		TMR2CLKPRESCALE			TMR2CLKSRCSEL		
R=0-0h		R/W-0h			R/W-0h		

**Table 2-173. TMR2CLKCTL Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R=0	0h	Reserved
15-6	RESERVED	R=0	0h	Reserved
5-3	TMR2CLKPRESCALE	R/W	0h	CPU Timer 2 Clock Pre-Scale Value: These bits select the pre-scale value for the selected clock source for CPU Timer 2: 0,0,0,/1 (default on reset) 0,0,1,/2, 0,1,0,/4 0,1,1,/8 1,0,0,/16 1,0,1,spare (defaults to /16) 1,1,0,spare (defaults to /16) 1,1,1,spare (defaults to /16)  Note: [1] The CPU Timer2s Clock sync logic detects an input clock edge when configured for any clock source other than SYSCLK and generates an appropriate clock pulse to the CPU timer2. If SYSCLK is approximately the same or less then the input clock source, then the user would need to configure the pre-scale value such that SYSCLK is at least twice as fast as the pre-scaled value. Reset type: SYSRSn

**Table 2-173. TMR2CLKCTL Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
2-0	TMR2CLKSRCSEL	R/W	0h	CPU Timer 2 Clock Source Select Bit: This bit selects the source for CPU Timer 2: 000 =SYSCLK Selected (default on reset, pre-scale is bypassed) 001 = INTOSC1 010 = INTOSC2 011 = XTAL 100 = Reserved 101 = Reserved 110 = AUXPLLCLK 111 = reserved Reset type: SYSRSn

**2.15.11.25 RESC Register (Offset = 80h) [reset = X]**

 RESC is shown in [Figure 2-161](#) and described in [Table 2-174](#).

 Return to [Summary Table](#).

Reset Cause register

**Figure 2-161. RESC Register**

31	30	29	28	27	26	25	24
TRSTn_pin_status	XRSn_pin_status	RESERVED					
R-X	R-X	R=0-0h					
23	22	21	20	19	18	17	16
RESERVED							
R=0-0h							
15	14	13	12	11	10	9	8
RESERVED							SCCRESETn
R=0-0h							R/W=1-0h
7	6	5	4	3	2	1	0
RESERVED	HIBRESETn	HWBISTn	RESERVED	NMIWDRSn	WDRSn	XRSn	POR
R=0-0h	R/W=1-0h	R/W=1-0h	R=0-0h	R/W=1-0h	R/W=1-0h	R/W=1-1h	R/W=1-1h

**Table 2-174. RESC Register Field Descriptions**

Bit	Field	Type	Reset	Description
31	TRSTn_pin_status	R	X	Reading this bit provides the current status of TRSTn at the respective C28x CPUs TRSTn input port. Reset value is reflective of the pin status. Reset type: N/A
30	XRSn_pin_status	R	X	Reading this bit provides the current status of the XRSn pin. Reset value is reflective of the pin status. Reset type: N/A
29-16	RESERVED	R=0	0h	Reserved
15-9	RESERVED	R=0	0h	Reserved
8	SCCRESETn	R/W=1	0h	If this bit is set, indicates that the device was reset by SCCRESETn (fired by DCSM).  Writing a 1 to this bit will force the bit to 0 Writing of 0 will have no effect. Reset type: PORn
7	RESERVED	R=0	0h	Reserved
6	HIBRESETn	R/W=1	0h	If this bit is set, indicates that the device was reset due to a Hibernate mode Wakeup.  Writing a 1 to this bit will force the bit to 0 Writing of 0 will have no effect. Reset type: raw-XRSn
5	HWBISTn	R/W=1	0h	If this bit is set, indicates that the device was reset by HWBIST.  Writing a 1 to this bit will force the bit to 0 Writing of 0 will have no effect. Reset type: PORn
4	RESERVED	R=0	0h	Reserved



**Table 2-174. RESC Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
3	NMIWDRSn	R/W=1	0h	<p>If this bit is set, indicates that the device was reset by NMIWDRSn.</p> <p>Writing a 1 to this bit will force the bit to 0 Writing of 0 will have no effect.</p> <p>To know the exact cause of NMI after the reset, software needs to read CPU1/2.NMISHDFLG registers Reset type: PORn</p>
2	WDRSn	R/W=1	0h	<p>If this bit is set, indicates that the device was reset by WDRSn.</p> <p>Writing a 1 to this bit will force the bit to 0 Writing of 0 will have no effect.</p> <p>Reset type: PORn</p>
1	XRSn	R/W=1	1h	<p>If this bit is set, indicates that the device was reset by XRSn.</p> <p>Writing a 1 to this bit will force the bit to 0 Writing of 0 will have no effect.</p> <p>Reset type: PORn</p>
0	POR	R/W=1	1h	<p>If this bit is set, indicates that the device was reset by PORn.</p> <p>Writing a 1 to this bit will force the bit to 0 Writing of 0 will have no effect.</p> <p>Reset type: PORn</p>

### 2.15.12 ROM\_PREFETCH\_REGS Registers

Table 2-175 lists the memory-mapped registers for the ROM\_PREFETCH\_REGS. All register offset addresses not listed in Table 2-175 should be considered as reserved locations and the register contents should not be modified.

**Table 2-175. ROM\_PREFETCH\_REGS Registers**

Offset	Acronym	Register Name	Write Protection	Section
0h	ROM_PREFETCH	ROM Prefetch Configuration Register	EALLOW	<a href="#">Go</a>

Complex bit access types are encoded to fit into small table cells. Table 2-176 shows the codes that are used for access types in this section.

**Table 2-176. ROM\_PREFETCH\_REGS Access Type Codes**

Access Type	Code	Description
<b>Read Type</b>		
R	R	Read
<b>Write Type</b>		
W	W	Write
<b>Reset or Default Value</b>		
-n		Value after reset or the default value
<b>Register Array Variables</b>		
i,j,k,l,m,n		When these variables are used in a register name, an offset, or an address, they refer to the value of a register array where the register is part of a group of repeating registers. The register groups form a hierarchical structure and the array is represented with a formula.
y		When this variable is used in a register name, an offset, or an address it refers to the value of a register array.

**2.15.12.1 ROMPREFETCH Register (Offset = 0h) [reset = 0h]**

ROMPREFETCH is shown in [Figure 2-162](#) and described in [Table 2-177](#).

Return to [Summary Table](#).

ROM Prefetch Configuration Register

**Figure 2-162. ROMPREFETCH Register**

31	30	29	28	27	26	25	24
RESERVED							
R-0h							
23	22	21	20	19	18	17	16
RESERVED							
R-0h							
15	14	13	12	11	10	9	8
RESERVED							
R-0h							
7	6	5	4	3	2	1	0
RESERVED							PFENABLE
R-0h							R/W-0h

**Table 2-177. ROMPREFETCH Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R	0h	Reserved
15-1	RESERVED	R	0h	Reserved
0	PFENABLE	R/W	0h	0: Prefetch is disabled for secure ROM and boot ROM. 1: Prefetch is enabled for secure ROM and boot ROM. Reset type: SYSRSn

### 2.15.13 DCSM\_COMMON\_REGS Registers

Table 2-178 lists the memory-mapped registers for the DCSM\_COMMON\_REGS. All register offset addresses not listed in Table 2-178 should be considered as reserved locations and the register contents should not be modified.

**Table 2-178. DCSM\_COMMON\_REGS Registers**

Offset	Acronym	Register Name	Write Protection	Section
0h	FLSEM	Flash Wrapper Semaphore Register		<a href="#">Go</a>
2h	SECTSTAT	Sectors Status Register		<a href="#">Go</a>
4h	RAMSTAT	RAM Status Register		<a href="#">Go</a>

Complex bit access types are encoded to fit into small table cells. Table 2-179 shows the codes that are used for access types in this section.

**Table 2-179. DCSM\_COMMON\_REGS Access Type Codes**

Access Type	Code	Description
<b>Read Type</b>		
R	R	Read
R=0	R	Read
<b>Write Type</b>		
W	W	Write
<b>Reset or Default Value</b>		
-n		Value after reset or the default value
<b>Register Array Variables</b>		
i,j,k,l,m,n		When these variables are used in a register name, an offset, or an address, they refer to the value of a register array where the register is part of a group of repeating registers. The register groups form a hierarchical structure and the array is represented with a formula.
y		When this variable is used in a register name, an offset, or an address it refers to the value of a register array.

**2.15.13.1 FLSEM Register (Offset = 0h) [reset = 0h]**

FLSEM is shown in [Figure 2-163](#) and described in [Table 2-180](#).

Return to [Summary Table](#).

Flash Wrapper Semaphore Register

**Figure 2-163. FLSEM Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
RESERVED															
R-0h															
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
KEY								RESERVED						SEM	
R=0/W-0h								R-0h						R/W-0h	

**Table 2-180. FLSEM Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R	0h	Reserved
15-8	KEY	R=0/W	0h	Writing a value 0xA5 into this field will allow the writing of the SEM bits, else writes are ignored. Reads will return 0. Reset type: SYSRSn
7-2	RESERVED	R	0h	Reserved
1-0	SEM	R/W	0h	00 : C28X Flash Wrapper registers can be written by code running from non-secure zone. 01 : Flash Wrapper registers can be written by code running from Zone1 security zone only. User must set this value to perform flash operation on flash sectors of Zone1. 10 : C28X Flash Wrapper registers can be written by code running from Zone2 security zone only. User must set this value to perform flash operation on flash sectors of Zone2. 11 : C28X Flash Wrapper registers can be written by code running from non-secure zone.  Allowed State Transitions in this field. 00 to 11 : Code running from anywhere. 11 to 00 : Not allowed. 00/11 to 01 : Code running from Zone1 only can perform this transition. 01 to 00/11 : Code running from Zone1 only can perform this transition. 00/11 to 10 : Code running from Zone2 only can perform this transition. 10 to 00/11 : Code running from Zone2 can perform this transition Reset type: SYSRSn

**2.15.13.2 SECTSTAT Register (Offset = 2h) [reset = 0h]**

SECTSTAT is shown in [Figure 2-164](#) and described in [Table 2-181](#).

Return to [Summary Table](#).

Sectors Status Register

**Figure 2-164. SECTSTAT Register**

31	30	29	28	27	26	25	24
RESERVED		STATUS_BANK1		STATUS_SECTN		STATUS_SECTM	
R-0h		R-0h		R-0h		R-0h	
23	22	21	20	19	18	17	16
STATUS_SECTL		STATUS_SECTK		STATUS_SECTJ		STATUS_SECTI	
R-0h		R-0h		R-0h		R-0h	
15	14	13	12	11	10	9	8
STATUS_SECTH		STATUS_SECTG		STATUS_SECTF		STATUS_SECTE	
R-0h		R-0h		R-0h		R-0h	
7	6	5	4	3	2	1	0
STATUS_SECTD		STATUS_SECTC		STATUS_SECTB		STATUS_SECTA	
R-0h		R-0h		R-0h		R-0h	

**Table 2-181. SECTSTAT Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-30	RESERVED	R	0h	Reserved
29-28	STATUS_BANK1	R	0h	Reflects the status of flash BANK1.  00 : Sector is in-accessible 01 : Sector belongs to Zone1. 10 : Sector belongs to Zone2. 11: Sector is un-secure and code running in both zone have full access to it. Reset type: SYSRSn
27-26	STATUS_SECTN	R	0h	Reflects the status of flash sector N.  00 : Sector is in-accessible 01 : Sector belongs to Zone1. 10 : Sector belongs to Zone2. 11: Sector is un-secure and code running in both zone have full access to it. Reset type: SYSRSn
25-24	STATUS_SECTM	R	0h	Reflects the status of flash sector M.  00 : Sector is in-accessible 01 : Sector belongs to Zone1. 10 : Sector belongs to Zone2. 11: Sector is un-secure and code running in both zone have full access to it. Reset type: SYSRSn
23-22	STATUS_SECTL	R	0h	Reflects the status of flash sector L.  00 : Sector is in-accessible 01 : Sector belongs to Zone1. 10 : Sector belongs to Zone2. 11: Sector is un-secure and code running in both zone have full access to it. Reset type: SYSRSn

**Table 2-181. SECTSTAT Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
21-20	STATUS_SECTK	R	0h	Reflects the status of flash sector K.  00 : Sector is in-accessible 01 : Sector belongs to Zone1. 10 : Sector belongs to Zone2. 11: Sector is un-secure and code running in both zone have full access to it. Reset type: SYSRSn
19-18	STATUS_SECTJ	R	0h	Reflects the status of flash sector J.  00 : Sector is in-accessible 01 : Sector belongs to Zone1. 10 : Sector belongs to Zone2. 11: Sector is un-secure and code running in both zone have full access to it. Reset type: SYSRSn
17-16	STATUS_SECTI	R	0h	Reflects the status of flash sector I.  00 : Sector is in-accessible 01 : Sector belongs to Zone1. 10 : Sector belongs to Zone2. 11: Sector is un-secure and code running in both zone have full access to it. Reset type: SYSRSn
15-14	STATUS_SECTH	R	0h	Reflects the status of flash sector H.  00 : Sector is in-accessible 01 : Sector belongs to Zone1. 10 : Sector belongs to Zone2. 11: Sector is un-secure and code running in both zone have full access to it. Reset type: SYSRSn
13-12	STATUS_SECTG	R	0h	Reflects the status of flash sector G.  00 : Sector is in-accessible 01 : Sector belongs to Zone1. 10 : Sector belongs to Zone2. 11: Sector is un-secure and code running in both zone have full access to it. Reset type: SYSRSn
11-10	STATUS_SECTF	R	0h	Reflects the status of flash sector F.  00 : Sector is in-accessible 01 : Sector belongs to Zone1. 10 : Sector belongs to Zone2. 11: Sector is un-secure and code running in both zone have full access to it. Reset type: SYSRSn
9-8	STATUS_SECTE	R	0h	Reflects the status of flash sector E.  00 : Sector is in-accessible 01 : Sector belongs to Zone1. 10 : Sector belongs to Zone2. 11: Sector is un-secure and code running in both zone have full access to it. Reset type: SYSRSn

**Table 2-181. SECTSTAT Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
7-6	STATUS_SECTD	R	0h	Reflects the status of flash sector D.  00 : Sector is in-accessible 01 : Sector belongs to Zone1. 10 : Sector belongs to Zone2. 11: Sector is un-secure and code running in both zone have full access to it. Reset type: SYSRSn
5-4	STATUS_SECTC	R	0h	Reflects the status of flash sector C.  00 : Sector is in-accessible 01 : Sector belongs to Zone1. 10 : Sector belongs to Zone2. 11: Sector is un-secure and code running in both zone have full access to it. Reset type: SYSRSn
3-2	STATUS_SECTB	R	0h	Reflects the status of flash sector B.  00 : Sector is in-accessible 01 : Sector belongs to Zone1. 10 : Sector belongs to Zone2. 11: Sector is un-secure and code running in both zone have full access to it. Reset type: SYSRSn
1-0	STATUS_SECTA	R	0h	Reflects the status of flash sector A.  00 : Sector is in-accessible 01 : Sector belongs to Zone1. 10 : Sector belongs to Zone2. 11: Sector is un-secure and code running in both zone have full access to it. Reset type: SYSRSn



### 2.15.13.3 RAMSTAT Register (Offset = 4h) [reset = 0h]

RAMSTAT is shown in [Figure 2-165](#) and described in [Table 2-182](#).

Return to [Summary Table](#).

RAM Status Register

**Figure 2-165. RAMSTAT Register**

31	30	29	28	27	26	25	24
RESERVED		STATUS_CLA1		RESERVED			
R-0h		R-0h		R-0h			
23	22	21	20	19	18	17	16
RESERVED							
R-0h							
15	14	13	12	11	10	9	8
STATUS_RAM7		STATUS_RAM6		STATUS_RAM5		STATUS_RAM4	
R-0h		R-0h		R-0h		R-0h	
7	6	5	4	3	2	1	0
STATUS_RAM3		STATUS_RAM2		STATUS_RAM1		STATUS_RAM0	
R-0h		R-0h		R-0h		R-0h	

**Table 2-182. RAMSTAT Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-30	RESERVED	R	0h	Reserved
29-28	STATUS_CLA1	R	0h	Reflects the status of CLA1.  00 : CLA is in-accessible 01 : CLA belongs to Zone1. 10 : CLA belongs to Zone2. 11: CLA is un-secure and code running in both zone have full access to it. Reset type: SYSRSn
27-16	RESERVED	R	0h	Reserved
15-14	STATUS_RAM7	R	0h	Reflects the status of D1 RAM.  00 : RAM is in-accessible 01 : RAM belongs to Zone1. 10 : RAM belongs to Zone2. 11: RAM is un-secure and code running in both zone have full access to it. Reset type: SYSRSn
13-12	STATUS_RAM6	R	0h	Reflects the status of D0 RAM.  00 : RAM is in-accessible 01 : RAM belongs to Zone1. 10 : RAM belongs to Zone2. 11: RAM is un-secure and code running in both zone have full access to it. Reset type: SYSRSn

**Table 2-182. RAMSTAT Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
11-10	STATUS_RAM5	R	0h	Reflects the status of LS5 RAM.  00 : RAM is in-accessible 01 : RAM belongs to Zone1. 10 : RAM belongs to Zone2. 11: RAM is un-secure and code running in both zone have full access to it. Reset type: SYSRSn
9-8	STATUS_RAM4	R	0h	Reflects the status of LS4 RAM.  00 : RAM is in-accessible 01 : RAM belongs to Zone1. 10 : RAM belongs to Zone2. 11: RAM is un-secure and code running in both zone have full access to it. Reset type: SYSRSn
7-6	STATUS_RAM3	R	0h	Reflects the status of LS3 RAM.  00 : RAM is in-accessible 01 : RAM belongs to Zone1. 10 : RAM belongs to Zone2. 11: RAM is un-secure and code running in both zone have full access to it. Reset type: SYSRSn
5-4	STATUS_RAM2	R	0h	Reflects the status of LS2 RAM.  00 : RAM is in-accessible 01 : RAM belongs to Zone1. 10 : RAM belongs to Zone2. 11: RAM is un-secure and code running in both zone have full access to it. Reset type: SYSRSn
3-2	STATUS_RAM1	R	0h	Reflects the status of LS1 RAM.  00 : RAM is in-accessible 01 : RAM belongs to Zone1. 10 : RAM belongs to Zone2. 11: RAM is un-secure and code running in both zone have full access to it. Reset type: SYSRSn
1-0	STATUS_RAM0	R	0h	Reflects the status of LS0 RAM.  00 : RAM is in-accessible 01 : RAM belongs to Zone1. 10 : RAM belongs to Zone2. 11: RAM is un-secure and code running in both zone have full access to it. Reset type: SYSRSn

### 2.15.14 DCSM\_Z1\_OTP Registers

Table 2-183 lists the memory-mapped registers for the DCSM\_Z1\_OTP. All register offset addresses not listed in Table 2-183 should be considered as reserved locations and the register contents should not be modified.

**Table 2-183. DCSM\_Z1\_OTP Registers**

Offset	Acronym	Register Name	Write Protection	Section
0h	Z1OTP_LINKPOINTER1	Zone 1 Link Pointer1 in Z1 OTP		<a href="#">Go</a>
4h	Z1OTP_LINKPOINTER2	Zone 1 Link Pointer2 in Z1 OTP		<a href="#">Go</a>
8h	Z1OTP_LINKPOINTER3	Zone 1 Link Pointer3 in Z1 OTP		<a href="#">Go</a>
10h	Z1OTP_PSWDLOCK	Secure Password Lock in Z1 OTP		<a href="#">Go</a>
14h	Z1OTP_CRCLOCK	Secure CRC Lock in Z1 OTP		<a href="#">Go</a>
1Eh	Z1OTP_BOOTCTRL	Boot Mode in Z1 OTP		<a href="#">Go</a>

Complex bit access types are encoded to fit into small table cells. Table 2-184 shows the codes that are used for access types in this section.

**Table 2-184. DCSM\_Z1\_OTP Access Type Codes**

Access Type	Code	Description
<b>Read Type</b>		
R	R	Read
<b>Reset or Default Value</b>		
-n		Value after reset or the default value
<b>Register Array Variables</b>		
i,j,k,l,m,n		When these variables are used in a register name, an offset, or an address, they refer to the value of a register array where the register is part of a group of repeating registers. The register groups form a hierarchical structure and the array is represented with a formula.
y		When this variable is used in a register name, an offset, or an address it refers to the value of a register array.

**2.15.14.1 Z1OTP\_LINKPOINTER1 Register (Offset = 0h) [reset = FFFFFFFFh]**

Z1OTP\_LINKPOINTER1 is shown in [Figure 2-166](#) and described in [Table 2-185](#).

Return to [Summary Table](#).

Zone 1 Link Pointer1 in Z1 OTP

**Figure 2-166. Z1OTP\_LINKPOINTER1 Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Z1OTP_LINKPOINTER1																															
R-FFFFFFFh																															

**Table 2-185. Z1OTP\_LINKPOINTER1 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-0	Z1OTP_LINKPOINTER1	R	FFFFFFFh	Zone1 Link Pointer 1 location in USER OTP. Reset type: SYSRSn

**2.15.14.2 Z1OTP\_LINKPOINTER2 Register (Offset = 4h) [reset = FFFFFFFFh]**

Z1OTP\_LINKPOINTER2 is shown in [Figure 2-167](#) and described in [Table 2-186](#).

Return to [Summary Table](#).

Zone 1 Link Pointer2 in Z1 OTP

**Figure 2-167. Z1OTP\_LINKPOINTER2 Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Z1OTP_LINKPOINTER2																															
R-FFFFFFFh																															

**Table 2-186. Z1OTP\_LINKPOINTER2 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-0	Z1OTP_LINKPOINTER2	R	FFFFFFFh	Zone1 Link Pointer 2 location in USER OTP. Reset type: SYSRSn

**2.15.14.3 Z1OTP\_LINKPOINTER3 Register (Offset = 8h) [reset = FFFFFFFFh]**

Z1OTP\_LINKPOINTER3 is shown in [Figure 2-168](#) and described in [Table 2-187](#).

Return to [Summary Table](#).

Zone 1 Link Pointer3 in Z1 OTP

**Figure 2-168. Z1OTP\_LINKPOINTER3 Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Z1OTP_LINKPOINTER3																															
R-FFFFFFFh																															

**Table 2-187. Z1OTP\_LINKPOINTER3 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-0	Z1OTP_LINKPOINTER3	R	FFFFFFFh	Zone1 Link Pointer 3 location in USER OTP. Reset type: SYSRSn

**2.15.14.4 Z1OTP\_PSWDLOCK Register (Offset = 10h) [reset = FFFFFFFFh]**

Z1OTP\_PSWDLOCK is shown in [Figure 2-169](#) and described in [Table 2-188](#).

Return to [Summary Table](#).

Secure Password Lock in Z1 OTP

**Figure 2-169. Z1OTP\_PSWDLOCK Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Z1OTP_PSWDLOCK																															
R-FFFFFFFh																															

**Table 2-188. Z1OTP\_PSWDLOCK Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-0	Z1OTP_PSWDLOCK	R	FFFFFFFh	Zone1 password lock location in USER OTP. Reset type: SYSRSn

**2.15.14.5 Z1OTP\_CRCLOCK Register (Offset = 14h) [reset = FFFFFFFFh]**

Z1OTP\_CRCLOCK is shown in [Figure 2-170](#) and described in [Table 2-189](#).

Return to [Summary Table](#).

Secure CRC Lock in Z1 OTP

**Figure 2-170. Z1OTP\_CRCLOCK Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Z1OTP_CRCLOCK																															
R-FFFFFFFh																															

**Table 2-189. Z1OTP\_CRCLOCK Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-0	Z1OTP_CRCLOCK	R	FFFFFFFh	Zone1 CRC lock location in USER OTP. Reset type: SYSRSn



**2.15.14.6 Z1OTP\_BOOTCTRL Register (Offset = 1Eh) [reset = FFFFFFFFh]**

Z1OTP\_BOOTCTRL is shown in [Figure 2-171](#) and described in [Table 2-190](#).

Return to [Summary Table](#).

Boot Mode in Z1 OTP

**Figure 2-171. Z1OTP\_BOOTCTRL Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Z1OTP_BOOTCTRL																															
R-FFFFFFFh																															

**Table 2-190. Z1OTP\_BOOTCTRL Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-0	Z1OTP_BOOTCTRL	R	FFFFFFFh	Zone1 Boot control location in USER OTP. Reset type: SYSRSn

## 2.15.15 DCSM\_Z1\_REGS Registers

Table 2-191 lists the memory-mapped registers for the DCSM\_Z1\_REGS. All register offset addresses not listed in Table 2-191 should be considered as reserved locations and the register contents should not be modified.

**Table 2-191. DCSM\_Z1\_REGS Registers**

Offset	Acronym	Register Name	Write Protection	Section
0h	Z1_LINKPOINTER	Zone 1 Link Pointer		<a href="#">Go</a>
2h	Z1_OTPSECLOCK	Zone 1 OTP Secure JTAG lock		<a href="#">Go</a>
4h	Z1_BOOTCTRL	Boot Mode		<a href="#">Go</a>
6h	Z1_LINKPOINTERERR	Link Pointer Error		<a href="#">Go</a>
10h	Z1_CSMKEY0	Zone 1 CSM Key 0		<a href="#">Go</a>
12h	Z1_CSMKEY1	Zone 1 CSM Key 1		<a href="#">Go</a>
14h	Z1_CSMKEY2	Zone 1 CSM Key 2		<a href="#">Go</a>
16h	Z1_CSMKEY3	Zone 1 CSM Key 3		<a href="#">Go</a>
19h	Z1_CR	Zone 1 CSM Control Register		<a href="#">Go</a>
1Ah	Z1_GRABSECTR	Zone 1 Grab Flash Sectors Register		<a href="#">Go</a>
1Ch	Z1_GRABRAMR	Zone 1 Grab RAM Blocks Register		<a href="#">Go</a>
1Eh	Z1_EXEONLYSECTR	Zone 1 Flash Execute_Only Sector Register		<a href="#">Go</a>
20h	Z1_EXEONLYRAMR	Zone 1 RAM Execute_Only Block Register		<a href="#">Go</a>

Complex bit access types are encoded to fit into small table cells. Table 2-192 shows the codes that are used for access types in this section.

**Table 2-192. DCSM\_Z1\_REGS Access Type Codes**

Access Type	Code	Description
<b>Read Type</b>		
R	R	Read
R=0	R	Read
<b>Write Type</b>		
W	W	Write
<b>Reset or Default Value</b>		
-n		Value after reset or the default value
<b>Register Array Variables</b>		
i,j,k,l,m,n		When these variables are used in a register name, an offset, or an address, they refer to the value of a register array where the register is part of a group of repeating registers. The register groups form a hierarchical structure and the array is represented with a formula.
y		When this variable is used in a register name, an offset, or an address it refers to the value of a register array.

**2.15.15.1 Z1\_LINKPOINTER Register (Offset = 0h) [reset = E000000h]**

Z1\_LINKPOINTER is shown in [Figure 2-172](#) and described in [Table 2-193](#).

Return to [Summary Table](#).

Zone 1 Link Pointer

**Figure 2-172. Z1\_LINKPOINTER Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
RESERVED			LINKPOINTER												
R-7h			R-0h												
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
LINKPOINTER															
R-0h															

**Table 2-193. Z1\_LINKPOINTER Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-29	RESERVED	R	7h	Reserved
28-0	LINKPOINTER	R	0h	This is resolved Link-Pointer value which is generated by looking at the three physical Link-Pointer values loaded from OTP. Reset type: SYSRSn

**2.15.15.2 Z1\_OTPSECLOCK Register (Offset = 2h) [reset = FFFh]**

Z1\_OTPSECLOCK is shown in [Figure 2-173](#) and described in [Table 2-194](#).

Return to [Summary Table](#).

Zone 1 OTP Secure JTAG lock

**Figure 2-173. Z1\_OTPSECLOCK Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
RESERVED															
R-0h															
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
RESERVED				CRCLOCK				PSWDLOCK				RESERVED			
R-0h				R-Fh				R-Fh				R-0h			

**Table 2-194. Z1\_OTPSECLOCK Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R	0h	Reserved
15-12	RESERVED	R	0h	Reserved
11-8	CRCLOCK	R	Fh	Value in this field gets loaded from Z1_CRCLOCK[11:8] when a read is issued to address location of Z1_CRCLOCK in OTP.  1111 : VCU has ability to calculate CRC on secure memories. Other Value : VCU doesn't have ability to calculate CRC on secure memories. Reset type: SYSRSn
7-4	PSWDLOCK	R	Fh	Value in this field gets loaded from Z1_PSWDLOCK[7:4] when a read is issued to address location of Z1_PSWDLOCK in OTP.  1111 : CSM password locations in OTP are not protected and can be read from debugger as well as code running from anywhere. Other Value : CSM password locations in OTP are protected and can't be read without unlocking CSM of that zone. Reset type: SYSRSn
3-0	RESERVED	R	0h	Reserved

### 2.15.15.3 Z1\_BOOTCTRL Register (Offset = 4h) [reset = 0h]

Z1\_BOOTCTRL is shown in [Figure 2-174](#) and described in [Table 2-195](#).

Return to [Summary Table](#).

Boot Mode

**Figure 2-174. Z1\_BOOTCTRL Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
BOOTPIN1								BOOTPIN0								BMODE								KEY							
R-0h								R-0h								R-0h								R-0h							

**Table 2-195. Z1\_BOOTCTRL Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-24	BOOTPIN1	R	0h	This field gets loaded with Z1_BOOTCTRL[31:24] when a dummy read is issued to address location of Z1_BOOTCTRL in OTP. This assigns the pin to be used as BOOTPIN1. 0 : Pick default bootmode pin. 1 : Pick GPIO0 as BOOTPIN1. 2 : Pick GPIO1 as BOOTPIN1. .... .... n : Pick GPIO <sub>n</sub> -1 as BOOTPIN1. Reset type: SYSRS <sub>n</sub>
23-16	BOOTPIN0	R	0h	This field gets loaded with Z1_BOOTCTRL[23:16] when a dummy read is issued to address location of Z1_BOOTCTRL in OTP. This assigns the pin to be used as BOOTPIN1. 0 : Pick default bootmode pin. 1 : Pick GPIO0 as BOOTPIN1. 2 : Pick GPIO1 as BOOTPIN1. .... .... n : Pick GPIO <sub>n</sub> -1 as BOOTPIN1. Reset type: SYSRS <sub>n</sub>
15-8	BMODE	R	0h	This field gets loaded with Z1_BOOTCTRL[16:8] when a dummy read is issued to address location of Z1_BOOTCTRL in OTP. Reset type: SYSRS <sub>n</sub>
7-0	KEY	R	0h	This field gets loaded with Z1_BOOTCTRL[7:0] when a dummy read is issued to address location of Z1_BOOTCTRL in OTP. Reset type: SYSRS <sub>n</sub>

#### 2.15.15.4 Z1\_LINKPOINTERERR Register (Offset = 6h) [reset = FFFFFFFFh]

Z1\_LINKPOINTERERR is shown in [Figure 2-175](#) and described in [Table 2-196](#).

Return to [Summary Table](#).

Link Pointer Error

**Figure 2-175. Z1\_LINKPOINTERERR Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Z1_LINKPOINTERERR																															
R-FFFFFFFh																															

**Table 2-196. Z1\_LINKPOINTERERR Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-0	Z1_LINKPOINTERERR	R	FFFFFFFh	These bits indicate errors during formation of the resolved Link-Pointer value after the three physical Link-Pointer values loaded of OTP. 0 : No Error. Other : Error on bit positions which is set to 1. Reset type: SYSRSn

**2.15.15.5 Z1\_CSMKEY0 Register (Offset = 10h) [reset = 0h]**

Z1\_CSMKEY0 is shown in [Figure 2-176](#) and described in [Table 2-197](#).

Return to [Summary Table](#).

Zone 1 CSM Key 0

**Figure 2-176. Z1\_CSMKEY0 Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Z1_CSMKEY0																															
R-0h																															

**Table 2-197. Z1\_CSMKEY0 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-0	Z1_CSMKEY0	R	0h	To unlock Zone1, user needs to write this register with exact value as Z1_CSMPWD0, programmed in OTP (zone gets unlock only if 128 bit password in OTP match with value written in four CSMKEY registers.) Reset type: SYSRSn

**2.15.15.6 Z1\_CSMKEY1 Register (Offset = 12h) [reset = 0h]**

Z1\_CSMKEY1 is shown in [Figure 2-177](#) and described in [Table 2-198](#).

Return to [Summary Table](#).

Zone 1 CSM Key 1

**Figure 2-177. Z1\_CSMKEY1 Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Z1_CSMKEY1																															
R-0h																															

**Table 2-198. Z1\_CSMKEY1 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-0	Z1_CSMKEY1	R	0h	To unlock Zone1, user needs to write this register with exact value as Z1_CSMPWD1, programmed in OTP (zone gets unlock only if 128 bit password in OTP match with value written in four CSMKEY registers.) Reset type: SYSRSn



**2.15.15.7 Z1\_CSMKEY2 Register (Offset = 14h) [reset = 0h]**

Z1\_CSMKEY2 is shown in [Figure 2-178](#) and described in [Table 2-199](#).

Return to [Summary Table](#).

Zone 1 CSM Key 2

**Figure 2-178. Z1\_CSMKEY2 Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Z1_CSMKEY2																															
R-0h																															

**Table 2-199. Z1\_CSMKEY2 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-0	Z1_CSMKEY2	R	0h	To unlock Zone1, user needs to write this register with exact value as Z1_CSMPWD2, programmed in OTP (zone gets unlock only if 128 bit password in OTP match with value written in four CSMKEY registers.) Reset type: SYSRSn

**2.15.15.8 Z1\_CSMKEY3 Register (Offset = 16h) [reset = 0h]**

Z1\_CSMKEY3 is shown in [Figure 2-179](#) and described in [Table 2-200](#).

Return to [Summary Table](#).

Zone 1 CSM Key 3

**Figure 2-179. Z1\_CSMKEY3 Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Z1_CSMKEY3																															
R-0h																															

**Table 2-200. Z1\_CSMKEY3 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-0	Z1_CSMKEY3	R	0h	To unlock Zone1, user needs to write this register with exact value as Z1_CSMPSWD3, programmed in OTP (zone gets unlock only if 128 bit password in OTP match with value written in four CSMKEY registers.) Reset type: SYSRSn

**2.15.15.9 Z1\_CR Register (Offset = 19h) [reset = 8h]**

Z1\_CR is shown in [Figure 2-180](#) and described in [Table 2-201](#).

Return to [Summary Table](#).

Zone 1 CSM Control Register

**Figure 2-180. Z1\_CR Register**

15	14	13	12	11	10	9	8
FORCESEC		RESERVED					
R=0/W-0h		R-0h					
7	6	5	4	3	2	1	0
RESERVED	ARMED	UNSECURE	ALLONE	ALLZERO	RESERVED		
R-0h	R-0h	R-0h	R-0h	R-1h	R-0h		

**Table 2-201. Z1\_CR Register Field Descriptions**

Bit	Field	Type	Reset	Description
15	FORCESEC	R=0/W	0h	A write '1' to this fields resets the state of zone. If zone is unlocked, it'll lock(secure) the zone and also resets all the bits in this register. Reset type: SYSRSn
14-8	RESERVED	R	0h	Reserved
7	RESERVED	R	0h	Reserved
6	ARMED	R	0h	0 : Dummy read to CSM Password locations in OTP hasn't been performed. 1 : Dummy read to CSM Password locations in OTP has been performed. Reset type: SYSRSn
5	UNSECURE	R	0h	Indiacates the state of Zone. 0 : Zone is in lock(secure) state. 1 : Zone is in unlock(unsecure) state. Reset type: SYSRSn
4	ALLONE	R	0h	Indicates the state of CSM passowrds. 0 : CSM Passwords are not all ones. 1 : CSM Passwords are all ones and zone is in unlock state. Reset type: SYSRSn
3	ALLZERO	R	1h	Indicates the state of CSM passowrds. 0 : CSM Passwords are not all zeros. 1 : CSM Passwords are all zero and device is permanently locked. Reset type: SYSRSn
2-0	RESERVED	R	0h	Reserved

### 2.15.15.10 Z1\_GRABSECTR Register (Offset = 1Ah) [reset = 0h]

Z1\_GRABSECTR is shown in [Figure 2-181](#) and described in [Table 2-202](#).

Return to [Summary Table](#).

Zone 1 Grab Flash Sectors Register

**Figure 2-181. Z1\_GRABSECTR Register**

31	30	29	28	27	26	25	24
RESERVED		GRAB_BANK1		GRAB_SECTN		GRAB_SECTM	
R-0h		R-0h		R-0h		R-0h	
23	22	21	20	19	18	17	16
GRAB_SECTL		GRAB_SECTK		GRAB_SECTJ		GRAB_SECTI	
R-0h		R-0h		R-0h		R-0h	
15	14	13	12	11	10	9	8
GRAB_SECTH		GRAB_SECTG		GRAB_SECTF		GRAB_SECTE	
R-0h		R-0h		R-0h		R-0h	
7	6	5	4	3	2	1	0
GRAB_SECTD		GRAB_SECTC		GRAB_SECTB		GRAB_SECTA	
R-0h		R-0h		R-0h		R-0h	

**Table 2-202. Z1\_GRABSECTR Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-30	RESERVED	R	0h	Reserved
29-28	GRAB_BANK1	R	0h	Value in this field gets loaded from Z1_GRABSECTR[29:28] when a read is issued to address location of Z1_GRABSECTR in OTP.  00 : Invalid. Flash BANK1 is inaccessible. 01 : Request to allocate Flash BANK1 to Zone1. 10 : Request to allocate Flash BANK1 to Zone1. 11 : Request to make Flash BANK1 Non-Secure. Reset type: SYSRSn
27-26	GRAB_SECTN	R	0h	Value in this field gets loaded from Z1_GRABSECTR[27:26] when a read is issued to address location of Z1_GRABSECTR in OTP.  00 : Invalid. Flash Sector N is inaccessible. 01 : Request to allocate Flash Sector N to Zone1. 10 : Request to allocate Flash Sector N to Zone1. 11 : Request to make Flash sector N Non-Secure. Reset type: SYSRSn
25-24	GRAB_SECTM	R	0h	Value in this field gets loaded from Z1_GRABSECTR[25:24] when a read is issued to address location of Z1_GRABSECTR in OTP.  00 : Invalid. Flash Sector M is inaccessible. 01 : Request to allocate Flash Sector M to Zone1. 10 : Request to allocate Flash Sector M to Zone1. 11 : Request to make Flash sector M Non-Secure. Reset type: SYSRSn
23-22	GRAB_SECTL	R	0h	Value in this field gets loaded from Z1_GRABSECTR[23:22] when a read is issued to address location of Z1_GRABSECTR in OTP.  00 : Invalid. Flash Sector L is inaccessible. 01 : Request to allocate Flash Sector L to Zone1. 10 : Request to allocate Flash Sector L to Zone1. 11 : Request to make Flash sector L Non-Secure. Reset type: SYSRSn

**Table 2-202. Z1\_GRABSECTR Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
21-20	GRAB_SECTK	R	0h	Value in this field gets loaded from Z1_GRABSECTR[21:20] when a read is issued to address location of Z1_GRABSECTR in OTP.  00 : Invalid. Flash Sector K is inaccessible. 01 : Request to allocate Flash Sector K to Zone1. 10 : Request to allocate Flash Sector K to Zone1. 11 : Request to make Flash sector K Non-Secure. Reset type: SYSRSn
19-18	GRAB_SECTJ	R	0h	Value in this field gets loaded from Z1_GRABSECTR[19:18] when a read is issued to address location of Z1_GRABSECTR in OTP.  00 : Invalid. Flash Sector J is inaccessible. 01 : Request to allocate Flash Sector J to Zone1. 10 : Request to allocate Flash Sector J to Zone1. 11 : Request to make Flash sector J Non-Secure. Reset type: SYSRSn
17-16	GRAB_SECTI	R	0h	Value in this field gets loaded from Z1_GRABSECTR[17:16] when a read is issued to address location of Z1_GRABSECTR in OTP.  00 : Invalid. Flash Sector I is inaccessible. 01 : Request to allocate Flash Sector I to Zone1. 10 : Request to allocate Flash Sector I to Zone1. 11 : Request to make Flash sector I Non-Secure. Reset type: SYSRSn
15-14	GRAB_SECTH	R	0h	Value in this field gets loaded from Z1_GRABSECTR[15:14] when a read is issued to address location of Z1_GRABSECTR in OTP.  00 : Invalid. Flash Sector H is inaccessible. 01 : Request to allocate Flash Sector H to Zone1. 10 : Request to allocate Flash Sector H to Zone1. 11 : Request to make Flash sector H Non-Secure. Reset type: SYSRSn
13-12	GRAB_SECTG	R	0h	Value in this field gets loaded from Z1_GRABSECTR[13:12] when a read is issued to address location of Z1_GRABSECTR in OTP.  00 : Invalid. Flash Sector G is inaccessible. 01 : Request to allocate Flash Sector G to Zone1. 10 : Request to allocate Flash Sector G to Zone1. 11 : Request to make Flash sector G Non-Secure. Reset type: SYSRSn
11-10	GRAB_SECTF	R	0h	Value in this field gets loaded from Z1_GRABSECTR[11:10] when a read is issued to address location of Z1_GRABSECTR in OTP.  00 : Invalid. Flash Sector F is inaccessible. 01 : Request to allocate Flash Sector F to Zone1. 10 : Request to allocate Flash Sector F to Zone1. 11 : Request to make Flash sector F Non-Secure. Reset type: SYSRSn
9-8	GRAB_SECTE	R	0h	Value in this field gets loaded from Z1_GRABSECTR[9:8] when a read is issued to address location of Z1_GRABSECTR in OTP.  00 : Invalid. Flash Sector E is inaccessible. 01 : Request to allocate Flash Sector E to Zone1. 10 : Request to allocate Flash Sector E to Zone1. 11 : Request to make Flash sector E Non-Secure. Reset type: SYSRSn

**Table 2-202. Z1\_GRABSECTR Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
7-6	GRAB_SECTD	R	0h	<p>Value in this field gets loaded from Z1_GRABSECT[7:6] when a read is issued to address location of Z1_GRABSECT in OTP.</p> <p>00 : Invalid. Flash Sector D is inaccessible.            01 : Request to allocate Flash Sector D to Zone1.            10 : Request to allocate Flash Sector D to Zone1.            11 : Request to make Flash sector D Non-Secure.            Reset type: SYSRSn</p>
5-4	GRAB_SECTC	R	0h	<p>Value in this field gets loaded from Z1_GRABSECT[5:4] when a read is issued to address location of Z1_GRABSECT in OTP.</p> <p>00 : Invalid. Flash Sector C is inaccessible.            01 : Request to allocate Flash Sector C to Zone1.            10 : Request to allocate Flash Sector C to Zone1.            11 : Request to make Flash sector C Non-Secure.            Reset type: SYSRSn</p>
3-2	GRAB_SECTB	R	0h	<p>Value in this field gets loaded from Z1_GRABSECT[3:2] when a read is issued to address location of Z1_GRABSECT in OTP.</p> <p>00 : Invalid. Flash Sector B is inaccessible.            01 : Request to allocate Flash Sector B to Zone1.            10 : Request to allocate Flash Sector B to Zone1.            11 : Request to make Flash sector B Non-Secure.            Reset type: SYSRSn</p>
1-0	GRAB_SECTA	R	0h	<p>Value in this field gets loaded from Z1_GRABSECT[1:0] when a read is issued to address location of Z1_GRABSECT in OTP.</p> <p>00 : Invalid. Flash Sector A is inaccessible.            01 : Request to allocate Flash Sector A to Zone1.            10 : Request to allocate Flash Sector A to Zone1.            11 : Request to make Flash sector A Non-Secure.            Reset type: SYSRSn</p>

### 2.15.15.11 Z1\_GRABRAMR Register (Offset = 1Ch) [reset = 0h]

Z1\_GRABRAMR is shown in [Figure 2-182](#) and described in [Table 2-203](#).

Return to [Summary Table](#).

Zone 1 Grab RAM Blocks Register

**Figure 2-182. Z1\_GRABRAMR Register**

31	30	29	28	27	26	25	24
RESERVED		GRAB_CLA1		RESERVED			
R-0h		R-0h		R-0h			
23	22	21	20	19	18	17	16
RESERVED							
R-0h							
15	14	13	12	11	10	9	8
GRAB_RAM7		GRAB_RAM6		GRAB_RAM5		GRAB_RAM4	
R-0h		R-0h		R-0h		R-0h	
7	6	5	4	3	2	1	0
GRAB_RAM3		GRAB_RAM2		GRAB_RAM1		GRAB_RAM0	
R-0h		R-0h		R-0h		R-0h	

**Table 2-203. Z1\_GRABRAMR Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-30	RESERVED	R	0h	Reserved
29-28	GRAB_CLA1	R	0h	Value in this field gets loaded from Z1_GRABRAM[29:28] when a read is issued to address location of Z1_GRABRAM in OTP.  00 : Invalid. CLA1 is inaccessible. 01 : Request to allocate CLA1 to Zone1. 10 : Request to allocate CLA1 to Zone1. 11 : Request to make CLA1 Non-Secure. Reset type: SYSRSn
27-16	RESERVED	R	0h	Reserved
15-14	GRAB_RAM7	R	0h	Value in this field gets loaded from Z1_GRABRAM[15:14] when a read is issued to address location of Z1_GRABRAM in OTP.  00 : Invalid. D1 RAM is inaccessible. 01 : Request to allocate D1 RAM to Zone1. 10 : Request to allocate D1 RAM to Zone1. 11 : Request to make D1 RAM Non-Secure. Reset type: SYSRSn
13-12	GRAB_RAM6	R	0h	Value in this field gets loaded from Z1_GRABRAM[13:12] when a read is issued to address location of Z1_GRABRAM in OTP.  00 : Invalid. D0 RAM is inaccessible. 01 : Request to allocate D0 RAM to Zone1. 10 : Request to allocate D0 RAM to Zone1. 11 : Request to make D0 RAM Non-Secure. Reset type: SYSRSn

**Table 2-203. Z1\_GRABRAMR Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
11-10	GRAB_RAM5	R	0h	Value in this field gets loaded from Z1_GRABRAM[11:10] when a read is issued to address location of Z1_GRABRAM in OTP.  00 : Invalid. LS5 RAM is inaccessible. 01 : Request to allocate LS5 RAM to Zone1. 10 : Request to allocate LS5 RAM to Zone1. 11 : Request to make LS5 RAM Non-Secure. Reset type: SYSRSn
9-8	GRAB_RAM4	R	0h	Value in this field gets loaded from Z1_GRABRAM[9:8] when a read is issued to address location of Z1_GRABRAM in OTP.  00 : Invalid. LS4 RAM is inaccessible. 01 : Request to allocate LS4 RAM to Zone1. 10 : Request to allocate LS4 RAM to Zone1. 11 : Request to make LS4 RAM Non-Secure. Reset type: SYSRSn
7-6	GRAB_RAM3	R	0h	Value in this field gets loaded from Z1_GRABRAM[7:6] when a read is issued to address location of Z1_GRABRAM in OTP.  00 : Invalid. LS3 RAM is inaccessible. 01 : Request to allocate LS3 RAM to Zone1. 10 : Request to allocate LS3 RAM to Zone1. 11 : Request to make LS3 RAM Non-Secure. Reset type: SYSRSn
5-4	GRAB_RAM2	R	0h	Value in this field gets loaded from Z1_GRABRAM[5:4] when a read is issued to address location of Z1_GRABRAM in OTP.  00 : Invalid. LS2 RAM is inaccessible. 01 : Request to allocate LS2 RAM to Zone1. 10 : Request to allocate LS2 RAM to Zone1. 11 : Request to make LS2 RAM Non-Secure. Reset type: SYSRSn
3-2	GRAB_RAM1	R	0h	Value in this field gets loaded from Z1_GRABRAM[3:2] when a read is issued to address location of Z1_GRABRAM in OTP.  00 : Invalid. LS1 RAM is inaccessible. 01 : Request to allocate LS1 RAM to Zone1. 10 : Request to allocate LS1 RAM to Zone1. 11 : Request to make LS1 RAM Non-Secure. Reset type: SYSRSn
1-0	GRAB_RAM0	R	0h	Value in this field gets loaded from Z1_GRABRAM[1:0] when a read is issued to address location of Z1_GRABRAM in OTP.  00 : Invalid. LS0 RAM is inaccessible. 01 : Request to allocate LS0 RAM to Zone1. 10 : Request to allocate LS0 RAM to Zone1. 11 : Request to make LS0 RAM Non-Secure. Reset type: SYSRSn



### 2.15.15.12 Z1\_EXEONLYSECTR Register (Offset = 1Eh) [reset = 0h]

Z1\_EXEONLYSECTR is shown in [Figure 2-183](#) and described in [Table 2-204](#).

Return to [Summary Table](#).

Zone 1 Flash Execute\_Only Sector Register

**Figure 2-183. Z1\_EXEONLYSECTR Register**

31								30								29								28								27								26								25								24							
RESERVED																																																															
R-0h																																																															
23								22								21								20								19								18								17								16							
RESERVED																																																															
R-0h																																																															
15								14								13								12								11								10								9								8							
RESERVED								EXEONLY_BA NK1								EXEONLY_SE CTN								EXEONLY_SE CTM								EXEONLY_SE CTL								EXEONLY_SE CTK								EXEONLY_SE CTJ								EXEONLY_SE CTI							
R-0h								R-0h								R-0h								R-0h								R-0h								R-0h								R-0h								R-0h							
7								6								5								4								3								2								1								0							
EXEONLY_SE CTH								EXEONLY_SE CTG								EXEONLY_SE CTF								EXEONLY_SE CTE								EXEONLY_SE CTD								EXEONLY_SE CTC								EXEONLY_SE CTB								EXEONLY_SE CTA							
R-0h								R-0h								R-0h								R-0h								R-0h								R-0h								R-0h								R-0h							

**Table 2-204. Z1\_EXEONLYSECTR Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R	0h	Reserved
15	RESERVED	R	0h	Reserved
14	EXEONLY_BANK1	R	0h	Value in this field gets loaded from Z1_EXEONLYSECTR[14:14] when a read is issued to Z1_EXEONLYSECTR address location in OTP.  0 : Execute-Only protection is enabled for Flash BANK1 (only if it's allocated to Zone1) 1 : Execute-Only protection is disabled for Flash BANK1 (only if it's allocated to Zone1) Reset type: SYSRSn
13	EXEONLY_SECTN	R	0h	Value in this field gets loaded from Z1_EXEONLYSECTR[13:13] when a read is issued to Z1_EXEONLYSECTR address location in OTP.  0 : Execute-Only protection is enabled for Flash Sector N (only if it's allocated to Zone1) 1 : Execute-Only protection is disabled for Flash Sector N (only if it's allocated to Zone1) Reset type: SYSRSn
12	EXEONLY_SECTM	R	0h	Value in this field gets loaded from Z1_EXEONLYSECTR[12:12] when a read is issued to Z1_EXEONLYSECTR address location in OTP.  0 : Execute-Only protection is enabled for Flash Sector M (only if it's allocated to Zone1) 1 : Execute-Only protection is disabled for Flash Sector M (only if it's allocated to Zone1) Reset type: SYSRSn

**Table 2-204. Z1\_EXEONLYSECTR Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
11	EXEONLY_SECTL	R	0h	Value in this field gets loaded from Z1_EXEONLYSECTR[11:11] when a read is issued to Z1_EXEONLYSECTR address location in OTP.  0 : Execute-Only protection is enabled for Flash Sector L (only if it's allocated to Zone1) 1 : Execute-Only protection is disabled for Flash Sector L (only if it's allocated to Zone1) Reset type: SYSRSn
10	EXEONLY_SECTK	R	0h	Value in this field gets loaded from Z1_EXEONLYSECTR[10:10] when a read is issued to Z1_EXEONLYSECTR address location in OTP.  0 : Execute-Only protection is enabled for Flash Sector K (only if it's allocated to Zone1) 1 : Execute-Only protection is disabled for Flash Sector K (only if it's allocated to Zone1) Reset type: SYSRSn
9	EXEONLY_SECTJ	R	0h	Value in this field gets loaded from Z1_EXEONLYSECTR[9:9] when a read is issued to Z1_EXEONLYSECTR address location in OTP.  0 : Execute-Only protection is enabled for Flash Sector J (only if it's allocated to Zone1) 1 : Execute-Only protection is disabled for Flash Sector J (only if it's allocated to Zone1) Reset type: SYSRSn
8	EXEONLY_SECTI	R	0h	Value in this field gets loaded from Z1_EXEONLYSECTR[8:8] when a read is issued to Z1_EXEONLYSECTR address location in OTP.  0 : Execute-Only protection is enabled for Flash Sector I (only if it's allocated to Zone1) 1 : Execute-Only protection is disabled for Flash Sector I (only if it's allocated to Zone1) Reset type: SYSRSn
7	EXEONLY_SECTH	R	0h	Value in this field gets loaded from Z1_EXEONLYSECTR[7:7] when a read is issued to Z1_EXEONLYSECTR address location in OTP.  0 : Execute-Only protection is enabled for Flash Sector H (only if it's allocated to Zone1) 1 : Execute-Only protection is disabled for Flash Sector H (only if it's allocated to Zone1) Reset type: SYSRSn
6	EXEONLY_SECTG	R	0h	Value in this field gets loaded from Z1_EXEONLYSECTR[6:6] when a read is issued to Z1_EXEONLYSECTR address location in OTP.  0 : Execute-Only protection is enabled for Flash Sector G (only if it's allocated to Zone1) 1 : Execute-Only protection is disabled for Flash Sector G (only if it's allocated to Zone1) Reset type: SYSRSn
5	EXEONLY_SECTF	R	0h	Value in this field gets loaded from Z1_EXEONLYSECTR[5:5] when a read is issued to Z1_EXEONLYSECTR address location in OTP.  0 : Execute-Only protection is enabled for Flash Sector F (only if it's allocated to Zone1) 1 : Execute-Only protection is disabled for Flash Sector F (only if it's allocated to Zone1) Reset type: SYSRSn

**Table 2-204. Z1\_EXEONLYSECTR Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
4	EXEONLY_SECTE	R	0h	Value in this field gets loaded from Z1_EXEONLYSECT[4:4] when a read is issued to Z1_EXEONLYSECT address location in OTP.  0 : Execute-Only protection is enabled for Flash Sector E (only if it's allocated to Zone1) 1 : Execute-Only protection is disabled for Flash Sector E (only if it's allocated to Zone1) Reset type: SYSRSn
3	EXEONLY_SECTD	R	0h	Value in this field gets loaded from Z1_EXEONLYSECT[3:3] when a read is issued to Z1_EXEONLYSECT address location in OTP.  0 : Execute-Only protection is enabled for Flash Sector D (only if it's allocated to Zone1) 1 : Execute-Only protection is disabled for Flash Sector D (only if it's allocated to Zone1) Reset type: SYSRSn
2	EXEONLY_SECTC	R	0h	Value in this field gets loaded from Z1_EXEONLYSECT[2:2] when a read is issued to Z1_EXEONLYSECT address location in OTP.  0 : Execute-Only protection is enabled for Flash Sector C (only if it's allocated to Zone1) 1 : Execute-Only protection is disabled for Flash Sector C (only if it's allocated to Zone1) Reset type: SYSRSn
1	EXEONLY_SECTB	R	0h	Value in this field gets loaded from Z1_EXEONLYSECT[1:1] when a read is issued to Z1_EXEONLYSECT address location in OTP.  0 : Execute-Only protection is enabled for Flash Sector B (only if it's allocated to Zone1) 1 : Execute-Only protection is disabled for Flash Sector B (only if it's allocated to Zone1) Reset type: SYSRSn
0	EXEONLY_SECTA	R	0h	Value in this field gets loaded from Z1_EXEONLYSECT[0:0] when a read is issued to Z1_EXEONLYSECT address location in OTP.  0 : Execute-Only protection is enabled for Flash Sector A (only if it's allocated to Zone1) 1 : Execute-Only protection is disabled for Flash Sector A (only if it's allocated to Zone1) Reset type: SYSRSn

**2.15.15.13 Z1\_EXEONLYRAMR Register (Offset = 20h) [reset = 0h]**

 Z1\_EXEONLYRAMR is shown in [Figure 2-184](#) and described in [Table 2-205](#).

 Return to [Summary Table](#).

Zone 1 RAM Execute\_Only Block Register

**Figure 2-184. Z1\_EXEONLYRAMR Register**

31	30	29	28	27	26	25	24
RESERVED							
R-0h							
23	22	21	20	19	18	17	16
RESERVED							
R-0h							
15	14	13	12	11	10	9	8
RESERVED							
R-0h							
7	6	5	4	3	2	1	0
EXEONLY_RA M7	EXEONLY_RA M6	EXEONLY_RA M5	EXEONLY_RA M4	EXEONLY_RA M3	EXEONLY_RA M2	EXEONLY_RA M1	EXEONLY_RA M0
R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h

**Table 2-205. Z1\_EXEONLYRAMR Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R	0h	Reserved
15-8	RESERVED	R	0h	Reserved
7	EXEONLY_RAM7	R	0h	Value in this field gets loaded from Z1_EXEONLYRAM[7:7] when a read is issued to Z1_EXEONLYRAM address location in OTP.  0 : Execute-Only protection is enabled for D1 RAM (only if it's allocated to Zone1) 1 : Execute-Only protection is disabled for D1 RAM (only if it's allocated to Zone1) Reset type: SYSRSn
6	EXEONLY_RAM6	R	0h	Value in this field gets loaded from Z1_EXEONLYRAM[6:6] when a read is issued to Z1_EXEONLYRAM address location in OTP.  0 : Execute-Only protection is enabled for D0 RAM (only if it's allocated to Zone1) 1 : Execute-Only protection is disabled for D0 RAM (only if it's allocated to Zone1) Reset type: SYSRSn
5	EXEONLY_RAM5	R	0h	Value in this field gets loaded from Z1_EXEONLYRAM[5:5] when a read is issued to Z1_EXEONLYRAM address location in OTP.  0 : Execute-Only protection is enabled for LS5 RAM (only if it's allocated to Zone1) 1 : Execute-Only protection is disabled for LS5 RAM (only if it's allocated to Zone1) Reset type: SYSRSn
4	EXEONLY_RAM4	R	0h	Value in this field gets loaded from Z1_EXEONLYRAM[4:4] when a read is issued to Z1_EXEONLYRAM address location in OTP.  0 : Execute-Only protection is enabled for LS4 RAM (only if it's allocated to Zone1) 1 : Execute-Only protection is disabled for LS4 RAM (only if it's allocated to Zone1) Reset type: SYSRSn

**Table 2-205. Z1\_EXEONLYRAMR Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
3	EXEONLY_RAM3	R	0h	<p>Value in this field gets loaded from Z1_EXEONLYRAM[3:3] when a read is issued to Z1_EXEONLYRAM address location in OTP.</p> <p>0 : Execute-Only protection is enabled for LS3 RAM (only if it's allocated to Zone1)</p> <p>1 : Execute-Only protection is disabled for LS3 RAM (only if it's allocated to Zone1)</p> <p>Reset type: SYSRSn</p>
2	EXEONLY_RAM2	R	0h	<p>Value in this field gets loaded from Z1_EXEONLYRAM[2:2] when a read is issued to Z1_EXEONLYRAM address location in OTP.</p> <p>0 : Execute-Only protection is enabled for LS2 RAM (only if it's allocated to Zone1)</p> <p>1 : Execute-Only protection is disabled for LS2 RAM (only if it's allocated to Zone1)</p> <p>Reset type: SYSRSn</p>
1	EXEONLY_RAM1	R	0h	<p>Value in this field gets loaded from Z1_EXEONLYRAM[1:1] when a read is issued to Z1_EXEONLYRAM address location in OTP.</p> <p>0 : Execute-Only protection is enabled for LS1 RAM (only if it's allocated to Zone1)</p> <p>1 : Execute-Only protection is disabled for LS1 RAM (only if it's allocated to Zone1)</p> <p>Reset type: SYSRSn</p>
0	EXEONLY_RAM0	R	0h	<p>Value in this field gets loaded from Z1_EXEONLYRAM[0:0] when a read is issued to Z1_EXEONLYRAM address location in OTP.</p> <p>0 : Execute-Only protection is enabled for LS0 RAM (only if it's allocated to Zone1)</p> <p>1 : Execute-Only protection is disabled for LS0 RAM (only if it's allocated to Zone1)</p> <p>Reset type: SYSRSn</p>

## 2.15.16 DCSM\_Z2\_OTP Registers

Table 2-206 lists the memory-mapped registers for the DCSM\_Z2\_OTP. All register offset addresses not listed in Table 2-206 should be considered as reserved locations and the register contents should not be modified.

**Table 2-206. DCSM\_Z2\_OTP Registers**

Offset	Acronym	Register Name	Write Protection	Section
0h	Z2OTP_LINKPOINTER1	Zone 2 Link Pointer1 in Z2 OTP		<a href="#">Go</a>
4h	Z2OTP_LINKPOINTER2	Zone 2 Link Pointer2 in Z2 OTP		<a href="#">Go</a>
8h	Z2OTP_LINKPOINTER3	Zone 2 Link Pointer3 in Z2 OTP		<a href="#">Go</a>
10h	Z2OTP_PSWDLOCK	Secure Password Lock in Z2 OTP		<a href="#">Go</a>
14h	Z2OTP_CRCLOCK	Secure CRC Lock in Z2 OTP		<a href="#">Go</a>
1Eh	Z2OTP_BOOTCTRL	Boot Mode in Z2 OTP		<a href="#">Go</a>

Complex bit access types are encoded to fit into small table cells. Table 2-207 shows the codes that are used for access types in this section.

**Table 2-207. DCSM\_Z2\_OTP Access Type Codes**

Access Type	Code	Description
<b>Read Type</b>		
R	R	Read
<b>Reset or Default Value</b>		
-n		Value after reset or the default value
<b>Register Array Variables</b>		
i,j,k,l,m,n		When these variables are used in a register name, an offset, or an address, they refer to the value of a register array where the register is part of a group of repeating registers. The register groups form a hierarchical structure and the array is represented with a formula.
y		When this variable is used in a register name, an offset, or an address it refers to the value of a register array.

**2.15.16.1 Z2OTP\_LINKPOINTER1 Register (Offset = 0h) [reset = FFFFFFFFh]**

Z2OTP\_LINKPOINTER1 is shown in [Figure 2-185](#) and described in [Table 2-208](#).

Return to [Summary Table](#).

Zone 2 Link Pointer1 in Z2 OTP

**Figure 2-185. Z2OTP\_LINKPOINTER1 Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Z2OTP_LINKPOINTER1																															
R-FFFFFFFh																															

**Table 2-208. Z2OTP\_LINKPOINTER1 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-0	Z2OTP_LINKPOINTER1	R	FFFFFFFh	Zone2 Link Pointer 1 location in USER OTP. Reset type: SYSRSn

**2.15.16.2 Z2OTP\_LINKPOINTER2 Register (Offset = 4h) [reset = FFFFFFFFh]**

Z2OTP\_LINKPOINTER2 is shown in [Figure 2-186](#) and described in [Table 2-209](#).

Return to [Summary Table](#).

Zone 2 Link Pointer2 in Z2 OTP

**Figure 2-186. Z2OTP\_LINKPOINTER2 Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Z2OTP_LINKPOINTER2																															
R-FFFFFFFh																															

**Table 2-209. Z2OTP\_LINKPOINTER2 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-0	Z2OTP_LINKPOINTER2	R	FFFFFFFh	Zone2 Link Pointer 2 location in USER OTP. Reset type: SYSRSn



**2.15.16.3 Z2OTP\_LINKPOINTER3 Register (Offset = 8h) [reset = FFFFFFFFh]**

Z2OTP\_LINKPOINTER3 is shown in [Figure 2-187](#) and described in [Table 2-210](#).

Return to [Summary Table](#).

Zone 2 Link Pointer3 in Z2 OTP

**Figure 2-187. Z2OTP\_LINKPOINTER3 Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Z2OTP_LINKPOINTER3																															
R-FFFFFFFh																															

**Table 2-210. Z2OTP\_LINKPOINTER3 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-0	Z2OTP_LINKPOINTER3	R	FFFFFFFh	Zone2 Link Pointer 3 location in USER OTP. Reset type: SYSRSn

#### 2.15.16.4 Z2OTP\_PSWDLOCK Register (Offset = 10h) [reset = FFFFFFFFh]

Z2OTP\_PSWDLOCK is shown in [Figure 2-188](#) and described in [Table 2-211](#).

Return to [Summary Table](#).

Secure Password Lock in Z2 OTP

**Figure 2-188. Z2OTP\_PSWDLOCK Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Z2OTP_PSWDLOCK																															
R-FFFFFFFh																															

**Table 2-211. Z2OTP\_PSWDLOCK Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-0	Z2OTP_PSWDLOCK	R	FFFFFFFh	Zone2 password lock location in USER OTP. Reset type: SYSRSn

**2.15.16.5 Z2OTP\_CRCLOCK Register (Offset = 14h) [reset = FFFFFFFFh]**

Z2OTP\_CRCLOCK is shown in [Figure 2-189](#) and described in [Table 2-212](#).

Return to [Summary Table](#).

Secure CRC Lock in Z2 OTP

**Figure 2-189. Z2OTP\_CRCLOCK Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Z2OTP_CRCLOCK																															
R-FFFFFFFh																															

**Table 2-212. Z2OTP\_CRCLOCK Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-0	Z2OTP_CRCLOCK	R	FFFFFFFh	Zone2 CRC lock location in USER OTP. Reset type: SYSRSn

**2.15.16.6 Z2OTP\_BOOTCTRL Register (Offset = 1Eh) [reset = FFFFFFFFh]**

Z2OTP\_BOOTCTRL is shown in [Figure 2-190](#) and described in [Table 2-213](#).

Return to [Summary Table](#).

Boot Mode in Z2 OTP

**Figure 2-190. Z2OTP\_BOOTCTRL Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Z2OTP_BOOTCTRL																															
R-FFFFFFFh																															

**Table 2-213. Z2OTP\_BOOTCTRL Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-0	Z2OTP_BOOTCTRL	R	FFFFFFFh	Zone2 Boot control location in USER OTP. Reset type: SYSRSn

### 2.15.17 DCSM\_Z2\_REGS Registers

Table 2-214 lists the memory-mapped registers for the DCSM\_Z2\_REGS. All register offset addresses not listed in Table 2-214 should be considered as reserved locations and the register contents should not be modified.

**Table 2-214. DCSM\_Z2\_REGS Registers**

Offset	Acronym	Register Name	Write Protection	Section
0h	Z2_LINKPOINTER	Zone 2 Link Pointer		<a href="#">Go</a>
2h	Z2_OTPSECLOCK	Zone 2 OTP Secure JTAG lock		<a href="#">Go</a>
4h	Z2_BOOTCTRL	Boot Mode		<a href="#">Go</a>
6h	Z2_LINKPOINTERERR	Link Pointer Error		<a href="#">Go</a>
10h	Z2_CSMKEY0	Zone 2 CSM Key 0		<a href="#">Go</a>
12h	Z2_CSMKEY1	Zone 2 CSM Key 1		<a href="#">Go</a>
14h	Z2_CSMKEY2	Zone 2 CSM Key 2		<a href="#">Go</a>
16h	Z2_CSMKEY3	Zone 2 CSM Key 3		<a href="#">Go</a>
19h	Z2_CR	Zone 2 CSM Control Register		<a href="#">Go</a>
1Ah	Z2_GRABSECTR	Zone 2 Grab Flash Sectors Register		<a href="#">Go</a>
1Ch	Z2_GRABRAMR	Zone 2 Grab RAM Blocks Register		<a href="#">Go</a>
1Eh	Z2_EXEONLYSECTR	Zone 2 Flash Execute_Only Sector Register		<a href="#">Go</a>
20h	Z2_EXEONLYRAMR	Zone 2 RAM Execute_Only Block Register		<a href="#">Go</a>

Complex bit access types are encoded to fit into small table cells. Table 2-215 shows the codes that are used for access types in this section.

**Table 2-215. DCSM\_Z2\_REGS Access Type Codes**

Access Type	Code	Description
<b>Read Type</b>		
R	R	Read
R=0	R	Read
<b>Write Type</b>		
W	W	Write
<b>Reset or Default Value</b>		
-n		Value after reset or the default value
<b>Register Array Variables</b>		
i,j,k,l,m,n		When these variables are used in a register name, an offset, or an address, they refer to the value of a register array where the register is part of a group of repeating registers. The register groups form a hierarchical structure and the array is represented with a formula.
y		When this variable is used in a register name, an offset, or an address it refers to the value of a register array.

**2.15.17.1 Z2\_LINKPOINTER Register (Offset = 0h) [reset = E000000h]**

Z2\_LINKPOINTER is shown in [Figure 2-191](#) and described in [Table 2-216](#).

Return to [Summary Table](#).

Zone 2 Link Pointer

**Figure 2-191. Z2\_LINKPOINTER Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
RESERVED				LINKPOINTER											
R-7h				R-0h											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
LINKPOINTER															
R-0h															

**Table 2-216. Z2\_LINKPOINTER Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-29	RESERVED	R	7h	Reserved
28-0	LINKPOINTER	R	0h	This is the Resolved Link-Pointer value which is generated by looking at the three physical Link-Pointer values loaded from OTP. Reset type: SYSRSn

**2.15.17.2 Z2\_OTPSECLOCK Register (Offset = 2h) [reset = FFFh]**

Z2\_OTPSECLOCK is shown in [Figure 2-192](#) and described in [Table 2-217](#).

Return to [Summary Table](#).

Zone 2 OTP Secure JTAG lock

**Figure 2-192. Z2\_OTPSECLOCK Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
RESERVED															
R-0h															
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
RESERVED				CRCLOCK				PSWDLOCK				RESERVED			
R-0h				R-Fh				R-Fh				R-0h			

**Table 2-217. Z2\_OTPSECLOCK Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R	0h	Reserved
15-12	RESERVED	R	0h	Reserved
11-8	CRCLOCK	R	Fh	Value in this field gets loaded from Z2_CRCLOCK[11:8] when a read is issued to address location of Z2_CRCLOCK in OTP.  1111 : VCU has ability to calculate CRC on secure memories. Other Value : VCU doesn't have ability to calculate CRC on secure memories. Reset type: SYSRSn
7-4	PSWDLOCK	R	Fh	Value in this field gets loaded from Z2_PSWDLOCK[7:4] when a read is issued to address location of Z2_PSWDLOCK in OTP.  1111 : CSM password locations in OTP are not protected and can be read from debugger as well as code running from anywhere. Other Value : CSM password locations in OTP are protected and can't be read without unlocking CSM of that zone. Reset type: SYSRSn
3-0	RESERVED	R	0h	Reserved

### 2.15.17.3 Z2\_BOOTCTRL Register (Offset = 4h) [reset = 0h]

Z2\_BOOTCTRL is shown in [Figure 2-193](#) and described in [Table 2-218](#).

Return to [Summary Table](#).

Boot Mode

**Figure 2-193. Z2\_BOOTCTRL Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
BOOTPIN1								BOOTPIN0								BMODE								KEY							
R-0h								R-0h								R-0h								R-0h							

**Table 2-218. Z2\_BOOTCTRL Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-24	BOOTPIN1	R	0h	This field gets loaded with Z2_BOOTCTRL[31:24] when a dummy read is issued to address location of Z2_BOOTCTRL in OTP. This assigns the pin to be used as BOOTPIN1. 0 : Pick default bootmode pin. 1 : Pick GPIO0 as BOOTPIN1. 2 : Pick GPIO1 as BOOTPIN1. .... .... n : Pick GPIO <sub>n-1</sub> as BOOTPIN1. Reset type: SYSRS <sub>n</sub>
23-16	BOOTPIN0	R	0h	This field gets loaded with Z2_BOOTCTRL[23:16] when a dummy read is issued to address location of Z2_BOOTCTRL in OTP. This assigns the pin to be used as BOOTPIN1. 0 : Pick default bootmode pin. 1 : Pick GPIO0 as BOOTPIN1. 2 : Pick GPIO1 as BOOTPIN1. .... .... n : Pick GPIO <sub>n-1</sub> as BOOTPIN1. Reset type: SYSRS <sub>n</sub>
15-8	BMODE	R	0h	This field gets loaded with Z2_BOOTCTRL[16:8] when a dummy read is issued to address location of Z2_BOOTCTRL in OTP. Reset type: SYSRS <sub>n</sub>
7-0	KEY	R	0h	This field gets loaded with Z2_BOOTCTRL[7:0] when a dummy read is issued to address location of Z2_BOOTCTRL in OTP. Reset type: SYSRS <sub>n</sub>



**2.15.17.4 Z2\_LINKPOINTERERR Register (Offset = 6h) [reset = FFFFFFFFh]**

Z2\_LINKPOINTERERR is shown in [Figure 2-194](#) and described in [Table 2-219](#).

Return to [Summary Table](#).

Link Pointer Error

**Figure 2-194. Z2\_LINKPOINTERERR Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Z2_LINKPOINTERERR																															
R-FFFFFFFh																															

**Table 2-219. Z2\_LINKPOINTERERR Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-0	Z2_LINKPOINTERERR	R	FFFFFFFh	<p>These bits indicate errors during formation of the resolved Link-Pointer value after the three physical Link-Pointer values loaded of OTP.</p> <p>0 : No Error.</p> <p>Other : Error on bit positions which is set to 1.</p> <p>Reset type: SYSRSn</p>

**2.15.17.5 Z2\_CSMKEY0 Register (Offset = 10h) [reset = 0h]**

Z2\_CSMKEY0 is shown in [Figure 2-195](#) and described in [Table 2-220](#).

Return to [Summary Table](#).

Zone 2 CSM Key 0

**Figure 2-195. Z2\_CSMKEY0 Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Z2_CSMKEY0																															
R-0h																															

**Table 2-220. Z2\_CSMKEY0 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-0	Z2_CSMKEY0	R	0h	To unlock Zone2, user needs to write this register with exact value as Z2_CSMPWD0, programmed in OTP (zone gets unlock only if 128 bit password in OTP match with value written in four CSMKEY registers.) Reset type: SYSRSn

**2.15.17.6 Z2\_CSMKEY1 Register (Offset = 12h) [reset = 0h]**

Z2\_CSMKEY1 is shown in [Figure 2-196](#) and described in [Table 2-221](#).

Return to [Summary Table](#).

Zone 2 CSM Key 1

**Figure 2-196. Z2\_CSMKEY1 Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Z2_CSMKEY1																															
R-0h																															

**Table 2-221. Z2\_CSMKEY1 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-0	Z2_CSMKEY1	R	0h	To unlock Zone2, user needs to write this register with exact value as Z2_CSMPWD1, programmed in OTP (zone gets unlock only if 128 bit password in OTP match with value written in four CSMKEY registers.) Reset type: SYSRSn

**2.15.17.7 Z2\_CSMKEY2 Register (Offset = 14h) [reset = 0h]**

Z2\_CSMKEY2 is shown in [Figure 2-197](#) and described in [Table 2-222](#).

Return to [Summary Table](#).

Zone 2 CSM Key 2

**Figure 2-197. Z2\_CSMKEY2 Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Z2_CSMKEY2																															
R-0h																															

**Table 2-222. Z2\_CSMKEY2 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-0	Z2_CSMKEY2	R	0h	To unlock Zone2, user needs to write this register with exact value as Z2_CSMPWD2, programmed in OTP (zone gets unlock only if 128 bit password in OTP match with value written in four CSMKEY registers.) Reset type: SYSRSn

**2.15.17.8 Z2\_CSMKEY3 Register (Offset = 16h) [reset = 0h]**

Z2\_CSMKEY3 is shown in [Figure 2-198](#) and described in [Table 2-223](#).

Return to [Summary Table](#).

Zone 2 CSM Key 3

**Figure 2-198. Z2\_CSMKEY3 Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Z2_CSMKEY3																															
R-0h																															

**Table 2-223. Z2\_CSMKEY3 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-0	Z2_CSMKEY3	R	0h	To unlock Zone2, user needs to write this register with exact value as Z2_CSMPWD3, programmed in OTP (zone gets unlock only if 128 bit password in OTP match with value written in four CSMKEY registers.) Reset type: SYSRSn

**2.15.17.9 Z2\_CR Register (Offset = 19h) [reset = 8h]**

Z2\_CR is shown in [Figure 2-199](#) and described in [Table 2-224](#).

Return to [Summary Table](#).

Zone 2 CSM Control Register

**Figure 2-199. Z2\_CR Register**

15	14	13	12	11	10	9	8
FORCESEC	RESERVED						
R=0/W-0h	R=0-0h						
7	6	5	4	3	2	1	0
RESERVED	ARMED	UNSECURE	ALLONE	ALLZERO	RESERVED		
R-0h	R-0h	R-0h	R-0h	R-1h	R-0h		

**Table 2-224. Z2\_CR Register Field Descriptions**

Bit	Field	Type	Reset	Description
15	FORCESEC	R=0/W	0h	A write '1' to this fields resets the state of zone. If zone is unlocked, it'll lock(secure) the zone and also resets all the bits in this register. Reset type: SYSRSn
14-8	RESERVED	R=0	0h	Reserved
7	RESERVED	R	0h	Reserved
6	ARMED	R	0h	0 : Dummy read to CSM Password locations in OTP hasn't been performed. 1 : Dummy read to CSM Password locations in OTP has been performed. Reset type: SYSRSn
5	UNSECURE	R	0h	Indiacates the state of Zone. 0 : Zone is in lock(secure) state. 1 : Zone is in unlock(unsecure) state. Reset type: SYSRSn
4	ALLONE	R	0h	Indicates the state of CSM passowrds. 0 : CSM Passwords are not all ones. 1 : CSM Passwords are all ones and zone is in unlock state. Reset type: SYSRSn
3	ALLZERO	R	1h	Indicates the state of CSM passowrds. 0 : CSM Passwords are not all zeros. 1 : CSM Passwords are all zero and device is permanently locked. Reset type: SYSRSn
2-0	RESERVED	R	0h	Reserved

### 2.15.17.10 Z2\_GRABSECTR Register (Offset = 1Ah) [reset = 0h]

Z2\_GRABSECTR is shown in [Figure 2-200](#) and described in [Table 2-225](#).

Return to [Summary Table](#).

Zone 2 Grab Flash Sectors Register

**Figure 2-200. Z2\_GRABSECTR Register**

31	30	29	28	27	26	25	24
RESERVED		GRAB_BANK1		GRAB_SECTN		GRAB_SECTM	
R-0h		R-0h		R-0h		R-0h	
23	22	21	20	19	18	17	16
GRAB_SECTL		GRAB_SECTK		GRAB_SECTJ		GRAB_SECTI	
R-0h		R-0h		R-0h		R-0h	
15	14	13	12	11	10	9	8
GRAB_SECTH		GRAB_SECTG		GRAB_SECTF		GRAB_SECTE	
R-0h		R-0h		R-0h		R-0h	
7	6	5	4	3	2	1	0
GRAB_SECTD		GRAB_SECTC		GRAB_SECTB		GRAB_SECTA	
R-0h		R-0h		R-0h		R-0h	

**Table 2-225. Z2\_GRABSECTR Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-30	RESERVED	R	0h	Reserved
29-28	GRAB_BANK1	R	0h	Value in this field gets loaded from Z2_GRABSECTR[29:28] when a read is issued to address location of Z2_GRABSECTR in OTP.  00 : Invalid. Flash BANK1 J is inaccessible. 01 : Request to allocate Flash BANK1 to Zone2. 10 : Request to allocate Flash BANK1 to Zone2. 11 : Request to make Flash sector BANK1 Non-Secure. Reset type: SYSRStn
27-26	GRAB_SECTN	R	0h	Value in this field gets loaded from Z2_GRABSECTR[27:26] when a read is issued to address location of Z2_GRABSECTR in OTP.  00 : Invalid. Flash Sector N is inaccessible. 01 : Request to allocate Flash Sector N to Zone2. 10 : Request to allocate Flash Sector N to Zone2. 11 : Request to make Flash sector N Non-Secure. Reset type: SYSRStn
25-24	GRAB_SECTM	R	0h	Value in this field gets loaded from Z2_GRABSECTR[25:24] when a read is issued to address location of Z2_GRABSECTR in OTP.  00 : Invalid. Flash Sector M is inaccessible. 01 : Request to allocate Flash Sector M to Zone2. 10 : Request to allocate Flash Sector M to Zone2. 11 : Request to make Flash sector M Non-Secure. Reset type: SYSRStn
23-22	GRAB_SECTL	R	0h	Value in this field gets loaded from Z2_GRABSECTR[23:22] when a read is issued to address location of Z2_GRABSECTR in OTP.  00 : Invalid. Flash Sector L is inaccessible. 01 : Request to allocate Flash Sector L to Zone2. 10 : Request to allocate Flash Sector L to Zone2. 11 : Request to make Flash sector L Non-Secure. Reset type: SYSRStn

**Table 2-225. Z2\_GRABSECTR Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
21-20	GRAB_SECTK	R	0h	Value in this field gets loaded from Z2_GRABSECTR[21:20] when a read is issued to address location of Z2_GRABSECTR in OTP.  00 : Invalid. Flash Sector K is inaccessible. 01 : Request to allocate Flash Sector K to Zone2. 10 : Request to allocate Flash Sector K to Zone2. 11 : Request to make Flash sector K Non-Secure. Reset type: SYSRSn
19-18	GRAB_SECTJ	R	0h	Value in this field gets loaded from Z2_GRABSECTR[19:18] when a read is issued to address location of Z2_GRABSECTR in OTP.  00 : Invalid. Flash Sector J is inaccessible. 01 : Request to allocate Flash Sector J to Zone2. 10 : Request to allocate Flash Sector J to Zone2. 11 : Request to make Flash sector J Non-Secure. Reset type: SYSRSn
17-16	GRAB_SECTI	R	0h	Value in this field gets loaded from Z2_GRABSECTR[17:16] when a read is issued to address location of Z2_GRABSECTR in OTP.  00 : Invalid. Flash Sector I is inaccessible. 01 : Request to allocate Flash Sector I to Zone2. 10 : Request to allocate Flash Sector I to Zone2. 11 : Request to make Flash sector I Non-Secure. Reset type: SYSRSn
15-14	GRAB_SECTH	R	0h	Value in this field gets loaded from Z2_GRABSECTR[15:14] when a read is issued to address location of Z2_GRABSECTR in OTP.  00 : Invalid. Flash Sector H is inaccessible. 01 : Request to allocate Flash Sector H to Zone2. 10 : Request to allocate Flash Sector H to Zone2. 11 : Request to make Flash sector H Non-Secure. Reset type: SYSRSn
13-12	GRAB_SECTG	R	0h	Value in this field gets loaded from Z2_GRABSECTR[13:12] when a read is issued to address location of Z2_GRABSECTR in OTP.  00 : Invalid. Flash Sector G is inaccessible. 01 : Request to allocate Flash Sector G to Zone2. 10 : Request to allocate Flash Sector G to Zone2. 11 : Request to make Flash sector G Non-Secure. Reset type: SYSRSn
11-10	GRAB_SECTF	R	0h	Value in this field gets loaded from Z2_GRABSECTR[11:10] when a read is issued to address location of Z2_GRABSECTR in OTP.  00 : Invalid. Flash Sector F is inaccessible. 01 : Request to allocate Flash Sector F to Zone2. 10 : Request to allocate Flash Sector F to Zone2. 11 : Request to make Flash sector F Non-Secure. Reset type: SYSRSn
9-8	GRAB_SECTE	R	0h	Value in this field gets loaded from Z2_GRABSECTR[9:8] when a read is issued to address location of Z2_GRABSECTR in OTP.  00 : Invalid. Flash Sector E is inaccessible. 01 : Request to allocate Flash Sector E to Zone2. 10 : Request to allocate Flash Sector E to Zone2. 11 : Request to make Flash sector E Non-Secure. Reset type: SYSRSn



**Table 2-225. Z2\_GRABSECTR Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
7-6	GRAB_SECTD	R	0h	<p>Value in this field gets loaded from Z2_GRABSECT[7:6] when a read is issued to address location of Z2_GRABSECT in OTP.</p> <p>00 : Invalid. Flash Sector D is inaccessible.            01 : Request to allocate Flash Sector D to Zone2.            10 : Request to allocate Flash Sector D to Zone2.            11 : Request to make Flash sector D Non-Secure.            Reset type: SYSRSn</p>
5-4	GRAB_SECTC	R	0h	<p>Value in this field gets loaded from Z2_GRABSECT[5:4] when a read is issued to address location of Z2_GRABSECT in OTP.</p> <p>00 : Invalid. Flash Sector C is inaccessible.            01 : Request to allocate Flash Sector C to Zone2.            10 : Request to allocate Flash Sector C to Zone2.            11 : Request to make Flash sector C Non-Secure.            Reset type: SYSRSn</p>
3-2	GRAB_SECTB	R	0h	<p>Value in this field gets loaded from Z2_GRABSECT[3:2] when a read is issued to address location of Z2_GRABSECT in OTP.</p> <p>00 : Invalid. Flash Sector B is inaccessible.            01 : Request to allocate Flash Sector B to Zone2.            10 : Request to allocate Flash Sector B to Zone2.            11 : Request to make Flash sector B Non-Secure.            Reset type: SYSRSn</p>
1-0	GRAB_SECTA	R	0h	<p>Value in this field gets loaded from Z2_GRABSECT[1:0] when a read is issued to address location of Z2_GRABSECT in OTP.</p> <p>00 : Invalid. Flash Sector A is inaccessible.            01 : Request to allocate Flash Sector A to Zone2.            10 : Request to allocate Flash Sector A to Zone2.            11 : Request to make Flash sector A Non-Secure.            Reset type: SYSRSn</p>

**2.15.17.11 Z2\_GRABRAMR Register (Offset = 1Ch) [reset = 0h]**

Z2\_GRABRAMR is shown in [Figure 2-201](#) and described in [Table 2-226](#).

Return to [Summary Table](#).

Zone 2 Grab RAM Blocks Register

**Figure 2-201. Z2\_GRABRAMR Register**

31	30	29	28	27	26	25	24
RESERVED		GRAB_CLA1		RESERVED			
R-0h		R-0h		R-0h			
23	22	21	20	19	18	17	16
RESERVED							
R-0h							
15	14	13	12	11	10	9	8
GRAB_RAM7		GRAB_RAM6		GRAB_RAM5		GRAB_RAM4	
R-0h		R-0h		R-0h		R-0h	
7	6	5	4	3	2	1	0
GRAB_RAM3		GRAB_RAM2		GRAB_RAM1		GRAB_RAM0	
R-0h		R-0h		R-0h		R-0h	

**Table 2-226. Z2\_GRABRAMR Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-30	RESERVED	R	0h	Reserved
29-28	GRAB_CLA1	R	0h	Value in this field gets loaded from Z2_GRABRAM[29:28] when a read is issued to address location of Z2_GRABRAM in OTP.  00 : Invalid. CLA1 is inaccessible. 01 : Request to allocate CLA1 to Zone2. 10 : Request to allocate CLA1 to Zone2. 11 : Request to make CLA1 Non-Secure. Reset type: SYSRSn
27-16	RESERVED	R	0h	Reserved
15-14	GRAB_RAM7	R	0h	Value in this field gets loaded from Z2_GRABRAM[15:14] when a read is issued to address location of Z2_GRABRAM in OTP.  00 : Invalid. D1 RAM is inaccessible. 01 : Request to allocate D1 RAM to Zone2. 10 : Request to allocate D1 RAM to Zone2. 11 : Request to make D1 RAM Non-Secure. Reset type: SYSRSn
13-12	GRAB_RAM6	R	0h	Value in this field gets loaded from Z2_GRABRAM[13:12] when a read is issued to address location of Z2_GRABRAM in OTP.  00 : Invalid. D0 RAM is inaccessible. 01 : Request to allocate D0 RAM to Zone2. 10 : Request to allocate D0 RAM to Zone2. 11 : Request to make D0 RAM Non-Secure. Reset type: SYSRSn

**Table 2-226. Z2\_GRABRAMR Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
11-10	GRAB_RAM5	R	0h	Value in this field gets loaded from Z2_GRABRAM[11:10] when a read is issued to address location of Z2_GRABRAM in OTP.  00 : Invalid. LS5 RAM is inaccessible. 01 : Request to allocate LS5 RAM to Zone2. 10 : Request to allocate LS5 RAM to Zone2. 11 : Request to make LS5 RAM Non-Secure. Reset type: SYSRSn
9-8	GRAB_RAM4	R	0h	Value in this field gets loaded from Z2_GRABRAM[9:8] when a read is issued to address location of Z2_GRABRAM in OTP.  00 : Invalid. LS4 RAM is inaccessible. 01 : Request to allocate LS4 RAM to Zone2. 10 : Request to allocate LS4 RAM to Zone2. 11 : Request to make LS4 RAM Non-Secure. Reset type: SYSRSn
7-6	GRAB_RAM3	R	0h	Value in this field gets loaded from Z2_GRABRAM[7:6] when a read is issued to address location of Z2_GRABRAM in OTP.  00 : Invalid. LS3 RAM is inaccessible. 01 : Request to allocate LS3 RAM to Zone2. 10 : Request to allocate LS3 RAM to Zone2. 11 : Request to make LS3 RAM Non-Secure. Reset type: SYSRSn
5-4	GRAB_RAM2	R	0h	Value in this field gets loaded from Z2_GRABRAM[5:4] when a read is issued to address location of Z2_GRABRAM in OTP.  00 : Invalid. LS2 RAM is inaccessible. 01 : Request to allocate LS2 RAM to Zone2. 10 : Request to allocate LS2 RAM to Zone2. 11 : Request to make LS2 RAM Non-Secure. Reset type: SYSRSn
3-2	GRAB_RAM1	R	0h	Value in this field gets loaded from Z2_GRABRAM[3:2] when a read is issued to address location of Z2_GRABRAM in OTP.  00 : Invalid. LS1 RAM is inaccessible. 01 : Request to allocate LS1 RAM to Zone2. 10 : Request to allocate LS1 RAM to Zone2. 11 : Request to make LS1 RAM Non-Secure. Reset type: SYSRSn
1-0	GRAB_RAM0	R	0h	Value in this field gets loaded from Z2_GRABRAM[1:0] when a read is issued to address location of Z2_GRABRAM in OTP.  00 : Invalid. LS0 RAM is inaccessible. 01 : Request to allocate LS0 RAM to Zone2. 10 : Request to allocate LS0 RAM to Zone2. 11 : Request to make LS0 RAM Non-Secure. Reset type: SYSRSn

**2.15.17.12 Z2\_EXEONLYSECTR Register (Offset = 1Eh) [reset = 0h]**

 Z2\_EXEONLYSECTR is shown in [Figure 2-202](#) and described in [Table 2-227](#).

 Return to [Summary Table](#).

Zone 2 Flash Execute\_Only Sector Register

**Figure 2-202. Z2\_EXEONLYSECTR Register**

31	30	29	28	27	26	25	24
RESERVED							
R-0h							
23	22	21	20	19	18	17	16
RESERVED							
R-0h							
15	14	13	12	11	10	9	8
RESERVED	EXEONLY_BA NK1	EXEONLY_SE CTN	EXEONLY_SE CTM	EXEONLY_SE CTL	EXEONLY_SE CTK	EXEONLY_SE CTJ	EXEONLY_SE CTI
R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h
7	6	5	4	3	2	1	0
EXEONLY_SE CTH	EXEONLY_SE CTG	EXEONLY_SE CTF	EXEONLY_SE CTE	EXEONLY_SE CTD	EXEONLY_SE CTC	EXEONLY_SE CTB	EXEONLY_SE CTA
R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h

**Table 2-227. Z2\_EXEONLYSECTR Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R	0h	Reserved
15	RESERVED	R	0h	Reserved
14	EXEONLY_BANK1	R	0h	Value in this field gets loaded from Z2_EXEONLYSECTR[14:14] when a read is issued to Z2_EXEONLYSECTR address location in OTP.  0 : Execute-Only protection is enabled for Flash BANK1 (only if it's allocated to Zone2) 1 : Execute-Only protection is disabled for Flash BANK1 (only if it's allocated to Zone2) Reset type: SYSRSn
13	EXEONLY_SECTN	R	0h	Value in this field gets loaded from Z2_EXEONLYSECTR[13:13] when a read is issued to Z2_EXEONLYSECTR address location in OTP.  0 : Execute-Only protection is enabled for Flash Sector N (only if it's allocated to Zone2) 1 : Execute-Only protection is disabled for Flash Sector N (only if it's allocated to Zone2) Reset type: SYSRSn
12	EXEONLY_SECTM	R	0h	Value in this field gets loaded from Z2_EXEONLYSECTR[12:12] when a read is issued to Z2_EXEONLYSECTR address location in OTP.  0 : Execute-Only protection is enabled for Flash Sector M (only if it's allocated to Zone2) 1 : Execute-Only protection is disabled for Flash Sector M (only if it's allocated to Zone2) Reset type: SYSRSn

**Table 2-227. Z2\_EXEONLYSECTR Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
11	EXEONLY_SECTL	R	0h	Value in this field gets loaded from Z2_EXEONLYSECT[11:11] when a read is issued to Z2_EXEONLYSECT address location in OTP.  0 : Execute-Only protection is enabled for Flash Sector L (only if it's allocated to Zone2) 1 : Execute-Only protection is disabled for Flash Sector L (only if it's allocated to Zone2) Reset type: SYSRSn
10	EXEONLY_SECTK	R	0h	Value in this field gets loaded from Z2_EXEONLYSECT[10:10] when a read is issued to Z2_EXEONLYSECT address location in OTP.  0 : Execute-Only protection is enabled for Flash Sector K (only if it's allocated to Zone2) 1 : Execute-Only protection is disabled for Flash Sector K (only if it's allocated to Zone2) Reset type: SYSRSn
9	EXEONLY_SECTJ	R	0h	Value in this field gets loaded from Z2_EXEONLYSECT[9:9] when a read is issued to Z2_EXEONLYSECT address location in OTP.  0 : Execute-Only protection is enabled for Flash Sector J (only if it's allocated to Zone2) 1 : Execute-Only protection is disabled for Flash Sector J (only if it's allocated to Zone2) Reset type: SYSRSn
8	EXEONLY_SECTI	R	0h	Value in this field gets loaded from Z2_EXEONLYSECT[8:8] when a read is issued to Z2_EXEONLYSECT address location in OTP.  0 : Execute-Only protection is enabled for Flash Sector I (only if it's allocated to Zone2) 1 : Execute-Only protection is disabled for Flash Sector I (only if it's allocated to Zone2) Reset type: SYSRSn
7	EXEONLY_SECTH	R	0h	Value in this field gets loaded from Z2_EXEONLYSECT[7:7] when a read is issued to Z2_EXEONLYSECT address location in OTP.  0 : Execute-Only protection is enabled for Flash Sector H (only if it's allocated to Zone2) 1 : Execute-Only protection is disabled for Flash Sector H (only if it's allocated to Zone2) Reset type: SYSRSn
6	EXEONLY_SECTG	R	0h	Value in this field gets loaded from Z2_EXEONLYSECT[6:6] when a read is issued to Z2_EXEONLYSECT address location in OTP.  0 : Execute-Only protection is enabled for Flash Sector G (only if it's allocated to Zone2) 1 : Execute-Only protection is disabled for Flash Sector G (only if it's allocated to Zone2) Reset type: SYSRSn
5	EXEONLY_SECTF	R	0h	Value in this field gets loaded from Z2_EXEONLYSECT[5:5] when a read is issued to Z2_EXEONLYSECT address location in OTP.  0 : Execute-Only protection is enabled for Flash Sector F (only if it's allocated to Zone2) 1 : Execute-Only protection is disabled for Flash Sector F (only if it's allocated to Zone2) Reset type: SYSRSn

**Table 2-227. Z2\_EXEONLYSECTR Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
4	EXEONLY_SECTE	R	0h	Value in this field gets loaded from Z2_EXEONLYSECT[4:4] when a read is issued to Z2_EXEONLYSECT address location in OTP.  0 : Execute-Only protection is enabled for Flash Sector E (only if it's allocated to Zone2) 1 : Execute-Only protection is disabled for Flash Sector E (only if it's allocated to Zone2) Reset type: SYSRSn
3	EXEONLY_SECTD	R	0h	Value in this field gets loaded from Z2_EXEONLYSECT[3:3] when a read is issued to Z2_EXEONLYSECT address location in OTP.  0 : Execute-Only protection is enabled for Flash Sector D (only if it's allocated to Zone2) 1 : Execute-Only protection is disabled for Flash Sector D (only if it's allocated to Zone2) Reset type: SYSRSn
2	EXEONLY_SECTC	R	0h	Value in this field gets loaded from Z2_EXEONLYSECT[2:2] when a read is issued to Z2_EXEONLYSECT address location in OTP.  0 : Execute-Only protection is enabled for Flash Sector C (only if it's allocated to Zone2) 1 : Execute-Only protection is disabled for Flash Sector C (only if it's allocated to Zone2) Reset type: SYSRSn
1	EXEONLY_SECTB	R	0h	Value in this field gets loaded from Z2_EXEONLYSECT[1:1] when a read is issued to Z2_EXEONLYSECT address location in OTP.  0 : Execute-Only protection is enabled for Flash Sector B (only if it's allocated to Zone2) 1 : Execute-Only protection is disabled for Flash Sector B (only if it's allocated to Zone2) Reset type: SYSRSn
0	EXEONLY_SECTA	R	0h	Value in this field gets loaded from Z2_EXEONLYSECT[0:0] when a read is issued to Z2_EXEONLYSECT address location in OTP.  0 : Execute-Only protection is enabled for Flash Sector A (only if it's allocated to Zone2) 1 : Execute-Only protection is disabled for Flash Sector A (only if it's allocated to Zone2) Reset type: SYSRSn

### 2.15.17.13 Z2\_EXEONLYRAMR Register (Offset = 20h) [reset = 0h]

Z2\_EXEONLYRAMR is shown in [Figure 2-203](#) and described in [Table 2-228](#).

Return to [Summary Table](#).

Zone 2 RAM Execute\_Only Block Register

**Figure 2-203. Z2\_EXEONLYRAMR Register**

31	30	29	28	27	26	25	24
RESERVED							
R=0-0h							
23	22	21	20	19	18	17	16
RESERVED							
R=0-0h							
15	14	13	12	11	10	9	8
RESERVED							
R=0-0h							
7	6	5	4	3	2	1	0
EXEONLY_RA M7	EXEONLY_RA M6	EXEONLY_RA M5	EXEONLY_RA M4	EXEONLY_RA M3	EXEONLY_RA M2	EXEONLY_RA M1	EXEONLY_RA M0
R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h

**Table 2-228. Z2\_EXEONLYRAMR Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R=0	0h	Reserved
15-8	RESERVED	R=0	0h	Reserved
7	EXEONLY_RAM7	R	0h	Value in this field gets loaded from Z2_EXEONLYRAM[7:7] when a read is issued to Z2_EXEONLYRAM address location in OTP.  0 : Execute-Only protection is enabled for D1 RAM (only if it's allocated to Zone2) 1 : Execute-Only protection is disabled for D1 RAM (only if it's allocated to Zone2) Reset type: SYSRSn
6	EXEONLY_RAM6	R	0h	Value in this field gets loaded from Z2_EXEONLYRAM[6:6] when a read is issued to Z2_EXEONLYRAM address location in OTP.  0 : Execute-Only protection is enabled for D0 RAM (only if it's allocated to Zone2) 1 : Execute-Only protection is disabled for D0 RAM (only if it's allocated to Zone2) Reset type: SYSRSn
5	EXEONLY_RAM5	R	0h	Value in this field gets loaded from Z2_EXEONLYRAM[5:5] when a read is issued to Z2_EXEONLYRAM address location in OTP.  0 : Execute-Only protection is enabled for LS5 RAM (only if it's allocated to Zone2) 1 : Execute-Only protection is disabled for LS5 RAM (only if it's allocated to Zone2) Reset type: SYSRSn
4	EXEONLY_RAM4	R	0h	Value in this field gets loaded from Z2_EXEONLYRAM[4:4] when a read is issued to Z2_EXEONLYRAM address location in OTP.  0 : Execute-Only protection is enabled for LS4 RAM (only if it's allocated to Zone2) 1 : Execute-Only protection is disabled for LS4 RAM (only if it's allocated to Zone2) Reset type: SYSRSn

**Table 2-228. Z2\_EXEONLYRAMR Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
3	EXEONLY_RAM3	R	0h	<p>Value in this field gets loaded from Z2_EXEONLYRAM[3:3] when a read is issued to Z2_EXEONLYRAM address location in OTP.</p> <p>0 : Execute-Only protection is enabled for LS3 RAM (only if it's allocated to Zone2)</p> <p>1 : Execute-Only protection is disabled for LS3 RAM (only if it's allocated to Zone2)</p> <p>Reset type: SYSRSn</p>
2	EXEONLY_RAM2	R	0h	<p>Value in this field gets loaded from Z2_EXEONLYRAM[2:2] when a read is issued to Z2_EXEONLYRAM address location in OTP.</p> <p>0 : Execute-Only protection is enabled for LS2 RAM (only if it's allocated to Zone2)</p> <p>1 : Execute-Only protection is disabled for LS2 RAM (only if it's allocated to Zone2)</p> <p>Reset type: SYSRSn</p>
1	EXEONLY_RAM1	R	0h	<p>Value in this field gets loaded from Z2_EXEONLYRAM[1:1] when a read is issued to Z2_EXEONLYRAM address location in OTP.</p> <p>0 : Execute-Only protection is enabled for LS1 RAM (only if it's allocated to Zone2)</p> <p>1 : Execute-Only protection is disabled for LS1 RAM (only if it's allocated to Zone2)</p> <p>Reset type: SYSRSn</p>
0	EXEONLY_RAM0	R	0h	<p>Value in this field gets loaded from Z2_EXEONLYRAM[0:0] when a read is issued to Z2_EXEONLYRAM address location in OTP.</p> <p>0 : Execute-Only protection is enabled for LS0 RAM (only if it's allocated to Zone2)</p> <p>1 : Execute-Only protection is disabled for LS0 RAM (only if it's allocated to Zone2)</p> <p>Reset type: SYSRSn</p>



## 2.15.18 MEM\_CFG\_REGS Registers

Table 2-229 lists the memory-mapped registers for the MEM\_CFG\_REGS. All register offset addresses not listed in Table 2-229 should be considered as reserved locations and the register contents should not be modified.

**Table 2-229. MEM\_CFG\_REGS Registers**

Offset	Acronym	Register Name	Write Protection	Section
0h	DxLOCK	Dedicated RAM Config Lock Register	EALLOW	<a href="#">Go</a>
2h	DxCOMMIT	Dedicated RAM Config Lock Commit Register	EALLOW	<a href="#">Go</a>
8h	DxACCPROT0	Dedicated RAM Config Register	EALLOW	<a href="#">Go</a>
10h	DxTEST	Dedicated RAM TEST Register	EALLOW	<a href="#">Go</a>
12h	DxINIT	Dedicated RAM Init Register	EALLOW	<a href="#">Go</a>
14h	DxINITDONE	Dedicated RAM InitDone Status Register		<a href="#">Go</a>
20h	LSxLOCK	Local Shared RAM Config Lock Register	EALLOW	<a href="#">Go</a>
22h	LSxCOMMIT	Local Shared RAM Config Lock Commit Register	EALLOW	<a href="#">Go</a>
24h	LSxMSEL	Local Shared RAM Master Sel Register	EALLOW	<a href="#">Go</a>
26h	LSxCLAPGM	Local Shared RAM Prog/Exe control Register	EALLOW	<a href="#">Go</a>
28h	LSxACCPROT0	Local Shared RAM Config Register 0	EALLOW	<a href="#">Go</a>
2Ah	LSxACCPROT1	Local Shared RAM Config Register 1	EALLOW	<a href="#">Go</a>
30h	LSxTEST	Local Shared RAM TEST Register	EALLOW	<a href="#">Go</a>
32h	LSxINIT	Local Shared RAM Init Register	EALLOW	<a href="#">Go</a>
34h	LSxINITDONE	Local Shared RAM InitDone Status Register		<a href="#">Go</a>
40h	GSxLOCK	Global Shared RAM Config Lock Register	EALLOW	<a href="#">Go</a>
42h	GSxCOMMIT	Global Shared RAM Config Lock Commit Register	EALLOW	<a href="#">Go</a>
48h	GSxACCPROT0	Global Shared RAM Config Register 0	EALLOW	<a href="#">Go</a>
4Ah	GSxACCPROT1	Global Shared RAM Config Register 1	EALLOW	<a href="#">Go</a>
4Ch	GSxACCPROT2	Global Shared RAM Config Register 2	EALLOW	<a href="#">Go</a>
4Eh	GSxACCPROT3	Global Shared RAM Config Register 3	EALLOW	<a href="#">Go</a>
50h	GSxTEST	Global Shared RAM TEST Register	EALLOW	<a href="#">Go</a>
52h	GSxINIT	Global Shared RAM Init Register	EALLOW	<a href="#">Go</a>
54h	GSxINITDONE	Global Shared RAM InitDone Status Register		<a href="#">Go</a>
70h	MSGxTEST	Message RAM TEST Register	EALLOW	<a href="#">Go</a>
72h	MSGxINIT	Message RAM Init Register	EALLOW	<a href="#">Go</a>
74h	MSGxINITDONE	Message RAM InitDone Status Register		<a href="#">Go</a>

Complex bit access types are encoded to fit into small table cells. Table 2-230 shows the codes that are used for access types in this section.

**Table 2-230. MEM\_CFG\_REGS Access Type Codes**

Access Type	Code	Description
<b>Read Type</b>		
R	R	Read
R=0	R	Read
<b>Write Type</b>		
W	W	Write
W=1	W	Write
WSOnce	SOnce W	Set once Write
<b>Reset or Default Value</b>		

**Table 2-230. MEM\_CFG\_REGS Access Type Codes (continued)**

Access Type	Code	Description
-n		Value after reset or the default value
<b>Register Array Variables</b>		
i,j,k,l,m,n		When these variables are used in a register name, an offset, or an address, they refer to the value of a register array where the register is part of a group of repeating registers. The register groups form a hierarchical structure and the array is represented with a formula.
y		When this variable is used in a register name, an offset, or an address it refers to the value of a register array.

**2.15.18.1 DxLOCK Register (Offset = 0h) [reset = 0h]**

DxLOCK is shown in [Figure 2-204](#) and described in [Table 2-231](#).

Return to [Summary Table](#).

Dedicated RAM Config Lock Register

**Figure 2-204. DxLOCK Register**

31	30	29	28	27	26	25	24
RESERVED							
R-0h							
23	22	21	20	19	18	17	16
RESERVED							
R-0h							
15	14	13	12	11	10	9	8
RESERVED							
R-0h							
7	6	5	4	3	2	1	0
RESERVED				LOCK_D1	LOCK_D0	RESERVED	
R-0h				R/W-0h	R/W-0h	R-0h	

**Table 2-231. DxLOCK Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R	0h	Reserved
15-4	RESERVED	R	0h	Reserved
3	LOCK_D1	R/W	0h	Locks the write to access protection and master select fields for D1 RAM: 0: Write to ACCPROT and Mselect fields are allowed. 1: Write to ACCPROT and Mselect fields are blocked. Reset type: SYSRSn
2	LOCK_D0	R/W	0h	Locks the write to access protection and master select fields for D0 RAM: 0: Write to ACCPROT and Mselect fields are allowed. 1: Write to ACCPROT and Mselect fields are blocked. Reset type: SYSRSn
1-0	RESERVED	R	0h	Reserved

**2.15.18.2 DxCOMMIT Register (Offset = 2h) [reset = 0h]**

DxCOMMIT is shown in [Figure 2-205](#) and described in [Table 2-232](#).

Return to [Summary Table](#).

Dedicated RAM Config Lock Commit Register

**Figure 2-205. DxCOMMIT Register**

31	30	29	28	27	26	25	24
RESERVED							
R-0h							
23	22	21	20	19	18	17	16
RESERVED							
R-0h							
15	14	13	12	11	10	9	8
RESERVED							
R-0h							
7	6	5	4	3	2	1	0
RESERVED				COMMIT_D1	COMMIT_D0	RESERVED	
R-0h				R/WSONce-0h	R/WSONce-0h	R-0h	

**Table 2-232. DxCOMMIT Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R	0h	Reserved
15-4	RESERVED	R	0h	Reserved
3	COMMIT_D1	R/WSONce	0h	Permanently Locks the write to access protection and master select fields for D1 RAM: 0: Write to ACCPROT and Mselect fields are allowed based on value of lock field in DxLOCK register. 1: Write to ACCPROT and Mselect fields are permanently blocked. Reset type: SYSRSn
2	COMMIT_D0	R/WSONce	0h	Permanently Locks the write to access protection and master select fields for D0 RAM: 0: Write to ACCPROT and Mselect fields are allowed based on value of lock field in DxLOCK register. 1: Write to ACCPROT and Mselect fields are permanently blocked. Reset type: SYSRSn
1-0	RESERVED	R	0h	Reserved

### 2.15.18.3 DxACCPROT0 Register (Offset = 8h) [reset = 0h]

DxACCPROT0 is shown in [Figure 2-206](#) and described in [Table 2-233](#).

Return to [Summary Table](#).

Dedicated RAM Config Register

**Figure 2-206. DxACCPROT0 Register**

31	30	29	28	27	26	25	24
RESERVED						CPUWRPROT_D1	FETCHPROT_D1
R-0h						R/W-0h	R/W-0h
23	22	21	20	19	18	17	16
RESERVED						CPUWRPROT_D0	FETCHPROT_D0
R-0h						R/W-0h	R/W-0h
15	14	13	12	11	10	9	8
RESERVED							
R-0h							
7	6	5	4	3	2	1	0
RESERVED							
R-0h							

**Table 2-233. DxACCPROT0 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-26	RESERVED	R	0h	Reserved
25	CPUWRPROT_D1	R/W	0h	CPU WR Protection For D1 RAM: 0: CPU Writes are allowed. 1: CPU Writes are blocked. Reset type: SYSRSn
24	FETCHPROT_D1	R/W	0h	Fetch Protection For D1 RAM: 0: CPU Fetch are allowed. 1: CPU Fetch are blocked. Reset type: SYSRSn
23-18	RESERVED	R	0h	Reserved
17	CPUWRPROT_D0	R/W	0h	CPU WR Protection For D0 RAM: 0: CPU Writes are allowed. 1: CPU Writes are block. Reset type: SYSRSn
16	FETCHPROT_D0	R/W	0h	Fetch Protection For D0 RAM: 0: CPU Fetch are allowed. 1: CPU Fetch are blocked. Reset type: SYSRSn
15-0	RESERVED	R	0h	Reserved

**2.15.18.4 DxTEST Register (Offset = 10h) [reset = 0h]**

DxTEST is shown in [Figure 2-207](#) and described in [Table 2-234](#).

Return to [Summary Table](#).

Dedicated RAM TEST Register

**Figure 2-207. DxTEST Register**

31	30	29	28	27	26	25	24
RESERVED							
R-0h							
23	22	21	20	19	18	17	16
RESERVED							
R-0h							
15	14	13	12	11	10	9	8
RESERVED							
R-0h							
7	6	5	4	3	2	1	0
TEST_D1		TEST_D0		TEST_M1		TEST_M0	
R/W-0h		R/W-0h		R/W-0h		R/W-0h	

**Table 2-234. DxTEST Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R	0h	Reserved
15-8	RESERVED	R	0h	Reserved
7-6	TEST_D1	R/W	0h	Selects the different modes for D1 RAM: 00: Functional Mode. 01: Writes are allowed to data bits only. No write to ECC bits. 10: Writes are allowed to ECC bits only. No write to data bits. 11: Functional Mode. Reset type: SYSRSn
5-4	TEST_D0	R/W	0h	Selects the different modes for D0 RAM: 00: Functional Mode. 01: Writes are allowed to data bits only. No write to ECC bits. 10: Writes are allowed to ECC bits only. No write to data bits. 11: Functional Mode. Reset type: SYSRSn
3-2	TEST_M1	R/W	0h	Selects the different modes for M1 RAM: 00: Functional Mode. 01: Writes are allowed to data bits only. No write to ECC bits. 10: Writes are allowed to ECC bits only. No write to data bits. 11: Functional Mode. Reset type: SYSRSn
1-0	TEST_M0	R/W	0h	Selects the different modes for M0 RAM: 00: Functional Mode. 01: Writes are allowed to data bits only. No write to ECC bits. 10: Writes are allowed to ECC bits only. No write to data bits. 11: Functional Mode. Reset type: SYSRSn

**2.15.18.5 DxINIT Register (Offset = 12h) [reset = 0h]**

DxINIT is shown in [Figure 2-208](#) and described in [Table 2-235](#).

Return to [Summary Table](#).

Dedicated RAM Init Register

**Figure 2-208. DxINIT Register**

31	30	29	28	27	26	25	24
RESERVED							
R-0h							
23	22	21	20	19	18	17	16
RESERVED							
R-0h							
15	14	13	12	11	10	9	8
RESERVED							
R-0h							
7	6	5	4	3	2	1	0
RESERVED				INIT_D1	INIT_D0	INIT_M1	INIT_M0
R-0h				R=0/W=1-0h	R=0/W=1-0h	R=0/W=1-0h	R=0/W=1-0h

**Table 2-235. DxINIT Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R	0h	Reserved
15-4	RESERVED	R	0h	Reserved
3	INIT_D1	R=0/W=1	0h	RAM Initialization control for D1 RAM: 0: None. 1: Start RAM Initialization. Reset type: SYSRSn
2	INIT_D0	R=0/W=1	0h	RAM Initialization control for D0 RAM: 0: None. 1: Start RAM Initialization. Reset type: SYSRSn
1	INIT_M1	R=0/W=1	0h	RAM Initialization control for M1 RAM: 0: None. 1: Start RAM Initialization. Reset type: SYSRSn
0	INIT_M0	R=0/W=1	0h	RAM Initialization control for M0 RAM: 0: None. 1: Start RAM Initialization. Reset type: SYSRSn

**2.15.18.6 DxINITDONE Register (Offset = 14h) [reset = 0h]**

DxINITDONE is shown in [Figure 2-209](#) and described in [Table 2-236](#).

Return to [Summary Table](#).

Dedicated RAM InitDone Status Register

**Figure 2-209. DxINITDONE Register**

31	30	29	28	27	26	25	24
RESERVED							
R-0h							
23	22	21	20	19	18	17	16
RESERVED							
R-0h							
15	14	13	12	11	10	9	8
RESERVED							
R-0h							
7	6	5	4	3	2	1	0
RESERVED				INITDONE_D1	INITDONE_D0	INITDONE_M1	INITDONE_M0
R-0h				R-0h	R-0h	R-0h	R-0h

**Table 2-236. DxINITDONE Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R	0h	Reserved
15-4	RESERVED	R	0h	Reserved
3	INITDONE_D1	R	0h	RAM Initialization status for D1 RAM: 0: RAM Initialization has completed. 1: RAM Initialization has completed. Reset type: SYSRSn
2	INITDONE_D0	R	0h	RAM Initialization status for D0 RAM: 0: RAM Initialization is not done. 1: RAM Initialization is done. Reset type: SYSRSn
1	INITDONE_M1	R	0h	RAM Initialization status for M1 RAM: 0: RAM Initialization has completed. 1: RAM Initialization has completed. Reset type: SYSRSn
0	INITDONE_M0	R	0h	RAM Initialization status for M0 RAM: 0: RAM Initialization is not done. 1: RAM Initialization is done. Reset type: SYSRSn



### 2.15.18.7 LSxLOCK Register (Offset = 20h) [reset = 0h]

LSxLOCK is shown in [Figure 2-210](#) and described in [Table 2-237](#).

Return to [Summary Table](#).

Local Shared RAM Config Lock Register

**Figure 2-210. LSxLOCK Register**

31	30	29	28	27	26	25	24
RESERVED							
R-0h							
23	22	21	20	19	18	17	16
RESERVED							
R-0h							
15	14	13	12	11	10	9	8
RESERVED							
R-0h							
7	6	5	4	3	2	1	0
RESERVED		LOCK_LS5	LOCK_LS4	LOCK_LS3	LOCK_LS2	LOCK_LS1	LOCK_LS0
R-0h		R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h

**Table 2-237. LSxLOCK Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R	0h	Reserved
15-6	RESERVED	R	0h	Reserved
5	LOCK_LS5	R/W	0h	Locks the write to access protection and master select fields for LS5 RAM: 0: Write to ACCPROT and Mselect fields are allowed. 1: Write to ACCPROT and Mselect fields are blocked. Reset type: SYSRSn
4	LOCK_LS4	R/W	0h	Locks the write to access protection and master select fields for LS4 RAM: 0: Write to ACCPROT and Mselect fields are allowed. 1: Write to ACCPROT and Mselect fields are blocked. Reset type: SYSRSn
3	LOCK_LS3	R/W	0h	Locks the write to access protection and master select fields for LS3 RAM: 0: Write to ACCPROT and Mselect fields are allowed. 1: Write to ACCPROT and Mselect fields are blocked. Reset type: SYSRSn
2	LOCK_LS2	R/W	0h	Locks the write to access protection and master select fields for LS2 RAM: 0: Write to ACCPROT and Mselect fields are allowed. 1: Write to ACCPROT and Mselect fields are blocked. Reset type: SYSRSn
1	LOCK_LS1	R/W	0h	Locks the write to access protection and master select fields for LS1 RAM: 0: Write to ACCPROT and Mselect fields are allowed. 1: Write to ACCPROT and Mselect fields are blocked. Reset type: SYSRSn

**Table 2-237. LSxLOCK Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
0	LOCK_LS0	R/W	0h	Locks the write to access protection and master select fields for LS0 RAM: 0: Write to ACCPROT and Mselect fields are allowed. 1: Write to ACCPROT and Mselect fields are blocked. Reset type: SYSRSn

### 2.15.18.8 LSxCOMMIT Register (Offset = 22h) [reset = 0h]

LSxCOMMIT is shown in [Figure 2-211](#) and described in [Table 2-238](#).

Return to [Summary Table](#).

Local Shared RAM Config Lock Commit Register

**Figure 2-211. LSxCOMMIT Register**

31	30	29	28	27	26	25	24
RESERVED							
R-0h							
23	22	21	20	19	18	17	16
RESERVED							
R-0h							
15	14	13	12	11	10	9	8
RESERVED							
R-0h							
7	6	5	4	3	2	1	0
RESERVED		COMMIT_LS5	COMMIT_LS4	COMMIT_LS3	COMMIT_LS2	COMMIT_LS1	COMMIT_LS0
R-0h		R/WSONce-0h	R/WSONce-0h	R/WSONce-0h	R/WSONce-0h	R/WSONce-0h	R/WSONce-0h

**Table 2-238. LSxCOMMIT Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R	0h	Reserved
15-6	RESERVED	R	0h	Reserved
5	COMMIT_LS5	R/WSONce	0h	Permanently Locks the write to access protection and master select fields for LS5 RAM: 0: Write to ACCPROT and Mselect fields are allowed based on value of lock field in LSxLOCK register. 1: Write to ACCPROT and Mselect fields are permanently blocked. Reset type: SYSRSn
4	COMMIT_LS4	R/WSONce	0h	Permanently Locks the write to access protection and master select fields for LS4 RAM: 0: Write to ACCPROT and Mselect fields are allowed based on value of lock field in LSxLOCK register. 1: Write to ACCPROT and Mselect fields are permanently blocked. Reset type: SYSRSn
3	COMMIT_LS3	R/WSONce	0h	Permanently Locks the write to access protection and master select fields for LS3 RAM: 0: Write to ACCPROT and Mselect fields are allowed based on value of lock field in LSxLOCK register. 1: Write to ACCPROT and Mselect fields are permanently blocked. Reset type: SYSRSn
2	COMMIT_LS2	R/WSONce	0h	Permanently Locks the write to access protection and master select fields for LS2 RAM: 0: Write to ACCPROT and Mselect fields are allowed based on value of lock field in LSxLOCK register. 1: Write to ACCPROT and Mselect fields are permanently blocked. Reset type: SYSRSn

**Table 2-238. LSxCOMMIT Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
1	COMMIT_LS1	R/WOnce	0h	Permanently Locks the write to access protection and master select fields for LS1 RAM: 0: Write to ACCPROT and Mselect fields are allowed based on value of lock field in LSxLOCK register. 1: Write to ACCPROT and Mselect fields are permanently blocked. Reset type: SYSRSn
0	COMMIT_LS0	R/WOnce	0h	Permanently Locks the write to access protection and master select fields for LS0 RAM: 0: Write to ACCPROT and Mselect fields are allowed based on value of lock field in LSxLOCK register. 1: Write to ACCPROT and Mselect fields are permanently blocked. Reset type: SYSRSn

### 2.15.18.9 LSxMSEL Register (Offset = 24h) [reset = 0h]

LSxMSEL is shown in [Figure 2-212](#) and described in [Table 2-239](#).

Return to [Summary Table](#).

Local Shared RAM Master Sel Register

**Figure 2-212. LSxMSEL Register**

31	30	29	28	27	26	25	24
RESERVED							
R-0h							
23	22	21	20	19	18	17	16
RESERVED							
R-0h							
15	14	13	12	11	10	9	8
RESERVED				MSEL_LS5		MSEL_LS4	
R-0h				R/W-0h		R/W-0h	
7	6	5	4	3	2	1	0
MSEL_LS3		MSEL_LS2		MSEL_LS1		MSEL_LS0	
R/W-0h		R/W-0h		R/W-0h		R/W-0h	

**Table 2-239. LSxMSEL Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R	0h	Reserved
15-12	RESERVED	R	0h	Reserved
11-10	MSEL_LS5	R/W	0h	Master Select for LS5 RAM: 00: Memory is dedicated to CPU. 01: Memory is shared between CPU and CLA1. 10: Reserved. 11: Reserved. Reset type: SYSRSn
9-8	MSEL_LS4	R/W	0h	Master Select for LS4 RAM: 00: Memory is dedicated to CPU. 01: Memory is shared between CPU and CLA1. 10: Reserved. 11: Reserved. Reset type: SYSRSn
7-6	MSEL_LS3	R/W	0h	Master Select for LS3 RAM: 00: Memory is dedicated to CPU. 01: Memory is shared between CPU and CLA1. 10: Reserved. 11: Reserved. Reset type: SYSRSn
5-4	MSEL_LS2	R/W	0h	Master Select for LS2 RAM: 00: Memory is dedicated to CPU. 01: Memory is shared between CPU and CLA1. 10: Reserved. 11: Reserved. Reset type: SYSRSn

**Table 2-239. LSxMSEL Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
3-2	MSEL_LS1	R/W	0h	Master Select for LS1 RAM: 00: Memory is dedicated to CPU. 01: Memory is shared between CPU and CLA1. 10: Reserved. 11: Reserved. Reset type: SYSRSn
1-0	MSEL_LS0	R/W	0h	Master Select for LS0 RAM: 00: Memory is dedicated to CPU. 01: Memory is shared between CPU and CLA1. 10: Reserved. 11: Reserved. Reset type: SYSRSn

**2.15.18.10 LSxCLAPGM Register (Offset = 26h) [reset = 0h]**

LSxCLAPGM is shown in [Figure 2-213](#) and described in [Table 2-240](#).

Return to [Summary Table](#).

Local Shared RAM Prog/Exe control Register

**Figure 2-213. LSxCLAPGM Register**

31	30	29	28	27	26	25	24
RESERVED							
R-0h							
23	22	21	20	19	18	17	16
RESERVED							
R-0h							
15	14	13	12	11	10	9	8
RESERVED							
R-0h							
7	6	5	4	3	2	1	0
RESERVED		CLAPGM_LS5	CLAPGM_LS4	CLAPGM_LS3	CLAPGM_LS2	CLAPGM_LS1	CLAPGM_LS0
R-0h		R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h

**Table 2-240. LSxCLAPGM Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R	0h	Reserved
15-6	RESERVED	R	0h	Reserved
5	CLAPGM_LS5	R/W	0h	Selects LS5 RAM as program vs data memory for CLA: 0: CLA Data memory. 1: CLA Program memory. Reset type: SYSRSn
4	CLAPGM_LS4	R/W	0h	Selects LS4 RAM as program vs data memory for CLA: 0: CLA Data memory. 1: CLA Program memory. Reset type: SYSRSn
3	CLAPGM_LS3	R/W	0h	Selects LS3 RAM as program vs data memory for CLA: 0: CLA Data memory. 1: CLA Program memory. Reset type: SYSRSn
2	CLAPGM_LS2	R/W	0h	Selects LS2 RAM as program vs data memory for CLA: 0: CLA Data memory. 1: CLA Program memory. Reset type: SYSRSn
1	CLAPGM_LS1	R/W	0h	Selects LS1 RAM as program vs data memory for CLA: 0: CLA Data memory. 1: CLA Program memory. Reset type: SYSRSn
0	CLAPGM_LS0	R/W	0h	Selects LS0 RAM as program vs data memory for CLA: 0: CLA Data memory. 1: CLA Program memory. Reset type: SYSRSn

### 2.15.18.11 LSxACCPROT0 Register (Offset = 28h) [reset = 0h]

LSxACCPROT0 is shown in [Figure 2-214](#) and described in [Table 2-241](#).

Return to [Summary Table](#).

Local Shared RAM Config Register 0

**Figure 2-214. LSxACCPROT0 Register**

31	30	29	28	27	26	25	24
RESERVED						CPUWRPROT_ LS3	FETCHPROT_ LS3
R-0h						R/W-0h	R/W-0h
23	22	21	20	19	18	17	16
RESERVED						CPUWRPROT_ LS2	FETCHPROT_ LS2
R-0h						R/W-0h	R/W-0h
15	14	13	12	11	10	9	8
RESERVED						CPUWRPROT_ LS1	FETCHPROT_ LS1
R-0h						R/W-0h	R/W-0h
7	6	5	4	3	2	1	0
RESERVED						CPUWRPROT_ LS0	FETCHPROT_ LS0
R-0h						R/W-0h	R/W-0h

**Table 2-241. LSxACCPROT0 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-26	RESERVED	R	0h	Reserved
25	CPUWRPROT_LS3	R/W	0h	CPU WR Protection For LS3 RAM: 0: CPU Writes are allowed. 1: CPU Writes are blocked. Reset type: SYSRSn
24	FETCHPROT_LS3	R/W	0h	Fetch Protection For LS3 RAM: 0: CPU Fetch are allowed. 1: CPU Fetch are blocked. Reset type: SYSRSn
23-18	RESERVED	R	0h	Reserved
17	CPUWRPROT_LS2	R/W	0h	CPU WR Protection For LS2 RAM: 0: CPU Writes are allowed. 1: CPU Writes are blocked. Reset type: SYSRSn
16	FETCHPROT_LS2	R/W	0h	Fetch Protection For LS2 RAM: 0: CPU Fetch are allowed. 1: CPU Fetch are blocked. Reset type: SYSRSn
15-10	RESERVED	R	0h	Reserved
9	CPUWRPROT_LS1	R/W	0h	CPU WR Protection For LS1 RAM: 0: CPU Writes are allowed. 1: CPU Writes are blocked. Reset type: SYSRSn



**Table 2-241. LSxACCPROT0 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
8	FETCHPROT_LS1	R/W	0h	Fetch Protection For LS1 RAM: 0: CPU Fetch are allowed. 1: CPU Fetch are blocked. Reset type: SYSRSn
7-2	RESERVED	R	0h	Reserved
1	CPUWRPROT_LS0	R/W	0h	CPU WR Protection For LS0 RAM: 0: CPU Writes are allowed. 1: CPU Writes are blocked. Reset type: SYSRSn
0	FETCHPROT_LS0	R/W	0h	Fetch Protection For LS0 RAM: 0: CPU Fetch are allowed. 1: CPU Fetch are blocked. Reset type: SYSRSn

**2.15.18.12 LSxACCPROT1 Register (Offset = 2Ah) [reset = 0h]**

 LSxACCPROT1 is shown in [Figure 2-215](#) and described in [Table 2-242](#).

 Return to [Summary Table](#).

Local Shared RAM Config Register 1

**Figure 2-215. LSxACCPROT1 Register**

31	30	29	28	27	26	25	24
RESERVED							
R-0h							
23	22	21	20	19	18	17	16
RESERVED							
R-0h							
15	14	13	12	11	10	9	8
RESERVED						CPUWRPROT_ LS5	FETCHPROT_ LS5
R-0h						R/W-0h	R/W-0h
7	6	5	4	3	2	1	0
RESERVED						CPUWRPROT_ LS4	FETCHPROT_ LS4
R-0h						R/W-0h	R/W-0h

**Table 2-242. LSxACCPROT1 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R	0h	Reserved
15-10	RESERVED	R	0h	Reserved
9	CPUWRPROT_LS5	R/W	0h	CPU WR Protection For LS5 RAM: 0: CPU Writes are allowed. 1: CPU Writes are blocked. Reset type: SYSRSn
8	FETCHPROT_LS5	R/W	0h	Fetch Protection For LS5 RAM: 0: CPU Fetch are allowed. 1: CPU Fetch are blocked. Reset type: SYSRSn
7-2	RESERVED	R	0h	Reserved
1	CPUWRPROT_LS4	R/W	0h	CPU WR Protection For LS4 RAM: 0: CPU Writes are allowed. 1: CPU Writes are blocked. Reset type: SYSRSn
0	FETCHPROT_LS4	R/W	0h	Fetch Protection For LS4 RAM: 0: CPU Fetch are allowed. 1: CPU Fetch are blocked. Reset type: SYSRSn

### 2.15.18.13 LSxTEST Register (Offset = 30h) [reset = 0h]

LSxTEST is shown in [Figure 2-216](#) and described in [Table 2-243](#).

Return to [Summary Table](#).

Local Shared RAM TEST Register

**Figure 2-216. LSxTEST Register**

31	30	29	28	27	26	25	24
RESERVED							
R-0h							
23	22	21	20	19	18	17	16
RESERVED							
R-0h							
15	14	13	12	11	10	9	8
RESERVED				TEST_LS5		TEST_LS4	
R-0h				R/W-0h		R/W-0h	
7	6	5	4	3	2	1	0
TEST_LS3		TEST_LS2		TEST_LS1		TEST_LS0	
R/W-0h		R/W-0h		R/W-0h		R/W-0h	

**Table 2-243. LSxTEST Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R	0h	Reserved
15-12	RESERVED	R	0h	Reserved
11-10	TEST_LS5	R/W	0h	Selects the different modes for LS5 RAM: 00: Functional Mode. 01: Writes are allowed to data bits only. No write to parity bits. 10: Writes are allowed to parity bits only. No write to data bits. 11: Functional Mode. Reset type: SYSRSn
9-8	TEST_LS4	R/W	0h	Selects the different modes for LS4 RAM: 00: Functional Mode. 01: Writes are allowed to data bits only. No write to parity bits. 10: Writes are allowed to parity bits only. No write to data bits. 11: Functional Mode. Reset type: SYSRSn
7-6	TEST_LS3	R/W	0h	Selects the different modes for LS3 RAM: 00: Functional Mode. 01: Writes are allowed to data bits only. No write to parity bits. 10: Writes are allowed to parity bits only. No write to data bits. 11: Functional Mode. Reset type: SYSRSn
5-4	TEST_LS2	R/W	0h	Selects the different modes for LS2 RAM: 00: Functional Mode. 01: Writes are allowed to data bits only. No write to parity bits. 10: Writes are allowed to parity bits only. No write to data bits. 11: Functional Mode. Reset type: SYSRSn

**Table 2-243. LSxTEST Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
3-2	TEST_LS1	R/W	0h	Selects the defferent modes for LS1 RAM: 00: Functional Mode. 01: Writes are allowed to data bits only. No write to parity bits. 10: Writes are allowed to parity bits only. No write to data bits. 11: Functional Mode. Reset type: SYSRSn
1-0	TEST_LS0	R/W	0h	Selects the defferent modes for LS0 RAM: 00: Functional Mode. 01: Writes are allowed to data bits only. No write to parity bits. 10: Writes are allowed to parity bits only. No write to data bits. 11: Functional Mode. Reset type: SYSRSn

### 2.15.18.14 LSxINIT Register (Offset = 32h) [reset = 0h]

LSxINIT is shown in [Figure 2-217](#) and described in [Table 2-244](#).

Return to [Summary Table](#).

Local Shared RAM Init Register

**Figure 2-217. LSxINIT Register**

31	30	29	28	27	26	25	24
RESERVED							
R-0h							
23	22	21	20	19	18	17	16
RESERVED							
R-0h							
15	14	13	12	11	10	9	8
RESERVED							
R-0h							
7	6	5	4	3	2	1	0
RESERVED		INIT_LS5	INIT_LS4	INIT_LS3	INIT_LS2	INIT_LS1	INIT_LS0
R-0h		R=0/W=1-0h	R=0/W=1-0h	R=0/W=1-0h	R=0/W=1-0h	R=0/W=1-0h	R=0/W=1-0h

**Table 2-244. LSxINIT Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R	0h	Reserved
15-6	RESERVED	R	0h	Reserved
5	INIT_LS5	R=0/W=1	0h	RAM Initialization control for LS5 RAM: 0: None. 1: Start RAM Initialization. Reset type: SYSRSn
4	INIT_LS4	R=0/W=1	0h	RAM Initialization control for LS4 RAM: 0: None. 1: Start RAM Initialization. Reset type: SYSRSn
3	INIT_LS3	R=0/W=1	0h	RAM Initialization control for LS3 RAM: 0: None. 1: Start RAM Initialization. Reset type: SYSRSn
2	INIT_LS2	R=0/W=1	0h	RAM Initialization control for LS2 RAM: 0: None. 1: Start RAM Initialization. Reset type: SYSRSn
1	INIT_LS1	R=0/W=1	0h	RAM Initialization control for LS1 RAM: 0: None. 1: Start RAM Initialization. Reset type: SYSRSn
0	INIT_LS0	R=0/W=1	0h	RAM Initialization control for LS0 RAM: 0: None. 1: Start RAM Initialization. Reset type: SYSRSn

**2.15.18.15 LSxINITDONE Register (Offset = 34h) [reset = 0h]**

LSxINITDONE is shown in [Figure 2-218](#) and described in [Table 2-245](#).

Return to [Summary Table](#).

Local Shared RAM InitDone Status Register

**Figure 2-218. LSxINITDONE Register**

31	30	29	28	27	26	25	24
RESERVED							
R-0h							
23	22	21	20	19	18	17	16
RESERVED							
R-0h							
15	14	13	12	11	10	9	8
RESERVED							
R-0h							
7	6	5	4	3	2	1	0
RESERVED		INITDONE_LS5	INITDONE_LS4	INITDONE_LS3	INITDONE_LS2	INITDONE_LS1	INITDONE_LS0
R-0h		R-0h	R-0h	R-0h	R-0h	R-0h	R-0h

**Table 2-245. LSxINITDONE Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R	0h	Reserved
15-6	RESERVED	R	0h	Reserved
5	INITDONE_LS5	R	0h	RAM Initialization status for LS5 RAM: 0: RAM Initialization is not done. 1: RAM Initialization is done. Reset type: SYSRSn
4	INITDONE_LS4	R	0h	RAM Initialization status for LS4 RAM: 0: RAM Initialization is not done. 1: RAM Initialization is done. Reset type: SYSRSn
3	INITDONE_LS3	R	0h	RAM Initialization status for LS3 RAM: 0: RAM Initialization is not done. 1: RAM Initialization is done. Reset type: SYSRSn
2	INITDONE_LS2	R	0h	RAM Initialization status for LS2 RAM: 0: RAM Initialization is not done. 1: RAM Initialization is done. Reset type: SYSRSn
1	INITDONE_LS1	R	0h	RAM Initialization status for LS1 RAM: 0: RAM Initialization is not done. 1: RAM Initialization is done. Reset type: SYSRSn
0	INITDONE_LS0	R	0h	RAM Initialization status for LS0 RAM: 0: RAM Initialization is not done. 1: RAM Initialization is done. Reset type: SYSRSn

**2.15.18.16 GSxLOCK Register (Offset = 40h) [reset = 0h]**

GSxLOCK is shown in [Figure 2-219](#) and described in [Table 2-246](#).

Return to [Summary Table](#).

Global Shared RAM Config Lock Register

**Figure 2-219. GSxLOCK Register**

31								30								29								28								27								26								25								24							
RESERVED																																																															
R-0h																																																															
23								22								21								20								19								18								17								16							
RESERVED																																																															
R-0h																																																															
15								14								13								12								11								10								9								8							
LOCK_GS15								LOCK_GS14								LOCK_GS13								LOCK_GS12								LOCK_GS11								LOCK_GS10								LOCK_GS9								LOCK_GS8							
R/W-0h								R/W-0h								R/W-0h								R/W-0h								R/W-0h								R/W-0h								R/W-0h															
7								6								5								4								3								2								1								0							
LOCK_GS7								LOCK_GS6								LOCK_GS5								LOCK_GS4								LOCK_GS3								LOCK_GS2								LOCK_GS1								LOCK_GS0							
R/W-0h								R/W-0h								R/W-0h								R/W-0h								R/W-0h								R/W-0h								R/W-0h															

**Table 2-246. GSxLOCK Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R	0h	Reserved
15	LOCK_GS15	R/W	0h	Locks the write to access protection and master select fields for GS15 RAM: 0: Write to ACCPROT and Mselect fields are allowed. 1: Write to ACCPROT and Mselect fields are blocked. Reset type: SYSRSn
14	LOCK_GS14	R/W	0h	Locks the write to access protection and master select fields for GS14 RAM: 0: Write to ACCPROT and Mselect fields are allowed. 1: Write to ACCPROT and Mselect fields are blocked. Reset type: SYSRSn
13	LOCK_GS13	R/W	0h	Locks the write to access protection and master select fields for GS13 RAM: 0: Write to ACCPROT and Mselect fields are allowed. 1: Write to ACCPROT and Mselect fields are blocked. Reset type: SYSRSn
12	LOCK_GS12	R/W	0h	Locks the write to access protection and master select fields for GS12 RAM: 0: Write to ACCPROT and Mselect fields are allowed. 1: Write to ACCPROT and Mselect fields are blocked. Reset type: SYSRSn
11	LOCK_GS11	R/W	0h	Locks the write to access protection and master select fields for GS11 RAM: 0: Write to ACCPROT and Mselect fields are allowed. 1: Write to ACCPROT and Mselect fields are blocked. Reset type: SYSRSn

**Table 2-246. GSxLOCK Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
10	LOCK_GS10	R/W	0h	Locks the write to access protection and master select fields for GS10 RAM: 0: Write to ACCPROT and Mselect fields are allowed. 1: Write to ACCPROT and Mselect fields are blocked. Reset type: SYSRSn
9	LOCK_GS9	R/W	0h	Locks the write to access protection and master select fields for GS9 RAM: 0: Write to ACCPROT and Mselect fields are allowed. 1: Write to ACCPROT and Mselect fields are blocked. Reset type: SYSRSn
8	LOCK_GS8	R/W	0h	Locks the write to access protection and master select fields for GS8 RAM: 0: Write to ACCPROT and Mselect fields are allowed. 1: Write to ACCPROT and Mselect fields are blocked. Reset type: SYSRSn
7	LOCK_GS7	R/W	0h	Locks the write to access protection and master select fields for GS7 RAM: 0: Write to ACCPROT and Mselect fields are allowed. 1: Write to ACCPROT and Mselect fields are blocked. Reset type: SYSRSn
6	LOCK_GS6	R/W	0h	Locks the write to access protection and master select fields for GS6 RAM: 0: Write to ACCPROT and Mselect fields are allowed. 1: Write to ACCPROT and Mselect fields are blocked. Reset type: SYSRSn
5	LOCK_GS5	R/W	0h	Locks the write to access protection and master select fields for GS5 RAM: 0: Write to ACCPROT and Mselect fields are allowed. 1: Write to ACCPROT and Mselect fields are blocked. Reset type: SYSRSn
4	LOCK_GS4	R/W	0h	Locks the write to access protection and master select fields for GS4 RAM: 0: Write to ACCPROT and Mselect fields are allowed. 1: Write to ACCPROT and Mselect fields are blocked. Reset type: SYSRSn
3	LOCK_GS3	R/W	0h	Locks the write to access protection and master select fields for GS3 RAM: 0: Write to ACCPROT and Mselect fields are allowed. 1: Write to ACCPROT and Mselect fields are blocked. Reset type: SYSRSn
2	LOCK_GS2	R/W	0h	Locks the write to access protection and master select fields for GS2 RAM: 0: Write to ACCPROT and Mselect fields are allowed. 1: Write to ACCPROT and Mselect fields are blocked. Reset type: SYSRSn
1	LOCK_GS1	R/W	0h	Locks the write to access protection and master select fields for GS1 RAM: 0: Write to ACCPROT and Mselect fields are allowed. 1: Write to ACCPROT and Mselect fields are blocked. Reset type: SYSRSn



**Table 2-246. GSxLOCK Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
0	LOCK_GS0	R/W	0h	<p>Locks the write to access protection and master select fields for GS0 RAM:</p> <p>0: Write to ACCPROT and Mselect fields are allowed.</p> <p>1: Write to ACCPROT and Mselect fields are blocked.</p> <p>Reset type: SYSRSn</p>

**2.15.18.17 GSxCOMMIT Register (Offset = 42h) [reset = 0h]**

 GSxCOMMIT is shown in [Figure 2-220](#) and described in [Table 2-247](#).

 Return to [Summary Table](#).

Global Shared RAM Config Lock Commit Register

**Figure 2-220. GSxCOMMIT Register**

31	30	29	28	27	26	25	24
RESERVED							
R-0h							
23	22	21	20	19	18	17	16
RESERVED							
R-0h							
15	14	13	12	11	10	9	8
COMMIT_GS1 5	COMMIT_GS1 4	COMMIT_GS1 3	COMMIT_GS1 2	COMMIT_GS1 1	COMMIT_GS1 0	COMMIT_GS9	COMMIT_GS8
R/WSONce-0h	R/WSONce-0h	R/WSONce-0h	R/WSONce-0h	R/WSONce-0h	R/WSONce-0h	R/WSONce-0h	R/WSONce-0h
7	6	5	4	3	2	1	0
COMMIT_GS7	COMMIT_GS6	COMMIT_GS5	COMMIT_GS4	COMMIT_GS3	COMMIT_GS2	COMMIT_GS1	COMMIT_GS0
R/WSONce-0h	R/WSONce-0h	R/WSONce-0h	R/WSONce-0h	R/WSONce-0h	R/WSONce-0h	R/WSONce-0h	R/WSONce-0h

**Table 2-247. GSxCOMMIT Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R	0h	Reserved
15	COMMIT_GS15	R/WSONce	0h	Permanently Locks the write to access protection and master select fields for GS15 RAM: 0: Write to ACCPROT and Mselect fields are allowed based on value of lock field in GSxLOCK register. 1: Write to ACCPROT and Mselect fields are permanently blocked. Reset type: SYSRSn
14	COMMIT_GS14	R/WSONce	0h	Permanently Locks the write to access protection and master select fields for GS14 RAM: 0: Write to ACCPROT and Mselect fields are allowed based on value of lock field in GSxLOCK register. 1: Write to ACCPROT and Mselect fields are permanently blocked. Reset type: SYSRSn
13	COMMIT_GS13	R/WSONce	0h	Permanently Locks the write to access protection and master select fields for GS13 RAM: 0: Write to ACCPROT and Mselect fields are allowed based on value of lock field in GSxLOCK register. 1: Write to ACCPROT and Mselect fields are permanently blocked. Reset type: SYSRSn
12	COMMIT_GS12	R/WSONce	0h	Permanently Locks the write to access protection and master select fields for GS12 RAM: 0: Write to ACCPROT and Mselect fields are allowed based on value of lock field in GSxLOCK register. 1: Write to ACCPROT and Mselect fields are permanently blocked. Reset type: SYSRSn
11	COMMIT_GS11	R/WSONce	0h	Permanently Locks the write to access protection and master select fields for GS11 RAM: 0: Write to ACCPROT and Mselect fields are allowed based on value of lock field in GSxLOCK register. 1: Write to ACCPROT and Mselect fields are permanently blocked. Reset type: SYSRSn

**Table 2-247. GSxCOMMIT Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
10	COMMIT_GS10	R/WSONce	0h	Permanently Locks the write to access protection and master select fields for GS10 RAM: 0: Write to ACCPROT and Mselect fields are allowed based on value of lock field in GSxLOCK register. 1: Write to ACCPROT and Mselect fields are permanently blocked. Reset type: SYSRSn
9	COMMIT_GS9	R/WSONce	0h	Permanently Locks the write to access protection and master select fields for GS9 RAM: 0: Write to ACCPROT and Mselect fields are allowed based on value of lock field in GSxLOCK register. 1: Write to ACCPROT and Mselect fields are permanently blocked. Reset type: SYSRSn
8	COMMIT_GS8	R/WSONce	0h	Permanently Locks the write to access protection and master select fields for GS2 RAM: 0: Write to ACCPROT and Mselect fields are allowed based on value of lock field in GSxLOCK register. 1: Write to ACCPROT and Mselect fields are permanently blocked. Reset type: SYSRSn
7	COMMIT_GS7	R/WSONce	0h	Permanently Locks the write to access protection and master select fields for GS7 RAM: 0: Write to ACCPROT and Mselect fields are allowed based on value of lock field in GSxLOCK register. 1: Write to ACCPROT and Mselect fields are permanently blocked. Reset type: SYSRSn
6	COMMIT_GS6	R/WSONce	0h	Permanently Locks the write to access protection and master select fields for GS6 RAM: 0: Write to ACCPROT and Mselect fields are allowed based on value of lock field in GSxLOCK register. 1: Write to ACCPROT and Mselect fields are permanently blocked. Reset type: SYSRSn
5	COMMIT_GS5	R/WSONce	0h	Permanently Locks the write to access protection and master select fields for GS5 RAM: 0: Write to ACCPROT and Mselect fields are allowed based on value of lock field in GSxLOCK register. 1: Write to ACCPROT and Mselect fields are permanently blocked. Reset type: SYSRSn
4	COMMIT_GS4	R/WSONce	0h	Permanently Locks the write to access protection and master select fields for GS4 RAM: 0: Write to ACCPROT and Mselect fields are allowed based on value of lock field in GSxLOCK register. 1: Write to ACCPROT and Mselect fields are permanently blocked. Reset type: SYSRSn
3	COMMIT_GS3	R/WSONce	0h	Permanently Locks the write to access protection and master select fields for GS3 RAM: 0: Write to ACCPROT and Mselect fields are allowed based on value of lock field in GSxLOCK register. 1: Write to ACCPROT and Mselect fields are permanently blocked. Reset type: SYSRSn
2	COMMIT_GS2	R/WSONce	0h	Permanently Locks the write to access protection and master select fields for GS2 RAM: 0: Write to ACCPROT and Mselect fields are allowed based on value of lock field in GSxLOCK register. 1: Write to ACCPROT and Mselect fields are permanently blocked. Reset type: SYSRSn

**Table 2-247. GSxCOMMIT Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
1	COMMIT_GS1	R/WOnce	0h	Permanently Locks the write to access protection and master select fields for GS1 RAM: 0: Write to ACCPROT and Mselect fields are allowed based on value of lock field in GSxLOCK register. 1: Write to ACCPROT and Mselect fields are permanently blocked. Reset type: SYSRSn
0	COMMIT_GS0	R/WOnce	0h	Permanently Locks the write to access protection and master select fields for GS0 RAM: 0: Write to ACCPROT and Mselect fields are allowed based on value of lock field in GSxLOCK register. 1: Write to ACCPROT and Mselect fields are permanently blocked. Reset type: SYSRSn

### 2.15.18.18 GSxACCPROT0 Register (Offset = 48h) [reset = 0h]

GSxACCPROT0 is shown in [Figure 2-221](#) and described in [Table 2-248](#).

Return to [Summary Table](#).

Global Shared RAM Config Register 0

**Figure 2-221. GSxACCPROT0 Register**

31	30	29	28	27	26	25	24
RESERVED					DMAWRPROT_GS3	CPUWRPROT_GS3	FETCHPROT_GS3
R-0h					R/W-0h	R/W-0h	R/W-0h
23	22	21	20	19	18	17	16
RESERVED					DMAWRPROT_GS2	CPUWRPROT_GS2	FETCHPROT_GS2
R-0h					R/W-0h	R/W-0h	R/W-0h
15	14	13	12	11	10	9	8
RESERVED					DMAWRPROT_GS1	CPUWRPROT_GS1	FETCHPROT_GS1
R-0h					R/W-0h	R/W-0h	R/W-0h
7	6	5	4	3	2	1	0
RESERVED					DMAWRPROT_GS0	CPUWRPROT_GS0	FETCHPROT_GS0
R-0h					R/W-0h	R/W-0h	R/W-0h

**Table 2-248. GSxACCPROT0 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-27	RESERVED	R	0h	Reserved
26	DMAWRPROT_GS3	R/W	0h	DMA WR Protection For GS3 RAM: 0: DMA Writes are allowed. 1: DMA Writes are blocked. Reset type: SYSRSn
25	CPUWRPROT_GS3	R/W	0h	CPU WR Protection For GS3 RAM: 0: CPU Writes are allowed. 1: CPU Writes are blocked. Reset type: SYSRSn
24	FETCHPROT_GS3	R/W	0h	Fetch Protection For GS3 RAM: 0: CPU Fetch are allowed. 1: CPU Fetch are blocked. Reset type: SYSRSn
23-19	RESERVED	R	0h	Reserved
18	DMAWRPROT_GS2	R/W	0h	DMA WR Protection For GS2 RAM: 0: DMA Writes are allowed. 1: DMA Writes are blocked. Reset type: SYSRSn
17	CPUWRPROT_GS2	R/W	0h	CPU WR Protection For GS2 RAM: 0: CPU Writes are allowed. 1: CPU Writes are blocked. Reset type: SYSRSn

**Table 2-248. GSxACCPROT0 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
16	FETCHPROT_GS2	R/W	0h	Fetch Protection For GS2 RAM: 0: CPU Fetch are allowed. 1: CPU Fetch are blocked. Reset type: SYSRSn
15-11	RESERVED	R	0h	Reserved
10	DMAWRPROT_GS1	R/W	0h	DMA WR Protection For GS1 RAM: 0: DMA Writes are allowed. 1: DMA Writes are blocked. Reset type: SYSRSn
9	CPUWRPROT_GS1	R/W	0h	CPU WR Protection For GS1 RAM: 0: CPU Writes are allowed. 1: CPU Writes are blocked. Reset type: SYSRSn
8	FETCHPROT_GS1	R/W	0h	Fetch Protection For GS1 RAM: 0: CPU Fetch are allowed. 1: CPU Fetch are blocked. Reset type: SYSRSn
7-3	RESERVED	R	0h	Reserved
2	DMAWRPROT_GS0	R/W	0h	DMA WR Protection For GS0 RAM: 0: DMA Writes are allowed. 1: DMA Writes are blocked. Reset type: SYSRSn
1	CPUWRPROT_GS0	R/W	0h	CPU WR Protection For GS0 RAM: 0: CPU Writes are allowed. 1: CPU Writes are blocked. Reset type: SYSRSn
0	FETCHPROT_GS0	R/W	0h	Fetch Protection For GS0 RAM: 0: CPU Fetch are allowed. 1: CPU Fetch are blocked. Reset type: SYSRSn

### 2.15.18.19 GSxACCPROT1 Register (Offset = 4Ah) [reset = 0h]

GSxACCPROT1 is shown in [Figure 2-222](#) and described in [Table 2-249](#).

Return to [Summary Table](#).

Global Shared RAM Config Register 1

**Figure 2-222. GSxACCPROT1 Register**

31	30	29	28	27	26	25	24
RESERVED					DMAWRPROT_GS7	CPUWRPROT_GS7	FETCHPROT_GS7
R-0h					R/W-0h	R/W-0h	R/W-0h
23	22	21	20	19	18	17	16
RESERVED					DMAWRPROT_GS6	CPUWRPROT_GS6	FETCHPROT_GS6
R-0h					R/W-0h	R/W-0h	R/W-0h
15	14	13	12	11	10	9	8
RESERVED					DMAWRPROT_GS5	CPUWRPROT_GS5	FETCHPROT_GS5
R-0h					R/W-0h	R/W-0h	R/W-0h
7	6	5	4	3	2	1	0
RESERVED					DMAWRPROT_GS4	CPUWRPROT_GS4	FETCHPROT_GS4
R-0h					R/W-0h	R/W-0h	R/W-0h

**Table 2-249. GSxACCPROT1 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-27	RESERVED	R	0h	Reserved
26	DMAWRPROT_GS7	R/W	0h	DMA WR Protection For GS7 RAM: 0: DMA Writes are allowed. 1: DMA Writes are blocked. Reset type: SYSRSn
25	CPUWRPROT_GS7	R/W	0h	CPU WR Protection For GS7 RAM: 0: CPU Writes are allowed. 1: CPU Writes are blocked. Reset type: SYSRSn
24	FETCHPROT_GS7	R/W	0h	Fetch Protection For GS7 RAM: 0: CPU Fetch are allowed. 1: CPU Fetch are blocked. Reset type: SYSRSn
23-19	RESERVED	R	0h	Reserved
18	DMAWRPROT_GS6	R/W	0h	DMA WR Protection For GS6 RAM: 0: DMA Writes are allowed. 1: DMA Writes are blocked. Reset type: SYSRSn
17	CPUWRPROT_GS6	R/W	0h	CPU WR Protection For GS6 RAM: 0: CPU Writes are allowed. 1: CPU Writes are blocked. Reset type: SYSRSn

**Table 2-249. GSxACCPROT1 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
16	FETCHPROT_GS6	R/W	0h	Fetch Protection For GS6 RAM: 0: CPU Fetch are allowed. 1: CPU Fetch are blocked. Reset type: SYSRSn
15-11	RESERVED	R	0h	Reserved
10	DMAWRPROT_GS5	R/W	0h	DMA WR Protection For GS5 RAM: 0: DMA Writes are allowed. 1: DMA Writes are blocked. Reset type: SYSRSn
9	CPUWRPROT_GS5	R/W	0h	CPU WR Protection For GS5 RAM: 0: CPU Writes are allowed. 1: CPU Writes are blocked. Reset type: SYSRSn
8	FETCHPROT_GS5	R/W	0h	Fetch Protection For GS5 RAM: 0: CPU Fetch are allowed. 1: CPU Fetch are blocked. Reset type: SYSRSn
7-3	RESERVED	R	0h	Reserved
2	DMAWRPROT_GS4	R/W	0h	DMA WR Protection For GS4 RAM: 0: DMA Writes are allowed. 1: DMA Writes are blocked. Reset type: SYSRSn
1	CPUWRPROT_GS4	R/W	0h	CPU WR Protection For GS4 RAM: 0: CPU Writes are allowed. 1: CPU Writes are blocked. Reset type: SYSRSn
0	FETCHPROT_GS4	R/W	0h	Fetch Protection For GS4 RAM: 0: CPU Fetch are allowed. 1: CPU Fetch are blocked. Reset type: SYSRSn



### 2.15.18.20 GSxACCPROT2 Register (Offset = 4Ch) [reset = 0h]

GSxACCPROT2 is shown in [Figure 2-223](#) and described in [Table 2-250](#).

Return to [Summary Table](#).

Global Shared RAM Config Register 2

**Figure 2-223. GSxACCPROT2 Register**

31	30	29	28	27	26	25	24
RESERVED					DMAWRPROT_GS11	CPUWRPROT_GS11	FETCHPROT_GS11
R-0h					R/W-0h	R/W-0h	R/W-0h
23	22	21	20	19	18	17	16
RESERVED					DMAWRPROT_GS10	CPUWRPROT_GS10	FETCHPROT_GS10
R-0h					R/W-0h	R/W-0h	R/W-0h
15	14	13	12	11	10	9	8
RESERVED					DMAWRPROT_GS9	CPUWRPROT_GS9	FETCHPROT_GS9
R-0h					R/W-0h	R/W-0h	R/W-0h
7	6	5	4	3	2	1	0
RESERVED					DMAWRPROT_GS8	CPUWRPROT_GS8	FETCHPROT_GS8
R-0h					R/W-0h	R/W-0h	R/W-0h

**Table 2-250. GSxACCPROT2 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-27	RESERVED	R	0h	Reserved
26	DMAWRPROT_GS11	R/W	0h	DMA WR Protection For GS11 RAM: 0: DMA Writes are allowed. 1: DMA Writes are blocked. Reset type: SYSRSn
25	CPUWRPROT_GS11	R/W	0h	CPU WR Protection For GS11 RAM: 0: CPU Writes are allowed. 1: CPU Writes are blocked. Reset type: SYSRSn
24	FETCHPROT_GS11	R/W	0h	Fetch Protection For GS11 RAM: 0: CPU Fetch are allowed. 1: CPU Fetch are blocked. Reset type: SYSRSn
23-19	RESERVED	R	0h	Reserved
18	DMAWRPROT_GS10	R/W	0h	DMA WR Protection For GS10 RAM: 0: DMA Writes are allowed. 1: DMA Writes are blocked. Reset type: SYSRSn
17	CPUWRPROT_GS10	R/W	0h	CPU WR Protection For GS10 RAM: 0: CPU Writes are allowed. 1: CPU Writes are blocked. Reset type: SYSRSn

**Table 2-250. GSxACCPROT2 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
16	FETCHPROT_GS10	R/W	0h	Fetch Protection For GS10 RAM: 0: CPU Fetch are allowed. 1: CPU Fetch are blocked. Reset type: SYSRSn
15-11	RESERVED	R	0h	Reserved
10	DMAWRPROT_GS9	R/W	0h	DMA WR Protection For GS9 RAM: 0: DMA Writes are allowed. 1: DMA Writes are blocked. Reset type: SYSRSn
9	CPUWRPROT_GS9	R/W	0h	CPU WR Protection For GS9 RAM: 0: CPU Writes are allowed. 1: CPU Writes are blocked. Reset type: SYSRSn
8	FETCHPROT_GS9	R/W	0h	Fetch Protection For GS9 RAM: 0: CPU Fetch are allowed. 1: CPU Fetch are blocked. Reset type: SYSRSn
7-3	RESERVED	R	0h	Reserved
2	DMAWRPROT_GS8	R/W	0h	DMA WR Protection For GS8 RAM: 0: DMA Writes are allowed. 1: DMA Writes are blocked. Reset type: SYSRSn
1	CPUWRPROT_GS8	R/W	0h	CPU WR Protection For GS8 RAM: 0: CPU Writes are allowed. 1: CPU Writes are blocked. Reset type: SYSRSn
0	FETCHPROT_GS8	R/W	0h	Fetch Protection For GS8 RAM: 0: CPU Fetch are allowed. 1: CPU Fetch are blocked. Reset type: SYSRSn

### 2.15.18.21 GSxACCPROT3 Register (Offset = 4Eh) [reset = 0h]

GSxACCPROT3 is shown in [Figure 2-224](#) and described in [Table 2-251](#).

Return to [Summary Table](#).

Global Shared RAM Config Register 3

**Figure 2-224. GSxACCPROT3 Register**

31	30	29	28	27	26	25	24
RESERVED					DMAWRPROT_GS15	CPUWRPROT_GS15	FETCHPROT_GS15
R-0h					R/W-0h	R/W-0h	R/W-0h
23	22	21	20	19	18	17	16
RESERVED					DMAWRPROT_GS14	CPUWRPROT_GS14	FETCHPROT_GS14
R-0h					R/W-0h	R/W-0h	R/W-0h
15	14	13	12	11	10	9	8
RESERVED					DMAWRPROT_GS13	CPUWRPROT_GS13	FETCHPROT_GS13
R-0h					R/W-0h	R/W-0h	R/W-0h
7	6	5	4	3	2	1	0
RESERVED					DMAWRPROT_GS12	CPUWRPROT_GS12	FETCHPROT_GS12
R-0h					R/W-0h	R/W-0h	R/W-0h

**Table 2-251. GSxACCPROT3 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-27	RESERVED	R	0h	Reserved
26	DMAWRPROT_GS15	R/W	0h	DMA WR Protection For GS15 RAM: 0: DMA Writes are allowed. 1: DMA Writes are blocked. Reset type: SYSRSn
25	CPUWRPROT_GS15	R/W	0h	CPU WR Protection For GS15 RAM: 0: CPU Writes are allowed. 1: CPU Writes are blocked. Reset type: SYSRSn
24	FETCHPROT_GS15	R/W	0h	Fetch Protection For GS15 RAM: 0: CPU Fetch are allowed. 1: CPU Fetch are blocked. Reset type: SYSRSn
23-19	RESERVED	R	0h	Reserved
18	DMAWRPROT_GS14	R/W	0h	DMA WR Protection For GS14 RAM: 0: DMA Writes are allowed. 1: DMA Writes are blocked. Reset type: SYSRSn
17	CPUWRPROT_GS14	R/W	0h	CPU WR Protection For GS14 RAM: 0: CPU Writes are allowed. 1: CPU Writes are blocked. Reset type: SYSRSn

**Table 2-251. GSxACCPROT3 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
16	FETCHPROT_GS14	R/W	0h	Fetch Protection For GS14 RAM: 0: CPU Fetch are allowed. 1: CPU Fetch are blocked. Reset type: SYSRSn
15-11	RESERVED	R	0h	Reserved
10	DMAWRPROT_GS13	R/W	0h	DMA WR Protection For GS13 RAM: 0: DMA Writes are allowed. 1: DMA Writes are blocked. Reset type: SYSRSn
9	CPUWRPROT_GS13	R/W	0h	CPU WR Protection For GS13 RAM: 0: CPU Writes are allowed. 1: CPU Writes are blocked. Reset type: SYSRSn
8	FETCHPROT_GS13	R/W	0h	Fetch Protection For GS13 RAM: 0: CPU Fetch are allowed. 1: CPU Fetch are blocked. Reset type: SYSRSn
7-3	RESERVED	R	0h	Reserved
2	DMAWRPROT_GS12	R/W	0h	DMA WR Protection For GS12 RAM: 0: DMA Writes are allowed. 1: DMA Writes are blocked. Reset type: SYSRSn
1	CPUWRPROT_GS12	R/W	0h	CPU WR Protection For GS12 RAM: 0: CPU Writes are allowed. 1: CPU Writes are blocked. Reset type: SYSRSn
0	FETCHPROT_GS12	R/W	0h	Fetch Protection For GS12 RAM: 0: CPU Fetch are allowed. 1: CPU Fetch are blocked. Reset type: SYSRSn

### 2.15.18.22 GSxTEST Register (Offset = 50h) [reset = 0h]

GSxTEST is shown in [Figure 2-225](#) and described in [Table 2-252](#).

Return to [Summary Table](#).

Global Shared RAM TEST Register

**Figure 2-225. GSxTEST Register**

31	30	29	28	27	26	25	24
TEST_GS15		TEST_GS14		TEST_GS13		TEST_GS12	
R/W-0h		R/W-0h		R/W-0h		R/W-0h	
23	22	21	20	19	18	17	16
TEST_GS11		TEST_GS10		TEST_GS9		TEST_GS8	
R/W-0h		R/W-0h		R/W-0h		R/W-0h	
15	14	13	12	11	10	9	8
TEST_GS7		TEST_GS6		TEST_GS5		TEST_GS4	
R/W-0h		R/W-0h		R/W-0h		R/W-0h	
7	6	5	4	3	2	1	0
TEST_GS3		TEST_GS2		TEST_GS1		TEST_GS0	
R/W-0h		R/W-0h		R/W-0h		R/W-0h	

**Table 2-252. GSxTEST Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-30	TEST_GS15	R/W	0h	Selects the different modes for GS15 RAM: 00: Functional Mode. 01: Writes are allowed to data bits only. No write to parity bits. 10: Writes are allowed to parity bits only. No write to data bits. 11: Functional Mode. Reset type: SYSRSn
29-28	TEST_GS14	R/W	0h	Selects the different modes for GS14 RAM: 00: Functional Mode. 01: Writes are allowed to data bits only. No write to parity bits. 10: Writes are allowed to parity bits only. No write to data bits. 11: Functional Mode. Reset type: SYSRSn
27-26	TEST_GS13	R/W	0h	Selects the different modes for GS13 RAM: 00: Functional Mode. 01: Writes are allowed to data bits only. No write to parity bits. 10: Writes are allowed to parity bits only. No write to data bits. 11: Functional Mode. Reset type: SYSRSn
25-24	TEST_GS12	R/W	0h	Selects the different modes for GS12 RAM: 00: Functional Mode. 01: Writes are allowed to data bits only. No write to parity bits. 10: Writes are allowed to parity bits only. No write to data bits. 11: Functional Mode. Reset type: SYSRSn

**Table 2-252. GSxTEST Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
23-22	TEST_GS11	R/W	0h	Selects the defferent modes for GS11 RAM: 00: Functional Mode. 01: Writes are allowed to data bits only. No write to parity bits. 10: Writes are allowed to parity bits only. No write to data bits. 11: Functional Mode. Reset type: SYSRSn
21-20	TEST_GS10	R/W	0h	Selects the defferent modes for GS10 RAM: 00: Functional Mode. 01: Writes are allowed to data bits only. No write to parity bits. 10: Writes are allowed to parity bits only. No write to data bits. 11: Functional Mode. Reset type: SYSRSn
19-18	TEST_GS9	R/W	0h	Selects the defferent modes for GS9 RAM: 00: Functional Mode. 01: Writes are allowed to data bits only. No write to parity bits. 10: Writes are allowed to parity bits only. No write to data bits. 11: Functional Mode. Reset type: SYSRSn
17-16	TEST_GS8	R/W	0h	Selects the defferent modes for GS8 RAM: 00: Functional Mode. 01: Writes are allowed to data bits only. No write to parity bits. 10: Writes are allowed to parity bits only. No write to data bits. 11: Functional Mode. Reset type: SYSRSn
15-14	TEST_GS7	R/W	0h	Selects the defferent modes for GS7 RAM: 00: Functional Mode. 01: Writes are allowed to data bits only. No write to parity bits. 10: Writes are allowed to parity bits only. No write to data bits. 11: Functional Mode. Reset type: SYSRSn
13-12	TEST_GS6	R/W	0h	Selects the defferent modes for GS6 RAM: 00: Functional Mode. 01: Writes are allowed to data bits only. No write to parity bits. 10: Writes are allowed to parity bits only. No write to data bits. 11: Functional Mode. Reset type: SYSRSn
11-10	TEST_GS5	R/W	0h	Selects the defferent modes for GS5 RAM: 00: Functional Mode. 01: Writes are allowed to data bits only. No write to parity bits. 10: Writes are allowed to parity bits only. No write to data bits. 11: Functional Mode. Reset type: SYSRSn
9-8	TEST_GS4	R/W	0h	Selects the defferent modes for GS4 RAM: 00: Functional Mode. 01: Writes are allowed to data bits only. No write to parity bits. 10: Writes are allowed to parity bits only. No write to data bits. 11: Functional Mode. Reset type: SYSRSn

**Table 2-252. GSxTEST Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
7-6	TEST_GS3	R/W	0h	Selects the defferent modes for GS3 RAM: 00: Functional Mode. 01: Writes are allowed to data bits only. No write to parity bits. 10: Writes are allowed to parity bits only. No write to data bits. 11: Functional Mode. Reset type: SYSRSn
5-4	TEST_GS2	R/W	0h	Selects the defferent modes for GS2 RAM: 00: Functional Mode. 01: Writes are allowed to data bits only. No write to parity bits. 10: Writes are allowed to parity bits only. No write to data bits. 11: Functional Mode. Reset type: SYSRSn
3-2	TEST_GS1	R/W	0h	Selects the defferent modes for GS1 RAM: 00: Functional Mode. 01: Writes are allowed to data bits only. No write to parity bits. 10: Writes are allowed to parity bits only. No write to data bits. 11: Functional Mode. Reset type: SYSRSn
1-0	TEST_GS0	R/W	0h	Selects the defferent modes for GS0 RAM: 00: Functional Mode. 01: Writes are allowed to data bits only. No write to parity bits. 10: Writes are allowed to parity bits only. No write to data bits. 11: Functional Mode. Reset type: SYSRSn

**2.15.18.23 GSxINIT Register (Offset = 52h) [reset = 0h]**

 GSxINIT is shown in [Figure 2-226](#) and described in [Table 2-253](#).

 Return to [Summary Table](#).

Global Shared RAM Init Register

**Figure 2-226. GSxINIT Register**

31	30	29	28	27	26	25	24
RESERVED							
R-0h							
23	22	21	20	19	18	17	16
RESERVED							
R-0h							
15	14	13	12	11	10	9	8
INIT_GS15	INIT_GS14	INIT_GS13	INIT_GS12	INIT_GS11	INIT_GS10	INIT_GS9	INIT_GS8
R=0/W=1-0h	R=0/W=1-0h	R=0/W=1-0h	R=0/W=1-0h	R=0/W=1-0h	R=0/W=1-0h	R=0/W=1-0h	R=0/W=1-0h
7	6	5	4	3	2	1	0
INIT_GS7	INIT_GS6	INIT_GS5	INIT_GS4	INIT_GS3	INIT_GS2	INIT_GS1	INIT_GS0
R=0/W=1-0h	R=0/W=1-0h	R=0/W=1-0h	R=0/W=1-0h	R=0/W=1-0h	R=0/W=1-0h	R=0/W=1-0h	R=0/W=1-0h

**Table 2-253. GSxINIT Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R	0h	Reserved
15	INIT_GS15	R=0/W=1	0h	RAM Initialization control for GS15 RAM: 0: None. 1: Start RAM Initialization. Reset type: SYSRSn
14	INIT_GS14	R=0/W=1	0h	RAM Initialization control for GS14 RAM: 0: None. 1: Start RAM Initialization. Reset type: SYSRSn
13	INIT_GS13	R=0/W=1	0h	RAM Initialization control for GS13 RAM: 0: None. 1: Start RAM Initialization. Reset type: SYSRSn
12	INIT_GS12	R=0/W=1	0h	RAM Initialization control for GS12 RAM: 0: None. 1: Start RAM Initialization. Reset type: SYSRSn
11	INIT_GS11	R=0/W=1	0h	RAM Initialization control for GS11 RAM: 0: None. 1: Start RAM Initialization. Reset type: SYSRSn
10	INIT_GS10	R=0/W=1	0h	RAM Initialization control for GS10 RAM: 0: None. 1: Start RAM Initialization. Reset type: SYSRSn



**Table 2-253. GSxINIT Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
9	INIT_GS9	R=0/W=1	0h	RAM Initialization control for GS9 RAM: 0: None. 1: Start RAM Initialization. Reset type: SYSRSn
8	INIT_GS8	R=0/W=1	0h	RAM Initialization control for GS8 RAM: 0: None. 1: Start RAM Initialization. Reset type: SYSRSn
7	INIT_GS7	R=0/W=1	0h	RAM Initialization control for GS7 RAM: 0: None. 1: Start RAM Initialization. Reset type: SYSRSn
6	INIT_GS6	R=0/W=1	0h	RAM Initialization control for GS6 RAM: 0: None. 1: Start RAM Initialization. Reset type: SYSRSn
5	INIT_GS5	R=0/W=1	0h	RAM Initialization control for GS5 RAM: 0: None. 1: Start RAM Initialization. Reset type: SYSRSn
4	INIT_GS4	R=0/W=1	0h	RAM Initialization control for GS4 RAM: 0: None. 1: Start RAM Initialization. Reset type: SYSRSn
3	INIT_GS3	R=0/W=1	0h	RAM Initialization control for GS3 RAM: 0: None. 1: Start RAM Initialization. Reset type: SYSRSn
2	INIT_GS2	R=0/W=1	0h	RAM Initialization control for GS2 RAM: 0: None. 1: Start RAM Initialization. Reset type: SYSRSn
1	INIT_GS1	R=0/W=1	0h	RAM Initialization control for GS1 RAM: 0: None. 1: Start RAM Initialization. Reset type: SYSRSn
0	INIT_GS0	R=0/W=1	0h	RAM Initialization control for GS0 RAM: 0: None. 1: Start RAM Initialization. Reset type: SYSRSn

**2.15.18.24 GSxINITDONE Register (Offset = 54h) [reset = 0h]**

 GSxINITDONE is shown in [Figure 2-227](#) and described in [Table 2-254](#).

 Return to [Summary Table](#).

Global Shared RAM InitDone Status Register

**Figure 2-227. GSxINITDONE Register**

31	30	29	28	27	26	25	24
RESERVED							
R-0h							
23	22	21	20	19	18	17	16
RESERVED							
R-0h							
15	14	13	12	11	10	9	8
INITDONE_GS 15	INITDONE_GS 14	INITDONE_GS 13	INITDONE_GS 12	INITDONE_GS 11	INITDONE_GS 10	INITDONE_GS 9	INITDONE_GS 8
R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h
7	6	5	4	3	2	1	0
INITDONE_GS 7	INITDONE_GS 6	INITDONE_GS 5	INITDONE_GS 4	INITDONE_GS 3	INITDONE_GS 2	INITDONE_GS 1	INITDONE_GS 0
R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h

**Table 2-254. GSxINITDONE Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R	0h	Reserved
15	INITDONE_GS15	R	0h	RAM Initialization status for GS15 RAM: 0: RAM Initialization is not done. 1: RAM Initialization is done. Reset type: SYSRSn
14	INITDONE_GS14	R	0h	RAM Initialization status for GS14 RAM: 0: RAM Initialization is not done. 1: RAM Initialization is done. Reset type: SYSRSn
13	INITDONE_GS13	R	0h	RAM Initialization status for GS13 RAM: 0: RAM Initialization is not done. 1: RAM Initialization is done. Reset type: SYSRSn
12	INITDONE_GS12	R	0h	RAM Initialization status for GS12 RAM: 0: RAM Initialization is not done. 1: RAM Initialization is done. Reset type: SYSRSn
11	INITDONE_GS11	R	0h	RAM Initialization status for GS11 RAM: 0: RAM Initialization is not done. 1: RAM Initialization is done. Reset type: SYSRSn
10	INITDONE_GS10	R	0h	RAM Initialization status for GS10 RAM: 0: RAM Initialization is not done. 1: RAM Initialization is done. Reset type: SYSRSn

**Table 2-254. GSxINITDONE Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
9	INITDONE_GS9	R	0h	RAM Initialization status for GS9 RAM: 0: RAM Initialization is not done. 1: RAM Initialization is done. Reset type: SYSRSn
8	INITDONE_GS8	R	0h	RAM Initialization status for GS8 RAM: 0: RAM Initialization is not done. 1: RAM Initialization is done. Reset type: SYSRSn
7	INITDONE_GS7	R	0h	RAM Initialization status for GS7 RAM: 0: RAM Initialization is not done. 1: RAM Initialization is done. Reset type: SYSRSn
6	INITDONE_GS6	R	0h	RAM Initialization status for GS6 RAM: 0: RAM Initialization is not done. 1: RAM Initialization is done. Reset type: SYSRSn
5	INITDONE_GS5	R	0h	RAM Initialization status for GS5 RAM: 0: RAM Initialization is not done. 1: RAM Initialization is done. Reset type: SYSRSn
4	INITDONE_GS4	R	0h	RAM Initialization status for GS4 RAM: 0: RAM Initialization is not done. 1: RAM Initialization is done. Reset type: SYSRSn
3	INITDONE_GS3	R	0h	RAM Initialization status for GS3 RAM: 0: RAM Initialization is not done. 1: RAM Initialization is done. Reset type: SYSRSn
2	INITDONE_GS2	R	0h	RAM Initialization status for GS2 RAM: 0: RAM Initialization is not done. 1: RAM Initialization is done. Reset type: SYSRSn
1	INITDONE_GS1	R	0h	RAM Initialization status for GS1 RAM: 0: RAM Initialization is not done. 1: RAM Initialization is done. Reset type: SYSRSn
0	INITDONE_GS0	R	0h	RAM Initialization status for GS0 RAM: 0: RAM Initialization is not done. 1: RAM Initialization is done. Reset type: SYSRSn

**2.15.18.25 MSGxTEST Register (Offset = 70h) [reset = 0h]**

MSGxTEST is shown in [Figure 2-228](#) and described in [Table 2-255](#).

Return to [Summary Table](#).

Message RAM TEST Register

**Figure 2-228. MSGxTEST Register**

31	30	29	28	27	26	25	24
RESERVED							
R-0h							
23	22	21	20	19	18	17	16
RESERVED							
R-0h							
15	14	13	12	11	10	9	8
RESERVED						RESERVED	
R-0h						R-0h	
7	6	5	4	3	2	1	0
RESERVED		TEST_CLA1TOCPU		TEST_CPUTOCLA1		TEST_CPUTOCPU	
R-0h		R/W-0h		R/W-0h		R/W-0h	

**Table 2-255. MSGxTEST Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R	0h	Reserved
15-10	RESERVED	R	0h	Reserved
9-8	RESERVED	R	0h	Reserved
7-6	RESERVED	R	0h	Reserved
5-4	TEST_CLA1TOCPU	R/W	0h	Selects the defferent modes for CLA1TOCPU MSG RAM: 00: Functional Mode. 01: Writes are allowed to data bits only. No write to parity bits. 10: Writes are allowed to parity bits only. No write to data bits. 11: Functional Mode. Reset type: SYSRSn
3-2	TEST_CPUTOCLA1	R/W	0h	Selects the defferent modes for CPUTOCLA1 MSG RAM: 00: Functional Mode. 01: Writes are allowed to data bits only. No write to parity bits. 10: Writes are allowed to parity bits only. No write to data bits. 11: Functional Mode. Reset type: SYSRSn
1-0	TEST_CPUTOCPU	R/W	0h	Selects the defferent modes for CPUTOCPU MSG RAM: 00: Functional Mode. 01: Writes are allowed to data bits only. No write to parity bits. 10: Writes are allowed to parity bits only. No write to data bits. 11: Functional Mode. Reset type: SYSRSn

**2.15.18.26 MSGxINIT Register (Offset = 72h) [reset = 0h]**

MSGxINIT is shown in [Figure 2-229](#) and described in [Table 2-256](#).

Return to [Summary Table](#).

Message RAM Init Register

**Figure 2-229. MSGxINIT Register**

31	30	29	28	27	26	25	24
RESERVED							
R-0h							
23	22	21	20	19	18	17	16
RESERVED							
R-0h							
15	14	13	12	11	10	9	8
RESERVED							
R-0h							
7	6	5	4	3	2	1	0
RESERVED			RESERVED	RESERVED	INIT_CLA1TOC PU	INIT_CPUTOC LA1	INIT_CPUTOC PU
R-0h			R-0h	R-0h	R=0/W=1-0h	R=0/W=1-0h	R=0/W=1-0h

**Table 2-256. MSGxINIT Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R	0h	Reserved
15-5	RESERVED	R	0h	Reserved
4	RESERVED	R	0h	Reserved
3	RESERVED	R	0h	Reserved
2	INIT_CLA1TOCPU	R=0/W=1	0h	RAM Initialization control for CLA1TOCPU MSG RAM: 0: None. 1: Start RAM Initialization. Reset type: SYSRSn
1	INIT_CPUTOCLA1	R=0/W=1	0h	RAM Initialization control for CPUTOCLA1 MSG RAM: 0: None. 1: Start RAM Initialization. Reset type: SYSRSn
0	INIT_CPUTOCPU	R=0/W=1	0h	RAM Initialization control for CPUTOCPU MSG RAM: 0: None. 1: Start RAM Initialization. Reset type: SYSRSn

**2.15.18.27 MSGxINITDONE Register (Offset = 74h) [reset = 0h]**

MSGxINITDONE is shown in [Figure 2-230](#) and described in [Table 2-257](#).

Return to [Summary Table](#).

Message RAM InitDone Status Register

**Figure 2-230. MSGxINITDONE Register**

31	30	29	28	27	26	25	24
RESERVED							
R-0h							
23	22	21	20	19	18	17	16
RESERVED							
R-0h							
15	14	13	12	11	10	9	8
RESERVED							
R-0h							
7	6	5	4	3	2	1	0
RESERVED			RESERVED	RESERVED	INITDONE_CL A1TOCPU	INITDONE_CP UTOCLA1	INITDONE_CP UTOCPU
R-0h			R-0h	R-0h	R-0h	R-0h	R-0h

**Table 2-257. MSGxINITDONE Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R	0h	Reserved
15-5	RESERVED	R	0h	Reserved
4	RESERVED	R	0h	Reserved
3	RESERVED	R	0h	Reserved
2	INITDONE_CLA1TOCPU	R	0h	RAM Initialization status for CLA1TOCPU MSG RAM: 0: RAM Initialization is not done. 1: RAM Initialization is done. Reset type: SYSRSn
1	INITDONE_CPUTOCLA1	R	0h	RAM Initialization status for CPUTOCLA1 MSG RAM: 0: RAM Initialization is not done. 1: RAM Initialization is done. Reset type: SYSRSn
0	INITDONE_CPUTOCPU	R	0h	RAM Initialization status for CPUTOCPU MSG RAM: 0: RAM Initialization is not done. 1: RAM Initialization is done. Reset type: SYSRSn

## 2.15.19 ACCESS\_PROTECTION\_REGS Registers

Table 2-258 lists the memory-mapped registers for the ACCESS\_PROTECTION\_REGS. All register offset addresses not listed in Table 2-258 should be considered as reserved locations and the register contents should not be modified.

**Table 2-258. ACCESS\_PROTECTION\_REGS Registers**

Offset	Acronym	Register Name	Write Protection	Section
0h	NMAVFLG	Non-Master Access Violation Flag Register		<a href="#">Go</a>
2h	NMAVSET	Non-Master Access Violation Flag Set Register	EALLOW	<a href="#">Go</a>
4h	NMAVCLR	Non-Master Access Violation Flag Clear Register	EALLOW	<a href="#">Go</a>
6h	NMAVINTEN	Non-Master Access Violation Interrupt Enable Register	EALLOW	<a href="#">Go</a>
8h	NMCPURDAVADDR	Non-Master CPU Read Access Violation Address		<a href="#">Go</a>
Ah	NMCPUWRAVADDR	Non-Master CPU Write Access Violation Address		<a href="#">Go</a>
Ch	NMCPUFAVADDR	Non-Master CPU Fetch Access Violation Address		<a href="#">Go</a>
Eh	NMDMAWRAVADDR	Non-Master DMA Write Access Violation Address		<a href="#">Go</a>
10h	NMCLA1RDAVADDR	Non-Master CLA1 Read Access Violation Address		<a href="#">Go</a>
12h	NMCLA1WRAVADDR	Non-Master CLA1 Write Access Violation Address		<a href="#">Go</a>
14h	NMCLA1FAVADDR	Non-Master CLA1 Fetch Access Violation Address		<a href="#">Go</a>
20h	MAVFLG	Master Access Violation Flag Register		<a href="#">Go</a>
22h	MAVSET	Master Access Violation Flag Set Register	EALLOW	<a href="#">Go</a>
24h	MAVCLR	Master Access Violation Flag Clear Register	EALLOW	<a href="#">Go</a>
26h	MAVINTEN	Master Access Violation Interrupt Enable Register	EALLOW	<a href="#">Go</a>
28h	MCPUFAVADDR	Master CPU Fetch Access Violation Address		<a href="#">Go</a>
2Ah	MCPUWRAVADDR	Master CPU Write Access Violation Address		<a href="#">Go</a>
2Ch	MDMAWRAVADDR	Master DMA Write Access Violation Address		<a href="#">Go</a>

Complex bit access types are encoded to fit into small table cells. Table 2-259 shows the codes that are used for access types in this section.

**Table 2-259. ACCESS\_PROTECTION\_REGS Access Type Codes**

Access Type	Code	Description
<b>Read Type</b>		
R	R	Read
R=0	R	Read
<b>Write Type</b>		
W	W	Write
W=1	W	Write
<b>Reset or Default Value</b>		
-n		Value after reset or the default value
<b>Register Array Variables</b>		

**Table 2-259. ACCESS\_PROTECTION\_REGS Access  
Type Codes (continued)**

Access Type	Code	Description
i,j,k,l,m,n		When these variables are used in a register name, an offset, or an address, they refer to the value of a register array where the register is part of a group of repeating registers. The register groups form a hierarchical structure and the array is represented with a formula.
y		When this variable is used in a register name, an offset, or an address it refers to the value of a register array.



### 2.15.19.1 NMAVFLG Register (Offset = 0h) [reset = 0h]

NMAVFLG is shown in [Figure 2-231](#) and described in [Table 2-260](#).

Return to [Summary Table](#).

Non-Master Access Violation Flag Register

**Figure 2-231. NMAVFLG Register**

31	30	29	28	27	26	25	24
RESERVED							
R-0h							
23	22	21	20	19	18	17	16
RESERVED							
R-0h							
15	14	13	12	11	10	9	8
RESERVED						RESERVED	RESERVED
R-0h						R-0h	R-0h
7	6	5	4	3	2	1	0
RESERVED	CLA1FETCH	CLA1WRITE	CLA1READ	DMAWRITE	CPUFETCH	CPUWRITE	CPUREAD
R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h

**Table 2-260. NMAVFLG Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R	0h	Reserved
15-10	RESERVED	R	0h	Reserved
9	RESERVED	R	0h	Reserved
8	RESERVED	R	0h	Reserved
7	RESERVED	R	0h	Reserved
6	CLA1FETCH	R	0h	Non Master CLA1 Fetch Access Violation Flag: 0: No violation. 1: Access violation occurred. Reset type: SYSRSn
5	CLA1WRITE	R	0h	Non Master CLA1 Write Access Violation Flag: 0: No violation. 1: Access violation occurred. Reset type: SYSRSn
4	CLA1READ	R	0h	Non Master CLA1 Read Access Violation Flag: 0: No violation. 1: Access violation occurred. Reset type: SYSRSn
3	DMAWRITE	R	0h	Non Master DMA Write Access Violation Flag: 0: No violation. 1: Access violation occurred. Reset type: SYSRSn
2	CPUFETCH	R	0h	Non Master CPU Fetch Access Violation Flag: 0: No violation. 1: Access violation occurred. Reset type: SYSRSn

**Table 2-260. NMAVFLG Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
1	CPUWRITE	R	0h	Non Master CPU Write Access Violation Flag: 0: No violation. 1: Access violation occurred. Reset type: SYSRSn
0	CPUREAD	R	0h	Non Master CPU Read Access Violation Flag: 0: No violation. 1: Access violation occurred. Reset type: SYSRSn

### 2.15.19.2 NMAVSET Register (Offset = 2h) [reset = 0h]

NMAVSET is shown in [Figure 2-232](#) and described in [Table 2-261](#).

Return to [Summary Table](#).

Non-Master Access Violation Flag Set Register

**Figure 2-232. NMAVSET Register**

31	30	29	28	27	26	25	24
RESERVED							
R-0h							
23	22	21	20	19	18	17	16
RESERVED							
R-0h							
15	14	13	12	11	10	9	8
RESERVED						RESERVED	RESERVED
R-0h						R-0h	R-0h
7	6	5	4	3	2	1	0
RESERVED	CLA1FETCH	CLA1WRITE	CLA1READ	DMAWRITE	CPUFETCH	CPUWRITE	CPUREAD
R-0h	R=0/W=1-0h	R=0/W=1-0h	R=0/W=1-0h	R=0/W=1-0h	R=0/W=1-0h	R=0/W=1-0h	R=0/W=1-0h

**Table 2-261. NMAVSET Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R	0h	Reserved
15-10	RESERVED	R	0h	Reserved
9	RESERVED	R	0h	Reserved
8	RESERVED	R	0h	Reserved
7	RESERVED	R	0h	Reserved
6	CLA1FETCH	R=0/W=1	0h	0: No action. 1: CLA1 Fetch Access Violation Flag in NMAVFLG register will be set and interrupt will be generated if enabled.. Reset type: SYSRSn
5	CLA1WRITE	R=0/W=1	0h	0: No action. 1: CLA1 Write Access Violation Flag in NMAVFLG register will be set and interrupt will be generated if enabled.. Reset type: SYSRSn
4	CLA1READ	R=0/W=1	0h	0: No action. 1: CLA1 Read Access Violation Flag in NMAVFLG register will be set and interrupt will be generated if enabled.. Reset type: SYSRSn
3	DMAWRITE	R=0/W=1	0h	0: No action. 1: DMA Write Access Violation Flag in NMAVFLG register will be set and interrupt will be generated if enabled.. Reset type: SYSRSn
2	CPUFETCH	R=0/W=1	0h	0: No action. 1: CPU Fetch Access Violation Flag in NMAVFLG register will be set and interrupt will be generated if enabled.. Reset type: SYSRSn
1	CPUWRITE	R=0/W=1	0h	0: No action. 1: CPU Write Access Violation Flag in NMAVFLG register will be set and interrupt will be generated if enabled.. Reset type: SYSRSn

**Table 2-261. NMAVSET Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
0	CPUREAD	R=0/W=1	0h	0: No action. 1: CPU Read Access Violation Flag in NMAVFLG register will be set and interrupt will be generated if enabled.. Reset type: SYSRSn

### 2.15.19.3 NMAVCLR Register (Offset = 4h) [reset = 0h]

NMAVCLR is shown in [Figure 2-233](#) and described in [Table 2-262](#).

Return to [Summary Table](#).

Non-Master Access Violation Flag Clear Register

**Figure 2-233. NMAVCLR Register**

31	30	29	28	27	26	25	24
RESERVED							
R-0h							
23	22	21	20	19	18	17	16
RESERVED							
R-0h							
15	14	13	12	11	10	9	8
RESERVED						RESERVED	RESERVED
R-0h						R-0h	R-0h
7	6	5	4	3	2	1	0
RESERVED	CLA1FETCH	CLA1WRITE	CLA1READ	DMAWRITE	CPUFETCH	CPUWRITE	CPUREAD
R-0h	R=0/W=1-0h	R=0/W=1-0h	R=0/W=1-0h	R=0/W=1-0h	R=0/W=1-0h	R=0/W=1-0h	R=0/W=1-0h

**Table 2-262. NMAVCLR Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R	0h	Reserved
15-10	RESERVED	R	0h	Reserved
9	RESERVED	R	0h	Reserved
8	RESERVED	R	0h	Reserved
7	RESERVED	R	0h	Reserved
6	CLA1FETCH	R=0/W=1	0h	0: No action. 1: CLA1 Fetch Access Violation Flag in NMAVFLG register will be cleared. Reset type: SYSRSn
5	CLA1WRITE	R=0/W=1	0h	0: No action. 1: CLA1 Write Access Violation Flag in NMAVFLG register will be cleared. Reset type: SYSRSn
4	CLA1READ	R=0/W=1	0h	0: No action. 1: CLA1 Read Access Violation Flag in NMAVFLG register will be cleared. Reset type: SYSRSn
3	DMAWRITE	R=0/W=1	0h	0: No action. 1: DMA Write Access Violation Flag in NMAVFLG register will be cleared. Reset type: SYSRSn
2	CPUFETCH	R=0/W=1	0h	0: No action. 1: CPU Fetch Access Violation Flag in NMAVFLG register will be cleared. Reset type: SYSRSn
1	CPUWRITE	R=0/W=1	0h	0: No action. 1: CPU Write Access Violation Flag in NMAVFLG register will be cleared. Reset type: SYSRSn

**Table 2-262. NMAVCLR Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
0	CPUREAD	R=0/W=1	0h	0: No action. 1: CPU Read Access Violation Flag in NMAVFLG register will be cleared. Reset type: SYSRSn

### 2.15.19.4 NMAVINTEN Register (Offset = 6h) [reset = 0h]

NMAVINTEN is shown in [Figure 2-234](#) and described in [Table 2-263](#).

Return to [Summary Table](#).

Non-Master Access Violation Interrupt Enable Register

**Figure 2-234. NMAVINTEN Register**

31	30	29	28	27	26	25	24
RESERVED							
R-0h							
23	22	21	20	19	18	17	16
RESERVED							
R-0h							
15	14	13	12	11	10	9	8
RESERVED						RESERVED	RESERVED
R-0h						R-0h	R-0h
7	6	5	4	3	2	1	0
RESERVED	CLA1FETCH	CLA1WRITE	CLA1READ	DMAWRITE	CPUFETCH	CPUWRITE	CPUREAD
R-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h

**Table 2-263. NMAVINTEN Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R	0h	Reserved
15-10	RESERVED	R	0h	Reserved
9	RESERVED	R	0h	Reserved
8	RESERVED	R	0h	Reserved
7	RESERVED	R	0h	Reserved
6	CLA1FETCH	R/W	0h	0: CLA1 Non Master Fetch Access Violation Interrupt is disabled. 1: CLA1 Non Master Fetch Access Violation Interrupt is enabled. Reset type: SYSRSn
5	CLA1WRITE	R/W	0h	0: CLA1 Non Master Write Access Violation Interrupt is disabled. 1: CLA1 Non Master Write Access Violation Interrupt is enabled. Reset type: SYSRSn
4	CLA1READ	R/W	0h	0: CLA1 Non Master Read Access Violation Interrupt is disabled. 1: CLA1 Non Master Read Access Violation Interrupt is enabled. Reset type: SYSRSn
3	DMAWRITE	R/W	0h	0: DMA Non Master Write Access Violation Interrupt is disabled. 1: DMA Non Master Write Access Violation Interrupt is enabled. Reset type: SYSRSn
2	CPUFETCH	R/W	0h	0: CPU Non Master Fetch Access Violation Interrupt is disabled. 1: CPU Non Master Fetch Access Violation Interrupt is enabled. Reset type: SYSRSn
1	CPUWRITE	R/W	0h	0: CPU Non Master Write Access Violation Interrupt is disabled. 1: CPU Non Master Write Access Violation Interrupt is enabled. Reset type: SYSRSn
0	CPUREAD	R/W	0h	0: CPU Non Master Read Access Violation Interrupt is disabled. 1: CPU Non Master Read Access Violation Interrupt is enabled. Reset type: SYSRSn

### 2.15.19.5 NMCPURDAVADDR Register (Offset = 8h) [reset = 0h]

NMCPURDAVADDR is shown in [Figure 2-235](#) and described in [Table 2-264](#).

Return to [Summary Table](#).

Non-Master CPU Read Access Violation Address

**Figure 2-235. NMCPURDAVADDR Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
NMCPURDAVADDR																															
R-0h																															

**Table 2-264. NMCPURDAVADDR Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-0	NMCPURDAVADDR	R	0h	This register captures the address location for which non master CPU read access violation occurred. Reset type: SYSRSn



**2.15.19.6 NMCPUWRAVADDR Register (Offset = Ah) [reset = 0h]**

NMCPUWRAVADDR is shown in [Figure 2-236](#) and described in [Table 2-265](#).

Return to [Summary Table](#).

Non-Master CPU Write Access Violation Address

**Figure 2-236. NMCPUWRAVADDR Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
NMCPUWRAVADDR																															
R-0h																															

**Table 2-265. NMCPUWRAVADDR Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-0	NMCPUWRAVADDR	R	0h	This register captures the address location for which non master CPU write access violation occurred. Reset type: SYSRSn

**2.15.19.7 NMCPUFAVADDR Register (Offset = Ch) [reset = 0h]**

NMCPUFAVADDR is shown in [Figure 2-237](#) and described in [Table 2-266](#).

Return to [Summary Table](#).

Non-Master CPU Fetch Access Violation Address

**Figure 2-237. NMCPUFAVADDR Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
NMCPUFAVADDR																															
R-0h																															

**Table 2-266. NMCPUFAVADDR Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-0	NMCPUFAVADDR	R	0h	This register captures the address location for which non master CPU fetch access violation occurred. Reset type: SYSRSn

**2.15.19.8 NMDMAWRAVADDR Register (Offset = Eh) [reset = 0h]**

NMDMAWRAVADDR is shown in [Figure 2-238](#) and described in [Table 2-267](#).

Return to [Summary Table](#).

Non-Master DMA Write Access Violation Address

**Figure 2-238. NMDMAWRAVADDR Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
NMDMAWRAVADDR																															
R-0h																															

**Table 2-267. NMDMAWRAVADDR Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-0	NMDMAWRAVADDR	R	0h	This register captures the address location for which non master DMA write access violation occurred. Reset type: SYSRSn

**2.15.19.9 NMCLA1RDAVADDR Register (Offset = 10h) [reset = 0h]**

NMCLA1RDAVADDR is shown in [Figure 2-239](#) and described in [Table 2-268](#).

Return to [Summary Table](#).

Non-Master CLA1 Read Access Violation Address

**Figure 2-239. NMCLA1RDAVADDR Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
NMCLA1RDAVADDR																															
R-0h																															

**Table 2-268. NMCLA1RDAVADDR Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-0	NMCLA1RDAVADDR	R	0h	This register captures the address location for which non master CLA1 read access violation occurred. Reset type: SYSRSn

**2.15.19.10 NMCLA1WRAVADDR Register (Offset = 12h) [reset = 0h]**

NMCLA1WRAVADDR is shown in [Figure 2-240](#) and described in [Table 2-269](#).

Return to [Summary Table](#).

Non-Master CLA1 Write Access Violation Address

**Figure 2-240. NMCLA1WRAVADDR Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
NMCLA1WRAVADDR																															
R-0h																															

**Table 2-269. NMCLA1WRAVADDR Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-0	NMCLA1WRAVADDR	R	0h	This register captures the address location for which non master CLA1 write access violation occurred. Reset type: SYSRSn

**2.15.19.11 NMCLA1FAVADDR Register (Offset = 14h) [reset = 0h]**

NMCLA1FAVADDR is shown in [Figure 2-241](#) and described in [Table 2-270](#).

Return to [Summary Table](#).

Non-Master CLA1 Fetch Access Violation Address

**Figure 2-241. NMCLA1FAVADDR Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
NMCLA1FAVADDR																															
R-0h																															

**Table 2-270. NMCLA1FAVADDR Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-0	NMCLA1FAVADDR	R	0h	This register captures the address location for which non master CLA1 fetch access violation occurred. Reset type: SYSRSn

**2.15.19.12 MAVFLG Register (Offset = 20h) [reset = 0h]**

MAVFLG is shown in [Figure 2-242](#) and described in [Table 2-271](#).

Return to [Summary Table](#).

Master Access Violation Flag Register

**Figure 2-242. MAVFLG Register**

31	30	29	28	27	26	25	24
RESERVED							
R-0h							
23	22	21	20	19	18	17	16
RESERVED							
R-0h							
15	14	13	12	11	10	9	8
RESERVED							
R-0h							
7	6	5	4	3	2	1	0
RESERVED					DMAWRITE	CPUWRITE	CPUFETCH
R-0h					R-0h	R-0h	R-0h

**Table 2-271. MAVFLG Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R	0h	Reserved
15-3	RESERVED	R	0h	Reserved
2	DMAWRITE	R	0h	Master DMA Write Access Violation Flag: 0: No violation. 1: Access violation occurred. Reset type: SYSRSn
1	CPUWRITE	R	0h	Master CPU Write Access Violation Flag: 0: No violation. 1: Access violation occurred. Reset type: SYSRSn
0	CPUFETCH	R	0h	Master CPU Fetch Access Violation Flag: 0: No violation. 1: Access violation occurred. Reset type: SYSRSn

**2.15.19.13 MAVSET Register (Offset = 22h) [reset = 0h]**

MAVSET is shown in [Figure 2-243](#) and described in [Table 2-272](#).

Return to [Summary Table](#).

Master Access Violation Flag Set Register

**Figure 2-243. MAVSET Register**

31	30	29	28	27	26	25	24
RESERVED							
R-0h							
23	22	21	20	19	18	17	16
RESERVED							
R-0h							
15	14	13	12	11	10	9	8
RESERVED							
R-0h							
7	6	5	4	3	2	1	0
RESERVED					DMAWRITE	CPUWRITE	CPUFETCH
R-0h					R=0/W=1-0h	R=0/W=1-0h	R=0/W=1-0h

**Table 2-272. MAVSET Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R	0h	Reserved
15-3	RESERVED	R	0h	Reserved
2	DMAWRITE	R=0/W=1	0h	0: No action. 1: DMA Write Access Violation Flag in MAVFLG register will be set and interrupt will be generated if enabled.. Reset type: SYSRSn
1	CPUWRITE	R=0/W=1	0h	0: No action. 1: CPU Write Access Violation Flag in MAVFLG register will be set and interrupt will be generated if enabled.. Reset type: SYSRSn
0	CPUFETCH	R=0/W=1	0h	0: No action. 1: CPU Fetch Access Violation Flag in MAVFLG register will be set and interrupt will be generated if enabled.. Reset type: SYSRSn



### 2.15.19.14 MAVCLR Register (Offset = 24h) [reset = 0h]

MAVCLR is shown in [Figure 2-244](#) and described in [Table 2-273](#).

Return to [Summary Table](#).

Master Access Violation Flag Clear Register

**Figure 2-244. MAVCLR Register**

31	30	29	28	27	26	25	24
RESERVED							
R-0h							
23	22	21	20	19	18	17	16
RESERVED							
R-0h							
15	14	13	12	11	10	9	8
RESERVED							
R-0h							
7	6	5	4	3	2	1	0
RESERVED					DMAWRITE	CPUWRITE	CPUFETCH
R-0h					R=0/W=1-0h	R=0/W=1-0h	R=0/W=1-0h

**Table 2-273. MAVCLR Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R	0h	Reserved
15-3	RESERVED	R	0h	Reserved
2	DMAWRITE	R=0/W=1	0h	0: No action. 1: DMA Write Access Violation Flag in MAVFLG register will be cleared. Reset type: SYSRSn
1	CPUWRITE	R=0/W=1	0h	0: No action. 1: CPU Write Access Violation Flag in MAVFLG register will be cleared . Reset type: SYSRSn
0	CPUFETCH	R=0/W=1	0h	0: No action. 1: CPU Fetch Access Violation Flag in MAVFLG register will be cleared. Reset type: SYSRSn

**2.15.19.15 MAVINTEN Register (Offset = 26h) [reset = 0h]**

MAVINTEN is shown in [Figure 2-245](#) and described in [Table 2-274](#).

Return to [Summary Table](#).

Master Access Violation Interrupt Enable Register

**Figure 2-245. MAVINTEN Register**

31	30	29	28	27	26	25	24
RESERVED							
R-0h							
23	22	21	20	19	18	17	16
RESERVED							
R-0h							
15	14	13	12	11	10	9	8
RESERVED							
R-0h							
7	6	5	4	3	2	1	0
RESERVED					DMAWRITE	CPUWRITE	CPUFETCH
R-0h					R/W-0h	R/W-0h	R/W-0h

**Table 2-274. MAVINTEN Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R	0h	Reserved
15-3	RESERVED	R	0h	Reserved
2	DMAWRITE	R/W	0h	0: DMA Write Access Violation Interrupt is disabled. 1: DMA Write Access Violation Interrupt is enabled. Reset type: SYSRSn
1	CPUWRITE	R/W	0h	0: CPU Write Access Violation Interrupt is disabled. 1: CPU Write Access Violation Interrupt is enabled. Reset type: SYSRSn
0	CPUFETCH	R/W	0h	0: CPU Fetch Access Violation Interrupt is disabled. 1: CPU Fetch Access Violation Interrupt is enabled. Reset type: SYSRSn

**2.15.19.16 MCPUFAVADDR Register (Offset = 28h) [reset = 0h]**

MCPUFAVADDR is shown in [Figure 2-246](#) and described in [Table 2-275](#).

Return to [Summary Table](#).

Master CPU Fetch Access Violation Address

**Figure 2-246. MCPUFAVADDR Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
MCPUFAVADDR																															
R-0h																															

**Table 2-275. MCPUFAVADDR Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-0	MCPUFAVADDR	R	0h	This register captures the address location for which master CPU fetch access violation occurred. Reset type: SYSRSn

**2.15.19.17 MCPUWRAVADDR Register (Offset = 2Ah) [reset = 0h]**

MCPUWRAVADDR is shown in [Figure 2-247](#) and described in [Table 2-276](#).

Return to [Summary Table](#).

Master CPU Write Access Violation Address

**Figure 2-247. MCPUWRAVADDR Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
MCPUWRAVADDR																															
R-0h																															

**Table 2-276. MCPUWRAVADDR Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-0	MCPUWRAVADDR	R	0h	This register captures the address location for which master CPU write access violation occurred. Reset type: SYSRSn

**2.15.19.18 MDMAWRAVADDR Register (Offset = 2Ch) [reset = 0h]**

MDMAWRAVADDR is shown in [Figure 2-248](#) and described in [Table 2-277](#).

Return to [Summary Table](#).

Master DMA Write Access Violation Address

**Figure 2-248. MDMAWRAVADDR Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
MDMAWRAVADDR																															
R-0h																															

**Table 2-277. MDMAWRAVADDR Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-0	MDMAWRAVADDR	R	0h	This register captures the address location for which master DMA write access violation occurred. Reset type: SYSRSn

## 2.15.20 MEMORY\_ERROR\_REGS Registers

Table 2-278 lists the memory-mapped registers for the MEMORY\_ERROR\_REGS. All register offset addresses not listed in Table 2-278 should be considered as reserved locations and the register contents should not be modified.

**Table 2-278. MEMORY\_ERROR\_REGS Registers**

Offset	Acronym	Register Name	Write Protection	Section
0h	UCERRFLG	Uncorrectable Error Flag Register		<a href="#">Go</a>
2h	UCERRSET	Uncorrectable Error Flag Set Register	EALLOW	<a href="#">Go</a>
4h	UCERRCLR	Uncorrectable Error Flag Clear Register	EALLOW	<a href="#">Go</a>
6h	UCCPUREADDR	Uncorrectable CPU Read Error Address		<a href="#">Go</a>
8h	UCDMAREADDR	Uncorrectable DMA Read Error Address		<a href="#">Go</a>
Ah	UCCLA1READDR	Uncorrectable CLA1 Read Error Address		<a href="#">Go</a>
20h	CERRFLG	Correctable Error Flag Register		<a href="#">Go</a>
22h	CERRSET	Correctable Error Flag Set Register	EALLOW	<a href="#">Go</a>
24h	CERRCLR	Correctable Error Flag Clear Register	EALLOW	<a href="#">Go</a>
26h	CCPUREADDR	Correctable CPU Read Error Address		<a href="#">Go</a>
2Eh	CERRCNT	Correctable Error Count Register		<a href="#">Go</a>
30h	CERRTHRES	Correctable Error Threshold Value Register	EALLOW	<a href="#">Go</a>
32h	CEINTFLG	Correctable Error Interrupt Flag Status Register		<a href="#">Go</a>
34h	CEINTCLR	Correctable Error Interrupt Flag Clear Register	EALLOW	<a href="#">Go</a>
36h	CEINTSET	Correctable Error Interrupt Flag Set Register	EALLOW	<a href="#">Go</a>
38h	CEINTEN	Correctable Error Interrupt Enable Register	EALLOW	<a href="#">Go</a>

Complex bit access types are encoded to fit into small table cells. Table 2-279 shows the codes that are used for access types in this section.

**Table 2-279. MEMORY\_ERROR\_REGS Access Type Codes**

Access Type	Code	Description
<b>Read Type</b>		
R	R	Read
R=0	R	Read
<b>Write Type</b>		
W	W	Write
W=1	W	Write
<b>Reset or Default Value</b>		
-n		Value after reset or the default value
<b>Register Array Variables</b>		
i,j,k,l,m,n		When these variables are used in a register name, an offset, or an address, they refer to the value of a register array where the register is part of a group of repeating registers. The register groups form a hierarchical structure and the array is represented with a formula.
y		When this variable is used in a register name, an offset, or an address it refers to the value of a register array.

### 2.15.20.1 UCERRFLG Register (Offset = 0h) [reset = 0h]

UCERRFLG is shown in [Figure 2-249](#) and described in [Table 2-280](#).

Return to [Summary Table](#).

Uncorrectable Error Flag Register

**Figure 2-249. UCERRFLG Register**

31	30	29	28	27	26	25	24
RESERVED							
R-0h							
23	22	21	20	19	18	17	16
RESERVED							
R-0h							
15	14	13	12	11	10	9	8
RESERVED							
R-0h							
7	6	5	4	3	2	1	0
RESERVED				RESERVED	CLA1RDERR	DMARDERR	CPURDERR
R-0h				R-0h	R-0h	R-0h	R-0h

**Table 2-280. UCERRFLG Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R	0h	Reserved
15-4	RESERVED	R	0h	Reserved
3	RESERVED	R	0h	Reserved
2	CLA1RDERR	R	0h	CLA1 Uncorrectable Read Error Flag 0: No Error. 1: Uncorrectable error occurred during CLA1 read. Reset type: SYSRSn
1	DMARDERR	R	0h	DMA Uncorrectable Read Error Flag 0: No Error. 1: Uncorrectable error occurred during DMA read. Reset type: SYSRSn
0	CPURDERR	R	0h	CPU Uncorrectable Read Error Flag 0: No Error. 1: Uncorrectable error occurred during CPU read. Reset type: SYSRSn

**2.15.20.2 UCERRSET Register (Offset = 2h) [reset = 0h]**

UCERRSET is shown in [Figure 2-250](#) and described in [Table 2-281](#).

Return to [Summary Table](#).

Uncorrectable Error Flag Set Register

**Figure 2-250. UCERRSET Register**

31	30	29	28	27	26	25	24
RESERVED							
R-0h							
23	22	21	20	19	18	17	16
RESERVED							
R-0h							
15	14	13	12	11	10	9	8
RESERVED							
R-0h							
7	6	5	4	3	2	1	0
RESERVED				RESERVED	CLA1RDERR	DMARDERR	CPURDERR
R-0h				R-0h	R=0/W=1-0h	R=0/W=1-0h	R=0/W=1-0h

**Table 2-281. UCERRSET Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R	0h	Reserved
15-4	RESERVED	R	0h	Reserved
3	RESERVED	R	0h	Reserved
2	CLA1RDERR	R=0/W=1	0h	0: No action. 1: CLA1 Read Error Flag in UCERRFLG register will be set and interrupt will be generated if enabled.. Reset type: SYSRSn
1	DMARDERR	R=0/W=1	0h	0: No action. 1: DMA Read Error Flag in UCERRFLG register will be set and interrupt will be generated if enabled.. Reset type: SYSRSn
0	CPURDERR	R=0/W=1	0h	0: No action. 1: CPU Read Error Flag in UCERRFLG register will be set and interrupt will be generated if enabled.. Reset type: SYSRSn



**2.15.20.3 UCERRCLR Register (Offset = 4h) [reset = 0h]**

UCERRCLR is shown in [Figure 2-251](#) and described in [Table 2-282](#).

Return to [Summary Table](#).

Uncorrectable Error Flag Clear Register

**Figure 2-251. UCERRCLR Register**

31	30	29	28	27	26	25	24	
RESERVED								
R-0h								
23	22	21	20	19	18	17	16	
RESERVED								
R-0h								
15	14	13	12	11	10	9	8	
RESERVED								
R-0h								
7	6	5	4	3	2	1	0	
RESERVED				RESERVED		CLA1RDERR	DMARDERR	CPURDERR
R-0h				R-0h		R=0/W=1-0h	R=0/W=1-0h	R=0/W=1-0h

**Table 2-282. UCERRCLR Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R	0h	Reserved
15-4	RESERVED	R	0h	Reserved
3	RESERVED	R	0h	Reserved
2	CLA1RDERR	R=0/W=1	0h	0: No action. 1: CLA1 Read Error Flag in UCERRFLG register will be cleared. Reset type: SYSRSn
1	DMARDERR	R=0/W=1	0h	0: No action. 1: DMA Read Error Flag in UCERRFLG register will be cleared . Reset type: SYSRSn
0	CPURDERR	R=0/W=1	0h	0: No action. 1: CPU Read Error Flag in UCERRFLG register will be cleared. Reset type: SYSRSn

#### 2.15.20.4 UCCPUREADDR Register (Offset = 6h) [reset = 0h]

UCCPUREADDR is shown in [Figure 2-252](#) and described in [Table 2-283](#).

Return to [Summary Table](#).

Uncorrectable CPU Read Error Address

**Figure 2-252. UCCPUREADDR Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
UCCPUREADDR																															
R-0h																															

**Table 2-283. UCCPUREADDR Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-0	UCCPUREADDR	R	0h	This register captures the address location for which CPU read/fetch access resulted in uncorrectable ECC/Parity error. Reset type: SYSRSn

**2.15.20.5 UCDMAREADDR Register (Offset = 8h) [reset = 0h]**

UCDMAREADDR is shown in [Figure 2-253](#) and described in [Table 2-284](#).

Return to [Summary Table](#).

Uncorrectable DMA Read Error Address

**Figure 2-253. UCDMAREADDR Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
UCDMAREADDR																															
R-0h																															

**Table 2-284. UCDMAREADDR Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-0	UCDMAREADDR	R	0h	This register captures the address location for which DMA read access resulted in uncorrectable ECC/Parity error. Reset type: SYSRSn

**2.15.20.6 UCCLA1READDR Register (Offset = Ah) [reset = 0h]**

UCCLA1READDR is shown in [Figure 2-254](#) and described in [Table 2-285](#).

Return to [Summary Table](#).

Uncorrectable CLA1 Read Error Address

**Figure 2-254. UCCLA1READDR Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
UCCLA1READDR																															
R-0h																															

**Table 2-285. UCCLA1READDR Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-0	UCCLA1READDR	R	0h	This register captures the address location for which CLA1 read/fetch access resulted in uncorrectable ECC/Parity error. Reset type: SYSRSn

**2.15.20.7 CERRFLG Register (Offset = 20h) [reset = 0h]**

CERRFLG is shown in [Figure 2-255](#) and described in [Table 2-286](#).

Return to [Summary Table](#).

Correctable Error Flag Register

**Figure 2-255. CERRFLG Register**

31	30	29	28	27	26	25	24
RESERVED							
R-0h							
23	22	21	20	19	18	17	16
RESERVED							
R-0h							
15	14	13	12	11	10	9	8
RESERVED							
R-0h							
7	6	5	4	3	2	1	0
RESERVED				RESERVED	CLA1RDERR	DMARDERR	CPURDERR
R-0h				R-0h	R-0h	R-0h	R-0h

**Table 2-286. CERRFLG Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R	0h	Reserved
15-4	RESERVED	R	0h	Reserved
3	RESERVED	R	0h	Reserved
2	CLA1RDERR	R	0h	CLA1 Correctable Read Error Flag 0: No Error. 1: Correctable error occurred during CLA1 read. Reset type: SYSRSn
1	DMARDERR	R	0h	DMA Correctable Read Error Flag 0: No Error. 1: Correctable error occurred during DMA read. Reset type: SYSRSn
0	CPURDERR	R	0h	CPU Correctable Read Error Flag 0: No Error. 1: Correctable error occurred during CPU read. Reset type: SYSRSn

**2.15.20.8 CERRSET Register (Offset = 22h) [reset = 0h]**

CERRSET is shown in [Figure 2-256](#) and described in [Table 2-287](#).

Return to [Summary Table](#).

Correctable Error Flag Set Register

**Figure 2-256. CERRSET Register**

31	30	29	28	27	26	25	24
RESERVED							
R-0h							
23	22	21	20	19	18	17	16
RESERVED							
R-0h							
15	14	13	12	11	10	9	8
RESERVED							
R-0h							
7	6	5	4	3	2	1	0
RESERVED				RESERVED	CLA1RDERR	DMARDERR	CPURDERR
R-0h				R-0h	R=0/W=1-0h	R=0/W=1-0h	R=0/W=1-0h

**Table 2-287. CERRSET Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R	0h	Reserved
15-4	RESERVED	R	0h	Reserved
3	RESERVED	R	0h	Reserved
2	CLA1RDERR	R=0/W=1	0h	0: No action. 1: CLA1 Read Error Flag in CERRFLG register will be set and interrupt will be generated if enabled.. Reset type: SYSRSn
1	DMARDERR	R=0/W=1	0h	0: No action. 1: DMA Read Error Flag in CERRFLG register will be set and interrupt will be generated if enabled.. Reset type: SYSRSn
0	CPURDERR	R=0/W=1	0h	0: No action. 1: CPU Read Error Flag in CERRFLG register will be set and interrupt will be generated if enabled.. Reset type: SYSRSn

**2.15.20.9 CERRCLR Register (Offset = 24h) [reset = 0h]**

CERRCLR is shown in [Figure 2-257](#) and described in [Table 2-288](#).

Return to [Summary Table](#).

Correctable Error Flag Clear Register

**Figure 2-257. CERRCLR Register**

31	30	29	28	27	26	25	24
RESERVED							
R-0h							
23	22	21	20	19	18	17	16
RESERVED							
R-0h							
15	14	13	12	11	10	9	8
RESERVED							
R-0h							
7	6	5	4	3	2	1	0
RESERVED				RESERVED	CLA1RDERR	DMARDERR	CPURDERR
R-0h				R-0h	R=0/W=1-0h	R=0/W=1-0h	R=0/W=1-0h

**Table 2-288. CERRCLR Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R	0h	Reserved
15-4	RESERVED	R	0h	Reserved
3	RESERVED	R	0h	Reserved
2	CLA1RDERR	R=0/W=1	0h	0: No action. 1: CLA1 Read Error Flag in CERRFLG register will be cleared. Reset type: SYSRSn
1	DMARDERR	R=0/W=1	0h	0: No action. 1: DMA Read Error Flag in CERRFLG register will be cleared . Reset type: SYSRSn
0	CPURDERR	R=0/W=1	0h	0: No action. 1: CPU Read Error Flag in CERRFLG register will be cleared. Reset type: SYSRSn

**2.15.20.10 CCPUREADDR Register (Offset = 26h) [reset = 0h]**

CCPUREADDR is shown in [Figure 2-258](#) and described in [Table 2-289](#).

Return to [Summary Table](#).

Correctable CPU Read Error Address

**Figure 2-258. CCPUREADDR Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
CCPUREADDR																															
R-0h																															

**Table 2-289. CCPUREADDR Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-0	CCPUREADDR	R	0h	This register captures the address location for which CPU read/fetch access resulted in correctable ECC error. Reset type: SYSRSn



**2.15.20.11 CERRCNT Register (Offset = 2Eh) [reset = 0h]**

CERRCNT is shown in [Figure 2-259](#) and described in [Table 2-290](#).

Return to [Summary Table](#).

Correctable Error Count Register

**Figure 2-259. CERRCNT Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
CERRCNT																															
R-0h																															

**Table 2-290. CERRCNT Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-0	CERRCNT	R	0h	This register holds the count of how many times correctable error occurred. Reset type: SYSRSn

**2.15.20.12 CERRTHRES Register (Offset = 30h) [reset = 0h]**

CERRTHRES is shown in [Figure 2-260](#) and described in [Table 2-291](#).

Return to [Summary Table](#).

Correctable Error Threshold Value Register

**Figure 2-260. CERRTHRES Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
CERRTHRES																															
R/W-0h																															

**Table 2-291. CERRTHRES Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-0	CERRTHRES	R/W	0h	When value in CERRCNT register is greater or equal to than value configured in this register, correctable interrupt gets generated, if enabled. Reset type: SYSRSn

**2.15.20.13 CEINTFLG Register (Offset = 32h) [reset = 0h]**

CEINTFLG is shown in [Figure 2-261](#) and described in [Table 2-292](#).

Return to [Summary Table](#).

Correctable Error Interrupt Flag Status Register

**Figure 2-261. CEINTFLG Register**

31	30	29	28	27	26	25	24
RESERVED							
R-0h							
23	22	21	20	19	18	17	16
RESERVED							
R-0h							
15	14	13	12	11	10	9	8
RESERVED							
R-0h							
7	6	5	4	3	2	1	0
RESERVED							CEINTFLAG
R-0h							R-0h

**Table 2-292. CEINTFLG Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R	0h	Reserved
15-1	RESERVED	R	0h	Reserved
0	CEINTFLAG	R	0h	Total corrected error count exceeded threshold Flag 0: Total correctable errors < Threshold value configured in CERRTHRES register. 1: Total correctable errors >= Threshold value configured in CERRTHRES register. Reset type: SYSRSn

**2.15.20.14 CEINTCLR Register (Offset = 34h) [reset = 0h]**

CEINTCLR is shown in [Figure 2-262](#) and described in [Table 2-293](#).

Return to [Summary Table](#).

Correctable Error Interrupt Flag Clear Register

**Figure 2-262. CEINTCLR Register**

31	30	29	28	27	26	25	24
RESERVED							
R-0h							
23	22	21	20	19	18	17	16
RESERVED							
R-0h							
15	14	13	12	11	10	9	8
RESERVED							
R-0h							
7	6	5	4	3	2	1	0
RESERVED							CEINTCLR
R-0h							R=0/W=1-0h

**Table 2-293. CEINTCLR Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R	0h	Reserved
15-1	RESERVED	R	0h	Reserved
0	CEINTCLR	R=0/W=1	0h	0: No action. 1: Total corrected error count exceeded flag in CEINTFLG register will be cleared. Reset type: SYSRSn

**2.15.20.15 CEINTSET Register (Offset = 36h) [reset = 0h]**

CEINTSET is shown in [Figure 2-263](#) and described in [Table 2-294](#).

Return to [Summary Table](#).

Correctable Error Interrupt Flag Set Register

**Figure 2-263. CEINTSET Register**

31	30	29	28	27	26	25	24
RESERVED							
R-0h							
23	22	21	20	19	18	17	16
RESERVED							
R-0h							
15	14	13	12	11	10	9	8
RESERVED							
R-0h							
7	6	5	4	3	2	1	0
RESERVED							CEINTSET
R-0h							R=0/W=1-0h

**Table 2-294. CEINTSET Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R	0h	Reserved
15-1	RESERVED	R	0h	Reserved
0	CEINTSET	R=0/W=1	0h	0: No action. 1: Total corrected error count exceeded flag in CEINTFLG register will be set and interrupt will be generated if enabled. Reset type: SYSRSn

**2.15.20.16 CEINTEN Register (Offset = 38h) [reset = 0h]**

CEINTEN is shown in [Figure 2-264](#) and described in [Table 2-295](#).

Return to [Summary Table](#).

Correctable Error Interrupt Enable Register

**Figure 2-264. CEINTEN Register**

31	30	29	28	27	26	25	24
RESERVED							
R-0h							
23	22	21	20	19	18	17	16
RESERVED							
R-0h							
15	14	13	12	11	10	9	8
RESERVED							
R-0h							
7	6	5	4	3	2	1	0
RESERVED							CEINTEN
R-0h							R/W-0h

**Table 2-295. CEINTEN Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R	0h	Reserved
15-1	RESERVED	R	0h	Reserved
0	CEINTEN	R/W	0h	0: Correctable Error Interrupt is disabled. 1: Correctable Error Interrupt is enabled. Reset type: SYSRSn

### 2.15.21 ROM\_WAIT\_STATE\_REGS Registers

Table 2-296 lists the memory-mapped registers for the ROM\_WAIT\_STATE\_REGS. All register offset addresses not listed in Table 2-296 should be considered as reserved locations and the register contents should not be modified.

**Table 2-296. ROM\_WAIT\_STATE\_REGS Registers**

Offset	Acronym	Register Name	Write Protection	Section
0h	ROMWAITSTATE	ROM Wait State Configuration Register	EALLOW	<a href="#">Go</a>

Complex bit access types are encoded to fit into small table cells. Table 2-297 shows the codes that are used for access types in this section.

**Table 2-297. ROM\_WAIT\_STATE\_REGS Access Type Codes**

Access Type	Code	Description
<b>Read Type</b>		
R	R	Read
<b>Write Type</b>		
W	W	Write
<b>Reset or Default Value</b>		
-n		Value after reset or the default value
<b>Register Array Variables</b>		
i,j,k,l,m,n		When these variables are used in a register name, an offset, or an address, they refer to the value of a register array where the register is part of a group of repeating registers. The register groups form a hierarchical structure and the array is represented with a formula.
y		When this variable is used in a register name, an offset, or an address it refers to the value of a register array.

**2.15.21.1 ROMWAITSTATE Register (Offset = 0h) [reset = 0h]**

ROMWAITSTATE is shown in [Figure 2-265](#) and described in [Table 2-298](#).

Return to [Summary Table](#).

ROM Wait State Configuration Register

**Figure 2-265. ROMWAITSTATE Register**

31	30	29	28	27	26	25	24
RESERVED							
R-0h							
23	22	21	20	19	18	17	16
RESERVED							
R-0h							
15	14	13	12	11	10	9	8
RESERVED							
R-0h							
7	6	5	4	3	2	1	0
RESERVED							WSDISABLE
R-0h							R/W-0h

**Table 2-298. ROMWAITSTATE Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R	0h	Reserved
15-1	RESERVED	R	0h	Reserved
0	WSDISABLE	R/W	0h	0: ROM Wait State is enabled. CPU accesses to ROM are 1-wait. 1: ROM Wait State is disabled. CPU accesses to ROM are 0-wait. Reset type: SYSRSn



## 2.15.22 FLASH\_CTRL\_REGS Registers

Table 2-299 lists the memory-mapped registers for the FLASH\_CTRL\_REGS. All register offset addresses not listed in Table 2-299 should be considered as reserved locations and the register contents should not be modified.

**Table 2-299. FLASH\_CTRL\_REGS Registers**

Offset	Acronym	Register Name	Write Protection	Section
0h	FRDCNTL	Flash Read Control Register	EALLOW	<a href="#">Go</a>
1Eh	FBAC	Flash Bank Access Control Register	EALLOW	<a href="#">Go</a>
20h	FBFALLBACK	Flash Bank Fallback Power Register	EALLOW	<a href="#">Go</a>
22h	FBPRDY	Flash Bank Pump Ready Register	EALLOW	<a href="#">Go</a>
24h	FPAC1	Flash Pump Access Control Register 1	EALLOW	<a href="#">Go</a>
2Ah	FMSTAT	Flash Module Status Register	EALLOW	<a href="#">Go</a>
180h	FRD_INTF_CTRL	Flash Read Interface Control Register	EALLOW	<a href="#">Go</a>

Complex bit access types are encoded to fit into small table cells. Table 2-300 shows the codes that are used for access types in this section.

**Table 2-300. FLASH\_CTRL\_REGS Access Type Codes**

Access Type	Code	Description
<b>Read Type</b>		
R	R	Read
<b>Write Type</b>		
W	W	Write
<b>Reset or Default Value</b>		
-n		Value after reset or the default value
<b>Register Array Variables</b>		
i,j,k,l,m,n		When these variables are used in a register name, an offset, or an address, they refer to the value of a register array where the register is part of a group of repeating registers. The register groups form a hierarchical structure and the array is represented with a formula.
y		When this variable is used in a register name, an offset, or an address it refers to the value of a register array.

**2.15.22.1 FRDCNTL Register (Offset = 0h) [reset = F00h]**

FRDCNTL is shown in [Figure 2-266](#) and described in [Table 2-301](#).

Return to [Summary Table](#).

Flash Read Control Register

**Figure 2-266. FRDCNTL Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
RESERVED															
R-0h															
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
RESERVED				RWAIT				RESERVED							
R-0h				R/W-Fh				R-0h							

**Table 2-301. FRDCNTL Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R	0h	Reserved
15-12	RESERVED	R	0h	Reserved
11-8	RWAIT	R/W	Fh	Random read waitstate  These bits indicate how many waitstates are added to a flash read access. The RWAIT value can be set anywhere from 0 to 0xF. For a flash access, data is returned in RWAIT+1 SYSCLK cycles.  Note: The required wait states for each SYSCLK frequency can be found in the device data manual.  Reset type: SYSRSn
7-0	RESERVED	R	0h	Reserved

**2.15.22.2 FBAC Register (Offset = 1Eh) [reset = Fh]**

FBAC is shown in [Figure 2-267](#) and described in [Table 2-302](#).

Return to [Summary Table](#).

Flash Bank Access Control Register

**Figure 2-267. FBAC Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
RESERVED																RESERVED						VREADST									
R-0h																R-0h						R/W-Fh									

**Table 2-302. FBAC Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R	0h	Reserved
15-8	RESERVED	R	0h	Reserved
7-0	VREADST	R/W	Fh	This bit-field ensures that the requisite delay is introduced for the flash pump/bank to come out of low-power mode, so that the flash/OTP array is ready for CPU accesses. The reset value of this bit-field is 0xF. Before entering any low-power mode for the flash bank/pump, this bit-field must be configured as described in the "Flash and OTP Memory" chapter of the TRM. Applications typically use the flash bank/pump low-power modes to reduce power (i) during the device low-power modes such as IDLE/STANDBY/HALT (ii) while running code off RAM after powering down the flash. Reset type: SYSRSn

**2.15.22.3 FBFALLBACK Register (Offset = 20h) [reset = 0h]**

FBFALLBACK is shown in [Figure 2-268](#) and described in [Table 2-303](#).

Return to [Summary Table](#).

Flash Bank Fallback Power Register

**Figure 2-268. FBFALLBACK Register**

31	30	29	28	27	26	25	24
RESERVED							
R-0h							
23	22	21	20	19	18	17	16
RESERVED							
R-0h							
15	14	13	12	11	10	9	8
RESERVED							
R-0h							
7	6	5	4	3	2	1	0
RESERVED						BNKPWR0	
R-0h						R/W-0h	

**Table 2-303. FBFALLBACK Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R	0h	Reserved
15-2	RESERVED	R	0h	Reserved
1-0	BNKPWR0	R/W	0h	Bank Power Mode Control 00 Sleep (Sense amplifiers and sense reference disabled) 01 Standby (Sense amplifiers disabled, but sense reference enabled) 10 Reserved 11 Active (Both sense amplifiers and sense reference enabled) Note: If the bank and pump are not in active mode and an access is made, the value of this register is automatically changed to active. Reset type: SYSRSn

**2.15.22.4 FBPRDY Register (Offset = 22h) [reset = 0h]**

FBPRDY is shown in [Figure 2-269](#) and described in [Table 2-304](#).

Return to [Summary Table](#).

Flash Bank Pump Ready Register

**Figure 2-269. FBPRDY Register**

31	30	29	28	27	26	25	24
RESERVED							
R-0h							
23	22	21	20	19	18	17	16
RESERVED							
R-0h							
15	14	13	12	11	10	9	8
PUMPRDY	RESERVED						
R-0h	R-0h			R-0h			
7	6	5	4	3	2	1	0
RESERVED							BANKRDY
R-0h							R-0h

**Table 2-304. FBPRDY Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R	0h	Reserved
15	PUMPRDY	R	0h	Pump Ready. This is a read-only bit which allows software to determine if the pump is ready for flash access before attempting the actual access. If an access is made to a bank when the pump is not ready, wait states are asserted until it becomes ready. 0 Pump is not ready. 1 Pump is ready, in active power state. Reset type: SYSRSn
14-1	RESERVED	R	0h	Reserved
0	BANKRDY	R	0h	Bank Ready. This is a read-only register which allows software to determine if the bank is ready for Flash access before the access is attempted. Note: The user should wait for both the pump and the bank to be ready before attempting an access. 0 Bank is not ready. 1 Bank is in active power mode and is ready for access. Reset type: SYSRSn

**2.15.22.5 FPAC1 Register (Offset = 24h) [reset = 08600000h]**

 FPAC1 is shown in [Figure 2-270](#) and described in [Table 2-305](#).

 Return to [Summary Table](#).

Flash Pump Access Control Register 1

**Figure 2-270. FPAC1 Register**

31	30	29	28	27	26	25	24
RESERVED				PSLEEP			
R-0h				R/W-860h			
23	22	21	20	19	18	17	16
PSLEEP							
R/W-860h							
15	14	13	12	11	10	9	8
RESERVED							
R-0h							
7	6	5	4	3	2	1	0
RESERVED							PMPPWR
R-0h							R/W-0h

**Table 2-305. FPAC1 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-28	RESERVED	R	0h	Reserved
27-16	PSLEEP	R/W	860h	Pump sleep. These bits contain the starting count value for the charge pump sleep down counter. While the charge pump is in sleep mode, the power mode management logic holds the charge pump sleep counter at this value. When the charge pump exits sleep power mode, the down counter delays from 0 to PSLEEP prescaled SYSCLK clock cycles before putting the charge pump into active power mode.  Note: The pump sleep down counter uses a prescaled clock which is divided by 2 of input SYSCLK. The configured PSLEEP value should yield a delay of at least 20 microseconds for the pump to go to active mode.  Reset type: SYSRSn
15-1	RESERVED	R	0h	Reserved
0	PMPPWR	R/W	0h	Flash Charge Pump Control Power Mode. Configures the power mode of the charge pump. 0 Sleep (all pump circuits disabled) 1 Active (all pump circuits active) Reset type: SYSRSn

### 2.15.22.6 FMSTAT Register (Offset = 2Ah) [reset = 0h]

FMSTAT is shown in [Figure 2-271](#) and described in [Table 2-306](#).

Return to [Summary Table](#).

Flash Module Status Register

**Figure 2-271. FMSTAT Register**

31	30	29	28	27	26	25	24
RESERVED							
R-0h							
23	22	21	20	19	18	17	16
RESERVED						RESERVED	RESERVED
R-0h						R-0h	R-0h
15	14	13	12	11	10	9	8
RESERVED	RESERVED	RESERVED	PGV	RESERVED	EV	RESERVED	BUSY
R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h
7	6	5	4	3	2	1	0
ERS	PGM	INVDAT	CSTAT	VOLTSTAT	RESERVED	RESERVED	RESERVED
R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h

**Table 2-306. FMSTAT Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-18	RESERVED	R	0h	Reserved
17	RESERVED	R	0h	Reserved
16	RESERVED	R	0h	Reserved
15	RESERVED	R	0h	Reserved
14	RESERVED	R	0h	Reserved
13	RESERVED	R	0h	Reserved
12	PGV	R	0h	Program verify When set, indicates that a word is not successfully programmed after the maximum allowed number of program pulses are given for program operation. Reset type: SYSRSn
11	RESERVED	R	0h	Reserved
10	EV	R	0h	Erase verify When set, indicates that a sector is not successfully erased after the maximum allowed number of erase pulses are given for erase operation. Reset type: SYSRSn
9	RESERVED	R	0h	Reserved
8	BUSY	R	0h	When set, this bit indicates that a program, erase, or suspend operation is being processed. Reset type: SYSRSn
7	ERS	R	0h	Erase Active. When set, this bit indicates that the flash module is actively performing an erase operation. This bit is set when erasing starts and is cleared when erasing is complete. It is also cleared when the erase is suspended and set when the erase resumes. Reset type: SYSRSn
6	PGM	R	0h	Program Active. When set, this bit indicates that the flash module is currently performing a program operation. This bit is set when programming starts and is cleared when programming is complete. It is also cleared when programming is suspended and set when programming is resumed. Reset type: SYSRSn

**Table 2-306. FMSTAT Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
5	INVSTAT	R	0h	Invalid Data. When set, this bit indicates that the user attempted to program a "1" where a "0" was already present. Reset type: SYSRSn
4	CSTAT	R	0h	Command Status. Once the FSM starts any failure will set this bit. When set, this bit informs the host that the program, erase, or validate sector command failed and the command was stopped. This bit is cleared by the Clear Status command. For some errors, this will be the only indication of an FSM error because the cause does not fall within the other error bit types. Reset type: SYSRSn
3	VOLTSTAT	R	0h	Core Voltage Status. When set, this bit indicates that the core voltage generator of the pump power supply dipped below the lower limit allowable during a program or erase operation. Reset type: SYSRSn
2	RESERVED	R	0h	Reserved
1	RESERVED	R	0h	Reserved
0	RESERVED	R	0h	Reserved



**2.15.22.7 FRD\_INTF\_CTRL Register (Offset = 180h) [reset = 0h]**

FRD\_INTF\_CTRL is shown in [Figure 2-272](#) and described in [Table 2-307](#).

Return to [Summary Table](#).

Flash Read Interface Control Register

**Figure 2-272. FRD\_INTF\_CTRL Register**

31	30	29	28	27	26	25	24
RESERVED							
R-0h							
23	22	21	20	19	18	17	16
RESERVED							
R-0h							
15	14	13	12	11	10	9	8
RESERVED							
R-0h							
7	6	5	4	3	2	1	0
RESERVED						DATA_CACHE _EN	PREFETCH_E N
R-0h						R/W-0h	R/W-0h

**Table 2-307. FRD\_INTF\_CTRL Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R	0h	Reserved
15-2	RESERVED	R	0h	Reserved
1	DATA_CACHE_EN	R/W	0h	Data cache enable. 0 A value of 0 disables the data cache. 1 A value of 1 enables the data cache. Reset type: SYSRSn
0	PREFETCH_EN	R/W	0h	Prefetch enable. 0 A value of 0 disables prefetch mechanism. 1 A value of 1 enables pre-fetch mechanism. Reset type: SYSRSn

### 2.15.23 FLASH\_ECC\_REGS Registers

Table 2-308 lists the memory-mapped registers for the FLASH\_ECC\_REGS. All register offset addresses not listed in Table 2-308 should be considered as reserved locations and the register contents should not be modified.

**Table 2-308. FLASH\_ECC\_REGS Registers**

Offset	Acronym	Register Name	Write Protection	Section
0h	ECC_ENABLE	ECC Enable	EALLOW	<a href="#">Go</a>
2h	SINGLE_ERR_ADDR_LOW	Single Error Address Low	EALLOW	<a href="#">Go</a>
4h	SINGLE_ERR_ADDR_HIGH	Single Error Address High	EALLOW	<a href="#">Go</a>
6h	UNC_ERR_ADDR_LOW	Uncorrectable Error Address Low	EALLOW	<a href="#">Go</a>
8h	UNC_ERR_ADDR_HIGH	Uncorrectable Error Address High	EALLOW	<a href="#">Go</a>
Ah	ERR_STATUS	Error Status	EALLOW	<a href="#">Go</a>
Ch	ERR_POS	Error Position	EALLOW	<a href="#">Go</a>
Eh	ERR_STATUS_CLR	Error Status Clear	EALLOW	<a href="#">Go</a>
10h	ERR_CNT	Error Control	EALLOW	<a href="#">Go</a>
12h	ERR_THRESHOLD	Error Threshold	EALLOW	<a href="#">Go</a>
14h	ERR_INTFLG	Error Interrupt Flag	EALLOW	<a href="#">Go</a>
16h	ERR_INTCLR	Error Interrupt Flag Clear	EALLOW	<a href="#">Go</a>
18h	FDATAH_TEST	Data High Test	EALLOW	<a href="#">Go</a>
1Ah	FDATAL_TEST	Data Low Test	EALLOW	<a href="#">Go</a>
1Ch	FADDR_TEST	ECC Test Address	EALLOW	<a href="#">Go</a>
1Eh	FECC_TEST	ECC Test Address	EALLOW	<a href="#">Go</a>
20h	FECC_CTRL	ECC Control	EALLOW	<a href="#">Go</a>
22h	FOUTH_TEST	Test Data Out High	EALLOW	<a href="#">Go</a>
24h	FOUTL_TEST	Test Data Out Low	EALLOW	<a href="#">Go</a>
26h	FECC_STATUS	ECC Status	EALLOW	<a href="#">Go</a>

Complex bit access types are encoded to fit into small table cells. Table 2-309 shows the codes that are used for access types in this section.

**Table 2-309. FLASH\_ECC\_REGS Access Type Codes**

Access Type	Code	Description
<b>Read Type</b>		
R	R	Read
R=0	R	Read
<b>Write Type</b>		
W	W	Write
W=1	W	Write
<b>Reset or Default Value</b>		
-n		Value after reset or the default value
<b>Register Array Variables</b>		
i,j,k,l,m,n		When these variables are used in a register name, an offset, or an address, they refer to the value of a register array where the register is part of a group of repeating registers. The register groups form a hierarchical structure and the array is represented with a formula.

**Table 2-309. FLASH\_ECC\_REGS Access Type  
Codes (continued)**

Access Type	Code	Description
y		When this variable is used in a register name, an offset, or an address it refers to the value of a register array.

**2.15.23.1 ECC\_ENABLE Register (Offset = 0h) [reset = Ah]**

ECC\_ENABLE is shown in [Figure 2-273](#) and described in [Table 2-310](#).

Return to [Summary Table](#).

ECC Enable

**Figure 2-273. ECC\_ENABLE Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
RESERVED															
R-0h															
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
RESERVED												ENABLE			
R-0h												R/W-Ah			

**Table 2-310. ECC\_ENABLE Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R	0h	Reserved
15-4	RESERVED	R	0h	Reserved
3-0	ENABLE	R/W	Ah	ECC enable. A value of 0xA would enable ECC. Any other value would disable ECC. Reset type: SYSRSn

**2.15.23.2 SINGLE\_ERR\_ADDR\_LOW Register (Offset = 2h) [reset = 0h]**

SINGLE\_ERR\_ADDR\_LOW is shown in [Figure 2-274](#) and described in [Table 2-311](#).

Return to [Summary Table](#).

Single Error Address Low

**Figure 2-274. SINGLE\_ERR\_ADDR\_LOW Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ERR_ADDR_L																															
R/W-0h																															

**Table 2-311. SINGLE\_ERR\_ADDR\_LOW Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-0	ERR_ADDR_L	R/W	0h	64-bit aligned address at which a single bit error occurred in the lower 64-bits of a 128-bit aligned memory. Reset type: SYSRSn

**2.15.23.3 SINGLE\_ERR\_ADDR\_HIGH Register (Offset = 4h) [reset = 0h]**

SINGLE\_ERR\_ADDR\_HIGH is shown in [Figure 2-275](#) and described in [Table 2-312](#).

Return to [Summary Table](#).

Single Error Address High

**Figure 2-275. SINGLE\_ERR\_ADDR\_HIGH Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ERR_ADDR_H																															
R/W-0h																															

**Table 2-312. SINGLE\_ERR\_ADDR\_HIGH Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-0	ERR_ADDR_H	R/W	0h	64-bit aligned address at which a single bit error occurred in the upper 64-bits of a 128-bit aligned memory. Reset type: SYSRSn

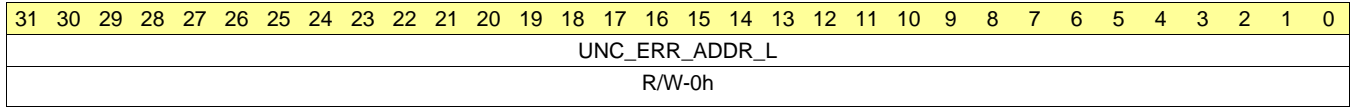
**2.15.23.4 UNC\_ERR\_ADDR\_LOW Register (Offset = 6h) [reset = 0h]**

UNC\_ERR\_ADDR\_LOW is shown in [Figure 2-276](#) and described in [Table 2-313](#).

Return to [Summary Table](#).

Uncorrectable Error Address Low

**Figure 2-276. UNC\_ERR\_ADDR\_LOW Register**



**Table 2-313. UNC\_ERR\_ADDR\_LOW Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-0	UNC_ERR_ADDR_L	R/W	0h	64-bit aligned address at which an uncorrectable error occurred in the lower 64-bits of a 128-bit aligned memory. Reset type: SYSRSn

**2.15.23.5 UNC\_ERR\_ADDR\_HIGH Register (Offset = 8h) [reset = 0h]**

UNC\_ERR\_ADDR\_HIGH is shown in [Figure 2-277](#) and described in [Table 2-314](#).

Return to [Summary Table](#).

Uncorrectable Error Address High

**Figure 2-277. UNC\_ERR\_ADDR\_HIGH Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
UNC_ERR_ADDR_H																															
R/W-0h																															

**Table 2-314. UNC\_ERR\_ADDR\_HIGH Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-0	UNC_ERR_ADDR_H	R/W	0h	64-bit aligned address at which an uncorrectable error occurred in the upper 64-bits of a 128-bit aligned memory. Reset type: SYSRSn



### 2.15.23.6 ERR\_STATUS Register (Offset = Ah) [reset = 0h]

ERR\_STATUS is shown in [Figure 2-278](#) and described in [Table 2-315](#).

Return to [Summary Table](#).

Error Status

**Figure 2-278. ERR\_STATUS Register**

31	30	29	28	27	26	25	24
RESERVED							
R-0h							
23	22	21	20	19	18	17	16
RESERVED					UNC_ERR_H	FAIL_1_H	FAIL_0_H
R-0h					R-0h	R-0h	R-0h
15	14	13	12	11	10	9	8
RESERVED							
R-0h							
7	6	5	4	3	2	1	0
RESERVED					UNC_ERR_L	FAIL_1_L	FAIL_0_L
R-0h					R-0h	R-0h	R-0h

**Table 2-315. ERR\_STATUS Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-19	RESERVED	R	0h	Reserved
18	UNC_ERR_H	R	0h	Uncorrectable error. A value of 1 indicates that an un-correctable error occurred in upper 64bits of a 128-bit aligned address. Cleared by writing a 1 to UNC_ERR_H_CLR bit of ERR_STATUS_CLR register. Reset type: SYSRSn
17	FAIL_1_H	R	0h	Fail on 1. 0 Fail on 1 single bit error did not occur in upper 64bits of a 128-bit aligned address. 1 A value of 1 would indicate that a single bit error occurred in upper 64bits of a 128-bit aligned address and the corrected value was 1. Cleared by writing a 1 to FAIL_1_H_CLR bit of ERR_STATUS_CLR register. Note: This bit is updated on every flash access which results in a single bit error, So, in case of multiple single bit error, the status would correspond to the last error which occurred. Reset type: SYSRSn
16	FAIL_0_H	R	0h	Fail on 0. 0 Fail on 0 single bit error did not occur in upper 64bits of a 128-bit aligned address. 1 A value of 1 would indicate that a single bit error occurred in upper 64bits of a 128-bit aligned address and the corrected value was 0. Cleared by writing a 1 to FAIL_0_H_CLR bit of ERR_STATUS_CLR register. Note: This bit is updated on every flash access which results in a single bit error, So, in case of multiple single bit error, the status would correspond to the last error which occurred. Reset type: SYSRSn
15-3	RESERVED	R	0h	Reserved
2	UNC_ERR_L	R	0h	Uncorrectable error. A value of 1 indicates that an un-correctable error occurred in lower 64bits of a 128-bit aligned address. Cleared by writing a 1 to UNC_ERR_L_CLR bit of ERR_STATUS_CLR register. Reset type: SYSRSn

**Table 2-315. ERR\_STATUS Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
1	FAIL_1_L	R	0h	<p>Fail on 1.</p> <p>0 Fail on 1 single bit error did not occur in lower 64bits of a 128-bit aligned address.</p> <p>1 A value of 1 would indicate that a single bit error occurred in lower 64bits of a 128-bit aligned address and the corrected value was 1. Cleared by writing a 1 to FAIL_1_L_CLR bit of ERR_STATUS_CLR register.</p> <p>Note: This bit is updated on every flash access which results in a single bit error, So, in case of multiple single bit error, the status would correspond to the last error which occurred.</p> <p>Reset type: SYSRSn</p>
0	FAIL_0_L	R	0h	<p>Fail on 0.</p> <p>0 Fail on 0 single bit error did not occur in lower 64bits of a 128-bit aligned address.</p> <p>1 Would indicate that a single bit error occurred in lower 64bits of a 128-bit aligned address and the corrected value was 0. Cleared by writing a 1 to FAIL_0_L_CLR bit of ERR_STATUS_CLR register.</p> <p>Note: This bit is updated on every flash access which results in a single bit error, So, in case of multiple single bit error, the status would correspond to the last error which occurred.</p> <p>Reset type: SYSRSn</p>

**2.15.23.7 ERR\_POS Register (Offset = Ch) [reset = 0h]**

ERR\_POS is shown in [Figure 2-279](#) and described in [Table 2-316](#).

Return to [Summary Table](#).

Error Position

**Figure 2-279. ERR\_POS Register**

31	30	29	28	27	26	25	24
RESERVED							ERR_TYPE_H
R-0h							R-0h
23	22	21	20	19	18	17	16
RESERVED		ERR_POS_H					
R-0h		R-0h					
15	14	13	12	11	10	9	8
RESERVED							ERR_TYPE_L
R-0h							R-0h
7	6	5	4	3	2	1	0
RESERVED		ERR_POS_L					
R-0h		R-0h					

**Table 2-316. ERR\_POS Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-25	RESERVED	R	0h	Reserved
24	ERR_TYPE_H	R	0h	Error type 0 Indicates that a single bit error occurred in upper 64 data bits of a 128-bit aligned address. 1 Indicates that a single bit error occurred in ECC check bits of upper 64bits of a 128-bit aligned address. Reset type: SYSRSn
23-22	RESERVED	R	0h	Reserved
21-16	ERR_POS_H	R	0h	Error position. Bit position of the single bit error in upper 64bits of a 128-bit aligned address. The position is interpreted depending on whether the ERR_TYPE bit indicates a check bit or a data bit. If ERR_TYPE indicates a check bit error, the error position could range from 0 to 7, else it could range from 0 to 63. Reset type: SYSRSn
15-9	RESERVED	R	0h	Reserved
8	ERR_TYPE_L	R	0h	Error type 0 Indicates that a single bit error occurred in lower 64 data bits of a 128-bit aligned address. 1 Indicates that a single bit error occurred in ECC check bits of lower 64bits of a 128-bit aligned address. Reset type: SYSRSn
7-6	RESERVED	R	0h	Reserved
5-0	ERR_POS_L	R	0h	Error position. Bit position of the single bit error in lower 64bits of a 128-bit aligned address. The position is interpreted depending on whether the ERR_TYPE bit indicates a check bit or a data bit. If ERR_TYPE indicates a check bit error, the error position could range from 0 to 7, else it could range from 0 to 63. Reset type: SYSRSn

**2.15.23.8 ERR\_STATUS\_CLR Register (Offset = Eh) [reset = 0h]**

 ERR\_STATUS\_CLR is shown in [Figure 2-280](#) and described in [Table 2-317](#).

[Return to Summary Table.](#)

Error Status Clear

**Figure 2-280. ERR\_STATUS\_CLR Register**

31	30	29	28	27	26	25	24
RESERVED							
R-0h							
23	22	21	20	19	18	17	16
RESERVED					UNC_ERR_H_CLR	FAIL_1_H_CLR	FAIL_0_H_CLR
R-0h					R=0/W=1-0h	R=0/W=1-0h	R=0/W=1-0h
15	14	13	12	11	10	9	8
RESERVED							
R-0h							
7	6	5	4	3	2	1	0
RESERVED					UNC_ERR_L_CLR	FAIL_1_L_CLR	FAIL_0_L_CLR
R-0h					R=0/W=1-0h	R=0/W=1-0h	R=0/W=1-0h

**Table 2-317. ERR\_STATUS\_CLR Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-19	RESERVED	R	0h	Reserved
18	UNC_ERR_H_CLR	R=0/W=1	0h	Uncorrectable error clear. Writing a 1 to this bit will clear the UNC_ERR_H bit of ERR_STATUS register. Writes of 0 have no effect. Read returns 0. Reset type: SYSRSn
17	FAIL_1_H_CLR	R=0/W=1	0h	Fail on 1 clear. Writing a 1 to this bit will clear the FAIL_1_H bit of ERR_STATUS register. Writes of 0 have no effect. Read returns 0. Reset type: SYSRSn
16	FAIL_0_H_CLR	R=0/W=1	0h	Fail on 0 clear. Writing a 1 to this bit will clear the FAIL_0_H bit of ERR_STATUS register. Writes of 0 have no effect. Read returns 0. Reset type: SYSRSn
15-3	RESERVED	R	0h	Reserved
2	UNC_ERR_L_CLR	R=0/W=1	0h	Uncorrectable error clear. Writing a 1 to this bit will clear the UNC_ERR_L bit of ERR_STATUS register. Writes of 0 have no effect. Read returns 0. Reset type: SYSRSn
1	FAIL_1_L_CLR	R=0/W=1	0h	Fail on 1 clear. Writing a 1 to this bit will clear the FAIL_1_L bit of ERR_STATUS register. Writes of 0 have no effect. Read returns 0. Reset type: SYSRSn
0	FAIL_0_L_CLR	R=0/W=1	0h	Fail on 0 clear. Writing a 1 to this bit will clear the FAIL_0_L bit of ERR_STATUS register. Writes of 0 have no effect. Read returns 0. Reset type: SYSRSn

**2.15.23.9 ERR\_CNT Register (Offset = 10h) [reset = 0h]**

ERR\_CNT is shown in [Figure 2-281](#) and described in [Table 2-318](#).

Return to [Summary Table](#).

Error Control

**Figure 2-281. ERR\_CNT Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
RESERVED																ERR_CNT															
R-0h																R/W-0h															

**Table 2-318. ERR\_CNT Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R	0h	Reserved
15-0	ERR_CNT	R/W	0h	Single bit error count. This counter increments with every single bit ECC error occurrence. Upon reaching the threshold value counter stops counting on single bit errors. ERR_CNT can be cleared (irrespective of whether threshold is met or not) using "Single Err Int Clear" bit. This is applicable for ECC logic test mode and normal operational mode. Reset type: SYSRSn

**2.15.23.10 ERR\_THRESHOLD Register (Offset = 12h) [reset = 0h]**

ERR\_THRESHOLD is shown in [Figure 2-282](#) and described in [Table 2-319](#).

Return to [Summary Table](#).

Error Threshold

**Figure 2-282. ERR\_THRESHOLD Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
RESERVED																ERR_THRESHOLD															
R-0h																R/W-0h															

**Table 2-319. ERR\_THRESHOLD Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R	0h	Reserved
15-0	ERR_THRESHOLD	R/W	0h	Single bit error threshold. Sets the threshold for single bit errors. When the ERR_CNT value equals the THRESHOLD value and a single bit error occurs, SINGLE_ERR_INT flag is set, and an interrupt is fired. Reset type: SYSRSn

### 2.15.23.11 ERR\_INTFLG Register (Offset = 14h) [reset = 0h]

ERR\_INTFLG is shown in [Figure 2-283](#) and described in [Table 2-320](#).

Return to [Summary Table](#).

Error Interrupt Flag

**Figure 2-283. ERR\_INTFLG Register**

31	30	29	28	27	26	25	24
RESERVED							
R-0h							
23	22	21	20	19	18	17	16
RESERVED							
R-0h							
15	14	13	12	11	10	9	8
RESERVED							
R-0h							
7	6	5	4	3	2	1	0
RESERVED						UNC_ERR_INT FLG	SINGLE_ERR_ INTFLG
R-0h						R-0h	R-0h

**Table 2-320. ERR\_INTFLG Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R	0h	Reserved
15-2	RESERVED	R	0h	Reserved
1	UNC_ERR_INTFLG	R	0h	Uncorrectable bit error interrupt flag. When a Un-correctable error occurs, this bit is set and the UNC_ERR_INT interrupt is fired. When UNC_ERR_INTCLR bit of ERR_INTCLR register is written a value of 1 this bit is cleared. Reset type: SYSRSn
0	SINGLE_ERR_INTFLG	R	0h	Single bit error interrupt flag. When the ERR_CNT value equals the ERR_THRESHOLD value and a single bit error occurs then SINGLE_ERR_INT flag is set and SINGLE_ERR_INT interrupt is fired. When SINGLE_ERR_INTCLR bit of ERR_INTCLR register is written a value of 1 this bit is cleared. Reset type: SYSRSn

**2.15.23.12 ERR\_INTCLR Register (Offset = 16h) [reset = 0h]**

ERR\_INTCLR is shown in [Figure 2-284](#) and described in [Table 2-321](#).

Return to [Summary Table](#).

Error Interrupt Flag Clear

**Figure 2-284. ERR\_INTCLR Register**

31	30	29	28	27	26	25	24
RESERVED							
R-0h							
23	22	21	20	19	18	17	16
RESERVED							
R-0h							
15	14	13	12	11	10	9	8
RESERVED							
R-0h							
7	6	5	4	3	2	1	0
RESERVED						UNC_ERR_INT CLR	SINGLE_ERR_ INTCLR
R-0h						R=0/W=1-0h	R=0/W=1-0h

**Table 2-321. ERR\_INTCLR Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R	0h	Reserved
15-2	RESERVED	R	0h	Reserved
1	UNC_ERR_INTCLR	R=0/W=1	0h	Uncorrectable bit error interrupt flag clear. Writing a 1 to this bit will clear UNC_ERR_INT_FLG. Writes of 0 have no effect. Reset type: SYSRSn
0	SINGLE_ERR_INTCLR	R=0/W=1	0h	Single bit error interrupt flag clear. Writing a 1 to this bit will clear SINGLE_ERR_INT_FLG. Writes of 0 have no effect. Reset type: SYSRSn



**2.15.23.13 FDATAH\_TEST Register (Offset = 18h) [reset = 0h]**

FDATAH\_TEST is shown in [Figure 2-285](#) and described in [Table 2-322](#).

Return to [Summary Table](#).

Data High Test

**Figure 2-285. FDATAH\_TEST Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
FDATAH																															
R/W-0h																															

**Table 2-322. FDATAH\_TEST Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-0	FDATAH	R/W	0h	High double word of selected 64-bit data. User-configurable bits 63:32 of the selected data block in ECC test mode. Reset type: SYSRSn

**2.15.23.14 FDATA<sub>L</sub>\_TEST Register (Offset = 1Ah) [reset = 0h]**

FDATA<sub>L</sub>\_TEST is shown in [Figure 2-286](#) and described in [Table 2-323](#).

Return to [Summary Table](#).

Data Low Test

**Figure 2-286. FDATA<sub>L</sub>\_TEST Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
FDATA <sub>L</sub>																															
R/W-0h																															

**Table 2-323. FDATA<sub>L</sub>\_TEST Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-0	FDATA <sub>L</sub>	R/W	0h	Low double word of selected 64-bit data. User-configurable bits 31:0 of the selected data block in ECC test mode. Reset type: SYSRSn

### 2.15.23.15 FADDR\_TEST Register (Offset = 1Ch) [reset = 0h]

FADDR\_TEST is shown in [Figure 2-287](#) and described in [Table 2-324](#).

Return to [Summary Table](#).

ECC Test Address

**Figure 2-287. FADDR\_TEST Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
RESERVED										ADDRH					
R-0h										R/W-0h					
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ADDRL												RESERVED			
R/W-0h												R-0h			

**Table 2-324. FADDR\_TEST Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-22	RESERVED	R	0h	Reserved
21-16	ADDRH	R/W	0h	Address for selected 64-bit data. User-configurable address bits of the selected data in ECC test mode. Left-shift the address by one bit (to provide byte address) and ignore the three least significant bits of the address and write the bits 21:16 in remaining address bits in this field. Reset type: SYSRSn
15-3	ADDRL	R/W	0h	Address for selected 64-bit data. User-configurable address bits of the selected data in ECC test mode. Left-shift the address by one bit (to provide byte address) and ignore the three least significant bits of the address and write the bits 15:3 in remaining address bits in this field. Reset type: SYSRSn
2-0	RESERVED	R	0h	Reserved

**2.15.23.16 FECC\_TEST Register (Offset = 1Eh) [reset = 0h]**

FECC\_TEST is shown in [Figure 2-288](#) and described in [Table 2-325](#).

Return to [Summary Table](#).

ECC Test Address

**Figure 2-288. FECC\_TEST Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
RESERVED																RESERVED								ECC							
R-0h																R-0h								R/W-0h							

**Table 2-325. FECC\_TEST Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R	0h	Reserved
15-8	RESERVED	R	0h	Reserved
7-0	ECC	R/W	0h	8-bit ECC for selected 64-bit data. User-configurable ECC bits of the selected 64-bit data block in ECC test mode. Reset type: SYSRSn

### 2.15.23.17 FECC\_CTRL Register (Offset = 20h) [reset = 0h]

FECC\_CTRL is shown in [Figure 2-289](#) and described in [Table 2-326](#).

Return to [Summary Table](#).

ECC Control

**Figure 2-289. FECC\_CTRL Register**

31	30	29	28	27	26	25	24
RESERVED							
R-0h							
23	22	21	20	19	18	17	16
RESERVED							
R-0h							
15	14	13	12	11	10	9	8
RESERVED							
R-0h							
7	6	5	4	3	2	1	0
RESERVED					DO_ECC_CALC	ECC_SELECT	ECC_TEST_EN
R-0h					R=0/W=1-0h	R/W-0h	R/W-0h

**Table 2-326. FECC\_CTRL Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R	0h	Reserved
15-3	RESERVED	R	0h	Reserved
2	DO_ECC_CALC	R=0/W=1	0h	Enable ECC calculation. ECC logic will calculate ECC in one cycle for the data and address written in ECC test registers when ECC test logic is enabled by setting ECC_TEST_EN. Reset type: SYSRSn
1	ECC_SELECT	R/W	0h	ECC block select. 0 Selects the ECC block on bits [63:0] of bank data. 1 Selects the ECC block on bits [127:64] of bank data. Reset type: SYSRSn
0	ECC_TEST_EN	R/W	0h	ECC test mode enable. 0 ECC test mode disabled 1 ECC test mode enabled Reset type: SYSRSn

**2.15.23.18 FOUTH\_TEST Register (Offset = 22h) [reset = 0h]**

FOUTH\_TEST is shown in [Figure 2-290](#) and described in [Table 2-327](#).

Return to [Summary Table](#).

Test Data Out High

**Figure 2-290. FOUTH\_TEST Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
DATAOUTH																															
R-0h																															

**Table 2-327. FOUTH\_TEST Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-0	DATAOUTH	R	0h	High double word test data out. Holds bits 63:32 of the data out of the selected ECC block. Reset type: SYSRSn

**2.15.23.19 FOUTL\_TEST Register (Offset = 24h) [reset = 0h]**

FOUTL\_TEST is shown in [Figure 2-291](#) and described in [Table 2-328](#).

Return to [Summary Table](#).

Test Data Out Low

**Figure 2-291. FOUTL\_TEST Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
DATAOUTL																															
R-0h																															

**Table 2-328. FOUTL\_TEST Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-0	DATAOUTL	R	0h	Low double word test data out. Holds bits 31:0 of the data out of the selected ECC block. Reset type: SYSRSn

**2.15.23.20 FECC\_STATUS Register (Offset = 26h) [reset = 0h]**

 FECC\_STATUS is shown in [Figure 2-292](#) and described in [Table 2-329](#).

 Return to [Summary Table](#).

ECC Status

**Figure 2-292. FECC\_STATUS Register**

31	30	29	28	27	26	25	24
RESERVED							
R-0h							
23	22	21	20	19	18	17	16
RESERVED							
R-0h							
15	14	13	12	11	10	9	8
RESERVED							ERR_TYPE
R-0h							R-0h
7	6	5	4	3	2	1	0
DATA_ERR_POS						UNC_ERR	SINGLE_ERR
R-0h						R-0h	R-0h

**Table 2-329. FECC\_STATUS Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R	0h	Reserved
15-9	RESERVED	R	0h	Reserved
8	ERR_TYPE	R	0h	Test mode ECC single bit error indicator. When 1, indicates that the single bit error is in check bits. When 0, indicates that the single bit error is in data bits (If SINGLE_ERR field is also set). Reset type: SYSRSn
7-2	DATA_ERR_POS	R	0h	Test mode single bit error position. Holds the bit position where the single bit error occurred. The position is interpreted depending on whether the CHK_ERR bit indicates a check bit or a data bit. If CHK_ERR indicates a check bit error, the error position could range from 0 to 7, or it could range from 0 to 63. Reset type: SYSRSn
1	UNC_ERR	R	0h	Test mode ECC double bit error. When 1 indicates that the ECC test resulted in an uncorrectable bit error. Reset type: SYSRSn
0	SINGLE_ERR	R	0h	Test mode ECC single bit error. When 1 indicates that the ECC test resulted in a single bit error. Reset type: SYSRSn



### 2.15.24 UID\_REGS Registers

Table 2-330 lists the memory-mapped registers for the UID\_REGS. All register offset addresses not listed in Table 2-330 should be considered as reserved locations and the register contents should not be modified.

**Table 2-330. UID\_REGS Registers**

Offset	Acronym	Register Name	Write Protection	Section
0h	UID_PSRAND0	UID Psuedo-random 192 bit number		<a href="#">Go</a>
2h	UID_PSRAND1	UID Psuedo-random 192 bit number		<a href="#">Go</a>
4h	UID_PSRAND2	UID Psuedo-random 192 bit number		<a href="#">Go</a>
6h	UID_PSRAND3	UID Psuedo-random 192 bit number		<a href="#">Go</a>
8h	UID_PSRAND4	UID Psuedo-random 192 bit number		<a href="#">Go</a>
Ah	UID_PSRAND5	UID Psuedo-random 192 bit number		<a href="#">Go</a>
Ch	UID_UNIQUE	UID Unique 32 bit number		<a href="#">Go</a>
Eh	UID_CHECKSUM	UID Checksum		<a href="#">Go</a>

Complex bit access types are encoded to fit into small table cells. Table 2-331 shows the codes that are used for access types in this section.

**Table 2-331. UID\_REGS Access Type Codes**

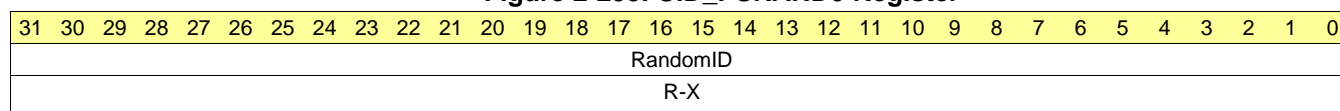
Access Type	Code	Description
<b>Read Type</b>		
R	R	Read
<b>Reset or Default Value</b>		
-n		Value after reset or the default value
<b>Register Array Variables</b>		
i,j,k,l,m,n		When these variables are used in a register name, an offset, or an address, they refer to the value of a register array where the register is part of a group of repeating registers. The register groups form a hierarchical structure and the array is represented with a formula.
y		When this variable is used in a register name, an offset, or an address it refers to the value of a register array.

**2.15.24.1 UID\_PSRAND0 Register (Offset = 0h) [reset = X]**

UID\_PSRAND0 is shown in [Figure 2-293](#) and described in [Table 2-332](#).

Return to [Summary Table](#).

UID Psuedo-random 192 bit number

**Figure 2-293. UID\_PSRAND0 Register**

**Table 2-332. UID\_PSRAND0 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-0	RandomID	R	X	Psuedorandom portion of the UID Reset type: N/A

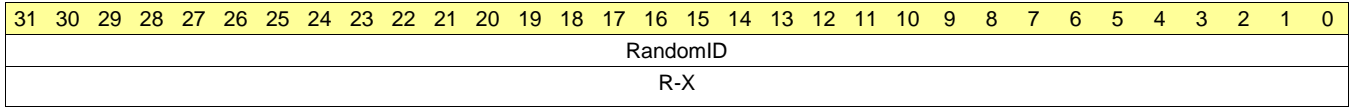
**2.15.24.2 UID\_PSRAND1 Register (Offset = 2h) [reset = X]**

UID\_PSRAND1 is shown in [Figure 2-294](#) and described in [Table 2-333](#).

Return to [Summary Table](#).

UID Psuedo-random 192 bit number

**Figure 2-294. UID\_PSRAND1 Register**



**Table 2-333. UID\_PSRAND1 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-0	RandomID	R	X	Psuedorandom portion of the UID Reset type: N/A

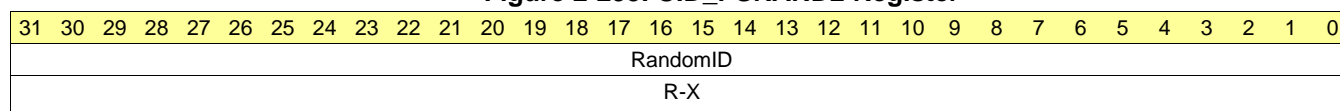
### 2.15.24.3 UID\_PSRAND2 Register (Offset = 4h) [reset = X]

UID\_PSRAND2 is shown in [Figure 2-295](#) and described in [Table 2-334](#).

Return to [Summary Table](#).

UID Psuedo-random 192 bit number

**Figure 2-295. UID\_PSRAND2 Register**



**Table 2-334. UID\_PSRAND2 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-0	RandomID	R	X	Psuedorandom portion of the UID Reset type: N/A

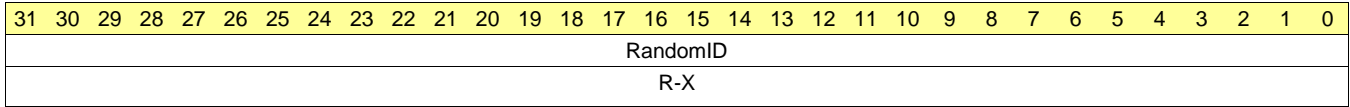
**2.15.24.4 UID\_PSRAND3 Register (Offset = 6h) [reset = X]**

UID\_PSRAND3 is shown in [Figure 2-296](#) and described in [Table 2-335](#).

Return to [Summary Table](#).

UID Psuedo-random 192 bit number

**Figure 2-296. UID\_PSRAND3 Register**



**Table 2-335. UID\_PSRAND3 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-0	RandomID	R	X	Psuedorandom portion of the UID Reset type: N/A

### 2.15.24.5 UID\_PSRAND4 Register (Offset = 8h) [reset = X]

UID\_PSRAND4 is shown in [Figure 2-297](#) and described in [Table 2-336](#).

Return to [Summary Table](#).

UID Psuedo-random 192 bit number

**Figure 2-297. UID\_PSRAND4 Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
RandomID																															
R-X																															

**Table 2-336. UID\_PSRAND4 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-0	RandomID	R	X	Psuedorandom portion of the UID Reset type: N/A

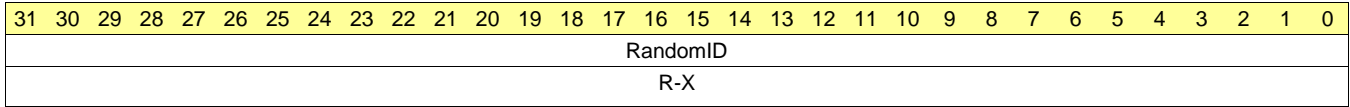
**2.15.24.6 UID\_PSRAND5 Register (Offset = Ah) [reset = X]**

UID\_PSRAND5 is shown in [Figure 2-298](#) and described in [Table 2-337](#).

Return to [Summary Table](#).

UID Psuedo-random 192 bit number

**Figure 2-298. UID\_PSRAND5 Register**



**Table 2-337. UID\_PSRAND5 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-0	RandomID	R	X	Psuedorandom portion of the UID Reset type: N/A

**2.15.24.7 UID\_UNIQUE Register (Offset = Ch) [reset = X]**

UID\_UNIQUE is shown in [Figure 2-299](#) and described in [Table 2-338](#).

Return to [Summary Table](#).

UID Unique 32 bit number

**Figure 2-299. UID\_UNIQUE Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
UniqueID																															
R-X																															

**Table 2-338. UID\_UNIQUE Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-0	UniqueID	R	X	Unique portion of the UID. This identifier will be unique across all devices with the same PARTIDH. Reset type: N/A



**2.15.24.8 UID\_CHECKSUM Register (Offset = Eh) [reset = X]**

UID\_CHECKSUM is shown in [Figure 2-300](#) and described in [Table 2-339](#).

Return to [Summary Table](#).

Fletcher checksum of UID\_PSRAND and UID\_UNIQUE registers

**Figure 2-300. UID\_CHECKSUM Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Checksum																															
R-X																															

**Table 2-339. UID\_CHECKSUM Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-0	Checksum	R	X	Fletcher checksum of UID_PSRANDx and UID_UNIQUE Reset type: N/A

## ***ROM Code and Peripheral Booting***

This chapter describes the booting functionality of this device.

**NOTE:** Any CPU2 and IPC relevant information mentioned in this chapter is not applicable and should be disregarded.

Topic	Page
<b>3.1 Introduction .....</b>	<b>547</b>
<b>3.2 Device Boot Philosophy .....</b>	<b>547</b>
<b>3.3 Device Boot Modes .....</b>	<b>547</b>
<b>3.4 Configuring Boot Mode Pins .....</b>	<b>548</b>
<b>3.5 Configuring Get Boot Options .....</b>	<b>549</b>
<b>3.6 Configuring Emulation Boot Options .....</b>	<b>550</b>
<b>3.7 Device Boot Flow Diagrams .....</b>	<b>551</b>
<b>3.8 Device Reset and Exception Handling .....</b>	<b>553</b>
<b>3.9 Boot ROM Description .....</b>	<b>554</b>

### 3.1 Introduction

This chapter explains the boot ROM code functionality including the boot procedure when executed, the functions and features of the boot ROM code, and details the ROM memory map contents. On every reset, the device executes a boot sequence in the ROM depending on the reset type and boot configuration. This sequence will initialize the device to run application code. The boot ROM also contains peripheral bootloaders which can be used to load an application into RAM. ROM Memory is shown in [Table 3-1](#).

**Table 3-1. ROM Memory**

ROM	CPU1 Size
Unsecure boot ROM	64 KB
Secure ROM	64 KB
CLA Data ROM	8 KB

### 3.2 Device Boot Philosophy

The boot philosophy describes the general boot ROM procedure each time the CPU core is reset.

During booting, the boot ROM code updates a boot status location in RAM that details the actions taken during this process. Refer to [Section 3.9.9](#) for more details.

**Table 3-2. Boot ROM Philosophy**

Step	CPU1 Action
1	After reset, the FUSE error register is checked for any errors and are handled accordingly.
2	Clock and Flash Configuration
3	Device configuration registers are programmed from OTP.
4	All CPU RAMs are initialized.
5	Any pending NMI is handled by the code.
6	DSCM initialization and OTPJTAGLOCK sequence is executed.
7	Based on the boot mode select GPIO pins and boot mode set in OTP, the boot mode is determined, and the appropriate boot sequence is executed. Refer to <a href="#">Section 3.7</a> for a flow chart of the device boot sequences.

### 3.3 Device Boot Modes

This section explains the boot modes supported on this device. The boot ROM uses the boot select GPIO pins to determine the boot mode configuration. The device can be configured to boot to RAM, boot to flash, execute a bootloader, or hold in a wait mode.

[Table 3-3](#) shows the boot mode options available through selection by the default boot mode select pins. The boot mode select pins' GPIOs and realized boot mode for when Get boot mode is selected can be customized through the BOOTCTRL register detailed in [Section 3.4](#).

**Table 3-3. Device Default Boot Modes**

Boot Mode	GPIO72 (Default boot mode select pin 1)	GPIO84 (Default boot mode select pin 0)
Parallel IO	0	0
SCI	0	1
Wait	1	0
Get / Flash <sup>(1)</sup>	1	1

<sup>(1)</sup> Get boot mode, by default, on an unprogrammed device, or when the BOOTCTRL register contains an invalid key, will boot to flash. Get boot mode can be programmed on the device to change its default boot mode. Refer to [Section 3.5](#) for more details on using Get boot mode.

**Table 3-4. All Available Boot Modes**

Boot Mode
Parallel IO
SCI
Wait
Get
SPI
I2C
CAN
RAM
Flash
USB

**NOTE:** All the peripheral boot modes that are supported use the first instance of the peripheral module (SCIA, SPIA, I2CA, CANA, and so forth). Whenever these boot modes are referred to in this chapter, such as SCI boot, it is actually referring to the first module instance, meaning the SCI boot on the SCIA port. The same applies to the other peripheral boots.

### 3.4 Configuring Boot Mode Pins

This section details how the boot mode select pins can be customized by the user, by programming the BOOTCTRL register location in user-configurable DCSM OTP. The BOOTCTRL register, when programmed with a valid key, allows different GPIOs to be used for the two boot mode select pins. Additionally, the boot mode select pins allow the same GPIO to be assigned to each pin for single GPIO use cases. Also within the BOOTCTRL register, the default boot mode for use with Get boot can be changed. When debugging, EMU\_BOOTCTRL is the emulation equivalent of the BOOTCTRL register and allows users to experiment with different boot modes without writing to OTP. Refer to [Section 3.6](#) for details on values that can be set in the EMU\_BOOTCTRL register.

**Table 3-5. BOOTCTRL<sup>(1)</sup> Register Bit Fields**

Bit	Name	Description
31-24	Boot Mode Select Pin 1 (BMSP1)	Set to the GPIO pin to be used during boot (up to 255). 0 = Default BMSP1 1 = GPIO0; 2 = GPIO1 and so on to 255 = GPIO254
23-16	Boot Mode Select Pin 0 (BMSP0)	Set to the GPIO pin to be used during boot (up to 255). 0 = Default BMSP0 1 = GPIO0; 2 = GPIO1 and so on to 255 = GPIO254

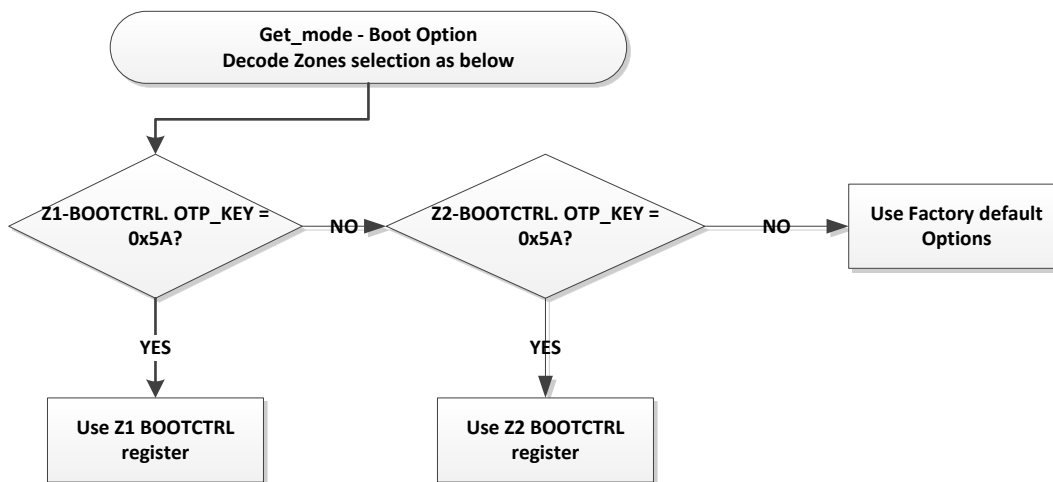
<sup>(1)</sup> Refer to the DCSM chapter for the address of this register location in the user-configurable DCSM OTP.

**Table 3-5. BOOTCTRL<sup>(1)</sup> Register Bit Fields (continued)**

Bit	Name	Description
15-8	Boot Mode (BMODE)	Boot mode definition when using Get boot mode option. Refer to <a href="#">Section 3.5</a> for valid BMODE values.
7 - 0	Key	Write 0x5A to these 8-bits to tell the boot ROM code that the bits in this register are valid

On this device, the DCSM has two zones. Each zone, Z1 and Z2, has its own copy of the BOOTCTRL register. The boot ROM is designed to be able to read from either location and uses the procedure in [Figure 3-1](#) to identify which register to use. By default, if the Z1 BOOTCTRL is programmed, then that register is given the priority. If the Z1 BOOTCTRL isn't programmed, then the boot ROM will check if Z2 BOOTCTRL is programmed, if not, then the factory default options are used.

**Figure 3-1. Z1 and Z2 BOOTCTRL Selection**



### 3.5 Configuring Get Boot Options

In Get boot mode, the boot ROM reads the boot mode (BMODE) bit field in the BOOTCTRL register to determine which boot procedure to execute. By default, Get boot mode executes flash boot when in standalone mode or wait boot when an emulator is connected to the device. [Table 3-6](#) lists the values that can be set to the BMODE field in BOOTCTRL and the corresponding boot mode that they represent. For additional details on the GPIOs used for each boot mode, refer to the [Section 3.9.6](#) section. When debugging the device using an emulator and EMU\_BOOTCTRL, the BMODE field has some additional values which can be found in [Section 3.6](#).

**Table 3-6. Get Mode Decoding**

Key	BMODE Value	Realized Boot Mode
!= 0x5A	Don't Care	Flash Boot / Wait Boot <sup>(1)</sup>
	0x00	Parallel Boot
	0x01	SCI Boot 0
	0x02	Wait Boot
	0x04	SPI Boot 0
	0x05	I2C Boot 0
	0x07	CAN Boot 0
= 0x5A	0x0A	RAM Boot

<sup>(1)</sup> When an emulator is connected (TRSTn = 1) to the device, then an invalid key or invalid boot mode value results in wait boot mode.

**Table 3-6. Get Mode Decoding (continued)**

Key	BMODE Value	Realized Boot Mode
	0x0B	Flash Boot
	0x0C	USB Boot
	0x81	SCI Boot 1
	0x84	SPI Boot 1
	0x85	I2C Boot 1
	0x87	CAN Boot 1
	Other	Flash Boot / Wait Boot <sup>(1)</sup>

### 3.6 Configuring Emulation Boot Options

When connected to the device using an emulator, the EMU\_BOOTCTRL register is used to determine the boot mode. This register allows the user to experiment with various boot mode settings before writing to the BOOTCTRL register in the user-configurable DCSM OTP. The values that can be set in the BMODE field of the EMU\_BOOTCTRL register are listed in [Section 3.6](#). Some notable options include being able to have emulation boot read from the boot mode select pins, emulate standalone boot using the values in OTP, and boot according to the Get boot value stored in OTP. Refer to [Section 3.9.6](#) for details on the GPIOs used in the various boot modes.

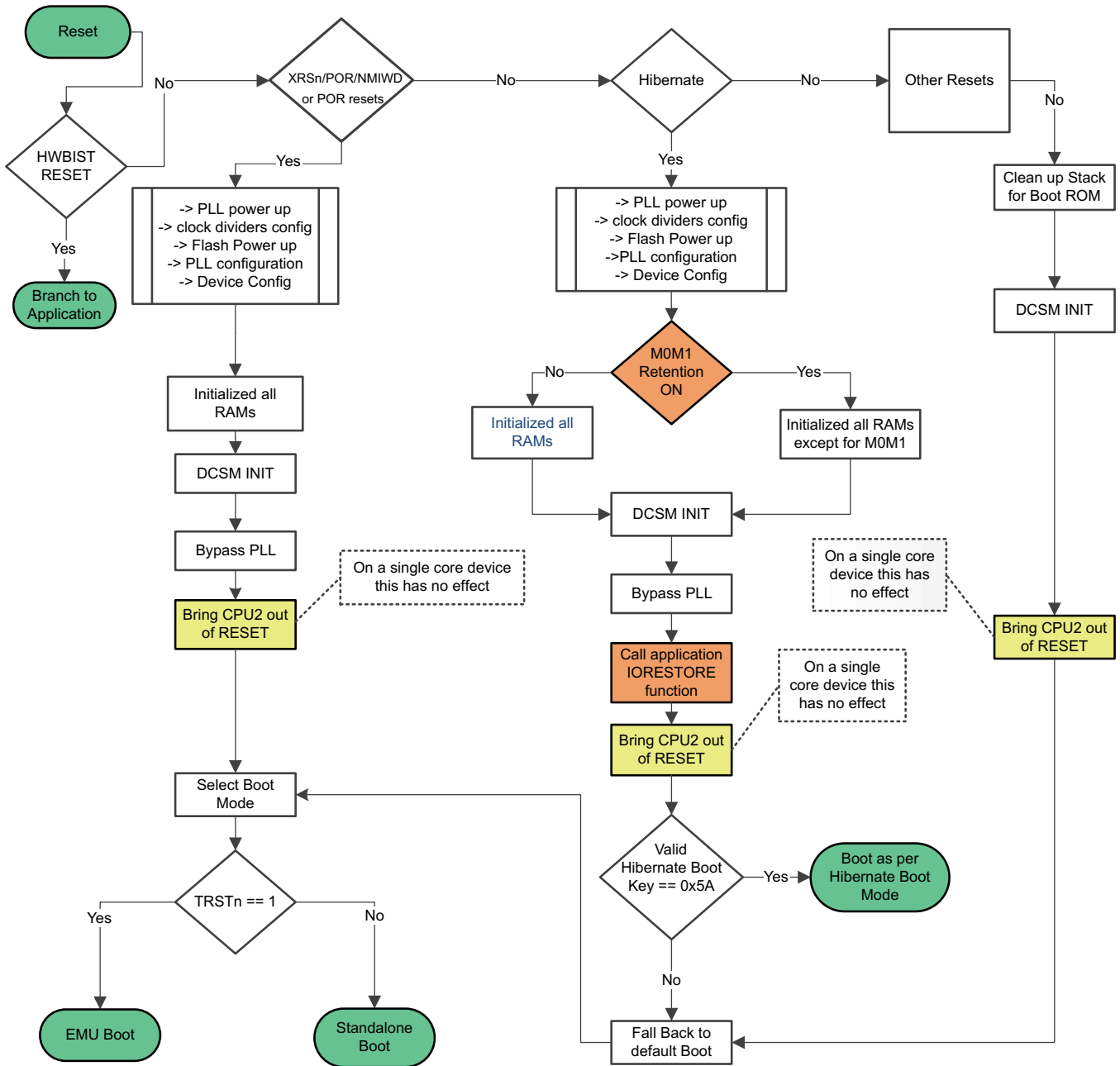
**Table 3-7. Emulation Boot Options**

Key	BMODE Value	Realized Boot Mode
!= 0x5A	Don't Care	Wait Boot
= 0x5A	0xFE	Boot as per BMSP0 and BMSP1
	0xFF	Emulate Standalone boot
	0x00	Parallel Boot
	0x01	SCI Boot 0
	0x02	Wait Boot
	0x03	Get Mode (read OTP BOOTCTRL)
	0x04	SPI Boot 0
	0x05	I2C Boot 0
	0x07	CAN Boot 0
	0x0A	RAM Boot
	0x0B	Flash Boot
	0x0C	USB Boot
	0x81	SCI Boot 1
	0x84	SPI Boot 1
	0x85	I2C Boot 1
	0x87	CAN Boot 1
	Other	Wait Boot

### 3.7 Device Boot Flow Diagrams

Figure 3-2 shows the device boot flow detailing the actions executed by boot ROM after a reset.

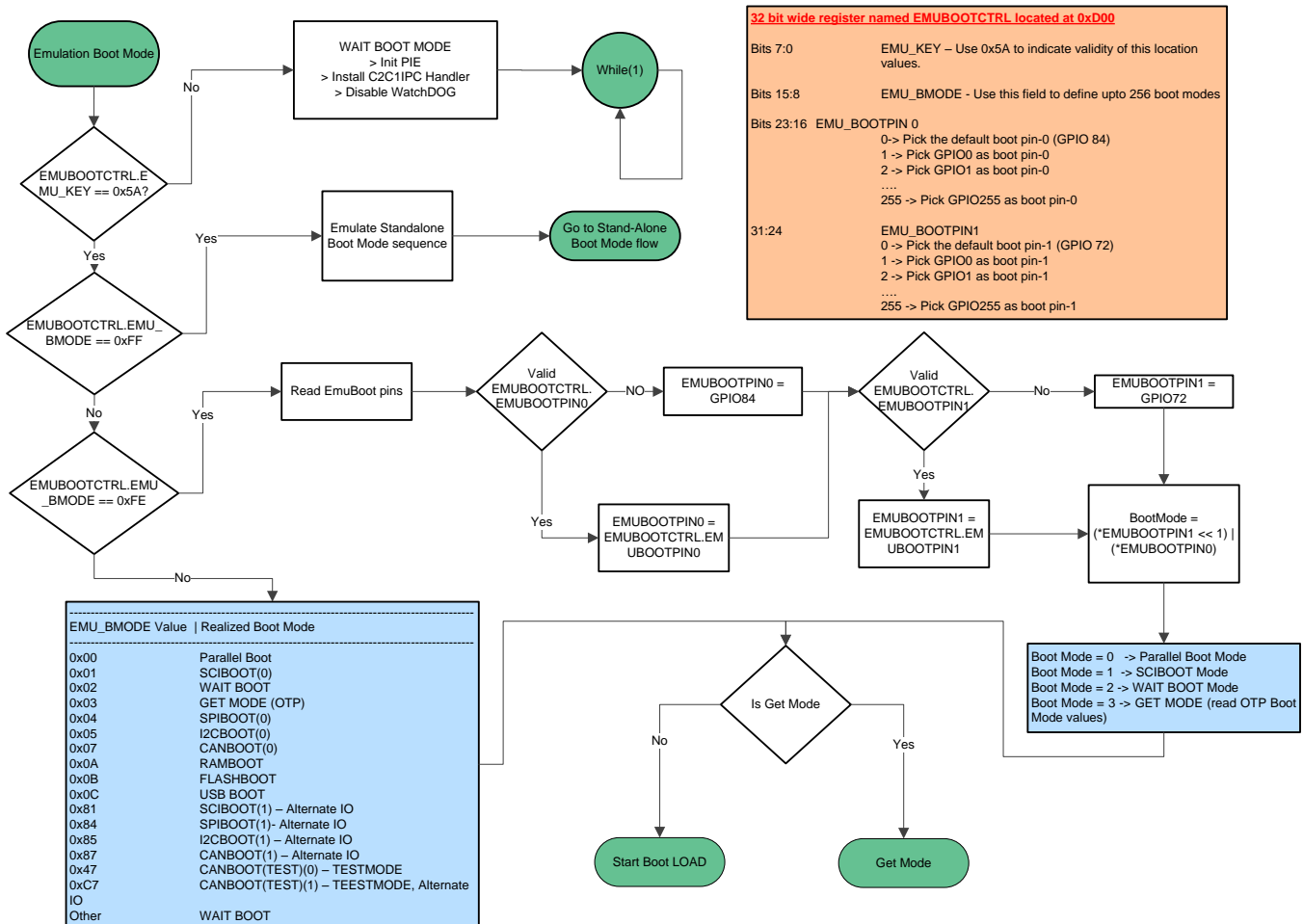
Figure 3-2. CPU1 Device Boot Flow



#### 3.7.1 Emulation Boot Flow Diagrams

Figure 3-3 shows the device boot flow when running the device in emulation mode.

Figure 3-3. CPU1 Emulation Boot Flow

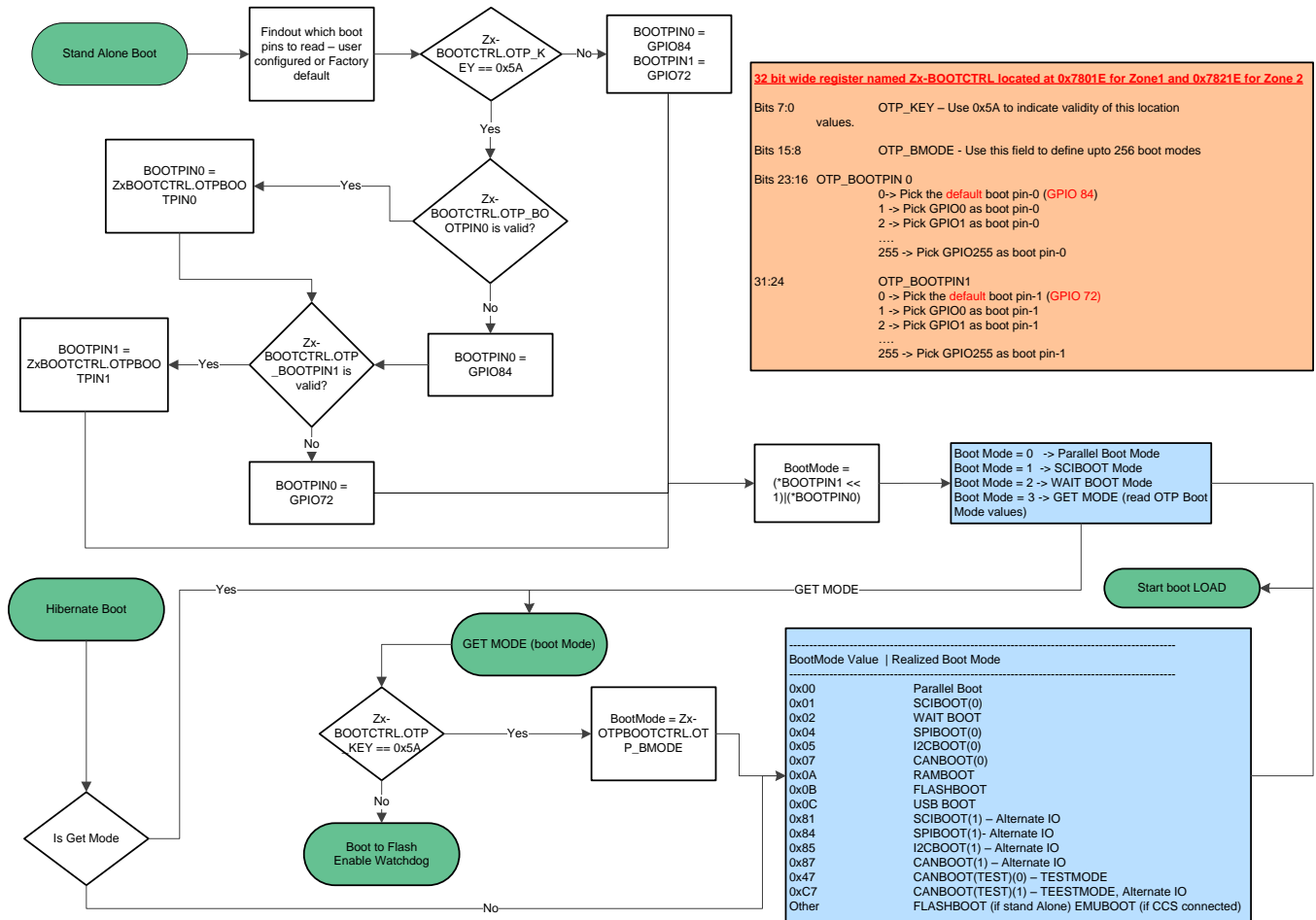


3.7.2 Standalone and Hibernate Boot Flow Diagrams

Figure 3-4 shows the device boot flow when running the device in standalone boot mode or when booting from hibernate.



Figure 3-4. CPU1 Standalone and Hibernate Boot Flow



### 3.8 Device Reset and Exception Handling

#### 3.8.1 Reset Causes and Handling

This section explains the actions boot ROM performs upon reset after checking the reset cause.

Table 3-8. Boot ROM Reset Causes and Actions

Reset Source	CPU1 Boot ROM Action
POR	<ol style="list-style-type: none"> <li>Adjust clock divider to /1</li> <li>Device configuration</li> <li>RAM initialization</li> <li>Continue default boot flow</li> </ol>
XRS	<ol style="list-style-type: none"> <li>Adjust clock divider to /1</li> <li>Device configuration</li> <li>RAM initialization</li> <li>Continue default boot flow</li> </ol>
HWBIST	Branch to application code

**Table 3-8. Boot ROM Reset Causes and Actions (continued)**

Reset Source	CPU1 Boot ROM Action
Hibernate	<ol style="list-style-type: none"> <li>1. Adjust clock divider to /1</li> <li>2. Device configuration</li> <li>3. RAM initialization (Either all RAMS except for M0M1 or all RAMS)</li> <li>4. Continue default boot flow</li> </ol>
WDRS (CPU1)	<ol style="list-style-type: none"> <li>1. Adjust clock divider to /1</li> <li>2. Device configuration</li> <li>3. RAM initialization</li> <li>4. Continue default boot flow</li> </ol>
NMIWDRS (CPU1)	<ol style="list-style-type: none"> <li>1. Adjust clock divider to /1</li> <li>2. Device configuration</li> <li>3. RAM initialization</li> <li>4. Continue default boot flow</li> </ol>
Debugger (CPU1)	<ol style="list-style-type: none"> <li>1. Clear boot stack</li> <li>2. Continue default boot flow</li> </ol>
SCCRESET (CPU1)	<ol style="list-style-type: none"> <li>1. Clear boot stack</li> <li>2. Continue default boot flow</li> </ol>

### 3.8.2 Exceptions and Interrupts Handling

This section explains the actions boot ROM performs if any exceptions that can occur happen during boot.

**Table 3-9. Boot ROM Exceptions and Actions**

Exception Event Source	CPU1 Boot ROM Action	Event Logged
Single-bit error in FUSEERR	Ignore and continue to boot	No
Multi-bit error in FUSEERR	Reset the device	No
Clock fail condition detected	Clear the NMI and continue to boot	Yes
Double-bit ECC error from RAM	Reset the device	Yes
Double-bit error from Flash	Reset the device	Yes
PIE Vector Error	Ignore and continue to boot	Yes
HWBIST Error	Ignore and continue to boot	Yes
ITRAP Exception	Provide ROM location where it will loop	Yes
Any spurious PIE interrupt occurs	Acknowledge interrupt and continue to boot	No

## 3.9 Boot ROM Description

This section explains the details regarding the device boot ROM.

### 3.9.1 Entry Points

This section gives details about the entry point addresses for various boot modes. These entry points tell the boot ROM where to branch to at the end of booting as per the selected boot mode.

**Table 3-10. Entry Point Addresses**

Entry Point	Address
RAM	0x0000 0000
Flash	0x0008 0000

### 3.9.2 Wait Points

During boot ROM execution, there are situations where the CPU may enter a wait loop in the code. This state can occur for a variety of reasons.

[Table 3-11](#) details the address ranges that the CPU1 PC register value will fall between if it has entered one of these instances.

**Table 3-11. Wait Point Addresses for CPU1**

Address Range	Description
0x003FE2D4 – 0x003FE2EF	In Wait Boot
0x003FE73E – 0x003FE824	In NMI Handler (startup)
0x003FE35A – 0x003FE468	In NMI Handler (PIE)
0x003FE468 – 0x003FE495	In ITRAP ISR

### 3.9.3 Memory Maps

This section details the ROM memory maps.

#### 3.9.3.1 Boot ROM Memory Map

**Table 3-12. Boot ROM Memory Map**

Memory	Start Address	End Address	Length
ROM Signature	0x003F 8000	0x003F 8001	0x0002
TI-RTOS (ROM)	0x003F 8002	0x003F 9E0F	0x1E0E
PLC Tables 1	0x003F 9E10	0x003F D817	0x3A08
PLC Tables 2	0x003F D818	0x003F DE17	0x0600
Boot	0x003F DE18	0x003F FF31	0x211A
CRC Table	0x003F FF32	0x003F FF39	0x0008
BIST Signature	0x003F FF3A	0x003F FF79	0x0040
Version	0x003F FF7A	0x003F FF7B	0x0002
Checksum	0x003F FF7C	0x003F FFBD	0x0042
Vectors	0x003F FFBE	0x003F FFFF	0x0042
TI-RTOS (Flash)	0x0008 2000	0x0008 3FFF	0x2000

#### 3.9.3.2 CLA Data ROM Memory Map

**Table 3-13. CLA Data ROM Memory Map**

Memory	Start Address	End Address	Length
FFT Tables (Load)	0x0100 1070	0x0100 186F	0x0800
Data (Load)	0x0100 1870	0x0100 1FF9	0x078A
Version (Load)	0x0100 1FFA	0x0100 1FFF	0x0006

#### 3.9.3.3 Reserved RAM and Flash Memory Map

**Table 3-14. Reserved RAM and Flash Memory Map**

Memory	Description	Start Address	End Address	Length
RAM	Boot ROM	0x0000 0002	0x0000 0121	0x0120
	TI-RTOS <sup>(1)</sup>	0x0000 0780	0x0000 07FF	0x0080
Flash	TI-RTOS <sup>(1)(2)</sup>	0x0008 2000	0x0008 2823	0x0824

<sup>(1)</sup> If the user is not planning on using TI-RTOS in ROM, then these memory locations are free to be used by the application.

<sup>(2)</sup> For using the TI-RTOS in flash sector A, TI recommends that this sector be made unsecure, or at minimum, the sector should be verified that there is no secure zone claiming this sector.

### 3.9.3.4 ROM Tables

This section details the boot ROM and CLA ROM symbol tables.

#### 3.9.3.4.1 Boot ROM Tables

The boot ROM symbols and their addresses can be located in the .map file that is included with the released boot ROM source and header code. Within the .map file, locate the Global Symbols category to get a list of the boot ROM symbols and addresses present.

#### 3.9.3.4.2 CLA ROM Tables

**Table 3-15. CLA Data ROM Tables**

	Start Address From CLA in Hex	Start Address From CPU in Hex
_CLAatan2HalfPITable	F870	01001870
_CLAINV2PI	F874	01001874
_CLAatan2Table	F876	01001876
_CLAasinHalfPITable	F9fc	010019fc
_CLAatan2TableEnd	F9fc	010019fc
_CLAasinTable	Fa00	01001a00
_CLAacosinHalfPITable	Fb86	01001b86
_CLAasinTableEnd	Fb86	01001b86
_CLAacosinTable	Fb8a	01001b8a
_CLAacosinTableEnd	Fd0a	01001d0a
_CLAsinTable	Fd0a	01001d0a
_CLAsincosTable	Fd0a	01001d0a
_CLAsincosTable_Sin0	Fd0a	01001d0a
_CLAcosTable	Fd4a	01001d4a
_CLAsincosTable_Cos0	Fd4a	01001d4a
_CLAsinTableEnd	Fe0a	01001e0a
_CLAcosTableEnd	Fe4c	01001e4c
_CLAsincosTable_TABLE_SIZE	Fe4c	01001e4c
_CLAsincosTable_TABLE_SIZEDivTwoPi	Fe4e	01001e4e
_CLAsincosTable_TwoPiDivTABLE_SIZE	Fe50	01001e50
_CLAsincosTable_TABLE_MASK	Fe52	01001e52
_CLAsincosTable_Coef0	Fe54	01001e54
_CLAsincosTable_Coef1	Fe56	01001e56
_CLAsincosTable_Coef1_pos	Fe58	01001e58
_CLAsincosTable_Coef2	Fe5a	01001e5a
_CLAsincosTable_Coef3	Fe5c	01001e5c
_CLAsincosTable_Coef3_neg	Fe5e	01001e5e
_CLALNV2	Fe60	01001e60

**Table 3-15. CLA Data ROM Tables (continued)**

	Start Address From CLA in Hex	Start Address From CPU in Hex
_CLAsincosTableEnd	Fe60	01001e60
_CLALNVe	Fe62	01001e62
_CLALNV10	Fe64	01001e64
_CLABIAS	Fe66	01001e66
_CLALN_TABLE_MASK1	Fe68	01001e68
_CLALN_TABLE_MASK2	Fe6a	01001e6a
_CLALnTable	Fe6c	01001e6c
_CLAINV1	Ff32	01001f32
_CLALnTableEnd	Ff32	01001f32
_CLAINV2	Ff34	01001f34
_CLAINV3	Ff36	01001f36
_CLAINV4	Ff38	01001f38
_CLAINV5	Ff3a	01001f3a
_CLAINV6	Ff3c	01001f3c
_CLAINV7	Ff3e	01001f3e
_CLALOG10	Ff40	01001f40
_CLAExpTable	Ff42	01001f42
_CLAExpTableEnd	Fff4	01001ff4
CROM VERSION	FFFA	01001FFA (2 16-bit words) .word 0x0100 ; Boot ROM Version v1.0 .word 0x0413 ; Month/Year: (ex: 0x0109 = 1/09 = Jan 2009)

### 3.9.4 Boot Modes

The available boot modes supported on this device are detailed in this section. Each boot mode allows for various options, providing configurations with different IOs to be used, depending on the application.

#### 3.9.4.1 Wait Boot Mode

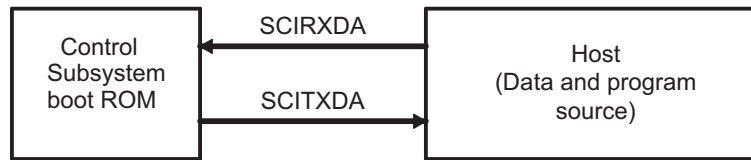
The wait boot mode puts the CPU in a loop and does not branch to the user application code. The device can enter wait boot mode either manually or because an error occurred during boot up. TI recommends using wait boot when using a debugger to avoid any JTAG complications.

Actions resulting in entering wait boot mode:

- Wait boot is set by the user as the boot mode
- The boot mode is unrecognized and a debugger is connected to the device
- The emulation BOOCTRL key is not equal to 0xA5 or 0x5A
- An error occurs during emulation boot and the boot mode pins are decoded with a value not recognized as a valid boot mode

#### 3.9.4.2 SCI Boot Mode

The SCI boot mode asynchronously transfers code from SCI-A to internal memory. This boot mode only supports an incoming 8-bit data stream and follows the data flow as outlined in [Example 3-1](#).

**Figure 3-5. Overview of SCI Bootloader Operation**


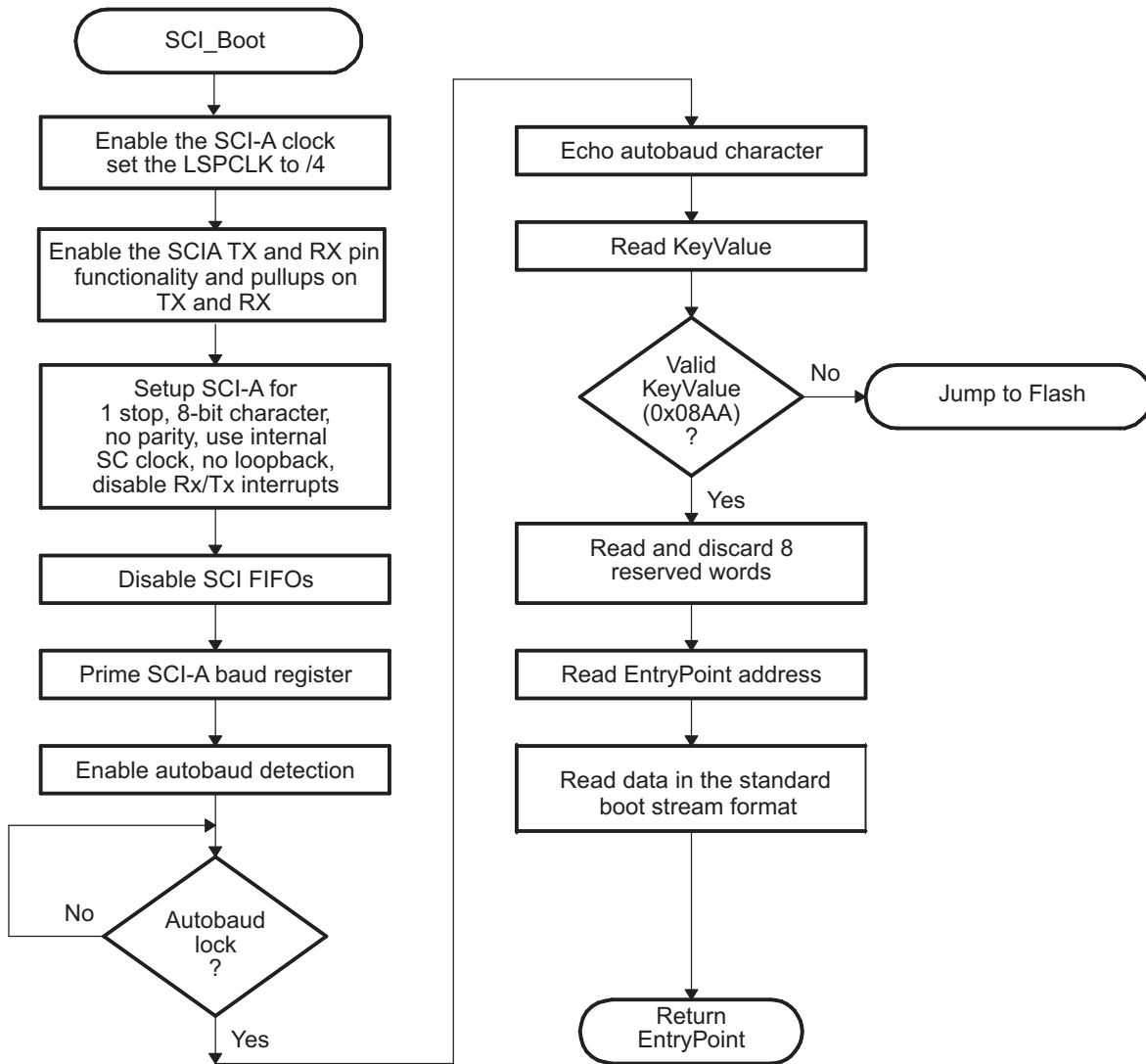
The device communicates with the external host by communication through the SCI-A peripheral. The autobaud feature of the SCI port is used to lock baud rates with the host. For this reason the SCI loader is very flexible and you can use a number of different baud rates to communicate with the device.

After each data transfer, the bootloader will echo back the 8-bit character received to the host. This allows the host to check that each character was received by the bootloader.

At higher baud rates, the slew rate of the incoming data bits can be affected by transceiver and connector performance. While normal serial communications may work well, this slew rate may limit reliable auto-baud detection at higher baud rates (typically beyond 100kbaud) and cause the auto-baud lock feature to fail. To avoid this, the following is recommended:

1. Achieve a baud-lock between the host and SCI bootloader using a lower baud rate.
2. Load the incoming application or custom loader at this lower baud rate.
3. The host may then handshake with the loaded application to set the SCI baud rate register to the desired high baud rate.

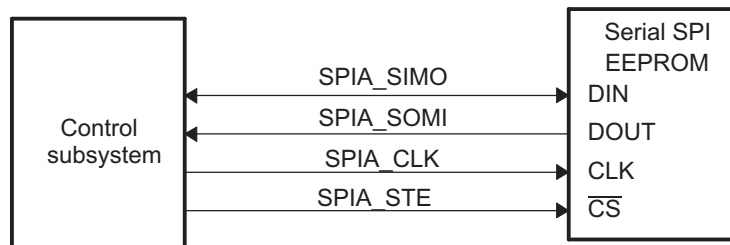
Figure 3-6. Overview of SCI Boot Function



3.9.4.3 SPI Boot Mode

The SPI loader expects an SPI-compatible 16-bit or 24-bit addressable serial EEPROM or serial flash device to be present on the SPI-A pins as indicated in Figure 3-7. The SPI bootloader supports an 8-bit data stream. It does not support a 16-bit data stream.

Figure 3-7. SPI Loader



The SPI boot ROM loader initializes the SPI module to interface to a serial SPI EEPROM or flash. Devices of this type include, but are not limited to, the Xicor X25320 (4Kx8) and Xicor X25256 (32Kx8) SPI serial SPI EEPROMs and the Atmel AT25F1024A serial flash.

The SPI boot ROM loader initializes the SPI with the following settings: FIFO enabled, 8-bit character, internal SPICLK master mode and talk mode, clock phase = 1, polarity = 0, using the slowest baud rate.

If the download is to be performed from an SPI port on another device, then that device must be setup to operate in the slave mode and mimic a serial SPI EEPROM. Immediately after entering the SPI\_Boot function, the pin functions for the SPI pins are set to primary and the SPI is initialized. The initialization is done at the slowest speed possible. Once the SPI is initialized and the key value read, you could specify a change in baud rate or low speed peripheral clock.

**Table 3-16. SPI 8-Bit Data Stream**

Byte	Contents
1	LSB: AA (KeyValue for memory width = 8-bits)
2	MSB: 08h (KeyValue for memory width = 8-bits)
3	LSB: LOSPCP
4	MSB: SPIBRR
5	LSB: reserved for future use
6	MSB: reserved for future use
...	...
...	Data for this section.
...	...
17	LSB: reserved for future use
18	MSB: reserved for future use
19	LSB: Upper half (MSW) of Entry point PC[23:16]
20	MSB: Upper half (MSW) of Entry point PC[31:24] (Note: Always 0x00)
21	LSB: Lower half (LSW) of Entry point PC[7:0]
22	MSB: Lower half (LSW) of Entry point PC[15:8]
...	....
...	Data for this section.
...	...
...	Blocks of data in the format size/destination address/data as shown in the generic data stream description
...	...
...	Data for this section.
...	...
n	LSB: 00h
n+1	MSB: 00h - indicates the end of the source

The data transfer is done in "burst" mode from the serial SPI EEPROM. The transfer is carried out entirely in byte mode (SPI at 8 bits/character). A step-by-step description of the sequence follows:

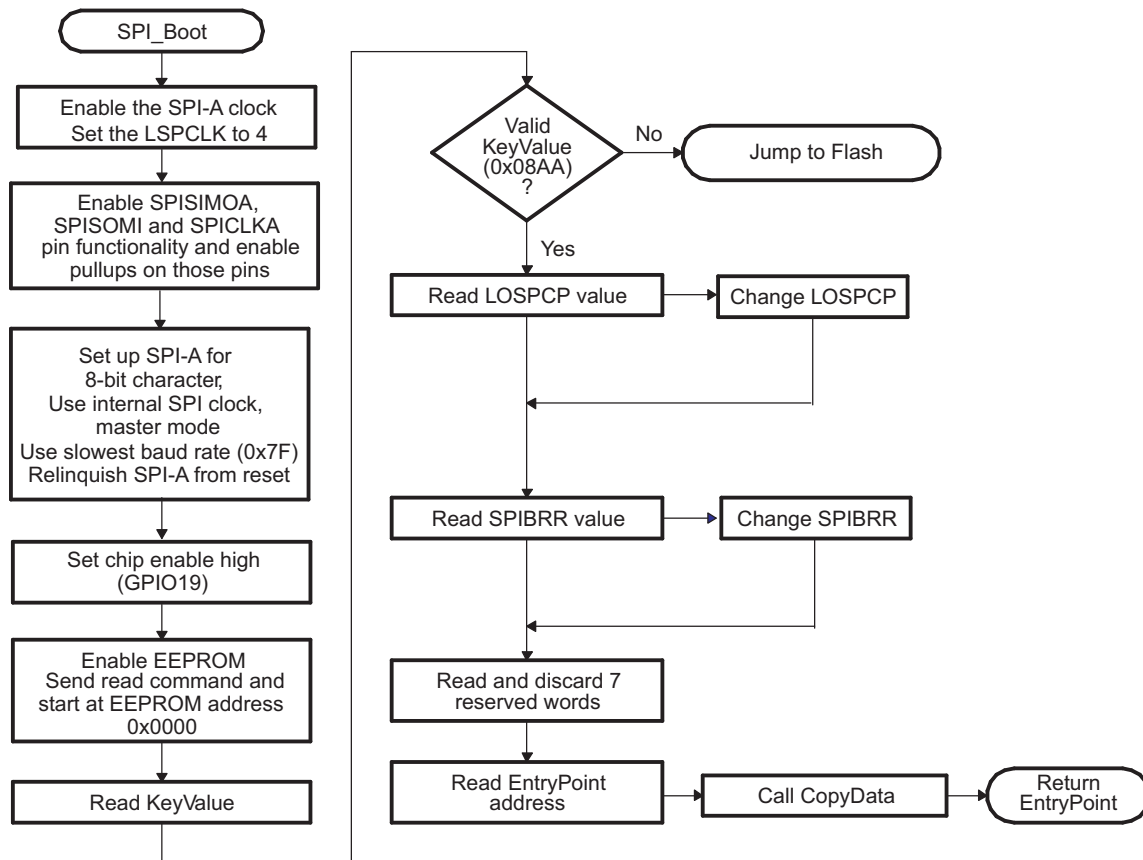
- Step 1. The SPI-A port is initialized
- Step 2. The GPIO19 (SPISTE) pin is used as a chip-select for the serial SPI EEPROM or flash
- Step 3. The SPI-A outputs a read command for the serial SPI EEPROM or flash
- Step 4. The SPI-A sends the serial SPI EEPROM an address 0x0000; that is, the host requires that the EEPROM or flash must have the downloadable packet starting at address 0x0000 in the EEPROM or flash. The loader is compatible with both 16-bit addresses and 24-bit addresses.
- Step 5. The next word fetched must match the key value for an 8-bit data stream (0x08AA). The least significant byte of this word is the byte read first and the most significant byte is the next byte fetched. This is true of all word transfers on the SPI. If the key value does not match, then the load is aborted and the bootloader jumps to flash.
- Step 6. The next 2 bytes fetched can be used to change the value of the low speed peripheral clock register (LOSPCP) and the SPI baud rate register (SPIBRR). The first byte read is the LOSPCP value and the second byte read is the SPIBRR value. The next 7 words are reserved for future enhancements. The SPI bootloader reads these 7 words and discards them.
- Step 7. The next two words makeup the 32-bit entry point address where execution will continue after



the boot load process is complete. This is typically the entry point for the program being downloaded through the SPI port.

- Step 8. Multiple blocks of code and data are then copied into memory from the external serial SPI EEPROM through the SPI port. The blocks of code are organized in the standard data stream structure presented earlier. This is done until a block size of 0x0000 is encountered. At that point in time the entry point address is returned to the calling routine that then exits the bootloader and resumes execution at the address specified.

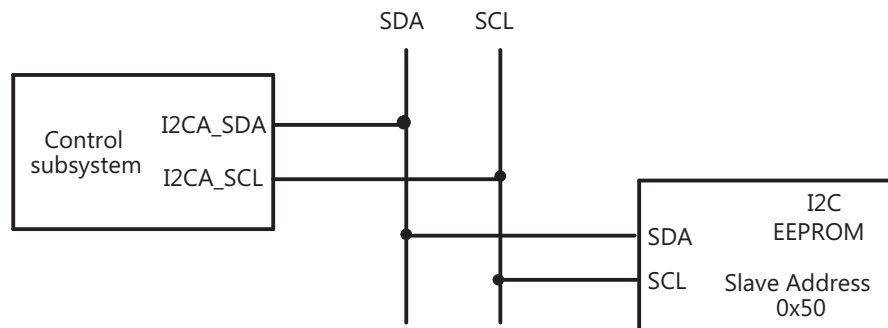
Figure 3-8. Data Transfer From EEPROM Flow



### 3.9.4.4 I2C Boot Mode

The I2C bootloader expects an 8-bit wide I2C-compatible EEPROM device to be present at address 0x50 on the I2C-A bus as indicated in Figure 3-9. The EEPROM must adhere to conventional I2C EEPROM protocol, as described in this section, with a 16-bit base address architecture.

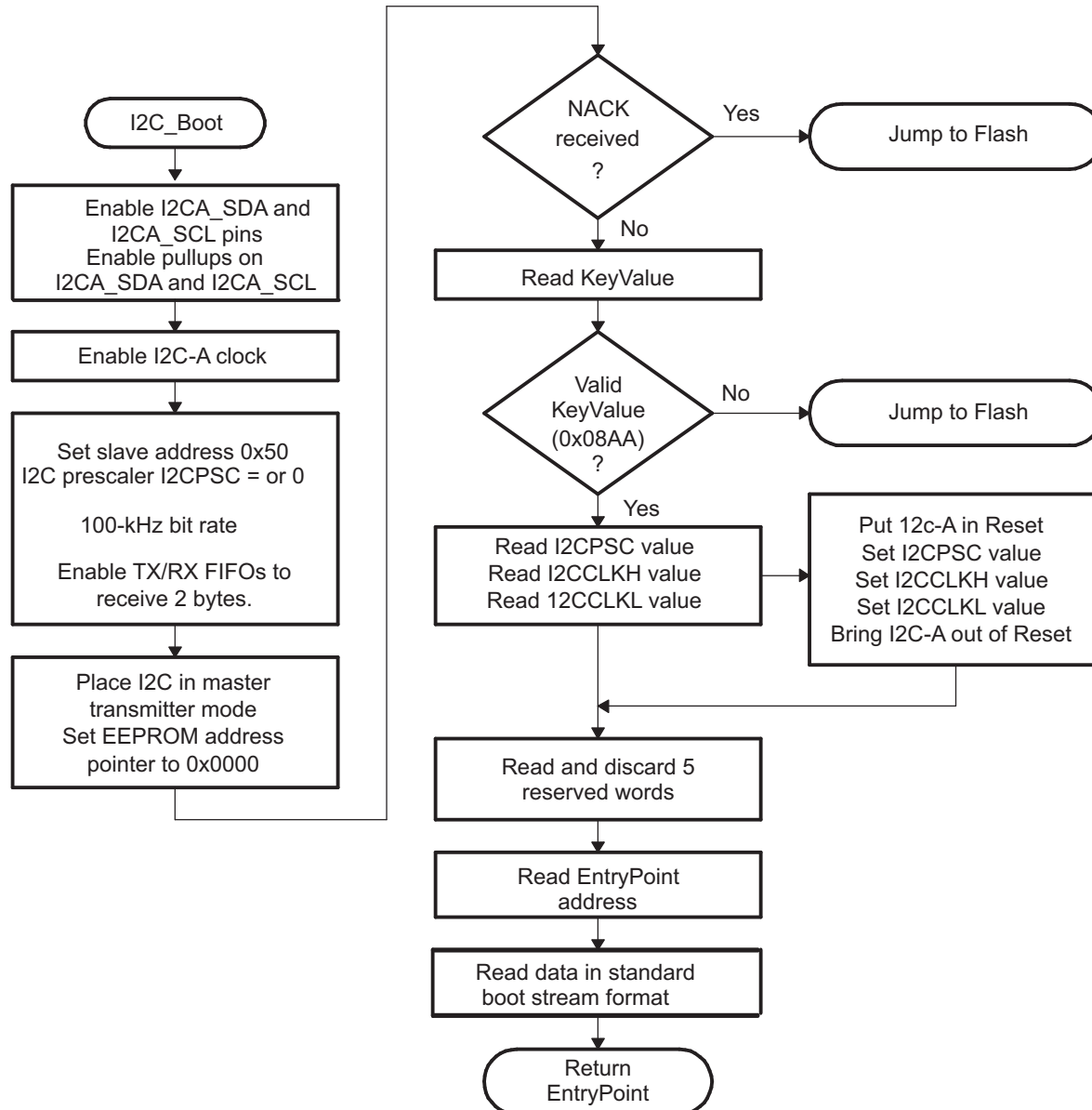
Figure 3-9. EEPROM Device at Address 0x50



If the download is to be performed from a device other than an EEPROM, then that device must be set up to operate in the slave mode and mimic the I2C EEPROM. Immediately after entering the I2C boot function, the GPIO pins are configured for I2C-A operation and the I2C is initialized. The following requirements must be met when booting from the I2C module:

- The input frequency to the device must be in the appropriate range.
- The EEPROM must be at slave address 0x50.

**Figure 3-10. Overview of I2C Boot Function**



The bit-period prescalers (I2CCLKH and I2CCLKL) are configured by the bootloader to run the I2C at a 50 percent duty cycle at 100-kHz bit rate (standard I2C mode) when the system clock is 10 MHz. These registers can be modified after receiving the first few bytes from the EEPROM. This allows the communication to be increased up to a 400-kHz bit rate (fast I2C mode) during the remaining data reads.

Arbitration, bus busy, and slave signals are not checked. Therefore, no other master is allowed to control the bus during this initialization phase. If the application requires another master during I2C boot mode, that master must be configured to hold off sending any I2C messages until the application software signals that it is past the bootloader portion of initialization.

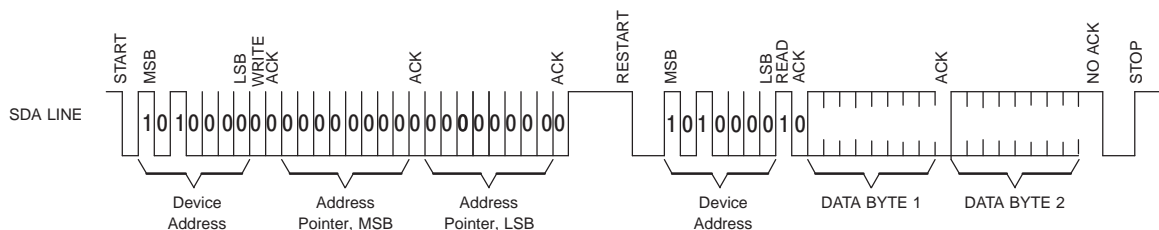
The non-acknowledgment bit is checked only during the first message sent to initialize the EEPROM base address. This is to make sure that an EEPROM is present at address 0x50 before continuing. If an EEPROM is not present, the non-acknowledgment bit is not checked during the address phase of the data read messages (I2C\_Get Word). If a non acknowledgment is received during the data read messages, the I2C bus will hang. Table 13-1 shows the 8-bit data stream used by the I2C.

**Table 3-17. I2C 8-Bit Data Stream**

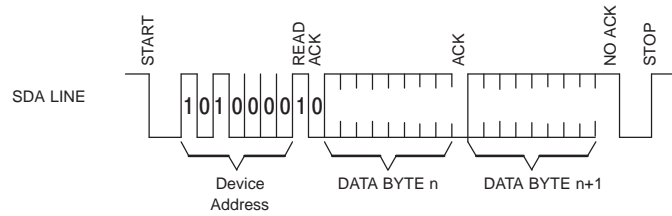
Byte	Contents
1	LSB: AA (KeyValue for memory width = 8 bits)
2	MSB: 08h (KeyValue for memory width = 8 bits)
3	LSB: I2CPSC[7:0]
4	reserved
5	LSB: I2CCLKH[7:0]
6	MSB: I2CCLKH[15:8]
7	LSB: I2CCLKL[7:0]
8	MSB: I2CCLKL[15:8]
...	...
...	Data for this section.
...	...
17	LSB: Reserved for future use
18	MSB: Reserved for future use
19	LSB: Upper half of entry point PC
20	MSB: Upper half of entry point PC[22:16] (Note: Always 0x00)
21	LSB: Lower half of entry point PC[15:8]
22	MSB: Lower half of entry point PC[7:0]
...	...
...	Data for this section.
...	...
...	Blocks of data in the format size/destination address/data as shown in the generic data stream description.
...	...
...	Data for this section.
...	...
n	LSB: 00h
n+1	MSB: 00h - indicates the end of the source

The I2C EEPROM protocol required by the I2C bootloader is shown in Figure 3-11 and Figure 3-12. The first communication, which sets the EEPROM address pointer to 0x0000 and reads the KeyValue (0x08AA) from it, is shown in Figure 3-11. All subsequent reads are shown in Figure 3-12 and are read two bytes at a time.

**Figure 3-11. Random Read**



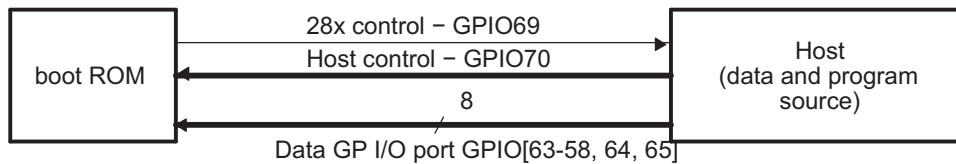
**Figure 3-12. Sequential Read**



**3.9.4.5 Parallel Boot Mode**

The parallel general purpose I/O (GPIO) boot mode asynchronously transfers code from GPIO58 - GPIO63, GPIO64-GPIO65 to internal memory. Each value is 8 bits long and follows the same data flow as outlined in [Figure 3-13](#).

**Figure 3-13. Overview of Parallel GPIO Bootloader Operation**



The control subsystem communicates with the external host device by polling/driving the GPIO70 and GPIO69 lines. The handshake protocol shown in [Figure 3-14](#) must be used to successfully transfer each word via GPIO [63-58,64,65]. This protocol is very robust and allows for a slower or faster host to communicate with the master subsystem.

Two consecutive 8-bit words are read to form a single 16-bit word. The most significant byte (MSB) is read first followed by the least significant byte (LSB). In this case, data is read from GPIO[63-58,64,65].

The 8-bit data stream is shown in [Table 3-18](#).

**Table 3-18. Parallel GPIO Boot 8-Bit Data Stream**

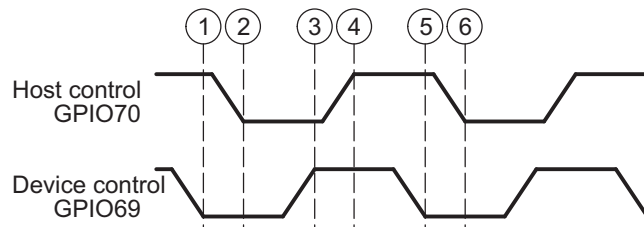
Bytes	GPIO[63:58,64,65] (Byte 1 of 2)	GPIO[63:58,64,65] (Byte 2 of 2)	Description
1 2	AA	08	0x08AA (KeyValue for memory width = 16 bits)
3 4	00	00	8 reserved words (words 2 - 9)
...	...	...	...
17 18	00	00	Last reserved word
19 20	BB	00	Entry point PC[22:16]
21 22	DD	CC	Entry point PC[15:0] (PC = 0x00BCCDD)
23 24	NN	MM	Block size of the first block of data to load = 0xMMNN words
25 26	BB	AA	Destination address of first block Addr[31:16]
27 28	DD	CC	Destination address of first block Addr[15:0] (Addr = 0xAABCCDD)
29 30	BB	AA	First word of the first block in the source being loaded = 0xAABB
...			...
...			Data for this section.
...			...
.	BB	AA	Last word of the first block of the source being loaded = 0xAABB
.	NN	MM	Block size of the 2nd block to load = 0xMMNN words
.	BB	AA	Destination address of second block Addr[31:16]
.	DD	CC	Destination address of second block Addr[15:0]
.	BB	AA	First word of the second block in the source being loaded
.			...

**Table 3-18. Parallel GPIO Boot 8-Bit Data Stream (continued)**

Bytes	GPIO[63:58,64,65] (Byte 1 of 2)	GPIO[63:58,64,65] (Byte 2 of 2)	Description
n n+1	BB	AA	Last word of the last block of the source being loaded (More sections if required)
n+2 n+3	00	00	Block size of 0000h - indicates end of the source program

The device first signals the host that it is ready to begin data transfer by pulling the GPIO69 pin low. The host load then initiates the data transfer by pulling the GPIO70 pin low. The complete protocol is shown in Figure 3-14:

**Figure 3-14. Parallel GPIO Bootloader Handshake Protocol**



1. The device indicates it is ready to start receiving data by pulling the GPIO69 pin low.
2. The bootloader waits until the host puts data on GPIO [63-58,64,65]. The host signals to the device that data is ready by pulling the GPIO70 pin low.
3. The device reads the data and signals the host that the read is complete by pulling GPIO69 high.
4. The bootloader waits until the host acknowledges the device by pulling GPIO70 high.
5. The device again indicates it is ready for more data by pulling the GPIO69 pin low.

This process is repeated for each data value to be sent.

Figure 3-15 shows an overview of the Parallel GPIO bootloader flow.

**Figure 3-15. Parallel GPIO Mode Overview**

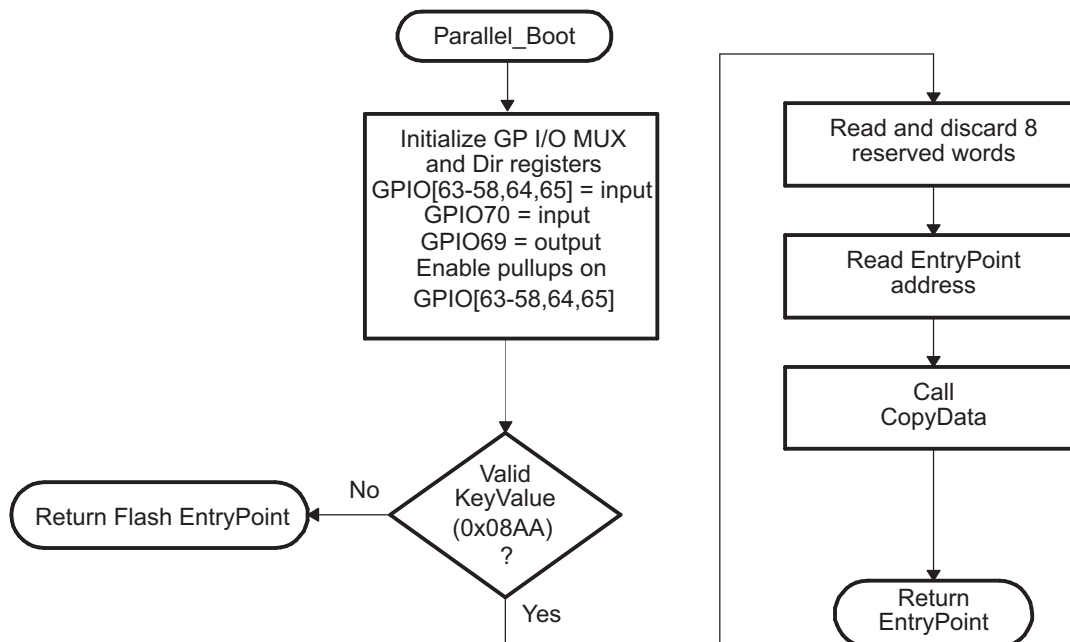


Figure 3-16 shows the transfer flow from the host side. The operating speed of the CPU and host are not critical in this mode as the host will wait for the device and the device will in turn wait for the host. In this manner the protocol will work with both a host running faster and a host running slower than the device.

**Figure 3-16. Parallel GPIO Mode - Host Transfer Flow**

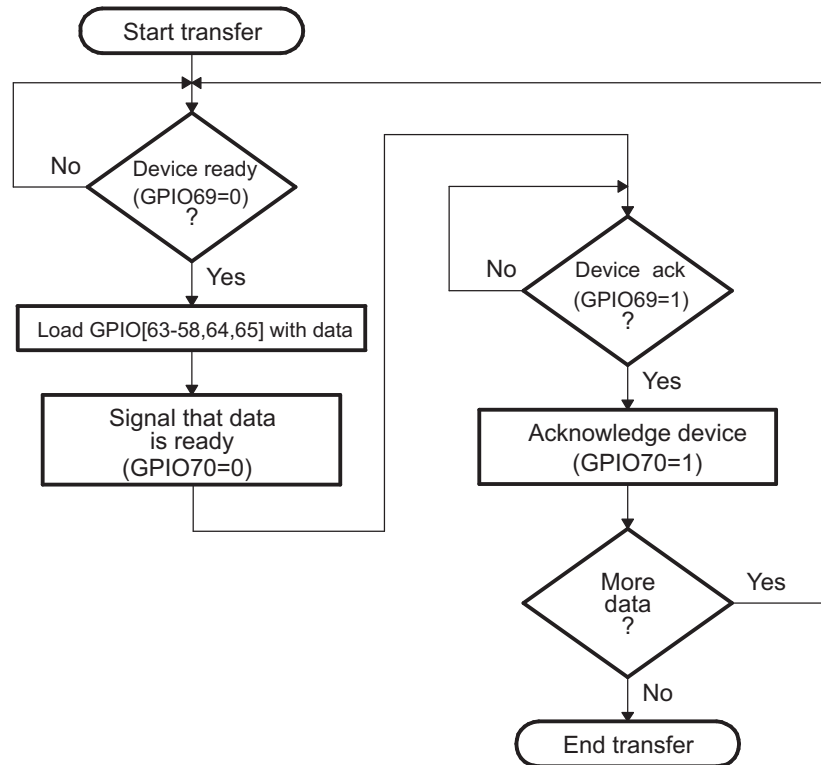
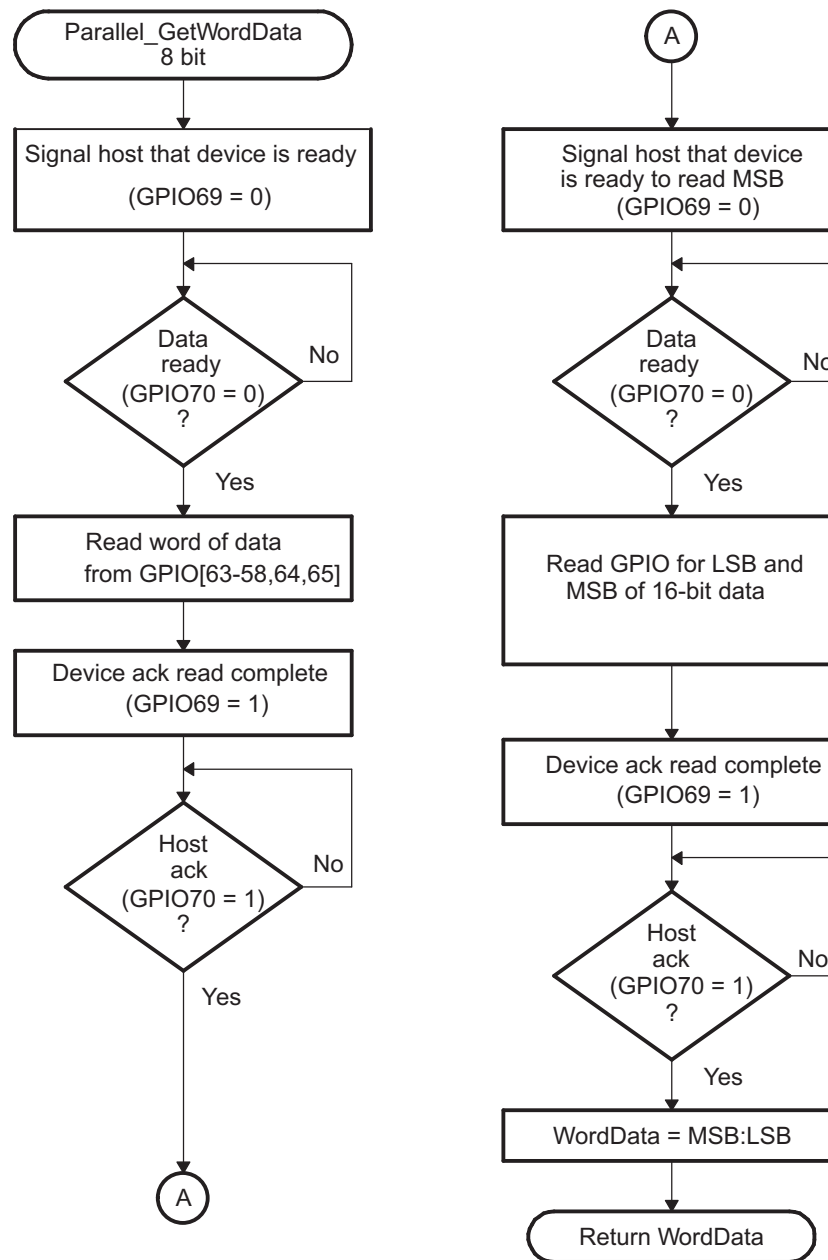


Figure 3-17 shows the flow used to read a single word of data from the parallel port.

- **8-bit data stream**

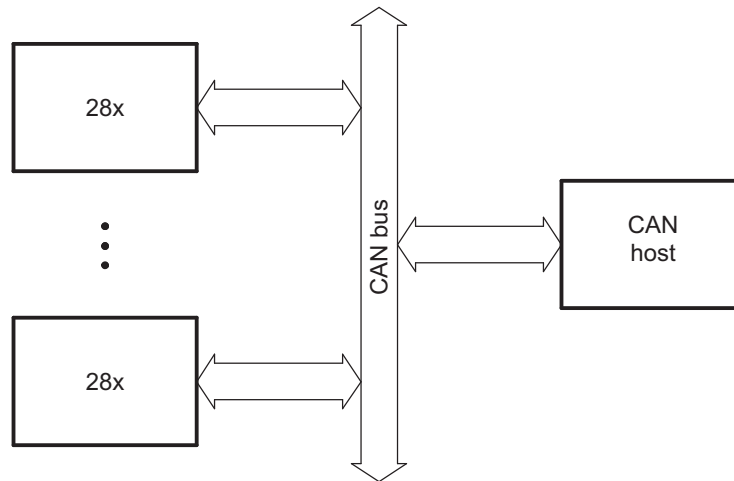
The 8-bit routine, shown in Figure 3-17, discards the upper 8 bits of the first read from the port and treats the lower 8 bits masked with GPIO65 in bit position 7 and GPIO64 in bit position 6 as the least significant byte (LSB) of the word to be fetched. The routine will then perform a second read to fetch the most significant byte (MSB). The routine will then perform a second read to fetch the most significant byte (MSB). It then combines the MSB and LSB into a single 16-bit value to be passed back to the calling routine.

Figure 3-17. 8-Bit Parallel GetWord Function



### 3.9.4.6 CAN Boot Mode

The CAN bootloader asynchronously transfers code from CAN-A to internal memory. The host can be any CAN node. The communication is first done with 11-bit standard identifiers (with a MSGID of 0x1) using two bytes per data frame. The host can download a kernel to reconfigure the CAN if higher data throughput is desired.

**Figure 3-18. Overview of CAN-A Bootloader Operation**


The bit timing registers are programmed in such a way that a 100 kbps bit rate is achieved with a 20 MHz external oscillator, as shown in [Table 3-19](#).

**Table 3-19. Bit-Rate Value for Internal Oscillators**

OSCCLK	SYSCLK	Bit Rate
20 MHz	10 MHz	100 kbps

The SYSCLKOUT values shown are the reset values with the default PLL setting. The BRP and bit-time values are hard-coded to 10 and 20, respectively.

Mailbox 1 is programmed with a standard MSGID of 0x1 for boot-loader communication. The CAN host should transmit only 2 bytes at a time, LSB first and MSB next. For example, to transmit the word 0x08AA to the device, transmit AA first, followed by 08. The program flow of the CAN bootloader is identical to the SCI bootloader. The data sequence for the CAN bootloader is shown in [Table 3-20](#):

**Table 3-20. CAN 8-Bit Data Stream**

Bytes	Byte 1 of 2	Byte 2 of 2	Description
1 2	AA	08	0x08AA (KeyValue for memory width = 16 bits)
3 4	00	00	reserved
5 6	00	00	reserved
7 8	00	00	reserved
9 10	00	00	reserved
11 12	00	00	reserved
13 14	00	00	reserved
15 16	00	00	reserved
17 18	00	00	reserved
19 20	BB	AA	Entry point PC[22:16]
21 22	DD	CC	Entry point PC[15:0] (PC = 0xAABBCCDD)
23 24	NN	MM	Block size of the first block of data to load = 0xMMNN words
25 26	BB	AA	Destination address of first block Addr[31:16]
27 28	DD	CC	Destination address of first block Addr[15:0] (Addr = 0xAABBCCDD)
29 30	BB	AA	First word of the first block in the source being loaded = 0xAABB
...			....
...			Data for this section.
...			....
.	BB	AA	Last word of the first block of the source being loaded = 0xAABB



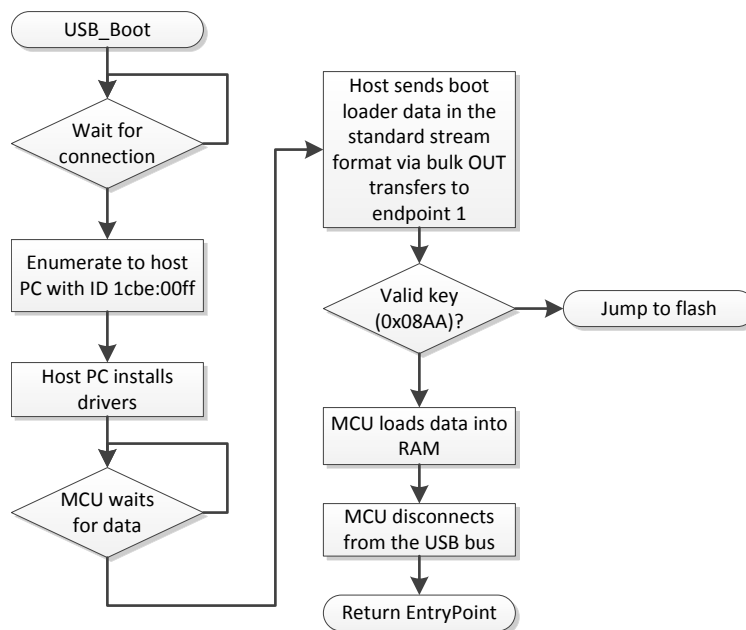
**Table 3-20. CAN 8-Bit Data Stream (continued)**

Bytes	Byte 1 of 2	Byte 2 of 2	Description	
.	NN	MM	Block size of the 2nd block to load = 0xMMNN words	
.	BB	AA	Destination address of second block Addr[31:16]	
.	DD	CC	Destination address of second block Addr[15:0]	
.	BB	AA	First word of the second block in the source being loaded	
.			...	
n	n+1	BB	AA	Last word of the last block of the source being loaded (More sections if required)
n+2	n+3	00	00	Block size of 0000h - indicates end of the source program

**3.9.4.7 USB Boot Mode**

In USB boot mode, the device will enumerate with vendor ID 0x1cbe and product ID 0x00ff. The device descriptor and interface descriptor both show the class as 0xFF (vendor-specific), the subclass as 0x00, and the protocol as 0x00. After enumeration, the device will wait for data. Data should be sent via bulk OUT transfers to endpoint 1. The data is interpreted as a series of 8-bit bytes in the standard data stream format described in Section 3.9.5, shown here in Table 3-21. No reserved bytes are used. Once the data transfer is complete (block size of 0x0000 sent), the device will disconnect from the USB bus, allowing other software to make use of the module if desired. Figure 3-19 illustrates the flow for USB boot mode.

**Figure 3-19. USB Boot Flow**



**Table 3-21. USB 8-Bit Data Stream**

Bytes	First Byte (LSB)	Second Byte (MSB)	Description	
1	2	AA	08	0x08AA (KeyValue for memory width = 16bits)
3	4	00	00	reserved
5	6	00	00	reserved
7	8	00	00	reserved
9	10	00	00	reserved
11	12	00	00	reserved
13	14	00	00	reserved

**Table 3-21. USB 8-Bit Data Stream (continued)**

Bytes	First Byte (LSB)	Second Byte (MSB)	Description
15 16	00	00	reserved
17 18	00	00	reserved
19 20	BB	AA	Entry point PC[22:16]
21 22	DD	CC	Entry point PC[15:0] (PC = 0xAABBCCDD)
23 24	NN	MM	Block size of the first block of data to load = 0xMMNN words
25 26	BB	AA	Destination address of first block Addr[31:16]
27 28	DD	CC	Destination address of first block Addr[15:0] (Addr = 0xAABBCCDD)
29 30	BB	AA	First word of the first block in the source being loaded = 0xAABB
...			....
...			Data for this section.
...			....
.	BB	AA	Last word of the first block of the source being loaded = 0xAABB
.	NN	MM	Block size of the 2nd block to load = 0xMMNN words
.	BB	AA	Destination address of second block Addr[31:16]
.	DD	CC	Destination address of second block Addr[15:0]
.	BB	AA	First word of the second block in the source being loaded
.			....
n n+1	BB	AA	Last word of the last block of the source being loaded (More sections if required)
n+2 n+3	00	00	Block size of 0000h - indicates end of the source program

Implementing PC-side USB software is not trivial. It is recommended to use the TI-provided tools and drivers to load data in USB boot mode. Hex and binary files for loader tools can be generated from COFF (.out) files using the hex2000 tool. To produce a plain binary file in the boot loader format, use the following command line:

```
hex2000 -boot -b Program_to_Load.out -o Binary_Loader_Data.dat
```

For more information on hex2000, please see the *TMS320C28x Assembly Language Tools User's Guide (SPRU513)*.

---

**NOTE:** INTOSC2 must be enabled before invoking the USB boot loader. If INTOSC2 is not enabled, the boot loader will hang. A debugger reset or SCC reset will not enable INTOSC2 if it has been disabled by the application.

---

### 3.9.5 Boot Data Stream Structure

This section details the data transfer protocols or stream structures that allow boot data transfer between boot ROM and host device. This data transfer protocol is compatible to the respective bootloaders on the Piccolo class of C2000 devices.

#### 3.9.5.1 Bootloader Data Stream Structure

The following table and associated examples show the structure of the data stream incoming to the bootloader. The basic structure is the same for all the bootloaders and is based on the C54x source data stream generated by the C54x hex utility. The C28x hex utility (hex2000.exe) has been updated to support this structure. The hex2000.exe utility is included with the C2000 code generation tools. All values in the data stream structure are in hex.

The first 16-bit word in the data stream is known as the key value. The key value is used to tell the bootloader the width of the incoming stream: 8 or 16 bits. Note that not all bootloaders will accept both 8 and 16-bit streams. Please refer to the detailed information on each loader for the valid data stream width. For an 8-bit data stream, the key value is 0x08AA and for a 16-bit stream it is 0x10AA. If a bootloader receives an invalid key value, then the load is aborted.

The next eight words are used to initialize register values or otherwise enhance the bootloader by passing values to it. If a bootloader does not use these values then they are reserved for future use and the bootloader simply reads the value and then discards it. Currently only the SPI and I2C and parallel bootloaders use these words to initialize registers.

The tenth and eleventh words comprise the 22-bit entry point address. This address is used to initialize the PC after the boot load is complete. This address is most likely the entry point of the program downloaded by the bootloader.

The twelfth word in the data stream is the size of the first data block to be transferred. The size of the block is defined as 8-bit data stream format. For example, to transfer a block of 20 8-bit data values from an 8-bit data stream, the block size would be 0x000A to indicate 10 16-bit words.

The next two words tell the loader the destination address of the block of data. Following the size and address will be the 16-bit words that makeup that block of data.

This pattern of block size/destination address repeats for each block of data to be transferred. Once all the blocks have been transferred, a block size of 0x0000 signals to the loader that the transfer is complete. At this point the loader will return the entry point address to the calling routine which in turn will cleanup and exit. Execution will then continue at the entry point address as determined by the input data stream contents.

**Table 3-22. LSB/MSB Loading Sequence in 8-Bit Data Stream**

Byte		Contents	
		LSB (First Byte of 2)	MSB (Second Byte of 2)
1	2	LSB: AA (KeyValue for memory width = 8 bits)	MSB: 08h (KeyValue for memory width = 8 bits)
3	4	LSB: Register initialization value or reserved	MSB: Register initialization value or reserved
5	6	LSB: Register initialization value or reserved	MSB: Register initialization value or reserved
7	8	LSB: Register initialization value or reserved	MSB: Register initialization value or reserved
...	...	...	...
17	18	LSB: Register initialization value or reserved	MSB: Register initialization value or reserved
19	20	LSB: Upper half of Entry point PC[23:16]	MSB: Upper half of entry point PC[31:24] (Always 0x00)
21	22	LSB: Lower half of Entry point PC[7:0]	MSB: Lower half of Entry point PC[15:8]
23	24	LSB: Block size in words of the first block to load. If the block size is 0, this indicates the end of the source program. Otherwise another block follows. For example, a block size of 0x000A would indicate 10 words or 20 bytes in the block.	MSB: block size
25	26	LSB: MSW destination address, first block Addr[23:16]	MSB: MSW destination address, first block Addr[31:24]
27	28	LSB: LSW destination address, first block Addr[7:0]	MSB: LSW destination address, first block Addr[15:8]
29	30	LSB: First word of the first block being loaded	MSB: First word of the first block being loaded
...	...	...	...
...	...	...	...
.	.	LSB: Last word of the first block to load	MSB: Last word of the first block to load
.	.	LSB: Block size of the second block	MSB: Block size of the second block
.	.	LSB: MSW destination address, second block Addr[23:16]	MSB: MSW destination address, second block Addr[31:24]
.	.	LSB: LSW destination address, second block Addr[7:0]	MSB: LSW destination address, second block Addr[15:8]
.	.	LSB: First word of the second block being loaded	MSB: First word of the second block being loaded
...	...	...	...
...	...	...	...
.	.	LSB: Last word of the second block	MSB: Last word of the second block

**Table 3-22. LSB/MSB Loading Sequence in 8-Bit Data Stream (continued)**

Byte	Contents	
	LSB (First Byte of 2)	MSB (Second Byte of 2)
. .	LSB: Block size of the last block	MSB: Block size of the last block
. .	LSB: MSW of destination address of last block Addr[23:16]	MSB: MSW destination address, last block Addr[31:24]
. .	LSB: LSW destination address, last block Addr[7:0]	MSB: LSW destination address, last block Addr[15:8]
. .	LSB: First word of the last block being loaded	MSB: First word of the last block being loaded
... ..	...	...
. .	LSB: Last word of the last block	MSB: Last word of the last block
n n+1	LSB: 00h	MSB: 00h - indicates the end of the source

**Example 3-1. Data Stream Structure 8-bit**

```

AA 08      ; 0x08AA 8-bit key value
00 00 00 00 ; 8 reserved words
00 00 00 00
00 00 00 00
00 00 00 00
3F 00 00 80 ; 0x003F8000 EntryAddr, starting point after boot load completes
05 00      ; 0x0005 - First block consists of 5 16-bit words
3F 00 10 90 ; 0x003F9010 - First block will be loaded starting at 0x3F9010
01 00      ; Data loaded = 0x0001 0x0002 0x0003 0x0004 0x0005
02 00
03 00
04 00
05 00
02 00      ; 0x0002 - 2nd block consists of 2 16-bit words
3F 00 00 80 ; 0x003F8000 - 2nd block will be loaded starting at 0x3F8000
00 77      ; Data loaded = 0x7700 0x7625
25 76
00 00      ; 0x0000 - Size of 0 indicates end of data stream

After load has completed the following memory values will have been initialized as follows:

Location  Value
0x3F9010  0x0001
0x3F9011  0x0002
0x3F9012  0x0003
0x3F9013  0x0004
0x3F9014  0x0005
0x3F8000  0x7700
0x3F8001  0x7625
PC Begins execution at 0x3F8000

```

**3.9.6 GPIO Assignments**

This section details the GPIOs and boot options used for each boot mode set in the BMODE bit-field of the BOOTCTRL register in OTP. Refer to [Section 3.4](#) on the details of the BOOTCTRL fields.

**Table 3-23. SCI Boot Options**

Option	BMODE Value	SCITXDA GPIO	SCIRXDA GPIO
0 (default)	0x01	GPIO84	GPIO85
1	0x81	GPIO29	GPIO28

**Table 3-24. CAN Boot Options**

Option	BMODE Value	CANTXA GPIO	CANRXA GPIO
0	0x07	GPIO71	GPIO70
1	0x87	GPIO63	GPIO62

**Table 3-25. I2C Boot Options**

Option	BMODE Value	SDAA GPIO	SCLA GPIO
0	0x05	GPIO91	GPIO92
1	0x85	GPIO32	GPIO33

**Table 3-26. USB Boot Options**

Option	BMODE Value	USBDM GPIO	USBDP GPIO
0	0x0C	GPIO42	GPIO43

**Table 3-27. RAM Boot Options**

Option	BMODE Value	RAM Entry Point (Address)
0	0x0A	0x0000 0000

**Table 3-28. Flash Boot Options**

Option	BMODE Value	Flash Entry Point (Address)	Flash Sector
0	0x0B	0x0008 0000	Sector A

**Table 3-29. Wait Boot Options**

Option	BMODE Value
0 (default)	0x02

**Table 3-30. SPI Boot Options**

Option	BMODE Value	SPISIMOA	SPISOMIA	SPICLKA	SPISTEA
0	0x04	GPIO58	GPIO59	GPIO60	GPIO61
1	0x84	GPIO16	GPIO17	GPIO18	GPIO19

**Table 3-31. Parallel Boot Options**

Option	BMODE Value	D0-D7 GPIO	DSP Control GPIO	Host Control GPIO
0 (default)	0x0	D0 - GPIO65	GPIO69	GPIO70
		D1 - GPIO64		
		D2 - GPIO58		
		D3 - GPIO59		
		D4 - GPIO60		
		D5 - GPIO61		
		D6 - GPIO62		
		D7 - GPIO63		

### 3.9.7 Clock Initializations

During boot up, the boot ROM initializes the device clocking, depending upon the reset source, to assist in faster boot time response. Clock configurations are performed by the boot ROM code only for POR, XRS, and HIBERNATE reset types. For all other resets, the boot ROM starts executing with the clocks that were already set up before reset.

**Table 3-32. Boot Clock Sources**

Source	Frequency	Description
INTOSC2	10 MHz	Default clock source
INTOSC1	10 MHz	Set as clock source if missing clock is detected at power up or right after device reset

**Table 3-33. Clock State After Boot ROM**

Reset Source	Clock State
POR/XRS/HIBERNATE	Bypassed PLL.
	PLL multiplier is set to 0x0
	Clock divider is set to /1.
All other Resets	Maintain clocks setup before device reset.

**NOTE:** If the PLL is used during the boot process, it will be bypassed by the boot ROM code before branching to the user application.

### 3.9.8 Wait State Configuration

This section details the ROM memory wait state configurations. By default, the ROM memory on this device is not zero-wait state; it is 1-wait state with pre-fetch disabled. ROM does support pre-fetch enable and disable configurations in order to provide better execution speeds at varying clock frequencies. Configuring the wait state enables user applications to adjust for when performing callbacks into ROM or secure copy code (SCC).

**Table 3-34. ROM Wait States**

Wait State Disable Bit (Bit 0 – 0x5F540)	Pre-Fetch Enable Bit (Bit 0 – 0x5E608)	ROM Configuration
0	0	<ul style="list-style-type: none"> <li>• Wait state enabled</li> <li>• Pre-fetch disabled</li> <li>• Max Frequency: 200MHz</li> </ul>
0	1	<ul style="list-style-type: none"> <li>• Wait state enabled</li> <li>• Pre-fetch enabled</li> <li>• Max Frequency: 180MHz</li> </ul>
1	Don't Care	<ul style="list-style-type: none"> <li>• 0 Wait state</li> <li>• Pre-fetch disabled</li> <li>• Max Frequency: 150MHz</li> </ul>

### 3.9.9 Boot Status information

Boot ROM keeps a record of the different events that can occur during boot ROM execution. This is because NMI and other exceptions are enabled by default in the device, and must be handled accordingly. Boot ROM stores the boot status information in a RAM location so that the user application can look at this boot status and take the necessary actions per the application's needs to handle these events.

### 3.9.9.1 Booting Status

This section details the boot status RAM location and its bit field definitions. When the specific bit field is set, the described event or action has occurred.

**Table 3-35. CPU1 Boot Status Address**

Description	Address
CPU1 Boot ROM Status	0x0000 002C

**Table 3-36. CPU1 Boot Status Bit Fields**

Bit	Description
31	CPU1 Boot ROM has finished running
30	Boot ROM detected a missing clock NMI
29	Boot ROM detected a RAM bit error NMI
28	Boot ROM detected a Flash bit error NMI
27	Boot ROM detected CPU1 HWBIST error NMI
25	Boot ROM detected PIE vector error NMI
20	Boot ROM detected OVF NMI
19	Boot ROM detected a PIE mismatch
17	Boot ROM detected an ITRAP
15	Boot ROM handled POR
14	Boot ROM handled XRS
13	Boot ROM handled HWBIST reset
12	Boot ROM handled hibernate reset
11	Boot ROM handled all the resets
10	DCSM initialization has completed
9	Flash boot has started
8	CPU1 Boot ROM has started running

### 3.9.10 ROM Version

The ROM revision and release date information is stored at the ROM locations specified in this section.

**Table 3-37. Boot ROM Version Information**

Start Address	End Address	Contents
0x003F FF7A	0x003F FF7B	Revision Number
0x003F FF7C	0x003F FF7D	Revision Date

Interpreting the contents:

- Reading a revision value of 0x100 represents version 1.0.
- Reading a revision date value of 0x0715 represents 07/15 or July 2015.

## Direct Memory Access (DMA)

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The direct memory access (DMA) module provides a hardware method of transferring data between peripherals and/or memory without intervention from the CPU, thereby freeing up bandwidth for other system functions. Additionally, the DMA has the capability to orthogonally rearrange the data as it is transferred as well as “ping-pong” data between buffers. These features are useful for structuring data into blocks for optimal CPU processing.

Topic	Page
<b>4.1 Introduction .....</b>	<b>577</b>
<b>4.2 Architecture .....</b>	<b>578</b>
<b>4.3 Pipeline Timing and Throughput .....</b>	<b>584</b>
<b>4.4 CPU Arbitration .....</b>	<b>585</b>
<b>4.5 Channel Priority .....</b>	<b>586</b>
<b>4.6 Address Pointer and Transfer Control.....</b>	<b>588</b>
<b>4.7 Overrun Detection Feature.....</b>	<b>592</b>
<b>4.8 Register Descriptions.....</b>	<b>594</b>



## 4.1 Introduction

The strength of a controller is not measured purely in processor speed, but in total system capabilities. As a part of the equation, any time the CPU bandwidth for a given function can be reduced, the greater the system capabilities. Many times applications spend a significant amount of their bandwidth moving data, whether it is from off-chip memory to on-chip memory, or from a peripheral such as an analog-to-digital converter (ADC) to RAM, or even from one peripheral to another. Furthermore, many times this data comes in a format that is not conducive to the optimum processing powers of the CPU. The DMA module described in this reference guide has the ability to free up CPU bandwidth and rearrange the data into a pattern for more streamlined processing.

The DMA module is an event-based machine, meaning it requires a peripheral or software trigger to start a DMA transfer. Although it can be made into a periodic time-driven machine by configuring a timer as the interrupt trigger source, there is no mechanism within the module itself to start memory transfers periodically. The interrupt trigger source for each of the six DMA channels can be configured separately and each channel contains its own independent PIE interrupt to let the CPU know when a DMA transfer has either started or completed. Five of the six channels are exactly the same, while Channel 1 has the ability to be configured at a higher priority than the others. At the heart of the DMA is a state machine and tightly coupled address control logic. It is this address control logic that allows for rearrangement of the block of data during the transfer as well as the process of ping-ponging data between buffers. Each of these features, along with others, will be discussed in detail in this document.

DMA features include:

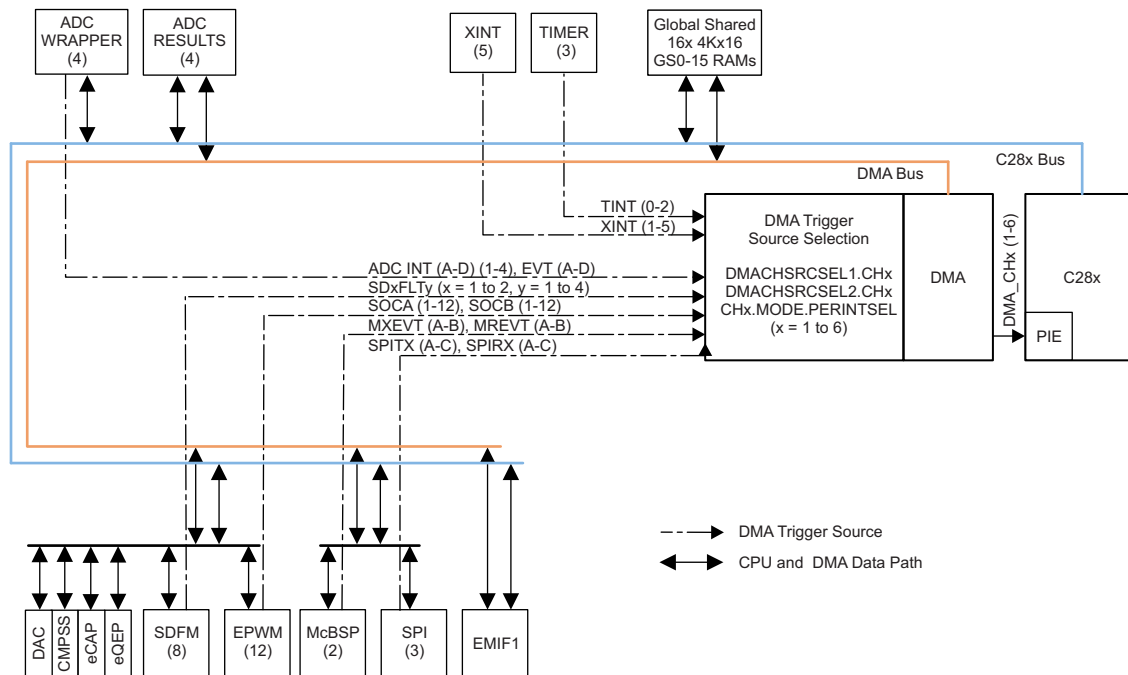
- Six channels with independent PIE interrupts
- Peripheral interrupt trigger sources
  - ADC interrupts and EVT signals
  - McBSPx transmit and receive
  - External Interrupts
  - CPU Timers
  - EPWMxSOC signals
  - SPIx transmit and receive
  - USBx transmit and receive
  - Sigma Delta filter module
  - Software trigger
- Data sources and destinations:
  - GSx RAM
  - CPU message RAM (IPC RAM)
  - ADC memory-bus mapped result registers
  - ePWMx
  - SPI, McBSP, EMIF
- Word Size: 16-bit or 32-bit (SPI and McBSP limited to 16-bit)
- Throughput: 4 cycles/word without arbitration

## 4.2 Architecture

### 4.2.1 Block Diagram

Figure 4-1 shows a device-level block diagram of the DMA.

Figure 4-1. DMA Block Diagram



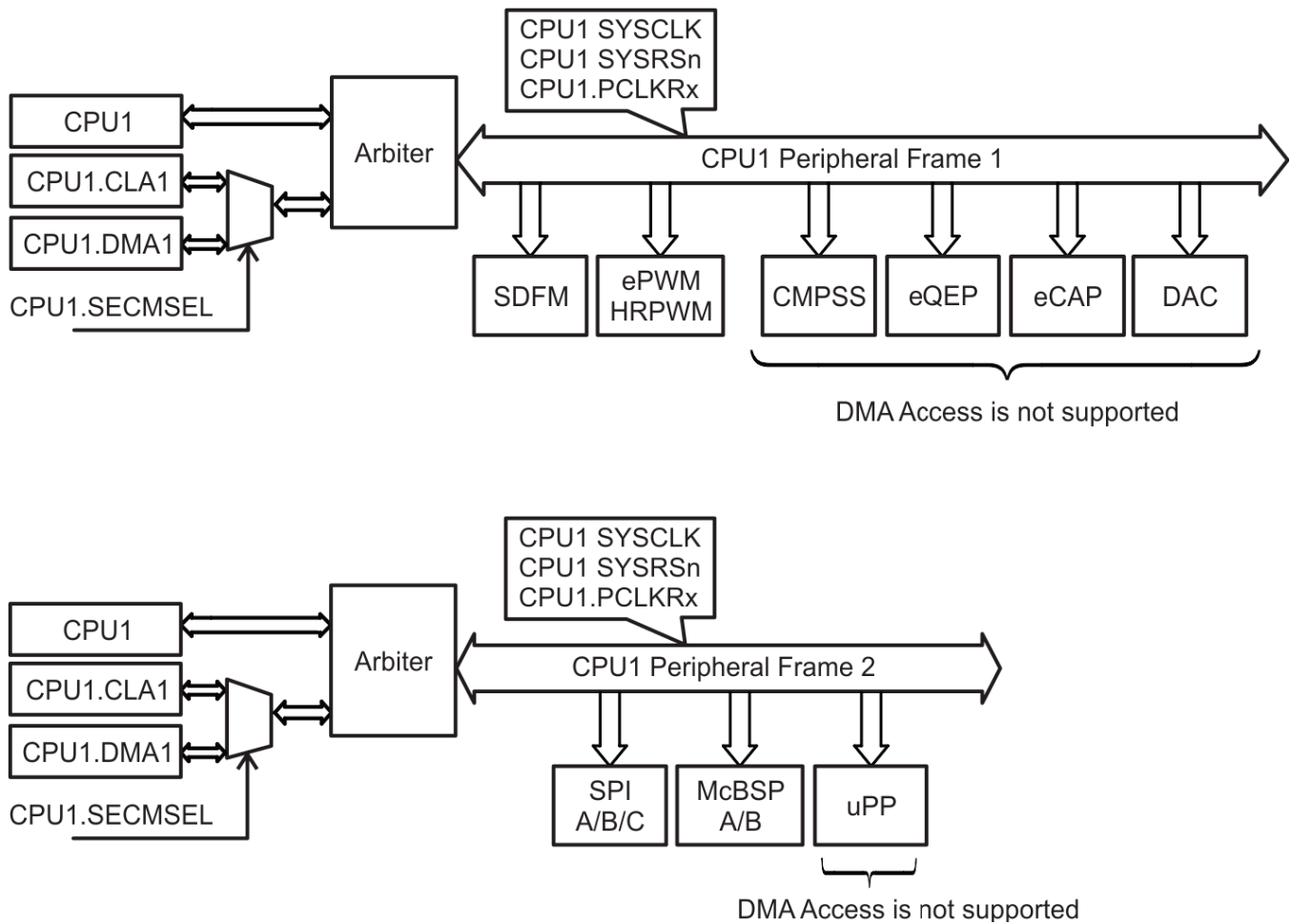
### 4.2.2 Common Peripheral Architecture

The architecture of this device allows for common peripherals to be accessed by different masters. A peripheral can be accessed by the CPU and one of the secondary masters (DMA or CLA1). The secondary master is selected using the SECMSEL register. Refer to the SECMSEL register definition for more details. If a secondary master is not selected, all writes from that master are ignored and all reads will return 0x0.

Refer to [Section 4.4](#) for more details on the arbitration scheme for all masters.

**NOTE:** If the CPU and DMA make an access to the same peripheral frame in the same cycle, the DMA has priority and the CPU is stalled.

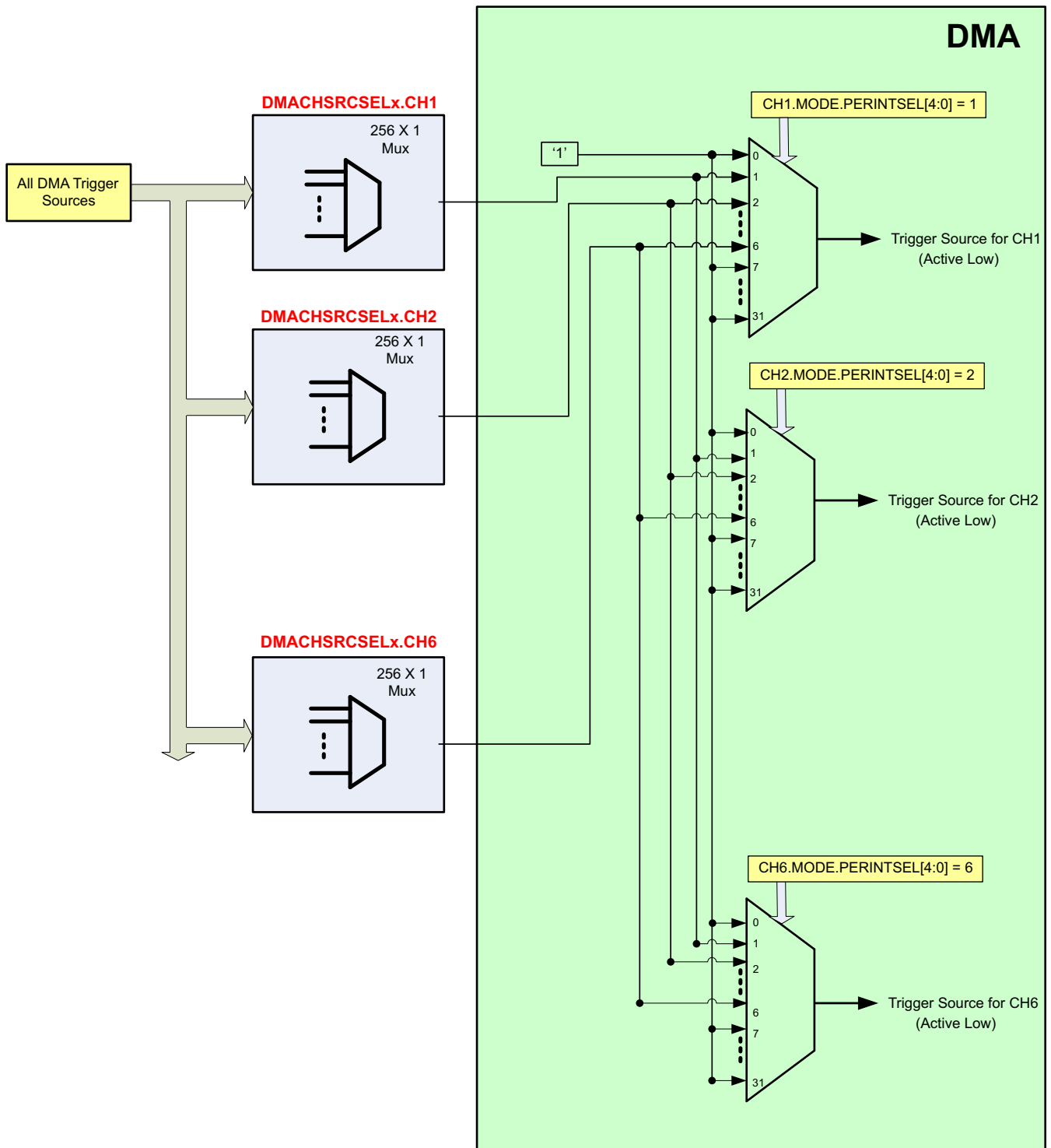
Figure 4-2. Common Peripheral Architecture



### 4.2.3 Peripheral Interrupt Event Trigger Sources

As shown in Figure 4-3 the peripheral interrupt event trigger can be independently configured as any of the sources from the DMACHSRCSELx register for each of the six DMA channels. Included in these sources are five external interrupt signals which can be connected to most of the general-purpose input/output (GPIO) pins on the device. This adds significant flexibility to the event trigger capabilities. The DMA trigger source is selected in the DMACHSRCSELx register (Table 2-16), for each channel. The PERINTSEL in the MODE register of each channel should be set to the channel number (for example, CH2.MODE.PERINTSEL[4:0] = 2). An active peripheral interrupt trigger will be latched into the PERINTFLG bit of the CONTROL register, and if the respective interrupt and DMA channel is enabled (see the MODE.CHx[PERINTE] and CONTROL.CHx[RUNSTS] bits), it will be serviced by the DMA channel. Upon receipt of a peripheral interrupt event signal, the DMA will automatically send a clear signal to the interrupt source so that subsequent interrupt events will occur.

Figure 4-3. DMA Trigger Architecture



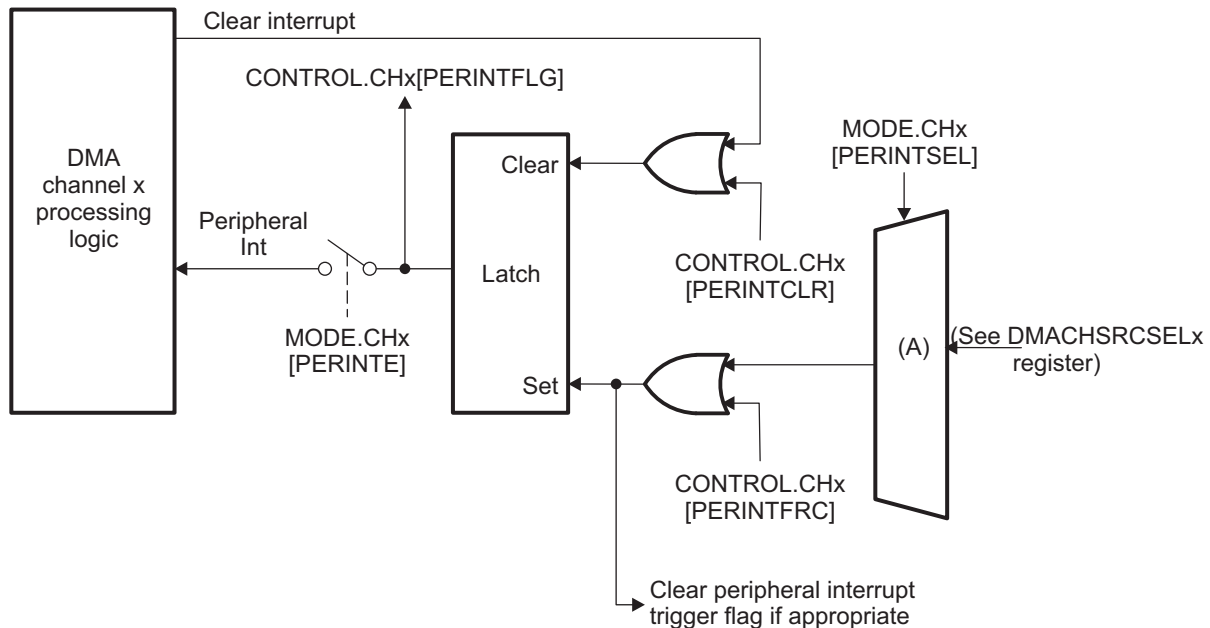
**NOTE:** To use the system level DMA Trigger source selection, the DMA internal trigger source selection configuration for each channel should be done using the DMACHSRCSELx register (Table 2-16), and the CHx.MODE.PERINTSEL register as shown here. See Table 4-1 or the DMACHSRCSELx register definition for a complete list of DMA trigger sources.

Regardless of the value of the MODE.CHx[PERINTSEL] bit field, software can always force a trigger by using the CONTROL.CHx[PERINTFRC] bit. Likewise, software can always clear a pending DMA trigger using the CONTROL.CHx[PERINTCLR] bit.

Once a particular interrupt trigger sets a channel's PERINTFLG bit, the bit stays pending until the priority logic of the state machine starts the burst transfer for that channel. Once the burst transfer starts, the flag is cleared. If a new interrupt trigger is generated while a burst is in progress, the burst will complete before responding to the new interrupt trigger (after proper prioritization). If a third interrupt trigger occurs before the pending interrupt is serviced, an error flag is set in the CONTROL.CHx[OVRFLG] bit. If a peripheral interrupt trigger occurs at the same time as the latched flag is being cleared, the peripheral interrupt trigger has priority and the PERINTFLG will remain set.

Figure 4-4 shows a diagram of the trigger select circuit. See the DMACHSRCSELx register, (Table 2-16) description for the complete list of peripheral interrupt trigger sources.

Figure 4-4. Peripheral Interrupt Trigger Input Diagram



A See Figure 4-3.

Table 4-1 shows the interrupt trigger source options that are available for each channel.

Table 4-1. Peripheral Interrupt Trigger Source Options

Select Value (8-bit)	DMA ChTrigger Source
0	No Peripheral
1	ADCA.1
2	ADCA.2
3	ADCA.3
4	ADCA.4
5	ADCAEVT
6	ADCB.1
7	ADCB.2
8	ADCB.3
9	ADCB.4
10	ADCBEVT
11	ADCC.1
12	ADCC.2

**Table 4-1. Peripheral Interrupt Trigger Source Options (continued)**

Select Value (8-bit)	DMA ChTrigger Source
13	ADCC.3
14	ADCC.4
15	ADCCEVT
16	ADCD.1
17	ADCD.2
18	ADCD.3
19	ADCD.4
20	ADCDEVT
21	No Peripheral
22	No Peripheral
23	No Peripheral
24	No Peripheral
25	No Peripheral
26	No Peripheral
27	No Peripheral
28	No Peripheral
29	XINT1
30	XINT2
31	XINT3
32	XINT4
33	XINT5
34	No Peripheral
35	No Peripheral
36	EPWM1.SOCA
37	EPWM1.SOCB
38	EPWM2.SOCA
39	EPWM2.SOCB
40	EPWM3.SOCA
41	EPWM3.SOCB
42	EPWM4.SOCA
43	EPWM4.SOCB
44	EPWM5.SOCA
45	EPWM5.SOCB
46	EPWM6.SOCA
47	EPWM6.SOCB
48	EPWM7.SOCA
49	EPWM7.SOCB
50	EPWM8.SOCA
51	EPWM8.SOCB
52	EPWM9.SOCA
53	EPWM9.SOCB
54	EPWM10.SOCA
55	EPWM10.SOCB
56	EPWM11.SOCA
57	EPWM11.SOCB
58	EPWM12.SOCA
59	EPWM12.SOCB

**Table 4-1. Peripheral Interrupt Trigger Source Options (continued)**

Select Value (8-bit)	DMA ChTrigger Source
60	No Peripheral
61	No Peripheral
62	No Peripheral
63	No Peripheral
64	No Peripheral
65	No Peripheral
66	No Peripheral
67	No Peripheral
68	TINT0
69	TINT1
70	TINT2
71	MXEVTA
72	MREVTA
73	MXEVTB
74	MREVTB
75	No Peripheral
76	No Peripheral
77	No Peripheral
78	No Peripheral
79	No Peripheral
80	No Peripheral
81	No Peripheral
82	No Peripheral
83	No Peripheral
84	No Peripheral
85	No Peripheral
86	No Peripheral
87	No Peripheral
88	No Peripheral
89	No Peripheral
90	No Peripheral
91	No Peripheral
92	No Peripheral
93	No Peripheral
94	No Peripheral
95	SD1FLT1
96	SD1FLT2
97	SD1FLT3
98	SD1FLT4
99	SD2FLT1
100	SD2FLT2
101	SD2FLT3
102	SD2FLT4
103	No Peripheral
104	No Peripheral
105	No Peripheral
106	No Peripheral

**Table 4-1. Peripheral Interrupt Trigger Source Options (continued)**

Select Value (8-bit)	DMA ChTrigger Source
107	No Peripheral
108	No Peripheral
109	SPITXDMAA
110	SPIRXDMAA
111	SPITXDMAB
112	SPIRXDMAB
113	SPITXDMAC
114	SPIRXDMAC
115	No Peripheral
116	No Peripheral
117	No Peripheral
118	No Peripheral
119	No Peripheral
120	No Peripheral
121	No Peripheral
122	No Peripheral
123	No Peripheral
124	No Peripheral
125	No Peripheral
126	No Peripheral
127	No Peripheral
128	No Peripheral
129	No Peripheral
130	No Peripheral
131	USBA_EPx_RX1
132	USBA_EPx_TX1
133	USBA_EPx_RX2
134	USBA_EPx_TX2
135	USBA_EPx_RX3
136	USBA_EPx_TX3
137:255	No Peripheral

#### 4.2.4 DMA Bus

The DMA bus architecture consists of a 32-bit address bus, a 32-bit data read bus, and a 32-bit data write bus. Memories and register locations connected to the DMA bus are via interfaces that sometimes share resources with the CPU memory or peripheral bus. Arbitration rules are defined in [Section 4.4](#).

### 4.3 Pipeline Timing and Throughput

The DMA module consists of a 4-stage pipeline as shown in [Figure 4-5](#). The one exception to this is when a DMA channel is configured to have the McBSP as its data source. A read of a McBSP DRR register stalls the DMA bus for one cycle during the read portion of the transfer, as shown in [Figure 4-6](#).



Figure 4-5. 4-Stage Pipeline DMA Transfer

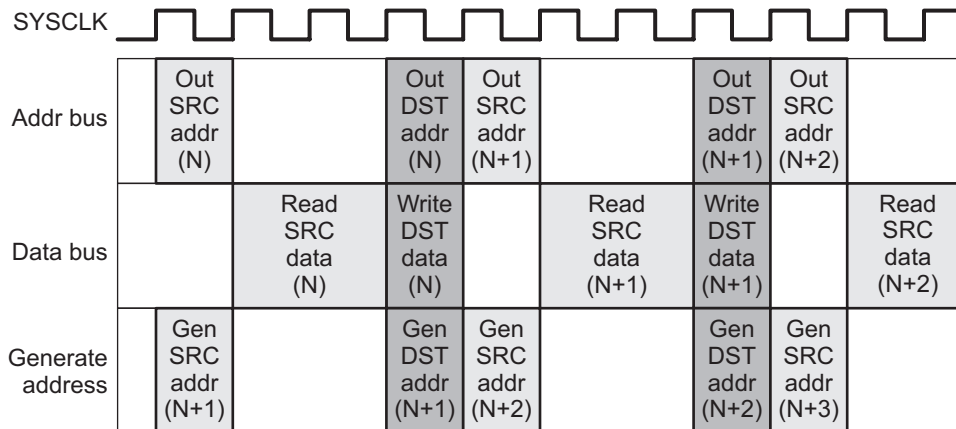
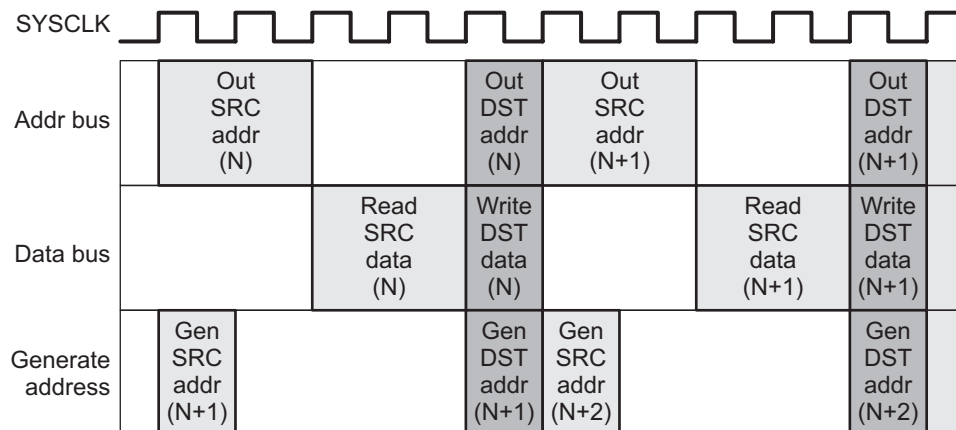


Figure 4-6. 4-Stage Pipeline With One Read Stall (McBSP as source)



In addition to the pipeline there are a few other behaviors of the DMA that affect its total throughput:

- A 1-cycle delay is added at the beginning of each burst
- A 1-cycle delay is added when returning from a CH1 high priority interrupt
- Collisions with the CPU may add delay slots (see Section 4.4)
- 32-bit transfers run at double the speed of a 16-bit transfer (it takes the same amount of time to transfer a 32-bit word as it does a 16-bit word)

For example, to transfer 128 16-bit words from GS0 RAM to GS15 RAM, a channel can be configured to transfer 8 bursts of 16 words/burst. This will give:

$$8 \text{ bursts} * [(4 \text{ cycles/word} * 16 \text{ words/burst}) + 1] = 520 \text{ cycles}$$

If instead the channel were configured to transfer the same amount of data 32 bits at a time (the word size is configured to 32 bits) the transfer would take:

$$8 \text{ bursts} * [(4 \text{ cycles/word} * 8 \text{ words/burst}) + 1] = 264 \text{ cycles}$$

#### 4.4 CPU Arbitration

Typically, DMA activity is independent of the CPU activity. When the DMA and the CPU access a peripheral register within the same peripheral frame concurrently, an arbitration procedure will occur. Any combined accesses between the different interfaces, or where the CPU access is outside of the interface that the DMA is accessing, do not create a conflict.

**Conflict Example:** the CPU is accessing SPI FIFO while the DMA is simultaneously accessing McBSP, it will create a conflict because both SPI and McBSP reside in a common interface (peripheral frame 2).

**Non-conflict Example:** the CPU is accessing shared ePWM while the DMA is accessing message McBSP, there will be no conflict, since these two peripherals are located in different interfaces (peripheral frame 1 and peripheral frame 2).

The interfaces which internally contain conflicts are:

- Global shared RAMs (GSRAMs)
- USB registers
- EMIF1 registers
- Peripheral frame 1 (ePWM, HRPWM, eCAP, eQEP, DAC, CMPSS, and SDFM)
- Peripheral frame 2 (McBSP, SPI, and uPP)

The ADC result registers are duplicated for each bus master. Therefore, the CPU, DMA, and CLA can all simultaneously read these registers with no stalls for any master.

If the CPU and the DMA make an access to the same peripheral frame in the same cycle, the DMA has priority and the CPU is stalled.

A DMA transfer consists of four phases: send source address, read source data, send destination address, and write destination data (see [Section 4.3](#)). In the case of a bulk DMA transfer to and from the same memory block the CPU is trying to access, the arbitration will stall CPU access until the DMA completes single access, not the entire bulk transfer.. This arbitration is based on a round robin priority scheme described in [Section 4.5](#).

The following priority schemes are implemented for the various interfaces on the device.

- On the peripheral register interface, the fixed priority scheme is:
  - CLA/DMA Write
  - CLA/DMA Read
  - CPU Write
  - CPU Read
- For ADC result registers (refer to the *ADC* chapter for more detailed information):
  - Parallel access is possible from all masters
- For GSxRAM (refer to the *System Control* chapter for more detailed information):
  - Round-robin

---

**NOTE:** If the CPU is performing a read-modify-write operation and the DMA performs a write to the same location, the DMA write may be lost if the operation occurs in between the CPU read and the CPU write. For this reason, it is advised not to mix such CPU accesses with DMA accesses to the same locations.

---

## 4.5 Channel Priority

Two priority schemes exist when determining channel priority: Round-robin mode and Channel 1 high-priority mode.

### 4.5.1 Round-Robin Mode

In this mode, all channels have *equal* priority and each enabled channel is serviced in round-robin fashion as follows:

CH1 → CH2 → CH3 → CH4 → CH5 → CH6 → CH1 → CH2 → ...

In the case above, after each channel has transferred a burst of words, the next channel is serviced. You can specify the size of the burst for each channel. Once CH6 (or the last enabled channel) has been serviced, and no other channels are pending, the round-robin state machine enters an idle state.

From the idle state, channel 1 (if enabled) is always serviced first. However, if the DMA is currently processing another channel *x*, all other pending channels between *x* and the end of the round are serviced before CH1. It is in this sense that all the channels are of *equal* priority. For instance, take an example where CH1, CH4, and CH5 are enabled in round-robin mode and CH4 is currently being processed. Then CH1 and CH5 both receive an interrupt trigger from their respective peripherals before CH4 completes. CH1 and CH5 are now both pending. When CH4 completes its burst, CH5 will be serviced next. Only after CH5 completes will CH1 be serviced. Upon completion of CH1, if there are no more channels pending, the round-robin state machine will enter an idle state.

A more complicated example is shown below:

- Assume all channels are enabled, and the DMA is in an idle state,
- Initially a trigger occurs on CH1, CH3, and CH5 on the same cycle,
- When the CH1 burst transfer starts, requests from CH3 and CH5 are pending,
- Before completion of the CH1 burst, the DMA receives a request from CH2. Now the pending requests are from CH2, CH3, and CH5,
- After completing the CH1 burst, CH2 will be serviced since it is next in the round-robin scheme after CH1.
- After the burst from CH2 is finished, the CH3 burst will be serviced, followed by CH5 burst.
- Now while the CH5 burst is being serviced, the DMA receives a request from CH1, CH3, and CH6.
- The burst from CH6 will start after the completion of the CH5 burst since it is the next channel after CH5 in the round-robin scheme.
- This will be followed by the CH1 burst and then the CH3 burst
- After the CH3 burst finishes, assuming no more triggers have occurred, the round-robin state machine will enter an idle state.

The round-robin state machine may be reset to the idle state via the DMACTRL[PRIORITYRESET] bit.

#### 4.5.2 Channel 1 High Priority Mode

In this mode, if a CH1 trigger occurs, the current word transfer or the current + 1 word transfer (depends on which phase of the current DMA transfer the new CH1 trigger occurred) on any other channel is completed (not the complete burst), execution is halted, and CH1 is serviced for the complete burst count. When the CH1 burst is complete, execution returns to the channel that was active when the CH1 trigger occurred. All other channels have equal priority and each enabled channel is serviced in round-robin fashion as follows:

Higher Priority:	CH1
Lower priority:	CH2 → CH3 → CH4 → CH5 → CH6 → CH2 → ...

Given an example where CH1, CH4 and CH5 are enabled in Channel 1 High Priority Mode and CH4 is currently being processed. Then CH1 and CH5 both receive an interrupt trigger from their respective peripherals before CH4 completes. CH1 and CH5 are now both pending. When the current CH4 word transfer is completed, regardless of whether the DMA has completed the entire CH4 burst, CH4 execution will be suspended and CH1 will be serviced. After the CH1 burst completes, CH4 will resume execution.

Upon completion of CH4, CH5 will be serviced. After CH5 completes, if there are no more channels pending, the round-robin state machine will enter an idle state.

Typically Channel 1 would be used in this mode for the ADC, since its data rate is so high. However, Channel 1 High Priority Mode may be used in conjunction with any peripheral.

---

**NOTE:** High-priority mode and ONESHOT mode may not be used at the same time on channel 1. Other channels may use ONESHOT mode when channel 1 is in high-priority mode.

---

## 4.6 Address Pointer and Transfer Control

The DMA state machine is, at its most basic level, two nested loops. The inner loop transfers a burst of data when a peripheral interrupt trigger is received. A burst is the smallest amount of data that can be transferred at one time and its size is defined by the BURST\_SIZE register for each channel. The BURST\_SIZE register allows a maximum of 32 sixteen-bit words to be transferred in one burst. The outer loop, whose size is set by the TRANSFER\_SIZE register for each channel, defines how many bursts are performed in the entire transfer. Since TRANSFER\_SIZE is a 16-bit register, the total size of a transfer allowed is well beyond any practical requirement. One CPU interrupt is generated, if enabled, for each transfer. This interrupt can be configured to occur at the beginning or the end of the transfer via the MODE.CHx[CHINTMODE] bit.

In the default setting of the MODE.CHx[ONESHOT] bit, the DMA transfers one burst of data each time a peripheral interrupt trigger is received. After the burst is completed, the state machine moves on to the next pending channel in the priority scheme, even if another trigger for the channel just completed is pending. This feature keeps any single channel from monopolizing the DMA bus. If a transfer of more than the maximum number of words per burst is desired for a single trigger, the MODE.CHx[ONESHOT] bit can be set to complete the entire transfer when triggered. Care is advised when using this mode, since this can create a condition where one trigger uses up the majority of the DMA bandwidth.

Each DMA channel contains a shadowed address pointer for the source and the destination address. These pointers, SRC\_ADDR and DST\_ADDR, can be independently controlled during the state machine operation. At the beginning of each transfer, the shadowed version of each pointer is copied into its respective active register. During the burst loop, after each word is transferred, the signed value contained in the appropriate source or destination BURST\_STEP register is added to the active SRC/DST\_ADDR register. During the transfer loop, after each burst is complete, there are two methods that can be used to modify the active address pointer. The first, and default, method is by adding the signed value contained in the SRC/DST\_TRANSFER\_STEP register to the appropriate pointer. The second is via a process called wrapping, where a wrap address is loaded into the active address pointer. When a wrap procedure occurs, the associated SRC/DST\_TRANSFER\_STEP register has no effect.

Address wrapping occurs when a number of bursts specified by the appropriate SRC/DST\_WRAP\_SIZE register completes. Each DMA channel contains two shadowed wrap address pointers, SRC\_BEG\_ADDR and DST\_BEG\_ADDR, allowing the source and destination wrapping to be independent of each other. Like the SRC\_ADDR and DST\_ADDR registers, the active SRC/DST\_BEG\_ADDR registers are loaded from their shadow counterpart at the beginning of a transfer. When the specified number of bursts has occurred, a two part wrap procedure takes place:

- The appropriate active SRC/DST\_BEG\_ADDR register is incremented by the signed value contained in the SRC/DST\_WRAP\_STEP register, then
- The new active SRC/DST\_BEG\_ADDR register is loaded into the active SRC/DST\_ADDR register.

Additionally the wrap counter (SRC/DST\_WRAP\_COUNT) register is reloaded with the SRC/DST\_WRAP\_SIZE value to setup the next wrap period. This allows the channel to wrap multiple times within a single transfer. Combined with the first bullet above, this allows the channel to address multiple buffers within a single transfer.

The DMA contains both an active and shadow set of the following address pointers. When a DMA transfer begins, the shadow register set is copied to the active working set of registers. This allows you to program the values of the shadow registers for the next transfer while the DMA works with the active set. It also allows you to implement Ping-Pong buffer schemes without disrupting the DMA channel execution.

**Source/Destination Address Pointers (SRC/DST\_ADDR)**— The value written into the shadow register is the start address of the first location where data is read or written to.

At the beginning of a transfer the shadow register is copied into the active register. The active register performs as the current address pointer.

**Source/Destination Begin Address Pointers (SRC/DST\_BEG\_ADDR)**— This is the wrap pointer.

The value written into the shadow register will be loaded into the active register at the start of a transfer. On a wrap condition, the active register will be incremented by the signed value in the appropriate SRC/DST\_WRAP\_STEP register prior to being loaded into the active SRC/DST\_ADDR register.

For each channel, the transfer process can be controlled with the following size values:

**Source and Destination Burst Size (BURST\_SIZE):** — This specifies the number of words to be transferred in a burst.

This value is loaded into the BURST\_COUNT register at the beginning of each burst. The BURST\_COUNT decrements each word that is transferred and when it reaches a zero value, the burst is complete, indicating that the next channel can be serviced. The behavior of the current channel is defined by the ONE\_SHOT bit in the MODE register. The maximum size of the burst is dictated by the type of peripheral. For the ADC, the burst size could be all 16 registers (if all 16 registers are used). For a McBSP peripheral, the burst size is limited to 1 since there is no FIFO and the receive or transmit data register must be loaded or copied every word transferred. For RAM the burst size can be up to the maximum allowed by the BURST\_SIZE register, which is 32.

**Source and Destination Transfer Size (TRANSFER\_SIZE):** — This specifies the number of bursts to be transferred before per CPU interrupt (if enabled).

Whether this interrupt is generated at the beginning or the end of the transfer is defined in the CHINTMODE bit in the MODE register. Whether the channel remains enabled or not after the transfer is completed is defined by the CONTINUOUS bit in the MODE register. The TRANSFER\_SIZE register is loaded into the TRANSFER\_COUNT register at the beginning of each transfer. The TRANSFER\_COUNT register keeps track of how many bursts of data the channel has transferred and when it reaches zero, the DMA transfer is complete.

**Source/Destination Wrap Size (SRC/DST\_WRAP\_SIZE)**— This specifies the number of bursts to be transferred before the current address pointer wraps around to the beginning.

This feature is used to implement a circular addressing type function. This value is loaded into the appropriate SRC/DST\_WRAP\_COUNT register at the beginning of each transfer. The SRC/DST\_WRAP\_COUNT registers keep track of how many bursts of data the channel has transferred and when they reaches zero, the wrap procedure is performed on the appropriate source or destination address pointer. A separate size and count register is allocated for source and destination pointers. To *disable* the wrap function, assign the value of these registers to be larger than the TRANSFER\_SIZE.

---

**NOTE:** The value written to the SIZE registers is one less than the intended size. So, to transfer three 16-bit words, the value 2 should be placed in the SIZE register.

Regardless of the state of the DATASIZE bit, the value specified in the SIZE registers are for 16-bit addresses. So, to transfer three 32-bit words, the value 5 should be placed in the SIZE register.

---

For each source/destination pointer, the address changes can be controlled with the following step values:

**Source/Destination Burst Step (SRC/DST\_BURST\_STEP)**— Within each burst transfer, the address source and destination step sizes are specified by these registers.

This value is a signed 2's compliment number so that the address pointer can be incremented or decremented as required. If no increment is desired, such as when accessing the McBSP data receive or transmit registers, the value of these registers should be set to zero.

**Source/Destination Transfer Step (SRC/DST\_TRANSFER\_STEP)**— This specifies the address offset to start the next burst transfer after completing the current burst transfer.

This is used in cases where registers or data memory locations are spaced at constant intervals. This value is a signed 2's compliment number so that the address pointer can be incremented or decremented as required.

**Source/Destination Wrap Step (SRC/DST\_WRAP\_STEP):** — When the wrap counter reaches zero, this value specifies the number of words to add/subtract from the BEG\_ADDR pointer and hence sets the new start address.

This implements a circular type of addressing mode, useful in many applications. This value is a signed 2's compliment number so that the address pointer can be incremented or decremented as required.

---

**NOTE:** Regardless of the state of the DATASIZE bit, the value specified in the STEP registers are for 16-bit addresses. So, to increment one 32-bit address, a value of 2 should be placed in these registers.

---

Three modes are provided to control the way the state machine behaves during the burst loop and the transfer loop:

**One Shot Mode (ONESHOT)**— If one shot mode is enabled when an interrupt event trigger occurs, the DMA will continue transferring data in bursts until TRANSFER\_COUNT is zero. If one shot mode is disabled, then an interrupt event trigger is required for each burst transfer and this will continue until TRANSFER\_COUNT is zero.

---

**NOTE:** When ONESHOT mode is enabled, the DMA will continuously transfer bursts of data on the given channel until the TRANSFER\_COUNT value is zero. This could potentially hog the bandwidth of a peripheral and cause long CPU stalls to occur. To avoid this, you could configure a CPU timer (or similar) and disable ONESHOT so as to avoid this situation. High-priority mode and one-shot mode may not be used at the same time on channel 1. Other channels may use ONESHOT mode when channel 1 is in high-priority mode

---

**Continuous Mode (CONTINUOUS)**— If continuous mode is disabled the RUNSTS bit in the CONTROL register is cleared at the end of the transfer, disabling the DMA channel.

The channel must be re-enabled by setting the RUN bit in the CONTROL register before another transfer can be started on that channel. If the continuous mode is enabled the RUNSTS bit is not cleared at the end of the transfer.

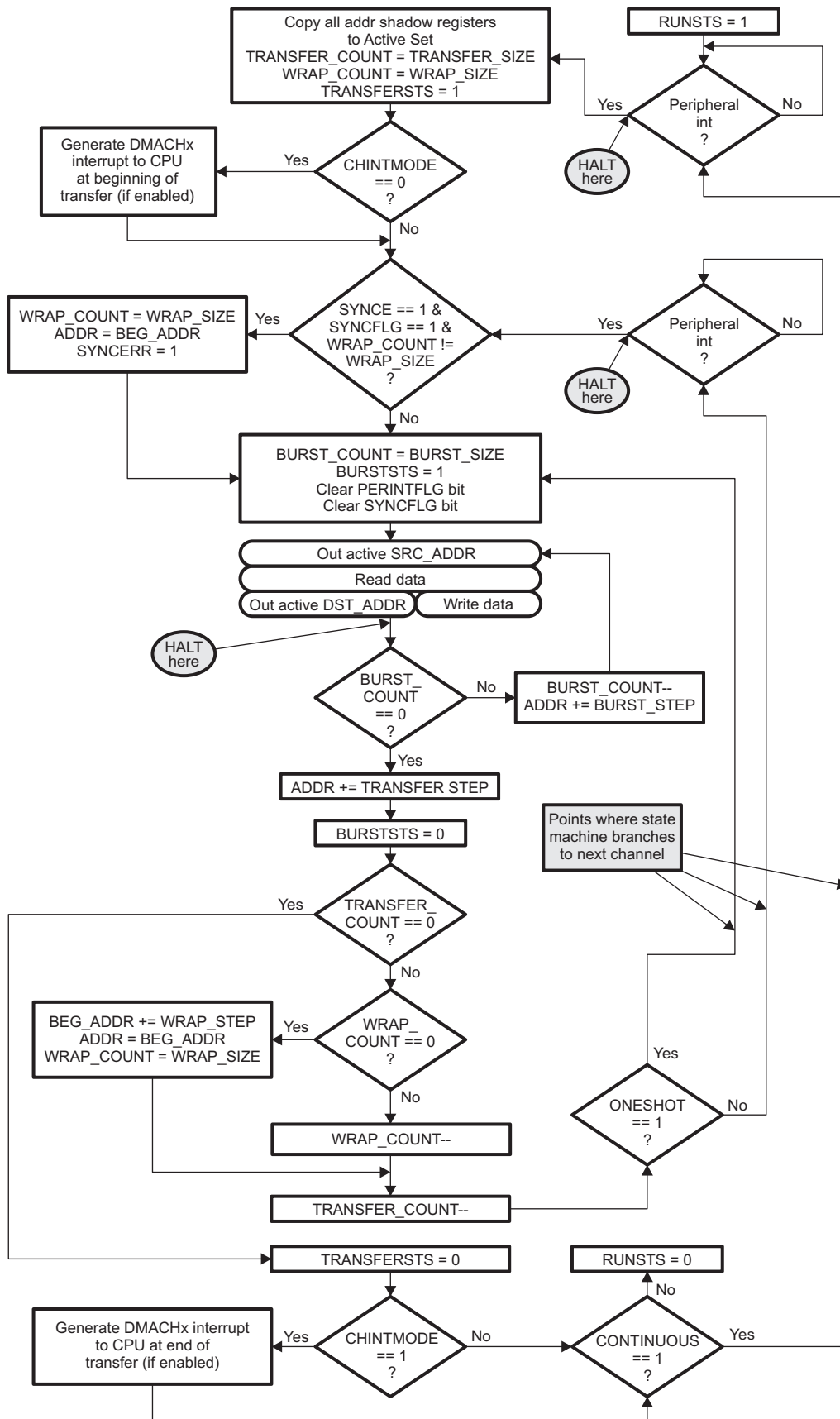
**Channel Interrupt Mode (CHINTMODE)**— This mode bit selects whether the DMA interrupt from the respective channel is generated at the beginning of a new transfer or at the end of the transfer.

If implementing a ping-pong buffer scheme with continuous mode of operation, then the interrupt would be generated at the beginning, just after the working registers are copied to the shadow set. If the DMA does not operate in continuous mode, then the interrupt is typically generated at the end when the transfer is complete.

All of the above features and modes are shown in [Figure 4-7](#).



Figure 4-7. DMA State Diagram



The following items are in reference to [Figure 4-7](#).

- The *HALT* points represent where the channel halts operation when interrupted by a high priority channel 1 trigger, or when the HALT command is set, or when an emulation halt is issued and the FREE bit is cleared to 0.
- The ADDR registers are not affected by BEG\_ADDR at the start of a transfer. BEG\_ADDR only affects the ADDR registers on a wrap or sync error. Following is what happens to each of the ADDR registers when a transfer first starts:
  - BEG\_ADDR\_SHADOW remains unchanged.
  - ADDR\_SHADOW remains unchanged.
  - BEG\_ADDR = BEG\_ADDR\_SHADOW
  - ADDR = ADDR\_SHADOW
- The active registers get updated when a wrap occurs. The shadow registers remain unchanged. Specifically:
  - BEG\_ADDR\_SHADOW remains unchanged.
  - ADDR\_SHADOW remains unchanged.
  - BEG\_ADDR += WRAP\_STEP
  - ADDR = BEG\_ADDR
- The active registers get updated when a sync error occurs. The shadow registers remain unchanged. Specifically:
  - BEG\_ADDR\_SHADOW remains unchanged.
  - ADDR\_SHADOW remains unchanged.
  - BEG\_ADDR remains unchanged.
  - ADDR = BEG\_ADDR

Probably the easiest way to remember all this is that:

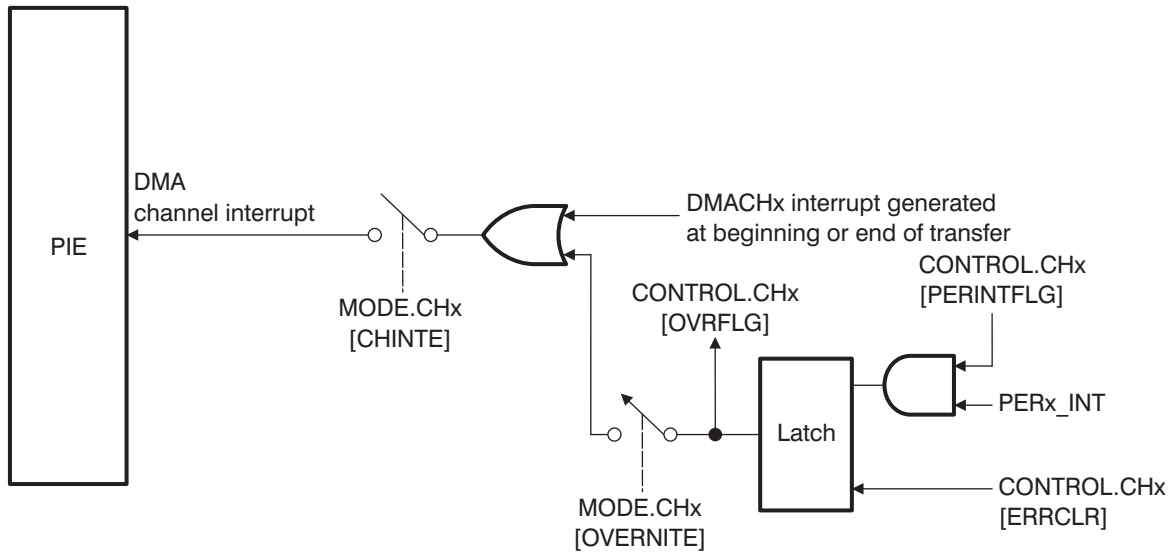
- The shadow registers never change except by software.
- The active registers never change except by hardware, and a shadow register is only copied into its own active register, never an active register by another name.

## 4.7 Overrun Detection Feature

The DMA contains overrun detection logic. When a peripheral event trigger is received by the DMA, the PERINTFLG bit in the CONTROL register is set, pending the channel to the DMA state machine. When the burst for that channel is started, the PERINTFLG is cleared. If however, between the time that the PERINTFLG bit is set by an event trigger and cleared by the start of the burst, an additional event trigger arrives, the second trigger will be lost. This condition will set the OVRFLG bit in the CONTROL register as in [Figure 4-8](#). If the overrun interrupt is enabled then the channel interrupt will be generated to the PIE module.



Figure 4-8. Overrun Detection Logic



## 4.8 Register Descriptions

The complete DMA register set is shown in [Table 4-2](#).

**Table 4-2. DMA Register Summary<sup>(1)</sup>**

Address	Acronym	Description	Section
<b>DMA Control, Mode and Status Registers</b>			
0x1000	DMACTRL	DMA Control Register	<a href="#">Section 4.8.1</a>
0x1001	DEBUGCTRL	Debug Control Register	<a href="#">Section 4.8.2</a>
0x1002	REVISION	Peripheral Revision Register	<a href="#">Section 4.8.3</a>
0x1003	Reserved	Reserved	
0x1004	PRIORITYCTRL1	Priority Control Register 1	<a href="#">Section 4.8.4</a>
0x1005	Reserved	Reserved	
0x1006	PRIORITYSTAT	Priority Status Register	<a href="#">Table 4-7</a>
0x1007 0x101F	Reserved	Reserved	
<b>DMA Channel 1 Registers</b>			
0x1020	MODE	Mode Register	<a href="#">Section 4.8.6</a>
0x1021	CONTROL	Control Register	<a href="#">Section 4.8.7</a>
0x1022	BURST_SIZE	Burst Size Register	<a href="#">Section 4.8.8</a>
0x1023	BURST_COUNT	Burst Count Register	<a href="#">Section 4.8.9</a>
0x1024	SRC_BURST_STEP	Source Burst Step Size Register	<a href="#">Section 4.8.10</a>
0x1025	DST_BURST_STEP	Destination Burst Step Size Register	<a href="#">Section 4.8.11</a>
0x1026	TRANSFER_SIZE	Transfer Size Register	<a href="#">Table 4-13</a>
0x1027	TRANSFER_COUNT	Transfer Count Register	<a href="#">Section 4.8.13</a>
0x1028	SRC_TRANSFER_STEP	Source Transfer Step Size Register	<a href="#">Section 4.8.14</a>
0x1029	DST_TRANSFER_STEP	Destination Transfer Step Size Register	<a href="#">Section 4.8.15</a>
0x102A	SRC_WRAP_SIZE	Source Wrap Size Register	<a href="#">Section 4.8.16</a>
0x102B	SRC_WRAP_COUNT	Source Wrap Count Register	<a href="#">Section 4.8.17</a>
0x102C	SRC_WRAP_STEP	Source Wrap Step Size Register	<a href="#">Section 4.8.18</a>
0x102D	DST_WRAP_SIZE	Destination Wrap Size Register	<a href="#">Section 4.8.16</a>
0x102E	DST_WRAP_COUNT	Destination Wrap Count Register	<a href="#">Section 4.8.17</a>
0x102F	DST_WRAP_STEP	Destination Wrap Step Size Register	<a href="#">Section 4.8.18</a>
0x1030	SRC_BEG_ADDR_SHADOW	Shadow Source Begin and Current Address Pointer Registers	<a href="#">Section 4.8.19</a>
0x1032	SRC_ADDR_SHADOW		<a href="#">Section 4.8.19</a>
0x1034	SRC_BEG_ADDR	Active Source Begin and Current Address Pointer Registers	<a href="#">Section 4.8.20</a>
0x1036	SRC_ADDR		<a href="#">Section 4.8.20</a>
0x1038	DST_BEG_ADDR_SHADOW	Shadow Destination Begin and Current Address Pointer Registers	<a href="#">Section 4.8.21</a>
0x103A	DST_ADDR_SHADOW		<a href="#">Section 4.8.21</a>
0x103C	DST_BEG_ADDR	Active Destination Begin and Current Address Pointer Registers	<a href="#">Section 4.8.22</a>
0x103E	DST_ADDR		<a href="#">Section 4.8.22</a>
0x103F	Reserved	Reserved	
<b>DMA Channel 2 Registers</b>			
0x1040 0x105F	Same as above		
<b>DMA Channel 3 Registers</b>			
0x1060 0x107F	Same as above		
<b>DMA Channel 4 Registers</b>			

<sup>(1)</sup> All DMA register writes are EALLOW protected.

**Table 4-2. DMA Register Summary<sup>(1)</sup> (continued)**

Address	Acronym	Description	Section
0x1080 0x109F	Same as above		
<b>DMA Channel 5 Registers</b>			
0x10A0 0x10BF	Same as above		
<b>DMA Channel 6 Registers</b>			
0x10C0 0x10DF	Same as above		

#### 4.8.1 DMA Control Register (DMACTRL) — EALLOW Protected

The DMA control register (DMACTRL) is shown in [Figure 4-9](#) and described in [Table 4-3](#).

**Figure 4-9. DMA Control Register (DMACTRL)**

15	14	13	12	11	10	9	8
Reserved							
R-0							
7	6	5	4	3	2	1	0
			Reserved			PRIORITY RESET	HARD RESET
R-0						R0/S-0	R0/S-0

LEGEND: R0/S = Read 0/Set; R = Read only; -n = value after reset

**Table 4-3. DMA Control Register (DMACTRL) Field Descriptions**

Bit	Field	Value	Description
15-2	Reserved		Reserved
1	PRIORITYRESET	0	<p>The priority reset bit resets the round-robin state machine when a 1 is written. Service starts from the first enabled channel. Writes of 0 are ignored and this bit always reads back a 0.</p> <p>When a 1 is written to this bit, any pending burst transfer completes before resetting the channel priority machine. If CH1 is configured as a high priority channel, and this bit is written to while CH1 is servicing a burst, the CH1 burst is completed and then any lower priority channel burst is also completed (if CH1 interrupted in the middle of a burst), before the state machine is reset.</p> <p>In case CH1 is high priority, the <i>state machine</i> restarts from CH2 (or the next highest enabled channel).</p>
0	HARDRESET	0	<p>Writing a 1 to the hard reset bit resets the whole DMA and aborts any current access (similar to applying a device reset). Writes of 0 are ignored and this bit always reads back a 0.</p> <p>For a <i>soft</i> reset, a bit is provided for each channel to perform a gentler reset. Refer to the channel control registers.</p> <p>When writing to this bit, there is a one cycle delay before it takes effect. Hence at least a one cycle delay (that is, a NOP instruction) after writing to this bit should be introduced before attempting an access to any other DMA register.</p>

### 4.8.2 Debug Control Register (DEBUGCTRL) — EALLOW Protected

The debug control register (DEBUGCTRL) is shown in [Figure 4-10](#) and described in [Table 4-4](#).

**Figure 4-10. Debug Control Register (DEBUGCTRL)**

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
FREE	Reserved														
R/W-0															
R-0															

LEGEND: R/W = Read/Write; R = Read only; -n = value after reset

**Table 4-4. Debug Control Register (DEBUGCTRL) Field Descriptions**

Bit	Field	Value	Description
15	FREE	0	Emulation Control Bit: This bit specifies the action when an emulation halt event occurs.
		1	DMA runs until the current DMA read-write access is completed and the current status of a DMA is frozen. See the <i>HALT</i> points in <a href="#">Figure 4-7</a> for possible halt states.
			DMA is unaffected by emulation suspend (run free)
14-0	Reserved		Reserved

### 4.8.3 Revision Register (REVISION)

The revision register (REVISION) is shown in [Figure 4-11](#) and described in [Table 4-5](#).

**Figure 4-11. Revision Register (REVISION)**

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
TYPE								REV							
R								R							

LEGEND: R/W = Read/Write; R = Read only; -n = value after reset

**Table 4-5. Revision Register (REVISION) Field Descriptions**

Bit	Field	Value	Description
15-8	TYPE	0x0000	DMA Type Bits. A type change represents a major functional feature difference in a peripheral module. Within a peripheral type, there may be minor differences between devices which do not affect the basic functionality of the module. These device-specific differences are listed in the <i>TMS320x28xx, 28xxx DSP Peripheral Reference Guide (SPRU566)</i> . This document describes a Type0 DMA.
7-0	REV	0x0000	DMA Silicon Revision Bits: These bits specify the DMA revision and are changed if any bug fixes are performed. First release

#### 4.8.4 Priority Control Register 1 (PRIORITYCTRL1) — EALLOW Protected

The priority control register 1 (PRIORITYCTRL1) is shown in [Figure 4-12](#) and described in [Table 4-6](#).

**Figure 4-12. Priority Control Register 1 (PRIORITYCTRL1)**

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Reserved														CH1 PRIOR ITY	
R-0														R/W-0	

LEGEND: R/W = Read/Write; R = Read only; -n = value after reset

**Table 4-6. Priority Control Register 1 (PRIORITYCTRL1) Field Descriptions**

Bit	Field	Value	Description
15-1	Reserved		Reserved
0	CH1PRIORITY	0 1	DMA Ch1 Priority: This bit selects whether channel 1 has higher priority or not: Same priority as all other channels Highest priority channel Channel priority can only be changed when all channels are disabled. A priority reset should be performed before restarting channels after changing priority.

### 4.8.5 Priority Status Register (PRIORITYSTAT)

The priority status register (PRIORITYSTAT) is shown in [Figure 4-13](#) and described in [Table 4-7](#).

**Figure 4-13. Priority Status Register (PRIORITYSTAT)**

15	14	13	12	11	10	9	8
Reserved							
R-0							
7	6	5	4	3	2	1	0
Reserved	ACTIVESTS_SHADOW			Reserved	ACTIVESTS		
R-0	R-0			R-0	R-0		

LEGEND: R/W = Read/Write; R = Read only; -n = value after reset

**Table 4-7. Priority Status Register (PRIORITYSTAT) Field Descriptions**

Bit	Field	Value	Description
15-7	Reserved		Reserved
6-4	ACTIVESTS_SHADOW	0,0,0 0,0,1 0,1,0 0,1,1 1,0,0 1,0,1 1,1,0	Active Channel Status Shadow Bits: These bits are only useful when CH1 is enabled as a higher priority channel. When CH1 is serviced, the ACTIVESTS bits are copied to the shadow bits and indicate which channel was interrupted by CH1. When CH1 service is completed, the shadow bits are copied back to the ACTIVESTS bits. If this bit field is zero or the same as the ACTIVESTS bit field, then no channel is pending due to a CH1 interrupt. When CH1 is not a higher priority channel, these bits should be ignored:  No channel pending CH 1 CH 2 CH 3 CH 4 CH 5 CH 6
3	Reserved		Reserved
2-0	ACTIVESTS	0,0,0 0,0,1 0,1,0 0,1,1 1,0,0 1,0,1 1,1,0	Active Channel Status Bits: These bits indicate which channel is currently active or performing a transfer:  no channel active CH 1 CH 2 CH 3 CH 4 CH 5 CH 6

#### 4.8.6 Mode Register (MODE) — EALLOW Protected

The mode register (MODE) is shown in [Figure 4-14](#) and described in [Table 4-8](#).

**Figure 4-14. Mode Register (MODE)**

15		14		13		12		11		10		9		8	
CHINTE		DATASIZE		Reserved		CONTINUOUS		ONESHOT		CHINTMODE		PERINTE			
R/W-0		R/W-0		R/W-0		R/W-0		R/W-0		R/W-0		R/W-0		R/W-0	
7		6		5		4		3		2		1		0	
OVRINTE		Reserved								PERINTSEL					
R/W-0		R-0								R/W-0					

LEGEND: R/W = Read/Write; R = Read only; -n = value after reset

**Table 4-8. Mode Register (MODE) Field Descriptions**

Bit	Field	Value	Description
15	CHINTE	0 1	Channel Interrupt Enable Bit: This bit enables/disables the respective DMA channel interrupt to the CPU (via the PIE). Interrupt disabled Interrupt enabled
14	DATASIZE	0 1	Data Size Mode Bit: This bit selects if the DMA channel transfers 16-bits or 32-bits of data at a time. 16-bit data transfer size 32-bit data transfer size  <b>NOTE:</b> Regardless of the value of this bit all of the registers in the DMA refer to 16-bit words. The only effect this bit causes is whether the databus width is 16 or 32 bits.  It is up to you to configure the pointer step increment and size to accommodate 32-bit data transfers. See section <a href="#">Section 4.6</a> for details.
13-12	Reserved		Reserved
11	CONTINUOUS		Continuous Mode Bit: If this bit is set to 1, then DMA re-initializes when TRANSFER_COUNT is zero and waits for the next interrupt event trigger. If this bit is 0, then the DMA stops and clears the RUNSTS bit to 0.
10	ONESHOT		One Shot Mode Bit: If this bit is set to 1, then subsequent burst transfers occur without additional event triggers after the first event trigger. If this bit is 0 then only one burst transfer is performed per event trigger. <b>Note:</b> High-priority mode and One-shot mode may not be used at the same time on CH1.
9	CHINTMODE	0 1	Channel Interrupt Generation Mode Bit: This bit specifies when the respective DMA channel interrupt should be generated to the CPU (via the PIE). Generate interrupt at beginning of new transfer Generate interrupt at end of transfer.
8	PERINTE	0 1	Peripheral Interrupt Trigger Enable Bit: This bit enables/disables the selected peripheral interrupt trigger to the DMA. Interrupt trigger disabled. Neither the selected peripheral nor software can start a DMA burst. Interrupt trigger enabled.
7	OVRINTE	0 1	Overflow Interrupt Enable: This bit when set to 1 enables the DMA to generate an interrupt when an overflow event is detected. Overflow interrupt disabled Overflow interrupt enabled  An overflow interrupt is generated when the PERINTFLG is set and another interrupt event occurs. The PERINTFLG being set indicates a previous peripheral event is latched and has not been serviced by the DMA.
6-5	Reserved		Reserved

**Table 4-8. Mode Register (MODE) Field Descriptions (continued)**

Bit	Field	Value	Description
4-0	PERINTSEL		The Peripheral Interrupt Source Select Bits: These bits should be set to the channel number (i.e. CH2.MODE.PERINTSEL[4:0] = 2).



#### 4.8.7 Control Register (CONTROL) — EALLOW Protected

The control register (CONTROL) is shown in [Figure 4-15](#) and described in [Table 4-9](#).

**Figure 4-15. Control Register (CONTROL)**

15	14	13	12	11	10	9	8
Reserved	OVRFLG	RUNSTS	BURSTSTS	TRANSFERSTS	Reserved		PERINTFLG
R-0	R-0	R-0	R-0	R-0	R-0		R-0
7	6	5	4	3	2	1	0
ERRCLR	Reserved		PERINTCLR	PERINTFRC	SOFTRESET	HALT	RUN
R0/S-0	R-0		R0/S-0	R0/S-0	R0/S-0	R0/S-0	R0/S-0

LEGEND: R0/S = Read 0/Set; R = Read only; -n = value after reset

**Table 4-9. Control Register (CONTROL) Field Descriptions**

Bit	Field	Value	Description
15	Reserved		Reserved
14	OVRFLG	0 1	<p>Overflow Flag Bit: This bit indicates if a peripheral interrupt event trigger is received from the selected peripheral and the PERINTFLG is already set.</p> <p>0 No overflow event 1 Overflow event</p> <p>The ERRCLR bit can be used to clear the state of this bit to 0. The OVRFLG bit is not affected by the PERINTFRC event.</p>
13	RUNSTS	0 1	<p>Run Status Bit: This bit is set to 1 when the RUN bit is written to with a 1. This indicates the DMA channel is now ready to process peripheral interrupt event triggers. This bit is cleared to 0 when TRANSFER_COUNT reaches zero and CONTINUOUS mode bit is set to 0. This bit is also cleared to 0 when either the HARDRESET bit, the SOFTRESET bit, or the HALT bit is activated.</p> <p>0 Channel is disabled. 1 Channel is enabled.</p>
12	BURSTSTS	0 1	<p>Burst Status Bit: This bit is set to 1 when a DMA burst transfer begins and the BURST_COUNT is initialized with the BURST_SIZE. This bit is cleared to zero when BURST_COUNT reaches zero. This bit is also cleared to 0 when either the HARDRESET or the SOFTRESET bit is activated.</p> <p>0 No burst activity 1 The DMA is currently servicing or suspending a burst transfer from this channel.</p>
11	TRANSFERSTS	0 1	<p>Transfer Status Bit: This bit is set to 1 when a DMA transfer begins and the address registers are copied to the shadow set and the TRANSFER_COUNT is initialized with the TRANSFER_SIZE. This bit is cleared to zero when TRANSFER_COUNT reaches zero. This bit is also cleared to 0 when either the HARDRESET or the SOFTRESET bit is activated.</p> <p>0 No transfer activity 1 The channel is currently in the middle of a transfer regardless of whether a burst of data is actively being transferred or not.</p>
10-9	Reserved		Reserved
8	PERINTFLG	0 1	<p>Peripheral Interrupt Trigger Flag Bit: This bit indicates if a peripheral interrupt event trigger has occurred. This flag is automatically cleared when the first burst transfer begins.</p> <p>0 No interrupt event trigger 1 Interrupt event trigger</p> <p>The PERINTFRC bit can be used to set the state of this bit to 1 and force a software DMA event. The PERINTCLR bit can be used to clear the state of this bit to 0.</p>
7	ERRCLR	0	<p>Error Clear Bit: Writing a 1 to this bit will clear any latched sync error event and clear the SYNCERR bit. This bit will also clear the OVRFLG bit. This bit would normally be used when initializing the DMA for the first time or if an overflow condition is detected. If an ADCSYNC error event or overflow event occurs at the same time as writing to this bit, the ADC or overrun has priority and the SYNCERR or OVRFLG bit is set.</p>
6-5	Reserved		Reserved

**Table 4-9. Control Register (CONTROL) Field Descriptions (continued)**

Bit	Field	Value	Description
4	PERINTCLR	0	Peripheral Interrupt Clear Bit: Writing a 1 to this bit clears any latched peripheral interrupt event and clears the PERINTFLG bit. This bit would normally be used when initializing the DMA for the first time. If a peripheral event occurs at the same time as writing to this bit, the peripheral has priority and the PERINTFLG bit is set.
3	PERINTFRC	0	Peripheral Interrupt Force Bit: Writing a 1 to this bit latches a peripheral interrupt event trigger and sets the PERINTFLG bit. If the PERINTE bit is set, this bit can be used like a software force for a DMA burst transfer.
2	SOFTRESET	0	Channel Soft Reset Bit: Writing a 1 to this bit completes current read-write access and places the channel into a default state as follows: RUNSTS = 0 TRANSFERSTS = 0 BURSTSTS = 0 BURST_COUNT = 0 TRANSFER_COUNT = 0 SRC_WRAP_COUNT = 0 DST_WRAP_COUNT = 0  This is a <i>soft</i> reset that basically allows the DMA to complete the current read-write access and then places the DMA channel into the default reset state.
1	HALT	0	Channel Halt Bit: Writing a 1 to this bit halts the DMA at the current state and any current read-write access is completed. See <a href="#">Figure 4-7</a> for the various positions the state machine can be at when HALTED. The RUNSTS bit is set to 0. To take the device out of HALT, the RUN bit needs to be activated.
0	RUN	0	Channel Run Bit: Writing a 1 to this bit starts the DMA channel. The RUNSTS bit is set to 1. This bit is also used to take the device out of HALT.  The RUN bit is typically used to start the DMA running after you have configured the DMA. It will then wait for the first interrupt event (PERINTFLG == 1) to start operation. The RUN bit can also be used to take the DMA channel out of a HALT condition. See <a href="#">Figure 4-7</a> for the various positions the state machine can be at when HALTED.

#### 4.8.8 Burst Size Register (BURST\_SIZE) — EALLOW Protected

The burst size register (BURST\_SIZE) is shown in [Figure 4-16](#) and described in [Table 4-10](#).

**Figure 4-16. Burst Size Register (BURST\_SIZE)**

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Reserved										BURSTSIZE					
R-0										R/W-0					

LEGEND: R/W = Read/Write; R = Read only; -n = value after reset

**Table 4-10. Burst Size Register (BURST\_SIZE) Field Descriptions**

Bit	Field	Value	Description
15-5	Reserved		Reserved
4-0	BURSTSIZE	0	Transfer 1 word in a burst
		1	Transfer 2 words in a burst
		...	...
		31	Transfer 32 words in a burst

#### 4.8.9 BURST\_COUNT Register

The burst count register (BURST\_COUNT) is shown in [Figure 4-17](#) and described in [Table 4-11](#).

**Figure 4-17. Burst Size Register (BURST\_COUNT)**

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Reserved										BURSTCOUNT					
R-0										R/W-0					

LEGEND: R/W = Read/Write; R = Read only; -n = value after reset

**Table 4-11. Burst Count Register (BURST\_COUNT) Field Descriptions**

Bit	Field	Value	Description
15-5	Reserved		Reserved
4-0	BURSTCOUNT	0	0 word left in a burst
		1	1 word left in a burst
		2	2 words left in a burst
		...	...
		31	31 words left in a burst
			The above values represent the state of the counter at the HALT conditions.

#### 4.8.10 Source Burst Step Register Size (SRC\_BURST\_STEP) — EALLOW Protected

The source burst step size register (SRC\_BURST\_STEP) is shown in [Figure 4-18](#) and described in [Table 4-12](#).

**Figure 4-18. Source Burst Step Size Register (SRC\_BURST\_STEP)**

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
SRCBURSTSTEP															
R/W-0															

LEGEND: R/W = Read/Write; R = Read only; -n = value after reset

**Table 4-12. Source Burst Step Size Register (SRC\_BURST\_STEP) Field Descriptions**

Bit	Field	Value	Description
15-0	SRCBURSTSTEP		These bits specify the source address post-increment/decrement step size while processing a burst of data:
		0x0FFF	Add 4095 to address
		...	...
		0x0002	Add 2 to address
		0x0001	Add 1 to address
		0x0000	No address change
		0xFFFF	Sub 1 from address
		0xFFFFE	Sub 2 from address
		...	...
		0xF000	Sub 4096 from address
			Only values from -4096 to 4095 are valid.

#### 4.8.11 Destination Burst Step Register Size (DST\_BURST\_STEP) — EALLOW Protected

The destination burst step register size (DST\_BURST\_STEP) is shown in [Figure 4-19](#) and described in [Table 4-13](#).

**Figure 4-19. Destination Burst Step Register Size (DST\_BURST\_STEP)**

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
DSTBURSTSTEP															
R/W-0															

LEGEND: R/W = Read/Write; R = Read only; -n = value after reset

**Table 4-13. Destination Burst Step Register Size (DST\_BURST\_STEP) Field Descriptions**

Bit	Field	Value	Description
15-0	DSTBURSTSTEP		These bits specify the destination address post-increment/decrement step size while processing a burst of data:
		0x0FFF	Add 4095 to address
		...	...
		0x0002	Add 2 to address
		0x0001	Add 1 to address
		0x0000	No address change
		0xFFFF	Sub 1 from address
		0xFFFFE	Sub 2 from address
		...	...
		0xF000	Sub 4096 from address
			Only values from -4096 to 4095 are valid.

#### 4.8.12 Transfer Size Register (TRANSFER\_SIZE) — EALLOW Protected

The transfer size register (TRANSFER\_SIZE) is shown in [Figure 4-20](#) and described in [Table 4-14](#).

**Figure 4-20. Transfer Size Register (TRANSFER\_SIZE)**

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
TRANSFERSIZE															
R/W-0															

LEGEND: R/W = Read/Write; R = Read only; -n = value after reset

**Table 4-14. Transfer Size Register (TRANSFER\_SIZE) Field Descriptions**

Bit	Field	Value	Description
15-0	TRANSFERSIZE		These bits specify the number of bursts to transfer:
		0x0000	Transfer 1 burst
		0x0001	Transfer 2 bursts
		0x0002	Transfer 3 bursts
		...	...
		0xFFFF	Transfer 65536 bursts

#### 4.8.13 Transfer Count Register (TRANSFER\_COUNT)

The transfer count register (TRANSFER\_COUNT) is shown in [Figure 4-21](#) and described in [Table 4-15](#).

**Figure 4-21. Transfer Count Register (TRANSFER\_COUNT)**

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
TRANSFERCOUNT															
R/W-0															

LEGEND: R/W = Read/Write; R = Read only; -n = value after reset

**Table 4-15. Transfer Count Register (TRANSFER\_COUNT) Field Descriptions**

Bit	Field	Value	Description
15-0	TRANSFERCOUNT		These bits specify the current transfer counter value:
		0x0000	0 bursts left to transfer
		0x0001	1 burst left to transfer
		0x0002	2 bursts left to transfer
		...	...
		0xFFFF	65535 bursts left to transfer
			The above values represent the state of the counter at the HALT conditions.

#### 4.8.14 Source Transfer Step Size Register (SRC\_TRANSFER\_STEP) — EALLOW Protected

The source transfer step size register (SRC\_TRANSFER\_STEP) is shown in [Figure 4-22](#) and described in [Table 4-16](#).

**Figure 4-22. Source Transfer Step Size Register (SRC\_TRANSFER\_STEP)**

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
SRCTRANSFERSTEP															
R/W-0															

LEGEND: R/W = Read/Write; R = Read only; -n = value after reset

**Table 4-16. Source Transfer Step Size Register (SRC\_TRANSFER\_STEP) Field Descriptions**

Bit	Field	Value	Description
15-0	SRCTRANSFERSTEP		These bits specify the source address pointer post-increment/decrement step size after processing a burst of data:
		0x0FFF	Add 4095 to address
		...	...
		0x0002	Add 2 to address
		0x0001	Add 1 to address
		0x0000	No address change
		0xFFFF	Sub 1 from address
		0xFFFE	Sub 2 from address
		...	...
		0xF000	Sub 4096 from address
			Only values from -4096 to 4095 are valid.

#### 4.8.15 Destination Transfer Step Size Register (DST\_TRANSFER\_STEP) — EALLOW Protected

The destination transfer step size register (DST\_TRANSFER\_STEP) is shown in [Figure 4-23](#) and described in [Table 4-17](#).

**Figure 4-23. Destination Transfer Step Size Register (DST\_TRANSFER\_STEP)**

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
DSTTRANSFERSTEP															
R/W-0															

LEGEND: R/W = Read/Write; R = Read only; -n = value after reset

**Table 4-17. Destination Transfer Step Size Register (DST\_TRANSFER\_STEP) Field Descriptions**

Bit	Field	Value	Description
15-0	DSTTRANSFERSTEP		These bits specify the destination address pointer post-increment/decrement step size after processing a burst of data:
		0x0FFF	Add 4095 to address
		...	...
		0x0002	Add 2 to address
		0x0001	Add 1 to address
		0x0000	No address change
		0xFFFF	Sub 1 from address
		0xFFFE	Sub 2 from address
		...	...
		0xF000	Sub 4096 from address
			Only values from -4096 to 4095 are valid.

#### 4.8.16 Source/Destination Wrap Size Register (SRC/DST\_WRAP\_SIZE) — EALLOW protected

The source/destination wrap size register is shown in [Figure 4-24](#) and described in [Table 4-18](#).

**Figure 4-24. Source/Destination Wrap Size Register (SRC/DST\_WRAP\_SIZE)**

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
WRAPSIZE															
R/W-0															

LEGEND: R/W = Read/Write; R = Read only; -n = value after reset

**Table 4-18. Source/Destination Wrap Size Register (SRC/DST\_WRAP\_SIZE) Field Descriptions**

Bit	Field	Value	Description
15-0	WRAPSIZE		These bits specify the number of bursts to transfer before wrapping back to begin address pointer:
		0x0000	Wrap after 1 burst
		0x0001	Wrap after 2 bursts
		0x0002	Wrap after 3 bursts
		...	...
		0xFFFF	Wrap after 65536 bursts
			To <i>disable</i> the wrap function, set the WRAPSIZE bit field to a number larger than the TRANSFERSIZE bit field.

#### 4.8.17 Source/Destination Wrap Count Register (SCR/DST\_WRAP\_COUNT)

The source/destination wrap count register (SCR/DST\_WRAP\_COUNT) is shown in [Figure 4-25](#) and described in [Table 4-19](#).

**Figure 4-25. Source/Destination Wrap Count Register (SCR/DST\_WRAP\_COUNT)**

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
WRAPCOUNT															
R/W-0															

LEGEND: R/W = Read/Write; R = Read only; -n = value after reset

**Table 4-19. Source/Destination Wrap Count Register (SCR/DST\_WRAP\_COUNT) Field Descriptions**

Bit	Field	Value	Description
15-0	WRAPCOUNT		These bits indicate the current wrap counter value:
		0x0000	Wrap complete
		0x0001	1 burst left
		0x0002	2 burst left
		...	...
		0xFFFF	65535 burst left
			The above values represent the state of the counter at the HALT conditions.

#### 4.8.18 Source/Destination Wrap Step Size Registers (SRC/DST\_WRAP\_STEP) — EALLOW Protected

The source/destination wrap step size register (SRC/DST\_WRAP\_STEP) are shown in [Figure 4-26](#) and described in [Table 4-20](#).

**Figure 4-26. Source/Destination Wrap Step Size Registers (SRC/DST\_WRAP\_STEP)**

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
WRAPSTEP															
R/W-0															

LEGEND: R/W = Read/Write; R = Read only; -n = value after reset

**Table 4-20. Source/Destination Wrap Step Size Registers (SRC/DST\_WRAP\_STEP) Field Descriptions**

Bit	Field	Value	Description
15-0	WRAPSTEP		These bits specify the source begin address pointer post-increment/decrement step size after wrap counter expires:
		0x0FFF	Add 4095 to address
		...	...
		0x0002	Add 2 to address
		0x0001	Add 1 to address
		0x0000	No address change
		0xFFFF	Sub 1 from address
		0xFFFE	Sub 2 from address
		...	...
		0xF000	Sub 4096 from address
			Only values from -4096 to 4095 are valid.



#### 4.8.19 Shadow Source Begin and Current Address Pointer Registers (SRC\_BEG\_ADDR\_SHADOW/DST\_BEG\_ADDR\_SHADOW) — All EALLOW Protected

The shadow source begin and current address pointer registers (SRC\_BEG\_ADDR\_SHADOW/DST\_BEG\_ADDR\_SHADOW) are shown in [Figure 4-27](#) and described in [Table 4-21](#).

**Figure 4-27. Shadow Source Begin and Current Address Pointer Registers  
(SRC\_BEG\_ADDR\_SHADOW/DST\_BEG\_ADDR\_SHADOW)**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
BEGADDR																															
R/W-0																															

LEGEND: R/W = Read/Write; R = Read only; -n = value after reset

**Table 4-21. Shadow Source Begin and Current Address Pointer Registers  
(SRC\_BEG\_ADDR\_SHADOW/DST\_BEG\_ADDR\_SHADOW) Field Descriptions**

Bit	Field	Value	Description
31-0	BEGADDR		32-bit address value

#### 4.8.20 Active Source Begin and Current Address Pointer Registers (SRC\_BEG\_ADDR/DST\_BEG\_ADDR)

The active source begin and current address pointer registers (SRC\_BEG\_ADDR/DST\_BEG\_ADDR) are shown in [Figure 4-28](#) and described in [Table 4-22](#).

**Figure 4-28. Active Source Begin and Current Address Pointer Registers  
(SRC\_BEG\_ADDR/DST\_BEG\_ADDR)**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
BEGADDR																															
R-0																															

LEGEND: R/W = Read/Write; R = Read only; -n = value after reset

**Table 4-22. Active Source Begin and Current Address Pointer Registers  
(SRC\_BEG\_ADDR/DST\_BEG\_ADDR) Field Descriptions**

Bit	Field	Value	Description
31-0	BEGADDR		32-bit address value

#### 4.8.21 Shadow Destination Begin and Current Address Pointer Registers (SRC\_ADDR\_SHADOW/DST\_ADDR\_SHADOW) — All EALLOW Protected

The shadow destination begin and current address pointer registers (SRC\_ADDR\_SHADOW/DST\_ADDR\_SHADOW) are shown in [Figure 4-29](#) and described in [Table 4-23](#).

**Figure 4-29. Shadow Destination Begin and Current Address Pointer Registers  
(SRC\_ADDR\_SHADOW/DST\_ADDR\_SHADOW)**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
																ADDR															
																RW-0															

LEGEND: R/W = Read/Write; R = Read only; -n = value after reset

**Table 4-23. Shadow Destination Begin and Current Address Pointer Registers  
(SRC\_ADDR\_SHADOW/DST\_ADDR\_SHADOW) Field Descriptions**

Bit	Field	Value	Description
31-0	ADDR		32-bit address value

#### 4.8.22 Active Destination Begin and Current Address Pointer Registers (SRC\_ADDR/DST\_ADDR)

The active destination begin and current address pointer registers (SRC\_ADDR/DST\_ADDR) are shown in [Figure 4-30](#) and described in [Table 4-24](#).

**Figure 4-30. Active Destination Begin and Current Address Pointer Registers  
(SRC\_ADDR/DST\_ADDR)**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
																ADDR															
																R-0															

LEGEND: R/W = Read/Write; R = Read only; -n = value after reset

**Table 4-24. Active Destination Begin and Current Address Pointer Registers  
(SRC\_ADDR/DST\_ADDR) Field Descriptions**

Bit	Field	Value	Description
31-0	ADDR		32-bit address value

## Control Law Accelerator (CLA)

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The control law accelerator (CLA) Type-1 is an independent, fully-programmable, 32-bit floating-point math processor that brings concurrent control-loop execution to the C28x family. The low interrupt-latency of the CLA allows it to read ADC samples "just-in-time." This significantly reduces the ADC sample to output delay to enable faster system response and higher MHz control loops. By using the CLA to service time-critical control loops, the main CPU is free to perform other system tasks such as communications and diagnostics. This chapter provides an overview of the architectural structure and components of the control law accelerator.

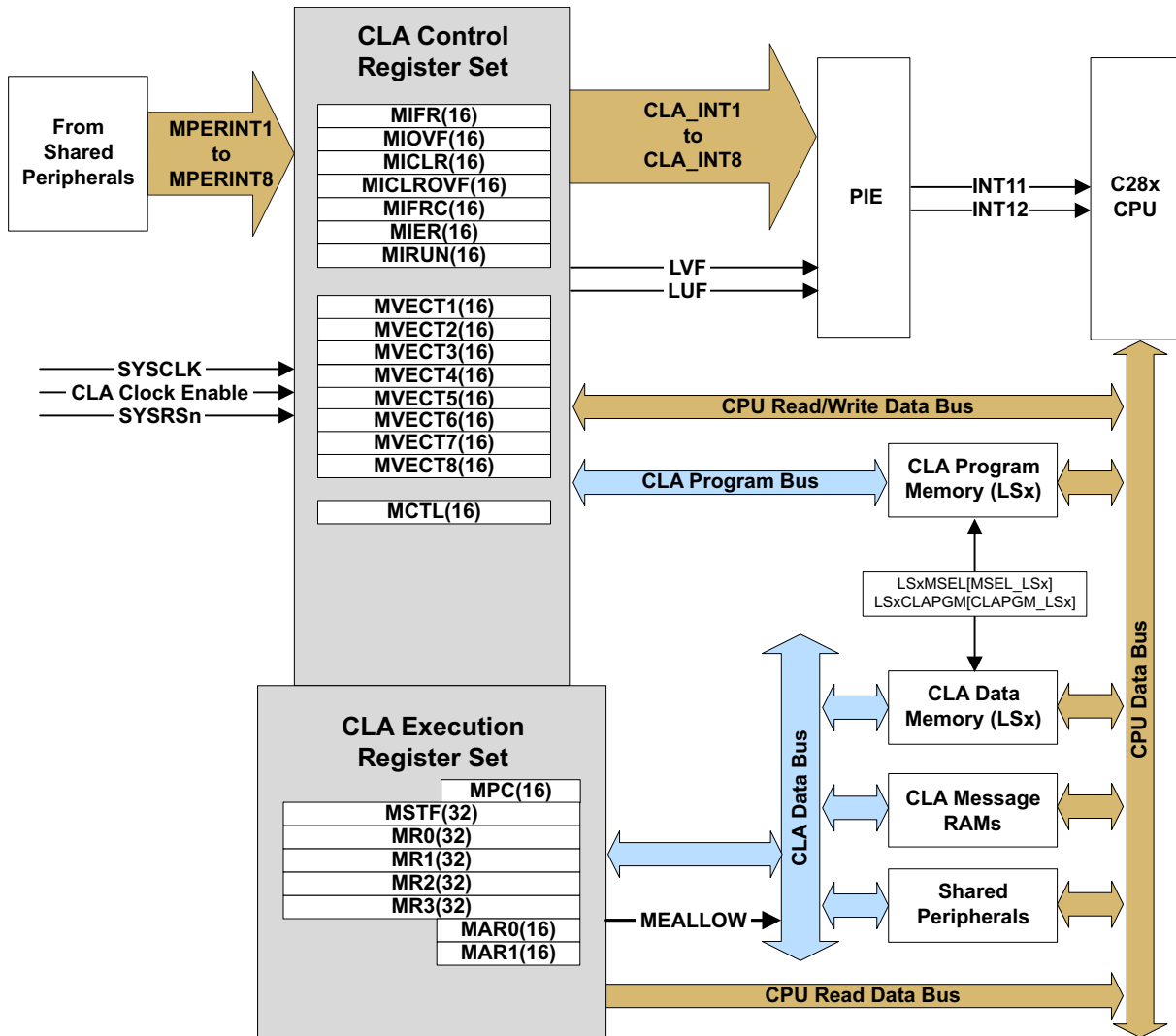
<b>Topic</b>		<b>Page</b>
<b>5.1 Control Law Accelerator (CLA) Overview</b> .....		<b>612</b>
<b>5.2 CLA Interface</b> .....		<b>614</b>
<b>5.3 CLA and CPU Arbitration</b> .....		<b>618</b>
<b>5.4 CLA Configuration and Debug</b> .....		<b>620</b>
<b>5.5 Pipeline</b> .....		<b>624</b>
<b>5.6 Instruction Set</b> .....		<b>629</b>
<b>5.7 Registers</b> .....		<b>744</b>

## 5.1 Control Law Accelerator (CLA) Overview

The control law accelerator extends the capabilities of the C28x CPU by adding parallel processing. Time-critical control loops serviced by the CLA can achieve low ADC sample to output delay. Thus, the CLA enables faster system response and higher frequency control loops. Utilizing the CLA for time-critical tasks frees up the main CPU to perform other system and communication functions concurrently. The following is a list of major features of the CLA.

- Clocked at the same rate as the main CPU (SYSCLKOUT).
- An independent architecture allowing CLA algorithm execution independent of the main C28x CPU.
  - Complete bus architecture:
    - Program Address Bus (PAB) and Program Data Bus (PDB)
    - Data Read Address Bus (DRAB), Data Read Data Bus (DRDB), Data Write Address Bus (DWAB), and Data Write Data Bus (DWDB)
  - Independent eight stage pipeline.
  - 16-bit program counter (MPC)
  - Four 32-bit result registers (MR0-MR3)
  - Two 16-bit auxiliary registers (MAR0, MAR1)
  - Status register (MSTF)
- Instruction set includes:
  - IEEE single-precision (32-bit) floating point math operations
  - Floating-point math with parallel load or store
  - Floating-point multiply with parallel add or subtract
  - 1/X and 1/sqrt(X) estimations
  - Data type conversions.
  - Conditional branch and call
  - Data load/store operations
- The CLA program code can consist of up to eight tasks or interrupt service routines.
  - The start address of each task is specified by the MVECT registers.
  - No limit on task size as long as the tasks fit within the configurable CLA program memory space.
  - One task is serviced at a time until its completion. There is no nesting of tasks.
  - Upon task completion a task-specific interrupt is flagged within the PIE.
  - When a task finishes the next highest-priority pending task is automatically started.
- Task trigger mechanisms:
  - C28x CPU via the IACK instruction
  - Task1 to Task8: up to 256 possible trigger sources from peripherals connected to the shared bus on which the CLA assumes secondary ownership.
- Memory and Shared Peripherals:
  - Two dedicated message RAMs for communication between the CLA and the main CPU.
  - The C28x CPU can map CLA program and data memory to the main CPU space or CLA space.
  - The CLA, on reset, is the secondary master for all peripherals which can have either the CLA or DMA as their secondary master.

Figure 5-1. CLA Block Diagram



## 5.2 CLA Interface

This chapter describes how the C28x main CPU can interface to the CLA and vice versa.

### 5.2.1 CLA Memory

The CLA can access three types of memory: program, data and message RAMs. The behavior and arbitration for each type of memory is described in detail below.

- **CLA Program Memory**

The CLA program can be loaded to any of the local shared memories (LSxRAM) on the core that it is tied to. At reset, all memory blocks are mapped to the master CPU. While mapped to the CPU space, the CPU can copy the CLA program code into the memory block(s). During debug, the block(s) can also be loaded directly by Code Composer Studio™.

Once the memory is initialized with CLA code, the master CPU maps it to the CLA program space by:

1. Assigning ownership of the memory block to the CLA by writing a 1 to the memory block's MemCfgRegs.LSxMSEL[MSEL\_LSx] bit.
2. Specifying the memory block as a code block for the CLA by writing a 1 to the MemCfgRegs.LSxCLAPGM[CLAPGM\_LSx] bit.

When an LSx memory is configured as CLA program memory, only debug accesses are allowed on cycles that the CLA is not fetching a new instruction. A detailed explanation of the memory configurations and access arbitration (CPU/CLA/DEBUG) process can be found in [Section 2.11](#).

All CLA program fetches are performed as 32-bit read operations and all opcodes must be aligned to an even address. Since all CLA opcodes are 32-bits, this alignment naturally occurs.

- **CLA Data Memory**

Any of the device's LSxRAMs can serve as data memory blocks to the CLA. At reset, all blocks are mapped to the master CPU memory space, whereby the master can initialize the memory with data tables, coefficients, and so on, for the CLA to use.

Once the memory is initialized with CLA data, the master CPU maps it to the CLA data space by :

1. Assigning ownership of the memory block to the CLA by writing a 1 to the memory block's MemCfgRegs.LSxMSEL[MSEL\_LSx] bit.
2. Specifying the memory block as a data block for the CLA by writing a 0 to the MemCfgRegs.LSxCLAPGM[CLAPGM\_LSx] bit. The value of this bit at reset is 0.

When an LSx memory is configured as a CLA data memory, the CLA read/write access are arbitrated along with CPU accesses. The user has the option of turning on CPU fetch or write protection to the memory by writing to the appropriate bits of the MemCfgRegs.LSxACCPROT<sub>x</sub> registers. A detailed explanation of the memory configurations and access arbitration (CPU/CLA/DEBUG) process can be found in [Section 2.11](#).

The CLA RAMs and registers are protected by the security module. Refer to the *DCSM* chapter of this manual for more details on the security scheme.

- **CLA Shared Message RAMs**

There are two small memory blocks for data sharing and communication between the CLA and the master CPU on each CPU subsystem. The message RAMs are always mapped to both CPU and CLA memory spaces and are protected by the DCSM. The message RAMs allow data accesses only; no program fetches can be performed.

- **CLA to CPU Message RAM**

The CLA can use this block to pass data to the master CPU. This block is both readable and writable by the CLA. This block is also readable by the master CPU but writes by the master CPU are ignored.

- **CPU to CLA Message RAM**

The master CPU can use this block to pass data and messages to the CLA. This message RAM is both readable and writable by the master CPU. The CLA can perform reads but writes by the CLA are ignored.

### 5.2.2 CLA Memory Bus

The CLA has dedicated bus architecture similar to that of the C28x CPU where there is a program read, data read, and data write bus. Thus, there can be simultaneous instruction fetch, data read, and data write in a single cycle. Like the C28x CPU, the CLA expects memory logic to align any 32-bit read or write to an even address. If the address-generation logic generates an odd address, the CLA will begin reading or writing at the previous even address. This alignment does not affect the address values generated by the address-generation logic.

- **CLA Program Bus**

The CLA program bus has a access range of 32K 32-bit instructions. Since all CLA instructions are 32 bits, this bus always fetches 32 bits at a time and the opcodes must be even-word aligned. The amount of program space available for the CLA is limited to the number of available LSxRAM blocks. This number is device-dependent and will be described in the device-specific data manual.

- **CLA Data Read Bus**

The CLA data read bus has a 64K x 16 address range. The bus can perform 16 or 32-bit reads and will automatically stall if there are memory access conflicts. The data read bus has access to both the message RAMs, CLA data memory, and the shared peripherals.

- **CLA Data Write Bus**

The CLA data write bus has a 64K x 16 address range. This bus can perform 16 or 32-bit writes. The bus will automatically stall if there are memory access conflicts. The data write bus has access to the CLA to CPU message RAM, CLA data memory, and the shared peripherals.

### 5.2.3 Shared Peripherals and EALLOW Protection

For a given CPU subsystem, the CLA and DMA share secondary access to some peripherals. The secondary ownership of the bus is determined by the CpuSysRegs.SECMSEL[VBUS32\_x] bit. If it is set to 0, the CLA is the secondary owner. If it is set to 1, the DMA is the secondary owner. By default, at reset, the CLA is given the secondary ownership of the bus and, therefore, can access all the peripherals connected to it.

**Note:** The CLA read access time to the bus is 2-wait states while write access is 0-wait.

Refer to the device data manual for the list of peripherals connected to the bus.

Several peripheral control registers are protected from spurious 28x CPU writes by the EALLOW protection mechanism. These same registers are also protected from spurious CLA writes. The EALLOW bit in the main CPU status register 1 (ST1) indicates the state of protection for the main CPU. Likewise the MEALLOW bit in the CLA status register (MSTF) indicates the state of write protection for the CLA. The MEALLOW CLA instruction enables write access by the CLA to EALLOW protected registers. Likewise the MEDIS CLA instruction will disable write access. This way the CLA can enable/disable write access independent of the main CPU.

The ADC offers the option to generate an early interrupt pulse at the start of a sample conversion. If this option is used to start an ADC-triggered CLA task, the user may use the intervening cycles, until the completion of the conversion, to perform preliminary calculations or loads and stores before finally reading the ADC value. The CLA pipeline activity for this scenario is shown in [Section 5.5](#).

## 5.2.4 CLA Tasks and Interrupt Vectors

The CLA program code is divided up into tasks or interrupt service routines. Tasks do not have a fixed starting location or length. The CLA program memory can be divided up as desired. The CLA knows where a task begins by the content of the associated interrupt vector (MVECT1 to MVECT8) and the end is indicated by the MSTOP instruction.

The CLA supports eight tasks. Task 1 has the highest priority and task 8 has the lowest priority. A task can be requested by a peripheral interrupt or by software:

- **Peripheral interrupt trigger**

Each task can be triggered by up to 256 interrupt sources. The trigger for each task is defined by writing an appropriate value to the `DmaClaSrcSelRegs.CLA1TASKSRCSELx[TASKx]` bit field. Each of the possible 256 values specifies an interrupt source from a specific peripheral on the shared bus. The configuration options are listed in [Table 5-1](#).

**Table 5-1. Configuration Options**

Select Value (8-bit)	CLA Trigger Source
0	Software Trigger
1	ADCAINT1
2	ADCAINT2
3	ADCAINT3
4	ADCAINT4
5	ADCAEVT
6	ADCBINT1
7	ADCBINT2
8	ADCBINT3
9	ADCBINT4
10	ADCB EVT
11	ADCCINT1
12	ADCCINT2
13	ADCCINT3
14	ADCCINT4
15	ADCCEVT
16	ADCDINT1
17	ADCDINT2
18	ADCDINT3
19	ADCDINT4
20	ADCDEV T
28:21	Reserved
29	XINT1
30	XINT2
31	XINT3
32	XINT4
33	XINT5
34	Reserved
35	Reserved
36	EPWM1INT
37	EPWM2INT
38	EPWM3INT
39	EPWM4INT
40	EPWM5INT
41	EPWM6INT



**Table 5-1. Configuration Options (continued)**

Select Value (8-bit)	CLA Trigger Source
42	EPWM7INT
43	EPWM8INT
44	EPWM9INT
45	EPWM10INT
46	EPWM11INT
47	EPWM12INT
67:48	Reserved
68	TINT0
69	TINT1
70	TINT2
71	MXINTA
72	MRINTA
73	MXINTB
74	MRINTB
75	ECAP1INT
76	ECAP2INT
77	ECAP3INT
78	ECAP4INT
79	ECAP5INT
80	ECAP6INT
81	Reserved
82	Reserved
83	EQEP1INT
84	EQEP2INT
85	EQEP3INT
86	Reserved
87	Reserved
88	Reserved
94:89	Reserved
95	SD1INT
96	SD2INT
106:97	Reserved
107	UPP1INT
108	Reserved
109	SPITXINTA
110	SPIRXINTA
111	SPITXINTB
112	SPIRXINTB
113	SPITXINTC
114	SPIRXINTC
255:115	Reserved

For example, task 1 (MVECT1) can be set to trigger on EPWMINT1 by writing 36 to DmaClaSrcSelRegs.CLA1TASKSRCSEL1.bit.TASK1. To disable the triggering of a task by a peripheral, the user must set the DmaClaSrcSelRegs.CLA1TASKSRCSELx[TASKx] bit field to 0. It should be noted that a CLA task only triggers on a level transition (an edge) of the configured interrupt source.

- **Software Trigger**

Tasks can also be started by the main CPU software writing to the MIFRC register or by the IACK instruction. Using the IACK instruction is more efficient because it does not require you to issue an EALLOW to set MIFR bits. Set the MCTL[IACKE] bit to enable the IACK feature. Each bit in the operand of the IACK instruction corresponds to a task. For example IACK #0x0001 will set bit 0 in the MIFR register to start task 1. Likewise IACK #0x0003 will set bits 0 and 1 in the MIFR register to start task 1 and task 2.

The CLA has its own fetch mechanism and can run and execute a task independent of the main CPU. Only one task is serviced at a time; there is no nesting of tasks. The task currently running is indicated in the MIRUN register. Interrupts that have been received but not yet serviced are indicated in the flag register (MIFR). If an interrupt request from a peripheral is received and that same task is already flagged, then the overflow flag bit is set. Overflow flags will remain set until they are cleared by the main CPU.

If the CLA is idle (no task is currently running) then the highest priority interrupt request that is both flagged (MIFR) and enabled (MIER) will start. The flow is as follows:

1. The associated RUN register bit is set (MIRUN) and the flag bit (MIFR) is cleared.
2. The CLA begins execution at the location indicated by the associated interrupt vector (MVECTx). MVECT contains the absolute 16-bit address of the task in the lower 64K memory space.
3. The CLA executes instructions until the MSTOP instruction is found. This indicates the end of the task.
4. The MIRUN bit is cleared.
5. The task-specific interrupt to the PIE is issued. This informs the main CPU that the task has completed.
6. The CLA returns to idle.

Once a task completes the next highest-priority pending task is automatically serviced and this sequence repeats.

### 5.2.5 CLA Software Interrupt to CPU

The CLA can issue a software interrupt to the C28x CPU (on the same subsystem) at any point in the code through the use of the CLA1SOFTINTEN and CLA1INTFRC registers. Please see [Section 5.7](#) for a description of these registers. If a software interrupt is selected for a CLA task, then an end-of-task interrupt will not be issued to the C28x when that task completes

## 5.3 CLA and CPU Arbitration

Typically, CLA activity is independent of the CPU activity. Under the circumstance where both the CLA and the CPU are attempting to access memory or a peripheral register within the same interface concurrently, an arbitration procedure will occur. This appendix describes this arbitration.

### 5.3.1 CLA and CPU Arbitration

The Local Shared RAMs can have access from the CPU as well as the DMA. The arbitration is a combination of fixed and round robin schemes; they are covered in detail in the [Section 2.11](#).

### 5.3.2 CLA Message RAM

Message RAMs consist of two blocks

- CLA1 to CPU – CLA to CPU Message RAM
- CPU to CLA1 – CPU to CLA Message RAM

These blocks are for passing data between the CPU and the CLA. No opcode fetches, from either the CLA or CPU, are allowed from the message RAMs. A write protection violation will not be generated if the CLA attempts to write to the CPU to CLA1 message RAM but the write will be ignored. The arbitration scheme for the message RAMs are the same as those for the shared memories described in the [Section 2.11](#).

The two message RAMs have the following characteristics:

- CLA1 to CPU Message RAM:  
The following accesses are allowed:
  - CPU reads
  - CLA1 data reads and writes
  - CPU debug reads and writes  
The following accesses are ignored:
  - CPU writes
- CPU to CLA1 Message RAM:  
The following accesses are allowed:
  - CPU reads and writes
  - CLA1 reads
  - CPU debug reads and writes  
The following accesses are ignored:
  - CLA1 writes

## 5.4 CLA Configuration and Debug

This section discusses the steps necessary to configure and debug the CLA.

### 5.4.1 Building a CLA Application

The control law accelerator can be programmed in either CLA assembly code using the instructions described in [Section 5.6](#) or a reduced subset of the C language. CLA assembly code resides in the same project with C28x code. The only restriction is the CLA code must be in its own assembly section. This can be easily done using the `.sect` assembly directive. This does not prevent CLA and C28x code from being linked into the same memory region in the linker command file.

System and CLA initialization are performed by the main CPU. This would typically be done in C or C++ but can also include C28x assembly code. The main CPU will also copy the CLA code to the program memory and, if needed, initialize the CLA data RAM(s). Once system initialization is complete and the application begins, the CLA will service its interrupts using the CLA assembly code (or tasks). Concurrently the main CPU can perform other tasks.

The CLA type 1 requires Codegen V6.2.4 or later with the following switch: `--cla_support=cla1`.

### 5.4.2 Typical CLA Initialization Sequence

A typical CLA initialization sequence is performed by the main CPU as described in this section.

#### 1. Copy CLA code into the CLA program RAM

The source for the CLA code can initially reside in the flash or a data stream from a communications peripheral or anywhere the main CPU can access it. The debugger can also be used to load code directly to the CLA program RAM during development.

#### 2. Initialize CLA data RAM if necessary

Populate the CLA data RAM with any required data coefficients or constants.

#### 3. Configure the CLA registers

Configure the CLA registers, but keep interrupts disabled until later (leave `MIER == 0`):

- **Enable the CLA clock in the PCLKCR0 register.**

PCLKCR0 register is defined in the *System Control and Interrupts* chapter.

- **Populate the CLA task interrupt vectors: MVECT1 to MVECT8.**

Each vector needs to be initialized with the start address of the task to be executed when the CLA receives the associated interrupt. This address is the full 16-bit starting address of the task in the lower 64K section of memory.

- **Select the task interrupt sources**

For each task select the interrupt source in the `CLA1TASKSRCSELx` register. If a task is going to be generated by software, select no interrupt.

- **Enable IACK to start a task from software if desired**

To enable the IACK instruction to start a task set the `MCTL[IACKE]` bit. Using the IACK instruction avoids having to set and clear the `EALLOW` bit.

- **Map CLA data RAM(s) to CLA space if necessary**

Map the data RAM to the CLA space by first, assigning ownership of the memory block to the CLA by writing a 1 to the memory block's `MemCfgRegs.LSxMSEL[MSEL_LSx]` bit and then specifying the memory block as a CLA data block by writing a 0 to the `MemCfgRegs.LSxCLAPGM[CLAPGM_LSx]` bit. When an LSx memory is configured as a CLA data memory, the CLA read/write access are arbitrated along with CPU accesses. The user has the option of turning on CPU fetch or write protection to the memory by writing to the appropriate bits of the `MemCfgRegs.LSxACCPROTx` registers.

- **Map CLA program RAM to CLA space**

Map the CLA program RAM to CLA space by first, assigning ownership of the memory block to the CLA by writing a 1 to the memory block's `MemCfgRegs.LSxMSEL[MSEL_LSx]` bit and then specifying the memory block as CLA code memory by writing a 1 to the `MemCfgRegs.LSxCLAPGM[CLAPGM_LSx]` bit. When an LSx memory is configured as CLA

program memory, only debug accesses are allowed on cycles that the CLA is not fetching a new instruction.

**4. Initialize the PIE vector table and registers**

When a CLA task completes, the associated interrupt in the PIE will be flagged. The CLA overflow and underflow flags also have associated interrupts within the PIE.

**5. Enable CLA tasks/interrupts**

Set appropriate bits in the interrupt enable register (MIER) to allow the CLA to service interrupts.

**6. Initialize other peripherals**

Initialize any peripherals (ePWM, ADC, and others) that will generate an interrupt to the CLA and be serviced by a CLA task.

The CLA is now ready to service interrupts and the message RAMs can be used to pass data between the CPU and the CLA. Typically mapping of the CLA program and data RAMs occurs only during the initialization process. If after some time you want to re-map these memories back to CPU space then disable interrupts and make sure all tasks have completed by checking the MIRUN register.

### 5.4.3 Debugging CLA Code

Debugging the CLA code is a simple process that occurs independently of the main CPU.

#### 1. Insert a breakpoint in CLA code

Insert a CLA breakpoint (MDEBUGSTOP instruction) into the code where you want the CLA to halt, then rebuild and reload the code. Because the CLA does not flush its pipeline when you single-step, the MDEBUGSTOP instruction must be inserted as part of the code. The debugger cannot insert it as needed.

If CLA breakpoints are not enabled, then the MDEBUGSTOP will be ignored and is treated as a MNOP. The MDEBUGSTOP instruction can be placed anywhere in the CLA code as long as it is not within three instructions of a MBCNDD, MCCNDD, or MRCNDD instruction. When programming in C, the user can use the `__mdebugstop()` intrinsic instead; the compiler will ensure that the placement of the MDEBUGSTOP instruction in the generated assembly does not violate any of the pipeline restrictions.

#### 2. Enable CLA breakpoints

First, enable the CLA breakpoints in the debugger. In Code Composer Studio, this is done by connecting the core from the debug perspective. Breakpoints are disabled when the core is disconnected.

#### 3. Start the task

There are three ways to start the task:

- The peripheral can assert an interrupt
- The main CPU can execute an IACK instruction, or
- You can manually write to the MIFRC register in the debugger window

When the task starts, the CLA will execute instructions until the MDEBUGSTOP is in the D2 phase of the pipeline. At this point, the CLA will halt and the pipeline will be frozen. The MPC register will reflect the address of the MDEBUGSTOP instruction.

#### 4. Single-step the CLA code

Once halted, you can single-step the CLA code one cycle at a time. The behavior of a CLA single-step is different than the main C28x. When issuing a CLA single-step, the pipeline is clocked only one cycle and then again frozen. On the 28x CPU, the pipeline is flushed for each single-step.

You can also run to the next MDEBUGSTOP or to the end of the task. If another task is pending, it will automatically start when you run to the end of the task.

---

**NOTE:** A CLA fetch has higher priority than CPU debug reads. For this reason, it is possible for the CLA to permanently block CPU debug accesses if the CLA is executing in a loop. This might occur when initially developing CLA code due to a bug that causes an infinite loop. To avoid locking up the main CPU, the program memory will return all 0x0000 for CPU debug reads when the CLA is running. When the CLA is halted or idle then normal CPU debug read and write access to CLA program memory can be performed.

If the CLA gets caught in a infinite loop, you can use a soft or hard reset to exit the condition. A debugger reset will also exit the condition.

---

There are special cases that can occur when single-stepping a task such that the program counter, MPC, reaches the MSTOP instruction at the end of the task.

- **MPC halts at or after the MSTOP with a task already pending**

If you are single-stepping or halted in "task A" and "task B" comes in before the MPC reaches the MSTOP, then "task B" will start if you continue to step through the MSTOP instruction. Basically if "task B" is pending before the MPC reaches MSTOP in "task A" then there is no issue in "task B" starting and no special action is required.

- **MPC halts at or after the MSTOP with no task pending**

In this case you have single-stepped or halted in "task A" and the MPC has reached the MSTOP with no tasks pending. If "task B" comes in at this point, it will be flagged in the MIFR register but it may or may not start if you continue to single-step through the MSTOP instruction of "task A."

It depends on exactly when the new task comes in. To reliably start "task B" perform a soft reset

and reconfigure the MIER bits. Once this is done, you can start single-stepping "task B."

This case can be handled slightly differently if there is control over when "task B" comes in (for example using the IACK instruction to start the task). In this case you have single-stepped or halted in "task A" and the MPC has reached the MSTOP with no tasks pending. Before forcing "task B," run free to force the CLA out of the debug state. Once this is done you can force "task B" and continue debugging.

#### 5. If desired, disable CLA breakpoints

In Code Composer Studio you can disable the CLA breakpoints by disconnecting the CLA core in the debug perspective. Make sure to first issue a run or reset; otherwise, the CLA will be halted and no other tasks will start.

#### 5.4.4 CLA Illegal Opcode Behavior

If the CLA fetches an opcode that does not correspond to a legal instruction, it will behave as follows:

- The CLA will halt with the illegal opcode in the D2 phase of the pipeline as if it were a breakpoint. This will occur whether CLA breakpoints are enabled or not.
- The CLA will issue the task-specific interrupt to the PIE.
- The MIRUN bit for the task will remain set.

Further single-stepping is ignored once execution halts due to an illegal op-code. To exit this situation, issue either a soft or hard reset of the CLA as described in [Section 5.4.5](#).

#### 5.4.5 Resetting the CLA

There may be times when you need to reset the CLA. For example, during code debug the CLA may enter an infinite loop due to a code bug. The CLA has two types of resets: hard and soft. Both of these resets can be performed by the debugger or by the main CPU.

- **Hard Reset**

Writing a 1 to the MCTL[HARDRESET] bit will perform a hard reset of the CLA. The behavior of a hard reset is the same as a system reset (via  $\overline{XRS}$  or the debugger). In this case all CLA configuration and execution registers will be set to their default state and CLA execution will halt.

- **Soft Reset**

Writing a 1 to the MCTL[SOFTRESET] bit performs a soft reset of the CLA. If a task is executing it will halt and the associated MIRUN bit will be cleared. All bits within the interrupt enable (MIER) register will also be cleared so that no new tasks start.

## 5.5 Pipeline

This section describes the CLA pipeline stages and presents cases where pipeline alignment must be considered.

### 5.5.1 Pipeline Overview

The CLA pipeline is very similar to the C28x pipeline. The pipeline has eight stages:

- **Fetch 1 (F1)**  
During the F1 stage the program read address is placed on the CLA program address bus.
- **Fetch 2 (F2)**  
During the F2 stage the instruction is read using the CLA program data bus.
- **Decode 1 (D1)**  
During D1 the instruction is decoded.
- **Decode 2 (D2)**  
Generate the data read address. Changes to MAR0 and MAR1 due to post-increment using indirect addressing takes place in the D2 phase. Conditional branch decisions are also made at this stage based on the MSTF register flags.
- **Read 1 (R1)**  
Place the data read address on the CLA data-read address bus. If a memory conflict exists, the R1 stage will be stalled.
- **Read 2 (R2)**  
Read the data value using the CLA data read data bus.
- **Execute (EXE)**  
Execute the operation. Changes to MAR0 and MAR1 due to loading an immediate value or value from memory take place in this stage.
- **Write (W)**  
Place the write address and write data on the CLA write data bus. If a memory conflict exists, the W stage will be stalled.

### 5.5.2 CLA Pipeline Alignment

The majority of the CLA instructions do not require any special pipeline considerations. This section lists the few operations that do require special consideration.

- **Write Followed by Read**  
In both the C28x and the CLA pipeline the read operation occurs before the write. This means that if a read operation immediately follows a write, then the read will complete first as shown in [Table 5-2](#). In most cases this does not cause a problem since the contents of one memory location does not depend on the state of another. For accesses to peripherals where a write to one location can affect the value in another location the code must wait for the write to complete before issuing the read as shown in [Table 5-3](#).  
  
This behavior is different for the 28x CPU. For the 28x CPU any write followed by read to the same location is protected by what is called write-followed-by-read protection. This protection automatically stalls the pipeline so that the write will complete before the read. In addition some peripheral frames are protected such that a 28x CPU write to one location within the frame will always complete before a read to the frame. The CLA does not have this protection mechanism. Instead the code must wait to perform the read.



**Table 5-2. Write Followed by Read - Read Occurs First**

Instruction	F1	F2	D1	D2	R1	R2	E	W
I1 MMOV16 @Reg1, MR3	I1							
I2 MMOV16 MR2, @Reg2	I2	I1						
		I2	I1					
			I2	I1				
				I2	I1			
					I2	I1		
						I2	I1	
							I2	I1

**Table 5-3. Write Followed by Read - Write Occurs First**

Instruction	F1	F2	D1	D2	R1	R2	E	W
I1 MMOV16 @Reg1, MR3	I1							
I2	I2	I1						
I3	I3	I2	I1					
I4	I4	I3	I2	I1				
I5 MMOV16 MR2, @Reg2	I5	I4	I3	I2	I1			
		I5	I4	I3	I2	I1		
			I5	I4	I3	I2	I1	
				I5	I4	I3	I2	I1
					I5	I4	I3	I2
						I5	I4	I3
							I5	I4
								I5

- **Delayed Conditional instructions: MBCNDD, MCCNDD and MRCNDD**

Referring to [Example 5-1](#), the following applies to delayed conditional instructions:

- **I1**

I1 is the last instruction that can effect the CNDF flags for the branch, call or return instruction. The CNDF flags are tested in the D2 phase of the pipeline. That is, a decision is made whether to branch or not when [MBCNDD](#), [MCCNDD](#) or [MRCNDD](#) is in the D2 phase.

- **I2, I3 and I4**

The three instructions preceding [MBCNDD](#) can change MSTF flags but will have no effect on whether the [MBCNDD](#) instruction branches or not. This is because the flag modification will occur after the D2 phase of the branch, call or return instruction. These three instructions must not be a [MSTOP](#), [MDEBUGSTOP](#), [MBCNDD](#), [MCCNDD](#) or [MRCNDD](#).

- **I5, I6 and I7**

The three instructions following a branch, call or return are always executed irrespective of whether the condition is true or not. These instructions must not be [MSTOP](#), [MDEBUGSTOP](#), [MBCNDD](#), [MCCNDD](#) or [MRCNDD](#).

For a more detailed description refer to the functional description for [MBCNDD](#), [MCCNDD](#) and [MRCNDD](#).

**Example 5-1. Code Fragment For MBCNDD, MCCNDD or MRCNDD**

```

<Instruction 1> ; I1 Last instruction that can affect flags for
                ; the branch, call or return operation

<Instruction 2> ; I2 Cannot be stop, branch, call or return
<Instruction 3> ; I3 Cannot be stop, branch, call or return
<Instruction 4> ; I4 Cannot be stop, branch, call or return

<branch/call/ret> ; MBCNDD, MCCNDD or MRCNDD

                ; I5-I7: Three instructions after are always
                ; executed whether the branch/call or return is
                ; taken or not

<Instruction 5> ; I5 Cannot be stop, branch, call or return
<Instruction 6> ; I6 Cannot be stop, branch, call or return
<Instruction 7> ; I7 Cannot be stop, branch, call or return

<Instruction 8> ; I8
<Instruction 9> ; I9
....

```

- **Stop or Halting a Task: MSTOP and MDEBUGSTOP**

The [MSTOP](#) and [MDEBUGSTOP](#) instructions cannot be placed three instructions before or after a conditional branch, call or return instruction ([MBCNDD](#), [MCCNDD](#) or [MRCNDD](#)). Refer to [Example 5-1](#). To single-step through a branch/call or return, insert the [MDEBUGSTOP](#) at least four instructions back and step from there.

- **Loading MAR0 or MAR1**

A load of auxiliary register MAR0 or MAR1 will occur in the EXE phase of the pipeline. Any post increment of MAR0 or MAR1 using indirect addressing will occur in the D2 phase of the pipeline. Referring to [Example 5-2](#), the following applies when loading the auxiliary registers:

- **I1 and I2**

The two instructions following the load instruction will use the value in MAR0 or MAR1 before the update occurs.

- **I3**

Loading of an auxiliary register occurs in the EXE phase while updates due to post-increment addressing occur in the D2 phase. Thus I3 cannot use the auxiliary register or there will be a conflict. In the case of a conflict, the update due to address-mode post increment will win and the auxiliary register will not be updated with #\_X.

- **I4**

Starting with the 4th instruction MAR0 or MAR1 will have the new value.

**Example 5-2. Code Fragment for Loading MAR0 or MAR1**

```

; Assume MAR0 is 50 and #_X is 20

MMOVI16 MAR0, #_X ; Load MAR0 with address of X (20)
<Instruction 1> ; I1 Will use the old value of MAR0 (50)
<Instruction 2> ; I2 Will use the old value of MAR0 (50)
<Instruction 3> ; I3 Cannot use MAR0
<Instruction 4> ; I4 Will use the new value of MAR0 (20)
<Instruction 5> ; I5 Will use the new value of MAR0 (20)
....

```

### 5.5.2.1 ADC Early Interrupt to CLA Response

The ADC offers the option to generate an early interrupt pulse when the ADC begins conversion. This option is selected by setting the ADCCTL1[INTPULSEPOS] bit as documented in the Analog-to-Digital Converter and Comparator section in this manual. If this option is used to start a CLA task then the CLA will be able to read the result as soon as the conversion completes and the ADC result register updates. This just-in-time sampling along with the low interrupt response of the CLA enable faster system response and higher frequency control loops.

The timing for the ADC conversion is shown in the ADC Reference Guide timing diagrams. If the ADCCLK is a divided down version of the SYSCLK, the user will have to account for the conversion time in SYSCLK cycles. For example, if using the 12-bit ADC with ADCCLK at  $\frac{1}{4}$  SYSCLK, it would take 10.5 ADCCLK (42 SYSCLK) cycles to complete a conversion. If using the ADC in 16-bit mode at the same ADCCLK, it would take 29.5 ADCCLK (118 SYSCLK) cycles, and so on.

From a CLA perspective, the pipeline activity is shown in Table 5-4 an n-cycle (SYSCLK) conversion. The nth-2 instruction is in the R2 phase just in time to read the result register. While the previous n-3 instructions in the task (I1 to I<sub>n-3</sub>) will enter the R2 phase of the pipeline too soon to read the conversion, they can be efficiently used for pre-processing calculations needed by the task.

**Table 5-4. ADC to CLA Early Interrupt Response**

ADC Activity	CLA Activity	F1	F2	D1	D2	R1	R2	E	W
Sample									
Sample									
...									
Sample									
Conversion (1)	Interrupt Received								
Conversion (2)	Task Startup								
Conversion (3)	Task Startup								
Conversion (4)	I1	I1							
Conversion (5)	I2	I2	I1						
Conversion (6)	I3	I3	I2	I1					
Conversion (7)	...	...	...	...	...	...	...		
Conversion (n-6)	I(n-6)	I(n-6)							
Conversion (n-5)	I(n-5)	I(n-5)	I(n-6)						
Conversion (n-4)	I(n-4)	I(n-4)	I(n-5)	I(n-6)					
Conversion (n-3)	I(n-3)	I(n-3)	I(n-4)	I(n-5)	I(n-6)				
Conversion (n-2)	I(n-2) Read ADC RESULT	I(n-2)	I(n-3)	I(n-4)	I(n-5)	I(n-6)			
Conversion (n-1)			I(n-2)	I(n-3)	I(n-4)	I(n-5)	I(n-6)		
Conversion (n)				I(n-2)	I(n-3)	I(n-4)	I(n-5)		
Conversion Complete					I(n-2)	I(n-3)	I(n-4)		
RESULT Latched						I(n-2)	I(n-3)		
RESULT Available							I(n-2)		

### 5.5.3 Parallel Instructions

Parallel instructions are single opcodes that perform two operations in parallel. The following types of parallel instructions are available: math operation in parallel with a move operation, or two math operations in parallel. Both operations complete in a single cycle and there are no special pipeline alignment requirements.

#### Example 5-3. Math Operation with Parallel Load

```

; MADD32 || MMOV32 instruction: 32-bit floating-point add with parallel move
; MADD32 is a 1 cycle operation
; MMOV32 is a 1 cycle operation
      MADD32    MR0, MR1, #2    ; MR0 = MR1 + 2,
    
```

**Example 5-3. Math Operation with Parallel Load (continued)**

```

|| MMOV32 MR1, @Val ; MR1 gets the contents of Val
; <-- MMOV32 completes here (MR1 is valid)
; <-- DDF32 completes here (MR0 is valid)
MMPYF32 MR0, MR0, MR1 ; Any instruction, can use MR1 and/or MR0

```

**Example 5-4. Multiply with Parallel Add**

```

; MMPYF32 || MADDF32 instruction: 32-bit floating-point multiply with parallel add
; MMPYF32 is a 1 cycle operation
; MADDF32 is a 1 cycle operation
MMPYF32 MR0, MR1, MR3 ; MR0 = MR1 * MR3
|| MADDF32 MR1, MR2, MR0 ; MR1 = MR2 + MR0 (Uses value of MR0 before MMPYF32)
; <-- MMPYF32 and MADDF32 complete here (MR0 and MR1 are valid)
MMPYF32 MR1, MR1, MR0 ; Any instruction, can use MR1 and/or MR0

```

## 5.6 Instruction Set

This section describes the assembly language instructions of the control law accelerator. Also described are parallel operations, conditional operations, resource constraints, and addressing modes. The instructions listed here are independent from C28x and C28x+FPU instruction sets.

### 5.6.1 Instruction Descriptions

This section gives detailed information on the instruction set. Each instruction may present the following information:

- Operands
- Opcode
- Description
- Exceptions
- Pipeline
- Examples
- See also

The example INSTRUCTION is shown to familiarize you with the way each instruction is described. The example describes the kind of information you will find in each part of the individual instruction description and where to obtain more information. CLA instructions follow the same format as the C28x; the source operand(s) are always on the right and the destination operand(s) are on the left.

The explanations for the syntax of the operands used in the instruction descriptions for the C28x CLA are given in [Table 5-5](#).

**Table 5-5. Operand Nomenclature**

Symbol	Description
#16FHi	16-bit immediate (hex or float) value that represents the upper 16-bits of an IEEE 32-bit floating-point value. Lower 16-bits of the mantissa are assumed to be zero.
#16FHiHex	16-bit immediate hex value that represents the upper 16-bits of an IEEE 32-bit floating-point value. Lower 16-bits of the mantissa are assumed to be zero.
#16FLoHex	A 16-bit immediate hex value that represents the lower 16-bits of an IEEE 32-bit floating-point value
#32Fhex	32-bit immediate value that represents an IEEE 32-bit floating-point value
#32F	Immediate float value represented in floating-point representation
#0.0	Immediate zero
#SHIFT	Immediate value of 1 to 32 used for arithmetic and logical shifts.
addr	Opcode field indicating the addressing mode
CNDF	Condition to test the flags in the MSTF register
FLAG	Selected flags from MSTF register (OR) 8 bit mask indicating which floating-point status flags to change
MAR0	auxiliary register 0
MAR1	auxiliary register 1
MARx	Either MAR0 or MAR1
mem16	16-bit memory location accessed using direct, indirect, or offset addressing modes
mem32	32-bit memory location accessed using direct, indirect, or offset addressing modes
MRa	MR0 to MR3 registers
MRb	MR0 to MR3 registers
MRc	MR0 to MR3 registers
MRd	MR0 to MR3 registers
MRe	MR0 to MR3 registers
MRf	MR0 to MR3 registers
MSTF	CLA Floating-point Status Register
shift	Opcode field indicating the number of bits to shift.
VALUE	Flag value of 0 or 1 for selected flag (OR) 8 bit mask indicating the flag value; 0 or 1

Each instruction has a table that gives a list of the operands and a short description. Instructions always have their destination operand(s) first followed by the source operand(s).

**Table 5-6. INSTRUCTION dest, source1, source2 Short Description**

	Description
dest1	Description for the 1st operand for the instruction
source1	Description for the 2nd operand for the instruction
source2	Description for the 3rd operand for the instruction
Opcode	This section shows the opcode for the instruction
Description	Detailed description of the instruction execution is described. Any constraints on the operands imposed by the processor or the assembler are discussed.
Restrictions	Any constraints on the operands or use of the instruction imposed by the processor are discussed.
Pipeline	This section describes the instruction in terms of pipeline cycles as described in <a href="#">Section 5.5</a>
Example	Examples of instruction execution. If applicable, register and memory values are given before and after instruction execution. Some examples are code fragments while other examples are full tasks that assume the CLA is correctly configured and the main CPU has passed it data.
Operands	Each instruction has a table that gives a list of the operands and a short description. Instructions always have their destination operand(s) first followed by the source operand(s).

## 5.6.2 Addressing Modes and Encoding

The CLA uses the same address to access data and registers as the main CPU. For example if the main CPU accesses an ePWM register at address 0x00 6800, then the CLA will access it using address 0x6800. Since all CLA accessible memory and registers are within the low 64k x 16 of memory, only the low 16-bits of the address are used by the CLA.

To address the CLA data memory, message RAMs and shared peripherals, the CLA supports two addressing modes:

- Direct addressing mode: Uses the address of the variable or register directly.
- Indirect addressing with 16-bit post increment. This mode uses either XAR0 or XAR1.

The CLA does not use a data page pointer or a stack pointer. The two addressing modes are encoded as shown [Table 5-7](#).

**Table 5-7. Addressing Modes**

Addressing Mode	'addr' Opcode Field Encode <sup>(1)</sup>	Description
@dir	0000	<p><b>Direct Addressing Mode</b></p> <p>Example 1: MMOV32 MR1, @_VarA</p> <p>Example 2: MMOV32 MR1, @_EPwm1Regs.CMPA.all</p> <p>In this case the 'm m m m m m m m m m m m m m m m' opcode field will be populated with the 16-bit address of the variable. This is the low 16-bits of the address that you would use to access the variable using the main CPU.</p> <p>For example @_VarA will populate the address of the variable VarA. and @_EPwm1Regs.CMPA.all will populate the address of the CMPA register.</p>
*MAR0[#imm16]++	0001	<p><b>MAR0 Indirect Addressing with 16-bit Immediate Post Increment</b></p>
*MAR1[#imm16]++	0010	<p><b>MAR1 Indirect Addressing with 16-bit Immediate Post Increment</b></p> <p>addr = MAR0 (or MAR1) Access memory using the address stored in MAR0 (or MAR1).  MAR0 (or MAR1) += Then post increment MAR0 (or MAR1) by #imm16.  #imm16</p> <p>Example 1: MMOV32 MR0, *MAR0[2]++</p> <p>Example 2: MMOV32 MR1, *MAR1[-2]++</p> <p>For a post increment of 0 the assembler will accept both *MAR0 and *MAR0[0]++.</p> <p>The 'm m m m m m m m m m m m m m m m' opcode field will be populated with the signed 16-bit pointer offset. For example if #imm16 is 2, then the opcode field will be 0x0002. Likewise if #imm16 is -2, then the opcode field will be 0xFFFF.</p> <p>If addition of the 16-bit immediate causes overflow, then the value will wrap around on a 16-bit boundary.</p>
*MAR0+[#imm16]	0101	<p><b>MAR0 Offset Addressing with 16-bit Immediate Offset</b></p>
*MAR1+[#imm16]	0110	<p><b>MAR1 Offset Addressing with 16-bit Immediate Offset</b></p> <p>addr = MAR0 Add the offset #imm16  (or MAR1) + #imm16to address stored in MAR0(MAR1) to access the desired memory  the base location</p> <p>Example 1: MMOV32 MR0, *MAR0+[2]</p> <p>Example 1: MMOV32 MR1, *MAR1+[-2]</p> <p>The 'm m m m m m m m m m m m m m m m' opcode field will be populated with the signed 16-bit pointer offset. For example if #imm16 is 2, then the opcode field will be 0x0002. Likewise if #imm16 is -2, then the opcode field will be 0xFFFF.</p> <p>If the addition of the 16-bit immediate causes overflow, the value will wrap around on a 16-bit boundary.</p>

<sup>(1)</sup> Values not shown are reserved.

Encoding for the shift fields in the MASR32, MLRS32 and MLSL32 instructions is shown in [Table 5-8](#)

**Table 5-8. Shift Field Encoding**

Shift Value	'shift' Opcode Field Encode
1	0000
2	0001
3	0010
....	....
32	1111

Table 5-10 shows the condition field encoding for conditional instructions such as MNEGF, MSWAPF, MBCNDD, MCCNDD, and MRCNDD.

For instructions that use MRx (where x could be 'a' through 'f') as operands, the trailing alphabet appears in the opcode as a two-bit field.

For example,

MMPYF32 MRa, MRb, MRc||MADDF32 MRd, MRe, MRf

whose opcode is

LSW: 0000 ffee ddcc bbaa

MSW: 0111 1010 0000 0000

the two-bit field specifies one of four working registers according to the following table:

**Table 5-9. Operand Encoding**

Two-bit Field	Working Register
b'00	MR0
b'01	MR1
b'10	MR2
b'11	MR3

**Table 5-10. Condition Field Encoding**

Encode <sup>(1)</sup>	CNDF	Description	MSTF Flags Tested
0000	NEQ	Not equal to zero	ZF == 0
0001	EQ	Equal to zero	ZF == 1
0010	GT	Greater than zero	ZF == 0 AND NF == 0
0011	GEQ	Greater than or equal to zero	NF == 0
0100	LT	Less than zero	NF == 1
0101	LEQ	Less than or equal to zero	ZF == 1 OR NF == 1
1010	TF	Test flag set	TF == 1
1011	NTF	Test flag not set	TF == 0
1100	LU	Latched underflow	LUF == 1
1101	LV	Latched overflow	LVF == 1
1110	UNC	Unconditional	None
1111	UNCF <sup>(2)</sup>	Unconditional with flag modification	None

<sup>(1)</sup> Values not shown are reserved.

<sup>(2)</sup> This is the default operation if no CNDF field is specified. This condition will allow the ZF and NF flags to be modified when a conditional operation is executed. All other conditions will not modify these flags.



### 5.6.3 Instructions

The instructions are listed alphabetically, preceded by a summary.

**Table 5-11. General Instructions**

Title	Page
<b>MABSF32 MRa, MRb</b> — 32-Bit Floating-Point Absolute Value .....	635
<b>MADD32 MRa, MRb, MRc</b> — 32-Bit Integer Add .....	636
<b>MADDF32 MRa, #16FHi, MRb</b> — 32-Bit Floating-Point Addition .....	637
<b>MADDF32 MRa, MRb, #16FHi</b> — 32-Bit Floating-Point Addition .....	638
<b>MADDF32 MRa, MRb, MRc</b> — 32-Bit Floating-Point Addition .....	640
<b>MADDF32 MRd, MRe, MRf   MMOV32 mem32, MRa</b> — 32-Bit Floating-Point Addition with Parallel Move.....	641
<b>MADDF32 MRd, MRe, MRf   MMOV32 MRa, mem32</b> — 32-Bit Floating-Point Addition with Parallel Move.....	642
<b>MAND32 MRa, MRb, MRc</b> — Bitwise AND.....	644
<b>MASR32 MRa, #SHIFT</b> — Arithmetic Shift Right .....	645
<b>MBCNDD 16BitDest {, CNDF}</b> — Branch Conditional Delayed .....	646
<b>MCCNDD 16BitDest {, CNDF}</b> — Call Conditional Delayed .....	651
<b>MCMP32 MRa, MRb</b> — 32-Bit Integer Compare for Equal, Less Than or Greater Than.....	655
<b>MCMPF32 MRa, MRb</b> — 32-Bit Floating-Point Compare for Equal, Less Than or Greater Than.....	656
<b>MCMPF32 MRa, #16FHi</b> — 32-Bit Floating-Point Compare for Equal, Less Than or Greater Than.....	657
<b>MDEBUGSTOP</b> — Debug Stop Task.....	659
<b>MEALLOW</b> — Enable CLA Write Access to EALLOW Protected Registers .....	660
<b>MEDIS</b> — Disable CLA Write Access to EALLOW Protected Registers .....	661
<b>MEINVF32 MRa, MRb</b> — 32-Bit Floating-Point Reciprocal Approximation.....	662
<b>MEISQRTF32 MRa, MRb</b> — 32-Bit Floating-Point Square-Root Reciprocal Approximation .....	663
<b>MF32TOI16 MRa, MRb</b> — Convert 32-Bit Floating-Point Value to 16-Bit Integer .....	664
<b>MF32TOI16R MRa, MRb</b> — Convert 32-Bit Floating-Point Value to 16-Bit Integer and Round .....	665
<b>MF32TOI32 MRa, MRb</b> — Convert 32-Bit Floating-Point Value to 32-Bit Integer .....	666
<b>MF32TOUI16 MRa, MRb</b> — Convert 32-Bit Floating-Point Value to 16-bit Unsigned Integer .....	667
<b>MF32TOUI16R MRa, MRb</b> — Convert 32-Bit Floating-Point Value to 16-bit Unsigned Integer and Round .....	668
<b>MF32TOUI32 MRa, MRb</b> — Convert 32-Bit Floating-Point Value to 32-Bit Unsigned Integer .....	669
<b>MFRACF32 MRa, MRb</b> — Fractional Portion of a 32-Bit Floating-Point Value .....	670
<b>MI16TOF32 MRa, MRb</b> — Convert 16-Bit Integer to 32-Bit Floating-Point Value .....	671
<b>MI16TOF32 MRa, mem16</b> — Convert 16-Bit Integer to 32-Bit Floating-Point Value .....	672
<b>MI32TOF32 MRa, mem32</b> — Convert 32-Bit Integer to 32-Bit Floating-Point Value .....	673
<b>MI32TOF32 MRa, MRb</b> — Convert 32-Bit Integer to 32-Bit Floating-Point Value .....	674
<b>MLSL32 MRa, #SHIFT</b> — Logical Shift Left .....	675
<b>MLSR32 MRa, #SHIFT</b> — Logical Shift Right .....	676
<b>MMACF32 MR3, MR2, MRd, MRe, MRf   MMOV32 MRa, mem32</b> — 32-Bit Floating-Point Multiply and Accumulate with Parallel Move .....	677
<b>MMAXF32 MRa, MRb</b> — 32-Bit Floating-Point Maximum .....	680
<b>MMAXF32 MRa, #16FHi</b> — 32-Bit Floating-Point Maximum .....	682
<b>MMINF32 MRa, MRb</b> — 32-Bit Floating-Point Minimum .....	683
<b>MMINF32 MRa, #16FHi</b> — 32-Bit Floating-Point Minimum .....	685
<b>MMOV16 MARx, MRa, #16I</b> — Load the Auxiliary Register with MRa + 16-bit Immediate Value .....	686
<b>MMOV16 MARx, mem16</b> — Load MAR1 with 16-bit Value .....	689
<b>MMOV16 mem16, MARx</b> — Move 16-Bit Auxiliary Register Contents to Memory.....	691
<b>MMOV16 mem16, MRa</b> — Move 16-Bit Floating-Point Register Contents to Memory .....	692
<b>MMOV32 mem32, MRa</b> — Move 32-Bit Floating-Point Register Contents to Memory .....	694
<b>MMOV32 mem32, MSTF</b> — Move 32-Bit MSTF Register to Memory .....	695
<b>MMOV32 MRa, mem32 {, CNDF}</b> — Conditional 32-Bit Move .....	696
<b>MMOV32 MRa, MRb {, CNDF}</b> — Conditional 32-Bit Move .....	698

**Table 5-11. General Instructions (continued)**

<b>MMOV32 MSTF, mem32</b> —Move 32-Bit Value from Memory to the MSTF Register .....	700
<b>MMOVED32 MRa, mem32</b> —Move 32-Bit Value from Memory with Data Copy .....	701
<b>MMOV32 MRa, #32F</b> —Load the 32-Bits of a 32-Bit Floating-Point Register .....	702
<b>MMOV16 MARx, #16I</b> —Load the Auxiliary Register with the 16-Bit Immediate Value .....	703
<b>MMOV32 MRa, #32FHex</b> —Load the 32-Bits of a 32-Bit Floating-Point Register with the Immediate.....	704
<b>MMOV32 MRa, #16FHi</b> —Load the Upper 16-Bits of a 32-Bit Floating-Point Register .....	705
<b>MMOVZ16 MRa, mem16</b> —Load MRx With 16-bit Value.....	706
<b>MMOVXI MRa, #16FLoHex</b> —Move Immediate to the Low 16-Bits of a Floating-Point Register .....	707
<b>MMPYF32 MRa, MRb, MRc</b> —32-Bit Floating-Point Multiply.....	708
<b>MMPYF32 MRa, #16FHi, MRb</b> —32-Bit Floating-Point Multiply .....	709
<b>MMPYF32 MRa, MRb, #16FHi</b> —32-Bit Floating-Point Multiply .....	711
<b>MMPYF32 MRa, MRb, MRc  MADDF32 MRd, MRe, MRf</b> —32-Bit Floating-Point Multiply with Parallel Add.....	713
<b>MMPYF32 MRd, MRe, MRf   MMOV32 MRa, mem32</b> —32-Bit Floating-Point Multiply with Parallel Move .....	715
<b>MMPYF32 MRd, MRe, MRf   MMOV32 mem32, MRa</b> —32-Bit Floating-Point Multiply with Parallel Move .....	717
<b>MMPYF32 MRa, MRb, MRc   MSUBF32 MRd, MRe, MRf</b> —32-Bit Floating-Point Multiply with Parallel Subtract.....	718
<b>MNEGF32 MRa, MRb{, CNDF}</b> —Conditional Negation .....	719
<b>MNOP</b> —No Operation .....	721
<b>MOR32 MRa, MRb, MRc</b> —Bitwise OR .....	722
<b>MRCNDD {CNDF}</b> —Return Conditional Delayed .....	723
<b>MSETFLG FLAG, VALUE</b> —Set or Clear Selected Floating-Point Status Flags .....	727
<b>MSTOP</b> —Stop Task .....	728
<b>MSUB32 MRa, MRb, MRc</b> —32-Bit Integer Subtraction .....	730
<b>MSUBF32 MRa, MRb, MRc</b> —32-Bit Floating-Point Subtraction .....	731
<b>MSUBF32 MRa, #16FHi, MRb</b> —32-Bit Floating-Point Subtraction .....	732
<b>MSUBF32 MRd, MRe, MRf   MMOV32 MRa, mem32</b> —32-Bit Floating-Point Subtraction with Parallel Move .....	733
<b>MSUBF32 MRd, MRe, MRf   MMOV32 mem32, MRa</b> —32-Bit Floating-Point Subtraction with Parallel Move .....	734
<b>MSWAPF MRa, MRb {, CNDF}</b> —Conditional Swap .....	735
<b>MTESTTF CNDF</b> —Test MSTF Register Flag Condition.....	737
<b>MUI16TOF32 MRa, mem16</b> —Convert Unsigned 16-Bit Integer to 32-Bit Floating-Point Value .....	739
<b>MUI16TOF32 MRa, MRb</b> —Convert Unsigned 16-Bit Integer to 32-Bit Floating-Point Value .....	740
<b>MUI32TOF32 MRa, mem32</b> —Convert Unsigned 32-Bit Integer to 32-Bit Floating-Point Value .....	741
<b>MUI32TOF32 MRa, MRb</b> —Convert Unsigned 32-Bit Integer to 32-Bit Floating-Point Value .....	742
<b>MXOR32 MRa, MRb, MRc</b> —Bitwise Exclusive Or .....	743

## MABSF32 MRa, MRb 32-Bit Floating-Point Absolute Value

### Operands

MRa	CLA floating-point destination register (MR0 to MR3)
MRb	CLA floating-point source register (MR0 to MR3)

### Opcode

LSW: 0000 0000 0000 bbaa  
MSW: 0111 1110 0010 0000

### Description

The absolute value of MRb is loaded into MRa. Only the sign bit of the operand is modified by the MABSF32 instruction.

```
if (MRb < 0) {MRa = -MRb};
else {MRa = MRb};
```

### Flags

This instruction modifies the following flags in the MSTF register:

Flag	TF	ZF	NF	LUF	LVF
Modified	No	Yes	Yes	No	No

The MSTF register flags are modified as follows:

```
NF = 0;
ZF = 0;
if ( MRa(30:23) == 0) ZF = 1;
```

### Pipeline

This is a single-cycle instruction.

### Example

```
MMOVIZ MR0, #-2.0 ; MR0 = -2.0 (0xC0000000)
MABSF32 MR0, MR0 ; MR0 = 2.0 (0x40000000), ZF = NF = 0
```

```
MMOVIZ MR0, #5.0 ; MR0 = 5.0 (0x40A00000)
MABSF32 MR0, MR0 ; MR0 = 5.0 (0x40A00000), ZF = NF = 0
```

```
MMOVIZ MR0, #0.0 ; MR0 = 0.0
MABSF32 MR0, MR0 ; MR0 = 0.0 ZF = 1, NF = 0
```

### See also

[MNEGF32 MRa, MRb {, CNDF}](#)

**MADD32 MRa, MRb, MRc 32-Bit Integer Add**
**Operands**

MRa	CLA floating-point destination register (MR0 to MR3)
MRb	CLA floating-point destination register (MR0 to MR3)
MRc	CLA floating-point destination register (MR0 to MR3)

**Opcode**

```
LSW: 0000 0000 000cc bbaa
MSW: 0111 1110 1100 0000
```

**Description**

32-bit integer addition of MRb and MRc.

```
MRa(31:0) = MRb(31:0) + MRc(31:0);
```

**Flags**

This instruction modifies the following flags in the MSTF register:

Flag	TF	ZF	NF	LUF	LVF
Modified	No	Yes	Yes	No	No

The MSTF register flags are modified based on the integer results of the operation.

```
NF = MRa(31);
ZF = 0;
if(MRa(31:0) == 0) { ZF = 1; };
```

**Pipeline**

This is a single-cycle instruction.

**Example**

```
; Given A = (int32)1
;      B = (int32)2
;      C = (int32)-7
;
; Calculate Y2 = A + B + C
;
_ClalTask1:
    MMOV32 MR0, @_A      ; MR0 = 1 (0x00000001)
    MMOV32 MR1, @_B      ; MR1 = 2 (0x00000002)
    MMOV32 MR2, @_C      ; MR2 = -7 (0xFFFFFFFF9)
    MADD32 MR3, MR0, MR1 ; A + B
    MADD32 MR3, MR2, MR3 ; A + B + C = -4 (0xFFFFFFFFC)
    MMOV32 @_y2, MR3     ; Store y2
    MSTOP                ; end of task
```

**See also**

[MAND32 MRa, MRb, MRc](#)  
[MASR32 MRa, #SHIFT](#)  
[MLSL32 MRa, #SHIFT](#)  
[MLSR32 MRa, #SHIFT](#)  
[MOR32 MRa, MRb, MRc](#)  
[MXOR32 MRa, MRb, MRc](#)  
[MSUB32 MRa, MRb, MRc](#)

## MADDF32 MRa, #16FHi, MRb 32-Bit Floating-Point Addition

### Operands

MRa	CLA floating-point destination register (MR0 to MR3)
#16FHi	A 16-bit immediate value that represents the upper 16-bits of an IEEE 32-bit floating-point value. The low 16-bits of the mantissa are assumed to be all 0.
MRb	CLA floating-point source register (MR0 to MR3)

### Opcode

LSW: I I I I I I I I I I I I I I I I I I  
MSW: 0111 0111 1100 bbaa

### Description

Add MRb to the floating-point value represented by the immediate operand. Store the result of the addition in MRa.

#16FHi is a 16-bit immediate value that represents the upper 16-bits of an IEEE 32-bit floating-point value. The low 16-bits of the mantissa are assumed to be all 0. #16FHi is most useful for representing constants where the lowest 16-bits of the mantissa are 0. Some examples are 2.0 (0x40000000), 4.0 (0x40800000), 0.5 (0x3F000000), and -1.5 (0xBFC00000). The assembler will accept either a hex or float as the immediate value. That is, the value -1.5 can be represented as #-1.5 or #0xBFC0.

MRa = MRb + #16FHi:0;

This instruction can also be written as MADDF32 MRa, MRb, #16FHi.

### Flags

This instruction modifies the following flags in the MSTF register:

Flag	TF	ZF	NF	LUF	LVF
Modified	No	No	No	Yes	Yes

The MSTF register flags are modified as follows:

- LUF = 1 if MADDF32 generates an underflow condition.
- LVF = 1 if MADDF32 generates an overflow condition.

### Pipeline

This is a single-cycle instruction.

### Example

```
; Add to MR1 the value 2.0 in 32-bit floating-point format
; Store the result in MR0
MADDF32 MR0, #2.0, MR1 ; MR0 = 2.0 + MR1

; Add to MR3 the value -2.5 in 32-bit floating-point format
; Store the result in MR2
MADDF32 MR2, #-2.5, MR3 ; MR2 = -2.5 + MR3

; Add to MR3 the value 0x3FC00000 (1.5)
; Store the result in MR3
MADDF32 MR3, #0x3FC0, MR3 ; MR3 = 1.5 + MR3
```

### See also

[MADDF32 MRa, MRb, #16FHi](#)  
[MADDF32 MRa, MRb, MRc](#)  
[MADDF32 MRd, MRe, MRf || MMOV32 MRa, mem32](#)  
[MADDF32 MRd, MRe, MRf || MMOV32 mem32, MRa](#)  
[MMPYF32 MRa, MRb, MRc || MADDF32 MRd, MRe, MRf](#)

**MADDF32 MRa, MRb, #16FHi 32-Bit Floating-Point Addition**
**Operands**

MRa	CLA floating-point destination register (MR0 to MR3)
MRb	CLA floating-point source register (MR0 to MR3)
#16FHi	A 16-bit immediate value that represents the upper 16-bits of an IEEE 32-bit floating-point value. The low 16-bits of the mantissa are assumed to be all 0.

**Opcode**

```
LSW: I I I I I I I I I I I I I I I I
MSW: 0 1 1 1 0 1 1 1 1 1 0 0 b b a a
```

**Description**

Add MRb to the floating-point value represented by the immediate operand. Store the result of the addition in MRa.

#16FHi is a 16-bit immediate value that represents the upper 16-bits of an IEEE 32-bit floating-point value. The low 16-bits of the mantissa are assumed to be all 0. #16FHi is most useful for representing constants where the lowest 16-bits of the mantissa are 0. Some examples are 2.0 (0x40000000), 4.0 (0x40800000), 0.5 (0x3F000000), and -1.5 (0xBFC00000). The assembler will accept either a hex or float as the immediate value. That is, the value -1.5 can be represented as #-1.5 or #0xBFC0.

```
MRa = MRb + #16FHi:0;
```

This instruction can also be written as MADDF32 MRa, #16FHi, MRb.

**Flags**

This instruction modifies the following flags in the MSTF register:

Flag	TF	ZF	NF	LUF	LVF
Modified	No	No	No	Yes	Yes

The MSTF register flags are modified as follows:

- LUF = 1 if MADDF32 generates an underflow condition.
- LVF = 1 if MADDF32 generates an overflow condition.

**Pipeline**

This is a single-cycle instruction.

**Example 1**

```
; X is an array of 32-bit floating-point values
; Find the maximum value in an array X
; and store it in Result
;
_ClalTask1:
    MMOV16    MAR1,#_X          ; Start address
    MUI16TOF32 MR0, @_len      ; Length of the array
    MNOP
    MNOP          ; delay for MAR1 load
    MMOV32    MR1, *MAR1[2]++  ; MR1 = X0
LOOP
    MMOV32    MR2, *MAR1[2]++  ; MR2 = next element
    MMAXF32   MR1, MR2         ; MR1 = MAX(MR1, MR2)
    MADDF32   MR0, MR0, #-1.0  ; Decrement the counter
    MCMPPF32  MR0 #0.0         ; Set/clear flags for MBCNDD
    MNOP
    MNOP
    MNOP
    MBCNDD   LOOP, NEQ         ; Branch if not equal to zero
    MMOV32   @_Result, MR1     ; Always executed
    MNOP          ; Always executed
    MNOP          ; Always executed
    MSTOP
```

**Example 2**

```
; Show the basic operation of MADDF32
;
; Add to MR1 the value 2.0 in 32-bit floating-point format
; Store the result in MR0
    MADDF32 MR0, MR1, #2.0    ; MR0 = MR1 + 2.0

; Add to MR3 the value -2.5 in 32-bit floating-point format
; Store the result in MR2
    MADDF32 MR2, MR3, #-2.5  ; MR2 = MR3 + (-2.5)

; Add to MR0 the value 0x3FC00000 (1.5)
; Store the result in MR0
    MADDF32 MR0, MR0, #0x3FC0 ; MR0 = MR0 + 1.5
```

**See also**

[MADDF32 MRa, #16FHi, MRb](#)  
[MADDF32 MRa, MRb, MRc](#)  
[MADDF32 MRd, MRe, MRf || MMOV32 MRa, mem32](#)  
[MADDF32 MRd, MRe, MRf || MMOV32 mem32, MRa](#)  
[MMPYF32 MRa, MRb, MRc || MADDF32 MRd, MRe, MRf](#)

**MADDF32 MRa, MRb, MRc 32-Bit Floating-Point Addition**
**Operands**

MRa	CLA floating-point destination register (MR0 to MR3)
MRb	CLA floating-point source register (MR0 to MR3)
MRc	CLA floating-point source register (MR0 to MR3)

**Opcode**

```
LSW: 000 0000 00cc bbaa
MSW: 0111 1100 0010 0000
```

**Description**

Add the contents of MRc to the contents of MRb and load the result into MRa.

$$MRa = MRb + MRc;$$
**Flags**

This instruction modifies the following flags in the MSTF register:

Flag	TF	ZF	NF	LUF	LVF
Modified	No	No	No	Yes	Yes

The MSTF register flags are modified as follows:

- LUF = 1 if MADDF32 generates an underflow condition.
- LVF = 1 if MADDF32 generates an overflow condition.

**Pipeline**

This is a single-cycle instruction.

**Example**

```
; Given M1, X1 and B1 are 32-bit floating point numbers
; Calculate Y1 = M1*X1+B1
;
_ClalTask1:
  MMOV32 MR0,@M1      ; Load MR0 with M1
  MMOV32 MR1,@X1      ; Load MR1 with X1
  MMPYF32 MR1,MR1,MR0 ; Multiply M1*X1
|| MMOV32 MR0,@B1     ; and in parallel load MR0 with B1
  MADDF32 MR1,MR1,MR0 ; Add M*X1 to B1 and store in MR1
  MMOV32 @Y1,MR1     ; Store the result
  MSTOP              ; end of task
```

**See also**

[MADDF32 MRa, #16FHi, MRb](#)  
[MADDF32 MRa, MRb, #16FHi](#)  
[MADDF32 MRd, MRe, MRf || MMOV32 MRa, mem32](#)  
[MADDF32 MRd, MRe, MRf || MMOV32 mem32, MRa](#)  
[MMPYF32 MRa, MRb, MRc || MADDF32 MRd, MRe, MRf](#)



## MADDF32 MRd, MRe, MRf||MMOV32 mem32, MRa 32-Bit Floating-Point Addition with Parallel Move

### Operands

MRd	CLA floating-point destination register for the MADDF32 (MR0 to MR3)
MRe	CLA floating-point source register for the MADDF32 (MR0 to MR3)
MRf	CLA floating-point source register for the MADDF32 (MR0 to MR3)
mem32	32-bit memory location accessed using one of the available addressing modes. This will be the destination of the MMOV32.
MRa	CLA floating-point source register for the MMOV32 (MR0 to MR3)

### Opcode

LSW: mmmm mmmm mmmm mmmm  
MSW: 0101 ffee ddaa addr

### Description

Perform an MADDF32 and a MMOV32 in parallel. Add MRf to the contents of MRe and store the result in MRd. In parallel move the contents of MRa to the 32-bit location mem32.

MRd = MRe + MRf;  
[mem32] = MRa;

### Flags

This instruction modifies the following flags in the MSTF register:

Flag	TF	ZF	NF	LUF	LVF
Modified	No	No	No	Yes	Yes

The MSTF register flags are modified as follows:

- LUF = 1 if MADDF32 generates an underflow condition.
- LVF = 1 if MADDF32 generates an overflow condition.

### Pipeline

Both MADDF32 and MMOV32 complete in a single cycle.

### Example

```
; Given A, B and C are 32-bit floating-point numbers
; Calculate Y2 = (A * B)
;           Y3 = (A * B) + C
;
;_ClalTask2:
    MMOV32  MR0, @_A      ; Load MR0 with A
    MMOV32  MR1, @_B      ; Load MR1 with B
    MMPYF32 MR1, MR1, MR0 ; Multiply A*B
| | MMOV32  MR0, @_C      ; and in parallel load MR0 with C
    MADDF32 MR1, MR1, MR0 ; Add (A*B) to C
| | MMOV32  @_Y2, MR1     ; and in parallel store A*B
    MMOV32  @_Y3, MR1     ; Store the A*B + C
    MSTOP                ; end of task
```

### See also

[MADDF32 MRa, #16FHi, MRb](#)  
[MADDF32 MRa, MRb, #16FHi](#)  
[MADDF32 MRa, MRb, MRc](#)  
[MMPYF32 MRa, MRb, MRc || MADDF32 MRd, MRe, MRf](#)  
[MADDF32 MRd, MRe, MRf || MMOV32 MRa, mem32](#)

**MADDF32 MRd, MRe, MRf ||MMOV32 MRa, mem32 32-Bit Floating-Point Addition with Parallel Move**
**Operands**

MRd	CLA floating-point destination register for the MADDF32 (MR0 to MR3). MRd cannot be the same register as MRa.
MRe	CLA floating-point source register for the MADDF32 (MR0 to MR3)
MRf	CLA floating-point source register for the MADDF32 (MR0 to MR3)
MRa	CLA floating-point destination register for the MMOV32 (MR0 to MR3). MRa cannot be the same register as MRd.
mem32	32-bit memory location accessed using one of the available addressing modes. This is the source for the MMOV32.

**Opcode**

```
LSW: mmmm mmmm mmmm mmmm
MSW: 0001 ffee ddaa addr
```

**Description**

Perform an MADDF32 and a MMOV32 operation in parallel. Add MRf to the contents of MRe and store the result in MRd. In parallel move the contents of the 32-bit location mem32 to MRa.

```
MRd = MRe + MRf;
MRa = [mem32];
```

**Restrictions**

The destination register for the MADDF32 and the MMOV32 must be unique. That is, MRa and MRd cannot be the same register.

**Flags**

This instruction modifies the following flags in the MSTF register:

Flag	TF	ZF	NF	LUF	LVF
Modified	No	Yes	Yes	Yes	Yes

The MSTF register flags are modified as follows:

- LUF = 1 if MADDF32 generates an underflow condition.
- LVF = 1 if MADDF32 generates an overflow condition.

The MMOV32 Instruction will set the NF and ZF flags as follows:

```
NF = MRa(31);
ZF = 0;
if(MRa(30:23) == 0) { ZF = 1; NF = 0; };
```

**Pipeline**

The MADDF32 and the MMOV32 both complete in a single cycle.

**Example 1**

```
; Given A, B and C are 32-bit floating-point numbers
; Calculate Y1 = A + 4B
;           Y2 = A + C
;
_ClalTask1:
    MMOV32 MR0, @A           ; Load MR0 with A
    MMOV32 MR1, @B           ; Load MR1 with B
    MMPYF32 MR1, MR1, #4.0 ; Multiply 4 * B
|| MMOV32 MR2, @C           ; and in parallel load C
    MADDF32 MR3, MR0, MR1   ; Add A + 4B
    MADDF32 MR3, MR0, MR2   ; Add A + C
|| MMOV32 @Y1, MR3          ; and in parallel store A+4B
    MMOV32 @Y2, MR3         ; store A + C MSTOP
; end of task
```

**Example 2**

```

; Given A, B and C are 32-bit floating-point numbers
; Calculate Y3 = (A + B)
;           Y4 = (A + B) * C
;
_ClalTask2:
    MMOV32 MR0, @A           ; Load MR0 with A
    MMOV32 MR1, @B           ; Load MR1 with B
    MADDF32 MR1, MR1, MR0    ; Add A+B
||  MMOV32 MR0, @C           ; and in parallel load MR0 with C
    MMPYF32 MR1, MR1, MR0    ; Multiply (A+B) by C
||  MMOV32 @Y3, MR1          ; and in parallel store A+B
    MMOV32 @Y4, MR1          ; Store the (A+B) * C
    MSTOP                    ; end of task

```

**See also**

[MADDF32 MRa, #16FHi, MRb](#)  
[MADDF32 MRa, MRb, #16FHi](#)  
[MADDF32 MRa, MRb, MRc](#)  
[MADDF32 MRd, MRe, MRf || MMOV32 mem32, MRa](#)  
[MMPYF32 MRa, MRb, MRc || MADDF32 MRd, MRe, MRf](#)

**MAND32 MRa, MRb, MRc Bitwise AND**
**Operands**

MRa	CLA floating-point destination register (MR0 to MR3)
MRb	CLA floating-point source register (MR0 to MR3)
MRc	CLA floating-point source register (MR0 to MR3)

**Opcode**

```
LSW: 0000 0000 00cc bbaa
MSW: 0111 1100 0110 0000
```

**Description**

Bitwise AND of MRb with MRc.

```
MRa(31:0) = MRb(31:0) AND MRc(31:0);
```

**Flags**

This instruction modifies the following flags in the MSTF register:

Flag	TF	ZF	NF	LUF	LVF
Modified	No	Yes	Yes	No	No

The MSTF register flags are modified based on the integer results of the operation.

```
NF = MRa(31);
ZF = 0;
if(MRa(31:0) == 0) { ZF = 1; }
```

**Pipeline**

This is a single-cycle instruction.

**Example**

```
MMOVIZ MR0, #0x5555 ; MR0 = 0x5555AAAA
MMOVXI MR0, #0xAAAA

MMOVIZ MR1, #0x5432 ; MR1 = 0x5432FEDC
MMOVXI MR1, #0xFEDC

; 0101 AND 0101 = 0101 (5)
; 0101 AND 0100 = 0100 (4)
; 0101 AND 0011 = 0001 (1)
; 0101 AND 0010 = 0000 (0)
; 1010 AND 1111 = 1010 (A)
; 1010 AND 1110 = 1010 (A)
; 1010 AND 1101 = 1000 (8)
; 1010 AND 1100 = 1000 (8)

MAND32 MR2, MR1, MR0 ; MR3 = 0x5410AA88
```

**See also**

[MADD32 MRa, MRb, MRc](#)  
[MASR32 MRa, #SHIFT](#)  
[MLSL32 MRa, #SHIFT](#)  
[MLSR32 MRa, #SHIFT](#)  
[MOR32 MRa, MRb, MRc](#)  
[MXOR32 MRa, MRb, MRc](#)  
[MSUB32 MRa, MRb, MRc](#)

## MASR32 MRa, #SHIFT *Arithmetic Shift Right*

### Operands

MRa	CLA floating-point source/destination register (MR0 to MR3)
#SHIFT	Number of bits to shift (1 to 32)

### Opcode

```
LSW: 0000 0000 0shi ftaa
MSW: 0111 1011 0100 0000
```

### Description

Arithmetic shift right of MRa by the number of bits indicated. The number of bits can be 1 to 32.

```
MARa(31:0) = Arithmetic Shift(MARa(31:0) by #SHIFT bits);
```

### Flags

This instruction modifies the following flags in the MSTF register:

Flag	TF	ZF	NF	LUF	LVF
Modified	No	Yes	Yes	No	No

The MSTF register flags are modified based on the integer results of the operation.

```
NF = MRa(31);
ZF = 0;
if(MRa(31:0) == 0) { ZF = 1; }
```

### Pipeline

This is a single-cycle instruction.

### Example

```
; Given m2 = (int32)32
;         x2 = (int32)64
;         b2 = (int32)-128
;
; Calculate
;         m2 = m2/2
;         x2 = x2/4
;         b2 = b2/8
;
_ClalTask2:
    MMOV32 MR0, @_m2 ; MR0 = 32 (0x00000020)
    MMOV32 MR1, @_x2 ; MR1 = 64 (0x00000040)
    MMOV32 MR2, @_b2 ; MR2 = -128 (0xFFFFFFFF80)
    MASR32 MR0, #1 ; MR0 = 16 (0x00000010)
    MASR32 MR1, #2 ; MR1 = 16 (0x00000010)
    MASR32 MR2, #3 ; MR2 = -16 (0xFFFFFFFFF0)
    MMOV32 @_m2, MR0 ; store results
    MMOV32 @_x2, MR1
    MMOV32 @_b2, MR2
    MSTOP ; end of task
```

### See also

[MADD32 MRa, MRb, MRc](#)  
[MAND32 MRa, MRb, MRc](#)  
[MLSL32 MRa, #SHIFT](#)  
[MLSR32 MRa, #SHIFT](#)  
[MOR32 MRa, MRb, MRc](#)  
[MXOR32 MRa, MRb, MRc](#)  
[MSUB32 MRa, MRb, MRc](#)

**MBCNDD 16BitDest {, CNDF} Branch Conditional Delayed**
**Operands**

16BitDest	16-bit destination if condition is true
CNDF	Optional condition tested

**Opcode**

```
LSW: dest dest dest dest
MSW: 0111 1001 1000 cndf
```

**Description**

If the specified condition is true, then branch by adding the signed 16BitDest value to the MPC value. Otherwise, continue without branching. If the address overflows, it wraps around. Therefore a value of "0xFFFFE" will put the MPC back to the MBCNDD instruction.

Please refer to the pipeline section for important information regarding this instruction.

```
if (CNDF == TRUE) MPC += 16BitDest;
```

CNDF is one of the following conditions:

Encode <sup>(1)</sup>	CNDF	Description	MSTF Flags Tested
0000	NEQ	Not equal to zero	ZF == 0
0001	EQ	Equal to zero	ZF == 1
0010	GT	Greater than zero	ZF == 0 AND NF == 0
0011	GEQ	Greater than or equal to zero	NF == 0
0100	LT	Less than zero	NF == 1
0101	LEQ	Less than or equal to zero	ZF == 1 OR NF == 1
1010	TF	Test flag set	TF == 1
1011	NTF	Test flag not set	TF == 0
1100	LU	Latched underflow	LUF == 1
1101	LV	Latched overflow	LVF == 1
1110	UNC	Unconditional	None
1111	UNCF <sup>(2)</sup>	Unconditional with flag modification	None

<sup>(1)</sup> Values not shown are reserved.

<sup>(2)</sup> This is the default operation if no CNDF field is specified. This condition will allow the ZF and NF flags to be modified when a conditional operation is executed. All other conditions will not modify these flags.

**Restrictions**

The MBCNDD instruction is not allowed three instructions before or after a MBCNDD, MCCNDD or MRCNDD instruction. Refer to the pipeline section for more information.

**Flags**

This instruction does not modify flags in the MSTF register.

Flag	TF	ZF	NF	LUF	LVF
Modified	No	No	No	No	No

**Pipeline**

The MBCNDD instruction by itself is a single-cycle instruction. As shown in [Table 5-12](#) for each branch 6 instruction slots are executed; three before the branch instruction (12-14) and three after the branch instruction (15-17). The total number of cycles for a branch taken or not taken depends on the usage of these slots. That is, the number of cycles depends on how many slots are filled with a MNOP as well as which slots are filled. The effective number of cycles for a branch can, therefore, range from 1 to 7 cycles. The number of cycles for a branch taken may not be the same as for a branch not taken.

Referring to [Table 5-12](#) and [Table 5-13](#), the instructions before and after MBCNDD have the following properties:

- **I1**
  - I1 is the last instruction that can effect the CNDF flags for the MBCNDD instruction. The CNDF flags are tested in the D2 phase of the pipeline. That is, a decision is made whether to branch or not when MBCNDD is in the D2 phase.
  - There are no restrictions on the type of instruction for I1.
- **I2, I3 and I4**
  - The three instructions proceeding MBCNDD can change MSTF flags but will have no effect on whether the MBCNDD instruction branches or not. This is because the flag modification will occur after the D2 phase of the MBCNDD instruction.
  - These instructions must not be the following: MSTOP, MDEBUGSTOP, MBCNDD, MCCNDD or MRCNDD.
- **I5, I6 and I7**
  - The three instructions following MBCNDD are always executed irrespective of whether the branch is taken or not.
  - These instructions must not be the following: MSTOP, MDEBUGSTOP, MBCNDD, MCCNDD or MRCNDD.

```

<Instruction 1> ; I1 Last instruction that can affect flags for
                ; the MBCNDD operation
<Instruction 2> ; I2 Cannot be stop, branch, call or return
<Instruction 3> ; I3 Cannot be stop, branch, call or return
<Instruction 4> ; I4 Cannot be stop, branch, call or return
MBCNDD _Skip, NEQ ; Branch to Skip if not equal to zero
                ; Three instructions after MBCNDD are always
                ; executed whether the branch is taken or not
<Instruction 5> ; I5 Cannot be stop, branch, call or return
<Instruction 6> ; I6 Cannot be stop, branch, call or return
<Instruction 7> ; I7 Cannot be stop, branch, call or return
<Instruction 8> ; I8
<Instruction 9> ; I9
....
_Skip:
<Destination 1> ; d1 Can be any instruction
<Destination 2> ; d2
<Destination 3> ; d3
....
....
MSTOP
....

```

**Table 5-12. Pipeline Activity For MBCNDD, Branch Not Taken**

Instruction	F1	F2	D1	D2	R1	R2	E	W
I1	I1							
I2	I2	I1						
I3	I3	I2	I1					
I4	I4	I3	I2	I1				
MBCNDD	MBCNDD	I4	I3	I2	I1			
I5	I5	MBCNDD	I4	I3	I2	I1		
I6	I6	I5	MBCNDD	I4	I3	I2	I1	
I7	I7	I6	I5	MBCNDD	I4	I3	I2	
I8	I8	I7	I6	I5	-	I4	I3	
I9	I9	I8	I7	I6	I5	-	I4	
I10	I10	I9	I8	I7	I6	I5	-	
		I10	I9	I8	I7	I6	I5	
			I10	I9	I8	I7	I6	
				I10	I9	I8	I7	
					I10	I9	I8	
						I10	I9	
							I10	

**Table 5-13. Pipeline Activity For MBCNDD, Branch Taken**

Instruction	F1	F2	D1	D2	R1	R2	E	W
I1	I1							
I2	I2	I1						
I3	I3	I2	I1					
I4	I4	I3	I2	I1				
MBCNDD	MBCNDD	I4	I3	I2	I1			
I5	I5	MBCNDD	I4	I3	I2	I1		
I6	I6	I5	MBCNDD	I4	I3	I2	I1	
I7	I7	I6	I5	MBCNDD	I4	I3	I2	
d1	d1	I7	I6	I5	-	I4	I3	
d2	d2	d1	I7	I6	I5	-	I4	
d3	d3	d2	d1	I7	I6	I5	-	
		d3	d2	d1	I7	I6	I5	
			d3	d2	d1	I7	I6	
				d3	d2	d1	I7	
					d3	d2	d1	
						d3	d2	
							d3	



**Example 1**

```

; if (State == 0.1)
; RampState = RampState || RAMPMASK
; else if (State == 0.01)
; CoastState = CoastState || COASTMASK
; else
; SteadyState = SteadyState || STEADYMASK
;
_ClalTask1:
MMOV32 MR0, @State
MCMPPF32 MR0, #0.1          ; Affects flags for 1st MBCNDD (A)
MNOP
MNOP
MNOP
MBCNDD Skip1, NEQ          ; (A) If State != 0.1, go to Skip1
MNOP ; Always executed
MNOP ; Always executed
MNOP ; Always executed
MMOV32 MR1, @RampState     ; Execute if (A) branch not taken
MMOVXI MR2, #RAMPMASK     ; Execute if (A) branch not taken
MOR32 MR1, MR2             ; Execute if (A) branch not taken
MMOV32 @RampState, MR1    ; Execute if (A) branch not taken
MSTOP                     ; end of task if (A) branch not taken
Skip1:
MCMPPF32 MR0,#0.01        ; Affects flags for 2nd MBCNDD (B)
MNOP
MNOP
MNOP
MBCNDD Skip2,NEQ          ; (B) If State != 0.01, go to Skip2
MNOP ; Always executed
MNOP ; Always executed
MNOP ; Always executed
MMOV32 MR1, @CoastState   ; Execute if (B) branch not taken
MMOVXI MR2, #COASTMASK   ; Execute if (B) branch not taken
MOR32 MR1, MR2           ; Execute if (B) branch not taken
MMOV32 @CoastState, MR1  ; Execute if (B) branch not taken
MSTOP
Skip2:
MMOV32 MR3, @SteadyState  ; Executed if (B) branch taken
MMOVXI MR2, #STEADYMASK  ; Executed if (B) branch taken
MOR32 MR3, MR2           ; Executed if (B) branch taken
MMOV32 @SteadyState, MR3 ; Executed if (B) branch taken
MSTOP

```

**Example 2**

```

; This example is the same as Example 1, except
; the code is optimized to take advantage of delay slots
;
; if (State == 0.1)
; RampState = RampState || RAMPMASK
; else if (State == 0.01)
; CoastState = CoastState || COASTMASK
; else
; SteadyState = SteadyState || STEADYMASK
;
_ClalTask2:
MMOV32 MR0, @State
MCMPPF32 MR0, #0.1           ; Affects flags for 1st MBCNDD (A)
MCMPPF32 MR0, #0.01         ; Check used by 2nd MBCNDD (B)
MTESTTF EQ                   ; Store EQ flag in TF for 2nd MBCNDD (B)
MNOP
MBCNDD Skip1, NEQ            ; (A) If State != 0.1, go to Skip1
MMOV32 MR1, @RampState       ; Always executed
MMOVXI MR2, #RAMPMASK        ; Always executed
MOR32 MR1, MR2               ; Always executed
MMOV32 @RampState, MR1       ; Execute if (A) branch not taken
MSTOP                        ; end of task if (A) branch not taken

Skip1:
MMOV32 MR3, @SteadyState
MMOVXI MR2, #STEADYMASK
MOR32 MR3, MR2
MBCNDD Skip2, NTF           ; (B) if State != .01, go to Skip2
MMOV32 MR1, @CoastState     ; Always executed
MMOVXI MR2, #COASTMASK      ; Always executed
MOR32 MR1, MR2              ; Always executed
MMOV32 @CoastState, MR1     ; Execute if (B) branch not taken
MSTOP                        ; end of task if (B) branch not taken

Skip2:
MMOV32 @SteadyState, MR3    ; Executed if (B) branch taken
MSTOP

```

**See also**

[MCCNDD 16BitDest, CNDF](#)  
[MRCNDD CNDF](#)

## MCCNDD 16BitDest {, CNDF} *Call Conditional Delayed*

### Operands

16BitDest	16-bit destination if condition is true
CNDF	Optional condition to be tested

### Opcode

LSW: dest dest dest dest  
MSW: 0111 1001 1001 cndf

### Description

If the specified condition is true, then store the return address in the RPC field of MSTF and make the call by adding the signed 16BitDest value to the MPC value. Otherwise, continue code execution without making the call. If the address overflows, it wraps around. Therefore a value of "0xFFFFE" will put the MPC back to the MCCNDD instruction.

Please refer to the pipeline section for important information regarding this instruction.

```
if (CNDF == TRUE)
{
    RPC = return address;
    MPC += 16BitDest;
};
```

CNDF is one of the following conditions:

Encode <sup>(3)</sup>	CNDF	Description	MSTF Flags Tested
0000	NEQ	Not equal to zero	ZF == 0
0001	EQ	Equal to zero	ZF == 1
0010	GT	Greater than zero	ZF == 0 AND NF == 0
0011	GEQ	Greater than or equal to zero	NF == 0
0100	LT	Less than zero	NF == 1
0101	LEQ	Less than or equal to zero	ZF == 1 OR NF == 1
1010	TF	Test flag set	TF == 1
1011	NTF	Test flag not set	TF == 0
1100	LU	Latched underflow	LUF == 1
1101	LV	Latched overflow	LVF == 1
1110	UNC	Unconditional	None
1111	UNCF <sup>(4)</sup>	Unconditional with flag modification	None

<sup>(3)</sup> Values not shown are reserved.

<sup>(4)</sup> This is the default operation if no CNDF field is specified. This condition will allow the ZF and NF flags to be modified when a conditional operation is executed. All other conditions will not modify these flags.

### Restrictions

The MCCNDD instruction is not allowed three instructions before or after a MBCNDD, MCCNDD, or MRCNDD instruction. Refer to the Pipeline section for more details.

### Flags

This instruction does not modify flags in the MSTF register.

Flag	TF	ZF	NF	LUF	LVF
Modified	No	No	No	No	No

**Pipeline**

The MCCNDD instruction by itself is a single-cycle instruction. As shown in [Table 5-14](#), for each call 6 instruction slots are executed; three before the call instruction (I2-I4) and three after the call instruction (I5-I7). The total number of cycles for a call taken or not taken depends on the usage of these slots. That is, the number of cycles depends on how many slots are filled with a MNOP as well as which slots are filled. The effective number of cycles for a call can, therefore, range from 1 to 7 cycles. The number of cycles for a call taken may not be the same as for a call not taken.

Referring to the following code fragment and the pipeline diagrams in [Table 5-14](#) and [Table 5-15](#), the instructions before and after MCCNDD have the following properties:

- **I1**
  - I1 is the last instruction that can effect the CNDF flags for the MCCNDD instruction. The CNDF flags are tested in the D2 phase of the pipeline. That is, a decision is made whether to branch or not when MCCNDD is in the D2 phase.
  - There are no restrictions on the type of instruction for I1.
- **I2, I3 and I4**
  - The three instructions proceeding MCCNDD can change MSTF flags but will have no effect on whether the MCCNDD instruction makes the call or not. This is because the flag modification will occur after the D2 phase of the MCCNDD instruction.
  - These instructions must not be the following: MSTOP, MDEBUGSTOP, MBCNDD, MCCNDD or MRCNDD.
- **I5, I6 and I7**
  - The three instructions following MBCNDD are always executed irrespective of whether the branch is taken or not.
  - These instructions must not be the following: MSTOP, MDEBUGSTOP, MBCNDD, MCCNDD or MRCNDD.

```

<Instruction 1> ; I1 Last instruction that can affect flags for
                ; the MCCNDD operation
<Instruction 2> ; I2 Cannot be stop, branch, call or return
<Instruction 3> ; I3 Cannot be stop, branch, call or return
<Instruction 4> ; I4 Cannot be stop, branch, call or return

MCCNDD _func, NEQ ; Call to func if not equal to zero

                ; Three instructions after MCCNDD are always
                ; executed whether the call is taken or not

<Instruction 5> ; I5 Cannot be stop, branch, call or return
<Instruction 6> ; I6 Cannot be stop, branch, call or return
<Instruction 7> ; I7 Cannot be stop, branch, call or return
<Instruction 8> ; I8 The address of this instruction is saved
                ; in the RPC field of the MSTF register.
                ; Upon return this value is loaded into MPC
                ; and fetching continues from this point.
<Instruction 9> ; I9
....
_func:
<Destination 1> ; d1 Can be any instruction
<Destination 2> ; d2
<Destination 3> ; d3
<Destination 4> ; d4 Last instruction that can affect flags for
                ; the MRCNDD operation

<Destination 5> ; d5 Cannot be stop, branch, call or return
<Destination 6> ; d6 Cannot be stop, branch, call or return
<Destination 7> ; d7 Cannot be stop, branch, call or return

MRCNDD UNC      ; Return to <Instruction 8>, unconditional

                ; Three instructions after MRCNDD are always
                ; executed whether the return is taken or not

<Destination 8> ; d8 Cannot be stop, branch, call or return
<Destination 9> ; d9 Cannot be stop, branch, call or return
<Destination 10> ; d10 Cannot be stop, branch, call or return
<Destination 11> ; d11
....
MSTOP

```

**Table 5-14. Pipeline Activity For MCCNDD, Call Not Taken**

Instruction	F1	F2	D1	D2	R1	R2	E	W
I1	I1							
I2	I2	I1						
I3	I3	I2	I1					
I4	I4	I3	I2	I1				
MCCNDD	MCCNDD	I4	I3	I2	I1			
I5	I5	MCCNDD	I4	I3	I2	I1		
I6	I6	I5	MCCNDD	I4	I3	I2	I1	
I7	I7	I6	I5	MCCNDD	I4	I3	I2	
I8	I8	I7	I6	I5	-	I4	I3	
I9	I9	I8	I7	I6	I5	-	I4	
I10	I10	I9	I8	I7	I6	I5	-	
etc ....		I10	I9	I8	I7	I6	I5	
....			I10	I9	I8	I7	I6	
....				I10	I9	I8	I7	
....					I10	I9	I8	
						I10	I9	
							I10	

**Table 5-15. Pipeline Activity For MCCNDD, Call Taken**

Instruction	F1	F2	D1	D2	R1	R2	E	W
I1	I1							
I2	I2	I1						
I3	I3	I2	I1					
I4	I4	I3	I2	I1				
MCCNDD	MCCNDD	I4	I3	I2	I1			
I5	I5	MCCNDD	I4	I3	I2	I1		
I6	I6	I5	MCCNDD	I4	I3	I2	I1	
I7 <sup>(1)</sup>	I7	I6	I5	MCCNDD	I4	I3	I2	
d1	d1	I7	I6	I5	-	I4	I3	
d2	d2	d1	I7	I6	I5	-	I4	
d3	d3	d2	d1	I7	I6	I5	-	
etc ....		d3	d2	d1	I7	I6	I5	
....			d3	d2	d1	I7	I6	
....				d3	d2	d1	I7	
....					d3	d2	d1	
						d3	d2	
							d3	

<sup>(1)</sup> The RPC value in the MSTF register will point to the instruction following I7 (instruction I8).

**Example**

;

**See also**

[MBCNDD #16BitDest, CNDF](#)  
[MMOV32 mem32, MSTF](#)  
[MMOV32 MSTF, mem32](#)  
[MRCNDD CNDF](#)

## MCMP32 MRa, MRb 32-Bit Integer Compare for Equal, Less Than or Greater Than

### Operands

MRa	CLA floating-point source register (MR0 to MR3)
MRb	CLA floating-point source register (MR0 to MR3)

### Opcode

LSW: 0000 0000 0000 bbaa  
MSW: 0111 1111 0010 0000

### Description

Set ZF and NF flags on the result of MRa - MRb where MRa and MRb are 32-bit integers. For a floating point compare refer to [MCMFP32](#).

### Flags

This instruction modifies the following flags in the MSTF register:

Flag	TF	ZF	NF	LUF	LVF
Modified	No	Yes	Yes	No	No

The MSTF register flags are modified based on the integer results of the operation.

```
If(MRa == MRb) {ZF=1; NF=0;}
If(MRa > MRb) {ZF=0; NF=0;}
If(MRa < MRb) {ZF=0; NF=1;}
```

### Pipeline

This is a single-cycle instruction.

### Example

```
; Behavior of ZF and NF flags for different comparisons
;
; Given A = (int32)1
;       B = (int32)2
;       C = (int32)-7
;
MMOV32 MR0, @_A ; MR0 = 1 (0x00000001)
MMOV32 MR1, @_B ; MR1 = 2 (0x00000002)
MMOV32 MR2, @_C ; MR2 = -7 (0xFFFFFFFF9)
MCMP32 MR2, MR2 ; NF = 0, ZF = 1
MCMP32 MR0, MR1 ; NF = 1, ZF = 0
MCMP32 MR1, MR0 ; NF = 0, ZF = 0
```

### See also

[MADD32 MRa, MRb, MRc](#)  
[MSUB32 MRa, MRb, MRc](#)

---

**MCMPF32 MRa, MRb 32-Bit Floating-Point Compare for Equal, Less Than or Greater Than**


---

**Operands**

MRa	CLA floating-point source register (MR0 to MR3)
MRb	CLA floating-point source register (MR0 to MR3)

**Opcode**

```
LSW: 0000 0000 0000 bbaa
MSW: 0111 1101 0000 0000
```

**Description**

Set ZF and NF flags on the result of MRa - MRb. The MCMPF32 instruction is performed as a logical compare operation. This is possible because of the IEEE format offsetting the exponent. Basically the bigger the binary number, the bigger the floating-point value.

Special cases for inputs:

- Negative zero will be treated as positive zero.
- A denormalized value will be treated as positive zero.
- Not-a-Number (NaN) will be treated as infinity.

**Flags**

This instruction modifies the following flags in the MSTF register:

Flag	TF	ZF	NF	LUF	LVF
Modified	No	Yes	Yes	No	No

The MSTF register flags are modified as follows:

```
If(MRa == MRb) {ZF=1; NF=0;}
If(MRa > MRb) {ZF=0; NF=0;}
If(MRa < MRb) {ZF=0; NF=1;}
```

**Pipeline**

This is a single-cycle instruction.

**Example**

; Behavior of ZF and NF flags for different comparisons

```
MMOVIZ MR1, #-2.0 ; MR1 = -2.0 (0xC0000000)
MMOVIZ MR0, #5.0 ; MR0 = 5.0 (0x40A00000)
MCMPF32 MR1, MR0 ; ZF = 0, NF = 1
MCMPF32 MR0, MR1 ; ZF = 0, NF = 0
MCMPF32 MR0, MR0 ; ZF = 1, NF = 0
```

**See also**

[MCMPF32 MRa, #16FHi](#)  
[MMAXF32 MRa, #16FHi](#)  
[MMAXF32 MRa, MRb](#)  
[MMINF32 MRa, #16FHi](#)  
[MMINF32 MRa, MRb](#)



## MCMPF32 MRa, #16FHi 32-Bit Floating-Point Compare for Equal, Less Than or Greater Than

### Operands

MRa	CLA floating-point source register (MR0 to MR3)
#16FHi	A 16-bit immediate value that represents the upper 16-bits of an IEEE 32-bit floating-point value. The low 16-bits of the mantissa are assumed to be all 0.

### Opcode

```
LSW: I I I I I I I I I I I I I I I I
MSW: 0 1 1 1 1 0 0 0 1 1 0 0 0 0 a a
```

### Description

Compare the value in MRa with the floating-point value represented by the immediate operand. Set the ZF and NF flags on (MRa - #16FHi:0).

#16FHi is a 16-bit immediate value that represents the upper 16-bits of an IEEE 32-bit floating-point value. The low 16-bits of the mantissa are assumed to be all 0. This addressing mode is most useful for constants where the lowest 16-bits of the mantissa are 0. Some examples are 2.0 (0x40000000), 4.0 (0x40800000), 0.5 (0x3F000000), and -1.5 (0xBFC00000). The assembler will accept either a hex or float as the immediate value. That is, -1.5 can be represented as #-1.5 or #0xBFC0.

The MCMPF32 instruction is performed as a logical compare operation. This is possible because of the IEEE floating-point format offsets the exponent. Basically the bigger the binary number, the bigger the floating-point value.

Special cases for inputs:

- Negative zero will be treated as positive zero.
- Denormalized value will be treated as positive zero.
- Not-a-Number (NaN) will be treated as infinity.

### Flags

This instruction modifies the following flags in the MSTF register:

Flag	TF	ZF	NF	LUF	LVF
Modified	No	Yes	Yes	No	No

The MSTF register flags are modified as follows:

```
If (MRa == #16FHi:0) {ZF=1, NF=0;}
If (MRa > #16FHi:0) {ZF=0, NF=0;}
If (MRa < #16FHi:0) {ZF=0, NF=1;}
```

### Pipeline

This is a single-cycle instruction

### Example 1

; Behavior of ZF and NF flags for different comparisons

```
MMOVIZ MR1, #-2.0 ; MR1 = -2.0 (0xC0000000)
MMOVIZ MR0, #5.0 ; MR0 = 5.0 (0x40A00000)
MCMPF32 MR1, #-2.2 ; ZF = 0, NF = 0
MCMPF32 MR0, #6.5 ; ZF = 0, NF = 1
MCMPF32 MR0, #5.0 ; ZF = 1, NF = 0
```

**Example 2**

```

; X is an array of 32-bit floating-point values
; and has len elements. Find the maximum value in
; the array and store it in Result
;
; Note: MCMPPF32 and MSWAPF can be replaced with MMAXF32
;
_ClalTask1:
  MMOV16 MAR1,#_X      ; Start address
  MUI16TOF32 MR0, @_len ; Length of the array
  MNOP                 ; delay for MAR1 load
  MNOP                 ; delay for MAR1 load
  MMOV32 MR1, *MAR1[2]++ ; MR1 = X0

LOOP
  MMOV32 MR2, *MAR1[2]++ ; MR2 = next element
  MCMPPF32 MR2, MR1      ; Compare MR2 with MR1
  MSWAPF MR1, MR2, GT   ; MR1 = MAX(MR1, MR2)
  MADD32 MR0, MR0, #-1.0 ; Decrement the counter
  MCMPPF32 MR0 #0.0     ; Set/clear flags for MBCNDD
  MNOP
  MNOP
  MNOP
  MBCNDD LOOP, NEQ      ; Branch if not equal to zero
  MMOV32 @_Result, MR1  ; Always executed
  MNOP                  ; Always executed
  MNOP                  ; Always executed
  MSTOP                 ; End of task

```

**See also**

[MCMPPF32 MRa, MRb](#)  
[MMAXF32 MRa, #16FHi](#)  
[MMAXF32 MRa, MRb](#)  
[MMINF32 MRa, #16FHi](#)  
[MMINF32 MRa, MRb](#)

**MDEBUGSTOP**      *Debug Stop Task*
**Operands**

none                      This instruction does not have any operands

**Opcode**

LSW: 0000 0000 0000 0000  
MSW: 0111 1111 0110 0000

**Description**

When CLA breakpoints are enabled, the MDEBUGSTOP instruction is used to halt a task so that it can be debugged. That is, MDEBUGSTOP is the CLA breakpoint. If CLA breakpoints are not enabled, the MDEBUGSTOP instruction behaves like a MNOP. Unlike the MSTOP, the MIRUN flag is not cleared and an interrupt is not issued. A single-step or run operation will continue execution of the task.

**Restrictions**

The MDEBUGSTOP instruction cannot be placed 3 instructions before or after a [MBCNDD](#), [MCCNDD](#) or [MRCNDD](#) instruction.

**Flags**

This instruction does not modify flags in the MSTF register.

Flag	TF	ZF	NF	LUF	LVF
Modified	No	No	No	No	No

**Pipeline**

This is a single-cycle instruction.

**Example**

;

**See also**

[MSTOP](#)

---

**MEALLOW**                      ***Enable CLA Write Access to EALLOW Protected Registers***


---

**Operands**

none	This instruction does not have any operands
------	---

---

**Opcode**

```
LSW: 0000 0000 0000 0000
MSW: 0111 1111 1001 0000
```

**Description**

This instruction sets the MEALLOW bit in the CLA status register MSTF. When this bit is set, the CLA is allowed write access to EALLOW protected registers. To again protect against CLA writes to protected registers, use the MEDIS instruction.

MEALLOW and MEDIS only control CLA write access; reads are allowed even if MEALLOW has not been executed. MEALLOW and MEDIS are also independent from the main CPU's EALLOW/EDIS. This instruction does not modify the EALLOW bit in the main CPU's status register. The MEALLOW bit in MSTF only controls access for the CLA while the EALLOW bit in the ST1 register only controls access for the main CPU.

As with EALLOW, the MEALLOW bit is overridden via the JTAG port, allowing full control of register accesses during debug from Code Composer Studio.

**Flags**

This instruction does not modify flags in the MSTF register.

Flag	TF	ZF	NF	LUF	LVF
Modified	No	No	No	No	No

---

**Pipeline**

This is a single-cycle instruction.

**Example**

```
; C header file including definition of
; the EPwm1Regs structure
;
; The ePWM TZSEL register is EALLOW protected
;
    .cdecls C,LIST, "CLAShared.h"
    ...
_ClalTask1:
    ...
    MEALLOW                ; Allow CLA write access
    MMOV16 @_EPwm1Regs.TZSEL.all, MR3 ; Write to TZSEL
    MEDIS                  ; Disallow CLA write access
    ...
    ...
    MSTOP
```

**See also**

[MEDIS](#)

## MEDIS *Disable CLA Write Access to EALLOW Protected Registers*

### Operands

none This instruction does not have any operands

### Opcode

LSW: 0000 0000 0000 0000  
MSW: 0111 1111 1011 0000

### Description

This instruction clears the MEALLOW bit in the CLA status register MSTF. When this bit is clear, the CLA is not allowed write access to EALLOW-protected registers. To enable CLA writes to protected registers, use the MEALLOW instruction.

MEALLOW and MEDIS only control CLA write access; reads are allowed even if MEALLOW has not been executed. MEALLOW and MEDIS are also independent from the main CPU's EALLOW/EDIS. This instruction does not modify the EALLOW bit in the main CPU's status register. The MEALLOW bit in MSTF only controls access for the CLA while the EALLOW bit in the ST1 register only controls access for the main CPU.

As with EALLOW, the MEALLOW bit is overridden via the JTAG port, allowing full control of register accesses during debug from Code Composer Studio.

### Flags

This instruction does not modify flags in the MSTF register.

Flag	TF	ZF	NF	LUF	LVF
Modified	No	No	No	No	No

### Pipeline

This is a single-cycle instruction.

### Example

```
; C header file including definition of
; the EPwm1Regs structure
;
; The ePWM TZSEL register is EALLOW protected
;
    .cdecls C,LIST, "CLAShared.h"
    ...
_ClalTask1:
    ...
    MEALLOW                ; Allow CLA write access
    MMOV16 @_EPwm1Regs.TZSEL.all, MR3 ; Write to TZSEL
    MEDIS                   ; Disallow CLA write access
    ...
    ...
    MSTOP
```

### See also

[MEALLOW](#)

**MEINVF32 MRa, MRb 32-Bit Floating-Point Reciprocal Approximation**
**Operands**

MRa	CLA floating-point destination register (MR0 to MR3)
MRb	CLA floating-point source register (MR0 to MR3)

**Opcode**

```
LSW: 0000 0000 0000 bbaa
MSW: 0111 1111 0000 0000
```

**Description**

This operation generates an estimate of  $1/X$  in 32-bit floating-point format accurate to approximately 8 bits. This value can be used in a Newton-Raphson algorithm to get a more accurate answer. That is:

```
Ye = Estimate(1/X);
Ye = Ye*(2.0 - Ye*X);
Ye = Ye*(2.0 - Ye*X);
```

After two iterations of the Newton-Raphson algorithm, you will get an exact answer accurate to the 32-bit floating-point format. On each iteration the mantissa bit accuracy approximately doubles. The MEINVF32 operation will not generate a negative zero, DeNorm or NaN value.

```
MRa = Estimate of 1/MRb;
```

**Flags**

This instruction modifies the following flags in the MSTF register:

Flag	TF	ZF	NF	LUF	LVF
Modified	No	No	No	Yes	Yes

The MSTF register flags are modified as follows:

- LUF = 1 if MEINVF32 generates an underflow condition.
- LVF = 1 if MEINVF32 generates an overflow condition.

**Pipeline**

This is a single-cycle instruction.

**Example**

```
; Calculate Num/Den using a Newton-Raphson algorithm for 1/Den
; Ye = Estimate(1/X)
; Ye = Ye*(2.0 - Ye*X)
; Ye = Ye*(2.0 - Ye*X)
;
_ClalTask1:
    MMOV32 MR1, @_Den      ; MR1 = Den
    MEINVF32 MR2, MR1      ; MR2 = Ye = Estimate(1/Den)
    MMPYF32 MR3, MR2, MR1  ; MR3 = Ye*Den
    MSUBF32 MR3, #2.0, MR3 ; MR3 = 2.0 - Ye*Den
    MMPYF32 MR2, MR2, MR3  ; MR2 = Ye = Ye*(2.0 - Ye*Den)
    MMPYF32 MR3, MR2, MR1  ; MR3 = Ye*Den
|| MMOV32 MR0, @_Num      ; MR0 = Num
    MSUBF32 MR3, #2.0, MR3 ; MR3 = 2.0 - Ye*Den
    MMPYF32 MR2, MR2, MR3  ; MR2 = Ye = Ye*(2.0 - Ye*Den)
|| MMOV32 MR1, @_Den      ; Reload Den To Set Sign
    MNEGF32 MR0, MR0, EQ   ; if(Den == 0.0) Change Sign Of Num
    MMPYF32 MR0, MR2, MR0  ; MR0 = Y = Ye*Num
    MMOV32 @_Dest, MR0    ; Store result
    MSTOP                  ; end of task
```

**See also**

[MEISQRTF32 MRa, MRb](#)

## MEISQRTF32 MRa, MRb 32-Bit Floating-Point Square-Root Reciprocal Approximation

### Operands

MRa	CLA floating-point destination register (MR0 to MR3)
MRb	CLA floating-point source register (MR0 to MR3)

### Opcode

```
LSW: 0000 0000 0000 bbaa
MSW: 0111 1110 0100 0000
```

### Description

This operation generates an estimate of  $1/\sqrt{X}$  in 32-bit floating-point format accurate to approximately 8 bits. This value can be used in a Newton-Raphson algorithm to get a more accurate answer. That is:

```
Ye = Estimate(1/sqrt(X));
Ye = Ye*(1.5 - Ye*Ye*X/2.0);
Ye = Ye*(1.5 - Ye*Ye*X/2.0);
```

After 2 iterations of the Newton-Raphson algorithm, you will get an exact answer accurate to the 32-bit floating-point format. On each iteration the mantissa bit accuracy approximately doubles. The MEISQRTF32 operation will not generate a negative zero, DeNorm or NaN value.

```
MRa = Estimate of 1/sqrt (MRb);
```

### Flags

This instruction modifies the following flags in the MSTF register:

Flag	TF	ZF	NF	LUF	LVF
Modified	No	No	No	Yes	Yes

The MSTF register flags are modified as follows:

- LUF = 1 if MEISQRTF32 generates an underflow condition.
- LVF = 1 if MEISQRTF32 generates an overflow condition.

### Pipeline

This is a single-cycle instruction.

### Example

```
; Y = sqrt(X)
; Ye = Estimate(1/sqrt(X));
; Ye = Ye*(1.5 - Ye*Ye*X*0.5)
; Ye = Ye*(1.5 - Ye*Ye*X*0.5)
; Y = X*Ye
;
_ClalTask3:
    MMOV32 MR0, @_x          ; MR0 = X
    MEISQRTF32 MR1, MR0      ; MR1 = Ye = Estimate(1/sqrt(X))
    MMOV32 MR1, @_x, EQ      ; if(X == 0.0) Ye = 0.0
    MMPYF32 MR3, MR0, #0.5    ; MR3 = X*0.5
    MMPYF32 MR2, MR1, MR3     ; MR2 = Ye*X*0.5
    MMPYF32 MR2, MR1, MR2     ; MR2 = Ye*Ye*X*0.5
    MSUBF32 MR2, #1.5, MR2    ; MR2 = 1.5 - Ye*Ye*X*0.5
    MMPYF32 MR1, MR1, MR2     ; MR1 = Ye = Ye*(1.5 - Ye*Ye*X*0.5)
    MMPYF32 MR2, MR1, MR3     ; MR2 = Ye*X*0.5
    MMPYF32 MR2, MR1, MR2     ; MR2 = Ye*Ye*X*0.5
    MSUBF32 MR2, #1.5, MR2    ; MR2 = 1.5 - Ye*Ye*X*0.5
    MMPYF32 MR1, MR1, MR2     ; MR1 = Ye = Ye*(1.5 - Ye*Ye*X*0.5)
    MMPYF32 MR0, MR1, MR0     ; MR0 = Y = Ye*X
    MMOV32 @_y, MR0          ; Store Y = sqrt(X)
    MSTOP                    ; end of task
```

### See also

[MEINVF32 MRa, MRb](#)

**MF32TOI16 MRa, MRb Convert 32-Bit Floating-Point Value to 16-Bit Integer**
**Operands**

MRa	CLA floating-point destination register (MR0 to MR3)
MRb	CLA floating-point source register (MR0 to MR3)

**Opcode**

```
LSW: 0000 0000 0000 bbaa
MSW: 0111 1101 1110 0000
```

**Description**

Convert a 32-bit floating point value in MRb to a 16-bit integer and truncate. The result will be stored in MRa.

```
MRa(15:0) = F32TOI16(MRb);
MRa(31:16) = sign extension of MRa(15);
```

**Flags**

This instruction does not affect any flags:

Flag	TF	ZF	NF	LUF	LVF
Modified	No	No	No	No	No

**Pipeline**

This is a single-cycle instruction.

**Example**

```
MMOVIZ      MR0, #5.0   ; MR0      = 5.0 (0x40A00000)
MF32TOI16   MR1, MR0   ; MR1(15:0) = MF32TOI16(MR0) = 0x0005
              ; MR1(31:16) = Sign extension of MR1(15) = 0x0000
MMOVIZ      MR2, #-5.0  ; MR2      = -5.0 (0xC0A00000)
MF32TOI16   MR3, MR2   ; MR3(15:0) = MF32TOI16(MR2) = -5 (0xFFFFB)
              ; MR3(31:16) = Sign extension of MR3(15) = 0xFFFF
```

**See also**

[MF32TOI16R MRa, MRb](#)  
[MF32TOUI16 MRa, MRb](#)  
[MF32TOUI16R MRa, MRb](#)  
[MI16TOF32 MRa, MRb](#)  
[MI16TOF32 MRa, mem16](#)  
[MUI16TOF32 MRa, mem16](#)  
[MUI16TOF32 MRa, MRb](#)



**MF32TOI16R MRa, MRb Convert 32-Bit Floating-Point Value to 16-Bit Integer and Round**
**Operands**

MRa	CLA floating-point destination register (MR0 to MR3)
MRb	CLA floating-point source register (MR0 to MR3)

**Opcode**

LSW: 0000 0000 0000 bbaa  
MSW: 0111 1110 0110 0000

**Description**

Convert the 32-bit floating point value in MRb to a 16-bit integer and round to the nearest even value. The result is stored in MRa.

MRa(15:0) = F32TOI16round(MRb);  
MRa(31:16) = sign extension of MRa(15);

**Flags**

This instruction does not affect any flags:

Flag	TF	ZF	NF	LUF	LVF
Modified	No	No	No	No	No

**Pipeline**

This is a single-cycle instruction.

**Example**

```
MMOVIZ MR0, #0x3FD9 ; MR0(31:16) = 0x3FD9
MMOVXI MR0, #0x999A ; MR0(15:0) = 0x999A
                    ; MR0 = 1.7 (0x3FD9999A)
MF32TOI16R MR1, MR0 ; MR1(15:0) = MF32TOI16round (MR0) = 2 (0x0002)
                    ; MR1(31:16) = Sign extension of MR1(15) = 0x0000
MMOVF32 MR2, #-1.7 ; MR2 = -1.7 (0xBFD9999A)
MF32TOI16R MR3, MR2 ; MR3(15:0) = MF32TOI16round (MR2) = -2 (0xFFFFE)
                    ; MR3(31:16) = Sign extension of MR2(15) = 0xFFFF
```

**See also**

[MF32TOI16 MRa, MRb](#)  
[MF32TOUI16 MRa, MRb](#)  
[MF32TOUI16R MRa, MRb](#)  
[MI16TOF32 MRa, MRb](#)  
[MI16TOF32 MRa, mem16](#)  
[MUI16TOF32 MRa, mem16](#)  
[MUI16TOF32 MRa, MRb](#)

**MF32TOI32 MRa, MRb Convert 32-Bit Floating-Point Value to 32-Bit Integer**
**Operands**

MRa	CLA floating-point destination register (MR0 to MR3)
MRb	CLA floating-point source register (MR0 to MR3)

**Opcode**

```
LSW: 0000 0000 0000 bbaa
MSW: 0111 1101 0110 0000
```

**Description**

Convert the 32-bit floating-point value in MRb to a 32-bit integer value and truncate. Store the result in MRa.

```
MRa = F32TOI32(MRb);
```

**Flags**

This instruction does not affect any flags:

Flag	TF	ZF	NF	LUF	LVF
Modified	No	No	No	No	No

**Pipeline**

This is a single-cycle instruction.

**Example 1**

```
MMOVF32 MR2, #11204005.0 ; MR2 = 11204005.0 (0x4B2AF5A5)
MF32TOI32 MR3, MR2 ; MR3 = MF32TOI32(MR2) = 11204005 (0x00AAF5A5)
MMOVF32 MR0, #-11204005.0 ; MR0 = -11204005.0 (0xCB2AF5A5)
MF32TOI32 MR1, MR0 ; MR1 = MF32TOI32(MR0) = -11204005 (0xFF550A5B)
```

**Example 2**

```
; Given X, M and B are IQ24 numbers:
; X = IQ24(+2.5) = 0x02800000
; M = IQ24(+1.5) = 0x01800000
; B = IQ24(-0.5) = 0xFF800000
;
; Calculate Y = X * M + B
;
; Convert M, X and B from IQ24 to float
;
_ClalTask2:
    MI32TOF32 MR0, @_M ; MR0 = 0x4BC00000
    MI32TOF32 MR1, @_X ; MR1 = 0x4C200000
    MI32TOF32 MR2, @_B ; MR2 = 0xCB000000
    MMPYF32 MR0, MR0, #0x3380 ; M = 1/(1*2^24) * iqm = 1.5 (0x3FC00000)
    MMPYF32 MR1, MR1, #0x3380 ; X = 1/(1*2^24) * iqx = 2.5 (0x40200000)
    MMPYF32 MR2, MR2, #0x3380 ; B = 1/(1*2^24) * iqb = -.5 (0xBF000000)
    MMPYF32 MR3, MR0, MR1 ; M*X
    MADDF32 MR2, MR2, MR3 ; Y=MX+B = 3.25 (0x40500000)

; Convert Y from float32 to IQ24
MMPYF32 MR2, MR2, #0x4B80 ; Y * 1*2^24
MF32TOI32 MR2, MR2 ; IQ24(Y) = 0x03400000
MMOV32 @_Y, MR2 ; store result
MSTOP ; end of task
```

**See also**

[MF32TOUI32 MRa, MRb](#)  
[MI32TOF32 MRa, MRb](#)  
[MI32TOF32 MRa, mem32](#)  
[MUI32TOF32 MRa, MRb](#)  
[MUI32TOF32 MRa, mem32](#)

## MF32TOUI16 MRa, MRb *Convert 32-Bit Floating-Point Value to 16-bit Unsigned Integer*

### Operands

MRa	CLA floating-point destination register (MR0 to MR3)
MRb	CLA floating-point source register (MR0 to MR3)

### Opcode

LSW: 0000 0000 0000 bbaa  
MSW: 0111 1110 1010 0000

### Description

Convert the 32-bit floating point value in MRb to an unsigned 16-bit integer value and truncate to zero. The result will be stored in MRa. To instead round the integer to the nearest even value use the MF32TOUI16R instruction.

MRa(15:0) = F32TOUI16(MRb);  
MRa(31:16) = 0x0000;

### Flags

This instruction does not affect any flags:

Flag	TF	ZF	NF	LUF	LVF
Modified	No	No	No	No	No

### Pipeline

This is a single-cycle instruction.

### Example

```
MMOVIZ      MR0, #9.0      ; MR0 = 9.0 (0x41100000)
MF32TOUI16  MR1, MR0      ; MR1(15:0) = MF32TOUI16(MR0) = 9 (0x0009)
              ; MR1(31:16) = 0x0000
MMOVIZ      MR2, #-9.0     ; MR2 = -9.0 (0xC1100000)
MF32TOUI16  MR3, MR2      ; MR3(15:0) = MF32TOUI16(MR2) = 0 (0x0000)
              ; MR3(31:16) = 0x0000
```

### See also

[MF32TOI16 MRa, MRb](#)  
[MF32TOUI16 MRa, MRb](#)  
[MF32TOUI16R MRa, MRb](#)  
[MI16TOF32 MRa, MRb](#)  
[MI16TOF32 MRa, mem16](#)  
[MUI16TOF32 MRa, mem16](#)  
[MUI16TOF32 MRa, MRb](#)

**MF32TOUI16R MRa, MRb *Convert 32-Bit Floating-Point Value to 16-bit Unsigned Integer and Round***
**Operands**

MRa	CLA floating-point destination register (MR0 to MR3)
MRb	CLA floating-point source register (MR0 to MR3)

**Opcode**

```
LSW: 0000 0000 0000 bbaa
MSW: 0111 1110 1100 0000
```

**Description**

Convert the 32-bit floating-point value in MRb to an unsigned 16-bit integer and round to the closest even value. The result will be stored in MRa. To instead truncate the converted value, use the MF32TOUI16 instruction.

```
MRa(15:0) = MF32TOUI16round(MRb);
MRa(31:16) = 0x0000;
```

**Flags**

This instruction does not affect any flags:

Flag	TF	ZF	NF	LUF	LVF
Modified	No	No	No	No	No

**Pipeline**

This is a single-cycle instruction.

**Example**

```
MMOVIZ      MR0, #0x412C      ; MR0 = 0x412C
MMOVXI      MR0, #0xCCCD      ; MR0 = 0xCCCD ; MR0 = 10.8 (0x412CCCCD)
MF32TOUI16R MR1, MR0          ; MR1(15:0) = MF32TOUI16round(MR0) = 11 (0x000B)
                                     ; MR1(31:16) = 0x0000
MMOVF32     MR2, #-10.8       ; MR2 = -10.8 (0x0xC12CCCCD)
MF32TOUI16R MR3, MR2          ; MR3(15:0) = MF32TOUI16round(MR2) = 0 (0x0000)
                                     ; MR3(31:16) = 0x0000
```

**See also**

[MF32TOI16 MRa, MRb](#)  
[MF32TOI16R MRa, MRb](#)  
[MF32TOUI16 MRa, MRb](#)  
[MI16TOF32 MRa, MRb](#)  
[MI16TOF32 MRa, mem16](#)  
[MUI16TOF32 MRa, mem16](#)  
[MUI16TOF32 MRa, MRb](#)

**MF32TOUI32 MRa, MRb Convert 32-Bit Floating-Point Value to 32-Bit Unsigned Integer**


---

**Operands**

MRa	CLA floating-point destination register (MR0 to MR3)
MRb	CLA floating-point source register (MR0 to MR3)

**Opcode**

LSW: 0000 0000 0000 bbaa  
MSW: 0111 1101 1010 0000

**Description**

Convert the 32-bit floating-point value in MRb to an unsigned 32-bit integer and store the result in MRa.

MRa = F32TOUI32(MRb);

**Flags**

This instruction does not affect any flags:

Flag	TF	ZF	NF	LUF	LVF
Modified	No	No	No	No	No

**Pipeline**

This is a single-cycle instruction.

**Example**

```
MMOVIZ      MR0, #12.5 ; MR0 = 12.5 (0x41480000)
MF32TOUI32  MR0, MR0   ; MR0 = MF32TOUI32 (MR0) = 12 (0x0000000C)
MMOVIZ      MR1, #-6.5 ; MR1 = -6.5 (0xC0D00000)
MF32TOUI32  MR2, MR1   ; MR2 = MF32TOUI32 (MR1) = 0.0 (0x00000000)
```

**See also**

[MF32TOI32 MRa, MRb](#)  
[MI32TOF32 MRa, MRb](#)  
[MI32TOF32 MRa, mem32](#)  
[MUI32TOF32 MRa, MRb](#)  
[MUI32TOF32 MRa, mem32](#)

**MFRACF32 MRa, MRb** *Fractional Portion of a 32-Bit Floating-Point Value*
**Operands**

MRa	CLA floating-point destination register (MR0 to MR3)
MRb	CLA floating-point source register (MR0 to MR3)

**Opcode**

```
LSW: 0000 0000 0000 bbaa
MSW: 0111 1110 0000 0000
```

**Description**

Returns in MRa the fractional portion of the 32-bit floating-point value in MRb

**Flags**

This instruction does not affect any flags:

Flag	TF	ZF	NF	LUF	LVF
Modified	No	No	No	No	No

**Pipeline**

This is a single-cycle instruction.

**Example**

```
MMOVIZ MR2, #19.625 ; MR2 = 19.625 (0x419D0000)
MFRACF32 MR3, MR2 ; MR3 = MFRACF32(MR2) = 0.625 (0x3F200000)0
```

**See also**

## MI16TOF32 MRa, MRb *Convert 16-Bit Integer to 32-Bit Floating-Point Value*

### Operands

MRa	CLA floating-point destination register (MR0 to MR3)
MRb	CLA floating-point source register (MR0 to MR3)

### Opcode

LSW: 0000 0000 0000 bbaa  
MSW: 0111 1110 1000 0000

### Description

Convert the 16-bit signed integer in MRb to a 32-bit floating point value and store the result in MRa.

MRa = MI16TOF32(MRb);

### Flags

This instruction does not affect any flags:

Flag	TF	ZF	NF	LUF	LVF
Modified	No	No	No	No	No

### Pipeline

This is a single-cycle instruction.

### Example

```
MMOVIZ    MR0, #0x0000    ; MR0(31:16) = 0.0 (0x0000)
MMOVXI    MR0, #0x0004    ; MR0(15:0) = 4.0 (0x0004)
MI16TOF32 MR1, MR0        ; MR1 = MI16TOF32 (MR0) = 4.0 (0x40800000)

MMOVIZ    MR2, #0x0000    ; MR2(31:16) = 0.0 (0x0000)
MMOVXI    MR2, #0xFFFC    ; MR2(15:0) = -4.0 (0xFFFC)
MI16TOF32 MR3, MR2        ; MR3 = MI16TOF32 (MR2) = -4.0 (0xC0800000)
MSTOP
```

### See also

[MF32TOI16 MRa, MRb](#)  
[MF32TOI16R MRa, MRb](#)  
[MF32TOUI16 MRa, MRb](#)  
[MF32TOUI16R MRa, MRb](#)  
[MI16TOF32 MRa, mem16](#)  
[MUI16TOF32 MRa, mem16](#)  
[MUI16TOF32 MRa, MRb](#)

**MI16TOF32 MRa, mem16 *Convert 16-Bit Integer to 32-Bit Floating-Point Value***
**Operands**

MRa	CLA floating-point destination register (MR0 to MR3)
mem16	16-bit source memory location to be converted

**Opcode**

```
LSW: mmmm mmmm mmmm mmmm
MSW: 0111 0101 00aa addr
```

**Description**

Convert the 16-bit signed integer indicated by the mem16 pointer to a 32-bit floating-point value and store the result in MRa.

```
MRa = MI16TOF32[mem16];
```

**Flags**

This instruction does not affect any flags:

Flag	TF	ZF	NF	LUF	LVF
Modified	No	No	No	No	No

**Pipeline**

This is a single-cycle instruction:

**Example**

```
; Assume A = 4 (0x0004)
;           B = -4 (0xFFFC)

MI16TOF32 MR0, @_A ; MR0 = MI16TOF32(A) = 4.0 (0x40800000)
MI16TOF32 MR1, @_B ; MR1 = MI16TOF32(B) = -4.0 (0xC0800000)
```

**See also**

[MF32TOI16 MRa, MRb](#)  
[MF32TOI16R MRa, MRb](#)  
[MF32TOUI16 MRa, MRb](#)  
[MF32TOUI16R MRa, MRb](#)  
[MI16TOF32 MRa, MRb](#)  
[MUI16TOF32 MRa, mem16](#)  
[MUI16TOF32 MRa, MRb](#)



## MI32TOF32 MRa, mem32 *Convert 32-Bit Integer to 32-Bit Floating-Point Value*

### Operands

MRa	CLA floating-point destination register (MR0 to MR3)
mem32	32-bit memory source for the MMOV32 operation.

### Opcode

LSW: mmmm mmmm mmmm mmmm  
MSW: 0111 0100 01aa addr

### Description

Convert the 32-bit signed integer indicated by mem32 to a 32-bit floating point value and store the result in MRa.

MRa = MI32TOF32[mem32];

### Flags

This instruction does not affect any flags:

Flag	TF	ZF	NF	LUF	LVF
Modified	No	No	No	No	No

### Pipeline

This is a single-cycle instruction.

### Example

```
; Given X, M and B are IQ24 numbers:
; X = IQ24(+2.5) = 0x02800000
; M = IQ24(+1.5) = 0x01800000
; B = IQ24(-0.5) = 0xFF800000
;
; Calculate Y = X * M + B
;
; Convert M, X and B from IQ24 to float

_ClalTask3:
    MI32TOF32 MR0, @_M           ; MR0 = 0x4BC00000
    MI32TOF32 MR1, @_X           ; MR1 = 0x4C200000
    MI32TOF32 MR2, @_B           ; MR2 = 0xCB000000
    MMPYF32 MR0, MR0, #0x3380    ; M = 1/(1*2^24) * iqm = 1.5 (0x3FC00000)
    MMPYF32 MR1, MR1, #0x3380    ; X = 1/(1*2^24) * iqx = 2.5 (0x40200000)
    MMPYF32 MR2, MR2, #0x3380    ; B = 1/(1*2^24) * iqb = -.5 (0xBF000000)
    MMPYF32 MR3, MR0, MR1        ; M*X
    MADDF32 MR2, MR2, MR3        ; Y=MX+B = 3.25 (0x40500000)

; Convert Y from float32 to IQ24
    MMPYF32 MR2, MR2, #0x4B80    ; Y * 1*2^24
    MF32TOI32 MR2, MR2           ; IQ24(Y) = 0x03400000
    MMOV32 @_Y, MR2              ; store result
    MSTOP                        ; end of task
```

### See also

[MF32TOI32 MRa, MRb](#)  
[MF32TOUI32 MRa, MRb](#)  
[MI32TOF32 MRa, MRb](#)  
[MUI32TOF32 MRa, MRb](#)  
[MUI32TOF32 MRa, mem32](#)

**MI32TOF32 MRa, MRb Convert 32-Bit Integer to 32-Bit Floating-Point Value**
**Operands**

MRa	CLA floating-point destination register (MR0 to MR3)
MRb	CLA floating-point source register (MR0 to MR3)

**Opcode**

```
LSW: 0000 0000 0000 bbaa
MSW: 0111 1101 1000 0000
```

**Description**

Convert the signed 32-bit integer in MRb to a 32-bit floating-point value and store the result in MRa.

```
MRa = MI32TOF32(MRb);
```

**Flags**

This instruction does not affect any flags:

Flag	TF	ZF	NF	LUF	LVF
Modified	No	No	No	No	No

**Pipeline**

This is a single-cycle instruction.

**Example**

```
; Example1:
;
MMOVIZ MR2, #0x1111 ; MR2(31:16) = 4369 (0x1111)
MMOVXI MR2, #0x1111 ; MR2(15:0) = 4369 (0x1111)
; MR2 = +286331153 (0x11111111)
MI32TOF32 MR3, MR2 ; MR3 = MI32TOF32 (MR2) = 286331153.0 (0x4D888888)
```

**See also**

[MF32TOI32 MRa, MRb](#)  
[MF32TOUI32 MRa, MRb](#)  
[MI32TOF32 MRa, mem32](#)  
[MUI32TOF32 MRa, MRb](#)  
[MUI32TOF32 MRa, mem32](#)

## MLSL32 MRa, #SHIFT *Logical Shift Left*

### Operands

MRa	CLA floating-point source/destination register (MR0 to MR3)
#SHIFT	Number of bits to shift (1 to 32)

### Opcode

```
LSW: 0000 0000 0shi ftaa
MSW: 0111 1011 1100 0000
```

### Description

Logical shift left of MRa by the number of bits indicated. The number of bits can be 1 to 32.

```
MARa(31:0) = Logical Shift Left(MARa(31:0) by #SHIFT bits);
```

### Flags

This instruction modifies the following flags in the MSTF register:

Flag	TF	ZF	NF	LUF	LVF
Modified	No	Yes	Yes	No	No

The MSTF register flags are modified based on the integer results of the operation.

```
NF = MRa(31);
ZF = 0;
if(MRa(31:0) == 0) { ZF = 1; }
```

### Pipeline

This is a single-cycle instruction.

### Example

```
; Given m2 = (int32)32
;         x2 = (int32)64
;         b2 = (int32)-128
;
; Calculate:
;         m2 = m2*2
;         x2 = x2*4
;         b2 = b2*8
;
_ClalTask3:
    MMOV32 MR0, @_m2 ; MR0 = 32 (0x00000020)
    MMOV32 MR1, @_x2 ; MR1 = 64 (0x00000040)
    MMOV32 MR2, @_b2 ; MR2 = -128 (0xFFFFFFFF80)
    MLSL32 MR0, #1 ; MR0 = 64 (0x00000040)
    MLSL32 MR1, #2 ; MR1 = 256 (0x00000100)
    MLSL32 MR2, #3 ; MR2 = -1024 (0xFFFFFC00)
    MMOV32 @_m2, MR0 ; Store results
    MMOV32 @_x2, MR1
    MMOV32 @_b2, MR2
    MSTOP ; end of task
```

### See also

[MADD32 MRa, MRb, MRc](#)  
[MASR32 MRa, #SHIFT](#)  
[MAND32 MRa, MRb, MRc](#)  
[MLSR32 MRa, #SHIFT](#)  
[MOR32 MRa, MRb, MRc](#)  
[MXOR32 MRa, MRb, MRc](#)  
[MSUB32 MRa, MRb, MRc](#)

**MLSR32 MRa, #SHIFT Logical Shift Right**
**Operands**

MRa	CLA floating-point source/destination register (MR0 to MR3)
#SHIFT	Number of bits to shift (1 to 32)

**Opcode**

```
LSW: 0000 0000 0shi ftaa
MSW: 0111 1011 1000 0000
```

**Description**

Logical shift right of MRa by the number of bits indicated. The number of bits can be 1 to 32. Unlike the arithmetic shift (MASR32), the logical shift does not preserve the number's sign bit. Every bit in the operand is moved the specified number of bit positions, and the vacant bit-positions are filled in with zeros

```
MARa(31:0) = Logical Shift Right(MARa(31:0) by #SHIFT bits);
```

**Flags**

This instruction modifies the following flags in the MSTF register:

Flag	TF	ZF	NF	LUF	LVF
Modified	No	Yes	Yes	No	No

The MSTF register flags are modified based on the integer results of the operation.

```
NF = MRa(31);
ZF = 0;
if(MRa(31:0) == 0) { ZF = 1;}
```

**Pipeline**

This is a single-cycle instruction.

**Example**

```
; Illustrate the difference between MASR32 and MLSR32
```

```
MMOVIZ MR0, #0xAAAA ; MR0 = 0xAAAA5555
MMOVXI MR0, #0x5555
```

```
MMOV32 MR1, MR0 ; MR1 = 0xAAAA5555
MMOV32 MR2, MR0 ; MR2 = 0xAAAA5555
```

```
MASR32 MR1, #1 ; MR1 = 0xD5552AAA
MLSR32 MR2, #1 ; MR2 = 0x55552AAA
```

```
MASR32 MR1, #1 ; MR1 = 0xEAAA9555
MLSR32 MR2, #1 ; MR2 = 0x2AAA9555
```

```
MASR32 MR1, #6 ; MR1 = 0xFFAAA555
MLSR32 MR2, #6 ; MR2 = 0x00AAA555
```

**See also**

[MADD32 MRa, MRb, MRc](#)  
[MASR32 MRa, #SHIFT](#)  
[MAND32 MRa, MRb, MRc](#)  
[MLSL32 MRa, #SHIFT](#)  
[MOR32 MRa, MRb, MRc](#)  
[MXOR32 MRa, MRb, MRc](#)  
[MSUB32 MRa, MRb, MRc](#)

## MMACF32 MR3, MR2, MRd, MRe, MRf ||MMOV32 MRa, mem32 32-Bit Floating-Point Multiply and Accumulate with Parallel Move

### Operands

MR3	floating-point destination/source register MR3 for the add operation
MR2	CLA floating-point source register MR2 for the add operation
MRd	CLA floating-point destination register (MR0 to MR3) for the multiply operation MRd cannot be the same register as MRa
MRe	CLA floating-point source register (MR0 to MR3) for the multiply operation
MRf	CLA floating-point source register (MR0 to MR3) for the multiply operation
MRa	CLA floating-point destination register for the MMOV32 operation (MR0 to MR3). MRa cannot be MR3 or the same register as MRd.
mem32	32-bit source for the MMOV32 operation

### Opcode

LSW: `mmmm mmmm mmmm mmmm`  
MSW: `0011 ffee ddaa addr`

### Description

Multiply and accumulate the contents of floating-point registers and move from register to memory. The destination register for the MMOV32 cannot be the same as the destination registers for the MMACF32.

```
MR3 = MR3 + MR2;
MRd = MRe * MRf;
MRa = [mem32];
```

### Restrictions

The destination registers for the MMACF32 and the MMOV32 must be unique. That is, MRa cannot be MR3 and MRa cannot be the same register as MRd.

### Flags

This instruction modifies the following flags in the MSTF register:

Flag	TF	ZF	NF	LUF	LVF
Modified	No	Yes	Yes	Yes	Yes

The MSTF register flags are modified as follows:

- LUF = 1 if MMACF32 (add or multiply) generates an underflow condition.
- LVF = 1 if MMACF32 (add or multiply) generates an overflow condition.

MMOV32 sets the NF and ZF flags as follows:

```
NF = MRa(31);
ZF = 0;
if(MRa(30:23) == 0) { ZF = 1; NF = 0; }
```

### Pipeline

MMACF32 and MMOV32 complete in a single cycle.

**Example 1**

```

; Perform 5 multiply and accumulate operations:
;
; X and Y are 32-bit floating point arrays
;
; 1st multiply: A = X0 * Y0
; 2nd multiply: B = X1 * Y1
; 3rd multiply: C = X2 * Y2
; 4th multiply: D = X3 * Y3
; 5th multiply: E = X3 * Y3
;
; Result = A + B + C + D + E
;
_ClalTask1:
    MMOV16 MAR0, #_X                ; MAR0 points to X array
    MMOV16 MAR1, #_Y                ; MAR1 points to Y array
    MNOP                            ; Delay for MAR0, MAR1 load
    MNOP                            ; Delay for MAR0, MAR1 load
    ; <-- MAR0 valid
    MMOV32 MR0, *MAR0[2]++          ; MR0 = X0, MAR0 += 2
    ; <-- MAR1 valid
    MMOV32 MR1, *MAR1[2]++          ; MR1 = Y0, MAR1 += 2
    ;
    MMPYF32 MR2, MR0, MR1           ; MR2 = A = X0 * Y0
    | MMOV32 MR0, *MAR0[2]++          ; In parallel MR0 = X1, MAR0 += 2
    MMOV32 MR1, *MAR1[2]++          ; MR1 = Y1, MAR1 += 2
    ;
    MMPYF32 MR3, MR0, MR1           ; MR3 = B = X1 * Y1
    | MMOV32 MR0, *MAR0[2]++          ; In parallel MR0 = X2, MAR0 += 2
    MMOV32 MR1, *MAR1[2]++          ; MR1 = Y2, MAR2 += 2
    ;
    MMACF32 MR3, MR2, MR2, MR0, MR1 ; MR3 = A + B, MR2 = C = X2 * Y2
    | MMOV32 MR0, *MAR0[2]++          ; In parallel MR0 = X3
    MMOV32 MR1, *MAR1[2]++          ; MR1 = Y3 M
    ;
    MACF32 MR3, MR2, MR2, MR0, MR1 ; MR3 = (A + B) + C, MR2 = D = X3 * Y3
    | MMOV32 MR0, *MAR0              ; In parallel MR0 = X4
    MMOV32 MR1, *MAR1              ; MR1 = Y4
    ;
    MMPYF32 MR2, MR0, MR1           ; MR2 = E = X4 * Y4
    | MADD32 MR3, MR3, MR2           ; in parallel MR3 = (A + B + C) + D
    ;
    MADD32 MR3, MR3, MR2            ; MR3 = (A + B + C + D) + E
    MMOV32 @_Result, MR3           ; Store the result
    MSTOP                          ; end of task

```

**Example 2**

```

; sum = X0*B0 + X1*B1 + X2*B2 + Y1*A1 + Y2*B2
;
;      X2 = X1
;      X1 = X0
;      Y2 = Y1 ; Y1 = sum
;
_ClaTask2:
    MMOV32    MR0, @_B2      ; MR0 = B2
    MMOV32    MR1, @_X2      ; MR1 = X2
    MMPYF32   MR2, MR1, MR0  ; MR2 = X2*B2
    || MMOV32    MR0, @_B1      ; MR0 = B1
    MMOVD32   MR1, @_X1      ; MR1 = X1, X2 = X1
    MMPYF32   MR3, MR1, MR0  ; MR3 = X1*B1
    || MMOV32    MR0, @_B0      ; MR0 = B0
    MMOVD32   MR1, @_X0      ; MR1 = X0, X1 = X0

; MR3 = X1*B1 + X2*B2, MR2 = X0*B0
; MR0 = A2
    MMACF32   MR3, MR2, MR2, MR1, MR0
    || MMOV32   MR0, @_A2 M

    MOV32    MR1, @_Y2      ; MR1 = Y2

; MR3 = X0*B0 + X1*B1 + X2*B2, MR2 = Y2*A2
; MR0 = A1
    MMACF32   MR3, MR2, MR2, MR1, MR0
    || MMOV32   MR0, @_A1

    MMOVD32   MR1, @_Y1      ; MR1 = Y1, Y2 = Y1
    MADDF32   MR3, MR3, MR2  ; MR3 = Y2*A2 + X0*B0 + X1*B1 + X2*B2
    || MMPYF32   MR2, MR1, MR0 ; MR2 = Y1*A1
    MADDF32   MR3, MR3, MR2  ; MR3 = Y1*A1 + Y2*A2 + X0*B0 + X1*B1 + X2*B2
    MMOV32    @_Y1, MR3      ; Y1 = MR3
    MSTOP
; end of task

```

**See also**

[MMPYF32 MRa, MRb, MRc || MADDF32 MRd, MRe, MRf](#)

**MMAXF32 MRa, MRb 32-Bit Floating-Point Maximum**
**Operands**

MRa	CLA floating-point source/destination register (MR0 to MR3)
MRb	CLA floating-point source register (MR0 to MR3)

**Opcode**

```
LSW: 0000 0000 0000 bbaa
MSW: 0111 1101 0010 0000
```

**Description**

```
if(MRa < MRb) MRa = MRb;
```

Special cases for the output from the MMAXF32 operation:

- NaN output will be converted to infinity
- A denormalized output will be converted to positive zero.

**Flags**

This instruction modifies the following flags in the MSTF register:

Flag	TF	ZF	NF	LUF	LVF
Modified	No	Yes	Yes	No	No

The ZF and NF flags are configured on the result of the operation, not the result stored in the destination register.

```
if(MRa == MRb) {ZF=1; NF=0;}
if(MRa > MRb) {ZF=0; NF=0;}
if(MRa < MRb) {ZF=0; NF=1;}
```

**Pipeline**

This is a single-cycle instruction.

**Example 1**

```
MMOVIZ MR0, #5.0 ; MR0 = 5.0 (0x40A00000)
MMOVIZ MR1, #-2.0 ; MR1 = -2.0 (0xC0000000)
MMOVIZ MR2, #-1.5 ; MR2 = -1.5 (0xBFC00000)
MMAXF32 MR2, MR1 ; MR2 = -1.5, ZF = NF = 0
MMAXF32 MR1, MR2 ; MR1 = -1.5, ZF = 0, NF = 1
MMAXF32 MR2, MR0 ; MR2 = 5.0, ZF = 0, NF = 1
MAXF32 MR0, MR2 ; MR2 = 5.0, ZF = 1, NF = 0
```

**Example 2**

```
; X is an array of 32-bit floating-point values
; Find the maximum value in an array X
; and store it in Result
;
_ClalTask1:
  MMOV16 MAR1, #_X ; Start address
  MUI16TOF32 MR0, @_len ; Length of the array
  MNOP ; delay for MAR1 load
  MNOP ; delay for MAR1 load
  MMOV32 MR1, *MAR1[2]++ ; MR1 = X0
LOOP
  MMOV32 MR2, *MAR1[2]++ ; MR2 = next element
  MMAXF32 MR1, MR2 ; MR1 = MAX(MR1, MR2)
  MADDF32 MR0, MR0, #-1.0 ; Decrement the counter
  MCMPF32 MR0 #0.0 ; Set/clear flags for MBCNDD
  MNOP
  MNOP
  MNOP
  MBCNDD LOOP, NEQ ; Branch if not equal to zero
  MMOV32 @_Result, MR1 ; Always executed
  MNOP ; Always executed
  MNOP ; Always executed
  MSTOP ; End of task
```



**See also**

[MCM PF32 MRa, MRb](#)  
[MCM PF32 MRa, #16FHi](#)  
[MMA XF32 MRa, #16FHi](#)  
[MMIN F32 MRa, MRb](#)  
[MMIN F32 MRa, #16FHi](#)

**MMAXF32 MRa, #16FHi 32-Bit Floating-Point Maximum**
**Operands**

MRa	CLA floating-point source/destination register (MR0 to MR3)
#16FHi	A 16-bit immediate value that represents the upper 16-bits of an IEEE 32-bit floating-point value. The low 16-bits of the mantissa are assumed to be all 0.

**Opcode**

```
LSW: IIII IIII IIII IIII
MSW: 0111 1001 0000 00aa
```

**Description**

Compare MRa with the floating-point value represented by the immediate operand. If the immediate value is larger, then load it into MRa.

```
if(MRa < #16FHi:0) MRa = #16FHi:0;
```

#16FHi is a 16-bit immediate value that represents the upper 16-bits of an IEEE 32-bit floating-point value. The low 16-bits of the mantissa are assumed to be all 0. This addressing mode is most useful for constants where the lowest 16-bits of the mantissa are 0. Some examples are 2.0 (0x40000000), 4.0 (0x40800000), 0.5 (0x3F000000), and -1.5 (0xBFC00000). The assembler will accept either a hex or float as the immediate value. That is, -1.5 can be represented as #-1.5 or #0xBFC0.

Special cases for the output from the MMAXF32 operation:

- NaN output will be converted to infinity
- A denormalized output will be converted to positive zero.

**Flags**

This instruction modifies the following flags in the MSTF register:

Flag	TF	ZF	NF	LUF	LVF
Modified	No	Yes	Yes	No	No

The ZF and NF flags are configured on the result of the operation, not the result stored in the destination register.

```
if(MRa == #16FHi:0) {ZF=1; NF=0;}
if(MRa > #16FHi:0) {ZF=0; NF=0;}
if(MRa < #16FHi:0) {ZF=0; NF=1;}
```

**Pipeline**

This is a single-cycle instruction.

**Example**

```
MMOVIZ MR0, #5.0 ; MR0 = 5.0 (0x40A00000)
MMOVIZ MR1, #4.0 ; MR1 = 4.0 (0x40800000)
MMOVIZ MR2, #-1.5 ; MR2 = -1.5 (0xBFC00000)
MMAXF32 MR0, #5.5 ; MR0 = 5.5, ZF = 0, NF = 1
MMAXF32 MR1, #2.5 ; MR1 = 4.0, ZF = 0, NF = 0
MMAXF32 MR2, #-1.0 ; MR2 = -1.0, ZF = 0, NF = 1
MMAXF32 MR2, #-1.0 ; MR2 = -1.5, ZF = 1, NF = 0
```

**See also**

[MMAXF32 MRa, MRb](#)  
[MMINF32 MRa, MRb](#)  
[MMINF32 MRa, #16FHi](#)

## MMINF32 MRa, MRb 32-Bit Floating-Point Minimum

### Operands

MRa	CLA floating-point source/destination register (MR0 to MR3)
MRb	CLA floating-point source register (MR0 to MR3)

### Opcode

```
LSW: 0000 0000 0000 bbaa
MSW: 0111 1101 0100 0000
```

### Description

```
if (MRa > MRb) MRa = MRb;
```

Special cases for the output from the MMINF32 operation:

- NaN output will be converted to infinity
- A denormalized output will be converted to positive zero.

### Flags

This instruction modifies the following flags in the MSTF register:

Flag	TF	ZF	NF	LUF	LVF
Modified	No	Yes	Yes	No	No

The ZF and NF flags are configured on the result of the operation, not the result stored in the destination register.

```
if (MRa == MRb) {ZF=1; NF=0;}
if (MRa > MRb) {ZF=0; NF=0;}
if (MRa < MRb) {ZF=0; NF=1;}

```

### Pipeline

This is a single-cycle instruction.

### Example 1

```
MMOVIZ MR0, #5.0 ; MR0 = 5.0 (0x40A00000)
MMOVIZ MR1, #4.0 ; MR1 = 4.0 (0x40800000)
MMOVIZ MR2, #-1.5 ; MR2 = -1.5 (0xBFC00000)
MMINF32 MR0, MR1 ; MR0 = 4.0, ZF = 0, NF = 0
MMINF32 MR1, MR2 ; MR1 = -1.5, ZF = 0, NF = 0
MMINF32 MR2, MR1 ; MR2 = -1.5, ZF = 1, NF = 0
MMINF32 MR1, MR0 ; MR2 = -1.5, ZF = 0, NF = 1

```

### Example 2

```
;
; X is an array of 32-bit floating-point values
; Find the minimum value in an array X
; and store it in Result
;

_ClalTask1:
MMOVI16   MAR1, #_X           ; Start address
MUI16TOF32 MR0, @_len        ; Length of the array
MNOP                                           ; delay for MAR1 load
MNOP                                           ; delay for MAR1 load
MMOV32    MR1, *MAR1[2]++    ; MR1 = X0
LOOP
MMOV32    MR2, *MAR1[2]++    ; MR2 = next element
MMINF32   MR1, MR2           ; MR1 = MAX(MR1, MR2)
MADDF32   MR0, MR0, #-1.0    ; Decrement the counter
MCMPIF32  MR0 #0.0           ; Set/clear flags for MBCNDD
MNOP
MNOP
MNOP
MBCNDD    LOOP, NEQ          ; Branch if not equal to zero
MMOV32    @_Result, MR1     ; Always executed
MNOP                                           ; Always executed
MNOP                                           ; Always executed
MSTOP                                           ; End of task

```

**See also**

[MMAXF32 MRa, MRb](#)  
[MMAXF32 MRa, #16FHi](#)  
[MMINF32 MRa, #16FHi](#)

## MMINF32 MRa, #16FHi 32-Bit Floating-Point Minimum

### Operands

MRa	floating-point source/destination register (MR0 to MR3)
#16FHi	A 16-bit immediate value that represents the upper 16-bits of an IEEE 32-bit floating-point value. The low 16-bits of the mantissa are assumed to be all 0.

### Opcode

```
LSW: IIII IIII IIII IIII
MSW: 0111 1001 0100 00aa
```

### Description

Compare MRa with the floating-point value represented by the immediate operand. If the immediate value is smaller, then load it into MRa.

```
if(MRa > #16FHi:0) MRa = #16FHi:0;
```

#16FHi is a 16-bit immediate value that represents the upper 16-bits of an IEEE 32-bit floating-point value. The low 16-bits of the mantissa are assumed to be all 0. This addressing mode is most useful for constants where the lowest 16-bits of the mantissa are 0. Some examples are 2.0 (0x40000000), 4.0 (0x40800000), 0.5 (0x3F000000), and -1.5 (0xBFC00000). The assembler will accept either a hex or float as the immediate value. That is, -1.5 can be represented as #-1.5 or #0xBFC0.

Special cases for the output from the MMINF32 operation:

- NaN output will be converted to infinity
- A denormalized output will be converted to positive zero.

### Flags

This instruction modifies the following flags in the MSTF register:

Flag	TF	ZF	NF	LUF	LVF
Modified	No	Yes	Yes	No	No

The ZF and NF flags are configured on the result of the operation, not the result stored in the destination register.

```
if(MRa == #16FHi:0) {ZF=1; NF=0;}
if(MRa > #16FHi:0) {ZF=0; NF=0;}
if(MRa < #16FHi:0) {ZF=0; NF=1;}
```

### Pipeline

This is a single-cycle instruction.

### Example

```
MMOVIZ MR0, #5.0 ; MR0 = 5.0 (0x40A00000)
MMOVIZ MR1, #4.0 ; MR1 = 4.0 (0x40800000)
MMOVIZ MR2, #-1.5 ; MR2 = -1.5 (0xBFC00000)
MMINF32 MR0, #5.5 ; MR0 = 5.0, ZF = 0, NF = 1
MMINF32 MR1, #2.5 ; MR1 = 2.5, ZF = 0, NF = 0
MMINF32 MR2, #-1.0 ; MR2 = -1.5, ZF = 0, NF = 1
MMINF32 MR2, #-1.5 ; MR2 = -1.5, ZF = 1, NF = 0
```

### See also

[MMAXF32 MRa, #16FHi](#)  
[MMAXF32 MRa, MRb](#)  
[MMINF32 MRa, MRb](#)

### MMOV16 MARx, MRa, #16I Load the Auxiliary Register with MRa + 16-bit Immediate Value

**Operands**

MARx	Auxiliary register MAR0 or MAR1
MRa	CLA Floating-point register (MR0 to MR3)
#16I	16-bit immediate value

**Opcode**

LSW: I I I I I I I I I I I I I I (opcode of MMOV16 MAR0, MRa, #16I)  
 MSW: 0111 1111 1101 00AA

LSW: I I I I I I I I I I I I I I (opcode of MMOV16 MAR1, MRa, #16I)  
 MSW: 0111 1111 1111 00AA

**Description**

Load the auxiliary register, MAR0 or MAR1, with MRa(15:0) + 16-bit immediate value. Refer to the pipeline section for important information regarding this instruction.

$$MARx = MRa(15:0) + \#16I;$$

**Flags**

This instruction does not modify flags in the MSTF register:

Flag	TF	ZF	NF	LUF	LVF
Modified	No	No	No	No	No

**Pipeline**

This is a single-cycle instruction. The load of MAR0 or MAR1 will occur in the EXE phase of the pipeline. Any post increment of MAR0 or MAR1 using indirect addressing will occur in the D2 phase of the pipeline. Therefore the following applies when loading the auxiliary registers:

- I1 and I2**

The two instructions following MMOV16 will use MAR0/MAR1 before the update occurs. Thus these two instructions will use the old value of MAR0 or MAR1.
- I3**

Loading of an auxiliary register occurs in the EXE phase while updates due to post-increment addressing occur in the D2 phase. Thus I3 cannot use the auxiliary register or there will be a conflict. In the case of a conflict, the update due to address-mode post increment will win and the auxiliary register will not be updated with #\_X.
- I4**

Starting with the 4th instruction MAR0 or MAR1 will be the new value loaded with MMOV16.

; Assume MAR0 is 50, MR0 is 10, and #\_X is 20

```

MMOV16 MAR0, MR0, #_X      ; Load MAR0 with address of X (20) + MR0 (10)
<Instruction 1>             ; I1 Will use the old value of MAR0 (50)
<Instruction 2>             ; I2 Will use the old value of MAR0 (50)
<Instruction 3>             ; I3 Cannot use MAR0
<Instruction 4>             ; I4 Will use the new value of MAR0 (30)
<Instruction 5>             ; I5
  
```

**Table 5-16. Pipeline Activity For MMOV16 MARx, MRa , #16I**

Instruction	F1	F2	D1	D2	R1	R2	E	W
MMOV16 MAR0, MR0, #_X	MMOV16							
I1	I1	MMOV16						
I2	I2	I1	MMOV16					
I3	I3	I2	I1	MMOV16				
I4	I4	I3	I2	I1	MMOV16			
I5	I5	I4	I3	I2	I1	MMOV16		
I6	I6	I5	I4	I3	I2	I1	MMOV16	

**Example 1**

```

; Calculate an offset into a sin/cos table
;
_ClalTask1:
    MMOV32 MR0,@_rad                ; MR0 = rad
    MMOV32 MR1,@_TABLE_SIZEDivTwoPi ; MR1 = TABLE_SIZE/(2*Pi)
    MMPYF32 MR1,MR0,MR1              ; MR1 = rad* TABLE_SIZE/(2*Pi)
||  MMOV32 MR2,@_TABLE_MASK          ; MR2 = TABLE_MASK
    MF32TOI32 MR3,MR1                ; MR3 = K=int(rad*TABLE_SIZE/(2*Pi))
    MAND32 MR3,MR3,MR2               ; MR3 = K & TABLE_MASK
    MLSL32 MR3,#1                    ; MR3 = K * 2

    MMOV16 MAR0,MR3,#_Cos0            ; MAR0 K*2+addr of table.Cos0
    MFRACF32 MR1,MR1                 ; I1
    MMOV32 MR0,@_TwoPiDivTABLE_SIZE ; I2
    MMPYF32 MR1,MR1,MR0              ; I3
||  MMOV32 MR0,@_Coef3

    MMOV32 MR2,*MAR0[#-64]++         ; MR2 = *MAR0, MAR0 += (-64)
    ...
    ...
    MSTOP ; end of task

```

**Example 2**

```

; This task logs the last NUM_DATA_POINTS
; ADCRESULT1 values in the array VoltageCLA
;
; When the last element in the array has been
; filled, the task will go back to the
; the first element.
;
; Before starting the ADC conversions, force
; Task 8 to initialize the ConversionCount to zero
;
; The ADC is set to sample (acquire) for 15 SYSCLK cycles
; or 75ns. After the capacitor has captured the analog
; value, the ADC will trigger this task early.
; It takes 10.5 ADCCLKs to complete a conversion,
; the ADCCLK being SYSCLK/4
;   T_sys = 1/200MHz = 5ns
;   T_adc = 4*T_sys = 20ns
; The ADC will take 10.5 * 4 or 42 SYSCLK cycles to complete
; a conversion. The ADC result register may be read on the
; 36th instruction after the task begins.
;
_ClalTask2:
    .asg          0, N
    .loop
    MNOP                                     ;I1 - I28 Wait till I36 to read result
    .eval        N + 1, N
    .break       N = 28
    .endloop
    MMOVZ16     MR0, @_ConversionCount        ;I29 Current Conversion
    MMOV16      MAR1, MR0, #_VoltageCLA       ;I30 Next array location
    MUI16TOF32 MR0, MR0                       ;I31 Convert count to float32
    MADDF32     MR0, MR0, #1.0                ;I32 Add 1 to conversion count
    MCMFP32     MR0, #NUM_DATA_POINTS.0      ;I33 Compare count to max
    MF32TOUI16 MR0, MR0                       ;I34 Convert count to Uint16
    MNOP                                               ;I35 Wait till I36 to read result
    MMOVZ16     MR2, @_AdcaResultRegs.ADCRESULT1 ;I36 Read ADCRESULT1
    MMOV16      *MAR1, MR2                    ; Store ADCRESULT1
    MBCNDD     _RestartCount, GEQ            ; If count >= NUM_DATA_POINTS
    MMOVIZ     MR1, #0.0                      ; Always executed: MR1=0
    MNOP
    MNOP
    MMOV16      @_ConversionCount, MR0       ; If branch not taken
    MSTOP                                             ; store current count

```

```
_RestartCount
    MMOV16    @_ConversionCount, MR1        ; If branch taken, restart count
    MSTOP                                         ; end of task

; This task initializes the ConversionCount
; to zero
;
_Cla1Task8:
    MMOVIZ    MR0, #0.0
    MMOV16    @_ConversionCount, MR0
    MSTOP
_ClaT8End:
```

**See also**



## MMOV16 MARx, mem16 *Load MAR1 with 16-bit Value*

### Operands

MARx	CLA auxiliary register MAR0 or MAR1
mem16	16-bit destination memory accessed using one of the available addressing modes

### Opcode

LSW: mmmm mmmm mmmm mmmm (Opcode for MMOV16 MAR0, mem16)  
MSW: 0111 0110 0000 addr

LSW: mmmm mmmm mmmm mmmm (Opcode for MMOV16 MAR1, mem16)  
MSW: 0111 0110 0100 addr

### Description

Load MAR0 or MAR1 with the 16-bit value pointed to by mem16. Refer to the pipeline section for important information regarding this instruction.

MAR1 = [mem16];

### Flags

No flags MSTF flags are affected.

Flag	TF	ZF	NF	LUF	LVF
Modified	No	No	No	No	No

### Pipeline

This is a single-cycle instruction. The load of MAR0 or MAR1 will occur in the EXE phase of the pipeline. Any post increment of MAR0 or MAR1 using indirect addressing will occur in the D2 phase of the pipeline. Therefore the following applies when loading the auxiliary registers:

- **I1 and I2**

The two instructions following MMOV16 will use MAR0/MAR1 before the update occurs. Thus these two instructions will use the old value of MAR0 or MAR1.

- **I3**

Loading of an auxiliary register occurs in the EXE phase while updates due to post-increment addressing occur in the D2 phase. Thus I3 cannot use the auxiliary register or there will be a conflict. In the case of a conflict, the update due to address-mode post increment will win send the auxiliary register will not be updated with #\_X.

- **I4**

Starting with the 4th instruction MAR0 or MAR1 will be the new value loaded with MMOV16.

; Assume MAR0 is 50 and @\_X is 20

```
MMOV16 MAR0, @_X ; Load MAR0 with the contents of X (20)
<Instruction 1> ; I1 Will use the old value of MAR0 (50)
<Instruction 2> ; I2 Will use the old value of MAR0 (50)
<Instruction 3> ; I3 Cannot use MAR0
<Instruction 4> ; I4 Will use the new value of MAR0 (20)
<Instruction 5> ; I5
....
```

**Table 5-17. Pipeline Activity For MMOV16 MAR0/MAR1, mem16**

Instruction	F1	F2	D1	D2	R1	R2	E	W
MMOV16 MAR0, @_X	MMOV16							
I1	I1	MMOV16						
I2	I2	I1	MMOV16					
I3	I3	I2	I1	MMOV16				
I4	I4	I3	I2	I1	MMOV16			
I5	I5	I4	I3	I2	I1	MMOV16		
I6	I6	I5	I4	I3	I2	I1	MMOV16	

**Example**

```

; This task logs the last NUM_DATA_POINTS
; ADCRESULT1 values in the array VoltageCLA
;
; When the last element in the array has been
; filled, the task will go back to the
; the first element.
;
; Before starting the ADC conversions, force
; Task 8 to initialize the ConversionCount to zero
;
; The ADC is set to sample (acquire) for 15 SYSCLK cycles
; or 75ns. After the capacitor has captured the analog
; value, the ADC will trigger this task early.
; It takes 10.5 ADCCLKs to complete a conversion,
; the ADCCLK being SYSCLK/4
;   T_sys = 1/200MHz = 5ns
;   T_adc = 4*T_sys = 20ns
; The ADC will take 10.5 * 4 or 42 SYSCLK cycles to complete
; a conversion. The ADC result register may be read on the
; 36th instruction after the task begins.
;
_Cla1Task2:
    .asg      0, N
    .loop
    MNOP
;I1 - I28 Wait till I36 to read result
    .eval    N + 1, N
    .break   N = 28
    .endloop
    MMOVZ16 MR0, @_ConversionCount           ;I29 Current Conversion
    MMOV16  MAR1, MR0, #_VoltageCLA         ;I30 Next array location
    MUI16TOF32 MR0, MR0                     ;I31 Convert count to float32
    MADDF32 MR0, MR0, #1.0                  ;I32 Add 1 to conversion count
    MCMFP32 MR0, #NUM_DATA_POINTS.0        ;I33 Compare count to max
    MF32TOUI16 MR0, MR0                    ;I34 Convert count to Uint16
    MNOP
    MMOVZ16 MR2, @_AdcaResultRegs.ADCRESULT1 ;I36 Read ADCRESULT1
    MMOV16  *MAR1, MR2                      ; Store ADCRESULT1
    MBCNDD  _RestartCount, GEQ              ; If count >= NUM_DATA_POINTS
    MMOVIZ  MR1, #0.0                       ; Always executed: MR1=0
    MNOP
    MNOP
    MMOV16  @_ConversionCount, MR0          ; If branch not taken
    MSTOP   ; store current count

    _RestartCount
    MMOV16  @_ConversionCount, MR1          ; If branch taken, restart count
    MSTOP   ; end of task

; This task initializes the ConversionCount
; to zero
;
_Cla1Task8:
    MMOVIZ  MR0, #0.0
    MMOV16  @_ConversionCount, MR0
    MSTOP
_ClaT8End:

```

**See also**

**MMOV16 mem16, MARx *Move 16-Bit Auxiliary Register Contents to Memory***
**Operands**

mem16	16-bit destination memory accessed using one of the available addressing modes
MARx	CLA auxiliary register MAR0 or MAR1

**Opcode**

LSW: mmmm mmmm mmmm mmmm (Opcode for MMOV16 mem16, MAR0)  
 MSW: 0111 0110 1000 addr

LSW: mmmm mmmm mmmm mmmm (Opcode for MMOV16 mem16, MAR1)  
 MSW: 0111 0110 1100 addr

**Description**

Store the contents of MAR0 or MAR1 in the 16-bit memory location pointed to by mem16.

[mem16] = MAR0;

**Flags**

No flags MSTF flags are affected.

Flag	TF	ZF	NF	LUF	LVF
Modified	No	No	No	No	No

**Pipeline**

This is a single-cycle instruction.

**Example**
**See also**

**MMOV16 mem16, MRa Move 16-Bit Floating-Point Register Contents to Memory**
**Operands**

mem16	16-bit destination memory accessed using one of the available addressing modes
MRa	CLA floating-point source register (MR0 to MR3)

**Opcode**

```
LSW: mmmm mmmm mmmm mmmm
MSW: 0111 0101 11aa addr
```

**Description**

Move 16-bit value from the lower 16-bits of the floating-point register (MRa(15:0)) to the location pointed to by mem16.

```
[mem16] = MRa(15:0);
```

**Flags**

No flags MSTF flags are affected.

Flag	TF	ZF	NF	LUF	LVF
Modified	No	No	No	No	No

**Pipeline**

This is a single-cycle instruction.

**Example**

```
; This task logs the last NUM_DATA_POINTS
; ADCRESULT1 values in the array VoltageCLA
;
; When the last element in the array has been
; filled, the task will go back to the
; the first element.
;
; Before starting the ADC conversions, force
; Task 8 to initialize the ConversionCount to zero
;
; The ADC is set to sample (acquire) for 15 SYSCLK cycles
; or 75ns. After the capacitor has captured the analog
; value, the ADC will trigger this task early.
; It takes 10.5 ADCCLKs to complete a conversion,
; the ADCCLK being SYSCLK/4
; T_sys = 1/200MHz = 5ns
; T_adc = 4*T_sys = 20ns
; The ADC will take 10.5 * 4 or 42 SYSCLK cycles to complete
; a conversion. The ADC result register may be read on the
; 36th instruction after the task begins.
;
_ClalTask2:
    .asg      0, N
    .loop
    MNOPI
;I1 - I28 Wait till I36 to read result
    .eval    N + 1, N
    .break   N = 28
    .endloop
MMOVZ16    MR0, @_ConversionCount           ;I29 Current Conversion
MMOV16     MAR1, MR0, #_VoltageCLA          ;I30 Next array location
MUI16TOF32 MR0, MR0                         ;I31 Convert count to float32
MADDF32    MR0, MR0, #1.0                   ;I32 Add 1 to conversion count
MCMFP32    MR0, #NUM_DATA_POINTS.0         ;I33 Compare count to max
MF32TOUI16 MR0, MR0                         ;I34 Convert count to Uint16
MNOPI
MMOVZ16    MR2, @_AdcaResultRegs.ADCRESULT1 ;I36 Read ADCRESULT1
MMOV16     *MAR1, MR2                       ; Store ADCRESULT1
MBCNDD     _RestartCount, GEQ               ; If count >= NUM_DATA_POINTS
MMOVIZ     MR1, #0.0                        ; Always executed: MR1=0
MNOPI
MNOPI
MMOV16     @_ConversionCount, MR0          ; If branch not taken
MSTOP     ; store current count
```

```
_RestartCount
    MMOV16    @_ConversionCount, MR1        ; If branch taken, restart count
    MSTOP                                         ; end of task

; This task initializes the ConversionCount
; to zero
;
_Cla1Task8:
    MMOVIZ    MR0, #0.0
    MMOV16    @_ConversionCount, MR0
    MSTOP
_ClaT8End:
```

**See also**

[MMOVIZ MRa, #16FHi](#)  
[MMOVXI MRa, #16FLoHex](#)

**MMOV32 mem32, MRa *Move 32-Bit Floating-Point Register Contents to Memory***
**Operands**

MRa	floating-point register (MR0 to MR3)
mem32	32-bit destination memory accessed using one of the available addressing modes

**Opcode**

```
LSW: mmmmm mmmmm mmmmm mmmmm
MSW: 0111 0100 11aa addr
```

**Description**

Move from MRa to 32-bit memory location indicated by mem32.

```
[mem32] = MRa;
```

**Flags**

This instruction modifies the following flags in the MSTF register:

Flag	TF	ZF	NF	LUF	LVF
Modified	No	No	No	No	No

No flags affected.

**Pipeline**

This is a single-cycle instruction.

**Example**

```
; Perform 5 multiply and accumulate operations:
;
; X and Y are 32-bit floating point arrays;
; 1st multiply: A = X0 * Y0
; 2nd multiply: B = X1 * Y1
; 3rd multiply: C = X2 * Y2
; 4th multiply: D = X3 * Y3
; 5th multiply: E = X3 * Y3;
; Result = A + B + C + D + E
;
_ClalTask1:
    MMOV16    MAR0, #_X           ; MAR0 points to X array
    MMOV16    MAR1, #_Y           ; MAR1 points to Y array
    MNOP      ; Delay for MAR0, MAR1 load
    MNOP      ; Delay for MAR0, MAR1 load
    ; <-- MAR0 valid
    MMOV32    MR0, *MAR0[2]++     ; MR0 = X0, MAR0 += 2
    ; <-- MAR1 valid
    MMOV32    MR1, *MAR1[2]++     ; MR1 = Y0, MAR1 += 2
    MMPYF32   MR2, MR0, MR1       ; MR2 = A = X0 * Y0
    | MMOV32   MR0, *MAR0[2]++     ; In parallel MR0 = X1, MAR0 += 2
    MMOV32    MR1, *MAR1[2]++     ; MR1 = Y1, MAR1 += 2
    MMPYF32   MR3, MR0, MR1       ; MR3 = B = X1 * Y1
    | MMOV32   MR0, *MAR0[2]++     ; In parallel MR0 = X2, MAR0 += 2
    MMOV32    MR1, *MAR1[2]++     ; MR1 = Y2, MAR2 += 2

    MMACF32   MR3, MR2, MR2, MR0, MR1 ; MR3 = A + B, MR2 = C = X2 * Y2
    | MMOV32   MR0, *MAR0[2]++     ; In parallel MR0 = X3
    MMOV32    MR1, *MAR1[2]++     ; MR1 = Y3

    MMACF32   MR3, MR2, MR2, MR0, MR1 ; MR3 = (A + B) + C, MR2 = D = X3 * Y3
    | MMOV32   MR0, *MAR0
    MMOV32    MR1, *MAR1           ; MR1 = Y4
    MMPYF32   MR2, MR0, MR1       ; MR2 = E = X4 * Y4
    | MADDF32  MR3, MR3, MR2       ; in parallel MR3 = (A + B + C) + D
    MADDF32   MR3, MR3, MR2       ; MR3 = (A + B + C + D) + E
    MMOV32    @_Result, MR3       ; Store the result MSTOP ; end of task
```

**See also**

[MMOV32 mem32, MSTF](#)

**MMOV32 mem32, MSTF** *Move 32-Bit MSTF Register to Memory*
**Operands**

MSTF	floating-point status register
mem32	32-bit destination memory

**Opcode**

LSW: mmmm mmmm mmmm mmmm  
 MSW: 0111 0111 0100 addr

**Description**

Copy the CLA's floating-point status register, MSTF, to memory.

[mem32] = MSTF;

**Flags**

This instruction does not modify flags in the MSTF register:

Flag	TF	ZF	NF	LUF	LVF
Modified	No	No	No	No	No

**Pipeline**

This is a single-cycle instruction.

**Example**
**See also**

[MMOV32 mem32, MRa](#)

**MMOV32 MRa, mem32 {, CNDF} *Conditional 32-Bit Move***
**Operands**

MRa	CLA floating-point destination register (MR0 to MR3)
mem32	32-bit memory location accessed using one of the available addressing modes
CNDF	optional condition.

**Opcode**

```
LSW: mmmm mmmm mmmm mmmm
MSW: 0111 00cn dfaa addr
```

**Description**

If the condition is true, then move the 32-bit value referenced by mem32 to the floating-point register indicated by MRa.

```
if (CNDF == TRUE) MRa = [mem32];
```

CNDF is one of the following conditions:

Encode <sup>(1)</sup>	CNDF	Description	MSTF Flags Tested
0000	NEQ	Not equal to zero	ZF == 0
0001	EQ	Equal to zero	ZF == 1
0010	GT	Greater than zero	ZF == 0 AND NF == 0
0011	GEQ	Greater than or equal to zero	NF == 0
0100	LT	Less than zero	NF == 1
0101	LEQ	Less than or equal to zero	ZF == 1 OR NF == 1
1010	TF	Test flag set	TF == 1
1011	NTF	Test flag not set	TF == 0
1100	LU	Latched underflow	LUF == 1
1101	LV	Latched overflow	LVF == 1
1110	UNC	Unconditional	None
1111	UNCF <sup>(2)</sup>	Unconditional with flag modification	None

<sup>(1)</sup> Values not shown are reserved.

<sup>(2)</sup> This is the default operation if no CNDF field is specified. This condition will allow the ZF and NF flags to be modified when a conditional operation is executed. All other conditions will not modify these flags.

**Flags**

This instruction modifies the following flags in the MSTF register:

Flag	TF	ZF	NF	LUF	LVF
Modified	No	Yes	Yes	No	No

```
if (CNDF == UNCF)
{
    NF = MRa(31);
    ZF = 0;
    if (MRa(30:23) == 0) { ZF = 1; NF = 0; }
}
else No flags modified;
```

**Pipeline**

This is a single-cycle instruction.



**Example**

```

; Given A, B, X, M1 and M2 are 32-bit floating-point
; numbers
;
; if(A == B) calculate Y = X*M1
; if(A! = B) calculate Y = X*M2
;
_Cla1Task5:
    MMOV32    MR0, @_A
    MMOV32    MR1, @_B
    MCMFP32   MR0, MR1
    MMOV32    MR2, @_M1, EQ ; if A == B, MR2 = M1
                          ; Y = M1*X
    MMOV32    MR2, @_M2, NEQ ; if A! = B, MR2 = M2
                          ; Y = M2*X

    MMOV32    MR3, @_X
    MMPYF32   MR3, MR2, MR3 ; Calculate Y
    MMOV32    @_Y, MR3      ; Store Y
    MSTOP
                          ; end of task

```

**See also**

[MMOV32 MRa, MRb {, CNDF}](#)  
[MMOVD32 MRa, mem32](#)

**MMOV32 MRa, MRb {, CNDF} Conditional 32-Bit Move**
**Operands**

MRa	CLA floating-point destination register (MR0 to MR3)
MRb	CLA floating-point source register (MR0 to MR3)
CNDF	optional condition.

**Opcode**

```
LSW: 0000 0000 cndf bbaa
MSW: 0111 1010 1100 0000
```

**Description**

If the condition is true, then move the 32-bit value in MRb to the floating-point register indicated by MRa.

```
if (CNDF == TRUE) MRa = MRb;
```

CNDF is one of the following conditions:

Encode <sup>(3)</sup>	CNDF	Description	MSTF Flags Tested
0000	NEQ	Not equal to zero	ZF == 0
0001	EQ	Equal to zero	ZF == 1
0010	GT	Greater than zero	ZF == 0 AND NF == 0
0011	GEQ	Greater than or equal to zero	NF == 0
0100	LT	Less than zero	NF == 1
0101	LEQ	Less than or equal to zero	ZF == 1 OR NF == 1
1010	TF	Test flag set	TF == 1
1011	NTF	Test flag not set	TF == 0
1100	LU	Latched underflow	LUF == 1
1101	LV	Latched overflow	LVF == 1
1110	UNC	Unconditional	None
1111	UNCF <sup>(4)</sup>	Unconditional with flag modification	None

<sup>(3)</sup> Values not shown are reserved.

<sup>(4)</sup> This is the default operation if no CNDF field is specified. This condition will allow the ZF, and NF flags to be modified when a conditional operation is executed. All other conditions will not modify these flags.

**Flags**

This instruction modifies the following flags in the MSTF register:

Flag	TF	ZF	NF	LUF	LVF
Modified	No	Yes	Yes	No	No

```
if (CNDF == UNCF)
{
    NF = MRa(31); ZF = 0;
    if (MRa(30:23) == 0) {ZF = 1; NF = 0;}
}
else No flags modified;
```

**Pipeline**

This is a single-cycle instruction.

**Example**

```

; Given: X = 8.0
;         Y = 7.0
;         A = 2.0
;         B = 5.0
; _ClaTask1
MMOV32 MR3, @_X      ; MR3 = X = 8.0
MMOV32 MR0, @_Y      ; MR0 = Y = 7.0
MMAXF32 MR3, MR0     ; ZF = 0, NF = 0, MR3 = 8.0
MMOV32 MR1, @_A, GT  ; true, MR1 = A = 2.0
MMOV32 MR1, @_B, LT  ; false, does not load MR1
MMOV32 MR2, MR1, GT  ; true, MR2 = MR1 = 2.0
MMOV32 MR2, MR0, LT  ; false, does not load MR2
MSTOP

```

**See also**

[MMOV32 MRa, mem32 {,CNDF}](#)

**MMOV32 MSTF, mem32** *Move 32-Bit Value from Memory to the MSTF Register*


---

**Operands**

MSTF	CLA status register
mem32	32-bit source memory location

**Opcode**

LSW: mmmm mmmm mmmm mmmm  
 MSW: 0111 0111 0000 addr

**Description**

Move from memory to the CLA's status register MSTF. This instruction is most useful when nesting function calls (via MCCNDD).

MSTF = [mem32];

**Flags**

This instruction modifies the following flags in the MSTF register:

Flag	TF	ZF	NF	LUF	LVF
Modified	Yes	Yes	Yes	Yes	Yes

Loading the status register will overwrite all flags and the RPC field. The MEALLOW field is not affected.

**Pipeline**

This is a single-cycle instruction.

**Example**
**See also**

[MMOV32 mem32, MSTF](#)

## MMOVD32 MRa, mem32 *Move 32-Bit Value from Memory with Data Copy*

### Operands

MRa	CLA floating-point register (MR0 to MR3)
mem32	32-bit memory location accessed using one of the available addressing modes

### Opcode

LSW: mmmm mmmm mmmm mmmm  
MSW: 0111 0100 00aa addr

### Description

Move the 32-bit value referenced by mem32 to the floating-point register indicated by MRa.

```
MRa = [mem32];
[mem32+2] = [mem32];
```

### Flags

This instruction modifies the following flags in the MSTF register:

Flag	TF	ZF	NF	LUF	LVF
Modified	No	Yes	Yes	No	No

```
NF = MRa(31);
ZF = 0;
if(MRa(30:23) == 0){ ZF = 1; NF = 0; }
```

### Pipeline

This is a single-cycle instruction.

### Example

```
; sum = X0*B0 + X1*B1 + X2*B2 + Y1*A1 + Y2*B2
;
;      X2 = X1
;      X1 = X0
;      Y2 = Y1
;      Y1 = sum
;
_ClalTask2:
    MMOV32 MR0, @_B2      ; MR0 = B2
    MMOV32 MR1, @_X2      ; MR1 = X2
    MMPYF32 MR2, MR1, MR0 ; MR2 = X2*B2
||  MMOV32 MR0, @_B1      ; MR0 = B1
    MMOVD32 MR1, @_X1     ; MR1 = X1, X2 = X1
    MMPYF32 MR3, MR1, MR0 ; MR3 = X1*B1
||  MMOV32 MR0, @_B0      ; MR0 = B0
    MMOVD32 MR1, @_X0     ; MR1 = X0, X1 = X0

; MR3 = X1*B1 + X2*B2, MR2 = X0*B0
; MR0 = A2
    MMACF32 MR3, MR2, MR2, MR1, MR0
||  MMOV32 MR0, @_A2

    MMOV32 MR1, @_Y2      ; MR1 = Y2

; MR3 = X0*B0 + X1*B1 + X2*B2, MR2 = Y2*A2
; MR0 = A1
    MMACF32 MR3, MR2, MR2, MR1, MR0
||  MMOV32 MR0, @_A1

    MMOVD32 MR1,@_Y1      ; MR1 = Y1, Y2 = Y1
    MADD32 MR3, MR3, MR2  ; MR3 = Y2*A2 + X0*B0 + X1*B1 + X2*B2
||  MMPYF32 MR2, MR1, MR0 ; MR2 = Y1*A1
    MADD32 MR3, MR3, MR2  ; MR3 = Y1*A1 + Y2*A2 + X0*B0 + X1*B1 + X2*B2
    MMOV32 @_Y1, MR3      ; Y1 = MR3
    MSTOP                  ; end of task
```

### See also

[MMOV32 MRa, mem32 {,CNDF}](#)

**MMOVF32 MRa, #32F *Load the 32-Bits of a 32-Bit Floating-Point Register***
**Operands**

This instruction is an alias for MMOVIZ and MMOVXI instructions. The second operand is translated by the assembler such that the instruction becomes:

```
MMOVIZ MRa, #16FHiHex MMOVXI MRa, #16FLoHex
```

```
MRa          CLA floating-point destination register (MR0 to MR3)
```

```
#32F        immediate float value represented in floating-point representation
```

**Opcode**

```
LSW: I I I I I I I I I I I I I I (opcode of MMOVIZ MRa, #16FHiHex)
```

```
MSW: 0111 1000 0100 00aa
```

```
LSW: I I I I I I I I I I I I I I (opcode of MMOVXI MRa, #16FLoHex)
```

```
MSW: 0111 1000 1000 00aa
```

**Description**

Note: This instruction accepts the immediate operand only in floating-point representation. To specify the immediate value as a hex value (IEEE 32-bit floating-point format) use the MOVI32 MRa, #32FHex instruction.

Load the 32-bits of MRa with the immediate float value represented by #32F.

#32F is a float value represented in floating-point representation. The assembler will only accept a float value represented in floating-point representation. That is, 3.0 can only be represented as #3.0. #0x40400000 will result in an error.

```
MRa = #32F;
```

**Flags**

This instruction modifies the following flags in the MSTF register:

Flag	TF	ZF	NF	LUF	LVF
Modified	No	No	No	No	No

**Pipeline**

Depending on #32FH, this instruction takes one or two cycles. If all of the lower 16-bits of the IEEE 32-bit floating-point format of #32F are zeros, then the assembler will convert MMOV32 into only MMOVIZ instruction. If the lower 16-bits of the IEEE 32-bit floating-point format of #32F are not zeros, then the assembler will convert MMOV32 into MMOVIZ and MMOVXI instructions.

**Example**

```
MMOVF32 MR1, #3.0      ; MR1 = 3.0 (0x40400000)
                       ; Assembler converts this instruction as
                       ; MMOVIZ MR1, #0x4040

MMOVF32 MR2, #0.0     ; MR2 = 0.0 (0x00000000)
                       ; Assembler converts this instruction as
                       ; MMOVIZ MR2, #0x0

MMOVF32 MR3, #12.265  ; MR3 = 12.625 (0x41443D71)
                       ; Assembler converts this instruction as
                       ; MMOVIZ MR3, #0x4144
                       ; MMOVXI MR3, #0x3D71
```

**See also**

[MMOVIZ MRa, #16FHi](#)  
[MMOVXI MRa, #16FLoHex](#)  
[MMOVI32 MRa, #32FHex](#)

## MMOVI16 MARx, #16I Load the Auxiliary Register with the 16-Bit Immediate Value

### Operands

MARx	Auxiliary register MAR0 or MAR1
#16I	16-bit immediate value

### Opcode

LSW: I III I III I III I III (opcode of MMOVI16 MAR0, #16I)  
MSW: 0111 1111 1100 0000

LSW: I III I III I III I III (opcode of MMOVI16 MAR1, #16I)  
MSW: 0111 1111 1110 0000

### Description

Load the auxiliary register, MAR0 or MAR1, with a 16-bit immediate value. Refer to the pipeline section for important information regarding this instruction.

MARx = #16I;

### Flags

This instruction does not modify flags in the MSTF register:

Flag	TF	ZF	NF	LUF	LVF
Modified	No	No	No	No	No

### Pipeline

This is a single-cycle instruction. The immediate load of MAR0 or MAR1 will occur in the EXE phase of the pipeline. Any post increment of MAR0 or MAR1 using indirect addressing will occur in the D2 phase of the pipeline. Therefore the following applies when loading the auxiliary registers:

- **I1 and I2**

The two instructions following MMOVI16 will use MAR0/MAR1 before the update occurs. Thus these two instructions will use the old value of MAR0 or MAR1.

- **I3**

Loading of an auxiliary register occurs in the EXE phase while updates due to post-increment addressing occur in the D2 phase. Thus I3 cannot use the auxiliary register or there will be a conflict. In the case of a conflict, the update due to address-mode post increment will win and the auxiliary register will not be updated with #\_X.

- **I4**

Starting with the 4th instruction MAR0 or MAR1 will be the new value loaded with MMOVI16.

; Assume MAR0 is 50 and #\_X is 20

```
MMOVI16 MAR0, #_X           ; Load MAR0 with address of X (20)
<Instruction 1>             ; I1 Will use the old value of MAR0 (50)
<Instruction 2>             ; I2 Will use the old value of MAR0 (50)
<Instruction 3>             ; I3 Cannot use MAR0
<Instruction 4>             ; I4 Will use the new value of MAR0 (20)
<Instruction 5>             ; I5
....
```

**Table 5-18. Pipeline Activity For MMOVI16 MAR0/MAR1, #16I**

Instruction	F1	F2	D1	D2	R1	R2	E	W
MMOVI16 MAR0, #_X	MMOVI16							
I1	I1	MMOVI16						
I2	I2	I1	MMOVI16					
I3	I3	I2	I1	MMOVI16				
I4	I4	I3	I2	I1	MMOVI16			
I5	I5	I4	I3	I2	I1	MMOVI16		
I6	I6	I5	I4	I3	I2	I1	MMOVI16	

**MMOVI32 MRa, #32FHex** *Load the 32-Bits of a 32-Bit Floating-Point Register with the Immediate*
**Operands**

MRa	floating-point register (MR0 to MR3)
#32FHex	A 32-bit immediate value that represents an IEEE 32-bit floating-point value.

This instruction is an alias for MMOVIZ and MMOVXI instructions. The second operand is translated by the assembler such that the instruction becomes:

```
MMOVIZ MRa, #16FHiHex
MMOVXI MRa, #16FLoHex
```

**Opcode**

```
LSW: I I I I I I I I I I (opcode of MMOVIZ MRa, #16FHiHex)
MSW: 0111 1000 0100 00aa
```

```
LSW: I I I I I I I I I I (opcode of MMOVXI MRa, #16FLoHex)
MSW: 0111 1000 1000 00aa
```

**Description**

Note: This instruction only accepts a hex value as the immediate operand. To specify the immediate value with a floating-point representation use the MMOVF32 MRa, #32F instruction.

Load the 32-bits of MRa with the immediate 32-bit hex value represented by #32FHex.

#32FHex is a 32-bit immediate hex value that represents the IEEE 32-bit floating-point value of a floating-point number. The assembler will only accept a hex immediate value. That is, 3.0 can only be represented as #0x40400000. #3.0 will result in an error.

MRa = #32FHex;

**Flags**

This instruction modifies the following flags in the MSTF register:

Flag	TF	ZF	NF	LUF	LVF
Modified	No	No	No	No	No

**Pipeline**

Depending on #32FHex, this instruction takes one or two cycles. If all of the lower 16-bits of #32FHex are zeros, then assembler will convert MOVIZ to the MMOVIZ instruction. If the lower 16-bits of #32FHex are not zeros, then assembler will convert MOVIZ to a MMOVIZ and a MMOVXI instruction.

**Example**

```
MMOVI32 MR1, #0x40400000 ; MR1 = 0x40400000
                          ; Assembler converts this instruction as
                          ; MMOVIZ MR1, #0x4040

MMOVI32 MR2, #0x00000000 ; MR2 = 0x00000000
                          ; Assembler converts this instruction as
                          ; MMOVIZ MR2, #0x0

MMOVI32 MR3, #0x40004001 ; MR3 = 0x40004001
                          ; Assembler converts this instruction as
                          ; MMOVIZ MR3, #0x4000
                          ; MMOVXI MR3, #0x4001

MMOVI32 MR0, #0x00004040 ; MR0 = 0x00004040
                          ; Assembler converts this instruction as
                          ; MMOVIZ MR0, #0x0000
                          ; MMOVXI MR0, #0x4040
```

**See also**

[MMOVIZ MRa, #16FHi](#)  
[MMOVXI MRa, #16FLoHex](#)  
[MMOVF32 MRa, #32F](#)



## MMOVIZ MRa, #16FHi *Load the Upper 16-Bits of a 32-Bit Floating-Point Register*

### Operands

MRa	floating-point register (MR0 to MR3)
#16FHi	A 16-bit immediate value that represents the upper 16-bits of an IEEE 32-bit floating-point value. The low 16-bits of the mantissa are assumed to be all 0.

### Opcode

```
LSW: I I I I I I I I I I I I I I
MSW: 0 1 1 1 1 0 0 0 0 1 0 0 0 0 a a
```

### Description

Load the upper 16-bits of MRa with the immediate value #16FHi and clear the low 16-bits of MRa.

#16FHiHex is a 16-bit immediate value that represents the upper 16-bits of an IEEE 32-bit floating-point value. The low 16-bits of the mantissa are assumed to be all 0. The assembler will only accept a decimal or hex immediate value. That is, -1.5 can be represented as #-1.5 or #0xBFC0.

By itself, MMOVIZ is useful for loading a floating-point register with a constant in which the lowest 16-bits of the mantissa are 0. Some examples are 2.0 (0x40000000), 4.0 (0x40800000), 0.5 (0x3F000000), and -1.5 (0xBFC00000). If a constant requires all 32-bits of a floating-point register to be initialized, then use MMOVIZ along with the MMOVXI instruction.

```
MRa(31:16) = #16FHi;
MRa(15:0) = 0;
```

### Flags

This instruction modifies the following flags in the MSTF register:

Flag	TF	ZF	NF	LUF	LVF
Modified	No	No	No	No	No

### Pipeline

This is a single-cycle instruction.

### Example

```
; Load MR0 and MR1 with -1.5 (0xBFC00000)
MMOVIZ MR0, #0xBFC0 ; MR0 = 0xBFC00000 (1.5)
MMOVIZ MR1, #-1.5 ; MR1 = -1.5 (0xBFC00000)

; Load MR2 with pi = 3.141593 (0x40490FDB)
MMOVIZ MR2, #0x4049 ; MR2 = 0x40490000
MMOVXI MR2, #0x0FDB ; MR2 = 0x40490FDB
```

### See also

[MMOVF32 MRa, #32F](#)  
[MMOVI32 MRa, #32FHex](#)  
[MMOVXI MRa, #16FLoHex](#)

**MMOVZ16 MRa, mem16 *Load MRx With 16-bit Value***
**Operands**

MRa	CLA floating-point destination register (MR0 to MR3)
mem16	16-bit source memory location

**Opcode**

```
LSW: mmmm mmmm mmmm mmmm
MSW: 0111 0101 10aa addr
```

**Description**

Move the 16-bit value referenced by mem16 to the floating-point register indicated by MRa.

```
MRa(31:16) = 0;
MRa(15:0) = [mem16];
```

**Flags**

This instruction modifies the following flags in the MSTF register:

Flag	TF	ZF	NF	LUF	LVF
Modified	No	Yes	Yes	No	No

The MSTF register flags are modified based on the integer results of the operation.

```
NF = 0;
if (MRa(31:0) == 0) { ZF = 1; }
```

**Pipeline**

This is a single-cycle instruction.

## MMOVXI MRa, #16FLoHex *Move Immediate to the Low 16-Bits of a Floating-Point Register*

### Operands

MRa	CLA floating-point register (MR0 to MR3)
#16FLoHex	A 16-bit immediate hex value that represents the lower 16-bits of an IEEE 32-bit floating-point value. The upper 16-bits will not be modified.

### Opcode

```
LSW: I I I I I I I I I I I I I I I I
MSW: 0 1 1 1 1 0 0 0 1 0 0 0 0 0 a a
```

### Description

Load the low 16-bits of MRa with the immediate value #16FLoHex. #16FLoHex represents the lower 16-bits of an IEEE 32-bit floating-point value. The upper 16-bits of MRa will not be modified. MMOVXI can be combined with the MMOVIZ instruction to initialize all 32-bits of a MRa register.

```
MRa(15:0) = #16FLoHex;
MRa(31:16) = Unchanged;
```

### Flags

Flag	TF	ZF	NF	LUF	LVF
Modified	No	No	No	No	No

### Pipeline

This is a single-cycle instruction.

### Example

```
; Load MR0 with pi = 3.141593 (0x40490FDB)
MMOVIZ    MR0,#0x4049    ; MR0 = 0x40490000
MMOVXI    MR0,#0x0FDB    ; MR0 = 0x40490FDB
```

### See also

[MMOVIZ MRa, #16FHi](#)

**MMPYF32 MRa, MRb, MRc 32-Bit Floating-Point Multiply**
**Operands**

MRa	CLA floating-point destination register (MR0 to MR3)
MRb	CLA floating-point source register (MR0 to MR3)
MRc	CLA floating-point source register (MR0 to MR3)

**Opcode**

```
LSW: 0000 0000 00cc bbaa
MSW: 0111 1100 0000 0000
```

**Description**

Multiply the contents of two floating-point registers.

```
MRa = MRb * MRc;
```

**Flags**

This instruction modifies the following flags in the MSTF register:

Flag	TF	ZF	NF	LUF	LVF
Modified	No	No	No	Yes	Yes

The MSTF register flags are modified as follows:

- LUF = 1 if MMPYF32 generates an underflow condition.
- LVF = 1 if MMPYF32 generates an overflow condition.

**Pipeline**

This is a single-cycle instruction.

**Example**

```
; Calculate Num/Den using a Newton-Raphson algorithm for 1/Den
; Ye = Estimate(1/X)
; Ye = Ye*(2.0 - Ye*X)
; Ye = Ye*(2.0 - Ye*X)
;
_ClalTask1:
    MMOV32    MR1, @_Den    ; MR1 = Den
    MEINVF32  MR2, MR1     ; MR2 = Ye = Estimate(1/Den)
    MMPYF32   MR3, MR2, MR1 ; MR3 = Ye*Den
    MSUBF32   MR3, #2.0, MR3 ; MR3 = 2.0 - Ye*Den
    MMPYF32   MR2, MR2, MR3 ; MR2 = Ye = Ye*(2.0 - Ye*Den)
    MMPYF32   MR3, MR2, MR1 ; MR3 = Ye*Den
||  MMOV32    MR0, @_Num    ; MR0 = Num
    MSUBF32   MR3, #2.0, MR3 ; MR3 = 2.0 - Ye*Den
    MMPYF32   MR2, MR2, MR3 ; MR2 = Ye = Ye*(2.0 - Ye*Den)
||  MMOV32    MR1, @_Den    ; Reload Den To Set Sign
    MNEGF32   MR0, MR0, EQ  ; if(Den == 0.0) Change Sign Of Num
    MMPYF32   MR0, MR2, MR0 ; MR0 = Y = Ye*Num
    MMOV32    @_Dest, MR0   ; Store result
    MSTOP
```

**See also**

[MMPYF32 MRa, #16FHi, MRb](#)  
[MMPYF32 MRa, MRb, MRc || MADDF32 MRd, MRe, MRf](#)  
[MMPYF32 MRd, MRe, MRf || MMOV32 MRa, mem32](#)  
[MMPYF32 MRd, MRe, MRf || MMOV32 mem32, MRa](#)  
[MMPYF32 MRa, MRb, MRc || MSUBF32 MRd, MRe, MRf](#)  
[MMACF32 MR3, MR2, MRd, MRe, MRf || MMOV32 MRa, mem32](#)

## MMPYF32 MRa, #16FHi, MRb 32-Bit Floating-Point Multiply

### Operands

MRa	CLA floating-point destination register (MR0 to MR3)
#16FHi	A 16-bit immediate value that represents the upper 16-bits of an IEEE 32-bit floating-point value. The low 16-bits of the mantissa are assumed to be all 0.
MRc	CLA floating-point source register (MR0 to MR3)

### Opcode

LSW: I I I I I I I I I I I I I I I I I I  
MSW: 0111 0111 1000 baaa

### Description

Multiply MRb with the floating-point value represented by the immediate operand. Store the result of the addition in MRa.

#16FHi is a 16-bit immediate value that represents the upper 16-bits of an IEEE 32-bit floating-point value. The low 16-bits of the mantissa are assumed to be all 0. #16FHi is most useful for representing constants where the lowest 16-bits of the mantissa are 0. Some examples are 2.0 (0x40000000), 4.0 (0x40800000), 0.5 (0x3F000000), and -1.5 (0xBFC00000). The assembler will accept either a hex or float as the immediate value. That is, the value -1.5 can be represented as #-1.5 or #0xBFC0.

MRa = MRb \* #16FHi:0;

This instruction can also be written as MMPYF32 MRa, MRb, #16FHi.

### Flags

This instruction modifies the following flags in the MSTF register:.

Flag	TF	ZF	NF	LUF	LVF
Modified	No	No	No	Yes	Yes

The MSTF register flags are modified as follows:

- LUF = 1 if MMPYF32 generates an underflow condition.
- LVF = 1 if MMPYF32 generates an overflow condition.

### Pipeline

This is a single-cycle instruction.

### Example 1

```
; Same as example 2 but #16FHi is represented in float
MMOVIZ MR3, #2.0 ; MR3 = 2.0 (0x40000000)
MMPYF32 MR0, #3.0, MR3 ; MR0 = 3.0 * MR3 = 6.0 (0x40C00000)
MMOV32 @_X, MR0 ; Save the result in variable X
```

### Example 2

```
; Same as example 1 but #16FHi is represented in Hex
MMOVIZ MR3, #2.0 ; MR3 = 2.0 (0x40000000)
MMPYF32 MR0, #0x4040, MR3 ; MR0 = 0x4040 * MR3 = 6.0 (0x40C00000)
MMOV32 @_X, MR0 ; Save the result in variable X
```

**Example 3**

```

; Given X, M and B are IQ24 numbers:
; X = IQ24(+2.5) = 0x02800000
; M = IQ24(+1.5) = 0x01800000
; B = IQ24(-0.5) = 0xFF800000
;
; Calculate Y = X * M + B
;
;
_ClalTask2:
;
; Convert M, X and B from IQ24 to float
    MI32TOF32    MR0, @_M           ; MR0 = 0x4BC00000
    MI32TOF32    MR1, @_X           ; MR1 = 0x4C200000
    MI32TOF32    MR2, @_B           ; MR2 = 0xCB000000
    MMPYF32      MR0, MR0, #0x3380 ; M = 1/(1*2^24) * iqm = 1.5 (0x3FC00000)
    MMPYF32      MR1, MR1, #0x3380 ; X = 1/(1*2^24) * iqx = 2.5 (0x40200000)
    MMPYF32      MR2, MR2, #0x3380 ; B = 1/(1*2^24) * iqb = -.5 (0xBF000000)
    MMPYF32      MR3, MR0, MR1     ; M*X
    MADDF32      MR2, MR2, MR3     ; Y=MX+B = 3.25 (0x40500000)
; Convert Y from float32 to IQ24
    MMPYF32      MR2, MR2, #0x4B80 ; Y * 1*2^24
    MF32TOI32    MR2, MR2         ; IQ24(Y) = 0x03400000
    MMOV32      @_Y, MR2         ; store result
    MSTOP
; end of task

```

**See also**

[MMPYF32 MRa, MRb, #16FHi](#)  
[MMPYF32 MRa, MRb, MRc](#)  
[MMPYF32 MRa, MRb, MRc || MADDF32 MRd, MRe, MRf](#)

## MMPYF32 MRa, MRb, #16FHi 32-Bit Floating-Point Multiply

### Operands

MRa	CLA floating-point destination register (MR0 to MR3)
MRb	CLA floating-point source register (MR0 to MR3)
#16FHi	A 16-bit immediate value that represents the upper 16-bits of an IEEE 32-bit floating-point value. The low 16-bits of the mantissa are assumed to be all 0.

### Opcode

LSW: I I I I I I I I I I I I I I I I I I  
MSW: 0111 0111 1000 baaa

### Description

Multiply MRb with the floating-point value represented by the immediate operand. Store the result of the addition in MRa.

#16FHi is a 16-bit immediate value that represents the upper 16-bits of an IEEE 32-bit floating-point value. The low 16-bits of the mantissa are assumed to be all 0. #16FHi is most useful for representing constants where the lowest 16-bits of the mantissa are 0. Some examples are 2.0 (0x40000000), 4.0 (0x40800000), 0.5 (0x3F000000), and -1.5 (0xBFC00000). The assembler will accept either a hex or float as the immediate value. That is, the value -1.5 can be represented as #-1.5 or #0xBFC0.

MRa = MRb \* #16FHi:0;

This instruction can also be written as MMPYF32 MRa, #16FHi, MRb.

### Flags

This instruction modifies the following flags in the MSTF register:.

Flag	TF	ZF	NF	LUF	LVF
Modified	No	No	No	Yes	Yes

The MSTF register flags are modified as follows:

- LUF = 1 if MMPYF32 generates an underflow condition.
- LVF = 1 if MMPYF32 generates an overflow condition.

### Pipeline

This is a single-cycle instruction.

### Example 1

```
;Same as example 2 but #16FHi is represented in float
MMOVIZ MR3, #2.0 ; MR3 = 2.0 (0x40000000)
MMPYF32 MR0, MR3, #3.0 ; MR0 = MR3 * 3.0 = 6.0 (0x40C00000)
MMOV32 @_X, MR0 ; Save the result in variable X
```

### Example 2

```
;Same as above example but #16FHi is represented in Hex
MMOVIZ MR3, #2.0 ; MR3 = 2.0 (0x40000000)
MMPYF32 MR0, MR3, #0x4040 ; MR0 = MR3 * 0x4040 = 6.0 (0x40C00000)
MMOV32 @_X, MR0 ; Save the result in variable X
```

**Example 3**

```

; Given X, M and B are IQ24 numbers:
; X = IQ24(+2.5) = 0x02800000
; M = IQ24(+1.5) = 0x01800000
; B = IQ24(-0.5) = 0xFF800000
;
; Calculate Y = X * M + B
;
_ClalTask2:
;
; Convert M, X and B from IQ24 to float
    MI32TOF32    MR0, @_M          ; MR0 = 0x4BC00000
    MI32TOF32    MR1, @_X          ; MR1 = 0x4C200000
    MI32TOF32    MR2, @_B          ; MR2 = 0xCB000000
    MMPYF32      MR0, #0x3380, MR0 ; M = 1/(1*2^24) * iqm = 1.5 (0x3FC00000)
    MMPYF32      MR1, #0x3380, MR1 ; X = 1/(1*2^24) * iqx = 2.5 (0x40200000)
    MMPYF32      MR2, #0x3380, MR2 ; B = 1/(1*2^24) * iqb = -.5 (0xBF000000)
    MMPYF32      MR3, MR0, MR1     ; M*X
    MADDF32      MR2, MR2, MR3     ; Y=MX+B = 3.25 (0x40500000)

; Convert Y from float32 to IQ24
    MMPYF32      MR2, #0x4B80, MR2 ; Y * 1*2^24
    MF32TOI32    MR2, MR2         ; IQ24(Y) = 0x03400000
    MMOV32       @_Y, MR2        ; store result
    MSTOP
; end of task

```

**See also**

[MMPYF32 MRa, #16FHi, MRb](#)  
[MMPYF32 MRa, MRb, MRc](#)



## MMPYF32 MRa, MRb, MRc||MADDF32 MRd, MRe, MRf 32-Bit Floating-Point Multiply with Parallel Add

### Operands

MRa	CLA floating-point destination register for MMPYF32 (MR0 to MR3) MRa cannot be the same register as MRd
MRb	CLA floating-point source register for MMPYF32 (MR0 to MR3)
MRc	CLA floating-point source register for MMPYF32 (MR0 to MR3)
MRd	CLA floating-point destination register for MADDF32 (MR0 to MR3) MRd cannot be the same register as MRa
MRe	CLA floating-point source register for MADDF32 (MR0 to MR3)
MRf	CLA floating-point source register for MADDF32 (MR0 to MR3)

### Opcode

LSW: 0000 ffee ddcc bbaa  
MSW: 0111 1010 0000 0000

### Description

Multiply the contents of two floating-point registers with parallel addition of two registers.

MRa = MRb \* MRc;  
MRd = MRe + MRf;

### Restrictions

The destination register for the MMPYF32 and the MADDF32 must be unique. That is, MRa cannot be the same register as MRd.

### Flags

This instruction modifies the following flags in the MSTF register:

Flag	TF	ZF	NF	LUF	LVF
Modified	No	No	No	Yes	Yes

The MSTF register flags are modified as follows:

- LUF = 1 if MMPYF32 or MADDF32 generates an underflow condition.
- LVF = 1 if MMPYF32 or MADDF32 generates an overflow condition.

### Pipeline

Both MMPYF32 and MADDF32 complete in a single cycle.

**Example**

```

; Perform 5 multiply and accumulate operations:
;
; X and Y are 32-bit floating point arrays
;
; 1st multiply: A = X0 * Y0
; 2nd multiply: B = X1 * Y1
; 3rd multiply: C = X2 * Y2
; 4th multiply: D = X3 * Y3
; 5th multiply: E = X3 * Y3
;
; Result = A + B + C + D + E
;
_ClalTask1:
    MMOV16    MAR0, #_X           ; MAR0 points to X array
    MMOV16    MAR1, #_Y           ; MAR1 points to Y array
    MNOOP     ; Delay for MAR0, MAR1 load
    MNOOP     ; Delay for MAR0, MAR1 load
    ; <-- MAR0 valid
    MMOV32    MR0, *MAR0[2]++     ; MR0 = X0, MAR0 += 2
    ; <-- MAR1 valid
    MMOV32    MR1, *MAR1[2]++     ; MR1 = Y0, MAR1 += 2

    MMPYF32   MR2, MR0, MR1       ; MR2 = A = X0 * Y0
    || MMOV32  MR0, *MAR0[2]++     ; In parallel MR0 = X1, MAR0 += 2
    MMOV32    MR1, *MAR1[2]++     ; MR1 = Y1, MAR1 += 2

    MMPYF32   MR3, MR0, MR1       ; MR3 = B = X1 * Y1
    || MMOV32  MR0, *MAR0[2]++     ; In parallel MR0 = X2, MAR0 += 2
    MMOV32    MR1, *MAR1[2]++     ; MR1 = Y2, MAR2 += 2

    MMACF32   MR3, MR2, MR2, MR0, MR1 ; MR3 = A + B, MR2 = C = X2 * Y2
    || MMOV32  MR0, *MAR0[2]++     ; In parallel MR0 = X3
    MMOV32    MR1, *MAR1[2]++     ; MR1 = Y3

    MMACF32   MR3, MR2, MR2, MR0, MR1 ; MR3 = (A + B) + C, MR2 = D = X3 * Y3
    || MMOV32  MR0, *MAR0
    MMOV32    MR1, *MAR1           ; MR1 = Y4

    MMPYF32   MR2, MR0, MR1       ; MR2 = E = X4 * Y4
    || MADD32  MR3, MR3, MR2       ; in parallel MR3 = (A + B + C) + D

    MADD32    MR3, MR3, MR2       ; MR3 = (A + B + C + D) + E
    MMOV32    @_Result, MR3       ; Store the result
    MSTOP
    ; end of task

```

**See also**

[MMACF32 MR3, MR2, MRd, MRe, MRf || MMOV32 MRa, mem32](#)

## MMPYF32 MRd, MRe, MRf ||MMOV32 MRa, mem32 32-Bit Floating-Point Multiply with Parallel Move

### Operands

MRd	CLA floating-point destination register for the MMPYF32 (MR0 to MR3) MRd cannot be the same register as MRa
MRe	CLA floating-point source register for the MMPYF32 (MR0 to MR3)
MRf	CLA floating-point source register for the MMPYF32 (MR0 to MR3)
MRa	CLA floating-point destination register for the MMOV32 (MR0 to MR3) MRa cannot be the same register as MRd
mem32	32-bit memory location accessed using one of the available addressing modes. This will be the source of the MMOV32.

### Opcode

LSW: mmmm mmmm mmmm mmmm  
MSW: 0000 ffee ddaa addr

### Description

Multiply the contents of two floating-point registers and load another.

MRd = MRe \* MRf;  
MRa = [mem32];

### Restrictions

The destination register for the MMPYF32 and the MMOV32 must be unique. That is, MRa cannot be the same register as MRd.

### Flags

This instruction modifies the following flags in the MSTF register:.

Flag	TF	ZF	NF	LUF	LVF
Modified	No	Yes	Yes	Yes	Yes

The MSTF register flags are modified as follows:

- LUF = 1 if MMPYF32 generates an underflow condition.
- LVF = 1 if MMPYF32 generates an overflow condition.

The MMOV32 Instruction will set the NF and ZF flags as follows:

NF = MRa(31);  
ZF = 0;  
if(MRa(30:23) == 0) { ZF = 1; NF = 0; }

### Pipeline

Both MMPYF32 and MMOV32 complete in a single cycle.

### Example 1

```
; Given M1, X1 and B1 are 32-bit floating point
; Calculate Y1 = M1*X1+B1
;
_Cla1Task1:
    MMOV32    MR0, @M1        ; Load MR0 with M1
    MMOV32    MR1, @X1        ; Load MR1 with X1
    MMPYF32   MR1, MR1, MR0    ; Multiply M1*X1
    || MMOV32  MR0, @B1        ; and in parallel load MR0 with B1
    MADDF32   MR1, MR1, MR0    ; Add M*X1 to B1 and store in MR1
    MMOV32    @Y1, MR1        ; Store the result
    MSTOP
```

**Example 2**

```

; Given A, B and C are 32-bit floating-point numbers
; Calculate Y2 = (A * B)
;           Y3 = (A * B) * C
;
_ClalTask2:
    MMOV32    MR0, @A        ; Load MR0 with A
    MMOV32    MR1, @B        ; Load MR1 with B
    MMPYF32   MR1, MR1, MR0  ; Multiply A*B
|| MMOV32    MR0, @C        ; and in parallel load MR0 with C
    MMPYF32   MR1, MR1, MR0  ; Multiply (A*B) by C
|| MMOV32    @Y2, MR1       ; and in parallel store A*B
    MMOV32    @Y3, MR1       ; Store the result
    MSTOP                    ; end of task

```

**See also**

[MMPYF32 MRd, MRe, MRf || MMOV32 mem32, MRa](#)  
[MMACF32 MR3, MR2, MRd, MRe, MRf || MMOV32 MRa, mem32](#)

**MMPYF32 MRd, MRe, MRf ||MMOV32 mem32, MRa 32-Bit Floating-Point Multiply with Parallel Move**
**Operands**

MRd	CLA floating-point destination register for the MMPYF32 (MR0 to MR3)
MRe	CLA floating-point source register for the MMPYF32 (MR0 to MR3)
MRf	CLA floating-point source register for the MMPYF32 (MR0 to MR3)
mem32	32-bit memory location accessed using one of the available addressing modes. This will be the destination of the MMOV32.
MRa	CLA floating-point source register for the MMOV32 (MR0 to MR3)

**Opcode**

```
LSW: mmmm mmmm mmmm mmmm
MSW: 0100 ffee ddaa addr
```

**Description**

Multiply the contents of two floating-point registers and move from memory to register.

```
MRd = MRe * MRf;
[mem32] = MRa;
```

**Flags**

This instruction modifies the following flags in the MSTF register:

Flag	TF	ZF	NF	LUF	LVF
Modified	No	No	No	Yes	Yes

The MSTF register flags are modified as follows:

- LUF = 1 if MMPYF32 generates an underflow condition.
- LVF = 1 if MMPYF32 generates an overflow condition.

**Pipeline**

MMPYF32 and MMOV32 both complete in a single cycle.

**Example**

```
; Given A, B and C are 32-bit floating-point numbers
; Calculate Y2 = (A * B)
;           Y3 = (A * B) * C
;
_ClalTask2:
    MMOV32    MR0, @A           ; Load MR0 with A
    MMOV32    MR1, @B           ; Load MR1 with B
    MMPYF32   MR1, MR1, MR0     ; Multiply A*B
||    MMOV32    MR0, @C           ; and in parallel load MR0 with C
    MMPYF32   MR1, MR1, MR0     ; Multiply (A*B) by C
||    MMOV32    @Y2, MR1         ; and in parallel store A*B
    MMOV32    @Y3, MR1         ; Store the result
    MSTOP
```

**See also**

[MMPYF32 MRd, MRe, MRf || MMOV32 MRa, mem32](#)  
[MMACF32 MR3, MR2, MRd, MRe, MRf || MMOV32 MRa, mem32](#)

**MMPYF32 MRa, MRb, MRc || MSUBF32 MRd, MRe, MRf 32-Bit Floating-Point Multiply with Parallel Subtract**
**Operands**

MRa	CLA floating-point destination register for MMPYF32 (MR0 to MR3) MRa cannot be the same register as MRd
MRb	CLA floating-point source register for MMPYF32 (MR0 to MR3)
MRc	CLA floating-point source register for MMPYF32 (MR0 to MR3)
MRd	CLA floating-point destination register for MSUBF32 (MR0 to MR3) MRd cannot be the same register as MRa
MRe	CLA floating-point source register for MSUBF32 (MR0 to MR3)
MRf	CLA floating-point source register for MSUBF32 (MR0 to MR3)

**Opcode**

```
LSW: 0000 ffee ddc bbaa
MSW: 0111 1010 0100 0000
```

**Description**

Multiply the contents of two floating-point registers with parallel subtraction of two registers.

```
MRa = MRb * MRc;
MRd = MRe - MRf;
```

**Restrictions**

The destination register for the MMPYF32 and the MSUBF32 must be unique. That is, MRa cannot be the same register as MRd.

**Flags**

This instruction modifies the following flags in the MSTF register:

Flag	TF	ZF	NF	LUF	LVF
Modified	No	No	No	Yes	Yes

The MSTF register flags are modified as follows:

- LUF = 1 if MMPYF32 or MSUBF32 generates an underflow condition.
- LVF = 1 if MMPYF32 or MSUBF32 generates an overflow condition.

**Pipeline**

MMPYF32 and MSUBF32 both complete in a single cycle.

**Example**

```
; Given A, B and C are 32-bit floating-point numbers
; Calculate Y2 = (A * B)
;           Y3 = (A - B)
;
_ClalTask2:
    MOV32    MR0, @A           ; Load MR0 with A
    MOV32    MR1, @B           ; Load MR1 with B
    MMPYF32  MR2, MR0, MR1     ; Multiply (A*B)
    || MSUBF32 MR3, MR0, MR1   ; and in parallel Sub (A-B)
    MOV32    @Y2, MR2          ; Store A*B
    MOV32    @Y3, MR3          ; Store A-B
    MSTOP                                ; end of task
```

**See also**

[MSUBF32 MRa, MRb, MRc](#)  
[MSUBF32 MRd, MRe, MRf || MMOV32 MRa, mem32](#)  
[MSUBF32 MRd, MRe, MRf || MMOV32 mem32, MRa](#)

## MNEGF32 MRa, MRb{, CNDF} *Conditional Negation*

### Operands

MRa	CLA floating-point destination register (MR0 to MR3)
MRb	CLA floating-point source register (MR0 to MR3)
CNDF	condition tested

### Opcode

LSW: 0000 0000 cndf bbaa  
MSW: 0111 1010 1000 0000

### Description

```
if (CNDF == true) {MRa = - MRb; }
else {MRa = MRb; }
```

CNDF is one of the following conditions:

Encode <sup>(5)</sup>	CNDF	Description	MSTF Flags Tested
0000	NEQ	Not equal to zero	ZF == 0
0001	EQ	Equal to zero	ZF == 1
0010	GT	Greater than zero	ZF == 0 AND NF == 0
0011	GEQ	Greater than or equal to zero	NF == 0
0100	LT	Less than zero	NF == 1
0101	LEQ	Less than or equal to zero	ZF == 1 OR NF == 1
1010	TF	Test flag set	TF == 1
1011	NTF	Test flag not set	TF == 0
1100	LU	Latched underflow	LUF == 1
1101	LV	Latched overflow	LVF == 1
1110	UNC	Unconditional	None
1111	UNCF <sup>(6)</sup>	Unconditional with flag modification	None

<sup>(5)</sup> Values not shown are reserved.

<sup>(6)</sup> This is the default operation if no CNDF field is specified. This condition will allow the ZF, and NF flags to be modified when a conditional operation is executed. All other conditions will not modify these flags.

### Flags

This instruction modifies the following flags in the MSTF register:

Flag	TF	ZF	NF	LUF	LVF
Modified	No	Yes	Yes	No	No

### Pipeline

This is a single-cycle instruction.

### Example 1

```
; Show the basic operation of MNEGF32
;
MMOVIZ MR0, #5.0 ; MR0 = 5.0 (0x40A00000)
MMOVIZ MR1, #4.0 ; MR1 = 4.0 (0x40800000)
MMOVIZ MR2, #-1.5 ; MR2 = -1.5 (0xBF000000)
MMPYF32 MR3, MR1, MR2 ; MR3 = -6.0
MMPYF32 MR0, MR0, MR1 ; MR0 = 20.0
MMOVIZ MR1, #0.0
MCMPPF32 MR3, MR1 ; NF = 1
MNEGF32 MR3, MR3, LT ; if NF = 1, MR3 = 6.0
MCMPPF32 MR0, MR1 ; NF = 0
MNEGF32 MR0, MR0, GEQ ; if NF = 0, MR0 = -20.0
```

**Example 2**

```

; Calculate Num/Den using a Newton-Raphson algorithm for 1/Den
; Ye = Estimate(1/X)
; Ye = Ye*(2.0 - Ye*X)
; Ye = Ye*(2.0 - Ye*X)
;
_ClalTask1:
    MMOV32    MR1, @_Den        ; MR1 = Den
    MEINVF32  MR2, MR1         ; MR2 = Ye = Estimate(1/Den)
    MMPYF32   MR3, MR2, MR1    ; MR3 = Ye*Den
    MSUBF32   MR3, #2.0, MR3   ; MR3 = 2.0 - Ye*Den
    MMPYF32   MR2, MR2, MR3    ; MR2 = Ye = Ye*(2.0 - Ye*Den)
    MMPYF32   MR3, MR2, MR1    ; MR3 = Ye*Den
| | MMOV32    MR0, @_Num        ; MR0 = Num
| | MSUBF32   MR3, #2.0, MR3   ; MR3 = 2.0 - Ye*Den
| | MMPYF32   MR2, MR2, MR3    ; MR2 = Ye = Ye*(2.0 - Ye*Den)
| | MMOV32    MR1, @_Den        ; Reload Den To Set Sign
| | MNEGF32   MR0, MR0, EQ     ; if(Den == 0.0) Change Sign Of Num
| | MMPYF32   MR0, MR2, MR0    ; MR0 = Y = Ye*Num
| | MMOV32    @_Dest, MR0      ; Store result
| | MSTOP
; end of task

```

**See also**
[MABSF32 MRa, MRb](#)



## MNOP *No Operation*

### Operands

none This instruction does not have any operands

### Opcode

LSW: 0000 0000 0000 0000  
MSW: 0111 1111 1010 0000

### Description

Do nothing. This instruction is used to fill required pipeline delay slots when other instructions are not available to fill the slots.

### Flags

This instruction does not modify flags in the MSTF register.

Flag	TF	ZF	NF	LUF	LVF
Modified	No	No	No	No	No

### Pipeline

This is a single-cycle instruction.

### Example

```

; X is an array of 32-bit floating-point values
; Find the maximum value in an array X
; and store it in Result
;
_ClalTask1:
    MMOVI16    MAR1, #_X           ; Start address
    MUII16TOF32 MR0, @_len        ; Length of the array
    MNOP                          ; delay for MAR1 load
    MNOP                          ; delay for MAR1 load
    MMOV32     MR1, *MAR1[2]++    ; MR1 = X0
LOOP
    MMOV32     MR2, *MAR1[2]++    ; MR2 = next element
    MMAXF32    MR1, MR2           ; MR1 = MAX(MR1, MR2)
    MADDF32    MR0, MR0, #-1.0    ; Decrement the counter
    MCMFP32    MR0 #0.0          ; Set/clear flags for MBCNDD
    MNOP                          ; Too late to affect MBCNDD
    MNOP                          ; Too late to affect MBCNDD
    MNOP                          ; Too late to affect MBCNDD
    MBCNDD     LOOP, NEQ          ; Branch if not equal to zero
    MMOV32     @_Result, MR1      ; Always executed
    MNOP                          ; Pad to separate MBCNDD and MSTOP
    MNOP                          ; Pad to separate MBCNDD and MSTOP
    MSTOP                                           ; End of task

```

### See also

**MOR32 MRa, MRb, MRc *Bitwise OR***
**Operands**

MRa	CLA floating-point destination register (MR0 to MR3)
MRb	CLA floating-point source register (MR0 to MR3)
MRc	CLA floating-point source register (MR0 to MR3)

**Opcode**

```
LSW: 0000 0000 00cc bbaa
MSW: 0111 1100 1000 0000
```

**Description**

Bitwise OR of MRb with MRc.

```
MARa(31:0) = MARb(31:0) OR MRc(31:0);
```

**Flags**

This instruction modifies the following flags in the MSTF register:

Flag	TF	ZF	NF	LUF	LVF
Modified	No	Yes	Yes	No	No

The MSTF register flags are modified based on the integer results of the operation.

```
NF = MRa(31);
ZF = 0;
if(MRa(31:0) == 0) { ZF = 1; }
```

**Pipeline**

This is a single-cycle instruction.

**Example**

```
MMOVIZ MR0, #0x5555 ; MR0 = 0x5555AAAA
MMOVXI MR0, #0xAAAA

MMOVIZ MR1, #0x5432 ; MR1 = 0x5432FEDC
MMOVXI MR1, #0xFEDC

; 0101 OR 0101 = 0101 (5)
; 0101 OR 0100 = 0101 (5)
; 0101 OR 0011 = 0111 (7)
; 0101 OR 0010 = 0111 (7)
; 1010 OR 1111 = 1111 (F)
; 1010 OR 1110 = 1110 (E)
; 1010 OR 1101 = 1111 (F)
; 1010 OR 1100 = 1110 (E)

MOR32 MR2, MR1, MR0 ; MR3 = 0x5555FEFE
```

**See also**

[MAND32 MRa, MRb, MRc](#)  
[MXOR32 MRa, MRb, MRc](#)

**MRCNDD {CNDF}     *Return Conditional Delayed***
**Operands**

CNDF	optional condition.
------	---------------------

**Opcode**

```
LSW: 0000 0000 0000 0000
MSW: 0111 1001 1010 cndf
```

**Description**

If the specified condition is true, then the RPC field of MSTF is loaded into MPC and fetching continues from that location. Otherwise program fetches will continue without the return.

Please refer to the pipeline section for important information regarding this instruction.

```
if (CNDF == TRUE) MPC = RPC;
```

CNDF is one of the following conditions:

Encode <sup>(7)</sup>	CNDF	Description	MSTF Flags Tested
0000	NEQ	Not equal to zero	ZF == 0
0001	EQ	Equal to zero	ZF == 1
0010	GT	Greater than zero	ZF == 0 AND NF == 0
0011	GEQ	Greater than or equal to zero	NF == 0
0100	LT	Less than zero	NF == 1
0101	LEQ	Less than or equal to zero	ZF == 1 OR NF == 1
1010	TF	Test flag set	TF == 1
1011	NTF	Test flag not set	TF == 0
1100	LU	Latched underflow	LUF == 1
1101	LV	Latched overflow	LVF == 1
1110	UNC	Unconditional	None
1111	UNCF <sup>(8)</sup>	Unconditional with flag modification	None

<sup>(7)</sup> Values not shown are reserved.

<sup>(8)</sup> This is the default operation if no CNDF field is specified. This condition will allow the ZF and NF flags to be modified when a conditional operation is executed. All other conditions will not modify these flags.

**Flags**

This instruction does not modify flags in the MSTF register.

Flag	TF	ZF	NF	LUF	LVF
Modified	No	No	No	No	No

**Pipeline**

The MRCNDD instruction by itself is a single-cycle instruction. As shown in [Table 5-19](#), for each return 6 instruction slots are executed; three before the return instruction (d5-d7) and three after the return instruction (d8-d10). The total number of cycles for a return taken or not taken depends on the usage of these slots. That is, the number of cycles depends on how many slots are filled with a MNOP as well as which slots are filled. The effective number of cycles for a return can, therefore, range from 1 to 7 cycles. The number of cycles for a return taken may not be the same as for a return not taken.

Referring to the following code fragment and the pipeline diagrams in [Table 5-19](#) and [Table 5-20](#), the instructions before and after MRCNDD have the following properties:

```

;
;
<Instruction 1>    ; I1 Last instruction that can affect flags for
                  ; the MCCNDD operation
<Instruction 2>    ; I2 Cannot be stop, branch, call or return
<Instruction 3>    ; I3 Cannot be stop, branch, call or return
<Instruction 4>    ; I4 Cannot be stop, branch, call or return

MCCNDD _func, NEQ ; Call to func if not equal to zero
                  ; Three instructions after MCCNDD are always
                  ; executed whether the call is taken or not
<Instruction 5>    ; I5 Cannot be stop, branch, call or return
<Instruction 6>    ; I6 Cannot be stop, branch, call or return
<Instruction 7>    ; I7 Cannot be stop, branch, call or return
<Instruction 8>    ; I8 The address of this instruction is saved
                  ; in the RPC field of the MSTF register.
                  ; Upon return this value is loaded into MPC
                  ; and fetching continues from this point.

<Instruction 9>    ; I9
<Instruction 10>   ; I10
....
....
_func:
<Destination 1>   ; d1 Can be any instruction
<Destination 2>   ; d2
<Destination 3>   ; d3
<Destination 4>   ; d4 Last instruction that can affect flags for
                  ; the MRCNDD operation
<Destination 5>   ; d5 Cannot be stop, branch, call or return
<Destination 6>   ; d6 Cannot be stop, branch, call or return
<Destination 7>   ; d7 Cannot be stop, branch, call or return

MRCNDD NEQ        ; Return to <Instruction 8> if not equal to zero
                  ; Three instructions after MRCNDD are always
                  ; executed whether the return is taken or not
<Destination 8>   ; d8 Cannot be stop, branch, call or return
<Destination 9>   ; d9 Cannot be stop, branch, call or return
<Destination 10>  ; d10 Cannot be stop, branch, call or return
<Destination 11>  ; d11
<Destination 12>  ; d12
....
....
MSTOP
....

```

- **d4**

- d4 is the last instruction that can effect the CNDF flags for the MRCNDD instruction. The CNDF flags are tested in the D2 phase of the pipeline. That is, a decision is made whether to return or not when MRCNDD is in the D2 phase.
- There are no restrictions on the type of instruction for d4.

- **d5, d6 and d7**

- The three instructions proceeding MRCNDD can change MSTF flags but will have no effect on whether the MRCNDD instruction makes the return or not. This is

because the flag modification will occur after the D2 phase of the MRCNDD instruction.

- These instructions must not be the following: MSTOP, MDEBUGSTOP, MBCNDD, MCCNDD or MRCNDD.
- **d8, d9 and d10**
  - The three instructions following MRCNDD are always executed irrespective of whether the return is taken or not.
  - These instructions must not be the following: MSTOP, MDEBUGSTOP, MBCNDD, MCCNDD or MRCNDD.

**Table 5-19. Pipeline Activity For MRCNDD, Return Not Taken**

Instruction	F1	F2	D1	D2	R1	R2	E	W
d4	d4	d3	d2	d1	l7	l6	l5	
d5	d5	d4	d3	d2	d1	l7	l6	
d6	d6	d5	d4	d3	d2	d1	i7	
d7	d7	d6	d5	d4	d3	d2	d1	
MRCNDD	MRCNDD	d7	d6	d5	d4	d3	d2	
d8	d8	MRCNDD	d7	d6	d5	d4	d3	
d9	d9	d8	MRCNDD	d7	d6	d5	d4	
d10	d10	d9	d8	MRCNDD	d7	d6	d5	
d11	d11	d10	d9	d8	-	d7	d6	
d12	d12	d11	d10	d9	d8	-	d7	
etc....	....	d12	d11	d10	d9	d8	-	
....	....	....	d12	d11	d10	d9	d8	
....	....	....	....	d12	d11	d10	d9	
					d12	d11	d10	
						d12	d11	
							d12	

**Table 5-20. Pipeline Activity For MRCNDD, Return Taken**

Instruction	F1	F2	D1	D2	R1	R2	E	W
d4	d4	d3	d2	d1	l7	l6	l5	
d5	d5	d4	d3	d2	d1	l7	l6	
d6	d6	d5	d4	d3	d2	d1	i7	
d7	d7	d6	d5	d4	d3	d2	d1	
MRCNDD	MRCNDD	d7	d6	d5	d4	d3	d2	
d8	d8	MRCNDD	d7	d6	d5	d4	d3	
d9	d9	d8	MRCNDD	d7	d6	d5	d4	
d10	d10	d9	d8	MRCNDD	d7	d6	d5	
l8	l8	d10	d9	d8	-	d7	d6	
l9	l9	l8	d10	d9	d8	-	d7	
l10	l10	l9	l8	d10	d9	d8	-	
etc....	....	l10	l9	l8	d10	d9	d8	
....	....	....	l10	l9	l8	d10	d9	
....	....	....	....	l10	l9	l8	d10	
					l10	l9	l8	
						l10	l9	
							l10	

**Example**

;

**See also**

[MBCNDD #16BitDest, CNDF](#)  
[MCCNDD 16BitDest, CNDF](#)  
[MMOV32 mem32, MSTF](#)  
[MMOV32 MSTF, mem32](#)

## MSETFLG FLAG, VALUE *Set or Clear Selected Floating-Point Status Flags*

### Operands

FLAG	8 bit mask indicating which floating-point status flags to change.
VALUE	8 bit mask indicating the flag value; 0 or 1.

### Opcode

LSW: FFFF FFFF VVVV VVVV  
MSW: 0111 1001 1100 0000

### Description

The MSETFLG instruction is used to set or clear selected floating-point status flags in the MSTF register. The FLAG field is an 11-bit value that indicates which flags will be changed. That is, if a FLAG bit is set to 1 it indicates that flag will be changed; all other flags will not be modified. The bit mapping of the FLAG field is shown below:

RNDF3 2	reserve d	reserve d	TF	reserve d	reserved	ZF	NF	LUF	LVF
9	8	7	6	5	4	3	2	1	0

The VALUE field indicates the value the flag should be set to; 0 or 1.

### Flags

This instruction modifies the following flags in the MSTF register:

Flag	TF	ZF	NF	LUF	LVF
Modified	Yes	Yes	Yes	Yes	Yes

Any flag can be modified by this instruction. The MEALLOW and RPC fields cannot be modified with this instruction.

### Pipeline

This is a single-cycle instruction.

### Example

To make it easier and legible, the assembler accepts a FLAG=VALUE syntax for the MSETFLG operation as shown below:

```
MSETFLG RNDF32=0, TF=0, NF=1; FLAG = 11000100; VALUE = 00XXX1XX;
```

### See also

[MMOV32 mem32, MSTF](#)  
[MMOV32 MSTF, mem32](#)

**MSTOP**
**Stop Task**
**Operands**

none	This instruction does not have any operands
------	---

**Opcode**

```
LSW: 0000 0000 0000 0000
MSW: 0111 1111 1000 0000
```

**Description**

The MSTOP instruction must be placed to indicate the end of each task. In addition, placing MSTOP in unused memory locations within the CLA program RAM can be useful for debugging and preventing run away CLA code. When MSTOP enters the D2 phase of the pipeline, the MIRUN flag for the task is cleared and the associated interrupt is flagged in the PIE vector table.

There are three special cases that can occur when single-stepping a task such that the MPC reaches the MSTOP instruction.

1. If you are single-stepping or halted in "task A" and "task B" comes in before the MPC reaches the MSTOP, then "task B" will start if you continue to step through the MSTOP instruction. Basically if "task B" is pending before the MPC reaches MSTOP in "task A" then there is no issue in "task B" starting and no special action is required.
2. In this case you have single-stepped or halted in "task A" and the MPC has reached the MSTOP with no tasks pending. If "task B" comes in at this point, it will be flagged in the MIFR register but it may or may not start if you continue to single-step through the MSTOP instruction of "task A". It depends on exactly when the new task comes in. To reliably start "task B" perform a soft reset and reconfigure the MIER bits. Once this is done, you can start single-stepping "task B".
3. Case 2 can be handled slightly differently if there is control over when "task B" comes in (for example using the IACK instruction to start the task). In this case you have single-stepped or halted in "task A" and the MPC has reached the MSTOP with no tasks pending. Before forcing "task B", run free to force the CLA out of the debug state. Once this is done you can force "task B" and continue debugging.

**Restrictions**

The MSTOP instruction cannot be placed 3 instructions before or after a [MBCNDD](#), [MCCNDD](#) or [MRCNDD](#) instruction.

**Flags**

This instruction does not modify flags in the MSTF register.

Flag	TF	ZF	NF	LUF	LVF
Modified	No	No	No	No	No

**Pipeline**

This is a single-cycle instruction. [Table 5-21](#) shows the pipeline behavior of the MSTOP instruction. The MSTOP instruction cannot be placed with 3 instructions of a [MBCNDD](#), [MCCNDD](#) or [MRCNDD](#) instruction.



**Table 5-21. Pipeline Activity For MSTOP**

Instruction	F1	F2	D1	D2	R1	R2	E	W
I1	I1							
I2	I2	I1						
I3	I3	I2	I1					
MSTOP	MSTOP	I3	I2	I1				
I4	I4	MSTOP	I3	I2	I1			
I5	I5	I4	MSTOP	I3	I2	I1		
I6	I6	I5	I4	MSTOP	I3	I2	I1	
New Task Arbitrated and Piroitized	-	-	-	-	-	I3	I2	
New Task Arbitrated and Piroitized	-	-	-	-	-	-	I3	
I1	I1	-	-	-	-	-	-	-
I2	I2	I1	-	-	-	-	-	-
I3	I3	I2	I1	-	-	-	-	-
I4	I4	I3	I2	I1	-	-	-	-
I5	I5	I4	I3	I2	I1	-	-	-
I6	I6	I5	I4	I3	I2	I1	-	-
I7	I7	I6	I5	I4	I3	I2	I1	
etc ....								

**Example**

```

; Given A = (int32)1
;       B = (int32)2
;       C = (int32)-7
;
; Calculate Y2 = A - B - C
_C1a1Task3:
  MMOV32  MR0, @_A      ; MR0 = 1 (0x00000001)
  MMOV32  MR1, @_B      ; MR1 = 2 (0x00000002)
  MMOV32  MR2, @_C      ; MR2 = -7 (0xFFFFFFFF9)
  MSUB32  MR3, MR0, MR1 ; A + B
  MSUB32  MR3, MR3, MR2 ; A + B + C = 6 (0x00000006)
  MMOV32  @_y2, MR3     ; Store y2
  MSTOP   ; End of task

```

**See also**
[MDEBUGSTOP](#)

**MSUB32 MRa, MRb, MRc 32-Bit Integer Subtraction**
**Operands**

MRa	CLA floating-point destination register (MR0 to MR3)
MRb	CLA floating-point destination register (MR0 to MR3)
MRc	CLA floating-point destination register (MR0 to MR3)

**Opcode**

```
LSW: 0000 0000 00cc bbaa
MSW: 0111 1100 1110 0000
```

**Description**

32-bit integer addition of MRb and MRc.

```
MARa(31:0) = MARb(31:0) - MRc(31:0);
```

**Flags**

This instruction modifies the following flags in the MSTF register:

Flag	TF	ZF	NF	LUF	LVF
Modified	No	Yes	Yes	No	No

The MSTF register flags are modified as follows:

```
NF = MRa(31);
ZF = 0;
if(MRa(31:0) == 0) { ZF = 1; }
```

**Pipeline**

This is a single-cycle instruction.

**Example**

```
; Given A = (int32)1
;      B = (int32)2
;      C = (int32)-7
;
;
Calculate Y2 = A - B - C
;
_ClalTask3:
    MMOV32 MR0, @_A      ; MR0 = 1 (0x00000001)
    MMOV32 MR1, @_B      ; MR1 = 2 (0x00000002)
    MMOV32 MR2, @_C      ; MR2 = -7 (0xFFFFFFFF9)
    MSUB32 MR3, MR0, MR1 ; A + B
    MSUB32 MR3, MR3, MR2 ; A + B + C = 6 (0x00000006)
    MMOV32 @_y2, MR3     ; Store y2
    MSTOP                ; End of task
```

**See also**

[MADD32 MRa, MRb, MRc](#)  
[MAND32 MRa, MRb, MRc](#)  
[MASR32 MRa, #SHIFT](#)  
[MLSL32 MRa, #SHIFT](#)  
[MLSR32 MRa, #SHIFT](#)  
[MOR32 MRa, MRb, MRc](#)  
[MXOR32 MRa, MRb, MRc](#)

## MSUBF32 MRa, MRb, MRc 32-Bit Floating-Point Subtraction

### Operands

MRa	CLA floating-point destination register (MR0 to R1)
MRb	CLA floating-point source register (MR0 to R1)
MRc	CLA floating-point source register (MR0 to R1)

### Opcode

LSW: 0000 0000 00cc bbaa  
MSW: 0111 1100 0100 0000

### Description

Subtract the contents of two floating-point registers

MRa = MRb - MRc;

### Flags

This instruction modifies the following flags in the MSTF register:

Flag	TF	ZF	NF	LUF	LVF
Modified	No	No	No	Yes	Yes

The MSTF register flags are modified as follows:

- LUF = 1 if MSUBF32 generates an underflow condition.
- LVF = 1 if MSUBF32 generates an overflow condition.

### Pipeline

This is a single-cycle instruction.

### Example

```
; Given A, B and C are 32-bit floating-point numbers
; Calculate Y2 = A + B - C
;
_ClalTask5:
    MMOV32    MR0, @_A      ; Load MR0 with A
    MMOV32    MR1, @_B      ; Load MR1 with B
    MADDF32   MR0, MR1, MR0 ; Add A + B
|| MMOV32    MR1, @_C      ; and in parallel load C
    MSUBF32   MR0, MR0, MR1 ; Subtract C from (A + B)
    MMOV32    @Y, MR0      ; (A+B) - C
    MSTOP
```

### See also

[MSUBF32 MRa, #16FHi, MRb](#)  
[MSUBF32 MRd, MRe, MRf || MMOV32 MRa, mem32](#)  
[MSUBF32 MRd, MRe, MRf || MMOV32 mem32, MRa](#)  
[MMPYF32 MRa, MRb, MRc || MSUBF32 MRd, MRe, MRf](#)

**MSUBF32 MRa, #16FHi, MRb 32-Bit Floating-Point Subtraction**
**Operands**

MRa	CLA floating-point destination register (MR0 to R1)
#16FHi	A 16-bit immediate value that represents the upper 16-bits of an IEEE 32-bit floating-point value. The low 16-bits of the mantissa are assumed to be all 0.
MRb	CLA floating-point source register (MR0 to R1)

**Opcode**

```
LSW: I I I I I I I I I I I I I I I I
MSW: 0111 1000 0000 baaa
```

**Description**

Subtract MRb from the floating-point value represented by the immediate operand. Store the result of the addition in MRa.

#16FHi is a 16-bit immediate value that represents the upper 16-bits of an IEEE 32-bit floating-point value. The low 16-bits of the mantissa are assumed to be all 0. #16FHi is most useful for representing constants where the lowest 16-bits of the mantissa are 0. Some examples are 2.0 (0x40000000), 4.0 (0x40800000), 0.5 (0x3F000000), and -1.5 (0xBFC00000). The assembler will accept either a hex or float as the immediate value. That is, the value -1.5 can be represented as #-1.5 or #0xBFC0.

```
MRa = #16FHi:0 - MRb;
```

**Flags**

This instruction modifies the following flags in the MSTF register:

Flag	TF	ZF	NF	LUF	LVF
Modified	No	No	No	Yes	Yes

The MSTF register flags are modified as follows:

- LUF = 1 if MSUBF32 generates an underflow condition.
- LVF = 1 if MSUBF32 generates an overflow condition.

**Pipeline**

This is a single-cycle instruction.

**Example**

```
; Y = sqrt(X)
; Ye = Estimate(1/sqrt(X));
; Ye = Ye*(1.5 - Ye*Ye*X*0.5)
; Ye = Ye*(1.5 - Ye*Ye*X*0.5)
; Y = X*Ye
;
_ClalTask3:
    MMOV32    MR0, @_x          ; MR0 = X
    MEISQRTF32 MR1, MR0        ; MR1 = Ye = Estimate(1/sqrt(X))
    MMOV32    MR1, @_x, EQ      ; if(X == 0.0) Ye = 0.0
    MMPYF32   MR3, MR0, #0.5    ; MR3 = X*0.5
    MMPYF32   MR2, MR1, MR3     ; MR2 = Ye*X*0.5
    MMPYF32   MR2, MR1, MR2     ; MR2 = Ye*Ye*X*0.5
    MSUBF32   MR2, #1.5, MR2    ; MR2 = 1.5 - Ye*Ye*X*0.5
    MMPYF32   MR1, MR1, MR2     ; MR1 = Ye = Ye*(1.5 - Ye*Ye*X*0.5)
    MMPYF32   MR2, MR1, MR3     ; MR2 = Ye*X*0.5
    MMPYF32   MR2, MR1, MR2     ; MR2 = Ye*Ye*X*0.5
    MSUBF32   MR2, #1.5, MR2    ; MR2 = 1.5 - Ye*Ye*X*0.5
    MMPYF32   MR1, MR1, MR2     ; MR1 = Ye = Ye*(1.5 - Ye*Ye*X*0.5)
    MMPYF32   MR0, MR1, MR0     ; MR0 = Y = Ye*X
    MMOV32    @_y, MR0         ; Store Y = sqrt(X)
    MSTOP
```

**See also**

[MSUBF32 MRa, MRb, MRc](#)  
[MSUBF32 MRd, MRe, MRf || MMOV32 MRa, mem32](#)  
[MSUBF32 MRd, MRe, MRf || MMOV32 mem32, MRa](#)  
[MMPYF32 MRa, MRb, MRc || MSUBF32 MRd, MRe, MRf](#)

## MSUBF32 MRd, MRe, MRf ||MMOV32 MRa, mem32 *32-Bit Floating-Point Subtraction with Parallel Move*

### Operands

MRd	CLA floating-point destination register (MR0 to MR3) for the MSUBF32 operation MRd cannot be the same register as MRa
MRe	CLA floating-point source register (MR0 to MR3) for the MSUBF32 operation
MRf	CLA floating-point source register (MR0 to MR3) for the MSUBF32 operation
MRa	CLA floating-point destination register (MR0 to MR3) for the MMOV32 operation MRa cannot be the same register as MRd
mem32	32-bit memory location accessed using one of the available addressing modes. Source for the MMOV32 operation.

### Opcode

```
LSW: rrrrrr rrrrrr rrrrrr rrrrrr
MSW: 0010 ffee ddaa addr
```

### Description

Subtract the contents of two floating-point registers and move from memory to a floating-point register.

```
MRd = MRe - MRf;
MRa = [mem32];
```

### Restrictions

The destination register for the MSUBF32 and the MMOV32 must be unique. That is, MRa cannot be the same register as MRd.

### Flags

This instruction modifies the following flags in the MSTF register:

Flag	TF	ZF	NF	LUF	LVF
Modified	No	Yes	Yes	Yes	Yes

The MSTF register flags are modified as follows:

- LUF = 1 if MSUBF32 generates an underflow condition.
- LVF = 1 if MSUBF32 generates an overflow condition.

The MMOV32 Instruction will set the NF and ZF flags as follows:

### Pipeline

Both MSUBF32 and MMOV32 complete in a single cycle.

### Example

```
NF = MRa(31);
ZF = 0;
if(MRa(30:23) == 0) { ZF = 1; NF = 0; }
```

### See also

[MSUBF32 MRa, MRb, MRc](#)  
[MSUBF32 MRa, #16FHi, MRb](#)  
[MMPYF32 MRa, MRb, MRc || MSUBF32 MRd, MRe, MRf](#)

---

**MSUBF32 MRd, MRe, MRf ||MMOV32 mem32, MRa 32-Bit Floating-Point Subtraction with Parallel Move**


---

**Operands**

MRd	CLA floating-point destination register (MR0 to MR3) for the MSUBF32 operation
MRe	CLA floating-point source register (MR0 to MR3) for the MSUBF32 operation
MRf	CLA floating-point source register (MR0 to MR3) for the MSUBF32 operation
mem32	32-bit destination memory location for the MMOV32 operation
MRa	CLA floating-point source register (MR0 to MR3) for the MMOV32 operation

**Opcode**

```
LSW: mmmm mmmm mmmm mmmm
MSW: 0110 ffee ddaa addr
```

**Description**

Subtract the contents of two floating-point registers and move from a floating-point register to memory.

```
MRd = MRe - MRf;
[mem32] = MRa;
```

**Flags**

This instruction modifies the following flags in the MSTF register:

Flag	TF	ZF	NF	LUF	LVF
Modified	No	No	No	Yes	Yes

The MSTF register flags are modified as follows:

- LUF = 1 if MSUBF32 generates an underflow condition.
- LVF = 1 if MSUBF32 generates an overflow condition.

**Pipeline**

Both MSUBF32 and MMOV32 complete in a single cycle.

**Example**
**See also**

[MSUBF32 MRa, MRb, MRc](#)  
[MSUBF32 MRa, #16FHi, MRb](#)  
[MSUBF32 MRd, MRe, MRf || MMOV32 MRa, mem32](#)  
[MMPYF32 MRa, MRb, MRc || MSUBF32 MRd, MRe, MRf](#)

## MSWAPF MRa, MRb {, CNDF} *Conditional Swap*

### Operands

MRa	CLA floating-point register (MR0 to MR3)
MRb	CLA floating-point register (MR0 to MR3)
CNDF	Optional condition tested based on the MSTF flags

### Opcode

LSW: 0000 0000 CNDF bbaa  
MSW: 0111 1011 0000 0000

### Description

Conditional swap of MRa and MRb.

if (CNDF == true) swap MRa and MRb;

CNDF is one of the following conditions:

Encode <sup>(1)</sup>	CNDF	Description	MSTF Flags Tested
0000	NEQ	Not equal to zero	ZF == 0
0001	EQ	Equal to zero	ZF == 1
0010	GT	Greater than zero	ZF == 0 AND NF == 0
0011	GEQ	Greater than or equal to zero	NF == 0
0100	LT	Less than zero	NF == 1
0101	LEQ	Less than or equal to zero	ZF == 1 OR NF == 1
1010	TF	Test flag set	TF == 1
1011	NTF	Test flag not set	TF == 0
1100	LU	Latched underflow	LUF == 1
1101	LV	Latched overflow	LVF == 1
1110	UNC	Unconditional	None
1111	UNCF <sup>(2)</sup>	Unconditional with flag modification	None

<sup>(1)</sup> Values not shown are reserved.

<sup>(2)</sup> This is the default operation if no CNDF field is specified. This condition will allow the ZF and NF flags to be modified when a conditional operation is executed. All other conditions will not modify these flags.

### Flags

This instruction modifies the following flags in the MSTF register:

Flag	TF	ZF	NF	LUF	LVF
Modified	No	No	No	No	No

No flags affected

### Pipeline

This is a single-cycle instruction.

**Example**

```

; X is an array of 32-bit floating-point values
; and has len elements. Find the maximum value in
; the array and store it in Result
;
; Note: MCMFP32 and MSWAPF can be replaced by MMAXF32
;
_ClalTask1:
    MMOVI16    MAR1, #_X          ; Start address
    MUI16TOF32 MR0, @_len        ; Length of the array
    MNOF32    ; delay for MAR1 load
    MNOF32    ; delay for MAR1 load
    MMOV32    MR1, *MAR1[2]++    ; MR1 = X0
LOOP
    MMOV32    MR2, *MAR1[2]++    ; MR2 = next element
    MCMFP32   MR2, MR1           ; Compare MR2 with MR1
    MSWAPF    MR1, MR2, GT      ; MR1 = MAX(MR1, MR2)
    MADD32    MR0, MR0, #-1.0    ; Decrement the counter
    MCMFP32   MR0 #0.0          ; Set/clear flags for MBCNDD
    MNOF32
    MNOF32
    MNOF32
    MBCNDD    LOOP, NEQ         ; Branch if not equal to zero
    MMOV32    @_Result, MR1     ; Always executed
    MNOF32
    MNOF32
    MNOF32
    MSTOP
; End of task

```

**See also**



**MTESTTF CNDF**      *Test MSTF Register Flag Condition*
**Operands**

CNDF	condition to test based on MSTF flags
------	---------------------------------------

**Opcode**

```
LSW: 0000 0000 0000 cndf
MSW: 0111 1111 0100 0000
```

**Description**

Test the CLA floating-point condition and if true, set the MSTF[TF] flag. If the condition is false, clear the MSTF[TF] flag. This is useful for temporarily storing a condition for later use.

```
if (CNDF == true) TF = 1;
else TF = 0;
```

CNDF is one of the following conditions:

Encode <sup>(3)</sup>	CNDF	Description	MSTF Flags Tested
0000	NEQ	Not equal to zero	ZF == 0
0001	EQ	Equal to zero	ZF == 1
0010	GT	Greater than zero	ZF == 0 AND NF == 0
0011	GEQ	Greater than or equal to zero	NF == 0
0100	LT	Less than zero	NF == 1
0101	LEQ	Less than or equal to zero	ZF == 1 OR NF == 1
1010	TF	Test flag set	TF == 1
1011	NTF	Test flag not set	TF == 0
1100	LU	Latched underflow	LUF == 1
1101	LV	Latched overflow	LVF == 1
1110	UNC	Unconditional	None
1111	UNCF <sup>(4)</sup>	Unconditional with flag modification	None

<sup>(3)</sup> Values not shown are reserved.

<sup>(4)</sup> This is the default operation if no CNDF field is specified. This condition will allow the ZF and NF flags to be modified when a conditional operation is executed. All other conditions will not modify these flags.

**Flags**

This instruction modifies the following flags in the MSTF register:

Flag	TF	ZF	NF	LUF	LVF
Modified	Yes	No	No	No	No

```
TF = 0;
if (CNDF == true) TF = 1;
```

Note: If (CNDF == UNC or UNCF), the TF flag will be set to 1.

**Pipeline**

This is a single-cycle instruction.

**Example**

```

; if (State == 0.1)
;   RampState = RampState || RAMPMASK
; else if (State == 0.01)
;   CoastState = CoastState || COASTMASK
; else
;   SteadyState = SteadyState || STEADYMASK
;
_ClalTask2:
MMOV32   MR0, @_State
MCMPF32  MR0, #0.1      ; Affects flags for 1st MBCNDD (A)
MCMPF32  MR0, #0.01    ; Check used by 2nd MBCNDD (B)
MTESTTF  EQ            ; Store EQ flag in TF for 2nd MBCNDD (B)
MNOPI
MBCNDD   _Skip1, NEQ   ; (A) If State != 0.1, go to Skip1
MMOV32   MR1, @_RampState ; Always executed
MMOVXI   MR2, #RAMPMASK ; Always executed
MOR32    MR1, MR2      ; Always executed
MMOV32   @_RampState, MR1 ; Execute if (A) branch not taken
MSTOP    ; end of task if (A) branch not taken

_Skip1:
MMOV32   MR3, @_SteadyState
MMOVXI   MR2, #STEADYMASK
MOR32    MR3, MR2
MBCNDD   _Skip2, NTF   ; (B) if State != .01, go to Skip2
MMOV32   MR1, @_CoastState ; Always executed
MMOVXI   MR2, #COASTMASK ; Always executed
MOR32    MR1, MR2      ; Always executed
MMOV32   @_CoastState, MR1 ; Execute if (B) branch not taken
MSTOP    ; end of task if (B) branch not taken

_Skip2:
MMOV32   @_SteadyState, MR3 ; Executed if (B) branch taken
MSTOP

```

**See also**

---

**MUI16TOF32 MRa, mem16 *Convert Unsigned 16-Bit Integer to 32-Bit Floating-Point Value***


---

**Operands**

MRa	CLA floating-point destination register (MR0 to MR3)
mem16	16-bit source memory location

**Opcode**

LSW: mmmm mmmm mmmm mmmm  
 MSW: 0111 0101 01aa addr

**Description**

When converting F32 to I16/UI16 data format, the MF32TOI16/UI16 operation truncates to zero while the MF32TOI16R/UI16R operation will round to nearest (even) value.

MRa = UI16TOF32[mem16];

**Flags**

This instruction does not affect any flags:

Flag	TF	ZF	NF	LUF	LVF
Modified	No	No	No	No	No

**Pipeline**

This is a single-cycle instruction.

**Example**
**See also**

[MF32TOI16 MRa, MRb](#)  
[MF32TOI16R MRa, MRb](#)  
[MF32TOUI16 MRa, MRb](#)  
[MF32TOUI16R MRa, MRb](#)  
[MI16TOF32 MRa, MRb](#)  
[MI16TOF32 MRa, mem16](#)  
[MUI16TOF32 MRa, MRb](#)

**MUI16TOF32 MRa, MRb *Convert Unsigned 16-Bit Integer to 32-Bit Floating-Point Value***
**Operands**

MRa	CLA floating-point destination register (MR0 to MR3)
MRb	CLA floating-point source register (MR0 to MR3)

**Opcode**

```
LSW: 0000 0000 0000 bbaa
MSW: 0111 1110 1110 0000
```

**Description**

Convert an unsigned 16-bit integer to a 32-bit floating-point value. When converting float32 to I16/UI16 data format, the MF32TOI16/UI16 operation truncates to zero while the MF32TOI16R/UI16R operation will round to nearest (even) value.

```
MRa = UI16TOF32[MRb];
```

**Flags**

This instruction does not affect any flags:

Flag	TF	ZF	NF	LUF	LVF
Modified	No	No	No	No	No

**Pipeline**

This is a single-cycle instruction.

**Example**

```
MMOVXI MR1, #0x800F ; MR1(15:0) = 32783 (0x800F)
MUI16TOF32 MR0, MR1 ; MR0 = UI16TOF32 (MR1(15:0))
; = 32783.0 (0x47000F00)
```

**See also**

[MF32TOI16 MRa, MRb](#)  
[MF32TOI16R MRa, MRb](#)  
[MF32TOUI16 MRa, MRb](#)  
[MF32TOUI16R MRa, MRb](#)  
[MI16TOF32 MRa, MRb](#)  
[MI16TOF32 MRa, mem16](#)  
[MUI16TOF32 MRa, mem16](#)

## MUI32TOF32 MRa, mem32 *Convert Unsigned 32-Bit Integer to 32-Bit Floating-Point Value*

### Operands

MRa	CLA floating-point destination register (MR0 to MR3)
mem32	32-bit memory location accessed using one of the available addressing modes

### Opcode

LSW: mmmm mmmm mmmm mmmm  
MSW: 0111 0100 10aa addr

### Description

MRa = UI32TOF32[mem32];

### Flags

This instruction does not affect any flags:

Flag	TF	ZF	NF	LUF	LVF
Modified	No	No	No	No	No

### Pipeline

This is a single-cycle instruction.

### Example

```
; Given x2, m2 and b2 are Uint32 numbers:
;
; x2 = Uint32(2) = 0x00000002
; m2 = Uint32(1) = 0x00000001
; b2 = Uint32(3) = 0x00000003
;
; Calculate y2 = x2 * m2 + b2
;
_ClalTask1:
    MUI32TOF32 MR0, @_m2      ; MR0 = 1.0 (0x3F800000)
    MUI32TOF32 MR1, @_x2      ; MR1 = 2.0 (0x40000000)
    MUI32TOF32 MR2, @_b2      ; MR2 = 3.0 (0x40400000)
    MMPYF32 MR3, MR0, MR1     ; M*X
    MADD32 MR3, MR2, MR3      ; Y=MX+B = 5.0 (0x40A00000)
    MF32TOUI32 MR3, MR3       ; Y = Uint32(5.0) = 0x00000005
    MMOV32 @_y2, MR3          ; store result
    MSTOP                      ; end of task
```

### See also

[MF32TOI32 MRa, MRb](#)  
[MF32TOUI32 MRa, MRb](#)  
[MI32TOF32 MRa, mem32](#)  
[MI32TOF32 MRa, MRb](#)  
[MUI32TOF32 MRa, MRb](#)

---

**MUI32TOF32 MRa, MRb *Convert Unsigned 32-Bit Integer to 32-Bit Floating-Point Value***


---

**Operands**

MRa	CLA floating-point destination register (MR0 to MR3)
MRb	CLA floating-point source register (MR0 to MR3)

**Opcode**

```
LSW: 0000 0000 0000 bbaa
MSW: 0111 1101 1100 0000
```

**Description**

```
MRa = UI32TOF32 [MRb];
```

**Flags**

This instruction does not affect any flags:

Flag	TF	ZF	NF	LUF	LVF
Modified	No	No	No	No	No

**Pipeline**

This is a single-cycle instruction.

**Example**

```
MMOVIZ    MR3, #0x8000 ; MR3(31:16) = 0x8000
MMOVXI    MR3, #0x1111 ; MR3(15:0) = 0x1111
           ; MR3 = 2147488017
MUI32TOF32 MR3, MR3    ; MR3 = MUI32TOF32 (MR3) = 2147488017.0 (0x4F000011)
```

**See also**

[MF32TOI32 MRa, MRb](#)  
[MF32TOUI32 MRa, MRb](#)  
[MI32TOF32 MRa, mem32](#)  
[MI32TOF32 MRa, MRb](#)  
[MUI32TOF32 MRa, mem32](#)

## MXOR32 MRa, MRb, MRc *Bitwise Exclusive Or*

### Operands

MRa	CLA floating-point destination register (MR0 to MR3)
MRb	CLA floating-point source register (MR0 to MR3)
MRc	CLA floating-point source register (MR0 to MR3)

### Opcode

LSW: 0000 0000 00cc bbaa  
MSW: 0111 1100 1010 0000

### Description

Bitwise XOR of MRb with MRc.

$MARa(31:0) = MARb(31:0) \text{ XOR } MRc(31:0);$

### Flags

This instruction modifies the following flags in the MSTF register:

Flag	TF	ZF	NF	LUF	LVF
Modified	No	Yes	Yes	No	No

The MSTF register flags are modified based on the integer results of the operation.

```
NF = MRa(31);
ZF = 0;
if(MRa(31:0) == 0) { ZF = 1; }
```

### Pipeline

This is a single-cycle instruction.

### Example

```
MMOVIZ MR0, #0x5555 ; MR0 = 0x5555AAAA
MMOVXI MR0, #0xAAAA

MMOVIZ MR1, #0x5432 ; MR1 = 0x5432FEDC
MMOVXI MR1, #0xFEDC

; 0101 XOR 0101 = 0000 (0)
; 0101 XOR 0100 = 0001 (1)
; 0101 XOR 0011 = 0110 (6)
; 0101 XOR 0010 = 0111 (7)
; 1010 XOR 1111 = 0101 (5)
; 1010 XOR 1110 = 0100 (4)
; 1010 XOR 1101 = 0111 (7)
; 1010 XOR 1100 = 0110 (6)

MXOR32 MR2, MR1, MR0 ; MR3 = 0x01675476
```

### See also

[MAND32 MRa, MRb, MRc](#)  
[MOR32 MRa, MRb, MRc](#)

## 5.7 Registers

### 5.7.1 CLA Base Addresses

**Table 5-22. CLA Base Address Table**

Device Register	Register Name	Start Address	End Address
ClA1Regs	CLA_REGS	0x0000_1400	0x0000_147F
ClA1SoftIntRegs <sup>(1)</sup>	CLA_SOFTINT_REGS	0x0000_0CE0	0x0000_0CFF

<sup>(1)</sup> This register is only accessible from the CLA.



## 5.7.2 CLA\_REGS Registers

Table 5-23 lists the memory-mapped registers for the CLA\_REGS. All register offset addresses not listed in Table 5-23 should be considered as reserved locations and the register contents should not be modified.

**Table 5-23. CLA\_REGS Registers**

Offset	Acronym	Register Name	Write Protection	Section
0h	MVECT1	Task Interrupt Vector	EALLOW	<a href="#">Go</a>
1h	MVECT2	Task Interrupt Vector	EALLOW	<a href="#">Go</a>
2h	MVECT3	Task Interrupt Vector	EALLOW	<a href="#">Go</a>
3h	MVECT4	Task Interrupt Vector	EALLOW	<a href="#">Go</a>
4h	MVECT5	Task Interrupt Vector	EALLOW	<a href="#">Go</a>
5h	MVECT6	Task Interrupt Vector	EALLOW	<a href="#">Go</a>
6h	MVECT7	Task Interrupt Vector	EALLOW	<a href="#">Go</a>
7h	MVECT8	Task Interrupt Vector	EALLOW	<a href="#">Go</a>
10h	MCTL	Control Register	EALLOW	<a href="#">Go</a>
20h	MIFR	Interrupt Flag Register	EALLOW	<a href="#">Go</a>
21h	MIOVF	Interrupt Overflow Flag Register	EALLOW	<a href="#">Go</a>
22h	MIFRC	Interrupt Force Register	EALLOW	<a href="#">Go</a>
23h	MICLR	Interrupt Flag Clear Register	EALLOW	<a href="#">Go</a>
24h	MICLROVF	Interrupt Overflow Flag Clear Register	EALLOW	<a href="#">Go</a>
25h	MIER	Interrupt Enable Register	EALLOW	<a href="#">Go</a>
26h	MIRUN	Interrupt Run Status Register	EALLOW	<a href="#">Go</a>
28h	_MPC	CLA Program Counter		<a href="#">Go</a>
2Ah	_MAR0	CLA Auxiliary Register 0		<a href="#">Go</a>
2Bh	_MAR1	CLA Auxiliary Register 1		<a href="#">Go</a>
2Eh	_MSTF	CLA Floating-Point Status Register		<a href="#">Go</a>
30h	_MR0	CLA Floating-Point Result Register 0		<a href="#">Go</a>
34h	_MR1	CLA Floating-Point Result Register 1		<a href="#">Go</a>
38h	_MR2	CLA Floating-Point Result Register 2		<a href="#">Go</a>
3Ch	_MR3	CLA Floating-Point Result Register 3		<a href="#">Go</a>

Complex bit access types are encoded to fit into small table cells. Table 5-24 shows the codes that are used for access types in this section.

**Table 5-24. CLA\_REGS Access Type Codes**

Access Type	Code	Description
<b>Read Type</b>		
R	R	Read
<b>Write Type</b>		
W	W	Write
<b>Reset or Default Value</b>		
-n		Value after reset or the default value
<b>Register Array Variables</b>		

**Table 5-24. CLA\_REGS Access Type Codes (continued)**

Access Type	Code	Description
i,j,k,l,m,n		When these variables are used in a register name, an offset, or an address, they refer to the value of a register array where the register is part of a group of repeating registers. The register groups form a hierarchical structure and the array is represented with a formula.
y		When this variable is used in a register name, an offset, or an address it refers to the value of a register array.

### 5.7.2.1 MVECT1 Register (Offset = 0h) [reset = 0h]

MVECT1 is shown in [Figure 5-2](#) and described in [Table 5-25](#).

Return to [Summary Table](#).

Each CLA interrupt has its own interrupt vector (MVECT1 to MVECT8). This interrupt vector points to the first instruction of the associated task. When a task begins, the CLA will start fetching instructions at the location indicated by the appropriate MVECT register .

**Figure 5-2. MVECT1 Register**

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
MVECT															
R/W-0h															

**Table 5-25. MVECT1 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-0	MVECT	R/W	0h	<p>MPC Start Address: These bits specify the start address for the given interrupt (task). The address range of the CLA with a 16-bit MVECT is 64Kx16 words or 32K MCLA instructions.</p> <p>There is one MVECT register per interrupt (task). Interrupt 1 uses MVECT1, interrupt 2 uses MVECT2 and so forth.</p> <p>Note: While the CLA is running or executing a task, the CPU can change the MVECT values..</p> <p>Reset type: SYSRSn</p>

### 5.7.2.2 MVECT2 Register (Offset = 1h) [reset = 0h]

MVECT2 is shown in [Figure 5-3](#) and described in [Table 5-26](#).

Return to [Summary Table](#).

Each CLA interrupt has its own interrupt vector (MVECT1 to MVECT8). This interrupt vector points to the first instruction of the associated task. When a task begins, the CLA will start fetching instructions at the location indicated by the appropriate MVECT register .

**Figure 5-3. MVECT2 Register**

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
MVECT															
R/W-0h															

**Table 5-26. MVECT2 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-0	MVECT	R/W	0h	MPC Start Address: These bits specify the start address for the given interrupt (task). The address range of the CLA with a 16-bit MVECT is 64Kx16 words or 32K MCLA instructions. There is one MVECT register per interrupt (task). Interrupt 1 uses MVECT1, interrupt 2 uses MVECT2 and so forth. Note: While the CLA is running or executing a task, the CPU can change the MVECT values.. Reset type: SYSRSn

### 5.7.2.3 MVECT3 Register (Offset = 2h) [reset = 0h]

MVECT3 is shown in [Figure 5-4](#) and described in [Table 5-27](#).

Return to [Summary Table](#).

Each CLA interrupt has its own interrupt vector (MVECT1 to MVECT8). This interrupt vector points to the first instruction of the associated task. When a task begins, the CLA will start fetching instructions at the location indicated by the appropriate MVECT register .

**Figure 5-4. MVECT3 Register**

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
MVECT															
R/W-0h															

**Table 5-27. MVECT3 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-0	MVECT	R/W	0h	<p>MPC Start Address: These bits specify the start address for the given interrupt (task). The address range of the CLA with a 16-bit MVECT is 64Kx16 words or 32K MCLA instructions.</p> <p>There is one MVECT register per interrupt (task). Interrupt 1 uses MVECT1, interrupt 2 uses MVECT2 and so forth.</p> <p>Note: While the CLA is running or executing a task, the CPU can change the MVECT values..</p> <p>Reset type: SYSRSn</p>

### 5.7.2.4 MVECT4 Register (Offset = 3h) [reset = 0h]

MVECT4 is shown in [Figure 5-5](#) and described in [Table 5-28](#).

Return to [Summary Table](#).

Each CLA interrupt has its own interrupt vector (MVECT1 to MVECT8). This interrupt vector points to the first instruction of the associated task. When a task begins, the CLA will start fetching instructions at the location indicated by the appropriate MVECT register .

**Figure 5-5. MVECT4 Register**

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
MVECT															
R/W-0h															

**Table 5-28. MVECT4 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-0	MVECT	R/W	0h	MPC Start Address: These bits specify the start address for the given interrupt (task). The address range of the CLA with a 16-bit MVECT is 64Kx16 words or 32K MCLA instructions. There is one MVECT register per interrupt (task). Interrupt 1 uses MVECT1, interrupt 2 uses MVECT2 and so forth. Note: While the CLA is running or executing a task, the CPU can change the MVECT values.. Reset type: SYSRSn

### 5.7.2.5 MVECT5 Register (Offset = 4h) [reset = 0h]

MVECT5 is shown in [Figure 5-6](#) and described in [Table 5-29](#).

Return to [Summary Table](#).

Each CLA interrupt has its own interrupt vector (MVECT1 to MVECT8). This interrupt vector points to the first instruction of the associated task. When a task begins, the CLA will start fetching instructions at the location indicated by the appropriate MVECT register .

**Figure 5-6. MVECT5 Register**

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
MVECT															
R/W-0h															

**Table 5-29. MVECT5 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-0	MVECT	R/W	0h	<p>MPC Start Address: These bits specify the start address for the given interrupt (task). The address range of the CLA with a 16-bit MVECT is 64Kx16 words or 32K MCLA instructions.</p> <p>There is one MVECT register per interrupt (task). Interrupt 1 uses MVECT1, interrupt 2 uses MVECT2 and so forth.</p> <p>Note: While the CLA is running or executing a task, the CPU can change the MVECT values..</p> <p>Reset type: SYSRSn</p>

### 5.7.2.6 MVECT6 Register (Offset = 5h) [reset = 0h]

MVECT6 is shown in [Figure 5-7](#) and described in [Table 5-30](#).

Return to [Summary Table](#).

Each CLA interrupt has its own interrupt vector (MVECT1 to MVECT8). This interrupt vector points to the first instruction of the associated task. When a task begins, the CLA will start fetching instructions at the location indicated by the appropriate MVECT register .

**Figure 5-7. MVECT6 Register**

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
MVECT															
R/W-0h															

**Table 5-30. MVECT6 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-0	MVECT	R/W	0h	MPC Start Address: These bits specify the start address for the given interrupt (task). The address range of the CLA with a 16-bit MVECT is 64Kx16 words or 32K MCLA instructions.  There is one MVECT register per interrupt (task). Interrupt 1 uses MVECT1, interrupt 2 uses MVECT2 and so forth.  Note: While the CLA is running or executing a task, the CPU can change the MVECT values..  Reset type: SYSRSn



### 5.7.2.7 MVECT7 Register (Offset = 6h) [reset = 0h]

MVECT7 is shown in [Figure 5-8](#) and described in [Table 5-31](#).

Return to [Summary Table](#).

Each CLA interrupt has its own interrupt vector (MVECT1 to MVECT8). This interrupt vector points to the first instruction of the associated task. When a task begins, the CLA will start fetching instructions at the location indicated by the appropriate MVECT register .

**Figure 5-8. MVECT7 Register**

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
MVECT															
R/W-0h															

**Table 5-31. MVECT7 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-0	MVECT	R/W	0h	<p>MPC Start Address: These bits specify the start address for the given interrupt (task). The address range of the CLA with a 16-bit MVECT is 64Kx16 words or 32K MCLA instructions.</p> <p>There is one MVECT register per interrupt (task). Interrupt 1 uses MVECT1, interrupt 2 uses MVECT2 and so forth.</p> <p>Note: While the CLA is running or executing a task, the CPU can change the MVECT values..</p> <p>Reset type: SYSRSn</p>

### 5.7.2.8 MVECT8 Register (Offset = 7h) [reset = 0h]

MVECT8 is shown in [Figure 5-9](#) and described in [Table 5-32](#).

Return to [Summary Table](#).

Each CLA interrupt has its own interrupt vector (MVECT1 to MVECT8). This interrupt vector points to the first instruction of the associated task. When a task begins, the CLA will start fetching instructions at the location indicated by the appropriate MVECT register .

**Figure 5-9. MVECT8 Register**

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
MVECT															
R/W-0h															

**Table 5-32. MVECT8 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-0	MVECT	R/W	0h	MPC Start Address: These bits specify the start address for the given interrupt (task). The address range of the CLA with a 16-bit MVECT is 64Kx16 words or 32K MCLA instructions.  There is one MVECT register per interrupt (task). Interrupt 1 uses MVECT1, interrupt 2 uses MVECT2 and so forth.  Note: While the CLA is running or executing a task, the CPU can change the MVECT values..  Reset type: SYSRSn

### 5.7.2.9 MCTL Register (Offset = 10h) [reset = 0h]

MCTL is shown in [Figure 5-10](#) and described in [Table 5-33](#).

Return to [Summary Table](#).

Control Register

**Figure 5-10. MCTL Register**

15	14	13	12	11	10	9	8
RESERVED							
R-0h							
7	6	5	4	3	2	1	0
RESERVED					IACKE	SOFTRESET	HARDRESET
R-0h					R/W-0h	R/W-0h	R/W-0h

**Table 5-33. MCTL Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-3	RESERVED	R	0h	Reserved
2	IACKE	R/W	0h	IACK enable Reset type: SYSRSn 0h (R/W) = The CLA ignores the IACK instruction. (default) 1h (R/W) = Enable the main CPU to use the IACK #16bit instruction to set MIFR bits in the same manner as writing to the MIFRC register. Each bit in the operand, #16bit, corresponds to a bit in the MIFRC register. Using IACK has the advantage of not having to first set the EALLOW bit. This allows the main CPU to efficiently trigger a CLA task through software.  Examples IACK #0x0001 Write a 1 to MIFRC bit 0 to force task 1 IACK #0x0003 Write a 1 to MIFRC bit 0 and 1 to force task 1 and task 2
1	SOFTRESET	R/W	0h	Soft Reset Reset type: SYSRSn 0h (R/W) = This bit always reads back 0 and writes of 0 are ignored. 1h (R/W) = Writing a 1 will cause a soft reset of the CLA. This will stop the current task, clear the MIRUN flag and clear all bits in the MIER register. After a soft reset you must wait at least 1 SYSCLKOUT cycle before reconfiguring the MIER bits. If these two operations are done back-to-back then the MIER bits will not get set.
0	HARDRESET	R/W	0h	Hard Reset Reset type: SYSRSn 0h (R/W) = This bit always reads back 0 and writes of 0 are ignored. 1h (R/W) = Writing a 1 will cause a hard reset of the CLA. This will set all CLA registers to their default state.

### 5.7.2.10 MIFR Register (Offset = 20h) [reset = 0h]

MIFR is shown in [Figure 5-11](#) and described in [Table 5-34](#).

Return to [Summary Table](#).

Each bit in the interrupt flag register corresponds to a CLA task. The corresponding bit is automatically set when the task request is received from the peripheral interrupt. The bit can also be set by the main CPU writing to the MIFRC register or using the IACK instruction to start the task. To use the IACK instruction to begin a task first enable this feature in the MCTL register. If the bit is already set when a new peripheral interrupt is received, then the corresponding overflow bit will be set in the MIOVF register. The corresponding MIFR bit is automatically cleared when the task begins execution. This will occur if the interrupt is enabled in the MIER register and no other higher priority task is pending. The bits can also be cleared manually by writing to the MICLR register. Writes to the MIFR register are ignored.

**Figure 5-11. MIFR Register**

15	14	13	12	11	10	9	8
RESERVED							
R-0h							
7	6	5	4	3	2	1	0
INT8	INT7	INT6	INT5	INT4	INT3	INT2	INT1
R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h

**Table 5-34. MIFR Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-8	RESERVED	R	0h	Reserved
7	INT8	R	0h	Task 8 Interrupt Flag Reset type: SYSRSn 0h (R/W) = TASK_FLAG_DISABLE Task 8 interrupt is currently not flagged (default) 1h (R/W) = TASK_FLAG_ENABLE Task 8 interrupt has been received and is pending execution
6	INT7	R	0h	Task 7 Interrupt Flag Reset type: SYSRSn 0h (R/W) = TASK_FLAG_DISABLE Task 7 interrupt is currently not flagged (default) 1h (R/W) = TASK_FLAG_ENABLE Task 7 interrupt has been received and is pending execution
5	INT6	R	0h	Task 6 Interrupt Flag Reset type: SYSRSn 0h (R/W) = TASK_FLAG_DISABLE Task 6 interrupt is currently not flagged (default) 1h (R/W) = TASK_FLAG_ENABLE Task 6 interrupt has been received and is pending execution
4	INT5	R	0h	Task 5 Interrupt Flag Reset type: SYSRSn 0h (R/W) = TASK_FLAG_DISABLE Task 5 interrupt is currently not flagged (default) 1h (R/W) = TASK_FLAG_ENABLE Task 5 interrupt has been received and is pending execution

**Table 5-34. MIFR Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
3	INT4	R	0h	Task 4 Interrupt Flag Reset type: SYSRSn 0h (R/W) = TASK_FLAG_DISABLE Task 4 interrupt is currently not flagged (default) 1h (R/W) = TASK_FLAG_ENABLE Task 4 interrupt has been received and is pending execution
2	INT3	R	0h	Task 3 Interrupt Flag Reset type: SYSRSn 0h (R/W) = TASK_FLAG_DISABLE Task 3 interrupt is currently not flagged (default) 1h (R/W) = TASK_FLAG_ENABLE Task 3 interrupt has been received and is pending execution
1	INT2	R	0h	Task 2 Interrupt Flag Reset type: SYSRSn 0h (R/W) = TASK_FLAG_DISABLE Task 2 interrupt is currently not flagged (default) 1h (R/W) = TASK_FLAG_ENABLE Task 2 interrupt has been received and is pending execution
0	INT1	R	0h	Task 1 Interrupt Flag Reset type: SYSRSn 0h (R/W) = TASK_FLAG_DISABLE Task 1 interrupt is currently not flagged (default) 1h (R/W) = TASK_FLAG_ENABLE Task 1 interrupt has been received and is pending execution

### 5.7.2.11 MIOVF Register (Offset = 21h) [reset = 0h]

MIOVF is shown in [Figure 5-12](#) and described in [Table 5-35](#).

Return to [Summary Table](#).

Each bit in the overflow flag register corresponds to a CLA task. The bit is set when an interrupt overflow event has occurred for the specific task. An overflow event occurs when the MIFR register bit is already set when a new interrupt is received from a peripheral source. The MIOVF bits are only affected by peripheral interrupt events. They do not respond to a task request by the main CPU IACK instruction or by directly setting MIFR bits. The overflow flag will remain latched and can only be cleared by writing to the overflow flag clear (MICLROVF) register. Writes to the MIOVF register are ignored.

**Figure 5-12. MIOVF Register**

15	14	13	12	11	10	9	8
RESERVED							
R-0h							
7	6	5	4	3	2	1	0
INT8	INT7	INT6	INT5	INT4	INT3	INT2	INT1
R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h

**Table 5-35. MIOVF Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-8	RESERVED	R	0h	Reserved
7	INT8	R	0h	Task 8 Interrupt Overflow Flag Reset type: SYSRSn 0h (R/W) = A task 8 interrupt overflow has not occurred (default) 1h (R/W) = A task 8 interrupt overflow has occurred
6	INT7	R	0h	Task 7 Interrupt Overflow Flag Reset type: SYSRSn 0h (R/W) = A task 7 interrupt overflow has not occurred (default) 1h (R/W) = A task 7 interrupt overflow has occurred
5	INT6	R	0h	Task 6 Interrupt Overflow Flag Reset type: SYSRSn 0h (R/W) = A task 6 interrupt overflow has not occurred (default) 1h (R/W) = A task 6 interrupt overflow has occurred
4	INT5	R	0h	Task 5 Interrupt Overflow Flag Reset type: SYSRSn 0h (R/W) = A task 5 interrupt overflow has not occurred (default) 1h (R/W) = A task 5 interrupt overflow has occurred
3	INT4	R	0h	Task 4 Interrupt Overflow Flag Reset type: SYSRSn 0h (R/W) = A task 4 interrupt overflow has not occurred (default) 1h (R/W) = A task 4 interrupt overflow has occurred
2	INT3	R	0h	Task 3 Interrupt Overflow Flag Reset type: SYSRSn 0h (R/W) = A task 3 interrupt overflow has not occurred (default) 1h (R/W) = A task 3 interrupt overflow has occurred
1	INT2	R	0h	Task 2 Interrupt Overflow Flag Reset type: SYSRSn 0h (R/W) = A task 2 interrupt overflow has not occurred (default) 1h (R/W) = A task 2 interrupt overflow has occurred

**Table 5-35. MIOVF Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
0	INT1	R	0h	Task 1 Interrupt Overflow Flag Reset type: SYSRSn 0h (R/W) = A task 1 interrupt overflow has not occurred (default) 1h (R/W) = A task 1 interrupt overflow has occurred

### 5.7.2.12 MIFRC Register (Offset = 22h) [reset = 0h]

MIFRC is shown in [Figure 5-13](#) and described in [Table 5-36](#).

Return to [Summary Table](#).

The interrupt force register can be used by the main CPU to start tasks through software. Writing a 1 to a MIFRC bit will set the corresponding bit in the MIFR register. Writes of 0 are ignored and reads always return 0. The IACK #16bit operation can also be used to start tasks and has the same effect as the MIFRC register. To enable IACK to set MIFR bits you must first set the MCTL[IACKE] bit. Using IACK has the advantage of not having to first set the EALLOW bit. This allows the main CPU to efficiently trigger CLA tasks through software.

**Figure 5-13. MIFRC Register**

15	14	13	12	11	10	9	8
RESERVED							
R-0h							
7	6	5	4	3	2	1	0
INT8	INT7	INT6	INT5	INT4	INT3	INT2	INT1
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h

**Table 5-36. MIFRC Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-8	RESERVED	R	0h	Reserved
7	INT8	R/W	0h	Task 8 Interrupt Force Reset type: SYSRSn 0h (R/W) = This bit always reads back 0 and writes of 0 have no effect 1h (R/W) = Write a 1 to force the task 8 interrupt
6	INT7	R/W	0h	Task 7 Interrupt Force Reset type: SYSRSn 0h (R/W) = This bit always reads back 0 and writes of 0 have no effect 1h (R/W) = Write a 1 to force the task 7 interrupt
5	INT6	R/W	0h	Task 6 Interrupt Force Reset type: SYSRSn 0h (R/W) = This bit always reads back 0 and writes of 0 have no effect 1h (R/W) = Write a 1 to force the task 6 interrupt
4	INT5	R/W	0h	Task 5 Interrupt Force Reset type: SYSRSn 0h (R/W) = This bit always reads back 0 and writes of 0 have no effect 1h (R/W) = Write a 1 to force the task 5 interrupt
3	INT4	R/W	0h	Task 4 Interrupt Force Reset type: SYSRSn 0h (R/W) = This bit always reads back 0 and writes of 0 have no effect 1h (R/W) = Write a 1 to force the task 4 interrupt
2	INT3	R/W	0h	Task 3 Interrupt Force Reset type: SYSRSn 0h (R/W) = This bit always reads back 0 and writes of 0 have no effect 1h (R/W) = Write a 1 to force the task 3 interrupt



**Table 5-36. MIFRC Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
1	INT2	R/W	0h	Task 2 Interrupt Force Reset type: SYSRSn 0h (R/W) = This bit always reads back 0 and writes of 0 have no effect 1h (R/W) = Write a 1 to force the task 2 interrupt
0	INT1	R/W	0h	Task 1 Interrupt Force Reset type: SYSRSn 0h (R/W) = This bit always reads back 0 and writes of 0 have no effect 1h (R/W) = Write a 1 to force the task 1 interrupt

### 5.7.2.13 MICLR Register (Offset = 23h) [reset = 0h]

MICLR is shown in [Figure 5-14](#) and described in [Table 5-37](#).

Return to [Summary Table](#).

Normally bits in the MIFR register are automatically cleared when a task begins. The interrupt flag clear register can be used to instead manually clear bits in the interrupt flag (MIFR) register. Writing a 1 to a MICLR bit will clear the corresponding bit in the MIFR register. Writes of 0 are ignored and reads always return 0.

**Figure 5-14. MICLR Register**

15	14	13	12	11	10	9	8
RESERVED							
R-0h							
7	6	5	4	3	2	1	0
INT8	INT7	INT6	INT5	INT4	INT3	INT2	INT1
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h

**Table 5-37. MICLR Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-8	RESERVED	R	0h	Reserved
7	INT8	R/W	0h	Task 8 Interrupt Flag Clear Reset type: SYSRSn 0h (R/W) = This bit always reads back 0 and writes of 0 have no effect 1h (R/W) = Write a 1 to clear the task 8 interrupt flag
6	INT7	R/W	0h	Task 7 Interrupt Flag Clear Reset type: SYSRSn 0h (R/W) = This bit always reads back 0 and writes of 0 have no effect 1h (R/W) = Write a 1 to clear the task 7 interrupt flag
5	INT6	R/W	0h	Task 6 Interrupt Flag Clear Reset type: SYSRSn 0h (R/W) = This bit always reads back 0 and writes of 0 have no effect 1h (R/W) = Write a 1 to clear the task 6 interrupt flag
4	INT5	R/W	0h	Task 5 Interrupt Flag Clear Reset type: SYSRSn 0h (R/W) = This bit always reads back 0 and writes of 0 have no effect 1h (R/W) = Write a 1 to clear the task 5 interrupt flag
3	INT4	R/W	0h	Task 4 Interrupt Flag Clear Reset type: SYSRSn 0h (R/W) = This bit always reads back 0 and writes of 0 have no effect 1h (R/W) = Write a 1 to clear the task 4 interrupt flag
2	INT3	R/W	0h	Task 3 Interrupt Flag Clear Reset type: SYSRSn 0h (R/W) = This bit always reads back 0 and writes of 0 have no effect 1h (R/W) = Write a 1 to clear the task 3 interrupt flag
1	INT2	R/W	0h	Task 2 Interrupt Flag Clear Reset type: SYSRSn 0h (R/W) = This bit always reads back 0 and writes of 0 have no effect 1h (R/W) = Write a 1 to clear the task 2 interrupt flag

**Table 5-37. MICLR Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
0	INT1	R/W	0h	Task 1 Interrupt Flag Clear Reset type: SYSRSn 0h (R/W) = This bit always reads back 0 and writes of 0 have no effect 1h (R/W) = Write a 1 to clear the task 1 interrupt flag

### 5.7.2.14 MICLROVF Register (Offset = 24h) [reset = 0h]

MICLROVF is shown in [Figure 5-15](#) and described in [Table 5-38](#).

Return to [Summary Table](#).

Overflow flag bits in the MIOVF register are latched until manually cleared using the MICLROVF register. Writing a 1 to a MICLROVF bit will clear the corresponding bit in the MIOVF register. Writes of 0 are ignored and reads always return 0.

**Figure 5-15. MICLROVF Register**

15		14		13		12		11		10		9		8	
RESERVED															
R-0h															
7		6		5		4		3		2		1		0	
INT8		INT7		INT6		INT5		INT4		INT3		INT2		INT1	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	

**Table 5-38. MICLROVF Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-8	RESERVED	R	0h	Reserved
7	INT8	R/W	0h	Task 8 Interrupt Overflow Flag Clear Reset type: SYSRSn 0h (R/W) = This bit always reads back 0 and writes of 0 have no effect 1h (R/W) = Write a 1 to clear the task 8 interrupt overflow flag
6	INT7	R/W	0h	Task 7 Interrupt Overflow Flag Clear Reset type: SYSRSn 0h (R/W) = This bit always reads back 0 and writes of 0 have no effect 1h (R/W) = Write a 1 to clear the task 7 interrupt overflow flag
5	INT6	R/W	0h	Task 6 Interrupt Overflow Flag Clear Reset type: SYSRSn 0h (R/W) = This bit always reads back 0 and writes of 0 have no effect 1h (R/W) = Write a 1 to clear the task 6 interrupt overflow flag
4	INT5	R/W	0h	Task 5 Interrupt Overflow Flag Clear Reset type: SYSRSn 0h (R/W) = This bit always reads back 0 and writes of 0 have no effect 1h (R/W) = Write a 1 to clear the task 5 interrupt overflow flag
3	INT4	R/W	0h	Task 4 Interrupt Overflow Flag Clear Reset type: SYSRSn 0h (R/W) = This bit always reads back 0 and writes of 0 have no effect 1h (R/W) = Write a 1 to clear the task 4 interrupt overflow flag
2	INT3	R/W	0h	Task 3 Interrupt Overflow Flag Clear Reset type: SYSRSn 0h (R/W) = This bit always reads back 0 and writes of 0 have no effect 1h (R/W) = Write a 1 to clear the task 3 interrupt overflow flag
1	INT2	R/W	0h	Task 2 Interrupt Overflow Flag Clear Reset type: SYSRSn 0h (R/W) = This bit always reads back 0 and writes of 0 have no effect 1h (R/W) = Write a 1 to clear the task 2 interrupt overflow flag

**Table 5-38. MICLROVF Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
0	INT1	R/W	0h	Task 1 Interrupt Overflow Flag Clear Reset type: SYSRSn 0h (R/W) = This bit always reads back 0 and writes of 0 have no effect 1h (R/W) = Write a 1 to clear the task 1 interrupt overflow flag

### 5.7.2.15 MIER Register (Offset = 25h) [reset = 0h]

MIER is shown in [Figure 5-16](#) and described in [Table 5-39](#).

Return to [Summary Table](#).

Setting the bits in the interrupt enable register (MIER) allow an incoming interrupt or main CPU software to start the corresponding CLA task. Writing a 0 will block the task, but the interrupt request will still be latched in the flag register (MIFLG). Setting the MIER register bit to 0 while the corresponding task is executing will have no effect on the task. The task will continue to run until it hits the MSTOP instruction. When a soft reset is issued, the MIER bits are cleared. There should always be at least a 1 SYSCLKOUT delay between issuing the soft reset and reconfiguring the MIER bits.

**Figure 5-16. MIER Register**

15	14	13	12	11	10	9	8
RESERVED							
R-0h							
7	6	5	4	3	2	1	0
INT8	INT7	INT6	INT5	INT4	INT3	INT2	INT1
R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h

**Table 5-39. MIER Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-8	RESERVED	R	0h	Reserved
7	INT8	R	0h	Task 8 Interrupt Enable Reset type: SYSRSn 0h (R/W) = TASK_INT_DISABLE Task 8 interrupt is disabled (default) 1h (R/W) = TASK_INT_ENABLE Task 8 interrupt is enabled
6	INT7	R	0h	Task 7 Interrupt Enable Reset type: SYSRSn 0h (R/W) = TASK_INT_DISABLE Task 7 interrupt is disabled (default) 1h (R/W) = TASK_INT_ENABLE Task 7 interrupt is enabled
5	INT6	R	0h	Task 6 Interrupt Enable Reset type: SYSRSn 0h (R/W) = TASK_INT_DISABLE Task 6 interrupt is disabled (default) 1h (R/W) = TASK_INT_ENABLE Task 6 interrupt is enabled
4	INT5	R	0h	Task 5 Interrupt Enable Reset type: SYSRSn 0h (R/W) = TASK_INT_DISABLE Task 5 interrupt is disabled (default) 1h (R/W) = TASK_INT_ENABLE Task 5 interrupt is enabled
3	INT4	R	0h	Task 4 Interrupt Enable Reset type: SYSRSn 0h (R/W) = TASK_INT_DISABLE Task 4 interrupt is disabled (default) 1h (R/W) = TASK_INT_ENABLE Task 4 interrupt is enabled

**Table 5-39. MIER Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
2	INT3	R	0h	Task 3 Interrupt Enable Reset type: SYSRSn 0h (R/W) = TASK_INT_DISABLE Task 3 interrupt is disabled (default) 1h (R/W) = TASK_INT_ENABLE Task 3 interrupt is enabled
1	INT2	R	0h	Task 2 Interrupt Enable Reset type: SYSRSn 0h (R/W) = TASK_INT_DISABLE Task 2 interrupt is disabled (default) 1h (R/W) = TASK_INT_ENABLE Task 2 interrupt is enabled
0	INT1	R	0h	Task 1 Interrupt Enable Reset type: SYSRSn 0h (R/W) = TASK_INT_DISABLE Task 1 interrupt is disabled (default) 1h (R/W) = TASK_INT_ENABLE Task 1 interrupt is enabled

### 5.7.2.16 MIRUN Register (Offset = 26h) [reset = 0h]

MIRUN is shown in [Figure 5-17](#) and described in [Table 5-40](#).

Return to [Summary Table](#).

The interrupt run status register (MIRUN) indicates which task is currently executing. Only one MIRUN bit will ever be set to a 1 at any given time. The bit is automatically cleared when the task completes and the respective interrupt is fed to the peripheral interrupt expansion (PIE) block of the device. This lets the main CPU know when a task has completed. The main CPU can stop a currently running task by writing to the MCTL[SOFTRESET] bit. This will clear the MIRUN flag and stop the task. In this case no interrupt will be generated to the PIE.

**Figure 5-17. MIRUN Register**

15	14	13	12	11	10	9	8
RESERVED							
R-0h							
7	6	5	4	3	2	1	0
INT8	INT7	INT6	INT5	INT4	INT3	INT2	INT1
R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h

**Table 5-40. MIRUN Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-8	RESERVED	R	0h	Reserved
7	INT8	R	0h	Task 8 Run Status Reset type: SYSRSn 0h (R/W) = Task 8 is not executing (default) 1h (R/W) = Task 8 is executing
6	INT7	R	0h	Task 7 Run Status Reset type: SYSRSn 0h (R/W) = Task 7 is not executing (default) 1h (R/W) = Task 7 is executing
5	INT6	R	0h	Task 6 Run Status Reset type: SYSRSn 0h (R/W) = Task 6 is not executing (default) 1h (R/W) = Task 6 is executing
4	INT5	R	0h	Task 5 Run Status Reset type: SYSRSn 0h (R/W) = Task 5 is not executing (default) 1h (R/W) = Task 5 is executing
3	INT4	R	0h	Task 4 Run Status Reset type: SYSRSn 0h (R/W) = Task 4 is not executing (default) 1h (R/W) = Task 4 is executing
2	INT3	R	0h	Task 3 Run Status Reset type: SYSRSn 0h (R/W) = Task 3 is not executing (default) 1h (R/W) = Task 3 is executing
1	INT2	R	0h	Task 2 Run Status Reset type: SYSRSn 0h (R/W) = Task 2 is not executing (default) 1h (R/W) = Task 2 is executing



**Table 5-40. MIRUN Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
0	INT1	R	0h	Task 1 Run Status Reset type: SYSRSn 0h (R/W) = Task 1 is not executing (default) 1h (R/W) = Task 1 is executing

**5.7.2.17 \_MPC Register (Offset = 28h) [reset = 0h]**

\_MPC is shown in [Figure 5-18](#) and described in [Table 5-41](#).

Return to [Summary Table](#).

CLA Program Counter

**Figure 5-18. \_MPC Register**

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
_MPC															
R/W-0h															

**Table 5-41. \_MPC Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-0	_MPC	R/W	0h	Points to the instruction currently in the decode 2 phase of the CLA pipeline. The address range of the CLA with a 16-bit MPC is 64K 16-bit words or 32K CLA instructions. Reset type: SYSRSn

**5.7.2.18 \_MAR0 Register (Offset = 2Ah) [reset = 0h]**

\_MAR0 is shown in [Figure 5-19](#) and described in [Table 5-42](#).

Return to [Summary Table](#).

CLA Auxiliary Register 0

**Figure 5-19. \_MAR0 Register**

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
_MAR0															
R/W-0h															

**Table 5-42. \_MAR0 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-0	_MAR0	R/W	0h	CLA Auxillary Register 0 Reset type: SYSRSn

**5.7.2.19 \_MAR1 Register (Offset = 2Bh) [reset = 0h]**

\_MAR1 is shown in [Figure 5-20](#) and described in [Table 5-43](#).

Return to [Summary Table](#).

CLA Auxiliary Register 1

**Figure 5-20. \_MAR1 Register**

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
_MAR1															
R/W-0h															

**Table 5-43. \_MAR1 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-0	_MAR1	R/W	0h	CLA Auxillary Register 1 Reset type: SYSRSn

### 5.7.2.20 \_MSTF Register (Offset = 2Eh) [reset = 0h]

\_MSTF is shown in [Figure 5-21](#) and described in [Table 5-44](#).

Return to [Summary Table](#).

The CLA status register (MSTF) reflects the results of different operations. These are the basic rules for the flags:

- Zero and negative flags are cleared or set based on:
- floating-point moves to registers
- the result of compare, minimum, maximum, negative and absolute value operations
- the integer result of operations such as MMOV16, MAND32, MOR32, MXOR32, MCMP32, MASR32, MLSR32
- Overflow and underflow flags are set by floating-point math instructions such as multiply, add, subtract and 1/x. These flags may also be connected to the peripheral interrupt expansion (PIE) block on your device. This can be useful for debugging underflow and overflow conditions within an application.

**Figure 5-21. \_MSTF Register**

31	30	29	28	27	26	25	24
RESERVED				_RPC			
R-0h				R/W-0h			
23	22	21	20	19	18	17	16
_RPC							
R/W-0h							
15	14	13	12	11	10	9	8
_RPC				MEALLOW	RESERVED	RNDF32	RESERVED
R/W-0h				R/W-0h	R-0h	R/W-0h	R-0h
7	6	5	4	3	2	1	0
RESERVED	TF	RESERVED		ZF	NF	LUF	LVF
R-0h	R/W-0h	R/W-0h		R/W-0h	R/W-0h	R/W-0h	R/W-0h

**Table 5-44. \_MSTF Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-28	RESERVED	R	0h	Reserved
27-12	_RPC	R/W	0h	Return program counter The RPC is used to save and restore the MPC address by the MCCNDD and MRCNDD operations Reset type: SYSRSn
11	MEALLOW	R/W	0h	MEALLOW Status This bit enables and disables CLA write access to EALLOW protected registers This is independent of the state of the EALLOW bit in the main CPU status register This status bit can be saved and restored by the MMOV32 STF, mem32 instruction Reset type: SYSRSn 0h (R/W) = The CLA cannot write to EALLOW protected registers. This bit is cleared by the CLA instruction, MEDIS. 1h (R/W) = The CLA is allowed to write to EALLOW protected registers. This bit is set by the CLA instruction, MEALLOW.
10	RESERVED	R	0h	Reserved
9	RNDF32	R/W	0h	Round 32-bit Floating-Point Mode Use the MSETFLG and MMOV32 MSTF, mem32 instructions to change the rounding mode Reset type: SYSRSn 0h (R/W) = If this bit is zero, the MMPYF32, MADD32 and MSUBF32 instructions will round to zero (truncate). 1h (R/W) = If this bit is one, the MMPYF32, MADD32 and MSUBF32 instructions will round to the nearest even value.

**Table 5-44. \_MSTF Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
8-7	RESERVED	R	0h	Reserved
6	TF	R/W	0h	<p>Test Flag</p> <p>The MTESTTF instruction can modify this flag based on the condition tested. The MSETFLG and MMOV32 MSTF, mem32 instructions can also be used to modify this flag.</p> <p>Reset type: SYSRSn</p> <p>0h (R/W) = The condition tested with the MTESTTF instruction is false.</p> <p>1h (R/W) = The condition tested with the MTESTTF instruction is true.</p>
5-4	RESERVED	R/W	0h	Reserved
3	ZF	R/W	0h	<p>Zero Flag</p> <p>- Instructions that modify this flag based on the floating-point value stored in the destination register: MMOV32, MMOVD32, MABSF32, MNEGF32</p> <p>- Instructions that modify this flag based on the floating-point result of the operation: MCMPF32, MMAXF32, and MMINF32</p> <p>- Instructions that modify this flag based on the integer result of the operation: MMOV16, MAND32, MOR32, MXOR32, MCMP32, MASR32, MLSR32 and MLSL32</p> <p>The MSETFLG and MMOV32 MSTF, mem32 instructions can also be used to modify this flag.</p> <p>Reset type: SYSRSn</p> <p>0h (R/W) = The value is not zero</p> <p>1h (R/W) = The value is zero</p>
2	NF	R/W	0h	<p>Negative Flag</p> <p>- Instructions that modify this flag based on the floating-point value stored in the destination register: MMOV32, MMOVD32, MABSF32, MNEGF32</p> <p>- Instructions that modify this flag based on the floating-point result of the operation: MCMPF32, MMAXF32, and MMINF32</p> <p>- Instructions that modify this flag based on the integer result of the operation: MMOV16, MAND32, MOR32, MXOR32, MCMP32, MASR32, MLSR32 and MLSL32</p> <p>The MSETFLG and MMOV32 MSTF, mem32 instructions can also be used to modify this flag.</p> <p>Reset type: SYSRSn</p> <p>0h (R/W) = The value is not negative</p> <p>1h (R/W) = The value is negative</p>
1	LUF	R/W	0h	<p>Latched Underflow Flag</p> <p>The following instructions will set this flag to 1 if an underflow occurs: MMPYF32, MADDF32, MSUBF32, MMACF32, MEINVF32, MEISQRTF32</p> <p>The MSETFLG and MMOV32 MSTF, mem32 instructions can also be used to modify this flag.</p> <p>Reset type: SYSRSn</p> <p>0h (R/W) = An underflow condition has not been latched</p> <p>1h (R/W) = An underflow condition has been latched</p>

**Table 5-44. \_MSTF Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
0	LVF	R/W	0h	<p>Latched Overflow Flag</p> <p>The following instructions will set this flag to 1 if an overflow occurs: MMPYF32, MADD32, MSUBF32, MMACF32, MEINVF32, MEISQRTF32</p> <p>The MSETFLG and MMOV32 MSTF, mem32 instructions can also be used to modify this flag</p> <p>Reset type: SYSRSn</p> <p>0h (R/W) = An overflow condition has not been latched 1h (R/W) = An overflow condition has been latched</p>

**5.7.2.21 \_MR0 Register (Offset = 30h) [reset = 0h]**

\_MR0 is shown in [Figure 5-22](#) and described in [Table 5-45](#).

Return to [Summary Table](#).

CLA Floating-Point Result Register 0

**Figure 5-22. \_MR0 Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
i32																															
R/W-0h																															

**Table 5-45. \_MR0 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-0	i32	R/W	0h	CLA Result Register 0 Reset type: SYSRSn



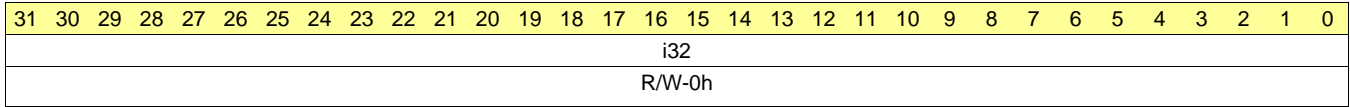
**5.7.2.22 \_MR1 Register (Offset = 34h) [reset = 0h]**

\_MR1 is shown in [Figure 5-23](#) and described in [Table 5-46](#).

Return to [Summary Table](#).

CLA Floating-Point Result Register 1

**Figure 5-23. \_MR1 Register**



**Table 5-46. \_MR1 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-0	i32	R/W	0h	CLA Result Register 1 Reset type: SYSRSn

**5.7.2.23 \_MR2 Register (Offset = 38h) [reset = 0h]**

\_MR2 is shown in [Figure 5-24](#) and described in [Table 5-47](#).

Return to [Summary Table](#).

CLA Floating-Point Result Register 2

**Figure 5-24. \_MR2 Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
i32																															
R/W-0h																															

**Table 5-47. \_MR2 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-0	i32	R/W	0h	CLA Result Register 2 Reset type: SYSRSn

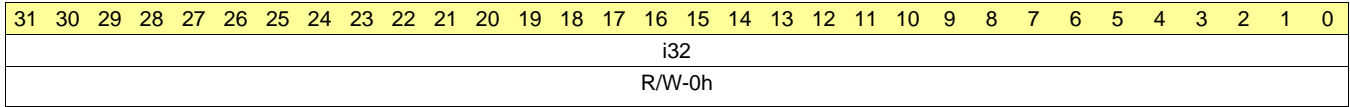
**5.7.2.24 \_MR3 Register (Offset = 3Ch) [reset = 0h]**

\_MR3 is shown in [Figure 5-25](#) and described in [Table 5-48](#).

Return to [Summary Table](#).

CLA Floating-Point Result Register 3

**Figure 5-25. \_MR3 Register**



**Table 5-48. \_MR3 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-0	i32	R/W	0h	CLA Result Register 3 Reset type: SYSRSn

### 5.7.3 CLA\_SOFTINT\_REGS Registers

Table 5-49 lists the memory-mapped registers for the CLA\_SOFTINT\_REGS. All register offset addresses not listed in Table 5-49 should be considered as reserved locations and the register contents should not be modified.

**Table 5-49. CLA\_SOFTINT\_REGS Registers**

Offset	Acronym	Register Name	Write Protection	Section
0h	SOFTINTEN	CLA Software Interrupt Enable Register		<a href="#">Go</a>
2h	SOFTINTFRC	CLA Software Interrupt Force Register		<a href="#">Go</a>

Complex bit access types are encoded to fit into small table cells. Table 5-50 shows the codes that are used for access types in this section.

**Table 5-50. CLA\_SOFTINT\_REGS Access Type Codes**

Access Type	Code	Description
<b>Read Type</b>		
R	R	Read
<b>Write Type</b>		
W	W	Write
<b>Reset or Default Value</b>		
-n		Value after reset or the default value
<b>Register Array Variables</b>		
i,j,k,l,m,n		When these variables are used in a register name, an offset, or an address, they refer to the value of a register array where the register is part of a group of repeating registers. The register groups form a hierarchical structure and the array is represented with a formula.
y		When this variable is used in a register name, an offset, or an address it refers to the value of a register array.

### 5.7.3.1 SOFTINTEN Register (Offset = 0h) [reset = 0h]

SOFTINTEN is shown in [Figure 5-26](#) and described in [Table 5-51](#).

Return to [Summary Table](#).

Enables the ability to generate CLA task interrupt from within the task, by writing to SOFTINTFRC register. SOFTINTFRC register can only be written from CLA.

**Figure 5-26. SOFTINTEN Register**

31	30	29	28	27	26	25	24
RESERVED							
R-0h							
23	22	21	20	19	18	17	16
RESERVED							
R-0h							
15	14	13	12	11	10	9	8
RESERVED							
R-0h							
7	6	5	4	3	2	1	0
TASK8	TASK7	TASK6	TASK5	TASK4	TASK3	TASK2	TASK1
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h

**Table 5-51. SOFTINTEN Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-8	RESERVED	R	0h	Reserved
7	TASK8	R/W	0h	Task 8 Software Interrupt Enable Reset type: SYSRSn 0h (R/W) = Task8 Software Interrupt is disabled. 1h (R/W) = Task8 Software Interrupt is enabled.
6	TASK7	R/W	0h	Task 7 Software Interrupt Enable Reset type: SYSRSn 0h (R/W) = Task7 Software Interrupt is disabled. 1h (R/W) = Task7 Software Interrupt is enabled.
5	TASK6	R/W	0h	Task 6 Software Interrupt Enable Reset type: SYSRSn 0h (R/W) = Task6 Software Interrupt is disabled. 1h (R/W) = Task6 Software Interrupt is enabled.
4	TASK5	R/W	0h	Task 5 Software Interrupt Enable Reset type: SYSRSn 0h (R/W) = Task5 Software Interrupt is disabled. 1h (R/W) = Task5 Software Interrupt is enabled.
3	TASK4	R/W	0h	Task 4 Software Interrupt Enable Reset type: SYSRSn 0h (R/W) = Task4 Software Interrupt is disabled. 1h (R/W) = Task4 Software Interrupt is enabled.
2	TASK3	R/W	0h	Task 3 Software Interrupt Enable Reset type: SYSRSn 0h (R/W) = Task3 Software Interrupt is disabled. 1h (R/W) = Task3 Software Interrupt is enabled.
1	TASK2	R/W	0h	Task 2 Software Interrupt Enable Reset type: SYSRSn 0h (R/W) = Task2 Software Interrupt is disabled. 1h (R/W) = Task2 Software Interrupt is enabled.

**Table 5-51. SOFTINTEN Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
0	TASK1	R/W	0h	Task 1 Software Interrupt Enable Reset type: SYSRSn 0h (R/W) = Task1 Software Interrupt is disabled. 1h (R/W) = Task1 Software Interrupt is enabled.

### 5.7.3.2 SOFTINTFRC Register (Offset = 2h) [reset = 0h]

SOFTINTFRC is shown in [Figure 5-27](#) and described in [Table 5-52](#).

Return to [Summary Table](#).

Writing a value of 1 in a bit will generate the corresponding task interrupt. This register is only accessible by the CLA (not the CPU).

**Figure 5-27. SOFTINTFRC Register**

31	30	29	28	27	26	25	24
RESERVED							
R-0h							
23	22	21	20	19	18	17	16
RESERVED							
R-0h							
15	14	13	12	11	10	9	8
RESERVED							
R-0h							
7	6	5	4	3	2	1	0
TASK8	TASK7	TASK6	TASK5	TASK4	TASK3	TASK2	TASK1
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h

**Table 5-52. SOFTINTFRC Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-8	RESERVED	R	0h	Reserved
7	TASK8	R/W	0h	Task 8 Software Interrupt Force Reset type: SYSRSn 0h (R/W) = No action performed 1h (R/W) = Forces Task8 Software Interrupt
6	TASK7	R/W	0h	Task 7 Software Interrupt Force Reset type: SYSRSn 0h (R/W) = No action performed 1h (R/W) = Forces Task7 Software Interrupt
5	TASK6	R/W	0h	Task 6 Software Interrupt Force Reset type: SYSRSn 0h (R/W) = No action performed 1h (R/W) = Forces Task6 Software Interrupt
4	TASK5	R/W	0h	Task 5 Software Interrupt Force Reset type: SYSRSn 0h (R/W) = No action performed 1h (R/W) = Forces Task5 Software Interrupt
3	TASK4	R/W	0h	Task 4 Software Interrupt Force Reset type: SYSRSn 0h (R/W) = No action performed 1h (R/W) = Forces Task4 Software Interrupt
2	TASK3	R/W	0h	Task 3 Software Interrupt Force Reset type: SYSRSn 0h (R/W) = No action performed 1h (R/W) = Forces Task3 Software Interrupt
1	TASK2	R/W	0h	Task 2 Software Interrupt Force Reset type: SYSRSn 0h (R/W) = No action performed 1h (R/W) = Forces Task2 Software Interrupt

**Table 5-52. SOFTINTFRC Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
0	TASK1	R/W	0h	Task 1 Software Interrupt Force Reset type: SYSRSn 0h (R/W) = No action performed 1h (R/W) = Forces Task1 Software Interrupt



## General-Purpose Input/Output (GPIO)

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The GPIO module controls the device's digital I/O MUX, which uses shared pins to maximize application flexibility. The pins are named by their general-purpose I/O name (for example, GPIO0, GPIO25, GPIO58). These pins can be individually selected to operate as digital I/O (also called GPIO mode), or connected to one of several peripheral I/O signals. You can qualify the input signals to remove unwanted noise.

Topic	Page
<b>6.1 GPIO Overview .....</b>	<b>786</b>
<b>6.2 Configuration Overview .....</b>	<b>787</b>
<b>6.3 Digital General-Purpose I/O Control .....</b>	<b>787</b>
<b>6.4 Input Qualification .....</b>	<b>789</b>
<b>6.5 USB Signals .....</b>	<b>792</b>
<b>6.6 SPI Signals .....</b>	<b>792</b>
<b>6.7 GPIO and Peripheral Muxing .....</b>	<b>794</b>
<b>6.8 Internal Pullup Configuration Requirements .....</b>	<b>795</b>
<b>6.9 Registers .....</b>	<b>797</b>

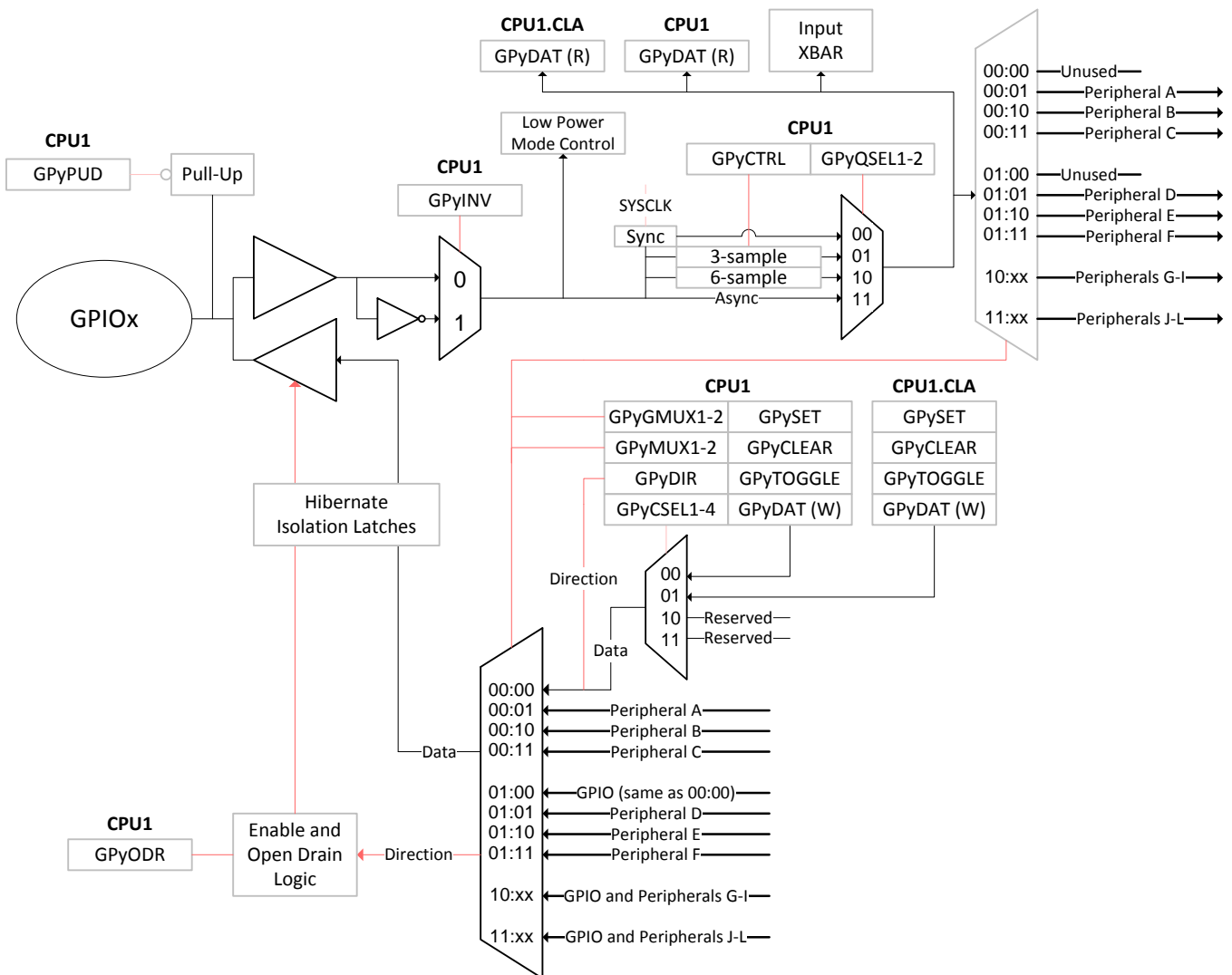
### 6.1 GPIO Overview

Up to twelve independent peripheral signals are multiplexed on a single GPIO-enabled pin in addition to the CPU-controlled I/O capability. Each pin output can be controlled by either a peripheral or one of the CPU masters (CPU1, CPU1.CLA). There are six I/O ports:

- Port A consists of GPIO0-GPIO31
- Port B consists of GPIO32-GPIO63
- Port C consists of GPIO64-GPIO95
- Port D consists of GPIO96-GPIO127
- Port E consists of GPIO128-GPIO159
- Port F consists of GPIO160-GPIO168

Figure 6-1 shows the GPIO logic for a single pin.

Figure 6-1. GPIO Logic for a Single Pin



**NOTE:** High-speed SPI and AUXCLKIN use a different signal path that does not support inversion or qualification. For more details on high-speed SPI pins, see Section 6.6.

The USB PHY pin muxing is not shown in this diagram. For more details on USB pins, see Section 6.5.

There are two key features to note in this diagram. The first is that the input and output paths are entirely separate, connecting only at the pin. The second is that peripheral muxing takes place far from the pin. As a result, it is always possible for both CPUs and CLAs to read the physical state of the pin independent of CPU mastering and peripheral muxing. Likewise, external interrupts can be generated from peripheral activity. All pin options such as input qualification and open-drain output are valid for all masters and peripherals. However, the peripheral muxing, CPU muxing, and pin options can only be configured by CPU1.

A separate configuration is required for the USB signals. See [Section 6.5](#) for details.

## 6.2 Configuration Overview

I/O pin configuration consists of several steps:

### 1. Plan the device pin-out

Make a list of all required peripherals for the application. Using the peripheral mux information in the device data manual, choose which GPIOs to use for the peripheral signals. Decide which of the remaining GPIOs to use as inputs and outputs for each CPU and CLA. Note that GPIOs 42, 43, 46, and 47 are the only available USB pins. GPIO41 is hard-wired to be the wake-up signal in hibernate mode.

Once the peripheral muxing has been chosen, it should be implemented by writing the appropriate values to the GPyMUX1/2 and GPyGMUX1/2 registers. When changing the GPyGMUX value for a pin, always set the corresponding GPyMUX bits to zero first to avoid glitching in the muxes. By default, all pins are general-purpose I/Os, not peripheral signals.

### 2. (Optional) Enable internal pullup resistors

To enable or disable the pullup resistors, write to the appropriate bits in the GPIO pullup disable registers (GPyPUD). All pullups are disabled by default. pullups can be used to keep input pins in a known state when there is no external signal driving them.

### 3. Select input qualification

If the pin will be used as an input, specify the required input qualification, if any. The input qualification sampling period is selected in the GPyCTRL registers, while the type of qualification is selected in the GPyQSEL1 and GPyQSEL2 registers. By default, all qualification is synchronous with a sampling period equal to PLLSYSCLK. For an explanation of input qualification, see [section Section 6.4](#).

### 4. Select the direction of any general-purpose I/O pins

For each pin configured as a GPIO, specify the direction of the pin as either input or output using the GPyDIR registers. By default, all GPIO pins are inputs. Before changing a pin to an output, load the output latch with the value to be driven by writing that value to the GPySET, GPyCLEAR, or GPyDAT registers. Once the latch is loaded, write to GPyDIR to change the pin direction. By default, all output latches are zero.

### 5. Select low-power mode wake-up sources

GPIOs 0-63 can be used to wake the system up from Standby or Halt mode. To select one or more GPIOs for wake-up, write to the appropriate bits in the GPIOLPMSEL0 and GPIOLPMSEL1 registers. These registers are part of the CPU system register space. In Hibernate mode, GPIO 41 is the only wake-up pin. For more information on low-power modes and GPIO wake-up, see the Low Power Modes section in the *System Control and Interrupts* chapter.

### 6. Select external interrupt sources

Configuring external interrupts is a two-step process. First, the interrupts themselves must be enabled and their polarity must be configured via the XINTnCR registers. Second, the XINT1-5 GPIO pins must be set by selecting the sources for Input X-BAR signals 4, 5, 6, 13, and 14, respectively. For more information on the Input X-BAR architecture, see the *ePWM* chapter of this manual.

## 6.3 Digital General-Purpose I/O Control

The values on the pins that are configured as GPIO can be changed by using these registers.

- **GPyDAT Registers**

Each I/O port has one data register. Each bit in the data register corresponds to one GPIO pin. No matter how the pin is configured (GPIO or peripheral function), the corresponding bit in the data register reflects the current state of the pin after qualification. Writing to the GPyDAT register clears or sets the corresponding output latch and if the pin is enabled as a general purpose output (GPIO

output) the pin will also be driven either low or high. If the pin is not configured as a GPIO output then the value will be latched, but the pin will not be driven. Only if the pin is later configured as a GPIO output, will the latched value be driven onto the pin.

When using the GPyDAT register to change the level of an output pin, you should be cautious not to accidentally change the level of another pin. For example, if you mean to change the output latch level of GPIOA1 by writing to the GPADAT register bit 0 using a read-modify-write instruction, a problem can occur if another I/O port A signal changes level between the read and the write stage of the instruction. Following is an analysis of why this happens:

The GPyDAT registers reflect the state of the pin, not the latch. This means the register reflects the actual pin value. However, there is a lag between when the register is written to when the new pin value is reflected back in the register. This may pose a problem when this register is used in subsequent program statements to alter the state of GPIO pins. An example is shown below where two program statements attempt to drive two different GPIO pins that are currently low to a high state.

If Read-Modify-Write operations are used on the GPyDAT registers, because of the delay between the output and the input of the first instruction (I1), the second instruction (I2) will read the old value and write it back.

```
GpioDataRegs.GPADAT.bit.GPIO1 = 1; //I1 performs read-modify-write of GPADAT
GpioDataRegs.GPADAT.bit.GPIO2 = 1; //I2 also a read-modify-write of GPADAT.
                                     //GPADAT gets the old value of GPIO1 due to the delay
```

The second instruction will wait for the first to finish its write due to the write-followed-by-read protection on this peripheral frame. There will be some lag, however, between the write of (I1) and the GPyDAT bit reflecting the new value (1) on the pin. During this lag, the second instruction will read the old value of GPIO1 (0) and write it back along with the new value of GPIO2 (1). Therefore, GPIO1 pin stays low.

One solution is to put some NOPs between instructions. A better solution is to use the GPySET/GPyCLEAR/GPyTOGGLE registers instead of the GPyDAT registers. These registers always read back a 0 and writes of 0 have no effect. Only bits that need to be changed can be specified without disturbing any other bit(s) that are currently in the process of changing.

- **GPySET Registers**

The set registers are used to drive specified GPIO pins high without disturbing other pins. Each I/O port has one set register and each bit corresponds to one GPIO pin. The set registers always read back 0. If the corresponding pin is configured as an output, then writing a 1 to that bit in the set register will set the output latch high and the corresponding pin will be driven high. If the pin is not configured as a GPIO output, then the value will be latched but the pin will not be driven. Only if the pin is later configured as a GPIO output will the latched value will be driven onto the pin. Writing a 0 to any bit in the set registers has no effect.

- **GPyCLEAR Registers**

The clear registers are used to drive specified GPIO pins low without disturbing other pins. Each I/O port has one clear register. The clear registers always read back 0. If the corresponding pin is configured as a general purpose output, then writing a 1 to the corresponding bit in the clear register will clear the output latch and the pin will be driven low. If the pin is not configured as a GPIO output, then the value will be latched but the pin will not be driven. Only if the pin is later configured as a GPIO output will the latched value will be driven onto the pin. Writing a 0 to any bit in the clear registers has no effect.

- **GPyTOGGLE Registers**

The toggle registers are used to drive specified GPIO pins to the opposite level without disturbing other pins. Each I/O port has one toggle register. The toggle registers always read back 0. If the corresponding pin is configured as an output, then writing a 1 to that bit in the toggle register flips the output latch and pulls the corresponding pin in the opposite direction. That is, if the output pin is driven low, then writing a 1 to the corresponding bit in the toggle register will pull the pin high. Likewise, if the output pin is high, then writing a 1 to the corresponding bit in the toggle register will pull the pin low. If the pin is not configured as a GPIO output, then the value will be latched but the pin will not be driven. Only if the pin is later configured as a GPIO output will the latched value will be driven onto the pin. Writing a 0 to any bit in the toggle registers has no effect.

## 6.4 Input Qualification

The input qualification scheme has been designed to be very flexible. You can select the type of input qualification for each GPIO pin by configuring the GPyQSEL1 and GPyQSEL2 registers. In the case of a GPIO input pin, the qualification can be specified as only synchronize to SYSCLKOUT or qualification by a sampling window. For pins that are configured as peripheral inputs, the input can also be asynchronous in addition to synchronized to SYSCLKOUT or qualified by a sampling window. The remainder of this section describes the options available.

### 6.4.1 No Synchronization (Asynchronous Input)

This mode is used for peripherals where input synchronization is not required or the peripheral itself performs the synchronization. Examples include communication ports McBSP, SCI, SPI, and I<sup>2</sup>C. In addition, it may be desirable to have the ePWM trip zone ( $\overline{TZn}$ ) signals function independent of the presence of SYSCLKOUT.

The asynchronous option is not valid if the pin is used as a general purpose digital input pin (GPIO). If the pin is configured as a GPIO input and the asynchronous option is selected then the qualification defaults to synchronization to SYSCLKOUT as described in [Section 6.4.2](#).

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**NOTE:** Using input synchronization when the peripheral itself performs the synchronization may cause unexpected results. The user should ensure that the GPIO pin is configured for asynchronous in this case.

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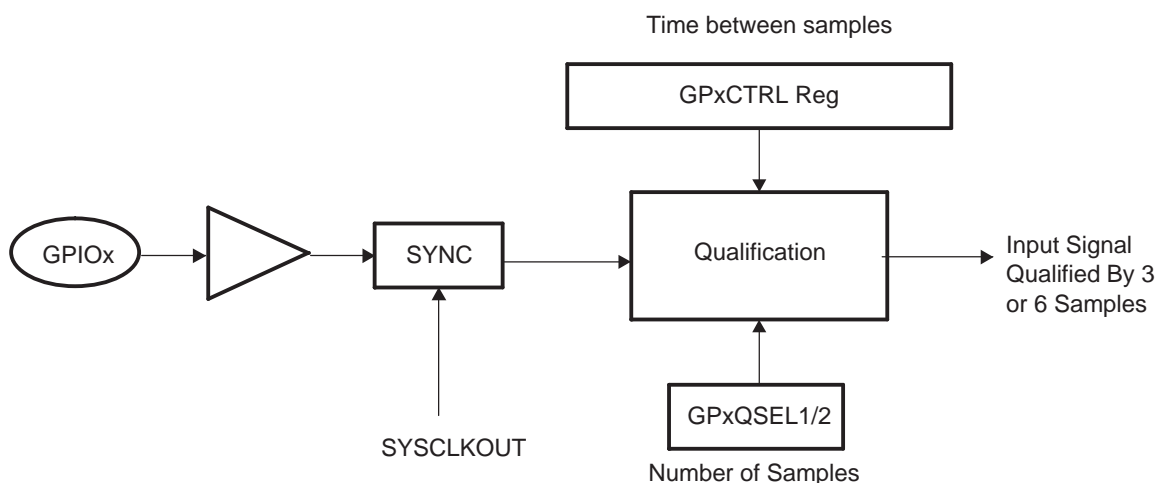
### 6.4.2 Synchronization to SYSCLKOUT Only

This is the default qualification mode of all the pins at reset. In this mode, the input signal is only synchronized to the system clock (SYSCLKOUT). Because the incoming signal is asynchronous, it can take up to a SYSCLKOUT period of delay in order for the input to the MCU to be changed. No further qualification is performed on the signal.

### 6.4.3 Qualification Using a Sampling Window

In this mode, the signal is first synchronized to the system clock (SYSCLKOUT) and then qualified by a specified number of cycles before the input is allowed to change. [Figure 6-2](#) and [Figure 6-3](#) show how the input qualification is performed to eliminate unwanted noise. Two parameters are specified by the user for this type of qualification: 1) the sampling period, or how often the signal is sampled, and 2) the number of samples to be taken.

**Figure 6-2. Input Qualification Using a Sampling Window**



**Time between samples (sampling period):**

To qualify the signal, the input signal is sampled at a regular period. The sampling period is specified by the user and determines the time duration between samples, or how often the signal will be sampled, relative to the CPU clock (SYSCLKOUT).

The sampling period is specified by the qualification period (QUALPRDn) bits in the GPxCTRL register. The sampling period is configurable in groups of 8 input signals. For example, GPIO0 to GPIO7 use GPaCTRL[QUALPRD0] setting and GPIO8 to GPIO15 use GPaCTRL[QUALPRD1]. [Table 6-1](#) and [Table 6-2](#) show the relationship between the sampling period or sampling frequency and the GPxCTRL[QUALPRDn] setting.

**Table 6-1. Sampling Period**

	Sampling Period
If GPxCTRL[QUALPRDn] = 0	$1 \times T_{\text{SYSCLKOUT}}$
If GPxCTRL[QUALPRDn] $\neq$ 0	$2 \times \text{GPxCTRL[QUALPRDn]} \times T_{\text{SYSCLKOUT}}$
	Where $T_{\text{SYSCLKOUT}}$ is the period in time of SYSCLKOUT

**Table 6-2. Sampling Frequency**

	Sampling Frequency
If GPxCTRL[QUALPRDn] = 0	$f_{\text{SYSCLKOUT}}$
If GPxCTRL[QUALPRDn] $\neq$ 0	$f_{\text{SYSCLKOUT}} \times 1 \div (2 \times \text{GPxCTRL[QUALPRDn]})$
	Where $f_{\text{SYSCLKOUT}}$ is the frequency of SYSCLKOUT

From these equations, the minimum and maximum time between samples can be calculated for a given SYSCLKOUT frequency:

**Example: Maximum Sampling Frequency:**

If GPxCTRL[QUALPRDn] = 0  
 then the sampling frequency is  $f_{\text{SYSCLKOUT}}$   
 If, for example,  $f_{\text{SYSCLKOUT}} = 60 \text{ MHz}$   
 then the signal will be sampled at 60 MHz or one sample every 16.67 ns.

**Example: Minimum Sampling Frequency:**

If GPxCTRL[QUALPRDn] = 0xFF (255)  
 then the sampling frequency is  $f_{\text{SYSCLKOUT}} \times 1 \div (2 \times \text{GPxCTRL[QUALPRDn]})$   
 If, for example,  $f_{\text{SYSCLKOUT}} = 60 \text{ MHz}$   
 then the signal will be sampled at  $60 \text{ MHz} \times 1 \div (2 \times 255)$  or one sample every 8.5  $\mu\text{s}$ .

**Number of samples:**

The number of times the signal is sampled is either three samples or six samples as specified in the qualification selection (GPAQSEL1, GPAQSEL2, GPBQSEL1, and GPBQSEL2) registers. When three or six consecutive cycles are the same, then the input change will be passed through to the MCU.

**Total Sampling Window Width:**

The sampling window is the time during which the input signal will be sampled as shown in [Figure 6-3](#). By using the equation for the sampling period along with the number of samples to be taken, the total width of the window can be determined.

For the input qualifier to detect a change in the input, the level of the signal must be stable for the duration of the sampling window width or longer.

The number of sampling periods within the window is always one less than the number of samples taken. For a three-sample window, the sampling window width is two sampling periods wide where the sampling period is defined in [Table 6-1](#). Likewise, for a six-sample window, the sampling window width is five sampling periods wide. [Table 6-3](#) and [Table 6-4](#) show the calculations that can be used to determine the total sampling window width based on GPxCTRL[QUALPRDn] and the number of samples taken.

**Table 6-3. Case 1: Three-Sample Sampling Window Width**

Total Sampling Window Width	
If GPxCTRL[QUALPRDn] = 0	$2 \times T_{\text{SYSCLKOUT}}$
If GPxCTRL[QUALPRDn] $\neq$ 0	$2 \times 2 \times \text{GPxCTRL[QUALPRDn]} \times T_{\text{SYSCLKOUT}}$
Where $T_{\text{SYSCLKOUT}}$ is the period in time of SYSCLKOUT	

**Table 6-4. Case 2: Six-Sample Sampling Window Width**

Total Sampling Window Width	
If GPxCTRL[QUALPRDn] = 0	$5 \times T_{\text{SYSCLKOUT}}$
If GPxCTRL[QUALPRDn] $\neq$ 0	$5 \times 2 \times \text{GPxCTRL[QUALPRDn]} \times T_{\text{SYSCLKOUT}}$
Where $T_{\text{SYSCLKOUT}}$ is the period in time of SYSCLKOUT	

**NOTE:** The external signal change is asynchronous with respect to both the sampling period and SYSCLKOUT. Due to the asynchronous nature of the external signal, the input should be held stable for a time greater than the sampling window width to make sure the logic detects a change in the signal. The extra time required can be up to an additional sampling period +  $T_{\text{SYSCLKOUT}}$ .

The required duration for an input signal to be stable for the qualification logic to detect a change is described in the device-specific data manual.

**Example Qualification Window:**

For the example shown in [Figure 6-3](#), the input qualification has been configured as follows:

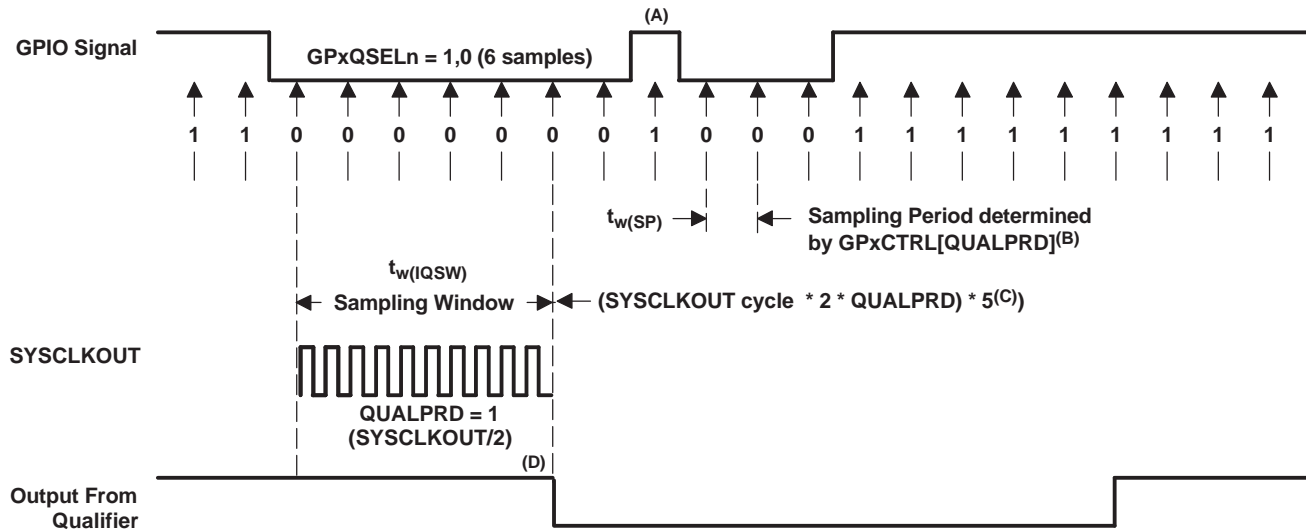
- GPxQSEL1/2 = 1,0. This indicates a six-sample qualification.
- GPxCTRL[QUALPRDn] = 1. The sampling period is  $t_w(\text{SP}) = 2 \times \text{GPxCTRL[QUALPRDn]} \times T_{\text{SYSCLKOUT}}$ .

This configuration results in the following:

- The width of the sampling window is:
  - $t_w(\text{IQSW}) = 5 \times t_w(\text{SP}) = 5 \times 2 \times \text{GPxCTRL[QUALPRDn]} \times T_{\text{SYSCLKOUT}}$  or  $5 \times 2 \times T_{\text{SYSCLKOUT}}$
- If, for example,  $T_{\text{SYSCLKOUT}} = 16.67 \text{ ns}$ , then the duration of the sampling window is:
  - $t_w(\text{IQSW}) = 5 \times 2 \times 16.67 \text{ ns} = 166.7 \text{ ns}$ .
- To account for the asynchronous nature of the input relative to the sampling period and SYSCLKOUT, up to an additional sampling period,  $t_w(\text{SP})$ , +  $T_{\text{SYSCLKOUT}}$  may be required to detect a change in the input signal. For this example:
  - $t_w(\text{SP}) + T_{\text{SYSCLKOUT}} = 333.4 \text{ ns} + 166.67 \text{ ns} = 500.1 \text{ ns}$
- In [Figure 6-3](#), the glitch (A) is shorter than the qualification window and will be ignored by the input qualifier.



**Figure 6-3. Input Qualifier Clock Cycles**



- A. This glitch will be ignored by the input qualifier. The QUALPRD bit field specifies the qualification sampling period. It can vary from 00 to 0xFF. If QUALPRD = 00, then the sampling period is 1 SYSCLKOUT cycle. For any other value "n", the qualification sampling period is 2n SYSCLKOUT cycles (i.e., at every 2n SYSCLKOUT cycles, the GPIO pin will be sampled).
- B. The qualification period selected via the GPxCTRL register applies to groups of 8 GPIO pins.
- C. The qualification block can take either three or six samples. The GPxQSELn Register selects which sample mode is used.
- D. In the example shown, for the qualifier to detect the change, the input should be stable for 10 SYSCLKOUT cycles or greater. In other words, the inputs should be stable for (5 x QUALPRD x 2) SYSCLKOUT cycles. That would ensure 5 sampling periods for detection to occur. Since external signals are driven asynchronously, a 13-SYSCLKOUT-wide pulse ensures reliable recognition.

## 6.5 USB Signals

The USB module on this device has an internal physical layer transceiver (PHY). Its I/O signals are not normal digital signals, and as a result, they do not connect to the pins through the normal GPIO mux path. Instead, a special analog mux is used. To connect the USB signals to the device pins, set the GPyAMSEL bits appropriately as shown in Table 6-5. Do not enable pullups or any other special pin option when using the USB signals.

**Table 6-5. USB I/O Signal Muxing**

Signal	GPIO	AMSEL
USBDM	42	GPBAMSEL[10]
USBDP	43	GPBAMSEL[11]

## 6.6 SPI Signals

The SPI module on this device has a high-speed mode that enables 40 Mbps communication. To achieve the highest possible speed, a special GPIO configuration is used on a single GPIO mux option for each SPI. These GPIOs may also be used by the SPI when not in high-speed mode (HS\_MODE = 0). Table 6-6 shows which GPIOs have the special mux option to allow SPI high-speed mode.

**Table 6-6. High-Speed SPI-Enabled GPIOs**

SPI pin	SPIA	SPIB	SPIC
SPISIMO	GPIO58	GPIO63	GPIO69
SPISOMI	GPIO59	GPIO64	GPIO70
SPICLK	GPIO60	GPIO65	GPIO71
SPISTE	GPIO61	GPIO66	GPIO72



To select these mux options the user should configure GPyGMUX and GPyMUX registers as shown in [Table 6-7](#).

**Table 6-7. GPIO Configuration for High-Speed SPI**

GPIO	SPI Signal	Mux Configuration	
GPIO58	SPISIMOA	GPBGMUX2[21:20]=11	GPBMUX2[21:20]=11
GPIO59	SPISOMIA	GPBGMUX2[23:22]=11	GPBMUX2[23:22]=11
GPIO60	SPICLKA	GPBGMUX2[25:24]=11	GPBMUX2[25:24]=11
GPIO61	SPISTEA	GPBGMUX2[27:26]=11	GPBMUX2[27:26]=11
GPIO63	SPISIMOB	GPBGMUX2[31:30]=11	GPBMUX2[31:30]=11
GPIO64	SPISOMIB	GPCGMUX1[1:0]=11	GPCMUX1[1:0]=11
GPIO65	SPICLKB	GPCGMUX1[3:2]=11	GPCMUX1[3:2]=11
GPIO66	SPISTEB	GPCGMUX1[5:4]=11	GPCMUX1[5:4]=11
GPIO69	SPISIMOC	GPCGMUX1[11:10]=11	GPCMUX1[11:10]=11
GPIO70	SPISOMIC	GPCGMUX1[13:12]=11	GPCMUX1[13:12]=11
GPIO71	SPICLKC	GPCGMUX1[15:14]=11	GPCMUX1[15:14]=11
GPIO72	SPISTEC	GPCGMUX1[17:16]=11	GPCMUX1[17:16]=11

## 6.7 GPIO and Peripheral Muxing

Up to twelve different peripheral functions are multiplexed to each pin along with a general-purpose input/output (GPIO) function. This allows you to choose the peripheral mix and pinout that will work best for your particular application. Refer to the table below for muxing combinations and definitions.

For example, the multiplexing for the GPIO 6 pin is controlled by writing to GPAGMUX[13:12] and GPAMUX[13:12]. By writing to these bits, GPIO 6 can be configured as either a general-purpose digital I/O or one of four different peripheral functions. The options are shown in [Table 6-8](#).

**Table 6-8. GPIO and Peripheral Muxing**

GPAGMUX1[13:12]	GPAMUX1[13:12]	Pin functionality
00	00	GPIO
00	01	EPWM4A
00	10	OUTPUTXBAR4
00	11	EXTSYNCOUT
01	00	GPIO
01	01	EQEP3A
01	10	CANTXB
10	00	GPIO
11	00	GPIO
All others		Reserved

The devices have different multiplexing schemes. If a peripheral is not available on a particular device, that mux selection is reserved on that device and should not be used.

Note: If you select a reserved GPIO mux configuration that is not mapped to either a peripheral or GPIO mode, the state of the pin will be undefined and the pin may be driven. Unimplemented configurations are for future expansion and must not be selected. In the device mux table (see datasheet), these options are indicated as Reserved or left blank.

Some peripherals can be assigned to more than one pin via the mux registers. For example, OUTPUTXBAR1 can be assigned to GPIOs 2, 24, 34, or 58, depending on individual system requirements. An example of this is shown in [Table 6-9](#).

**Table 6-9. Peripheral Muxing (multiple pins assigned)**

GMUX Configuration	MUX Configuration	
Choice 1 GPIO2	GPAGMUX1[5:4]=01	GPAMUX1[5:4]=01
or Choice 2 GPIO24	GPAGMUX2[17:16]=00	GPAMUX2[17:16]=01
or Choice 3 GPIO34	GPBGMUX1[5:4]=00	GPBMUX1[5:4]=01
or Choice 4 GPIO58	GPBGMUX2[21:20]=01	GPBMUX2[21:20]=01

If no pin is configured as an input to a peripheral, or if more than one pin is configured to an input for the same peripheral, then that input will be set to a hard-wired default value.

## 6.8 Internal Pullup Configuration Requirements

On reset, GPIOs are in input mode and have the internal pullups disabled. An un-driven input can float to a mid-rail voltage and cause wasted shoot-through current on the input buffer. The user should always put each GPIO in one of these configurations:

- Input mode and driven on the board by another component to a level above  $V_{ih}$  or below  $V_{il}$
- Input mode with GPIO internal pullup enabled
- Output mode

On devices in the 176PTP or 100PZP packages, the pullups for any internally unbonded GPIO must be enabled to prevent floating inputs. TI has provided functions in controlSUITE which users can call to enable the pullup on any unbonded GPIO for the package they are using. This function, `GPIO_EnabledUnbondedIOPullups()`, resides in the `(Device)_Sysctrl.c` file and is called by default from `InitSysCtrl()`. The user should take care to avoid disabling these pullups in their application code.

For 176-pin packages, pullup resistors should be enabled on the following GPIOs:

**Table 6-10. Pullup Resistors for 176-pin Packages**

Unbonded GPIOs on the 176-pin package							
95	106	116	126	137	147	157	167
96	107	117	127	138	148	158	168
97	108	118	128	139	149	159	
98	109	119	129	140	150	160	
100	110	120	130	141	151	161	
101	111	121	131	142	152	162	
102	112	122	132	143	153	163	
103	113	123	134	144	154	164	
104	114	124	135	145	155	165	
105	115	125	136	146	156	166	

For 100-pin packages, pullup resistors should be enabled on the following GPIOs:

**Table 6-11. Pullup Resistors for 100-pin Packages**

Unbonded GPIOs on the 100-pin package								
0	30	48	77	101	116	131	146	161
1	31	49	79	102	117	132	147	162
5	32	50	80	103	118	133	148	163
6	33	51	81	104	119	134	149	164
7	34	52	82	105	120	135	150	165
8	35	53	83	106	121	136	151	166
9	36	54	88	107	122	137	152	167
22	37	55	93	108	123	138	153	168
23	38	56	94	109	124	139	154	
24	39	57	95	110	125	140	155	
25	40	67	96	111	126	141	156	
26	44	68	97	112	127	142	157	
27	45	74	98	113	128	143	158	
28	46	75	100	114	129	144	159	
29	47	76	101	115	130	145	160	

## 6.9 Registers

### 6.9.1 GPIO Base Addresses

**Table 6-12. GPIO Base Address Table**

Device Registers	Register Name	Start Address	End Address
GpioCtrlRegs <sup>(1)</sup>	GPIO_CTRL_REGS	0x0000_7C00	0x0000_7D7F
GpioDataRegs	GPIO_DATA_REGS	0x0000_7F00	0x0000_7F2F

<sup>(1)</sup> Only available on CPU1.

The following table provides both specific and generic terms for registers described in this section and throughout this document.

**Table 6-13. Specific vs Generic Terminology for Registers**

Specific Term	Generic Term Used in the Document
GPAQSEL1, GPAQSEL2, GPBQSEL1, GPBQSEL2, GPCQSEL1, GPCQSEL2, GPDQSEL1, GPDQSEL2, GPEQSEL1, GPEQSEL2, GPFQSEL1, GPFQSEL2	GPxQSEL
GPACTRL, GPBCTRL, GPCCTRL, GPDCTRL, GPECTRL, GPFCTRL	GPxCTRL
GPADIR, GPBDIR, GPCDIR, GPDDIR, GPEDIR, GPFDIR	GPxDIR
GPAPUD, GPBPUD, GPCPUD, GPDPU, GPEPUD, GPFPU	GPxPUD
GPAINV, GPBINV, GPCINV, GPDINV, GPEINV, GPFINV	GPxINV
GPAODR, GPBODR, GPCODR, GPDODR, GPEODR, GPFODR, GPxODR, GPALOCK, GPBLOCK, GPCLOCK, GPDLOCK, GPELOCK, GPFLOCK	GPxODR GPxLOCK
GPACR, GPBCR, GPCCR, GPDCR, GPECR, GPFGR	GPxCR
GPAMUX1, GPAMUX2, GPBMUX1, GPBMUX2, GPCMUX1, GPCMUX2, GPDMUX1, GPDMUX2, GPEMUX1, GPEMUX2, GPFMUX1, GPFMUX2	GPxMUX
GPAGMUX1, GPAGMUX2, GPBGMUX1, GPBGMUX2, GPCGMUX1, GPCGMUX2, GPDGMUX1, GPDGMUX2, GPEGMUX1, GPEGMUX2, GPFGMUX1, GPFGMUX2	GPxGMUX
GPADAT, GPBDAT, GPCDAT, GPDDAT, GPEMAT, GPFMAT	GPxDAT

## 6.9.2 GPIO\_CTRL\_REGS Registers

Table 6-14 lists the memory-mapped registers for the GPIO\_CTRL\_REGS. All register offset addresses not listed in Table 6-14 should be considered as reserved locations and the register contents should not be modified.

**Table 6-14. GPIO\_CTRL\_REGS Registers**

Offset	Acronym	Register Name	Write Protection	Section
0h	GPACTRL	GPIO A Qualification Sampling Period Control (GPIO0 to 31)	EALLOW	<a href="#">Go</a>
2h	GPAQSEL1	GPIO A Qualifier Select 1 Register (GPIO0 to 15)	EALLOW	<a href="#">Go</a>
4h	GPAQSEL2	GPIO A Qualifier Select 2 Register (GPIO16 to 31)	EALLOW	<a href="#">Go</a>
6h	GPAMUX1	GPIO A Mux 1 Register (GPIO0 to 15)	EALLOW	<a href="#">Go</a>
8h	GPAMUX2	GPIO A Mux 2 Register (GPIO16 to 31)	EALLOW	<a href="#">Go</a>
Ah	GPADIR	GPIO A Direction Register (GPIO0 to 31)	EALLOW	<a href="#">Go</a>
Ch	GPAPUD	GPIO A Pull Up Disable Register (GPIO0 to 31)	EALLOW	<a href="#">Go</a>
10h	GPAINV	GPIO A Input Polarity Invert Registers (GPIO0 to 31)	EALLOW	<a href="#">Go</a>
12h	GPAODR	GPIO A Open Drain Output Register (GPIO0 to GPIO31)	EALLOW	<a href="#">Go</a>
20h	GPAGMUX1	GPIO A Peripheral Group Mux (GPIO0 to 15)	EALLOW	<a href="#">Go</a>
22h	GPAGMUX2	GPIO A Peripheral Group Mux (GPIO16 to 31)	EALLOW	<a href="#">Go</a>
28h	GPACSEL1	GPIO A Core Select Register (GPIO0 to 7)	EALLOW	<a href="#">Go</a>
2Ah	GPACSEL2	GPIO A Core Select Register (GPIO8 to 15)	EALLOW	<a href="#">Go</a>
2Ch	GPACSEL3	GPIO A Core Select Register (GPIO16 to 23)	EALLOW	<a href="#">Go</a>
2Eh	GPACSEL4	GPIO A Core Select Register (GPIO24 to 31)	EALLOW	<a href="#">Go</a>
3Ch	GPALOCK	GPIO A Lock Configuration Register (GPIO0 to 31)	EALLOW	<a href="#">Go</a>
3Eh	GPACR	GPIO A Lock Commit Register (GPIO0 to 31)	EALLOW	<a href="#">Go</a>
40h	GPBCTRL	GPIO B Qualification Sampling Period Control (GPIO32 to 63)	EALLOW	<a href="#">Go</a>
42h	GPBQSEL1	GPIO B Qualifier Select 1 Register (GPIO32 to 47)	EALLOW	<a href="#">Go</a>
44h	GPBQSEL2	GPIO B Qualifier Select 2 Register (GPIO48 to 63)	EALLOW	<a href="#">Go</a>
46h	GPBMUX1	GPIO B Mux 1 Register (GPIO32 to 47)	EALLOW	<a href="#">Go</a>
48h	GPBMUX2	GPIO B Mux 2 Register (GPIO48 to 63)	EALLOW	<a href="#">Go</a>
4Ah	GPBDIR	GPIO B Direction Register (GPIO32 to 63)	EALLOW	<a href="#">Go</a>
4Ch	GPBPUD	GPIO B Pull Up Disable Register (GPIO32 to 63)	EALLOW	<a href="#">Go</a>
50h	GPBINV	GPIO B Input Polarity Invert Registers (GPIO32 to 63)	EALLOW	<a href="#">Go</a>
52h	GPBODR	GPIO B Open Drain Output Register (GPIO32 to GPIO63)	EALLOW	<a href="#">Go</a>
54h	GPBAMSEL	GPIO B Analog Mode Select register (GPIO32 to GPIO63)	EALLOW	<a href="#">Go</a>
60h	GPBGMUX1	GPIO B Peripheral Group Mux (GPIO32 to 47)	EALLOW	<a href="#">Go</a>
62h	GPBGMUX2	GPIO B Peripheral Group Mux (GPIO48 to 63)	EALLOW	<a href="#">Go</a>
68h	GPBCSEL1	GPIO B Core Select Register (GPIO32 to 39)	EALLOW	<a href="#">Go</a>
6Ah	GPBCSEL2	GPIO B Core Select Register (GPIO40 to 47)	EALLOW	<a href="#">Go</a>
6Ch	GPBCSEL3	GPIO B Core Select Register (GPIO48 to 55)	EALLOW	<a href="#">Go</a>
6Eh	GPBCSEL4	GPIO B Core Select Register (GPIO56 to 63)	EALLOW	<a href="#">Go</a>
7Ch	GPBLOCK	GPIO B Lock Configuration Register (GPIO32 to 63)	EALLOW	<a href="#">Go</a>

**Table 6-14. GPIO\_CTRL\_REGS Registers (continued)**

Offset	Acronym	Register Name	Write Protection	Section
7Eh	GPBCR	GPIO B Lock Commit Register (GPIO32 to 63)	EALLOW	<a href="#">Go</a>
80h	GPCCTRL	GPIO C Qualification Sampling Period Control (GPIO64 to 95)	EALLOW	<a href="#">Go</a>
82h	GPCQSEL1	GPIO C Qualifier Select 1 Register (GPIO64 to 79)	EALLOW	<a href="#">Go</a>
84h	GPCQSEL2	GPIO C Qualifier Select 2 Register (GPIO80 to 95)	EALLOW	<a href="#">Go</a>
86h	GPCMUX1	GPIO C Mux 1 Register (GPIO64 to 79)	EALLOW	<a href="#">Go</a>
88h	GPCMUX2	GPIO C Mux 2 Register (GPIO80 to 95)	EALLOW	<a href="#">Go</a>
8Ah	GPCDIR	GPIO C Direction Register (GPIO64 to 95)	EALLOW	<a href="#">Go</a>
8Ch	GPCPUD	GPIO C Pull Up Disable Register (GPIO64 to 95)	EALLOW	<a href="#">Go</a>
90h	GPCINV	GPIO C Input Polarity Invert Registers (GPIO64 to 95)	EALLOW	<a href="#">Go</a>
92h	GPCODR	GPIO C Open Drain Output Register (GPIO64 to GPIO95)	EALLOW	<a href="#">Go</a>
A0h	GPCGMUX1	GPIO C Peripheral Group Mux (GPIO64 to 79)	EALLOW	<a href="#">Go</a>
A2h	GPCGMUX2	GPIO C Peripheral Group Mux (GPIO80 to 95)	EALLOW	<a href="#">Go</a>
A8h	GPCCSEL1	GPIO C Core Select Register (GPIO64 to 71)	EALLOW	<a href="#">Go</a>
AAh	GPCCSEL2	GPIO C Core Select Register (GPIO72 to 79)	EALLOW	<a href="#">Go</a>
ACh	GPCCSEL3	GPIO C Core Select Register (GPIO80 to 87)	EALLOW	<a href="#">Go</a>
A Eh	GPCCSEL4	GPIO C Core Select Register (GPIO88 to 95)	EALLOW	<a href="#">Go</a>
BCh	GPCLOCK	GPIO C Lock Configuration Register (GPIO64 to 95)	EALLOW	<a href="#">Go</a>
BEh	GPCCR	GPIO C Lock Commit Register (GPIO64 to 95)	EALLOW	<a href="#">Go</a>
C0h	GPDCTRL	GPIO D Qualification Sampling Period Control (GPIO96 to 127)	EALLOW	<a href="#">Go</a>
C2h	GPDQSEL1	GPIO D Qualifier Select 1 Register (GPIO96 to 111)	EALLOW	<a href="#">Go</a>
C4h	GPDQSEL2	GPIO D Qualifier Select 2 Register (GPIO112 to 127)	EALLOW	<a href="#">Go</a>
C6h	GPDMUX1	GPIO D Mux 1 Register (GPIO96 to 111)	EALLOW	<a href="#">Go</a>
C8h	GPDMUX2	GPIO D Mux 2 Register (GPIO112 to 127)	EALLOW	<a href="#">Go</a>
CAh	GPDDIR	GPIO D Direction Register (GPIO96 to 127)	EALLOW	<a href="#">Go</a>
CCh	GPDPUD	GPIO D Pull Up Disable Register (GPIO96 to 127)	EALLOW	<a href="#">Go</a>
D0h	GPDINV	GPIO D Input Polarity Invert Registers (GPIO96 to 127)	EALLOW	<a href="#">Go</a>
D2h	GPDODR	GPIO D Open Drain Output Register (GPIO96 to GPIO127)	EALLOW	<a href="#">Go</a>
E0h	GPDGMUX1	GPIO D Peripheral Group Mux (GPIO96 to 111)	EALLOW	<a href="#">Go</a>
E2h	GPDGMUX2	GPIO D Peripheral Group Mux (GPIO112 to 127)	EALLOW	<a href="#">Go</a>
E8h	GPDCSEL1	GPIO D Core Select Register (GPIO96 to 103)	EALLOW	<a href="#">Go</a>
E Ah	GPDCSEL2	GPIO D Core Select Register (GPIO104 to 111)	EALLOW	<a href="#">Go</a>
E Ch	GPDCSEL3	GPIO D Core Select Register (GPIO112 to 119)	EALLOW	<a href="#">Go</a>
E Eh	GPDCSEL4	GPIO D Core Select Register (GPIO120 to 127)	EALLOW	<a href="#">Go</a>
FCh	GPDLOCK	GPIO D Lock Configuration Register (GPIO96 to 127)	EALLOW	<a href="#">Go</a>
FEh	GPDCR	GPIO D Lock Commit Register (GPIO96 to 127)	EALLOW	<a href="#">Go</a>
100h	GPECTRL	GPIO E Qualification Sampling Period Control (GPIO128 to 159)	EALLOW	<a href="#">Go</a>
102h	GPEQSEL1	GPIO E Qualifier Select 1 Register (GPIO128 to 143)	EALLOW	<a href="#">Go</a>

**Table 6-14. GPIO\_CTRL\_REGS Registers (continued)**

Offset	Acronym	Register Name	Write Protection	Section
104h	GPEQSEL2	GPIO E Qualifier Select 2 Register (GPIO144 to 159)	EALLOW	<a href="#">Go</a>
106h	GPEMUX1	GPIO E Mux 1 Register (GPIO128 to 143)	EALLOW	<a href="#">Go</a>
108h	GPEMUX2	GPIO E Mux 2 Register (GPIO144 to 159)	EALLOW	<a href="#">Go</a>
10Ah	GPEDIR	GPIO E Direction Register (GPIO128 to 159)	EALLOW	<a href="#">Go</a>
10Ch	GPEPUD	GPIO E Pull Up Disable Register (GPIO128 to 159)	EALLOW	<a href="#">Go</a>
110h	GPEINV	GPIO E Input Polarity Invert Registers (GPIO128 to 159)	EALLOW	<a href="#">Go</a>
112h	GPEODR	GPIO E Open Drain Output Register (GPIO128 to GPIO159)	EALLOW	<a href="#">Go</a>
120h	GPEGMUX1	GPIO E Peripheral Group Mux (GPIO128 to 143)	EALLOW	<a href="#">Go</a>
122h	GPEGMUX2	GPIO E Peripheral Group Mux (GPIO144 to 159)	EALLOW	<a href="#">Go</a>
128h	GPECSEL1	GPIO E Core Select Register (GPIO128 to 135)	EALLOW	<a href="#">Go</a>
12Ah	GPECSEL2	GPIO E Core Select Register (GPIO136 to 143)	EALLOW	<a href="#">Go</a>
12Ch	GPECSEL3	GPIO E Core Select Register (GPIO144 to 151)	EALLOW	<a href="#">Go</a>
12Eh	GPECSEL4	GPIO E Core Select Register (GPIO152 to 159)	EALLOW	<a href="#">Go</a>
13Ch	GPELOCK	GPIO E Lock Configuration Register (GPIO128 to 159)	EALLOW	<a href="#">Go</a>
13Eh	GPECR	GPIO E Lock Commit Register (GPIO128 to 159)	EALLOW	<a href="#">Go</a>
140h	GPFCTRL	GPIO F Qualification Sampling Period Control (GPIO160 to 168)	EALLOW	<a href="#">Go</a>
142h	GPFQSEL1	GPIO F Qualifier Select 1 Register (GPIO160 to 168)	EALLOW	<a href="#">Go</a>
146h	GPFMUX1	GPIO F Mux 1 Register (GPIO160 to 168)	EALLOW	<a href="#">Go</a>
14Ah	GPFDIR	GPIO F Direction Register (GPIO160 to 168)	EALLOW	<a href="#">Go</a>
14Ch	GFPUD	GPIO F Pull Up Disable Register (GPIO160 to 168)	EALLOW	<a href="#">Go</a>
150h	GPFINV	GPIO F Input Polarity Invert Registers (GPIO160 to 168)	EALLOW	<a href="#">Go</a>
152h	GPFODR	GPIO F Open Drain Output Register (GPIO160 to GPIO168)	EALLOW	<a href="#">Go</a>
160h	GPFGMUX1	GPIO F Peripheral Group Mux (GPIO160 to 168)	EALLOW	<a href="#">Go</a>
168h	GPFSEL1	GPIO F Core Select Register (GPIO160 to 167)	EALLOW	<a href="#">Go</a>
16Ah	GPFSEL2	GPIO F Core Select Register (GPIO168)	EALLOW	<a href="#">Go</a>
17Ch	GPFLOCK	GPIO F Lock Configuration Register (GPIO160 to 168)	EALLOW	<a href="#">Go</a>
17Eh	GPFRCR	GPIO F Lock Commit Register (GPIO160 to 168)	EALLOW	<a href="#">Go</a>

Complex bit access types are encoded to fit into small table cells. [Table 6-15](#) shows the codes that are used for access types in this section.

**Table 6-15. GPIO\_CTRL\_REGS Access Type Codes**

Access Type	Code	Description
<b>Read Type</b>		
R	R	Read
<b>Write Type</b>		
W	W	Write
WOnce	W	Write
<b>Reset or Default Value</b>		



**Table 6-15. GPIO\_CTRL\_REGS Access Type Codes (continued)**

Access Type	Code	Description
-n		Value after reset or the default value
<b>Register Array Variables</b>		
i,j,k,l,m,n		When these variables are used in a register name, an offset, or an address, they refer to the value of a register array where the register is part of a group of repeating registers. The register groups form a hierarchical structure and the array is represented with a formula.
y		When this variable is used in a register name, an offset, or an address it refers to the value of a register array.

### 6.9.2.1 GPACTRL Register (Offset = 0h) [reset = 0h]

GPACTRL is shown in [Figure 6-4](#) and described in [Table 6-16](#).

Return to [Summary Table](#).

GPIO A Qualification Sampling Period Control (GPIO0 to 31)

**Figure 6-4. GPACTRL Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
QUALPRD3								QUALPRD2								QUALPRD1								QUALPRD0							
R/W-0h								R/W-0h								R/W-0h								R/W-0h							

**Table 6-16. GPACTRL Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-24	QUALPRD3	R/W	0h	Qualification sampling period for GPIO24 to GPIO31: 0x00, QUALPRDx = PLLSYSCLK 0x01, QUALPRDx = PLLSYSCLK/2 0x02, QUALPRDx = PLLSYSCLK/4 .... 0xFF, QUALPRDx = PLLSYSCLK/510 Reset type: SYSRSn
23-16	QUALPRD2	R/W	0h	Qualification sampling period for GPIO16 to GPIO23: 0x00, QUALPRDx = PLLSYSCLK 0x01, QUALPRDx = PLLSYSCLK/2 0x02, QUALPRDx = PLLSYSCLK/4 .... 0xFF, QUALPRDx = PLLSYSCLK/510 Reset type: SYSRSn
15-8	QUALPRD1	R/W	0h	Qualification sampling period for GPIO8 to GPIO15: 0x00, QUALPRDx = PLLSYSCLK 0x01, QUALPRDx = PLLSYSCLK/2 0x02, QUALPRDx = PLLSYSCLK/4 .... 0xFF, QUALPRDx = PLLSYSCLK/510 Reset type: SYSRSn
7-0	QUALPRD0	R/W	0h	Qualification sampling period for GPIO0 to GPIO7: 0x00, QUALPRDx = PLLSYSCLK 0x01, QUALPRDx = PLLSYSCLK/2 0x02, QUALPRDx = PLLSYSCLK/4 .... 0xFF, QUALPRDx = PLLSYSCLK/510 Reset type: SYSRSn

### 6.9.2.2 GPAQSEL1 Register (Offset = 2h) [reset = 0h]

GPAQSEL1 is shown in [Figure 6-5](#) and described in [Table 6-17](#).

Return to [Summary Table](#).

GPIO A Qualifier Select 1 Register (GPIO0 to 15)

Input qualification type:

0,0 Sync

0,1 Qualification (3 samples)

1,0 Qualification (6 samples)

1,1 Async (no Sync or Qualification)

**Figure 6-5. GPAQSEL1 Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
GPIO15		GPIO14		GPIO13		GPIO12		GPIO11		GPIO10		GPIO9		GPIO8	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
GPIO7		GPIO6		GPIO5		GPIO4		GPIO3		GPIO2		GPIO1		GPIO0	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	

**Table 6-17. GPAQSEL1 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-30	GPIO15	R/W	0h	Input qualification type Reset type: SYSRSn
29-28	GPIO14	R/W	0h	Input qualification type Reset type: SYSRSn
27-26	GPIO13	R/W	0h	Input qualification type Reset type: SYSRSn
25-24	GPIO12	R/W	0h	Input qualification type Reset type: SYSRSn
23-22	GPIO11	R/W	0h	Input qualification type Reset type: SYSRSn
21-20	GPIO10	R/W	0h	Input qualification type Reset type: SYSRSn
19-18	GPIO9	R/W	0h	Input qualification type Reset type: SYSRSn
17-16	GPIO8	R/W	0h	Input qualification type Reset type: SYSRSn
15-14	GPIO7	R/W	0h	Input qualification type Reset type: SYSRSn
13-12	GPIO6	R/W	0h	Input qualification type Reset type: SYSRSn
11-10	GPIO5	R/W	0h	Input qualification type Reset type: SYSRSn
9-8	GPIO4	R/W	0h	Input qualification type Reset type: SYSRSn
7-6	GPIO3	R/W	0h	Input qualification type Reset type: SYSRSn
5-4	GPIO2	R/W	0h	Input qualification type Reset type: SYSRSn

**Table 6-17. GPAQSEL1 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
3-2	GPIO1	R/W	0h	Input qualification type Reset type: SYSRSn
1-0	GPIO0	R/W	0h	Input qualification type Reset type: SYSRSn

### 6.9.2.3 GPAQSEL2 Register (Offset = 4h) [reset = 0h]

GPAQSEL2 is shown in [Figure 6-6](#) and described in [Table 6-18](#).

Return to [Summary Table](#).

GPIO A Qualifier Select 2 Register (GPIO16 to 31)

Input qualification type:

0,0 Sync

0,1 Qualification (3 samples)

1,0 Qualification (6 samples)

1,1 Async (no Sync or Qualification)

**Figure 6-6. GPAQSEL2 Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
GPIO31		GPIO30		GPIO29		GPIO28		GPIO27		GPIO26		GPIO25		GPIO24	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
GPIO23		GPIO22		GPIO21		GPIO20		GPIO19		GPIO18		GPIO17		GPIO16	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	

**Table 6-18. GPAQSEL2 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-30	GPIO31	R/W	0h	Input qualification type Reset type: SYSRSn
29-28	GPIO30	R/W	0h	Input qualification type Reset type: SYSRSn
27-26	GPIO29	R/W	0h	Input qualification type Reset type: SYSRSn
25-24	GPIO28	R/W	0h	Input qualification type Reset type: SYSRSn
23-22	GPIO27	R/W	0h	Input qualification type Reset type: SYSRSn
21-20	GPIO26	R/W	0h	Input qualification type Reset type: SYSRSn
19-18	GPIO25	R/W	0h	Input qualification type Reset type: SYSRSn
17-16	GPIO24	R/W	0h	Input qualification type Reset type: SYSRSn
15-14	GPIO23	R/W	0h	Input qualification type Reset type: SYSRSn
13-12	GPIO22	R/W	0h	Input qualification type Reset type: SYSRSn
11-10	GPIO21	R/W	0h	Input qualification type Reset type: SYSRSn
9-8	GPIO20	R/W	0h	Input qualification type Reset type: SYSRSn
7-6	GPIO19	R/W	0h	Input qualification type Reset type: SYSRSn
5-4	GPIO18	R/W	0h	Input qualification type Reset type: SYSRSn

**Table 6-18. GPAQSEL2 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
3-2	GPIO17	R/W	0h	Input qualification type Reset type: SYSRSn
1-0	GPIO16	R/W	0h	Input qualification type Reset type: SYSRSn

### 6.9.2.4 GPAMUX1 Register (Offset = 6h) [reset = 0h]

GPAMUX1 is shown in [Figure 6-7](#) and described in [Table 6-19](#).

Return to [Summary Table](#).

GPIO A Mux 1 Register (GPIO0 to 15)

Defines pin-muxing selection for GPIO.

Notes:

The respective GPyGMUXn.GPIOz must be configured prior to this register to avoid intermediate peripheral selects being mapped to the GPIO.

**Figure 6-7. GPAMUX1 Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
GPIO15		GPIO14		GPIO13		GPIO12		GPIO11		GPIO10		GPIO9		GPIO8	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
GPIO7		GPIO6		GPIO5		GPIO4		GPIO3		GPIO2		GPIO1		GPIO0	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	

**Table 6-19. GPAMUX1 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-30	GPIO15	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
29-28	GPIO14	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
27-26	GPIO13	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
25-24	GPIO12	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
23-22	GPIO11	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
21-20	GPIO10	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
19-18	GPIO9	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
17-16	GPIO8	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
15-14	GPIO7	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
13-12	GPIO6	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
11-10	GPIO5	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
9-8	GPIO4	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
7-6	GPIO3	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
5-4	GPIO2	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
3-2	GPIO1	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn

**Table 6-19. GPAMUX1 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
1-0	GPIO0	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn



### 6.9.2.5 GPAMUX2 Register (Offset = 8h) [reset = 0h]

GPAMUX2 is shown in [Figure 6-8](#) and described in [Table 6-20](#).

Return to [Summary Table](#).

GPIO A Mux 2 Register (GPIO16 to 31)

Defines pin-muxing selection for GPIO.

Notes:

The respective GPyGMUXn.GPIOz must be configured prior to this register to avoid intermediate peripheral selects being mapped to the GPIO.

**Figure 6-8. GPAMUX2 Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
GPIO31		GPIO30		GPIO29		GPIO28		GPIO27		GPIO26		GPIO25		GPIO24	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
GPIO23		GPIO22		GPIO21		GPIO20		GPIO19		GPIO18		GPIO17		GPIO16	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	

**Table 6-20. GPAMUX2 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-30	GPIO31	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
29-28	GPIO30	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
27-26	GPIO29	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
25-24	GPIO28	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
23-22	GPIO27	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
21-20	GPIO26	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
19-18	GPIO25	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
17-16	GPIO24	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
15-14	GPIO23	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
13-12	GPIO22	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
11-10	GPIO21	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
9-8	GPIO20	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
7-6	GPIO19	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
5-4	GPIO18	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
3-2	GPIO17	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn

**Table 6-20. GPAMUX2 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
1-0	GPIO16	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn

### 6.9.2.6 GPADIR Register (Offset = Ah) [reset = 0h]

GPADIR is shown in [Figure 6-9](#) and described in [Table 6-21](#).

Return to [Summary Table](#).

GPIO A Direction Register (GPIO0 to 31)

Controls direction of GPIO pins when the specified pin is configured in GPIO mode.

0: Configures pin as input.

1: Configures pin as output.

Reading the register returns the current value of the register setting.

**Figure 6-9. GPADIR Register**

31	30	29	28	27	26	25	24
GPIO31	GPIO30	GPIO29	GPIO28	GPIO27	GPIO26	GPIO25	GPIO24
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
23	22	21	20	19	18	17	16
GPIO23	GPIO22	GPIO21	GPIO20	GPIO19	GPIO18	GPIO17	GPIO16
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
15	14	13	12	11	10	9	8
GPIO15	GPIO14	GPIO13	GPIO12	GPIO11	GPIO10	GPIO9	GPIO8
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
7	6	5	4	3	2	1	0
GPIO7	GPIO6	GPIO5	GPIO4	GPIO3	GPIO2	GPIO1	GPIO0
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h

**Table 6-21. GPADIR Register Field Descriptions**

Bit	Field	Type	Reset	Description
31	GPIO31	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
30	GPIO30	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
29	GPIO29	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
28	GPIO28	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
27	GPIO27	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
26	GPIO26	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
25	GPIO25	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
24	GPIO24	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
23	GPIO23	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
22	GPIO22	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
21	GPIO21	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
20	GPIO20	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn

**Table 6-21. GPADIR Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
19	GPIO19	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
18	GPIO18	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
17	GPIO17	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
16	GPIO16	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
15	GPIO15	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
14	GPIO14	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
13	GPIO13	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
12	GPIO12	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
11	GPIO11	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
10	GPIO10	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
9	GPIO9	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
8	GPIO8	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
7	GPIO7	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
6	GPIO6	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
5	GPIO5	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
4	GPIO4	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
3	GPIO3	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
2	GPIO2	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
1	GPIO1	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
0	GPIO0	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn

### 6.9.2.7 GPAPUD Register (Offset = Ch) [reset = FFFFFFFh]

GPAPUD is shown in [Figure 6-10](#) and described in [Table 6-22](#).

Return to [Summary Table](#).

GPIO A Pull Up Disable Register (GPIO0 to 31)

Disables the Pull-Up on GPIO.

0: Enables the Pull-Up.

1: Disables the Pull-Up.

Reading the register returns the current value of the register setting.

**Figure 6-10. GPAPUD Register**

31		30		29		28		27		26		25		24	
GPIO31	GPIO30	GPIO29	GPIO28	GPIO27	GPIO26	GPIO25	GPIO24	GPIO23	GPIO22	GPIO21	GPIO20	GPIO19	GPIO18	GPIO17	GPIO16
R/W-1h	R/W-1h	R/W-1h	R/W-1h	R/W-1h	R/W-1h	R/W-1h	R/W-1h	R/W-1h	R/W-1h	R/W-1h	R/W-1h	R/W-1h	R/W-1h	R/W-1h	R/W-1h
23		22		21		20		19		18		17		16	
GPIO23	GPIO22	GPIO21	GPIO20	GPIO19	GPIO18	GPIO17	GPIO16	GPIO15	GPIO14	GPIO13	GPIO12	GPIO11	GPIO10	GPIO9	GPIO8
R/W-1h	R/W-1h	R/W-1h	R/W-1h	R/W-1h	R/W-1h	R/W-1h	R/W-1h	R/W-1h	R/W-1h	R/W-1h	R/W-1h	R/W-1h	R/W-1h	R/W-1h	R/W-1h
15		14		13		12		11		10		9		8	
GPIO15	GPIO14	GPIO13	GPIO12	GPIO11	GPIO10	GPIO9	GPIO8	GPIO7	GPIO6	GPIO5	GPIO4	GPIO3	GPIO2	GPIO1	GPIO0
R/W-1h	R/W-1h	R/W-1h	R/W-1h	R/W-1h	R/W-1h	R/W-1h	R/W-1h	R/W-1h	R/W-1h	R/W-1h	R/W-1h	R/W-1h	R/W-1h	R/W-1h	R/W-1h
7		6		5		4		3		2		1		0	
GPIO7	GPIO6	GPIO5	GPIO4	GPIO3	GPIO2	GPIO1	GPIO0	GPIO7	GPIO6	GPIO5	GPIO4	GPIO3	GPIO2	GPIO1	GPIO0
R/W-1h	R/W-1h	R/W-1h	R/W-1h	R/W-1h	R/W-1h	R/W-1h	R/W-1h	R/W-1h	R/W-1h	R/W-1h	R/W-1h	R/W-1h	R/W-1h	R/W-1h	R/W-1h

**Table 6-22. GPAPUD Register Field Descriptions**

Bit	Field	Type	Reset	Description
31	GPIO31	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
30	GPIO30	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
29	GPIO29	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
28	GPIO28	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
27	GPIO27	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
26	GPIO26	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
25	GPIO25	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
24	GPIO24	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
23	GPIO23	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
22	GPIO22	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
21	GPIO21	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
20	GPIO20	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn

**Table 6-22. GPAPUD Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
19	GPIO19	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
18	GPIO18	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
17	GPIO17	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
16	GPIO16	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
15	GPIO15	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
14	GPIO14	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
13	GPIO13	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
12	GPIO12	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
11	GPIO11	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
10	GPIO10	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
9	GPIO9	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
8	GPIO8	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
7	GPIO7	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
6	GPIO6	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
5	GPIO5	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
4	GPIO4	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
3	GPIO3	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
2	GPIO2	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
1	GPIO1	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
0	GPIO0	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn

### 6.9.2.8 GPAINV Register (Offset = 10h) [reset = 0h]

GPAINV is shown in [Figure 6-11](#) and described in [Table 6-23](#).

Return to [Summary Table](#).

GPIO A Input Polarity Invert Registers (GPIO0 to 31)

Selects between non-inverted and inverted GPIO input to the device.

0: selects non-inverted GPIO input

1: selects inverted GPIO input

Reading the register returns the current value of the register setting.

**Figure 6-11. GPAINV Register**

31		30		29		28		27		26		25		24	
GPIO31	GPIO30	GPIO29	GPIO28	GPIO27	GPIO26	GPIO25	GPIO24	GPIO23	GPIO22	GPIO21	GPIO20	GPIO19	GPIO18	GPIO17	GPIO16
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
23		22		21		20		19		18		17		16	
GPIO23	GPIO22	GPIO21	GPIO20	GPIO19	GPIO18	GPIO17	GPIO16	GPIO15	GPIO14	GPIO13	GPIO12	GPIO11	GPIO10	GPIO9	GPIO8
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
15		14		13		12		11		10		9		8	
GPIO15	GPIO14	GPIO13	GPIO12	GPIO11	GPIO10	GPIO9	GPIO8	GPIO7	GPIO6	GPIO5	GPIO4	GPIO3	GPIO2	GPIO1	GPIO0
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
7		6		5		4		3		2		1		0	
GPIO7	GPIO6	GPIO5	GPIO4	GPIO3	GPIO2	GPIO1	GPIO0	GPIO7	GPIO6	GPIO5	GPIO4	GPIO3	GPIO2	GPIO1	GPIO0
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h

**Table 6-23. GPAINV Register Field Descriptions**

Bit	Field	Type	Reset	Description
31	GPIO31	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
30	GPIO30	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
29	GPIO29	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
28	GPIO28	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
27	GPIO27	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
26	GPIO26	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
25	GPIO25	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
24	GPIO24	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
23	GPIO23	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
22	GPIO22	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
21	GPIO21	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
20	GPIO20	R/W	0h	Input inversion control for this pin Reset type: SYSRSn

**Table 6-23. GPAINV Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
19	GPIO19	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
18	GPIO18	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
17	GPIO17	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
16	GPIO16	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
15	GPIO15	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
14	GPIO14	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
13	GPIO13	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
12	GPIO12	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
11	GPIO11	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
10	GPIO10	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
9	GPIO9	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
8	GPIO8	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
7	GPIO7	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
6	GPIO6	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
5	GPIO5	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
4	GPIO4	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
3	GPIO3	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
2	GPIO2	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
1	GPIO1	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
0	GPIO0	R/W	0h	Input inversion control for this pin Reset type: SYSRSn



### 6.9.2.9 GPAODR Register (Offset = 12h) [reset = 0h]

GPAODR is shown in [Figure 6-12](#) and described in [Table 6-24](#).

Return to [Summary Table](#).

GPIO A Open Drain Output Register (GPIO0 to GPIO31)

Selects between normal and open-drain output for the GPIO pin.

0: Normal Output

1: Open Drain Output

Reading the register returns the current value of the register setting.

Note:

[1] In the Open Drain output mode, if the buffer is configured for output mode, a 0 value to be driven out comes out on the on the PAD while a 1 value to be driven out tri-states the buffer.

**Figure 6-12. GPAODR Register**

31	30	29	28	27	26	25	24
GPIO31	GPIO30	GPIO29	GPIO28	GPIO27	GPIO26	GPIO25	GPIO24
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
23	22	21	20	19	18	17	16
GPIO23	GPIO22	GPIO21	GPIO20	GPIO19	GPIO18	GPIO17	GPIO16
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
15	14	13	12	11	10	9	8
GPIO15	GPIO14	GPIO13	GPIO12	GPIO11	GPIO10	GPIO9	GPIO8
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
7	6	5	4	3	2	1	0
GPIO7	GPIO6	GPIO5	GPIO4	GPIO3	GPIO2	GPIO1	GPIO0
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h

**Table 6-24. GPAODR Register Field Descriptions**

Bit	Field	Type	Reset	Description
31	GPIO31	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
30	GPIO30	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
29	GPIO29	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
28	GPIO28	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
27	GPIO27	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
26	GPIO26	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
25	GPIO25	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
24	GPIO24	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
23	GPIO23	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
22	GPIO22	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn

**Table 6-24. GPAODR Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
21	GPIO21	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
20	GPIO20	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
19	GPIO19	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
18	GPIO18	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
17	GPIO17	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
16	GPIO16	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
15	GPIO15	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
14	GPIO14	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
13	GPIO13	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
12	GPIO12	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
11	GPIO11	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
10	GPIO10	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
9	GPIO9	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
8	GPIO8	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
7	GPIO7	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
6	GPIO6	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
5	GPIO5	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
4	GPIO4	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
3	GPIO3	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
2	GPIO2	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
1	GPIO1	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
0	GPIO0	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn

### 6.9.2.10 GPAGMUX1 Register (Offset = 20h) [reset = 0h]

GPAGMUX1 is shown in [Figure 6-13](#) and described in [Table 6-25](#).

Return to [Summary Table](#).

GPIO A Peripheral Group Mux (GPIO0 to 15)

Defines pin-muxing selection for GPIO.

Note: For complete pin-mux selection on GPIOx, GPAMUXy.GPIOx configuration is also required.

**Figure 6-13. GPAGMUX1 Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
GPIO15		GPIO14		GPIO13		GPIO12		GPIO11		GPIO10		GPIO9		GPIO8	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
GPIO7		GPIO6		GPIO5		GPIO4		GPIO3		GPIO2		GPIO1		GPIO0	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	

**Table 6-25. GPAGMUX1 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-30	GPIO15	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
29-28	GPIO14	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
27-26	GPIO13	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
25-24	GPIO12	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
23-22	GPIO11	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
21-20	GPIO10	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
19-18	GPIO9	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
17-16	GPIO8	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
15-14	GPIO7	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
13-12	GPIO6	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
11-10	GPIO5	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
9-8	GPIO4	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
7-6	GPIO3	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
5-4	GPIO2	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
3-2	GPIO1	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
1-0	GPIO0	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn

### 6.9.2.11 GPAGMUX2 Register (Offset = 22h) [reset = 0h]

GPAGMUX2 is shown in [Figure 6-14](#) and described in [Table 6-26](#).

Return to [Summary Table](#).

GPIO A Peripheral Group Mux (GPIO16 to 31)

Defines pin-muxing selection for GPIO.

Note: For complete pin-mux selection on GPIOx, GPAMUXy.GPIOx configuration is also required.

**Figure 6-14. GPAGMUX2 Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
GPIO31		GPIO30		GPIO29		GPIO28		GPIO27		GPIO26		GPIO25		GPIO24	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
GPIO23		GPIO22		GPIO21		GPIO20		GPIO19		GPIO18		GPIO17		GPIO16	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	

**Table 6-26. GPAGMUX2 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-30	GPIO31	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
29-28	GPIO30	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
27-26	GPIO29	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
25-24	GPIO28	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
23-22	GPIO27	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
21-20	GPIO26	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
19-18	GPIO25	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
17-16	GPIO24	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
15-14	GPIO23	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
13-12	GPIO22	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
11-10	GPIO21	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
9-8	GPIO20	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
7-6	GPIO19	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
5-4	GPIO18	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
3-2	GPIO17	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
1-0	GPIO16	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn

### 6.9.2.12 GPACSEL1 Register (Offset = 28h) [reset = 0h]

GPACSEL1 is shown in [Figure 6-15](#) and described in [Table 6-27](#).

Return to [Summary Table](#).

GPIO A Core Select Register (GPIO0 to 7)

Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin

xx00: CPU1 selected

xx01: CPU1.CLA1 selected

xx1x: Reserved

**Figure 6-15. GPACSEL1 Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
GPIO7				GPIO6				GPIO5				GPIO4			
R/W-0h				R/W-0h				R/W-0h				R/W-0h			
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
GPIO3				GPIO2				GPIO1				GPIO0			
R/W-0h				R/W-0h				R/W-0h				R/W-0h			

**Table 6-27. GPACSEL1 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-28	GPIO7	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
27-24	GPIO6	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
23-20	GPIO5	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
19-16	GPIO4	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
15-12	GPIO3	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
11-8	GPIO2	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
7-4	GPIO1	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
3-0	GPIO0	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn

### 6.9.2.13 GPACSEL2 Register (Offset = 2Ah) [reset = 0h]

GPACSEL2 is shown in [Figure 6-16](#) and described in [Table 6-28](#).

Return to [Summary Table](#).

GPIO A Core Select Register (GPIO8 to 15)

Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin

xx00: CPU1 selected

xx01: CPU1.CLA1 selected

xx1x: Reserved

**Figure 6-16. GPACSEL2 Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
GPIO15				GPIO14				GPIO13				GPIO12			
R/W-0h				R/W-0h				R/W-0h				R/W-0h			
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
GPIO11				GPIO10				GPIO9				GPIO8			
R/W-0h				R/W-0h				R/W-0h				R/W-0h			

**Table 6-28. GPACSEL2 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-28	GPIO15	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
27-24	GPIO14	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
23-20	GPIO13	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
19-16	GPIO12	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
15-12	GPIO11	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
11-8	GPIO10	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
7-4	GPIO9	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
3-0	GPIO8	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn

### 6.9.2.14 GPACSEL3 Register (Offset = 2Ch) [reset = 0h]

GPACSEL3 is shown in [Figure 6-17](#) and described in [Table 6-29](#).

Return to [Summary Table](#).

GPIO A Core Select Register (GPIO16 to 23)

Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin

xx00: CPU1 selected

xx01: CPU1.CLA1 selected

xx1x: Reserved

**Figure 6-17. GPACSEL3 Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
GPIO23				GPIO22				GPIO21				GPIO20			
R/W-0h				R/W-0h				R/W-0h				R/W-0h			
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
GPIO19				GPIO18				GPIO17				GPIO16			
R/W-0h				R/W-0h				R/W-0h				R/W-0h			

**Table 6-29. GPACSEL3 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-28	GPIO23	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
27-24	GPIO22	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
23-20	GPIO21	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
19-16	GPIO20	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
15-12	GPIO19	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
11-8	GPIO18	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
7-4	GPIO17	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
3-0	GPIO16	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn

### 6.9.2.15 GPACSEL4 Register (Offset = 2Eh) [reset = 0h]

GPACSEL4 is shown in [Figure 6-18](#) and described in [Table 6-30](#).

Return to [Summary Table](#).

GPIO A Core Select Register (GPIO24 to 31)

Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin

xx00: CPU1 selected

xx01: CPU1.CLA1 selected

xx1x: Reserved

**Figure 6-18. GPACSEL4 Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
GPIO31				GPIO30				GPIO29				GPIO28			
R/W-0h				R/W-0h				R/W-0h				R/W-0h			
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
GPIO27				GPIO26				GPIO25				GPIO24			
R/W-0h				R/W-0h				R/W-0h				R/W-0h			

**Table 6-30. GPACSEL4 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-28	GPIO31	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
27-24	GPIO30	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
23-20	GPIO29	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
19-16	GPIO28	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
15-12	GPIO27	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
11-8	GPIO26	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
7-4	GPIO25	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
3-0	GPIO24	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn



### 6.9.2.16 GPALOCK Register (Offset = 3Ch) [reset = 0h]

GPALOCK is shown in [Figure 6-19](#) and described in [Table 6-31](#).

Return to [Summary Table](#).

GPIO A Lock Configuration Register (GPIO0 to 31)

GPIO Configuration Lock for GPIO.

0: Bits in GPyMUX1, GPyMUX2, GPyDIR, GPyINV, GPyODR, GPyAMSEL, GPyGMUX1, GPyGMUX2 and GPyCSELx register which control the same pin can be changed

1: Locks changes to the bits in GPyMUX1, GPyMUX2, GPyDIR, GPyINV, GPyODR, GPyAMSEL, GPyGMUX1, GPyGMUX2 and GPyCSELx registers which control the same pin

**Figure 6-19. GPALOCK Register**

31	30	29	28	27	26	25	24
GPIO31	GPIO30	GPIO29	GPIO28	GPIO27	GPIO26	GPIO25	GPIO24
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
23	22	21	20	19	18	17	16
GPIO23	GPIO22	GPIO21	GPIO20	GPIO19	GPIO18	GPIO17	GPIO16
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
15	14	13	12	11	10	9	8
GPIO15	GPIO14	GPIO13	GPIO12	GPIO11	GPIO10	GPIO9	GPIO8
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
7	6	5	4	3	2	1	0
GPIO7	GPIO6	GPIO5	GPIO4	GPIO3	GPIO2	GPIO1	GPIO0
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h

**Table 6-31. GPALOCK Register Field Descriptions**

Bit	Field	Type	Reset	Description
31	GPIO31	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
30	GPIO30	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
29	GPIO29	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
28	GPIO28	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
27	GPIO27	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
26	GPIO26	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
25	GPIO25	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
24	GPIO24	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
23	GPIO23	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
22	GPIO22	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
21	GPIO21	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn

**Table 6-31. GPALOCK Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
20	GPIO20	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
19	GPIO19	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
18	GPIO18	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
17	GPIO17	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
16	GPIO16	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
15	GPIO15	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
14	GPIO14	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
13	GPIO13	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
12	GPIO12	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
11	GPIO11	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
10	GPIO10	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
9	GPIO9	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
8	GPIO8	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
7	GPIO7	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
6	GPIO6	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
5	GPIO5	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
4	GPIO4	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
3	GPIO3	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
2	GPIO2	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
1	GPIO1	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
0	GPIO0	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn

### 6.9.2.17 GPACR Register (Offset = 3Eh) [reset = 0h]

GPACR is shown in [Figure 6-20](#) and described in [Table 6-32](#).

Return to [Summary Table](#).

GPIO A Lock Commit Register (GPIO0 to 31)

GPIO Configuration Lock Commit for GPIO:

- 1: Locks changes to the bit in GPyLOCK register which controls the same pin
- 0: Bit in the GPyLOCK register which controls the same pin can be changed

**Figure 6-20. GPACR Register**

31		30		29		28		27		26		25		24	
GPIO31		GPIO30		GPIO29		GPIO28		GPIO27		GPIO26		GPIO25		GPIO24	
R/WOnce-0h		R/WOnce-0h		R/WOnce-0h		R/WOnce-0h		R/WOnce-0h		R/WOnce-0h		R/WOnce-0h		R/WOnce-0h	
23		22		21		20		19		18		17		16	
GPIO23		GPIO22		GPIO21		GPIO20		GPIO19		GPIO18		GPIO17		GPIO16	
R/WOnce-0h		R/WOnce-0h		R/WOnce-0h		R/WOnce-0h		R/WOnce-0h		R/WOnce-0h		R/WOnce-0h		R/WOnce-0h	
15		14		13		12		11		10		9		8	
GPIO15		GPIO14		GPIO13		GPIO12		GPIO11		GPIO10		GPIO9		GPIO8	
R/WOnce-0h		R/WOnce-0h		R/WOnce-0h		R/WOnce-0h		R/WOnce-0h		R/WOnce-0h		R/WOnce-0h		R/WOnce-0h	
7		6		5		4		3		2		1		0	
GPIO7		GPIO6		GPIO5		GPIO4		GPIO3		GPIO2		GPIO1		GPIO0	
R/WOnce-0h		R/WOnce-0h		R/WOnce-0h		R/WOnce-0h		R/WOnce-0h		R/WOnce-0h		R/WOnce-0h		R/WOnce-0h	

**Table 6-32. GPACR Register Field Descriptions**

Bit	Field	Type	Reset	Description
31	GPIO31	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
30	GPIO30	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
29	GPIO29	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
28	GPIO28	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
27	GPIO27	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
26	GPIO26	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
25	GPIO25	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
24	GPIO24	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
23	GPIO23	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
22	GPIO22	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
21	GPIO21	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
20	GPIO20	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn

**Table 6-32. GPACR Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
19	GPIO19	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
18	GPIO18	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
17	GPIO17	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
16	GPIO16	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
15	GPIO15	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
14	GPIO14	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
13	GPIO13	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
12	GPIO12	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
11	GPIO11	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
10	GPIO10	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
9	GPIO9	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
8	GPIO8	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
7	GPIO7	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
6	GPIO6	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
5	GPIO5	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
4	GPIO4	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
3	GPIO3	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
2	GPIO2	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
1	GPIO1	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
0	GPIO0	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn

### 6.9.2.18 GPBCTRL Register (Offset = 40h) [reset = 0h]

GPBCTRL is shown in [Figure 6-21](#) and described in [Table 6-33](#).

Return to [Summary Table](#).

GPIO B Qualification Sampling Period Control (GPIO32 to 63)

**Figure 6-21. GPBCTRL Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
QUALPRD3								QUALPRD2								QUALPRD1								QUALPRD0							
R/W-0h								R/W-0h								R/W-0h								R/W-0h							

**Table 6-33. GPBCTRL Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-24	QUALPRD3	R/W	0h	Qualification sampling period for GPIO56 to GPIO63: 0x00, QUALPRDx = PLLSYSCLK 0x01, QUALPRDx = PLLSYSCLK/2 0x02, QUALPRDx = PLLSYSCLK/4 .... 0xFF, QUALPRDx = PLLSYSCLK/510 Reset type: SYSRSn
23-16	QUALPRD2	R/W	0h	Qualification sampling period for GPIO48 to GPIO55: 0x00, QUALPRDx = PLLSYSCLK 0x01, QUALPRDx = PLLSYSCLK/2 0x02, QUALPRDx = PLLSYSCLK/4 .... 0xFF, QUALPRDx = PLLSYSCLK/510 Reset type: SYSRSn
15-8	QUALPRD1	R/W	0h	Qualification sampling period for GPIO40 to GPIO47: 0x00, QUALPRDx = PLLSYSCLK 0x01, QUALPRDx = PLLSYSCLK/2 0x02, QUALPRDx = PLLSYSCLK/4 .... 0xFF, QUALPRDx = PLLSYSCLK/510 Reset type: SYSRSn
7-0	QUALPRD0	R/W	0h	Qualification sampling period for GPIO32 to GPIO39: 0x00, QUALPRDx = PLLSYSCLK 0x01, QUALPRDx = PLLSYSCLK/2 0x02, QUALPRDx = PLLSYSCLK/4 .... 0xFF, QUALPRDx = PLLSYSCLK/510 Reset type: SYSRSn

### 6.9.2.19 GPBQSEL1 Register (Offset = 42h) [reset = 0h]

GPBQSEL1 is shown in [Figure 6-22](#) and described in [Table 6-34](#).

Return to [Summary Table](#).

GPIO B Qualifier Select 1 Register (GPIO32 to 47)

Input qualification type:

0,0 Sync

0,1 Qualification (3 samples)

1,0 Qualification (6 samples)

1,1 Async (no Sync or Qualification)

**Figure 6-22. GPBQSEL1 Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
GPIO47		GPIO46		GPIO45		GPIO44		GPIO43		GPIO42		GPIO41		GPIO40	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
GPIO39		GPIO38		GPIO37		GPIO36		GPIO35		GPIO34		GPIO33		GPIO32	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	

**Table 6-34. GPBQSEL1 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-30	GPIO47	R/W	0h	Input qualification type Reset type: SYSRSn
29-28	GPIO46	R/W	0h	Input qualification type Reset type: SYSRSn
27-26	GPIO45	R/W	0h	Input qualification type Reset type: SYSRSn
25-24	GPIO44	R/W	0h	Input qualification type Reset type: SYSRSn
23-22	GPIO43	R/W	0h	Input qualification type Reset type: SYSRSn
21-20	GPIO42	R/W	0h	Input qualification type Reset type: SYSRSn
19-18	GPIO41	R/W	0h	Input qualification type Reset type: SYSRSn
17-16	GPIO40	R/W	0h	Input qualification type Reset type: SYSRSn
15-14	GPIO39	R/W	0h	Input qualification type Reset type: SYSRSn
13-12	GPIO38	R/W	0h	Input qualification type Reset type: SYSRSn
11-10	GPIO37	R/W	0h	Input qualification type Reset type: SYSRSn
9-8	GPIO36	R/W	0h	Input qualification type Reset type: SYSRSn
7-6	GPIO35	R/W	0h	Input qualification type Reset type: SYSRSn
5-4	GPIO34	R/W	0h	Input qualification type Reset type: SYSRSn

**Table 6-34. GPBQSEL1 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
3-2	GPIO33	R/W	0h	Input qualification type Reset type: SYSRSn
1-0	GPIO32	R/W	0h	Input qualification type Reset type: SYSRSn

### 6.9.2.20 GPBQSEL2 Register (Offset = 44h) [reset = 0h]

GPBQSEL2 is shown in [Figure 6-23](#) and described in [Table 6-35](#).

Return to [Summary Table](#).

GPIO B Qualifier Select 2 Register (GPIO48 to 63)

Input qualification type:

0,0 Sync

0,1 Qualification (3 samples)

1,0 Qualification (6 samples)

1,1 Async (no Sync or Qualification)

**Figure 6-23. GPBQSEL2 Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
GPIO63		GPIO62		GPIO61		GPIO60		GPIO59		GPIO58		GPIO57		GPIO56	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
GPIO55		GPIO54		GPIO53		GPIO52		GPIO51		GPIO50		GPIO49		GPIO48	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	

**Table 6-35. GPBQSEL2 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-30	GPIO63	R/W	0h	Input qualification type Reset type: SYSRSn
29-28	GPIO62	R/W	0h	Input qualification type Reset type: SYSRSn
27-26	GPIO61	R/W	0h	Input qualification type Reset type: SYSRSn
25-24	GPIO60	R/W	0h	Input qualification type Reset type: SYSRSn
23-22	GPIO59	R/W	0h	Input qualification type Reset type: SYSRSn
21-20	GPIO58	R/W	0h	Input qualification type Reset type: SYSRSn
19-18	GPIO57	R/W	0h	Input qualification type Reset type: SYSRSn
17-16	GPIO56	R/W	0h	Input qualification type Reset type: SYSRSn
15-14	GPIO55	R/W	0h	Input qualification type Reset type: SYSRSn
13-12	GPIO54	R/W	0h	Input qualification type Reset type: SYSRSn
11-10	GPIO53	R/W	0h	Input qualification type Reset type: SYSRSn
9-8	GPIO52	R/W	0h	Input qualification type Reset type: SYSRSn
7-6	GPIO51	R/W	0h	Input qualification type Reset type: SYSRSn
5-4	GPIO50	R/W	0h	Input qualification type Reset type: SYSRSn



**Table 6-35. GPBQSEL2 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
3-2	GPIO49	R/W	0h	Input qualification type Reset type: SYSRSn
1-0	GPIO48	R/W	0h	Input qualification type Reset type: SYSRSn

### 6.9.2.21 GPBMUX1 Register (Offset = 46h) [reset = 0h]

GPBMUX1 is shown in [Figure 6-24](#) and described in [Table 6-36](#).

Return to [Summary Table](#).

GPIO B Mux 1 Register (GPIO32 to 47)

Defines pin-muxing selection for GPIO.

Notes:

The respective GPyGMUXn.GPIOz must be configured prior to this register to avoid intermediate peripheral selects being mapped to the GPIO.

**Figure 6-24. GPBMUX1 Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
GPIO47		GPIO46		GPIO45		GPIO44		GPIO43		GPIO42		GPIO41		GPIO40	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
GPIO39		GPIO38		GPIO37		GPIO36		GPIO35		GPIO34		GPIO33		GPIO32	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	

**Table 6-36. GPBMUX1 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-30	GPIO47	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
29-28	GPIO46	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
27-26	GPIO45	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
25-24	GPIO44	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
23-22	GPIO43	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
21-20	GPIO42	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
19-18	GPIO41	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
17-16	GPIO40	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
15-14	GPIO39	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
13-12	GPIO38	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
11-10	GPIO37	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
9-8	GPIO36	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
7-6	GPIO35	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
5-4	GPIO34	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
3-2	GPIO33	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn

**Table 6-36. GPBMUX1 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
1-0	GPIO32	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn

### 6.9.2.22 GPBMUX2 Register (Offset = 48h) [reset = 0h]

GPBMUX2 is shown in [Figure 6-25](#) and described in [Table 6-37](#).

Return to [Summary Table](#).

GPIO B Mux 2 Register (GPIO48 to 63)

Defines pin-muxing selection for GPIO.

Notes:

The respective GPyGMUXn.GPIOz must be configured prior to this register to avoid intermediate peripheral selects being mapped to the GPIO.

**Figure 6-25. GPBMUX2 Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
GPIO63		GPIO62		GPIO61		GPIO60		GPIO59		GPIO58		GPIO57		GPIO56	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
GPIO55		GPIO54		GPIO53		GPIO52		GPIO51		GPIO50		GPIO49		GPIO48	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	

**Table 6-37. GPBMUX2 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-30	GPIO63	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
29-28	GPIO62	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
27-26	GPIO61	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
25-24	GPIO60	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
23-22	GPIO59	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
21-20	GPIO58	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
19-18	GPIO57	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
17-16	GPIO56	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
15-14	GPIO55	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
13-12	GPIO54	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
11-10	GPIO53	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
9-8	GPIO52	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
7-6	GPIO51	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
5-4	GPIO50	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
3-2	GPIO49	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn

**Table 6-37. GPBMUX2 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
1-0	GPIO48	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn

### 6.9.2.23 GPBDIR Register (Offset = 4Ah) [reset = 0h]

GPBDIR is shown in [Figure 6-26](#) and described in [Table 6-38](#).

Return to [Summary Table](#).

GPIO B Direction Register (GPIO32 to 63)

Controls direction of GPIO pins when the specified pin is configured in GPIO mode.

0: Configures pin as input.

1: Configures pin as output.

Reading the register returns the current value of the register setting.

**Figure 6-26. GPBDIR Register**

31	30	29	28	27	26	25	24
GPIO63	GPIO62	GPIO61	GPIO60	GPIO59	GPIO58	GPIO57	GPIO56
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
23	22	21	20	19	18	17	16
GPIO55	GPIO54	GPIO53	GPIO52	GPIO51	GPIO50	GPIO49	GPIO48
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
15	14	13	12	11	10	9	8
GPIO47	GPIO46	GPIO45	GPIO44	GPIO43	GPIO42	GPIO41	GPIO40
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
7	6	5	4	3	2	1	0
GPIO39	GPIO38	GPIO37	GPIO36	GPIO35	GPIO34	GPIO33	GPIO32
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h

**Table 6-38. GPBDIR Register Field Descriptions**

Bit	Field	Type	Reset	Description
31	GPIO63	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
30	GPIO62	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
29	GPIO61	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
28	GPIO60	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
27	GPIO59	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
26	GPIO58	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
25	GPIO57	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
24	GPIO56	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
23	GPIO55	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
22	GPIO54	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
21	GPIO53	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
20	GPIO52	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn

**Table 6-38. GPBDir Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
19	GPIO51	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
18	GPIO50	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
17	GPIO49	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
16	GPIO48	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
15	GPIO47	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
14	GPIO46	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
13	GPIO45	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
12	GPIO44	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
11	GPIO43	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
10	GPIO42	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
9	GPIO41	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
8	GPIO40	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
7	GPIO39	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
6	GPIO38	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
5	GPIO37	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
4	GPIO36	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
3	GPIO35	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
2	GPIO34	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
1	GPIO33	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
0	GPIO32	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn

### 6.9.2.24 GPBPUD Register (Offset = 4Ch) [reset = FFFFFFFFh]

GPBPUD is shown in [Figure 6-27](#) and described in [Table 6-39](#).

Return to [Summary Table](#).

GPIO B Pull Up Disable Register (GPIO32 to 63)

Disables the Pull-Up on GPIO.

0: Enables the Pull-Up.

1: Disables the Pull-Up.

Reading the register returns the current value of the register setting.

**Figure 6-27. GPBPUD Register**

31	30	29	28	27	26	25	24
GPIO63	GPIO62	GPIO61	GPIO60	GPIO59	GPIO58	GPIO57	GPIO56
R/W-1h	R/W-1h	R/W-1h	R/W-1h	R/W-1h	R/W-1h	R/W-1h	R/W-1h
23	22	21	20	19	18	17	16
GPIO55	GPIO54	GPIO53	GPIO52	GPIO51	GPIO50	GPIO49	GPIO48
R/W-1h	R/W-1h	R/W-1h	R/W-1h	R/W-1h	R/W-1h	R/W-1h	R/W-1h
15	14	13	12	11	10	9	8
GPIO47	GPIO46	GPIO45	GPIO44	GPIO43	GPIO42	GPIO41	GPIO40
R/W-1h	R/W-1h	R/W-1h	R/W-1h	R/W-1h	R/W-1h	R/W-1h	R/W-1h
7	6	5	4	3	2	1	0
GPIO39	GPIO38	GPIO37	GPIO36	GPIO35	GPIO34	GPIO33	GPIO32
R/W-1h	R/W-1h	R/W-1h	R/W-1h	R/W-1h	R/W-1h	R/W-1h	R/W-1h

**Table 6-39. GPBPUD Register Field Descriptions**

Bit	Field	Type	Reset	Description
31	GPIO63	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
30	GPIO62	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
29	GPIO61	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
28	GPIO60	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
27	GPIO59	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
26	GPIO58	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
25	GPIO57	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
24	GPIO56	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
23	GPIO55	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
22	GPIO54	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
21	GPIO53	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
20	GPIO52	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn



**Table 6-39. GPBPUD Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
19	GPIO51	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
18	GPIO50	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
17	GPIO49	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
16	GPIO48	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
15	GPIO47	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
14	GPIO46	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
13	GPIO45	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
12	GPIO44	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
11	GPIO43	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
10	GPIO42	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
9	GPIO41	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
8	GPIO40	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
7	GPIO39	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
6	GPIO38	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
5	GPIO37	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
4	GPIO36	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
3	GPIO35	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
2	GPIO34	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
1	GPIO33	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
0	GPIO32	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn

### 6.9.2.25 GPBINV Register (Offset = 50h) [reset = 0h]

GPBINV is shown in [Figure 6-28](#) and described in [Table 6-40](#).

Return to [Summary Table](#).

GPIO B Input Polarity Invert Registers (GPIO32 to 63)

Selects between non-inverted and inverted GPIO input to the device.

0: selects non-inverted GPIO input

1: selects inverted GPIO input

Reading the register returns the current value of the register setting.

**Figure 6-28. GPBINV Register**

31	30	29	28	27	26	25	24
GPIO63	GPIO62	GPIO61	GPIO60	GPIO59	GPIO58	GPIO57	GPIO56
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
23	22	21	20	19	18	17	16
GPIO55	GPIO54	GPIO53	GPIO52	GPIO51	GPIO50	GPIO49	GPIO48
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
15	14	13	12	11	10	9	8
GPIO47	GPIO46	GPIO45	GPIO44	GPIO43	GPIO42	GPIO41	GPIO40
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
7	6	5	4	3	2	1	0
GPIO39	GPIO38	GPIO37	GPIO36	GPIO35	GPIO34	GPIO33	GPIO32
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h

**Table 6-40. GPBINV Register Field Descriptions**

Bit	Field	Type	Reset	Description
31	GPIO63	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
30	GPIO62	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
29	GPIO61	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
28	GPIO60	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
27	GPIO59	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
26	GPIO58	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
25	GPIO57	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
24	GPIO56	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
23	GPIO55	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
22	GPIO54	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
21	GPIO53	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
20	GPIO52	R/W	0h	Input inversion control for this pin Reset type: SYSRSn

**Table 6-40. GPBINV Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
19	GPIO51	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
18	GPIO50	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
17	GPIO49	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
16	GPIO48	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
15	GPIO47	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
14	GPIO46	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
13	GPIO45	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
12	GPIO44	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
11	GPIO43	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
10	GPIO42	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
9	GPIO41	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
8	GPIO40	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
7	GPIO39	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
6	GPIO38	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
5	GPIO37	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
4	GPIO36	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
3	GPIO35	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
2	GPIO34	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
1	GPIO33	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
0	GPIO32	R/W	0h	Input inversion control for this pin Reset type: SYSRSn

### 6.9.2.26 GPBODR Register (Offset = 52h) [reset = 0h]

GPBODR is shown in [Figure 6-29](#) and described in [Table 6-41](#).

Return to [Summary Table](#).

GPIO B Open Drain Output Register (GPIO32 to GPIO63)

Selects between normal and open-drain output for the GPIO pin.

0: Normal Output

1: Open Drain Output

Reading the register returns the current value of the register setting.

Note:

[1] In the Open Drain output mode, if the buffer is configured for output mode, a 0 value to be driven out comes out on the on the PAD while a 1 value to be driven out tri-states the buffer.

**Figure 6-29. GPBODR Register**

31	30	29	28	27	26	25	24
GPIO63	GPIO62	GPIO61	GPIO60	GPIO59	GPIO58	GPIO57	GPIO56
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
23	22	21	20	19	18	17	16
GPIO55	GPIO54	GPIO53	GPIO52	GPIO51	GPIO50	GPIO49	GPIO48
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
15	14	13	12	11	10	9	8
GPIO47	GPIO46	GPIO45	GPIO44	GPIO43	GPIO42	GPIO41	GPIO40
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
7	6	5	4	3	2	1	0
GPIO39	GPIO38	GPIO37	GPIO36	GPIO35	GPIO34	GPIO33	GPIO32
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h

**Table 6-41. GPBODR Register Field Descriptions**

Bit	Field	Type	Reset	Description
31	GPIO63	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
30	GPIO62	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
29	GPIO61	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
28	GPIO60	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
27	GPIO59	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
26	GPIO58	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
25	GPIO57	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
24	GPIO56	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
23	GPIO55	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
22	GPIO54	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn

**Table 6-41. GPBODR Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
21	GPIO53	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
20	GPIO52	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
19	GPIO51	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
18	GPIO50	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
17	GPIO49	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
16	GPIO48	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
15	GPIO47	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
14	GPIO46	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
13	GPIO45	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
12	GPIO44	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
11	GPIO43	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
10	GPIO42	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
9	GPIO41	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
8	GPIO40	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
7	GPIO39	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
6	GPIO38	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
5	GPIO37	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
4	GPIO36	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
3	GPIO35	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
2	GPIO34	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
1	GPIO33	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
0	GPIO32	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn

### 6.9.2.27 GPBAMSEL Register (Offset = 54h) [reset = 0h]

GPBAMSEL is shown in Figure 6-30 and described in Table 6-42.

Return to [Summary Table](#).

GPIO B Analog Mode Select register

Selects between digital and analog functionality for GPIO pins.

0: The pin is configured to digital functions according to the other GPIO configuration registers

1: The analog function of the pin is enabled

**Figure 6-30. GPBAMSEL Register**

31	30	29	28	27	26	25	24
RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED
R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h
23	22	21	20	19	18	17	16
RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED
R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h
15	14	13	12	11	10	9	8
RESERVED	RESERVED	RESERVED	RESERVED	GPIO43	GPIO42	RESERVED	RESERVED
R-0h	R-0h	R-0h	R-0h	R/W-0h	R/W-0h	R-0h	R-0h
7	6	5	4	3	2	1	0
RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED
R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h

**Table 6-42. GPBAMSEL Register Field Descriptions**

Bit	Field	Type	Reset	Description
31	RESERVED	R	0h	Reserved
30	RESERVED	R	0h	Reserved
29	RESERVED	R	0h	Reserved
28	RESERVED	R	0h	Reserved
27	RESERVED	R	0h	Reserved
26	RESERVED	R	0h	Reserved
25	RESERVED	R	0h	Reserved
24	RESERVED	R	0h	Reserved
23	RESERVED	R	0h	Reserved
22	RESERVED	R	0h	Reserved
21	RESERVED	R	0h	Reserved
20	RESERVED	R	0h	Reserved
19	RESERVED	R	0h	Reserved
18	RESERVED	R	0h	Reserved
17	RESERVED	R	0h	Reserved
16	RESERVED	R	0h	Reserved
15	RESERVED	R	0h	Reserved
14	RESERVED	R	0h	Reserved
13	RESERVED	R	0h	Reserved
12	RESERVED	R	0h	Reserved
11	GPIO43	R/W	0h	Selects the USB0DP function Reset type: SYSRSn
10	GPIO42	R/W	0h	Selects the USB0DM function Reset type: SYSRSn
9	RESERVED	R	0h	Reserved

**Table 6-42. GPBAMSEL Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
8	RESERVED	R	0h	Reserved
7	RESERVED	R	0h	Reserved
6	RESERVED	R	0h	Reserved
5	RESERVED	R	0h	Reserved
4	RESERVED	R	0h	Reserved
3	RESERVED	R	0h	Reserved
2	RESERVED	R	0h	Reserved
1	RESERVED	R	0h	Reserved
0	RESERVED	R	0h	Reserved

### 6.9.2.28 GPBGMUX1 Register (Offset = 60h) [reset = 0h]

GPBGMUX1 is shown in [Figure 6-31](#) and described in [Table 6-43](#).

Return to [Summary Table](#).

GPIO B Peripheral Group Mux (GPIO32 to 47)

Defines pin-muxing selection for GPIO.

Note: For complete pin-mux selection on GPIOx, GPAMUXy.GPIOx configuration is also required.

**Figure 6-31. GPBGMUX1 Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
GPIO47		GPIO46		GPIO45		GPIO44		GPIO43		GPIO42		GPIO41		GPIO40	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
GPIO39		GPIO38		GPIO37		GPIO36		GPIO35		GPIO34		GPIO33		GPIO32	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	

**Table 6-43. GPBGMUX1 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-30	GPIO47	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
29-28	GPIO46	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
27-26	GPIO45	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
25-24	GPIO44	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
23-22	GPIO43	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
21-20	GPIO42	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
19-18	GPIO41	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
17-16	GPIO40	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
15-14	GPIO39	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
13-12	GPIO38	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
11-10	GPIO37	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
9-8	GPIO36	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
7-6	GPIO35	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
5-4	GPIO34	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
3-2	GPIO33	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
1-0	GPIO32	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn



### 6.9.2.29 GPBGMUX2 Register (Offset = 62h) [reset = 0h]

GPBGMUX2 is shown in [Figure 6-32](#) and described in [Table 6-44](#).

Return to [Summary Table](#).

GPIO B Peripheral Group Mux (GPIO48 to 63)

Defines pin-muxing selection for GPIO.

Note: For complete pin-mux selection on GPIOx, GPAMUXy.GPIOx configuration is also required.

**Figure 6-32. GPBGMUX2 Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
GPIO63		GPIO62		GPIO61		GPIO60		GPIO59		GPIO58		GPIO57		GPIO56	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
GPIO55		GPIO54		GPIO53		GPIO52		GPIO51		GPIO50		GPIO49		GPIO48	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	

**Table 6-44. GPBGMUX2 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-30	GPIO63	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
29-28	GPIO62	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
27-26	GPIO61	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
25-24	GPIO60	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
23-22	GPIO59	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
21-20	GPIO58	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
19-18	GPIO57	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
17-16	GPIO56	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
15-14	GPIO55	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
13-12	GPIO54	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
11-10	GPIO53	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
9-8	GPIO52	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
7-6	GPIO51	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
5-4	GPIO50	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
3-2	GPIO49	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
1-0	GPIO48	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn

### 6.9.2.30 GPBCSEL1 Register (Offset = 68h) [reset = 0h]

GPBCSEL1 is shown in [Figure 6-33](#) and described in [Table 6-45](#).

Return to [Summary Table](#).

GPIO B Core Select Register (GPIO32 to 39)

Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin

xx00: CPU1 selected

xx01: CPU1.CLA1 selected

xx1x: Reserved

**Figure 6-33. GPBCSEL1 Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
GPIO39				GPIO38				GPIO37				GPIO36			
R/W-0h				R/W-0h				R/W-0h				R/W-0h			
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
GPIO35				GPIO34				GPIO33				GPIO32			
R/W-0h				R/W-0h				R/W-0h				R/W-0h			

**Table 6-45. GPBCSEL1 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-28	GPIO39	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
27-24	GPIO38	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
23-20	GPIO37	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
19-16	GPIO36	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
15-12	GPIO35	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
11-8	GPIO34	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
7-4	GPIO33	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
3-0	GPIO32	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn

### 6.9.2.31 GPBCSEL2 Register (Offset = 6Ah) [reset = 0h]

GPBCSEL2 is shown in [Figure 6-34](#) and described in [Table 6-46](#).

Return to [Summary Table](#).

GPIO B Core Select Register (GPIO40 to 47)

Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin

xx00: CPU1 selected

xx01: CPU1.CLA1 selected

xx1x: Reserved

**Figure 6-34. GPBCSEL2 Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
GPIO47				GPIO46				GPIO45				GPIO44			
R/W-0h				R/W-0h				R/W-0h				R/W-0h			
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
GPIO43				GPIO42				GPIO41				GPIO40			
R/W-0h				R/W-0h				R/W-0h				R/W-0h			

**Table 6-46. GPBCSEL2 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-28	GPIO47	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
27-24	GPIO46	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
23-20	GPIO45	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
19-16	GPIO44	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
15-12	GPIO43	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
11-8	GPIO42	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
7-4	GPIO41	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
3-0	GPIO40	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn

### 6.9.2.32 GPBCSEL3 Register (Offset = 6Ch) [reset = 0h]

GPBCSEL3 is shown in [Figure 6-35](#) and described in [Table 6-47](#).

Return to [Summary Table](#).

GPIO B Core Select Register (GPIO48 to 55)

Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin

xx00: CPU1 selected

xx01: CPU1.CLA1 selected

xx1x: Reserved

**Figure 6-35. GPBCSEL3 Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
GPIO55				GPIO54				GPIO53				GPIO52			
R/W-0h				R/W-0h				R/W-0h				R/W-0h			
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
GPIO51				GPIO50				GPIO49				GPIO48			
R/W-0h				R/W-0h				R/W-0h				R/W-0h			

**Table 6-47. GPBCSEL3 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-28	GPIO55	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
27-24	GPIO54	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
23-20	GPIO53	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
19-16	GPIO52	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
15-12	GPIO51	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
11-8	GPIO50	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
7-4	GPIO49	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
3-0	GPIO48	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn

### 6.9.2.33 GPBCSEL4 Register (Offset = 6Eh) [reset = 0h]

GPBCSEL4 is shown in [Figure 6-36](#) and described in [Table 6-48](#).

Return to [Summary Table](#).

GPIO B Core Select Register (GPIO56 to 63)

Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin

xx00: CPU1 selected

xx01: CPU1.CLA1 selected

xx1x: Reserved

**Figure 6-36. GPBCSEL4 Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
GPIO63				GPIO62				GPIO61				GPIO60			
R/W-0h				R/W-0h				R/W-0h				R/W-0h			
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
GPIO59				GPIO58				GPIO57				GPIO56			
R/W-0h				R/W-0h				R/W-0h				R/W-0h			

**Table 6-48. GPBCSEL4 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-28	GPIO63	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
27-24	GPIO62	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
23-20	GPIO61	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
19-16	GPIO60	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
15-12	GPIO59	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
11-8	GPIO58	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
7-4	GPIO57	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
3-0	GPIO56	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn

### 6.9.2.34 GPBLOCK Register (Offset = 7Ch) [reset = 0h]

GPBLOCK is shown in [Figure 6-37](#) and described in [Table 6-49](#).

Return to [Summary Table](#).

GPIO B Lock Configuration Register (GPIO32 to 63)

GPIO Configuration Lock for GPIO.

0: Bits in GPyMUX1, GPyMUX2, GPyDIR, GPyINV, GPyODR, GPyAMSEL, GPyGMUX1, GPyGMUX2 and GPyCSELx register which control the same pin can be changed

1: Locks changes to the bits in GPyMUX1, GPyMUX2, GPyDIR, GPyINV, GPyODR, GPyAMSEL, GPyGMUX1, GPyGMUX2 and GPyCSELx registers which control the same pin

**Figure 6-37. GPBLOCK Register**

31	30	29	28	27	26	25	24
GPIO63	GPIO62	GPIO61	GPIO60	GPIO59	GPIO58	GPIO57	GPIO56
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
23	22	21	20	19	18	17	16
GPIO55	GPIO54	GPIO53	GPIO52	GPIO51	GPIO50	GPIO49	GPIO48
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
15	14	13	12	11	10	9	8
GPIO47	GPIO46	GPIO45	GPIO44	GPIO43	GPIO42	GPIO41	GPIO40
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
7	6	5	4	3	2	1	0
GPIO39	GPIO38	GPIO37	GPIO36	GPIO35	GPIO34	GPIO33	GPIO32
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h

**Table 6-49. GPBLOCK Register Field Descriptions**

Bit	Field	Type	Reset	Description
31	GPIO63	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
30	GPIO62	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
29	GPIO61	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
28	GPIO60	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
27	GPIO59	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
26	GPIO58	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
25	GPIO57	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
24	GPIO56	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
23	GPIO55	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
22	GPIO54	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
21	GPIO53	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn

**Table 6-49. GPBLOCK Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
20	GPIO52	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
19	GPIO51	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
18	GPIO50	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
17	GPIO49	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
16	GPIO48	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
15	GPIO47	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
14	GPIO46	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
13	GPIO45	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
12	GPIO44	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
11	GPIO43	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
10	GPIO42	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
9	GPIO41	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
8	GPIO40	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
7	GPIO39	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
6	GPIO38	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
5	GPIO37	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
4	GPIO36	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
3	GPIO35	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
2	GPIO34	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
1	GPIO33	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
0	GPIO32	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn

### 6.9.2.35 GPBCR Register (Offset = 7Eh) [reset = 0h]

GPBCR is shown in [Figure 6-38](#) and described in [Table 6-50](#).

Return to [Summary Table](#).

GPIO B Lock Commit Register (GPIO32 to 63)

GPIO Configuration Lock Commit for GPIO:

1: Locks changes to the bit in GPyLOCK register which controls the same pin

0: Bit in the GPyLOCK register which controls the same pin can be changed

**Figure 6-38. GPBCR Register**

31	30	29	28	27	26	25	24
GPIO63	GPIO62	GPIO61	GPIO60	GPIO59	GPIO58	GPIO57	GPIO56
R/WOnce-0h	R/WOnce-0h	R/WOnce-0h	R/WOnce-0h	R/WOnce-0h	R/WOnce-0h	R/WOnce-0h	R/WOnce-0h
23	22	21	20	19	18	17	16
GPIO55	GPIO54	GPIO53	GPIO52	GPIO51	GPIO50	GPIO49	GPIO48
R/WOnce-0h	R/WOnce-0h	R/WOnce-0h	R/WOnce-0h	R/WOnce-0h	R/WOnce-0h	R/WOnce-0h	R/WOnce-0h
15	14	13	12	11	10	9	8
GPIO47	GPIO46	GPIO45	GPIO44	GPIO43	GPIO42	GPIO41	GPIO40
R/WOnce-0h	R/WOnce-0h	R/WOnce-0h	R/WOnce-0h	R/WOnce-0h	R/WOnce-0h	R/WOnce-0h	R/WOnce-0h
7	6	5	4	3	2	1	0
GPIO39	GPIO38	GPIO37	GPIO36	GPIO35	GPIO34	GPIO33	GPIO32
R/WOnce-0h	R/WOnce-0h	R/WOnce-0h	R/WOnce-0h	R/WOnce-0h	R/WOnce-0h	R/WOnce-0h	R/WOnce-0h

**Table 6-50. GPBCR Register Field Descriptions**

Bit	Field	Type	Reset	Description
31	GPIO63	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
30	GPIO62	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
29	GPIO61	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
28	GPIO60	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
27	GPIO59	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
26	GPIO58	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
25	GPIO57	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
24	GPIO56	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
23	GPIO55	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
22	GPIO54	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
21	GPIO53	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
20	GPIO52	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn



**Table 6-50. GPBCR Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
19	GPIO51	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
18	GPIO50	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
17	GPIO49	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
16	GPIO48	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
15	GPIO47	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
14	GPIO46	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
13	GPIO45	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
12	GPIO44	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
11	GPIO43	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
10	GPIO42	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
9	GPIO41	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
8	GPIO40	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
7	GPIO39	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
6	GPIO38	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
5	GPIO37	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
4	GPIO36	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
3	GPIO35	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
2	GPIO34	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
1	GPIO33	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
0	GPIO32	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn

### 6.9.2.36 GPCCTRL Register (Offset = 80h) [reset = 0h]

GPCCTRL is shown in [Figure 6-39](#) and described in [Table 6-51](#).

Return to [Summary Table](#).

GPIO C Qualification Sampling Period Control (GPIO64 to 95)

**Figure 6-39. GPCCTRL Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
QUALPRD3								QUALPRD2								QUALPRD1								QUALPRD0							
R/W-0h								R/W-0h								R/W-0h								R/W-0h							

**Table 6-51. GPCCTRL Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-24	QUALPRD3	R/W	0h	Qualification sampling period for GPIO88 to GPIO95: 0x00, QUALPRDx = PLLSYSCLK 0x01, QUALPRDx = PLLSYSCLK/2 0x02, QUALPRDx = PLLSYSCLK/4 .... 0xFF, QUALPRDx = PLLSYSCLK/510 Reset type: SYSRSn
23-16	QUALPRD2	R/W	0h	Qualification sampling period for GPIO80 to GPIO87: 0x00, QUALPRDx = PLLSYSCLK 0x01, QUALPRDx = PLLSYSCLK/2 0x02, QUALPRDx = PLLSYSCLK/4 .... 0xFF, QUALPRDx = PLLSYSCLK/510 Reset type: SYSRSn
15-8	QUALPRD1	R/W	0h	Qualification sampling period for GPIO72 to GPIO79: 0x00, QUALPRDx = PLLSYSCLK 0x01, QUALPRDx = PLLSYSCLK/2 0x02, QUALPRDx = PLLSYSCLK/4 .... 0xFF, QUALPRDx = PLLSYSCLK/510 Reset type: SYSRSn
7-0	QUALPRD0	R/W	0h	Qualification sampling period for GPIO64 to GPIO71: 0x00, QUALPRDx = PLLSYSCLK 0x01, QUALPRDx = PLLSYSCLK/2 0x02, QUALPRDx = PLLSYSCLK/4 .... 0xFF, QUALPRDx = PLLSYSCLK/510 Reset type: SYSRSn

### 6.9.2.37 GPCQSEL1 Register (Offset = 82h) [reset = 0h]

GPCQSEL1 is shown in [Figure 6-40](#) and described in [Table 6-52](#).

Return to [Summary Table](#).

GPIO C Qualifier Select 1 Register (GPIO64 to 79)

Input qualification type:

0,0 Sync

0,1 Qualification (3 samples)

1,0 Qualification (6 samples)

1,1 Async (no Sync or Qualification)

**Figure 6-40. GPCQSEL1 Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
GPIO79		GPIO78		GPIO77		GPIO76		GPIO75		GPIO74		GPIO73		GPIO72	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
GPIO71		GPIO70		GPIO69		GPIO68		GPIO67		GPIO66		GPIO65		GPIO64	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	

**Table 6-52. GPCQSEL1 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-30	GPIO79	R/W	0h	Input qualification type Reset type: SYSRSn
29-28	GPIO78	R/W	0h	Input qualification type Reset type: SYSRSn
27-26	GPIO77	R/W	0h	Input qualification type Reset type: SYSRSn
25-24	GPIO76	R/W	0h	Input qualification type Reset type: SYSRSn
23-22	GPIO75	R/W	0h	Input qualification type Reset type: SYSRSn
21-20	GPIO74	R/W	0h	Input qualification type Reset type: SYSRSn
19-18	GPIO73	R/W	0h	Input qualification type Reset type: SYSRSn
17-16	GPIO72	R/W	0h	Input qualification type Reset type: SYSRSn
15-14	GPIO71	R/W	0h	Input qualification type Reset type: SYSRSn
13-12	GPIO70	R/W	0h	Input qualification type Reset type: SYSRSn
11-10	GPIO69	R/W	0h	Input qualification type Reset type: SYSRSn
9-8	GPIO68	R/W	0h	Input qualification type Reset type: SYSRSn
7-6	GPIO67	R/W	0h	Input qualification type Reset type: SYSRSn
5-4	GPIO66	R/W	0h	Input qualification type Reset type: SYSRSn

**Table 6-52. GPCQSEL1 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
3-2	GPIO65	R/W	0h	Input qualification type Reset type: SYSRSn
1-0	GPIO64	R/W	0h	Input qualification type Reset type: SYSRSn

### 6.9.2.38 GPCQSEL2 Register (Offset = 84h) [reset = 0h]

GPCQSEL2 is shown in [Figure 6-41](#) and described in [Table 6-53](#).

Return to [Summary Table](#).

GPIO C Qualifier Select 2 Register (GPIO80 to 95)

Input qualification type:

0,0 Sync

0,1 Qualification (3 samples)

1,0 Qualification (6 samples)

1,1 Async (no Sync or Qualification)

**Figure 6-41. GPCQSEL2 Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
GPIO95		GPIO94		GPIO93		GPIO92		GPIO91		GPIO90		GPIO89		GPIO88	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
GPIO87		GPIO86		GPIO85		GPIO84		GPIO83		GPIO82		GPIO81		GPIO80	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	

**Table 6-53. GPCQSEL2 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-30	GPIO95	R/W	0h	Input qualification type Reset type: SYSRSn
29-28	GPIO94	R/W	0h	Input qualification type Reset type: SYSRSn
27-26	GPIO93	R/W	0h	Input qualification type Reset type: SYSRSn
25-24	GPIO92	R/W	0h	Input qualification type Reset type: SYSRSn
23-22	GPIO91	R/W	0h	Input qualification type Reset type: SYSRSn
21-20	GPIO90	R/W	0h	Input qualification type Reset type: SYSRSn
19-18	GPIO89	R/W	0h	Input qualification type Reset type: SYSRSn
17-16	GPIO88	R/W	0h	Input qualification type Reset type: SYSRSn
15-14	GPIO87	R/W	0h	Input qualification type Reset type: SYSRSn
13-12	GPIO86	R/W	0h	Input qualification type Reset type: SYSRSn
11-10	GPIO85	R/W	0h	Input qualification type Reset type: SYSRSn
9-8	GPIO84	R/W	0h	Input qualification type Reset type: SYSRSn
7-6	GPIO83	R/W	0h	Input qualification type Reset type: SYSRSn
5-4	GPIO82	R/W	0h	Input qualification type Reset type: SYSRSn

**Table 6-53. GPCQSEL2 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
3-2	GPIO81	R/W	0h	Input qualification type Reset type: SYSRSn
1-0	GPIO80	R/W	0h	Input qualification type Reset type: SYSRSn

### 6.9.2.39 GPCMUX1 Register (Offset = 86h) [reset = 0h]

GPCMUX1 is shown in [Figure 6-42](#) and described in [Table 6-54](#).

Return to [Summary Table](#).

GPIO C Mux 1 Register (GPIO64 to 79)

Defines pin-muxing selection for GPIO.

Notes:

The respective GPyGMUXn.GPIOz must be configured prior to this register to avoid intermediate peripheral selects being mapped to the GPIO.

**Figure 6-42. GPCMUX1 Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
GPIO79		GPIO78		GPIO77		GPIO76		GPIO75		GPIO74		GPIO73		GPIO72	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
GPIO71		GPIO70		GPIO69		GPIO68		GPIO67		GPIO66		GPIO65		GPIO64	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	

**Table 6-54. GPCMUX1 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-30	GPIO79	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
29-28	GPIO78	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
27-26	GPIO77	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
25-24	GPIO76	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
23-22	GPIO75	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
21-20	GPIO74	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
19-18	GPIO73	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
17-16	GPIO72	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
15-14	GPIO71	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
13-12	GPIO70	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
11-10	GPIO69	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
9-8	GPIO68	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
7-6	GPIO67	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
5-4	GPIO66	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
3-2	GPIO65	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn

**Table 6-54. GPCMUX1 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
1-0	GPIO64	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn



### 6.9.2.40 GPCMUX2 Register (Offset = 88h) [reset = 0h]

GPCMUX2 is shown in [Figure 6-43](#) and described in [Table 6-55](#).

Return to [Summary Table](#).

GPIO C Mux 2 Register (GPIO80 to 95)  
Defines pin-muxing selection for GPIO.

**Notes:**

The respective GPyGMUXn.GPIOz must be configured prior to this register to avoid intermediate peripheral selects being mapped to the GPIO.

**Figure 6-43. GPCMUX2 Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
GPIO95		GPIO94		GPIO93		GPIO92		GPIO91		GPIO90		GPIO89		GPIO88	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
GPIO87		GPIO86		GPIO85		GPIO84		GPIO83		GPIO82		GPIO81		GPIO80	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	

**Table 6-55. GPCMUX2 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-30	GPIO95	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
29-28	GPIO94	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
27-26	GPIO93	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
25-24	GPIO92	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
23-22	GPIO91	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
21-20	GPIO90	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
19-18	GPIO89	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
17-16	GPIO88	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
15-14	GPIO87	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
13-12	GPIO86	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
11-10	GPIO85	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
9-8	GPIO84	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
7-6	GPIO83	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
5-4	GPIO82	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
3-2	GPIO81	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn

**Table 6-55. GPCMUX2 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
1-0	GPIO80	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn

### 6.9.2.41 GPCDIR Register (Offset = 8Ah) [reset = 0h]

GPCDIR is shown in [Figure 6-44](#) and described in [Table 6-56](#).

Return to [Summary Table](#).

GPIO C Direction Register (GPIO64 to 95)

Controls direction of GPIO pins when the specified pin is configured in GPIO mode.

0: Configures pin as input.

1: Configures pin as output.

Reading the register returns the current value of the register setting.

**Figure 6-44. GPCDIR Register**

31	30	29	28	27	26	25	24
GPIO95	GPIO94	GPIO93	GPIO92	GPIO91	GPIO90	GPIO89	GPIO88
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
23	22	21	20	19	18	17	16
GPIO87	GPIO86	GPIO85	GPIO84	GPIO83	GPIO82	GPIO81	GPIO80
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
15	14	13	12	11	10	9	8
GPIO79	GPIO78	GPIO77	GPIO76	GPIO75	GPIO74	GPIO73	GPIO72
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
7	6	5	4	3	2	1	0
GPIO71	GPIO70	GPIO69	GPIO68	GPIO67	GPIO66	GPIO65	GPIO64
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h

**Table 6-56. GPCDIR Register Field Descriptions**

Bit	Field	Type	Reset	Description
31	GPIO95	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
30	GPIO94	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
29	GPIO93	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
28	GPIO92	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
27	GPIO91	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
26	GPIO90	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
25	GPIO89	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
24	GPIO88	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
23	GPIO87	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
22	GPIO86	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
21	GPIO85	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
20	GPIO84	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn

**Table 6-56. GPCDIR Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
19	GPIO83	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
18	GPIO82	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
17	GPIO81	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
16	GPIO80	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
15	GPIO79	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
14	GPIO78	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
13	GPIO77	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
12	GPIO76	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
11	GPIO75	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
10	GPIO74	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
9	GPIO73	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
8	GPIO72	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
7	GPIO71	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
6	GPIO70	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
5	GPIO69	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
4	GPIO68	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
3	GPIO67	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
2	GPIO66	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
1	GPIO65	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
0	GPIO64	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn

**6.9.2.42 GPCPUD Register (Offset = 8Ch) [reset = FFFFFFFFh]**

GPCPUD is shown in [Figure 6-45](#) and described in [Table 6-57](#).

Return to [Summary Table](#).

GPIO C Pull Up Disable Register (GPIO64 to 95)

Disables the Pull-Up on GPIO.

0: Enables the Pull-Up.

1: Disables the Pull-Up.

Reading the register returns the current value of the register setting.

**Figure 6-45. GPCPUD Register**

31		30		29		28		27		26		25		24	
GPIO95		GPIO94		GPIO93		GPIO92		GPIO91		GPIO90		GPIO89		GPIO88	
R/W-1h		R/W-1h		R/W-1h		R/W-1h		R/W-1h		R/W-1h		R/W-1h		R/W-1h	
23		22		21		20		19		18		17		16	
GPIO87		GPIO86		GPIO85		GPIO84		GPIO83		GPIO82		GPIO81		GPIO80	
R/W-1h		R/W-1h		R/W-1h		R/W-1h		R/W-1h		R/W-1h		R/W-1h		R/W-1h	
15		14		13		12		11		10		9		8	
GPIO79		GPIO78		GPIO77		GPIO76		GPIO75		GPIO74		GPIO73		GPIO72	
R/W-1h		R/W-1h		R/W-1h		R/W-1h		R/W-1h		R/W-1h		R/W-1h		R/W-1h	
7		6		5		4		3		2		1		0	
GPIO71		GPIO70		GPIO69		GPIO68		GPIO67		GPIO66		GPIO65		GPIO64	
R/W-1h		R/W-1h		R/W-1h		R/W-1h		R/W-1h		R/W-1h		R/W-1h		R/W-1h	

**Table 6-57. GPCPUD Register Field Descriptions**

Bit	Field	Type	Reset	Description
31	GPIO95	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
30	GPIO94	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
29	GPIO93	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
28	GPIO92	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
27	GPIO91	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
26	GPIO90	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
25	GPIO89	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
24	GPIO88	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
23	GPIO87	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
22	GPIO86	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
21	GPIO85	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
20	GPIO84	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn

**Table 6-57. GPCPUD Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
19	GPIO83	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
18	GPIO82	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
17	GPIO81	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
16	GPIO80	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
15	GPIO79	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
14	GPIO78	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
13	GPIO77	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
12	GPIO76	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
11	GPIO75	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
10	GPIO74	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
9	GPIO73	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
8	GPIO72	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
7	GPIO71	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
6	GPIO70	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
5	GPIO69	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
4	GPIO68	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
3	GPIO67	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
2	GPIO66	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
1	GPIO65	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
0	GPIO64	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn

### 6.9.2.43 GPCINV Register (Offset = 90h) [reset = 0h]

GPCINV is shown in [Figure 6-46](#) and described in [Table 6-58](#).

Return to [Summary Table](#).

GPIO C Input Polarity Invert Registers (GPIO64 to 95)

Selects between non-inverted and inverted GPIO input to the device.

0: selects non-inverted GPIO input

1: selects inverted GPIO input

Reading the register returns the current value of the register setting.

**Figure 6-46. GPCINV Register**

31	30	29	28	27	26	25	24
GPIO95	GPIO94	GPIO93	GPIO92	GPIO91	GPIO90	GPIO89	GPIO88
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
23	22	21	20	19	18	17	16
GPIO87	GPIO86	GPIO85	GPIO84	GPIO83	GPIO82	GPIO81	GPIO80
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
15	14	13	12	11	10	9	8
GPIO79	GPIO78	GPIO77	GPIO76	GPIO75	GPIO74	GPIO73	GPIO72
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
7	6	5	4	3	2	1	0
GPIO71	GPIO70	GPIO69	GPIO68	GPIO67	GPIO66	GPIO65	GPIO64
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h

**Table 6-58. GPCINV Register Field Descriptions**

Bit	Field	Type	Reset	Description
31	GPIO95	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
30	GPIO94	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
29	GPIO93	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
28	GPIO92	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
27	GPIO91	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
26	GPIO90	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
25	GPIO89	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
24	GPIO88	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
23	GPIO87	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
22	GPIO86	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
21	GPIO85	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
20	GPIO84	R/W	0h	Input inversion control for this pin Reset type: SYSRSn

**Table 6-58. GPCINV Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
19	GPIO83	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
18	GPIO82	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
17	GPIO81	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
16	GPIO80	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
15	GPIO79	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
14	GPIO78	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
13	GPIO77	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
12	GPIO76	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
11	GPIO75	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
10	GPIO74	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
9	GPIO73	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
8	GPIO72	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
7	GPIO71	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
6	GPIO70	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
5	GPIO69	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
4	GPIO68	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
3	GPIO67	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
2	GPIO66	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
1	GPIO65	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
0	GPIO64	R/W	0h	Input inversion control for this pin Reset type: SYSRSn



### 6.9.2.44 GPCODR Register (Offset = 92h) [reset = 0h]

GPCODR is shown in [Figure 6-47](#) and described in [Table 6-59](#).

Return to [Summary Table](#).

GPIO C Open Drain Output Register (GPIO64 to GPIO95)

Selects between normal and open-drain output for the GPIO pin.

0: Normal Output

1: Open Drain Output

Reading the register returns the current value of the register setting.

Note:

[1] In the Open Drain output mode, if the buffer is configured for output mode, a 0 value to be driven out comes out on the on the PAD while a 1 value to be driven out tri-states the buffer.

**Figure 6-47. GPCODR Register**

31	30	29	28	27	26	25	24
GPIO95	GPIO94	GPIO93	GPIO92	GPIO91	GPIO90	GPIO89	GPIO88
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
23	22	21	20	19	18	17	16
GPIO87	GPIO86	GPIO85	GPIO84	GPIO83	GPIO82	GPIO81	GPIO80
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
15	14	13	12	11	10	9	8
GPIO79	GPIO78	GPIO77	GPIO76	GPIO75	GPIO74	GPIO73	GPIO72
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
7	6	5	4	3	2	1	0
GPIO71	GPIO70	GPIO69	GPIO68	GPIO67	GPIO66	GPIO65	GPIO64
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h

**Table 6-59. GPCODR Register Field Descriptions**

Bit	Field	Type	Reset	Description
31	GPIO95	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
30	GPIO94	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
29	GPIO93	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
28	GPIO92	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
27	GPIO91	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
26	GPIO90	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
25	GPIO89	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
24	GPIO88	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
23	GPIO87	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
22	GPIO86	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn

**Table 6-59. GPCODR Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
21	GPIO85	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
20	GPIO84	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
19	GPIO83	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
18	GPIO82	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
17	GPIO81	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
16	GPIO80	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
15	GPIO79	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
14	GPIO78	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
13	GPIO77	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
12	GPIO76	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
11	GPIO75	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
10	GPIO74	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
9	GPIO73	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
8	GPIO72	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
7	GPIO71	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
6	GPIO70	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
5	GPIO69	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
4	GPIO68	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
3	GPIO67	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
2	GPIO66	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
1	GPIO65	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
0	GPIO64	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn

### 6.9.2.45 GPCGMUX1 Register (Offset = A0h) [reset = 0h]

GPCGMUX1 is shown in [Figure 6-48](#) and described in [Table 6-60](#).

Return to [Summary Table](#).

GPIO C Peripheral Group Mux (GPIO64 to 79)

Defines pin-muxing selection for GPIO.

Note: For complete pin-mux selection on GPIOx, GPAMUXy.GPIOx configuration is also required.

**Figure 6-48. GPCGMUX1 Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
GPIO79		GPIO78		GPIO77		GPIO76		GPIO75		GPIO74		GPIO73		GPIO72	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
GPIO71		GPIO70		GPIO69		GPIO68		GPIO67		GPIO66		GPIO65		GPIO64	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	

**Table 6-60. GPCGMUX1 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-30	GPIO79	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
29-28	GPIO78	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
27-26	GPIO77	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
25-24	GPIO76	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
23-22	GPIO75	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
21-20	GPIO74	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
19-18	GPIO73	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
17-16	GPIO72	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
15-14	GPIO71	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
13-12	GPIO70	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
11-10	GPIO69	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
9-8	GPIO68	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
7-6	GPIO67	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
5-4	GPIO66	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
3-2	GPIO65	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
1-0	GPIO64	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn

### 6.9.2.46 GPCGMUX2 Register (Offset = A2h) [reset = 0h]

GPCGMUX2 is shown in [Figure 6-49](#) and described in [Table 6-61](#).

Return to [Summary Table](#).

GPIO C Peripheral Group Mux (GPIO80 to 95)

Defines pin-muxing selection for GPIO.

Note: For complete pin-mux selection on GPIOx, GPAMUXy.GPIOx configuration is also required.

**Figure 6-49. GPCGMUX2 Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
GPIO95		GPIO94		GPIO93		GPIO92		GPIO91		GPIO90		GPIO89		GPIO88	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
GPIO87		GPIO86		GPIO85		GPIO84		GPIO83		GPIO82		GPIO81		GPIO80	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	

**Table 6-61. GPCGMUX2 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-30	GPIO95	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
29-28	GPIO94	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
27-26	GPIO93	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
25-24	GPIO92	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
23-22	GPIO91	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
21-20	GPIO90	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
19-18	GPIO89	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
17-16	GPIO88	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
15-14	GPIO87	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
13-12	GPIO86	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
11-10	GPIO85	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
9-8	GPIO84	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
7-6	GPIO83	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
5-4	GPIO82	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
3-2	GPIO81	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
1-0	GPIO80	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn

### 6.9.2.47 GPCCSSEL1 Register (Offset = A8h) [reset = 0h]

GPCCSSEL1 is shown in [Figure 6-50](#) and described in [Table 6-62](#).

Return to [Summary Table](#).

GPIO C Core Select Register (GPIO64 to 71)

Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin

xx00: CPU1 selected

xx01: CPU1.CLA1 selected

xx1x: Reserved

**Figure 6-50. GPCCSSEL1 Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
GPIO71				GPIO70				GPIO69				GPIO68			
R/W-0h				R/W-0h				R/W-0h				R/W-0h			
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
GPIO67				GPIO66				GPIO65				GPIO64			
R/W-0h				R/W-0h				R/W-0h				R/W-0h			

**Table 6-62. GPCCSSEL1 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-28	GPIO71	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
27-24	GPIO70	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
23-20	GPIO69	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
19-16	GPIO68	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
15-12	GPIO67	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
11-8	GPIO66	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
7-4	GPIO65	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
3-0	GPIO64	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn

### 6.9.2.48 GPCCSSEL2 Register (Offset = AAh) [reset = 0h]

GPCCSSEL2 is shown in [Figure 6-51](#) and described in [Table 6-63](#).

Return to [Summary Table](#).

GPIO C Core Select Register (GPIO72 to 79)

Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin

xx00: CPU1 selected

xx01: CPU1.CLA1 selected

xx1x: Reserved

**Figure 6-51. GPCCSSEL2 Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
GPIO79				GPIO78				GPIO77				GPIO76			
R/W-0h				R/W-0h				R/W-0h				R/W-0h			
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
GPIO75				GPIO74				GPIO73				GPIO72			
R/W-0h				R/W-0h				R/W-0h				R/W-0h			

**Table 6-63. GPCCSSEL2 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-28	GPIO79	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
27-24	GPIO78	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
23-20	GPIO77	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
19-16	GPIO76	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
15-12	GPIO75	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
11-8	GPIO74	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
7-4	GPIO73	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
3-0	GPIO72	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn

### 6.9.2.49 GPCCSEL3 Register (Offset = ACh) [reset = 0h]

GPCCSEL3 is shown in [Figure 6-52](#) and described in [Table 6-64](#).

Return to [Summary Table](#).

GPIO C Core Select Register (GPIO80 to 87)

Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin

xx00: CPU1 selected

xx01: CPU1.CLA1 selected

xx1x: Reserved

**Figure 6-52. GPCCSEL3 Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
GPIO87				GPIO86				GPIO85				GPIO84			
R/W-0h				R/W-0h				R/W-0h				R/W-0h			
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
GPIO83				GPIO82				GPIO81				GPIO80			
R/W-0h				R/W-0h				R/W-0h				R/W-0h			

**Table 6-64. GPCCSEL3 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-28	GPIO87	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
27-24	GPIO86	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
23-20	GPIO85	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
19-16	GPIO84	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
15-12	GPIO83	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
11-8	GPIO82	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
7-4	GPIO81	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
3-0	GPIO80	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn

### 6.9.2.50 GPCCSEL4 Register (Offset = AEh) [reset = 0h]

GPCCSEL4 is shown in [Figure 6-53](#) and described in [Table 6-65](#).

Return to [Summary Table](#).

GPIO C Core Select Register (GPIO88 to 95)

Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin

xx00: CPU1 selected

xx01: CPU1.CLA1 selected

xx1x: Reserved

**Figure 6-53. GPCCSEL4 Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
GPIO95				GPIO94				GPIO93				GPIO92			
R/W-0h				R/W-0h				R/W-0h				R/W-0h			
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
GPIO91				GPIO90				GPIO89				GPIO88			
R/W-0h				R/W-0h				R/W-0h				R/W-0h			

**Table 6-65. GPCCSEL4 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-28	GPIO95	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
27-24	GPIO94	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
23-20	GPIO93	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
19-16	GPIO92	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
15-12	GPIO91	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
11-8	GPIO90	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
7-4	GPIO89	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
3-0	GPIO88	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn



### 6.9.2.51 GPCLOCK Register (Offset = BCh) [reset = 0h]

GPCLOCK is shown in [Figure 6-54](#) and described in [Table 6-66](#).

Return to [Summary Table](#).

GPIO C Lock Configuration Register (GPIO64 to 95)

GPIO Configuration Lock for GPIO.

0: Bits in GPyMUX1, GPyMUX2, GPyDIR, GPyINV, GPyODR, GPyAMSEL, GPyGMUX1, GPyGMUX2 and GPyCSELx register which control the same pin can be changed

1: Locks changes to the bits in GPyMUX1, GPyMUX2, GPyDIR, GPyINV, GPyODR, GPyAMSEL, GPyGMUX1, GPyGMUX2 and GPyCSELx registers which control the same pin

**Figure 6-54. GPCLOCK Register**

31	30	29	28	27	26	25	24
GPIO95	GPIO94	GPIO93	GPIO92	GPIO91	GPIO90	GPIO89	GPIO88
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
23	22	21	20	19	18	17	16
GPIO87	GPIO86	GPIO85	GPIO84	GPIO83	GPIO82	GPIO81	GPIO80
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
15	14	13	12	11	10	9	8
GPIO79	GPIO78	GPIO77	GPIO76	GPIO75	GPIO74	GPIO73	GPIO72
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
7	6	5	4	3	2	1	0
GPIO71	GPIO70	GPIO69	GPIO68	GPIO67	GPIO66	GPIO65	GPIO64
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h

**Table 6-66. GPCLOCK Register Field Descriptions**

Bit	Field	Type	Reset	Description
31	GPIO95	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
30	GPIO94	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
29	GPIO93	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
28	GPIO92	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
27	GPIO91	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
26	GPIO90	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
25	GPIO89	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
24	GPIO88	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
23	GPIO87	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
22	GPIO86	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
21	GPIO85	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn

**Table 6-66. GPCLOCK Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
20	GPIO84	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
19	GPIO83	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
18	GPIO82	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
17	GPIO81	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
16	GPIO80	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
15	GPIO79	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
14	GPIO78	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
13	GPIO77	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
12	GPIO76	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
11	GPIO75	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
10	GPIO74	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
9	GPIO73	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
8	GPIO72	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
7	GPIO71	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
6	GPIO70	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
5	GPIO69	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
4	GPIO68	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
3	GPIO67	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
2	GPIO66	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
1	GPIO65	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
0	GPIO64	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn

### 6.9.2.52 GPCCR Register (Offset = BEh) [reset = 0h]

GPCCR is shown in [Figure 6-55](#) and described in [Table 6-67](#).

Return to [Summary Table](#).

GPIO C Lock Commit Register (GPIO64 to 95)

GPIO Configuration Lock Commit for GPIO:

- 1: Locks changes to the bit in GPyLOCK register which controls the same pin
- 0: Bit in the GPyLOCK register which controls the same pin can be changed

**Figure 6-55. GPCCR Register**

31		30		29		28		27		26		25		24	
GPIO95		GPIO94		GPIO93		GPIO92		GPIO91		GPIO90		GPIO89		GPIO88	
R/WOnce-0h		R/WOnce-0h		R/WOnce-0h		R/WOnce-0h		R/WOnce-0h		R/WOnce-0h		R/WOnce-0h		R/WOnce-0h	
23		22		21		20		19		18		17		16	
GPIO87		GPIO86		GPIO85		GPIO84		GPIO83		GPIO82		GPIO81		GPIO80	
R/WOnce-0h		R/WOnce-0h		R/WOnce-0h		R/WOnce-0h		R/WOnce-0h		R/WOnce-0h		R/WOnce-0h		R/WOnce-0h	
15		14		13		12		11		10		9		8	
GPIO79		GPIO78		GPIO77		GPIO76		GPIO75		GPIO74		GPIO73		GPIO72	
R/WOnce-0h		R/WOnce-0h		R/WOnce-0h		R/WOnce-0h		R/WOnce-0h		R/WOnce-0h		R/WOnce-0h		R/WOnce-0h	
7		6		5		4		3		2		1		0	
GPIO71		GPIO70		GPIO69		GPIO68		GPIO67		GPIO66		GPIO65		GPIO64	
R/WOnce-0h		R/WOnce-0h		R/WOnce-0h		R/WOnce-0h		R/WOnce-0h		R/WOnce-0h		R/WOnce-0h		R/WOnce-0h	

**Table 6-67. GPCCR Register Field Descriptions**

Bit	Field	Type	Reset	Description
31	GPIO95	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
30	GPIO94	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
29	GPIO93	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
28	GPIO92	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
27	GPIO91	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
26	GPIO90	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
25	GPIO89	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
24	GPIO88	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
23	GPIO87	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
22	GPIO86	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
21	GPIO85	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
20	GPIO84	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn

**Table 6-67. GPCCR Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
19	GPIO83	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
18	GPIO82	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
17	GPIO81	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
16	GPIO80	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
15	GPIO79	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
14	GPIO78	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
13	GPIO77	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
12	GPIO76	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
11	GPIO75	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
10	GPIO74	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
9	GPIO73	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
8	GPIO72	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
7	GPIO71	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
6	GPIO70	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
5	GPIO69	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
4	GPIO68	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
3	GPIO67	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
2	GPIO66	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
1	GPIO65	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
0	GPIO64	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn

### 6.9.2.53 GPDCTRL Register (Offset = C0h) [reset = 0h]

GPDCTRL is shown in [Figure 6-56](#) and described in [Table 6-68](#).

Return to [Summary Table](#).

GPIO D Qualification Sampling Period Control (GPIO96 to 127)

**Figure 6-56. GPDCTRL Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
QUALPRD3								QUALPRD2								QUALPRD1								QUALPRD0							
R/W-0h								R/W-0h								R/W-0h								R/W-0h							

**Table 6-68. GPDCTRL Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-24	QUALPRD3	R/W	0h	Qualification sampling period for GPIO120 to GPIO127: 0x00, QUALPRDx = PLLSYSCLK 0x01, QUALPRDx = PLLSYSCLK/2 0x02, QUALPRDx = PLLSYSCLK/4 .... 0xFF, QUALPRDx = PLLSYSCLK/510 Reset type: SYSRSn
23-16	QUALPRD2	R/W	0h	Qualification sampling period for GPIO112 to GPIO119: 0x00, QUALPRDx = PLLSYSCLK 0x01, QUALPRDx = PLLSYSCLK/2 0x02, QUALPRDx = PLLSYSCLK/4 .... 0xFF, QUALPRDx = PLLSYSCLK/510 Reset type: SYSRSn
15-8	QUALPRD1	R/W	0h	Qualification sampling period for GPIO104 to GPIO111: 0x00, QUALPRDx = PLLSYSCLK 0x01, QUALPRDx = PLLSYSCLK/2 0x02, QUALPRDx = PLLSYSCLK/4 .... 0xFF, QUALPRDx = PLLSYSCLK/510 Reset type: SYSRSn
7-0	QUALPRD0	R/W	0h	Qualification sampling period for GPIO96 to GPIO103: 0x00, QUALPRDx = PLLSYSCLK 0x01, QUALPRDx = PLLSYSCLK/2 0x02, QUALPRDx = PLLSYSCLK/4 .... 0xFF, QUALPRDx = PLLSYSCLK/510 Reset type: SYSRSn

### 6.9.2.54 GPDQSEL1 Register (Offset = C2h) [reset = 0h]

GPDQSEL1 is shown in [Figure 6-57](#) and described in [Table 6-69](#).

Return to [Summary Table](#).

GPIO D Qualifier Select 1 Register (GPIO96 to 111)

Input qualification type:

0,0 Sync

0,1 Qualification (3 samples)

1,0 Qualification (6 samples)

1,1 Async (no Sync or Qualification)

**Figure 6-57. GPDQSEL1 Register**

31	30	29	28	27	26	25	24
GPIO111		GPIO110		GPIO109		GPIO108	
R/W-0h		R/W-0h		R/W-0h		R/W-0h	
23	22	21	20	19	18	17	16
GPIO107		GPIO106		GPIO105		GPIO104	
R/W-0h		R/W-0h		R/W-0h		R/W-0h	
15	14	13	12	11	10	9	8
GPIO103		GPIO102		GPIO101		GPIO100	
R/W-0h		R/W-0h		R/W-0h		R/W-0h	
7	6	5	4	3	2	1	0
GPIO99		GPIO98		GPIO97		GPIO96	
R/W-0h		R/W-0h		R/W-0h		R/W-0h	

**Table 6-69. GPDQSEL1 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-30	GPIO111	R/W	0h	Input qualification type Reset type: SYSRSn
29-28	GPIO110	R/W	0h	Input qualification type Reset type: SYSRSn
27-26	GPIO109	R/W	0h	Input qualification type Reset type: SYSRSn
25-24	GPIO108	R/W	0h	Input qualification type Reset type: SYSRSn
23-22	GPIO107	R/W	0h	Input qualification type Reset type: SYSRSn
21-20	GPIO106	R/W	0h	Input qualification type Reset type: SYSRSn
19-18	GPIO105	R/W	0h	Input qualification type Reset type: SYSRSn
17-16	GPIO104	R/W	0h	Input qualification type Reset type: SYSRSn
15-14	GPIO103	R/W	0h	Input qualification type Reset type: SYSRSn
13-12	GPIO102	R/W	0h	Input qualification type Reset type: SYSRSn
11-10	GPIO101	R/W	0h	Input qualification type Reset type: SYSRSn
9-8	GPIO100	R/W	0h	Input qualification type Reset type: SYSRSn

**Table 6-69. GPDQSEL1 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
7-6	GPIO99	R/W	0h	Input qualification type Reset type: SYSRSn
5-4	GPIO98	R/W	0h	Input qualification type Reset type: SYSRSn
3-2	GPIO97	R/W	0h	Input qualification type Reset type: SYSRSn
1-0	GPIO96	R/W	0h	Input qualification type Reset type: SYSRSn

**6.9.2.55 GPDQSEL2 Register (Offset = C4h) [reset = 0h]**

GPDQSEL2 is shown in [Figure 6-58](#) and described in [Table 6-70](#).

Return to [Summary Table](#).

GPIO D Qualifier Select 2 Register (GPIO112 to 127)

Input qualification type:

0,0 Sync

0,1 Qualification (3 samples)

1,0 Qualification (6 samples)

1,1 Async (no Sync or Qualification)

**Figure 6-58. GPDQSEL2 Register**

31	30	29	28	27	26	25	24
GPIO127		GPIO126		GPIO125		GPIO124	
R/W-0h		R/W-0h		R/W-0h		R/W-0h	
23	22	21	20	19	18	17	16
GPIO123		GPIO122		GPIO121		GPIO120	
R/W-0h		R/W-0h		R/W-0h		R/W-0h	
15	14	13	12	11	10	9	8
GPIO119		GPIO118		GPIO117		GPIO116	
R/W-0h		R/W-0h		R/W-0h		R/W-0h	
7	6	5	4	3	2	1	0
GPIO115		GPIO114		GPIO113		GPIO112	
R/W-0h		R/W-0h		R/W-0h		R/W-0h	

**Table 6-70. GPDQSEL2 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-30	GPIO127	R/W	0h	Input qualification type Reset type: SYSRSn
29-28	GPIO126	R/W	0h	Input qualification type Reset type: SYSRSn
27-26	GPIO125	R/W	0h	Input qualification type Reset type: SYSRSn
25-24	GPIO124	R/W	0h	Input qualification type Reset type: SYSRSn
23-22	GPIO123	R/W	0h	Input qualification type Reset type: SYSRSn
21-20	GPIO122	R/W	0h	Input qualification type Reset type: SYSRSn
19-18	GPIO121	R/W	0h	Input qualification type Reset type: SYSRSn
17-16	GPIO120	R/W	0h	Input qualification type Reset type: SYSRSn
15-14	GPIO119	R/W	0h	Input qualification type Reset type: SYSRSn
13-12	GPIO118	R/W	0h	Input qualification type Reset type: SYSRSn
11-10	GPIO117	R/W	0h	Input qualification type Reset type: SYSRSn
9-8	GPIO116	R/W	0h	Input qualification type Reset type: SYSRSn



**Table 6-70. GPDQSEL2 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
7-6	GPIO115	R/W	0h	Input qualification type Reset type: SYSRSn
5-4	GPIO114	R/W	0h	Input qualification type Reset type: SYSRSn
3-2	GPIO113	R/W	0h	Input qualification type Reset type: SYSRSn
1-0	GPIO112	R/W	0h	Input qualification type Reset type: SYSRSn

### 6.9.2.56 GPDMUX1 Register (Offset = C6h) [reset = 0h]

GPDMUX1 is shown in [Figure 6-59](#) and described in [Table 6-71](#).

Return to [Summary Table](#).

GPIO D Mux 1 Register (GPIO96 to 111)

Defines pin-muxing selection for GPIO.

Notes:

The respective GPyGMUXn.GPIOz must be configured prior to this register to avoid intermediate peripheral selects being mapped to the GPIO.

**Figure 6-59. GPDMUX1 Register**

31	30	29	28	27	26	25	24
GPIO111		GPIO110		GPIO109		GPIO108	
R/W-0h		R/W-0h		R/W-0h		R/W-0h	
23	22	21	20	19	18	17	16
GPIO107		GPIO106		GPIO105		GPIO104	
R/W-0h		R/W-0h		R/W-0h		R/W-0h	
15	14	13	12	11	10	9	8
GPIO103		GPIO102		GPIO101		GPIO100	
R/W-0h		R/W-0h		R/W-0h		R/W-0h	
7	6	5	4	3	2	1	0
GPIO99		GPIO98		GPIO97		GPIO96	
R/W-0h		R/W-0h		R/W-0h		R/W-0h	

**Table 6-71. GPDMUX1 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-30	GPIO111	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
29-28	GPIO110	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
27-26	GPIO109	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
25-24	GPIO108	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
23-22	GPIO107	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
21-20	GPIO106	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
19-18	GPIO105	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
17-16	GPIO104	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
15-14	GPIO103	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
13-12	GPIO102	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
11-10	GPIO101	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
9-8	GPIO100	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn

**Table 6-71. GPDMUX1 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
7-6	GPIO99	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
5-4	GPIO98	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
3-2	GPIO97	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
1-0	GPIO96	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn

### 6.9.2.57 GPDMUX2 Register (Offset = C8h) [reset = 0h]

GPDMUX2 is shown in [Figure 6-60](#) and described in [Table 6-72](#).

Return to [Summary Table](#).

GPIO D Mux 2 Register (GPIO112 to 127)

Defines pin-muxing selection for GPIO.

Notes:

The respective GPyGMUXn.GPIOz must be configured prior to this register to avoid intermediate peripheral selects being mapped to the GPIO.

**Figure 6-60. GPDMUX2 Register**

31	30	29	28	27	26	25	24
GPIO127		GPIO126		GPIO125		GPIO124	
R/W-0h		R/W-0h		R/W-0h		R/W-0h	
23	22	21	20	19	18	17	16
GPIO123		GPIO122		GPIO121		GPIO120	
R/W-0h		R/W-0h		R/W-0h		R/W-0h	
15	14	13	12	11	10	9	8
GPIO119		GPIO118		GPIO117		GPIO116	
R/W-0h		R/W-0h		R/W-0h		R/W-0h	
7	6	5	4	3	2	1	0
GPIO115		GPIO114		GPIO113		GPIO112	
R/W-0h		R/W-0h		R/W-0h		R/W-0h	

**Table 6-72. GPDMUX2 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-30	GPIO127	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
29-28	GPIO126	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
27-26	GPIO125	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
25-24	GPIO124	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
23-22	GPIO123	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
21-20	GPIO122	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
19-18	GPIO121	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
17-16	GPIO120	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
15-14	GPIO119	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
13-12	GPIO118	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
11-10	GPIO117	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
9-8	GPIO116	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn

**Table 6-72. GPDMUX2 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
7-6	GPIO115	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
5-4	GPIO114	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
3-2	GPIO113	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
1-0	GPIO112	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn

### 6.9.2.58 GPDDIR Register (Offset = CAh) [reset = 0h]

GPDDIR is shown in [Figure 6-61](#) and described in [Table 6-73](#).

Return to [Summary Table](#).

GPIO D Direction Register (GPIO96 to 127)

Controls direction of GPIO pins when the specified pin is configured in GPIO mode.

0: Configures pin as input.

1: Configures pin as output.

Reading the register returns the current value of the register setting.

**Figure 6-61. GPDDIR Register**

31	30	29	28	27	26	25	24
GPIO127	GPIO126	GPIO125	GPIO124	GPIO123	GPIO122	GPIO121	GPIO120
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
23	22	21	20	19	18	17	16
GPIO119	GPIO118	GPIO117	GPIO116	GPIO115	GPIO114	GPIO113	GPIO112
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
15	14	13	12	11	10	9	8
GPIO111	GPIO110	GPIO109	GPIO108	GPIO107	GPIO106	GPIO105	GPIO104
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
7	6	5	4	3	2	1	0
GPIO103	GPIO102	GPIO101	GPIO100	GPIO99	GPIO98	GPIO97	GPIO96
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h

**Table 6-73. GPDDIR Register Field Descriptions**

Bit	Field	Type	Reset	Description
31	GPIO127	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
30	GPIO126	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
29	GPIO125	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
28	GPIO124	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
27	GPIO123	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
26	GPIO122	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
25	GPIO121	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
24	GPIO120	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
23	GPIO119	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
22	GPIO118	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
21	GPIO117	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
20	GPIO116	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn

**Table 6-73. GPDIR Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
19	GPIO115	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
18	GPIO114	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
17	GPIO113	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
16	GPIO112	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
15	GPIO111	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
14	GPIO110	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
13	GPIO109	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
12	GPIO108	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
11	GPIO107	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
10	GPIO106	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
9	GPIO105	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
8	GPIO104	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
7	GPIO103	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
6	GPIO102	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
5	GPIO101	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
4	GPIO100	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
3	GPIO99	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
2	GPIO98	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
1	GPIO97	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
0	GPIO96	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn

### 6.9.2.59 GPDPU Register (Offset = CCh) [reset = FFFFFFFFh]

GPDPU is shown in [Figure 6-62](#) and described in [Table 6-74](#).

Return to [Summary Table](#).

GPIO D Pull Up Disable Register (GPIO96 to 127)

Disables the Pull-Up on GPIO.

0: Enables the Pull-Up.

1: Disables the Pull-Up.

Reading the register returns the current value of the register setting.

**Figure 6-62. GPDPU Register**

31	30	29	28	27	26	25	24
GPIO127	GPIO126	GPIO125	GPIO124	GPIO123	GPIO122	GPIO121	GPIO120
R/W-1h	R/W-1h	R/W-1h	R/W-1h	R/W-1h	R/W-1h	R/W-1h	R/W-1h
23	22	21	20	19	18	17	16
GPIO119	GPIO118	GPIO117	GPIO116	GPIO115	GPIO114	GPIO113	GPIO112
R/W-1h	R/W-1h	R/W-1h	R/W-1h	R/W-1h	R/W-1h	R/W-1h	R/W-1h
15	14	13	12	11	10	9	8
GPIO111	GPIO110	GPIO109	GPIO108	GPIO107	GPIO106	GPIO105	GPIO104
R/W-1h	R/W-1h	R/W-1h	R/W-1h	R/W-1h	R/W-1h	R/W-1h	R/W-1h
7	6	5	4	3	2	1	0
GPIO103	GPIO102	GPIO101	GPIO100	GPIO99	GPIO98	GPIO97	GPIO96
R/W-1h	R/W-1h	R/W-1h	R/W-1h	R/W-1h	R/W-1h	R/W-1h	R/W-1h

**Table 6-74. GPDPU Register Field Descriptions**

Bit	Field	Type	Reset	Description
31	GPIO127	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
30	GPIO126	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
29	GPIO125	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
28	GPIO124	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
27	GPIO123	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
26	GPIO122	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
25	GPIO121	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
24	GPIO120	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
23	GPIO119	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
22	GPIO118	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
21	GPIO117	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
20	GPIO116	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn



**Table 6-74. GPDPU Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
19	GPIO115	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
18	GPIO114	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
17	GPIO113	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
16	GPIO112	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
15	GPIO111	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
14	GPIO110	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
13	GPIO109	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
12	GPIO108	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
11	GPIO107	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
10	GPIO106	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
9	GPIO105	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
8	GPIO104	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
7	GPIO103	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
6	GPIO102	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
5	GPIO101	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
4	GPIO100	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
3	GPIO99	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
2	GPIO98	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
1	GPIO97	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
0	GPIO96	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn

### 6.9.2.60 GPDINV Register (Offset = D0h) [reset = 0h]

GPDINV is shown in [Figure 6-63](#) and described in [Table 6-75](#).

Return to [Summary Table](#).

GPIO D Input Polarity Invert Registers (GPIO96 to 127)

Selects between non-inverted and inverted GPIO input to the device.

0: selects non-inverted GPIO input

1: selects inverted GPIO input

Reading the register returns the current value of the register setting.

**Figure 6-63. GPDINV Register**

31	30	29	28	27	26	25	24
GPIO127	GPIO126	GPIO125	GPIO124	GPIO123	GPIO122	GPIO121	GPIO120
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
23	22	21	20	19	18	17	16
GPIO119	GPIO118	GPIO117	GPIO116	GPIO115	GPIO114	GPIO113	GPIO112
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
15	14	13	12	11	10	9	8
GPIO111	GPIO110	GPIO109	GPIO108	GPIO107	GPIO106	GPIO105	GPIO104
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
7	6	5	4	3	2	1	0
GPIO103	GPIO102	GPIO101	GPIO100	GPIO99	GPIO98	GPIO97	GPIO96
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h

**Table 6-75. GPDINV Register Field Descriptions**

Bit	Field	Type	Reset	Description
31	GPIO127	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
30	GPIO126	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
29	GPIO125	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
28	GPIO124	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
27	GPIO123	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
26	GPIO122	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
25	GPIO121	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
24	GPIO120	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
23	GPIO119	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
22	GPIO118	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
21	GPIO117	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
20	GPIO116	R/W	0h	Input inversion control for this pin Reset type: SYSRSn

**Table 6-75. GPDINV Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
19	GPIO115	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
18	GPIO114	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
17	GPIO113	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
16	GPIO112	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
15	GPIO111	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
14	GPIO110	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
13	GPIO109	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
12	GPIO108	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
11	GPIO107	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
10	GPIO106	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
9	GPIO105	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
8	GPIO104	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
7	GPIO103	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
6	GPIO102	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
5	GPIO101	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
4	GPIO100	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
3	GPIO99	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
2	GPIO98	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
1	GPIO97	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
0	GPIO96	R/W	0h	Input inversion control for this pin Reset type: SYSRSn

### 6.9.2.61 GPDODR Register (Offset = D2h) [reset = 0h]

GPDODR is shown in [Figure 6-64](#) and described in [Table 6-76](#).

Return to [Summary Table](#).

GPIO D Open Drain Output Register (GPIO96 to GPIO127)

Selects between normal and open-drain output for the GPIO pin.

0: Normal Output

1: Open Drain Output

Reading the register returns the current value of the register setting.

Note:

[1] In the Open Drain output mode, if the buffer is configured for output mode, a 0 value to be driven out comes out on the on the PAD while a 1 value to be driven out tri-states the buffer.

**Figure 6-64. GPDODR Register**

31	30	29	28	27	26	25	24
GPIO127	GPIO126	GPIO125	GPIO124	GPIO123	GPIO122	GPIO121	GPIO120
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
23	22	21	20	19	18	17	16
GPIO119	GPIO118	GPIO117	GPIO116	GPIO115	GPIO114	GPIO113	GPIO112
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
15	14	13	12	11	10	9	8
GPIO111	GPIO110	GPIO109	GPIO108	GPIO107	GPIO106	GPIO105	GPIO104
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
7	6	5	4	3	2	1	0
GPIO103	GPIO102	GPIO101	GPIO100	GPIO99	GPIO98	GPIO97	GPIO96
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h

**Table 6-76. GPDODR Register Field Descriptions**

Bit	Field	Type	Reset	Description
31	GPIO127	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
30	GPIO126	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
29	GPIO125	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
28	GPIO124	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
27	GPIO123	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
26	GPIO122	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
25	GPIO121	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
24	GPIO120	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
23	GPIO119	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
22	GPIO118	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn

**Table 6-76. GPDODR Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
21	GPIO117	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
20	GPIO116	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
19	GPIO115	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
18	GPIO114	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
17	GPIO113	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
16	GPIO112	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
15	GPIO111	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
14	GPIO110	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
13	GPIO109	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
12	GPIO108	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
11	GPIO107	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
10	GPIO106	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
9	GPIO105	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
8	GPIO104	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
7	GPIO103	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
6	GPIO102	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
5	GPIO101	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
4	GPIO100	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
3	GPIO99	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
2	GPIO98	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
1	GPIO97	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
0	GPIO96	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn

### 6.9.2.62 GPDGMUX1 Register (Offset = E0h) [reset = 0h]

GPDGMUX1 is shown in [Figure 6-65](#) and described in [Table 6-77](#).

Return to [Summary Table](#).

GPIO D Peripheral Group Mux (GPIO96 to 111)

Defines pin-muxing selection for GPIO.

Note: For complete pin-mux selection on GPIOx, GPAMUXy.GPIOx configuration is also required.

**Figure 6-65. GPDGMUX1 Register**

31	30	29	28	27	26	25	24
GPIO111		GPIO110		GPIO109		GPIO108	
R/W-0h		R/W-0h		R/W-0h		R/W-0h	
23	22	21	20	19	18	17	16
GPIO107		GPIO106		GPIO105		GPIO104	
R/W-0h		R/W-0h		R/W-0h		R/W-0h	
15	14	13	12	11	10	9	8
GPIO103		GPIO102		GPIO101		GPIO100	
R/W-0h		R/W-0h		R/W-0h		R/W-0h	
7	6	5	4	3	2	1	0
GPIO99		GPIO98		GPIO97		GPIO96	
R/W-0h		R/W-0h		R/W-0h		R/W-0h	

**Table 6-77. GPDGMUX1 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-30	GPIO111	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
29-28	GPIO110	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
27-26	GPIO109	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
25-24	GPIO108	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
23-22	GPIO107	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
21-20	GPIO106	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
19-18	GPIO105	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
17-16	GPIO104	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
15-14	GPIO103	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
13-12	GPIO102	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
11-10	GPIO101	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
9-8	GPIO100	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
7-6	GPIO99	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn

**Table 6-77. GPDGMUX1 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
5-4	GPIO98	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
3-2	GPIO97	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
1-0	GPIO96	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn

### 6.9.2.63 GPDGMUX2 Register (Offset = E2h) [reset = 0h]

GPDGMUX2 is shown in [Figure 6-66](#) and described in [Table 6-78](#).

Return to [Summary Table](#).

GPIO D Peripheral Group Mux (GPIO112 to 127)

Defines pin-muxing selection for GPIO.

Note: For complete pin-mux selection on GPIOx, GPAMUXy.GPIOx configuration is also required.

**Figure 6-66. GPDGMUX2 Register**

31	30	29	28	27	26	25	24
GPIO127		GPIO126		GPIO125		GPIO124	
R/W-0h		R/W-0h		R/W-0h		R/W-0h	
23	22	21	20	19	18	17	16
GPIO123		GPIO122		GPIO121		GPIO120	
R/W-0h		R/W-0h		R/W-0h		R/W-0h	
15	14	13	12	11	10	9	8
GPIO119		GPIO118		GPIO117		GPIO116	
R/W-0h		R/W-0h		R/W-0h		R/W-0h	
7	6	5	4	3	2	1	0
GPIO115		GPIO114		GPIO113		GPIO112	
R/W-0h		R/W-0h		R/W-0h		R/W-0h	

**Table 6-78. GPDGMUX2 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-30	GPIO127	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
29-28	GPIO126	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
27-26	GPIO125	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
25-24	GPIO124	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
23-22	GPIO123	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
21-20	GPIO122	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
19-18	GPIO121	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
17-16	GPIO120	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
15-14	GPIO119	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
13-12	GPIO118	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
11-10	GPIO117	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
9-8	GPIO116	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
7-6	GPIO115	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn



**Table 6-78. GPDGMUX2 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
5-4	GPIO114	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
3-2	GPIO113	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
1-0	GPIO112	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn

### 6.9.2.64 GPDCSEL1 Register (Offset = E8h) [reset = 0h]

GPDCSEL1 is shown in [Figure 6-67](#) and described in [Table 6-79](#).

Return to [Summary Table](#).

GPIO D Core Select Register (GPIO96 to 103)

Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin

xx00: CPU1 selected

xx01: CPU1.CLA1 selected

xx1x: Reserved

**Figure 6-67. GPDCSEL1 Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
GPIO103				GPIO102				GPIO101				GPIO100			
R/W-0h				R/W-0h				R/W-0h				R/W-0h			
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
GPIO99				GPIO98				GPIO97				GPIO96			
R/W-0h				R/W-0h				R/W-0h				R/W-0h			

**Table 6-79. GPDCSEL1 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-28	GPIO103	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
27-24	GPIO102	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
23-20	GPIO101	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
19-16	GPIO100	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
15-12	GPIO99	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
11-8	GPIO98	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
7-4	GPIO97	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
3-0	GPIO96	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn

### 6.9.2.65 GPDCSEL2 Register (Offset = EAh) [reset = 0h]

GPDCSEL2 is shown in [Figure 6-68](#) and described in [Table 6-80](#).

Return to [Summary Table](#).

GPIO D Core Select Register (GPIO104 to 111)

Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin

xx00: CPU1 selected

xx01: CPU1.CLA1 selected

xx1x: Reserved

**Figure 6-68. GPDCSEL2 Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
GPIO111				GPIO110				GPIO109				GPIO108			
R/W-0h				R/W-0h				R/W-0h				R/W-0h			
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
GPIO107				GPIO106				GPIO105				GPIO104			
R/W-0h				R/W-0h				R/W-0h				R/W-0h			

**Table 6-80. GPDCSEL2 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-28	GPIO111	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
27-24	GPIO110	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
23-20	GPIO109	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
19-16	GPIO108	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
15-12	GPIO107	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
11-8	GPIO106	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
7-4	GPIO105	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
3-0	GPIO104	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn

### 6.9.2.66 GPDCSEL3 Register (Offset = ECh) [reset = 0h]

GPDCSEL3 is shown in [Figure 6-69](#) and described in [Table 6-81](#).

Return to [Summary Table](#).

GPIO D Core Select Register (GPIO112 to 119)

Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin

xx00: CPU1 selected

xx01: CPU1.CLA1 selected

xx1x: Reserved

**Figure 6-69. GPDCSEL3 Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
GPIO119				GPIO118				GPIO117				GPIO116			
R/W-0h				R/W-0h				R/W-0h				R/W-0h			
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
GPIO115				GPIO114				GPIO113				GPIO112			
R/W-0h				R/W-0h				R/W-0h				R/W-0h			

**Table 6-81. GPDCSEL3 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-28	GPIO119	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
27-24	GPIO118	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
23-20	GPIO117	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
19-16	GPIO116	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
15-12	GPIO115	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
11-8	GPIO114	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
7-4	GPIO113	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
3-0	GPIO112	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn

### 6.9.2.67 GPDCSEL4 Register (Offset = EEh) [reset = 0h]

GPDCSEL4 is shown in [Figure 6-70](#) and described in [Table 6-82](#).

Return to [Summary Table](#).

GPIO D Core Select Register (GPIO120 to 127)

Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin

xx00: CPU1 selected

xx01: CPU1.CLA1 selected

xx1x: Reserved

**Figure 6-70. GPDCSEL4 Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
GPIO127				GPIO126				GPIO125				GPIO124			
R/W-0h				R/W-0h				R/W-0h				R/W-0h			
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
GPIO123				GPIO122				GPIO121				GPIO120			
R/W-0h				R/W-0h				R/W-0h				R/W-0h			

**Table 6-82. GPDCSEL4 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-28	GPIO127	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
27-24	GPIO126	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
23-20	GPIO125	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
19-16	GPIO124	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
15-12	GPIO123	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
11-8	GPIO122	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
7-4	GPIO121	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
3-0	GPIO120	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn

### 6.9.2.68 GPDLOCK Register (Offset = FCh) [reset = 0h]

GPDLOCK is shown in [Figure 6-71](#) and described in [Table 6-83](#).

Return to [Summary Table](#).

GPIO D Lock Configuration Register (GPIO96 to 127)

GPIO Configuration Lock for GPIO.

0: Bits in GPyMUX1, GPyMUX2, GPyDIR, GPyINV, GPyODR, GPyAMSEL, GPyGMUX1, GPyGMUX2 and GPyCSELx register which control the same pin can be changed

1: Locks changes to the bits in GPyMUX1, GPyMUX2, GPyDIR, GPyINV, GPyODR, GPyAMSEL, GPyGMUX1, GPyGMUX2 and GPyCSELx registers which control the same pin

**Figure 6-71. GPDLOCK Register**

31		30		29		28		27		26		25		24	
GPIO127		GPIO126		GPIO125		GPIO124		GPIO123		GPIO122		GPIO121		GPIO120	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	
23		22		21		20		19		18		17		16	
GPIO119		GPIO118		GPIO117		GPIO116		GPIO115		GPIO114		GPIO113		GPIO112	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	
15		14		13		12		11		10		9		8	
GPIO111		GPIO110		GPIO109		GPIO108		GPIO107		GPIO106		GPIO105		GPIO104	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	
7		6		5		4		3		2		1		0	
GPIO103		GPIO102		GPIO101		GPIO100		GPIO99		GPIO98		GPIO97		GPIO96	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	

**Table 6-83. GPDLOCK Register Field Descriptions**

Bit	Field	Type	Reset	Description
31	GPIO127	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
30	GPIO126	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
29	GPIO125	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
28	GPIO124	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
27	GPIO123	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
26	GPIO122	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
25	GPIO121	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
24	GPIO120	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
23	GPIO119	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
22	GPIO118	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
21	GPIO117	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn

**Table 6-83. GPDLOCK Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
20	GPIO116	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
19	GPIO115	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
18	GPIO114	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
17	GPIO113	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
16	GPIO112	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
15	GPIO111	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
14	GPIO110	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
13	GPIO109	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
12	GPIO108	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
11	GPIO107	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
10	GPIO106	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
9	GPIO105	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
8	GPIO104	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
7	GPIO103	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
6	GPIO102	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
5	GPIO101	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
4	GPIO100	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
3	GPIO99	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
2	GPIO98	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
1	GPIO97	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
0	GPIO96	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn

### 6.9.2.69 GPDCR Register (Offset = FEh) [reset = 0h]

GPDCR is shown in [Figure 6-72](#) and described in [Table 6-84](#).

Return to [Summary Table](#).

GPIO D Lock Commit Register (GPIO96 to 127)

GPIO Configuration Lock Commit for GPIO:

- 1: Locks changes to the bit in GPyLOCK register which controls the same pin
- 0: Bit in the GPyLOCK register which controls the same pin can be changed

**Figure 6-72. GPDCR Register**

31	30	29	28	27	26	25	24
GPIO127	GPIO126	GPIO125	GPIO124	GPIO123	GPIO122	GPIO121	GPIO120
R/WOnce-0h	R/WOnce-0h	R/WOnce-0h	R/WOnce-0h	R/WOnce-0h	R/WOnce-0h	R/WOnce-0h	R/WOnce-0h
23	22	21	20	19	18	17	16
GPIO119	GPIO118	GPIO117	GPIO116	GPIO115	GPIO114	GPIO113	GPIO112
R/WOnce-0h	R/WOnce-0h	R/WOnce-0h	R/WOnce-0h	R/WOnce-0h	R/WOnce-0h	R/WOnce-0h	R/WOnce-0h
15	14	13	12	11	10	9	8
GPIO111	GPIO110	GPIO109	GPIO108	GPIO107	GPIO106	GPIO105	GPIO104
R/WOnce-0h	R/WOnce-0h	R/WOnce-0h	R/WOnce-0h	R/WOnce-0h	R/WOnce-0h	R/WOnce-0h	R/WOnce-0h
7	6	5	4	3	2	1	0
GPIO103	GPIO102	GPIO101	GPIO100	GPIO99	GPIO98	GPIO97	GPIO96
R/WOnce-0h	R/WOnce-0h	R/WOnce-0h	R/WOnce-0h	R/WOnce-0h	R/WOnce-0h	R/WOnce-0h	R/WOnce-0h

**Table 6-84. GPDCR Register Field Descriptions**

Bit	Field	Type	Reset	Description
31	GPIO127	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
30	GPIO126	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
29	GPIO125	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
28	GPIO124	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
27	GPIO123	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
26	GPIO122	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
25	GPIO121	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
24	GPIO120	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
23	GPIO119	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
22	GPIO118	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
21	GPIO117	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
20	GPIO116	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn



**Table 6-84. GPDCR Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
19	GPIO115	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
18	GPIO114	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
17	GPIO113	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
16	GPIO112	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
15	GPIO111	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
14	GPIO110	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
13	GPIO109	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
12	GPIO108	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
11	GPIO107	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
10	GPIO106	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
9	GPIO105	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
8	GPIO104	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
7	GPIO103	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
6	GPIO102	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
5	GPIO101	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
4	GPIO100	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
3	GPIO99	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
2	GPIO98	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
1	GPIO97	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
0	GPIO96	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn

### 6.9.2.70 GPECTRL Register (Offset = 100h) [reset = 0h]

GPECTRL is shown in [Figure 6-73](#) and described in [Table 6-85](#).

Return to [Summary Table](#).

GPIO E Qualification Sampling Period Control (GPIO128 to 159)

**Figure 6-73. GPECTRL Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
QUALPRD3								QUALPRD2								QUALPRD1								QUALPRD0							
R/W-0h								R/W-0h								R/W-0h								R/W-0h							

**Table 6-85. GPECTRL Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-24	QUALPRD3	R/W	0h	Qualification sampling period for GPIO152 to GPIO159: 0x00, QUALPRDx = PLLSYSCLK 0x01, QUALPRDx = PLLSYSCLK/2 0x02, QUALPRDx = PLLSYSCLK/4 .... 0xFF, QUALPRDx = PLLSYSCLK/510 Reset type: SYSRSn
23-16	QUALPRD2	R/W	0h	Qualification sampling period for GPIO144 to GPIO151: 0x00, QUALPRDx = PLLSYSCLK 0x01, QUALPRDx = PLLSYSCLK/2 0x02, QUALPRDx = PLLSYSCLK/4 .... 0xFF, QUALPRDx = PLLSYSCLK/510 Reset type: SYSRSn
15-8	QUALPRD1	R/W	0h	Qualification sampling period for GPIO136 to GPIO143: 0x00, QUALPRDx = PLLSYSCLK 0x01, QUALPRDx = PLLSYSCLK/2 0x02, QUALPRDx = PLLSYSCLK/4 .... 0xFF, QUALPRDx = PLLSYSCLK/510 Reset type: SYSRSn
7-0	QUALPRD0	R/W	0h	Qualification sampling period for GPIO128 to GPIO135: 0x00, QUALPRDx = PLLSYSCLK 0x01, QUALPRDx = PLLSYSCLK/2 0x02, QUALPRDx = PLLSYSCLK/4 .... 0xFF, QUALPRDx = PLLSYSCLK/510 Reset type: SYSRSn

**6.9.2.71 GPEQSEL1 Register (Offset = 102h) [reset = 0h]**

GPEQSEL1 is shown in [Figure 6-74](#) and described in [Table 6-86](#).

Return to [Summary Table](#).

GPIO E Qualifier Select 1 Register (GPIO128 to 143)

Input qualification type:

0,0 Sync

0,1 Qualification (3 samples)

1,0 Qualification (6 samples)

1,1 Async (no Sync or Qualification)

**Figure 6-74. GPEQSEL1 Register**

31	30	29	28	27	26	25	24
GPIO143		GPIO142		GPIO141		GPIO140	
R/W-0h		R/W-0h		R/W-0h		R/W-0h	
23	22	21	20	19	18	17	16
GPIO139		GPIO138		GPIO137		GPIO136	
R/W-0h		R/W-0h		R/W-0h		R/W-0h	
15	14	13	12	11	10	9	8
GPIO135		GPIO134		GPIO133		GPIO132	
R/W-0h		R/W-0h		R/W-0h		R/W-0h	
7	6	5	4	3	2	1	0
GPIO131		GPIO130		GPIO129		GPIO128	
R/W-0h		R/W-0h		R/W-0h		R/W-0h	

**Table 6-86. GPEQSEL1 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-30	GPIO143	R/W	0h	Input qualification type Reset type: SYSRSn
29-28	GPIO142	R/W	0h	Input qualification type Reset type: SYSRSn
27-26	GPIO141	R/W	0h	Input qualification type Reset type: SYSRSn
25-24	GPIO140	R/W	0h	Input qualification type Reset type: SYSRSn
23-22	GPIO139	R/W	0h	Input qualification type Reset type: SYSRSn
21-20	GPIO138	R/W	0h	Input qualification type Reset type: SYSRSn
19-18	GPIO137	R/W	0h	Input qualification type Reset type: SYSRSn
17-16	GPIO136	R/W	0h	Input qualification type Reset type: SYSRSn
15-14	GPIO135	R/W	0h	Input qualification type Reset type: SYSRSn
13-12	GPIO134	R/W	0h	Input qualification type Reset type: SYSRSn
11-10	GPIO133	R/W	0h	Input qualification type Reset type: SYSRSn
9-8	GPIO132	R/W	0h	Input qualification type Reset type: SYSRSn

**Table 6-86. GPEQSEL1 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
7-6	GPIO131	R/W	0h	Input qualification type Reset type: SYSRSn
5-4	GPIO130	R/W	0h	Input qualification type Reset type: SYSRSn
3-2	GPIO129	R/W	0h	Input qualification type Reset type: SYSRSn
1-0	GPIO128	R/W	0h	Input qualification type Reset type: SYSRSn

### 6.9.2.72 GPEQSEL2 Register (Offset = 104h) [reset = 0h]

GPEQSEL2 is shown in [Figure 6-75](#) and described in [Table 6-87](#).

Return to [Summary Table](#).

GPIO E Qualifier Select 2 Register (GPIO144 to 159)

Input qualification type:

0,0 Sync

0,1 Qualification (3 samples)

1,0 Qualification (6 samples)

1,1 Async (no Sync or Qualification)

**Figure 6-75. GPEQSEL2 Register**

31	30	29	28	27	26	25	24
GPIO159		GPIO158		GPIO157		GPIO156	
R/W-0h		R/W-0h		R/W-0h		R/W-0h	
23	22	21	20	19	18	17	16
GPIO155		GPIO154		GPIO153		GPIO152	
R/W-0h		R/W-0h		R/W-0h		R/W-0h	
15	14	13	12	11	10	9	8
GPIO151		GPIO150		GPIO149		GPIO148	
R/W-0h		R/W-0h		R/W-0h		R/W-0h	
7	6	5	4	3	2	1	0
GPIO147		GPIO146		GPIO145		GPIO144	
R/W-0h		R/W-0h		R/W-0h		R/W-0h	

**Table 6-87. GPEQSEL2 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-30	GPIO159	R/W	0h	Input qualification type Reset type: SYSRSn
29-28	GPIO158	R/W	0h	Input qualification type Reset type: SYSRSn
27-26	GPIO157	R/W	0h	Input qualification type Reset type: SYSRSn
25-24	GPIO156	R/W	0h	Input qualification type Reset type: SYSRSn
23-22	GPIO155	R/W	0h	Input qualification type Reset type: SYSRSn
21-20	GPIO154	R/W	0h	Input qualification type Reset type: SYSRSn
19-18	GPIO153	R/W	0h	Input qualification type Reset type: SYSRSn
17-16	GPIO152	R/W	0h	Input qualification type Reset type: SYSRSn
15-14	GPIO151	R/W	0h	Input qualification type Reset type: SYSRSn
13-12	GPIO150	R/W	0h	Input qualification type Reset type: SYSRSn
11-10	GPIO149	R/W	0h	Input qualification type Reset type: SYSRSn
9-8	GPIO148	R/W	0h	Input qualification type Reset type: SYSRSn

**Table 6-87. GPEQSEL2 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
7-6	GPIO147	R/W	0h	Input qualification type Reset type: SYSRSn
5-4	GPIO146	R/W	0h	Input qualification type Reset type: SYSRSn
3-2	GPIO145	R/W	0h	Input qualification type Reset type: SYSRSn
1-0	GPIO144	R/W	0h	Input qualification type Reset type: SYSRSn

### 6.9.2.73 GPEMUX1 Register (Offset = 106h) [reset = 0h]

GPEMUX1 is shown in [Figure 6-76](#) and described in [Table 6-88](#).

Return to [Summary Table](#).

GPIO E Mux 1 Register (GPIO128 to 143)

Defines pin-muxing selection for GPIO.

Notes:

The respective GPyGMUXn.GPIOz must be configured prior to this register to avoid intermediate peripheral selects being mapped to the GPIO.

**Figure 6-76. GPEMUX1 Register**

31	30	29	28	27	26	25	24
GPIO143		GPIO142		GPIO141		GPIO140	
R/W-0h		R/W-0h		R/W-0h		R/W-0h	
23	22	21	20	19	18	17	16
GPIO139		GPIO138		GPIO137		GPIO136	
R/W-0h		R/W-0h		R/W-0h		R/W-0h	
15	14	13	12	11	10	9	8
GPIO135		GPIO134		GPIO133		GPIO132	
R/W-0h		R/W-0h		R/W-0h		R/W-0h	
7	6	5	4	3	2	1	0
GPIO131		GPIO130		GPIO129		GPIO128	
R/W-0h		R/W-0h		R/W-0h		R/W-0h	

**Table 6-88. GPEMUX1 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-30	GPIO143	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
29-28	GPIO142	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
27-26	GPIO141	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
25-24	GPIO140	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
23-22	GPIO139	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
21-20	GPIO138	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
19-18	GPIO137	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
17-16	GPIO136	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
15-14	GPIO135	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
13-12	GPIO134	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
11-10	GPIO133	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
9-8	GPIO132	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn

**Table 6-88. GPOMUX1 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
7-6	GPIO131	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
5-4	GPIO130	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
3-2	GPIO129	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
1-0	GPIO128	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn



### 6.9.2.74 GPEMUX2 Register (Offset = 108h) [reset = 0h]

GPEMUX2 is shown in [Figure 6-77](#) and described in [Table 6-89](#).

Return to [Summary Table](#).

GPIO E Mux 2 Register (GPIO144 to 159)

Defines pin-muxing selection for GPIO.

Notes:

The respective GPyGMUXn.GPIOz must be configured prior to this register to avoid intermediate peripheral selects being mapped to the GPIO.

**Figure 6-77. GPEMUX2 Register**

31	30	29	28	27	26	25	24
GPIO159		GPIO158		GPIO157		GPIO156	
R/W-0h		R/W-0h		R/W-0h		R/W-0h	
23	22	21	20	19	18	17	16
GPIO155		GPIO154		GPIO153		GPIO152	
R/W-0h		R/W-0h		R/W-0h		R/W-0h	
15	14	13	12	11	10	9	8
GPIO151		GPIO150		GPIO149		GPIO148	
R/W-0h		R/W-0h		R/W-0h		R/W-0h	
7	6	5	4	3	2	1	0
GPIO147		GPIO146		GPIO145		GPIO144	
R/W-0h		R/W-0h		R/W-0h		R/W-0h	

**Table 6-89. GPEMUX2 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-30	GPIO159	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
29-28	GPIO158	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
27-26	GPIO157	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
25-24	GPIO156	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
23-22	GPIO155	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
21-20	GPIO154	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
19-18	GPIO153	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
17-16	GPIO152	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
15-14	GPIO151	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
13-12	GPIO150	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
11-10	GPIO149	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
9-8	GPIO148	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn

**Table 6-89. GPOMUX2 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
7-6	GPIO147	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
5-4	GPIO146	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
3-2	GPIO145	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
1-0	GPIO144	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn

### 6.9.2.75 GPEDIR Register (Offset = 10Ah) [reset = 0h]

GPEDIR is shown in [Figure 6-78](#) and described in [Table 6-90](#).

Return to [Summary Table](#).

GPIO E Direction Register (GPIO128 to 159)

Controls direction of GPIO pins when the specified pin is configured in GPIO mode.

0: Configures pin as input.

1: Configures pin as output.

Reading the register returns the current value of the register setting.

**Figure 6-78. GPEDIR Register**

31	30	29	28	27	26	25	24
GPIO159	GPIO158	GPIO157	GPIO156	GPIO155	GPIO154	GPIO153	GPIO152
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
23	22	21	20	19	18	17	16
GPIO151	GPIO150	GPIO149	GPIO148	GPIO147	GPIO146	GPIO145	GPIO144
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
15	14	13	12	11	10	9	8
GPIO143	GPIO142	GPIO141	GPIO140	GPIO139	GPIO138	GPIO137	GPIO136
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
7	6	5	4	3	2	1	0
GPIO135	GPIO134	GPIO133	GPIO132	GPIO131	GPIO130	GPIO129	GPIO128
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h

**Table 6-90. GPEDIR Register Field Descriptions**

Bit	Field	Type	Reset	Description
31	GPIO159	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
30	GPIO158	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
29	GPIO157	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
28	GPIO156	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
27	GPIO155	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
26	GPIO154	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
25	GPIO153	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
24	GPIO152	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
23	GPIO151	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
22	GPIO150	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
21	GPIO149	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
20	GPIO148	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn

**Table 6-90. GPEDIR Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
19	GPIO147	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
18	GPIO146	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
17	GPIO145	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
16	GPIO144	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
15	GPIO143	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
14	GPIO142	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
13	GPIO141	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
12	GPIO140	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
11	GPIO139	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
10	GPIO138	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
9	GPIO137	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
8	GPIO136	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
7	GPIO135	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
6	GPIO134	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
5	GPIO133	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
4	GPIO132	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
3	GPIO131	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
2	GPIO130	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
1	GPIO129	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
0	GPIO128	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn

### 6.9.2.76 GPEPUD Register (Offset = 10Ch) [reset = FFFFFFFFh]

GPEPUD is shown in [Figure 6-79](#) and described in [Table 6-91](#).

Return to [Summary Table](#).

GPIO E Pull Up Disable Register (GPIO128 to 159)

Disables the Pull-Up on GPIO.

0: Enables the Pull-Up.

1: Disables the Pull-Up.

Reading the register returns the current value of the register setting.

**Figure 6-79. GPEPUD Register**

31	30	29	28	27	26	25	24
GPIO159	GPIO158	GPIO157	GPIO156	GPIO155	GPIO154	GPIO153	GPIO152
R/W-1h	R/W-1h	R/W-1h	R/W-1h	R/W-1h	R/W-1h	R/W-1h	R/W-1h
23	22	21	20	19	18	17	16
GPIO151	GPIO150	GPIO149	GPIO148	GPIO147	GPIO146	GPIO145	GPIO144
R/W-1h	R/W-1h	R/W-1h	R/W-1h	R/W-1h	R/W-1h	R/W-1h	R/W-1h
15	14	13	12	11	10	9	8
GPIO143	GPIO142	GPIO141	GPIO140	GPIO139	GPIO138	GPIO137	GPIO136
R/W-1h	R/W-1h	R/W-1h	R/W-1h	R/W-1h	R/W-1h	R/W-1h	R/W-1h
7	6	5	4	3	2	1	0
GPIO135	GPIO134	GPIO133	GPIO132	GPIO131	GPIO130	GPIO129	GPIO128
R/W-1h	R/W-1h	R/W-1h	R/W-1h	R/W-1h	R/W-1h	R/W-1h	R/W-1h

**Table 6-91. GPEPUD Register Field Descriptions**

Bit	Field	Type	Reset	Description
31	GPIO159	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
30	GPIO158	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
29	GPIO157	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
28	GPIO156	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
27	GPIO155	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
26	GPIO154	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
25	GPIO153	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
24	GPIO152	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
23	GPIO151	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
22	GPIO150	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
21	GPIO149	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
20	GPIO148	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn

**Table 6-91. GPEPUD Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
19	GPIO147	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
18	GPIO146	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
17	GPIO145	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
16	GPIO144	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
15	GPIO143	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
14	GPIO142	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
13	GPIO141	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
12	GPIO140	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
11	GPIO139	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
10	GPIO138	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
9	GPIO137	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
8	GPIO136	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
7	GPIO135	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
6	GPIO134	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
5	GPIO133	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
4	GPIO132	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
3	GPIO131	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
2	GPIO130	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
1	GPIO129	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
0	GPIO128	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn

**6.9.2.77 GPEINV Register (Offset = 110h) [reset = 0h]**

GPEINV is shown in [Figure 6-80](#) and described in [Table 6-92](#).

Return to [Summary Table](#).

GPIO E Input Polarity Invert Registers (GPIO128 to 159)

Selects between non-inverted and inverted GPIO input to the device.

0: selects non-inverted GPIO input

1: selects inverted GPIO input

Reading the register returns the current value of the register setting.

**Figure 6-80. GPEINV Register**

31	30	29	28	27	26	25	24
GPIO159	GPIO158	GPIO157	GPIO156	GPIO155	GPIO154	GPIO153	GPIO152
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
23	22	21	20	19	18	17	16
GPIO151	GPIO150	GPIO149	GPIO148	GPIO147	GPIO146	GPIO145	GPIO144
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
15	14	13	12	11	10	9	8
GPIO143	GPIO142	GPIO141	GPIO140	GPIO139	GPIO138	GPIO137	GPIO136
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
7	6	5	4	3	2	1	0
GPIO135	GPIO134	GPIO133	GPIO132	GPIO131	GPIO130	GPIO129	GPIO128
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h

**Table 6-92. GPEINV Register Field Descriptions**

Bit	Field	Type	Reset	Description
31	GPIO159	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
30	GPIO158	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
29	GPIO157	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
28	GPIO156	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
27	GPIO155	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
26	GPIO154	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
25	GPIO153	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
24	GPIO152	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
23	GPIO151	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
22	GPIO150	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
21	GPIO149	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
20	GPIO148	R/W	0h	Input inversion control for this pin Reset type: SYSRSn

**Table 6-92. GPEINV Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
19	GPIO147	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
18	GPIO146	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
17	GPIO145	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
16	GPIO144	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
15	GPIO143	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
14	GPIO142	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
13	GPIO141	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
12	GPIO140	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
11	GPIO139	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
10	GPIO138	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
9	GPIO137	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
8	GPIO136	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
7	GPIO135	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
6	GPIO134	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
5	GPIO133	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
4	GPIO132	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
3	GPIO131	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
2	GPIO130	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
1	GPIO129	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
0	GPIO128	R/W	0h	Input inversion control for this pin Reset type: SYSRSn



### 6.9.2.78 GPEODR Register (Offset = 112h) [reset = 0h]

GPEODR is shown in [Figure 6-81](#) and described in [Table 6-93](#).

Return to [Summary Table](#).

GPIO E Open Drain Output Register (GPIO128 to GPIO159)

Selects between normal and open-drain output for the GPIO pin.

0: Normal Output

1: Open Drain Output

Reading the register returns the current value of the register setting.

Note:

[1] In the Open Drain output mode, if the buffer is configured for output mode, a 0 value to be driven out comes out on the on the PAD while a 1 value to be driven out tri-states the buffer.

**Figure 6-81. GPEODR Register**

31	30	29	28	27	26	25	24
GPIO159	GPIO158	GPIO157	GPIO156	GPIO155	GPIO154	GPIO153	GPIO152
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
23	22	21	20	19	18	17	16
GPIO151	GPIO150	GPIO149	GPIO148	GPIO147	GPIO146	GPIO145	GPIO144
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
15	14	13	12	11	10	9	8
GPIO143	GPIO142	GPIO141	GPIO140	GPIO139	GPIO138	GPIO137	GPIO136
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
7	6	5	4	3	2	1	0
GPIO135	GPIO134	GPIO133	GPIO132	GPIO131	GPIO130	GPIO129	GPIO128
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h

**Table 6-93. GPEODR Register Field Descriptions**

Bit	Field	Type	Reset	Description
31	GPIO159	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
30	GPIO158	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
29	GPIO157	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
28	GPIO156	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
27	GPIO155	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
26	GPIO154	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
25	GPIO153	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
24	GPIO152	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
23	GPIO151	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
22	GPIO150	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn

**Table 6-93. GPEODR Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
21	GPIO149	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
20	GPIO148	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
19	GPIO147	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
18	GPIO146	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
17	GPIO145	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
16	GPIO144	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
15	GPIO143	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
14	GPIO142	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
13	GPIO141	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
12	GPIO140	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
11	GPIO139	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
10	GPIO138	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
9	GPIO137	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
8	GPIO136	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
7	GPIO135	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
6	GPIO134	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
5	GPIO133	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
4	GPIO132	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
3	GPIO131	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
2	GPIO130	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
1	GPIO129	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
0	GPIO128	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn

### 6.9.2.79 GPEGMUX1 Register (Offset = 120h) [reset = 0h]

GPEGMUX1 is shown in [Figure 6-82](#) and described in [Table 6-94](#).

Return to [Summary Table](#).

GPIO E Peripheral Group Mux (GPIO128 to 143)

Defines pin-muxing selection for GPIO.

Note: For complete pin-mux selection on GPIOx, GPAMUXy.GPIOx configuration is also required.

**Figure 6-82. GPEGMUX1 Register**

31	30	29	28	27	26	25	24
GPIO143		GPIO142		GPIO141		GPIO140	
R/W-0h		R/W-0h		R/W-0h		R/W-0h	
23	22	21	20	19	18	17	16
GPIO139		GPIO138		GPIO137		GPIO136	
R/W-0h		R/W-0h		R/W-0h		R/W-0h	
15	14	13	12	11	10	9	8
GPIO135		GPIO134		GPIO133		GPIO132	
R/W-0h		R/W-0h		R/W-0h		R/W-0h	
7	6	5	4	3	2	1	0
GPIO131		GPIO130		GPIO129		GPIO128	
R/W-0h		R/W-0h		R/W-0h		R/W-0h	

**Table 6-94. GPEGMUX1 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-30	GPIO143	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
29-28	GPIO142	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
27-26	GPIO141	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
25-24	GPIO140	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
23-22	GPIO139	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
21-20	GPIO138	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
19-18	GPIO137	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
17-16	GPIO136	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
15-14	GPIO135	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
13-12	GPIO134	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
11-10	GPIO133	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
9-8	GPIO132	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
7-6	GPIO131	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn

**Table 6-94. GPEGMUX1 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
5-4	GPIO130	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
3-2	GPIO129	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
1-0	GPIO128	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn

### 6.9.2.80 GPEGMUX2 Register (Offset = 122h) [reset = 0h]

GPEGMUX2 is shown in [Figure 6-83](#) and described in [Table 6-95](#).

Return to [Summary Table](#).

GPIO E Peripheral Group Mux (GPIO144 to 159)

Defines pin-muxing selection for GPIO.

Note: For complete pin-mux selection on GPIOx, GPAMUXy.GPIOx configuration is also required.

**Figure 6-83. GPEGMUX2 Register**

31	30	29	28	27	26	25	24
GPIO159		GPIO158		GPIO157		GPIO156	
R/W-0h		R/W-0h		R/W-0h		R/W-0h	
23	22	21	20	19	18	17	16
GPIO155		GPIO154		GPIO153		GPIO152	
R/W-0h		R/W-0h		R/W-0h		R/W-0h	
15	14	13	12	11	10	9	8
GPIO151		GPIO150		GPIO149		GPIO148	
R/W-0h		R/W-0h		R/W-0h		R/W-0h	
7	6	5	4	3	2	1	0
GPIO147		GPIO146		GPIO145		GPIO144	
R/W-0h		R/W-0h		R/W-0h		R/W-0h	

**Table 6-95. GPEGMUX2 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-30	GPIO159	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
29-28	GPIO158	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
27-26	GPIO157	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
25-24	GPIO156	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
23-22	GPIO155	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
21-20	GPIO154	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
19-18	GPIO153	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
17-16	GPIO152	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
15-14	GPIO151	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
13-12	GPIO150	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
11-10	GPIO149	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
9-8	GPIO148	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
7-6	GPIO147	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn

**Table 6-95. GPEGMUX2 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
5-4	GPIO146	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
3-2	GPIO145	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
1-0	GPIO144	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn

### 6.9.2.81 GPECSEL1 Register (Offset = 128h) [reset = 0h]

GPECSEL1 is shown in [Figure 6-84](#) and described in [Table 6-96](#).

Return to [Summary Table](#).

GPIO E Core Select Register (GPIO128 to 135)

Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin

xx00: CPU1 selected

xx01: CPU1.CLA1 selected

xx1x: Reserved

**Figure 6-84. GPECSEL1 Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
GPIO135				GPIO134				GPIO133				GPIO132			
R/W-0h				R/W-0h				R/W-0h				R/W-0h			
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
GPIO131				GPIO130				GPIO129				GPIO128			
R/W-0h				R/W-0h				R/W-0h				R/W-0h			

**Table 6-96. GPECSEL1 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-28	GPIO135	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
27-24	GPIO134	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
23-20	GPIO133	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
19-16	GPIO132	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
15-12	GPIO131	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
11-8	GPIO130	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
7-4	GPIO129	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
3-0	GPIO128	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn

### 6.9.2.82 GPECSEL2 Register (Offset = 12Ah) [reset = 0h]

GPECSEL2 is shown in [Figure 6-85](#) and described in [Table 6-97](#).

Return to [Summary Table](#).

GPIO E Core Select Register (GPIO136 to 143)

Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin

xx00: CPU1 selected

xx01: CPU1.CLA1 selected

xx1x: Reserved

**Figure 6-85. GPECSEL2 Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
GPIO143				GPIO142				GPIO141				GPIO140			
R/W-0h				R/W-0h				R/W-0h				R/W-0h			
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
GPIO139				GPIO138				GPIO137				GPIO136			
R/W-0h				R/W-0h				R/W-0h				R/W-0h			

**Table 6-97. GPECSEL2 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-28	GPIO143	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
27-24	GPIO142	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
23-20	GPIO141	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
19-16	GPIO140	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
15-12	GPIO139	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
11-8	GPIO138	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
7-4	GPIO137	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
3-0	GPIO136	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn



### 6.9.2.83 GPECSEL3 Register (Offset = 12Ch) [reset = 0h]

GPECSEL3 is shown in [Figure 6-86](#) and described in [Table 6-98](#).

Return to [Summary Table](#).

GPIO E Core Select Register (GPIO144 to 151)

Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin

xx00: CPU1 selected

xx01: CPU1.CLA1 selected

xx1x: Reserved

**Figure 6-86. GPECSEL3 Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
GPIO151				GPIO150				GPIO149				GPIO148			
R/W-0h				R/W-0h				R/W-0h				R/W-0h			
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
GPIO147				GPIO146				GPIO145				GPIO144			
R/W-0h				R/W-0h				R/W-0h				R/W-0h			

**Table 6-98. GPECSEL3 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-28	GPIO151	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
27-24	GPIO150	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
23-20	GPIO149	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
19-16	GPIO148	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
15-12	GPIO147	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
11-8	GPIO146	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
7-4	GPIO145	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
3-0	GPIO144	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn

### 6.9.2.84 GPECSEL4 Register (Offset = 12Eh) [reset = 0h]

GPECSEL4 is shown in [Figure 6-87](#) and described in [Table 6-99](#).

Return to [Summary Table](#).

GPIO E Core Select Register (GPIO152 to 159)

Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin

xx00: CPU1 selected

xx01: CPU1.CLA1 selected

xx1x: Reserved

**Figure 6-87. GPECSEL4 Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
GPIO159				GPIO158				GPIO157				GPIO156			
R/W-0h				R/W-0h				R/W-0h				R/W-0h			
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
GPIO155				GPIO154				GPIO153				GPIO152			
R/W-0h				R/W-0h				R/W-0h				R/W-0h			

**Table 6-99. GPECSEL4 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-28	GPIO159	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
27-24	GPIO158	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
23-20	GPIO157	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
19-16	GPIO156	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
15-12	GPIO155	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
11-8	GPIO154	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
7-4	GPIO153	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
3-0	GPIO152	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn

### 6.9.2.85 GPELOCK Register (Offset = 13Ch) [reset = 0h]

GPELOCK is shown in [Figure 6-88](#) and described in [Table 6-100](#).

Return to [Summary Table](#).

GPIO E Lock Configuration Register (GPIO128 to 159)

GPIO Configuration Lock for GPIO.

0: Bits in GPyMUX1, GPyMUX2, GPyDIR, GPyINV, GPyODR, GPyAMSEL, GPyGMUX1, GPyGMUX2 and GPyCSELx register which control the same pin can be changed

1: Locks changes to the bits in GPyMUX1, GPyMUX2, GPyDIR, GPyINV, GPyODR, GPyAMSEL, GPyGMUX1, GPyGMUX2 and GPyCSELx registers which control the same pin

**Figure 6-88. GPELOCK Register**

31		30		29		28		27		26		25		24	
GPIO159	GPIO158	GPIO157	GPIO156	GPIO155	GPIO154	GPIO153	GPIO152	GPIO151	GPIO150	GPIO149	GPIO148	GPIO147	GPIO146	GPIO145	GPIO144
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
23		22		21		20		19		18		17		16	
GPIO151	GPIO150	GPIO149	GPIO148	GPIO147	GPIO146	GPIO145	GPIO144	GPIO143	GPIO142	GPIO141	GPIO140	GPIO139	GPIO138	GPIO137	GPIO136
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
15		14		13		12		11		10		9		8	
GPIO143	GPIO142	GPIO141	GPIO140	GPIO139	GPIO138	GPIO137	GPIO136	GPIO135	GPIO134	GPIO133	GPIO132	GPIO131	GPIO130	GPIO129	GPIO128
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
7		6		5		4		3		2		1		0	
GPIO135	GPIO134	GPIO133	GPIO132	GPIO131	GPIO130	GPIO129	GPIO128	GPIO127	GPIO126	GPIO125	GPIO124	GPIO123	GPIO122	GPIO121	GPIO120
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h

**Table 6-100. GPELOCK Register Field Descriptions**

Bit	Field	Type	Reset	Description
31	GPIO159	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
30	GPIO158	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
29	GPIO157	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
28	GPIO156	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
27	GPIO155	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
26	GPIO154	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
25	GPIO153	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
24	GPIO152	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
23	GPIO151	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
22	GPIO150	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
21	GPIO149	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn

**Table 6-100. GPELOCK Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
20	GPIO148	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
19	GPIO147	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
18	GPIO146	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
17	GPIO145	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
16	GPIO144	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
15	GPIO143	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
14	GPIO142	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
13	GPIO141	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
12	GPIO140	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
11	GPIO139	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
10	GPIO138	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
9	GPIO137	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
8	GPIO136	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
7	GPIO135	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
6	GPIO134	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
5	GPIO133	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
4	GPIO132	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
3	GPIO131	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
2	GPIO130	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
1	GPIO129	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
0	GPIO128	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn

### 6.9.2.86 GPECR Register (Offset = 13Eh) [reset = 0h]

GPECR is shown in [Figure 6-89](#) and described in [Table 6-101](#).

Return to [Summary Table](#).

GPIO E Lock Commit Register (GPIO128 to 159)

GPIO Configuration Lock Commit for GPIO:

- 1: Locks changes to the bit in GPyLOCK register which controls the same pin
- 0: Bit in the GPyLOCK register which controls the same pin can be changed

**Figure 6-89. GPECR Register**

31		30		29		28		27		26		25		24	
GPIO159		GPIO158		GPIO157		GPIO156		GPIO155		GPIO154		GPIO153		GPIO152	
R/WOnce-0h		R/WOnce-0h		R/WOnce-0h		R/WOnce-0h		R/WOnce-0h		R/WOnce-0h		R/WOnce-0h		R/WOnce-0h	
23		22		21		20		19		18		17		16	
GPIO151		GPIO150		GPIO149		GPIO148		GPIO147		GPIO146		GPIO145		GPIO144	
R/WOnce-0h		R/WOnce-0h		R/WOnce-0h		R/WOnce-0h		R/WOnce-0h		R/WOnce-0h		R/WOnce-0h		R/WOnce-0h	
15		14		13		12		11		10		9		8	
GPIO143		GPIO142		GPIO141		GPIO140		GPIO139		GPIO138		GPIO137		GPIO136	
R/WOnce-0h		R/WOnce-0h		R/WOnce-0h		R/WOnce-0h		R/WOnce-0h		R/WOnce-0h		R/WOnce-0h		R/WOnce-0h	
7		6		5		4		3		2		1		0	
GPIO135		GPIO134		GPIO133		GPIO132		GPIO131		GPIO130		GPIO129		GPIO128	
R/WOnce-0h		R/WOnce-0h		R/WOnce-0h		R/WOnce-0h		R/WOnce-0h		R/WOnce-0h		R/WOnce-0h		R/WOnce-0h	

**Table 6-101. GPECR Register Field Descriptions**

Bit	Field	Type	Reset	Description
31	GPIO159	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
30	GPIO158	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
29	GPIO157	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
28	GPIO156	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
27	GPIO155	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
26	GPIO154	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
25	GPIO153	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
24	GPIO152	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
23	GPIO151	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
22	GPIO150	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
21	GPIO149	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
20	GPIO148	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn

**Table 6-101. GPECR Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
19	GPIO147	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
18	GPIO146	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
17	GPIO145	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
16	GPIO144	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
15	GPIO143	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
14	GPIO142	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
13	GPIO141	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
12	GPIO140	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
11	GPIO139	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
10	GPIO138	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
9	GPIO137	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
8	GPIO136	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
7	GPIO135	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
6	GPIO134	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
5	GPIO133	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
4	GPIO132	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
3	GPIO131	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
2	GPIO130	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
1	GPIO129	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
0	GPIO128	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn

**6.9.2.87 GPFCTRL Register (Offset = 140h) [reset = 0h]**

GPFCTRL is shown in [Figure 6-90](#) and described in [Table 6-102](#).

Return to [Summary Table](#).

GPIO F Qualification Sampling Period Control (GPIO160 to 168)

**Figure 6-90. GPFCTRL Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
RESERVED								RESERVED								QUALPRD1								QUALPRD0							
R-0h								R-0h								R/W-0h								R/W-0h							

**Table 6-102. GPFCTRL Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-24	RESERVED	R	0h	Reserved
23-16	RESERVED	R	0h	Reserved
15-8	QUALPRD1	R/W	0h	Qualification sampling period for GPIO168: 0x00,QUALPRDx = PLLSYSCLK 0x01,QUALPRDx = PLLSYSCLK/2 0x02,QUALPRDx = PLLSYSCLK/4 .... 0xFF,QUALPRDx = PLLSYSCLK/510 Reset type: SYSRSn
7-0	QUALPRD0	R/W	0h	Qualification sampling period for GPIO160 to GPIO167: 0x00,QUALPRDx = PLLSYSCLK 0x01,QUALPRDx = PLLSYSCLK/2 0x02,QUALPRDx = PLLSYSCLK/4 .... 0xFF,QUALPRDx = PLLSYSCLK/510 Reset type: SYSRSn

**6.9.2.88 GPFQSEL1 Register (Offset = 142h) [reset = 0h]**

GPFQSEL1 is shown in [Figure 6-91](#) and described in [Table 6-103](#).

Return to [Summary Table](#).

GPIO F Qualifier Select 1 Register (GPIO160 to 168)

Input qualification type:

0,0 Sync

0,1 Qualification (3 samples)

1,0 Qualification (6 samples)

1,1 Async (no Sync or Qualification)

**Figure 6-91. GPFQSEL1 Register**

31	30	29	28	27	26	25	24
RESERVED		RESERVED		RESERVED		RESERVED	
R-0h		R-0h		R-0h		R-0h	
23	22	21	20	19	18	17	16
RESERVED		RESERVED		RESERVED		GPIO168	
R-0h		R-0h		R-0h		R/W-0h	
15	14	13	12	11	10	9	8
GPIO167		GPIO166		GPIO165		GPIO164	
R/W-0h		R/W-0h		R/W-0h		R/W-0h	
7	6	5	4	3	2	1	0
GPIO163		GPIO162		GPIO161		GPIO160	
R/W-0h		R/W-0h		R/W-0h		R/W-0h	

**Table 6-103. GPFQSEL1 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-30	RESERVED	R	0h	Reserved
29-28	RESERVED	R	0h	Reserved
27-26	RESERVED	R	0h	Reserved
25-24	RESERVED	R	0h	Reserved
23-22	RESERVED	R	0h	Reserved
21-20	RESERVED	R	0h	Reserved
19-18	RESERVED	R	0h	Reserved
17-16	GPIO168	R/W	0h	Input qualification type Reset type: SYSRSn
15-14	GPIO167	R/W	0h	Input qualification type Reset type: SYSRSn
13-12	GPIO166	R/W	0h	Input qualification type Reset type: SYSRSn
11-10	GPIO165	R/W	0h	Input qualification type Reset type: SYSRSn
9-8	GPIO164	R/W	0h	Input qualification type Reset type: SYSRSn
7-6	GPIO163	R/W	0h	Input qualification type Reset type: SYSRSn
5-4	GPIO162	R/W	0h	Input qualification type Reset type: SYSRSn
3-2	GPIO161	R/W	0h	Input qualification type Reset type: SYSRSn



**Table 6-103. GPFQSEL1 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
1-0	GPIO160	R/W	0h	Input qualification type Reset type: SYSRSn

### 6.9.2.89 GPFMUX1 Register (Offset = 146h) [reset = 0h]

GPFMUX1 is shown in [Figure 6-92](#) and described in [Table 6-104](#).

Return to [Summary Table](#).

GPIO F Mux 1 Register (GPIO160 to 168)

Defines pin-muxing selection for GPIO.

Notes:

The respective GPyGMUXn.GPIOz must be configured prior to this register to avoid intermediate peripheral selects being mapped to the GPIO.

**Figure 6-92. GPFMUX1 Register**

31	30	29	28	27	26	25	24
RESERVED		RESERVED		RESERVED		RESERVED	
R-0h		R-0h		R-0h		R-0h	
23	22	21	20	19	18	17	16
RESERVED		RESERVED		RESERVED		GPIO168	
R-0h		R-0h		R-0h		R/W-0h	
15	14	13	12	11	10	9	8
GPIO167		GPIO166		GPIO165		GPIO164	
R/W-0h		R/W-0h		R/W-0h		R/W-0h	
7	6	5	4	3	2	1	0
GPIO163		GPIO162		GPIO161		GPIO160	
R/W-0h		R/W-0h		R/W-0h		R/W-0h	

**Table 6-104. GPFMUX1 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-30	RESERVED	R	0h	Reserved
29-28	RESERVED	R	0h	Reserved
27-26	RESERVED	R	0h	Reserved
25-24	RESERVED	R	0h	Reserved
23-22	RESERVED	R	0h	Reserved
21-20	RESERVED	R	0h	Reserved
19-18	RESERVED	R	0h	Reserved
17-16	GPIO168	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
15-14	GPIO167	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
13-12	GPIO166	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
11-10	GPIO165	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
9-8	GPIO164	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
7-6	GPIO163	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
5-4	GPIO162	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
3-2	GPIO161	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn

**Table 6-104. GPFMUX1 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
1-0	GPIO160	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn

### 6.9.2.90 GPFDIR Register (Offset = 14Ah) [reset = 0h]

GPFDIR is shown in [Figure 6-93](#) and described in [Table 6-105](#).

Return to [Summary Table](#).

GPIO F Direction Register (GPIO160 to 168)

Controls direction of GPIO pins when the specified pin is configured in GPIO mode.

0: Configures pin as input.

1: Configures pin as output.

Reading the register returns the current value of the register setting.

**Figure 6-93. GPFDIR Register**

31	30	29	28	27	26	25	24
RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED
R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h
23	22	21	20	19	18	17	16
RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED
R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h
15	14	13	12	11	10	9	8
RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	GPIO168
R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R/W-0h
7	6	5	4	3	2	1	0
GPIO167	GPIO166	GPIO165	GPIO164	GPIO163	GPIO162	GPIO161	GPIO160
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h

**Table 6-105. GPFDIR Register Field Descriptions**

Bit	Field	Type	Reset	Description
31	RESERVED	R	0h	Reserved
30	RESERVED	R	0h	Reserved
29	RESERVED	R	0h	Reserved
28	RESERVED	R	0h	Reserved
27	RESERVED	R	0h	Reserved
26	RESERVED	R	0h	Reserved
25	RESERVED	R	0h	Reserved
24	RESERVED	R	0h	Reserved
23	RESERVED	R	0h	Reserved
22	RESERVED	R	0h	Reserved
21	RESERVED	R	0h	Reserved
20	RESERVED	R	0h	Reserved
19	RESERVED	R	0h	Reserved
18	RESERVED	R	0h	Reserved
17	RESERVED	R	0h	Reserved
16	RESERVED	R	0h	Reserved
15	RESERVED	R	0h	Reserved
14	RESERVED	R	0h	Reserved
13	RESERVED	R	0h	Reserved
12	RESERVED	R	0h	Reserved
11	RESERVED	R	0h	Reserved
10	RESERVED	R	0h	Reserved
9	RESERVED	R	0h	Reserved

**Table 6-105. GPFDIR Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
8	GPIO168	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
7	GPIO167	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
6	GPIO166	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
5	GPIO165	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
4	GPIO164	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
3	GPIO163	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
2	GPIO162	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
1	GPIO161	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn
0	GPIO160	R/W	0h	Defines direction for this pin in GPIO mode Reset type: SYSRSn

**6.9.2.91 GPFPU Register (Offset = 14Ch) [reset = FFFFFFFh]**

GPFPU is shown in [Figure 6-94](#) and described in [Table 6-106](#).

Return to [Summary Table](#).

GPIO F Pull Up Disable Register (GPIO160 to 168)

Disables the Pull-Up on GPIO.

0: Enables the Pull-Up.

1: Disables the Pull-Up.

Reading the register returns the current value of the register setting.

**Figure 6-94. GPFPU Register**

31	30	29	28	27	26	25	24
RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED
R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h
23	22	21	20	19	18	17	16
RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED
R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h
15	14	13	12	11	10	9	8
RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	GPIO168
R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R/W-1h
7	6	5	4	3	2	1	0
GPIO167	GPIO166	GPIO165	GPIO164	GPIO163	GPIO162	GPIO161	GPIO160
R/W-1h	R/W-1h	R/W-1h	R/W-1h	R/W-1h	R/W-1h	R/W-1h	R/W-1h

**Table 6-106. GPFPU Register Field Descriptions**

Bit	Field	Type	Reset	Description
31	RESERVED	R	0h	Reserved
30	RESERVED	R	0h	Reserved
29	RESERVED	R	0h	Reserved
28	RESERVED	R	0h	Reserved
27	RESERVED	R	0h	Reserved
26	RESERVED	R	0h	Reserved
25	RESERVED	R	0h	Reserved
24	RESERVED	R	0h	Reserved
23	RESERVED	R	0h	Reserved
22	RESERVED	R	0h	Reserved
21	RESERVED	R	0h	Reserved
20	RESERVED	R	0h	Reserved
19	RESERVED	R	0h	Reserved
18	RESERVED	R	0h	Reserved
17	RESERVED	R	0h	Reserved
16	RESERVED	R	0h	Reserved
15	RESERVED	R	0h	Reserved
14	RESERVED	R	0h	Reserved
13	RESERVED	R	0h	Reserved
12	RESERVED	R	0h	Reserved
11	RESERVED	R	0h	Reserved
10	RESERVED	R	0h	Reserved
9	RESERVED	R	0h	Reserved

**Table 6-106. GPPUD Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
8	GPIO168	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
7	GPIO167	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
6	GPIO166	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
5	GPIO165	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
4	GPIO164	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
3	GPIO163	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
2	GPIO162	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
1	GPIO161	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn
0	GPIO160	R/W	1h	Pull-Up Disable control for this pin Reset type: SYSRSn

### 6.9.2.92 GPFINV Register (Offset = 150h) [reset = 0h]

GPFINV is shown in [Figure 6-95](#) and described in [Table 6-107](#).

Return to [Summary Table](#).

GPIO F Input Polarity Invert Registers (GPIO160 to 168)

Selects between non-inverted and inverted GPIO input to the device.

0: selects non-inverted GPIO input

1: selects inverted GPIO input

Reading the register returns the current value of the register setting.

**Figure 6-95. GPFINV Register**

31	30	29	28	27	26	25	24
RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED
R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h
23	22	21	20	19	18	17	16
RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED
R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h
15	14	13	12	11	10	9	8
RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	GPIO168
R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R/W-0h
7	6	5	4	3	2	1	0
GPIO167	GPIO166	GPIO165	GPIO164	GPIO163	GPIO162	GPIO161	GPIO160
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h

**Table 6-107. GPFINV Register Field Descriptions**

Bit	Field	Type	Reset	Description
31	RESERVED	R	0h	Reserved
30	RESERVED	R	0h	Reserved
29	RESERVED	R	0h	Reserved
28	RESERVED	R	0h	Reserved
27	RESERVED	R	0h	Reserved
26	RESERVED	R	0h	Reserved
25	RESERVED	R	0h	Reserved
24	RESERVED	R	0h	Reserved
23	RESERVED	R	0h	Reserved
22	RESERVED	R	0h	Reserved
21	RESERVED	R	0h	Reserved
20	RESERVED	R	0h	Reserved
19	RESERVED	R	0h	Reserved
18	RESERVED	R	0h	Reserved
17	RESERVED	R	0h	Reserved
16	RESERVED	R	0h	Reserved
15	RESERVED	R	0h	Reserved
14	RESERVED	R	0h	Reserved
13	RESERVED	R	0h	Reserved
12	RESERVED	R	0h	Reserved
11	RESERVED	R	0h	Reserved
10	RESERVED	R	0h	Reserved
9	RESERVED	R	0h	Reserved



**Table 6-107. GPFINV Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
8	GPIO168	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
7	GPIO167	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
6	GPIO166	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
5	GPIO165	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
4	GPIO164	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
3	GPIO163	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
2	GPIO162	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
1	GPIO161	R/W	0h	Input inversion control for this pin Reset type: SYSRSn
0	GPIO160	R/W	0h	Input inversion control for this pin Reset type: SYSRSn

### 6.9.2.93 GPFODR Register (Offset = 152h) [reset = 0h]

GPFODR is shown in [Figure 6-96](#) and described in [Table 6-108](#).

Return to [Summary Table](#).

GPIO F Open Drain Output Register (GPIO160 to GPIO168)

Selects between normal and open-drain output for the GPIO pin.

0: Normal Output

1: Open Drain Output

Reading the register returns the current value of the register setting.

Note:

[1] In the Open Drain output mode, if the buffer is configured for output mode, a 0 value to be driven out comes out on the on the PAD while a 1 value to be driven out tri-states the buffer.

**Figure 6-96. GPFODR Register**

31	30	29	28	27	26	25	24
RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED
R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h
23	22	21	20	19	18	17	16
RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED
R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h
15	14	13	12	11	10	9	8
RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	GPIO168
R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R/W-0h
7	6	5	4	3	2	1	0
GPIO167	GPIO166	GPIO165	GPIO164	GPIO163	GPIO162	GPIO161	GPIO160
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h

**Table 6-108. GPFODR Register Field Descriptions**

Bit	Field	Type	Reset	Description
31	RESERVED	R	0h	Reserved
30	RESERVED	R	0h	Reserved
29	RESERVED	R	0h	Reserved
28	RESERVED	R	0h	Reserved
27	RESERVED	R	0h	Reserved
26	RESERVED	R	0h	Reserved
25	RESERVED	R	0h	Reserved
24	RESERVED	R	0h	Reserved
23	RESERVED	R	0h	Reserved
22	RESERVED	R	0h	Reserved
21	RESERVED	R	0h	Reserved
20	RESERVED	R	0h	Reserved
19	RESERVED	R	0h	Reserved
18	RESERVED	R	0h	Reserved
17	RESERVED	R	0h	Reserved
16	RESERVED	R	0h	Reserved
15	RESERVED	R	0h	Reserved
14	RESERVED	R	0h	Reserved
13	RESERVED	R	0h	Reserved
12	RESERVED	R	0h	Reserved
11	RESERVED	R	0h	Reserved
10	RESERVED	R	0h	Reserved

**Table 6-108. GPFODR Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
9	RESERVED	R	0h	Reserved
8	GPIO168	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
7	GPIO167	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
6	GPIO166	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
5	GPIO165	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
4	GPIO164	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
3	GPIO163	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
2	GPIO162	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
1	GPIO161	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn
0	GPIO160	R/W	0h	Output Open-Drain control for this pin Reset type: SYSRSn

**6.9.2.94 GPFGMUX1 Register (Offset = 160h) [reset = 0h]**

GPFGMUX1 is shown in [Figure 6-97](#) and described in [Table 6-109](#).

Return to [Summary Table](#).

GPIO F Peripheral Group Mux (GPIO160 to 168)

Defines pin-muxing selection for GPIO.

Note: For complete pin-mux selection on GPIOx, GPAMUXy.GPIOx configuration is also required.

**Figure 6-97. GPFGMUX1 Register**

31	30	29	28	27	26	25	24
RESERVED		RESERVED		RESERVED		RESERVED	
R-0h		R-0h		R-0h		R-0h	
23	22	21	20	19	18	17	16
RESERVED		RESERVED		RESERVED		GPIO168	
R-0h		R-0h		R-0h		R/W-0h	
15	14	13	12	11	10	9	8
GPIO167		GPIO166		GPIO165		GPIO164	
R/W-0h		R/W-0h		R/W-0h		R/W-0h	
7	6	5	4	3	2	1	0
GPIO163		GPIO162		GPIO161		GPIO160	
R/W-0h		R/W-0h		R/W-0h		R/W-0h	

**Table 6-109. GPFGMUX1 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-30	RESERVED	R	0h	Reserved
29-28	RESERVED	R	0h	Reserved
27-26	RESERVED	R	0h	Reserved
25-24	RESERVED	R	0h	Reserved
23-22	RESERVED	R	0h	Reserved
21-20	RESERVED	R	0h	Reserved
19-18	RESERVED	R	0h	Reserved
17-16	GPIO168	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
15-14	GPIO167	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
13-12	GPIO166	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
11-10	GPIO165	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
9-8	GPIO164	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
7-6	GPIO163	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
5-4	GPIO162	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
3-2	GPIO161	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn
1-0	GPIO160	R/W	0h	Defines pin-muxing selection for GPIO Reset type: SYSRSn

### 6.9.2.95 GPFCSSEL1 Register (Offset = 168h) [reset = 0h]

GPFCSSEL1 is shown in [Figure 6-98](#) and described in [Table 6-110](#).

Return to [Summary Table](#).

GPIO F Core Select Register (GPIO160 to 167)

Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin

xx00: CPU1 selected

xx01: CPU1.CLA1 selected

xx1x: Reserved

**Figure 6-98. GPFCSSEL1 Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
GPIO167				GPIO166				GPIO165				GPIO164			
R/W-0h				R/W-0h				R/W-0h				R/W-0h			
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
GPIO163				GPIO162				GPIO161				GPIO160			
R/W-0h				R/W-0h				R/W-0h				R/W-0h			

**Table 6-110. GPFCSSEL1 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-28	GPIO167	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
27-24	GPIO166	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
23-20	GPIO165	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
19-16	GPIO164	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
15-12	GPIO163	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
11-8	GPIO162	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
7-4	GPIO161	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn
3-0	GPIO160	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn

### 6.9.2.96 GPFSEL2 Register (Offset = 16Ah) [reset = 0h]

GPFSEL2 is shown in [Figure 6-99](#) and described in [Table 6-111](#).

Return to [Summary Table](#).

GPIO F Core Select Register (GPIO168)

Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin

xx00: CPU1 selected

xx01: CPU1.CLA1 selected

xx1x: Reserved

**Figure 6-99. GPFSEL2 Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
RESERVED				RESERVED				RESERVED				RESERVED			
R-0h				R-0h				R-0h				R-0h			
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
RESERVED				RESERVED				RESERVED				GPIO168			
R-0h				R-0h				R-0h				R/W-0h			

**Table 6-111. GPFSEL2 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-28	RESERVED	R	0h	Reserved
27-24	RESERVED	R	0h	Reserved
23-20	RESERVED	R	0h	Reserved
19-16	RESERVED	R	0h	Reserved
15-12	RESERVED	R	0h	Reserved
11-8	RESERVED	R	0h	Reserved
7-4	RESERVED	R	0h	Reserved
3-0	GPIO168	R/W	0h	Selects which master's GPIODAT/SET/CLEAR/TOGGLE registers control this GPIO pin Reset type: SYSRSn

### 6.9.2.97 GPFLOCK Register (Offset = 17Ch) [reset = 0h]

GPFLOCK is shown in [Figure 6-100](#) and described in [Table 6-112](#).

Return to [Summary Table](#).

GPIO F Lock Configuration Register (GPIO160 to 168)

GPIO Configuration Lock for GPIO.

0: Bits in GPyMUX1, GPyMUX2, GPyDIR, GPyINV, GPyODR, GPyAMSEL, GPyGMUX1, GPyGMUX2 and GPyCSELx register which control the same pin can be changed

1: Locks changes to the bits in GPyMUX1, GPyMUX2, GPyDIR, GPyINV, GPyODR, GPyAMSEL, GPyGMUX1, GPyGMUX2 and GPyCSELx registers which control the same pin

**Figure 6-100. GPFLOCK Register**

31		30		29		28		27		26		25		24	
RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED
R-0h		R-0h		R-0h		R-0h		R-0h		R-0h		R-0h		R-0h	
23		22		21		20		19		18		17		16	
RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED
R-0h		R-0h		R-0h		R-0h		R-0h		R-0h		R-0h		R-0h	
15		14		13		12		11		10		9		8	
RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	GPIO168	
R-0h		R-0h		R-0h		R-0h		R-0h		R-0h		R-0h		R/W-0h	
7		6		5		4		3		2		1		0	
GPIO167	GPIO166	GPIO165	GPIO164	GPIO163	GPIO162	GPIO161	GPIO160								
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	

**Table 6-112. GPFLOCK Register Field Descriptions**

Bit	Field	Type	Reset	Description
31	RESERVED	R	0h	Reserved
30	RESERVED	R	0h	Reserved
29	RESERVED	R	0h	Reserved
28	RESERVED	R	0h	Reserved
27	RESERVED	R	0h	Reserved
26	RESERVED	R	0h	Reserved
25	RESERVED	R	0h	Reserved
24	RESERVED	R	0h	Reserved
23	RESERVED	R	0h	Reserved
22	RESERVED	R	0h	Reserved
21	RESERVED	R	0h	Reserved
20	RESERVED	R	0h	Reserved
19	RESERVED	R	0h	Reserved
18	RESERVED	R	0h	Reserved
17	RESERVED	R	0h	Reserved
16	RESERVED	R	0h	Reserved
15	RESERVED	R	0h	Reserved
14	RESERVED	R	0h	Reserved
13	RESERVED	R	0h	Reserved
12	RESERVED	R	0h	Reserved
11	RESERVED	R	0h	Reserved
10	RESERVED	R	0h	Reserved
9	RESERVED	R	0h	Reserved

**Table 6-112. GPFLOCK Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
8	GPIO168	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
7	GPIO167	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
6	GPIO166	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
5	GPIO165	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
4	GPIO164	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
3	GPIO163	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
2	GPIO162	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
1	GPIO161	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn
0	GPIO160	R/W	0h	Configuration Lock bit for this pin Reset type: SYSRSn



### 6.9.2.98 GPFCR Register (Offset = 17Eh) [reset = 0h]

GPFCR is shown in [Figure 6-101](#) and described in [Table 6-113](#).

Return to [Summary Table](#).

GPIO F Lock Commit Register (GPIO160 to 168)

GPIO Configuration Lock Commit for GPIO:

- 1: Locks changes to the bit in GPyLOCK register which controls the same pin
- 0: Bit in the GPyLOCK register which controls the same pin can be changed

**Figure 6-101. GPFCR Register**

31		30		29		28		27		26		25		24	
RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED
R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h
23		22		21		20		19		18		17		16	
RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED
R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h
15		14		13		12		11		10		9		8	
RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	GPIO168	
R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R/WOnce-0h	
7		6		5		4		3		2		1		0	
GPIO167	GPIO166	GPIO165	GPIO164	GPIO163	GPIO162	GPIO161	GPIO160								
R/WOnce-0h	R/WOnce-0h	R/WOnce-0h	R/WOnce-0h	R/WOnce-0h	R/WOnce-0h	R/WOnce-0h	R/WOnce-0h	R/WOnce-0h	R/WOnce-0h	R/WOnce-0h	R/WOnce-0h	R/WOnce-0h	R/WOnce-0h	R/WOnce-0h	R/WOnce-0h

**Table 6-113. GPFCR Register Field Descriptions**

Bit	Field	Type	Reset	Description
31	RESERVED	R	0h	Reserved
30	RESERVED	R	0h	Reserved
29	RESERVED	R	0h	Reserved
28	RESERVED	R	0h	Reserved
27	RESERVED	R	0h	Reserved
26	RESERVED	R	0h	Reserved
25	RESERVED	R	0h	Reserved
24	RESERVED	R	0h	Reserved
23	RESERVED	R	0h	Reserved
22	RESERVED	R	0h	Reserved
21	RESERVED	R	0h	Reserved
20	RESERVED	R	0h	Reserved
19	RESERVED	R	0h	Reserved
18	RESERVED	R	0h	Reserved
17	RESERVED	R	0h	Reserved
16	RESERVED	R	0h	Reserved
15	RESERVED	R	0h	Reserved
14	RESERVED	R	0h	Reserved
13	RESERVED	R	0h	Reserved
12	RESERVED	R	0h	Reserved
11	RESERVED	R	0h	Reserved
10	RESERVED	R	0h	Reserved
9	RESERVED	R	0h	Reserved
8	GPIO168	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn

**Table 6-113. GPFCR Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
7	GPIO167	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
6	GPIO166	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
5	GPIO165	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
4	GPIO164	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
3	GPIO163	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
2	GPIO162	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
1	GPIO161	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn
0	GPIO160	R/WOnce	0h	Configuration lock commit bit for this pin Reset type: SYSRSn

### 6.9.3 GPIO\_DATA\_REGS Registers

Table 6-114 lists the memory-mapped registers for the GPIO\_DATA\_REGS. All register offset addresses not listed in Table 6-114 should be considered as reserved locations and the register contents should not be modified.

**Table 6-114. GPIO\_DATA\_REGS Registers**

Offset	Acronym	Register Name	Write Protection	Section
0h	GPADAT	GPIO A Data Register (GPIO0 to 31)		<a href="#">Go</a>
2h	GPASET	GPIO A Data Set Register (GPIO0 to 31)		<a href="#">Go</a>
4h	GPACLEAR	GPIO A Data Clear Register (GPIO0 to 31)		<a href="#">Go</a>
6h	GPATOGGLE	GPIO A Data Toggle Register (GPIO0 to 31)		<a href="#">Go</a>
8h	GPBDAT	GPIO B Data Register (GPIO32 to 63)		<a href="#">Go</a>
Ah	GPBSET	GPIO B Data Set Register (GPIO32 to 63)		<a href="#">Go</a>
Ch	GPBCLEAR	GPIO B Data Clear Register (GPIO32 to 63)		<a href="#">Go</a>
Eh	GPBTOGGLE	GPIO B Data Toggle Register (GPIO32 to 63)		<a href="#">Go</a>
10h	GPCDAT	GPIO C Data Register (GPIO64 to 95)		<a href="#">Go</a>
12h	GPCSET	GPIO C Data Set Register (GPIO64 to 95)		<a href="#">Go</a>
14h	GPCCLEAR	GPIO C Data Clear Register (GPIO64 to 95)		<a href="#">Go</a>
16h	GPCTOGGLE	GPIO C Data Toggle Register (GPIO64 to 95)		<a href="#">Go</a>
18h	GPDDAT	GPIO D Data Register (GPIO96 to 127)		<a href="#">Go</a>
1Ah	GPDSET	GPIO D Data Set Register (GPIO96 to 127)		<a href="#">Go</a>
1Ch	GPDCLEAR	GPIO D Data Clear Register (GPIO96 to 127)		<a href="#">Go</a>
1Eh	GPDTOGGLE	GPIO D Data Toggle Register (GPIO96 to 127)		<a href="#">Go</a>
20h	GPEDAT	GPIO E Data Register (GPIO128 to 159)		<a href="#">Go</a>
22h	GPASET	GPIO E Data Set Register (GPIO128 to 159)		<a href="#">Go</a>
24h	GPETOGGLE	GPIO E Data Toggle Register (GPIO128 to 159)		<a href="#">Go</a>
26h	GPETOGGLE	GPIO E Data Toggle Register (GPIO128 to 159)		<a href="#">Go</a>
28h	GPFDAT	GPIO F Data Register (GPIO160 to 168)		<a href="#">Go</a>
2Ah	GPFSET	GPIO F Data Set Register (GPIO160 to 168)		<a href="#">Go</a>
2Ch	GPFCLEAR	GPIO F Data Clear Register (GPIO160 to 168)		<a href="#">Go</a>
2Eh	GPFTOGGLE	GPIO F Data Toggle Register (GPIO160 to 168)		<a href="#">Go</a>

Complex bit access types are encoded to fit into small table cells. Table 6-115 shows the codes that are used for access types in this section.

**Table 6-115. GPIO\_DATA\_REGS Access Type Codes**

Access Type	Code	Description
<b>Read Type</b>		
R	R	Read
<b>Write Type</b>		
W	W	Write
<b>Reset or Default Value</b>		
-n		Value after reset or the default value
<b>Register Array Variables</b>		

**Table 6-115. GPIO\_DATA\_REGS Access Type Codes (continued)**

Access Type	Code	Description
i,j,k,l,m,n		When these variables are used in a register name, an offset, or an address, they refer to the value of a register array where the register is part of a group of repeating registers. The register groups form a hierarchical structure and the array is represented with a formula.
y		When this variable is used in a register name, an offset, or an address it refers to the value of a register array.

### 6.9.3.1 GPADAT Register (Offset = 0h) [reset = 0h]

GPADAT is shown in [Figure 6-102](#) and described in [Table 6-116](#).

Return to [Summary Table](#).

GPIO A Data Register (GPIO0 to 31)

Reading this register reflects the current state of the GPIO pin regardless of which mode the GPIO is in. Writing to this register will set the GPIO pin high or low if the pin is enabled for GPIO output mode. If the GPIO is not in output mode the value written is latched but will not be reflected on the GPIO pin or reads of the GPxDAT register. The written value latched will become active when the GPIO is put into GPIO Output mode

A system reset will clear all bits and latched values to zero.

NOTE: Bit-wise read-modify-write operations should not be performed on this register. For bit-wise operations the GPxSET, GPxCLEAR, or GPxTOGGLE registers should be used instead. If direct writes to GPxDAT are necessary, the entire register should be written at one time.

**Figure 6-102. GPADAT Register**

31	30	29	28	27	26	25	24
GPIO31	GPIO30	GPIO29	GPIO28	GPIO27	GPIO26	GPIO25	GPIO24
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
23	22	21	20	19	18	17	16
GPIO23	GPIO22	GPIO21	GPIO20	GPIO19	GPIO18	GPIO17	GPIO16
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
15	14	13	12	11	10	9	8
GPIO15	GPIO14	GPIO13	GPIO12	GPIO11	GPIO10	GPIO9	GPIO8
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
7	6	5	4	3	2	1	0
GPIO7	GPIO6	GPIO5	GPIO4	GPIO3	GPIO2	GPIO1	GPIO0
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h

**Table 6-116. GPADAT Register Field Descriptions**

Bit	Field	Type	Reset	Description
31	GPIO31	R/W	0h	Data Register for this pin Reset type: SYSRSn
30	GPIO30	R/W	0h	Data Register for this pin Reset type: SYSRSn
29	GPIO29	R/W	0h	Data Register for this pin Reset type: SYSRSn
28	GPIO28	R/W	0h	Data Register for this pin Reset type: SYSRSn
27	GPIO27	R/W	0h	Data Register for this pin Reset type: SYSRSn
26	GPIO26	R/W	0h	Data Register for this pin Reset type: SYSRSn
25	GPIO25	R/W	0h	Data Register for this pin Reset type: SYSRSn
24	GPIO24	R/W	0h	Data Register for this pin Reset type: SYSRSn
23	GPIO23	R/W	0h	Data Register for this pin Reset type: SYSRSn
22	GPIO22	R/W	0h	Data Register for this pin Reset type: SYSRSn

**Table 6-116. GPADAT Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
21	GPIO21	R/W	0h	Data Register for this pin Reset type: SYSRSn
20	GPIO20	R/W	0h	Data Register for this pin Reset type: SYSRSn
19	GPIO19	R/W	0h	Data Register for this pin Reset type: SYSRSn
18	GPIO18	R/W	0h	Data Register for this pin Reset type: SYSRSn
17	GPIO17	R/W	0h	Data Register for this pin Reset type: SYSRSn
16	GPIO16	R/W	0h	Data Register for this pin Reset type: SYSRSn
15	GPIO15	R/W	0h	Data Register for this pin Reset type: SYSRSn
14	GPIO14	R/W	0h	Data Register for this pin Reset type: SYSRSn
13	GPIO13	R/W	0h	Data Register for this pin Reset type: SYSRSn
12	GPIO12	R/W	0h	Data Register for this pin Reset type: SYSRSn
11	GPIO11	R/W	0h	Data Register for this pin Reset type: SYSRSn
10	GPIO10	R/W	0h	Data Register for this pin Reset type: SYSRSn
9	GPIO9	R/W	0h	Data Register for this pin Reset type: SYSRSn
8	GPIO8	R/W	0h	Data Register for this pin Reset type: SYSRSn
7	GPIO7	R/W	0h	Data Register for this pin Reset type: SYSRSn
6	GPIO6	R/W	0h	Data Register for this pin Reset type: SYSRSn
5	GPIO5	R/W	0h	Data Register for this pin Reset type: SYSRSn
4	GPIO4	R/W	0h	Data Register for this pin Reset type: SYSRSn
3	GPIO3	R/W	0h	Data Register for this pin Reset type: SYSRSn
2	GPIO2	R/W	0h	Data Register for this pin Reset type: SYSRSn
1	GPIO1	R/W	0h	Data Register for this pin Reset type: SYSRSn
0	GPIO0	R/W	0h	Data Register for this pin Reset type: SYSRSn

### 6.9.3.2 GPASET Register (Offset = 2h) [reset = 0h]

GPASET is shown in [Figure 6-103](#) and described in [Table 6-117](#).

Return to [Summary Table](#).

GPIO A Data Set Register (GPIO0 to 31)

Writing a 1 will force GPIO output data latch to 1.

Writes of 0 are ignored.

Always reads back a 0.

**Figure 6-103. GPASET Register**

31		30		29		28		27		26		25		24	
GPIO31	GPIO30	GPIO29	GPIO28	GPIO27	GPIO26	GPIO25	GPIO24	GPIO23	GPIO22	GPIO21	GPIO20	GPIO19	GPIO18	GPIO17	GPIO16
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
23		22		21		20		19		18		17		16	
GPIO23	GPIO22	GPIO21	GPIO20	GPIO19	GPIO18	GPIO17	GPIO16	GPIO15	GPIO14	GPIO13	GPIO12	GPIO11	GPIO10	GPIO9	GPIO8
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
15		14		13		12		11		10		9		8	
GPIO15	GPIO14	GPIO13	GPIO12	GPIO11	GPIO10	GPIO9	GPIO8	GPIO7	GPIO6	GPIO5	GPIO4	GPIO3	GPIO2	GPIO1	GPIO0
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
7		6		5		4		3		2		1		0	
GPIO7	GPIO6	GPIO5	GPIO4	GPIO3	GPIO2	GPIO1	GPIO0	GPIO7	GPIO6	GPIO5	GPIO4	GPIO3	GPIO2	GPIO1	GPIO0
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h

**Table 6-117. GPASET Register Field Descriptions**

Bit	Field	Type	Reset	Description
31	GPIO31	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
30	GPIO30	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
29	GPIO29	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
28	GPIO28	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
27	GPIO27	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
26	GPIO26	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
25	GPIO25	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
24	GPIO24	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
23	GPIO23	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
22	GPIO22	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
21	GPIO21	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
20	GPIO20	R/W	0h	Output Set bit for this pin Reset type: SYSRSn

**Table 6-117. GPASET Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
19	GPIO19	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
18	GPIO18	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
17	GPIO17	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
16	GPIO16	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
15	GPIO15	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
14	GPIO14	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
13	GPIO13	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
12	GPIO12	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
11	GPIO11	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
10	GPIO10	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
9	GPIO9	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
8	GPIO8	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
7	GPIO7	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
6	GPIO6	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
5	GPIO5	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
4	GPIO4	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
3	GPIO3	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
2	GPIO2	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
1	GPIO1	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
0	GPIO0	R/W	0h	Output Set bit for this pin Reset type: SYSRSn



### 6.9.3.3 GPACLEAR Register (Offset = 4h) [reset = 0h]

GPACLEAR is shown in [Figure 6-104](#) and described in [Table 6-118](#).

Return to [Summary Table](#).

GPIO A Data Clear Register (GPIO0 to 31)

Writing a 1 will force GPIO0 output data latch to 0.

Writes of 0 are ignored.

Always reads back a 0.

**Figure 6-104. GPACLEAR Register**

31	30	29	28	27	26	25	24
GPIO31	GPIO30	GPIO29	GPIO28	GPIO27	GPIO26	GPIO25	GPIO24
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
23	22	21	20	19	18	17	16
GPIO23	GPIO22	GPIO21	GPIO20	GPIO19	GPIO18	GPIO17	GPIO16
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
15	14	13	12	11	10	9	8
GPIO15	GPIO14	GPIO13	GPIO12	GPIO11	GPIO10	GPIO9	GPIO8
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
7	6	5	4	3	2	1	0
GPIO7	GPIO6	GPIO5	GPIO4	GPIO3	GPIO2	GPIO1	GPIO0
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h

**Table 6-118. GPACLEAR Register Field Descriptions**

Bit	Field	Type	Reset	Description
31	GPIO31	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
30	GPIO30	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
29	GPIO29	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
28	GPIO28	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
27	GPIO27	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
26	GPIO26	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
25	GPIO25	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
24	GPIO24	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
23	GPIO23	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
22	GPIO22	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
21	GPIO21	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
20	GPIO20	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn

**Table 6-118. GPACLEAR Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
19	GPIO19	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
18	GPIO18	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
17	GPIO17	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
16	GPIO16	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
15	GPIO15	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
14	GPIO14	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
13	GPIO13	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
12	GPIO12	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
11	GPIO11	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
10	GPIO10	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
9	GPIO9	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
8	GPIO8	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
7	GPIO7	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
6	GPIO6	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
5	GPIO5	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
4	GPIO4	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
3	GPIO3	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
2	GPIO2	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
1	GPIO1	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
0	GPIO0	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn

### 6.9.3.4 GPATOGGLE Register (Offset = 6h) [reset = 0h]

GPATOGGLE is shown in [Figure 6-105](#) and described in [Table 6-119](#).

Return to [Summary Table](#).

GPIO A Data Toggle Register (GPIO0 to 31)

Writing a 1 will toggle GPIO0 output data latch 1 to 0 or 0 to 1.

Writes of 0 are ignored.

Always reads back a 0.

**Figure 6-105. GPATOGGLE Register**

31		30		29		28		27		26		25		24	
GPIO31		GPIO30		GPIO29		GPIO28		GPIO27		GPIO26		GPIO25		GPIO24	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	
23		22		21		20		19		18		17		16	
GPIO23		GPIO22		GPIO21		GPIO20		GPIO19		GPIO18		GPIO17		GPIO16	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	
15		14		13		12		11		10		9		8	
GPIO15		GPIO14		GPIO13		GPIO12		GPIO11		GPIO10		GPIO9		GPIO8	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	
7		6		5		4		3		2		1		0	
GPIO7		GPIO6		GPIO5		GPIO4		GPIO3		GPIO2		GPIO1		GPIO0	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	

**Table 6-119. GPATOGGLE Register Field Descriptions**

Bit	Field	Type	Reset	Description
31	GPIO31	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
30	GPIO30	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
29	GPIO29	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
28	GPIO28	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
27	GPIO27	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
26	GPIO26	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
25	GPIO25	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
24	GPIO24	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
23	GPIO23	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
22	GPIO22	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
21	GPIO21	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
20	GPIO20	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn

**Table 6-119. GPATOGGLE Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
19	GPIO19	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
18	GPIO18	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
17	GPIO17	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
16	GPIO16	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
15	GPIO15	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
14	GPIO14	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
13	GPIO13	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
12	GPIO12	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
11	GPIO11	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
10	GPIO10	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
9	GPIO9	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
8	GPIO8	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
7	GPIO7	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
6	GPIO6	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
5	GPIO5	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
4	GPIO4	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
3	GPIO3	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
2	GPIO2	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
1	GPIO1	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
0	GPIO0	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn

### 6.9.3.5 GPBDAT Register (Offset = 8h) [reset = 0h]

GPBDAT is shown in [Figure 6-106](#) and described in [Table 6-120](#).

Return to [Summary Table](#).

GPIO B Data Register (GPIO32 to 63)

Reading this register reflects the current state of the GPIO pin regardless of which mode the GPIO is in. Writing to this register will set the GPIO pin high or low if the pin is enabled for GPIO output mode. If the GPIO is not in output mode the value written is latched but will not be reflected on the GPIO pin or reads of the GPxDAT register. The written value latched will become active when the GPIO is put into GPIO Output mode

A system reset will clear all bits and latched values to zero.

NOTE: Bit-wise read-modify-write operations should not be performed on this register. For bit-wise operations the GPxSET, GPxCLEAR, or GPxTOGGLE registers should be used instead. If direct writes to GPxDAT are necessary, the entire register should be written at one time.

**Figure 6-106. GPBDAT Register**

31	30	29	28	27	26	25	24
GPIO63	GPIO62	GPIO61	GPIO60	GPIO59	GPIO58	GPIO57	GPIO56
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
23	22	21	20	19	18	17	16
GPIO55	GPIO54	GPIO53	GPIO52	GPIO51	GPIO50	GPIO49	GPIO48
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
15	14	13	12	11	10	9	8
GPIO47	GPIO46	GPIO45	GPIO44	GPIO43	GPIO42	GPIO41	GPIO40
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
7	6	5	4	3	2	1	0
GPIO39	GPIO38	GPIO37	GPIO36	GPIO35	GPIO34	GPIO33	GPIO32
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h

**Table 6-120. GPBDAT Register Field Descriptions**

Bit	Field	Type	Reset	Description
31	GPIO63	R/W	0h	Data Register for this pin Reset type: SYSRSn
30	GPIO62	R/W	0h	Data Register for this pin Reset type: SYSRSn
29	GPIO61	R/W	0h	Data Register for this pin Reset type: SYSRSn
28	GPIO60	R/W	0h	Data Register for this pin Reset type: SYSRSn
27	GPIO59	R/W	0h	Data Register for this pin Reset type: SYSRSn
26	GPIO58	R/W	0h	Data Register for this pin Reset type: SYSRSn
25	GPIO57	R/W	0h	Data Register for this pin Reset type: SYSRSn
24	GPIO56	R/W	0h	Data Register for this pin Reset type: SYSRSn
23	GPIO55	R/W	0h	Data Register for this pin Reset type: SYSRSn
22	GPIO54	R/W	0h	Data Register for this pin Reset type: SYSRSn

**Table 6-120. GPBDAT Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
21	GPIO53	R/W	0h	Data Register for this pin Reset type: SYSRSn
20	GPIO52	R/W	0h	Data Register for this pin Reset type: SYSRSn
19	GPIO51	R/W	0h	Data Register for this pin Reset type: SYSRSn
18	GPIO50	R/W	0h	Data Register for this pin Reset type: SYSRSn
17	GPIO49	R/W	0h	Data Register for this pin Reset type: SYSRSn
16	GPIO48	R/W	0h	Data Register for this pin Reset type: SYSRSn
15	GPIO47	R/W	0h	Data Register for this pin Reset type: SYSRSn
14	GPIO46	R/W	0h	Data Register for this pin Reset type: SYSRSn
13	GPIO45	R/W	0h	Data Register for this pin Reset type: SYSRSn
12	GPIO44	R/W	0h	Data Register for this pin Reset type: SYSRSn
11	GPIO43	R/W	0h	Data Register for this pin Reset type: SYSRSn
10	GPIO42	R/W	0h	Data Register for this pin Reset type: SYSRSn
9	GPIO41	R/W	0h	Data Register for this pin Reset type: SYSRSn
8	GPIO40	R/W	0h	Data Register for this pin Reset type: SYSRSn
7	GPIO39	R/W	0h	Data Register for this pin Reset type: SYSRSn
6	GPIO38	R/W	0h	Data Register for this pin Reset type: SYSRSn
5	GPIO37	R/W	0h	Data Register for this pin Reset type: SYSRSn
4	GPIO36	R/W	0h	Data Register for this pin Reset type: SYSRSn
3	GPIO35	R/W	0h	Data Register for this pin Reset type: SYSRSn
2	GPIO34	R/W	0h	Data Register for this pin Reset type: SYSRSn
1	GPIO33	R/W	0h	Data Register for this pin Reset type: SYSRSn
0	GPIO32	R/W	0h	Data Register for this pin Reset type: SYSRSn

### 6.9.3.6 GPBSET Register (Offset = Ah) [reset = 0h]

GPBSET is shown in [Figure 6-107](#) and described in [Table 6-121](#).

Return to [Summary Table](#).

GPIO B Data Set Register (GPIO32 to 63)

Writing a 1 will force GPIO output data latch to 1.

Writes of 0 are ignored.

Always reads back a 0.

**Figure 6-107. GPBSET Register**

31		30		29		28		27		26		25		24	
GPIO63		GPIO62		GPIO61		GPIO60		GPIO59		GPIO58		GPIO57		GPIO56	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	
23		22		21		20		19		18		17		16	
GPIO55		GPIO54		GPIO53		GPIO52		GPIO51		GPIO50		GPIO49		GPIO48	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	
15		14		13		12		11		10		9		8	
GPIO47		GPIO46		GPIO45		GPIO44		GPIO43		GPIO42		GPIO41		GPIO40	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	
7		6		5		4		3		2		1		0	
GPIO39		GPIO38		GPIO37		GPIO36		GPIO35		GPIO34		GPIO33		GPIO32	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	

**Table 6-121. GPBSET Register Field Descriptions**

Bit	Field	Type	Reset	Description
31	GPIO63	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
30	GPIO62	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
29	GPIO61	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
28	GPIO60	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
27	GPIO59	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
26	GPIO58	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
25	GPIO57	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
24	GPIO56	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
23	GPIO55	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
22	GPIO54	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
21	GPIO53	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
20	GPIO52	R/W	0h	Output Set bit for this pin Reset type: SYSRSn

**Table 6-121. GPBSET Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
19	GPIO51	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
18	GPIO50	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
17	GPIO49	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
16	GPIO48	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
15	GPIO47	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
14	GPIO46	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
13	GPIO45	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
12	GPIO44	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
11	GPIO43	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
10	GPIO42	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
9	GPIO41	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
8	GPIO40	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
7	GPIO39	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
6	GPIO38	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
5	GPIO37	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
4	GPIO36	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
3	GPIO35	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
2	GPIO34	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
1	GPIO33	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
0	GPIO32	R/W	0h	Output Set bit for this pin Reset type: SYSRSn



### 6.9.3.7 GPBCLEAR Register (Offset = Ch) [reset = 0h]

GPBCLEAR is shown in [Figure 6-108](#) and described in [Table 6-122](#).

Return to [Summary Table](#).

GPIO B Data Clear Register (GPIO32 to 63)

Writing a 1 will force GPIO0 output data latch to 0.

Writes of 0 are ignored.

Always reads back a 0.

**Figure 6-108. GPBCLEAR Register**

31		30		29		28		27		26		25		24	
GPIO63		GPIO62		GPIO61		GPIO60		GPIO59		GPIO58		GPIO57		GPIO56	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	
23		22		21		20		19		18		17		16	
GPIO55		GPIO54		GPIO53		GPIO52		GPIO51		GPIO50		GPIO49		GPIO48	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	
15		14		13		12		11		10		9		8	
GPIO47		GPIO46		GPIO45		GPIO44		GPIO43		GPIO42		GPIO41		GPIO40	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	
7		6		5		4		3		2		1		0	
GPIO39		GPIO38		GPIO37		GPIO36		GPIO35		GPIO34		GPIO33		GPIO32	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	

**Table 6-122. GPBCLEAR Register Field Descriptions**

Bit	Field	Type	Reset	Description
31	GPIO63	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
30	GPIO62	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
29	GPIO61	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
28	GPIO60	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
27	GPIO59	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
26	GPIO58	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
25	GPIO57	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
24	GPIO56	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
23	GPIO55	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
22	GPIO54	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
21	GPIO53	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
20	GPIO52	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn

**Table 6-122. GPBCLEAR Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
19	GPIO51	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
18	GPIO50	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
17	GPIO49	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
16	GPIO48	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
15	GPIO47	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
14	GPIO46	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
13	GPIO45	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
12	GPIO44	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
11	GPIO43	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
10	GPIO42	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
9	GPIO41	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
8	GPIO40	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
7	GPIO39	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
6	GPIO38	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
5	GPIO37	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
4	GPIO36	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
3	GPIO35	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
2	GPIO34	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
1	GPIO33	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
0	GPIO32	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn

### 6.9.3.8 GPBTOGGLE Register (Offset = Eh) [reset = 0h]

GPBTOGGLE is shown in [Figure 6-109](#) and described in [Table 6-123](#).

Return to [Summary Table](#).

GPIO B Data Toggle Register (GPIO32 to 63)

Writing a 1 will toggle GPIO0 output data latch 1 to 0 or 0 to 1.

Writes of 0 are ignored.

Always reads back a 0.

**Figure 6-109. GPBTOGGLE Register**

31		30		29		28		27		26		25		24	
GPIO63		GPIO62		GPIO61		GPIO60		GPIO59		GPIO58		GPIO57		GPIO56	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	
23		22		21		20		19		18		17		16	
GPIO55		GPIO54		GPIO53		GPIO52		GPIO51		GPIO50		GPIO49		GPIO48	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	
15		14		13		12		11		10		9		8	
GPIO47		GPIO46		GPIO45		GPIO44		GPIO43		GPIO42		GPIO41		GPIO40	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	
7		6		5		4		3		2		1		0	
GPIO39		GPIO38		GPIO37		GPIO36		GPIO35		GPIO34		GPIO33		GPIO32	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	

**Table 6-123. GPBTOGGLE Register Field Descriptions**

Bit	Field	Type	Reset	Description
31	GPIO63	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
30	GPIO62	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
29	GPIO61	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
28	GPIO60	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
27	GPIO59	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
26	GPIO58	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
25	GPIO57	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
24	GPIO56	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
23	GPIO55	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
22	GPIO54	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
21	GPIO53	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
20	GPIO52	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn

**Table 6-123. GPBTOGGLE Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
19	GPIO51	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
18	GPIO50	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
17	GPIO49	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
16	GPIO48	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
15	GPIO47	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
14	GPIO46	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
13	GPIO45	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
12	GPIO44	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
11	GPIO43	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
10	GPIO42	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
9	GPIO41	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
8	GPIO40	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
7	GPIO39	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
6	GPIO38	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
5	GPIO37	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
4	GPIO36	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
3	GPIO35	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
2	GPIO34	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
1	GPIO33	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
0	GPIO32	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn

### 6.9.3.9 GPCDAT Register (Offset = 10h) [reset = 0h]

GPCDAT is shown in [Figure 6-110](#) and described in [Table 6-124](#).

Return to [Summary Table](#).

GPIO C Data Register (GPIO64 to 95)

Reading this register reflects the current state of the GPIO pin regardless of which mode the GPIO is in. Writing to this register will set the GPIO pin high or low if the pin is enabled for GPIO output mode. If the GPIO is not in output mode the value written is latched but will not be reflected on the GPIO pin or reads of the GPxDAT register. The written value latched will become active when the GPIO is put into GPIO Output mode

A system reset will clear all bits and latched values to zero.

NOTE: Bit-wise read-modify-write operations should not be performed on this register. For bit-wise operations the GPxSET, GPxCLEAR, or GPxTOGGLE registers should be used instead. If direct writes to GPxDAT are necessary, the entire register should be written at one time.

**Figure 6-110. GPCDAT Register**

31	30	29	28	27	26	25	24
GPIO95	GPIO94	GPIO93	GPIO92	GPIO91	GPIO90	GPIO89	GPIO88
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
23	22	21	20	19	18	17	16
GPIO87	GPIO86	GPIO85	GPIO84	GPIO83	GPIO82	GPIO81	GPIO80
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
15	14	13	12	11	10	9	8
GPIO79	GPIO78	GPIO77	GPIO76	GPIO75	GPIO74	GPIO73	GPIO72
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
7	6	5	4	3	2	1	0
GPIO71	GPIO70	GPIO69	GPIO68	GPIO67	GPIO66	GPIO65	GPIO64
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h

**Table 6-124. GPCDAT Register Field Descriptions**

Bit	Field	Type	Reset	Description
31	GPIO95	R/W	0h	Data Register for this pin Reset type: SYSRSn
30	GPIO94	R/W	0h	Data Register for this pin Reset type: SYSRSn
29	GPIO93	R/W	0h	Data Register for this pin Reset type: SYSRSn
28	GPIO92	R/W	0h	Data Register for this pin Reset type: SYSRSn
27	GPIO91	R/W	0h	Data Register for this pin Reset type: SYSRSn
26	GPIO90	R/W	0h	Data Register for this pin Reset type: SYSRSn
25	GPIO89	R/W	0h	Data Register for this pin Reset type: SYSRSn
24	GPIO88	R/W	0h	Data Register for this pin Reset type: SYSRSn
23	GPIO87	R/W	0h	Data Register for this pin Reset type: SYSRSn
22	GPIO86	R/W	0h	Data Register for this pin Reset type: SYSRSn

**Table 6-124. GPCDAT Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
21	GPIO85	R/W	0h	Data Register for this pin Reset type: SYSRSn
20	GPIO84	R/W	0h	Data Register for this pin Reset type: SYSRSn
19	GPIO83	R/W	0h	Data Register for this pin Reset type: SYSRSn
18	GPIO82	R/W	0h	Data Register for this pin Reset type: SYSRSn
17	GPIO81	R/W	0h	Data Register for this pin Reset type: SYSRSn
16	GPIO80	R/W	0h	Data Register for this pin Reset type: SYSRSn
15	GPIO79	R/W	0h	Data Register for this pin Reset type: SYSRSn
14	GPIO78	R/W	0h	Data Register for this pin Reset type: SYSRSn
13	GPIO77	R/W	0h	Data Register for this pin Reset type: SYSRSn
12	GPIO76	R/W	0h	Data Register for this pin Reset type: SYSRSn
11	GPIO75	R/W	0h	Data Register for this pin Reset type: SYSRSn
10	GPIO74	R/W	0h	Data Register for this pin Reset type: SYSRSn
9	GPIO73	R/W	0h	Data Register for this pin Reset type: SYSRSn
8	GPIO72	R/W	0h	Data Register for this pin Reset type: SYSRSn
7	GPIO71	R/W	0h	Data Register for this pin Reset type: SYSRSn
6	GPIO70	R/W	0h	Data Register for this pin Reset type: SYSRSn
5	GPIO69	R/W	0h	Data Register for this pin Reset type: SYSRSn
4	GPIO68	R/W	0h	Data Register for this pin Reset type: SYSRSn
3	GPIO67	R/W	0h	Data Register for this pin Reset type: SYSRSn
2	GPIO66	R/W	0h	Data Register for this pin Reset type: SYSRSn
1	GPIO65	R/W	0h	Data Register for this pin Reset type: SYSRSn
0	GPIO64	R/W	0h	Data Register for this pin Reset type: SYSRSn

### 6.9.3.10 GPCSET Register (Offset = 12h) [reset = 0h]

GPCSET is shown in [Figure 6-111](#) and described in [Table 6-125](#).

Return to [Summary Table](#).

GPIO C Data Set Register (GPIO64 to 95)

Writing a 1 will force GPIO output data latch to 1.

Writes of 0 are ignored.

Always reads back a 0.

**Figure 6-111. GPCSET Register**

31		30		29		28		27		26		25		24	
GPIO95		GPIO94		GPIO93		GPIO92		GPIO91		GPIO90		GPIO89		GPIO88	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	
23		22		21		20		19		18		17		16	
GPIO87		GPIO86		GPIO85		GPIO84		GPIO83		GPIO82		GPIO81		GPIO80	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	
15		14		13		12		11		10		9		8	
GPIO79		GPIO78		GPIO77		GPIO76		GPIO75		GPIO74		GPIO73		GPIO72	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	
7		6		5		4		3		2		1		0	
GPIO71		GPIO70		GPIO69		GPIO68		GPIO67		GPIO66		GPIO65		GPIO64	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	

**Table 6-125. GPCSET Register Field Descriptions**

Bit	Field	Type	Reset	Description
31	GPIO95	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
30	GPIO94	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
29	GPIO93	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
28	GPIO92	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
27	GPIO91	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
26	GPIO90	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
25	GPIO89	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
24	GPIO88	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
23	GPIO87	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
22	GPIO86	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
21	GPIO85	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
20	GPIO84	R/W	0h	Output Set bit for this pin Reset type: SYSRSn

**Table 6-125. GPCSET Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
19	GPIO83	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
18	GPIO82	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
17	GPIO81	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
16	GPIO80	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
15	GPIO79	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
14	GPIO78	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
13	GPIO77	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
12	GPIO76	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
11	GPIO75	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
10	GPIO74	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
9	GPIO73	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
8	GPIO72	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
7	GPIO71	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
6	GPIO70	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
5	GPIO69	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
4	GPIO68	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
3	GPIO67	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
2	GPIO66	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
1	GPIO65	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
0	GPIO64	R/W	0h	Output Set bit for this pin Reset type: SYSRSn



### 6.9.3.11 GPCCLEAR Register (Offset = 14h) [reset = 0h]

GPCCLEAR is shown in Figure 6-112 and described in Table 6-126.

Return to [Summary Table](#).

GPIO C Data Clear Register (GPIO64 to 95)

Writing a 1 will force GPIO0 output data latch to 0.

Writes of 0 are ignored.

Always reads back a 0.

**Figure 6-112. GPCCLEAR Register**

31		30		29		28		27		26		25		24	
GPIO95		GPIO94		GPIO93		GPIO92		GPIO91		GPIO90		GPIO89		GPIO88	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	
23		22		21		20		19		18		17		16	
GPIO87		GPIO86		GPIO85		GPIO84		GPIO83		GPIO82		GPIO81		GPIO80	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	
15		14		13		12		11		10		9		8	
GPIO79		GPIO78		GPIO77		GPIO76		GPIO75		GPIO74		GPIO73		GPIO72	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	
7		6		5		4		3		2		1		0	
GPIO71		GPIO70		GPIO69		GPIO68		GPIO67		GPIO66		GPIO65		GPIO64	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	

**Table 6-126. GPCCLEAR Register Field Descriptions**

Bit	Field	Type	Reset	Description
31	GPIO95	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
30	GPIO94	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
29	GPIO93	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
28	GPIO92	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
27	GPIO91	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
26	GPIO90	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
25	GPIO89	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
24	GPIO88	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
23	GPIO87	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
22	GPIO86	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
21	GPIO85	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
20	GPIO84	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn

**Table 6-126. GPCCLEAR Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
19	GPIO83	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
18	GPIO82	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
17	GPIO81	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
16	GPIO80	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
15	GPIO79	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
14	GPIO78	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
13	GPIO77	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
12	GPIO76	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
11	GPIO75	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
10	GPIO74	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
9	GPIO73	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
8	GPIO72	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
7	GPIO71	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
6	GPIO70	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
5	GPIO69	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
4	GPIO68	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
3	GPIO67	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
2	GPIO66	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
1	GPIO65	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
0	GPIO64	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn

### 6.9.3.12 GPCTOGGLE Register (Offset = 16h) [reset = 0h]

GPCTOGGLE is shown in [Figure 6-113](#) and described in [Table 6-127](#).

Return to [Summary Table](#).

GPIO C Data Toggle Register (GPIO64 to 95)

Writing a 1 will toggle GPIO0 output data latch 1 to 0 or 0 to 1.

Writes of 0 are ignored.

Always reads back a 0.

**Figure 6-113. GPCTOGGLE Register**

31		30		29		28		27		26		25		24	
GPIO95		GPIO94		GPIO93		GPIO92		GPIO91		GPIO90		GPIO89		GPIO88	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	
23		22		21		20		19		18		17		16	
GPIO87		GPIO86		GPIO85		GPIO84		GPIO83		GPIO82		GPIO81		GPIO80	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	
15		14		13		12		11		10		9		8	
GPIO79		GPIO78		GPIO77		GPIO76		GPIO75		GPIO74		GPIO73		GPIO72	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	
7		6		5		4		3		2		1		0	
GPIO71		GPIO70		GPIO69		GPIO68		GPIO67		GPIO66		GPIO65		GPIO64	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	

**Table 6-127. GPCTOGGLE Register Field Descriptions**

Bit	Field	Type	Reset	Description
31	GPIO95	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
30	GPIO94	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
29	GPIO93	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
28	GPIO92	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
27	GPIO91	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
26	GPIO90	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
25	GPIO89	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
24	GPIO88	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
23	GPIO87	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
22	GPIO86	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
21	GPIO85	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
20	GPIO84	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn

**Table 6-127. GPCTOGGLE Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
19	GPIO83	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
18	GPIO82	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
17	GPIO81	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
16	GPIO80	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
15	GPIO79	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
14	GPIO78	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
13	GPIO77	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
12	GPIO76	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
11	GPIO75	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
10	GPIO74	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
9	GPIO73	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
8	GPIO72	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
7	GPIO71	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
6	GPIO70	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
5	GPIO69	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
4	GPIO68	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
3	GPIO67	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
2	GPIO66	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
1	GPIO65	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
0	GPIO64	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn

### 6.9.3.13 GPDDAT Register (Offset = 18h) [reset = 0h]

GPDDAT is shown in [Figure 6-114](#) and described in [Table 6-128](#).

Return to [Summary Table](#).

GPIO D Data Register (GPIO96 to 127)

Reading this register reflects the current state of the GPIO pin regardless of which mode the GPIO is in. Writing to this register will set the GPIO pin high or low if the pin is enabled for GPIO output mode. If the GPIO is not in output mode the value written is latched but will not be reflected on the GPIO pin or reads of the GPxDAT register. The written value latched will become active when the GPIO is put into GPIO Output mode

A system reset will clear all bits and latched values to zero.

NOTE: Bit-wise read-modify-write operations should not be performed on this register. For bit-wise operations the GPxSET, GPxCLEAR, or GPxTOGGLE registers should be used instead. If direct writes to GPxDAT are necessary, the entire register should be written at one time.

**Figure 6-114. GPDDAT Register**

31	30	29	28	27	26	25	24
GPIO127	GPIO126	GPIO125	GPIO124	GPIO123	GPIO122	GPIO121	GPIO120
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
23	22	21	20	19	18	17	16
GPIO119	GPIO118	GPIO117	GPIO116	GPIO115	GPIO114	GPIO113	GPIO112
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
15	14	13	12	11	10	9	8
GPIO111	GPIO110	GPIO109	GPIO108	GPIO107	GPIO106	GPIO105	GPIO104
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
7	6	5	4	3	2	1	0
GPIO103	GPIO102	GPIO101	GPIO100	GPIO99	GPIO98	GPIO97	GPIO96
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h

**Table 6-128. GPDDAT Register Field Descriptions**

Bit	Field	Type	Reset	Description
31	GPIO127	R/W	0h	Data Register for this pin Reset type: SYSRSn
30	GPIO126	R/W	0h	Data Register for this pin Reset type: SYSRSn
29	GPIO125	R/W	0h	Data Register for this pin Reset type: SYSRSn
28	GPIO124	R/W	0h	Data Register for this pin Reset type: SYSRSn
27	GPIO123	R/W	0h	Data Register for this pin Reset type: SYSRSn
26	GPIO122	R/W	0h	Data Register for this pin Reset type: SYSRSn
25	GPIO121	R/W	0h	Data Register for this pin Reset type: SYSRSn
24	GPIO120	R/W	0h	Data Register for this pin Reset type: SYSRSn
23	GPIO119	R/W	0h	Data Register for this pin Reset type: SYSRSn
22	GPIO118	R/W	0h	Data Register for this pin Reset type: SYSRSn

**Table 6-128. GPDDAT Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
21	GPIO117	R/W	0h	Data Register for this pin Reset type: SYSRSn
20	GPIO116	R/W	0h	Data Register for this pin Reset type: SYSRSn
19	GPIO115	R/W	0h	Data Register for this pin Reset type: SYSRSn
18	GPIO114	R/W	0h	Data Register for this pin Reset type: SYSRSn
17	GPIO113	R/W	0h	Data Register for this pin Reset type: SYSRSn
16	GPIO112	R/W	0h	Data Register for this pin Reset type: SYSRSn
15	GPIO111	R/W	0h	Data Register for this pin Reset type: SYSRSn
14	GPIO110	R/W	0h	Data Register for this pin Reset type: SYSRSn
13	GPIO109	R/W	0h	Data Register for this pin Reset type: SYSRSn
12	GPIO108	R/W	0h	Data Register for this pin Reset type: SYSRSn
11	GPIO107	R/W	0h	Data Register for this pin Reset type: SYSRSn
10	GPIO106	R/W	0h	Data Register for this pin Reset type: SYSRSn
9	GPIO105	R/W	0h	Data Register for this pin Reset type: SYSRSn
8	GPIO104	R/W	0h	Data Register for this pin Reset type: SYSRSn
7	GPIO103	R/W	0h	Data Register for this pin Reset type: SYSRSn
6	GPIO102	R/W	0h	Data Register for this pin Reset type: SYSRSn
5	GPIO101	R/W	0h	Data Register for this pin Reset type: SYSRSn
4	GPIO100	R/W	0h	Data Register for this pin Reset type: SYSRSn
3	GPIO99	R/W	0h	Data Register for this pin Reset type: SYSRSn
2	GPIO98	R/W	0h	Data Register for this pin Reset type: SYSRSn
1	GPIO97	R/W	0h	Data Register for this pin Reset type: SYSRSn
0	GPIO96	R/W	0h	Data Register for this pin Reset type: SYSRSn

### 6.9.3.14 GPDSET Register (Offset = 1Ah) [reset = 0h]

GPDSET is shown in [Figure 6-115](#) and described in [Table 6-129](#).

Return to [Summary Table](#).

GPIO D Data Set Register (GPIO96 to 127)

Writing a 1 will force GPIO output data latch to 1.

Writes of 0 are ignored.

Always reads back a 0.

**Figure 6-115. GPDSET Register**

31		30		29		28		27		26		25		24	
GPIO127		GPIO126		GPIO125		GPIO124		GPIO123		GPIO122		GPIO121		GPIO120	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	
23		22		21		20		19		18		17		16	
GPIO119		GPIO118		GPIO117		GPIO116		GPIO115		GPIO114		GPIO113		GPIO112	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	
15		14		13		12		11		10		9		8	
GPIO111		GPIO110		GPIO109		GPIO108		GPIO107		GPIO106		GPIO105		GPIO104	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	
7		6		5		4		3		2		1		0	
GPIO103		GPIO102		GPIO101		GPIO100		GPIO99		GPIO98		GPIO97		GPIO96	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	

**Table 6-129. GPDSET Register Field Descriptions**

Bit	Field	Type	Reset	Description
31	GPIO127	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
30	GPIO126	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
29	GPIO125	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
28	GPIO124	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
27	GPIO123	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
26	GPIO122	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
25	GPIO121	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
24	GPIO120	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
23	GPIO119	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
22	GPIO118	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
21	GPIO117	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
20	GPIO116	R/W	0h	Output Set bit for this pin Reset type: SYSRSn

**Table 6-129. GPDSET Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
19	GPIO115	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
18	GPIO114	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
17	GPIO113	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
16	GPIO112	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
15	GPIO111	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
14	GPIO110	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
13	GPIO109	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
12	GPIO108	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
11	GPIO107	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
10	GPIO106	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
9	GPIO105	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
8	GPIO104	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
7	GPIO103	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
6	GPIO102	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
5	GPIO101	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
4	GPIO100	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
3	GPIO99	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
2	GPIO98	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
1	GPIO97	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
0	GPIO96	R/W	0h	Output Set bit for this pin Reset type: SYSRSn



### 6.9.3.15 GPDCLEAR Register (Offset = 1Ch) [reset = 0h]

GPDCLEAR is shown in [Figure 6-116](#) and described in [Table 6-130](#).

Return to [Summary Table](#).

GPIO D Data Clear Register (GPIO96 to 127)

Writing a 1 will force GPIO0 output data latch to 0.

Writes of 0 are ignored.

Always reads back a 0.

**Figure 6-116. GPDCLEAR Register**

31		30		29		28		27		26		25		24	
GPIO127	GPIO126	GPIO125	GPIO124	GPIO123	GPIO122	GPIO121	GPIO120								
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h								
23		22		21		20		19		18		17		16	
GPIO119	GPIO118	GPIO117	GPIO116	GPIO115	GPIO114	GPIO113	GPIO112								
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h								
15		14		13		12		11		10		9		8	
GPIO111	GPIO110	GPIO109	GPIO108	GPIO107	GPIO106	GPIO105	GPIO104								
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h								
7		6		5		4		3		2		1		0	
GPIO103	GPIO102	GPIO101	GPIO100	GPIO99	GPIO98	GPIO97	GPIO96								
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h								

**Table 6-130. GPDCLEAR Register Field Descriptions**

Bit	Field	Type	Reset	Description
31	GPIO127	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
30	GPIO126	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
29	GPIO125	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
28	GPIO124	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
27	GPIO123	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
26	GPIO122	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
25	GPIO121	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
24	GPIO120	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
23	GPIO119	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
22	GPIO118	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
21	GPIO117	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
20	GPIO116	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn

**Table 6-130. GPDCLEAR Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
19	GPIO115	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
18	GPIO114	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
17	GPIO113	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
16	GPIO112	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
15	GPIO111	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
14	GPIO110	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
13	GPIO109	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
12	GPIO108	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
11	GPIO107	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
10	GPIO106	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
9	GPIO105	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
8	GPIO104	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
7	GPIO103	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
6	GPIO102	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
5	GPIO101	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
4	GPIO100	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
3	GPIO99	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
2	GPIO98	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
1	GPIO97	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
0	GPIO96	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn

### 6.9.3.16 GPDTOGGLE Register (Offset = 1Eh) [reset = 0h]

GPDTOGGLE is shown in [Figure 6-117](#) and described in [Table 6-131](#).

Return to [Summary Table](#).

GPIO D Data Toggle Register (GPIO96 to 127)

Writing a 1 will toggle GPIO0 output data latch 1 to 0 or 0 to 1.

Writes of 0 are ignored.

Always reads back a 0.

**Figure 6-117. GPDTOGGLE Register**

31	30	29	28	27	26	25	24
GPIO127	GPIO126	GPIO125	GPIO124	GPIO123	GPIO122	GPIO121	GPIO120
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
23	22	21	20	19	18	17	16
GPIO119	GPIO118	GPIO117	GPIO116	GPIO115	GPIO114	GPIO113	GPIO112
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
15	14	13	12	11	10	9	8
GPIO111	GPIO110	GPIO109	GPIO108	GPIO107	GPIO106	GPIO105	GPIO104
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
7	6	5	4	3	2	1	0
GPIO103	GPIO102	GPIO101	GPIO100	GPIO99	GPIO98	GPIO97	GPIO96
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h

**Table 6-131. GPDTOGGLE Register Field Descriptions**

Bit	Field	Type	Reset	Description
31	GPIO127	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
30	GPIO126	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
29	GPIO125	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
28	GPIO124	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
27	GPIO123	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
26	GPIO122	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
25	GPIO121	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
24	GPIO120	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
23	GPIO119	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
22	GPIO118	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
21	GPIO117	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
20	GPIO116	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn

**Table 6-131. GPDTOGGLE Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
19	GPIO115	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
18	GPIO114	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
17	GPIO113	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
16	GPIO112	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
15	GPIO111	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
14	GPIO110	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
13	GPIO109	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
12	GPIO108	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
11	GPIO107	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
10	GPIO106	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
9	GPIO105	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
8	GPIO104	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
7	GPIO103	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
6	GPIO102	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
5	GPIO101	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
4	GPIO100	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
3	GPIO99	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
2	GPIO98	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
1	GPIO97	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
0	GPIO96	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn

### 6.9.3.17 GPEDAT Register (Offset = 20h) [reset = 0h]

GPEDAT is shown in [Figure 6-118](#) and described in [Table 6-132](#).

Return to [Summary Table](#).

GPIO E Data Register (GPIO128 to 159)

Reading this register reflects the current state of the GPIO pin regardless of which mode the GPIO is in. Writing to this register will set the GPIO pin high or low if the pin is enabled for GPIO output mode. If the GPIO is not in output mode the value written is latched but will not be reflected on the GPIO pin or reads of the GPxDAT register. The written value latched will become active when the GPIO is put into GPIO Output mode

A system reset will clear all bits and latched values to zero.

NOTE: Bit-wise read-modify-write operations should not be performed on this register. For bit-wise operations the GPxSET, GPxCLEAR, or GPxTOGGLE registers should be used instead. If direct writes to GPxDAT are necessary, the entire register should be written at one time.

**Figure 6-118. GPEDAT Register**

31	30	29	28	27	26	25	24
GPIO159	GPIO158	GPIO157	GPIO156	GPIO155	GPIO154	GPIO153	GPIO152
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
23	22	21	20	19	18	17	16
GPIO151	GPIO150	GPIO149	GPIO148	GPIO147	GPIO146	GPIO145	GPIO144
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
15	14	13	12	11	10	9	8
GPIO143	GPIO142	GPIO141	GPIO140	GPIO139	GPIO138	GPIO137	GPIO136
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
7	6	5	4	3	2	1	0
GPIO135	GPIO134	GPIO133	GPIO132	GPIO131	GPIO130	GPIO129	GPIO128
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h

**Table 6-132. GPEDAT Register Field Descriptions**

Bit	Field	Type	Reset	Description
31	GPIO159	R/W	0h	Data Register for this pin Reset type: SYSRSn
30	GPIO158	R/W	0h	Data Register for this pin Reset type: SYSRSn
29	GPIO157	R/W	0h	Data Register for this pin Reset type: SYSRSn
28	GPIO156	R/W	0h	Data Register for this pin Reset type: SYSRSn
27	GPIO155	R/W	0h	Data Register for this pin Reset type: SYSRSn
26	GPIO154	R/W	0h	Data Register for this pin Reset type: SYSRSn
25	GPIO153	R/W	0h	Data Register for this pin Reset type: SYSRSn
24	GPIO152	R/W	0h	Data Register for this pin Reset type: SYSRSn
23	GPIO151	R/W	0h	Data Register for this pin Reset type: SYSRSn
22	GPIO150	R/W	0h	Data Register for this pin Reset type: SYSRSn

**Table 6-132. GPEDAT Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
21	GPIO149	R/W	0h	Data Register for this pin Reset type: SYSRSn
20	GPIO148	R/W	0h	Data Register for this pin Reset type: SYSRSn
19	GPIO147	R/W	0h	Data Register for this pin Reset type: SYSRSn
18	GPIO146	R/W	0h	Data Register for this pin Reset type: SYSRSn
17	GPIO145	R/W	0h	Data Register for this pin Reset type: SYSRSn
16	GPIO144	R/W	0h	Data Register for this pin Reset type: SYSRSn
15	GPIO143	R/W	0h	Data Register for this pin Reset type: SYSRSn
14	GPIO142	R/W	0h	Data Register for this pin Reset type: SYSRSn
13	GPIO141	R/W	0h	Data Register for this pin Reset type: SYSRSn
12	GPIO140	R/W	0h	Data Register for this pin Reset type: SYSRSn
11	GPIO139	R/W	0h	Data Register for this pin Reset type: SYSRSn
10	GPIO138	R/W	0h	Data Register for this pin Reset type: SYSRSn
9	GPIO137	R/W	0h	Data Register for this pin Reset type: SYSRSn
8	GPIO136	R/W	0h	Data Register for this pin Reset type: SYSRSn
7	GPIO135	R/W	0h	Data Register for this pin Reset type: SYSRSn
6	GPIO134	R/W	0h	Data Register for this pin Reset type: SYSRSn
5	GPIO133	R/W	0h	Data Register for this pin Reset type: SYSRSn
4	GPIO132	R/W	0h	Data Register for this pin Reset type: SYSRSn
3	GPIO131	R/W	0h	Data Register for this pin Reset type: SYSRSn
2	GPIO130	R/W	0h	Data Register for this pin Reset type: SYSRSn
1	GPIO129	R/W	0h	Data Register for this pin Reset type: SYSRSn
0	GPIO128	R/W	0h	Data Register for this pin Reset type: SYSRSn

### 6.9.3.18 GPESET Register (Offset = 22h) [reset = 0h]

GPESET is shown in [Figure 6-119](#) and described in [Table 6-133](#).

Return to [Summary Table](#).

GPIO E Data Set Register (GPIO128 to 159)

Writing a 1 will force GPIO output data latch to 1.

Writes of 0 are ignored.

Always reads back a 0.

**Figure 6-119. GPESET Register**

31	30	29	28	27	26	25	24
GPIO159	GPIO158	GPIO157	GPIO156	GPIO155	GPIO154	GPIO153	GPIO152
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
23	22	21	20	19	18	17	16
GPIO151	GPIO150	GPIO149	GPIO148	GPIO147	GPIO146	GPIO145	GPIO144
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
15	14	13	12	11	10	9	8
GPIO143	GPIO142	GPIO141	GPIO140	GPIO139	GPIO138	GPIO137	GPIO136
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
7	6	5	4	3	2	1	0
GPIO135	GPIO134	GPIO133	GPIO132	GPIO131	GPIO130	GPIO129	GPIO128
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h

**Table 6-133. GPESET Register Field Descriptions**

Bit	Field	Type	Reset	Description
31	GPIO159	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
30	GPIO158	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
29	GPIO157	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
28	GPIO156	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
27	GPIO155	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
26	GPIO154	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
25	GPIO153	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
24	GPIO152	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
23	GPIO151	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
22	GPIO150	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
21	GPIO149	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
20	GPIO148	R/W	0h	Output Set bit for this pin Reset type: SYSRSn

**Table 6-133. GPESET Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
19	GPIO147	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
18	GPIO146	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
17	GPIO145	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
16	GPIO144	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
15	GPIO143	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
14	GPIO142	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
13	GPIO141	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
12	GPIO140	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
11	GPIO139	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
10	GPIO138	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
9	GPIO137	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
8	GPIO136	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
7	GPIO135	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
6	GPIO134	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
5	GPIO133	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
4	GPIO132	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
3	GPIO131	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
2	GPIO130	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
1	GPIO129	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
0	GPIO128	R/W	0h	Output Set bit for this pin Reset type: SYSRSn



### 6.9.3.19 GPECLEAR Register (Offset = 24h) [reset = 0h]

GPECLEAR is shown in [Figure 6-120](#) and described in [Table 6-134](#).

Return to [Summary Table](#).

GPIO E Data Clear Register (GPIO128 to 159)

Writing a 1 will force GPIO0 output data latch to 0.

Writes of 0 are ignored.

Always reads back a 0.

**Figure 6-120. GPECLEAR Register**

31		30		29		28		27		26		25		24	
GPIO159	GPIO158	GPIO157	GPIO156	GPIO155	GPIO154	GPIO153	GPIO152								
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h								
23		22		21		20		19		18		17		16	
GPIO151	GPIO150	GPIO149	GPIO148	GPIO147	GPIO146	GPIO145	GPIO144								
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h								
15		14		13		12		11		10		9		8	
GPIO143	GPIO142	GPIO141	GPIO140	GPIO139	GPIO138	GPIO137	GPIO136								
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h								
7		6		5		4		3		2		1		0	
GPIO135	GPIO134	GPIO133	GPIO132	GPIO131	GPIO130	GPIO129	GPIO128								
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h								

**Table 6-134. GPECLEAR Register Field Descriptions**

Bit	Field	Type	Reset	Description
31	GPIO159	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
30	GPIO158	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
29	GPIO157	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
28	GPIO156	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
27	GPIO155	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
26	GPIO154	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
25	GPIO153	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
24	GPIO152	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
23	GPIO151	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
22	GPIO150	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
21	GPIO149	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
20	GPIO148	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn

**Table 6-134. GPECLEAR Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
19	GPIO147	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
18	GPIO146	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
17	GPIO145	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
16	GPIO144	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
15	GPIO143	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
14	GPIO142	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
13	GPIO141	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
12	GPIO140	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
11	GPIO139	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
10	GPIO138	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
9	GPIO137	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
8	GPIO136	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
7	GPIO135	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
6	GPIO134	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
5	GPIO133	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
4	GPIO132	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
3	GPIO131	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
2	GPIO130	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
1	GPIO129	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
0	GPIO128	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn

### 6.9.3.20 GPETOGGLE Register (Offset = 26h) [reset = 0h]

GPETOGGLE is shown in [Figure 6-121](#) and described in [Table 6-135](#).

Return to [Summary Table](#).

GPIO E Data Toggle Register (GPIO128 to 159)

Writing a 1 will toggle GPIO0 output data latch 1 to 0 or 0 to 1.

Writes of 0 are ignored.

Always reads back a 0.

**Figure 6-121. GPETOGGLE Register**

31	30	29	28	27	26	25	24
GPIO159	GPIO158	GPIO157	GPIO156	GPIO155	GPIO154	GPIO153	GPIO152
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
23	22	21	20	19	18	17	16
GPIO151	GPIO150	GPIO149	GPIO148	GPIO147	GPIO146	GPIO145	GPIO144
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
15	14	13	12	11	10	9	8
GPIO143	GPIO142	GPIO141	GPIO140	GPIO139	GPIO138	GPIO137	GPIO136
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
7	6	5	4	3	2	1	0
GPIO135	GPIO134	GPIO133	GPIO132	GPIO131	GPIO130	GPIO129	GPIO128
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h

**Table 6-135. GPETOGGLE Register Field Descriptions**

Bit	Field	Type	Reset	Description
31	GPIO159	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
30	GPIO158	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
29	GPIO157	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
28	GPIO156	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
27	GPIO155	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
26	GPIO154	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
25	GPIO153	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
24	GPIO152	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
23	GPIO151	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
22	GPIO150	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
21	GPIO149	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
20	GPIO148	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn

**Table 6-135. GPETOGGLE Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
19	GPIO147	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
18	GPIO146	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
17	GPIO145	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
16	GPIO144	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
15	GPIO143	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
14	GPIO142	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
13	GPIO141	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
12	GPIO140	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
11	GPIO139	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
10	GPIO138	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
9	GPIO137	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
8	GPIO136	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
7	GPIO135	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
6	GPIO134	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
5	GPIO133	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
4	GPIO132	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
3	GPIO131	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
2	GPIO130	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
1	GPIO129	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
0	GPIO128	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn

### 6.9.3.21 GPFDAT Register (Offset = 28h) [reset = 0h]

GPFDAT is shown in [Figure 6-122](#) and described in [Table 6-136](#).

Return to [Summary Table](#).

GPIO F Data Register (GPIO160 to 168)

Reading this register reflects the current state of the GPIO pin regardless of which mode the GPIO is in.

Writing to this register will set the GPIO pin high or low if the pin is enabled for GPIO output mode. If the GPIO is not in output mode the value written is latched but will not be reflected on the GPIO pin or reads of the GPxDAT register. The written value latched will become active when the GPIO is put into GPIO Output mode

A system reset will clear all bits and latched values to zero.

NOTE: Bit-wise read-modify-write operations should not be performed on this register. For bit-wise operations the GPxSET, GPxCLEAR, or GPxTOGGLE registers should be used instead. If direct writes to GPxDAT are necessary, the entire register should be written at one time.

**Figure 6-122. GPFDAT Register**

31	30	29	28	27	26	25	24
RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED
R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h
23	22	21	20	19	18	17	16
RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED
R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h
15	14	13	12	11	10	9	8
RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	GPIO168
R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R/W-0h
7	6	5	4	3	2	1	0
GPIO167	GPIO166	GPIO165	GPIO164	GPIO163	GPIO162	GPIO161	GPIO160
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h

**Table 6-136. GPFDAT Register Field Descriptions**

Bit	Field	Type	Reset	Description
31	RESERVED	R	0h	Reserved
30	RESERVED	R	0h	Reserved
29	RESERVED	R	0h	Reserved
28	RESERVED	R	0h	Reserved
27	RESERVED	R	0h	Reserved
26	RESERVED	R	0h	Reserved
25	RESERVED	R	0h	Reserved
24	RESERVED	R	0h	Reserved
23	RESERVED	R	0h	Reserved
22	RESERVED	R	0h	Reserved
21	RESERVED	R	0h	Reserved
20	RESERVED	R	0h	Reserved
19	RESERVED	R	0h	Reserved
18	RESERVED	R	0h	Reserved
17	RESERVED	R	0h	Reserved
16	RESERVED	R	0h	Reserved
15	RESERVED	R	0h	Reserved
14	RESERVED	R	0h	Reserved
13	RESERVED	R	0h	Reserved
12	RESERVED	R	0h	Reserved

**Table 6-136. GPFDAT Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
11	RESERVED	R	0h	Reserved
10	RESERVED	R	0h	Reserved
9	RESERVED	R	0h	Reserved
8	GPIO168	R/W	0h	Data Register for this pin Reset type: SYSRSn
7	GPIO167	R/W	0h	Data Register for this pin Reset type: SYSRSn
6	GPIO166	R/W	0h	Data Register for this pin Reset type: SYSRSn
5	GPIO165	R/W	0h	Data Register for this pin Reset type: SYSRSn
4	GPIO164	R/W	0h	Data Register for this pin Reset type: SYSRSn
3	GPIO163	R/W	0h	Data Register for this pin Reset type: SYSRSn
2	GPIO162	R/W	0h	Data Register for this pin Reset type: SYSRSn
1	GPIO161	R/W	0h	Data Register for this pin Reset type: SYSRSn
0	GPIO160	R/W	0h	Data Register for this pin Reset type: SYSRSn

### 6.9.3.22 GPFSET Register (Offset = 2Ah) [reset = 0h]

GPFSET is shown in [Figure 6-123](#) and described in [Table 6-137](#).

Return to [Summary Table](#).

GPIO F Data Set Register (GPIO160 to 168)

Writing a 1 will force GPIO output data latch to 1.

Writes of 0 are ignored.

Always reads back a 0.

**Figure 6-123. GPFSET Register**

31		30		29		28		27		26		25		24	
RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED
R-0h		R-0h		R-0h		R-0h		R-0h		R-0h		R-0h		R-0h	
23		22		21		20		19		18		17		16	
RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED
R-0h		R-0h		R-0h		R-0h		R-0h		R-0h		R-0h		R-0h	
15		14		13		12		11		10		9		8	
RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	GPIO168	
R-0h		R-0h		R-0h		R-0h		R-0h		R-0h		R-0h		R/W-0h	
7		6		5		4		3		2		1		0	
GPIO167	GPIO166	GPIO165	GPIO164	GPIO163	GPIO162	GPIO161	GPIO160								
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	

**Table 6-137. GPFSET Register Field Descriptions**

Bit	Field	Type	Reset	Description
31	RESERVED	R	0h	Reserved
30	RESERVED	R	0h	Reserved
29	RESERVED	R	0h	Reserved
28	RESERVED	R	0h	Reserved
27	RESERVED	R	0h	Reserved
26	RESERVED	R	0h	Reserved
25	RESERVED	R	0h	Reserved
24	RESERVED	R	0h	Reserved
23	RESERVED	R	0h	Reserved
22	RESERVED	R	0h	Reserved
21	RESERVED	R	0h	Reserved
20	RESERVED	R	0h	Reserved
19	RESERVED	R	0h	Reserved
18	RESERVED	R	0h	Reserved
17	RESERVED	R	0h	Reserved
16	RESERVED	R	0h	Reserved
15	RESERVED	R	0h	Reserved
14	RESERVED	R	0h	Reserved
13	RESERVED	R	0h	Reserved
12	RESERVED	R	0h	Reserved
11	RESERVED	R	0h	Reserved
10	RESERVED	R	0h	Reserved
9	RESERVED	R	0h	Reserved
8	GPIO168	R/W	0h	Output Set bit for this pin Reset type: SYSRSn

**Table 6-137. GPFSET Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
7	GPIO167	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
6	GPIO166	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
5	GPIO165	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
4	GPIO164	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
3	GPIO163	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
2	GPIO162	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
1	GPIO161	R/W	0h	Output Set bit for this pin Reset type: SYSRSn
0	GPIO160	R/W	0h	Output Set bit for this pin Reset type: SYSRSn



### 6.9.3.23 GPFCLEAR Register (Offset = 2Ch) [reset = 0h]

GPFCLEAR is shown in [Figure 6-124](#) and described in [Table 6-138](#).

Return to [Summary Table](#).

GPIO F Data Clear Register (GPIO160 to 168)

Writing a 1 will force GPIO0 output data latch to 0.

Writes of 0 are ignored.

Always reads back a 0.

**Figure 6-124. GPFCLEAR Register**

31		30		29		28		27		26		25		24	
RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED
R-0h		R-0h		R-0h		R-0h		R-0h		R-0h		R-0h		R-0h	
23		22		21		20		19		18		17		16	
RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED
R-0h		R-0h		R-0h		R-0h		R-0h		R-0h		R-0h		R-0h	
15		14		13		12		11		10		9		8	
RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	GPIO168	
R-0h		R-0h		R-0h		R-0h		R-0h		R-0h		R-0h		R/W-0h	
7		6		5		4		3		2		1		0	
GPIO167	GPIO166	GPIO165	GPIO164	GPIO163	GPIO162	GPIO161	GPIO160								
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	

**Table 6-138. GPFCLEAR Register Field Descriptions**

Bit	Field	Type	Reset	Description
31	RESERVED	R	0h	Reserved
30	RESERVED	R	0h	Reserved
29	RESERVED	R	0h	Reserved
28	RESERVED	R	0h	Reserved
27	RESERVED	R	0h	Reserved
26	RESERVED	R	0h	Reserved
25	RESERVED	R	0h	Reserved
24	RESERVED	R	0h	Reserved
23	RESERVED	R	0h	Reserved
22	RESERVED	R	0h	Reserved
21	RESERVED	R	0h	Reserved
20	RESERVED	R	0h	Reserved
19	RESERVED	R	0h	Reserved
18	RESERVED	R	0h	Reserved
17	RESERVED	R	0h	Reserved
16	RESERVED	R	0h	Reserved
15	RESERVED	R	0h	Reserved
14	RESERVED	R	0h	Reserved
13	RESERVED	R	0h	Reserved
12	RESERVED	R	0h	Reserved
11	RESERVED	R	0h	Reserved
10	RESERVED	R	0h	Reserved
9	RESERVED	R	0h	Reserved
8	GPIO168	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn

**Table 6-138. GPFCLEAR Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
7	GPIO167	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
6	GPIO166	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
5	GPIO165	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
4	GPIO164	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
3	GPIO163	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
2	GPIO162	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
1	GPIO161	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn
0	GPIO160	R/W	0h	Output Clear bit for this pin Reset type: SYSRSn

### 6.9.3.24 GPFTOGGLE Register (Offset = 2Eh) [reset = 0h]

GPFTOGGLE is shown in [Figure 6-125](#) and described in [Table 6-139](#).

Return to [Summary Table](#).

GPIO F Data Toggle Register (GPIO160 to 168)

Writing a 1 will toggle GPIO0 output data latch 1 to 0 or 0 to 1.

Writes of 0 are ignored.

Always reads back a 0.

**Figure 6-125. GPFTOGGLE Register**

31	30	29	28	27	26	25	24
RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED
R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h
23	22	21	20	19	18	17	16
RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED
R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h
15	14	13	12	11	10	9	8
RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	GPIO168
R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R/W-0h
7	6	5	4	3	2	1	0
GPIO167	GPIO166	GPIO165	GPIO164	GPIO163	GPIO162	GPIO161	GPIO160
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h

**Table 6-139. GPFTOGGLE Register Field Descriptions**

Bit	Field	Type	Reset	Description
31	RESERVED	R	0h	Reserved
30	RESERVED	R	0h	Reserved
29	RESERVED	R	0h	Reserved
28	RESERVED	R	0h	Reserved
27	RESERVED	R	0h	Reserved
26	RESERVED	R	0h	Reserved
25	RESERVED	R	0h	Reserved
24	RESERVED	R	0h	Reserved
23	RESERVED	R	0h	Reserved
22	RESERVED	R	0h	Reserved
21	RESERVED	R	0h	Reserved
20	RESERVED	R	0h	Reserved
19	RESERVED	R	0h	Reserved
18	RESERVED	R	0h	Reserved
17	RESERVED	R	0h	Reserved
16	RESERVED	R	0h	Reserved
15	RESERVED	R	0h	Reserved
14	RESERVED	R	0h	Reserved
13	RESERVED	R	0h	Reserved
12	RESERVED	R	0h	Reserved
11	RESERVED	R	0h	Reserved
10	RESERVED	R	0h	Reserved
9	RESERVED	R	0h	Reserved
8	GPIO168	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn

**Table 6-139. GPFTOGGLE Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
7	GPIO167	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
6	GPIO166	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
5	GPIO165	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
4	GPIO164	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
3	GPIO163	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
2	GPIO162	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
1	GPIO161	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn
0	GPIO160	R/W	0h	Output Toggle Register GPIO pin Reset type: SYSRSn

## Crossbar (X-BAR)

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The crossbars (referred to as X-BAR throughout this document) provide flexibility to connect device inputs, outputs, and internal resources in a variety of configurations. The device contains a total of three X-BARs: the Input X-BAR, the Output X-BAR, and the ePWM X-BAR. Each of the X-BARs is named according to where they take signals. For example, the Input X-BAR brings external signals “in” to the device. The Output X-BAR takes internal signals “out” of the device to a GPIO. The ePWM X-BAR takes signals and brings them to the ePWM modules. You can read more about each of these X-BARs in the following sections.

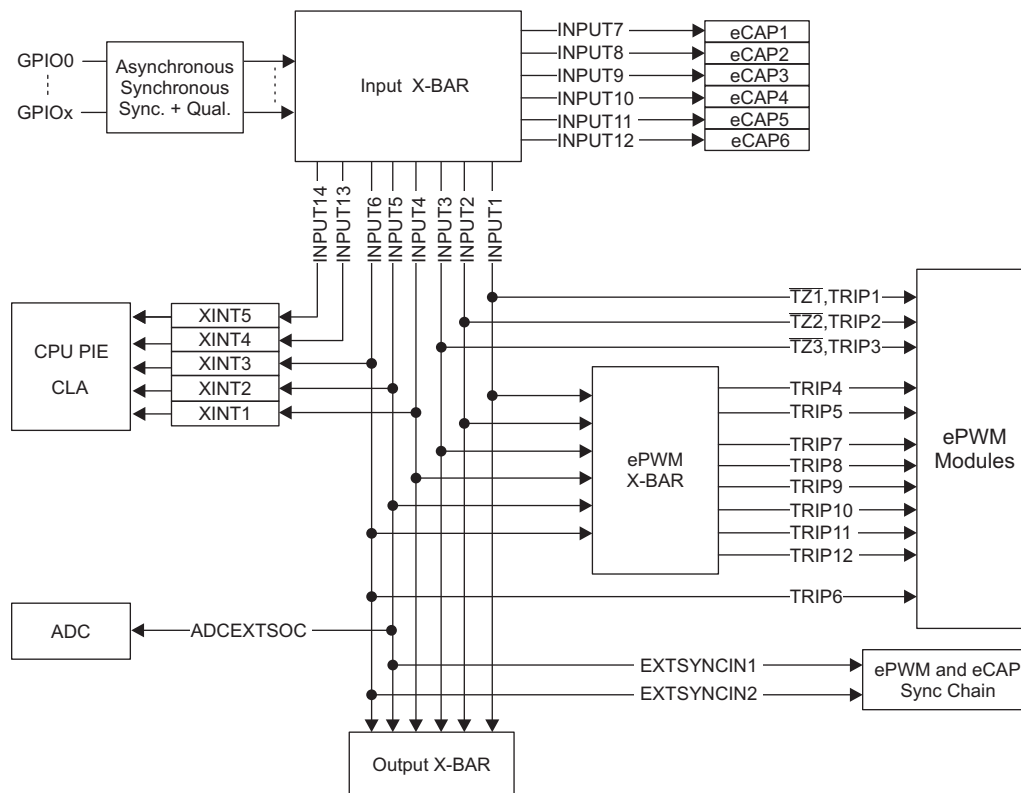
Topic	Page
7.1 GPIO Input X-BAR .....	1014
7.2 ePWM and GPIO Output X-BAR .....	1015
7.3 X-BAR Registers .....	1021

## 7.1 GPIO Input X-BAR

On this device, the Input X-BAR is used to route signals from a GPIO to many different IP blocks such as the ADC(s), eCAP(s), ePWM(s), and external interrupts. The Input X-BAR has access to every GPIO and can route each signal to any (or multiple) of the IP blocks previously mentioned. This flexibility relieves some of the constraints on peripheral muxing by just requiring any GPIO pin to be available. It is important to note that the function selected on the GPIO mux does not affect the Input X-BAR. The Input X-BAR simply connects the signal on the input buffer to the selected destination. Therefore, you can do things such as route the output of one peripheral to another (that is, measure the output of an ePWM with an eCAP for a frequency test).

The Input X-BAR is configured via the INPUTxSELECT registers. The available IP destination(s) for each INPUTx is shown in [Figure 7-1](#). For more information on configuration, see the INPUT\_XBAR\_REGS register definitions at the end of this chapter.

**Figure 7-1. Input X-BAR**



**Table 7-1. Input X-BAR Destinations**

Input	Destinations
INPUT1	ePWM[TZ1,TRIP1], ePWM X-BAR, Output X-BAR
INPUT2	ePWM[TZ2,TRIP2], ePWM X-BAR, Output X-BAR
INPUT3	ePWM[TZ3,TRIP3], ePWM X-BAR, Output X-BAR
INPUT4	XINT1, ePWM X-BAR, Output X-BAR
INPUT5	XINT2, ADCEXTSOC, EXTSYNCIN1, ePWM X-BAR, Output X-BAR
INPUT6	XINT3, ePWM[TRIP6], EXTSYNCIN2, ePWM X-BAR, Output X-BAR
INPUT7	ECAP1
INPUT8	ECAP2
INPUT9	ECAP3
INPUT10	ECAP4
INPUT11	ECAP5
INPUT12	ECAP6
INPUT13	XINT4
INPUT14	XINT5

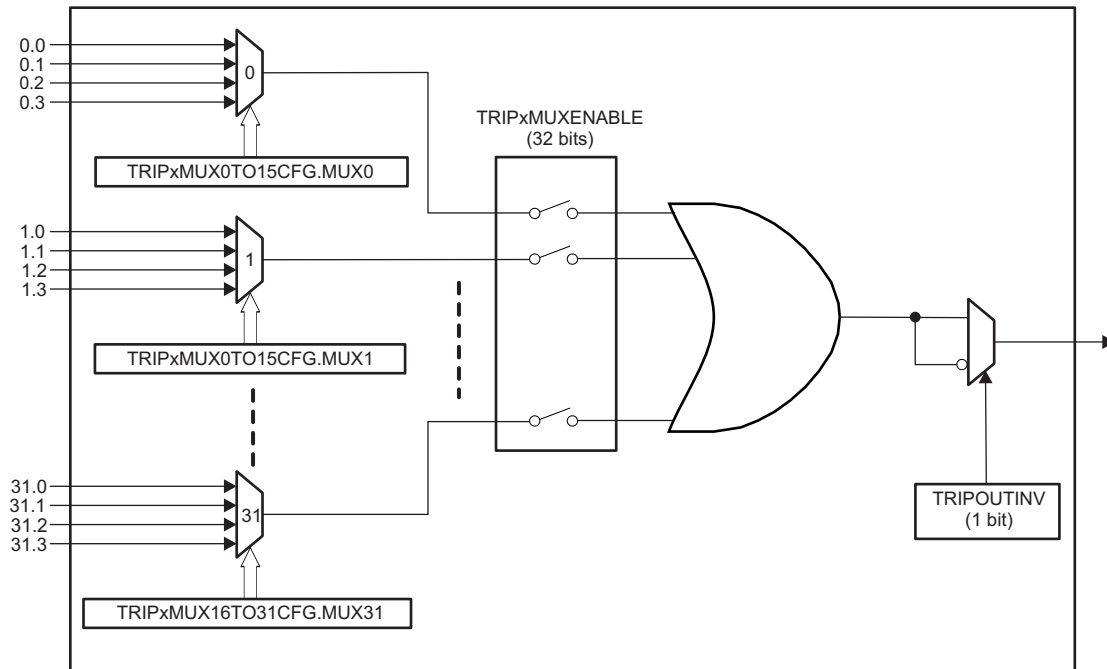
## 7.2 ePWM and GPIO Output X-BAR

### 7.2.1 ePWM X-BAR

The ePWM X-BAR brings signals to the ePWM modules. Specifically, the ePWM X-BAR is connected to the Digital Compare (DC) submodule of each ePWM module for actions such as tripzones and syncing. Please refer to the *ePWM* chapter for more information on additional ways the DC submodule can be used. [Figure 7-4](#) shows the architecture of the ePWM X-BAR. It is worth noting that the architecture of the ePWM X-BAR is identical to the architecture of the Output X-BAR (with the exception of the output latch).

#### 7.2.1.1 ePWM X-BAR Architecture

The ePWM X-BAR has eight outputs which are routed to each ePWM module. [Figure 7-2](#) represents the architecture of a single output but it is identical to the architecture of all of the other outputs.

**Figure 7-2. ePWM Architecture - Single Output**


First, determine the signal(s) which should be passed to the ePWM by referencing [Table 7-3](#). You may select up to one signal per mux (32 total muxes) for each TRIPx output. Select the inputs to each mux via the TRIPxMUX0TO15CFG and TRIPxMUX16TO31CFG registers. In order to pass any signal through to the ePWM, you must also enable the mux in the TRIPxMUXENABLE register. All muxes which are enabled will be logically OR'd before being passed on to the respective TRIPx signal on the ePWM. You may also optionally invert the signal via the TRIPxOUTINV register.



**Table 7-2. ePWM X-BAR Mux Configuration Table**

Mux	0	1	2	3
0	CMPSS1.CTRIPH	CMPSS1.CTRIPH_OR_CTRIPL	ADCAEVT1	ECAP1OUT
1	CMPSS1.CTRIPL	INPUTXBAR1		ADCCEVT1
2	CMPSS2.CTRIPH	CMPSS2.CTRIPH_OR_CTRIPL	ADCAEVT2	ECAP2OUT
3	CMPSS2.CTRIPL	INPUTXBAR2		ADCCEVT2
4	CMPSS3.CTRIPH	CMPSS3.CTRIPH_OR_CTRIPL	ADCAEVT3	ECAP3OUT
5	CMPSS3.CTRIPL	INPUTXBAR3		ADCCEVT3
6	CMPSS4.CTRIPH	CMPSS4.CTRIPH_OR_CTRIPL	ADCAEVT4	ECAP4OUT
7	CMPSS4.CTRIPL	INPUTXBAR4		ADCCEVT4
8	CMPSS5.CTRIPH	CMPSS5.CTRIPH_OR_CTRIPL	ADCBEVT1	ECAP5OUT
9	CMPSS5.CTRIPL	INPUTXBAR5		ADCDEVT1
10	CMPSS6.CTRIPH	CMPSS6.CTRIPH_OR_CTRIPL	ADCBEVT2	ECAP6OUT
11	CMPSS6.CTRIPL	INPUTXBAR6		ADCDEVT2
12	CMPSS7.CTRIPH	CMPSS7.CTRIPH_OR_CTRIPL	ADCBEVT3	
13	CMPSS7.CTRIPL	ADCSOCAO <sup>(1)</sup>		ADCDEVT3
14	CMPSS8.CTRIPH	CMPSS8.CTRIPH_OR_CTRIPL	ADCBEVT4	EXTSYNCOUT
15	CMPSS8.CTRIPL	ADCSOCBO <sup>(1)</sup>		ADCDEVT4
16	SD1FLT1.COMPH	SD1FLT1.COMPH_OR_COMPL		
17	SD1FLT1.COMPL			
18	SD1FLT2.COMPH	SD1FLT2.COMPH_OR_COMPL		
19	SD1FLT2.COMPL			
20	SD1FLT3.COMPH	SD1FLT3.COMPH_OR_COMPL		
21	SD1FLT3.COMPL			
22	SD1FLT4.COMPH	SD1FLT4.COMPH_OR_COMPL		
23	SD1FLT4.COMPL			
24	SD2FLT1.COMPH	SD2FLT1.COMPH_OR_COMPL		
25	SD2FLT1.COMPL			
26	SD2FLT2.COMPH	SD2FLT2.COMPH_OR_COMPL		
27	SD2FLT2.COMPL			
28	SD2FLT3.COMPH	SD2FLT3.COMPH_OR_COMPL		
29	SD2FLT3.COMPL			
30	SD2FLT4.COMPH	SD2FLT4.COMPH_OR_COMPL		
31	SD2FLT4.COMPL			

<sup>(1)</sup> This signal is active high when routed through the X-Bar. It may need to be inverted by the respective TRIPOUTINV bit depending on the application.

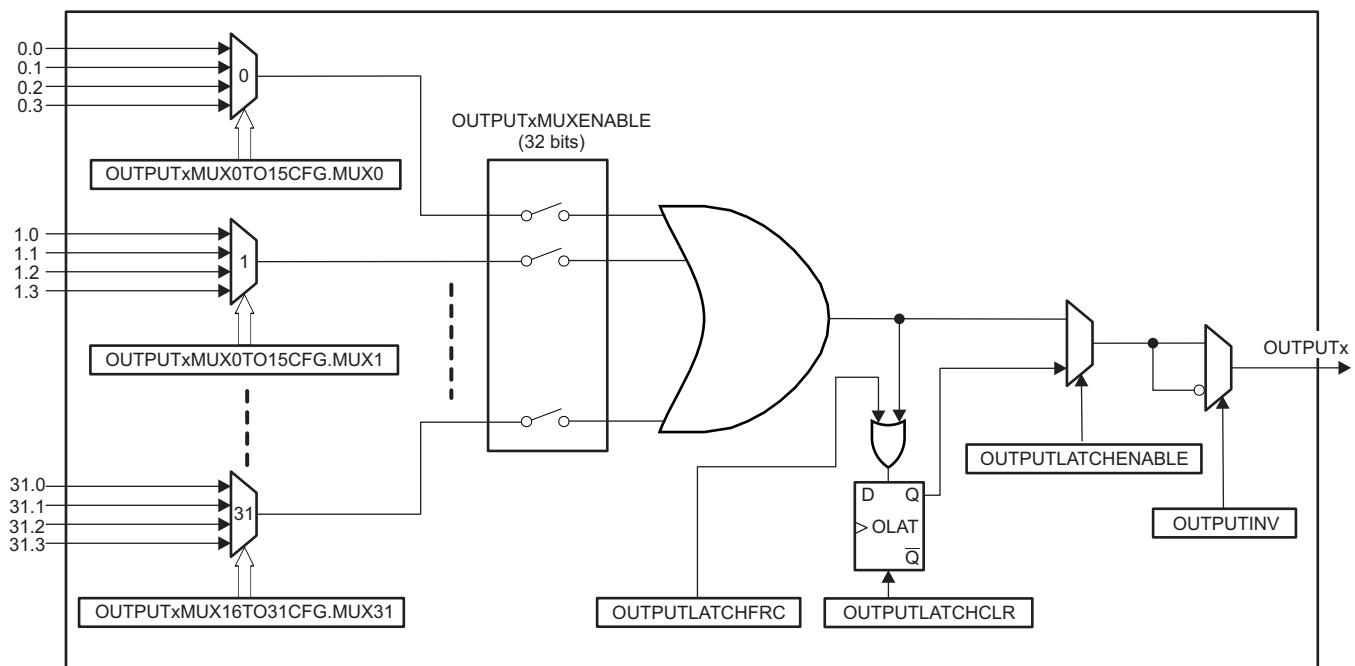
## 7.2.2 GPIO Output X-BAR

The GPIO Output X-BAR takes signals from inside the device and brings them out to a GPIO. [Figure 7-3](#) shows the architecture of the GPIO Output X-BAR. The signals which are available to bring to the GPIO are listed in [Table 7-3](#). The X-BAR contains eight outputs and each will contain at least one position on the GPIO mux, denoted as OUTPUTXBARx. The X-BAR allows the selection of a single signal or a logical OR of up to 32 signals.

### 7.2.2.1 GPIO Output X-BAR Architecture

The Output X-BAR has eight outputs which are routed to the GPIO module. [Figure 7-3](#) represents the architecture of a single output, but it is identical to the architecture of all of the other outputs. It is worth noting that the architecture of the Output X-BAR (with the exception of the output latch) is identical to the architecture of the ePWM X-BAR.

**Figure 7-3. GPIO Output X-BAR Architecture**



First, determine the signal(s) which should be passed to the GPIO by referencing [Table 7-3](#). You may select up to one signal per mux (32 total muxes) for each OUTPUTXBARx output. Select the inputs to each mux via the OUTPUTxMUX0TO15CFG and OUTPUTxMUX16TO31CFG registers.

In order to pass any signal through to the GPIO, you must also enable the mux in the OUTPUTxMUXENABLE register. All muxes which are enabled will be logically OR'd before being passed on to the respective OUTPUTx signal on the GPIO module. You may also optionally invert the signal via the OUTPUTINV register. The signal will only be seen on the GPIO if the proper OUTPUTx muxing options are selected via the GpioCtrlRegs.GPxMUX and GpioCtrlRegs.GPxGMUX registers.

**Table 7-3. Output X-Bar Mux Configuration Table**

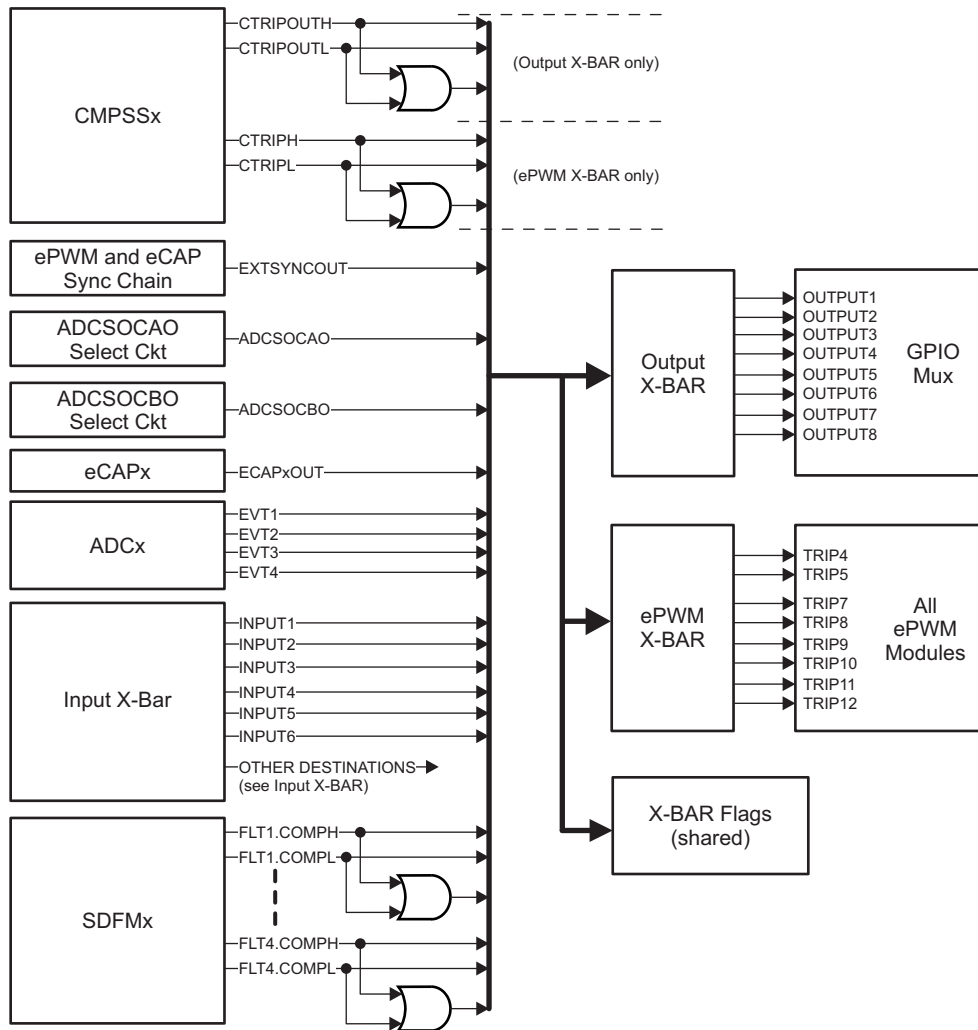
Mux	0	1	2	3
0	CMPSS1.CTRIPOUTH	CMPSS1.CTRIPOUTH_OR_CTRIPOUTL	ADCAEVT1	ECAP1OUT
1	CMPSS1.CTRIPOUTL	INPUTXBAR1		ADCCEVT1
2	CMPSS2.CTRIPOUTH	CMPSS2.CTRIPOUTH_OR_CTRIPOUTL	ADCAEVT2	ECAP2OUT
3	CMPSS2.CTRIPOUTL	INPUTXBAR2		ADCCEVT2
4	CMPSS3.CTRIPOUTH	CMPSS3.CTRIPOUTH_OR_CTRIPOUTL	ADCAEVT3	ECAP3OUT
5	CMPSS3.CTRIPOUTL	INPUTXBAR3		ADCCEVT3
6	CMPSS4.CTRIPOUTH	CMPSS4.CTRIPOUTH_OR_CTRIPOUTL	ADCAEVT4	ECAP4OUT
7	CMPSS4.CTRIPOUTL	INPUTXBAR4		ADCCEVT4
8	CMPSS5.CTRIPOUTH	CMPSS5.CTRIPOUTH_OR_CTRIPOUTL	ADCB EVT1	ECAP5OUT
9	CMPSS5.CTRIPOUTL	INPUTXBAR5		ADCDEVT1
10	CMPSS6.CTRIPOUTH	CMPSS6.CTRIPOUTH_OR_CTRIPOUTL	ADCB EVT2	ECAP6OUT
11	CMPSS6.CTRIPOUTL	INPUTXBAR6		ADCDEVT2
12	CMPSS7.CTRIPOUTH	CMPSS7.CTRIPOUTH_OR_CTRIPOUTL	ADCB EVT3	
13	CMPSS7.CTRIPOUTL	ADCSOAO <sup>(1)</sup>		ADCDEVT3
14	CMPSS8.CTRIPOUTH	CMPSS8.CTRIPOUTH_OR_CTRIPOUTL	ADCB EVT4	EXTSYNCOUT
15	CMPSS8.CTRIPOUTL	ADCSOBO <sup>(1)</sup>		ADCDEVT4
16	SD1FLT1.COMPH	SD1FLT1.COMPH_OR_COMPL		
17	SD1FLT1.COMPL			
18	SD1FLT2.COMPH	SD1FLT2.COMPH_OR_COMPL		
19	SD1FLT2.COMPL			
20	SD1FLT3.COMPH	SD1FLT3.COMPH_OR_COMPL		
21	SD1FLT3.COMPL			
22	SD1FLT4.COMPH	SD1FLT4.COMPH_OR_COMPL		
23	SD1FLT4.COMPL			
24	SD2FLT1.COMPH	SD2FLT1.COMPH_OR_COMPL		
25	SD2FLT1.COMPL			
26	SD2FLT2.COMPH	SD2FLT2.COMPH_OR_COMPL		
27	SD2FLT2.COMPL			
28	SD2FLT3.COMPH	SD2FLT3.COMPH_OR_COMPL		
29	SD2FLT3.COMPL			
30	SD2FLT4.COMPH	SD2FLT4.COMPH_OR_COMPL		
31	SD2FLT4.COMPL			

<sup>(1)</sup> This signal is active high when routed through the X-Bar. It may need to be inverted by the respective OUTPUTINV bit depending on the application.

### 7.2.3 X-BAR Flags

With the exception of the CMPSS signals, the ePWM X-BAR and the Output X-BAR have all of the same input signals. Due to the inputs being similar, the ePWM X-BAR and Output X-BAR leverage a single set of input flags to indicate which input signals have been triggered. This allows software to check the input flags when an event occurs. See [Figure 7-4](#) for more information. There is a bit allocated for each input signal in one of the XBARFLGx registers. The flag will remain set until cleared through the appropriate XBARCLR register.

Figure 7-4. ePWM and Output X-BARs Architectures



## 7.3 X-BAR Registers

### 7.3.1 X-BAR Base Addresses

**Table 7-4. X-BAR Base Address Table**

Device Registers	Register Name	Start Address	End Address
InputXbarRegs <sup>(1)</sup>	INPUT_XBAR_REGS	0x0000_7900	0x0000_791F
XbarRegs <sup>(1)</sup>	XBAR_REGS	0x0000_7920	0x0000_793F
EPwmXbarRegs <sup>(1)</sup>	ePWM_XBAR_REGS	0x0000_7A00	0x0000_7A3F
OutputXbarRegs <sup>(1)</sup>	OUTPUT_XBAR_REGS	0x0000_7A80	0x0000_7ABF

<sup>(1)</sup> Only available on CPU1.

### 7.3.2 INPUT\_XBAR\_REGS Registers

Table 7-5 lists the memory-mapped registers for the INPUT\_XBAR\_REGS. All register offset addresses not listed in Table 7-5 should be considered as reserved locations and the register contents should not be modified.

**Table 7-5. INPUT\_XBAR\_REGS Registers**

Offset	Acronym	Register Name	Write Protection	Section
0h	INPUT1SELECT	INPUT1 Input Select Register (GPIO0 to x)	EALLOW	<a href="#">Go</a>
1h	INPUT2SELECT	INPUT2 Input Select Register (GPIO0 to x)	EALLOW	<a href="#">Go</a>
2h	INPUT3SELECT	INPUT3 Input Select Register (GPIO0 to x)	EALLOW	<a href="#">Go</a>
3h	INPUT4SELECT	INPUT4 Input Select Register (GPIO0 to x)	EALLOW	<a href="#">Go</a>
4h	INPUT5SELECT	INPUT5 Input Select Register (GPIO0 to x)	EALLOW	<a href="#">Go</a>
5h	INPUT6SELECT	INPUT6 Input Select Register (GPIO0 to x)	EALLOW	<a href="#">Go</a>
6h	INPUT7SELECT	INPUT7 Input Select Register (GPIO0 to x)	EALLOW	<a href="#">Go</a>
7h	INPUT8SELECT	INPUT8 Input Select Register (GPIO0 to x)	EALLOW	<a href="#">Go</a>
8h	INPUT9SELECT	INPUT9 Input Select Register (GPIO0 to x)	EALLOW	<a href="#">Go</a>
9h	INPUT10SELECT	INPUT10 Input Select Register (GPIO0 to x)	EALLOW	<a href="#">Go</a>
Ah	INPUT11SELECT	INPUT11 Input Select Register (GPIO0 to x)	EALLOW	<a href="#">Go</a>
Bh	INPUT12SELECT	INPUT12 Input Select Register (GPIO0 to x)	EALLOW	<a href="#">Go</a>
Ch	INPUT13SELECT	INPUT13 Input Select Register (GPIO0 to x)	EALLOW	<a href="#">Go</a>
Dh	INPUT14SELECT	INPUT14 Input Select Register (GPIO0 to x)	EALLOW	<a href="#">Go</a>
1Eh	INPUTSELECTLOCK	Input Select Lock Register	EALLOW	<a href="#">Go</a>

Complex bit access types are encoded to fit into small table cells. Table 7-6 shows the codes that are used for access types in this section.

**Table 7-6. INPUT\_XBAR\_REGS Access Type Codes**

Access Type	Code	Description
<b>Read Type</b>		
R	R	Read
R=0	R	Read
<b>Write Type</b>		
W	W	Write
WSOnce	SOnce W	Set once Write
<b>Reset or Default Value</b>		
-n		Value after reset or the default value
<b>Register Array Variables</b>		
i,j,k,l,m,n		When these variables are used in a register name, an offset, or an address, they refer to the value of a register array where the register is part of a group of repeating registers. The register groups form a hierarchical structure and the array is represented with a formula.
y		When this variable is used in a register name, an offset, or an address it refers to the value of a register array.

**7.3.2.1 INPUT1SELECT Register (Offset = 0h) [reset = 0h]**

INPUT1SELECT is shown in [Figure 7-5](#) and described in [Table 7-7](#).

Return to [Summary Table](#).

INPUT1 Input Select Register (GPIO0 to x)

**Figure 7-5. INPUT1SELECT Register**

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
SELECT															
R/W-0h															

**Table 7-7. INPUT1SELECT Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-0	SELECT	R/W	0h	Select GPIO for INPUT1 signal: 0x0 : Select GPIO0 0x1 : Select GPIO1 0x2 : Select GPIO2 ... 0xn : Select GPIO <sub>n</sub> Reset type: CPU1.SYSRS <sub>n</sub>

**7.3.2.2 INPUT2SELECT Register (Offset = 1h) [reset = 0h]**

INPUT2SELECT is shown in [Figure 7-6](#) and described in [Table 7-8](#).

Return to [Summary Table](#).

INPUT2 Input Select Register (GPIO0 to x)

**Figure 7-6. INPUT2SELECT Register**

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
SELECT															
R/W-0h															

**Table 7-8. INPUT2SELECT Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-0	SELECT	R/W	0h	Select GPIO for INPUT2 signal: 0x0 : Select GPIO0 0x1 : Select GPIO1 0x2 : Select GPIO2 ... 0xn : Select GPIO <sub>n</sub> Reset type: CPU1.SYSRS <sub>n</sub>



### 7.3.2.3 INPUT3SELECT Register (Offset = 2h) [reset = 0h]

INPUT3SELECT is shown in [Figure 7-7](#) and described in [Table 7-9](#).

Return to [Summary Table](#).

INPUT3 Input Select Register (GPIO0 to x)

**Figure 7-7. INPUT3SELECT Register**

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
SELECT															
R/W-0h															

**Table 7-9. INPUT3SELECT Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-0	SELECT	R/W	0h	Select GPIO for INPUT3 signal: 0x0 : Select GPIO0 0x1 : Select GPIO1 0x2 : Select GPIO2 ... 0xn : Select GPIO n Reset type: CPU1.SYSRSn

**7.3.2.4 INPUT4SELECT Register (Offset = 3h) [reset = 0h]**

INPUT4SELECT is shown in [Figure 7-8](#) and described in [Table 7-10](#).

Return to [Summary Table](#).

INPUT4 Input Select Register (GPIO0 to x)

**Figure 7-8. INPUT4SELECT Register**

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
SELECT															
R/W-0h															

**Table 7-10. INPUT4SELECT Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-0	SELECT	R/W	0h	Select GPIO for INPUT4 signal: 0x0 : Select GPIO0 0x1 : Select GPIO1 0x2 : Select GPIO2 ... 0xn : Select GPIO <sub>n</sub> Reset type: CPU1.SYSRS <sub>n</sub>

### 7.3.2.5 INPUT5SELECT Register (Offset = 4h) [reset = 0h]

INPUT5SELECT is shown in [Figure 7-9](#) and described in [Table 7-11](#).

Return to [Summary Table](#).

INPUT5 Input Select Register (GPIO0 to x)

**Figure 7-9. INPUT5SELECT Register**

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
SELECT															
R/W-0h															

**Table 7-11. INPUT5SELECT Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-0	SELECT	R/W	0h	Select GPIO for INPUT5 signal: 0x0 : Select GPIO0 0x1 : Select GPIO1 0x2 : Select GPIO2 ... 0xn : Select GPIO <sub>n</sub> Reset type: CPU1.SYSRS <sub>n</sub>

**7.3.2.6 INPUT6SELECT Register (Offset = 5h) [reset = 0h]**

INPUT6SELECT is shown in [Figure 7-10](#) and described in [Table 7-12](#).

Return to [Summary Table](#).

INPUT6 Input Select Register (GPIO0 to x)

**Figure 7-10. INPUT6SELECT Register**

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
SELECT															
R/W-0h															

**Table 7-12. INPUT6SELECT Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-0	SELECT	R/W	0h	Select GPIO for INPUT6 signal: 0x0 : Select GPIO0 0x1 : Select GPIO1 0x2 : Select GPIO2 ... 0xn : Select GPIO <sub>n</sub> Reset type: CPU1.SYSRS <sub>n</sub>

**7.3.2.7 INPUT7SELECT Register (Offset = 6h) [reset = 0h]**

INPUT7SELECT is shown in [Figure 7-11](#) and described in [Table 7-13](#).

Return to [Summary Table](#).

INPUT7 Input Select Register (GPIO0 to x)

**Figure 7-11. INPUT7SELECT Register**

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
SELECT															
R/W-0h															

**Table 7-13. INPUT7SELECT Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-0	SELECT	R/W	0h	Select GPIO for INPUT7 signal: 0x0 : Select GPIO0 0x1 : Select GPIO1 0x2 : Select GPIO2 ... 0xn : Select GPIO <sub>n</sub> Reset type: CPU1.SYSRS <sub>n</sub>

**7.3.2.8 INPUT8SELECT Register (Offset = 7h) [reset = 0h]**

INPUT8SELECT is shown in [Figure 7-12](#) and described in [Table 7-14](#).

Return to [Summary Table](#).

INPUT8 Input Select Register (GPIO0 to x)

**Figure 7-12. INPUT8SELECT Register**

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
SELECT															
R/W-0h															

**Table 7-14. INPUT8SELECT Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-0	SELECT	R/W	0h	Select GPIO for INPUT8 signal: 0x0 : Select GPIO0 0x1 : Select GPIO1 0x2 : Select GPIO2 ... 0xn : Select GPIO <sub>n</sub> Reset type: CPU1.SYSRS <sub>n</sub>

### 7.3.2.9 INPUT9SELECT Register (Offset = 8h) [reset = 0h]

INPUT9SELECT is shown in [Figure 7-13](#) and described in [Table 7-15](#).

Return to [Summary Table](#).

INPUT9 Input Select Register (GPIO0 to x)

**Figure 7-13. INPUT9SELECT Register**

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
SELECT															
R/W-0h															

**Table 7-15. INPUT9SELECT Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-0	SELECT	R/W	0h	Select GPIO for INPUT9 signal: 0x0 : Select GPIO0 0x1 : Select GPIO1 0x2 : Select GPIO2 ... 0xn : Select GPIO n Reset type: CPU1.SYSRSn

**7.3.2.10 INPUT10SELECT Register (Offset = 9h) [reset = 0h]**

INPUT10SELECT is shown in [Figure 7-14](#) and described in [Table 7-16](#).

Return to [Summary Table](#).

INPUT10 Input Select Register (GPIO0 to x)

**Figure 7-14. INPUT10SELECT Register**

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
SELECT															
R/W-0h															

**Table 7-16. INPUT10SELECT Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-0	SELECT	R/W	0h	Select GPIO for INPUT10 signal: 0x0 : Select GPIO0 0x1 : Select GPIO1 0x2 : Select GPIO2 ... 0xn : Select GPIO <sub>n</sub> Reset type: CPU1.SYSRS <sub>n</sub>



**7.3.2.11 INPUT11SELECT Register (Offset = Ah) [reset = 0h]**

INPUT11SELECT is shown in [Figure 7-15](#) and described in [Table 7-17](#).

Return to [Summary Table](#).

INPUT11 Input Select Register (GPIO0 to x)

**Figure 7-15. INPUT11SELECT Register**

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
SELECT															
R/W-0h															

**Table 7-17. INPUT11SELECT Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-0	SELECT	R/W	0h	Select GPIO for INPUT11 signal: 0x0 : Select GPIO0 0x1 : Select GPIO1 0x2 : Select GPIO2 ... 0xn : Select GPIO <sub>n</sub> Reset type: CPU1.SYSR <sub>S<sub>n</sub></sub>

**7.3.2.12 INPUT12SELECT Register (Offset = Bh) [reset = 0h]**

INPUT12SELECT is shown in [Figure 7-16](#) and described in [Table 7-18](#).

Return to [Summary Table](#).

INPUT12 Input Select Register (GPIO0 to x)

**Figure 7-16. INPUT12SELECT Register**

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
SELECT															
R/W-0h															

**Table 7-18. INPUT12SELECT Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-0	SELECT	R/W	0h	Select GPIO for INPUT12 signal: 0x0 : Select GPIO0 0x1 : Select GPIO1 0x2 : Select GPIO2 ... 0xn : Select GPIO <sub>n</sub> Reset type: CPU1.SYSR <sub>S<sub>n</sub></sub>

**7.3.2.13 INPUT13SELECT Register (Offset = Ch) [reset = 0h]**

INPUT13SELECT is shown in [Figure 7-17](#) and described in [Table 7-19](#).

Return to [Summary Table](#).

INPUT13 Input Select Register (GPIO0 to x)

**Figure 7-17. INPUT13SELECT Register**

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
SELECT															
R/W-0h															

**Table 7-19. INPUT13SELECT Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-0	SELECT	R/W	0h	Select GPIO for INPUT13 signal: 0x0 : Select GPIO0 0x1 : Select GPIO1 0x2 : Select GPIO2 ... 0xn : Select GPIO n Reset type: CPU1.SYSRSn

**7.3.2.14 INPUT14SELECT Register (Offset = Dh) [reset = 0h]**

INPUT14SELECT is shown in [Figure 7-18](#) and described in [Table 7-20](#).

Return to [Summary Table](#).

INPUT14 Input Select Register (GPIO0 to x)

**Figure 7-18. INPUT14SELECT Register**

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
SELECT															
R/W-0h															

**Table 7-20. INPUT14SELECT Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-0	SELECT	R/W	0h	Select GPIO for INPUT14 signal: 0x0 : Select GPIO0 0x1 : Select GPIO1 0x2 : Select GPIO2 ... 0xn : Select GPIO <sub>n</sub> Reset type: CPU1.SYSR <sub>S<sub>n</sub></sub>

### 7.3.2.15 INPUTSELECTLOCK Register (Offset = 1Eh) [reset = 0h]

INPUTSELECTLOCK is shown in [Figure 7-19](#) and described in [Table 7-21](#).

Return to [Summary Table](#).

Input Select Lock Register

**Figure 7-19. INPUTSELECTLOCK Register**

31								30								29								28								27								26								25								24							
RESERVED																																																															
R=0-0h																																																															
23								22								21								20								19								18								17								16							
RESERVED																																																															
R=0-0h																																																															
15								14								13								12								11								10								9								8							
INPUT16SELE CT								INPUT15SELE CT								INPUT14SELE CT								INPUT13SELE CT								INPUT12SELE CT								INPUT11SELE CT								INPUT10SELE CT								INPUT9SELEC T							
R/WSONce-0h								R/WSONce-0h								R/WSONce-0h								R/WSONce-0h								R/WSONce-0h								R/WSONce-0h								R/WSONce-0h								R/WSONce-0h							
7								6								5								4								3								2								1								0							
INPUT8SELEC T								INPUT7SELEC T								INPUT6SELEC T								INPUT5SELEC T								INPUT4SELEC T								INPUT3SELEC T								INPUT2SELEC T								INPUT1SELEC T							
R/WSONce-0h								R/WSONce-0h								R/WSONce-0h								R/WSONce-0h								R/WSONce-0h								R/WSONce-0h								R/WSONce-0h								R/WSONce-0h							

**Table 7-21. INPUTSELECTLOCK Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R=0	0h	Reserved
15	INPUT16SELECT	R/WSONce	0h	<p>Lock bit for INPUT16SELECT Register:</p> <p>0: Respective register is not locked 1: Respective register is locked.</p> <p>Any bit in this register, once set can only be cleared through a CPU1.SYSRSn. Write of 0 to any bit of this register has no effect</p> <p>Notes:</p> <p>[1] The locking mechanism applies to only writes. Reads to the registers which have LOCK protection are always allowed. Reset type: CPU1.SYSRSn</p>
14	INPUT15SELECT	R/WSONce	0h	<p>Lock bit for INPUT15SELECT Register:</p> <p>0: Respective register is not locked 1: Respective register is locked.</p> <p>Any bit in this register, once set can only be cleared through a CPU1.SYSRSn. Write of 0 to any bit of this register has no effect</p> <p>Notes:</p> <p>[1] The locking mechanism applies to only writes. Reads to the registers which have LOCK protection are always allowed. Reset type: CPU1.SYSRSn</p>

**Table 7-21. INPUTSELECTLOCK Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
13	INPUT14SELECT	R/WOnce	0h	<p>Lock bit for INPUT14SELECT Register: 0: Respective register is not locked 1: Respective register is locked.</p> <p>Any bit in this register, once set can only be cleared through a CPU1.SYSRSn. Write of 0 to any bit of this register has no effect</p> <p>Notes: [1] The locking mechanism applies to only writes. Reads to the registers which have LOCK protection are always allowed. Reset type: CPU1.SYSRSn</p>
12	INPUT13SELECT	R/WOnce	0h	<p>Lock bit for INPUT13SELECT Register: 0: Respective register is not locked 1: Respective register is locked.</p> <p>Any bit in this register, once set can only be cleared through a CPU1.SYSRSn. Write of 0 to any bit of this register has no effect</p> <p>Notes: [1] The locking mechanism applies to only writes. Reads to the registers which have LOCK protection are always allowed. Reset type: CPU1.SYSRSn</p>
11	INPUT12SELECT	R/WOnce	0h	<p>Lock bit for INPUT12SELECT Register: 0: Respective register is not locked 1: Respective register is locked.</p> <p>Any bit in this register, once set can only be cleared through a CPU1.SYSRSn. Write of 0 to any bit of this register has no effect</p> <p>Notes: [1] The locking mechanism applies to only writes. Reads to the registers which have LOCK protection are always allowed. Reset type: CPU1.SYSRSn</p>
10	INPUT11SELECT	R/WOnce	0h	<p>Lock bit for INPUT11SELECT Register: 0: Respective register is not locked 1: Respective register is locked.</p> <p>Any bit in this register, once set can only be cleared through a CPU1.SYSRSn. Write of 0 to any bit of this register has no effect</p> <p>Notes: [1] The locking mechanism applies to only writes. Reads to the registers which have LOCK protection are always allowed. Reset type: CPU1.SYSRSn</p>
9	INPUT10SELECT	R/WOnce	0h	<p>Lock bit for INPUT10SELECT Register: 0: Respective register is not locked 1: Respective register is locked.</p> <p>Any bit in this register, once set can only be cleared through a CPU1.SYSRSn. Write of 0 to any bit of this register has no effect</p> <p>Notes: [1] The locking mechanism applies to only writes. Reads to the registers which have LOCK protection are always allowed. Reset type: CPU1.SYSRSn</p>

**Table 7-21. INPUTSELECTLOCK Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
8	INPUT9SELECT	R/WOnce	0h	<p>Lock bit for INPUT9SELECT Register:</p> <p>0: Respective register is not locked 1: Respective register is locked.</p> <p>Any bit in this register, once set can only be cleared through a CPU1.SYSRSn. Write of 0 to any bit of this register has no effect</p> <p>Notes:</p> <p>[1] The locking mechanism applies to only writes. Reads to the registers which have LOCK protection are always allowed. Reset type: CPU1.SYSRSn</p>
7	INPUT8SELECT	R/WOnce	0h	<p>Lock bit for INPUT8SELECT Register:</p> <p>0: Respective register is not locked 1: Respective register is locked.</p> <p>Any bit in this register, once set can only be cleared through a CPU1.SYSRSn. Write of 0 to any bit of this register has no effect</p> <p>Notes:</p> <p>[1] The locking mechanism applies to only writes. Reads to the registers which have LOCK protection are always allowed. Reset type: CPU1.SYSRSn</p>
6	INPUT7SELECT	R/WOnce	0h	<p>Lock bit for INPUT7SELECT Register:</p> <p>0: Respective register is not locked 1: Respective register is locked.</p> <p>Any bit in this register, once set can only be cleared through a CPU1.SYSRSn. Write of 0 to any bit of this register has no effect</p> <p>Notes:</p> <p>[1] The locking mechanism applies to only writes. Reads to the registers which have LOCK protection are always allowed. Reset type: CPU1.SYSRSn</p>
5	INPUT6SELECT	R/WOnce	0h	<p>Lock bit for INPUT6SELECT Register:</p> <p>0: Respective register is not locked 1: Respective register is locked.</p> <p>Any bit in this register, once set can only be cleared through a CPU1.SYSRSn. Write of 0 to any bit of this register has no effect</p> <p>Notes:</p> <p>[1] The locking mechanism applies to only writes. Reads to the registers which have LOCK protection are always allowed. Reset type: CPU1.SYSRSn</p>
4	INPUT5SELECT	R/WOnce	0h	<p>Lock bit for INPUT5SELECT Register:</p> <p>0: Respective register is not locked 1: Respective register is locked.</p> <p>Any bit in this register, once set can only be cleared through a CPU1.SYSRSn. Write of 0 to any bit of this register has no effect</p> <p>Notes:</p> <p>[1] The locking mechanism applies to only writes. Reads to the registers which have LOCK protection are always allowed. Reset type: CPU1.SYSRSn</p>

**Table 7-21. INPUTSELECTLOCK Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
3	INPUT4SELECT	R/WOnce	0h	<p>Lock bit for INPUT4SELECT Register:  0: Respective register is not locked  1: Respective register is locked.</p> <p>Any bit in this register, once set can only be cleared through a CPU1.SYSRSn. Write of 0 to any bit of this register has no effect</p> <p>Notes:  [1] The locking mechanism applies to only writes. Reads to the registers which have LOCK protection are always allowed.  Reset type: CPU1.SYSRSn</p>
2	INPUT3SELECT	R/WOnce	0h	<p>Lock bit for INPUT3SELECT Register:  0: Respective register is not locked  1: Respective register is locked.</p> <p>Any bit in this register, once set can only be cleared through a CPU1.SYSRSn. Write of 0 to any bit of this register has no effect</p> <p>Notes:  [1] The locking mechanism applies to only writes. Reads to the registers which have LOCK protection are always allowed.  Reset type: CPU1.SYSRSn</p>
1	INPUT2SELECT	R/WOnce	0h	<p>Lock bit for INPUT2SELECT Register:  0: Respective register is not locked  1: Respective register is locked.</p> <p>Any bit in this register, once set can only be cleared through a CPU1.SYSRSn. Write of 0 to any bit of this register has no effect</p> <p>Notes:  [1] The locking mechanism applies to only writes. Reads to the registers which have LOCK protection are always allowed.  Reset type: CPU1.SYSRSn</p>
0	INPUT1SELECT	R/WOnce	0h	<p>Lock bit for INPUT1SELECT Register:  0: Respective register is not locked  1: Respective register is locked.</p> <p>Any bit in this register, once set can only be cleared through a CPU1.SYSRSn. Write of 0 to any bit of this register has no effect</p> <p>Notes:  [1] The locking mechanism applies to only writes. Reads to the registers which have LOCK protection are always allowed.  Reset type: CPU1.SYSRSn</p>



### 7.3.3 XBAR\_REGS Registers

Table 7-22 lists the memory-mapped registers for the XBAR\_REGS. All register offset addresses not listed in Table 7-22 should be considered as reserved locations and the register contents should not be modified.

**Table 7-22. XBAR\_REGS Registers**

Offset	Acronym	Register Name	Write Protection	Section
0h	XBARFLG1	X-Bar Input Flag Register 1		<a href="#">Go</a>
2h	XBARFLG2	X-Bar Input Flag Register 2		<a href="#">Go</a>
4h	XBARFLG3	X-Bar Input Flag Register 3		<a href="#">Go</a>
8h	XBARCLR1	X-Bar Input Flag Clear Register 1		<a href="#">Go</a>
Ah	XBARCLR2	X-Bar Input Flag Clear Register 2		<a href="#">Go</a>
Ch	XBARCLR3	X-Bar Input Flag Clear Register 3		<a href="#">Go</a>

Complex bit access types are encoded to fit into small table cells. Table 7-23 shows the codes that are used for access types in this section.

**Table 7-23. XBAR\_REGS Access Type Codes**

Access Type	Code	Description
<b>Read Type</b>		
R	R	Read
R=0	R	Read
<b>Write Type</b>		
W=1	W	Write
<b>Reset or Default Value</b>		
-n		Value after reset or the default value
<b>Register Array Variables</b>		
i,j,k,l,m,n		When these variables are used in a register name, an offset, or an address, they refer to the value of a register array where the register is part of a group of repeating registers. The register groups form a hierarchical structure and the array is represented with a formula.
y		When this variable is used in a register name, an offset, or an address it refers to the value of a register array.

**7.3.3.1 XBARFLG1 Register (Offset = 0h) [reset = 0h]**

XBARFLG1 is shown in [Figure 7-20](#) and described in [Table 7-24](#).

Return to [Summary Table](#).

This register is used to flag the inputs of the X-Bars to provide software knowledge of the input sources which got triggered.

- 1: Corresponding Input was triggered
- 0: Corresponding Input was not triggered

**Figure 7-20. XBARFLG1 Register**

31	30	29	28	27	26	25	24
CMPSS8_CTRL POUTH	CMPSS8_CTRL POUTL	CMPSS7_CTRL POUTH	CMPSS7_CTRL POUTL	CMPSS6_CTRL POUTH	CMPSS6_CTRL POUTL	CMPSS5_CTRL POUTH	CMPSS5_CTRL POUTL
R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h
23	22	21	20	19	18	17	16
CMPSS4_CTRL POUTH	CMPSS4_CTRL POUTL	CMPSS3_CTRL POUTH	CMPSS3_CTRL POUTL	CMPSS2_CTRL POUTH	CMPSS2_CTRL POUTL	CMPSS1_CTRL POUTH	CMPSS1_CTRL POUTL
R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h
15	14	13	12	11	10	9	8
CMPSS8_CTRL PH	CMPSS8_CTRL PL	CMPSS7_CTRL PH	CMPSS7_CTRL PL	CMPSS6_CTRL PH	CMPSS6_CTRL PL	CMPSS5_CTRL PH	CMPSS5_CTRL PL
R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h
7	6	5	4	3	2	1	0
CMPSS4_CTRL PH	CMPSS4_CTRL PL	CMPSS3_CTRL PH	CMPSS3_CTRL PL	CMPSS2_CTRL PH	CMPSS2_CTRL PL	CMPSS1_CTRL PH	CMPSS1_CTRL PL
R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h

**Table 7-24. XBARFLG1 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31	CMPSS8_CTRLPOUTH	R	0h	CMPSS8_CTRLPOUTH X-BAR Flag Reset type: CPU1.SYSRSn
30	CMPSS8_CTRLPOUTL	R	0h	CMPSS8_CTRLPOUTL X-BAR Flag Reset type: CPU1.SYSRSn
29	CMPSS7_CTRLPOUTH	R	0h	CMPSS7_CTRLPOUTH X-BAR Flag Reset type: CPU1.SYSRSn
28	CMPSS7_CTRLPOUTL	R	0h	CMPSS7_CTRLPOUTL X-BAR Flag Reset type: CPU1.SYSRSn
27	CMPSS6_CTRLPOUTH	R	0h	CMPSS6_CTRLPOUTH X-BAR Flag Reset type: CPU1.SYSRSn
26	CMPSS6_CTRLPOUTL	R	0h	CMPSS6_CTRLPOUTL X-BAR Flag Reset type: CPU1.SYSRSn
25	CMPSS5_CTRLPOUTH	R	0h	CMPSS5_CTRLPOUTH X-BAR Flag Reset type: CPU1.SYSRSn
24	CMPSS5_CTRLPOUTL	R	0h	CMPSS5_CTRLPOUTL X-BAR Flag Reset type: CPU1.SYSRSn
23	CMPSS4_CTRLPOUTH	R	0h	CMPSS4_CTRLPOUTH X-BAR Flag Reset type: CPU1.SYSRSn
22	CMPSS4_CTRLPOUTL	R	0h	CMPSS4_CTRLPOUTL X-BAR Flag Reset type: CPU1.SYSRSn
21	CMPSS3_CTRLPOUTH	R	0h	CMPSS3_CTRLPOUTH X-BAR Flag Reset type: CPU1.SYSRSn

**Table 7-24. XBARFLG1 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
20	CMPSS3_CTRIPOUTL	R	0h	CMPSS3_CTRIPOUTL X-BAR Flag Reset type: CPU1.SYSRSn
19	CMPSS2_CTRIPOUTH	R	0h	CMPSS2_CTRIPOUTH X-BAR Flag Reset type: CPU1.SYSRSn
18	CMPSS2_CTRIPOUTL	R	0h	CMPSS2_CTRIPOUTL X-BAR Flag Reset type: CPU1.SYSRSn
17	CMPSS1_CTRIPOUTH	R	0h	CMPSS1_CTRIPOUTH X-BAR Flag Reset type: CPU1.SYSRSn
16	CMPSS1_CTRIPOUTL	R	0h	CMPSS1_CTRIPOUTL X-BAR Flag Reset type: CPU1.SYSRSn
15	CMPSS8_CTRIPH	R	0h	CMPSS8_CTRIPH X-BAR Flag Reset type: CPU1.SYSRSn
14	CMPSS8_CTRIPL	R	0h	CMPSS8_CTRIPL X-BAR Flag Reset type: CPU1.SYSRSn
13	CMPSS7_CTRIPH	R	0h	CMPSS7_CTRIPH X-BAR Flag Reset type: CPU1.SYSRSn
12	CMPSS7_CTRIPL	R	0h	CMPSS7_CTRIPL X-BAR Flag Reset type: CPU1.SYSRSn
11	CMPSS6_CTRIPH	R	0h	CMPSS6_CTRIPH X-BAR Flag Reset type: CPU1.SYSRSn
10	CMPSS6_CTRIPL	R	0h	CMPSS6_CTRIPL X-BAR Flag Reset type: CPU1.SYSRSn
9	CMPSS5_CTRIPH	R	0h	CMPSS5_CTRIPH X-BAR Flag Reset type: CPU1.SYSRSn
8	CMPSS5_CTRIPL	R	0h	CMPSS5_CTRIPL X-BAR Flag Reset type: CPU1.SYSRSn
7	CMPSS4_CTRIPH	R	0h	CMPSS4_CTRIPH X-BAR Flag Reset type: CPU1.SYSRSn
6	CMPSS4_CTRIPL	R	0h	CMPSS4_CTRIPL X-BAR Flag Reset type: CPU1.SYSRSn
5	CMPSS3_CTRIPH	R	0h	CMPSS3_CTRIPH X-BAR Flag Reset type: CPU1.SYSRSn
4	CMPSS3_CTRIPL	R	0h	CMPSS3_CTRIPL X-BAR Flag Reset type: CPU1.SYSRSn
3	CMPSS2_CTRIPH	R	0h	CMPSS2_CTRIPH X-BAR Flag Reset type: CPU1.SYSRSn
2	CMPSS2_CTRIPL	R	0h	CMPSS2_CTRIPL X-BAR Flag Reset type: CPU1.SYSRSn
1	CMPSS1_CTRIPH	R	0h	CMPSS1_CTRIPH X-BAR Flag Reset type: CPU1.SYSRSn
0	CMPSS1_CTRIPL	R	0h	CMPSS1_CTRIPL X-BAR Flag Reset type: CPU1.SYSRSn

### 7.3.3.2 XBARFLG2 Register (Offset = 2h) [reset = 0h]

XBARFLG2 is shown in [Figure 7-21](#) and described in [Table 7-25](#).

Return to [Summary Table](#).

This register is used to flag the inputs of the X-Bars to provide software knowledge of the input sources which got triggered.

- 1: Corresponding Input was triggered
- 0: Corresponding Input was not triggered

**Figure 7-21. XBARFLG2 Register**

31		30		29		28		27		26		25		24	
ADCCEVT1	ADCBEVT4	ADCBEVT3	ADCBEVT2	ADCBEVT1	ADCAEVT4	ADCAEVT3	ADCAEVT2	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h
23		22		21		20		19		18		17		16	
ADCAEVT1	EXTSYNCOU	ECAP6_OUT	ECAP5_OUT	ECAP4_OUT	ECAP3_OUT	ECAP2_OUT	ECAP1_OUT	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h
15		14		13		12		11		10		9		8	
RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h
7		6		5		4		3		2		1		0	
ADCSOCBO	ADCSOCAO	INPUT6	INPUT5	INPUT4	INPUT3	INPUT2	INPUT1	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h

**Table 7-25. XBARFLG2 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31	ADCCEVT1	R	0h	ADCCEVT1 X-BAR Flag Reset type: CPU1.SYSRSn
30	ADCBEVT4	R	0h	ADCBEVT4 X-BAR Flag Reset type: CPU1.SYSRSn
29	ADCBEVT3	R	0h	ADCBEVT3 X-BAR Flag Reset type: CPU1.SYSRSn
28	ADCBEVT2	R	0h	ADCBEVT2 X-BAR Flag Reset type: CPU1.SYSRSn
27	ADCBEVT1	R	0h	ADCBEVT1 X-BAR Flag Reset type: CPU1.SYSRSn
26	ADCAEVT4	R	0h	ADCAEVT4 X-BAR Flag Reset type: CPU1.SYSRSn
25	ADCAEVT3	R	0h	ADCAEVT3 X-BAR Flag Reset type: CPU1.SYSRSn
24	ADCAEVT2	R	0h	ADCAEVT2 X-BAR Flag Reset type: CPU1.SYSRSn
23	ADCAEVT1	R	0h	ADCAEVT1 X-BAR Flag Reset type: CPU1.SYSRSn
22	EXTSYNCOU	R	0h	EXTSYNCOU X-BAR Flag Reset type: CPU1.SYSRSn
21	ECAP6_OUT	R	0h	ECAP6_OUT X-BAR Flag Reset type: CPU1.SYSRSn
20	ECAP5_OUT	R	0h	ECAP5_OUT X-BAR Flag Reset type: CPU1.SYSRSn

**Table 7-25. XBARFLG2 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
19	ECAP4_OUT	R	0h	ECAP4_OUT X-BAR Flag Reset type: CPU1.SYSRSn
18	ECAP3_OUT	R	0h	ECAP3_OUT X-BAR Flag Reset type: CPU1.SYSRSn
17	ECAP2_OUT	R	0h	ECAP2_OUT X-BAR Flag Reset type: CPU1.SYSRSn
16	ECAP1_OUT	R	0h	ECAP1_OUT X-BAR Flag Reset type: CPU1.SYSRSn
15	RESERVED	R	0h	Reserved
14	RESERVED	R	0h	Reserved
13	RESERVED	R	0h	Reserved
12	RESERVED	R	0h	Reserved
11	RESERVED	R	0h	Reserved
10	RESERVED	R	0h	Reserved
9	RESERVED	R	0h	Reserved
8	RESERVED	R	0h	Reserved
7	ADCSOCBO	R	0h	ADCSOCBO X-BAR Flag Reset type: CPU1.SYSRSn
6	ADCSOCAO	R	0h	ADCSOCAO X-BAR Flag Reset type: CPU1.SYSRSn
5	INPUT6	R	0h	INPUT6 X-BAR Flag Reset type: CPU1.SYSRSn
4	INPUT5	R	0h	INPUT5 X-BAR Flag Reset type: CPU1.SYSRSn
3	INPUT4	R	0h	INPUT4 X-BAR Flag Reset type: CPU1.SYSRSn
2	INPUT3	R	0h	INPUT3 X-BAR Flag Reset type: CPU1.SYSRSn
1	INPUT2	R	0h	INPUT2 X-BAR Flag Reset type: CPU1.SYSRSn
0	INPUT1	R	0h	INPUT1 X-BAR Flag Reset type: CPU1.SYSRSn

### 7.3.3.3 XBARFLG3 Register (Offset = 4h) [reset = 0h]

XBARFLG3 is shown in [Figure 7-22](#) and described in [Table 7-26](#).

Return to [Summary Table](#).

This register is used to flag the inputs of the X-Bars to provide software knowledge of the input sources which got triggered.

- 1: Corresponding Input was triggered
- 0: Corresponding Input was not triggered

**Figure 7-22. XBARFLG3 Register**

31								30								29								28								27								26								25								24							
RESERVED																																																															
R=0-0h																																																															
23								22								21								20								19								18								17								16							
RESERVED								SD2FLT4_CO MPH								SD2FLT4_CO MPL								SD2FLT3_CO MPH								SD2FLT3_CO MPL								SD2FLT2_CO MPH								SD2FLT2_CO MPL								SD2FLT1_CO MPH							
R=0-0h								R-0h								R-0h								R-0h								R-0h								R-0h								R-0h															
15								14								13								12								11								10								9								8							
SD2FLT1_CO MPL								SD1FLT4_CO MPH								SD1FLT4_CO MPL								SD1FLT3_CO MPH								SD1FLT3_CO MPL								SD1FLT2_CO MPH								SD1FLT2_CO MPL								SD1FLT1_CO MPH							
R-0h								R-0h								R-0h								R-0h								R-0h								R-0h								R-0h															
7								6								5								4								3								2								1								0							
SD1FLT1_CO MPL								ADCDEVT4								ADCDEVT3								ADCDEVT2								ADCDEVT1								ADCCEVT4								ADCCEVT3								ADCCEVT2							
R-0h								R-0h								R-0h								R-0h								R-0h								R-0h								R-0h								R-0h							

**Table 7-26. XBARFLG3 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-23	RESERVED	R=0	0h	Reserved
22	SD2FLT4_COMPH	R	0h	SD2FLT4_COMPH X-BAR Flag Reset type: CPU1.SYSRSn
21	SD2FLT4_COMPL	R	0h	SD2FLT4_COMPL X-BAR Flag Reset type: CPU1.SYSRSn
20	SD2FLT3_COMPH	R	0h	SD2FLT3_COMPH X-BAR Flag Reset type: CPU1.SYSRSn
19	SD2FLT3_COMPL	R	0h	SD2FLT3_COMPL X-BAR Flag Reset type: CPU1.SYSRSn
18	SD2FLT2_COMPH	R	0h	SD2FLT2_COMPH X-BAR Flag Reset type: CPU1.SYSRSn
17	SD2FLT2_COMPL	R	0h	SD2FLT2_COMPL X-BAR Flag Reset type: CPU1.SYSRSn
16	SD2FLT1_COMPH	R	0h	SD2FLT1_COMPH X-BAR Flag Reset type: CPU1.SYSRSn
15	SD2FLT1_COMPL	R	0h	SD2FLT1_COMPL X-BAR Flag Reset type: CPU1.SYSRSn
14	SD1FLT4_COMPH	R	0h	SD1FLT4_COMPH X-BAR Flag Reset type: CPU1.SYSRSn
13	SD1FLT4_COMPL	R	0h	SD1FLT4_COMPL X-BAR Flag Reset type: CPU1.SYSRSn
12	SD1FLT3_COMPH	R	0h	SD1FLT3_COMPH X-BAR Flag Reset type: CPU1.SYSRSn

**Table 7-26. XBARFLG3 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
11	SD1FLT3_COMPL	R	0h	SD1FLT3_COMPL X-BAR Flag Reset type: CPU1.SYSRSn
10	SD1FLT2_COMPH	R	0h	SD1FLT2_COMPH X-BAR Flag Reset type: CPU1.SYSRSn
9	SD1FLT2_COMPL	R	0h	SD1FLT2_COMPL X-BAR Flag Reset type: CPU1.SYSRSn
8	SD1FLT1_COMPH	R	0h	SD1FLT1_COMPH X-BAR Flag Reset type: CPU1.SYSRSn
7	SD1FLT1_COMPL	R	0h	SD1FLT1_COMPL X-BAR Flag Reset type: CPU1.SYSRSn
6	ADCDEVT4	R	0h	ADCDEVT4 X-BAR Flag Reset type: CPU1.SYSRSn
5	ADCDEVT3	R	0h	ADCDEVT3 X-BAR Flag Reset type: CPU1.SYSRSn
4	ADCDEVT2	R	0h	ADCDEVT2 X-BAR Flag Reset type: CPU1.SYSRSn
3	ADCDEVT1	R	0h	ADCDEVT1 X-BAR Flag Reset type: CPU1.SYSRSn
2	ADCCEVT4	R	0h	ADCCEVT4 X-BAR Flag Reset type: CPU1.SYSRSn
1	ADCCEVT3	R	0h	ADCCEVT3 X-BAR Flag Reset type: CPU1.SYSRSn
0	ADCCEVT2	R	0h	ADCCEVT2 X-BAR Flag Reset type: CPU1.SYSRSn

### 7.3.3.4 XBARCLR1 Register (Offset = 8h) [reset = 0h]

XBARCLR1 is shown in [Figure 7-23](#) and described in [Table 7-27](#).

Return to [Summary Table](#).

This register is used to clear the flag(s) in the XBARFLG1 register.

1: Clears the corresponding bit in the XBARFLG1 register.

0: Writing 0 has no effect

**Figure 7-23. XBARCLR1 Register**

31		30		29		28		27		26		25		24	
CMPSS8_CTRI POUTH	CMPSS8_CTRI POUTL	CMPSS7_CTRI POUTH	CMPSS7_CTRI POUTL	CMPSS6_CTRI POUTH	CMPSS6_CTRI POUTL	CMPSS5_CTRI POUTH	CMPSS5_CTRI POUTL	CMPSS4_CTRI POUTH	CMPSS4_CTRI POUTL	CMPSS3_CTRI POUTH	CMPSS3_CTRI POUTL	CMPSS2_CTRI POUTH	CMPSS2_CTRI POUTL	CMPSS1_CTRI POUTH	CMPSS1_CTRI POUTL
R=0/W=1-0h		R=0/W=1-0h		R=0/W=1-0h		R=0/W=1-0h		R=0/W=1-0h		R=0/W=1-0h		R=0/W=1-0h		R=0/W=1-0h	
23		22		21		20		19		18		17		16	
CMPSS4_CTRI POUTH	CMPSS4_CTRI POUTL	CMPSS3_CTRI POUTH	CMPSS3_CTRI POUTL	CMPSS2_CTRI POUTH	CMPSS2_CTRI POUTL	CMPSS1_CTRI POUTH	CMPSS1_CTRI POUTL	CMPSS8_CTRI PH	CMPSS8_CTRI PL	CMPSS7_CTRI PH	CMPSS7_CTRI PL	CMPSS6_CTRI PH	CMPSS6_CTRI PL	CMPSS5_CTRI PH	CMPSS5_CTRI PL
R=0/W=1-0h		R=0/W=1-0h		R=0/W=1-0h		R=0/W=1-0h		R=0/W=1-0h		R=0/W=1-0h		R=0/W=1-0h		R=0/W=1-0h	
15		14		13		12		11		10		9		8	
CMPSS8_CTRI PH	CMPSS8_CTRI PL	CMPSS7_CTRI PH	CMPSS7_CTRI PL	CMPSS6_CTRI PH	CMPSS6_CTRI PL	CMPSS5_CTRI PH	CMPSS5_CTRI PL	CMPSS4_CTRI PH	CMPSS4_CTRI PL	CMPSS3_CTRI PH	CMPSS3_CTRI PL	CMPSS2_CTRI PH	CMPSS2_CTRI PL	CMPSS1_CTRI PH	CMPSS1_CTRI PL
R=0/W=1-0h		R=0/W=1-0h		R=0/W=1-0h		R=0/W=1-0h		R=0/W=1-0h		R=0/W=1-0h		R=0/W=1-0h		R=0/W=1-0h	
7		6		5		4		3		2		1		0	
CMPSS4_CTRI PH	CMPSS4_CTRI PL	CMPSS3_CTRI PH	CMPSS3_CTRI PL	CMPSS2_CTRI PH	CMPSS2_CTRI PL	CMPSS1_CTRI PH	CMPSS1_CTRI PL	CMPSS8_CTRI PH	CMPSS8_CTRI PL	CMPSS7_CTRI PH	CMPSS7_CTRI PL	CMPSS6_CTRI PH	CMPSS6_CTRI PL	CMPSS5_CTRI PH	CMPSS5_CTRI PL
R=0/W=1-0h		R=0/W=1-0h		R=0/W=1-0h		R=0/W=1-0h		R=0/W=1-0h		R=0/W=1-0h		R=0/W=1-0h		R=0/W=1-0h	

**Table 7-27. XBARCLR1 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31	CMPSS8_CTRIPOUTH	R=0/W=1	0h	CMPSS8_CTRIPOUTH X-BAR Flag Clear Reset type: CPU1.SYSRSn
30	CMPSS8_CTRIPOUTL	R=0/W=1	0h	CMPSS8_CTRIPOUTL X-BAR Flag Clear Reset type: CPU1.SYSRSn
29	CMPSS7_CTRIPOUTH	R=0/W=1	0h	CMPSS7_CTRIPOUTH X-BAR Flag Clear Reset type: CPU1.SYSRSn
28	CMPSS7_CTRIPOUTL	R=0/W=1	0h	CMPSS7_CTRIPOUTL X-BAR Flag Clear Reset type: CPU1.SYSRSn
27	CMPSS6_CTRIPOUTH	R=0/W=1	0h	CMPSS6_CTRIPOUTH X-BAR Flag Clear Reset type: CPU1.SYSRSn
26	CMPSS6_CTRIPOUTL	R=0/W=1	0h	CMPSS6_CTRIPOUTL X-BAR Flag Clear Reset type: CPU1.SYSRSn
25	CMPSS5_CTRIPOUTH	R=0/W=1	0h	CMPSS5_CTRIPOUTH X-BAR Flag Clear Reset type: CPU1.SYSRSn
24	CMPSS5_CTRIPOUTL	R=0/W=1	0h	CMPSS5_CTRIPOUTL X-BAR Flag Clear Reset type: CPU1.SYSRSn
23	CMPSS4_CTRIPOUTH	R=0/W=1	0h	CMPSS4_CTRIPOUTH X-BAR Flag Clear Reset type: CPU1.SYSRSn
22	CMPSS4_CTRIPOUTL	R=0/W=1	0h	CMPSS4_CTRIPOUTL X-BAR Flag Clear Reset type: CPU1.SYSRSn
21	CMPSS3_CTRIPOUTH	R=0/W=1	0h	CMPSS3_CTRIPOUTH X-BAR Flag Clear Reset type: CPU1.SYSRSn



**Table 7-27. XBARCLR1 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
20	CMPSS3_CTRIPOUTL	R=0/W=1	0h	CMPSS3_CTRIPOUTL X-BAR Flag Clear Reset type: CPU1.SYSRSn
19	CMPSS2_CTRIPOUTH	R=0/W=1	0h	CMPSS2_CTRIPOUTH X-BAR Flag Clear Reset type: CPU1.SYSRSn
18	CMPSS2_CTRIPOUTL	R=0/W=1	0h	CMPSS2_CTRIPOUTL X-BAR Flag Clear Reset type: CPU1.SYSRSn
17	CMPSS1_CTRIPOUTH	R=0/W=1	0h	CMPSS1_CTRIPOUTH X-BAR Flag Clear Reset type: CPU1.SYSRSn
16	CMPSS1_CTRIPOUTL	R=0/W=1	0h	CMPSS1_CTRIPOUTL X-BAR Flag Clear Reset type: CPU1.SYSRSn
15	CMPSS8_CTRIPH	R=0/W=1	0h	CMPSS8_CTRIPH X-BAR Flag Clear Reset type: CPU1.SYSRSn
14	CMPSS8_CTRIPL	R=0/W=1	0h	CMPSS8_CTRIPL X-BAR Flag Clear Reset type: CPU1.SYSRSn
13	CMPSS7_CTRIPH	R=0/W=1	0h	CMPSS7_CTRIPH X-BAR Flag Clear Reset type: CPU1.SYSRSn
12	CMPSS7_CTRIPL	R=0/W=1	0h	CMPSS7_CTRIPL X-BAR Flag Clear Reset type: CPU1.SYSRSn
11	CMPSS6_CTRIPH	R=0/W=1	0h	CMPSS6_CTRIPH X-BAR Flag Clear Reset type: CPU1.SYSRSn
10	CMPSS6_CTRIPL	R=0/W=1	0h	CMPSS6_CTRIPL X-BAR Flag Clear Reset type: CPU1.SYSRSn
9	CMPSS5_CTRIPH	R=0/W=1	0h	CMPSS5_CTRIPH X-BAR Flag Clear Reset type: CPU1.SYSRSn
8	CMPSS5_CTRIPL	R=0/W=1	0h	CMPSS5_CTRIPL X-BAR Flag Clear Reset type: CPU1.SYSRSn
7	CMPSS4_CTRIPH	R=0/W=1	0h	CMPSS4_CTRIPH X-BAR Flag Clear Reset type: CPU1.SYSRSn
6	CMPSS4_CTRIPL	R=0/W=1	0h	CMPSS4_CTRIPL X-BAR Flag Clear Reset type: CPU1.SYSRSn
5	CMPSS3_CTRIPH	R=0/W=1	0h	CMPSS3_CTRIPH X-BAR Flag Clear Reset type: CPU1.SYSRSn
4	CMPSS3_CTRIPL	R=0/W=1	0h	CMPSS3_CTRIPL X-BAR Flag Clear Reset type: CPU1.SYSRSn
3	CMPSS2_CTRIPH	R=0/W=1	0h	CMPSS2_CTRIPH X-BAR Flag Clear Reset type: CPU1.SYSRSn
2	CMPSS2_CTRIPL	R=0/W=1	0h	CMPSS2_CTRIPL X-BAR Flag Clear Reset type: CPU1.SYSRSn
1	CMPSS1_CTRIPH	R=0/W=1	0h	CMPSS1_CTRIPH X-BAR Flag Clear Reset type: CPU1.SYSRSn
0	CMPSS1_CTRIPL	R=0/W=1	0h	CMPSS1_CTRIPL X-BAR Flag Clear Reset type: CPU1.SYSRSn

### 7.3.3.5 XBARCLR2 Register (Offset = Ah) [reset = 0h]

XBARCLR2 is shown in [Figure 7-24](#) and described in [Table 7-28](#).

Return to [Summary Table](#).

This register is used to clear the flag(s) in the XBARFLG2 register.

1: Clears the corresponding bit in the XBARFLG2 register.

0: Writing 0 has no effect

**Figure 7-24. XBARCLR2 Register**

31		30		29		28		27		26		25		24	
ADCCEVT1	ADCBEVT4	ADCBEVT3	ADCBEVT2	ADCBEVT1	ADCAEVT4	ADCAEVT3	ADCAEVT2								
R=0/W=1-0h	R=0/W=1-0h	R=0/W=1-0h	R=0/W=1-0h	R=0/W=1-0h	R=0/W=1-0h	R=0/W=1-0h	R=0/W=1-0h								
23		22		21		20		19		18		17		16	
ADCAEVT1	EXTSYNCOUT	ECAP6_OUT	ECAP5_OUT	ECAP4_OUT	ECAP3_OUT	ECAP2_OUT	ECAP1_OUT								
R=0/W=1-0h	R=0/W=1-0h	R=0/W=1-0h	R=0/W=1-0h	R=0/W=1-0h	R=0/W=1-0h	R=0/W=1-0h	R=0/W=1-0h								
15		14		13		12		11		10		9		8	
RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED
R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h
7		6		5		4		3		2		1		0	
ADCSOCBO	ADCSOCAO	INPUT7	INPUT5	INPUT4	INPUT3	INPUT2	INPUT1								
R=0/W=1-0h	R=0/W=1-0h	R=0/W=1-0h	R=0/W=1-0h	R=0/W=1-0h	R=0/W=1-0h	R=0/W=1-0h	R=0/W=1-0h								

**Table 7-28. XBARCLR2 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31	ADCCEVT1	R=0/W=1	0h	ADCCEVT1 X-BAR Flag Clear Reset type: CPU1.SYSRSn
30	ADCBEVT4	R=0/W=1	0h	ADCBEVT4 X-BAR Flag Clear Reset type: CPU1.SYSRSn
29	ADCBEVT3	R=0/W=1	0h	ADCBEVT3 X-BAR Flag Clear Reset type: CPU1.SYSRSn
28	ADCBEVT2	R=0/W=1	0h	ADCBEVT2 X-BAR Flag Clear Reset type: CPU1.SYSRSn
27	ADCBEVT1	R=0/W=1	0h	ADCBEVT1 X-BAR Flag Clear Reset type: CPU1.SYSRSn
26	ADCAEVT4	R=0/W=1	0h	ADCAEVT4 X-BAR Flag Clear Reset type: CPU1.SYSRSn
25	ADCAEVT3	R=0/W=1	0h	ADCAEVT3 X-BAR Flag Clear Reset type: CPU1.SYSRSn
24	ADCAEVT2	R=0/W=1	0h	ADCAEVT2 X-BAR Flag Clear Reset type: CPU1.SYSRSn
23	ADCAEVT1	R=0/W=1	0h	ADCAEVT1 X-BAR Flag Clear Reset type: CPU1.SYSRSn
22	EXTSYNCOUT	R=0/W=1	0h	EXTSYNCOUT X-BAR Flag Clear Reset type: CPU1.SYSRSn
21	ECAP6_OUT	R=0/W=1	0h	ECAP6_OUT X-BAR Flag Clear Reset type: CPU1.SYSRSn
20	ECAP5_OUT	R=0/W=1	0h	ECAP5_OUT X-BAR Flag Clear Reset type: CPU1.SYSRSn
19	ECAP4_OUT	R=0/W=1	0h	ECAP4_OUT X-BAR Flag Clear Reset type: CPU1.SYSRSn

**Table 7-28. XBARCLR2 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
18	ECAP3_OUT	R=0/W=1	0h	ECAP3_OUT X-BAR Flag Clear Reset type: CPU1.SYSRSn
17	ECAP2_OUT	R=0/W=1	0h	ECAP2_OUT X-BAR Flag Clear Reset type: CPU1.SYSRSn
16	ECAP1_OUT	R=0/W=1	0h	ECAP1_OUT X-BAR Flag Clear Reset type: CPU1.SYSRSn
15	RESERVED	R	0h	Reserved
14	RESERVED	R	0h	Reserved
13	RESERVED	R	0h	Reserved
12	RESERVED	R	0h	Reserved
11	RESERVED	R	0h	Reserved
10	RESERVED	R	0h	Reserved
9	RESERVED	R	0h	Reserved
8	RESERVED	R	0h	Reserved
7	ADCSOCBO	R=0/W=1	0h	ADCSOCBO X-BAR Flag Clear Reset type: CPU1.SYSRSn
6	ADCSOCAO	R=0/W=1	0h	ADCSOCAO X-BAR Flag Clear Reset type: CPU1.SYSRSn
5	INPUT7	R=0/W=1	0h	INPUT7 X-BAR Flag Clear Reset type: CPU1.SYSRSn
4	INPUT5	R=0/W=1	0h	INPUT5 X-BAR Flag Clear Reset type: CPU1.SYSRSn
3	INPUT4	R=0/W=1	0h	INPUT4 X-BAR Flag Clear Reset type: CPU1.SYSRSn
2	INPUT3	R=0/W=1	0h	INPUT3 X-BAR Flag Clear Reset type: CPU1.SYSRSn
1	INPUT2	R=0/W=1	0h	INPUT2 X-BAR Flag Clear Reset type: CPU1.SYSRSn
0	INPUT1	R=0/W=1	0h	INPUT1 X-BAR Flag Clear Reset type: CPU1.SYSRSn

### 7.3.3.6 XBARCLR3 Register (Offset = Ch) [reset = 0h]

XBARCLR3 is shown in [Figure 7-25](#) and described in [Table 7-29](#).

Return to [Summary Table](#).

This register is used to clear the flag(s) in the XBARFLG3 register.

1: Clears the corresponding bit in the XBARFLG3 register.

0: Writing 0 has no effect

**Figure 7-25. XBARCLR3 Register**

31								30								29								28								27								26								25								24							
RESERVED																																																															
R=0-0h																																																															
23								22								21								20								19								18								17								16							
RESERVED								SD2FLT4_CO MPH								SD2FLT4_CO MPL								SD2FLT3_CO MPH								SD2FLT3_CO MPL								SD2FLT2_CO MPH								SD2FLT2_CO MPL								SD2FLT1_CO MPH							
R=0-0h								R=0/W=1-0h								R=0/W=1-0h								R=0/W=1-0h								R=0/W=1-0h								R=0/W=1-0h								R=0/W=1-0h															
15								14								13								12								11								10								9								8							
SD2FLT1_CO MPL								SD1FLT4_CO MPH								SD1FLT4_CO MPL								SD1FLT3_CO MPH								SD1FLT3_CO MPL								SD1FLT2_CO MPH								SD1FLT2_CO MPL								SD1FLT1_CO MPH							
R=0/W=1-0h								R=0/W=1-0h								R=0/W=1-0h								R=0/W=1-0h								R=0/W=1-0h								R=0/W=1-0h								R=0/W=1-0h															
7								6								5								4								3								2								1								0							
SD1FLT1_CO MPL								ADCDEVT4								ADCDEVT3								ADCDEVT2								ADCDEVT1								ADCCEVT4								ADCCEVT3								ADCCEVT2							
R=0/W=1-0h								R=0/W=1-0h								R=0/W=1-0h								R=0/W=1-0h								R=0/W=1-0h								R=0/W=1-0h								R=0/W=1-0h															

**Table 7-29. XBARCLR3 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-23	RESERVED	R=0	0h	Reserved
22	SD2FLT4_COMPH	R=0/W=1	0h	SD2FLT4_COMPH X-BAR Flag Clear Reset type: CPU1.SYSRSn
21	SD2FLT4_COMPL	R=0/W=1	0h	SD2FLT4_COMPL X-BAR Flag Clear Reset type: CPU1.SYSRSn
20	SD2FLT3_COMPH	R=0/W=1	0h	SD2FLT3_COMPH X-BAR Flag Clear Reset type: CPU1.SYSRSn
19	SD2FLT3_COMPL	R=0/W=1	0h	SD2FLT3_COMPL X-BAR Flag Clear Reset type: CPU1.SYSRSn
18	SD2FLT2_COMPH	R=0/W=1	0h	SD2FLT2_COMPH X-BAR Flag Clear Reset type: CPU1.SYSRSn
17	SD2FLT2_COMPL	R=0/W=1	0h	SD2FLT2_COMPL X-BAR Flag Clear Reset type: CPU1.SYSRSn
16	SD2FLT1_COMPH	R=0/W=1	0h	SD2FLT1_COMPH X-BAR Flag Clear Reset type: CPU1.SYSRSn
15	SD2FLT1_COMPL	R=0/W=1	0h	SD2FLT1_COMPL X-BAR Flag Clear Reset type: CPU1.SYSRSn
14	SD1FLT4_COMPH	R=0/W=1	0h	SD1FLT4_COMPH X-BAR Flag Clear Reset type: CPU1.SYSRSn
13	SD1FLT4_COMPL	R=0/W=1	0h	SD1FLT4_COMPL X-BAR Flag Clear Reset type: CPU1.SYSRSn
12	SD1FLT3_COMPH	R=0/W=1	0h	SD1FLT3_COMPH X-BAR Flag Clear Reset type: CPU1.SYSRSn

**Table 7-29. XBARCLR3 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
11	SD1FLT3_COMPL	R=0/W=1	0h	SD1FLT3_COMPL X-BAR Flag Clear Reset type: CPU1.SYSRSn
10	SD1FLT2_COMPH	R=0/W=1	0h	SD1FLT2_COMPH X-BAR Flag Clear Reset type: CPU1.SYSRSn
9	SD1FLT2_COMPL	R=0/W=1	0h	SD1FLT2_COMPL X-BAR Flag Clear Reset type: CPU1.SYSRSn
8	SD1FLT1_COMPH	R=0/W=1	0h	SD1FLT1_COMPH X-BAR Flag Clear Reset type: CPU1.SYSRSn
7	SD1FLT1_COMPL	R=0/W=1	0h	SD1FLT1_COMPL X-BAR Flag Clear Reset type: CPU1.SYSRSn
6	ADCDEVT4	R=0/W=1	0h	ADCDEVT4 X-BAR Flag Clear Reset type: CPU1.SYSRSn
5	ADCDEVT3	R=0/W=1	0h	ADCDEVT3 X-BAR Flag Clear Reset type: CPU1.SYSRSn
4	ADCDEVT2	R=0/W=1	0h	ADCDEVT2 X-BAR Flag Clear Reset type: CPU1.SYSRSn
3	ADCDEVT1	R=0/W=1	0h	ADCDEVT1 X-BAR Flag Clear Reset type: CPU1.SYSRSn
2	ADCCEVT4	R=0/W=1	0h	ADCCEVT4 X-BAR Flag Clear Reset type: CPU1.SYSRSn
1	ADCCEVT3	R=0/W=1	0h	ADCCEVT3 X-BAR Flag Clear Reset type: CPU1.SYSRSn
0	ADCCEVT2	R=0/W=1	0h	ADCCEVT2 X-BAR Flag Clear Reset type: CPU1.SYSRSn

### 7.3.4 EPWM\_XBAR\_REGS Registers

Table 13-100 lists the memory-mapped registers for the EPWM\_XBAR\_REGS. All register offset addresses not listed in Table 13-100 should be considered as reserved locations and the register contents should not be modified.

**Table 7-30. EPWM\_XBAR\_REGS Registers**

Offset	Acronym	Register Name	Write Protection	Section
0h	TRIP4MUX0TO15CFG	ePWM XBAR Mux Configuration for TRIP4	EALLOW	<a href="#">Go</a>
2h	TRIP4MUX16TO31CFG	ePWM XBAR Mux Configuration for TRIP4	EALLOW	<a href="#">Go</a>
4h	TRIP5MUX0TO15CFG	ePWM XBAR Mux Configuration for TRIP5	EALLOW	<a href="#">Go</a>
6h	TRIP5MUX16TO31CFG	ePWM XBAR Mux Configuration for TRIP5	EALLOW	<a href="#">Go</a>
8h	TRIP7MUX0TO15CFG	ePWM XBAR Mux Configuration for TRIP7	EALLOW	<a href="#">Go</a>
Ah	TRIP7MUX16TO31CFG	ePWM XBAR Mux Configuration for TRIP7	EALLOW	<a href="#">Go</a>
Ch	TRIP8MUX0TO15CFG	ePWM XBAR Mux Configuration for TRIP8	EALLOW	<a href="#">Go</a>
Eh	TRIP8MUX16TO31CFG	ePWM XBAR Mux Configuration for TRIP8	EALLOW	<a href="#">Go</a>
10h	TRIP9MUX0TO15CFG	ePWM XBAR Mux Configuration for TRIP9	EALLOW	<a href="#">Go</a>
12h	TRIP9MUX16TO31CFG	ePWM XBAR Mux Configuration for TRIP9	EALLOW	<a href="#">Go</a>
14h	TRIP10MUX0TO15CFG	ePWM XBAR Mux Configuration for TRIP10	EALLOW	<a href="#">Go</a>
16h	TRIP10MUX16TO31CFG	ePWM XBAR Mux Configuration for TRIP10	EALLOW	<a href="#">Go</a>
18h	TRIP11MUX0TO15CFG	ePWM XBAR Mux Configuration for TRIP11	EALLOW	<a href="#">Go</a>
1Ah	TRIP11MUX16TO31CFG	ePWM XBAR Mux Configuration for TRIP11	EALLOW	<a href="#">Go</a>
1Ch	TRIP12MUX0TO15CFG	ePWM XBAR Mux Configuration for TRIP12	EALLOW	<a href="#">Go</a>
1Eh	TRIP12MUX16TO31CFG	ePWM XBAR Mux Configuration for TRIP12	EALLOW	<a href="#">Go</a>
20h	TRIP4MUXENABLE	ePWM XBAR Mux Enable for TRIP4	EALLOW	<a href="#">Go</a>
22h	TRIP5MUXENABLE	ePWM XBAR Mux Enable for TRIP5	EALLOW	<a href="#">Go</a>
24h	TRIP7MUXENABLE	ePWM XBAR Mux Enable for TRIP7	EALLOW	<a href="#">Go</a>
26h	TRIP8MUXENABLE	ePWM XBAR Mux Enable for TRIP8	EALLOW	<a href="#">Go</a>
28h	TRIP9MUXENABLE	ePWM XBAR Mux Enable for TRIP9	EALLOW	<a href="#">Go</a>
2Ah	TRIP10MUXENABLE	ePWM XBAR Mux Enable for TRIP10	EALLOW	<a href="#">Go</a>
2Ch	TRIP11MUXENABLE	ePWM XBAR Mux Enable for TRIP11	EALLOW	<a href="#">Go</a>
2Eh	TRIP12MUXENABLE	ePWM XBAR Mux Enable for TRIP12	EALLOW	<a href="#">Go</a>
38h	TRIPOUTINV	ePWM XBAR Output Inversion Register	EALLOW	<a href="#">Go</a>
3Eh	TRIPLOCK	ePWM XBAR Configuration Lock register	EALLOW	<a href="#">Go</a>

Complex bit access types are encoded to fit into small table cells. Table 13-101 shows the codes that are used for access types in this section.

**Table 7-31. EPWM\_XBAR\_REGS Access Type Codes**

Access Type	Code	Description
<b>Read Type</b>		
R	R	Read
R=0	R	Read
<b>Write Type</b>		
W	W	Write
W=1	W	Write
WSOnce	SOnce W	Set once Write
<b>Reset or Default Value</b>		
-n		Value after reset or the default value
<b>Register Array Variables</b>		

**Table 7-31. EPWM\_XBAR\_REGS Access Type Codes (continued)**

Access Type	Code	Description
i,j,k,l,m,n		When these variables are used in a register name, an offset, or an address, they refer to the value of a register array where the register is part of a group of repeating registers. The register groups form a hierarchical structure and the array is represented with a formula.
y		When this variable is used in a register name, an offset, or an address it refers to the value of a register array.

**7.3.4.1 TRIP4MUX0TO15CFG Register (Offset = 0h) [reset = 0h]**

TRIP4MUX0TO15CFG is shown in [Figure 13-161](#) and described in [Table 13-102](#).

Return to [Summary Table](#).

ePWM XBAR Mux Configuration for TRIP4

**Figure 7-26. TRIP4MUX0TO15CFG Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
MUX15		MUX14		MUX13		MUX12		MUX11		MUX10		MUX9		MUX8	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
MUX7		MUX6		MUX5		MUX4		MUX3		MUX2		MUX1		MUX0	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	

**Table 7-32. TRIP4MUX0TO15CFG Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-30	MUX15	R/W	0h	Select Bits for EPWM-XBAR TRIP4 Mux15: 00 : Select .0 input for Mux15 01 : Select .1 input for Mux15 10 : Select .2 input for Mux15 11 : Select .3 input for Mux15  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
29-28	MUX14	R/W	0h	Select Bits for EPWM-XBAR TRIP4 Mux14: 00 : Select .0 input for Mux14 01 : Select .1 input for Mux14 10 : Select .2 input for Mux14 11 : Select .3 input for Mux14  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
27-26	MUX13	R/W	0h	Select Bits for EPWM-XBAR TRIP4 Mux13: 00 : Select .0 input for Mux13 01 : Select .1 input for Mux13 10 : Select .2 input for Mux13 11 : Select .3 input for Mux13  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
25-24	MUX12	R/W	0h	Select Bits for EPWM-XBAR TRIP4 Mux12: 00 : Select .0 input for Mux12 01 : Select .1 input for Mux12 10 : Select .2 input for Mux12 11 : Select .3 input for Mux12  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn



**Table 7-32. TRIP4MUX0TO15CFG Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
23-22	MUX11	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP4 Mux11:</p> <p>00 : Select .0 input for Mux11            01 : Select .1 input for Mux11            10 : Select .2 input for Mux11            11 : Select .3 input for Mux11</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>
21-20	MUX10	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP4 Mux10:</p> <p>00 : Select .0 input for Mux10            01 : Select .1 input for Mux10            10 : Select .2 input for Mux10            11 : Select .3 input for Mux10</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>
19-18	MUX9	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP4 Mux9:</p> <p>00 : Select .0 input for Mux9            01 : Select .1 input for Mux9            10 : Select .2 input for Mux9            11 : Select .3 input for Mux9</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>
17-16	MUX8	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP4 Mux8:</p> <p>00 : Select .0 input for Mux8            01 : Select .1 input for Mux8            10 : Select .2 input for Mux8            11 : Select .3 input for Mux8</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>
15-14	MUX7	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP4 Mux7:</p> <p>00 : Select .0 input for Mux7            01 : Select .1 input for Mux7            10 : Select .2 input for Mux7            11 : Select .3 input for Mux7</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>
13-12	MUX6	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP4 Mux6:</p> <p>00 : Select .0 input for Mux6            01 : Select .1 input for Mux6            10 : Select .2 input for Mux6            11 : Select .3 input for Mux6</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>

**Table 7-32. TRIP4MUX0TO15CFG Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
11-10	MUX5	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP4 Mux5:</p> <p>00 : Select .0 input for Mux5  01 : Select .1 input for Mux5  10 : Select .2 input for Mux5  11 : Select .3 input for Mux5</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>
9-8	MUX4	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP4 Mux4:</p> <p>00 : Select .0 input for Mux4  01 : Select .1 input for Mux4  10 : Select .2 input for Mux4  11 : Select .3 input for Mux4</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>
7-6	MUX3	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP4 Mux3:</p> <p>00 : Select .0 input for Mux3  01 : Select .1 input for Mux3  10 : Select .2 input for Mux3  11 : Select .3 input for Mux3</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>
5-4	MUX2	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP4 Mux2:</p> <p>00 : Select .0 input for Mux2  01 : Select .1 input for Mux2  10 : Select .2 input for Mux2  11 : Select .3 input for Mux2</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>
3-2	MUX1	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP4 Mux1:</p> <p>00 : Select .0 input for Mux1  01 : Select .1 input for Mux1  10 : Select .2 input for Mux1  11 : Select .3 input for Mux1</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>
1-0	MUX0	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP4 Mux0:</p> <p>00 : Select .0 input for Mux0  01 : Select .1 input for Mux0  10 : Select .2 input for Mux0  11 : Select .3 input for Mux0</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>

### 7.3.4.2 TRIP4MUX16TO31CFG Register (Offset = 2h) [reset = 0h]

TRIP4MUX16TO31CFG is shown in [Figure 13-162](#) and described in [Table 13-103](#).

Return to [Summary Table](#).

ePWM XBAR Mux Configuration for TRIP4

**Figure 7-27. TRIP4MUX16TO31CFG Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
MUX31		MUX30		MUX29		MUX28		MUX27		MUX26		MUX25		MUX24	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
MUX23		MUX22		MUX21		MUX20		MUX19		MUX18		MUX17		MUX16	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	

**Table 7-33. TRIP4MUX16TO31CFG Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-30	MUX31	R/W	0h	Select Bits for EPWM-XBAR TRIP4 Mux31:  00 : Select .0 input for Mux31 01 : Select .1 input for Mux31 10 : Select .2 input for Mux31 11 : Select .3 input for Mux31  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
29-28	MUX30	R/W	0h	Select Bits for EPWM-XBAR TRIP4 Mux30:  00 : Select .0 input for Mux30 01 : Select .1 input for Mux30 10 : Select .2 input for Mux30 11 : Select .3 input for Mux30  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
27-26	MUX29	R/W	0h	Select Bits for EPWM-XBAR TRIP4 Mux29:  00 : Select .0 input for Mux29 01 : Select .1 input for Mux29 10 : Select .2 input for Mux29 11 : Select .3 input for Mux29  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
25-24	MUX28	R/W	0h	Select Bits for EPWM-XBAR TRIP4 Mux28:  00 : Select .0 input for Mux28 01 : Select .1 input for Mux28 10 : Select .2 input for Mux28 11 : Select .3 input for Mux28  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn

**Table 7-33. TRIP4MUX16TO31CFG Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
23-22	MUX27	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP4 Mux27:</p> <p>00 : Select .0 input for Mux27  01 : Select .1 input for Mux27  10 : Select .2 input for Mux27  11 : Select .3 input for Mux27</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>
21-20	MUX26	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP4 Mux26:</p> <p>00 : Select .0 input for Mux26  01 : Select .1 input for Mux26  10 : Select .2 input for Mux26  11 : Select .3 input for Mux26</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>
19-18	MUX25	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP4 Mux25:</p> <p>00 : Select .0 input for Mux25  01 : Select .1 input for Mux25  10 : Select .2 input for Mux25  11 : Select .3 input for Mux25</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>
17-16	MUX24	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP4 Mux24:</p> <p>00 : Select .0 input for Mux24  01 : Select .1 input for Mux24  10 : Select .2 input for Mux24  11 : Select .3 input for Mux24</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>
15-14	MUX23	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP4 Mux23:</p> <p>00 : Select .0 input for Mux23  01 : Select .1 input for Mux23  10 : Select .2 input for Mux23  11 : Select .3 input for Mux23</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>
13-12	MUX22	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP4 Mux22:</p> <p>00 : Select .0 input for Mux22  01 : Select .1 input for Mux22  10 : Select .2 input for Mux22  11 : Select .3 input for Mux22</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>

**Table 7-33. TRIP4MUX16TO31CFG Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
11-10	MUX21	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP4 Mux21:</p> <p>00 : Select .0 input for Mux21  01 : Select .1 input for Mux21  10 : Select .2 input for Mux21  11 : Select .3 input for Mux21</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>
9-8	MUX20	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP4 Mux20:</p> <p>00 : Select .0 input for Mux20  01 : Select .1 input for Mux20  10 : Select .2 input for Mux20  11 : Select .3 input for Mux20</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>
7-6	MUX19	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP4 Mux19:</p> <p>00 : Select .0 input for Mux19  01 : Select .1 input for Mux19  10 : Select .2 input for Mux19  11 : Select .3 input for Mux19</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>
5-4	MUX18	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP4 Mux18:</p> <p>00 : Select .0 input for Mux18  01 : Select .1 input for Mux18  10 : Select .2 input for Mux18  11 : Select .3 input for Mux18</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>
3-2	MUX17	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP4 Mux17:</p> <p>00 : Select .0 input for Mux17  01 : Select .1 input for Mux17  10 : Select .2 input for Mux17  11 : Select .3 input for Mux17</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>
1-0	MUX16	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP4 Mux16:</p> <p>00 : Select .0 input for Mux16  01 : Select .1 input for Mux16  10 : Select .2 input for Mux16  11 : Select .3 input for Mux16</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>

**7.3.4.3 TRIP5MUX0TO15CFG Register (Offset = 4h) [reset = 0h]**

TRIP5MUX0TO15CFG is shown in [Figure 13-163](#) and described in [Table 13-104](#).

Return to [Summary Table](#).

ePWM XBAR Mux Configuration for TRIP5

**Figure 7-28. TRIP5MUX0TO15CFG Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
MUX15		MUX14		MUX13		MUX12		MUX11		MUX10		MUX9		MUX8	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
MUX7		MUX6		MUX5		MUX4		MUX3		MUX2		MUX1		MUX0	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	

**Table 7-34. TRIP5MUX0TO15CFG Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-30	MUX15	R/W	0h	Select Bits for EPWM-XBAR TRIP5 Mux15: 00 : Select .0 input for Mux15 01 : Select .1 input for Mux15 10 : Select .2 input for Mux15 11 : Select .3 input for Mux15  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
29-28	MUX14	R/W	0h	Select Bits for EPWM-XBAR TRIP5 Mux14: 00 : Select .0 input for Mux14 01 : Select .1 input for Mux14 10 : Select .2 input for Mux14 11 : Select .3 input for Mux14  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
27-26	MUX13	R/W	0h	Select Bits for EPWM-XBAR TRIP5 Mux13: 00 : Select .0 input for Mux13 01 : Select .1 input for Mux13 10 : Select .2 input for Mux13 11 : Select .3 input for Mux13  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
25-24	MUX12	R/W	0h	Select Bits for EPWM-XBAR TRIP5 Mux12: 00 : Select .0 input for Mux12 01 : Select .1 input for Mux12 10 : Select .2 input for Mux12 11 : Select .3 input for Mux12  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn

**Table 7-34. TRIP5MUX0TO15CFG Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
23-22	MUX11	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP5 Mux11:</p> <p>00 : Select .0 input for Mux11            01 : Select .1 input for Mux11            10 : Select .2 input for Mux11            11 : Select .3 input for Mux11</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>
21-20	MUX10	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP5 Mux10:</p> <p>00 : Select .0 input for Mux10            01 : Select .1 input for Mux10            10 : Select .2 input for Mux10            11 : Select .3 input for Mux10</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>
19-18	MUX9	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP5 Mux9:</p> <p>00 : Select .0 input for Mux9            01 : Select .1 input for Mux9            10 : Select .2 input for Mux9            11 : Select .3 input for Mux9</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>
17-16	MUX8	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP5 Mux8:</p> <p>00 : Select .0 input for Mux8            01 : Select .1 input for Mux8            10 : Select .2 input for Mux8            11 : Select .3 input for Mux8</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>
15-14	MUX7	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP5 Mux7:</p> <p>00 : Select .0 input for Mux7            01 : Select .1 input for Mux7            10 : Select .2 input for Mux7            11 : Select .3 input for Mux7</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>
13-12	MUX6	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP5 Mux6:</p> <p>00 : Select .0 input for Mux6            01 : Select .1 input for Mux6            10 : Select .2 input for Mux6            11 : Select .3 input for Mux6</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>

**Table 7-34. TRIP5MUX0TO15CFG Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
11-10	MUX5	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP5 Mux5:</p> <p>00 : Select .0 input for Mux5  01 : Select .1 input for Mux5  10 : Select .2 input for Mux5  11 : Select .3 input for Mux5</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>
9-8	MUX4	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP5 Mux4:</p> <p>00 : Select .0 input for Mux4  01 : Select .1 input for Mux4  10 : Select .2 input for Mux4  11 : Select .3 input for Mux4</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>
7-6	MUX3	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP5 Mux3:</p> <p>00 : Select .0 input for Mux3  01 : Select .1 input for Mux3  10 : Select .2 input for Mux3  11 : Select .3 input for Mux3</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>
5-4	MUX2	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP5 Mux2:</p> <p>00 : Select .0 input for Mux2  01 : Select .1 input for Mux2  10 : Select .2 input for Mux2  11 : Select .3 input for Mux2</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>
3-2	MUX1	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP5 Mux1:</p> <p>00 : Select .0 input for Mux1  01 : Select .1 input for Mux1  10 : Select .2 input for Mux1  11 : Select .3 input for Mux1</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>
1-0	MUX0	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP5 Mux0:</p> <p>00 : Select .0 input for Mux0  01 : Select .1 input for Mux0  10 : Select .2 input for Mux0  11 : Select .3 input for Mux0</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>



### 7.3.4.4 TRIP5MUX16TO31CFG Register (Offset = 6h) [reset = 0h]

TRIP5MUX16TO31CFG is shown in [Figure 13-164](#) and described in [Table 13-105](#).

Return to [Summary Table](#).

ePWM XBAR Mux Configuration for TRIP5

**Figure 7-29. TRIP5MUX16TO31CFG Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
MUX31		MUX30		MUX29		MUX28		MUX27		MUX26		MUX25		MUX24	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
MUX23		MUX22		MUX21		MUX20		MUX19		MUX18		MUX17		MUX16	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	

**Table 7-35. TRIP5MUX16TO31CFG Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-30	MUX31	R/W	0h	Select Bits for EPWM-XBAR TRIP5 Mux31:  00 : Select .0 input for Mux31 01 : Select .1 input for Mux31 10 : Select .2 input for Mux31 11 : Select .3 input for Mux31  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
29-28	MUX30	R/W	0h	Select Bits for EPWM-XBAR TRIP5 Mux30:  00 : Select .0 input for Mux30 01 : Select .1 input for Mux30 10 : Select .2 input for Mux30 11 : Select .3 input for Mux30  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
27-26	MUX29	R/W	0h	Select Bits for EPWM-XBAR TRIP5 Mux29:  00 : Select .0 input for Mux29 01 : Select .1 input for Mux29 10 : Select .2 input for Mux29 11 : Select .3 input for Mux29  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
25-24	MUX28	R/W	0h	Select Bits for EPWM-XBAR TRIP5 Mux28:  00 : Select .0 input for Mux28 01 : Select .1 input for Mux28 10 : Select .2 input for Mux28 11 : Select .3 input for Mux28  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn

**Table 7-35. TRIP5MUX16TO31CFG Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
23-22	MUX27	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP5 Mux27:</p> <p>00 : Select .0 input for Mux27  01 : Select .1 input for Mux27  10 : Select .2 input for Mux27  11 : Select .3 input for Mux27</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>
21-20	MUX26	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP5 Mux26:</p> <p>00 : Select .0 input for Mux26  01 : Select .1 input for Mux26  10 : Select .2 input for Mux26  11 : Select .3 input for Mux26</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>
19-18	MUX25	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP5 Mux25:</p> <p>00 : Select .0 input for Mux25  01 : Select .1 input for Mux25  10 : Select .2 input for Mux25  11 : Select .3 input for Mux25</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>
17-16	MUX24	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP5 Mux24:</p> <p>00 : Select .0 input for Mux24  01 : Select .1 input for Mux24  10 : Select .2 input for Mux24  11 : Select .3 input for Mux24</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>
15-14	MUX23	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP5 Mux23:</p> <p>00 : Select .0 input for Mux23  01 : Select .1 input for Mux23  10 : Select .2 input for Mux23  11 : Select .3 input for Mux23</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>
13-12	MUX22	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP5 Mux22:</p> <p>00 : Select .0 input for Mux22  01 : Select .1 input for Mux22  10 : Select .2 input for Mux22  11 : Select .3 input for Mux22</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>

**Table 7-35. TRIP5MUX16TO31CFG Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
11-10	MUX21	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP5 Mux21:</p> <p>00 : Select .0 input for Mux21            01 : Select .1 input for Mux21            10 : Select .2 input for Mux21            11 : Select .3 input for Mux21</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>
9-8	MUX20	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP5 Mux20:</p> <p>00 : Select .0 input for Mux20            01 : Select .1 input for Mux20            10 : Select .2 input for Mux20            11 : Select .3 input for Mux20</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>
7-6	MUX19	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP5 Mux19:</p> <p>00 : Select .0 input for Mux19            01 : Select .1 input for Mux19            10 : Select .2 input for Mux19            11 : Select .3 input for Mux19</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>
5-4	MUX18	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP5 Mux18:</p> <p>00 : Select .0 input for Mux18            01 : Select .1 input for Mux18            10 : Select .2 input for Mux18            11 : Select .3 input for Mux18</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>
3-2	MUX17	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP5 Mux17:</p> <p>00 : Select .0 input for Mux17            01 : Select .1 input for Mux17            10 : Select .2 input for Mux17            11 : Select .3 input for Mux17</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>
1-0	MUX16	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP5 Mux16:</p> <p>00 : Select .0 input for Mux16            01 : Select .1 input for Mux16            10 : Select .2 input for Mux16            11 : Select .3 input for Mux16</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>

**7.3.4.5 TRIP7MUX0TO15CFG Register (Offset = 8h) [reset = 0h]**

TRIP7MUX0TO15CFG is shown in [Figure 13-165](#) and described in [Table 13-106](#).

Return to [Summary Table](#).

ePWM XBAR Mux Configuration for TRIP7

**Figure 7-30. TRIP7MUX0TO15CFG Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
MUX15		MUX14		MUX13		MUX12		MUX11		MUX10		MUX9		MUX8	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
MUX7		MUX6		MUX5		MUX4		MUX3		MUX2		MUX1		MUX0	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	

**Table 7-36. TRIP7MUX0TO15CFG Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-30	MUX15	R/W	0h	Select Bits for EPWM-XBAR TRIP7 Mux15: 00 : Select .0 input for Mux15 01 : Select .1 input for Mux15 10 : Select .2 input for Mux15 11 : Select .3 input for Mux15  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
29-28	MUX14	R/W	0h	Select Bits for EPWM-XBAR TRIP7 Mux14: 00 : Select .0 input for Mux14 01 : Select .1 input for Mux14 10 : Select .2 input for Mux14 11 : Select .3 input for Mux14  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
27-26	MUX13	R/W	0h	Select Bits for EPWM-XBAR TRIP7 Mux13: 00 : Select .0 input for Mux13 01 : Select .1 input for Mux13 10 : Select .2 input for Mux13 11 : Select .3 input for Mux13  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
25-24	MUX12	R/W	0h	Select Bits for EPWM-XBAR TRIP7 Mux12: 00 : Select .0 input for Mux12 01 : Select .1 input for Mux12 10 : Select .2 input for Mux12 11 : Select .3 input for Mux12  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn

**Table 7-36. TRIP7MUX0TO15CFG Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
23-22	MUX11	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP7 Mux11:</p> <p>00 : Select .0 input for Mux11            01 : Select .1 input for Mux11            10 : Select .2 input for Mux11            11 : Select .3 input for Mux11</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>
21-20	MUX10	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP7 Mux10:</p> <p>00 : Select .0 input for Mux10            01 : Select .1 input for Mux10            10 : Select .2 input for Mux10            11 : Select .3 input for Mux10</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>
19-18	MUX9	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP7 Mux9:</p> <p>00 : Select .0 input for Mux9            01 : Select .1 input for Mux9            10 : Select .2 input for Mux9            11 : Select .3 input for Mux9</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>
17-16	MUX8	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP7 Mux8:</p> <p>00 : Select .0 input for Mux8            01 : Select .1 input for Mux8            10 : Select .2 input for Mux8            11 : Select .3 input for Mux8</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>
15-14	MUX7	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP7 Mux7:</p> <p>00 : Select .0 input for Mux7            01 : Select .1 input for Mux7            10 : Select .2 input for Mux7            11 : Select .3 input for Mux7</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>
13-12	MUX6	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP7 Mux6:</p> <p>00 : Select .0 input for Mux6            01 : Select .1 input for Mux6            10 : Select .2 input for Mux6            11 : Select .3 input for Mux6</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>

**Table 7-36. TRIP7MUX0TO15CFG Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
11-10	MUX5	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP7 Mux5:</p> <p>00 : Select .0 input for Mux5  01 : Select .1 input for Mux5  10 : Select .2 input for Mux5  11 : Select .3 input for Mux5</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>
9-8	MUX4	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP7 Mux4:</p> <p>00 : Select .0 input for Mux4  01 : Select .1 input for Mux4  10 : Select .2 input for Mux4  11 : Select .3 input for Mux4</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>
7-6	MUX3	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP7 Mux3:</p> <p>00 : Select .0 input for Mux3  01 : Select .1 input for Mux3  10 : Select .2 input for Mux3  11 : Select .3 input for Mux3</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>
5-4	MUX2	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP7 Mux2:</p> <p>00 : Select .0 input for Mux2  01 : Select .1 input for Mux2  10 : Select .2 input for Mux2  11 : Select .3 input for Mux2</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>
3-2	MUX1	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP7 Mux1:</p> <p>00 : Select .0 input for Mux1  01 : Select .1 input for Mux1  10 : Select .2 input for Mux1  11 : Select .3 input for Mux1</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>
1-0	MUX0	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP7 Mux0:</p> <p>00 : Select .0 input for Mux0  01 : Select .1 input for Mux0  10 : Select .2 input for Mux0  11 : Select .3 input for Mux0</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>

### 7.3.4.6 TRIP7MUX16TO31CFG Register (Offset = Ah) [reset = 0h]

TRIP7MUX16TO31CFG is shown in [Figure 13-166](#) and described in [Table 13-107](#).

Return to [Summary Table](#).

ePWM XBAR Mux Configuration for TRIP7

**Figure 7-31. TRIP7MUX16TO31CFG Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
MUX31		MUX30		MUX29		MUX28		MUX27		MUX26		MUX25		MUX24	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
MUX23		MUX22		MUX21		MUX20		MUX19		MUX18		MUX17		MUX16	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	

**Table 7-37. TRIP7MUX16TO31CFG Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-30	MUX31	R/W	0h	Select Bits for EPWM-XBAR TRIP7 Mux31:  00 : Select .0 input for Mux31 01 : Select .1 input for Mux31 10 : Select .2 input for Mux31 11 : Select .3 input for Mux31  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
29-28	MUX30	R/W	0h	Select Bits for EPWM-XBAR TRIP7 Mux30:  00 : Select .0 input for Mux30 01 : Select .1 input for Mux30 10 : Select .2 input for Mux30 11 : Select .3 input for Mux30  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
27-26	MUX29	R/W	0h	Select Bits for EPWM-XBAR TRIP7 Mux29:  00 : Select .0 input for Mux29 01 : Select .1 input for Mux29 10 : Select .2 input for Mux29 11 : Select .3 input for Mux29  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
25-24	MUX28	R/W	0h	Select Bits for EPWM-XBAR TRIP7 Mux28:  00 : Select .0 input for Mux28 01 : Select .1 input for Mux28 10 : Select .2 input for Mux28 11 : Select .3 input for Mux28  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn

**Table 7-37. TRIP7MUX16TO31CFG Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
23-22	MUX27	R/W	0h	Select Bits for EPWM-XBAR TRIP7 Mux27: 00 : Select .0 input for Mux27 01 : Select .1 input for Mux27 10 : Select .2 input for Mux27 11 : Select .3 input for Mux27  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
21-20	MUX26	R/W	0h	Select Bits for EPWM-XBAR TRIP7 Mux26: 00 : Select .0 input for Mux26 01 : Select .1 input for Mux26 10 : Select .2 input for Mux26 11 : Select .3 input for Mux26  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
19-18	MUX25	R/W	0h	Select Bits for EPWM-XBAR TRIP7 Mux25: 00 : Select .0 input for Mux25 01 : Select .1 input for Mux25 10 : Select .2 input for Mux25 11 : Select .3 input for Mux25  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
17-16	MUX24	R/W	0h	Select Bits for EPWM-XBAR TRIP7 Mux24: 00 : Select .0 input for Mux24 01 : Select .1 input for Mux24 10 : Select .2 input for Mux24 11 : Select .3 input for Mux24  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
15-14	MUX23	R/W	0h	Select Bits for EPWM-XBAR TRIP7 Mux23: 00 : Select .0 input for Mux23 01 : Select .1 input for Mux23 10 : Select .2 input for Mux23 11 : Select .3 input for Mux23  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
13-12	MUX22	R/W	0h	Select Bits for EPWM-XBAR TRIP7 Mux22: 00 : Select .0 input for Mux22 01 : Select .1 input for Mux22 10 : Select .2 input for Mux22 11 : Select .3 input for Mux22  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn



**Table 7-37. TRIP7MUX16TO31CFG Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
11-10	MUX21	R/W	0h	Select Bits for EPWM-XBAR TRIP7 Mux21: 00 : Select .0 input for Mux21 01 : Select .1 input for Mux21 10 : Select .2 input for Mux21 11 : Select .3 input for Mux21  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
9-8	MUX20	R/W	0h	Select Bits for EPWM-XBAR TRIP7 Mux20: 00 : Select .0 input for Mux20 01 : Select .1 input for Mux20 10 : Select .2 input for Mux20 11 : Select .3 input for Mux20  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
7-6	MUX19	R/W	0h	Select Bits for EPWM-XBAR TRIP7 Mux19: 00 : Select .0 input for Mux19 01 : Select .1 input for Mux19 10 : Select .2 input for Mux19 11 : Select .3 input for Mux19  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
5-4	MUX18	R/W	0h	Select Bits for EPWM-XBAR TRIP7 Mux18: 00 : Select .0 input for Mux18 01 : Select .1 input for Mux18 10 : Select .2 input for Mux18 11 : Select .3 input for Mux18  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
3-2	MUX17	R/W	0h	Select Bits for EPWM-XBAR TRIP7 Mux17: 00 : Select .0 input for Mux17 01 : Select .1 input for Mux17 10 : Select .2 input for Mux17 11 : Select .3 input for Mux17  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
1-0	MUX16	R/W	0h	Select Bits for EPWM-XBAR TRIP7 Mux16: 00 : Select .0 input for Mux16 01 : Select .1 input for Mux16 10 : Select .2 input for Mux16 11 : Select .3 input for Mux16  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn

**7.3.4.7 TRIP8MUX0TO15CFG Register (Offset = Ch) [reset = 0h]**

TRIP8MUX0TO15CFG is shown in [Figure 13-167](#) and described in [Table 13-108](#).

Return to [Summary Table](#).

ePWM XBAR Mux Configuration for TRIP8

**Figure 7-32. TRIP8MUX0TO15CFG Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
MUX15		MUX14		MUX13		MUX12		MUX11		MUX10		MUX9		MUX8	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
MUX7		MUX6		MUX5		MUX4		MUX3		MUX2		MUX1		MUX0	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	

**Table 7-38. TRIP8MUX0TO15CFG Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-30	MUX15	R/W	0h	Select Bits for EPWM-XBAR TRIP8 Mux15:  00 : Select .0 input for Mux15 01 : Select .1 input for Mux15 10 : Select .2 input for Mux15 11 : Select .3 input for Mux15  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
29-28	MUX14	R/W	0h	Select Bits for EPWM-XBAR TRIP8 Mux14:  00 : Select .0 input for Mux14 01 : Select .1 input for Mux14 10 : Select .2 input for Mux14 11 : Select .3 input for Mux14  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
27-26	MUX13	R/W	0h	Select Bits for EPWM-XBAR TRIP8 Mux13:  00 : Select .0 input for Mux13 01 : Select .1 input for Mux13 10 : Select .2 input for Mux13 11 : Select .3 input for Mux13  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
25-24	MUX12	R/W	0h	Select Bits for EPWM-XBAR TRIP8 Mux12:  00 : Select .0 input for Mux12 01 : Select .1 input for Mux12 10 : Select .2 input for Mux12 11 : Select .3 input for Mux12  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn

**Table 7-38. TRIP8MUX0TO15CFG Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
23-22	MUX11	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP8 Mux11:</p> <p>00 : Select .0 input for Mux11            01 : Select .1 input for Mux11            10 : Select .2 input for Mux11            11 : Select .3 input for Mux11</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>
21-20	MUX10	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP8 Mux10:</p> <p>00 : Select .0 input for Mux10            01 : Select .1 input for Mux10            10 : Select .2 input for Mux10            11 : Select .3 input for Mux10</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>
19-18	MUX9	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP8 Mux9:</p> <p>00 : Select .0 input for Mux9            01 : Select .1 input for Mux9            10 : Select .2 input for Mux9            11 : Select .3 input for Mux9</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>
17-16	MUX8	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP8 Mux8:</p> <p>00 : Select .0 input for Mux8            01 : Select .1 input for Mux8            10 : Select .2 input for Mux8            11 : Select .3 input for Mux8</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>
15-14	MUX7	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP8 Mux7:</p> <p>00 : Select .0 input for Mux7            01 : Select .1 input for Mux7            10 : Select .2 input for Mux7            11 : Select .3 input for Mux7</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>
13-12	MUX6	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP8 Mux6:</p> <p>00 : Select .0 input for Mux6            01 : Select .1 input for Mux6            10 : Select .2 input for Mux6            11 : Select .3 input for Mux6</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>

**Table 7-38. TRIP8MUX0TO15CFG Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
11-10	MUX5	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP8 Mux5:</p> <p>00 : Select .0 input for Mux5  01 : Select .1 input for Mux5  10 : Select .2 input for Mux5  11 : Select .3 input for Mux5</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>
9-8	MUX4	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP8 Mux4:</p> <p>00 : Select .0 input for Mux4  01 : Select .1 input for Mux4  10 : Select .2 input for Mux4  11 : Select .3 input for Mux4</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>
7-6	MUX3	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP8 Mux3:</p> <p>00 : Select .0 input for Mux3  01 : Select .1 input for Mux3  10 : Select .2 input for Mux3  11 : Select .3 input for Mux3</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>
5-4	MUX2	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP8 Mux2:</p> <p>00 : Select .0 input for Mux2  01 : Select .1 input for Mux2  10 : Select .2 input for Mux2  11 : Select .3 input for Mux2</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>
3-2	MUX1	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP8 Mux1:</p> <p>00 : Select .0 input for Mux1  01 : Select .1 input for Mux1  10 : Select .2 input for Mux1  11 : Select .3 input for Mux1</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>
1-0	MUX0	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP8 Mux0:</p> <p>00 : Select .0 input for Mux0  01 : Select .1 input for Mux0  10 : Select .2 input for Mux0  11 : Select .3 input for Mux0</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>

### 7.3.4.8 TRIP8MUX16TO31CFG Register (Offset = Eh) [reset = 0h]

TRIP8MUX16TO31CFG is shown in [Figure 13-168](#) and described in [Table 13-109](#).

Return to [Summary Table](#).

ePWM XBAR Mux Configuration for TRIP8

**Figure 7-33. TRIP8MUX16TO31CFG Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
MUX31		MUX30		MUX29		MUX28		MUX27		MUX26		MUX25		MUX24	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
MUX23		MUX22		MUX21		MUX20		MUX19		MUX18		MUX17		MUX16	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	

**Table 7-39. TRIP8MUX16TO31CFG Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-30	MUX31	R/W	0h	Select Bits for EPWM-XBAR TRIP8 Mux31:  00 : Select .0 input for Mux31 01 : Select .1 input for Mux31 10 : Select .2 input for Mux31 11 : Select .3 input for Mux31  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
29-28	MUX30	R/W	0h	Select Bits for EPWM-XBAR TRIP8 Mux30:  00 : Select .0 input for Mux30 01 : Select .1 input for Mux30 10 : Select .2 input for Mux30 11 : Select .3 input for Mux30  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
27-26	MUX29	R/W	0h	Select Bits for EPWM-XBAR TRIP8 Mux29:  00 : Select .0 input for Mux29 01 : Select .1 input for Mux29 10 : Select .2 input for Mux29 11 : Select .3 input for Mux29  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
25-24	MUX28	R/W	0h	Select Bits for EPWM-XBAR TRIP8 Mux28:  00 : Select .0 input for Mux28 01 : Select .1 input for Mux28 10 : Select .2 input for Mux28 11 : Select .3 input for Mux28  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn

**Table 7-39. TRIP8MUX16TO31CFG Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
23-22	MUX27	R/W	0h	Select Bits for EPWM-XBAR TRIP8 Mux27: 00 : Select .0 input for Mux27 01 : Select .1 input for Mux27 10 : Select .2 input for Mux27 11 : Select .3 input for Mux27  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
21-20	MUX26	R/W	0h	Select Bits for EPWM-XBAR TRIP8 Mux26: 00 : Select .0 input for Mux26 01 : Select .1 input for Mux26 10 : Select .2 input for Mux26 11 : Select .3 input for Mux26  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
19-18	MUX25	R/W	0h	Select Bits for EPWM-XBAR TRIP8 Mux25: 00 : Select .0 input for Mux25 01 : Select .1 input for Mux25 10 : Select .2 input for Mux25 11 : Select .3 input for Mux25  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
17-16	MUX24	R/W	0h	Select Bits for EPWM-XBAR TRIP8 Mux24: 00 : Select .0 input for Mux24 01 : Select .1 input for Mux24 10 : Select .2 input for Mux24 11 : Select .3 input for Mux24  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
15-14	MUX23	R/W	0h	Select Bits for EPWM-XBAR TRIP8 Mux23: 00 : Select .0 input for Mux23 01 : Select .1 input for Mux23 10 : Select .2 input for Mux23 11 : Select .3 input for Mux23  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
13-12	MUX22	R/W	0h	Select Bits for EPWM-XBAR TRIP8 Mux22: 00 : Select .0 input for Mux22 01 : Select .1 input for Mux22 10 : Select .2 input for Mux22 11 : Select .3 input for Mux22  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn

**Table 7-39. TRIP8MUX16TO31CFG Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
11-10	MUX21	R/W	0h	Select Bits for EPWM-XBAR TRIP8 Mux21:  00 : Select .0 input for Mux21 01 : Select .1 input for Mux21 10 : Select .2 input for Mux21 11 : Select .3 input for Mux21  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
9-8	MUX20	R/W	0h	Select Bits for EPWM-XBAR TRIP8 Mux20:  00 : Select .0 input for Mux20 01 : Select .1 input for Mux20 10 : Select .2 input for Mux20 11 : Select .3 input for Mux20  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
7-6	MUX19	R/W	0h	Select Bits for EPWM-XBAR TRIP8 Mux19:  00 : Select .0 input for Mux19 01 : Select .1 input for Mux19 10 : Select .2 input for Mux19 11 : Select .3 input for Mux19  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
5-4	MUX18	R/W	0h	Select Bits for EPWM-XBAR TRIP8 Mux18:  00 : Select .0 input for Mux18 01 : Select .1 input for Mux18 10 : Select .2 input for Mux18 11 : Select .3 input for Mux18  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
3-2	MUX17	R/W	0h	Select Bits for EPWM-XBAR TRIP8 Mux17:  00 : Select .0 input for Mux17 01 : Select .1 input for Mux17 10 : Select .2 input for Mux17 11 : Select .3 input for Mux17  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
1-0	MUX16	R/W	0h	Select Bits for EPWM-XBAR TRIP8 Mux16:  00 : Select .0 input for Mux16 01 : Select .1 input for Mux16 10 : Select .2 input for Mux16 11 : Select .3 input for Mux16  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn

**7.3.4.9 TRIP9MUX0TO15CFG Register (Offset = 10h) [reset = 0h]**

TRIP9MUX0TO15CFG is shown in [Figure 13-169](#) and described in [Table 13-110](#).

Return to [Summary Table](#).

ePWM XBAR Mux Configuration for TRIP9

**Figure 7-34. TRIP9MUX0TO15CFG Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
MUX15		MUX14		MUX13		MUX12		MUX11		MUX10		MUX9		MUX8	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
MUX7		MUX6		MUX5		MUX4		MUX3		MUX2		MUX1		MUX0	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	

**Table 7-40. TRIP9MUX0TO15CFG Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-30	MUX15	R/W	0h	Select Bits for EPWM-XBAR TRIP9 Mux15: 00 : Select .0 input for Mux15 01 : Select .1 input for Mux15 10 : Select .2 input for Mux15 11 : Select .3 input for Mux15  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
29-28	MUX14	R/W	0h	Select Bits for EPWM-XBAR TRIP9 Mux14: 00 : Select .0 input for Mux14 01 : Select .1 input for Mux14 10 : Select .2 input for Mux14 11 : Select .3 input for Mux14  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
27-26	MUX13	R/W	0h	Select Bits for EPWM-XBAR TRIP9 Mux13: 00 : Select .0 input for Mux13 01 : Select .1 input for Mux13 10 : Select .2 input for Mux13 11 : Select .3 input for Mux13  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
25-24	MUX12	R/W	0h	Select Bits for EPWM-XBAR TRIP9 Mux12: 00 : Select .0 input for Mux12 01 : Select .1 input for Mux12 10 : Select .2 input for Mux12 11 : Select .3 input for Mux12  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn



**Table 7-40. TRIP9MUX0TO15CFG Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
23-22	MUX11	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP9 Mux11:</p> <p>00 : Select .0 input for Mux11            01 : Select .1 input for Mux11            10 : Select .2 input for Mux11            11 : Select .3 input for Mux11</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>
21-20	MUX10	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP9 Mux10:</p> <p>00 : Select .0 input for Mux10            01 : Select .1 input for Mux10            10 : Select .2 input for Mux10            11 : Select .3 input for Mux10</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>
19-18	MUX9	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP9 Mux9:</p> <p>00 : Select .0 input for Mux9            01 : Select .1 input for Mux9            10 : Select .2 input for Mux9            11 : Select .3 input for Mux9</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>
17-16	MUX8	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP9 Mux8:</p> <p>00 : Select .0 input for Mux8            01 : Select .1 input for Mux8            10 : Select .2 input for Mux8            11 : Select .3 input for Mux8</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>
15-14	MUX7	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP9 Mux7:</p> <p>00 : Select .0 input for Mux7            01 : Select .1 input for Mux7            10 : Select .2 input for Mux7            11 : Select .3 input for Mux7</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>
13-12	MUX6	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP9 Mux6:</p> <p>00 : Select .0 input for Mux6            01 : Select .1 input for Mux6            10 : Select .2 input for Mux6            11 : Select .3 input for Mux6</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>

**Table 7-40. TRIP9MUX0TO15CFG Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
11-10	MUX5	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP9 Mux5:</p> <p>00 : Select .0 input for Mux5  01 : Select .1 input for Mux5  10 : Select .2 input for Mux5  11 : Select .3 input for Mux5</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>
9-8	MUX4	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP9 Mux4:</p> <p>00 : Select .0 input for Mux4  01 : Select .1 input for Mux4  10 : Select .2 input for Mux4  11 : Select .3 input for Mux4</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>
7-6	MUX3	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP9 Mux3:</p> <p>00 : Select .0 input for Mux3  01 : Select .1 input for Mux3  10 : Select .2 input for Mux3  11 : Select .3 input for Mux3</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>
5-4	MUX2	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP9 Mux2:</p> <p>00 : Select .0 input for Mux2  01 : Select .1 input for Mux2  10 : Select .2 input for Mux2  11 : Select .3 input for Mux2</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>
3-2	MUX1	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP9 Mux1:</p> <p>00 : Select .0 input for Mux1  01 : Select .1 input for Mux1  10 : Select .2 input for Mux1  11 : Select .3 input for Mux1</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>
1-0	MUX0	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP9 Mux0:</p> <p>00 : Select .0 input for Mux0  01 : Select .1 input for Mux0  10 : Select .2 input for Mux0  11 : Select .3 input for Mux0</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>

### 7.3.4.10 TRIP9MUX16TO31CFG Register (Offset = 12h) [reset = 0h]

TRIP9MUX16TO31CFG is shown in [Figure 13-170](#) and described in [Table 13-111](#).

Return to [Summary Table](#).

ePWM XBAR Mux Configuration for TRIP9

**Figure 7-35. TRIP9MUX16TO31CFG Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
MUX31		MUX30		MUX29		MUX28		MUX27		MUX26		MUX25		MUX24	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
MUX23		MUX22		MUX21		MUX20		MUX19		MUX18		MUX17		MUX16	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	

**Table 7-41. TRIP9MUX16TO31CFG Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-30	MUX31	R/W	0h	Select Bits for EPWM-XBAR TRIP9 Mux31:  00 : Select .0 input for Mux31 01 : Select .1 input for Mux31 10 : Select .2 input for Mux31 11 : Select .3 input for Mux31  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
29-28	MUX30	R/W	0h	Select Bits for EPWM-XBAR TRIP9 Mux30:  00 : Select .0 input for Mux30 01 : Select .1 input for Mux30 10 : Select .2 input for Mux30 11 : Select .3 input for Mux30  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
27-26	MUX29	R/W	0h	Select Bits for EPWM-XBAR TRIP9 Mux29:  00 : Select .0 input for Mux29 01 : Select .1 input for Mux29 10 : Select .2 input for Mux29 11 : Select .3 input for Mux29  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
25-24	MUX28	R/W	0h	Select Bits for EPWM-XBAR TRIP9 Mux28:  00 : Select .0 input for Mux28 01 : Select .1 input for Mux28 10 : Select .2 input for Mux28 11 : Select .3 input for Mux28  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn

**Table 7-41. TRIP9MUX16TO31CFG Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
23-22	MUX27	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP9 Mux27:</p> <p>00 : Select .0 input for Mux27  01 : Select .1 input for Mux27  10 : Select .2 input for Mux27  11 : Select .3 input for Mux27</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>
21-20	MUX26	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP9 Mux26:</p> <p>00 : Select .0 input for Mux26  01 : Select .1 input for Mux26  10 : Select .2 input for Mux26  11 : Select .3 input for Mux26</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>
19-18	MUX25	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP9 Mux25:</p> <p>00 : Select .0 input for Mux25  01 : Select .1 input for Mux25  10 : Select .2 input for Mux25  11 : Select .3 input for Mux25</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>
17-16	MUX24	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP9 Mux24:</p> <p>00 : Select .0 input for Mux24  01 : Select .1 input for Mux24  10 : Select .2 input for Mux24  11 : Select .3 input for Mux24</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>
15-14	MUX23	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP9 Mux23:</p> <p>00 : Select .0 input for Mux23  01 : Select .1 input for Mux23  10 : Select .2 input for Mux23  11 : Select .3 input for Mux23</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>
13-12	MUX22	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP9 Mux22:</p> <p>00 : Select .0 input for Mux22  01 : Select .1 input for Mux22  10 : Select .2 input for Mux22  11 : Select .3 input for Mux22</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>

**Table 7-41. TRIP9MUX16TO31CFG Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
11-10	MUX21	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP9 Mux21:</p> <p>00 : Select .0 input for Mux21            01 : Select .1 input for Mux21            10 : Select .2 input for Mux21            11 : Select .3 input for Mux21</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>
9-8	MUX20	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP9 Mux20:</p> <p>00 : Select .0 input for Mux20            01 : Select .1 input for Mux20            10 : Select .2 input for Mux20            11 : Select .3 input for Mux20</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>
7-6	MUX19	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP9 Mux19:</p> <p>00 : Select .0 input for Mux19            01 : Select .1 input for Mux19            10 : Select .2 input for Mux19            11 : Select .3 input for Mux19</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>
5-4	MUX18	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP9 Mux18:</p> <p>00 : Select .0 input for Mux18            01 : Select .1 input for Mux18            10 : Select .2 input for Mux18            11 : Select .3 input for Mux18</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>
3-2	MUX17	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP9 Mux17:</p> <p>00 : Select .0 input for Mux17            01 : Select .1 input for Mux17            10 : Select .2 input for Mux17            11 : Select .3 input for Mux17</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>
1-0	MUX16	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP9 Mux16:</p> <p>00 : Select .0 input for Mux16            01 : Select .1 input for Mux16            10 : Select .2 input for Mux16            11 : Select .3 input for Mux16</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>

**7.3.4.11 TRIP10MUX0TO15CFG Register (Offset = 14h) [reset = 0h]**

TRIP10MUX0TO15CFG is shown in [Figure 13-171](#) and described in [Table 13-112](#).

Return to [Summary Table](#).

ePWM XBAR Mux Configuration for TRIP10

**Figure 7-36. TRIP10MUX0TO15CFG Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
MUX15		MUX14		MUX13		MUX12		MUX11		MUX10		MUX9		MUX8	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
MUX7		MUX6		MUX5		MUX4		MUX3		MUX2		MUX1		MUX0	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	

**Table 7-42. TRIP10MUX0TO15CFG Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-30	MUX15	R/W	0h	Select Bits for EPWM-XBAR TRIP10 Mux15:  00 : Select .0 input for Mux15 01 : Select .1 input for Mux15 10 : Select .2 input for Mux15 11 : Select .3 input for Mux15  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
29-28	MUX14	R/W	0h	Select Bits for EPWM-XBAR TRIP10 Mux14:  00 : Select .0 input for Mux14 01 : Select .1 input for Mux14 10 : Select .2 input for Mux14 11 : Select .3 input for Mux14  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
27-26	MUX13	R/W	0h	Select Bits for EPWM-XBAR TRIP10 Mux13:  00 : Select .0 input for Mux13 01 : Select .1 input for Mux13 10 : Select .2 input for Mux13 11 : Select .3 input for Mux13  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
25-24	MUX12	R/W	0h	Select Bits for EPWM-XBAR TRIP10 Mux12:  00 : Select .0 input for Mux12 01 : Select .1 input for Mux12 10 : Select .2 input for Mux12 11 : Select .3 input for Mux12  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn

**Table 7-42. TRIP10MUX0TO15CFG Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
23-22	MUX11	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP10 Mux11:</p> <p>00 : Select .0 input for Mux11            01 : Select .1 input for Mux11            10 : Select .2 input for Mux11            11 : Select .3 input for Mux11</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>
21-20	MUX10	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP10 Mux10:</p> <p>00 : Select .0 input for Mux10            01 : Select .1 input for Mux10            10 : Select .2 input for Mux10            11 : Select .3 input for Mux10</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>
19-18	MUX9	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP10 Mux9:</p> <p>00 : Select .0 input for Mux9            01 : Select .1 input for Mux9            10 : Select .2 input for Mux9            11 : Select .3 input for Mux9</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>
17-16	MUX8	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP10 Mux8:</p> <p>00 : Select .0 input for Mux8            01 : Select .1 input for Mux8            10 : Select .2 input for Mux8            11 : Select .3 input for Mux8</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>
15-14	MUX7	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP10 Mux7:</p> <p>00 : Select .0 input for Mux7            01 : Select .1 input for Mux7            10 : Select .2 input for Mux7            11 : Select .3 input for Mux7</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>
13-12	MUX6	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP10 Mux6:</p> <p>00 : Select .0 input for Mux6            01 : Select .1 input for Mux6            10 : Select .2 input for Mux6            11 : Select .3 input for Mux6</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>

**Table 7-42. TRIP10MUX0TO15CFG Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
11-10	MUX5	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP10 Mux5:</p> <p>00 : Select .0 input for Mux5  01 : Select .1 input for Mux5  10 : Select .2 input for Mux5  11 : Select .3 input for Mux5</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>
9-8	MUX4	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP10 Mux4:</p> <p>00 : Select .0 input for Mux4  01 : Select .1 input for Mux4  10 : Select .2 input for Mux4  11 : Select .3 input for Mux4</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>
7-6	MUX3	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP10 Mux3:</p> <p>00 : Select .0 input for Mux3  01 : Select .1 input for Mux3  10 : Select .2 input for Mux3  11 : Select .3 input for Mux3</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>
5-4	MUX2	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP10 Mux2:</p> <p>00 : Select .0 input for Mux2  01 : Select .1 input for Mux2  10 : Select .2 input for Mux2  11 : Select .3 input for Mux2</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>
3-2	MUX1	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP10 Mux1:</p> <p>00 : Select .0 input for Mux1  01 : Select .1 input for Mux1  10 : Select .2 input for Mux1  11 : Select .3 input for Mux1</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>
1-0	MUX0	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP10 Mux0:</p> <p>00 : Select .0 input for Mux0  01 : Select .1 input for Mux0  10 : Select .2 input for Mux0  11 : Select .3 input for Mux0</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>



### 7.3.4.12 TRIP10MUX16TO31CFG Register (Offset = 16h) [reset = 0h]

TRIP10MUX16TO31CFG is shown in [Figure 13-172](#) and described in [Table 13-113](#).

Return to [Summary Table](#).

ePWM XBAR Mux Configuration for TRIP10

**Figure 7-37. TRIP10MUX16TO31CFG Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
MUX31		MUX30		MUX29		MUX28		MUX27		MUX26		MUX25		MUX24	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
MUX23		MUX22		MUX21		MUX20		MUX19		MUX18		MUX17		MUX16	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	

**Table 7-43. TRIP10MUX16TO31CFG Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-30	MUX31	R/W	0h	Select Bits for EPWM-XBAR TRIP10 Mux31:  00 : Select .0 input for Mux31 01 : Select .1 input for Mux31 10 : Select .2 input for Mux31 11 : Select .3 input for Mux31  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
29-28	MUX30	R/W	0h	Select Bits for EPWM-XBAR TRIP10 Mux30:  00 : Select .0 input for Mux30 01 : Select .1 input for Mux30 10 : Select .2 input for Mux30 11 : Select .3 input for Mux30  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
27-26	MUX29	R/W	0h	Select Bits for EPWM-XBAR TRIP10 Mux29:  00 : Select .0 input for Mux29 01 : Select .1 input for Mux29 10 : Select .2 input for Mux29 11 : Select .3 input for Mux29  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
25-24	MUX28	R/W	0h	Select Bits for EPWM-XBAR TRIP10 Mux28:  00 : Select .0 input for Mux28 01 : Select .1 input for Mux28 10 : Select .2 input for Mux28 11 : Select .3 input for Mux28  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn

**Table 7-43. TRIP10MUX16TO31CFG Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
23-22	MUX27	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP10 Mux27:</p> <p>00 : Select .0 input for Mux27  01 : Select .1 input for Mux27  10 : Select .2 input for Mux27  11 : Select .3 input for Mux27</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>
21-20	MUX26	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP10 Mux26:</p> <p>00 : Select .0 input for Mux26  01 : Select .1 input for Mux26  10 : Select .2 input for Mux26  11 : Select .3 input for Mux26</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>
19-18	MUX25	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP10 Mux25:</p> <p>00 : Select .0 input for Mux25  01 : Select .1 input for Mux25  10 : Select .2 input for Mux25  11 : Select .3 input for Mux25</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>
17-16	MUX24	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP10 Mux24:</p> <p>00 : Select .0 input for Mux24  01 : Select .1 input for Mux24  10 : Select .2 input for Mux24  11 : Select .3 input for Mux24</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>
15-14	MUX23	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP10 Mux23:</p> <p>00 : Select .0 input for Mux23  01 : Select .1 input for Mux23  10 : Select .2 input for Mux23  11 : Select .3 input for Mux23</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>
13-12	MUX22	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP10 Mux22:</p> <p>00 : Select .0 input for Mux22  01 : Select .1 input for Mux22  10 : Select .2 input for Mux22  11 : Select .3 input for Mux22</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>

**Table 7-43. TRIP10MUX16TO31CFG Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
11-10	MUX21	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP10 Mux21:</p> <p>00 : Select .0 input for Mux21            01 : Select .1 input for Mux21            10 : Select .2 input for Mux21            11 : Select .3 input for Mux21</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>
9-8	MUX20	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP10 Mux20:</p> <p>00 : Select .0 input for Mux20            01 : Select .1 input for Mux20            10 : Select .2 input for Mux20            11 : Select .3 input for Mux20</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>
7-6	MUX19	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP10 Mux19:</p> <p>00 : Select .0 input for Mux19            01 : Select .1 input for Mux19            10 : Select .2 input for Mux19            11 : Select .3 input for Mux19</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>
5-4	MUX18	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP10 Mux18:</p> <p>00 : Select .0 input for Mux18            01 : Select .1 input for Mux18            10 : Select .2 input for Mux18            11 : Select .3 input for Mux18</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>
3-2	MUX17	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP10 Mux17:</p> <p>00 : Select .0 input for Mux17            01 : Select .1 input for Mux17            10 : Select .2 input for Mux17            11 : Select .3 input for Mux17</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>
1-0	MUX16	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP10 Mux16:</p> <p>00 : Select .0 input for Mux16            01 : Select .1 input for Mux16            10 : Select .2 input for Mux16            11 : Select .3 input for Mux16</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>

**7.3.4.13 TRIP11MUX0TO15CFG Register (Offset = 18h) [reset = 0h]**

TRIP11MUX0TO15CFG is shown in [Figure 13-173](#) and described in [Table 13-114](#).

Return to [Summary Table](#).

ePWM XBAR Mux Configuration for TRIP11

**Figure 7-38. TRIP11MUX0TO15CFG Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
MUX15		MUX14		MUX13		MUX12		MUX11		MUX10		MUX9		MUX8	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
MUX7		MUX6		MUX5		MUX4		MUX3		MUX2		MUX1		MUX0	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	

**Table 7-44. TRIP11MUX0TO15CFG Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-30	MUX15	R/W	0h	Select Bits for EPWM-XBAR TRIP11 Mux15:  00 : Select .0 input for Mux15 01 : Select .1 input for Mux15 10 : Select .2 input for Mux15 11 : Select .3 input for Mux15  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
29-28	MUX14	R/W	0h	Select Bits for EPWM-XBAR TRIP11 Mux14:  00 : Select .0 input for Mux14 01 : Select .1 input for Mux14 10 : Select .2 input for Mux14 11 : Select .3 input for Mux14  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
27-26	MUX13	R/W	0h	Select Bits for EPWM-XBAR TRIP11 Mux13:  00 : Select .0 input for Mux13 01 : Select .1 input for Mux13 10 : Select .2 input for Mux13 11 : Select .3 input for Mux13  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
25-24	MUX12	R/W	0h	Select Bits for EPWM-XBAR TRIP11 Mux12:  00 : Select .0 input for Mux12 01 : Select .1 input for Mux12 10 : Select .2 input for Mux12 11 : Select .3 input for Mux12  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn

**Table 7-44. TRIP11MUX0TO15CFG Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
23-22	MUX11	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP11 Mux11:</p> <p>00 : Select .0 input for Mux11  01 : Select .1 input for Mux11  10 : Select .2 input for Mux11  11 : Select .3 input for Mux11</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>
21-20	MUX10	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP11 Mux10:</p> <p>00 : Select .0 input for Mux10  01 : Select .1 input for Mux10  10 : Select .2 input for Mux10  11 : Select .3 input for Mux10</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>
19-18	MUX9	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP11 Mux9:</p> <p>00 : Select .0 input for Mux9  01 : Select .1 input for Mux9  10 : Select .2 input for Mux9  11 : Select .3 input for Mux9</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>
17-16	MUX8	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP11 Mux8:</p> <p>00 : Select .0 input for Mux8  01 : Select .1 input for Mux8  10 : Select .2 input for Mux8  11 : Select .3 input for Mux8</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>
15-14	MUX7	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP11 Mux7:</p> <p>00 : Select .0 input for Mux7  01 : Select .1 input for Mux7  10 : Select .2 input for Mux7  11 : Select .3 input for Mux7</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>
13-12	MUX6	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP11 Mux6:</p> <p>00 : Select .0 input for Mux6  01 : Select .1 input for Mux6  10 : Select .2 input for Mux6  11 : Select .3 input for Mux6</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>

**Table 7-44. TRIP11MUX0TO15CFG Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
11-10	MUX5	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP11 Mux5:</p> <p>00 : Select .0 input for Mux5  01 : Select .1 input for Mux5  10 : Select .2 input for Mux5  11 : Select .3 input for Mux5</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>
9-8	MUX4	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP11 Mux4:</p> <p>00 : Select .0 input for Mux4  01 : Select .1 input for Mux4  10 : Select .2 input for Mux4  11 : Select .3 input for Mux4</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>
7-6	MUX3	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP11 Mux3:</p> <p>00 : Select .0 input for Mux3  01 : Select .1 input for Mux3  10 : Select .2 input for Mux3  11 : Select .3 input for Mux3</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>
5-4	MUX2	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP11 Mux2:</p> <p>00 : Select .0 input for Mux2  01 : Select .1 input for Mux2  10 : Select .2 input for Mux2  11 : Select .3 input for Mux2</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>
3-2	MUX1	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP11 Mux1:</p> <p>00 : Select .0 input for Mux1  01 : Select .1 input for Mux1  10 : Select .2 input for Mux1  11 : Select .3 input for Mux1</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>
1-0	MUX0	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP11 Mux0:</p> <p>00 : Select .0 input for Mux0  01 : Select .1 input for Mux0  10 : Select .2 input for Mux0  11 : Select .3 input for Mux0</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>

### 7.3.4.14 TRIP11MUX16TO31CFG Register (Offset = 1Ah) [reset = 0h]

TRIP11MUX16TO31CFG is shown in [Figure 13-174](#) and described in [Table 13-115](#).

Return to [Summary Table](#).

ePWM XBAR Mux Configuration for TRIP11

**Figure 7-39. TRIP11MUX16TO31CFG Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
MUX31		MUX30		MUX29		MUX28		MUX27		MUX26		MUX25		MUX24	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
MUX23		MUX22		MUX21		MUX20		MUX19		MUX18		MUX17		MUX16	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	

**Table 7-45. TRIP11MUX16TO31CFG Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-30	MUX31	R/W	0h	Select Bits for EPWM-XBAR TRIP11 Mux31:  00 : Select .0 input for Mux31 01 : Select .1 input for Mux31 10 : Select .2 input for Mux31 11 : Select .3 input for Mux31  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
29-28	MUX30	R/W	0h	Select Bits for EPWM-XBAR TRIP11 Mux30:  00 : Select .0 input for Mux30 01 : Select .1 input for Mux30 10 : Select .2 input for Mux30 11 : Select .3 input for Mux30  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
27-26	MUX29	R/W	0h	Select Bits for EPWM-XBAR TRIP11 Mux29:  00 : Select .0 input for Mux29 01 : Select .1 input for Mux29 10 : Select .2 input for Mux29 11 : Select .3 input for Mux29  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
25-24	MUX28	R/W	0h	Select Bits for EPWM-XBAR TRIP11 Mux28:  00 : Select .0 input for Mux28 01 : Select .1 input for Mux28 10 : Select .2 input for Mux28 11 : Select .3 input for Mux28  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn

**Table 7-45. TRIP11MUX16TO31CFG Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
23-22	MUX27	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP11 Mux27:</p> <p>00 : Select .0 input for Mux27  01 : Select .1 input for Mux27  10 : Select .2 input for Mux27  11 : Select .3 input for Mux27</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>
21-20	MUX26	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP11 Mux26:</p> <p>00 : Select .0 input for Mux26  01 : Select .1 input for Mux26  10 : Select .2 input for Mux26  11 : Select .3 input for Mux26</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>
19-18	MUX25	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP11 Mux25:</p> <p>00 : Select .0 input for Mux25  01 : Select .1 input for Mux25  10 : Select .2 input for Mux25  11 : Select .3 input for Mux25</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>
17-16	MUX24	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP11 Mux24:</p> <p>00 : Select .0 input for Mux24  01 : Select .1 input for Mux24  10 : Select .2 input for Mux24  11 : Select .3 input for Mux24</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>
15-14	MUX23	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP11 Mux23:</p> <p>00 : Select .0 input for Mux23  01 : Select .1 input for Mux23  10 : Select .2 input for Mux23  11 : Select .3 input for Mux23</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>
13-12	MUX22	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP11 Mux22:</p> <p>00 : Select .0 input for Mux22  01 : Select .1 input for Mux22  10 : Select .2 input for Mux22  11 : Select .3 input for Mux22</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>



**Table 7-45. TRIP11MUX16TO31CFG Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
11-10	MUX21	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP11 Mux21:</p> <p>00 : Select .0 input for Mux21            01 : Select .1 input for Mux21            10 : Select .2 input for Mux21            11 : Select .3 input for Mux21</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>
9-8	MUX20	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP11 Mux20:</p> <p>00 : Select .0 input for Mux20            01 : Select .1 input for Mux20            10 : Select .2 input for Mux20            11 : Select .3 input for Mux20</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>
7-6	MUX19	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP11 Mux19:</p> <p>00 : Select .0 input for Mux19            01 : Select .1 input for Mux19            10 : Select .2 input for Mux19            11 : Select .3 input for Mux19</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>
5-4	MUX18	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP11 Mux18:</p> <p>00 : Select .0 input for Mux18            01 : Select .1 input for Mux18            10 : Select .2 input for Mux18            11 : Select .3 input for Mux18</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>
3-2	MUX17	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP11 Mux17:</p> <p>00 : Select .0 input for Mux17            01 : Select .1 input for Mux17            10 : Select .2 input for Mux17            11 : Select .3 input for Mux17</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>
1-0	MUX16	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP11 Mux16:</p> <p>00 : Select .0 input for Mux16            01 : Select .1 input for Mux16            10 : Select .2 input for Mux16            11 : Select .3 input for Mux16</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>

**7.3.4.15 TRIP12MUX0TO15CFG Register (Offset = 1Ch) [reset = 0h]**

TRIP12MUX0TO15CFG is shown in [Figure 13-175](#) and described in [Table 13-116](#).

Return to [Summary Table](#).

ePWM XBAR Mux Configuration for TRIP12

**Figure 7-40. TRIP12MUX0TO15CFG Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
MUX15		MUX14		MUX13		MUX12		MUX11		MUX10		MUX9		MUX8	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
MUX7		MUX6		MUX5		MUX4		MUX3		MUX2		MUX1		MUX0	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	

**Table 7-46. TRIP12MUX0TO15CFG Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-30	MUX15	R/W	0h	Select Bits for EPWM-XBAR TRIP12 Mux15:  00 : Select .0 input for Mux15 01 : Select .1 input for Mux15 10 : Select .2 input for Mux15 11 : Select .3 input for Mux15  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
29-28	MUX14	R/W	0h	Select Bits for EPWM-XBAR TRIP12 Mux14:  00 : Select .0 input for Mux14 01 : Select .1 input for Mux14 10 : Select .2 input for Mux14 11 : Select .3 input for Mux14  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
27-26	MUX13	R/W	0h	Select Bits for EPWM-XBAR TRIP12 Mux13:  00 : Select .0 input for Mux13 01 : Select .1 input for Mux13 10 : Select .2 input for Mux13 11 : Select .3 input for Mux13  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
25-24	MUX12	R/W	0h	Select Bits for EPWM-XBAR TRIP12 Mux12:  00 : Select .0 input for Mux12 01 : Select .1 input for Mux12 10 : Select .2 input for Mux12 11 : Select .3 input for Mux12  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn

**Table 7-46. TRIP12MUX0TO15CFG Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
23-22	MUX11	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP12 Mux11:</p> <p>00 : Select .0 input for Mux11            01 : Select .1 input for Mux11            10 : Select .2 input for Mux11            11 : Select .3 input for Mux11</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>
21-20	MUX10	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP12 Mux10:</p> <p>00 : Select .0 input for Mux10            01 : Select .1 input for Mux10            10 : Select .2 input for Mux10            11 : Select .3 input for Mux10</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>
19-18	MUX9	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP12 Mux9:</p> <p>00 : Select .0 input for Mux9            01 : Select .1 input for Mux9            10 : Select .2 input for Mux9            11 : Select .3 input for Mux9</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>
17-16	MUX8	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP12 Mux8:</p> <p>00 : Select .0 input for Mux8            01 : Select .1 input for Mux8            10 : Select .2 input for Mux8            11 : Select .3 input for Mux8</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>
15-14	MUX7	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP12 Mux7:</p> <p>00 : Select .0 input for Mux7            01 : Select .1 input for Mux7            10 : Select .2 input for Mux7            11 : Select .3 input for Mux7</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>
13-12	MUX6	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP12 Mux6:</p> <p>00 : Select .0 input for Mux6            01 : Select .1 input for Mux6            10 : Select .2 input for Mux6            11 : Select .3 input for Mux6</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>

**Table 7-46. TRIP12MUX0TO15CFG Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
11-10	MUX5	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP12 Mux5:</p> <p>00 : Select .0 input for Mux5  01 : Select .1 input for Mux5  10 : Select .2 input for Mux5  11 : Select .3 input for Mux5</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>
9-8	MUX4	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP12 Mux4:</p> <p>00 : Select .0 input for Mux4  01 : Select .1 input for Mux4  10 : Select .2 input for Mux4  11 : Select .3 input for Mux4</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>
7-6	MUX3	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP12 Mux3:</p> <p>00 : Select .0 input for Mux3  01 : Select .1 input for Mux3  10 : Select .2 input for Mux3  11 : Select .3 input for Mux3</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>
5-4	MUX2	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP12 Mux2:</p> <p>00 : Select .0 input for Mux2  01 : Select .1 input for Mux2  10 : Select .2 input for Mux2  11 : Select .3 input for Mux2</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>
3-2	MUX1	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP12 Mux1:</p> <p>00 : Select .0 input for Mux1  01 : Select .1 input for Mux1  10 : Select .2 input for Mux1  11 : Select .3 input for Mux1</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>
1-0	MUX0	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP12 Mux0:</p> <p>00 : Select .0 input for Mux0  01 : Select .1 input for Mux0  10 : Select .2 input for Mux0  11 : Select .3 input for Mux0</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>

### 7.3.4.16 TRIP12MUX16TO31CFG Register (Offset = 1Eh) [reset = 0h]

TRIP12MUX16TO31CFG is shown in [Figure 13-176](#) and described in [Table 13-117](#).

Return to [Summary Table](#).

ePWM XBAR Mux Configuration for TRIP12

**Figure 7-41. TRIP12MUX16TO31CFG Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
MUX31		MUX30		MUX29		MUX28		MUX27		MUX26		MUX25		MUX24	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
MUX23		MUX22		MUX21		MUX20		MUX19		MUX18		MUX17		MUX16	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	

**Table 7-47. TRIP12MUX16TO31CFG Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-30	MUX31	R/W	0h	Select Bits for EPWM-XBAR TRIP12 Mux31:  00 : Select .0 input for Mux31 01 : Select .1 input for Mux31 10 : Select .2 input for Mux31 11 : Select .3 input for Mux31  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
29-28	MUX30	R/W	0h	Select Bits for EPWM-XBAR TRIP12 Mux30:  00 : Select .0 input for Mux30 01 : Select .1 input for Mux30 10 : Select .2 input for Mux30 11 : Select .3 input for Mux30  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
27-26	MUX29	R/W	0h	Select Bits for EPWM-XBAR TRIP12 Mux29:  00 : Select .0 input for Mux29 01 : Select .1 input for Mux29 10 : Select .2 input for Mux29 11 : Select .3 input for Mux29  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
25-24	MUX28	R/W	0h	Select Bits for EPWM-XBAR TRIP12 Mux28:  00 : Select .0 input for Mux28 01 : Select .1 input for Mux28 10 : Select .2 input for Mux28 11 : Select .3 input for Mux28  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn

**Table 7-47. TRIP12MUX16TO31CFG Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
23-22	MUX27	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP12 Mux27:</p> <p>00 : Select .0 input for Mux27  01 : Select .1 input for Mux27  10 : Select .2 input for Mux27  11 : Select .3 input for Mux27</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>
21-20	MUX26	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP12 Mux26:</p> <p>00 : Select .0 input for Mux26  01 : Select .1 input for Mux26  10 : Select .2 input for Mux26  11 : Select .3 input for Mux26</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>
19-18	MUX25	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP12 Mux25:</p> <p>00 : Select .0 input for Mux25  01 : Select .1 input for Mux25  10 : Select .2 input for Mux25  11 : Select .3 input for Mux25</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>
17-16	MUX24	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP12 Mux24:</p> <p>00 : Select .0 input for Mux24  01 : Select .1 input for Mux24  10 : Select .2 input for Mux24  11 : Select .3 input for Mux24</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>
15-14	MUX23	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP12 Mux23:</p> <p>00 : Select .0 input for Mux23  01 : Select .1 input for Mux23  10 : Select .2 input for Mux23  11 : Select .3 input for Mux23</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>
13-12	MUX22	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP12 Mux22:</p> <p>00 : Select .0 input for Mux22  01 : Select .1 input for Mux22  10 : Select .2 input for Mux22  11 : Select .3 input for Mux22</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>

**Table 7-47. TRIP12MUX16TO31CFG Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
11-10	MUX21	R/W	0h	Select Bits for EPWM-XBAR TRIP12 Mux21:  00 : Select .0 input for Mux21 01 : Select .1 input for Mux21 10 : Select .2 input for Mux21 11 : Select .3 input for Mux21  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
9-8	MUX20	R/W	0h	Select Bits for EPWM-XBAR TRIP12 Mux20:  00 : Select .0 input for Mux20 01 : Select .1 input for Mux20 10 : Select .2 input for Mux20 11 : Select .3 input for Mux20  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
7-6	MUX19	R/W	0h	Select Bits for EPWM-XBAR TRIP12 Mux19:  00 : Select .0 input for Mux19 01 : Select .1 input for Mux19 10 : Select .2 input for Mux19 11 : Select .3 input for Mux19  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
5-4	MUX18	R/W	0h	Select Bits for EPWM-XBAR TRIP12 Mux18:  00 : Select .0 input for Mux18 01 : Select .1 input for Mux18 10 : Select .2 input for Mux18 11 : Select .3 input for Mux18  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
3-2	MUX17	R/W	0h	Select Bits for EPWM-XBAR TRIP12 Mux17:  00 : Select .0 input for Mux17 01 : Select .1 input for Mux17 10 : Select .2 input for Mux17 11 : Select .3 input for Mux17  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
1-0	MUX16	R/W	0h	Select Bits for EPWM-XBAR TRIP12 Mux16:  00 : Select .0 input for Mux16 01 : Select .1 input for Mux16 10 : Select .2 input for Mux16 11 : Select .3 input for Mux16  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn

**7.3.4.17 TRIP4MUXENABLE Register (Offset = 20h) [reset = 0h]**

TRIP4MUXENABLE is shown in [Figure 13-177](#) and described in [Table 13-118](#).

Return to [Summary Table](#).

ePWM XBAR Mux Enable for TRIP4

**Figure 7-42. TRIP4MUXENABLE Register**

31		30		29		28		27		26		25		24	
MUX31		MUX30		MUX29		MUX28		MUX27		MUX26		MUX25		MUX24	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	
23		22		21		20		19		18		17		16	
MUX23		MUX22		MUX21		MUX20		MUX19		MUX18		MUX17		MUX16	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	
15		14		13		12		11		10		9		8	
MUX15		MUX14		MUX13		MUX12		MUX11		MUX10		MUX9		MUX8	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	
7		6		5		4		3		2		1		0	
MUX7		MUX6		MUX5		MUX4		MUX3		MUX2		MUX1		MUX0	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	

**Table 7-48. TRIP4MUXENABLE Register Field Descriptions**

Bit	Field	Type	Reset	Description
31	MUX31	R/W	0h	Selects the output of Mux31 to drive TRIP4 of EPWM-XBAR 0: Respective output of Mux31 is enabled to drive the TRIP4 of EPWM-XBAR 1: Respective output of Mux31 is enabled to drive the TRIP4 of EPWM-XBAR Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
30	MUX30	R/W	0h	Selects the output of Mux30 to drive TRIP4 of EPWM-XBAR 0: Respective output of Mux30 is enabled to drive the TRIP4 of EPWM-XBAR 1: Respective output of Mux30 is enabled to drive the TRIP4 of EPWM-XBAR Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
29	MUX29	R/W	0h	Selects the output of Mux29 to drive TRIP4 of EPWM-XBAR 0: Respective output of Mux29 is enabled to drive the TRIP4 of EPWM-XBAR 1: Respective output of Mux29 is enabled to drive the TRIP4 of EPWM-XBAR Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
28	MUX28	R/W	0h	Selects the output of Mux28 to drive TRIP4 of EPWM-XBAR 0: Respective output of Mux28 is enabled to drive the TRIP4 of EPWM-XBAR 1: Respective output of Mux28 is enabled to drive the TRIP4 of EPWM-XBAR Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn



**Table 7-48. TRIP4MUXENABLE Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
27	MUX27	R/W	0h	<p>Selects the output of Mux27 to drive TRIP4 of EPWM-XBAR</p> <p>0: Respective output of Mux27 is enabled to drive the TRIP4 of EPWM-XBAR</p> <p>1: Respective output of Mux27 is enabled to drive the TRIP4 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
26	MUX26	R/W	0h	<p>Selects the output of Mux26 to drive TRIP4 of EPWM-XBAR</p> <p>0: Respective output of Mux26 is enabled to drive the TRIP4 of EPWM-XBAR</p> <p>1: Respective output of Mux26 is enabled to drive the TRIP4 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
25	MUX25	R/W	0h	<p>Selects the output of Mux25 to drive TRIP4 of EPWM-XBAR</p> <p>0: Respective output of Mux25 is enabled to drive the TRIP4 of EPWM-XBAR</p> <p>1: Respective output of Mux25 is enabled to drive the TRIP4 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
24	MUX24	R/W	0h	<p>Selects the output of Mux24 to drive TRIP4 of EPWM-XBAR</p> <p>0: Respective output of Mux24 is enabled to drive the TRIP4 of EPWM-XBAR</p> <p>1: Respective output of Mux24 is enabled to drive the TRIP4 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
23	MUX23	R/W	0h	<p>Selects the output of Mux23 to drive TRIP4 of EPWM-XBAR</p> <p>0: Respective output of Mux23 is disabled to drive the TRIP4 of EPWM-XBAR</p> <p>1: Respective output of Mux23 is enabled to drive the TRIP4 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
22	MUX22	R/W	0h	<p>Selects the output of Mux22 to drive TRIP4 of EPWM-XBAR</p> <p>0: Respective output of Mux22 is disabled to drive the TRIP4 of EPWM-XBAR</p> <p>1: Respective output of Mux22 is enabled to drive the TRIP4 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
21	MUX21	R/W	0h	<p>Selects the output of Mux21 to drive TRIP4 of EPWM-XBAR</p> <p>0: Respective output of Mux21 is disabled to drive the TRIP4 of EPWM-XBAR</p> <p>1: Respective output of Mux21 is enabled to drive the TRIP4 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>

**Table 7-48. TRIP4MUXENABLE Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
20	MUX20	R/W	0h	<p>Selects the output of Mux20 to drive TRIP4 of EPWM-XBAR</p> <p>0: Respective output of Mux20 is disabled to drive the TRIP4 of EPWM-XBAR</p> <p>1: Respective output of Mux20 is enabled to drive the TRIP4 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
19	MUX19	R/W	0h	<p>Selects the output of Mux19 to drive TRIP4 of EPWM-XBAR</p> <p>0: Respective output of Mux19 is disabled to drive the TRIP4 of EPWM-XBAR</p> <p>1: Respective output of Mux19 is enabled to drive the TRIP4 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
18	MUX18	R/W	0h	<p>Selects the output of Mux18 to drive TRIP4 of EPWM-XBAR</p> <p>0: Respective output of Mux18 is disabled to drive the TRIP4 of EPWM-XBAR</p> <p>1: Respective output of Mux18 is enabled to drive the TRIP4 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
17	MUX17	R/W	0h	<p>Selects the output of Mux17 to drive TRIP4 of EPWM-XBAR</p> <p>0: Respective output of Mux17 is disabled to drive the TRIP4 of EPWM-XBAR</p> <p>1: Respective output of Mux17 is enabled to drive the TRIP4 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
16	MUX16	R/W	0h	<p>Selects the output of Mux16 to drive TRIP4 of EPWM-XBAR</p> <p>0: Respective output of Mux16 is disabled to drive the TRIP4 of EPWM-XBAR</p> <p>1: Respective output of Mux16 is enabled to drive the TRIP4 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
15	MUX15	R/W	0h	<p>Selects the output of Mux15 to drive TRIP4 of EPWM-XBAR</p> <p>0: Respective output of Mux15 is disabled to drive the TRIP4 of EPWM-XBAR</p> <p>1: Respective output of Mux15 is enabled to drive the TRIP4 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
14	MUX14	R/W	0h	<p>Selects the output of Mux14 to drive TRIP4 of EPWM-XBAR</p> <p>0: Respective output of Mux14 is disabled to drive the TRIP4 of EPWM-XBAR</p> <p>1: Respective output of Mux14 is enabled to drive the TRIP4 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>

**Table 7-48. TRIP4MUXENABLE Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
13	MUX13	R/W	0h	<p>Selects the output of Mux13 to drive TRIP4 of EPWM-XBAR</p> <p>0: Respective output of Mux13 is disabled to drive the TRIP4 of EPWM-XBAR</p> <p>1: Respective output of Mux13 is enabled to drive the TRIP4 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
12	MUX12	R/W	0h	<p>Selects the output of Mux12 to drive TRIP4 of EPWM-XBAR</p> <p>0: Respective output of Mux12 is disabled to drive the TRIP4 of EPWM-XBAR</p> <p>1: Respective output of Mux12 is enabled to drive the TRIP4 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
11	MUX11	R/W	0h	<p>Selects the output of Mux11 to drive TRIP4 of EPWM-XBAR</p> <p>0: Respective output of Mux11 is disabled to drive the TRIP4 of EPWM-XBAR</p> <p>1: Respective output of Mux11 is enabled to drive the TRIP4 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
10	MUX10	R/W	0h	<p>Selects the output of Mux10 to drive TRIP4 of EPWM-XBAR</p> <p>0: Respective output of Mux10 is disabled to drive the TRIP4 of EPWM-XBAR</p> <p>1: Respective output of Mux10 is enabled to drive the TRIP4 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
9	MUX9	R/W	0h	<p>Selects the output of Mux9 to drive TRIP4 of EPWM-XBAR</p> <p>0: Respective output of Mux9 is disabled to drive the TRIP4 of EPWM-XBAR</p> <p>1: Respective output of Mux9 is enabled to drive the TRIP4 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
8	MUX8	R/W	0h	<p>Selects the output of Mux8 to drive TRIP4 of EPWM-XBAR</p> <p>0: Respective output of Mux8 is disabled to drive the TRIP4 of EPWM-XBAR</p> <p>1: Respective output of Mux8 is enabled to drive the TRIP4 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
7	MUX7	R/W	0h	<p>Selects the output of Mux7 to drive TRIP4 of EPWM-XBAR</p> <p>0: Respective output of Mux7 is disabled to drive the TRIP4 of EPWM-XBAR</p> <p>1: Respective output of Mux7 is enabled to drive the TRIP4 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>

**Table 7-48. TRIP4MUXENABLE Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
6	MUX6	R/W	0h	<p>Selects the output of Mux6 to drive TRIP4 of EPWM-XBAR</p> <p>0: Respective output of Mux6 is disabled to drive the TRIP4 of EPWM-XBAR</p> <p>1: Respective output of Mux6 is enabled to drive the TRIP4 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
5	MUX5	R/W	0h	<p>Selects the output of Mux5 to drive TRIP4 of EPWM-XBAR</p> <p>0: Respective output of Mux5 is disabled to drive the TRIP4 of EPWM-XBAR</p> <p>1: Respective output of Mux5 is enabled to drive the TRIP4 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
4	MUX4	R/W	0h	<p>Selects the output of Mux4 to drive TRIP4 of EPWM-XBAR</p> <p>0: Respective output of Mux4 is disabled to drive the TRIP4 of EPWM-XBAR</p> <p>1: Respective output of Mux4 is enabled to drive the TRIP4 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
3	MUX3	R/W	0h	<p>Selects the output of Mux3 to drive TRIP4 of EPWM-XBAR</p> <p>0: Respective output of Mux3 is disabled to drive the TRIP4 of EPWM-XBAR</p> <p>1: Respective output of Mux3 is enabled to drive the TRIP4 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
2	MUX2	R/W	0h	<p>Selects the output of Mux2 to drive TRIP4 of EPWM-XBAR</p> <p>0: Respective output of Mux2 is disabled to drive the TRIP4 of EPWM-XBAR</p> <p>1: Respective output of Mux2 is enabled to drive the TRIP4 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
1	MUX1	R/W	0h	<p>Selects the output of Mux1 to drive TRIP4 of EPWM-XBAR</p> <p>0: Respective output of Mux1 is disabled to drive the TRIP4 of EPWM-XBAR</p> <p>1: Respective output of Mux1 is enabled to drive the TRIP4 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
0	MUX0	R/W	0h	<p>Selects the output of Mux0 to drive TRIP4 of EPWM-XBAR</p> <p>0: Respective output of Mux0 is disabled to drive the TRIP4 of EPWM-XBAR</p> <p>1: Respective output of Mux0 is enabled to drive the TRIP4 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>

**7.3.4.18 TRIP5MUXENABLE Register (Offset = 22h) [reset = 0h]**

TRIP5MUXENABLE is shown in [Figure 13-178](#) and described in [Table 13-119](#).

Return to [Summary Table](#).

ePWM XBAR Mux Enable for TRIP5

**Figure 7-43. TRIP5MUXENABLE Register**

31		30		29		28		27		26		25		24	
MUX31	MUX30	MUX29	MUX28	MUX27	MUX26	MUX25	MUX24	MUX23	MUX22	MUX21	MUX20	MUX19	MUX18	MUX17	MUX16
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
23		22		21		20		19		18		17		16	
MUX23	MUX22	MUX21	MUX20	MUX19	MUX18	MUX17	MUX16	MUX15	MUX14	MUX13	MUX12	MUX11	MUX10	MUX9	MUX8
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
15		14		13		12		11		10		9		8	
MUX15	MUX14	MUX13	MUX12	MUX11	MUX10	MUX9	MUX8	MUX7	MUX6	MUX5	MUX4	MUX3	MUX2	MUX1	MUX0
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
7		6		5		4		3		2		1		0	
MUX7	MUX6	MUX5	MUX4	MUX3	MUX2	MUX1	MUX0	MUX7	MUX6	MUX5	MUX4	MUX3	MUX2	MUX1	MUX0
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h

**Table 7-49. TRIP5MUXENABLE Register Field Descriptions**

Bit	Field	Type	Reset	Description
31	MUX31	R/W	0h	<p>Selects the output of Mux31 to drive TRIP5 of EPWM-XBAR</p> <p>0: Respective output of Mux31 is enabled to drive the TRIP5 of EPWM-XBAR</p> <p>1: Respective output of Mux31 is enabled to drive the TRIP5 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.</p> <p>Reset type: CPU1.SYSRSn</p>
30	MUX30	R/W	0h	<p>Selects the output of Mux30 to drive TRIP5 of EPWM-XBAR</p> <p>0: Respective output of Mux30 is enabled to drive the TRIP5 of EPWM-XBAR</p> <p>1: Respective output of Mux30 is enabled to drive the TRIP5 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.</p> <p>Reset type: CPU1.SYSRSn</p>
29	MUX29	R/W	0h	<p>Selects the output of Mux29 to drive TRIP5 of EPWM-XBAR</p> <p>0: Respective output of Mux29 is enabled to drive the TRIP5 of EPWM-XBAR</p> <p>1: Respective output of Mux29 is enabled to drive the TRIP5 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.</p> <p>Reset type: CPU1.SYSRSn</p>
28	MUX28	R/W	0h	<p>Selects the output of Mux28 to drive TRIP5 of EPWM-XBAR</p> <p>0: Respective output of Mux28 is enabled to drive the TRIP5 of EPWM-XBAR</p> <p>1: Respective output of Mux28 is enabled to drive the TRIP5 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.</p> <p>Reset type: CPU1.SYSRSn</p>

**Table 7-49. TRIP5MUXENABLE Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
27	MUX27	R/W	0h	<p>Selects the output of Mux27 to drive TRIP5 of EPWM-XBAR</p> <p>0: Respective output of Mux27 is enabled to drive the TRIP5 of EPWM-XBAR</p> <p>1: Respective output of Mux27 is enabled to drive the TRIP5 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
26	MUX26	R/W	0h	<p>Selects the output of Mux26 to drive TRIP5 of EPWM-XBAR</p> <p>0: Respective output of Mux26 is enabled to drive the TRIP5 of EPWM-XBAR</p> <p>1: Respective output of Mux26 is enabled to drive the TRIP5 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
25	MUX25	R/W	0h	<p>Selects the output of Mux25 to drive TRIP5 of EPWM-XBAR</p> <p>0: Respective output of Mux25 is enabled to drive the TRIP5 of EPWM-XBAR</p> <p>1: Respective output of Mux25 is enabled to drive the TRIP5 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
24	MUX24	R/W	0h	<p>Selects the output of Mux24 to drive TRIP5 of EPWM-XBAR</p> <p>0: Respective output of Mux24 is enabled to drive the TRIP5 of EPWM-XBAR</p> <p>1: Respective output of Mux24 is enabled to drive the TRIP5 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
23	MUX23	R/W	0h	<p>Selects the output of Mux23 to drive TRIP5 of EPWM-XBAR</p> <p>0: Respective output of Mux23 is disabled to drive the TRIP5 of EPWM-XBAR</p> <p>1: Respective output of Mux23 is enabled to drive the TRIP5 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
22	MUX22	R/W	0h	<p>Selects the output of Mux22 to drive TRIP5 of EPWM-XBAR</p> <p>0: Respective output of Mux22 is disabled to drive the TRIP5 of EPWM-XBAR</p> <p>1: Respective output of Mux22 is enabled to drive the TRIP5 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
21	MUX21	R/W	0h	<p>Selects the output of Mux21 to drive TRIP5 of EPWM-XBAR</p> <p>0: Respective output of Mux21 is disabled to drive the TRIP5 of EPWM-XBAR</p> <p>1: Respective output of Mux21 is enabled to drive the TRIP5 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>

**Table 7-49. TRIP5MUXENABLE Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
20	MUX20	R/W	0h	<p>Selects the output of Mux20 to drive TRIP5 of EPWM-XBAR</p> <p>0: Respective output of Mux20 is disabled to drive the TRIP5 of EPWM-XBAR</p> <p>1: Respective output of Mux20 is enabled to drive the TRIP5 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
19	MUX19	R/W	0h	<p>Selects the output of Mux19 to drive TRIP5 of EPWM-XBAR</p> <p>0: Respective output of Mux19 is disabled to drive the TRIP5 of EPWM-XBAR</p> <p>1: Respective output of Mux19 is enabled to drive the TRIP5 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
18	MUX18	R/W	0h	<p>Selects the output of Mux18 to drive TRIP5 of EPWM-XBAR</p> <p>0: Respective output of Mux18 is disabled to drive the TRIP5 of EPWM-XBAR</p> <p>1: Respective output of Mux18 is enabled to drive the TRIP5 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
17	MUX17	R/W	0h	<p>Selects the output of Mux17 to drive TRIP5 of EPWM-XBAR</p> <p>0: Respective output of Mux17 is disabled to drive the TRIP5 of EPWM-XBAR</p> <p>1: Respective output of Mux17 is enabled to drive the TRIP5 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
16	MUX16	R/W	0h	<p>Selects the output of Mux16 to drive TRIP5 of EPWM-XBAR</p> <p>0: Respective output of Mux16 is disabled to drive the TRIP5 of EPWM-XBAR</p> <p>1: Respective output of Mux16 is enabled to drive the TRIP5 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
15	MUX15	R/W	0h	<p>Selects the output of Mux15 to drive TRIP5 of EPWM-XBAR</p> <p>0: Respective output of Mux15 is disabled to drive the TRIP5 of EPWM-XBAR</p> <p>1: Respective output of Mux15 is enabled to drive the TRIP5 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
14	MUX14	R/W	0h	<p>Selects the output of Mux14 to drive TRIP5 of EPWM-XBAR</p> <p>0: Respective output of Mux14 is disabled to drive the TRIP5 of EPWM-XBAR</p> <p>1: Respective output of Mux14 is enabled to drive the TRIP5 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>

**Table 7-49. TRIP5MUXENABLE Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
13	MUX13	R/W	0h	<p>Selects the output of Mux13 to drive TRIP5 of EPWM-XBAR</p> <p>0: Respective output of Mux13 is disabled to drive the TRIP5 of EPWM-XBAR</p> <p>1: Respective output of Mux13 is enabled to drive the TRIP5 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
12	MUX12	R/W	0h	<p>Selects the output of Mux12 to drive TRIP5 of EPWM-XBAR</p> <p>0: Respective output of Mux12 is disabled to drive the TRIP5 of EPWM-XBAR</p> <p>1: Respective output of Mux12 is enabled to drive the TRIP5 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
11	MUX11	R/W	0h	<p>Selects the output of Mux11 to drive TRIP5 of EPWM-XBAR</p> <p>0: Respective output of Mux11 is disabled to drive the TRIP5 of EPWM-XBAR</p> <p>1: Respective output of Mux11 is enabled to drive the TRIP5 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
10	MUX10	R/W	0h	<p>Selects the output of Mux10 to drive TRIP5 of EPWM-XBAR</p> <p>0: Respective output of Mux10 is disabled to drive the TRIP5 of EPWM-XBAR</p> <p>1: Respective output of Mux10 is enabled to drive the TRIP5 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
9	MUX9	R/W	0h	<p>Selects the output of Mux9 to drive TRIP5 of EPWM-XBAR</p> <p>0: Respective output of Mux9 is disabled to drive the TRIP5 of EPWM-XBAR</p> <p>1: Respective output of Mux9 is enabled to drive the TRIP5 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
8	MUX8	R/W	0h	<p>Selects the output of Mux8 to drive TRIP5 of EPWM-XBAR</p> <p>0: Respective output of Mux8 is disabled to drive the TRIP5 of EPWM-XBAR</p> <p>1: Respective output of Mux8 is enabled to drive the TRIP5 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
7	MUX7	R/W	0h	<p>Selects the output of Mux7 to drive TRIP5 of EPWM-XBAR</p> <p>0: Respective output of Mux7 is disabled to drive the TRIP5 of EPWM-XBAR</p> <p>1: Respective output of Mux7 is enabled to drive the TRIP5 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>



**Table 7-49. TRIP5MUXENABLE Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
6	MUX6	R/W	0h	<p>Selects the output of Mux6 to drive TRIP5 of EPWM-XBAR</p> <p>0: Respective output of Mux6 is disabled to drive the TRIP5 of EPWM-XBAR</p> <p>1: Respective output of Mux6 is enabled to drive the TRIP5 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
5	MUX5	R/W	0h	<p>Selects the output of Mux5 to drive TRIP5 of EPWM-XBAR</p> <p>0: Respective output of Mux5 is disabled to drive the TRIP5 of EPWM-XBAR</p> <p>1: Respective output of Mux5 is enabled to drive the TRIP5 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
4	MUX4	R/W	0h	<p>Selects the output of Mux4 to drive TRIP5 of EPWM-XBAR</p> <p>0: Respective output of Mux4 is disabled to drive the TRIP5 of EPWM-XBAR</p> <p>1: Respective output of Mux4 is enabled to drive the TRIP5 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
3	MUX3	R/W	0h	<p>Selects the output of Mux3 to drive TRIP5 of EPWM-XBAR</p> <p>0: Respective output of Mux3 is disabled to drive the TRIP5 of EPWM-XBAR</p> <p>1: Respective output of Mux3 is enabled to drive the TRIP5 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
2	MUX2	R/W	0h	<p>Selects the output of Mux2 to drive TRIP5 of EPWM-XBAR</p> <p>0: Respective output of Mux2 is disabled to drive the TRIP5 of EPWM-XBAR</p> <p>1: Respective output of Mux2 is enabled to drive the TRIP5 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
1	MUX1	R/W	0h	<p>Selects the output of Mux1 to drive TRIP5 of EPWM-XBAR</p> <p>0: Respective output of Mux1 is disabled to drive the TRIP5 of EPWM-XBAR</p> <p>1: Respective output of Mux1 is enabled to drive the TRIP5 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
0	MUX0	R/W	0h	<p>Selects the output of mux0 to drive TRIP5 of EPWM-XBAR</p> <p>0: Respective output of Mux0 is disabled to drive the TRIP5 of EPWM-XBAR</p> <p>1: Respective output of Mux0 is enabled to drive the TRIP5 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>

**7.3.4.19 TRIP7MUXENABLE Register (Offset = 24h) [reset = 0h]**

TRIP7MUXENABLE is shown in [Figure 13-179](#) and described in [Table 13-120](#).

Return to [Summary Table](#).

ePWM XBAR Mux Enable for TRIP7

**Figure 7-44. TRIP7MUXENABLE Register**

31		30		29		28		27		26		25		24	
MUX31	MUX30	MUX29	MUX28	MUX27	MUX26	MUX25	MUX24	MUX23	MUX22	MUX21	MUX20	MUX19	MUX18	MUX17	MUX16
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
23		22		21		20		19		18		17		16	
MUX23	MUX22	MUX21	MUX20	MUX19	MUX18	MUX17	MUX16	MUX15	MUX14	MUX13	MUX12	MUX11	MUX10	MUX9	MUX8
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
15		14		13		12		11		10		9		8	
MUX15	MUX14	MUX13	MUX12	MUX11	MUX10	MUX9	MUX8	MUX7	MUX6	MUX5	MUX4	MUX3	MUX2	MUX1	MUX0
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
7		6		5		4		3		2		1		0	
MUX7	MUX6	MUX5	MUX4	MUX3	MUX2	MUX1	MUX0	MUX7	MUX6	MUX5	MUX4	MUX3	MUX2	MUX1	MUX0
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h

**Table 7-50. TRIP7MUXENABLE Register Field Descriptions**

Bit	Field	Type	Reset	Description
31	MUX31	R/W	0h	Selects the output of Mux31 to drive TRIP7 of EPWM-XBAR 0: Respective output of Mux31 is enabled to drive the TRIP7 of EPWM-XBAR 1: Respective output of Mux31 is enabled to drive the TRIP7 of EPWM-XBAR Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
30	MUX30	R/W	0h	Selects the output of Mux30 to drive TRIP7 of EPWM-XBAR 0: Respective output of Mux30 is enabled to drive the TRIP7 of EPWM-XBAR 1: Respective output of Mux30 is enabled to drive the TRIP7 of EPWM-XBAR Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
29	MUX29	R/W	0h	Selects the output of Mux29 to drive TRIP7 of EPWM-XBAR 0: Respective output of Mux29 is enabled to drive the TRIP7 of EPWM-XBAR 1: Respective output of Mux29 is enabled to drive the TRIP7 of EPWM-XBAR Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
28	MUX28	R/W	0h	Selects the output of Mux28 to drive TRIP7 of EPWM-XBAR 0: Respective output of Mux28 is enabled to drive the TRIP7 of EPWM-XBAR 1: Respective output of Mux28 is enabled to drive the TRIP7 of EPWM-XBAR Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn

**Table 7-50. TRIP7MUXENABLE Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
27	MUX27	R/W	0h	<p>Selects the output of Mux27 to drive TRIP7 of EPWM-XBAR</p> <p>0: Respective output of Mux27 is enabled to drive the TRIP7 of EPWM-XBAR</p> <p>1: Respective output of Mux27 is enabled to drive the TRIP7 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
26	MUX26	R/W	0h	<p>Selects the output of Mux26 to drive TRIP7 of EPWM-XBAR</p> <p>0: Respective output of Mux26 is enabled to drive the TRIP7 of EPWM-XBAR</p> <p>1: Respective output of Mux26 is enabled to drive the TRIP7 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
25	MUX25	R/W	0h	<p>Selects the output of Mux25 to drive TRIP7 of EPWM-XBAR</p> <p>0: Respective output of Mux25 is enabled to drive the TRIP7 of EPWM-XBAR</p> <p>1: Respective output of Mux25 is enabled to drive the TRIP7 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
24	MUX24	R/W	0h	<p>Selects the output of Mux24 to drive TRIP7 of EPWM-XBAR</p> <p>0: Respective output of Mux24 is enabled to drive the TRIP7 of EPWM-XBAR</p> <p>1: Respective output of Mux24 is enabled to drive the TRIP7 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
23	MUX23	R/W	0h	<p>Selects the output of Mux23 to drive TRIP7 of EPWM-XBAR</p> <p>0: Respective output of Mux23 is disabled to drive the TRIP7 of EPWM-XBAR</p> <p>1: Respective output of Mux23 is enabled to drive the TRIP7 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
22	MUX22	R/W	0h	<p>Selects the output of Mux22 to drive TRIP7 of EPWM-XBAR</p> <p>0: Respective output of Mux22 is disabled to drive the TRIP7 of EPWM-XBAR</p> <p>1: Respective output of Mux22 is enabled to drive the TRIP7 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
21	MUX21	R/W	0h	<p>Selects the output of Mux21 to drive TRIP7 of EPWM-XBAR</p> <p>0: Respective output of Mux21 is disabled to drive the TRIP7 of EPWM-XBAR</p> <p>1: Respective output of Mux21 is enabled to drive the TRIP7 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>

**Table 7-50. TRIP7MUXENABLE Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
20	MUX20	R/W	0h	<p>Selects the output of Mux20 to drive TRIP7 of EPWM-XBAR</p> <p>0: Respective output of Mux20 is disabled to drive the TRIP7 of EPWM-XBAR</p> <p>1: Respective output of Mux20 is enabled to drive the TRIP7 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
19	MUX19	R/W	0h	<p>Selects the output of Mux19 to drive TRIP7 of EPWM-XBAR</p> <p>0: Respective output of Mux19 is disabled to drive the TRIP7 of EPWM-XBAR</p> <p>1: Respective output of Mux19 is enabled to drive the TRIP7 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
18	MUX18	R/W	0h	<p>Selects the output of Mux18 to drive TRIP7 of EPWM-XBAR</p> <p>0: Respective output of Mux18 is disabled to drive the TRIP7 of EPWM-XBAR</p> <p>1: Respective output of Mux18 is enabled to drive the TRIP7 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
17	MUX17	R/W	0h	<p>Selects the output of Mux17 to drive TRIP7 of EPWM-XBAR</p> <p>0: Respective output of Mux17 is disabled to drive the TRIP7 of EPWM-XBAR</p> <p>1: Respective output of Mux17 is enabled to drive the TRIP7 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
16	MUX16	R/W	0h	<p>Selects the output of Mux16 to drive TRIP7 of EPWM-XBAR</p> <p>0: Respective output of Mux16 is disabled to drive the TRIP7 of EPWM-XBAR</p> <p>1: Respective output of Mux16 is enabled to drive the TRIP7 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
15	MUX15	R/W	0h	<p>Selects the output of Mux15 to drive TRIP7 of EPWM-XBAR</p> <p>0: Respective output of Mux15 is disabled to drive the TRIP7 of EPWM-XBAR</p> <p>1: Respective output of Mux15 is enabled to drive the TRIP7 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
14	MUX14	R/W	0h	<p>Selects the output of Mux14 to drive TRIP7 of EPWM-XBAR</p> <p>0: Respective output of Mux14 is disabled to drive the TRIP7 of EPWM-XBAR</p> <p>1: Respective output of Mux14 is enabled to drive the TRIP7 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>

**Table 7-50. TRIP7MUXENABLE Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
13	MUX13	R/W	0h	<p>Selects the output of Mux13 to drive TRIP7 of EPWM-XBAR</p> <p>0: Respective output of Mux13 is disabled to drive the TRIP7 of EPWM-XBAR</p> <p>1: Respective output of Mux13 is enabled to drive the TRIP7 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
12	MUX12	R/W	0h	<p>Selects the output of Mux12 to drive TRIP7 of EPWM-XBAR</p> <p>0: Respective output of Mux12 is disabled to drive the TRIP7 of EPWM-XBAR</p> <p>1: Respective output of Mux12 is enabled to drive the TRIP7 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
11	MUX11	R/W	0h	<p>Selects the output of Mux11 to drive TRIP7 of EPWM-XBAR</p> <p>0: Respective output of Mux11 is disabled to drive the TRIP7 of EPWM-XBAR</p> <p>1: Respective output of Mux11 is enabled to drive the TRIP7 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
10	MUX10	R/W	0h	<p>Selects the output of Mux10 to drive TRIP7 of EPWM-XBAR</p> <p>0: Respective output of Mux10 is disabled to drive the TRIP7 of EPWM-XBAR</p> <p>1: Respective output of Mux10 is enabled to drive the TRIP7 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
9	MUX9	R/W	0h	<p>Selects the output of Mux9 to drive TRIP7 of EPWM-XBAR</p> <p>0: Respective output of Mux9 is disabled to drive the TRIP7 of EPWM-XBAR</p> <p>1: Respective output of Mux9 is enabled to drive the TRIP7 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
8	MUX8	R/W	0h	<p>Selects the output of Mux8 to drive TRIP7 of EPWM-XBAR</p> <p>0: Respective output of Mux8 is disabled to drive the TRIP7 of EPWM-XBAR</p> <p>1: Respective output of Mux8 is enabled to drive the TRIP7 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
7	MUX7	R/W	0h	<p>Selects the output of Mux7 to drive TRIP7 of EPWM-XBAR</p> <p>0: Respective output of Mux7 is disabled to drive the TRIP7 of EPWM-XBAR</p> <p>1: Respective output of Mux7 is enabled to drive the TRIP7 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>

**Table 7-50. TRIP7MUXENABLE Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
6	MUX6	R/W	0h	<p>Selects the output of Mux6 to drive TRIP7 of EPWM-XBAR</p> <p>0: Respective output of Mux6 is disabled to drive the TRIP7 of EPWM-XBAR</p> <p>1: Respective output of Mux6 is enabled to drive the TRIP7 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
5	MUX5	R/W	0h	<p>Selects the output of Mux5 to drive TRIP7 of EPWM-XBAR</p> <p>0: Respective output of Mux5 is disabled to drive the TRIP7 of EPWM-XBAR</p> <p>1: Respective output of Mux5 is enabled to drive the TRIP7 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
4	MUX4	R/W	0h	<p>Selects the output of Mux4 to drive TRIP7 of EPWM-XBAR</p> <p>0: Respective output of Mux4 is disabled to drive the TRIP7 of EPWM-XBAR</p> <p>1: Respective output of Mux4 is enabled to drive the TRIP7 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
3	MUX3	R/W	0h	<p>Selects the output of Mux3 to drive TRIP7 of EPWM-XBAR</p> <p>0: Respective output of Mux3 is disabled to drive the TRIP7 of EPWM-XBAR</p> <p>1: Respective output of Mux3 is enabled to drive the TRIP7 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
2	MUX2	R/W	0h	<p>Selects the output of Mux2 to drive TRIP7 of EPWM-XBAR</p> <p>0: Respective output of Mux2 is disabled to drive the TRIP7 of EPWM-XBAR</p> <p>1: Respective output of Mux2 is enabled to drive the TRIP7 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
1	MUX1	R/W	0h	<p>Selects the output of Mux1 to drive TRIP7 of EPWM-XBAR</p> <p>0: Respective output of Mux1 is disabled to drive the TRIP7 of EPWM-XBAR</p> <p>1: Respective output of Mux1 is enabled to drive the TRIP7 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
0	MUX0	R/W	0h	<p>Selects the output of mux0 to drive TRIP7 of EPWM-XBAR</p> <p>0: Respective output of Mux0 is disabled to drive the TRIP7 of EPWM-XBAR</p> <p>1: Respective output of Mux0 is enabled to drive the TRIP7 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>

### 7.3.4.20 TRIP8MUXENABLE Register (Offset = 26h) [reset = 0h]

TRIP8MUXENABLE is shown in [Figure 13-180](#) and described in [Table 13-121](#).

Return to [Summary Table](#).

ePWM XBAR Mux Enable for TRIP8

**Figure 7-45. TRIP8MUXENABLE Register**

31	30	29	28	27	26	25	24
MUX31	MUX30	MUX29	MUX28	MUX27	MUX26	MUX25	MUX24
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
23	22	21	20	19	18	17	16
MUX23	MUX22	MUX21	MUX20	MUX19	MUX18	MUX17	MUX16
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
15	14	13	12	11	10	9	8
MUX15	MUX14	MUX13	MUX12	MUX11	MUX10	MUX9	MUX8
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
7	6	5	4	3	2	1	0
MUX7	MUX6	MUX5	MUX4	MUX3	MUX2	MUX1	MUX0
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h

**Table 7-51. TRIP8MUXENABLE Register Field Descriptions**

Bit	Field	Type	Reset	Description
31	MUX31	R/W	0h	<p>Selects the output of Mux31 to drive TRIP8 of EPWM-XBAR</p> <p>0: Respective output of Mux31 is enabled to drive the TRIP8 of EPWM-XBAR</p> <p>1: Respective output of Mux31 is enabled to drive the TRIP8 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
30	MUX30	R/W	0h	<p>Selects the output of Mux30 to drive TRIP8 of EPWM-XBAR</p> <p>0: Respective output of Mux30 is enabled to drive the TRIP8 of EPWM-XBAR</p> <p>1: Respective output of Mux30 is enabled to drive the TRIP8 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
29	MUX29	R/W	0h	<p>Selects the output of Mux29 to drive TRIP8 of EPWM-XBAR</p> <p>0: Respective output of Mux29 is enabled to drive the TRIP8 of EPWM-XBAR</p> <p>1: Respective output of Mux29 is enabled to drive the TRIP8 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
28	MUX28	R/W	0h	<p>Selects the output of Mux28 to drive TRIP8 of EPWM-XBAR</p> <p>0: Respective output of Mux28 is enabled to drive the TRIP8 of EPWM-XBAR</p> <p>1: Respective output of Mux28 is enabled to drive the TRIP8 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>

**Table 7-51. TRIP8MUXENABLE Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
27	MUX27	R/W	0h	<p>Selects the output of Mux27 to drive TRIP8 of EPWM-XBAR</p> <p>0: Respective output of Mux27 is enabled to drive the TRIP8 of EPWM-XBAR</p> <p>1: Respective output of Mux27 is enabled to drive the TRIP8 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
26	MUX26	R/W	0h	<p>Selects the output of Mux26 to drive TRIP8 of EPWM-XBAR</p> <p>0: Respective output of Mux26 is enabled to drive the TRIP8 of EPWM-XBAR</p> <p>1: Respective output of Mux26 is enabled to drive the TRIP8 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
25	MUX25	R/W	0h	<p>Selects the output of Mux25 to drive TRIP8 of EPWM-XBAR</p> <p>0: Respective output of Mux25 is enabled to drive the TRIP8 of EPWM-XBAR</p> <p>1: Respective output of Mux25 is enabled to drive the TRIP8 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
24	MUX24	R/W	0h	<p>Selects the output of Mux24 to drive TRIP8 of EPWM-XBAR</p> <p>0: Respective output of Mux24 is enabled to drive the TRIP8 of EPWM-XBAR</p> <p>1: Respective output of Mux24 is enabled to drive the TRIP8 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
23	MUX23	R/W	0h	<p>Selects the output of Mux23 to drive TRIP8 of EPWM-XBAR</p> <p>0: Respective output of Mux23 is disabled to drive the TRIP8 of EPWM-XBAR</p> <p>1: Respective output of Mux23 is enabled to drive the TRIP8 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
22	MUX22	R/W	0h	<p>Selects the output of Mux22 to drive TRIP8 of EPWM-XBAR</p> <p>0: Respective output of Mux22 is disabled to drive the TRIP8 of EPWM-XBAR</p> <p>1: Respective output of Mux22 is enabled to drive the TRIP8 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
21	MUX21	R/W	0h	<p>Selects the output of Mux21 to drive TRIP8 of EPWM-XBAR</p> <p>0: Respective output of Mux21 is disabled to drive the TRIP8 of EPWM-XBAR</p> <p>1: Respective output of Mux21 is enabled to drive the TRIP8 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>



**Table 7-51. TRIP8MUXENABLE Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
20	MUX20	R/W	0h	<p>Selects the output of Mux20 to drive TRIP8 of EPWM-XBAR</p> <p>0: Respective output of Mux20 is disabled to drive the TRIP8 of EPWM-XBAR</p> <p>1: Respective output of Mux20 is enabled to drive the TRIP8 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
19	MUX19	R/W	0h	<p>Selects the output of Mux19 to drive TRIP8 of EPWM-XBAR</p> <p>0: Respective output of Mux19 is disabled to drive the TRIP8 of EPWM-XBAR</p> <p>1: Respective output of Mux19 is enabled to drive the TRIP8 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
18	MUX18	R/W	0h	<p>Selects the output of Mux18 to drive TRIP8 of EPWM-XBAR</p> <p>0: Respective output of Mux18 is disabled to drive the TRIP8 of EPWM-XBAR</p> <p>1: Respective output of Mux18 is enabled to drive the TRIP8 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
17	MUX17	R/W	0h	<p>Selects the output of Mux17 to drive TRIP8 of EPWM-XBAR</p> <p>0: Respective output of Mux17 is disabled to drive the TRIP8 of EPWM-XBAR</p> <p>1: Respective output of Mux17 is enabled to drive the TRIP8 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
16	MUX16	R/W	0h	<p>Selects the output of Mux16 to drive TRIP8 of EPWM-XBAR</p> <p>0: Respective output of Mux16 is disabled to drive the TRIP8 of EPWM-XBAR</p> <p>1: Respective output of Mux16 is enabled to drive the TRIP8 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
15	MUX15	R/W	0h	<p>Selects the output of Mux15 to drive TRIP8 of EPWM-XBAR</p> <p>0: Respective output of Mux15 is disabled to drive the TRIP8 of EPWM-XBAR</p> <p>1: Respective output of Mux15 is enabled to drive the TRIP8 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
14	MUX14	R/W	0h	<p>Selects the output of Mux14 to drive TRIP8 of EPWM-XBAR</p> <p>0: Respective output of Mux14 is disabled to drive the TRIP8 of EPWM-XBAR</p> <p>1: Respective output of Mux14 is enabled to drive the TRIP8 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>

**Table 7-51. TRIP8MUXENABLE Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
13	MUX13	R/W	0h	<p>Selects the output of Mux13 to drive TRIP8 of EPWM-XBAR</p> <p>0: Respective output of Mux13 is disabled to drive the TRIP8 of EPWM-XBAR</p> <p>1: Respective output of Mux13 is enabled to drive the TRIP8 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
12	MUX12	R/W	0h	<p>Selects the output of Mux12 to drive TRIP8 of EPWM-XBAR</p> <p>0: Respective output of Mux12 is disabled to drive the TRIP8 of EPWM-XBAR</p> <p>1: Respective output of Mux12 is enabled to drive the TRIP8 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
11	MUX11	R/W	0h	<p>Selects the output of Mux11 to drive TRIP8 of EPWM-XBAR</p> <p>0: Respective output of Mux11 is disabled to drive the TRIP8 of EPWM-XBAR</p> <p>1: Respective output of Mux11 is enabled to drive the TRIP8 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
10	MUX10	R/W	0h	<p>Selects the output of Mux10 to drive TRIP8 of EPWM-XBAR</p> <p>0: Respective output of Mux10 is disabled to drive the TRIP8 of EPWM-XBAR</p> <p>1: Respective output of Mux10 is enabled to drive the TRIP8 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
9	MUX9	R/W	0h	<p>Selects the output of Mux9 to drive TRIP8 of EPWM-XBAR</p> <p>0: Respective output of Mux9 is disabled to drive the TRIP8 of EPWM-XBAR</p> <p>1: Respective output of Mux9 is enabled to drive the TRIP8 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
8	MUX8	R/W	0h	<p>Selects the output of Mux8 to drive TRIP8 of EPWM-XBAR</p> <p>0: Respective output of Mux8 is disabled to drive the TRIP8 of EPWM-XBAR</p> <p>1: Respective output of Mux8 is enabled to drive the TRIP8 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
7	MUX7	R/W	0h	<p>Selects the output of Mux7 to drive TRIP8 of EPWM-XBAR</p> <p>0: Respective output of Mux7 is disabled to drive the TRIP8 of EPWM-XBAR</p> <p>1: Respective output of Mux7 is enabled to drive the TRIP8 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>

**Table 7-51. TRIP8MUXENABLE Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
6	MUX6	R/W	0h	<p>Selects the output of Mux6 to drive TRIP8 of EPWM-XBAR</p> <p>0: Respective output of Mux6 is disabled to drive the TRIP8 of EPWM-XBAR</p> <p>1: Respective output of Mux6 is enabled to drive the TRIP8 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
5	MUX5	R/W	0h	<p>Selects the output of Mux5 to drive TRIP8 of EPWM-XBAR</p> <p>0: Respective output of Mux5 is disabled to drive the TRIP8 of EPWM-XBAR</p> <p>1: Respective output of Mux5 is enabled to drive the TRIP8 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
4	MUX4	R/W	0h	<p>Selects the output of Mux4 to drive TRIP8 of EPWM-XBAR</p> <p>0: Respective output of Mux4 is disabled to drive the TRIP8 of EPWM-XBAR</p> <p>1: Respective output of Mux4 is enabled to drive the TRIP8 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
3	MUX3	R/W	0h	<p>Selects the output of Mux3 to drive TRIP8 of EPWM-XBAR</p> <p>0: Respective output of Mux3 is disabled to drive the TRIP8 of EPWM-XBAR</p> <p>1: Respective output of Mux3 is enabled to drive the TRIP8 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
2	MUX2	R/W	0h	<p>Selects the output of Mux2 to drive TRIP8 of EPWM-XBAR</p> <p>0: Respective output of Mux2 is disabled to drive the TRIP8 of EPWM-XBAR</p> <p>1: Respective output of Mux2 is enabled to drive the TRIP8 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
1	MUX1	R/W	0h	<p>Selects the output of Mux1 to drive TRIP8 of EPWM-XBAR</p> <p>0: Respective output of Mux1 is disabled to drive the TRIP8 of EPWM-XBAR</p> <p>1: Respective output of Mux1 is enabled to drive the TRIP8 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
0	MUX0	R/W	0h	<p>Selects the output of mux0 to drive TRIP8 of EPWM-XBAR</p> <p>0: Respective output of Mux0 is disabled to drive the TRIP8 of EPWM-XBAR</p> <p>1: Respective output of Mux0 is enabled to drive the TRIP8 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>

### 7.3.4.21 TRIP9MUXENABLE Register (Offset = 28h) [reset = 0h]

TRIP9MUXENABLE is shown in [Figure 13-181](#) and described in [Table 13-122](#).

Return to [Summary Table](#).

ePWM XBAR Mux Enable for TRIP9

**Figure 7-46. TRIP9MUXENABLE Register**

31		30		29		28		27		26		25		24	
MUX31	MUX30	MUX29	MUX28	MUX27	MUX26	MUX25	MUX24	MUX23	MUX22	MUX21	MUX20	MUX19	MUX18	MUX17	MUX16
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
23		22		21		20		19		18		17		16	
MUX23	MUX22	MUX21	MUX20	MUX19	MUX18	MUX17	MUX16	MUX15	MUX14	MUX13	MUX12	MUX11	MUX10	MUX9	MUX8
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
15		14		13		12		11		10		9		8	
MUX15	MUX14	MUX13	MUX12	MUX11	MUX10	MUX9	MUX8	MUX7	MUX6	MUX5	MUX4	MUX3	MUX2	MUX1	MUX0
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
7		6		5		4		3		2		1		0	
MUX7	MUX6	MUX5	MUX4	MUX3	MUX2	MUX1	MUX0	MUX7	MUX6	MUX5	MUX4	MUX3	MUX2	MUX1	MUX0
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h

**Table 7-52. TRIP9MUXENABLE Register Field Descriptions**

Bit	Field	Type	Reset	Description
31	MUX31	R/W	0h	<p>Selects the output of Mux31 to drive TRIP9 of EPWM-XBAR</p> <p>0: Respective output of Mux31 is enabled to drive the TRIP9 of EPWM-XBAR</p> <p>1: Respective output of Mux31 is enabled to drive the TRIP9 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.</p> <p>Reset type: CPU1.SYSRSn</p>
30	MUX30	R/W	0h	<p>Selects the output of Mux30 to drive TRIP9 of EPWM-XBAR</p> <p>0: Respective output of Mux30 is enabled to drive the TRIP9 of EPWM-XBAR</p> <p>1: Respective output of Mux30 is enabled to drive the TRIP9 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.</p> <p>Reset type: CPU1.SYSRSn</p>
29	MUX29	R/W	0h	<p>Selects the output of Mux29 to drive TRIP9 of EPWM-XBAR</p> <p>0: Respective output of Mux29 is enabled to drive the TRIP9 of EPWM-XBAR</p> <p>1: Respective output of Mux29 is enabled to drive the TRIP9 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.</p> <p>Reset type: CPU1.SYSRSn</p>
28	MUX28	R/W	0h	<p>Selects the output of Mux28 to drive TRIP9 of EPWM-XBAR</p> <p>0: Respective output of Mux28 is enabled to drive the TRIP9 of EPWM-XBAR</p> <p>1: Respective output of Mux28 is enabled to drive the TRIP9 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.</p> <p>Reset type: CPU1.SYSRSn</p>

**Table 7-52. TRIP9MUXENABLE Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
27	MUX27	R/W	0h	<p>Selects the output of Mux27 to drive TRIP9 of EPWM-XBAR</p> <p>0: Respective output of Mux27 is enabled to drive the TRIP9 of EPWM-XBAR</p> <p>1: Respective output of Mux27 is enabled to drive the TRIP9 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
26	MUX26	R/W	0h	<p>Selects the output of Mux26 to drive TRIP9 of EPWM-XBAR</p> <p>0: Respective output of Mux26 is enabled to drive the TRIP9 of EPWM-XBAR</p> <p>1: Respective output of Mux26 is enabled to drive the TRIP9 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
25	MUX25	R/W	0h	<p>Selects the output of Mux25 to drive TRIP9 of EPWM-XBAR</p> <p>0: Respective output of Mux25 is enabled to drive the TRIP9 of EPWM-XBAR</p> <p>1: Respective output of Mux25 is enabled to drive the TRIP9 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
24	MUX24	R/W	0h	<p>Selects the output of Mux24 to drive TRIP9 of EPWM-XBAR</p> <p>0: Respective output of Mux24 is enabled to drive the TRIP9 of EPWM-XBAR</p> <p>1: Respective output of Mux24 is enabled to drive the TRIP9 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
23	MUX23	R/W	0h	<p>Selects the output of Mux23 to drive TRIP9 of EPWM-XBAR</p> <p>0: Respective output of Mux23 is disabled to drive the TRIP9 of EPWM-XBAR</p> <p>1: Respective output of Mux23 is enabled to drive the TRIP9 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
22	MUX22	R/W	0h	<p>Selects the output of Mux22 to drive TRIP9 of EPWM-XBAR</p> <p>0: Respective output of Mux22 is disabled to drive the TRIP9 of EPWM-XBAR</p> <p>1: Respective output of Mux22 is enabled to drive the TRIP9 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
21	MUX21	R/W	0h	<p>Selects the output of Mux21 to drive TRIP9 of EPWM-XBAR</p> <p>0: Respective output of Mux21 is disabled to drive the TRIP9 of EPWM-XBAR</p> <p>1: Respective output of Mux21 is enabled to drive the TRIP9 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>

**Table 7-52. TRIP9MUXENABLE Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
20	MUX20	R/W	0h	<p>Selects the output of Mux20 to drive TRIP9 of EPWM-XBAR</p> <p>0: Respective output of Mux20 is disabled to drive the TRIP9 of EPWM-XBAR</p> <p>1: Respective output of Mux20 is enabled to drive the TRIP9 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
19	MUX19	R/W	0h	<p>Selects the output of Mux19 to drive TRIP9 of EPWM-XBAR</p> <p>0: Respective output of Mux19 is disabled to drive the TRIP9 of EPWM-XBAR</p> <p>1: Respective output of Mux19 is enabled to drive the TRIP9 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
18	MUX18	R/W	0h	<p>Selects the output of Mux18 to drive TRIP9 of EPWM-XBAR</p> <p>0: Respective output of Mux18 is disabled to drive the TRIP9 of EPWM-XBAR</p> <p>1: Respective output of Mux18 is enabled to drive the TRIP9 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
17	MUX17	R/W	0h	<p>Selects the output of Mux17 to drive TRIP9 of EPWM-XBAR</p> <p>0: Respective output of Mux17 is disabled to drive the TRIP9 of EPWM-XBAR</p> <p>1: Respective output of Mux17 is enabled to drive the TRIP9 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
16	MUX16	R/W	0h	<p>Selects the output of Mux16 to drive TRIP9 of EPWM-XBAR</p> <p>0: Respective output of Mux16 is disabled to drive the TRIP9 of EPWM-XBAR</p> <p>1: Respective output of Mux16 is enabled to drive the TRIP9 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
15	MUX15	R/W	0h	<p>Selects the output of Mux15 to drive TRIP9 of EPWM-XBAR</p> <p>0: Respective output of Mux15 is disabled to drive the TRIP9 of EPWM-XBAR</p> <p>1: Respective output of Mux15 is enabled to drive the TRIP9 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
14	MUX14	R/W	0h	<p>Selects the output of Mux14 to drive TRIP9 of EPWM-XBAR</p> <p>0: Respective output of Mux14 is disabled to drive the TRIP9 of EPWM-XBAR</p> <p>1: Respective output of Mux14 is enabled to drive the TRIP9 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>

**Table 7-52. TRIP9MUXENABLE Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
13	MUX13	R/W	0h	<p>Selects the output of Mux13 to drive TRIP9 of EPWM-XBAR</p> <p>0: Respective output of Mux13 is disabled to drive the TRIP9 of EPWM-XBAR</p> <p>1: Respective output of Mux13 is enabled to drive the TRIP9 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
12	MUX12	R/W	0h	<p>Selects the output of Mux12 to drive TRIP9 of EPWM-XBAR</p> <p>0: Respective output of Mux12 is disabled to drive the TRIP9 of EPWM-XBAR</p> <p>1: Respective output of Mux12 is enabled to drive the TRIP9 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
11	MUX11	R/W	0h	<p>Selects the output of Mux11 to drive TRIP9 of EPWM-XBAR</p> <p>0: Respective output of Mux11 is disabled to drive the TRIP9 of EPWM-XBAR</p> <p>1: Respective output of Mux11 is enabled to drive the TRIP9 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
10	MUX10	R/W	0h	<p>Selects the output of Mux10 to drive TRIP9 of EPWM-XBAR</p> <p>0: Respective output of Mux10 is disabled to drive the TRIP9 of EPWM-XBAR</p> <p>1: Respective output of Mux10 is enabled to drive the TRIP9 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
9	MUX9	R/W	0h	<p>Selects the output of Mux9 to drive TRIP9 of EPWM-XBAR</p> <p>0: Respective output of Mux9 is disabled to drive the TRIP9 of EPWM-XBAR</p> <p>1: Respective output of Mux9 is enabled to drive the TRIP9 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
8	MUX8	R/W	0h	<p>Selects the output of Mux8 to drive TRIP9 of EPWM-XBAR</p> <p>0: Respective output of Mux8 is disabled to drive the TRIP9 of EPWM-XBAR</p> <p>1: Respective output of Mux8 is enabled to drive the TRIP9 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
7	MUX7	R/W	0h	<p>Selects the output of Mux7 to drive TRIP9 of EPWM-XBAR</p> <p>0: Respective output of Mux7 is disabled to drive the TRIP9 of EPWM-XBAR</p> <p>1: Respective output of Mux7 is enabled to drive the TRIP9 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>

**Table 7-52. TRIP9MUXENABLE Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
6	MUX6	R/W	0h	<p>Selects the output of Mux6 to drive TRIP9 of EPWM-XBAR</p> <p>0: Respective output of Mux6 is disabled to drive the TRIP9 of EPWM-XBAR</p> <p>1: Respective output of Mux6 is enabled to drive the TRIP9 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
5	MUX5	R/W	0h	<p>Selects the output of Mux5 to drive TRIP9 of EPWM-XBAR</p> <p>0: Respective output of Mux5 is disabled to drive the TRIP9 of EPWM-XBAR</p> <p>1: Respective output of Mux5 is enabled to drive the TRIP9 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
4	MUX4	R/W	0h	<p>Selects the output of Mux4 to drive TRIP9 of EPWM-XBAR</p> <p>0: Respective output of Mux4 is disabled to drive the TRIP9 of EPWM-XBAR</p> <p>1: Respective output of Mux4 is enabled to drive the TRIP9 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
3	MUX3	R/W	0h	<p>Selects the output of Mux3 to drive TRIP9 of EPWM-XBAR</p> <p>0: Respective output of Mux3 is disabled to drive the TRIP9 of EPWM-XBAR</p> <p>1: Respective output of Mux3 is enabled to drive the TRIP9 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
2	MUX2	R/W	0h	<p>Selects the output of Mux2 to drive TRIP9 of EPWM-XBAR</p> <p>0: Respective output of Mux2 is disabled to drive the TRIP9 of EPWM-XBAR</p> <p>1: Respective output of Mux2 is enabled to drive the TRIP9 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
1	MUX1	R/W	0h	<p>Selects the output of Mux1 to drive TRIP9 of EPWM-XBAR</p> <p>0: Respective output of Mux1 is disabled to drive the TRIP9 of EPWM-XBAR</p> <p>1: Respective output of Mux1 is enabled to drive the TRIP9 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
0	MUX0	R/W	0h	<p>Selects the output of mux0 to drive TRIP9 of EPWM-XBAR</p> <p>0: Respective output of Mux0 is disabled to drive the TRIP9 of EPWM-XBAR</p> <p>1: Respective output of Mux0 is enabled to drive the TRIP9 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>



### 7.3.4.22 TRIP10MUXENABLE Register (Offset = 2Ah) [reset = 0h]

TRIP10MUXENABLE is shown in [Figure 13-182](#) and described in [Table 13-123](#).

Return to [Summary Table](#).

ePWM XBAR Mux Enable for TRIP10

**Figure 7-47. TRIP10MUXENABLE Register**

31	30	29	28	27	26	25	24
MUX31	MUX30	MUX29	MUX28	MUX27	MUX26	MUX25	MUX24
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
23	22	21	20	19	18	17	16
MUX23	MUX22	MUX21	MUX20	MUX19	MUX18	MUX17	MUX16
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
15	14	13	12	11	10	9	8
MUX15	MUX14	MUX13	MUX12	MUX11	MUX10	MUX9	MUX8
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
7	6	5	4	3	2	1	0
MUX7	MUX6	MUX5	MUX4	MUX3	MUX2	MUX1	MUX0
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h

**Table 7-53. TRIP10MUXENABLE Register Field Descriptions**

Bit	Field	Type	Reset	Description
31	MUX31	R/W	0h	<p>Selects the output of Mux31 to drive TRIP10 of EPWM-XBAR</p> <p>0: Respective output of Mux31 is enabled to drive the TRIP10 of EPWM-XBAR</p> <p>1: Respective output of Mux31 is enabled to drive the TRIP10 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
30	MUX30	R/W	0h	<p>Selects the output of Mux30 to drive TRIP10 of EPWM-XBAR</p> <p>0: Respective output of Mux30 is enabled to drive the TRIP10 of EPWM-XBAR</p> <p>1: Respective output of Mux30 is enabled to drive the TRIP10 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
29	MUX29	R/W	0h	<p>Selects the output of Mux29 to drive TRIP10 of EPWM-XBAR</p> <p>0: Respective output of Mux29 is enabled to drive the TRIP10 of EPWM-XBAR</p> <p>1: Respective output of Mux29 is enabled to drive the TRIP10 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
28	MUX28	R/W	0h	<p>Selects the output of Mux28 to drive TRIP10 of EPWM-XBAR</p> <p>0: Respective output of Mux28 is enabled to drive the TRIP10 of EPWM-XBAR</p> <p>1: Respective output of Mux28 is enabled to drive the TRIP10 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>

**Table 7-53. TRIP10MUXENABLE Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
27	MUX27	R/W	0h	<p>Selects the output of Mux27 to drive TRIP10 of EPWM-XBAR</p> <p>0: Respective output of Mux27 is enabled to drive the TRIP10 of EPWM-XBAR</p> <p>1: Respective output of Mux27 is enabled to drive the TRIP10 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
26	MUX26	R/W	0h	<p>Selects the output of Mux26 to drive TRIP10 of EPWM-XBAR</p> <p>0: Respective output of Mux26 is enabled to drive the TRIP10 of EPWM-XBAR</p> <p>1: Respective output of Mux26 is enabled to drive the TRIP10 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
25	MUX25	R/W	0h	<p>Selects the output of Mux25 to drive TRIP10 of EPWM-XBAR</p> <p>0: Respective output of Mux25 is enabled to drive the TRIP10 of EPWM-XBAR</p> <p>1: Respective output of Mux25 is enabled to drive the TRIP10 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
24	MUX24	R/W	0h	<p>Selects the output of Mux24 to drive TRIP10 of EPWM-XBAR</p> <p>0: Respective output of Mux24 is enabled to drive the TRIP10 of EPWM-XBAR</p> <p>1: Respective output of Mux24 is enabled to drive the TRIP10 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
23	MUX23	R/W	0h	<p>Selects the output of Mux23 to drive TRIP10 of EPWM-XBAR</p> <p>0: Respective output of Mux23 is disabled to drive the TRIP10 of EPWM-XBAR</p> <p>1: Respective output of Mux23 is enabled to drive the TRIP10 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
22	MUX22	R/W	0h	<p>Selects the output of Mux22 to drive TRIP10 of EPWM-XBAR</p> <p>0: Respective output of Mux22 is disabled to drive the TRIP10 of EPWM-XBAR</p> <p>1: Respective output of Mux22 is enabled to drive the TRIP10 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
21	MUX21	R/W	0h	<p>Selects the output of Mux21 to drive TRIP10 of EPWM-XBAR</p> <p>0: Respective output of Mux21 is disabled to drive the TRIP10 of EPWM-XBAR</p> <p>1: Respective output of Mux21 is enabled to drive the TRIP10 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>

**Table 7-53. TRIP10MUXENABLE Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
20	MUX20	R/W	0h	<p>Selects the output of Mux20 to drive TRIP10 of EPWM-XBAR</p> <p>0: Respective output of Mux20 is disabled to drive the TRIP10 of EPWM-XBAR</p> <p>1: Respective output of Mux20 is enabled to drive the TRIP10 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
19	MUX19	R/W	0h	<p>Selects the output of Mux19 to drive TRIP10 of EPWM-XBAR</p> <p>0: Respective output of Mux19 is disabled to drive the TRIP10 of EPWM-XBAR</p> <p>1: Respective output of Mux19 is enabled to drive the TRIP10 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
18	MUX18	R/W	0h	<p>Selects the output of Mux18 to drive TRIP10 of EPWM-XBAR</p> <p>0: Respective output of Mux18 is disabled to drive the TRIP10 of EPWM-XBAR</p> <p>1: Respective output of Mux18 is enabled to drive the TRIP10 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
17	MUX17	R/W	0h	<p>Selects the output of Mux17 to drive TRIP10 of EPWM-XBAR</p> <p>0: Respective output of Mux17 is disabled to drive the TRIP10 of EPWM-XBAR</p> <p>1: Respective output of Mux17 is enabled to drive the TRIP10 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
16	MUX16	R/W	0h	<p>Selects the output of Mux16 to drive TRIP10 of EPWM-XBAR</p> <p>0: Respective output of Mux16 is disabled to drive the TRIP10 of EPWM-XBAR</p> <p>1: Respective output of Mux16 is enabled to drive the TRIP10 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
15	MUX15	R/W	0h	<p>Selects the output of Mux15 to drive TRIP10 of EPWM-XBAR</p> <p>0: Respective output of Mux15 is disabled to drive the TRIP10 of EPWM-XBAR</p> <p>1: Respective output of Mux15 is enabled to drive the TRIP10 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
14	MUX14	R/W	0h	<p>Selects the output of Mux14 to drive TRIP10 of EPWM-XBAR</p> <p>0: Respective output of Mux14 is disabled to drive the TRIP10 of EPWM-XBAR</p> <p>1: Respective output of Mux14 is enabled to drive the TRIP10 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>

**Table 7-53. TRIP10MUXENABLE Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
13	MUX13	R/W	0h	<p>Selects the output of Mux13 to drive TRIP10 of EPWM-XBAR</p> <p>0: Respective output of Mux13 is disabled to drive the TRIP10 of EPWM-XBAR</p> <p>1: Respective output of Mux13 is enabled to drive the TRIP10 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
12	MUX12	R/W	0h	<p>Selects the output of Mux12 to drive TRIP10 of EPWM-XBAR</p> <p>0: Respective output of Mux12 is disabled to drive the TRIP10 of EPWM-XBAR</p> <p>1: Respective output of Mux12 is enabled to drive the TRIP10 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
11	MUX11	R/W	0h	<p>Selects the output of Mux11 to drive TRIP10 of EPWM-XBAR</p> <p>0: Respective output of Mux11 is disabled to drive the TRIP10 of EPWM-XBAR</p> <p>1: Respective output of Mux11 is enabled to drive the TRIP10 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
10	MUX10	R/W	0h	<p>Selects the output of Mux10 to drive TRIP10 of EPWM-XBAR</p> <p>0: Respective output of Mux10 is disabled to drive the TRIP10 of EPWM-XBAR</p> <p>1: Respective output of Mux10 is enabled to drive the TRIP10 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
9	MUX9	R/W	0h	<p>Selects the output of Mux9 to drive TRIP10 of EPWM-XBAR</p> <p>0: Respective output of Mux9 is disabled to drive the TRIP10 of EPWM-XBAR</p> <p>1: Respective output of Mux9 is enabled to drive the TRIP10 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
8	MUX8	R/W	0h	<p>Selects the output of Mux8 to drive TRIP10 of EPWM-XBAR</p> <p>0: Respective output of Mux8 is disabled to drive the TRIP10 of EPWM-XBAR</p> <p>1: Respective output of Mux8 is enabled to drive the TRIP10 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
7	MUX7	R/W	0h	<p>Selects the output of Mux7 to drive TRIP10 of EPWM-XBAR</p> <p>0: Respective output of Mux7 is disabled to drive the TRIP10 of EPWM-XBAR</p> <p>1: Respective output of Mux7 is enabled to drive the TRIP10 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>

**Table 7-53. TRIP10MUXENABLE Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
6	MUX6	R/W	0h	<p>Selects the output of Mux6 to drive TRIP10 of EPWM-XBAR</p> <p>0: Respective output of Mux6 is disabled to drive the TRIP10 of EPWM-XBAR</p> <p>1: Respective output of Mux6 is enabled to drive the TRIP10 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
5	MUX5	R/W	0h	<p>Selects the output of Mux5 to drive TRIP10 of EPWM-XBAR</p> <p>0: Respective output of Mux5 is disabled to drive the TRIP10 of EPWM-XBAR</p> <p>1: Respective output of Mux5 is enabled to drive the TRIP10 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
4	MUX4	R/W	0h	<p>Selects the output of Mux4 to drive TRIP10 of EPWM-XBAR</p> <p>0: Respective output of Mux4 is disabled to drive the TRIP10 of EPWM-XBAR</p> <p>1: Respective output of Mux4 is enabled to drive the TRIP10 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
3	MUX3	R/W	0h	<p>Selects the output of Mux3 to drive TRIP10 of EPWM-XBAR</p> <p>0: Respective output of Mux3 is disabled to drive the TRIP10 of EPWM-XBAR</p> <p>1: Respective output of Mux3 is enabled to drive the TRIP10 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
2	MUX2	R/W	0h	<p>Selects the output of Mux2 to drive TRIP10 of EPWM-XBAR</p> <p>0: Respective output of Mux2 is disabled to drive the TRIP10 of EPWM-XBAR</p> <p>1: Respective output of Mux2 is enabled to drive the TRIP10 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
1	MUX1	R/W	0h	<p>Selects the output of Mux1 to drive TRIP10 of EPWM-XBAR</p> <p>0: Respective output of Mux1 is disabled to drive the TRIP10 of EPWM-XBAR</p> <p>1: Respective output of Mux1 is enabled to drive the TRIP10 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
0	MUX0	R/W	0h	<p>Selects the output of mux0 to drive TRIP10 of EPWM-XBAR</p> <p>0: Respective output of Mux0 is disabled to drive the TRIP10 of EPWM-XBAR</p> <p>1: Respective output of Mux0 is enabled to drive the TRIP10 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>

**7.3.4.23 TRIP11MUXENABLE Register (Offset = 2Ch) [reset = 0h]**

TRIP11MUXENABLE is shown in [Figure 13-183](#) and described in [Table 13-124](#).

Return to [Summary Table](#).

ePWM XBAR Mux Enable for TRIP11

**Figure 7-48. TRIP11MUXENABLE Register**

31		30		29		28		27		26		25		24	
MUX31	MUX30	MUX29	MUX28	MUX27	MUX26	MUX25	MUX24	MUX23	MUX22	MUX21	MUX20	MUX19	MUX18	MUX17	MUX16
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
23		22		21		20		19		18		17		16	
MUX23	MUX22	MUX21	MUX20	MUX19	MUX18	MUX17	MUX16	MUX15	MUX14	MUX13	MUX12	MUX11	MUX10	MUX9	MUX8
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
15		14		13		12		11		10		9		8	
MUX15	MUX14	MUX13	MUX12	MUX11	MUX10	MUX9	MUX8	MUX7	MUX6	MUX5	MUX4	MUX3	MUX2	MUX1	MUX0
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
7		6		5		4		3		2		1		0	
MUX7	MUX6	MUX5	MUX4	MUX3	MUX2	MUX1	MUX0	MUX7	MUX6	MUX5	MUX4	MUX3	MUX2	MUX1	MUX0
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h

**Table 7-54. TRIP11MUXENABLE Register Field Descriptions**

Bit	Field	Type	Reset	Description
31	MUX31	R/W	0h	<p>Selects the output of Mux31 to drive TRIP11 of EPWM-XBAR</p> <p>0: Respective output of Mux31 is enabled to drive the TRIP11 of EPWM-XBAR</p> <p>1: Respective output of Mux31 is enabled to drive the TRIP11 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.</p> <p>Reset type: CPU1.SYSRSn</p>
30	MUX30	R/W	0h	<p>Selects the output of Mux30 to drive TRIP11 of EPWM-XBAR</p> <p>0: Respective output of Mux30 is enabled to drive the TRIP11 of EPWM-XBAR</p> <p>1: Respective output of Mux30 is enabled to drive the TRIP11 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.</p> <p>Reset type: CPU1.SYSRSn</p>
29	MUX29	R/W	0h	<p>Selects the output of Mux29 to drive TRIP11 of EPWM-XBAR</p> <p>0: Respective output of Mux29 is enabled to drive the TRIP11 of EPWM-XBAR</p> <p>1: Respective output of Mux29 is enabled to drive the TRIP11 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.</p> <p>Reset type: CPU1.SYSRSn</p>
28	MUX28	R/W	0h	<p>Selects the output of Mux28 to drive TRIP11 of EPWM-XBAR</p> <p>0: Respective output of Mux28 is enabled to drive the TRIP11 of EPWM-XBAR</p> <p>1: Respective output of Mux28 is enabled to drive the TRIP11 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.</p> <p>Reset type: CPU1.SYSRSn</p>

**Table 7-54. TRIP11MUXENABLE Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
27	MUX27	R/W	0h	<p>Selects the output of Mux27 to drive TRIP11 of EPWM-XBAR</p> <p>0: Respective output of Mux27 is enabled to drive the TRIP11 of EPWM-XBAR</p> <p>1: Respective output of Mux27 is enabled to drive the TRIP11 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
26	MUX26	R/W	0h	<p>Selects the output of Mux26 to drive TRIP11 of EPWM-XBAR</p> <p>0: Respective output of Mux26 is enabled to drive the TRIP11 of EPWM-XBAR</p> <p>1: Respective output of Mux26 is enabled to drive the TRIP11 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
25	MUX25	R/W	0h	<p>Selects the output of Mux25 to drive TRIP11 of EPWM-XBAR</p> <p>0: Respective output of Mux25 is enabled to drive the TRIP11 of EPWM-XBAR</p> <p>1: Respective output of Mux25 is enabled to drive the TRIP11 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
24	MUX24	R/W	0h	<p>Selects the output of Mux24 to drive TRIP11 of EPWM-XBAR</p> <p>0: Respective output of Mux24 is enabled to drive the TRIP11 of EPWM-XBAR</p> <p>1: Respective output of Mux24 is enabled to drive the TRIP11 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
23	MUX23	R/W	0h	<p>Selects the output of Mux23 to drive TRIP11 of EPWM-XBAR</p> <p>0: Respective output of Mux23 is disabled to drive the TRIP11 of EPWM-XBAR</p> <p>1: Respective output of Mux23 is enabled to drive the TRIP11 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
22	MUX22	R/W	0h	<p>Selects the output of Mux22 to drive TRIP11 of EPWM-XBAR</p> <p>0: Respective output of Mux22 is disabled to drive the TRIP11 of EPWM-XBAR</p> <p>1: Respective output of Mux22 is enabled to drive the TRIP11 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
21	MUX21	R/W	0h	<p>Selects the output of Mux21 to drive TRIP11 of EPWM-XBAR</p> <p>0: Respective output of Mux21 is disabled to drive the TRIP11 of EPWM-XBAR</p> <p>1: Respective output of Mux21 is enabled to drive the TRIP11 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>

**Table 7-54. TRIP11MUXENABLE Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
20	MUX20	R/W	0h	<p>Selects the output of Mux20 to drive TRIP11 of EPWM-XBAR</p> <p>0: Respective output of Mux20 is disabled to drive the TRIP11 of EPWM-XBAR</p> <p>1: Respective output of Mux20 is enabled to drive the TRIP11 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
19	MUX19	R/W	0h	<p>Selects the output of Mux19 to drive TRIP11 of EPWM-XBAR</p> <p>0: Respective output of Mux19 is disabled to drive the TRIP11 of EPWM-XBAR</p> <p>1: Respective output of Mux19 is enabled to drive the TRIP11 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
18	MUX18	R/W	0h	<p>Selects the output of Mux18 to drive TRIP11 of EPWM-XBAR</p> <p>0: Respective output of Mux18 is disabled to drive the TRIP11 of EPWM-XBAR</p> <p>1: Respective output of Mux18 is enabled to drive the TRIP11 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
17	MUX17	R/W	0h	<p>Selects the output of Mux17 to drive TRIP11 of EPWM-XBAR</p> <p>0: Respective output of Mux17 is disabled to drive the TRIP11 of EPWM-XBAR</p> <p>1: Respective output of Mux17 is enabled to drive the TRIP11 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
16	MUX16	R/W	0h	<p>Selects the output of Mux16 to drive TRIP11 of EPWM-XBAR</p> <p>0: Respective output of Mux16 is disabled to drive the TRIP11 of EPWM-XBAR</p> <p>1: Respective output of Mux16 is enabled to drive the TRIP11 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
15	MUX15	R/W	0h	<p>Selects the output of Mux15 to drive TRIP11 of EPWM-XBAR</p> <p>0: Respective output of Mux15 is disabled to drive the TRIP11 of EPWM-XBAR</p> <p>1: Respective output of Mux15 is enabled to drive the TRIP11 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
14	MUX14	R/W	0h	<p>Selects the output of Mux14 to drive TRIP11 of EPWM-XBAR</p> <p>0: Respective output of Mux14 is disabled to drive the TRIP11 of EPWM-XBAR</p> <p>1: Respective output of Mux14 is enabled to drive the TRIP11 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>



**Table 7-54. TRIP11MUXENABLE Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
13	MUX13	R/W	0h	<p>Selects the output of Mux13 to drive TRIP11 of EPWM-XBAR</p> <p>0: Respective output of Mux13 is disabled to drive the TRIP11 of EPWM-XBAR</p> <p>1: Respective output of Mux13 is enabled to drive the TRIP11 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
12	MUX12	R/W	0h	<p>Selects the output of Mux12 to drive TRIP11 of EPWM-XBAR</p> <p>0: Respective output of Mux12 is disabled to drive the TRIP11 of EPWM-XBAR</p> <p>1: Respective output of Mux12 is enabled to drive the TRIP11 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
11	MUX11	R/W	0h	<p>Selects the output of Mux11 to drive TRIP11 of EPWM-XBAR</p> <p>0: Respective output of Mux11 is disabled to drive the TRIP11 of EPWM-XBAR</p> <p>1: Respective output of Mux11 is enabled to drive the TRIP11 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
10	MUX10	R/W	0h	<p>Selects the output of Mux10 to drive TRIP11 of EPWM-XBAR</p> <p>0: Respective output of Mux10 is disabled to drive the TRIP11 of EPWM-XBAR</p> <p>1: Respective output of Mux10 is enabled to drive the TRIP11 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
9	MUX9	R/W	0h	<p>Selects the output of Mux9 to drive TRIP11 of EPWM-XBAR</p> <p>0: Respective output of Mux9 is disabled to drive the TRIP11 of EPWM-XBAR</p> <p>1: Respective output of Mux9 is enabled to drive the TRIP11 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
8	MUX8	R/W	0h	<p>Selects the output of Mux8 to drive TRIP11 of EPWM-XBAR</p> <p>0: Respective output of Mux8 is disabled to drive the TRIP11 of EPWM-XBAR</p> <p>1: Respective output of Mux8 is enabled to drive the TRIP11 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
7	MUX7	R/W	0h	<p>Selects the output of Mux7 to drive TRIP11 of EPWM-XBAR</p> <p>0: Respective output of Mux7 is disabled to drive the TRIP11 of EPWM-XBAR</p> <p>1: Respective output of Mux7 is enabled to drive the TRIP11 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>

**Table 7-54. TRIP11MUXENABLE Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
6	MUX6	R/W	0h	<p>Selects the output of Mux6 to drive TRIP11 of EPWM-XBAR</p> <p>0: Respective output of Mux6 is disabled to drive the TRIP11 of EPWM-XBAR</p> <p>1: Respective output of Mux6 is enabled to drive the TRIP11 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
5	MUX5	R/W	0h	<p>Selects the output of Mux5 to drive TRIP11 of EPWM-XBAR</p> <p>0: Respective output of Mux5 is disabled to drive the TRIP11 of EPWM-XBAR</p> <p>1: Respective output of Mux5 is enabled to drive the TRIP11 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
4	MUX4	R/W	0h	<p>Selects the output of Mux4 to drive TRIP11 of EPWM-XBAR</p> <p>0: Respective output of Mux4 is disabled to drive the TRIP11 of EPWM-XBAR</p> <p>1: Respective output of Mux4 is enabled to drive the TRIP11 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
3	MUX3	R/W	0h	<p>Selects the output of Mux3 to drive TRIP11 of EPWM-XBAR</p> <p>0: Respective output of Mux3 is disabled to drive the TRIP11 of EPWM-XBAR</p> <p>1: Respective output of Mux3 is enabled to drive the TRIP11 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
2	MUX2	R/W	0h	<p>Selects the output of Mux2 to drive TRIP11 of EPWM-XBAR</p> <p>0: Respective output of Mux2 is disabled to drive the TRIP11 of EPWM-XBAR</p> <p>1: Respective output of Mux2 is enabled to drive the TRIP11 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
1	MUX1	R/W	0h	<p>Selects the output of Mux1 to drive TRIP11 of EPWM-XBAR</p> <p>0: Respective output of Mux1 is disabled to drive the TRIP11 of EPWM-XBAR</p> <p>1: Respective output of Mux1 is enabled to drive the TRIP11 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
0	MUX0	R/W	0h	<p>Selects the output of mux0 to drive TRIP11 of EPWM-XBAR</p> <p>0: Respective output of Mux0 is disabled to drive the TRIP11 of EPWM-XBAR</p> <p>1: Respective output of Mux0 is enabled to drive the TRIP11 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>

### 7.3.4.24 TRIP12MUXENABLE Register (Offset = 2Eh) [reset = 0h]

TRIP12MUXENABLE is shown in [Figure 13-184](#) and described in [Table 13-125](#).

Return to [Summary Table](#).

ePWM XBAR Mux Enable for TRIP12

**Figure 7-49. TRIP12MUXENABLE Register**

31	30	29	28	27	26	25	24
MUX31	MUX30	MUX29	MUX28	MUX27	MUX26	MUX25	MUX24
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
23	22	21	20	19	18	17	16
MUX23	MUX22	MUX21	MUX20	MUX19	MUX18	MUX17	MUX16
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
15	14	13	12	11	10	9	8
MUX15	MUX14	MUX13	MUX12	MUX11	MUX10	MUX9	MUX8
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
7	6	5	4	3	2	1	0
MUX7	MUX6	MUX5	MUX4	MUX3	MUX2	MUX1	MUX0
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h

**Table 7-55. TRIP12MUXENABLE Register Field Descriptions**

Bit	Field	Type	Reset	Description
31	MUX31	R/W	0h	Selects the output of Mux31 to drive TRIP12 of EPWM-XBAR  0: Respective output of Mux31 is enabled to drive the TRIP12 of EPWM-XBAR 1: Respective output of Mux31 is enabled to drive the TRIP12 of EPWM-XBAR  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
30	MUX30	R/W	0h	Selects the output of Mux30 to drive TRIP12 of EPWM-XBAR  0: Respective output of Mux30 is enabled to drive the TRIP12 of EPWM-XBAR 1: Respective output of Mux30 is enabled to drive the TRIP12 of EPWM-XBAR  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
29	MUX29	R/W	0h	Selects the output of Mux29 to drive TRIP12 of EPWM-XBAR  0: Respective output of Mux29 is enabled to drive the TRIP12 of EPWM-XBAR 1: Respective output of Mux29 is enabled to drive the TRIP12 of EPWM-XBAR  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
28	MUX28	R/W	0h	Selects the output of Mux28 to drive TRIP12 of EPWM-XBAR  0: Respective output of Mux28 is enabled to drive the TRIP12 of EPWM-XBAR 1: Respective output of Mux28 is enabled to drive the TRIP12 of EPWM-XBAR  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn

**Table 7-55. TRIP12MUXENABLE Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
27	MUX27	R/W	0h	<p>Selects the output of Mux27 to drive TRIP12 of EPWM-XBAR</p> <p>0: Respective output of Mux27 is enabled to drive the TRIP12 of EPWM-XBAR</p> <p>1: Respective output of Mux27 is enabled to drive the TRIP12 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
26	MUX26	R/W	0h	<p>Selects the output of Mux26 to drive TRIP12 of EPWM-XBAR</p> <p>0: Respective output of Mux26 is enabled to drive the TRIP12 of EPWM-XBAR</p> <p>1: Respective output of Mux26 is enabled to drive the TRIP12 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
25	MUX25	R/W	0h	<p>Selects the output of Mux25 to drive TRIP12 of EPWM-XBAR</p> <p>0: Respective output of Mux25 is enabled to drive the TRIP12 of EPWM-XBAR</p> <p>1: Respective output of Mux25 is enabled to drive the TRIP12 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
24	MUX24	R/W	0h	<p>Selects the output of Mux24 to drive TRIP12 of EPWM-XBAR</p> <p>0: Respective output of Mux24 is enabled to drive the TRIP12 of EPWM-XBAR</p> <p>1: Respective output of Mux24 is enabled to drive the TRIP12 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
23	MUX23	R/W	0h	<p>Selects the output of Mux23 to drive TRIP12 of EPWM-XBAR</p> <p>0: Respective output of Mux23 is disabled to drive the TRIP12 of EPWM-XBAR</p> <p>1: Respective output of Mux23 is enabled to drive the TRIP12 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
22	MUX22	R/W	0h	<p>Selects the output of Mux22 to drive TRIP12 of EPWM-XBAR</p> <p>0: Respective output of Mux22 is disabled to drive the TRIP12 of EPWM-XBAR</p> <p>1: Respective output of Mux22 is enabled to drive the TRIP12 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
21	MUX21	R/W	0h	<p>Selects the output of Mux21 to drive TRIP12 of EPWM-XBAR</p> <p>0: Respective output of Mux21 is disabled to drive the TRIP12 of EPWM-XBAR</p> <p>1: Respective output of Mux21 is enabled to drive the TRIP12 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>

**Table 7-55. TRIP12MUXENABLE Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
20	MUX20	R/W	0h	<p>Selects the output of Mux20 to drive TRIP12 of EPWM-XBAR</p> <p>0: Respective output of Mux20 is disabled to drive the TRIP12 of EPWM-XBAR</p> <p>1: Respective output of Mux20 is enabled to drive the TRIP12 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
19	MUX19	R/W	0h	<p>Selects the output of Mux19 to drive TRIP12 of EPWM-XBAR</p> <p>0: Respective output of Mux19 is disabled to drive the TRIP12 of EPWM-XBAR</p> <p>1: Respective output of Mux19 is enabled to drive the TRIP12 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
18	MUX18	R/W	0h	<p>Selects the output of Mux18 to drive TRIP12 of EPWM-XBAR</p> <p>0: Respective output of Mux18 is disabled to drive the TRIP12 of EPWM-XBAR</p> <p>1: Respective output of Mux18 is enabled to drive the TRIP12 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
17	MUX17	R/W	0h	<p>Selects the output of Mux17 to drive TRIP12 of EPWM-XBAR</p> <p>0: Respective output of Mux17 is disabled to drive the TRIP12 of EPWM-XBAR</p> <p>1: Respective output of Mux17 is enabled to drive the TRIP12 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
16	MUX16	R/W	0h	<p>Selects the output of Mux16 to drive TRIP12 of EPWM-XBAR</p> <p>0: Respective output of Mux16 is disabled to drive the TRIP12 of EPWM-XBAR</p> <p>1: Respective output of Mux16 is enabled to drive the TRIP12 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
15	MUX15	R/W	0h	<p>Selects the output of Mux15 to drive TRIP12 of EPWM-XBAR</p> <p>0: Respective output of Mux15 is disabled to drive the TRIP12 of EPWM-XBAR</p> <p>1: Respective output of Mux15 is enabled to drive the TRIP12 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
14	MUX14	R/W	0h	<p>Selects the output of Mux14 to drive TRIP12 of EPWM-XBAR</p> <p>0: Respective output of Mux14 is disabled to drive the TRIP12 of EPWM-XBAR</p> <p>1: Respective output of Mux14 is enabled to drive the TRIP12 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>

**Table 7-55. TRIP12MUXENABLE Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
13	MUX13	R/W	0h	<p>Selects the output of Mux13 to drive TRIP12 of EPWM-XBAR</p> <p>0: Respective output of Mux13 is disabled to drive the TRIP12 of EPWM-XBAR</p> <p>1: Respective output of Mux13 is enabled to drive the TRIP12 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
12	MUX12	R/W	0h	<p>Selects the output of Mux12 to drive TRIP12 of EPWM-XBAR</p> <p>0: Respective output of Mux12 is disabled to drive the TRIP12 of EPWM-XBAR</p> <p>1: Respective output of Mux12 is enabled to drive the TRIP12 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
11	MUX11	R/W	0h	<p>Selects the output of Mux11 to drive TRIP12 of EPWM-XBAR</p> <p>0: Respective output of Mux11 is disabled to drive the TRIP12 of EPWM-XBAR</p> <p>1: Respective output of Mux11 is enabled to drive the TRIP12 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
10	MUX10	R/W	0h	<p>Selects the output of Mux10 to drive TRIP12 of EPWM-XBAR</p> <p>0: Respective output of Mux10 is disabled to drive the TRIP12 of EPWM-XBAR</p> <p>1: Respective output of Mux10 is enabled to drive the TRIP12 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
9	MUX9	R/W	0h	<p>Selects the output of Mux9 to drive TRIP12 of EPWM-XBAR</p> <p>0: Respective output of Mux9 is disabled to drive the TRIP12 of EPWM-XBAR</p> <p>1: Respective output of Mux9 is enabled to drive the TRIP12 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
8	MUX8	R/W	0h	<p>Selects the output of Mux8 to drive TRIP12 of EPWM-XBAR</p> <p>0: Respective output of Mux8 is disabled to drive the TRIP12 of EPWM-XBAR</p> <p>1: Respective output of Mux8 is enabled to drive the TRIP12 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
7	MUX7	R/W	0h	<p>Selects the output of Mux7 to drive TRIP12 of EPWM-XBAR</p> <p>0: Respective output of Mux7 is disabled to drive the TRIP12 of EPWM-XBAR</p> <p>1: Respective output of Mux7 is enabled to drive the TRIP12 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>

**Table 7-55. TRIP12MUXENABLE Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
6	MUX6	R/W	0h	<p>Selects the output of Mux6 to drive TRIP12 of EPWM-XBAR</p> <p>0: Respective output of Mux6 is disabled to drive the TRIP12 of EPWM-XBAR</p> <p>1: Respective output of Mux6 is enabled to drive the TRIP12 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
5	MUX5	R/W	0h	<p>Selects the output of Mux5 to drive TRIP12 of EPWM-XBAR</p> <p>0: Respective output of Mux5 is disabled to drive the TRIP12 of EPWM-XBAR</p> <p>1: Respective output of Mux5 is enabled to drive the TRIP12 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
4	MUX4	R/W	0h	<p>Selects the output of Mux4 to drive TRIP12 of EPWM-XBAR</p> <p>0: Respective output of Mux4 is disabled to drive the TRIP12 of EPWM-XBAR</p> <p>1: Respective output of Mux4 is enabled to drive the TRIP12 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
3	MUX3	R/W	0h	<p>Selects the output of Mux3 to drive TRIP12 of EPWM-XBAR</p> <p>0: Respective output of Mux3 is disabled to drive the TRIP12 of EPWM-XBAR</p> <p>1: Respective output of Mux3 is enabled to drive the TRIP12 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
2	MUX2	R/W	0h	<p>Selects the output of Mux2 to drive TRIP12 of EPWM-XBAR</p> <p>0: Respective output of Mux2 is disabled to drive the TRIP12 of EPWM-XBAR</p> <p>1: Respective output of Mux2 is enabled to drive the TRIP12 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
1	MUX1	R/W	0h	<p>Selects the output of Mux1 to drive TRIP12 of EPWM-XBAR</p> <p>0: Respective output of Mux1 is disabled to drive the TRIP12 of EPWM-XBAR</p> <p>1: Respective output of Mux1 is enabled to drive the TRIP12 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
0	MUX0	R/W	0h	<p>Selects the output of mux0 to drive TRIP12 of EPWM-XBAR</p> <p>0: Respective output of Mux0 is disabled to drive the TRIP12 of EPWM-XBAR</p> <p>1: Respective output of Mux0 is enabled to drive the TRIP12 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>

**7.3.4.25 TRIPOUTINV Register (Offset = 38h) [reset = 0h]**

TRIPOUTINV is shown in [Figure 13-185](#) and described in [Table 13-126](#).

Return to [Summary Table](#).

ePWM XBAR Output Inversion Register

**Figure 7-50. TRIPOUTINV Register**

31	30	29	28	27	26	25	24
RESERVED							
R=0-0h							
23	22	21	20	19	18	17	16
RESERVED							
R=0-0h							
15	14	13	12	11	10	9	8
RESERVED							
R=0-0h							
7	6	5	4	3	2	1	0
TRIP12	TRIP11	TRIP10	TRIP9	TRIP8	TRIP7	TRIP5	TRIP4
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h

**Table 7-56. TRIPOUTINV Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R=0	0h	Reserved
15-8	RESERVED	R=0	0h	Reserved
7	TRIP12	R/W	0h	Selects polarity for TRIP12 of EPWM-XBAR 0: drives active high output 1: drives active-low output Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
6	TRIP11	R/W	0h	Selects polarity for TRIP11 of EPWM-XBAR 0: drives active high output 1: drives active-low output Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
5	TRIP10	R/W	0h	Selects polarity for TRIP10 of EPWM-XBAR 0: drives active high output 1: drives active-low output Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
4	TRIP9	R/W	0h	Selects polarity for TRIP9 of EPWM-XBAR 0: drives active high output 1: drives active-low output Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn



**Table 7-56. TRIPOUTINV Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
3	TRIP8	R/W	0h	<p>Selects polarity for TRIP8 of EPWM-XBAR</p> <p>0: drives active high output 1: drives active-low output</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
2	TRIP7	R/W	0h	<p>Selects polarity for TRIP7 of EPWM-XBAR</p> <p>0: drives active high output 1: drives active-low output</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
1	TRIP5	R/W	0h	<p>Selects polarity for TRIP5 of EPWM-XBAR</p> <p>0: drives active high output 1: drives active-low output</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
0	TRIP4	R/W	0h	<p>Selects polarity for TRIP4 of EPWM-XBAR</p> <p>0: drives active high output 1: drives active-low output</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>

**7.3.4.26 TRIPLOCK Register (Offset = 3Eh) [reset = 0h]**

TRIPLOCK is shown in [Figure 13-186](#) and described in [Table 13-127](#).

Return to [Summary Table](#).

ePWM XBAR Configuration Lock register

**Figure 7-51. TRIPLOCK Register**

31	30	29	28	27	26	25	24
KEY							
R=0/W=1-0h							
23	22	21	20	19	18	17	16
KEY							
R=0/W=1-0h							
15	14	13	12	11	10	9	8
RESERVED							
R=0-0h							
7	6	5	4	3	2	1	0
RESERVED							LOCK
R=0-0h							R/WOnce-0h

**Table 7-57. TRIPLOCK Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	KEY	R=0/W=1	0h	Bit-0 of this register can be set only if KEY= 0x5a5a Reset type: CPU1.SYSRSn
15-1	RESERVED	R=0	0h	Reserved
0	LOCK	R/WOnce	0h	Locks the configuration for EPWM-XBAR. Once the configuration is locked, writes to the below registers for EPWM-XBAR is blocked.  Registers Affected by the LOCK mechanism: EPWM-XBAROUTyMUX0TO15CFG EPWM-XBAROUTyMUX16TO31CFG EPWM-XBAROUTyMUXENABLE EPWM-XBAROUTLATEN EPWM-XBAROUTINV  0: Writes to the above registers are allowed 1: Writes to the above registers are blocked  Note: [1] LOCK mechanism only applies to writes. Reads are never blocked. Reset type: CPU1.SYSRSn

### 7.3.5 OUTPUT\_XBAR\_REGS Registers

Table 7-58 lists the memory-mapped registers for the OUTPUT\_XBAR\_REGS. All register offset addresses not listed in Table 7-58 should be considered as reserved locations and the register contents should not be modified.

**Table 7-58. OUTPUT\_XBAR\_REGS Registers**

Offset	Acronym	Register Name	Write Protection	Section
0h	OUTPUT1MUX0TO15CFG	Output X-BAR Mux Configuration for Output 1	EALLOW	<a href="#">Go</a>
2h	OUTPUT1MUX16TO31CFG	Output X-BAR Mux Configuration for Output 1	EALLOW	<a href="#">Go</a>
4h	OUTPUT2MUX0TO15CFG	Output X-BAR Mux Configuration for Output 2	EALLOW	<a href="#">Go</a>
6h	OUTPUT2MUX16TO31CFG	Output X-BAR Mux Configuration for Output 2	EALLOW	<a href="#">Go</a>
8h	OUTPUT3MUX0TO15CFG	Output X-BAR Mux Configuration for Output 3	EALLOW	<a href="#">Go</a>
Ah	OUTPUT3MUX16TO31CFG	Output X-BAR Mux Configuration for Output 3	EALLOW	<a href="#">Go</a>
Ch	OUTPUT4MUX0TO15CFG	Output X-BAR Mux Configuration for Output 4	EALLOW	<a href="#">Go</a>
Eh	OUTPUT4MUX16TO31CFG	Output X-BAR Mux Configuration for Output 4	EALLOW	<a href="#">Go</a>
10h	OUTPUT5MUX0TO15CFG	Output X-BAR Mux Configuration for Output 5	EALLOW	<a href="#">Go</a>
12h	OUTPUT5MUX16TO31CFG	Output X-BAR Mux Configuration for Output 5	EALLOW	<a href="#">Go</a>
14h	OUTPUT6MUX0TO15CFG	Output X-BAR Mux Configuration for Output 6	EALLOW	<a href="#">Go</a>
16h	OUTPUT6MUX16TO31CFG	Output X-BAR Mux Configuration for Output 6	EALLOW	<a href="#">Go</a>
18h	OUTPUT7MUX0TO15CFG	Output X-BAR Mux Configuration for Output 7	EALLOW	<a href="#">Go</a>
1Ah	OUTPUT7MUX16TO31CFG	Output X-BAR Mux Configuration for Output 7	EALLOW	<a href="#">Go</a>
1Ch	OUTPUT8MUX0TO15CFG	Output X-BAR Mux Configuration for Output 8	EALLOW	<a href="#">Go</a>
1Eh	OUTPUT8MUX16TO31CFG	Output X-BAR Mux Configuration for Output 8	EALLOW	<a href="#">Go</a>
20h	OUTPUT1MUXENABLE	Output X-BAR Mux Enable for Output 1	EALLOW	<a href="#">Go</a>
22h	OUTPUT2MUXENABLE	Output X-BAR Mux Enable for Output 2	EALLOW	<a href="#">Go</a>
24h	OUTPUT3MUXENABLE	Output X-BAR Mux Enable for Output 3	EALLOW	<a href="#">Go</a>
26h	OUTPUT4MUXENABLE	Output X-BAR Mux Enable for Output 4	EALLOW	<a href="#">Go</a>
28h	OUTPUT5MUXENABLE	Output X-BAR Mux Enable for Output 5	EALLOW	<a href="#">Go</a>
2Ah	OUTPUT6MUXENABLE	Output X-BAR Mux Enable for Output 6	EALLOW	<a href="#">Go</a>
2Ch	OUTPUT7MUXENABLE	Output X-BAR Mux Enable for Output 7	EALLOW	<a href="#">Go</a>
2Eh	OUTPUT8MUXENABLE	Output X-BAR Mux Enable for Output 8	EALLOW	<a href="#">Go</a>
30h	OUTPUTLATCH	Output X-BAR Output Latch		<a href="#">Go</a>
32h	OUTPUTLATCHCLR	Output X-BAR Output Latch Clear		<a href="#">Go</a>
34h	OUTPUTLATCHFRC	Output X-BAR Output Latch Clear		<a href="#">Go</a>
36h	OUTPUTLATCHENABLE	Output X-BAR Output Latch Enable	EALLOW	<a href="#">Go</a>
38h	OUTPUTINV	Output X-BAR Output Inversion	EALLOW	<a href="#">Go</a>
3Eh	OUTPUTLOCK	Output X-BAR Configuration Lock register	EALLOW	<a href="#">Go</a>

Complex bit access types are encoded to fit into small table cells. Table 7-59 shows the codes that are used for access types in this section.

**Table 7-59. OUTPUT\_XBAR\_REGS Access Type Codes**

Access Type	Code	Description
<b>Read Type</b>		
R	R	Read
R=0	R	Read
<b>Write Type</b>		
W	W	Write
W=1	W	Write

**Table 7-59. OUTPUT\_XBAR\_REGS Access Type Codes (continued)**

Access Type	Code	Description
WSOnce	SOnce W	Set once Write
<b>Reset or Default Value</b>		
<i>-n</i>		Value after reset or the default value
<b>Register Array Variables</b>		
<i>i,j,k,l,m,n</i>		When these variables are used in a register name, an offset, or an address, they refer to the value of a register array where the register is part of a group of repeating registers. The register groups form a hierarchical structure and the array is represented with a formula.
<i>y</i>		When this variable is used in a register name, an offset, or an address it refers to the value of a register array.

### 7.3.5.1 OUTPUT1MUX0TO15CFG Register (Offset = 0h) [reset = 0h]

OUTPUT1MUX0TO15CFG is shown in [Figure 7-52](#) and described in [Table 7-60](#).

Return to [Summary Table](#).

Output X-BAR Mux Configuration for Output 1

**Figure 7-52. OUTPUT1MUX0TO15CFG Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
MUX15		MUX14		MUX13		MUX12		MUX11		MUX10		MUX9		MUX8	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
MUX7		MUX6		MUX5		MUX4		MUX3		MUX2		MUX1		MUX0	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	

**Table 7-60. OUTPUT1MUX0TO15CFG Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-30	MUX15	R/W	0h	Select Bits for OUTPUT1 Mux15:  00 : Select .0 input for Mux15 01 : Select .1 input for Mux15 10 : Select .2 input for Mux15 11 : Select .3 input for Mux15  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
29-28	MUX14	R/W	0h	Select Bits for OUTPUT1 Mux14:  00 : Select .0 input for Mux14 01 : Select .1 input for Mux14 10 : Select .2 input for Mux14 11 : Select .3 input for Mux14  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
27-26	MUX13	R/W	0h	Select Bits for OUTPUT1 Mux13:  00 : Select .0 input for Mux13 01 : Select .1 input for Mux13 10 : Select .2 input for Mux13 11 : Select .3 input for Mux13  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
25-24	MUX12	R/W	0h	Select Bits for OUTPUT1 Mux12:  00 : Select .0 input for Mux12 01 : Select .1 input for Mux12 10 : Select .2 input for Mux12 11 : Select .3 input for Mux12  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn

**Table 7-60. OUTPUT1MUX0TO15CFG Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
23-22	MUX11	R/W	0h	Select Bits for OUTPUT1 Mux11: 00 : Select .0 input for Mux11 01 : Select .1 input for Mux11 10 : Select .2 input for Mux11 11 : Select .3 input for Mux11  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
21-20	MUX10	R/W	0h	Select Bits for OUTPUT1 Mux10: 00 : Select .0 input for Mux10 01 : Select .1 input for Mux10 10 : Select .2 input for Mux10 11 : Select .3 input for Mux10  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
19-18	MUX9	R/W	0h	Select Bits for OUTPUT1 Mux9: 00 : Select .0 input for Mux9 01 : Select .1 input for Mux9 10 : Select .2 input for Mux9 11 : Select .3 input for Mux9  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
17-16	MUX8	R/W	0h	Select Bits for OUTPUT1 Mux8: 00 : Select .0 input for Mux8 01 : Select .1 input for Mux8 10 : Select .2 input for Mux8 11 : Select .3 input for Mux8  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
15-14	MUX7	R/W	0h	Select Bits for OUTPUT1 Mux7: 00 : Select .0 input for Mux7 01 : Select .1 input for Mux7 10 : Select .2 input for Mux7 11 : Select .3 input for Mux7  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
13-12	MUX6	R/W	0h	Select Bits for OUTPUT1 Mux6: 00 : Select .0 input for Mux6 01 : Select .1 input for Mux6 10 : Select .2 input for Mux6 11 : Select .3 input for Mux6  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn

**Table 7-60. OUTPUT1MUX0TO15CFG Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
11-10	MUX5	R/W	0h	<p>Select Bits for OUTPUT1 Mux5:</p> <p>00 : Select .0 input for Mux5            01 : Select .1 input for Mux5            10 : Select .2 input for Mux5            11 : Select .3 input for Mux5</p> <p>Refer to the Output X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>
9-8	MUX4	R/W	0h	<p>Select Bits for OUTPUT1 Mux4:</p> <p>00 : Select .0 input for Mux4            01 : Select .1 input for Mux4            10 : Select .2 input for Mux4            11 : Select .3 input for Mux4</p> <p>Refer to the Output X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>
7-6	MUX3	R/W	0h	<p>Select Bits for OUTPUT1 Mux3:</p> <p>00 : Select .0 input for Mux3            01 : Select .1 input for Mux3            10 : Select .2 input for Mux3            11 : Select .3 input for Mux3</p> <p>Refer to the Output X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>
5-4	MUX2	R/W	0h	<p>Select Bits for OUTPUT1 Mux2:</p> <p>00 : Select .0 input for Mux2            01 : Select .1 input for Mux2            10 : Select .2 input for Mux2            11 : Select .3 input for Mux2</p> <p>Refer to the Output X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>
3-2	MUX1	R/W	0h	<p>Select Bits for OUTPUT1 Mux1:</p> <p>00 : Select .0 input for Mux1            01 : Select .1 input for Mux1            10 : Select .2 input for Mux1            11 : Select .3 input for Mux1</p> <p>Refer to the Output X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>
1-0	MUX0	R/W	0h	<p>Select Bits for OUTPUT1 Mux0:</p> <p>00 : Select .0 input for Mux0            01 : Select .1 input for Mux0            10 : Select .2 input for Mux0            11 : Select .3 input for Mux0</p> <p>Refer to the Output X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>

**7.3.5.2 OUTPUT1MUX16TO31CFG Register (Offset = 2h) [reset = 0h]**

OUTPUT1MUX16TO31CFG is shown in [Figure 7-53](#) and described in [Table 7-61](#).

Return to [Summary Table](#).

Output X-BAR Mux Configuration for Output 1

**Figure 7-53. OUTPUT1MUX16TO31CFG Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
MUX31		MUX30		MUX29		MUX28		MUX27		MUX26		MUX25		MUX24	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
MUX23		MUX22		MUX21		MUX20		MUX19		MUX18		MUX17		MUX16	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	

**Table 7-61. OUTPUT1MUX16TO31CFG Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-30	MUX31	R/W	0h	Select Bits for OUTPUT1 Mux31:  00 : Select .0 input for Mux31 01 : Select .1 input for Mux31 10 : Select .2 input for Mux31 11 : Select .3 input for Mux31  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
29-28	MUX30	R/W	0h	Select Bits for OUTPUT1 Mux30:  00 : Select .0 input for Mux30 01 : Select .1 input for Mux30 10 : Select .2 input for Mux30 11 : Select .3 input for Mux30  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
27-26	MUX29	R/W	0h	Select Bits for OUTPUT1 Mux29:  00 : Select .0 input for Mux29 01 : Select .1 input for Mux29 10 : Select .2 input for Mux29 11 : Select .3 input for Mux29  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
25-24	MUX28	R/W	0h	Select Bits for OUTPUT1 Mux28:  00 : Select .0 input for Mux28 01 : Select .1 input for Mux28 10 : Select .2 input for Mux28 11 : Select .3 input for Mux28  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn



**Table 7-61. OUTPUT1MUX16TO31CFG Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
23-22	MUX27	R/W	0h	<p>Select Bits for OUTPUT1 Mux27:</p> <p>00 : Select .0 input for Mux27            01 : Select .1 input for Mux27            10 : Select .2 input for Mux27            11 : Select .3 input for Mux27</p> <p>Refer to the Output X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>
21-20	MUX26	R/W	0h	<p>Select Bits for OUTPUT1 Mux26:</p> <p>00 : Select .0 input for Mux26            01 : Select .1 input for Mux26            10 : Select .2 input for Mux26            11 : Select .3 input for Mux26</p> <p>Refer to the Output X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>
19-18	MUX25	R/W	0h	<p>Select Bits for OUTPUT1 Mux25:</p> <p>00 : Select .0 input for Mux25            01 : Select .1 input for Mux25            10 : Select .2 input for Mux25            11 : Select .3 input for Mux25</p> <p>Refer to the Output X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>
17-16	MUX24	R/W	0h	<p>Select Bits for OUTPUT1 Mux24:</p> <p>00 : Select .0 input for Mux24            01 : Select .1 input for Mux24            10 : Select .2 input for Mux24            11 : Select .3 input for Mux24</p> <p>Refer to the Output X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>
15-14	MUX23	R/W	0h	<p>Select Bits for OUTPUT1 Mux23:</p> <p>00 : Select .0 input for Mux23            01 : Select .1 input for Mux23            10 : Select .2 input for Mux23            11 : Select .3 input for Mux23</p> <p>Refer to the Output X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>
13-12	MUX22	R/W	0h	<p>Select Bits for OUTPUT1 Mux22:</p> <p>00 : Select .0 input for Mux22            01 : Select .1 input for Mux22            10 : Select .2 input for Mux22            11 : Select .3 input for Mux22</p> <p>Refer to the Output X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>

**Table 7-61. OUTPUT1MUX16TO31CFG Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
11-10	MUX21	R/W	0h	<p>Select Bits for OUTPUT1 Mux21:</p> <p>00 : Select .0 input for Mux21  01 : Select .1 input for Mux21  10 : Select .2 input for Mux21  11 : Select .3 input for Mux21</p> <p>Refer to the Output X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>
9-8	MUX20	R/W	0h	<p>Select Bits for OUTPUT1 Mux20:</p> <p>00 : Select .0 input for Mux20  01 : Select .1 input for Mux20  10 : Select .2 input for Mux20  11 : Select .3 input for Mux20</p> <p>Refer to the Output X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>
7-6	MUX19	R/W	0h	<p>Select Bits for OUTPUT1 Mux19:</p> <p>00 : Select .0 input for Mux19  01 : Select .1 input for Mux19  10 : Select .2 input for Mux19  11 : Select .3 input for Mux19</p> <p>Refer to the Output X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>
5-4	MUX18	R/W	0h	<p>Select Bits for OUTPUT1 Mux18:</p> <p>00 : Select .0 input for Mux18  01 : Select .1 input for Mux18  10 : Select .2 input for Mux18  11 : Select .3 input for Mux18</p> <p>Refer to the Output X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>
3-2	MUX17	R/W	0h	<p>Select Bits for OUTPUT1 Mux17:</p> <p>00 : Select .0 input for Mux17  01 : Select .1 input for Mux17  10 : Select .2 input for Mux17  11 : Select .3 input for Mux17</p> <p>Refer to the Output X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>
1-0	MUX16	R/W	0h	<p>Select Bits for OUTPUT1 Mux16:</p> <p>00 : Select .0 input for Mux16  01 : Select .1 input for Mux16  10 : Select .2 input for Mux16  11 : Select .3 input for Mux16</p> <p>Refer to the Output X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>

### 7.3.5.3 OUTPUT2MUX0TO15CFG Register (Offset = 4h) [reset = 0h]

OUTPUT2MUX0TO15CFG is shown in [Figure 7-54](#) and described in [Table 7-62](#).

Return to [Summary Table](#).

Output X-BAR Mux Configuration for Output 2

**Figure 7-54. OUTPUT2MUX0TO15CFG Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
MUX15		MUX14		MUX13		MUX12		MUX11		MUX10		MUX9		MUX8	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
MUX7		MUX6		MUX5		MUX4		MUX3		MUX2		MUX1		MUX0	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	

**Table 7-62. OUTPUT2MUX0TO15CFG Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-30	MUX15	R/W	0h	Select Bits for OUTPUT2 Mux15:  00 : Select .0 input for Mux15 01 : Select .1 input for Mux15 10 : Select .2 input for Mux15 11 : Select .3 input for Mux15  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
29-28	MUX14	R/W	0h	Select Bits for OUTPUT2 Mux14:  00 : Select .0 input for Mux14 01 : Select .1 input for Mux14 10 : Select .2 input for Mux14 11 : Select .3 input for Mux14  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
27-26	MUX13	R/W	0h	Select Bits for OUTPUT2 Mux13:  00 : Select .0 input for Mux13 01 : Select .1 input for Mux13 10 : Select .2 input for Mux13 11 : Select .3 input for Mux13  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
25-24	MUX12	R/W	0h	Select Bits for OUTPUT2 Mux12:  00 : Select .0 input for Mux12 01 : Select .1 input for Mux12 10 : Select .2 input for Mux12 11 : Select .3 input for Mux12  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn

**Table 7-62. OUTPUT2MUX0TO15CFG Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
23-22	MUX11	R/W	0h	<p>Select Bits for OUTPUT2 Mux11:</p> <p>00 : Select .0 input for Mux11  01 : Select .1 input for Mux11  10 : Select .2 input for Mux11  11 : Select .3 input for Mux11</p> <p>Refer to the Output X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>
21-20	MUX10	R/W	0h	<p>Select Bits for OUTPUT2 Mux10:</p> <p>00 : Select .0 input for Mux10  01 : Select .1 input for Mux10  10 : Select .2 input for Mux10  11 : Select .3 input for Mux10</p> <p>Refer to the Output X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>
19-18	MUX9	R/W	0h	<p>Select Bits for OUTPUT2 Mux9:</p> <p>00 : Select .0 input for Mux9  01 : Select .1 input for Mux9  10 : Select .2 input for Mux9  11 : Select .3 input for Mux9</p> <p>Refer to the Output X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>
17-16	MUX8	R/W	0h	<p>Select Bits for OUTPUT2 Mux8:</p> <p>00 : Select .0 input for Mux8  01 : Select .1 input for Mux8  10 : Select .2 input for Mux8  11 : Select .3 input for Mux8</p> <p>Refer to the Output X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>
15-14	MUX7	R/W	0h	<p>Select Bits for OUTPUT2 Mux7:</p> <p>00 : Select .0 input for Mux7  01 : Select .1 input for Mux7  10 : Select .2 input for Mux7  11 : Select .3 input for Mux7</p> <p>Refer to the Output X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>
13-12	MUX6	R/W	0h	<p>Select Bits for OUTPUT2 Mux6:</p> <p>00 : Select .0 input for Mux6  01 : Select .1 input for Mux6  10 : Select .2 input for Mux6  11 : Select .3 input for Mux6</p> <p>Refer to the Output X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>

**Table 7-62. OUTPUT2MUX0TO15CFG Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
11-10	MUX5	R/W	0h	Select Bits for OUTPUT2 Mux5: 00 : Select .0 input for Mux5 01 : Select .1 input for Mux5 10 : Select .2 input for Mux5 11 : Select .3 input for Mux5  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
9-8	MUX4	R/W	0h	Select Bits for OUTPUT2 Mux4: 00 : Select .0 input for Mux4 01 : Select .1 input for Mux4 10 : Select .2 input for Mux4 11 : Select .3 input for Mux4  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
7-6	MUX3	R/W	0h	Select Bits for OUTPUT2 Mux3: 00 : Select .0 input for Mux3 01 : Select .1 input for Mux3 10 : Select .2 input for Mux3 11 : Select .3 input for Mux3  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
5-4	MUX2	R/W	0h	Select Bits for OUTPUT2 Mux2: 00 : Select .0 input for Mux2 01 : Select .1 input for Mux2 10 : Select .2 input for Mux2 11 : Select .3 input for Mux2  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
3-2	MUX1	R/W	0h	Select Bits for OUTPUT2 Mux1: 00 : Select .0 input for Mux1 01 : Select .1 input for Mux1 10 : Select .2 input for Mux1 11 : Select .3 input for Mux1  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
1-0	MUX0	R/W	0h	Select Bits for OUTPUT2 Mux0: 00 : Select .0 input for Mux0 01 : Select .1 input for Mux0 10 : Select .2 input for Mux0 11 : Select .3 input for Mux0  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn

### 7.3.5.4 OUTPUT2MUX16TO31CFG Register (Offset = 6h) [reset = 0h]

OUTPUT2MUX16TO31CFG is shown in [Figure 7-55](#) and described in [Table 7-63](#).

Return to [Summary Table](#).

Output X-BAR Mux Configuration for Output 2

**Figure 7-55. OUTPUT2MUX16TO31CFG Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
MUX31		MUX30		MUX29		MUX28		MUX27		MUX26		MUX25		MUX24	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
MUX23		MUX22		MUX21		MUX20		MUX19		MUX18		MUX17		MUX16	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	

**Table 7-63. OUTPUT2MUX16TO31CFG Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-30	MUX31	R/W	0h	Select Bits for OUTPUT2 Mux31: 00 : Select .0 input for Mux31 01 : Select .1 input for Mux31 10 : Select .2 input for Mux31 11 : Select .3 input for Mux31  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
29-28	MUX30	R/W	0h	Select Bits for OUTPUT2 Mux30: 00 : Select .0 input for Mux30 01 : Select .1 input for Mux30 10 : Select .2 input for Mux30 11 : Select .3 input for Mux30  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
27-26	MUX29	R/W	0h	Select Bits for OUTPUT2 Mux29: 00 : Select .0 input for Mux29 01 : Select .1 input for Mux29 10 : Select .2 input for Mux29 11 : Select .3 input for Mux29  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
25-24	MUX28	R/W	0h	Select Bits for OUTPUT2 Mux28: 00 : Select .0 input for Mux28 01 : Select .1 input for Mux28 10 : Select .2 input for Mux28 11 : Select .3 input for Mux28  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn

**Table 7-63. OUTPUT2MUX16TO31CFG Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
23-22	MUX27	R/W	0h	Select Bits for OUTPUT2 Mux27: 00 : Select .0 input for Mux27 01 : Select .1 input for Mux27 10 : Select .2 input for Mux27 11 : Select .3 input for Mux27  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
21-20	MUX26	R/W	0h	Select Bits for OUTPUT2 Mux26: 00 : Select .0 input for Mux26 01 : Select .1 input for Mux26 10 : Select .2 input for Mux26 11 : Select .3 input for Mux26  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
19-18	MUX25	R/W	0h	Select Bits for OUTPUT2 Mux25: 00 : Select .0 input for Mux25 01 : Select .1 input for Mux25 10 : Select .2 input for Mux25 11 : Select .3 input for Mux25  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
17-16	MUX24	R/W	0h	Select Bits for OUTPUT2 Mux24: 00 : Select .0 input for Mux24 01 : Select .1 input for Mux24 10 : Select .2 input for Mux24 11 : Select .3 input for Mux24  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
15-14	MUX23	R/W	0h	Select Bits for OUTPUT2 Mux23: 00 : Select .0 input for Mux23 01 : Select .1 input for Mux23 10 : Select .2 input for Mux23 11 : Select .3 input for Mux23  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
13-12	MUX22	R/W	0h	Select Bits for OUTPUT2 Mux22: 00 : Select .0 input for Mux22 01 : Select .1 input for Mux22 10 : Select .2 input for Mux22 11 : Select .3 input for Mux22  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn

**Table 7-63. OUTPUT2MUX16TO31CFG Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
11-10	MUX21	R/W	0h	Select Bits for OUTPUT2 Mux21: 00 : Select .0 input for Mux21 01 : Select .1 input for Mux21 10 : Select .2 input for Mux21 11 : Select .3 input for Mux21  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
9-8	MUX20	R/W	0h	Select Bits for OUTPUT2 Mux20: 00 : Select .0 input for Mux20 01 : Select .1 input for Mux20 10 : Select .2 input for Mux20 11 : Select .3 input for Mux20  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
7-6	MUX19	R/W	0h	Select Bits for OUTPUT2 Mux19: 00 : Select .0 input for Mux19 01 : Select .1 input for Mux19 10 : Select .2 input for Mux19 11 : Select .3 input for Mux19  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
5-4	MUX18	R/W	0h	Select Bits for OUTPUT2 Mux18: 00 : Select .0 input for Mux18 01 : Select .1 input for Mux18 10 : Select .2 input for Mux18 11 : Select .3 input for Mux18  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
3-2	MUX17	R/W	0h	Select Bits for OUTPUT2 Mux17: 00 : Select .0 input for Mux17 01 : Select .1 input for Mux17 10 : Select .2 input for Mux17 11 : Select .3 input for Mux17  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
1-0	MUX16	R/W	0h	Select Bits for OUTPUT2 Mux16: 00 : Select .0 input for Mux16 01 : Select .1 input for Mux16 10 : Select .2 input for Mux16 11 : Select .3 input for Mux16  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn



### 7.3.5.5 OUTPUT3MUX0TO15CFG Register (Offset = 8h) [reset = 0h]

OUTPUT3MUX0TO15CFG is shown in [Figure 7-56](#) and described in [Table 7-64](#).

Return to [Summary Table](#).

Output X-BAR Mux Configuration for Output 3

**Figure 7-56. OUTPUT3MUX0TO15CFG Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
MUX15		MUX14		MUX13		MUX12		MUX11		MUX10		MUX9		MUX8	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
MUX7		MUX6		MUX5		MUX4		MUX3		MUX2		MUX1		MUX0	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	

**Table 7-64. OUTPUT3MUX0TO15CFG Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-30	MUX15	R/W	0h	Select Bits for OUTPUT3 Mux15:  00 : Select .0 input for Mux15 01 : Select .1 input for Mux15 10 : Select .2 input for Mux15 11 : Select .3 input for Mux15  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
29-28	MUX14	R/W	0h	Select Bits for OUTPUT3 Mux14:  00 : Select .0 input for Mux14 01 : Select .1 input for Mux14 10 : Select .2 input for Mux14 11 : Select .3 input for Mux14  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
27-26	MUX13	R/W	0h	Select Bits for OUTPUT3 Mux13:  00 : Select .0 input for Mux13 01 : Select .1 input for Mux13 10 : Select .2 input for Mux13 11 : Select .3 input for Mux13  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
25-24	MUX12	R/W	0h	Select Bits for OUTPUT3 Mux12:  00 : Select .0 input for Mux12 01 : Select .1 input for Mux12 10 : Select .2 input for Mux12 11 : Select .3 input for Mux12  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn

**Table 7-64. OUTPUT3MUX0TO15CFG Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
23-22	MUX11	R/W	0h	<p>Select Bits for OUTPUT3 Mux11:</p> <p>00 : Select .0 input for Mux11  01 : Select .1 input for Mux11  10 : Select .2 input for Mux11  11 : Select .3 input for Mux11</p> <p>Refer to the Output X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>
21-20	MUX10	R/W	0h	<p>Select Bits for OUTPUT3 Mux10:</p> <p>00 : Select .0 input for Mux10  01 : Select .1 input for Mux10  10 : Select .2 input for Mux10  11 : Select .3 input for Mux10</p> <p>Refer to the Output X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>
19-18	MUX9	R/W	0h	<p>Select Bits for OUTPUT3 Mux9:</p> <p>00 : Select .0 input for Mux9  01 : Select .1 input for Mux9  10 : Select .2 input for Mux9  11 : Select .3 input for Mux9</p> <p>Refer to the Output X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>
17-16	MUX8	R/W	0h	<p>Select Bits for OUTPUT3 Mux8:</p> <p>00 : Select .0 input for Mux8  01 : Select .1 input for Mux8  10 : Select .2 input for Mux8  11 : Select .3 input for Mux8</p> <p>Refer to the Output X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>
15-14	MUX7	R/W	0h	<p>Select Bits for OUTPUT3 Mux7:</p> <p>00 : Select .0 input for Mux7  01 : Select .1 input for Mux7  10 : Select .2 input for Mux7  11 : Select .3 input for Mux7</p> <p>Refer to the Output X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>
13-12	MUX6	R/W	0h	<p>Select Bits for OUTPUT3 Mux6:</p> <p>00 : Select .0 input for Mux6  01 : Select .1 input for Mux6  10 : Select .2 input for Mux6  11 : Select .3 input for Mux6</p> <p>Refer to the Output X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>

**Table 7-64. OUTPUT3MUX0TO15CFG Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
11-10	MUX5	R/W	0h	<p>Select Bits for OUTPUT3 Mux5:</p> <p>00 : Select .0 input for Mux5            01 : Select .1 input for Mux5            10 : Select .2 input for Mux5            11 : Select .3 input for Mux5</p> <p>Refer to the Output X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>
9-8	MUX4	R/W	0h	<p>Select Bits for OUTPUT3 Mux4:</p> <p>00 : Select .0 input for Mux4            01 : Select .1 input for Mux4            10 : Select .2 input for Mux4            11 : Select .3 input for Mux4</p> <p>Refer to the Output X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>
7-6	MUX3	R/W	0h	<p>Select Bits for OUTPUT3 Mux3:</p> <p>00 : Select .0 input for Mux3            01 : Select .1 input for Mux3            10 : Select .2 input for Mux3            11 : Select .3 input for Mux3</p> <p>Refer to the Output X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>
5-4	MUX2	R/W	0h	<p>Select Bits for OUTPUT3 Mux2:</p> <p>00 : Select .0 input for Mux2            01 : Select .1 input for Mux2            10 : Select .2 input for Mux2            11 : Select .3 input for Mux2</p> <p>Refer to the Output X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>
3-2	MUX1	R/W	0h	<p>Select Bits for OUTPUT3 Mux1:</p> <p>00 : Select .0 input for Mux1            01 : Select .1 input for Mux1            10 : Select .2 input for Mux1            11 : Select .3 input for Mux1</p> <p>Refer to the Output X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>
1-0	MUX0	R/W	0h	<p>Select Bits for OUTPUT3 Mux0:</p> <p>00 : Select .0 input for Mux0            01 : Select .1 input for Mux0            10 : Select .2 input for Mux0            11 : Select .3 input for Mux0</p> <p>Refer to the Output X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>

**7.3.5.6 OUTPUT3MUX16TO31CFG Register (Offset = Ah) [reset = 0h]**

OUTPUT3MUX16TO31CFG is shown in [Figure 7-57](#) and described in [Table 7-65](#).

Return to [Summary Table](#).

Output X-BAR Mux Configuration for Output 3

**Figure 7-57. OUTPUT3MUX16TO31CFG Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
MUX31		MUX30		MUX29		MUX28		MUX27		MUX26		MUX25		MUX24	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
MUX23		MUX22		MUX21		MUX20		MUX19		MUX18		MUX17		MUX16	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	

**Table 7-65. OUTPUT3MUX16TO31CFG Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-30	MUX31	R/W	0h	Select Bits for OUTPUT3 Mux31:  00 : Select .0 input for Mux31 01 : Select .1 input for Mux31 10 : Select .2 input for Mux31 11 : Select .3 input for Mux31  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
29-28	MUX30	R/W	0h	Select Bits for OUTPUT3 Mux30:  00 : Select .0 input for Mux30 01 : Select .1 input for Mux30 10 : Select .2 input for Mux30 11 : Select .3 input for Mux30  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
27-26	MUX29	R/W	0h	Select Bits for OUTPUT3 Mux29:  00 : Select .0 input for Mux29 01 : Select .1 input for Mux29 10 : Select .2 input for Mux29 11 : Select .3 input for Mux29  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
25-24	MUX28	R/W	0h	Select Bits for OUTPUT3 Mux28:  00 : Select .0 input for Mux28 01 : Select .1 input for Mux28 10 : Select .2 input for Mux28 11 : Select .3 input for Mux28  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn

**Table 7-65. OUTPUT3MUX16TO31CFG Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
23-22	MUX27	R/W	0h	Select Bits for OUTPUT3 Mux27: 00 : Select .0 input for Mux27 01 : Select .1 input for Mux27 10 : Select .2 input for Mux27 11 : Select .3 input for Mux27  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
21-20	MUX26	R/W	0h	Select Bits for OUTPUT3 Mux26: 00 : Select .0 input for Mux26 01 : Select .1 input for Mux26 10 : Select .2 input for Mux26 11 : Select .3 input for Mux26  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
19-18	MUX25	R/W	0h	Select Bits for OUTPUT3 Mux25: 00 : Select .0 input for Mux25 01 : Select .1 input for Mux25 10 : Select .2 input for Mux25 11 : Select .3 input for Mux25  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
17-16	MUX24	R/W	0h	Select Bits for OUTPUT3 Mux24: 00 : Select .0 input for Mux24 01 : Select .1 input for Mux24 10 : Select .2 input for Mux24 11 : Select .3 input for Mux24  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
15-14	MUX23	R/W	0h	Select Bits for OUTPUT3 Mux23: 00 : Select .0 input for Mux23 01 : Select .1 input for Mux23 10 : Select .2 input for Mux23 11 : Select .3 input for Mux23  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
13-12	MUX22	R/W	0h	Select Bits for OUTPUT3 Mux22: 00 : Select .0 input for Mux22 01 : Select .1 input for Mux22 10 : Select .2 input for Mux22 11 : Select .3 input for Mux22  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn

**Table 7-65. OUTPUT3MUX16TO31CFG Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
11-10	MUX21	R/W	0h	<p>Select Bits for OUTPUT3 Mux21:</p> <p>00 : Select .0 input for Mux21  01 : Select .1 input for Mux21  10 : Select .2 input for Mux21  11 : Select .3 input for Mux21</p> <p>Refer to the Output X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>
9-8	MUX20	R/W	0h	<p>Select Bits for OUTPUT3 Mux20:</p> <p>00 : Select .0 input for Mux20  01 : Select .1 input for Mux20  10 : Select .2 input for Mux20  11 : Select .3 input for Mux20</p> <p>Refer to the Output X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>
7-6	MUX19	R/W	0h	<p>Select Bits for OUTPUT3 Mux19:</p> <p>00 : Select .0 input for Mux19  01 : Select .1 input for Mux19  10 : Select .2 input for Mux19  11 : Select .3 input for Mux19</p> <p>Refer to the Output X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>
5-4	MUX18	R/W	0h	<p>Select Bits for OUTPUT3 Mux18:</p> <p>00 : Select .0 input for Mux18  01 : Select .1 input for Mux18  10 : Select .2 input for Mux18  11 : Select .3 input for Mux18</p> <p>Refer to the Output X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>
3-2	MUX17	R/W	0h	<p>Select Bits for OUTPUT3 Mux17:</p> <p>00 : Select .0 input for Mux17  01 : Select .1 input for Mux17  10 : Select .2 input for Mux17  11 : Select .3 input for Mux17</p> <p>Refer to the Output X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>
1-0	MUX16	R/W	0h	<p>Select Bits for OUTPUT3 Mux16:</p> <p>00 : Select .0 input for Mux16  01 : Select .1 input for Mux16  10 : Select .2 input for Mux16  11 : Select .3 input for Mux16</p> <p>Refer to the Output X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>

### 7.3.5.7 OUTPUT4MUX0TO15CFG Register (Offset = Ch) [reset = 0h]

OUTPUT4MUX0TO15CFG is shown in [Figure 7-58](#) and described in [Table 7-66](#).

Return to [Summary Table](#).

Output X-BAR Mux Configuration for Output 4

**Figure 7-58. OUTPUT4MUX0TO15CFG Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
MUX15		MUX14		MUX13		MUX12		MUX11		MUX10		MUX9		MUX8	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
MUX7		MUX6		MUX5		MUX4		MUX3		MUX2		MUX1		MUX0	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	

**Table 7-66. OUTPUT4MUX0TO15CFG Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-30	MUX15	R/W	0h	Select Bits for OUTPUT4 Mux15:  00 : Select .0 input for Mux15 01 : Select .1 input for Mux15 10 : Select .2 input for Mux15 11 : Select .3 input for Mux15  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
29-28	MUX14	R/W	0h	Select Bits for OUTPUT4 Mux14:  00 : Select .0 input for Mux14 01 : Select .1 input for Mux14 10 : Select .2 input for Mux14 11 : Select .3 input for Mux14  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
27-26	MUX13	R/W	0h	Select Bits for OUTPUT4 Mux13:  00 : Select .0 input for Mux13 01 : Select .1 input for Mux13 10 : Select .2 input for Mux13 11 : Select .3 input for Mux13  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
25-24	MUX12	R/W	0h	Select Bits for OUTPUT4 Mux12:  00 : Select .0 input for Mux12 01 : Select .1 input for Mux12 10 : Select .2 input for Mux12 11 : Select .3 input for Mux12  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn

**Table 7-66. OUTPUT4MUX0TO15CFG Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
23-22	MUX11	R/W	0h	<p>Select Bits for OUTPUT4 Mux11:</p> <p>00 : Select .0 input for Mux11  01 : Select .1 input for Mux11  10 : Select .2 input for Mux11  11 : Select .3 input for Mux11</p> <p>Refer to the Output X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>
21-20	MUX10	R/W	0h	<p>Select Bits for OUTPUT4 Mux10:</p> <p>00 : Select .0 input for Mux10  01 : Select .1 input for Mux10  10 : Select .2 input for Mux10  11 : Select .3 input for Mux10</p> <p>Refer to the Output X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>
19-18	MUX9	R/W	0h	<p>Select Bits for OUTPUT4 Mux9:</p> <p>00 : Select .0 input for Mux9  01 : Select .1 input for Mux9  10 : Select .2 input for Mux9  11 : Select .3 input for Mux9</p> <p>Refer to the Output X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>
17-16	MUX8	R/W	0h	<p>Select Bits for OUTPUT4 Mux8:</p> <p>00 : Select .0 input for Mux8  01 : Select .1 input for Mux8  10 : Select .2 input for Mux8  11 : Select .3 input for Mux8</p> <p>Refer to the Output X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>
15-14	MUX7	R/W	0h	<p>Select Bits for OUTPUT4 Mux7:</p> <p>00 : Select .0 input for Mux7  01 : Select .1 input for Mux7  10 : Select .2 input for Mux7  11 : Select .3 input for Mux7</p> <p>Refer to the Output X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>
13-12	MUX6	R/W	0h	<p>Select Bits for OUTPUT4 Mux6:</p> <p>00 : Select .0 input for Mux6  01 : Select .1 input for Mux6  10 : Select .2 input for Mux6  11 : Select .3 input for Mux6</p> <p>Refer to the Output X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>



**Table 7-66. OUTPUT4MUX0TO15CFG Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
11-10	MUX5	R/W	0h	Select Bits for OUTPUT4 Mux5: 00 : Select .0 input for Mux5 01 : Select .1 input for Mux5 10 : Select .2 input for Mux5 11 : Select .3 input for Mux5  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
9-8	MUX4	R/W	0h	Select Bits for OUTPUT4 Mux4: 00 : Select .0 input for Mux4 01 : Select .1 input for Mux4 10 : Select .2 input for Mux4 11 : Select .3 input for Mux4  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
7-6	MUX3	R/W	0h	Select Bits for OUTPUT4 Mux3: 00 : Select .0 input for Mux3 01 : Select .1 input for Mux3 10 : Select .2 input for Mux3 11 : Select .3 input for Mux3  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
5-4	MUX2	R/W	0h	Select Bits for OUTPUT4 Mux2: 00 : Select .0 input for Mux2 01 : Select .1 input for Mux2 10 : Select .2 input for Mux2 11 : Select .3 input for Mux2  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
3-2	MUX1	R/W	0h	Select Bits for OUTPUT4 Mux1: 00 : Select .0 input for Mux1 01 : Select .1 input for Mux1 10 : Select .2 input for Mux1 11 : Select .3 input for Mux1  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
1-0	MUX0	R/W	0h	Select Bits for OUTPUT4 Mux0: 00 : Select .0 input for Mux0 01 : Select .1 input for Mux0 10 : Select .2 input for Mux0 11 : Select .3 input for Mux0  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn

**7.3.5.8 OUTPUT4MUX16TO31CFG Register (Offset = Eh) [reset = 0h]**

OUTPUT4MUX16TO31CFG is shown in [Figure 7-59](#) and described in [Table 7-67](#).

Return to [Summary Table](#).

Output X-BAR Mux Configuration for Output 4

**Figure 7-59. OUTPUT4MUX16TO31CFG Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
MUX31		MUX30		MUX29		MUX28		MUX27		MUX26		MUX25		MUX24	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
MUX23		MUX22		MUX21		MUX20		MUX19		MUX18		MUX17		MUX16	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	

**Table 7-67. OUTPUT4MUX16TO31CFG Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-30	MUX31	R/W	0h	Select Bits for OUTPUT4 Mux31:  00 : Select .0 input for Mux31 01 : Select .1 input for Mux31 10 : Select .2 input for Mux31 11 : Select .3 input for Mux31  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
29-28	MUX30	R/W	0h	Select Bits for OUTPUT4 Mux30:  00 : Select .0 input for Mux30 01 : Select .1 input for Mux30 10 : Select .2 input for Mux30 11 : Select .3 input for Mux30  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
27-26	MUX29	R/W	0h	Select Bits for OUTPUT4 Mux29:  00 : Select .0 input for Mux29 01 : Select .1 input for Mux29 10 : Select .2 input for Mux29 11 : Select .3 input for Mux29  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
25-24	MUX28	R/W	0h	Select Bits for OUTPUT4 Mux28:  00 : Select .0 input for Mux28 01 : Select .1 input for Mux28 10 : Select .2 input for Mux28 11 : Select .3 input for Mux28  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn

**Table 7-67. OUTPUT4MUX16TO31CFG Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
23-22	MUX27	R/W	0h	Select Bits for OUTPUT4 Mux27: 00 : Select .0 input for Mux27 01 : Select .1 input for Mux27 10 : Select .2 input for Mux27 11 : Select .3 input for Mux27  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
21-20	MUX26	R/W	0h	Select Bits for OUTPUT4 Mux26: 00 : Select .0 input for Mux26 01 : Select .1 input for Mux26 10 : Select .2 input for Mux26 11 : Select .3 input for Mux26  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
19-18	MUX25	R/W	0h	Select Bits for OUTPUT4 Mux25: 00 : Select .0 input for Mux25 01 : Select .1 input for Mux25 10 : Select .2 input for Mux25 11 : Select .3 input for Mux25  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
17-16	MUX24	R/W	0h	Select Bits for OUTPUT4 Mux24: 00 : Select .0 input for Mux24 01 : Select .1 input for Mux24 10 : Select .2 input for Mux24 11 : Select .3 input for Mux24  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
15-14	MUX23	R/W	0h	Select Bits for OUTPUT4 Mux23: 00 : Select .0 input for Mux23 01 : Select .1 input for Mux23 10 : Select .2 input for Mux23 11 : Select .3 input for Mux23  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
13-12	MUX22	R/W	0h	Select Bits for OUTPUT4 Mux22: 00 : Select .0 input for Mux22 01 : Select .1 input for Mux22 10 : Select .2 input for Mux22 11 : Select .3 input for Mux22  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn

**Table 7-67. OUTPUT4MUX16TO31CFG Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
11-10	MUX21	R/W	0h	Select Bits for OUTPUT4 Mux21: 00 : Select .0 input for Mux21 01 : Select .1 input for Mux21 10 : Select .2 input for Mux21 11 : Select .3 input for Mux21  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
9-8	MUX20	R/W	0h	Select Bits for OUTPUT4 Mux20: 00 : Select .0 input for Mux20 01 : Select .1 input for Mux20 10 : Select .2 input for Mux20 11 : Select .3 input for Mux20  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
7-6	MUX19	R/W	0h	Select Bits for OUTPUT4 Mux19: 00 : Select .0 input for Mux19 01 : Select .1 input for Mux19 10 : Select .2 input for Mux19 11 : Select .3 input for Mux19  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
5-4	MUX18	R/W	0h	Select Bits for OUTPUT4 Mux18: 00 : Select .0 input for Mux18 01 : Select .1 input for Mux18 10 : Select .2 input for Mux18 11 : Select .3 input for Mux18  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
3-2	MUX17	R/W	0h	Select Bits for OUTPUT4 Mux17: 00 : Select .0 input for Mux17 01 : Select .1 input for Mux17 10 : Select .2 input for Mux17 11 : Select .3 input for Mux17  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
1-0	MUX16	R/W	0h	Select Bits for OUTPUT4 Mux16: 00 : Select .0 input for Mux16 01 : Select .1 input for Mux16 10 : Select .2 input for Mux16 11 : Select .3 input for Mux16  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn

### 7.3.5.9 OUTPUT5MUX0TO15CFG Register (Offset = 10h) [reset = 0h]

OUTPUT5MUX0TO15CFG is shown in [Figure 7-60](#) and described in [Table 7-68](#).

Return to [Summary Table](#).

Output X-BAR Mux Configuration for Output 5

**Figure 7-60. OUTPUT5MUX0TO15CFG Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
MUX15		MUX14		MUX13		MUX12		MUX11		MUX10		MUX9		MUX8	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
MUX7		MUX6		MUX5		MUX4		MUX3		MUX2		MUX1		MUX0	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	

**Table 7-68. OUTPUT5MUX0TO15CFG Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-30	MUX15	R/W	0h	Select Bits for OUTPUT5 Mux15:  00 : Select .0 input for Mux15 01 : Select .1 input for Mux15 10 : Select .2 input for Mux15 11 : Select .3 input for Mux15  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
29-28	MUX14	R/W	0h	Select Bits for OUTPUT5 Mux14:  00 : Select .0 input for Mux14 01 : Select .1 input for Mux14 10 : Select .2 input for Mux14 11 : Select .3 input for Mux14  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
27-26	MUX13	R/W	0h	Select Bits for OUTPUT5 Mux13:  00 : Select .0 input for Mux13 01 : Select .1 input for Mux13 10 : Select .2 input for Mux13 11 : Select .3 input for Mux13  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
25-24	MUX12	R/W	0h	Select Bits for OUTPUT5 Mux12:  00 : Select .0 input for Mux12 01 : Select .1 input for Mux12 10 : Select .2 input for Mux12 11 : Select .3 input for Mux12  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn

**Table 7-68. OUTPUT5MUX0TO15CFG Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
23-22	MUX11	R/W	0h	Select Bits for OUTPUT5 Mux11: 00 : Select .0 input for Mux11 01 : Select .1 input for Mux11 10 : Select .2 input for Mux11 11 : Select .3 input for Mux11  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
21-20	MUX10	R/W	0h	Select Bits for OUTPUT5 Mux10: 00 : Select .0 input for Mux10 01 : Select .1 input for Mux10 10 : Select .2 input for Mux10 11 : Select .3 input for Mux10  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
19-18	MUX9	R/W	0h	Select Bits for OUTPUT5 Mux9: 00 : Select .0 input for Mux9 01 : Select .1 input for Mux9 10 : Select .2 input for Mux9 11 : Select .3 input for Mux9  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
17-16	MUX8	R/W	0h	Select Bits for OUTPUT5 Mux8: 00 : Select .0 input for Mux8 01 : Select .1 input for Mux8 10 : Select .2 input for Mux8 11 : Select .3 input for Mux8  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
15-14	MUX7	R/W	0h	Select Bits for OUTPUT5 Mux7: 00 : Select .0 input for Mux7 01 : Select .1 input for Mux7 10 : Select .2 input for Mux7 11 : Select .3 input for Mux7  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
13-12	MUX6	R/W	0h	Select Bits for OUTPUT5 Mux6: 00 : Select .0 input for Mux6 01 : Select .1 input for Mux6 10 : Select .2 input for Mux6 11 : Select .3 input for Mux6  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn

**Table 7-68. OUTPUT5MUX0TO15CFG Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
11-10	MUX5	R/W	0h	<p>Select Bits for OUTPUT5 Mux5:</p> <p>00 : Select .0 input for Mux5            01 : Select .1 input for Mux5            10 : Select .2 input for Mux5            11 : Select .3 input for Mux5</p> <p>Refer to the Output X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>
9-8	MUX4	R/W	0h	<p>Select Bits for OUTPUT5 Mux4:</p> <p>00 : Select .0 input for Mux4            01 : Select .1 input for Mux4            10 : Select .2 input for Mux4            11 : Select .3 input for Mux4</p> <p>Refer to the Output X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>
7-6	MUX3	R/W	0h	<p>Select Bits for OUTPUT5 Mux3:</p> <p>00 : Select .0 input for Mux3            01 : Select .1 input for Mux3            10 : Select .2 input for Mux3            11 : Select .3 input for Mux3</p> <p>Refer to the Output X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>
5-4	MUX2	R/W	0h	<p>Select Bits for OUTPUT5 Mux2:</p> <p>00 : Select .0 input for Mux2            01 : Select .1 input for Mux2            10 : Select .2 input for Mux2            11 : Select .3 input for Mux2</p> <p>Refer to the Output X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>
3-2	MUX1	R/W	0h	<p>Select Bits for OUTPUT5 Mux1:</p> <p>00 : Select .0 input for Mux1            01 : Select .1 input for Mux1            10 : Select .2 input for Mux1            11 : Select .3 input for Mux1</p> <p>Refer to the Output X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>
1-0	MUX0	R/W	0h	<p>Select Bits for OUTPUT5 Mux0:</p> <p>00 : Select .0 input for Mux0            01 : Select .1 input for Mux0            10 : Select .2 input for Mux0            11 : Select .3 input for Mux0</p> <p>Refer to the Output X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>

**7.3.5.10 OUTPUT5MUX16TO31CFG Register (Offset = 12h) [reset = 0h]**

OUTPUT5MUX16TO31CFG is shown in [Figure 7-61](#) and described in [Table 7-69](#).

Return to [Summary Table](#).

Output X-BAR Mux Configuration for Output 5

**Figure 7-61. OUTPUT5MUX16TO31CFG Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
MUX31		MUX30		MUX29		MUX28		MUX27		MUX26		MUX25		MUX24	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
MUX23		MUX22		MUX21		MUX20		MUX19		MUX18		MUX17		MUX16	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	

**Table 7-69. OUTPUT5MUX16TO31CFG Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-30	MUX31	R/W	0h	Select Bits for OUTPUT5 Mux31:  00 : Select .0 input for Mux31 01 : Select .1 input for Mux31 10 : Select .2 input for Mux31 11 : Select .3 input for Mux31  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
29-28	MUX30	R/W	0h	Select Bits for OUTPUT5 Mux30:  00 : Select .0 input for Mux30 01 : Select .1 input for Mux30 10 : Select .2 input for Mux30 11 : Select .3 input for Mux30  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
27-26	MUX29	R/W	0h	Select Bits for OUTPUT5 Mux29:  00 : Select .0 input for Mux29 01 : Select .1 input for Mux29 10 : Select .2 input for Mux29 11 : Select .3 input for Mux29  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
25-24	MUX28	R/W	0h	Select Bits for OUTPUT5 Mux28:  00 : Select .0 input for Mux28 01 : Select .1 input for Mux28 10 : Select .2 input for Mux28 11 : Select .3 input for Mux28  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn



**Table 7-69. OUTPUT5MUX16TO31CFG Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
23-22	MUX27	R/W	0h	<p>Select Bits for OUTPUT5 Mux27:</p> <p>00 : Select .0 input for Mux27            01 : Select .1 input for Mux27            10 : Select .2 input for Mux27            11 : Select .3 input for Mux27</p> <p>Refer to the Output X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>
21-20	MUX26	R/W	0h	<p>Select Bits for OUTPUT5 Mux26:</p> <p>00 : Select .0 input for Mux26            01 : Select .1 input for Mux26            10 : Select .2 input for Mux26            11 : Select .3 input for Mux26</p> <p>Refer to the Output X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>
19-18	MUX25	R/W	0h	<p>Select Bits for OUTPUT5 Mux25:</p> <p>00 : Select .0 input for Mux25            01 : Select .1 input for Mux25            10 : Select .2 input for Mux25            11 : Select .3 input for Mux25</p> <p>Refer to the Output X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>
17-16	MUX24	R/W	0h	<p>Select Bits for OUTPUT5 Mux24:</p> <p>00 : Select .0 input for Mux24            01 : Select .1 input for Mux24            10 : Select .2 input for Mux24            11 : Select .3 input for Mux24</p> <p>Refer to the Output X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>
15-14	MUX23	R/W	0h	<p>Select Bits for OUTPUT5 Mux23:</p> <p>00 : Select .0 input for Mux23            01 : Select .1 input for Mux23            10 : Select .2 input for Mux23            11 : Select .3 input for Mux23</p> <p>Refer to the Output X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>
13-12	MUX22	R/W	0h	<p>Select Bits for OUTPUT5 Mux22:</p> <p>00 : Select .0 input for Mux22            01 : Select .1 input for Mux22            10 : Select .2 input for Mux22            11 : Select .3 input for Mux22</p> <p>Refer to the Output X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>

**Table 7-69. OUTPUT5MUX16TO31CFG Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
11-10	MUX21	R/W	0h	Select Bits for OUTPUT5 Mux21: 00 : Select .0 input for Mux21 01 : Select .1 input for Mux21 10 : Select .2 input for Mux21 11 : Select .3 input for Mux21  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
9-8	MUX20	R/W	0h	Select Bits for OUTPUT5 Mux20: 00 : Select .0 input for Mux20 01 : Select .1 input for Mux20 10 : Select .2 input for Mux20 11 : Select .3 input for Mux20  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
7-6	MUX19	R/W	0h	Select Bits for OUTPUT5 Mux19: 00 : Select .0 input for Mux19 01 : Select .1 input for Mux19 10 : Select .2 input for Mux19 11 : Select .3 input for Mux19  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
5-4	MUX18	R/W	0h	Select Bits for OUTPUT5 Mux18: 00 : Select .0 input for Mux18 01 : Select .1 input for Mux18 10 : Select .2 input for Mux18 11 : Select .3 input for Mux18  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
3-2	MUX17	R/W	0h	Select Bits for OUTPUT5 Mux17: 00 : Select .0 input for Mux17 01 : Select .1 input for Mux17 10 : Select .2 input for Mux17 11 : Select .3 input for Mux17  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
1-0	MUX16	R/W	0h	Select Bits for OUTPUT5 Mux16: 00 : Select .0 input for Mux16 01 : Select .1 input for Mux16 10 : Select .2 input for Mux16 11 : Select .3 input for Mux16  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn

### 7.3.5.11 OUTPUT6MUX0TO15CFG Register (Offset = 14h) [reset = 0h]

OUTPUT6MUX0TO15CFG is shown in [Figure 7-62](#) and described in [Table 7-70](#).

Return to [Summary Table](#).

Output X-BAR Mux Configuration for Output 6

**Figure 7-62. OUTPUT6MUX0TO15CFG Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
MUX15		MUX14		MUX13		MUX12		MUX11		MUX10		MUX9		MUX8	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
MUX7		MUX6		MUX5		MUX4		MUX3		MUX2		MUX1		MUX0	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	

**Table 7-70. OUTPUT6MUX0TO15CFG Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-30	MUX15	R/W	0h	Select Bits for OUTPUT6 Mux15:  00 : Select .0 input for Mux15 01 : Select .1 input for Mux15 10 : Select .2 input for Mux15 11 : Select .3 input for Mux15  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
29-28	MUX14	R/W	0h	Select Bits for OUTPUT6 Mux14:  00 : Select .0 input for Mux14 01 : Select .1 input for Mux14 10 : Select .2 input for Mux14 11 : Select .3 input for Mux14  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
27-26	MUX13	R/W	0h	Select Bits for OUTPUT6 Mux13:  00 : Select .0 input for Mux13 01 : Select .1 input for Mux13 10 : Select .2 input for Mux13 11 : Select .3 input for Mux13  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
25-24	MUX12	R/W	0h	Select Bits for OUTPUT6 Mux12:  00 : Select .0 input for Mux12 01 : Select .1 input for Mux12 10 : Select .2 input for Mux12 11 : Select .3 input for Mux12  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn

**Table 7-70. OUTPUT6MUX0TO15CFG Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
23-22	MUX11	R/W	0h	<p>Select Bits for OUTPUT6 Mux11:</p> <p>00 : Select .0 input for Mux11  01 : Select .1 input for Mux11  10 : Select .2 input for Mux11  11 : Select .3 input for Mux11</p> <p>Refer to the Output X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>
21-20	MUX10	R/W	0h	<p>Select Bits for OUTPUT6 Mux10:</p> <p>00 : Select .0 input for Mux10  01 : Select .1 input for Mux10  10 : Select .2 input for Mux10  11 : Select .3 input for Mux10</p> <p>Refer to the Output X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>
19-18	MUX9	R/W	0h	<p>Select Bits for OUTPUT6 Mux9:</p> <p>00 : Select .0 input for Mux9  01 : Select .1 input for Mux9  10 : Select .2 input for Mux9  11 : Select .3 input for Mux9</p> <p>Refer to the Output X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>
17-16	MUX8	R/W	0h	<p>Select Bits for OUTPUT6 Mux8:</p> <p>00 : Select .0 input for Mux8  01 : Select .1 input for Mux8  10 : Select .2 input for Mux8  11 : Select .3 input for Mux8</p> <p>Refer to the Output X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>
15-14	MUX7	R/W	0h	<p>Select Bits for OUTPUT6 Mux7:</p> <p>00 : Select .0 input for Mux7  01 : Select .1 input for Mux7  10 : Select .2 input for Mux7  11 : Select .3 input for Mux7</p> <p>Refer to the Output X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>
13-12	MUX6	R/W	0h	<p>Select Bits for OUTPUT6 Mux6:</p> <p>00 : Select .0 input for Mux6  01 : Select .1 input for Mux6  10 : Select .2 input for Mux6  11 : Select .3 input for Mux6</p> <p>Refer to the Output X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>

**Table 7-70. OUTPUT6MUX0TO15CFG Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
11-10	MUX5	R/W	0h	<p>Select Bits for OUTPUT6 Mux5:</p> <p>00 : Select .0 input for Mux5            01 : Select .1 input for Mux5            10 : Select .2 input for Mux5            11 : Select .3 input for Mux5</p> <p>Refer to the Output X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>
9-8	MUX4	R/W	0h	<p>Select Bits for OUTPUT6 Mux4:</p> <p>00 : Select .0 input for Mux4            01 : Select .1 input for Mux4            10 : Select .2 input for Mux4            11 : Select .3 input for Mux4</p> <p>Refer to the Output X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>
7-6	MUX3	R/W	0h	<p>Select Bits for OUTPUT6 Mux3:</p> <p>00 : Select .0 input for Mux3            01 : Select .1 input for Mux3            10 : Select .2 input for Mux3            11 : Select .3 input for Mux3</p> <p>Refer to the Output X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>
5-4	MUX2	R/W	0h	<p>Select Bits for OUTPUT6 Mux2:</p> <p>00 : Select .0 input for Mux2            01 : Select .1 input for Mux2            10 : Select .2 input for Mux2            11 : Select .3 input for Mux2</p> <p>Refer to the Output X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>
3-2	MUX1	R/W	0h	<p>Select Bits for OUTPUT6 Mux1:</p> <p>00 : Select .0 input for Mux1            01 : Select .1 input for Mux1            10 : Select .2 input for Mux1            11 : Select .3 input for Mux1</p> <p>Refer to the Output X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>
1-0	MUX0	R/W	0h	<p>Select Bits for OUTPUT6 Mux0:</p> <p>00 : Select .0 input for Mux0            01 : Select .1 input for Mux0            10 : Select .2 input for Mux0            11 : Select .3 input for Mux0</p> <p>Refer to the Output X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>

**7.3.5.12 OUTPUT6MUX16TO31CFG Register (Offset = 16h) [reset = 0h]**

OUTPUT6MUX16TO31CFG is shown in [Figure 7-63](#) and described in [Table 7-71](#).

Return to [Summary Table](#).

Output X-BAR Mux Configuration for Output 6

**Figure 7-63. OUTPUT6MUX16TO31CFG Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
MUX31		MUX30		MUX29		MUX28		MUX27		MUX26		MUX25		MUX24	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
MUX23		MUX22		MUX21		MUX20		MUX19		MUX18		MUX17		MUX16	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	

**Table 7-71. OUTPUT6MUX16TO31CFG Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-30	MUX31	R/W	0h	Select Bits for OUTPUT6 Mux31:  00 : Select .0 input for Mux31 01 : Select .1 input for Mux31 10 : Select .2 input for Mux31 11 : Select .3 input for Mux31  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
29-28	MUX30	R/W	0h	Select Bits for OUTPUT6 Mux30:  00 : Select .0 input for Mux30 01 : Select .1 input for Mux30 10 : Select .2 input for Mux30 11 : Select .3 input for Mux30  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
27-26	MUX29	R/W	0h	Select Bits for OUTPUT6 Mux29:  00 : Select .0 input for Mux29 01 : Select .1 input for Mux29 10 : Select .2 input for Mux29 11 : Select .3 input for Mux29  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
25-24	MUX28	R/W	0h	Select Bits for OUTPUT6 Mux28:  00 : Select .0 input for Mux28 01 : Select .1 input for Mux28 10 : Select .2 input for Mux28 11 : Select .3 input for Mux28  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn

**Table 7-71. OUTPUT6MUX16TO31CFG Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
23-22	MUX27	R/W	0h	Select Bits for OUTPUT6 Mux27: 00 : Select .0 input for Mux27 01 : Select .1 input for Mux27 10 : Select .2 input for Mux27 11 : Select .3 input for Mux27  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
21-20	MUX26	R/W	0h	Select Bits for OUTPUT6 Mux26: 00 : Select .0 input for Mux26 01 : Select .1 input for Mux26 10 : Select .2 input for Mux26 11 : Select .3 input for Mux26  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
19-18	MUX25	R/W	0h	Select Bits for OUTPUT6 Mux25: 00 : Select .0 input for Mux25 01 : Select .1 input for Mux25 10 : Select .2 input for Mux25 11 : Select .3 input for Mux25  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
17-16	MUX24	R/W	0h	Select Bits for OUTPUT6 Mux24: 00 : Select .0 input for Mux24 01 : Select .1 input for Mux24 10 : Select .2 input for Mux24 11 : Select .3 input for Mux24  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
15-14	MUX23	R/W	0h	Select Bits for OUTPUT6 Mux23: 00 : Select .0 input for Mux23 01 : Select .1 input for Mux23 10 : Select .2 input for Mux23 11 : Select .3 input for Mux23  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
13-12	MUX22	R/W	0h	Select Bits for OUTPUT6 Mux22: 00 : Select .0 input for Mux22 01 : Select .1 input for Mux22 10 : Select .2 input for Mux22 11 : Select .3 input for Mux22  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn

**Table 7-71. OUTPUT6MUX16TO31CFG Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
11-10	MUX21	R/W	0h	<p>Select Bits for OUTPUT6 Mux21:</p> <p>00 : Select .0 input for Mux21  01 : Select .1 input for Mux21  10 : Select .2 input for Mux21  11 : Select .3 input for Mux21</p> <p>Refer to the Output X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>
9-8	MUX20	R/W	0h	<p>Select Bits for OUTPUT6 Mux20:</p> <p>00 : Select .0 input for Mux20  01 : Select .1 input for Mux20  10 : Select .2 input for Mux20  11 : Select .3 input for Mux20</p> <p>Refer to the Output X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>
7-6	MUX19	R/W	0h	<p>Select Bits for OUTPUT6 Mux19:</p> <p>00 : Select .0 input for Mux19  01 : Select .1 input for Mux19  10 : Select .2 input for Mux19  11 : Select .3 input for Mux19</p> <p>Refer to the Output X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>
5-4	MUX18	R/W	0h	<p>Select Bits for OUTPUT6 Mux18:</p> <p>00 : Select .0 input for Mux18  01 : Select .1 input for Mux18  10 : Select .2 input for Mux18  11 : Select .3 input for Mux18</p> <p>Refer to the Output X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>
3-2	MUX17	R/W	0h	<p>Select Bits for OUTPUT6 Mux17:</p> <p>00 : Select .0 input for Mux17  01 : Select .1 input for Mux17  10 : Select .2 input for Mux17  11 : Select .3 input for Mux17</p> <p>Refer to the Output X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>
1-0	MUX16	R/W	0h	<p>Select Bits for OUTPUT6 Mux16:</p> <p>00 : Select .0 input for Mux16  01 : Select .1 input for Mux16  10 : Select .2 input for Mux16  11 : Select .3 input for Mux16</p> <p>Refer to the Output X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>



### 7.3.5.13 OUTPUT7MUX0TO15CFG Register (Offset = 18h) [reset = 0h]

OUTPUT7MUX0TO15CFG is shown in [Figure 7-64](#) and described in [Table 7-72](#).

Return to [Summary Table](#).

Output X-BAR Mux Configuration for Output 7

**Figure 7-64. OUTPUT7MUX0TO15CFG Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
MUX15		MUX14		MUX13		MUX12		MUX11		MUX10		MUX9		MUX8	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
MUX7		MUX6		MUX5		MUX4		MUX3		MUX2		MUX1		MUX0	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	

**Table 7-72. OUTPUT7MUX0TO15CFG Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-30	MUX15	R/W	0h	Select Bits for OUTPUT7 Mux15:  00 : Select .0 input for Mux15 01 : Select .1 input for Mux15 10 : Select .2 input for Mux15 11 : Select .3 input for Mux15  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
29-28	MUX14	R/W	0h	Select Bits for OUTPUT7 Mux14:  00 : Select .0 input for Mux14 01 : Select .1 input for Mux14 10 : Select .2 input for Mux14 11 : Select .3 input for Mux14  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
27-26	MUX13	R/W	0h	Select Bits for OUTPUT7 Mux13:  00 : Select .0 input for Mux13 01 : Select .1 input for Mux13 10 : Select .2 input for Mux13 11 : Select .3 input for Mux13  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
25-24	MUX12	R/W	0h	Select Bits for OUTPUT7 Mux12:  00 : Select .0 input for Mux12 01 : Select .1 input for Mux12 10 : Select .2 input for Mux12 11 : Select .3 input for Mux12  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn

**Table 7-72. OUTPUT7MUX0TO15CFG Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
23-22	MUX11	R/W	0h	<p>Select Bits for OUTPUT7 Mux11:</p> <p>00 : Select .0 input for Mux11  01 : Select .1 input for Mux11  10 : Select .2 input for Mux11  11 : Select .3 input for Mux11</p> <p>Refer to the Output X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>
21-20	MUX10	R/W	0h	<p>Select Bits for OUTPUT7 Mux10:</p> <p>00 : Select .0 input for Mux10  01 : Select .1 input for Mux10  10 : Select .2 input for Mux10  11 : Select .3 input for Mux10</p> <p>Refer to the Output X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>
19-18	MUX9	R/W	0h	<p>Select Bits for OUTPUT7 Mux9:</p> <p>00 : Select .0 input for Mux9  01 : Select .1 input for Mux9  10 : Select .2 input for Mux9  11 : Select .3 input for Mux9</p> <p>Refer to the Output X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>
17-16	MUX8	R/W	0h	<p>Select Bits for OUTPUT7 Mux8:</p> <p>00 : Select .0 input for Mux8  01 : Select .1 input for Mux8  10 : Select .2 input for Mux8  11 : Select .3 input for Mux8</p> <p>Refer to the Output X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>
15-14	MUX7	R/W	0h	<p>Select Bits for OUTPUT7 Mux7:</p> <p>00 : Select .0 input for Mux7  01 : Select .1 input for Mux7  10 : Select .2 input for Mux7  11 : Select .3 input for Mux7</p> <p>Refer to the Output X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>
13-12	MUX6	R/W	0h	<p>Select Bits for OUTPUT7 Mux6:</p> <p>00 : Select .0 input for Mux6  01 : Select .1 input for Mux6  10 : Select .2 input for Mux6  11 : Select .3 input for Mux6</p> <p>Refer to the Output X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>

**Table 7-72. OUTPUT7MUX0TO15CFG Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
11-10	MUX5	R/W	0h	Select Bits for OUTPUT7 Mux5: 00 : Select .0 input for Mux5 01 : Select .1 input for Mux5 10 : Select .2 input for Mux5 11 : Select .3 input for Mux5  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
9-8	MUX4	R/W	0h	Select Bits for OUTPUT7 Mux4: 00 : Select .0 input for Mux4 01 : Select .1 input for Mux4 10 : Select .2 input for Mux4 11 : Select .3 input for Mux4  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
7-6	MUX3	R/W	0h	Select Bits for OUTPUT7 Mux3: 00 : Select .0 input for Mux3 01 : Select .1 input for Mux3 10 : Select .2 input for Mux3 11 : Select .3 input for Mux3  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
5-4	MUX2	R/W	0h	Select Bits for OUTPUT7 Mux2: 00 : Select .0 input for Mux2 01 : Select .1 input for Mux2 10 : Select .2 input for Mux2 11 : Select .3 input for Mux2  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
3-2	MUX1	R/W	0h	Select Bits for OUTPUT7 Mux1: 00 : Select .0 input for Mux1 01 : Select .1 input for Mux1 10 : Select .2 input for Mux1 11 : Select .3 input for Mux1  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
1-0	MUX0	R/W	0h	Select Bits for OUTPUT7 Mux0: 00 : Select .0 input for Mux0 01 : Select .1 input for Mux0 10 : Select .2 input for Mux0 11 : Select .3 input for Mux0  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn

### 7.3.5.14 OUTPUT7MUX16TO31CFG Register (Offset = 1Ah) [reset = 0h]

OUTPUT7MUX16TO31CFG is shown in [Figure 7-65](#) and described in [Table 7-73](#).

Return to [Summary Table](#).

Output X-BAR Mux Configuration for Output 7

**Figure 7-65. OUTPUT7MUX16TO31CFG Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
MUX31		MUX30		MUX29		MUX28		MUX27		MUX26		MUX25		MUX24	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
MUX23		MUX22		MUX21		MUX20		MUX19		MUX18		MUX17		MUX16	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	

**Table 7-73. OUTPUT7MUX16TO31CFG Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-30	MUX31	R/W	0h	Select Bits for OUTPUT7 Mux31:  00 : Select .0 input for Mux31 01 : Select .1 input for Mux31 10 : Select .2 input for Mux31 11 : Select .3 input for Mux31  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
29-28	MUX30	R/W	0h	Select Bits for OUTPUT7 Mux30:  00 : Select .0 input for Mux30 01 : Select .1 input for Mux30 10 : Select .2 input for Mux30 11 : Select .3 input for Mux30  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
27-26	MUX29	R/W	0h	Select Bits for OUTPUT7 Mux29:  00 : Select .0 input for Mux29 01 : Select .1 input for Mux29 10 : Select .2 input for Mux29 11 : Select .3 input for Mux29  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
25-24	MUX28	R/W	0h	Select Bits for OUTPUT7 Mux28:  00 : Select .0 input for Mux28 01 : Select .1 input for Mux28 10 : Select .2 input for Mux28 11 : Select .3 input for Mux28  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn

**Table 7-73. OUTPUT7MUX16TO31CFG Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
23-22	MUX27	R/W	0h	Select Bits for OUTPUT7 Mux27: 00 : Select .0 input for Mux27 01 : Select .1 input for Mux27 10 : Select .2 input for Mux27 11 : Select .3 input for Mux27  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
21-20	MUX26	R/W	0h	Select Bits for OUTPUT7 Mux26: 00 : Select .0 input for Mux26 01 : Select .1 input for Mux26 10 : Select .2 input for Mux26 11 : Select .3 input for Mux26  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
19-18	MUX25	R/W	0h	Select Bits for OUTPUT7 Mux25: 00 : Select .0 input for Mux25 01 : Select .1 input for Mux25 10 : Select .2 input for Mux25 11 : Select .3 input for Mux25  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
17-16	MUX24	R/W	0h	Select Bits for OUTPUT7 Mux24: 00 : Select .0 input for Mux24 01 : Select .1 input for Mux24 10 : Select .2 input for Mux24 11 : Select .3 input for Mux24  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
15-14	MUX23	R/W	0h	Select Bits for OUTPUT7 Mux23: 00 : Select .0 input for Mux23 01 : Select .1 input for Mux23 10 : Select .2 input for Mux23 11 : Select .3 input for Mux23  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
13-12	MUX22	R/W	0h	Select Bits for OUTPUT7 Mux22: 00 : Select .0 input for Mux22 01 : Select .1 input for Mux22 10 : Select .2 input for Mux22 11 : Select .3 input for Mux22  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn

**Table 7-73. OUTPUT7MUX16TO31CFG Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
11-10	MUX21	R/W	0h	Select Bits for OUTPUT7 Mux21: 00 : Select .0 input for Mux21 01 : Select .1 input for Mux21 10 : Select .2 input for Mux21 11 : Select .3 input for Mux21  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
9-8	MUX20	R/W	0h	Select Bits for OUTPUT7 Mux20: 00 : Select .0 input for Mux20 01 : Select .1 input for Mux20 10 : Select .2 input for Mux20 11 : Select .3 input for Mux20  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
7-6	MUX19	R/W	0h	Select Bits for OUTPUT7 Mux19: 00 : Select .0 input for Mux19 01 : Select .1 input for Mux19 10 : Select .2 input for Mux19 11 : Select .3 input for Mux19  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
5-4	MUX18	R/W	0h	Select Bits for OUTPUT7 Mux18: 00 : Select .0 input for Mux18 01 : Select .1 input for Mux18 10 : Select .2 input for Mux18 11 : Select .3 input for Mux18  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
3-2	MUX17	R/W	0h	Select Bits for OUTPUT7 Mux17: 00 : Select .0 input for Mux17 01 : Select .1 input for Mux17 10 : Select .2 input for Mux17 11 : Select .3 input for Mux17  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
1-0	MUX16	R/W	0h	Select Bits for OUTPUT7 Mux16: 00 : Select .0 input for Mux16 01 : Select .1 input for Mux16 10 : Select .2 input for Mux16 11 : Select .3 input for Mux16  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn

### 7.3.5.15 OUTPUT8MUX0TO15CFG Register (Offset = 1Ch) [reset = 0h]

OUTPUT8MUX0TO15CFG is shown in [Figure 7-66](#) and described in [Table 7-74](#).

Return to [Summary Table](#).

Output X-BAR Mux Configuration for Output 8

**Figure 7-66. OUTPUT8MUX0TO15CFG Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
MUX15		MUX14		MUX13		MUX12		MUX11		MUX10		MUX9		MUX8	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
MUX7		MUX6		MUX5		MUX4		MUX3		MUX2		MUX1		MUX0	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	

**Table 7-74. OUTPUT8MUX0TO15CFG Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-30	MUX15	R/W	0h	Select Bits for OUTPUT8 Mux15:  00 : Select .0 input for Mux15 01 : Select .1 input for Mux15 10 : Select .2 input for Mux15 11 : Select .3 input for Mux15  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
29-28	MUX14	R/W	0h	Select Bits for OUTPUT8 Mux14:  00 : Select .0 input for Mux14 01 : Select .1 input for Mux14 10 : Select .2 input for Mux14 11 : Select .3 input for Mux14  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
27-26	MUX13	R/W	0h	Select Bits for OUTPUT8 Mux13:  00 : Select .0 input for Mux13 01 : Select .1 input for Mux13 10 : Select .2 input for Mux13 11 : Select .3 input for Mux13  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
25-24	MUX12	R/W	0h	Select Bits for OUTPUT8 Mux12:  00 : Select .0 input for Mux12 01 : Select .1 input for Mux12 10 : Select .2 input for Mux12 11 : Select .3 input for Mux12  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn

**Table 7-74. OUTPUT8MUX0TO15CFG Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
23-22	MUX11	R/W	0h	<p>Select Bits for OUTPUT8 Mux11:</p> <p>00 : Select .0 input for Mux11  01 : Select .1 input for Mux11  10 : Select .2 input for Mux11  11 : Select .3 input for Mux11</p> <p>Refer to the Output X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>
21-20	MUX10	R/W	0h	<p>Select Bits for OUTPUT8 Mux10:</p> <p>00 : Select .0 input for Mux10  01 : Select .1 input for Mux10  10 : Select .2 input for Mux10  11 : Select .3 input for Mux10</p> <p>Refer to the Output X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>
19-18	MUX9	R/W	0h	<p>Select Bits for OUTPUT8 Mux9:</p> <p>00 : Select .0 input for Mux9  01 : Select .1 input for Mux9  10 : Select .2 input for Mux9  11 : Select .3 input for Mux9</p> <p>Refer to the Output X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>
17-16	MUX8	R/W	0h	<p>Select Bits for OUTPUT8 Mux8:</p> <p>00 : Select .0 input for Mux8  01 : Select .1 input for Mux8  10 : Select .2 input for Mux8  11 : Select .3 input for Mux8</p> <p>Refer to the Output X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>
15-14	MUX7	R/W	0h	<p>Select Bits for OUTPUT8 Mux7:</p> <p>00 : Select .0 input for Mux7  01 : Select .1 input for Mux7  10 : Select .2 input for Mux7  11 : Select .3 input for Mux7</p> <p>Refer to the Output X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>
13-12	MUX6	R/W	0h	<p>Select Bits for OUTPUT8 Mux6:</p> <p>00 : Select .0 input for Mux6  01 : Select .1 input for Mux6  10 : Select .2 input for Mux6  11 : Select .3 input for Mux6</p> <p>Refer to the Output X-BAR section of this chapter for more details.  Reset type: CPU1.SYSRSn</p>



**Table 7-74. OUTPUT8MUX0TO15CFG Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
11-10	MUX5	R/W	0h	<p>Select Bits for OUTPUT8 Mux5:</p> <p>00 : Select .0 input for Mux5            01 : Select .1 input for Mux5            10 : Select .2 input for Mux5            11 : Select .3 input for Mux5</p> <p>Refer to the Output X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>
9-8	MUX4	R/W	0h	<p>Select Bits for OUTPUT8 Mux4:</p> <p>00 : Select .0 input for Mux4            01 : Select .1 input for Mux4            10 : Select .2 input for Mux4            11 : Select .3 input for Mux4</p> <p>Refer to the Output X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>
7-6	MUX3	R/W	0h	<p>Select Bits for OUTPUT8 Mux3:</p> <p>00 : Select .0 input for Mux3            01 : Select .1 input for Mux3            10 : Select .2 input for Mux3            11 : Select .3 input for Mux3</p> <p>Refer to the Output X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>
5-4	MUX2	R/W	0h	<p>Select Bits for OUTPUT8 Mux2:</p> <p>00 : Select .0 input for Mux2            01 : Select .1 input for Mux2            10 : Select .2 input for Mux2            11 : Select .3 input for Mux2</p> <p>Refer to the Output X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>
3-2	MUX1	R/W	0h	<p>Select Bits for OUTPUT8 Mux1:</p> <p>00 : Select .0 input for Mux1            01 : Select .1 input for Mux1            10 : Select .2 input for Mux1            11 : Select .3 input for Mux1</p> <p>Refer to the Output X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>
1-0	MUX0	R/W	0h	<p>Select Bits for OUTPUT8 Mux0:</p> <p>00 : Select .0 input for Mux0            01 : Select .1 input for Mux0            10 : Select .2 input for Mux0            11 : Select .3 input for Mux0</p> <p>Refer to the Output X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>

### 7.3.5.16 OUTPUT8MUX16TO31CFG Register (Offset = 1Eh) [reset = 0h]

OUTPUT8MUX16TO31CFG is shown in [Figure 7-67](#) and described in [Table 7-75](#).

Return to [Summary Table](#).

Output X-BAR Mux Configuration for Output 8

**Figure 7-67. OUTPUT8MUX16TO31CFG Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
MUX31		MUX30		MUX29		MUX28		MUX27		MUX26		MUX25		MUX24	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
MUX23		MUX22		MUX21		MUX20		MUX19		MUX18		MUX17		MUX16	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	

**Table 7-75. OUTPUT8MUX16TO31CFG Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-30	MUX31	R/W	0h	Select Bits for OUTPUT8 Mux31:  00 : Select .0 input for Mux31 01 : Select .1 input for Mux31 10 : Select .2 input for Mux31 11 : Select .3 input for Mux31  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
29-28	MUX30	R/W	0h	Select Bits for OUTPUT8 Mux30:  00 : Select .0 input for Mux30 01 : Select .1 input for Mux30 10 : Select .2 input for Mux30 11 : Select .3 input for Mux30  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
27-26	MUX29	R/W	0h	Select Bits for OUTPUT8 Mux29:  00 : Select .0 input for Mux29 01 : Select .1 input for Mux29 10 : Select .2 input for Mux29 11 : Select .3 input for Mux29  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
25-24	MUX28	R/W	0h	Select Bits for OUTPUT8 Mux28:  00 : Select .0 input for Mux28 01 : Select .1 input for Mux28 10 : Select .2 input for Mux28 11 : Select .3 input for Mux28  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn

**Table 7-75. OUTPUT8MUX16TO31CFG Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
23-22	MUX27	R/W	0h	Select Bits for OUTPUT8 Mux27: 00 : Select .0 input for Mux27 01 : Select .1 input for Mux27 10 : Select .2 input for Mux27 11 : Select .3 input for Mux27  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
21-20	MUX26	R/W	0h	Select Bits for OUTPUT8 Mux26: 00 : Select .0 input for Mux26 01 : Select .1 input for Mux26 10 : Select .2 input for Mux26 11 : Select .3 input for Mux26  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
19-18	MUX25	R/W	0h	Select Bits for OUTPUT8 Mux25: 00 : Select .0 input for Mux25 01 : Select .1 input for Mux25 10 : Select .2 input for Mux25 11 : Select .3 input for Mux25  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
17-16	MUX24	R/W	0h	Select Bits for OUTPUT8 Mux24: 00 : Select .0 input for Mux24 01 : Select .1 input for Mux24 10 : Select .2 input for Mux24 11 : Select .3 input for Mux24  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
15-14	MUX23	R/W	0h	Select Bits for OUTPUT8 Mux23: 00 : Select .0 input for Mux23 01 : Select .1 input for Mux23 10 : Select .2 input for Mux23 11 : Select .3 input for Mux23  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
13-12	MUX22	R/W	0h	Select Bits for OUTPUT8 Mux22: 00 : Select .0 input for Mux22 01 : Select .1 input for Mux22 10 : Select .2 input for Mux22 11 : Select .3 input for Mux22  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn

**Table 7-75. OUTPUT8MUX16TO31CFG Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
11-10	MUX21	R/W	0h	Select Bits for OUTPUT8 Mux21: 00 : Select .0 input for Mux21 01 : Select .1 input for Mux21 10 : Select .2 input for Mux21 11 : Select .3 input for Mux21  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
9-8	MUX20	R/W	0h	Select Bits for OUTPUT8 Mux20: 00 : Select .0 input for Mux20 01 : Select .1 input for Mux20 10 : Select .2 input for Mux20 11 : Select .3 input for Mux20  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
7-6	MUX19	R/W	0h	Select Bits for OUTPUT8 Mux19: 00 : Select .0 input for Mux19 01 : Select .1 input for Mux19 10 : Select .2 input for Mux19 11 : Select .3 input for Mux19  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
5-4	MUX18	R/W	0h	Select Bits for OUTPUT8 Mux18: 00 : Select .0 input for Mux18 01 : Select .1 input for Mux18 10 : Select .2 input for Mux18 11 : Select .3 input for Mux18  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
3-2	MUX17	R/W	0h	Select Bits for OUTPUT8 Mux17: 00 : Select .0 input for Mux17 01 : Select .1 input for Mux17 10 : Select .2 input for Mux17 11 : Select .3 input for Mux17  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
1-0	MUX16	R/W	0h	Select Bits for OUTPUT8 Mux16: 00 : Select .0 input for Mux16 01 : Select .1 input for Mux16 10 : Select .2 input for Mux16 11 : Select .3 input for Mux16  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn

### 7.3.5.17 OUTPUT1MUXENABLE Register (Offset = 20h) [reset = 0h]

OUTPUT1MUXENABLE is shown in [Figure 7-68](#) and described in [Table 7-76](#).

Return to [Summary Table](#).

Output X-BAR Mux Enable for Output 1

**Figure 7-68. OUTPUT1MUXENABLE Register**

31	30	29	28	27	26	25	24
MUX31	MUX30	MUX29	MUX28	MUX27	MUX26	MUX25	MUX24
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
23	22	21	20	19	18	17	16
MUX23	MUX22	MUX21	MUX20	MUX19	MUX18	MUX17	MUX16
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
15	14	13	12	11	10	9	8
MUX15	MUX14	MUX13	MUX12	MUX11	MUX10	MUX9	MUX8
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
7	6	5	4	3	2	1	0
MUX7	MUX6	MUX5	MUX4	MUX3	MUX2	MUX1	MUX0
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h

**Table 7-76. OUTPUT1MUXENABLE Register Field Descriptions**

Bit	Field	Type	Reset	Description
31	MUX31	R/W	0h	<p>Selects the output of Mux31 to drive OUTPUT1 of OUTPUT-XBAR</p> <p>0: Respective output of Mux31 is disabled to drive the OUTPUT1 of OUTPUT-XBAR</p> <p>1: Respective output of Mux31 is enabled to drive the OUTPUT1 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details.</p> <p>Reset type: CPU1.SYSRSn</p>
30	MUX30	R/W	0h	<p>Selects the output of Mux30 to drive OUTPUT1 of OUTPUT-XBAR</p> <p>0: Respective output of Mux30 is disabled to drive the OUTPUT1 of OUTPUT-XBAR</p> <p>1: Respective output of Mux30 is enabled to drive the OUTPUT1 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details.</p> <p>Reset type: CPU1.SYSRSn</p>
29	MUX29	R/W	0h	<p>Selects the output of Mux29 to drive OUTPUT1 of OUTPUT-XBAR</p> <p>0: Respective output of Mux29 is disabled to drive the OUTPUT1 of OUTPUT-XBAR</p> <p>1: Respective output of Mux29 is enabled to drive the OUTPUT1 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details.</p> <p>Reset type: CPU1.SYSRSn</p>
28	MUX28	R/W	0h	<p>Selects the output of Mux28 to drive OUTPUT1 of OUTPUT-XBAR</p> <p>0: Respective output of Mux28 is disabled to drive the OUTPUT1 of OUTPUT-XBAR</p> <p>1: Respective output of Mux28 is enabled to drive the OUTPUT1 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details.</p> <p>Reset type: CPU1.SYSRSn</p>

**Table 7-76. OUTPUT1MUXENABLE Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
27	MUX27	R/W	0h	<p>Selects the output of Mux27 to drive OUTPUT1 of OUTPUT-XBAR</p> <p>0: Respective output of Mux27 is disabled to drive the OUTPUT1 of OUTPUT-XBAR</p> <p>1: Respective output of Mux27 is enabled to drive the OUTPUT1 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
26	MUX26	R/W	0h	<p>Selects the output of Mux26 to drive OUTPUT1 of OUTPUT-XBAR</p> <p>0: Respective output of Mux26 is disabled to drive the OUTPUT1 of OUTPUT-XBAR</p> <p>1: Respective output of Mux26 is enabled to drive the OUTPUT1 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
25	MUX25	R/W	0h	<p>Selects the output of Mux25 to drive OUTPUT1 of OUTPUT-XBAR</p> <p>0: Respective output of Mux25 is disabled to drive the OUTPUT1 of OUTPUT-XBAR</p> <p>1: Respective output of Mux25 is enabled to drive the OUTPUT1 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
24	MUX24	R/W	0h	<p>Selects the output of Mux24 to drive OUTPUT1 of OUTPUT-XBAR</p> <p>0: Respective output of Mux24 is disabled to drive the OUTPUT1 of OUTPUT-XBAR</p> <p>1: Respective output of Mux24 is enabled to drive the OUTPUT1 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
23	MUX23	R/W	0h	<p>Selects the output of Mux23 to drive OUTPUT1 of OUTPUT-XBAR</p> <p>0: Respective output of Mux23 is disabled to drive the OUTPUT1 of OUTPUT-XBAR</p> <p>1: Respective output of Mux23 is enabled to drive the OUTPUT1 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
22	MUX22	R/W	0h	<p>Selects the output of Mux22 to drive OUTPUT1 of OUTPUT-XBAR</p> <p>0: Respective output of Mux22 is disabled to drive the OUTPUT1 of OUTPUT-XBAR</p> <p>1: Respective output of Mux22 is enabled to drive the OUTPUT1 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
21	MUX21	R/W	0h	<p>Selects the output of Mux21 to drive OUTPUT1 of OUTPUT-XBAR</p> <p>0: Respective output of Mux21 is disabled to drive the OUTPUT1 of OUTPUT-XBAR</p> <p>1: Respective output of Mux21 is enabled to drive the OUTPUT1 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>

**Table 7-76. OUTPUT1MUXENABLE Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
20	MUX20	R/W	0h	<p>Selects the output of Mux20 to drive OUTPUT1 of OUTPUT-XBAR</p> <p>0: Respective output of Mux20 is disabled to drive the OUTPUT1 of OUTPUT-XBAR</p> <p>1: Respective output of Mux20 is enabled to drive the OUTPUT1 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
19	MUX19	R/W	0h	<p>Selects the output of Mux19 to drive OUTPUT1 of OUTPUT-XBAR</p> <p>0: Respective output of Mux19 is disabled to drive the OUTPUT1 of OUTPUT-XBAR</p> <p>1: Respective output of Mux19 is enabled to drive the OUTPUT1 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
18	MUX18	R/W	0h	<p>Selects the output of Mux18 to drive OUTPUT1 of OUTPUT-XBAR</p> <p>0: Respective output of Mux18 is disabled to drive the OUTPUT1 of OUTPUT-XBAR</p> <p>1: Respective output of Mux18 is enabled to drive the OUTPUT1 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
17	MUX17	R/W	0h	<p>Selects the output of Mux17 to drive OUTPUT1 of OUTPUT-XBAR</p> <p>0: Respective output of Mux17 is disabled to drive the OUTPUT1 of OUTPUT-XBAR</p> <p>1: Respective output of Mux17 is enabled to drive the OUTPUT1 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
16	MUX16	R/W	0h	<p>Selects the output of Mux16 to drive OUTPUT1 of OUTPUT-XBAR</p> <p>0: Respective output of Mux16 is disabled to drive the OUTPUT1 of OUTPUT-XBAR</p> <p>1: Respective output of Mux16 is enabled to drive the OUTPUT1 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
15	MUX15	R/W	0h	<p>Selects the output of Mux15 to drive OUTPUT1 of OUTPUT-XBAR</p> <p>0: Respective output of Mux15 is disabled to drive the OUTPUT1 of OUTPUT-XBAR</p> <p>1: Respective output of Mux15 is enabled to drive the OUTPUT1 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
14	MUX14	R/W	0h	<p>Selects the output of Mux14 to drive OUTPUT1 of OUTPUT-XBAR</p> <p>0: Respective output of Mux14 is disabled to drive the OUTPUT1 of OUTPUT-XBAR</p> <p>1: Respective output of Mux14 is enabled to drive the OUTPUT1 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>

**Table 7-76. OUTPUT1MUXENABLE Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
13	MUX13	R/W	0h	<p>Selects the output of Mux13 to drive OUTPUT1 of OUTPUT-XBAR</p> <p>0: Respective output of Mux13 is disabled to drive the OUTPUT1 of OUTPUT-XBAR</p> <p>1: Respective output of Mux13 is enabled to drive the OUTPUT1 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
12	MUX12	R/W	0h	<p>Selects the output of Mux12 to drive OUTPUT1 of OUTPUT-XBAR</p> <p>0: Respective output of Mux12 is disabled to drive the OUTPUT1 of OUTPUT-XBAR</p> <p>1: Respective output of Mux12 is enabled to drive the OUTPUT1 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
11	MUX11	R/W	0h	<p>Selects the output of Mux11 to drive OUTPUT1 of OUTPUT-XBAR</p> <p>0: Respective output of Mux11 is disabled to drive the OUTPUT1 of OUTPUT-XBAR</p> <p>1: Respective output of Mux11 is enabled to drive the OUTPUT1 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
10	MUX10	R/W	0h	<p>Selects the output of Mux10 to drive OUTPUT1 of OUTPUT-XBAR</p> <p>0: Respective output of Mux10 is disabled to drive the OUTPUT1 of OUTPUT-XBAR</p> <p>1: Respective output of Mux10 is enabled to drive the OUTPUT1 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
9	MUX9	R/W	0h	<p>Selects the output of Mux9 to drive OUTPUT1 of OUTPUT-XBAR</p> <p>0: Respective output of Mux9 is disabled to drive the OUTPUT1 of OUTPUT-XBAR</p> <p>1: Respective output of Mux9 is enabled to drive the OUTPUT1 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
8	MUX8	R/W	0h	<p>Selects the output of Mux8 to drive OUTPUT1 of OUTPUT-XBAR</p> <p>0: Respective output of Mux8 is disabled to drive the OUTPUT1 of OUTPUT-XBAR</p> <p>1: Respective output of Mux8 is enabled to drive the OUTPUT1 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
7	MUX7	R/W	0h	<p>Selects the output of Mux7 to drive OUTPUT1 of OUTPUT-XBAR</p> <p>0: Respective output of Mux7 is disabled to drive the OUTPUT1 of OUTPUT-XBAR</p> <p>1: Respective output of Mux7 is enabled to drive the OUTPUT1 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>



**Table 7-76. OUTPUT1MUXENABLE Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
6	MUX6	R/W	0h	<p>Selects the output of Mux6 to drive OUTPUT1 of OUTPUT-XBAR</p> <p>0: Respective output of Mux6 is disabled to drive the OUTPUT1 of OUTPUT-XBAR</p> <p>1: Respective output of Mux6 is enabled to drive the OUTPUT1 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
5	MUX5	R/W	0h	<p>Selects the output of Mux5 to drive OUTPUT1 of OUTPUT-XBAR</p> <p>0: Respective output of Mux5 is disabled to drive the OUTPUT1 of OUTPUT-XBAR</p> <p>1: Respective output of Mux5 is enabled to drive the OUTPUT1 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
4	MUX4	R/W	0h	<p>Selects the output of Mux4 to drive OUTPUT1 of OUTPUT-XBAR</p> <p>0: Respective output of Mux4 is disabled to drive the OUTPUT1 of OUTPUT-XBAR</p> <p>1: Respective output of Mux4 is enabled to drive the OUTPUT1 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
3	MUX3	R/W	0h	<p>Selects the output of Mux3 to drive OUTPUT1 of OUTPUT-XBAR</p> <p>0: Respective output of Mux3 is disabled to drive the OUTPUT1 of OUTPUT-XBAR</p> <p>1: Respective output of Mux3 is enabled to drive the OUTPUT1 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
2	MUX2	R/W	0h	<p>Selects the output of Mux2 to drive OUTPUT1 of OUTPUT-XBAR</p> <p>0: Respective output of Mux2 is disabled to drive the OUTPUT1 of OUTPUT-XBAR</p> <p>1: Respective output of Mux2 is enabled to drive the OUTPUT1 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
1	MUX1	R/W	0h	<p>Selects the output of Mux1 to drive OUTPUT1 of OUTPUT-XBAR</p> <p>0: Respective output of Mux1 is disabled to drive the OUTPUT1 of OUTPUT-XBAR</p> <p>1: Respective output of Mux1 is enabled to drive the OUTPUT1 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
0	MUX0	R/W	0h	<p>Selects the output of mux0 to drive OUTPUT1 of OUTPUT-XBAR</p> <p>0: Respective output of Mux0 is disabled to drive the OUTPUT1 of OUTPUT-XBAR</p> <p>1: Respective output of Mux0 is enabled to drive the OUTPUT1 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>

**7.3.5.18 OUTPUT2MUXENABLE Register (Offset = 22h) [reset = 0h]**

OUTPUT2MUXENABLE is shown in [Figure 7-69](#) and described in [Table 7-77](#).

Return to [Summary Table](#).

Output X-BAR Mux Enable for Output 2

**Figure 7-69. OUTPUT2MUXENABLE Register**

31		30		29		28		27		26		25		24	
MUX31	MUX30	MUX29	MUX28	MUX27	MUX26	MUX25	MUX24	MUX23	MUX22	MUX21	MUX20	MUX19	MUX18	MUX17	MUX16
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
23		22		21		20		19		18		17		16	
MUX23	MUX22	MUX21	MUX20	MUX19	MUX18	MUX17	MUX16	MUX15	MUX14	MUX13	MUX12	MUX11	MUX10	MUX9	MUX8
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
15		14		13		12		11		10		9		8	
MUX15	MUX14	MUX13	MUX12	MUX11	MUX10	MUX9	MUX8	MUX7	MUX6	MUX5	MUX4	MUX3	MUX2	MUX1	MUX0
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
7		6		5		4		3		2		1		0	
MUX7	MUX6	MUX5	MUX4	MUX3	MUX2	MUX1	MUX0	MUX7	MUX6	MUX5	MUX4	MUX3	MUX2	MUX1	MUX0
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h

**Table 7-77. OUTPUT2MUXENABLE Register Field Descriptions**

Bit	Field	Type	Reset	Description
31	MUX31	R/W	0h	Selects the output of Mux31 to drive OUTPUT2 of OUTPUT-XBAR  0: Respective output of Mux31 is disabled to drive the OUTPUT2 of OUTPUT-XBAR 1: Respective output of Mux31 is enabled to drive the OUTPUT2 of OUTPUT-XBAR  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
30	MUX30	R/W	0h	Selects the output of Mux30 to drive OUTPUT2 of OUTPUT-XBAR  0: Respective output of Mux30 is disabled to drive the OUTPUT2 of OUTPUT-XBAR 1: Respective output of Mux30 is enabled to drive the OUTPUT2 of OUTPUT-XBAR  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
29	MUX29	R/W	0h	Selects the output of Mux29 to drive OUTPUT2 of OUTPUT-XBAR  0: Respective output of Mux29 is disabled to drive the OUTPUT2 of OUTPUT-XBAR 1: Respective output of Mux29 is enabled to drive the OUTPUT2 of OUTPUT-XBAR  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
28	MUX28	R/W	0h	Selects the output of Mux28 to drive OUTPUT2 of OUTPUT-XBAR  0: Respective output of Mux28 is disabled to drive the OUTPUT2 of OUTPUT-XBAR 1: Respective output of Mux28 is enabled to drive the OUTPUT2 of OUTPUT-XBAR  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn

**Table 7-77. OUTPUT2MUXENABLE Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
27	MUX27	R/W	0h	<p>Selects the output of Mux27 to drive OUTPUT2 of OUTPUT-XBAR</p> <p>0: Respective output of Mux27 is disabled to drive the OUTPUT2 of OUTPUT-XBAR</p> <p>1: Respective output of Mux27 is enabled to drive the OUTPUT2 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
26	MUX26	R/W	0h	<p>Selects the output of Mux26 to drive OUTPUT2 of OUTPUT-XBAR</p> <p>0: Respective output of Mux26 is disabled to drive the OUTPUT2 of OUTPUT-XBAR</p> <p>1: Respective output of Mux26 is enabled to drive the OUTPUT2 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
25	MUX25	R/W	0h	<p>Selects the output of Mux25 to drive OUTPUT2 of OUTPUT-XBAR</p> <p>0: Respective output of Mux25 is disabled to drive the OUTPUT2 of OUTPUT-XBAR</p> <p>1: Respective output of Mux25 is enabled to drive the OUTPUT2 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
24	MUX24	R/W	0h	<p>Selects the output of Mux24 to drive OUTPUT2 of OUTPUT-XBAR</p> <p>0: Respective output of Mux24 is disabled to drive the OUTPUT2 of OUTPUT-XBAR</p> <p>1: Respective output of Mux24 is enabled to drive the OUTPUT2 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
23	MUX23	R/W	0h	<p>Selects the output of Mux23 to drive OUTPUT2 of OUTPUT-XBAR</p> <p>0: Respective output of Mux23 is disabled to drive the OUTPUT2 of OUTPUT-XBAR</p> <p>1: Respective output of Mux23 is enabled to drive the OUTPUT2 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
22	MUX22	R/W	0h	<p>Selects the output of Mux22 to drive OUTPUT2 of OUTPUT-XBAR</p> <p>0: Respective output of Mux22 is disabled to drive the OUTPUT2 of OUTPUT-XBAR</p> <p>1: Respective output of Mux22 is enabled to drive the OUTPUT2 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
21	MUX21	R/W	0h	<p>Selects the output of Mux21 to drive OUTPUT2 of OUTPUT-XBAR</p> <p>0: Respective output of Mux21 is disabled to drive the OUTPUT2 of OUTPUT-XBAR</p> <p>1: Respective output of Mux21 is enabled to drive the OUTPUT2 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>

**Table 7-77. OUTPUT2MUXENABLE Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
20	MUX20	R/W	0h	<p>Selects the output of Mux20 to drive OUTPUT2 of OUTPUT-XBAR</p> <p>0: Respective output of Mux20 is disabled to drive the OUTPUT2 of OUTPUT-XBAR</p> <p>1: Respective output of Mux20 is enabled to drive the OUTPUT2 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
19	MUX19	R/W	0h	<p>Selects the output of Mux19 to drive OUTPUT2 of OUTPUT-XBAR</p> <p>0: Respective output of Mux19 is disabled to drive the OUTPUT2 of OUTPUT-XBAR</p> <p>1: Respective output of Mux19 is enabled to drive the OUTPUT2 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
18	MUX18	R/W	0h	<p>Selects the output of Mux18 to drive OUTPUT2 of OUTPUT-XBAR</p> <p>0: Respective output of Mux18 is disabled to drive the OUTPUT2 of OUTPUT-XBAR</p> <p>1: Respective output of Mux18 is enabled to drive the OUTPUT2 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
17	MUX17	R/W	0h	<p>Selects the output of Mux17 to drive OUTPUT2 of OUTPUT-XBAR</p> <p>0: Respective output of Mux17 is disabled to drive the OUTPUT2 of OUTPUT-XBAR</p> <p>1: Respective output of Mux17 is enabled to drive the OUTPUT2 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
16	MUX16	R/W	0h	<p>Selects the output of Mux16 to drive OUTPUT2 of OUTPUT-XBAR</p> <p>0: Respective output of Mux16 is disabled to drive the OUTPUT2 of OUTPUT-XBAR</p> <p>1: Respective output of Mux16 is enabled to drive the OUTPUT2 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
15	MUX15	R/W	0h	<p>Selects the output of Mux15 to drive OUTPUT2 of OUTPUT-XBAR</p> <p>0: Respective output of Mux15 is disabled to drive the OUTPUT2 of OUTPUT-XBAR</p> <p>1: Respective output of Mux15 is enabled to drive the OUTPUT2 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
14	MUX14	R/W	0h	<p>Selects the output of Mux14 to drive OUTPUT2 of OUTPUT-XBAR</p> <p>0: Respective output of Mux14 is disabled to drive the OUTPUT2 of OUTPUT-XBAR</p> <p>1: Respective output of Mux14 is enabled to drive the OUTPUT2 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>

**Table 7-77. OUTPUT2MUXENABLE Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
13	MUX13	R/W	0h	<p>Selects the output of Mux13 to drive OUTPUT2 of OUTPUT-XBAR</p> <p>0: Respective output of Mux13 is disabled to drive the OUTPUT2 of OUTPUT-XBAR</p> <p>1: Respective output of Mux13 is enabled to drive the OUTPUT2 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
12	MUX12	R/W	0h	<p>Selects the output of Mux12 to drive OUTPUT2 of OUTPUT-XBAR</p> <p>0: Respective output of Mux12 is disabled to drive the OUTPUT2 of OUTPUT-XBAR</p> <p>1: Respective output of Mux12 is enabled to drive the OUTPUT2 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
11	MUX11	R/W	0h	<p>Selects the output of Mux11 to drive OUTPUT2 of OUTPUT-XBAR</p> <p>0: Respective output of Mux11 is disabled to drive the OUTPUT2 of OUTPUT-XBAR</p> <p>1: Respective output of Mux11 is enabled to drive the OUTPUT2 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
10	MUX10	R/W	0h	<p>Selects the output of Mux10 to drive OUTPUT2 of OUTPUT-XBAR</p> <p>0: Respective output of Mux10 is disabled to drive the OUTPUT2 of OUTPUT-XBAR</p> <p>1: Respective output of Mux10 is enabled to drive the OUTPUT2 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
9	MUX9	R/W	0h	<p>Selects the output of Mux9 to drive OUTPUT2 of OUTPUT-XBAR</p> <p>0: Respective output of Mux9 is disabled to drive the OUTPUT2 of OUTPUT-XBAR</p> <p>1: Respective output of Mux9 is enabled to drive the OUTPUT2 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
8	MUX8	R/W	0h	<p>Selects the output of Mux8 to drive OUTPUT2 of OUTPUT-XBAR</p> <p>0: Respective output of Mux8 is disabled to drive the OUTPUT2 of OUTPUT-XBAR</p> <p>1: Respective output of Mux8 is enabled to drive the OUTPUT2 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
7	MUX7	R/W	0h	<p>Selects the output of Mux7 to drive OUTPUT2 of OUTPUT-XBAR</p> <p>0: Respective output of Mux7 is disabled to drive the OUTPUT2 of OUTPUT-XBAR</p> <p>1: Respective output of Mux7 is enabled to drive the OUTPUT2 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>

**Table 7-77. OUTPUT2MUXENABLE Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
6	MUX6	R/W	0h	<p>Selects the output of Mux6 to drive OUTPUT2 of OUTPUT-XBAR</p> <p>0: Respective output of Mux6 is disabled to drive the OUTPUT2 of OUTPUT-XBAR</p> <p>1: Respective output of Mux6 is enabled to drive the OUTPUT2 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
5	MUX5	R/W	0h	<p>Selects the output of Mux5 to drive OUTPUT2 of OUTPUT-XBAR</p> <p>0: Respective output of Mux5 is disabled to drive the OUTPUT2 of OUTPUT-XBAR</p> <p>1: Respective output of Mux5 is enabled to drive the OUTPUT2 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
4	MUX4	R/W	0h	<p>Selects the output of Mux4 to drive OUTPUT2 of OUTPUT-XBAR</p> <p>0: Respective output of Mux4 is disabled to drive the OUTPUT2 of OUTPUT-XBAR</p> <p>1: Respective output of Mux4 is enabled to drive the OUTPUT2 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
3	MUX3	R/W	0h	<p>Selects the output of Mux3 to drive OUTPUT2 of OUTPUT-XBAR</p> <p>0: Respective output of Mux3 is disabled to drive the OUTPUT2 of OUTPUT-XBAR</p> <p>1: Respective output of Mux3 is enabled to drive the OUTPUT2 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
2	MUX2	R/W	0h	<p>Selects the output of Mux2 to drive OUTPUT2 of OUTPUT-XBAR</p> <p>0: Respective output of Mux2 is disabled to drive the OUTPUT2 of OUTPUT-XBAR</p> <p>1: Respective output of Mux2 is enabled to drive the OUTPUT2 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
1	MUX1	R/W	0h	<p>Selects the output of Mux1 to drive OUTPUT2 of OUTPUT-XBAR</p> <p>0: Respective output of Mux1 is disabled to drive the OUTPUT2 of OUTPUT-XBAR</p> <p>1: Respective output of Mux1 is enabled to drive the OUTPUT2 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
0	MUX0	R/W	0h	<p>Selects the output of mux0 to drive OUTPUT2 of OUTPUT-XBAR</p> <p>0: Respective output of Mux0 is disabled to drive the OUTPUT2 of OUTPUT-XBAR</p> <p>1: Respective output of Mux0 is enabled to drive the OUTPUT2 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>

### 7.3.5.19 OUTPUT3MUXENABLE Register (Offset = 24h) [reset = 0h]

OUTPUT3MUXENABLE is shown in [Figure 7-70](#) and described in [Table 7-78](#).

Return to [Summary Table](#).

Output X-BAR Mux Enable for Output 3

**Figure 7-70. OUTPUT3MUXENABLE Register**

31	30	29	28	27	26	25	24
MUX31	MUX30	MUX29	MUX28	MUX27	MUX26	MUX25	MUX24
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
23	22	21	20	19	18	17	16
MUX23	MUX22	MUX21	MUX20	MUX19	MUX18	MUX17	MUX16
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
15	14	13	12	11	10	9	8
MUX15	MUX14	MUX13	MUX12	MUX11	MUX10	MUX9	MUX8
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
7	6	5	4	3	2	1	0
MUX7	MUX6	MUX5	MUX4	MUX3	MUX2	MUX1	MUX0
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h

**Table 7-78. OUTPUT3MUXENABLE Register Field Descriptions**

Bit	Field	Type	Reset	Description
31	MUX31	R/W	0h	<p>Selects the output of Mux31 to drive OUTPUT3 of OUTPUT-XBAR</p> <p>0: Respective output of Mux31 is disabled to drive the OUTPUT3 of OUTPUT-XBAR</p> <p>1: Respective output of Mux31 is enabled to drive the OUTPUT3 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details.</p> <p>Reset type: CPU1.SYSRSn</p>
30	MUX30	R/W	0h	<p>Selects the output of Mux30 to drive OUTPUT3 of OUTPUT-XBAR</p> <p>0: Respective output of Mux30 is disabled to drive the OUTPUT3 of OUTPUT-XBAR</p> <p>1: Respective output of Mux30 is enabled to drive the OUTPUT3 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details.</p> <p>Reset type: CPU1.SYSRSn</p>
29	MUX29	R/W	0h	<p>Selects the output of Mux29 to drive OUTPUT3 of OUTPUT-XBAR</p> <p>0: Respective output of Mux29 is disabled to drive the OUTPUT3 of OUTPUT-XBAR</p> <p>1: Respective output of Mux29 is enabled to drive the OUTPUT3 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details.</p> <p>Reset type: CPU1.SYSRSn</p>
28	MUX28	R/W	0h	<p>Selects the output of Mux28 to drive OUTPUT3 of OUTPUT-XBAR</p> <p>0: Respective output of Mux28 is disabled to drive the OUTPUT3 of OUTPUT-XBAR</p> <p>1: Respective output of Mux28 is enabled to drive the OUTPUT3 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details.</p> <p>Reset type: CPU1.SYSRSn</p>

**Table 7-78. OUTPUT3MUXENABLE Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
27	MUX27	R/W	0h	<p>Selects the output of Mux27 to drive OUTPUT3 of OUTPUT-XBAR</p> <p>0: Respective output of Mux27 is disabled to drive the OUTPUT3 of OUTPUT-XBAR</p> <p>1: Respective output of Mux27 is enabled to drive the OUTPUT3 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
26	MUX26	R/W	0h	<p>Selects the output of Mux26 to drive OUTPUT3 of OUTPUT-XBAR</p> <p>0: Respective output of Mux26 is disabled to drive the OUTPUT3 of OUTPUT-XBAR</p> <p>1: Respective output of Mux26 is enabled to drive the OUTPUT3 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
25	MUX25	R/W	0h	<p>Selects the output of Mux25 to drive OUTPUT3 of OUTPUT-XBAR</p> <p>0: Respective output of Mux25 is disabled to drive the OUTPUT3 of OUTPUT-XBAR</p> <p>1: Respective output of Mux25 is enabled to drive the OUTPUT3 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
24	MUX24	R/W	0h	<p>Selects the output of Mux24 to drive OUTPUT3 of OUTPUT-XBAR</p> <p>0: Respective output of Mux24 is disabled to drive the OUTPUT3 of OUTPUT-XBAR</p> <p>1: Respective output of Mux24 is enabled to drive the OUTPUT3 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
23	MUX23	R/W	0h	<p>Selects the output of Mux23 to drive OUTPUT3 of OUTPUT-XBAR</p> <p>0: Respective output of Mux23 is disabled to drive the OUTPUT3 of OUTPUT-XBAR</p> <p>1: Respective output of Mux23 is enabled to drive the OUTPUT3 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
22	MUX22	R/W	0h	<p>Selects the output of Mux22 to drive OUTPUT3 of OUTPUT-XBAR</p> <p>0: Respective output of Mux22 is disabled to drive the OUTPUT3 of OUTPUT-XBAR</p> <p>1: Respective output of Mux22 is enabled to drive the OUTPUT3 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
21	MUX21	R/W	0h	<p>Selects the output of Mux21 to drive OUTPUT3 of OUTPUT-XBAR</p> <p>0: Respective output of Mux21 is disabled to drive the OUTPUT3 of OUTPUT-XBAR</p> <p>1: Respective output of Mux21 is enabled to drive the OUTPUT3 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>



**Table 7-78. OUTPUT3MUXENABLE Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
20	MUX20	R/W	0h	<p>Selects the output of Mux20 to drive OUTPUT3 of OUTPUT-XBAR</p> <p>0: Respective output of Mux20 is disabled to drive the OUTPUT3 of OUTPUT-XBAR</p> <p>1: Respective output of Mux20 is enabled to drive the OUTPUT3 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
19	MUX19	R/W	0h	<p>Selects the output of Mux19 to drive OUTPUT3 of OUTPUT-XBAR</p> <p>0: Respective output of Mux19 is disabled to drive the OUTPUT3 of OUTPUT-XBAR</p> <p>1: Respective output of Mux19 is enabled to drive the OUTPUT3 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
18	MUX18	R/W	0h	<p>Selects the output of Mux18 to drive OUTPUT3 of OUTPUT-XBAR</p> <p>0: Respective output of Mux18 is disabled to drive the OUTPUT3 of OUTPUT-XBAR</p> <p>1: Respective output of Mux18 is enabled to drive the OUTPUT3 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
17	MUX17	R/W	0h	<p>Selects the output of Mux17 to drive OUTPUT3 of OUTPUT-XBAR</p> <p>0: Respective output of Mux17 is disabled to drive the OUTPUT3 of OUTPUT-XBAR</p> <p>1: Respective output of Mux17 is enabled to drive the OUTPUT3 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
16	MUX16	R/W	0h	<p>Selects the output of Mux16 to drive OUTPUT3 of OUTPUT-XBAR</p> <p>0: Respective output of Mux16 is disabled to drive the OUTPUT3 of OUTPUT-XBAR</p> <p>1: Respective output of Mux16 is enabled to drive the OUTPUT3 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
15	MUX15	R/W	0h	<p>Selects the output of Mux15 to drive OUTPUT3 of OUTPUT-XBAR</p> <p>0: Respective output of Mux15 is disabled to drive the OUTPUT3 of OUTPUT-XBAR</p> <p>1: Respective output of Mux15 is enabled to drive the OUTPUT3 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
14	MUX14	R/W	0h	<p>Selects the output of Mux14 to drive OUTPUT3 of OUTPUT-XBAR</p> <p>0: Respective output of Mux14 is disabled to drive the OUTPUT3 of OUTPUT-XBAR</p> <p>1: Respective output of Mux14 is enabled to drive the OUTPUT3 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>

**Table 7-78. OUTPUT3MUXENABLE Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
13	MUX13	R/W	0h	<p>Selects the output of Mux13 to drive OUTPUT3 of OUTPUT-XBAR</p> <p>0: Respective output of Mux13 is disabled to drive the OUTPUT3 of OUTPUT-XBAR</p> <p>1: Respective output of Mux13 is enabled to drive the OUTPUT3 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
12	MUX12	R/W	0h	<p>Selects the output of Mux12 to drive OUTPUT3 of OUTPUT-XBAR</p> <p>0: Respective output of Mux12 is disabled to drive the OUTPUT3 of OUTPUT-XBAR</p> <p>1: Respective output of Mux12 is enabled to drive the OUTPUT3 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
11	MUX11	R/W	0h	<p>Selects the output of Mux11 to drive OUTPUT3 of OUTPUT-XBAR</p> <p>0: Respective output of Mux11 is disabled to drive the OUTPUT3 of OUTPUT-XBAR</p> <p>1: Respective output of Mux11 is enabled to drive the OUTPUT3 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
10	MUX10	R/W	0h	<p>Selects the output of Mux10 to drive OUTPUT3 of OUTPUT-XBAR</p> <p>0: Respective output of Mux10 is disabled to drive the OUTPUT3 of OUTPUT-XBAR</p> <p>1: Respective output of Mux10 is enabled to drive the OUTPUT3 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
9	MUX9	R/W	0h	<p>Selects the output of Mux9 to drive OUTPUT3 of OUTPUT-XBAR</p> <p>0: Respective output of Mux9 is disabled to drive the OUTPUT3 of OUTPUT-XBAR</p> <p>1: Respective output of Mux9 is enabled to drive the OUTPUT3 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
8	MUX8	R/W	0h	<p>Selects the output of Mux8 to drive OUTPUT3 of OUTPUT-XBAR</p> <p>0: Respective output of Mux8 is disabled to drive the OUTPUT3 of OUTPUT-XBAR</p> <p>1: Respective output of Mux8 is enabled to drive the OUTPUT3 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
7	MUX7	R/W	0h	<p>Selects the output of Mux7 to drive OUTPUT3 of OUTPUT-XBAR</p> <p>0: Respective output of Mux7 is disabled to drive the OUTPUT3 of OUTPUT-XBAR</p> <p>1: Respective output of Mux7 is enabled to drive the OUTPUT3 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>

**Table 7-78. OUTPUT3MUXENABLE Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
6	MUX6	R/W	0h	<p>Selects the output of Mux6 to drive OUTPUT3 of OUTPUT-XBAR</p> <p>0: Respective output of Mux6 is disabled to drive the OUTPUT3 of OUTPUT-XBAR</p> <p>1: Respective output of Mux6 is enabled to drive the OUTPUT3 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
5	MUX5	R/W	0h	<p>Selects the output of Mux5 to drive OUTPUT3 of OUTPUT-XBAR</p> <p>0: Respective output of Mux5 is disabled to drive the OUTPUT3 of OUTPUT-XBAR</p> <p>1: Respective output of Mux5 is enabled to drive the OUTPUT3 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
4	MUX4	R/W	0h	<p>Selects the output of Mux4 to drive OUTPUT3 of OUTPUT-XBAR</p> <p>0: Respective output of Mux4 is disabled to drive the OUTPUT3 of OUTPUT-XBAR</p> <p>1: Respective output of Mux4 is enabled to drive the OUTPUT3 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
3	MUX3	R/W	0h	<p>Selects the output of Mux3 to drive OUTPUT3 of OUTPUT-XBAR</p> <p>0: Respective output of Mux3 is disabled to drive the OUTPUT3 of OUTPUT-XBAR</p> <p>1: Respective output of Mux3 is enabled to drive the OUTPUT3 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
2	MUX2	R/W	0h	<p>Selects the output of Mux2 to drive OUTPUT3 of OUTPUT-XBAR</p> <p>0: Respective output of Mux2 is disabled to drive the OUTPUT3 of OUTPUT-XBAR</p> <p>1: Respective output of Mux2 is enabled to drive the OUTPUT3 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
1	MUX1	R/W	0h	<p>Selects the output of Mux1 to drive OUTPUT3 of OUTPUT-XBAR</p> <p>0: Respective output of Mux1 is disabled to drive the OUTPUT3 of OUTPUT-XBAR</p> <p>1: Respective output of Mux1 is enabled to drive the OUTPUT3 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
0	MUX0	R/W	0h	<p>Selects the output of mux0 to drive OUTPUT3 of OUTPUT-XBAR</p> <p>0: Respective output of Mux0 is disabled to drive the OUTPUT3 of OUTPUT-XBAR</p> <p>1: Respective output of Mux0 is enabled to drive the OUTPUT3 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>

### 7.3.5.20 OUTPUT4MUXENABLE Register (Offset = 26h) [reset = 0h]

OUTPUT4MUXENABLE is shown in [Figure 7-71](#) and described in [Table 7-79](#).

Return to [Summary Table](#).

Output X-BAR Mux Enable for Output 4

**Figure 7-71. OUTPUT4MUXENABLE Register**

31		30		29		28		27		26		25		24	
MUX31	MUX30	MUX29	MUX28	MUX27	MUX26	MUX25	MUX24	MUX23	MUX22	MUX21	MUX20	MUX19	MUX18	MUX17	MUX16
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
23		22		21		20		19		18		17		16	
MUX23	MUX22	MUX21	MUX20	MUX19	MUX18	MUX17	MUX16	MUX15	MUX14	MUX13	MUX12	MUX11	MUX10	MUX9	MUX8
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
15		14		13		12		11		10		9		8	
MUX15	MUX14	MUX13	MUX12	MUX11	MUX10	MUX9	MUX8	MUX7	MUX6	MUX5	MUX4	MUX3	MUX2	MUX1	MUX0
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
7		6		5		4		3		2		1		0	
MUX7	MUX6	MUX5	MUX4	MUX3	MUX2	MUX1	MUX0	MUX7	MUX6	MUX5	MUX4	MUX3	MUX2	MUX1	MUX0
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h

**Table 7-79. OUTPUT4MUXENABLE Register Field Descriptions**

Bit	Field	Type	Reset	Description
31	MUX31	R/W	0h	Selects the output of Mux31 to drive OUTPUT4 of OUTPUT-XBAR  0: Respective output of Mux31 is disabled to drive the OUTPUT4 of OUTPUT-XBAR 1: Respective output of Mux31 is enabled to drive the OUTPUT4 of OUTPUT-XBAR  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
30	MUX30	R/W	0h	Selects the output of Mux30 to drive OUTPUT4 of OUTPUT-XBAR  0: Respective output of Mux30 is disabled to drive the OUTPUT4 of OUTPUT-XBAR 1: Respective output of Mux30 is enabled to drive the OUTPUT4 of OUTPUT-XBAR  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
29	MUX29	R/W	0h	Selects the output of Mux29 to drive OUTPUT4 of OUTPUT-XBAR  0: Respective output of Mux29 is disabled to drive the OUTPUT4 of OUTPUT-XBAR 1: Respective output of Mux29 is enabled to drive the OUTPUT4 of OUTPUT-XBAR  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
28	MUX28	R/W	0h	Selects the output of Mux28 to drive OUTPUT4 of OUTPUT-XBAR  0: Respective output of Mux28 is disabled to drive the OUTPUT4 of OUTPUT-XBAR 1: Respective output of Mux28 is enabled to drive the OUTPUT4 of OUTPUT-XBAR  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn

**Table 7-79. OUTPUT4MUXENABLE Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
27	MUX27	R/W	0h	<p>Selects the output of Mux27 to drive OUTPUT4 of OUTPUT-XBAR</p> <p>0: Respective output of Mux27 is disabled to drive the OUTPUT4 of OUTPUT-XBAR</p> <p>1: Respective output of Mux27 is enabled to drive the OUTPUT4 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
26	MUX26	R/W	0h	<p>Selects the output of Mux26 to drive OUTPUT4 of OUTPUT-XBAR</p> <p>0: Respective output of Mux26 is disabled to drive the OUTPUT4 of OUTPUT-XBAR</p> <p>1: Respective output of Mux26 is enabled to drive the OUTPUT4 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
25	MUX25	R/W	0h	<p>Selects the output of Mux25 to drive OUTPUT4 of OUTPUT-XBAR</p> <p>0: Respective output of Mux25 is disabled to drive the OUTPUT4 of OUTPUT-XBAR</p> <p>1: Respective output of Mux25 is enabled to drive the OUTPUT4 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
24	MUX24	R/W	0h	<p>Selects the output of Mux24 to drive OUTPUT4 of OUTPUT-XBAR</p> <p>0: Respective output of Mux24 is disabled to drive the OUTPUT4 of OUTPUT-XBAR</p> <p>1: Respective output of Mux24 is enabled to drive the OUTPUT4 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
23	MUX23	R/W	0h	<p>Selects the output of Mux23 to drive OUTPUT4 of OUTPUT-XBAR</p> <p>0: Respective output of Mux23 is disabled to drive the OUTPUT4 of OUTPUT-XBAR</p> <p>1: Respective output of Mux23 is enabled to drive the OUTPUT4 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
22	MUX22	R/W	0h	<p>Selects the output of Mux22 to drive OUTPUT4 of OUTPUT-XBAR</p> <p>0: Respective output of Mux22 is disabled to drive the OUTPUT4 of OUTPUT-XBAR</p> <p>1: Respective output of Mux22 is enabled to drive the OUTPUT4 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
21	MUX21	R/W	0h	<p>Selects the output of Mux21 to drive OUTPUT4 of OUTPUT-XBAR</p> <p>0: Respective output of Mux21 is disabled to drive the OUTPUT4 of OUTPUT-XBAR</p> <p>1: Respective output of Mux21 is enabled to drive the OUTPUT4 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>

**Table 7-79. OUTPUT4MUXENABLE Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
20	MUX20	R/W	0h	<p>Selects the output of Mux20 to drive OUTPUT4 of OUTPUT-XBAR</p> <p>0: Respective output of Mux20 is disabled to drive the OUTPUT4 of OUTPUT-XBAR</p> <p>1: Respective output of Mux20 is enabled to drive the OUTPUT4 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
19	MUX19	R/W	0h	<p>Selects the output of Mux19 to drive OUTPUT4 of OUTPUT-XBAR</p> <p>0: Respective output of Mux19 is disabled to drive the OUTPUT4 of OUTPUT-XBAR</p> <p>1: Respective output of Mux19 is enabled to drive the OUTPUT4 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
18	MUX18	R/W	0h	<p>Selects the output of Mux18 to drive OUTPUT4 of OUTPUT-XBAR</p> <p>0: Respective output of Mux18 is disabled to drive the OUTPUT4 of OUTPUT-XBAR</p> <p>1: Respective output of Mux18 is enabled to drive the OUTPUT4 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
17	MUX17	R/W	0h	<p>Selects the output of Mux17 to drive OUTPUT4 of OUTPUT-XBAR</p> <p>0: Respective output of Mux17 is disabled to drive the OUTPUT4 of OUTPUT-XBAR</p> <p>1: Respective output of Mux17 is enabled to drive the OUTPUT4 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
16	MUX16	R/W	0h	<p>Selects the output of Mux16 to drive OUTPUT4 of OUTPUT-XBAR</p> <p>0: Respective output of Mux16 is disabled to drive the OUTPUT4 of OUTPUT-XBAR</p> <p>1: Respective output of Mux16 is enabled to drive the OUTPUT4 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
15	MUX15	R/W	0h	<p>Selects the output of Mux15 to drive OUTPUT4 of OUTPUT-XBAR</p> <p>0: Respective output of Mux15 is disabled to drive the OUTPUT4 of OUTPUT-XBAR</p> <p>1: Respective output of Mux15 is enabled to drive the OUTPUT4 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
14	MUX14	R/W	0h	<p>Selects the output of Mux14 to drive OUTPUT4 of OUTPUT-XBAR</p> <p>0: Respective output of Mux14 is disabled to drive the OUTPUT4 of OUTPUT-XBAR</p> <p>1: Respective output of Mux14 is enabled to drive the OUTPUT4 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>

**Table 7-79. OUTPUT4MUXENABLE Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
13	MUX13	R/W	0h	<p>Selects the output of Mux13 to drive OUTPUT4 of OUTPUT-XBAR</p> <p>0: Respective output of Mux13 is disabled to drive the OUTPUT4 of OUTPUT-XBAR</p> <p>1: Respective output of Mux13 is enabled to drive the OUTPUT4 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
12	MUX12	R/W	0h	<p>Selects the output of Mux12 to drive OUTPUT4 of OUTPUT-XBAR</p> <p>0: Respective output of Mux12 is disabled to drive the OUTPUT4 of OUTPUT-XBAR</p> <p>1: Respective output of Mux12 is enabled to drive the OUTPUT4 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
11	MUX11	R/W	0h	<p>Selects the output of Mux11 to drive OUTPUT4 of OUTPUT-XBAR</p> <p>0: Respective output of Mux11 is disabled to drive the OUTPUT4 of OUTPUT-XBAR</p> <p>1: Respective output of Mux11 is enabled to drive the OUTPUT4 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
10	MUX10	R/W	0h	<p>Selects the output of Mux10 to drive OUTPUT4 of OUTPUT-XBAR</p> <p>0: Respective output of Mux10 is disabled to drive the OUTPUT4 of OUTPUT-XBAR</p> <p>1: Respective output of Mux10 is enabled to drive the OUTPUT4 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
9	MUX9	R/W	0h	<p>Selects the output of Mux9 to drive OUTPUT4 of OUTPUT-XBAR</p> <p>0: Respective output of Mux9 is disabled to drive the OUTPUT4 of OUTPUT-XBAR</p> <p>1: Respective output of Mux9 is enabled to drive the OUTPUT4 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
8	MUX8	R/W	0h	<p>Selects the output of Mux8 to drive OUTPUT4 of OUTPUT-XBAR</p> <p>0: Respective output of Mux8 is disabled to drive the OUTPUT4 of OUTPUT-XBAR</p> <p>1: Respective output of Mux8 is enabled to drive the OUTPUT4 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
7	MUX7	R/W	0h	<p>Selects the output of Mux7 to drive OUTPUT4 of OUTPUT-XBAR</p> <p>0: Respective output of Mux7 is disabled to drive the OUTPUT4 of OUTPUT-XBAR</p> <p>1: Respective output of Mux7 is enabled to drive the OUTPUT4 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>

**Table 7-79. OUTPUT4MUXENABLE Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
6	MUX6	R/W	0h	<p>Selects the output of Mux6 to drive OUTPUT4 of OUTPUT-XBAR</p> <p>0: Respective output of Mux6 is disabled to drive the OUTPUT4 of OUTPUT-XBAR</p> <p>1: Respective output of Mux6 is enabled to drive the OUTPUT4 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
5	MUX5	R/W	0h	<p>Selects the output of Mux5 to drive OUTPUT4 of OUTPUT-XBAR</p> <p>0: Respective output of Mux5 is disabled to drive the OUTPUT4 of OUTPUT-XBAR</p> <p>1: Respective output of Mux5 is enabled to drive the OUTPUT4 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
4	MUX4	R/W	0h	<p>Selects the output of Mux4 to drive OUTPUT4 of OUTPUT-XBAR</p> <p>0: Respective output of Mux4 is disabled to drive the OUTPUT4 of OUTPUT-XBAR</p> <p>1: Respective output of Mux4 is enabled to drive the OUTPUT4 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
3	MUX3	R/W	0h	<p>Selects the output of Mux3 to drive OUTPUT4 of OUTPUT-XBAR</p> <p>0: Respective output of Mux3 is disabled to drive the OUTPUT4 of OUTPUT-XBAR</p> <p>1: Respective output of Mux3 is enabled to drive the OUTPUT4 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
2	MUX2	R/W	0h	<p>Selects the output of Mux2 to drive OUTPUT4 of OUTPUT-XBAR</p> <p>0: Respective output of Mux2 is disabled to drive the OUTPUT4 of OUTPUT-XBAR</p> <p>1: Respective output of Mux2 is enabled to drive the OUTPUT4 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
1	MUX1	R/W	0h	<p>Selects the output of Mux1 to drive OUTPUT4 of OUTPUT-XBAR</p> <p>0: Respective output of Mux1 is disabled to drive the OUTPUT4 of OUTPUT-XBAR</p> <p>1: Respective output of Mux1 is enabled to drive the OUTPUT4 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
0	MUX0	R/W	0h	<p>Selects the output of mux0 to drive OUTPUT4 of OUTPUT-XBAR</p> <p>0: Respective output of Mux0 is disabled to drive the OUTPUT4 of OUTPUT-XBAR</p> <p>1: Respective output of Mux0 is enabled to drive the OUTPUT4 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>



### 7.3.5.21 OUTPUT5MUXENABLE Register (Offset = 28h) [reset = 0h]

OUTPUT5MUXENABLE is shown in [Figure 7-72](#) and described in [Table 7-80](#).

Return to [Summary Table](#).

Output X-BAR Mux Enable for Output 5

**Figure 7-72. OUTPUT5MUXENABLE Register**

31	30	29	28	27	26	25	24
MUX31	MUX30	MUX29	MUX28	MUX27	MUX26	MUX25	MUX24
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
23	22	21	20	19	18	17	16
MUX23	MUX22	MUX21	MUX20	MUX19	MUX18	MUX17	MUX16
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
15	14	13	12	11	10	9	8
MUX15	MUX14	MUX13	MUX12	MUX11	MUX10	MUX9	MUX8
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
7	6	5	4	3	2	1	0
MUX7	MUX6	MUX5	MUX4	MUX3	MUX2	MUX1	MUX0
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h

**Table 7-80. OUTPUT5MUXENABLE Register Field Descriptions**

Bit	Field	Type	Reset	Description
31	MUX31	R/W	0h	<p>Selects the output of Mux31 to drive OUTPUT5 of OUTPUT-XBAR</p> <p>0: Respective output of Mux31 is disabled to drive the OUTPUT5 of OUTPUT-XBAR</p> <p>1: Respective output of Mux31 is enabled to drive the OUTPUT5 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
30	MUX30	R/W	0h	<p>Selects the output of Mux30 to drive OUTPUT5 of OUTPUT-XBAR</p> <p>0: Respective output of Mux30 is disabled to drive the OUTPUT5 of OUTPUT-XBAR</p> <p>1: Respective output of Mux30 is enabled to drive the OUTPUT5 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
29	MUX29	R/W	0h	<p>Selects the output of Mux29 to drive OUTPUT5 of OUTPUT-XBAR</p> <p>0: Respective output of Mux29 is disabled to drive the OUTPUT5 of OUTPUT-XBAR</p> <p>1: Respective output of Mux29 is enabled to drive the OUTPUT5 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
28	MUX28	R/W	0h	<p>Selects the output of Mux28 to drive OUTPUT5 of OUTPUT-XBAR</p> <p>0: Respective output of Mux28 is disabled to drive the OUTPUT5 of OUTPUT-XBAR</p> <p>1: Respective output of Mux28 is enabled to drive the OUTPUT5 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>

**Table 7-80. OUTPUT5MUXENABLE Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
27	MUX27	R/W	0h	<p>Selects the output of Mux27 to drive OUTPUT5 of OUTPUT-XBAR</p> <p>0: Respective output of Mux27 is disabled to drive the OUTPUT5 of OUTPUT-XBAR</p> <p>1: Respective output of Mux27 is enabled to drive the OUTPUT5 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
26	MUX26	R/W	0h	<p>Selects the output of Mux26 to drive OUTPUT5 of OUTPUT-XBAR</p> <p>0: Respective output of Mux26 is disabled to drive the OUTPUT5 of OUTPUT-XBAR</p> <p>1: Respective output of Mux26 is enabled to drive the OUTPUT5 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
25	MUX25	R/W	0h	<p>Selects the output of Mux25 to drive OUTPUT5 of OUTPUT-XBAR</p> <p>0: Respective output of Mux25 is disabled to drive the OUTPUT5 of OUTPUT-XBAR</p> <p>1: Respective output of Mux25 is enabled to drive the OUTPUT5 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
24	MUX24	R/W	0h	<p>Selects the output of Mux24 to drive OUTPUT5 of OUTPUT-XBAR</p> <p>0: Respective output of Mux24 is disabled to drive the OUTPUT5 of OUTPUT-XBAR</p> <p>1: Respective output of Mux24 is enabled to drive the OUTPUT5 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
23	MUX23	R/W	0h	<p>Selects the output of Mux23 to drive OUTPUT5 of OUTPUT-XBAR</p> <p>0: Respective output of Mux23 is disabled to drive the OUTPUT5 of OUTPUT-XBAR</p> <p>1: Respective output of Mux23 is enabled to drive the OUTPUT5 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
22	MUX22	R/W	0h	<p>Selects the output of Mux22 to drive OUTPUT5 of OUTPUT-XBAR</p> <p>0: Respective output of Mux22 is disabled to drive the OUTPUT5 of OUTPUT-XBAR</p> <p>1: Respective output of Mux22 is enabled to drive the OUTPUT5 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
21	MUX21	R/W	0h	<p>Selects the output of Mux21 to drive OUTPUT5 of OUTPUT-XBAR</p> <p>0: Respective output of Mux21 is disabled to drive the OUTPUT5 of OUTPUT-XBAR</p> <p>1: Respective output of Mux21 is enabled to drive the OUTPUT5 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>

**Table 7-80. OUTPUT5MUXENABLE Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
20	MUX20	R/W	0h	<p>Selects the output of Mux20 to drive OUTPUT5 of OUTPUT-XBAR</p> <p>0: Respective output of Mux20 is disabled to drive the OUTPUT5 of OUTPUT-XBAR</p> <p>1: Respective output of Mux20 is enabled to drive the OUTPUT5 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
19	MUX19	R/W	0h	<p>Selects the output of Mux19 to drive OUTPUT5 of OUTPUT-XBAR</p> <p>0: Respective output of Mux19 is disabled to drive the OUTPUT5 of OUTPUT-XBAR</p> <p>1: Respective output of Mux19 is enabled to drive the OUTPUT5 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
18	MUX18	R/W	0h	<p>Selects the output of Mux18 to drive OUTPUT5 of OUTPUT-XBAR</p> <p>0: Respective output of Mux18 is disabled to drive the OUTPUT5 of OUTPUT-XBAR</p> <p>1: Respective output of Mux18 is enabled to drive the OUTPUT5 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
17	MUX17	R/W	0h	<p>Selects the output of Mux17 to drive OUTPUT5 of OUTPUT-XBAR</p> <p>0: Respective output of Mux17 is disabled to drive the OUTPUT5 of OUTPUT-XBAR</p> <p>1: Respective output of Mux17 is enabled to drive the OUTPUT5 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
16	MUX16	R/W	0h	<p>Selects the output of Mux16 to drive OUTPUT5 of OUTPUT-XBAR</p> <p>0: Respective output of Mux16 is disabled to drive the OUTPUT5 of OUTPUT-XBAR</p> <p>1: Respective output of Mux16 is enabled to drive the OUTPUT5 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
15	MUX15	R/W	0h	<p>Selects the output of Mux15 to drive OUTPUT5 of OUTPUT-XBAR</p> <p>0: Respective output of Mux15 is disabled to drive the OUTPUT5 of OUTPUT-XBAR</p> <p>1: Respective output of Mux15 is enabled to drive the OUTPUT5 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
14	MUX14	R/W	0h	<p>Selects the output of Mux14 to drive OUTPUT5 of OUTPUT-XBAR</p> <p>0: Respective output of Mux14 is disabled to drive the OUTPUT5 of OUTPUT-XBAR</p> <p>1: Respective output of Mux14 is enabled to drive the OUTPUT5 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>

**Table 7-80. OUTPUT5MUXENABLE Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
13	MUX13	R/W	0h	<p>Selects the output of Mux13 to drive OUTPUT5 of OUTPUT-XBAR</p> <p>0: Respective output of Mux13 is disabled to drive the OUTPUT5 of OUTPUT-XBAR</p> <p>1: Respective output of Mux13 is enabled to drive the OUTPUT5 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
12	MUX12	R/W	0h	<p>Selects the output of Mux12 to drive OUTPUT5 of OUTPUT-XBAR</p> <p>0: Respective output of Mux12 is disabled to drive the OUTPUT5 of OUTPUT-XBAR</p> <p>1: Respective output of Mux12 is enabled to drive the OUTPUT5 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
11	MUX11	R/W	0h	<p>Selects the output of Mux11 to drive OUTPUT5 of OUTPUT-XBAR</p> <p>0: Respective output of Mux11 is disabled to drive the OUTPUT5 of OUTPUT-XBAR</p> <p>1: Respective output of Mux11 is enabled to drive the OUTPUT5 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
10	MUX10	R/W	0h	<p>Selects the output of Mux10 to drive OUTPUT5 of OUTPUT-XBAR</p> <p>0: Respective output of Mux10 is disabled to drive the OUTPUT5 of OUTPUT-XBAR</p> <p>1: Respective output of Mux10 is enabled to drive the OUTPUT5 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
9	MUX9	R/W	0h	<p>Selects the output of Mux9 to drive OUTPUT5 of OUTPUT-XBAR</p> <p>0: Respective output of Mux9 is disabled to drive the OUTPUT5 of OUTPUT-XBAR</p> <p>1: Respective output of Mux9 is enabled to drive the OUTPUT5 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
8	MUX8	R/W	0h	<p>Selects the output of Mux8 to drive OUTPUT5 of OUTPUT-XBAR</p> <p>0: Respective output of Mux8 is disabled to drive the OUTPUT5 of OUTPUT-XBAR</p> <p>1: Respective output of Mux8 is enabled to drive the OUTPUT5 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
7	MUX7	R/W	0h	<p>Selects the output of Mux7 to drive OUTPUT5 of OUTPUT-XBAR</p> <p>0: Respective output of Mux7 is disabled to drive the OUTPUT5 of OUTPUT-XBAR</p> <p>1: Respective output of Mux7 is enabled to drive the OUTPUT5 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>

**Table 7-80. OUTPUT5MUXENABLE Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
6	MUX6	R/W	0h	<p>Selects the output of Mux6 to drive OUTPUT5 of OUTPUT-XBAR</p> <p>0: Respective output of Mux6 is disabled to drive the OUTPUT5 of OUTPUT-XBAR</p> <p>1: Respective output of Mux6 is enabled to drive the OUTPUT5 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
5	MUX5	R/W	0h	<p>Selects the output of Mux5 to drive OUTPUT5 of OUTPUT-XBAR</p> <p>0: Respective output of Mux5 is disabled to drive the OUTPUT5 of OUTPUT-XBAR</p> <p>1: Respective output of Mux5 is enabled to drive the OUTPUT5 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
4	MUX4	R/W	0h	<p>Selects the output of Mux4 to drive OUTPUT5 of OUTPUT-XBAR</p> <p>0: Respective output of Mux4 is disabled to drive the OUTPUT5 of OUTPUT-XBAR</p> <p>1: Respective output of Mux4 is enabled to drive the OUTPUT5 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
3	MUX3	R/W	0h	<p>Selects the output of Mux3 to drive OUTPUT5 of OUTPUT-XBAR</p> <p>0: Respective output of Mux3 is disabled to drive the OUTPUT5 of OUTPUT-XBAR</p> <p>1: Respective output of Mux3 is enabled to drive the OUTPUT5 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
2	MUX2	R/W	0h	<p>Selects the output of Mux2 to drive OUTPUT5 of OUTPUT-XBAR</p> <p>0: Respective output of Mux2 is disabled to drive the OUTPUT5 of OUTPUT-XBAR</p> <p>1: Respective output of Mux2 is enabled to drive the OUTPUT5 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
1	MUX1	R/W	0h	<p>Selects the output of Mux1 to drive OUTPUT5 of OUTPUT-XBAR</p> <p>0: Respective output of Mux1 is disabled to drive the OUTPUT5 of OUTPUT-XBAR</p> <p>1: Respective output of Mux1 is enabled to drive the OUTPUT5 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
0	MUX0	R/W	0h	<p>Selects the output of mux0 to drive OUTPUT5 of OUTPUT-XBAR</p> <p>0: Respective output of Mux0 is disabled to drive the OUTPUT5 of OUTPUT-XBAR</p> <p>1: Respective output of Mux0 is enabled to drive the OUTPUT5 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>

### 7.3.5.22 OUTPUT6MUXENABLE Register (Offset = 2Ah) [reset = 0h]

OUTPUT6MUXENABLE is shown in [Figure 7-73](#) and described in [Table 7-81](#).

Return to [Summary Table](#).

Output X-BAR Mux Enable for Output 6

**Figure 7-73. OUTPUT6MUXENABLE Register**

31		30		29		28		27		26		25		24	
MUX31	MUX30	MUX29	MUX28	MUX27	MUX26	MUX25	MUX24	MUX23	MUX22	MUX21	MUX20	MUX19	MUX18	MUX17	MUX16
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
23		22		21		20		19		18		17		16	
MUX23	MUX22	MUX21	MUX20	MUX19	MUX18	MUX17	MUX16	MUX15	MUX14	MUX13	MUX12	MUX11	MUX10	MUX9	MUX8
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
15		14		13		12		11		10		9		8	
MUX15	MUX14	MUX13	MUX12	MUX11	MUX10	MUX9	MUX8	MUX7	MUX6	MUX5	MUX4	MUX3	MUX2	MUX1	MUX0
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
7		6		5		4		3		2		1		0	
MUX7	MUX6	MUX5	MUX4	MUX3	MUX2	MUX1	MUX0	MUX7	MUX6	MUX5	MUX4	MUX3	MUX2	MUX1	MUX0
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h

**Table 7-81. OUTPUT6MUXENABLE Register Field Descriptions**

Bit	Field	Type	Reset	Description
31	MUX31	R/W	0h	Selects the output of Mux31 to drive OUTPUT6 of OUTPUT-XBAR  0: Respective output of Mux31 is disabled to drive the OUTPUT6 of OUTPUT-XBAR 1: Respective output of Mux31 is enabled to drive the OUTPUT6 of OUTPUT-XBAR  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
30	MUX30	R/W	0h	Selects the output of Mux30 to drive OUTPUT6 of OUTPUT-XBAR  0: Respective output of Mux30 is disabled to drive the OUTPUT6 of OUTPUT-XBAR 1: Respective output of Mux30 is enabled to drive the OUTPUT6 of OUTPUT-XBAR  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
29	MUX29	R/W	0h	Selects the output of Mux29 to drive OUTPUT6 of OUTPUT-XBAR  0: Respective output of Mux29 is disabled to drive the OUTPUT6 of OUTPUT-XBAR 1: Respective output of Mux29 is enabled to drive the OUTPUT6 of OUTPUT-XBAR  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
28	MUX28	R/W	0h	Selects the output of Mux28 to drive OUTPUT6 of OUTPUT-XBAR  0: Respective output of Mux28 is disabled to drive the OUTPUT6 of OUTPUT-XBAR 1: Respective output of Mux28 is enabled to drive the OUTPUT6 of OUTPUT-XBAR  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn

**Table 7-81. OUTPUT6MUXENABLE Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
27	MUX27	R/W	0h	<p>Selects the output of Mux27 to drive OUTPUT6 of OUTPUT-XBAR</p> <p>0: Respective output of Mux27 is disabled to drive the OUTPUT6 of OUTPUT-XBAR</p> <p>1: Respective output of Mux27 is enabled to drive the OUTPUT6 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
26	MUX26	R/W	0h	<p>Selects the output of Mux26 to drive OUTPUT6 of OUTPUT-XBAR</p> <p>0: Respective output of Mux26 is disabled to drive the OUTPUT6 of OUTPUT-XBAR</p> <p>1: Respective output of Mux26 is enabled to drive the OUTPUT6 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
25	MUX25	R/W	0h	<p>Selects the output of Mux25 to drive OUTPUT6 of OUTPUT-XBAR</p> <p>0: Respective output of Mux25 is disabled to drive the OUTPUT6 of OUTPUT-XBAR</p> <p>1: Respective output of Mux25 is enabled to drive the OUTPUT6 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
24	MUX24	R/W	0h	<p>Selects the output of Mux24 to drive OUTPUT6 of OUTPUT-XBAR</p> <p>0: Respective output of Mux24 is disabled to drive the OUTPUT6 of OUTPUT-XBAR</p> <p>1: Respective output of Mux24 is enabled to drive the OUTPUT6 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
23	MUX23	R/W	0h	<p>Selects the output of Mux23 to drive OUTPUT6 of OUTPUT-XBAR</p> <p>0: Respective output of Mux23 is disabled to drive the OUTPUT6 of OUTPUT-XBAR</p> <p>1: Respective output of Mux23 is enabled to drive the OUTPUT6 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
22	MUX22	R/W	0h	<p>Selects the output of Mux22 to drive OUTPUT6 of OUTPUT-XBAR</p> <p>0: Respective output of Mux22 is disabled to drive the OUTPUT6 of OUTPUT-XBAR</p> <p>1: Respective output of Mux22 is enabled to drive the OUTPUT6 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
21	MUX21	R/W	0h	<p>Selects the output of Mux21 to drive OUTPUT6 of OUTPUT-XBAR</p> <p>0: Respective output of Mux21 is disabled to drive the OUTPUT6 of OUTPUT-XBAR</p> <p>1: Respective output of Mux21 is enabled to drive the OUTPUT6 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>

**Table 7-81. OUTPUT6MUXENABLE Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
20	MUX20	R/W	0h	<p>Selects the output of Mux20 to drive OUTPUT6 of OUTPUT-XBAR</p> <p>0: Respective output of Mux20 is disabled to drive the OUTPUT6 of OUTPUT-XBAR</p> <p>1: Respective output of Mux20 is enabled to drive the OUTPUT6 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
19	MUX19	R/W	0h	<p>Selects the output of Mux19 to drive OUTPUT6 of OUTPUT-XBAR</p> <p>0: Respective output of Mux19 is disabled to drive the OUTPUT6 of OUTPUT-XBAR</p> <p>1: Respective output of Mux19 is enabled to drive the OUTPUT6 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
18	MUX18	R/W	0h	<p>Selects the output of Mux18 to drive OUTPUT6 of OUTPUT-XBAR</p> <p>0: Respective output of Mux18 is disabled to drive the OUTPUT6 of OUTPUT-XBAR</p> <p>1: Respective output of Mux18 is enabled to drive the OUTPUT6 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
17	MUX17	R/W	0h	<p>Selects the output of Mux17 to drive OUTPUT6 of OUTPUT-XBAR</p> <p>0: Respective output of Mux17 is disabled to drive the OUTPUT6 of OUTPUT-XBAR</p> <p>1: Respective output of Mux17 is enabled to drive the OUTPUT6 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
16	MUX16	R/W	0h	<p>Selects the output of Mux16 to drive OUTPUT6 of OUTPUT-XBAR</p> <p>0: Respective output of Mux16 is disabled to drive the OUTPUT6 of OUTPUT-XBAR</p> <p>1: Respective output of Mux16 is enabled to drive the OUTPUT6 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
15	MUX15	R/W	0h	<p>Selects the output of Mux15 to drive OUTPUT6 of OUTPUT-XBAR</p> <p>0: Respective output of Mux15 is disabled to drive the OUTPUT6 of OUTPUT-XBAR</p> <p>1: Respective output of Mux15 is enabled to drive the OUTPUT6 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
14	MUX14	R/W	0h	<p>Selects the output of Mux14 to drive OUTPUT6 of OUTPUT-XBAR</p> <p>0: Respective output of Mux14 is disabled to drive the OUTPUT6 of OUTPUT-XBAR</p> <p>1: Respective output of Mux14 is enabled to drive the OUTPUT6 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>



**Table 7-81. OUTPUT6MUXENABLE Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
13	MUX13	R/W	0h	<p>Selects the output of Mux13 to drive OUTPUT6 of OUTPUT-XBAR</p> <p>0: Respective output of Mux13 is disabled to drive the OUTPUT6 of OUTPUT-XBAR</p> <p>1: Respective output of Mux13 is enabled to drive the OUTPUT6 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
12	MUX12	R/W	0h	<p>Selects the output of Mux12 to drive OUTPUT6 of OUTPUT-XBAR</p> <p>0: Respective output of Mux12 is disabled to drive the OUTPUT6 of OUTPUT-XBAR</p> <p>1: Respective output of Mux12 is enabled to drive the OUTPUT6 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
11	MUX11	R/W	0h	<p>Selects the output of Mux11 to drive OUTPUT6 of OUTPUT-XBAR</p> <p>0: Respective output of Mux11 is disabled to drive the OUTPUT6 of OUTPUT-XBAR</p> <p>1: Respective output of Mux11 is enabled to drive the OUTPUT6 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
10	MUX10	R/W	0h	<p>Selects the output of Mux10 to drive OUTPUT6 of OUTPUT-XBAR</p> <p>0: Respective output of Mux10 is disabled to drive the OUTPUT6 of OUTPUT-XBAR</p> <p>1: Respective output of Mux10 is enabled to drive the OUTPUT6 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
9	MUX9	R/W	0h	<p>Selects the output of Mux9 to drive OUTPUT6 of OUTPUT-XBAR</p> <p>0: Respective output of Mux9 is disabled to drive the OUTPUT6 of OUTPUT-XBAR</p> <p>1: Respective output of Mux9 is enabled to drive the OUTPUT6 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
8	MUX8	R/W	0h	<p>Selects the output of Mux8 to drive OUTPUT6 of OUTPUT-XBAR</p> <p>0: Respective output of Mux8 is disabled to drive the OUTPUT6 of OUTPUT-XBAR</p> <p>1: Respective output of Mux8 is enabled to drive the OUTPUT6 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
7	MUX7	R/W	0h	<p>Selects the output of Mux7 to drive OUTPUT6 of OUTPUT-XBAR</p> <p>0: Respective output of Mux7 is disabled to drive the OUTPUT6 of OUTPUT-XBAR</p> <p>1: Respective output of Mux7 is enabled to drive the OUTPUT6 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>

**Table 7-81. OUTPUT6MUXENABLE Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
6	MUX6	R/W	0h	<p>Selects the output of Mux6 to drive OUTPUT6 of OUTPUT-XBAR</p> <p>0: Respective output of Mux6 is disabled to drive the OUTPUT6 of OUTPUT-XBAR</p> <p>1: Respective output of Mux6 is enabled to drive the OUTPUT6 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
5	MUX5	R/W	0h	<p>Selects the output of Mux5 to drive OUTPUT6 of OUTPUT-XBAR</p> <p>0: Respective output of Mux5 is disabled to drive the OUTPUT6 of OUTPUT-XBAR</p> <p>1: Respective output of Mux5 is enabled to drive the OUTPUT6 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
4	MUX4	R/W	0h	<p>Selects the output of Mux4 to drive OUTPUT6 of OUTPUT-XBAR</p> <p>0: Respective output of Mux4 is disabled to drive the OUTPUT6 of OUTPUT-XBAR</p> <p>1: Respective output of Mux4 is enabled to drive the OUTPUT6 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
3	MUX3	R/W	0h	<p>Selects the output of Mux3 to drive OUTPUT6 of OUTPUT-XBAR</p> <p>0: Respective output of Mux3 is disabled to drive the OUTPUT6 of OUTPUT-XBAR</p> <p>1: Respective output of Mux3 is enabled to drive the OUTPUT6 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
2	MUX2	R/W	0h	<p>Selects the output of Mux2 to drive OUTPUT6 of OUTPUT-XBAR</p> <p>0: Respective output of Mux2 is disabled to drive the OUTPUT6 of OUTPUT-XBAR</p> <p>1: Respective output of Mux2 is enabled to drive the OUTPUT6 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
1	MUX1	R/W	0h	<p>Selects the output of Mux1 to drive OUTPUT6 of OUTPUT-XBAR</p> <p>0: Respective output of Mux1 is disabled to drive the OUTPUT6 of OUTPUT-XBAR</p> <p>1: Respective output of Mux1 is enabled to drive the OUTPUT6 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
0	MUX0	R/W	0h	<p>Selects the output of mux0 to drive OUTPUT6 of OUTPUT-XBAR</p> <p>0: Respective output of Mux0 is disabled to drive the OUTPUT6 of OUTPUT-XBAR</p> <p>1: Respective output of Mux0 is enabled to drive the OUTPUT6 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>

### 7.3.5.23 OUTPUT7MUXENABLE Register (Offset = 2Ch) [reset = 0h]

OUTPUT7MUXENABLE is shown in [Figure 7-74](#) and described in [Table 7-82](#).

Return to [Summary Table](#).

Output X-BAR Mux Enable for Output 7

**Figure 7-74. OUTPUT7MUXENABLE Register**

31	30	29	28	27	26	25	24
MUX31	MUX30	MUX29	MUX28	MUX27	MUX26	MUX25	MUX24
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
23	22	21	20	19	18	17	16
MUX23	MUX22	MUX21	MUX20	MUX19	MUX18	MUX17	MUX16
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
15	14	13	12	11	10	9	8
MUX15	MUX14	MUX13	MUX12	MUX11	MUX10	MUX9	MUX8
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
7	6	5	4	3	2	1	0
MUX7	MUX6	MUX5	MUX4	MUX3	MUX2	MUX1	MUX0
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h

**Table 7-82. OUTPUT7MUXENABLE Register Field Descriptions**

Bit	Field	Type	Reset	Description
31	MUX31	R/W	0h	<p>Selects the output of Mux31 to drive OUTPUT7 of OUTPUT-XBAR</p> <p>0: Respective output of Mux31 is disabled to drive the OUTPUT7 of OUTPUT-XBAR</p> <p>1: Respective output of Mux31 is enabled to drive the OUTPUT7 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details.</p> <p>Reset type: CPU1.SYSRSn</p>
30	MUX30	R/W	0h	<p>Selects the output of Mux30 to drive OUTPUT7 of OUTPUT-XBAR</p> <p>0: Respective output of Mux30 is disabled to drive the OUTPUT7 of OUTPUT-XBAR</p> <p>1: Respective output of Mux30 is enabled to drive the OUTPUT7 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details.</p> <p>Reset type: CPU1.SYSRSn</p>
29	MUX29	R/W	0h	<p>Selects the output of Mux29 to drive OUTPUT7 of OUTPUT-XBAR</p> <p>0: Respective output of Mux29 is disabled to drive the OUTPUT7 of OUTPUT-XBAR</p> <p>1: Respective output of Mux29 is enabled to drive the OUTPUT7 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details.</p> <p>Reset type: CPU1.SYSRSn</p>
28	MUX28	R/W	0h	<p>Selects the output of Mux28 to drive OUTPUT7 of OUTPUT-XBAR</p> <p>0: Respective output of Mux28 is disabled to drive the OUTPUT7 of OUTPUT-XBAR</p> <p>1: Respective output of Mux28 is enabled to drive the OUTPUT7 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details.</p> <p>Reset type: CPU1.SYSRSn</p>

**Table 7-82. OUTPUT7MUXENABLE Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
27	MUX27	R/W	0h	<p>Selects the output of Mux27 to drive OUTPUT7 of OUTPUT-XBAR</p> <p>0: Respective output of Mux27 is disabled to drive the OUTPUT7 of OUTPUT-XBAR</p> <p>1: Respective output of Mux27 is enabled to drive the OUTPUT7 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
26	MUX26	R/W	0h	<p>Selects the output of Mux26 to drive OUTPUT7 of OUTPUT-XBAR</p> <p>0: Respective output of Mux26 is disabled to drive the OUTPUT7 of OUTPUT-XBAR</p> <p>1: Respective output of Mux26 is enabled to drive the OUTPUT7 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
25	MUX25	R/W	0h	<p>Selects the output of Mux25 to drive OUTPUT7 of OUTPUT-XBAR</p> <p>0: Respective output of Mux25 is disabled to drive the OUTPUT7 of OUTPUT-XBAR</p> <p>1: Respective output of Mux25 is enabled to drive the OUTPUT7 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
24	MUX24	R/W	0h	<p>Selects the output of Mux24 to drive OUTPUT7 of OUTPUT-XBAR</p> <p>0: Respective output of Mux24 is disabled to drive the OUTPUT7 of OUTPUT-XBAR</p> <p>1: Respective output of Mux24 is enabled to drive the OUTPUT7 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
23	MUX23	R/W	0h	<p>Selects the output of Mux23 to drive OUTPUT7 of OUTPUT-XBAR</p> <p>0: Respective output of Mux23 is disabled to drive the OUTPUT7 of OUTPUT-XBAR</p> <p>1: Respective output of Mux23 is enabled to drive the OUTPUT7 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
22	MUX22	R/W	0h	<p>Selects the output of Mux22 to drive OUTPUT7 of OUTPUT-XBAR</p> <p>0: Respective output of Mux22 is disabled to drive the OUTPUT7 of OUTPUT-XBAR</p> <p>1: Respective output of Mux22 is enabled to drive the OUTPUT7 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
21	MUX21	R/W	0h	<p>Selects the output of Mux21 to drive OUTPUT7 of OUTPUT-XBAR</p> <p>0: Respective output of Mux21 is disabled to drive the OUTPUT7 of OUTPUT-XBAR</p> <p>1: Respective output of Mux21 is enabled to drive the OUTPUT7 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>

**Table 7-82. OUTPUT7MUXENABLE Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
20	MUX20	R/W	0h	<p>Selects the output of Mux20 to drive OUTPUT7 of OUTPUT-XBAR</p> <p>0: Respective output of Mux20 is disabled to drive the OUTPUT7 of OUTPUT-XBAR</p> <p>1: Respective output of Mux20 is enabled to drive the OUTPUT7 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
19	MUX19	R/W	0h	<p>Selects the output of Mux19 to drive OUTPUT7 of OUTPUT-XBAR</p> <p>0: Respective output of Mux19 is disabled to drive the OUTPUT7 of OUTPUT-XBAR</p> <p>1: Respective output of Mux19 is enabled to drive the OUTPUT7 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
18	MUX18	R/W	0h	<p>Selects the output of Mux18 to drive OUTPUT7 of OUTPUT-XBAR</p> <p>0: Respective output of Mux18 is disabled to drive the OUTPUT7 of OUTPUT-XBAR</p> <p>1: Respective output of Mux18 is enabled to drive the OUTPUT7 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
17	MUX17	R/W	0h	<p>Selects the output of Mux17 to drive OUTPUT7 of OUTPUT-XBAR</p> <p>0: Respective output of Mux17 is disabled to drive the OUTPUT7 of OUTPUT-XBAR</p> <p>1: Respective output of Mux17 is enabled to drive the OUTPUT7 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
16	MUX16	R/W	0h	<p>Selects the output of Mux16 to drive OUTPUT7 of OUTPUT-XBAR</p> <p>0: Respective output of Mux16 is disabled to drive the OUTPUT7 of OUTPUT-XBAR</p> <p>1: Respective output of Mux16 is enabled to drive the OUTPUT7 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
15	MUX15	R/W	0h	<p>Selects the output of Mux15 to drive OUTPUT7 of OUTPUT-XBAR</p> <p>0: Respective output of Mux15 is disabled to drive the OUTPUT7 of OUTPUT-XBAR</p> <p>1: Respective output of Mux15 is enabled to drive the OUTPUT7 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
14	MUX14	R/W	0h	<p>Selects the output of Mux14 to drive OUTPUT7 of OUTPUT-XBAR</p> <p>0: Respective output of Mux14 is disabled to drive the OUTPUT7 of OUTPUT-XBAR</p> <p>1: Respective output of Mux14 is enabled to drive the OUTPUT7 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>

**Table 7-82. OUTPUT7MUXENABLE Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
13	MUX13	R/W	0h	<p>Selects the output of Mux13 to drive OUTPUT7 of OUTPUT-XBAR</p> <p>0: Respective output of Mux13 is disabled to drive the OUTPUT7 of OUTPUT-XBAR</p> <p>1: Respective output of Mux13 is enabled to drive the OUTPUT7 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
12	MUX12	R/W	0h	<p>Selects the output of Mux12 to drive OUTPUT7 of OUTPUT-XBAR</p> <p>0: Respective output of Mux12 is disabled to drive the OUTPUT7 of OUTPUT-XBAR</p> <p>1: Respective output of Mux12 is enabled to drive the OUTPUT7 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
11	MUX11	R/W	0h	<p>Selects the output of Mux11 to drive OUTPUT7 of OUTPUT-XBAR</p> <p>0: Respective output of Mux11 is disabled to drive the OUTPUT7 of OUTPUT-XBAR</p> <p>1: Respective output of Mux11 is enabled to drive the OUTPUT7 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
10	MUX10	R/W	0h	<p>Selects the output of Mux10 to drive OUTPUT7 of OUTPUT-XBAR</p> <p>0: Respective output of Mux10 is disabled to drive the OUTPUT7 of OUTPUT-XBAR</p> <p>1: Respective output of Mux10 is enabled to drive the OUTPUT7 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
9	MUX9	R/W	0h	<p>Selects the output of Mux9 to drive OUTPUT7 of OUTPUT-XBAR</p> <p>0: Respective output of Mux9 is disabled to drive the OUTPUT7 of OUTPUT-XBAR</p> <p>1: Respective output of Mux9 is enabled to drive the OUTPUT7 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
8	MUX8	R/W	0h	<p>Selects the output of Mux8 to drive OUTPUT7 of OUTPUT-XBAR</p> <p>0: Respective output of Mux8 is disabled to drive the OUTPUT7 of OUTPUT-XBAR</p> <p>1: Respective output of Mux8 is enabled to drive the OUTPUT7 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
7	MUX7	R/W	0h	<p>Selects the output of Mux7 to drive OUTPUT7 of OUTPUT-XBAR</p> <p>0: Respective output of Mux7 is disabled to drive the OUTPUT7 of OUTPUT-XBAR</p> <p>1: Respective output of Mux7 is enabled to drive the OUTPUT7 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>

**Table 7-82. OUTPUT7MUXENABLE Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
6	MUX6	R/W	0h	<p>Selects the output of Mux6 to drive OUTPUT7 of OUTPUT-XBAR</p> <p>0: Respective output of Mux6 is disabled to drive the OUTPUT7 of OUTPUT-XBAR</p> <p>1: Respective output of Mux6 is enabled to drive the OUTPUT7 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
5	MUX5	R/W	0h	<p>Selects the output of Mux5 to drive OUTPUT7 of OUTPUT-XBAR</p> <p>0: Respective output of Mux5 is disabled to drive the OUTPUT7 of OUTPUT-XBAR</p> <p>1: Respective output of Mux5 is enabled to drive the OUTPUT7 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
4	MUX4	R/W	0h	<p>Selects the output of Mux4 to drive OUTPUT7 of OUTPUT-XBAR</p> <p>0: Respective output of Mux4 is disabled to drive the OUTPUT7 of OUTPUT-XBAR</p> <p>1: Respective output of Mux4 is enabled to drive the OUTPUT7 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
3	MUX3	R/W	0h	<p>Selects the output of Mux3 to drive OUTPUT7 of OUTPUT-XBAR</p> <p>0: Respective output of Mux3 is disabled to drive the OUTPUT7 of OUTPUT-XBAR</p> <p>1: Respective output of Mux3 is enabled to drive the OUTPUT7 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
2	MUX2	R/W	0h	<p>Selects the output of Mux2 to drive OUTPUT7 of OUTPUT-XBAR</p> <p>0: Respective output of Mux2 is disabled to drive the OUTPUT7 of OUTPUT-XBAR</p> <p>1: Respective output of Mux2 is enabled to drive the OUTPUT7 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
1	MUX1	R/W	0h	<p>Selects the output of Mux1 to drive OUTPUT7 of OUTPUT-XBAR</p> <p>0: Respective output of Mux1 is disabled to drive the OUTPUT7 of OUTPUT-XBAR</p> <p>1: Respective output of Mux1 is enabled to drive the OUTPUT7 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
0	MUX0	R/W	0h	<p>Selects the output of mux0 to drive OUTPUT7 of OUTPUT-XBAR</p> <p>0: Respective output of Mux0 is disabled to drive the OUTPUT7 of OUTPUT-XBAR</p> <p>1: Respective output of Mux0 is enabled to drive the OUTPUT7 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>

**7.3.5.24 OUTPUT8MUXENABLE Register (Offset = 2Eh) [reset = 0h]**

OUTPUT8MUXENABLE is shown in [Figure 7-75](#) and described in [Table 7-83](#).

Return to [Summary Table](#).

Output X-BAR Mux Enable for Output 8

**Figure 7-75. OUTPUT8MUXENABLE Register**

31		30		29		28		27		26		25		24	
MUX31	MUX30	MUX29	MUX28	MUX27	MUX26	MUX25	MUX24	MUX23	MUX22	MUX21	MUX20	MUX19	MUX18	MUX17	MUX16
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
23		22		21		20		19		18		17		16	
MUX23	MUX22	MUX21	MUX20	MUX19	MUX18	MUX17	MUX16	MUX15	MUX14	MUX13	MUX12	MUX11	MUX10	MUX9	MUX8
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
15		14		13		12		11		10		9		8	
MUX15	MUX14	MUX13	MUX12	MUX11	MUX10	MUX9	MUX8	MUX7	MUX6	MUX5	MUX4	MUX3	MUX2	MUX1	MUX0
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
7		6		5		4		3		2		1		0	
MUX7	MUX6	MUX5	MUX4	MUX3	MUX2	MUX1	MUX0	MUX7	MUX6	MUX5	MUX4	MUX3	MUX2	MUX1	MUX0
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h

**Table 7-83. OUTPUT8MUXENABLE Register Field Descriptions**

Bit	Field	Type	Reset	Description
31	MUX31	R/W	0h	<p>Selects the output of Mux31 to drive OUTPUT8 of OUTPUT-XBAR</p> <p>0: Respective output of Mux31 is disabled to drive the OUTPUT8 of OUTPUT-XBAR</p> <p>1: Respective output of Mux31 is enabled to drive the OUTPUT8 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
30	MUX30	R/W	0h	<p>Selects the output of Mux30 to drive OUTPUT8 of OUTPUT-XBAR</p> <p>0: Respective output of Mux30 is disabled to drive the OUTPUT8 of OUTPUT-XBAR</p> <p>1: Respective output of Mux30 is enabled to drive the OUTPUT8 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
29	MUX29	R/W	0h	<p>Selects the output of Mux29 to drive OUTPUT8 of OUTPUT-XBAR</p> <p>0: Respective output of Mux29 is disabled to drive the OUTPUT8 of OUTPUT-XBAR</p> <p>1: Respective output of Mux29 is enabled to drive the OUTPUT8 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
28	MUX28	R/W	0h	<p>Selects the output of Mux28 to drive OUTPUT8 of OUTPUT-XBAR</p> <p>0: Respective output of Mux28 is disabled to drive the OUTPUT8 of OUTPUT-XBAR</p> <p>1: Respective output of Mux28 is enabled to drive the OUTPUT8 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>



**Table 7-83. OUTPUT8MUXENABLE Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
27	MUX27	R/W	0h	<p>Selects the output of Mux27 to drive OUTPUT8 of OUTPUT-XBAR</p> <p>0: Respective output of Mux27 is disabled to drive the OUTPUT8 of OUTPUT-XBAR</p> <p>1: Respective output of Mux27 is enabled to drive the OUTPUT8 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
26	MUX26	R/W	0h	<p>Selects the output of Mux26 to drive OUTPUT8 of OUTPUT-XBAR</p> <p>0: Respective output of Mux26 is disabled to drive the OUTPUT8 of OUTPUT-XBAR</p> <p>1: Respective output of Mux26 is enabled to drive the OUTPUT8 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
25	MUX25	R/W	0h	<p>Selects the output of Mux25 to drive OUTPUT8 of OUTPUT-XBAR</p> <p>0: Respective output of Mux25 is disabled to drive the OUTPUT8 of OUTPUT-XBAR</p> <p>1: Respective output of Mux25 is enabled to drive the OUTPUT8 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
24	MUX24	R/W	0h	<p>Selects the output of Mux24 to drive OUTPUT8 of OUTPUT-XBAR</p> <p>0: Respective output of Mux24 is disabled to drive the OUTPUT8 of OUTPUT-XBAR</p> <p>1: Respective output of Mux24 is enabled to drive the OUTPUT8 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
23	MUX23	R/W	0h	<p>Selects the output of Mux23 to drive OUTPUT8 of OUTPUT-XBAR</p> <p>0: Respective output of Mux23 is disabled to drive the OUTPUT8 of OUTPUT-XBAR</p> <p>1: Respective output of Mux23 is enabled to drive the OUTPUT8 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
22	MUX22	R/W	0h	<p>Selects the output of Mux22 to drive OUTPUT8 of OUTPUT-XBAR</p> <p>0: Respective output of Mux22 is disabled to drive the OUTPUT8 of OUTPUT-XBAR</p> <p>1: Respective output of Mux22 is enabled to drive the OUTPUT8 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
21	MUX21	R/W	0h	<p>Selects the output of Mux21 to drive OUTPUT8 of OUTPUT-XBAR</p> <p>0: Respective output of Mux21 is disabled to drive the OUTPUT8 of OUTPUT-XBAR</p> <p>1: Respective output of Mux21 is enabled to drive the OUTPUT8 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>

**Table 7-83. OUTPUT8MUXENABLE Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
20	MUX20	R/W	0h	<p>Selects the output of Mux20 to drive OUTPUT8 of OUTPUT-XBAR</p> <p>0: Respective output of Mux20 is disabled to drive the OUTPUT8 of OUTPUT-XBAR</p> <p>1: Respective output of Mux20 is enabled to drive the OUTPUT8 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
19	MUX19	R/W	0h	<p>Selects the output of Mux19 to drive OUTPUT8 of OUTPUT-XBAR</p> <p>0: Respective output of Mux19 is disabled to drive the OUTPUT8 of OUTPUT-XBAR</p> <p>1: Respective output of Mux19 is enabled to drive the OUTPUT8 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
18	MUX18	R/W	0h	<p>Selects the output of Mux18 to drive OUTPUT8 of OUTPUT-XBAR</p> <p>0: Respective output of Mux18 is disabled to drive the OUTPUT8 of OUTPUT-XBAR</p> <p>1: Respective output of Mux18 is enabled to drive the OUTPUT8 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
17	MUX17	R/W	0h	<p>Selects the output of Mux17 to drive OUTPUT8 of OUTPUT-XBAR</p> <p>0: Respective output of Mux17 is disabled to drive the OUTPUT8 of OUTPUT-XBAR</p> <p>1: Respective output of Mux17 is enabled to drive the OUTPUT8 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
16	MUX16	R/W	0h	<p>Selects the output of Mux16 to drive OUTPUT8 of OUTPUT-XBAR</p> <p>0: Respective output of Mux16 is disabled to drive the OUTPUT8 of OUTPUT-XBAR</p> <p>1: Respective output of Mux16 is enabled to drive the OUTPUT8 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
15	MUX15	R/W	0h	<p>Selects the output of Mux15 to drive OUTPUT8 of OUTPUT-XBAR</p> <p>0: Respective output of Mux15 is disabled to drive the OUTPUT8 of OUTPUT-XBAR</p> <p>1: Respective output of Mux15 is enabled to drive the OUTPUT8 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
14	MUX14	R/W	0h	<p>Selects the output of Mux14 to drive OUTPUT8 of OUTPUT-XBAR</p> <p>0: Respective output of Mux14 is disabled to drive the OUTPUT8 of OUTPUT-XBAR</p> <p>1: Respective output of Mux14 is enabled to drive the OUTPUT8 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>

**Table 7-83. OUTPUT8MUXENABLE Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
13	MUX13	R/W	0h	<p>Selects the output of Mux13 to drive OUTPUT8 of OUTPUT-XBAR</p> <p>0: Respective output of Mux13 is disabled to drive the OUTPUT8 of OUTPUT-XBAR</p> <p>1: Respective output of Mux13 is enabled to drive the OUTPUT8 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
12	MUX12	R/W	0h	<p>Selects the output of Mux12 to drive OUTPUT8 of OUTPUT-XBAR</p> <p>0: Respective output of Mux12 is disabled to drive the OUTPUT8 of OUTPUT-XBAR</p> <p>1: Respective output of Mux12 is enabled to drive the OUTPUT8 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
11	MUX11	R/W	0h	<p>Selects the output of Mux11 to drive OUTPUT8 of OUTPUT-XBAR</p> <p>0: Respective output of Mux11 is disabled to drive the OUTPUT8 of OUTPUT-XBAR</p> <p>1: Respective output of Mux11 is enabled to drive the OUTPUT8 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
10	MUX10	R/W	0h	<p>Selects the output of Mux10 to drive OUTPUT8 of OUTPUT-XBAR</p> <p>0: Respective output of Mux10 is disabled to drive the OUTPUT8 of OUTPUT-XBAR</p> <p>1: Respective output of Mux10 is enabled to drive the OUTPUT8 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
9	MUX9	R/W	0h	<p>Selects the output of Mux9 to drive OUTPUT8 of OUTPUT-XBAR</p> <p>0: Respective output of Mux9 is disabled to drive the OUTPUT8 of OUTPUT-XBAR</p> <p>1: Respective output of Mux9 is enabled to drive the OUTPUT8 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
8	MUX8	R/W	0h	<p>Selects the output of Mux8 to drive OUTPUT8 of OUTPUT-XBAR</p> <p>0: Respective output of Mux8 is disabled to drive the OUTPUT8 of OUTPUT-XBAR</p> <p>1: Respective output of Mux8 is enabled to drive the OUTPUT8 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
7	MUX7	R/W	0h	<p>Selects the output of Mux7 to drive OUTPUT8 of OUTPUT-XBAR</p> <p>0: Respective output of Mux7 is disabled to drive the OUTPUT8 of OUTPUT-XBAR</p> <p>1: Respective output of Mux7 is enabled to drive the OUTPUT8 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>

**Table 7-83. OUTPUT8MUXENABLE Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
6	MUX6	R/W	0h	<p>Selects the output of Mux6 to drive OUTPUT8 of OUTPUT-XBAR</p> <p>0: Respective output of Mux6 is disabled to drive the OUTPUT8 of OUTPUT-XBAR</p> <p>1: Respective output of Mux6 is enabled to drive the OUTPUT8 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
5	MUX5	R/W	0h	<p>Selects the output of Mux5 to drive OUTPUT8 of OUTPUT-XBAR</p> <p>0: Respective output of Mux5 is disabled to drive the OUTPUT8 of OUTPUT-XBAR</p> <p>1: Respective output of Mux5 is enabled to drive the OUTPUT8 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
4	MUX4	R/W	0h	<p>Selects the output of Mux4 to drive OUTPUT8 of OUTPUT-XBAR</p> <p>0: Respective output of Mux4 is disabled to drive the OUTPUT8 of OUTPUT-XBAR</p> <p>1: Respective output of Mux4 is enabled to drive the OUTPUT8 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
3	MUX3	R/W	0h	<p>Selects the output of Mux3 to drive OUTPUT8 of OUTPUT-XBAR</p> <p>0: Respective output of Mux3 is disabled to drive the OUTPUT8 of OUTPUT-XBAR</p> <p>1: Respective output of Mux3 is enabled to drive the OUTPUT8 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
2	MUX2	R/W	0h	<p>Selects the output of Mux2 to drive OUTPUT8 of OUTPUT-XBAR</p> <p>0: Respective output of Mux2 is disabled to drive the OUTPUT8 of OUTPUT-XBAR</p> <p>1: Respective output of Mux2 is enabled to drive the OUTPUT8 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
1	MUX1	R/W	0h	<p>Selects the output of Mux1 to drive OUTPUT8 of OUTPUT-XBAR</p> <p>0: Respective output of Mux1 is disabled to drive the OUTPUT8 of OUTPUT-XBAR</p> <p>1: Respective output of Mux1 is enabled to drive the OUTPUT8 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
0	MUX0	R/W	0h	<p>Selects the output of mux0 to drive OUTPUT8 of OUTPUT-XBAR</p> <p>0: Respective output of Mux0 is disabled to drive the OUTPUT8 of OUTPUT-XBAR</p> <p>1: Respective output of Mux0 is enabled to drive the OUTPUT8 of OUTPUT-XBAR</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>

**7.3.5.25 OUTPUTLATCH Register (Offset = 30h) [reset = 0h]**

OUTPUTLATCH is shown in [Figure 7-76](#) and described in [Table 7-84](#).

Return to [Summary Table](#).

Output X-BAR Output Latch

**Figure 7-76. OUTPUTLATCH Register**

31	30	29	28	27	26	25	24
RESERVED							
R=0-0h							
23	22	21	20	19	18	17	16
RESERVED							
R=0-0h							
15	14	13	12	11	10	9	8
RESERVED							
R=0-0h							
7	6	5	4	3	2	1	0
OUTPUT8	OUTPUT7	OUTPUT6	OUTPUT5	OUTPUT4	OUTPUT3	OUTPUT2	OUTPUT1
R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h

**Table 7-84. OUTPUTLATCH Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R=0	0h	Reserved
15-8	RESERVED	R=0	0h	Reserved
7	OUTPUT8	R	0h	Records the OUTPUT8 of OUTPUT-XBAR. 0: Respective output has not been triggered 1: Respective output is triggered  Refer to the Output X-BAR section of this chapter for more details.  Note: [1] setting of this bit has priority over clear by software Reset type: CPU1.SYSRSn
6	OUTPUT7	R	0h	Records the OUTPUT7 of OUTPUT-XBAR. 0: Respective output has not been triggered 1: Respective output is triggered  Refer to the Output X-BAR section of this chapter for more details.  Note: [1] setting of this bit has priority over clear by software Reset type: CPU1.SYSRSn
5	OUTPUT6	R	0h	Records the OUTPUT6 of OUTPUT-XBAR. 0: Respective output has not been triggered 1: Respective output is triggered  Refer to the Output X-BAR section of this chapter for more details.  Note: [1] setting of this bit has priority over clear by software Reset type: CPU1.SYSRSn

**Table 7-84. OUTPUTLATCH Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
4	OUTPUT5	R	0h	<p>Records the OUTPUT5 of OUTPUT-XBAR.</p> <p>0: Respective output has not been triggered 1: Respective output is triggered</p> <p>Refer to the Output X-BAR section of this chapter for more details.</p> <p>Note: [1] setting of this bit has priority over clear by software Reset type: CPU1.SYSRSn</p>
3	OUTPUT4	R	0h	<p>Records the OUTPUT4 of OUTPUT-XBAR.</p> <p>0: Respective output has not been triggered 1: Respective output is triggered</p> <p>Refer to the Output X-BAR section of this chapter for more details.</p> <p>Note: [1] setting of this bit has priority over clear by software Reset type: CPU1.SYSRSn</p>
2	OUTPUT3	R	0h	<p>Records the OUTPUT3 of OUTPUT-XBAR.</p> <p>0: Respective output has not been triggered 1: Respective output is triggered</p> <p>Refer to the Output X-BAR section of this chapter for more details.</p> <p>Note: [1] setting of this bit has priority over clear by software Reset type: CPU1.SYSRSn</p>
1	OUTPUT2	R	0h	<p>Records the OUTPUT2 of OUTPUT-XBAR.</p> <p>0: Respective output has not been triggered 1: Respective output is triggered</p> <p>Refer to the Output X-BAR section of this chapter for more details.</p> <p>Note: [1] setting of this bit has priority over clear by software Reset type: CPU1.SYSRSn</p>
0	OUTPUT1	R	0h	<p>Records the OUTPUT1 of OUTPUT-XBAR.</p> <p>0: Respective output has not been triggered 1: Respective output is triggered</p> <p>Refer to the Output X-BAR section of this chapter for more details.</p> <p>Note: [1] setting of this bit has priority over clear by software Reset type: CPU1.SYSRSn</p>

### 7.3.5.26 OUTPUTLATCHCLR Register (Offset = 32h) [reset = 0h]

OUTPUTLATCHCLR is shown in [Figure 7-77](#) and described in [Table 7-85](#).

Return to [Summary Table](#).

Output X-BAR Output Latch Clear

**Figure 7-77. OUTPUTLATCHCLR Register**

31	30	29	28	27	26	25	24
RESERVED							
R=0-0h							
23	22	21	20	19	18	17	16
RESERVED							
R=0-0h							
15	14	13	12	11	10	9	8
RESERVED							
R=0-0h							
7	6	5	4	3	2	1	0
OUTPUT8	OUTPUT7	OUTPUT6	OUTPUT5	OUTPUT4	OUTPUT3	OUTPUT2	OUTPUT1
R=0/W=1-0h	R=0/W=1-0h	R=0/W=1-0h	R=0/W=1-0h	R=0/W=1-0h	R=0/W=1-0h	R=0/W=1-0h	R=0/W=1-0h

**Table 7-85. OUTPUTLATCHCLR Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R=0	0h	Reserved
15-8	RESERVED	R=0	0h	Reserved
7	OUTPUT8	R=0/W=1	0h	Clears the Output-Latch for OUTPUT8 of OUTPUT-XBAR  Writing 1 clears the corresponding output latch bit in the OUTPUTLATCH register Write of 0 has no effect  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
6	OUTPUT7	R=0/W=1	0h	Clears the Output-Latch for OUTPUT7 of OUTPUT-XBAR  Writing 1 clears the corresponding output latch bit in the OUTPUTLATCH register Write of 0 has no effect  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
5	OUTPUT6	R=0/W=1	0h	Clears the Output-Latch for OUTPUT6 of OUTPUT-XBAR  Writing 1 clears the corresponding output latch bit in the OUTPUTLATCH register Write of 0 has no effect  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
4	OUTPUT5	R=0/W=1	0h	Clears the Output-Latch for OUTPUT5 of OUTPUT-XBAR  Writing 1 clears the corresponding output latch bit in the OUTPUTLATCH register Write of 0 has no effect  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn

**Table 7-85. OUTPUTLATCHCLR Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
3	OUTPUT4	R=0/W=1	0h	<p>Clears the Output-Latch for OUTPUT4 of OUTPUT-XBAR</p> <p>Writing 1 clears the corresponding output latch bit in the OUTPUTLATCH register</p> <p>Write of 0 has no effect</p> <p>Refer to the Output X-BAR section of this chapter for more details.</p> <p>Reset type: CPU1.SYSRSn</p>
2	OUTPUT3	R=0/W=1	0h	<p>Clears the Output-Latch for OUTPUT3 of OUTPUT-XBAR</p> <p>Writing 1 clears the corresponding output latch bit in the OUTPUTLATCH register</p> <p>Write of 0 has no effect</p> <p>Refer to the Output X-BAR section of this chapter for more details.</p> <p>Reset type: CPU1.SYSRSn</p>
1	OUTPUT2	R=0/W=1	0h	<p>Clears the Output-Latch for OUTPUT2 of OUTPUT-XBAR</p> <p>Writing 1 clears the corresponding output latch bit in the OUTPUTLATCH register</p> <p>Write of 0 has no effect</p> <p>Refer to the Output X-BAR section of this chapter for more details.</p> <p>Reset type: CPU1.SYSRSn</p>
0	OUTPUT1	R=0/W=1	0h	<p>Clears the Output-Latch for OUTPUT1 of OUTPUT-XBAR</p> <p>Writing 1 clears the corresponding output latch bit in the OUTPUTLATCH register</p> <p>Write of 0 has no effect</p> <p>Refer to the Output X-BAR section of this chapter for more details.</p> <p>Reset type: CPU1.SYSRSn</p>



### 7.3.5.27 OUTPUTLATCHFRC Register (Offset = 34h) [reset = 0h]

OUTPUTLATCHFRC is shown in [Figure 7-78](#) and described in [Table 7-86](#).

Return to [Summary Table](#).

Output X-BAR Output Latch Clear

**Figure 7-78. OUTPUTLATCHFRC Register**

31	30	29	28	27	26	25	24
RESERVED							
R=0-0h							
23	22	21	20	19	18	17	16
RESERVED							
R=0-0h							
15	14	13	12	11	10	9	8
RESERVED							
R=0-0h							
7	6	5	4	3	2	1	0
OUTPUT8	OUTPUT7	OUTPUT6	OUTPUT5	OUTPUT4	OUTPUT3	OUTPUT2	OUTPUT1
R=0/W=1-0h	R=0/W=1-0h	R=0/W=1-0h	R=0/W=1-0h	R=0/W=1-0h	R=0/W=1-0h	R=0/W=1-0h	R=0/W=1-0h

**Table 7-86. OUTPUTLATCHFRC Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R=0	0h	Reserved
15-8	RESERVED	R=0	0h	Reserved
7	OUTPUT8	R=0/W=1	0h	Sets the Output-Latch for OUTPUT8 of OUTPUT-XBAR  Writing 1 sets the corresponding output latch bit in the OUTPUTLATCH register Write of 0 has no effect  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
6	OUTPUT7	R=0/W=1	0h	Sets the Output-Latch for OUTPUT7 of OUTPUT-XBAR  Writing 1 sets the corresponding output latch bit in the OUTPUTLATCH register Write of 0 has no effect  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
5	OUTPUT6	R=0/W=1	0h	Sets the Output-Latch for OUTPUT6 of OUTPUT-XBAR  Writing 1 sets the corresponding output latch bit in the OUTPUTLATCH register Write of 0 has no effect  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
4	OUTPUT5	R=0/W=1	0h	Sets the Output-Latch for OUTPUT5 of OUTPUT-XBAR  Writing 1 sets the corresponding output latch bit in the OUTPUTLATCH register Write of 0 has no effect  Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn

**Table 7-86. OUTPUTLATCHFRC Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
3	OUTPUT4	R=0/W=1	0h	<p>Sets the Output-Latch for OUTPUT4 of OUTPUT-XBAR</p> <p>Writing 1 sets the corresponding output latch bit in the OUTPUTLATCH register</p> <p>Write of 0 has no effect</p> <p>Refer to the Output X-BAR section of this chapter for more details.</p> <p>Reset type: CPU1.SYSRSn</p>
2	OUTPUT3	R=0/W=1	0h	<p>Sets the Output-Latch for OUTPUT3 of OUTPUT-XBAR</p> <p>Writing 1 sets the corresponding output latch bit in the OUTPUTLATCH register</p> <p>Write of 0 has no effect</p> <p>Refer to the Output X-BAR section of this chapter for more details.</p> <p>Reset type: CPU1.SYSRSn</p>
1	OUTPUT2	R=0/W=1	0h	<p>Sets the Output-Latch for OUTPUT2 of OUTPUT-XBAR</p> <p>Writing 1 sets the corresponding output latch bit in the OUTPUTLATCH register</p> <p>Write of 0 has no effect</p> <p>Refer to the Output X-BAR section of this chapter for more details.</p> <p>Reset type: CPU1.SYSRSn</p>
0	OUTPUT1	R=0/W=1	0h	<p>Sets the Output-Latch for OUTPUT1 of OUTPUT-XBAR</p> <p>Writing 1 sets the corresponding output latch bit in the OUTPUTLATCH register</p> <p>Write of 0 has no effect</p> <p>Refer to the Output X-BAR section of this chapter for more details.</p> <p>Reset type: CPU1.SYSRSn</p>

**7.3.5.28 OUTPUTLATCHENABLE Register (Offset = 36h) [reset = 0h]**

OUTPUTLATCHENABLE is shown in [Figure 7-79](#) and described in [Table 7-87](#).

Return to [Summary Table](#).

Output X-BAR Output Latch Enable

**Figure 7-79. OUTPUTLATCHENABLE Register**

31	30	29	28	27	26	25	24
RESERVED							
R=0-0h							
23	22	21	20	19	18	17	16
RESERVED							
R=0-0h							
15	14	13	12	11	10	9	8
RESERVED							
R=0-0h							
7	6	5	4	3	2	1	0
OUTPUT8	OUTPUT7	OUTPUT6	OUTPUT5	OUTPUT4	OUTPUT3	OUTPUT2	OUTPUT1
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h

**Table 7-87. OUTPUTLATCHENABLE Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R=0	0h	Reserved
15-8	RESERVED	R=0	0h	Reserved
7	OUTPUT8	R/W	0h	Selects the output latch to drive OUTPUT8 for OUTPUT-XBAR 0: Output Latch is not selected to driven the respective output 1: Output Latch is selected to drive the respective output Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
6	OUTPUT7	R/W	0h	Selects the output latch to drive OUTPUT7 for OUTPUT-XBAR 0: Output Latch is not selected to driven the respective output 1: Output Latch is selected to drive the respective output Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
5	OUTPUT6	R/W	0h	Selects the output latch to drive OUTPUT6 for OUTPUT-XBAR 0: Output Latch is not selected to driven the respective output 1: Output Latch is selected to drive the respective output Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
4	OUTPUT5	R/W	0h	Selects the output latch to drive OUTPUT5 for OUTPUT-XBAR 0: Output Latch is not selected to driven the respective output 1: Output Latch is selected to drive the respective output Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn

**Table 7-87. OUTPUTLATCHENABLE Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
3	OUTPUT4	R/W	0h	<p>Selects the output latch to drive OUTPUT4 for OUTPUT-XBAR</p> <p>0: Output Latch is not selected to driven the respective output 1: Output Latch is selected to drive the respective output</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
2	OUTPUT3	R/W	0h	<p>Selects the output latch to drive OUTPUT3 for OUTPUT-XBAR</p> <p>0: Output Latch is not selected to driven the respective output 1: Output Latch is selected to drive the respective output</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
1	OUTPUT2	R/W	0h	<p>Selects the output latch to drive OUTPUT2 for OUTPUT-XBAR</p> <p>0: Output Latch is not selected to driven the respective output 1: Output Latch is selected to drive the respective output</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
0	OUTPUT1	R/W	0h	<p>Selects the output latch to drive OUTPUT1 for OUTPUT-XBAR</p> <p>0: Output Latch is not selected to driven the respective output 1: Output Latch is selected to drive the respective output</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>

**7.3.5.29 OUTPUTINV Register (Offset = 38h) [reset = 0h]**

OUTPUTINV is shown in [Figure 7-80](#) and described in [Table 7-88](#).

Return to [Summary Table](#).

Output X-BAR Output Inversion

**Figure 7-80. OUTPUTINV Register**

31	30	29	28	27	26	25	24
RESERVED							
R=0-0h							
23	22	21	20	19	18	17	16
RESERVED							
R=0-0h							
15	14	13	12	11	10	9	8
RESERVED							
R=0-0h							
7	6	5	4	3	2	1	0
OUTPUT8	OUTPUT7	OUTPUT6	OUTPUT5	OUTPUT4	OUTPUT3	OUTPUT2	OUTPUT1
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h

**Table 7-88. OUTPUTINV Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R=0	0h	Reserved
15-8	RESERVED	R=0	0h	Reserved
7	OUTPUT8	R/W	0h	Selects polarity for OUTPUT8 of OUTPUT-XBAR 0: drives active high output 1: drives active-low output Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
6	OUTPUT7	R/W	0h	Selects polarity for OUTPUT7 of OUTPUT-XBAR 0: drives active high output 1: drives active-low output Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
5	OUTPUT6	R/W	0h	Selects polarity for OUTPUT6 of OUTPUT-XBAR 0: drives active high output 1: drives active-low output Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
4	OUTPUT5	R/W	0h	Selects polarity for OUTPUT5 of OUTPUT-XBAR 0: drives active high output 1: drives active-low output Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn

**Table 7-88. OUTPUTINV Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
3	OUTPUT4	R/W	0h	<p>Selects polarity for OUTPUT4 of OUTPUT-XBAR</p> <p>0: drives active high output 1: drives active-low output</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
2	OUTPUT3	R/W	0h	<p>Selects polarity for OUTPUT3 of OUTPUT-XBAR</p> <p>0: drives active high output 1: drives active-low output</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
1	OUTPUT2	R/W	0h	<p>Selects polarity for OUTPUT2 of OUTPUT-XBAR</p> <p>0: drives active high output 1: drives active-low output</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
0	OUTPUT1	R/W	0h	<p>Selects polarity for OUTPUT1 of OUTPUT-XBAR</p> <p>0: drives active high output 1: drives active-low output</p> <p>Refer to the Output X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>

**7.3.5.30 OUTPUTLOCK Register (Offset = 3Eh) [reset = 0h]**

OUTPUTLOCK is shown in [Figure 7-81](#) and described in [Table 7-89](#).

Return to [Summary Table](#).

Output X-BAR Configuration Lock register

**Figure 7-81. OUTPUTLOCK Register**

31	30	29	28	27	26	25	24
KEY							
R=0/W=1-0h							
23	22	21	20	19	18	17	16
KEY							
R=0/W=1-0h							
15	14	13	12	11	10	9	8
RESERVED							
R=0-0h							
7	6	5	4	3	2	1	0
RESERVED							LOCK
R=0-0h							R/WSONce-0h

**Table 7-89. OUTPUTLOCK Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	KEY	R=0/W=1	0h	Bit-0 of this register can be set only if KEY= 0x5a5a Reset type: CPU1.SYSRSn
15-1	RESERVED	R=0	0h	Reserved
0	LOCK	R/WSONce	0h	Locks the configuration for OUTPUT-XBAR. Once the configuration is locked, writes to the below registers for OUTPUT-XBAR is blocked.  Registers Affected by the LOCK mechanism: OUTPUT-XBAROUTyMUX0TO15CFG OUTPUT-XBAROUTyMUX16TO31CFG OUTPUT-XBAROUTyMUXENABLE OUTPUT-XBAROUTLATENABLE OUTPUT-XBAROUTINV  0: Writes to the above registers are allowed 1: Writes to the above registers are blocked  Note: [1] LOCK mechanism only applies to writes. Reads are never blocked. Reset type: CPU1.SYSRSn

## Analog Subsystem

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This analog subsystem module is described in this chapter.

Topic	Page
8.1 Analog Subsystem .....	1249
8.2 Registers .....	1253



## 8.1 Analog Subsystem

The analog modules on this device include the Analog-to-Digital Converter (ADC), Temperature Sensor, Buffered Digital-to-Analog Converter (DAC), and Comparator Subsystem (CMPSS).

### 8.1.1 Features

The analog subsystem has the following features:

- Flexible voltage references
  - The ADCs are referenced to VREFH<sub>ix</sub> and VREFLO<sub>x</sub> pins
    - VREFH<sub>ix</sub> pin voltage must be driven in externally
- The buffered DACs are referenced to VREFH<sub>ix</sub> and VREFLO<sub>x</sub>
  - Alternately, these DACs can be referenced to the VDAC pin and VSSA
- The comparator DACs are referenced to VDDA and VSSA
  - Alternately, these DACs can be referenced to the VDAC pin and VSSA
- Flexible pin usage
  - Buffered DAC and comparator subsystem functions multiplexed with ADC inputs
- Internal connection to VREFLO on all ADCs for offset self-calibration

### 8.1.2 Block Diagram

The subsystem block diagrams show the connections between the different integrated analog modules and to the device pins. These pins fall into two categories: analog module inputs/outputs and reference pins.

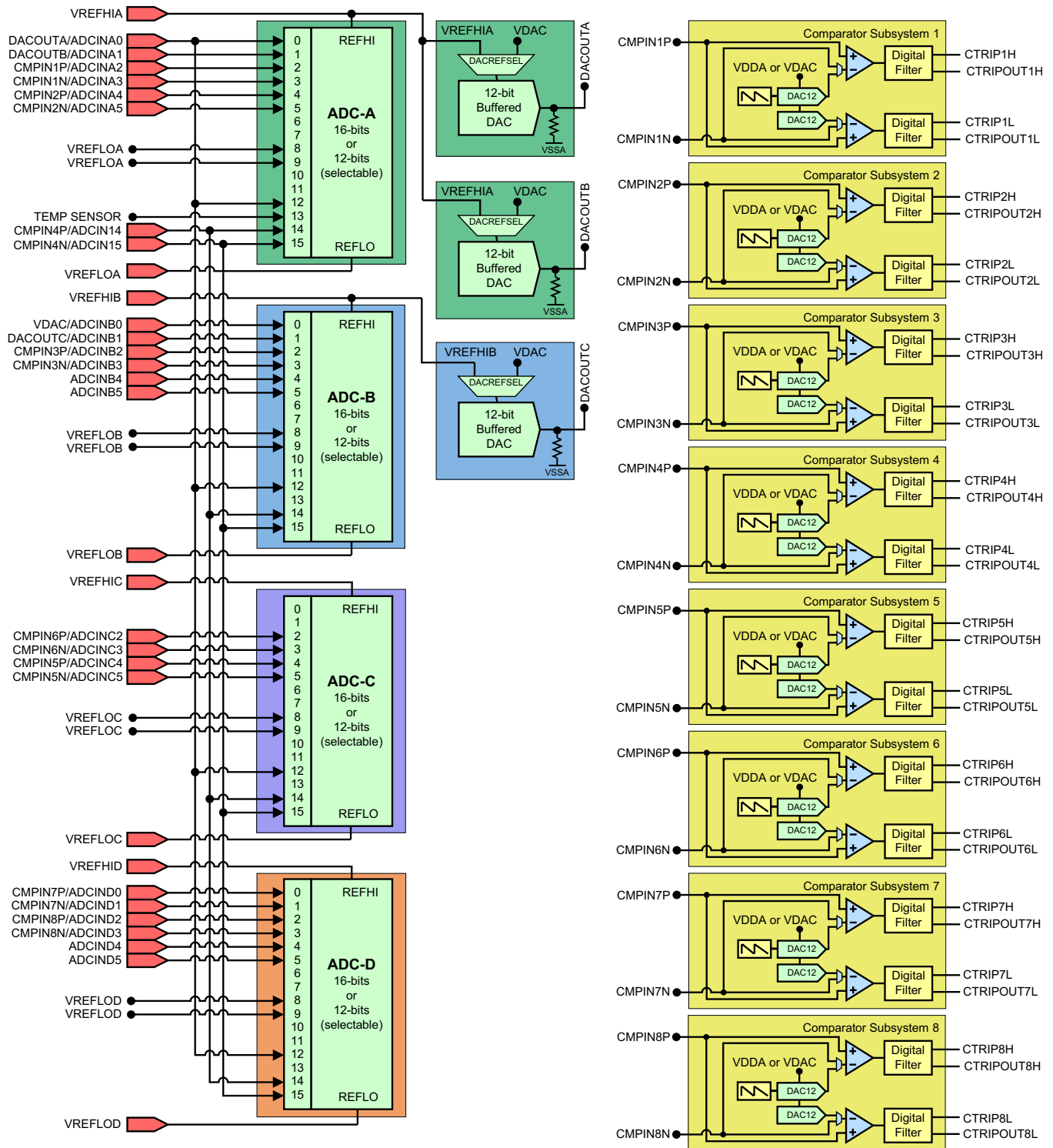
The reference pins, VREFH<sub>IA</sub> to VRFH<sub>ID</sub> and VREFLO<sub>A</sub> to VREFLO<sub>D</sub>, can be used to externally supply the reference to the ADC. VREFH<sub>IA</sub> can also be used to supply the reference voltage to DAC A and DAC B and VREFH<sub>IB</sub> can be used to supply the reference to DAC C.

The analog module input/outputs are all ADC inputs by default. The pins which connect to CMPSS inputs can be used for the CMPSS without further action and without preventing use as an ADC input simultaneously. DAC outputs must be enabled; this will prevent the channel from simultaneously being used as an ADC input (but the ADC can be used to sample the DAC output voltage if desired).

The VDAC reference pin can be used to set an alternate range for DAC A, DAC B, and DAC C and for the DACs inside the CMPSS modules (the CMPSS DACs are referenced to VDDA and VSSA by default). Using this pin as a reference will prevent the channel from being used as an ADC input (but the ADC can be used to sample the VDAC voltage if desired). The choice of reference is configurable per-module for each CMPSS or buffered DAC and the selection is made via the module's configuration registers.

The block diagram for the analog subsystem is presented in the following graphics.

Figure 8-1. Analog Subsystem Block Diagram (337-Ball ZWT)



**Figure 8-2. Analog Subsystem Block Diagram (176-Pin PTP)**

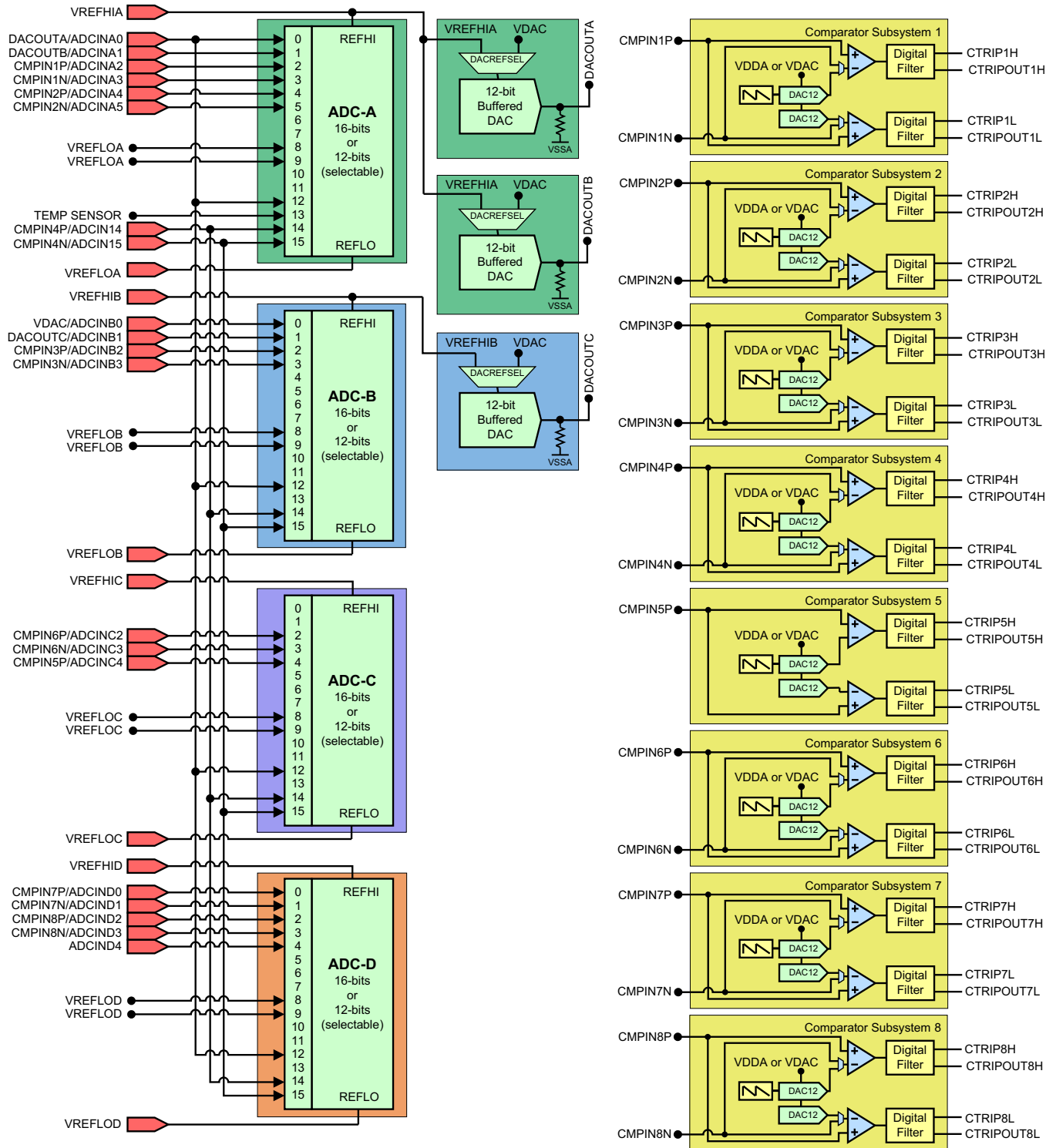
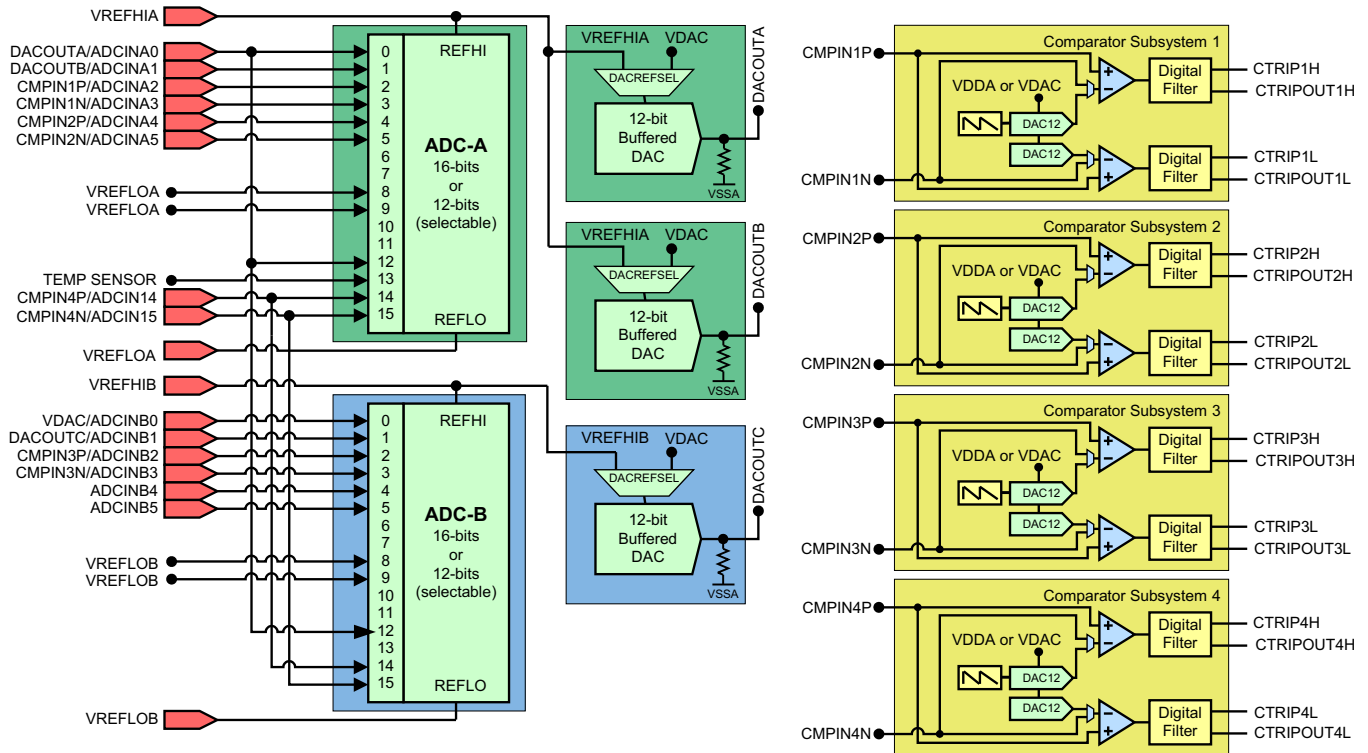


Figure 8-3. Analog Subsystem Block Diagram (100-Pin PZP)



**NOTES:**

- Not all analog pins are available on all devices. Consult the datasheet for your specific device to determine which pins are available.
- Consult the datasheet for your device to determine the allowable voltage range for VREFHI and VREFLO
- An external capacitor is required on the VREFHI pins. Consult the datasheet for the specific value required.
- For buffered DAC modules, VSSA will be the low reference whether VREFHIx or VDAC is selected as the high reference.
- For CMPSS modules, VSSA will be the low reference whether VDAC or VDDA is selected as the high reference.

**8.1.3 Lock Registers**

Setting the TSNSCTL bit in the LOCK register will disable any further changes in the TSNSCTL register.

## 8.2 Registers

### 8.2.1 Analog Subsystem Base Addresses

**Table 8-1. Analog Subsystem Base Address Table**

Device Registers	Register Name	Start Address	End Address
AnalogSubsysRegs	ANALOG_SUBSYS_REGS	0x0005_D180	0x0005_D1FF

## 8.2.2 ANALOG\_SUBSYS\_REGS Registers

Table 8-2 lists the memory-mapped registers for the ANALOG\_SUBSYS\_REGS. All register offset addresses not listed in Table 8-2 should be considered as reserved locations and the register contents should not be modified.

**Table 8-2. ANALOG\_SUBSYS\_REGS Registers**

Offset	Acronym	Register Name	Write Protection	Section
20h	INTOSC1TRIM	Internal Oscillator 1 Trim Register	EALLOW	<a href="#">Go</a>
22h	INTOSC2TRIM	Internal Oscillator 2 Trim Register	EALLOW	<a href="#">Go</a>
26h	TSNSCTL	Temperature Sensor Control Register	EALLOW	<a href="#">Go</a>
2Eh	LOCK	Lock Register	EALLOW	<a href="#">Go</a>
36h	ANAREFTRIMA	Analog Reference Trim A Register	EALLOW	<a href="#">Go</a>
38h	ANAREFTRIMB	Analog Reference Trim B Register	EALLOW	<a href="#">Go</a>
3Ah	ANAREFTRIMC	Analog Reference Trim C Register	EALLOW	<a href="#">Go</a>
3Ch	ANAREFTRIMD	Analog Reference Trim D Register	EALLOW	<a href="#">Go</a>

Complex bit access types are encoded to fit into small table cells. Table 8-3 shows the codes that are used for access types in this section.

**Table 8-3. ANALOG\_SUBSYS\_REGS Access Type Codes**

Access Type	Code	Description
<b>Read Type</b>		
R	R	Read
R=0	R	Read
<b>Write Type</b>		
W	W	Write
WOnce	W	Write
<b>Reset or Default Value</b>		
-n		Value after reset or the default value
<b>Register Array Variables</b>		
i,j,k,l,m,n		When these variables are used in a register name, an offset, or an address, they refer to the value of a register array where the register is part of a group of repeating registers. The register groups form a hierarchical structure and the array is represented with a formula.
y		When this variable is used in a register name, an offset, or an address it refers to the value of a register array.

### 8.2.2.1 INTOSC1TRIM Register (Offset = 20h) [reset = 0h]

INTOSC1TRIM is shown in [Figure 8-4](#) and described in [Table 8-4](#).

Return to [Summary Table](#).

Internal Oscillator 1 Trim Register

**Figure 8-4. INTOSC1TRIM Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
RESERVED								RESERVED							
R-0h								R-0h							
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
RESERVED				VALFINETRIM											
R-0h				R/W-0h											

**Table 8-4. INTOSC1TRIM Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-24	RESERVED	R	0h	Reserved
23-16	RESERVED	R	0h	Reserved
15-12	RESERVED	R	0h	Reserved
11-0	VALFINETRIM	R/W	0h	Oscillator Value Fine Trim Bits.  This register should not be modified unless specifically indicated by TI Errata or other documentation. Modifying the contents of this register could cause this module to operate outside of datasheet specifications. Reset type: XRSn

### 8.2.2.2 INTOSC2TRIM Register (Offset = 22h) [reset = 0h]

INTOSC2TRIM is shown in [Figure 8-5](#) and described in [Table 8-5](#).

Return to [Summary Table](#).

Internal Oscillator 2 Trim Register

**Figure 8-5. INTOSC2TRIM Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
RESERVED								RESERVED							
R-0h								R-0h							
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
RESERVED				VALFINETRIM											
R-0h				R/W-0h											

**Table 8-5. INTOSC2TRIM Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-24	RESERVED	R	0h	Reserved
23-16	RESERVED	R	0h	Reserved
15-12	RESERVED	R	0h	Reserved
11-0	VALFINETRIM	R/W	0h	Oscillator Value Fine Trim Bits.  This register should not be modified unless specifically indicated by TI Errata or other documentation. Modifying the contents of this register could cause this module to operate outside of datasheet specifications. Reset type: XRSn



### 8.2.2.3 TSENSCTL Register (Offset = 26h) [reset = 0h]

TSENSCTL is shown in [Figure 8-6](#) and described in [Table 8-6](#).

Return to [Summary Table](#).

Temperature Sensor Control Register

**Figure 8-6. TSENSCTL Register**

15	14	13	12	11	10	9	8
RESERVED							
R-0h							
7	6	5	4	3	2	1	0
RESERVED							ENABLE
R-0h							R/W-0h

**Table 8-6. TSENSCTL Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-1	RESERVED	R	0h	Reserved
0	ENABLE	R/W	0h	Temperature Sensor Enable. This bit enables the temperature sensor output to the ADC.  0 Disabled 1 Enabled Reset type: CPU1.SYSRSn

### 8.2.2.4 LOCK Register (Offset = 2Eh) [reset = 0h]

LOCK is shown in [Figure 8-7](#) and described in [Table 8-7](#).

Return to [Summary Table](#).

Lock Register

**Figure 8-7. LOCK Register**

31	30	29	28	27	26	25	24
RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED
R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h
23	22	21	20	19	18	17	16
RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED		
R-0h	R-0h	R-0h	R-0h	R-0h	R-0h		
15	14	13	12	11	10	9	8
RESERVED							
R-0h							
7	6	5	4	3	2	1	0
RESERVED	RESERVED	RESERVED	RESERVED	TSNSCTL	RESERVED	RESERVED	RESERVED
R-0h	R-0h	R-0h	R-0h	R/WOnce-0h	R-0h	R-0h	R-0h

**Table 8-7. LOCK Register Field Descriptions**

Bit	Field	Type	Reset	Description
31	RESERVED	R	0h	Reserved
30	RESERVED	R	0h	Reserved
29	RESERVED	R	0h	Reserved
28	RESERVED	R	0h	Reserved
27	RESERVED	R	0h	Reserved
26	RESERVED	R	0h	Reserved
25	RESERVED	R	0h	Reserved
24	RESERVED	R	0h	Reserved
23	RESERVED	R	0h	Reserved
22	RESERVED	R	0h	Reserved
21	RESERVED	R	0h	Reserved
20	RESERVED	R	0h	Reserved
19	RESERVED	R	0h	Reserved
18-7	RESERVED	R	0h	Reserved
6	RESERVED	R	0h	Reserved
5	RESERVED	R	0h	Reserved
4	RESERVED	R	0h	Reserved
3	TSNSCTL	R/WOnce	0h	Temperature Sensor Control Register Lock. Setting this bit will disable any future write to the respective register. This bit can only be cleared by a reset. Reset type: CPU1.SYSRSn
2	RESERVED	R	0h	Reserved
1	RESERVED	R	0h	Reserved
0	RESERVED	R	0h	Reserved

### 8.2.2.5 ANAREFTRIMA Register (Offset = 36h) [reset = 0h]

ANAREFTRIMA is shown in [Figure 8-8](#) and described in [Table 8-8](#).

Return to [Summary Table](#).

Analog Reference Trim A Register

**Figure 8-8. ANAREFTRIMA Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
RESERVED								RESERVED							
R-0h								R-0h							
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
IREFTRIM					BGSLOPETRIM					BGVALTRIM					
R/W-0h					R/W-0h					R/W-0h					

**Table 8-8. ANAREFTRIMA Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-24	RESERVED	R	0h	Reserved
23-16	RESERVED	R	0h	Reserved
15-11	IREFTRIM	R/W	0h	Reference Current Trim. This bit field defines the reference current trim value.  0x0 - Untrimmed all other values - Trimmed Reset type: XRSn
10-6	BGSLOPETRIM	R/W	0h	Bandgap Slope Trim. This bit field defines the bandgap slope trim value.  0x0 - Untrimmed all other values - Trimmed Reset type: XRSn
5-0	BGVALTRIM	R/W	0h	Bandgap Value Trim. This bit field defines the bandgap voltage offset trim value.  0x0 - Untrimmed all other values - Trimmed Reset type: XRSn

**8.2.2.6 ANAREFTRIMB Register (Offset = 38h) [reset = 0h]**

 ANAREFTRIMB is shown in [Figure 8-9](#) and described in [Table 8-9](#).

 Return to [Summary Table](#).

Analog Reference Trim B Register

**Figure 8-9. ANAREFTRIMB Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
RESERVED								RESERVED							
R-0h								R-0h							
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
IREFTRIM					BGSLOPETRIM					BGVALTRIM					
R/W-0h					R/W-0h					R/W-0h					

**Table 8-9. ANAREFTRIMB Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-24	RESERVED	R	0h	Reserved
23-16	RESERVED	R	0h	Reserved
15-11	IREFTRIM	R/W	0h	Reference Current Trim. This bit field defines the reference current trim value.  0x0 - Untrimmed all other values - Trimmed Reset type: XRSn
10-6	BGSLOPETRIM	R/W	0h	Bandgap Slope Trim. This bit field defines the bandgap slope trim value.  0x0 - Untrimmed all other values - Trimmed Reset type: XRSn
5-0	BGVALTRIM	R/W	0h	Bandgap Value Trim. This bit field defines the bandgap voltage offset trim value.  0x0 - Untrimmed all other values - Trimmed Reset type: XRSn

### 8.2.2.7 ANAREFTRIMC Register (Offset = 3Ah) [reset = 0h]

ANAREFTRIMC is shown in [Figure 8-10](#) and described in [Table 8-10](#).

Return to [Summary Table](#).

Analog Reference Trim C Register

**Figure 8-10. ANAREFTRIMC Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
RESERVED								RESERVED							
R-0h								R-0h							
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
IREFTRIM					BGSLOPETRIM					BGVALTRIM					
R/W-0h					R/W-0h					R/W-0h					

**Table 8-10. ANAREFTRIMC Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-24	RESERVED	R	0h	Reserved
23-16	RESERVED	R	0h	Reserved
15-11	IREFTRIM	R/W	0h	Reference Current Trim. This bit field defines the reference current trim value.  0x0 - Untrimmed all other values - Trimmed Reset type: XRSn
10-6	BGSLOPETRIM	R/W	0h	Bandgap Slope Trim. This bit field defines the bandgap slope trim value.  0x0 - Untrimmed all other values - Trimmed Reset type: XRSn
5-0	BGVALTRIM	R/W	0h	Bandgap Value Trim. This bit field defines the bandgap voltage offset trim value.  0x0 - Untrimmed all other values - Trimmed Reset type: XRSn

### 8.2.2.8 ANAREFTRIMD Register (Offset = 3Ch) [reset = 0h]

ANAREFTRIMD is shown in [Figure 8-11](#) and described in [Table 8-11](#).

Return to [Summary Table](#).

Analog Reference Trim D Register

**Figure 8-11. ANAREFTRIMD Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
RESERVED								RESERVED							
R-0h								R-0h							
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
IREFTRIM					BGSLOPETRIM					BGVALTRIM					
R/W-0h					R/W-0h					R/W-0h					

**Table 8-11. ANAREFTRIMD Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-24	RESERVED	R	0h	Reserved
23-16	RESERVED	R	0h	Reserved
15-11	IREFTRIM	R/W	0h	Reference Current Trim. This bit field defines the reference current trim value.  0x0 - Untrimmed all other values - Trimmed Reset type: XRSn
10-6	BGSLOPETRIM	R/W	0h	Bandgap Slope Trim. This bit field defines the bandgap slope trim value.  0x0 - Untrimmed all other values - Trimmed Reset type: XRSn
5-0	BGVALTRIM	R/W	0h	Bandgap Value Trim. This bit field defines the bandgap voltage offset trim value.  0x0 - Untrimmed all other values - Trimmed Reset type: XRSn

## Analog-to-Digital Converter (ADC)

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The analog-to-digital converter module described in this chapter is a Type 4 ADC. See the *TMS320C28xx, 28xxx DSP Peripheral Reference Guide* ([SPRU566](#)) for a list of all devices with modules of the same type, to determine the differences between the types, and for a list of device-specific differences within a type.

Topic	Page
<b>9.1 Analog-to-Digital Converter (ADC)</b> .....	<b>1264</b>
<b>9.2 ADC Timings</b> .....	<b>1284</b>
<b>9.3 Additional Information</b> .....	<b>1289</b>
<b>9.4 Registers</b> .....	<b>1297</b>

## 9.1 Analog-to-Digital Converter (ADC)

The ADC module described here is a successive approximation (SAR) style ADC with selectable resolution of either 16 bits or 12 bits. This chapter refers to the analog circuits of the converter as the “core,” and includes the channel select MUX, the sample-and-hold (S/H) circuit, the successive approximation circuits, voltage reference circuits, and other analog support circuits. The digital circuits of the converter are referred to as the “wrapper” and includes logic for programmable conversions, result registers, interfaces to analog circuits, interfaces to the peripheral buses, post-processing circuits, and interfaces to other on-chip modules.

### 9.1.1 Features

Each ADC module consists of a single sample-and-hold (s/h) circuit. The ADC module is designed to be duplicated multiple times on the same chip, allowing simultaneous sampling or independent operation of multiple ADCs. The ADC wrapper is start-of-conversion (SOC) based (see [Section 9.1.4](#)).

Each ADC has the following features:

- Selectable resolution of 12 bits or 16 bits
- Ratiometric external reference set by VREFHI\VREFLO
- Differential signal conversions (16-bit mode only)
- Single-ended signal conversions (12-bit mode only)
- Input multiplexer with up to 16 channels (single-ended) or 8 channels (differential)
- 16 configurable SOCs
- 16 individually addressable result registers
- Multiple trigger sources
  - S/W - software immediate start
  - All ePWMs - ADCSOC A or B
  - GPIO XINT2
  - CPU Timers 0/1/2
  - ADCINT1/2
- Four flexible PIE interrupts
- Burst mode
- Four post-processing blocks, each with:
  - Saturating offset calibration
  - Error from setpoint calculation
  - High, low, and zero-crossing compare, with interrupt and ePWM trip capability
  - Trigger-to-sample delay capture

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**NOTE:** Not every channel may be pinned out from all ADCs. Check the datasheet for your device to determine which channels are available.

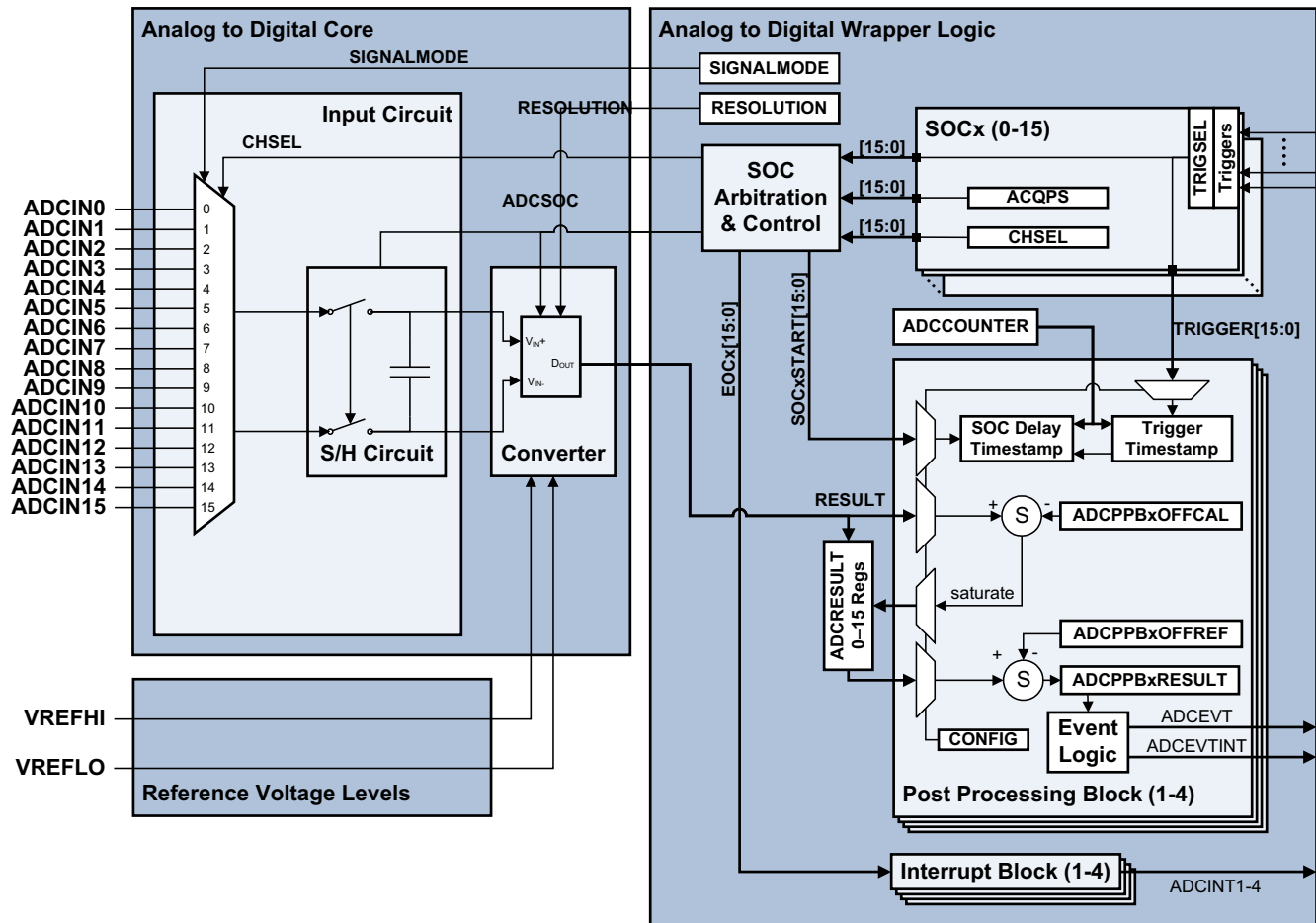
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### 9.1.2 ADC Block Diagram

The block diagram for the ADC core and ADC wrapper are presented in [Figure 9-1](#).



Figure 9-1. ADC Module Block Diagram



### 9.1.3 ADC Configurability

Some ADC configurations are individually controlled by the SOCs, while others are globally controlled per ADC module. Table 9-1 summarizes the basic ADC options and their level of configurability. The subsequent sections discuss these configurations.

Table 9-1. ADC Options and Configuration Levels

Options	Configurability
Clock	Per module <sup>(1)</sup>
Resolution	Per module <sup>(1)</sup>
Signal mode	Per module
Reference voltage source	Not configurable (external reference only)
Trigger source	Per SOC <sup>(1)</sup>
Converted channel	Per SOC
Acquisition window duration	Per SOC <sup>(1)</sup>
EOC location	Per module
Burst Mode	Per module <sup>(1)</sup>

<sup>(1)</sup> Writing these values differently to different ADC modules could cause the ADCs to operate asynchronously. See Section 9.3.1 for guidance on when the ADCs are operating synchronously or asynchronously.

### 9.1.3.1 Clock Configuration

The base ADC clock is provided directly by the system clock (SYSCLK). This clock is used to generate the ADC acquisition window. The register ADCCTL2 has a PRESCALE field which determines the ADCCLK. The ADCCLK is used to clock the converter.

In 16-bit mode, the core requires approximately 29.5 ADCCLK cycles to process a voltage into a conversion result, while in 12-bit mode, this process requires approximately 10.5 ADCCLK cycles. The choice of resolution will also determine the necessary duration of the acquisition window, see [Section 9.3.2](#).

---

**NOTE:** To determine an appropriate value for ADCCTL2.PRESCALE, consult the datasheet of your device to determine the maximum SYSCLK and ADCCLK frequency.

---

### 9.1.3.2 Resolution

The resolution of the ADC determines how finely the analog range is quantized into digital values. This ADC supports a configurable resolution of 16 bits or 12 bits. The resolution should be configured by using the AdcSetMode function provided in ControlSUITE in F2837xS\_Adc.c. This function ensures that the correct trim is loaded into the ADC trim registers. This function must be called at least once after a device reset. The resolution should not be configured by writing to the ADCCTL2 register directly. The resolution can be changed at any time when the ADC is idle (no active or pending SOCs). No wait time is necessary after changing the resolution before conversions can be initiated. If SOCs are active or pending when the resolution is changed, those SOCs may produce incorrect conversion results.

### 9.1.3.3 Voltage Reference

Each ADC has a VREFHI input and a VREFLO input, which is used as a ratiometric reference.

See [Section 9.3.4](#) for information on how to supply the reference voltage.

**NOTES:**

- On devices with no external VREFLO signals, VREFLO has been internally connected to the device analog ground, VSSA.
- Consult the datasheet for your device to determine the allowable voltage range for VREFHI and VREFLO.
- The external reference mode requires an external capacitor on the VREFHI pin. Consult the device datasheet for the specific value required.

### 9.1.3.4 Signal Mode

The ADC supports two signal modes: single-ended and differential. In single-ended mode, the input voltage to the converter is sampled through a single pin (ADCINx), referenced to VREFLO. In differential signaling mode, the input voltage to the converter is sampled through a pair of input pins, one of which is the positive input (ADCINxP) and the other is the negative input (ADCINxN). The actual input voltage is the difference between the two (ADCINxP – ADCINxN).

The signal mode should be configured by using the AdcSetMode function provided in ControlSUITE in F2837xS\_Adc.c. This function ensures that the correct trim is loaded into the ADC trim registers. This function must be called at least once after a device reset. The signal mode should not be configured by writing to the ADCCTL2 register directly.

**NOTES:**

- In 16-bit differential signaling mode, VREFLO must be connected to VSSA.
- In differential signal mode, the common mode voltage is
 
$$V_{CM} = (ADCINxP + ADCINxN)/2$$
 The datasheet for a particular device will place some requirements on how close this voltage needs to be to
 
$$(VREFHI + VREFLO)/2$$

**Note:** The above condition is not met by connecting the negative input to VSSA or VREFLO.

- Differential signaling mode is advantageous because noise encountered on both inputs will be largely cancelled. The effect can be maximized by routing the positive and negative traces for the same differential input as close together as possible and keeping them symmetrical with respect to the signal reference.

#### 9.1.3.5 Expected Conversion Results

Based on a given analog input voltage, the ideal expected digital conversion is given by the tables below. Fractional values are truncated.

**Table 9-2. Analog to 12-bit Digital Formulas**

	Analog Input	Digital Result
<b>Single-Ended</b>	when $ADCINy \leq VREFLO$	$ADCRESULTx = 0$
	when $VREFLO < ADCINy < VREFHI$	$ADCRESULTx = 4096 \left( \frac{ADCINy - VREFLO}{VREFHI - VREFLO} \right)$
	when $ADCINy \geq VREFHI$	$ADCRESULTx = 4095$
<b>Differential</b>	Invalid Mode	Invalid Mode

**Table 9-3. Analog to 16-bit Digital Formulas**

	Analog Input	Digital Result
<b>Single-Ended</b>	Invalid Mode	Invalid Mode
<b>Differential</b>	when $ADCINyP - ADCINyN \leq -VREFHI$	$ADCRESULTx = 0$
	when $-VREFHI < ADCINyP - ADCINyN \leq -VREFHI$	$ADCRESULTx = 65536 \left( \frac{ADCINyP - ADCINyN + VREFHI}{2 VREFHI} \right)$
	when $ADCINyP - ADCINyN \geq VREFHI$	$ADCRESULTx = 65535$

### 9.1.3.6 Interpreting Conversion Results

Based on a given ADC conversion result, the ideal corresponding analog input is given by the below tables. This corresponds to the center of the possible range of analog voltages that could have produced this conversion result.

**Table 9-4. 12-Bit Digital-to-Analog Formulas**

	Digital Value	Analog Equivalent
<b>Single-Ended</b>	when $ADCRESULTy = 0$	$ADCINx \leq VREFLO$
	when $0 < ADCRESULTy < 4095$	$ADCINx = (VREFHI - VREFLO) \left( \frac{ADCRESULTy}{4096} \right) + VREFLO$
	when $ADCRESULTy = 4095$	$ADCINx \geq VREFHI$
<b>Differential</b>	Invalid Mode	Invalid Mode

**Table 9-5. 16-Bit Digital-to-Analog Formulas**

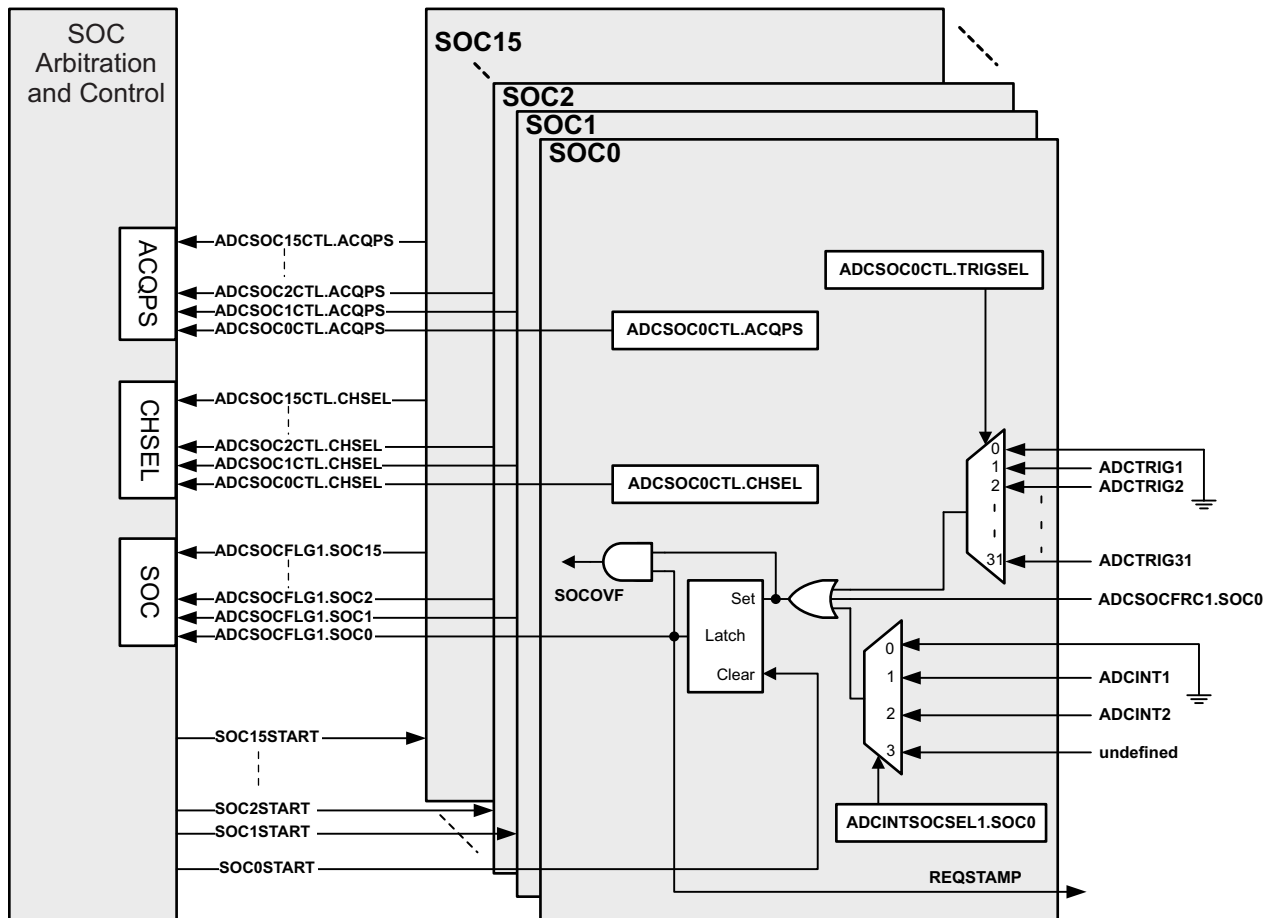
	Digital Value	Analog Equivalent
<b>Single-Ended</b>	Invalid Mode	Invalid Mode
<b>Differential</b>	when $ADCRESULTy = 0$	$ADCINxP - ADCINxN \leq -VREFHI$
	when $0 < ADCRESULTy < 65535$	$ADCINxP - ADCINxN = VREFHI \left( \frac{2 ADCRESULTy - 1}{65536} \right)$
	when $ADCRESULTy = 65535$	$ADCINxP - ADCINxN \geq VREFHI$

### 9.1.4 SOC Principle of Operation

The ADC triggering and conversion sequencing is accomplished through configurable start-of-conversions (SOCs). Each SOC is a configuration set defining the single conversion of a single channel. In that set there are three configurations: the trigger source that starts the conversion, the channel to convert, and the acquisition (sample) window duration. Upon receiving the trigger configured for a SOC, the wrapper will ensure that the specified channel is captured using the specified acquisition window duration.

Multiple SOCs can be configured for the same trigger, channel, and/or acquisition window as desired. Configuring multiple SOCs to use the same trigger will allow the trigger to generate a sequence of conversions. Configuring multiple SOCs to use the same trigger and channel will allow for oversampling.

Figure 9-2. SOC Block Diagram



#### 9.1.4.1 SOC Configuration

Each SOC has its own configuration register, ADCSOCxCTL. Within this register, SOCx can be configured for trigger source, channel to convert, and acquisition (sample) window duration.

#### 9.1.4.2 Trigger Operation

Each SOC can be configured to start on one of many input triggers. The primary trigger select for SOCx is in the ADCSOCxCTL.TRIGSEL register, which can select between:

- Disabled (software only)
- CPU Timers 0/1/2
- GPIO: Input X-Bar INPUT5
- ePWM1 to ePWM12, ADCSOCA or ADCSOCB

In addition, each SOC can also be triggered when the ADCINT1 flag or ADCINT2 flag is set. This is achieved by configuring the ADCINTSOCSEL1 register (for SOC0 to SOC7) or the ADCINTSOCSEL2 register (for SOC8 to SOC15). This is useful for creating continuous conversions.

#### 9.1.4.3 ADC Acquisition (Sample and Hold) Window

External signal sources vary in their ability to drive an analog signal quickly and effectively. In order to achieve rated resolution, the signal source needs to charge the sampling capacitor in the ADC core to within 0.5LSBs of the signal voltage. The acquisition window is the amount of time the sampling capacitor is allowed to charge and is configurable for SOCx by the ADCSOCxCTL.ACQPS register.

ACQPS is a 9-bit register that can be set to a value between 0 and 511, resulting in an acquisition window duration of:

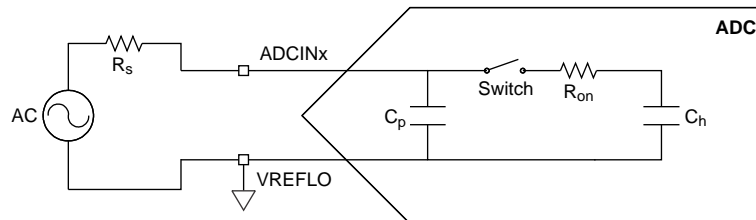
Acquisition window = (ACQPS + 1) · (System Clock (SYSCLK) cycle time)

- The acquisition window duration is based on the System Clock (SYSCLK), not the ADC clock (ADCCLK).
- The selected acquisition window duration must be at least as long as one ADCCLK cycle.
- The datasheet will specify a minimum acquisition window duration (in nanoseconds). The user is responsible for selecting an acquisition window duration that meets this requirement.

#### 9.1.4.4 ADC Input Models

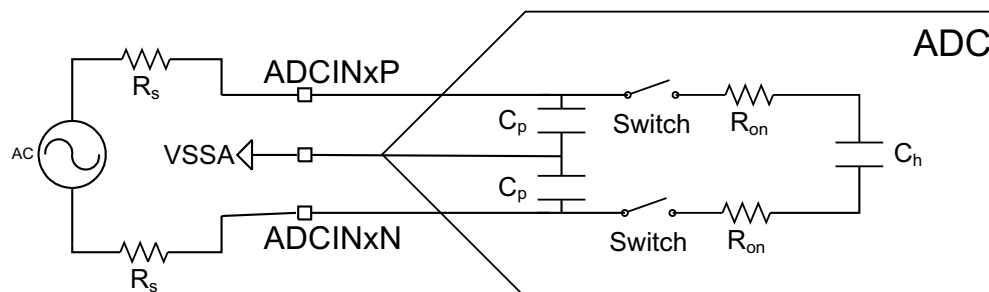
For single-ended operation, the ADC input characteristics for values in the single-ended input model (see [Figure 9-3](#)) can be found in the device data manual.

**Figure 9-3. Single-Ended Input Model**



For differential operation, the ADC input characteristics for values in the differential input model (see [Figure 9-4](#)) can be found in the device data manual.

**Figure 9-4. Differential Input Model**



These input models should be used along with actual signal source impedance to determine the acquisition window duration. See [Section 9.3.2](#) for more information.

### 9.1.4.5 Channel Selection

Each SOC can be configured to convert any of the ADC channels. This behavior is selected for SOCx by the ADCSOCxCTL.CHSEL register. Depending on the signal mode, the selection is different. For single-ended signal mode, the value in CHSEL selects a single pin as the input. For differential signal mode, the value in CHSEL selects an even-odd pin pair to be the positive and negative inputs. This is summarized in [Table 9-6](#).

**Table 9-6. Channel Selection of Input Pins**

Input Mode	CHSEL	Input	
Single-Ended	0	ADCIN0	
	1	ADCIN1	
	2	ADCIN2	
	3	ADCIN3	
	4	ADCIN4	
	5	ADCIN5	
	6	ADCIN6	
	7	ADCIN7	
	8	ADCIN8	
	9	ADCIN9	
	10	ADCIN10	
	11	ADCIN11	
	12	ADCIN12	
	13	ADCIN13	
	14	ADCIN14	
	15	ADCIN15	
	CHSEL	Positive Input	Negative Input
Differential	0 or 1	ADCIN0	ADCIN1
	2 or 3	ADCIN2	ADCIN3
	4 or 5	ADCIN4	ADCIN5
	6 or 7	ADCIN6	ADCIN7
	8 or 9	ADCIN8	ADCIN9
	10 or 11	ADCIN10	ADCIN11
	12 or 13	ADCIN12	ADCIN13
	14 or 15	ADCIN14	ADCIN15

## 9.1.5 SOC Configuration Examples

The following sections provide some specific examples of how to configure the SOCs to produce some conversions.

### 9.1.5.1 Single Conversion from ePWM Trigger

To configure ADCA to perform a single conversion on channel ADCINA1 when the ePWM timer reaches its period match, a few things are necessary. First, ePWM3 must be configured to generate an SOCA or SOCB signal (in this statement, SOC refers to a signal in the ePWM module). See the *Enhanced Pulse Width Modulator Module (ePWM)* chapter on how to do this. Assume that SOCB was chosen.

SOC5 is chosen arbitrarily. Any of the 16 SOCs could be used.

Assuming a 100ns sample window is desired with a SYSCLK frequency of 200MHz, then the acquisition window duration should be  $100\text{ns}/5\text{ns} = 20$  SYSCLK cycles. The ACQPS field should therefore be set to  $20 - 1 = 19$ .

```
AdcaRegs.ADCSOC5CTL.bit.CHSEL = 1;           //SOC5 will convert ADCINA1
AdcaRegs.ADCSOC5CTL.bit.ACQPS = 19;          //SOC5 will use sample duration of 20 SYSCLK cycles
AdcaRegs.ADCSOC5CTL.bit.TRIGSEL = 10;        //SOC5 will begin conversion on ePWM3 SOCB
```

As configured, when ePWM3 matches its period and generates the SOCB signal, the ADC will begin sampling channel ADCINA1 (SOC5) immediately if the ADC is idle. If the ADC is busy, ADCINA1 will begin sampling when SOC5 gains priority (see [Section 9.1.6](#)). The ADC control logic will sample ADCINA1 with the specified acquisition window width of 100 ns. Immediately after the acquisition is complete, the ADC will begin converting the sampled voltage to a digital value. When the ADC conversion is complete, the results will be available in the ADCRESULT5 register (see [Section 9.2](#) for exact sample, conversion, and result latch timings).

### 9.1.5.2 Oversampled Conversion from ePWM Trigger

To configure the ADC to oversample ADCINA1 4 times, we use the same configurations as the previous example, but apply them to SOC5, SOC6, SOC7, and SOC8.

```
AdcaRegs.ADCSOC5CTL.bit.CHSEL = 1;           //SOC5 will convert ADCINA1
AdcaRegs.ADCSOC5CTL.bit.ACQPS = 19;          //SOC5 will use sample duration of 20 SYSCLK cycles
AdcaRegs.ADCSOC5CTL.bit.TRIGSEL = 10;        //SOC5 will begin conversion on ePWM3 SOCB
AdcaRegs.ADCSOC6CTL.bit.CHSEL = 1;           //SOC6 will convert ADCINA1
AdcaRegs.ADCSOC6CTL.bit.ACQPS = 19;          //SOC6 will use sample duration of 20 SYSCLK cycles
AdcaRegs.ADCSOC6CTL.bit.TRIGSEL = 10;        //SOC6 will begin conversion on ePWM3 SOCB
AdcaRegs.ADCSOC7CTL.bit.CHSEL = 1;           //SOC7 will convert ADCINA1
AdcaRegs.ADCSOC7CTL.bit.ACQPS = 19;          //SOC7 will use sample duration of 20 SYSCLK cycles
AdcaRegs.ADCSOC7CTL.bit.TRIGSEL = 10;        //SOC7 will begin conversion on ePWM3 SOCB
AdcaRegs.ADCSOC8CTL.bit.CHSEL = 1;           //SOC8 will convert ADCINA1
AdcaRegs.ADCSOC8CTL.bit.ACQPS = 19;          //SOC8 will use sample duration of 20 SYSCLK cycles
AdcaRegs.ADCSOC8CTL.bit.TRIGSEL = 10;        //SOC8 will begin conversion on ePWM3 SOCB
```

As configured, when ePWM3 matches its period and generates the SOCB signal, the ADC will begin sampling channel ADCINA1 (SOC5) immediately if the ADC is idle. If the ADC is busy, ADCINA1 will begin sampling when SOC5 gains priority (see [ADC Conversion Priority](#)). Once the conversion is complete for SOC5, SOC6 will begin converting ADCINA1 and the results for SOC5 will be placed in the ADCRESULT5 register. All four conversions will eventually be completed sequentially, with the results in ADCRESULT5, ADCRESULT6, ADCRESULT7, and ADCRESULT8 for SOC5, SOC6, SOC7, and SOC8, respectively.

---

**NOTE:** It is possible, but unlikely, that the ADC could begin converting SOC6, SOC7, or SOC8 before SOC5 depending on the position of the round-robin pointer when the ePWM trigger is received. See [ADC Conversion Priority](#) to understand how the next SOC to be converted is chosen.

---



### 9.1.5.3 Multiple Conversions from CPU Timer Trigger

This example will show how to sample multiple signals with different acquisition window requirements. CPU1 Timer 2 will be used to generate the trigger. To see how to configure the CPU timer, see the *System Control and Interrupts* chapter.

A good first step when designing a sampling scheme with many signals is to list out the signals and their required acquisition window. From this, calculate the necessary number of SYSCLK cycles for each signal, then the ACQPS register setting. This is shown in [Table 9-7](#), where a SYCLK of 200MHz is assumed ( 5ns cycle time).

**Table 9-7. Example Requirements for Multiple Signal Sampling**

Signal Name	Acquisition Window Requirement (ns)	Acquisition Window SYSCLK Cycles	ACQPS Register Value
Signal 1	>120ns	120ns/5ns = 24	24 – 1 = 23
Signal 2	>444ns	444ns/5ns = 89 (round up)	89 – 1 = 88
Signal 3	>110ns	110ns/5ns = 22	22 – 1 = 21
Signal 4	>291ns	291ns/5ns = 59 (round up)	59 – 1 = 58

Next decide which ADC pins to connect to each signal. This will be highly dependent on application board layout. Once the pins are selected, determining the value of CHSEL is straightforward (see [Table 9-8](#)).

**Table 9-8. Example Connections for Multiple Signal Sampling**

Signal Name	ADC PIN	CHSEL Register Value
Signal 1	ADCINA5	5
Signal 2	ADCINA0	0
Signal 3	ADCINA3	3
Signal 4	ADCINA2	2

With the information tabulated, it is easy to generate the SOC configurations:

```
AdcaRegs.ADCSOC0CTL.bit.CHSEL = 5;           //SOC0 will convert ADCINA5
AdcaRegs.ADCSOC0CTL.bit.ACQPS = 23;         //SOC0 will use sample duration of 24 SYSCLK cycles
AdcaRegs.ADCSOC0CTL.bit.TRIGSEL = 3;        //SOC0 will begin conversion on CPU1 Timer 2
AdcaRegs.ADCSOC1CTL.bit.CHSEL = 0;         //SOC1 will convert ADCINA0
AdcaRegs.ADCSOC1CTL.bit.ACQPS = 88;        //SOC1 will use sample duration of 89 SYSCLK cycles
AdcaRegs.ADCSOC1CTL.bit.TRIGSEL = 3;        //SOC1 will begin conversion on CPU1 Timer 2
AdcaRegs.ADCSOC2CTL.bit.CHSEL = 3;         //SOC2 will convert ADCINA3
AdcaRegs.ADCSOC2CTL.bit.ACQPS = 21;        //SOC2 will use sample duration of 22 SYSCLK cycles
AdcaRegs.ADCSOC2CTL.bit.TRIGSEL = 3;        //SOC2 will begin conversion on CPU1 Timer 2
AdcaRegs.ADCSOC3CTL.bit.CHSEL = 2;         //SOC3 will convert ADCINA2
AdcaRegs.ADCSOC3CTL.bit.ACQPS = 58;        //SOC3 will use sample duration of 59 SYSCLK cycles
AdcaRegs.ADCSOC3CTL.bit.TRIGSEL = 3;        //SOC3 will begin conversion on CPU1 Timer 2
```

As configured, when CPU1 Timer 2 generates an event, SOC0, SOC1, SOC2, and SOC3 will eventually be sampled and converted, in that order. The conversion results for ACINA5 (Signal 1) will be in ADCRESULT0. Similarly, The results for ADCINA0 (Signal 2), ADCINA3 (Signal 3), and ADCINA2 (Signal 4) will be in ADCRESULT1, ADCRESULT2, and ADCRESULT3, respectively.

---

**NOTE:** It is possible, but unlikely, that the ADC could begin converting SOC1, SOC2, or SOC3 before SOC0 depending on the position of the round-robin pointer when the CPU Timer trigger is received. See [ADC Conversion Priority](#) to understand how the next SOC to be converted is chosen.

---

#### 9.1.5.4 Software Triggering of SOC's

At any point, whether or not the SOC's have been configured to accept a specific trigger, a software trigger can set the SOC's to be converted. This is accomplished by writing bits in the ADCSOCFRC1 register.

Software triggering of the previous example without waiting for the CPU1 Timer 2 to generate the trigger could be accomplished by the statement:

```
AdcaRegs.ADCSOCFRC1.all = 0x000F;           //set SOC flags for SOC0 to SOC3
```

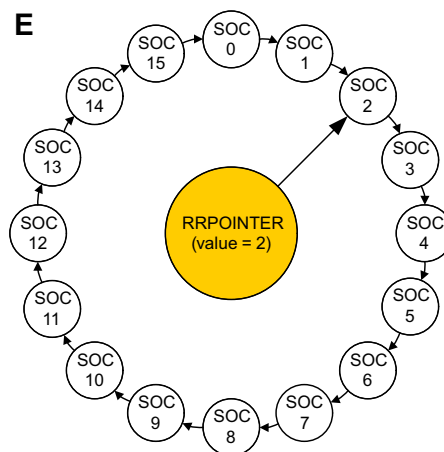
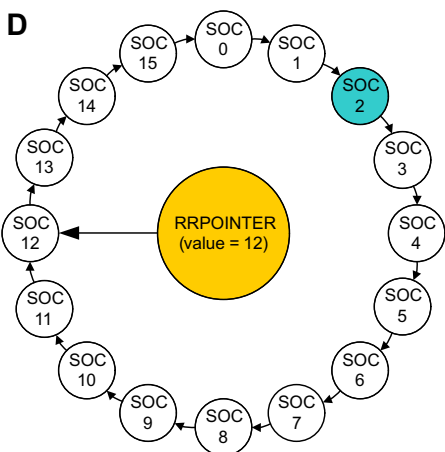
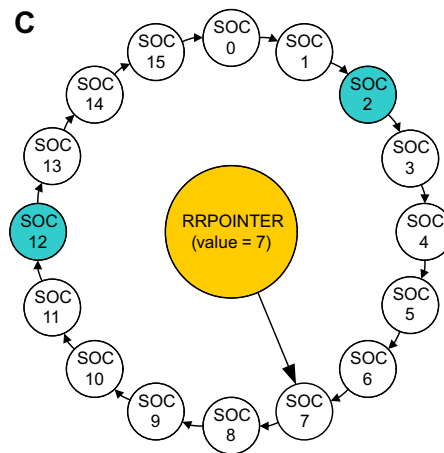
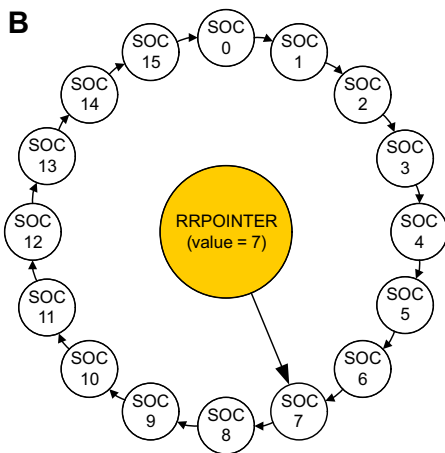
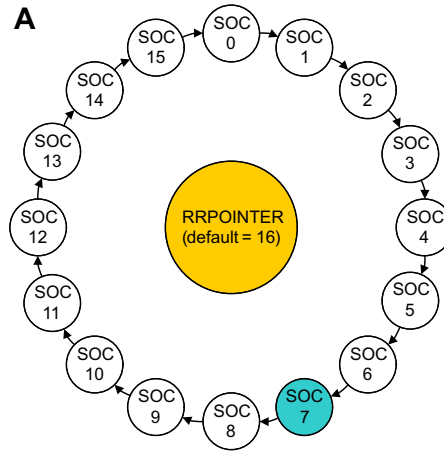
#### 9.1.6 ADC Conversion Priority

When multiple SOC flags are set at the same time, one of two forms of priority determines the order in which they are converted. The default priority method is round robin. In this scheme, no SOC has an inherent higher priority than another. Priority depends on the round robin pointer (RRPOINTER). The RRPOINTER reflected in the ADCSOCPRIORITYCTL register points to the last SOC converted. The highest priority SOC is given to the next value greater than the RRPOINTER value, wrapping around back to SOC0 after SOC15. At reset the value is 16 since 0 indicates a conversion has already occurred. When RRPOINTER equals 16 the highest priority is given to SOC0. The RRPOINTER is reset by a device reset, when the ADCCTL1.RESET bit is set, or when the SOCPRICL register is written.

An example of the round robin priority method is given in [Figure 9-5](#).

Figure 9-5. Round Robin Priority Example

- A After reset, SOC0 is highest priority SOC ; SOC7 receives trigger; SOC7 configured channel is converted immediately .
- B RRPOINTER changes to point to SOC 7; SOC8 is now highest priority SOC .
- C SOC2 & SOC12 triggers rcvd. simultaneously; SOC12 is first on round robin wheel ; SOC12 configured channel is converted while SOC2 stays pending .
- D RRPOINTER changes to point to SOC 12; SOC2 configured channel is now converted .
- E RRPOINTER changes to point to SOC 2; SOC3 is now highest priority SOC .



The SOC PRIORITY field in the ADCSOC PRIORITY CTL register can be used to assign high priority from a single to all of the SOC s. When configured as high priority, an SOC will interrupt the round robin wheel after any current conversion completes and insert itself in as the next conversion. After its conversion completes, the round robin wheel will continue where it was interrupted. If two high priority SOC s are triggered at the same time, the SOC with the lower number will take precedence.

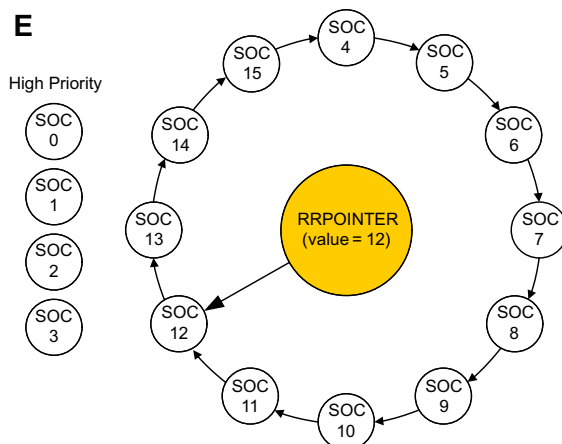
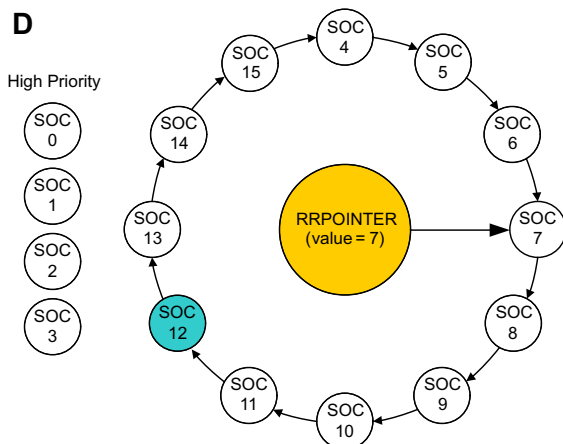
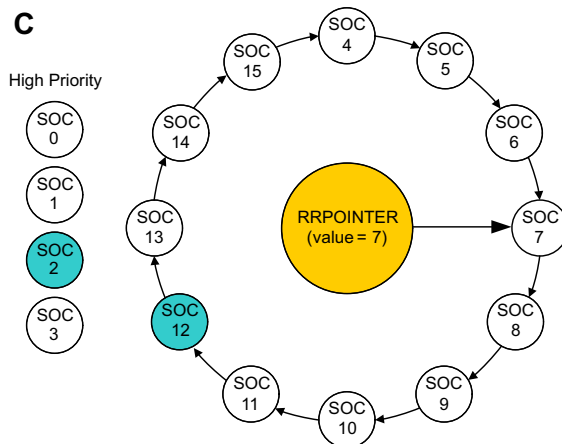
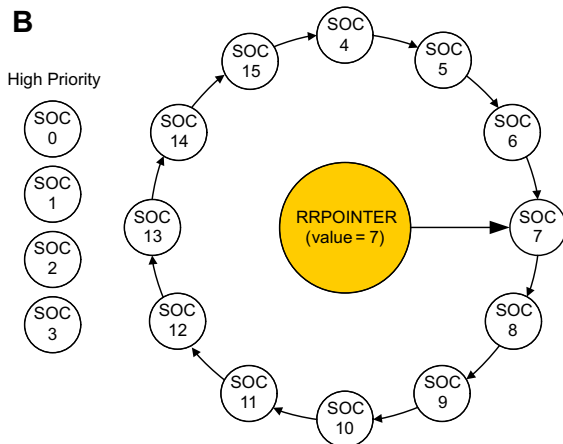
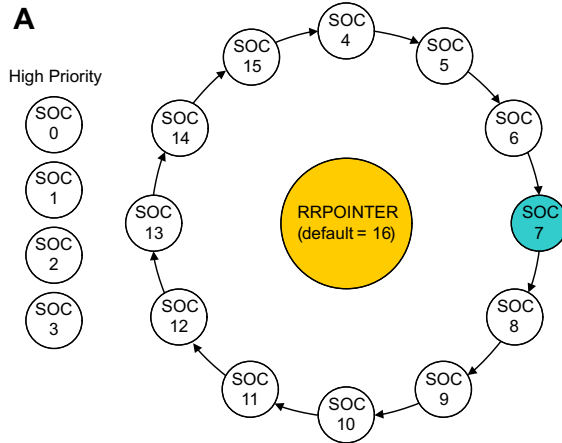
High priority mode is assigned first to SOC0, then in increasing numerical order. The value written in the SOC PRIORITY field defines the first SOC that is not high priority. In other words, if a value of 4 is written into SOC PRIORITY, then SOC0, SOC1, SOC2, and SOC3 are defined as high priority, with SOC0 the highest.

An example using high priority SOC's is given in Figure 9-6 .

Figure 9-6. High Priority Example

Example when SOC PRIORITY = 4

- A** After reset, SOC4 is 1<sup>st</sup> on round robin wheel ;  
SOC7 receives trigger ;  
SOC7 configured channel is converted immediately .
- B** RRPOINTER changes to point to SOC 7 ;  
SOC8 is now 1<sup>st</sup> on round robin wheel .
- C** SOC2 & SOC12 triggers rcvd . simultaneously ;  
SOC2 interrupts round robin wheel and SOC 2 configured channel is converted while SOC 12 stays pending .
- D** RRPOINTER stays pointing to 7 ;  
SOC12 configured channel is now converted .
- E** RRPOINTER changes to point to SOC 12 ;  
SOC13 is now 1<sup>st</sup> on round robin wheel .



### 9.1.7 Burst Mode

Burst mode allows a single trigger to walk through the round-robin SOC's one or more at a time. Setting the bit BURSTEN in the ADCBURSTCTL register configures the ADC wrapper for burst mode. This causes the TRIGSEL field to be ignored, but only for SOC's that are configured for round-robin operation (not high priority). Instead of the TRIGSEL field, all round-robin SOC's are triggered based on the BURSTTRIG field in the ADCBURSTCTL register. Upon reception of the burst trigger, the ADC wrapper will not set all round-robin SOC's to be converted, but only (ADCBURSTCTL.BURSTSIZE + 1) SOC's. The first SOC to be set will be that with the highest priority based on the round-robin pointer, and subsequent SOC's will be set until BURSTSIZE SOC's have been set.

---

**NOTE:** When configuring the ADC for burst mode, the user is responsible for ensuring that each burst of conversions is allowed to complete before the next burst trigger is received.

---

#### 9.1.7.1 Burst Mode Example

Burst mode can be used to sample a different set of signals on every other trigger. In the following example, ADCIN7 and ADCIN5 are converted on the first trigger from CPU1 Timer 2 and every other trigger thereafter. ADCIN2 and ACIN3 are converted on the second trigger from CPU1 Timer 2 and every other trigger thereafter. All signals are converted with 20 SYSCLK cycle wide acquisition windows, but different durations could be configured for each SOC as desired.

```
AdcaRegs.BURSTCTL.BURSTEN = 1;           //Enable ADC burst mode
AdcaRegs.BURSTCTL.BURSTTRIG = 3;        //CPU1 Timer 2 will trigger burst of conversions
AdcaRegs.BURSTCTL.BURSTSIZE = 1;       //conversion bursts are 1 + 1 = 2 conversions long

AdcaRegs.SOCPRCTL.bit.SOCPRIORITY = 12; //SOC0 to SOC11 are high priority

AdcaRegs.ADCSOC12CTL.bit.CHSEL = 7;     //SOC12 will convert ADCINA7
AdcaRegs.ADCSOC12CTL.bit.ACQPS = 19;    //SOC12 will use sample duration of 20 SYSCLK cycles
AdcaRegs.ADCSOC13CTL.bit.CHSEL = 5;     //SOC13 will convert ADCINA5
AdcaRegs.ADCSOC13CTL.bit.ACQPS = 19;    //SOC13 will use sample duration of 20 SYSCLK cycles
AdcaRegs.ADCSOC14CTL.bit.CHSEL = 2;     //SOC14 will convert ADCINA2
AdcaRegs.ADCSOC14CTL.bit.ACQPS = 19;    //SOC14 will use sample duration of 20 SYSCLK cycles
AdcaRegs.ADCSOC15CTL.bit.CHSEL = 3;     //SOC15 will convert ADCINA3
AdcaRegs.ADCSOC15CTL.bit.ACQPS = 19;    //SOC15 will use sample duration of 20 SYSCLK cycles
```

When the first CPU1 Timer 2 trigger is received, SOC12 and SOC13 will be converted immediately if the ADC is idle. If the ADC is busy, SOC12 and SOC13 will be converted once their SOC's gain priority. The results for SOC12 and SOC13 will be in ADCRESULT12 and ADCRESULT13, respectively. After SOC13 completes, the round robin pointer will give highest priority to SOC14. Because of this, when the next CPU1 Timer 2 trigger is received, SOC14 and SOC15 will be set as pending and eventually be converted. The results for SOC14 and SOC15 will be in ADCRESULT14 and ADCRESULT15, respectively. Subsequent triggers will continue to toggle between converting SOC12 and SOC13, and converting SOC14 and SOC15.

While the above example toggles between two sets of conversions, three or more different sets of conversions could be achieved using a similar approach.

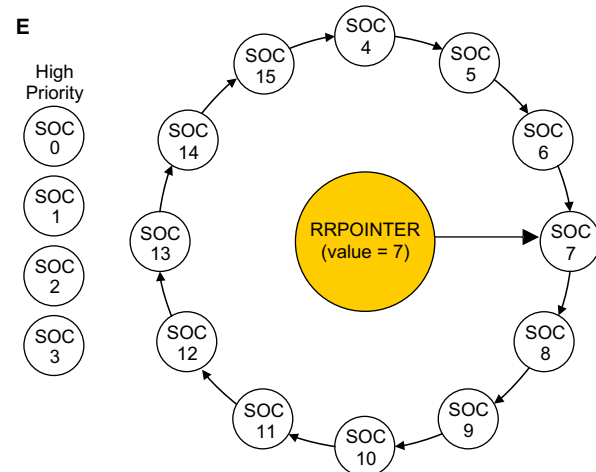
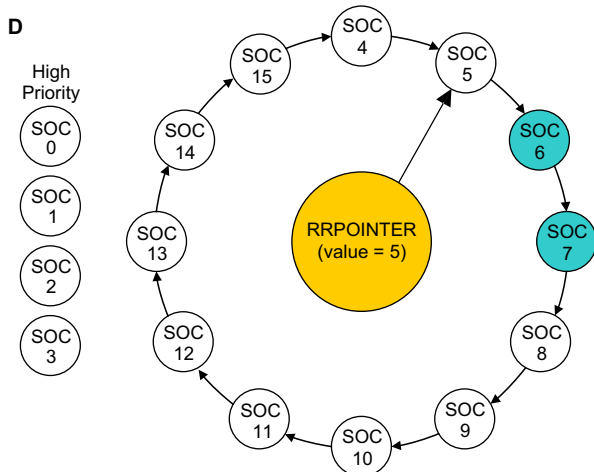
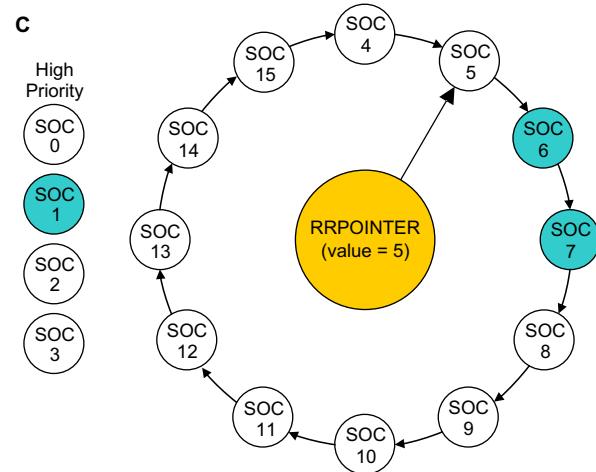
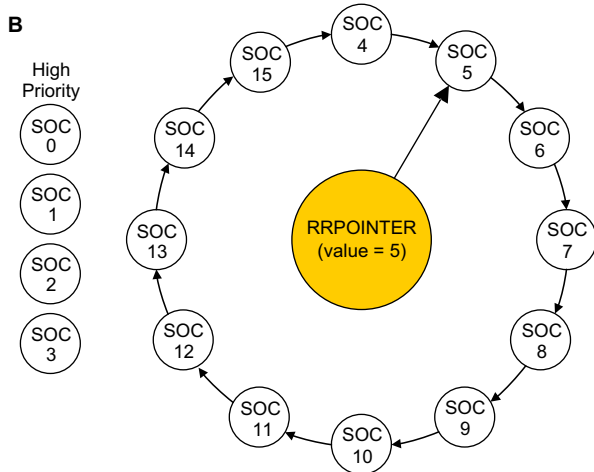
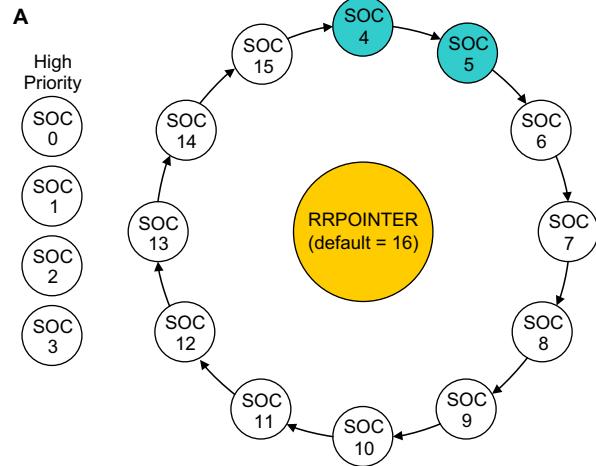
#### 9.1.7.2 Burst Mode Priority Example

An example of priority resolution using burst mode and high-priority SOC's is presented in [Figure 9-7](#).

Figure 9-7. Burst Priority Example

Example when SOC PRIORITY = 4, BURSTEN = 1, and BURSTSIZE = 1

- A** After reset, SOC4 is 1<sup>st</sup> on round robin wheel; BURSTTRIG trigger is received; SOC4 & SOC5 are set and configured channels converted immediately.
- B** RRPOINTER changes to point to SOC5; SOC6 is now 1<sup>st</sup> on round robin wheel.
- C** BURSTTRIG & SOC1 triggers rcvd. simultaneously; SOC1, SOC6, and SOC7 are set; SOC1 interrupts round robin wheel and SOC1 configured channel is converted while SOC6 and SOC7 stay pending.
- D** RRPOINTER stays pointing to 5; SOC6/SOC7 configured channels are now converted.
- E** RRPOINTER changes to point to SOC7; SOC8 is now 1<sup>st</sup> on round robin wheel, waiting for BURSTTRIG.



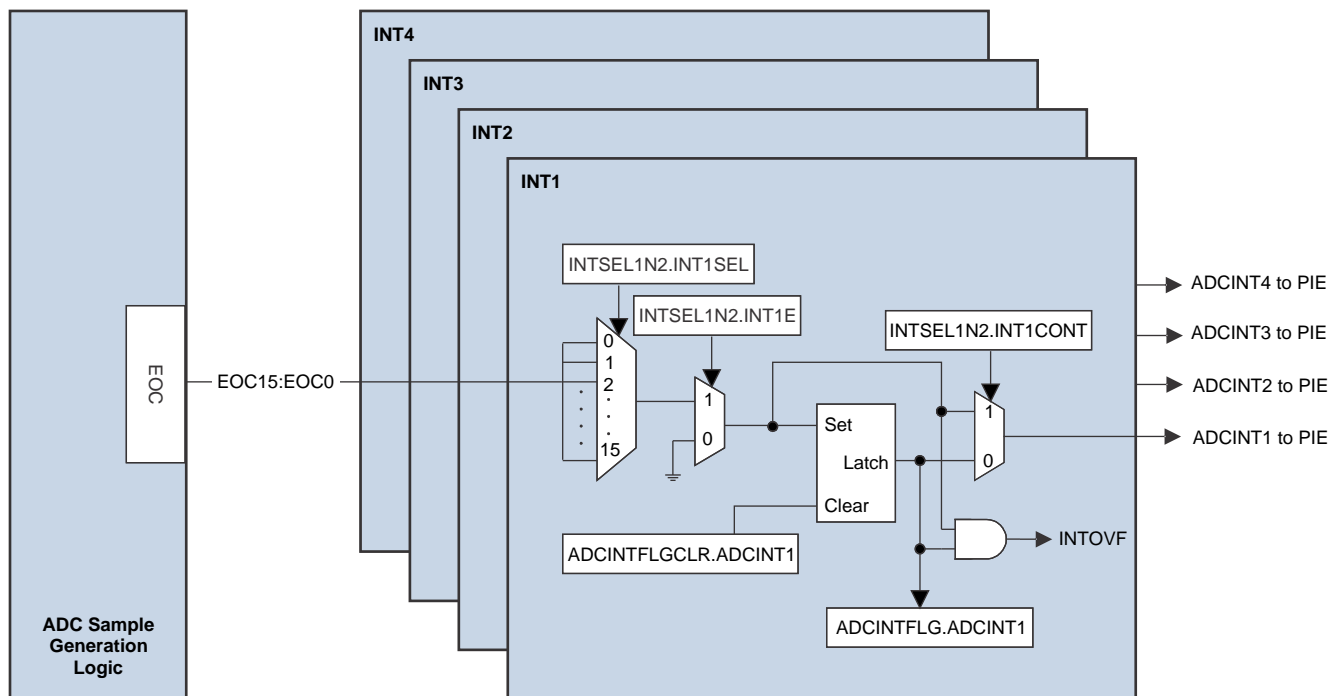
### 9.1.8 EOC and Interrupt Operation

Each SOC has a corresponding end-of-conversion (EOC) signal. This EOC signal can be used to trigger an ADC interrupt. The ADC can be configured to generate the EOC pulse at either the end of the acquisition window or at the end of the voltage conversion. This is configured using the bit `INTPULSEPOS` in the `ADCCTL1` register. See [Section 9.2](#), for exact EOC pulse location.

Each ADC module has 4 configurable ADC interrupts. These interrupts can be triggered by any of the 16 EOC signals. The flag bit for each `ADCINT` can be read directly or the interrupt can be passed on to the PIE.

Figure 9-8 shows a block diagram of the ADC interrupt structure.

Figure 9-8. ADC EOC Interrupts

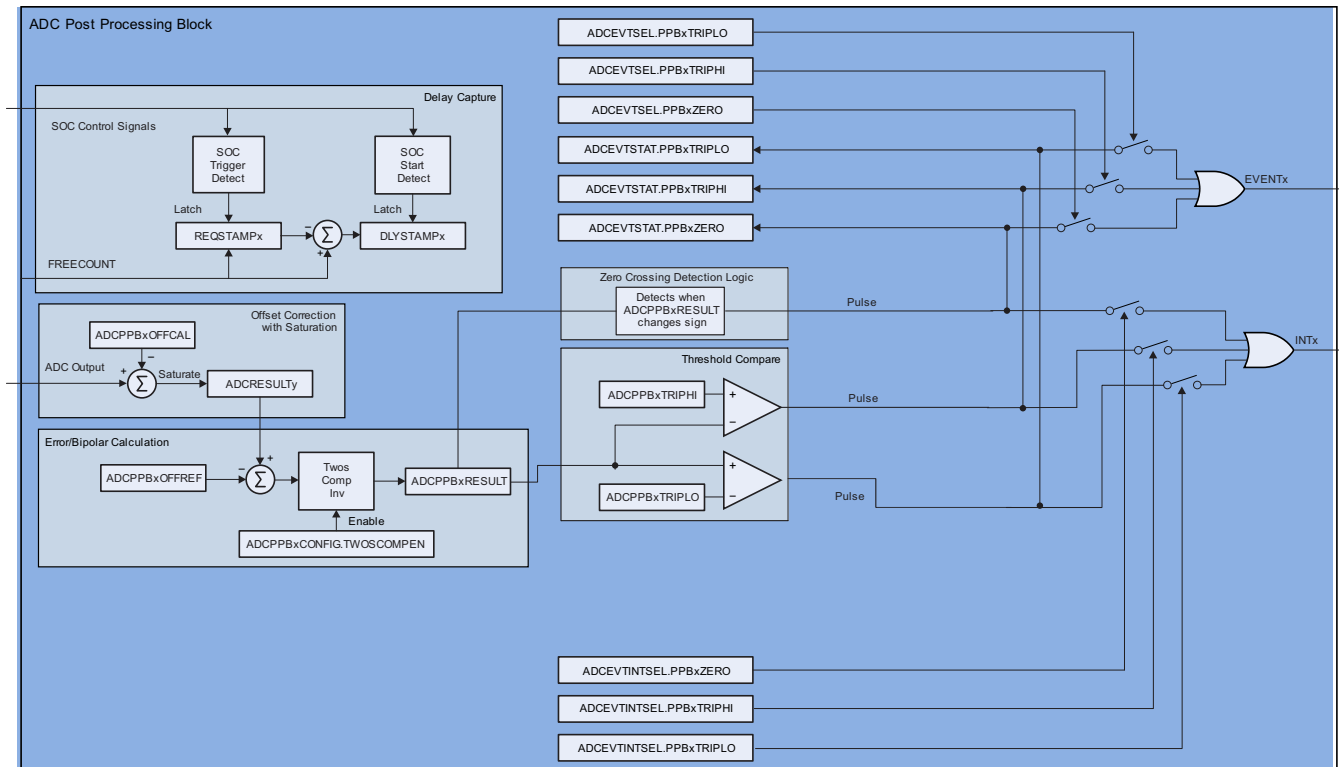


### 9.1.9 Post-Processing Blocks

Each ADC module contains four post-processing blocks (PPB). These blocks can be associated with any of the 16 `RESULT` registers using the `ADCPPBxCONFIG.CONFIG` bit field. Each PPB can simultaneously remove an offset associated with the `ADCIN` channel, subtract out a reference value, flag a zero-crossing point, and flag a high or low compare limit. Furthermore, the zero-crossing and compare flags can trip a PWM and/or generate an interrupt. A PPB is also capable of recording the delay between when the SOC associated with the PPB is triggered and when it actually begins to be sampled. [Figure 9-9](#) presents the structure of each PPB. Subsequent sections explain the use of each submodule.



Figure 9-9. ADC PPB Block Diagram



### 9.1.9.1 PPB Offset Correction

In many applications, external sensors and signal sources produce an offset. A global trimming of the ADC offset is not enough to compensate for these offsets, which vary from channel to channel. The post-processing block can remove these offsets with zero overhead, saving numerous cycles in tight control loops.

Offset correction is accomplished by first pointing the ADCPPBxCONFIG.CONFIG to the desired SOC, then writing an offset correction value to the ADCPPBxOFFCAL.OFFCAL register. The post-processing block will automatically add or subtract the value in the OFFCAL register from the raw conversion result and store it in the ADCRESULT register. This addition/subtraction will saturate at 0 on the low end and either 4095 or 65535 on the high end for 12-bit or 16-bit mode, respectively.

#### NOTES:

- Writing a 0 to the OFFCAL register effectively disables the offset correction feature, passing the raw result unchanged to the ADCRESULT register.
- It is possible to point multiple PPBs to the same SOC. In this case, the OFFCAL value that will actually be applied will be that of the PPB with the highest number.
- In particular, care needs to be taken when using the PPB on SOC0, as all the PPB point to this SOC by default. This may cause unintentional overwriting of offset correction of a lower numbered PPB by a higher numbered PPB.

### 9.1.9.2 PPB Error Calculation

In many applications, an error from a setpoint or expected value must be computed from the digital output of an ADC conversion. In other cases, a bipolar signal is necessary or convenient for control calculations. The PPB can perform these function automatically, reducing the sample to output latency and reducing software overhead.



Error calculation is accomplished by first pointing the ADCPPBxCONFIG.CONFIG to the desired SOC, then writing a value to the ADCPPBxOFFCAL.OFFREF register. The post-processing block will automatically subtract the value in the OFFREF register from the ADCRESULT value and store it in the ADCPPBxRESULT register. This subtraction will produce a sign-extended 32-bit result. It is also possible to selectively invert the calculated value before storing in the ADCPPBxRESULT register by setting the TWOSCOMPEN bit in the ADCPPBxCONFIG register.

**NOTES:**

- In 12-bit mode, do not write a value larger than 12 bits to the OFFREF register.
- Since the PPBxRESULT register is unique for each PPB, it is possible to point multiple PPBs to the same SOC and get different results for each PPB.
- Writing a 0 to the OFFREF register effectively disables the error calculation feature, passing the ADCRESULT value unchanged to the ADCPPBxRESULT register.

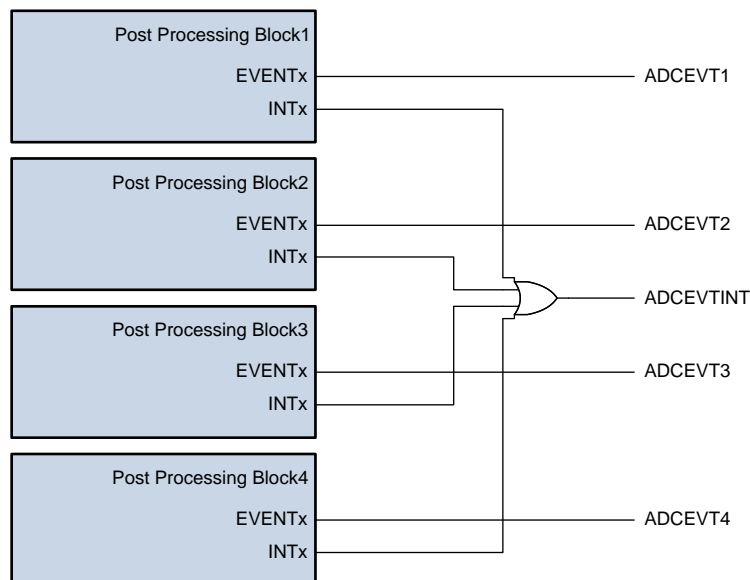
**9.1.9.3 PPB Limit Detection and Zero-Crossing Detection**

Many applications perform a limit check against the ADC conversion results. The PPB can automatically perform a check against a high and low limit or whenever ADCPPBxRESULT changes sign. Based on these comparisons, it can generate a trip to the PWM and/or an interrupt automatically, lowering the sample to ePWM latency and reducing software overhead. This functionality also enables safety conscious applications to trip the ePWM based on an out-of-range ADC conversion without any CPU intervention.

To enable this functionality, first point the ADCPPBxCONFIG.CONFIG to the desired SOC, then write a value to one or both of the registers ADCPPBxTRIPHI.LIMITHI and ADCPPBxTRIPLO.LIMITLO (zerocrossing detection does not require further configuration). Whenever these limits are exceeded, the PPBxTRIPHI bit or PPBxTRIPLO bit will be set in the ADCEVTSTAT register. Note that the PPBxZERO bit in the ADCEVTSTAT register is gated by EOC and not by the sign change in the ADCPPBxRESULT register. The ADCEVTCLR register has corresponding bits to clear these event flags. The ADCEVTSEL register has corresponding bits which allow the events to propagate through to the PWM. The ADCINTSEL register has corresponding bits which allow the events to propagate through to the PIE.

One PIE interrupt is shared between all the PPBs for a given ADC module as shown in [Figure 9-10](#).

**Figure 9-10. ADC PPB Interrupt Event**



**NOTES:**

- Zero-crossing and limit compare reference the ADCPPBxRESULT register. This will include any correction applied by the OFFCAL and OFFREF registers. TRIPHI and TRIPLO do NOT perform a signed comparison. It is recommended to leave OFFREF as 0 when using limit compare functionality.

- If different actions need to be taken for different PPB events from the same ADC module, then the ADCEVTINT ISR will have to read the PPB event flags in the ADCEVTSTAT register to determine which event caused the interrupt.
- If different ePWM trips need to be generated separately for high compare, low compare, and/or zero-crossing, this can be achieved by pointing multiple PPBs to the same SOC.

#### 9.1.9.4 PPB Sample Delay Capture

When multiple control loops are running asynchronously on the same ADC, there is a chance that an ADC request from two or more loops will collide, causing one of the samples to be delayed. This shows up as a measurement error in the system. By knowing when this delay occurs and the amount of delay that has occurred software can employ extrapolation techniques to reduce the error.

To this effect, each PPB has the field DLYSTAMP in the ADCPPBxSTAMP register. This field will contain the number of SYSCLK cycles between when the associate SOC was triggered and when it began converting.

This is achieved by having a global 12-bit free running counter based off of SYSCLK, which is in the field FREECOUNT in the ADCCOUNTER register. When the trigger for the associated SOC arrives, the value of this counter is loaded into the bit field ADCPPBxTRIPLO.REQSTAMP. When the actual sample window for that SOC begins, the value in REQSTAMP is subtracted from the current FREECOUNT value and stored in DLYSTAMP.

---

**NOTE:** If more than 4096 SYSCLK cycles elapse between the SOC trigger and the actual start of the SOC acquisition, the FREECOUNT register may overflow more than once, leading to incorrect DLYSTAMP value. Be cautious when using very slow conversions to prevent this from happening.

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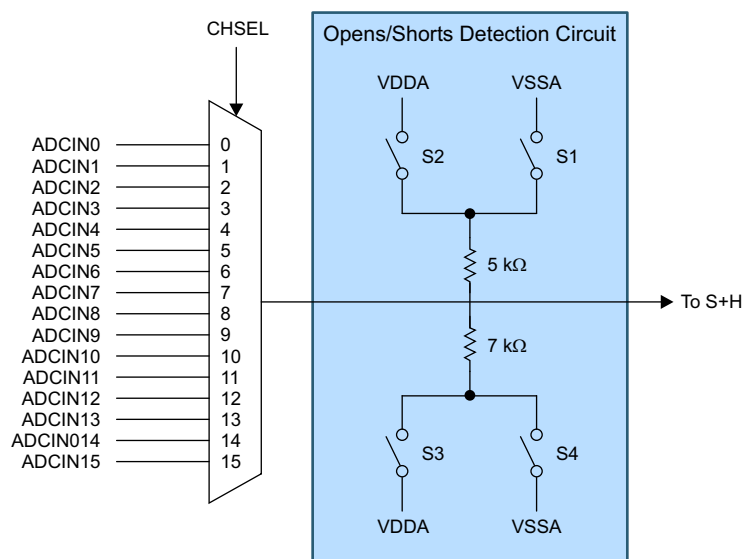
**NOTE:** The sample delay capture will not function if the associated SOC is triggered via software. It will, however, correctly record the delay if the software triggering of a different SOC causes the SOC associated with the PPB to be delayed

---

#### 9.1.10 Opens/Shorts Detection Circuit (OSDETECT)

The opens/shorts detection circuit (OSDETECT) can be used to detect pin faults in the system. The circuit connects to the ADC input after the channel select multiplexer but before the S+H circuit as shown in Figure 9-11.

**Figure 9-11. Opens/Shorts Detection Circuit**



The circuit can be operated by writing a value to the DETECTCFG field in the ADCOSDETECT register. This will cause the circuit to source a voltage onto the input during the S+H phase of any conversion. The voltage and drive strength of the OSDETECT circuit for different DETECTCFG settings is given in [Table 9-9](#).

**Table 9-9. DETECTCFG Settings**

ADCOSDETECT.DETEC TCFG	Source Voltage	S4	S3	S2	S1	Drive Impedance
0	Off	Open	Open	Open	Open	Open
1	Zero Scale	Closed	Open	Open	Closed	5K    7K
2	Full Scale	Open	Closed	Closed	Open	5K    7K
3	5/12 VDDA	Open	Closed	Open	Closed	5K    7K
4	7/12 VDDA	Closed	Open	Closed	Open	5K    7K
5	Zero Scale	Open	Open	Open	Closed	5K
6	Full Scale	Open	Open	Closed	Open	5K
7	Zero Scale	Closed	Open	Open	Open	7K

#### 9.1.10.1 Detecting an Open Input Pin

By cycling through the various OSDETECT settings, the input signal will be pulled towards the sourced voltages. An input with good drive strength (pin not open) will be minimally affected. However, if the pin is open, the sampled voltages will be close to the source voltages specified in [Section 9.1.11](#).

#### 9.1.10.2 Detecting a Shorted Input Pin

By cycling through the various OSDETECT settings, the input signal will be pulled towards the sourced voltages. An input with finite drive strength (pin not shorted) will be pulled toward each sourced voltage. However, if the pin is shorted, the signal will remain at the same voltage.

#### 9.1.11 Power-Up Sequence

Upon device power-up or system level reset, the ADC will be powered down and disabled. When powering up the ADC, use the following sequence:

1. Set the bit to enable the desired ADC clock in the PCLKCR13 register.
2. Set the desired ADC clock divider in the PRESCALE field of ADCCTL2.
3. Power up the ADC by setting the ADCPWDNZ bit in ADCCTL1.
4. Allow a delay before sampling. See the data manual for the necessary time.

If multiple ADCs are powered up simultaneously, steps 1 and step 3 can each be done for all ADCs in one write instruction. Also, only one delay is necessary as long as it occurs after all the ADCs have begun powering up.

#### 9.1.12 ADC Calibration

During the fabrication and test process, Texas Instruments calibrates the gain, offset, and linearity of the ADCs and the offset of the buffered DACs. These trim settings are embedded into TI reserved OTP memory as part of C-callable functions.

- The Device\_cal() function copies the trim values for ADC gain and DAC offset from OTP memory to their respective trim registers.
- The CalAdcXINL() functions copy the trim values for linearity from OTP memory to the respective trim registers.
- A different offset trim is required for each possible combination of resolution and signalmode. The GetAdcOffsetTrimOTP(UINT16) function takes an input value corresponding to the ADC, resolution, and signal mode and returns the corresponding offset trim value from OTP memory, which the user then moves into the ADC offset trim register.

Until the appropriate factory trim is loaded, the ADC (and other modules) will not be guaranteed to operate within datasheet specifications. Similarly, if trim values other than the factory settings are placed into the trim registers, the ADC (and other modules) will not be guaranteed to operate within datasheet specifications.

The boot ROM will call the calibration functions, so trim values should be initially populated without user intervention. However, if the trims are cleared due to a module reset or modified for some other reason, then the user can call the calibration functions (defined in the headerfiles).

### 9.1.12.1 ADC Zero Offset Calibration

Zero offset error is defined as the difference from 0 that occurs when converting a voltage at VREFLO (single-ended operation) or the difference from (maximum code/2) when converting  $ADCINxP = ADCINxN$  (differential mode). The zero offset error can be positive or negative. To correct this error, an adjustment of equal magnitude and opposite polarity is written into the ADCOFFTRIM register. The value contained in this register will be applied before the results are available in the ADC result registers. This operation is fully contained within the ADC core, so the timing of the results will not be affected and the full dynamic range of the ADC will be maintained for any trim value.

Using the `GetAdcOffsetTrimOTP(Uint16)` function, the ADCOFFTRIM register can be loaded with the factory calibrated offset error correction. The user can modify the ADCOFFTRIM register to compensate for additional offset error induced by the application environment if desired, but this is not typically necessary to achieve datasheet specified performance.

---

**NOTE:** Regardless of the converter resolution, the size of each ADCOFFTRIM step is  $(VREFHI - VREFLO)/65536$ .

---

Use the following procedure to re-calibrate the ADC offset in 12-bit, single-ended mode:

1. Set ADCOFFTRIM to +112 steps (0x70). This adds an artificial offset to account for negative offset that may reside in the ADC core.
2. Perform some multiple of 16 conversions on VREFLO (internal connection), accumulating the results (for example,  $32 * 16$  conversions = 512 conversions).
3. Divide the accumulated result by the multiple of 16 (for example, for 512 conversions, divide by 32).
4. Set ADCOFFTRIM to  $112 - \text{result from step 3}$ .

Use the following procedure to re-calibrate the ADC offset in 16-bit, differential mode:

1. Set ADCOFFTRIM to no adjustment (0x00).
2. Short  $ADCINxP$  and  $ADCINyN$  together (external connection) and accumulate some multiple of 16 conversions (e.g.  $32 * 16$  conversions = 512 conversions).
3. Divide the accumulated result by the number of conversions (for example, for 512 conversions, divide by 512).
4. Set ADCOFFTRIM to  $0 - \text{result from step 3}$ .

## 9.2 ADC Timings

The process of converting an analog voltage to a digital value is broken down into an S+H phase and a conversion phase. The ADC sample and hold circuits (S+H) are clocked by SYSCLK while the ADC conversion process is clocked by ADCCLK. ADCCLK is generated by dividing down SYSCLK based on the PRESCALE field in the ADCCTL2 register.

The S+H duration is the value of the ACQPS field of the SOC being converted, plus one, times the SYSCLK period. The user must ensure that this duration exceeds both 1 ADCCLK period and the minimum S+H duration specified in the datasheet. The conversion time is approximately 10.5 ADCCLK cycles in 12-bit mode and 29.5 ADCCLK cycles in 16-bit mode. The exact conversion time is always a whole number of SYSCLK cycles. See the timing diagrams and tables in [Section 9.2.1](#) for exact timings.

### 9.2.1 ADC Timing Diagrams

The following diagrams show the ADC conversion timings for two SOCs given the following assumptions:

- SOC0 and SOC1 are configured to use the same trigger.
- No other SOCs are converting or pending when the trigger occurs.
- The round robin pointer is in a state that causes SOC0 to convert first.
- ADCINTSEL is configured to set an ADCINT flag upon end of conversion for SOC0 (whether this flag propagates through to the CPU to cause an interrupt is determined by the configurations in the PIE module).

The following parameters are identified in the timing diagrams:

- The parameter  $t_{SH}$  is the duration of the S+H window. At the end of this window, the value on the S+H capacitor becomes the voltage to be converted into a digital value. The duration is given by  $(ACQPS + 1)$  SYSCLK cycles. ACQPS can be configured individually for each SOC, so  $t_{SH}$  will not necessarily be the same for different SOCs.
- The parameter  $t_{LAT}$  is the time from the end of the S+H window until the ADC conversion results latch in the ADCRESULTx register. If the ADCRESULTx register is read before this time, the previous conversion results will be returned.
- The parameter  $t_{EOC}$  is the time from the end of the S+H window until the next ADC conversion S+H window can begin. In 16-bit mode, this will coincide with the latching of the conversion results, while in 12-bit mode, the subsequent sample can start before the conversion results are latched.
- The parameter  $t_{INT}$  is the time from the end of the S+H window until an ADCINT flag is set (if configured). If the INTPULSEPOS bit in the ADCCTL1 register is set, this will coincide with the conversion results being latched into the result register. If the bit is cleared, this will coincide with the end of the S+H window.

**Figure 9-12. ADC Timings for 12-bit Mode in Early Interrupt Mode**

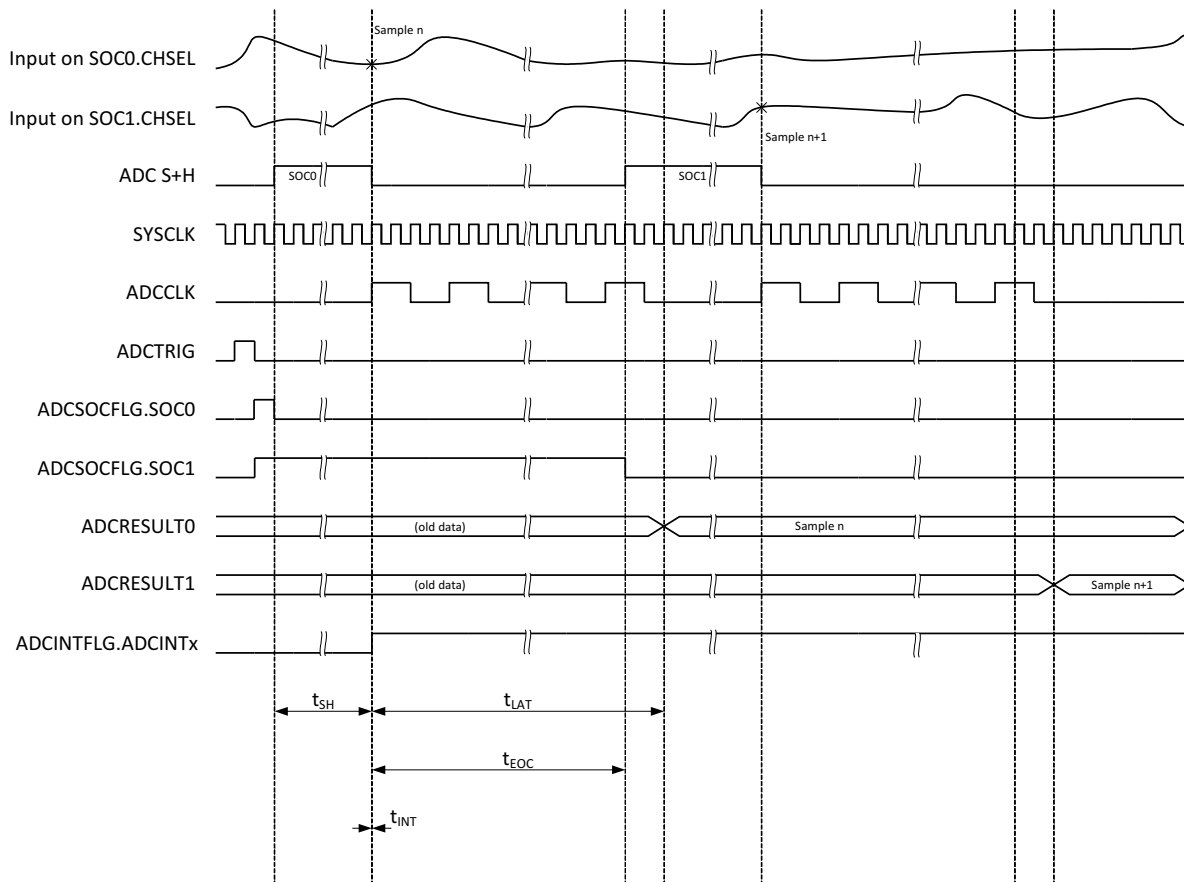


Figure 9-13. ADC Timings for 12-bit Mode in Late Interrupt Mode

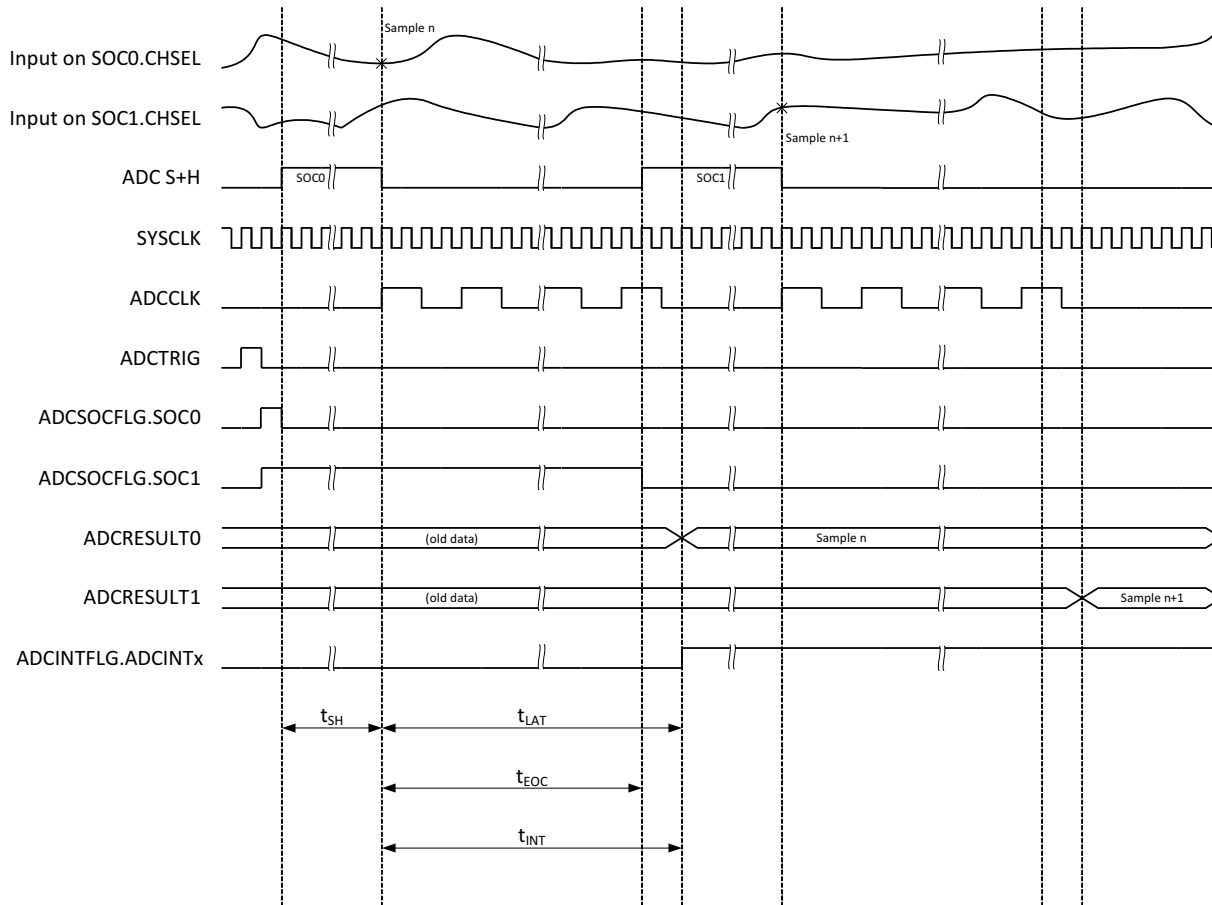
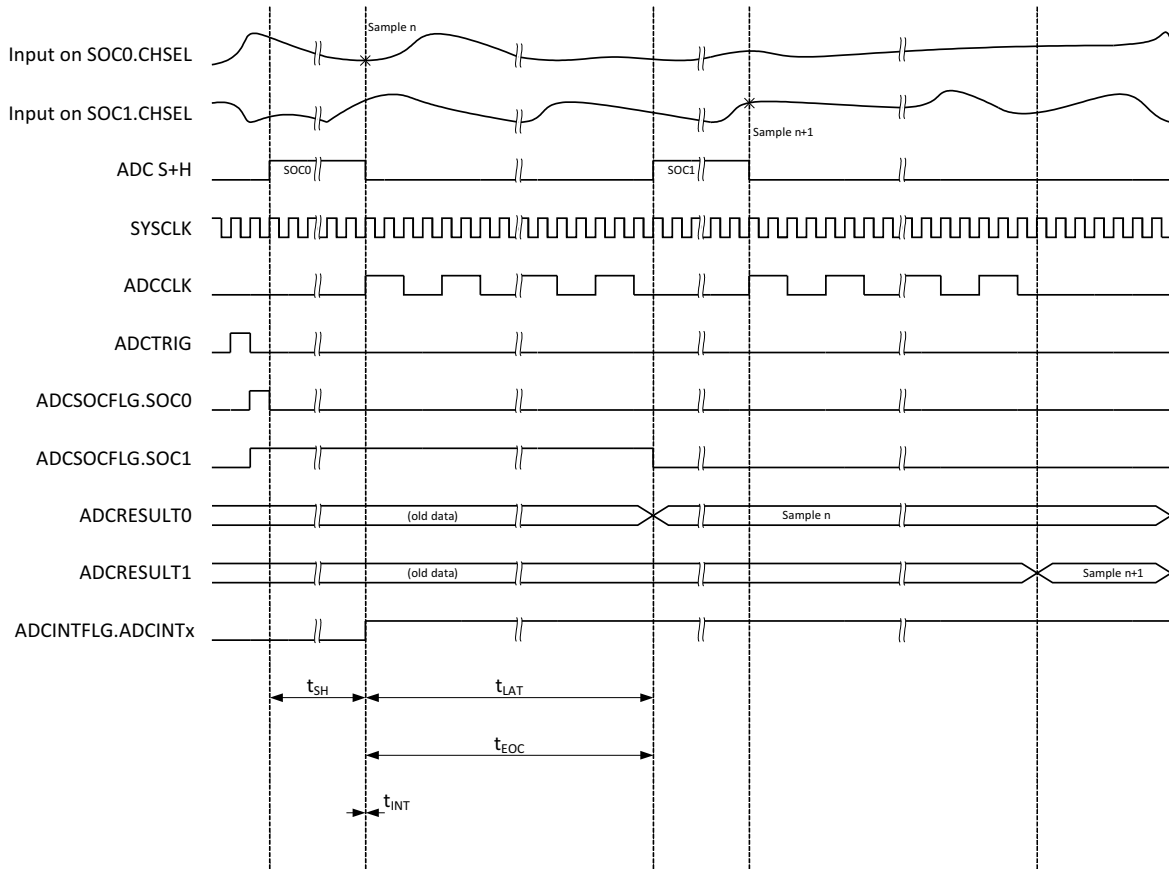
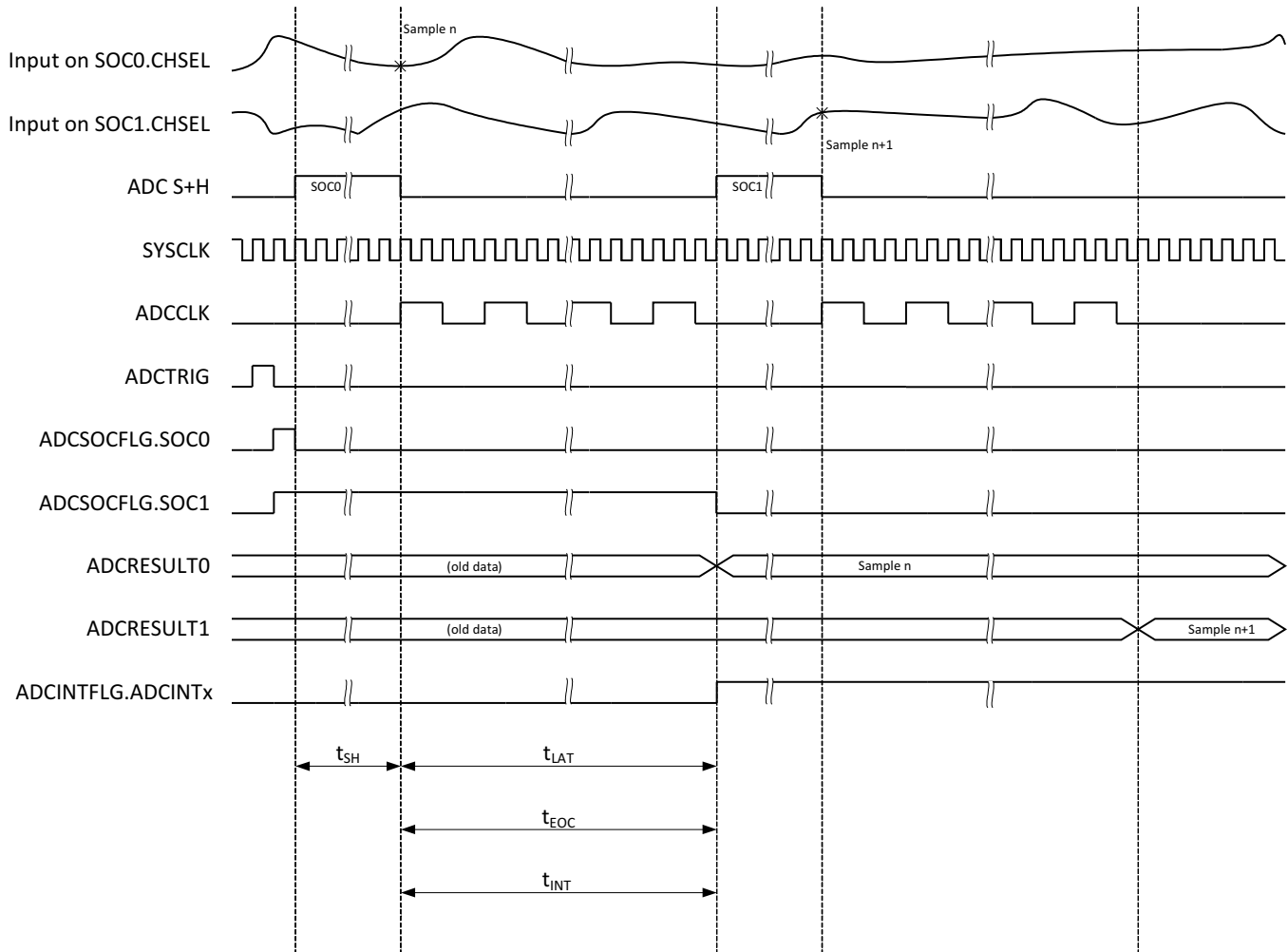


Figure 9-14. ADC Timings for 16-bit Mode in Early Interrupt Mode



**Figure 9-15. ADC Timings for 16-bit Mode in Late Interrupt Mode (SYSCLK Cycles)**

**Table 9-10. ADC Timings in 12-bit Mode (SYSCLK Cycles)**

ADCCTL2. PRESCALE	Prescale Ratio	$t_{EOC}$	$t_{LAT}$	$t_{INT}$ (Early)	$t_{INT}$ (Late)
0	1	11	12	0	12
2	2	21	22	0	22
3	2.5	26	27	0	27
4	3	31	33	0	33
5	3.5	36	38	0	38
6	4	41	43	0	43
7	4.5	46	48	0	48
8	5	51	54	0	54
9	5.5	56	59	0	59
10	6	61	64	0	64
11	6.5	66	69	0	69
12	7	71	75	0	75
13	7.5	76	80	0	80
14	8	81	85	0	85
15	8.5	86	90	0	90



**Table 9-11. ADC Timings in 16-bit Mode**

ADCCTL2. PRESCALE	Prescale Ratio	$t_{EOC}$	$t_{LAT}$	$t_{INT}$ (Early)	$t_{INT}$ (Late)
0	1	31	31	0	31
2	2	60	60	0	60
3	2.5	75	75	0	75
4	3	90	90	0	90
5	3.5	104	104	0	104
6	4	119	119	0	119
7	4.5	134	134	0	134
8	5	149	149	0	149
9	5.5	163	163	0	163
10	6	178	178	0	178
11	6.5	193	193	0	193
12	7	208	208	0	208
13	7.5	222	222	0	222
14	8	237	237	0	237
15	8.5	252	252	0	252

## 9.3 Additional Information

The following sections contain additional practical information.

### 9.3.1 Ensuring Synchronous Operation

For best performance, all ADCs on the device should be operated synchronously. The device datasheet specifies the performance in both synchronous and asynchronous mode for those parameters which differ between the modes of operation.

To ensure synchronous operation, all ADCs on the device should operate in lockstep. This is accomplished by writing configurations to all ADCs that cause the sampling and conversion phases of all ADCs to be exactly aligned. The easiest way to accomplish this is to write identical values to the SOC configurations for each ADC for trigger select and ACQPS (S+H duration).

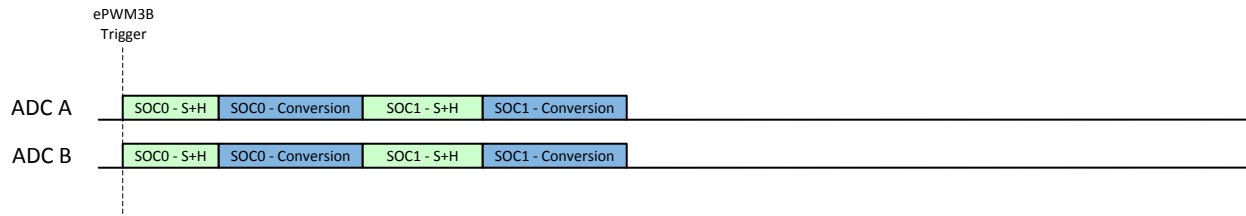
#### 9.3.1.1 Basic Synchronous Operation

The below example configures two SOC0s each on ADCA and ADCB with identical trigger select and ACQPS values. This will result in synchronous operation between ADCA and ADCB. For devices with more than two ADCs, the same principles can be used to synchronize all the ADCs.

##### Example 1: Basic Synchronous Operation

```
AdcaRegs.ADCSOC0CTL.bit.CHSEL = 4; //SOC0 will convert ADCINA4
AdcaRegs.ADCSOC0CTL.bit.ACQPS = 19; //SOC0 will use sample duration of 20 SYSCLK cycles
AdcaRegs.ADCSOC0CTL.bit.TRIGSEL = 10; //SOC0 will begin conversion on ePWM3 SOCB
AdcbRegs.ADCSOC0CTL.bit.CHSEL = 0; //SOC0 will convert ADCINB0
AdcbRegs.ADCSOC0CTL.bit.ACQPS = 19; //SOC0 will use sample duration of 20 SYSCLK cycles
AdcbRegs.ADCSOC0CTL.bit.TRIGSEL = 10; //SOC0 will begin conversion on ePWM3 SOCB

AdcaRegs.ADCSOC1CTL.bit.CHSEL = 4; //SOC1 will convert ADCINA4
AdcaRegs.ADCSOC1CTL.bit.ACQPS = 30; //SOC1 will use sample duration of 31 SYSCLK cycles
AdcaRegs.ADCSOC1CTL.bit.TRIGSEL = 10; //SOC1 will begin conversion on ePWM3 SOCB
AdcbRegs.ADCSOC1CTL.bit.CHSEL = 1; //SOC1 will convert ADCINB1
AdcbRegs.ADCSOC1CTL.bit.ACQPS = 30; //SOC1 will use sample duration of 31 SYSCLK cycles
AdcbRegs.ADCSOC1CTL.bit.TRIGSEL = 10; //SOC1 will begin conversion on ePWM3 SOCB
```

**Figure 9-16. Example: Basic Synchronous Operation**


Several things should be noted from Example 1. First, while the ACQPS values must be the same for SOC0s with the same number, different ACQPS values can be used for SOC0s with different numbers. Because of this, synchronous operation does not require a single global S+H time, but instead only channels sampled simultaneously require identical S+H durations. Another important point from this example is that any channel select value can be used for any SOC. Finally, this example assumes round-robin operation. If high priority SOC0s are to be used, the priority must be configured the same on all ADCs.

### 9.3.1.2 Synchronous Operation with Multiple Trigger Sources

As long as each set of SOC0s has identical trigger select and ACQPS settings, multiple trigger sources can be used while still achieving synchronous operation.

The below example demonstrates synchronous operation between ADCA and ADCB while using 3 SOC0s and 2 trigger sources. [Figure 9-17](#) demonstrates that any combination of relative trigger timings still results in synchronous operation.

#### Example: Synchronous Operation with Multiple Trigger Sources

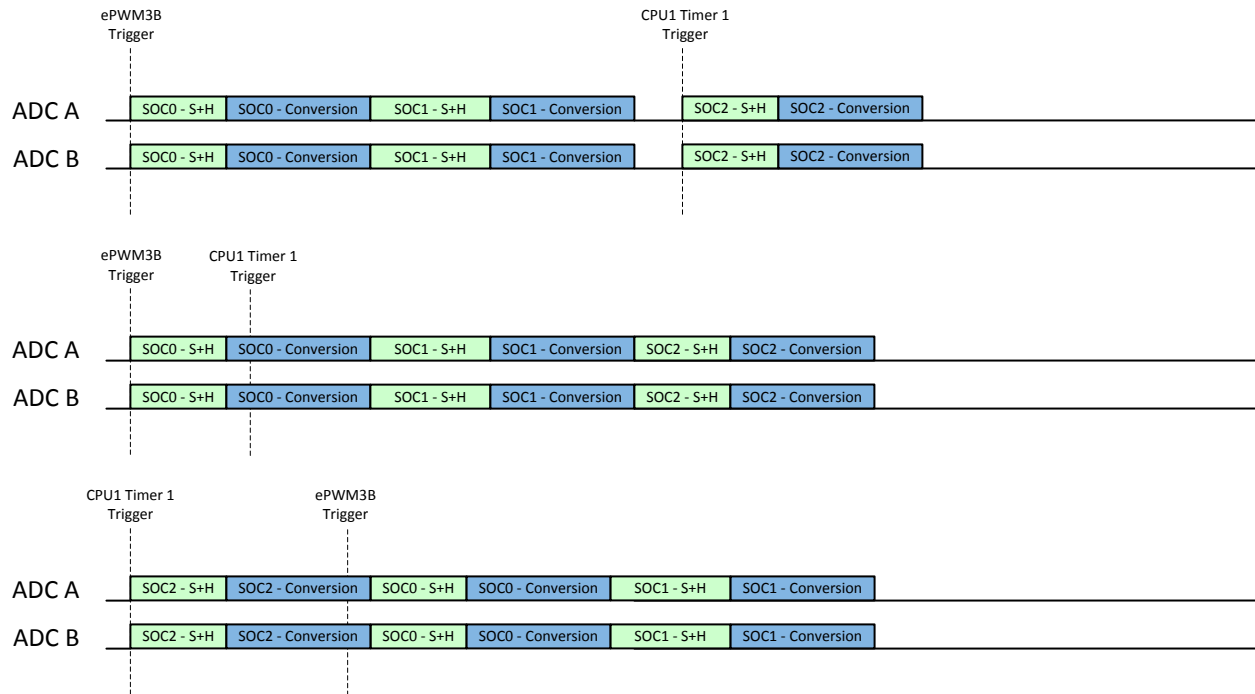
```

AdcaRegs.ADCSOC0CTL.bit.CHSEL = 4; //SOC0 will convert ADCINA4
AdcaRegs.ADCSOC0CTL.bit.ACQPS = 19; //SOC0 will use sample duration of 20 SYSCLK cycles
AdcaRegs.ADCSOC0CTL.bit.TRIGSEL = 10; //SOC0 will begin conversion on ePWM3 SOCB
AdcbRegs.ADCSOC0CTL.bit.CHSEL = 0; //SOC0 will convert ADCINB0
AdcbRegs.ADCSOC0CTL.bit.ACQPS = 19; //SOC0 will use sample duration of 20 SYSCLK cycles
AdcbRegs.ADCSOC0CTL.bit.TRIGSEL = 10; //SOC0 will begin conversion on ePWM3 SOCB

AdcaRegs.ADCSOC1CTL.bit.CHSEL = 4; //SOC1 will convert ADCINA4
AdcaRegs.ADCSOC1CTL.bit.ACQPS = 30; //SOC1 will use sample duration of 31 SYSCLK cycles
AdcaRegs.ADCSOC1CTL.bit.TRIGSEL = 10; //SOC1 will begin conversion on ePWM3 SOCB
AdcbRegs.ADCSOC1CTL.bit.CHSEL = 1; //SOC1 will convert ADCINB1
AdcbRegs.ADCSOC1CTL.bit.ACQPS = 30; //SOC1 will use sample duration of 31 SYSCLK cycles
AdcbRegs.ADCSOC1CTL.bit.TRIGSEL = 10; //SOC1 will begin conversion on ePWM3 SOCB

AdcaRegs.ADCSOC2CTL.bit.CHSEL = 0; //SOC2 will convert ADCINA0
AdcaRegs.ADCSOC2CTL.bit.ACQPS = 19; //SOC2 will use sample duration of 31 SYSCLK cycles
AdcaRegs.ADCSOC2CTL.bit.TRIGSEL = 2; //SOC2 will begin conversion on CPU1 Timer1
AdcbRegs.ADCSOC2CTL.bit.CHSEL = 2; //SOC2 will convert ADCINB2
AdcbRegs.ADCSOC2CTL.bit.ACQPS = 19; //SOC2 will use sample duration of 31 SYSCLK cycles
AdcbRegs.ADCSOC2CTL.bit.TRIGSEL = 2; //SOC2 will begin conversion on CPU1 Timer1
  
```

**Figure 9-17. Example: Synchronous Operation with Multiple Trigger Sources**



Note that any trigger source that can be selected in the TRIGSEL field can be used except for software triggering. There is no way to issue the software triggers for all ADCs simultaneously, so it will likely result in asynchronous operation. ADCINT1 or ADCINT2 can also be used as a trigger as long as the ADCINTSOCSEL1 and ADCINTSOCSEL2 registers are configured identically for all ADCs and software triggering is not used to start the chain of conversions.

### 9.3.1.3 Synchronous Operation with Uneven SOC Numbers

If only one trigger source is used, one ADC can use more SOCs than the other ADCs while still operating synchronously.

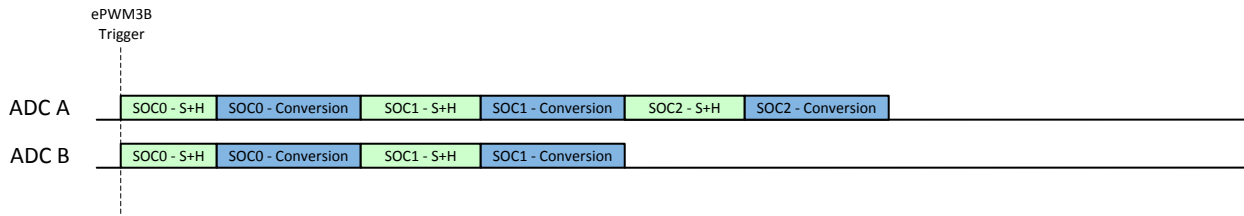
#### Example: Synchronous Operation With Uneven SOC Numbers

```
AdcaRegs.ADCSOC0CTL.bit.CHSEL = 4; //SOC0 will convert ADCINA4
AdcaRegs.ADCSOC0CTL.bit.ACQPS = 19; //SOC0 will use sample duration of 20 SYSCLK cycles
AdcaRegs.ADCSOC0CTL.bit.TRIGSEL = 10; //SOC0 will begin conversion on ePWM3 SOCB
AdcbRegs.ADCSOC0CTL.bit.CHSEL = 0; //SOC0 will convert ADCINB0
AdcbRegs.ADCSOC0CTL.bit.ACQPS = 19; //SOC0 will use sample duration of 20 SYSCLK cycles
AdcbRegs.ADCSOC0CTL.bit.TRIGSEL = 10; //SOC0 will begin conversion on ePWM3 SOCB
```

```
AdcaRegs.ADCSOC1CTL.bit.CHSEL = 4; //SOC1 will convert ADCINA4
AdcaRegs.ADCSOC1CTL.bit.ACQPS = 30; //SOC1 will use sample duration of 31 SYSCLK cycles
AdcaRegs.ADCSOC1CTL.bit.TRIGSEL = 10; //SOC1 will begin conversion on ePWM3 SOCB
AdcbRegs.ADCSOC1CTL.bit.CHSEL = 1; //SOC1 will convert ADCINB1
AdcbRegs.ADCSOC1CTL.bit.ACQPS = 30; //SOC1 will use sample duration of 31 SYSCLK cycles
AdcbRegs.ADCSOC1CTL.bit.TRIGSEL = 10; //SOC1 will begin conversion on ePWM3 SOCB
```

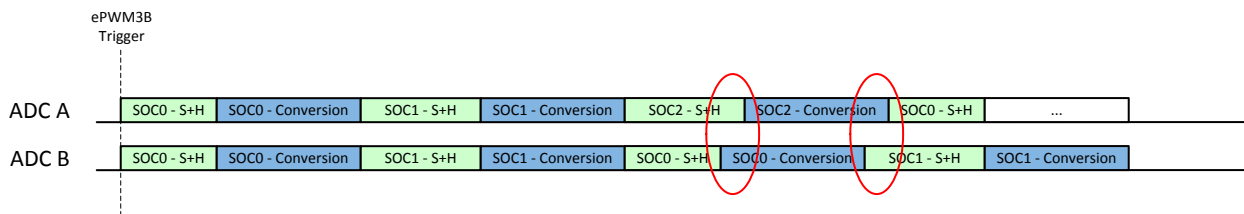
```
AdcaRegs.ADCSOC2CTL.bit.CHSEL = 0; //SOC2 will convert ADCINA0
AdcaRegs.ADCSOC2CTL.bit.ACQPS = 19; //SOC2 will use sample duration of 31 SYSCLK cycles
AdcaRegs.ADCSOC2CTL.bit.TRIGSEL = 10; //SOC2 will begin conversion on ePWM3 SOCB
```

**Figure 9-18. Example: Synchronous Operation with Uneven SOC Numbers**



Note that if the trigger comes again before all SOC's have completed their conversions, ADCB will begin converting immediately on SOC0 while ADCA will not start converting SOC0 again until SOC2 is complete. This will result in asynchronous operation, so care must be taken to not overflow the trigger.

**Figure 9-19. Example: Asynchronous Operation with Uneven SOC Numbers – Trigger Overflow**



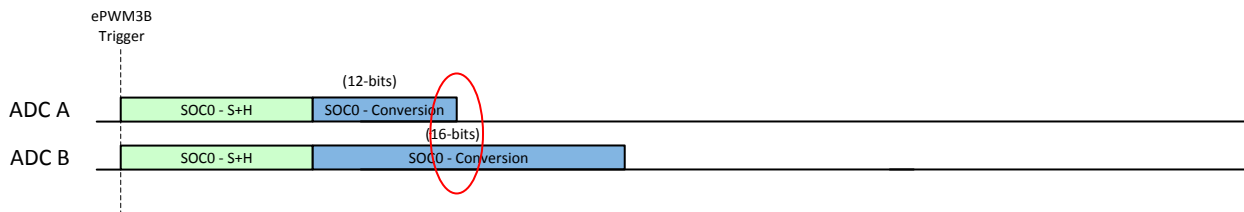
### 9.3.1.4 Synchronous Operation with Different Resolutions

Configuring different ADCs to use different resolutions will result in asynchronous operation. This will occur because the conversion time for 12-bit mode and 16-bit mode are different. Synchronous operation requires both the start and end of the conversion phase to be aligned, so even using the same S+H window duration will not result in synchronous operation.

**Example: Asynchronous Operation with Different Resolutions**

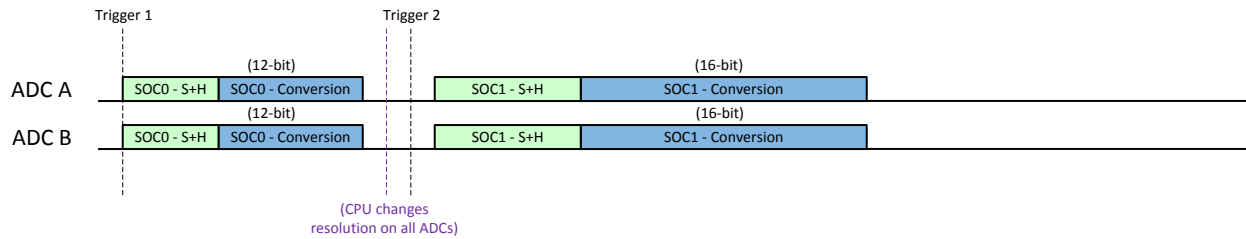
```
//ADCA = 12-bit mode
AdcaRegs.ADCSOC0CTL.bit.CHSEL = 4; //SOC0 will convert ADCINA4
AdcaRegs.ADCSOC0CTL.bit.ACQPS = 50; //SOC0 will use sample duration of 51 SYSCLK cycles
AdcaRegs.ADCSOC0CTL.bit.TRIGSEL = 10; //SOC0 will begin conversion on ePWM3 SOCB
//ADCB = 16-bit mode
AdcbRegs.ADCSOC0CTL.bit.CHSEL = 0; //SOC0 will convert ADCINB0/B1
AdcbRegs.ADCSOC0CTL.bit.ACQPS = 50; //SOC0 will use sample duration of 51 SYSCLK cycles
AdcbRegs.ADCSOC0CTL.bit.TRIGSEL = 10; //SOC0 will begin conversion on ePWM3 SOCB
```

**Figure 9-20. Example: Asynchronous Operation with Different Resolutions**



In order to achieve synchronous operation while using both 12-bit and 16-bit resolution, conversions must be done in parallel at one resolution. Once conversions are complete at one resolution, the CPU must switch the resolution on all ADCs and then cause another trigger (this trigger should not be a software SOC force, as all ADCs can't be started simultaneously via this method).

Figure 9-21. Example: Synchronous Operation with Different Resolutions



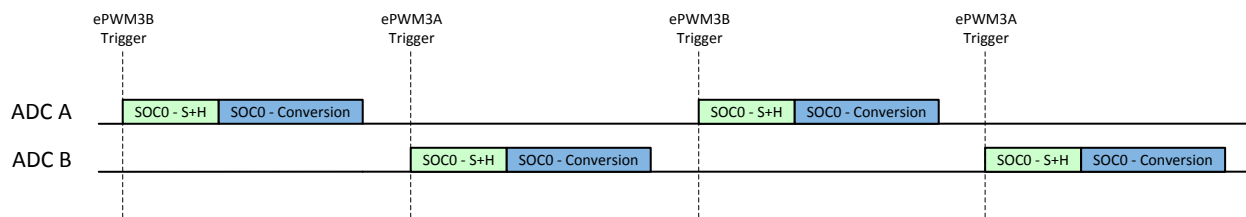
### 9.3.1.5 Non-overlapping Conversions

If conversion timings can be guaranteed to not overlap by the user, then it is not necessary to configure all SOC0s identically on all ADCs to achieve performance equivalent to synchronous operation. For example, if the two ADC triggers in a system come from two ePWM sources which are always 180 degrees out-of-phase, then SOC0 could be used for both ADCA and ADCB with different trigger sources and different ACQPS values.

#### Example: Operation with Non-overlapping Conversions

```
//ePWM3 SOCA and SOCB are 180 degrees out of phase
AdcaRegs.ADCSOC0CTL.bit.CHSEL = 4; //SOC0 will convert ADCINA4
AdcaRegs.ADCSOC0CTL.bit.ACQPS = 19; //SOC0 will use sample duration of 20 SYSCLK cycles
AdcaRegs.ADCSOC0CTL.bit.TRIGSEL = 10; //SOC0 will begin conversion on ePWM3 SOCB
AdcbRegs.ADCSOC0CTL.bit.CHSEL = 0; //SOC0 will convert ADCINB0
AdcbRegs.ADCSOC0CTL.bit.ACQPS = 19; //SOC0 will use sample duration of 20 SYSCLK cycles
AdcbRegs.ADCSOC0CTL.bit.TRIGSEL = 9; //SOC0 will begin conversion on ePWM3 SOCA
```

Figure 9-22. Example: Synchronous Equivalent Operation with Non-Overlapping Conversions



### 9.3.2 Choosing an Acquisition Window Duration

For correct operation, the input signal to the ADC must be allowed adequate time to charge the sample and hold capacitor, Ch. Typically, the S+H duration is chosen such that the sampling capacitor will be charged to within 1/2 LSB or 1/4 LSB of the final value, depending on tolerable settling error. A rough approximation of the required sampling time can be determined using a first-order RC model with R = Rs + Ron and C = Ch. The RC time constant is then (Rs + Ron)·(Ch). The required number of time constants is:

$$t = -\ln\left(\frac{\text{settling accuracy (LSBs)}}{2^N}\right)$$

For example, assuming desired accuracy is 1/4 LSB, resolution is 12-bits, Rs = 250Ω, Ron = 300Ω, and Ch = 14.5pF.

$$t = -\ln\left(\frac{\text{settling accuracy (LSBs)}}{2^N}\right) T$$

$$t = -\ln\left(\frac{0.25}{2^{12}}\right) (550k\Omega \cdot 14.5 \text{ pf}) = 77 \text{ ns}$$

The sample and hold window duration for this ADC is

$$T_{S+H} = (ACQPS + 1) \frac{1}{SYSCLK}$$

If SYSCLK = 200 MHz, then 1/SYSCLK = 5ns, and 1+ACQPS should therefore be chosen to be 16, giving ACQPS = 15.

While this gives a rough estimate of the required acquisition window, a better method would be to setup a circuit with the ADC input model, a model of the source impedance/capacitance, and any board parasitics in SPICE (or similar software) and simulate to verify that the sampling capacitor settles to the desired accuracy.

---

**NOTE:** The device datasheet will specify a minimum ADC S+H window duration. Do not use an ACQPS value that gives a duration less than this specification.

---

### 9.3.3 Achieving Simultaneous Sampling

While the Type 4 ADC does not have dual S+H circuits, it is easy to achieve simultaneous sampling. This is accomplished by setting the SOC triggers on two or more ADC modules to use the same trigger source. The example below demonstrates x4 simultaneous sampling based on an ePWM3 event. ADCINA3, ADCINB5, ADCINC5, and ADCIND2 are sampled. An acquisition window of 20 SYSCLK cycles is used, but different durations are possible.

```

AdcaRegs.ADCSOC0CTL.bit.CHSEL = 3;           //SOC0 will convert ADCINA3
AdcaRegs.ADCSOC0CTL.bit.ACQPS = 19;          //SOC0 will use sample duration of 20 SYSCLK cycles
AdcaRegs.ADCSOC0CTL.bit.TRIGSEL = 10;        //SOC0 will begin conversion on ePWM3 SOCB
AdcbRegs.ADCSOC0CTL.bit.CHSEL = 5;           //SOC0 will convert ADCINB5
AdcbRegs.ADCSOC0CTL.bit.ACQPS = 19;          //SOC0 will use sample duration of 20 SYSCLK cycles
AdcbRegs.ADCSOC0CTL.bit.TRIGSEL = 10;        //SOC0 will begin conversion on ePWM3 SOCB
AdccRegs.ADCSOC0CTL.bit.CHSEL = 5;           //SOC0 will convert ADCINC5
AdccRegs.ADCSOC0CTL.bit.ACQPS = 19;          //SOC0 will use sample duration of 20 SYSCLK cycles
AdccRegs.ADCSOC0CTL.bit.TRIGSEL = 10;        //SOC0 will begin conversion on ePWM3 SOCB
AdcdRegs.ADCSOC0CTL.bit.CHSEL = 2;           //SOC0 will convert ADCIND2
AdcdRegs.ADCSOC0CTL.bit.ACQPS = 19;          //SOC0 will use sample duration of 20 SYSCLK cycles
AdcdRegs.ADCSOC0CTL.bit.TRIGSEL = 10;        //SOC0 will begin conversion on ePWM3 SOCB
\
  
```

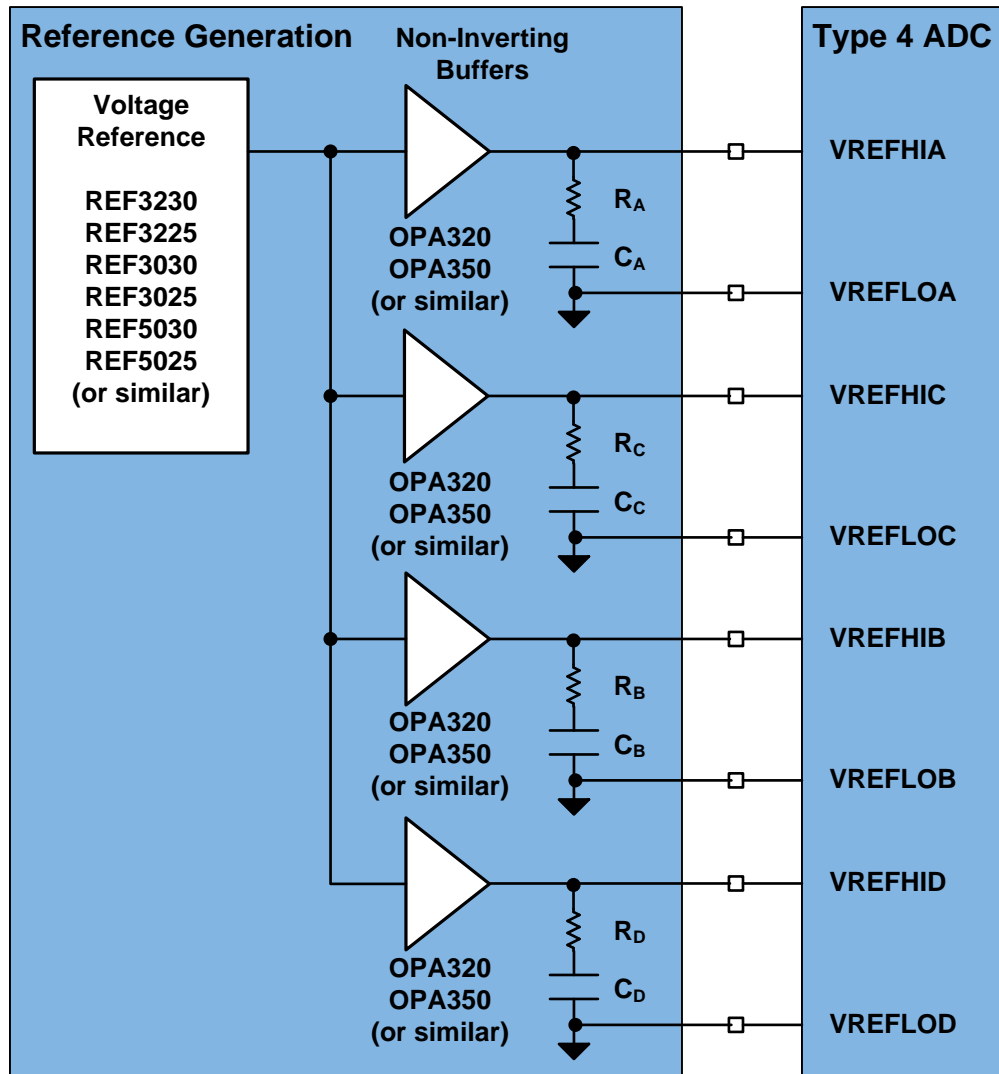
When the ePWM3 trigger is received, all four ADCs will begin converting in parallel immediately. All results will be in the ADCRESULT0 register for each ADC. Note that this assumes that all ADCs are idle when the trigger is received. If one or more ADCs is busy, the samples will not happen at exactly the same time.

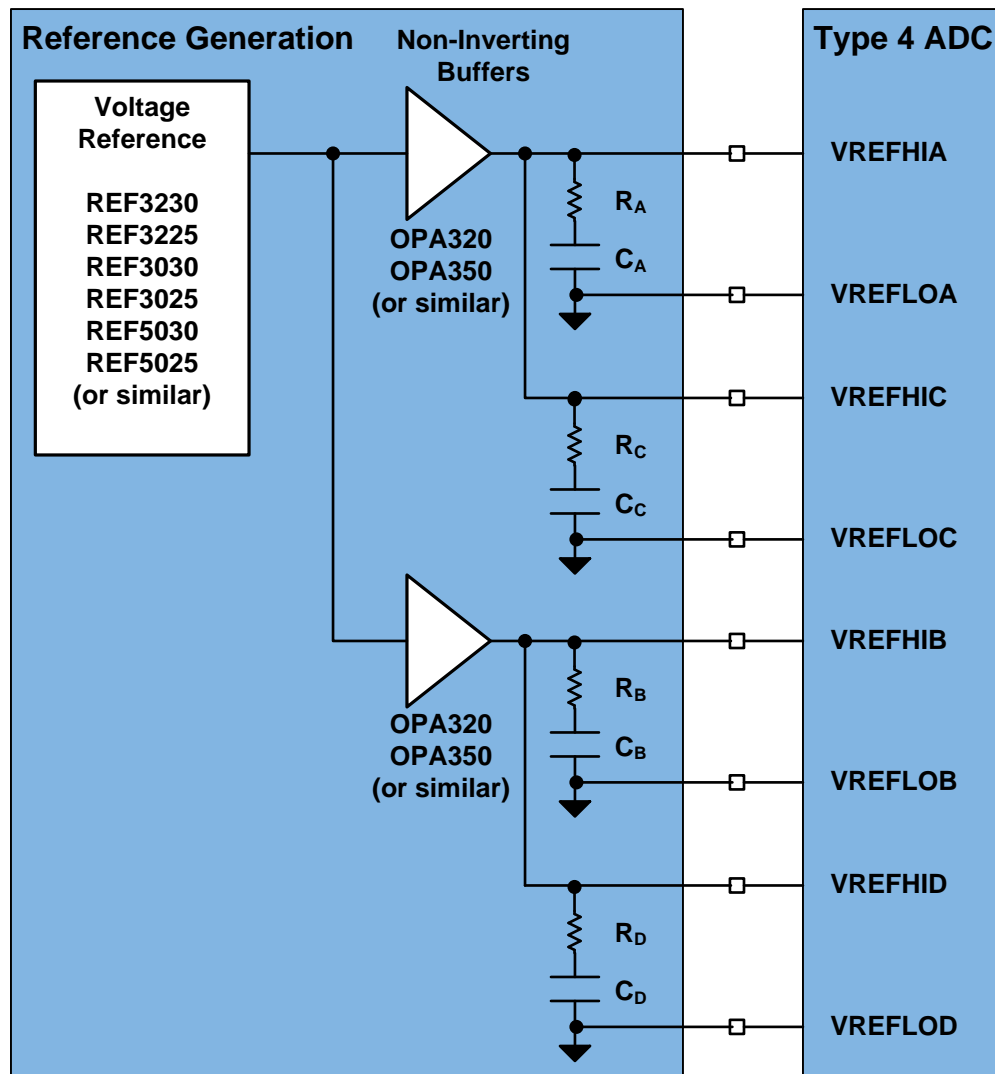
### 9.3.4 Designing an External Reference Circuit

Figure 9-23 shows the basic organization of the external voltage reference generation circuitry. A single reference voltage generation should be shared by all ADC modules. This will minimize reference voltage mismatch between ADC modules. The reference voltage should then be buffered by a precision op-amp with good bandwidth and low output impedance before being driven into the reference pin. A capacitor between the high and low reference pins should be placed on the PCB as close to the pins as practical to help absorb high frequency currents. A series resistor (typically <math><1\Omega</math>) in series with this capacitor may be necessary to ensure op-amp

It is also possible to share two reference pins between one op-amp driver. This organization is shown in Figure 9-24. This will give slightly reduced performance compared to the case where each reference pin has a dedicated op-amp buffer, but it should still be possible to achieve all ADC specifications in the data manual..

Figure 9-23. ADC Reference System



**Figure 9-24. ADC Shared Reference System**


### 9.3.5 Internal Temperature Sensor

The internal temperature sensor measures the junction temperature of the device. The output of the sensor can be sampled with the ADC through an internal connection. This can be enabled on channel ADCIN13 on ADCA by setting the ENABLE bit in the TSNSCTL register.

To convert the temperature sensor reading into a temperature, pass the temperature sensor reading to the GetTemperatureC() function in

F2837xS\_TempSensorConv.c. Note that this function assumes that the temperature reading was taken with VREFHI = 2.5V. If a different reference voltage is used, the sample should be scaled appropriately before passing it to the function by using the below formula.

$$\text{adjusted sensor reading} = \text{raw sensor reading} * (\text{VREFHI} / 2.5\text{V})$$

**NOTE:** To sample the temperature sensor, the ADC must be in single-ended 12-bit mode.

If the temperature sensor is sampled in 16-bit mode, the ADC will switch to 12-bit mode to perform the conversion. This could cause incorrect ADC results.



## 9.4 Registers

### 9.4.1 ADC Base Addresses

**Table 9-12. ADC Base Address Table**

Device Registers	Register Name	Start Address	End Address
AdcaResultRegs	ADC_RESULT_REGS	0x0000_0B00	0x0000_0B1F
AdcbResultRegs	ADC_RESULT_REGS	0x0000_0B20	0x0000_0B3F
AdccResultRegs	ADC_RESULT_REGS	0x0000_0B40	0x0000_0B5F
AdcdResultRegs	ADC_RESULT_REGS	0x0000_0B60	0x0000_0B7F
AdcaRegs	ADC_REGS	0x0000_7400	0x0000_747F
AdcbRegs	ADC_REGS	0x0000_7480	0x0000_74FF
AdccRegs	ADC_REGS	0x0000_7500	0x0000_757F
AdcdRegs	ADC_REGS	0x0000_7580	0x0000_75FF

## 9.4.2 ADC\_REGS Registers

Table 9-13 lists the memory-mapped registers for the ADC\_REGS. All register offset addresses not listed in Table 9-13 should be considered as reserved locations and the register contents should not be modified.

**Table 9-13. ADC\_REGS Registers**

Offset	Acronym	Register Name	Write Protection	Section
0h	ADCCTL1	ADC Control 1 Register	EALLOW	<a href="#">Go</a>
1h	ADCCTL2	ADC Control 2 Register	EALLOW	<a href="#">Go</a>
2h	ADCBURSTCTL_1	ADC Burst Control Register	EALLOW	<a href="#">Go</a>
3h	ADCINTFLG	ADC Interrupt Flag Register		<a href="#">Go</a>
4h	ADCINTFLGCLR	ADC Interrupt Flag Clear Register		<a href="#">Go</a>
5h	ADCINTOVF	ADC Interrupt Overflow Register		<a href="#">Go</a>
6h	ADCINTOVFCLR	ADC Interrupt Overflow Clear Register		<a href="#">Go</a>
7h	ADCINTSEL1N2	ADC Interrupt 1 and 2 Selection Register	EALLOW	<a href="#">Go</a>
8h	ADCINTSEL3N4	ADC Interrupt 3 and 4 Selection Register	EALLOW	<a href="#">Go</a>
9h	ADCSOCPRICTL	ADC SOC Priority Control Register	EALLOW	<a href="#">Go</a>
Ah	ADCINTSOCSEL1	ADC Interrupt SOC Selection 1 Register	EALLOW	<a href="#">Go</a>
Bh	ADCINTSOCSEL2	ADC Interrupt SOC Selection 2 Register	EALLOW	<a href="#">Go</a>
Ch	ADCSOCFLG1	ADC SOC Flag 1 Register		<a href="#">Go</a>
Dh	ADCSOCFRC1	ADC SOC Force 1 Register		<a href="#">Go</a>
Eh	ADCSOCOVF1	ADC SOC Overflow 1 Register		<a href="#">Go</a>
Fh	ADCSOCOVFCLR1	ADC SOC Overflow Clear 1 Register		<a href="#">Go</a>
10h	ADCSOC0CTL_1	ADC SOC0 Control Register	EALLOW	<a href="#">Go</a>
12h	ADCSOC1CTL_1	ADC SOC1 Control Register	EALLOW	<a href="#">Go</a>
14h	ADCSOC2CTL_1	ADC SOC2 Control Register	EALLOW	<a href="#">Go</a>
16h	ADCSOC3CTL_1	ADC SOC3 Control Register	EALLOW	<a href="#">Go</a>
18h	ADCSOC4CTL_1	ADC SOC4 Control Register	EALLOW	<a href="#">Go</a>
1Ah	ADCSOC5CTL_1	ADC SOC5 Control Register	EALLOW	<a href="#">Go</a>
1Ch	ADCSOC6CTL_1	ADC SOC6 Control Register	EALLOW	<a href="#">Go</a>
1Eh	ADCSOC7CTL_1	ADC SOC7 Control Register	EALLOW	<a href="#">Go</a>
20h	ADCSOC8CTL_1	ADC SOC8 Control Register	EALLOW	<a href="#">Go</a>
22h	ADCSOC9CTL_1	ADC SOC9 Control Register	EALLOW	<a href="#">Go</a>
24h	ADCSOC10CTL_1	ADC SOC10 Control Register	EALLOW	<a href="#">Go</a>
26h	ADCSOC11CTL_1	ADC SOC11 Control Register	EALLOW	<a href="#">Go</a>
28h	ADCSOC12CTL_1	ADC SOC12 Control Register	EALLOW	<a href="#">Go</a>
2Ah	ADCSOC13CTL_1	ADC SOC13 Control Register	EALLOW	<a href="#">Go</a>
2Ch	ADCSOC14CTL_1	ADC SOC14 Control Register	EALLOW	<a href="#">Go</a>
2Eh	ADCSOC15CTL_1	ADC SOC15 Control Register	EALLOW	<a href="#">Go</a>
30h	ADCEVTSTAT	ADC Event Status Register		<a href="#">Go</a>
32h	ADCEVTCLR	ADC Event Clear Register		<a href="#">Go</a>
34h	ADCEVTSEL	ADC Event Selection Register	EALLOW	<a href="#">Go</a>
36h	ADCEVTINTSEL	ADC Event Interrupt Selection Register	EALLOW	<a href="#">Go</a>
39h	ADCCOUNTER	ADC Counter Register		<a href="#">Go</a>
3Ah	ADCREV	ADC Revision Register		<a href="#">Go</a>
3Bh	ADCOFFTRIM	ADC Offset Trim Register	EALLOW	<a href="#">Go</a>
40h	ADCPPB1CONFIG	ADC PPB1 Config Register	EALLOW	<a href="#">Go</a>
41h	ADCPPB1STAMP	ADC PPB1 Sample Delay Time Stamp Register		<a href="#">Go</a>
42h	ADCPPB1OFFCAL	ADC PPB1 Offset Calibration Register	EALLOW	<a href="#">Go</a>
43h	ADCPPB1OFFREF	ADC PPB1 Offset Reference Register		<a href="#">Go</a>

**Table 9-13. ADC\_REGS Registers (continued)**

Offset	Acronym	Register Name	Write Protection	Section
44h	ADCPPB1TRIPHI	ADC PPB1 Trip High Register	EALLOW	<a href="#">Go</a>
46h	ADCPPB1TRIPLO	ADC PPB1 Trip Low/Trigger Time Stamp Register	EALLOW	<a href="#">Go</a>
48h	ADCPPB2CONFIG	ADC PPB2 Config Register	EALLOW	<a href="#">Go</a>
49h	ADCPPB2STAMP	ADC PPB2 Sample Delay Time Stamp Register		<a href="#">Go</a>
4Ah	ADCPPB2OFFCAL	ADC PPB2 Offset Calibration Register	EALLOW	<a href="#">Go</a>
4Bh	ADCPPB2OFFREF	ADC PPB2 Offset Reference Register		<a href="#">Go</a>
4Ch	ADCPPB2TRIPHI	ADC PPB2 Trip High Register	EALLOW	<a href="#">Go</a>
4Eh	ADCPPB2TRIPLO	ADC PPB2 Trip Low/Trigger Time Stamp Register	EALLOW	<a href="#">Go</a>
50h	ADCPPB3CONFIG	ADC PPB3 Config Register	EALLOW	<a href="#">Go</a>
51h	ADCPPB3STAMP	ADC PPB3 Sample Delay Time Stamp Register		<a href="#">Go</a>
52h	ADCPPB3OFFCAL	ADC PPB3 Offset Calibration Register	EALLOW	<a href="#">Go</a>
53h	ADCPPB3OFFREF	ADC PPB3 Offset Reference Register		<a href="#">Go</a>
54h	ADCPPB3TRIPHI	ADC PPB3 Trip High Register	EALLOW	<a href="#">Go</a>
56h	ADCPPB3TRIPLO	ADC PPB3 Trip Low/Trigger Time Stamp Register	EALLOW	<a href="#">Go</a>
58h	ADCPPB4CONFIG	ADC PPB4 Config Register	EALLOW	<a href="#">Go</a>
59h	ADCPPB4STAMP	ADC PPB4 Sample Delay Time Stamp Register		<a href="#">Go</a>
5Ah	ADCPPB4OFFCAL	ADC PPB4 Offset Calibration Register	EALLOW	<a href="#">Go</a>
5Bh	ADCPPB4OFFREF	ADC PPB4 Offset Reference Register		<a href="#">Go</a>
5Ch	ADCPPB4TRIPHI	ADC PPB4 Trip High Register	EALLOW	<a href="#">Go</a>
5Eh	ADCPPB4TRIPLO	ADC PPB4 Trip Low/Trigger Time Stamp Register	EALLOW	<a href="#">Go</a>
70h	ADCINLTRIM1	ADC Linearity Trim 1 Register	EALLOW	<a href="#">Go</a>
72h	ADCINLTRIM2	ADC Linearity Trim 2 Register	EALLOW	<a href="#">Go</a>
74h	ADCINLTRIM3	ADC Linearity Trim 3 Register	EALLOW	<a href="#">Go</a>
76h	ADCINLTRIM4	ADC Linearity Trim 4 Register	EALLOW	<a href="#">Go</a>
78h	ADCINLTRIM5	ADC Linearity Trim 5 Register	EALLOW	<a href="#">Go</a>
7Ah	ADCINLTRIM6	ADC Linearity Trim 6 Register	EALLOW	<a href="#">Go</a>

Complex bit access types are encoded to fit into small table cells. [Table 9-14](#) shows the codes that are used for access types in this section.

**Table 9-14. ADC\_REGS Access Type Codes**

Access Type	Code	Description
<b>Read Type</b>		
R	R	Read
R=0	R	Read
<b>Write Type</b>		
W	W	Write
W=1	W	Write
<b>Reset or Default Value</b>		
-n		Value after reset or the default value
<b>Register Array Variables</b>		

**Table 9-14. ADC\_REGS Access Type Codes (continued)**

Access Type	Code	Description
i,j,k,l,m,n		When these variables are used in a register name, an offset, or an address, they refer to the value of a register array where the register is part of a group of repeating registers. The register groups form a hierarchical structure and the array is represented with a formula.
y		When this variable is used in a register name, an offset, or an address it refers to the value of a register array.

### 9.4.2.1 ADCCTL1 Register (Offset = 0h) [reset = 0h]

ADCCTL1 is shown in [Figure 9-25](#) and described in [Table 9-15](#).

Return to [Summary Table](#).

ADC Control 1 Register

**Figure 9-25. ADCCTL1 Register**

15	14	13	12	11	10	9	8
RESERVED		ADCBSY	RESERVED	ADCBSYCHN			
R-0h		R-0h	R-0h	R-0h			
7	6	5	4	3	2	1	0
ADCPWDNZ	RESERVED				INTPULSEPOS	RESERVED	
R/W-0h	R-0h			R/W-0h		R-0h	

**Table 9-15. ADCCTL1 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-14	RESERVED	R	0h	Reserved
13	ADCBSY	R	0h	ADC Busy. Set when ADC SOC is generated, cleared by hardware four ADC clocks after negative edge of S/H pulse. Used by the ADC state machine to determine if ADC is available to sample.  0 ADC is available to sample next channel 1 ADC is busy and cannot sample another channel Reset type: SYSRSn
12	RESERVED	R	0h	Reserved
11-8	ADCBSYCHN	R	0h	ADC Busy Channel. Set when an ADC Start of Conversion (SOC) is generated. When ADCBSY=0: holds the value of the last converted SOC When ADCBSY=1: reflects the SOC currently being processed 0h SOC0 is currently processing or was last SOC converted 1h SOC1 is currently processing or was last SOC converted 2h SOC2 is currently processing or was last SOC converted 3h SOC3 is currently processing or was last SOC converted 4h SOC4 is currently processing or was last SOC converted 5h SOC5 is currently processing or was last SOC converted 6h SOC6 is currently processing or was last SOC converted 7h SOC7 is currently processing or was last SOC converted 8h SOC8 is currently processing or was last SOC converted 9h SOC9 is currently processing or was last SOC converted Ah SOC10 is currently processing or was last SOC converted Bh SOC11 is currently processing or was last SOC converted Ch SOC12 is currently processing or was last SOC converted Dh SOC13 is currently processing or was last SOC converted Eh SOC14 is currently processing or was last SOC converted Fh SOC15 is currently processing or was last SOC converted Reset type: SYSRSn
7	ADCPWDNZ	R/W	0h	ADC Power Down (active low). This bit controls the power up and power down of all the analog circuitry inside the analog core.  0 All analog circuitry inside the core is powered down 1 All analog circuitry inside the core is powered up Reset type: SYSRSn
6-3	RESERVED	R	0h	Reserved

**Table 9-15. ADCCTL1 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
2	INTPULSEPOS	R/W	0h	ADC Interrupt Pulse Position.  0 Interrupt pulse generation occurs at the end of the acquisition window 1 Interrupt pulse generation occurs at the end of the conversion, 1 cycle prior to the ADC result latching into its result register Reset type: SYSRSn
1-0	RESERVED	R	0h	Reserved

### 9.4.2.2 ADCCTL2 Register (Offset = 1h) [reset = 0h]

ADCCTL2 is shown in [Figure 9-26](#) and described in [Table 9-16](#).

Return to [Summary Table](#).

ADC Control 2 Register

**Figure 9-26. ADCCTL2 Register**

15	14	13	12	11	10	9	8
RESERVED				RESERVED			
R-0h				R-0h			
7	6	5	4	3	2	1	0
SIGNALMODE	RESOLUTION	RESERVED		PRESCALE			
R/W-0h	R/W-0h	R-0h		R/W-0h			

**Table 9-16. ADCCTL2 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-13	RESERVED	R	0h	Reserved
12-8	RESERVED	R	0h	Reserved
7	SIGNALMODE	R/W	0h	SOC Signaling Mode. Selects the input mode of the converter. Use the AdcSetMode function to change the signal mode. 0 Single-ended 1 Differential Reset type: SYSRSn
6	RESOLUTION	R/W	0h	SOC Conversion Resolution. Selects the resolution of the converter. Use the AdcSetMode function to change the resolution. 0 12-bit resolution 1 16-bit resolution Reset type: SYSRSn
5-4	RESERVED	R	0h	Reserved
3-0	PRESCALE	R/W	0h	ADC Clock Prescaler. 0000 ADCCLK = Input Clock / 1.0 0001 Invalid 0010 ADCCLK = Input Clock / 2.0 0011 ADCCLK = Input Clock / 2.5 0100 ADCCLK = Input Clock / 3.0 0101 ADCCLK = Input Clock / 3.5 0110 ADCCLK = Input Clock / 4.0 0111 ADCCLK = Input Clock / 4.5 1000 ADCCLK = Input Clock / 5.0 1001 ADCCLK = Input Clock / 5.5 1010 ADCCLK = Input Clock / 6.0 1011 ADCCLK = Input Clock / 6.5 1100 ADCCLK = Input Clock / 7.0 1101 ADCCLK = Input Clock / 7.5 1110 ADCCLK = Input Clock / 8.0 1111 ADCCLK = Input Clock / 8.5 Reset type: SYSRSn

### 9.4.2.3 ADCBURSTCTL\_1 Register (Offset = 2h) [reset = 0h]

ADCBURSTCTL\_1 is shown in [Figure 9-27](#) and described in [Table 9-17](#).

Return to [Summary Table](#).

ADC Burst Control Register

**Figure 9-27. ADCBURSTCTL\_1 Register**

15	14	13	12	11	10	9	8
BURSTEN	RESERVED			BURSTSIZE			
R/W-0h	R-0h			R/W-0h			
7	6	5	4	3	2	1	0
RESERVED		BURSTTRIGSEL					
R-0h		R/W-0h					

**Table 9-17. ADCBURSTCTL\_1 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15	BURSTEN	R/W	0h	SOC Burst Mode Enable. This bit enables the SOC Burst Mode of operation.  0 Burst mode is disabled. 1 Burst mode is enabled. Reset type: SYSRSn
14-12	RESERVED	R	0h	Reserved
11-8	BURSTSIZE	R/W	0h	SOC Burst Size Select. This bit field determines how many SOCs are converted when a burst conversion sequence is started. The first SOC converted is defined by the round robin pointer, which is advanced as each SOC is converted.  0h 1 SOC converted 1h 2 SOCs converted 2h 3 SOCs converted 3h 4 SOCs converted 4h 5 SOCs converted 5h 6 SOCs converted 6h 7 SOCs converted 7h 8 SOCs converted 8h 9 SOCs converted 9h 10 SOCs converted Ah 11 SOCs converted Bh 12 SOCs converted Ch 13 SOCs converted Dh 14 SOCs converted Eh 15 SOCs converted Fh 16 SOCs converted Reset type: SYSRSn
7-6	RESERVED	R	0h	Reserved



**Table 9-17. ADCBURSTCTL\_1 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
5-0	BURSTTRIGSEL	R/W	0h	<p>SOC Burst Trigger Source Select. Configures which trigger will start a burst conversion sequence.</p> <p>00h BURSTTRIG0 - Software only</p> <p>01h BURSTTRIG1 - CPU1 Timer 0, TINT0n</p> <p>02h BURSTTRIG2 - CPU1 Timer 1, TINT1n</p> <p>03h BURSTTRIG3 - CPU1 Timer 2, TINT2n</p> <p>04h BURSTTRIG4 - GPIO, Input X-Bar INPUT5</p> <p>05h BURSTTRIG5 - ePWM1, ADCSOCA</p> <p>06h BURSTTRIG6 - ePWM1, ADCSOCB</p> <p>07h BURSTTRIG7 - ePWM2, ADCSOCA</p> <p>08h BURSTTRIG8 - ePWM2, ADCSOCB</p> <p>09h BURSTTRIG9 - ePWM3, ADCSOCA</p> <p>0Ah BURSTTRIG10 - ePWM3, ADCSOCB</p> <p>0Bh BURSTTRIG11 - ePWM4, ADCSOCA</p> <p>0Ch BURSTTRIG12 - ePWM4, ADCSOCB</p> <p>0Dh BURSTTRIG13 - ePWM5, ADCSOCA</p> <p>0Eh BURSTTRIG14 - ePWM5, ADCSOCB</p> <p>0Fh BURSTTRIG15 - ePWM6, ADCSOCA</p> <p>10h BURSTTRIG16 - ePWM6, ADCSOCB</p> <p>11h BURSTTRIG17 - ePWM7, ADCSOCA</p> <p>12h BURSTTRIG18 - ePWM7, ADCSOCB</p> <p>13h BURSTTRIG19 - ePWM8, ADCSOCA</p> <p>14h BURSTTRIG20 - ePWM8, ADCSOCB</p> <p>15h BURSTTRIG21 - ePWM9, ADCSOCA</p> <p>16h BURSTTRIG22 - ePWM9, ADCSOCB</p> <p>17h BURSTTRIG23 - ePWM10, ADCSOCA</p> <p>18h BURSTTRIG24 - ePWM10, ADCSOCB</p> <p>19h BURSTTRIG25 - ePWM11, ADCSOCA</p> <p>1Ah BURSTTRIG26 - ePWM11, ADCSOCB</p> <p>1Bh BURSTTRIG27 - ePWM12, ADCSOCA</p> <p>1Ch BURSTTRIG28 - ePWM12, ADCSOCB</p> <p>1Dh - 3Fh - Reserved</p> <p>Reset type: SYSRSn</p>

#### 9.4.2.4 ADCINTFLG Register (Offset = 3h) [reset = 0h]

ADCINTFLG is shown in [Figure 9-28](#) and described in [Table 9-18](#).

Return to [Summary Table](#).

ADC Interrupt Flag Register

**Figure 9-28. ADCINTFLG Register**

15	14	13	12	11	10	9	8
RESERVED							
R-0h							
7	6	5	4	3	2	1	0
RESERVED				ADCINT4	ADCINT3	ADCINT2	ADCINT1
R-0h				R-0h	R-0h	R-0h	R-0h

**Table 9-18. ADCINTFLG Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-4	RESERVED	R	0h	Reserved
3	ADCINT4	R	0h	<p>ADC Interrupt 4 Flag. Reading these flags indicates if the associated ADCINT pulse was generated since the last clear.</p> <p>0 No ADC interrupt pulse generated 1 ADC interrupt pulse generated</p> <p>If the ADC interrupt is placed in continuous mode (INTSELxNy register) then further interrupt pulses are generated whenever a selected EOC event occurs even if the flag bit is set. If the continuous mode is not enabled, then no further interrupt pulses are generated until the user clears this flag bit using the ADCINFLGCLR register. Rather, an ADC interrupt overflow event occurs in the ADCINTOVF register.</p> <p>Reset type: SYSRSn</p>
2	ADCINT3	R	0h	<p>ADC Interrupt 3 Flag. Reading these flags indicates if the associated ADCINT pulse was generated since the last clear.</p> <p>0 No ADC interrupt pulse generated 1 ADC interrupt pulse generated</p> <p>If the ADC interrupt is placed in continuous mode (INTSELxNy register) then further interrupt pulses are generated whenever a selected EOC event occurs even if the flag bit is set. If the continuous mode is not enabled, then no further interrupt pulses are generated until the user clears this flag bit using the ADCINFLGCLR register. Rather, an ADC interrupt overflow event occurs in the ADCINTOVF register.</p> <p>Reset type: SYSRSn</p>
1	ADCINT2	R	0h	<p>ADC Interrupt 2 Flag. Reading these flags indicates if the associated ADCINT pulse was generated since the last clear.</p> <p>0 No ADC interrupt pulse generated 1 ADC interrupt pulse generated</p> <p>If the ADC interrupt is placed in continuous mode (INTSELxNy register) then further interrupt pulses are generated whenever a selected EOC event occurs even if the flag bit is set. If the continuous mode is not enabled, then no further interrupt pulses are generated until the user clears this flag bit using the ADCINFLGCLR register. Rather, an ADC interrupt overflow event occurs in the ADCINTOVF register.</p> <p>Reset type: SYSRSn</p>

**Table 9-18. ADCINTFLG Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
0	ADCINT1	R	0h	<p>ADC Interrupt 1 Flag. Reading these flags indicates if the associated ADCINT pulse was generated since the last clear.</p> <p>0 No ADC interrupt pulse generated 1 ADC interrupt pulse generated</p> <p>If the ADC interrupt is placed in continuous mode (INTSELxNy register) then further interrupt pulses are generated whenever a selected EOC event occurs even if the flag bit is set. If the continuous mode is not enabled, then no further interrupt pulses are generated until the user clears this flag bit using the ADCINFLGCLR register. Rather, an ADC interrupt overflow event occurs in the ADCINTOVF register.</p> <p>Reset type: SYSRSn</p>

### 9.4.2.5 ADCINTFLGCLR Register (Offset = 4h) [reset = 0h]

ADCINTFLGCLR is shown in [Figure 9-29](#) and described in [Table 9-19](#).

Return to [Summary Table](#).

ADC Interrupt Flag Clear Register

**Figure 9-29. ADCINTFLGCLR Register**

15	14	13	12	11	10	9	8
RESERVED							
R-0h							
7	6	5	4	3	2	1	0
RESERVED				ADCINT4	ADCINT3	ADCINT2	ADCINT1
R-0h				R=0/W=1-0h	R=0/W=1-0h	R=0/W=1-0h	R=0/W=1-0h

**Table 9-19. ADCINTFLGCLR Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-4	RESERVED	R	0h	Reserved
3	ADCINT4	R=0/W=1	0h	ADC Interrupt 4 Flag Clear. Reads return 0. 0 No action 1 Clears respective flag bit in the ADCINTFLG register. If software sets the clear bit on the same cycle that hardware is trying to set the flag bit, then hardware has priority but the overflow bit will not be affected (retains current state) Boundary condition: If hardware is trying to set the bit flag while software tries to clear the bit in the same cycle, the following will take place: 1. SW has priority and will clear the flag 2. HW set will be discarded no signal will propagate to the PIE from the latch 3. Overflow flag/condition will be generated Reset type: SYSRSn
2	ADCINT3	R=0/W=1	0h	ADC Interrupt 3 Flag Clear. Reads return 0. 0 No action 1 Clears respective flag bit in the ADCINTFLG register. If software sets the clear bit on the same cycle that hardware is trying to set the flag bit, then hardware has priority but the overflow bit will not be affected (retains current state) Boundary condition: If hardware is trying to set the bit flag while software tries to clear the bit in the same cycle, the following will take place: 1. SW has priority and will clear the flag 2. HW set will be discarded no signal will propagate to the PIE from the latch 3. Overflow flag/condition will be generated Reset type: SYSRSn
1	ADCINT2	R=0/W=1	0h	ADC Interrupt 2 Flag Clear. Reads return 0. 0 No action 1 Clears respective flag bit in the ADCINTFLG register. If software sets the clear bit on the same cycle that hardware is trying to set the flag bit, then hardware has priority but the overflow bit will not be affected (retains current state) Boundary condition: If hardware is trying to set the bit flag while software tries to clear the bit in the same cycle, the following will take place: 1. SW has priority and will clear the flag 2. HW set will be discarded no signal will propagate to the PIE from the latch 3. Overflow flag/condition will be generated Reset type: SYSRSn

**Table 9-19. ADCINTFLGCLR Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
0	ADCINT1	R=0/W=1	0h	ADC Interrupt 1 Flag Clear. Reads return 0. 0 No action 1 Clears respective flag bit in the ADCINTFLG register. If software sets the clear bit on the same cycle that hardware is trying to set the flag bit, then hardware has priority but the overflow bit will not be affected (retains current state) Boundary condition: If hardware is trying to set the bit flag while software tries to clear the bit in the same cycle, the following will take place: 1. SW has priority and will clear the flag 2. HW set will be discarded no signal will propagate to the PIE from the latch 3. Overflow flag/condition will be generated Reset type: SYSRSn

### 9.4.2.6 ADCINTOVF Register (Offset = 5h) [reset = 0h]

ADCINTOVF is shown in [Figure 9-30](#) and described in [Table 9-20](#).

Return to [Summary Table](#).

ADC Interrupt Overflow Register

**Figure 9-30. ADCINTOVF Register**

15	14	13	12	11	10	9	8
RESERVED							
R-0h							
7	6	5	4	3	2	1	0
RESERVED				ADCINT4	ADCINT3	ADCINT2	ADCINT1
R-0h				R-0h	R-0h	R-0h	R-0h

**Table 9-20. ADCINTOVF Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-4	RESERVED	R	0h	Reserved
3	ADCINT4	R	0h	<p>ADC Interrupt 4 Overflow Flags</p> <p>Indicates if an overflow occurred when generating ADCINT pulses. If the respective ADCINTFLG bit is set and a selected additional EOC trigger is generated, then an overflow condition occurs.</p> <p>0 No ADC interrupt overflow event detected. 1 ADC Interrupt overflow event detected.</p> <p>The overflow bit does not care about the continuous mode bit state. An overflow condition is generated irrespective of this mode selection.</p> <p>Reset type: SYSRSn</p>
2	ADCINT3	R	0h	<p>ADC Interrupt 3 Overflow Flags</p> <p>Indicates if an overflow occurred when generating ADCINT pulses. If the respective ADCINTFLG bit is set and a selected additional EOC trigger is generated, then an overflow condition occurs.</p> <p>0 No ADC interrupt overflow event detected. 1 ADC Interrupt overflow event detected.</p> <p>The overflow bit does not care about the continuous mode bit state. An overflow condition is generated irrespective of this mode selection.</p> <p>Reset type: SYSRSn</p>
1	ADCINT2	R	0h	<p>ADC Interrupt 2 Overflow Flags</p> <p>Indicates if an overflow occurred when generating ADCINT pulses. If the respective ADCINTFLG bit is set and a selected additional EOC trigger is generated, then an overflow condition occurs.</p> <p>0 No ADC interrupt overflow event detected. 1 ADC Interrupt overflow event detected.</p> <p>The overflow bit does not care about the continuous mode bit state. An overflow condition is generated irrespective of this mode selection.</p> <p>Reset type: SYSRSn</p>

**Table 9-20. ADCINTOVF Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
0	ADCINT1	R	0h	<p>ADC Interrupt 1 Overflow Flags</p> <p>Indicates if an overflow occurred when generating ADCINT pulses. If the respective ADCINTFLG bit is set and a selected additional EOC trigger is generated, then an overflow condition occurs.</p> <p>0 No ADC interrupt overflow event detected. 1 ADC Interrupt overflow event detected.</p> <p>The overflow bit does not care about the continuous mode bit state. An overflow condition is generated irrespective of this mode selection.</p> <p>Reset type: SYSRSn</p>

**9.4.2.7 ADCINTOVFCLR Register (Offset = 6h) [reset = 0h]**

ADCINTOVFCLR is shown in [Figure 9-31](#) and described in [Table 9-21](#).

Return to [Summary Table](#).

ADC Interrupt Overflow Clear Register

**Figure 9-31. ADCINTOVFCLR Register**

15	14	13	12	11	10	9	8
RESERVED							
R-0h							
7	6	5	4	3	2	1	0
RESERVED				ADCINT4	ADCINT3	ADCINT2	ADCINT1
R-0h				R=0/W=1-0h	R=0/W=1-0h	R=0/W=1-0h	R=0/W=1-0h

**Table 9-21. ADCINTOVFCLR Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-4	RESERVED	R	0h	Reserved
3	ADCINT4	R=0/W=1	0h	ADC Interrupt 4 Overflow Clear Bits  0 No action. 1 Clears the respective overflow bit in the ADCINTOVF register. If software tries to set this bit on the same clock cycle that hardware tries to set the overflow bit in the ADCINTOVF register, then hardware has priority and the ADCINTOVF bit will be set. Reset type: SYSRSn
2	ADCINT3	R=0/W=1	0h	ADC Interrupt 3 Overflow Clear Bits  0 No action. 1 Clears the respective overflow bit in the ADCINTOVF register. If software tries to set this bit on the same clock cycle that hardware tries to set the overflow bit in the ADCINTOVF register, then hardware has priority and the ADCINTOVF bit will be set. Reset type: SYSRSn
1	ADCINT2	R=0/W=1	0h	ADC Interrupt 2 Overflow Clear Bits  0 No action. 1 Clears the respective overflow bit in the ADCINTOVF register. If software tries to set this bit on the same clock cycle that hardware tries to set the overflow bit in the ADCINTOVF register, then hardware has priority and the ADCINTOVF bit will be set. Reset type: SYSRSn
0	ADCINT1	R=0/W=1	0h	ADC Interrupt 1 Overflow Clear Bits  0 No action. 1 Clears the respective overflow bit in the ADCINTOVF register. If software tries to set this bit on the same clock cycle that hardware tries to set the overflow bit in the ADCINTOVF register, then hardware has priority and the ADCINTOVF bit will be set. Reset type: SYSRSn



### 9.4.2.8 ADCINTSEL1N2 Register (Offset = 7h) [reset = 0h]

ADCINTSEL1N2 is shown in [Figure 9-32](#) and described in [Table 9-22](#).

Return to [Summary Table](#).

ADC Interrupt 1 and 2 Selection Register

**Figure 9-32. ADCINTSEL1N2 Register**

15	14	13	12	11	10	9	8
RESERVED	INT2CONT	INT2E	RESERVED	INT2SEL			
R-0h	R/W-0h	R/W-0h	R-0h	R/W-0h			
7	6	5	4	3	2	1	0
RESERVED	INT1CONT	INT1E	RESERVED	INT1SEL			
R-0h	R/W-0h	R/W-0h	R-0h	R/W-0h			

**Table 9-22. ADCINTSEL1N2 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15	RESERVED	R	0h	Reserved
14	INT2CONT	R/W	0h	ADCINT2 Continuous Mode Enable 0 No further ADCINT2 pulses are generated until ADCINT2 flag (in ADCINTFLG register) is cleared by user. 1 ADCINT2 pulses are generated whenever an EOC pulse is generated irrespective of whether the flag bit is cleared or not. Reset type: SYSRSn
13	INT2E	R/W	0h	ADCINT2 Interrupt Enable 0 ADCINT2 is disabled 1 ADCINT2 is enabled Reset type: SYSRSn
12	RESERVED	R	0h	Reserved
11-8	INT2SEL	R/W	0h	ADCINT2 EOC Source Select 0h EOC0 is trigger for ADCINT2 1h EOC1 is trigger for ADCINT2 2h EOC2 is trigger for ADCINT2 3h EOC3 is trigger for ADCINT2 4h EOC4 is trigger for ADCINT2 5h EOC5 is trigger for ADCINT2 6h EOC6 is trigger for ADCINT2 7h EOC7 is trigger for ADCINT2 8h EOC8 is trigger for ADCINT2 9h EOC9 is trigger for ADCINT2 Ah EOC10 is trigger for ADCINT2 Bh EOC11 is trigger for ADCINT2 Ch EOC12 is trigger for ADCINT2 Dh EOC13 is trigger for ADCINT2 Eh EOC14 is trigger for ADCINT2 Fh EOC15 is trigger for ADCINT2 Reset type: SYSRSn
7	RESERVED	R	0h	Reserved

**Table 9-22. ADCINTSEL1N2 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
6	INT1CONT	R/W	0h	ADCINT1 Continuous Mode Enable 0 No further ADCINT1 pulses are generated until ADCINT1 flag (in ADCINTFLG register) is cleared by user. 1 ADCINT1 pulses are generated whenever an EOC pulse is generated irrespective of whether the flag bit is cleared or not. Reset type: SYSRSn
5	INT1E	R/W	0h	ADCINT1 Interrupt Enable 0 ADCINT1 is disabled 1 ADCINT1 is enabled Reset type: SYSRSn
4	RESERVED	R	0h	Reserved
3-0	INT1SEL	R/W	0h	ADCINT1 EOC Source Select 0h EOC0 is trigger for ADCINT1 1h EOC1 is trigger for ADCINT1 2h EOC2 is trigger for ADCINT1 3h EOC3 is trigger for ADCINT1 4h EOC4 is trigger for ADCINT1 5h EOC5 is trigger for ADCINT1 6h EOC6 is trigger for ADCINT1 7h EOC7 is trigger for ADCINT1 8h EOC8 is trigger for ADCINT1 9h EOC9 is trigger for ADCINT1 Ah EOC10 is trigger for ADCINT1 Bh EOC11 is trigger for ADCINT1 Ch EOC12 is trigger for ADCINT1 Dh EOC13 is trigger for ADCINT1 Eh EOC14 is trigger for ADCINT1 Fh EOC15 is trigger for ADCINT1 Reset type: SYSRSn

### 9.4.2.9 ADCINTSEL3N4 Register (Offset = 8h) [reset = 0h]

ADCINTSEL3N4 is shown in [Figure 9-33](#) and described in [Table 9-23](#).

Return to [Summary Table](#).

ADC Interrupt 3 and 4 Selection Register

**Figure 9-33. ADCINTSEL3N4 Register**

15	14	13	12	11	10	9	8
RESERVED	INT4CONT	INT4E	RESERVED			INT4SEL	
R-0h	R/W-0h	R/W-0h	R-0h			R/W-0h	
7	6	5	4	3	2	1	0
RESERVED	INT3CONT	INT3E	RESERVED			INT3SEL	
R-0h	R/W-0h	R/W-0h	R-0h			R/W-0h	

**Table 9-23. ADCINTSEL3N4 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15	RESERVED	R	0h	Reserved
14	INT4CONT	R/W	0h	ADCINT4 Continuous Mode Enable 0 No further ADCINT4 pulses are generated until ADCINT4 flag (in ADCINTFLG register) is cleared by user. 1 ADCINT4 pulses are generated whenever an EOC pulse is generated irrespective of whether the flag bit is cleared or not. Reset type: SYSRSn
13	INT4E	R/W	0h	ADCINT4 Interrupt Enable 0 ADCINT4 is disabled 1 ADCINT4 is enabled Reset type: SYSRSn
12	RESERVED	R	0h	Reserved
11-8	INT4SEL	R/W	0h	ADCINT4 EOC Source Select 0h EOC0 is trigger for ADCINT4 1h EOC1 is trigger for ADCINT4 2h EOC2 is trigger for ADCINT4 3h EOC3 is trigger for ADCINT4 4h EOC4 is trigger for ADCINT4 5h EOC5 is trigger for ADCINT4 6h EOC6 is trigger for ADCINT4 7h EOC7 is trigger for ADCINT4 8h EOC8 is trigger for ADCINT4 9h EOC9 is trigger for ADCINT4 Ah EOC10 is trigger for ADCINT4 Bh EOC11 is trigger for ADCINT4 Ch EOC12 is trigger for ADCINT4 Dh EOC13 is trigger for ADCINT4 Eh EOC14 is trigger for ADCINT4 Fh EOC15 is trigger for ADCINT4 Reset type: SYSRSn
7	RESERVED	R	0h	Reserved

**Table 9-23. ADCINTSEL3N4 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
6	INT3CONT	R/W	0h	ADCINT3 Continuous Mode Enable 0 No further ADCINT3 pulses are generated until ADCINT3 flag (in ADCINTFLG register) is cleared by user. 1 ADCINT3 pulses are generated whenever an EOC pulse is generated irrespective of whether the flag bit is cleared or not. Reset type: SYSRSn
5	INT3E	R/W	0h	ADCINT3 Interrupt Enable 0 ADCINT3 is disabled 1 ADCINT3 is enabled Reset type: SYSRSn
4	RESERVED	R	0h	Reserved
3-0	INT3SEL	R/W	0h	ADCINT3 EOC Source Select 0h EOC0 is trigger for ADCINT3 1h EOC1 is trigger for ADCINT3 2h EOC2 is trigger for ADCINT3 3h EOC3 is trigger for ADCINT3 4h EOC4 is trigger for ADCINT3 5h EOC5 is trigger for ADCINT3 6h EOC6 is trigger for ADCINT3 7h EOC7 is trigger for ADCINT3 8h EOC8 is trigger for ADCINT3 9h EOC9 is trigger for ADCINT3 Ah EOC10 is trigger for ADCINT3 Bh EOC11 is trigger for ADCINT3 Ch EOC12 is trigger for ADCINT3 Dh EOC13 is trigger for ADCINT3 Eh EOC14 is trigger for ADCINT3 Fh EOC15 is trigger for ADCINT3 Reset type: SYSRSn

**9.4.2.10 ADCSOCPRICTL Register (Offset = 9h) [reset = 200h]**

ADCSOCPRICTL is shown in [Figure 9-34](#) and described in [Table 9-24](#).

Return to [Summary Table](#).

ADC SOC Priority Control Register

**Figure 9-34. ADCSOCPRICTL Register**

15	14	13	12	11	10	9	8
RESERVED						RRPOINTER	
R-0h						R-10h	
7	6	5	4	3	2	1	0
RRPOINTER			SOCPRIORITY				
R-10h			R/W-0h				

**Table 9-24. ADCSOCPRICTL Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-10	RESERVED	R	0h	Reserved

**Table 9-24. ADCSOCPRICTL Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
9-5	RRPOINTER	R	10h	<p>Round Robin Pointer. Holds the value of the last converted round robin SOCx to be used by the round robin scheme to determine order of conversions.</p> <p>00h SOC0 was last round robin SOC to convert, SOC1 is highest round robin priority.</p> <p>01h SOC1 was last round robin SOC to convert, SOC2 is highest round robin priority.</p> <p>02h SOC2 was last round robin SOC to convert, SOC3 is highest round robin priority.</p> <p>03h SOC3 was last round robin SOC to convert, SOC4 is highest round robin priority.</p> <p>04h SOC4 was last round robin SOC to convert, SOC5 is highest round robin priority.</p> <p>05h SOC5 was last round robin SOC to convert, SOC6 is highest round robin priority.</p> <p>06h SOC6 was last round robin SOC to convert, SOC7 is highest round robin priority.</p> <p>07h SOC7 was last round robin SOC to convert, SOC8 is highest round robin priority.</p> <p>08h SOC8 was last round robin SOC to convert, SOC9 is highest round robin priority.</p> <p>09h SOC9 was last round robin SOC to convert, SOC10 is highest round robin priority.</p> <p>0Ah SOC10 was last round robin SOC to convert, SOC11 is highest round robin priority.</p> <p>0Bh SOC11 was last round robin SOC to convert, SOC12 is highest round robin priority.</p> <p>0Ch SOC12 was last round robin SOC to convert, SOC13 is highest round robin priority.</p> <p>0Dh SOC13 was last round robin SOC to convert, SOC14 is highest round robin priority.</p> <p>0Eh SOC14 was last round robin SOC to convert, SOC15 is highest round robin priority.</p> <p>0Fh SOC15 was last round robin SOC to convert, SOC0 is highest round robin priority.</p> <p>10h Reset value to indicate no SOC has been converted. SOC0 is highest round robin priority. Set to this value when the device is reset, when the ADCCTL1.RESET bit is set, or when the ADCSOCPRICTL register is written. In the latter case, if a conversion is currently in progress, it will complete and then the new priority will take effect.</p> <p>Others Invalid value.</p> <p>Reset type: SYSRSn</p>

**Table 9-24. ADCSOCPRCTL Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
4-0	SOC PRIORITY	R/W	0h	<p>SOC Priority</p> <p>Determines the cutoff point for priority mode and round robin arbitration for SOCx</p> <p>00h SOC priority is handled in round robin mode for all channels.</p> <p>01h SOC0 is high priority, rest of channels are in round robin mode.</p> <p>02h SOC0-SOC1 are high priority, SOC2-SOC15 are in round robin mode.</p> <p>03h SOC0-SOC2 are high priority, SOC3-SOC15 are in round robin mode.</p> <p>04h SOC0-SOC3 are high priority, SOC4-SOC15 are in round robin mode.</p> <p>05h SOC0-SOC4 are high priority, SOC5-SOC15 are in round robin mode.</p> <p>06h SOC0-SOC5 are high priority, SOC6-SOC15 are in round robin mode.</p> <p>07h SOC0-SOC6 are high priority, SOC7-SOC15 are in round robin mode.</p> <p>08h SOC0-SOC7 are high priority, SOC8-SOC15 are in round robin mode.</p> <p>09h SOC0-SOC8 are high priority, SOC9-SOC15 are in round robin mode.</p> <p>0Ah SOC0-SOC9 are high priority, SOC10-SOC15 are in round robin mode.</p> <p>0Bh SOC0-SOC10 are high priority, SOC11-SOC15 are in round robin mode.</p> <p>0Ch SOC0-SOC11 are high priority, SOC12-SOC15 are in round robin mode.</p> <p>0Dh SOC0-SOC12 are high priority, SOC13-SOC15 are in round robin mode.</p> <p>0Eh SOC0-SOC13 are high priority, SOC14-SOC15 are in round robin mode.</p> <p>0Fh SOC0-SOC14 are high priority, SOC15 is in round robin mode.</p> <p>10h All SOCx are in high priority mode, arbitrated by SOC number.</p> <p>Others Invalid selection.</p> <p>Reset type: SYSRSn</p>

### 9.4.2.11 ADCINTSOCSEL1 Register (Offset = Ah) [reset = 0h]

ADCINTSOCSEL1 is shown in [Figure 9-35](#) and described in [Table 9-25](#).

Return to [Summary Table](#).

ADC Interrupt SOC Selection 1 Register

**Figure 9-35. ADCINTSOCSEL1 Register**

15	14	13	12	11	10	9	8
SOC7		SOC6		SOC5		SOC4	
R/W-0h		R/W-0h		R/W-0h		R/W-0h	
7	6	5	4	3	2	1	0
SOC3		SOC2		SOC1		SOC0	
R/W-0h		R/W-0h		R/W-0h		R/W-0h	

**Table 9-25. ADCINTSOCSEL1 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-14	SOC7	R/W	0h	SOC7 ADC Interrupt Trigger Select. Selects which, if any, ADCINT triggers SOC7. The trigger selected in this field is in addition to the TRIGSEL field in the ADCSOCxCTL register. 00 No ADCINT will trigger SOC7. TRIGSEL field alone determines SOC0 trigger. 01 ADCINT1 will trigger SOC7. 10 ADCINT2 will trigger SOC7. 11 Invalid selection. Reset type: SYSRSn
13-12	SOC6	R/W	0h	SOC6 ADC Interrupt Trigger Select. Selects which, if any, ADCINT triggers SOC6. The trigger selected in this field is in addition to the TRIGSEL field in the ADCSOCxCTL register. 00 No ADCINT will trigger SOC6. TRIGSEL field alone determines SOC0 trigger. 01 ADCINT1 will trigger SOC6. 10 ADCINT2 will trigger SOC6. 11 Invalid selection. Reset type: SYSRSn
11-10	SOC5	R/W	0h	SOC5 ADC Interrupt Trigger Select. Selects which, if any, ADCINT triggers SOC5. The trigger selected in this field is in addition to the TRIGSEL field in the ADCSOCxCTL register. 00 No ADCINT will trigger SOC5. TRIGSEL field alone determines SOC0 trigger. 01 ADCINT1 will trigger SOC5. 10 ADCINT2 will trigger SOC5. 11 Invalid selection. Reset type: SYSRSn
9-8	SOC4	R/W	0h	SOC4 ADC Interrupt Trigger Select. Selects which, if any, ADCINT triggers SOC4. The trigger selected in this field is in addition to the TRIGSEL field in the ADCSOCxCTL register. 00 No ADCINT will trigger SOC4. TRIGSEL field alone determines SOC0 trigger. 01 ADCINT1 will trigger SOC4. 10 ADCINT2 will trigger SOC4. 11 Invalid selection. Reset type: SYSRSn



**Table 9-25. ADCINTSOCSEL1 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
7-6	SOC3	R/W	0h	<p>SOC3 ADC Interrupt Trigger Select. Selects which, if any, ADCINT triggers SOC3. The trigger selected in this field is in addition to the TRIGSEL field in the ADCSOCxCTL register.</p> <p>00 No ADCINT will trigger SOC3. TRIGSEL field alone determines SOC0 trigger.</p> <p>01 ADCINT1 will trigger SOC3.</p> <p>10 ADCINT2 will trigger SOC3.</p> <p>11 Invalid selection.</p> <p>Reset type: SYSRSn</p>
5-4	SOC2	R/W	0h	<p>SOC2 ADC Interrupt Trigger Select. Selects which, if any, ADCINT triggers SOC2. The trigger selected in this field is in addition to the TRIGSEL field in the ADCSOCxCTL register.</p> <p>00 No ADCINT will trigger SOC2. TRIGSEL field alone determines SOC0 trigger.</p> <p>01 ADCINT1 will trigger SOC2.</p> <p>10 ADCINT2 will trigger SOC2.</p> <p>11 Invalid selection.</p> <p>Reset type: SYSRSn</p>
3-2	SOC1	R/W	0h	<p>SOC1 ADC Interrupt Trigger Select. Selects which, if any, ADCINT triggers SOC1. The trigger selected in this field is in addition to the TRIGSEL field in the ADCSOCxCTL register.</p> <p>00 No ADCINT will trigger SOC1. TRIGSEL field alone determines SOC0 trigger.</p> <p>01 ADCINT1 will trigger SOC1.</p> <p>10 ADCINT2 will trigger SOC1.</p> <p>11 Invalid selection.</p> <p>Reset type: SYSRSn</p>
1-0	SOC0	R/W	0h	<p>SOC0 ADC Interrupt Trigger Select. Selects which, if any, ADCINT triggers SOC0. The trigger selected in this field is in addition to the TRIGSEL field in the ADCSOCxCTL register.</p> <p>00 No ADCINT will trigger SOC0. TRIGSEL field alone determines SOC0 trigger.</p> <p>01 ADCINT1 will trigger SOC0.</p> <p>10 ADCINT2 will trigger SOC0.</p> <p>11 Invalid selection.</p> <p>Reset type: SYSRSn</p>

### 9.4.2.12 ADCINTSOCSEL2 Register (Offset = Bh) [reset = 0h]

ADCINTSOCSEL2 is shown in [Figure 9-36](#) and described in [Table 9-26](#).

Return to [Summary Table](#).

ADC Interrupt SOC Selection 2 Register

**Figure 9-36. ADCINTSOCSEL2 Register**

15	14	13	12	11	10	9	8
SOC15		SOC14		SOC13		SOC12	
R/W-0h		R/W-0h		R/W-0h		R/W-0h	
7	6	5	4	3	2	1	0
SOC11		SOC10		SOC9		SOC8	
R/W-0h		R/W-0h		R/W-0h		R/W-0h	

**Table 9-26. ADCINTSOCSEL2 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-14	SOC15	R/W	0h	<p>SOC15 ADC Interrupt Trigger Select. Selects which, if any, ADCINT triggers SOC15. The trigger selected in this field is in addition to the TRIGSEL field in the ADCSOCxCTL register.</p> <p>00 No ADCINT will trigger SOC15. TRIGSEL field alone determines SOC0 trigger.</p> <p>01 ADCINT1 will trigger SOC15.</p> <p>10 ADCINT2 will trigger SOC15.</p> <p>11 Invalid selection.</p> <p>Reset type: SYSRSn</p>
13-12	SOC14	R/W	0h	<p>SOC14 ADC Interrupt Trigger Select. Selects which, if any, ADCINT triggers SOC14. The trigger selected in this field is in addition to the TRIGSEL field in the ADCSOCxCTL register.</p> <p>00 No ADCINT will trigger SOC14. TRIGSEL field alone determines SOC0 trigger.</p> <p>01 ADCINT1 will trigger SOC14.</p> <p>10 ADCINT2 will trigger SOC14.</p> <p>11 Invalid selection.</p> <p>Reset type: SYSRSn</p>
11-10	SOC13	R/W	0h	<p>SOC13 ADC Interrupt Trigger Select. Selects which, if any, ADCINT triggers SOC13. The trigger selected in this field is in addition to the TRIGSEL field in the ADCSOCxCTL register.</p> <p>00 No ADCINT will trigger SOC13. TRIGSEL field alone determines SOC0 trigger.</p> <p>01 ADCINT1 will trigger SOC13.</p> <p>10 ADCINT2 will trigger SOC13.</p> <p>11 Invalid selection.</p> <p>Reset type: SYSRSn</p>
9-8	SOC12	R/W	0h	<p>SOC12 ADC Interrupt Trigger Select. Selects which, if any, ADCINT triggers SOC12. The trigger selected in this field is in addition to the TRIGSEL field in the ADCSOCxCTL register.</p> <p>00 No ADCINT will trigger SOC12. TRIGSEL field alone determines SOC0 trigger.</p> <p>01 ADCINT1 will trigger SOC12.</p> <p>10 ADCINT2 will trigger SOC12.</p> <p>11 Invalid selection.</p> <p>Reset type: SYSRSn</p>

**Table 9-26. ADCINTSOCSEL2 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
7-6	SOC11	R/W	0h	<p>SOC11 ADC Interrupt Trigger Select. Selects which, if any, ADCINT triggers SOC11. The trigger selected in this field is in addition to the TRIGSEL field in the ADCSOCxCTL register.</p> <p>00 No ADCINT will trigger SOC11. TRIGSEL field alone determines SOC0 trigger.</p> <p>01 ADCINT1 will trigger SOC11.</p> <p>10 ADCINT2 will trigger SOC11.</p> <p>11 Invalid selection.</p> <p>Reset type: SYSRSn</p>
5-4	SOC10	R/W	0h	<p>SOC10 ADC Interrupt Trigger Select. Selects which, if any, ADCINT triggers SOC10. The trigger selected in this field is in addition to the TRIGSEL field in the ADCSOCxCTL register.</p> <p>00 No ADCINT will trigger SOC10. TRIGSEL field alone determines SOC0 trigger.</p> <p>01 ADCINT1 will trigger SOC10.</p> <p>10 ADCINT2 will trigger SOC10.</p> <p>11 Invalid selection.</p> <p>Reset type: SYSRSn</p>
3-2	SOC9	R/W	0h	<p>SOC9 ADC Interrupt Trigger Select. Selects which, if any, ADCINT triggers SOC9. The trigger selected in this field is in addition to the TRIGSEL field in the ADCSOCxCTL register.</p> <p>00 No ADCINT will trigger SOC9. TRIGSEL field alone determines SOC0 trigger.</p> <p>01 ADCINT1 will trigger SOC9.</p> <p>10 ADCINT2 will trigger SOC9.</p> <p>11 Invalid selection.</p> <p>Reset type: SYSRSn</p>
1-0	SOC8	R/W	0h	<p>SOC8 ADC Interrupt Trigger Select. Selects which, if any, ADCINT triggers SOC8. The trigger selected in this field is in addition to the TRIGSEL field in the ADCSOCxCTL register.</p> <p>00 No ADCINT will trigger SOC8. TRIGSEL field alone determines SOC0 trigger.</p> <p>01 ADCINT1 will trigger SOC8.</p> <p>10 ADCINT2 will trigger SOC8.</p> <p>11 Invalid selection.</p> <p>Reset type: SYSRSn</p>

### 9.4.2.13 ADCSOCFLG1 Register (Offset = Ch) [reset = 0h]

ADCSOCFLG1 is shown in [Figure 9-37](#) and described in [Table 9-27](#).

Return to [Summary Table](#).

ADC SOC Flag 1 Register

**Figure 9-37. ADCSOCFLG1 Register**

15		14		13		12		11		10		9		8	
SOC15		SOC14		SOC13		SOC12		SOC11		SOC10		SOC9		SOC8	
R-0h		R-0h		R-0h		R-0h		R-0h		R-0h		R-0h		R-0h	
7		6		5		4		3		2		1		0	
SOC7		SOC6		SOC5		SOC4		SOC3		SOC2		SOC1		SOC0	
R-0h		R-0h		R-0h		R-0h		R-0h		R-0h		R-0h		R-0h	

**Table 9-27. ADCSOCFLG1 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15	SOC15	R	0h	<p>SOC15 Start of Conversion Flag. Indicates the state of SOC15 conversions.</p> <p>0 No sample pending for SOC15. 1 Trigger has been received and sample is pending for SOC15.</p> <p>This bit will be automatically cleared when the SOC15 conversion is started. If contention exists where this bit receives both a request to set and a request to clear on the same cycle, regardless of the source of either, this bit will be set and the request to clear will be ignored. In this case the overflow bit in the ADCSOCOVF1 register will not be affected regardless of whether this bit was previously set or not.</p> <p>Reset type: SYSRSn</p>
14	SOC14	R	0h	<p>SOC14 Start of Conversion Flag. Indicates the state of SOC14 conversions.</p> <p>0 No sample pending for SOC14. 1 Trigger has been received and sample is pending for SOC14.</p> <p>This bit will be automatically cleared when the SOC14 conversion is started. If contention exists where this bit receives both a request to set and a request to clear on the same cycle, regardless of the source of either, this bit will be set and the request to clear will be ignored. In this case the overflow bit in the ADCSOCOVF1 register will not be affected regardless of whether this bit was previously set or not.</p> <p>Reset type: SYSRSn</p>
13	SOC13	R	0h	<p>SOC13 Start of Conversion Flag. Indicates the state of SOC13 conversions.</p> <p>0 No sample pending for SOC13. 1 Trigger has been received and sample is pending for SOC13.</p> <p>This bit will be automatically cleared when the SOC13 conversion is started. If contention exists where this bit receives both a request to set and a request to clear on the same cycle, regardless of the source of either, this bit will be set and the request to clear will be ignored. In this case the overflow bit in the ADCSOCOVF1 register will not be affected regardless of whether this bit was previously set or not.</p> <p>Reset type: SYSRSn</p>

**Table 9-27. ADCSOCFLG1 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
12	SOC12	R	0h	<p>SOC12 Start of Conversion Flag. Indicates the state of SOC12 conversions.</p> <p>0 No sample pending for SOC12. 1 Trigger has been received and sample is pending for SOC12.</p> <p>This bit will be automatically cleared when the SOC12 conversion is started. If contention exists where this bit receives both a request to set and a request to clear on the same cycle, regardless of the source of either, this bit will be set and the request to clear will be ignored. In this case the overflow bit in the ADCSOCOVF1 register will not be affected regardless of whether this bit was previously set or not.</p> <p>Reset type: SYSRSn</p>
11	SOC11	R	0h	<p>SOC11 Start of Conversion Flag. Indicates the state of SOC11 conversions.</p> <p>0 No sample pending for SOC11. 1 Trigger has been received and sample is pending for SOC11.</p> <p>This bit will be automatically cleared when the SOC11 conversion is started. If contention exists where this bit receives both a request to set and a request to clear on the same cycle, regardless of the source of either, this bit will be set and the request to clear will be ignored. In this case the overflow bit in the ADCSOCOVF1 register will not be affected regardless of whether this bit was previously set or not.</p> <p>Reset type: SYSRSn</p>
10	SOC10	R	0h	<p>SOC10 Start of Conversion Flag. Indicates the state of SOC10 conversions.</p> <p>0 No sample pending for SOC10. 1 Trigger has been received and sample is pending for SOC10.</p> <p>This bit will be automatically cleared when the SOC10 conversion is started. If contention exists where this bit receives both a request to set and a request to clear on the same cycle, regardless of the source of either, this bit will be set and the request to clear will be ignored. In this case the overflow bit in the ADCSOCOVF1 register will not be affected regardless of whether this bit was previously set or not.</p> <p>Reset type: SYSRSn</p>
9	SOC9	R	0h	<p>SOC9 Start of Conversion Flag. Indicates the state of SOC9 conversions.</p> <p>0 No sample pending for SOC9. 1 Trigger has been received and sample is pending for SOC9.</p> <p>This bit will be automatically cleared when the SOC9 conversion is started. If contention exists where this bit receives both a request to set and a request to clear on the same cycle, regardless of the source of either, this bit will be set and the request to clear will be ignored. In this case the overflow bit in the ADCSOCOVF1 register will not be affected regardless of whether this bit was previously set or not.</p> <p>Reset type: SYSRSn</p>

**Table 9-27. ADCSOCFLG1 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
8	SOC8	R	0h	<p>SOC8 Start of Conversion Flag. Indicates the state of SOC8 conversions.</p> <p>0 No sample pending for SOC8. 1 Trigger has been received and sample is pending for SOC8.</p> <p>This bit will be automatically cleared when the SOC8 conversion is started. If contention exists where this bit receives both a request to set and a request to clear on the same cycle, regardless of the source of either, this bit will be set and the request to clear will be ignored. In this case the overflow bit in the ADCSOCOVF1 register will not be affected regardless of whether this bit was previously set or not.</p> <p>Reset type: SYSRSn</p>
7	SOC7	R	0h	<p>SOC7 Start of Conversion Flag. Indicates the state of SOC7 conversions.</p> <p>0 No sample pending for SOC7. 1 Trigger has been received and sample is pending for SOC7.</p> <p>This bit will be automatically cleared when the SOC7 conversion is started. If contention exists where this bit receives both a request to set and a request to clear on the same cycle, regardless of the source of either, this bit will be set and the request to clear will be ignored. In this case the overflow bit in the ADCSOCOVF1 register will not be affected regardless of whether this bit was previously set or not.</p> <p>Reset type: SYSRSn</p>
6	SOC6	R	0h	<p>SOC6 Start of Conversion Flag. Indicates the state of SOC6 conversions.</p> <p>0 No sample pending for SOC6. 1 Trigger has been received and sample is pending for SOC6.</p> <p>This bit will be automatically cleared when the SOC6 conversion is started. If contention exists where this bit receives both a request to set and a request to clear on the same cycle, regardless of the source of either, this bit will be set and the request to clear will be ignored. In this case the overflow bit in the ADCSOCOVF1 register will not be affected regardless of whether this bit was previously set or not.</p> <p>Reset type: SYSRSn</p>
5	SOC5	R	0h	<p>SOC5 Start of Conversion Flag. Indicates the state of SOC5 conversions.</p> <p>0 No sample pending for SOC5. 1 Trigger has been received and sample is pending for SOC5.</p> <p>This bit will be automatically cleared when the SOC5 conversion is started. If contention exists where this bit receives both a request to set and a request to clear on the same cycle, regardless of the source of either, this bit will be set and the request to clear will be ignored. In this case the overflow bit in the ADCSOCOVF1 register will not be affected regardless of whether this bit was previously set or not.</p> <p>Reset type: SYSRSn</p>

**Table 9-27. ADCSOCFLG1 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
4	SOC4	R	0h	<p>SOC4 Start of Conversion Flag. Indicates the state of SOC4 conversions.</p> <p>0 No sample pending for SOC4. 1 Trigger has been received and sample is pending for SOC4.</p> <p>This bit will be automatically cleared when the SOC4 conversion is started. If contention exists where this bit receives both a request to set and a request to clear on the same cycle, regardless of the source of either, this bit will be set and the request to clear will be ignored. In this case the overflow bit in the ADCSOCOVF1 register will not be affected regardless of whether this bit was previously set or not.</p> <p>Reset type: SYSRSn</p>
3	SOC3	R	0h	<p>SOC3 Start of Conversion Flag. Indicates the state of SOC3 conversions.</p> <p>0 No sample pending for SOC3. 1 Trigger has been received and sample is pending for SOC3.</p> <p>This bit will be automatically cleared when the SOC3 conversion is started. If contention exists where this bit receives both a request to set and a request to clear on the same cycle, regardless of the source of either, this bit will be set and the request to clear will be ignored. In this case the overflow bit in the ADCSOCOVF1 register will not be affected regardless of whether this bit was previously set or not.</p> <p>Reset type: SYSRSn</p>
2	SOC2	R	0h	<p>SOC2 Start of Conversion Flag. Indicates the state of SOC2 conversions.</p> <p>0 No sample pending for SOC2. 1 Trigger has been received and sample is pending for SOC2.</p> <p>This bit will be automatically cleared when the SOC2 conversion is started. If contention exists where this bit receives both a request to set and a request to clear on the same cycle, regardless of the source of either, this bit will be set and the request to clear will be ignored. In this case the overflow bit in the ADCSOCOVF1 register will not be affected regardless of whether this bit was previously set or not.</p> <p>Reset type: SYSRSn</p>
1	SOC1	R	0h	<p>SOC1 Start of Conversion Flag. Indicates the state of SOC1 conversions.</p> <p>0 No sample pending for SOC1. 1 Trigger has been received and sample is pending for SOC1.</p> <p>This bit will be automatically cleared when the SOC1 conversion is started. If contention exists where this bit receives both a request to set and a request to clear on the same cycle, regardless of the source of either, this bit will be set and the request to clear will be ignored. In this case the overflow bit in the ADCSOCOVF1 register will not be affected regardless of whether this bit was previously set or not.</p> <p>Reset type: SYSRSn</p>

**Table 9-27. ADCSOCFLG1 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
0	SOC0	R	0h	<p>SOC0 Start of Conversion Flag. Indicates the state of SOC0 conversions.</p> <p>0 No sample pending for SOC0. 1 Trigger has been received and sample is pending for SOC0.</p> <p>This bit will be automatically cleared when the SOC0 conversion is started. If contention exists where this bit receives both a request to set and a request to clear on the same cycle, regardless of the source of either, this bit will be set and the request to clear will be ignored. In this case the overflow bit in the ADCSOCOVF1 register will not be affected regardless of whether this bit was previously set or not.</p> <p>Reset type: SYSRSn</p>



#### 9.4.2.14 ADCSOCFRC1 Register (Offset = Dh) [reset = 0h]

ADCSOCFRC1 is shown in [Figure 9-38](#) and described in [Table 9-28](#).

Return to [Summary Table](#).

ADC SOC Force 1 Register

**Figure 9-38. ADCSOCFRC1 Register**

15		14		13		12		11		10		9		8	
SOC15		SOC14		SOC13		SOC12		SOC11		SOC10		SOC9		SOC8	
R=0/W=1-0h		R=0/W=1-0h		R=0/W=1-0h		R=0/W=1-0h		R=0/W=1-0h		R=0/W=1-0h		R=0/W=1-0h		R=0/W=1-0h	
7		6		5		4		3		2		1		0	
SOC7		SOC6		SOC5		SOC4		SOC3		SOC2		SOC1		SOC0	
R=0/W=1-0h		R=0/W=1-0h		R=0/W=1-0h		R=0/W=1-0h		R=0/W=1-0h		R=0/W=1-0h		R=0/W=1-0h		R=0/W=1-0h	

**Table 9-28. ADCSOCFRC1 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15	SOC15	R=0/W=1	0h	<p>SOC15 Force Start of Conversion Bit. Writing a 1 will force to 1 the SOC15 flag in the ADCSOCFLG1 register. This can be used to initiate a software initiated conversion. Writes of 0 are ignored. This bit will always read as a 0.</p> <p>0 No action.</p> <p>1 Force SOC15 flag bit to 1. This will cause a conversion to start once priority is given to SOC15.</p> <p>If software tries to set this bit on the same clock cycle that hardware tries to clear the SOC15 bit in the ADCSOCFLG1 register, then software has priority and the ADCSOCFLG1 bit will be set. In this case the overflow bit in the ADCSOCOVF1 register will not be affected regardless of whether the ADCSOCFLG1 bit was previously set or not.</p> <p>Reset type: SYSRSn</p>
14	SOC14	R=0/W=1	0h	<p>SOC14 Force Start of Conversion Bit. Writing a 1 will force to 1 the SOC14 flag in the ADCSOCFLG1 register. This can be used to initiate a software initiated conversion. Writes of 0 are ignored. This bit will always read as a 0.</p> <p>0 No action.</p> <p>1 Force SOC14 flag bit to 1. This will cause a conversion to start once priority is given to SOC14.</p> <p>If software tries to set this bit on the same clock cycle that hardware tries to clear the SOC14 bit in the ADCSOCFLG1 register, then software has priority and the ADCSOCFLG1 bit will be set. In this case the overflow bit in the ADCSOCOVF1 register will not be affected regardless of whether the ADCSOCFLG1 bit was previously set or not.</p> <p>Reset type: SYSRSn</p>

**Table 9-28. ADCSOCFRC1 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
13	SOC13	R=0/W=1	0h	<p>SOC13 Force Start of Conversion Bit. Writing a 1 will force to 1 the SOC13 flag in the ADCSOCFLG1 register. This can be used to initiate a software initiated conversion. Writes of 0 are ignored. This bit will always read as a 0.</p> <p>0 No action.</p> <p>1 Force SOC13 flag bit to 1. This will cause a conversion to start once priority is given to SOC13.</p> <p>If software tries to set this bit on the same clock cycle that hardware tries to clear the SOC13 bit in the ADCSOCFLG1 register, then software has priority and the ADCSOCFLG1 bit will be set. In this case the overflow bit in the ADCSOCOVF1 register will not be affected regardless of whether the ADCSOCFLG1 bit was previously set or not.</p> <p>Reset type: SYSRSn</p>
12	SOC12	R=0/W=1	0h	<p>SOC12 Force Start of Conversion Bit. Writing a 1 will force to 1 the SOC12 flag in the ADCSOCFLG1 register. This can be used to initiate a software initiated conversion. Writes of 0 are ignored. This bit will always read as a 0.</p> <p>0 No action.</p> <p>1 Force SOC12 flag bit to 1. This will cause a conversion to start once priority is given to SOC12.</p> <p>If software tries to set this bit on the same clock cycle that hardware tries to clear the SOC12 bit in the ADCSOCFLG1 register, then software has priority and the ADCSOCFLG1 bit will be set. In this case the overflow bit in the ADCSOCOVF1 register will not be affected regardless of whether the ADCSOCFLG1 bit was previously set or not.</p> <p>Reset type: SYSRSn</p>
11	SOC11	R=0/W=1	0h	<p>SOC11 Force Start of Conversion Bit. Writing a 1 will force to 1 the SOC11 flag in the ADCSOCFLG1 register. This can be used to initiate a software initiated conversion. Writes of 0 are ignored. This bit will always read as a 0.</p> <p>0 No action.</p> <p>1 Force SOC11 flag bit to 1. This will cause a conversion to start once priority is given to SOC11.</p> <p>If software tries to set this bit on the same clock cycle that hardware tries to clear the SOC11 bit in the ADCSOCFLG1 register, then software has priority and the ADCSOCFLG1 bit will be set. In this case the overflow bit in the ADCSOCOVF1 register will not be affected regardless of whether the ADCSOCFLG1 bit was previously set or not.</p> <p>Reset type: SYSRSn</p>
10	SOC10	R=0/W=1	0h	<p>SOC10 Force Start of Conversion Bit. Writing a 1 will force to 1 the SOC10 flag in the ADCSOCFLG1 register. This can be used to initiate a software initiated conversion. Writes of 0 are ignored. This bit will always read as a 0.</p> <p>0 No action.</p> <p>1 Force SOC10 flag bit to 1. This will cause a conversion to start once priority is given to SOC10.</p> <p>If software tries to set this bit on the same clock cycle that hardware tries to clear the SOC10 bit in the ADCSOCFLG1 register, then software has priority and the ADCSOCFLG1 bit will be set. In this case the overflow bit in the ADCSOCOVF1 register will not be affected regardless of whether the ADCSOCFLG1 bit was previously set or not.</p> <p>Reset type: SYSRSn</p>

**Table 9-28. ADCSOCFRC1 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
9	SOC9	R=0/W=1	0h	<p>SOC9 Force Start of Conversion Bit. Writing a 1 will force to 1 the SOC9 flag in the ADCSOCFLG1 register. This can be used to initiate a software initiated conversion. Writes of 0 are ignored. This bit will always read as a 0.</p> <p>0 No action.</p> <p>1 Force SOC9 flag bit to 1. This will cause a conversion to start once priority is given to SOC9.</p> <p>If software tries to set this bit on the same clock cycle that hardware tries to clear the SOC9 bit in the ADCSOCFLG1 register, then software has priority and the ADCSOCFLG1 bit will be set. In this case the overflow bit in the ADCSOCOVF1 register will not be affected regardless of whether the ADCSOCFLG1 bit was previously set or not.</p> <p>Reset type: SYSRSn</p>
8	SOC8	R=0/W=1	0h	<p>SOC8 Force Start of Conversion Bit. Writing a 1 will force to 1 the SOC8 flag in the ADCSOCFLG1 register. This can be used to initiate a software initiated conversion. Writes of 0 are ignored. This bit will always read as a 0.</p> <p>0 No action.</p> <p>1 Force SOC8 flag bit to 1. This will cause a conversion to start once priority is given to SOC8.</p> <p>If software tries to set this bit on the same clock cycle that hardware tries to clear the SOC8 bit in the ADCSOCFLG1 register, then software has priority and the ADCSOCFLG1 bit will be set. In this case the overflow bit in the ADCSOCOVF1 register will not be affected regardless of whether the ADCSOCFLG1 bit was previously set or not.</p> <p>Reset type: SYSRSn</p>
7	SOC7	R=0/W=1	0h	<p>SOC7 Force Start of Conversion Bit. Writing a 1 will force to 1 the SOC7 flag in the ADCSOCFLG1 register. This can be used to initiate a software initiated conversion. Writes of 0 are ignored. This bit will always read as a 0.</p> <p>0 No action.</p> <p>1 Force SOC7 flag bit to 1. This will cause a conversion to start once priority is given to SOC7.</p> <p>If software tries to set this bit on the same clock cycle that hardware tries to clear the SOC7 bit in the ADCSOCFLG1 register, then software has priority and the ADCSOCFLG1 bit will be set. In this case the overflow bit in the ADCSOCOVF1 register will not be affected regardless of whether the ADCSOCFLG1 bit was previously set or not.</p> <p>Reset type: SYSRSn</p>
6	SOC6	R=0/W=1	0h	<p>SOC6 Force Start of Conversion Bit. Writing a 1 will force to 1 the SOC6 flag in the ADCSOCFLG1 register. This can be used to initiate a software initiated conversion. Writes of 0 are ignored. This bit will always read as a 0.</p> <p>0 No action.</p> <p>1 Force SOC6 flag bit to 1. This will cause a conversion to start once priority is given to SOC6.</p> <p>If software tries to set this bit on the same clock cycle that hardware tries to clear the SOC6 bit in the ADCSOCFLG1 register, then software has priority and the ADCSOCFLG1 bit will be set. In this case the overflow bit in the ADCSOCOVF1 register will not be affected regardless of whether the ADCSOCFLG1 bit was previously set or not.</p> <p>Reset type: SYSRSn</p>

**Table 9-28. ADCSOCFRC1 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
5	SOC5	R=0/W=1	0h	<p>SOC5 Force Start of Conversion Bit. Writing a 1 will force to 1 the SOC5 flag in the ADCSOCFLG1 register. This can be used to initiate a software initiated conversion. Writes of 0 are ignored. This bit will always read as a 0.</p> <p>0 No action.</p> <p>1 Force SOC5 flag bit to 1. This will cause a conversion to start once priority is given to SOC5.</p> <p>If software tries to set this bit on the same clock cycle that hardware tries to clear the SOC5 bit in the ADCSOCFLG1 register, then software has priority and the ADCSOCFLG1 bit will be set. In this case the overflow bit in the ADCSOCOVF1 register will not be affected regardless of whether the ADCSOCFLG1 bit was previously set or not.</p> <p>Reset type: SYSRSn</p>
4	SOC4	R=0/W=1	0h	<p>SOC4 Force Start of Conversion Bit. Writing a 1 will force to 1 the SOC4 flag in the ADCSOCFLG1 register. This can be used to initiate a software initiated conversion. Writes of 0 are ignored. This bit will always read as a 0.</p> <p>0 No action.</p> <p>1 Force SOC4 flag bit to 1. This will cause a conversion to start once priority is given to SOC4.</p> <p>If software tries to set this bit on the same clock cycle that hardware tries to clear the SOC4 bit in the ADCSOCFLG1 register, then software has priority and the ADCSOCFLG1 bit will be set. In this case the overflow bit in the ADCSOCOVF1 register will not be affected regardless of whether the ADCSOCFLG1 bit was previously set or not.</p> <p>Reset type: SYSRSn</p>
3	SOC3	R=0/W=1	0h	<p>SOC3 Force Start of Conversion Bit. Writing a 1 will force to 1 the SOC3 flag in the ADCSOCFLG1 register. This can be used to initiate a software initiated conversion. Writes of 0 are ignored. This bit will always read as a 0.</p> <p>0 No action.</p> <p>1 Force SOC3 flag bit to 1. This will cause a conversion to start once priority is given to SOC3.</p> <p>If software tries to set this bit on the same clock cycle that hardware tries to clear the SOC3 bit in the ADCSOCFLG1 register, then software has priority and the ADCSOCFLG1 bit will be set. In this case the overflow bit in the ADCSOCOVF1 register will not be affected regardless of whether the ADCSOCFLG1 bit was previously set or not.</p> <p>Reset type: SYSRSn</p>
2	SOC2	R=0/W=1	0h	<p>SOC2 Force Start of Conversion Bit. Writing a 1 will force to 1 the SOC2 flag in the ADCSOCFLG1 register. This can be used to initiate a software initiated conversion. Writes of 0 are ignored. This bit will always read as a 0.</p> <p>0 No action.</p> <p>1 Force SOC2 flag bit to 1. This will cause a conversion to start once priority is given to SOC2.</p> <p>If software tries to set this bit on the same clock cycle that hardware tries to clear the SOC2 bit in the ADCSOCFLG1 register, then software has priority and the ADCSOCFLG1 bit will be set. In this case the overflow bit in the ADCSOCOVF1 register will not be affected regardless of whether the ADCSOCFLG1 bit was previously set or not.</p> <p>Reset type: SYSRSn</p>

**Table 9-28. ADCSOCFRC1 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
1	SOC1	R=0/W=1	0h	<p>SOC1 Force Start of Conversion Bit. Writing a 1 will force to 1 the SOC1 flag in the ADCSOCFLG1 register. This can be used to initiate a software initiated conversion. Writes of 0 are ignored. This bit will always read as a 0.</p> <p>0 No action. 1 Force SOC1 flag bit to 1. This will cause a conversion to start once priority is given to SOC1.</p> <p>If software tries to set this bit on the same clock cycle that hardware tries to clear the SOC1 bit in the ADCSOCFLG1 register, then software has priority and the ADCSOCFLG1 bit will be set. In this case the overflow bit in the ADCSOCOVF1 register will not be affected regardless of whether the ADCSOCFLG1 bit was previously set or not.</p> <p>Reset type: SYSRSn</p>
0	SOC0	R=0/W=1	0h	<p>SOC0 Force Start of Conversion Bit. Writing a 1 will force to 1 the SOC0 flag in the ADCSOCFLG1 register. This can be used to initiate a software initiated conversion. Writes of 0 are ignored. This bit will always read as a 0.</p> <p>0 No action. 1 Force SOC0 flag bit to 1. This will cause a conversion to start once priority is given to SOC0.</p> <p>If software tries to set this bit on the same clock cycle that hardware tries to clear the SOC0 bit in the ADCSOCFLG1 register, then software has priority and the ADCSOCFLG1 bit will be set. In this case the overflow bit in the ADCSOCOVF1 register will not be affected regardless of whether the ADCSOCFLG1 bit was previously set or not.</p> <p>Reset type: SYSRSn</p>

### 9.4.2.15 ADCSOCOVF1 Register (Offset = Eh) [reset = 0h]

ADCSOCOVF1 is shown in [Figure 9-39](#) and described in [Table 9-29](#).

Return to [Summary Table](#).

ADC SOC Overflow 1 Register

**Figure 9-39. ADCSOCOVF1 Register**

15		14		13		12		11		10		9		8	
SOC15		SOC14		SOC13		SOC12		SOC11		SOC10		SOC9		SOC8	
R-0h		R-0h		R-0h		R-0h		R-0h		R-0h		R-0h		R-0h	
7		6		5		4		3		2		1		0	
SOC7		SOC6		SOC5		SOC4		SOC3		SOC2		SOC1		SOC0	
R-0h		R-0h		R-0h		R-0h		R-0h		R-0h		R-0h		R-0h	

**Table 9-29. ADCSOCOVF1 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15	SOC15	R	0h	<p>SOC15 Start of Conversion Overflow Flag. Indicates an SOC15 event was generated in hardware while an existing SOC15 event was already pending.</p> <p>0 No SOC15 event overflow. 1 SOC15 event overflow.</p> <p>An overflow condition does not stop SOC15 events from being processed. It simply is an indication that a hardware trigger was missed. A write to the ADCSOCFRC1 register does not affect this bit.</p> <p>Reset type: SYSRSn</p>
14	SOC14	R	0h	<p>SOC14 Start of Conversion Overflow Flag. Indicates an SOC14 event was generated in hardware while an existing SOC14 event was already pending.</p> <p>0 No SOC14 event overflow. 1 SOC14 event overflow.</p> <p>An overflow condition does not stop SOC14 events from being processed. It simply is an indication that a hardware trigger was missed. A write to the ADCSOCFRC1 register does not affect this bit.</p> <p>Reset type: SYSRSn</p>
13	SOC13	R	0h	<p>SOC13 Start of Conversion Overflow Flag. Indicates an SOC13 event was generated in hardware while an existing SOC13 event was already pending.</p> <p>0 No SOC13 event overflow. 1 SOC13 event overflow.</p> <p>An overflow condition does not stop SOC13 events from being processed. It simply is an indication that a hardware trigger was missed. A write to the ADCSOCFRC1 register does not affect this bit.</p> <p>Reset type: SYSRSn</p>

**Table 9-29. ADCSOCOVF1 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
12	SOC12	R	0h	<p>SOC12 Start of Conversion Overflow Flag. Indicates an SOC12 event was generated in hardware while an existing SOC12 event was already pending.</p> <p>0 No SOC12 event overflow. 1 SOC12 event overflow.</p> <p>An overflow condition does not stop SOC12 events from being processed. It simply is an indication that a hardware trigger was missed. A write to the ADCSOCFRC1 register does not affect this bit.</p> <p>Reset type: SYSRSn</p>
11	SOC11	R	0h	<p>SOC11 Start of Conversion Overflow Flag. Indicates an SOC11 event was generated in hardware while an existing SOC11 event was already pending.</p> <p>0 No SOC11 event overflow. 1 SOC11 event overflow.</p> <p>An overflow condition does not stop SOC11 events from being processed. It simply is an indication that a hardware trigger was missed. A write to the ADCSOCFRC1 register does not affect this bit.</p> <p>Reset type: SYSRSn</p>
10	SOC10	R	0h	<p>SOC10 Start of Conversion Overflow Flag. Indicates an SOC10 event was generated in hardware while an existing SOC10 event was already pending.</p> <p>0 No SOC10 event overflow. 1 SOC10 event overflow.</p> <p>An overflow condition does not stop SOC10 events from being processed. It simply is an indication that a hardware trigger was missed. A write to the ADCSOCFRC1 register does not affect this bit.</p> <p>Reset type: SYSRSn</p>
9	SOC9	R	0h	<p>SOC9 Start of Conversion Overflow Flag. Indicates an SOC9 event was generated in hardware while an existing SOC9 event was already pending.</p> <p>0 No SOC9 event overflow. 1 SOC9 event overflow.</p> <p>An overflow condition does not stop SOC9 events from being processed. It simply is an indication that a hardware trigger was missed. A write to the ADCSOCFRC1 register does not affect this bit.</p> <p>Reset type: SYSRSn</p>
8	SOC8	R	0h	<p>SOC8 Start of Conversion Overflow Flag. Indicates an SOC8 event was generated in hardware while an existing SOC8 event was already pending.</p> <p>0 No SOC8 event overflow. 1 SOC8 event overflow.</p> <p>An overflow condition does not stop SOC8 events from being processed. It simply is an indication that a hardware trigger was missed. A write to the ADCSOCFRC1 register does not affect this bit.</p> <p>Reset type: SYSRSn</p>

**Table 9-29. ADCSOCOVF1 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
7	SOC7	R	0h	<p>SOC7 Start of Conversion Overflow Flag. Indicates an SOC7 event was generated in hardware while an existing SOC7 event was already pending.</p> <p>0 No SOC7 event overflow. 1 SOC7 event overflow.</p> <p>An overflow condition does not stop SOC7 events from being processed. It simply is an indication that a hardware trigger was missed. A write to the ADCSOCFRC1 register does not affect this bit.</p> <p>Reset type: SYSRSn</p>
6	SOC6	R	0h	<p>SOC6 Start of Conversion Overflow Flag. Indicates an SOC6 event was generated in hardware while an existing SOC6 event was already pending.</p> <p>0 No SOC6 event overflow. 1 SOC6 event overflow.</p> <p>An overflow condition does not stop SOC6 events from being processed. It simply is an indication that a hardware trigger was missed. A write to the ADCSOCFRC1 register does not affect this bit.</p> <p>Reset type: SYSRSn</p>
5	SOC5	R	0h	<p>SOC5 Start of Conversion Overflow Flag. Indicates an SOC5 event was generated in hardware while an existing SOC5 event was already pending.</p> <p>0 No SOC5 event overflow. 1 SOC5 event overflow.</p> <p>An overflow condition does not stop SOC5 events from being processed. It simply is an indication that a hardware trigger was missed. A write to the ADCSOCFRC1 register does not affect this bit.</p> <p>Reset type: SYSRSn</p>
4	SOC4	R	0h	<p>SOC4 Start of Conversion Overflow Flag. Indicates an SOC4 event was generated in hardware while an existing SOC4 event was already pending.</p> <p>0 No SOC4 event overflow. 1 SOC4 event overflow.</p> <p>An overflow condition does not stop SOC4 events from being processed. It simply is an indication that a hardware trigger was missed. A write to the ADCSOCFRC1 register does not affect this bit.</p> <p>Reset type: SYSRSn</p>
3	SOC3	R	0h	<p>SOC3 Start of Conversion Overflow Flag. Indicates an SOC3 event was generated in hardware while an existing SOC3 event was already pending.</p> <p>0 No SOC3 event overflow. 1 SOC3 event overflow.</p> <p>An overflow condition does not stop SOC3 events from being processed. It simply is an indication that a hardware trigger was missed. A write to the ADCSOCFRC1 register does not affect this bit.</p> <p>Reset type: SYSRSn</p>



**Table 9-29. ADCSOCOVF1 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
2	SOC2	R	0h	<p>SOC2 Start of Conversion Overflow Flag. Indicates an SOC2 event was generated in hardware while an existing SOC2 event was already pending.</p> <p>0 No SOC2 event overflow. 1 SOC2 event overflow.</p> <p>An overflow condition does not stop SOC2 events from being processed. It simply is an indication that a hardware trigger was missed. A write to the ADCSOCFRC1 register does not affect this bit.</p> <p>Reset type: SYSRSn</p>
1	SOC1	R	0h	<p>SOC1 Start of Conversion Overflow Flag. Indicates an SOC1 event was generated in hardware while an existing SOC1 event was already pending.</p> <p>0 No SOC1 event overflow. 1 SOC1 event overflow.</p> <p>An overflow condition does not stop SOC1 events from being processed. It simply is an indication that a hardware trigger was missed. A write to the ADCSOCFRC1 register does not affect this bit.</p> <p>Reset type: SYSRSn</p>
0	SOC0	R	0h	<p>SOC0 Start of Conversion Overflow Flag. Indicates an SOC0 event was generated in hardware while an existing SOC0 event was already pending.</p> <p>0 No SOC0 event overflow. 1 SOC0 event overflow.</p> <p>An overflow condition does not stop SOC0 events from being processed. It simply is an indication that a hardware trigger was missed. A write to the ADCSOCFRC1 register does not affect this bit.</p> <p>Reset type: SYSRSn</p>

### 9.4.2.16 ADCSOCOVFCLR1 Register (Offset = Fh) [reset = 0h]

ADCSOCOVFCLR1 is shown in [Figure 9-40](#) and described in [Table 9-30](#).

Return to [Summary Table](#).

ADC SOC Overflow Clear 1 Register

**Figure 9-40. ADCSOCOVFCLR1 Register**

15		14		13		12		11		10		9		8	
SOC15		SOC14		SOC13		SOC12		SOC11		SOC10		SOC9		SOC8	
R=0/W=1-0h		R=0/W=1-0h		R=0/W=1-0h		R=0/W=1-0h		R=0/W=1-0h		R=0/W=1-0h		R=0/W=1-0h		R=0/W=1-0h	
7		6		5		4		3		2		1		0	
SOC7		SOC6		SOC5		SOC4		SOC3		SOC2		SOC1		SOC0	
R=0/W=1-0h		R=0/W=1-0h		R=0/W=1-0h		R=0/W=1-0h		R=0/W=1-0h		R=0/W=1-0h		R=0/W=1-0h		R=0/W=1-0h	

**Table 9-30. ADCSOCOVFCLR1 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15	SOC15	R=0/W=1	0h	<p>SOC15 Clear Start of Conversion Overflow Bit. Writing a 1 will clear the SOC15 overflow flag in the ADCSOCOVF1 register. Writes of 0 are ignored. Reads will always return a 0.</p> <p>0 No action. 1 Clear SOC15 overflow flag.</p> <p>If software tries to set this bit on the same clock cycle that hardware tries to set the overflow bit in the ADCSOCOVF1 register, then hardware has priority and the ADCSOCOVF1 bit will be set..</p> <p>Reset type: SYSRSn</p>
14	SOC14	R=0/W=1	0h	<p>SOC14 Clear Start of Conversion Overflow Bit. Writing a 1 will clear the SOC14 overflow flag in the ADCSOCOVF1 register. Writes of 0 are ignored. Reads will always return a 0.</p> <p>0 No action. 1 Clear SOC14 overflow flag.</p> <p>If software tries to set this bit on the same clock cycle that hardware tries to set the overflow bit in the ADCSOCOVF1 register, then hardware has priority and the ADCSOCOVF1 bit will be set..</p> <p>Reset type: SYSRSn</p>
13	SOC13	R=0/W=1	0h	<p>SOC13 Clear Start of Conversion Overflow Bit. Writing a 1 will clear the SOC13 overflow flag in the ADCSOCOVF1 register. Writes of 0 are ignored. Reads will always return a 0.</p> <p>0 No action. 1 Clear SOC13 overflow flag.</p> <p>If software tries to set this bit on the same clock cycle that hardware tries to set the overflow bit in the ADCSOCOVF1 register, then hardware has priority and the ADCSOCOVF1 bit will be set..</p> <p>Reset type: SYSRSn</p>
12	SOC12	R=0/W=1	0h	<p>SOC12 Clear Start of Conversion Overflow Bit. Writing a 1 will clear the SOC12 overflow flag in the ADCSOCOVF1 register. Writes of 0 are ignored. Reads will always return a 0.</p> <p>0 No action. 1 Clear SOC12 overflow flag.</p> <p>If software tries to set this bit on the same clock cycle that hardware tries to set the overflow bit in the ADCSOCOVF1 register, then hardware has priority and the ADCSOCOVF1 bit will be set..</p> <p>Reset type: SYSRSn</p>

**Table 9-30. ADCSOCOVFCLR1 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
11	SOC11	R=0/W=1	0h	<p>SOC11 Clear Start of Conversion Overflow Bit. Writing a 1 will clear the SOC11 overflow flag in the ADCSOCOVF1 register. Writes of 0 are ignored. Reads will always return a 0.</p> <p>0 No action. 1 Clear SOC11 overflow flag.</p> <p>If software tries to set this bit on the same clock cycle that hardware tries to set the overflow bit in the ADCSOCOVF1 register, then hardware has priority and the ADCSOCOVF1 bit will be set..</p> <p>Reset type: SYSRSn</p>
10	SOC10	R=0/W=1	0h	<p>SOC10 Clear Start of Conversion Overflow Bit. Writing a 1 will clear the SOC10 overflow flag in the ADCSOCOVF1 register. Writes of 0 are ignored. Reads will always return a 0.</p> <p>0 No action. 1 Clear SOC10 overflow flag.</p> <p>If software tries to set this bit on the same clock cycle that hardware tries to set the overflow bit in the ADCSOCOVF1 register, then hardware has priority and the ADCSOCOVF1 bit will be set..</p> <p>Reset type: SYSRSn</p>
9	SOC9	R=0/W=1	0h	<p>SOC9 Clear Start of Conversion Overflow Bit. Writing a 1 will clear the SOC9 overflow flag in the ADCSOCOVF1 register. Writes of 0 are ignored. Reads will always return a 0.</p> <p>0 No action. 1 Clear SOC9 overflow flag.</p> <p>If software tries to set this bit on the same clock cycle that hardware tries to set the overflow bit in the ADCSOCOVF1 register, then hardware has priority and the ADCSOCOVF1 bit will be set..</p> <p>Reset type: SYSRSn</p>
8	SOC8	R=0/W=1	0h	<p>SOC8 Clear Start of Conversion Overflow Bit. Writing a 1 will clear the SOC8 overflow flag in the ADCSOCOVF1 register. Writes of 0 are ignored. Reads will always return a 0.</p> <p>0 No action. 1 Clear SOC8 overflow flag.</p> <p>If software tries to set this bit on the same clock cycle that hardware tries to set the overflow bit in the ADCSOCOVF1 register, then hardware has priority and the ADCSOCOVF1 bit will be set..</p> <p>Reset type: SYSRSn</p>
7	SOC7	R=0/W=1	0h	<p>SOC7 Clear Start of Conversion Overflow Bit. Writing a 1 will clear the SOC7 overflow flag in the ADCSOCOVF1 register. Writes of 0 are ignored. Reads will always return a 0.</p> <p>0 No action. 1 Clear SOC7 overflow flag.</p> <p>If software tries to set this bit on the same clock cycle that hardware tries to set the overflow bit in the ADCSOCOVF1 register, then hardware has priority and the ADCSOCOVF1 bit will be set..</p> <p>Reset type: SYSRSn</p>

**Table 9-30. ADCSOCOVFCLR1 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
6	SOC6	R=0/W=1	0h	<p>SOC6 Clear Start of Conversion Overflow Bit. Writing a 1 will clear the SOC6 overflow flag in the ADCSOCOVF1 register. Writes of 0 are ignored. Reads will always return a 0.</p> <p>0 No action. 1 Clear SOC6 overflow flag.</p> <p>If software tries to set this bit on the same clock cycle that hardware tries to set the overflow bit in the ADCSOCOVF1 register, then hardware has priority and the ADCSOCOVF1 bit will be set..</p> <p>Reset type: SYSRSn</p>
5	SOC5	R=0/W=1	0h	<p>SOC5 Clear Start of Conversion Overflow Bit. Writing a 1 will clear the SOC5 overflow flag in the ADCSOCOVF1 register. Writes of 0 are ignored. Reads will always return a 0.</p> <p>0 No action. 1 Clear SOC5 overflow flag.</p> <p>If software tries to set this bit on the same clock cycle that hardware tries to set the overflow bit in the ADCSOCOVF1 register, then hardware has priority and the ADCSOCOVF1 bit will be set..</p> <p>Reset type: SYSRSn</p>
4	SOC4	R=0/W=1	0h	<p>SOC4 Clear Start of Conversion Overflow Bit. Writing a 1 will clear the SOC4 overflow flag in the ADCSOCOVF1 register. Writes of 0 are ignored. Reads will always return a 0.</p> <p>0 No action. 1 Clear SOC4 overflow flag.</p> <p>If software tries to set this bit on the same clock cycle that hardware tries to set the overflow bit in the ADCSOCOVF1 register, then hardware has priority and the ADCSOCOVF1 bit will be set..</p> <p>Reset type: SYSRSn</p>
3	SOC3	R=0/W=1	0h	<p>SOC3 Clear Start of Conversion Overflow Bit. Writing a 1 will clear the SOC3 overflow flag in the ADCSOCOVF1 register. Writes of 0 are ignored. Reads will always return a 0.</p> <p>0 No action. 1 Clear SOC3 overflow flag.</p> <p>If software tries to set this bit on the same clock cycle that hardware tries to set the overflow bit in the ADCSOCOVF1 register, then hardware has priority and the ADCSOCOVF1 bit will be set..</p> <p>Reset type: SYSRSn</p>
2	SOC2	R=0/W=1	0h	<p>SOC2 Clear Start of Conversion Overflow Bit. Writing a 1 will clear the SOC2 overflow flag in the ADCSOCOVF1 register. Writes of 0 are ignored. Reads will always return a 0.</p> <p>0 No action. 1 Clear SOC2 overflow flag.</p> <p>If software tries to set this bit on the same clock cycle that hardware tries to set the overflow bit in the ADCSOCOVF1 register, then hardware has priority and the ADCSOCOVF1 bit will be set..</p> <p>Reset type: SYSRSn</p>

**Table 9-30. ADCSOCOVFCLR1 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
1	SOC1	R=0/W=1	0h	<p>SOC1 Clear Start of Conversion Overflow Bit. Writing a 1 will clear the SOC1 overflow flag in the ADCSOCOVF1 register. Writes of 0 are ignored. Reads will always return a 0.</p> <p>0 No action. 1 Clear SOC1 overflow flag.</p> <p>If software tries to set this bit on the same clock cycle that hardware tries to set the overflow bit in the ADCSOCOVF1 register, then hardware has priority and the ADCSOCOVF1 bit will be set..</p> <p>Reset type: SYSRSn</p>
0	SOC0	R=0/W=1	0h	<p>SOC0 Clear Start of Conversion Overflow Bit. Writing a 1 will clear the SOC0 overflow flag in the ADCSOCOVF1 register. Writes of 0 are ignored. Reads will always return a 0.</p> <p>0 No action. 1 Clear SOC0 overflow flag.</p> <p>If software tries to set this bit on the same clock cycle that hardware tries to set the overflow bit in the ADCSOCOVF1 register, then hardware has priority and the ADCSOCOVF1 bit will be set..</p> <p>Reset type: SYSRSn</p>

**9.4.2.17 ADCSOC0CTL\_1 Register (Offset = 10h) [reset = 0h]**

ADCSOC0CTL\_1 is shown in [Figure 9-41](#) and described in [Table 9-31](#).

Return to [Summary Table](#).

ADC SOC0 Control Register

**Figure 9-41. ADCSOC0CTL\_1 Register**

31	30	29	28	27	26	25	24
RESERVED							TRIGSEL
R-0h							R/W-0h
23	22	21	20	19	18	17	16
TRIGSEL				RESERVED	CHSEL		
R/W-0h				R-0h	R/W-0h		
15	14	13	12	11	10	9	8
CHSEL	RESERVED						ACQPS
R/W-0h	R-0h						R/W-0h
7	6	5	4	3	2	1	0
ACQPS							
R/W-0h							

**Table 9-31. ADCSOC0CTL\_1 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-25	RESERVED	R	0h	Reserved

**Table 9-31. ADCSOC0CTL\_1 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
24-20	TRIGSEL	R/W	0h	<p>SOC0 Trigger Source Select. Along with the SOC0 field in the ADCINTSOCSEL1 register, this bit field configures which trigger will set the SOC0 flag in the ADCSOCFLG1 register to initiate a conversion to start once priority is given to it.</p> <p>00h ADCTRIG0 - Software only            01h ADCTRIG1 - CPU1 Timer 0, TINT0n            02h ADCTRIG2 - CPU1 Timer 1, TINT1n            03h ADCTRIG3 - CPU1 Timer 2, TINT2n            04h ADCTRIG4 - GPIO, ADCEXTSOC            05h ADCTRIG5 - ePWM1, ADCSOCA            06h ADCTRIG6 - ePWM1, ADCSOCA            07h ADCTRIG7 - ePWM2, ADCSOCA            08h ADCTRIG8 - ePWM2, ADCSOCA            09h ADCTRIG9 - ePWM3, ADCSOCA            0Ah ADCTRIG10 - ePWM3, ADCSOCA            0Bh ADCTRIG11 - ePWM4, ADCSOCA            0Ch ADCTRIG12 - ePWM4, ADCSOCA            0Dh ADCTRIG13 - ePWM5, ADCSOCA            0Eh ADCTRIG14 - ePWM5, ADCSOCA            0Fh ADCTRIG15 - ePWM6, ADCSOCA            10h ADCTRIG16 - ePWM6, ADCSOCA            11h ADCTRIG17 - ePWM7, ADCSOCA            12h ADCTRIG18 - ePWM7, ADCSOCA            13h ADCTRIG19 - ePWM8, ADCSOCA            14h ADCTRIG20 - ePWM8, ADCSOCA            15h ADCTRIG21 - ePWM9, ADCSOCA            16h ADCTRIG22 - ePWM9, ADCSOCA            17h ADCTRIG23 - ePWM10, ADCSOCA            18h ADCTRIG24 - ePWM10, ADCSOCA            19h ADCTRIG25 - ePWM11, ADCSOCA            1Ah ADCTRIG26 - ePWM11, ADCSOCA            1Bh ADCTRIG27 - ePWM12, ADCSOCA            1Ch ADCTRIG28 - ePWM12, ADCSOCA            1Dh - 1Fh - Reserved</p> <p>Reset type: SYSRSn</p>
19	RESERVED	R	0h	Reserved

**Table 9-31. ADCSOC0CTL\_1 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
18-15	CHSEL	R/W	0h	<p>SOC0 Channel Select. Selects the channel to be converted when SOC0 is received by the ADC.</p> <p>Single-ended Signaling Mode (SIGNALMODE = 0):</p> <p>0h ADCIN0 1h ADCIN1 2h ADCIN2 3h ADCIN3 4h ADCIN4 5h ADCIN5 6h ADCIN6 7h ADCIN7 8h ADCIN8 9h ADCIN9 Ah ADCIN10 Bh ADCIN11 Ch ADCIN12 Dh ADCIN13 Eh ADCIN14 Fh ADCIN15</p> <p>Differential Signaling Mode (SIGNALMODE = 1):</p> <p>0h ADCIN0 (non-inverting) and ADCIN1 (inverting) 1h ADCIN0 (non-inverting) and ADCIN1 (inverting) 2h ADCIN2 (non-inverting) and ADCIN3 (inverting) 3h ADCIN2 (non-inverting) and ADCIN3 (inverting) 4h ADCIN4 (non-inverting) and ADCIN5 (inverting) 5h ADCIN4 (non-inverting) and ADCIN5 (inverting) 6h ADCIN6 (non-inverting) and ADCIN7 (inverting) 7h ADCIN6 (non-inverting) and ADCIN7 (inverting) 8h ADCIN8 (non-inverting) and ADCIN9 (inverting) 9h ADCIN8 (non-inverting) and ADCIN9 (inverting) Ah ADCIN10 (non-inverting) and ADCIN11 (inverting) Bh ADCIN10 (non-inverting) and ADCIN11 (inverting) Ch ADCIN12 (non-inverting) and ADCIN13 (inverting) Dh ADCIN12 (non-inverting) and ADCIN13 (inverting) Eh ADCIN14 (non-inverting) and ADCIN15 (inverting) Fh ADCIN14 (non-inverting) and ADCIN15 (inverting) Reset type: SYSRSn</p>
14-9	RESERVED	R	0h	Reserved
8-0	ACQPS	R/W	0h	<p>SOC0 Acquisition Prescale. Controls the sample and hold window for this SOC. The configured acquisition time must be at least as long as one ADCCLK cycle for correct ADC operation. The device datasheet will also specify a minimum sample and hold window duration.</p> <p>000h Sample window is 1 system clock cycle wide 001h Sample window is 2 system clock cycles wide 002h Sample window is 3 system clock cycles wide ... 1FFh Sample window is 512 system clock cycles wide Reset type: SYSRSn</p>



**9.4.2.18 ADCSOC1CTL\_1 Register (Offset = 12h) [reset = 0h]**

ADCSOC1CTL\_1 is shown in [Figure 9-42](#) and described in [Table 9-32](#).

Return to [Summary Table](#).

ADC SOC1 Control Register

**Figure 9-42. ADCSOC1CTL\_1 Register**

31	30	29	28	27	26	25	24
RESERVED							TRIGSEL
R-0h							R/W-0h
23	22	21	20	19	18	17	16
TRIGSEL				RESERVED	CHSEL		
R/W-0h				R-0h	R/W-0h		
15	14	13	12	11	10	9	8
CHSEL	RESERVED						ACQPS
R/W-0h	R-0h						R/W-0h
7	6	5	4	3	2	1	0
ACQPS							
R/W-0h							

**Table 9-32. ADCSOC1CTL\_1 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-25	RESERVED	R	0h	Reserved

**Table 9-32. ADCSOC1CTL\_1 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
24-20	TRIGSEL	R/W	0h	<p>SOC1 Trigger Source Select. Along with the SOC1 field in the ADCINTSOCSEL1 register, this bit field configures which trigger will set the SOC1 flag in the ADCSOCFLG1 register to initiate a conversion to start once priority is given to it.</p> <p>00h ADCTRIG0 - Software only            01h ADCTRIG1 - CPU1 Timer 0, TINT0n            02h ADCTRIG2 - CPU1 Timer 1, TINT1n            03h ADCTRIG3 - CPU1 Timer 2, TINT2n            04h ADCTRIG4 - GPIO, ADCEXTSOC            05h ADCTRIG5 - ePWM1, ADCSOCA            06h ADCTRIG6 - ePWM1, ADCSOCA            07h ADCTRIG7 - ePWM2, ADCSOCA            08h ADCTRIG8 - ePWM2, ADCSOCA            09h ADCTRIG9 - ePWM3, ADCSOCA            0Ah ADCTRIG10 - ePWM3, ADCSOCA            0Bh ADCTRIG11 - ePWM4, ADCSOCA            0Ch ADCTRIG12 - ePWM4, ADCSOCA            0Dh ADCTRIG13 - ePWM5, ADCSOCA            0Eh ADCTRIG14 - ePWM5, ADCSOCA            0Fh ADCTRIG15 - ePWM6, ADCSOCA            10h ADCTRIG16 - ePWM6, ADCSOCA            11h ADCTRIG17 - ePWM7, ADCSOCA            12h ADCTRIG18 - ePWM7, ADCSOCA            13h ADCTRIG19 - ePWM8, ADCSOCA            14h ADCTRIG20 - ePWM8, ADCSOCA            15h ADCTRIG21 - ePWM9, ADCSOCA            16h ADCTRIG22 - ePWM9, ADCSOCA            17h ADCTRIG23 - ePWM10, ADCSOCA            18h ADCTRIG24 - ePWM10, ADCSOCA            19h ADCTRIG25 - ePWM11, ADCSOCA            1Ah ADCTRIG26 - ePWM11, ADCSOCA            1Bh ADCTRIG27 - ePWM12, ADCSOCA            1Ch ADCTRIG28 - ePWM12, ADCSOCA            1Dh - 1Fh - Reserved</p> <p>Reset type: SYSRSn</p>
19	RESERVED	R	0h	Reserved

**Table 9-32. ADCSOC1CTL\_1 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
18-15	CHSEL	R/W	0h	<p>SOC1 Channel Select. Selects the channel to be converted when SOC1 is received by the ADC.</p> <p>Single-ended Signaling Mode (SIGNALMODE = 0):</p> <p>0h ADCIN0 1h ADCIN1 2h ADCIN2 3h ADCIN3 4h ADCIN4 5h ADCIN5 6h ADCIN6 7h ADCIN7 8h ADCIN8 9h ADCIN9 Ah ADCIN10 Bh ADCIN11 Ch ADCIN12 Dh ADCIN13 Eh ADCIN14 Fh ADCIN15</p> <p>Differential Signaling Mode (SIGNALMODE = 1):</p> <p>0h ADCIN0 (non-inverting) and ADCIN1 (inverting) 1h ADCIN0 (non-inverting) and ADCIN1 (inverting) 2h ADCIN2 (non-inverting) and ADCIN3 (inverting) 3h ADCIN2 (non-inverting) and ADCIN3 (inverting) 4h ADCIN4 (non-inverting) and ADCIN5 (inverting) 5h ADCIN4 (non-inverting) and ADCIN5 (inverting) 6h ADCIN6 (non-inverting) and ADCIN7 (inverting) 7h ADCIN6 (non-inverting) and ADCIN7 (inverting) 8h ADCIN8 (non-inverting) and ADCIN9 (inverting) 9h ADCIN8 (non-inverting) and ADCIN9 (inverting) Ah ADCIN10 (non-inverting) and ADCIN11 (inverting) Bh ADCIN10 (non-inverting) and ADCIN11 (inverting) Ch ADCIN12 (non-inverting) and ADCIN13 (inverting) Dh ADCIN12 (non-inverting) and ADCIN13 (inverting) Eh ADCIN14 (non-inverting) and ADCIN15 (inverting) Fh ADCIN14 (non-inverting) and ADCIN15 (inverting) Reset type: SYSRSn</p>
14-9	RESERVED	R	0h	Reserved
8-0	ACQPS	R/W	0h	<p>SOC1 Acquisition Prescale. Controls the sample and hold window for this SOC. The configured acquisition time must be at least as long as one ADCCLK cycle for correct ADC operation. The device datasheet will also specify a minimum sample and hold window duration.</p> <p>000h Sample window is 1 system clock cycle wide 001h Sample window is 2 system clock cycles wide 002h Sample window is 3 system clock cycles wide ... 1FFh Sample window is 512 system clock cycles wide Reset type: SYSRSn</p>

**9.4.2.19 ADCSOC2CTL\_1 Register (Offset = 14h) [reset = 0h]**

ADCSOC2CTL\_1 is shown in [Figure 9-43](#) and described in [Table 9-33](#).

Return to [Summary Table](#).

ADC SOC2 Control Register

**Figure 9-43. ADCSOC2CTL\_1 Register**

31	30	29	28	27	26	25	24
RESERVED							TRIGSEL
R-0h							R/W-0h
23	22	21	20	19	18	17	16
TRIGSEL				RESERVED	CHSEL		
R/W-0h				R-0h	R/W-0h		
15	14	13	12	11	10	9	8
CHSEL	RESERVED						ACQPS
R/W-0h	R-0h						R/W-0h
7	6	5	4	3	2	1	0
ACQPS							
R/W-0h							

**Table 9-33. ADCSOC2CTL\_1 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-25	RESERVED	R	0h	Reserved

**Table 9-33. ADCSOC2CTL\_1 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
24-20	TRIGSEL	R/W	0h	<p>SOC2 Trigger Source Select. Along with the SOC2 field in the ADCINTSOCSEL1 register, this bit field configures which trigger will set the SOC2 flag in the ADCSOCFLG1 register to initiate a conversion to start once priority is given to it.</p> <p>00h ADCTRIG0 - Software only  01h ADCTRIG1 - CPU1 Timer 0, TINT0n  02h ADCTRIG2 - CPU1 Timer 1, TINT1n  03h ADCTRIG3 - CPU1 Timer 2, TINT2n  04h ADCTRIG4 - GPIO, ADCEXTSOC  05h ADCTRIG5 - ePWM1, ADCSOCA  06h ADCTRIG6 - ePWM1, ADCSOCA  07h ADCTRIG7 - ePWM2, ADCSOCA  08h ADCTRIG8 - ePWM2, ADCSOCA  09h ADCTRIG9 - ePWM3, ADCSOCA  0Ah ADCTRIG10 - ePWM3, ADCSOCA  0Bh ADCTRIG11 - ePWM4, ADCSOCA  0Ch ADCTRIG12 - ePWM4, ADCSOCA  0Dh ADCTRIG13 - ePWM5, ADCSOCA  0Eh ADCTRIG14 - ePWM5, ADCSOCA  0Fh ADCTRIG15 - ePWM6, ADCSOCA  10h ADCTRIG16 - ePWM6, ADCSOCA  11h ADCTRIG17 - ePWM7, ADCSOCA  12h ADCTRIG18 - ePWM7, ADCSOCA  13h ADCTRIG19 - ePWM8, ADCSOCA  14h ADCTRIG20 - ePWM8, ADCSOCA  15h ADCTRIG21 - ePWM9, ADCSOCA  16h ADCTRIG22 - ePWM9, ADCSOCA  17h ADCTRIG23 - ePWM10, ADCSOCA  18h ADCTRIG24 - ePWM10, ADCSOCA  19h ADCTRIG25 - ePWM11, ADCSOCA  1Ah ADCTRIG26 - ePWM11, ADCSOCA  1Bh ADCTRIG27 - ePWM12, ADCSOCA  1Ch ADCTRIG28 - ePWM12, ADCSOCA  1Dh - 1Fh - Reserved  Reset type: SYSRSn</p>
19	RESERVED	R	0h	Reserved

**Table 9-33. ADCSOC2CTL\_1 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
18-15	CHSEL	R/W	0h	<p>SOC2 Channel Select. Selects the channel to be converted when SOC2 is received by the ADC.</p> <p>Single-ended Signaling Mode (SIGNALMODE = 0):</p> <p>0h ADCIN0 1h ADCIN1 2h ADCIN2 3h ADCIN3 4h ADCIN4 5h ADCIN5 6h ADCIN6 7h ADCIN7 8h ADCIN8 9h ADCIN9 Ah ADCIN10 Bh ADCIN11 Ch ADCIN12 Dh ADCIN13 Eh ADCIN14 Fh ADCIN15</p> <p>Differential Signaling Mode (SIGNALMODE = 1):</p> <p>0h ADCIN0 (non-inverting) and ADCIN1 (inverting) 1h ADCIN0 (non-inverting) and ADCIN1 (inverting) 2h ADCIN2 (non-inverting) and ADCIN3 (inverting) 3h ADCIN2 (non-inverting) and ADCIN3 (inverting) 4h ADCIN4 (non-inverting) and ADCIN5 (inverting) 5h ADCIN4 (non-inverting) and ADCIN5 (inverting) 6h ADCIN6 (non-inverting) and ADCIN7 (inverting) 7h ADCIN6 (non-inverting) and ADCIN7 (inverting) 8h ADCIN8 (non-inverting) and ADCIN9 (inverting) 9h ADCIN8 (non-inverting) and ADCIN9 (inverting) Ah ADCIN10 (non-inverting) and ADCIN11 (inverting) Bh ADCIN10 (non-inverting) and ADCIN11 (inverting) Ch ADCIN12 (non-inverting) and ADCIN13 (inverting) Dh ADCIN12 (non-inverting) and ADCIN13 (inverting) Eh ADCIN14 (non-inverting) and ADCIN15 (inverting) Fh ADCIN14 (non-inverting) and ADCIN15 (inverting)</p> <p>Reset type: SYSRSn</p>
14-9	RESERVED	R	0h	Reserved
8-0	ACQPS	R/W	0h	<p>SOC2 Acquisition Prescale. Controls the sample and hold window for this SOC. The configured acquisition time must be at least as long as one ADCCLK cycle for correct ADC operation. The device datasheet will also specify a minimum sample and hold window duration.</p> <p>000h Sample window is 1 system clock cycle wide 001h Sample window is 2 system clock cycles wide 002h Sample window is 3 system clock cycles wide ... 1FFh Sample window is 512 system clock cycles wide</p> <p>Reset type: SYSRSn</p>

**9.4.2.20 ADCSOC3CTL\_1 Register (Offset = 16h) [reset = 0h]**

ADCSOC3CTL\_1 is shown in [Figure 9-44](#) and described in [Table 9-34](#).

Return to [Summary Table](#).

ADC SOC3 Control Register

**Figure 9-44. ADCSOC3CTL\_1 Register**

31	30	29	28	27	26	25	24
RESERVED							TRIGSEL
R-0h							R/W-0h
23	22	21	20	19	18	17	16
TRIGSEL				RESERVED	CHSEL		
R/W-0h				R-0h	R/W-0h		
15	14	13	12	11	10	9	8
CHSEL	RESERVED						ACQPS
R/W-0h	R-0h						R/W-0h
7	6	5	4	3	2	1	0
ACQPS							
R/W-0h							

**Table 9-34. ADCSOC3CTL\_1 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-25	RESERVED	R	0h	Reserved

**Table 9-34. ADCSOC3CTL\_1 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
24-20	TRIGSEL	R/W	0h	<p>SOC3 Trigger Source Select. Along with the SOC3 field in the ADCINTSOCSEL1 register, this bit field configures which trigger will set the SOC3 flag in the ADCSOCFLG1 register to initiate a conversion to start once priority is given to it.</p> <p>00h ADCTRIG0 - Software only            01h ADCTRIG1 - CPU1 Timer 0, TINT0n            02h ADCTRIG2 - CPU1 Timer 1, TINT1n            03h ADCTRIG3 - CPU1 Timer 2, TINT2n            04h ADCTRIG4 - GPIO, ADCEXTSOC            05h ADCTRIG5 - ePWM1, ADCSOCA            06h ADCTRIG6 - ePWM1, ADCSOCA            07h ADCTRIG7 - ePWM2, ADCSOCA            08h ADCTRIG8 - ePWM2, ADCSOCA            09h ADCTRIG9 - ePWM3, ADCSOCA            0Ah ADCTRIG10 - ePWM3, ADCSOCA            0Bh ADCTRIG11 - ePWM4, ADCSOCA            0Ch ADCTRIG12 - ePWM4, ADCSOCA            0Dh ADCTRIG13 - ePWM5, ADCSOCA            0Eh ADCTRIG14 - ePWM5, ADCSOCA            0Fh ADCTRIG15 - ePWM6, ADCSOCA            10h ADCTRIG16 - ePWM6, ADCSOCA            11h ADCTRIG17 - ePWM7, ADCSOCA            12h ADCTRIG18 - ePWM7, ADCSOCA            13h ADCTRIG19 - ePWM8, ADCSOCA            14h ADCTRIG20 - ePWM8, ADCSOCA            15h ADCTRIG21 - ePWM9, ADCSOCA            16h ADCTRIG22 - ePWM9, ADCSOCA            17h ADCTRIG23 - ePWM10, ADCSOCA            18h ADCTRIG24 - ePWM10, ADCSOCA            19h ADCTRIG25 - ePWM11, ADCSOCA            1Ah ADCTRIG26 - ePWM11, ADCSOCA            1Bh ADCTRIG27 - ePWM12, ADCSOCA            1Ch ADCTRIG28 - ePWM12, ADCSOCA            1Dh - 1Fh - Reserved</p> <p>Reset type: SYSRSn</p>
19	RESERVED	R	0h	Reserved



**Table 9-34. ADCSOC3CTL\_1 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
18-15	CHSEL	R/W	0h	<p>SOC3 Channel Select. Selects the channel to be converted when SOC3 is received by the ADC.</p> <p>Single-ended Signaling Mode (SIGNALMODE = 0):</p> <p>0h ADCIN0 1h ADCIN1 2h ADCIN2 3h ADCIN3 4h ADCIN4 5h ADCIN5 6h ADCIN6 7h ADCIN7 8h ADCIN8 9h ADCIN9 Ah ADCIN10 Bh ADCIN11 Ch ADCIN12 Dh ADCIN13 Eh ADCIN14 Fh ADCIN15</p> <p>Differential Signaling Mode (SIGNALMODE = 1):</p> <p>0h ADCIN0 (non-inverting) and ADCIN1 (inverting) 1h ADCIN0 (non-inverting) and ADCIN1 (inverting) 2h ADCIN2 (non-inverting) and ADCIN3 (inverting) 3h ADCIN2 (non-inverting) and ADCIN3 (inverting) 4h ADCIN4 (non-inverting) and ADCIN5 (inverting) 5h ADCIN4 (non-inverting) and ADCIN5 (inverting) 6h ADCIN6 (non-inverting) and ADCIN7 (inverting) 7h ADCIN6 (non-inverting) and ADCIN7 (inverting) 8h ADCIN8 (non-inverting) and ADCIN9 (inverting) 9h ADCIN8 (non-inverting) and ADCIN9 (inverting) Ah ADCIN10 (non-inverting) and ADCIN11 (inverting) Bh ADCIN10 (non-inverting) and ADCIN11 (inverting) Ch ADCIN12 (non-inverting) and ADCIN13 (inverting) Dh ADCIN12 (non-inverting) and ADCIN13 (inverting) Eh ADCIN14 (non-inverting) and ADCIN15 (inverting) Fh ADCIN14 (non-inverting) and ADCIN15 (inverting) Reset type: SYSRSn</p>
14-9	RESERVED	R	0h	Reserved
8-0	ACQPS	R/W	0h	<p>SOC3 Acquisition Prescale. Controls the sample and hold window for this SOC. The configured acquisition time must be at least as long as one ADCCLK cycle for correct ADC operation. The device datasheet will also specify a minimum sample and hold window duration.</p> <p>000h Sample window is 1 system clock cycle wide 001h Sample window is 2 system clock cycles wide 002h Sample window is 3 system clock cycles wide ... 1FFh Sample window is 512 system clock cycles wide Reset type: SYSRSn</p>

**9.4.2.21 ADCSOC4CTL\_1 Register (Offset = 18h) [reset = 0h]**

ADCSOC4CTL\_1 is shown in [Figure 9-45](#) and described in [Table 9-35](#).

Return to [Summary Table](#).

ADC SOC4 Control Register

**Figure 9-45. ADCSOC4CTL\_1 Register**

31	30	29	28	27	26	25	24
RESERVED							TRIGSEL
R-0h							R/W-0h
23	22	21	20	19	18	17	16
TRIGSEL				RESERVED	CHSEL		
R/W-0h				R-0h	R/W-0h		
15	14	13	12	11	10	9	8
CHSEL	RESERVED						ACQPS
R/W-0h	R-0h						R/W-0h
7	6	5	4	3	2	1	0
ACQPS							
R/W-0h							

**Table 9-35. ADCSOC4CTL\_1 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-25	RESERVED	R	0h	Reserved

**Table 9-35. ADCSOC4CTL\_1 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
24-20	TRIGSEL	R/W	0h	<p>SOC4 Trigger Source Select. Along with the SOC4 field in the ADCINTSOCSEL1 register, this bit field configures which trigger will set the SOC4 flag in the ADCSOCFLG1 register to initiate a conversion to start once priority is given to it.</p> <p>00h ADCTRIG0 - Software only</p> <p>01h ADCTRIG1 - CPU1 Timer 0, TINT0n</p> <p>02h ADCTRIG2 - CPU1 Timer 1, TINT1n</p> <p>03h ADCTRIG3 - CPU1 Timer 2, TINT2n</p> <p>04h ADCTRIG4 - GPIO, ADCEXTSOC</p> <p>05h ADCTRIG5 - ePWM1, ADCSOCA</p> <p>06h ADCTRIG6 - ePWM1, ADCSOCA</p> <p>07h ADCTRIG7 - ePWM2, ADCSOCA</p> <p>08h ADCTRIG8 - ePWM2, ADCSOCA</p> <p>09h ADCTRIG9 - ePWM3, ADCSOCA</p> <p>0Ah ADCTRIG10 - ePWM3, ADCSOCA</p> <p>0Bh ADCTRIG11 - ePWM4, ADCSOCA</p> <p>0Ch ADCTRIG12 - ePWM4, ADCSOCA</p> <p>0Dh ADCTRIG13 - ePWM5, ADCSOCA</p> <p>0Eh ADCTRIG14 - ePWM5, ADCSOCA</p> <p>0Fh ADCTRIG15 - ePWM6, ADCSOCA</p> <p>10h ADCTRIG16 - ePWM6, ADCSOCA</p> <p>11h ADCTRIG17 - ePWM7, ADCSOCA</p> <p>12h ADCTRIG18 - ePWM7, ADCSOCA</p> <p>13h ADCTRIG19 - ePWM8, ADCSOCA</p> <p>14h ADCTRIG20 - ePWM8, ADCSOCA</p> <p>15h ADCTRIG21 - ePWM9, ADCSOCA</p> <p>16h ADCTRIG22 - ePWM9, ADCSOCA</p> <p>17h ADCTRIG23 - ePWM10, ADCSOCA</p> <p>18h ADCTRIG24 - ePWM10, ADCSOCA</p> <p>19h ADCTRIG25 - ePWM11, ADCSOCA</p> <p>1Ah ADCTRIG26 - ePWM11, ADCSOCA</p> <p>1Bh ADCTRIG27 - ePWM12, ADCSOCA</p> <p>1Ch ADCTRIG28 - ePWM12, ADCSOCA</p> <p>1Dh - 1Fh - Reserved</p> <p>Reset type: SYSRSn</p>
19	RESERVED	R	0h	Reserved

**Table 9-35. ADCSOC4CTL\_1 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
18-15	CHSEL	R/W	0h	<p>SOC4 Channel Select. Selects the channel to be converted when SOC4 is received by the ADC.</p> <p>Single-ended Signaling Mode (SIGNALMODE = 0):</p> <p>0h ADCIN0 1h ADCIN1 2h ADCIN2 3h ADCIN3 4h ADCIN4 5h ADCIN5 6h ADCIN6 7h ADCIN7 8h ADCIN8 9h ADCIN9 Ah ADCIN10 Bh ADCIN11 Ch ADCIN12 Dh ADCIN13 Eh ADCIN14 Fh ADCIN15</p> <p>Differential Signaling Mode (SIGNALMODE = 1):</p> <p>0h ADCIN0 (non-inverting) and ADCIN1 (inverting) 1h ADCIN0 (non-inverting) and ADCIN1 (inverting) 2h ADCIN2 (non-inverting) and ADCIN3 (inverting) 3h ADCIN2 (non-inverting) and ADCIN3 (inverting) 4h ADCIN4 (non-inverting) and ADCIN5 (inverting) 5h ADCIN4 (non-inverting) and ADCIN5 (inverting) 6h ADCIN6 (non-inverting) and ADCIN7 (inverting) 7h ADCIN6 (non-inverting) and ADCIN7 (inverting) 8h ADCIN8 (non-inverting) and ADCIN9 (inverting) 9h ADCIN8 (non-inverting) and ADCIN9 (inverting) Ah ADCIN10 (non-inverting) and ADCIN11 (inverting) Bh ADCIN10 (non-inverting) and ADCIN11 (inverting) Ch ADCIN12 (non-inverting) and ADCIN13 (inverting) Dh ADCIN12 (non-inverting) and ADCIN13 (inverting) Eh ADCIN14 (non-inverting) and ADCIN15 (inverting) Fh ADCIN14 (non-inverting) and ADCIN15 (inverting)</p> <p>Reset type: SYSRSn</p>
14-9	RESERVED	R	0h	Reserved
8-0	ACQPS	R/W	0h	<p>SOC4 Acquisition Prescale. Controls the sample and hold window for this SOC. The configured acquisition time must be at least as long as one ADCCLK cycle for correct ADC operation. The device datasheet will also specify a minimum sample and hold window duration.</p> <p>000h Sample window is 1 system clock cycle wide 001h Sample window is 2 system clock cycles wide 002h Sample window is 3 system clock cycles wide ... 1FFh Sample window is 512 system clock cycles wide</p> <p>Reset type: SYSRSn</p>

**9.4.2.22 ADCSOC5CTL\_1 Register (Offset = 1Ah) [reset = 0h]**

ADCSOC5CTL\_1 is shown in [Figure 9-46](#) and described in [Table 9-36](#).

Return to [Summary Table](#).

ADC SOC5 Control Register

**Figure 9-46. ADCSOC5CTL\_1 Register**

31	30	29	28	27	26	25	24
RESERVED							TRIGSEL
R-0h							R/W-0h
23	22	21	20	19	18	17	16
TRIGSEL				RESERVED	CHSEL		
R/W-0h				R-0h	R/W-0h		
15	14	13	12	11	10	9	8
CHSEL	RESERVED						ACQPS
R/W-0h	R-0h						R/W-0h
7	6	5	4	3	2	1	0
ACQPS							
R/W-0h							

**Table 9-36. ADCSOC5CTL\_1 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-25	RESERVED	R	0h	Reserved

**Table 9-36. ADCSOC5CTL\_1 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
24-20	TRIGSEL	R/W	0h	<p>SOC5 Trigger Source Select. Along with the SOC5 field in the ADCINTSOCSEL1 register, this bit field configures which trigger will set the SOC5 flag in the ADCSOCFLG1 register to initiate a conversion to start once priority is given to it.</p> <p>00h ADCTRIG0 - Software only            01h ADCTRIG1 - CPU1 Timer 0, TINT0n            02h ADCTRIG2 - CPU1 Timer 1, TINT1n            03h ADCTRIG3 - CPU1 Timer 2, TINT2n            04h ADCTRIG4 - GPIO, ADCEXTSOC            05h ADCTRIG5 - ePWM1, ADCSOCA            06h ADCTRIG6 - ePWM1, ADCSOCB            07h ADCTRIG7 - ePWM2, ADCSOCA            08h ADCTRIG8 - ePWM2, ADCSOCB            09h ADCTRIG9 - ePWM3, ADCSOCA            0Ah ADCTRIG10 - ePWM3, ADCSOCB            0Bh ADCTRIG11 - ePWM4, ADCSOCA            0Ch ADCTRIG12 - ePWM4, ADCSOCB            0Dh ADCTRIG13 - ePWM5, ADCSOCA            0Eh ADCTRIG14 - ePWM5, ADCSOCB            0Fh ADCTRIG15 - ePWM6, ADCSOCA            10h ADCTRIG16 - ePWM6, ADCSOCB            11h ADCTRIG17 - ePWM7, ADCSOCA            12h ADCTRIG18 - ePWM7, ADCSOCB            13h ADCTRIG19 - ePWM8, ADCSOCA            14h ADCTRIG20 - ePWM8, ADCSOCB            15h ADCTRIG21 - ePWM9, ADCSOCA            16h ADCTRIG22 - ePWM9, ADCSOCB            17h ADCTRIG23 - ePWM10, ADCSOCA            18h ADCTRIG24 - ePWM10, ADCSOCB            19h ADCTRIG25 - ePWM11, ADCSOCA            1Ah ADCTRIG26 - ePWM11, ADCSOCB            1Bh ADCTRIG27 - ePWM12, ADCSOCA            1Ch ADCTRIG28 - ePWM12, ADCSOCB            1Dh - 1Fh - Reserved</p> <p>Reset type: SYSRSn</p>
19	RESERVED	R	0h	Reserved

**Table 9-36. ADCSOC5CTL\_1 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
18-15	CHSEL	R/W	0h	<p>SOC5 Channel Select. Selects the channel to be converted when SOC5 is received by the ADC.</p> <p>Single-ended Signaling Mode (SIGNALMODE = 0):</p> <p>0h ADCIN0 1h ADCIN1 2h ADCIN2 3h ADCIN3 4h ADCIN4 5h ADCIN5 6h ADCIN6 7h ADCIN7 8h ADCIN8 9h ADCIN9 Ah ADCIN10 Bh ADCIN11 Ch ADCIN12 Dh ADCIN13 Eh ADCIN14 Fh ADCIN15</p> <p>Differential Signaling Mode (SIGNALMODE = 1):</p> <p>0h ADCIN0 (non-inverting) and ADCIN1 (inverting) 1h ADCIN0 (non-inverting) and ADCIN1 (inverting) 2h ADCIN2 (non-inverting) and ADCIN3 (inverting) 3h ADCIN2 (non-inverting) and ADCIN3 (inverting) 4h ADCIN4 (non-inverting) and ADCIN5 (inverting) 5h ADCIN4 (non-inverting) and ADCIN5 (inverting) 6h ADCIN6 (non-inverting) and ADCIN7 (inverting) 7h ADCIN6 (non-inverting) and ADCIN7 (inverting) 8h ADCIN8 (non-inverting) and ADCIN9 (inverting) 9h ADCIN8 (non-inverting) and ADCIN9 (inverting) Ah ADCIN10 (non-inverting) and ADCIN11 (inverting) Bh ADCIN10 (non-inverting) and ADCIN11 (inverting) Ch ADCIN12 (non-inverting) and ADCIN13 (inverting) Dh ADCIN12 (non-inverting) and ADCIN13 (inverting) Eh ADCIN14 (non-inverting) and ADCIN15 (inverting) Fh ADCIN14 (non-inverting) and ADCIN15 (inverting)</p> <p>Reset type: SYSRSn</p>
14-9	RESERVED	R	0h	Reserved
8-0	ACQPS	R/W	0h	<p>SOC5 Acquisition Prescale. Controls the sample and hold window for this SOC. The configured acquisition time must be at least as long as one ADCCLK cycle for correct ADC operation. The device datasheet will also specify a minimum sample and hold window duration.</p> <p>000h Sample window is 1 system clock cycle wide 001h Sample window is 2 system clock cycles wide 002h Sample window is 3 system clock cycles wide ... 1FFh Sample window is 512 system clock cycles wide</p> <p>Reset type: SYSRSn</p>

**9.4.2.23 ADCSOC6CTL\_1 Register (Offset = 1Ch) [reset = 0h]**

ADCSOC6CTL\_1 is shown in [Figure 9-47](#) and described in [Table 9-37](#).

Return to [Summary Table](#).

ADC SOC6 Control Register

**Figure 9-47. ADCSOC6CTL\_1 Register**

31	30	29	28	27	26	25	24
RESERVED							TRIGSEL
R-0h							R/W-0h
23	22	21	20	19	18	17	16
TRIGSEL				RESERVED	CHSEL		
R/W-0h				R-0h	R/W-0h		
15	14	13	12	11	10	9	8
CHSEL	RESERVED						ACQPS
R/W-0h	R-0h						R/W-0h
7	6	5	4	3	2	1	0
ACQPS							
R/W-0h							

**Table 9-37. ADCSOC6CTL\_1 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-25	RESERVED	R	0h	Reserved



**Table 9-37. ADCSOC6CTL\_1 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
24-20	TRIGSEL	R/W	0h	<p>SOC6 Trigger Source Select. Along with the SOC6 field in the ADCINTSOCSEL1 register, this bit field configures which trigger will set the SOC6 flag in the ADCSOCFLG1 register to initiate a conversion to start once priority is given to it.</p> <p>00h ADCTRIG0 - Software only            01h ADCTRIG1 - CPU1 Timer 0, TINT0n            02h ADCTRIG2 - CPU1 Timer 1, TINT1n            03h ADCTRIG3 - CPU1 Timer 2, TINT2n            04h ADCTRIG4 - GPIO, ADCEXTSOC            05h ADCTRIG5 - ePWM1, ADCSOCA            06h ADCTRIG6 - ePWM1, ADCSOCA            07h ADCTRIG7 - ePWM2, ADCSOCA            08h ADCTRIG8 - ePWM2, ADCSOCA            09h ADCTRIG9 - ePWM3, ADCSOCA            0Ah ADCTRIG10 - ePWM3, ADCSOCA            0Bh ADCTRIG11 - ePWM4, ADCSOCA            0Ch ADCTRIG12 - ePWM4, ADCSOCA            0Dh ADCTRIG13 - ePWM5, ADCSOCA            0Eh ADCTRIG14 - ePWM5, ADCSOCA            0Fh ADCTRIG15 - ePWM6, ADCSOCA            10h ADCTRIG16 - ePWM6, ADCSOCA            11h ADCTRIG17 - ePWM7, ADCSOCA            12h ADCTRIG18 - ePWM7, ADCSOCA            13h ADCTRIG19 - ePWM8, ADCSOCA            14h ADCTRIG20 - ePWM8, ADCSOCA            15h ADCTRIG21 - ePWM9, ADCSOCA            16h ADCTRIG22 - ePWM9, ADCSOCA            17h ADCTRIG23 - ePWM10, ADCSOCA            18h ADCTRIG24 - ePWM10, ADCSOCA            19h ADCTRIG25 - ePWM11, ADCSOCA            1Ah ADCTRIG26 - ePWM11, ADCSOCA            1Bh ADCTRIG27 - ePWM12, ADCSOCA            1Ch ADCTRIG28 - ePWM12, ADCSOCA            1Dh - 1Fh - Reserved            Reset type: SYSRSn</p>
19	RESERVED	R	0h	Reserved

**Table 9-37. ADCSOC6CTL\_1 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
18-15	CHSEL	R/W	0h	<p>SOC6 Channel Select. Selects the channel to be converted when SOC6 is received by the ADC.</p> <p>Single-ended Signaling Mode (SIGNALMODE = 0):</p> <p>0h ADCIN0 1h ADCIN1 2h ADCIN2 3h ADCIN3 4h ADCIN4 5h ADCIN5 6h ADCIN6 7h ADCIN7 8h ADCIN8 9h ADCIN9 Ah ADCIN10 Bh ADCIN11 Ch ADCIN12 Dh ADCIN13 Eh ADCIN14 Fh ADCIN15</p> <p>Differential Signaling Mode (SIGNALMODE = 1):</p> <p>0h ADCIN0 (non-inverting) and ADCIN1 (inverting) 1h ADCIN0 (non-inverting) and ADCIN1 (inverting) 2h ADCIN2 (non-inverting) and ADCIN3 (inverting) 3h ADCIN2 (non-inverting) and ADCIN3 (inverting) 4h ADCIN4 (non-inverting) and ADCIN5 (inverting) 5h ADCIN4 (non-inverting) and ADCIN5 (inverting) 6h ADCIN6 (non-inverting) and ADCIN7 (inverting) 7h ADCIN6 (non-inverting) and ADCIN7 (inverting) 8h ADCIN8 (non-inverting) and ADCIN9 (inverting) 9h ADCIN8 (non-inverting) and ADCIN9 (inverting) Ah ADCIN10 (non-inverting) and ADCIN11 (inverting) Bh ADCIN10 (non-inverting) and ADCIN11 (inverting) Ch ADCIN12 (non-inverting) and ADCIN13 (inverting) Dh ADCIN12 (non-inverting) and ADCIN13 (inverting) Eh ADCIN14 (non-inverting) and ADCIN15 (inverting) Fh ADCIN14 (non-inverting) and ADCIN15 (inverting)</p> <p>Reset type: SYSRSn</p>
14-9	RESERVED	R	0h	Reserved
8-0	ACQPS	R/W	0h	<p>SOC6 Acquisition Prescale. Controls the sample and hold window for this SOC. The configured acquisition time must be at least as long as one ADCCLK cycle for correct ADC operation. The device datasheet will also specify a minimum sample and hold window duration.</p> <p>000h Sample window is 1 system clock cycle wide 001h Sample window is 2 system clock cycles wide 002h Sample window is 3 system clock cycles wide ... 1FFh Sample window is 512 system clock cycles wide</p> <p>Reset type: SYSRSn</p>

**9.4.2.24 ADCSOC7CTL\_1 Register (Offset = 1Eh) [reset = 0h]**

ADCSOC7CTL\_1 is shown in [Figure 9-48](#) and described in [Table 9-38](#).

Return to [Summary Table](#).

ADC SOC7 Control Register

**Figure 9-48. ADCSOC7CTL\_1 Register**

31	30	29	28	27	26	25	24
RESERVED							TRIGSEL
R-0h							R/W-0h
23	22	21	20	19	18	17	16
TRIGSEL				RESERVED	CHSEL		
R/W-0h				R-0h	R/W-0h		
15	14	13	12	11	10	9	8
CHSEL	RESERVED						ACQPS
R/W-0h	R-0h						R/W-0h
7	6	5	4	3	2	1	0
ACQPS							
R/W-0h							

**Table 9-38. ADCSOC7CTL\_1 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-25	RESERVED	R	0h	Reserved

**Table 9-38. ADCSOC7CTL\_1 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
24-20	TRIGSEL	R/W	0h	<p>SOC7 Trigger Source Select. Along with the SOC7 field in the ADCINTSOCSEL1 register, this bit field configures which trigger will set the SOC7 flag in the ADCSOCFLG1 register to initiate a conversion to start once priority is given to it.</p> <p>00h ADCTRIG0 - Software only            01h ADCTRIG1 - CPU1 Timer 0, TINT0n            02h ADCTRIG2 - CPU1 Timer 1, TINT1n            03h ADCTRIG3 - CPU1 Timer 2, TINT2n            04h ADCTRIG4 - GPIO, ADCEXTSOC            05h ADCTRIG5 - ePWM1, ADCSOCA            06h ADCTRIG6 - ePWM1, ADCSOCA            07h ADCTRIG7 - ePWM2, ADCSOCA            08h ADCTRIG8 - ePWM2, ADCSOCA            09h ADCTRIG9 - ePWM3, ADCSOCA            0Ah ADCTRIG10 - ePWM3, ADCSOCA            0Bh ADCTRIG11 - ePWM4, ADCSOCA            0Ch ADCTRIG12 - ePWM4, ADCSOCA            0Dh ADCTRIG13 - ePWM5, ADCSOCA            0Eh ADCTRIG14 - ePWM5, ADCSOCA            0Fh ADCTRIG15 - ePWM6, ADCSOCA            10h ADCTRIG16 - ePWM6, ADCSOCA            11h ADCTRIG17 - ePWM7, ADCSOCA            12h ADCTRIG18 - ePWM7, ADCSOCA            13h ADCTRIG19 - ePWM8, ADCSOCA            14h ADCTRIG20 - ePWM8, ADCSOCA            15h ADCTRIG21 - ePWM9, ADCSOCA            16h ADCTRIG22 - ePWM9, ADCSOCA            17h ADCTRIG23 - ePWM10, ADCSOCA            18h ADCTRIG24 - ePWM10, ADCSOCA            19h ADCTRIG25 - ePWM11, ADCSOCA            1Ah ADCTRIG26 - ePWM11, ADCSOCA            1Bh ADCTRIG27 - ePWM12, ADCSOCA            1Ch ADCTRIG28 - ePWM12, ADCSOCA            1Dh - 1Fh - Reserved</p> <p>Reset type: SYSRSn</p>
19	RESERVED	R	0h	Reserved

**Table 9-38. ADCSOC7CTL\_1 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
18-15	CHSEL	R/W	0h	<p>SOC7 Channel Select. Selects the channel to be converted when SOC7 is received by the ADC.</p> <p>Single-ended Signaling Mode (SIGNALMODE = 0):</p> <p>0h ADCIN0 1h ADCIN1 2h ADCIN2 3h ADCIN3 4h ADCIN4 5h ADCIN5 6h ADCIN6 7h ADCIN7 8h ADCIN8 9h ADCIN9 Ah ADCIN10 Bh ADCIN11 Ch ADCIN12 Dh ADCIN13 Eh ADCIN14 Fh ADCIN15</p> <p>Differential Signaling Mode (SIGNALMODE = 1):</p> <p>0h ADCIN0 (non-inverting) and ADCIN1 (inverting) 1h ADCIN0 (non-inverting) and ADCIN1 (inverting) 2h ADCIN2 (non-inverting) and ADCIN3 (inverting) 3h ADCIN2 (non-inverting) and ADCIN3 (inverting) 4h ADCIN4 (non-inverting) and ADCIN5 (inverting) 5h ADCIN4 (non-inverting) and ADCIN5 (inverting) 6h ADCIN6 (non-inverting) and ADCIN7 (inverting) 7h ADCIN6 (non-inverting) and ADCIN7 (inverting) 8h ADCIN8 (non-inverting) and ADCIN9 (inverting) 9h ADCIN8 (non-inverting) and ADCIN9 (inverting) Ah ADCIN10 (non-inverting) and ADCIN11 (inverting) Bh ADCIN10 (non-inverting) and ADCIN11 (inverting) Ch ADCIN12 (non-inverting) and ADCIN13 (inverting) Dh ADCIN12 (non-inverting) and ADCIN13 (inverting) Eh ADCIN14 (non-inverting) and ADCIN15 (inverting) Fh ADCIN14 (non-inverting) and ADCIN15 (inverting) Reset type: SYSRSn</p>
14-9	RESERVED	R	0h	Reserved
8-0	ACQPS	R/W	0h	<p>SOC7 Acquisition Prescale. Controls the sample and hold window for this SOC. The configured acquisition time must be at least as long as one ADCCLK cycle for correct ADC operation. The device datasheet will also specify a minimum sample and hold window duration.</p> <p>000h Sample window is 1 system clock cycle wide 001h Sample window is 2 system clock cycles wide 002h Sample window is 3 system clock cycles wide ... 1FFh Sample window is 512 system clock cycles wide Reset type: SYSRSn</p>

**9.4.2.25 ADCSOC8CTL\_1 Register (Offset = 20h) [reset = 0h]**

ADCSOC8CTL\_1 is shown in [Figure 9-49](#) and described in [Table 9-39](#).

Return to [Summary Table](#).

ADC SOC8 Control Register

**Figure 9-49. ADCSOC8CTL\_1 Register**

31	30	29	28	27	26	25	24
RESERVED							TRIGSEL
R-0h							R/W-0h
23	22	21	20	19	18	17	16
TRIGSEL				RESERVED	CHSEL		
R/W-0h				R-0h	R/W-0h		
15	14	13	12	11	10	9	8
CHSEL	RESERVED						ACQPS
R/W-0h	R-0h						R/W-0h
7	6	5	4	3	2	1	0
ACQPS							
R/W-0h							

**Table 9-39. ADCSOC8CTL\_1 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-25	RESERVED	R	0h	Reserved

**Table 9-39. ADCSOC8CTL\_1 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
24-20	TRIGSEL	R/W	0h	<p>SOC8 Trigger Source Select. Along with the SOC8 field in the ADCINTSOCSEL1 register, this bit field configures which trigger will set the SOC8 flag in the ADCSOCFLG1 register to initiate a conversion to start once priority is given to it.</p> <p>00h ADCTRIG0 - Software only            01h ADCTRIG1 - CPU1 Timer 0, TINT0n            02h ADCTRIG2 - CPU1 Timer 1, TINT1n            03h ADCTRIG3 - CPU1 Timer 2, TINT2n            04h ADCTRIG4 - GPIO, ADCEXTSOC            05h ADCTRIG5 - ePWM1, ADCSOCA            06h ADCTRIG6 - ePWM1, ADCSOCA            07h ADCTRIG7 - ePWM2, ADCSOCA            08h ADCTRIG8 - ePWM2, ADCSOCA            09h ADCTRIG9 - ePWM3, ADCSOCA            0Ah ADCTRIG10 - ePWM3, ADCSOCA            0Bh ADCTRIG11 - ePWM4, ADCSOCA            0Ch ADCTRIG12 - ePWM4, ADCSOCA            0Dh ADCTRIG13 - ePWM5, ADCSOCA            0Eh ADCTRIG14 - ePWM5, ADCSOCA            0Fh ADCTRIG15 - ePWM6, ADCSOCA            10h ADCTRIG16 - ePWM6, ADCSOCA            11h ADCTRIG17 - ePWM7, ADCSOCA            12h ADCTRIG18 - ePWM7, ADCSOCA            13h ADCTRIG19 - ePWM8, ADCSOCA            14h ADCTRIG20 - ePWM8, ADCSOCA            15h ADCTRIG21 - ePWM9, ADCSOCA            16h ADCTRIG22 - ePWM9, ADCSOCA            17h ADCTRIG23 - ePWM10, ADCSOCA            18h ADCTRIG24 - ePWM10, ADCSOCA            19h ADCTRIG25 - ePWM11, ADCSOCA            1Ah ADCTRIG26 - ePWM11, ADCSOCA            1Bh ADCTRIG27 - ePWM12, ADCSOCA            1Ch ADCTRIG28 - ePWM12, ADCSOCA            1Dh - 1Fh - Reserved            Reset type: SYSRSn</p>
19	RESERVED	R	0h	Reserved

**Table 9-39. ADCSOC8CTL\_1 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
18-15	CHSEL	R/W	0h	<p>SOC8 Channel Select. Selects the channel to be converted when SOC8 is received by the ADC.</p> <p>Single-ended Signaling Mode (SIGNALMODE = 0):</p> <p>0h ADCIN0 1h ADCIN1 2h ADCIN2 3h ADCIN3 4h ADCIN4 5h ADCIN5 6h ADCIN6 7h ADCIN7 8h ADCIN8 9h ADCIN9 Ah ADCIN10 Bh ADCIN11 Ch ADCIN12 Dh ADCIN13 Eh ADCIN14 Fh ADCIN15</p> <p>Differential Signaling Mode (SIGNALMODE = 1):</p> <p>0h ADCIN0 (non-inverting) and ADCIN1 (inverting) 1h ADCIN0 (non-inverting) and ADCIN1 (inverting) 2h ADCIN2 (non-inverting) and ADCIN3 (inverting) 3h ADCIN2 (non-inverting) and ADCIN3 (inverting) 4h ADCIN4 (non-inverting) and ADCIN5 (inverting) 5h ADCIN4 (non-inverting) and ADCIN5 (inverting) 6h ADCIN6 (non-inverting) and ADCIN7 (inverting) 7h ADCIN6 (non-inverting) and ADCIN7 (inverting) 8h ADCIN8 (non-inverting) and ADCIN9 (inverting) 9h ADCIN8 (non-inverting) and ADCIN9 (inverting) Ah ADCIN10 (non-inverting) and ADCIN11 (inverting) Bh ADCIN10 (non-inverting) and ADCIN11 (inverting) Ch ADCIN12 (non-inverting) and ADCIN13 (inverting) Dh ADCIN12 (non-inverting) and ADCIN13 (inverting) Eh ADCIN14 (non-inverting) and ADCIN15 (inverting) Fh ADCIN14 (non-inverting) and ADCIN15 (inverting)</p> <p>Reset type: SYSRSn</p>
14-9	RESERVED	R	0h	Reserved
8-0	ACQPS	R/W	0h	<p>SOC8 Acquisition Prescale. Controls the sample and hold window for this SOC. The configured acquisition time must be at least as long as one ADCCLK cycle for correct ADC operation. The device datasheet will also specify a minimum sample and hold window duration.</p> <p>000h Sample window is 1 system clock cycle wide 001h Sample window is 2 system clock cycles wide 002h Sample window is 3 system clock cycles wide ... 1FFh Sample window is 512 system clock cycles wide</p> <p>Reset type: SYSRSn</p>



**9.4.2.26 ADCSOC9CTL\_1 Register (Offset = 22h) [reset = 0h]**

ADCSOC9CTL\_1 is shown in [Figure 9-50](#) and described in [Table 9-40](#).

Return to [Summary Table](#).

ADC SOC9 Control Register

**Figure 9-50. ADCSOC9CTL\_1 Register**

31	30	29	28	27	26	25	24
RESERVED							TRIGSEL
R-0h							R/W-0h
23	22	21	20	19	18	17	16
TRIGSEL				RESERVED	CHSEL		
R/W-0h				R-0h	R/W-0h		
15	14	13	12	11	10	9	8
CHSEL	RESERVED						ACQPS
R/W-0h	R-0h						R/W-0h
7	6	5	4	3	2	1	0
ACQPS							
R/W-0h							

**Table 9-40. ADCSOC9CTL\_1 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-25	RESERVED	R	0h	Reserved

**Table 9-40. ADCSOC9CTL\_1 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
24-20	TRIGSEL	R/W	0h	<p>SOC9 Trigger Source Select. Along with the SOC9 field in the ADCINTSOCSEL1 register, this bit field configures which trigger will set the SOC9 flag in the ADCSOCFLG1 register to initiate a conversion to start once priority is given to it.</p> <p>00h ADCTRIG0 - Software only            01h ADCTRIG1 - CPU1 Timer 0, TINT0n            02h ADCTRIG2 - CPU1 Timer 1, TINT1n            03h ADCTRIG3 - CPU1 Timer 2, TINT2n            04h ADCTRIG4 - GPIO, ADCEXTSOC            05h ADCTRIG5 - ePWM1, ADCSOCA            06h ADCTRIG6 - ePWM1, ADCSOCA            07h ADCTRIG7 - ePWM2, ADCSOCA            08h ADCTRIG8 - ePWM2, ADCSOCA            09h ADCTRIG9 - ePWM3, ADCSOCA            0Ah ADCTRIG10 - ePWM3, ADCSOCA            0Bh ADCTRIG11 - ePWM4, ADCSOCA            0Ch ADCTRIG12 - ePWM4, ADCSOCA            0Dh ADCTRIG13 - ePWM5, ADCSOCA            0Eh ADCTRIG14 - ePWM5, ADCSOCA            0Fh ADCTRIG15 - ePWM6, ADCSOCA            10h ADCTRIG16 - ePWM6, ADCSOCA            11h ADCTRIG17 - ePWM7, ADCSOCA            12h ADCTRIG18 - ePWM7, ADCSOCA            13h ADCTRIG19 - ePWM8, ADCSOCA            14h ADCTRIG20 - ePWM8, ADCSOCA            15h ADCTRIG21 - ePWM9, ADCSOCA            16h ADCTRIG22 - ePWM9, ADCSOCA            17h ADCTRIG23 - ePWM10, ADCSOCA            18h ADCTRIG24 - ePWM10, ADCSOCA            19h ADCTRIG25 - ePWM11, ADCSOCA            1Ah ADCTRIG26 - ePWM11, ADCSOCA            1Bh ADCTRIG27 - ePWM12, ADCSOCA            1Ch ADCTRIG28 - ePWM12, ADCSOCA            1Dh - 1Fh - Reserved</p> <p>Reset type: SYSRSn</p>
19	RESERVED	R	0h	Reserved

**Table 9-40. ADCSOC9CTL\_1 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
18-15	CHSEL	R/W	0h	<p>SOC9 Channel Select. Selects the channel to be converted when SOC9 is received by the ADC.</p> <p>Single-ended Signaling Mode (SIGNALMODE = 0):</p> <p>0h ADCIN0 1h ADCIN1 2h ADCIN2 3h ADCIN3 4h ADCIN4 5h ADCIN5 6h ADCIN6 7h ADCIN7 8h ADCIN8 9h ADCIN9 Ah ADCIN10 Bh ADCIN11 Ch ADCIN12 Dh ADCIN13 Eh ADCIN14 Fh ADCIN15</p> <p>Differential Signaling Mode (SIGNALMODE = 1):</p> <p>0h ADCIN0 (non-inverting) and ADCIN1 (inverting) 1h ADCIN0 (non-inverting) and ADCIN1 (inverting) 2h ADCIN2 (non-inverting) and ADCIN3 (inverting) 3h ADCIN2 (non-inverting) and ADCIN3 (inverting) 4h ADCIN4 (non-inverting) and ADCIN5 (inverting) 5h ADCIN4 (non-inverting) and ADCIN5 (inverting) 6h ADCIN6 (non-inverting) and ADCIN7 (inverting) 7h ADCIN6 (non-inverting) and ADCIN7 (inverting) 8h ADCIN8 (non-inverting) and ADCIN9 (inverting) 9h ADCIN8 (non-inverting) and ADCIN9 (inverting) Ah ADCIN10 (non-inverting) and ADCIN11 (inverting) Bh ADCIN10 (non-inverting) and ADCIN11 (inverting) Ch ADCIN12 (non-inverting) and ADCIN13 (inverting) Dh ADCIN12 (non-inverting) and ADCIN13 (inverting) Eh ADCIN14 (non-inverting) and ADCIN15 (inverting) Fh ADCIN14 (non-inverting) and ADCIN15 (inverting) Reset type: SYSRSn</p>
14-9	RESERVED	R	0h	Reserved
8-0	ACQPS	R/W	0h	<p>SOC9 Acquisition Prescale. Controls the sample and hold window for this SOC. The configured acquisition time must be at least as long as one ADCCLK cycle for correct ADC operation. The device datasheet will also specify a minimum sample and hold window duration.</p> <p>000h Sample window is 1 system clock cycle wide 001h Sample window is 2 system clock cycles wide 002h Sample window is 3 system clock cycles wide ... 1FFh Sample window is 512 system clock cycles wide Reset type: SYSRSn</p>

**9.4.2.27 ADCSOC10CTL\_1 Register (Offset = 24h) [reset = 0h]**

ADCSOC10CTL\_1 is shown in [Figure 9-51](#) and described in [Table 9-41](#).

Return to [Summary Table](#).

ADC SOC10 Control Register

**Figure 9-51. ADCSOC10CTL\_1 Register**

31	30	29	28	27	26	25	24
RESERVED							TRIGSEL
R-0h							R/W-0h
23	22	21	20	19	18	17	16
TRIGSEL				RESERVED	CHSEL		
R/W-0h				R-0h	R/W-0h		
15	14	13	12	11	10	9	8
CHSEL	RESERVED						ACQPS
R/W-0h	R-0h						R/W-0h
7	6	5	4	3	2	1	0
ACQPS							
R/W-0h							

**Table 9-41. ADCSOC10CTL\_1 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-25	RESERVED	R	0h	Reserved

**Table 9-41. ADCSOC10CTL\_1 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
24-20	TRIGSEL	R/W	0h	<p>SOC10 Trigger Source Select. Along with the SOC10 field in the ADCINTSOCSEL1 register, this bit field configures which trigger will set the SOC10 flag in the ADCSOCFLG1 register to initiate a conversion to start once priority is given to it.</p> <p>00h ADCTRIG0 - Software only            01h ADCTRIG1 - CPU1 Timer 0, TINT0n            02h ADCTRIG2 - CPU1 Timer 1, TINT1n            03h ADCTRIG3 - CPU1 Timer 2, TINT2n            04h ADCTRIG4 - GPIO, ADCEXTSOC            05h ADCTRIG5 - ePWM1, ADCSOCA            06h ADCTRIG6 - ePWM1, ADCSOCA            07h ADCTRIG7 - ePWM2, ADCSOCA            08h ADCTRIG8 - ePWM2, ADCSOCA            09h ADCTRIG9 - ePWM3, ADCSOCA            0Ah ADCTRIG10 - ePWM3, ADCSOCA            0Bh ADCTRIG11 - ePWM4, ADCSOCA            0Ch ADCTRIG12 - ePWM4, ADCSOCA            0Dh ADCTRIG13 - ePWM5, ADCSOCA            0Eh ADCTRIG14 - ePWM5, ADCSOCA            0Fh ADCTRIG15 - ePWM6, ADCSOCA            10h ADCTRIG16 - ePWM6, ADCSOCA            11h ADCTRIG17 - ePWM7, ADCSOCA            12h ADCTRIG18 - ePWM7, ADCSOCA            13h ADCTRIG19 - ePWM8, ADCSOCA            14h ADCTRIG20 - ePWM8, ADCSOCA            15h ADCTRIG21 - ePWM9, ADCSOCA            16h ADCTRIG22 - ePWM9, ADCSOCA            17h ADCTRIG23 - ePWM10, ADCSOCA            18h ADCTRIG24 - ePWM10, ADCSOCA            19h ADCTRIG25 - ePWM11, ADCSOCA            1Ah ADCTRIG26 - ePWM11, ADCSOCA            1Bh ADCTRIG27 - ePWM12, ADCSOCA            1Ch ADCTRIG28 - ePWM12, ADCSOCA            1Dh - 1Fh - Reserved            Reset type: SYSRSn</p>
19	RESERVED	R	0h	Reserved

**Table 9-41. ADCSOC10CTL\_1 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
18-15	CHSEL	R/W	0h	<p>SOC10 Channel Select. Selects the channel to be converted when SOC10 is received by the ADC.</p> <p>Single-ended Signaling Mode (SIGNALMODE = 0):</p> <p>0h ADCIN0 1h ADCIN1 2h ADCIN2 3h ADCIN3 4h ADCIN4 5h ADCIN5 6h ADCIN6 7h ADCIN7 8h ADCIN8 9h ADCIN9 Ah ADCIN10 Bh ADCIN11 Ch ADCIN12 Dh ADCIN13 Eh ADCIN14 Fh ADCIN15</p> <p>Differential Signaling Mode (SIGNALMODE = 1):</p> <p>0h ADCIN0 (non-inverting) and ADCIN1 (inverting) 1h ADCIN0 (non-inverting) and ADCIN1 (inverting) 2h ADCIN2 (non-inverting) and ADCIN3 (inverting) 3h ADCIN2 (non-inverting) and ADCIN3 (inverting) 4h ADCIN4 (non-inverting) and ADCIN5 (inverting) 5h ADCIN4 (non-inverting) and ADCIN5 (inverting) 6h ADCIN6 (non-inverting) and ADCIN7 (inverting) 7h ADCIN6 (non-inverting) and ADCIN7 (inverting) 8h ADCIN8 (non-inverting) and ADCIN9 (inverting) 9h ADCIN8 (non-inverting) and ADCIN9 (inverting) Ah ADCIN10 (non-inverting) and ADCIN11 (inverting) Bh ADCIN10 (non-inverting) and ADCIN11 (inverting) Ch ADCIN12 (non-inverting) and ADCIN13 (inverting) Dh ADCIN12 (non-inverting) and ADCIN13 (inverting) Eh ADCIN14 (non-inverting) and ADCIN15 (inverting) Fh ADCIN14 (non-inverting) and ADCIN15 (inverting)</p> <p>Reset type: SYSRSn</p>
14-9	RESERVED	R	0h	Reserved
8-0	ACQPS	R/W	0h	<p>SOC10 Acquisition Prescale. Controls the sample and hold window for this SOC. The configured acquisition time must be at least as long as one ADCCLK cycle for correct ADC operation. The device datasheet will also specify a minimum sample and hold window duration.</p> <p>000h Sample window is 1 system clock cycle wide 001h Sample window is 2 system clock cycles wide 002h Sample window is 3 system clock cycles wide ... 1FFh Sample window is 512 system clock cycles wide</p> <p>Reset type: SYSRSn</p>

**9.4.2.28 ADCSOC11CTL\_1 Register (Offset = 26h) [reset = 0h]**

ADCSOC11CTL\_1 is shown in [Figure 9-52](#) and described in [Table 9-42](#).

Return to [Summary Table](#).

ADC SOC11 Control Register

**Figure 9-52. ADCSOC11CTL\_1 Register**

31	30	29	28	27	26	25	24
RESERVED							TRIGSEL
R-0h							R/W-0h
23	22	21	20	19	18	17	16
TRIGSEL				RESERVED	CHSEL		
R/W-0h				R-0h	R/W-0h		
15	14	13	12	11	10	9	8
CHSEL	RESERVED						ACQPS
R/W-0h	R-0h						R/W-0h
7	6	5	4	3	2	1	0
ACQPS							
R/W-0h							

**Table 9-42. ADCSOC11CTL\_1 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-25	RESERVED	R	0h	Reserved

**Table 9-42. ADCSOC11CTL\_1 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
24-20	TRIGSEL	R/W	0h	<p>SOC11 Trigger Source Select. Along with the SOC11 field in the ADCINTSOCSEL1 register, this bit field configures which trigger will set the SOC11 flag in the ADCSOCFLG1 register to initiate a conversion to start once priority is given to it.</p> <p>00h ADCTRIG0 - Software only            01h ADCTRIG1 - CPU1 Timer 0, TINT0n            02h ADCTRIG2 - CPU1 Timer 1, TINT1n            03h ADCTRIG3 - CPU1 Timer 2, TINT2n            04h ADCTRIG4 - GPIO, ADCEXTSOC            05h ADCTRIG5 - ePWM1, ADCSOCA            06h ADCTRIG6 - ePWM1, ADCSOCA            07h ADCTRIG7 - ePWM2, ADCSOCA            08h ADCTRIG8 - ePWM2, ADCSOCA            09h ADCTRIG9 - ePWM3, ADCSOCA            0Ah ADCTRIG10 - ePWM3, ADCSOCA            0Bh ADCTRIG11 - ePWM4, ADCSOCA            0Ch ADCTRIG12 - ePWM4, ADCSOCA            0Dh ADCTRIG13 - ePWM5, ADCSOCA            0Eh ADCTRIG14 - ePWM5, ADCSOCA            0Fh ADCTRIG15 - ePWM6, ADCSOCA            10h ADCTRIG16 - ePWM6, ADCSOCA            11h ADCTRIG17 - ePWM7, ADCSOCA            12h ADCTRIG18 - ePWM7, ADCSOCA            13h ADCTRIG19 - ePWM8, ADCSOCA            14h ADCTRIG20 - ePWM8, ADCSOCA            15h ADCTRIG21 - ePWM9, ADCSOCA            16h ADCTRIG22 - ePWM9, ADCSOCA            17h ADCTRIG23 - ePWM10, ADCSOCA            18h ADCTRIG24 - ePWM10, ADCSOCA            19h ADCTRIG25 - ePWM11, ADCSOCA            1Ah ADCTRIG26 - ePWM11, ADCSOCA            1Bh ADCTRIG27 - ePWM12, ADCSOCA            1Ch ADCTRIG28 - ePWM12, ADCSOCA            1Dh - 1Fh - Reserved</p> <p>Reset type: SYSRSn</p>
19	RESERVED	R	0h	Reserved



**Table 9-42. ADCSOC11CTL\_1 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
18-15	CHSEL	R/W	0h	<p>SOC11 Channel Select. Selects the channel to be converted when SOC11 is received by the ADC.</p> <p>Single-ended Signaling Mode (SIGNALMODE = 0):</p> <p>0h ADCIN0 1h ADCIN1 2h ADCIN2 3h ADCIN3 4h ADCIN4 5h ADCIN5 6h ADCIN6 7h ADCIN7 8h ADCIN8 9h ADCIN9 Ah ADCIN10 Bh ADCIN11 Ch ADCIN12 Dh ADCIN13 Eh ADCIN14 Fh ADCIN15</p> <p>Differential Signaling Mode (SIGNALMODE = 1):</p> <p>0h ADCIN0 (non-inverting) and ADCIN1 (inverting) 1h ADCIN0 (non-inverting) and ADCIN1 (inverting) 2h ADCIN2 (non-inverting) and ADCIN3 (inverting) 3h ADCIN2 (non-inverting) and ADCIN3 (inverting) 4h ADCIN4 (non-inverting) and ADCIN5 (inverting) 5h ADCIN4 (non-inverting) and ADCIN5 (inverting) 6h ADCIN6 (non-inverting) and ADCIN7 (inverting) 7h ADCIN6 (non-inverting) and ADCIN7 (inverting) 8h ADCIN8 (non-inverting) and ADCIN9 (inverting) 9h ADCIN8 (non-inverting) and ADCIN9 (inverting) Ah ADCIN10 (non-inverting) and ADCIN11 (inverting) Bh ADCIN10 (non-inverting) and ADCIN11 (inverting) Ch ADCIN12 (non-inverting) and ADCIN13 (inverting) Dh ADCIN12 (non-inverting) and ADCIN13 (inverting) Eh ADCIN14 (non-inverting) and ADCIN15 (inverting) Fh ADCIN14 (non-inverting) and ADCIN15 (inverting) Reset type: SYSRSn</p>
14-9	RESERVED	R	0h	Reserved
8-0	ACQPS	R/W	0h	<p>SOC11 Acquisition Prescale. Controls the sample and hold window for this SOC. The configured acquisition time must be at least as long as one ADCCLK cycle for correct ADC operation. The device datasheet will also specify a minimum sample and hold window duration.</p> <p>000h Sample window is 1 system clock cycle wide 001h Sample window is 2 system clock cycles wide 002h Sample window is 3 system clock cycles wide ... 1FFh Sample window is 512 system clock cycles wide Reset type: SYSRSn</p>

**9.4.2.29 ADCSOC12CTL\_1 Register (Offset = 28h) [reset = 0h]**

ADCSOC12CTL\_1 is shown in [Figure 9-53](#) and described in [Table 9-43](#).

Return to [Summary Table](#).

ADC SOC12 Control Register

**Figure 9-53. ADCSOC12CTL\_1 Register**

31	30	29	28	27	26	25	24
RESERVED							TRIGSEL
R-0h							R/W-0h
23	22	21	20	19	18	17	16
TRIGSEL				RESERVED	CHSEL		
R/W-0h				R-0h	R/W-0h		
15	14	13	12	11	10	9	8
CHSEL	RESERVED						ACQPS
R/W-0h	R-0h						R/W-0h
7	6	5	4	3	2	1	0
ACQPS							
R/W-0h							

**Table 9-43. ADCSOC12CTL\_1 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-25	RESERVED	R	0h	Reserved

**Table 9-43. ADCSOC12CTL\_1 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
24-20	TRIGSEL	R/W	0h	<p>SOC12 Trigger Source Select. Along with the SOC12 field in the ADCINTSOCSEL1 register, this bit field configures which trigger will set the SOC12 flag in the ADCSOCFLG1 register to initiate a conversion to start once priority is given to it.</p> <p>00h ADCTRIG0 - Software only            01h ADCTRIG1 - CPU1 Timer 0, TINT0n            02h ADCTRIG2 - CPU1 Timer 1, TINT1n            03h ADCTRIG3 - CPU1 Timer 2, TINT2n            04h ADCTRIG4 - GPIO, ADCEXTSOC            05h ADCTRIG5 - ePWM1, ADCSOCA            06h ADCTRIG6 - ePWM1, ADCSOCA            07h ADCTRIG7 - ePWM2, ADCSOCA            08h ADCTRIG8 - ePWM2, ADCSOCA            09h ADCTRIG9 - ePWM3, ADCSOCA            0Ah ADCTRIG10 - ePWM3, ADCSOCA            0Bh ADCTRIG11 - ePWM4, ADCSOCA            0Ch ADCTRIG12 - ePWM4, ADCSOCA            0Dh ADCTRIG13 - ePWM5, ADCSOCA            0Eh ADCTRIG14 - ePWM5, ADCSOCA            0Fh ADCTRIG15 - ePWM6, ADCSOCA            10h ADCTRIG16 - ePWM6, ADCSOCA            11h ADCTRIG17 - ePWM7, ADCSOCA            12h ADCTRIG18 - ePWM7, ADCSOCA            13h ADCTRIG19 - ePWM8, ADCSOCA            14h ADCTRIG20 - ePWM8, ADCSOCA            15h ADCTRIG21 - ePWM9, ADCSOCA            16h ADCTRIG22 - ePWM9, ADCSOCA            17h ADCTRIG23 - ePWM10, ADCSOCA            18h ADCTRIG24 - ePWM10, ADCSOCA            19h ADCTRIG25 - ePWM11, ADCSOCA            1Ah ADCTRIG26 - ePWM11, ADCSOCA            1Bh ADCTRIG27 - ePWM12, ADCSOCA            1Ch ADCTRIG28 - ePWM12, ADCSOCA            1Dh - 1Fh - Reserved            Reset type: SYSRSn</p>
19	RESERVED	R	0h	Reserved

**Table 9-43. ADCSOC12CTL\_1 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
18-15	CHSEL	R/W	0h	<p>SOC12 Channel Select. Selects the channel to be converted when SOC12 is received by the ADC.</p> <p>Single-ended Signaling Mode (SIGNALMODE = 0):</p> <p>0h ADCIN0 1h ADCIN1 2h ADCIN2 3h ADCIN3 4h ADCIN4 5h ADCIN5 6h ADCIN6 7h ADCIN7 8h ADCIN8 9h ADCIN9 Ah ADCIN10 Bh ADCIN11 Ch ADCIN12 Dh ADCIN13 Eh ADCIN14 Fh ADCIN15</p> <p>Differential Signaling Mode (SIGNALMODE = 1):</p> <p>0h ADCIN0 (non-inverting) and ADCIN1 (inverting) 1h ADCIN0 (non-inverting) and ADCIN1 (inverting) 2h ADCIN2 (non-inverting) and ADCIN3 (inverting) 3h ADCIN2 (non-inverting) and ADCIN3 (inverting) 4h ADCIN4 (non-inverting) and ADCIN5 (inverting) 5h ADCIN4 (non-inverting) and ADCIN5 (inverting) 6h ADCIN6 (non-inverting) and ADCIN7 (inverting) 7h ADCIN6 (non-inverting) and ADCIN7 (inverting) 8h ADCIN8 (non-inverting) and ADCIN9 (inverting) 9h ADCIN8 (non-inverting) and ADCIN9 (inverting) Ah ADCIN10 (non-inverting) and ADCIN11 (inverting) Bh ADCIN10 (non-inverting) and ADCIN11 (inverting) Ch ADCIN12 (non-inverting) and ADCIN13 (inverting) Dh ADCIN12 (non-inverting) and ADCIN13 (inverting) Eh ADCIN14 (non-inverting) and ADCIN15 (inverting) Fh ADCIN14 (non-inverting) and ADCIN15 (inverting)</p> <p>Reset type: SYSRSn</p>
14-9	RESERVED	R	0h	Reserved
8-0	ACQPS	R/W	0h	<p>SOC12 Acquisition Prescale. Controls the sample and hold window for this SOC. The configured acquisition time must be at least as long as one ADCCLK cycle for correct ADC operation. The device datasheet will also specify a minimum sample and hold window duration.</p> <p>000h Sample window is 1 system clock cycle wide 001h Sample window is 2 system clock cycles wide 002h Sample window is 3 system clock cycles wide ... 1FFh Sample window is 512 system clock cycles wide</p> <p>Reset type: SYSRSn</p>

**9.4.2.30 ADCSOC13CTL\_1 Register (Offset = 2Ah) [reset = 0h]**

ADCSOC13CTL\_1 is shown in [Figure 9-54](#) and described in [Table 9-44](#).

Return to [Summary Table](#).

ADC SOC13 Control Register

**Figure 9-54. ADCSOC13CTL\_1 Register**

31	30	29	28	27	26	25	24
RESERVED							TRIGSEL
R-0h							R/W-0h
23	22	21	20	19	18	17	16
TRIGSEL				RESERVED	CHSEL		
R/W-0h				R-0h	R/W-0h		
15	14	13	12	11	10	9	8
CHSEL	RESERVED						ACQPS
R/W-0h	R-0h						R/W-0h
7	6	5	4	3	2	1	0
ACQPS							
R/W-0h							

**Table 9-44. ADCSOC13CTL\_1 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-25	RESERVED	R	0h	Reserved

**Table 9-44. ADCSOC13CTL\_1 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
24-20	TRIGSEL	R/W	0h	<p>SOC13 Trigger Source Select. Along with the SOC13 field in the ADCINTSOCSEL1 register, this bit field configures which trigger will set the SOC13 flag in the ADCSOCFLG1 register to initiate a conversion to start once priority is given to it.</p> <p>00h ADCTRIG0 - Software only            01h ADCTRIG1 - CPU1 Timer 0, TINT0n            02h ADCTRIG2 - CPU1 Timer 1, TINT1n            03h ADCTRIG3 - CPU1 Timer 2, TINT2n            04h ADCTRIG4 - GPIO, ADCEXTSOC            05h ADCTRIG5 - ePWM1, ADCSOCA            06h ADCTRIG6 - ePWM1, ADCSOCA            07h ADCTRIG7 - ePWM2, ADCSOCA            08h ADCTRIG8 - ePWM2, ADCSOCA            09h ADCTRIG9 - ePWM3, ADCSOCA            0Ah ADCTRIG10 - ePWM3, ADCSOCA            0Bh ADCTRIG11 - ePWM4, ADCSOCA            0Ch ADCTRIG12 - ePWM4, ADCSOCA            0Dh ADCTRIG13 - ePWM5, ADCSOCA            0Eh ADCTRIG14 - ePWM5, ADCSOCA            0Fh ADCTRIG15 - ePWM6, ADCSOCA            10h ADCTRIG16 - ePWM6, ADCSOCA            11h ADCTRIG17 - ePWM7, ADCSOCA            12h ADCTRIG18 - ePWM7, ADCSOCA            13h ADCTRIG19 - ePWM8, ADCSOCA            14h ADCTRIG20 - ePWM8, ADCSOCA            15h ADCTRIG21 - ePWM9, ADCSOCA            16h ADCTRIG22 - ePWM9, ADCSOCA            17h ADCTRIG23 - ePWM10, ADCSOCA            18h ADCTRIG24 - ePWM10, ADCSOCA            19h ADCTRIG25 - ePWM11, ADCSOCA            1Ah ADCTRIG26 - ePWM11, ADCSOCA            1Bh ADCTRIG27 - ePWM12, ADCSOCA            1Ch ADCTRIG28 - ePWM12, ADCSOCA            1Dh - 1Fh - Reserved</p> <p>Reset type: SYSRSn</p>
19	RESERVED	R	0h	Reserved

**Table 9-44. ADCSOC13CTL\_1 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
18-15	CHSEL	R/W	0h	<p>SOC13 Channel Select. Selects the channel to be converted when SOC13 is received by the ADC.</p> <p>Single-ended Signaling Mode (SIGNALMODE = 0):</p> <p>0h ADCIN0 1h ADCIN1 2h ADCIN2 3h ADCIN3 4h ADCIN4 5h ADCIN5 6h ADCIN6 7h ADCIN7 8h ADCIN8 9h ADCIN9 Ah ADCIN10 Bh ADCIN11 Ch ADCIN12 Dh ADCIN13 Eh ADCIN14 Fh ADCIN15</p> <p>Differential Signaling Mode (SIGNALMODE = 1):</p> <p>0h ADCIN0 (non-inverting) and ADCIN1 (inverting) 1h ADCIN0 (non-inverting) and ADCIN1 (inverting) 2h ADCIN2 (non-inverting) and ADCIN3 (inverting) 3h ADCIN2 (non-inverting) and ADCIN3 (inverting) 4h ADCIN4 (non-inverting) and ADCIN5 (inverting) 5h ADCIN4 (non-inverting) and ADCIN5 (inverting) 6h ADCIN6 (non-inverting) and ADCIN7 (inverting) 7h ADCIN6 (non-inverting) and ADCIN7 (inverting) 8h ADCIN8 (non-inverting) and ADCIN9 (inverting) 9h ADCIN8 (non-inverting) and ADCIN9 (inverting) Ah ADCIN10 (non-inverting) and ADCIN11 (inverting) Bh ADCIN10 (non-inverting) and ADCIN11 (inverting) Ch ADCIN12 (non-inverting) and ADCIN13 (inverting) Dh ADCIN12 (non-inverting) and ADCIN13 (inverting) Eh ADCIN14 (non-inverting) and ADCIN15 (inverting) Fh ADCIN14 (non-inverting) and ADCIN15 (inverting) Reset type: SYSRSn</p>
14-9	RESERVED	R	0h	Reserved
8-0	ACQPS	R/W	0h	<p>SOC13 Acquisition Prescale. Controls the sample and hold window for this SOC. The configured acquisition time must be at least as long as one ADCCLK cycle for correct ADC operation. The device datasheet will also specify a minimum sample and hold window duration.</p> <p>000h Sample window is 1 system clock cycle wide 001h Sample window is 2 system clock cycles wide 002h Sample window is 3 system clock cycles wide ... 1FFh Sample window is 512 system clock cycles wide Reset type: SYSRSn</p>

**9.4.2.31 ADCSOC14CTL\_1 Register (Offset = 2Ch) [reset = 0h]**

ADCSOC14CTL\_1 is shown in [Figure 9-55](#) and described in [Table 9-45](#).

Return to [Summary Table](#).

ADC SOC14 Control Register

**Figure 9-55. ADCSOC14CTL\_1 Register**

31	30	29	28	27	26	25	24
RESERVED							TRIGSEL
R-0h							R/W-0h
23	22	21	20	19	18	17	16
TRIGSEL				RESERVED	CHSEL		
R/W-0h				R-0h	R/W-0h		
15	14	13	12	11	10	9	8
CHSEL	RESERVED						ACQPS
R/W-0h	R-0h						R/W-0h
7	6	5	4	3	2	1	0
ACQPS							
R/W-0h							

**Table 9-45. ADCSOC14CTL\_1 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-25	RESERVED	R	0h	Reserved



**Table 9-45. ADCSOC14CTL\_1 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
24-20	TRIGSEL	R/W	0h	<p>SOC14 Trigger Source Select. Along with the SOC14 field in the ADCINTSOCSEL1 register, this bit field configures which trigger will set the SOC14 flag in the ADCSOCFLG1 register to initiate a conversion to start once priority is given to it.</p> <p>00h ADCTRIG0 - Software only            01h ADCTRIG1 - CPU1 Timer 0, TINT0n            02h ADCTRIG2 - CPU1 Timer 1, TINT1n            03h ADCTRIG3 - CPU1 Timer 2, TINT2n            04h ADCTRIG4 - GPIO, ADCEXTSOC            05h ADCTRIG5 - ePWM1, ADCSOCA            06h ADCTRIG6 - ePWM1, ADCSOCA            07h ADCTRIG7 - ePWM2, ADCSOCA            08h ADCTRIG8 - ePWM2, ADCSOCA            09h ADCTRIG9 - ePWM3, ADCSOCA            0Ah ADCTRIG10 - ePWM3, ADCSOCA            0Bh ADCTRIG11 - ePWM4, ADCSOCA            0Ch ADCTRIG12 - ePWM4, ADCSOCA            0Dh ADCTRIG13 - ePWM5, ADCSOCA            0Eh ADCTRIG14 - ePWM5, ADCSOCA            0Fh ADCTRIG15 - ePWM6, ADCSOCA            10h ADCTRIG16 - ePWM6, ADCSOCA            11h ADCTRIG17 - ePWM7, ADCSOCA            12h ADCTRIG18 - ePWM7, ADCSOCA            13h ADCTRIG19 - ePWM8, ADCSOCA            14h ADCTRIG20 - ePWM8, ADCSOCA            15h ADCTRIG21 - ePWM9, ADCSOCA            16h ADCTRIG22 - ePWM9, ADCSOCA            17h ADCTRIG23 - ePWM10, ADCSOCA            18h ADCTRIG24 - ePWM10, ADCSOCA            19h ADCTRIG25 - ePWM11, ADCSOCA            1Ah ADCTRIG26 - ePWM11, ADCSOCA            1Bh ADCTRIG27 - ePWM12, ADCSOCA            1Ch ADCTRIG28 - ePWM12, ADCSOCA            1Dh - 1Fh - Reserved            Reset type: SYSRSn</p>
19	RESERVED	R	0h	Reserved

**Table 9-45. ADCSOC14CTL\_1 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
18-15	CHSEL	R/W	0h	<p>SOC14 Channel Select. Selects the channel to be converted when SOC14 is received by the ADC.</p> <p>Single-ended Signaling Mode (SIGNALMODE = 0):</p> <p>0h ADCIN0                      1h ADCIN1                      2h ADCIN2                      3h ADCIN3                      4h ADCIN4                      5h ADCIN5                      6h ADCIN6                      7h ADCIN7                      8h ADCIN8                      9h ADCIN9                      Ah ADCIN10                      Bh ADCIN11                      Ch ADCIN12                      Dh ADCIN13                      Eh ADCIN14                      Fh ADCIN15</p> <p>Differential Signaling Mode (SIGNALMODE = 1):</p> <p>0h ADCIN0 (non-inverting) and ADCIN1 (inverting)                      1h ADCIN0 (non-inverting) and ADCIN1 (inverting)                      2h ADCIN2 (non-inverting) and ADCIN3 (inverting)                      3h ADCIN2 (non-inverting) and ADCIN3 (inverting)                      4h ADCIN4 (non-inverting) and ADCIN5 (inverting)                      5h ADCIN4 (non-inverting) and ADCIN5 (inverting)                      6h ADCIN6 (non-inverting) and ADCIN7 (inverting)                      7h ADCIN6 (non-inverting) and ADCIN7 (inverting)                      8h ADCIN8 (non-inverting) and ADCIN9 (inverting)                      9h ADCIN8 (non-inverting) and ADCIN9 (inverting)                      Ah ADCIN10 (non-inverting) and ADCIN11 (inverting)                      Bh ADCIN10 (non-inverting) and ADCIN11 (inverting)                      Ch ADCIN12 (non-inverting) and ADCIN13 (inverting)                      Dh ADCIN12 (non-inverting) and ADCIN13 (inverting)                      Eh ADCIN14 (non-inverting) and ADCIN15 (inverting)                      Fh ADCIN14 (non-inverting) and ADCIN15 (inverting)</p> <p>Reset type: SYSRSn</p>
14-9	RESERVED	R	0h	Reserved
8-0	ACQPS	R/W	0h	<p>SOC14 Acquisition Prescale. Controls the sample and hold window for this SOC. The configured acquisition time must be at least as long as one ADCCLK cycle for correct ADC operation. The device datasheet will also specify a minimum sample and hold window duration.</p> <p>000h Sample window is 1 system clock cycle wide                      001h Sample window is 2 system clock cycles wide                      002h Sample window is 3 system clock cycles wide                      ...                      1FFh Sample window is 512 system clock cycles wide</p> <p>Reset type: SYSRSn</p>

**9.4.2.32 ADCSOC15CTL\_1 Register (Offset = 2Eh) [reset = 0h]**

ADCSOC15CTL\_1 is shown in [Figure 9-56](#) and described in [Table 9-46](#).

Return to [Summary Table](#).

ADC SOC15 Control Register

**Figure 9-56. ADCSOC15CTL\_1 Register**

31	30	29	28	27	26	25	24
RESERVED							TRIGSEL
R-0h							R/W-0h
23	22	21	20	19	18	17	16
TRIGSEL				RESERVED	CHSEL		
R/W-0h				R-0h	R/W-0h		
15	14	13	12	11	10	9	8
CHSEL	RESERVED						ACQPS
R/W-0h	R-0h						R/W-0h
7	6	5	4	3	2	1	0
ACQPS							
R/W-0h							

**Table 9-46. ADCSOC15CTL\_1 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-25	RESERVED	R	0h	Reserved

**Table 9-46. ADCSOC15CTL\_1 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
24-20	TRIGSEL	R/W	0h	<p>SOC15 Trigger Source Select. Along with the SOC15 field in the ADCINTSOCSEL1 register, this bit field configures which trigger will set the SOC15 flag in the ADCSOCFLG1 register to initiate a conversion to start once priority is given to it.</p> <p>00h ADCTRIG0 - Software only            01h ADCTRIG1 - CPU1 Timer 0, TINT0n            02h ADCTRIG2 - CPU1 Timer 1, TINT1n            03h ADCTRIG3 - CPU1 Timer 2, TINT2n            04h ADCTRIG4 - GPIO, ADCEXTSOC            05h ADCTRIG5 - ePWM1, ADCSOCA            06h ADCTRIG6 - ePWM1, ADCSOCA            07h ADCTRIG7 - ePWM2, ADCSOCA            08h ADCTRIG8 - ePWM2, ADCSOCA            09h ADCTRIG9 - ePWM3, ADCSOCA            0Ah ADCTRIG10 - ePWM3, ADCSOCA            0Bh ADCTRIG11 - ePWM4, ADCSOCA            0Ch ADCTRIG12 - ePWM4, ADCSOCA            0Dh ADCTRIG13 - ePWM5, ADCSOCA            0Eh ADCTRIG14 - ePWM5, ADCSOCA            0Fh ADCTRIG15 - ePWM6, ADCSOCA            10h ADCTRIG16 - ePWM6, ADCSOCA            11h ADCTRIG17 - ePWM7, ADCSOCA            12h ADCTRIG18 - ePWM7, ADCSOCA            13h ADCTRIG19 - ePWM8, ADCSOCA            14h ADCTRIG20 - ePWM8, ADCSOCA            15h ADCTRIG21 - ePWM9, ADCSOCA            16h ADCTRIG22 - ePWM9, ADCSOCA            17h ADCTRIG23 - ePWM10, ADCSOCA            18h ADCTRIG24 - ePWM10, ADCSOCA            19h ADCTRIG25 - ePWM11, ADCSOCA            1Ah ADCTRIG26 - ePWM11, ADCSOCA            1Bh ADCTRIG27 - ePWM12, ADCSOCA            1Ch ADCTRIG28 - ePWM12, ADCSOCA            1Dh - 1Fh - Reserved</p> <p>Reset type: SYSRSn</p>
19	RESERVED	R	0h	Reserved

**Table 9-46. ADCSOC15CTL\_1 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
18-15	CHSEL	R/W	0h	<p>SOC15 Channel Select. Selects the channel to be converted when SOC15 is received by the ADC.</p> <p>Single-ended Signaling Mode (SIGNALMODE = 0):</p> <p>0h ADCIN0 1h ADCIN1 2h ADCIN2 3h ADCIN3 4h ADCIN4 5h ADCIN5 6h ADCIN6 7h ADCIN7 8h ADCIN8 9h ADCIN9 Ah ADCIN10 Bh ADCIN11 Ch ADCIN12 Dh ADCIN13 Eh ADCIN14 Fh ADCIN15</p> <p>Differential Signaling Mode (SIGNALMODE = 1):</p> <p>0h ADCIN0 (non-inverting) and ADCIN1 (inverting) 1h ADCIN0 (non-inverting) and ADCIN1 (inverting) 2h ADCIN2 (non-inverting) and ADCIN3 (inverting) 3h ADCIN2 (non-inverting) and ADCIN3 (inverting) 4h ADCIN4 (non-inverting) and ADCIN5 (inverting) 5h ADCIN4 (non-inverting) and ADCIN5 (inverting) 6h ADCIN6 (non-inverting) and ADCIN7 (inverting) 7h ADCIN6 (non-inverting) and ADCIN7 (inverting) 8h ADCIN8 (non-inverting) and ADCIN9 (inverting) 9h ADCIN8 (non-inverting) and ADCIN9 (inverting) Ah ADCIN10 (non-inverting) and ADCIN11 (inverting) Bh ADCIN10 (non-inverting) and ADCIN11 (inverting) Ch ADCIN12 (non-inverting) and ADCIN13 (inverting) Dh ADCIN12 (non-inverting) and ADCIN13 (inverting) Eh ADCIN14 (non-inverting) and ADCIN15 (inverting) Fh ADCIN14 (non-inverting) and ADCIN15 (inverting) Reset type: SYSRSn</p>
14-9	RESERVED	R	0h	Reserved
8-0	ACQPS	R/W	0h	<p>SOC15 Acquisition Prescale. Controls the sample and hold window for this SOC. The configured acquisition time must be at least as long as one ADCCLK cycle for correct ADC operation. The device datasheet will also specify a minimum sample and hold window duration.</p> <p>000h Sample window is 1 system clock cycle wide 001h Sample window is 2 system clock cycles wide 002h Sample window is 3 system clock cycles wide ... 1FFh Sample window is 512 system clock cycles wide Reset type: SYSRSn</p>

### 9.4.2.33 ADCEVTSTAT Register (Offset = 30h) [reset = 0h]

ADCEVTSTAT is shown in [Figure 9-57](#) and described in [Table 9-47](#).

Return to [Summary Table](#).

ADC Event Status Register

**Figure 9-57. ADCEVTSTAT Register**

15	14	13	12	11	10	9	8
RESERVED	PPB4ZERO	PPB4TRIPLO	PPB4TRIPHI	RESERVED	PPB3ZERO	PPB3TRIPLO	PPB3TRIPHI
R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h
7	6	5	4	3	2	1	0
RESERVED	PPB2ZERO	PPB2TRIPLO	PPB2TRIPHI	RESERVED	PPB1ZERO	PPB1TRIPLO	PPB1TRIPHI
R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h

**Table 9-47. ADCEVTSTAT Register Field Descriptions**

Bit	Field	Type	Reset	Description
15	RESERVED	R	0h	Reserved
14	PPB4ZERO	R	0h	Post Processing Block 4 Zero Crossing Flag. When set indicates the ADCPPB4RESULT register has changed sign. This bit is gated by EOC signal. Reset type: SYSRSn
13	PPB4TRIPLO	R	0h	Post Processing Block 4 Trip Low Flag. When set indicates a digital compare trip low event has occurred. Reset type: SYSRSn
12	PPB4TRIPHI	R	0h	Post Processing Block 4 Trip High Flag. When set indicates a digital compare trip high event has occurred. Reset type: SYSRSn
11	RESERVED	R	0h	Reserved
10	PPB3ZERO	R	0h	Post Processing Block 3 Zero Crossing Flag. When set indicates the ADCPPB3RESULT register has changed sign. This bit is gated by EOC signal. Reset type: SYSRSn
9	PPB3TRIPLO	R	0h	Post Processing Block 3 Trip Low Flag. When set indicates a digital compare trip low event has occurred. Reset type: SYSRSn
8	PPB3TRIPHI	R	0h	Post Processing Block 3 Trip High Flag. When set indicates a digital compare trip high event has occurred. Reset type: SYSRSn
7	RESERVED	R	0h	Reserved
6	PPB2ZERO	R	0h	Post Processing Block 2 Zero Crossing Flag. When set indicates the ADCPPB2RESULT register has changed sign. This bit is gated by EOC signal. Reset type: SYSRSn
5	PPB2TRIPLO	R	0h	Post Processing Block 2 Trip Low Flag. When set indicates a digital compare trip low event has occurred. Reset type: SYSRSn
4	PPB2TRIPHI	R	0h	Post Processing Block 2 Trip High Flag. When set indicates a digital compare trip high event has occurred. Reset type: SYSRSn
3	RESERVED	R	0h	Reserved
2	PPB1ZERO	R	0h	Post Processing Block 1 Zero Crossing Flag. When set indicates the ADCPPB1RESULT register has changed sign. This bit is gated by EOC signal. Reset type: SYSRSn

**Table 9-47. ADCEVTSTAT Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
1	PPB1TRIPLO	R	0h	Post Processing Block 1 Trip Low Flag. When set indicates a digital compare trip low event has occurred. Reset type: SYSRSn
0	PPB1TRIPHI	R	0h	Post Processing Block 1 Trip High Flag. When set indicates a digital compare trip high event has occurred. Reset type: SYSRSn

### 9.4.2.34 ADCEVTCLR Register (Offset = 32h) [reset = 0h]

ADCEVTCLR is shown in [Figure 9-58](#) and described in [Table 9-48](#).

Return to [Summary Table](#).

ADC Event Clear Register

**Figure 9-58. ADCEVTCLR Register**

15		14		13		12		11		10		9		8	
RESERVED	PPB4ZERO	PPB4TRIPLO	PPB4TRIPHI	RESERVED	PPB3ZERO	PPB3TRIPLO	PPB3TRIPHI	RESERVED	PPB2ZERO	PPB2TRIPLO	PPB2TRIPHI	RESERVED	PPB1ZERO	PPB1TRIPLO	PPB1TRIPHI
R-0h	R/W-0h	R/W-0h	R/W-0h	R-0h	R/W-0h	R/W-0h	R/W-0h	R-0h	R/W-0h	R/W-0h	R/W-0h	R-0h	R/W-0h	R/W-0h	R/W-0h
7		6		5		4		3		2		1		0	
RESERVED	PPB2ZERO	PPB2TRIPLO	PPB2TRIPHI	RESERVED	PPB1ZERO	PPB1TRIPLO	PPB1TRIPHI	RESERVED	PPB0ZERO	PPB0TRIPLO	PPB0TRIPHI	RESERVED	PPB0ZERO	PPB0TRIPLO	PPB0TRIPHI
R-0h	R/W-0h	R/W-0h	R/W-0h	R-0h	R/W-0h	R/W-0h	R/W-0h	R-0h	R/W-0h	R/W-0h	R/W-0h	R-0h	R/W-0h	R/W-0h	R/W-0h

**Table 9-48. ADCEVTCLR Register Field Descriptions**

Bit	Field	Type	Reset	Description
15	RESERVED	R	0h	Reserved
14	PPB4ZERO	R/W	0h	Post Processing Block 4 Zero Crossing Clear. Clears the corresponding zero crossing flag in the ADCEVTSTAT register. Reset type: SYSRSn
13	PPB4TRIPLO	R/W	0h	Post Processing Block 4 Trip Low Clear. Clears the corresponding trip low flag in the ADCEVTSTAT register. Reset type: SYSRSn
12	PPB4TRIPHI	R/W	0h	Post Processing Block 4 Trip High Clear. Clears the corresponding trip high flag in the ADCEVTSTAT register. Reset type: SYSRSn
11	RESERVED	R	0h	Reserved
10	PPB3ZERO	R/W	0h	Post Processing Block 3 Zero Crossing Clear. Clears the corresponding zero crossing flag in the ADCEVTSTAT register. Reset type: SYSRSn
9	PPB3TRIPLO	R/W	0h	Post Processing Block 3 Trip Low Clear. Clears the corresponding trip low flag in the ADCEVTSTAT register. Reset type: SYSRSn
8	PPB3TRIPHI	R/W	0h	Post Processing Block 3 Trip High Clear. Clears the corresponding trip high flag in the ADCEVTSTAT register. Reset type: SYSRSn
7	RESERVED	R	0h	Reserved
6	PPB2ZERO	R/W	0h	Post Processing Block 2 Zero Crossing Clear. Clears the corresponding zero crossing flag in the ADCEVTSTAT register. Reset type: SYSRSn
5	PPB2TRIPLO	R/W	0h	Post Processing Block 2 Trip Low Clear. Clears the corresponding trip low flag in the ADCEVTSTAT register. Reset type: SYSRSn
4	PPB2TRIPHI	R/W	0h	Post Processing Block 2 Trip High Clear. Clears the corresponding trip high flag in the ADCEVTSTAT register. Reset type: SYSRSn
3	RESERVED	R	0h	Reserved
2	PPB1ZERO	R/W	0h	Post Processing Block 1 Zero Crossing Clear. Clears the corresponding zero crossing flag in the ADCEVTSTAT register. Reset type: SYSRSn
1	PPB1TRIPLO	R/W	0h	Post Processing Block 1 Trip Low Clear. Clears the corresponding trip low flag in the ADCEVTSTAT register. Reset type: SYSRSn



**Table 9-48. ADCEVTCLR Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
0	PPB1TRIPHI	R/W	0h	Post Processing Block 1 Trip High Clear. Clears the corresponding trip high flag in the ADCEVTSTAT register. Reset type: SYSRSn

**9.4.2.35 ADCEVTSEL Register (Offset = 34h) [reset = 0h]**

ADCEVTSEL is shown in [Figure 9-59](#) and described in [Table 9-49](#).

Return to [Summary Table](#).

ADC Event Selection Register

**Figure 9-59. ADCEVTSEL Register**

15		14		13		12		11		10		9		8	
RESERVED	PPB4ZERO	PPB4TRIPLO	PPB4TRIPHI	RESERVED	PPB3ZERO	PPB3TRIPLO	PPB3TRIPHI	RESERVED	PPB2ZERO	PPB2TRIPLO	PPB2TRIPHI	RESERVED	PPB1ZERO	PPB1TRIPLO	PPB1TRIPHI
R-0h	R/W-0h	R/W-0h	R/W-0h	R-0h	R/W-0h	R/W-0h	R/W-0h	R-0h	R/W-0h	R/W-0h	R/W-0h	R-0h	R/W-0h	R/W-0h	R/W-0h
7		6		5		4		3		2		1		0	
RESERVED	PPB2ZERO	PPB2TRIPLO	PPB2TRIPHI	RESERVED	PPB1ZERO	PPB1TRIPLO	PPB1TRIPHI	RESERVED	PPB0ZERO	PPB0TRIPLO	PPB0TRIPHI	RESERVED	PPB0ZERO	PPB0TRIPLO	PPB0TRIPHI
R-0h	R/W-0h	R/W-0h	R/W-0h	R-0h	R/W-0h	R/W-0h	R/W-0h	R-0h	R/W-0h	R/W-0h	R/W-0h	R-0h	R/W-0h	R/W-0h	R/W-0h

**Table 9-49. ADCEVTSEL Register Field Descriptions**

Bit	Field	Type	Reset	Description
15	RESERVED	R	0h	Reserved
14	PPB4ZERO	R/W	0h	Post Processing Block 4 Zero Crossing Event Enable. Setting this bit allows the corresponding rising zero crossing flag to activate the event signal to the PWM blocks. The flag must be cleared before it can produce additional events to the PWM blocks. Reset type: SYSRSn
13	PPB4TRIPLO	R/W	0h	Post Processing Block 4 Trip Low Event Enable. Setting this bit allows the corresponding rising trip low flag to activate the event signal to the PWM blocks. The flag must be cleared before it can produce additional events to the PWM blocks. Reset type: SYSRSn
12	PPB4TRIPHI	R/W	0h	Post Processing Block 4 Trip High Event Enable. Setting this bit allows the corresponding rising trip high flag to activate the event signal to the PWM blocks. The flag must be cleared before it can produce additional events to the PWM blocks. Reset type: SYSRSn
11	RESERVED	R	0h	Reserved
10	PPB3ZERO	R/W	0h	Post Processing Block 3 Zero Crossing Event Enable. Setting this bit allows the corresponding rising zero crossing flag to activate the event signal to the PWM blocks. The flag must be cleared before it can produce additional events to the PWM blocks. Reset type: SYSRSn
9	PPB3TRIPLO	R/W	0h	Post Processing Block 3 Trip Low Event Enable. Setting this bit allows the corresponding rising trip low flag to activate the event signal to the PWM blocks. The flag must be cleared before it can produce additional events to the PWM blocks. Reset type: SYSRSn
8	PPB3TRIPHI	R/W	0h	Post Processing Block 3 Trip High Event Enable. Setting this bit allows the corresponding rising trip high flag to activate the event signal to the PWM blocks. The flag must be cleared before it can produce additional events to the PWM blocks. Reset type: SYSRSn
7	RESERVED	R	0h	Reserved
6	PPB2ZERO	R/W	0h	Post Processing Block 2 Zero Crossing Event Enable. Setting this bit allows the corresponding rising zero crossing flag to activate the event signal to the PWM blocks. The flag must be cleared before it can produce additional events to the PWM blocks. Reset type: SYSRSn

**Table 9-49. ADCEVTSEL Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
5	PPB2TRIPLO	R/W	0h	Post Processing Block 2 Trip Low Event Enable. Setting this bit allows the corresponding rising trip low flag to activate the event signal to the PWM blocks. The flag must be cleared before it can produce additional events to the PWM blocks. Reset type: SYSRSn
4	PPB2TRIPHI	R/W	0h	Post Processing Block 2 Trip High Event Enable. Setting this bit allows the corresponding rising trip high flag to activate the event signal to the PWM blocks. The flag must be cleared before it can produce additional events to the PWM blocks. Reset type: SYSRSn
3	RESERVED	R	0h	Reserved
2	PPB1ZERO	R/W	0h	Post Processing Block 1 Zero Crossing Event Enable. Setting this bit allows the corresponding rising zero crossing flag to activate the event signal to the PWM blocks. The flag must be cleared before it can produce additional events to the PWM blocks. Reset type: SYSRSn
1	PPB1TRIPLO	R/W	0h	Post Processing Block 1 Trip Low Event Enable. Setting this bit allows the corresponding rising trip low flag to activate the event signal to the PWM blocks. The flag must be cleared before it can produce additional events to the PWM blocks. Reset type: SYSRSn
0	PPB1TRIPHI	R/W	0h	Post Processing Block 1 Trip High Event Enable. Setting this bit allows the corresponding rising trip high flag to activate the event signal to the PWM blocks. The flag must be cleared before it can produce additional events to the PWM blocks. Reset type: SYSRSn

**9.4.2.36 ADCEVTINTSEL Register (Offset = 36h) [reset = 0h]**

ADCEVTINTSEL is shown in [Figure 9-60](#) and described in [Table 9-50](#).

Return to [Summary Table](#).

ADC Event Interrupt Selection Register

**Figure 9-60. ADCEVTINTSEL Register**

15		14		13		12		11		10		9		8	
RESERVED	PPB4ZERO	PPB4TRIPLO	PPB4TRIPHI	RESERVED	PPB3ZERO	PPB3TRIPLO	PPB3TRIPHI	RESERVED	PPB2ZERO	PPB2TRIPLO	PPB2TRIPHI	RESERVED	PPB1ZERO	PPB1TRIPLO	PPB1TRIPHI
R-0h	R/W-0h	R/W-0h	R/W-0h	R-0h	R/W-0h	R/W-0h	R/W-0h	R-0h	R/W-0h	R/W-0h	R/W-0h	R-0h	R/W-0h	R/W-0h	R/W-0h
7		6		5		4		3		2		1		0	
RESERVED	PPB2ZERO	PPB2TRIPLO	PPB2TRIPHI	RESERVED	PPB1ZERO	PPB1TRIPLO	PPB1TRIPHI	RESERVED	PPB0ZERO	PPB0TRIPLO	PPB0TRIPHI	RESERVED	PPB0ZERO	PPB0TRIPLO	PPB0TRIPHI
R-0h	R/W-0h	R/W-0h	R/W-0h	R-0h	R/W-0h	R/W-0h	R/W-0h	R-0h	R/W-0h	R/W-0h	R/W-0h	R-0h	R/W-0h	R/W-0h	R/W-0h

**Table 9-50. ADCEVTINTSEL Register Field Descriptions**

Bit	Field	Type	Reset	Description
15	RESERVED	R	0h	Reserved
14	PPB4ZERO	R/W	0h	Post Processing Block 4 Zero Crossing Interrupt Enable. Setting this bit allows the corresponding rising zero crossing flag to activate the event interrupt signal to the PIE. The flag must be cleared before it can produce additional interrupts to the PIE. Reset type: SYSRSn
13	PPB4TRIPLO	R/W	0h	Post Processing Block 4 Trip Low Interrupt Enable. Setting this bit allows the corresponding rising trip low flag to activate the event interrupt signal to the PIE. The flag must be cleared before it can produce additional interrupts to the PIE. Reset type: SYSRSn
12	PPB4TRIPHI	R/W	0h	Post Processing Block 4 Trip High Interrupt Enable. Setting this bit allows the corresponding rising trip high flag to activate the event interrupt signal to the PIE. The flag must be cleared before it can produce additional interrupts to the PIE. Reset type: SYSRSn
11	RESERVED	R	0h	Reserved
10	PPB3ZERO	R/W	0h	Post Processing Block 3 Zero Crossing Interrupt Enable. Setting this bit allows the corresponding rising zero crossing flag to activate the event interrupt signal to the PIE. The flag must be cleared before it can produce additional interrupts to the PIE. Reset type: SYSRSn
9	PPB3TRIPLO	R/W	0h	Post Processing Block 3 Trip Low Interrupt Enable. Setting this bit allows the corresponding rising trip low flag to activate the event interrupt signal to the PIE. The flag must be cleared before it can produce additional interrupts to the PIE. Reset type: SYSRSn
8	PPB3TRIPHI	R/W	0h	Post Processing Block 3 Trip High Interrupt Enable. Setting this bit allows the corresponding rising trip high flag to activate the event interrupt signal to the PIE. The flag must be cleared before it can produce additional interrupts to the PIE. Reset type: SYSRSn
7	RESERVED	R	0h	Reserved
6	PPB2ZERO	R/W	0h	Post Processing Block 2 Zero Crossing Interrupt Enable. Setting this bit allows the corresponding rising zero crossing flag to activate the event interrupt signal to the PIE. The flag must be cleared before it can produce additional interrupts to the PIE. Reset type: SYSRSn

**Table 9-50. ADCEVTINTSEL Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
5	PPB2TRIPLO	R/W	0h	Post Processing Block 2 Trip Low Interrupt Enable. Setting this bit allows the corresponding rising trip low flag to activate the event interrupt signal to the PIE. The flag must be cleared before it can produce additional interrupts to the PIE. Reset type: SYSRSn
4	PPB2TRIPHI	R/W	0h	Post Processing Block 2 Trip High Interrupt Enable. Setting this bit allows the corresponding rising trip high flag to activate the event interrupt signal to the PIE. The flag must be cleared before it can produce additional interrupts to the PIE. Reset type: SYSRSn
3	RESERVED	R	0h	Reserved
2	PPB1ZERO	R/W	0h	Post Processing Block 1 Zero Crossing Interrupt Enable. Setting this bit allows the corresponding rising zero crossing flag to activate the event interrupt signal to the PIE. The flag must be cleared before it can produce additional interrupts to the PIE. Reset type: SYSRSn
1	PPB1TRIPLO	R/W	0h	Post Processing Block 1 Trip Low Interrupt Enable. Setting this bit allows the corresponding rising trip low flag to activate the event interrupt signal to the PIE. The flag must be cleared before it can produce additional interrupts to the PIE. Reset type: SYSRSn
0	PPB1TRIPHI	R/W	0h	Post Processing Block 1 Trip High Interrupt Enable. Setting this bit allows the corresponding rising trip high flag to activate the event interrupt signal to the PIE. The flag must be cleared before it can produce additional interrupts to the PIE. Reset type: SYSRSn

### 9.4.2.37 ADCCOUNTER Register (Offset = 39h) [reset = 0h]

ADCCOUNTER is shown in [Figure 9-61](#) and described in [Table 9-51](#).

Return to [Summary Table](#).

ADC Counter Register

**Figure 9-61. ADCCOUNTER Register**

15	14	13	12	11	10	9	8
RESERVED				FREECOUNT			
R-0h				R-0h			
7	6	5	4	3	2	1	0
FREECOUNT							
R-0h							

**Table 9-51. ADCCOUNTER Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-12	RESERVED	R	0h	Reserved
11-0	FREECOUNT	R	0h	ADC Free Running Counter Value. This bit field reflects the status of the free running ADC counter. Reset type: SYSRSn

**9.4.2.38 ADCREV Register (Offset = 3Ah) [reset = 4h]**

ADCREV is shown in [Figure 9-62](#) and described in [Table 9-52](#).

Return to [Summary Table](#).

ADC Revision Register

**Figure 9-62. ADCREV Register**

15	14	13	12	11	10	9	8
REV							
R-0h							
7	6	5	4	3	2	1	0
TYPE							
R-4h							

**Table 9-52. ADCREV Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-8	REV	R	0h	ADC Revision. To allow documentation of differences between revisions. First version is labeled as 00h. Reset type: SYSRSn
7-0	TYPE	R	4h	ADC Type. Always set to 4 for this ADC. Reset type: SYSRSn

**9.4.2.39 ADCOFFTRIM Register (Offset = 3Bh) [reset = 0h]**

ADCOFFTRIM is shown in [Figure 9-63](#) and described in [Table 9-53](#).

Return to [Summary Table](#).

ADC Offset Trim Register

**Figure 9-63. ADCOFFTRIM Register**

15	14	13	12	11	10	9	8
RESERVED							
R-0h							
7	6	5	4	3	2	1	0
OFFTRIM							
R/W-0h							

**Table 9-53. ADCOFFTRIM Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-8	RESERVED	R	0h	Reserved
7-0	OFFTRIM	R/W	0h	ADC Offset Trim. Adjusts the conversion results of the converter up or down to account for offset error in the ADC. A different offset trim is required for each combination of resolution and signal mode. Using the <code>AdcSetMode</code> function to set the resolution and signal mode will ensure that the correct offset trim is loaded.  Range is +127 steps to -128 steps (2's compliment format).  Regardless of the converter resolution, the size of each trim step is $(VREFHI-VREFLO)/65536$ .  Reset type: SYSRSn



#### 9.4.2.40 ADCPPB1CONFIG Register (Offset = 40h) [reset = 0h]

ADCPPB1CONFIG is shown in [Figure 9-64](#) and described in [Table 9-54](#).

Return to [Summary Table](#).

ADC PPB1 Config Register

**Figure 9-64. ADCPPB1CONFIG Register**

15	14	13	12	11	10	9	8
RESERVED							
R-0h							
7	6	5	4	3	2	1	0
RESERVED		CBCEN	TWOSCOMPEN	CONFIG			
R-0h		R/W-0h	R/W-0h	R/W-0h			

**Table 9-54. ADCPPB1CONFIG Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-6	RESERVED	R	0h	Reserved
5	CBCEN	R/W	0h	ADC Post Processing Block Cycle By Cycle Enable. When set, this bit enables the post conversion hardware processing circuit to automatically clear the ADCEVTSTAT on a conversion if the event condition is no longer present. Reset type: SYSRSn
4	TWOSCOMPEN	R/W	0h	ADC Post Processing Block 1 Two's Complement Enable. When set this bit enables the post conversion hardware processing circuit that performs a two's complement on the output of the offset/reference subtraction unit before storing the result in the ADCPPB1RESULT register.  0 ADCPPB1RESULT = ADCRESULTx - ADCPPB1OFFREF 1 ADCPPB1RESULT = ADCPPB1OFFREF - ADCRESULTx Reset type: SYSRSn

**Table 9-54. ADCPPB1CONFIG Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
3-0	CONFIG	R/W	0h	ADC Post Processing Block 1 Configuration. This bit field defines which SOC/EOC/RESULT is associated with this post processing block.  0000 SOC0/EOC0/RESULT0 is associated with post processing block 1 0001 SOC1/EOC1/RESULT1 is associated with post processing block 1 0010 SOC2/EOC2/RESULT2 is associated with post processing block 1 0011 SOC3/EOC3/RESULT3 is associated with post processing block 1 0100 SOC4/EOC4/RESULT4 is associated with post processing block 1 0101 SOC5/EOC5/RESULT5 is associated with post processing block 1 0110 SOC6/EOC6/RESULT6 is associated with post processing block 1 0111 SOC7/EOC7/RESULT7 is associated with post processing block 1 1000 SOC8/EOC8/RESULT8 is associated with post processing block 1 1001 SOC9/EOC9/RESULT9 is associated with post processing block 1 1010 SOC10/EOC10/RESULT10 is associated with post processing block 1 1011 SOC11/EOC11/RESULT11 is associated with post processing block 1 1100 SOC12/EOC12/RESULT12 is associated with post processing block 1 1101 SOC13/EOC13/RESULT13 is associated with post processing block 1 1110 SOC14/EOC14/RESULT14 is associated with post processing block 1 1111 SOC15/EOC15/RESULT15 is associated with post processing block 1 Reset type: SYSRSn

**9.4.2.41 ADCPPB1STAMP Register (Offset = 41h) [reset = 0h]**

ADCPPB1STAMP is shown in [Figure 9-65](#) and described in [Table 9-55](#).

Return to [Summary Table](#).

ADC PPB1 Sample Delay Time Stamp Register

**Figure 9-65. ADCPPB1STAMP Register**

15	14	13	12	11	10	9	8
RESERVED				DLYSTAMP			
R-0h				R-0h			
7	6	5	4	3	2	1	0
DLYSTAMP							
R-0h							

**Table 9-55. ADCPPB1STAMP Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-12	RESERVED	R	0h	Reserved
11-0	DLYSTAMP	R	0h	ADC Post Processing Block 1 Delay Time Stamp. When an SOC starts sampling the value contained in REQSTAMP is subtracted from the value in ADCCOUNTER.FREECOUNT and loaded into this bit field, thereby giving the number of system clock cycles delay between the SOC trigger and the actual start of the sample. Reset type: SYSRSn

**9.4.2.42 ADCPPB1OFFCAL Register (Offset = 42h) [reset = 0h]**

ADCPPB1OFFCAL is shown in [Figure 9-66](#) and described in [Table 9-56](#).

Return to [Summary Table](#).

ADC PPB1 Offset Calibration Register

**Figure 9-66. ADCPPB1OFFCAL Register**

15	14	13	12	11	10	9	8
RESERVED						OFFCAL	
R-0h						R/W-0h	
7	6	5	4	3	2	1	0
OFFCAL							
R/W-0h							

**Table 9-56. ADCPPB1OFFCAL Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-10	RESERVED	R	0h	Reserved
9-0	OFFCAL	R/W	0h	<p>ADC Post Processing Block 1 Offset Correction. This bit field can be used to digitally remove any system level offset inherent in the ADCIN circuit. This 10-bit signed value is subtracted from the ADC output before being stored in the ADCRESULT register.</p> <p>000h No change. The ADC output is stored directly into ADCRESULT.</p> <p>001h ADC output - 1 is stored into ADCRESULT.</p> <p>002h ADC output - 2 is stored into ADCRESULT.</p> <p>...</p> <p>200h ADC output + 512 is stored into ADCRESULT.</p> <p>...</p> <p>3FFh ADC output + 1 is stored into ADCRESULT.</p> <p>NOTE: In 16-bit mode, the subtraction will saturate at 0000h and FFFFh before being stored into the ADCRESULT register. In 12-bit mode, the subtraction will saturate at 0000h and 0FFFh before being stored into the ADCRESULT register.</p> <p>Reset type: SYSRSn</p>

### 9.4.2.43 ADCPPB1OFFREF Register (Offset = 43h) [reset = 0h]

ADCPPB1OFFREF is shown in [Figure 9-67](#) and described in [Table 9-57](#).

Return to [Summary Table](#).

ADC PPB1 Offset Reference Register

**Figure 9-67. ADCPPB1OFFREF Register**

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
OFFREF															
R/W-0h															

**Table 9-57. ADCPPB1OFFREF Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-0	OFFREF	R/W	0h	<p>ADC Post Processing Block 1 Offset Correction. This bit field can be used to either calculate the feedback error or convert a unipolar signal to bipolar by subtracting a reference value. This 16-bit unsigned value is subtracted from the ADCRESULT register before being passed through an optional two's complement function and stored in the ADCPPB1RESULT register. This subtraction is not saturated.</p> <p>0000h No change. The ADCRESULT value is passed on.            0001h ADCRESULT - 1 is passed on.            0002h ADCRESULT - 2 is passed on.            ...            8000h ADCRESULT - 32,768 is passed on.            ...            FFFFh ADCRESULT - 65,535 is passed on.</p> <p>NOTE: In 12-bit mode the size of this register does not change from 16-bits. It is the user's responsibility to ensure that only a 12-bit value is written to this register when in 12-bit mode.            Reset type: SYSRSn</p>

**9.4.2.44 ADCPPB1TRIPHI Register (Offset = 44h) [reset = 0h]**

ADCPPB1TRIPHI is shown in [Figure 9-68](#) and described in [Table 9-58](#).

Return to [Summary Table](#).

ADC PPB1 Trip High Register

**Figure 9-68. ADCPPB1TRIPHI Register**

31	30	29	28	27	26	25	24
RESERVED							
R-0h							
23	22	21	20	19	18	17	16
RESERVED							HSIGN
R-0h							R/W-0h
15	14	13	12	11	10	9	8
LIMITHI							
R/W-0h							
7	6	5	4	3	2	1	0
LIMITHI							
R/W-0h							

**Table 9-58. ADCPPB1TRIPHI Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-17	RESERVED	R	0h	Reserved
16	HSIGN	R/W	0h	High Limit Sign Bit. This is the sign bit (17th bit) to the LIMITHI bit field when in 16-bit ADC mode. Reset type: SYSRSn
15-0	LIMITHI	R/W	0h	ADC Post Processing Block 1 Trip High Limit. This value sets the digital comparator trip high limit. In 16-bit mode all 17 bits will be compared against the 17 bits of the PPBRESULT bit field of the ADCPPB1RESULT register. In 12-bit mode bits 12:0 will be compared against bits 12:0 of the PPBRESULT bit field of the ADCPPB1RESULT register. Reset type: SYSRSn

#### 9.4.2.45 ADCPPB1TRIPLO Register (Offset = 46h) [reset = 0h]

ADCPPB1TRIPLO is shown in [Figure 9-69](#) and described in [Table 9-59](#).

Return to [Summary Table](#).

ADC PPB1 Trip Low/Trigger Time Stamp Register

**Figure 9-69. ADCPPB1TRIPLO Register**

31	30	29	28	27	26	25	24
REQSTAMP							
R-0h							
23	22	21	20	19	18	17	16
REQSTAMP				RESERVED			LSIGN
R-0h				R-0h			R/W-0h
15	14	13	12	11	10	9	8
LIMITLO							
R/W-0h							
7	6	5	4	3	2	1	0
LIMITLO							
R/W-0h							

**Table 9-59. ADCPPB1TRIPLO Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-20	REQSTAMP	R	0h	ADC Post Processing Block 1 Request Time Stamp. When a trigger sets the associated SOC flag in the ADCSOCFLG1 register the value of ADCCOUNTER.FREECOUNT is loaded into this bit field. Reset type: SYSRSn
19-17	RESERVED	R	0h	Reserved
16	LSIGN	R/W	0h	Low Limit Sign Bit. This is the sign bit (17th bit) to the LIMITLO bit field when in 16-bit ADC mode. Reset type: SYSRSn
15-0	LIMITLO	R/W	0h	ADC Post Processing Block 1 Trip Low Limit. This value sets the digital comparator trip low limit. In 16-bit mode all 17 bits will be compared against the 17 bits of the PPBRESULT bit field of the ADCPPB1RESULT register. In 12-bit mode bits 12:0 will be compared against bits 12:0 of the PPBRESULT bit field of the ADCPPB1RESULT register. Reset type: SYSRSn

**9.4.2.46 ADCPPB2CONFIG Register (Offset = 48h) [reset = 0h]**

ADCPPB2CONFIG is shown in [Figure 9-70](#) and described in [Table 9-60](#).

Return to [Summary Table](#).

ADC PPB2 Config Register

**Figure 9-70. ADCPPB2CONFIG Register**

15	14	13	12	11	10	9	8
RESERVED							
R-0h							
7	6	5	4	3	2	1	0
RESERVED		CBCEN	TWOSCOMPEN	CONFIG			
R-0h		R/W-0h	R/W-0h	R/W-0h			

**Table 9-60. ADCPPB2CONFIG Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-6	RESERVED	R	0h	Reserved
5	CBCEN	R/W	0h	ADC Post Processing Block Cycle By Cycle Enable. When set, this bit enables the post conversion hardware processing circuit to automatically clear the ADCEVTSTAT on a conversion if the event condition is no longer present. Reset type: SYSRSn
4	TWOSCOMPEN	R/W	0h	ADC Post Processing Block 2 Two's Complement Enable. When set this bit enables the post conversion hardware processing circuit that performs a two's complement on the output of the offset/reference subtraction unit before storing the result in the ADCPPB2RESULT register.  0 ADCPPB2RESULT = ADCRESULTx - ADCPPB2OFFREF 1 ADCPPB2RESULT = ADCPPB2OFFREF - ADCRESULTx Reset type: SYSRSn



**Table 9-60. ADCPPB2CONFIG Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
3-0	CONFIG	R/W	0h	<p>ADC Post Processing Block 2 Configuration. This bit field defines which SOC/EOC/RESULT is associated with this post processing block.</p> <p>0000 SOC0/EOC0/RESULT0 is associated with post processing block 2</p> <p>0001 SOC1/EOC1/RESULT1 is associated with post processing block 2</p> <p>0010 SOC2/EOC2/RESULT2 is associated with post processing block 2</p> <p>0011 SOC3/EOC3/RESULT3 is associated with post processing block 2</p> <p>0100 SOC4/EOC4/RESULT4 is associated with post processing block 2</p> <p>0101 SOC5/EOC5/RESULT5 is associated with post processing block 2</p> <p>0110 SOC6/EOC6/RESULT6 is associated with post processing block 2</p> <p>0111 SOC7/EOC7/RESULT7 is associated with post processing block 2</p> <p>1000 SOC8/EOC8/RESULT8 is associated with post processing block 2</p> <p>1001 SOC9/EOC9/RESULT9 is associated with post processing block 2</p> <p>1010 SOC10/EOC10/RESULT10 is associated with post processing block 2</p> <p>1011 SOC11/EOC11/RESULT11 is associated with post processing block 2</p> <p>1100 SOC12/EOC12/RESULT12 is associated with post processing block 2</p> <p>1101 SOC13/EOC13/RESULT13 is associated with post processing block 2</p> <p>1110 SOC14/EOC14/RESULT14 is associated with post processing block 2</p> <p>1111 SOC15/EOC15/RESULT15 is associated with post processing block 2</p> <p>Reset type: SYSRSn</p>

**9.4.2.47 ADCPPB2STAMP Register (Offset = 49h) [reset = 0h]**

ADCPPB2STAMP is shown in [Figure 9-71](#) and described in [Table 9-61](#).

Return to [Summary Table](#).

ADC PPB2 Sample Delay Time Stamp Register

**Figure 9-71. ADCPPB2STAMP Register**

15	14	13	12	11	10	9	8
RESERVED				DLYSTAMP			
R-0h				R-0h			
7	6	5	4	3	2	1	0
DLYSTAMP							
R-0h							

**Table 9-61. ADCPPB2STAMP Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-12	RESERVED	R	0h	Reserved
11-0	DLYSTAMP	R	0h	ADC Post Processing Block 2 Delay Time Stamp. When an SOC starts sampling the value contained in REQSTAMP is subtracted from the value in ADCCOUNTER.FREECOUNT and loaded into this bit field, thereby giving the number of system clock cycles delay between the SOC trigger and the actual start of the sample. Reset type: SYSRSn

**9.4.2.48 ADCPPB2OFFCAL Register (Offset = 4Ah) [reset = 0h]**

 ADCPPB2OFFCAL is shown in [Figure 9-72](#) and described in [Table 9-62](#).

 Return to [Summary Table](#).

ADC PPB2 Offset Calibration Register

**Figure 9-72. ADCPPB2OFFCAL Register**

15	14	13	12	11	10	9	8
RESERVED						OFFCAL	
R-0h						R/W-0h	
7	6	5	4	3	2	1	0
OFFCAL							
R/W-0h							

**Table 9-62. ADCPPB2OFFCAL Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-10	RESERVED	R	0h	Reserved
9-0	OFFCAL	R/W	0h	<p>ADC Post Processing Block 2 Offset Correction. This bit field can be used to digitally remove any system level offset inherent in the ADCIN circuit. This 10-bit signed value is subtracted from the ADC output before being stored in the ADCRESULT register.</p> <p>000h No change. The ADC output is stored directly into ADCRESULT.</p> <p>001h ADC output - 1 is stored into ADCRESULT.</p> <p>002h ADC output - 2 is stored into ADCRESULT.</p> <p>...</p> <p>200h ADC output + 512 is stored into ADCRESULT.</p> <p>...</p> <p>3FFh ADC output + 1 is stored into ADCRESULT.</p> <p>NOTE: In 16-bit mode, the subtraction will saturate at 0000h and FFFFh before being stored into the ADCRESULT register. In 12-bit mode, the subtraction will saturate at 0000h and 0FFFh before being stored into the ADCRESULT register.</p> <p>Reset type: SYSRSn</p>

**9.4.2.49 ADCPPB2OFFREF Register (Offset = 4Bh) [reset = 0h]**

ADCPPB2OFFREF is shown in [Figure 9-73](#) and described in [Table 9-63](#).

Return to [Summary Table](#).

ADC PPB2 Offset Reference Register

**Figure 9-73. ADCPPB2OFFREF Register**

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
OFFREF															
R/W-0h															

**Table 9-63. ADCPPB2OFFREF Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-0	OFFREF	R/W	0h	<p>ADC Post Processing Block 2 Offset Correction. This bit field can be used to either calculate the feedback error or convert a unipolar signal to bipolar by subtracting a reference value. This 16-bit unsigned value is subtracted from the ADCRESULT register before being passed through an optional two's complement function and stored in the ADCPPB2RESULT register. This subtraction is not saturated.</p> <p>0000h No change. The ADCRESULT value is passed on.                      0001h ADCRESULT - 1 is passed on.                      0002h ADCRESULT - 2 is passed on.                      ...                      8000h ADCRESULT - 32,768 is passed on.                      ...                      FFFFh ADCRESULT - 65,535 is passed on.</p> <p>NOTE: In 12-bit mode the size of this register does not change from 16-bits. It is the user's responsibility to ensure that only a 12-bit value is written to this register when in 12-bit mode.                      Reset type: SYSRSn</p>

#### 9.4.2.50 ADCPPB2TRIPHI Register (Offset = 4Ch) [reset = 0h]

ADCPPB2TRIPHI is shown in [Figure 9-74](#) and described in [Table 9-64](#).

Return to [Summary Table](#).

ADC PPB2 Trip High Register

**Figure 9-74. ADCPPB2TRIPHI Register**

31	30	29	28	27	26	25	24
RESERVED							
R-0h							
23	22	21	20	19	18	17	16
RESERVED							HSIGN
R-0h							R/W-0h
15	14	13	12	11	10	9	8
LIMITHI							
R/W-0h							
7	6	5	4	3	2	1	0
LIMITHI							
R/W-0h							

**Table 9-64. ADCPPB2TRIPHI Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-17	RESERVED	R	0h	Reserved
16	HSIGN	R/W	0h	High Limit Sign Bit. This is the sign bit (17th bit) to the LIMITHI bit field when in 16-bit ADC mode. Reset type: SYSRSn
15-0	LIMITHI	R/W	0h	ADC Post Processing Block 2 Trip High Limit. This value sets the digital comparator trip high limit. In 16-bit mode all 17 bits will be compared against the 17 bits of the PPBRESULT bit field of the ADCPPB2RESULT register. In 12-bit mode bits 12:0 will be compared against bits 12:0 of the PPBRESULT bit field of the ADCPPB2RESULT register. Reset type: SYSRSn

**9.4.2.51 ADCPPB2TRIPLO Register (Offset = 4Eh) [reset = 0h]**

ADCPPB2TRIPLO is shown in [Figure 9-75](#) and described in [Table 9-65](#).

Return to [Summary Table](#).

ADC PPB2 Trip Low/Trigger Time Stamp Register

**Figure 9-75. ADCPPB2TRIPLO Register**

31	30	29	28	27	26	25	24
REQSTAMP							
R-0h							
23	22	21	20	19	18	17	16
REQSTAMP				RESERVED			LSIGN
R-0h				R-0h			R/W-0h
15	14	13	12	11	10	9	8
LIMITLO							
R/W-0h							
7	6	5	4	3	2	1	0
LIMITLO							
R/W-0h							

**Table 9-65. ADCPPB2TRIPLO Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-20	REQSTAMP	R	0h	ADC Post Processing Block 2 Request Time Stamp. When a trigger sets the associated SOC flag in the ADCSOCFLG1 register the value of ADCCOUNTER.FREECOUNT is loaded into this bit field. Reset type: SYSRSn
19-17	RESERVED	R	0h	Reserved
16	LSIGN	R/W	0h	Low Limit Sign Bit. This is the sign bit (17th bit) to the LIMITLO bit field when in 16-bit ADC mode. Reset type: SYSRSn
15-0	LIMITLO	R/W	0h	ADC Post Processing Block 2 Trip Low Limit. This value sets the digital comparator trip low limit. In 16-bit mode all 17 bits will be compared against the 17 bits of the PPBRESULT bit field of the ADCPPB2RESULT register. In 12-bit mode bits 12:0 will be compared against bits 12:0 of the PPBRESULT bit field of the ADCPPB2RESULT register. Reset type: SYSRSn

### 9.4.2.52 ADCPPB3CONFIG Register (Offset = 50h) [reset = 0h]

ADCPPB3CONFIG is shown in [Figure 9-76](#) and described in [Table 9-66](#).

Return to [Summary Table](#).

ADC PPB3 Config Register

**Figure 9-76. ADCPPB3CONFIG Register**

15	14	13	12	11	10	9	8
RESERVED							
R-0h							
7	6	5	4	3	2	1	0
RESERVED		CBCEN	TWOSCOMPEN	CONFIG			
R-0h		R/W-0h	R/W-0h	R/W-0h			

**Table 9-66. ADCPPB3CONFIG Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-6	RESERVED	R	0h	Reserved
5	CBCEN	R/W	0h	ADC Post Processing Block Cycle By Cycle Enable. When set, this bit enables the post conversion hardware processing circuit to automatically clear the ADCEVTSTAT on a conversion if the event condition is no longer present. Reset type: SYSRSn
4	TWOSCOMPEN	R/W	0h	ADC Post Processing Block 3 Two's Complement Enable. When set this bit enables the post conversion hardware processing circuit that performs a two's complement on the output of the offset/reference subtraction unit before storing the result in the ADCPPB3RESULT register.  0 ADCPPB3RESULT = ADCRESULTx - ADCPPB3OFFREF 1 ADCPPB3RESULT = ADCPPB3OFFREF - ADCRESULTx Reset type: SYSRSn

**Table 9-66. ADCPPB3CONFIG Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
3-0	CONFIG	R/W	0h	<p>ADC Post Processing Block 3 Configuration. This bit field defines which SOC/EOC/RESULT is associated with this post processing block.</p> <p>0000 SOC0/EOC0/RESULT0 is associated with post processing block 3</p> <p>0001 SOC1/EOC1/RESULT1 is associated with post processing block 3</p> <p>0010 SOC2/EOC2/RESULT2 is associated with post processing block 3</p> <p>0011 SOC3/EOC3/RESULT3 is associated with post processing block 3</p> <p>0100 SOC4/EOC4/RESULT4 is associated with post processing block 3</p> <p>0101 SOC5/EOC5/RESULT5 is associated with post processing block 3</p> <p>0110 SOC6/EOC6/RESULT6 is associated with post processing block 3</p> <p>0111 SOC7/EOC7/RESULT7 is associated with post processing block 3</p> <p>1000 SOC8/EOC8/RESULT8 is associated with post processing block 3</p> <p>1001 SOC9/EOC9/RESULT9 is associated with post processing block 3</p> <p>1010 SOC10/EOC10/RESULT10 is associated with post processing block 3</p> <p>1011 SOC11/EOC11/RESULT11 is associated with post processing block 3</p> <p>1100 SOC12/EOC12/RESULT12 is associated with post processing block 3</p> <p>1101 SOC13/EOC13/RESULT13 is associated with post processing block 3</p> <p>1110 SOC14/EOC14/RESULT14 is associated with post processing block 3</p> <p>1111 SOC15/EOC15/RESULT15 is associated with post processing block 3</p> <p>Reset type: SYSRSn</p>



**9.4.2.53 ADCPPB3STAMP Register (Offset = 51h) [reset = 0h]**

ADCPPB3STAMP is shown in [Figure 9-77](#) and described in [Table 9-67](#).

Return to [Summary Table](#).

ADC PPB3 Sample Delay Time Stamp Register

**Figure 9-77. ADCPPB3STAMP Register**

15	14	13	12	11	10	9	8
RESERVED				DLYSTAMP			
R-0h				R-0h			
7	6	5	4	3	2	1	0
DLYSTAMP							
R-0h							

**Table 9-67. ADCPPB3STAMP Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-12	RESERVED	R	0h	Reserved
11-0	DLYSTAMP	R	0h	ADC Post Processing Block 3 Delay Time Stamp. When an SOC starts sampling the value contained in REQSTAMP is subtracted from the value in ADCCOUNTER.FREECOUNT and loaded into this bit field, thereby giving the number of system clock cycles delay between the SOC trigger and the actual start of the sample. Reset type: SYSRSn

#### 9.4.2.54 ADCPPB3OFFCAL Register (Offset = 52h) [reset = 0h]

ADCPPB3OFFCAL is shown in [Figure 9-78](#) and described in [Table 9-68](#).

Return to [Summary Table](#).

ADC PPB3 Offset Calibration Register

**Figure 9-78. ADCPPB3OFFCAL Register**

15	14	13	12	11	10	9	8
RESERVED						OFFCAL	
R-0h						R/W-0h	
7	6	5	4	3	2	1	0
OFFCAL							
R/W-0h							

**Table 9-68. ADCPPB3OFFCAL Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-10	RESERVED	R	0h	Reserved
9-0	OFFCAL	R/W	0h	<p>ADC Post Processing Block 3 Offset Correction. This bit field can be used to digitally remove any system level offset inherent in the ADCIN circuit. This 10-bit signed value is subtracted from the ADC output before being stored in the ADCRESULT register.</p> <p>000h No change. The ADC output is stored directly into ADCRESULT.</p> <p>001h ADC output - 1 is stored into ADCRESULT.</p> <p>002h ADC output - 2 is stored into ADCRESULT.</p> <p>...</p> <p>200h ADC output + 512 is stored into ADCRESULT.</p> <p>...</p> <p>3FFh ADC output + 1 is stored into ADCRESULT.</p> <p>NOTE: In 16-bit mode, the subtraction will saturate at 0000h and FFFFh before being stored into the ADCRESULT register. In 12-bit mode, the subtraction will saturate at 0000h and 0FFFh before being stored into the ADCRESULT register.</p> <p>Reset type: SYSRSn</p>

**9.4.2.55 ADCPPB3OFFREF Register (Offset = 53h) [reset = 0h]**

ADCPPB3OFFREF is shown in [Figure 9-79](#) and described in [Table 9-69](#).

Return to [Summary Table](#).

ADC PPB3 Offset Reference Register

**Figure 9-79. ADCPPB3OFFREF Register**

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
OFFREF															
R/W-0h															

**Table 9-69. ADCPPB3OFFREF Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-0	OFFREF	R/W	0h	<p>ADC Post Processing Block 3 Offset Correction. This bit field can be used to either calculate the feedback error or convert a unipolar signal to bipolar by subtracting a reference value. This 16-bit unsigned value is subtracted from the ADCRESULT register before being passed through an optional two's complement function and stored in the ADCPPB3RESULT register. This subtraction is not saturated.</p> <p>0000h No change. The ADCRESULT value is passed on.            0001h ADCRESULT - 1 is passed on.            0002h ADCRESULT - 2 is passed on.            ...            8000h ADCRESULT - 32,768 is passed on.            ...            FFFFh ADCRESULT - 65,535 is passed on.</p> <p>NOTE: In 12-bit mode the size of this register does not change from 16-bits. It is the user's responsibility to ensure that only a 12-bit value is written to this register when in 12-bit mode.            Reset type: SYSRSn</p>

**9.4.2.56 ADCPPB3TRIPHI Register (Offset = 54h) [reset = 0h]**

ADCPPB3TRIPHI is shown in [Figure 9-80](#) and described in [Table 9-70](#).

Return to [Summary Table](#).

ADC PPB3 Trip High Register

**Figure 9-80. ADCPPB3TRIPHI Register**

31	30	29	28	27	26	25	24
RESERVED							
R-0h							
23	22	21	20	19	18	17	16
RESERVED							HSIGN
R-0h							R/W-0h
15	14	13	12	11	10	9	8
LIMITHI							
R/W-0h							
7	6	5	4	3	2	1	0
LIMITHI							
R/W-0h							

**Table 9-70. ADCPPB3TRIPHI Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-17	RESERVED	R	0h	Reserved
16	HSIGN	R/W	0h	High Limit Sign Bit. This is the sign bit (17th bit) to the LIMITHI bit field when in 16-bit ADC mode. Reset type: SYSRSn
15-0	LIMITHI	R/W	0h	ADC Post Processing Block 3 Trip High Limit. This value sets the digital comparator trip high limit. In 16-bit mode all 17 bits will be compared against the 17 bits of the PPBRESULT bit field of the ADCPPB3RESULT register. In 12-bit mode bits 12:0 will be compared against bits 12:0 of the PPBRESULT bit field of the ADCPPB3RESULT register. Reset type: SYSRSn

**9.4.2.57 ADCPPB3TRIPLO Register (Offset = 56h) [reset = 0h]**

ADCPPB3TRIPLO is shown in [Figure 9-81](#) and described in [Table 9-71](#).

Return to [Summary Table](#).

ADC PPB3 Trip Low/Trigger Time Stamp Register

**Figure 9-81. ADCPPB3TRIPLO Register**

31	30	29	28	27	26	25	24
REQSTAMP							
R-0h							
23	22	21	20	19	18	17	16
REQSTAMP				RESERVED			LSIGN
R-0h				R-0h			R/W-0h
15	14	13	12	11	10	9	8
LIMITLO							
R/W-0h							
7	6	5	4	3	2	1	0
LIMITLO							
R/W-0h							

**Table 9-71. ADCPPB3TRIPLO Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-20	REQSTAMP	R	0h	ADC Post Processing Block 3 Request Time Stamp. When a trigger sets the associated SOC flag in the ADCSOCFLG1 register the value of ADCCOUNTER.FREECOUNT is loaded into this bit field. Reset type: SYSRSn
19-17	RESERVED	R	0h	Reserved
16	LSIGN	R/W	0h	Low Limit Sign Bit. This is the sign bit (17th bit) to the LIMITLO bit field when in 16-bit ADC mode. Reset type: SYSRSn
15-0	LIMITLO	R/W	0h	ADC Post Processing Block 3 Trip Low Limit. This value sets the digital comparator trip low limit. In 16-bit mode all 17 bits will be compared against the 17 bits of the PPBRESULT bit field of the ADCPPB3RESULT register. In 12-bit mode bits 12:0 will be compared against bits 12:0 of the PPBRESULT bit field of the ADCPPB3RESULT register. Reset type: SYSRSn

**9.4.2.58 ADCPPB4CONFIG Register (Offset = 58h) [reset = 0h]**

ADCPPB4CONFIG is shown in [Figure 9-82](#) and described in [Table 9-72](#).

Return to [Summary Table](#).

ADC PPB4 Config Register

**Figure 9-82. ADCPPB4CONFIG Register**

15	14	13	12	11	10	9	8
RESERVED							
R-0h							
7	6	5	4	3	2	1	0
RESERVED		CBCEN	TWOSCOMPEN	CONFIG			
R-0h		R/W-0h	R/W-0h	R/W-0h			

**Table 9-72. ADCPPB4CONFIG Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-6	RESERVED	R	0h	Reserved
5	CBCEN	R/W	0h	ADC Post Processing Block Cycle By Cycle Enable. When set, this bit enables the post conversion hardware processing circuit to automatically clear the ADCEVTSTAT on a conversion if the event condition is no longer present. Reset type: SYSRSn
4	TWOSCOMPEN	R/W	0h	ADC Post Processing Block 4 Two's Complement Enable. When set this bit enables the post conversion hardware processing circuit that performs a two's complement on the output of the offset/reference subtraction unit before storing the result in the ADCPPB4RESULT register.  0 ADCPPB4RESULT = ADCRESULTx - ADCPPB4OFFREF 1 ADCPPB4RESULT = ADCPPB4OFFREF - ADCRESULTx Reset type: SYSRSn

**Table 9-72. ADCPPB4CONFIG Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
3-0	CONFIG	R/W	0h	<p>ADC Post Processing Block 4 Configuration. This bit field defines which SOC/EOC/RESULT is associated with this post processing block.</p> <p>0000 SOC0/EOC0/RESULT0 is associated with post processing block 4</p> <p>0001 SOC1/EOC1/RESULT1 is associated with post processing block 4</p> <p>0010 SOC2/EOC2/RESULT2 is associated with post processing block 4</p> <p>0011 SOC3/EOC3/RESULT3 is associated with post processing block 4</p> <p>0100 SOC4/EOC4/RESULT4 is associated with post processing block 4</p> <p>0101 SOC5/EOC5/RESULT5 is associated with post processing block 4</p> <p>0110 SOC6/EOC6/RESULT6 is associated with post processing block 4</p> <p>0111 SOC7/EOC7/RESULT7 is associated with post processing block 4</p> <p>1000 SOC8/EOC8/RESULT8 is associated with post processing block 4</p> <p>1001 SOC9/EOC9/RESULT9 is associated with post processing block 4</p> <p>1010 SOC10/EOC10/RESULT10 is associated with post processing block 4</p> <p>1011 SOC11/EOC11/RESULT11 is associated with post processing block 4</p> <p>1100 SOC12/EOC12/RESULT12 is associated with post processing block 4</p> <p>1101 SOC13/EOC13/RESULT13 is associated with post processing block 4</p> <p>1110 SOC14/EOC14/RESULT14 is associated with post processing block 4</p> <p>1111 SOC15/EOC15/RESULT15 is associated with post processing block 4</p> <p>Reset type: SYSRSn</p>

### 9.4.2.59 ADCPPB4STAMP Register (Offset = 59h) [reset = 0h]

ADCPPB4STAMP is shown in [Figure 9-83](#) and described in [Table 9-73](#).

Return to [Summary Table](#).

ADC PPB4 Sample Delay Time Stamp Register

**Figure 9-83. ADCPPB4STAMP Register**

15	14	13	12	11	10	9	8
RESERVED				DLYSTAMP			
R-0h				R-0h			
7	6	5	4	3	2	1	0
DLYSTAMP							
R-0h							

**Table 9-73. ADCPPB4STAMP Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-12	RESERVED	R	0h	Reserved
11-0	DLYSTAMP	R	0h	ADC Post Processing Block 4 Delay Time Stamp. When an SOC starts sampling the value contained in REQSTAMP is subtracted from the value in ADCCOUNTER.FREECOUNT and loaded into this bit field, thereby giving the number of system clock cycles delay between the SOC trigger and the actual start of the sample. Reset type: SYSRSn



**9.4.2.60 ADCPPB4OFFCAL Register (Offset = 5Ah) [reset = 0h]**

 ADCPPB4OFFCAL is shown in [Figure 9-84](#) and described in [Table 9-74](#).

 Return to [Summary Table](#).

ADC PPB4 Offset Calibration Register

**Figure 9-84. ADCPPB4OFFCAL Register**

15	14	13	12	11	10	9	8
RESERVED						OFFCAL	
R-0h						R/W-0h	
7	6	5	4	3	2	1	0
OFFCAL							
R/W-0h							

**Table 9-74. ADCPPB4OFFCAL Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-10	RESERVED	R	0h	Reserved
9-0	OFFCAL	R/W	0h	ADC Post Processing Block 4 Offset Correction. This bit field can be used to digitally remove any system level offset inherent in the ADCIN circuit. This 10-bit signed value is subtracted from the ADC output before being stored in the ADCRESULT register.  000h No change. The ADC output is stored directly into ADCRESULT. 001h ADC output - 1 is stored into ADCRESULT. 002h ADC output - 2 is stored into ADCRESULT. ... 200h ADC output + 512 is stored into ADCRESULT. ... 3FFh ADC output + 1 is stored into ADCRESULT.  NOTE: In 16-bit mode, the subtraction will saturate at 0000h and FFFFh before being stored into the ADCRESULT register. In 12-bit mode, the subtraction will saturate at 0000h and 0FFFh before being stored into the ADCRESULT register. Reset type: SYSRSn

**9.4.2.61 ADCPPB4OFFREF Register (Offset = 5Bh) [reset = 0h]**

ADCPPB4OFFREF is shown in [Figure 9-85](#) and described in [Table 9-75](#).

Return to [Summary Table](#).

ADC PPB4 Offset Reference Register

**Figure 9-85. ADCPPB4OFFREF Register**

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
OFFREF															
R/W-0h															

**Table 9-75. ADCPPB4OFFREF Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-0	OFFREF	R/W	0h	<p>ADC Post Processing Block 4 Offset Correction. This bit field can be used to either calculate the feedback error or convert a unipolar signal to bipolar by subtracting a reference value. This 16-bit unsigned value is subtracted from the ADCRESULT register before being passed through an optional two's complement function and stored in the ADCPPB4RESULT register. This subtraction is not saturated.</p> <p>0000h No change. The ADCRESULT value is passed on.                      0001h ADCRESULT - 1 is passed on.                      0002h ADCRESULT - 2 is passed on.                      ...                      8000h ADCRESULT - 32,768 is passed on.                      ...                      FFFFh ADCRESULT - 65,535 is passed on.</p> <p>NOTE: In 12-bit mode the size of this register does not change from 16-bits. It is the user's responsibility to ensure that only a 12-bit value is written to this register when in 12-bit mode.                      Reset type: SYSRSn</p>

**9.4.2.62 ADCPPB4TRIPHI Register (Offset = 5Ch) [reset = 0h]**

ADCPPB4TRIPHI is shown in [Figure 9-86](#) and described in [Table 9-76](#).

Return to [Summary Table](#).

ADC PPB4 Trip High Register

**Figure 9-86. ADCPPB4TRIPHI Register**

31	30	29	28	27	26	25	24
RESERVED							
R-0h							
23	22	21	20	19	18	17	16
RESERVED							HSIGN
R-0h							R/W-0h
15	14	13	12	11	10	9	8
LIMITHI							
R/W-0h							
7	6	5	4	3	2	1	0
LIMITHI							
R/W-0h							

**Table 9-76. ADCPPB4TRIPHI Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-17	RESERVED	R	0h	Reserved
16	HSIGN	R/W	0h	High Limit Sign Bit. This is the sign bit (17th bit) to the LIMITHI bit field when in 16-bit ADC mode. Reset type: SYSRSn
15-0	LIMITHI	R/W	0h	ADC Post Processing Block 4 Trip High Limit. This value sets the digital comparator trip high limit. In 16-bit mode all 17 bits will be compared against the 17 bits of the PPBRESULT bit field of the ADCPPB4RESULT register. In 12-bit mode bits 12:0 will be compared against bits 12:0 of the PPBRESULT bit field of the ADCPPB4RESULT register. Reset type: SYSRSn

**9.4.2.63 ADCPPB4TRIPLO Register (Offset = 5Eh) [reset = 0h]**

ADCPPB4TRIPLO is shown in [Figure 9-87](#) and described in [Table 9-77](#).

Return to [Summary Table](#).

ADC PPB4 Trip Low/Trigger Time Stamp Register

**Figure 9-87. ADCPPB4TRIPLO Register**

31	30	29	28	27	26	25	24
REQSTAMP							
R-0h							
23	22	21	20	19	18	17	16
REQSTAMP				RESERVED			LSIGN
R-0h				R-0h			R/W-0h
15	14	13	12	11	10	9	8
LIMITLO							
R/W-0h							
7	6	5	4	3	2	1	0
LIMITLO							
R/W-0h							

**Table 9-77. ADCPPB4TRIPLO Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-20	REQSTAMP	R	0h	ADC Post Processing Block 4 Request Time Stamp. When a trigger sets the associated SOC flag in the ADCSOCFLG1 register the value of ADCCOUNTER.FREECOUNT is loaded into this bit field. Reset type: SYSRSn
19-17	RESERVED	R	0h	Reserved
16	LSIGN	R/W	0h	Low Limit Sign Bit. This is the sign bit (17th bit) to the LIMITLO bit field when in 16-bit ADC mode. Reset type: SYSRSn
15-0	LIMITLO	R/W	0h	ADC Post Processing Block 4 Trip Low Limit. This value sets the digital comparator trip low limit. In 16-bit mode all 17 bits will be compared against the 17 bits of the PPBRESULT bit field of the ADCPPB4RESULT register. In 12-bit mode bits 12:0 will be compared against bits 12:0 of the PPBRESULT bit field of the ADCPPB4RESULT register. Reset type: SYSRSn

**9.4.2.64 ADCINLTRIM1 Register (Offset = 70h) [reset = 0h]**

ADCINLTRIM1 is shown in [Figure 9-88](#) and described in [Table 9-78](#).

Return to [Summary Table](#).

ADC Linearity Trim 1 Register

**Figure 9-88. ADCINLTRIM1 Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
INLTRIM31TO0																															
R/W-0h																															

**Table 9-78. ADCINLTRIM1 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-0	INLTRIM31TO0	R/W	0h	<p>ADC Linearity Trim Bits 31-0.</p> <p>This register should not be modified unless specifically indicated by TI Errata or other documentation. Modifying the contents of this register could cause this module to operate outside of datasheet specifications.</p> <p>Reset type: SYSRSn</p>

### 9.4.2.65 ADCINLTRIM2 Register (Offset = 72h) [reset = 0h]

ADCINLTRIM2 is shown in [Figure 9-89](#) and described in [Table 9-79](#).

Return to [Summary Table](#).

ADC Linearity Trim 2 Register

**Figure 9-89. ADCINLTRIM2 Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
INLTRIM63TO32																															
R/W-0h																															

**Table 9-79. ADCINLTRIM2 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-0	INLTRIM63TO32	R/W	0h	ADC Linearity Trim Bits 63-32.  This register should not be modified unless specifically indicated by TI Errata or other documentation. Modifying the contents of this register could cause this module to operate outside of datasheet specifications. Reset type: SYSRSn

**9.4.2.66 ADCINLTRIM3 Register (Offset = 74h) [reset = 0h]**

ADCINLTRIM3 is shown in [Figure 9-90](#) and described in [Table 9-80](#).

Return to [Summary Table](#).

ADC Linearity Trim 3 Register

**Figure 9-90. ADCINLTRIM3 Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
INLTRIM95TO64																															
R/W-0h																															

**Table 9-80. ADCINLTRIM3 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-0	INLTRIM95TO64	R/W	0h	<p>ADC Linearity Trim Bits 95-64.</p> <p>This register should not be modified unless specifically indicated by TI Errata or other documentation. Modifying the contents of this register could cause this module to operate outside of datasheet specifications.</p> <p>Reset type: SYSRSn</p>

### 9.4.2.67 ADCINLTRIM4 Register (Offset = 76h) [reset = 0h]

ADCINLTRIM4 is shown in [Figure 9-91](#) and described in [Table 9-81](#).

Return to [Summary Table](#).

ADC Linearity Trim 4 Register

**Figure 9-91. ADCINLTRIM4 Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
INLTRIM127TO96																															
R/W-0h																															

**Table 9-81. ADCINLTRIM4 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-0	INLTRIM127TO96	R/W	0h	ADC Linearity Trim Bits 127-96.  This register should not be modified unless specifically indicated by TI Errata or other documentation. Modifying the contents of this register could cause this module to operate outside of datasheet specifications. Reset type: SYSRSn



**9.4.2.68 ADCINLTRIM5 Register (Offset = 78h) [reset = 0h]**

ADCINLTRIM5 is shown in [Figure 9-92](#) and described in [Table 9-82](#).

Return to [Summary Table](#).

ADC Linearity Trim 5 Register

**Figure 9-92. ADCINLTRIM5 Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
INLTRIM159TO128																															
R/W-0h																															

**Table 9-82. ADCINLTRIM5 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-0	INLTRIM159TO128	R/W	0h	<p>ADC Linearity Trim Bits 159-128.</p> <p>This register should not be modified unless specifically indicated by TI Errata or other documentation. Modifying the contents of this register could cause this module to operate outside of datasheet specifications.</p> <p>Reset type: SYSRSn</p>

### 9.4.2.69 ADCINLTRIM6 Register (Offset = 7Ah) [reset = 0h]

ADCINLTRIM6 is shown in [Figure 9-93](#) and described in [Table 9-83](#).

Return to [Summary Table](#).

ADC Linearity Trim 6 Register

**Figure 9-93. ADCINLTRIM6 Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
INLTRIM191TO160																															
R/W-0h																															

**Table 9-83. ADCINLTRIM6 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-0	INLTRIM191TO160	R/W	0h	ADC Linearity Trim Bits 191-160.  This register should not be modified unless specifically indicated by TI Errata or other documentation. Modifying the contents of this register could cause this module to operate outside of datasheet specifications. Reset type: SYSRSn



### 9.4.3 ADC\_RESULT\_REGS Registers

Table 9-84 lists the memory-mapped registers for the ADC\_RESULT\_REGS. All register offset addresses not listed in Table 9-84 should be considered as reserved locations and the register contents should not be modified.

**Table 9-84. ADC\_RESULT\_REGS Registers**

Offset	Acronym	Register Name	Write Protection	Section
0h	ADCRESULT0	ADC Result 0 Register		<a href="#">Go</a>
1h	ADCRESULT1	ADC Result 1 Register		<a href="#">Go</a>
2h	ADCRESULT2	ADC Result 2 Register		<a href="#">Go</a>
3h	ADCRESULT3	ADC Result 3 Register		<a href="#">Go</a>
4h	ADCRESULT4	ADC Result 4 Register		<a href="#">Go</a>
5h	ADCRESULT5	ADC Result 5 Register		<a href="#">Go</a>
6h	ADCRESULT6	ADC Result 6 Register		<a href="#">Go</a>
7h	ADCRESULT7	ADC Result 7 Register		<a href="#">Go</a>
8h	ADCRESULT8	ADC Result 8 Register		<a href="#">Go</a>
9h	ADCRESULT9	ADC Result 9 Register		<a href="#">Go</a>
Ah	ADCRESULT10	ADC Result 10 Register		<a href="#">Go</a>
Bh	ADCRESULT11	ADC Result 11 Register		<a href="#">Go</a>
Ch	ADCRESULT12	ADC Result 12 Register		<a href="#">Go</a>
Dh	ADCRESULT13	ADC Result 13 Register		<a href="#">Go</a>
Eh	ADCRESULT14	ADC Result 14 Register		<a href="#">Go</a>
Fh	ADCRESULT15	ADC Result 15 Register		<a href="#">Go</a>
10h	ADCPPB1RESULT	ADC Post Processing Block 1 Result Register		<a href="#">Go</a>
12h	ADCPPB2RESULT	ADC Post Processing Block 2 Result Register		<a href="#">Go</a>
14h	ADCPPB3RESULT	ADC Post Processing Block 3 Result Register		<a href="#">Go</a>
16h	ADCPPB4RESULT	ADC Post Processing Block 4 Result Register		<a href="#">Go</a>

Complex bit access types are encoded to fit into small table cells. Table 9-85 shows the codes that are used for access types in this section.

**Table 9-85. ADC\_RESULT\_REGS Access Type Codes**

Access Type	Code	Description
<b>Read Type</b>		
R	R	Read
<b>Reset or Default Value</b>		
-n		Value after reset or the default value
<b>Register Array Variables</b>		
i,j,k,l,m,n		When these variables are used in a register name, an offset, or an address, they refer to the value of a register array where the register is part of a group of repeating registers. The register groups form a hierarchical structure and the array is represented with a formula.
y		When this variable is used in a register name, an offset, or an address it refers to the value of a register array.

**9.4.3.1 ADCRESULT0 Register (Offset = 0h) [reset = 0h]**

ADCRESULT0 is shown in [Figure 9-94](#) and described in [Table 9-86](#).

Return to [Summary Table](#).

ADC Result 0 Register

**Figure 9-94. ADCRESULT0 Register**

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
RESULT															
R-0h															

**Table 9-86. ADCRESULT0 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-0	RESULT	R	0h	ADC Result 0. 16-bit ADC result. After the ADC completes a conversion of SOC0, the digital result is placed in this bit field. Reset type: SYSRSn

### 9.4.3.2 ADCRESULT1 Register (Offset = 1h) [reset = 0h]

ADCRESULT1 is shown in [Figure 9-95](#) and described in [Table 9-87](#).

Return to [Summary Table](#).

ADC Result 1 Register

**Figure 9-95. ADCRESULT1 Register**

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
RESULT															
R-0h															

**Table 9-87. ADCRESULT1 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-0	RESULT	R	0h	ADC Result 1. 16-bit ADC result. After the ADC completes a conversion of SOC1, the digital result is placed in this bit field. Reset type: SYSRSn

### 9.4.3.3 ADCRESULT2 Register (Offset = 2h) [reset = 0h]

ADCRESULT2 is shown in [Figure 9-96](#) and described in [Table 9-88](#).

Return to [Summary Table](#).

ADC Result 2 Register

**Figure 9-96. ADCRESULT2 Register**

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
RESULT															
R-0h															

**Table 9-88. ADCRESULT2 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-0	RESULT	R	0h	ADC Result 2. 16-bit ADC result. After the ADC completes a conversion of SOC2, the digital result is placed in this bit field. Reset type: SYSRSn

#### 9.4.3.4 ADCRESULT3 Register (Offset = 3h) [reset = 0h]

ADCRESULT3 is shown in [Figure 9-97](#) and described in [Table 9-89](#).

Return to [Summary Table](#).

ADC Result 3 Register

**Figure 9-97. ADCRESULT3 Register**

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
RESULT															
R-0h															

**Table 9-89. ADCRESULT3 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-0	RESULT	R	0h	ADC Result 3. 16-bit ADC result. After the ADC completes a conversion of SOC3, the digital result is placed in this bit field. Reset type: SYSRSn



#### 9.4.3.5 ADCRESULT4 Register (Offset = 4h) [reset = 0h]

ADCRESULT4 is shown in [Figure 9-98](#) and described in [Table 9-90](#).

Return to [Summary Table](#).

ADC Result 4 Register

**Figure 9-98. ADCRESULT4 Register**

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
RESULT															
R-0h															

**Table 9-90. ADCRESULT4 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-0	RESULT	R	0h	ADC Result 4. 16-bit ADC result. After the ADC completes a conversion of SOC4, the digital result is placed in this bit field. Reset type: SYSRSn

#### 9.4.3.6 ADCRESULT5 Register (Offset = 5h) [reset = 0h]

ADCRESULT5 is shown in [Figure 9-99](#) and described in [Table 9-91](#).

Return to [Summary Table](#).

ADC Result 5 Register

**Figure 9-99. ADCRESULT5 Register**

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
RESULT															
R-0h															

**Table 9-91. ADCRESULT5 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-0	RESULT	R	0h	ADC Result 5. 16-bit ADC result. After the ADC completes a conversion of SOC5, the digital result is placed in this bit field. Reset type: SYSRSn

#### 9.4.3.7 ADCRESULT6 Register (Offset = 6h) [reset = 0h]

ADCRESULT6 is shown in [Figure 9-100](#) and described in [Table 9-92](#).

Return to [Summary Table](#).

ADC Result 6 Register

**Figure 9-100. ADCRESULT6 Register**

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
RESULT															
R-0h															

**Table 9-92. ADCRESULT6 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-0	RESULT	R	0h	ADC Result 6. 16-bit ADC result. After the ADC completes a conversion of SOC6, the digital result is placed in this bit field. Reset type: SYSRSn

### 9.4.3.8 ADCRESULT7 Register (Offset = 7h) [reset = 0h]

ADCRESULT7 is shown in [Figure 9-101](#) and described in [Table 9-93](#).

Return to [Summary Table](#).

ADC Result 7 Register

**Figure 9-101. ADCRESULT7 Register**

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
RESULT															
R-0h															

**Table 9-93. ADCRESULT7 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-0	RESULT	R	0h	ADC Result 7. 16-bit ADC result. After the ADC completes a conversion of SOC7, the digital result is placed in this bit field. Reset type: SYSRSn

### 9.4.3.9 ADCRESULT8 Register (Offset = 8h) [reset = 0h]

ADCRESULT8 is shown in [Figure 9-102](#) and described in [Table 9-94](#).

Return to [Summary Table](#).

ADC Result 8 Register

**Figure 9-102. ADCRESULT8 Register**

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
RESULT															
R-0h															

**Table 9-94. ADCRESULT8 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-0	RESULT	R	0h	ADC Result 8. 16-bit ADC result. After the ADC completes a conversion of SOC8, the digital result is placed in this bit field. Reset type: SYSRSn

### 9.4.3.10 ADCRESULT9 Register (Offset = 9h) [reset = 0h]

ADCRESULT9 is shown in [Figure 9-103](#) and described in [Table 9-95](#).

Return to [Summary Table](#).

ADC Result 9 Register

**Figure 9-103. ADCRESULT9 Register**

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
RESULT															
R-0h															

**Table 9-95. ADCRESULT9 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-0	RESULT	R	0h	ADC Result 9. 16-bit ADC result. After the ADC completes a conversion of SOC9, the digital result is placed in this bit field. Reset type: SYSRSn

**9.4.3.11 ADCRESULT10 Register (Offset = Ah) [reset = 0h]**

ADCRESULT10 is shown in [Figure 9-104](#) and described in [Table 9-96](#).

Return to [Summary Table](#).

ADC Result 10 Register

**Figure 9-104. ADCRESULT10 Register**

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
RESULT															
R-0h															

**Table 9-96. ADCRESULT10 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-0	RESULT	R	0h	ADC Result 10. 16-bit ADC result. After the ADC completes a conversion of SOC10, the digital result is placed in this bit field. Reset type: SYSRSn

### 9.4.3.12 ADCRESULT11 Register (Offset = Bh) [reset = 0h]

ADCRESULT11 is shown in [Figure 9-105](#) and described in [Table 9-97](#).

Return to [Summary Table](#).

ADC Result 11 Register

**Figure 9-105. ADCRESULT11 Register**

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
RESULT															
R-0h															

**Table 9-97. ADCRESULT11 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-0	RESULT	R	0h	ADC Result 11. 16-bit ADC result. After the ADC completes a conversion of SOC11, the digital result is placed in this bit field. Reset type: SYSRSn



**9.4.3.13 ADCRESULT12 Register (Offset = Ch) [reset = 0h]**

ADCRESULT12 is shown in [Figure 9-106](#) and described in [Table 9-98](#).

Return to [Summary Table](#).

ADC Result 12 Register

**Figure 9-106. ADCRESULT12 Register**

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
RESULT															
R-0h															

**Table 9-98. ADCRESULT12 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-0	RESULT	R	0h	ADC Result 12. 16-bit ADC result. After the ADC completes a conversion of SOC12, the digital result is placed in this bit field. Reset type: SYSRSn

### 9.4.3.14 ADCRESULT13 Register (Offset = Dh) [reset = 0h]

ADCRESULT13 is shown in [Figure 9-107](#) and described in [Table 9-99](#).

Return to [Summary Table](#).

ADC Result 13 Register

**Figure 9-107. ADCRESULT13 Register**

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
RESULT															
R-0h															

**Table 9-99. ADCRESULT13 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-0	RESULT	R	0h	ADC Result 13. 16-bit ADC result. After the ADC completes a conversion of SOC13, the digital result is placed in this bit field. Reset type: SYSRSn

### 9.4.3.15 ADCRESULT14 Register (Offset = Eh) [reset = 0h]

ADCRESULT14 is shown in [Figure 9-108](#) and described in [Table 9-100](#).

Return to [Summary Table](#).

ADC Result 14 Register

**Figure 9-108. ADCRESULT14 Register**

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
RESULT															
R-0h															

**Table 9-100. ADCRESULT14 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-0	RESULT	R	0h	ADC Result 14. 16-bit ADC result. After the ADC completes a conversion of SOC14, the digital result is placed in this bit field. Reset type: SYSRSn

### 9.4.3.16 ADCRESULT15 Register (Offset = Fh) [reset = 0h]

ADCRESULT15 is shown in [Figure 9-109](#) and described in [Table 9-101](#).

Return to [Summary Table](#).

ADC Result 15 Register

**Figure 9-109. ADCRESULT15 Register**

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
RESULT															
R-0h															

**Table 9-101. ADCRESULT15 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-0	RESULT	R	0h	ADC Result 15. 16-bit ADC result. After the ADC completes a conversion of SOC15, the digital result is placed in this bit field. Reset type: SYSRSn

**9.4.3.17 ADCPPB1RESULT Register (Offset = 10h) [reset = 0h]**

ADCPPB1RESULT is shown in [Figure 9-110](#) and described in [Table 9-102](#).

Return to [Summary Table](#).

ADC Post Processing Block 1 Result Register

**Figure 9-110. ADCPPB1RESULT Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
SIGN																PPBRESULT															
R-0h																R-0h															

**Table 9-102. ADCPPB1RESULT Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	SIGN	R	0h	<p>Sign Extended Bits. These bits reflect the same value as bit 16.</p> <p>NOTE: If the conversion associated with this Post Processing Block is a 12-bit conversion, the SIGN bits extend down to bit 12, and all reflect the same value as bit 12.</p> <p>Reset type: SYSRSn</p>
15-0	PPBRESULT	R	0h	<p>ADC Post Processing Block Result 1. The result of the offset/reference subtraction post conversion processing is stored in this register.</p> <p>NOTE: If the conversion associated with this Post Processing Block is a 12-bit conversion, the PPBRESULT bits are limited to bits 11:0.</p> <p>Reset type: SYSRSn</p>

**9.4.3.18 ADCPPB2RESULT Register (Offset = 12h) [reset = 0h]**

ADCPPB2RESULT is shown in [Figure 9-111](#) and described in [Table 9-103](#).

Return to [Summary Table](#).

ADC Post Processing Block 2 Result Register

**Figure 9-111. ADCPPB2RESULT Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
SIGN																PPBRESULT															
R-0h																R-0h															

**Table 9-103. ADCPPB2RESULT Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	SIGN	R	0h	Sign Extended Bits. These bits reflect the same value as bit 16.  NOTE: If the conversion associated with this Post Processing Block is a 12-bit conversion, the SIGN bits extend down to bit 12, and all reflect the same value as bit 12. Reset type: SYSRSn
15-0	PPBRESULT	R	0h	ADC Post Processing Block Result 2. The result of the offset/reference subtraction post conversion processing is stored in this register.  NOTE: If the conversion associated with this Post Processing Block is a 12-bit conversion, the PPBRESULT bits are limited to bits 11:0. Reset type: SYSRSn

### 9.4.3.19 ADCPPB3RESULT Register (Offset = 14h) [reset = 0h]

ADCPPB3RESULT is shown in [Figure 9-112](#) and described in [Table 9-104](#).

Return to [Summary Table](#).

ADC Post Processing Block 3 Result Register

**Figure 9-112. ADCPPB3RESULT Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
SIGN																PPBRESULT															
R-0h																R-0h															

**Table 9-104. ADCPPB3RESULT Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	SIGN	R	0h	<p>Sign Extended Bits. These bits reflect the same value as bit 16.</p> <p>NOTE: If the conversion associated with this Post Processing Block is a 12-bit conversion, the SIGN bits extend down to bit 12, and all reflect the same value as bit 12.</p> <p>Reset type: SYSRSn</p>
15-0	PPBRESULT	R	0h	<p>ADC Post Processing Block Result 3. The result of the offset/reference subtraction post conversion processing is stored in this register.</p> <p>NOTE: If the conversion associated with this Post Processing Block is a 12-bit conversion, the PPBRESULT bits are limited to bits 11:0.</p> <p>Reset type: SYSRSn</p>

### 9.4.3.20 ADCPPB4RESULT Register (Offset = 16h) [reset = 0h]

ADCPPB4RESULT is shown in [Figure 9-113](#) and described in [Table 9-105](#).

Return to [Summary Table](#).

ADC Post Processing Block 4 Result Register

**Figure 9-113. ADCPPB4RESULT Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
SIGN																PPBRESULT															
R-0h																R-0h															

**Table 9-105. ADCPPB4RESULT Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	SIGN	R	0h	Sign Extended Bits. These bits reflect the same value as bit 16.  NOTE: If the conversion associated with this Post Processing Block is a 12-bit conversion, the SIGN bits extend down to bit 12, and all reflect the same value as bit 12. Reset type: SYSRSn
15-0	PPBRESULT	R	0h	ADC Post Processing Block Result 4. The result of the offset/reference subtraction post conversion processing is stored in this register.  NOTE: If the conversion associated with this Post Processing Block is a 12-bit conversion, the PPBRESULT bits are limited to bits 11:0. Reset type: SYSRSn



## ***Buffered Digital to Analog Converter (DAC)***

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The buffered digital to analog converter (DAC) is an analog module that can output a programmable, arbitrary reference voltage.

<b>Topic</b>	<b>Page</b>
<b>10.1 Buffered Digital to Analog Converter (DAC) Overview .....</b>	<b>1458</b>
<b>10.2 Using the DAC .....</b>	<b>1458</b>
<b>10.3 Lock Registers .....</b>	<b>1459</b>
<b>10.4 Registers .....</b>	<b>1459</b>

## 10.1 Buffered Digital to Analog Converter (DAC) Overview

The buffered DAC module consists of an internal reference DAC and an analog output buffer that is capable of driving an external load. An integrated pull-down resistor on the DAC output helps to provide a known pin voltage when the output buffer is disabled. This pull-down resistor cannot be disabled and remains as a passive component on the pin, even for other shared pinmux functions. Software writes to the DAC value register can take effect immediately or can be synchronized with PWMSYNC events.

### 10.1.1 Features

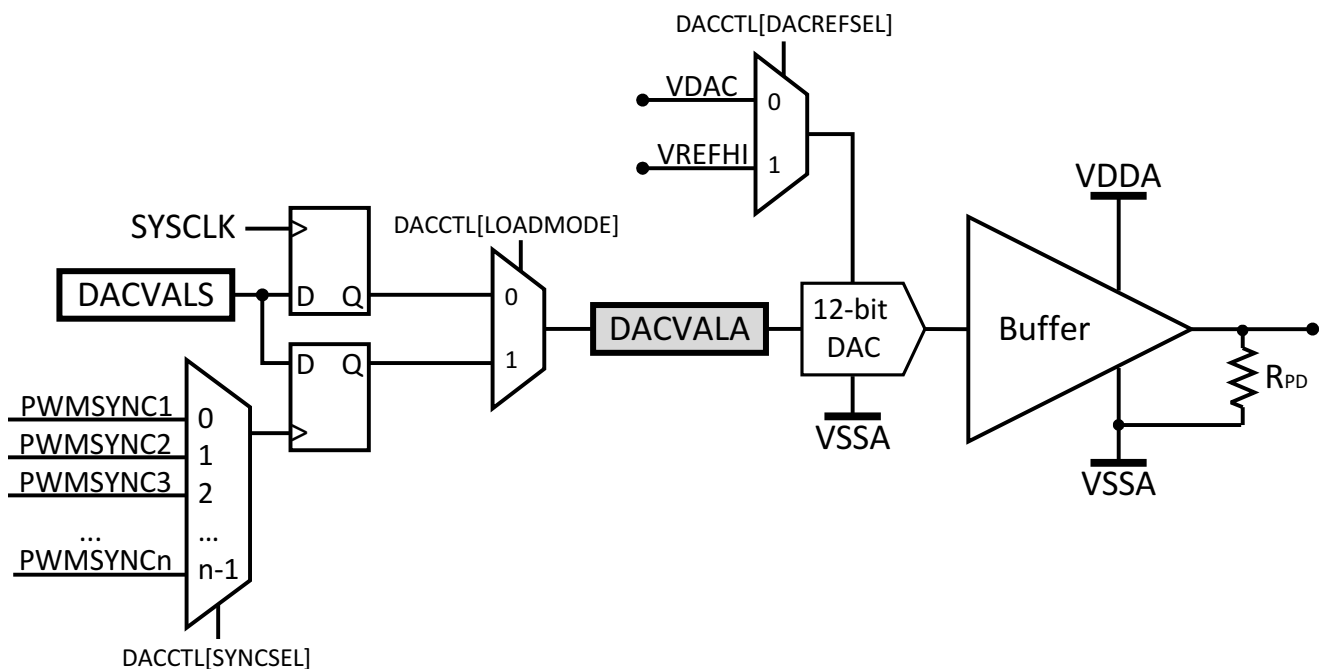
Each buffered DAC has the following features:

- 12-bit programmable internal DAC
- Selectable reference voltage
- Pull-down resistor on output
- Ability to synchronize with PWMSYNC

### 10.1.2 Block Diagram

The block diagram for the buffered DAC is shown in [Figure 10-1](#).

**Figure 10-1. DAC Module Block Diagram**



## 10.2 Using the DAC

The reference voltage for the internal DAC is selectable between the VDAC and VREFHI.

Two sets of DACVAL registers are present in the buffered DAC module: DACVALA and DACVALS. DACVALA is a read-only register that actively controls the DAC value. DACVALS is a writable shadow register that loads into DACVALA either immediately or synchronized with the next PWMSYNC event.

The ideal output of the internal DAC can be calculated as follows:

$$V_{\text{DAC}} = \frac{\text{DACVALA} * \text{DACREF}}{4096}$$

The Buffered DAC output buffer may exhibit non-linear behavior near the supply rails (VDDA/VSSA). See the device datasheet to determine the valid operating range of the Buffered DAC.

## 10.3 Lock Registers

A DACLOCK register is provided to prevent spurious writes from modifying the DACCTL, DACVALS, and DACOUTEN registers. Once a register is protected through DACLOCK, write access will be locked out until the device is reset.

## 10.4 Registers

### 10.4.1 DAC Base Addresses

**Table 10-1. DAC Base Address Table**

Device Registers	Register Name	Start Address	End Address
DacaRegs	DAC_REGS	0x0000_5C00	0x0000_5C0F
DacbRegs	DAC_REGS	0x0000_5C10	0x0000_5C1F
DaccRegs	DAC_REGS	0x0000_5C20	0x0000_5C2F

### 10.4.2 DAC\_REGS Registers

Table 10-2 lists the memory-mapped registers for the DAC\_REGS. All register offset addresses not listed in Table 10-2 should be considered as reserved locations and the register contents should not be modified.

**Table 10-2. DAC\_REGS Registers**

Offset	Acronym	Register Name	Write Protection	Section
0h	DACREV	DAC Revision Register		<a href="#">Go</a>
1h	DACCTL	DAC Control Register	EALLOW	<a href="#">Go</a>
2h	DACVALA	DAC Value Register - Active		<a href="#">Go</a>
3h	DACVALS	DAC Value Register - Shadow		<a href="#">Go</a>
4h	DACOUTEN	DAC Output Enable Register	EALLOW	<a href="#">Go</a>
5h	DACLOCK	DAC Lock Register	EALLOW	<a href="#">Go</a>
6h	DACTRIM	DAC Trim Register	EALLOW	<a href="#">Go</a>

Complex bit access types are encoded to fit into small table cells. Table 10-3 shows the codes that are used for access types in this section.

**Table 10-3. DAC\_REGS Access Type Codes**

Access Type	Code	Description
<b>Read Type</b>		
R	R	Read
<b>Write Type</b>		
W	W	Write
WSOnce	SOnce W	Set once Write
<b>Reset or Default Value</b>		
-n		Value after reset or the default value
<b>Register Array Variables</b>		
i,j,k,l,m,n		When these variables are used in a register name, an offset, or an address, they refer to the value of a register array where the register is part of a group of repeating registers. The register groups form a hierarchical structure and the array is represented with a formula.
y		When this variable is used in a register name, an offset, or an address it refers to the value of a register array.

**10.4.2.1 DACREV Register (Offset = 0h) [reset = 0h]**

DACREV is shown in [Figure 10-2](#) and described in [Table 10-4](#).

Return to [Summary Table](#).

DAC Revision Register

**Figure 10-2. DACREV Register**

15	14	13	12	11	10	9	8
RESERVED							
R-0h							
7	6	5	4	3	2	1	0
REV							
R-0h							

**Table 10-4. DACREV Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-8	RESERVED	R	0h	Reserved
7-0	REV	R	0h	DAC Revision Reset type: SYSRStn

### 10.4.2.2 DACCTL Register (Offset = 1h) [reset = 0h]

DACCTL is shown in [Figure 10-3](#) and described in [Table 10-5](#).

Return to [Summary Table](#).

DAC Control Register

**Figure 10-3. DACCTL Register**

15	14	13	12	11	10	9	8
RESERVED							
R-0h							
7	6	5	4	3	2	1	0
SYNCSEL				RESERVED	LOADMODE	RESERVED	DACREFSEL
R/W-0h				R-0h	R/W-0h	R-0h	R/W-0h

**Table 10-5. DACCTL Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-8	RESERVED	R	0h	Reserved
7-4	SYNCSEL	R/W	0h	DAC PWMSYNC select. Determines which PWMSYNC signal will update the DACVALA register.  Where n represents the maximum number of PWMSYNC signals available on the device:  0 PWMSYNC1 1 PWMSYNC2 2 PWMSYNC3 ... n-1 PWMSYNcn Reset type: SYSRSn
3	RESERVED	R	0h	Reserved
2	LOADMODE	R/W	0h	DACVALA load mode. Determines when the DACVALA register is updated with the value from DACVALS.  0 Load on next SYSCLK 1 Load on next PWMSYNC specified by SYNCSEL Reset type: SYSRSn
1	RESERVED	R	0h	Reserved
0	DACREFSEL	R/W	0h	DAC reference select. Selects which voltage references are used by the DAC.  0 VDAC/VSSA are the reference voltages 1 ADC VREFHI/VREFLO are the reference voltages Reset type: SYSRSn

### 10.4.2.3 DACVALA Register (Offset = 2h) [reset = 0h]

DACVALA is shown in [Figure 10-4](#) and described in [Table 10-6](#).

Return to [Summary Table](#).

DAC Value Register - Active

**Figure 10-4. DACVALA Register**

15	14	13	12	11	10	9	8
RESERVED				DACVALA			
R-0h				R-0h			
7	6	5	4	3	2	1	0
DACVALA							
R-0h							

**Table 10-6. DACVALA Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-12	RESERVED	R	0h	Reserved
11-0	DACVALA	R	0h	Active output code currently driven by the DAC Reset type: SYSRSn

#### 10.4.2.4 DACVALS Register (Offset = 3h) [reset = 0h]

DACVALS is shown in [Figure 10-5](#) and described in [Table 10-7](#).

Return to [Summary Table](#).

DAC Value Register - Shadow

**Figure 10-5. DACVALS Register**

15	14	13	12	11	10	9	8
RESERVED				DACVALS			
R-0h				R/W-0h			
7	6	5	4	3	2	1	0
DACVALS							
R/W-0h							

**Table 10-7. DACVALS Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-12	RESERVED	R	0h	Reserved
11-0	DACVALS	R/W	0h	Shadow output code to be loaded into DACVALA Reset type: SYSRSn



### 10.4.2.5 DACOUTEN Register (Offset = 4h) [reset = 0h]

DACOUTEN is shown in [Figure 10-6](#) and described in [Table 10-8](#).

Return to [Summary Table](#).

DAC Output Enable Register

**Figure 10-6. DACOUTEN Register**

15	14	13	12	11	10	9	8
RESERVED							
R-0h							
7	6	5	4	3	2	1	0
RESERVED							DACOUTEN
R-0h							R/W-0h

**Table 10-8. DACOUTEN Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-1	RESERVED	R	0h	Reserved
0	DACOUTEN	R/W	0h	DAC output enable 0 DAC output is disabled 1 DAC output is enabled Reset type: SYSRSn

### 10.4.2.6 DACLOCK Register (Offset = 5h) [reset = 0h]

DACLOCK is shown in [Figure 10-7](#) and described in [Table 10-9](#).

Return to [Summary Table](#).

DAC Lock Register

**Figure 10-7. DACLOCK Register**

15	14	13	12	11	10	9	8
RESERVED							
R-0h							
7	6	5	4	3	2	1	0
RESERVED					DACOUTEN	DACVAL	DACCTL
R-0h					R/WSONce-0h	R/WSONce-0h	R/WSONce-0h

**Table 10-9. DACLOCK Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-3	RESERVED	R	0h	Reserved
2	DACOUTEN	R/WSONce	0h	Lock write-access to the DACOUTEN register.  0 DACOUTEN register is not locked. Write 0 to this bit has no effect. 1 DACOUTEN register is locked. Only a system reset can clear this bit. Reset type: SYSRSn
1	DACVAL	R/WSONce	0h	Lock write-access to the DACVALS register.  0 DACVALS register is not locked. Write 0 to this bit has no effect. 1 DACVALS register is locked. Only a system reset can clear this bit. Reset type: SYSRSn
0	DACCTL	R/WSONce	0h	Lock write-access to the DACCTL register.  0 DACCTL register is not locked. Write 0 to this bit has no effect. 1 DACCTL register is locked. Only a system reset can clear this bit. Reset type: SYSRSn

### 10.4.2.7 DACTRIM Register (Offset = 6h) [reset = 0h]

DACTRIM is shown in [Figure 10-8](#) and described in [Table 10-10](#).

Return to [Summary Table](#).

DAC Trim Register

**Figure 10-8. DACTRIM Register**

15	14	13	12	11	10	9	8
RESERVED				RESERVED			
R-0h				R-0h			
7	6	5	4	3	2	1	0
OFFSET_TRIM							
R/W-0h							

**Table 10-10. DACTRIM Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-12	RESERVED	R	0h	Reserved
11-8	RESERVED	R	0h	Reserved
7-0	OFFSET_TRIM	R/W	0h	DAC Offset Trim.  This register should not be modified unless specifically indicated by TI Errata or other documentation. Modifying the contents of this register could cause this module to operate outside of datasheet specifications. Reset type: SYSRSn

## Comparator Subsystem (CMPSS)

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The Comparator Subsystem (CMPSS) consists of analog comparators and supporting circuits that are useful for power applications such as peak current mode control, switched-mode power, power factor correction, and voltage trip monitoring.

Topic	Page
11.1 CMPSS Overview .....	1469
11.2 Comparator .....	1470
11.3 Internal DAC .....	1470
11.4 Ramp Generator .....	1471
11.5 Digital Filter .....	1472
11.6 Registers .....	1474

## 11.1 CMPSS Overview

The comparator subsystem is built around a number of modules, each comprising a pair of analog comparators. Comparators are denoted "H" or "L" within each module. Each comparator generates a digital output which indicates whether the voltage on the positive input is greater than the voltage on the negative input. The positive input of the comparator is always driven from an external pin, but the negative input can be driven by either an external pin or by an internal programmable 12-bit DAC. Each comparator output passes through a programmable digital filter that can remove spurious trip signals. A ramp generator circuit is optionally available to control the internal DAC value for one comparator in the subsystem.

### 11.1.1 Features

#### CMPSS Features

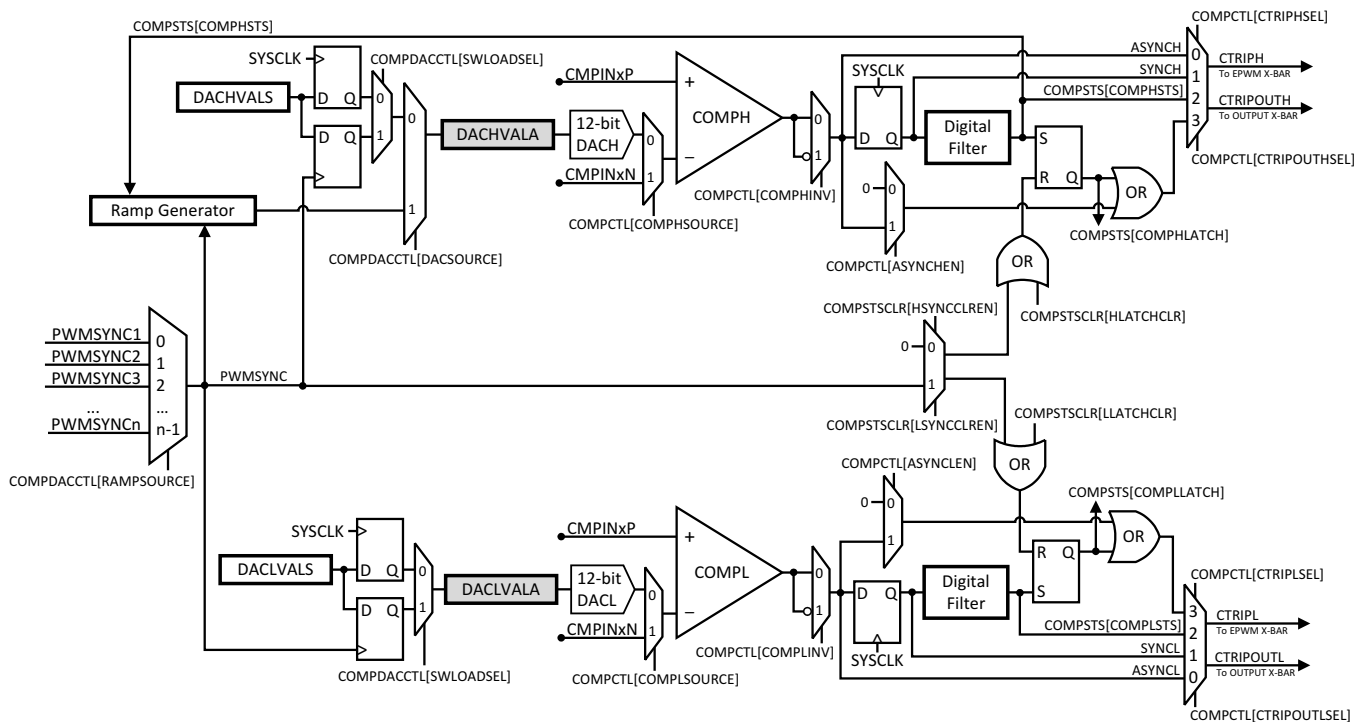
- Each CMPSS module includes:
  - Two analog comparators
  - Two programmable 12-bit DACs
  - One ramp generator
  - Two digital filters
- Ability to synchronize with PWMSYNC
- Option for negative input of comparator to be driven by an external signal or by an internal DAC
- Option to choose between VDDA or VDAC to be the DAC reference voltage

### 11.1.2 Block Diagram

The block diagram for the CMPSS is shown in [Figure 11-1](#).

- CTRIPx(x= "H" or "L") signals are connected to the ePWM X-BAR for ePWM trip response. See the ePWM chapter for more details on the ePWM X-BAR mux configuration.
- CTRIPxOUT signals are connected to the Output X-BAR for external signaling. See the *GPIO* chapter for more details on the Output X-BAR mux configuration.

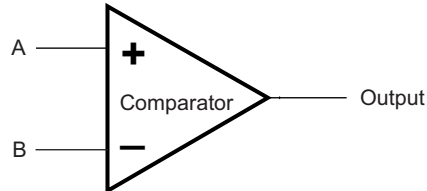
**Figure 11-1. CMPSS Module Block Diagram**



## 11.2 Comparator

The comparator generates a digital output which indicates whether the voltage on the positive input is greater than the voltage on the negative input.

**Figure 11-2. Comparator Digital Output**



Voltages	Output
Voltage A > Voltage B	1
Voltage A < Voltage B	0

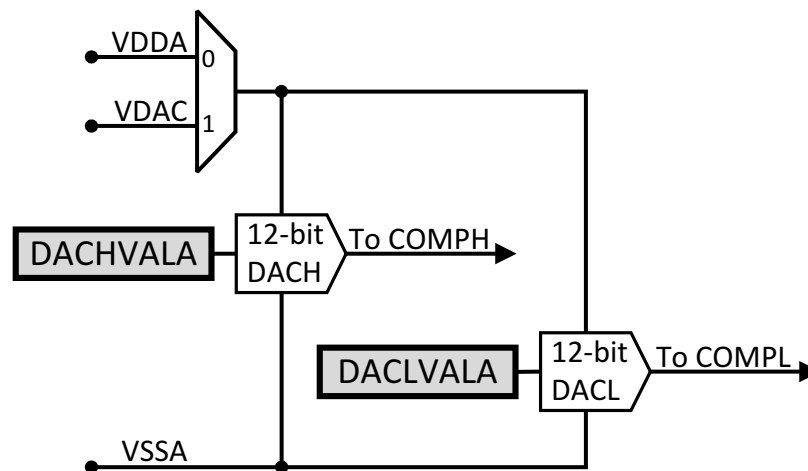
## 11.3 Internal DAC

Each 12-bit internal DAC can be configured to drive the reference voltage into the negative input of its respective comparator. The DAC output is internal only and cannot be observed externally.

Two sets of DACxVAL registers are present for each DAC: DACxVALA and DACxVALS. DACxVALA is a read-only register that actively controls the DAC value. DACxVALS is a writable shadow register that loads into DACxVALA either immediately or synchronized with the next PWMSYNC event. The high DAC (DACH) can optionally source its DACHVALA value from the Ramp Generator instead of DACHVALS.

The operating range of the DACs is bounded by its high and low reference voltages. The high voltage reference is VDDA by default, but it can be configured to be VDAC if desired.

**Figure 11-3. DAC Reference Select**



The ideal output voltage of the DACs can be calculated as follows:

**Figure 11-4. Output Voltage Calculation**

$$V_{DACx} = \frac{DACxVALA * DACREF}{4096}$$

### 11.4 Ramp Generator

When selected, the ramp generator produces a falling-ramp reference for DACH. In this mode, the DAC uses the most significant 12 bits of the RAMPSTS countdown register as its input.

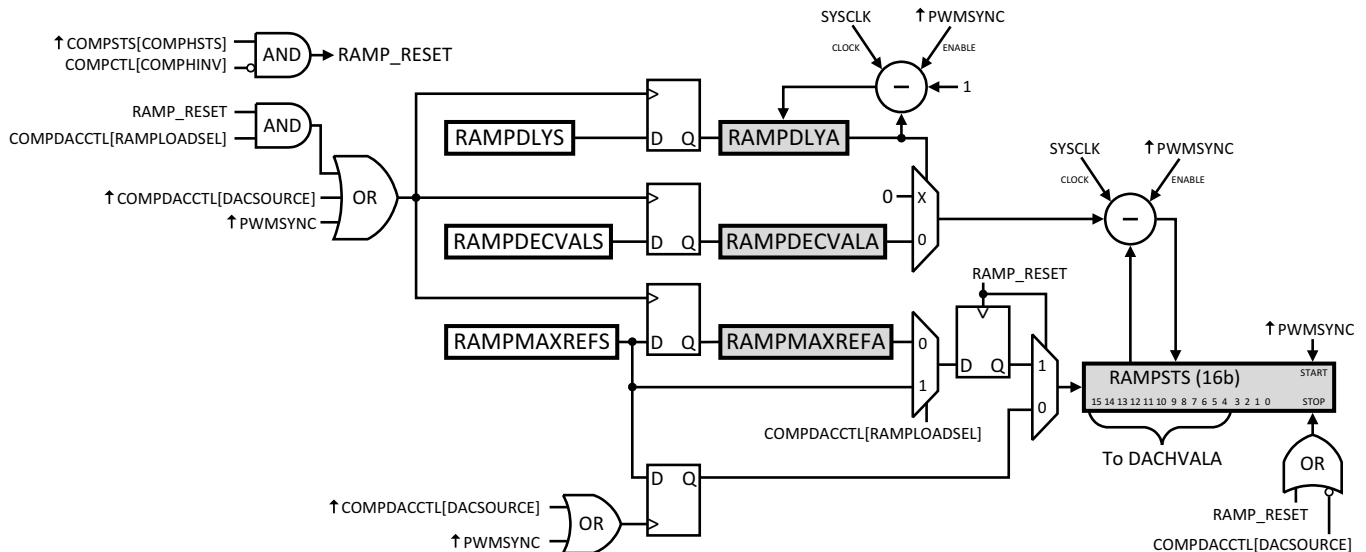
The RAMPSTS register is loaded from RAMPMAXREFS when the selected PWMSYNC signal is received. After the PWMSYNC event, the value of RAMPDECVALA is subtracted from RAMPSTS on every SYSCLK cycle thereafter.

The RAMPDLYA register serves as a delay counter to hold off the RAMPSTS subtraction. When a PWMSYNC signal is received, the value of RAMPDLYA is decremented by one for every SYSCLK cycle until the register reaches zero. RAMPSTS subtraction will only begin when RAMPDLYA is zero.

When the ramp generator is first enabled by setting DACSOURCE = 1, the value of RAMPSTS is loaded from RAMPMAXREFS, and the register remains static until the first PWMSYNC signal is received.

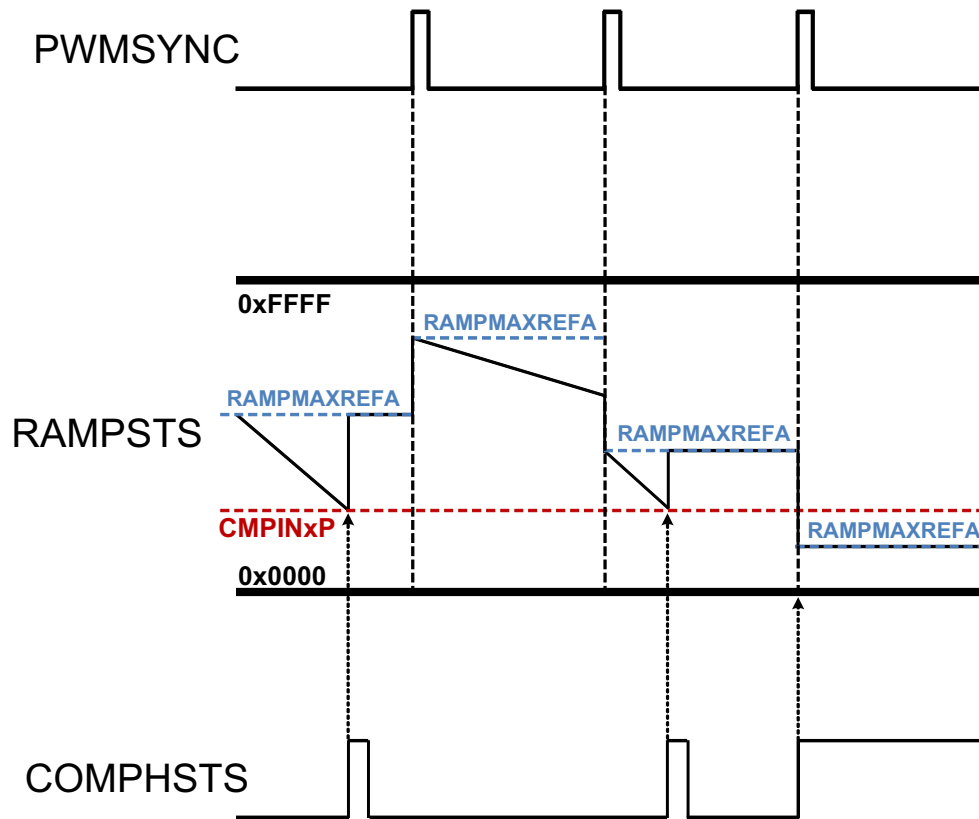
If the COMPHSTS bit is set by the comparator while the ramp generator is active, the RAMPSTS register will reset to the value of RAMPMAXREFA and remain static until the next PWMSYNC signal is received. If the value of RAMPSTS reaches zero, the RAMPSTS register will remain static at zero until the next PWMSYNC is received. The ramp generator is illustrated in Figure 11-5.

Figure 11-5. Ramp Generator



The ramp generator behavior is further illustrated in Figure 11-6.

Figure 11-6. Ramp Generator Behavior



### 11.5 Digital Filter

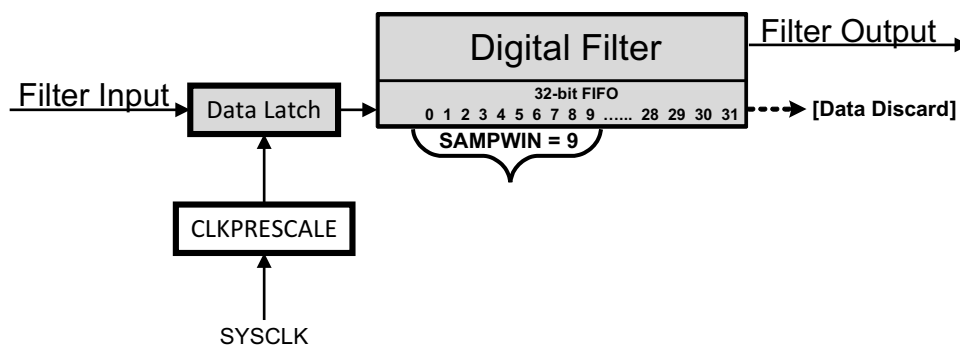
The digital filter works on a window of FIFO samples ( $SAMPWIN + 1$ ) taken from the input. The filter output resolves to the majority value of the sample window, where majority is defined by the threshold (THRESH) value. If the majority threshold is not satisfied, the filter output remains unchanged.

For proper operation, the value of THRESH must be greater than  $SAMPWIN / 2$ .

A prescale function (CLKPRESCALE) determines the filter sampling rate, where the filter FIFO captures one sample every CLKPRESCALE system clocks. Old data from the FIFO is discarded.

A conceptual model of the digital filter is shown in Figure 11-7.

Figure 11-7. Digital Filter Behavior



Equivalent C code of the filter implementation is shown below:

```

if (FILTER_OUTPUT == 0) {
    if (Num_1s_in_SAMPWIN >= THRESH) {
        FILTER_OUTPUT = 1;
    }
}

```



```
    }  
  }  
  else {  
    if (Num_0s_in_SAMPWIN >= THRESH) {  
      FILTER_OUTPUT = 0;  
    }  
  }  
}
```

To ensure proper operation of the digital filter, the following initialization sequence is recommended:

1. Configure and enable the comparator for operation
2. Configure the digital filter parameters for operation
  - Set SAMPWIN for the number of samples to monitor in FIFO window
  - Set THRESH for the threshold required for majority qualification
  - Set CLKPRESCALE for the digital filter clock prescale value
3. Initialize the sample values in the digital FIFO window by setting FILINIT
4. Clear COMPSTS latch via COMPSTSCLR if the latched path is desired
5. Configure the CTRIP and CTRIPOUT signal paths
6. If desired, configure the ePWM and GPIO modules to accept the filtered signals

## 11.6 Registers

### 11.6.1 CMPSS Base Addresses

**Table 11-1. CMPSS Base Address Table**

Device Registers	Register Name	Start Address	End Address
Cmpss1Regs	CMPSS_REGS	0x0000_5C80	0x0000_5C9F
Cmpss2Regs	CMPSS_REGS	0x0000_5CA0	0x0000_5CBF
Cmpss3Regs	CMPSS_REGS	0x0000_5CC0	0x0000_5CDF
Cmpss4Regs	CMPSS_REGS	0x0000_5CE0	0x0000_5CFF
Cmpss5Regs	CMPSS_REGS	0x0000_5D00	0x0000_5D1F
Cmpss6Regs	CMPSS_REGS	0x0000_5D20	0x0000_5D3F
Cmpss7Regs	CMPSS_REGS	0x0000_5D40	0x0000_5D5F
Cmpss8Regs	CMPSS_REGS	0x0000_5D60	0x0000_5D7F

## 11.6.2 CMPSS\_REGS Registers

Table 11-2 lists the memory-mapped registers for the CMPSS\_REGS. All register offset addresses not listed in Table 11-2 should be considered as reserved locations and the register contents should not be modified.

**Table 11-2. CMPSS\_REGS Registers**

Offset	Acronym	Register Name	Write Protection	Section
0h	COMPCTL	CMPSS Comparator Control Register	EALLOW	<a href="#">Go</a>
1h	COMPHYSCTL	CMPSS Comparator Hysteresis Control Register	EALLOW	<a href="#">Go</a>
2h	COMPSTS	CMPSS Comparator Status Register		<a href="#">Go</a>
3h	COMPSTSLR	CMPSS Comparator Status Clear Register	EALLOW	<a href="#">Go</a>
4h	COMPDACCTL	CMPSS DAC Control Register	EALLOW	<a href="#">Go</a>
6h	DACHVALS	CMPSS High DAC Value Shadow Register		<a href="#">Go</a>
7h	DACHVALA	CMPSS High DAC Value Active Register		<a href="#">Go</a>
8h	RAMPMAXREFA	CMPSS Ramp Max Reference Active Register		<a href="#">Go</a>
Ah	RAMPMAXREFS	CMPSS Ramp Max Reference Shadow Register		<a href="#">Go</a>
Ch	RAMPDECVALA	CMPSS Ramp Decrement Value Active Register		<a href="#">Go</a>
Eh	RAMPDECVALS	CMPSS Ramp Decrement Value Shadow Register		<a href="#">Go</a>
10h	RAMPSTS	CMPSS Ramp Status Register		<a href="#">Go</a>
12h	DACLVALS	CMPSS Low DAC Value Shadow Register		<a href="#">Go</a>
13h	DACLVALA	CMPSS Low DAC Value Active Register		<a href="#">Go</a>
14h	RAMPDLYA	CMPSS Ramp Delay Active Register		<a href="#">Go</a>
15h	RAMPDLYS	CMPSS Ramp Delay Shadow Register		<a href="#">Go</a>
16h	CTRIPLFILCTL	CTRIPL Filter Control Register	EALLOW	<a href="#">Go</a>
17h	CTRIPLFILCLKCTL	CTRIPL Filter Clock Control Register	EALLOW	<a href="#">Go</a>
18h	CTRIPHFILCTL	CTRIPH Filter Control Register	EALLOW	<a href="#">Go</a>
19h	CTRIPHFILCLKCTL	CTRIPH Filter Clock Control Register	EALLOW	<a href="#">Go</a>
1Ah	COMPLOCK	CMPSS Lock Register	EALLOW	<a href="#">Go</a>

Complex bit access types are encoded to fit into small table cells. Table 11-3 shows the codes that are used for access types in this section.

**Table 11-3. CMPSS\_REGS Access Type Codes**

Access Type	Code	Description
<b>Read Type</b>		
R	R	Read
R=0	R	Read
<b>Write Type</b>		
W	W	Write
W=1	W	Write
WSOnce	SOnce W	Set once Write
<b>Reset or Default Value</b>		
-n		Value after reset or the default value
<b>Register Array Variables</b>		

**Table 11-3. CMPSS\_REGS Access Type Codes (continued)**

Access Type	Code	Description
i,j,k,l,m,n		When these variables are used in a register name, an offset, or an address, they refer to the value of a register array where the register is part of a group of repeating registers. The register groups form a hierarchical structure and the array is represented with a formula.
y		When this variable is used in a register name, an offset, or an address it refers to the value of a register array.

### 11.6.2.1 COMPCTL Register (Offset = 0h) [reset = 0h]

COMPCTL is shown in [Figure 11-8](#) and described in [Table 11-4](#).

Return to [Summary Table](#).

CMPSS Comparator Control Register

**Figure 11-8. COMPCTL Register**

15	14	13	12	11	10	9	8
COMPDA CE	ASYNCL EN	CTRIPOUTLSEL		CTRIPLSEL		COMPLIN V	COMPLSOUR CE
R/W-0h	R/W-0h	R/W-0h		R/W-0h		R/W-0h	R/W-0h
7	6	5	4	3	2	1	0
RESERVED	ASYNCH EN	CTRIPOUTHSEL		CTRIPHSEL		COMPHIN V	COMPHSOUR CE
R-0h	R/W-0h	R/W-0h		R/W-0h		R/W-0h	R/W-0h

**Table 11-4. COMPCTL Register Field Descriptions**

Bit	Field	Type	Reset	Description
15	COMPDA CE	R/W	0h	Comparator/DAC enable. 0 Comparator/DAC disabled 1 Comparator/DAC enabled Reset type: SYSRSn
14	ASYNCL EN	R/W	0h	Low comparator asynchronous path enable. Allows asynchronous comparator output to feed into OR gate with latched digital filter signal when CTRIPLSEL=3 or CTRIPOUTLSEL=3. 0 Asynchronous comparator output does not feed into OR gate with latched digital filter output 1 Asynchronous comparator output feeds into OR gate with latched digital filter output Reset type: SYSRSn
13-12	CTRIPOUTLSEL	R/W	0h	Low comparator CTRIPOUTL source select. 0 Asynchronous comparator output drives CTRIPOUTL 1 Synchronous comparator output drives CTRIPOUTL 2 Output of digital filter drives CTRIPOUTL 3 Latched output of digital filter drives CTRIPOUTL Reset type: SYSRSn
11-10	CTRIPLSEL	R/W	0h	Low comparator CTRIPL source select. 0 Asynchronous comparator output drives CTRIPL 1 Synchronous comparator output drives CTRIPL 2 Output of digital filter drives CTRIPL 3 Latched output of digital filter drives CTRIPL Reset type: SYSRSn
9	COMPLIN V	R/W	0h	Low comparator output invert. 0 Output of comparator is not inverted 1 Output of comparator is inverted Reset type: SYSRSn
8	COMPLSOUR CE	R/W	0h	Low comparator input source. 0 Inverting input of comparator driven by internal DAC 1 Inverting input of comparator driven through external pin Reset type: SYSRSn
7	RESERVED	R	0h	Reserved

**Table 11-4. COMPCTL Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
6	ASYNCHEN	R/W	0h	<p>High comparator asynchronous path enable. Allows asynchronous comparator output to feed into OR gate with latched digital filter signal when CTRIPHSEL=3 or CTRIPOUTHSEL=3.</p> <p>0 Asynchronous comparator output does not feed into OR gate with latched digital filter output            1 Asynchronous comparator output feeds into OR gate with latched digital filter output            Reset type: SYSRSn</p>
5-4	CTRIPOUTHSEL	R/W	0h	<p>High comparator CTRIPOUTH source select.</p> <p>0 Asynchronous comparator output drives CTRIPOUTH            1 Synchronous comparator output drives CTRIPOUTH            2 Output of digital filter drives CTRIPOUTH            3 Latched output of digital filter drives CTRIPOUTH            Reset type: SYSRSn</p>
3-2	CTRIPHSEL	R/W	0h	<p>High comparator CTRIPH source select.</p> <p>0 Asynchronous comparator output drives CTRIPH            1 Synchronous comparator output drives CTRIPH            2 Output of digital filter drives CTRIPH            3 Latched output of digital filter drives CTRIPH            Reset type: SYSRSn</p>
1	COMPHINV	R/W	0h	<p>High comparator output invert.</p> <p>0 Output of comparator is not inverted            1 Output of comparator is inverted            Reset type: SYSRSn</p>
0	COMPHSOURCE	R/W	0h	<p>High comparator input source.</p> <p>0 Inverting input of comparator driven by internal DAC            1 Inverting input of comparator driven through external pin            Reset type: SYSRSn</p>

**11.6.2.2 COMPHYCTL Register (Offset = 1h) [reset = 0h]**

COMPHYCTL is shown in [Figure 11-9](#) and described in [Table 11-5](#).

Return to [Summary Table](#).

CMPSS Comparator Hysteresis Control Register

**Figure 11-9. COMPHYCTL Register**

15	14	13	12	11	10	9	8
RESERVED							
R-0h							
7	6	5	4	3	2	1	0
RESERVED					COMPHYCTL		
R-0h					R/W-0h		

**Table 11-5. COMPHYCTL Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-3	RESERVED	R	0h	Reserved
2-0	COMPHYCTL	R/W	0h	<p>Comparator hysteresis. Sets the amount of hysteresis on the comparator inputs.</p> <p>0 None            1 Set to typical hysteresis            2 Set to 2x of typical hysteresis            3 Set to 3x of typical hysteresis            4 Set to 4x of typical hysteresis</p> <p>Reset type: SYSRSn</p>

### 11.6.2.3 COMPSTS Register (Offset = 2h) [reset = 0h]

COMPSTS is shown in [Figure 11-10](#) and described in [Table 11-6](#).

Return to [Summary Table](#).

CMPSS Comparator Status Register

**Figure 11-10. COMPSTS Register**

15	14	13	12	11	10	9	8
RESERVED						COMPLLATCH	COMPLSTS
R-0h						R-0h	R-0h
7	6	5	4	3	2	1	0
RESERVED						COMPHLATCH	COMPHSTS
R-0h						R-0h	R-0h

**Table 11-6. COMPSTS Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-10	RESERVED	R	0h	Reserved
9	COMPLLATCH	R	0h	Latched value of low comparator digital filter output Reset type: SYSRSn
8	COMPLSTS	R	0h	Low comparator digital filter output Reset type: SYSRSn
7-2	RESERVED	R	0h	Reserved
1	COMPHLATCH	R	0h	Latched value of high comparator digital filter output Reset type: SYSRSn
0	COMPHSTS	R	0h	High comparator digital filter output Reset type: SYSRSn



#### 11.6.2.4 COMPSTSCLR Register (Offset = 3h) [reset = 0h]

COMPSTSCLR is shown in [Figure 11-11](#) and described in [Table 11-7](#).

Return to [Summary Table](#).

CMPSS Comparator Status Clear Register

**Figure 11-11. COMPSTSCLR Register**

15	14	13	12	11	10	9	8
RESERVED					LSYNCCLREN	LLATCHCLR	RESERVED
R-0h					R/W-0h	R=0/W=1-0h	R-0h
7	6	5	4	3	2	1	0
RESERVED					HSYNCCLREN	HLATCHCLR	RESERVED
R-0h					R/W-0h	R=0/W=1-0h	R-0h

**Table 11-7. COMPSTSCLR Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-11	RESERVED	R	0h	Reserved
10	LSYNCCLREN	R/W	0h	Low comparator latch PWMSYNC clear. Enable PWMSYNC reset of low comparator digital filter output latch COMPSTS[COMPLLATCH].  0 PWMSYNC will not reset latch 1 PWMSYNC will reset latch Reset type: SYSRSn
9	LLATCHCLR	R=0/W=1	0h	Low comparator latch software clear. Perform software reset of low comparator digital filter output latch COMPSTS[COMPLLATCH]. Reads always return 0.  0 No effect 1 Generate a single pulse of latch reset signal for COMPSTS[COMPLLATCH] Reset type: SYSRSn
8-3	RESERVED	R	0h	Reserved
2	HSYNCCLREN	R/W	0h	High comparator latch PWMSYNC clear. Enable PWMSYNC reset of high comparator digital filter output latch COMPSTS[COMPHLATCH].  0 PWMSYNC will not reset latch 1 PWMSYNC will reset latch Reset type: SYSRSn
1	HLATCHCLR	R=0/W=1	0h	High comparator latch software clear. Perform software reset of high comparator digital filter output latch COMPSTS[COMPHLATCH]. Reads always return 0.  0 No effect 1 Generate a single pulse of latch reset signal for COMPSTS[COMPHLATCH] Reset type: SYSRSn
0	RESERVED	R	0h	Reserved

**11.6.2.5 COMPDACCTL Register (Offset = 4h) [reset = 0h]**

 COMPDACCTL is shown in [Figure 11-12](#) and described in [Table 11-8](#).

 Return to [Summary Table](#).

CMPSS DAC Control Register

**Figure 11-12. COMPDACCTL Register**

15	14	13	12	11	10	9	8
FREESOFT			RESERVED				
R/W-0h			R-0h				
7	6	5	4	3	2	1	0
SWLOADSEL	RAMPLOADSEL	SELREF	RAMPSOURCE			DACSOURCE	
R/W-0h	R/W-0h	R/W-0h	R/W-0h			R/W-0h	

**Table 11-8. COMPDACCTL Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-14	FREESOFT	R/W	0h	Free-run or software-run emulation behavior. Behavior of the ramp generator during emulation suspend.  00b Ramp generator stops immediately during emulation suspend 01b Ramp generator completes current ramp and stops at next PWMSYNC during emulation suspend 1Xb Ramp generator runs freely Reset type: SYSRSn
13-8	RESERVED	R	0h	Reserved
7	SWLOADSEL	R/W	0h	Software load select. Determines whether DACxVALA is updated from DACxVALS on SYSCLK or PWMSYNC.  0 DACxVALA is updated from DACxVALS on SYSCLK 1 DACxVALA is updated from DACxVALS on PWMSYNC Reset type: SYSRSn
6	RAMPLOADSEL	R/W	0h	Ramp load select. Determines whether RAMPSTS is updated from RAMPMAXREFA or RAMPMAXREFS when COMPSTS[COMPSTST] is triggered.  0 RAMPSTS is loaded from RAMPMAXREFA 1 RAMPSTS is loaded from RAMPMAXREFS Reset type: SYSRSn
5	SELREF	R/W	0h	DAC reference select. Determines which voltage supply is used as the reference for the internal comparator DACs.  0 VDDA is the voltage reference for the DAC 1 VDAC is the voltage reference for the DAC Reset type: SYSRSn
4-1	RAMPSOURCE	R/W	0h	Ramp generator source select. Determines which PWMSYNC signal is used within the CMPSS module.  Where n represents the maximum number of PWMSYNC signals available on the device:  0 PWMSYNC1 1 PWMSYNC2 2 PWMSYNC3 ... n-1 PWMSYNcn Reset type: SYSRSn

**Table 11-8. COMPDACCTL Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
0	DACSOURCE	R/W	0h	<p>DAC source select. Determines whether DACHVALA is updated from DACHVALS or from the ramp generator.</p> <p>0 DACHVALA is updated from DACHVALS            1 DACHVALA is updated from the ramp generator            Reset type: SYSRSn</p>

### 11.6.2.6 DACHVALS Register (Offset = 6h) [reset = 0h]

DACHVALS is shown in [Figure 11-13](#) and described in [Table 11-9](#).

Return to [Summary Table](#).

CMPSS High DAC Value Shadow Register

**Figure 11-13. DACHVALS Register**

15	14	13	12	11	10	9	8
RESERVED				DACVAL			
R-0h				R/W-0h			
7	6	5	4	3	2	1	0
DACVAL							
R/W-0h							

**Table 11-9. DACHVALS Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-12	RESERVED	R	0h	Reserved
11-0	DACVAL	R/W	0h	High DAC shadow value. When COMPDACCTL[DACSOURCE]=0, the value of DACHVALS is loaded into DACHVALA on the trigger signal selected by COMPDACCTL[SWLOADSEL]. Reset type: SYSRSn

**11.6.2.7 DACHVALA Register (Offset = 7h) [reset = 0h]**

DACHVALA is shown in [Figure 11-14](#) and described in [Table 11-10](#).

Return to [Summary Table](#).

CMPSS High DAC Value Active Register

**Figure 11-14. DACHVALA Register**

15	14	13	12	11	10	9	8
RESERVED				DACVAL			
R-0h				R-0h			
7	6	5	4	3	2	1	0
DACVAL							
R-0h							

**Table 11-10. DACHVALA Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-12	RESERVED	R	0h	Reserved
11-0	DACVAL	R	0h	High DAC active value. Value that is actively driven by the high DAC. Reset type: SYSRSn

### 11.6.2.8 RAMPMAXREFA Register (Offset = 8h) [reset = 0h]

RAMPMAXREFA is shown in [Figure 11-15](#) and described in [Table 11-11](#).

Return to [Summary Table](#).

CMPSS Ramp Max Reference Active Register

**Figure 11-15. RAMPMAXREFA Register**

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
RAMPMAXREF															
R-0h															

**Table 11-11. RAMPMAXREFA Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-0	RAMPMAXREF	R	0h	Ramp maximum reference active value. Latched value to be loaded into ramp generator RAMPSTS. Reset type: SYSRSn

**11.6.2.9 RAMPMAXREFS Register (Offset = Ah) [reset = 0h]**

RAMPMAXREFS is shown in [Figure 11-16](#) and described in [Table 11-12](#).

Return to [Summary Table](#).

CMPSS Ramp Max Reference Shadow Register

**Figure 11-16. RAMPMAXREFS Register**

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
RAMPMAXREF															
R/W-0h															

**Table 11-12. RAMPMAXREFS Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-0	RAMPMAXREF	R/W	0h	Ramp maximum reference shadow. Unlatched value to be loaded into ramp generator RAMPSTS. Reset type: SYSRSn

**11.6.2.10 RAMPDECVALA Register (Offset = Ch) [reset = 0h]**

RAMPDECVALA is shown in [Figure 11-17](#) and described in [Table 11-13](#).

Return to [Summary Table](#).

CMPSS Ramp Decrement Value Active Register

**Figure 11-17. RAMPDECVALA Register**

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
RAMPDECVAL															
R-0h															

**Table 11-13. RAMPDECVALA Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-0	RAMPDECVAL	R	0h	Ramp decrement value active. Latched value that will be subtracted from RAMPSTS. Reset type: SYSRSn



**11.6.2.11 RAMPDECVALS Register (Offset = Eh) [reset = 0h]**

RAMPDECVALS is shown in [Figure 11-18](#) and described in [Table 11-14](#).

Return to [Summary Table](#).

CMPSS Ramp Decrement Value Shadow Register

**Figure 11-18. RAMPDECVALS Register**

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
RAMPDECVAL															
R/W-0h															

**Table 11-14. RAMPDECVALS Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-0	RAMPDECVAL	R/W	0h	Ramp decrement value shadow. Unlatched value to be loaded into RAMPDECVALA. Reset type: SYSRSn

**11.6.2.12 RAMPSTS Register (Offset = 10h) [reset = 0h]**

RAMPSTS is shown in [Figure 11-19](#) and described in [Table 11-15](#).

Return to [Summary Table](#).

CMPSS Ramp Status Register

**Figure 11-19. RAMPSTS Register**

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
RAMPVALUE															
R-0h															

**Table 11-15. RAMPSTS Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-0	RAMPVALUE	R	0h	Ramp value. Present value of ramp generator. Reset type: SYSRSn

**11.6.2.13 DACLVALS Register (Offset = 12h) [reset = 0h]**

DACLVALS is shown in [Figure 11-20](#) and described in [Table 11-16](#).

Return to [Summary Table](#).

CMPSS Low DAC Value Shadow Register

**Figure 11-20. DACLVALS Register**

15	14	13	12	11	10	9	8
RESERVED				DACVAL			
R-0h				R/W-0h			
7	6	5	4	3	2	1	0
DACVAL							
R/W-0h							

**Table 11-16. DACLVALS Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-12	RESERVED	R	0h	Reserved
11-0	DACVAL	R/W	0h	Low DAC shadow value. value to be loaded into DACLVALA on the trigger signal selected by COMPDACCTL[SWLOADSEL]. Reset type: SYSRSn

**11.6.2.14 DACLVALA Register (Offset = 13h) [reset = 0h]**

DACLVALA is shown in [Figure 11-21](#) and described in [Table 11-17](#).

Return to [Summary Table](#).

CMPSS Low DAC Value Active Register

**Figure 11-21. DACLVALA Register**

15	14	13	12	11	10	9	8
RESERVED				DACVAL			
R-0h				R-0h			
7	6	5	4	3	2	1	0
DACVAL							
R-0h							

**Table 11-17. DACLVALA Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-12	RESERVED	R	0h	Reserved
11-0	DACVAL	R	0h	Low DAC active value. Value that is actively driven by the low DAC. Reset type: SYSRSn

**11.6.2.15 RAMPDLYA Register (Offset = 14h) [reset = 0h]**

RAMPDLYA is shown in [Figure 11-22](#) and described in [Table 11-18](#).

Return to [Summary Table](#).

CMPSS Ramp Delay Active Register

**Figure 11-22. RAMPDLYA Register**

15	14	13	12	11	10	9	8
RESERVED				DELAY			
R-0h				R-0h			
7	6	5	4	3	2	1	0
DELAY							
R-0h							

**Table 11-18. RAMPDLYA Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-13	RESERVED	R	0h	Reserved
12-0	DELAY	R	0h	Ramp delay active value. Latched value of the number of cycles to delay the start of the ramp generator decrementer after a PWMSYNC is received. Reset type: SYSRSn

**11.6.2.16 RAMPDLYS Register (Offset = 15h) [reset = 0h]**

RAMPDLYS is shown in [Figure 11-23](#) and described in [Table 11-19](#).

Return to [Summary Table](#).

CMPSS Ramp Delay Shadow Register

**Figure 11-23. RAMPDLYS Register**

15	14	13	12	11	10	9	8
RESERVED			DELAY				
R-0h			R/W-0h				
7	6	5	4	3	2	1	0
DELAY							
R/W-0h							

**Table 11-19. RAMPDLYS Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-13	RESERVED	R	0h	Reserved
12-0	DELAY	R/W	0h	Ramp delay shadow value. Unlatched value to be loaded into RAMPDLYA. Reset type: SYSRSn

**11.6.2.17 CTRIPLFILCTL Register (Offset = 16h) [reset = 0h]**

 CTRIPLFILCTL is shown in [Figure 11-24](#) and described in [Table 11-20](#).

 Return to [Summary Table](#).

CTRIPL Filter Control Register

**Figure 11-24. CTRIPLFILCTL Register**

15	14	13	12	11	10	9	8
FILINIT	RESERVED	THRESH				SAMPWIN	
R=0/W=1-0h	R-0h	R/W-0h				R/W-0h	
7	6	5	4	3	2	1	0
SAMPWIN				RESERVED			
R/W-0h				R-0h			

**Table 11-20. CTRIPLFILCTL Register Field Descriptions**

Bit	Field	Type	Reset	Description
15	FILINIT	R=0/W=1	0h	Low filter initialization.  0 No effect 1 Initialize all samples to the filter input value Reset type: SYSRSn
14	RESERVED	R	0h	Reserved
13-9	THRESH	R/W	0h	Low filter majority voting threshold. At least THRESH samples of the opposite state must appear within the sample window in order for the output to change state. Reset type: SYSRSn
8-4	SAMPWIN	R/W	0h	Low filter sample window size. Number of samples to monitor is SAMPWIN+1. Reset type: SYSRSn
3-0	RESERVED	R	0h	Reserved

**11.6.2.18 CTRIPLFILCLKCTL Register (Offset = 17h) [reset = 0h]**

CTRIPLFILCLKCTL is shown in [Figure 11-25](#) and described in [Table 11-21](#).

Return to [Summary Table](#).

CTRIPL Filter Clock Control Register

**Figure 11-25. CTRIPLFILCLKCTL Register**

15	14	13	12	11	10	9	8
RESERVED						CLKPRESCALE	
R-0h						R/W-0h	
7	6	5	4	3	2	1	0
CLKPRESCALE							
R/W-0h							

**Table 11-21. CTRIPLFILCLKCTL Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-10	RESERVED	R	0h	Reserved
9-0	CLKPRESCALE	R/W	0h	Low filter sample clock prescale. Number of system clocks between samples. Reset type: SYSRSn



### 11.6.2.19 CTRIPFILCTL Register (Offset = 18h) [reset = 0h]

CTRIPFILCTL is shown in [Figure 11-26](#) and described in [Table 11-22](#).

Return to [Summary Table](#).

CTRIPH Filter Control Register

**Figure 11-26. CTRIPFILCTL Register**

15	14	13	12	11	10	9	8
FILINIT	RESERVED			THRESH			SAMPWIN
R=0/W=1-0h	R-0h			R/W-0h			R/W-0h
7	6	5	4	3	2	1	0
	SAMPWIN				RESERVED		
	R/W-0h				R-0h		

**Table 11-22. CTRIPFILCTL Register Field Descriptions**

Bit	Field	Type	Reset	Description
15	FILINIT	R=0/W=1	0h	High filter initialization. 0 No effect 1 Initialize all samples to the filter input value Reset type: SYSRSn
14	RESERVED	R	0h	Reserved
13-9	THRESH	R/W	0h	High filter majority voting threshold. At least THRESH samples of the opposite state must appear within the sample window in order for the output to change state. Reset type: SYSRSn
8-4	SAMPWIN	R/W	0h	High filter sample window size. Number of samples to monitor is SAMPWIN+1. Reset type: SYSRSn
3-0	RESERVED	R	0h	Reserved

**11.6.2.20 CTRIPFILCLKCTL Register (Offset = 19h) [reset = 0h]**

CTRIPFILCLKCTL is shown in [Figure 11-27](#) and described in [Table 11-23](#).

Return to [Summary Table](#).

CTRIPH Filter Clock Control Register

**Figure 11-27. CTRIPFILCLKCTL Register**

15	14	13	12	11	10	9	8
RESERVED						CLKPRESCALE	
R-0h						R/W-0h	
7	6	5	4	3	2	1	0
CLKPRESCALE							
R/W-0h							

**Table 11-23. CTRIPFILCLKCTL Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-10	RESERVED	R	0h	Reserved
9-0	CLKPRESCALE	R/W	0h	High filter sample clock prescale. Number of system clocks between samples. Reset type: SYSRSn

### 11.6.2.21 COMPLOCK Register (Offset = 1Ah) [reset = 0h]

COMPLOCK is shown in [Figure 11-28](#) and described in [Table 11-24](#).

Return to [Summary Table](#).

CMPSS Lock Register

**Figure 11-28. COMPLOCK Register**

15	14	13	12	11	10	9	8
RESERVED							
R-0h							
7	6	5	4	3	2	1	0
RESERVED		RESERVED		CTRIP	DACCTL	COMPHYSCTL	COMPCTL
R-0h		R-0h		R/WSONce-0h	R/WSONce-0h	R/WSONce-0h	R/WSONce-0h

**Table 11-24. COMPLOCK Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-5	RESERVED	R	0h	Reserved
4	RESERVED	R	0h	Reserved
3	CTRIP	R/WSONce	0h	Lock write-access to the CTRIPxFILTCTL and CTRIPxFILCLKCTL registers.  0 CTRIPxFILCTL and CTRIPxFILCLKCTL registers are not locked. Write 0 to this bit has no effect. 1 CTRIPxFILCTL and CTRIPxFILCLKCTL registers are locked. Only a system reset can clear this bit. Reset type: SYSRSn
2	DACCTL	R/WSONce	0h	Lock write-access to the DACCTL register.  0 DACCTL register is not locked. Write 0 to this bit has no effect. 1 DACCTL register is locked. Only a system reset can clear this bit. Reset type: SYSRSn
1	COMPHYSCTL	R/WSONce	0h	Lock write-access to the COMPHYSCTL register.  0 COMPHYSCTL register is not locked. Write 0 to this bit has no effect. 1 COMPHYSCTL register is locked. Only a system reset can clear this bit. Reset type: SYSRSn
0	COMPCTL	R/WSONce	0h	Lock write-access to the COMPCTL register.  0 COMPCTL register is not locked. Write 0 to this bit has no effect. 1 COMPCTL register is locked. Only a system reset can clear this bit. Reset type: SYSRSn

## Sigma Delta Filter Module (SDFM)

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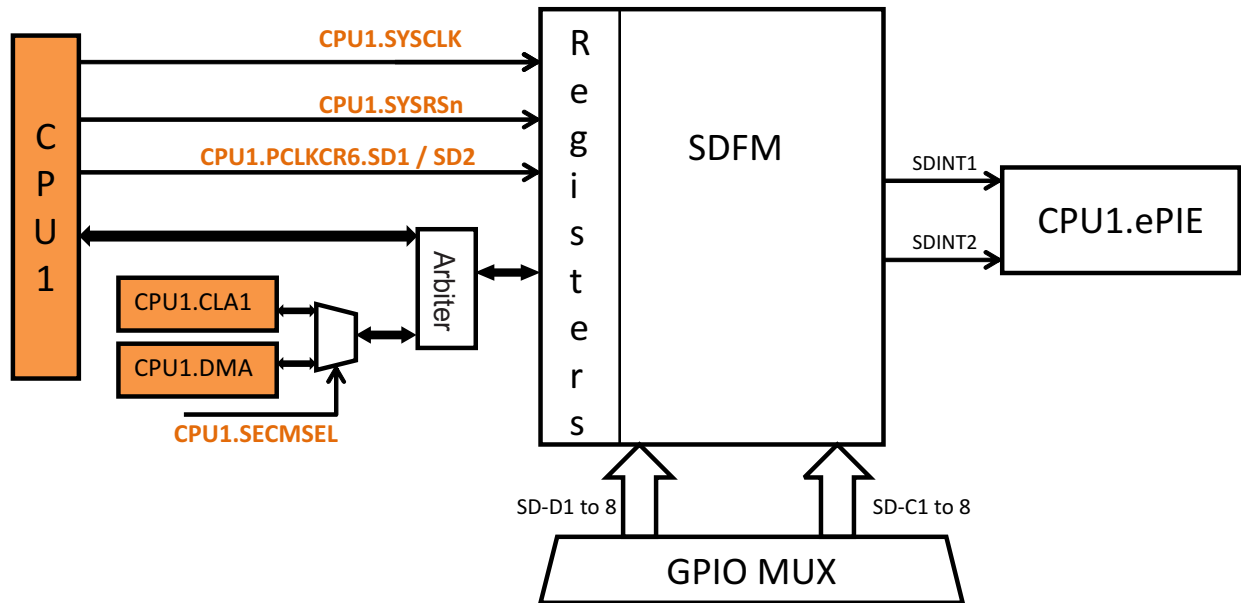
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This chapter describes the sigma delta filter module (SDFM). SDFM is a four-channel digital filter designed specifically for current measurement and resolver position decoding in motor control applications. Each channel can receive an independent delta-sigma ( $\Delta\Sigma$ ) modulator bit stream. The bit streams are processed by four individually-programmable digital decimation filters. The filter set includes a fast comparator for immediate digital threshold comparisons for over-current and under-current monitoring.

Topic	Page
12.1 SDFM Module Overview .....	1501
12.2 Configuring Device Pins .....	1503
12.3 Input Control Unit .....	1504
12.4 Comparator Unit .....	1505
12.5 Data Filter Unit .....	1506
12.6 Interrupt Unit .....	1510
12.7 Register Descriptions .....	1512
12.8 Registers .....	1513

## 12.1 SDFM Module Overview

shows the SDFM CPU interfaces:



### 12.1.1 SDFM Features

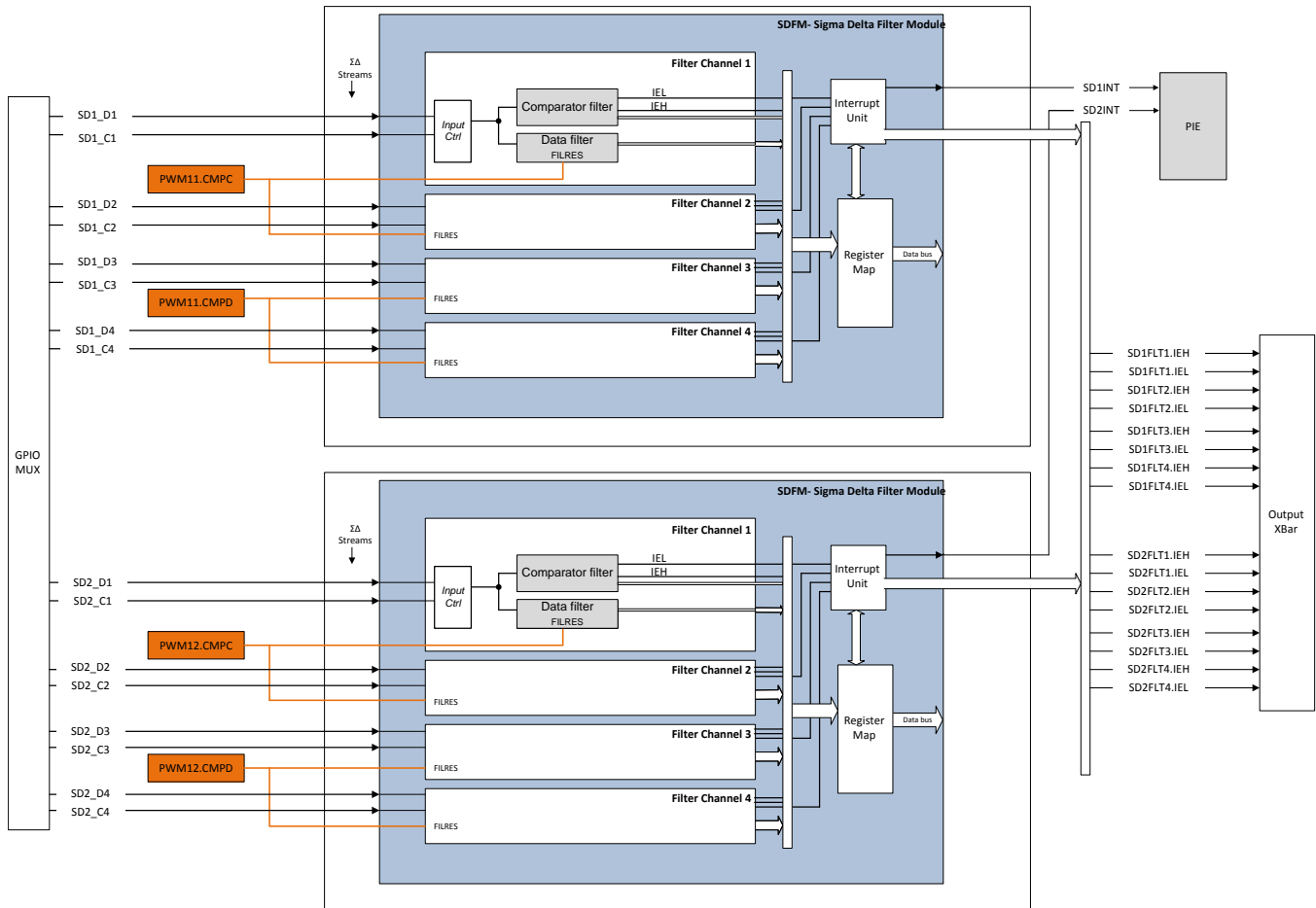
The SDFM features include:

- 8 external pins per SDFM module
  - 4 sigma delta data input pins per SDFM module (SD-Dx, where x = 1 to 4)
  - 4 sigma delta clock input pins per SDFM module (SD-Cx, where x = 1 to 4)
- 4 different configurable modulator clock modes:
  - Mode 0: Modulator clock rate equals modulator data rate
  - Mode 1: Modulator clock rate running at half the modulator data rate
  - Mode 2: Modulator data is Manchester encoded. Modulator clock not required.
  - Mode 3: Modulator clock rate is double that of modulator data rate
- 4 independent configurable comparator units per SDFM module:
  - 4 different filter type selection (Sinc1/Sinc2/Sincfast/Sinc3) options available
  - Ability to detect over and under value conditions
  - OSR value for comparator programmable from 1 to 32
- 4 independent configurable sinc filter units per SDFM module:
  - 4 different filter type selection (Sinc1/Sinc2/Sincfast/Sinc3) options available
  - OSR value for filter unit programmable from 1 to 256
  - Ability to enable / disable individual filter module
  - Ability to synchronize all the 4 independent filters of a SDFM module using Master Filter Enable (MFE) bit (or) using PWM signals.
- Data filter output can be represented in either 16 bits (or) 32 bits
- PWMs can be used to generate a modulator clock for sigma delta modulators

### 12.1.2 Block Diagram

Figure 12-1 shows the SDFM module block diagram. The SDFM port operation is configured and controlled by the registers listed in Table 12-1.

Figure 12-1. Sigma Delta Filter Module (SDFM) Block Diagram



Each SDFM module has four independent filter modules. These filter modules are identical and can be configured independently. Each individual filter module has the following units:

- Input Control unit
- Data filter unit
- Comparator unit

Figure 12-2 shows the block diagram of one filter module. When the SDDFPARMx.SDSYNCEN bit is set, the filter reset signal (SDSYNC) from the PWM module can be used to synchronize filters. It should be noted that the SDSYNC input is ONLY connected to the main Data Filter Unit and NOT the comparator, and that the reset function is limited to resetting the OSR counter. The SDSYNC input does not reset the data registers in the Filter Unit. Figure 12-3 shows how the PWM signals are connected to sigma delta module. In this device, PWM11 can be used to reset SDFM1 module and PWM12 can be used to reset SDFM2 module.

Figure 12-2. Block Diagram of One Filter Module

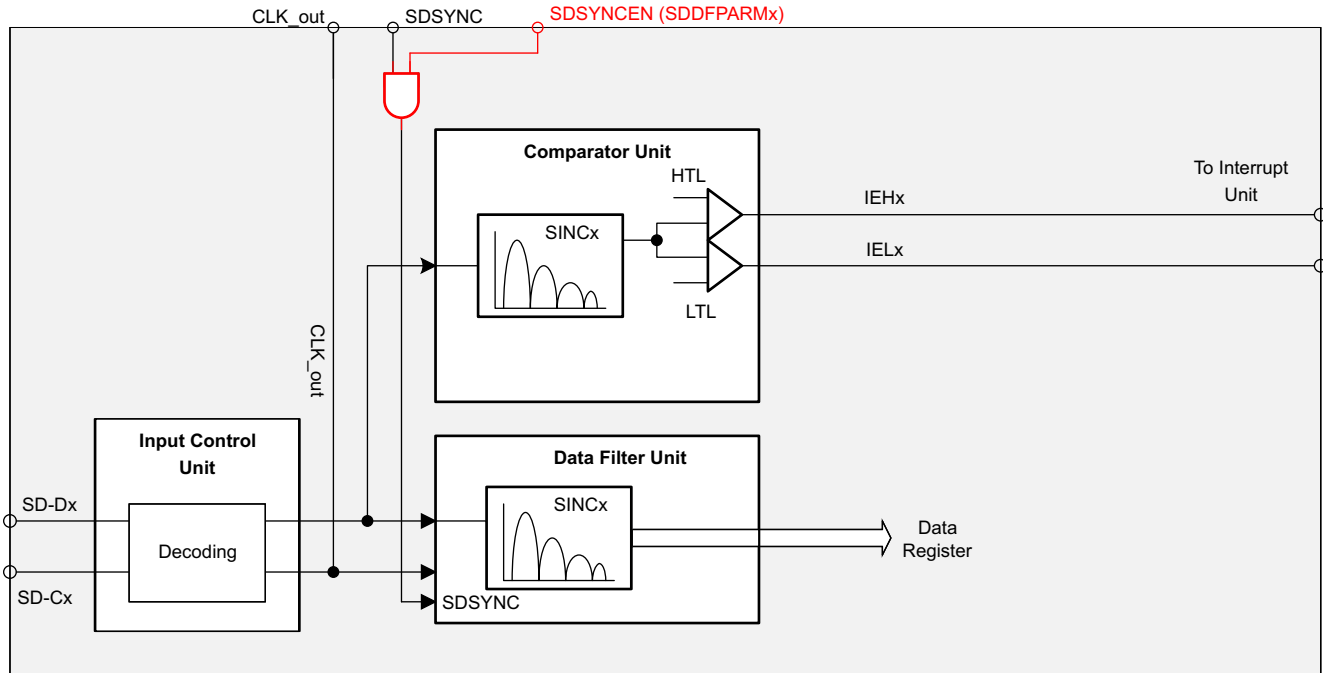
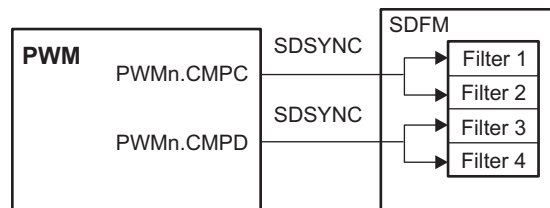


Figure 12-3. Typical PWM Interface to Sigma Delta Filter Module



**Note:** When using PWM11 (or) PWM12 for SDFM filter synchronization, users MUST ensure that ONLY ONE CMPC (or) CMPD event will be generated per PWM timer period. Using PWM in up-count (or) down-count mode would automatically ensure that you get ONLY one PWMC (or) PWMD event. But, if the user wishes to use up-down count mode, then they need to make sure that only one CMPC (or) CMPD event per PWM cycle is generated otherwise filter synchronizer will corrupt SDFM timing by providing two pulses per PWM cycle.

## 12.2 Configuring Device Pins

The GPIO mux registers must be configured to connect this peripheral to the device pins. To avoid glitches on the pins, the GPyGMUX bits must be configured first (while keeping the corresponding GPyMUX bits at the default of zero), followed by writing the GPyMUX register to the desired value.

Some IO functionality is defined by GPIO register settings independent of this peripheral. For input signals, the GPIO input qualification should be set to asynchronous mode by setting the appropriate GPxQSELn register bits to 11b. The internal pullups can be configured in the GPyPUD register.

See the *GPIO* chapter for more details on GPIO mux and settings.

## 12.3 Input Control Unit

The input control unit receives sigma delta modulated data and a sigma delta modulated clock. The modulated data received is captured and passed onto the data filter unit and comparator unit. This unit can be configured to receive the modulated data in four different modes. [Table 12-1](#) shows how SDCTLPARMx.MOD bits can be configured in these four different modes.

**Table 12-1. Modulator Clock Modes**

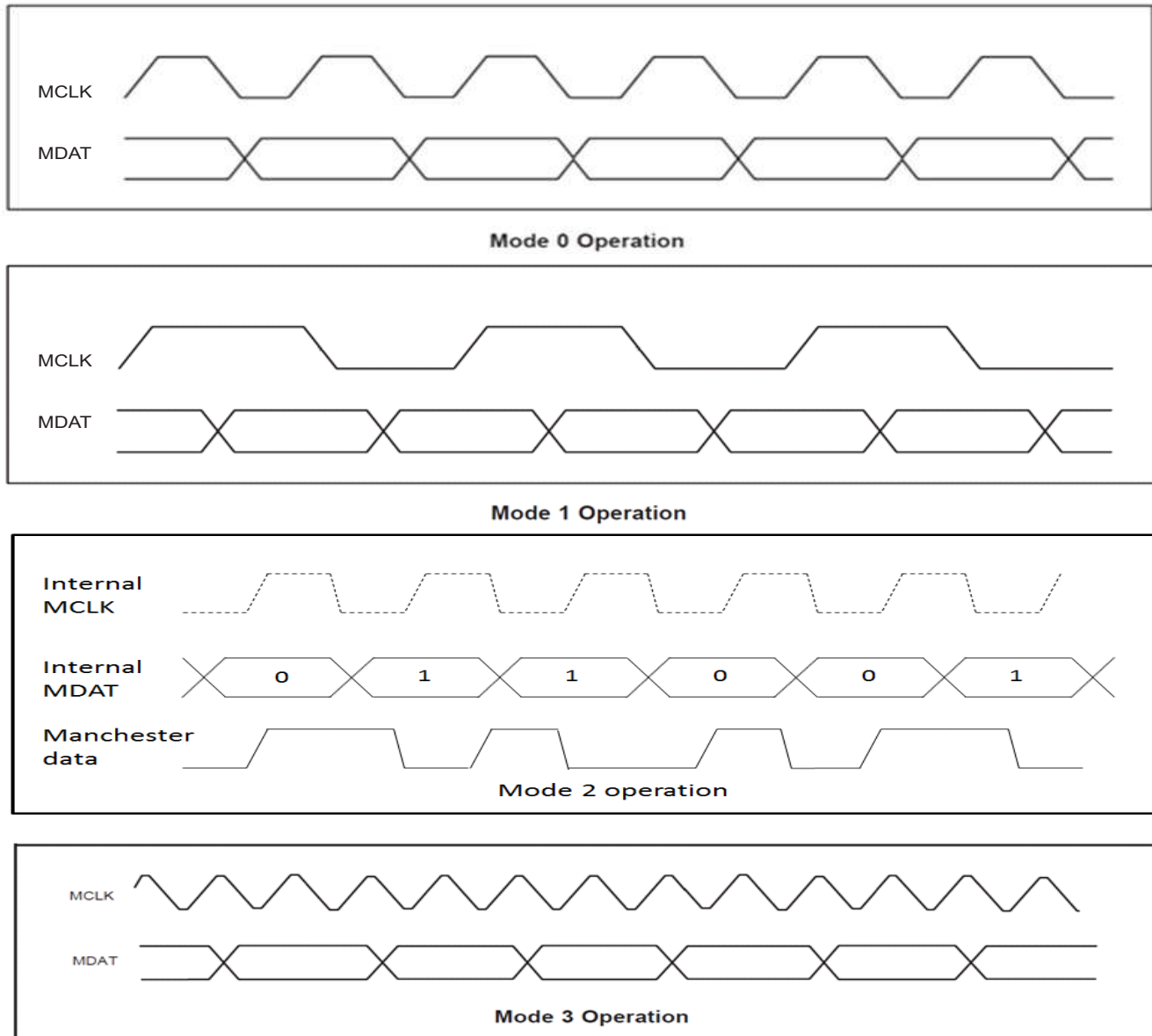
MODULATOR MODE [MOD]	DESCRIPTION
Mode0 <sup>(1)</sup>	The modulator clock is running with the modulator data rate. The modulator data is strobed at every rising edge of the modulator clock.
Mode1 <sup>(1)</sup>	The modulator clock is running with half of the modulator data rate. The modulator data is strobed at every edge of the modulator clock.
Mode2 <sup>(1)</sup>	The modulator clock is off and the modulator data is Manchester-encoded. <sup>(2)</sup>
Mode3 <sup>(1)</sup>	The modulator clock is running with double of the modulator data rate. The modulator data is strobed at every other positive modulator clock edge.

<sup>(1)</sup> Irrespective of which SDFM mode is selected, care **MUST** be taken to guarantee that differential input voltage applied to the sigma delta modulator stays within linear full scale range specified in the sigma delta modulator data sheet

<sup>(2)</sup> Because of the inherent architecture of the Manchester decoder, input data rate of mode2 supported depends on SYSCLK frequency. Please refer to the SDFM Electrical Data and Timing in device data sheet.



Figure 12-4. Operation Diagrams



When MOD=2, data and modulated clock signals are encoded into modulated data as shown in Figure 12-4. In this mode, the clock input SDCLKx.pin should be left floating. The input control unit performs continuous automatic calibration to achieve optimum decoding performance.

## 12.4 Comparator Unit

An independent comparator unit allows the user to monitor input conditions with a fast settling time without sacrificing input measurement resolution. The comparator filter is a configurable sinc filter which supports the following filter types:- Sinc1, Sinc2, Sinc3 and Sincfast filter. Comparator filter OSR (COSR) value can be configured from 1 to 32. With Sinc3 as filter type and OSR = 32, a maximum 15-bit output width of 32,768 can be achieved. The output of the filter is compared with two programmed threshold levels to

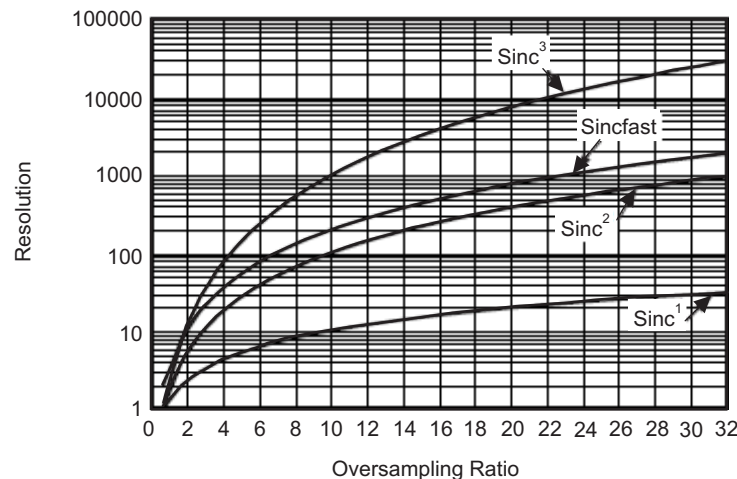
detect over- and under-value conditions. But output of the comparator filter cannot be read out of the filter. The comparator unit can be configured by high- and low-level Threshold registers (SDCMPHx and SDCMPLx) for each individual filter module. When an over- or under-value condition occurs, appropriate bits in SDIFLG (Interrupt Flag) register are set and then this register can be polled to see which condition caused interrupt signal.

The comparator filter unit and the data filter unit differ in the way they handle input data. The comparator filter unit translates a low input signal to a '0' and a high input signal to a '1', whereas the data filter unit uses '-1' and '1'. The resulting calculations give only positive values for the output of the comparator filter. The data representation is straight binary. Table 12-2 and Figure 12-5 show the different full-scale values that the comparator filter can store using different oversampling ratios.

**Table 12-2. Peak Data Values for Different OSR/Filter Combinations**

OSR	Sinc1	Sinc2	Sinc3	Sincfast
x	0 to x	0 to x <sup>2</sup>	0 to x <sup>3</sup>	0 to 2x <sup>2</sup>
4	0 to 4	0 to 16	0 to 64	0 to 32
8	0 to 8	0 to 64	0 to 512	0 to 128
16	0 to 16	0 to 256	0 to 4096	0 to 512
32	0 to 32	0 to 1024	0 to 32,768	0 to 2048

**Figure 12-5. Comparator Filter Resolution**

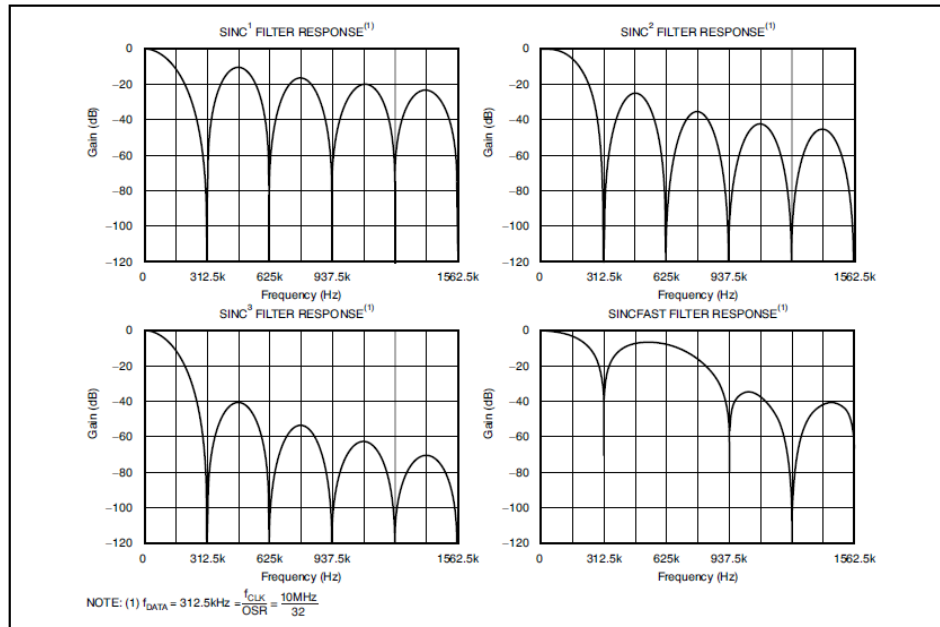


In order to achieve the maximum value, the delta-sigma modulator is operated at absolute maximum positive or negative full-scale, which is outside of the recommended full-scale range of 80% of most delta-sigma modulators.

## 12.5 Data Filter Unit

The data filter is a configurable sinc filter which supports the following filter types: Sinc1, Sinc2, Sinc3 and Sincfast filter. The data filter OSR (DOSR) value can be configured from 1 to 256. Figure 12-6 illustrates the frequency response of each type of filter when DOSR = 32 and modulator rate = 10 MHz.

Figure 12-6. Frequency Response of Various Sinc Filters

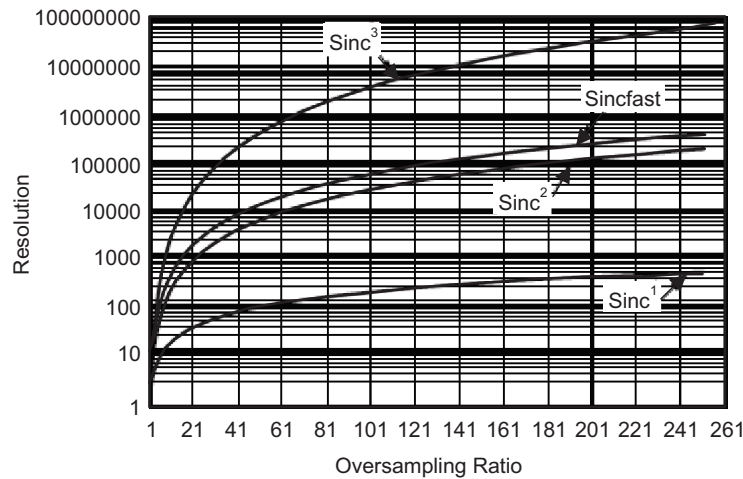


The user can achieve a higher resolution by increasing the data filter oversampling ratio (DOSR) but this would reduce the data rate of the data filter. Table 12-3 shows the peak data for different filter type or DOSR combinations and Figure 12-7 shows the relationship between the DOSR and filter resolution. The highest resolution for any given DOSR can be achieved by using the Sinc3 filter and the highest possible resolution can be achieved with DOSR = 256 and Sinc3 filter.

Table 12-3. Peak Data Values for Different DOSR/Filter Combinations

DOSR	Sinc1	Sinc2	Sinc3	Sincfast
x	x	x <sup>2</sup>	x <sup>3</sup>	2x <sup>2</sup>
4	-4 to 4	-16 to 16	-64 to 64	-32 to 32
8	-8 to 8	-64 to 64	-512 to 512	-128 to 128
16	-16 to 16	-256 to 256	-4096 to 4096	-512 to 512
32	-32 to 32	-1024 to 1024	-32,768 to 32,768	-2048 to 2048
64	-64 to 64	-4096 to 4096	-262,144 to 262,144	-8192 to 8192
128	-128 to 128	-16,384 to 16,384	-2,097,152 to 2,097,152	-32,768 to 32,768
256	-256 to 256	-65,536 to 65,536	-16,777,216 to 16,777,215	-131,072 to 131,072

**Figure 12-7. Data Filter Resolution**



The data filter uses 25 bits to represent signed integer in two's complement format. The maximum possible resolution gives a 25-bit word (-16,777,216 to +16,777,215). Note that this value is only reached if the delta-sigma modulator is operated at absolute maximum positive or negative full-scale, which is beyond the recommended full-scale range of 80% of most delta-sigma modulators. This value also does not represent the resolution of the signal. The signal resolution is determined by the modulator, and increasing the filter bit width will not offer any improved noise performance beyond the modulator capabilities.

**NOTE:** Because of the inherent architecture of the Sinc filter (Sinc1, Sinc2, SincFast, and Sinc3), the first few samples, depending upon the filter type, will be incorrect. [Table 12-4](#) tabulates the number of incorrect samples after the filter is enabled and configured. This is an expected behavior.

**Table 12-4. Number of Incorrect Samples Tabulated**

Filter type	Number of incorrect samples after the filter is enabled and configured
Sinc1	No incorrect sample
Sinc2	The first sample of the Sinc2 filter is incorrect
SincFast	The first two samples of the SincFast filter are incorrect
Sinc3	The first two samples of the Sinc3 filter are incorrect

SDFM Comparator interrupts (IELx and IEHx) should be enabled only after providing sufficient settling time to make sure the comparator filter does not trip on these incorrect samples. Therefore, SDFM comparator interrupts (IELx and IEHx) should be enabled only after a sufficient delay is provided after the comparator filter is configured. This sufficient delay is calculated by adding the latency of the comparator filter and five SD-Cx clock cycles.

In case of the SDFM data filter, each time the filter is enabled or reconfigured, or the filter is reset by the PWM sync pulse, or the filter is reset by SDDFPARMx.FEN, depending upon the filter type, there will be some incorrect samples as mentioned in [Table 12-4](#).

### 12.5.1 32-bit or 16-bit Data Filter Output Representation

The data filter output can be represented in either 32-bit (or) 16 bit format.

32-bit data filter representation:

- When SDDPARMx.DR = 1, data filter output is represented in 32-bit format. Writes to shift control bits do not have any bearing on the output of the data filter in this configuration.

16-bit data filter representation:

- By default, data filter output is represented in 16-bit format
- When SDDPARMx.DR = 0, data filter output is represented in 16-bit format. But it is the responsibility of the user to configure the corresponding shift control bits in the SDDPARMx register to control which 16-bit part of the 32-bit word is sent to the register map.

For example, for the data filter configuration below:

- Filter type = Sinc3

The data filter with a 25-bit signed output value can be in the range of –16,777,216 to 16,777,215. But, 16-bit signed output can support values only from –32,768 to 32,767. Therefore, it is required to configure shift control bits (SDDPARMx.SH) to 9 to represent the data filter output correctly in 16-bit format. [Table 12-5](#) shows the configuration settings of shift control bits for different OSR and filter types.

**Table 12-5. Shift Control Bit Configuration Settings**

OSR	SINC1	SINC2	SINCFAST	SINC3
1 to 31	0	0	0	0
32 to 40	0	0	0	1
41 to 50	0	0	0	2
51 to 63	0	0	0	3
64 to 80	0	0	0	4
81 to 101	0	0	0	5
102 to 127	0	0	0	6
128 to 161	0	0	1	7
162 to 181	0	0	1	8
182 to 203	0	1	2	8
204 to 255	0	1	2	9
256	0	2	3	9

### **WARNING**

**Configuring shift control bits incorrectly will result in getting wrong 16-bit data filter output.**

#### **12.5.2 Data Rate and Latency of the Sinc Filter**

The data rate of the sinc filter (filter throughput) represented in samples/sec can be calculated by the formula shown here:

$$\text{Data rate of Sinc filter} = \frac{\text{Modulator data rate}}{\text{OSR}}$$

The latency of the sinc filter represented in secs is defined as the amount of time taken by a sinc filter type to deliver the correct filtered output upon initiation. For a given filter type, latency can be calculated as shown in this equation:

$$\text{Latency of Sinc filter} = \frac{\text{Order of Sinc filter}}{\text{Data rate of Sinc filter}}$$

Example configuration:

Sinc filter type	= sinc3
Modulator data rate	= 10 MHz
OSR	= 256
Data rate of Sinc Filter	= 10 MHz / 256 = 39.1 K samples / sec

Sinc filter latency	= 76.8 $\mu$ s
Sinc filter type	= sinc2
Modulator data rate	= 10 MHz
OSR	= 256
Data rate of Sinc Filter	= 10 MHz / 256 = 39.1 K samples / sec
Sinc filter latency	=51.2 $\mu$ s

## 12.6 Interrupt Unit

Figure 12-8 shows the structure of the interrupt unit. Each SDFM module can generate a CPU interrupt. An SDFM interrupt can be triggered by any of these 16 interrupt sources:

- Four comparator low (IELx)
 

This interrupt source can be enabled when the master interrupt (SDCTL.MIE = 1) and the appropriate individual filter interrupts are enabled (SDCPARMx.IEL = 1). The Comparator compares the comparator filter output results continuously with the LLT threshold value. If the comparator filter output  $\leq$  LLT, the SDIFLG.IELx bit is set, triggering an under-value condition. This SDIFLG.IELx flag can be reset if the corresponding bit in the SDIFLGCLR register is set and the interrupt source is no longer active.

For example, since the comparator output changes only after every OSR SD-Cx clock cycle, writing to the SDIFLGCLR.IELx bit will clear the flag for only one SYSCLK cycle. On the next cycle, since the interrupt source is still active, the Comparator compares the comparator filter output with the lower threshold and sets the SDIFLG.IELx bit again. To avoid this situation, the comparator lower threshold setting should be changed to LLT = 0x0 before writing to the SDIFLGCLR.IELx bit.
- Four comparator high (IEHx)
 

This interrupt source can be enabled when the master interrupt (SDCTL.MIE = 1) and the appropriate individual filter interrupt are enabled (SDCPARMx.IEH = 1). The Comparator compares the comparator filter output results continuously with the HLT threshold value. If the comparator filter output  $\geq$  HLT, the SDIFLG.IEHx bit is set, triggering an over-value condition. This SDIFLG.IEHx flag can be reset if the corresponding bit in SDIFLGCLR register is set and the interrupt source is no longer active.

For example, since the comparator output changes only after every OSR SD-Cx clock cycle, writing to the SDIFLGCLR.IEHx bit will clear the flag for only one SYSCLK cycle. On the next cycle, since the interrupt source is still active, the Comparator compares the comparator filter output with the higher threshold and sets the SDIFLG.IEHx bit again. To avoid this situation, the comparator higher threshold setting should be changed to HLT = 0x7FFF before writing to the SDIFLGCLR.IEHx bit.
- Four modulator failure (MFx)
 

This interrupt source can be enabled when the master interrupt (SDCTL.MIE = 1) and the appropriate individual filter interrupt are enabled (SDCPARMx.MFIE = 1). When the modulator clock (SD-Cx) fails or goes missing, the appropriate MFx flag bit is set in the Interrupt Flag Register (SDIFLG). This flag will be reset if the Interrupt Register is cleared (by setting the corresponding bit in the SDIFLGCLR register) and the interrupt source is no longer active. If the modulator clock is failing (when the modulator clock is slower than 1/128th of the system clock SYSCLK), the appropriate MFx flag bit is set if the appropriate modulator flag interrupt enable bit (MFIE<sub>x</sub>) and the master interrupt enable (MIE) is set.
- Four filter data acknowledge (AFx)
 

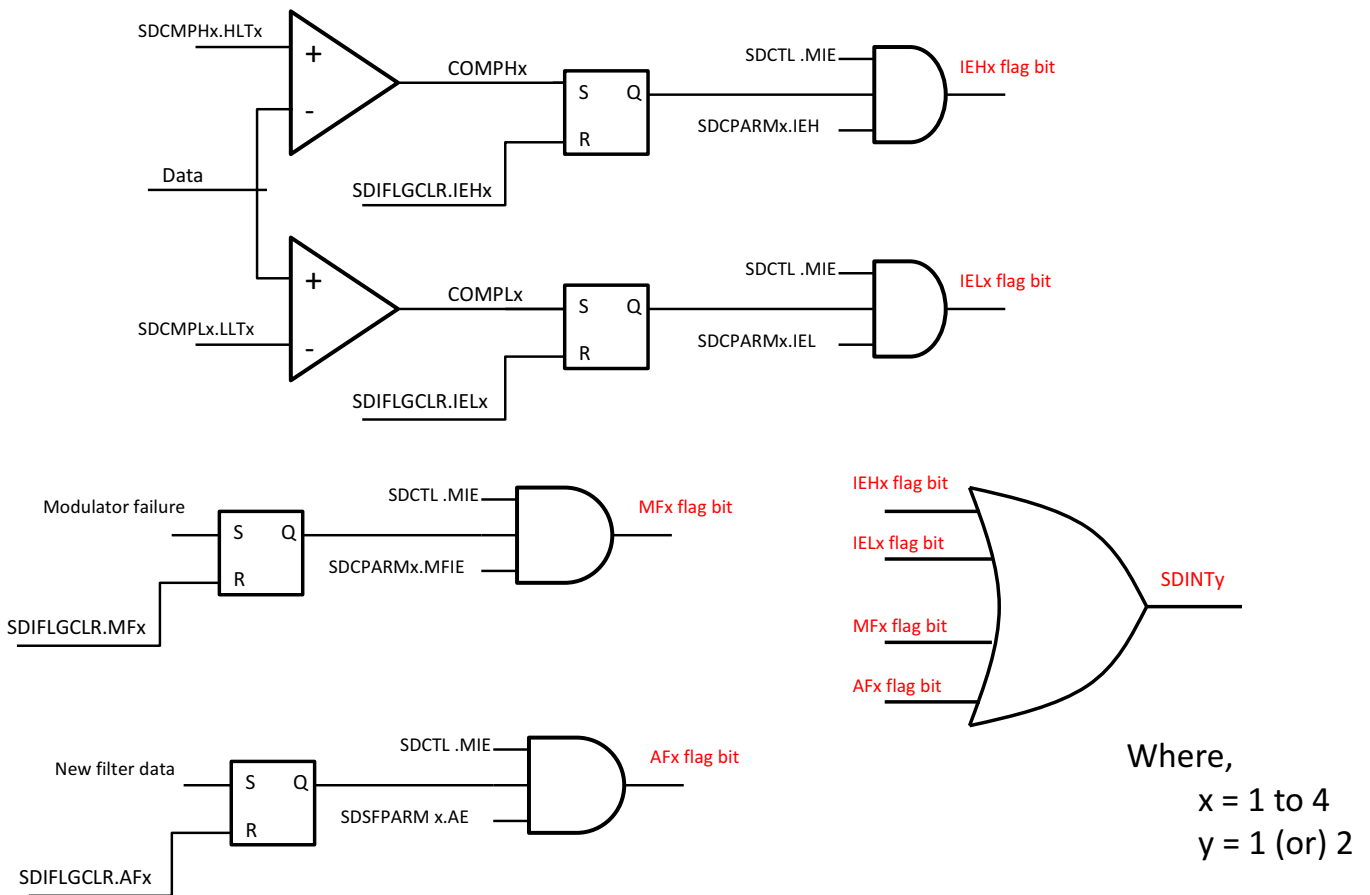
This interrupt source can be enabled when the master interrupt (SDCTL.MIE = 1) and the appropriate individual filter interrupts are enabled (SDDFPARMx.AE = 1). When the data filter generates new data, the appropriate AFx flag bit is set in the Interrupt Flag Register (SDIFLG). This flag will be reset if the Interrupt Register is cleared (by setting the corresponding bit in the SDIFLGCLR register) and the interrupt source is no longer active. The acknowledge flags cannot be set if the data filter is disabled. Each acknowledge flag can be disabled if the Acknowledge Enable control bit (AE) in the appropriate Data Filter Parameter Register SDDFPARMx is set to low.

For some reason, if the user wishes to disable the data acknowledge event (AFx) and use a timer to

generate an interrupt at the data filter rate to read filter data results, there is a possibility of reading a metastable filter data. In such cases, there are two possible options:

- Option 1: Make sure timer interrupts at a rate shown below
  - Timer interrupt time interval = Latency of data filter + 5 SD clock cycles
- Option 2: If the user disables PIE interrupts from SDFM, or if the Master Interrupt Enable (MIE) bit is disabled, a timer can be used to generate an interrupt at the data filter rate and filter data should be read after the data acknowledge event (AFx) is set

**Figure 12-8. SDFM Interrupt Unit**



## 12.7 Register Descriptions

The register descriptions are shown in the following table and subsections.

**Table 12-6. General Registers**

Name	SDFM1 address	SDFM2 address	Size (x16)	Description	EALLOW?
SDIFLG	0x5E00	0x5E80	2	Interrupt Flag Register	
SDIFLGCLR	0x5E02	0x5E82	2	Interrupt Flag Clear Register	
SDCTL	0x5E04	0x5E84	1	SD Control Register	YES
SDMFILEN	0x5E06	0x5E86	1	SD Master Filter Enable	YES
Reserved	0x5E07	0x5E87	1	Reserved	

**Table 12-7. Filter 1 Registers**

Name	SDFM1 address	SDFM2 address	Size (x16)	Description	EALLOW?
SDCTLPARM1	0x5E10	0x5E90	1	Control Parameter Register for Ch1	YES
SDDFPARM1	0x5E11	0x5E91	1	Data Filter Parameter Register for Ch1	YES
SDDPARM1	0x5E12	0x5E92	1	Integer Parameter Register for Ch1	YES
SDCMPH1	0x5E13	0x5E93	1	High-level Threshold Register for Ch1	YES
SDCMPL1	0x5E14	0x5E94	1	Low-level Threshold Register for Ch1	YES
SDCPARM1	0x5E15	0x5E95	1	Comparator Parameter Register for Ch1	YES
SDDATA1	0x5E16	0x5E96	2	Filter Data Register (16- or 32-bit) for Ch1	

**Table 12-8. Filter 2 Registers**

Name	SDFM1 address	SDFM2 address	Size (x16)	Description	EALLOW?
SDCTLPARM2	0x5E20	0x5EA0	1	Control Parameter Register for Ch2	YES
SDDFPARM2	0x5E21	0x5EA1	1	Data Filter Parameter Register for Ch2	YES
SDDPARM2	0x5E22	0x5EA2	1	Integer Parameter Register for Ch2	YES
SDCMPH2	0x5E23	0x5EA3	1	High-level Threshold Register for Ch2	YES
SDCMPL2	0x5E24	0x5EA4	1	Low-level Threshold Register for Ch2	YES
SDCPARM2	0x5E25	0x5EA5	1	Comparator Parameter Register for Ch2	YES
SDDATA2	0x5E26	0x5EA6	2	Filter Data Register (16- or 32-bit) for Ch2	

**Table 12-9. Filter 3 Registers**

Name	SDFM1 address	SDFM2 address	Size (x16)	Description	EALLOW?
SDCTLPARM3	0x5E30	0x5EB0	1	Control Parameter Register for Ch3	YES
SDDFPARM3	0x5E31	0x5EB1	1	Data Filter Parameter Register for Ch3	YES
SDDPARM3	0x5E32	0x5EB2	1	Integer Parameter Register for Ch3	YES



**Table 12-9. Filter 3 Registers (continued)**

Name	SDFM1 address	SDFM2 address	Size (x16)	Description	EALLOW?
SDCMPH3	0x5E33	0x5EB3	1	High-level Threshold Register for Ch3	YES
SDCMPL3	0x5E34	0x5EB4	1	Low-level Threshold Register for Ch3	YES
SDCPARM3	0x5E35	0x5EB5	1	Comparator Parameter Register for Ch3	YES
SDDATA3	0x5E36	0x5EB6	2	Filter Data Register (16- or 32-bit) for Ch3	

**Table 12-10. Filter 4 Registers**

Name	SDFM1 address	SDFM2 address	Size (x16)	Description	EALLOW?
SDCTLPARAM4	0x5E40	0x5EC0	1	Control Parameter Register for Ch4	YES
SDDFPARM4	0x5E41	0x5EC1	1	Data Filter Parameter Register for Ch4	YES
SDDPARAM4	0x5E42	0x5EC2	1	Integer Parameter Register for Ch4	YES
SDCMPH4	0x5E43	0x5EC3	1	High-level Threshold Register for Ch4	YES
SDCMPL4	0x5E44	0x5EC4	1	Low-level Threshold Register for Ch4	YES
SDCPARM4	0x5E45	0x5EC5	1	Comparator Parameter Register for Ch4	YES
SDDATA4	0x5E46	0x5EC6	2	Filter Data Register (16- or 32-bit) for Ch4	

## 12.8 Registers

### 12.8.1 SDFM Base Addresses

**Table 12-11. SDFM Base Address Table**

Device Registers	Register Name	Start Address	End Address
Sdfm1Regs	SDFM_REGS	0x0000_5E00	0x0000_5E7F
Sdfm2Regs	SDFM_REGS	0x0000_5E80	0x0000_5EFF

## 12.8.2 SDFM\_REGS Registers

Table 12-12 lists the memory-mapped registers for the SDFM\_REGS. All register offset addresses not listed in Table 12-12 should be considered as reserved locations and the register contents should not be modified.

**Table 12-12. SDFM\_REGS Registers**

Offset	Acronym	Register Name	Write Protection	Section
0h	SDIFLG	Interrupt Flag Register		<a href="#">Go</a>
2h	SDIFLGCLR	Interrupt Flag Clear Register		<a href="#">Go</a>
4h	SDCTL	SD Control Register	EALLOW	<a href="#">Go</a>
6h	SDFILEN	SD Master Filter Enable	EALLOW	<a href="#">Go</a>
10h	SDCTLPARM1	Control Parameter Register for Ch1	EALLOW	<a href="#">Go</a>
11h	SDDFPARM1	Data Filter Parameter Register for Ch1	EALLOW	<a href="#">Go</a>
12h	SDDPARM1	Integer Parameter Register for Ch1	EALLOW	<a href="#">Go</a>
13h	SDCMPH1	High-level Threshold Register for Ch1	EALLOW	<a href="#">Go</a>
14h	SDCMPL1	Low-level Threshold Register for Ch1	EALLOW	<a href="#">Go</a>
15h	SDCPARM1	Comparator Parameter Register for Ch1	EALLOW	<a href="#">Go</a>
16h	SDDATA1	Filter Data Register (16 or 32bit) for Ch1		<a href="#">Go</a>
20h	SDCTLPARM2	Control Parameter Register for Ch2	EALLOW	<a href="#">Go</a>
21h	SDDFPARM2	Data Filter Parameter Register for Ch2	EALLOW	<a href="#">Go</a>
22h	SDDPARM2	Integer Parameter Register for Ch2	EALLOW	<a href="#">Go</a>
23h	SDCMPH2	High-level Threshold Register for Ch2	EALLOW	<a href="#">Go</a>
24h	SDCMPL2	Low-level Threshold Register for Ch2	EALLOW	<a href="#">Go</a>
25h	SDCPARM2	Comparator Parameter Register for Ch2	EALLOW	<a href="#">Go</a>
26h	SDDATA2	Filter Data Register (16 or 32bit) for Ch2		<a href="#">Go</a>
30h	SDCTLPARM3	Control Parameter Register for Ch3	EALLOW	<a href="#">Go</a>
31h	SDDFPARM3	Data Filter Parameter Register for Ch3	EALLOW	<a href="#">Go</a>
32h	SDDPARM3	Integer Parameter Register for Ch3	EALLOW	<a href="#">Go</a>
33h	SDCMPH3	High-level Threshold Register for Ch3	EALLOW	<a href="#">Go</a>
34h	SDCMPL3	Low-level Threshold Register for Ch3	EALLOW	<a href="#">Go</a>
35h	SDCPARM3	Comparator Parameter Register for Ch3	EALLOW	<a href="#">Go</a>
36h	SDDATA3	Filter Data Register (16 or 32bit) for Ch3		<a href="#">Go</a>
40h	SDCTLPARM4	Control Parameter Register for Ch4	EALLOW	<a href="#">Go</a>
41h	SDDFPARM4	Data Filter Parameter Register for Ch4	EALLOW	<a href="#">Go</a>
42h	SDDPARM4	Integer Parameter Register for Ch4	EALLOW	<a href="#">Go</a>
43h	SDCMPH4	High-level Threshold Register for Ch4	EALLOW	<a href="#">Go</a>
44h	SDCMPL4	Low-level Threshold Register for Ch4	EALLOW	<a href="#">Go</a>
45h	SDCPARM4	Comparator Parameter Register for Ch4	EALLOW	<a href="#">Go</a>
46h	SDDATA4	Filter Data Register (16 or 32bit) for Ch4		<a href="#">Go</a>

Complex bit access types are encoded to fit into small table cells. Table 12-13 shows the codes that are used for access types in this section.

**Table 12-13. SDFM\_REGS Access Type Codes**

Access Type	Code	Description
<b>Read Type</b>		
R	R	Read
R=0	R	Read
<b>Write Type</b>		
W	W	Write

**Table 12-13. SDFM\_REGS Access Type Codes (continued)**

Access Type	Code	Description
W=1	W	Write
<b>Reset or Default Value</b>		
-n		Value after reset or the default value
<b>Register Array Variables</b>		
i,j,k,l,m,n		When these variables are used in a register name, an offset, or an address, they refer to the value of a register array where the register is part of a group of repeating registers. The register groups form a hierarchical structure and the array is represented with a formula.
y		When this variable is used in a register name, an offset, or an address it refers to the value of a register array.

**12.8.2.1 SDIFLG Register (Offset = 0h) [reset = 0h]**

 SDIFLG is shown in [Figure 12-9](#) and described in [Table 12-14](#).

 Return to [Summary Table](#).

Interrupt Flag Register

**Figure 12-9. SDIFLG Register**

31	30	29	28	27	26	25	24
MIF	RESERVED						
R-0h	R-0h						
23	22	21	20	19	18	17	16
RESERVED							
R-0h							
15	14	13	12	11	10	9	8
AF4	AF3	AF2	AF1	MF4	MF3	MF2	MF1
R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h
7	6	5	4	3	2	1	0
IFL4	IFH4	IFL3	IFH3	IFL2	IFH2	IFL1	IFH1
R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h

**Table 12-14. SDIFLG Register Field Descriptions**

Bit	Field	Type	Reset	Description
31	MIF	R	0h	Set whenever any interrupt (ACK1-4, MF1-4, IFL1-4, IFH1-4) is active Reset type: SYSRSn
30-16	RESERVED	R	0h	Reserved
15	AF4	R	0h	0: No new data available from Filter 4 1: New data available from Filter 4 Reset type: SYSRSn
14	AF3	R	0h	0: No new data available from Filter 3 1: New data available from Filter 3 Reset type: SYSRSn
13	AF2	R	0h	0: No new data available from Filter 2 1: New data available from Filter 2 Reset type: SYSRSn
12	AF1	R	0h	0: No new data available from Filter 1 1: New data available from Filter 1 Reset type: SYSRSn
11	MF4	R	0h	0: Modulator is operating normally for Filter 4 1: Modulator failure for Filter 4 Reset type: SYSRSn
10	MF3	R	0h	0: Modulator is operating normally for Filter 3 1: Modulator failure for Filter 3 Reset type: SYSRSn
9	MF2	R	0h	0: Modulator is operating normally for Filter 2 1: Modulator failure for Filter 2 Reset type: SYSRSn
8	MF1	R	0h	0: Modulator is operating normally for Filter 1 1: Modulator failure for Filter 1 Reset type: SYSRSn

**Table 12-14. SDIFLG Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
7	IFL4	R	0h	0: Comparator Filter 4 output is above the low limit threshold 1: Comparator Filter 4 output is equal to or below the low level threshold, if enabled Reset type: SYSRSn
6	IFH4	R	0h	0: Comparator Filter 4 output is below the high limit threshold 1: Comparator Filter 4 output is equal to or above the high level threshold, if enabled Reset type: SYSRSn
5	IFL3	R	0h	0: Comparator Filter 3 output is above the low limit threshold 1: Comparator Filter 3 output is equal to or below the low level threshold, if enabled Reset type: SYSRSn
4	IFH3	R	0h	0: Comparator Filter 3 output is below the high limit threshold 1: Comparator Filter 3 output is equal to or above the high level threshold, if enabled Reset type: SYSRSn
3	IFL2	R	0h	0: Comparator Filter 2 output is above the low limit threshold 1: Comparator Filter 2 output is equal to or below the low level threshold, if enabled Reset type: SYSRSn
2	IFH2	R	0h	0: Comparator Filter 2 output is below the high limit threshold 1: Comparator Filter 2 output is equal to or above the high level threshold, if enabled Reset type: SYSRSn
1	IFL1	R	0h	0: Comparator Filter 1 output is above the low limit threshold 1: Comparator Filter 1 output is equal to or below the low level threshold, if enabled Reset type: SYSRSn
0	IFH1	R	0h	0: Comparator Filter 1 output is below the high limit threshold 1: Comparator Filter 1 output is equal to or above the high level threshold, if enabled Reset type: SYSRSn

**12.8.2.2 SDIFLGCLR Register (Offset = 2h) [reset = 0h]**

SDIFLGCLR is shown in [Figure 12-10](#) and described in [Table 12-15](#).

Return to [Summary Table](#).

Interrupt Flag Clear Register

**Figure 12-10. SDIFLGCLR Register**

31	30	29	28	27	26	25	24
MIF	RESERVED						
R=0/W=1-0h				R-0h			
23	22	21	20	19	18	17	16
RESERVED							
R-0h							
15	14	13	12	11	10	9	8
AF4	AF3	AF2	AF1	MF4	MF3	MF2	MF1
R=0/W=1-0h	R=0/W=1-0h	R=0/W=1-0h	R=0/W=1-0h	R=0/W=1-0h	R=0/W=1-0h	R=0/W=1-0h	R=0/W=1-0h
7	6	5	4	3	2	1	0
IFL4	IFH4	IFL3	IFH3	IFL2	IFH2	IFL1	IFH1
R=0/W=1-0h	R=0/W=1-0h	R=0/W=1-0h	R=0/W=1-0h	R=0/W=1-0h	R=0/W=1-0h	R=0/W=1-0h	R=0/W=1-0h

**Table 12-15. SDIFLGCLR Register Field Descriptions**

Bit	Field	Type	Reset	Description
31	MIF	R=0/W=1	0h	Flag-clear bit for SDFM Master Interrupt flag. Write 1 to clear MIF. Writes of "0" are ignored.  Note: If the MIF flag is cleared and other Interrupts are still pending, MIF will again be set to 1 on the following SysClk cycle, and the INT output will be reasserted (pulsed low) Reset type: SYSRSn
30-16	RESERVED	R	0h	Reserved
15	AF4	R=0/W=1	0h	SD Module Interrupt Flag Clear Bits: Writing a "1" will clear the respective flag bit in the SDINTFLG register. Writes of "0" are ignored.  Note: If user writes a "1" to clear a bit on the same cycle that the hardware is trying to set the bit to "1", then hardware has priority and the bit will not be cleared. Flag-clear bit for Acknowledge flag for Filter 4 Reset type: SYSRSn
14	AF3	R=0/W=1	0h	Flag-clear bit for Acknowledge flag for Filter 3 Reset type: SYSRSn
13	AF2	R=0/W=1	0h	Flag-clear bit for Acknowledge flag for Filter 2 Reset type: SYSRSn
12	AF1	R=0/W=1	0h	Flag-clear bit for Acknowledge flag for Filter 1 Reset type: SYSRSn
11	MF4	R=0/W=1	0h	Flag-clear bit for Modulator Failure for Filter 4 Reset type: SYSRSn
10	MF3	R=0/W=1	0h	Flag-clear bit for Modulator Failure for Filter 3 Reset type: SYSRSn
9	MF2	R=0/W=1	0h	Flag-clear bit for Modulator Failure for Filter 2 Reset type: SYSRSn
8	MF1	R=0/W=1	0h	Flag-clear bit for Modulator Failure for Filter 1 Reset type: SYSRSn

**Table 12-15. SDIFLGCLR Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
7	IFL4	R=0/W=1	0h	Flag-clear bit for Low-Level Interrupt flag Filter 4 Reset type: SYSRSn
6	IFH4	R=0/W=1	0h	Flag-clear bit for High-level Interrupt flag Filter 4 Reset type: SYSRSn
5	IFL3	R=0/W=1	0h	Flag-clear bit for Low-Level Interrupt flag Filter 3 Reset type: SYSRSn
4	IFH3	R=0/W=1	0h	Flag-clear bit for High-level Interrupt flag Filter 3 Reset type: SYSRSn
3	IFL2	R=0/W=1	0h	Flag-clear bit for Low-Level Interrupt flag Filter 2 Reset type: SYSRSn
2	IFH2	R=0/W=1	0h	Flag-clear bit for High-level Interrupt flag Filter 2 Reset type: SYSRSn
1	IFL1	R=0/W=1	0h	Flag-clear bit for Low-Level Interrupt flag Filter 1 Reset type: SYSRSn
0	IFH1	R=0/W=1	0h	Flag-clear bit for High-level Interrupt flag Filter 1 Reset type: SYSRSn

### 12.8.2.3 SDCTL Register (Offset = 4h) [reset = 0h]

SDCTL is shown in [Figure 12-11](#) and described in [Table 12-16](#).

Return to [Summary Table](#).

SD Control Register

**Figure 12-11. SDCTL Register**

15	14	13	12	11	10	9	8
RESERVED	RESERVED	MIE	RESERVED				
R-0h	R-0h	R/W-0h	R-0h				
7	6	5	4	3	2	1	0
RESERVED							
R-0h							

**Table 12-16. SDCTL Register Field Descriptions**

Bit	Field	Type	Reset	Description
15	RESERVED	R	0h	Reserved
14	RESERVED	R	0h	Reserved
13	MIE	R/W	0h	Master interrupt enable. 0: Interrupt pin and interrupt flags are blocked (interrupt pin INT always inactive). 1: Interrupt pin and interrupt flags are not blocked and can be set and reset (if individually enabled). Reset type: SYSRSn
12-0	RESERVED	R	0h	Reserved



#### 12.8.2.4 SDMFILEN Register (Offset = 6h) [reset = 0h]

SDMFILEN is shown in [Figure 12-12](#) and described in [Table 12-17](#).

Return to [Summary Table](#).

SD Master Filter Enable

**Figure 12-12. SDMFILEN Register**

15	14	13	12	11	10	9	8
RESERVED			RESERVED	MFE	RESERVED	RESERVED	RESERVED
R-0h			R-0h	R/W-0h	R-0h	R-0h	R-0h
7	6	5	4	3	2	1	0
RESERVED	RESERVED			RESERVED			
R-0h	R-0h			R-0h			

**Table 12-17. SDMFILEN Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-13	RESERVED	R	0h	Reserved
12	RESERVED	R	0h	Reserved
11	MFE	R/W	0h	Master Filter Enable. Functionally AND'ed with bit FEN in the Data Filter Parameter Register  0: Data filter units of all filter modules are disabled. 1: Data filter units can be enabled if bit FEN is '1'. Reset type: SYSRSn
10	RESERVED	R	0h	Reserved
9	RESERVED	R	0h	Reserved
8-7	RESERVED	R	0h	Reserved
6-4	RESERVED	R	0h	Reserved
3-0	RESERVED	R	0h	Reserved

### 12.8.2.5 SDCTLPARM1 Register (Offset = 10h) [reset = 0h]

SDCTLPARM1 is shown in [Figure 12-13](#) and described in [Table 12-18](#).

Return to [Summary Table](#).

Control Parameter Register for Ch1

**Figure 12-13. SDCTLPARM1 Register**

15	14	13	12	11	10	9	8
RESERVED							
R-0h							
7	6	5	4	3	2	1	0
RESERVED			RESERVED	RESERVED	RESERVED	MOD	
R-0h			R-0h	R-0h	R-0h	R/W-0h	

**Table 12-18. SDCTLPARM1 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-5	RESERVED	R	0h	Reserved
4	RESERVED	R	0h	Reserved
3	RESERVED	R	0h	Reserved
2	RESERVED	R	0h	Reserved
1-0	MOD	R/W	0h	Delta-Sigma Modulator mode 00: The clock speed is equal to the data rate from the modulator 01: The clock rate is half of the data rate from the modulator 10: The data from the modulator is Manchester decoded 11: The clock rate is twice the data rate of the modulator Reset type: SYSRSn

### 12.8.2.6 SDDFPARM1 Register (Offset = 11h) [reset = 0h]

SDDFPARM1 is shown in [Figure 12-14](#) and described in [Table 12-19](#).

Return to [Summary Table](#).

Data Filter Parameter Register for Ch1

**Figure 12-14. SDDFPARM1 Register**

15	14	13	12	11	10	9	8
RESERVED			SDSYNCEN	SST		AE	FEN
R-0h			R/W-0h	R/W-0h		R/W-0h	R/W-0h
7	6	5	4	3	2	1	0
DOSR							
R/W-0h							

**Table 12-19. SDDFPARM1 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-13	RESERVED	R	0h	Reserved
12	SDSYNCEN	R/W	0h	Data Filter Reset enable for External Reset typ from PWM Compare output. 0: Data filter cannot be reset by external PWM compare output 1: Data filter can be reset by external PWM compare output Reset type: SYSRSn
11-10	SST	R/W	0h	Data filter structure. 00: Data filter runs with a Sincfast structure 01: Data filter runs with a Sinc1 structure 10: Data filter runs with a Sinc2 structure 11: Data filter runs with a Sinc3 structure Reset type: SYSRSn
9	AE	R/W	0h	Acknowledge enable. 0: Acknowledge flag is disabled for the particular filter 1: Acknowledge flag is enabled for the particular filter Reset type: SYSRSn
8	FEN	R/W	0h	Filter enable. 0: The filter is disabled and no data is produced 1: The filter is enabled and data are produced in the Data filter Reset type: SYSRSn
7-0	DOSR	R/W	0h	Oversampling ratio. The actual rate is DOSR + 1. These bits set the oversampling ratio of the filter. 0x0FF represents an oversampling ratio of 256. Reset type: SYSRSn

### 12.8.2.7 SDDPARM1 Register (Offset = 12h) [reset = 0h]

SDDPARM1 is shown in [Figure 12-15](#) and described in [Table 12-20](#).

Return to [Summary Table](#).

Integer Parameter Register for Ch1

**Figure 12-15. SDDPARM1 Register**

15	14	13	12	11	10	9	8
SH			DR		RESERVED	RESERVED	
R/W-0h			R/W-0h		R/W-0h	R/W-0h	
7	6	5	4	3	2	1	0
RESERVED		RESERVED					
R-0h		R/W-0h					

**Table 12-20. SDDPARM1 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-11	SH	R/W	0h	Shift Control These bits indicate by how many bits the 16-bit window is shifted up when 16-bit data representation is chosen. Reset type: SYSRSn
10	DR	R/W	0h	Data representation 0: Data stored in 16b 2's complement 1: Data stored in 32b 2's complement Reset type: SYSRSn
9	RESERVED	R/W	0h	Reserved
8	RESERVED	R/W	0h	Reserved
7	RESERVED	R	0h	Reserved
6-0	RESERVED	R/W	0h	Reserved

### 12.8.2.8 SDCMPH1 Register (Offset = 13h) [reset = 0h]

SDCMPH1 is shown in [Figure 12-16](#) and described in [Table 12-21](#).

Return to [Summary Table](#).

High-level Threshold Register for Ch1

**Figure 12-16. SDCMPH1 Register**

15	14	13	12	11	10	9	8
RESERVED							HLT
R-0h				R/W-0h			
7	6	5	4	3	2	1	0
HLT							
R/W-0h							

**Table 12-21. SDCMPH1 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15	RESERVED	R	0h	Reserved
14-0	HLT	R/W	0h	Unsigned high-level threshold for the comparator filter output. Reset type: SYSRSn

### 12.8.2.9 SDCMPL1 Register (Offset = 14h) [reset = 0h]

SDCMPL1 is shown in [Figure 12-17](#) and described in [Table 12-22](#).

Return to [Summary Table](#).

Low-level Threshold Register for Ch1

**Figure 12-17. SDCMPL1 Register**

15	14	13	12	11	10	9	8
RESERVED							LLT
R-0h				R/W-0h			
7	6	5	4	3	2	1	0
LLT							
R/W-0h							

**Table 12-22. SDCMPL1 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15	RESERVED	R	0h	Reserved
14-0	LLT	R/W	0h	Unsigned low-level threshold for the comparator filter output. Reset type: SYSRSn

### 12.8.2.10 SDCPARAM1 Register (Offset = 15h) [reset = 0h]

SDCPARM1 is shown in [Figure 12-18](#) and described in [Table 12-23](#).

Return to [Summary Table](#).

Comparator Parameter Register for Ch1

**Figure 12-18. SDCPARAM1 Register**

15	14	13	12	11	10	9	8	
RESERVED						MFIE	CS1_CS0	
R-0h						R/W-0h	R/W-0h	
7	6	5	4	3	2	1	0	
CS1_CS0	IEL	IEH	COSR					
R/W-0h	R/W-0h	R/W-0h	R/W-0h					

**Table 12-23. SDCPARAM1 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-10	RESERVED	R	0h	Reserved
9	MFIE	R/W	0h	0: The modulator failure flag as well as the output INT is disabled for this particular flag 1: The modulator failure flag is enabled Reset type: SYSRSn
8-7	CS1_CS0	R/W	0h	Comparator filter structure. 00: Comparator filter runs with a sincfast structure 01: Comparator filter runs with a Sinc1 structure 10: Comparator filter runs with a Sinc2 structure 11: Comparator filter runs with a Sinc3 structure Reset type: SYSRSn
6	IEL	R/W	0h	Low-level interrupt enable. 0: The low-level interrupt flag as well as the output INT is disabled for this particular flag 1: The low-level interrupt flag is enabled Reset type: SYSRSn
5	IEH	R/W	0h	High-level interrupt enable. 0: The high-level interrupt flag as well as the output INT is disabled for this particular flag 1: The high-level interrupt flag is enabled Reset type: SYSRSn
4-0	COSR	R/W	0h	Oversampling ratio. The actual rate is COSR + 1. These bits set the oversampling ratio of the filter. 0x1F represents an oversampling ratio of 31. Reset type: SYSRSn

### 12.8.2.11 SDDATA1 Register (Offset = 16h) [reset = 0h]

SDDATA1 is shown in [Figure 12-19](#) and described in [Table 12-24](#).

Return to [Summary Table](#).

Filter Data Register (16 or 32bit) for Ch1

**Figure 12-19. SDDATA1 Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
DATA32HI																DATA16															
R-0h																R-0h															

**Table 12-24. SDDATA1 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	DATA32HI	R	0h	Hi-order 16-bit in 32-bit mode Reset type: SYSRSn
15-0	DATA16	R	0h	Hi-order 16-bit in 32 mode, 16-bit data in 16-bit mode Reset type: SYSRSn



**12.8.2.12 SDCTLPARM2 Register (Offset = 20h) [reset = 0h]**

SDCTLPARM2 is shown in [Figure 12-20](#) and described in [Table 12-25](#).

Return to [Summary Table](#).

Control Parameter Register for Ch2

**Figure 12-20. SDCTLPARM2 Register**

15	14	13	12	11	10	9	8
RESERVED							
R-0h							
7	6	5	4	3	2	1	0
RESERVED			RESERVED	RESERVED	RESERVED	MOD	
R-0h			R-0h	R-0h	R-0h	R/W-0h	

**Table 12-25. SDCTLPARM2 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-5	RESERVED	R	0h	Reserved
4	RESERVED	R	0h	Reserved
3	RESERVED	R	0h	Reserved
2	RESERVED	R	0h	Reserved
1-0	MOD	R/W	0h	Delta-Sigma Modulator mode 00: The clock speed is equal to the data rate from the modulator 01: The clock rate is half of the data rate from the modulator 10: The data from the modulator is Manchester decoded 11: The clock rate is twice the data rate of the modulator Reset type: SYSRSn

**12.8.2.13 SDDFPARM2 Register (Offset = 21h) [reset = 0h]**

SDDFPARM2 is shown in [Figure 12-21](#) and described in [Table 12-26](#).

Return to [Summary Table](#).

Data Filter Parameter Register for Ch2

**Figure 12-21. SDDFPARM2 Register**

15	14	13	12	11	10	9	8
RESERVED			SDSYNCEN	SST		AE	FEN
R-0h			R/W-0h	R/W-0h		R/W-0h	R/W-0h
7	6	5	4	3	2	1	0
DOSR							
R/W-0h							

**Table 12-26. SDDFPARM2 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-13	RESERVED	R	0h	Reserved
12	SDSYNCEN	R/W	0h	Data Filter Reset enable for External Reset typ from PWM Compare output. 0: Data filter cannot be reset by external PWM compare output 1: Data filter can be reset by external PWM compare output Reset type: SYSRSn
11-10	SST	R/W	0h	Data filter structure. 00: Data filter runs with a Sincfast structure 01: Data filter runs with a Sinc1 structure 10: Data filter runs with a Sinc2 structure 11: Data filter runs with a Sinc3 structure Reset type: SYSRSn
9	AE	R/W	0h	Acknowledge enable. 0: Acknowledge flag is disabled for the particular filter 1: Acknowledge flag is enabled for the particular filter Reset type: SYSRSn
8	FEN	R/W	0h	Filter enable. 0: The filter is disabled and no data is produced 1: The filter is enabled and data are produced in the Data filter Reset type: SYSRSn
7-0	DOSR	R/W	0h	Oversampling ratio. The actual rate is DOSR + 1. These bits set the oversampling ratio of the filter. 0x0FF represents an oversampling ratio of 256. Reset type: SYSRSn

**12.8.2.14 SDDPARM2 Register (Offset = 22h) [reset = 0h]**

SDDPARM2 is shown in [Figure 12-22](#) and described in [Table 12-27](#).

Return to [Summary Table](#).

Integer Parameter Register for Ch2

**Figure 12-22. SDDPARM2 Register**

15	14	13	12	11	10	9	8
SH					DR	RESERVED	RESERVED
R/W-0h					R/W-0h	R/W-0h	R/W-0h
7	6	5	4	3	2	1	0
RESERVED		RESERVED					
R-0h		R/W-0h					

**Table 12-27. SDDPARM2 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-11	SH	R/W	0h	Shift Control These bits indicate by how many bits the 16-bit window is shifted up when 16-bit data representation is chosen. Reset type: SYSRSn
10	DR	R/W	0h	Data representation 0: Data stored in 16b 2's complement 1: Data stored in 32b 2's complement Reset type: SYSRSn
9	RESERVED	R/W	0h	Reserved
8	RESERVED	R/W	0h	Reserved
7	RESERVED	R	0h	Reserved
6-0	RESERVED	R/W	0h	Reserved

**12.8.2.15 SDCMPH2 Register (Offset = 23h) [reset = 0h]**

SDCMPH2 is shown in [Figure 12-23](#) and described in [Table 12-28](#).

Return to [Summary Table](#).

High-level Threshold Register for Ch2

**Figure 12-23. SDCMPH2 Register**

15	14	13	12	11	10	9	8
RESERVED							HLT
R-0h				R/W-0h			
7	6	5	4	3	2	1	0
HLT							
R/W-0h							

**Table 12-28. SDCMPH2 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15	RESERVED	R	0h	Reserved
14-0	HLT	R/W	0h	Unsigned high-level threshold for the comparator filter output. Reset type: SYSRSn

**12.8.2.16 SDCMPL2 Register (Offset = 24h) [reset = 0h]**

SDCMPL2 is shown in [Figure 12-24](#) and described in [Table 12-29](#).

Return to [Summary Table](#).

Low-level Threshold Register for Ch2

**Figure 12-24. SDCMPL2 Register**

15	14	13	12	11	10	9	8
RESERVED							LLT
R-0h				R/W-0h			
7	6	5	4	3	2	1	0
LLT							
R/W-0h							

**Table 12-29. SDCMPL2 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15	RESERVED	R	0h	Reserved
14-0	LLT	R/W	0h	Unsigned low-level threshold for the comparator filter output. Reset type: SYSRSn

**12.8.2.17 SDCPARAM2 Register (Offset = 25h) [reset = 0h]**

SDCPARM2 is shown in [Figure 12-25](#) and described in [Table 12-30](#).

Return to [Summary Table](#).

Comparator Parameter Register for Ch2

**Figure 12-25. SDCPARAM2 Register**

15	14	13	12	11	10	9	8	
RESERVED						MFIE	CS1_CS0	
R-0h						R/W-0h	R/W-0h	
7	6	5	4	3	2	1	0	
CS1_CS0	IEL	IEH	COSR					
R/W-0h	R/W-0h	R/W-0h	R/W-0h					

**Table 12-30. SDCPARAM2 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-10	RESERVED	R	0h	Reserved
9	MFIE	R/W	0h	0: The modulator failure flag as well as the output INT is disabled for this particular flag 1: The modulator failure flag is enabled Reset type: SYSRSn
8-7	CS1_CS0	R/W	0h	Comparator filter structure. 00: Comparator filter runs with a sincfast structure 01: Comparator filter runs with a Sinc1 structure 10: Comparator filter runs with a Sinc2 structure 11: Comparator filter runs with a Sinc3 structure Reset type: SYSRSn
6	IEL	R/W	0h	Low-level interrupt enable. 0: The low-level interrupt flag as well as the output INT is disabled for this particular flag 1: The low-level interrupt flag is enabled Reset type: SYSRSn
5	IEH	R/W	0h	High-level interrupt enable. 0: The high-level interrupt flag as well as the output INT is disabled for this particular flag 1: The high-level interrupt flag is enabled Reset type: SYSRSn
4-0	COSR	R/W	0h	Oversampling ratio. The actual rate is COSR + 1. These bits set the oversampling ratio of the filter. 0x1F represents an oversampling ratio of 31. Reset type: SYSRSn

**12.8.2.18 SDDATA2 Register (Offset = 26h) [reset = 0h]**

SDDATA2 is shown in [Figure 12-26](#) and described in [Table 12-31](#).

Return to [Summary Table](#).

Filter Data Register (16 or 32bit) for Ch2

**Figure 12-26. SDDATA2 Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
DATA32HI																DATA16															
R-0h																R-0h															

**Table 12-31. SDDATA2 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	DATA32HI	R	0h	Hi-order 16b in 32b mode Reset type: SYSRSn
15-0	DATA16	R	0h	16-bit Data in 16b mode, Lo-order 16b in 32b mode Reset type: SYSRSn

### 12.8.2.19 SDCTLPARM3 Register (Offset = 30h) [reset = 0h]

SDCTLPARM3 is shown in [Figure 12-27](#) and described in [Table 12-32](#).

Return to [Summary Table](#).

Control Parameter Register for Ch3

**Figure 12-27. SDCTLPARM3 Register**

15	14	13	12	11	10	9	8
RESERVED							
R-0h							
7	6	5	4	3	2	1	0
RESERVED			RESERVED	RESERVED	RESERVED	MOD	
R-0h			R-0h	R-0h	R-0h	R/W-0h	

**Table 12-32. SDCTLPARM3 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-5	RESERVED	R	0h	Reserved
4	RESERVED	R	0h	Reserved
3	RESERVED	R	0h	Reserved
2	RESERVED	R	0h	Reserved
1-0	MOD	R/W	0h	Delta-Sigma Modulator mode 00: The clock speed is equal to the data rate from the modulator 01: The clock rate is half of the data rate from the modulator 10: The data from the modulator is Manchester decoded 11: The clock rate is twice the data rate of the modulator Reset type: SYSRSn



### 12.8.2.20 SDDFPARM3 Register (Offset = 31h) [reset = 0h]

SDDFPARM3 is shown in [Figure 12-28](#) and described in [Table 12-33](#).

Return to [Summary Table](#).

Data Filter Parameter Register for Ch3

**Figure 12-28. SDDFPARM3 Register**

15	14	13	12	11	10	9	8
RESERVED			SDSYNCEN	SST		AE	FEN
R-0h			R/W-0h	R/W-0h		R/W-0h	R/W-0h
7	6	5	4	3	2	1	0
DOSR							
R/W-0h							

**Table 12-33. SDDFPARM3 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-13	RESERVED	R	0h	Reserved
12	SDSYNCEN	R/W	0h	Data Filter Reset enable for External Reset typ from PWM Compare output. 0: Data filter cannot be reset by external PWM compare output 1: Data filter can be reset by external PWM compare output Reset type: SYSRSn
11-10	SST	R/W	0h	Data filter structure. 00: Data filter runs with a Sincfast structure 01: Data filter runs with a Sinc1 structure 10: Data filter runs with a Sinc2 structure 11: Data filter runs with a Sinc3 structure Reset type: SYSRSn
9	AE	R/W	0h	Acknowledge enable. 0: Acknowledge flag is disabled for the particular filter 1: Acknowledge flag is enabled for the particular filter Reset type: SYSRSn
8	FEN	R/W	0h	Filter enable. 0: The filter is disabled and no data is produced 1: The filter is enabled and data are produced in the data filter Reset type: SYSRSn
7-0	DOSR	R/W	0h	Oversampling ratio. The actual rate is DOSR + 1. These bits set the oversampling ratio of the filter. 0x0FF represents an oversampling ratio of 256. Reset type: SYSRSn

**12.8.2.21 SDDPARM3 Register (Offset = 32h) [reset = 0h]**

SDDPARM3 is shown in [Figure 12-29](#) and described in [Table 12-34](#).

Return to [Summary Table](#).

Integer Parameter Register for Ch3

**Figure 12-29. SDDPARM3 Register**

15	14	13	12	11	10	9	8
SH			DR		RESERVED	RESERVED	
R/W-0h			R/W-0h		R/W-0h	R/W-0h	
7	6	5	4	3	2	1	0
RESERVED		RESERVED					
R-0h		R/W-0h					

**Table 12-34. SDDPARM3 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-11	SH	R/W	0h	Shift Control These bits indicate by how many bits the 16-bit window is shifted up when 16-bit data representation is chosen. Reset type: SYSRSn
10	DR	R/W	0h	Data representation 0: Data stored in 16b 2's complement 1: Data stored in 32b 2's complement Reset type: SYSRSn
9	RESERVED	R/W	0h	Reserved
8	RESERVED	R/W	0h	Reserved
7	RESERVED	R	0h	Reserved
6-0	RESERVED	R/W	0h	Reserved

**12.8.2.22 SDCMPH3 Register (Offset = 33h) [reset = 0h]**

SDCMPH3 is shown in [Figure 12-30](#) and described in [Table 12-35](#).

Return to [Summary Table](#).

High-level Threshold Register for Ch3

**Figure 12-30. SDCMPH3 Register**

15	14	13	12	11	10	9	8
RESERVED							HLT
R-0h				R/W-0h			
7	6	5	4	3	2	1	0
HLT							
R/W-0h							

**Table 12-35. SDCMPH3 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15	RESERVED	R	0h	Reserved
14-0	HLT	R/W	0h	Unsigned high-level threshold for the comparator filter output. Reset type: SYSRSn

**12.8.2.23 SDCMPL3 Register (Offset = 34h) [reset = 0h]**

SDCMPL3 is shown in [Figure 12-31](#) and described in [Table 12-36](#).

Return to [Summary Table](#).

Low-level Threshold Register for Ch3

**Figure 12-31. SDCMPL3 Register**

15	14	13	12	11	10	9	8
RESERVED							LLT
R-0h				R/W-0h			
7	6	5	4	3	2	1	0
LLT							
R/W-0h							

**Table 12-36. SDCMPL3 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15	RESERVED	R	0h	Reserved
14-0	LLT	R/W	0h	Unsigned low-level threshold for the comparator filter output. Reset type: SYSRSn

### 12.8.2.24 SDCPARAM3 Register (Offset = 35h) [reset = 0h]

SDCPARM3 is shown in [Figure 12-32](#) and described in [Table 12-37](#).

Return to [Summary Table](#).

Comparator Parameter Register for Ch3

**Figure 12-32. SDCPARAM3 Register**

15	14	13	12	11	10	9	8	
RESERVED						MFIE	CS1_CS0	
R-0h						R/W-0h	R/W-0h	
7	6	5	4	3	2	1	0	
CS1_CS0	IEL	IEH	COSR					
R/W-0h	R/W-0h	R/W-0h	R/W-0h					

**Table 12-37. SDCPARAM3 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-10	RESERVED	R	0h	Reserved
9	MFIE	R/W	0h	0: The modulator failure flag as well as the output INT is disabled for this particular flag 1: The modulator failure flag is enabled Reset type: SYSRSn
8-7	CS1_CS0	R/W	0h	Comparator filter structure. 00: Comparator filter runs with a sincfast structure 01: Comparator filter runs with a Sinc1 structure 10: Comparator filter runs with a Sinc2 structure 11: Comparator filter runs with a Sinc3 structure Reset type: SYSRSn
6	IEL	R/W	0h	Low-level interrupt enable. 0: The low-level interrupt flag as well as the output INT is disabled for this particular flag 1: The low-level interrupt flag is enabled Reset type: SYSRSn
5	IEH	R/W	0h	High-level interrupt enable. 0: The high-level interrupt flag as well as the output INT is disabled for this particular flag 1: The high-level interrupt flag is enabled Reset type: SYSRSn
4-0	COSR	R/W	0h	Oversampling ratio. The actual rate is COSR + 1. These bits set the oversampling ratio of the filter. 0x1F represents an oversampling ratio of 31. Reset type: SYSRSn

### 12.8.2.25 SDDATA3 Register (Offset = 36h) [reset = 0h]

SDDATA3 is shown in [Figure 12-33](#) and described in [Table 12-38](#).

Return to [Summary Table](#).

Filter Data Register (16 or 32bit) for Ch3

**Figure 12-33. SDDATA3 Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
DATA32HI																DATA16															
R-0h																R-0h															

**Table 12-38. SDDATA3 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	DATA32HI	R	0h	Hi-order 16b in 32b mode Reset type: SYSRSn
15-0	DATA16	R	0h	16-bit Data in 16b mode, Lo-order 16b in 32b mode Reset type: SYSRSn

**12.8.2.26 SDCTLPARM4 Register (Offset = 40h) [reset = 0h]**

SDCTLPARM4 is shown in [Figure 12-34](#) and described in [Table 12-39](#).

Return to [Summary Table](#).

Control Parameter Register for Ch4

**Figure 12-34. SDCTLPARM4 Register**

15	14	13	12	11	10	9	8
RESERVED							
R-0h							
7	6	5	4	3	2	1	0
RESERVED			RESERVED	RESERVED	RESERVED	MOD	
R-0h			R-0h	R-0h	R-0h	R/W-0h	

**Table 12-39. SDCTLPARM4 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-5	RESERVED	R	0h	Reserved
4	RESERVED	R	0h	Reserved
3	RESERVED	R	0h	Reserved
2	RESERVED	R	0h	Reserved
1-0	MOD	R/W	0h	Delta-Sigma Modulator mode 00: The clock speed is equal to the data rate from the modulator 01: The clock rate is half of the data rate from the modulator 10: The data from the modulator is Manchester decoded 11: The clock rate is twice the data rate of the modulator Reset type: SYSRSn

**12.8.2.27 SDDFPARM4 Register (Offset = 41h) [reset = 0h]**

SDDFPARM4 is shown in [Figure 12-35](#) and described in [Table 12-40](#).

Return to [Summary Table](#).

Data Filter Parameter Register for Ch4

**Figure 12-35. SDDFPARM4 Register**

15	14	13	12	11	10	9	8
RESERVED			SDSYNCEN	SST		AE	FEN
R-0h			R/W-0h	R/W-0h		R/W-0h	R/W-0h
7	6	5	4	3	2	1	0
DOSR							
R/W-0h							

**Table 12-40. SDDFPARM4 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-13	RESERVED	R	0h	Reserved
12	SDSYNCEN	R/W	0h	Data Filter Reset enable for External Reset typ from PWM Compare output. 0: Data filter cannot be reset by external PWM compare output 1: Data filter can be reset by external PWM compare output Reset type: SYSRSn
11-10	SST	R/W	0h	Data filter structure. 00: Data filter runs with a Sincfast structure 01: Data filter runs with a Sinc1 structure 10: Data filter runs with a Sinc2 structure 11: Data filter runs with a Sinc3 structure Reset type: SYSRSn
9	AE	R/W	0h	Acknowledge enable. 0: Acknowledge flag is disabled for the particular filter 1: Acknowledge flag is enabled for the particular filter Reset type: SYSRSn
8	FEN	R/W	0h	Filter enable. 0: The filter is disabled and no data is produced 1: The filter is enabled and data are produced in the sinc filter Reset type: SYSRSn
7-0	DOSR	R/W	0h	Oversampling ratio. The actual rate is DOSR + 1. These bits set the oversampling ratio of the filter. 0x0FF represents an oversampling ratio of 256. Reset type: SYSRSn



### 12.8.2.28 SDDPARM4 Register (Offset = 42h) [reset = 0h]

SDDPARM4 is shown in [Figure 12-36](#) and described in [Table 12-41](#).

Return to [Summary Table](#).

Integer Parameter Register for Ch4

**Figure 12-36. SDDPARM4 Register**

15	14	13	12	11	10	9	8
SH			DR		RESERVED	RESERVED	
R/W-0h			R/W-0h		R/W-0h	R/W-0h	
7	6	5	4	3	2	1	0
RESERVED		RESERVED					
R-0h		R/W-0h					

**Table 12-41. SDDPARM4 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-11	SH	R/W	0h	Shift Control These bits indicate by how many bits the 16-bit window is shifted up when 16-bit data representation is chosen. Reset type: SYSRSn
10	DR	R/W	0h	Data representation 0: Data stored in 16b 2's complement 1: Data stored in 32b 2's complement Reset type: SYSRSn
9	RESERVED	R/W	0h	Reserved
8	RESERVED	R/W	0h	Reserved
7	RESERVED	R	0h	Reserved
6-0	RESERVED	R/W	0h	Reserved

**12.8.2.29 SDCMPH4 Register (Offset = 43h) [reset = 0h]**

SDCMPH4 is shown in [Figure 12-37](#) and described in [Table 12-42](#).

Return to [Summary Table](#).

High-level Threshold Register for Ch4

**Figure 12-37. SDCMPH4 Register**

15	14	13	12	11	10	9	8
RESERVED							HLT
R-0h				R/W-0h			
7	6	5	4	3	2	1	0
HLT							
R/W-0h							

**Table 12-42. SDCMPH4 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15	RESERVED	R	0h	Reserved
14-0	HLT	R/W	0h	Unsigned high-level threshold for the comparator filter output. Reset type: SYSRSn

**12.8.2.30 SDCMPL4 Register (Offset = 44h) [reset = 0h]**

SDCMPL4 is shown in [Figure 12-38](#) and described in [Table 12-43](#).

Return to [Summary Table](#).

Low-level Threshold Register for Ch4

**Figure 12-38. SDCMPL4 Register**

15	14	13	12	11	10	9	8
RESERVED							LLT
R-0h				R/W-0h			
7	6	5	4	3	2	1	0
LLT							
R/W-0h							

**Table 12-43. SDCMPL4 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15	RESERVED	R	0h	Reserved
14-0	LLT	R/W	0h	Unsigned low-level threshold for the comparator filter output. Reset type: SYSRSn

**12.8.2.31 SDCPARM4 Register (Offset = 45h) [reset = 0h]**

SDCPARM4 is shown in [Figure 12-39](#) and described in [Table 12-44](#).

Return to [Summary Table](#).

Comparator Parameter Register for Ch4

**Figure 12-39. SDCPARM4 Register**

15	14	13	12	11	10	9	8	
RESERVED						MFIE	CS1_CS0	
R-0h						R/W-0h	R/W-0h	
7	6	5	4	3	2	1	0	
CS1_CS0	IEL	IEH	COSR					
R/W-0h	R/W-0h	R/W-0h	R/W-0h					

**Table 12-44. SDCPARM4 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-10	RESERVED	R	0h	Reserved
9	MFIE	R/W	0h	0: The modulator failure flag as well as the output INT is disabled for this particular flag 1: The modulator failure flag is enabled Reset type: SYSRSn
8-7	CS1_CS0	R/W	0h	Comparator filter structure. 00: Comparator filter runs with a sincfast structure 01: Comparator filter runs with a Sinc1 structure 10: Comparator filter runs with a Sinc2 structure 11: Comparator filter runs with a Sinc3 structure Reset type: SYSRSn
6	IEL	R/W	0h	Low-level interrupt enable. 0: The low-level interrupt flag as well as the output INT is disabled for this particular flag 1: The low-level interrupt flag is enabled Reset type: SYSRSn
5	IEH	R/W	0h	High-level interrupt enable. 0: The high-level interrupt flag as well as the output INT is disabled for this particular flag 1: The high-level interrupt flag is enabled Reset type: SYSRSn
4-0	COSR	R/W	0h	Oversampling ratio. The actual rate is COSR + 1. These bits set the oversampling ratio of the filter. 0x1F represents an oversampling ratio of 31. Reset type: SYSRSn

**12.8.2.32 SDDATA4 Register (Offset = 46h) [reset = 0h]**

SDDATA4 is shown in [Figure 12-40](#) and described in [Table 12-45](#).

Return to [Summary Table](#).

Filter Data Register (16 or 32bit) for Ch4

**Figure 12-40. SDDATA4 Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
DATA32HI																DATA16															
R-0h																R-0h															

**Table 12-45. SDDATA4 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	DATA32HI	R	0h	Hi-order 16b in 32b mode Reset type: SYSRSn
15-0	DATA16	R	0h	16-bit Data in 16b mode, Lo-order 16b in 32b mode Reset type: SYSRSn

## **Enhanced Pulse Width Modulator (ePWM)**

The enhanced pulse width modulator (ePWM) peripheral is a key element in controlling many of the power electronic systems found in both commercial and industrial equipment. These systems include digital motor control, switch mode power supply control, uninterruptible power supplies (UPS), and other forms of power conversion. The ePWM peripheral performs a digital to analog (DAC) function, where the duty cycle is equivalent to a DAC analog value; it is sometimes referred to as a power DAC.

This chapter is applicable for ePWM type 4. See the *TMS320x28xx, 28xxx DSP Peripheral Reference Guide* ([SPRU566](#)) for a list of all devices with an ePWM module of the same type, to determine the differences between the types, and for a list of device-specific differences within a type.

Topic	Page
13.1 Introduction .....	1551
13.2 Configuring Device Pins .....	1558
13.3 Overview.....	1558
13.4 Time-Base (TB) Submodule.....	1560
13.5 Counter-Compare (CC) Submodule .....	1571
13.6 Action-Qualifier (AQ) Submodule .....	1577
13.7 Dead-Band Generator (DB) Submodule .....	1590
13.8 PWM Chopper (PC) Submodule .....	1597
13.9 Trip-Zone (TZ) Submodule .....	1601
13.10 Event-Trigger (ET) Submodule .....	1606
13.11 Digital Compare (DC) Submodule .....	1612
13.12 EPWM X-BAR .....	1620
13.13 Applications to Power Topologies .....	1621
13.14 Registers .....	1639

## 13.1 Introduction

This chapter includes an overview of the module and information about each of its submodules:

- Time-Base Submodule
- Counter Compare Submodule
- Action Qualifier Submodule
- Dead-Band Generator Submodule
- PWM Chopper (PC) Submodule
- Trip Zone Submodule
- Event Trigger Submodule
- Digital Compare Submodule

The ePWM Type 4 is functionally compatible to Type 2 (a Type 3 does not exist). Type 4 has the following enhancements in addition to the Type 2 features:

- **Register Address Map**

Additional registers are required for new features on ePWM Type 4. The ePWM register address space has been remapped for better alignment and easy usage.

- **Delayed Trip Functionality**

Changes have been added to achieve deadband insertion capabilities to support, for example, delayed trip functionality needed for peak current mode control type application scenarios. This has been accomplished by allowing comparator events to go into the Action Qualifier as a trigger event (Events T1 and T2). If comparator T1/T2 events are used to edit the PWM, changes to the PWM waveform will not take place immediately. Instead, they will synchronize to the next TBCLK.

- **Dead-Band Generator Submodule Enhancements**

Shadowing of DBCTL register to allow dynamic configuration changes.

- **One Shot and Global Load of Registers**

The ePWM Type 4 allows one-shot and global load capability from shadow to active registers to avoid partial loads in, for example, multi-phase applications. It also allows programmable pre-scale of shadow to active load events.

- **Trip Zone Submodule Enhancements**

Independent flags have been added to reflect the trip status for each of the TZ sources. Changes have been made to the trip zone submodule to support certain power converter switching techniques like valley switching.

- **Digital Compare Submodule Enhancements**

Blanking window filter register width has been increased from 8 to 16 bits. DCCAP functionality has been enhanced to provide more programmability.

- **PWM SYNC Related Enhancements**

The ePWM Type 4 allows PWM SYNCOUT generation based on CMPC and CMPD events. These events can also be used for PWMSYNC pulse selection.

The ePWM Type 2 is fully compatible to Type 1. Type 2 has the following enhancements in addition to the Type 1 features:

- **High Resolution Dead-Band Capability**

High resolution capability is added to dead-band RED and FED in half-cycle clocking mode.

- **Dead-Band Generator Submodule Enhancements**

The ePWM Type 2 has features to enable both RED and FED on either PWM outputs. Provides increased dead band with 14-bit counters and dead-band / dead-band high-resolution registers are shadowed

- **High Resolution Extension Available on ePWMxB Outputs**

Provides the ability to enable high-resolution period and duty cycle control on ePWMxB outputs. This is discussed in more detail in the *HRPWM* chapter in this manual.

- **Counter Compare Submodule Enhancements**  
The ePWM Type 2 allows Interrupts and SOC events to be generated by additional counter compares CMPC and CMPD.
- **Event Trigger Submodule Enhancements**  
Prescaling logic to issue interrupt requests and ADC start of conversion expanded up to every 15 events. It allows Software initialization of event counters on SYNC event.
- **Digital Compare Submodule Enhancements**  
Digital Compare Trip Select logic [DCTRIPSEL] has up to 12 external trip sources selected by the Input X-BAR logic in addition to an ability to OR all of them (up to 14 [external and internal sources]) to create the respective DCxEVTs.
- **Simultaneous Writes to TBPRD and CMPx Registers**  
This feature allows writes to TBPRD, CMPA:CMPAHR, CMPB:CMPBHR, CMPC and CMPD of any ePWM module to be tied to any other ePWM module, and also allows all ePWM modules to be tied to a particular ePWM module if desired.
- **Shadow to Active Load on SYNC of TBPRD and CMP Registers**  
This feature supports simultaneous writes of TBPRD and CMPA/B/C/D registers.

The ePWM Type 1 is functionally compatible to Type 0. Type 1 has the following enhancements in addition to the Type 0 features:

- **Increased Dead-Band Resolution**  
Dead-band clocking has been enhanced to allow half-cycle clocking to double resolution.
- **Enhanced Interrupt and SOC Generation**  
Interrupts and ADC start-of-conversion can now be generated on both the TBCTR == zero and TBCTR == period events. This feature enables dual edge PWM control. Additionally, the ADC start-of-conversion can be generated from an event defined in the digital compare submodule.
- **High Resolution Period Capability**  
Provides the ability to enable high-resolution period. This is discussed in more detail in the device-specific HRPWM Reference Guide.
- **Digital Compare Submodule**  
The digital compare submodule enhances the event triggering and trip zone submodules by providing filtering, blanking and improved trip functionality to digital compare signals. Such features are essential for peak current mode control and for support of analog comparators.

An effective PWM peripheral must be able to generate complex pulse width waveforms with minimal CPU overhead or intervention. It needs to be highly programmable and very flexible while being easy to understand and use. The ePWM unit described here addresses these requirements by allocating all needed timing and control resources on a per PWM channel basis. Cross coupling or sharing of resources has been avoided; instead, the ePWM is built up from smaller single channel submodules with separate resources that can operate together as required to form a system. This modular approach results in an orthogonal architecture and provides a more transparent view of the peripheral structure, helping users to understand its operation quickly.

In this document, the letter x within a signal or submodule name is used to indicate a generic ePWM instance on a device. For example, output signals EPWMxA and EPWMxB refer to the output signals from the ePWMx instance. Thus, EPWM1A and EPWM1B belong to ePWM1 and likewise EPWM4A and EPWM4B belong to ePWM4.



### 13.1.1 Submodule Overview

The ePWM module represents one complete PWM channel composed of two PWM outputs: EPWMxA and EPWMxB. Multiple ePWM submodules are instantiated within a device as shown in [Figure 13-1](#). Each ePWM instance is identical with one exception. Some instances include a hardware extension that allows more precise control of the PWM outputs. This extension is the high-resolution pulse width modulator (HRPWM) and is described in the device-specific *High-Resolution Pulse Width Modulator (HRPWM)* chapter. See the device-specific data manual to determine which ePWM instances include this feature. Each ePWM submodule is indicated by a numerical value starting with 1. For example ePWM1 is the first instance and ePWM3 is the third instance in the system and ePWMx indicates any instance.

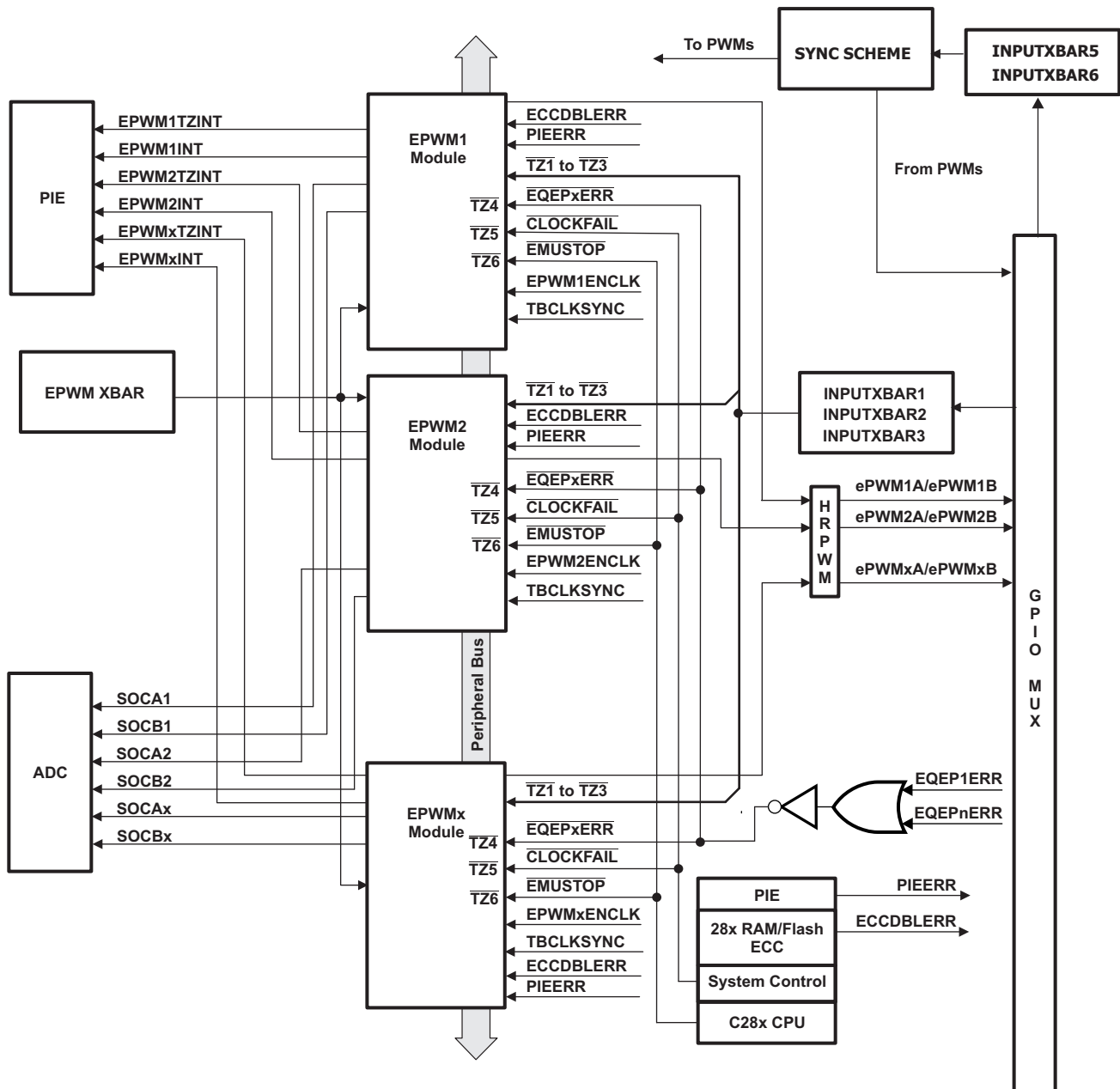
The ePWM submodules are chained together via a clock synchronization scheme that allows them to operate as a single system when required. Additionally, this synchronization scheme can be extended to the capture peripheral modules (eCAP). The number of submodules is device-dependent and based on target application needs. Modules can also operate standalone.

Each ePWM submodule supports the following features:

- Dedicated 16-bit time-base counter with period and frequency control
- Two PWM outputs (EPWMxA and EPWMxB) that can be used in the following configurations:
  - Two independent PWM outputs with single-edge operation
  - Two independent PWM outputs with dual-edge symmetric operation
  - One independent PWM output with dual-edge asymmetric operation
- Asynchronous override control of PWM signals through software.
- Programmable phase-control support for lag or lead operation relative to other ePWM modules.
- Hardware-locked (synchronized) phase relationship on a cycle-by-cycle basis.
- Dead-band generation with independent rising and falling edge delay control.
- Programmable trip zone allocation of both cycle-by-cycle trip and one-shot trip on fault conditions.
- A trip condition can force either high, low, or high-impedance state logic levels at PWM outputs.
- All events can trigger both CPU interrupts and ADC start of conversion (SOC)
- Programmable event prescaling minimizes CPU overhead on interrupts.
- PWM chopping by high-frequency carrier signal, useful for pulse transformer gate drives.

Each ePWM submodule is connected to the input/output signals shown in [Figure 13-1](#). The signals are described in detail in subsequent sections.

Figure 13-1. Multiple ePWM Modules



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The order in which the ePWM submodules are connected may differ from what is shown in [Figure 13-1](#). See [Figure 15-8](#) for the synchronization scheme for a particular device. Each ePWM submodule consists of eight submodules and is connected within a system via the signals shown in [Figure 13-2](#).

**Figure 13-2. Submodules and Signal Connections for an ePWM Module**

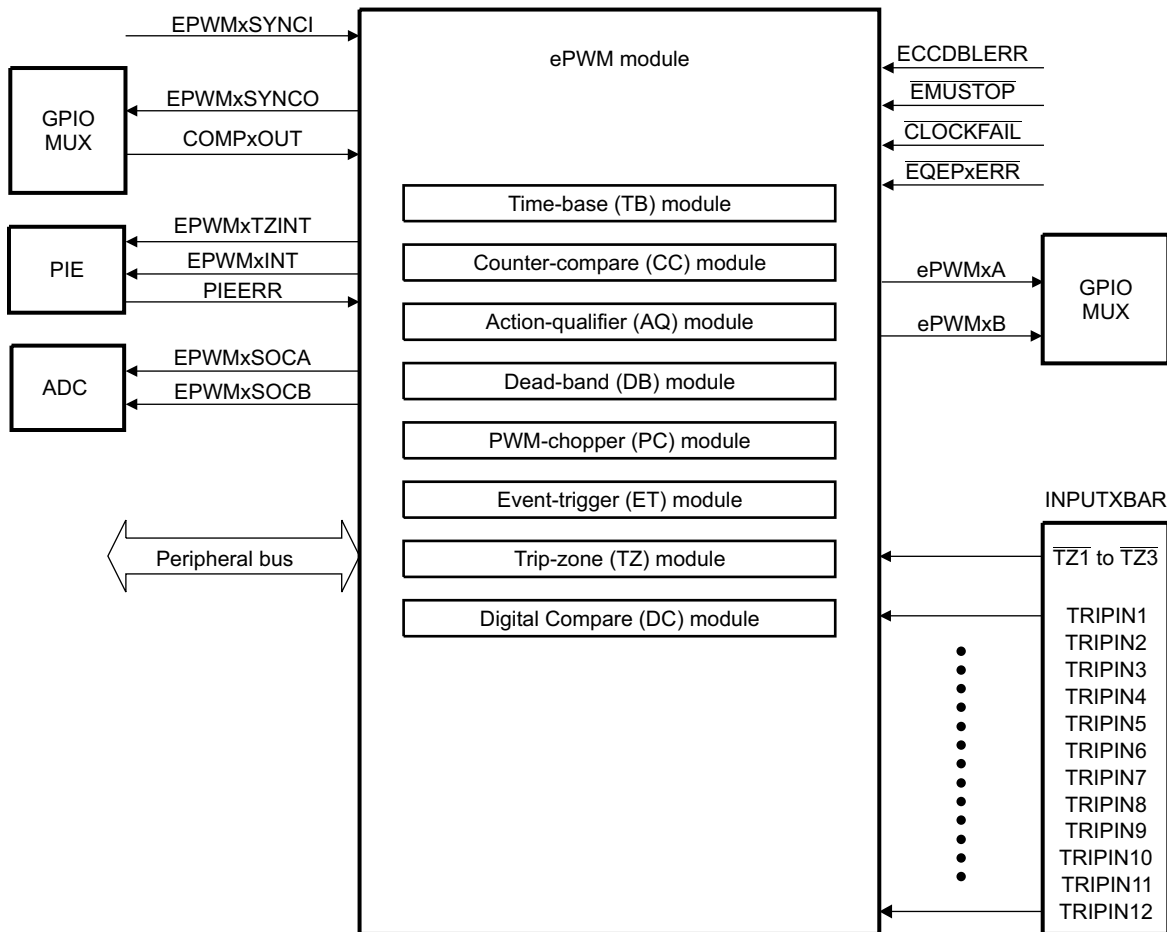


Figure 13-3 shows more internal details of a single ePWM submodule. The main signals used by the ePWM submodules are:

- **PWM output signals (EPWMxA and EPWMxB).**

The PWM output signals are made available external to the device through the GPIO peripheral described in the *System Control and Interrupts* chapter for your device.

- **Trip-zone signals (TZ1 to TZ6).**

These input signals alert the ePWM submodule of fault conditions external to the ePWM submodule. Each submodule on a device can be configured to either use or ignore any of the trip-zone signals. The TZ1 to TZ3 trip-zone signals can be configured as asynchronous inputs through the GPIO peripheral using the Input X-BAR logic, refer to Figure 13-49. TZ4 is connected to an inverted EQEPx error signal (EQEPxERR), which can be generated from any one of the EQEP submodule (for those devices with an EQEP module). TZ5 is connected to the system clock fail logic, and TZ6 is connected to the EMUSTOP output from the CPU. This allows you to configure a trip action when the clock fails or the CPU halts.

- **Time-base synchronization input (EPWMxSYNCl) and output (EPWMxSYNCO) signals.**

The synchronization signals daisy chain the ePWM submodules together. Each submodule can be configured via INPUTXBAR6 to either use or ignore its synchronization input. The clock synchronization input and output signal are brought out to pins only for ePWM1 (ePWM module #1). The ePWM submodules are separated into groups of three for syncing purposes. An external sync signal (EXTSYNClN1 or EXTSYNClN2) may be used to issue a sync signal to the first ePWM submodule in each chain. These same submodules can also send their EPWMxSYNCO signal to a GPIO. For more information, see Section 13.4.3.3.

- **ADC start-of-conversion signals (EPWMxSOCA and EPWMxSOCB).**

Each ePWM module has two ADC start of conversion signals. Any ePWM submodule can trigger a start of conversion. Whichever event triggers the start of conversion is configured in the event-trigger subsubmodule of the ePWM.

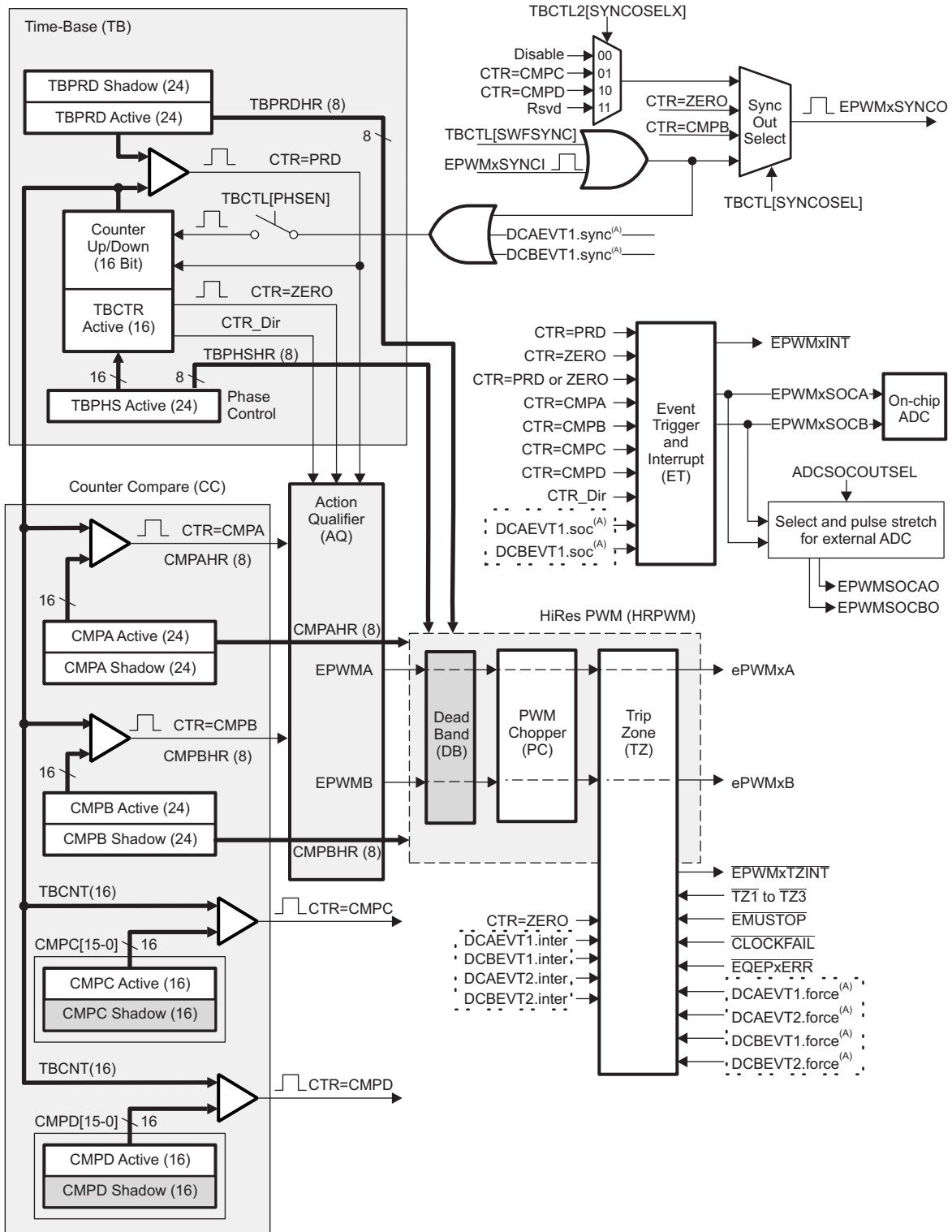
- **Comparator output signals (COMPxOUT).**

Output signals from the comparator submodule can be fed through the Input X-BAR to one or all of the 12 trip inputs [TRIPIN1 - TRIPIN12] and in conjunction with the trip zone signals can generate digital compare events.

- **Peripheral Bus**

The peripheral bus is 32-bits wide and allows both 16-bit and 32-bit writes to the ePWM register file.

Figure 13-3. ePWM Submodules and Critical Internal Signal Interconnects



A These events are generated by the ePWM digital compare (DC) submodule based on the levels of the TRIPIN inputs.

### 13.2 Configuring Device Pins

To connect the device input pins to the module, the Input X-BAR must be used. Some examples of when an external signal may be needed are TZx, TRIPx, and EXTSYNCIN. Any GPIO on the device can be configured as an input. The GPIO input qualification should be set to asynchronous mode by setting the appropriate GPxQSEL register bits to 11b. The internal pullups can be configured in the GPyPUD register. Since the GPIO mode is used, the GPyINV register can invert the signals. Additionally, some TRIPx (TRIP4-12 excluding TRIP6) signals must be routed through the EPWM X-Bar in addition to the Input X-Bar.

The GPIO mux registers must be configured for this peripheral. To avoid glitches on the pins, the GPyGMUX bits must be configured first (while keeping the corresponding GPyMUX bits at the default of zero), followed by writing the GPyMUX register to the desired value.

See the *GPIO* chapter for more details on GPIO mux, GPIO settings, and XBAR configuration.

### 13.3 Overview

Table 13-1 lists the eight key submodules together with a list of their main configuration parameters. For example, if you need to adjust or control the duty cycle of a PWM waveform, then you should see the counter-compare submodule in Section 13.5 for relevant details.

**Table 13-1. Submodule Configuration Parameters**

Submodule	Configuration Parameter or Option
Time Base (TB)	<ul style="list-style-type: none"> <li>• Scale the time-base clock (TBCLK) relative to the EPWM clock (EPWMCLK).</li> <li>• Configure the PWM time-base counter (TBCTR) frequency or period.</li> <li>• Set the mode for the time-base counter:               <ul style="list-style-type: none"> <li>– count-up mode: used for asymmetric PWM</li> <li>– count-down mode: used for asymmetric PWM</li> <li>– count-up-and-down mode: used for symmetric PWM</li> </ul> </li> <li>• Configure the time-base phase relative to another ePWM module.</li> <li>• Synchronize the time-base counter between modules through hardware or software.</li> <li>• Configure the direction (up or down) of the time-base counter after a synchronization event.</li> <li>• Simultaneous writes to the TBPRD registers on all PWM's corresponding to the configuration on EPWMLINK.</li> <li>• Configure how the time-base counter will behave when the device is halted by an emulator.</li> <li>• Specify the source for the synchronization output of the ePWM module:               <ul style="list-style-type: none"> <li>– Synchronization input signal</li> <li>– Time-base counter equal to zero</li> <li>– Time-base counter equal to counter-compare B (CMPB)</li> <li>– No output synchronization signal generated.</li> </ul> </li> <li>• Configure one shot and global load of registers in this module.</li> </ul>
Counter Compare (CC)	<ul style="list-style-type: none"> <li>• Specify the PWM duty cycle for output EPWMxA and/or output EPWMxB</li> <li>• Specify the time at which switching events occur on the EPWMxA or EPWMxB output</li> <li>• Specify the programmable delay for interrupt and SOC generation with additional comparators</li> <li>• Simultaneous writes to the CMPA, CMPB, CMPC, CMPD registers on all PWM's corresponding to the configuration on EPWMLINK.</li> <li>• Configure one shot and global load of registers in this module.</li> </ul>
Action Qualifier (AQ)	<ul style="list-style-type: none"> <li>• Specify the type of action taken when a time-base counter-compare, trip-zone submodule, or comparator event occurs:               <ul style="list-style-type: none"> <li>– No action taken</li> <li>– Output EPWMxA and/or EPWMxB switched high</li> <li>– Output EPWMxA and/or EPWMxB switched low</li> <li>– Output EPWMxA and/or EPWMxB toggled</li> </ul> </li> <li>• Force the PWM output state through software control</li> <li>• Configure and control the PWM dead band through software</li> <li>• Configure one shot and global load of registers in this module.</li> </ul>

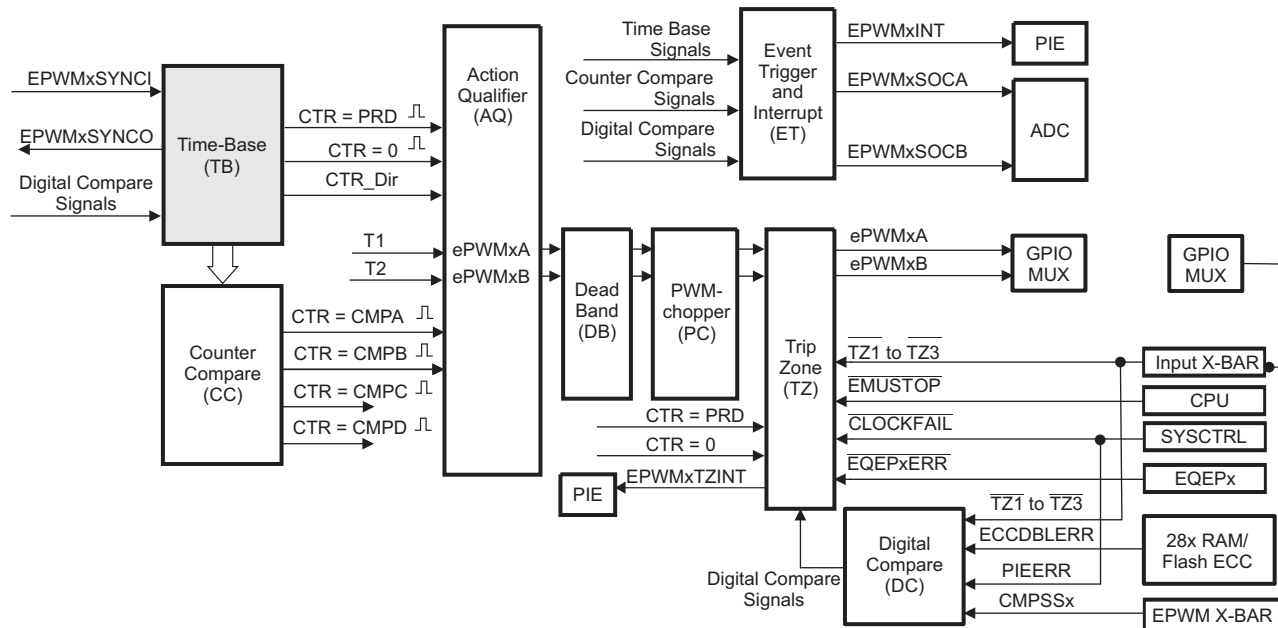
**Table 13-1. Submodule Configuration Parameters (continued)**

Submodule	Configuration Parameter or Option
Dead Band (DB)	<ul style="list-style-type: none"> <li>Control of traditional complementary dead-band relationship between upper and lower switches</li> <li>Specify the output rising-edge-delay value</li> <li>Specify the output falling-edge delay value</li> <li>Bypass the dead-band module entirely. In this case the PWM waveform is passed through without modification.</li> <li>Option to enable half-cycle clocking for double resolution.</li> <li>Allow ePWMxB phase shifting with respect to the ePWMxA output.</li> <li>Configure one shot and global load of registers in this module.</li> </ul>
PWM Chopper (PC)	<ul style="list-style-type: none"> <li>Create a chopping (carrier) frequency.</li> <li>Pulse width of the first pulse in the chopped pulse train.</li> <li>Duty cycle of the second and subsequent pulses.</li> <li>Bypass the PWM chopper module entirely. In this case the PWM waveform is passed through without modification.</li> </ul>
Trip Zone (TZ)	<ul style="list-style-type: none"> <li>Configure the ePWM module to react to one, all, or none of the trip-zone signals or digital compare events.</li> <li>Specify the trip action taken when a fault occurs: <ul style="list-style-type: none"> <li>Force EPWMxA and/or EPWMxB high</li> <li>Force EPWMxA and/or EPWMxB low</li> <li>Force EPWMxA and/or EPWMxB to a high-impedance state</li> <li>Configure EPWMxA and/or EPWMxB to ignore any trip condition.</li> </ul> </li> <li>Configure how often the ePWM will react to each trip-zone signal: <ul style="list-style-type: none"> <li>One-shot</li> <li>Cycle-by-cycle</li> </ul> </li> <li>Enable the trip-zone to initiate an interrupt.</li> <li>Bypass the trip-zone module entirely.</li> <li>Programmable option for cycle-by-cycle trip clear</li> <li>If desired, independently configure trip actions taken when time-base counter is counting down.</li> </ul>
Event Trigger (ET)	<ul style="list-style-type: none"> <li>Enable the ePWM events that will trigger an interrupt.</li> <li>Enable ePWM events that will trigger an ADC start-of-conversion event.</li> <li>Specify the rate at which events cause triggers (every occurrence or every 2nd or up to 15th occurrence)</li> <li>Poll, set, or clear event flags</li> </ul>
Digital Compare (DC)	<ul style="list-style-type: none"> <li>Enables comparator (COMP) module outputs and trip zone signals which are configured using the Input X-BAR to create events and filtered events</li> <li>Specify event-filtering options to capture TBCTR counter, generate blanking window, or insert delay in PWM output or time-base counter based on captured value.</li> </ul>

## 13.4 Time-Base (TB) Submodule

Each ePWM module has its own time-base submodule that determines all of the event timing for the ePWM module. Built-in synchronization logic allows the time-base of multiple ePWM modules to work together as a single system. Figure 13-4 illustrates the time-base submodule's place within the ePWM.

**Figure 13-4. Time-Base Submodule**



### 13.4.1 Purpose of the Time-Base Submodule

You can configure the time-base submodule for the following:

- Specify the ePWM time-base counter (TBCTR) frequency or period to control how often events occur.
- Manage time-base synchronization with other ePWM modules.
- Maintain a phase relationship with other ePWM modules.
- Set the time-base counter to count-up, count-down, or count-up-and-down mode.
- Generate the following events:
  - CTR = PRD: Time-base counter equal to the specified period (TBCTR = TBPRD) .
  - CTR = Zero: Time-base counter equal to zero (TBCTR = 0x00).
- Configure the rate of the time-base clock; a prescaled version of the EPWM clock (EPWMCLK). This allows the time-base counter to increment/decrement at a slower rate.

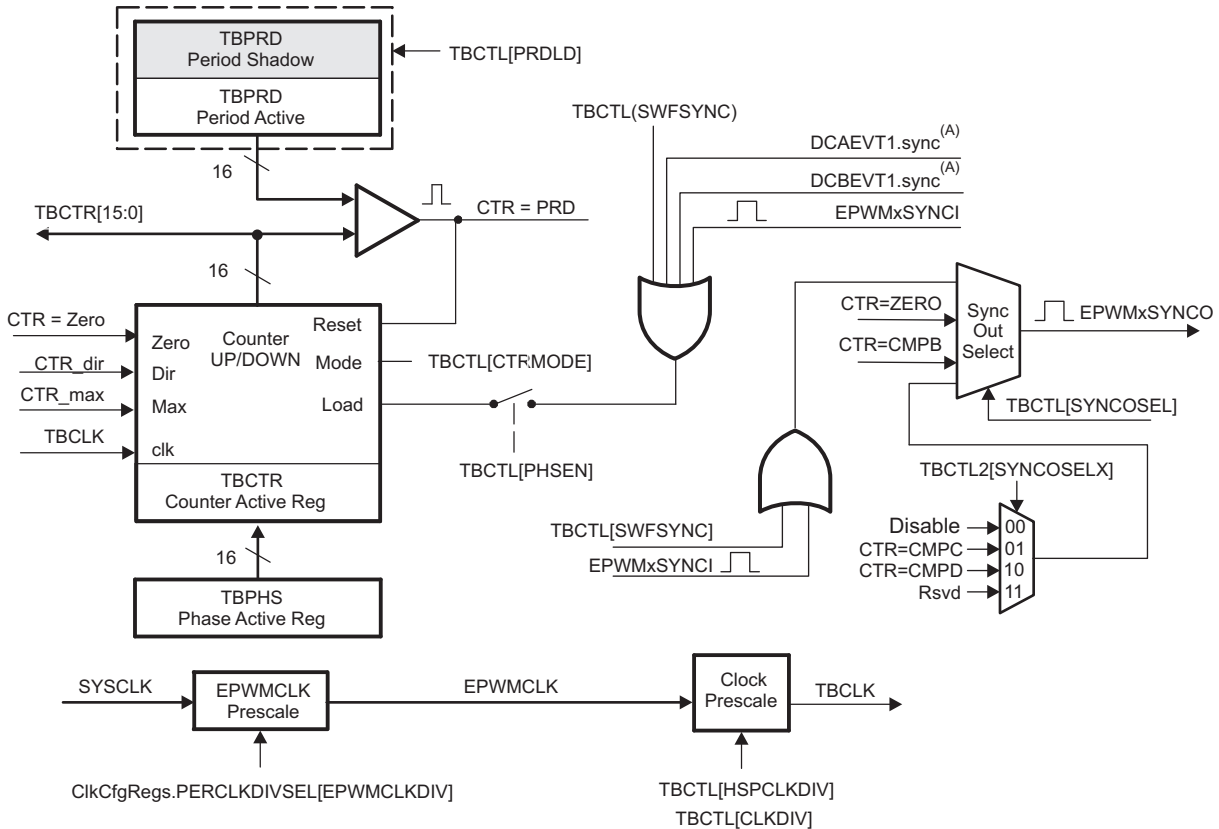
**Note:** The Type 4 EPWM clocking varies from previous EPWM types. Prior to the Type 4 EPWM, the time-base submodule was clocked directly by the system clock (SYSCLKOUT). On this version of the ePWM, there is a divider (EPWMCLKDIV) of the system clock which defaults to  $EPWMCLK = SYSCLKOUT / 2$ .



### 13.4.2 Controlling and Monitoring the Time-Base Submodule

The block diagram in Figure 13-5 shows the critical signals and registers of the time-base submodule. Table 13-2 provides descriptions of the key signals associated with the time-base submodule.

Figure 13-5. Time-Base Submodule Signals and Registers



A. These signals are generated by the digital compare (DC) submodule.

Table 13-2. Key Time-Base Signals

Signal	Description
EPWMxSYNCl	Time-base synchronization input.  Input pulse used to synchronize the time-base counter with the counter of ePWM module earlier in the synchronization chain. An ePWM peripheral can be configured to use or ignore this signal. For the first ePWM module in each synchronization chain, this signal may come from a device pin via INPUT5 or INPUT6 of the Input X-BAR or from a previous ePWM module. For subsequent ePWM modules in each chain, this signal is passed from another ePWM peripheral. For example, EPWM2SYNCl is generated by the ePWM1 peripheral, EPWM3SYNCl is generated by ePWM2 and so forth. For information on the synchronization order of a particular device, see Section 13.4.3.3.
EPWMxSYNCO	Time-base synchronization output.  This output pulse is used to synchronize the counter of an ePWM module later in the synchronization chain. The ePWM module generates this signal from one of three event sources: <ol style="list-style-type: none"> <li>EPWMxSYNCl (Synchronization input pulse)</li> <li>CTR = Zero: The time-base counter equal to zero (TBCTR = 0x00).</li> <li>CTR = CMPB: The time-base counter equal to the counter-compare B (TBCTR = CMPB) register.</li> </ol>
CTR = PRD	Time-base counter equal to the specified period.  This signal is generated whenever the counter value is equal to the active period register value. That is when TBCTR = TBPRD.
CTR = Zero	Time-base counter equal to zero  This signal is generated whenever the counter value is zero. That is when TBCTR equals 0x00.

**Table 13-2. Key Time-Base Signals (continued)**

Signal	Description
CTR = CMPB	Time-base counter equal to active counter-compare B register (TBCTR = CMPB). This event is generated by the counter-compare submodule and used by the synchronization out logic
CTR_dir	Time-base counter direction. Indicates the current direction of the ePWM's time-base counter. This signal is high when the counter is increasing and low when it is decreasing.
CTR_max	Time-base counter equal max value. (TBCTR = 0xFFFF) Generated event when the TBCTR value reaches its maximum value. This signal is only used only as a status bit
TBCLK	Time-base clock. This is a prescaled version of the EPWM clock (EPWMCLK) and is used by all submodules within the ePWM. This clock determines the rate at which time-base counter increments or decrements.

### 13.4.3 Calculating PWM Period and Frequency

The frequency of PWM events is controlled by the time-base period (TBPRD) register and the mode of the time-base counter. Figure 13-6 shows the period ( $T_{pwm}$ ) and frequency ( $F_{pwm}$ ) relationships for the up-count, down-count, and up-down-count time-base counter modes when the period is set to 4 (TBPRD = 4). The time increment for each step is defined by the time-base clock (TBCLK) which is a prescaled version of the EPWM clock (EPWMCLK).

The time-base counter has three modes of operation selected by the time-base control register (TBCTL):

- **Up-Down-Count Mode:**

In up-down-count mode, the time-base counter starts from zero and increments until the period (TBPRD) value is reached. When the period value is reached, the time-base counter then decrements until it reaches zero. At this point the counter repeats the pattern and begins to increment.

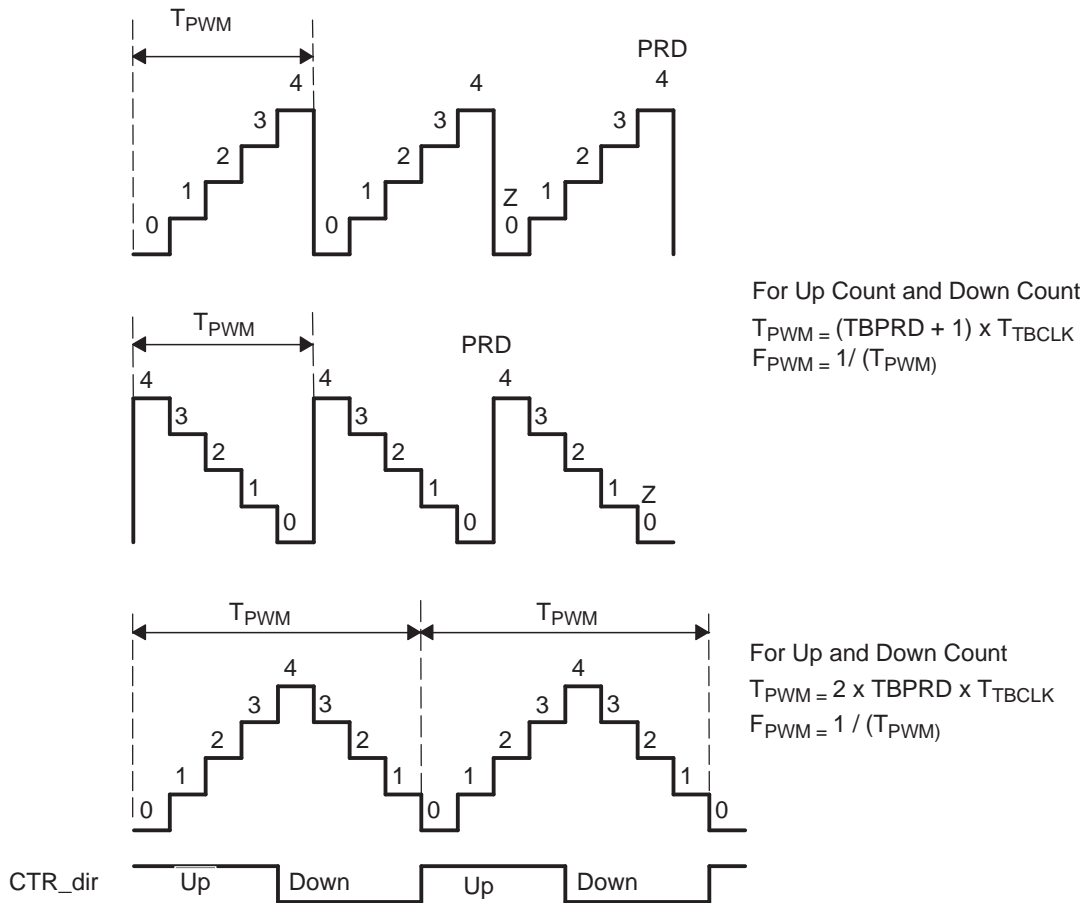
- **Up-Count Mode:**

In this mode, the time-base counter starts from zero and increments until it reaches the value in the period register (TBPRD). When the period value is reached, the time-base counter resets to zero and begins to increment once again.

- **Down-Count Mode:**

In down-count mode, the time-base counter starts from the period (TBPRD) value and decrements until it reaches zero. When it reaches zero, the time-base counter is reset to the period value and it begins to decrement once again.

Figure 13-6. Time-Base Frequency and Period



### 13.4.3.1 Time-Base Period Shadow Register

The time-base period register (TBPRD) has a shadow register. Shadowing allows the register update to be synchronized with the hardware. The following definitions are used to describe all shadow registers in the ePWM module:

- **Active Register**

The active register controls the hardware and is responsible for actions that the hardware causes or invokes.

- **Shadow Register**

The shadow register buffers or provides a temporary holding location for the active register. It has no direct effect on any control hardware. At a strategic point in time the shadow register's content is transferred to the active register. This prevents corruption or spurious operation due to the register being asynchronously modified by software.

The memory address of the shadow period register is the same as the active register. Which register is written to or read from is determined by the TBCTL[PRDL] bit. This bit enables and disables the TBPRD shadow register as follows:

- **Time-Base Period Shadow Mode:**

The TBPRD shadow register is enabled when TBCTL[PRDL] = 0. Reads from and writes to the TBPRD memory address go to the shadow register. The shadow register contents are transferred to the active register (TBPRD (Active) ← TBPRD (shadow)) when the time-base counter equals zero (TBCTR = 0x00) and/or a sync event as determined by the TBCTL2[PRDLDSYNC] bit. The PRDLDSYNC bit is valid only if TBCTL[PRDL] = 0. By default the TBPRD shadow register is enabled. The sources for the SYNC input is explained in [Section 13.4.3.3](#).

The global load control mechanism can also be used with the time-base period register by configuring the appropriate bits in the global load configuration register (GLDCFG). When global load mode is selected the transfer of contents from shadow register to active register, for all registers that have this mode enabled, occurs at the same event as defined by the configuration bits in Global Shadow to Active Load Control Register (GLDCTL). Global load control mechanism is explained in [Section 13.4.7](#).

- **Time-Base Period Immediate Load Mode:**

If immediate load mode is selected (TBCTL[PRDL] = 1), then a read from or a write to the TBPRD memory address goes directly to the active register.

### 13.4.3.2 Time-Base Clock Synchronization

The TBCLKSYNC bit in the peripheral clock enable registers allows all users to globally synchronize all enabled ePWM modules to the time-base clock (TBCLK). When set, all enabled ePWM module clocks are started with the first rising edge of TBCLK aligned. For perfectly synchronized TBCLKs, the prescalers for each ePWM module must be set identically.

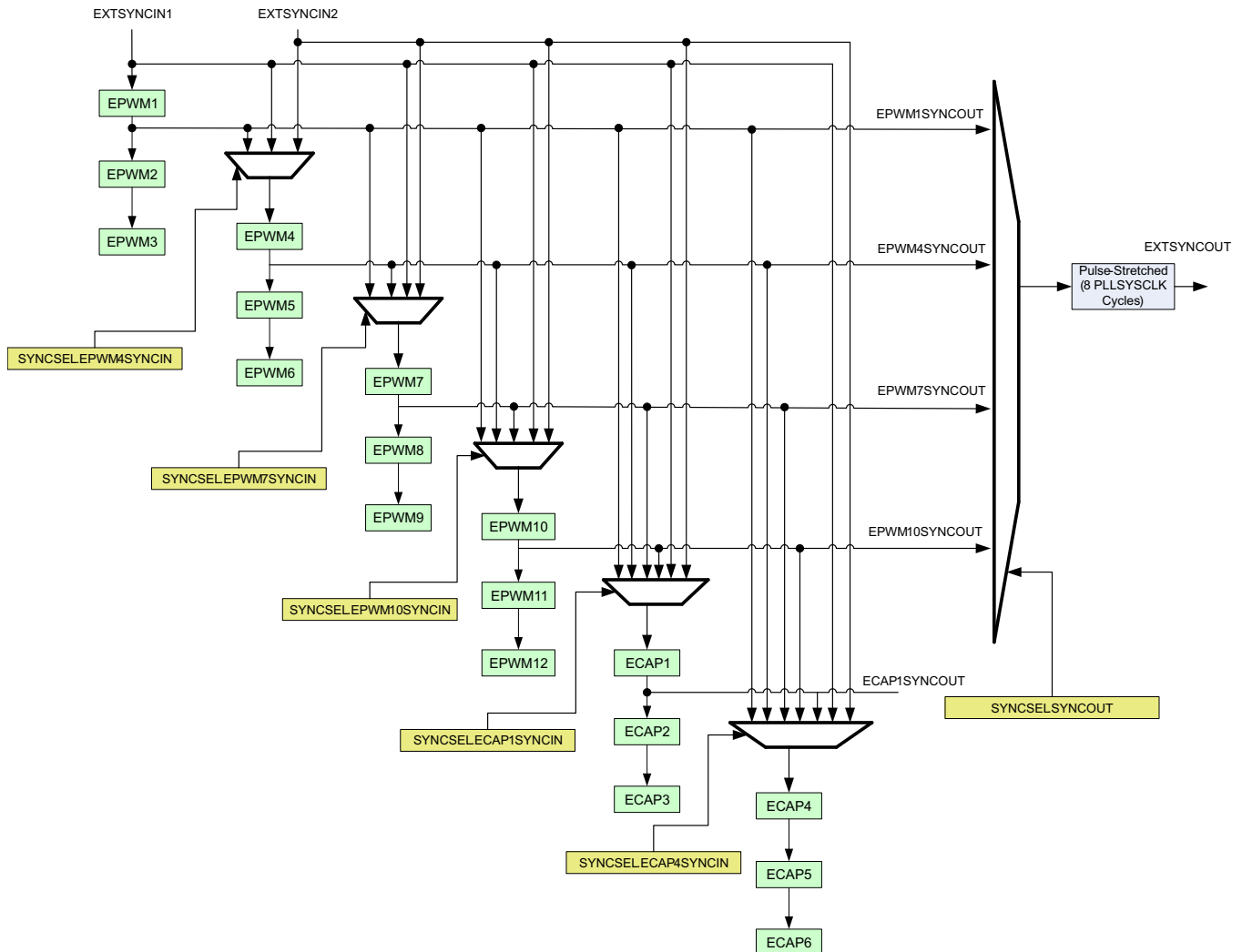
The proper procedure for enabling ePWM clocks is as follows:

1. Enable ePWM module clocks in the PCLKCRx register
2. Set TBCLKSYNC= 0
3. Configure ePWM modules
4. Set TBCLKSYNC=1

### 13.4.3.3 Time-Base Counter Synchronization

The ePWM type 4 introduces a new synchronization scheme that allows for increased flexibility of synchronization of the ePWM modules. Each ePWM module has a synchronization input (SYNCI) and a synchronization output (SYNCO). In [Figure 15-8](#), EXTSYNC1 is sourced from INPUTXBAR5 and EXTSYNC2 is sourced from INPUTXBAR6, which can be configured to select any GPIO as the synchronization input. When configuring the sync chain propagation path using the SYNCSEL registers, make sure that the longest path does not exceed four ePWM/eCAP modules.

Figure 13-7. Time-Base Counter Synchronization Scheme



**NOTE:** See the data manual for the number of ePWM and eCAP modules available on your specific device.

Each ePWM module can be configured to use or ignore the synchronization input. If the TBCTL[PHSEN] bit is set, then the time-base counter (TBCTR) of the ePWM module will be automatically loaded with the phase register (TBPHS) contents when one of the following conditions occur:

- **EPWMxSYNCl: Synchronization Input Pulse:**

The value of the phase register is loaded into the counter register when an input synchronization pulse is detected (TBPHS → TBCTR). This operation occurs on the next valid time-base clock (TBCLK) edge.

The delay from internal master module to slave modules is given by:

- if ( TBCLK = EPWMCLK): 2 x EPWMCLK
- if ( TBCLK != EPWMCLK): 1 TBCLK

- **Software Forced Synchronization Pulse:**

Writing a 1 to the TBCTL[SWFSYNC] control bit invokes a software forced synchronization. This pulse is ORed with the synchronization input signal, and therefore has the same effect as a pulse on EPWMxSYNCl.

- **Digital Compare Event Synchronization Pulse:**

DCAEVT1 and DCBEVT1 digital compare events can be configured to generate synchronization

pulses which have the same affect as EPWMxSYNCl.

This feature enables the ePWM module to be automatically synchronized to the time base of another ePWM module. Lead or lag phase control can be added to the waveforms generated by different ePWM modules to synchronize them. In up-down-count mode, the TBCTL[PSHDIR] bit configures the direction of the time-base counter immediately after a synchronization event. The new direction is independent of the direction prior to the synchronization event. The PSHDIR bit is ignored in count-up or count-down modes. See [Figure 13-8](#) through [Figure 13-11](#) for examples.

Clearing the TBCTL[PHSEN] bit configures the ePWM to ignore the synchronization input pulse. The synchronization pulse can still be allowed to flow-through to the EPWMxSYNCO and be used to synchronize other ePWM modules. In this way, you can set up a master time-base (for example, ePWM1) and downstream modules (ePWM2 - ePWMx) may elect to run in synchronization with the master. See [Section 13.13](#) for more details on synchronization strategies.

#### 13.4.4 Phase Locking the Time-Base Clocks of Multiple ePWM Modules

The TBCLKSYNC bit can be used to globally synchronize the time-base clocks of all enabled ePWM modules on a device. This bit is part of the device's clock enable registers and is described in the *System Control and Interrupts* section of this manual. When TBCLKSYNC = 0, the time-base clock of all ePWM modules is stopped (default). When TBCLKSYNC = 1, all ePWM time-base clocks are started with the rising edge of TBCLK aligned. For perfectly synchronized TBCLKs, the prescaler bits in the TBCTL register of each ePWM module must be set identically. The proper procedure for enabling the ePWM clocks is as follows:

1. Enable the individual ePWM module clocks. This is described in the *System Control and Interrupts* chapter.
2. Set TBCLKSYNC = 0. This will stop the time-base clock within any enabled ePWM module.
3. Configure the prescaler values and desired ePWM modes.
4. Set TBCLKSYNC = 1.

#### 13.4.5 Simultaneous Writes to TBPRD and CMPx Registers Between ePWM Modules

For variable frequency applications, there is a need for simultaneous writes of TBPRD and CMPx registers between ePWM modules. This prevents situations where a CTR = 0 or CTR = PRD pulse forces a shadow to active load of these registers before all registers are updated between ePWM modules (resulting in some registers being loaded from new shadow values while others are loaded from old shadow values). To support this, an ePWM register linking scheme for TBPRD:TBPRDHR, CMPA:CMPAHR, CMPB:CMPBHR, CMPC, and CMPD registers between PWM modules has been added.

For a particular ePWM module # A , user code writes "B+1", to the linked register bit-field in EPWMXLINK. "B" is the ePWM module # being linked to (that is, writes to the ePWM module "B" TBPRD:TBPRDHR, CMPA:CMPAHR, CMPB:CMPBHR, or CMPC will simultaneously be written to corresponding register in ePWM module "A"). For instance if ePWM3 EPWMXLINK register is configured so that CMPA:CMPAHR are linked to ePWM1, then a write to CMPA:CMPAHR in ePWM 1 will simultaneously write the same value to CMPA:CMPAHR in ePWM3. If ePWM4 also has its CMPA:CMPAHR registers linked to ePWM1, then a write to ePWM 1 will write the same value to the CMPA:CMPAHR registers in both ePWM3 and ePWM4.

The register description for EPWMXLINK clearly explains the linked register bit-field values for corresponding ePWM.

---

**NOTE:** The ePWM register linking scheme works with the TBPRD:TBPRDHR [Mirrored instance], CMPA:CMPAHR [Mirrored instance], CMPB:CMPBHR [Mirrored instance], CMPC, and CMPD registers present in the upper page offset. Only the instance of these registers in offsets 0x62-0x6B are linked between ePWM modules

A typical example snippet will use the following registers linked between modules

```
EPwmxRegs.TBPRDHRM2, EPwmxRegs.CMPAM2, EPwmxRegs.CMPBM,
EPwmxRegs.CMPC, EPwmxRegs.CMPD
```

---

### 13.4.6 Time-Base Counter Modes and Timing Waveforms

The time-base counter operates in one of four modes:

- Up-count mode which is asymmetrical
- Down-count mode which is asymmetrical
- Up-down-count which is symmetrical
- Frozen where the time-base counter is held constant at the current value

To illustrate the operation of the first three modes, the following timing diagrams show when events are generated and how the time-base responds to an EPWMxSYNCl signal.

**Figure 13-8. Time-Base Up-Count Mode Waveforms**

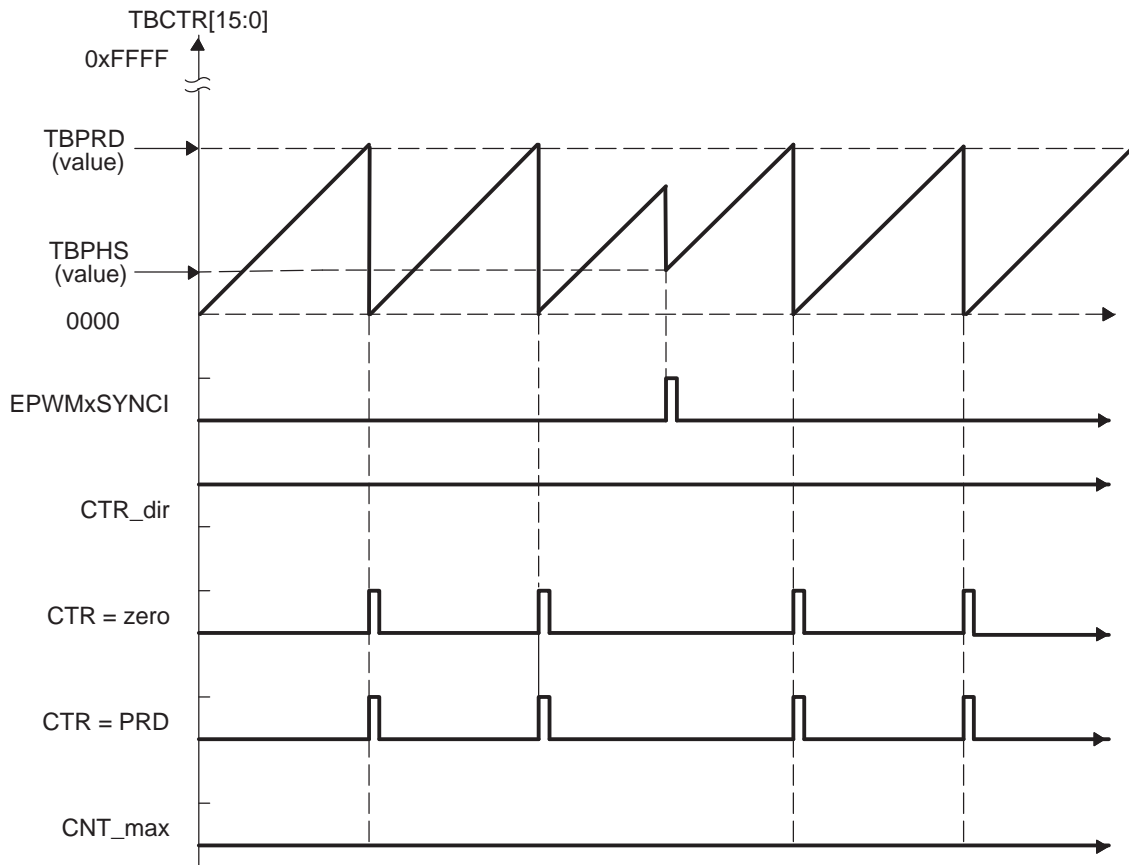


Figure 13-9. Time-Base Down-Count Mode Waveforms

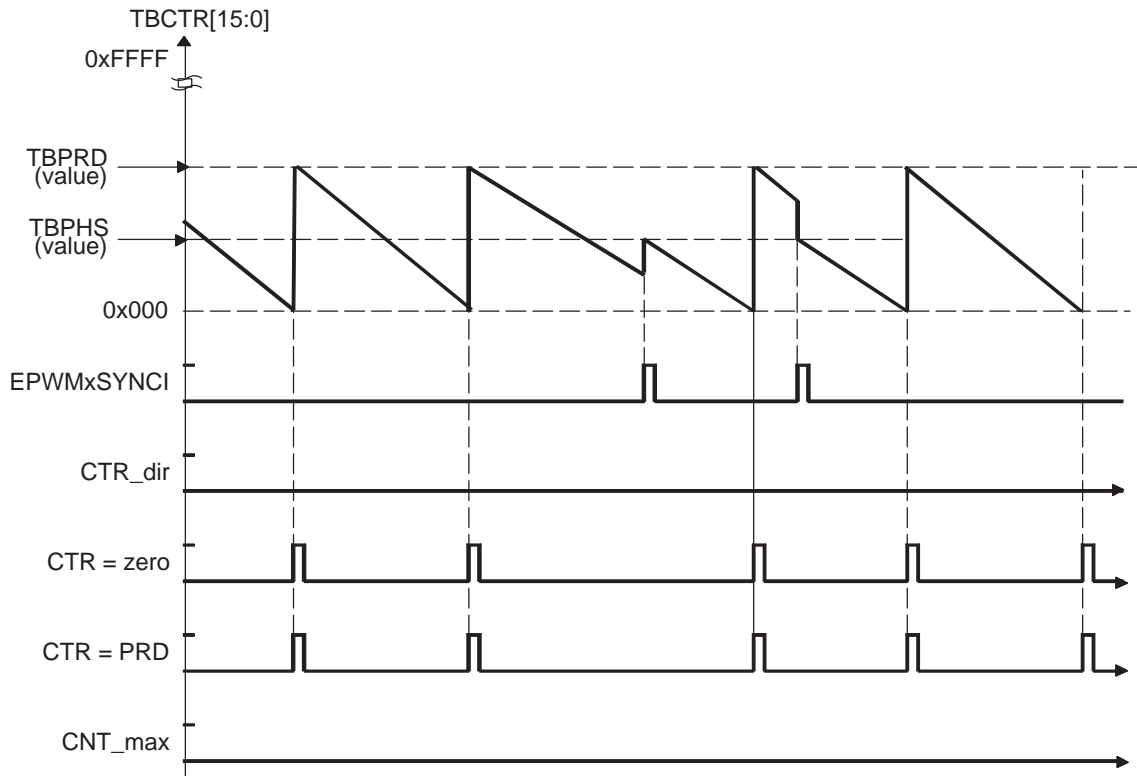
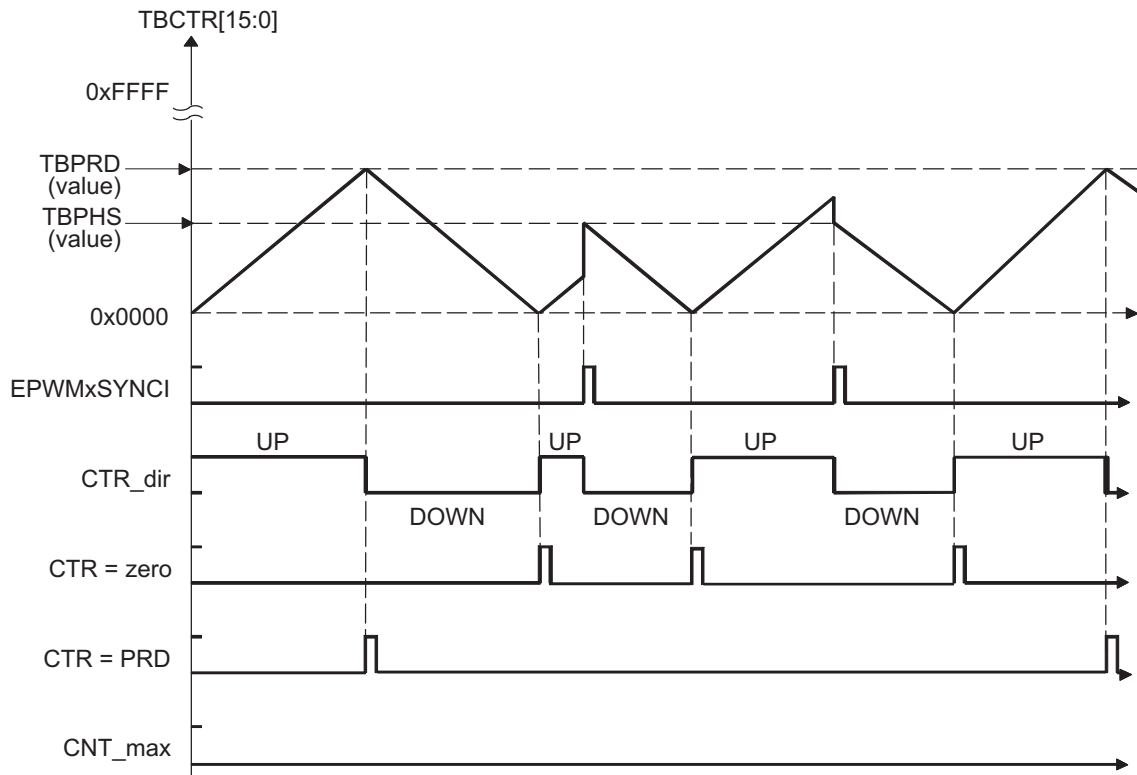
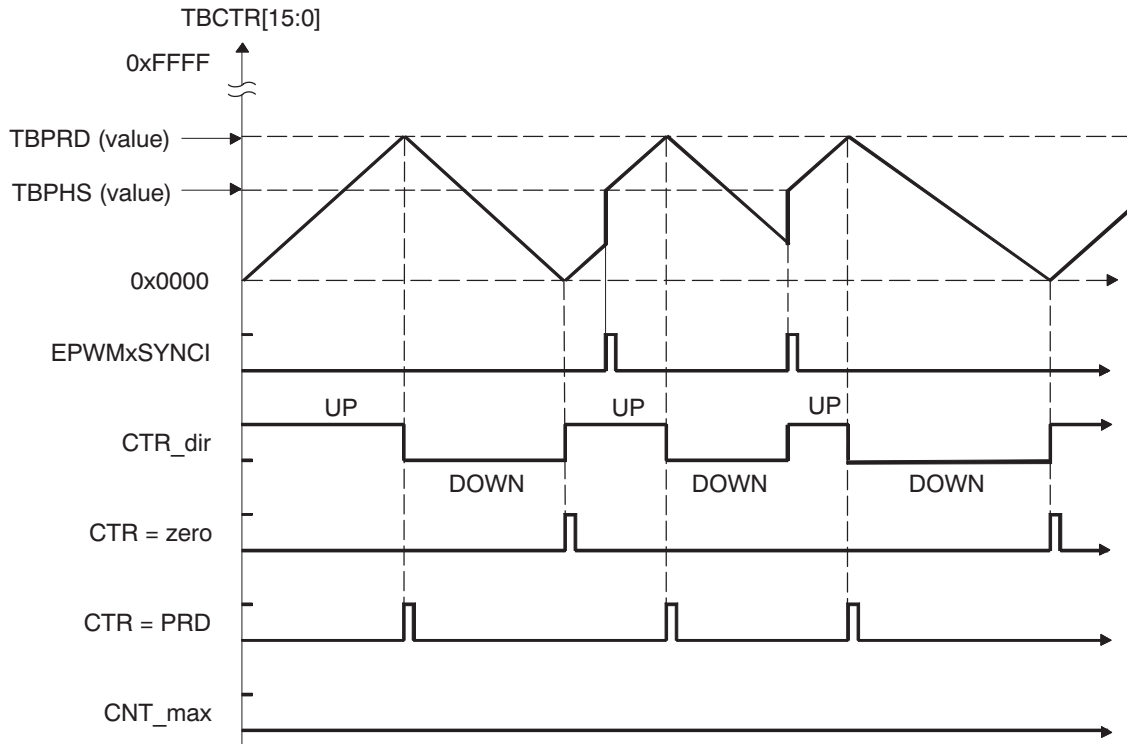


Figure 13-10. Time-Base Up-Down-Count Waveforms, TBCTL[PHSDIR = 0] Count Down On Synchronization Event



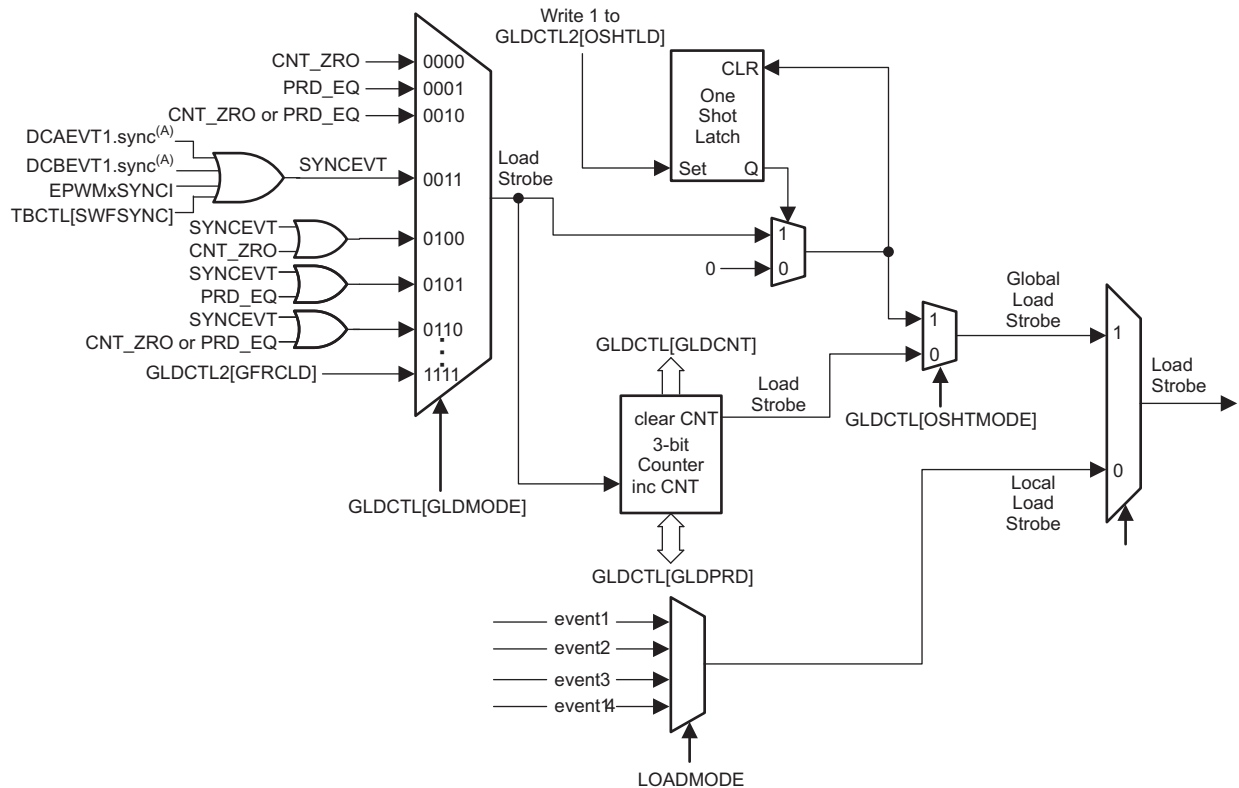


**Figure 13-11. Time-Base Up-Down Count Waveforms, TBCTL[PHSDIR = 1] Count Up On Synchronization Event**



### 13.4.7 Global Load

Figure 13-12 illustrates the signals and registers associated with the global load feature.

**Figure 13-12. Global Load: Signals and Registers**


When this feature is enabled, the transfer of contents from the shadow register to the active register, for all registers that have this mode enabled, occurs at the same event as defined by the configuration bits in Global Shadow to Active Load Control Register (GLDCTL[GLDMODE]). When GLDCTL[GLD] = '1', shadow to active load event selection bits for individual shadowed registers are ignored and global load mode takes effect for the corresponding registers enabled by GLDCFG[REGx].

When GLDCTL[GLD] = '1' and GLDCFG[REGx] = '0' global load mode does not affect the corresponding register (REGx). Shadow to active load event selection bits for individual shadowed registers decide how the transfer of contents from shadow register to active register takes place.

#### 13.4.7.1 Global Load Pulse Pre-Scalar

This feature provides the capability to choose shadow to active transfers to happen once in 'N' occurrences of selected global load pulse (GLDCTL[GLDMODE]). This pre-scale functionality is not available for registers that cannot or are not configured to use the global load mechanism (that is, GLDCTL[GLD] = '0' or GLDCFG[REGx] = '0').

#### 13.4.7.2 One-Shot Load Mode

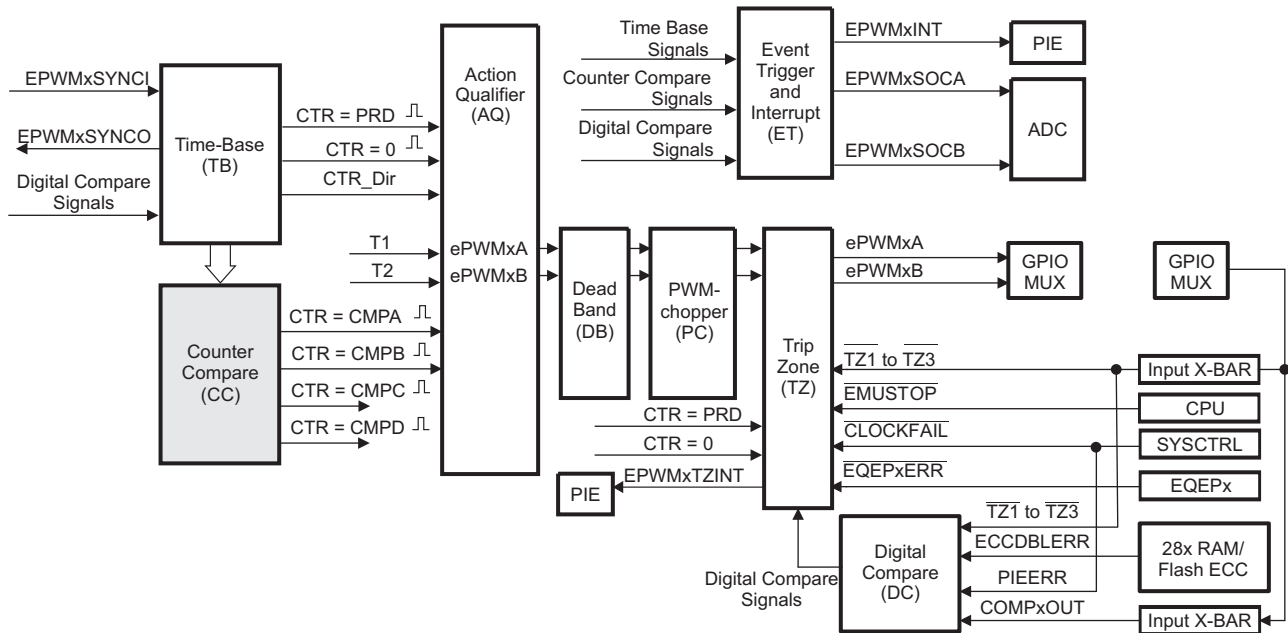
This feature allows users to cause the shadow register to active register transfers to occur once. When GLDCTL2[OSHTLD] = '1' the shadow to active register transfer, for registers that are configured to use the global load mechanism, takes place on the event selected by GLDCTL[GLDMODE].

Software force loading of contents from shadow register to active register is possible by using GLDCTL2[GFRCLD]. The GLDCTL2 register can also be linked across multiple PWM modules by using EPWMXLINK[GLDCTL2LINK]. This, along with the one-shot load mode feature discussed above, provides a method to correctly update multiple PWM registers in one or more PWM modules at certain PWM events or, if desired, in the same clock cycle. This is very useful in variable frequency applications and/or multi-phase interleaved applications.

### 13.5 Counter-Compare (CC) Submodule

Figure 13-13 illustrates the counter-compare submodule within the ePWM.

Figure 13-13. Counter-Compare Submodule



#### 13.5.1 Purpose of the Counter-Compare Submodule

The counter-compare submodule takes as input the time-base counter value. This value is continuously compared to the counter-compare A (CMPA) counter-compare B (CMPB) counter-compare C (CMPC) and counter-compare D (CMPD) registers. When the time-base counter is equal to one of the compare registers, the counter-compare unit generates an appropriate event.

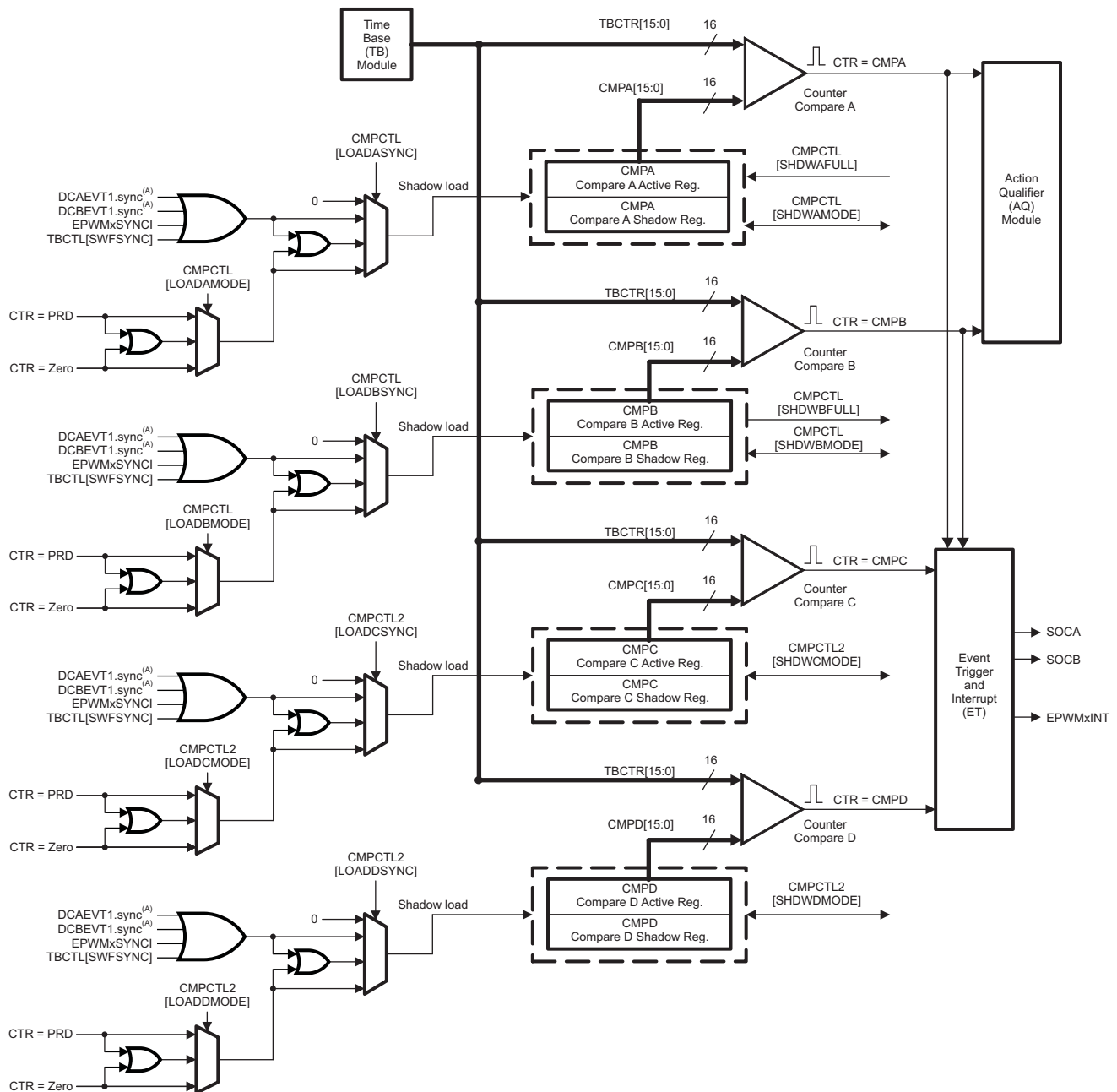
The counter-compare:

- Generates events based on programmable time stamps using the CMPA, CMPB, CMPC and CMPD registers
  - CTR = CMPA: Time-base counter equals counter-compare A register (TBCTR = CMPA).
  - CTR = CMPB: Time-base counter equals counter-compare B register (TBCTR = CMPB)
  - CTR = CMPC: Time-base counter equals counter-compare C register (TBCTR = CMPC).
  - CTR = CMPD: Time-base counter equals counter-compare D register (TBCTR = CMPD)
- Controls the PWM duty cycle if the action-qualifier submodule is configured appropriately using counter-compare A (CMPA) & counter-compare B (CMPB)
- Shadows new compare values to prevent corruption or glitches during the active PWM cycle

#### 13.5.2 Controlling and Monitoring the Counter-Compare Submodule

The counter-compare submodule operation is shown in Figure 13-14.

Figure 13-14. Detailed View of the Counter-Compare Submodule



A These events are generated by the type 4 ePWM digital compare (DC) submodule based on the levels of the TRIPIN inputs (for example, CMPSSx and TZ signals).

### 13.5.3 Operational Highlights for the Counter-Compare Submodule

The counter-compare submodule is responsible for generating two independent compare events based on two compare registers, which is fed to action-qualifier submodule and event trigger submodule :

1. CTR = CMPA: Time-base counter equal to counter-compare A register (TBCTR = CMPA).
2. CTR = CMPB: Time-base counter equal to counter-compare B register (TBCTR = CMPB).

For up-count or down-count mode, each event occurs only once per cycle. For up-down count mode each event occurs twice per cycle if the compare value is between 0x00-TBPRD and once per cycle if the compare value is equal to 0x00 or equal to TBPRD. These events are fed into the action-qualifier submodule where they are qualified by the counter direction and converted into actions if enabled. Refer to [Section 13.6.1](#) for more details.

The counter-compare registers CMPA and CMPB each have an associated shadow register. Shadowing provides a way to keep updates to the registers synchronized with the hardware. When shadowing is used, updates to the active registers only occur at strategic points. This prevents corruption or spurious operation due to the register being asynchronously modified by software. The memory address of the active register and the shadow register is identical. Which register is written to or read from is determined by the CMPCTL[SHDWAMODE] and CMPCTL[SHDWBMODE] bits. These bits enable and disable the CMPC shadow register and CMPB shadow register respectively. The behavior of the two load modes is described below:

#### **Shadow Mode:**

The shadow mode for the CMPA is enabled by clearing the CMPCTL[SHDWAMODE] bit and the shadow register for CMPB is enabled by clearing the CMPCTL[SHDWBMODE] bit. Shadow mode is enabled by default for both CMPA and CMPB.

If the shadow register is enabled then the content of the shadow register is transferred to the active register on one of the following events as specified by the CMPCTL[LOADAMODE] CMPCTL[LOADBMODE] CMPCTL[LOADASYNC] & CMPCTL[LOADBSYNC] register bits:

- CTR = PRD: Time-base counter equal to the period (TBCTR = TBPRD).
- CTR = Zero: Time-base counter equal to zero (TBCTR = 0x00)
- Both CTR = PRD and CTR = Zero
- SYNC event caused by DCAEVT1 or DCBEVT1 or EPWMxSYNCl or TBCTL[SWFSYNC]
- Both SYNC event or a selection made by LOADAMODE/LOADBMODE

Only the active register contents are used by the counter-compare submodule to generate events to be sent to the action-qualifier.

#### **Immediate Mode:**

If immediate load mode is selected (that is, CMPCTL[SHDWAMODE] = 1 or CMPCTL[SHDWBMODE] = 1), then a read from or a write to the register will go directly to the active register.

#### **Additional Comparators**

The counter-compare submodule on ePWMs type 2 and later are responsible for generating two additional independent compare events based on two compare registers, which is fed to Event Trigger submodule :

1. CTR = CMPC: Time-base counter equal to counter-compare C register (TBCTR = CMPC).
2. CTR = CMPD: Time-base counter equal to counter-compare D register (TBCTR = CMPD).

The counter-compare registers CMPC and CMPD each have an associated shadow register. By default this register is shadowed. The memory address of the active register and the shadow register is identical. The value in the active CMPC and CMPD register is compared to the time-base counter (TBCTR). When the values are equal, the counter compare module generates a “time-base counter equal to counter compare C or counter compare D ” event respectively. Shadowing of this register is enabled and disabled by the CMPCTL2[SHDWCMODE] and CMPCTL2[SHDWDMODE] bit. These bits enable and disable the CMPA shadow register and CMPB shadow register respectively. The behavior of the two load modes is described below:

#### **Shadow Mode:**

The shadow mode for the CMPC is enabled by clearing the CMPCTL2[SHDWCMODE] bit and the shadow register for CMPD is enabled by clearing the CMPCTL2[SHDWDMODE] bit. Shadow mode is enabled by default for both CMPC and CMPD.

If the shadow register is enabled then the content of the shadow register is transferred to the active register on one of the following events as specified by the CMPCTL2[LOADCMODE] CMPCTL2[LOADDMODE] CMPCTL2[LOADCSYNC] & CMPCTL2[LOADDSYNC] register bits:

- CTR = PRD: Time-base counter equal to the period (TBCTR = TBPRD).
- CTR = Zero: Time-base counter equal to zero (TBCTR = 0x00)
- Both CTR = PRD and CTR = Zero
- SYNC event caused by DCAEVT1 or DCBEVT1 or EPWMxSYNCl or TBCTL[SWFSYNC]
- Both SYNC event or a selection made by LOADCMODE/LOADDMODE

Only the active register contents are used by the counter-compare submodule to generate events to be sent to the action-qualifier.

#### Immediate Load Mode:

If the immediate load mode is selected (that is, CMPCTL2[SHDWCMODE] = 1 or CMPCTL2[SHDWDMODE] = 1), then a read from or a write to the register will go directly to the active register.

#### Global Load Support

The global load control mechanism can also be used for all counter-compare registers by configuring the appropriate bits in the global load configuration register (GLDCFG). When the global load mode is selected the transfer of contents from shadow register to active register, for all registers that have this mode enabled, occurs at the same event as defined by the configuration bits in the Global Shadow to Active Load Control Register (GLDCTL). The global load control mechanism is explained in [Section 13.4.7](#).

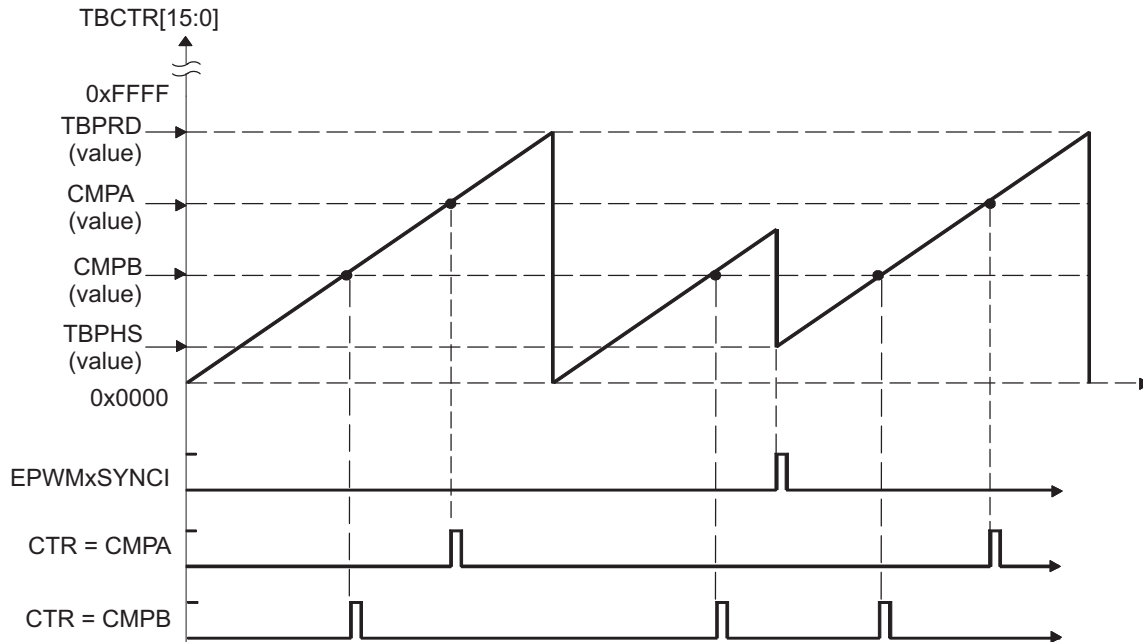
### 13.5.4 Count Mode Timing Waveforms

The counter-compare module can generate compare events in all three count modes:

- Up-count mode: used to generate an asymmetrical PWM waveform.
- Down-count mode: used to generate an asymmetrical PWM waveform.
- Up-down-count mode: used to generate a symmetrical PWM waveform.

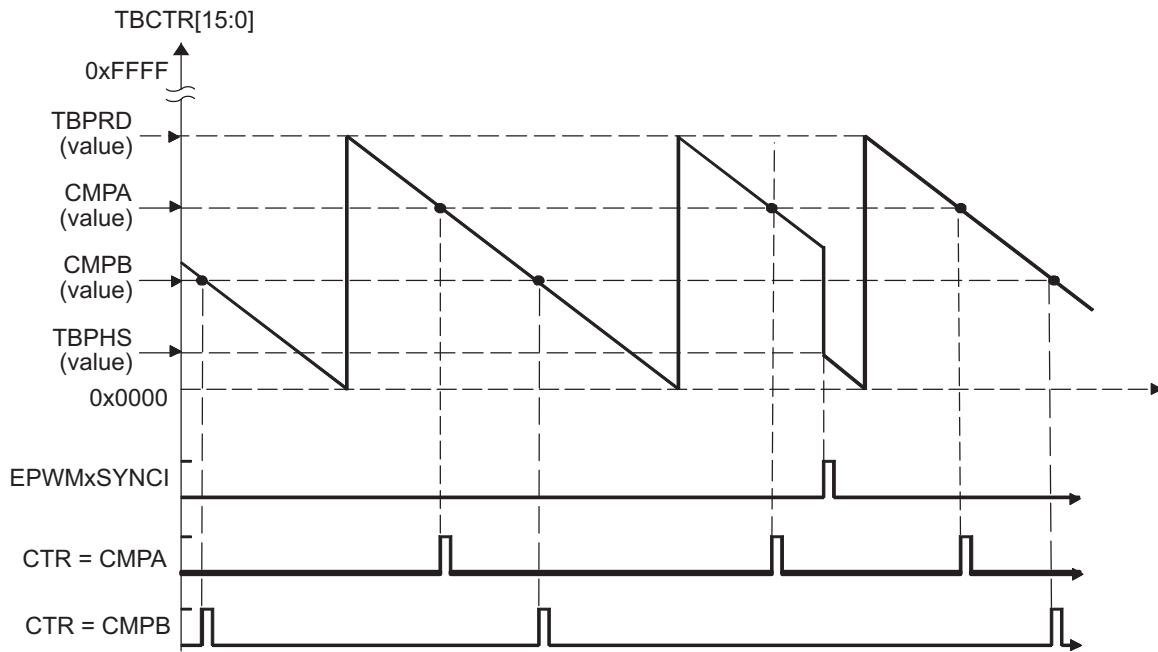
To best illustrate the operation of the first three modes, the timing diagrams in [Figure 13-15](#) through [Figure 13-18](#) show when events are generated and how the EPWMxSYNCl signal interacts.

Figure 13-15. Counter-Compare Event Waveforms in Up-Count Mode



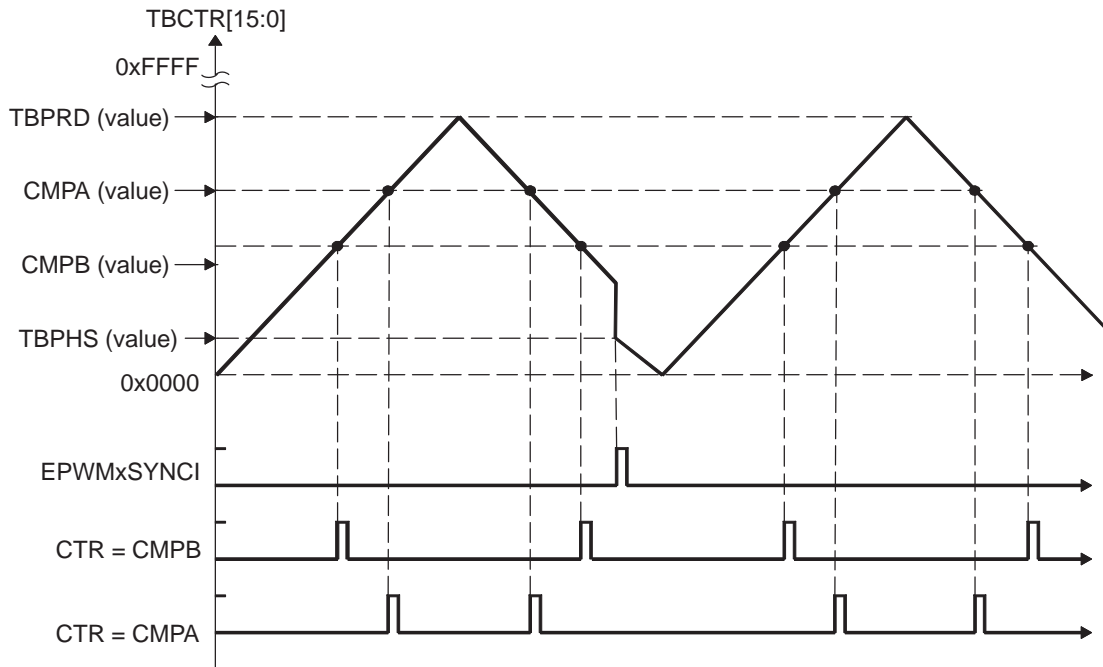
NOTE: An EPWMxSYNCl external synchronization event can cause a discontinuity in the TBCTR count sequence. This can lead to a compare event being skipped. This skipping is considered normal operation and must be taken into account.

Figure 13-16. Counter-Compare Events in Down-Count Mode

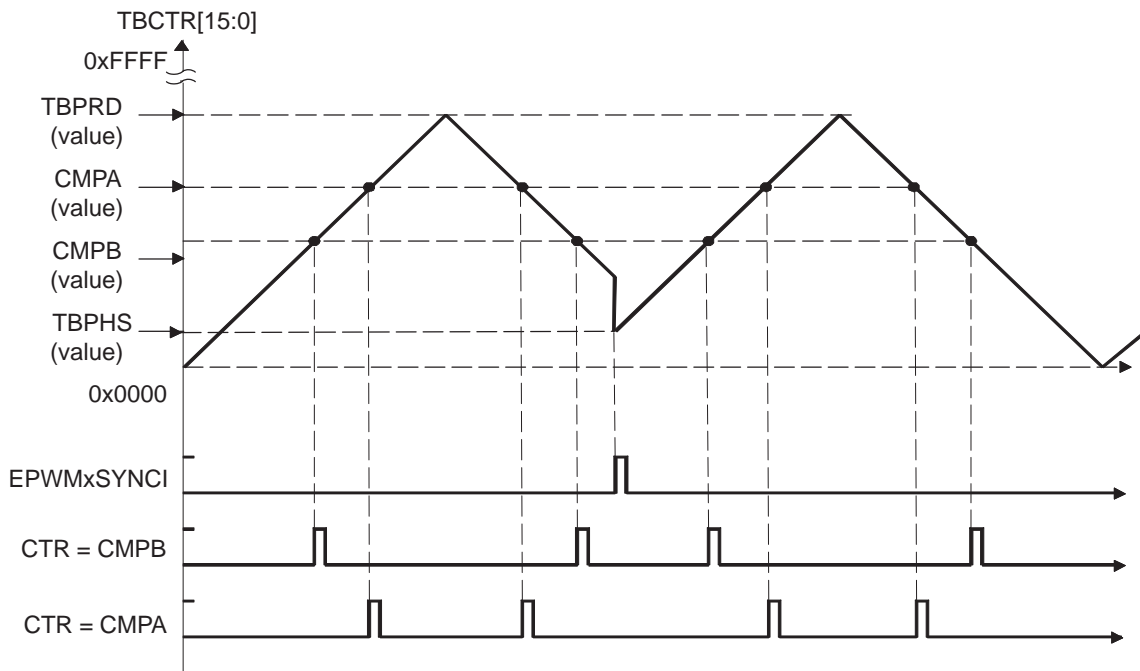




**Figure 13-17. Counter-Compare Events In Up-Down-Count Mode, TBCTL[PHSDIR = 0] Count Down On Synchronization Event**

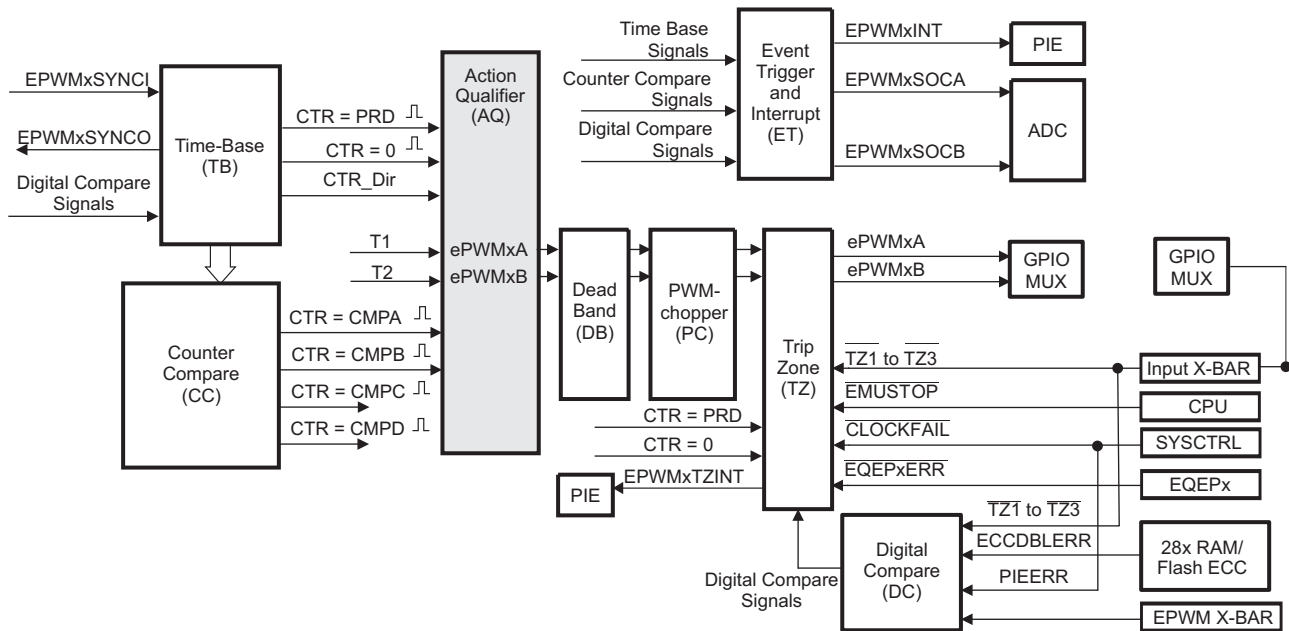


**Figure 13-18. Counter-Compare Events In Up-Down-Count Mode, TBCTL[PHSDIR = 1] Count Up On Synchronization Event**



### 13.6 Action-Qualifier (AQ) Submodule

Figure 13-19 shows the action-qualifier (AQ) submodule in the ePWM system.

**Figure 13-19. Action-Qualifier Submodule**


The action-qualifier submodule has the most important role in waveform construction and PWM generation. It decides which events are converted into various action types, thereby producing the required switched waveforms at the EPWMxA and EPWMxB outputs.

### 13.6.1 Purpose of the Action-Qualifier Submodule

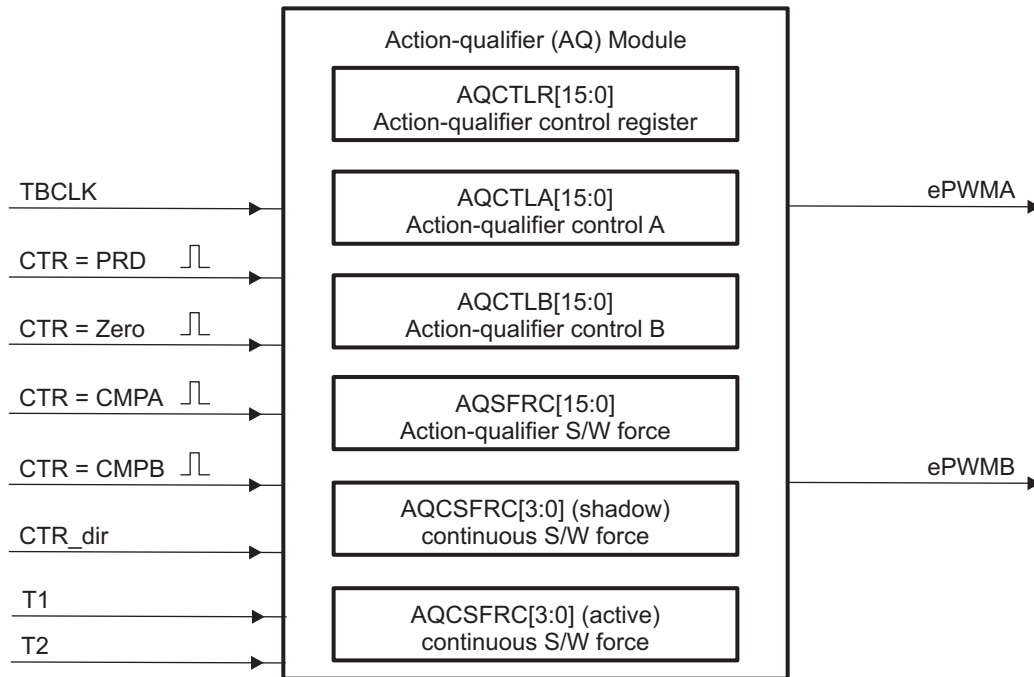
The action-qualifier submodule is responsible for the following:

- Qualifying and generating actions (set, clear, toggle) based on the following events:
  - CTR = PRD: Time-base counter equal to the period (TBCTR = TBPRD).
  - CTR = Zero: Time-base counter equal to zero (TBCTR = 0x00)
  - CTR = CMPA: Time-base counter equal to the counter-compare A register (TBCTR = CMPA)
  - CTR = CMPB: Time-base counter equal to the counter-compare B register (TBCTR = CMPB)
- T1, T2 events: Trigger events based on comparator, trip or syncin events
- Managing priority when these events occur concurrently
- Providing independent control of events when the time-base counter is increasing and when it is decreasing

### 13.6.2 Action-Qualifier Submodule Control and Status Register Definitions

The action-qualifier submodule operation is shown in [Figure 13-20](#) rolled and monitored via the registers in [Section 13.14](#).

Figure 13-20. Action-Qualifier Submodule Inputs and Outputs



For convenience, the possible input events are summarized again in [Table 13-3](#).

Table 13-3. Action-Qualifier Submodule Possible Input Events

Signal	Description	Registers Compared
CTR = PRD	Time-base counter equal to the period value	TBCTR = TBPRD
CTR = Zero	Time-base counter equal to zero	TBCTR = 0x00
CTR = CMPA	Time-base counter equal to the counter-compare A	TBCTR = CMPA
CTR = CMPB	Time-base counter equal to the counter-compare B	TBCTR = CMPB
T1 event	Based on comparator, trip or syncin events	None
T2 event	Based on comparator, trip or syncin events	None
Software forced event	Asynchronous event initiated by software	

The software forced action is a useful asynchronous event. This control is handled by the AQSFR and AQCSFRC registers.

The action-qualifier submodule controls how the two outputs EPWMxA and EPWMxB behave when a particular event occurs. The event inputs to the action-qualifier submodule are further qualified by the counter direction (up or down). This allows for independent action on outputs on both the count-up and count-down phases.

The possible actions imposed on outputs EPWMxA and EPWMxB are:





























- **Set High:**  
Set output EPWMxA or EPWMxB to a high level.
- **Clear Low:**  
Set output EPWMxA or EPWMxB to a low level.
- **Toggle:**  
If EPWMxA or EPWMxB is currently pulled high, then pull the output low. If EPWMxA or EPWMxB is currently pulled low, then pull the output high.
- **Do Nothing:**  
Keep outputs EPWMxA and EPWMxB at same level as currently set. Although the "Do Nothing" option

prevents an event from causing an action on the EPWMxA and EPWMxB outputs, this event can still trigger interrupts and ADC start of conversion. See the Event-trigger submodule description in [Section 13.10](#) for details.

Actions are specified independently for either output (EPWMxA or EPWMxB). Any or all events can be configured to generate actions on a given output. For example, both CTR = CMPA and CTR = CMPB can operate on output EPWMxA. All qualifier actions are configured via the control registers found at the end of this section.

For clarity, the drawings in this document use a set of symbolic actions. These symbols are summarized in [Figure 13-21](#). Each symbol represents an action as a marker in time. Some actions are fixed in time (zero and period) while the CMPA and CMPB actions are moveable and their time positions are programmed via the counter-compare A and B registers, respectively. To turn off or disable an action, use the "Do Nothing option"; it is the default at reset.

**Figure 13-21. Possible Action-Qualifier Actions for EPWMxA and EPWMxB Outputs**

SW force	TB Counter equals				Trigger Events		Actions
	Zero	Comp A	Comp B	Period	T1	T2	
							Do Nothing
							Clear Lo
							Set Hi
							Toggle

The Action Qualifier Trigger Event Source Selection register (AQTSRCSEL) is used to select the source for T1 and T2 events. T1/T2 selection and configuration of a trip/digital-compare event in Action Qualifier submodule is independent of the configuration of that event in the Trip-Zone submodule. A particular trip event may or may not be configured to cause trip action in the Trip Zone submodule, but the same event can be used by the Action Qualifier to generate T1/T2 for controlling PWM generation.

### 13.6.3 Action-Qualifier Event Priority

It is possible for the ePWM action qualifier to receive more than one event at the same time. In this case events are assigned a priority by the hardware. The general rule is events occurring later in time have a higher priority and software forced events always have the highest priority. The event priority levels for up-down-count mode are shown in [Table 13-4](#). A priority level of 1 is the highest priority and level 10 is the lowest. The priority changes slightly depending on the direction of TBCTR.

**Table 13-4. Action-Qualifier Event Priority for Up-Down-Count Mode**

Priority Level	Event If TBCTR is Incrementing TBCTR = Zero up to TBCTR = TBPRD	Event If TBCTR is Decrementing TBCTR = TBPRD down to TBCTR = 1
1 (Highest)	Software forced event	Software forced event
2	T1 on up-count (T1U)	T1 on down-count (T1D)
3	T2 on up-count (T2U)	T2 on down-count (T2D)
4	Counter equals CMPB on up-count (CBU)	Counter equals CMPB on down-count (CBD)
5	Counter equals CMPA on up-count (CAU)	Counter equals CMPA on down-count (CAD)
6	Counter equals zero	Counter equals period (TBPRD)
7	T1 on down-count (T1D)	T1 on up-count (T1U)
8	T2 on down-count (T2D)	T2 on up-count (T2U)
9	Counter equals CMPB on down-count (CBD)	Counter equals CMPB on up-count (CBU)
10 (Lowest)	Counter equals CMPA on down-count (CAD)	Counter equals CMPA on up-count (CAU)

[Table 13-5](#) shows the action-qualifier priority for up-count mode. In this case, the counter direction is always defined as up and thus down-count events will never be taken.

**Table 13-5. Action-Qualifier Event Priority for Up-Count Mode**

Priority Level	Event
1 (Highest)	Software forced event
2	Counter equal to period (TBPRD)
3	T1 on up-count (T1U)
4	T2 on up-count (T2U)
5	Counter equal to CMPB on up-count (CBU)
6	Counter equal to CMPA on up-count (CAU)
7 (Lowest)	Counter equal to Zero

[Table 13-6](#) shows the action-qualifier priority for down-count mode. In this case, the counter direction is always defined as down and thus up-count events will never be taken.

**Table 13-6. Action-Qualifier Event Priority for Down-Count Mode**

Priority Level	Event
1 (Highest)	Software forced event
2	Counter equal to Zero
3	T1 on down-count (T1D)
4	T2 on down-count (T2D)
5	Counter equal to CMPB on down-count (CBD)
6	Counter equal to CMPA on down-count (CAD)
7 (Lowest)	Counter equal to period (TBPRD)

It is possible to set the compare value greater than the period. In this case the action will take place as shown in [Table 13-7](#).

**Table 13-7. Behavior if CMPA/CMPB is Greater than the Period**

Counter Mode	Compare on Up-Count Event CAD/CBD	Compare on Down-Count Event CAD/CBD
Up-Count Mode	If $CMPA/CMPB \leq TBPRD$ period, then the event occurs on a compare match (TBCTR=CMPA or CMPB).  If $CMPA/CMPB > TBPRD$ , then the event will not occur.	Never occurs.
Down-Count Mode	Never occurs.	If $CMPA/CMPB < TBPRD$ , the event will occur on a compare match (TBCTR=CMPA or CMPB).  If $CMPA/CMPB \geq TBPRD$ , the event will occur on a period match (TBCTR=TBPRD).
Up-Down-Count Mode	If $CMPA/CMPB < TBPRD$ and the counter is incrementing, the event occurs on a compare match (TBCTR=CMPA or CMPB).  If $CMPA/CMPB \geq TBPRD$ , the event will occur on a period match (TBCTR = TBPRD).	If $CMPA/CMPB < TBPRD$ and the counter is decrementing, the event occurs on a compare match (TBCTR=CMPA or CMPB).  If $CMPA/CMPB \geq TBPRD$ , the event occurs on a period match (TBCTR=TBPRD).

### 13.6.4 AQCTLA and AQCTLB Shadow Mode Operations

To enable Action Qualifier mode changes which must occur at the end of a period even when the phase changes, shadowing of the AQCTLA and AQCTLB registers has been added on ePWMs type 2 and later. Additionally, shadow to active load on SYNC of these registers is supported as well. Shadowing of this register is enabled and disabled by the AQCTLR[SHDWAQAMODE] and AQCTLR[SHDWAQBMODE] bits. These bits enable and disable the AQCTLA shadow register and AQCTLB shadow register, respectively. The behavior of the two load modes is described below:

#### Shadow Mode:

The shadow mode for the AQCTLA is enabled by setting the AQCTLR[SHDWAQAMODE] bit, and the shadow register for AQCTLB is enabled by setting the AQCTLR[SHDWAQBMODE] bit. Shadow mode is disabled by default for both AQCTLA and AQCTLB

If the shadow register is enabled, then the content of the shadow register is transferred to the active register on one of the following events as specified by the AQCTLR[LDAQAMODE] AQCTLR[LDAQBMODE] AQCTLR[LDAQASYNC] & AQCTLR[LDAQBSYNC] register bits:

- CTR = PRD: Time-base counter equal to the period (TBCTR = TBPRD).
- CTR = Zero: Time-base counter equal to zero (TBCTR = 0x00)
- Both CTR = PRD and CTR = Zero
- SYNC event caused by DCAEVT1 or DCBEVT1 or EPWMxSYNCl or TBCTL[SWFSYNC]
- Both SYNC event or a selection made by LDAQAMODE/LDAQBMODE

#### Global Load Support

Global load control mechanism can also be used for AQCTLA:AQCTLA2, AQCTLB:AQCTLB2 and AQCSFRC registers by configuring the appropriate bits in the global load configuration register (GLDCFG). When global load mode is selected, the transfer of contents from shadow register to active register for all registers that have this mode enabled, occurs at the same event as defined by the configuration bits in the Global Shadow to Active Load Control Register (GLDCTL). The global load control mechanism is explained in [Section 13.4.7](#).

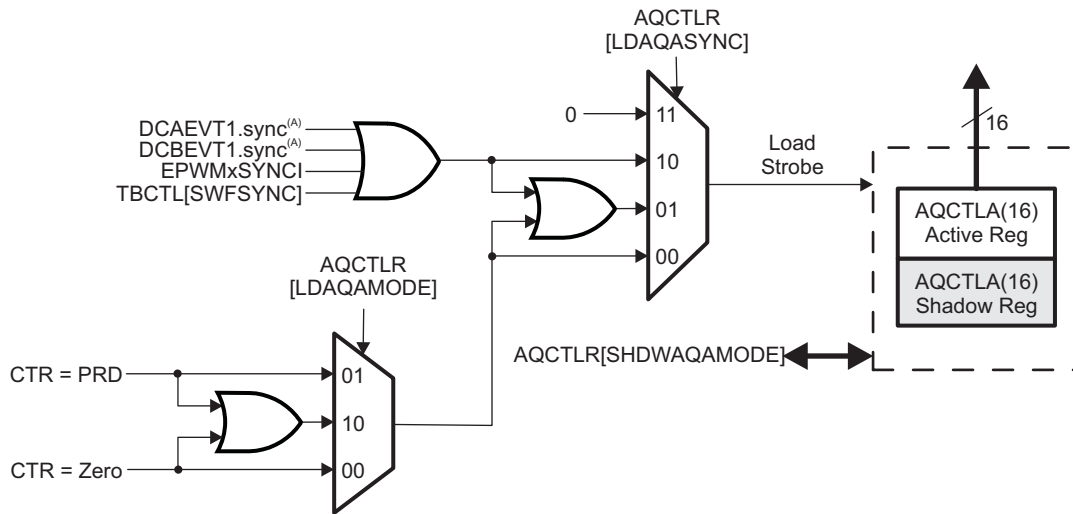
#### Immediate Load Mode:

If immediate load mode is selected (that is, AQCTLR[SHDWAQAMODE] = 0 or AQCTLR[SHDWAQBMODE] = 0), then a read from or a write to the register will go directly to the active register. See [Figure 13-22](#) and [Figure 13-23](#).

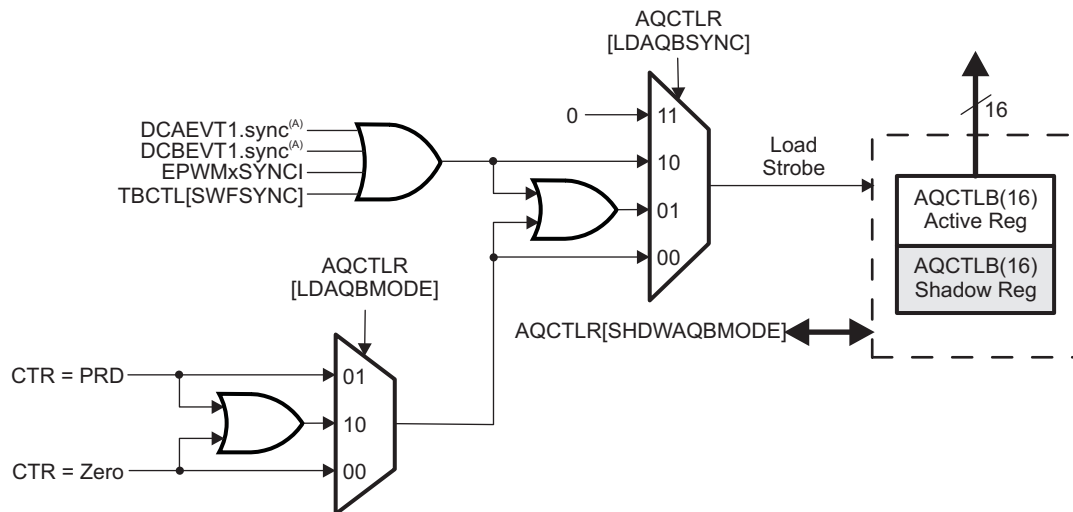
**NOTE:** Shadow to Active Load of Action Qualifier Output A/B Control Register [AQCTLA & AQCTLB] on CMPA = 0 or CMPB = 0 boundary

If the Counter-Compare A Register (CMPA) or Counter-Compare B Register (CMPB) is set to a value of 0 and the action qualifier action on AQCTLA and AQCTLB is configured to occur in the same instant as a shadow to active load (that is, CMPA=0 and AQCTLA shadow to active load on TBCTR=0 using AQCTLR register LDAQAMODE and LDAQAMODE bits), then both events enter contention and it is recommended to use a Non-Zero Counter-Compare when using Shadow to Active Load of Action Qualifier Output A/B Control Register on TBCTR = 0 boundary.

**Figure 13-22. AQCTLR[LDAQAMODE]**



**Figure 13-23. AQCTLR[SHDWAQBMODE]**



### 13.6.5 Waveforms for Common Configurations

**NOTE:** The waveforms in this document show the behavior of the ePWMs for a static compare register value. In a running system, the active compare registers (CMPA and CMPB) are typically updated from their respective shadow registers once every period. The user specifies when the update will take place; either when the time-base counter reaches zero or when the time-base counter reaches period. There are some cases when the action based on the new value can be delayed by one period or the action based on the old value can take effect for an extra period. Some PWM configurations avoid this situation. These include, but are not limited to, the following:

**Use up-down-count mode to generate a symmetric PWM:**

- If you load CMPA/CMPB on zero, then use CMPA/CMPB values greater than or equal to 1.
- If you load CMPA/CMPB on period, then use CMPA/CMPB values less than or equal to TBPRD-1.

This means there will always be a pulse of at least one TBCLK cycle in a PWM period which, when very short, tend to be ignored by the system.

**Use up-down-count mode to generate an asymmetric PWM:**

- To achieve 50%-0% asymmetric PWM use the following configuration: Load CMPA/CMPB on period and use the period action to clear the PWM and a compare-up action to set the PWM. Modulate the compare value from 0 to TBPRD to achieve 50%-0% PWM duty.

**When using up-count mode to generate an asymmetric PWM:**

- To achieve 0-100% asymmetric PWM use the following configuration: Load CMPA/CMPB on TBPRD. Use the Zero action to set the PWM and a compare-up action to clear the PWM. Modulate the compare value from 0 to TBPRD+1 to achieve 0-100% PWM duty.

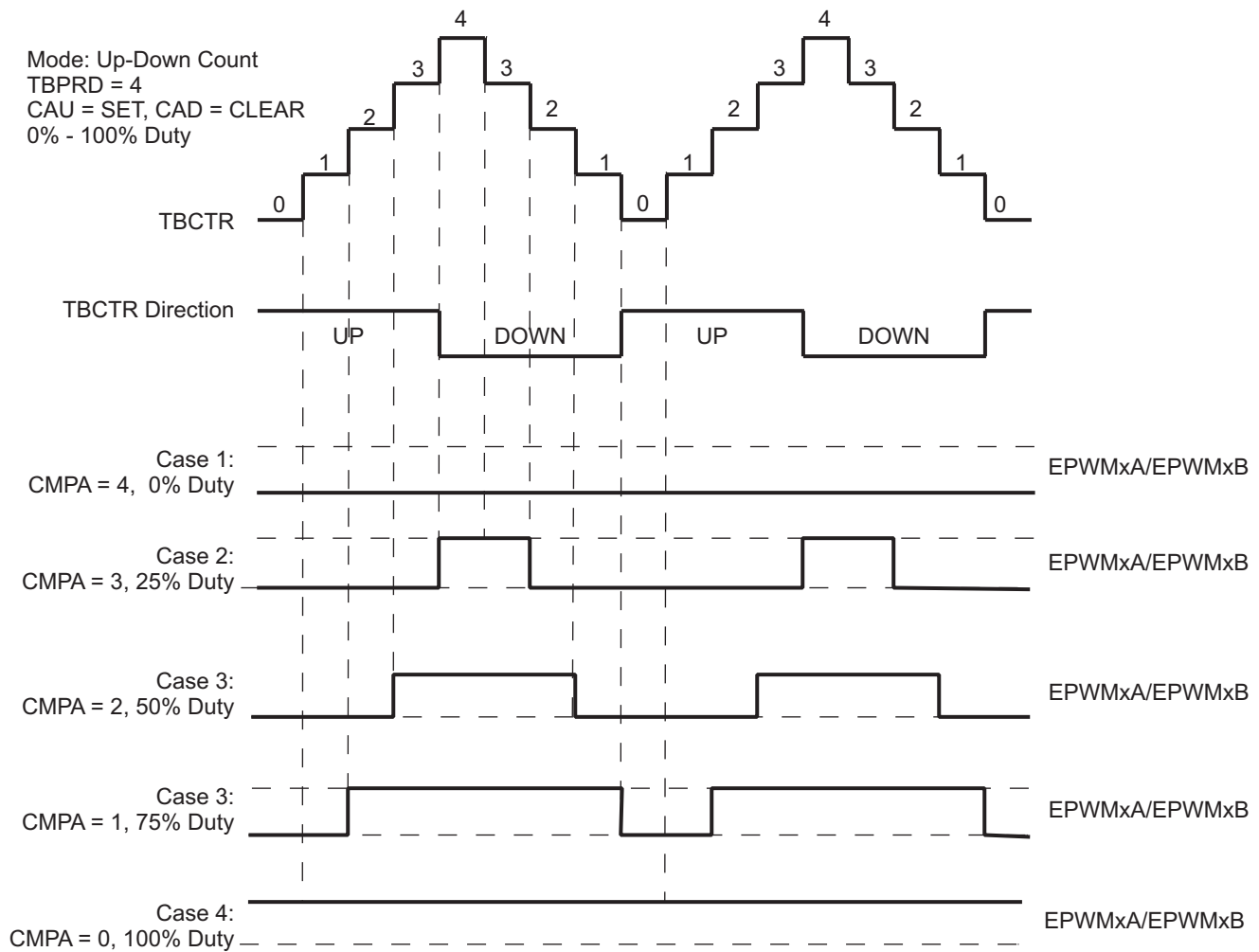
See the *Using Enhanced Pulse Width Modulator (ePWM) Module for 0-100% Duty Cycle Control Application Report* (literature number [SPRAA11](#))

[Figure 13-24](#) shows how a symmetric PWM waveform can be generated using the up-down-count mode of the TBCTR. In this mode, 0%-100% DC modulation is achieved by using equal compare matches on the up count and down count portions of the waveform. In the example shown, CMPA is used to make the comparison. When the counter is incrementing the CMPA match will pull the PWM output high. Likewise, when the counter is decrementing the compare match will pull the PWM signal low. When CMPA = 0, the PWM signal is low for the entire period giving the 0% duty waveform. When CMPA = TBPRD, the PWM signal is high achieving 100% duty.

When using this configuration in practice, if you load CMPA/CMPB on zero, then use CMPA/CMPB values greater than or equal to 1. If you load CMPA/CMPB on period, then use CMPA/CMPB values less than or equal to TBPRD-1. This means there will always be a pulse of at least one TBCLK cycle in a PWM period which, when very short, tend to be ignored by the system.

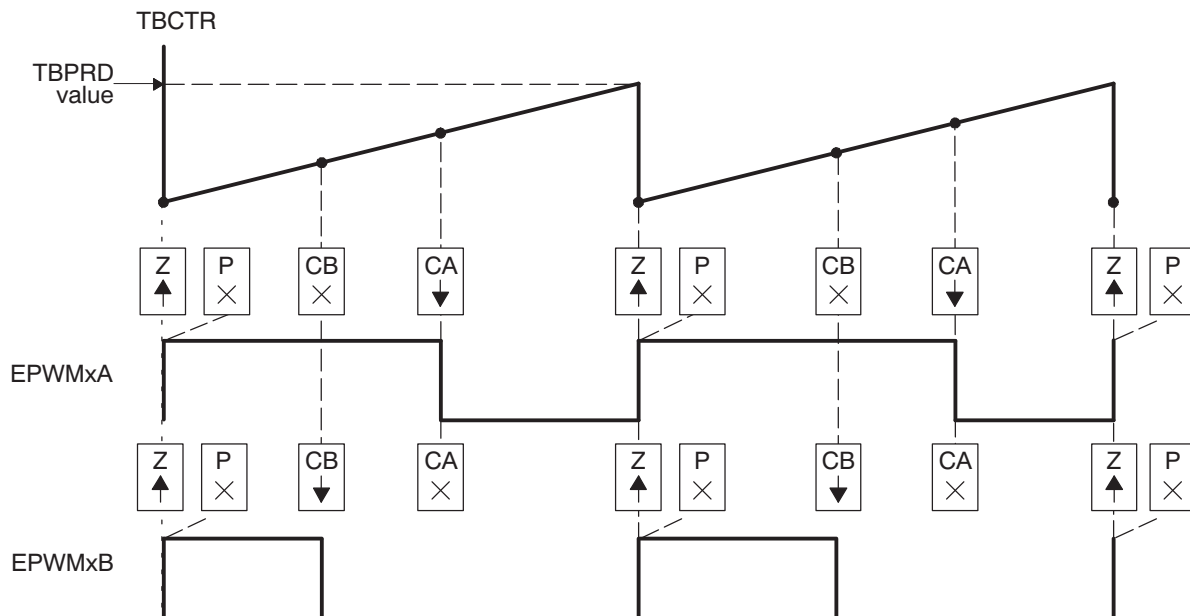


Figure 13-24. Up-Down-Count Mode Symmetrical Waveform



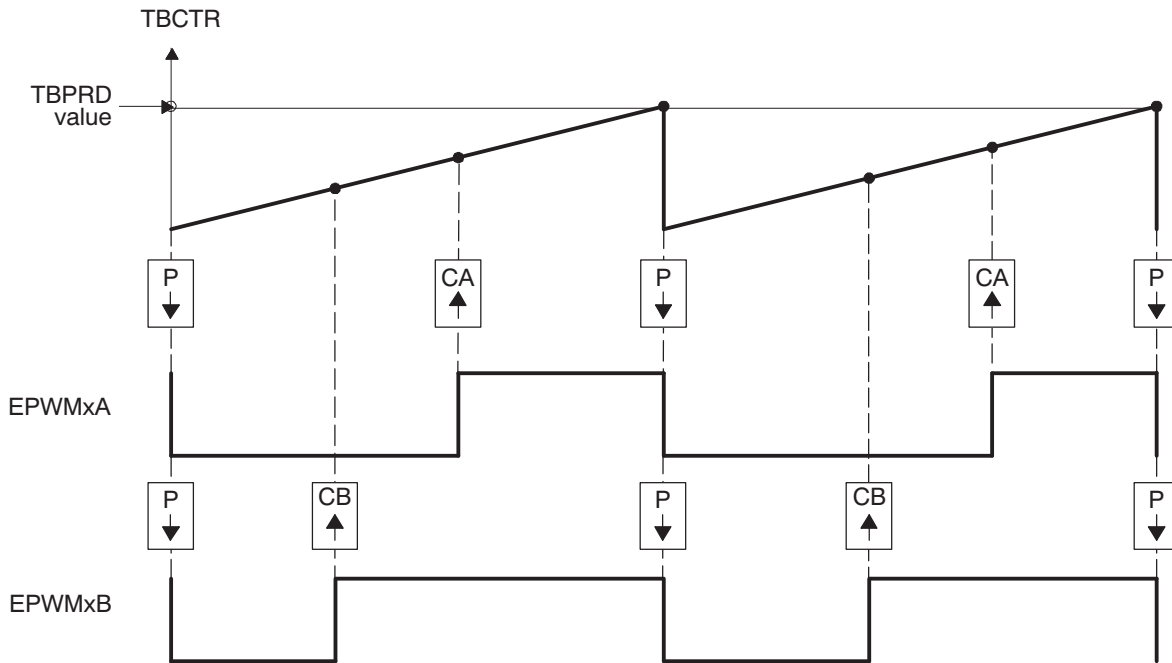
The PWM waveforms in [Figure 13-25](#) through [Figure 13-30](#) show some common action-qualifier configurations. Some conventions used in the figures and examples are as follows:

- TBPRD, CMPA, and CMPB refer to the value written in their respective registers. The active register, not the shadow register, is used by the hardware.
- CMPx, refers to either CMPA or CMPB.
- EPWMxA and EPWMxB refer to the output signals from ePWMx
- Up-Down means Count-up-and-down mode, Up means up-count mode and Dwn means down-count mode
- Sym = Symmetric, Asym = Asymmetric

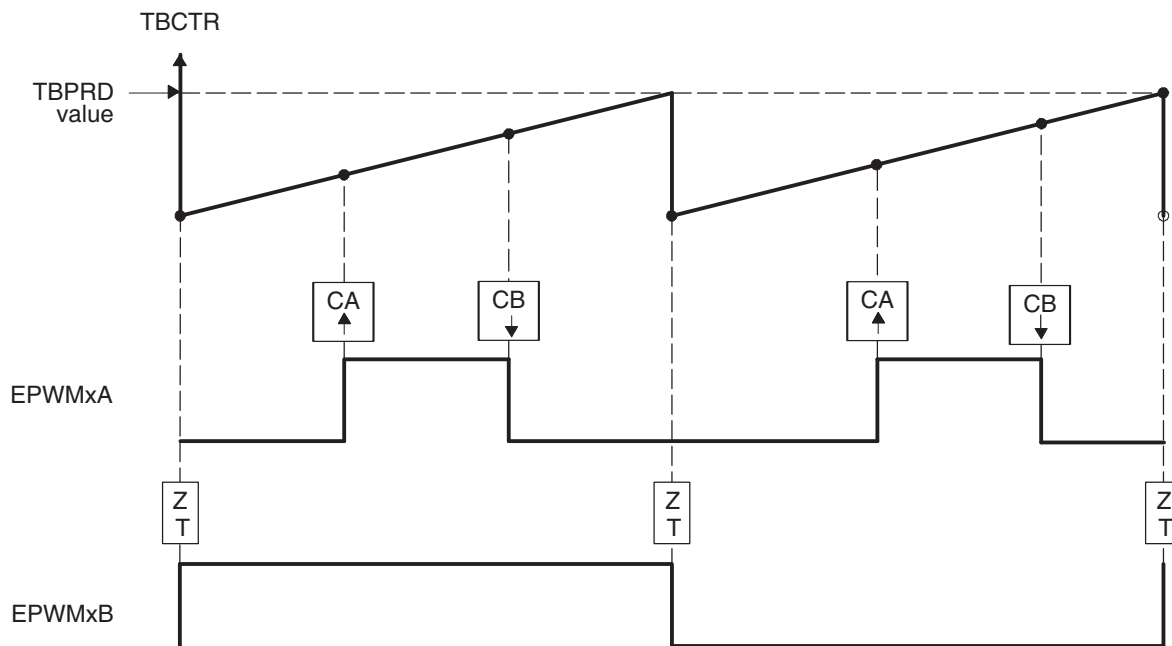
**Figure 13-25. Up, Single Edge Asymmetric Waveform, With Independent Modulation on EPWMxA and EPWMxB—Active High**


- A  $PWM\ period = (TBPRD + 1) \times T_{TBCLK}$
- B Duty modulation for EPWMxA is set by CMPA, and is active high (that is, high time duty proportional to CMPA).
- C Duty modulation for EPWMxB is set by CMPB and is active high (that is, high time duty proportional to CMPB).
- D The "Do Nothing" actions ( X ) are shown for completeness, but will not be shown on subsequent diagrams.
- E Actions at zero and period, although appearing to occur concurrently, are actually separated by one TBCLK period. TBCTR wraps from period to 0000.

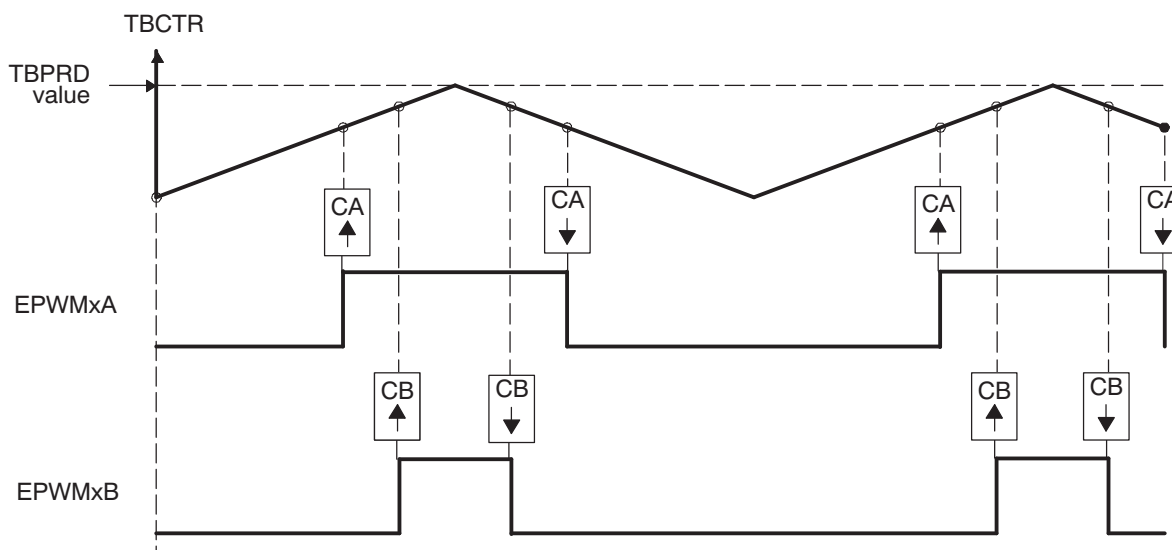
**Figure 13-26. Up, Single Edge Asymmetric Waveform With Independent Modulation on EPWMxA and EPWMxB—Active Low**



- A PWM period =  $(TBPRD + 1) \times T_{TBCLK}$
- B Duty modulation for EPWMxA is set by CMPA, and is active low (that is, the low time duty is proportional to CMPA).
- C Duty modulation for EPWMxB is set by CMPB and is active low (that is, the low time duty is proportional to CMPB).
- D Actions at zero and period, although appearing to occur concurrently, are actually separated by one TBCLK period. TBCTR wraps from period to 0000.

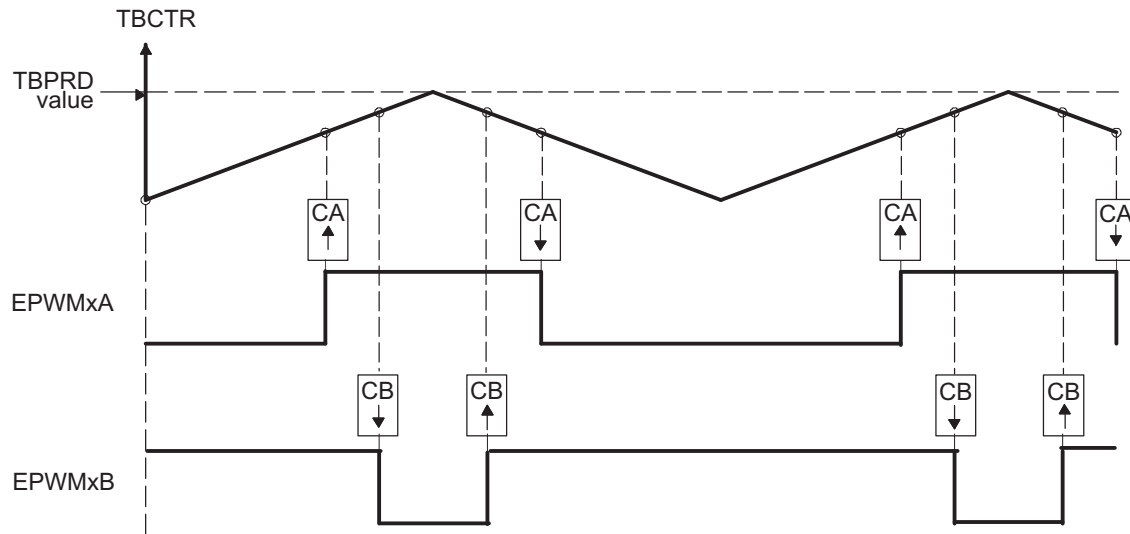
**Figure 13-27. Up-Count, Pulse Placement Asymmetric Waveform With Independent Modulation on EPWMxA**


- A  $\text{PWM frequency} = 1 / ((\text{TBPRD} + 1) \times T_{\text{TBCLK}})$
- B Pulse can be placed anywhere within the PWM cycle (0000 - TBPRD)
- C High time duty proportional to (CMPB - CMPA)

**Figure 13-28. Up-Down-Count, Dual Edge Symmetric Waveform, With Independent Modulation on EPWMxA and EPWMxB — Active Low**


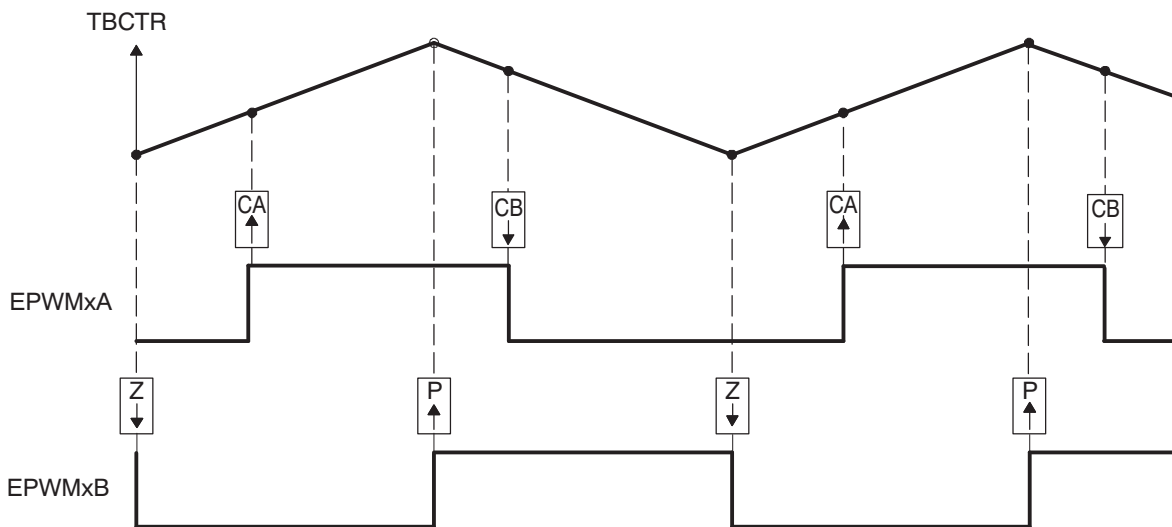
- A  $\text{PWM period} = 2 \times \text{TBPRD} \times T_{\text{TBCLK}}$
- B Duty modulation for EPWMxA is set by CMPA, and is active low (that is, the low time duty is proportional to CMPA).
- C Duty modulation for EPWMxB is set by CMPB and is active low (that is, the low time duty is proportional to CMPB).
- D Outputs EPWMxA and EPWMxB can drive independent power switches.

**Figure 13-29. Up-Down-Count, Dual Edge Symmetric Waveform, With Independent Modulation on EPWMxA and EPWMxB — Complementary**



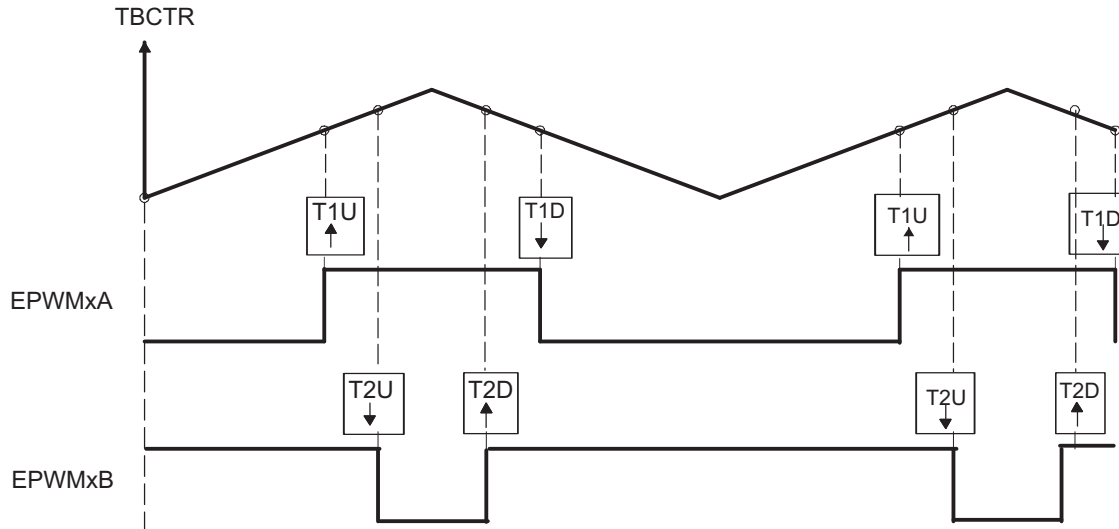
- A PWM period =  $2 \times \text{TBPRD} \times T_{\text{TBCLK}}$
- B Duty modulation for EPWMxA is set by CMPA, and is active low, that is, low time duty proportional to CMPA.
- C Duty modulation for EPWMxB is set by CMPB and is active high, that is, high time duty proportional to CMPB.
- D Outputs EPWMx can drive upper/lower (complementary) power switches.
- E Dead-band =  $\text{CMPB} - \text{CMPA}$  (fully programmable edge placement by software). Note the dead-band module is also available if the more classical edge delay method is required.

**Figure 13-30. Up-Down-Count, Dual Edge Asymmetric Waveform, With Independent Modulation on EPWMxA—Active Low**



- A PWM period =  $2 \times \text{TBPRD} \times \text{TBCLK}$
- B Rising edge and falling edge can be asymmetrically positioned within a PWM cycle. This allows for pulse placement techniques.
- C Duty modulation for EPWMxA is set by CMPA and CMPB.
- D Low time duty for EPWMxA is proportional to  $(\text{CMPA} + \text{CMPB})$ .
- E To change this example to active high, CMPA and CMPB actions need to be inverted (that is, Clear on CMPA, Set on CMPB).
- F Duty modulation for EPWMxB is fixed at 50% (utilizes spare action resources for EPWMxB).

Figure 13-31. Up-Down-Count, PWM Waveform Generation Utilizing T1 and T2 Events

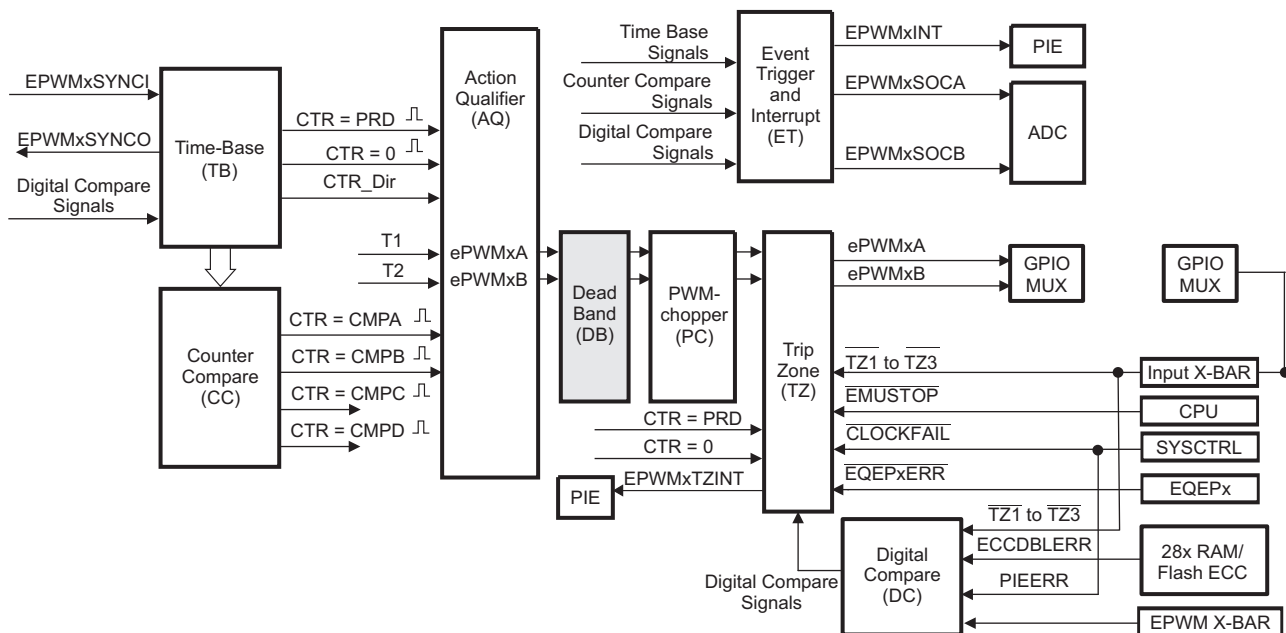


- A PWM period =  $2 \times TBPRD \times TTCLK$
- B Independent T1 event actions when counter is counting up and when it is counting down are used to generate EPWMxA output.
- C Independent T2 event actions when counter is counting up and when it is counting down are used to generate EPWMxB output.
- D TZ1 is selected as the source for T1.
- E TZ2 is selected as the source for T2.

### 13.7 Dead-Band Generator (DB) Submodule

Figure 13-32 illustrates the dead-band submodule within the ePWM module.

Figure 13-32. Dead\_Band Submodule



### 13.7.1 Purpose of the Dead-Band Submodule

The action-qualifier (AQ) module section discussed how it is possible to generate the required dead band by having full control over edge placement using both the CMPA and CMPB resources of the ePWM module. However, if the more classical edge delay-based dead band with polarity control is required, then the dead-band submodule described here should be used.

The key functions of the dead-band module are:

- Generating appropriate signal pairs (EPWMxA and EPWMxB) with dead-band relationship from a single EPWMxA input
- Programming signal pairs for:
  - Active high (AH)
  - Active low (AL)
  - Active high complementary (AHC)
  - Active low complementary (ALC)
- Adding programmable delay to rising edges (RED)
- Adding programmable delay to falling edges (FED)
- Can be totally bypassed from the signal path (note dotted lines in diagram)

### 13.7.2 Dead-band Submodule Additional Operating Modes

On type 1 ePWM RED could appear on one channel output and FED could appear on the other channel output.

The following list shows the distinct difference between type 1 and type 4 modules with respect to dead-band operating modes:

- By adding S6, S7, and S8 in [Figure 13-33](#), RED and FED can appear on both the A-channel and B-channel outputs. Additionally, both RED and FED together can be applied to either the A-channel or B-channel outputs to allow B-channel phase shifting with respect to the A-channel.  
**Note:** Phase shifting B-channel with respect to the A-channel using the dead-band submodule additional operating modes has limitations with respect to the choice of RED and FED delay with respect to the operating duty cycle of the ePWMxA and ePWMxB outputs.
- The dead-band counters have also been increased to 14 bits
- Dead-band and dead-band High-resolution registers are now shadowed.
- High-resolution dead-band RED and FED have been enabled using the DBREDHR and DBFEDHR registers

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**NOTE:** The PWM chopper will not be enabled when high-resolution dead band is enabled.

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**NOTE:** High-resolution dead-band RED and FED requires Half-Cycle clocking mode (DBCTL[HALFCYCLE] = 1).

Cannot have both RED and FED together applied to both ePWMxA and ePWMxB. RED and FED together can be applied only to either OutA OR OutB.

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**NOTE:** Phase shifting B-channel with respect to the A-channel: When PWMxB is derived from PWMxA using the DEDB\_MODE bit and by delaying rising edge and falling edge by the phase shift amount. When the duty cycle value on PWMxA is less than this phase shift amount, PWMxA's falling edge has precedence over the delayed rising edge for PWMxB. It is recommended to make sure the duty cycle value of the current waveform fed to the dead-band module is greater than the required phase shift amount.

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#### Shadow Mode:

The shadow mode for the DBRED is enabled by setting the DBCTL[SHDWDBREDDMODE] bit and the shadow register for DBFED is enabled by setting the DBCTL [SHDWDBFEDMODE] bit. Shadow mode is disabled by default for both DBRED and DBFED

If the shadow register is enabled, then the content of the shadow register is transferred to the active register on one of the following events as specified by the DBCTL [LOADREDDMODE] & DBCTL [LOADFEDMODE] register bits:

- CTR = PRD: Time-base counter equal to the period (TBCTR = TBPRD).
- CTR = Zero: Time-base counter equal to zero (TBCTR = 0x00)
- Both CTR = PRD and CTR = Zero

The DBCTL register can be shadowed. The shadow mode for DBCTL is enabled by setting the DBCTL2[SHDWDBCTLMODE] bit. If the shadow register is enabled then the content of the shadow register is transferred to the active register on one of the following events as specified by the DBCTL2[LOADDBCTLMODE] register bit:

- CTR = PRD: Time-base counter equal to the period (TBCTR = TBPRD)
- CTR = Zero: Time-base counter equal to zero (TBCTR = 0x00)
- Both CTR = PRD and CTR = Zero

### **Global Load Support**

Global load control mechanism can also be used for DBRED:DBREDHR, DBFED:DBFEDHR and DBCTL registers by configuring the appropriate bits in the global load configuration register (GLDCFG). When global load mode is selected the transfer of contents from shadow register to active register, for all registers that have this mode enabled, occurs at the same event as defined by the configuration bits in the Global Shadow to Active Load Control Register (GLDCTL). The global load control mechanism is explained in [Section 13.4.7](#).

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**NOTE:** When DBRED/DBFED active is loaded with a new shadow value while DB counters are counting, the new DBRED / DBFED value only affects the NEXT PWMx edge and not the current edge.

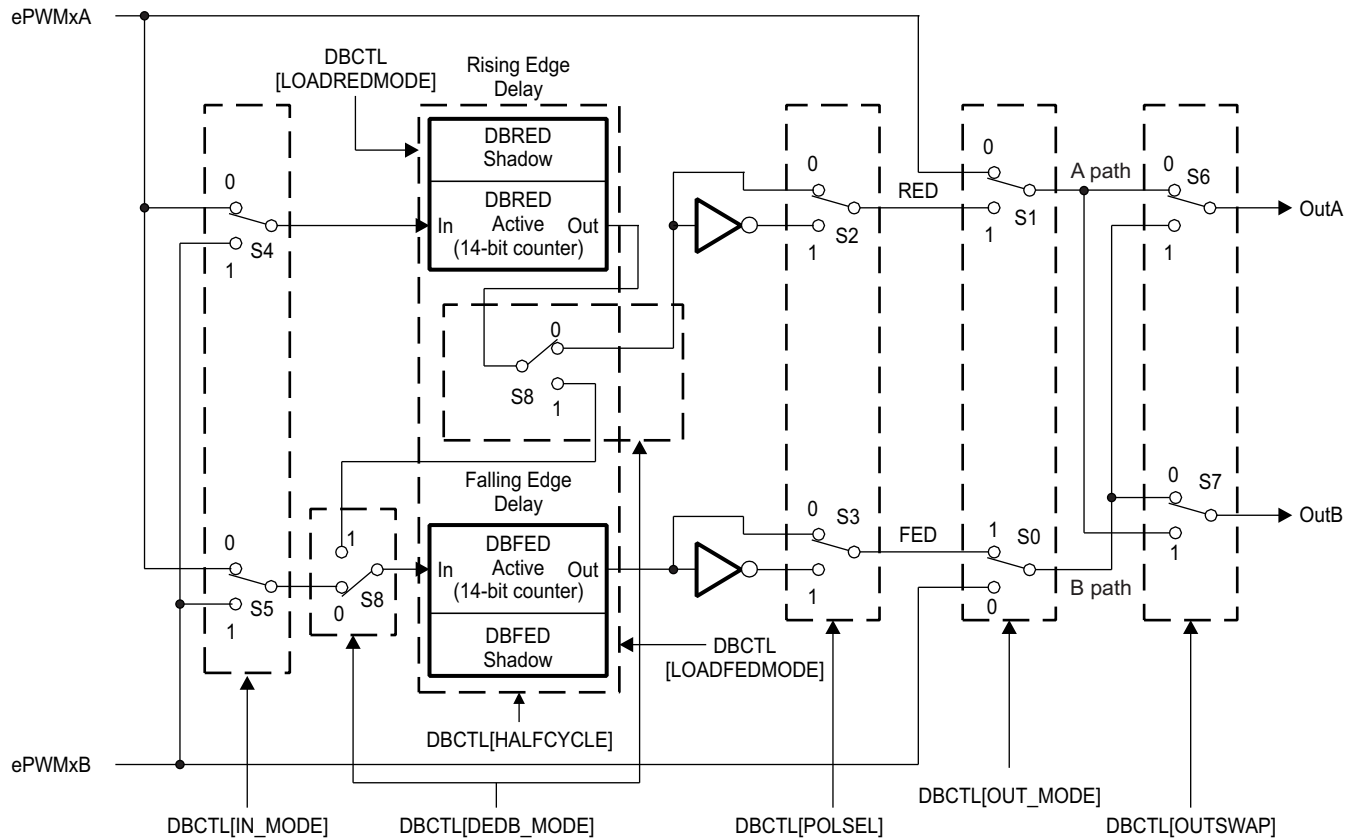
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### **13.7.3 Operational Highlights for the Dead-Band Submodule**

The configuration options for the dead-band submodule are shown in [Figure 13-33](#).



Figure 13-33. Configuration Options for the Dead-Band Submodule



Although all combinations are supported, not all are typical usage modes. Table 13-8 documents some classical dead-band configurations. These modes assume that the DBCTL[IN\_MODE] is configured such that EPWMxA In is the source for both falling-edge and rising-edge delay. Enhanced, or non-traditional modes can be achieved by changing the input signal source. The modes shown in Table 13-8 fall into the following categories:

- **Mode 1: Bypass both falling-edge delay (FED) and rising-edge delay (RED)**  
Allows you to fully disable the dead-band submodule from the PWM signal path.
- **Mode 2-5: Classical Dead-Band Polarity Settings:**  
These represent typical polarity configurations that should address all the active high/low modes required by available industry power switch gate drivers. The waveforms for these typical cases are shown in Figure 13-34. Note that to generate equivalent waveforms to Figure 13-34, configure the action-qualifier submodule to generate the signal as shown for EPWMxA.
- **Mode 6: Bypass rising-edge-delay and Mode 7: Bypass falling-edge-delay**  
Finally the last two entries in Table 13-8 show combinations where either the falling-edge-delay (FED) or rising-edge-delay (RED) blocks are bypassed.

**Table 13-8. Classical Dead-Band Operating Modes**

Mode	Mode Description	DBCTL[POLSEL]		DBCTL[OUT_MODE]	
		S3	S2	S1	S0
1	EPWMxA and EPWMxB Passed Through (No Delay)	X	X	0	0
2	Active High Complementary (AHC)	1	0	1	1
3	Active Low Complementary (ALC)	0	1	1	1
4	Active High (AH)	0	0	1	1
5	Active Low (AL)	1	1	1	1
6	EPWMxA Out = EPWMxA In (No Delay)	0 or 1	0 or 1	0	1
	EPWMxB Out = EPWMxA In with Falling Edge Delay				
7	EPWMxA Out = EPWMxA In with Rising Edge Delay	0 or 1	0 or 1	1	0
	EPWMxB Out = EPWMxB In with No Delay				

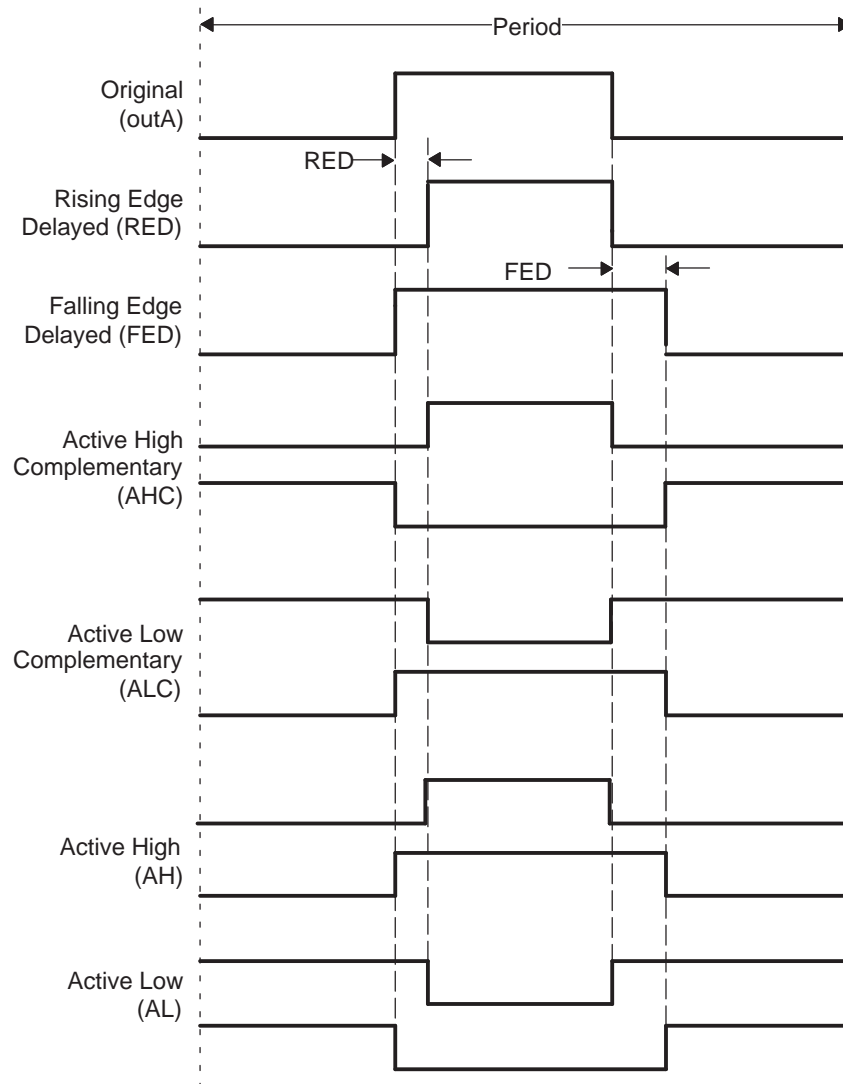
**Table 13-9. Additional Dead-Band Operating Modes**

Mode Description	DBCTL[DEDB-MODE]	DBCTL[OUTSWAP]	
	S8	S6	S7
EPWMxA and EPWMxB signals are as defined by OUT-MODE bits.	0	0	0
EPWMxA = A-path as defined by OUT-MODE bits. EPWMxB = A-path as defined by OUT-MODE bits (rising edge delay or delay-bypassed A-signal path)	0	0	1
EPWMxA = B-path as defined by OUT-MODE bits (falling edge delay or delay-bypassed B-signal path) EPWMxB = B-path as defined by OUT-MODE bits	0	1	0
EPWMxA = B-path as defined by OUT-MODE bits (falling edge delay or delay-bypassed B-signal path) EPWMxB = A-path as defined by OUT-MODE bits (rising edge delay or delay-bypassed A-signal path)	0	1	1
Rising edge delay applied to EPWMxA / EPWMxB as selected by S4 switch (IN-MODE bits) on A signal path only. Falling edge delay applied to EPWMxA / EPWMxB as selected by S5 switch (IN-MODE bits) on B signal path only.	0	X	X
Rising edge delay and falling edge delay applied to source selected by S4 switch (IN-MODE bits) and output to B signal path only. <sup>(1)</sup>	1	X	X

<sup>(1)</sup> When this bit is set to 1, user should always either set OUT\_MODE bits such that Apath = InA **or** OUTSWAP bits such that EPWMxA=Bpath. Otherwise, EPWMxA will be invalid.

Figure 13-34 shows waveforms for typical cases where  $0\% < \text{duty} < 100\%$ .

**Figure 13-34. Dead-Band Waveforms for Typical Cases ( $0\% < \text{Duty} < 100\%$ )**



The dead-band submodule supports independent values for rising-edge (RED) and falling-edge (FED) delays. The amount of delay is programmed using the DBRED and DBFED registers. These are 10-bit registers and their value represents the number of time-base clock (TBCLK) periods by which a signal edge is delayed. For example, the formula to calculate falling-edge-delay and rising-edge-delay is:

$$\begin{aligned} \text{FED} &= \text{DBFED} \times T_{\text{TBCLK}} \\ \text{RED} &= \text{DBRED} \times T_{\text{TBCLK}} \end{aligned}$$

Where  $T_{\text{TBCLK}}$  is the period of TBCLK, the prescaled version of EPWMCLK.

For convenience, delay values for various TBCLK options are shown in [Table 13-10](#). The ePWM input clock frequency that these delay values have been computed by is 100 MHz.

**Table 13-10. Dead-Band Delay Values in  $\mu\text{S}$  as a Function of DBFED and DBRED**

Dead-Band Value DBFED, DBRED	Dead-Band Delay in $\mu\text{S}$		
	TBCLK = EPWMCLK/1	TBCLK = EPWMCLK /2	TBCLK = EPWMCLK/4
1	0.01	0.02	0.04
5	0.05	0.1	0.2
10	0.1	0.2	0.4
100	1	2	4
200	2	4	8
400	4	8	16
500	5	10	20
600	6	12	24
700	7	14	28
800	8	16	32
900	9	18	36
1000	10	20	40

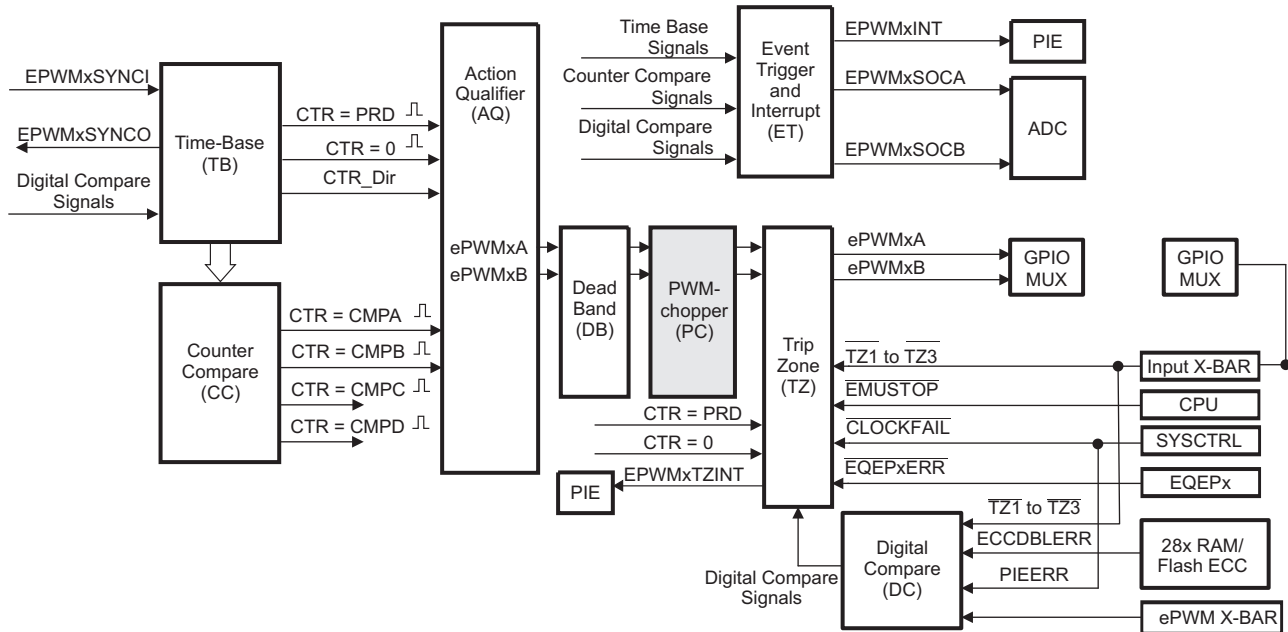
When half-cycle clocking is enabled, the formula to calculate the falling-edge-delay and rising-edge-delay becomes:

$$\begin{aligned} \text{FED} &= \text{DBFED} \times T_{\text{TBCLK}}/2 \\ \text{RED} &= \text{DBRED} \times T_{\text{TBCLK}}/2 \end{aligned}$$

### 13.8 PWM Chopper (PC) Submodule

Figure 13-35 illustrates the PWM chopper (PC) submodule within the ePWM module.

Figure 13-35. PWM Chopper Submodule



The PWM chopper submodule allows a high-frequency carrier signal to modulate the PWM waveform generated by the action-qualifier and dead-band submodules. This capability is important if you need pulse transformer-based gate drivers to control the power switching elements.

#### 13.8.1 Purpose of the PWM Chopper Submodule

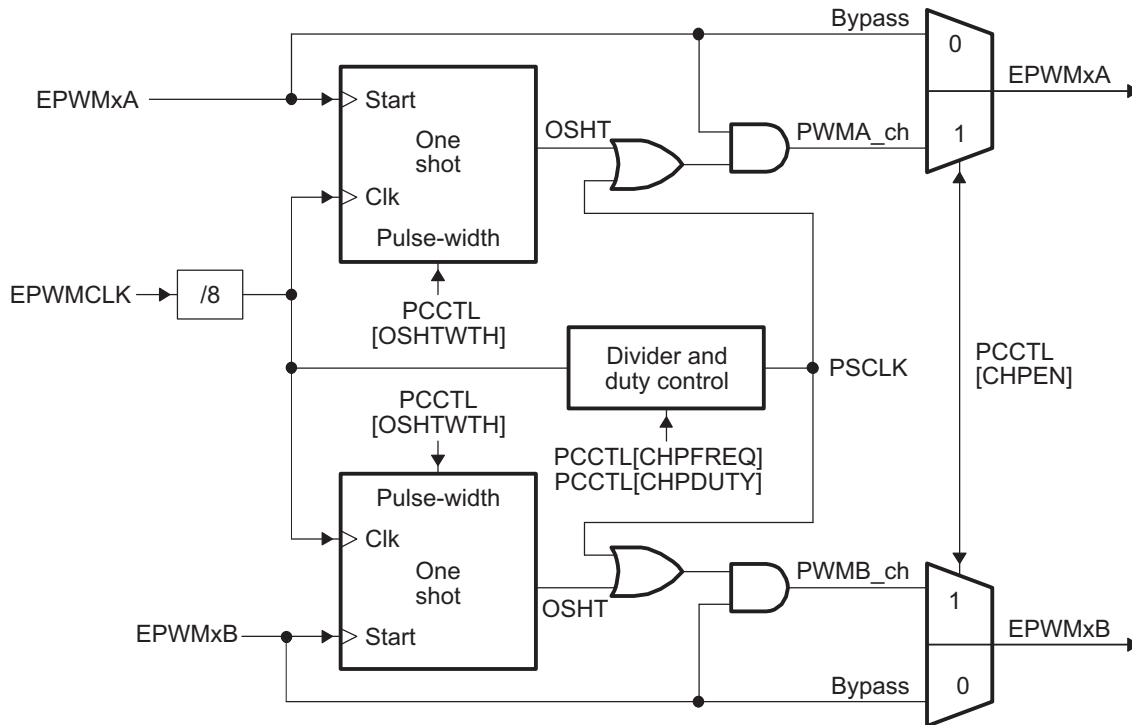
The key functions of the PWM chopper submodule are:

- Programmable chopping (carrier) frequency
- Programmable pulse width of first pulse
- Programmable duty cycle of second and subsequent pulses
- Can be fully bypassed if not required

#### 13.8.2 Operational Highlights for the PWM Chopper Submodule

Figure 13-36 shows the operational details of the PWM chopper submodule. The carrier clock is derived from EPWMCLK. Its frequency and duty cycle are controlled via the CHPFREQ and CHPDUTY bits in the PCCTL register. The one-shot block is a feature that provides a high energy first pulse to ensure hard and fast power switch turn on, while the subsequent pulses sustain pulses, ensuring the power switch remains on. The one-shot width is programmed via the OSHTWTH bits. The PWM chopper submodule can be fully disabled (bypassed) via the CHPEN bit.

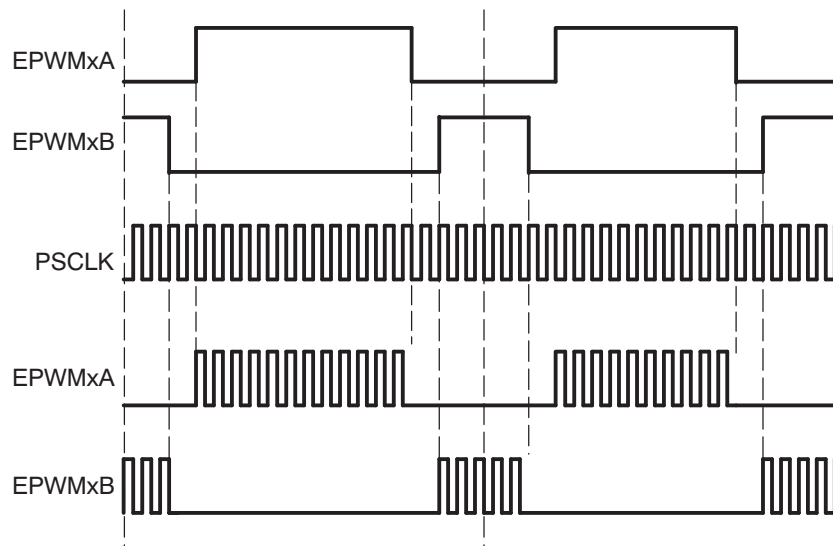
Figure 13-36. PWM Chopper Submodule Operational Details



### 13.8.3 Waveforms

Figure 13-37 shows simplified waveforms of the chopping action only; one-shot and duty-cycle control are not shown. Details of the one-shot and duty-cycle control are discussed in the following sections.

Figure 13-37. Simple PWM Chopper Submodule Waveforms Showing Chopping Action Only



### 13.8.3.1 One-Shot Pulse

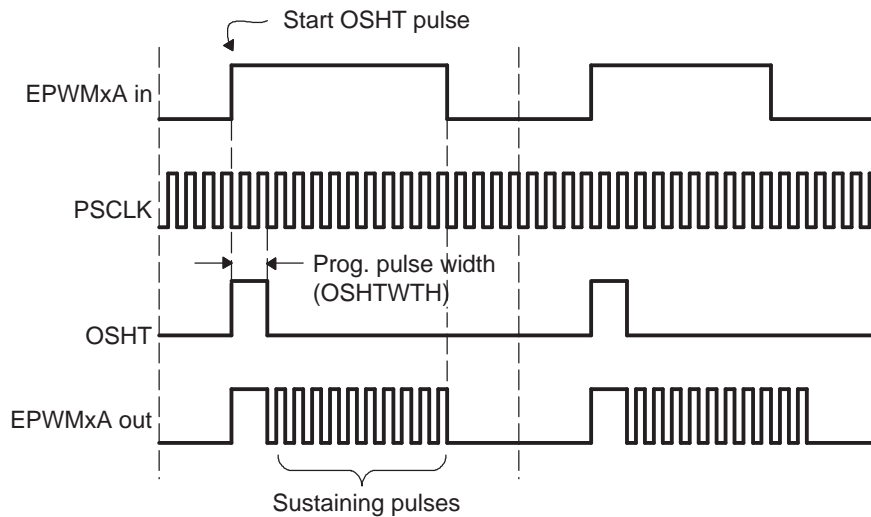
The width of the first pulse can be programmed to any of 16 possible pulse width values. The width or period of the first pulse is given by:

$$T_{1stpulse} = T_{EPWMCLK} \times 8 \times OSHTWTH$$

Where  $T_{EPWMCLK}$  is the period of the system clock (EPWMCLK) and OSHTWTH is the four control bits (value from 1 to 16)

Figure 13-38 shows the first and subsequent sustaining pulses and Table 13-11 gives the possible pulse width values for a EPWMCLK = 80 MHz.

**Figure 13-38. PWM Chopper Submodule Waveforms Showing the First Pulse and Subsequent Sustaining Pulses**



**Table 13-11. Possible Pulse Width Values for EPWMCLK = 80 MHz**

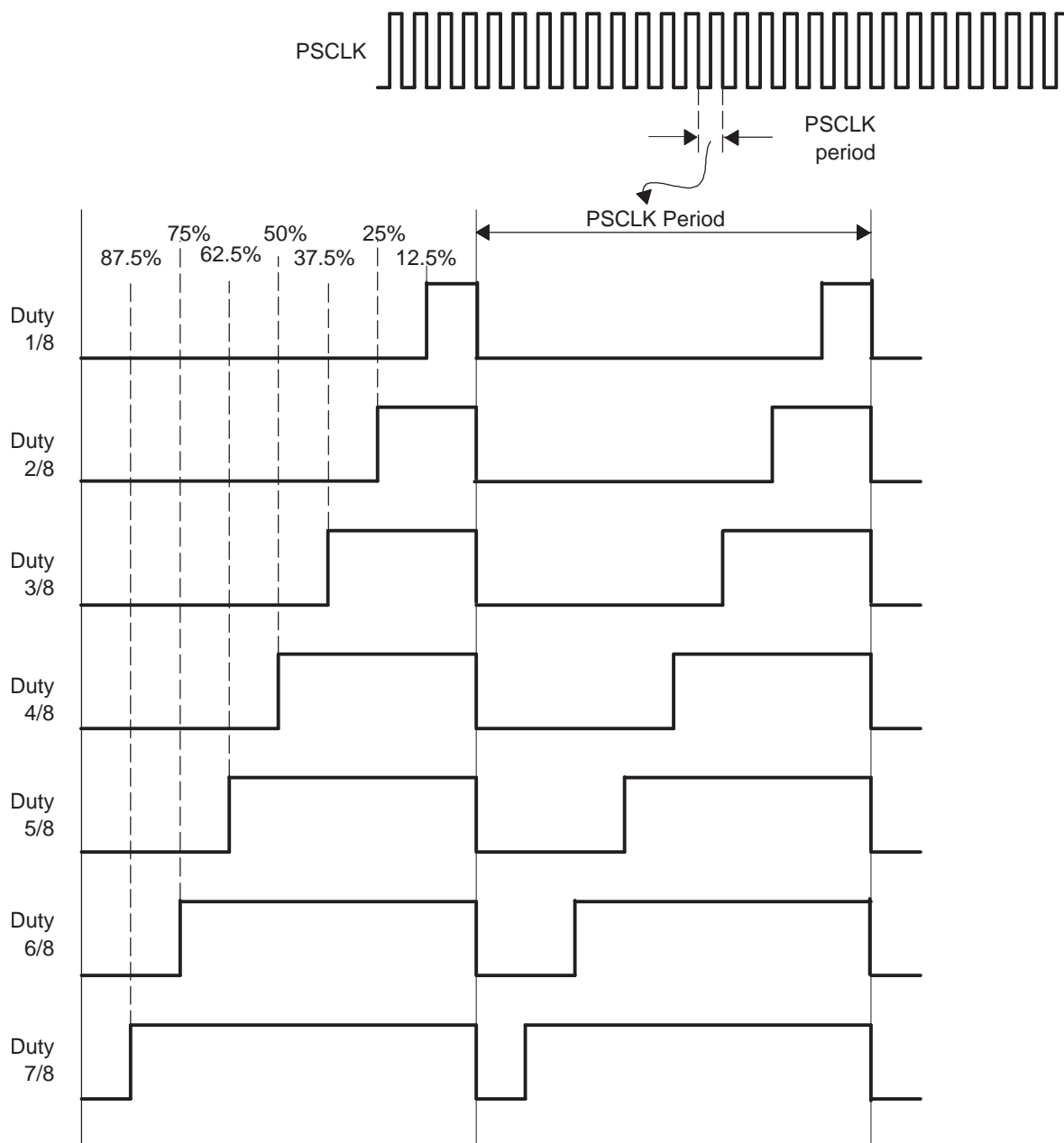
OSHTWTHz (hex)	Pulse Width (nS)
0	100
1	200
2	300
3	400
4	500
5	600
6	700
7	800
8	900
9	1000
A	1100
B	1200
C	1300
D	1400
E	1500
F	1600

### 13.8.3.2 Duty Cycle Control

Pulse transformer-based gate drive designs need to comprehend the magnetic properties or characteristics of the transformer and associated circuitry. Saturation is one such consideration. To assist the gate drive designer, the duty cycles of the second and subsequent pulses have been made programmable. These sustaining pulses ensure the correct drive strength and polarity is maintained on the power switch gate during the on period, and hence a programmable duty cycle allows a design to be tuned or optimized via software control.

Figure 13-39 shows the duty cycle control that is possible by programming the CHPDUTY bits. One of seven possible duty ratios can be selected ranging from 12.5% to 87.5%.

**Figure 13-39. PWM Chopper Submodule Waveforms Showing the Pulse Width (Duty Cycle) Control of Sustaining Pulses**

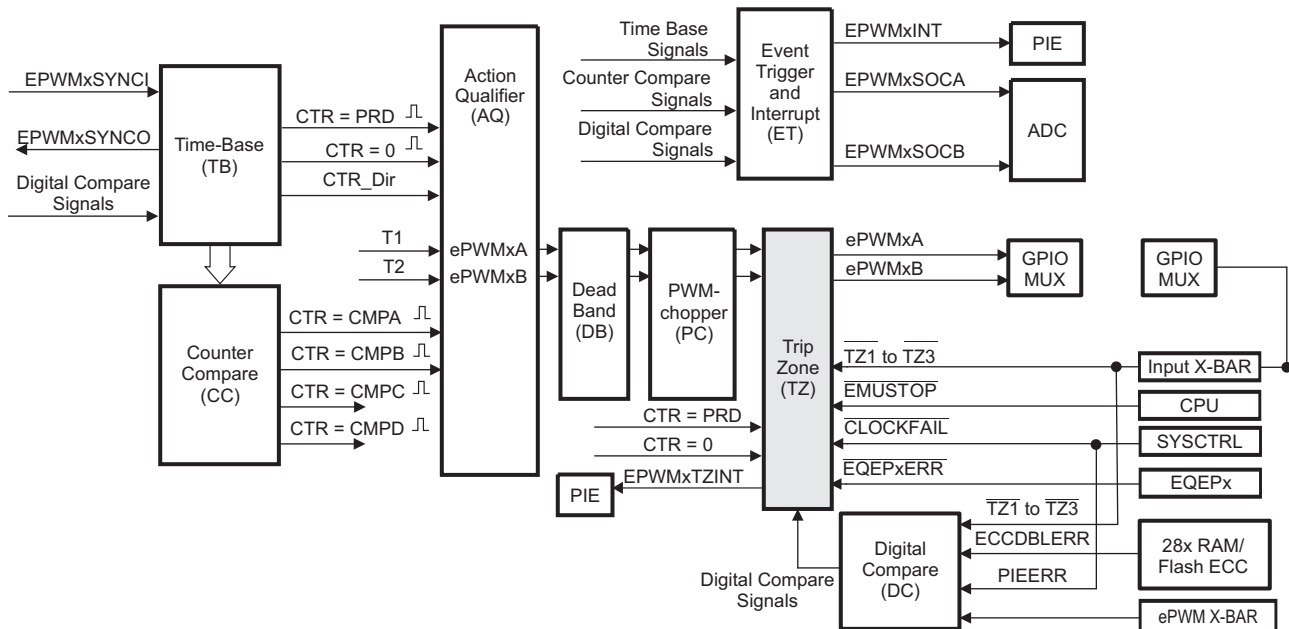




### 13.9 Trip-Zone (TZ) Submodule

Figure 13-40 shows how the trip-zone (TZ) submodule fits within the ePWM module.

Figure 13-40. Trip-Zone Submodule



Each ePWM module is connected to six  $\overline{TZn}$  signals ( $\overline{TZ1}$  to  $\overline{TZ6}$ ).  $\overline{TZ1}$  to  $\overline{TZ3}$  are sourced from the GPIO mux.  $\overline{TZ4}$  is sourced from an inverted EQEPxERR signal on those devices with an EQEP module.  $\overline{TZ5}$  is connected to the system clock fail logic, and  $\overline{TZ6}$  is sourced from the EMUSTOP output from the CPU. These signals indicate external fault or trip conditions, and the ePWM outputs can be programmed to respond accordingly when faults occur.

#### 13.9.1 Purpose of the Trip-Zone Submodule

The key functions of the trip-zone submodule are:

- Trip inputs  $\overline{TZ1}$  to  $\overline{TZ6}$  can be flexibly mapped to any ePWM module.
- Upon a fault condition, outputs EPWMxA and EPWMxB can be forced to one of the following:
  - High
  - Low
  - High-impedance
  - No action taken
- Support for one-shot trip (OSHT) for major short circuits or over-current conditions.
- Support for cycle-by-cycle tripping (CBC) for current limiting operation.
- Support for digital compare tripping (DC) based on state of on-chip analog comparator module outputs and/or  $\overline{TZ1}$  to  $\overline{TZ3}$  signals.
- Each trip-zone input and digital compare (DC) submodule DCAEVT1/2 or DCBEVT1/2 force event can be allocated to either one-shot or cycle-by-cycle operation.
- Interrupt generation is possible on any trip-zone input.
- Software-forced tripping is also supported.
- The trip-zone submodule can be fully bypassed if it is not required.

#### 13.9.2 Operational Highlights for the Trip-Zone Submodule

The following sections describe the operational highlights and configuration options for the trip-zone submodule.

The trip-zone signals  $\overline{TZ1}$  to  $\overline{TZ6}$  (also collectively referred to as  $\overline{TZn}$ ) are active low input signals. When one of these signals goes low, or when a DCAEVT1/2 or DCBEVT1/2 force happens based on the TZDCSEL register event selection, it indicates that a trip event has occurred. Each ePWM module can be individually configured to ignore or use each of the trip-zone signals or DC events. Which trip-zone signals or DC events are used by a particular ePWM module is determined by the TZSEL register for that specific ePWM module. The trip-zone signals may or may not be synchronized to the EPWM clock (EPWMCLK) and digitally filtered within the GPIO MUX block. A minimum of  $3 \cdot TBCLK$  low pulse width on  $\overline{TZn}$  inputs is sufficient to trigger a fault condition on the ePWM module. If the pulse width is less than this, the trip condition may not be latched by CBC or OST latches. The asynchronous trip makes sure that if clocks are missing for any reason, the outputs can still be tripped by a valid event present on  $\overline{TZn}$  inputs. The GPIOs or peripherals must be appropriately configured. For more information, see the device-specific version of the *System Control and Interrupts* chapter.

Each  $\overline{TZn}$  input can be individually configured to provide either a cycle-by-cycle or one-shot trip event for an ePWM module. DCAEVT1 and DCBEVT1 events can be configured to directly trip an ePWM module or provide a one-shot trip event to the module. Likewise, DCAEVT2 and DCBEVT2 events can also be configured to directly trip an ePWM module or provide a cycle-by-cycle trip event to the module. This configuration is determined by the TZSEL[DCAEVT1/2], TZSEL[DCBEVT1/2], TZSEL[CBCn], and TZSEL[OSHTn] control bits (where n corresponds to the trip input) respectively.

- **Cycle-by-Cycle (CBC):**

When a cycle-by-cycle trip event occurs, the action specified in the TZCTL[TZA] and TZCTL[TZB] bits is carried out immediately on the EPWMxA and/or EPWMxB outputs. [Table 13-12](#) lists some of the possible actions. Independent actions can be specified based on the occurrence of the event while the counter is counting up and/or while it is counting down by appropriately configuring bits in the TZCTL2 register. Actions specified in the TZCTL2 register take effect only when the ETZE bit in TZCTL2 is set.

Additionally, when a cycle-by-cycle trip event occurs, the cycle-by-cycle trip event flag (TZFLG[CBC]) is set and a EPWMx\_TZINT interrupt is generated if it is enabled in the TZEINT register and PIE peripheral. A corresponding flag for the event that caused the CBC event is also set in register TZCBCFLG.

If the CBC interrupt is enabled via the TZEINT register, and DCAEVT2 or DCBEVT2 are selected as CBC trip sources via the TZSEL register, it is not necessary to also enable the DCAEVT2 or DCBEVT2 interrupts in the TZEINT register, as the DC events trigger interrupts through the CBC mechanism.

The specified condition on the inputs is automatically cleared based on the selection made with TZCLR[CBCPULSE] if the trip event is no longer present. Therefore, in this mode, the trip event is cleared or reset every PWM cycle. The TZFLG[CBC] and TZCBCFLG flag bits will remain set until they are manually cleared by writing to the TZCLR[CBC] and TZCBCCLR flag bits. If the cycle-by-cycle trip event is still present when the TZFLG[CBC] and/or TZCBCFLG register bits are cleared, then these bits will again be immediately set.

- **One-Shot (OSHT):**

When a one-shot trip event occurs, the action specified in the TZCTL[TZA] and TZCTL[TZB] bits is carried out immediately on the EPWMxA and/or EPWMxB output. [Table 13-12](#) lists some of the possible actions. Independent actions can be specified based on the occurrence of the event while the counter is counting up and/or while it is counting down by appropriately configuring bits in TZCTL2 register. Actions specified in TZCTL2 register take effect only when ETZE bit in TZCTL2 is set.

Additionally, when a one-shot trip event occurs, the one-shot trip event flag (TZFLG[OST]) is set and a EPWMx\_TZINT interrupt is generated if it is enabled in the TZEINT register and PIE peripheral. A corresponding flag for the event that caused the OST event is also set in register TZOSTFLG. The one-shot trip condition must be cleared manually by writing to the TZCLR[OST] bit. If desired, TZOSTFLG register bit should be cleared by manually writing to the corresponding bit in the TZOSTCLR register.

If the one-shot interrupt is enabled via the TZEINT register, and DCAEVT1 or DCBEVT1 are selected as OSHT trip sources via the TZSEL register, it is not necessary to also enable the DCAEVT1 or DCBEVT1 interrupts in the TZEINT register, as the DC events trigger interrupts through the OSHT mechanism.

- **Digital Compare Events (DCAEVT1/2 and DCBEVT1/2):**

A digital compare DCAEVT1/2 or DCBEVT1/2 event is generated based on a combination of the DCAH/DCAL and DCBH/DCBL signals as selected by the TZDCSEL register. The signals which

source the DCAH/DCAL and DCBH/DCBL signals are selected via the DCTRISEL register and can be either trip zone input pins or analog comparator CMPSSx signals. For more information on the digital compare submodule signals, see [Section 13.11](#).

When a digital compare event occurs, the action specified in the TZCTL[DCAEVT1/2] and TZCTL[DCBEVT1/2] bits is carried out immediately on the EPWMxA and/or EPWMxB output. [Table 13-12](#) lists the possible actions. Independent actions can be specified based on the occurrence of the event while the counter is counting up and/or while it is counting down by appropriately configuring bits in TZCTLDCA and TZCTLDCA register. Actions specified in TZCTLDCA and TZCTLDCA registers take effect only when ETZE bit in TZCTL2 is set.

In addition, the relevant DC trip event flag (TZFLG[DCAEVT1/2] / TZFLG[DCBEVT1/2]) is set and a EPWMx\_TZINT interrupt is generated if it is enabled in the TZEINT register and PIE peripheral.

The specified condition on the pins is automatically cleared when the DC trip event is no longer present. The TZFLG[DCAEVT1/2] or TZFLG[DCBEVT1/2] flag bit will remain set until it is manually cleared by writing to the TZCLR[DCAEVT1/2] or TZCLR[DCBEVT1/2] bit. If the DC trip event is still present when the TZFLG[DCAEVT1/2] or TZFLG[DCBEVT1/2] flag is cleared, then it will again be immediately set.

The action taken when a trip event occurs can be configured individually for each of the ePWM output pins by way of the TZCTL, TZCTL2, TZCTLDCA,, and TZCTLDCA register bit fields. Some of the possible actions, shown in [Table 13-12](#), can be taken on a trip event.

**Table 13-12. Possible Actions On a Trip Event**

TZCTL Register bit-field Settings	EPWMxA and/or EPWMxB	Comment
0,0	High-Impedance	Tripped
0,1	Force to High State	Tripped
1,0	Force to Low State	Tripped
1,1	No Change	Do Nothing.
		No change is made to the output.

### Example 13-1. Trip-Zone Configurations

#### Scenario A:

A one-shot trip event on  $\overline{TZ1}$  pulls both EPWM1A, EPWM1B low and also forces EPWM2A and EPWM2B high.

- Configure the ePWM1 registers as follows:
  - TZSEL[OSHT1] = 1: enables  $\overline{TZ1}$  as a one-shot event source for ePWM1
  - TZCTL[TZA] = 2: EPWM1A will be forced low on a trip event.
  - TZCTL[TZB] = 2: EPWM1B will be forced low on a trip event.
- Configure the ePWM2 registers as follows:
  - TZSEL[OSHT1] = 1: enables  $\overline{TZ1}$  as a one-shot event source for ePWM2
  - TZCTL[TZA] = 1: EPWM2A will be forced high on a trip event.
  - TZCTL[TZB] = 1: EPWM2B will be forced high on a trip event.

#### Scenario B:

A cycle-by-cycle event on  $\overline{TZ5}$  pulls both EPWM1A, EPWM1B low.  
A one-shot event on  $\overline{TZ1}$  or  $\overline{TZ6}$  puts EPWM2A into a high impedance state.

- Configure the ePWM1 registers as follows:
  - TZSEL[OSHT1] = 1: enables  $\overline{TZ5}$  as a one-shot event source for ePWM1
  - TZCTL[TZA] = 2: EPWM1A will be forced low on a trip event.
  - TZCTL[TZB] = 2: EPWM1B will be forced low on a trip event.
- Configure the ePWM2 registers as follows:

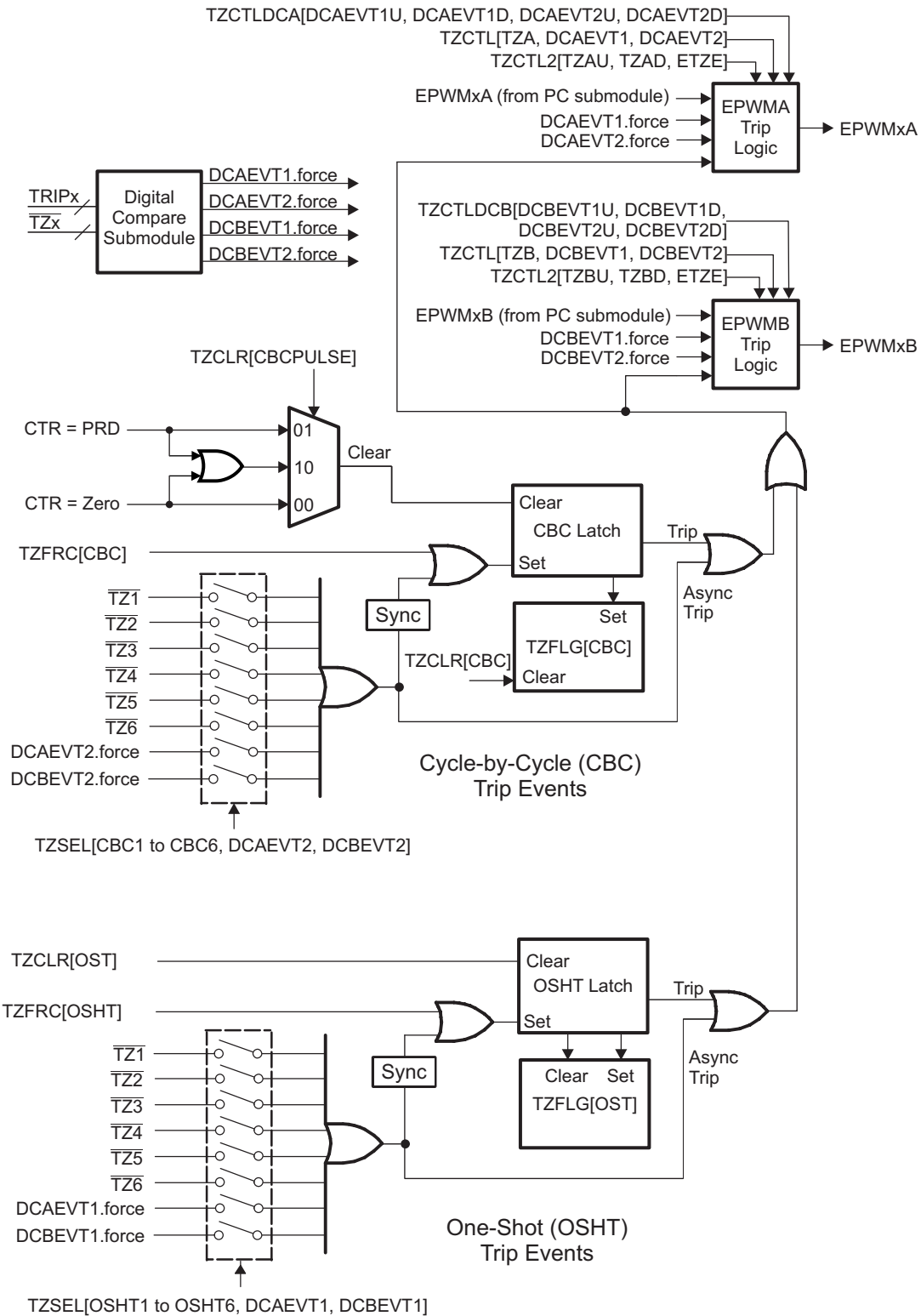
**Example 13-1. Trip-Zone Configurations (continued)**

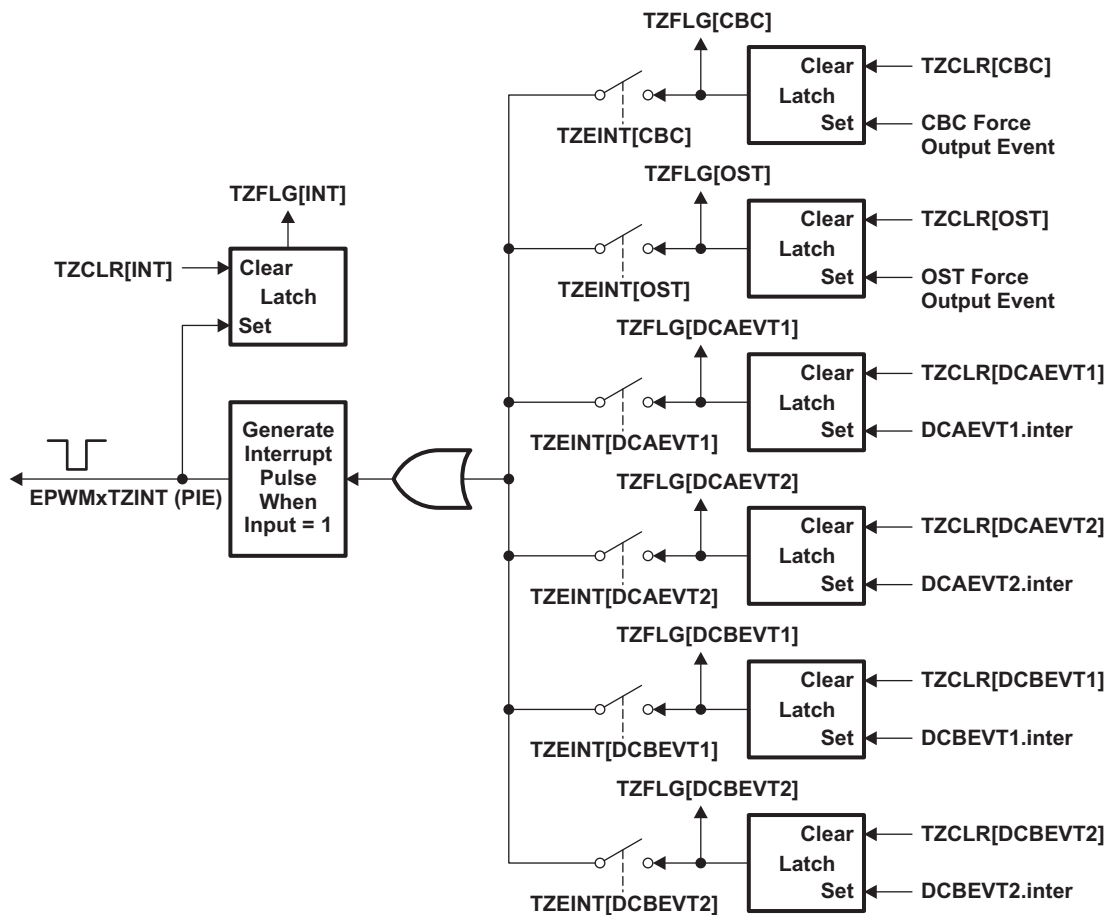
- TZSEL[OSHT1] = 1: enables  $\overline{TZ1}$  as a one-shot event source for ePWM2
- TZSEL[OSHT6] = 1: enables  $\overline{TZ6}$  as a one-shot event source for ePWM2
- TZCTL[TZA] = 0: EPWM2A will be put into a high-impedance state on a trip event.
- TZCTL[TZB] = 3: EPWM2B will ignore the trip event.

**13.9.3 Generating Trip Event Interrupts**

[Figure 13-41](#) and [Figure 13-42](#) illustrate the trip-zone submodule control and interrupt logic, respectively. DCAEVT1/2 and DCBEVT1/2 signals are described in further detail in [Section 13.11](#).

Figure 13-41. Trip-Zone Submodule Mode Control Logic



**Figure 13-42. Trip-Zone Submodule Interrupt Logic**


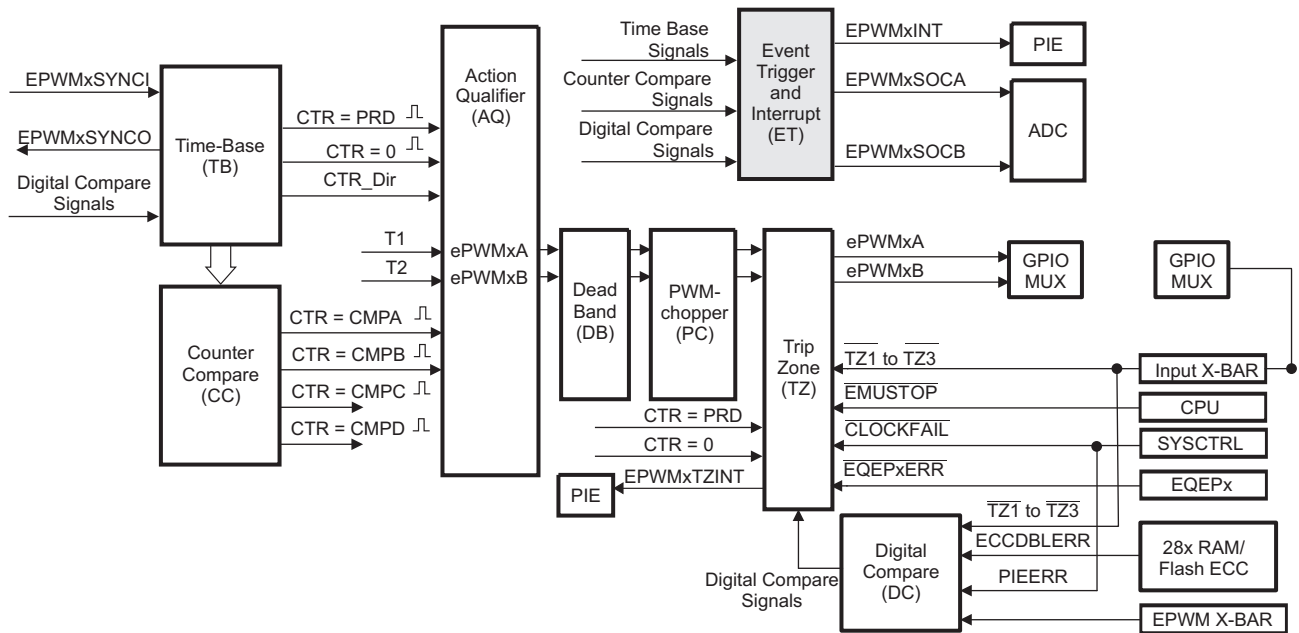
### 13.10 Event-Trigger (ET) Submodule

The key functions of the event-trigger submodule are:

- Receives event inputs generated by the time-base, counter-compare, and digital-compare submodules
- Uses the time-base direction information for up/down event qualification
- Uses prescaling logic to issue interrupt requests and ADC start of conversion at:
  - Every event
  - Every second event
  - Up to every fifteenth event
- Provides full visibility of event generation via event counters and flags
- Allows software forcing of Interrupts and ADC start of conversion

The event-trigger submodule manages the events generated by the time-base submodule, the counter-compare submodule, and the digital-compare submodule to generate an interrupt to the CPU and/or a start of conversion pulse to the ADC when a selected event occurs. [Figure 13-43](#) illustrates where the event-trigger submodule fits within the ePWM system.

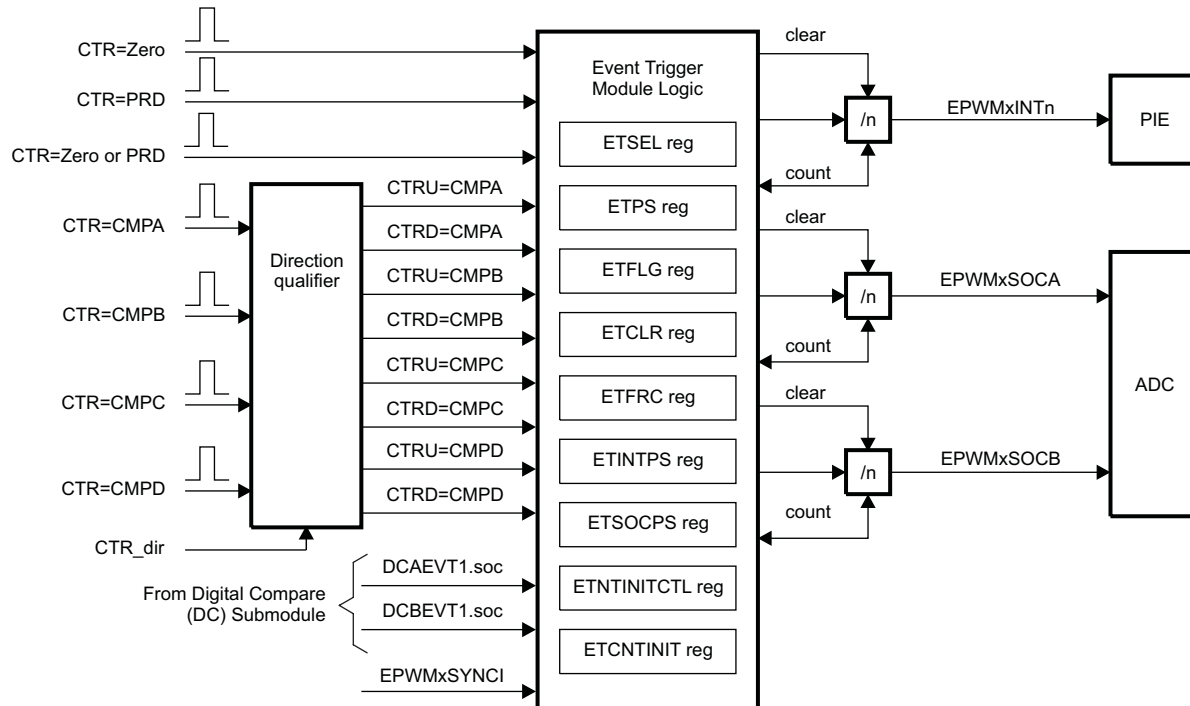
Figure 13-43. Event-Trigger Submodule



### 13.10.1 Operational Overview of the ePWM Type 4 Event-Trigger Submodule

The event-trigger submodule monitors various event conditions (shown as inputs on the left side of Figure 13-44) and can be configured to prescale these events before issuing an Interrupt request or an ADC start of conversion. The event-trigger prescaling logic can issue Interrupt requests and ADC start of conversion at:

- Every event
- Every second event
- Up to Every fifteenth event

**Figure 13-44. Event-Trigger Submodule Showing Event Inputs and Prescaled Outputs**


- ETSEL - This selects which of the possible events will trigger an interrupt or start an ADC conversion.
- ETPS - This programs the event prescaling options mentioned above.
- ETFLG - These are flag bits indicating status of the selected and prescaled events.
- ETCLR - These bits allow you to clear the flag bits in the ETFLG register via software.
- ETFRC - These bits allow software forcing of an event. Useful for debugging or software intervention.
- ETINTPS - This programs the interrupt event prescaling options, supporting count and period up to 15 events.
- ETSOCPS - This programs the SOC event prescaling options, supporting count and period up to 15 events.
- ETCNTINITCTL - These bits enable ETCNTINIT initialization via SYNC event OR via software force.
- ETCNTINIT - These bits allow you to initialize INT/SOCA/SOCB counters on SYNC events (or software force) with user programmed value.

A more detailed look at how the various register bits interact with the Interrupt and ADC start of conversion logic are shown in [Figure 13-45](#), [Figure 13-46](#), and [Figure 13-47](#).

[Figure 13-45](#) shows the event-trigger's interrupt generation logic. The interrupt-period (ETPS[INTPRD]) bits specify the number of events required to cause an interrupt pulse to be generated. The choices available are:

- Do not generate an interrupt.
- Generate an interrupt on every event
- Generate an interrupt on every second event
- Generate an interrupt on every third event

On ePWM type 4, in order to enable event generation capability up to 15 events the following changes have been made. The selection made on ETPS[INTPSSSEL] bit determines whether ETINTPS register, INTCNT2 and INTPRD2 bit fields determine frequency of events (interrupt once every 0-15 events).

Which event can cause an interrupt is configured by the interrupt selection (ETSEL[INTSEL]) and (ETSEL[INTSELCMP]) bits. The event can be one of the following:



- Time-base counter equal to zero (TBCTR = 0x00).
- Time-base counter equal to period (TBCTR = TBPRD).
- Time-base counter equal to zero or period (TBCTR = 0x00 || TBCTR = TBPRD).
- Time-base counter equal to the compare A register (CMPA) when the timer is incrementing.
- Time-base counter equal to the compare A register (CMPA) when the timer is decrementing.
- Time-base counter equal to the compare B register (CMPB) when the timer is incrementing.
- Time-base counter equal to the compare B register (CMPB) when the timer is decrementing.
- Time-base counter equal to the compare C register (CMPC) when the timer is incrementing.
- Time-base counter equal to the compare C register (CMPC) when the timer is decrementing.
- Time-base counter equal to the compare D register (CMPD) when the timer is incrementing.
- Time-base counter equal to the compare D register (CMPD) when the timer is decrementing.

The number of events that have occurred can be read from the interrupt event counter ETPS[INTCNT] or ETINTPS[INTCNT2] register bits based off of the selection made using ETPS[INTPSSEL]. That is, when the specified event occurs the ETPS[INTCNT] or ETINTPS[INTCNT2] bits are incremented until they reach the value specified by ETPS[INTPRD] or ETINTPS[INTPRD2] determined again by the selection made in ETPS[INTPSSEL]. When ETPS[INTCNT] = ETPS[INTPRD] the counter stops counting and its output is set. The counter is only cleared when an interrupt is sent to the PIE.

When ETPS[INTCNT] reaches ETPS[INTPRD] the following behavior will occur [The below behavior is also applicable to ETINTPS[INTCNT2] & ETINTPS[INTPRD2] :

- If interrupts are enabled, ETSEL[INTEN] = 1 and the interrupt flag is clear, ETFLG[INT] = 0, then an interrupt pulse is generated and the interrupt flag is set, ETFLG[INT] = 1, and the event counter is cleared ETPS[INTCNT] = 0. The counter will begin counting events again.
- If interrupts are disabled, ETSEL[INTEN] = 0, or the interrupt flag is set, ETFLG[INT] = 1, the counter stops counting events when it reaches the period value ETPS[INTCNT] = ETPS[INTPRD].
- If interrupts are enabled, but the interrupt flag is already set, then the counter will hold its output high until the ENTFLG[INT] flag is cleared. This allows for one interrupt to be pending while one is serviced.

Writing a 1 to the ETFRC[INT] bit will increment the event counter INTCNT. The counter will behave as described above when INTCNT = INTPRD. When INTPRD = 0, the counter is disabled and hence no events will be detected and the ETFRC[INT] bit is also ignored. The same applies to ETINTPS[INTCNT2] & ETINTPS[INTPRD2]

The above definition means that you can generate an interrupt on every event, on every second event, or on every third event if using the INTCNT and INTPRD. You can generate an interrupt on every event up to 15 events if using the INTCNT2 and INTPRD2.

The INTCNT2 value can be initialized with the value from ETCNTINIT[INTINIT] based on the selection made in ETCNTINITCTL[INTINITEN]. When ETCNTINITCTL[INTINITEN] is set, then it enables initialization of INTCNT2 counter with contents of ETCNTINIT[INTINIT] on a SYNC event or software force determined by ETCNTINITCTL[INTINITFRC] .

Figure 13-45. Event-Trigger Interrupt Generator

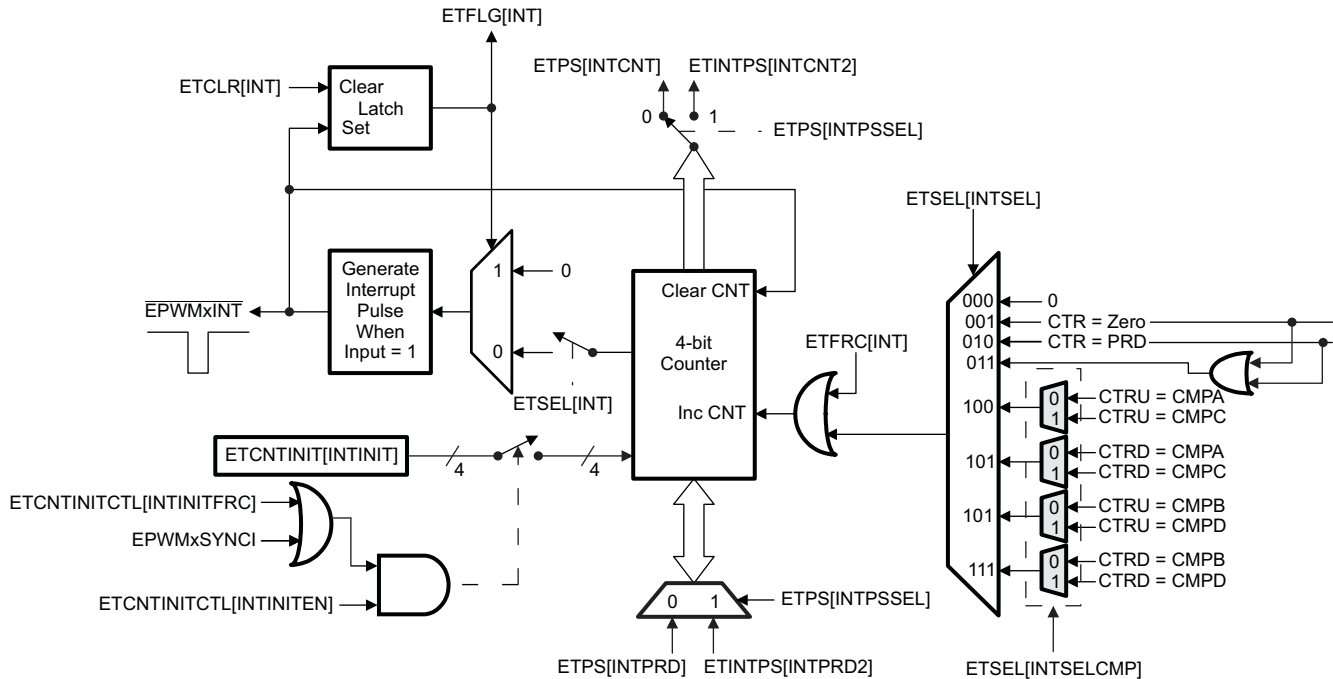
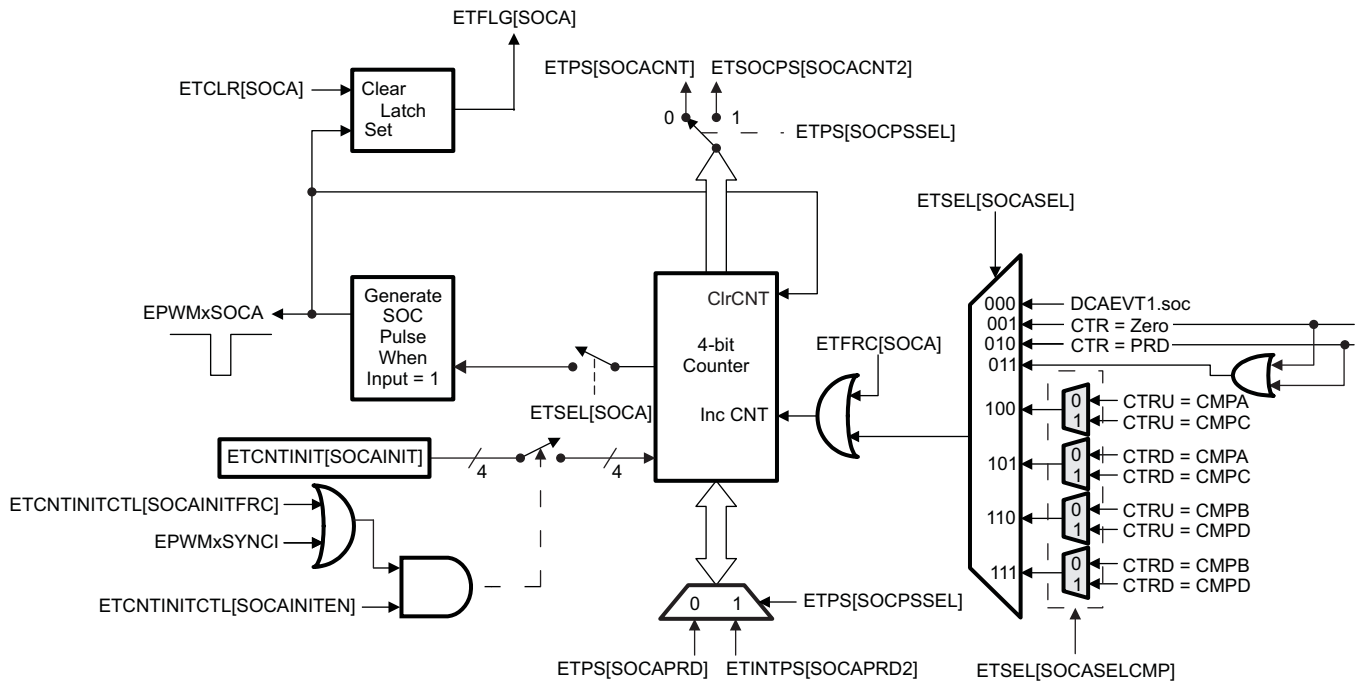


Figure 13-46 shows the operation of the event-trigger's start-of-conversion-A (SOCA) pulse generator. The enhancements include SOCASELCMP and SOCBSELCMP bit fields defined in the ETSEL register enable CMPC and CMPD events respectively to cause a start of conversion. The ETPS[SOCPSSEL] bit field determines whether SOCACNT2 and SOCAPRD2 take control or not. The ETPS[SOCACNT] counter and ETPS[SOCAPRD] period values behave similarly to the interrupt generator except that the pulses are continuously generated. That is, the pulse flag ETFLG[SOCA] is latched when a pulse is generated, but it does not stop further pulse generation. The enable/disable bit ETSEL[SOCAEN] stops pulse generation, but input events can still be counted until the period value is reached as with the interrupt generation logic. The event that will trigger an SOCA and SOCB pulse can be configured separately in the ETSEL[SOCASEL] and ETSEL[SOCBSEL] bits. The possible events are the same events that can be specified for the interrupt generation logic with the addition of the DCAEVT1.soc and DCBEVT1.soc event signals from the digital compare (DC) submodule. The SOCACNT2 initialization scheme is very similar to the interrupt generator with respective enable, value initialize and SYNC or software force options.

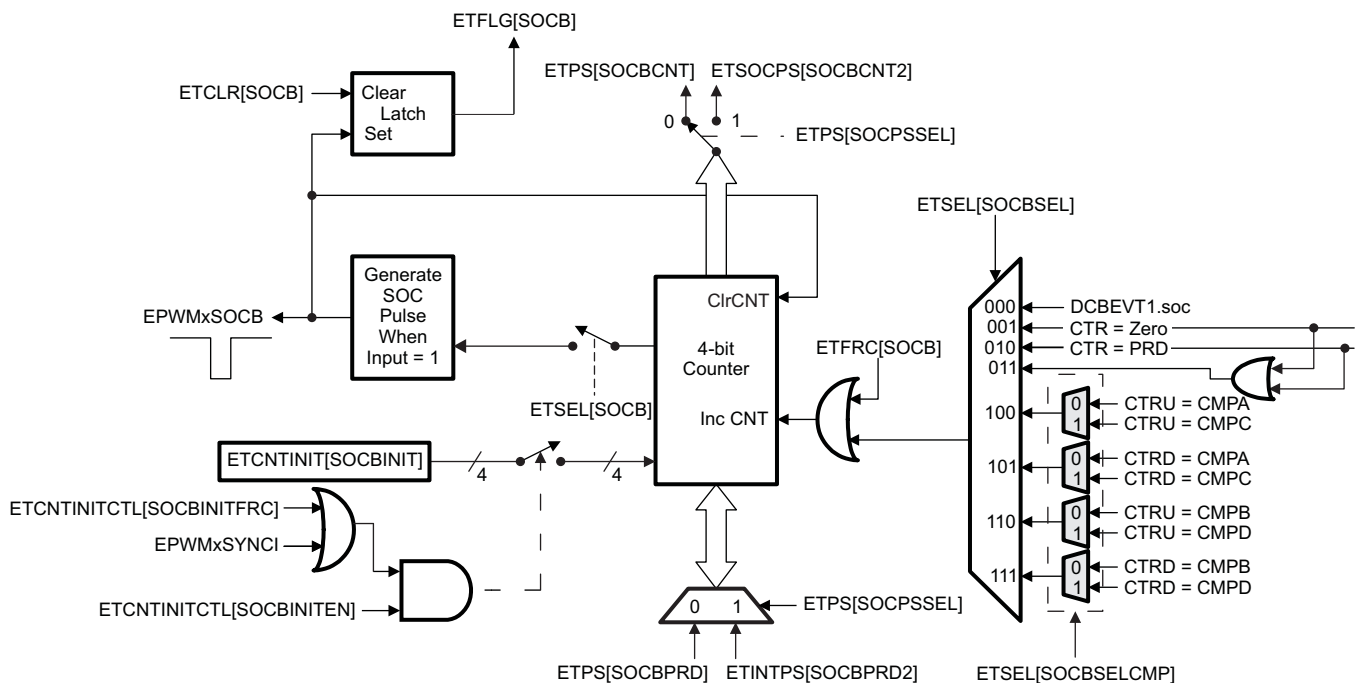
Figure 13-46. Event-Trigger SOCA Pulse Generator



A The DCAEVT1.soc signals are signals generated by the Digital compare (DC) submodule in Section 13.11.

Figure 13-47 shows the operation of the event-trigger's start-of-conversion-B (SOCB) pulse generator. The event-trigger's SOCB pulse generator operates the same way as the SOCA.

Figure 13-47. Event-Trigger SOCB Pulse Generator

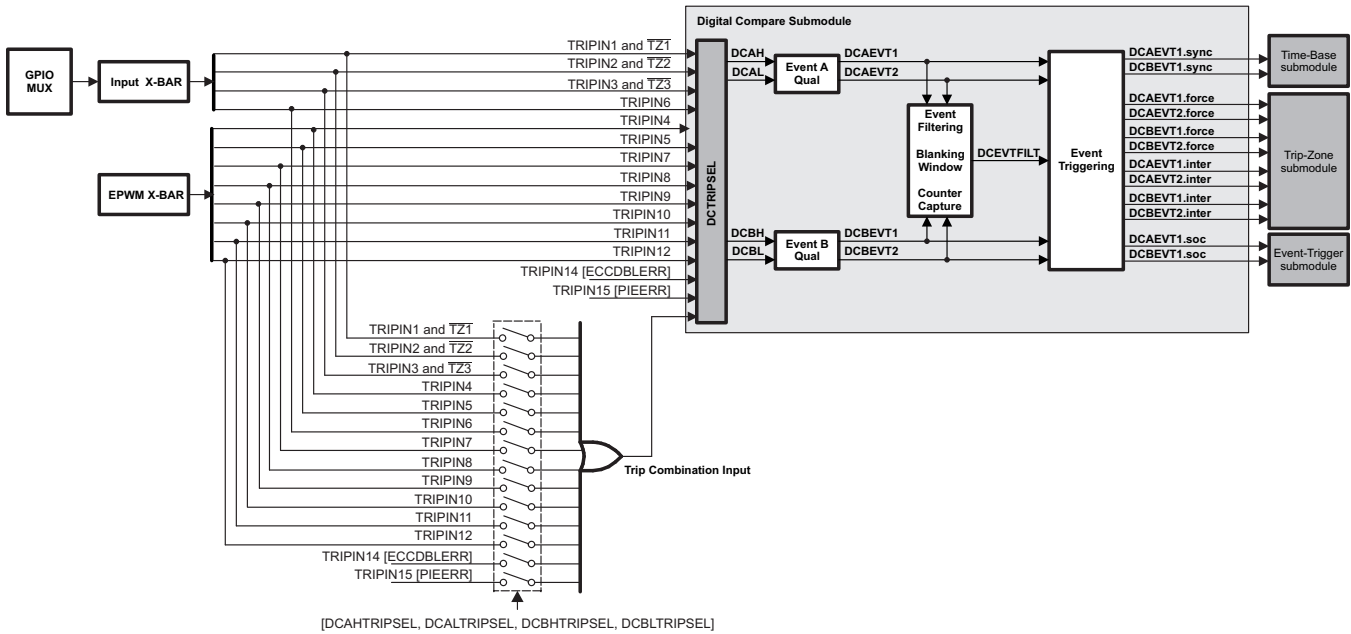


A The DCBEVT1.soc signals are signals generated by the Digital compare (DC) submodule in Section 13.11.

### 13.11 Digital Compare (DC) Submodule

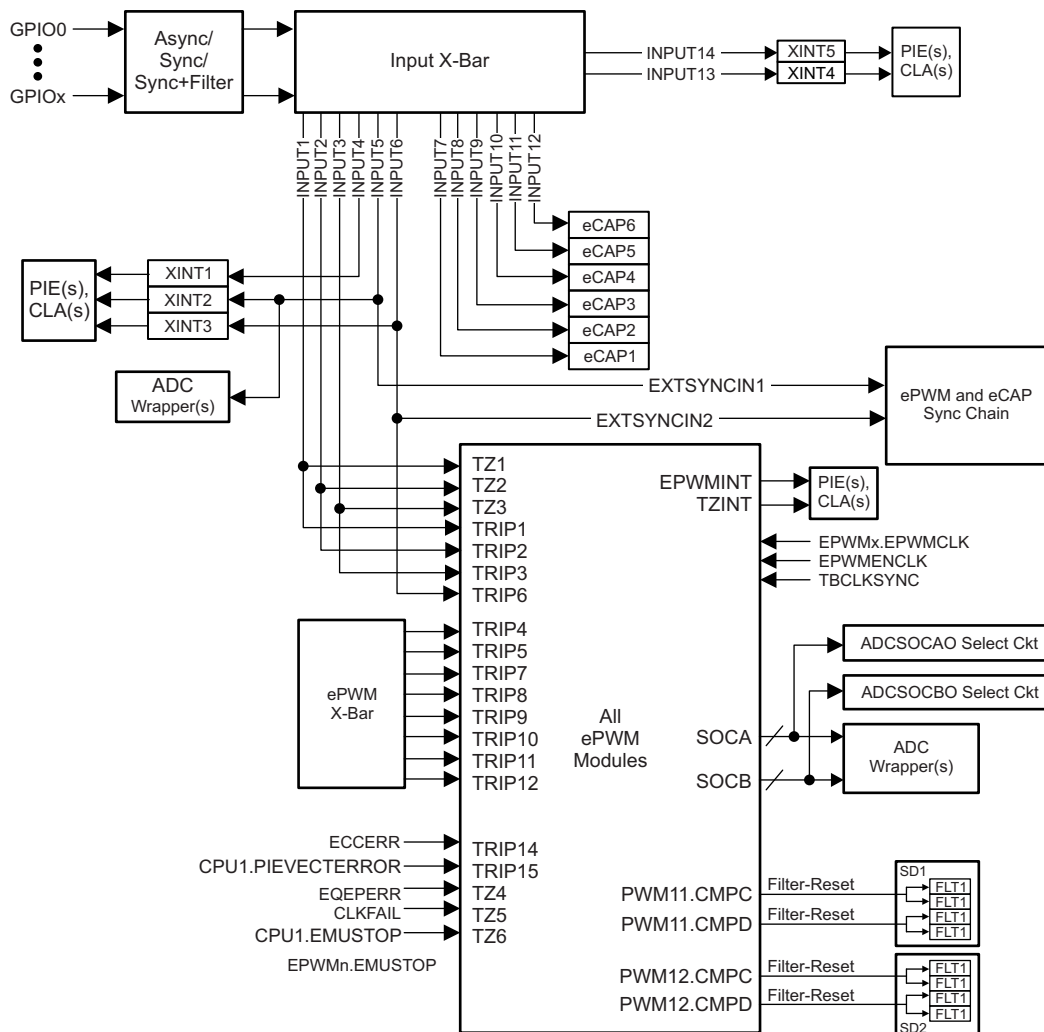
Figure 13-48 illustrates where the digital compare (DC) submodule signals interface to other submodules in the ePWM system.

Figure 13-48. Digital-Compare Submodule High-Level Block Diagram



The eCAP input signals are sourced from the Input X-BAR signals as shown in Figure 13-49.

Figure 13-49. ePWM Trip Input Connectivity



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On this device, any of the GPIO pins can be flexibly mapped to be the trip-zone input and/or trip inputs to the trip-zone submodule and digital compare submodule. The Input X-BAR Input Select (INPUTxSELECT) register defines which GPIO pins gets assigned to be the trip-zone inputs / trip inputs.

The digital compare (DC) submodule compares signals external to the ePWM module (for instance, CMPSSx signals from the analog comparators) to directly generate PWM events/actions which then feed to the event-trigger, trip-zone, and time-base submodules. Additionally, blanking window functionality is supported to filter noise or unwanted pulses from the DC event signals.

**NOTE:** The user is responsible for driving correct state on the selected pin before enabling clock and configuring the trip input for the respective ePWM peripheral to avoid spurious latch of TRIP signal.

### 13.11.1 Purpose of the Digital Compare Submodule

The key functions of the digital compare submodule are:

- Analog comparator (COMP) module outputs fed through the Input X-BAR logic externally using the GPIO peripheral, internal PIE, ECC error signals, TZ1, TZ2, and TZ3 inputs generate Digital Compare A High/Low (DCAH, DCAL) and Digital Compare B High/Low (DCBH, DCBL) signals.

- DCAH/L and DCBH/L signals trigger events which can then either be filtered or fed directly to the trip-zone, event-trigger, and time-base submodules to:
  - generate a trip zone interrupt
  - generate an ADC start of conversion
  - force an event
  - generate a synchronization event for synchronizing the ePWM module TBCTR.
- Event filtering (blanking window logic) can optionally blank the input signal to remove noise.

### 13.11.2 Enhanced Trip Action

In order to allow multiple comparators at a time to affect DCA/BEVTx events and trip actions, there is a OR logic to bring together ALL trip inputs (up to 15) from sources external to the ePWM module and feed into DCAH, DCAL, DCBH, and DCBL as “combinational input” using the DCTRIPSEL register. This is configured by writing appropriate value [Trip Combination input ] to the DCAHCOMPSEL,DCALCOMPSEL, DCBHCOMPSEL, DCBLCOMPSEL bit fields in the DCTRIPSEL register.

The user has an discrete choice for which trip input to put through the combinational logic for Digital Compare A High/Low (DCAH, DCAL) and Digital Compare B High/Low (DCBH, DCBL) signals generation. This is achieved using the selection from DCAHTRIPSEL, DCALTRIPSEL, DCBHTRIPSEL and DCBLTRIPSEL register. The appropriate bit when set indicates that Trip input is chosen for “combinational input” by the DCTRIPSEL register.

Apart from these options user can also make the external trip inputs which feed into the OR gate individually selectable and not go through the “combinational input” by using the DCTRIPSEL register.

### 13.11.3 Using CMPSS to Trip the ePWM on a Cycle-by-Cycle Basis

When using the CMPSS to trip the ePWM on a cycle-by-cycle basis, steps should be taken to prevent an asserted comparator trip state in one PWM cycle from extending into the following cycle. The CMPSS can be used to signal a trip condition to the downstream ePWM modules. For applications like peak current mode control, only one trip event per PWM cycle is expected. Under certain conditions, it is possible for a sustained or late trip event (arriving near the end of a PWM cycle) to carry over into the next PWM cycle if precautions are not taken. If either the CMPSS Digital Filter or the ePWM Digital Compare (DC) submodule is configured to qualify the comparator trip signal, “N” number of clock cycles of qualification will be introduced before the EPWM trip logic can respond to logic changes of the trip signal. Once an ePWM trip condition is qualified, the trip condition will remain active for N clock cycles after the comparator trip signal has de-asserted. If a qualified comparator trip signal remains asserted within N clock cycles prior to the end of a PWM cycle, the trip condition will not be cleared until after the following PWM cycle has started. Thus, the new PWM cycle will detect a trip condition as soon as it begins.

To avoid this undesired trip condition, the user application should take steps to ensure that the qualified trip signal seen by the ePWM trip logic is deasserted prior to the end of each PWM cycle. This can be accomplished through various methods:

- Design the system such that a comparator trip will not be asserted within N clock cycles prior to the end of the PWM cycle.
- Activate blanking of the comparator trip signal via the EPWM event filter at least two clock cycles prior to the PWMSYNC signal and continue blanking for at least N clock cycles into the next PWM cycle.
- If the CMPSS COMPxLATCH path is used, clear the COMPxLATCH at least N clock cycles prior to the end of the PWM cycle. The latch can be cleared by software (via COMPSTCLR) or by generating an early PWMSYNC signal. The ePWM modules on this device include the ability to generate PWMSYNC upon a CMPC or CMPD match (via HRPCTL) for arbitrary PWMSYNC placement within the PWM cycle.

### 13.11.4 Operation Highlights of the Digital Compare Submodule

The following sections describe the operational highlights and configuration options for the digital compare submodule.

### 13.11.4.1 Digital Compare Events

As illustrated in [Section 13.11.4.2](#) earlier in this section, trip zone inputs ( $\overline{TZ1}$ ,  $\overline{TZ2}$ , and  $\overline{TZ3}$ ) and CMPSSx signals from the analog comparator (COMP) module can be selected via the DCTRIPSEL bits to generate the Digital Compare A High and Low (DCAH/L) and Digital Compare B High and Low (DCBH/L) signals. Then, the configuration of the TZDSEL register qualifies the actions on the selected DCAH/L and DCBH/L signals, which generate the DCAEVT1/2 and DCBEVT1/2 events (Event Qualification A and B).

---

**NOTE:** The  $\overline{TZn}$  signals, when used as a DCEVT tripping functions, are treated as a normal input signal and can be defined to be active high or active low inputs. ePWM outputs are asynchronously tripped when either the  $\overline{TZn}$ , DCAEVTx.force, or DCBEVTx.force signals are active. For the condition to remain latched, a minimum of  $3 \cdot TBCLK$  sync pulse width is required. If pulse width is  $< 3 \cdot TBCLK$  sync pulse width, the trip condition may or may not get latched by CBC or OST latches.

---

The DCAEVT1/2 and DCBEVT1/2 events can then be filtered to provide a filtered version of the event signals (DCEVTFILT) or the filtering can be bypassed. Filtering is discussed further in [Section 13.11.4.2](#). Either the DCAEVT1/2 and DCBEVT1/2 event signals or the filtered DCEVTFILT event signals can generate a force to the trip zone module, a TZ interrupt, an ADC SOC, or a PWM sync signal.

- **force signal:**

DCAEVT1/2.force signals force trip zone conditions which either directly influence the output on the EPWMxA pin (via TZCTL, TZCTLDCA, TZCTLDCB register configurations) or, if the DCAEVT1/2 signals are selected as one-shot or cycle-by-cycle trip sources (via the TZSEL register), the DCAEVT1/2.force signals can effect the trip action via the TZCTL or TZCTL2 register configurations. The DCBEVT1/2.force signals behaves similarly, but affect the EPWMxB output pin instead of the EPWMxA output pin.

The priority of conflicting actions on the TZCTL, TZCTL2, TZCTLDCA and TZCTLDCB registers is as follows (highest priority overrides lower priority):

Output EPWMxA:

- TZA (highest) -> DCAEVT1 -> DCAEVT2 (lowest)
- TZAU (highest) -> DCAEVT1U -> DCAEVT2U (lowest)
- TZAD (highest) -> DCAEVT1D -> DCAEVT2D (lowest)

Output EPWMxB:

- TZB (highest) -> DCBEVT1 -> DCBEVT2 (lowest)
- TZBU (highest) -> DCBEVT1U -> DCBEVT2U (lowest)
- TZBD (highest) -> DCBEVT1D -> DCBEVT2D (lowest)

- **interrupt signal:**

DCAEVT1/2.interrupt signals generate trip zone interrupts to the PIE. To enable the interrupt, the user must set the DCAEVT1, DCAEVT2, DCBEVT1, or DCBEVT2 bits in the TZEINT register. Once one of these events occurs, an EPWMxTZINT interrupt is triggered, and the corresponding bit in the TZCLR register must be set in order to clear the interrupt.

- **soc signal:**

The DCAEVT1.soc signal interfaces with the event-trigger submodule and can be selected as an event which generates an ADC start-of-conversion-A (SOCA) pulse via the ETSEL[SOCASEL] bit. Likewise, the DCBEVT1.soc signal can be selected as an event which generates an ADC start-of-conversion-B (SOCB) pulse via the ETSEL[SOCBSEL] bit.

- **sync signal:**

The DCAEVT1.sync and DCBEVT1.sync events are ORed with the EPWMxSYNCl input signal and the TBCTL[SWFSYNC] signal to generate a synchronization pulse to the time-base counter.

The diagrams below show how the DCAEVT1, DCAEVT2 or DCEVTFILT signals are processed to generate the digital compare A event force, interrupt, soc and sync signals.

Figure 13-50. DCAEVT1 Event Triggering

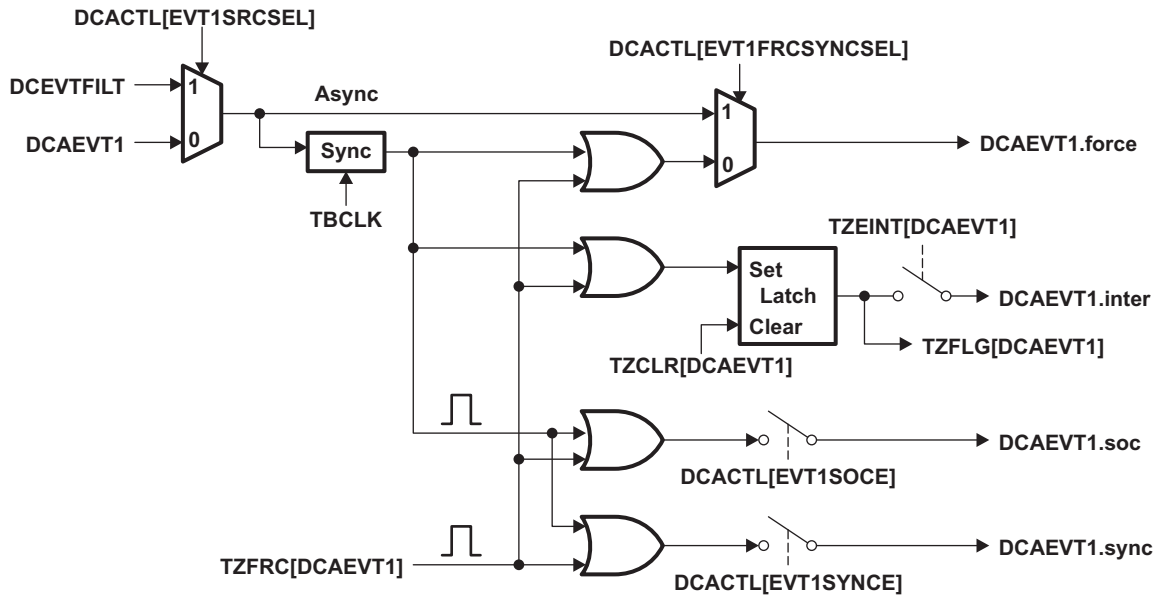


Figure 13-51. DCAEVT2 Event Triggering

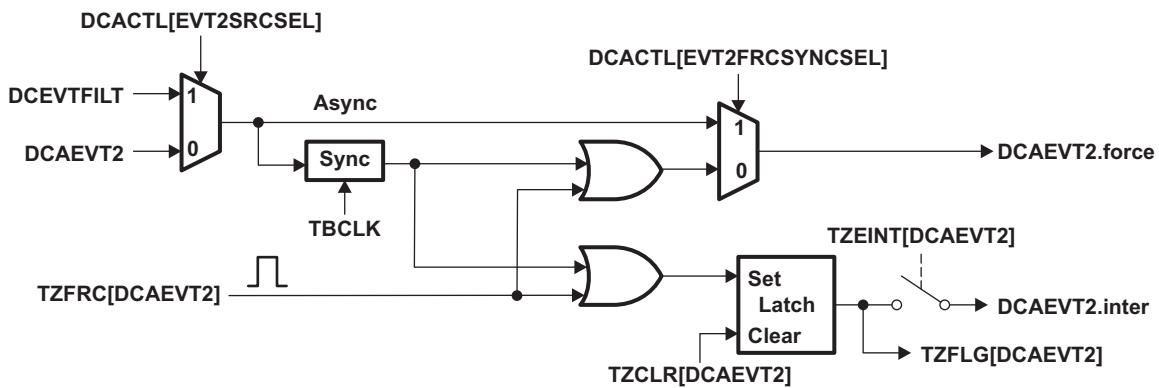




Figure 13-52 and Figure 13-53 show how the DCBEVT1, DCBEVT2 or DCEVTFLT signals are processed to generate the digital compare B event force, interrupt, soc and sync signals.

Figure 13-52. DCBEVT1 Event Triggering

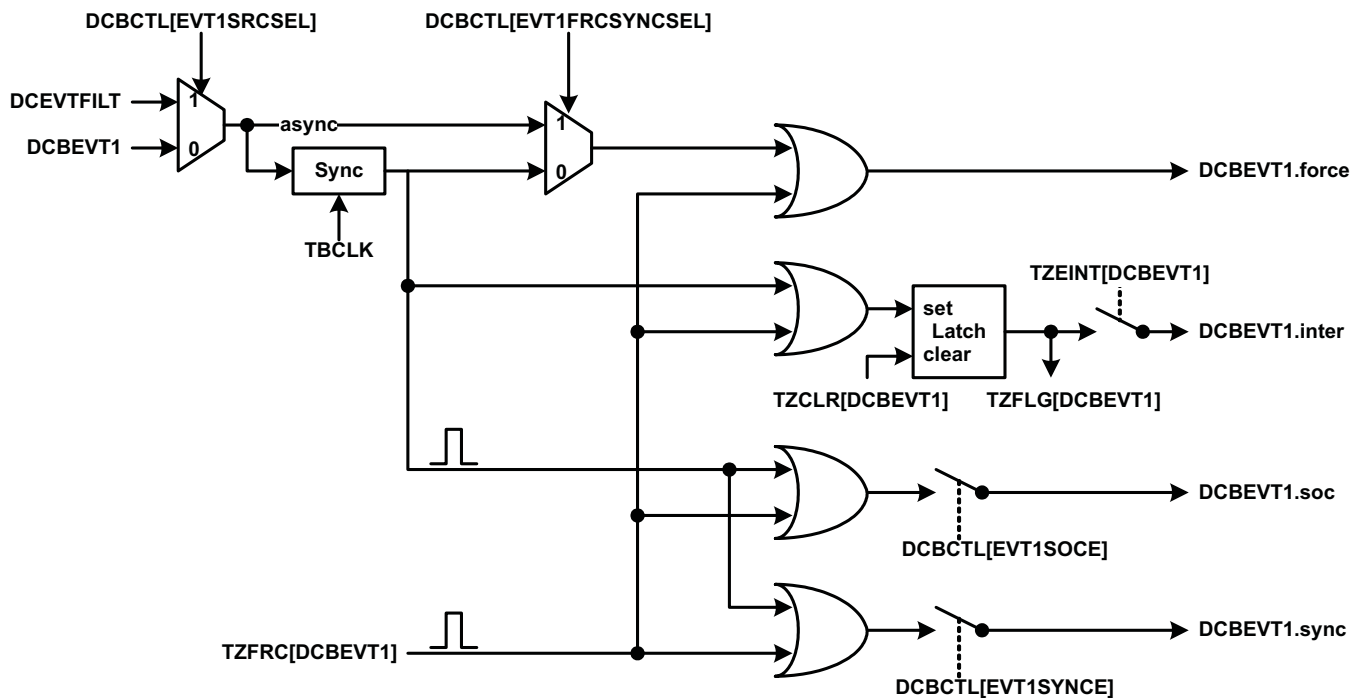
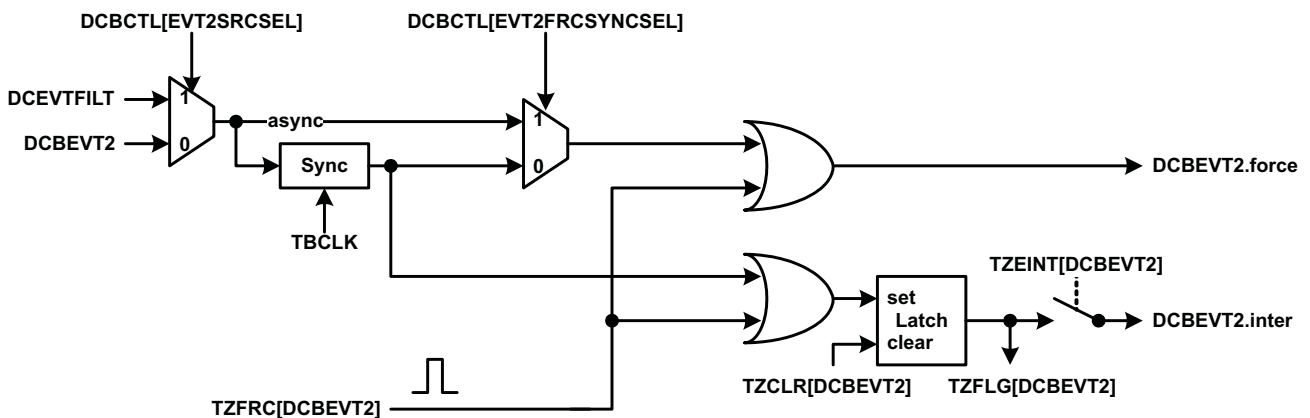


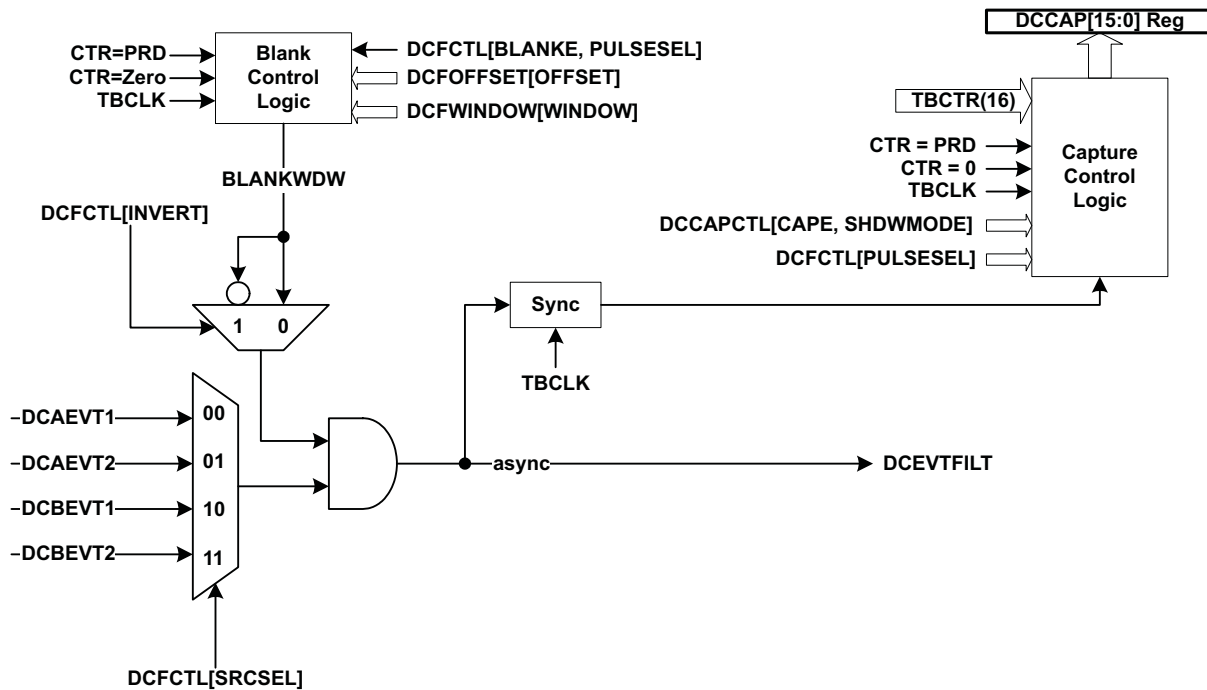
Figure 13-53. DCBEVT2 Event Triggering



### 13.11.4.2 Event Filtering

The DCAEVT1/2 and DCBEVT1/2 events can be filtered via event filtering logic to remove noise by optionally blanking events for a certain period of time. This is useful for cases where the analog comparator outputs may be selected to trigger DCAEVT1/2 and DCBEVT1/2 events, and the blanking logic is used to filter out potential noise on the signal prior to tripping the PWM outputs or generating an interrupt or ADC start-of-conversion. The event filtering can also capture the TBCTR value of the trip event. Figure 13-54 shows the details of the event filtering logic.

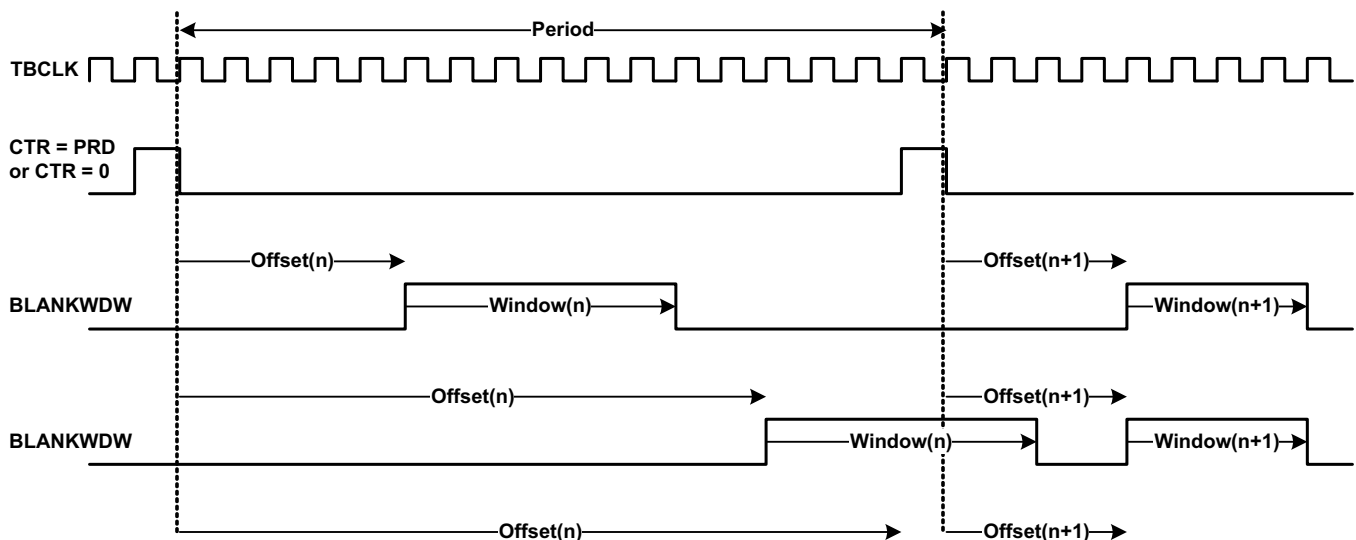
Figure 13-54. Event Filtering



If the blanking logic is enabled, one of the digital compare events – DCAEVT1, DCAEVT2, DCBEVT1, DCBEVT2 – is selected for filtering. The blanking window, which filters out all event occurrences on the signal while it is active, will be aligned to either a CTR = PRD pulse or a CTR = 0 pulse or both CTR = PRD and CTR = 0 (configured by the DCFCTL[PULSESEL] bits). An offset value in TBCLK counts is programmed into the DCFOFFSET register, which determines at what point after the CTR = PRD or CTR = 0 pulse the blanking window starts. The duration of the blanking window, in number of TBCLK counts after the offset counter expires, is written to the DCFWINDOW register by the application. During the blanking window, all events are ignored. Before and after the blanking window ends, events can generate soc, sync, interrupt, and force signals as before.

The diagram below illustrates several timing conditions for the offset and blanking window within an ePWM period. Notice that if the blanking window crosses the CTR = 0 or CTR = PRD boundary, the next window still starts at the same offset value after the CTR = 0 or CTR = PRD pulse.

Figure 13-55. Blanking Window Timing Diagram



### 13.11.4.3 Valley Switching

Event filtering depicts the valley switching function along with the event filtering logic described in [Section 13.11.4.2](#). This function can be used to achieve programmable valley switching without any additional external circuitry. This module provides an on-chip hardware mechanism that can:

- Capture the oscillation period
- Accurately delay the PWM switching instant
- Allow a programmable number of edges before the delay takes effect
- Provide multiple choices of triggers and events
- Allow easy adaptability for optimum performance under changing system/operating conditions

The DCxEVty signal needs further processing to support valley switching. Here is a brief description of how valley switching function is enabled:

1. Select one of the DCxEVty events as input to the valley switching block (DCFCTL[SRCSSEL]) with an option to add the blanking window (Blank Control Logic). This is where the comparator output (or external input) above is selected as an input to the valley switching block.
2. Configure the edge filter to capture 'n' rising, falling or both edges through the edge selection logic (DCFCTL[EDGEMODE, EDGECOUNT]).
3. Select the correct event to reset and restart the edge filter (VCAPCTL[TRIGSEL]). Edge capturing event is triggered or armed by this selected edge.
4. Enable valley capture logic (VCAPCTL[VCAPE]).
5. Select the start edge that will indicate the start of capture for oscillation period measurement (VCNTCFG[STARTEDGE]). This is where the 16-bit counter starts counting.
6. Select the stop edge (VCNTCFG[STOPEEDGE]) that will indicate the edge at which the 16-bit counter stops counting. The captured counter value (CNTVAL) provides oscillation period information.
  - The STOPEEDGE value must always be greater than STARTEDGE value.
7. Configure and apply the captured delay (CNTVAL) to the edge filtered DCxEVty signal. The CNTVAL value may be applied as is or applied in conjunction with a software programmed value (useful for offset adjustment) (SWVDELVAL) or only a fraction of the delay may be applied with or without SWVDELVAL. This is useful to correctly apply a delay corresponding to the valley point. (VCAPCTL[VDELAYDIV])
8. Configure VCAPCTL[EDGEFILTDLYSEL] to apply hardware delay based on the captured value above.

Once the counter is stopped, counter value is copied into CNTVAL register and counter is reset to zero. No further captures are done until the logic is triggered again by occurrence of event selected by VCAPCTL[TRIGSEL]. In this implementation, the software trigger is used as the source for VCAPCTL[TRIGSEL]. Upon occurrence of the trigger event, irrespective of the current status of the counter, the counter is reset and starts counting from zero upon occurrence of the STARTEDGE. Similarly, upon occurrence of the trigger event, the edge filter is reset and starts counting from zero upon occurrence of the STARTEDGE.

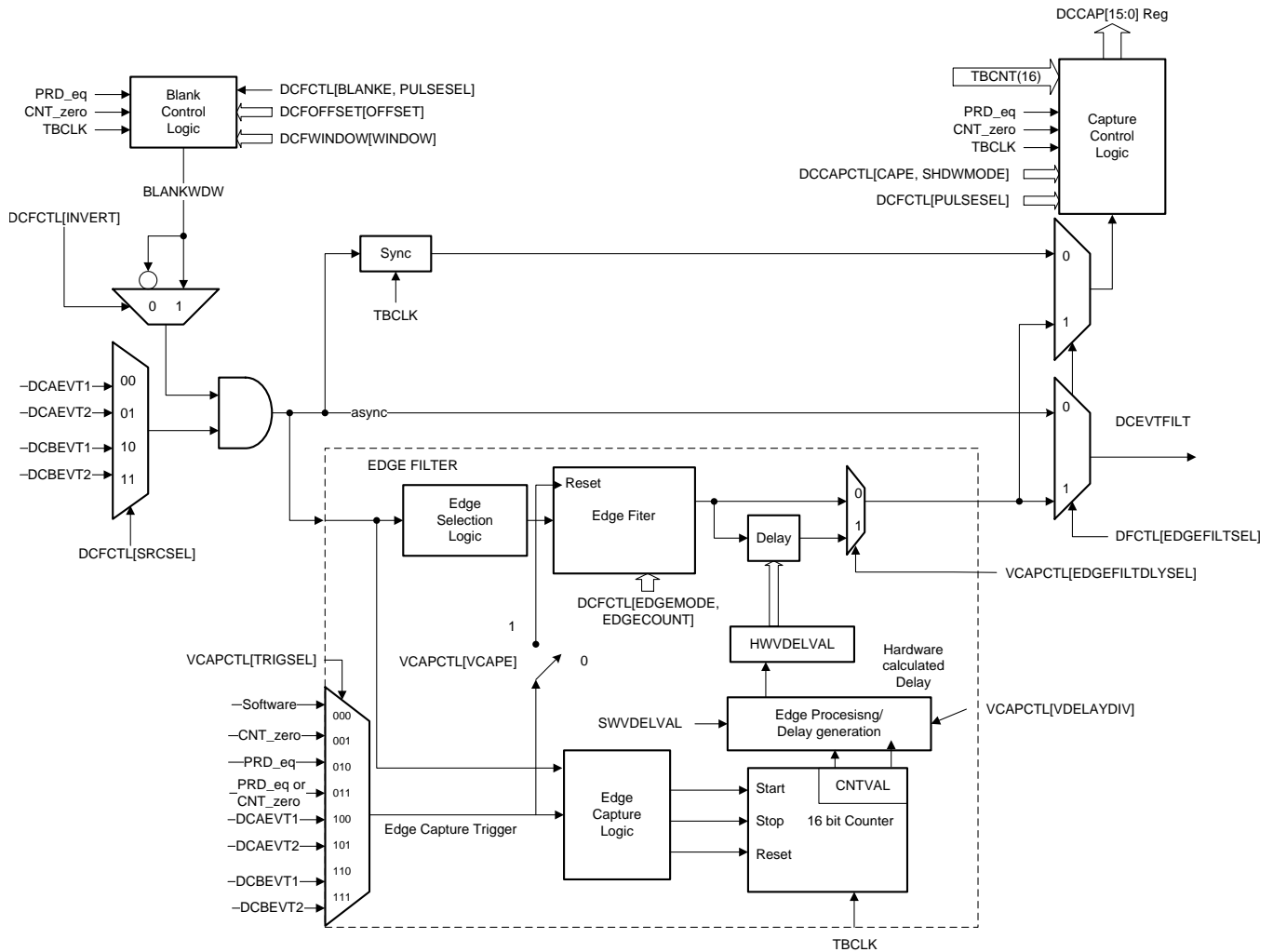
Output from the valley switching block (DCEVTFILT) is then used to synchronize the PWM time-base. The process is shown in [Figure 13-56](#).

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**NOTE:** A specific application example showcasing the usage of valley switching hardware and software is available on the controlSuite.

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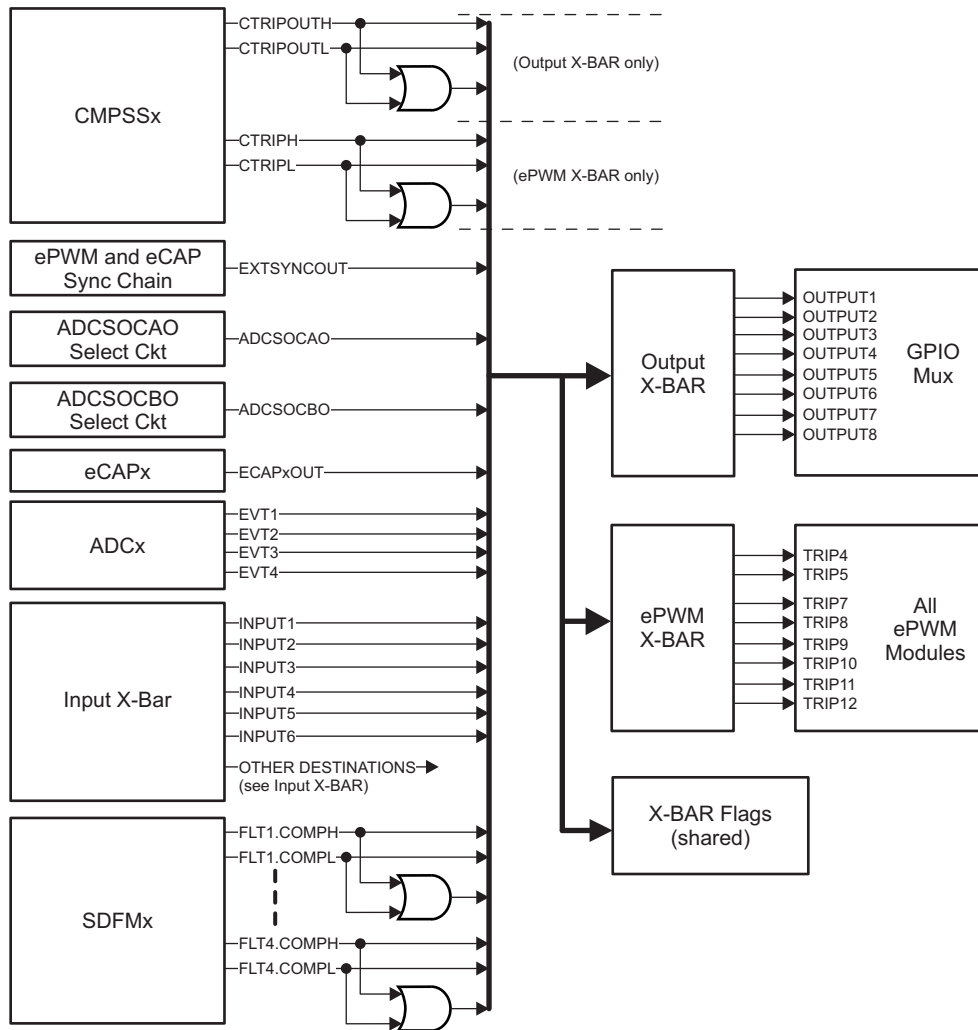
Figure 13-56. Valley Switching



### 13.12 EPWM X-BAR

Figure 13-57 shows the connections to the EPWM X-Bar. This module enables selection of various trigger sources into any of the eight dedicated ETWPM trips inputs, namely the TRIP4, TRIP5, TRIP7, TRIP8, TRIP9, TRIP10, TRIP11 and TRIP12. See the *Crossbar (X-BAR)* chapter for details on the X-BAR architecture and configuration.

Figure 13-57. EPWM X-BAR

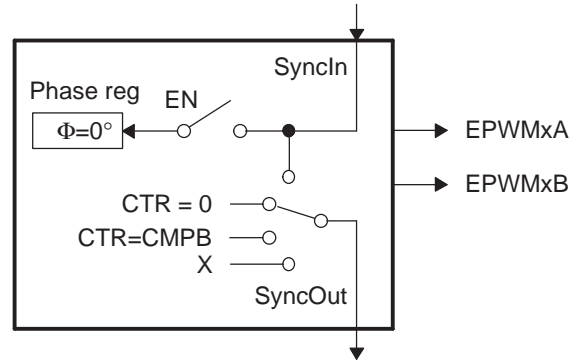


### 13.13 Applications to Power Topologies

An ePWM module has all the local resources necessary to operate completely as a standalone module or to operate in synchronization with other identical ePWM modules.

#### 13.13.1 Overview of Multiple Modules

Previously in this chapter, all discussions have described the operation of a single module. To facilitate the understanding of multiple modules working together in a system, the ePWM module described in reference is represented by the more simplified block diagram shown in Figure 13-58. This simplified ePWM block shows only the key resources needed to explain how a multiswitch power topology is controlled with multiple ePWM modules working together.

**Figure 13-58. Simplified ePWM Module**


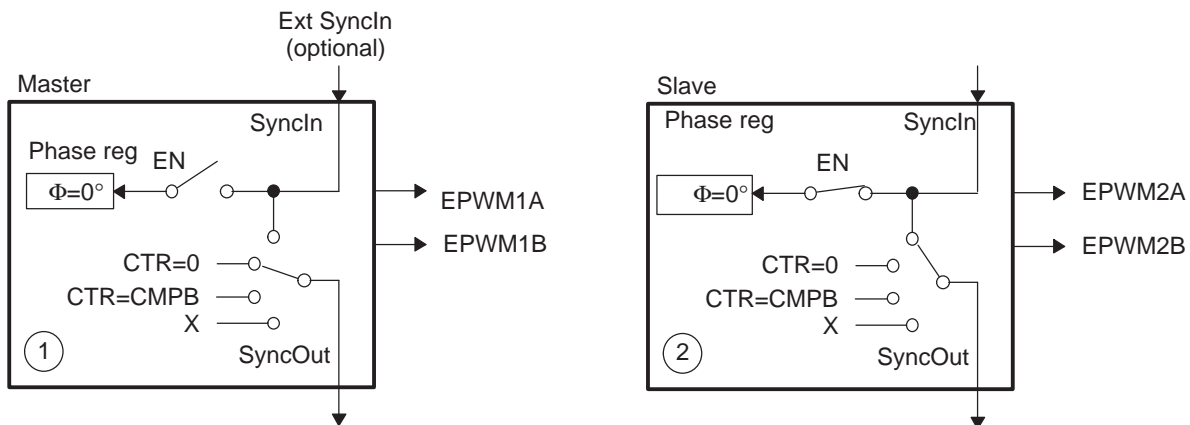
### 13.13.2 Key Configuration Capabilities

The key configuration choices available to each module are as follows:

- Options for SyncIn
  - Load own counter with phase register on an incoming sync strobe—enable (EN) switch closed
  - Do nothing or ignore incoming sync strobe—enable switch open
  - Sync flow-through - SyncOut connected to SyncIn
  - Master mode, provides a sync at PWM boundaries—SyncOut connected to CTR = PRD
  - Master mode, provides a sync at any programmable point in time—SyncOut connected to CTR = CMPB
  - Module is in standalone mode and provides No sync to other modules—SyncOut connected to X (disabled)
- Options for SyncOut
  - Sync flow-through - SyncOut connected to SyncIn
  - Master mode, provides a sync at PWM boundaries—SyncOut connected to CTR = PRD
  - Master mode, provides a sync at any programmable point in time—SyncOut connected to CTR = CMPB
  - Module is in standalone mode and provides No sync to other modules—SyncOut connected to X (disabled)

For each choice of SyncOut, a module may also choose to load its own counter with a new phase value on a SyncIn strobe input or choose to ignore it (that is, via the enable switch). Although various combinations are possible, the two most common—master module and slave module modes—are shown in [Figure 13-59](#).

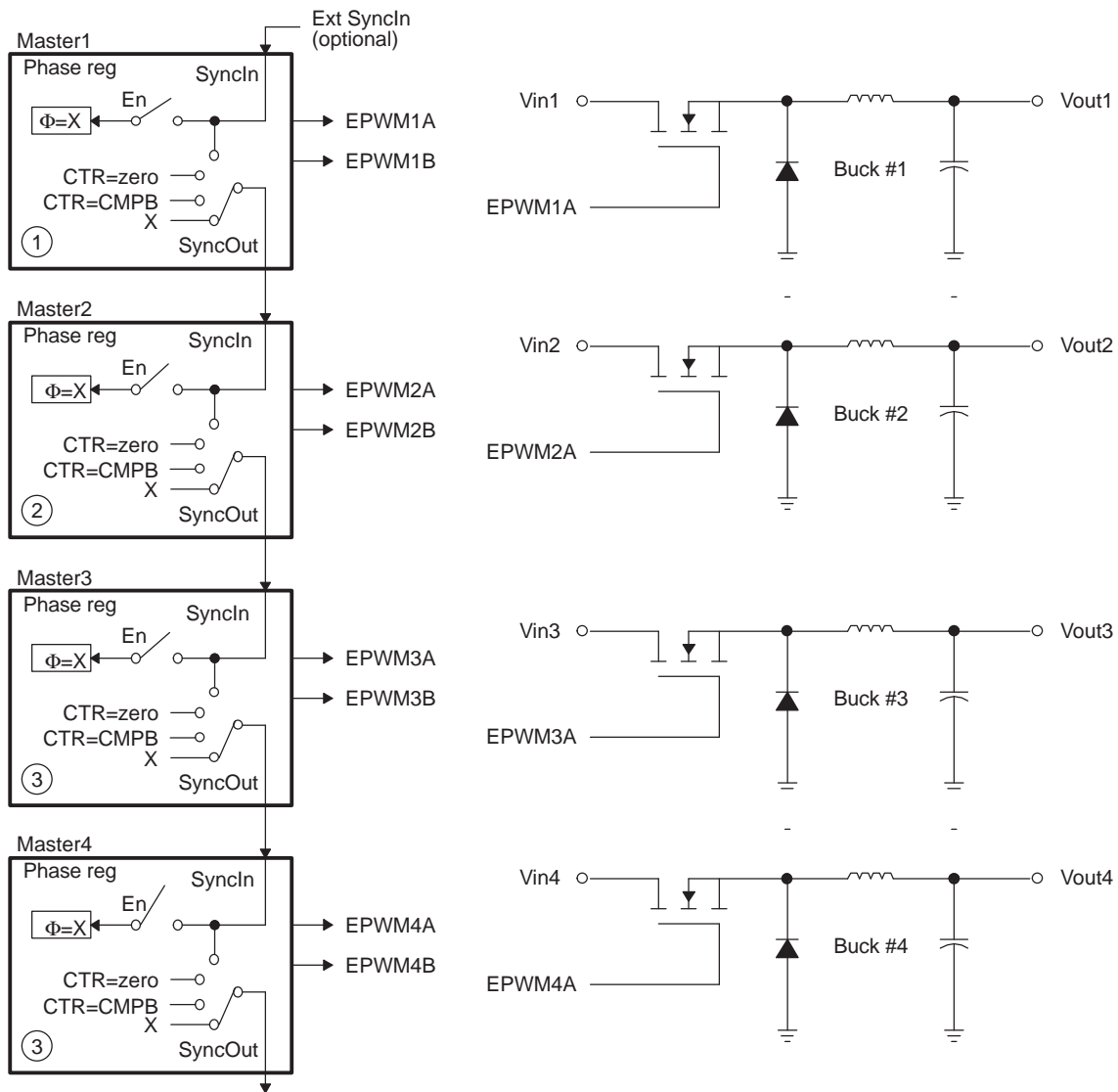
Figure 13-59. EPWM1 Configured as a Typical Master, EPWM2 Configured as a Slave



### 13.13.3 Controlling Multiple Buck Converters With Independent Frequencies

One of the simplest power converter topologies is the buck. A single ePWM module configured as a master can control two buck stages with the same PWM frequency. If independent frequency control is required for each buck converter, then one ePWM module must be allocated for each converter stage. Figure 13-60 shows four buck stages, each running at independent frequencies. In this case, all four ePWM modules are configured as Masters and no synchronization is used. Figure 13-61 shows the waveforms generated by the setup shown in Figure 13-60; note that only three waveforms are shown, although there are four stages.

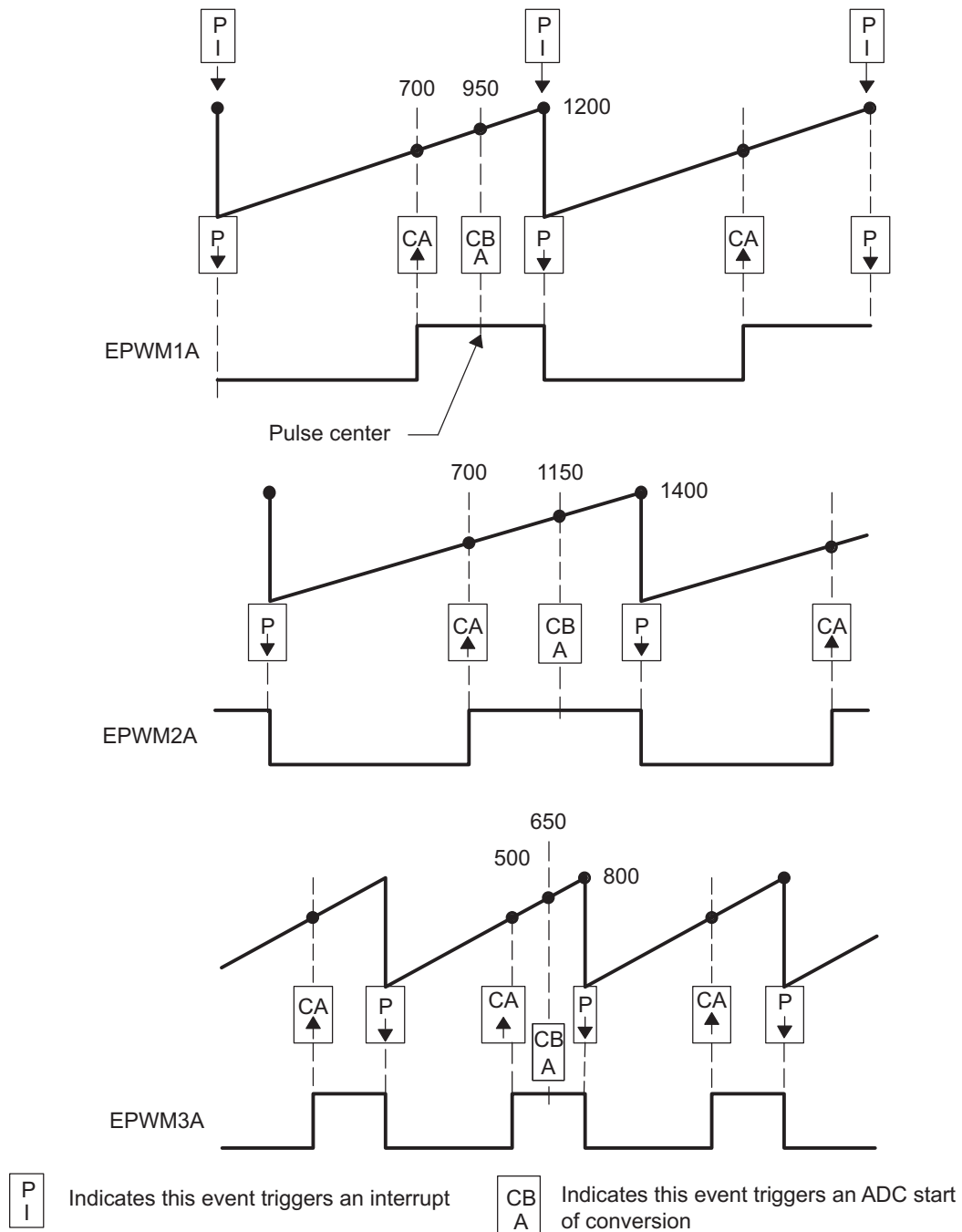
**Figure 13-60. Control of Four Buck Stages. Here  $F_{PWM1} \neq F_{PWM2} \neq F_{PWM3} \neq F_{PWM4}$**



NOTE:  $\phi = X$  indicates value in phase register is a "don't care"



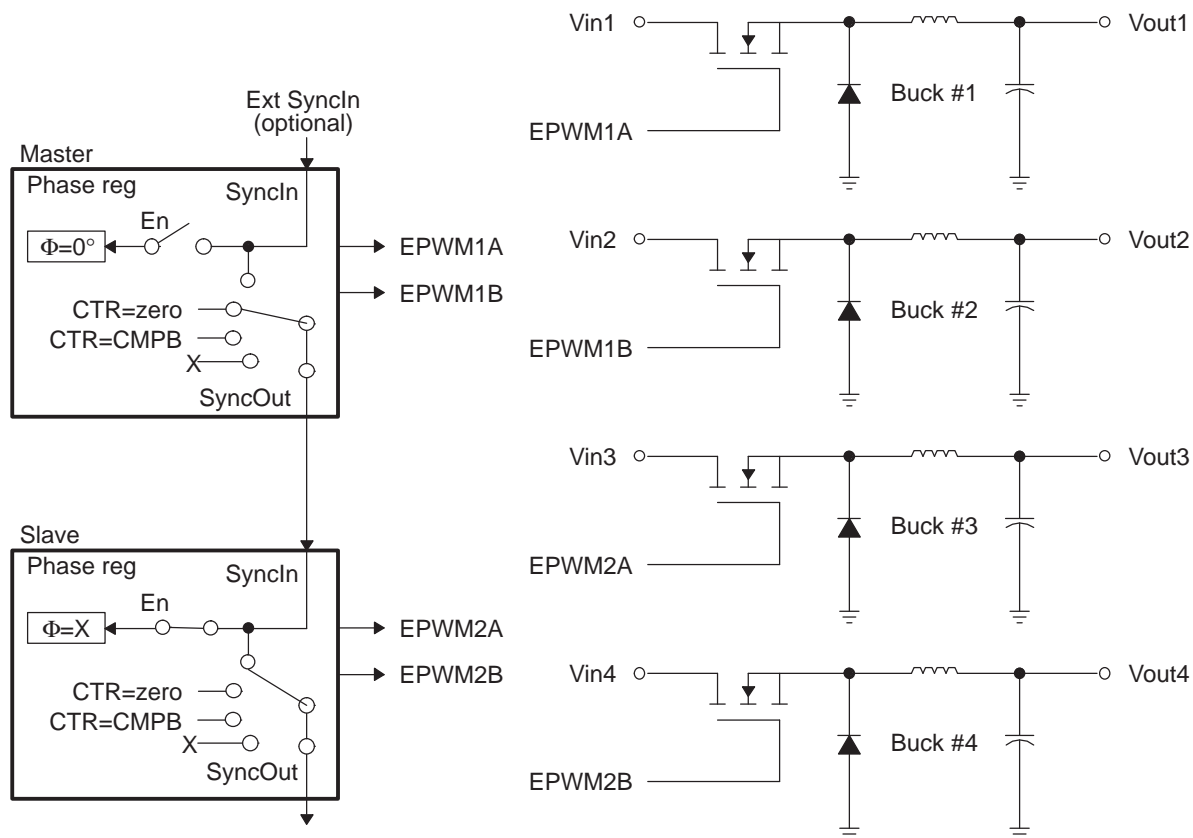
Figure 13-61. Buck Waveforms for Figure 13-60 (Note: Only three bucks shown here)



### 13.13.4 Controlling Multiple Buck Converters With Same Frequencies

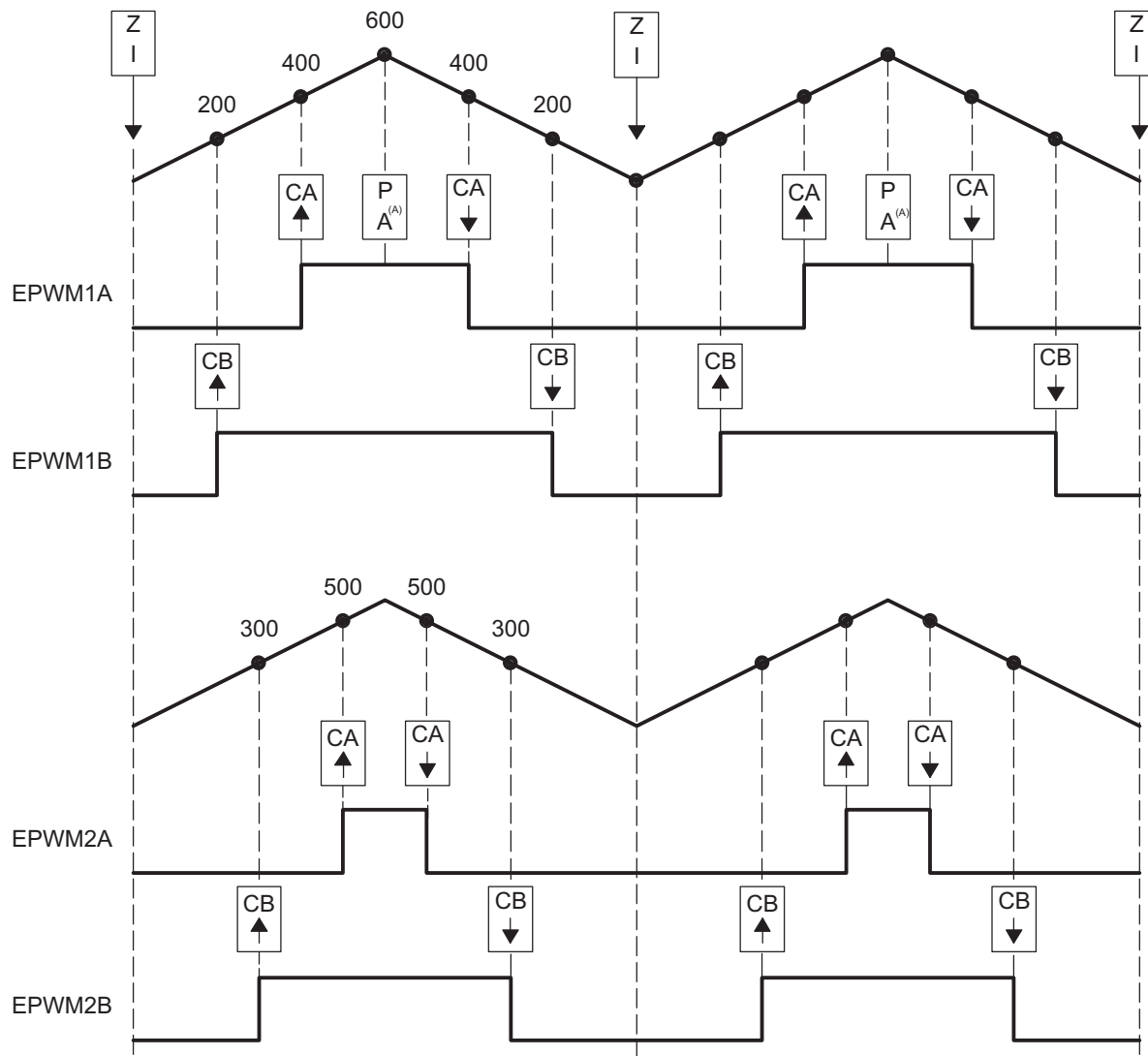
If synchronization is a requirement, ePWM module 2 can be configured as a slave and can operate at integer multiple (N) frequencies of module 1. The sync signal from master to slave ensures these modules remain locked. Figure 13-62 shows such a configuration; Figure 13-63 shows the waveforms generated by the configuration.

**Figure 13-62. Control of Four Buck Stages. (Note:  $F_{PWM2} = N \times F_{PWM1}$ )**



NOTE:  $\phi = X$  indicates value in phase register is a "don't care"

Figure 13-63. Buck Waveforms for Figure 13-62 (Note:  $F_{PWM2} = F_{PWM1}$ )



A Starts ADC conversion.

### 13.13.5 Controlling Multiple Half H-Bridge (HHB) Converters

Topologies that require control of multiple switching elements can also be addressed with these same ePWM modules. It is possible to control a Half-H bridge stage with a single ePWM module. This control can be extended to multiple stages. Figure 13-64 shows control of two synchronized Half-H bridge stages where stage 2 can operate at integer multiple (N) frequencies of stage 1. Figure 13-65 shows the waveforms generated by the configuration shown in Figure 13-64.

Module 2 (slave) is configured for Sync flow-through; if required, this configuration allows for a third Half-H bridge to be controlled by PWM module 3 and also, most importantly, to remain in synchronization with master module 1.

Figure 13-64. Control of Two Half-H Bridge Stages ( $F_{P_{WM2}} = N \times F_{P_{WM1}}$ )

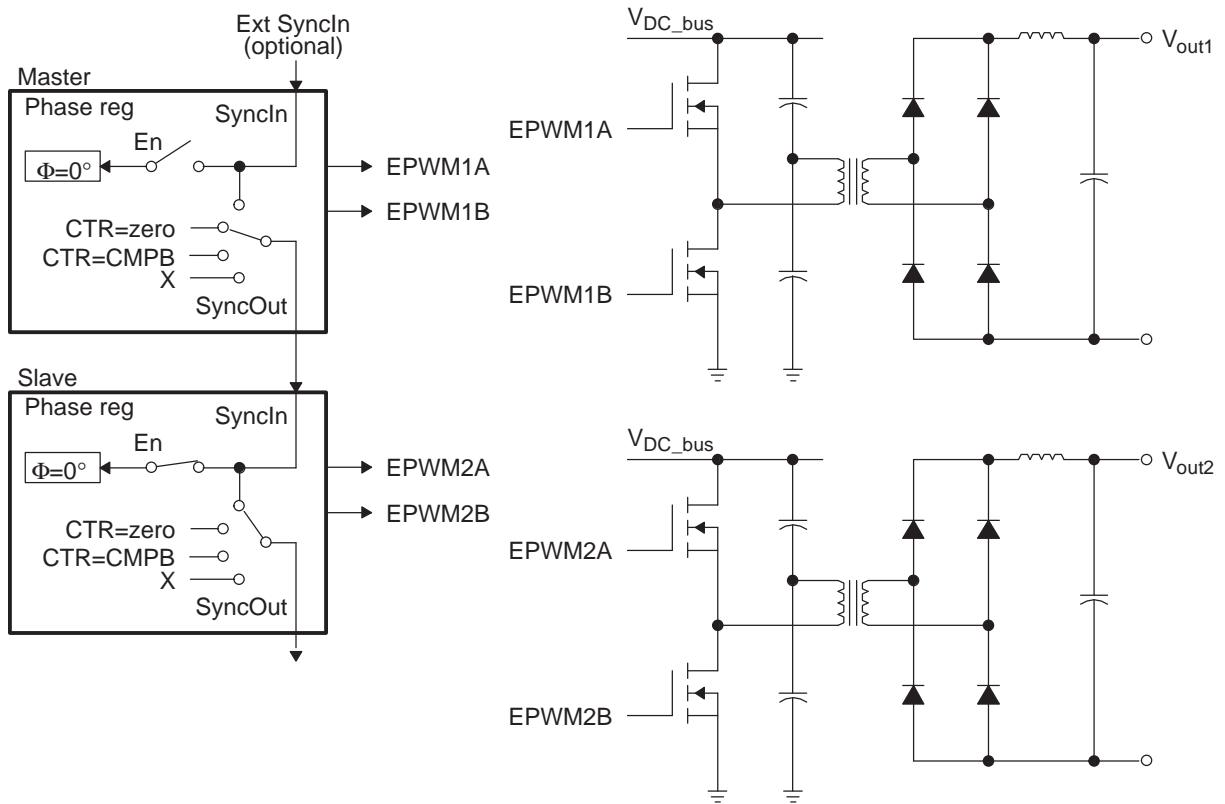
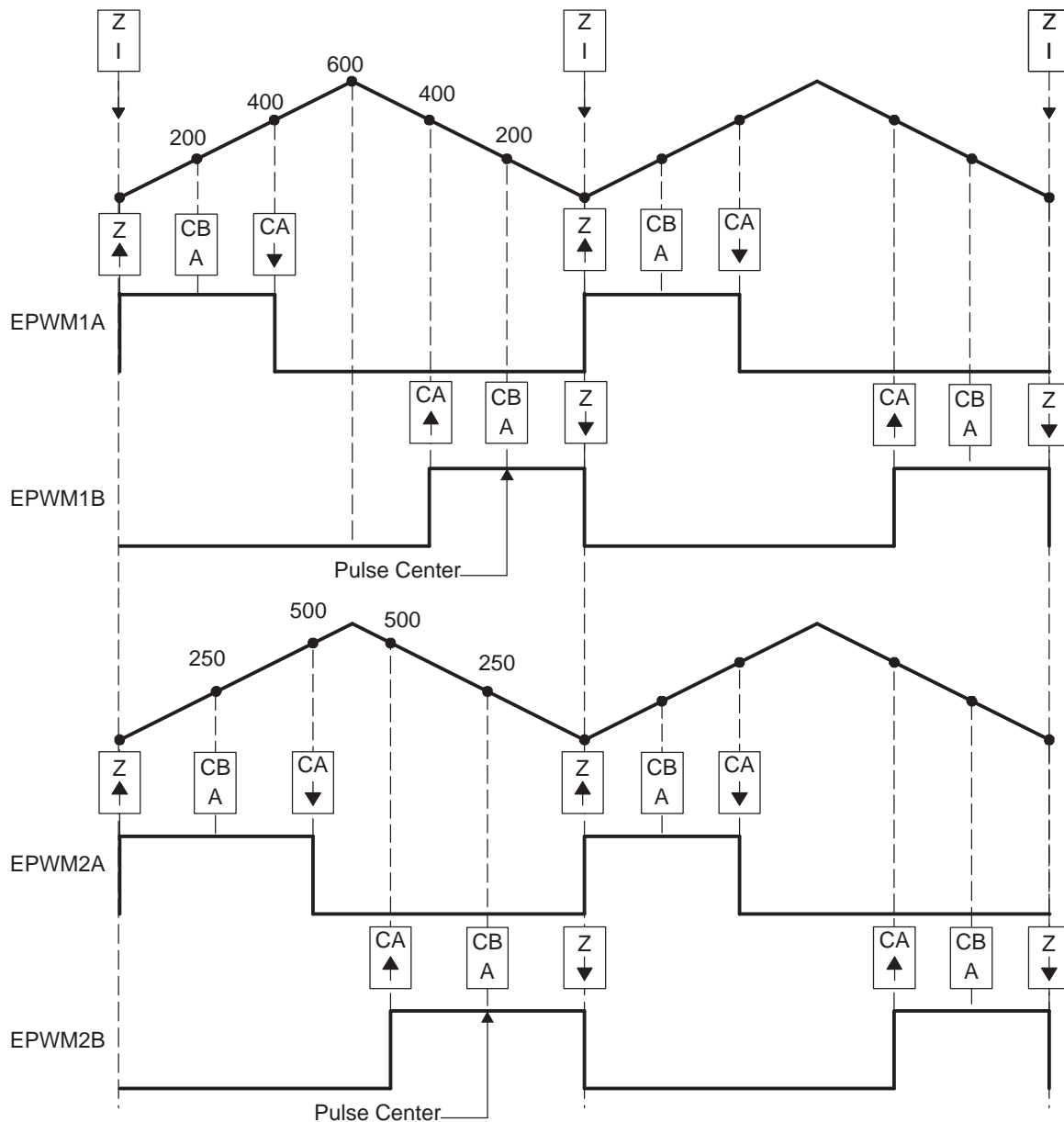


Figure 13-65. Half-H Bridge Waveforms for Figure 13-64 (Note: Here  $F_{P_{WM2}} = F_{P_{WM1}}$ )

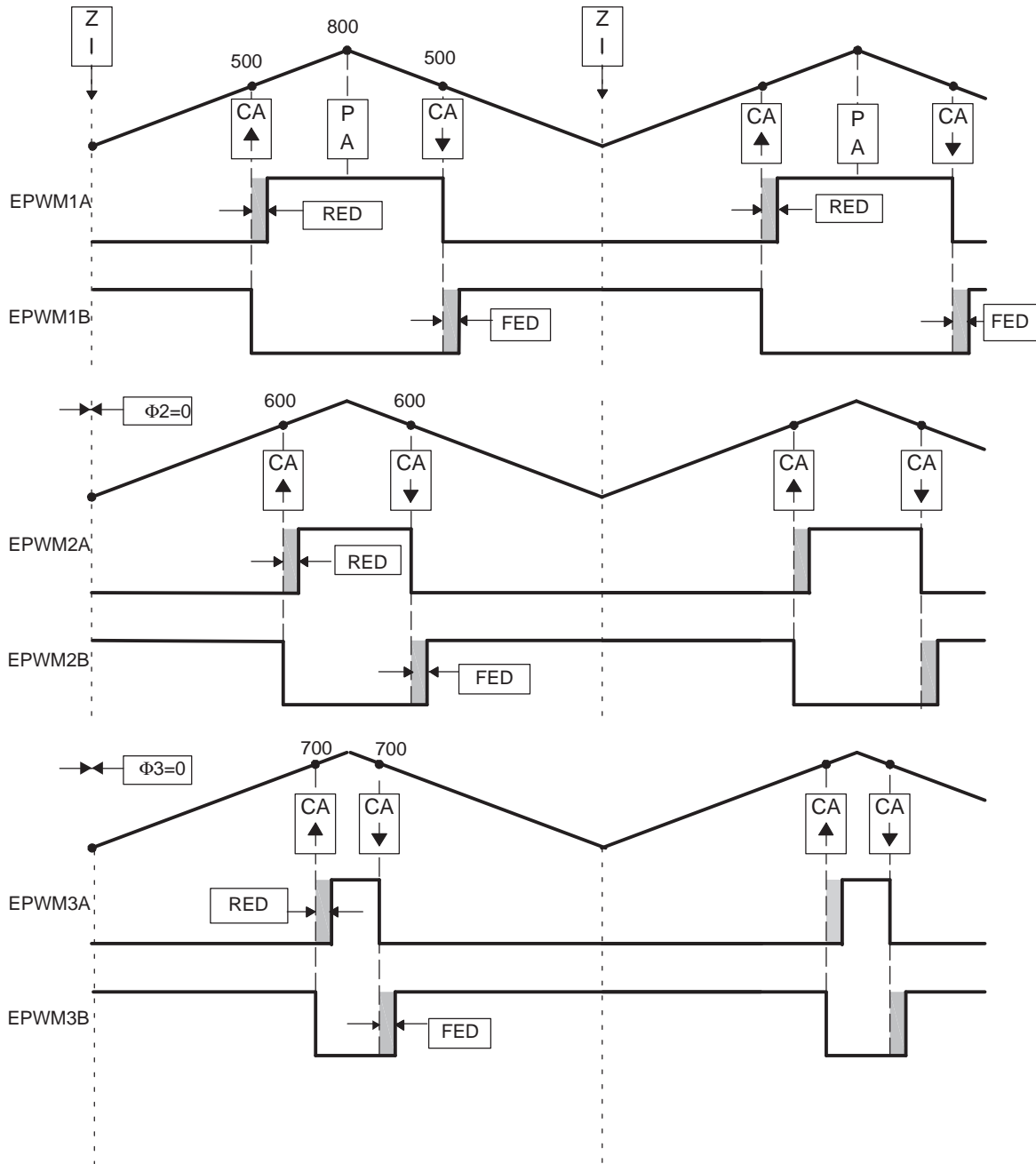


### 13.13.6 Controlling Dual 3-Phase Inverters for Motors (ACI and PMSM)

The idea of multiple modules controlling a single power stage can be extended to the 3-phase Inverter case. In such a case, six switching elements can be controlled using three PWM modules, one for each leg of the inverter. Each leg must switch at the same frequency and all legs must be synchronized. A master + two slaves configuration can easily address this requirement.

As in the cases shown in the previous sections, we have a choice of running each inverter at a different frequency (module 1 and module 4 are masters or both inverters can be synchronized by using one master (module 1) and five slaves. In this case, the frequency of modules 4, 5, and 6 (all equal) can be integer multiples of the frequency for modules 1, 2, 3 (also all equal).

Figure 13-66. 3-Phase Inverter Waveforms (Only One Inverter Shown)



### 13.13.7 Practical Applications Using Phase Control Between PWM Modules

So far, none of the examples have made use of the phase register (TBPHS). It has either been set to zero or its value has been a don't care. However, by programming appropriate values into TBPHS, multiple PWM modules can address another class of power topologies that rely on phase relationship between legs (or stages) for correct operation. As described in the TB module section, a PWM module can be configured to allow a SyncIn pulse to cause the TBPHS register to be loaded into the TBCTR register. To illustrate this concept, Figure 13-67 shows a master and slave module with a phase relationship of 120° (that is, the slave leads the master).

Figure 13-67. Configuring Two PWM Modules for Phase Control

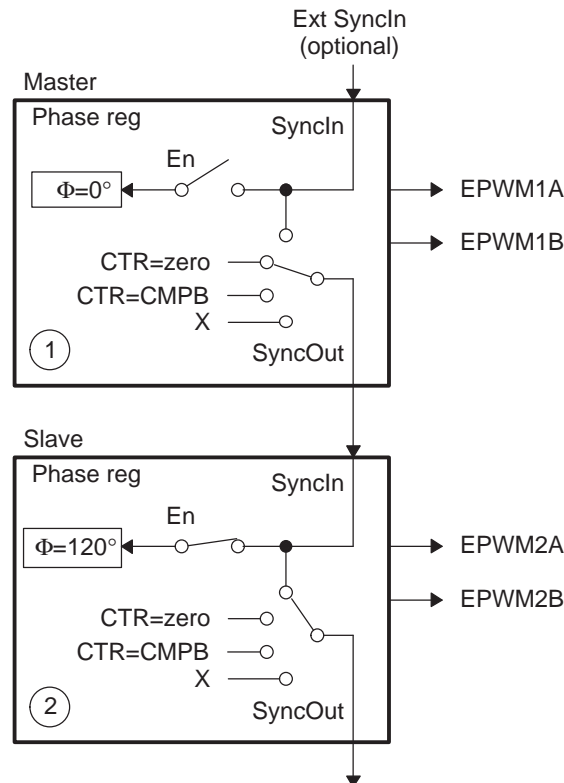
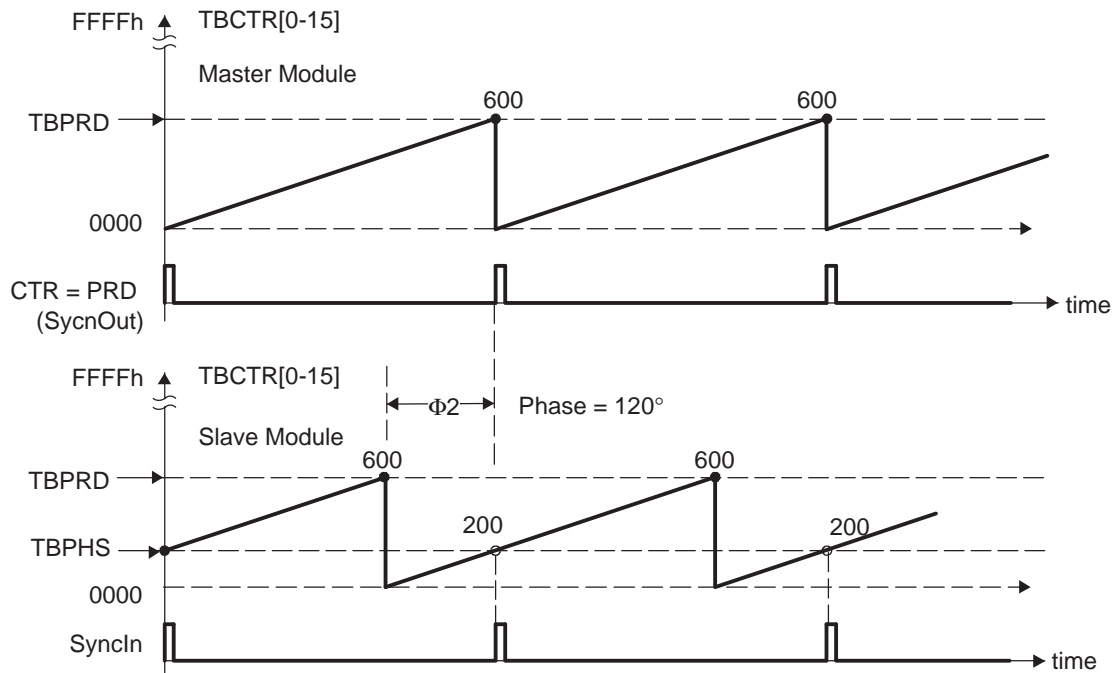


Figure 13-68 shows the associated timing waveforms for this configuration. Here, TBPRD = 600 for both master and slave. For the slave, TBPHS = 200 (that is,  $200/600 \times 360^\circ = 120^\circ$ ). Whenever the master generates a SyncIn pulse (CTR = PRD), the value of TBPHS = 200 is loaded into the slave TBCTR register so the slave time-base is always leading the master's time-base by 120°.

**Figure 13-68. Timing Waveforms Associated With Phase Control Between Two Modules**


### 13.13.8 Controlling a 3-Phase Interleaved DC/DC Converter

A popular power topology that makes use of phase-offset between modules is shown in [Figure 13-69](#). This system uses three PWM modules, with module 1 configured as the master. To work, the phase relationship between adjacent modules must be  $F = 120^\circ$ . This is achieved by setting the slave TBPHS registers 2 and 3 with values of 1/3 and 2/3 of the period value, respectively. For example, if the period register is loaded with a value of 600 counts, then TBPHS (slave 2) = 200 and TBPHS (slave 3) = 400. Both slave modules are synchronized to the master 1 module.

This concept can be extended to four or more phases, by setting the TBPHS values appropriately. The following formula gives the TBPHS values for N phases:

$$\text{TBPHS}(N,M) = (\text{TBPRD}/N) \times (M-1)$$

Where:

N = number of phases

M = PWM module number

For example, for the 3-phase case (N=3), TBPRD = 600,

$\text{TBPHS}(3,2) = (600/3) \times (2-1) = 200$  (that is, Phase value for Slave module 2)

$\text{TBPHS}(3,3) = 400$  (that is, Phase value for Slave module 3)

[Figure 13-70](#) shows the waveforms for the configuration in [Figure 13-69](#).



Figure 13-69. Control of a 3-Phase Interleaved DC/DC Converter

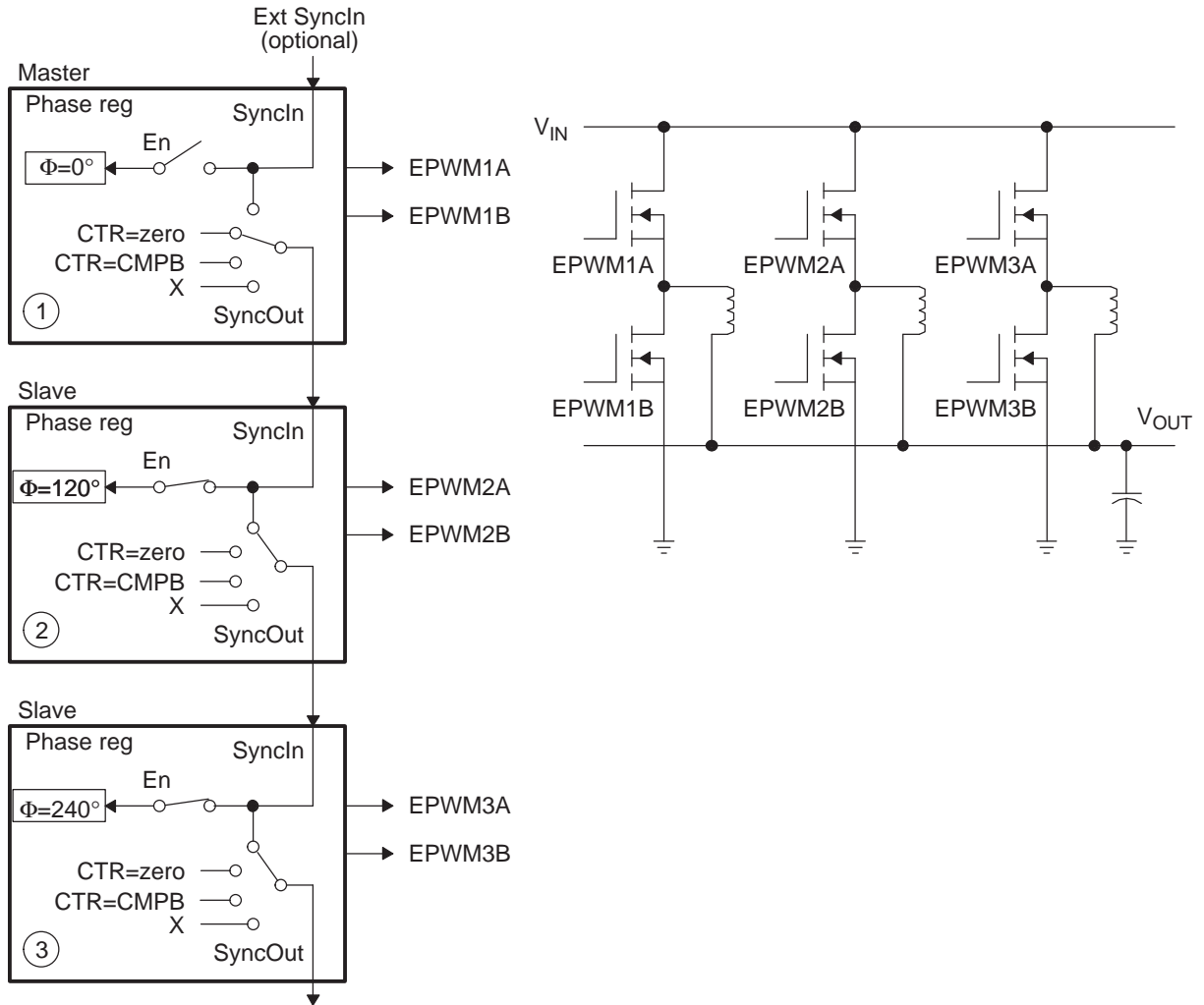
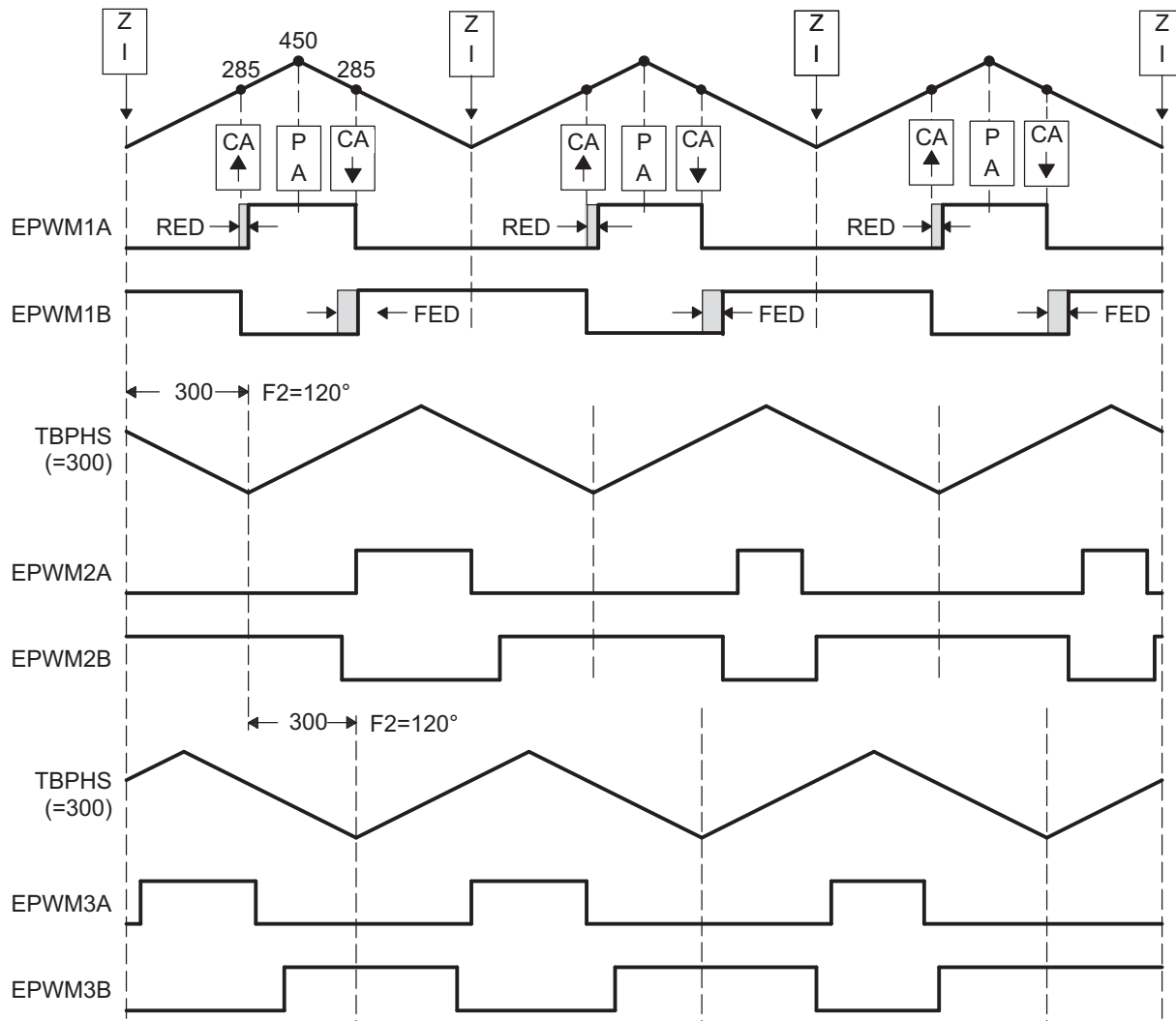


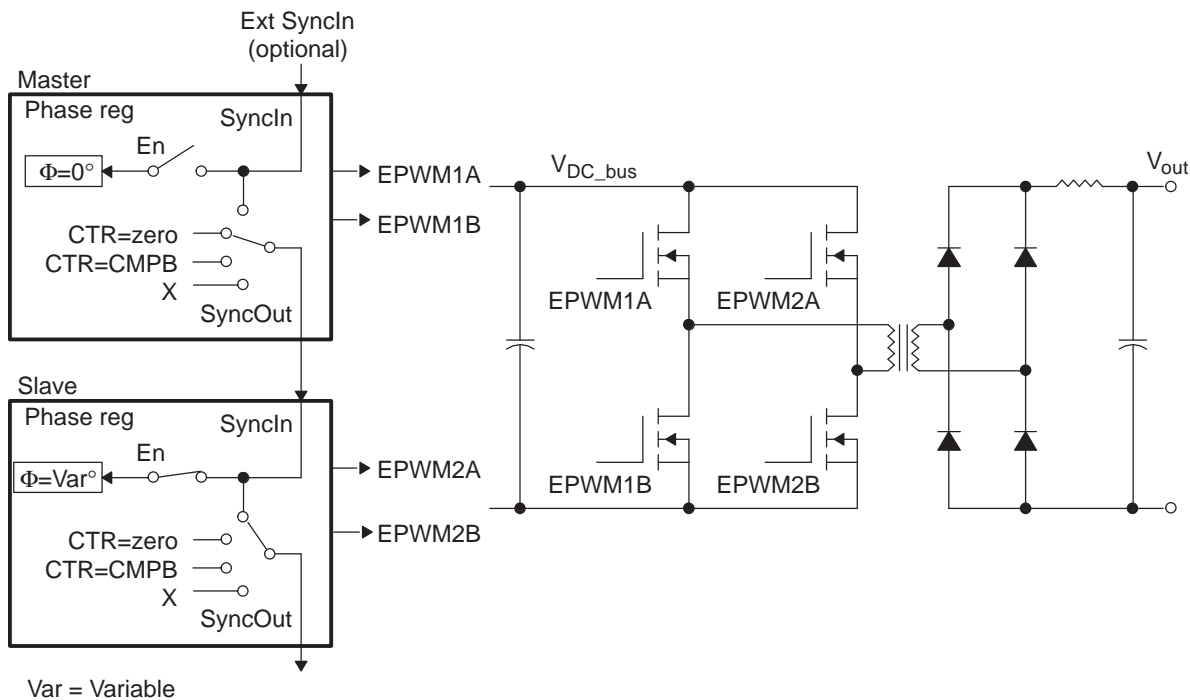
Figure 13-70. 3-Phase Interleaved DC/DC Converter Waveforms for Figure 13-69

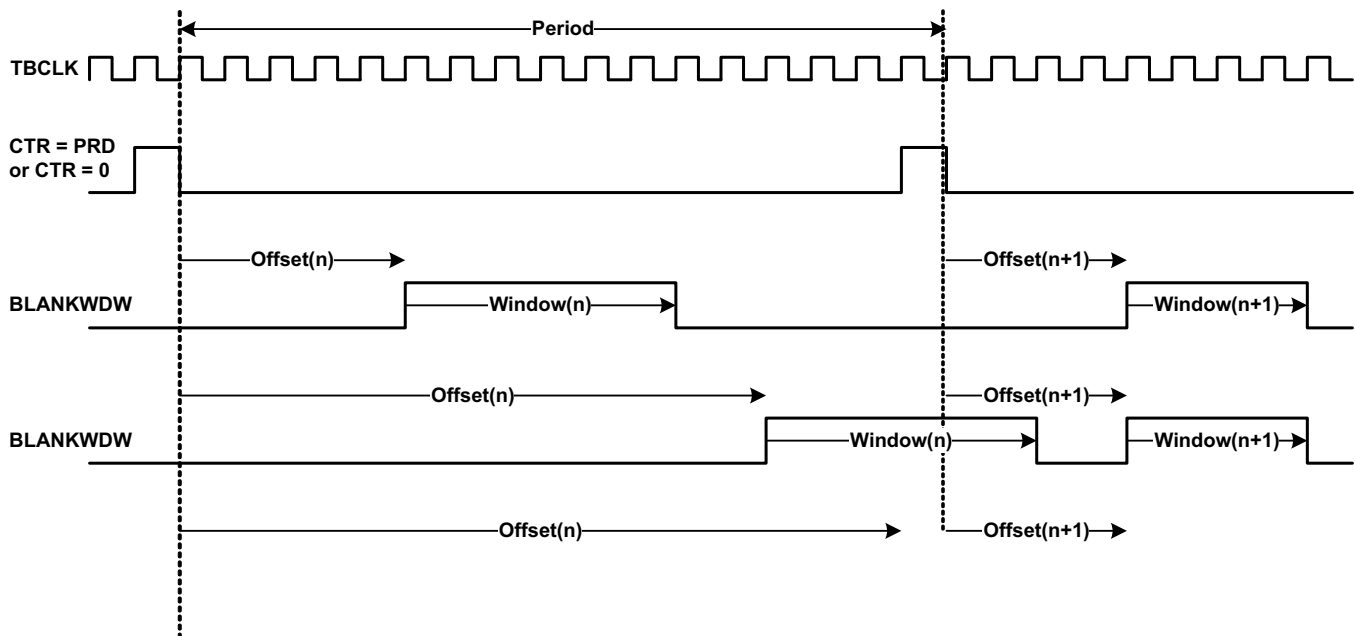


### 13.13.9 Controlling Zero Voltage Switched Full Bridge (ZVSFB) Converter

The example given in Figure 13-71 assumes a static or constant phase relationship between legs (modules). In such a case, control is achieved by modulating the duty cycle. It is also possible to dynamically change the phase value on a cycle-by-cycle basis. This feature lends itself to controlling a class of power topologies known as *phase-shifted full bridge*, or *zero voltage switched full bridge*. Here the controlled parameter is not duty cycle (this is kept constant at approximately 50 percent); instead it is the phase relationship between legs. Such a system can be implemented by allocating the resources of two PWM modules to control a single power stage, which in turn requires control of four switching elements. Figure 13-72 shows a master/slave module combination synchronized together to control a full H-bridge. In this case, both master and slave modules are required to switch at the same PWM frequency. The phase is controlled by using the slave's phase register (TBPHS). The master's phase register is not used and therefore can be initialized to zero.

Figure 13-71. Controlling a Full-H Bridge Stage ( $F_{PWM2} = F_{PWM1}$ )



**Figure 13-72. ZVS Full-H Bridge Waveforms**


### 13.13.10 Controlling a Peak Current Mode Controlled Buck Module

Peak current control techniques offer a number of benefits like automatic over current limiting, fast correction for input voltage variations and reducing magnetic saturation. [Figure 13-73](#) shows the use of ePWM1A along with the on-chip analog comparator for buck converter topology. The output current is sensed through a current sense resistor and fed to the positive terminal of the on-chip comparator. The internal programmable 10-bit DAC can be used to provide a reference peak current at the negative terminal of the comparator. Alternatively, an external reference could be connected at this input. The comparator output is an input to the Digital compare sub-module. The ePWM module is configured in such a way so as to trip the ePWM1A output as soon as the sensed current reaches the peak reference value. A cycle-by-cycle trip mechanism is used. [Figure 13-74](#) shows the waveforms generated by the configuration.

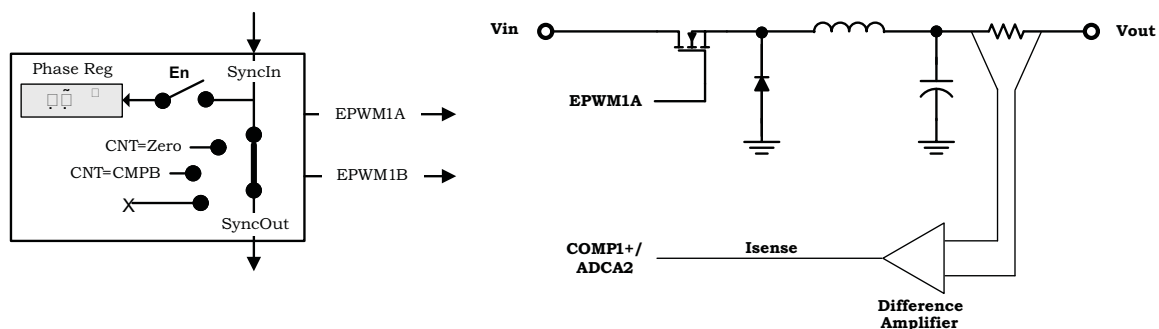
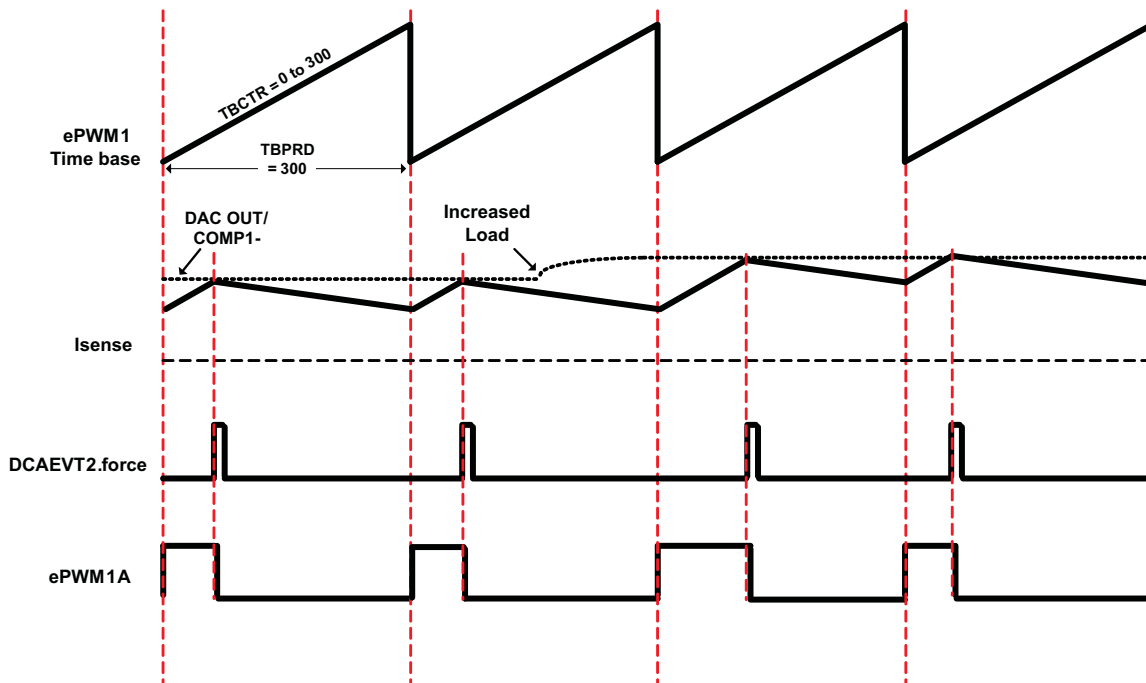
**Figure 13-73. Peak Current Mode Control of a Buck Converter**


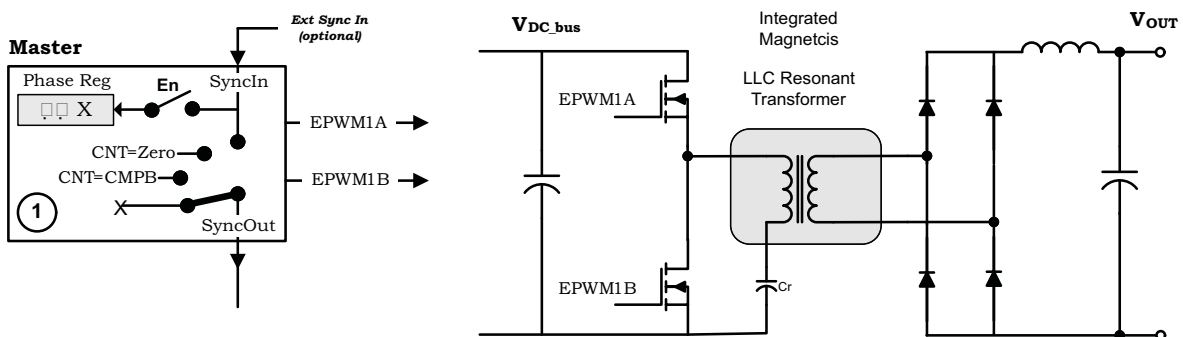
Figure 13-74. Peak Current Mode Control Waveforms for Figure 13-73



### 13.13.11 Controlling H-Bridge LLC Resonant Converter

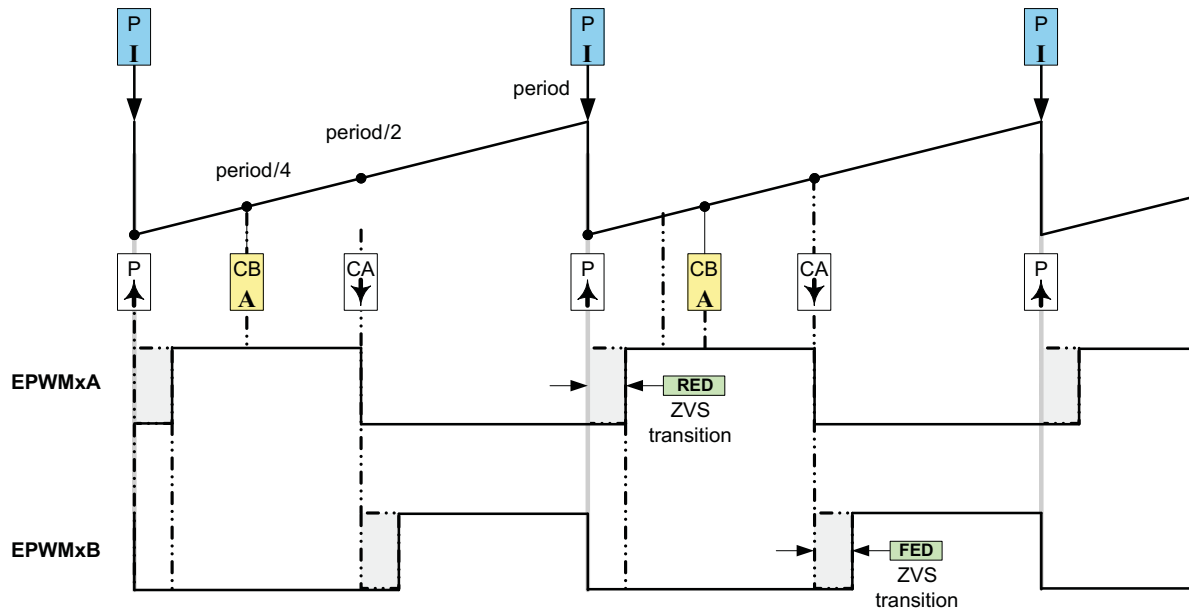
Various topologies of resonant converters are well-known in the field of power electronics for many years. In addition to these, H-bridge LLC resonant converter topology has recently gained popularity in many consumer electronics applications where high efficiency and power density are required. In this example single channel configuration of ePWM1 is detailed, yet the configuration can easily be extended to multi channel. Here the controlled parameter is not duty cycle (this is kept constant at approximately 50 percent); instead it is frequency. Although the deadband is not controlled and kept constant as 300ns (that is, 30 @ 100MHz TBCLK), it is up to user to update it in real time to enhance the efficiency by adjusting enough time delay for soft switching.

Figure 13-75. Control of Two Resonant Converter Stages



NOTE:  $\Theta = X$  indicates value in phase register is 'don't care'

Figure 13-76. H-Bridge LLC Resonant Converter PWM Waveforms



Indicates this event triggers an interrupt



Indicates this event triggers an ADC start of conversion

## 13.14 Registers

### 13.14.1 EPWM Base Addresses

**Table 13-13. EPWM Base Address Table**

Device Register	Register Name	Start Address	End Address
EPwm1Regs	EPWM_REGS	0x0000_4000	0x0000_40FF
EPwm2Regs	EPWM_REGS	0x0000_4100	0x0000_41FF
EPwm3Regs	EPWM_REGS	0x0000_4200	0x0000_42FF
EPwm4Regs	EPWM_REGS	0x0000_4300	0x0000_43FF
EPwm5Regs	EPWM_REGS	0x0000_4400	0x0000_44FF
EPwm6Regs	EPWM_REGS	0x0000_4500	0x0000_45FF
EPwm7Regs	EPWM_REGS	0x0000_4600	0x0000_46FF
EPwm8Regs	EPWM_REGS	0x0000_4700	0x0000_47FF
EPwm9Regs	EPWM_REGS	0x0000_4800	0x0000_48FF
EPwm10Regs	EPWM_REGS	0x0000_4900	0x0000_49FF
EPwm11Regs	EPWM_REGS	0x0000_4A00	0x0000_4AFF
EPwm12Regs	EPWM_REGS	0x0000_4B00	0x0000_4BFF
EPwmXbarRegs	EPWM_XBAR_REGS	0x0000_7A00	0x0000_7A3F
SyncSocRegs	SYNC_SOC_REGS	0x0000_7940	0x0000_794F

### 13.14.2 EPWM\_REGS Registers

Table 13-14 lists the memory-mapped registers for the EPWM\_REGS. All register offset addresses not listed in Table 13-14 should be considered as reserved locations and the register contents should not be modified.

**Table 13-14. EPWM\_REGS Registers**

Offset	Acronym	Register Name	Write Protection	Section
0h	TBCTL	Time Base Control Register		<a href="#">Go</a>
1h	TBCTL2	Time Base Control Register 2		<a href="#">Go</a>
3h	EPWMSYNCSINSEL	EPWMxSYNCSIN Source Select Register		<a href="#">Go</a>
4h	TBCTR	Time Base Counter Register		<a href="#">Go</a>
5h	TBSTS	Time Base Status Register		<a href="#">Go</a>
6h	EPWMSYNCSOUTEN	EPWMxSYNCSOUT Source Enable Register		<a href="#">Go</a>
8h	CMPCTL	Counter Compare Control Register		<a href="#">Go</a>
9h	CMPCTL2	Counter Compare Control Register 2		<a href="#">Go</a>
Ch	DBCTL	Dead-Band Generator Control Register		<a href="#">Go</a>
Dh	DBCTL2	Dead-Band Generator Control Register 2		<a href="#">Go</a>
10h	AQCTL	Action Qualifier Control Register		<a href="#">Go</a>
11h	AQTSRCSSEL	Action Qualifier Trigger Event Source Select Register		<a href="#">Go</a>
14h	PCCTL	PWM Chopper Control Register		<a href="#">Go</a>
18h	VCAPCTL	Valley Capture Control Register		<a href="#">Go</a>
19h	VCNTCFG	Valley Counter Config Register		<a href="#">Go</a>
20h	HRCNFG	HRPWM Configuration Register	EALLOW	<a href="#">Go</a>
21h	HRPWR	HRPWM Power Register	EALLOW	<a href="#">Go</a>
26h	HRMSTEP	HRPWM MEP Step Register	EALLOW	<a href="#">Go</a>
27h	HRCNFG2	HRPWM Configuration 2 Register	EALLOW	<a href="#">Go</a>
2Dh	HRPCTL	High Resolution Period Control Register	EALLOW	<a href="#">Go</a>
2Eh	TRREM	Translator High Resolution Remainder Register	EALLOW	<a href="#">Go</a>
34h	GLDCTL	Global PWM Load Control Register	EALLOW	<a href="#">Go</a>
35h	GLDCFG	Global PWM Load Config Register	EALLOW	<a href="#">Go</a>
38h	EPWMXLINK	EPWMx Link Register		<a href="#">Go</a>
3Eh	EPWMREV	EPWM Revision Register		<a href="#">Go</a>
40h	AQCTLA	Action Qualifier Control Register For Output A		<a href="#">Go</a>
41h	AQCTLA2	Additional Action Qualifier Control Register For Output A		<a href="#">Go</a>
42h	AQCTLB	Action Qualifier Control Register For Output B		<a href="#">Go</a>
43h	AQCTLB2	Additional Action Qualifier Control Register For Output B		<a href="#">Go</a>
47h	AQSFRC	Action Qualifier Software Force Register		<a href="#">Go</a>
49h	AQCSFRC	Action Qualifier Continuous S/W Force Register		<a href="#">Go</a>
50h	DBREDHR	Dead-Band Generator Rising Edge Delay High Resolution Mirror Register		<a href="#">Go</a>
51h	DBRED	Dead-Band Generator Rising Edge Delay High Resolution Mirror Register		<a href="#">Go</a>
52h	DBFEDHR	Dead-Band Generator Falling Edge Delay High Resolution Register		<a href="#">Go</a>
53h	DBFED	Dead-Band Generator Falling Edge Delay Count Register		<a href="#">Go</a>
60h	TBPHS	Time Base Phase High		<a href="#">Go</a>
62h	TBPRDHR	Time Base Period High Resolution Register		<a href="#">Go</a>
63h	TBPRD	Time Base Period Register		<a href="#">Go</a>



**Table 13-14. EPWM\_REGS Registers (continued)**

Offset	Acronym	Register Name	Write Protection	Section
6Ah	CMPA	Counter Compare A Register		<a href="#">Go</a>
6Ch	CMPB	Compare B Register		<a href="#">Go</a>
6Fh	CMPC	Counter Compare C Register		<a href="#">Go</a>
71h	CMPD	Counter Compare D Register		<a href="#">Go</a>
74h	GLDCTL2	Global PWM Load Control Register 2	EALLOW	<a href="#">Go</a>
77h	SWVDELVAL	Software Valley Mode Delay Register		<a href="#">Go</a>
80h	TZSEL	Trip Zone Select Register	EALLOW	<a href="#">Go</a>
82h	TZDCSEL	Trip Zone Digital Comparator Select Register	EALLOW	<a href="#">Go</a>
84h	TZCTL	Trip Zone Control Register	EALLOW	<a href="#">Go</a>
85h	TZCTL2	Additional Trip Zone Control Register	EALLOW	<a href="#">Go</a>
86h	TZCTLDCA	Trip Zone Control Register Digital Compare A	EALLOW	<a href="#">Go</a>
87h	TZCTLDCB	Trip Zone Control Register Digital Compare B	EALLOW	<a href="#">Go</a>
8Dh	TZEINT	Trip Zone Enable Interrupt Register	EALLOW	<a href="#">Go</a>
93h	TZFLG	Trip Zone Flag Register		<a href="#">Go</a>
94h	TZCBCFLG	Trip Zone CBC Flag Register		<a href="#">Go</a>
95h	TZOSTFLG	Trip Zone OST Flag Register		<a href="#">Go</a>
97h	TZCLR	Trip Zone Clear Register	EALLOW	<a href="#">Go</a>
98h	TZCBCCLR	Trip Zone CBC Clear Register	EALLOW	<a href="#">Go</a>
99h	TZOSTCLR	Trip Zone OST Clear Register	EALLOW	<a href="#">Go</a>
9Bh	TZFRC	Trip Zone Force Register	EALLOW	<a href="#">Go</a>
A4h	ETSEL	Event Trigger Selection Register		<a href="#">Go</a>
A6h	ETPS	Event Trigger Pre-Scale Register		<a href="#">Go</a>
A8h	ETFLG	Event Trigger Flag Register		<a href="#">Go</a>
AAh	ETCLR	Event Trigger Clear Register		<a href="#">Go</a>
ACh	ETFRC	Event Trigger Force Register		<a href="#">Go</a>
A Eh	ETINTPS	Event-Trigger Interrupt Pre-Scale Register		<a href="#">Go</a>
B0h	ETSOCPS	Event-Trigger SOC Pre-Scale Register		<a href="#">Go</a>
B2h	ETCNTINITCTL	Event-Trigger Counter Initialization Control Register		<a href="#">Go</a>
B4h	ETCNTINIT	Event-Trigger Counter Initialization Register		<a href="#">Go</a>
C0h	DCTRISEL	Digital Compare Trip Select Register	EALLOW	<a href="#">Go</a>
C3h	DCACTL	Digital Compare A Control Register	EALLOW	<a href="#">Go</a>
C4h	DCBCTL	Digital Compare B Control Register	EALLOW	<a href="#">Go</a>
C7h	DCFCTL	Digital Compare Filter Control Register	EALLOW	<a href="#">Go</a>
C8h	DCCAPCTL	Digital Compare Capture Control Register	EALLOW	<a href="#">Go</a>
C9h	DCFOFFSET	Digital Compare Filter Offset Register		<a href="#">Go</a>
CAh	DCFOFFSETCNT	Digital Compare Filter Offset Counter Register		<a href="#">Go</a>
CBh	DCFWINDOW	Digital Compare Filter Window Register		<a href="#">Go</a>
CCh	DCFWINDOWCNT	Digital Compare Filter Window Counter Register		<a href="#">Go</a>
CFh	DCCAP	Digital Compare Counter Capture Register		<a href="#">Go</a>
D2h	DCAHTRIPSEL	Digital Compare AH Trip Select	EALLOW	<a href="#">Go</a>
D3h	DCALTRIPSEL	Digital Compare AL Trip Select	EALLOW	<a href="#">Go</a>
D4h	DCBHTRIPSEL	Digital Compare BH Trip Select	EALLOW	<a href="#">Go</a>
D5h	DCBLTRIPSEL	Digital Compare BL Trip Select	EALLOW	<a href="#">Go</a>
FAh	EPWMLOCK	EPWM Lock Register		<a href="#">Go</a>
FDh	HWVDELVAL	Hardware Valley Mode Delay Register		<a href="#">Go</a>
FEh	VCNTVAL	Hardware Valley Counter Register		<a href="#">Go</a>

Complex bit access types are encoded to fit into small table cells. [Table 13-15](#) shows the codes that are used for access types in this section.

**Table 13-15. EPWM\_REGS Access Type Codes**

Access Type	Code	Description
<b>Read Type</b>		
R	R	Read
R=0	R	Read
<b>Write Type</b>		
W	W	Write
W1C	1C W	1 to clear Write
W=1	W	Write
WOnce	W	Write
<b>Reset or Default Value</b>		
-n		Value after reset or the default value
<b>Register Array Variables</b>		
i,j,k,l,m,n		When these variables are used in a register name, an offset, or an address, they refer to the value of a register array where the register is part of a group of repeating registers. The register groups form a hierarchical structure and the array is represented with a formula.
y		When this variable is used in a register name, an offset, or an address it refers to the value of a register array.

**13.14.2.1 TBCTL Register (Offset = 0h) [reset = 83h]**

TBCTL is shown in [Figure 13-77](#) and described in [Table 13-16](#).

Return to [Summary Table](#).

Time Base Control Register

**Figure 13-77. TBCTL Register**

15		14		13		12		11		10		9		8	
FREE_SOFT				PHSDIR		CLKDIV				HSPCLKDIV					
R/W-0h				R/W-0h		R/W-0h				R/W-1h					
7		6		5		4		3		2		1		0	
HSPCLKDIV		SWFSYNC		SYNCOSSEL				PRDLD		PHSEN		CTRMODE			
R/W-1h		R=0/W=1-0h		R/W-0h				R/W-0h		R/W-0h		R/W-3h			

**Table 13-16. TBCTL Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-14	FREE_SOFT	R/W	0h	<p>Emulation Mode Bits. These bits select the behavior of the ePWM time-base counter during emulation events</p> <p>00: Stop after the next time-base counter increment or decrement</p> <p>01: Stop when counter completes a whole cycle:</p> <ul style="list-style-type: none"> <li>- Up-count mode: stop when the time-base counter = period (TBCTR = TBPRD)</li> <li>- Down-count mode: stop when the time-base counter = 0x00 (TBCTR = 0x00)</li> <li>- Up-down-count mode: stop when the time-base counter = 0x00 (TBCTR = 0x00)</li> </ul> <p>1x: Free run</p> <p>Reset type: SYSRSn</p>
13	PHSDIR	R/W	0h	<p>Phase Direction Bit</p> <p>This bit is only used when the time-base counter is configured in the up-down-count mode. The PHSDIR bit indicates the direction the time-base counter (TBCTR) will count after a synchronization event occurs and a new phase value is loaded from the phase (TBPHS) register. This is irrespective of the direction of the counter before the synchronization event..</p> <p>In the up-count and down-count modes this bit is ignored.</p> <p>0: Count down after the synchronization event.</p> <p>1: Count up after the synchronization event.</p> <p>Reset type: SYSRSn</p>

**Table 13-16. TBCTL Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
12-10	CLKDIV	R/W	0h	<p>Time Base Clock Pre-Scale Bits</p> <p>These bits select the time base clock pre-scale value (TBCLK = EPWMCLK/(HSPCLKDIV * CLKDIV):</p> <p>000: /1 (default on reset)            001: /2            010: /4            011: /8            100: /16            101: /32            110: /64            111: /128</p> <p>Reset type: SYSRSn</p>
9-7	HSPCLKDIV	R/W	1h	<p>High Speed Time Base Clock Pre-Scale Bits</p> <p>These bits determine part of the time-base clock prescale value. TBCLK = EPWMCLK / (HSPCLKDIV x CLKDIV). This divisor emulates the HSPCLK in the TMS320x281x system as used on the Event Manager (EV) peripheral.</p> <p>000: /1            001: /2 (default on reset)            010: /4            011: /6            100: /8            101: /10            110: /12            111: /14</p> <p>Reset type: SYSRSn</p>
6	SWFSYNC	R=0/W=1	0h	<p>Software Forced Sync Pulse</p> <p>0: Writing a 0 has no effect and reads always return a 0.            1: Writing a 1 forces a one-time synchronization pulse to be generated.</p> <p>SWFSYNC affects EPWMxSYNCO only when SYNCOSSEL = 00.            Reset type: SYSRSn</p>
5-4	SYNCOSSEL	R/W	0h	<p>Sync Output Select</p> <p>00: EPWMxSYNCl / SWFSYNC            01: CTR = zero: Time-base counter equal to zero (TBCTR = 0x00)            10: CTR = CMPB : Time-base counter equal to counter-compare B (TBCTR = CMPB)            11: EPWMxSYNCO is defined by TBCTL2[SYNCOSSELX]</p> <p>Reset type: SYSRSn</p>
3	PRDL	R/W	0h	<p>Active Period Reg Load from Shadow Select</p> <p>0: The period register (TBPRD) is loaded from its shadow register when the time-base counter, TBCTR, is equal to zero and/or a sync event as determined by the TBCTL2[PRDLDSYNC] bit.            A write/read to the TBPRD register accesses the shadow register.</p> <p>1: Immediate Mode (Shadow register bypassed): A write or read to the TBPRD register accesses the active register.</p> <p>Reset type: SYSRSn</p>

**Table 13-16. TBCTL Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
2	PHSEN	R/W	0h	Counter Reg Load from Phase Reg Enable  0: Do not load the time-base counter (TBCTR) from the time-base phase register (TBPHS). 1: Allow Counter to be loaded from the Phase register (TBPHS) and shadow to active load events when an EPWMxSYNCl input signal occurs or a software-forced sync signal, see bit 6. Reset type: SYSRSn
1-0	CTRMODE	R/W	3h	Counter Mode  The time-base counter mode is normally configured once and not changed during normal operation. If you change the mode of the counter, the change will take effect at the next TBCLK edge and the current counter value shall increment or decrement from the value before the mode change. These bits set the time-base counter mode of operation as follows: 00: Up-count mode 01: Down-count mode 10: Up-down count mode 11: Freeze counter operation (default on reset) Reset type: SYSRSn

**13.14.2.2 TBCTL2 Register (Offset = 1h) [reset = 0h]**

 TBCTL2 is shown in [Figure 13-78](#) and described in [Table 13-17](#).

 Return to [Summary Table](#).

Time Base Control Register 2

**Figure 13-78. TBCTL2 Register**

15		14		13		12		11		10		9		8	
PRDLDSYNC				SYNCOSSELX				RESERVED							
R/W-0h				R/W-0h				R=0-0h							
7		6		5		4		3		2		1		0	
OSHTSYNC		OSHTSYNCMODE		RESERVED		RESERVED									
R=0/W=1-0h		R/W-0h		R-0h						R=0-0h					

**Table 13-17. TBCTL2 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-14	PRDLDSYNC	R/W	0h	Shadow to Active Period Register Load on SYNC event 00: Shadow to Active Load of TBPRD occurs only when TBCTR = 0 (same as legacy). 01: Shadow to Active Load of TBPRD occurs both when TBCTR = 0 and when SYNC occurs. 10: Shadow to Active Load of TBPRD occurs only when a SYNC is received. 11: Reserved Note: This bit selection is valid only if TBCTL[PRDLDD]=0. Reset type: SYSRSn
13-12	SYNCOSSELX	R/W	0h	Extended selection bits for SYNCOUT 00: Disabled EPWMxSYNCO sync signal 01: EPWMxSYNCO = CMPC 10: EPWMxSYNCO = CMPD 11: Reserved Reset type: SYSRSn
11-8	RESERVED	R=0	0h	Reserved
7	OSHTSYNC	R=0/W=1	0h	Oneshot sync bit 0: Writing a '0' has no effect. 1: Allow one sync pulse to propagate. Reset type: SYSRSn
6	OSHTSYNCMODE	R/W	0h	Oneshot sync enable bit 0: Oneshot sync mode disabled 1: Oneshot sync mode enabled Reset type: SYSRSn
5	RESERVED	R	0h	Reserved
4-0	RESERVED	R=0	0h	Reserved

**13.14.2.3 EPWMSYNCINSEL Register (Offset = 3h) [reset = 1h]**

EPWMSYNCINSEL is shown in [Figure 13-79](#) and described in [Table 13-18](#).

Return to [Summary Table](#).

EPWMxSYNClN Source Select Register

**Figure 13-79. EPWMSYNCINSEL Register**

15	14	13	12	11	10	9	8
RESERVED							
R-0h							
7	6	5	4	3	2	1	0
RESERVED				SEL			
R-0h				R/W-1h			

**Table 13-18. EPWMSYNCINSEL Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-5	RESERVED	R	0h	Reserved
4-0	SEL	R/W	1h	These bits determine the source of the EPWMxSYNClN signal. +I722 Reset type: SYSRSn

### 13.14.2.4 TBCTR Register (Offset = 4h) [reset = 0h]

TBCTR is shown in [Figure 13-80](#) and described in [Table 13-19](#).

Return to [Summary Table](#).

Time Base Counter Register

**Figure 13-80. TBCTR Register**

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
TBCTR															
R/W-0h															

**Table 13-19. TBCTR Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-0	TBCTR	R/W	0h	Time Base Counter Register Reset type: SYSRSn



**13.14.2.5 TBSTS Register (Offset = 5h) [reset = 1h]**

TBSTS is shown in [Figure 13-81](#) and described in [Table 13-20](#).

Return to [Summary Table](#).

Time Base Status Register

**Figure 13-81. TBSTS Register**

15	14	13	12	11	10	9	8
RESERVED							
R=0-0h							
7	6	5	4	3	2	1	0
RESERVED					CTRMAX	SYNCI	CTRDIR
R=0-0h					R/W1C-0h	R/W1C-0h	R-1h

**Table 13-20. TBSTS Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-3	RESERVED	R=0	0h	Reserved
2	CTRMAX	R/W1C	0h	Time-Base Counter Max Latched Status Bit  0: Reading a 0 indicates the time-base counter never reached its maximum value. Writing a 0 will have no effect. 1: Reading a 1 on this bit indicates that the time-base counter reached the max value 0xFFFF. Writing a 1 to this bit will clear the latched event. Reset type: SYSRSn
1	SYNCI	R/W1C	0h	Input Synchronization Latched Status Bit  0: Writing a 0 will have no effect. Reading a 0 indicates no external synchronization event has occurred. 1: Reading a 1 on this bit indicates that an external synchronization event has occurred (EPWMxSYNCI). Writing a 1 to this bit will clear the latched event. Reset type: SYSRSn
0	CTRDIR	R	1h	Time Base Counter Direction Status Bit  0: Time-Base Counter is currently counting down. 1: Time-Base Counter is currently counting up.  Note: This bit is only valid when the counter is not frozen. Reset type: SYSRSn

### 13.14.2.6 EPWMSYNCOUEN Register (Offset = 6h) [reset = 1h]

EPWMSYNCOUEN is shown in [Figure 13-82](#) and described in [Table 13-21](#).

Return to [Summary Table](#).

EPWMxSYNCOU Source Enable Register

**Figure 13-82. EPWMSYNCOUEN Register**

15	14	13	12	11	10	9	8
RESERVED							
R-0h							
7	6	5	4	3	2	1	0
RESERVED	DCBEVT1EN	DCAEVT1EN	CMPDEN	CMPDEN	CMPBEN	ZEROEN	SWEN
R-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-1h

**Table 13-21. EPWMSYNCOUEN Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-8	RESERVED	R	0h	Reserved
7	RESERVED	R	0h	Reserved
6	DCBEVT1EN	R/W	0h	This bit enables the DCBEVT1.sync event to set the EPWMxSYNCO signal. 0 Disabled 1 The EPWMxSYNCO signal is pulsed for one PWM clock period upon a DCBEVT1.sync event Reset type: SYSRSn
5	DCAEVT1EN	R/W	0h	This bit enables the DCAEVT1.sync event to set the EPWMxSYNCOU signal. 0 Disabled 1 The EPWMxSYNCOU signal is pulsed for one PWM clock period upon a DCAEVT1.sync event Reset type: SYSRSn
4	CMPDEN	R/W	0h	This bit enables the TBCTR = CMPD event to set the EPWMxSYNCO signal. 0 Disabled 1 The EPWMxSYNCO signal is pulsed for one PWM clock period upon a time-base counter equal to counter compare D event (TBCTR = CMPD) Reset type: SYSRSn
3	CMPDEN	R/W	0h	This bit enables the TBCTR = CMPC event to set the EPWMxSYNCO signal. 0 Disabled 1 The EPWMxSYNCO signal is pulsed for one PWM clock period upon a time-base counter equal to counter compare C event (TBCTR = CMPC) Reset type: SYSRSn
2	CMPBEN	R/W	0h	This bit enables the TBCTR = CMPB event to set the EPWMxSYNCO signal. 0 Disabled 1 The EPWMxSYNCO signal is pulsed for one PWM clock period upon a time-base counter equal to counter compare B event (TBCTR = CMPB) Reset type: SYSRSn

**Table 13-21. EPWMSYNCOUEN Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
1	ZEROEN	R/W	0h	<p>This bit enables the TBCTR = 0x0000 event to set the EPWMxSYNCOUEN signal.</p> <p>0 Disabled</p> <p>1 The EPWMxSYNCOUEN signal is pulsed for one PWM clock period upon the value of TBCTR changing to 0x0000</p> <p>Reset type: SYSRSn</p>
0	SWEN	R/W	1h	<p>This bit enables the TBCTL.SWFSYNC bit to set the EPWMxSYNCO signal.</p> <p>0 Disabled</p> <p>1 The EPWMxSYNCO signal is pulsed for one PWM clock period when the TBCTL.SWFSYNC bit is set</p> <p>Reset type: SYSRSn</p>

**13.14.2.7 CMPCTL Register (Offset = 8h) [reset = 0h]**

 CMPCTL is shown in [Figure 13-83](#) and described in [Table 13-22](#).

 Return to [Summary Table](#).

Counter Compare Control Register

**Figure 13-83. CMPCTL Register**

15	14	13	12	11	10	9	8
RESERVED		LOADBSYNC		LOADASYNC		SHDWBFULL	SHDWAFULL
R=0-0h		R/W-0h		R/W-0h		R-0h	R-0h
7	6	5	4	3	2	1	0
RESERVED	SHDWBMODE	RESERVED	SHDWAMODE	LOADBMODE		LOADAMODE	
R=0-0h	R/W-0h	R=0-0h	R/W-0h	R/W-0h		R/W-0h	

**Table 13-22. CMPCTL Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-14	RESERVED	R=0	0h	Reserved
13-12	LOADBSYNC	R/W	0h	Shadow to Active CMPB Register Load on SYNC event  00: Shadow to Active Load of CMPB:CMPBHR occurs according to LOADBMODE (bits 1,0) (same as legacy) 01: Shadow to Active Load of CMPB:CMPBHR occurs both according to LOADBMODE bits and when SYNC occurs 10: Shadow to Active Load of CMPB:CMPBHR occurs only when a SYNC is received 11: Reserved  Note: This bit is valid only if CMPCTL[SHDWBMODE] = 0. Reset type: SYSRSn
11-10	LOADASYNC	R/W	0h	Shadow to Active CMPA Register Load on SYNC event  00: Shadow to Active Load of CMPA:CMPAHR occurs according to LOADAMODE (bits 1,0) (same as legacy) 01: Shadow to Active Load of CMPA:CMPAHR occurs both according to LOADAMODE bits and when SYNC occurs 10: Shadow to Active Load of CMPA:CMPAHR occurs only when a SYNC is received 11: Reserved  Note: This bit is valid only if CMPCTL[SHDWAMODE] = 0. Reset type: SYSRSn
9	SHDWBFULL	R	0h	Counter-compare B (CMPB) Shadow Register Full Status Flag  This bit self clears once a loadstrobe occurs.  0: CMPB shadow FIFO not full yet 1: Indicates the CMPB shadow FIFO is full a CPU write will overwrite current shadow value Reset type: SYSRSn
8	SHDWAFULL	R	0h	Counter-compare A (CMPA) Shadow Register Full Status Flag  The flag bit is set when a 32-bit write to CMPA:CMPAHR register or a 16-bit write to CMPA register is made. A 16-bit write to CMPAHR register will not affect the flag. This bit self clears once a load-strobe occurs.  0: CMPA shadow FIFO not full yet 1: Indicates the CMPA shadow FIFO is full, a CPU write will overwrite the current shadow value Reset type: SYSRSn

**Table 13-22. CMPCTL Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
7	RESERVED	R=0	0h	Reserved
6	SHDWBMODE	R/W	0h	Counter-compare B (CMPB) Register Operating Mode 0: Shadow mode. Operates as a double buffer. All writes via the CPU access the shadow register 1: Immediate mode. Only the active compare B register is used. All writes and reads directly access the active register for immediate compare action Reset type: SYSRSn
5	RESERVED	R=0	0h	Reserved
4	SHDWAMODE	R/W	0h	Counter-compare A (CMPA) Register Operating Mode 0: Shadow mode. Operates as a double buffer. All writes via the CPU access the shadow register 1: Immediate mode. Only the active compare register is used. All writes and reads directly access the active register for immediate compare action Reset type: SYSRSn
3-2	LOADBMODE	R/W	0h	Active Counter-Compare B (CMPB) Load From Shadow Select Mode This bit has no effect in immediate mode (CMPCTL[SHDWBMODE] = 1). 00: Load on CTR = Zero: Time-base counter equal to zero (TBCTR = 0x0000) 01: Load on CTR = PRD: Time-base counter equal to period (TBCTR = TBPRD) 10: Load on either CTR = Zero or CTR = PRD 11: Freeze (no loads possible) Reset type: SYSRSn
1-0	LOADAMODE	R/W	0h	Active Counter-Compare A (CMPA) Load From Shadow Select Mode This bit has no effect in immediate mode (CMPCTL[SHDWAMODE] = 1). 00: Load on CTR = Zero: Time-base counter equal to zero (TBCTR = 0x0000) 01: Load on CTR = PRD: Time-base counter equal to period (TBCTR = TBPRD) 10: Load on either CTR = Zero or CTR = PRD 11: Freeze (no loads possible) Reset type: SYSRSn

### 13.14.2.8 CMPCTL2 Register (Offset = 9h) [reset = 0h]

CMPCTL2 is shown in [Figure 13-84](#) and described in [Table 13-23](#).

Return to [Summary Table](#).

Counter Compare Control Register 2

**Figure 13-84. CMPCTL2 Register**

15	14	13	12	11	10	9	8
RESERVED		LOADDSYNC		LOADCSYNC		RESERVED	
R=0-0h		R/W-0h		R/W-0h		R=0-0h	
7	6	5	4	3	2	1	0
RESERVED	SHDWDMODE	RESERVED	SHDWCMODE	LOADDMODE		LOADCMODE	
R=0-0h	R/W-0h	R=0-0h	R/W-0h	R/W-0h		R/W-0h	

**Table 13-23. CMPCTL2 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-14	RESERVED	R=0	0h	Reserved
13-12	LOADDSYNC	R/W	0h	Shadow to Active CMPD Register Load on SYNC event  00: Shadow to Active Load of CMPD occurs according to LOADDMODE 01: Shadow to Active Load of CMPD occurs both according to LOADDMODE bits and when SYNC occurs 10: Shadow to Active Load of CMPD occurs only when a SYNC is received 11: Reserved  Note: This bit is valid only if CMPCTL2[SHDWDMODE] = 0. Reset type: SYSRSn
11-10	LOADCSYNC	R/W	0h	Shadow to Active CMPC Register Load on SYNC event  00: Shadow to Active Load of CMPC occurs according to LOADCMODE 01: Shadow to Active Load of CMPC occurs both according to LOADCMODE bits and when SYNC occurs 10: Shadow to Active Load of CMPC occurs only when a SYNC is received 11: Reserved  Note: This bit is valid only if CMPCTL2[SHDWCMODE] = 0. Reset type: SYSRSn
9-7	RESERVED	R=0	0h	Reserved
6	SHDWDMODE	R/W	0h	Counter-Compare D Register Operating Mode  0: Shadow mode - operates as a double buffer. All writes via the CPU access Shadow register. 1: Immediate mode - only the Active compare register is used. All writes/reads via the CPU directly access the Active register for immediate Compare action. Reset type: SYSRSn
5	RESERVED	R=0	0h	Reserved

**Table 13-23. CMPCTL2 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
4	SHDWCMODE	R/W	0h	Counter-Compare C Register Operating Mode 0: Shadow mode - operates as a double buffer. All writes via the CPU access Shadow register. 1: Immediate mode - only the Active compare register is used. All writes/reads via the CPU directly access the Active register for immediate Compare action. Reset type: SYSRSn
3-2	LOADDMODE	R/W	0h	Active Counter-Compare D (CMPD) Load from Shadow Select Mode 00: Load on CTR = Zero: Time-base counter equal to zero (TBCTR = 0x0000) 01: Load on CTR = PRD: Time-base counter equal to period (TBCTR = TBPRD) 10: Load on either CTR = Zero or CTR = PRD 11: Freeze (no loads possible) Note: Has no effect in Immediate mode. Reset type: SYSRSn
1-0	LOADCMODE	R/W	0h	Active Counter-Compare C (CMPC) Load from Shadow Select Mode 00: Load on CTR = Zero: Time-base counter equal to zero (TBCTR = 0x0000) 01: Load on CTR = PRD: Time-base counter equal to period (TBCTR = TBPRD) 10: Load on either CTR = Zero or CTR = PRD 11: Freeze (no loads possible) Note: Has no effect in Immediate mode. Reset type: SYSRSn

**13.14.2.9 DBCTL Register (Offset = Ch) [reset = 0h]**

 DBCTL is shown in [Figure 13-85](#) and described in [Table 13-24](#).

 Return to [Summary Table](#).

Dead-Band Generator Control Register

**Figure 13-85. DBCTL Register**

15	14	13	12	11	10	9	8
HALFCYCLE	DEDB_MODE	OUTSWAP		SHDWDBFED MODE	SHDWDBRED MODE	LOADFEDMODE	
R/W-0h	R/W-0h	R/W-0h		R/W-0h	R/W-0h	R/W-0h	
7	6	5	4	3	2	1	0
LOADREDMODE		IN_MODE		POLSEL		OUT_MODE	
R/W-0h		R/W-0h		R/W-0h		R/W-0h	

**Table 13-24. DBCTL Register Field Descriptions**

Bit	Field	Type	Reset	Description
15	HALFCYCLE	R/W	0h	Half Cycle Clocking Enable Bit  0: Full cycle clocking enabled. The dead-band counters are clocked at the TBCLK rate. 1: Half cycle clocking enabled. The dead-band counters are clocked at TBCLK*2. Reset type: SYSRSn
14	DEDB_MODE	R/W	0h	Dead Band Dual-Edge B Mode Control (S8 switch)  0: Rising edge delay applied to InA/InB as selected by S4 switch (INMODE bits) on A signal path only. Falling edge delay applied to InA/InB as selected by S5 switch (INMODE bits) on B signal path only. 1: Rising edge delay and falling edge delay applied to source selected by S4 switch (INMODE bits) and output to B signal path only. Note: When this bit is set to 1, user should always either set OUT_MODE bits such that Apath = InA OR OUTSWAP bits such that OutA=Bpath otherwise, OutA will be invalid. Reset type: SYSRSn
13-12	OUTSWAP	R/W	0h	Dead Band Output Swap Control  Bit 13 controls the S7 switch and bit 12 controls the S6 switch.  00: OutA and OutB signals are as defined by OUT-MODE bits. 01: OutA = A-path as defined by OUT-MODE bits. OutB = A-path as defined by OUT-MODE bits (rising edge delay or delay-bypassed A signal path). 10: OutA = B-path as defined by OUT-MODE bits (falling edge delay or delay-bypassed B signal path). OutB = B-path as defined by OUT-MODE bits. 11: OutA = B-path as defined by OUT-MODE bits (falling edge delay or delay-bypassed B signal path). OutB = A-path as defined by OUT-MODE bits (rising edge delay or delay-bypassed A signal path). Reset type: SYSRSn



**Table 13-24. DBCTL Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
11	SHDWDBFEDMODE	R/W	0h	<p>FED Dead-Band Load Mode</p> <p>0: Immediate mode. Only the active DBFED register is used. All writes/reads via the CPU directly access the active register for immediate "FED dead-band action."</p> <p>1: Shadow mode. Operates as a double buffer. All writes via the CPU access Shadow register. Default at Reset is Immediate mode (for compatibility with legacy).</p> <p>Reset type: SYSRSn</p>
10	SHDWDBREDDMODE	R/W	0h	<p>RED Dead-Band Load Mode</p> <p>0: Immediate mode. Only the active DBRED register is used. All writes/reads via the CPU directly access the active register for immediate "RED dead-band action."</p> <p>1: Shadow mode. Operates as a double buffer. All writes via the CPU access Shadow register. Default at Reset is Immediate mode (for compatibility with legacy).</p> <p>Reset type: SYSRSn</p>
9-8	LOADFEDMODE	R/W	0h	<p>Active DBFED Load from Shadow Select Mode</p> <p>00: Load on Counter = 0 (CNT_eq) 01: Load on Counter = Period (PRD_eq) 10: Load on either Counter = 0, or Counter = Period 11: Freeze (no loads possible)</p> <p>Note: has no effect in Immediate mode.</p> <p>Reset type: SYSRSn</p>
7-6	LOADREDDMODE	R/W	0h	<p>Active DBRED Load from Shadow Select Mode</p> <p>00: Load on Counter = 0 (CNT_eq) 01: Load on Counter = Period (PRD_eq) 10: Load on either Counter = 0, or Counter = Period 11: Freeze (no loads possible)</p> <p>Note: has no effect in Immediate mode.</p> <p>Reset type: SYSRSn</p>
5-4	IN_MODE	R/W	0h	<p>Dead-Band Input Mode Control</p> <p>Bit 5 controls the S5 switch and bit 4 controls the S4 switch shown. This allows you to select the input source to the falling-edge and rising-edge delay. To produce classical dead-band waveforms the default is EPWMxA In is the source for both falling and rising-edge delays.</p> <p>00: EPWMxA In (from the action-qualifier) is the source for both falling-edge and rising-edge delay.</p> <p>01: EPWMxB In (from the action-qualifier) is the source for rising-edge delayed signal.</p> <p>EPWMxA In (from the action-qualifier) is the source for falling-edge delayed signal.</p> <p>10: EPWMxA In (from the action-qualifier) is the source for rising-edge delayed signal.</p> <p>EPWMxB In (from the action-qualifier) is the source for falling-edge delayed signal.</p> <p>11: EPWMxB In (from the action-qualifier) is the source for both rising-edge delay and falling-edge delayed signal.</p> <p>Reset type: SYSRSn</p>

**Table 13-24. DBCTL Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
3-2	POLSEL	R/W	0h	<p>Polarity Select Control</p> <p>Bit 3 controls the S3 switch and bit 2 controls the S2 switch. This allows you to selectively invert one of the delayed signals before it is sent out of the dead-band submodule. The following descriptions correspond to classical upper/lower switch control as found in one leg of a digital motor control inverter. These assume that DBCTL[OUT_MODE] = 1,1 and DBCTL[IN_MODE] = 0x0. Other enhanced modes are also possible, but not regarded as typical usage modes.</p> <p>00: Active high (AH) mode. Neither EPWMxA nor EPWMxB is inverted (default).            01: Active low complementary (ALC) mode. EPWMxA is inverted.            10: Active high complementary (AHC). EPWMxB is inverted.            11: Active low (AL) mode. Both EPWMxA and EPWMxB are inverted.</p> <p>Reset type: SYSRSn</p>
1-0	OUT_MODE	R/W	0h	<p>Dead-Band Output Mode Control</p> <p>Bit 1 controls the S1 switch and bit 0 controls the S0 switch.</p> <p>00: DBM is fully disabled or by-passed. In this mode the POLSEL and IN-MODE bits have no effect.            01: Apath = InA (delay is by-passed for A signal path)            Bpath = FED (Falling Edge Delay in B signal path)            10: Apath = RED (Rising Edge Delay in A signal path)            Bpath = InB (delay is by-passed for B signal path)            11: DBM is fully enabled (i.e. both RED and FED active)</p> <p>Reset type: SYSRSn</p>

### 13.14.2.10 DBCTL2 Register (Offset = Dh) [reset = 0h]

DBCTL2 is shown in [Figure 13-86](#) and described in [Table 13-25](#).

Return to [Summary Table](#).

Dead-Band Generator Control Register 2

**Figure 13-86. DBCTL2 Register**

15	14	13	12	11	10	9	8
RESERVED							
R=0-0h							
7	6	5	4	3	2	1	0
RESERVED					SHDWDBCTL MODE	LOADDBCTLMODE	
R=0-0h					R/W-0h	R/W-0h	

**Table 13-25. DBCTL2 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-3	RESERVED	R=0	0h	Reserved
2	SHDWDBCTLMODE	R/W	0h	DBCTL Load Mode  0: Immediate mode - only the Active DBCTL register is used. All writes/reads via the CPU directly access the Active register. 1: Shadow mode - All writes and reads via the CPU access the Shadow register. Reset type: SYSRSn
1-0	LOADDBCTLMODE	R/W	0h	Active DBCTL Load from Shadow Select Mode  00: Load on Counter = 0 (CNT_eq) 01: Load on Counter = Period (PRD_eq) 10: Load on either Counter = 0, or Counter = Period 11: Freeze (no loads possible)  Note: has no effect in Immediate mode Reset type: SYSRSn

**13.14.2.11 AQCTL Register (Offset = 10h) [reset = 0h]**

 AQCTL is shown in [Figure 13-87](#) and described in [Table 13-26](#).

 Return to [Summary Table](#).

Action Qualifier Control Register

**Figure 13-87. AQCTL Register**

15	14	13	12	11	10	9	8
RESERVED				LDAQBSYNC		LDAQASYNC	
R=0-0h				R/W-0h		R/W-0h	
7	6	5	4	3	2	1	0
RESERVED	SHDWAQBMODE	RESERVED	SHDWAQAMODE	LDAQBMODE		LDAQAMODE	
R=0-0h	R/W-0h	R=0-0h	R/W-0h	R/W-0h		R/W-0h	

**Table 13-26. AQCTL Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-12	RESERVED	R=0	0h	Reserved
11-10	LDAQBSYNC	R/W	0h	Shadow to Active AQCTLB Register Load on SYNC event  00: Shadow to Active Load of AQCTLB occurs according to LDAQBMODE 01: Shadow to Active Load of AQCTLB occurs both according to LDAQBMODE bits and when SYNC occurs. 10: Shadow to Active Load of AQCTLB occurs only when a SYNC is received. 11: Reserved  Note: This bit is valid only if AQCTLR[SHDWAQBMODE] = 1. Reset type: SYSRSn
9-8	LDAQASYNC	R/W	0h	Shadow to Active AQCTLA Register Load on SYNC event  00: Shadow to Active Load of AQCTLA occurs according to LDAQAMODE 01: Shadow to Active Load of AQCTLA occurs both according to LDAQAMODE bits and when SYNC occurs. 10: Shadow to Active Load of AQCTLA occurs only when a SYNC is received. 11: Reserved  Note: This bit is valid only if AQCTLR[SHDWAQAMODE] = 1. Reset type: SYSRSn
7	RESERVED	R=0	0h	Reserved
6	SHDWAQBMODE	R/W	0h	Action Qualifier B Register operating mode  1: Shadow mode - operates as a double buffer. All writes via the CPU access Shadow register. 0: Immediate mode - only the Active action qualifier register is used. All writes/reads via the CPU directly access the Active register. Reset type: SYSRSn
5	RESERVED	R=0	0h	Reserved
4	SHDWAQAMODE	R/W	0h	Action Qualifier A Register operating mode  1: Shadow mode - operates as a double buffer. All writes via the CPU access Shadow register. 0: Immediate mode - only the Active action qualifier register is used. All writes/reads via the CPU directly access the Active register. Reset type: SYSRSn

**Table 13-26. AQCTL Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
3-2	LDAQBMODE	R/W	0h	Active Action Qualifier B Load from Shadow Select Mode  00: Load on CTR = Zero: Time-base counter equal to zero (TBCTR = 0x0000) 01: Load on CTR = PRD: Time-base counter equal to period (TBCTR = TBPRD) 10: Load on either CTR = Zero or CTR = PRD 11: Freeze (no loads possible)  Note: has no effect in Immediate mode. Reset type: SYSRSn
1-0	LDAQAMODE	R/W	0h	Active Action Qualifier A Load from Shadow Select Mode  00: Load on CTR = Zero: Time-base counter equal to zero (TBCTR = 0x0000) 01: Load on CTR = PRD: Time-base counter equal to period (TBCTR = TBPRD) 10: Load on either CTR = Zero or CTR = PRD 11: Freeze (no loads possible)  Note: has no effect in Immediate mode. Reset type: SYSRSn

### 13.14.2.12 AQTSRCSEL Register (Offset = 11h) [reset = 0h]

AQTSRCSEL is shown in [Figure 13-88](#) and described in [Table 13-27](#).

Return to [Summary Table](#).

Action Qualifier Trigger Event Source Select Register

**Figure 13-88. AQTSRCSEL Register**

15	14	13	12	11	10	9	8
RESERVED							
R=0-0h							
7	6	5	4	3	2	1	0
T2SEL				T1SEL			
R/W-0h				R/W-0h			

**Table 13-27. AQTSRCSEL Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-8	RESERVED	R=0	0h	Reserved
7-4	T2SEL	R/W	0h	T2 Event Source Select Bits  0000: DCAEVT1 0001: DCAEVT2 0010: DCBEVT1 0011: DCBEVT2 0100: TZ1 0101: TZ2 0110: TZ3 0111: EPWMxSYNCl 1xxx: Reserved Reset type: SYSRSn
3-0	T1SEL	R/W	0h	T1 Event Source Select Bits  0000: DCAEVT1 0001: DCAEVT2 0010: DCBEVT1 0011: DCBEVT2 0100: TZ1 0101: TZ2 0110: TZ3 0111: EPWMxSYNCl 1xxx: Reserved Reset type: SYSRSn

**13.14.2.13 PCCTL Register (Offset = 14h) [reset = 0h]**

PCCTL is shown in [Figure 13-89](#) and described in [Table 13-28](#).

Return to [Summary Table](#).

PWM Chopper Control Register

**Figure 13-89. PCCTL Register**

15	14	13	12	11	10	9	8
RESERVED						CHPDUTY	
R=0-0h						R/W-0h	
7	6	5	4	3	2	1	0
CHPFREQ			OSHTWTH			CHPEN	
R/W-0h			R/W-0h			R/W-0h	

**Table 13-28. PCCTL Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-11	RESERVED	R=0	0h	Reserved
10-8	CHPDUTY	R/W	0h	Chopping Clock Duty Cycle  000: Duty = 1/8 (12.5%) 001: Duty = 2/8 (25.0%) 010: Duty = 3/8 (37.5%) 011: Duty = 4/8 (50.0%) 100: Duty = 5/8 (62.5%) 101: Duty = 6/8 (75.0%) 110: Duty = 7/8 (87.5%) 111: Reserved Reset type: SYSRSn
7-5	CHPFREQ	R/W	0h	Chopping Clock Frequency  000: Divide by 1 (no prescale, = 12.5 MHz at 100 MHz TBCLK) 001: Divide by 2 (6.25 MHz at 100 MHz TBCLK) 010: Divide by 3 (4.16 MHz at 100 MHz TBCLK) 011: Divide by 4 (3.12 MHz at 100 MHz TBCLK) 100: Divide by 5 (2.50 MHz at 100 MHz TBCLK) 101: Divide by 6 (2.08 MHz at 100 MHz TBCLK) 110: Divide by 7 (1.78 MHz at 100 MHz TBCLK) 111: Divide by 8 (1.56 MHz at 100 MHz TBCLK) Reset type: SYSRSn

**Table 13-28. PCCTL Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
4-1	OSHTWTH	R/W	0h	One-Shot Pulse Width  0000: 1 x EPWMCLK / 8 wide (= 80 ns at 100 MHz EPWMCLK) 0001: 2 x EPWMCLK / 8 wide (= 160 ns at 100 MHz EPWMCLK) 0010: 3 x EPWMCLK / 8 wide (= 240 ns at 100 MHz EPWMCLK) 0011: 4 x EPWMCLK / 8 wide (= 320 ns at 100 MHz EPWMCLK) 0100: 5 x EPWMCLK / 8 wide (= 400 ns at 100 MHz EPWMCLK) 0101: 6 x EPWMCLK / 8 wide (= 480 ns at 100 MHz EPWMCLK) 0110: 7 x EPWMCLK / 8 wide (= 560 ns at 100 MHz EPWMCLK) 0111: 8 x EPWMCLK / 8 wide (= 640 ns at 100 MHz EPWMCLK) 1000: 9 x EPWMCLK / 8 wide (= 720 ns at 100 MHz EPWMCLK) 1001: 10 x EPWMCLK / 8 wide (= 800 ns at 100 MHz EPWMCLK) 1010: 11 x EPWMCLK / 8 wide (= 880 ns at 100 MHz EPWMCLK) 1011: 12 x EPWMCLK / 8 wide (= 960 ns at 100 MHz EPWMCLK) 1100: 13 x EPWMCLK / 8 wide (= 1040 ns at 100 MHz EPWMCLK) 1101: 14 x EPWMCLK / 8 wide (= 1120 ns at 100 MHz EPWMCLK) 1110: 15 x EPWMCLK / 8 wide (= 1200 ns at 100 MHz EPWMCLK) 1111: 16 x EPWMCLK / 8 wide (= 1280 ns at 100 MHz EPWMCLK) Reset type: SYSRSn
0	CHPEN	R/W	0h	PWM-Chopping Enable  0: Disable (bypass) PWM chopping function 1: Enable chopping function Reset type: SYSRSn



**13.14.2.14 VCAPCTL Register (Offset = 18h) [reset = 0h]**

VCAPCTL is shown in [Figure 13-90](#) and described in [Table 13-29](#).

Return to [Summary Table](#).

Valley Capture Control Register

**Figure 13-90. VCAPCTL Register**

15	14	13	12	11	10	9	8
RESERVED					EDGEFILTDLY SEL	VDELAYDIV	
R=0-0h					R/W-0h	R/W-0h	
7	6	5	4	3	2	1	0
VDELAYDIV	RESERVED		TRIGSEL			VCAPSTART	VCAPE
R/W-0h	R=0-0h		R/W-0h			R=0/W=1-0h	R/W-0h

**Table 13-29. VCAPCTL Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-11	RESERVED	R=0	0h	Reserved
10	EDGEFILTDLYSEL	R/W	0h	Valley Switching Mode Delay Selection  0: No delay applied to the edge filter output 1: HWDELAYVAL delay applied to the edge filter output Reset type: SYSRSn
9-7	VDELAYDIV	R/W	0h	Valley Delay Mode Divide Enable  000: HWVDELVAL = SWVDELVAL 001: HWVDELVAL = VCNTVAL+SWVDELVAL 010: HWVDELVAL = VCNTVAL>>1+SWVDELVAL 011: HWVDELVAL = VCNTVAL>>2+SWVDELVAL 100: HWVDELVAL = VCNTVAL>>4+SWVDELVAL  Note: Delay value between the consecutive edge captures can optionally be divided by using these bits. Reset type: SYSRSn
6-5	RESERVED	R=0	0h	Reserved

**Table 13-29. VCAPCTL Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
4-2	TRIGSEL	R/W	0h	Status of Numbered of Captured Events  000: Capture sequence is triggered by software via writes to VCAPCTL[VCAPSTART]. 001: Capture sequence is triggered by CNT_zero event. 010: Capture sequence is triggered by PRD_eq event. 011: Capture sequence is triggered by CNT_zero or PRD_eq event. 100: Capture sequence is triggered by DCAEVT1 event. 101: Capture sequence is triggered by DCAEVT2 event. 110: Capture sequence is triggered by DCBEVT1 event. 111: Capture sequence is triggered by DCBEVT2 event.  Note: Valley capture sequence triggered by the selected event in this register field. Once the chosen event occurs the capture sequence is armed. Event captures occur based of the event chosen in DCFCTL[SRCSEL] register.  Note: Same event may not be chosen in both DCFCTL[SRCSEL] and VCAPCTL[TRIGSEL] registers.  Note: Once the chosen event in VCAPCTL[TRIGSEL] occurs, irrespective of the current capture status, capture sequence is retriggered.  Reset type: SYSRSn
1	VCAPSTART	R=0/W=1	0h	Valley Capture Start  0: Writing a 0 has no effect 1: Trigger the capture sequence once if VCAPCTL[TRIGSEL]=0x0  Note: This bit is used to start valley capture sequence through software. VCAPCTL[TRIGSEL] has to be chosen for software trigger for this bit to have any effect. Writing of 1 will result in one capture sequence trigger.  Reset type: SYSRSn
0	VCAPE	R/W	0h	Valley Capture Enable/Disable  0: Disabled 1: Enabled  Reset type: SYSRSn

### 13.14.2.15 VCNTCFG Register (Offset = 19h) [reset = 0h]

VCNTCFG is shown in [Figure 13-91](#) and described in [Table 13-30](#).

Return to [Summary Table](#).

Valley Counter Config Register

**Figure 13-91. VCNTCFG Register**

15	14	13	12	11	10	9	8
STOPEDESTS	RESERVED			STOPEDESTS			
R-0h	R=0-0h			R/W-0h			
7	6	5	4	3	2	1	0
STARTEDGESTS	RESERVED			STARTEDGESTS			
R-0h	R=0-0h			R/W-0h			

**Table 13-30. VCNTCFG Register Field Descriptions**

Bit	Field	Type	Reset	Description
15	STOPEDESTS	R	0h	Stop Edge Status Bit 0: Stop edge has not occurred 1: Stop edge occurred Note: This bit is set only after the trigger sequence is armed (upon occurrence of trigger pulse selected through VCAPCTL[TRIGSEL]) and STOPEDESTS occurs. Note: This bit is reset by the occurrence of the trigger pulse selected through VCAPCTL[TRIGSEL] Reset type: SYSRSn
14-12	RESERVED	R=0	0h	Reserved
11-8	STOPEDESTS	R/W	0h	Counter Stop Edge Selection Once the counter operation is armed, upon occurrence of trigger pulse selected through VCAPCTL[TRIGSEL] pulse - valley counter would stop counting upon the occurrence of chosen number of events through this bit field. Stop counting on occurrence of: 0000: Do not stop 0001 1st edge 0010: 2nd edge 0011: 3rd edge ... 1,1,1,1: 15th edge Reset type: SYSRSn
7	STARTEDGESTS	R	0h	Start Edge Status Bit 0: Start edge has not occurred 1: Start edge occurred Note: This bit is set only after the trigger sequence is armed (upon occurrence of trigger pulse selected through VCAPCTL[TRIGSEL]) and STARTEDGESTS occurs. Note: This bit is reset by the occurrence of the trigger pulse selected through VCAPCTL[TRIGSEL] Reset type: SYSRSn
6-4	RESERVED	R=0	0h	Reserved

**Table 13-30. VCNTCFG Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
3-0	STARTEDGE	R/W	0h	Counter Start Edge Selection  Once the counter operation is armed, upon occurrence of trigger pulse selected through VCAPCTL[TRIGSEL] pulse - valley counter would start counting upon the occurrence of chosen number of events thorough this bit field. Start counting on occurrence of  0000: Do not start 0001: 1st edge 0010: 2nd edge 0011: 3rd edge  ... 1111: 15th edge Reset type: SYSRSn

### 13.14.2.16 HRCNFG Register (Offset = 20h) [reset = 0h]

HRCNFG is shown in [Figure 13-92](#) and described in [Table 13-31](#).

Return to [Summary Table](#).

HRPWM Configuration Register

This register is only accessible on EPWM modules with HRPWM capabilities.

**Figure 13-92. HRCNFG Register**

15	14	13	12	11	10	9	8
RESERVED		RESERVED	HRLOADB		CTLMODEB	EDGMODEB	
R-0h		R=0-0h	R/W-0h		R/W-0h	R/W-0h	
7	6	5	4	3	2	1	0
SWAPAB	AUTOCONV	SELOUTB	HRLOAD		CTLMODE	EDGMODE	
R/W-0h	R/W-0h	R/W-0h	R/W-0h		R/W-0h	R/W-0h	

**Table 13-31. HRCNFG Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-14	RESERVED	R	0h	Reserved
13	RESERVED	R=0	0h	Reserved
12-11	HRLOADB	R/W	0h	Shadow Mode Bit  Selects the time event that loads the CMPBHR shadow value into the active register.  00: Load on CTR = Zero: Time-base counter equal to zero (TBCTR = 0x0000) 01: Load on CTR = PRD: Time-base counter equal to period (TBCTR = TBPRD) 10: Load on either CTR = Zero or CTR = PRD 11: Reserved Reset type: SYSRSn
10	CTLMODEB	R/W	0h	Control Mode Bits  Selects the register (CMP/TBPRD or TBPHS) that controls the MEP:  0: CMPBHR(8) or TBPRDHR(8) Register controls the edge position (i.e., this is duty or period control mode). (Default on Reset) 1: TBPHSHR(8) Register controls the edge position (i.e., this is phase control mode). Reset type: SYSRSn
9-8	EDGMODEB	R/W	0h	Edge Mode Bits  Selects the edge of the PWM that is controlled by the micro-edge position (MEP) logic:  00: HRPWM capability is disabled (default on reset) 01: MEP control of rising edge (CMPBHR) 10: MEP control of falling edge (CMPBHR) 11: MEP control of both edges (TBPHSHR or TBPRDHR) Reset type: SYSRSn
7	SWAPAB	R/W	0h	Swap ePWM A & B Output Signals  This bit enables the swapping of the A & B signal outputs. The selection is as follows:  0: ePWMxA and ePWMxB outputs are unchanged. 1: ePWMxA signal appears on ePWMxB output and ePWMxB signal appears on ePWMxA output. Reset type: SYSRSn

**Table 13-31. HRCNFG Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
6	AUTOCONV	R/W	0h	<p>Auto Convert Delay Line Value</p> <p>Selects whether the fractional duty cycle/period/phase in the CMPAHR/TBPRDHR/TBPHSHR register is automatically scaled by the MEP scale factor in the HRMSTEP register or manually scaled by calculations in application software. The SFO library function automatically updates the HRMSTEP register with the appropriate MEP scale factor.</p> <p>0: Automatic HRMSTEP scaling is disabled. 1: Automatic HRMSTEP scaling is enabled.</p> <p>If application software is manually scaling the fractional duty cycle, or phase (i.e. software sets <math>CMPAHR = (\text{fraction}(PWMduty * PWMperiod) * MEP \text{ Scale Factor}) &lt; &lt; 8 + 0x080</math> for duty cycle), then this mode must be disabled.</p> <p>Reset type: SYSRSn</p>
5	SELOUTB	R/W	0h	<p>EPWMxB Output Select Bit</p> <p>This bit selects which signal is output on the ePWMxB channel output.</p> <p>0: ePWMxB output is normal. 1: ePWMxB output is inverted version of ePWMxA signal.</p> <p>Reset type: SYSRSn</p>
4-3	HRLOAD	R/W	0h	<p>Shadow Mode Bit</p> <p>Selects the time event that loads the CMPAHR shadow value into the active register.</p> <p>00: Load on CTR = Zero: Time-base counter equal to zero (TBCTR = 0x0000) 01: Load on CTR = PRD: Time-base counter equal to period (TBCTR = TBPRD) 10: Load on either CTR = Zero or CTR = PRD 11: Reserved</p> <p>Reset type: SYSRSn</p>
2	CTLMODE	R/W	0h	<p>Control Mode Bits</p> <p>Selects the register (CMP/TBPRD or TBPHS) that controls the MEP:</p> <p>0: CMPAHR(8) or TBPRDHR(8) Register controls the edge position (i.e., this is duty or period control mode). (Default on Reset) 1: TBPHSHR(8) Register controls the edge position (i.e., this is phase control mode).</p> <p>Reset type: SYSRSn</p>
1-0	EDGMODE	R/W	0h	<p>Edge Mode Bits</p> <p>Selects the edge of the PWM that is controlled by the micro-edge position (MEP) logic:</p> <p>00: HRPWM capability is disabled (default on reset) 01: MEP control of rising edge (CMPAHR) 10: MEP control of falling edge (CMPAHR) 11: MEP control of both edges (TBPHSHR or TBPRDHR)</p> <p>Reset type: SYSRSn</p>

**13.14.2.17 HRPWR Register (Offset = 21h) [reset = 0h]**

HRPWR is shown in [Figure 13-93](#) and described in [Table 13-32](#).

Return to [Summary Table](#).

HRPWM Power Register

This register is only accessible on EPWM modules with HRPWM capabilities.

**Figure 13-93. HRPWR Register**

15	14	13	12	11	10	9	8
CALPWRON		RESERVED				RESERVED	
R/W-0h		R=0-0h				R-0h	
7	6	5	4	3	2	1	0
RESERVED		RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	
R-0h		R-0h	R-0h	R-0h	R-0h	R-0h	

**Table 13-32. HRPWR Register Field Descriptions**

Bit	Field	Type	Reset	Description
15	CALPWRON	R/W	0h	MEP Calibration Power Bits  0: Disables MEP calibration logic in the HRPWM and reduces power consumption. 1: Enables MEP calibration logic Reset type: SYSRSn
14-10	RESERVED	R=0	0h	Reserved
9-6	RESERVED	R	0h	Reserved
5	RESERVED	R	0h	Reserved
4	RESERVED	R	0h	Reserved
3	RESERVED	R	0h	Reserved
2	RESERVED	R	0h	Reserved
1-0	RESERVED	R	0h	Reserved

**13.14.2.18 HRMSTEP Register (Offset = 26h) [reset = 0h]**

HRMSTEP is shown in [Figure 13-94](#) and described in [Table 13-33](#).

Return to [Summary Table](#).

**HRPWM MEP Step Register**

This register is only accessible on EPWM modules with HRPWM capabilities. Only 16 bit accesses are allowed for this register. Debugger access in 32 bit mode may display incorrect values.

**Figure 13-94. HRMSTEP Register**

15	14	13	12	11	10	9	8
RESERVED							
R=0-0h							
7	6	5	4	3	2	1	0
HRMSTEP							
R/W-0h							

**Table 13-33. HRMSTEP Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-8	RESERVED	R=0	0h	Reserved
7-0	HRMSTEP	R/W	0h	High Resolution MEP Step  When auto-conversion is enabled (HRCNFG[AUTOCONV] = 1), This 8-bit field contains the MEP_ScaleFactor (number of MEP steps per coarse steps) used by the hardware to automatically convert the value in the CMPAHR, CMPBHR, DBFEDHR, DBREDHR, TBPHSHR, or TBPRDHR register to a scaled micro-edge delay on the high-resolution ePWM output. The value in this register is written by the SFO calibration software at the end of each calibration run. Reset type: SYSRSn



### 13.14.2.19 HRCNFG2 Register (Offset = 27h) [reset = 0h]

HRCNFG2 is shown in [Figure 13-95](#) and described in [Table 13-34](#).

Return to [Summary Table](#).

#### HRPWM Configuration 2 Register

This register is only accessible on EPWM modules with HRPWM capabilities. Only 16 bit accesses are allowed for this register. Debugger access in 32 bit mode may display incorrect values.

**Figure 13-95. HRCNFG2 Register**

15	14	13	12	11	10	9	8
RESERVED	RESERVED	RESERVED					
R=0h	R=0h	R=0-0h					
7	6	5	4	3	2	1	0
RESERVED		CTLMODEDBFED		CTLMODEDBRED		EDGMODEDB	
R=0-0h		R/W-0h		R/W-0h		R/W-0h	

**Table 13-34. HRCNFG2 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15	RESERVED	R	0h	Reserved
14	RESERVED	R	0h	Reserved
13-6	RESERVED	R=0	0h	Reserved
5-4	CTLMODEDBFED	R/W	0h	Shadow Mode Bit - selection should match DBCTL[LOADFEDMODE]  Selects the time event that loads the DBFEDHR shadow value into the active register.  00 Load on CTR = Zero: Time-base counter equal to zero (TBCTR = 0x0000) 01 Load on CTR = PRD: Time-base counter equal to period (TBCTR = TBPRD) 10 Load on either CTR = Zero or CTR = PRD 11 Reserved Reset type: SYSRSn
3-2	CTLMODEDBRED	R/W	0h	Shadow Mode Bit - selection should match DBCTL[LOADREDMODE]  Selects the time event that loads the DBREDHR shadow value into the active register.  00 Load on CTR = Zero: Time-base counter equal to zero (TBCTR = 0x0000) 01 Load on CTR = PRD: Time-base counter equal to period (TBCTR = TBPRD) 10 Load on either CTR = Zero or CTR = PRD 11 Reserved Reset type: SYSRSn
1-0	EDGMODEDB	R/W	0h	Edge Mode Bits  Selects the edge of the PWM that is controlled by the micro-edge position (MEP) logic:  00 HRPWM capability is disabled (default on reset) 01 MEP control of rising edge (DBREDHR) 10 MEP control of falling edge (DBFEDHR) 11 MEP control of both edges (rising edge of DBREDHR or falling edge of DBFEDHR ) Reset type: SYSRSn

**13.14.2.20 HRPCTL Register (Offset = 2Dh) [reset = 0h]**

HRPCTL is shown in [Figure 13-96](#) and described in [Table 13-35](#).

Return to [Summary Table](#).

High Resolution Period Control Register

This register is only accessible on EPWM modules with HRPWM capabilities.

**Figure 13-96. HRPCTL Register**

15	14	13	12	11	10	9	8
RESERVED							
R=0-0h							
7	6	5	4	3	2	1	0
RESERVED	PWMSYNCSELX			RESERVED	TBPHSHRLOA DE	PWMSYNCSEL	HRPE
R=0-0h	R/W-0h			R-0h	R/W-0h	R/W-0h	R/W-0h

**Table 13-35. HRPCTL Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-7	RESERVED	R=0	0h	Reserved
6-4	PWMSYNCSELX	R/W	0h	PWMSYNCX Source Select Bit  000: PWMSYNC is defined by PWMSYNCSEL - > default condition (compatible with previous EPWM versions) 001: Reserved 010: Reserved 011: Reserved 100: PWMSYNC = CMPC_eq, Count direction Up 101: PWMSYNC = CMPC_eq, Count direction Down 110: PWMSYNC = CMPD_eq, Count direction Up 111: PWMSYNC = CMPD_eq, Count direction Down Reset type: SYSRSn
3	RESERVED	R	0h	Reserved
2	TBPHSHRLOADE	R/W	0h	TBPHSHR Load Enable  This bit allows you to synchronize ePWM modules with a high-resolution phase on a SYNCIN, TBCTL[SWFSYNC] or digital compare event. This allows for multiple ePWM modules operating at the same frequency to be phase aligned with high-resolution.  0: Disables synchronization of high-resolution phase on a SYNCIN, TBCTL[SWFSYNC] or digital compare event: 1: Synchronize the high-resolution phase on a SYNCIN, TBCTL[SWFSYNC] or digital comparator synchronization event. The phase is synchronized using the contents of the high-resolution phase TBPHSHR register. The TBCTL[PHSEN] bit which enables the loading of the TBCTR register with TBPHS register value on a SYNCIN or TBCTL[SWFSYNC] event works independently. However, users need to enable this bit also if they want to control phase in conjunction with the high-resolution period feature.  This bit and the TBCTL[PHSEN] bit must be set to 1 when high-resolution period is enabled for up-down count mode even if TBPHSHR = 0x0000. This bit does not need to be set when only high-resolution duty is enabled. Reset type: SYSRSn

**Table 13-35. HRPCTL Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
1	PWMSYNCSEL	R/W	0h	<p>PWMSYNC Source Select Bit: This bit selects the source for the PWMSYNC signal. The PWMSYNC signal is used by external modules (such as COMP+DAC) for syncing timing to the selected EPWM module:</p> <p>0 PWMSYNC = PRD_eq signal pulse            1 PWMSYNC = CNT_zero signal pulse            Reset type: SYSRSn</p>
0	HRPE	R/W	0h	<p>High Resolution Period Enable Bit</p> <p>0: High resolution period feature disabled. In this mode the ePWM behaves as a Type 0 ePWM.</p> <p>1: High resolution period enabled. In this mode the HRPWM module can control high-resolution of both the duty and frequency. When high-resolution period is enabled, TBCTL[CTRMODE] = 0,1 (down-count mode) is not supported.</p> <p>Reset type: SYSRSn</p>

**13.14.2.21 TRREM Register (Offset = 2Eh) [reset = 0h]**

TRREM is shown in [Figure 13-97](#) and described in [Table 13-36](#).

Return to [Summary Table](#).

Translator High Resolution Remainder Register

This register is only accessible on EPWM modules with HRPWM capabilities.

**Figure 13-97. TRREM Register**

15	14	13	12	11	10	9	8
RESERVED					TRREM		
R=0-0h					R/W-0h		
7	6	5	4	3	2	1	0
TRREM							
R/W-0h							

**Table 13-36. TRREM Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-11	RESERVED	R=0	0h	Reserved
10-0	TRREM	R/W	0h	Translator Remainder Bits: This 11-bit value keeps track of the remainder portion of the translator algorithm calculations. Reset type: SYSRSn

### 13.14.2.22 GLDCTL Register (Offset = 34h) [reset = 0h]

GLDCTL is shown in [Figure 13-98](#) and described in [Table 13-37](#).

Return to [Summary Table](#).

Global PWM Load Control Register

**Figure 13-98. GLDCTL Register**

15	14	13	12	11	10	9	8
RESERVED			GLDCNT			GLDPRD	
R=0-0h			R-0h			R/W-0h	
7	6	5	4	3	2	1	0
GLDPRD	RESERVED	OSHTMODE	GLDMODE			GLD	
R/W-0h	R=0-0h	R/W-0h	R/W-0h			R/W-0h	

**Table 13-37. GLDCTL Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-13	RESERVED	R=0	0h	Reserved
12-10	GLDCNT	R	0h	Global Reload Strobe Counter Register These bits indicate how many selected events have occurred: 000: No events 001: 1 event 010: 2 events 011: 3 events 100: 4 events 101: 5 events 110: 6 events 111: 7 events Reset type: SYSRSn
9-7	GLDPRD	R/W	0h	Global Reload Strobe Period Select Register These bits select how many selected events need to occur before a load strobe is generated 000: Disable counter 001: Generate strobe on GLDCNT = 001 (1st event) 010: Generate strobe on GLDCNT = 010 (2nd event) 011: Generate strobe on GLDCNT = 011 (3rd event) 100: Generate strobe on GLDCNT = 011 (4th event) 101: Generate strobe on GLDCNT = 001 (5th event) 110: Generate strobe on GLDCNT = 010 (6th event) 111: Generate strobe on GLDCNT = 011 (7th event) Reset type: SYSRSn
6	RESERVED	R=0	0h	Reserved
5	OSHTMODE	R/W	0h	One Shot Load Mode Control Bit 0: One shot load mode is disabled and shadow to active loading happens continuously on all the chosen load strobes. 1: One shot mode is active. All load strobes are blocked until GLDCTL2[OSHTLD] is written with 1.  Note: One Shot mode can only be used with global shadow to active load mode enabled (GLDCTL[GLD]=1) Reset type: SYSRSn

**Table 13-37. GLDCTL Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
4-1	GLDMODE	R/W	0h	Global Load Pulse selection for Shadow to Active Mode Reloads 0000: Load on Counter = 0 (CNT_ZRO) 0001: Load on Counter = Period (PRD_EQ) 0010: Load on either Counter = 0, or Counter = Period 0011: Load on SYNCEVT - this is logical OR of DCAEVT1.sync, DCBEVT1.sync, EPWMxSYNCl and TBCTL[SWFSYNC] 0100: Load on SYNCEVT or CNT_ZRO 0101: Load on SYNCEVT or PRD_EQ 0110: Load on SYNCEVT or CNT_ZRO or PRD_EQ 1000: Reserved ... 1110: Reserved 1111: Load on GLDCTL[GLDFRCLD] write Reset type: SYSRSn
0	GLD	R/W	0h	Global Shadow to Active Load Event Control 0: Shadow to active reload for all shadowed registers happens as per the individual reload control bits specified (Compatible with previous EPWM versions). 1: When set, all the shadow to active reload events are defined by GLDMODE bits in GLDCTL register. All the shadow registers use same reload pulse from shadow to active reloading. Individual LOADMODE bits are ignored. Reset type: SYSRSn

### 13.14.2.23 GLDCFG Register (Offset = 35h) [reset = 0h]

GLDCFG is shown in [Figure 13-99](#) and described in [Table 13-38](#).

Return to [Summary Table](#).

Global PWM Load Config Register

**Figure 13-99. GLDCFG Register**

15	14	13	12	11	10	9	8
RESERVED					AQCSFRC	AQCTLB_AQC TLB2	AQCTLA_AQC TLA2
R=0-0h					R/W-0h	R/W-0h	R/W-0h
7	6	5	4	3	2	1	0
DBCTL	DBFED_DBFE DHR	DBRED_DBRE DHR	CMPD	CMPC	CMPB_CMPBH R	CMPA_CMPAH R	TBPRD_TBPR DHR
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h

**Table 13-38. GLDCFG Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-11	RESERVED	R=0	0h	Reserved
10	AQCSFRC	R/W	0h	Global load event configuration for AQCSFRC  0: Registers use local reload configuration even if GLDCTL(GLD)=1 (reload is compatible with previous EPWMs) 1: Registers use global reload configuration if this bit is set and GLDCTL(GLD)=1 Reset type: SYSRSn
9	AQCTLB_AQCTLB2	R/W	0h	Global load event configuration for AQCTLB_AQCTLB2  0: Registers use local reload configuration even if GLDCTL(GLD)=1 (reload is compatible with previous EPWMs) 1: Registers use global reload configuration if this bit is set and GLDCTL(GLD)=1 Reset type: SYSRSn
8	AQCTLA_AQCTLA2	R/W	0h	Global load event configuration for AQCTLA_AQCTLA2  0: Registers use local reload configuration even if GLDCTL(GLD)=1 (reload is compatible with previous EPWMs) 1: Registers use global reload configuration if this bit is set and GLDCTL(GLD)=1 Reset type: SYSRSn
7	DBCTL	R/W	0h	Global load event configuration for DBCTL  0: Registers use local reload configuration even if GLDCTL(GLD)=1 (reload is compatible with previous EPWMs) 1: Registers use global reload configuration if this bit is set and GLDCTL(GLD)=1 Reset type: SYSRSn
6	DBFED_DBFEDHR	R/W	0h	Global load event configuration for DBFED_DBFEDHR  0: Registers use local reload configuration even if GLDCTL(GLD)=1 (reload is compatible with previous EPWMs) 1: Registers use global reload configuration if this bit is set and GLDCTL(GLD)=1 Reset type: SYSRSn

**Table 13-38. GLDCFG Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
5	DBRED_DBREDHR	R/W	0h	Global load event configuration for DBRED_DBREDHR 0: Registers use local reload configuration even if GLDCTL(GLD)=1 (reload is compatible with previous EPWMs) 1: Registers use global reload configuration if this bit is set and GLDCTL(GLD)=1 Reset type: SYSRSn
4	CMPD	R/W	0h	Global load event configuration for CMPD 0: Registers use local reload configuration even if GLDCTL(GLD)=1 (reload is compatible with previous EPWMs) 1: Registers use global reload configuration if this bit is set and GLDCTL(GLD)=1 Reset type: SYSRSn
3	CMPC	R/W	0h	Global load event configuration for CMPC 0: Registers use local reload configuration even if GLDCTL(GLD)=1 (reload is compatible with previous EPWMs) 1: Registers use global reload configuration if this bit is set and GLDCTL(GLD)=1 Reset type: SYSRSn
2	CMPB_CMPBHR	R/W	0h	Global load event configuration for CMPB_CMPBHR 0: Registers use local reload configuration even if GLDCTL(GLD)=1 (reload is compatible with previous EPWMs) 1: Registers use global reload configuration if this bit is set and GLDCTL(GLD)=1 Reset type: SYSRSn
1	CMPA_CMPAHR	R/W	0h	Global load event configuration for CMPA_CMPAHR 0: Registers use local reload configuration even if GLDCTL(GLD)=1 (reload is compatible with previous EPWMs) 1: Registers use global reload configuration if this bit is set and GLDCTL(GLD)=1 Reset type: SYSRSn
0	TBPRD_TBPRDHR	R/W	0h	Global load event configuration for TBPRD_TBPRDHR 0: Registers use local reload configuration even if GLDCTL(GLD)=1 (reload is compatible with previous EPWMs) 1: Registers use global reload configuration if this bit is set and GLDCTL(GLD)=1 Reset type: SYSRSn



### 13.14.2.24 EPWMXLINK Register (Offset = 38h) [reset = X]

EPWMXLINK is shown in [Figure 13-100](#) and described in [Table 13-39](#).

Return to [Summary Table](#).

#### EPWMx Link Register

This register controls which EPWMs are linked to other EPWM modules. The default reset value will vary for each module. The reset value will link each EPWM module to itself to prevent unintentional linking of modules.

**Figure 13-100. EPWMXLINK Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
GLDCTL2LINK				RESERVED								CMPDLINK			
R/W-X				R=0-0h								R/W-X			
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
CMPCLINK				CMPBLINK				CMPALINK				TBPRDLINK			
R/W-X				R/W-X				R/W-X				R/W-X			

**Table 13-39. EPWMXLINK Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-28	GLDCTL2LINK	R/W	X	<p>GLDCTL2 Link Bits</p> <p>Writes to the GLDCTL2 registers in the ePWM module selected by the following bit selections results in a simultaneous write to the current ePWM module's GLDCTL2 registers.</p> <p>0000: ePWM1            0001: ePWM2            0010: ePWM3            0011: ePWM4            0100: ePWM5            0101: ePWM6            0110: ePWM7            0111: ePWM8            1000: ePWM9            1001: ePWM10            1010: ePWM11            1011: ePWM12            1100: Reserved            ...            1111: Reserved            Reset type: SYSRSn</p>
27-20	RESERVED	R=0	0h	Reserved

**Table 13-39. EPWMXLINK Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
19-16	CMPDLINK	R/W	X	CMPD Link Bits  Writes to the CMPD registers in the ePWM module selected by the following bit selections results in a simultaneous write to the current ePWM module's CMPD registers.  0000: ePWM1 0001: ePWM2 0010: ePWM3 0011: ePWM4 0100: ePWM5 0101: ePWM6 0110: ePWM7 0111: ePWM8 1000: ePWM9 1001: ePWM10 1010: ePWM11 1011: ePWM12 1100: Reserved ... 1111: Reserved Reset type: SYSRSn
15-12	CMPLINK	R/W	X	CMPC Link Bits  Writes to the CMPC registers in the ePWM module selected by the following bit selections results in a simultaneous write to the current ePWM module's CMPC registers.  0000: ePWM1 0001: ePWM2 0010: ePWM3 0011: ePWM4 0100: ePWM5 0101: ePWM6 0110: ePWM7 0111: ePWM8 1000: ePWM9 1001: ePWM10 1010: ePWM11 1011: ePWM12 1100: Reserved ... 1111: Reserved Reset type: SYSRSn

**Table 13-39. EPWMXLINK Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
11-8	CMPBLINK	R/W	X	CMPB_CMPBHR Link Bits  Writes to the CMPB_CMPBHR registers in the ePWM module selected by the following bit selections results in a simultaneous write to the current ePWM module's CMPB_CMPBHR registers.  0000: ePWM1 0001: ePWM2 0010: ePWM3 0011: ePWM4 0100: ePWM5 0101: ePWM6 0110: ePWM7 0111: ePWM8 1000: ePWM9 1001: ePWM10 1010: ePWM11 1011: ePWM12 1100: Reserved ... 1111: Reserved Reset type: SYSRSn
7-4	CMPALINK	R/W	X	CMPA_CMPAHR Link Bits  Writes to the CMPA_CMPAHR registers in the ePWM module selected by the following bit selections results in a simultaneous write to the current ePWM module's CMPA_CMPAHR registers.  0000: ePWM1 0001: ePWM2 0010: ePWM3 0011: ePWM4 0100: ePWM5 0101: ePWM6 0110: ePWM7 0111: ePWM8 1000: ePWM9 1001: ePWM10 1010: ePWM11 1011: ePWM12 1100: Reserved ... 1111: Reserved Reset type: SYSRSn

**Table 13-39. EPWMXLINK Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
3-0	TBPRDLINK	R/W	X	TBPRD_TBPRDHR Link Bits  Writes to the TBPRD:TBPRDHR registers in the ePWM module selected by the following bit selections results in a simultaneous write to the current ePWM module's TBPRD_TBPRDHR registers.  0000: ePWM1 0001: ePWM2 0010: ePWM3 0011: ePWM4 0100: ePWM5 0101: ePWM6 0110: ePWM7 0111: ePWM8 1000: ePWM9 1001: ePWM10 1010: ePWM11 1011: ePWM12 1100: Reserved ... 1111: Reserved Reset type: SYSRSn

**13.14.2.25 EPWMREV Register (Offset = 3Eh) [reset = X]**

EPWMREV is shown in [Figure 13-101](#) and described in [Table 13-40](#).

Return to [Summary Table](#).

EPWM Revision Register

**Figure 13-101. EPWMREV Register**

15	14	13	12	11	10	9	8
TYPE							
R-4h							
7	6	5	4	3	2	1	0
REV							
R-X							

**Table 13-40. EPWMREV Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-8	TYPE	R	4h	EPWM Type Bits: These bits specify the EPWM type. These bits are changed if the functionality of the EPWM is changed or any feature is added or removed: Reset type: SYSRSn
7-0	REV	R	X	EPWM Silicon Revision Bits: These bits specify the EPWM revision. These bits are changed if any bug fixes are performed: Reset type: SYSRSn

**13.14.2.26 AQCTLA Register (Offset = 40h) [reset = 0h]**

AQCTLA is shown in [Figure 13-102](#) and described in [Table 13-41](#).

Return to [Summary Table](#).

Action Qualifier Control Register For Output A

**Figure 13-102. AQCTLA Register**

15	14	13	12	11	10	9	8
RESERVED				CBD		CBU	
R=0-0h				R/W-0h		R/W-0h	
7	6	5	4	3	2	1	0
CAD		CAU		PRD		ZRO	
R/W-0h		R/W-0h		R/W-0h		R/W-0h	

**Table 13-41. AQCTLA Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-12	RESERVED	R=0	0h	Reserved
11-10	CBD	R/W	0h	Action When TBCTR = CMPB on Down Count  Note: By definition, in count up-down mode when the counter equals 0 the direction is defined as 1 or counting up.  00: Do nothing (action disabled) 01: Clear: force EPWMxA output low. 10: Set: force EPWMxA output high. 11: Toggle EPWMxA output: low output signal will be forced high, and a high signal will be forced low. Reset type: SYSRSn
9-8	CBU	R/W	0h	Action When TBCTR = CMPB on Up Count  Note: By definition, in count up-down mode when the counter equals 0 the direction is defined as 1 or counting up.  00: Do nothing (action disabled) 01: Clear: force EPWMxA output low. 10: Set: force EPWMxA output high. 11: Toggle EPWMxA output: low output signal will be forced high, and a high signal will be forced low. Reset type: SYSRSn
7-6	CAD	R/W	0h	Action When TBCTR = CMPA on Down Count  Note: By definition, in count up-down mode when the counter equals 0 the direction is defined as 1 or counting up.  00: Do nothing (action disabled) 01: Clear: force EPWMxA output low. 10: Set: force EPWMxA output high. 11: Toggle EPWMxA output: low output signal will be forced high, and a high signal will be forced low. Reset type: SYSRSn

**Table 13-41. AQCTLA Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
5-4	CAU	R/W	0h	<p>Action When TBCTR = CMPA on Up Count</p> <p>Note: By definition, in count up-down mode when the counter equals 0 the direction is defined as 1 or counting up.</p> <p>00: Do nothing (action disabled)            01: Clear: force EPWMxA output low.            10: Set: force EPWMxA output high.            11: Toggle EPWMxA output: low output signal will be forced high, and a high signal will be forced low.</p> <p>Reset type: SYSRSn</p>
3-2	PRD	R/W	0h	<p>Action When TBCTR = TBPRD</p> <p>Note: By definition, in count up-down mode when the counter equals 0 the direction is defined as 1 or counting up.</p> <p>00: Do nothing (action disabled)            01: Clear: force EPWMxA output low.            10: Set: force EPWMxA output high.            11: Toggle EPWMxA output: low output signal will be forced high, and a high signal will be forced low.</p> <p>Reset type: SYSRSn</p>
1-0	ZRO	R/W	0h	<p>Action When TBCTR = 0</p> <p>Note: By definition, in count up-down mode when the counter equals 0 the direction is defined as 1 or counting up.</p> <p>00: Do nothing (action disabled)            01: Clear: force EPWMxA output low.            10: Set: force EPWMxA output high.            11: Toggle EPWMxA output: low output signal will be forced high, and a high signal will be forced low.</p> <p>Reset type: SYSRSn</p>

**13.14.2.27 AQCTLA2 Register (Offset = 41h) [reset = 0h]**

AQCTLA2 is shown in [Figure 13-103](#) and described in [Table 13-42](#).

Return to [Summary Table](#).

Additional Action Qualifier Control Register For Output A

**Figure 13-103. AQCTLA2 Register**

15	14	13	12	11	10	9	8
RESERVED							
R=0-0h							
7	6	5	4	3	2	1	0
T2D		T2U		T1D		T1U	
R/W-0h		R/W-0h		R/W-0h		R/W-0h	

**Table 13-42. AQCTLA2 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-8	RESERVED	R=0	0h	Reserved
7-6	T2D	R/W	0h	Action when event occurs on T2 in DOWN-Count  Note: By definition, in count up-down mode when the counter equals 0 the direction is defined as 1 or counting up.  00: Do nothing (action disabled) 01: Clear: force EPWMxA output low. 10: Set: force EPWMxA output high. 11: Toggle EPWMxA output: low output signal will be forced high, and a high signal will be forced low. Reset type: SYSRSn
5-4	T2U	R/W	0h	Action when event occurs on T2 in UP-Count  Note: By definition, in count up-down mode when the counter equals 0 the direction is defined as 1 or counting up.  00: Do nothing (action disabled) 01: Clear: force EPWMxA output low. 10: Set: force EPWMxA output high. 11: Toggle EPWMxA output: low output signal will be forced high, and a high signal will be forced low. Reset type: SYSRSn
3-2	T1D	R/W	0h	Action when event occurs on T1 in DOWN-Count  Note: By definition, in count up-down mode when the counter equals 0 the direction is defined as 1 or counting up.  00: Do nothing (action disabled) 01: Clear: force EPWMxA output low. 10: Set: force EPWMxA output high. 11: Toggle EPWMxA output: low output signal will be forced high, and a high signal will be forced low. Reset type: SYSRSn



**Table 13-42. AQCTLA2 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
1-0	T1U	R/W	0h	<p>Action when event occurs on T1 in UP-Count</p> <p>Note: By definition, in count up-down mode when the counter equals 0 the direction is defined as 1 or counting up.</p> <p>00: Do nothing (action disabled)</p> <p>01: Clear: force EPWMxA output low.</p> <p>10: Set: force EPWMxA output high.</p> <p>11: Toggle EPWMxA output: low output signal will be forced high, and a high signal will be forced low.</p> <p>Reset type: SYSRSn</p>

**13.14.2.28 AQCTLB Register (Offset = 42h) [reset = 0h]**

 AQCTLB is shown in [Figure 13-104](#) and described in [Table 13-43](#).

 Return to [Summary Table](#).

Action Qualifier Control Register For Output B

**Figure 13-104. AQCTLB Register**

15	14	13	12	11	10	9	8
RESERVED				CBD		CBU	
R=0-0h				R/W-0h		R/W-0h	
7	6	5	4	3	2	1	0
CAD		CAU		PRD		ZRO	
R/W-0h		R/W-0h		R/W-0h		R/W-0h	

**Table 13-43. AQCTLB Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-12	RESERVED	R=0	0h	Reserved
11-10	CBD	R/W	0h	Action When TBCTR = CMPB on Down Count  Note: By definition, in count up-down mode when the counter equals 0 the direction is defined as 1 or counting up.  00: Do nothing (action disabled) 01: Clear: force EPWMxB output low. 10: Set: force EPWMxB output high. 11: Toggle EPWMxB output: low output signal will be forced high, and a high signal will be forced low. Reset type: SYSRSn
9-8	CBU	R/W	0h	Action When TBCTR = CMPB on Up Count  Note: By definition, in count up-down mode when the counter equals 0 the direction is defined as 1 or counting up.  00: Do nothing (action disabled) 01: Clear: force EPWMxB output low. 10: Set: force EPWMxB output high. 11: Toggle EPWMxB output: low output signal will be forced high, and a high signal will be forced low. Reset type: SYSRSn
7-6	CAD	R/W	0h	Action When TBCTR = CMPA on Down Count  Note: By definition, in count up-down mode when the counter equals 0 the direction is defined as 1 or counting up.  00: Do nothing (action disabled) 01: Clear: force EPWMxB output low. 10: Set: force EPWMxB output high. 11: Toggle EPWMxB output: low output signal will be forced high, and a high signal will be forced low. Reset type: SYSRSn

**Table 13-43. AQCTLB Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
5-4	CAU	R/W	0h	<p>Action When TBCTR = CMPA on Up Count</p> <p>Note: By definition, in count up-down mode when the counter equals 0 the direction is defined as 1 or counting up.</p> <p>00: Do nothing (action disabled)            01: Clear: force EPWMxB output low.            10: Set: force EPWMxB output high.            11: Toggle EPWMxB output: low output signal will be forced high, and a high signal will be forced low.</p> <p>Reset type: SYSRSn</p>
3-2	PRD	R/W	0h	<p>Action When TBCTR = TBPRD</p> <p>Note: By definition, in count up-down mode when the counter equals 0 the direction is defined as 1 or counting up.</p> <p>00: Do nothing (action disabled)            01: Clear: force EPWMxB output low.            10: Set: force EPWMxB output high.            11: Toggle EPWMxB output: low output signal will be forced high, and a high signal will be forced low.</p> <p>Reset type: SYSRSn</p>
1-0	ZRO	R/W	0h	<p>Action When TBCTR = 0</p> <p>Note: By definition, in count up-down mode when the counter equals 0 the direction is defined as 1 or counting up.</p> <p>00: Do nothing (action disabled)            01: Clear: force EPWMxB output low.            10: Set: force EPWMxB output high.            11: Toggle EPWMxB output: low output signal will be forced high, and a high signal will be forced low.</p> <p>Reset type: SYSRSn</p>

**13.14.2.29 AQCTLB2 Register (Offset = 43h) [reset = 0h]**

AQCTLB2 is shown in [Figure 13-105](#) and described in [Table 13-44](#).

Return to [Summary Table](#).

Additional Action Qualifier Control Register For Output B

**Figure 13-105. AQCTLB2 Register**

15	14	13	12	11	10	9	8
RESERVED							
R=0-0h							
7	6	5	4	3	2	1	0
T2D		T2U		T1D		T1U	
R/W-0h		R/W-0h		R/W-0h		R/W-0h	

**Table 13-44. AQCTLB2 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-8	RESERVED	R=0	0h	Reserved
7-6	T2D	R/W	0h	Action when event occurs on T2 in DOWN-Count  Note: By definition, in count up-down mode when the counter equals 0 the direction is defined as 1 or counting up.  00: Do nothing (action disabled) 01: Clear: force EPWMxB output low. 10: Set: force EPWMxB output high. 11: Toggle EPWMxB output: low output signal will be forced high, and a high signal will be forced low. Reset type: SYSRSn
5-4	T2U	R/W	0h	Action when event occurs on T2 in UP-Count  Note: By definition, in count up-down mode when the counter equals 0 the direction is defined as 1 or counting up.  00: Do nothing (action disabled) 01: Clear: force EPWMxB output low. 10: Set: force EPWMxB output high. 11: Toggle EPWMxB output: low output signal will be forced high, and a high signal will be forced low. Reset type: SYSRSn
3-2	T1D	R/W	0h	Action when event occurs on T1 in DOWN-Count  Note: By definition, in count up-down mode when the counter equals 0 the direction is defined as 1 or counting up.  00: Do nothing (action disabled) 01: Clear: force EPWMxB output low. 10: Set: force EPWMxB output high. 11: Toggle EPWMxB output: low output signal will be forced high, and a high signal will be forced low. Reset type: SYSRSn

**Table 13-44. AQCTLB2 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
1-0	T1U	R/W	0h	<p>Action when event occurs on T1 in UP-Count</p> <p>Note: By definition, in count up-down mode when the counter equals 0 the direction is defined as 1 or counting up.</p> <p>00: Do nothing (action disabled)</p> <p>01: Clear: force EPWMxB output low.</p> <p>10: Set: force EPWMxB output high.</p> <p>11: Toggle EPWMxB output: low output signal will be forced high, and a high signal will be forced low.</p> <p>Reset type: SYSRSn</p>

### 13.14.2.30 AQSFR Register (Offset = 47h) [reset = 0h]

AQSFR is shown in [Figure 13-106](#) and described in [Table 13-45](#).

Return to [Summary Table](#).

Action Qualifier Software Force Register

**Figure 13-106. AQSFR Register**

15	14	13	12	11	10	9	8
RESERVED							
R=0-0h							
7	6	5	4	3	2	1	0
RLDCSF		OTSFB		ACTSFB		OTSFA	
R/W-0h		R=0/W=1-0h		R/W-0h		R/W-0h	

**Table 13-45. AQSFR Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-8	RESERVED	R=0	0h	Reserved
7-6	RLDCSF	R/W	0h	AQSFR Active Register Reload From Shadow Options 00: Load on event counter equals zero 01: Load on event counter equals period 10: Load on event counter equals zero or counter equals period 11: Load immediately (the active register is directly accessed by the CPU and is not loaded from the shadow register). Reset type: SYSRSn
5	OTSFB	R=0/W=1	0h	One-Time Software Forced Event on Output B 0: Writing a 0 (zero) has no effect. Always reads back a 0. This bit is auto cleared once a write to this register is complete (i.e., a forced event is initiated.). This is a one-shot forced event. It can be overridden by another subsequent event on output B. 1: Initiates a single software forced event Reset type: SYSRSn
4-3	ACTSFB	R/W	0h	Action When One-Time Software Force B is Invoked 00: Does nothing (action disabled) 01: Clear (low) 10: Set (high) 11: Toggle (Low -> High, High -> Low) Note: This action is not qualified by counter direction (CNT_dir) Reset type: SYSRSn
2	OTSFA	R=0/W=1	0h	One-Time Software Forced Event on Output A 0: Writing a 0 (zero) has no effect. Always reads back a 0. This bit is auto cleared once a write to this register is complete (i.e., a forced event is initiated). This is a one-shot forced event. It can be overridden by another subsequent event on output A. 1: Initiates a single software forced event Reset type: SYSRSn

**Table 13-45. AQSFR Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
1-0	ACTSFA	R/W	0h	Action When One-Time Software Force A Is Invoked 00: Does nothing (action disabled) 01: Clear (low) 10: Set (high) 11: Toggle (Low -> High, High -> Low) Note: This action is not qualified by counter direction (CNT_dir) Reset type: SYSRSn

**13.14.2.31 AQCSFRC Register (Offset = 49h) [reset = 0h]**

AQCSFRC is shown in [Figure 13-107](#) and described in [Table 13-46](#).

Return to [Summary Table](#).

Action Qualifier Continuous S/W Force Register

**Figure 13-107. AQCSFRC Register**

15	14	13	12	11	10	9	8
RESERVED							
R=0-0h							
7	6	5	4	3	2	1	0
RESERVED				CSFB		CSFA	
R=0-0h				R/W-0h		R/W-0h	

**Table 13-46. AQCSFRC Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-4	RESERVED	R=0	0h	Reserved
3-2	CSFB	R/W	0h	Continuous Software Force on Output B  In immediate mode, a continuous force takes effect on the next TBCLK edge. In shadow mode, a continuous force takes effect on the next TBCLK edge after a shadow load into the active register. To configure shadow mode, use AQSFRC[RLDCSF].  00: Software forcing is disabled and has no effect 01: Forces a continuous low on output B 10: Forces a continuous high on output B 11: Software forcing is disabled and has no effect Reset type: SYSRSn
1-0	CSFA	R/W	0h	Continuous Software Force on Output A  In immediate mode, a continuous force takes effect on the next TBCLK edge. In shadow mode, a continuous force takes effect on the next TBCLK edge after a shadow load into the active register.  00: Software forcing is disabled and has no effect 01: Forces a continuous low on output A 10: Forces a continuous high on output A 11: Software forcing is disabled and has no effect Reset type: SYSRSn



**13.14.2.32 DBREDHR Register (Offset = 50h) [reset = 0h]**

DBREDHR is shown in [Figure 13-108](#) and described in [Table 13-47](#).

Return to [Summary Table](#).

Dead-Band Generator Rising Edge Delay High Resolution Mirror Register

**Figure 13-108. DBREDHR Register**

15	14	13	12	11	10	9	8
DBREDHR							RESERVED
R/W-0h							R-0h
7	6	5	4	3	2	1	0
RESERVED							RESERVED
R-0h							R-0h

**Table 13-47. DBREDHR Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-9	DBREDHR	R/W	0h	Dead Band Rising Edge Delay High Resolution Bits Reset type: SYSRSn
8	RESERVED	R	0h	Reserved
7-1	RESERVED	R	0h	Reserved
0	RESERVED	R	0h	Reserved

**13.14.2.33 DBRED Register (Offset = 51h) [reset = 0h]**

DBRED is shown in [Figure 13-109](#) and described in [Table 13-48](#).

Return to [Summary Table](#).

Dead-Band Generator Rising Edge Delay High Resolution Mirror Register

**Figure 13-109. DBRED Register**

15	14	13	12	11	10	9	8
RESERVED				DBRED			
R-0h				R/W-0h			
7	6	5	4	3	2	1	0
DBRED							
R/W-0h							

**Table 13-48. DBRED Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-14	RESERVED	R	0h	Reserved
13-0	DBRED	R/W	0h	Rising edge delay value Reset type: SYSRSn

**13.14.2.34 DBFEDHR Register (Offset = 52h) [reset = 0h]**

DBFEDHR is shown in [Figure 13-110](#) and described in [Table 13-49](#).

Return to [Summary Table](#).

Dead-Band Generator Falling Edge Delay High Resolution Register

**Figure 13-110. DBFEDHR Register**

15	14	13	12	11	10	9	8
DBFEDHR							RESERVED
R/W-0h							R-0h
7	6	5	4	3	2	1	0
RESERVED							RESERVED
R-0h							R-0h

**Table 13-49. DBFEDHR Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-9	DBFEDHR	R/W	0h	Dead Band Falling Edge Delay High Resolution Bits Reset type: SYSRSn
8	RESERVED	R	0h	Reserved
7-1	RESERVED	R	0h	Reserved
0	RESERVED	R	0h	Reserved

**13.14.2.35 DBFED Register (Offset = 53h) [reset = 0h]**

DBFED is shown in [Figure 13-111](#) and described in [Table 13-50](#).

Return to [Summary Table](#).

Dead-Band Generator Falling Edge Delay Count Register

**Figure 13-111. DBFED Register**

15	14	13	12	11	10	9	8
RESERVED				DBFED			
R-0h				R/W-0h			
7	6	5	4	3	2	1	0
DBFED							
R/W-0h							

**Table 13-50. DBFED Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-14	RESERVED	R	0h	Reserved
13-0	DBFED	R/W	0h	Falling Edge Delay Count 14-bit counter Reset type: SYSRSn

**13.14.2.36 TBPHS Register (Offset = 60h) [reset = 0h]**

TBPHS is shown in [Figure 13-112](#) and described in [Table 13-51](#).

Return to [Summary Table](#).

Time Base Phase High

**Figure 13-112. TBPHS Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
TBPHS																TBPHSHR															
R/W-0h																R/W-0h															

**Table 13-51. TBPHS Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	TBPHS	R/W	0h	<p>Phase Offset Register</p> <p>These bits set time-base counter phase of the selected ePWM relative to the time-base that is supplying the synchronization input signal.</p> <ul style="list-style-type: none"> <li>- If TBCTL[PHSEN] = 0, then the synchronization event is ignored and the time-base counter is not loaded with the phase.</li> <li>- If TBCTL[PHSEN] = 1, then the time-base counter (TBCTR) will be loaded with the phase (TBPHS) when a synchronization event occurs. The synchronization event can be initiated by the input synchronization signal (EPWMxSYNCl) or by a software forced synchronization.</li> </ul> <p>Reset type: SYSRSn</p>
15-0	TBPHSHR	R/W	0h	<p>Phase Offset (High Resolution) Register</p> <p>Reset type: SYSRSn</p>

**13.14.2.37 TBPRDHR Register (Offset = 62h) [reset = 0h]**

TBPRDHR is shown in [Figure 13-113](#) and described in [Table 13-52](#).

Return to [Summary Table](#).

Time Base Period High Resolution Register

**Figure 13-113. TBPRDHR Register**

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
TBPRDHR															
R/W-0h															

**Table 13-52. TBPRDHR Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-0	TBPRDHR	R/W	0h	Period High Resolution Bits  These 8-bits contain the high-resolution portion of the period value. The TBPRDHR register is not affected by the TBCTL[PRDL] bit. Reads from this register always reflect the shadow register. Likewise writes are also to the shadow register. The TBPRDHR register is only used when the high resolution period feature is enabled. This register is only available with ePWM modules which support high-resolution period control. Reset type: SYSRSn

**13.14.2.38 TBPRD Register (Offset = 63h) [reset = 0h]**

TBPRD is shown in [Figure 13-114](#) and described in [Table 13-53](#).

Return to [Summary Table](#).

Time Base Period Register

**Figure 13-114. TBPRD Register**

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
TBPRD															
R/W-0h															

**Table 13-53. TBPRD Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-0	TBPRD	R/W	0h	<p>Time Base Period Register</p> <p>These bits determine the period of the time-base counter. This sets the PWM frequency. Shadowing of this register is enabled and disabled by the TBCTL[PRDL] bit. By default this register is shadowed.</p> <ul style="list-style-type: none"> <li>- If TBCTL[PRDL] = 0, then the shadow is enabled and any write or read will automatically go to the shadow register. In this case, the active register will be loaded from the shadow register when the time-base counter equals zero.</li> <li>- If TBCTL[PRDL] = 1, then the shadow is disabled and any write or read will go directly to the active register, that is the register actively controlling the hardware.</li> <li>- The active and shadow registers share the same memory map address.</li> </ul> <p>Reset type: SYSRSn</p>

**13.14.2.39 CMPA Register (Offset = 6Ah) [reset = 0h]**

 CMPA is shown in [Figure 13-115](#) and described in [Table 13-54](#).

 Return to [Summary Table](#).

Counter Compare A Register

**Figure 13-115. CMPA Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
CMPA																CMPAHR															
R/W-0h																R/W-0h															

**Table 13-54. CMPA Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	CMPA	R/W	0h	<p>Compare A Register</p> <p>The value in the active CMPA register is continuously compared to the time-base counter (TBCTR). When the values are equal, the counter-compare module generates a "time-base counter equal to counter compare A" event. This event is sent to the action-qualifier where it is qualified and converted it into one or more actions. These actions can be applied to either the EPWMxA or the EPWMxB output depending on the configuration of the AQCTLA and AQCTLB registers. The actions that can be defined in the AQCTLA and AQCTLB registers include:</p> <ul style="list-style-type: none"> <li>- Do nothing</li> <li>- Clear: Pull the EPWMxA and/or EPWMxB signal low</li> <li>- Set: Pull the EPWMxA and/or EPWMxB signal high</li> <li>- Toggle the EPWMxA and/or EPWMxB signal</li> </ul> <p>Shadowing of this register is enabled and disabled by the CMPCTL[SHDWAMODE] bit. By default this register is shadowed.</p> <ul style="list-style-type: none"> <li>- If CMPCTL[SHDWAMODE] = 0, then the shadow is enabled and any write or read will automatically go to the shadow register. In this case, the CMPCTL[LOADAMODE] bit field determines which event will load the active register from the shadow register.</li> <li>- Before a write, the CMPCTL[SHDWAFULL] bit can be read to determine if the shadow register is currently full.</li> <li>- If CMPCTL[SHDWAMODE] = 1, then the shadow register is disabled and any write or read will go directly to the active register, that is the register actively controlling the hardware.</li> <li>- In either mode, the active and shadow registers share the same memory map address.</li> </ul> <p>Reset type: SYSRSn</p>
15-0	CMPAHR	R/W	0h	<p>Compare A HRPWM Extension Register</p> <p>These 8-bits contain the high-resolution portion (least significant 8-bits) of the counter-compare A value. CMPA:CMPAHR can be accessed in a single 32-bit read/write. Shadowing is enabled and disabled by the CMPCTL[SHDWAMODE] bit as described for the CMPA register.</p> <p>Reset type: SYSRSn</p>



### 13.14.2.40 CMPB Register (Offset = 6Ch) [reset = 0h]

CMPB is shown in [Figure 13-116](#) and described in [Table 13-55](#).

Return to [Summary Table](#).

Compare B Register

**Figure 13-116. CMPB Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
CMPB																CMPBHR															
R/W-0h																R/W-0h															

**Table 13-55. CMPB Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	CMPB	R/W	0h	<p>Compare B Register</p> <p>The value in the active CMPB register is continuously compared to the time-base counter (TBCTR). When the values are equal, the counter-compare module generates a "time-base counter equal to counter compare B" event. This event is sent to the action-qualifier where it is qualified and converted it into one or more actions. These actions can be applied to either the EPWMxA or the EPWMxB output depending on the configuration of the AQCTLA and AQCTLB registers. The actions that can be defined in the AQCTLA and AQCTLB registers include:</p> <ul style="list-style-type: none"> <li>- Do nothing</li> <li>- Clear: Pull the EPWMxA and/or EPWMxB signal low</li> <li>- Set: Pull the EPWMxA and/or EPWMxB signal high</li> <li>- Toggle the EPWMxA and/or EPWMxB signal</li> </ul> <p>Shadowing of this register is enabled and disabled by the CMPCTL[SHDWBMODE] bit. By default this register is shadowed.</p> <ul style="list-style-type: none"> <li>- If CMPCTL[SHDWBMODE] = 0, then the shadow is enabled and any write or read will automatically go to the shadow register. In this case, the CMPCTL[LOADBMODE] bit field determines which event will load the active register from the shadow register.</li> <li>- Before a write, the CMPCTL[SHDWBFULL] bit can be read to determine if the shadow register is currently full.</li> <li>- If CMPCTL[SHDWBMODE] = 1, then the shadow register is disabled and any write or read will go directly to the active register, that is the register actively controlling the hardware.</li> <li>- In either mode, the active and shadow registers share the same memory map address.</li> </ul> <p>Reset type: SYSRSn</p>
15-0	CMPBHR	R/W	0h	<p>Compare B High Resolution Bits</p> <p>Reset type: SYSRSn</p>

**13.14.2.41 CMPC Register (Offset = 6Fh) [reset = 0h]**

CMPC is shown in [Figure 13-117](#) and described in [Table 13-56](#).

Return to [Summary Table](#).

Counter Compare C Register

LINK feature access should always be 16-bit

**Figure 13-117. CMPC Register**

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
CMPC															
R/W-0h															

**Table 13-56. CMPC Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-0	CMPC	R/W	0h	<p>Compare C Register</p> <p>The value in the active CMPC register is continuously compared to the time-base counter (TBCTR). When the values are equal, the counter-compare module generates a "time-base counter equal to counter compare C" event.</p> <p>Shadowing of this register is enabled and disabled by the CMPCTL2[SHDWCMODE] bit. By default this register is shadowed.</p> <ul style="list-style-type: none"> <li>- If CMPCTL2[SHDWCMODE] = 0, then the shadow is enabled and any write or read will automatically go to the shadow register. In this case, the CMPCTL2[LOADCMODE] bit field determines which event will load the active register from the shadow register:</li> <li>- If CMPCTL2[SHDWCMODE] = 1, then the shadow register is disabled and any write or read will go directly to the active register that is, the register actively controlling the hardware.</li> <li>- In either mode, the active and shadow registers share the same memory map address.</li> </ul> <p>Reset type: SYSRSn</p>

**13.14.2.42 CMPD Register (Offset = 71h) [reset = 0h]**

CMPD is shown in [Figure 13-118](#) and described in [Table 13-57](#).

Return to [Summary Table](#).

Counter Compare D Register

LINK feature access should always be 16-bit

**Figure 13-118. CMPD Register**

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
CMPD															
R/W-0h															

**Table 13-57. CMPD Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-0	CMPD	R/W	0h	<p>Compare D Register</p> <p>The value in the active CMPD register is continuously compared to the time-base counter (TBCTR). When the values are equal, the counter-compare module generates a "time-base counter equal to counter compare D" event.</p> <p>Shadowing of this register is enabled and disabled by the CMPCTL2[SHDWDMODE] bit. By default this register is shadowed.</p> <ul style="list-style-type: none"> <li>- If CMPCTL2[SHDWDMODE] = 0, then the shadow is enabled and any write or read will automatically go to the shadow register. In this case, the CMPCTL2[LOADDMODE] bit field determines which event will load the active register from the shadow register:</li> <li>- If CMPCTL2[SHDWDMODE] = 1, then the shadow register is disabled and any write or read will go directly to the active register that is, the register actively controlling the hardware.</li> <li>- In either mode, the active and shadow registers share the same memory map address.</li> </ul> <p>Reset type: SYSRSn</p>

**13.14.2.43 GLDCTL2 Register (Offset = 74h) [reset = 0h]**

GLDCTL2 is shown in [Figure 13-119](#) and described in [Table 13-58](#).

Return to [Summary Table](#).

Global PWM Load Control Register 2

**Figure 13-119. GLDCTL2 Register**

15	14	13	12	11	10	9	8
RESERVED							
R=0-0h							
7	6	5	4	3	2	1	0
RESERVED						GFRCLD	OSHTLD
R=0-0h						R=0/W=1-0h	R=0/W=1-0h

**Table 13-58. GLDCTL2 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-2	RESERVED	R=0	0h	Reserved
1	GFRCLD	R=0/W=1	0h	Force Load Event in One Shot Mode  0: Writing of 0 will be ignored. Always reads back a 0. 1: Force one load event at the input of the event pre-scale counter as shown in the diagram below. This bit is intended to be used for testing and/or software force loading of the events in global load mode. Reset type: SYSRSn
0	OSHTLD	R=0/W=1	0h	Enable Reload Event in One Shot Mode  0: Writing of 0 will be ignored. Always reads back a 0. 1: Turns the one shot latch condition ON. Upon occurrence of a chosen load strobe, one shadow to active reload occurs and the latch will be cleared. Hence writing 1 to this bit would allow one load strobe event to pass through and block further strobe events. Reset type: SYSRSn

**13.14.2.44 SWVDELVAL Register (Offset = 77h) [reset = 0h]**

SWVDELVAL is shown in [Figure 13-120](#) and described in [Table 13-59](#).

Return to [Summary Table](#).

Software Valley Mode Delay Register

**Figure 13-120. SWVDELVAL Register**

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
SWVDELVAL															
R-0h															

**Table 13-59. SWVDELVAL Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-0	SWVDELVAL	R	0h	Software Valley Delay Value Register  This register can be optionally used define offset value for the hardware calculated delay HWDELAYVAL as defined in VCAPCTL[VDELAYDIV] bits. Reset type: SYSRSn

**13.14.2.45 TZSEL Register (Offset = 80h) [reset = 0h]**

 TZSEL is shown in [Figure 13-121](#) and described in [Table 13-60](#).

 Return to [Summary Table](#).

Trip Zone Select Register

**Figure 13-121. TZSEL Register**

15		14		13		12		11		10		9		8	
DCBEVT1	DCAEVT1	OSHT6	OSHT5	OSHT4	OSHT3	OSHT2	OSHT1								
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h								
7		6		5		4		3		2		1		0	
DCBEVT2	DCAEVT2	CBC6	CBC5	CBC4	CBC3	CBC2	CBC1								
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h								

**Table 13-60. TZSEL Register Field Descriptions**

Bit	Field	Type	Reset	Description
15	DCBEVT1	R/W	0h	Digital Compare Output B Event 1 Select 0: Disable DCBEVT1 as one-shot-trip source for this ePWM module. 1: Enable DCBEVT1 as one-shot-trip source for this ePWM module. Reset type: SYSRSn
14	DCAEVT1	R/W	0h	Digital Compare Output A Event 1 Select 0: Disable DCAEVT1 as one-shot-trip source for this ePWM module. 1: Enable DCAEVT1 as one-shot-trip source for this ePWM module. Reset type: SYSRSn
13	OSHT6	R/W	0h	Trip-zone 6 (TZ6) Select 0: Disable TZ6 as a one-shot trip source for this ePWM module 1: Enable TZ6 as a one-shot trip source for this ePWM module Reset type: SYSRSn
12	OSHT5	R/W	0h	Trip-zone 5 (TZ5) Select 0: Disable TZ5 as a one-shot trip source for this ePWM module 1: Enable TZ5 as a one-shot trip source for this ePWM module Reset type: SYSRSn
11	OSHT4	R/W	0h	Trip-zone 4 (TZ4) Select 0: Disable TZ4 as a one-shot trip source for this ePWM module 1: Enable TZ4 as a one-shot trip source for this ePWM module Reset type: SYSRSn
10	OSHT3	R/W	0h	Trip-zone 3 (TZ3) Select 0: Disable TZ3 as a one-shot trip source for this ePWM module 1: Enable TZ3 as a one-shot trip source for this ePWM module Reset type: SYSRSn
9	OSHT2	R/W	0h	Trip-zone 2 (TZ2) Select 0: Disable TZ2 as a one-shot trip source for this ePWM module 1: Enable TZ2 as a one-shot trip source for this ePWM module Reset type: SYSRSn
8	OSHT1	R/W	0h	Trip-zone 1 (TZ1) Select 0: Disable TZ1 as a one-shot trip source for this ePWM module 1: Enable TZ1 as a one-shot trip source for this ePWM module Reset type: SYSRSn

**Table 13-60. TZSEL Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
7	DCBEVT2	R/W	0h	Digital Compare Output B Event 2 Select 0: Disable DCBEVT2 as a CBC trip source for this ePWM module 1: Enable DCBEVT2 as a CBC trip source for this ePWM module Reset type: SYSRSn
6	DCAEVT2	R/W	0h	Digital Compare Output A Event 2 Select 0: Disable DCAEVT2 as a CBC trip source for this ePWM module 1: Enable DCAEVT2 as a CBC trip source for this ePWM module Reset type: SYSRSn
5	CBC6	R/W	0h	Trip-zone 6 (TZ6) Select 0: Disable TZ6 as a CBC trip source for this ePWM module 1: Enable TZ6 as a CBC trip source for this ePWM module Reset type: SYSRSn
4	CBC5	R/W	0h	Trip-zone 5 (TZ5) Select 0: Disable TZ5 as a CBC trip source for this ePWM module 1: Enable TZ5 as a CBC trip source for this ePWM module Reset type: SYSRSn
3	CBC4	R/W	0h	Trip-zone 4 (TZ4) Select 0: Disable TZ4 as a CBC trip source for this ePWM module 1: Enable TZ4 as a CBC trip source for this ePWM module Reset type: SYSRSn
2	CBC3	R/W	0h	Trip-zone 3 (TZ3) Select 0: Disable TZ3 as a CBC trip source for this ePWM module 1: Enable TZ3 as a CBC trip source for this ePWM module Reset type: SYSRSn
1	CBC2	R/W	0h	Trip-zone 2 (TZ2) Select 0: Disable TZ2 as a CBC trip source for this ePWM module 1: Enable TZ2 as a CBC trip source for this ePWM module Reset type: SYSRSn
0	CBC1	R/W	0h	Trip-zone 1 (TZ1) Select 0: Disable TZ1 as a CBC trip source for this ePWM module 1: Enable TZ1 as a CBC trip source for this ePWM module Reset type: SYSRSn

**13.14.2.46 TZDCSEL Register (Offset = 82h) [reset = 0h]**

 TZDCSEL is shown in [Figure 13-122](#) and described in [Table 13-61](#).

 Return to [Summary Table](#).

Trip Zone Digital Comparator Select Register

**Figure 13-122. TZDCSEL Register**

15	14	13	12	11	10	9	8
RESERVED				DCBEVT2		DCBEVT1	
R=0-0h				R/W-0h		R/W-0h	
7	6	5	4	3	2	1	0
DCBEVT1		DCAEVT2			DCAEVT1		
R/W-0h		R/W-0h			R/W-0h		

**Table 13-61. TZDCSEL Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-12	RESERVED	R=0	0h	Reserved
11-9	DCBEVT2	R/W	0h	Digital Compare Output B Event 2 Selection  000: Event disabled 001: DCBH = low, DCBL = don't care 010: DCBH = high, DCBL = don't care 011: DCBL = low, DCBH = don't care 100: DCBL = high, DCBH = don't care 101: DCBL = high, DCBH = low 110: Reserved 111: Reserved Reset type: SYSRSn
8-6	DCBEVT1	R/W	0h	Digital Compare Output B Event 1 Selection  000: Event disabled 001: DCBH = low, DCBL = don't care 010: DCBH = high, DCBL = don't care 011: DCBL = low, DCBH = don't care 100: DCBL = high, DCBH = don't care 101: DCBL = high, DCBH = low 110: Reserved 111: Reserved Reset type: SYSRSn
5-3	DCAEVT2	R/W	0h	Digital Compare Output A Event 2 Selection  000: Event disabled 001: DCAH = low, DCAL = don't care 010: DCAH = high, DCAL = don't care 011: DCAL = low, DCAH = don't care 100: DCAL = high, DCAH = don't care 101: DCAL = high, DCAH = low 110: Reserved 111: Reserved Reset type: SYSRSn



**Table 13-61. TZDCSEL Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
2-0	DCAEVT1	R/W	0h	Digital Compare Output A Event 1 Selection  000: Event disabled 001: DCAH = low, DCAL = don't care 010: DCAH = high, DCAL = don't care 011: DCAL = low, DCAH = don't care 100: DCAL = high, DCAH = don't care 101: DCAL = high, DCAH = low 110: Reserved 111: Reserved Reset type: SYSRSn

### 13.14.2.47 TZCTL Register (Offset = 84h) [reset = 0h]

TZCTL is shown in [Figure 13-123](#) and described in [Table 13-62](#).

Return to [Summary Table](#).

Trip Zone Control Register

**Figure 13-123. TZCTL Register**

15	14	13	12	11	10	9	8
RESERVED				DCBEVT2		DCBEVT1	
R=0-0h				R/W-0h		R/W-0h	
7	6	5	4	3	2	1	0
DCAEVT2		DCAEVT1		TZB		TZA	
R/W-0h		R/W-0h		R/W-0h		R/W-0h	

**Table 13-62. TZCTL Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-12	RESERVED	R=0	0h	Reserved
11-10	DCBEVT2	R/W	0h	Digital Compare Output B Event 2 Action On EPWMxB 00: High-impedance (EPWMxB = High-impedance state) 01: Force EPWMxB to a high state. 10: Force EPWMxB to a low state. 11: Do Nothing, trip action is disabled Reset type: SYSRSn
9-8	DCBEVT1	R/W	0h	Digital Compare Output B Event 1 Action On EPWMxB 00: High-impedance (EPWMxB = High-impedance state) 01: Force EPWMxB to a high state. 10: Force EPWMxB to a low state. 11: Do Nothing, trip action is disabled Reset type: SYSRSn
7-6	DCAEVT2	R/W	0h	Digital Compare Output A Event 2 Action On EPWMxA 00: High-impedance (EPWMxA = High-impedance state) 01: Force EPWMxA to a high state. 10: Force EPWMxA to a low state. 11: Do Nothing, trip action is disabled Reset type: SYSRSn
5-4	DCAEVT1	R/W	0h	Digital Compare Output A Event 1 Action On EPWMxA 00: High-impedance (EPWMxA = High-impedance state) 01: Force EPWMxA to a high state. 10: Force EPWMxA to a low state. 11: Do Nothing, trip action is disabled Reset type: SYSRSn
3-2	TZB	R/W	0h	TZ1 to TZ6, DCAEVT1/2, DCBEVT1/2 Trip Action On EPWMxB When a trip event occurs the following action is taken on output EPWMxB. Which trip-zone pins can cause an event is defined in the TZSEL register. 00: High-impedance (EPWMxB = High-impedance state) 01: Force EPWMxB to a high state 10: Force EPWMxB to a low state 11: Do nothing, no action is taken on EPWMxB. Reset type: SYSRSn

**Table 13-62. TZCTL Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
1-0	TZA	R/W	0h	<p>TZ1 to TZ6, DCAEVT1/2, DCBEVT1/2 Trip Action On EPWMxA</p> <p>When a trip event occurs the following action is taken on output EPWMxA. Which trip-zone pins can cause an event is defined in the TZSEL register.</p> <p>00: High-impedance (EPWMxA = High-impedance state)            01: Force EPWMxA to a high state            10: Force EPWMxA to a low state            11: Do nothing, no action is taken on EPWMxA.</p> <p>Reset type: SYSRSn</p>

### 13.14.2.48 TZCTL2 Register (Offset = 85h) [reset = 0h]

TZCTL2 is shown in [Figure 13-124](#) and described in [Table 13-63](#).

Return to [Summary Table](#).

Additional Trip Zone Control Register

**Figure 13-124. TZCTL2 Register**

15	14	13	12	11	10	9	8
ETZE	RESERVED			TZBD		TZBU	
R/W-0h	R=0-0h			R/W-0h		R/W-0h	
7	6	5	4	3	2	1	0
TZBU		TZAD			TZAU		
R/W-0h		R/W-0h			R/W-0h		

**Table 13-63. TZCTL2 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15	ETZE	R/W	0h	TZCTL2 Enable  0: Use trip action from TZCTL (legacy EPWM compatibility) 1: Use trip action defined in TZCTL2, TZCTLDCA and TZCTLDCA. Settings in TZCTL are ignored Reset type: SYSRSn
14-12	RESERVED	R=0	0h	Reserved
11-9	TZBD	R/W	0h	TZ1 to TZ6, DCAEVT1/2, DCBEVT1/2 Trip Action On EPWMxB while Count direction is DOWN  000: HiZ (EPWMxB = HiZ state) 001: Forced Hi (EPWMxB = High state) 010: Forced Lo (EPWMxB = Lo state) 011: Toggle (Low -> High, High -> Low) 100: Reserved 101: Reserved 110: Reserved 111: Do Nothing, trip action is disabled Reset type: SYSRSn
8-6	TZBU	R/W	0h	TZ1 to TZ6, DCAEVT1/2, DCBEVT1/2 Trip Action On EPWMxB while Count direction is UP  000: HiZ (EPWMxB = HiZ state) 001: Forced Hi (EPWMxB = High state) 010: Forced Lo (EPWMxB = Lo state) 011: Toggle (Low -> High, High -> Low) 100: Reserved 101: Reserved 110: Reserved 111: Do Nothing, trip action is disabled Reset type: SYSRSn

**Table 13-63. TZCTL2 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
5-3	TZAD	R/W	0h	TZ1 to TZ6, DCAEVT1/2, DCBEVT1/2 Trip Action On EPWMxA while Count direction is DOWN  000: HiZ (EPWMxA = HiZ state) 001: Forced Hi (EPWMxA = High state) 010: Forced Lo (EPWMxA = Lo state) 011: Toggle (Low -> High, High -> Low) 100: Reserved 101: Reserved 110: Reserved 111: Do Nothing, trip action is disabled Reset type: SYSRSn
2-0	TZAU	R/W	0h	TZ1 to TZ6, DCAEVT1/2, DCBEVT1/2 Trip Action On EPWMxA while Count direction is UP  000: HiZ (EPWMxA = HiZ state) 001: Forced Hi (EPWMxA = High state) 010: Forced Lo (EPWMxA = Lo state) 011: Toggle (Low -> High, High -> Low) 100: Reserved 101: Reserved 110: Reserved 111: Do Nothing, trip action is disabled Reset type: SYSRSn

**13.14.2.49 TZCTLDCA Register (Offset = 86h) [reset = 0h]**

 TZCTLDCA is shown in [Figure 13-125](#) and described in [Table 13-64](#).

 Return to [Summary Table](#).

Trip Zone Control Register Digital Compare A

**Figure 13-125. TZCTLDCA Register**

15	14	13	12	11	10	9	8
RESERVED				DCAEVT2D		DCAEVT2U	
R=0-0h				R/W-0h		R/W-0h	
7	6	5	4	3	2	1	0
DCAEVT2U		DCAEVT1D			DCAEVT1U		
R/W-0h		R/W-0h			R/W-0h		

**Table 13-64. TZCTLDCA Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-12	RESERVED	R=0	0h	Reserved
11-9	DCAEVT2D	R/W	0h	Digital Compare Output A Event 2 Action On EPWMxA while Count direction is DOWN  000: HiZ (EPWMxA = HiZ state) 001: Forced Hi (EPWMxA = High state) 010: Forced Lo (EPWMxA = Lo state) 011: Toggle (Low -> High, High -> Low) 100: Reserved 101: Reserved 110: Reserved 111: Do Nothing, trip action is disabled Reset type: SYSRSn
8-6	DCAEVT2U	R/W	0h	Digital Compare Output A Event 2 Action On EPWMxA while Count direction is UP  000: HiZ (EPWMxA = HiZ state) 001: Forced Hi (EPWMxA = High state) 010: Forced Lo (EPWMxA = Lo state) 011: Toggle (Low -> High, High -> Low) 100: Reserved 101: Reserved 110: Reserved 111: Do Nothing, trip action is disabled Reset type: SYSRSn
5-3	DCAEVT1D	R/W	0h	Digital Compare Output A Event 1 Action On EPWMxA while Count direction is DOWN  000: HiZ (EPWMxA = HiZ state) 001: Forced Hi (EPWMxA = High state) 010: Forced Lo (EPWMxA = Lo state) 011: Toggle (Low -> High, High -> Low) 100: Reserved 101: Reserved 110: Reserved 111: Do Nothing, trip action is disabled Reset type: SYSRSn

**Table 13-64. TZCTLDCA Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
2-0	DCAEVT1U	R/W	0h	Digital Compare Output A Event 1 Action On EPWMxA while Count direction is UP  000: HiZ (EPWMxA = HiZ state) 001: Forced Hi (EPWMxA = High state) 010: Forced Lo (EPWMxA = Lo state) 011: Toggle (Low -> High, High -> Low) 100: Reserved 101: Reserved 110: Reserved 111: Do Nothing, trip action is disabled Reset type: SYSRSn

**13.14.2.50 TZCTLDCB Register (Offset = 87h) [reset = 0h]**

 TZCTLDCB is shown in [Figure 13-126](#) and described in [Table 13-65](#).

 Return to [Summary Table](#).

Trip Zone Control Register Digital Compare B

**Figure 13-126. TZCTLDCB Register**

15	14	13	12	11	10	9	8
RESERVED				DCBEVT2D		DCBEVT2U	
R=0-0h				R/W-0h		R/W-0h	
7	6	5	4	3	2	1	0
DCBEVT2U		DCBEVT1D			DCBEVT1U		
R/W-0h		R/W-0h			R/W-0h		

**Table 13-65. TZCTLDCB Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-12	RESERVED	R=0	0h	Reserved
11-9	DCBEVT2D	R/W	0h	Digital Compare Output A Event 2 Action On EPWMxB while Count direction is DOWN  000: HiZ (EPWMxB = HiZ state) 001: Forced Hi (EPWMxB = High state) 010: Forced Lo (EPWMxB = Lo state) 011: Toggle (Low -> High, High -> Low) 100: Reserved 101: Reserved 110: Reserved 111: Do Nothing, trip action is disabled Reset type: SYSRSn
8-6	DCBEVT2U	R/W	0h	Digital Compare Output A Event 2 Action On EPWMxB while Count direction is UP  000: HiZ (EPWMxB = HiZ state) 001: Forced Hi (EPWMxB = High state) 010: Forced Lo (EPWMxB = Lo state) 011: Toggle (Low -> High, High -> Low) 100: Reserved 101: Reserved 110: Reserved 111: Do Nothing, trip action is disabled Reset type: SYSRSn
5-3	DCBEVT1D	R/W	0h	Digital Compare Output A Event 1 Action On EPWMxB while Count direction is DOWN  000: HiZ (EPWMxB = HiZ state) 001: Forced Hi (EPWMxB = High state) 010: Forced Lo (EPWMxB = Lo state) 011: Toggle (Low -> High, High -> Low) 100: Reserved 101: Reserved 110: Reserved 111: Do Nothing, trip action is disabled Reset type: SYSRSn



**Table 13-65. TZCTLDCB Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
2-0	DCBEVT1U	R/W	0h	Digital Compare Output A Event 1 Action On EPWMxB while Count direction is UP  000: HiZ (EPWMxB = HiZ state) 001: Forced Hi (EPWMxB = High state) 010: Forced Lo (EPWMxB = Lo state) 011: Toggle (Low -> High, High -> Low) 100: Reserved 101: Reserved 110: Reserved 111: Do Nothing, trip action is disabled Reset type: SYSRSn

**13.14.2.51 TZEINT Register (Offset = 8Dh) [reset = 0h]**

TZEINT is shown in [Figure 13-127](#) and described in [Table 13-66](#).

Return to [Summary Table](#).

Trip Zone Enable Interrupt Register

**Figure 13-127. TZEINT Register**

15	14	13	12	11	10	9	8
RESERVED							
R=0-0h							
7	6	5	4	3	2	1	0
RESERVED	DCBEVT2	DCBEVT1	DCAEVT2	DCAEVT1	OST	CBC	RESERVED
R=0-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R=0-0h

**Table 13-66. TZEINT Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-7	RESERVED	R=0	0h	Reserved
6	DCBEVT2	R/W	0h	Digital Compare Output B Event 2 Interrupt Enable 0: Disabled 1: Enabled Reset type: SYSRSn
5	DCBEVT1	R/W	0h	Digital Compare Output B Event 1 Interrupt Enable 0: Disabled 1: Enabled Reset type: SYSRSn
4	DCAEVT2	R/W	0h	Digital Compare Output A Event 2 Interrupt Enable 0: Disabled 1: Enabled Reset type: SYSRSn
3	DCAEVT1	R/W	0h	Digital Compare Output A Event 1 Interrupt Enable 0: Disabled 1: Enabled Reset type: SYSRSn
2	OST	R/W	0h	Trip-zone One-Shot Interrupt Enable 0: Disable one-shot interrupt generation 1: Enable Interrupt generation a one-shot trip event will cause a EPWMx_TZINT PIE interrupt. Reset type: SYSRSn
1	CBC	R/W	0h	Trip-zone Cycle-by-Cycle Interrupt Enable 0: Disable cycle-by-cycle interrupt generation. 1: Enable interrupt generation a cycle-by-cycle trip event will cause an EPWMx_TZINT PIE interrupt. Reset type: SYSRSn
0	RESERVED	R=0	0h	Reserved

### 13.14.2.52 TZFLG Register (Offset = 93h) [reset = 0h]

TZFLG is shown in [Figure 13-128](#) and described in [Table 13-67](#).

Return to [Summary Table](#).

Trip Zone Flag Register

**Figure 13-128. TZFLG Register**

15	14	13	12	11	10	9	8
RESERVED							
R=0-0h							
7	6	5	4	3	2	1	0
RESERVED	DCBEVT2	DCBEVT1	DCAEVT2	DCAEVT1	OST	CBC	INT
R=0-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h

**Table 13-67. TZFLG Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-7	RESERVED	R=0	0h	Reserved
6	DCBEVT2	R	0h	Latched Status Flag for Digital Compare Output B Event 2 0: Indicates no trip event has occurred on DCBEVT2 1: Indicates a trip event has occurred for the event defined for DCBEVT2 Reset type: SYSRSn
5	DCBEVT1	R	0h	Latched Status Flag for Digital Compare Output B Event 1 0: Indicates no trip event has occurred on DCBEVT1 1: Indicates a trip event has occurred for the event defined for DCBEVT1 Reset type: SYSRSn
4	DCAEVT2	R	0h	Latched Status Flag for Digital Compare Output A Event 2 0: Indicates no trip event has occurred on DCAEVT2 1: Indicates a trip event has occurred for the event defined for DCAEVT2 Reset type: SYSRSn
3	DCAEVT1	R	0h	Latched Status Flag for Digital Compare Output A Event 1 0: Indicates no trip event has occurred on DCAEVT1 1: Indicates a trip event has occurred for the event defined for DCAEVT1 Reset type: SYSRSn
2	OST	R	0h	Latched Status Flag for A One-Shot Trip Event 0: No one-shot trip event has occurred. 1: Indicates a trip event has occurred on a pin selected as a one-shot trip source.  This bit is cleared by writing the appropriate value to the TZCLR register. Reset type: SYSRSn

**Table 13-67. TZFLG Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
1	CBC	R	0h	<p>Latched Status Flag for Cycle-By-Cycle Trip Event</p> <p>0: No cycle-by-cycle trip event has occurred. 1: Indicates a trip event has occurred on a signal selected as a cycle-by-cycle trip source. The</p> <p>TZFLG[CBC] bit will remain set until it is manually cleared by the user. If the cycle-by-cycle trip event is still present when the CBC bit is cleared, then CBC will be immediately set again. The specified condition on the signal is automatically cleared when the ePWM time-base counter reaches zero (TBCTR = 0x00) if the trip condition is no longer present. The condition on the signal is only cleared when the TBCTR = 0x00 no matter where in the cycle the CBC flag is cleared.</p> <p>This bit is cleared by writing the appropriate value to the TZCLR register. Reset type: SYSRSn</p>
0	INT	R	0h	<p>Latched Trip Interrupt Status Flag</p> <p>0: Indicates no interrupt has been generated. 1: Indicates an EPWMx_TZINT PIE interrupt was generated because of a trip condition.</p> <p>No further EPWMx_TZINT PIE interrupts will be generated until this flag is cleared. If the interrupt flag is cleared when either CBC or OST is set, then another interrupt pulse will be generated. Clearing all flag bits will prevent further interrupts. This bit is cleared by writing the appropriate value to the TZCLR register. Reset type: SYSRSn</p>

### 13.14.2.53 TZCBCFLG Register (Offset = 94h) [reset = 0h]

TZCBCFLG is shown in [Figure 13-129](#) and described in [Table 13-68](#).

Return to [Summary Table](#).

Trip Zone CBC Flag Register

**Figure 13-129. TZCBCFLG Register**

15	14	13	12	11	10	9	8
RESERVED							
R=0-0h							
7	6	5	4	3	2	1	0
DCBEVT2	DCAEVT2	CBC6	CBC5	CBC4	CBC3	CBC2	CBC1
R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h

**Table 13-68. TZCBCFLG Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-8	RESERVED	R=0	0h	Reserved
7	DCBEVT2	R	0h	Latched Status Flag for Digital Compare B Output Event 2 Trip Latch 0: Reading a 0 indicates that no trip has occurred on DCBEVT2. 1: Reading a 1 indicates a trip has occurred on the DCBEVT2 selected event. Reset type: SYSRSn
6	DCAEVT2	R	0h	Latched Status Flag for Digital Compare A Output Event 2 Trip Latch 0: Reading a 0 indicates that no trip has occurred on DCAEVT2. 1: Reading a 1 indicates a trip has occurred on the DCAEVT2 selected event. Reset type: SYSRSn
5	CBC6	R	0h	Latched Status Flag for CBC6 Trip Latch 0: Reading a 0 indicates that no trip has occurred on CBC6. 1: Reading a 1 indicates a trip has occurred on the CBC6 selected event. Reset type: SYSRSn
4	CBC5	R	0h	Latched Status Flag for CBC5 Trip Latch 0: Reading a 0 indicates that no trip has occurred on CBC5. 1: Reading a 1 indicates a trip has occurred on the CBC5 selected event. Reset type: SYSRSn
3	CBC4	R	0h	Latched Status Flag for CBC4 Trip Latch 0: Reading a 0 indicates that no trip has occurred on CBC4. 1: Reading a 1 indicates a trip has occurred on the CBC4 selected event. Reset type: SYSRSn
2	CBC3	R	0h	Latched Status Flag for CBC3 Trip Latch 0: Reading a 0 indicates that no trip has occurred on CBC3. 1: Reading a 1 indicates a trip has occurred on the CBC3 selected event. Reset type: SYSRSn

**Table 13-68. TZCBCFLG Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
1	CBC2	R	0h	Latched Status Flag for CBC2 Trip Latch  0: Reading a 0 indicates that no trip has occurred on CBC2. 1: Reading a 1 indicates a trip has occurred on the CBC2 selected event. Reset type: SYSRSn
0	CBC1	R	0h	Latched Status Flag for CBC1 Trip Latch  0: Reading a 0 indicates that no trip has occurred on CBC1. 1: Reading a 1 indicates a trip has occurred on the CBC1 selected event. Reset type: SYSRSn

### 13.14.2.54 TZOSTFLG Register (Offset = 95h) [reset = 0h]

TZOSTFLG is shown in [Figure 13-130](#) and described in [Table 13-69](#).

Return to [Summary Table](#).

Trip Zone OST Flag Register

**Figure 13-130. TZOSTFLG Register**

15								14								13								12								11								10								9								8							
RESERVED																																																															
R=0-0h																																																															
7								6								5								4								3								2								1								0							
DCBEVT1								DCAEVT1								OST6								OST5								OST4								OST3								OST2								OST1							
R-0h								R-0h								R-0h								R-0h								R-0h								R-0h								R-0h															

**Table 13-69. TZOSTFLG Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-8	RESERVED	R=0	0h	Reserved
7	DCBEVT1	R	0h	Latched Status Flag for Digital Compare B Output Event 1 Trip Latch  0: Reading a 0 indicates that no trip has occurred on DCBEVT1. 1: Reading a 1 indicates a trip has occurred on the DCBEVT1 selected event. Reset type: SYSRSn
6	DCAEVT1	R	0h	Latched Status Flag for Digital Compare A Output Event 1 Trip Latch  0: Reading a 0 indicates that no trip has occurred on DCAEVT1. 1: Reading a 1 indicates a trip has occurred on the DCAEVT1 selected event. Reset type: SYSRSn
5	OST6	R	0h	Latched Status Flag for OST6 Trip Latch  0: Reading a 0 indicates that no trip has occurred on OST6. 1: Reading a 1 indicates a trip has occurred on the OST6 selected event. Reset type: SYSRSn
4	OST5	R	0h	Latched Status Flag for OST5 Trip Latch  0: Reading a 0 indicates that no trip has occurred on OST5. 1: Reading a 1 indicates a trip has occurred on the OST5 selected event. Reset type: SYSRSn
3	OST4	R	0h	Latched Status Flag for OST4 Trip Latch  0: Reading a 0 indicates that no trip has occurred on OST4. 1: Reading a 1 indicates a trip has occurred on the OST4 selected event. Reset type: SYSRSn
2	OST3	R	0h	Latched Status Flag for OST3 Trip Latch  0: Reading a 0 indicates that no trip has occurred on OST3. 1: Reading a 1 indicates a trip has occurred on the OST3 selected event. Reset type: SYSRSn

**Table 13-69. TZOSTFLG Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
1	OST2	R	0h	Latched Status Flag for OST2 Trip Latch  0: Reading a 0 indicates that no trip has occurred on OST2. 1: Reading a 1 indicates a trip has occurred on the OST2 selected event. Reset type: SYSRSn
0	OST1	R	0h	Latched Status Flag for OST1 Trip Latch  0: Reading a 0 indicates that no trip has occurred on OST1. 1: Reading a 1 indicates a trip has occurred on the OST1 selected event. Reset type: SYSRSn



**13.14.2.55 TZCLR Register (Offset = 97h) [reset = 0h]**

 TZCLR is shown in [Figure 13-131](#) and described in [Table 13-70](#).

 Return to [Summary Table](#).

Trip Zone Clear Register

**Figure 13-131. TZCLR Register**

15		14		13		12		11		10		9		8	
CBCPULSE				RESERVED											
R/W=0h				R=0=0h											
7		6		5		4		3		2		1		0	
RESERVED		DCBEVT2		DCBEVT1		DCAEVT2		DCAEVT1		OST		CBC		INT	
R=0=0h		R=0/W=1=0h		R=0/W=1=0h		R=0/W=1=0h		R=0/W=1=0h		R=0/W=1=0h		R=0/W=1=0h		R=0/W=1=0h	

**Table 13-70. TZCLR Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-14	CBCPULSE	R/W	0h	Clear Pulse for Cycle-By-Cycle (CBC) Trip Latch  This bit field determines which pulse clears the CBC trip latch.  00: CTR = zero pulse clears CBC trip latch. (Same as legacy designs.) 01: CTR = PRD pulse clears CBC trip latch. 10: CTR = zero or CTR = PRD pulse clears CBC trip latch. 11: CBC trip latch is not cleared Reset type: SYSRSn
13-7	RESERVED	R=0	0h	Reserved
6	DCBEVT2	R=0/W=1	0h	Clear Flag for Digital Compare Output B Event 2  0: Writing 0 has no effect. This bit always reads back 0. 1: Writing 1 clears the DCBEVT2 event trip condition. Reset type: SYSRSn
5	DCBEVT1	R=0/W=1	0h	Clear Flag for Digital Compare Output B Event 1  0: Writing 0 has no effect. This bit always reads back 0. 1: Writing 1 clears the DCBEVT1 event trip condition. Reset type: SYSRSn
4	DCAEVT2	R=0/W=1	0h	Clear Flag for Digital Compare Output A Event 2  0: Writing 0 has no effect. This bit always reads back 0. 1: Writing 1 clears the DCAEVT2 event trip condition. Reset type: SYSRSn
3	DCAEVT1	R=0/W=1	0h	Clear Flag for Digital Compare Output A Event 1  0: Writing 0 has no effect. This bit always reads back 0. 1: Writing 1 clears the DCAEVT1 event trip condition. Reset type: SYSRSn
2	OST	R=0/W=1	0h	Clear Flag for One-Shot Trip (OST) Latch  0: Has no effect. Always reads back a 0. 1: Clears this Trip (set) condition. Reset type: SYSRSn
1	CBC	R=0/W=1	0h	Clear Flag for Cycle-By-Cycle (CBC) Trip Latch  0: Has no effect. Always reads back a 0. 1: Clears this Trip (set) condition. Reset type: SYSRSn

**Table 13-70. TZCLR Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
0	INT	R=0/W=1	0h	Global Interrupt Clear Flag  0: Has no effect. Always reads back a 0. 1: Clears the trip-interrupt flag for this ePWM module (TZFLG[INT]).  NOTE: No further EPWMx_TZINT PIE interrupts will be generated until the flag is cleared. If the TZFLG[INT] bit is cleared and any of the other flag bits are set, then another interrupt pulse will be generated. Clearing all flag bits will prevent further interrupts. Reset type: SYSRSn

### 13.14.2.56 TZCBCCLR Register (Offset = 98h) [reset = 0h]

TZCBCCLR is shown in [Figure 13-132](#) and described in [Table 13-71](#).

Return to [Summary Table](#).

Trip Zone CBC Clear Register

**Figure 13-132. TZCBCCLR Register**

15	14	13	12	11	10	9	8
RESERVED							
R=0-0h							
7	6	5	4	3	2	1	0
DCBEVT2	DCAEVT2	CBC6	CBC5	CBC4	CBC3	CBC2	CBC1
R=0/W=1-0h	R=0/W=1-0h	R=0/W=1-0h	R=0/W=1-0h	R=0/W=1-0h	R=0/W=1-0h	R=0/W=1-0h	R=0/W=1-0h

**Table 13-71. TZCBCCLR Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-8	RESERVED	R=0	0h	Reserved
7	DCBEVT2	R=0/W=1	0h	Clear Flag for Digital Compare Output B Event 2 selected for CBC 0: Writing a 0 has no effect. 1: Writing a 1 will clear the TZCBCFLG[DCBEVT2] bit. Reset type: SYSRSn
6	DCAEVT2	R=0/W=1	0h	Clear Flag for Digital Compare Output A Event 2 selected for CBC 0: Writing a 0 has no effect. 1: Writing a 1 will clear the TZCBCFLG[DCAEVT2] bit. Reset type: SYSRSn
5	CBC6	R=0/W=1	0h	Clear Flag for Cycle-By-Cycle (CBC6) Trip Latch 0: Writing a 0 has no effect. 1: Writing a 1 will clear the TZCBCFLG[CBC6] bit. Reset type: SYSRSn
4	CBC5	R=0/W=1	0h	Clear Flag for Cycle-By-Cycle (CBC5) Trip Latch 0: Writing a 0 has no effect. 1: Writing a 1 will clear the TZCBCFLG[CBC5] bit. Reset type: SYSRSn
3	CBC4	R=0/W=1	0h	Clear Flag for Cycle-By-Cycle (CBC4) Trip Latch 0: Writing a 0 has no effect. 1: Writing a 1 will clear the TZCBCFLG[CBC4] bit. Reset type: SYSRSn
2	CBC3	R=0/W=1	0h	Clear Flag for Cycle-By-Cycle (CBC3) Trip Latch 0: Writing a 0 has no effect. 1: Writing a 1 will clear the TZCBCFLG[CBC3] bit. Reset type: SYSRSn
1	CBC2	R=0/W=1	0h	Clear Flag for Cycle-By-Cycle (CBC2) Trip Latch 0: Writing a 0 has no effect. 1: Writing a 1 will clear the TZCBCFLG[CBC2] bit. Reset type: SYSRSn

**Table 13-71. TZCBCCLR Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
0	CBC1	R=0/W=1	0h	Clear Flag for Cycle-By-Cycle (CBC1) Trip Latch 0: Writing a 0 has no effect. 1: Writing a 1 will clear the TZCBCFLG[CBC1] bit. Reset type: SYSRSn

### 13.14.2.57 TZOSTCLR Register (Offset = 99h) [reset = 0h]

TZOSTCLR is shown in [Figure 13-133](#) and described in [Table 13-72](#).

Return to [Summary Table](#).

Trip Zone OST Clear Register

**Figure 13-133. TZOSTCLR Register**

15	14	13	12	11	10	9	8
RESERVED							
R=0-0h							
7	6	5	4	3	2	1	0
DCBEVT1	DCAEVT1	OST6	OST5	OST4	OST3	OST2	OST1
R=0/W=1-0h	R=0/W=1-0h	R=0/W=1-0h	R=0/W=1-0h	R=0/W=1-0h	R=0/W=1-0h	R=0/W=1-0h	R=0/W=1-0h

**Table 13-72. TZOSTCLR Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-8	RESERVED	R=0	0h	Reserved
7	DCBEVT1	R=0/W=1	0h	Clear Flag for Digital Compare Output B Event 1 selected for OST 0: Writing a 0 has no effect. 1: Writing a 1 will clear the TZOSTFLG[DCBEVT1] bit. Reset type: SYSRSn
6	DCAEVT1	R=0/W=1	0h	Clear Flag for Digital Compare Output A Event 1 selected for OST 0: Writing a 0 has no effect. 1: Writing a 1 will clear the TZOSTFLG[DCAEVT1] bit. Reset type: SYSRSn
5	OST6	R=0/W=1	0h	Clear Flag for Oneshot (OST6) Trip Latch 0: Writing a 0 has no effect. 1: Writing a 1 will clear the TZOSTFLG[OST6] bit. Reset type: SYSRSn
4	OST5	R=0/W=1	0h	Clear Flag for Oneshot (OST5) Trip Latch 0: Writing a 0 has no effect. 1: Writing a 1 will clear the TZOSTFLG[OST5] bit. Reset type: SYSRSn
3	OST4	R=0/W=1	0h	Clear Flag for Oneshot (OST4) Trip Latch 0: Writing a 0 has no effect. 1: Writing a 1 will clear the TZOSTFLG[OST4] bit. Reset type: SYSRSn
2	OST3	R=0/W=1	0h	Clear Flag for Oneshot (OST3) Trip Latch 0: Writing a 0 has no effect. 1: Writing a 1 will clear the TZOSTFLG[OST3] bit. Reset type: SYSRSn
1	OST2	R=0/W=1	0h	Clear Flag for Oneshot (OST2) Trip Latch 0: Writing a 0 has no effect. 1: Writing a 1 will clear the TZOSTFLG[OST2] bit. Reset type: SYSRSn

**Table 13-72. TZOSTCLR Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
0	OST1	R=0/W=1	0h	Clear Flag for Oneshot (OST1) Trip Latch  0: Writing a 0 has no effect. 1: Writing a 1 will clear the TZOSTFLG[OST1] bit. Reset type: SYSRSn

### 13.14.2.58 TZFRC Register (Offset = 9Bh) [reset = 0h]

TZFRC is shown in [Figure 13-134](#) and described in [Table 13-73](#).

Return to [Summary Table](#).

Trip Zone Force Register

**Figure 13-134. TZFRC Register**

15	14	13	12	11	10	9	8
RESERVED							
R=0-0h							
7	6	5	4	3	2	1	0
RESERVED	DCBEVT2	DCBEVT1	DCAEVT2	DCAEVT1	OST	CBC	RESERVED
R=0-0h	R=0/W=1-0h	R=0/W=1-0h	R=0/W=1-0h	R=0/W=1-0h	R=0/W=1-0h	R=0/W=1-0h	R=0-0h

**Table 13-73. TZFRC Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-7	RESERVED	R=0	0h	Reserved
6	DCBEVT2	R=0/W=1	0h	Force Flag for Digital Compare Output B Event 2 0: Writing 0 has no effect. This bit always reads back 0. 1: Writing 1 forces the DCBEVT2 event trip condition and sets the TZFLG[DCBEVT2] bit. Reset type: SYSRSn
5	DCBEVT1	R=0/W=1	0h	Force Flag for Digital Compare Output B Event 1 0: Writing 0 has no effect. This bit always reads back 0. 1: Writing 1 forces the DCBEVT1 event trip condition and sets the TZFLG[DCBEVT1] bit. Reset type: SYSRSn
4	DCAEVT2	R=0/W=1	0h	Force Flag for Digital Compare Output A Event 2 0: Writing 0 has no effect. This bit always reads back 0. 1: Writing 1 forces the DCAEVT2 event trip condition and sets the TZFLG[DCAEVT2] bit. Reset type: SYSRSn
3	DCAEVT1	R=0/W=1	0h	Force Flag for Digital Compare Output A Event 1 0: Writing 0 has no effect. This bit always reads back 0 1: Writing 1 forces the DCAEVT1 event trip condition and sets the TZFLG[DCAEVT1] bit. Reset type: SYSRSn
2	OST	R=0/W=1	0h	Force a One-Shot Trip Event via Software 0: Writing of 0 is ignored. Always reads back a 0. 1: Forces a one-shot trip event and sets the TZFLG[OST] bit. Reset type: SYSRSn
1	CBC	R=0/W=1	0h	Force a Cycle-by-Cycle Trip Event via Software 0: Writing of 0 is ignored. Always reads back a 0. 1: Forces a cycle-by-cycle trip event and sets the TZFLG[CBC] bit. Reset type: SYSRSn
0	RESERVED	R=0	0h	Reserved

### 13.14.2.59 ETSEL Register (Offset = A4h) [reset = 0h]

ETSEL is shown in [Figure 13-135](#) and described in [Table 13-74](#).

Return to [Summary Table](#).

Event Trigger Selection Register

**Figure 13-135. ETSEL Register**

15		14		13		12		11		10		9		8	
SOCBEN		SOCBSEL				SOCAEN		SOCASEL							
R/W-0h		R/W-0h				R/W-0h		R/W-0h							
7		6		5		4		3		2		1		0	
RESERVED		INTSELCMP		SOCBSELCMP		SOCASELCMP		INTEN		INTSEL					
R=0-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h					

**Table 13-74. ETSEL Register Field Descriptions**

Bit	Field	Type	Reset	Description
15	SOCBEN	R/W	0h	Enable the ADC Start of Conversion B (EPWMxSOCB) Pulse 0: Disable EPWMxSOCB. 1: Enable EPWMxSOCB pulse. Reset type: SYSRSn
14-12	SOCBSEL	R/W	0h	EPWMxSOCB Selection Options These bits determine when a EPWMxSOCB pulse will be generated. 000: Enable DCBEVT1.soc event 001: Enable event time-base counter equal to zero. (TBCTR = 0x00) 010: Enable event time-base counter equal to period (TBCTR = TBPRD) 011: Enable event time-base counter equal to zero or period (TBCTR = 0x00 or TBCTR = TBPRD). This mode is useful in up-down count mode. 100: Enable event time-base counter equal to CMPA when the timer is incrementing or CMPC when the timer is incrementing 101: Enable event time-base counter equal to CMPA when the timer is decrementing or CMPC when the timer is decrementing 110: Enable event: time-base counter equal to CMPB when the timer is incrementing or CMPD when the timer is incrementing 111: Enable event: time-base counter equal to CMPB when the timer is decrementing or CMPD when the timer is decrementing (*) Event selected is determined by SOCBSELCMP bit. Reset type: SYSRSn
11	SOCAEN	R/W	0h	Enable the ADC Start of Conversion A (EPWMxSOCA) Pulse 0: Disable EPWMxSOCA. 1: Enable EPWMxSOCA pulse. Reset type: SYSRSn



**Table 13-74. ETSEL Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
10-8	SOCASEL	R/W	0h	<p>EPWMxSOCA Selection Options</p> <p>These bits determine when a EPWMxSOCA pulse will be generated.</p> <p>000: Enable DCAEVT1.soc event            001: Enable event time-base counter equal to zero. (TBCTR = 0x00)            010: Enable event time-base counter equal to period (TBCTR = TBPRD)            011: Enable event time-base counter equal to zero or period (TBCTR = 0x00 or TBCTR = TBPRD). This mode is useful in up-down count mode.            100: Enable event time-base counter equal to CMPA when the timer is incrementing or CMPC when the timer is incrementing            101: Enable event time-base counter equal to CMPA when the timer is decrementing or CMPC when the timer is decrementing            110: Enable event: time-base counter equal to CMPB when the timer is incrementing or CMPD when the timer is incrementing            111: Enable event: time-base counter equal to CMPB when the timer is decrementing or CMPD when the timer is decrementing (*) Event selected is determined by SOCASELCMP bit.</p> <p>Reset type: SYSRSn</p>
7	RESERVED	R=0	0h	Reserved
6	INTSELCMP	R/W	0h	<p>EPWMxINT Compare Register Selection Options</p> <p>0: Enable event time-base counter equal to CMPA when the timer is incrementing / Enable event time-base counter equal to CMPA when the timer is decrementing / Enable event: time-base counter equal to CMPB when the timer is incrementing / Enable event: time-base counter equal to CMPB when the timer is decrementing to INTSEL selection mux.            1: Enable event time-base counter equal to CMPC when the timer is incrementing / Enable event time-base counter equal to CMPC when the timer is decrementing / Enable event: time-base counter equal to CMPD when the timer is incrementing / Enable event: time-base counter equal to CMPD when the timer is decrementing to INTSEL selection mux.</p> <p>Reset type: SYSRSn</p>
5	SOCBSELCMP	R/W	0h	<p>EPWMxSOCB Compare Register Selection Options</p> <p>0: Enable event time-base counter equal to CMPA when the timer is incrementing / Enable event time-base counter equal to CMPA when the timer is decrementing / Enable event: time-base counter equal to CMPB when the timer is incrementing / Enable event: time-base counter equal to CMPB when the timer is decrementing to SOCBSEL selection mux.            1: Enable event time-base counter equal to CMPC when the timer is incrementing / Enable event time-base counter equal to CMPC when the timer is decrementing / Enable event: time-base counter equal to CMPD when the timer is incrementing / Enable event: time-base counter equal to CMPD when the timer is decrementing to SOCBSEL selection mux.</p> <p>Reset type: SYSRSn</p>

**Table 13-74. ETSEL Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
4	SOCASELCMP	R/W	0h	<p>EPWMxSOCA Compare Register Selection Options</p> <p>0: Enable event time-base counter equal to CMPA when the timer is incrementing / Enable event time-base counter equal to CMPA when the timer is decrementing / Enable event: time-base counter equal to CMPB when the timer is incrementing / Enable event: time-base counter equal to CMPB when the timer is decrementing to SOCASEL selection mux.</p> <p>1: Enable event time-base counter equal to CMPC when the timer is incrementing / Enable event time-base counter equal to CMPC when the timer is decrementing / Enable event: time-base counter equal to CMPD when the timer is incrementing / Enable event: time-base counter equal to CMPD when the timer is decrementing to SOCASEL selection mux.</p> <p>Reset type: SYSRSn</p>
3	INTEN	R/W	0h	<p>Enable ePWM Interrupt (EPWMx_INT) Generation</p> <p>0: Disable EPWMx_INT generation</p> <p>1: Enable EPWMx_INT generation</p> <p>Reset type: SYSRSn</p>
2-0	INTSEL	R/W	0h	<p>ePWM Interrupt (EPWMx_INT) Selection Options</p> <p>000: Reserved</p> <p>001: Enable event time-base counter equal to zero. (TBCTR = 0x00)</p> <p>010: Enable event time-base counter equal to period (TBCTR = TBPRD)</p> <p>011: Enable event time-base counter equal to zero or period (TBCTR = 0x00 or TBCTR = TBPRD). This mode is useful in up-down count mode.</p> <p>100: Enable event time-base counter equal to CMPA when the timer is incrementing or CMPC when the timer is incrementing</p> <p>101: Enable event time-base counter equal to CMPA when the timer is decrementing or CMPC when the timer is decrementing</p> <p>110: Enable event: time-base counter equal to CMPB when the timer is incrementing or CMPD when the timer is incrementing</p> <p>111: Enable event: time-base counter equal to CMPB when the timer is decrementing or CMPD when the timer is decrementing (*) Event selected is determined by INTSELCMP bit.</p> <p>Reset type: SYSRSn</p>

### 13.14.2.60 ETPS Register (Offset = A6h) [reset = 0h]

ETPS is shown in [Figure 13-136](#) and described in [Table 13-75](#).

Return to [Summary Table](#).

Event Trigger Pre-Scale Register

**Figure 13-136. ETPS Register**

15	14	13	12	11	10	9	8
SOCBCNT		SOCBPRD		SOCACNT		SOCAPRD	
R-0h		R/W-0h		R-0h		R/W-0h	
7	6	5	4	3	2	1	0
RESERVED		SOCPSSEL	INTPSSEL	INTCNT		INTPRD	
R=0-0h		R/W-0h	R/W-0h	R-0h		R/W-0h	

**Table 13-75. ETPS Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-14	SOCBCNT	R	0h	<p>ePWM ADC Start-of-Conversion B Event (EPWMxSOCB) Counter Register</p> <p>These bits indicate how many selected ETSEL[SOCBSEL] events have occurred:</p> <p>00: No events have occurred.            01: 1 event has occurred.            10: 2 events have occurred.            11: 3 events have occurred.</p> <p>Reset type: SYSRSn</p>
13-12	SOCBPRD	R/W	0h	<p>ePWM ADC Start-of-Conversion B Event (EPWMxSOCB) Period Select</p> <p>These bits determine how many selected ETSEL[SOCBSEL] events need to occur before an EPWMxSOCB pulse is generated. To be generated, the pulse must be enabled (ETSEL[SOCBEN] = 1). The SOCB pulse will be generated even if the status flag is set from a previous start of conversion (ETFLG[SOCB] = 1). Once the SOCB pulse is generated, the ETPS[SOCBCNT] bits will automatically be cleared.</p> <p>00: Disable the SOCB event counter. No EPWMxSOCB pulse will be generated</p> <p>01: Generate the EPWMxSOCB pulse on the first event: ETPS[SOCBCNT] = 0,1</p> <p>10: Generate the EPWMxSOCB pulse on the second event: ETPS[SOCBCNT] = 1,0</p> <p>11: Generate the EPWMxSOCB pulse on the third event: ETPS[SOCBCNT] = 1,1</p> <p>Reset type: SYSRSn</p>
11-10	SOCACNT	R	0h	<p>ePWM ADC Start-of-Conversion A Event (EPWMxSOCA) Counter Register</p> <p>These bits indicate how many selected ETSEL[SOCASEL] events have occurred:</p> <p>00: No events have occurred.            01: 1 event has occurred.            10: 2 events have occurred.            11: 3 events have occurred.</p> <p>Reset type: SYSRSn</p>

**Table 13-75. ETPS Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
9-8	SOCAPRD	R/W	0h	<p>ePWM ADC Start-of-Conversion A Event (EPWMxSOCA) Period Select</p> <p>These bits determine how many selected ETSEL[SOCASEL] events need to occur before an EPWMxSOCA pulse is generated. To be generated, the pulse must be enabled (ETSEL[SOCAEN] = 1). The SOCA pulse will be generated even if the status flag is set from a previous start of conversion (ETFLG[SOCA] = 1). Once the SOCA pulse is generated, the ETPS[SOCACNT] bits will automatically be cleared.</p> <p>00: Disable the SOCA event counter. No EPWMxSOCA pulse will be generated</p> <p>01: Generate the EPWMxSOCA pulse on the first event: ETPS[SOCACNT] = 0,1</p> <p>10: Generate the EPWMxSOCA pulse on the second event: ETPS[SOCACNT] = 1,0</p> <p>11: Generate the EPWMxSOCA pulse on the third event: ETPS[SOCACNT] = 1,1</p> <p>Reset type: SYSRSn</p>
7-6	RESERVED	R=0	0h	Reserved
5	SOCPSSEL	R/W	0h	<p>EPWMxSOC A/B Pre-Scale Selection Bits</p> <p>0: Selects ETPS [SOCACNT/SOCBCNT] and [SOCAPRD/SOCBPRD] registers to determine frequency of events (interrupt once every 0-3 events).</p> <p>1: Selects ETSOCPS [SOCACNT2/SOCBCNT2] and [SOCAPRD2/SOCBPRD2] registers to determine frequency of events (interrupt once every 0-15 events).</p> <p>Reset type: SYSRSn</p>
4	INTPSSEL	R/W	0h	<p>EPWMxINTn Pre-Scale Selection Bits</p> <p>0: Selects ETPS [INTCNT, and INTPRD] registers to determine frequency of events (interrupt once every 0-3 events).</p> <p>1: Selects ETINTPS [INTCNT2, and INTPRD2] registers to determine frequency of events (interrupt once every 0-15 events).</p> <p>Reset type: SYSRSn</p>
3-2	INTCNT	R	0h	<p>ePWM Interrupt Event (EPWMx_INT) Counter Register</p> <p>These bits indicate how many selected ETSEL[INTSEL] events have occurred. These bits are automatically cleared when an interrupt pulse is generated. If interrupts are disabled, ETSEL[INT] = 0 or the interrupt flag is set, ETFLG[INT] = 1, the counter will stop counting events when it reaches the period value ETPS[INTCNT] = ETPS[INTPRD].</p> <p>00: No events have occurred.</p> <p>01: 1 event has occurred.</p> <p>10: 2 events have occurred.</p> <p>11: 3 events have occurred.</p> <p>Reset type: SYSRSn</p>

**Table 13-75. ETPS Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
1-0	INTPRD	R/W	0h	<p>ePWM Interrupt (EPWMx_INT) Period Select</p> <p>These bits determine how many selected ETSEL[INTSEL] events need to occur before an interrupt is generated. To be generated, the interrupt must be enabled (ETSEL[INT] = 1). If the interrupt status flag is set from a previous interrupt (ETFLG[INT] = 1) then no interrupt will be generated until the flag is cleared via the ETCLR[INT] bit. This allows for one interrupt to be pending while another is still being serviced. Once the interrupt is generated, the ETPS[INTCNT] bits will automatically be cleared.</p> <p>Writing a INTPRD value that is the same as the current counter value will trigger an interrupt if it is enabled and the status flag is clear.</p> <p>Writing a INTPRD value that is less than the current counter value will result in an undefined state. If a counter event occurs at the same instant as a new zero or non-zero INTPRD value is written, the counter is incremented.</p> <p>00: Disable the interrupt event counter. No interrupt will be generated and ETFRC[INT] is ignored.</p> <p>01: Generate an interrupt on the first event INTCNT = 01 (first event)</p> <p>10: Generate interrupt on ETPS[INTCNT] = 1,0 (second event)</p> <p>11: Generate interrupt on ETPS[INTCNT] = 1,1 (third event)</p> <p>Reset type: SYSRSn</p>

**13.14.2.61 ETFLG Register (Offset = A8h) [reset = 0h]**

 ETFLG is shown in [Figure 13-137](#) and described in [Table 13-76](#).

 Return to [Summary Table](#).

Event Trigger Flag Register

**Figure 13-137. ETFLG Register**

15	14	13	12	11	10	9	8
RESERVED							
R=0-0h							
7	6	5	4	3	2	1	0
RESERVED				SOCB	SOCA	RESERVED	INT
R=0-0h				R-0h	R-0h	R=0-0h	R-0h

**Table 13-76. ETFLG Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-4	RESERVED	R=0	0h	Reserved
3	SOCB	R	0h	Latched ePWM ADC Start-of-Conversion A (EPWMxSOCB) Status Flag  Unlike the ETFLG[INT] flag, the EPWMxSOCB output will continue to pulse even if the flag bit is set.  0: Indicates no event occurred 1: Indicates that a start of conversion pulse was generated on EPWMxSOCB. The EPWMxSOCB output will continue to be generated even if the flag bit is set. Reset type: SYSRSn
2	SOCA	R	0h	Latched ePWM ADC Start-of-Conversion A (EPWMxSOCA) Status Flag  Unlike the ETFLG[INT] flag, the EPWMxSOCA output will continue to pulse even if the flag bit is set.  0: Indicates no event occurred 1: Indicates that a start of conversion pulse was generated on EPWMxSOCA. The EPWMxSOCA output will continue to be generated even if the flag bit is set. Reset type: SYSRSn
1	RESERVED	R=0	0h	Reserved
0	INT	R	0h	Latched ePWM Interrupt (EPWMx_INT) Status Flag  0: Indicates no event occurred 1: Indicates that an ePWMx interrupt (EPWMx_INT) was generated. No further interrupts will be generated until the flag bit is cleared. Up to one interrupt can be pending while the ETFLG[INT] bit is still set. If an interrupt is pending, it will not be generated until after the ETFLG[INT] bit is cleared. Reset type: SYSRSn

**13.14.2.62 ETCLR Register (Offset = AAh) [reset = 0h]**

 ETCLR is shown in [Figure 13-138](#) and described in [Table 13-77](#).

 Return to [Summary Table](#).

Event Trigger Clear Register

**Figure 13-138. ETCLR Register**

15	14	13	12	11	10	9	8
RESERVED							
R=0-0h							
7	6	5	4	3	2	1	0
RESERVED				SOCB	SOCA	RESERVED	INT
R=0-0h				R=0/W=1-0h	R=0/W=1-0h	R=0-0h	R=0/W=1-0h

**Table 13-77. ETCLR Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-4	RESERVED	R=0	0h	Reserved
3	SOCB	R=0/W=1	0h	ePWM ADC Start-of-Conversion A (EPWMxSOCB) Flag Clear Bit 0: Writing a 0 has no effect. Always reads back a 0 1: Clears the ETFLG[SOCB] flag bit Reset type: SYSRSn
2	SOCA	R=0/W=1	0h	ePWM ADC Start-of-Conversion A (EPWMxSOCA) Flag Clear Bit 0: Writing a 0 has no effect. Always reads back a 0 1: Clears the ETFLG[SOCA] flag bit Reset type: SYSRSn
1	RESERVED	R=0	0h	Reserved
0	INT	R=0/W=1	0h	ePWM Interrupt (EPWMx_INT) Flag Clear Bit 0: Writing a 0 has no effect. Always reads back a 0 1: Clears the ETFLG[INT] flag bit and enable further interrupts pulses to be generated Reset type: SYSRSn

**13.14.2.63 ETFRC Register (Offset = ACh) [reset = 0h]**

 ETFRC is shown in [Figure 13-139](#) and described in [Table 13-78](#).

 Return to [Summary Table](#).

Event Trigger Force Register

**Figure 13-139. ETFRC Register**

15	14	13	12	11	10	9	8
RESERVED							
R=0-0h							
7	6	5	4	3	2	1	0
RESERVED				SOCB	SOCA	RESERVED	INT
R=0-0h				R=0/W=1-0h	R=0/W=1-0h	R=0-0h	R=0/W=1-0h

**Table 13-78. ETFRC Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-4	RESERVED	R=0	0h	Reserved
3	SOCB	R=0/W=1	0h	SOCB Force Bit  The SOCB pulse will only be generated if the event is enabled in the ETSEL register. The ETFLG[SOCB] flag bit will be set regardless.  0: Writing 0 to this bit will be ignored. Always reads back a 0. 1: Generates a pulse on EPWMxSOCB and set the SOCBFLG bit. This bit is used for test purposes. Reset type: SYSRSn
2	SOCA	R=0/W=1	0h	SOCA Force Bit  The SOCA pulse will only be generated if the event is enabled in the ETSEL register. The ETFLG[SOCA] flag bit will be set regardless.  0: Writing 0 to this bit will be ignored. Always reads back a 0. 1: Generates a pulse on EPWMxSOCA and set the SOCAFLG bit. This bit is used for test purposes. Reset type: SYSRSn
1	RESERVED	R=0	0h	Reserved
0	INT	R=0/W=1	0h	INT Force Bit  The interrupt will only be generated if the event is enabled in the ETSEL register. The INT flag bit will be set regardless.  0: Writing 0 to this bit will be ignored. Always reads back a 0. 1: Generates an interrupt on EPWMxINT and set the INT flag bit. This bit is used for test purposes. Reset type: SYSRSn



**13.14.2.64 ETINTPS Register (Offset = AEh) [reset = 0h]**

ETINTPS is shown in [Figure 13-140](#) and described in [Table 13-79](#).

Return to [Summary Table](#).

Event-Trigger Interrupt Pre-Scale Register

**Figure 13-140. ETINTPS Register**

15	14	13	12	11	10	9	8
RESERVED							
R=0-0h							
7	6	5	4	3	2	1	0
INTCNT2				INTPRD2			
R-0h				R/W-0h			

**Table 13-79. ETINTPS Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-8	RESERVED	R=0	0h	Reserved
7-4	INTCNT2	R	0h	<p>EPWMxINT Counter 2</p> <p>When ETPS[INTPSSEL]=1, these bits indicate how many selected events have occurred:</p> <p>0000: No events            0001: 1 event            0010: 2 events            0011: 3 events            0100: 4 events            ...            1111: 15 events</p> <p>Reset type: SYSRSn</p>
3-0	INTPRD2	R/W	0h	<p>EPWMxINT Period 2 Select</p> <p>When ETPS[INTPSSEL] = 1, these bits select how many selected events need to occur before an interrupt is generated:</p> <p>0000: Disable counter            0001: Generate interrupt on INTCNT = 1 (first event)            0010: Generate interrupt on INTCNT = 2 (second event)            0011: Generate interrupt on INTCNT = 3 (third event)            0100: Generate interrupt on INTCNT = 4 (fourth event)            ...            1111: Generate interrupt on INTCNT = 15 (fifteenth event)</p> <p>Reset type: SYSRSn</p>

### 13.14.2.65 ETSOCPS Register (Offset = B0h) [reset = 0h]

ETSOCPS is shown in [Figure 13-141](#) and described in [Table 13-80](#).

Return to [Summary Table](#).

Event-Trigger SOC Pre-Scale Register

**Figure 13-141. ETSOCPS Register**

15	14	13	12	11	10	9	8
SOCBCNT2				SOCBPRD2			
R-0h				R/W-0h			
7	6	5	4	3	2	1	0
SOCACNT2				SOCAPRD2			
R-0h				R/W-0h			

**Table 13-80. ETSOCPS Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-12	SOCBCNT2	R	0h	<p>EPWMxSOCB Counter 2</p> <p>When ETPS[SOCPSSEL] = 1, these bits indicate how many selected events have occurred:</p> <p>0000: No events            0001: 1 event            0010: 2 events            0011: 3 events            0100: 4 events            ...            1111: 15 events</p> <p>Reset type: SYSRSn</p>
11-8	SOCBPRD2	R/W	0h	<p>EPWMxSOCB Period 2 Select</p> <p>When ETPS[SOCPSSEL] = 1, these bits select how many selected event need to occur before an SOCB pulse is generated:</p> <p>0000: Disable counter            0001: Generate interrupt on SOCBCNT2 = 1 (first event)            0010: Generate interrupt on SOCBCNT2 = 2 (second event)            0011: Generate interrupt on SOCBCNT2 = 3 (third event)            0100: Generate interrupt on SOCBCNT2 = 4 (fourth event)            ...            1111: Generate interrupt on SOCBCNT2 = 15 (fifteenth event)</p> <p>Reset type: SYSRSn</p>
7-4	SOCACNT2	R	0h	<p>EPWMxSOCA Counter 2</p> <p>When ETPS[SOCPSSEL] = 1, these bits indicate how many selected events have occurred:</p> <p>0000: No events            0001: 1 event            0010: 2 events            0011: 3 events            0100: 4 events            ...            1111: 15 events</p> <p>Reset type: SYSRSn</p>

**Table 13-80. ETSOCPS Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
3-0	SOCAPRD2	R/W	0h	<p>EPWMxSOCA Period 2 Select</p> <p>When ETPS[SOCPSSEL] = 1, these bits select how many selected event need to occur before an SOCA pulse is generated:</p> <p>0000: Disable counter            0001: Generate interrupt on SOCACNT2 = 1 (first event)            0010: Generate interrupt on SOCACNT2 = 2 (second event)            0011: Generate interrupt on SOCACNT2 = 3 (third event)            0100: Generate interrupt on SOCACNT2 = 4 (fourth event)            ...            1111: Generate interrupt on SOCACNT2 = 15 (fifteenth event)</p> <p>Reset type: SYSRSn</p>

### 13.14.2.66 ETCNTINITCTL Register (Offset = B2h) [reset = 0h]

ETCNTINITCTL is shown in [Figure 13-142](#) and described in [Table 13-81](#).

Return to [Summary Table](#).

Event-Trigger Counter Initialization Control Register

**Figure 13-142. ETCNTINITCTL Register**

15		14		13		12		11		10		9		8	
SOCBINITEN		SOCAINITEN		INTINITEN		SOCBINITFRC		SOCAINITFRC		INTINITFRC		RESERVED			
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R=0-0h			
7		6		5		4		3		2		1		0	
RESERVED															
R=0-0h															

**Table 13-81. ETCNTINITCTL Register Field Descriptions**

Bit	Field	Type	Reset	Description
15	SOCBINITEN	R/W	0h	EPWMxSOCB Counter 2 Initialization Enable  0: Has no effect. 1: Enable initialization of EPWMxSOCB counter with contents of ETCNTINIT[SOCBINIT] on a SYNC event or software force. Reset type: SYSRSn
14	SOCAINITEN	R/W	0h	EPWMxSOCA Counter 2 Initialization Enable  0: Has no effect. 1: Enable initialization of EPWMxSOCA counter with contents of ETCNTINIT[SOCAINIT] on a SYNC event or software force. Reset type: SYSRSn
13	INTINITEN	R/W	0h	EPWMxINT Counter 2 Initialization Enable  0: Has no effect. 1: Enable initialization of EPWMxINT counter 2 with contents of ETCNTINIT[INTINIT] on a SYNC event or software force. Reset type: SYSRSn
12	SOCBINITFRC	R/W	0h	EPWMxSOCB Counter 2 Initialization Force  0: Has no effect. 1: This bit forces the ET EPWMxSOCB counter to be initialized with the contents of ETCNTINIT[SOCBINIT]. Reset type: SYSRSn
11	SOCAINITFRC	R/W	0h	EPWMxSOCA Counter 2 Initialization Force  0: Has no effect. 1: This bit forces the ET EPWMxSOCA counter to be initialized with the contents of ETCNTINIT[SOCAINIT]. Reset type: SYSRSn
10	INTINITFRC	R/W	0h	EPWMxINT Counter 2 Initialization Force  0: Has no effect. 1: This bit forces the ET EPWMxINT counter to be initialized with the contents of ETCNTINIT[INTINIT]. Reset type: SYSRSn
9-0	RESERVED	R=0	0h	Reserved

### 13.14.2.67 ETCNTINIT Register (Offset = B4h) [reset = 0h]

ETCNTINIT is shown in [Figure 13-143](#) and described in [Table 13-82](#).

Return to [Summary Table](#).

Event-Trigger Counter Initialization Register

**Figure 13-143. ETCNTINIT Register**

15	14	13	12	11	10	9	8
RESERVED				SOCBINIT			
R-0h				R/W-0h			
7	6	5	4	3	2	1	0
SOCAINIT				INTINIT			
R/W-0h				R/W-0h			

**Table 13-82. ETCNTINIT Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-12	RESERVED	R	0h	Reserved
11-8	SOCBINIT	R/W	0h	EPWMxSOCB Counter 2 Initialization Bits The ET EPWMxSOCB counter is initialized with the contents of this register on an ePWM SYNC event or a software force. Reset type: SYSRSn
7-4	SOCAINIT	R/W	0h	EPWMxSOCA Counter 2 Initialization Bits The ET EPWMxSOCA counter is initialized with the contents of this register on an ePWM SYNC event or a software force. Reset type: SYSRSn
3-0	INTINIT	R/W	0h	EPWMxINT Counter 2 Initialization Bits The ET EPWMxINT counter is initialized with the contents of this register on an ePWM SYNC event or a software force. Reset type: SYSRSn

**13.14.2.68 DCTRIPSEL Register (Offset = C0h) [reset = 0h]**

DCTRIPSEL is shown in [Figure 13-144](#) and described in [Table 13-83](#).

Return to [Summary Table](#).

Digital Compare Trip Select Register

**Figure 13-144. DCTRIPSEL Register**

15	14	13	12	11	10	9	8
DCBLCOMPSEL				DCBHCOMPSEL			
R/W-0h				R/W-0h			
7	6	5	4	3	2	1	0
DCALCOMPSEL				DCAHCOMPSEL			
R/W-0h				R/W-0h			

**Table 13-83. DCTRIPSEL Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-12	DCBLCOMPSEL	R/W	0h	Digital Compare B Low Input Select Bits  0000: TRIPIN1 and (TZ1 input) 0001: TRIPIN2 and (TZ2 input) 0010: TRIPIN3 and (TZ3 input) 0011: TRIPIN4 ... 1011: TRIPIN12 1100: Reserved 1101: TRIPIN14 1110: TRIPIN15 1111: Trip combination input (all trip inputs selected by DCBLTRIPSEL register ORed together) Reset type: SYSRSn
11-8	DCBHCOMPSEL	R/W	0h	Digital Compare B High Input Select Bits  0000: TRIPIN1 and (TZ1 input) 0001: TRIPIN2 and (TZ2 input) 0010: TRIPIN3 and (TZ3 input) 0011: TRIPIN4 ... 1011: TRIPIN12 1100: Reserved 1101: TRIPIN14 1110: TRIPIN15 1111: Trip combination input (all trip inputs selected by DCBHTRIPSEL register ORed together) Reset type: SYSRSn

**Table 13-83. DCTRIPSEL Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
7-4	DCALCOMPSEL	R/W	0h	Digital Compare A Low Input Select Bits 0000: TRIPIN1 and (TZ1 input) 0001: TRIPIN2 and (TZ2 input) 0010: TRIPIN3 and (TZ3 input) 0011: TRIPIN4 ... 1011: TRIPIN12 1100: Reserved 1101: TRIPIN14 1110: TRIPIN15 1111: Trip combination input (all trip inputs selected by DCALTRIPSEL register ORed together) Reset type: SYSRSn
3-0	DCAHCOMPSEL	R/W	0h	Digital Compare A High Input Select Bits 0000: TRIPIN1 and (TZ1 input) 0001: TRIPIN2 and (TZ2 input) 0010: TRIPIN3 and (TZ3 input) 0011: TRIPIN4 ... 1011: TRIPIN12 1100: Reserved 1101: TRIPIN14 1110: TRIPIN15 1111: Trip combination input (all trip inputs selected by DCAHTRIPSEL register ORed together) Reset type: SYSRSn

**13.14.2.69 DCACTL Register (Offset = C3h) [reset = 0h]**

 DCACTL is shown in [Figure 13-145](#) and described in [Table 13-84](#).

 Return to [Summary Table](#).

Digital Compare A Control Register

**Figure 13-145. DCACTL Register**

15	14	13	12	11	10	9	8
EVT2LAT	EVT2LATCLRSEL	EVT2LATSEL	RESERVED		EVT2FRCSYN CSEL	EVT2SRCSEL	
R-0h	R/W-0h	R/W-0h	R=0-0h		R/W-0h	R/W-0h	
7	6	5	4	3	2	1	0
EVT1LAT	EVT1LATCLRSEL	EVT1LATSEL	EVT1SYNCE	EVT1SOCE	EVT1FRCSYN CSEL	EVT1SRCSEL	
R-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h

**Table 13-84. DCACTL Register Field Descriptions**

Bit	Field	Type	Reset	Description
15	EVT2LAT	R	0h	Indicates the status of DCAEVT2LAT signal. Reset type: SYSRSn
14-13	EVT2LATCLRSEL	R/W	0h	DCAEVT2 Latched clear source select: 00 CNT_ZERO event clears DCAEVT2 latch. 01 PRD_EQ event clears DCAEVT2 latch. 10 CNT_ZERO event or PRD_EQ event clears DCAEVT2 latch. 11 Reserved. Reset type: SYSRSn
12	EVT2LATSEL	R/W	0h	DCAEVT2 Latched signal select: 0 Does not select the DCAEVT2 latched signal (Refer figure "Modifications to DCAEVT1.force/DCAEVT2.force generation.") as source of DCAEVT2.force. 1 Selects the DCAEVT2 latched signal as source of DCAEVT2.force. Reset type: SYSRSn
11-10	RESERVED	R=0	0h	Reserved
9	EVT2FRCSYNSEL	R/W	0h	DCAEVT2 Force Synchronization Signal Select 0: Source Is Synchronous Signal 1: Source Is Asynchronous Signal Reset type: SYSRSn
8	EVT2SRCSEL	R/W	0h	DCAEVT2 Source Signal Select 0: Source Is DCAEVT2 Signal 1: Source Is DCEVTFILT Signal Reset type: SYSRSn
7	EVT1LAT	R	0h	Indicates the status of DCAEVT1LAT signal. Reset type: SYSRSn
6-5	EVT1LATCLRSEL	R/W	0h	DCAEVT1 Latched clear source select: 00 CNT_ZERO event clears DCAEVT1 latch. 01 PRD_EQ event clears DCAEVT1 latch. 10 CNT_ZERO event or PRD_EQ event clears DCAEVT1 latch. 11 Reserved. Reset type: SYSRSn



**Table 13-84. DCACTL Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
4	EVT1LATSEL	R/W	0h	DCAEVT1 Latched signal select: 0 Does not select the DCAEVT1 latched signal (Refer figure "Modifications to DCAEVT1.force/DCAEVT2.force generation.") as source of DCAEVT1.force. 1 Selects the DCAEVT1 latched signal as source of DCAEVT1.force. Reset type: SYSRSn
3	EVT1SYNCE	R/W	0h	DCAEVT1 SYNC, Enable/Disable 0: SYNC Generation Disabled 1: SYNC Generation Enabled Reset type: SYSRSn
2	EVT1SOCE	R/W	0h	DCAEVT1 SOC, Enable/Disable 0: SOC Generation Disabled 1: SOC Generation Enabled Reset type: SYSRSn
1	EVT1FRCSYNCSEL	R/W	0h	DCAEVT1 Force Synchronization Signal Select 0: Source is passed through asynchronously 1: Source is synchronized with EPWMCLK Reset type: SYSRSn
0	EVT1SRCSEL	R/W	0h	DCAEVT1 Source Signal Select 0: Source Is DCAEVT1 Signal 1: Source Is DCEVTFILT Signal Reset type: SYSRSn

### 13.14.2.70 DCBCTL Register (Offset = C4h) [reset = 0h]

DCBCTL is shown in [Figure 13-146](#) and described in [Table 13-85](#).

Return to [Summary Table](#).

Digital Compare B Control Register

**Figure 13-146. DCBCTL Register**

15	14	13	12	11	10	9	8
EVT2LAT	EVT2LATCLRSEL		EVT2LATSEL	RESERVED		EVT2FRCSYN CSEL	EVT2SRCSEL
R-0h	R/W-0h		R/W-0h	R=0-0h		R/W-0h	R/W-0h
7	6	5	4	3	2	1	0
EVT1LAT	EVT1LATCLRSEL		EVT1LATSEL	EVT1SYNCE	EVT1SOCE	EVT1FRCSYN CSEL	EVT1SRCSEL
R-0h	R/W-0h		R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h

**Table 13-85. DCBCTL Register Field Descriptions**

Bit	Field	Type	Reset	Description
15	EVT2LAT	R	0h	Indicates the status of DCBEVT2LAT signal. Reset type: SYSRSn
14-13	EVT2LATCLRSEL	R/W	0h	DCBEVT2 Latched clear source select: 00 CNT_ZERO event clears DCBEVT2 latch. 01 PRD_EQ event clears DCBEVT2 latch. 10 CNT_ZERO event or PRD_EQ event clears DCBEVT2 latch. 11 Reserved. Reset type: SYSRSn
12	EVT2LATSEL	R/W	0h	DCBEVT2 Latched signal select: 0 Does not select the DCBEVT2 latched signal (Refer figure "Modifications to DCBEVT1.force/DCBEVT2.force generation.") as source of DCBEVT2.force. 1 Selects the DCBEVT2 latched signal as source of DCBEVT2.force. Reset type: SYSRSn
11-10	RESERVED	R=0	0h	Reserved
9	EVT2FRCSYNSEL	R/W	0h	DCBEVT2 Force Synchronization Signal Select 0: Source Is Synchronous Signal 1: Source Is Asynchronous Signal Reset type: SYSRSn
8	EVT2SRCSEL	R/W	0h	DCBEVT2 Source Signal Select 0: Source Is DCBEVT2 Signal 1: Source Is DCEVTFILT Signal Reset type: SYSRSn
7	EVT1LAT	R	0h	Indicates the status of DCBEVT1LAT signal. Reset type: SYSRSn
6-5	EVT1LATCLRSEL	R/W	0h	DCBEVT1 Latched clear source select: 00 CNT_ZERO event clears DCBEVT1 latch. 01 PRD_EQ event clears DCBEVT1 latch. 10 CNT_ZERO event or PRD_EQ event clears DCBEVT1 latch. 11 Reserved. Reset type: SYSRSn

**Table 13-85. DCBCTL Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
4	EVT1LATSEL	R/W	0h	DCBEVT1 Latched signal select: 0 Does not select the DCBEVT1 latched signal (Refer figure "Modifications to DCBEVT1.force/DCBEVT2.force generation.") as source of DCBEVT1.force. 1 Selects the DCBEVT1 latched signal as source of DCBEVT1.force. Reset type: SYSRSn
3	EVT1SYNCE	R/W	0h	DCBEVT1 SYNC, Enable/Disable 0: SYNC Generation Disabled 1: SYNC Generation Enabled Reset type: SYSRSn
2	EVT1SOCE	R/W	0h	DCBEVT1 SOC, Enable/Disable 0: SOC Generation Disabled 1: SOC Generation Enabled Reset type: SYSRSn
1	EVT1FRCSYNCSEL	R/W	0h	DCBEVT1 Force Synchronization Signal Select 0: Source Is Synchronous Signal 1: Source Is Asynchronous Signal Reset type: SYSRSn
0	EVT1SRCSEL	R/W	0h	DCBEVT1 Source Signal Select 0: Source Is DCBEVT1 Signal 1: Source Is DCEVTFILT Signal Reset type: SYSRSn

**13.14.2.71 DCFCTL Register (Offset = C7h) [reset = 0h]**

DCFCTL is shown in [Figure 13-147](#) and described in [Table 13-86](#).

Return to [Summary Table](#).

Digital Compare Filter Control Register

**Figure 13-147. DCFCTL Register**

15	14	13	12	11	10	9	8
EDGESTATUS			EDGECOUNT			EDGEMODE	
R-0h			R/W-0h			R/W-0h	
7	6	5	4	3	2	1	0
RESERVED	EDGEFILTSEL	PULSESEL		BLANKINV	BLANKE	SRCSEL	
R=0-0h	R/W-0h	R/W-0h		R/W-0h	R/W-0h	R/W-0h	

**Table 13-86. DCFCTL Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-13	EDGESTATUS	R	0h	Edge Status: Reset type: SYSRSn
12-10	EDGECOUNT	R/W	0h	Edge Count: These bits select how many edges to count before generating a TBCLK wide pulse on the DCEVTFILT signal: Reset type: SYSRSn
9-8	EDGEMODE	R/W	0h	Edge Mode Select: Reset type: SYSRSn
7	RESERVED	R=0	0h	Reserved
6	EDGEFILTSEL	R/W	0h	Edge Filter Select: Reset type: SYSRSn
5-4	PULSESEL	R/W	0h	Pulse Select For Blanking & Capture Alignment 00: Time-base counter equal to period (TBCTR = TBPRD) 01: Time-base counter equal to zero (TBCTR = 0x00) 10: Time-base counter equal to zero (TBCTR = 0x00) or period (TBCTR = TBPRD) 11: Reserved Reset type: SYSRSn
3	BLANKINV	R/W	0h	Blanking Window Inversion 0: Blanking window not inverted 1: Blanking window inverted Reset type: SYSRSn
2	BLANKE	R/W	0h	Blanking Window Enable/Disable 0: Blanking window is disabled 1: Blanking window is enabled Reset type: SYSRSn
1-0	SRCSEL	R/W	0h	Filter Block Signal Source Select 00: Source Is DCAEVT1 Signal 01: Source Is DCAEVT2 Signal 10: Source Is DCBEVT1 Signal 11: Source Is DCBEVT2 Signal Reset type: SYSRSn

### 13.14.2.72 DCCAPCTL Register (Offset = C8h) [reset = 0h]

DCCAPCTL is shown in [Figure 13-148](#) and described in [Table 13-87](#).

Return to [Summary Table](#).

Digital Compare Capture Control Register

**Figure 13-148. DCCAPCTL Register**

15		14		13		12		11		10		9		8	
CAPMODE		CAPCLR		CAPSTS		RESERVED									
R/W-0h		R=0/W=1-0h		R-0h		R=0-0h									
7		6		5		4		3		2		1		0	
RESERVED												SHDWMODE		CAPE	
R=0-0h												R/W-0h		R/W-0h	

**Table 13-87. DCCAPCTL Register Field Descriptions**

Bit	Field	Type	Reset	Description
15	CAPMODE	R/W	0h	<p>Counter Capture Mode</p> <p>0: When a DCEVTFILT occurs and the counter capture is enabled, then the current TBCNT value is captured in the active register. When the respective trip event occurs, further trip (capture) events are ignored until the next PRD_eq or CNT_zero event (as selected by the PULSESEL bit in the DCFCTL register) re-triggers the capture mechanism.</p> <p>If active mode is enabled, via SHDWMODE bit in DCCAPCTL register, CPU reads of this register will return the active register value.</p> <p>If shadow mode is enabled, via SHDWMODE bit in DCCAPCTL register, the active register is copied to the shadow register on the PRD_eq or CNT_zero event (whichever is selected by PULSESEL bit in DCFCTL register). CPU reads of this register will return the shadow register value.</p> <p>1: When a DCEVTFILT occurs and the counter capture is enabled, then the current TBCNT value is captured in the active register. When the respective trip event occurs - it will set the CAPSTS flag and further trip (capture) events are ignored until this bit is cleared. CAPSTS can be cleared by writing to CAPCLR bit in DCCAPCTL register and it re-triggers the capture mechanism.</p> <p>If active mode is enabled, via SHDWMODE bit in DCCAPCTL register, CPU reads of this register will return the active register value.</p> <p>If shadow mode is enabled, via SHDWMODE bit in DCCAPCTL register, the active register is copied to the shadow register on the PRD_eq or CNT_zero event (whichever is selected by PULSESEL bit in DCFCTL register). CPU reads of this register will return the shadow register value.</p> <p>Reset type: SYSRSn</p>
14	CAPCLR	R=0/W=1	0h	<p>DC Capture Latched Status Clear Flag</p> <p>0: Writing a 0 has no effect.</p> <p>1: Writing a 1 will clear this CAPSTS (set) condition.</p> <p>Reset type: SYSRSn</p>
13	CAPSTS	R	0h	<p>Latched Status Flag for Capture Event</p> <p>0: No DC capture event occurred.</p> <p>1: A DC capture event has occurred.</p> <p>Reset type: SYSRSn</p>
12-2	RESERVED	R=0	0h	Reserved

**Table 13-87. DCCAPCTL Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
1	SHDWMODE	R/W	0h	TBCTR Counter Capture Shadow Select Mode  0: Enable shadow mode. The DCCAP active register is copied to shadow register on a TBCTR = TBPRD or TBCTR = zero event as defined by the DCFCTL[PULSESEL] bit. CPU reads of the DCCAP register will return the shadow register contents.  1: Active Mode. In this mode the shadow register is disabled. CPU reads from the DCCAP register will always return the active register contents.  Reset type: SYSRSn
0	CAPE	R/W	0h	TBCTR Counter Capture Enable/Disable  0: Disable the time-base counter capture.  1: Enable the time-base counter capture.  Reset type: SYSRSn

**13.14.2.73 DCFOFFSET Register (Offset = C9h) [reset = 0h]**

DCFOFFSET is shown in [Figure 13-149](#) and described in [Table 13-88](#).

Return to [Summary Table](#).

Digital Compare Filter Offset Register

**Figure 13-149. DCFOFFSET Register**

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
DCFOFFSET															
R/W-0h															

**Table 13-88. DCFOFFSET Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-0	DCFOFFSET	R/W	0h	<p>Blanking Window Offset</p> <p>These 16-bits specify the number of TBCLK cycles from the blanking window reference to the point when the blanking window is applied. The blanking window reference is either period or zero as defined by the DCFCTL[PULSESEL] bit. This offset register is shadowed and the active register is loaded at the reference point defined by DCFCTL[PULSESEL]. The offset counter is also initialized and begins to count down when the active register is loaded. When the counter expires, the blanking window is applied. If the blanking window is currently active, then the blanking window counter is restarted.</p> <p>Reset type: SYSRSn</p>

**13.14.2.74 DCFOFFSETCNT Register (Offset = CAh) [reset = 0h]**

DCFOFFSETCNT is shown in [Figure 13-150](#) and described in [Table 13-89](#).

Return to [Summary Table](#).

Digital Compare Filter Offset Counter Register

**Figure 13-150. DCFOFFSETCNT Register**

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
DCFOFFSETCNT															
R-0h															

**Table 13-89. DCFOFFSETCNT Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-0	DCFOFFSETCNT	R	0h	Blanking Offset Counter  These 16-bits are read only and indicate the current value of the offset counter. The counter counts down to zero and then stops until it is re-loaded on the next period or zero event as defined by the DCFCTL[PULSESEL] bit. The offset counter is not affected by the free/soft emulation bits. That is, it will always continue to count down if the device is halted by a emulation stop. Reset type: SYSRSn



**13.14.2.75 DCFWINDOW Register (Offset = CBh) [reset = 0h]**

DCFWINDOW is shown in [Figure 13-151](#) and described in [Table 13-90](#).

Return to [Summary Table](#).

Digital Compare Filter Window Register

**Figure 13-151. DCFWINDOW Register**

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
DCFWINDOW															
R/W-0h															

**Table 13-90. DCFWINDOW Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-0	DCFWINDOW	R/W	0h	Blanking Window Width  00h: No blanking window is generated.  01-FFh: Specifies the width of the blanking window in TBCLK cycles. The blanking window begins when the offset counter expires. When this occurs, the window counter is loaded and begins to count down. If the blanking window is currently active and the offset counter expires, the blanking window counter is not restarted and the blanking window is cut short prematurely. Care should be taken to avoid this situation. The blanking window can cross a PWM period boundary.  Reset type: SYSRSn

**13.14.2.76 DCFWINDOWCNT Register (Offset = CCh) [reset = 0h]**

DCFWINDOWCNT is shown in [Figure 13-152](#) and described in [Table 13-91](#).

Return to [Summary Table](#).

Digital Compare Filter Window Counter Register

**Figure 13-152. DCFWINDOWCNT Register**

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
DCFWINDOWCNT															
R-0h															

**Table 13-91. DCFWINDOWCNT Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-0	DCFWINDOWCNT	R	0h	Blanking Window Counter  These 16 bits are read only and indicate the current value of the window counter. The counter counts down to zero and then stops until it is re-loaded when the offset counter reaches zero again. Reset type: SYSRSn

**13.14.2.77 DCCAP Register (Offset = CFh) [reset = 0h]**

DCCAP is shown in [Figure 13-153](#) and described in [Table 13-92](#).

Return to [Summary Table](#).

Digital Compare Counter Capture Register

**Figure 13-153. DCCAP Register**

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
DCCAP															
R-0h															

**Table 13-92. DCCAP Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-0	DCCAP	R	0h	<p>Digital Compare Time-Base Counter Capture</p> <p>To enable time-base counter capture, set the DCCAPCLT[CAPE] bit to 1. If enabled, reflects the value of the time-base counter (TBCTR) on the low to high edge transition of a filtered (DCEVTFLT) event. Further capture events are ignored until the next period or zero as selected by the DCFCTL[PULSESEL] bit. Shadowing of DCCAP is enabled and disabled by the DCCAPCTL[SHDWMODE] bit. By default this register is shadowed.</p> <p>- If DCCAPCTL[SHDWMODE] = 0, then the shadow is enabled. In this mode, the active register is copied to the shadow register on the TBCTR = TBPRD or TBCTR = zero as defined by the DCFCTL[PULSESEL] bit. CPU reads of this register will return the shadow register value.</p> <p>- If DCCAPCTL[SHDWMODE] = 1, then the shadow register is disabled. In this mode, CPU reads will return the active register value. The active and shadow registers share the same memory map address.</p> <p>Reset type: SYSRSn</p>

**13.14.2.78 DCAHTRIPSEL Register (Offset = D2h) [reset = 0h]**

DCAHTRIPSEL is shown in [Figure 13-154](#) and described in [Table 13-93](#).

Return to [Summary Table](#).

Digital Compare AH Trip Select

**Figure 13-154. DCAHTRIPSEL Register**

15		14		13		12		11		10		9		8	
RESERVED	TRIPINPUT15	TRIPINPUT14	RESERVED	TRIPINPUT12	TRIPINPUT11	TRIPINPUT10	TRIPINPUT9								
R-0h	R/W-0h	R/W-0h	R-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h								
7		6		5		4		3		2		1		0	
TRIPINPUT8	TRIPINPUT7	TRIPINPUT6	TRIPINPUT5	TRIPINPUT4	TRIPINPUT3	TRIPINPUT2	TRIPINPUT1								
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h								

**Table 13-93. DCAHTRIPSEL Register Field Descriptions**

Bit	Field	Type	Reset	Description
15	RESERVED	R	0h	Reserved
14	TRIPINPUT15	R/W	0h	TRIP Input 15 0: Trip Input 15 not selected as combinational ORed input 1: Trip Input 15 selected as combinational ORed input to DCAH mux Reset type: SYSRSn
13	TRIPINPUT14	R/W	0h	TRIP Input 14 0: Trip Input 14 not selected as combinational ORed input 1: Trip Input 14 selected as combinational ORed input to DCAH mux Reset type: SYSRSn
12	RESERVED	R	0h	Reserved
11	TRIPINPUT12	R/W	0h	TRIP Input 12 0: Trip Input 12 not selected as combinational ORed input 1: Trip Input 12 selected as combinational ORed input to DCAH mux Reset type: SYSRSn
10	TRIPINPUT11	R/W	0h	TRIP Input 11 0: Trip Input 11 not selected as combinational ORed input 1: Trip Input 11 selected as combinational ORed input to DCAH mux Reset type: SYSRSn
9	TRIPINPUT10	R/W	0h	TRIP Input 10 0: Trip Input 10 not selected as combinational ORed input 1: Trip Input 10 selected as combinational ORed input to DCAH mux Reset type: SYSRSn
8	TRIPINPUT9	R/W	0h	TRIP Input 9 0: Trip Input 9 not selected as combinational ORed input 1: Trip Input 9 selected as combinational ORed input to DCAH mux Reset type: SYSRSn
7	TRIPINPUT8	R/W	0h	TRIP Input 8 0: Trip Input 8 not selected as combinational ORed input 1: Trip Input 8 selected as combinational ORed input to DCAH mux Reset type: SYSRSn

**Table 13-93. DCAHTRIPSEL Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
6	TRIPINPUT7	R/W	0h	TRIP Input 7 0: Trip Input 7 not selected as combinational ORed input 1: Trip Input 7 selected as combinational ORed input to DCAH mux Reset type: SYSRSn
5	TRIPINPUT6	R/W	0h	TRIP Input 6 0: Trip Input 6 not selected as combinational ORed input 1: Trip Input 6 selected as combinational ORed input to DCAH mux Reset type: SYSRSn
4	TRIPINPUT5	R/W	0h	TRIP Input 5 0: Trip Input 5 not selected as combinational ORed input 1: Trip Input 5 selected as combinational ORed input to DCAH mux Reset type: SYSRSn
3	TRIPINPUT4	R/W	0h	TRIP Input 4 0: Trip Input 4 not selected as combinational ORed input 1: Trip Input 4 selected as combinational ORed input to DCAH mux Reset type: SYSRSn
2	TRIPINPUT3	R/W	0h	TRIP Input 3 0: Trip Input 3 not selected as combinational ORed input 1: Trip Input 3 selected as combinational ORed input to DCAH mux Reset type: SYSRSn
1	TRIPINPUT2	R/W	0h	TRIP Input 2 0: Trip Input 2 not selected as combinational ORed input 1: Trip Input 2 selected as combinational ORed input to DCAH mux Reset type: SYSRSn
0	TRIPINPUT1	R/W	0h	TRIP Input 1 0: Trip Input 1 not selected as combinational ORed input 1: Trip Input 1 selected as combinational ORed input to DCAH mux Reset type: SYSRSn

**13.14.279 DCALTRIPSEL Register (Offset = D3h) [reset = 0h]**

 DCALTRIPSEL is shown in [Figure 13-155](#) and described in [Table 13-94](#).

 Return to [Summary Table](#).

Digital Compare AL Trip Select

**Figure 13-155. DCALTRIPSEL Register**

15		14		13		12		11		10		9		8	
RESERVED	TRIPINPUT15	TRIPINPUT14	RESERVED	TRIPINPUT12	TRIPINPUT11	TRIPINPUT10	TRIPINPUT9								
R-0h	R/W-0h	R/W-0h	R-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h								
7		6		5		4		3		2		1		0	
TRIPINPUT8	TRIPINPUT7	TRIPINPUT6	TRIPINPUT5	TRIPINPUT4	TRIPINPUT3	TRIPINPUT2	TRIPINPUT1								
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h								

**Table 13-94. DCALTRIPSEL Register Field Descriptions**

Bit	Field	Type	Reset	Description
15	RESERVED	R	0h	Reserved
14	TRIPINPUT15	R/W	0h	TRIP Input 15 0: Trip Input 15 not selected as combinational ORed input 1: Trip Input 15 selected as combinational ORed input to DCAL mux Reset type: SYSRSn
13	TRIPINPUT14	R/W	0h	TRIP Input 14 0: Trip Input 14 not selected as combinational ORed input 1: Trip Input 14 selected as combinational ORed input to DCAL mux Reset type: SYSRSn
12	RESERVED	R	0h	Reserved
11	TRIPINPUT12	R/W	0h	TRIP Input 12 0: Trip Input 12 not selected as combinational ORed input 1: Trip Input 12 selected as combinational ORed input to DCAL mux Reset type: SYSRSn
10	TRIPINPUT11	R/W	0h	TRIP Input 11 0: Trip Input 11 not selected as combinational ORed input 1: Trip Input 11 selected as combinational ORed input to DCAL mux Reset type: SYSRSn
9	TRIPINPUT10	R/W	0h	TRIP Input 10 0: Trip Input 10 not selected as combinational ORed input 1: Trip Input 10 selected as combinational ORed input to DCAL mux Reset type: SYSRSn
8	TRIPINPUT9	R/W	0h	TRIP Input 9 0: Trip Input 9 not selected as combinational ORed input 1: Trip Input 9 selected as combinational ORed input to DCAL mux Reset type: SYSRSn
7	TRIPINPUT8	R/W	0h	TRIP Input 8 0: Trip Input 8 not selected as combinational ORed input 1: Trip Input 8 selected as combinational ORed input to DCAL mux Reset type: SYSRSn

**Table 13-94. DCALTRIPSEL Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
6	TRIPINPUT7	R/W	0h	TRIP Input 7 0: Trip Input 7 not selected as combinational ORed input 1: Trip Input 7 selected as combinational ORed input to DCAL mux Reset type: SYSRSn
5	TRIPINPUT6	R/W	0h	TRIP Input 6 0: Trip Input 6 not selected as combinational ORed input 1: Trip Input 6 selected as combinational ORed input to DCAL mux Reset type: SYSRSn
4	TRIPINPUT5	R/W	0h	TRIP Input 5 0: Trip Input 5 not selected as combinational ORed input 1: Trip Input 5 selected as combinational ORed input to DCAL mux Reset type: SYSRSn
3	TRIPINPUT4	R/W	0h	TRIP Input 4 0: Trip Input 4 not selected as combinational ORed input 1: Trip Input 4 selected as combinational ORed input to DCAL mux Reset type: SYSRSn
2	TRIPINPUT3	R/W	0h	TRIP Input 3 0: Trip Input 3 not selected as combinational ORed input 1: Trip Input 3 selected as combinational ORed input to DCAL mux Reset type: SYSRSn
1	TRIPINPUT2	R/W	0h	TRIP Input 2 0: Trip Input 2 not selected as combinational ORed input 1: Trip Input 2 selected as combinational ORed input to DCAL mux Reset type: SYSRSn
0	TRIPINPUT1	R/W	0h	TRIP Input 1 0: Trip Input 1 not selected as combinational ORed input 1: Trip Input 1 selected as combinational ORed input to DCAL mux Reset type: SYSRSn

**13.14.2.80 DCBHTRIPSEL Register (Offset = D4h) [reset = 0h]**

DCBHTRIPSEL is shown in [Figure 13-156](#) and described in [Table 13-95](#).

Return to [Summary Table](#).

Digital Compare BH Trip Select

**Figure 13-156. DCBHTRIPSEL Register**

15		14		13		12		11		10		9		8	
RESERVED	TRIPINPUT15	TRIPINPUT14	RESERVED	TRIPINPUT12	TRIPINPUT11	TRIPINPUT10	TRIPINPUT9								
R-0h	R/W-0h	R/W-0h	R-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h								
7		6		5		4		3		2		1		0	
TRIPINPUT8	TRIPINPUT7	TRIPINPUT6	TRIPINPUT5	TRIPINPUT4	TRIPINPUT3	TRIPINPUT2	TRIPINPUT1								
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h								

**Table 13-95. DCBHTRIPSEL Register Field Descriptions**

Bit	Field	Type	Reset	Description
15	RESERVED	R	0h	Reserved
14	TRIPINPUT15	R/W	0h	TRIP Input 15 0: Trip Input 15 not selected as combinational ORed input 1: Trip Input 15 selected as combinational ORed input to DCBH mux Reset type: SYSRSn
13	TRIPINPUT14	R/W	0h	TRIP Input 14 0: Trip Input 14 not selected as combinational ORed input 1: Trip Input 14 selected as combinational ORed input to DCBH mux Reset type: SYSRSn
12	RESERVED	R	0h	Reserved
11	TRIPINPUT12	R/W	0h	TRIP Input 12 0: Trip Input 12 not selected as combinational ORed input 1: Trip Input 12 selected as combinational ORed input to DCBH mux Reset type: SYSRSn
10	TRIPINPUT11	R/W	0h	TRIP Input 11 0: Trip Input 11 not selected as combinational ORed input 1: Trip Input 11 selected as combinational ORed input to DCBH mux Reset type: SYSRSn
9	TRIPINPUT10	R/W	0h	TRIP Input 10 0: Trip Input 10 not selected as combinational ORed input 1: Trip Input 10 selected as combinational ORed input to DCBH mux Reset type: SYSRSn
8	TRIPINPUT9	R/W	0h	TRIP Input 9 0: Trip Input 9 not selected as combinational ORed input 1: Trip Input 9 selected as combinational ORed input to DCBH mux Reset type: SYSRSn
7	TRIPINPUT8	R/W	0h	TRIP Input 8 0: Trip Input 8 not selected as combinational ORed input 1: Trip Input 8 selected as combinational ORed input to DCBH mux Reset type: SYSRSn



**Table 13-95. DCBHTRIPSEL Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
6	TRIPINPUT7	R/W	0h	TRIP Input 7 0: Trip Input 7 not selected as combinational ORed input 1: Trip Input 7 selected as combinational ORed input to DCBH mux Reset type: SYSRSn
5	TRIPINPUT6	R/W	0h	TRIP Input 6 0: Trip Input 6 not selected as combinational ORed input 1: Trip Input 6 selected as combinational ORed input to DCBH mux Reset type: SYSRSn
4	TRIPINPUT5	R/W	0h	TRIP Input 5 0: Trip Input 5 not selected as combinational ORed input 1: Trip Input 5 selected as combinational ORed input to DCBH mux Reset type: SYSRSn
3	TRIPINPUT4	R/W	0h	TRIP Input 4 0: Trip Input 4 not selected as combinational ORed input 1: Trip Input 4 selected as combinational ORed input to DCBH mux Reset type: SYSRSn
2	TRIPINPUT3	R/W	0h	TRIP Input 3 0: Trip Input 3 not selected as combinational ORed input 1: Trip Input 3 selected as combinational ORed input to DCBH mux Reset type: SYSRSn
1	TRIPINPUT2	R/W	0h	TRIP Input 2 0: Trip Input 2 not selected as combinational ORed input 1: Trip Input 2 selected as combinational ORed input to DCBH mux Reset type: SYSRSn
0	TRIPINPUT1	R/W	0h	TRIP Input 1 0: Trip Input 1 not selected as combinational ORed input 1: Trip Input 1 selected as combinational ORed input to DCBH mux Reset type: SYSRSn

**13.14.2.81 DCBLTRIPSEL Register (Offset = D5h) [reset = 0h]**

 DCBLTRIPSEL is shown in [Figure 13-157](#) and described in [Table 13-96](#).

 Return to [Summary Table](#).

Digital Compare BL Trip Select

**Figure 13-157. DCBLTRIPSEL Register**

15		14		13		12		11		10		9		8	
RESERVED	TRIPINPUT15	TRIPINPUT14	RESERVED	TRIPINPUT12	TRIPINPUT11	TRIPINPUT10	TRIPINPUT9								
R-0h	R/W-0h	R/W-0h	R-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h								
7		6		5		4		3		2		1		0	
TRIPINPUT8	TRIPINPUT7	TRIPINPUT6	TRIPINPUT5	TRIPINPUT4	TRIPINPUT3	TRIPINPUT2	TRIPINPUT1								
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h								

**Table 13-96. DCBLTRIPSEL Register Field Descriptions**

Bit	Field	Type	Reset	Description
15	RESERVED	R	0h	Reserved
14	TRIPINPUT15	R/W	0h	TRIP Input 15 0: Trip Input 15 not selected as combinational ORed input 1: Trip Input 15 selected as combinational ORed input to DCAL mux Reset type: SYSRSn
13	TRIPINPUT14	R/W	0h	TRIP Input 14 0: Trip Input 14 not selected as combinational ORed input 1: Trip Input 14 selected as combinational ORed input to DCAL mux Reset type: SYSRSn
12	RESERVED	R	0h	Reserved
11	TRIPINPUT12	R/W	0h	TRIP Input 12 0: Trip Input 12 not selected as combinational ORed input 1: Trip Input 12 selected as combinational ORed input to DCAL mux Reset type: SYSRSn
10	TRIPINPUT11	R/W	0h	TRIP Input 11 0: Trip Input 11 not selected as combinational ORed input 1: Trip Input 11 selected as combinational ORed input to DCAL mux Reset type: SYSRSn
9	TRIPINPUT10	R/W	0h	TRIP Input 10 0: Trip Input 10 not selected as combinational ORed input 1: Trip Input 10 selected as combinational ORed input to DCAL mux Reset type: SYSRSn
8	TRIPINPUT9	R/W	0h	TRIP Input 9 0: Trip Input 9 not selected as combinational ORed input 1: Trip Input 9 selected as combinational ORed input to DCAL mux Reset type: SYSRSn
7	TRIPINPUT8	R/W	0h	TRIP Input 8 0: Trip Input 8 not selected as combinational ORed input 1: Trip Input 8 selected as combinational ORed input to DCAL mux Reset type: SYSRSn

**Table 13-96. DCBLTRIPSEL Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
6	TRIPINPUT7	R/W	0h	TRIP Input 7 0: Trip Input 7 not selected as combinational ORed input 1: Trip Input 7 selected as combinational ORed input to DCAL mux Reset type: SYSRSn
5	TRIPINPUT6	R/W	0h	TRIP Input 6 0: Trip Input 6 not selected as combinational ORed input 1: Trip Input 6 selected as combinational ORed input to DCAL mux Reset type: SYSRSn
4	TRIPINPUT5	R/W	0h	TRIP Input 5 0: Trip Input 5 not selected as combinational ORed input 1: Trip Input 5 selected as combinational ORed input to DCAL mux Reset type: SYSRSn
3	TRIPINPUT4	R/W	0h	TRIP Input 4 0: Trip Input 4 not selected as combinational ORed input 1: Trip Input 4 selected as combinational ORed input to DCAL mux Reset type: SYSRSn
2	TRIPINPUT3	R/W	0h	TRIP Input 3 0: Trip Input 3 not selected as combinational ORed input 1: Trip Input 3 selected as combinational ORed input to DCAL mux Reset type: SYSRSn
1	TRIPINPUT2	R/W	0h	TRIP Input 2 0: Trip Input 2 not selected as combinational ORed input 1: Trip Input 2 selected as combinational ORed input to DCAL mux Reset type: SYSRSn
0	TRIPINPUT1	R/W	0h	TRIP Input 1 0: Trip Input 1 not selected as combinational ORed input 1: Trip Input 1 selected as combinational ORed input to DCAL mux Reset type: SYSRSn

**13.14.2.82 EPWMLOCK Register (Offset = FAh) [reset = 0h]**

EPWMLOCK is shown in [Figure 13-158](#) and described in [Table 13-97](#).

Return to [Summary Table](#).

EPWM Lock Register

**Figure 13-158. EPWMLOCK Register**

31	30	29	28	27	26	25	24
KEY							
R=0/W=0h							
23	22	21	20	19	18	17	16
KEY							
R=0/W=0h							
15	14	13	12	11	10	9	8
RESERVED							
R=0h							
7	6	5	4	3	2	1	0
RESERVED			DCLOCK	TZCLRLOCK	TZCFGLOCK	GLLOCK	HRLOCK
R=0h			R/WOnce=0h	R/WOnce=0h	R/WOnce=0h	R/WOnce=0h	R/WOnce=0h

**Table 13-97. EPWMLOCK Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	KEY	R=0/W	0h	Write to this register succeeds only if this field is written with a value of 0xa5a5  Note: [1] Due to this KEY, only 32-bit writes will succeed (provided the KEY matches). 16-bit writes to the upper or lower half of this register will be ignored Reset type: SYSRSn
15-5	RESERVED	R	0h	Reserved
4	DCLOCK	R/WOnce	0h	0: Digital Compare registers from 0xC0 to 0xD5 offsets are protected by EALLOW. 1: Digital Compare registers from 0xC0 and 0xD5 offsets are locked and not writable. Reset type: SYSRSn
3	TZCLRLOCK	R/WOnce	0h	0: Digital Compare registers from 0x97 to 0x9B offsets are protected by EALLOW. 1: Digital Compare registers from 0x97 and 0x9B offsets are locked and not writable. Reset type: SYSRSn
2	TZCFGLOCK	R/WOnce	0h	0: TripZone registers from 0x80 to 0x8D offsets are protected by EALLOW. 1: TripZone registers from 0x80 and 0x8D offsets are locked and not writable. Reset type: SYSRSn
1	GLLOCK	R/WOnce	0h	0: TripZone registers from 0x34 to 0x35 offsets are protected by EALLOW. 1: TripZone registers from 0x34 to 0x35 offsets are locked and not writable Reset type: SYSRSn

**Table 13-97. EPWMLOCK Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
0	HRLOCK	R/WOnce	0h	0: HRPWM registers from 0x20 to 0x2D offsets are protected by EALLOW 1: HRPWM registers from 0x20 and 0x2D offsets are locked and not writable. Reset type: SYSRSn

**13.14.2.83 HWVDELVAL Register (Offset = FDh) [reset = 0h]**

HWVDELVAL is shown in [Figure 13-159](#) and described in [Table 13-98](#).

Return to [Summary Table](#).

Hardware Valley Mode Delay Register

**Figure 13-159. HWVDELVAL Register**

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
HWVDELVAL															
R-0h															

**Table 13-98. HWVDELVAL Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-0	HWVDELVAL	R	0h	Hardware Valley Delay Value Register  This read only register reflects the hardware delay value calculated by the equations defined in VCAPCTL[VDELAYDIV]. This reflects the latest value from the hardware calculations and can change every time valley capture sequence is triggered and VCAP1 and VCAP2 values are updated. Reset type: SYSRSn

**13.14.2.84 VCNTVAL Register (Offset = FEh) [reset = 0h]**

VCNTVAL is shown in [Figure 13-160](#) and described in [Table 13-99](#).

Return to [Summary Table](#).

Hardware Valley Counter Register

**Figure 13-160. VCNTVAL Register**

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
VCNTVAL															
R-0h															

**Table 13-99. VCNTVAL Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-0	VCNTVAL	R	0h	Valley Time Base Counter Register  This registers reflects the captured VCNT value upon occurrence of STOPEDGE selected in VCNTCFG register. Reset type: SYSRSn

### 13.14.3 EPWM\_XBAR\_REGS Registers

Table 13-100 lists the memory-mapped registers for the EPWM\_XBAR\_REGS. All register offset addresses not listed in Table 13-100 should be considered as reserved locations and the register contents should not be modified.

**Table 13-100. EPWM\_XBAR\_REGS Registers**

Offset	Acronym	Register Name	Write Protection	Section
0h	TRIP4MUX0TO15CFG	ePWM XBAR Mux Configuration for TRIP4	EALLOW	<a href="#">Go</a>
2h	TRIP4MUX16TO31CFG	ePWM XBAR Mux Configuration for TRIP4	EALLOW	<a href="#">Go</a>
4h	TRIP5MUX0TO15CFG	ePWM XBAR Mux Configuration for TRIP5	EALLOW	<a href="#">Go</a>
6h	TRIP5MUX16TO31CFG	ePWM XBAR Mux Configuration for TRIP5	EALLOW	<a href="#">Go</a>
8h	TRIP7MUX0TO15CFG	ePWM XBAR Mux Configuration for TRIP7	EALLOW	<a href="#">Go</a>
Ah	TRIP7MUX16TO31CFG	ePWM XBAR Mux Configuration for TRIP7	EALLOW	<a href="#">Go</a>
Ch	TRIP8MUX0TO15CFG	ePWM XBAR Mux Configuration for TRIP8	EALLOW	<a href="#">Go</a>
Eh	TRIP8MUX16TO31CFG	ePWM XBAR Mux Configuration for TRIP8	EALLOW	<a href="#">Go</a>
10h	TRIP9MUX0TO15CFG	ePWM XBAR Mux Configuration for TRIP9	EALLOW	<a href="#">Go</a>
12h	TRIP9MUX16TO31CFG	ePWM XBAR Mux Configuration for TRIP9	EALLOW	<a href="#">Go</a>
14h	TRIP10MUX0TO15CFG	ePWM XBAR Mux Configuration for TRIP10	EALLOW	<a href="#">Go</a>
16h	TRIP10MUX16TO31CFG	ePWM XBAR Mux Configuration for TRIP10	EALLOW	<a href="#">Go</a>
18h	TRIP11MUX0TO15CFG	ePWM XBAR Mux Configuration for TRIP11	EALLOW	<a href="#">Go</a>
1Ah	TRIP11MUX16TO31CFG	ePWM XBAR Mux Configuration for TRIP11	EALLOW	<a href="#">Go</a>
1Ch	TRIP12MUX0TO15CFG	ePWM XBAR Mux Configuration for TRIP12	EALLOW	<a href="#">Go</a>
1Eh	TRIP12MUX16TO31CFG	ePWM XBAR Mux Configuration for TRIP12	EALLOW	<a href="#">Go</a>
20h	TRIP4MUXENABLE	ePWM XBAR Mux Enable for TRIP4	EALLOW	<a href="#">Go</a>
22h	TRIP5MUXENABLE	ePWM XBAR Mux Enable for TRIP5	EALLOW	<a href="#">Go</a>
24h	TRIP7MUXENABLE	ePWM XBAR Mux Enable for TRIP7	EALLOW	<a href="#">Go</a>
26h	TRIP8MUXENABLE	ePWM XBAR Mux Enable for TRIP8	EALLOW	<a href="#">Go</a>
28h	TRIP9MUXENABLE	ePWM XBAR Mux Enable for TRIP9	EALLOW	<a href="#">Go</a>
2Ah	TRIP10MUXENABLE	ePWM XBAR Mux Enable for TRIP10	EALLOW	<a href="#">Go</a>
2Ch	TRIP11MUXENABLE	ePWM XBAR Mux Enable for TRIP11	EALLOW	<a href="#">Go</a>
2Eh	TRIP12MUXENABLE	ePWM XBAR Mux Enable for TRIP12	EALLOW	<a href="#">Go</a>
38h	TRIPOUTINV	ePWM XBAR Output Inversion Register	EALLOW	<a href="#">Go</a>
3Eh	TRIPLOCK	ePWM XBAR Configuration Lock register	EALLOW	<a href="#">Go</a>

Complex bit access types are encoded to fit into small table cells. Table 13-101 shows the codes that are used for access types in this section.

**Table 13-101. EPWM\_XBAR\_REGS Access Type Codes**

Access Type	Code	Description
<b>Read Type</b>		
R	R	Read
R=0	R	Read
<b>Write Type</b>		
W	W	Write
W=1	W	Write
WSOnce	SOnce W	Set once Write
<b>Reset or Default Value</b>		
-n		Value after reset or the default value
<b>Register Array Variables</b>		



**Table 13-101. EPWM\_XBAR\_REGS Access Type Codes (continued)**

Access Type	Code	Description
i,j,k,l,m,n		When these variables are used in a register name, an offset, or an address, they refer to the value of a register array where the register is part of a group of repeating registers. The register groups form a hierarchical structure and the array is represented with a formula.
y		When this variable is used in a register name, an offset, or an address it refers to the value of a register array.

**13.14.3.1 TRIP4MUX0TO15CFG Register (Offset = 0h) [reset = 0h]**

TRIP4MUX0TO15CFG is shown in [Figure 13-161](#) and described in [Table 13-102](#).

Return to [Summary Table](#).

ePWM XBAR Mux Configuration for TRIP4

**Figure 13-161. TRIP4MUX0TO15CFG Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
MUX15		MUX14		MUX13		MUX12		MUX11		MUX10		MUX9		MUX8	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
MUX7		MUX6		MUX5		MUX4		MUX3		MUX2		MUX1		MUX0	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	

**Table 13-102. TRIP4MUX0TO15CFG Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-30	MUX15	R/W	0h	Select Bits for EPWM-XBAR TRIP4 Mux15: 00 : Select .0 input for Mux15 01 : Select .1 input for Mux15 10 : Select .2 input for Mux15 11 : Select .3 input for Mux15  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
29-28	MUX14	R/W	0h	Select Bits for EPWM-XBAR TRIP4 Mux14: 00 : Select .0 input for Mux14 01 : Select .1 input for Mux14 10 : Select .2 input for Mux14 11 : Select .3 input for Mux14  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
27-26	MUX13	R/W	0h	Select Bits for EPWM-XBAR TRIP4 Mux13: 00 : Select .0 input for Mux13 01 : Select .1 input for Mux13 10 : Select .2 input for Mux13 11 : Select .3 input for Mux13  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
25-24	MUX12	R/W	0h	Select Bits for EPWM-XBAR TRIP4 Mux12: 00 : Select .0 input for Mux12 01 : Select .1 input for Mux12 10 : Select .2 input for Mux12 11 : Select .3 input for Mux12  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn

**Table 13-102. TRIP4MUX0TO15CFG Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
23-22	MUX11	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP4 Mux11:</p> <p>00 : Select .0 input for Mux11            01 : Select .1 input for Mux11            10 : Select .2 input for Mux11            11 : Select .3 input for Mux11</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>
21-20	MUX10	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP4 Mux10:</p> <p>00 : Select .0 input for Mux10            01 : Select .1 input for Mux10            10 : Select .2 input for Mux10            11 : Select .3 input for Mux10</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>
19-18	MUX9	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP4 Mux9:</p> <p>00 : Select .0 input for Mux9            01 : Select .1 input for Mux9            10 : Select .2 input for Mux9            11 : Select .3 input for Mux9</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>
17-16	MUX8	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP4 Mux8:</p> <p>00 : Select .0 input for Mux8            01 : Select .1 input for Mux8            10 : Select .2 input for Mux8            11 : Select .3 input for Mux8</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>
15-14	MUX7	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP4 Mux7:</p> <p>00 : Select .0 input for Mux7            01 : Select .1 input for Mux7            10 : Select .2 input for Mux7            11 : Select .3 input for Mux7</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>
13-12	MUX6	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP4 Mux6:</p> <p>00 : Select .0 input for Mux6            01 : Select .1 input for Mux6            10 : Select .2 input for Mux6            11 : Select .3 input for Mux6</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>

**Table 13-102. TRIP4MUX0TO15CFG Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
11-10	MUX5	R/W	0h	Select Bits for EPWM-XBAR TRIP4 Mux5: 00 : Select .0 input for Mux5 01 : Select .1 input for Mux5 10 : Select .2 input for Mux5 11 : Select .3 input for Mux5  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
9-8	MUX4	R/W	0h	Select Bits for EPWM-XBAR TRIP4 Mux4: 00 : Select .0 input for Mux4 01 : Select .1 input for Mux4 10 : Select .2 input for Mux4 11 : Select .3 input for Mux4  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
7-6	MUX3	R/W	0h	Select Bits for EPWM-XBAR TRIP4 Mux3: 00 : Select .0 input for Mux3 01 : Select .1 input for Mux3 10 : Select .2 input for Mux3 11 : Select .3 input for Mux3  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
5-4	MUX2	R/W	0h	Select Bits for EPWM-XBAR TRIP4 Mux2: 00 : Select .0 input for Mux2 01 : Select .1 input for Mux2 10 : Select .2 input for Mux2 11 : Select .3 input for Mux2  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
3-2	MUX1	R/W	0h	Select Bits for EPWM-XBAR TRIP4 Mux1: 00 : Select .0 input for Mux1 01 : Select .1 input for Mux1 10 : Select .2 input for Mux1 11 : Select .3 input for Mux1  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
1-0	MUX0	R/W	0h	Select Bits for EPWM-XBAR TRIP4 Mux0: 00 : Select .0 input for Mux0 01 : Select .1 input for Mux0 10 : Select .2 input for Mux0 11 : Select .3 input for Mux0  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn

### 13.14.3.2 TRIP4MUX16TO31CFG Register (Offset = 2h) [reset = 0h]

TRIP4MUX16TO31CFG is shown in [Figure 13-162](#) and described in [Table 13-103](#).

Return to [Summary Table](#).

ePWM XBAR Mux Configuration for TRIP4

**Figure 13-162. TRIP4MUX16TO31CFG Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
MUX31		MUX30		MUX29		MUX28		MUX27		MUX26		MUX25		MUX24	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
MUX23		MUX22		MUX21		MUX20		MUX19		MUX18		MUX17		MUX16	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	

**Table 13-103. TRIP4MUX16TO31CFG Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-30	MUX31	R/W	0h	Select Bits for EPWM-XBAR TRIP4 Mux31:  00 : Select .0 input for Mux31 01 : Select .1 input for Mux31 10 : Select .2 input for Mux31 11 : Select .3 input for Mux31  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
29-28	MUX30	R/W	0h	Select Bits for EPWM-XBAR TRIP4 Mux30:  00 : Select .0 input for Mux30 01 : Select .1 input for Mux30 10 : Select .2 input for Mux30 11 : Select .3 input for Mux30  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
27-26	MUX29	R/W	0h	Select Bits for EPWM-XBAR TRIP4 Mux29:  00 : Select .0 input for Mux29 01 : Select .1 input for Mux29 10 : Select .2 input for Mux29 11 : Select .3 input for Mux29  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
25-24	MUX28	R/W	0h	Select Bits for EPWM-XBAR TRIP4 Mux28:  00 : Select .0 input for Mux28 01 : Select .1 input for Mux28 10 : Select .2 input for Mux28 11 : Select .3 input for Mux28  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn

**Table 13-103. TRIP4MUX16TO31CFG Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
23-22	MUX27	R/W	0h	Select Bits for EPWM-XBAR TRIP4 Mux27: 00 : Select .0 input for Mux27 01 : Select .1 input for Mux27 10 : Select .2 input for Mux27 11 : Select .3 input for Mux27 Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
21-20	MUX26	R/W	0h	Select Bits for EPWM-XBAR TRIP4 Mux26: 00 : Select .0 input for Mux26 01 : Select .1 input for Mux26 10 : Select .2 input for Mux26 11 : Select .3 input for Mux26 Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
19-18	MUX25	R/W	0h	Select Bits for EPWM-XBAR TRIP4 Mux25: 00 : Select .0 input for Mux25 01 : Select .1 input for Mux25 10 : Select .2 input for Mux25 11 : Select .3 input for Mux25 Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
17-16	MUX24	R/W	0h	Select Bits for EPWM-XBAR TRIP4 Mux24: 00 : Select .0 input for Mux24 01 : Select .1 input for Mux24 10 : Select .2 input for Mux24 11 : Select .3 input for Mux24 Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
15-14	MUX23	R/W	0h	Select Bits for EPWM-XBAR TRIP4 Mux23: 00 : Select .0 input for Mux23 01 : Select .1 input for Mux23 10 : Select .2 input for Mux23 11 : Select .3 input for Mux23 Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
13-12	MUX22	R/W	0h	Select Bits for EPWM-XBAR TRIP4 Mux22: 00 : Select .0 input for Mux22 01 : Select .1 input for Mux22 10 : Select .2 input for Mux22 11 : Select .3 input for Mux22 Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn

**Table 13-103. TRIP4MUX16TO31CFG Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
11-10	MUX21	R/W	0h	Select Bits for EPWM-XBAR TRIP4 Mux21: 00 : Select .0 input for Mux21 01 : Select .1 input for Mux21 10 : Select .2 input for Mux21 11 : Select .3 input for Mux21 Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
9-8	MUX20	R/W	0h	Select Bits for EPWM-XBAR TRIP4 Mux20: 00 : Select .0 input for Mux20 01 : Select .1 input for Mux20 10 : Select .2 input for Mux20 11 : Select .3 input for Mux20 Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
7-6	MUX19	R/W	0h	Select Bits for EPWM-XBAR TRIP4 Mux19: 00 : Select .0 input for Mux19 01 : Select .1 input for Mux19 10 : Select .2 input for Mux19 11 : Select .3 input for Mux19 Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
5-4	MUX18	R/W	0h	Select Bits for EPWM-XBAR TRIP4 Mux18: 00 : Select .0 input for Mux18 01 : Select .1 input for Mux18 10 : Select .2 input for Mux18 11 : Select .3 input for Mux18 Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
3-2	MUX17	R/W	0h	Select Bits for EPWM-XBAR TRIP4 Mux17: 00 : Select .0 input for Mux17 01 : Select .1 input for Mux17 10 : Select .2 input for Mux17 11 : Select .3 input for Mux17 Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
1-0	MUX16	R/W	0h	Select Bits for EPWM-XBAR TRIP4 Mux16: 00 : Select .0 input for Mux16 01 : Select .1 input for Mux16 10 : Select .2 input for Mux16 11 : Select .3 input for Mux16 Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn

### 13.14.3.3 TRIP5MUX0TO15CFG Register (Offset = 4h) [reset = 0h]

TRIP5MUX0TO15CFG is shown in [Figure 13-163](#) and described in [Table 13-104](#).

Return to [Summary Table](#).

ePWM XBAR Mux Configuration for TRIP5

**Figure 13-163. TRIP5MUX0TO15CFG Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
MUX15		MUX14		MUX13		MUX12		MUX11		MUX10		MUX9		MUX8	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
MUX7		MUX6		MUX5		MUX4		MUX3		MUX2		MUX1		MUX0	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	

**Table 13-104. TRIP5MUX0TO15CFG Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-30	MUX15	R/W	0h	Select Bits for EPWM-XBAR TRIP5 Mux15: 00 : Select .0 input for Mux15 01 : Select .1 input for Mux15 10 : Select .2 input for Mux15 11 : Select .3 input for Mux15  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
29-28	MUX14	R/W	0h	Select Bits for EPWM-XBAR TRIP5 Mux14: 00 : Select .0 input for Mux14 01 : Select .1 input for Mux14 10 : Select .2 input for Mux14 11 : Select .3 input for Mux14  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
27-26	MUX13	R/W	0h	Select Bits for EPWM-XBAR TRIP5 Mux13: 00 : Select .0 input for Mux13 01 : Select .1 input for Mux13 10 : Select .2 input for Mux13 11 : Select .3 input for Mux13  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
25-24	MUX12	R/W	0h	Select Bits for EPWM-XBAR TRIP5 Mux12: 00 : Select .0 input for Mux12 01 : Select .1 input for Mux12 10 : Select .2 input for Mux12 11 : Select .3 input for Mux12  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn



**Table 13-104. TRIP5MUX0TO15CFG Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
23-22	MUX11	R/W	0h	Select Bits for EPWM-XBAR TRIP5 Mux11: 00 : Select .0 input for Mux11 01 : Select .1 input for Mux11 10 : Select .2 input for Mux11 11 : Select .3 input for Mux11 Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
21-20	MUX10	R/W	0h	Select Bits for EPWM-XBAR TRIP5 Mux10: 00 : Select .0 input for Mux10 01 : Select .1 input for Mux10 10 : Select .2 input for Mux10 11 : Select .3 input for Mux10 Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
19-18	MUX9	R/W	0h	Select Bits for EPWM-XBAR TRIP5 Mux9: 00 : Select .0 input for Mux9 01 : Select .1 input for Mux9 10 : Select .2 input for Mux9 11 : Select .3 input for Mux9 Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
17-16	MUX8	R/W	0h	Select Bits for EPWM-XBAR TRIP5 Mux8: 00 : Select .0 input for Mux8 01 : Select .1 input for Mux8 10 : Select .2 input for Mux8 11 : Select .3 input for Mux8 Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
15-14	MUX7	R/W	0h	Select Bits for EPWM-XBAR TRIP5 Mux7: 00 : Select .0 input for Mux7 01 : Select .1 input for Mux7 10 : Select .2 input for Mux7 11 : Select .3 input for Mux7 Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
13-12	MUX6	R/W	0h	Select Bits for EPWM-XBAR TRIP5 Mux6: 00 : Select .0 input for Mux6 01 : Select .1 input for Mux6 10 : Select .2 input for Mux6 11 : Select .3 input for Mux6 Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn

**Table 13-104. TRIP5MUX0TO15CFG Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
11-10	MUX5	R/W	0h	Select Bits for EPWM-XBAR TRIP5 Mux5: 00 : Select .0 input for Mux5 01 : Select .1 input for Mux5 10 : Select .2 input for Mux5 11 : Select .3 input for Mux5  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
9-8	MUX4	R/W	0h	Select Bits for EPWM-XBAR TRIP5 Mux4: 00 : Select .0 input for Mux4 01 : Select .1 input for Mux4 10 : Select .2 input for Mux4 11 : Select .3 input for Mux4  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
7-6	MUX3	R/W	0h	Select Bits for EPWM-XBAR TRIP5 Mux3: 00 : Select .0 input for Mux3 01 : Select .1 input for Mux3 10 : Select .2 input for Mux3 11 : Select .3 input for Mux3  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
5-4	MUX2	R/W	0h	Select Bits for EPWM-XBAR TRIP5 Mux2: 00 : Select .0 input for Mux2 01 : Select .1 input for Mux2 10 : Select .2 input for Mux2 11 : Select .3 input for Mux2  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
3-2	MUX1	R/W	0h	Select Bits for EPWM-XBAR TRIP5 Mux1: 00 : Select .0 input for Mux1 01 : Select .1 input for Mux1 10 : Select .2 input for Mux1 11 : Select .3 input for Mux1  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
1-0	MUX0	R/W	0h	Select Bits for EPWM-XBAR TRIP5 Mux0: 00 : Select .0 input for Mux0 01 : Select .1 input for Mux0 10 : Select .2 input for Mux0 11 : Select .3 input for Mux0  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn

### 13.14.3.4 TRIP5MUX16TO31CFG Register (Offset = 6h) [reset = 0h]

TRIP5MUX16TO31CFG is shown in [Figure 13-164](#) and described in [Table 13-105](#).

Return to [Summary Table](#).

ePWM XBAR Mux Configuration for TRIP5

**Figure 13-164. TRIP5MUX16TO31CFG Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
MUX31		MUX30		MUX29		MUX28		MUX27		MUX26		MUX25		MUX24	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
MUX23		MUX22		MUX21		MUX20		MUX19		MUX18		MUX17		MUX16	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	

**Table 13-105. TRIP5MUX16TO31CFG Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-30	MUX31	R/W	0h	Select Bits for EPWM-XBAR TRIP5 Mux31:  00 : Select .0 input for Mux31 01 : Select .1 input for Mux31 10 : Select .2 input for Mux31 11 : Select .3 input for Mux31  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
29-28	MUX30	R/W	0h	Select Bits for EPWM-XBAR TRIP5 Mux30:  00 : Select .0 input for Mux30 01 : Select .1 input for Mux30 10 : Select .2 input for Mux30 11 : Select .3 input for Mux30  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
27-26	MUX29	R/W	0h	Select Bits for EPWM-XBAR TRIP5 Mux29:  00 : Select .0 input for Mux29 01 : Select .1 input for Mux29 10 : Select .2 input for Mux29 11 : Select .3 input for Mux29  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
25-24	MUX28	R/W	0h	Select Bits for EPWM-XBAR TRIP5 Mux28:  00 : Select .0 input for Mux28 01 : Select .1 input for Mux28 10 : Select .2 input for Mux28 11 : Select .3 input for Mux28  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn

**Table 13-105. TRIP5MUX16TO31CFG Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
23-22	MUX27	R/W	0h	Select Bits for EPWM-XBAR TRIP5 Mux27: 00 : Select .0 input for Mux27 01 : Select .1 input for Mux27 10 : Select .2 input for Mux27 11 : Select .3 input for Mux27  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
21-20	MUX26	R/W	0h	Select Bits for EPWM-XBAR TRIP5 Mux26: 00 : Select .0 input for Mux26 01 : Select .1 input for Mux26 10 : Select .2 input for Mux26 11 : Select .3 input for Mux26  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
19-18	MUX25	R/W	0h	Select Bits for EPWM-XBAR TRIP5 Mux25: 00 : Select .0 input for Mux25 01 : Select .1 input for Mux25 10 : Select .2 input for Mux25 11 : Select .3 input for Mux25  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
17-16	MUX24	R/W	0h	Select Bits for EPWM-XBAR TRIP5 Mux24: 00 : Select .0 input for Mux24 01 : Select .1 input for Mux24 10 : Select .2 input for Mux24 11 : Select .3 input for Mux24  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
15-14	MUX23	R/W	0h	Select Bits for EPWM-XBAR TRIP5 Mux23: 00 : Select .0 input for Mux23 01 : Select .1 input for Mux23 10 : Select .2 input for Mux23 11 : Select .3 input for Mux23  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
13-12	MUX22	R/W	0h	Select Bits for EPWM-XBAR TRIP5 Mux22: 00 : Select .0 input for Mux22 01 : Select .1 input for Mux22 10 : Select .2 input for Mux22 11 : Select .3 input for Mux22  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn

**Table 13-105. TRIP5MUX16TO31CFG Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
11-10	MUX21	R/W	0h	Select Bits for EPWM-XBAR TRIP5 Mux21: 00 : Select .0 input for Mux21 01 : Select .1 input for Mux21 10 : Select .2 input for Mux21 11 : Select .3 input for Mux21  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
9-8	MUX20	R/W	0h	Select Bits for EPWM-XBAR TRIP5 Mux20: 00 : Select .0 input for Mux20 01 : Select .1 input for Mux20 10 : Select .2 input for Mux20 11 : Select .3 input for Mux20  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
7-6	MUX19	R/W	0h	Select Bits for EPWM-XBAR TRIP5 Mux19: 00 : Select .0 input for Mux19 01 : Select .1 input for Mux19 10 : Select .2 input for Mux19 11 : Select .3 input for Mux19  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
5-4	MUX18	R/W	0h	Select Bits for EPWM-XBAR TRIP5 Mux18: 00 : Select .0 input for Mux18 01 : Select .1 input for Mux18 10 : Select .2 input for Mux18 11 : Select .3 input for Mux18  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
3-2	MUX17	R/W	0h	Select Bits for EPWM-XBAR TRIP5 Mux17: 00 : Select .0 input for Mux17 01 : Select .1 input for Mux17 10 : Select .2 input for Mux17 11 : Select .3 input for Mux17  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
1-0	MUX16	R/W	0h	Select Bits for EPWM-XBAR TRIP5 Mux16: 00 : Select .0 input for Mux16 01 : Select .1 input for Mux16 10 : Select .2 input for Mux16 11 : Select .3 input for Mux16  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn

### 13.14.3.5 TRIP7MUX0TO15CFG Register (Offset = 8h) [reset = 0h]

TRIP7MUX0TO15CFG is shown in [Figure 13-165](#) and described in [Table 13-106](#).

Return to [Summary Table](#).

ePWM XBAR Mux Configuration for TRIP7

**Figure 13-165. TRIP7MUX0TO15CFG Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
MUX15		MUX14		MUX13		MUX12		MUX11		MUX10		MUX9		MUX8	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
MUX7		MUX6		MUX5		MUX4		MUX3		MUX2		MUX1		MUX0	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	

**Table 13-106. TRIP7MUX0TO15CFG Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-30	MUX15	R/W	0h	Select Bits for EPWM-XBAR TRIP7 Mux15:  00 : Select .0 input for Mux15 01 : Select .1 input for Mux15 10 : Select .2 input for Mux15 11 : Select .3 input for Mux15  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
29-28	MUX14	R/W	0h	Select Bits for EPWM-XBAR TRIP7 Mux14:  00 : Select .0 input for Mux14 01 : Select .1 input for Mux14 10 : Select .2 input for Mux14 11 : Select .3 input for Mux14  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
27-26	MUX13	R/W	0h	Select Bits for EPWM-XBAR TRIP7 Mux13:  00 : Select .0 input for Mux13 01 : Select .1 input for Mux13 10 : Select .2 input for Mux13 11 : Select .3 input for Mux13  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
25-24	MUX12	R/W	0h	Select Bits for EPWM-XBAR TRIP7 Mux12:  00 : Select .0 input for Mux12 01 : Select .1 input for Mux12 10 : Select .2 input for Mux12 11 : Select .3 input for Mux12  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn

**Table 13-106. TRIP7MUX0TO15CFG Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
23-22	MUX11	R/W	0h	Select Bits for EPWM-XBAR TRIP7 Mux11: 00 : Select .0 input for Mux11 01 : Select .1 input for Mux11 10 : Select .2 input for Mux11 11 : Select .3 input for Mux11 Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
21-20	MUX10	R/W	0h	Select Bits for EPWM-XBAR TRIP7 Mux10: 00 : Select .0 input for Mux10 01 : Select .1 input for Mux10 10 : Select .2 input for Mux10 11 : Select .3 input for Mux10 Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
19-18	MUX9	R/W	0h	Select Bits for EPWM-XBAR TRIP7 Mux9: 00 : Select .0 input for Mux9 01 : Select .1 input for Mux9 10 : Select .2 input for Mux9 11 : Select .3 input for Mux9 Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
17-16	MUX8	R/W	0h	Select Bits for EPWM-XBAR TRIP7 Mux8: 00 : Select .0 input for Mux8 01 : Select .1 input for Mux8 10 : Select .2 input for Mux8 11 : Select .3 input for Mux8 Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
15-14	MUX7	R/W	0h	Select Bits for EPWM-XBAR TRIP7 Mux7: 00 : Select .0 input for Mux7 01 : Select .1 input for Mux7 10 : Select .2 input for Mux7 11 : Select .3 input for Mux7 Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
13-12	MUX6	R/W	0h	Select Bits for EPWM-XBAR TRIP7 Mux6: 00 : Select .0 input for Mux6 01 : Select .1 input for Mux6 10 : Select .2 input for Mux6 11 : Select .3 input for Mux6 Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn

**Table 13-106. TRIP7MUX0TO15CFG Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
11-10	MUX5	R/W	0h	Select Bits for EPWM-XBAR TRIP7 Mux5: 00 : Select .0 input for Mux5 01 : Select .1 input for Mux5 10 : Select .2 input for Mux5 11 : Select .3 input for Mux5  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
9-8	MUX4	R/W	0h	Select Bits for EPWM-XBAR TRIP7 Mux4: 00 : Select .0 input for Mux4 01 : Select .1 input for Mux4 10 : Select .2 input for Mux4 11 : Select .3 input for Mux4  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
7-6	MUX3	R/W	0h	Select Bits for EPWM-XBAR TRIP7 Mux3: 00 : Select .0 input for Mux3 01 : Select .1 input for Mux3 10 : Select .2 input for Mux3 11 : Select .3 input for Mux3  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
5-4	MUX2	R/W	0h	Select Bits for EPWM-XBAR TRIP7 Mux2: 00 : Select .0 input for Mux2 01 : Select .1 input for Mux2 10 : Select .2 input for Mux2 11 : Select .3 input for Mux2  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
3-2	MUX1	R/W	0h	Select Bits for EPWM-XBAR TRIP7 Mux1: 00 : Select .0 input for Mux1 01 : Select .1 input for Mux1 10 : Select .2 input for Mux1 11 : Select .3 input for Mux1  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
1-0	MUX0	R/W	0h	Select Bits for EPWM-XBAR TRIP7 Mux0: 00 : Select .0 input for Mux0 01 : Select .1 input for Mux0 10 : Select .2 input for Mux0 11 : Select .3 input for Mux0  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn



### 13.14.3.6 TRIP7MUX16TO31CFG Register (Offset = Ah) [reset = 0h]

TRIP7MUX16TO31CFG is shown in [Figure 13-166](#) and described in [Table 13-107](#).

Return to [Summary Table](#).

ePWM XBAR Mux Configuration for TRIP7

**Figure 13-166. TRIP7MUX16TO31CFG Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
MUX31		MUX30		MUX29		MUX28		MUX27		MUX26		MUX25		MUX24	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
MUX23		MUX22		MUX21		MUX20		MUX19		MUX18		MUX17		MUX16	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	

**Table 13-107. TRIP7MUX16TO31CFG Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-30	MUX31	R/W	0h	Select Bits for EPWM-XBAR TRIP7 Mux31:  00 : Select .0 input for Mux31 01 : Select .1 input for Mux31 10 : Select .2 input for Mux31 11 : Select .3 input for Mux31  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
29-28	MUX30	R/W	0h	Select Bits for EPWM-XBAR TRIP7 Mux30:  00 : Select .0 input for Mux30 01 : Select .1 input for Mux30 10 : Select .2 input for Mux30 11 : Select .3 input for Mux30  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
27-26	MUX29	R/W	0h	Select Bits for EPWM-XBAR TRIP7 Mux29:  00 : Select .0 input for Mux29 01 : Select .1 input for Mux29 10 : Select .2 input for Mux29 11 : Select .3 input for Mux29  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
25-24	MUX28	R/W	0h	Select Bits for EPWM-XBAR TRIP7 Mux28:  00 : Select .0 input for Mux28 01 : Select .1 input for Mux28 10 : Select .2 input for Mux28 11 : Select .3 input for Mux28  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn

**Table 13-107. TRIP7MUX16TO31CFG Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
23-22	MUX27	R/W	0h	Select Bits for EPWM-XBAR TRIP7 Mux27: 00 : Select .0 input for Mux27 01 : Select .1 input for Mux27 10 : Select .2 input for Mux27 11 : Select .3 input for Mux27  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
21-20	MUX26	R/W	0h	Select Bits for EPWM-XBAR TRIP7 Mux26: 00 : Select .0 input for Mux26 01 : Select .1 input for Mux26 10 : Select .2 input for Mux26 11 : Select .3 input for Mux26  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
19-18	MUX25	R/W	0h	Select Bits for EPWM-XBAR TRIP7 Mux25: 00 : Select .0 input for Mux25 01 : Select .1 input for Mux25 10 : Select .2 input for Mux25 11 : Select .3 input for Mux25  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
17-16	MUX24	R/W	0h	Select Bits for EPWM-XBAR TRIP7 Mux24: 00 : Select .0 input for Mux24 01 : Select .1 input for Mux24 10 : Select .2 input for Mux24 11 : Select .3 input for Mux24  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
15-14	MUX23	R/W	0h	Select Bits for EPWM-XBAR TRIP7 Mux23: 00 : Select .0 input for Mux23 01 : Select .1 input for Mux23 10 : Select .2 input for Mux23 11 : Select .3 input for Mux23  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
13-12	MUX22	R/W	0h	Select Bits for EPWM-XBAR TRIP7 Mux22: 00 : Select .0 input for Mux22 01 : Select .1 input for Mux22 10 : Select .2 input for Mux22 11 : Select .3 input for Mux22  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn

**Table 13-107. TRIP7MUX16TO31CFG Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
11-10	MUX21	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP7 Mux21:</p> <p>00 : Select .0 input for Mux21            01 : Select .1 input for Mux21            10 : Select .2 input for Mux21            11 : Select .3 input for Mux21</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>
9-8	MUX20	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP7 Mux20:</p> <p>00 : Select .0 input for Mux20            01 : Select .1 input for Mux20            10 : Select .2 input for Mux20            11 : Select .3 input for Mux20</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>
7-6	MUX19	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP7 Mux19:</p> <p>00 : Select .0 input for Mux19            01 : Select .1 input for Mux19            10 : Select .2 input for Mux19            11 : Select .3 input for Mux19</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>
5-4	MUX18	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP7 Mux18:</p> <p>00 : Select .0 input for Mux18            01 : Select .1 input for Mux18            10 : Select .2 input for Mux18            11 : Select .3 input for Mux18</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>
3-2	MUX17	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP7 Mux17:</p> <p>00 : Select .0 input for Mux17            01 : Select .1 input for Mux17            10 : Select .2 input for Mux17            11 : Select .3 input for Mux17</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>
1-0	MUX16	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP7 Mux16:</p> <p>00 : Select .0 input for Mux16            01 : Select .1 input for Mux16            10 : Select .2 input for Mux16            11 : Select .3 input for Mux16</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>

**13.14.3.7 TRIP8MUX0TO15CFG Register (Offset = Ch) [reset = 0h]**

TRIP8MUX0TO15CFG is shown in [Figure 13-167](#) and described in [Table 13-108](#).

Return to [Summary Table](#).

ePWM XBAR Mux Configuration for TRIP8

**Figure 13-167. TRIP8MUX0TO15CFG Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
MUX15		MUX14		MUX13		MUX12		MUX11		MUX10		MUX9		MUX8	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
MUX7		MUX6		MUX5		MUX4		MUX3		MUX2		MUX1		MUX0	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	

**Table 13-108. TRIP8MUX0TO15CFG Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-30	MUX15	R/W	0h	Select Bits for EPWM-XBAR TRIP8 Mux15:  00 : Select .0 input for Mux15 01 : Select .1 input for Mux15 10 : Select .2 input for Mux15 11 : Select .3 input for Mux15  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
29-28	MUX14	R/W	0h	Select Bits for EPWM-XBAR TRIP8 Mux14:  00 : Select .0 input for Mux14 01 : Select .1 input for Mux14 10 : Select .2 input for Mux14 11 : Select .3 input for Mux14  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
27-26	MUX13	R/W	0h	Select Bits for EPWM-XBAR TRIP8 Mux13:  00 : Select .0 input for Mux13 01 : Select .1 input for Mux13 10 : Select .2 input for Mux13 11 : Select .3 input for Mux13  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
25-24	MUX12	R/W	0h	Select Bits for EPWM-XBAR TRIP8 Mux12:  00 : Select .0 input for Mux12 01 : Select .1 input for Mux12 10 : Select .2 input for Mux12 11 : Select .3 input for Mux12  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn

**Table 13-108. TRIP8MUX0TO15CFG Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
23-22	MUX11	R/W	0h	Select Bits for EPWM-XBAR TRIP8 Mux11:  00 : Select .0 input for Mux11 01 : Select .1 input for Mux11 10 : Select .2 input for Mux11 11 : Select .3 input for Mux11  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
21-20	MUX10	R/W	0h	Select Bits for EPWM-XBAR TRIP8 Mux10:  00 : Select .0 input for Mux10 01 : Select .1 input for Mux10 10 : Select .2 input for Mux10 11 : Select .3 input for Mux10  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
19-18	MUX9	R/W	0h	Select Bits for EPWM-XBAR TRIP8 Mux9:  00 : Select .0 input for Mux9 01 : Select .1 input for Mux9 10 : Select .2 input for Mux9 11 : Select .3 input for Mux9  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
17-16	MUX8	R/W	0h	Select Bits for EPWM-XBAR TRIP8 Mux8:  00 : Select .0 input for Mux8 01 : Select .1 input for Mux8 10 : Select .2 input for Mux8 11 : Select .3 input for Mux8  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
15-14	MUX7	R/W	0h	Select Bits for EPWM-XBAR TRIP8 Mux7:  00 : Select .0 input for Mux7 01 : Select .1 input for Mux7 10 : Select .2 input for Mux7 11 : Select .3 input for Mux7  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
13-12	MUX6	R/W	0h	Select Bits for EPWM-XBAR TRIP8 Mux6:  00 : Select .0 input for Mux6 01 : Select .1 input for Mux6 10 : Select .2 input for Mux6 11 : Select .3 input for Mux6  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn

**Table 13-108. TRIP8MUX0TO15CFG Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
11-10	MUX5	R/W	0h	Select Bits for EPWM-XBAR TRIP8 Mux5: 00 : Select .0 input for Mux5 01 : Select .1 input for Mux5 10 : Select .2 input for Mux5 11 : Select .3 input for Mux5  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
9-8	MUX4	R/W	0h	Select Bits for EPWM-XBAR TRIP8 Mux4: 00 : Select .0 input for Mux4 01 : Select .1 input for Mux4 10 : Select .2 input for Mux4 11 : Select .3 input for Mux4  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
7-6	MUX3	R/W	0h	Select Bits for EPWM-XBAR TRIP8 Mux3: 00 : Select .0 input for Mux3 01 : Select .1 input for Mux3 10 : Select .2 input for Mux3 11 : Select .3 input for Mux3  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
5-4	MUX2	R/W	0h	Select Bits for EPWM-XBAR TRIP8 Mux2: 00 : Select .0 input for Mux2 01 : Select .1 input for Mux2 10 : Select .2 input for Mux2 11 : Select .3 input for Mux2  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
3-2	MUX1	R/W	0h	Select Bits for EPWM-XBAR TRIP8 Mux1: 00 : Select .0 input for Mux1 01 : Select .1 input for Mux1 10 : Select .2 input for Mux1 11 : Select .3 input for Mux1  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
1-0	MUX0	R/W	0h	Select Bits for EPWM-XBAR TRIP8 Mux0: 00 : Select .0 input for Mux0 01 : Select .1 input for Mux0 10 : Select .2 input for Mux0 11 : Select .3 input for Mux0  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn

### 13.14.3.8 TRIP8MUX16TO31CFG Register (Offset = Eh) [reset = 0h]

TRIP8MUX16TO31CFG is shown in [Figure 13-168](#) and described in [Table 13-109](#).

Return to [Summary Table](#).

ePWM XBAR Mux Configuration for TRIP8

**Figure 13-168. TRIP8MUX16TO31CFG Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
MUX31		MUX30		MUX29		MUX28		MUX27		MUX26		MUX25		MUX24	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
MUX23		MUX22		MUX21		MUX20		MUX19		MUX18		MUX17		MUX16	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	

**Table 13-109. TRIP8MUX16TO31CFG Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-30	MUX31	R/W	0h	Select Bits for EPWM-XBAR TRIP8 Mux31:  00 : Select .0 input for Mux31 01 : Select .1 input for Mux31 10 : Select .2 input for Mux31 11 : Select .3 input for Mux31  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
29-28	MUX30	R/W	0h	Select Bits for EPWM-XBAR TRIP8 Mux30:  00 : Select .0 input for Mux30 01 : Select .1 input for Mux30 10 : Select .2 input for Mux30 11 : Select .3 input for Mux30  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
27-26	MUX29	R/W	0h	Select Bits for EPWM-XBAR TRIP8 Mux29:  00 : Select .0 input for Mux29 01 : Select .1 input for Mux29 10 : Select .2 input for Mux29 11 : Select .3 input for Mux29  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
25-24	MUX28	R/W	0h	Select Bits for EPWM-XBAR TRIP8 Mux28:  00 : Select .0 input for Mux28 01 : Select .1 input for Mux28 10 : Select .2 input for Mux28 11 : Select .3 input for Mux28  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn

**Table 13-109. TRIP8MUX16TO31CFG Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
23-22	MUX27	R/W	0h	Select Bits for EPWM-XBAR TRIP8 Mux27: 00 : Select .0 input for Mux27 01 : Select .1 input for Mux27 10 : Select .2 input for Mux27 11 : Select .3 input for Mux27  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
21-20	MUX26	R/W	0h	Select Bits for EPWM-XBAR TRIP8 Mux26: 00 : Select .0 input for Mux26 01 : Select .1 input for Mux26 10 : Select .2 input for Mux26 11 : Select .3 input for Mux26  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
19-18	MUX25	R/W	0h	Select Bits for EPWM-XBAR TRIP8 Mux25: 00 : Select .0 input for Mux25 01 : Select .1 input for Mux25 10 : Select .2 input for Mux25 11 : Select .3 input for Mux25  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
17-16	MUX24	R/W	0h	Select Bits for EPWM-XBAR TRIP8 Mux24: 00 : Select .0 input for Mux24 01 : Select .1 input for Mux24 10 : Select .2 input for Mux24 11 : Select .3 input for Mux24  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
15-14	MUX23	R/W	0h	Select Bits for EPWM-XBAR TRIP8 Mux23: 00 : Select .0 input for Mux23 01 : Select .1 input for Mux23 10 : Select .2 input for Mux23 11 : Select .3 input for Mux23  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
13-12	MUX22	R/W	0h	Select Bits for EPWM-XBAR TRIP8 Mux22: 00 : Select .0 input for Mux22 01 : Select .1 input for Mux22 10 : Select .2 input for Mux22 11 : Select .3 input for Mux22  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn



**Table 13-109. TRIP8MUX16TO31CFG Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
11-10	MUX21	R/W	0h	Select Bits for EPWM-XBAR TRIP8 Mux21: 00 : Select .0 input for Mux21 01 : Select .1 input for Mux21 10 : Select .2 input for Mux21 11 : Select .3 input for Mux21 Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
9-8	MUX20	R/W	0h	Select Bits for EPWM-XBAR TRIP8 Mux20: 00 : Select .0 input for Mux20 01 : Select .1 input for Mux20 10 : Select .2 input for Mux20 11 : Select .3 input for Mux20 Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
7-6	MUX19	R/W	0h	Select Bits for EPWM-XBAR TRIP8 Mux19: 00 : Select .0 input for Mux19 01 : Select .1 input for Mux19 10 : Select .2 input for Mux19 11 : Select .3 input for Mux19 Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
5-4	MUX18	R/W	0h	Select Bits for EPWM-XBAR TRIP8 Mux18: 00 : Select .0 input for Mux18 01 : Select .1 input for Mux18 10 : Select .2 input for Mux18 11 : Select .3 input for Mux18 Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
3-2	MUX17	R/W	0h	Select Bits for EPWM-XBAR TRIP8 Mux17: 00 : Select .0 input for Mux17 01 : Select .1 input for Mux17 10 : Select .2 input for Mux17 11 : Select .3 input for Mux17 Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
1-0	MUX16	R/W	0h	Select Bits for EPWM-XBAR TRIP8 Mux16: 00 : Select .0 input for Mux16 01 : Select .1 input for Mux16 10 : Select .2 input for Mux16 11 : Select .3 input for Mux16 Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn

**13.14.3.9 TRIP9MUX0TO15CFG Register (Offset = 10h) [reset = 0h]**

TRIP9MUX0TO15CFG is shown in [Figure 13-169](#) and described in [Table 13-110](#).

Return to [Summary Table](#).

ePWM XBAR Mux Configuration for TRIP9

**Figure 13-169. TRIP9MUX0TO15CFG Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
MUX15		MUX14		MUX13		MUX12		MUX11		MUX10		MUX9		MUX8	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
MUX7		MUX6		MUX5		MUX4		MUX3		MUX2		MUX1		MUX0	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	

**Table 13-110. TRIP9MUX0TO15CFG Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-30	MUX15	R/W	0h	Select Bits for EPWM-XBAR TRIP9 Mux15: 00 : Select .0 input for Mux15 01 : Select .1 input for Mux15 10 : Select .2 input for Mux15 11 : Select .3 input for Mux15  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
29-28	MUX14	R/W	0h	Select Bits for EPWM-XBAR TRIP9 Mux14: 00 : Select .0 input for Mux14 01 : Select .1 input for Mux14 10 : Select .2 input for Mux14 11 : Select .3 input for Mux14  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
27-26	MUX13	R/W	0h	Select Bits for EPWM-XBAR TRIP9 Mux13: 00 : Select .0 input for Mux13 01 : Select .1 input for Mux13 10 : Select .2 input for Mux13 11 : Select .3 input for Mux13  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
25-24	MUX12	R/W	0h	Select Bits for EPWM-XBAR TRIP9 Mux12: 00 : Select .0 input for Mux12 01 : Select .1 input for Mux12 10 : Select .2 input for Mux12 11 : Select .3 input for Mux12  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn

**Table 13-110. TRIP9MUX0TO15CFG Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
23-22	MUX11	R/W	0h	Select Bits for EPWM-XBAR TRIP9 Mux11: 00 : Select .0 input for Mux11 01 : Select .1 input for Mux11 10 : Select .2 input for Mux11 11 : Select .3 input for Mux11  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
21-20	MUX10	R/W	0h	Select Bits for EPWM-XBAR TRIP9 Mux10: 00 : Select .0 input for Mux10 01 : Select .1 input for Mux10 10 : Select .2 input for Mux10 11 : Select .3 input for Mux10  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
19-18	MUX9	R/W	0h	Select Bits for EPWM-XBAR TRIP9 Mux9: 00 : Select .0 input for Mux9 01 : Select .1 input for Mux9 10 : Select .2 input for Mux9 11 : Select .3 input for Mux9  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
17-16	MUX8	R/W	0h	Select Bits for EPWM-XBAR TRIP9 Mux8: 00 : Select .0 input for Mux8 01 : Select .1 input for Mux8 10 : Select .2 input for Mux8 11 : Select .3 input for Mux8  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
15-14	MUX7	R/W	0h	Select Bits for EPWM-XBAR TRIP9 Mux7: 00 : Select .0 input for Mux7 01 : Select .1 input for Mux7 10 : Select .2 input for Mux7 11 : Select .3 input for Mux7  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
13-12	MUX6	R/W	0h	Select Bits for EPWM-XBAR TRIP9 Mux6: 00 : Select .0 input for Mux6 01 : Select .1 input for Mux6 10 : Select .2 input for Mux6 11 : Select .3 input for Mux6  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn

**Table 13-110. TRIP9MUX0TO15CFG Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
11-10	MUX5	R/W	0h	Select Bits for EPWM-XBAR TRIP9 Mux5: 00 : Select .0 input for Mux5 01 : Select .1 input for Mux5 10 : Select .2 input for Mux5 11 : Select .3 input for Mux5  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
9-8	MUX4	R/W	0h	Select Bits for EPWM-XBAR TRIP9 Mux4: 00 : Select .0 input for Mux4 01 : Select .1 input for Mux4 10 : Select .2 input for Mux4 11 : Select .3 input for Mux4  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
7-6	MUX3	R/W	0h	Select Bits for EPWM-XBAR TRIP9 Mux3: 00 : Select .0 input for Mux3 01 : Select .1 input for Mux3 10 : Select .2 input for Mux3 11 : Select .3 input for Mux3  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
5-4	MUX2	R/W	0h	Select Bits for EPWM-XBAR TRIP9 Mux2: 00 : Select .0 input for Mux2 01 : Select .1 input for Mux2 10 : Select .2 input for Mux2 11 : Select .3 input for Mux2  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
3-2	MUX1	R/W	0h	Select Bits for EPWM-XBAR TRIP9 Mux1: 00 : Select .0 input for Mux1 01 : Select .1 input for Mux1 10 : Select .2 input for Mux1 11 : Select .3 input for Mux1  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
1-0	MUX0	R/W	0h	Select Bits for EPWM-XBAR TRIP9 Mux0: 00 : Select .0 input for Mux0 01 : Select .1 input for Mux0 10 : Select .2 input for Mux0 11 : Select .3 input for Mux0  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn

### 13.14.3.10 TRIP9MUX16TO31CFG Register (Offset = 12h) [reset = 0h]

TRIP9MUX16TO31CFG is shown in [Figure 13-170](#) and described in [Table 13-111](#).

Return to [Summary Table](#).

ePWM XBAR Mux Configuration for TRIP9

**Figure 13-170. TRIP9MUX16TO31CFG Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
MUX31		MUX30		MUX29		MUX28		MUX27		MUX26		MUX25		MUX24	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
MUX23		MUX22		MUX21		MUX20		MUX19		MUX18		MUX17		MUX16	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	

**Table 13-111. TRIP9MUX16TO31CFG Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-30	MUX31	R/W	0h	Select Bits for EPWM-XBAR TRIP9 Mux31:  00 : Select .0 input for Mux31 01 : Select .1 input for Mux31 10 : Select .2 input for Mux31 11 : Select .3 input for Mux31  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
29-28	MUX30	R/W	0h	Select Bits for EPWM-XBAR TRIP9 Mux30:  00 : Select .0 input for Mux30 01 : Select .1 input for Mux30 10 : Select .2 input for Mux30 11 : Select .3 input for Mux30  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
27-26	MUX29	R/W	0h	Select Bits for EPWM-XBAR TRIP9 Mux29:  00 : Select .0 input for Mux29 01 : Select .1 input for Mux29 10 : Select .2 input for Mux29 11 : Select .3 input for Mux29  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
25-24	MUX28	R/W	0h	Select Bits for EPWM-XBAR TRIP9 Mux28:  00 : Select .0 input for Mux28 01 : Select .1 input for Mux28 10 : Select .2 input for Mux28 11 : Select .3 input for Mux28  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn

**Table 13-111. TRIP9MUX16TO31CFG Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
23-22	MUX27	R/W	0h	Select Bits for EPWM-XBAR TRIP9 Mux27: 00 : Select .0 input for Mux27 01 : Select .1 input for Mux27 10 : Select .2 input for Mux27 11 : Select .3 input for Mux27  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
21-20	MUX26	R/W	0h	Select Bits for EPWM-XBAR TRIP9 Mux26: 00 : Select .0 input for Mux26 01 : Select .1 input for Mux26 10 : Select .2 input for Mux26 11 : Select .3 input for Mux26  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
19-18	MUX25	R/W	0h	Select Bits for EPWM-XBAR TRIP9 Mux25: 00 : Select .0 input for Mux25 01 : Select .1 input for Mux25 10 : Select .2 input for Mux25 11 : Select .3 input for Mux25  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
17-16	MUX24	R/W	0h	Select Bits for EPWM-XBAR TRIP9 Mux24: 00 : Select .0 input for Mux24 01 : Select .1 input for Mux24 10 : Select .2 input for Mux24 11 : Select .3 input for Mux24  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
15-14	MUX23	R/W	0h	Select Bits for EPWM-XBAR TRIP9 Mux23: 00 : Select .0 input for Mux23 01 : Select .1 input for Mux23 10 : Select .2 input for Mux23 11 : Select .3 input for Mux23  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
13-12	MUX22	R/W	0h	Select Bits for EPWM-XBAR TRIP9 Mux22: 00 : Select .0 input for Mux22 01 : Select .1 input for Mux22 10 : Select .2 input for Mux22 11 : Select .3 input for Mux22  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn

**Table 13-111. TRIP9MUX16TO31CFG Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
11-10	MUX21	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP9 Mux21:</p> <p>00 : Select .0 input for Mux21            01 : Select .1 input for Mux21            10 : Select .2 input for Mux21            11 : Select .3 input for Mux21</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>
9-8	MUX20	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP9 Mux20:</p> <p>00 : Select .0 input for Mux20            01 : Select .1 input for Mux20            10 : Select .2 input for Mux20            11 : Select .3 input for Mux20</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>
7-6	MUX19	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP9 Mux19:</p> <p>00 : Select .0 input for Mux19            01 : Select .1 input for Mux19            10 : Select .2 input for Mux19            11 : Select .3 input for Mux19</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>
5-4	MUX18	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP9 Mux18:</p> <p>00 : Select .0 input for Mux18            01 : Select .1 input for Mux18            10 : Select .2 input for Mux18            11 : Select .3 input for Mux18</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>
3-2	MUX17	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP9 Mux17:</p> <p>00 : Select .0 input for Mux17            01 : Select .1 input for Mux17            10 : Select .2 input for Mux17            11 : Select .3 input for Mux17</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>
1-0	MUX16	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP9 Mux16:</p> <p>00 : Select .0 input for Mux16            01 : Select .1 input for Mux16            10 : Select .2 input for Mux16            11 : Select .3 input for Mux16</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>

**13.14.3.11 TRIP10MUX0TO15CFG Register (Offset = 14h) [reset = 0h]**

TRIP10MUX0TO15CFG is shown in [Figure 13-171](#) and described in [Table 13-112](#).

Return to [Summary Table](#).

ePWM XBAR Mux Configuration for TRIP10

**Figure 13-171. TRIP10MUX0TO15CFG Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
MUX15		MUX14		MUX13		MUX12		MUX11		MUX10		MUX9		MUX8	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
MUX7		MUX6		MUX5		MUX4		MUX3		MUX2		MUX1		MUX0	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	

**Table 13-112. TRIP10MUX0TO15CFG Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-30	MUX15	R/W	0h	Select Bits for EPWM-XBAR TRIP10 Mux15:  00 : Select .0 input for Mux15 01 : Select .1 input for Mux15 10 : Select .2 input for Mux15 11 : Select .3 input for Mux15  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
29-28	MUX14	R/W	0h	Select Bits for EPWM-XBAR TRIP10 Mux14:  00 : Select .0 input for Mux14 01 : Select .1 input for Mux14 10 : Select .2 input for Mux14 11 : Select .3 input for Mux14  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
27-26	MUX13	R/W	0h	Select Bits for EPWM-XBAR TRIP10 Mux13:  00 : Select .0 input for Mux13 01 : Select .1 input for Mux13 10 : Select .2 input for Mux13 11 : Select .3 input for Mux13  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
25-24	MUX12	R/W	0h	Select Bits for EPWM-XBAR TRIP10 Mux12:  00 : Select .0 input for Mux12 01 : Select .1 input for Mux12 10 : Select .2 input for Mux12 11 : Select .3 input for Mux12  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn



**Table 13-112. TRIP10MUX0TO15CFG Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
23-22	MUX11	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP10 Mux11:</p> <p>00 : Select .0 input for Mux11            01 : Select .1 input for Mux11            10 : Select .2 input for Mux11            11 : Select .3 input for Mux11</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>
21-20	MUX10	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP10 Mux10:</p> <p>00 : Select .0 input for Mux10            01 : Select .1 input for Mux10            10 : Select .2 input for Mux10            11 : Select .3 input for Mux10</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>
19-18	MUX9	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP10 Mux9:</p> <p>00 : Select .0 input for Mux9            01 : Select .1 input for Mux9            10 : Select .2 input for Mux9            11 : Select .3 input for Mux9</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>
17-16	MUX8	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP10 Mux8:</p> <p>00 : Select .0 input for Mux8            01 : Select .1 input for Mux8            10 : Select .2 input for Mux8            11 : Select .3 input for Mux8</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>
15-14	MUX7	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP10 Mux7:</p> <p>00 : Select .0 input for Mux7            01 : Select .1 input for Mux7            10 : Select .2 input for Mux7            11 : Select .3 input for Mux7</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>
13-12	MUX6	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP10 Mux6:</p> <p>00 : Select .0 input for Mux6            01 : Select .1 input for Mux6            10 : Select .2 input for Mux6            11 : Select .3 input for Mux6</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>

**Table 13-112. TRIP10MUX0TO15CFG Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
11-10	MUX5	R/W	0h	Select Bits for EPWM-XBAR TRIP10 Mux5: 00 : Select .0 input for Mux5 01 : Select .1 input for Mux5 10 : Select .2 input for Mux5 11 : Select .3 input for Mux5  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
9-8	MUX4	R/W	0h	Select Bits for EPWM-XBAR TRIP10 Mux4: 00 : Select .0 input for Mux4 01 : Select .1 input for Mux4 10 : Select .2 input for Mux4 11 : Select .3 input for Mux4  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
7-6	MUX3	R/W	0h	Select Bits for EPWM-XBAR TRIP10 Mux3: 00 : Select .0 input for Mux3 01 : Select .1 input for Mux3 10 : Select .2 input for Mux3 11 : Select .3 input for Mux3  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
5-4	MUX2	R/W	0h	Select Bits for EPWM-XBAR TRIP10 Mux2: 00 : Select .0 input for Mux2 01 : Select .1 input for Mux2 10 : Select .2 input for Mux2 11 : Select .3 input for Mux2  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
3-2	MUX1	R/W	0h	Select Bits for EPWM-XBAR TRIP10 Mux1: 00 : Select .0 input for Mux1 01 : Select .1 input for Mux1 10 : Select .2 input for Mux1 11 : Select .3 input for Mux1  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
1-0	MUX0	R/W	0h	Select Bits for EPWM-XBAR TRIP10 Mux0: 00 : Select .0 input for Mux0 01 : Select .1 input for Mux0 10 : Select .2 input for Mux0 11 : Select .3 input for Mux0  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn

### 13.14.3.12 TRIP10MUX16TO31CFG Register (Offset = 16h) [reset = 0h]

TRIP10MUX16TO31CFG is shown in [Figure 13-172](#) and described in [Table 13-113](#).

Return to [Summary Table](#).

ePWM XBAR Mux Configuration for TRIP10

**Figure 13-172. TRIP10MUX16TO31CFG Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
MUX31		MUX30		MUX29		MUX28		MUX27		MUX26		MUX25		MUX24	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
MUX23		MUX22		MUX21		MUX20		MUX19		MUX18		MUX17		MUX16	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	

**Table 13-113. TRIP10MUX16TO31CFG Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-30	MUX31	R/W	0h	Select Bits for EPWM-XBAR TRIP10 Mux31:  00 : Select .0 input for Mux31 01 : Select .1 input for Mux31 10 : Select .2 input for Mux31 11 : Select .3 input for Mux31  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
29-28	MUX30	R/W	0h	Select Bits for EPWM-XBAR TRIP10 Mux30:  00 : Select .0 input for Mux30 01 : Select .1 input for Mux30 10 : Select .2 input for Mux30 11 : Select .3 input for Mux30  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
27-26	MUX29	R/W	0h	Select Bits for EPWM-XBAR TRIP10 Mux29:  00 : Select .0 input for Mux29 01 : Select .1 input for Mux29 10 : Select .2 input for Mux29 11 : Select .3 input for Mux29  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
25-24	MUX28	R/W	0h	Select Bits for EPWM-XBAR TRIP10 Mux28:  00 : Select .0 input for Mux28 01 : Select .1 input for Mux28 10 : Select .2 input for Mux28 11 : Select .3 input for Mux28  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn

**Table 13-113. TRIP10MUX16TO31CFG Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
23-22	MUX27	R/W	0h	Select Bits for EPWM-XBAR TRIP10 Mux27: 00 : Select .0 input for Mux27 01 : Select .1 input for Mux27 10 : Select .2 input for Mux27 11 : Select .3 input for Mux27  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
21-20	MUX26	R/W	0h	Select Bits for EPWM-XBAR TRIP10 Mux26: 00 : Select .0 input for Mux26 01 : Select .1 input for Mux26 10 : Select .2 input for Mux26 11 : Select .3 input for Mux26  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
19-18	MUX25	R/W	0h	Select Bits for EPWM-XBAR TRIP10 Mux25: 00 : Select .0 input for Mux25 01 : Select .1 input for Mux25 10 : Select .2 input for Mux25 11 : Select .3 input for Mux25  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
17-16	MUX24	R/W	0h	Select Bits for EPWM-XBAR TRIP10 Mux24: 00 : Select .0 input for Mux24 01 : Select .1 input for Mux24 10 : Select .2 input for Mux24 11 : Select .3 input for Mux24  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
15-14	MUX23	R/W	0h	Select Bits for EPWM-XBAR TRIP10 Mux23: 00 : Select .0 input for Mux23 01 : Select .1 input for Mux23 10 : Select .2 input for Mux23 11 : Select .3 input for Mux23  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
13-12	MUX22	R/W	0h	Select Bits for EPWM-XBAR TRIP10 Mux22: 00 : Select .0 input for Mux22 01 : Select .1 input for Mux22 10 : Select .2 input for Mux22 11 : Select .3 input for Mux22  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn

**Table 13-113. TRIP10MUX16TO31CFG Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
11-10	MUX21	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP10 Mux21:</p> <p>00 : Select .0 input for Mux21            01 : Select .1 input for Mux21            10 : Select .2 input for Mux21            11 : Select .3 input for Mux21</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>
9-8	MUX20	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP10 Mux20:</p> <p>00 : Select .0 input for Mux20            01 : Select .1 input for Mux20            10 : Select .2 input for Mux20            11 : Select .3 input for Mux20</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>
7-6	MUX19	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP10 Mux19:</p> <p>00 : Select .0 input for Mux19            01 : Select .1 input for Mux19            10 : Select .2 input for Mux19            11 : Select .3 input for Mux19</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>
5-4	MUX18	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP10 Mux18:</p> <p>00 : Select .0 input for Mux18            01 : Select .1 input for Mux18            10 : Select .2 input for Mux18            11 : Select .3 input for Mux18</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>
3-2	MUX17	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP10 Mux17:</p> <p>00 : Select .0 input for Mux17            01 : Select .1 input for Mux17            10 : Select .2 input for Mux17            11 : Select .3 input for Mux17</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>
1-0	MUX16	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP10 Mux16:</p> <p>00 : Select .0 input for Mux16            01 : Select .1 input for Mux16            10 : Select .2 input for Mux16            11 : Select .3 input for Mux16</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>

**13.14.3.13 TRIP11MUX0TO15CFG Register (Offset = 18h) [reset = 0h]**

TRIP11MUX0TO15CFG is shown in [Figure 13-173](#) and described in [Table 13-114](#).

Return to [Summary Table](#).

ePWM XBAR Mux Configuration for TRIP11

**Figure 13-173. TRIP11MUX0TO15CFG Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
MUX15		MUX14		MUX13		MUX12		MUX11		MUX10		MUX9		MUX8	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
MUX7		MUX6		MUX5		MUX4		MUX3		MUX2		MUX1		MUX0	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	

**Table 13-114. TRIP11MUX0TO15CFG Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-30	MUX15	R/W	0h	Select Bits for EPWM-XBAR TRIP11 Mux15:  00 : Select .0 input for Mux15 01 : Select .1 input for Mux15 10 : Select .2 input for Mux15 11 : Select .3 input for Mux15  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
29-28	MUX14	R/W	0h	Select Bits for EPWM-XBAR TRIP11 Mux14:  00 : Select .0 input for Mux14 01 : Select .1 input for Mux14 10 : Select .2 input for Mux14 11 : Select .3 input for Mux14  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
27-26	MUX13	R/W	0h	Select Bits for EPWM-XBAR TRIP11 Mux13:  00 : Select .0 input for Mux13 01 : Select .1 input for Mux13 10 : Select .2 input for Mux13 11 : Select .3 input for Mux13  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
25-24	MUX12	R/W	0h	Select Bits for EPWM-XBAR TRIP11 Mux12:  00 : Select .0 input for Mux12 01 : Select .1 input for Mux12 10 : Select .2 input for Mux12 11 : Select .3 input for Mux12  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn

**Table 13-114. TRIP11MUX0TO15CFG Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
23-22	MUX11	R/W	0h	Select Bits for EPWM-XBAR TRIP11 Mux11:  00 : Select .0 input for Mux11 01 : Select .1 input for Mux11 10 : Select .2 input for Mux11 11 : Select .3 input for Mux11  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
21-20	MUX10	R/W	0h	Select Bits for EPWM-XBAR TRIP11 Mux10:  00 : Select .0 input for Mux10 01 : Select .1 input for Mux10 10 : Select .2 input for Mux10 11 : Select .3 input for Mux10  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
19-18	MUX9	R/W	0h	Select Bits for EPWM-XBAR TRIP11 Mux9:  00 : Select .0 input for Mux9 01 : Select .1 input for Mux9 10 : Select .2 input for Mux9 11 : Select .3 input for Mux9  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
17-16	MUX8	R/W	0h	Select Bits for EPWM-XBAR TRIP11 Mux8:  00 : Select .0 input for Mux8 01 : Select .1 input for Mux8 10 : Select .2 input for Mux8 11 : Select .3 input for Mux8  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
15-14	MUX7	R/W	0h	Select Bits for EPWM-XBAR TRIP11 Mux7:  00 : Select .0 input for Mux7 01 : Select .1 input for Mux7 10 : Select .2 input for Mux7 11 : Select .3 input for Mux7  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
13-12	MUX6	R/W	0h	Select Bits for EPWM-XBAR TRIP11 Mux6:  00 : Select .0 input for Mux6 01 : Select .1 input for Mux6 10 : Select .2 input for Mux6 11 : Select .3 input for Mux6  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn

**Table 13-114. TRIP11MUX0TO15CFG Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
11-10	MUX5	R/W	0h	Select Bits for EPWM-XBAR TRIP11 Mux5: 00 : Select .0 input for Mux5 01 : Select .1 input for Mux5 10 : Select .2 input for Mux5 11 : Select .3 input for Mux5 Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
9-8	MUX4	R/W	0h	Select Bits for EPWM-XBAR TRIP11 Mux4: 00 : Select .0 input for Mux4 01 : Select .1 input for Mux4 10 : Select .2 input for Mux4 11 : Select .3 input for Mux4 Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
7-6	MUX3	R/W	0h	Select Bits for EPWM-XBAR TRIP11 Mux3: 00 : Select .0 input for Mux3 01 : Select .1 input for Mux3 10 : Select .2 input for Mux3 11 : Select .3 input for Mux3 Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
5-4	MUX2	R/W	0h	Select Bits for EPWM-XBAR TRIP11 Mux2: 00 : Select .0 input for Mux2 01 : Select .1 input for Mux2 10 : Select .2 input for Mux2 11 : Select .3 input for Mux2 Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
3-2	MUX1	R/W	0h	Select Bits for EPWM-XBAR TRIP11 Mux1: 00 : Select .0 input for Mux1 01 : Select .1 input for Mux1 10 : Select .2 input for Mux1 11 : Select .3 input for Mux1 Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
1-0	MUX0	R/W	0h	Select Bits for EPWM-XBAR TRIP11 Mux0: 00 : Select .0 input for Mux0 01 : Select .1 input for Mux0 10 : Select .2 input for Mux0 11 : Select .3 input for Mux0 Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn



### 13.14.3.14 TRIP11MUX16TO31CFG Register (Offset = 1Ah) [reset = 0h]

TRIP11MUX16TO31CFG is shown in [Figure 13-174](#) and described in [Table 13-115](#).

Return to [Summary Table](#).

ePWM XBAR Mux Configuration for TRIP11

**Figure 13-174. TRIP11MUX16TO31CFG Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
MUX31		MUX30		MUX29		MUX28		MUX27		MUX26		MUX25		MUX24	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
MUX23		MUX22		MUX21		MUX20		MUX19		MUX18		MUX17		MUX16	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	

**Table 13-115. TRIP11MUX16TO31CFG Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-30	MUX31	R/W	0h	Select Bits for EPWM-XBAR TRIP11 Mux31:  00 : Select .0 input for Mux31 01 : Select .1 input for Mux31 10 : Select .2 input for Mux31 11 : Select .3 input for Mux31  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
29-28	MUX30	R/W	0h	Select Bits for EPWM-XBAR TRIP11 Mux30:  00 : Select .0 input for Mux30 01 : Select .1 input for Mux30 10 : Select .2 input for Mux30 11 : Select .3 input for Mux30  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
27-26	MUX29	R/W	0h	Select Bits for EPWM-XBAR TRIP11 Mux29:  00 : Select .0 input for Mux29 01 : Select .1 input for Mux29 10 : Select .2 input for Mux29 11 : Select .3 input for Mux29  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
25-24	MUX28	R/W	0h	Select Bits for EPWM-XBAR TRIP11 Mux28:  00 : Select .0 input for Mux28 01 : Select .1 input for Mux28 10 : Select .2 input for Mux28 11 : Select .3 input for Mux28  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn

**Table 13-115. TRIP11MUX16TO31CFG Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
23-22	MUX27	R/W	0h	Select Bits for EPWM-XBAR TRIP11 Mux27: 00 : Select .0 input for Mux27 01 : Select .1 input for Mux27 10 : Select .2 input for Mux27 11 : Select .3 input for Mux27  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
21-20	MUX26	R/W	0h	Select Bits for EPWM-XBAR TRIP11 Mux26: 00 : Select .0 input for Mux26 01 : Select .1 input for Mux26 10 : Select .2 input for Mux26 11 : Select .3 input for Mux26  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
19-18	MUX25	R/W	0h	Select Bits for EPWM-XBAR TRIP11 Mux25: 00 : Select .0 input for Mux25 01 : Select .1 input for Mux25 10 : Select .2 input for Mux25 11 : Select .3 input for Mux25  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
17-16	MUX24	R/W	0h	Select Bits for EPWM-XBAR TRIP11 Mux24: 00 : Select .0 input for Mux24 01 : Select .1 input for Mux24 10 : Select .2 input for Mux24 11 : Select .3 input for Mux24  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
15-14	MUX23	R/W	0h	Select Bits for EPWM-XBAR TRIP11 Mux23: 00 : Select .0 input for Mux23 01 : Select .1 input for Mux23 10 : Select .2 input for Mux23 11 : Select .3 input for Mux23  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
13-12	MUX22	R/W	0h	Select Bits for EPWM-XBAR TRIP11 Mux22: 00 : Select .0 input for Mux22 01 : Select .1 input for Mux22 10 : Select .2 input for Mux22 11 : Select .3 input for Mux22  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn

**Table 13-115. TRIP11MUX16TO31CFG Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
11-10	MUX21	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP11 Mux21:</p> <p>00 : Select .0 input for Mux21            01 : Select .1 input for Mux21            10 : Select .2 input for Mux21            11 : Select .3 input for Mux21</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>
9-8	MUX20	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP11 Mux20:</p> <p>00 : Select .0 input for Mux20            01 : Select .1 input for Mux20            10 : Select .2 input for Mux20            11 : Select .3 input for Mux20</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>
7-6	MUX19	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP11 Mux19:</p> <p>00 : Select .0 input for Mux19            01 : Select .1 input for Mux19            10 : Select .2 input for Mux19            11 : Select .3 input for Mux19</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>
5-4	MUX18	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP11 Mux18:</p> <p>00 : Select .0 input for Mux18            01 : Select .1 input for Mux18            10 : Select .2 input for Mux18            11 : Select .3 input for Mux18</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>
3-2	MUX17	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP11 Mux17:</p> <p>00 : Select .0 input for Mux17            01 : Select .1 input for Mux17            10 : Select .2 input for Mux17            11 : Select .3 input for Mux17</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>
1-0	MUX16	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP11 Mux16:</p> <p>00 : Select .0 input for Mux16            01 : Select .1 input for Mux16            10 : Select .2 input for Mux16            11 : Select .3 input for Mux16</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>

**13.14.3.15 TRIP12MUX0TO15CFG Register (Offset = 1Ch) [reset = 0h]**

TRIP12MUX0TO15CFG is shown in [Figure 13-175](#) and described in [Table 13-116](#).

Return to [Summary Table](#).

ePWM XBAR Mux Configuration for TRIP12

**Figure 13-175. TRIP12MUX0TO15CFG Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
MUX15		MUX14		MUX13		MUX12		MUX11		MUX10		MUX9		MUX8	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
MUX7		MUX6		MUX5		MUX4		MUX3		MUX2		MUX1		MUX0	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	

**Table 13-116. TRIP12MUX0TO15CFG Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-30	MUX15	R/W	0h	Select Bits for EPWM-XBAR TRIP12 Mux15:  00 : Select .0 input for Mux15 01 : Select .1 input for Mux15 10 : Select .2 input for Mux15 11 : Select .3 input for Mux15  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
29-28	MUX14	R/W	0h	Select Bits for EPWM-XBAR TRIP12 Mux14:  00 : Select .0 input for Mux14 01 : Select .1 input for Mux14 10 : Select .2 input for Mux14 11 : Select .3 input for Mux14  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
27-26	MUX13	R/W	0h	Select Bits for EPWM-XBAR TRIP12 Mux13:  00 : Select .0 input for Mux13 01 : Select .1 input for Mux13 10 : Select .2 input for Mux13 11 : Select .3 input for Mux13  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
25-24	MUX12	R/W	0h	Select Bits for EPWM-XBAR TRIP12 Mux12:  00 : Select .0 input for Mux12 01 : Select .1 input for Mux12 10 : Select .2 input for Mux12 11 : Select .3 input for Mux12  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn

**Table 13-116. TRIP12MUX0TO15CFG Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
23-22	MUX11	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP12 Mux11:</p> <p>00 : Select .0 input for Mux11            01 : Select .1 input for Mux11            10 : Select .2 input for Mux11            11 : Select .3 input for Mux11</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>
21-20	MUX10	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP12 Mux10:</p> <p>00 : Select .0 input for Mux10            01 : Select .1 input for Mux10            10 : Select .2 input for Mux10            11 : Select .3 input for Mux10</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>
19-18	MUX9	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP12 Mux9:</p> <p>00 : Select .0 input for Mux9            01 : Select .1 input for Mux9            10 : Select .2 input for Mux9            11 : Select .3 input for Mux9</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>
17-16	MUX8	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP12 Mux8:</p> <p>00 : Select .0 input for Mux8            01 : Select .1 input for Mux8            10 : Select .2 input for Mux8            11 : Select .3 input for Mux8</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>
15-14	MUX7	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP12 Mux7:</p> <p>00 : Select .0 input for Mux7            01 : Select .1 input for Mux7            10 : Select .2 input for Mux7            11 : Select .3 input for Mux7</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>
13-12	MUX6	R/W	0h	<p>Select Bits for EPWM-XBAR TRIP12 Mux6:</p> <p>00 : Select .0 input for Mux6            01 : Select .1 input for Mux6            10 : Select .2 input for Mux6            11 : Select .3 input for Mux6</p> <p>Refer to the EPWM X-BAR section of this chapter for more details.            Reset type: CPU1.SYSRSn</p>

**Table 13-116. TRIP12MUX0TO15CFG Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
11-10	MUX5	R/W	0h	Select Bits for EPWM-XBAR TRIP12 Mux5: 00 : Select .0 input for Mux5 01 : Select .1 input for Mux5 10 : Select .2 input for Mux5 11 : Select .3 input for Mux5  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
9-8	MUX4	R/W	0h	Select Bits for EPWM-XBAR TRIP12 Mux4: 00 : Select .0 input for Mux4 01 : Select .1 input for Mux4 10 : Select .2 input for Mux4 11 : Select .3 input for Mux4  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
7-6	MUX3	R/W	0h	Select Bits for EPWM-XBAR TRIP12 Mux3: 00 : Select .0 input for Mux3 01 : Select .1 input for Mux3 10 : Select .2 input for Mux3 11 : Select .3 input for Mux3  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
5-4	MUX2	R/W	0h	Select Bits for EPWM-XBAR TRIP12 Mux2: 00 : Select .0 input for Mux2 01 : Select .1 input for Mux2 10 : Select .2 input for Mux2 11 : Select .3 input for Mux2  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
3-2	MUX1	R/W	0h	Select Bits for EPWM-XBAR TRIP12 Mux1: 00 : Select .0 input for Mux1 01 : Select .1 input for Mux1 10 : Select .2 input for Mux1 11 : Select .3 input for Mux1  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
1-0	MUX0	R/W	0h	Select Bits for EPWM-XBAR TRIP12 Mux0: 00 : Select .0 input for Mux0 01 : Select .1 input for Mux0 10 : Select .2 input for Mux0 11 : Select .3 input for Mux0  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn

### 13.14.3.16 TRIP12MUX16TO31CFG Register (Offset = 1Eh) [reset = 0h]

TRIP12MUX16TO31CFG is shown in [Figure 13-176](#) and described in [Table 13-117](#).

Return to [Summary Table](#).

ePWM XBAR Mux Configuration for TRIP12

**Figure 13-176. TRIP12MUX16TO31CFG Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
MUX31		MUX30		MUX29		MUX28		MUX27		MUX26		MUX25		MUX24	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
MUX23		MUX22		MUX21		MUX20		MUX19		MUX18		MUX17		MUX16	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	

**Table 13-117. TRIP12MUX16TO31CFG Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-30	MUX31	R/W	0h	Select Bits for EPWM-XBAR TRIP12 Mux31:  00 : Select .0 input for Mux31 01 : Select .1 input for Mux31 10 : Select .2 input for Mux31 11 : Select .3 input for Mux31  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
29-28	MUX30	R/W	0h	Select Bits for EPWM-XBAR TRIP12 Mux30:  00 : Select .0 input for Mux30 01 : Select .1 input for Mux30 10 : Select .2 input for Mux30 11 : Select .3 input for Mux30  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
27-26	MUX29	R/W	0h	Select Bits for EPWM-XBAR TRIP12 Mux29:  00 : Select .0 input for Mux29 01 : Select .1 input for Mux29 10 : Select .2 input for Mux29 11 : Select .3 input for Mux29  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
25-24	MUX28	R/W	0h	Select Bits for EPWM-XBAR TRIP12 Mux28:  00 : Select .0 input for Mux28 01 : Select .1 input for Mux28 10 : Select .2 input for Mux28 11 : Select .3 input for Mux28  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn

**Table 13-117. TRIP12MUX16TO31CFG Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
23-22	MUX27	R/W	0h	Select Bits for EPWM-XBAR TRIP12 Mux27: 00 : Select .0 input for Mux27 01 : Select .1 input for Mux27 10 : Select .2 input for Mux27 11 : Select .3 input for Mux27  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
21-20	MUX26	R/W	0h	Select Bits for EPWM-XBAR TRIP12 Mux26: 00 : Select .0 input for Mux26 01 : Select .1 input for Mux26 10 : Select .2 input for Mux26 11 : Select .3 input for Mux26  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
19-18	MUX25	R/W	0h	Select Bits for EPWM-XBAR TRIP12 Mux25: 00 : Select .0 input for Mux25 01 : Select .1 input for Mux25 10 : Select .2 input for Mux25 11 : Select .3 input for Mux25  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
17-16	MUX24	R/W	0h	Select Bits for EPWM-XBAR TRIP12 Mux24: 00 : Select .0 input for Mux24 01 : Select .1 input for Mux24 10 : Select .2 input for Mux24 11 : Select .3 input for Mux24  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
15-14	MUX23	R/W	0h	Select Bits for EPWM-XBAR TRIP12 Mux23: 00 : Select .0 input for Mux23 01 : Select .1 input for Mux23 10 : Select .2 input for Mux23 11 : Select .3 input for Mux23  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
13-12	MUX22	R/W	0h	Select Bits for EPWM-XBAR TRIP12 Mux22: 00 : Select .0 input for Mux22 01 : Select .1 input for Mux22 10 : Select .2 input for Mux22 11 : Select .3 input for Mux22  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn



**Table 13-117. TRIP12MUX16TO31CFG Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
11-10	MUX21	R/W	0h	Select Bits for EPWM-XBAR TRIP12 Mux21:  00 : Select .0 input for Mux21 01 : Select .1 input for Mux21 10 : Select .2 input for Mux21 11 : Select .3 input for Mux21  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
9-8	MUX20	R/W	0h	Select Bits for EPWM-XBAR TRIP12 Mux20:  00 : Select .0 input for Mux20 01 : Select .1 input for Mux20 10 : Select .2 input for Mux20 11 : Select .3 input for Mux20  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
7-6	MUX19	R/W	0h	Select Bits for EPWM-XBAR TRIP12 Mux19:  00 : Select .0 input for Mux19 01 : Select .1 input for Mux19 10 : Select .2 input for Mux19 11 : Select .3 input for Mux19  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
5-4	MUX18	R/W	0h	Select Bits for EPWM-XBAR TRIP12 Mux18:  00 : Select .0 input for Mux18 01 : Select .1 input for Mux18 10 : Select .2 input for Mux18 11 : Select .3 input for Mux18  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
3-2	MUX17	R/W	0h	Select Bits for EPWM-XBAR TRIP12 Mux17:  00 : Select .0 input for Mux17 01 : Select .1 input for Mux17 10 : Select .2 input for Mux17 11 : Select .3 input for Mux17  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
1-0	MUX16	R/W	0h	Select Bits for EPWM-XBAR TRIP12 Mux16:  00 : Select .0 input for Mux16 01 : Select .1 input for Mux16 10 : Select .2 input for Mux16 11 : Select .3 input for Mux16  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn

**13.14.3.17 TRIP4MUXENABLE Register (Offset = 20h) [reset = 0h]**

TRIP4MUXENABLE is shown in [Figure 13-177](#) and described in [Table 13-118](#).

Return to [Summary Table](#).

ePWM XBAR Mux Enable for TRIP4

**Figure 13-177. TRIP4MUXENABLE Register**

31	30	29	28	27	26	25	24
MUX31	MUX30	MUX29	MUX28	MUX27	MUX26	MUX25	MUX24
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
23	22	21	20	19	18	17	16
MUX23	MUX22	MUX21	MUX20	MUX19	MUX18	MUX17	MUX16
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
15	14	13	12	11	10	9	8
MUX15	MUX14	MUX13	MUX12	MUX11	MUX10	MUX9	MUX8
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
7	6	5	4	3	2	1	0
MUX7	MUX6	MUX5	MUX4	MUX3	MUX2	MUX1	MUX0
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h

**Table 13-118. TRIP4MUXENABLE Register Field Descriptions**

Bit	Field	Type	Reset	Description
31	MUX31	R/W	0h	Selects the output of Mux31 to drive TRIP4 of EPWM-XBAR  0: Respective output of Mux31 is enabled to drive the TRIP4 of EPWM-XBAR 1: Respective output of Mux31 is enabled to drive the TRIP4 of EPWM-XBAR  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
30	MUX30	R/W	0h	Selects the output of Mux30 to drive TRIP4 of EPWM-XBAR  0: Respective output of Mux30 is enabled to drive the TRIP4 of EPWM-XBAR 1: Respective output of Mux30 is enabled to drive the TRIP4 of EPWM-XBAR  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
29	MUX29	R/W	0h	Selects the output of Mux29 to drive TRIP4 of EPWM-XBAR  0: Respective output of Mux29 is enabled to drive the TRIP4 of EPWM-XBAR 1: Respective output of Mux29 is enabled to drive the TRIP4 of EPWM-XBAR  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
28	MUX28	R/W	0h	Selects the output of Mux28 to drive TRIP4 of EPWM-XBAR  0: Respective output of Mux28 is enabled to drive the TRIP4 of EPWM-XBAR 1: Respective output of Mux28 is enabled to drive the TRIP4 of EPWM-XBAR  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn

**Table 13-118. TRIP4MUXENABLE Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
27	MUX27	R/W	0h	<p>Selects the output of Mux27 to drive TRIP4 of EPWM-XBAR</p> <p>0: Respective output of Mux27 is enabled to drive the TRIP4 of EPWM-XBAR</p> <p>1: Respective output of Mux27 is enabled to drive the TRIP4 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
26	MUX26	R/W	0h	<p>Selects the output of Mux26 to drive TRIP4 of EPWM-XBAR</p> <p>0: Respective output of Mux26 is enabled to drive the TRIP4 of EPWM-XBAR</p> <p>1: Respective output of Mux26 is enabled to drive the TRIP4 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
25	MUX25	R/W	0h	<p>Selects the output of Mux25 to drive TRIP4 of EPWM-XBAR</p> <p>0: Respective output of Mux25 is enabled to drive the TRIP4 of EPWM-XBAR</p> <p>1: Respective output of Mux25 is enabled to drive the TRIP4 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
24	MUX24	R/W	0h	<p>Selects the output of Mux24 to drive TRIP4 of EPWM-XBAR</p> <p>0: Respective output of Mux24 is enabled to drive the TRIP4 of EPWM-XBAR</p> <p>1: Respective output of Mux24 is enabled to drive the TRIP4 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
23	MUX23	R/W	0h	<p>Selects the output of Mux23 to drive TRIP4 of EPWM-XBAR</p> <p>0: Respective output of Mux23 is disabled to drive the TRIP4 of EPWM-XBAR</p> <p>1: Respective output of Mux23 is enabled to drive the TRIP4 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
22	MUX22	R/W	0h	<p>Selects the output of Mux22 to drive TRIP4 of EPWM-XBAR</p> <p>0: Respective output of Mux22 is disabled to drive the TRIP4 of EPWM-XBAR</p> <p>1: Respective output of Mux22 is enabled to drive the TRIP4 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
21	MUX21	R/W	0h	<p>Selects the output of Mux21 to drive TRIP4 of EPWM-XBAR</p> <p>0: Respective output of Mux21 is disabled to drive the TRIP4 of EPWM-XBAR</p> <p>1: Respective output of Mux21 is enabled to drive the TRIP4 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>

**Table 13-118. TRIP4MUXENABLE Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
20	MUX20	R/W	0h	<p>Selects the output of Mux20 to drive TRIP4 of EPWM-XBAR</p> <p>0: Respective output of Mux20 is disabled to drive the TRIP4 of EPWM-XBAR</p> <p>1: Respective output of Mux20 is enabled to drive the TRIP4 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
19	MUX19	R/W	0h	<p>Selects the output of Mux19 to drive TRIP4 of EPWM-XBAR</p> <p>0: Respective output of Mux19 is disabled to drive the TRIP4 of EPWM-XBAR</p> <p>1: Respective output of Mux19 is enabled to drive the TRIP4 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
18	MUX18	R/W	0h	<p>Selects the output of Mux18 to drive TRIP4 of EPWM-XBAR</p> <p>0: Respective output of Mux18 is disabled to drive the TRIP4 of EPWM-XBAR</p> <p>1: Respective output of Mux18 is enabled to drive the TRIP4 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
17	MUX17	R/W	0h	<p>Selects the output of Mux17 to drive TRIP4 of EPWM-XBAR</p> <p>0: Respective output of Mux17 is disabled to drive the TRIP4 of EPWM-XBAR</p> <p>1: Respective output of Mux17 is enabled to drive the TRIP4 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
16	MUX16	R/W	0h	<p>Selects the output of Mux16 to drive TRIP4 of EPWM-XBAR</p> <p>0: Respective output of Mux16 is disabled to drive the TRIP4 of EPWM-XBAR</p> <p>1: Respective output of Mux16 is enabled to drive the TRIP4 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
15	MUX15	R/W	0h	<p>Selects the output of Mux15 to drive TRIP4 of EPWM-XBAR</p> <p>0: Respective output of Mux15 is disabled to drive the TRIP4 of EPWM-XBAR</p> <p>1: Respective output of Mux15 is enabled to drive the TRIP4 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
14	MUX14	R/W	0h	<p>Selects the output of Mux14 to drive TRIP4 of EPWM-XBAR</p> <p>0: Respective output of Mux14 is disabled to drive the TRIP4 of EPWM-XBAR</p> <p>1: Respective output of Mux14 is enabled to drive the TRIP4 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>

**Table 13-118. TRIP4MUXENABLE Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
13	MUX13	R/W	0h	<p>Selects the output of Mux13 to drive TRIP4 of EPWM-XBAR</p> <p>0: Respective output of Mux13 is disabled to drive the TRIP4 of EPWM-XBAR</p> <p>1: Respective output of Mux13 is enabled to drive the TRIP4 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
12	MUX12	R/W	0h	<p>Selects the output of Mux12 to drive TRIP4 of EPWM-XBAR</p> <p>0: Respective output of Mux12 is disabled to drive the TRIP4 of EPWM-XBAR</p> <p>1: Respective output of Mux12 is enabled to drive the TRIP4 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
11	MUX11	R/W	0h	<p>Selects the output of Mux11 to drive TRIP4 of EPWM-XBAR</p> <p>0: Respective output of Mux11 is disabled to drive the TRIP4 of EPWM-XBAR</p> <p>1: Respective output of Mux11 is enabled to drive the TRIP4 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
10	MUX10	R/W	0h	<p>Selects the output of Mux10 to drive TRIP4 of EPWM-XBAR</p> <p>0: Respective output of Mux10 is disabled to drive the TRIP4 of EPWM-XBAR</p> <p>1: Respective output of Mux10 is enabled to drive the TRIP4 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
9	MUX9	R/W	0h	<p>Selects the output of Mux9 to drive TRIP4 of EPWM-XBAR</p> <p>0: Respective output of Mux9 is disabled to drive the TRIP4 of EPWM-XBAR</p> <p>1: Respective output of Mux9 is enabled to drive the TRIP4 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
8	MUX8	R/W	0h	<p>Selects the output of Mux8 to drive TRIP4 of EPWM-XBAR</p> <p>0: Respective output of Mux8 is disabled to drive the TRIP4 of EPWM-XBAR</p> <p>1: Respective output of Mux8 is enabled to drive the TRIP4 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
7	MUX7	R/W	0h	<p>Selects the output of Mux7 to drive TRIP4 of EPWM-XBAR</p> <p>0: Respective output of Mux7 is disabled to drive the TRIP4 of EPWM-XBAR</p> <p>1: Respective output of Mux7 is enabled to drive the TRIP4 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>

**Table 13-118. TRIP4MUXENABLE Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
6	MUX6	R/W	0h	<p>Selects the output of Mux6 to drive TRIP4 of EPWM-XBAR</p> <p>0: Respective output of Mux6 is disabled to drive the TRIP4 of EPWM-XBAR</p> <p>1: Respective output of Mux6 is enabled to drive the TRIP4 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
5	MUX5	R/W	0h	<p>Selects the output of Mux5 to drive TRIP4 of EPWM-XBAR</p> <p>0: Respective output of Mux5 is disabled to drive the TRIP4 of EPWM-XBAR</p> <p>1: Respective output of Mux5 is enabled to drive the TRIP4 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
4	MUX4	R/W	0h	<p>Selects the output of Mux4 to drive TRIP4 of EPWM-XBAR</p> <p>0: Respective output of Mux4 is disabled to drive the TRIP4 of EPWM-XBAR</p> <p>1: Respective output of Mux4 is enabled to drive the TRIP4 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
3	MUX3	R/W	0h	<p>Selects the output of Mux3 to drive TRIP4 of EPWM-XBAR</p> <p>0: Respective output of Mux3 is disabled to drive the TRIP4 of EPWM-XBAR</p> <p>1: Respective output of Mux3 is enabled to drive the TRIP4 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
2	MUX2	R/W	0h	<p>Selects the output of Mux2 to drive TRIP4 of EPWM-XBAR</p> <p>0: Respective output of Mux2 is disabled to drive the TRIP4 of EPWM-XBAR</p> <p>1: Respective output of Mux2 is enabled to drive the TRIP4 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
1	MUX1	R/W	0h	<p>Selects the output of Mux1 to drive TRIP4 of EPWM-XBAR</p> <p>0: Respective output of Mux1 is disabled to drive the TRIP4 of EPWM-XBAR</p> <p>1: Respective output of Mux1 is enabled to drive the TRIP4 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
0	MUX0	R/W	0h	<p>Selects the output of Mux0 to drive TRIP4 of EPWM-XBAR</p> <p>0: Respective output of Mux0 is disabled to drive the TRIP4 of EPWM-XBAR</p> <p>1: Respective output of Mux0 is enabled to drive the TRIP4 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>

### 13.14.3.18 TRIP5MUXENABLE Register (Offset = 22h) [reset = 0h]

TRIP5MUXENABLE is shown in [Figure 13-178](#) and described in [Table 13-119](#).

Return to [Summary Table](#).

ePWM XBAR Mux Enable for TRIP5

**Figure 13-178. TRIP5MUXENABLE Register**

31	30	29	28	27	26	25	24
MUX31	MUX30	MUX29	MUX28	MUX27	MUX26	MUX25	MUX24
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
23	22	21	20	19	18	17	16
MUX23	MUX22	MUX21	MUX20	MUX19	MUX18	MUX17	MUX16
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
15	14	13	12	11	10	9	8
MUX15	MUX14	MUX13	MUX12	MUX11	MUX10	MUX9	MUX8
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
7	6	5	4	3	2	1	0
MUX7	MUX6	MUX5	MUX4	MUX3	MUX2	MUX1	MUX0
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h

**Table 13-119. TRIP5MUXENABLE Register Field Descriptions**

Bit	Field	Type	Reset	Description
31	MUX31	R/W	0h	Selects the output of Mux31 to drive TRIP5 of EPWM-XBAR  0: Respective output of Mux31 is enabled to drive the TRIP5 of EPWM-XBAR 1: Respective output of Mux31 is enabled to drive the TRIP5 of EPWM-XBAR  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
30	MUX30	R/W	0h	Selects the output of Mux30 to drive TRIP5 of EPWM-XBAR  0: Respective output of Mux30 is enabled to drive the TRIP5 of EPWM-XBAR 1: Respective output of Mux30 is enabled to drive the TRIP5 of EPWM-XBAR  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
29	MUX29	R/W	0h	Selects the output of Mux29 to drive TRIP5 of EPWM-XBAR  0: Respective output of Mux29 is enabled to drive the TRIP5 of EPWM-XBAR 1: Respective output of Mux29 is enabled to drive the TRIP5 of EPWM-XBAR  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
28	MUX28	R/W	0h	Selects the output of Mux28 to drive TRIP5 of EPWM-XBAR  0: Respective output of Mux28 is enabled to drive the TRIP5 of EPWM-XBAR 1: Respective output of Mux28 is enabled to drive the TRIP5 of EPWM-XBAR  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn

**Table 13-119. TRIP5MUXENABLE Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
27	MUX27	R/W	0h	<p>Selects the output of Mux27 to drive TRIP5 of EPWM-XBAR</p> <p>0: Respective output of Mux27 is enabled to drive the TRIP5 of EPWM-XBAR</p> <p>1: Respective output of Mux27 is enabled to drive the TRIP5 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
26	MUX26	R/W	0h	<p>Selects the output of Mux26 to drive TRIP5 of EPWM-XBAR</p> <p>0: Respective output of Mux26 is enabled to drive the TRIP5 of EPWM-XBAR</p> <p>1: Respective output of Mux26 is enabled to drive the TRIP5 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
25	MUX25	R/W	0h	<p>Selects the output of Mux25 to drive TRIP5 of EPWM-XBAR</p> <p>0: Respective output of Mux25 is enabled to drive the TRIP5 of EPWM-XBAR</p> <p>1: Respective output of Mux25 is enabled to drive the TRIP5 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
24	MUX24	R/W	0h	<p>Selects the output of Mux24 to drive TRIP5 of EPWM-XBAR</p> <p>0: Respective output of Mux24 is enabled to drive the TRIP5 of EPWM-XBAR</p> <p>1: Respective output of Mux24 is enabled to drive the TRIP5 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
23	MUX23	R/W	0h	<p>Selects the output of Mux23 to drive TRIP5 of EPWM-XBAR</p> <p>0: Respective output of Mux23 is disabled to drive the TRIP5 of EPWM-XBAR</p> <p>1: Respective output of Mux23 is enabled to drive the TRIP5 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
22	MUX22	R/W	0h	<p>Selects the output of Mux22 to drive TRIP5 of EPWM-XBAR</p> <p>0: Respective output of Mux22 is disabled to drive the TRIP5 of EPWM-XBAR</p> <p>1: Respective output of Mux22 is enabled to drive the TRIP5 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
21	MUX21	R/W	0h	<p>Selects the output of Mux21 to drive TRIP5 of EPWM-XBAR</p> <p>0: Respective output of Mux21 is disabled to drive the TRIP5 of EPWM-XBAR</p> <p>1: Respective output of Mux21 is enabled to drive the TRIP5 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>



**Table 13-119. TRIP5MUXENABLE Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
20	MUX20	R/W	0h	<p>Selects the output of Mux20 to drive TRIP5 of EPWM-XBAR</p> <p>0: Respective output of Mux20 is disabled to drive the TRIP5 of EPWM-XBAR</p> <p>1: Respective output of Mux20 is enabled to drive the TRIP5 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
19	MUX19	R/W	0h	<p>Selects the output of Mux19 to drive TRIP5 of EPWM-XBAR</p> <p>0: Respective output of Mux19 is disabled to drive the TRIP5 of EPWM-XBAR</p> <p>1: Respective output of Mux19 is enabled to drive the TRIP5 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
18	MUX18	R/W	0h	<p>Selects the output of Mux18 to drive TRIP5 of EPWM-XBAR</p> <p>0: Respective output of Mux18 is disabled to drive the TRIP5 of EPWM-XBAR</p> <p>1: Respective output of Mux18 is enabled to drive the TRIP5 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
17	MUX17	R/W	0h	<p>Selects the output of Mux17 to drive TRIP5 of EPWM-XBAR</p> <p>0: Respective output of Mux17 is disabled to drive the TRIP5 of EPWM-XBAR</p> <p>1: Respective output of Mux17 is enabled to drive the TRIP5 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
16	MUX16	R/W	0h	<p>Selects the output of Mux16 to drive TRIP5 of EPWM-XBAR</p> <p>0: Respective output of Mux16 is disabled to drive the TRIP5 of EPWM-XBAR</p> <p>1: Respective output of Mux16 is enabled to drive the TRIP5 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
15	MUX15	R/W	0h	<p>Selects the output of Mux15 to drive TRIP5 of EPWM-XBAR</p> <p>0: Respective output of Mux15 is disabled to drive the TRIP5 of EPWM-XBAR</p> <p>1: Respective output of Mux15 is enabled to drive the TRIP5 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
14	MUX14	R/W	0h	<p>Selects the output of Mux14 to drive TRIP5 of EPWM-XBAR</p> <p>0: Respective output of Mux14 is disabled to drive the TRIP5 of EPWM-XBAR</p> <p>1: Respective output of Mux14 is enabled to drive the TRIP5 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>

**Table 13-119. TRIP5MUXENABLE Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
13	MUX13	R/W	0h	<p>Selects the output of Mux13 to drive TRIP5 of EPWM-XBAR</p> <p>0: Respective output of Mux13 is disabled to drive the TRIP5 of EPWM-XBAR</p> <p>1: Respective output of Mux13 is enabled to drive the TRIP5 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
12	MUX12	R/W	0h	<p>Selects the output of Mux12 to drive TRIP5 of EPWM-XBAR</p> <p>0: Respective output of Mux12 is disabled to drive the TRIP5 of EPWM-XBAR</p> <p>1: Respective output of Mux12 is enabled to drive the TRIP5 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
11	MUX11	R/W	0h	<p>Selects the output of Mux11 to drive TRIP5 of EPWM-XBAR</p> <p>0: Respective output of Mux11 is disabled to drive the TRIP5 of EPWM-XBAR</p> <p>1: Respective output of Mux11 is enabled to drive the TRIP5 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
10	MUX10	R/W	0h	<p>Selects the output of Mux10 to drive TRIP5 of EPWM-XBAR</p> <p>0: Respective output of Mux10 is disabled to drive the TRIP5 of EPWM-XBAR</p> <p>1: Respective output of Mux10 is enabled to drive the TRIP5 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
9	MUX9	R/W	0h	<p>Selects the output of Mux9 to drive TRIP5 of EPWM-XBAR</p> <p>0: Respective output of Mux9 is disabled to drive the TRIP5 of EPWM-XBAR</p> <p>1: Respective output of Mux9 is enabled to drive the TRIP5 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
8	MUX8	R/W	0h	<p>Selects the output of Mux8 to drive TRIP5 of EPWM-XBAR</p> <p>0: Respective output of Mux8 is disabled to drive the TRIP5 of EPWM-XBAR</p> <p>1: Respective output of Mux8 is enabled to drive the TRIP5 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
7	MUX7	R/W	0h	<p>Selects the output of Mux7 to drive TRIP5 of EPWM-XBAR</p> <p>0: Respective output of Mux7 is disabled to drive the TRIP5 of EPWM-XBAR</p> <p>1: Respective output of Mux7 is enabled to drive the TRIP5 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>

**Table 13-119. TRIP5MUXENABLE Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
6	MUX6	R/W	0h	<p>Selects the output of Mux6 to drive TRIP5 of EPWM-XBAR</p> <p>0: Respective output of Mux6 is disabled to drive the TRIP5 of EPWM-XBAR</p> <p>1: Respective output of Mux6 is enabled to drive the TRIP5 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
5	MUX5	R/W	0h	<p>Selects the output of Mux5 to drive TRIP5 of EPWM-XBAR</p> <p>0: Respective output of Mux5 is disabled to drive the TRIP5 of EPWM-XBAR</p> <p>1: Respective output of Mux5 is enabled to drive the TRIP5 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
4	MUX4	R/W	0h	<p>Selects the output of Mux4 to drive TRIP5 of EPWM-XBAR</p> <p>0: Respective output of Mux4 is disabled to drive the TRIP5 of EPWM-XBAR</p> <p>1: Respective output of Mux4 is enabled to drive the TRIP5 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
3	MUX3	R/W	0h	<p>Selects the output of Mux3 to drive TRIP5 of EPWM-XBAR</p> <p>0: Respective output of Mux3 is disabled to drive the TRIP5 of EPWM-XBAR</p> <p>1: Respective output of Mux3 is enabled to drive the TRIP5 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
2	MUX2	R/W	0h	<p>Selects the output of Mux2 to drive TRIP5 of EPWM-XBAR</p> <p>0: Respective output of Mux2 is disabled to drive the TRIP5 of EPWM-XBAR</p> <p>1: Respective output of Mux2 is enabled to drive the TRIP5 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
1	MUX1	R/W	0h	<p>Selects the output of Mux1 to drive TRIP5 of EPWM-XBAR</p> <p>0: Respective output of Mux1 is disabled to drive the TRIP5 of EPWM-XBAR</p> <p>1: Respective output of Mux1 is enabled to drive the TRIP5 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
0	MUX0	R/W	0h	<p>Selects the output of mux0 to drive TRIP5 of EPWM-XBAR</p> <p>0: Respective output of Mux0 is disabled to drive the TRIP5 of EPWM-XBAR</p> <p>1: Respective output of Mux0 is enabled to drive the TRIP5 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>

**13.14.3.19 TRIP7MUXENABLE Register (Offset = 24h) [reset = 0h]**

 TRIP7MUXENABLE is shown in [Figure 13-179](#) and described in [Table 13-120](#).

 Return to [Summary Table](#).

ePWM XBAR Mux Enable for TRIP7

**Figure 13-179. TRIP7MUXENABLE Register**

31	30	29	28	27	26	25	24
MUX31	MUX30	MUX29	MUX28	MUX27	MUX26	MUX25	MUX24
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
23	22	21	20	19	18	17	16
MUX23	MUX22	MUX21	MUX20	MUX19	MUX18	MUX17	MUX16
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
15	14	13	12	11	10	9	8
MUX15	MUX14	MUX13	MUX12	MUX11	MUX10	MUX9	MUX8
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
7	6	5	4	3	2	1	0
MUX7	MUX6	MUX5	MUX4	MUX3	MUX2	MUX1	MUX0
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h

**Table 13-120. TRIP7MUXENABLE Register Field Descriptions**

Bit	Field	Type	Reset	Description
31	MUX31	R/W	0h	Selects the output of Mux31 to drive TRIP7 of EPWM-XBAR  0: Respective output of Mux31 is enabled to drive the TRIP7 of EPWM-XBAR 1: Respective output of Mux31 is enabled to drive the TRIP7 of EPWM-XBAR  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
30	MUX30	R/W	0h	Selects the output of Mux30 to drive TRIP7 of EPWM-XBAR  0: Respective output of Mux30 is enabled to drive the TRIP7 of EPWM-XBAR 1: Respective output of Mux30 is enabled to drive the TRIP7 of EPWM-XBAR  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
29	MUX29	R/W	0h	Selects the output of Mux29 to drive TRIP7 of EPWM-XBAR  0: Respective output of Mux29 is enabled to drive the TRIP7 of EPWM-XBAR 1: Respective output of Mux29 is enabled to drive the TRIP7 of EPWM-XBAR  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
28	MUX28	R/W	0h	Selects the output of Mux28 to drive TRIP7 of EPWM-XBAR  0: Respective output of Mux28 is enabled to drive the TRIP7 of EPWM-XBAR 1: Respective output of Mux28 is enabled to drive the TRIP7 of EPWM-XBAR  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn

**Table 13-120. TRIP7MUXENABLE Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
27	MUX27	R/W	0h	<p>Selects the output of Mux27 to drive TRIP7 of EPWM-XBAR</p> <p>0: Respective output of Mux27 is enabled to drive the TRIP7 of EPWM-XBAR</p> <p>1: Respective output of Mux27 is enabled to drive the TRIP7 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
26	MUX26	R/W	0h	<p>Selects the output of Mux26 to drive TRIP7 of EPWM-XBAR</p> <p>0: Respective output of Mux26 is enabled to drive the TRIP7 of EPWM-XBAR</p> <p>1: Respective output of Mux26 is enabled to drive the TRIP7 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
25	MUX25	R/W	0h	<p>Selects the output of Mux25 to drive TRIP7 of EPWM-XBAR</p> <p>0: Respective output of Mux25 is enabled to drive the TRIP7 of EPWM-XBAR</p> <p>1: Respective output of Mux25 is enabled to drive the TRIP7 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
24	MUX24	R/W	0h	<p>Selects the output of Mux24 to drive TRIP7 of EPWM-XBAR</p> <p>0: Respective output of Mux24 is enabled to drive the TRIP7 of EPWM-XBAR</p> <p>1: Respective output of Mux24 is enabled to drive the TRIP7 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
23	MUX23	R/W	0h	<p>Selects the output of Mux23 to drive TRIP7 of EPWM-XBAR</p> <p>0: Respective output of Mux23 is disabled to drive the TRIP7 of EPWM-XBAR</p> <p>1: Respective output of Mux23 is enabled to drive the TRIP7 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
22	MUX22	R/W	0h	<p>Selects the output of Mux22 to drive TRIP7 of EPWM-XBAR</p> <p>0: Respective output of Mux22 is disabled to drive the TRIP7 of EPWM-XBAR</p> <p>1: Respective output of Mux22 is enabled to drive the TRIP7 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
21	MUX21	R/W	0h	<p>Selects the output of Mux21 to drive TRIP7 of EPWM-XBAR</p> <p>0: Respective output of Mux21 is disabled to drive the TRIP7 of EPWM-XBAR</p> <p>1: Respective output of Mux21 is enabled to drive the TRIP7 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>

**Table 13-120. TRIP7MUXENABLE Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
20	MUX20	R/W	0h	<p>Selects the output of Mux20 to drive TRIP7 of EPWM-XBAR</p> <p>0: Respective output of Mux20 is disabled to drive the TRIP7 of EPWM-XBAR</p> <p>1: Respective output of Mux20 is enabled to drive the TRIP7 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
19	MUX19	R/W	0h	<p>Selects the output of Mux19 to drive TRIP7 of EPWM-XBAR</p> <p>0: Respective output of Mux19 is disabled to drive the TRIP7 of EPWM-XBAR</p> <p>1: Respective output of Mux19 is enabled to drive the TRIP7 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
18	MUX18	R/W	0h	<p>Selects the output of Mux18 to drive TRIP7 of EPWM-XBAR</p> <p>0: Respective output of Mux18 is disabled to drive the TRIP7 of EPWM-XBAR</p> <p>1: Respective output of Mux18 is enabled to drive the TRIP7 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
17	MUX17	R/W	0h	<p>Selects the output of Mux17 to drive TRIP7 of EPWM-XBAR</p> <p>0: Respective output of Mux17 is disabled to drive the TRIP7 of EPWM-XBAR</p> <p>1: Respective output of Mux17 is enabled to drive the TRIP7 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
16	MUX16	R/W	0h	<p>Selects the output of Mux16 to drive TRIP7 of EPWM-XBAR</p> <p>0: Respective output of Mux16 is disabled to drive the TRIP7 of EPWM-XBAR</p> <p>1: Respective output of Mux16 is enabled to drive the TRIP7 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
15	MUX15	R/W	0h	<p>Selects the output of Mux15 to drive TRIP7 of EPWM-XBAR</p> <p>0: Respective output of Mux15 is disabled to drive the TRIP7 of EPWM-XBAR</p> <p>1: Respective output of Mux15 is enabled to drive the TRIP7 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
14	MUX14	R/W	0h	<p>Selects the output of Mux14 to drive TRIP7 of EPWM-XBAR</p> <p>0: Respective output of Mux14 is disabled to drive the TRIP7 of EPWM-XBAR</p> <p>1: Respective output of Mux14 is enabled to drive the TRIP7 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>

**Table 13-120. TRIP7MUXENABLE Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
13	MUX13	R/W	0h	<p>Selects the output of Mux13 to drive TRIP7 of EPWM-XBAR</p> <p>0: Respective output of Mux13 is disabled to drive the TRIP7 of EPWM-XBAR</p> <p>1: Respective output of Mux13 is enabled to drive the TRIP7 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
12	MUX12	R/W	0h	<p>Selects the output of Mux12 to drive TRIP7 of EPWM-XBAR</p> <p>0: Respective output of Mux12 is disabled to drive the TRIP7 of EPWM-XBAR</p> <p>1: Respective output of Mux12 is enabled to drive the TRIP7 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
11	MUX11	R/W	0h	<p>Selects the output of Mux11 to drive TRIP7 of EPWM-XBAR</p> <p>0: Respective output of Mux11 is disabled to drive the TRIP7 of EPWM-XBAR</p> <p>1: Respective output of Mux11 is enabled to drive the TRIP7 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
10	MUX10	R/W	0h	<p>Selects the output of Mux10 to drive TRIP7 of EPWM-XBAR</p> <p>0: Respective output of Mux10 is disabled to drive the TRIP7 of EPWM-XBAR</p> <p>1: Respective output of Mux10 is enabled to drive the TRIP7 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
9	MUX9	R/W	0h	<p>Selects the output of Mux9 to drive TRIP7 of EPWM-XBAR</p> <p>0: Respective output of Mux9 is disabled to drive the TRIP7 of EPWM-XBAR</p> <p>1: Respective output of Mux9 is enabled to drive the TRIP7 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
8	MUX8	R/W	0h	<p>Selects the output of Mux8 to drive TRIP7 of EPWM-XBAR</p> <p>0: Respective output of Mux8 is disabled to drive the TRIP7 of EPWM-XBAR</p> <p>1: Respective output of Mux8 is enabled to drive the TRIP7 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
7	MUX7	R/W	0h	<p>Selects the output of Mux7 to drive TRIP7 of EPWM-XBAR</p> <p>0: Respective output of Mux7 is disabled to drive the TRIP7 of EPWM-XBAR</p> <p>1: Respective output of Mux7 is enabled to drive the TRIP7 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>

**Table 13-120. TRIP7MUXENABLE Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
6	MUX6	R/W	0h	<p>Selects the output of Mux6 to drive TRIP7 of EPWM-XBAR</p> <p>0: Respective output of Mux6 is disabled to drive the TRIP7 of EPWM-XBAR</p> <p>1: Respective output of Mux6 is enabled to drive the TRIP7 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
5	MUX5	R/W	0h	<p>Selects the output of Mux5 to drive TRIP7 of EPWM-XBAR</p> <p>0: Respective output of Mux5 is disabled to drive the TRIP7 of EPWM-XBAR</p> <p>1: Respective output of Mux5 is enabled to drive the TRIP7 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
4	MUX4	R/W	0h	<p>Selects the output of Mux4 to drive TRIP7 of EPWM-XBAR</p> <p>0: Respective output of Mux4 is disabled to drive the TRIP7 of EPWM-XBAR</p> <p>1: Respective output of Mux4 is enabled to drive the TRIP7 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
3	MUX3	R/W	0h	<p>Selects the output of Mux3 to drive TRIP7 of EPWM-XBAR</p> <p>0: Respective output of Mux3 is disabled to drive the TRIP7 of EPWM-XBAR</p> <p>1: Respective output of Mux3 is enabled to drive the TRIP7 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
2	MUX2	R/W	0h	<p>Selects the output of Mux2 to drive TRIP7 of EPWM-XBAR</p> <p>0: Respective output of Mux2 is disabled to drive the TRIP7 of EPWM-XBAR</p> <p>1: Respective output of Mux2 is enabled to drive the TRIP7 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
1	MUX1	R/W	0h	<p>Selects the output of Mux1 to drive TRIP7 of EPWM-XBAR</p> <p>0: Respective output of Mux1 is disabled to drive the TRIP7 of EPWM-XBAR</p> <p>1: Respective output of Mux1 is enabled to drive the TRIP7 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
0	MUX0	R/W	0h	<p>Selects the output of mux0 to drive TRIP7 of EPWM-XBAR</p> <p>0: Respective output of Mux0 is disabled to drive the TRIP7 of EPWM-XBAR</p> <p>1: Respective output of Mux0 is enabled to drive the TRIP7 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>



### 13.14.3.20 TRIP8MUXENABLE Register (Offset = 26h) [reset = 0h]

TRIP8MUXENABLE is shown in [Figure 13-180](#) and described in [Table 13-121](#).

Return to [Summary Table](#).

ePWM XBAR Mux Enable for TRIP8

**Figure 13-180. TRIP8MUXENABLE Register**

31	30	29	28	27	26	25	24
MUX31	MUX30	MUX29	MUX28	MUX27	MUX26	MUX25	MUX24
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
23	22	21	20	19	18	17	16
MUX23	MUX22	MUX21	MUX20	MUX19	MUX18	MUX17	MUX16
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
15	14	13	12	11	10	9	8
MUX15	MUX14	MUX13	MUX12	MUX11	MUX10	MUX9	MUX8
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
7	6	5	4	3	2	1	0
MUX7	MUX6	MUX5	MUX4	MUX3	MUX2	MUX1	MUX0
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h

**Table 13-121. TRIP8MUXENABLE Register Field Descriptions**

Bit	Field	Type	Reset	Description
31	MUX31	R/W	0h	<p>Selects the output of Mux31 to drive TRIP8 of EPWM-XBAR</p> <p>0: Respective output of Mux31 is enabled to drive the TRIP8 of EPWM-XBAR</p> <p>1: Respective output of Mux31 is enabled to drive the TRIP8 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
30	MUX30	R/W	0h	<p>Selects the output of Mux30 to drive TRIP8 of EPWM-XBAR</p> <p>0: Respective output of Mux30 is enabled to drive the TRIP8 of EPWM-XBAR</p> <p>1: Respective output of Mux30 is enabled to drive the TRIP8 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
29	MUX29	R/W	0h	<p>Selects the output of Mux29 to drive TRIP8 of EPWM-XBAR</p> <p>0: Respective output of Mux29 is enabled to drive the TRIP8 of EPWM-XBAR</p> <p>1: Respective output of Mux29 is enabled to drive the TRIP8 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
28	MUX28	R/W	0h	<p>Selects the output of Mux28 to drive TRIP8 of EPWM-XBAR</p> <p>0: Respective output of Mux28 is enabled to drive the TRIP8 of EPWM-XBAR</p> <p>1: Respective output of Mux28 is enabled to drive the TRIP8 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>

**Table 13-121. TRIP8MUXENABLE Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
27	MUX27	R/W	0h	<p>Selects the output of Mux27 to drive TRIP8 of EPWM-XBAR</p> <p>0: Respective output of Mux27 is enabled to drive the TRIP8 of EPWM-XBAR</p> <p>1: Respective output of Mux27 is enabled to drive the TRIP8 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
26	MUX26	R/W	0h	<p>Selects the output of Mux26 to drive TRIP8 of EPWM-XBAR</p> <p>0: Respective output of Mux26 is enabled to drive the TRIP8 of EPWM-XBAR</p> <p>1: Respective output of Mux26 is enabled to drive the TRIP8 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
25	MUX25	R/W	0h	<p>Selects the output of Mux25 to drive TRIP8 of EPWM-XBAR</p> <p>0: Respective output of Mux25 is enabled to drive the TRIP8 of EPWM-XBAR</p> <p>1: Respective output of Mux25 is enabled to drive the TRIP8 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
24	MUX24	R/W	0h	<p>Selects the output of Mux24 to drive TRIP8 of EPWM-XBAR</p> <p>0: Respective output of Mux24 is enabled to drive the TRIP8 of EPWM-XBAR</p> <p>1: Respective output of Mux24 is enabled to drive the TRIP8 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
23	MUX23	R/W	0h	<p>Selects the output of Mux23 to drive TRIP8 of EPWM-XBAR</p> <p>0: Respective output of Mux23 is disabled to drive the TRIP8 of EPWM-XBAR</p> <p>1: Respective output of Mux23 is enabled to drive the TRIP8 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
22	MUX22	R/W	0h	<p>Selects the output of Mux22 to drive TRIP8 of EPWM-XBAR</p> <p>0: Respective output of Mux22 is disabled to drive the TRIP8 of EPWM-XBAR</p> <p>1: Respective output of Mux22 is enabled to drive the TRIP8 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
21	MUX21	R/W	0h	<p>Selects the output of Mux21 to drive TRIP8 of EPWM-XBAR</p> <p>0: Respective output of Mux21 is disabled to drive the TRIP8 of EPWM-XBAR</p> <p>1: Respective output of Mux21 is enabled to drive the TRIP8 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>

**Table 13-121. TRIP8MUXENABLE Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
20	MUX20	R/W	0h	<p>Selects the output of Mux20 to drive TRIP8 of EPWM-XBAR</p> <p>0: Respective output of Mux20 is disabled to drive the TRIP8 of EPWM-XBAR</p> <p>1: Respective output of Mux20 is enabled to drive the TRIP8 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
19	MUX19	R/W	0h	<p>Selects the output of Mux19 to drive TRIP8 of EPWM-XBAR</p> <p>0: Respective output of Mux19 is disabled to drive the TRIP8 of EPWM-XBAR</p> <p>1: Respective output of Mux19 is enabled to drive the TRIP8 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
18	MUX18	R/W	0h	<p>Selects the output of Mux18 to drive TRIP8 of EPWM-XBAR</p> <p>0: Respective output of Mux18 is disabled to drive the TRIP8 of EPWM-XBAR</p> <p>1: Respective output of Mux18 is enabled to drive the TRIP8 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
17	MUX17	R/W	0h	<p>Selects the output of Mux17 to drive TRIP8 of EPWM-XBAR</p> <p>0: Respective output of Mux17 is disabled to drive the TRIP8 of EPWM-XBAR</p> <p>1: Respective output of Mux17 is enabled to drive the TRIP8 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
16	MUX16	R/W	0h	<p>Selects the output of Mux16 to drive TRIP8 of EPWM-XBAR</p> <p>0: Respective output of Mux16 is disabled to drive the TRIP8 of EPWM-XBAR</p> <p>1: Respective output of Mux16 is enabled to drive the TRIP8 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
15	MUX15	R/W	0h	<p>Selects the output of Mux15 to drive TRIP8 of EPWM-XBAR</p> <p>0: Respective output of Mux15 is disabled to drive the TRIP8 of EPWM-XBAR</p> <p>1: Respective output of Mux15 is enabled to drive the TRIP8 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
14	MUX14	R/W	0h	<p>Selects the output of Mux14 to drive TRIP8 of EPWM-XBAR</p> <p>0: Respective output of Mux14 is disabled to drive the TRIP8 of EPWM-XBAR</p> <p>1: Respective output of Mux14 is enabled to drive the TRIP8 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>

**Table 13-121. TRIP8MUXENABLE Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
13	MUX13	R/W	0h	<p>Selects the output of Mux13 to drive TRIP8 of EPWM-XBAR</p> <p>0: Respective output of Mux13 is disabled to drive the TRIP8 of EPWM-XBAR</p> <p>1: Respective output of Mux13 is enabled to drive the TRIP8 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
12	MUX12	R/W	0h	<p>Selects the output of Mux12 to drive TRIP8 of EPWM-XBAR</p> <p>0: Respective output of Mux12 is disabled to drive the TRIP8 of EPWM-XBAR</p> <p>1: Respective output of Mux12 is enabled to drive the TRIP8 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
11	MUX11	R/W	0h	<p>Selects the output of Mux11 to drive TRIP8 of EPWM-XBAR</p> <p>0: Respective output of Mux11 is disabled to drive the TRIP8 of EPWM-XBAR</p> <p>1: Respective output of Mux11 is enabled to drive the TRIP8 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
10	MUX10	R/W	0h	<p>Selects the output of Mux10 to drive TRIP8 of EPWM-XBAR</p> <p>0: Respective output of Mux10 is disabled to drive the TRIP8 of EPWM-XBAR</p> <p>1: Respective output of Mux10 is enabled to drive the TRIP8 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
9	MUX9	R/W	0h	<p>Selects the output of Mux9 to drive TRIP8 of EPWM-XBAR</p> <p>0: Respective output of Mux9 is disabled to drive the TRIP8 of EPWM-XBAR</p> <p>1: Respective output of Mux9 is enabled to drive the TRIP8 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
8	MUX8	R/W	0h	<p>Selects the output of Mux8 to drive TRIP8 of EPWM-XBAR</p> <p>0: Respective output of Mux8 is disabled to drive the TRIP8 of EPWM-XBAR</p> <p>1: Respective output of Mux8 is enabled to drive the TRIP8 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
7	MUX7	R/W	0h	<p>Selects the output of Mux7 to drive TRIP8 of EPWM-XBAR</p> <p>0: Respective output of Mux7 is disabled to drive the TRIP8 of EPWM-XBAR</p> <p>1: Respective output of Mux7 is enabled to drive the TRIP8 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>

**Table 13-121. TRIP8MUXENABLE Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
6	MUX6	R/W	0h	<p>Selects the output of Mux6 to drive TRIP8 of EPWM-XBAR</p> <p>0: Respective output of Mux6 is disabled to drive the TRIP8 of EPWM-XBAR</p> <p>1: Respective output of Mux6 is enabled to drive the TRIP8 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
5	MUX5	R/W	0h	<p>Selects the output of Mux5 to drive TRIP8 of EPWM-XBAR</p> <p>0: Respective output of Mux5 is disabled to drive the TRIP8 of EPWM-XBAR</p> <p>1: Respective output of Mux5 is enabled to drive the TRIP8 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
4	MUX4	R/W	0h	<p>Selects the output of Mux4 to drive TRIP8 of EPWM-XBAR</p> <p>0: Respective output of Mux4 is disabled to drive the TRIP8 of EPWM-XBAR</p> <p>1: Respective output of Mux4 is enabled to drive the TRIP8 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
3	MUX3	R/W	0h	<p>Selects the output of Mux3 to drive TRIP8 of EPWM-XBAR</p> <p>0: Respective output of Mux3 is disabled to drive the TRIP8 of EPWM-XBAR</p> <p>1: Respective output of Mux3 is enabled to drive the TRIP8 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
2	MUX2	R/W	0h	<p>Selects the output of Mux2 to drive TRIP8 of EPWM-XBAR</p> <p>0: Respective output of Mux2 is disabled to drive the TRIP8 of EPWM-XBAR</p> <p>1: Respective output of Mux2 is enabled to drive the TRIP8 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
1	MUX1	R/W	0h	<p>Selects the output of Mux1 to drive TRIP8 of EPWM-XBAR</p> <p>0: Respective output of Mux1 is disabled to drive the TRIP8 of EPWM-XBAR</p> <p>1: Respective output of Mux1 is enabled to drive the TRIP8 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
0	MUX0	R/W	0h	<p>Selects the output of mux0 to drive TRIP8 of EPWM-XBAR</p> <p>0: Respective output of Mux0 is disabled to drive the TRIP8 of EPWM-XBAR</p> <p>1: Respective output of Mux0 is enabled to drive the TRIP8 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>

**13.14.3.21 TRIP9MUXENABLE Register (Offset = 28h) [reset = 0h]**

TRIP9MUXENABLE is shown in [Figure 13-181](#) and described in [Table 13-122](#).

Return to [Summary Table](#).

ePWM XBAR Mux Enable for TRIP9

**Figure 13-181. TRIP9MUXENABLE Register**

31	30	29	28	27	26	25	24
MUX31	MUX30	MUX29	MUX28	MUX27	MUX26	MUX25	MUX24
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
23	22	21	20	19	18	17	16
MUX23	MUX22	MUX21	MUX20	MUX19	MUX18	MUX17	MUX16
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
15	14	13	12	11	10	9	8
MUX15	MUX14	MUX13	MUX12	MUX11	MUX10	MUX9	MUX8
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
7	6	5	4	3	2	1	0
MUX7	MUX6	MUX5	MUX4	MUX3	MUX2	MUX1	MUX0
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h

**Table 13-122. TRIP9MUXENABLE Register Field Descriptions**

Bit	Field	Type	Reset	Description
31	MUX31	R/W	0h	Selects the output of Mux31 to drive TRIP9 of EPWM-XBAR  0: Respective output of Mux31 is enabled to drive the TRIP9 of EPWM-XBAR 1: Respective output of Mux31 is enabled to drive the TRIP9 of EPWM-XBAR  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
30	MUX30	R/W	0h	Selects the output of Mux30 to drive TRIP9 of EPWM-XBAR  0: Respective output of Mux30 is enabled to drive the TRIP9 of EPWM-XBAR 1: Respective output of Mux30 is enabled to drive the TRIP9 of EPWM-XBAR  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
29	MUX29	R/W	0h	Selects the output of Mux29 to drive TRIP9 of EPWM-XBAR  0: Respective output of Mux29 is enabled to drive the TRIP9 of EPWM-XBAR 1: Respective output of Mux29 is enabled to drive the TRIP9 of EPWM-XBAR  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
28	MUX28	R/W	0h	Selects the output of Mux28 to drive TRIP9 of EPWM-XBAR  0: Respective output of Mux28 is enabled to drive the TRIP9 of EPWM-XBAR 1: Respective output of Mux28 is enabled to drive the TRIP9 of EPWM-XBAR  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn

**Table 13-122. TRIP9MUXENABLE Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
27	MUX27	R/W	0h	<p>Selects the output of Mux27 to drive TRIP9 of EPWM-XBAR</p> <p>0: Respective output of Mux27 is enabled to drive the TRIP9 of EPWM-XBAR</p> <p>1: Respective output of Mux27 is enabled to drive the TRIP9 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
26	MUX26	R/W	0h	<p>Selects the output of Mux26 to drive TRIP9 of EPWM-XBAR</p> <p>0: Respective output of Mux26 is enabled to drive the TRIP9 of EPWM-XBAR</p> <p>1: Respective output of Mux26 is enabled to drive the TRIP9 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
25	MUX25	R/W	0h	<p>Selects the output of Mux25 to drive TRIP9 of EPWM-XBAR</p> <p>0: Respective output of Mux25 is enabled to drive the TRIP9 of EPWM-XBAR</p> <p>1: Respective output of Mux25 is enabled to drive the TRIP9 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
24	MUX24	R/W	0h	<p>Selects the output of Mux24 to drive TRIP9 of EPWM-XBAR</p> <p>0: Respective output of Mux24 is enabled to drive the TRIP9 of EPWM-XBAR</p> <p>1: Respective output of Mux24 is enabled to drive the TRIP9 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
23	MUX23	R/W	0h	<p>Selects the output of Mux23 to drive TRIP9 of EPWM-XBAR</p> <p>0: Respective output of Mux23 is disabled to drive the TRIP9 of EPWM-XBAR</p> <p>1: Respective output of Mux23 is enabled to drive the TRIP9 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
22	MUX22	R/W	0h	<p>Selects the output of Mux22 to drive TRIP9 of EPWM-XBAR</p> <p>0: Respective output of Mux22 is disabled to drive the TRIP9 of EPWM-XBAR</p> <p>1: Respective output of Mux22 is enabled to drive the TRIP9 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
21	MUX21	R/W	0h	<p>Selects the output of Mux21 to drive TRIP9 of EPWM-XBAR</p> <p>0: Respective output of Mux21 is disabled to drive the TRIP9 of EPWM-XBAR</p> <p>1: Respective output of Mux21 is enabled to drive the TRIP9 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>

**Table 13-122. TRIP9MUXENABLE Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
20	MUX20	R/W	0h	<p>Selects the output of Mux20 to drive TRIP9 of EPWM-XBAR</p> <p>0: Respective output of Mux20 is disabled to drive the TRIP9 of EPWM-XBAR</p> <p>1: Respective output of Mux20 is enabled to drive the TRIP9 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
19	MUX19	R/W	0h	<p>Selects the output of Mux19 to drive TRIP9 of EPWM-XBAR</p> <p>0: Respective output of Mux19 is disabled to drive the TRIP9 of EPWM-XBAR</p> <p>1: Respective output of Mux19 is enabled to drive the TRIP9 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
18	MUX18	R/W	0h	<p>Selects the output of Mux18 to drive TRIP9 of EPWM-XBAR</p> <p>0: Respective output of Mux18 is disabled to drive the TRIP9 of EPWM-XBAR</p> <p>1: Respective output of Mux18 is enabled to drive the TRIP9 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
17	MUX17	R/W	0h	<p>Selects the output of Mux17 to drive TRIP9 of EPWM-XBAR</p> <p>0: Respective output of Mux17 is disabled to drive the TRIP9 of EPWM-XBAR</p> <p>1: Respective output of Mux17 is enabled to drive the TRIP9 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
16	MUX16	R/W	0h	<p>Selects the output of Mux16 to drive TRIP9 of EPWM-XBAR</p> <p>0: Respective output of Mux16 is disabled to drive the TRIP9 of EPWM-XBAR</p> <p>1: Respective output of Mux16 is enabled to drive the TRIP9 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
15	MUX15	R/W	0h	<p>Selects the output of Mux15 to drive TRIP9 of EPWM-XBAR</p> <p>0: Respective output of Mux15 is disabled to drive the TRIP9 of EPWM-XBAR</p> <p>1: Respective output of Mux15 is enabled to drive the TRIP9 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
14	MUX14	R/W	0h	<p>Selects the output of Mux14 to drive TRIP9 of EPWM-XBAR</p> <p>0: Respective output of Mux14 is disabled to drive the TRIP9 of EPWM-XBAR</p> <p>1: Respective output of Mux14 is enabled to drive the TRIP9 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>



**Table 13-122. TRIP9MUXENABLE Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
13	MUX13	R/W	0h	<p>Selects the output of Mux13 to drive TRIP9 of EPWM-XBAR</p> <p>0: Respective output of Mux13 is disabled to drive the TRIP9 of EPWM-XBAR</p> <p>1: Respective output of Mux13 is enabled to drive the TRIP9 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
12	MUX12	R/W	0h	<p>Selects the output of Mux12 to drive TRIP9 of EPWM-XBAR</p> <p>0: Respective output of Mux12 is disabled to drive the TRIP9 of EPWM-XBAR</p> <p>1: Respective output of Mux12 is enabled to drive the TRIP9 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
11	MUX11	R/W	0h	<p>Selects the output of Mux11 to drive TRIP9 of EPWM-XBAR</p> <p>0: Respective output of Mux11 is disabled to drive the TRIP9 of EPWM-XBAR</p> <p>1: Respective output of Mux11 is enabled to drive the TRIP9 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
10	MUX10	R/W	0h	<p>Selects the output of Mux10 to drive TRIP9 of EPWM-XBAR</p> <p>0: Respective output of Mux10 is disabled to drive the TRIP9 of EPWM-XBAR</p> <p>1: Respective output of Mux10 is enabled to drive the TRIP9 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
9	MUX9	R/W	0h	<p>Selects the output of Mux9 to drive TRIP9 of EPWM-XBAR</p> <p>0: Respective output of Mux9 is disabled to drive the TRIP9 of EPWM-XBAR</p> <p>1: Respective output of Mux9 is enabled to drive the TRIP9 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
8	MUX8	R/W	0h	<p>Selects the output of Mux8 to drive TRIP9 of EPWM-XBAR</p> <p>0: Respective output of Mux8 is disabled to drive the TRIP9 of EPWM-XBAR</p> <p>1: Respective output of Mux8 is enabled to drive the TRIP9 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
7	MUX7	R/W	0h	<p>Selects the output of Mux7 to drive TRIP9 of EPWM-XBAR</p> <p>0: Respective output of Mux7 is disabled to drive the TRIP9 of EPWM-XBAR</p> <p>1: Respective output of Mux7 is enabled to drive the TRIP9 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>

**Table 13-122. TRIP9MUXENABLE Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
6	MUX6	R/W	0h	<p>Selects the output of Mux6 to drive TRIP9 of EPWM-XBAR</p> <p>0: Respective output of Mux6 is disabled to drive the TRIP9 of EPWM-XBAR</p> <p>1: Respective output of Mux6 is enabled to drive the TRIP9 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
5	MUX5	R/W	0h	<p>Selects the output of Mux5 to drive TRIP9 of EPWM-XBAR</p> <p>0: Respective output of Mux5 is disabled to drive the TRIP9 of EPWM-XBAR</p> <p>1: Respective output of Mux5 is enabled to drive the TRIP9 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
4	MUX4	R/W	0h	<p>Selects the output of Mux4 to drive TRIP9 of EPWM-XBAR</p> <p>0: Respective output of Mux4 is disabled to drive the TRIP9 of EPWM-XBAR</p> <p>1: Respective output of Mux4 is enabled to drive the TRIP9 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
3	MUX3	R/W	0h	<p>Selects the output of Mux3 to drive TRIP9 of EPWM-XBAR</p> <p>0: Respective output of Mux3 is disabled to drive the TRIP9 of EPWM-XBAR</p> <p>1: Respective output of Mux3 is enabled to drive the TRIP9 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
2	MUX2	R/W	0h	<p>Selects the output of Mux2 to drive TRIP9 of EPWM-XBAR</p> <p>0: Respective output of Mux2 is disabled to drive the TRIP9 of EPWM-XBAR</p> <p>1: Respective output of Mux2 is enabled to drive the TRIP9 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
1	MUX1	R/W	0h	<p>Selects the output of Mux1 to drive TRIP9 of EPWM-XBAR</p> <p>0: Respective output of Mux1 is disabled to drive the TRIP9 of EPWM-XBAR</p> <p>1: Respective output of Mux1 is enabled to drive the TRIP9 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
0	MUX0	R/W	0h	<p>Selects the output of mux0 to drive TRIP9 of EPWM-XBAR</p> <p>0: Respective output of Mux0 is disabled to drive the TRIP9 of EPWM-XBAR</p> <p>1: Respective output of Mux0 is enabled to drive the TRIP9 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>

### 13.14.3.22 TRIP10MUXENABLE Register (Offset = 2Ah) [reset = 0h]

TRIP10MUXENABLE is shown in [Figure 13-182](#) and described in [Table 13-123](#).

Return to [Summary Table](#).

ePWM XBAR Mux Enable for TRIP10

**Figure 13-182. TRIP10MUXENABLE Register**

31	30	29	28	27	26	25	24
MUX31	MUX30	MUX29	MUX28	MUX27	MUX26	MUX25	MUX24
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
23	22	21	20	19	18	17	16
MUX23	MUX22	MUX21	MUX20	MUX19	MUX18	MUX17	MUX16
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
15	14	13	12	11	10	9	8
MUX15	MUX14	MUX13	MUX12	MUX11	MUX10	MUX9	MUX8
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
7	6	5	4	3	2	1	0
MUX7	MUX6	MUX5	MUX4	MUX3	MUX2	MUX1	MUX0
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h

**Table 13-123. TRIP10MUXENABLE Register Field Descriptions**

Bit	Field	Type	Reset	Description
31	MUX31	R/W	0h	<p>Selects the output of Mux31 to drive TRIP10 of EPWM-XBAR</p> <p>0: Respective output of Mux31 is enabled to drive the TRIP10 of EPWM-XBAR</p> <p>1: Respective output of Mux31 is enabled to drive the TRIP10 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
30	MUX30	R/W	0h	<p>Selects the output of Mux30 to drive TRIP10 of EPWM-XBAR</p> <p>0: Respective output of Mux30 is enabled to drive the TRIP10 of EPWM-XBAR</p> <p>1: Respective output of Mux30 is enabled to drive the TRIP10 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
29	MUX29	R/W	0h	<p>Selects the output of Mux29 to drive TRIP10 of EPWM-XBAR</p> <p>0: Respective output of Mux29 is enabled to drive the TRIP10 of EPWM-XBAR</p> <p>1: Respective output of Mux29 is enabled to drive the TRIP10 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
28	MUX28	R/W	0h	<p>Selects the output of Mux28 to drive TRIP10 of EPWM-XBAR</p> <p>0: Respective output of Mux28 is enabled to drive the TRIP10 of EPWM-XBAR</p> <p>1: Respective output of Mux28 is enabled to drive the TRIP10 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>

**Table 13-123. TRIP10MUXENABLE Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
27	MUX27	R/W	0h	<p>Selects the output of Mux27 to drive TRIP10 of EPWM-XBAR</p> <p>0: Respective output of Mux27 is enabled to drive the TRIP10 of EPWM-XBAR</p> <p>1: Respective output of Mux27 is enabled to drive the TRIP10 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
26	MUX26	R/W	0h	<p>Selects the output of Mux26 to drive TRIP10 of EPWM-XBAR</p> <p>0: Respective output of Mux26 is enabled to drive the TRIP10 of EPWM-XBAR</p> <p>1: Respective output of Mux26 is enabled to drive the TRIP10 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
25	MUX25	R/W	0h	<p>Selects the output of Mux25 to drive TRIP10 of EPWM-XBAR</p> <p>0: Respective output of Mux25 is enabled to drive the TRIP10 of EPWM-XBAR</p> <p>1: Respective output of Mux25 is enabled to drive the TRIP10 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
24	MUX24	R/W	0h	<p>Selects the output of Mux24 to drive TRIP10 of EPWM-XBAR</p> <p>0: Respective output of Mux24 is enabled to drive the TRIP10 of EPWM-XBAR</p> <p>1: Respective output of Mux24 is enabled to drive the TRIP10 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
23	MUX23	R/W	0h	<p>Selects the output of Mux23 to drive TRIP10 of EPWM-XBAR</p> <p>0: Respective output of Mux23 is disabled to drive the TRIP10 of EPWM-XBAR</p> <p>1: Respective output of Mux23 is enabled to drive the TRIP10 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
22	MUX22	R/W	0h	<p>Selects the output of Mux22 to drive TRIP10 of EPWM-XBAR</p> <p>0: Respective output of Mux22 is disabled to drive the TRIP10 of EPWM-XBAR</p> <p>1: Respective output of Mux22 is enabled to drive the TRIP10 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
21	MUX21	R/W	0h	<p>Selects the output of Mux21 to drive TRIP10 of EPWM-XBAR</p> <p>0: Respective output of Mux21 is disabled to drive the TRIP10 of EPWM-XBAR</p> <p>1: Respective output of Mux21 is enabled to drive the TRIP10 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>

**Table 13-123. TRIP10MUXENABLE Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
20	MUX20	R/W	0h	<p>Selects the output of Mux20 to drive TRIP10 of EPWM-XBAR</p> <p>0: Respective output of Mux20 is disabled to drive the TRIP10 of EPWM-XBAR</p> <p>1: Respective output of Mux20 is enabled to drive the TRIP10 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
19	MUX19	R/W	0h	<p>Selects the output of Mux19 to drive TRIP10 of EPWM-XBAR</p> <p>0: Respective output of Mux19 is disabled to drive the TRIP10 of EPWM-XBAR</p> <p>1: Respective output of Mux19 is enabled to drive the TRIP10 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
18	MUX18	R/W	0h	<p>Selects the output of Mux18 to drive TRIP10 of EPWM-XBAR</p> <p>0: Respective output of Mux18 is disabled to drive the TRIP10 of EPWM-XBAR</p> <p>1: Respective output of Mux18 is enabled to drive the TRIP10 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
17	MUX17	R/W	0h	<p>Selects the output of Mux17 to drive TRIP10 of EPWM-XBAR</p> <p>0: Respective output of Mux17 is disabled to drive the TRIP10 of EPWM-XBAR</p> <p>1: Respective output of Mux17 is enabled to drive the TRIP10 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
16	MUX16	R/W	0h	<p>Selects the output of Mux16 to drive TRIP10 of EPWM-XBAR</p> <p>0: Respective output of Mux16 is disabled to drive the TRIP10 of EPWM-XBAR</p> <p>1: Respective output of Mux16 is enabled to drive the TRIP10 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
15	MUX15	R/W	0h	<p>Selects the output of Mux15 to drive TRIP10 of EPWM-XBAR</p> <p>0: Respective output of Mux15 is disabled to drive the TRIP10 of EPWM-XBAR</p> <p>1: Respective output of Mux15 is enabled to drive the TRIP10 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
14	MUX14	R/W	0h	<p>Selects the output of Mux14 to drive TRIP10 of EPWM-XBAR</p> <p>0: Respective output of Mux14 is disabled to drive the TRIP10 of EPWM-XBAR</p> <p>1: Respective output of Mux14 is enabled to drive the TRIP10 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>

**Table 13-123. TRIP10MUXENABLE Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
13	MUX13	R/W	0h	<p>Selects the output of Mux13 to drive TRIP10 of EPWM-XBAR</p> <p>0: Respective output of Mux13 is disabled to drive the TRIP10 of EPWM-XBAR</p> <p>1: Respective output of Mux13 is enabled to drive the TRIP10 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
12	MUX12	R/W	0h	<p>Selects the output of Mux12 to drive TRIP10 of EPWM-XBAR</p> <p>0: Respective output of Mux12 is disabled to drive the TRIP10 of EPWM-XBAR</p> <p>1: Respective output of Mux12 is enabled to drive the TRIP10 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
11	MUX11	R/W	0h	<p>Selects the output of Mux11 to drive TRIP10 of EPWM-XBAR</p> <p>0: Respective output of Mux11 is disabled to drive the TRIP10 of EPWM-XBAR</p> <p>1: Respective output of Mux11 is enabled to drive the TRIP10 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
10	MUX10	R/W	0h	<p>Selects the output of Mux10 to drive TRIP10 of EPWM-XBAR</p> <p>0: Respective output of Mux10 is disabled to drive the TRIP10 of EPWM-XBAR</p> <p>1: Respective output of Mux10 is enabled to drive the TRIP10 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
9	MUX9	R/W	0h	<p>Selects the output of Mux9 to drive TRIP10 of EPWM-XBAR</p> <p>0: Respective output of Mux9 is disabled to drive the TRIP10 of EPWM-XBAR</p> <p>1: Respective output of Mux9 is enabled to drive the TRIP10 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
8	MUX8	R/W	0h	<p>Selects the output of Mux8 to drive TRIP10 of EPWM-XBAR</p> <p>0: Respective output of Mux8 is disabled to drive the TRIP10 of EPWM-XBAR</p> <p>1: Respective output of Mux8 is enabled to drive the TRIP10 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
7	MUX7	R/W	0h	<p>Selects the output of Mux7 to drive TRIP10 of EPWM-XBAR</p> <p>0: Respective output of Mux7 is disabled to drive the TRIP10 of EPWM-XBAR</p> <p>1: Respective output of Mux7 is enabled to drive the TRIP10 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>

**Table 13-123. TRIP10MUXENABLE Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
6	MUX6	R/W	0h	<p>Selects the output of Mux6 to drive TRIP10 of EPWM-XBAR</p> <p>0: Respective output of Mux6 is disabled to drive the TRIP10 of EPWM-XBAR</p> <p>1: Respective output of Mux6 is enabled to drive the TRIP10 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
5	MUX5	R/W	0h	<p>Selects the output of Mux5 to drive TRIP10 of EPWM-XBAR</p> <p>0: Respective output of Mux5 is disabled to drive the TRIP10 of EPWM-XBAR</p> <p>1: Respective output of Mux5 is enabled to drive the TRIP10 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
4	MUX4	R/W	0h	<p>Selects the output of Mux4 to drive TRIP10 of EPWM-XBAR</p> <p>0: Respective output of Mux4 is disabled to drive the TRIP10 of EPWM-XBAR</p> <p>1: Respective output of Mux4 is enabled to drive the TRIP10 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
3	MUX3	R/W	0h	<p>Selects the output of Mux3 to drive TRIP10 of EPWM-XBAR</p> <p>0: Respective output of Mux3 is disabled to drive the TRIP10 of EPWM-XBAR</p> <p>1: Respective output of Mux3 is enabled to drive the TRIP10 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
2	MUX2	R/W	0h	<p>Selects the output of Mux2 to drive TRIP10 of EPWM-XBAR</p> <p>0: Respective output of Mux2 is disabled to drive the TRIP10 of EPWM-XBAR</p> <p>1: Respective output of Mux2 is enabled to drive the TRIP10 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
1	MUX1	R/W	0h	<p>Selects the output of Mux1 to drive TRIP10 of EPWM-XBAR</p> <p>0: Respective output of Mux1 is disabled to drive the TRIP10 of EPWM-XBAR</p> <p>1: Respective output of Mux1 is enabled to drive the TRIP10 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
0	MUX0	R/W	0h	<p>Selects the output of mux0 to drive TRIP10 of EPWM-XBAR</p> <p>0: Respective output of Mux0 is disabled to drive the TRIP10 of EPWM-XBAR</p> <p>1: Respective output of Mux0 is enabled to drive the TRIP10 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>

**13.14.3.23 TRIP11MUXENABLE Register (Offset = 2Ch) [reset = 0h]**

TRIP11MUXENABLE is shown in [Figure 13-183](#) and described in [Table 13-124](#).

Return to [Summary Table](#).

ePWM XBAR Mux Enable for TRIP11

**Figure 13-183. TRIP11MUXENABLE Register**

31		30		29		28		27		26		25		24	
MUX31	MUX30	MUX29	MUX28	MUX27	MUX26	MUX25	MUX24	MUX23	MUX22	MUX21	MUX20	MUX19	MUX18	MUX17	MUX16
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
23		22		21		20		19		18		17		16	
MUX23	MUX22	MUX21	MUX20	MUX19	MUX18	MUX17	MUX16	MUX15	MUX14	MUX13	MUX12	MUX11	MUX10	MUX9	MUX8
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
15		14		13		12		11		10		9		8	
MUX15	MUX14	MUX13	MUX12	MUX11	MUX10	MUX9	MUX8	MUX7	MUX6	MUX5	MUX4	MUX3	MUX2	MUX1	MUX0
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
7		6		5		4		3		2		1		0	
MUX7	MUX6	MUX5	MUX4	MUX3	MUX2	MUX1	MUX0	MUX7	MUX6	MUX5	MUX4	MUX3	MUX2	MUX1	MUX0
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h

**Table 13-124. TRIP11MUXENABLE Register Field Descriptions**

Bit	Field	Type	Reset	Description
31	MUX31	R/W	0h	Selects the output of Mux31 to drive TRIP11 of EPWM-XBAR  0: Respective output of Mux31 is enabled to drive the TRIP11 of EPWM-XBAR 1: Respective output of Mux31 is enabled to drive the TRIP11 of EPWM-XBAR  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
30	MUX30	R/W	0h	Selects the output of Mux30 to drive TRIP11 of EPWM-XBAR  0: Respective output of Mux30 is enabled to drive the TRIP11 of EPWM-XBAR 1: Respective output of Mux30 is enabled to drive the TRIP11 of EPWM-XBAR  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
29	MUX29	R/W	0h	Selects the output of Mux29 to drive TRIP11 of EPWM-XBAR  0: Respective output of Mux29 is enabled to drive the TRIP11 of EPWM-XBAR 1: Respective output of Mux29 is enabled to drive the TRIP11 of EPWM-XBAR  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
28	MUX28	R/W	0h	Selects the output of Mux28 to drive TRIP11 of EPWM-XBAR  0: Respective output of Mux28 is enabled to drive the TRIP11 of EPWM-XBAR 1: Respective output of Mux28 is enabled to drive the TRIP11 of EPWM-XBAR  Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn



**Table 13-124. TRIP11MUXENABLE Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
27	MUX27	R/W	0h	<p>Selects the output of Mux27 to drive TRIP11 of EPWM-XBAR</p> <p>0: Respective output of Mux27 is enabled to drive the TRIP11 of EPWM-XBAR</p> <p>1: Respective output of Mux27 is enabled to drive the TRIP11 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
26	MUX26	R/W	0h	<p>Selects the output of Mux26 to drive TRIP11 of EPWM-XBAR</p> <p>0: Respective output of Mux26 is enabled to drive the TRIP11 of EPWM-XBAR</p> <p>1: Respective output of Mux26 is enabled to drive the TRIP11 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
25	MUX25	R/W	0h	<p>Selects the output of Mux25 to drive TRIP11 of EPWM-XBAR</p> <p>0: Respective output of Mux25 is enabled to drive the TRIP11 of EPWM-XBAR</p> <p>1: Respective output of Mux25 is enabled to drive the TRIP11 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
24	MUX24	R/W	0h	<p>Selects the output of Mux24 to drive TRIP11 of EPWM-XBAR</p> <p>0: Respective output of Mux24 is enabled to drive the TRIP11 of EPWM-XBAR</p> <p>1: Respective output of Mux24 is enabled to drive the TRIP11 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
23	MUX23	R/W	0h	<p>Selects the output of Mux23 to drive TRIP11 of EPWM-XBAR</p> <p>0: Respective output of Mux23 is disabled to drive the TRIP11 of EPWM-XBAR</p> <p>1: Respective output of Mux23 is enabled to drive the TRIP11 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
22	MUX22	R/W	0h	<p>Selects the output of Mux22 to drive TRIP11 of EPWM-XBAR</p> <p>0: Respective output of Mux22 is disabled to drive the TRIP11 of EPWM-XBAR</p> <p>1: Respective output of Mux22 is enabled to drive the TRIP11 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
21	MUX21	R/W	0h	<p>Selects the output of Mux21 to drive TRIP11 of EPWM-XBAR</p> <p>0: Respective output of Mux21 is disabled to drive the TRIP11 of EPWM-XBAR</p> <p>1: Respective output of Mux21 is enabled to drive the TRIP11 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>

**Table 13-124. TRIP11MUXENABLE Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
20	MUX20	R/W	0h	<p>Selects the output of Mux20 to drive TRIP11 of EPWM-XBAR</p> <p>0: Respective output of Mux20 is disabled to drive the TRIP11 of EPWM-XBAR</p> <p>1: Respective output of Mux20 is enabled to drive the TRIP11 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
19	MUX19	R/W	0h	<p>Selects the output of Mux19 to drive TRIP11 of EPWM-XBAR</p> <p>0: Respective output of Mux19 is disabled to drive the TRIP11 of EPWM-XBAR</p> <p>1: Respective output of Mux19 is enabled to drive the TRIP11 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
18	MUX18	R/W	0h	<p>Selects the output of Mux18 to drive TRIP11 of EPWM-XBAR</p> <p>0: Respective output of Mux18 is disabled to drive the TRIP11 of EPWM-XBAR</p> <p>1: Respective output of Mux18 is enabled to drive the TRIP11 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
17	MUX17	R/W	0h	<p>Selects the output of Mux17 to drive TRIP11 of EPWM-XBAR</p> <p>0: Respective output of Mux17 is disabled to drive the TRIP11 of EPWM-XBAR</p> <p>1: Respective output of Mux17 is enabled to drive the TRIP11 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
16	MUX16	R/W	0h	<p>Selects the output of Mux16 to drive TRIP11 of EPWM-XBAR</p> <p>0: Respective output of Mux16 is disabled to drive the TRIP11 of EPWM-XBAR</p> <p>1: Respective output of Mux16 is enabled to drive the TRIP11 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
15	MUX15	R/W	0h	<p>Selects the output of Mux15 to drive TRIP11 of EPWM-XBAR</p> <p>0: Respective output of Mux15 is disabled to drive the TRIP11 of EPWM-XBAR</p> <p>1: Respective output of Mux15 is enabled to drive the TRIP11 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
14	MUX14	R/W	0h	<p>Selects the output of Mux14 to drive TRIP11 of EPWM-XBAR</p> <p>0: Respective output of Mux14 is disabled to drive the TRIP11 of EPWM-XBAR</p> <p>1: Respective output of Mux14 is enabled to drive the TRIP11 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>

**Table 13-124. TRIP11MUXENABLE Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
13	MUX13	R/W	0h	<p>Selects the output of Mux13 to drive TRIP11 of EPWM-XBAR</p> <p>0: Respective output of Mux13 is disabled to drive the TRIP11 of EPWM-XBAR</p> <p>1: Respective output of Mux13 is enabled to drive the TRIP11 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
12	MUX12	R/W	0h	<p>Selects the output of Mux12 to drive TRIP11 of EPWM-XBAR</p> <p>0: Respective output of Mux12 is disabled to drive the TRIP11 of EPWM-XBAR</p> <p>1: Respective output of Mux12 is enabled to drive the TRIP11 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
11	MUX11	R/W	0h	<p>Selects the output of Mux11 to drive TRIP11 of EPWM-XBAR</p> <p>0: Respective output of Mux11 is disabled to drive the TRIP11 of EPWM-XBAR</p> <p>1: Respective output of Mux11 is enabled to drive the TRIP11 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
10	MUX10	R/W	0h	<p>Selects the output of Mux10 to drive TRIP11 of EPWM-XBAR</p> <p>0: Respective output of Mux10 is disabled to drive the TRIP11 of EPWM-XBAR</p> <p>1: Respective output of Mux10 is enabled to drive the TRIP11 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
9	MUX9	R/W	0h	<p>Selects the output of Mux9 to drive TRIP11 of EPWM-XBAR</p> <p>0: Respective output of Mux9 is disabled to drive the TRIP11 of EPWM-XBAR</p> <p>1: Respective output of Mux9 is enabled to drive the TRIP11 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
8	MUX8	R/W	0h	<p>Selects the output of Mux8 to drive TRIP11 of EPWM-XBAR</p> <p>0: Respective output of Mux8 is disabled to drive the TRIP11 of EPWM-XBAR</p> <p>1: Respective output of Mux8 is enabled to drive the TRIP11 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
7	MUX7	R/W	0h	<p>Selects the output of Mux7 to drive TRIP11 of EPWM-XBAR</p> <p>0: Respective output of Mux7 is disabled to drive the TRIP11 of EPWM-XBAR</p> <p>1: Respective output of Mux7 is enabled to drive the TRIP11 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>

**Table 13-124. TRIP11MUXENABLE Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
6	MUX6	R/W	0h	<p>Selects the output of Mux6 to drive TRIP11 of EPWM-XBAR</p> <p>0: Respective output of Mux6 is disabled to drive the TRIP11 of EPWM-XBAR</p> <p>1: Respective output of Mux6 is enabled to drive the TRIP11 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
5	MUX5	R/W	0h	<p>Selects the output of Mux5 to drive TRIP11 of EPWM-XBAR</p> <p>0: Respective output of Mux5 is disabled to drive the TRIP11 of EPWM-XBAR</p> <p>1: Respective output of Mux5 is enabled to drive the TRIP11 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
4	MUX4	R/W	0h	<p>Selects the output of Mux4 to drive TRIP11 of EPWM-XBAR</p> <p>0: Respective output of Mux4 is disabled to drive the TRIP11 of EPWM-XBAR</p> <p>1: Respective output of Mux4 is enabled to drive the TRIP11 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
3	MUX3	R/W	0h	<p>Selects the output of Mux3 to drive TRIP11 of EPWM-XBAR</p> <p>0: Respective output of Mux3 is disabled to drive the TRIP11 of EPWM-XBAR</p> <p>1: Respective output of Mux3 is enabled to drive the TRIP11 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
2	MUX2	R/W	0h	<p>Selects the output of Mux2 to drive TRIP11 of EPWM-XBAR</p> <p>0: Respective output of Mux2 is disabled to drive the TRIP11 of EPWM-XBAR</p> <p>1: Respective output of Mux2 is enabled to drive the TRIP11 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
1	MUX1	R/W	0h	<p>Selects the output of Mux1 to drive TRIP11 of EPWM-XBAR</p> <p>0: Respective output of Mux1 is disabled to drive the TRIP11 of EPWM-XBAR</p> <p>1: Respective output of Mux1 is enabled to drive the TRIP11 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
0	MUX0	R/W	0h	<p>Selects the output of mux0 to drive TRIP11 of EPWM-XBAR</p> <p>0: Respective output of Mux0 is disabled to drive the TRIP11 of EPWM-XBAR</p> <p>1: Respective output of Mux0 is enabled to drive the TRIP11 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>

### 13.14.3.24 TRIP12MUXENABLE Register (Offset = 2Eh) [reset = 0h]

TRIP12MUXENABLE is shown in [Figure 13-184](#) and described in [Table 13-125](#).

Return to [Summary Table](#).

ePWM XBAR Mux Enable for TRIP12

**Figure 13-184. TRIP12MUXENABLE Register**

31	30	29	28	27	26	25	24
MUX31	MUX30	MUX29	MUX28	MUX27	MUX26	MUX25	MUX24
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
23	22	21	20	19	18	17	16
MUX23	MUX22	MUX21	MUX20	MUX19	MUX18	MUX17	MUX16
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
15	14	13	12	11	10	9	8
MUX15	MUX14	MUX13	MUX12	MUX11	MUX10	MUX9	MUX8
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
7	6	5	4	3	2	1	0
MUX7	MUX6	MUX5	MUX4	MUX3	MUX2	MUX1	MUX0
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h

**Table 13-125. TRIP12MUXENABLE Register Field Descriptions**

Bit	Field	Type	Reset	Description
31	MUX31	R/W	0h	<p>Selects the output of Mux31 to drive TRIP12 of EPWM-XBAR</p> <p>0: Respective output of Mux31 is enabled to drive the TRIP12 of EPWM-XBAR</p> <p>1: Respective output of Mux31 is enabled to drive the TRIP12 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
30	MUX30	R/W	0h	<p>Selects the output of Mux30 to drive TRIP12 of EPWM-XBAR</p> <p>0: Respective output of Mux30 is enabled to drive the TRIP12 of EPWM-XBAR</p> <p>1: Respective output of Mux30 is enabled to drive the TRIP12 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
29	MUX29	R/W	0h	<p>Selects the output of Mux29 to drive TRIP12 of EPWM-XBAR</p> <p>0: Respective output of Mux29 is enabled to drive the TRIP12 of EPWM-XBAR</p> <p>1: Respective output of Mux29 is enabled to drive the TRIP12 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
28	MUX28	R/W	0h	<p>Selects the output of Mux28 to drive TRIP12 of EPWM-XBAR</p> <p>0: Respective output of Mux28 is enabled to drive the TRIP12 of EPWM-XBAR</p> <p>1: Respective output of Mux28 is enabled to drive the TRIP12 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>

**Table 13-125. TRIP12MUXENABLE Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
27	MUX27	R/W	0h	<p>Selects the output of Mux27 to drive TRIP12 of EPWM-XBAR</p> <p>0: Respective output of Mux27 is enabled to drive the TRIP12 of EPWM-XBAR</p> <p>1: Respective output of Mux27 is enabled to drive the TRIP12 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
26	MUX26	R/W	0h	<p>Selects the output of Mux26 to drive TRIP12 of EPWM-XBAR</p> <p>0: Respective output of Mux26 is enabled to drive the TRIP12 of EPWM-XBAR</p> <p>1: Respective output of Mux26 is enabled to drive the TRIP12 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
25	MUX25	R/W	0h	<p>Selects the output of Mux25 to drive TRIP12 of EPWM-XBAR</p> <p>0: Respective output of Mux25 is enabled to drive the TRIP12 of EPWM-XBAR</p> <p>1: Respective output of Mux25 is enabled to drive the TRIP12 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
24	MUX24	R/W	0h	<p>Selects the output of Mux24 to drive TRIP12 of EPWM-XBAR</p> <p>0: Respective output of Mux24 is enabled to drive the TRIP12 of EPWM-XBAR</p> <p>1: Respective output of Mux24 is enabled to drive the TRIP12 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
23	MUX23	R/W	0h	<p>Selects the output of Mux23 to drive TRIP12 of EPWM-XBAR</p> <p>0: Respective output of Mux23 is disabled to drive the TRIP12 of EPWM-XBAR</p> <p>1: Respective output of Mux23 is enabled to drive the TRIP12 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
22	MUX22	R/W	0h	<p>Selects the output of Mux22 to drive TRIP12 of EPWM-XBAR</p> <p>0: Respective output of Mux22 is disabled to drive the TRIP12 of EPWM-XBAR</p> <p>1: Respective output of Mux22 is enabled to drive the TRIP12 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
21	MUX21	R/W	0h	<p>Selects the output of Mux21 to drive TRIP12 of EPWM-XBAR</p> <p>0: Respective output of Mux21 is disabled to drive the TRIP12 of EPWM-XBAR</p> <p>1: Respective output of Mux21 is enabled to drive the TRIP12 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>

**Table 13-125. TRIP12MUXENABLE Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
20	MUX20	R/W	0h	<p>Selects the output of Mux20 to drive TRIP12 of EPWM-XBAR</p> <p>0: Respective output of Mux20 is disabled to drive the TRIP12 of EPWM-XBAR</p> <p>1: Respective output of Mux20 is enabled to drive the TRIP12 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
19	MUX19	R/W	0h	<p>Selects the output of Mux19 to drive TRIP12 of EPWM-XBAR</p> <p>0: Respective output of Mux19 is disabled to drive the TRIP12 of EPWM-XBAR</p> <p>1: Respective output of Mux19 is enabled to drive the TRIP12 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
18	MUX18	R/W	0h	<p>Selects the output of Mux18 to drive TRIP12 of EPWM-XBAR</p> <p>0: Respective output of Mux18 is disabled to drive the TRIP12 of EPWM-XBAR</p> <p>1: Respective output of Mux18 is enabled to drive the TRIP12 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
17	MUX17	R/W	0h	<p>Selects the output of Mux17 to drive TRIP12 of EPWM-XBAR</p> <p>0: Respective output of Mux17 is disabled to drive the TRIP12 of EPWM-XBAR</p> <p>1: Respective output of Mux17 is enabled to drive the TRIP12 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
16	MUX16	R/W	0h	<p>Selects the output of Mux16 to drive TRIP12 of EPWM-XBAR</p> <p>0: Respective output of Mux16 is disabled to drive the TRIP12 of EPWM-XBAR</p> <p>1: Respective output of Mux16 is enabled to drive the TRIP12 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
15	MUX15	R/W	0h	<p>Selects the output of Mux15 to drive TRIP12 of EPWM-XBAR</p> <p>0: Respective output of Mux15 is disabled to drive the TRIP12 of EPWM-XBAR</p> <p>1: Respective output of Mux15 is enabled to drive the TRIP12 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
14	MUX14	R/W	0h	<p>Selects the output of Mux14 to drive TRIP12 of EPWM-XBAR</p> <p>0: Respective output of Mux14 is disabled to drive the TRIP12 of EPWM-XBAR</p> <p>1: Respective output of Mux14 is enabled to drive the TRIP12 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>

**Table 13-125. TRIP12MUXENABLE Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
13	MUX13	R/W	0h	<p>Selects the output of Mux13 to drive TRIP12 of EPWM-XBAR</p> <p>0: Respective output of Mux13 is disabled to drive the TRIP12 of EPWM-XBAR</p> <p>1: Respective output of Mux13 is enabled to drive the TRIP12 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
12	MUX12	R/W	0h	<p>Selects the output of Mux12 to drive TRIP12 of EPWM-XBAR</p> <p>0: Respective output of Mux12 is disabled to drive the TRIP12 of EPWM-XBAR</p> <p>1: Respective output of Mux12 is enabled to drive the TRIP12 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
11	MUX11	R/W	0h	<p>Selects the output of Mux11 to drive TRIP12 of EPWM-XBAR</p> <p>0: Respective output of Mux11 is disabled to drive the TRIP12 of EPWM-XBAR</p> <p>1: Respective output of Mux11 is enabled to drive the TRIP12 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
10	MUX10	R/W	0h	<p>Selects the output of Mux10 to drive TRIP12 of EPWM-XBAR</p> <p>0: Respective output of Mux10 is disabled to drive the TRIP12 of EPWM-XBAR</p> <p>1: Respective output of Mux10 is enabled to drive the TRIP12 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
9	MUX9	R/W	0h	<p>Selects the output of Mux9 to drive TRIP12 of EPWM-XBAR</p> <p>0: Respective output of Mux9 is disabled to drive the TRIP12 of EPWM-XBAR</p> <p>1: Respective output of Mux9 is enabled to drive the TRIP12 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
8	MUX8	R/W	0h	<p>Selects the output of Mux8 to drive TRIP12 of EPWM-XBAR</p> <p>0: Respective output of Mux8 is disabled to drive the TRIP12 of EPWM-XBAR</p> <p>1: Respective output of Mux8 is enabled to drive the TRIP12 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
7	MUX7	R/W	0h	<p>Selects the output of Mux7 to drive TRIP12 of EPWM-XBAR</p> <p>0: Respective output of Mux7 is disabled to drive the TRIP12 of EPWM-XBAR</p> <p>1: Respective output of Mux7 is enabled to drive the TRIP12 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>



**Table 13-125. TRIP12MUXENABLE Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
6	MUX6	R/W	0h	<p>Selects the output of Mux6 to drive TRIP12 of EPWM-XBAR</p> <p>0: Respective output of Mux6 is disabled to drive the TRIP12 of EPWM-XBAR</p> <p>1: Respective output of Mux6 is enabled to drive the TRIP12 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
5	MUX5	R/W	0h	<p>Selects the output of Mux5 to drive TRIP12 of EPWM-XBAR</p> <p>0: Respective output of Mux5 is disabled to drive the TRIP12 of EPWM-XBAR</p> <p>1: Respective output of Mux5 is enabled to drive the TRIP12 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
4	MUX4	R/W	0h	<p>Selects the output of Mux4 to drive TRIP12 of EPWM-XBAR</p> <p>0: Respective output of Mux4 is disabled to drive the TRIP12 of EPWM-XBAR</p> <p>1: Respective output of Mux4 is enabled to drive the TRIP12 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
3	MUX3	R/W	0h	<p>Selects the output of Mux3 to drive TRIP12 of EPWM-XBAR</p> <p>0: Respective output of Mux3 is disabled to drive the TRIP12 of EPWM-XBAR</p> <p>1: Respective output of Mux3 is enabled to drive the TRIP12 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
2	MUX2	R/W	0h	<p>Selects the output of Mux2 to drive TRIP12 of EPWM-XBAR</p> <p>0: Respective output of Mux2 is disabled to drive the TRIP12 of EPWM-XBAR</p> <p>1: Respective output of Mux2 is enabled to drive the TRIP12 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
1	MUX1	R/W	0h	<p>Selects the output of Mux1 to drive TRIP12 of EPWM-XBAR</p> <p>0: Respective output of Mux1 is disabled to drive the TRIP12 of EPWM-XBAR</p> <p>1: Respective output of Mux1 is enabled to drive the TRIP12 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>
0	MUX0	R/W	0h	<p>Selects the output of mux0 to drive TRIP12 of EPWM-XBAR</p> <p>0: Respective output of Mux0 is disabled to drive the TRIP12 of EPWM-XBAR</p> <p>1: Respective output of Mux0 is enabled to drive the TRIP12 of EPWM-XBAR</p> <p>Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn</p>

**13.14.3.25 TRIPOUTINV Register (Offset = 38h) [reset = 0h]**

TRIPOUTINV is shown in [Figure 13-185](#) and described in [Table 13-126](#).

Return to [Summary Table](#).

ePWM XBAR Output Inversion Register

**Figure 13-185. TRIPOUTINV Register**

31	30	29	28	27	26	25	24
RESERVED							
R=0-0h							
23	22	21	20	19	18	17	16
RESERVED							
R=0-0h							
15	14	13	12	11	10	9	8
RESERVED							
R=0-0h							
7	6	5	4	3	2	1	0
TRIP12	TRIP11	TRIP10	TRIP9	TRIP8	TRIP7	TRIP5	TRIP4
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h

**Table 13-126. TRIPOUTINV Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R=0	0h	Reserved
15-8	RESERVED	R=0	0h	Reserved
7	TRIP12	R/W	0h	Selects polarity for TRIP12 of EPWM-XBAR 0: drives active high output 1: drives active-low output Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
6	TRIP11	R/W	0h	Selects polarity for TRIP11 of EPWM-XBAR 0: drives active high output 1: drives active-low output Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
5	TRIP10	R/W	0h	Selects polarity for TRIP10 of EPWM-XBAR 0: drives active high output 1: drives active-low output Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
4	TRIP9	R/W	0h	Selects polarity for TRIP9 of EPWM-XBAR 0: drives active high output 1: drives active-low output Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn

**Table 13-126. TRIPOUTINV Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
3	TRIP8	R/W	0h	Selects polarity for TRIP8 of EPWM-XBAR 0: drives active high output 1: drives active-low output Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
2	TRIP7	R/W	0h	Selects polarity for TRIP7 of EPWM-XBAR 0: drives active high output 1: drives active-low output Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
1	TRIP5	R/W	0h	Selects polarity for TRIP5 of EPWM-XBAR 0: drives active high output 1: drives active-low output Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn
0	TRIP4	R/W	0h	Selects polarity for TRIP4 of EPWM-XBAR 0: drives active high output 1: drives active-low output Refer to the EPWM X-BAR section of this chapter for more details. Reset type: CPU1.SYSRSn

**13.14.3.26 TRIPLOCK Register (Offset = 3Eh) [reset = 0h]**

TRIPLOCK is shown in [Figure 13-186](#) and described in [Table 13-127](#).

Return to [Summary Table](#).

ePWM XBAR Configuration Lock register

**Figure 13-186. TRIPLOCK Register**

31	30	29	28	27	26	25	24
KEY							
R=0/W=1-0h							
23	22	21	20	19	18	17	16
KEY							
R=0/W=1-0h							
15	14	13	12	11	10	9	8
RESERVED							
R=0-0h							
7	6	5	4	3	2	1	0
RESERVED							LOCK
R=0-0h							R/WSONce-0h

**Table 13-127. TRIPLOCK Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	KEY	R=0/W=1	0h	Bit-0 of this register can be set only if KEY= 0x5a5a Reset type: CPU1.SYSRSn
15-1	RESERVED	R=0	0h	Reserved
0	LOCK	R/WSONce	0h	Locks the configuration for EPWM-XBAR. Once the configuration is locked, writes to the below registers for EPWM-XBAR is blocked.  Registers Affected by the LOCK mechanism: EPWM-XBAROUTyMUX0TO15CFG EPWM-XBAROUTyMUX16TO31CFG EPWM-XBAROUTyMUXENABLE EPWM-XBAROUTLATEN EPWM-XBAROUTINV  0: Writes to the above registers are allowed 1: Writes to the above registers are blocked  Note: [1] LOCK mechanism only applies to writes. Reads are never blocked. Reset type: CPU1.SYSRSn

### 13.14.4 SYNC\_SOC\_REGS Registers

Table 13-128 lists the memory-mapped registers for the SYNC\_SOC\_REGS. All register offset addresses not listed in Table 13-128 should be considered as reserved locations and the register contents should not be modified.

**Table 13-128. SYNC\_SOC\_REGS Registers**

Offset	Acronym	Register Name	Write Protection	Section
0h	SYNCSELECT	Sync Input and Output Select Register	EALLOW	<a href="#">Go</a>
2h	ADCSOCOUTSELECT	External ADC (Off Chip) SOC Select Register	EALLOW	<a href="#">Go</a>
4h	SYNCSOCLOCK	SYNCSEL and EXTADCSOC Select Lock register	EALLOW	<a href="#">Go</a>

Complex bit access types are encoded to fit into small table cells. Table 13-129 shows the codes that are used for access types in this section.

**Table 13-129. SYNC\_SOC\_REGS Access Type Codes**

Access Type	Code	Description
<b>Read Type</b>		
R	R	Read
R=0	R	Read
<b>Write Type</b>		
W	W	Write
WSOnce	SOnce W	Set once Write
<b>Reset or Default Value</b>		
-n		Value after reset or the default value
<b>Register Array Variables</b>		
i,j,k,l,m,n		When these variables are used in a register name, an offset, or an address, they refer to the value of a register array where the register is part of a group of repeating registers. The register groups form a hierarchical structure and the array is represented with a formula.
y		When this variable is used in a register name, an offset, or an address it refers to the value of a register array.

**13.14.4.1 SYNCSELECT Register (Offset = 0h) [reset = 0h]**

 SYNCSELECT is shown in [Figure 13-187](#) and described in [Table 13-130](#).

 Return to [Summary Table](#).

Sync Input and Output Select Register

**Figure 13-187. SYNCSELECT Register**

31	30	29	28	27	26	25	24
RESERVED			SYNCOUT			RESERVED	
R=0-0h			R/W-0h			R=0-0h	
23	22	21	20	19	18	17	16
RESERVED							
R=0-0h							
15	14	13	12	11	10	9	8
RESERVED	ECAP4SYNCIN			ECAP1SYNCIN			EPWM10SYNCIN
R=0-0h	R/W-0h			R/W-0h			R/W-0h
7	6	5	4	3	2	1	0
EPWM10SYNCIN		EPWM7SYNCIN			EPWM4SYNCIN		
R/W-0h		R/W-0h			R/W-0h		

**Table 13-130. SYNCSELECT Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-29	RESERVED	R=0	0h	Reserved
28-27	SYNCOUT	R/W	0h	Select Syncout Source:  00: EPWM1SYNCOUT selected 01: EPWM4SYNCOUT selected 10: EPPW7SYNCOUT selected 11: EPWM10SYNCOUT selected Reset type: CPU1.SYSRSn
26-16	RESERVED	R=0	0h	Reserved
15	RESERVED	R=0	0h	Reserved
14-12	ECAP4SYNCIN	R/W	0h	Selects Sync Input Source for ECAP4:  000: EPWM1SYNCOUT selected 001: EPWM4SYNCOUT selected 010: EPPW7SYNCOUT selected 011: EPWM10SYNCOUT selected 100: ECAP1SYNCOUT selected 101: EXTSYNCIN1 selected 110: EXTSYNCIN2 selected 111: Reserved  Notes: [1] Reserved position defaults to 000 selection Reset type: CPU1.SYSRSn

**Table 13-130. SYNCSELECT Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
11-9	ECAP1SYNCIN	R/W	0h	<p>Selects Sync Input Source for ECAP1:</p> <p>000: EPWM1SYNCOOUT selected            001: EPWM4SYNCOOUT selected            010: EPPW7SYNCOOUT selected            011: EPWM10SYNCOOUT selected            100: ECAP1SYNCOOUT selected (Reserved)            101: EXTSYNINCIN1 selected            110: EXTSYNINCIN2 selected            111: Reserved</p> <p>Notes:            [1] Reserved position defaults to 000 selection            Reset type: CPU1.SYSRSn</p>
8-6	EPWM10SYNCIN	R/W	0h	<p>Selects Sync Input Source for EPWM10:</p> <p>000: EPWM1SYNCOOUT selected            001: EPWM4SYNCOOUT selected            010: EPPW7SYNCOOUT selected            011: EPWM10SYNCOOUT selected (Reserved)            100: ECAP1SYNCOOUT selected (Reserved)            101: EXTSYNINCIN1 selected            110: EXTSYNINCIN2 selected            111: Reserved</p> <p>Notes:            [1] Reserved position defaults to 000 selection            Reset type: CPU1.SYSRSn</p>
5-3	EPWM7SYNCIN	R/W	0h	<p>Selects Sync Input Source for EPWM7:</p> <p>000: EPWM1SYNCOOUT selected            001: EPWM4SYNCOOUT selected            010: EPPW7SYNCOOUT selected (Reserved)            011: EPWM10SYNCOOUT selected (Reserved)            100: ECAP1SYNCOOUT selected (Reserved)            101: EXTSYNINCIN1 selected            110: EXTSYNINCIN2 selected            111: Reserved</p> <p>Notes:            [1] Reserved position defaults to 000 selection            Reset type: CPU1.SYSRSn</p>

**Table 13-130. SYNCSELECT Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
2-0	EPWM4SYNCIN	R/W	0h	Selects Sync Input Source for EPWM4: 000: EPWM1SYNCOUT selected 001: EPWM4SYNCOUT selected (Reserved) 010: EPPW7SYNCOUT selected (Reserved) 011: EPWM10SYNCOUT selected (Reserved) 100: ECAP1SYNCOUT selected (Reserved) 101: EXTSYNIN1 selected 110: EXTSYNIN2 selected 111: Reserved  Notes: [1] Reserved position defaults to 000 selection Reset type: CPU1.SYSRSn



### 13.14.4.2 ADCSOCOUTSELECT Register (Offset = 2h) [reset = 0h]

ADCSOCOUTSELECT is shown in [Figure 13-188](#) and described in [Table 13-131](#).

Return to [Summary Table](#).

The ADCSOCAO and ADCSOCBO signals will be active low for 32 SYSCLK cycles. They can be used to trigger a conversion on an external ADC.

**Figure 13-188. ADCSOCOUTSELECT Register**

31		30		29		28		27		26		25		24	
RESERVED								PWM12SOCBE N	PWM11SOCBE N	PWM10SOCBE N	PWM9SOCBE N				
R=0-0h								R/W-0h	R/W-0h	R/W-0h	R/W-0h				
23		22		21		20		19		18		17		16	
PWM8SOCBE N	PWM7SOCBE N	PWM6SOCBE N	PWM5SOCBE N	PWM4SOCBE N	PWM3SOCBE N	PWM2SOCBE N	PWM1SOCBE N								
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h								
15		14		13		12		11		10		9		8	
RESERVED								PWM12SOCAE N	PWM11SOCAE N	PWM10SOCAE N	PWM9SOCAE N				
R=0-0h								R/W-0h	R/W-0h	R/W-0h	R/W-0h				
7		6		5		4		3		2		1		0	
PWM8SOCAE N	PWM7SOCAE N	PWM6SOCAE N	PWM5SOCAE N	PWM4SOCAE N	PWM3SOCAE N	PWM2SOCAE N	PWM1SOCAE N								
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h								

**Table 13-131. ADCSOCOUTSELECT Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-28	RESERVED	R=0	0h	Reserved
27	PWM12SOCBEN	R/W	0h	ADCSOCBO source select: 0: Respective EPWM SOCB output is not selected 1: Respective EPWM SOCB output is selected Reset type: CPU1.SYSRSn
26	PWM11SOCBEN	R/W	0h	ADCSOCBO source select: 0: Respective EPWM SOCB output is not selected 1: Respective EPWM SOCB output is selected Reset type: CPU1.SYSRSn
25	PWM10SOCBEN	R/W	0h	ADCSOCBO source select: 0: Respective EPWM SOCB output is not selected 1: Respective EPWM SOCB output is selected Reset type: CPU1.SYSRSn
24	PWM9SOCBEN	R/W	0h	ADCSOCBO source select: 0: Respective EPWM SOCB output is not selected 1: Respective EPWM SOCB output is selected Reset type: CPU1.SYSRSn
23	PWM8SOCBEN	R/W	0h	ADCSOCBO source select: 0: Respective EPWM SOCB output is not selected 1: Respective EPWM SOCB output is selected Reset type: CPU1.SYSRSn

**Table 13-131. ADCSOCOUTSELECT Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
22	PWM7SOCBEN	R/W	0h	ADCSOCBO source select: 0: Respective EPWM SOCB output is not selected 1: Respective EPWM SOCB output is selected Reset type: CPU1.SYSRSn
21	PWM6SOCBEN	R/W	0h	ADCSOCBO source select: 0: Respective EPWM SOCB output is not selected 1: Respective EPWM SOCB output is selected Reset type: CPU1.SYSRSn
20	PWM5SOCBEN	R/W	0h	ADCSOCBO source select: 0: Respective EPWM SOCB output is not selected 1: Respective EPWM SOCB output is selected Reset type: CPU1.SYSRSn
19	PWM4SOCBEN	R/W	0h	ADCSOCBO source select: 0: Respective EPWM SOCB output is not selected 1: Respective EPWM SOCB output is selected Reset type: CPU1.SYSRSn
18	PWM3SOCBEN	R/W	0h	ADCSOCBO source select: 0: Respective EPWM SOCB output is not selected 1: Respective EPWM SOCB output is selected Reset type: CPU1.SYSRSn
17	PWM2SOCBEN	R/W	0h	ADCSOCBO source select: 0: Respective EPWM SOCB output is not selected 1: Respective EPWM SOCB output is selected Reset type: CPU1.SYSRSn
16	PWM1SOCBEN	R/W	0h	ADCSOCBO source select: 0: Respective EPWM SOCB output is not selected 1: Respective EPWM SOCB output is selected Reset type: CPU1.SYSRSn
15-12	RESERVED	R=0	0h	Reserved
11	PWM12SOCAEN	R/W	0h	ADCSOCAO source select: 0: Respective EPWM SOCA output is not selected 1: Respective EPWM SOCA output is selected Reset type: CPU1.SYSRSn
10	PWM11SOCAEN	R/W	0h	ADCSOCAO source select: 0: Respective EPWM SOCA output is not selected 1: Respective EPWM SOCA output is selected Reset type: CPU1.SYSRSn
9	PWM10SOCAEN	R/W	0h	ADCSOCAO source select: 0: Respective EPWM SOCA output is not selected 1: Respective EPWM SOCA output is selected Reset type: CPU1.SYSRSn
8	PWM9SOCAEN	R/W	0h	ADCSOCAO source select: 0: Respective EPWM SOCA output is not selected 1: Respective EPWM SOCA output is selected Reset type: CPU1.SYSRSn

**Table 13-131. ADCSOCOUTSELECT Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
7	PWM8SOCAEN	R/W	0h	ADCSOCAO source select: 0: Respective EPWM SOCA output is not selected 1: Respective EPWM SOCA output is selected Reset type: CPU1.SYSRSn
6	PWM7SOCAEN	R/W	0h	ADCSOCAO source select: 0: Respective EPWM SOCA output is not selected 1: Respective EPWM SOCA output is selected Reset type: CPU1.SYSRSn
5	PWM6SOCAEN	R/W	0h	ADCSOCAO source select: 0: Respective EPWM SOCA output is not selected 1: Respective EPWM SOCA output is selected Reset type: CPU1.SYSRSn
4	PWM5SOCAEN	R/W	0h	ADCSOCAO source select: 0: Respective EPWM SOCA output is not selected 1: Respective EPWM SOCA output is selected Reset type: CPU1.SYSRSn
3	PWM4SOCAEN	R/W	0h	ADCSOCAO source select: 0: Respective EPWM SOCA output is not selected 1: Respective EPWM SOCA output is selected Reset type: CPU1.SYSRSn
2	PWM3SOCAEN	R/W	0h	ADCSOCAO source select: 0: Respective EPWM SOCA output is not selected 1: Respective EPWM SOCA output is selected Reset type: CPU1.SYSRSn
1	PWM2SOCAEN	R/W	0h	ADCSOCAO source select: 0: Respective EPWM SOCA output is not selected 1: Respective EPWM SOCA output is selected Reset type: CPU1.SYSRSn
0	PWM1SOCAEN	R/W	0h	ADCSOCAO source select: 0: Respective EPWM SOCA output is not selected 1: Respective EPWM SOCA output is selected Reset type: CPU1.SYSRSn

### 13.14.4.3 SYNCSOCLOCK Register (Offset = 4h) [reset = 0h]

SYNCSOCLOCK is shown in [Figure 13-189](#) and described in [Table 13-132](#).

Return to [Summary Table](#).

SYNCSEL and EXTADCSOC Select Lock register

**Figure 13-189. SYNCSOCLOCK Register**

31	30	29	28	27	26	25	24
RESERVED							
R=0-0h							
23	22	21	20	19	18	17	16
RESERVED							
R=0-0h							
15	14	13	12	11	10	9	8
RESERVED							
R=0-0h							
7	6	5	4	3	2	1	0
RESERVED						ADCSOCOUTS ELECT	SYNCSELECT
R=0-0h						R/WSONce-0h	R/WSONce-0h

**Table 13-132. SYNCSOCLOCK Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R=0	0h	Reserved
15-2	RESERVED	R=0	0h	Reserved
1	ADCSOCOUTSELECT	R/WSONce	0h	ADCSOCOUTSELECT Register Lock bit: 0: Respective register is not locked 1: Respective register is locked. Notes: [1] Any bit in this register, once set can only be created through a CPU1.SYSRSn. Write of 0 to any bit of this register has no effect [2] The locking mechanism applies to only writes. Reads to the registers which have LOCK protection are always allowed Reset type: CPU1.SYSRSn
0	SYNCSELECT	R/WSONce	0h	SYNCSELECT Register Lock bit: 0: Respective register is not locked 1: Respective register is locked. Notes: [1] Any bit in this register, once set can only be created through a CPU1.SYSRSn. Write of 0 to any bit of this register has no effect [2] The locking mechanism applies to only writes. Reads to the registers which have LOCK protection are always allowed Reset type: CPU1.SYSRSn

## **High-Resolution Pulse Width Modulator (HRPWM)**

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This document is used in conjunction with the device-specific *Enhanced Pulse Width Modulator (ePWM) Module Reference Guide*. The HRPWM module described in this reference guide is a Type 2 HRPWM. See the *TMS320x28xx, 28xxx DSP Peripheral Reference Guide (SPRU566)* for a list of all devices with an HRPWM module of the same type, to determine the differences between types, and for a list of device-specific differences within a type.

<b>Topic</b>	<b>Page</b>
<b>14.1 Introduction .....</b>	<b>1878</b>
<b>14.2 Operational Description of HRPWM.....</b>	<b>1880</b>
<b>14.3 Appendix A: SFO Library Software - SFO_TI_Build_V7.lib .....</b>	<b>1901</b>

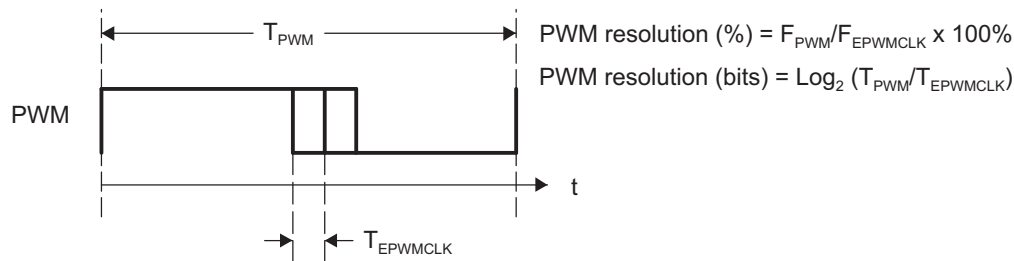
## 14.1 Introduction

This module extends the time resolution capabilities of the conventionally derived digital pulse width modulator (PWM). HRPWM is typically used when PWM resolution falls below ~ 9-10 bits. The key features of HRPWM are:

- Extended time resolution capability
- Used in both duty cycle and phase-shift control methods
- Finer time granularity control or edge positioning using extensions to the Compare A, Compare B and Phase registers
- Implemented using the A & B signal path of PWM, that is, on the EPWMxA and EPWMxB output.
- Dead band high-resolution control for falling and rising edge delay in half cycle clocking operation
- Self-check diagnostics software mode to check if the micro edge positioner (MEP) logic is running optimally
- Enables high resolution output swapping on the EPWMxA and EPWMxB output
- Enables high-resolution output on EPWMxB signal output via inversion of EPWMxA signal output
- Enables high-resolution period, duty and phase control on the EPWMxA and EPWMxB output on devices with an ePWM module. See the device-specific data manual to determine if your device has an ePWM module for high-resolution period support.

The ePWM peripheral is used to perform a function mathematically equivalent to a digital-to-analog converter (DAC). As shown in [Figure 14-1](#), the effective resolution for conventionally generated PWM is a function of PWM frequency (or period) and system clock frequency.

**Figure 14-1. Resolution Calculations for Conventionally Generated PWM**



If the required PWM operating frequency does not offer sufficient resolution in PWM mode, you may want to consider HRPWM. As an example of improved performance offered by HRPWM, [Table 14-1](#) shows resolution in bits for various PWM frequencies. These values assume a MEP step size of 180 ps. See the device-specific data sheet for typical and maximum performance specifications for the MEP.

**Table 14-1. Resolution for PWM and HRPWM**

PWM Freq  (kHz)	Regular Resolution (PWM)		High Resolution (HRPWM)	
	100 MHz EPWMCLK			
	Bits	%	Bits	%
20	12.3	0.02	18.1	0.000
50	11	0.05	16.8	0.001
100	10	0.1	15.8	0.002
150	9.4	0.15	15.2	0.003
200	9	0.2	14.8	0.004
250	8.6	0.25	14.4	0.005
500	7.6	0.5	13.4	0.009
1000	6.6	1	12.4	0.018
1500	6.1	1.5	11.9	0.027
2000	5.6	2	11.4	0.036

Although each application may differ, typical low frequency PWM operation (below 250 kHz) may not require HRPWM. HRPWM capability is most useful for high frequency PWM requirements of power conversion topologies such as:

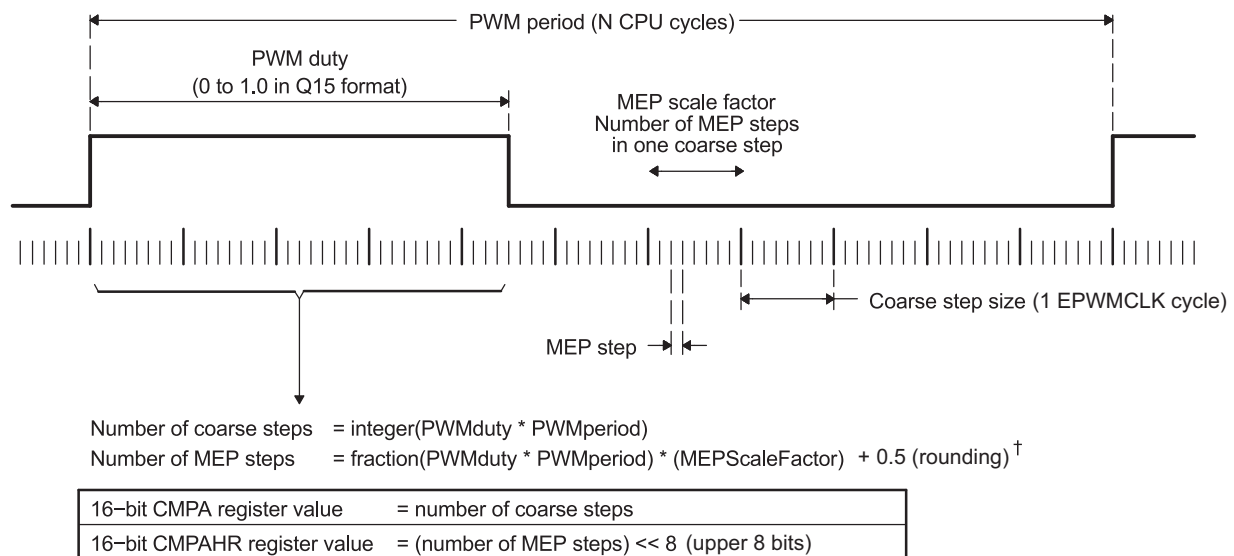
- Single-phase buck, boost, and flyback
- Multi-phase buck, boost, and flyback
- Phase-shifted full bridge
- Direct modulation of D-Class power amplifiers

## 14.2 Operational Description of HRPWM

The HRPWM is based on micro edge positioner (MEP) technology. MEP logic is capable of positioning an edge very finely by sub-dividing one coarse system clock of a conventional PWM generator. The time step accuracy is on the order of 150 ps. See the device-specific data sheet for the typical MEP step size on a particular device. The HRPWM also has a self-check software diagnostics mode to check if the MEP logic is running optimally, under all operating conditions. Details on software diagnostics and functions are in [Section 14.2.6](#).

[Figure 14-2](#) shows the relationship between one coarse system clock and edge position in terms of MEP steps, which are controlled via an 8-bit field in the Compare A extension register (CMPAHR). The same operating logic applies to CMPBHR as well.

**Figure 14-2. Operating Logic Using MEP**



† For MEP range and rounding adjustment. (0x0080 in Q8 format)

To generate an HRPWM waveform, configure the ePWM registers as you would to generate a conventional PWM of a given frequency and polarity. The HRPWM works together with the ePWM registers to extend edge resolution. Although many programming combinations are possible, only a few are needed and practical. These methods are described in [Section 14.2.7](#).

Registers discussed but not found in this document can be seen in the device-specific *Enhanced Pulse Width Modulator (ePWM) Module Reference Guide*.

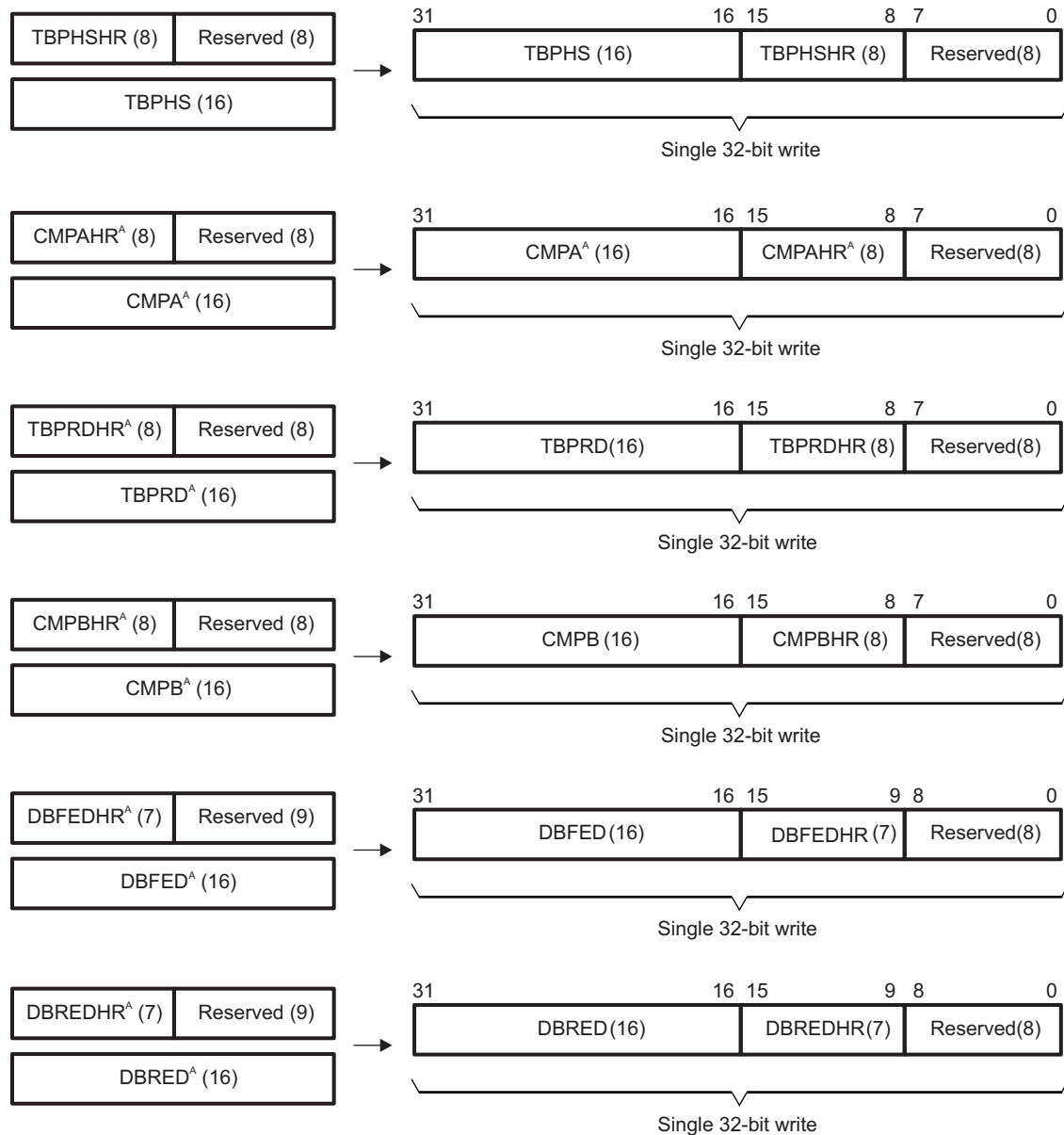
### 14.2.1 Controlling the HRPWM Capabilities

The MEP of the HRPWM is controlled by six extension registers. These HRPWM registers are concatenated with the 16-bit TBPHS, TBPRD, CMPA, CMPBM, DBREDM & DBFEDM registers used to control PWM operation.

- TBPHSHR - Time Base Phase High Resolution Register
- CMPAHR - Counter Compare A High Resolution Register
- TBPRDHR - Time Base Period High Resolution Register. (available on some devices)
- CMPBHR - Compare B High Resolution Register
- DBREDHR - Deadband Generator Rising Edge Delay High Resolution Register
- DBFEDHR - Deadband Generator Falling Edge Delay High Resolution Register



**Figure 14-3. HRPWM Extension Registers and Memory Configuration**

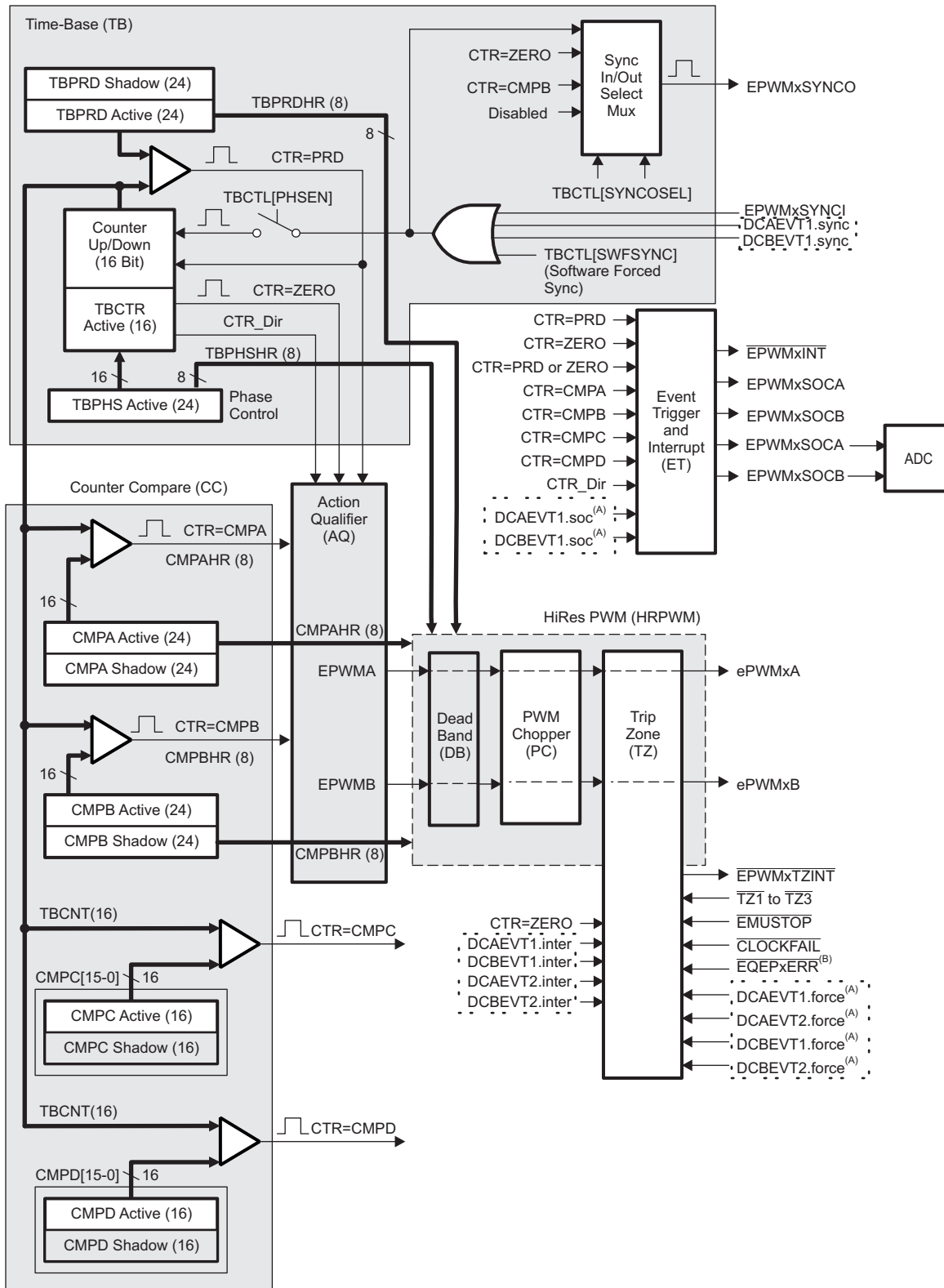


A Dependant upon your device, these registers may be mirrored and can be written to at two different memory locations. Check the device-specific Technical Reference Manual's *ePWM* chapter for more details on how to read and write to these locations.

**NOTE:** HRPWM capabilities on Deadband Rising Edge Delay and Falling Edge Delay is applicable only during Dead Band half cycle clocking Operation. The number of MEP steps is half in size [ bits 15:9 ]than duty and phase high resolution registers for the same reason

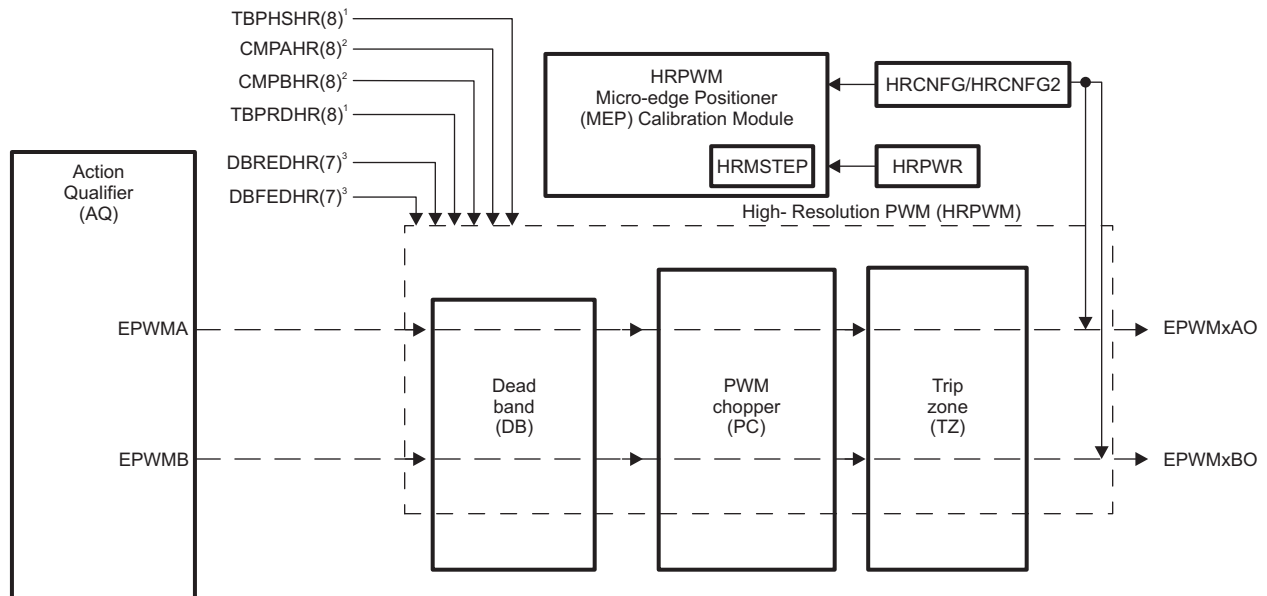
HRPWM capabilities are controlled using the Channel A & B PWM signal path. HRPWM support on the Dead band signal path is available by properly configuring the HRCNFG2 register. [Figure 14-4](#) shows how the HRPWM interfaces with the 8-bit extension registers.

Figure 14-4. HRPWM System Interface



A These events are generated by the ePWM digital compare (DC) submodule.

Figure 14-5. HRPWM Block Diagram



- (1) From ePWM Time-base (TB) submodule
- (2) From ePWM counter-compare (CC) submodule
- (3) From ePWM Deadband (DB) submodule

### 14.2.2 Configuring the HRPWM

Once the ePWM has been configured to provide conventional PWM of a given frequency and polarity, the HRPWM is configured by programming the HRCNFG register in that particular ePWM module's register space. This register provides the following configuration options:

**Edge Mode** — The MEP can be programmed to provide precise position control on the rising edge (RE), falling edge (FE) or both edges (BE) at the same time. FE and RE are used for power topologies requiring duty cycle control (CMPA or CMPB high-resolution control), while BE is used for topologies requiring phase shifting, for example, phase shifted full bridge (TBPHS or TBPRD high-resolution control).

**Control Mode** — The MEP is programmed to be controlled either from the CMPAHR / CMPBHR register in case of duty cycle control or the TBPHSHR register (phase control). RE or FE control mode should be used with CMPAHR or CMPBHR register. BE control mode should be used with TBPHSHR register. When the MEP is controlled from the TBPRDHR register (period control) the duty cycle and phase can also be controlled via their respective high-resolution registers.

**Shadow Mode** — This mode provides the same shadowing (double buffering) option as in regular PWM mode. This option is valid only when operating from the CMPAHR, CMPBHR and TBPRDHR registers and should be chosen to be the same as the regular load option for the CMPA, CMPB register. If TBPHSHR is used, then this option has no effect.

**High-Resolution B Signal Control** — The B signal path of an ePWM channel can generate a high-resolution output by outputting an inverted version of the high-resolution ePWMxA signal on the ePWMxB pin. A Type 2 HRPWM module can also enable high-resolution features on the B signal path independently of the A signal path as well.

**Swap ePWMxA and ePWMxB Outputs** — This mode enables the swapping of the high resolution A & B outputs. The mode selection allows either A & B Outputs Unchanged or A Output Comes Out On B and B Output Comes Out On A

**Auto-conversion Mode** — This mode is used in conjunction with the scale factor optimization (SFO) software only. For a type 2 HRPWM module, below is a description of the Auto-conversion Mode taking CMPAHR as an example. If auto-conversion is enabled,  $CMPAHR = \text{fraction}(PWMduty * PWMperiod) < 8$ . The scale factor optimization software will calculate the MEP scale factor in background code and automatically update the HRMSTEP register with the calculated number of MEP steps per coarse step. The MEP Calibration Module will then use the values in the HRMSTEP and CMPAHR register to automatically calculate the appropriate number of MEP steps represented by the fractional duty cycle and move the high-resolution ePWM signal edge accordingly. If auto-conversion is disabled, the CMPAHR register behaves like a type 0 HRPWM module and  $CMPAHR = (\text{fraction}(PWMduty * PWMperiod) * MEP \text{ Scale Factor} + 0.5) < 8$ . All calculations will need to be performed by user code in this mode, and the HRMSTEP register is ignored. Auto-conversion for high-resolution period has the same behavior as auto-conversion for high-resolution duty cycle. Auto-conversion must always be enabled for high-resolution period mode.

---

**NOTE:** Auto-conversion Mode performs the calculation for CMPBHR, DBREDHR and DBFEDHR as well. The scale factor optimization software will calculate the MEP scale factor in background code and automatically update the HRMSTEP register with the calculated number of MEP steps per coarse step. The MEP Calibration Module will then use the values in the HRMSTEP and CMPBHR or DBREDHR / DBFEDHR register to automatically calculate the appropriate number of MEP steps represented by the fractional components and move the high-resolution ePWM signal edge accordingly. If auto-conversion is disabled, CMPBHR behaves same as CMPAHR.  $CMPBHR = (\text{fraction}(PWMduty * PWMperiod) * MEP \text{ Scale Factor} + 0.5) < 8$ .

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### 14.2.3 Configuring Hi-Res in Deadband Rising Edge and Falling Edge Delay

Once the ePWM has been configured to provide conventional PWM of a given frequency, polarity and deadband enabled in half cycle clocking mode, the high resolution operation on dead band RED and FED lines are enabled by programming the HRCNFG2 register in that particular ePWM module's register space. This register provides the following configuration options:

**Edge Mode** — The MEP can be programmed to provide precise position control on the dead band rising edge (RED), dead band falling edge (FED) or both edges (rising edge of DBRED signal and falling edge of DBFED signal) at the same time.

**Control Mode** — Selects the time event that loads the shadow value in active register for DBRED and DBFED in high resolution mode. The user needs to select the pulse to match the selection in the ePWM DBCTL[LOADREDMODE] & DBCTL[LOADFEDMODE] bits.

### 14.2.4 Principle of Operation

The MEP logic is capable of placing an edge in one of 255 (8 bits) discrete time steps (see device-specific data sheet for typical MEP step size). The MEP works with the TBM and CCM registers to be certain that time steps are optimally applied and that edge placement accuracy is maintained over a wide range of PWM frequencies, system clock frequencies and other operating conditions.

The HRPWM module requires that  $TBCLK = EPWMCLK$ . TBCLK cannot be further divided now from EPWMCLK.

Table 14-2 shows the typical range of operating frequencies supported by the HRPWM.

**Table 14-2. Relationship Between MEP Steps, PWM Frequency and Resolution**

System (MHz)	MEP Steps Per EPWMCLK <sup>(1)(2)(3)</sup>	PWM MIN (Hz) <sup>(4)</sup>	PWM MAX (MHz)	Res. @ MAX (Bits) <sup>(5)</sup>
60.0	93	916	3.00	10.9
70.0	79	1068	3.50	10.6
80.0	69	1221	4.00	10.4
90.0	62	1373	4.50	10.3
100.0	56	1526	5.00	10.1

- (1) TBCLK = EPWMCLK.
- (2) Table data based on a MEP time resolution of 180 ps (this is an example value. See the device-specific data sheet for MEP limits)
- (3) MEP steps applied =  $T_{EPWMCLK}/180$  ps in this example.
- (4) PWM minimum frequency is based on a maximum period value, (TBPRD = 65535). PWM mode is asymmetrical up-count.
- (5) Resolution in bits is given for the maximum PWM frequency stated.

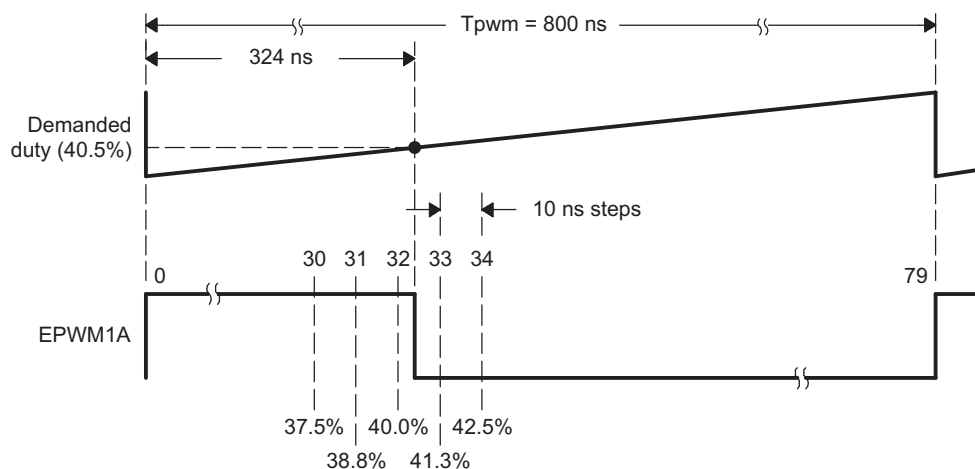
### 14.2.4.1 Edge Positioning

**NOTE:** The below example is presented using [CMPA:CMPAHR] register combination. The theory of operation and equations is same if the user intends to use [CMPBM:CMPBHRM] for duty cycle control.

In a typical power control loop, a digital controller issues a duty command, usually expressed in a per unit or percentage terms. Assume that for a particular operating point, the demanded duty cycle is 0.405 or 40.5% on time and the required converter PWM frequency is 1.25 MHz. In conventional PWM generation with a system clock of 100 MHz, the duty cycle choices are in the vicinity of 40.5%. As shown in Figure 14-6, a compare value of 32 counts (duty = 40%) is the closest to 40.5% that can be attained. This is equivalent to an edge position of 320 ns instead of the desired 324 ns. This data is shown in Table 14-3.

By utilizing the MEP, you can achieve an edge position much closer to the desired point of 324 ns. Table 14-3 shows that in addition to the CMPA value, 22 steps of the MEP (CMPAHR register) will position the edge at 323.96 ns, resulting in almost zero error. In this example, it is assumed that the MEP has a step resolution of 180 ps.

**Figure 14-6. Required PWM Waveform for a Requested Duty = 40.5%**



**Table 14-3. CMPA vs Duty (left), and [CMPA:CMPAHR] vs Duty (right)**

<b>CMPA (count)<sup>(1) (2) (3)</sup></b>	<b>DUTY %</b>	<b>High Time (ns)</b>	<b>CMPA (count)</b>	<b>CMPAHR (count)</b>	<b>Duty (%)</b>	<b>High Time (ns)</b>
28	<b>35.0</b>	280	32	18	<b>40.405</b>	323.24
29	<b>36.3</b>	290	32	19	<b>40.428</b>	323.42
30	<b>37.5</b>	300	32	20	<b>40.450</b>	323.60
31	<b>38.8</b>	310	32	21	<b>40.473</b>	323.78
32	<b>40.0</b>	320	32	22	<b>40.495</b>	323.96
33	<b>41.3</b>	330	32	23	<b>40.518</b>	324.14
34	<b>42.5</b>	340	32	24	<b>40.540</b>	324.32
			32	25	<b>40.563</b>	324.50
Required			32	26	<b>40.585</b>	324.68
32.40	<b>40.5</b>	324	32	27	<b>40.608</b>	324.86

<sup>(1)</sup> TBCLK = 100 MHz, 10 ns

<sup>(2)</sup> For a PWM Period register value of 80 counts, PWM Period = 80 x 10 ns = 800 ns, PWM frequency = 1/800 ns = 1.25 MHz

<sup>(3)</sup> Assumed MEP step size for the above example = 180 ps  
See the device-specific data manual for typical and maximum MEP values.

#### 14.2.4.2 Scaling Considerations

The mechanics of how to position an edge precisely in time has been demonstrated using the resources of the standard CMPA and MEP (CMPAHR) registers. In a practical application, however, it is necessary to seamlessly provide the CPU a mapping function from a per-unit (fractional) duty cycle to a final integer (non-fractional) representation that is written to the [CMPA:CMPAHR] register combination.

To do this, first examine the scaling or mapping steps involved. It is common in control software to express duty cycle in a per-unit or percentage basis. This has the advantage of performing all needed math calculations without concern for the final absolute duty cycle, expressed in clock counts or high time in ns. Furthermore, it makes the code more transportable across multiple converter types running different PWM frequencies.

To implement the mapping scheme, a two-step scaling procedure is required.

**Assumptions for this example:**

TBCLK	= 10 ns (100 MHz)
PWM frequency	= 1.25 MHz (1/800 ns)
Required PWM duty cycle, <b>PWMDuty</b>	= 0.405 (40.5%)
PWM period in terms of coarse steps, <b>PWMPeriod</b> (800 ns/10 ns)	= 80
Number of MEP steps per coarse step at 180 ps (10 n/180 ps ), <b>MEP_ScaleFactor</b>	= 55
Value to keep CMPAHR within the range of 1-255 and fractional rounding constant (default value)	= 0.5 (0080h in Q8 format)

**Step 1: Percentage Integer Duty value conversion for CMPA register**

CMPA register value	= $\text{int}(\text{PWMDuty} * \text{PWMPeriod})$ ; int means integer part
	= $\text{int}(0.405 * 80)$
	= $\text{int}(32.4)$
CMPA register value	= 32 (20h)

**Step 2: Fractional value conversion for CMPAHR register**

CMPAHR	= $(\text{frac}(\text{PWMDuty} * \text{PWMPeriod}) * \text{MEP\_ScaleFactor} + 0.5) \ll 8$ ; frac means fractional part
	= $(\text{frac}(32.4) * 55 + 0.5) \ll 8$ ; Shifting is to move the value to the high byte of CMPAHR.
	= $(0.4 * 55 + 0.5) \ll 8$
	= $(22 + 0.5) \ll 8$
	= $22.5 * 256$ ; Shifting left by 8 is the same as multiplying by 256.
	= 5760 (1680h)
CMPAHR	= 1680h CMPAHR value = 1600h (lower 8 bits will be ignored by hardware).

---

**NOTE:** If the AUTOCONV bit (HRCNFG.6) is set and the MEP\_ScaleFactor is in the HRMSTEP register, then CMPAHR / CMPBHR register value =  $\text{frac}(\text{PWMDuty} * \text{PWMperiod} \ll 8)$ . The rest of the conversion calculations are performed automatically in hardware, and the correct MEP-scaled signal edge appears on the ePWM channel output. If AUTOCONV is not set, the above calculations must be performed by software.

---

**NOTE:** The MEP scale factor (MEP\_ScaleFactor) varies with the system clock and DSP operating conditions. TI provides an MEP scale factor optimizing (SFO) software C function, which uses the built-in diagnostics in each HRPWM and returns the best scale factor for a given operating point.

The scale factor varies slowly over a limited range so the optimizing C function can be run very slowly in a background loop.

The CMPA, CMPB, CMPAHR and CMPBHR registers are configured in memory so that the 32-bit data capability of the 28x CPU can write this as a single concatenated value, that is, [CMPA:CMPAHR], [CMPB:CMPBHR], and so on.

The mapping scheme has been implemented in both C and assembly, as shown in [Section 14.2.7](#). The actual implementation takes advantage of the 32-bit CPU architecture of the 28xx, and is somewhat different from the steps shown in [Section 14.2.4.2](#).

For time-critical control loops where every cycle counts, the assembly version is recommended. This is a cycle optimized function (11 EPWMCLK cycles) that takes a Q15 duty value as input and writes a single [CMPA:CMPAHR] value.

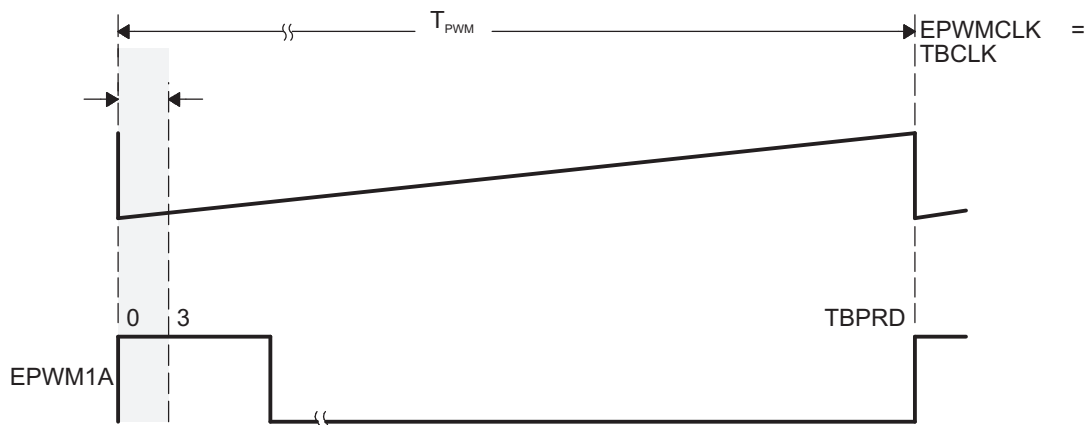
### 14.2.4.3 Duty Cycle Range Limitation

In high resolution mode, the MEP is not active for 100% of the PWM period. It becomes operational:

- Three EPWMCLK cycles after the period starts when high-resolution period (TBPRDHR) control is not enabled.
- When high resolution period (TBPRDHR) control is enabled via the HRPCTL register:
  - In up-count mode: three EPWMCLK cycles after the period starts until three EPWMCLK cycles before the period ends.
  - In up-down count mode: when counting up, three cycles after CTR = 0 until three cycles before CTR = PRD, and when counting down, three cycles after CTR = PRD until three cycles before CTR = 0.
- When using DBREDHR or DBFEDHR, DBRED and/or DBFED (the register corresponding to the edge with hi-resolution displacement) must be greater than or equal to 3.

Duty cycle range limitations are illustrated in [Figure 14-7](#) to [Figure 14-10](#). This limitation imposes a duty cycle limit on the MEP. For example, precision edge control is not available all the way down to 0% duty cycle. When high-resolution period control is disabled, regular PWM duty control is fully operational down to 0% duty cycle despite the unavailability of HRPWM features in the first three cycles. In most applications this should not be an issue as the controller regulation point is usually not designed to be close to 0% duty cycle. To better understand the useable duty cycle range, see [Table 14-4](#). When high-resolution period control is enabled (HRPCTL[HRPE]=1), the duty cycle must not fall within the restricted range. Otherwise, there may be undefined behavior on the ePWMxA output.

**Figure 14-7. Low % Duty Cycle Range Limitation Example (HRPCTL[HRPE] = 0)**





**Table 14-4. Duty Cycle Range Limitation for Three EPWMCLK/TBCLK Cycles**

PWM Frequency <sup>(1)</sup> (kHz)	3 Cycles Minimum Duty	3 Cycles Maximum Duty <sup>(2)</sup>
200	0.6%	99.4%
400	1.2%	98.8%
600	1.8%	98.2%
800	2.4%	97.6%
1000	3%	97%
1200	3.6%	96.4%
1400	4.2%	95.8%
1600	4.8%	95.2%
1800	5.4%	94.6%
2000	6%	94%

<sup>(1)</sup> EPWMCLK = TBCLK = 100 MHz

<sup>(2)</sup> This limitation applies only if high-resolution period (TBPRDHR) control is enabled.

If the application demands HRPWM operation below the minimum duty cycle limitation, then the HRPWM can be configured to operate in count-down mode with the rising edge position (REP) controlled by the MEP when high-resolution period is disabled (HRPCTL[HRPE] = 0). This is illustrated in [Figure 14-8](#). In this configuration, the minimum duty cycle limitation is no longer an issue. However, there will be a maximum duty limitation with same percent numbers as given in [Table 14-4](#).

Figure 14-8. High % Duty Cycle Range Limitation Example (HRPCTL[HRPE] = 0)

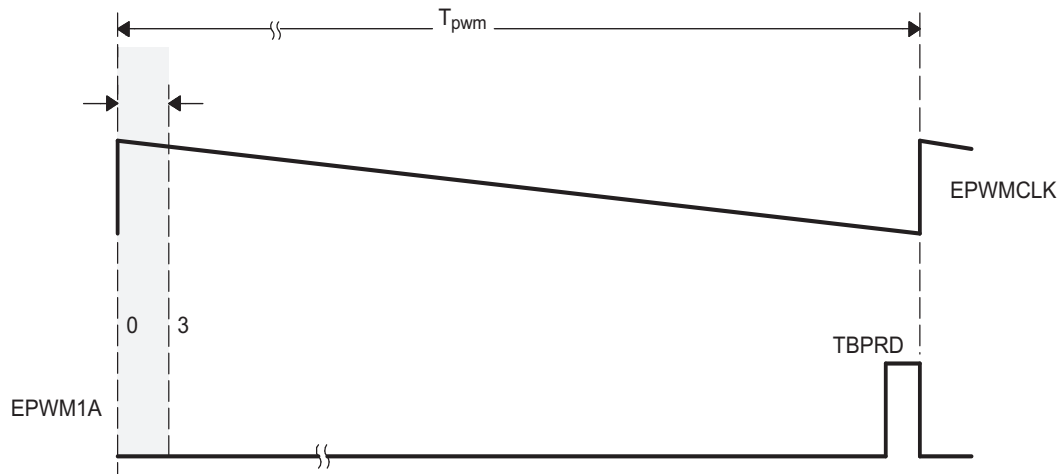
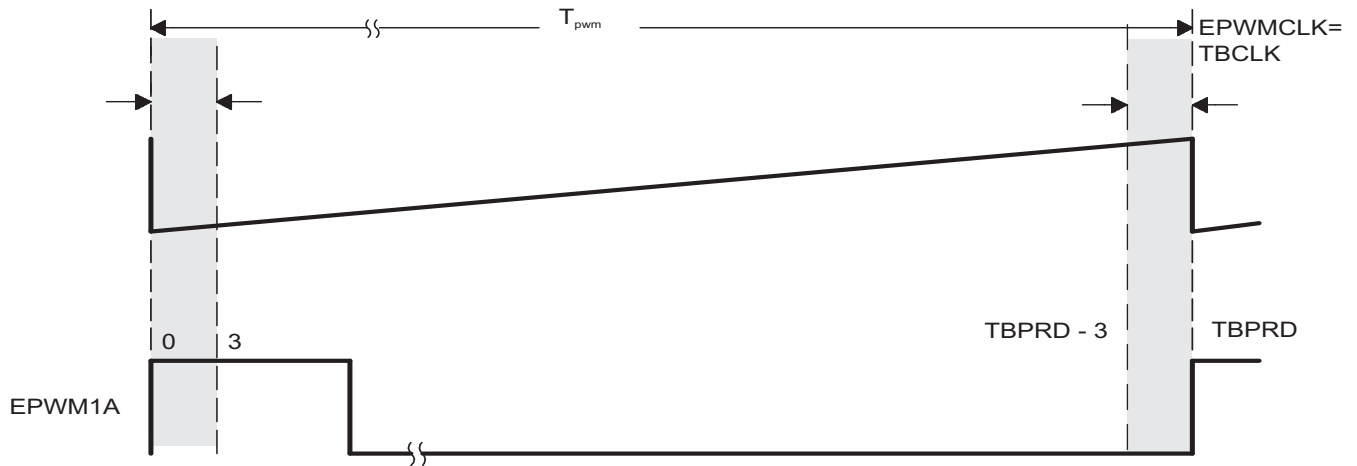
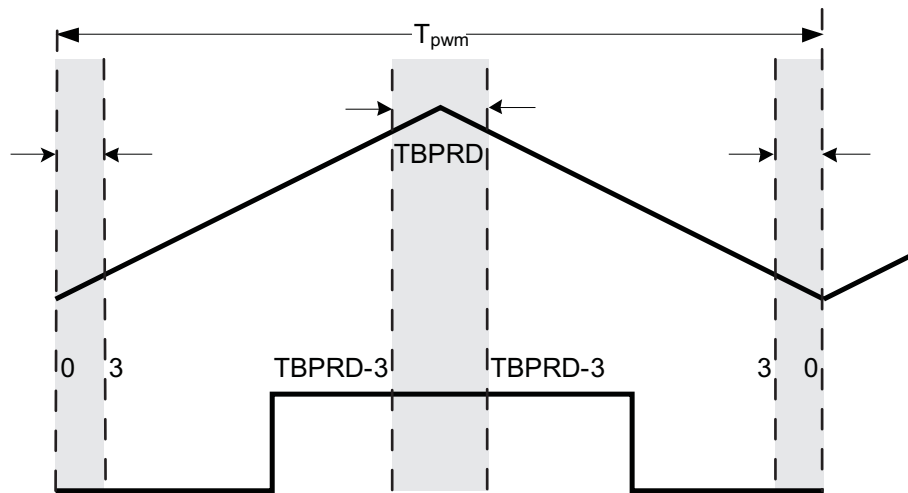


Figure 14-9. Up-Count Duty Cycle Range Limitation Example (HRPCTL[HRPE]=1)



**Figure 14-10. Up-Down Count Duty Cycle Range Limitation Example (HRPCTL[HRPE]=1)**



**NOTE:** If the application has enabled high-resolution period control (HRPCTL[HRPE]=1), the duty cycle must not fall within the restricted range. Otherwise, there will be undefined behavior on the ePWM output.

#### 14.2.4.4 High Resolution Period

High resolution period control using the MEP logic is supported on devices with a Type 1 ePWM module or greater.

---

**NOTE:** When high-resolution period control is enabled, on ePWMxA only, and not ePWMxB output and vice versa, the non hi-res output will have +/- 1 TBCLK cycle jitter in up-count mode and +/- 2 TBCLK cycle jitter in up-down count mode.

---

The scaling procedure described for duty cycle in [Section 14.2.4.2](#) applies for high-resolution period as well:

##### Assumptions for this example:

TBCLK	= 10 ns (100 MHz)
Required PWM frequency	= 175 kHz (period of 571.428)
Number of MEP steps per coarse step at 180 ps (MEP_ScaleFactor)	= 55 (10 ns / 180 ps)
Value to keep TBPRDHR within range of 1-255 and fractional rounding constant (default value)	= 0.5 (0080h in Q8 format)

##### Problem:

In up-count mode:

If TBPRD = 571, then PWM frequency = 174.82 kHz (period =  $(571+1) * T_{TBCLK}$ ).

If TBPRD = 570, then PWM frequency = 175.13 kHz (period =  $(570+1) * T_{TBCLK}$ ).

In up-down count mode:

If TBPRD = 286, then PWM frequency = 174.82 kHz (period =  $(286*2) * T_{TBCLK}$ ).

If TBPRD = 285, then PWM frequency = 175.44 kHz (period =  $(285*2) * T_{TBCLK}$ ).

##### Solution:

With 55 MEP steps per coarse step at 180 ps each:

##### Step 1: Percentage Integer Period value conversion for TBPRD register

$$\begin{aligned} \text{Integer period value} &= 571 * T_{TBCLK} \\ &= \text{int}(571.428) * T_{TBCLK} \\ &= \text{int}(\text{PWMperiod}) * T_{TBCLK} \end{aligned}$$

In up-count mode:

$$\begin{aligned} \text{TBPRD} &= 570 \text{ (TBPRD = period value - 1)} \\ &= 023Ah \end{aligned}$$

In up-down count mode:

$$\begin{aligned} \text{TBPRD} &= 285 \text{ (TBPRD = period value / 2)} \\ &= 011Dh \end{aligned}$$

##### Step 2: Fractional value conversion for TBPRDHR register

$$\text{TBPRDHR register value} = (\text{frac}(\text{PWMperiod}) * \text{MEP\_ScaleFactor} + 0.5)$$

If auto-conversion enabled and HRMSTEP =

$$\text{MEP\_ScaleFactor value (55):} = \text{frac}(\text{PWMperiod}) \ll 8 \text{ (Shifting is to move the value to the high byte of TBPRDHR)}$$

$$\begin{aligned} \text{TBPRDHR register value} &= \text{frac}(571.428) \ll 8 \\ &= 0.428 \times 256 \\ &= 6D00h \end{aligned}$$

The autoconversion will then automatically perform the calculation such that TBPRDHR MEP delay is scaled by hardware to:

$$\begin{aligned} &= ((\text{TBPRDHR}(15:0) \gg 8) \times \text{HRMSTEP} + 80\text{h}) \ll 8 \\ &= (006\text{Dh} \times 55 + 80\text{h}) \gg 8 \\ &= (17\text{EBh}) \gg 8 \\ \text{Period MEP delay} &= 0017\text{h MEP Steps} \end{aligned}$$

#### 14.2.4.4.1 High-Resolution Period Configuration

To use High Resolution Period, the ePWMx module must be initialized in the exact order presented.

The steps below use CMPA with shadow registers and the corresponding HRCNFG bits for hi-resolution operation on EPWMxA. For hi-resolution operation on EPWMxB, make the appropriate substitutions with the B channel fields.

1. Enable ePWMx clock
2. Enable HRPWM clock
3. Disable TBCLKSYNC
4. Configure ePWMx registers - AQ, TBPRD, CC, and so on.
  - ePWMx may only be configured for up-count or up-down count modes. High-resolution period is not compatible with down-count mode.
  - TBPRD and CC registers must be configured for shadow loads.
  - CMPCTL[LOADAMODE]
    - In up-count mode: CMPCTL[LOADAMODE] = 1 (load on CTR = PRD)
    - In up-down count mode: CMPCTL[LOADAMODE] = 2 (load on CTR=0 or CTR=PRD)
5. Configure the HRCNFG register such that:
  - HRCNFG[HRLOAD] = 2 (load on either CTR = 0 or CTR = PRD)
  - HRCNFG[AUTOCONV] = 1 (Enable auto-conversion)
  - HRCNFG[EDGMODE] = 3 (MEP control on both edges)
6. For TBPHS:TBPHSHR synchronization with high-resolution period, set both HRPCTL[TBPSHRLOADE] = 1 and TBCTL[PHSEN] = 1. In up-down count mode these bits must be set to 1 regardless of the contents of TBPHSHR.
7. Enable high-resolution period control (HRPCTL[HRPE] = 1)
8. Enable TBCLKSYNC
9. TBCTL[SWFSYNC] = 1
10. HRMSTEP must contain an accurate MEP scale factor (# of MEP steps per EPWMCLK coarse step) because auto-conversion is enabled. The MEP scale factor can be acquired via the SFO() function described in [Section 14.3](#).
11. To control high-resolution period, write to the TBPRDHR(M) registers.

---

**NOTE:** When high-resolution period mode is enabled, an EPWMxSYNC pulse will introduce +/- 1 - 2 cycle jitter to the PWM (+/- 1 cycle in up-count mode and +/- 2 cycle in up-down count mode). For this reason, TBCTL[SYNCOSEL] should not be set to 1 (CTR = 0 is EPWMxSYNCO source) or 2 (CTR = CMPB is EPWMxSYNCO source). Otherwise, the jitter will occur on every PWM cycle with the synchronization pulse.

When TBCTL[SYNCOSEL] = 0 (EPWMxSYNCL is EPWMxSYNCO source), a software synchronization pulse should be issued only once during high-resolution period initialization. If a software sync pulse is applied while the PWM is running, the jitter will appear on the PWM output at the time of the sync pulse.

---

### 14.2.5 Deadband High Resolution Operation

#### Assumptions for this example:

System clock	= 10 ns (100 MHz) &
Deadband Enabled in half cycle mode, TBCLK = EPWMCLK	
Required PWM frequency	1.33MHz (1 / 750 ns)
Required PWM duty cycle	0.5 (50%)
Required Dead band Rising Edge Delay	5% over duty
Required Dead band Rising Edge Delay in ns	(0.05 * 375 ns ) = 18.75 ns

---

**NOTE:** Just like the duty cycle restrictions when using HRPWM, the DBRED and DBFED values must be greater than 3 to use hi-res deadband.

---

#### Deadband Delay Values as a Function of DBFED and DBRED:

When half-cycle clocking is enabled, the formula to calculate the falling-edge-delay and rising-edge-delay becomes:

$$FED = DBFED * TBCLK / 2$$

$$RED = DBRED * TBCLK / 2$$

#### DBRED and DBFED Calculated Values:

Required Dead band Rising Edge Delay in ns = 18.75 ns

$$DBRED = RED / (TBCLK / 2)$$

$$DBRED = 18.75 \text{ ns} / 5 \text{ ns}$$

$$DBRED \text{ Required} = 3.75 \text{ ns}$$

With 55 MEP steps per coarse step at 180 ps each:

#### Step 1: Integer Dead band value conversion for DBREDM register

Integer DBRED value	= int (RED / (TBCLK / 2))
	= int (3.75)
DBRED	= 3

#### Step 2: Fractional value conversion for Dead band high resolution register DBREDHR

DBREDHR register value	= (frac(DBRED Required) * MEP_ScaleFactor + 0.5) << 8 (Shifting is to move the value to the high byte of DBREDHR)
	= (frac (3.75) * 55 + 0.5) << 8
	= ( 0.75 * 55 + 0.5 ) << 8
	= (41.75) * 256 Shifting left by 8 is the same as multiplying by 256.
DBREDHR value	= 29C0h MEP Steps
	Hardware will ignore lower 9 bits in the above calculated DBREDHR value

---

**NOTE:** If the AUTOCONV bit (HRCNFG.6) is set and the MEP\_ScaleFactor is in the HRMSTEP register, then DBREDHR:DBRED =  $\text{frac}(\text{required DB value}) < <8$ . The rest of the conversion calculations are performed automatically in hardware, and the correct MEP-scaled signal edge appears on the ePWM channel output. If AUTOCONV is not set, the above calculations must be performed by software.

---

### 14.2.6 Scale Factor Optimizing Software (SFO)

The micro edge positioner (MEP) logic is capable of placing an edge in one of 255 discrete time steps. As previously mentioned, the size of these steps is on the order of 150 ps (see device-specific data sheet for typical MEP step size on your device). The MEP step size varies based on worst-case process parameters, operating temperature, and voltage. MEP step size increases with decreasing voltage and increasing temperature and decreases with increasing voltage and decreasing temperature. Applications that use the HRPWM feature should use the TI-supplied MEP scale factor optimization (SFO) software function. The SFO function helps to dynamically determine the number of MEP steps per EPWMCLK period while the HRPWM is in operation.

To utilize the MEP capabilities effectively, the correct value for the MEP scaling factor needs to be known by the software. To accomplish this, the HRPWM module has built in self-check and diagnostic capabilities that can be used to determine the optimum MEP scale factor value for any operating condition. TI provides a C-callable library containing one SFO function that utilizes this hardware and determines the optimum MEP scale factor. As such, MEP control and diagnostics registers are reserved for TI use.

A detailed description of the SFO library - SFO\_TI\_Build\_V7.lib software can be found in [Section 14.3](#).

### 14.2.7 HRPWM Examples Using Optimized Assembly Code.

The best way to understand how to use the HRPWM capabilities is through two real examples:

1. Simple buck converter using asymmetrical PWM (count-up) with active high polarity.
2. DAC function using simple R+C reconstruction filter.

The following examples all have initialization and configuration code written in C. To make these easier to understand, the #defines shown below are used. Note, #defines introduced in the device-specific *Pulse Width Modulator (ePWM) Module Reference Guide* are also used.

**Example 14-1** This example assumes MEP step size of 150 ps and does not use the SFO library.

**Example 14-1. #Defines for HRPWM Header Files**

```

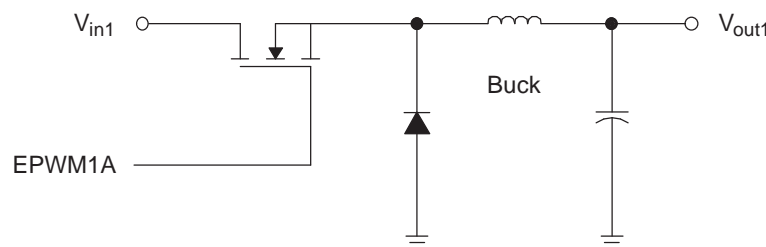
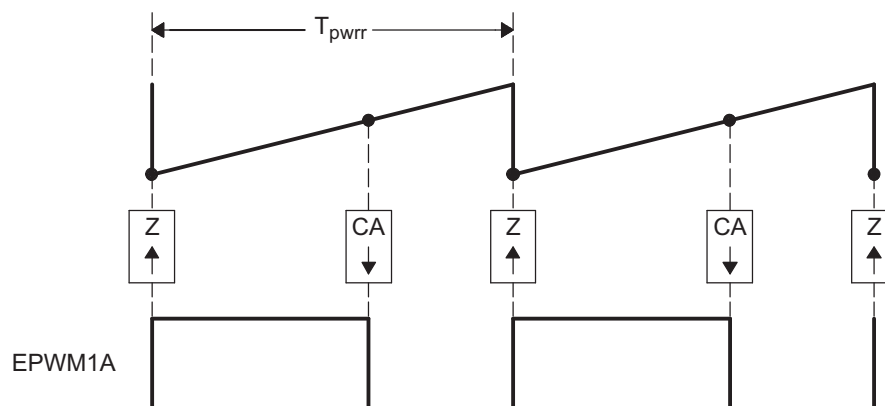
// HRPWM (High Resolution PWM) //
=====
// HRCNFG
#define HR_Disable 0x0
#define HR_REP 0x1          // Rising Edge position
#define HR_FEP 0x2          // Falling Edge position
#define HR_BEP 0x3          // Both Edge position #define HR_CMP 0x0 // CMPAHR controlled
#define HR_PHS 0x1          // TBPHSHR controlled #define HR_CTR_ZERO 0x0 // CTR = Zero event
#define HR_CTR_PRD 0x1      // CTR = Period event
#define HR_CTR_ZERO_PRD 0x2 // CTR = ZERO or Period event
#define HR_NORM_B 0x0       // Normal ePWMxB output
#define HR_INVERT_B 0x1     // ePWMxB is inverted ePWMxA output
    
```

**14.2.7.1 Implementing a Simple Buck Converter**

In this example, the PWM requirements are:

- PWM frequency = 1 MHz (that is, TBPRD = 100 )
- PWM mode = asymmetrical, up-count
- Resolution = 12.7 bits (with a MEP step size of 150 ps)

Figure 14-11 and Figure 14-12 show the required PWM waveform. As explained previously, configuration for the ePWM1 module is almost identical to the normal case except that the appropriate MEP options need to be enabled/selected.

**Figure 14-11. Simple Buck Controlled Converter Using a Single PWM**

**Figure 14-12. PWM Waveform Generated for Simple Buck Controlled Converter**




The example code shown consists of two main parts:

- Initialization code (executed once)
- Run time code (typically executed within an ISR)

[Example 14-2](#) shows the Initialization code. The first part is configured for conventional PWM. The second part sets up the HRPWM resources.

This example assumes MEP step size of 150 ps and does not use the SFO library.

### **Example 14-2. HRPWM Buck Converter Initialization Code**

```

void HrBuckDrvCnf(void)
{
// Config for conventional PWM first
EPwm1Regs.TBCTL.bit.PRDL = TB_IMMEDIATE;           // set Immediate load
EPwm1Regs.TBPRD = 100;                             // Period set for 1000 kHz PWM
hrbuck_period = 200;                               // Used for Q15 to Q0 scaling
EPwm1Regs.TBCTL.bit.CTRMODE = TB_COUNT_UP;
EPwm1Regs.TBCTL.bit.PHSEN = TB_DISABLE;           // EPWM1 is the Master
EPwm1Regs.TBCTL.bit.SYNCSEL = TB_SYNC_DISABLE;
EPwm1Regs.TBCTL.bit.HSPCLKDIV = TB_DIV1;
EPwm1Regs.TBCTL.bit.CLKDIV = TB_DIV1;
// Note: ChB is initialized here only for comparison purposes, it is not required

EPwm1Regs.CMPCTL.bit.LOADMODE = CC_CTR_ZERO;
EPwm1Regs.CMPCTL.bit.SHDWAMODE = CC_SHADOW;
EPwm1Regs.CMPCTL.bit.LOADBMODE = CC_CTR_ZERO;     // optional
EPwm1Regs.CMPCTL.bit.SHDWBMODE = CC_SHADOW;     // optional

EPwm1Regs.AQCTLA.bit.ZRO = AQ_SET;
EPwm1Regs.AQCTLA.bit.CAU = AQ_CLEAR;
EPwm1Regs.AQCTLB.bit.ZRO = AQ_SET;               // optional
EPwm1Regs.AQCTLB.bit.CBU = AQ_CLEAR;             // optional
// Now configure the HRPWM resources
EALLOW;                                           // Note these registers are protected
                                                    // and act only on ChA
EPwm1Regs.HRCNFG.all = 0x0;                       // clear all bits first
EPwm1Regs.HRCNFG.bit.EDGMODE = HR_FEP;           // Control Falling Edge Position
EPwm1Regs.HRCNFG.bit.CTLMODE = HR_CMP;           // CMPAHR controls the MEP
EPwm1Regs.HRCNFG.bit.HRLOAD = HR_CTR_ZERO;       // Shadow load on CTR=Zero
EDIS;
MEP_ScaleFactor = 66*256;                         // Start with typical Scale Factor
                                                    // value for 100 MHz
                                                    // Note: Use SFO functions to update
                                                    // MEP_ScaleFactor dynamically
}

```

[Example 14-3](#) shows an assembly example of run-time code for the HRPWM buck converter.

**Example 14-3. HRPWM Buck Converter Run-Time Code**

```

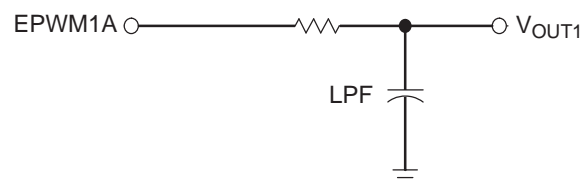
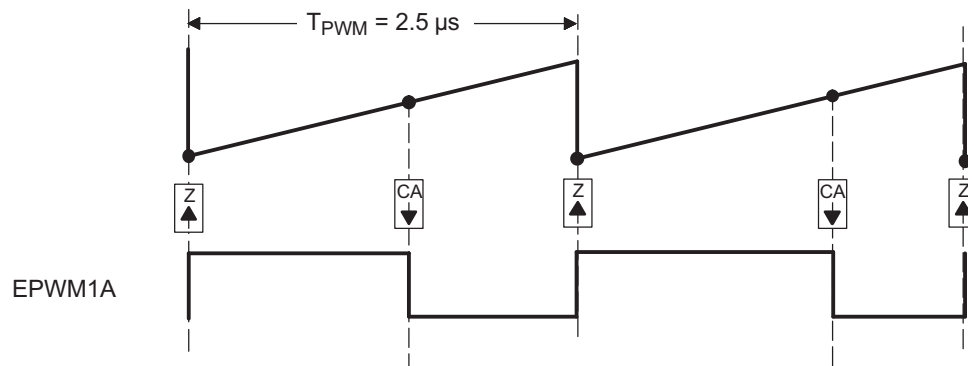
EPWM1_BASE .set 0x6800
CMPAHR1 .set EPWM1_BASE+0x8
;=====
HRBUCK_DRV; (can execute within an ISR or loop)
;=====
    MOVW DP, #_HRBUCK_In
    MOVL XAR2,@_HRBUCK_In      ; Pointer to Input Q15 Duty (XAR2)
    MOVL XAR3,#CMPAHR1        ; Pointer to HRPWM CMPA reg (XAR3)
; Output for EPWM1A (HRPWM)
    MOV T,*XAR2 ; T <= Duty
    MPYU ACC,T,@_hrbuck_period ; Q15 to Q0 scaling based on Period
    MOV T,@_MEP_ScaleFactor    ; MEP scale factor (from optimizer s/w)
    MPYU P,T,@AL               ; P <= T * AL, Optimizer scaling
    MOVH @AL,P                 ; AL <= P, move result back to ACC
    ADD ACC, #0x080            ; MEP range and rounding adjustment
    MOVL *XAR3,ACC             ; CMPA:CMPAHR(31:8) <= ACC
; Output for EPWM1B (Regular Res) Optional - for comparison purpose only
    MOV *+XAR3[2],AH           ; Store ACCH to regular CMPB
    
```

**14.2.7.2 Implementing a DAC function Using an R+C Reconstruction Filter**

In this example, the PWM requirements are:

- PWM frequency = 400 kHz (that is, TBPRD = 250)
- PWM mode = Asymmetrical, Up-count
- Resolution = 14 bits (MEP step size = 150 ps)

Figure 14-13 and Figure 14-14 show the DAC function and the required PWM waveform. As explained previously, configuration for the ePWM1 module is almost identical to the normal case except that the appropriate MEP options need to be enabled/selected.

**Figure 14-13. Simple Reconstruction Filter for a PWM-based DAC**

**Figure 14-14. PWM Waveform Generated for the PWM DAC Function**


The example code shown consists of two main parts:

- Initialization code (executed once)
- Run time code (typically executed within an ISR)

This example assumes a typical MEP\_SP and does not use the SFO library.

[Example 14-4](#) shows the Initialization code. The first part is configured for conventional PWM. The second part sets up the HRPWM resources.

#### **Example 14-4. PWM DAC Function Initialization Code**

```

void HrPwmDacDrvCnf(void)
{
// Config for conventional PWM first
EPwm1Regs.TBCTL.bit.PRDL = TB_IMMEDIATE;           // Set Immediate load
EPwm1Regs.TBPRD = 250;                             // Period set for 400 kHz PWM
hrDAC_period = 250;                                 // Used for Q15 to Q0 scaling
EPwm1Regs.TBCTL.bit.CTRMODE = TB_COUNT_UP;
EPwm1Regs.TBCTL.bit.PHSEN = TB_DISABLE;           // EPWM1 is the Master
EPwm1Regs.TBCTL.bit.SYNCSEL = TB_SYNC_DISABLE;
EPwm1Regs.TBCTL.bit.HSPCLKDIV = TB_DIV1;
EPwm1Regs.TBCTL.bit.CLKDIV = TB_DIV1;
// Note: ChB is initialized here only for comparison purposes, it is not required

EPwm1Regs.CMPCTL.bit.LOADAMODE = CC_CTR_ZERO;
EPwm1Regs.CMPCTL.bit.SHDWAMODE = CC_SHADOW;
EPwm1Regs.CMPCTL.bit.LOADBMODE = CC_CTR_ZERO; // optional
EPwm1Regs.CMPCTL.bit.SHDWBMODE = CC_SHADOW; // optional

EPwm1Regs.AQCTLA.bit.ZRO = AQ_SET;
EPwm1Regs.AQCTLA.bit.CAU = AQ_CLEAR;
EPwm1Regs.AQCTLB.bit.ZRO = AQ_SET;               // optional
EPwm1Regs.AQCTLB.bit.CBU = AQ_CLEAR;           // optional
// Now configure the HRPWM resources
EALLOW;                                           // Note these registers are protected
                                                    // and act only on ChA.
EPwm1Regs.HRCNFG.all = 0x0; // Clear all bits first
EPwm1Regs.HRCNFG.bit.EDGMODE = HR_FEP;          // Control falling edge position
EPwm1Regs.HRCNFG.bit.CTLMODE = HR_CMP;         // CMPAHR controls the MEP.
EPwm1Regs.HRCNFG.bit.HRLOAD = HR_CTR_ZERO;     // Shadow load on CTR=Zero.
EDIS;
MEP_ScaleFactor = 66*256;                        // Start with typical Scale Factor
                                                    // value for 100 MHz.
                                                    // Use SFO functions to update MEP_ScaleFactor
                                                    // dynamically.
}

```

[Example 14-5](#) shows an assembly example of run-time code that can execute in a high-speed ISR loop.

**Example 14-5. PWM DAC Function Run-Time Code**

```

EPWM1_BASE .set 0x6800
CMPAHR1 .set EPWM1_BASE+0x8
;=====
HRPWM_DAC_DRV; (can execute within an ISR or loop)
;=====
    MOVW DP, #_HRDAC_In
    MOVL XAR2,@_HRDAC_In          ; Pointer to input Q15 duty (XAR2)
    MOVL XAR3,#CMPAHR1           ; Pointer to HRPWM CMPA reg (XAR3)

; Output for EPWM1A (HRPWM
    MOV T,*XAR2                  ; T <= duty
    MPY ACC,T,@_hrDAC_period     ; Q15 to Q0 scaling based on period
    ADD ACC,@_hrDAC_period<<15 ; Offset for bipolar operation
    MOV T,@_MEP_ScaleFactor      ; MEP scale factor (from optimizer s/w)
    MPYU P,T,@AL                 ; P <= T * AL, optimizer scaling
    MOVH @AL,P                  ; AL <= P, move result back to ACC
    ADD ACC, #0x080             ; MEP range and rounding adjustment
    MOVL *XAR3,ACC              ; CMPA:CMPAHR(31:8) <= ACC

; Output for EPWM1B (Regular Res) Optional - for comparison purpose only
    MOV *+XAR3[2],AH            ; Store ACCH to regular CMPB
  
```

## 14.3 Appendix A: SFO Library Software - SFO\_TI\_Build\_V7.lib

The following table lists several features of the SFO\_TI\_Build\_V7.lib library.

**Table 14-5. SFO Library Features**

	SFO_TI_Build_V7.lib	Unit
Completion-checking?	Yes	Function return value
Typical cycles required for SFO() to update MEP_ScaleFactor if called repetitively without interrupts	130,000	EPWMCLK cycles

A functional description of the SFO library routine, SFO(), is found below.

### 14.3.1 Scale Factor Optimizer Function - int SFO()

This routine drives the micro-edge positioner (MEP) calibration module to run SFO diagnostics and determine the appropriate MEP scale factor (number of MEP steps per coarse EPWMCLK step) for a device at any given time.

If EPWMCLK = TBCLK = 100 MHz and assuming the MEP step size is 150 ps, the typical scale factor value at 100 MHz = 66 MEP steps per TBCLK unit (10 ns)

The function returns a MEP scale factor value:

$$\text{MEP\_ScaleFactor} = \text{Number of MEP steps per EPWMCLK.}$$

#### Constraints when using this function:

- SFO() can be used with a minimum EPWMCLK = TBCLK = 50 MHz. MEP diagnostics logic uses EPWMCLK and not TBCLK, so the EPWMCLK restriction is an important constraint. Below 50 MHz, with device process variation, the MEP step size may decrease under cold temperature and high core voltage conditions to such a point, that 255 MEP steps will not span an entire EPWMCLK cycle.
- At any time, SFO() can be called to run SFO diagnostics on the MEP calibration module

#### Usage:

- SFO() can be called at any time in the background while the ePWM channels are running in HRPWM mode. The scale factor result obtained can be applied to all ePWM channels running in HRPWM mode because the function makes use of the diagnostics logic in the MEP calibration module (which runs independently of ePWM channels).
- This routine returns a 1 when calibration is finished and a new scale factor has been calculated, or a 0 if calibration is still running. The routine returns a 2 if there is an error, and the MEP\_ScaleFactor is greater than the maximum 255 fine steps per coarse EPWMCLK cycle. In this case, the HRMSTEP register will maintain the last MEP scale factor value less than 256 for auto conversion.
- All ePWM modules operating in HRPWM incur only a 3-EPWMCLK cycle minimum duty cycle limitation when high-resolution period control is not used. If high-resolution period control is enabled, there is an additional duty cycle limitation 3-EPWMCLK cycles before the end of the PWM period (see [Section 14.2.4.3](#)).
- The SFO() function also updates the HRMSTEP register with the scale factor result. If the HRCNFG[AUTOCONV] bit is set, the application software is responsible only for setting CMPAHR =  $\text{fraction}(\text{PWMduty} * \text{PWMperiod}) \ll 8$  or CMPBHR =  $\text{fraction}(\text{PWMduty} * \text{PWMperiod}) \ll 8$  or TBPRDHR =  $\text{fraction}(\text{PWMperiod})$  while running SFO() in the background. The MEP Calibration Module will then use the values in the HRMSTEP and CMPAHR/CMPBHR/TBPRDHR register to automatically calculate the appropriate number of MEP steps represented by the fractional duty cycle or period and move the high-resolution ePWM signal edge accordingly.
- If the HRCNFG[AUTOCONV] bit is clear, the HRMSTEP register is ignored. The application software will need to perform the necessary calculations manually so that:
  - $\text{CMPAHR} = (\text{fraction}(\text{PWMduty} * \text{PWMperiod}) * \text{MEP Scale Factor}) \ll 8 + 0x080$ .
  - Similar behavior applies for TBPHSHR, CMPBHR, DBREDHR, DBFEDHR. Auto-conversion must be enabled when using TBPRDHR.

The routine can be run as a background task in a slow loop requiring negligible CPU cycles. The repetition rate at which an SFO function needs to be executed depends on the application's operating environment. As with all digital CMOS devices, temperature and supply voltage variations have an effect on MEP operation. However, in most applications these parameters vary slowly and therefore it is often sufficient to execute the SFO function once every 5 to 10 seconds. If more rapid variations are expected, then execution may have to be performed more frequently to match the application. Note, there is no high limit restriction on the SFO function repetition rate, hence it can execute as quickly as the background loop is capable.

While using the HRPWM feature, HRPWM logic will not be active for the first three EPWMCLK cycles of the PWM period (and the last three EPWMCLK cycles of the PWM period if TBPRDHR is used). While running the application in this configuration, if high-resolution period control is disabled (HRPCTL[HRPE=0]) and the CMPA/CMPB register value is less than three cycles, then its CMPAHR/CMPBHR register must be cleared to zero. If high-resolution period control is enabled (HRPCTL[HRPE=1]), the CMPA register value must not fall below three or above TBPRD-3. This would avoid any unexpected transitions on the PWM signal.

### 14.3.2 Software Usage

The software library function SFO(), calculates the MEP scale factor for the HRPWM-supported ePWM modules. The scale factor is an integer value in the range 1-255, and represents the number of micro step edge positions available for a system clock period. The scale factor value is returned in an integer variable called MEP\_ScaleFactor. For example, see [Table 14-6](#).

**Table 14-6. Factor Values**

Software Function call	Functional Description	Updated Variables
SFO()	Returns MEP scale factor in the HRMSTEP register	MEP_ScaleFactor & HRMSTEP register.

To use the HRPWM feature of the ePWMs, it is recommended that the SFO function be used as described here.

#### Step 1. Add "Include" Files

The SFO\_V7.h file needs to be included as follows. This include file is mandatory while using the SFO library function. For the SFO() to operate, the appropriate (Device)\_Device.h and (Device)\_Epwm\_defines.h must be included in the project. These include files are optional if customized header files are used in the end applications.

#### Example 14-6. A Sample of How to Add "Include" Files

```
#include "F28x7x_Device.h"           // F28x7x Headerfile
#include "F28x7x_EPwm_defines.h"    // init defines
#include "SFO_V7.h"                  // SFO lib functions (needed for HRPWM)
```

#### Step 2. Element Declaration

Declare an integer variable for the scale factor value as shown below.

### Example 14-7. Declaring an Element

```
int MEP_ScaleFactor = 0;    //scale factor value
volatile struct EPWM_REGS *ePWM[] = {0, &EPwm1Regs, &EPwm2Regs, &EPwm3Regs,
&EPwm4Regs};
```

#### Step 3. MEP\_ScaleFactor Initialization

The SFO() function does not require a starting scale factor value in MEP\_ScaleFactor. Prior to using the MEP\_ScaleFactor variable in application code, SFO() should be called to drive the MEP calibration module to calculate an MEP\_ScaleFactor value.

As part of the one-time initialization code prior to using MEP\_ScaleFactor, include the following:

### Example 14-8. Initializing With a Scale Factor Value

```
MEP_ScaleFactor initialized using function SFO ()
while (SFO() == 0) {} // MEP_ScaleFactor calculated by MEP Cal Module
```

#### Step 4. Application Code

While the application is running, fluctuations in both device temperature and supply voltage may be expected. To be sure that optimal Scale Factors are used for each ePWM module, the SFO function should be re-run periodically as part of a slower back-ground loop. Some examples of this are shown here.

---

**NOTE:** See the HRPWM\_SFO example in the device-specific C/C++ header files and peripheral examples available from the TI website.

---

### Example 14-9. SFO Function Calls

```
main ()
{
  int status;
  // User code
  // ePWM1, 2, 3, 4 are running in HRPWM mode
  // The status variable returns 1 once a new MEP_ScaleFactor has been
  // calculated by the MEP Calibration Module running SFO
  // diagnostics.

  status = SFO();
  if(status==2) {ESTOP0;} // The function returns a 2 if MEP_ScaleFactor is greater
                        // than the maximum 255 allowed (error condition)
}
```

## **Enhanced Capture (eCAP)**

This chapter describes the enhanced capture (eCAP), which is used in systems where accurate timing of external events is important.

The eCAP module described in this reference guide is a Type 0 eCAP. See the *TMS320C28xx, 28xxx DSP Peripheral Reference Guide* ([SPRU566](#)) for a list of all devices with a eCAP module of the same type, to determine the differences between the types, and for a list of device-specific differences within a type.

Topic	Page
15.1 Introduction .....	1905
15.2 Description .....	1905
15.3 Configuring Device Pins for the eCAP .....	1905
15.4 Capture and APWM Operating Mode .....	1906
15.5 Capture Mode Description .....	1907
15.6 Application of the ECAP Module .....	1915
15.7 Application of the APWM Mode .....	1924
15.8 Registers .....	1926



## 15.1 Introduction

Features for eCAP include:

- Speed measurements of rotating machinery (for example, toothed sprockets sensed via Hall sensors)
- Elapsed time measurements between position sensor pulses
- Period and duty cycle measurements of pulse train signals
- Decoding current or voltage amplitude derived from duty cycle encoded current/voltage sensors

The eCAP module described in this guide includes the following features:

- 4-event time-stamp registers (each 32 bits)
- Edge polarity selection for up to four sequenced time-stamp capture events
- Interrupt on any of the four events
- Single shot capture of up to four event time-stamps
- Continuous mode capture of time-stamps in a four-deep circular buffer
- Absolute time-stamp capture
- Difference (Delta) mode time-stamp capture
- All above resources dedicated to a single input pin
- When not used in capture mode, the ECAP module can be configured as a single channel PWM output

## 15.2 Description

The eCAP module represents one complete capture channel that can be instantiated multiple times depending on the target device. In the context of this guide, one eCAP channel has the following independent key resources:

- Dedicated input capture pin
- 32-bit time base (counter)
- 4 x 32-bit time-stamp capture registers (CAP1-CAP4)
- 4-stage sequencer (Modulo4 counter) that is synchronized to external events, ECAP pin rising/falling edges.
- Independent edge polarity (rising/falling edge) selection for all 4 events
- Input capture signal prescaling (from 2-62)
- One-shot compare register (2 bits) to freeze captures after 1 to 4 time-stamp events
- Control for continuous time-stamp captures using a 4-deep circular buffer (CAP1-CAP4) scheme
- Interrupt capabilities on any of the 4 capture events

## 15.3 Configuring Device Pins for the eCAP

To connect the device input pins to the module, the Input X-BAR must be used. Any GPIO on the device can be configured as an input. The GPIO input qualification can be set to synchronous or asynchronous mode. Using synchronized inputs can help with noise immunity; however, when synchronized inputs are used this will affect the eCAP's accuracy  $\pm 2$  cycles. The internal pull-ups can be configured in the GPyPUD register. Since the GPIO mode is used the GPyINV register can invert the signals.

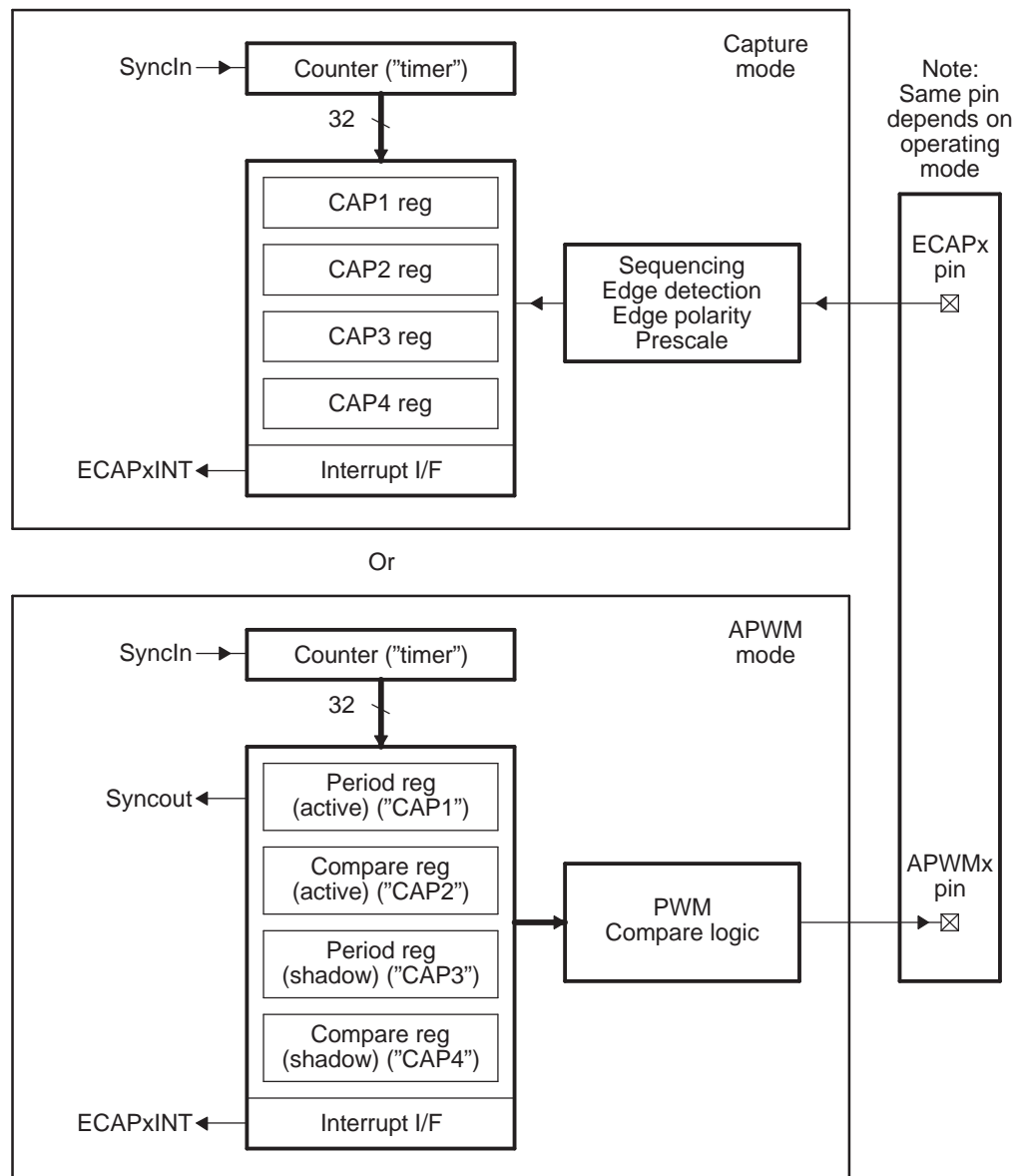
The Output X-BAR must be used to connect output signals to the OUTPUTXBARx output locations. The GPIO mux then be configured to connect the OUTPUTXBARx lines to any of several IO pins with the GPIO Mux. To avoid glitches on the pins, the GPyGMUX bits must be configured first (while keeping the corresponding GPyMUX bits at the default of zero), followed by writing the GPyMUX register to the desired value.

See the *GPIO Chapter* for more details on GPIO mux, GPIO settings, and XBAR configuration.

## 15.4 Capture and APWM Operating Mode

You can use the eCAP module resources to implement a single-channel PWM generator (with 32-bit capabilities) when it is not being used for input captures. The counter operates in count-up mode, providing a time-base for asymmetrical pulse width modulation (PWM) waveforms. The CAP1 and CAP2 registers become the active period and compare registers, respectively, while CAP3 and CAP4 registers become the period and capture shadow registers, respectively. Figure 15-1 is a high-level view of both the capture and auxiliary pulse-width modulator (APWM) modes of operation.

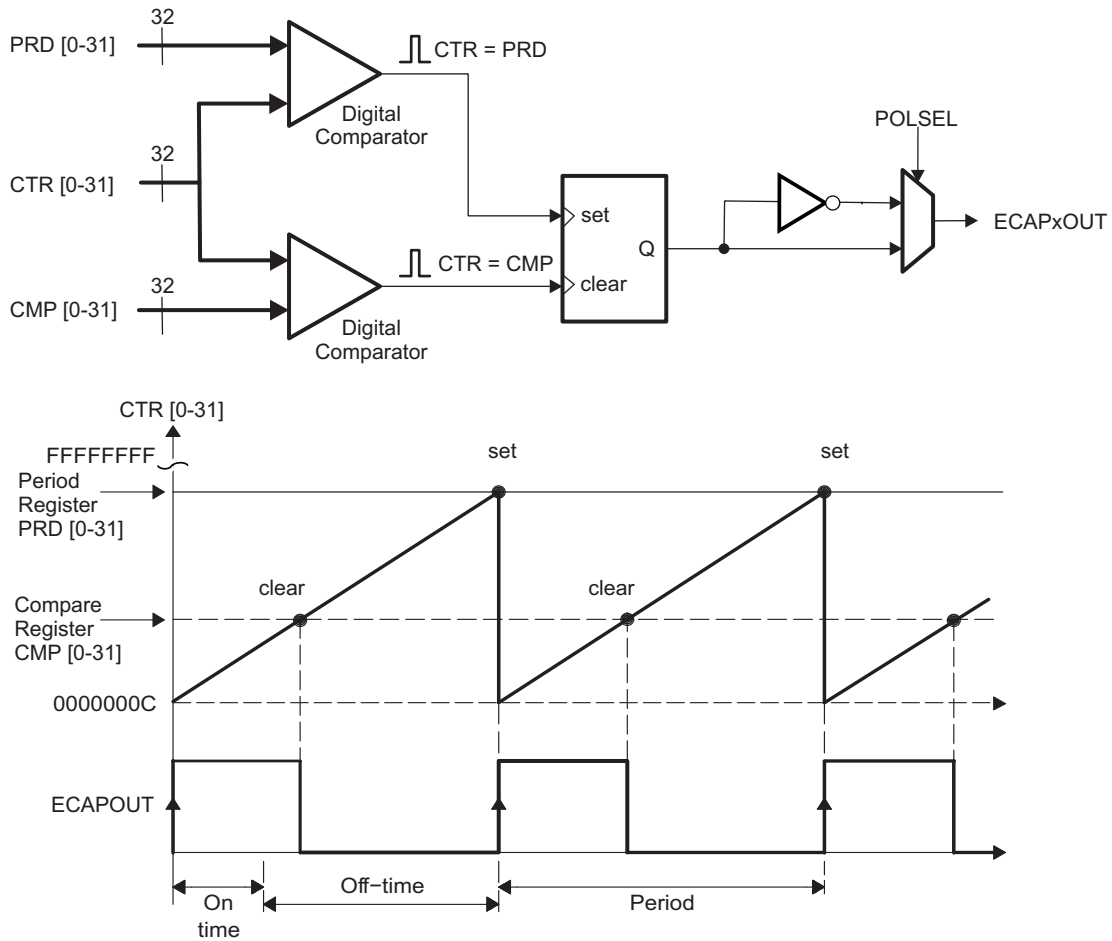
**Figure 15-1. Capture and APWM Modes of Operation**



- A A single pin is shared between CAP and APWM functions. In capture mode, it is an input; in APWM mode, it is an output.
- B In APWM mode, writing any value to CAP1/CAP2 active registers also writes the same value to the corresponding shadow registers CAP3/CAP4. This emulates immediate mode. Writing to the shadow registers CAP3/CAP4 invokes the shadow mode.

Figure 15-2 further describes the output of the eCAP in APWM mode based on the CMP and PRD values.

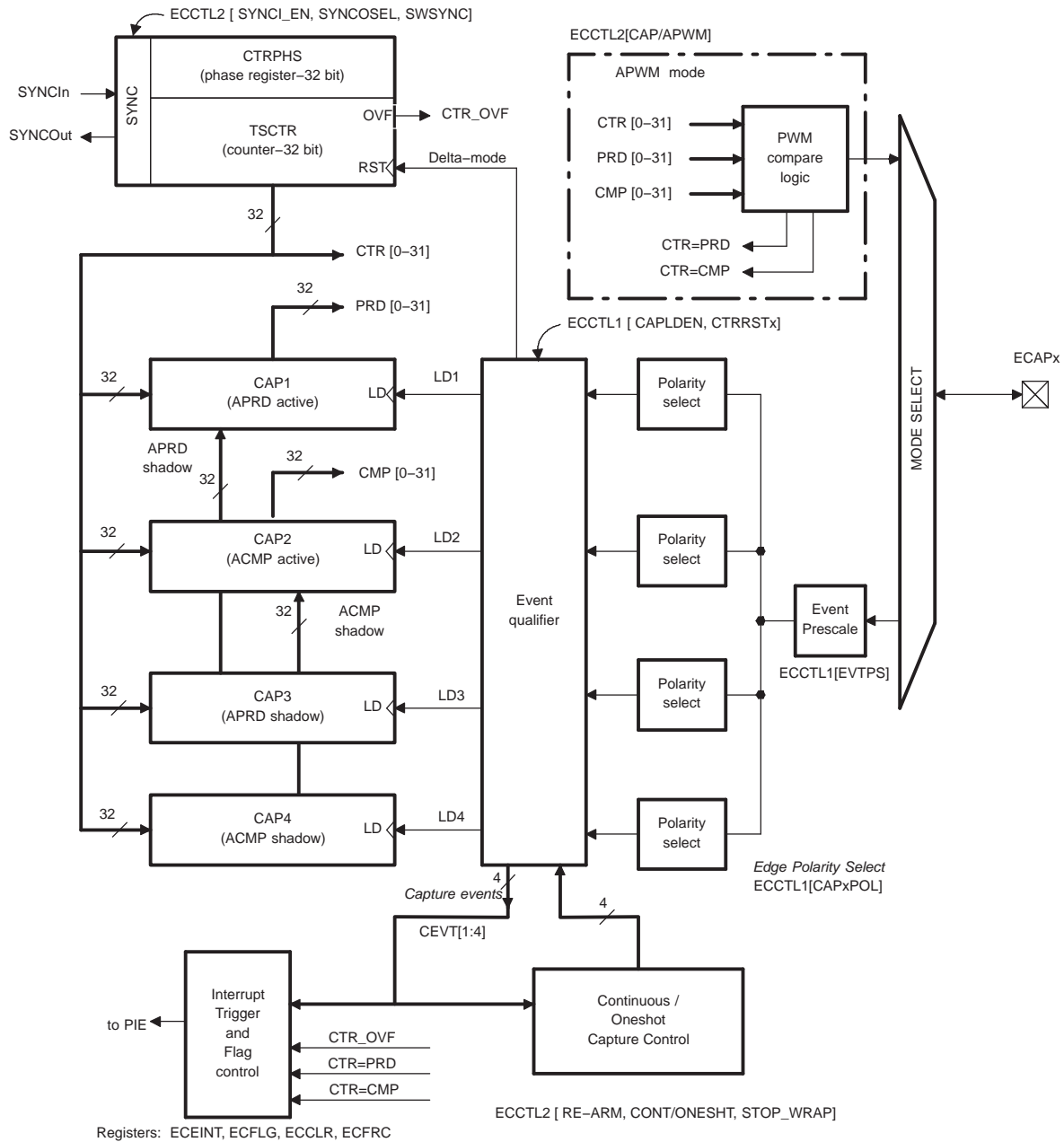
**Figure 15-2. Counter Compare and PRD Effects on the eCAP Output in APWM Mode**



### 15.5 Capture Mode Description

Figure 15-3 shows the various components that implement the capture function.

Figure 15-3. Capture Function Diagram

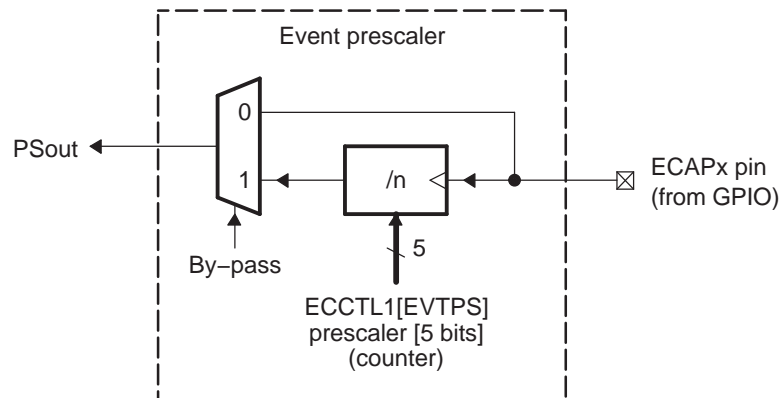


### 15.5.1 Event Prescaler

- An input capture signal (pulse train) can be prescaled by  $N = 2-62$  (in multiples of 2) or can bypass the prescaler.

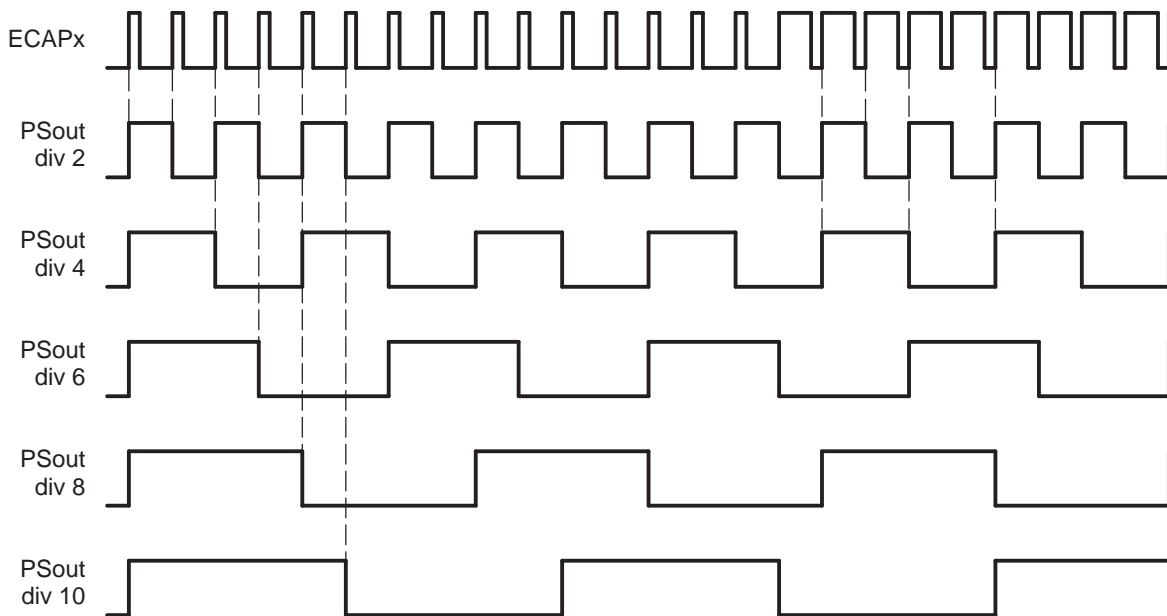
This is useful when very high frequency signals are used as inputs. Figure 15-4 shows a functional diagram and Figure 15-5 shows the operation of the prescale function.

Figure 15-4. Event Prescale Control



- A When a prescale value of 1 is chosen ( ECCTL1[13:9] = 0,0,0,0,0 ) the input capture signal by-passes the prescale logic completely.

Figure 15-5. Prescale Function Waveforms



### 15.5.2 Edge Polarity Select and Qualifier

- Four independent edge polarity (rising edge/falling edge) selection MUXes are used, one for each capture event.
- Each edge (up to 4) is event qualified by the Modulo4 sequencer.
- The edge event is gated to its respective CAPx register by the Mod4 counter. The CAPx register is loaded on the falling edge.

### 15.5.3 Continuous/One-Shot Control

- The Mod4 (2 bit) counter is incremented via edge qualified events (CEVT1-CEVT4).
- The Mod4 counter continues counting (0->1->2->3->0) and wraps around unless stopped.
- A 2-bit stop register is used to compare the Mod4 counter output, and when equal stops the Mod4 counter and inhibits further loads of the CAP1-CAP4 registers. This occurs during one-shot operation.

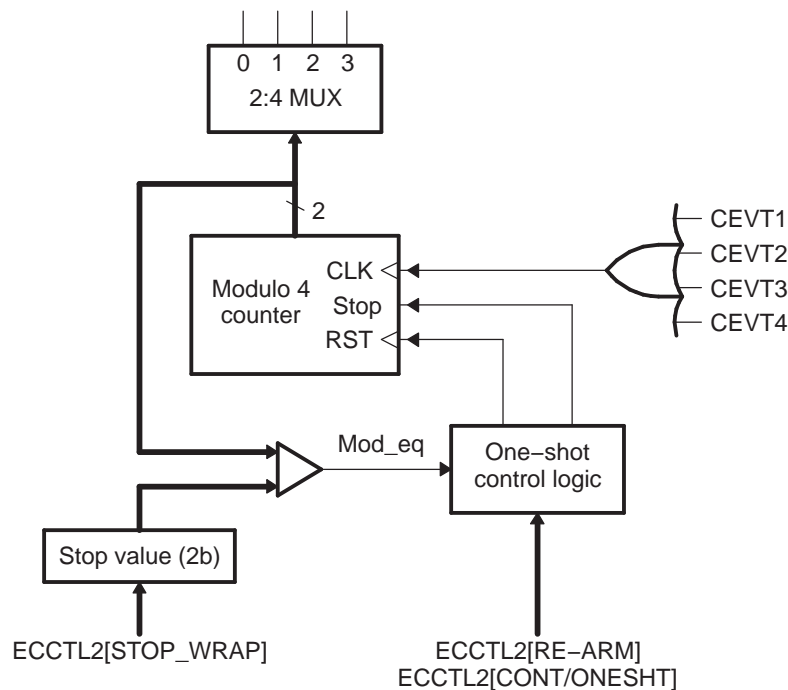
The continuous/one-shot block controls the start/stop and reset (zero) functions of the Mod4 counter via a mono-shot type of action that can be triggered by the stop-value comparator and re-armed via software control.

Once armed, the eCAP module waits for 1-4 (defined by stop-value) capture events before freezing both the Mod4 counter and contents of CAP1-4 registers (time-stamps).

Re-arming prepares the eCAP module for another capture sequence. Also re-arming clears (to zero) the Mod4 counter and permits loading of CAP1-4 registers again, providing the CAPLDEN bit is set.

In continuous mode, the Mod4 counter continues to run (0->1->2->3->0, the one-shot action is ignored, and capture values continue to be written to CAP1-4 in a circular buffer sequence).

**Figure 15-6. Details of the Continuous/One-shot Block**



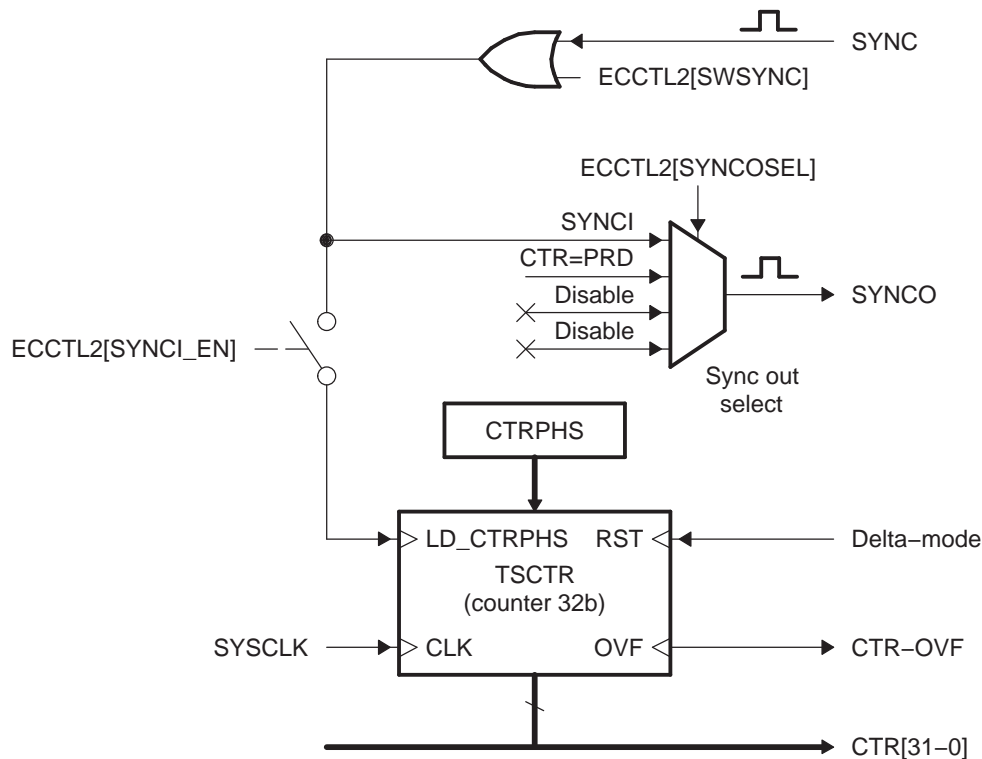
#### 15.5.4 32-Bit Counter and Phase Control

This counter provides the time-base for event captures, and is clocked via the system clock.

A phase register is provided to achieve synchronization with other counters, via a hardware and software forced sync. This is useful in APWM mode when a phase offset between modules is needed.

On any of the four event loads, an option to reset the 32-bit counter is given. This is useful for time difference capture. The 32-bit counter value is captured first, then it is reset to 0 by any of the LD1-LD4 signals.

Figure 15-7. Details of the Counter and Synchronization Block



### 15.5.5 CAP1-CAP4 Registers

These 32-bit registers are fed by the 32-bit counter timer bus, CTR[0-31] and are loaded (capture a timestamp) when their respective LD inputs are strobed.

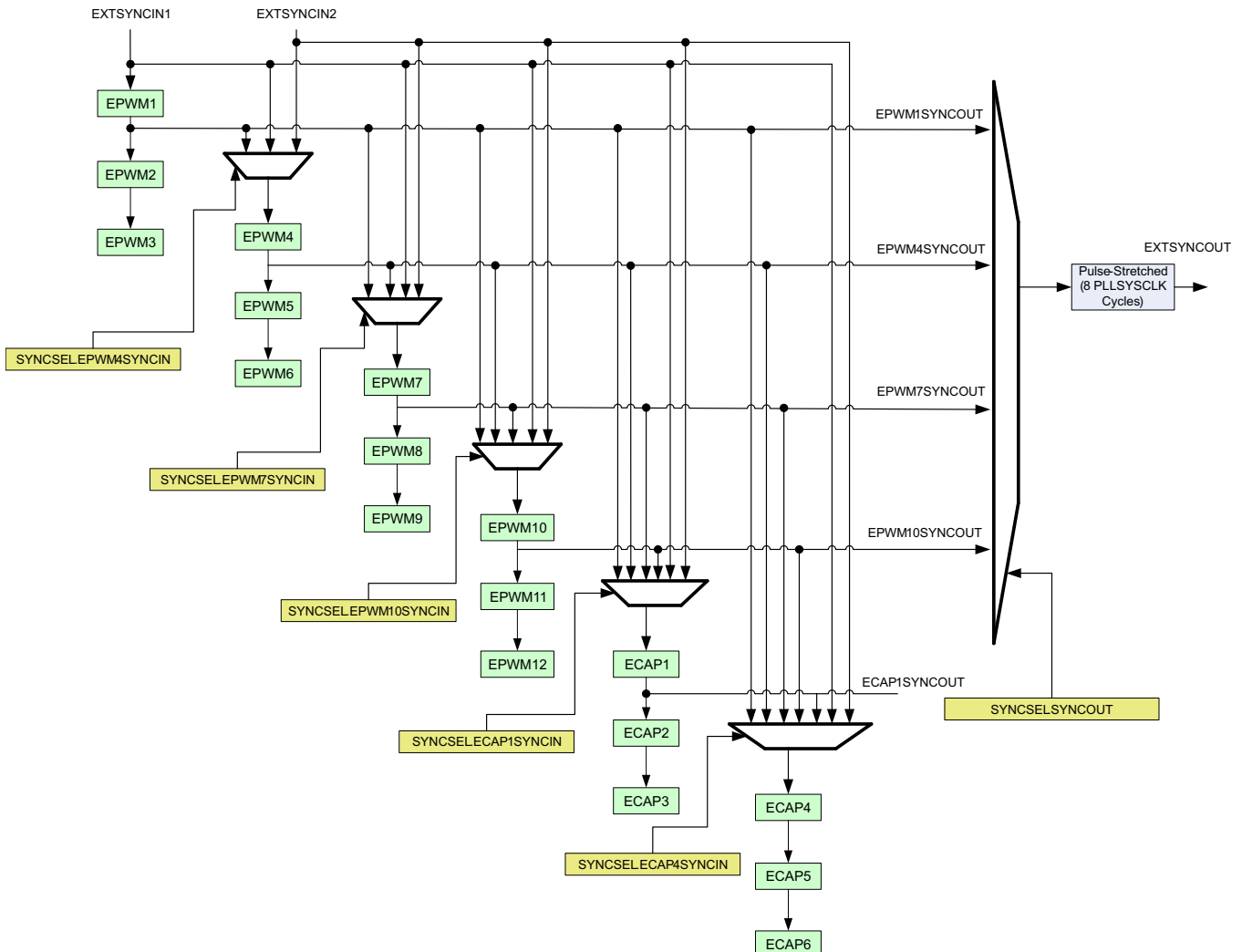
Loading of the capture registers can be inhibited via control bit CAPLDEN. During one-shot operation, this bit is cleared (loading is inhibited) automatically when a stop condition occurs, StopValue = Mod4.

CAP1 and CAP2 registers become the active period and compare registers, respectively, in APWM mode.

CAP3 and CAP4 registers become the respective shadow registers (APRD and ACMP) for CAP1 and CAP2 during APWM operation.

### 15.5.6 Using SWSYNC with the ECAP Module

The SWSYNC of the ECAP module is logical OR'd with the SYNC signal as shown in Figure 15-7. The SYNC signal is defined by the selection in the SYNCSEL[ECAPxSYNCLN] bit for ECAP1 and ECAP4 as shown in Figure 15-8.

**Figure 15-8. Time-Base Counter Synchronization Scheme 4**


Other ECAP modules receive the SYNC signal from the previous ECAP module. To use SWSYNC with ECAP1 and ECAP4, the following workaround can be implemented:

- Select an unused GPIO in InputXbarRegs.INPUT5SELECT.
- Configure this GPIO in output mode and Write '0' to GPIO DAT register. By default this is programmed to GPIO0 so any activity on this pin will cause problems with the SWSYNC
- Program SYNCSEL[ECAPxSYNCCIN] = 0x101. This will take ECAPx.EXTSYNCCIN to an inactive state.

To use SWSYNC with other ECAP modules, take measures to ensure that the previous ECAP chain is not generating a SYNCOUT signal which will interfere with the software synchronization.

### 15.5.7 Interrupt Control

An Interrupt can be generated on capture events (CEVT1-CEVT4, CTROVF) or APWM events (CTR = PRD, CTR = CMP).

A counter overflow event (FFFFFFFF->00000000) is also provided as an interrupt source (CTROVF).

The capture events are edge and sequencer qualified (ordered in time) by the polarity select and Mod4 gating, respectively.

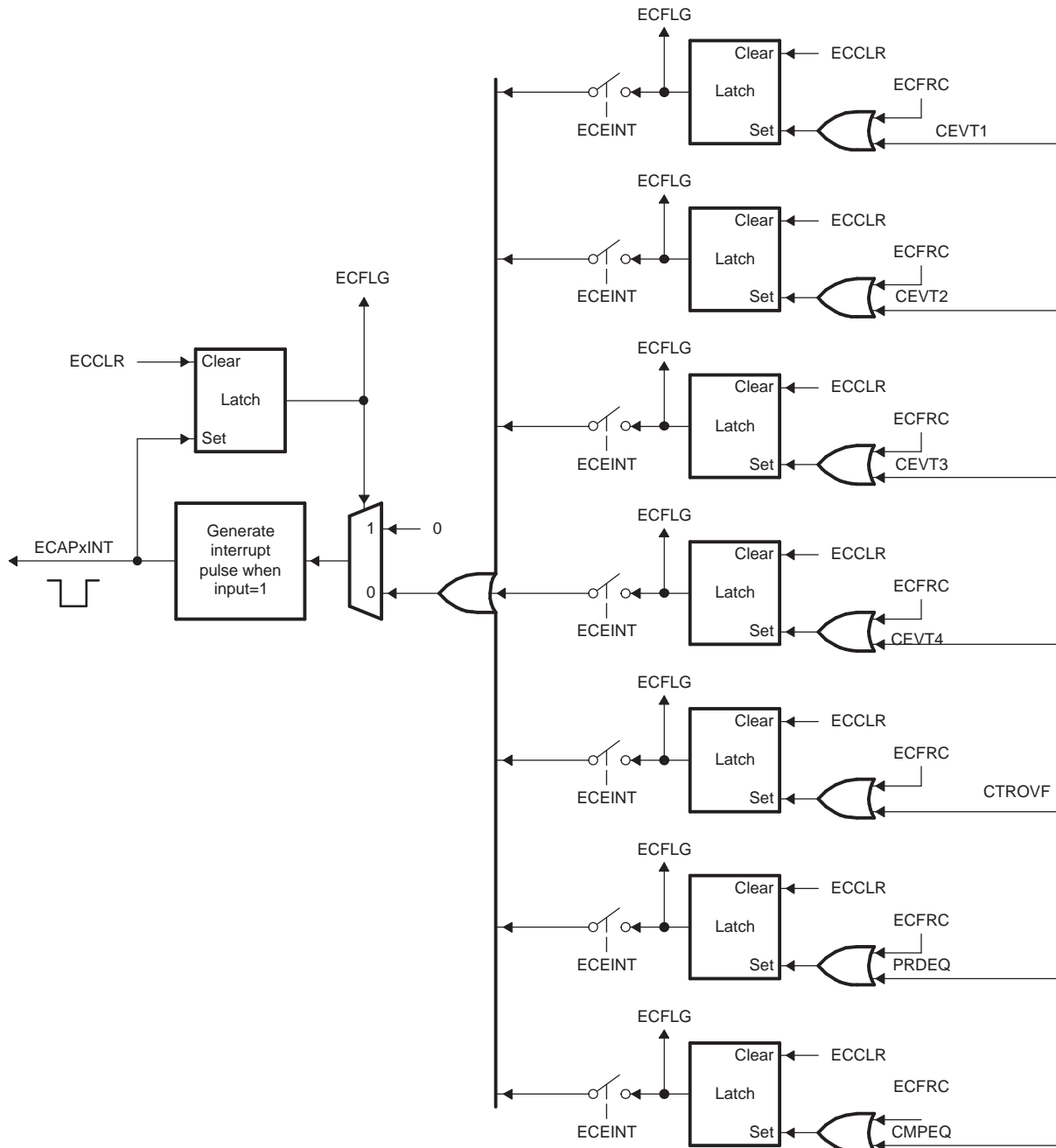
One of these events can be selected as the interrupt source (from the eCAPx module) going to the PIE.



Seven interrupt events (CEVT1, CEVT2, CEVT3, CEVT4, CNTOVF, CTR=PRD, CTR=CMP) can be generated. The interrupt enable register (ECEINT) is used to enable/disable individual interrupt event sources. The interrupt flag register (ECFLG) indicates if any interrupt event has been latched and contains the global interrupt flag bit (INT). An interrupt pulse is generated to the PIE only if any of the interrupt events are enabled, the flag bit is 1, and the INT flag bit is 0. The interrupt service routine must clear the global interrupt flag bit and the serviced event via the interrupt clear register (ECCLR) before any other interrupt pulses are generated. You can force an interrupt event via the interrupt force register (ECFRC). This is useful for test purposes.

**Note:** The CEVT1, CEVT2, CEVT3, CEVT4 flags are only active in capture mode (ECCTL2[CAP/APWM == 0]). The CTR=PRD, CTR=CMP flags are only valid in APWM mode (ECCTL2[CAP/APWM == 1]). CNTOVF flag is valid in both modes.

**Figure 15-9. Interrupts in eCAP Module**



### 15.5.8 Shadow Load and Lockout Control

In capture mode, this logic inhibits (locks out) any shadow loading of CAP1 or CAP2 from APRD and ACMP registers, respectively.

In APWM mode, shadow loading is active and two choices are permitted:

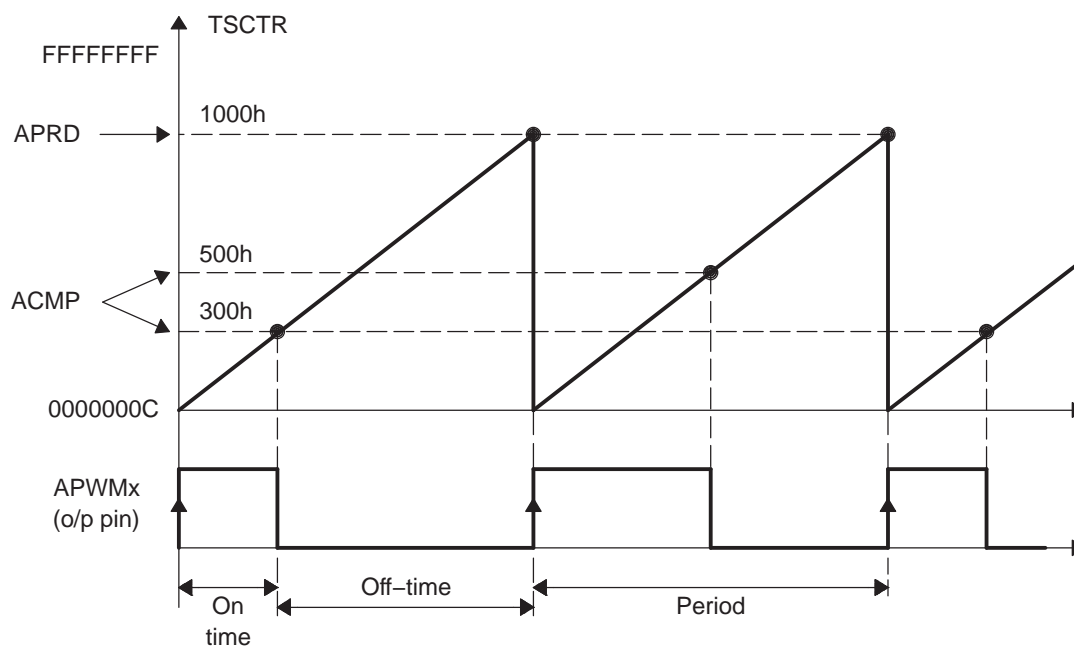
- Immediate - APRD or ACMP are transferred to CAP1 or CAP2 immediately upon writing a new value.
- On period equal,  $CTR[31:0] = PRD[31:0]$

### 15.5.9 APWM Mode Operation

Main operating highlights of the APWM section:

- The time-stamp counter bus is made available for comparison via 2 digital (32-bit) comparators.
- When CAP1/2 registers are not used in capture mode, their contents can be used as Period and Compare values in APWM mode.
- Double buffering is achieved via shadow registers APRD and ACMP (CAP3/4). The shadow register contents are transferred over to CAP1/2 registers either immediately upon a write, or on a  $CTR = PRD$  trigger.
- In APWM mode, writing to CAP1/CAP2 active registers will also write the same value to the corresponding shadow registers CAP3/CAP4. This emulates immediate mode. Writing to the shadow registers CAP3/CAP4 will invoke the shadow mode.
- During initialization, you must write to the active registers for both period and compare. This automatically copies the initial values into the shadow values. For subsequent compare updates, during run-time, you only need to use the shadow registers.

**Figure 15-10. PWM Waveform Details Of APWM Mode Operation**



The behavior of APWM active high mode ( $APWMPOL == 0$ ) is as follows:

$CMP = 0x00000000$ , output low for duration of period (0% duty)

$CMP = 0x00000001$ , output high 1 cycle

$CMP = 0x00000002$ , output high 2 cycles

$CMP = PERIOD$ , output high except for 1 cycle (<100% duty)

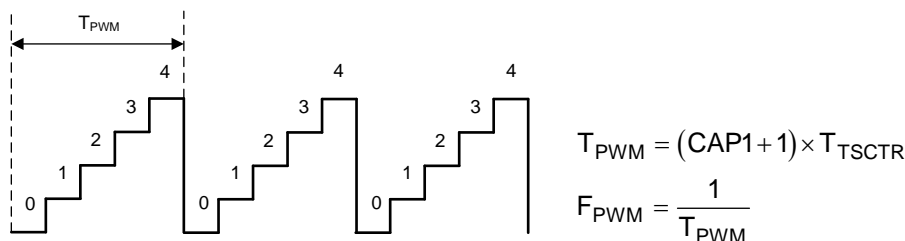
$CMP = PERIOD+1$ , output high for complete period (100% duty)

$CMP > PERIOD+1$ , output high for complete period

The behavior of APWM active low mode ( $APWMPOL == 1$ ) is as follows:

CMP = 0x00000000, output high for duration of period (0% duty)  
 CMP = 0x00000001, output low 1 cycle  
 CMP = 0x00000002, output low 2 cycles  
 CMP = PERIOD, output low except for 1 cycle (<100% duty)  
 CMP = PERIOD+1, output low for complete period (100% duty)  
 CMP > PERIOD+1, output low for complete period

Figure 15-11. Time-Base Frequency and Period Calculation



## 15.6 Application of the ECAP Module

The following sections will provide Applications examples and code snippets to show how to configure and operate the eCAP module. For clarity and ease of use, the examples use the eCAP “C” header files. Below are useful #defines which will help in the understanding of the examples.

```
// ECCTL1 (ECAP Control Reg 1)
//=====

// CAPxPOL bits      #define EC_RISING 0x0      #define EC_FALLING 0x1
// CTRRSTx bits      #define EC_ABS_MODE 0x0    #define EC_DELTA_MODE 0x1
// PRESCALE bits     #define EC_BYPASS 0x0      #define EC_DIV1 0x0 #define EC_DIV2 0x1
//                                     #define EC_DIV4 0x2 #define EC_DIV6 0x3
//                                     #define EC_DIV8 0x4 #define EC_DIV10 0x5

// ECCTL2 ( ECAP Control Reg 2)
//=====
// CONT/ONESHOT bit #define EC_CONTINUOUS 0x0 #define EC_ONESHOT 0x1
// STOPVALUE bit    #define EC_EVENT1 0x0     #define EC_EVENT2 0x1 #define EC_EVENT3 0x2
//                                     #define EC_EVENT4 0x3

// RE-ARM bit #define EC_ARM 0x1
// TSCTRSTOP bit #define EC_FREEZE 0x0        #define EC_RUN 0x1
// SYNCO_SEL bit #define EC_SYNCIN 0x0        #define EC_CTR_PRD 0x1
//                                     #define EC_SYNCO_DIS 0x2

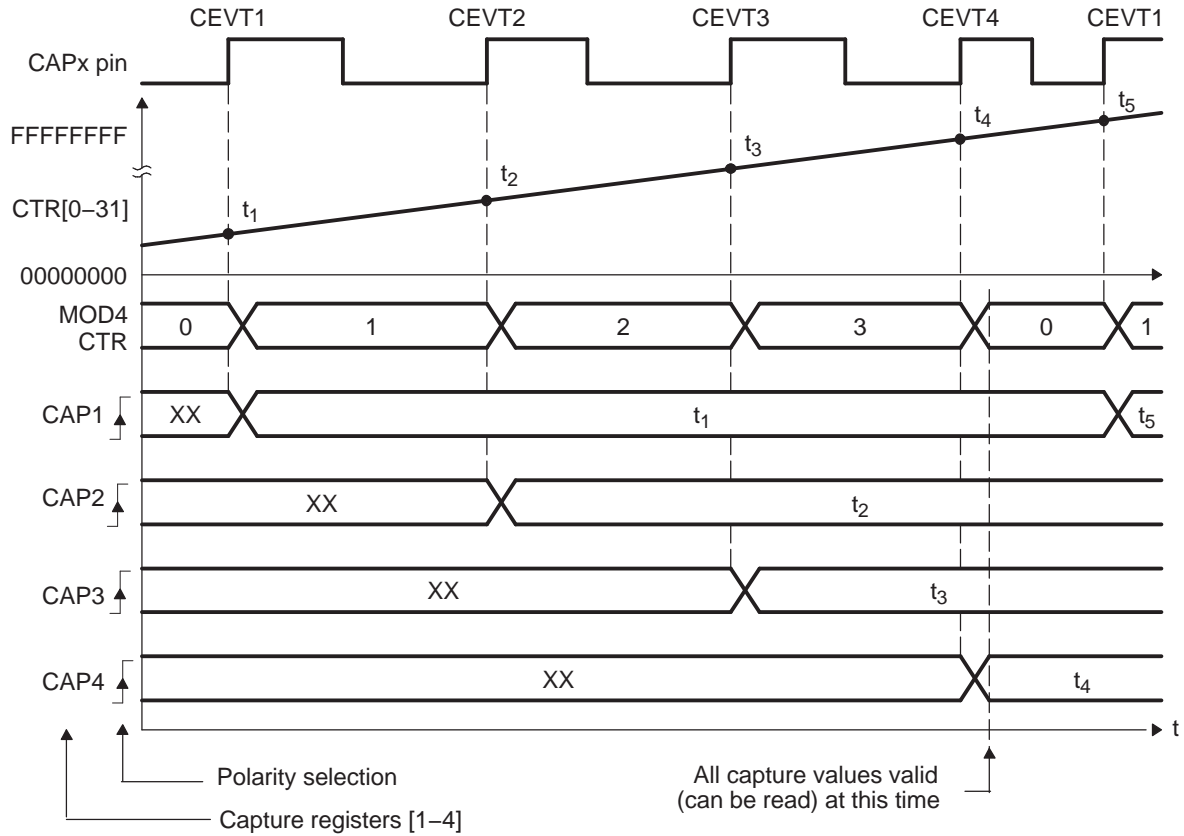
// CAP/APWM mode bit #define EC_CAP_MODE 0x0   #define EC_APWM_MODE 0x1
// APWMPOL bit       #define EC_ACTV_HI 0x0    #define EC_ACTV_LO 0x1
// Generic            #define EC_DISABLE 0x0   #define EC_ENABLE 0x1 #define EC_FORCE 0x1
```

### 15.6.1 Example 1 - Absolute Time-Stamp Operation Rising Edge Trigger

Figure 15-12 shows an example of continuous capture operation (Mod4 counter wraps around). In this figure, TSCTR counts-up without resetting and capture events are qualified on the rising edge only, this gives period (and frequency) information.

On an event, the TSCTR contents (time-stamp) is first captured, then Mod4 counter is incremented to the next state. When the TSCTR reaches FFFFFFFF (maximum value), it wraps around to 00000000 (not shown in Figure 15-12), if this occurs, the CTROVF (counter overflow) flag is set, and an interrupt (if enabled) occurs, CTROVF (counter overflow) Flag is set, and an Interrupt (if enabled) occurs. Captured Time-stamps are valid at the point indicated by the diagram (after the 4th event), hence event CEVT4 can conveniently be used to trigger an interrupt and the CPU can read data from the CAPx registers.

**Figure 15-12. Capture Sequence for Absolute Time-stamp and Rising Edge Detect**



### 15.6.1.1 Code snippet for CAP mode Absolute Time, Rising Edge Trigger

```
// Code snippet for CAP mode Absolute Time, Rising edge trigger

// Initialization Time
//=====

// ECAP module 1 config
ECap1Regs.ECCTL1.bit.CAP1POL = EC_RISING;
ECap1Regs.ECCTL1.bit.CAP2POL = EC_RISING;
ECap1Regs.ECCTL1.bit.CAP3POL = EC_RISING;
ECap1Regs.ECCTL1.bit.CAP4POL = EC_RISING;
ECap1Regs.ECCTL1.bit.CTRRST1 = EC_ABS_MODE;
ECap1Regs.ECCTL1.bit.CTRRST2 = EC_ABS_MODE;
ECap1Regs.ECCTL1.bit.CTRRST3 = EC_ABS_MODE;
ECap1Regs.ECCTL1.bit.CTRRST4 = EC_ABS_MODE;
ECap1Regs.ECCTL1.bit.CAPLDEN = EC_ENABLE;
ECap1Regs.ECCTL1.bit.PRESCALE = EC_DIV1;
ECap1Regs.ECCTL2.bit.CAP_APWM = EC_CAP_MODE;
ECap1Regs.ECCTL2.bit.CONT_ONESHT = EC_CONTINUOUS;
ECap1Regs.ECCTL2.bit.SYNCO_SEL = EC_SYNCO_DIS;
ECap1Regs.ECCTL2.bit.SYNCI_EN = EC_DISABLE;
ECap1Regs.ECCTL2.bit.TSCTRSTOP = EC_RUN;

// Allow TSCTR to run

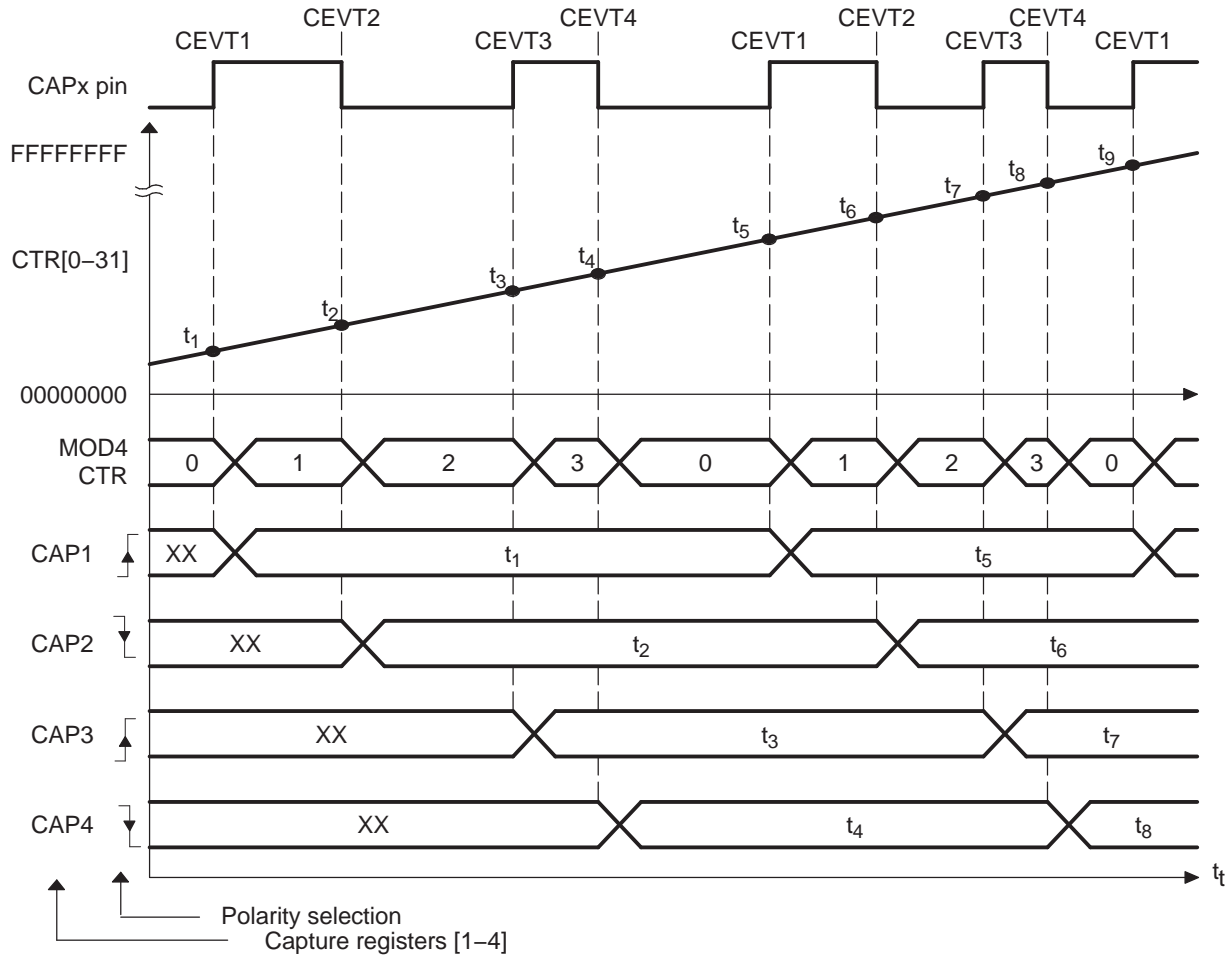
// Run Time (CEVT4 triggered ISR call)
//=====

TSt1 = ECap1Regs.CAP1;
// Fetch Time-Stamp captured at t1 TSt2 = ECap1Regs.CAP2;
// Fetch Time-Stamp captured at t2 TSt3 = ECap1Regs.CAP3;
// Fetch Time-Stamp captured at t3 TSt4 = ECap1Regs.CAP4;
// Fetch Time-Stamp captured at t4 Period1 = TSt2-TSt1;
// Calculate 1st period Period2 = TSt3-TSt2;
// Calculate 2nd period Period3 = TSt4-TSt3;
// Calculate 3rd period
```

### 15.6.2 Example 2 - Absolute Time-Stamp Operation Rising and Falling Edge Trigger

In Figure 15-13 the eCAP operating mode is almost the same as in the previous section except capture events are qualified as either rising or falling edge, this now gives both period and duty cycle information, i.e:  $\text{Period1} = t_3 - t_1$ ,  $\text{Period2} = t_5 - t_3$ , ...etc.  $\text{Duty Cycle1 (on-time \%)} = (t_2 - t_1) / \text{Period1} \times 100\%$ , and so on.  $\text{Duty Cycle1 (off-time \%)} = (t_3 - t_2) / \text{Period1} \times 100\%$ , and so on.

Figure 15-13. Capture Sequence for Absolute Time-stamp With Rising and Falling Edge Detect



### 15.6.2.1 Code Snippet for CAP mode Absolute Time, Rising and Falling Edge Triggers

```
// Code snippet for CAP mode Absolute Time, Rising and Falling

// edge triggers // Initialization Time

//=====

// ECAP module 1 config
ECap1Regs.ECCTL1.bit.CAP1POL = EC_RISING;
ECap1Regs.ECCTL1.bit.CAP2POL = EC_FALLING;
ECap1Regs.ECCTL1.bit.CAP3POL = EC_RISING;
ECap1Regs.ECCTL1.bit.CAP4POL = EC_FALLING;
ECap1Regs.ECCTL1.bit.CTRRST1 = EC_ABS_MODE;
ECap1Regs.ECCTL1.bit.CTRRST2 = EC_ABS_MODE;
ECap1Regs.ECCTL1.bit.CTRRST3 = EC_ABS_MODE;
ECap1Regs.ECCTL1.bit.CTRRST4 = EC_ABS_MODE;
ECap1Regs.ECCTL1.bit.CAPLDEN = EC_ENABLE;
ECap1Regs.ECCTL1.bit.PRESCALE = EC_DIV1;
ECap1Regs.ECCTL2.bit.CAP_APWM = EC_CAP_MODE;
ECap1Regs.ECCTL2.bit.CONT_ONESHT = EC_CONTINUOUS;
ECap1Regs.ECCTL2.bit.SYNCO_SEL = EC_SYNCO_DIS;
ECap1Regs.ECCTL2.bit.SYNCI_EN = EC_DISABLE;
ECap1Regs.ECCTL2.bit.TSCTRSTOP = EC_RUN;

// Allow TSCTR to run

// Run Time (CEVT4 triggered ISR call)

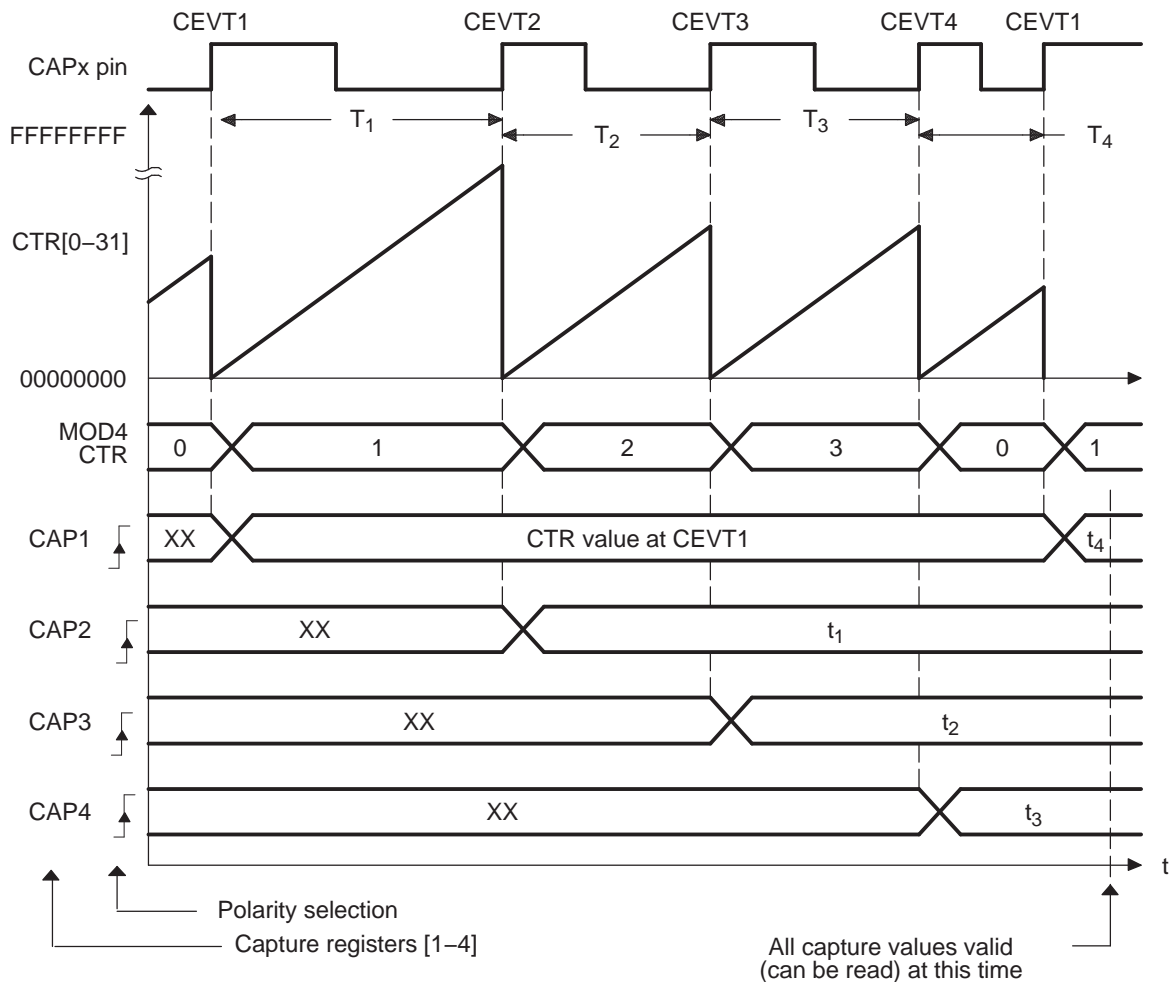
//=====

TSt1 = ECap1Regs.CAP1;
// Fetch Time-Stamp captured at t1 TSt2 = ECap1Regs.CAP2;
// Fetch Time-Stamp captured at t2 TSt3 = ECap1Regs.CAP3;
// Fetch Time-Stamp captured at t3 TSt4 = ECap1Regs.CAP4;
// Fetch Time-Stamp captured at t4 Period1 = TSt3-TSt1;
// Calculate 1st period DutyOnTime1 = TSt2-TSt1;
// Calculate On time DutyOffTime1 = TSt3-TSt2;
// Calculate Off time
```

### 15.6.3 Example 3 - Time Difference (Delta) Operation Rising Edge Trigger

This example Figure 15-14 shows how the eCAP module can be used to collect Delta timing data from pulse train waveforms. Here Continuous Capture mode (TSCTR counts-up without resetting, and Mod4 counter wraps around) is used. In Delta-time mode, TSCTR is Reset back to Zero on every valid event. Here Capture events are qualified as Rising edge only. On an event, TSCTR contents (Time-Stamp) is captured first, and then TSCTR is reset to Zero. The Mod4 counter then increments to the next state. If TSCTR reaches FFFFFFFF (Max value), before the next event, it wraps around to 00000000 and continues, a CANTOVF (counter overflow) Flag is set, and an Interrupt (if enabled) occurs. The advantage of Delta-time Mode is that the CAPx contents directly give timing data without the need for CPU calculations, that is,  $Period1 = T_1$ ,  $Period2 = T_2, \dots$  and so on. As shown in the diagram, the CEVT1 event is a good trigger point to read the timing data,  $T_1, T_2, T_3, T_4$  are all valid here.

**Figure 15-14. Capture Sequence for Delta Mode Time-stamp and Rising Edge Detect**





### 15.6.3.1 Code snippet for CAP mode Delta Time, Rising Edge Trigger

```

// Code snippet for CAP mode Delta Time, Rising edge trigger

// Initialization Time

//=====

// ECAP module 1 config
ECap1Regs.ECCTL1.bit.CAP1POL = EC_RISING;
ECap1Regs.ECCTL1.bit.CAP2POL = EC_RISING;
ECap1Regs.ECCTL1.bit.CAP3POL = EC_RISING;
ECap1Regs.ECCTL1.bit.CAP4POL = EC_RISING;
ECap1Regs.ECCTL1.bit.CTRRST1 = EC_DELTA_MODE;
ECap1Regs.ECCTL1.bit.CTRRST2 = EC_DELTA_MODE;
ECap1Regs.ECCTL1.bit.CTRRST3 = EC_DELTA_MODE;
ECap1Regs.ECCTL1.bit.CTRRST4 = EC_DELTA_MODE;
ECap1Regs.ECCTL1.bit.CAPLDEN = EC_ENABLE;
ECap1Regs.ECCTL1.bit.PRESCALE = EC_DIV1;
ECap1Regs.ECCTL2.bit.CAP_APWM = EC_CAP_MODE;
ECap1Regs.ECCTL2.bit.CONT_ONESHT = EC_CONTINUOUS;
ECap1Regs.ECCTL2.bit.SYNCO_SEL = EC_SYNCO_DIS;
ECap1Regs.ECCTL2.bit.SYNCI_EN = EC_DISABLE;
ECap1Regs.ECCTL2.bit.TSCTRSTOP = EC_RUN;

// Allow TSCTR to run

// Run Time (CEVT1 triggered ISR call)

//=====

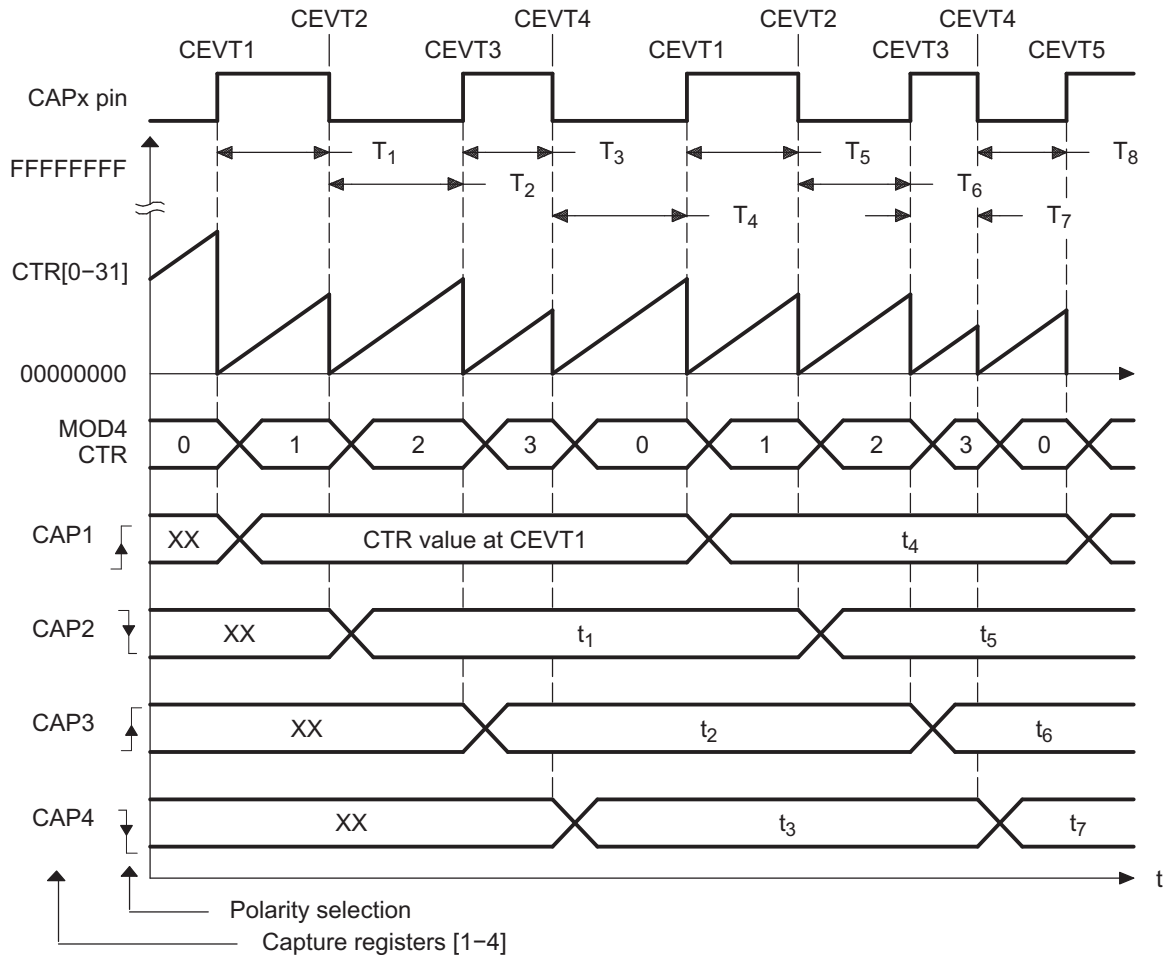
// Note: here Time-stamp directly represents the Period value. Period4 = ECap1Regs.CAP1;
// Fetch Time-Stamp captured at T1 Period1 = ECap1Regs.CAP2;
// Fetch Time-Stamp captured at T2 Period2 = ECap1Regs.CAP3;
// Fetch Time-Stamp captured at T3 Period3 = ECap1Regs.CAP4;
// Fetch Time-Stamp captured at T4

```

### 15.6.4 Example 4 - Time Difference (Delta) Operation Rising and Falling Edge Trigger

In Figure 15-15 the eCAP operating mode is almost the same as in the previous section except Capture events are qualified as either Rising or Falling edge. This now gives both Period and Duty cycle information, that is,  $\text{Period1} = T_1 + T_2$ ,  $\text{Period2} = T_3 + T_4$ , ...and so on,  $\text{Duty Cycle1 (on-time \%)} = T_1 / \text{Period1} \times 100\%$ , and so on,  $\text{Duty Cycle1 (off-time \%)} = T_2 / \text{Period1} \times 100\%$ , and so on.

Figure 15-15. Capture Sequence for Delta Mode Time-stamp With Rising and Falling Edge Detect



During initialization, you must write to the active registers for both period and compare. This will then automatically copy the init values into the shadow values. For subsequent compare updates, during run-time, only the shadow registers must be used.

### 15.6.4.1 Code snippet for CAP mode Delta Time, Rising and Falling Edge Triggers

```
// Code snippet for CAP mode Delta Time, Rising and Falling
// edge triggers
// Initialization Time

//=====

// ECAP module 1 config
ECap1Regs.ECCTL1.bit.CAP1POL = EC_RISING;
ECap1Regs.ECCTL1.bit.CAP2POL = EC_FALLING;
ECap1Regs.ECCTL1.bit.CAP3POL = EC_RISING;
ECap1Regs.ECCTL1.bit.CAP4POL = EC_FALLING;
ECap1Regs.ECCTL1.bit.CTRRST1 = EC_DELTA_MODE;
ECap1Regs.ECCTL1.bit.CTRRST2 = EC_DELTA_MODE;
ECap1Regs.ECCTL1.bit.CTRRST3 = EC_DELTA_MODE;
ECap1Regs.ECCTL1.bit.CTRRST4 = EC_DELTA_MODE;
ECap1Regs.ECCTL1.bit.CAPLDEN = EC_ENABLE;
ECap1Regs.ECCTL1.bit.PRESCALE = EC_DIV1;
ECap1Regs.ECCTL2.bit.CAP_APWM = EC_CAP_MODE;
ECap1Regs.ECCTL2.bit.CONT_ONESHT = EC_CONTINUOUS;
ECap1Regs.ECCTL2.bit.SYNCO_SEL = EC_SYNCO_DIS;
ECap1Regs.ECCTL2.bit.SYNCI_EN = EC_DISABLE;
ECap1Regs.ECCTL2.bit.TSCTRSTOP = EC_RUN;

// Allow TSCTR to run

// Run Time (CEVT1 triggered ISR call)

//=====
//
Note: here Time-stamp directly represents the Duty cycle values. DutyOnTime1 = ECap1Regs.CAP2;

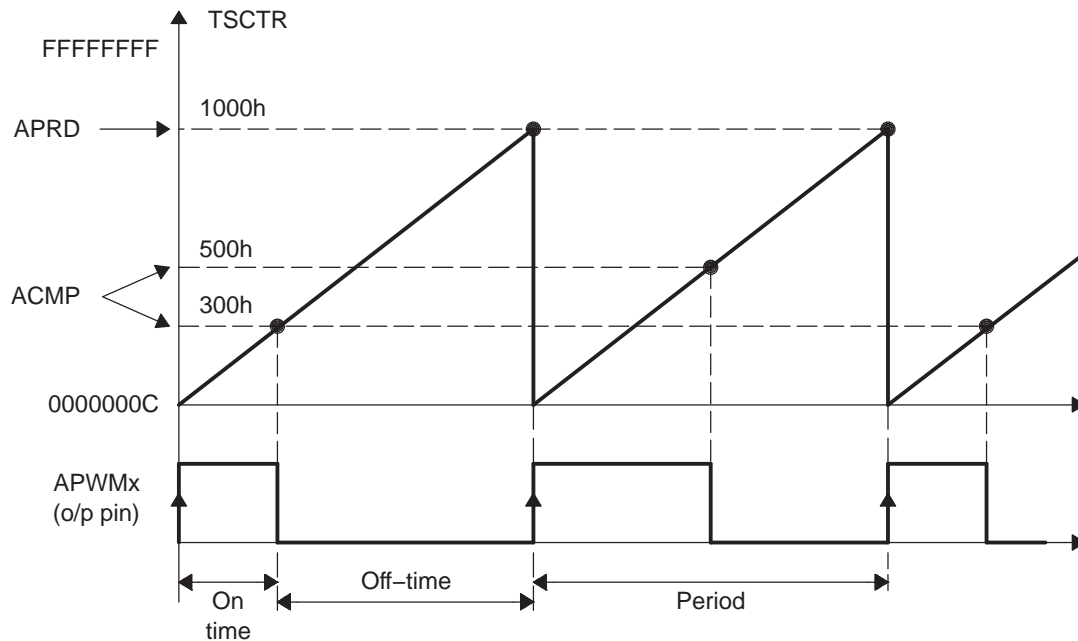
// Fetch Time-Stamp captured at T2 DutyOffTime1 = ECap1Regs.CAP3;
// Fetch Time-Stamp captured at T3 DutyOnTime2 = ECap1Regs.CAP4;
// Fetch Time-Stamp captured at T4 DutyOffTime2 = ECap1Regs.CAP1;
// Fetch Time-
Stamp captured at T1 Period1 = DutyOnTime1 + DutyOffTime1; Period2 = DutyOnTime2 + DutyOffTime2;
```

## 15.7 Application of the APWM Mode

In this example, the eCAP module is configured to operate as a PWM generator. Here a very simple single channel PWM waveform is generated from output pin APWMx. The PWM polarity is active high, which means that the compare value (CAP2 reg is now a compare register) represents the on-time (high level) of the period. Alternatively, if the APWMPOL bit is configured for active low, then the compare value represents the off-time. Note here values are in hexadecimal ("h") notation.

### 15.7.1 Example 1 - Simple PWM Generation (Independent Channel/s)

Figure 15-16. PWM Waveform Details of APWM Mode Operation



#### Example 15-1. Code Snippet for APWM Mode

```
// Code snippet for APWM mode Example 1
// Initialization Time
//=====
// ECAP module 1 config ECap1Regs.CAP1 = 0x1000;
// Set period value ECap1Regs.CTRPHS = 0x0;
// make phase zero ECap1Regs.ECCTL2.bit.CAP_APWM = EC_APWM_MODE;
//                   ECap1Regs.ECCTL2.bit.APWMPOL = EC_ACTV_HI;
// Active high ECap1Regs.ECCTL2.bit.SYNCI_EN = EC_DISABLE;
// Synch not used ECap1Regs.ECCTL2.bit.SYNCO_SEL = EC_SYNCO_DIS;
// Synch not used ECap1Regs.ECCTL2.bit.TSCTRSTOP = EC_RUN;
// Allow TSCTR to run
// Run Time (Instant 1, for example, ISR call)
//=====
ECap1Regs.CAP2 = 0x300;
```

**Example 15-1. Code Snippet for APWM Mode (continued)**

```
// Set Duty cycle, that is, compare value  
  
// Run Time (Instant 2, for example, another ISR call)  
  
//=====\  
    ECap1Regs.CAP2 = 0x500;  
  
// Set Duty cycle, that is, compare value
```

## 15.8 Registers

### 15.8.1 eCAP Base Addresses

**Table 15-1. eCAP Base Address Table**

Device Register	Register Name	Start Address	End Address
ECap1Regs	ECAP_REGS	0x0000_5000	0x0000_501F
ECap2Regs	ECAP_REGS	0x0000_5020	0x0000_503F
ECap3Regs	ECAP_REGS	0x0000_5040	0x0000_505F
ECap4Regs	ECAP_REGS	0x0000_5060	0x0000_507F
ECap5Regs	ECAP_REGS	0x0000_5080	0x0000_509F
ECap6Regs	ECAP_REGS	0x0000_50A0	0x0000_50BF

## 15.8.2 ECAP\_REGS Registers

Table 15-2 lists the memory-mapped registers for the ECAP\_REGS. All register offset addresses not listed in Table 15-2 should be considered as reserved locations and the register contents should not be modified.

**Table 15-2. ECAP\_REGS Registers**

Offset	Acronym	Register Name	Write Protection	Section
0h	TSCTR	Time-Stamp Counter		<a href="#">Go</a>
2h	CTRPHS	Counter Phase Offset Value Register		<a href="#">Go</a>
4h	CAP1	Capture 1 Register		<a href="#">Go</a>
6h	CAP2	Capture 2 Register		<a href="#">Go</a>
8h	CAP3	Capture 3 Register		<a href="#">Go</a>
Ah	CAP4	Capture 4 Register		<a href="#">Go</a>
14h	ECCTL1	Capture Control Register 1	EALLOW	<a href="#">Go</a>
15h	ECCTL2	Capture Control Register 2	EALLOW	<a href="#">Go</a>
16h	ECEINT	Capture Interrupt Enable Register	EALLOW	<a href="#">Go</a>
17h	ECFLG	Capture Interrupt Flag Register		<a href="#">Go</a>
18h	ECCLR	Capture Interrupt Clear Register		<a href="#">Go</a>
19h	ECFRC	Capture Interrupt Force Register		<a href="#">Go</a>

Complex bit access types are encoded to fit into small table cells. Table 15-3 shows the codes that are used for access types in this section.

**Table 15-3. ECAP\_REGS Access Type Codes**

Access Type	Code	Description
<b>Read Type</b>		
R	R	Read
R=0	R	Read
<b>Write Type</b>		
W	W	Write
W=1	W	Write
<b>Reset or Default Value</b>		
-n		Value after reset or the default value
<b>Register Array Variables</b>		
i,j,k,l,m,n		When these variables are used in a register name, an offset, or an address, they refer to the value of a register array where the register is part of a group of repeating registers. The register groups form a hierarchical structure and the array is represented with a formula.
y		When this variable is used in a register name, an offset, or an address it refers to the value of a register array.

### 15.8.2.1 TSCTR Register (Offset = 0h) [reset = 0h]

TSCTR is shown in [Figure 15-17](#) and described in [Table 15-4](#).

Return to [Summary Table](#).

Time-Stamp Counter

**Figure 15-17. TSCTR Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
TSCTR																															
R/W-0h																															

**Table 15-4. TSCTR Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-0	TSCTR	R/W	0h	Active 32-bit counter register that is used as the capture time-base Reset type: SYSRSn



### 15.8.2.2 CTRPHS Register (Offset = 2h) [reset = 0h]

CTRPHS is shown in [Figure 15-18](#) and described in [Table 15-5](#).

Return to [Summary Table](#).

Counter Phase Offset Value Register

**Figure 15-18. CTRPHS Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
CTRPHS																															
R/W-0h																															

**Table 15-5. CTRPHS Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-0	CTRPHS	R/W	0h	Counter phase value register that can be programmed for phase lag/lead. This register shadows TSCTR and is loaded into TSCTR upon either a SYNCI event or S/W force via a control bit. Used to achieve phase control synchronization with respect to other eCAP and EPWM time-bases. Reset type: SYSRSn

### 15.8.2.3 CAP1 Register (Offset = 4h) [reset = 0h]

CAP1 is shown in [Figure 15-19](#) and described in [Table 15-6](#).

Return to [Summary Table](#).

Capture 1 Register

**Figure 15-19. CAP1 Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
CAP1																															
R/W-0h																															

**Table 15-6. CAP1 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-0	CAP1	R/W	0h	This register can be loaded (written) by: <ul style="list-style-type: none"> <li>- Time-Stamp ( counter value) during a capture event</li> <li>- Software - may be useful for test purposes</li> <li>- APRD shadow register (CAP3) when used in APWM mode</li> </ul> Reset type: SYSRSn

#### 15.8.2.4 CAP2 Register (Offset = 6h) [reset = 0h]

CAP2 is shown in [Figure 15-20](#) and described in [Table 15-7](#).

Return to [Summary Table](#).

Capture 2 Register

**Figure 15-20. CAP2 Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
CAP2																															
R/W-0h																															

**Table 15-7. CAP2 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-0	CAP2	R/W	0h	This register can be loaded (written) by: <ul style="list-style-type: none"> <li>- Time-Stamp ( counter value) during a capture event</li> <li>- Software - may be useful for test purposes</li> <li>- APRD shadow register (CAP4) when used in APWM mode</li> </ul> Reset type: SYSRSn

### 15.8.2.5 CAP3 Register (Offset = 8h) [reset = 0h]

CAP3 is shown in [Figure 15-21](#) and described in [Table 15-8](#).

Return to [Summary Table](#).

Capture 3 Register

**Figure 15-21. CAP3 Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
CAP3																															
R/W-0h																															

**Table 15-8. CAP3 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-0	CAP3	R/W	0h	In CMP mode, this is a time-stamp capture register. In APWM mode, this is the period shadow (APRD) register. You update the PWM period value through this register. In this mode, CAP3 (APRD) shadows CAP1. Reset type: SYSRSn

### 15.8.2.6 CAP4 Register (Offset = Ah) [reset = 0h]

CAP4 is shown in [Figure 15-22](#) and described in [Table 15-9](#).

Return to [Summary Table](#).

Capture 4 Register

**Figure 15-22. CAP4 Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
CAP4																															
R/W-0h																															

**Table 15-9. CAP4 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-0	CAP4	R/W	0h	In CMP mode, this is a time-stamp capture register. In APWM mode, this is the compare shadow (ACMP) register. You update the PWM compare value via this register. In this mode, CAP4 (ACMP) shadows CAP2. Reset type: SYSRSn

**15.8.2.7 ECCTL1 Register (Offset = 14h) [reset = 0h]**

 ECCTL1 is shown in [Figure 15-23](#) and described in [Table 15-10](#).

 Return to [Summary Table](#).

Capture Control Register 1

**Figure 15-23. ECCTL1 Register**

15		14		13		12		11		10		9		8	
FREE_SOFT				PRESCALE								CAPLDEN			
R/W-0h				R/W-0h								R/W-0h			
7		6		5		4		3		2		1		0	
CTRRST4		CAP4POL		CTRRST3		CAP3POL		CTRRST2		CAP2POL		CTRRST1		CAP1POL	
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	

**Table 15-10. ECCTL1 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-14	FREE_SOFT	R/W	0h	Emulation Control Reset type: SYSRSn 0h (R/W) = TSCTR counter stops immediately on emulation suspend 1h (R/W) = TSCTR counter runs until = 0 2h (R/W) = TSCTR counter is unaffected by emulation suspend (Run Free) 3h (R/W) = TSCTR counter is unaffected by emulation suspend (Run Free)
13-9	PRESCALE	R/W	0h	Event Filter prescale select Reset type: SYSRSn 0h (R/W) = Divide by 1 (i.e., no prescale, by-pass the prescaler) 1h (R/W) = Divide by 2 2h (R/W) = Divide by 4 3h (R/W) = Divide by 6 4h (R/W) = Divide by 8 5h (R/W) = Divide by 10 1Eh (R/W) = Divide by 60 1Fh (R/W) = Divide by 62
8	CAPLDEN	R/W	0h	Enable Loading of CAP1-4 registers on a capture event. Note that this bit does not disable CEVTn events from being generated. Reset type: SYSRSn 0h (R/W) = Disable CAP1-4 register loads at capture event time. 1h (R/W) = Enable CAP1-4 register loads at capture event time.
7	CTRRST4	R/W	0h	Counter Reset on Capture Event 4 Reset type: SYSRSn 0h (R/W) = Do not reset counter on Capture Event 4 (absolute time stamp operation) 1h (R/W) = Reset counter after Capture Event 4 time-stamp has been captured (used in difference mode operation)
6	CAP4POL	R/W	0h	Capture Event 4 Polarity select Reset type: SYSRSn 0h (R/W) = Capture Event 4 triggered on a rising edge (RE) 1h (R/W) = Capture Event 4 triggered on a falling edge (FE)

**Table 15-10. ECCTL1 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
5	CTRRST3	R/W	0h	Counter Reset on Capture Event 3 Reset type: SYSRSn 0h (R/W) = Do not reset counter on Capture Event 3 (absolute time stamp) 1h (R/W) = Reset counter after Event 3 time-stamp has been captured (used in difference mode operation)
4	CAP3POL	R/W	0h	Capture Event 3 Polarity select Reset type: SYSRSn 0h (R/W) = Capture Event 3 triggered on a rising edge (RE) 1h (R/W) = Capture Event 3 triggered on a falling edge (FE)
3	CTRRST2	R/W	0h	Counter Reset on Capture Event 2 Reset type: SYSRSn 0h (R/W) = Do not reset counter on Capture Event 2 (absolute time stamp) 1h (R/W) = Reset counter after Event 2 time-stamp has been captured (used in difference mode operation)
2	CAP2POL	R/W	0h	Capture Event 2 Polarity select Reset type: SYSRSn 0h (R/W) = Capture Event 2 triggered on a rising edge (RE) 1h (R/W) = Capture Event 2 triggered on a falling edge (FE)
1	CTRRST1	R/W	0h	Counter Reset on Capture Event 1 Reset type: SYSRSn 0h (R/W) = Do not reset counter on Capture Event 1 (absolute time stamp) 1h (R/W) = Reset counter after Event 1 time-stamp has been captured (used in difference mode operation)
0	CAP1POL	R/W	0h	Capture Event 1 Polarity select Reset type: SYSRSn 0h (R/W) = Capture Event 1 triggered on a rising edge (RE) 1h (R/W) = Capture Event 1 triggered on a falling edge (FE)

**15.8.2.8 ECCTL2 Register (Offset = 15h) [reset = 6h]**

 ECCTL2 is shown in [Figure 15-24](#) and described in [Table 15-11](#).

 Return to [Summary Table](#).

Capture Control Register 2

**Figure 15-24. ECCTL2 Register**

15	14	13	12	11	10	9	8
RESERVED					APWMPOL	CAP_APWM	SWSYNC
R-0h					R/W-0h	R/W-0h	R/W-0h
7	6	5	4	3	2	1	0
SYNCO_SEL		SYNCL_EN	TSCTRSTOP	REARM	STOP_WRAP		CONT_ONESH T
R/W-0h		R/W-0h	R/W-0h	R/W-0h	R/W-3h		R/W-0h

**Table 15-11. ECCTL2 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-11	RESERVED	R	0h	Reserved
10	APWMPOL	R/W	0h	APWM output polarity select. Reset type: SYSRSn 0h (R/W) = Output is active high (Compare value defines high time) 1h (R/W) = Output is active low (Compare value defines low time)
9	CAP_APWM	R/W	0h	CAP/APWM operating mode select Reset type: SYSRSn 0h (R/W) = ECAP module operates in capture mode. This mode forces the following configuration: - Inhibits TSCTR resets via CTR = PRD event - Inhibits shadow loads on CAP1 and 2 registers - Permits user to enable CAP1-4 register load - CAPx/APWMx pin operates as a capture input 1h (R/W) = ECAP module operates in APWM mode. This mode forces the following configuration: - Resets TSCTR on CTR = PRD event (period boundary) - Permits shadow loading on CAP1 and 2 registers - Disables loading of time-stamps into CAP1-4 registers - CAPx/APWMx pin operates as a APWM output
8	SWSYNC	R/W	0h	Software-forced Counter (TSCTR) Synchronizing. Reset type: SYSRSn 0h (R/W) = Writing a zero has no effect. Reading always returns a zero 1h (R/W) = Writing a one forces a TSCTR shadow load of current ECAP module and any ECAP modules down-stream providing the SYNCO_SEL bits are 0,0. After writing a 1, this bit returns to a zero. Note: Selection CTR = PRD is meaningful only in APWM mode however, you can choose it in CAP mode if you find doing so useful.



**Table 15-11. ECCTL2 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
7-6	SYNCO_SEL	R/W	0h	<p>Sync-Out Select</p> <p>Reset type: SYSRSn</p> <p>0h (R/W) = Select sync-in event to be the sync-out signal pass through</p> <p>1h (R/W) = Select CTR = PRD event to be the sync-out signal</p> <p>2h (R/W) = Disable sync out signal</p> <p>3h (R/W) = Disable sync out signal</p>
5	SYNCI_EN	R/W	0h	<p>Counter (TSCTR) Sync-In select mode</p> <p>Reset type: SYSRSn</p> <p>0h (R/W) = Disable sync-in option</p> <p>1h (R/W) = Enable counter (TSCTR) to be loaded from CTRPHS register upon either a SYNCI signal or a S/W force event.</p>
4	TSCTRSTOP	R/W	0h	<p>Time Stamp (TSCTR) Counter Stop (freeze) Control</p> <p>Reset type: SYSRSn</p> <p>0h (R/W) = TSCTR stopped</p> <p>1h (R/W) = TSCTR free-running</p>
3	REARM	R/W	0h	<p>Re-Arming Control. Note: The re-arm function is valid in one shot or continuous mode.</p> <p>Reset type: SYSRSn</p> <p>0h (R/W) = Has no effect (reading always returns a 0)</p> <p>1h (R/W) = Arms the one-shot sequence as follows:</p> <ol style="list-style-type: none"> <li>1) Resets the Mod4 counter to zero</li> <li>2) Unfreezes the Mod4 counter</li> <li>3) Enables capture register loads</li> </ol>
2-1	STOP_WRAP	R/W	3h	<p>Stop value for one-shot mode. This is the number (between 1-4) of captures allowed to occur before the CAP(1-4) registers are frozen, that is, capture sequence is stopped.</p> <p>Wrap value for continuous mode. This is the number (between 1-4) of the capture register in which the circular buffer wraps around and starts again.</p> <p>Notes: STOP_WRAP is compared to Mod4 counter and, when equal, 2 actions occur:</p> <ul style="list-style-type: none"> <li>- Mod4 counter is stopped (frozen)</li> <li>- Capture register loads are inhibited</li> </ul> <p>In one-shot mode, further interrupt events are blocked until re-armed.</p> <p>Reset type: SYSRSn</p> <p>0h (R/W) = Stop after Capture Event 1 in one-shot mode Wrap after Capture Event 1 in continuous mode.</p> <p>1h (R/W) = Stop after Capture Event 2 in one-shot mode Wrap after Capture Event 2 in continuous mode.</p> <p>2h (R/W) = Stop after Capture Event 3 in one-shot mode Wrap after Capture Event 3 in continuous mode.</p> <p>3h (R/W) = Stop after Capture Event 4 in one-shot mode Wrap after Capture Event 4 in continuous mode.</p>
0	CONT_ONESHT	R/W	0h	<p>Continuous or one-shot mode control (applicable only in capture mode)</p> <p>Reset type: SYSRSn</p> <p>0h (R/W) = Operate in continuous mode</p> <p>1h (R/W) = Operate in one-Shot mode</p>

### 15.8.2.9 ECEINT Register (Offset = 16h) [reset = 0h]

ECEINT is shown in [Figure 15-25](#) and described in [Table 15-12](#).

Return to [Summary Table](#).

The interrupt enable bits (CEVT1, ...) block any of the selected events from generating an interrupt. Events will still be latched into the flag bit (ECFLG register) and can be forced/cleared via the ECFRC/ECCLR registers.

The proper procedure for configuring peripheral modes and interrupts is as follows:

- Disable global interrupts
- Stop eCAP counter
- Disable eCAP interrupts
- Configure peripheral registers
- Clear spurious eCAP interrupt flags
- Enable eCAP interrupts
- Start eCAP counter
- Enable global interrupts

**Figure 15-25. ECEINT Register**

15	14	13	12	11	10	9	8
RESERVED							
R/W-0h							
7	6	5	4	3	2	1	0
CTR_EQ_CMP	CTR_EQ_PRD	CTROVF	CEVT4	CEVT3	CEVT2	CEVT1	RESERVED
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h

**Table 15-12. ECEINT Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-8	RESERVED	R/W	0h	Reserved
7	CTR_EQ_CMP	R/W	0h	Counter Equal Compare Interrupt Enable Reset type: SYSRSn 0h (R/W) = Disable Compare Equal as an Interrupt source 1h (R/W) = Enable Compare Equal as an Interrupt source
6	CTR_EQ_PRD	R/W	0h	Counter Equal Period Interrupt Enable Reset type: SYSRSn 0h (R/W) = Disable Period Equal as an Interrupt source 1h (R/W) = Enable Period Equal as an Interrupt source
5	CTROVF	R/W	0h	Counter Overflow Interrupt Enable Reset type: SYSRSn 0h (R/W) = Disabled counter Overflow as an Interrupt source 1h (R/W) = Enable counter Overflow as an Interrupt source
4	CEVT4	R/W	0h	Capture Event 4 Interrupt Enable Reset type: SYSRSn 0h (R/W) = Disable Capture Event 4 as an Interrupt source 1h (R/W) = Capture Event 4 Interrupt Enable
3	CEVT3	R/W	0h	Capture Event 3 Interrupt Enable Reset type: SYSRSn 0h (R/W) = Disable Capture Event 3 as an Interrupt source 1h (R/W) = Enable Capture Event 3 as an Interrupt source
2	CEVT2	R/W	0h	Capture Event 2 Interrupt Enable Reset type: SYSRSn 0h (R/W) = Disable Capture Event 2 as an Interrupt source 1h (R/W) = Enable Capture Event 2 as an Interrupt source

**Table 15-12. ECEINT Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
1	CEVT1	R/W	0h	Capture Event 1 Interrupt Enable Reset type: SYSRSn 0h (R/W) = Disable Capture Event 1 as an Interrupt source 1h (R/W) = Enable Capture Event 1 as an Interrupt source
0	RESERVED	R/W	0h	Reserved

**15.8.2.10 ECFLG Register (Offset = 17h) [reset = 0h]**

ECFLG is shown in [Figure 15-26](#) and described in [Table 15-13](#).

Return to [Summary Table](#).

Capture Interrupt Flag Register

**Figure 15-26. ECFLG Register**

15	14	13	12	11	10	9	8
RESERVED							
R-0h							
7	6	5	4	3	2	1	0
CTR_CMP	CTR_PRD	CTROVF	CEVT4	CEVT3	CEVT2	CEVT1	INT
R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h

**Table 15-13. ECFLG Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-8	RESERVED	R	0h	Reserved
7	CTR_CMP	R	0h	Compare Equal Compare Status Flag. This flag is active only in APWM mode. Reset type: SYSRSn 0h (R/W) = Indicates no event occurred 1h (R/W) = Indicates the counter (TSCTR) reached the compare register value (ACMP)
6	CTR_PRD	R	0h	Counter Equal Period Status Flag. This flag is only active in APWM mode. Reset type: SYSRSn 0h (R/W) = Indicates no event occurred 1h (R/W) = Indicates the counter (TSCTR) reached the period register value (APRD) and was reset.
5	CTROVF	R	0h	Counter Overflow Status Flag. This flag is active in CAP and APWM mode. Reset type: SYSRSn 0h (R/W) = Indicates no event occurred 1h (R/W) = Indicates the counter (TSCTR) has made the transition from FFFFFFFF " 00000000
4	CEVT4	R	0h	Capture Event 4 Status Flag This flag is only active in CAP mode. Reset type: SYSRSn 0h (R/W) = Indicates no event occurred 1h (R/W) = ndicates the fourth event occurred at ECAPx pin
3	CEVT3	R	0h	Capture Event 3 Status Flag. This flag is active only in CAP mode. Reset type: SYSRSn 0h (R/W) = Indicates no event occurred 1h (R/W) = Indicates the third event occurred at ECAPx pin.
2	CEVT2	R	0h	Capture Event 2 Status Flag. This flag is only active in CAP mode. Reset type: SYSRSn 0h (R/W) = Indicates no event occurred 1h (R/W) = Indicates the second event occurred at ECAPx pin.
1	CEVT1	R	0h	Capture Event 1 Status Flag. This flag is only active in CAP mode. Reset type: SYSRSn 0h (R/W) = Indicates no event occurred 1h (R/W) = Indicates the first event occurred at ECAPx pin.

**Table 15-13. ECFLG Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
0	INT	R	0h	Global Interrupt Status Flag Reset type: SYSRSn 0h (R/W) = Indicates no event occurred 1h (R/W) = Indicates that an interrupt was generated.

**15.8.2.11 ECCLR Register (Offset = 18h) [reset = 0h]**

 ECCLR is shown in [Figure 15-27](#) and described in [Table 15-14](#).

 Return to [Summary Table](#).

Capture Interrupt Clear Register

**Figure 15-27. ECCLR Register**

15								14								13								12								11								10								9								8							
RESERVED																																																															
R-0h																																																															
7								6								5								4								3								2								1								0							
CTR_CMP								CTR_PRD								CTROVF								CEVT4								CEVT3								CEVT2								CEVT1								INT							
R=0/W=1-0h								R=0/W=1-0h								R=0/W=1-0h								R=0/W=1-0h								R=0/W=1-0h								R=0/W=1-0h								R=0/W=1-0h								R/W-0h							

**Table 15-14. ECCLR Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-8	RESERVED	R	0h	Reserved
7	CTR_CMP	R=0/W=1	0h	Counter Equal Compare Status Clear Reset type: SYSRSn 0h (R/W) = Writing a 0 has no effect. Always reads back a 0 1h (R/W) = Writing a 1 clears the CTR=CMP flag condition
6	CTR_PRD	R=0/W=1	0h	Counter Equal Period Status Clear Reset type: SYSRSn 0h (R/W) = Writing a 0 has no effect. Always reads back a 0 1h (R/W) = Writing a 1 clears the CTR=PRD flag condition
5	CTROVF	R=0/W=1	0h	Counter Overflow Status Clear Reset type: SYSRSn 0h (R/W) = Writing a 0 has no effect. Always reads back a 0 1h (R/W) = Writing a 1 clears the CTROVF flag condition
4	CEVT4	R=0/W=1	0h	Capture Event 4 Status Clear Reset type: SYSRSn 0h (R/W) = Writing a 0 has no effect. Always reads back a 0 1h (R/W) = Writing a 1 clears the CEVT4 flag condition.
3	CEVT3	R=0/W=1	0h	Capture Event 3 Status Clear Reset type: SYSRSn 0h (R/W) = Writing a 0 has no effect. Always reads back a 0 1h (R/W) = Writing a 1 clears the CEVT3 flag condition.
2	CEVT2	R=0/W=1	0h	Capture Event 2 Status Clear Reset type: SYSRSn 0h (R/W) = Writing a 0 has no effect. Always reads back a 0 1h (R/W) = Writing a 1 clears the CEVT2 flag condition.
1	CEVT1	R=0/W=1	0h	Capture Event 1 Status Clear Reset type: SYSRSn 0h (R/W) = Writing a 0 has no effect. Always reads back a 0 1h (R/W) = Writing a 1 clears the CEVT1 flag condition.
0	INT	R/W	0h	ECAP Global Interrupt Status Clear Reset type: SYSRSn 0h (R/W) = Writing a 0 has no effect. Always reads back a 0 1h (R/W) = Writing a 1 clears the INT flag and enable further interrupts to be generated if any of the event flags are set to 1

### 15.8.2.12 ECFRC Register (Offset = 19h) [reset = 0h]

ECFRC is shown in [Figure 15-28](#) and described in [Table 15-15](#).

Return to [Summary Table](#).

Capture Interrupt Force Register

**Figure 15-28. ECFRC Register**

15	14	13	12	11	10	9	8
RESERVED							
R-0h							
7	6	5	4	3	2	1	0
CTR_CMP	CTR_PRD	CTROVF	CEVT4	CEVT3	CEVT2	CEVT1	RESERVED
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R-0h

**Table 15-15. ECFRC Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-8	RESERVED	R	0h	Reserved
7	CTR_CMP	R/W	0h	Force Counter Equal Compare Interrupt. This event is only active in APWM mode. Reset type: SYSRSn 0h (R/W) = No effect. Always reads back a 0. 1h (R/W) = Writing a 1 sets the CTR=CMP flag bit.
6	CTR_PRD	R/W	0h	Force Counter Equal Period Interrupt. This event is only active in APWM mode. Reset type: SYSRSn 0h (R/W) = No effect. Always reads back a 0. 1h (R/W) = Writing a 1 sets the CTR=PRD flag bit.
5	CTROVF	R/W	0h	Force Counter Overflow. Reset type: SYSRSn 0h (R/W) = No effect. Always reads back a 0. 1h (R/W) = Writing a 1 to this bit sets the CTROVF flag bit.
4	CEVT4	R/W	0h	Force Capture Event 4. This event is only active in CAP mode. Reset type: SYSRSn 0h (R/W) = No effect. Always reads back a 0. 1h (R/W) = Writing a 1 sets the CEVT4 flag bit
3	CEVT3	R/W	0h	Force Capture Event 3. This event is only active in CAP mode. Reset type: SYSRSn 0h (R/W) = No effect. Always reads back a 0. 1h (R/W) = Writing a 1 sets the CEVT3 flag bit
2	CEVT2	R/W	0h	Force Capture Event 2. This event is only active in CAP mode. Reset type: SYSRSn 0h (R/W) = No effect. Always reads back a 0. 1h (R/W) = Writing a 1 sets the CEVT2 flag bit.
1	CEVT1	R/W	0h	Force Capture Event 1. This event is only active in CAP mode. Reset type: SYSRSn 0h (R/W) = No effect. Always reads back a 0. 1h (R/W) = Sets the CEVT1 flag bit.
0	RESERVED	R	0h	Reserved

## ***Enhanced QEP (eQEP)***

The enhanced QEP (eQEP) module described here is a Type 0 eQEP. See the *TMS320x28xx, 28xxx DSP Peripheral Reference Guide (SPRU566)* for a list of all devices with a module of the same type to determine the differences between types and for a list of device-specific differences within a type.

The enhanced quadrature encoder pulse (eQEP) module is used for direct interface with a linear or rotary incremental encoder to get position, direction, and speed information from a rotating machine for use in a high-performance motion and position-control system.

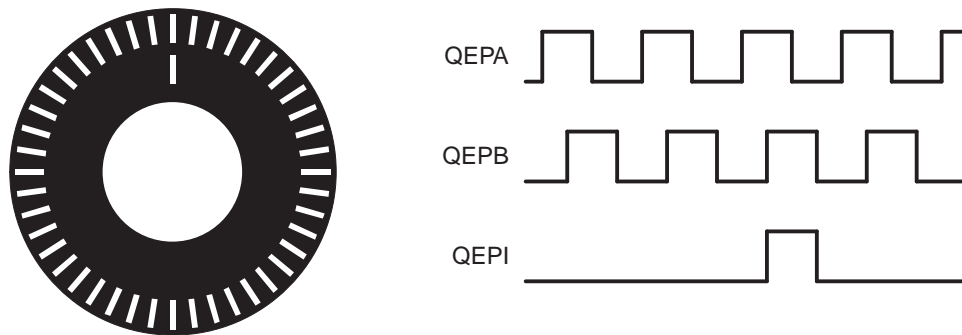
Topic	Page
<b>16.1 Introduction .....</b>	<b>1945</b>
<b>16.2 Configuring Device Pins .....</b>	<b>1947</b>
<b>16.3 Description .....</b>	<b>1947</b>
<b>16.4 Quadrature Decoder Unit (QDU).....</b>	<b>1950</b>
<b>16.5 Position Counter and Control Unit (PCCU).....</b>	<b>1953</b>
<b>16.6 eQEP Edge Capture Unit.....</b>	<b>1959</b>
<b>16.7 eQEP Watchdog.....</b>	<b>1963</b>
<b>16.8 Unit Timer Base .....</b>	<b>1963</b>
<b>16.9 eQEP Interrupt Structure .....</b>	<b>1964</b>
<b>16.10 Registers .....</b>	<b>1965</b>



## 16.1 Introduction

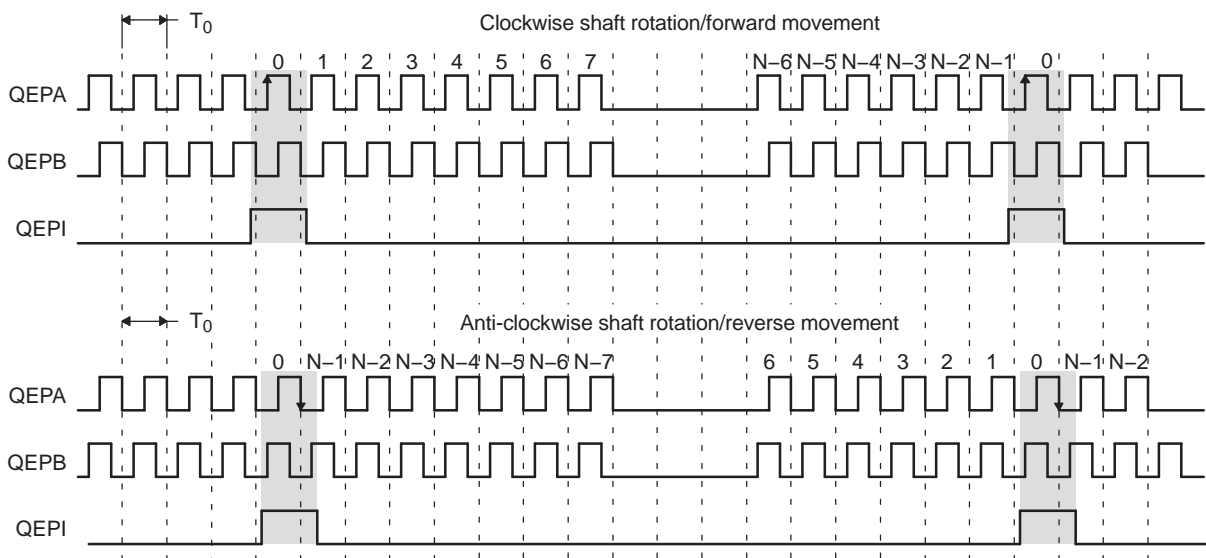
A single track of slots patterns the periphery of an incremental encoder disk, as shown in [Figure 16-1](#). These slots create an alternating pattern of dark and light lines. The disk count is defined as the number of dark/light line pairs that occur per revolution (lines per revolution). As a rule, a second track is added to generate a signal that occurs once per revolution (index signal: QEPI), which can be used to indicate an absolute position. Encoder manufacturers identify the index pulse using different terms such as index, marker, home position, and zero reference

**Figure 16-1. Optical Encoder Disk**



To derive direction information, the lines on the disk are read out by two different photo-elements that "look" at the disk pattern with a mechanical shift of 1/4 the pitch of a line pair between them. This shift is realized with a reticle or mask that restricts the view of the photo-element to the desired part of the disk lines. As the disk rotates, the two photo-elements generate signals that are shifted 90° out of phase from each other. These are commonly called the quadrature QEPA and QEPB signals. The clockwise direction for most encoders is defined as the QEPA channel going positive before the QEPB channel and vice versa as shown in [Figure 16-2](#).

**Figure 16-2. QEP Encoder Output Signal for Forward/Reverse Movement**

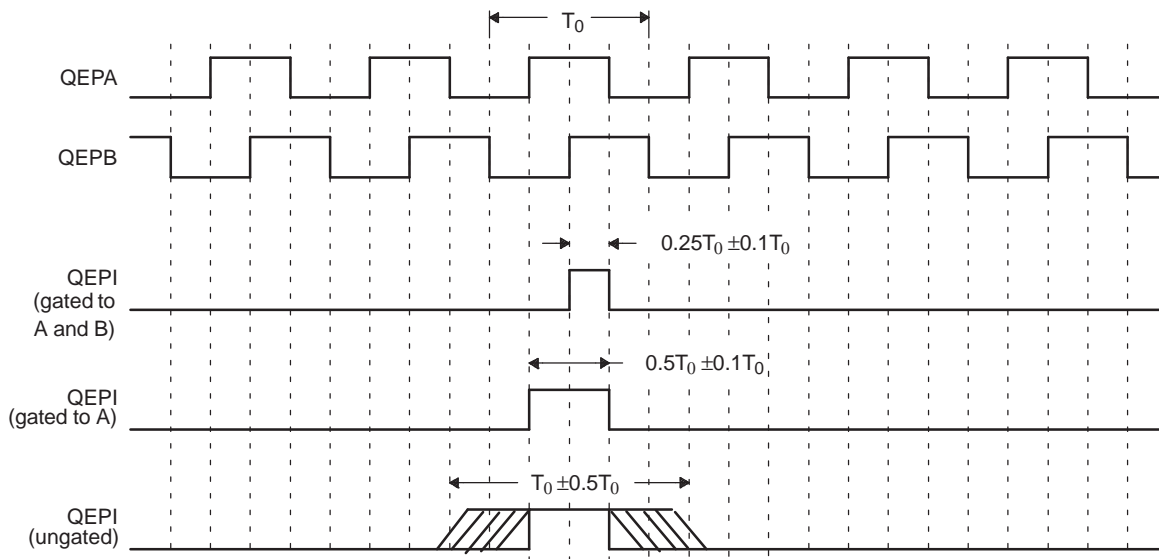


**Legend:** N = lines per revolution

The encoder wheel typically makes one revolution for every revolution of the motor or the wheel may be at a geared rotation ratio with respect to the motor. Therefore, the frequency of the digital signal coming from the QEPA and QEPB outputs varies proportionally with the velocity of the motor. For example, a 2000-line encoder directly coupled to a motor running at 5000 revolutions per minute (rpm) results in a frequency of 166.6 KHz, so by measuring the frequency of either the QEPA or QEPB output, the processor can determine the velocity of the motor.

Quadrature encoders from different manufacturers come with two forms of index pulse (gated index pulse or ungated index pulse) as shown in Figure 16-3. A nonstandard form of index pulse is ungated. In the ungated configuration, the index edges are not necessarily coincident with A and B signals. The gated index pulse is aligned to any of the four quadrature edges and width of the index pulse and can be equal to a quarter, half, or full period of the quadrature signal.

**Figure 16-3. Index Pulse Example**



Some typical applications of shaft encoders include robotics and even computer input in the form of a mouse. Inside your mouse you can see where the mouse ball spins a pair of axles (a left/right, and an up/down axle). These axles are connected to optical shaft encoders that effectively tell the computer how fast and in what direction the mouse is moving.

**General Issues:** Estimating velocity from a digital position sensor is a cost-effective strategy in motor control. Two different first order approximations for velocity may be written as:

$$v(k) \approx \frac{x(k) - x(k-1)}{T} = \frac{\Delta X}{T} \quad (1)$$

$$v(k) \approx \frac{X}{t(k) - t(k-1)} = \frac{X}{\Delta T} \quad (2)$$

where

$v(k)$ : Velocity at time instant  $k$

$x(k)$ : Position at time instant  $k$

$x(k-1)$ : Position at time instant  $k-1$

$T$ : Fixed unit time or inverse of velocity calculation rate

$\Delta X$ : Incremental position movement in unit time

$t(k)$ : Time instant " $k$ "

$t(k-1)$ : Time instant " $k-1$ "

$X$ : Fixed unit position

$\Delta T$ : Incremental time elapsed for unit position movement.

Equation 1 is the conventional approach to velocity estimation and it requires a time base to provide unit time event for velocity calculation. Unit time is basically the inverse of the velocity calculation rate.

The encoder count (position) is read once during each unit time event. The quantity  $[x(k) - x(k-1)]$  is formed by subtracting the previous reading from the current reading. Then the velocity estimate is computed by multiplying by the known constant  $1/T$  (where  $T$  is the constant time between unit time events and is known in advance).

Estimation based on [Equation 1](#) has an inherent accuracy limit directly related to the resolution of the position sensor and the unit time period  $T$ . For example, consider a 500-line per revolution quadrature encoder with a velocity calculation rate of 400 Hz. When used for position the quadrature encoder gives a four-fold increase in resolution, in this case, 2000 counts per revolution. The minimum rotation that can be detected is therefore 0.0005 revolutions, which gives a velocity resolution of 12 rpm when sampled at 400 Hz. While this resolution may be satisfactory at moderate or high speeds, e.g. 1% error at 1200 rpm, it would clearly prove inadequate at low speeds. In fact, at speeds below 12 rpm, the speed estimate would erroneously be zero much of the time.

At low speed, [Equation 2](#) provides a more accurate approach. It requires a position sensor that outputs a fixed interval pulse train, such as the aforementioned quadrature encoder. The width of each pulse is defined by motor speed for a given sensor resolution. [Equation 2](#) can be used to calculate motor speed by measuring the elapsed time between successive quadrature pulse edges. However, this method suffers from the opposite limitation, as does [Equation 1](#). A combination of relatively large motor speeds and high sensor resolution makes the time interval  $\Delta T$  small, and thus more greatly influenced by the timer resolution. This can introduce considerable error into high-speed estimates.

For systems with a large speed range (that is, speed estimation is needed at both low and high speeds), one approach is to use [Equation 2](#) at low speed and have the DSP software switch over to [Equation 1](#) when the motor speed rises above some specified threshold.

## 16.2 Configuring Device Pins

The GPIO mux registers must be configured to connect this peripheral to the device pins. To avoid glitches on the pins, the GPyGMUX bits must be configured first (while keeping the corresponding GPyMUX bits at the default of zero), followed by writing the GPyMUX register to the desired value.

For proper operation of the eQEP module, input GPIO pins must be configured via the GPxQSELn registers for synchronous input mode (with or without qualification). The asynchronous mode should not be used for eQEP input pins. The internal pullups can be configured in the GPyPUD register.

See the *GPIO* chapter for more details on GPIO mux and settings.

## 16.3 Description

This section provides the eQEP inputs, memory map, and functional description.

### 16.3.1 EQEP Inputs

The eQEP inputs include two pins for quadrature-clock mode or direction-count mode, an index (or 0 marker), and a strobe input. The eQEP module requires that the QEPA, QEPB, and QEPI inputs are synchronized to SYSCLK prior to entering the module. The application code should enable the synchronous GPIO input feature on any eQEP-enabled GPIO pins (see the *System Control and Interrupts* chapter for more details).

- *QEPA/XCLK and QEPB/XDIR*

These two pins can be used in quadrature-clock mode or direction-count mode.

- *Quadrature-clock Mode*

The eQEP encoders provide two square wave signals (A and B) 90 electrical degrees out of phase whose phase relationship is used to determine the direction of rotation of the input shaft and number of eQEP pulses from the index position to derive the relative position information. For forward or clockwise rotation, QEPA signal leads QEPB signal and vice versa. The quadrature decoder uses these two inputs to generate quadrature-clock and direction signals.

- *Direction-count Mode*

In direction-count mode, direction and clock signals are provided directly from the external source. Some position encoders have this type of output instead of quadrature output. The QEPA pin provides the clock input and the QEPB pin provides the direction input.

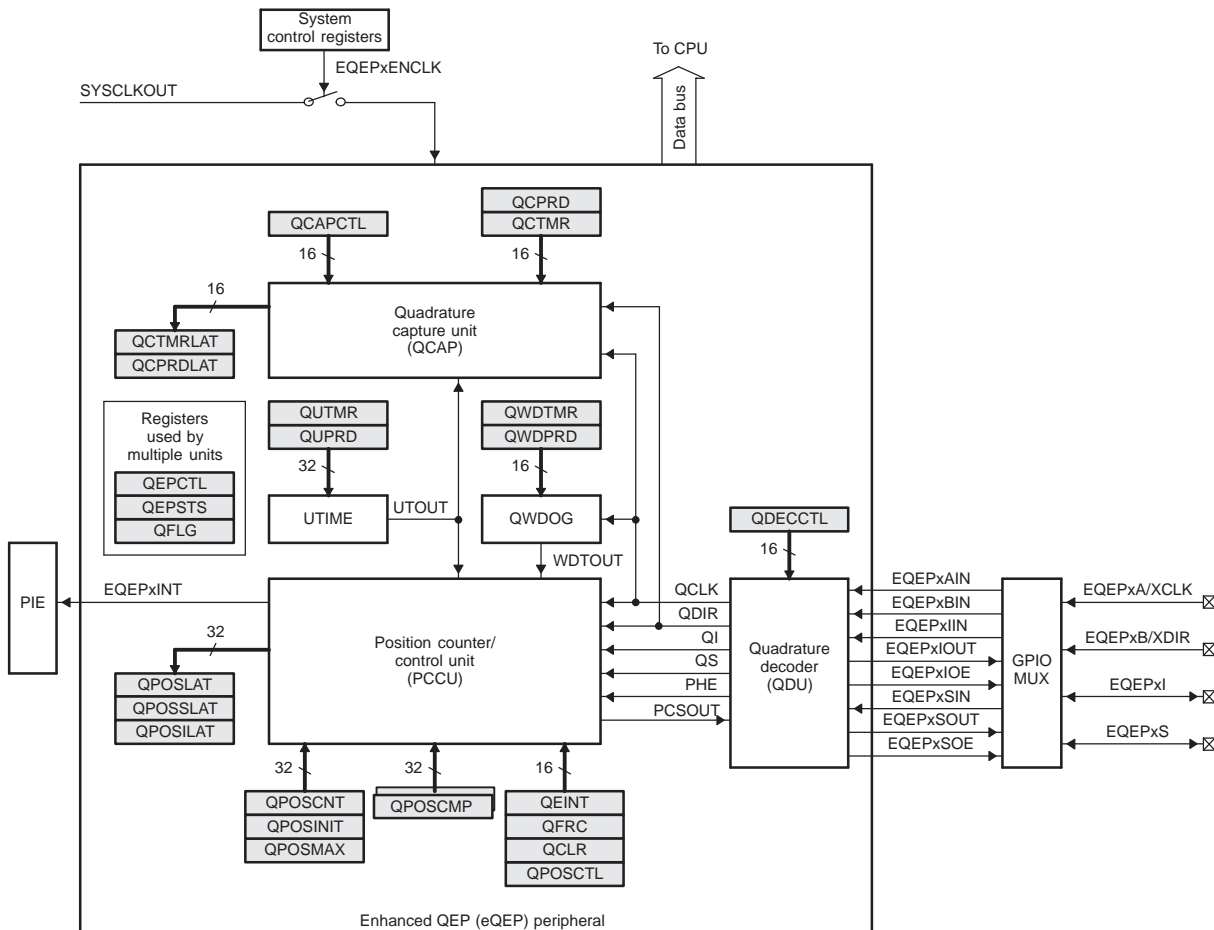
- QEPI: Index or Zero Marker**  
 The eQEP encoder uses an index signal to assign an absolute start position from which position information is incrementally encoded using quadrature pulses. This pin is connected to the index output of the eQEP encoder to optionally reset the position counter for each revolution. This signal can be used to initialize or latch the position counter on the occurrence of a desired event on the index pin.
- QEPS: Strobe Input**  
 This general-purpose strobe signal can initialize or latch the position counter on the occurrence of a desired event on the strobe pin. This signal is typically connected to a sensor or limit switch to notify that the motor has reached a defined position.

### 16.3.2 Functional Description

The eQEP peripheral contains the following major functional units (as shown in Figure 16-4):

- Programmable input qualification for each pin (part of the GPIO MUX)
- Quadrature decoder unit (QDU)
- Position counter and control unit for position measurement (PCCU)
- Quadrature edge-capture unit for low-speed measurement (QCAP)
- Unit time base for speed/frequency measurement (UTIME)
- Watchdog timer for detecting stalls (QWDOG)

**Figure 16-4. Functional Block Diagram of the eQEP Peripheral**



### 16.3.3 eQEP Memory Map

Table 16-1 lists the registers with their memory locations, sizes, and reset values.

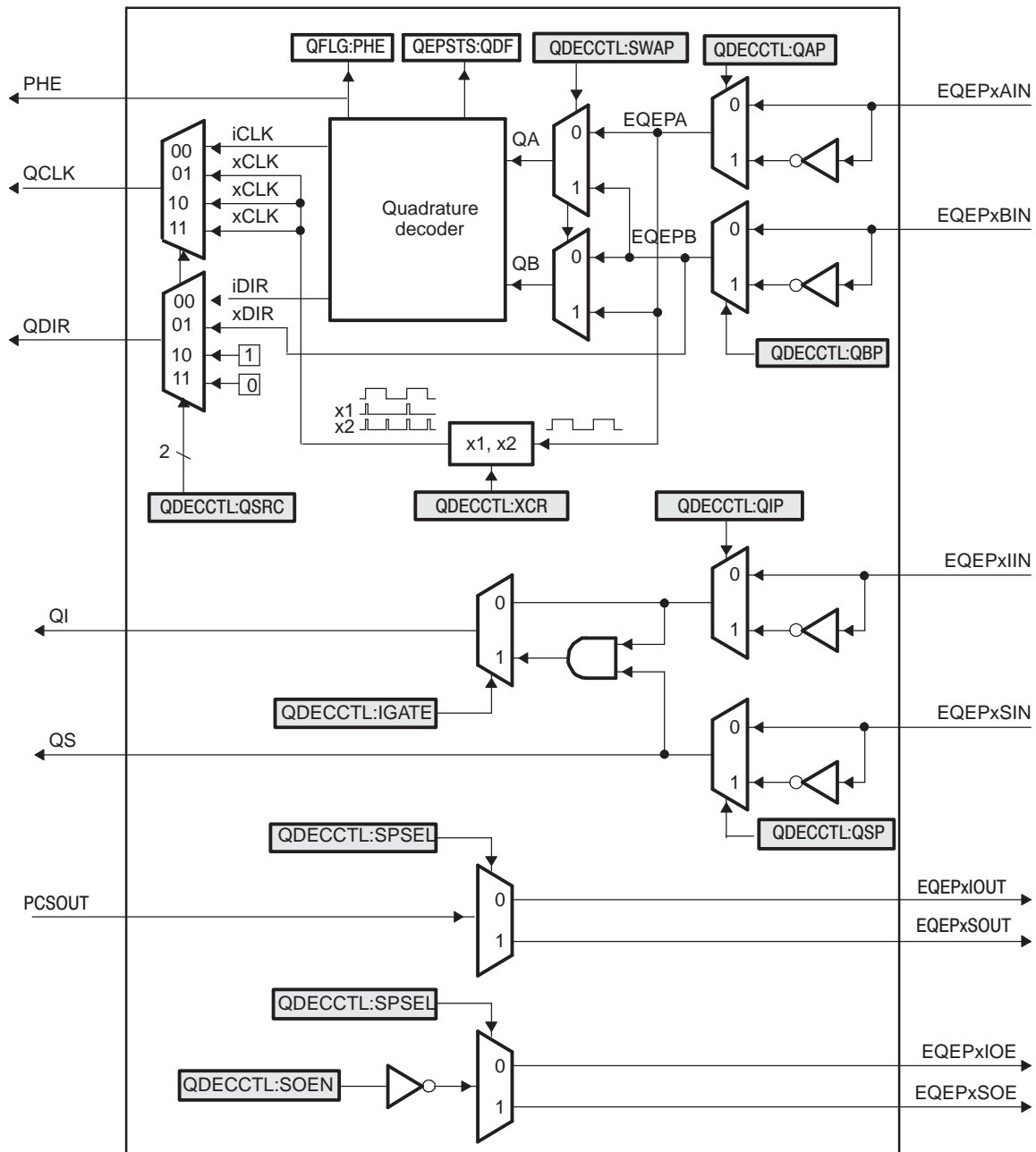
**Table 16-1. EQEP Memory Map**

Name	Offset	Size(x16)/ #shadow	Reset	Register Description
QPOSCNT	0x00	2/0	0x00000000	eQEP Position Counter
QPOSINIT	0x02	2/0	0x00000000	eQEP Initialization Position Count
QPOSMAX	0x04	2/0	0x00000000	eQEP Maximum Position Count
QPOSCMP	0x06	2/1	0x00000000	eQEP Position-compare
QPOSILAT	0x08	2/0	0x00000000	eQEP Index Position Latch
QPOSSLAT	0x0A	2/0	0x00000000	eQEP Strobe Position Latch
QPOSLAT	0x0C	2/0	0x00000000	eQEP Position Latch
QUTMR	0x0E	2/0	0x00000000	QEP Unit Timer
QUPRD	0x10	2/0	0x00000000	eQEP Unit Period Register
QWDTMR	0x12	1/0	0x0000	eQEP Watchdog Timer
QWDPRD	0x13	1/0	0x0000	eQEP Watchdog Period Register
QDECCTL	0x14	1/0	0x0000	eQEP Decoder Control Register
QEPCTL	0x15	1/0	0x0000	eQEP Control Register
QCAPCTL	0x16	1/0	0x0000	eQEP Capture Control Register
QPOSCTL	0x17	1/0	0x00000	eQEP Position-compare Control Register
QEINT	0x18	1/0	0x0000	eQEP Interrupt Enable Register
QFLG	0x19	1/0	0x0000	eQEP Interrupt Flag Register
QCLR	0x1A	1/0	0x0000	eQEP Interrupt Clear Register
QFRC	0x1B	1/0	0x0000	eQEP Interrupt Force Register
QEPSTS	0x1C	1/0	0x0000	eQEP Status Register
QCTMR	0x1D	1/0	0x0000	eQEP Capture Timer
QCPRD	0x1E	1/0	0x0000	eQEP Capture Period Register
QCTMRLAT	0x1F	1/0	0x0000	eQEP Capture Timer Latch
QCPRDLAT	0x20	1/0	0x0000	eQEP Capture Period Latch
reserved	0x21 to 0x3F	31/0		

### 16.4 Quadrature Decoder Unit (QDU)

Figure 16-5 shows a functional block diagram of the QDU.

Figure 16-5. Functional Block Diagram of Decoder Unit



#### 16.4.1 Position Counter Input Modes

Clock and direction input to position counter is selected using QDECCTL[QSRC] bits, based on interface input requirement as follows:

- Quadrature-count mode
- Direction-count mode
- UP-count mode
- DOWN-count mode

### 16.4.1.1 Quadrature Count Mode

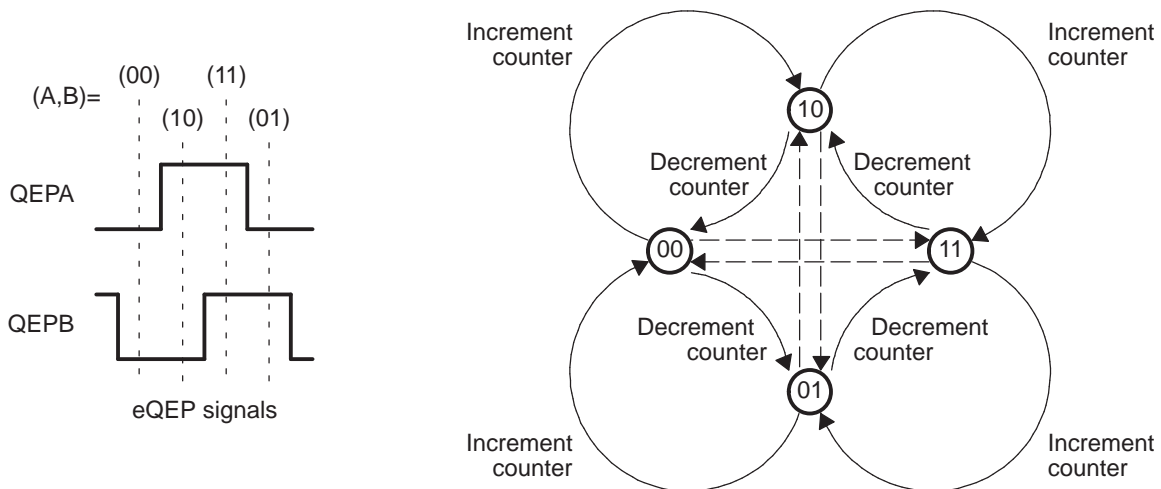
The quadrature decoder generates the direction and clock to the position counter in quadrature count mode.

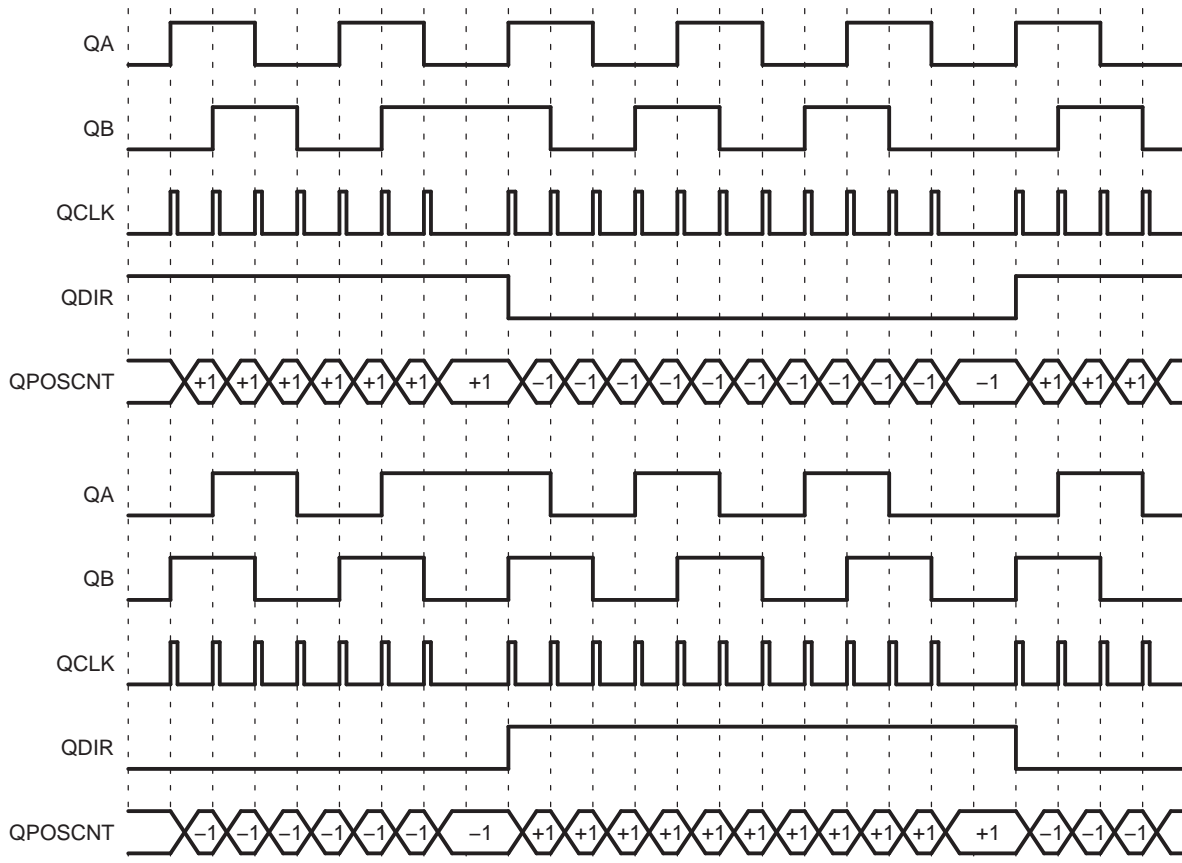
**Direction Decoding**— The direction decoding logic of the eQEP circuit determines which one of the sequences (QEPA, QEPB) is the leading sequence and accordingly updates the direction information in QEPSTS[QDF] bit. Table 16-2 and Figure 16-6 show the direction decoding logic in truth table and state machine form. Both edges of the QEPA and QEPB signals are sensed to generate count pulses for the position counter. Therefore, the frequency of the clock generated by the eQEP logic is four times that of each input sequence. Figure 16-7 shows the direction decoding and clock generation from the eQEP input signals.

**Table 16-2. Quadrature Decoder Truth Table**

Previous Edge	Present Edge	QDIR	QPOSCNT
QA↑	QB↑	UP	Increment
	QB↓	DOWN	Decrement
	QA↓	TOGGLE	Increment or Decrement
QA↓	QB↓	UP	Increment
	QB↑	DOWN	Decrement
	QA↑	TOGGLE	Increment or Decrement
QB↑	QA↑	DOWN	Increment
	QA↓	UP	Decrement
	QB↓	TOGGLE	Increment or Decrement
QB↓	QA↓	DOWN	Increment
	QA↑	UP	Decrement
	QB↑	TOGGLE	Increment or Decrement

**Figure 16-6. Quadrature Decoder State Machine**



**Figure 16-7. Quadrature-clock and Direction Decoding**


**Phase Error Flag**— In normal operating conditions, quadrature inputs QEPA and QEPB will be 90 degrees out of phase. The phase error flag (PHE) is set in the QFLG register when edge transition is detected simultaneously on the QEPA and QEPB signals to optionally generate interrupts. State transitions marked by dashed lines in [Figure 16-6](#) are invalid transitions that generate a phase error.

**Count Multiplication**— The eQEP position counter provides 4x times the resolution of an input clock by generating a quadrature-clock (QCLK) on the rising/falling edges of both eQEP input clocks (QEPA and QEPB) as shown in [Figure 16-7](#).

**Reverse Count**— In normal quadrature count operation, QEPA input is fed to the QA input of the quadrature decoder and the QEPB input is fed to the QB input of the quadrature decoder. Reverse counting is enabled by setting the SWAP bit in the QDECCTL register. This will swap the input to the quadrature decoder thereby reversing the counting direction.

#### 16.4.1.2 Direction-count Mode

Some position encoders provide direction and clock outputs, instead of quadrature outputs. In such cases, direction-count mode can be used. QEPA input will provide the clock for position counter and the QEPB input will have the direction information. The position counter is incremented on every rising edge of a QEPA input when the direction input is high and decremented when the direction input is low.



### 16.4.1.3 Up-Count Mode

The counter direction signal is hard-wired for up count and the position counter is used to measure the frequency of the QEPA input. Clearing the QDECCTL[XCR] bit enables clock generation to the position counter on both edges of the QEPA input, thereby increasing the measurement resolution by 2x factor. In up-count mode, it is recommended that the application not configure QEPB as a GPIO mux option, or ensure that a signal edge is not generated on the QEPB input.

### 16.4.1.4 Down-Count Mode

The counter direction signal is hardwired for a down count and the position counter is used to measure the frequency of the QEPA input. Setting of the QDECCTL[XCR] bit enables clock generation to the position counter on both edges of a QEPA input, thereby increasing the measurement resolution by 2x factor. In down-count mode, it is recommended that the application not configure QEPB as a GPIO mux option, or ensure that a signal edge is not generated on the QEPB input.

## 16.4.2 eQEP Input Polarity Selection

Each eQEP input can be inverted using QDECCTL[8:5] control bits. As an example, setting of QDECCTL[QIP] bit will invert the index input.

### 16.4.3 Position-Compare Sync Output

The enhanced eQEP peripheral includes a position-compare unit that is used to generate the position-compare sync signal on compare match between the position counter register (QPOSCNT) and the position-compare register (QPOSCMP). This sync signal can be output using an index pin or strobe pin of the EQEP peripheral.

Setting the QDECCTL[SOEN] bit enables the position-compare sync output and the QDECCTL[SPSEL] bit selects either an eQEP index pin or an eQEP strobe pin.

## 16.5 Position Counter and Control Unit (PCCU)

The position counter and control unit provides two configuration registers (QEPCTL and QPOSCTL) for setting up position counter operational modes, position counter initialization/latch modes and position-compare logic for sync signal generation.

### 16.5.1 Position Counter Operating Modes

Position counter data may be captured in different manners. In some systems, the position counter is accumulated continuously for multiple revolutions and the position counter value provides the position information with respect to the known reference. An example of this is the quadrature encoder mounted on the motor controlling the print head in the printer. Here the position counter is reset by moving the print head to the home position and then position counter provides absolute position information with respect to home position.

In other systems, the position counter is reset on every revolution using index pulse and position counter provides rotor angle with respect to index pulse position.

Position counter can be configured to operate in following four modes

- Position Counter Reset on Index Event
- Position Counter Reset on Maximum Position
- Position Counter Reset on the first Index Event
- Position Counter Reset on Unit Time Out Event (Frequency Measurement)

In all the above operating modes, position counter is reset to 0 on overflow and to QPOSMAX register value on underflow. Overflow occurs when the position counter counts up after QPOSMAX value. Underflow occurs when position counter counts down after "0". Interrupt flag is set to indicate overflow/underflow in QFLG register.

### 16.5.1.1 Position Counter Reset on Index Event (QEPCTL[PCRM]=00)

If the index event occurs during the forward movement, then position counter is reset to 0 on the next eQEP clock. If the index event occurs during the reverse movement, then the position counter is reset to the value in the QPOSMAX register on the next eQEP clock.

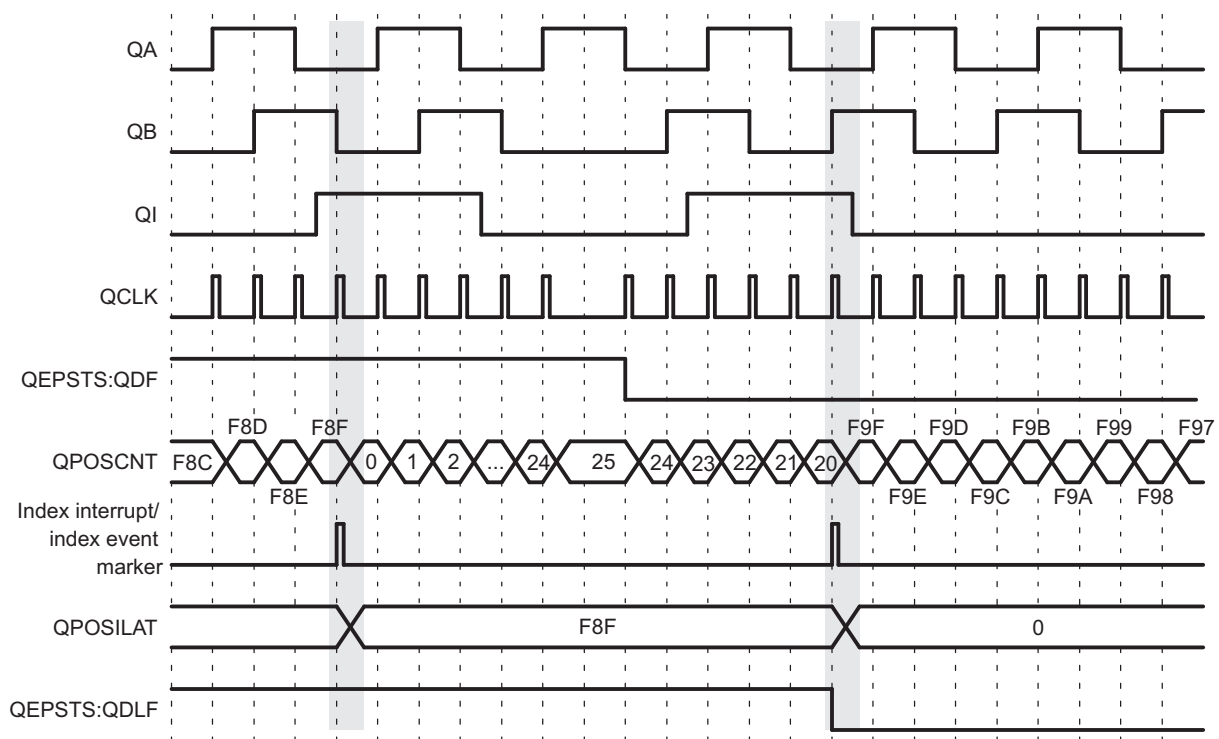
First index marker is defined as the quadrature edge following the first index edge. The eQEP peripheral records the occurrence of the first index marker (QEPSTS[FIMF]) and direction on the first index event marker (QEPSTS[FIDF]) in QEPSTS registers, it also remembers the quadrature edge on the first index marker so that same relative quadrature transition is used for index event reset operation.

For example, if the first reset operation occurs on the falling edge of QEPB during the forward direction, then all the subsequent reset must be aligned with the falling edge of QEPB for the forward rotation and on the rising edge of QEPB for the reverse rotation as shown in Figure 16-8.

The position-counter value is latched to the QPOSILAT register and direction information is recorded in the QEPSTS[QDLF] bit on every index event marker. The position-counter error flag (QEPSTS[PCEF]) and error interrupt flag (QLFG[PCE]) are set if the latched value is not equal to 0 or QPOSMAX. The position-counter error flag (QEPSTS[PCEF]) is updated on every index event marker and an interrupt flag (QLFG[PCE]) will be set on error that can be cleared only through software.

The index event latch configuration QEPCTL[IEL] must be configured to '00' or '11' when prcm=0 and the position counter error flag/interrupt flag are generated only in index event reset mode.

**Figure 16-8. Position Counter Reset by Index Pulse for 1000 Line Encoder (QPOSMAX = 3999 or 0xF9F)**

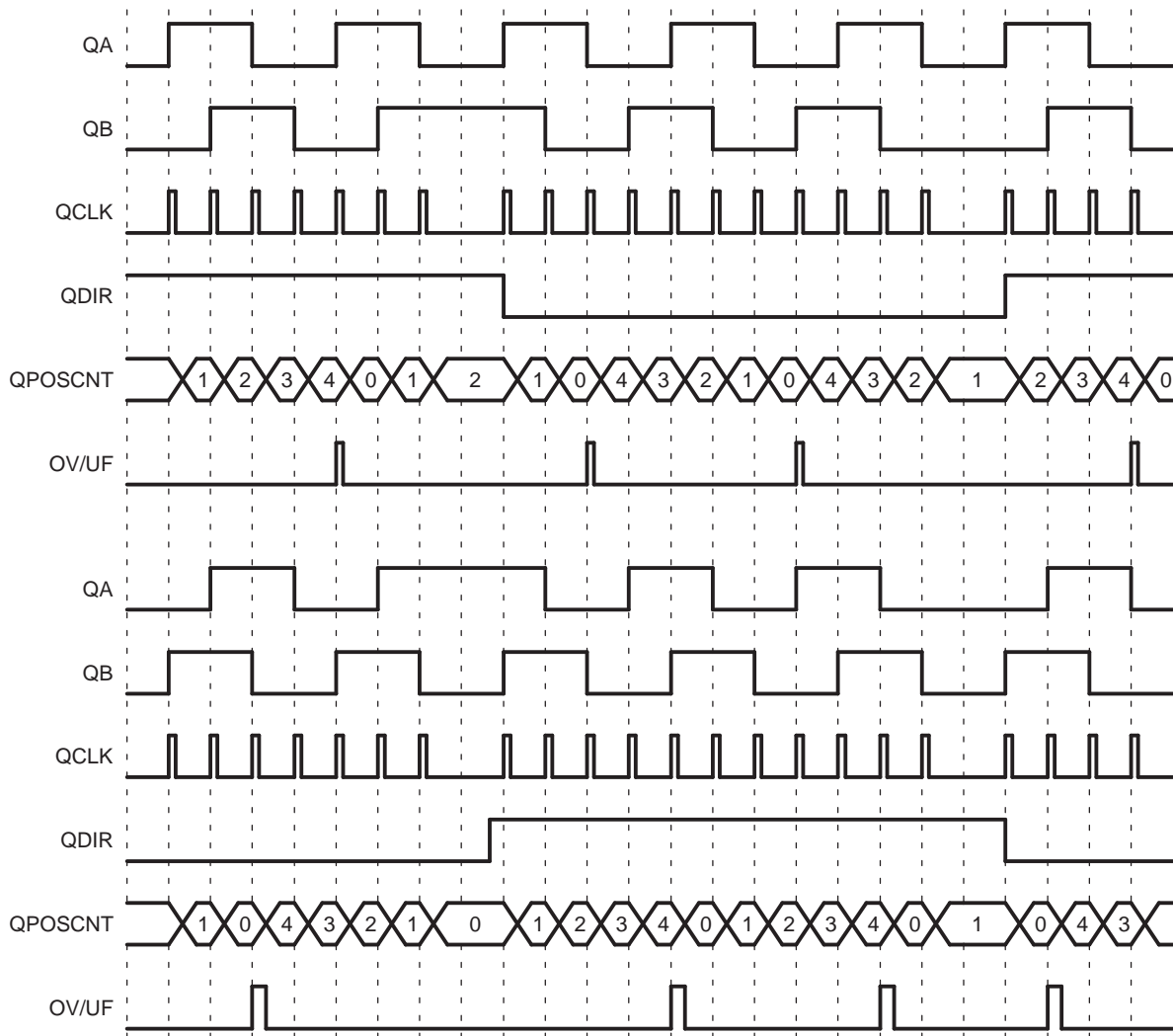


### 16.5.1.2 Position Counter Reset on Maximum Position (QEPCTL[PCRM]=01)

If the position counter is equal to QPOSMAX, then the position counter is reset to 0 on the next eQEP clock for forward movement and position counter overflow flag is set. If the position counter is equal to ZERO, then the position counter is reset to QPOSMAX on the next QEP clock for reverse movement and position counter underflow flag is set. Figure 16-9 shows the position counter reset operation in this mode.

The first index marker fields (QEPSTS[FIDF] and QEPSTS[FIMF]) are not applicable in this mode.

**Figure 16-9. Position Counter Underflow/Overflow (QPOSMAX = 4)**



**16.5.1.3 Position Counter Reset on the First Index Event (QEPCTL[PCRM] = 10)**

If the index event occurs during forward movement, then the position counter is reset to 0 on the next eQEP clock. If the index event occurs during the reverse movement, then the position counter is reset to the value in the QPOSMAX register on the next eQEP clock. Note that this is done only on the first occurrence and subsequently the position counter value is not reset on an index event; rather, it is reset based on maximum position as described in Section 16.5.1.2.

The first index marker fields (QEPSTS[FIDF] and QEPSTS[FIMF]) are not applicable in this mode.

**16.5.1.4 Position Counter Reset on Unit Time out Event (QEPCTL[PCRM] = 11)**

In this mode, the QPOSCNT value is latched to the QPOSLAT register and then the QPOSCNT is reset (to 0 or QPOSMAX, depending on the direction mode selected by QDECCTL[QSRC] bits on a unit time event). This is useful for frequency measurement.

**16.5.2 Position Counter Latch**

The eQEP index and strobe input can be configured to latch the position counter (QPOSCNT) into QPOSILAT and QPOSSLAT, respectively, on occurrence of a definite event on these pins.

### 16.5.2.1 Index Event Latch

In some applications, it may not be desirable to reset the position counter on every index event and instead it may be required to operate the position counter in full 32-bit mode (QEPCTL[PCRM] = 01 and QEPCTL[PCRM] = 10 modes).

In such cases, the eQEP position counter can be configured to latch on the following events and direction information is recorded in the QEPSTS[QDLF] bit on every index event marker.

- Latch on Rising edge (QEPCTL[IEL]=01)
- Latch on Falling edge (QEPCTL[IEL]=10)
- Latch on Index Event Marker (QEPCTL[IEL]=11)

This is particularly useful as an error checking mechanism to check if the position counter accumulated the correct number of counts between index events. As an example, the 1000-line encoder must count 4000 times when moving in the same direction between the index events.

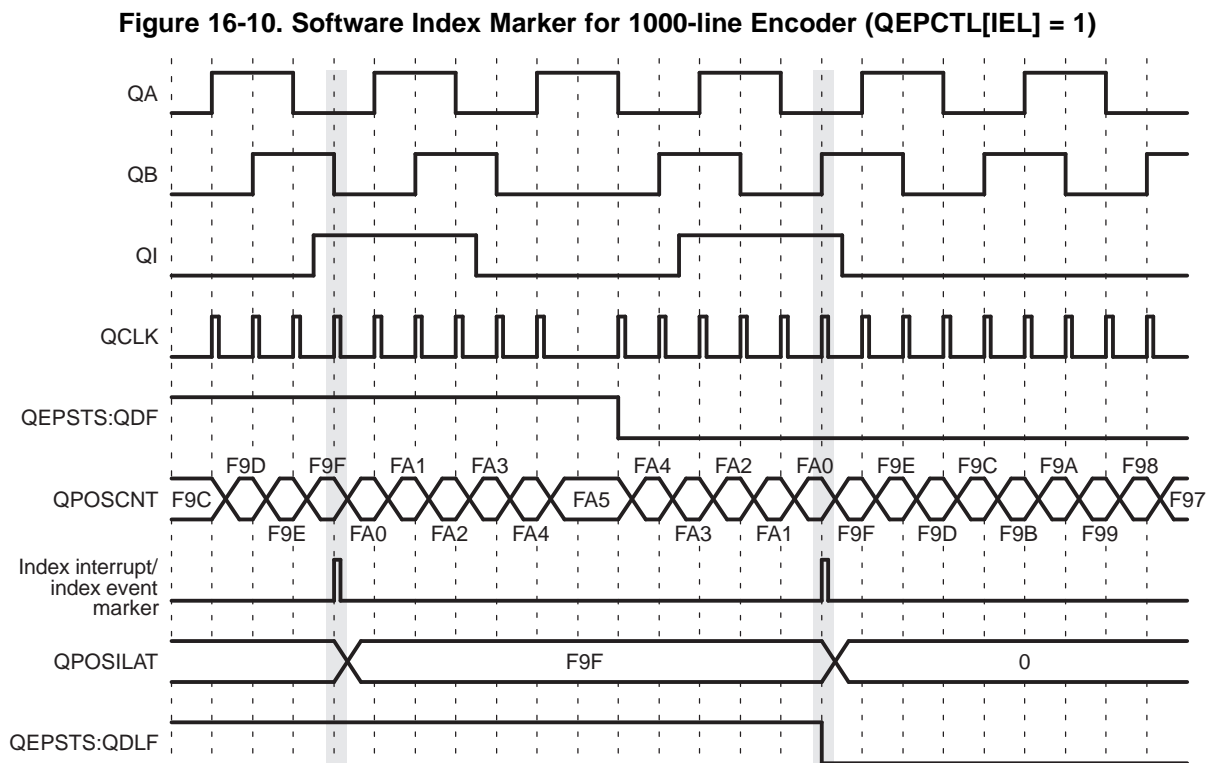
The index event latch interrupt flag (QFLG[IEL]) is set when the position counter is latched to the QPOSILAT register.

**Latch on Rising Edge (QEPCTL[IEL]=01)**— The position counter value (QPOSCNT) is latched to the QPOSILAT register on every rising edge of an index input.

**Latch on Falling Edge (QEPCTL[IEL] = 10)**— The position counter value (QPOSCNT) is latched to the QPOSILAT register on every falling edge of index input.

**Latch on Index Event Marker/Software Index Marker (QEPCTL[IEL] = 11)**— The first index marker is defined as the quadrature edge following the first index edge. The eQEP peripheral records the occurrence of the first index marker (QEPSTS[FIMF]) and direction on the first index event marker (QEPSTS[FIDF]) in the QEPSTS registers. It also remembers the quadrature edge on the first index marker so that same relative quadrature transition is used for latching the position counter (QEPCTL[IEL]=11).

Figure 16-10 shows the position counter latch using an index event marker.



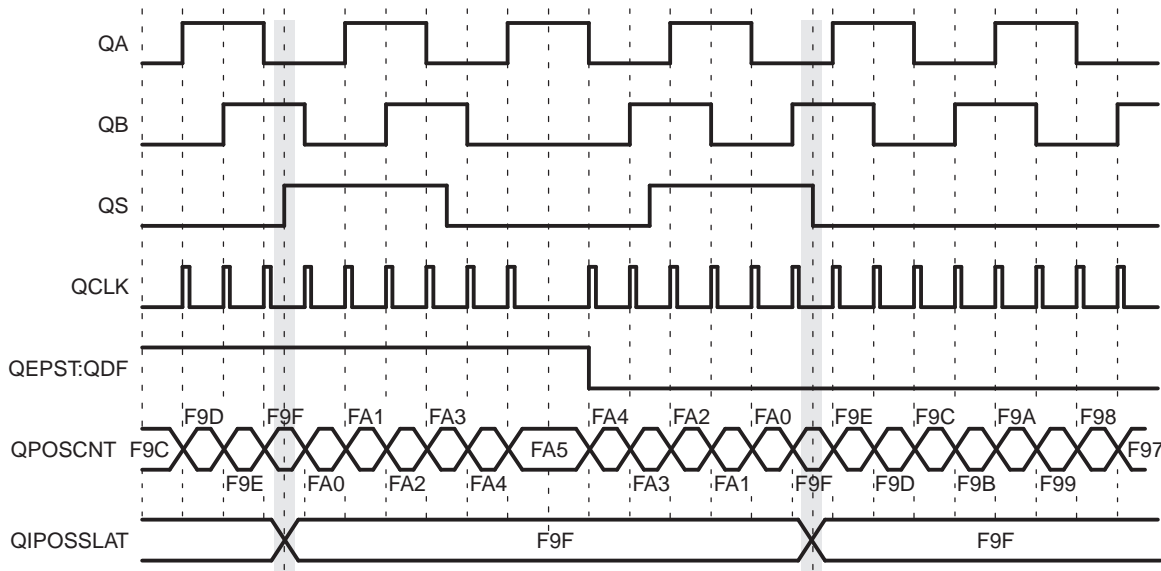
### 16.5.2.2 Strobe Event Latch

The position-counter value is latched to the QPOSSLAT register on the rising edge of the strobe input by clearing the QEPCTL[SEL] bit.

If the QEPCTL[SEL] bit is set, then the position counter value is latched to the QPOSSLAT register on the rising edge of the strobe input for forward direction and on the falling edge of the strobe input for reverse direction as shown in Figure 16-11.

The strobe event latch interrupt flag (QLFLG[SEL]) is set when the position counter is latched to the QPOSSLAT register.

Figure 16-11. Strobe Event Latch (QEPCTL[SEL] = 1)



### 16.5.3 Position Counter Initialization

The position counter can be initialized using following events:

- Index event
- Strobe event
- Software initialization

**Index Event Initialization (IEI)**— The QEPI index input can be used to trigger the initialization of the position counter at the rising or falling edge of the index input. If the QEPCTL[IEI] bits are 10, then the position counter (QPOSCNT) is initialized with a value in the QPOSINIT register on the rising edge of index input. Conversely, if the QEPCTL[IEI] bits are 11, initialization will be on the falling edge of the index input.

**Strobe Event Initialization (SEI)**— If the QEPCTL[SEI] bits are 10, then the position counter is initialized with a value in the QPOSINIT register on the rising edge of strobe input.

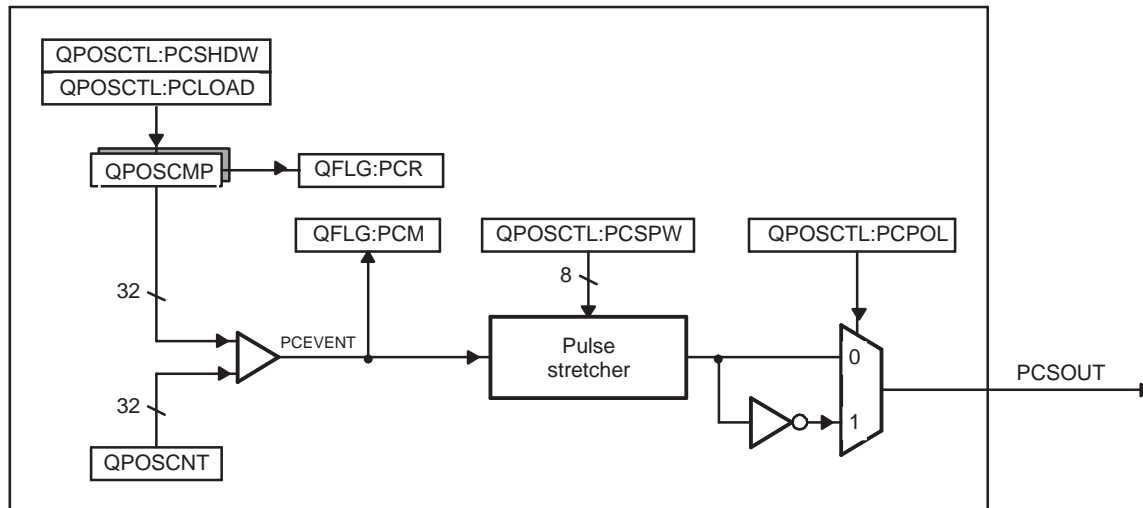
If QEPCTL[SEL] bits are 11, then the position counter is initialized with a value in the QPOSINIT register on the rising edge of strobe input for forward direction and on the falling edge of strobe input for reverse direction.

**Software Initialization (SWI)**— The position counter can be initialized in software by writing a 1 to the QEPCTL[SWI] bit. This bit is not automatically cleared. While the bit is still set, if a 1 is written to it again, the position counter will be re-initialized.

### 16.5.4 eQEP Position-compare Unit

The eQEP peripheral includes a position-compare unit that is used to generate a sync output and/or interrupt on a position-compare match. Figure 16-12 shows a diagram. The position-compare (QPOSCMP) register is shadowed and shadow mode can be enabled or disabled using the QPOSCTL[PSSHDW] bit. If the shadow mode is not enabled, the CPU writes directly to the active position compare register.

**Figure 16-12. eQEP Position-compare Unit**



In shadow mode, you can configure the position-compare unit (QPOSCTL[PCLOAD]) to load the shadow register value into the active register on the following events and to generate the position-compare ready (QFLG[PCR]) interrupt after loading.

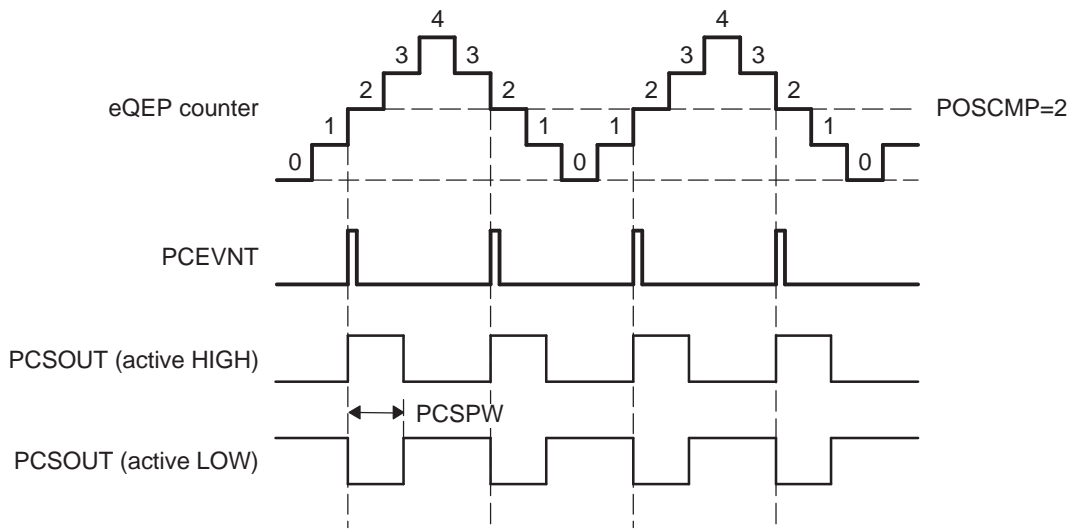
- Load on compare match
- Load on position-counter zero event

The position-compare match (QFLG[PCM]) is set when the position-counter value (QPOSCNT) matches with the active position-compare register (QPOSCMP) and the position-compare sync output of the programmable pulse width is generated on compare match to trigger an external device.

For example, if QPOSCMP = 2, the position-compare unit generates a position-compare event on 1 to 2 transitions of the eQEP position counter for forward counting direction and on 3 to 2 transitions of the eQEP position counter for reverse counting direction (see Figure 16-13).

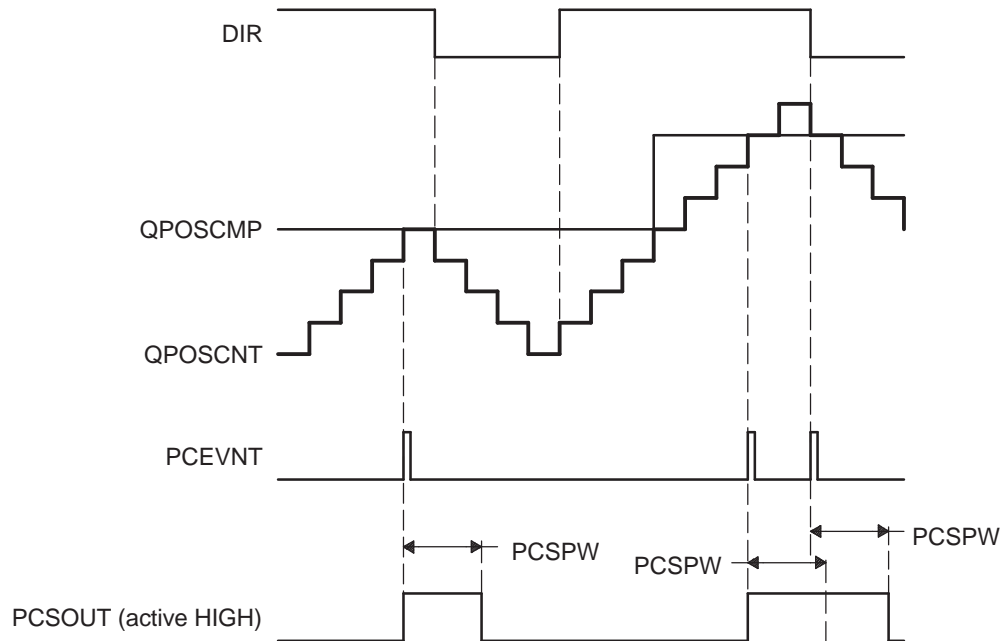
See the register section for the layout of the eQEP Position-Compare Control Register (QPOSCTL) and description of the QPOSCTL bit fields.

**Figure 16-13. eQEP Position-compare Event Generation Points**



The pulse stretcher logic in the position-compare unit generates a programmable position-compare sync pulse output on the position-compare match. In the event of a new position-compare match while a previous position-compare pulse is still active, then the pulse stretcher generates a pulse of specified duration from the new position-compare event as shown in Figure 16-14.

**Figure 16-14. eQEP Position-compare Sync Output Pulse Stretcher**



## 16.6 eQEP Edge Capture Unit

The eQEP peripheral includes an integrated edge capture unit to measure the elapsed time between the unit position events as shown in Figure 16-15. This feature is typically used for low speed measurement using the following equation:

$$v(k) = \frac{X}{t(k) - t(k - 1)} = \frac{X}{\Delta T} \quad (3)$$

where,

- X - Unit position is defined by integer multiple of quadrature edges (see [Figure 16-16](#))
- $\Delta T$  - Elapsed time between unit position events
- v(k) - Velocity at time instant "k"

The eQEP capture timer (QCTMR) runs from prescaled SYSCLKOUT and the prescaler is programmed by the QCAPCTL[CCPS] bits. The capture timer (QCTMR) value is latched into the capture period register (QCPRD) on every unit position event and then the capture timer is reset, a flag is set in QEPSTS:UPEVNT to indicate that new value is latched into the QCPRD register. Software can check this status flag before reading the period register for low speed measurement and clear the flag by writing 1.

Time measurement ( $\Delta T$ ) between unit position events will be correct if the following conditions are met:

- No more than 65,535 counts have occurred between unit position events.
- No direction change between unit position events.

The capture unit sets the eQEP overflow error flag (QEPSTS[COEF]) in the event of capture timer overflow between unit position events. If a direction change occurs between the unit position events, then an error flag is set in the status register (QEPSTS[CDEF]).

Capture Timer (QCTMR) and Capture period register (QCPRD) can be configured to latch on following events.

- CPU read of QPOSCNT register
- Unit time-out event

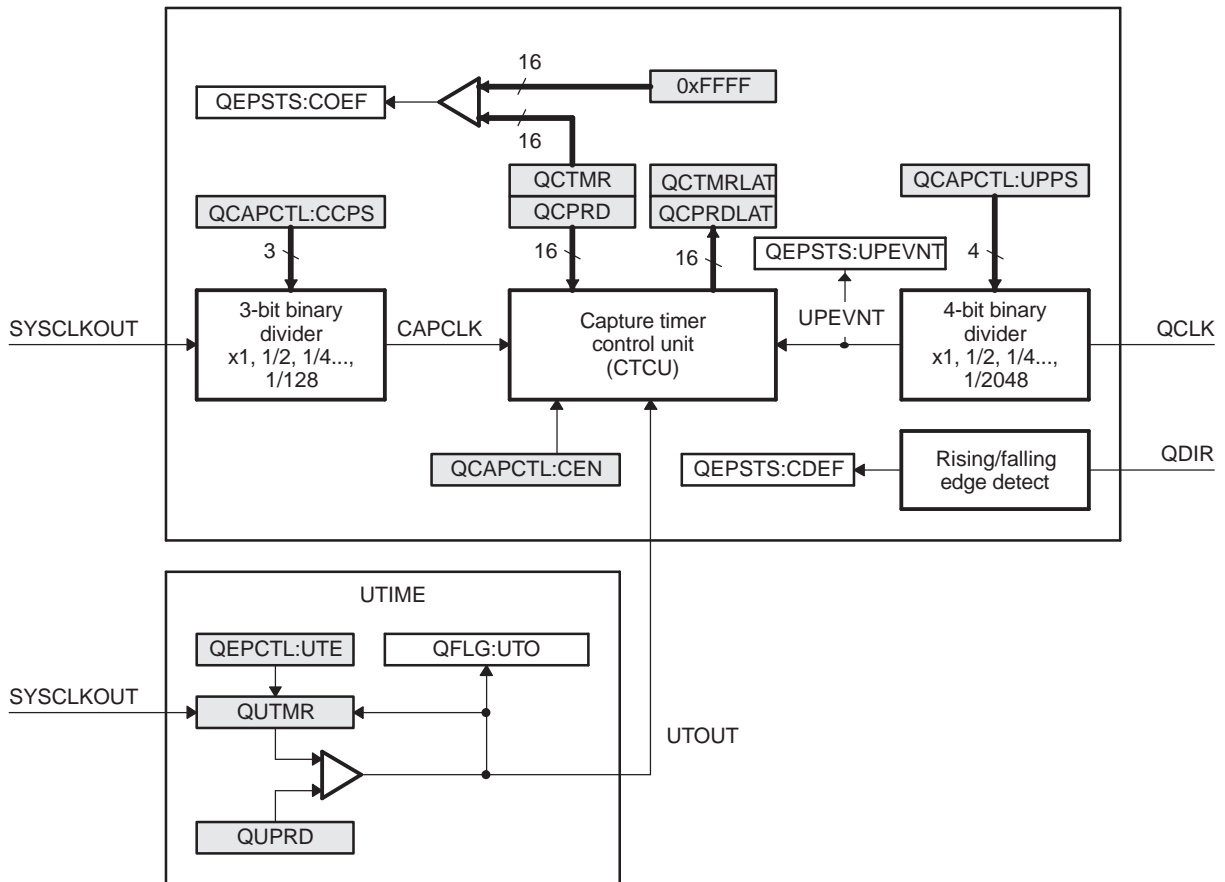
If the QEPCTL[QCLM] bit is cleared, then the capture timer and capture period values are latched into the QCTMRLAT and QCPRDLAT registers, respectively, when the CPU reads the position counter (QPOSCNT).

If the QEPCTL[QCLM] bit is set, then the position counter, capture timer, and capture period values are latched into the QPOSLAT, QCTMRLAT and QCPRDLAT registers, respectively, on unit time out.

[Figure 16-17](#) shows the capture unit operation along with the position counter.

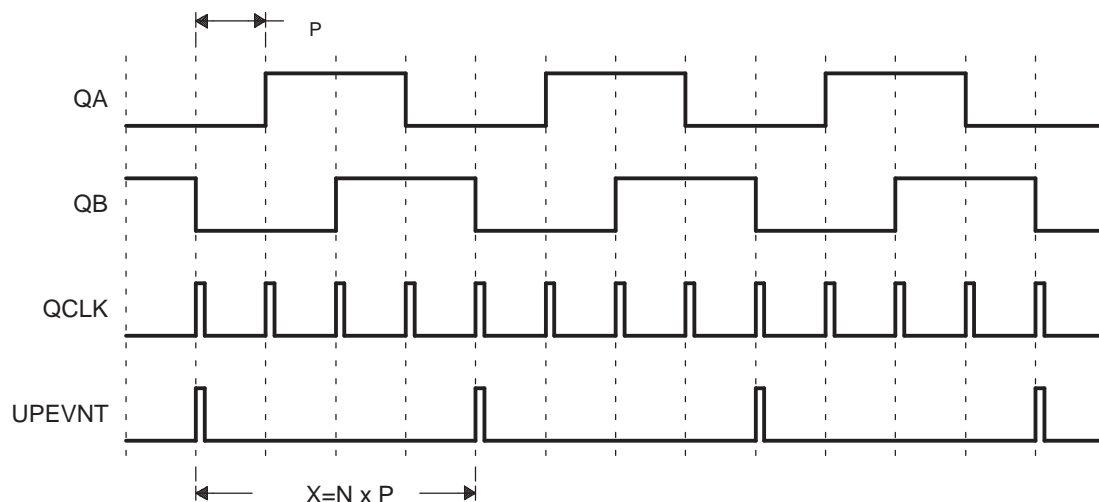


Figure 16-15. eQEP Edge Capture Unit

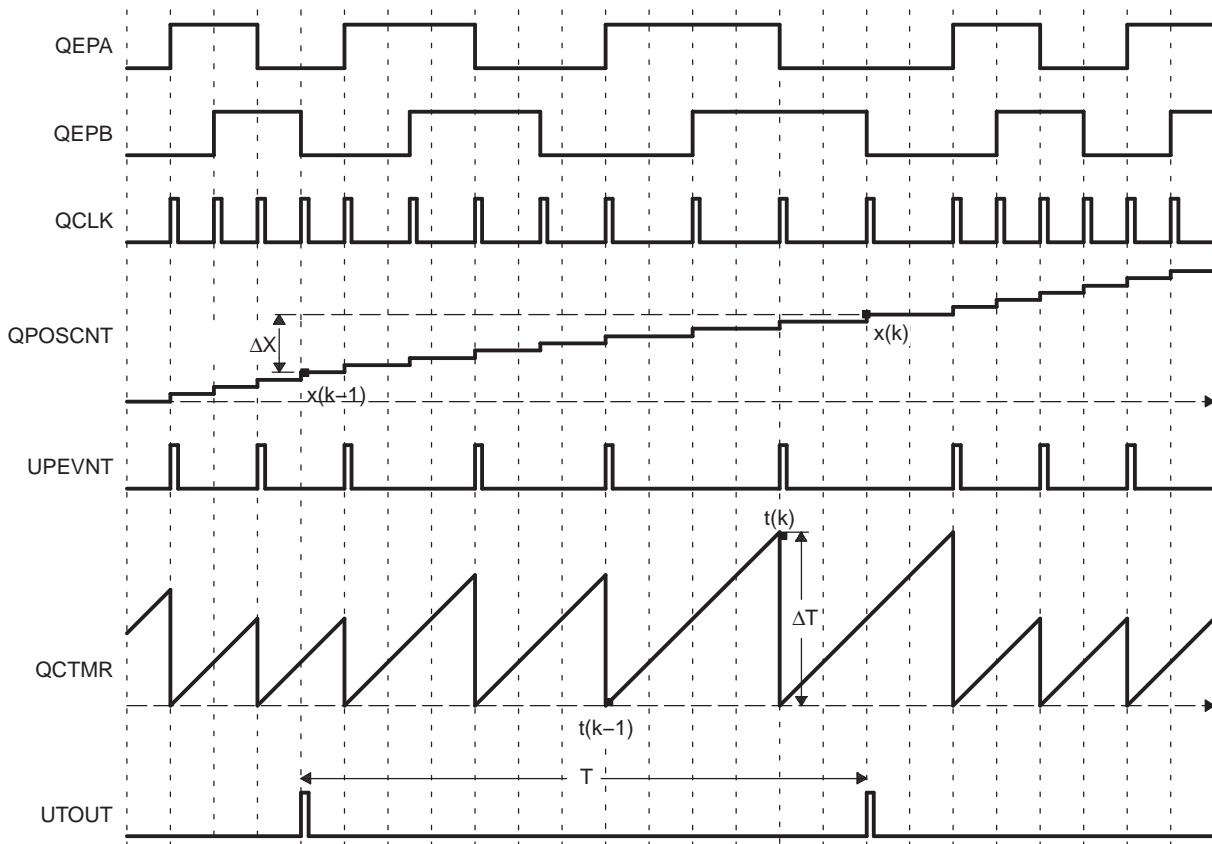


**NOTE:** The QCAPCTL[UPPS] prescaler should not be modified dynamically (such as switching the unit event prescaler from QCLK/4 to QCLK/8). Doing so may result in undefined behavior. The QCAPCTL[CPPS] prescaler can be modified dynamically (such as switching CAPCLK prescaling mode from SYSCLK/4 to SYSCLK/8) only after the capture unit is disabled.

Figure 16-16. Unit Position Event for Low Speed Measurement (QCAPCTL[UPPS] = 0010)



A N - Number of quadrature periods selected using QCAPCTL[UPPS] bits

**Figure 16-17. eQEP Edge Capture Unit - Timing Details**


Velocity Calculation Equations:

$$v(k) = \frac{x(k) - x(k-1)}{T} = \frac{\Delta X}{T} \quad (4)$$

where

$v(k)$ : Velocity at time instant  $k$

$x(k)$ : Position at time instant  $k$

$x(k-1)$ : Position at time instant  $k-1$

$T$ : Fixed unit time or inverse of velocity calculation rate

$\Delta X$ : Incremental position movement in unit time

$X$ : Fixed unit position

$\Delta T$ : Incremental time elapsed for unit position movement

$t(k)$ : Time instant " $k$ "

$t(k-1)$ : Time instant " $k-1$ "

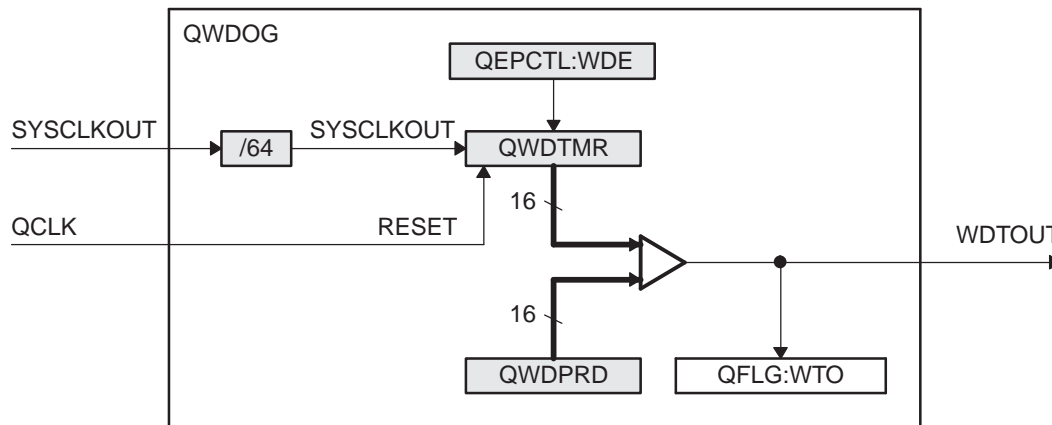
Unit time ( $T$ ) and unit period( $X$ ) are configured using the QUPRD and QCAPCTL[UPPS] registers. Incremental position output and incremental time output is available in the QPOS LAT and QCPRDLAT registers.

Parameter	Relevant Register to Configure or Read the Information
T	Unit Period Register (QUPRD)
$\Delta X$	Incremental Position = QOSLAT(k) - QOSLAT(K-1)
X	Fixed unit position defined by sensor resolution and ZCAPCTL[UPPS] bits
$\Delta T$	Capture Period Latch (QCPRDLAT)

### 16.7 eQEP Watchdog

The eQEP peripheral contains a 16-bit watchdog timer that monitors the quadrature-clock to indicate proper operation of the motion-control system. The eQEP watchdog timer is clocked from SYSCLKOUT/64 and the quadrature clock event (pulse) resets the watchdog timer. If no quadrature-clock event is detected until a period match ( $QWDPRD = QWDTMR$ ), then the watchdog timer will time out and the watchdog interrupt flag will be set (QFLG[WTO]). The time-out value is programmable through the watchdog period register (QWDPRD).

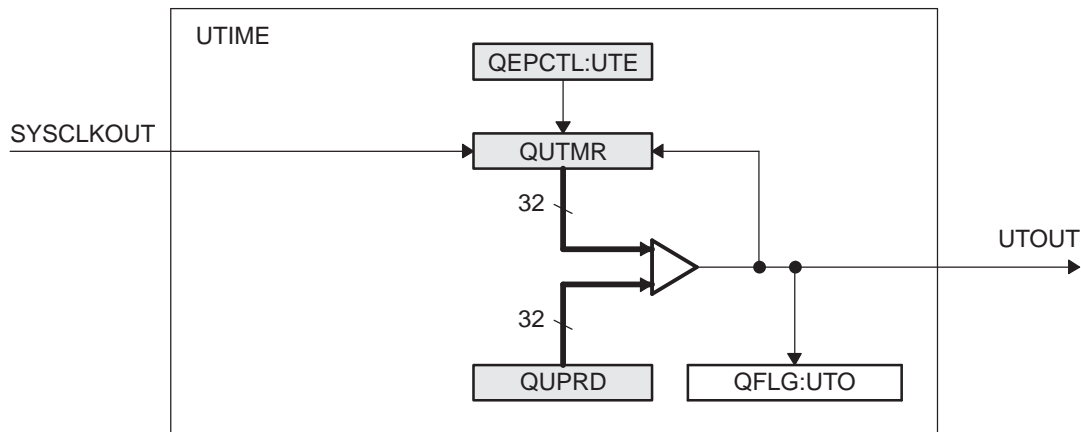
Figure 16-18. eQEP Watchdog Timer



### 16.8 Unit Timer Base

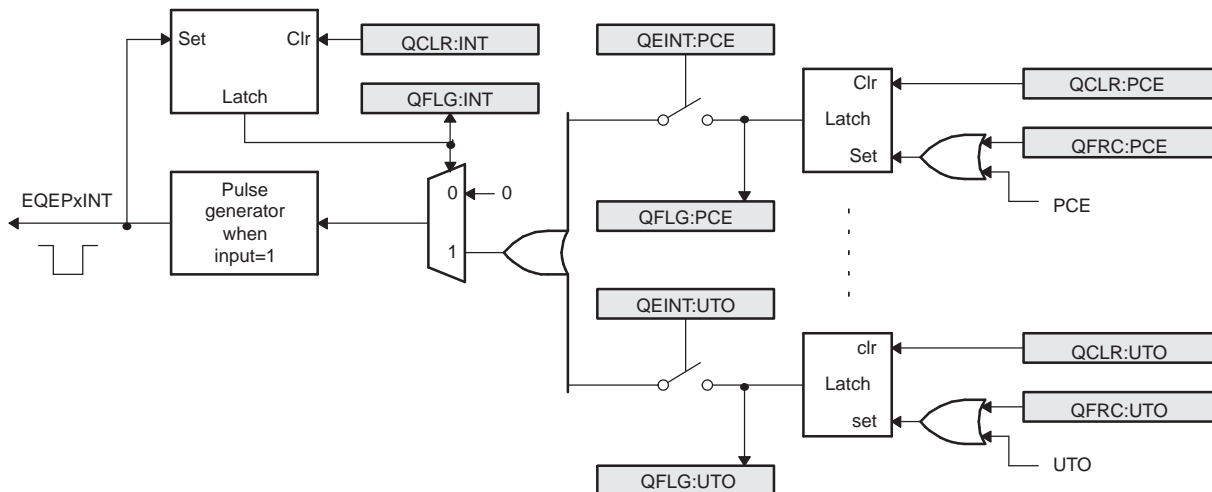
The eQEP peripheral includes a 32-bit timer (QUTMR) that is clocked by SYSCLKOUT to generate periodic interrupts for velocity calculations. The unit time out interrupt is set (QFLG[UTO]) when the unit timer (QUTMR) matches the unit period register (QUPRD). The unit timer gets reset whenever timer value equals to configured period value.

The eQEP peripheral can be configured to latch the position counter, capture timer, and capture period values on a unit time out event so that latched values are used for velocity calculation as described in [Section 16.6](#).

**Figure 16-19. eQEP Unit Time Base**


## 16.9 eQEP Interrupt Structure

Figure 16-20 shows how the interrupt mechanism works in the EQEP module.

**Figure 16-20. EQEP Interrupt Generation**


Eleven interrupt events (PCE, PHE, QDC, WTO, PCU, PCO, PCR, PCM, SEL, IEL and UTO) can be generated. The interrupt control register (QEINT) is used to enable/disable individual interrupt event sources. The interrupt flag register (QFLG) indicates if any interrupt event has been latched and contains the global interrupt flag bit (INT).

An Interrupt pulse is generated to PIE when:

- Interrupt is enabled for eQEP event inside QEINT register
- Interrupt flag for eQEP event inside QFLG register is set, and
- Global interrupt status flag bit QFLG[INT] had been cleared for previously generated interrupt event. The interrupt service routine will need to clear the global interrupt flag bit and the serviced event, via the interrupt clear register (QCLR), before any other interrupt pulses are generated. If either flags inside the QFLG register are not cleared, further interrupt event will not generate interrupt to PIE. You can force an interrupt event by way of the interrupt force register (QFRC), which is useful for test purposes

## 16.10 Registers

### 16.10.1 eQEP Base Addresses

**Table 16-3. eQEP Base Address Table**

Device Registers	Register Name	Start Address	End Address
EQep1Regs	EQEP_REGS	0x0000_5100	0x0000_513F
EQep2Regs	EQEP_REGS	0x0000_5140	0x0000_517F
EQep3Regs	EQEP_REGS	0x0000_5180	0x0000_51BF

### 16.10.2 EQEP\_REGS Registers

Table 16-4 lists the memory-mapped registers for the EQEP\_REGS. All register offset addresses not listed in Table 16-4 should be considered as reserved locations and the register contents should not be modified.

**Table 16-4. EQEP\_REGS Registers**

Offset	Acronym	Register Name	Write Protection	Section
0h	QPOSCNT	Position Counter		<a href="#">Go</a>
2h	QPOSINIT	Position Counter Init		<a href="#">Go</a>
4h	QPOSMAX	Maximum Position Count		<a href="#">Go</a>
6h	QPOSCMP	Position Compare		<a href="#">Go</a>
8h	QPOSILAT	Index Position Latch		<a href="#">Go</a>
Ah	QPOSSLAT	Strobe Position Latch		<a href="#">Go</a>
Ch	QPOSLAT	Position Latch		<a href="#">Go</a>
Eh	QUTMR	QEP Unit Timer		<a href="#">Go</a>
10h	QUPRD	QEP Unit Period		<a href="#">Go</a>
12h	QWDTMR	QEP Watchdog Timer		<a href="#">Go</a>
13h	QWDPRD	QEP Watchdog Period		<a href="#">Go</a>
14h	QDECCTL	Quadrature Decoder Control		<a href="#">Go</a>
15h	QEPCTL	QEP Control		<a href="#">Go</a>
16h	QCAPCTL	Quadrature Capture Control		<a href="#">Go</a>
17h	QPOSCTL	Position Compare Control		<a href="#">Go</a>
18h	QEINT	QEP Interrupt Control		<a href="#">Go</a>
19h	QFLG	QEP Interrupt Flag		<a href="#">Go</a>
1Ah	QCLR	QEP Interrupt Clear		<a href="#">Go</a>
1Bh	QFRC	QEP Interrupt Force		<a href="#">Go</a>
1Ch	QEPSTS	QEP Status		<a href="#">Go</a>
1Dh	QCTMR	QEP Capture Timer		<a href="#">Go</a>
1Eh	QCPRD	QEP Capture Period		<a href="#">Go</a>
1Fh	QCTMLAT	QEP Capture Latch		<a href="#">Go</a>
20h	QCPRDLAT	QEP Capture Period Latch		<a href="#">Go</a>

Complex bit access types are encoded to fit into small table cells. Table 16-5 shows the codes that are used for access types in this section.

**Table 16-5. EQEP\_REGS Access Type Codes**

Access Type	Code	Description
<b>Read Type</b>		
R	R	Read
R=0	R	Read
<b>Write Type</b>		
W	W	Write
W=1	W	Write
<b>Reset or Default Value</b>		
-n		Value after reset or the default value
<b>Register Array Variables</b>		

**Table 16-5. EQEP\_REGS Access Type  
Codes (continued)**

Access Type	Code	Description
i,j,k,l,m,n		When these variables are used in a register name, an offset, or an address, they refer to the value of a register array where the register is part of a group of repeating registers. The register groups form a hierarchical structure and the array is represented with a formula.
y		When this variable is used in a register name, an offset, or an address it refers to the value of a register array.

### 16.10.2.1 QPOSCNT Register (Offset = 0h) [reset = 0h]

QPOSCNT is shown in [Figure 16-21](#) and described in [Table 16-6](#).

Return to [Summary Table](#).

Position Counter

**Figure 16-21. QPOSCNT Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
QPOSCNT																															
R/W-0h																															

**Table 16-6. QPOSCNT Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-0	QPOSCNT	R/W	0h	Position Counter This 32-bit position counter register counts up/down on every eQEP pulse based on direction input. This counter acts as a position integrator whose count value is proportional to position from a give reference point. This Register acts as a Read ONLY register while counter is counting up/down. Reset type: SYSRSn



**16.10.2.2 QPOSINIT Register (Offset = 2h) [reset = 0h]**

QPOSINIT is shown in [Figure 16-22](#) and described in [Table 16-7](#).

Return to [Summary Table](#).

Position Counter Init

**Figure 16-22. QPOSINIT Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
QPOSINIT																															
R/W-0h																															

**Table 16-7. QPOSINIT Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-0	QPOSINIT	R/W	0h	Position Counter Init This register contains the position value that is used to initialize the position counter based on external strobe or index event. The position counter can be initialized through software. Writes to this register should always be full 32-bit writes. Reset type: SYSRSn

### 16.10.2.3 QPOSMAX Register (Offset = 4h) [reset = 0h]

QPOSMAX is shown in [Figure 16-23](#) and described in [Table 16-8](#).

Return to [Summary Table](#).

Maximum Position Count

**Figure 16-23. QPOSMAX Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
QPOSMAX																															
R/W-0h																															

**Table 16-8. QPOSMAX Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-0	QPOSMAX	R/W	0h	Maximum Position Count This register contains the maximum position counter value. Writes to this register should always be full 32-bit writes. Reset type: SYSRSn

**16.10.2.4 QPOSCMP Register (Offset = 6h) [reset = 0h]**

QPOSCMP is shown in [Figure 16-24](#) and described in [Table 16-9](#).

Return to [Summary Table](#).

Position Compare

**Figure 16-24. QPOSCMP Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
QPOSCMP																															
R/W-0h																															

**Table 16-9. QPOSCMP Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-0	QPOSCMP	R/W	0h	Position Compare The position-compare value in this register is compared with the position counter (QPOSCNT) to generate sync output and/or interrupt on compare match. Reset type: SYSRSn

### 16.10.2.5 QPOSILAT Register (Offset = 8h) [reset = 0h]

QPOSILAT is shown in [Figure 16-25](#) and described in [Table 16-10](#).

Return to [Summary Table](#).

Index Position Latch

**Figure 16-25. QPOSILAT Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
QPOSILAT																															
R-0h																															

**Table 16-10. QPOSILAT Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-0	QPOSILAT	R	0h	Index Position Latch The position-counter value is latched into this register on an index event as defined by the QEPCTL[IEL] bits. Reset type: SYSRSn

**16.10.2.6 QPOSSLAT Register (Offset = Ah) [reset = 0h]**

QPOSSLAT is shown in [Figure 16-26](#) and described in [Table 16-11](#).

Return to [Summary Table](#).

Strobe Position Latch

**Figure 16-26. QPOSSLAT Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
QPOSSLAT																															
R-0h																															

**Table 16-11. QPOSSLAT Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-0	QPOSSLAT	R	0h	Strobe Position Latch The position-counter value is latched into this register on strobe event as defined by the QEPCTL[SEL] bits. Reset type: SYSRSn

### 16.10.2.7 QPOSLAT Register (Offset = Ch) [reset = 0h]

QPOSLAT is shown in [Figure 16-27](#) and described in [Table 16-12](#).

Return to [Summary Table](#).

Position Latch

**Figure 16-27. QPOSLAT Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
QPOSLAT																															
R-0h																															

**Table 16-12. QPOSLAT Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-0	QPOSLAT	R	0h	Position Latch The position-counter value is latched into this register on unit time out event. Reset type: SYSRSn

**16.10.2.8 QUTMR Register (Offset = Eh) [reset = 0h]**

QUTMR is shown in [Figure 16-28](#) and described in [Table 16-13](#).

Return to [Summary Table](#).

QEP Unit Timer

**Figure 16-28. QUTMR Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
QUTMR																															
R/W-0h																															

**Table 16-13. QUTMR Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-0	QUTMR	R/W	0h	<p>QEP Unit Timer</p> <p>This register acts as time base for unit time event generation. When this timer value matches with unit time period value, unit time event is generated.</p> <p>Reset type: SYSRSn</p>

**16.10.2.9 QUPRD Register (Offset = 10h) [reset = 0h]**

QUPRD is shown in [Figure 16-29](#) and described in [Table 16-14](#).

Return to [Summary Table](#).

QEP Unit Period

**Figure 16-29. QUPRD Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
QUPRD																															
R/W-0h																															

**Table 16-14. QUPRD Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-0	QUPRD	R/W	0h	QEP Unit Period This register contains the period count for unit timer to generate periodic unit time events to latch the eQEP position information at periodic interval and optionally to generate interrupt. Writes to this register should always be full 32-bit writes. Reset type: SYSRSn



**16.10.2.10 QWDTMR Register (Offset = 12h) [reset = 0h]**

QWDTMR is shown in [Figure 16-30](#) and described in [Table 16-15](#).

Return to [Summary Table](#).

QEP Watchdog Timer

**Figure 16-30. QWDTMR Register**

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
QWDTMR															
R/W-0h															

**Table 16-15. QWDTMR Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-0	QWDTMR	R/W	0h	QEP Watchdog Timer This register acts as time base for watch dog to detect motor stalls. When this timer value matches with watch dog period value, watch dog timeout interrupt is generated. This register is reset upon edge transition in quadrature-clock indicating the motion. Reset type: SYSRSn

### 16.10.2.11 QWDPRD Register (Offset = 13h) [reset = 0h]

QWDPRD is shown in [Figure 16-31](#) and described in [Table 16-16](#).

Return to [Summary Table](#).

QEP Watchdog Period

**Figure 16-31. QWDPRD Register**

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
QWDPRD															
R/W-0h															

**Table 16-16. QWDPRD Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-0	QWDPRD	R/W	0h	QEP Watchdog Period This register contains the time-out count for the eQEP peripheral watch dog timer. When the watchdog timer value matches the watchdog period value, a watchdog timeout interrupt is generated. Reset type: SYSRSn

### 16.10.2.12 QDECCTL Register (Offset = 14h) [reset = 0h]

QDECCTL is shown in [Figure 16-32](#) and described in [Table 16-17](#).

Return to [Summary Table](#).

Quadrature Decoder Control

**Figure 16-32. QDECCTL Register**

15	14	13	12	11	10	9	8
QSRC		SOEN	SPSEL	XCR	SWAP	IGATE	QAP
R/W-0h		R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
7	6	5	4	3	2	1	0
QBP	QIP	QSP	RESERVED				
R/W-0h	R/W-0h	R/W-0h	R-0h				

**Table 16-17. QDECCTL Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-14	QSRC	R/W	0h	Position-counter source selection Reset type: SYSRSn 0h (R/W) = Quadrature count mode (QCLK = iCLK, QDIR = iDIR) 1h (R/W) = Direction-count mode (QCLK = xCLK, QDIR = xDIR) 2h (R/W) = UP count mode for frequency measurement (QCLK = xCLK, QDIR = 1) 3h (R/W) = DOWN count mode for frequency measurement (QCLK = xCLK, QDIR = 0)
13	SOEN	R/W	0h	Sync output-enable Reset type: SYSRSn 0h (R/W) = Disable position-compare sync output 1h (R/W) = Enable position-compare sync output
12	SPSEL	R/W	0h	Sync output pin selection Reset type: SYSRSn 0h (R/W) = Index pin is used for sync output 1h (R/W) = Strobe pin is used for sync output
11	XCR	R/W	0h	External Clock Rate Reset type: SYSRSn 0h (R/W) = 2x resolution: Count the rising/falling edge 1h (R/W) = 1x resolution: Count the rising edge only
10	SWAP	R/W	0h	CLK/DIR Signal Source for Position Counter Reset type: SYSRSn 0h (R/W) = Quadrature-clock inputs are not swapped 1h (R/W) = Quadrature-clock inputs are swapped
9	IGATE	R/W	0h	Index pulse gating option Reset type: SYSRSn 0h (R/W) = Disable gating of Index pulse 1h (R/W) = Gate the index pin with strobe
8	QAP	R/W	0h	QEPA input polarity Reset type: SYSRSn 0h (R/W) = No effect 1h (R/W) = Negates QEPA input
7	QBP	R/W	0h	QEPB input polarity Reset type: SYSRSn 0h (R/W) = No effect 1h (R/W) = Negates QEPB input

**Table 16-17. QDECCTL Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
6	QIP	R/W	0h	QEPI input polarity Reset type: SYSRSn 0h (R/W) = No effect 1h (R/W) = Negates QEPI input
5	QSP	R/W	0h	QEPS input polarity Reset type: SYSRSn 0h (R/W) = No effect 1h (R/W) = Negates QEPS input
4-0	RESERVED	R	0h	Reserved

### 16.10.2.13 QEPCTL Register (Offset = 15h) [reset = 0h]

QEPCTL is shown in [Figure 16-33](#) and described in [Table 16-18](#).

Return to [Summary Table](#).

QEP Control

**Figure 16-33. QEPCTL Register**

15	14	13	12	11	10	9	8
FREE_SOFT		PCRM		SEI		IEI	
R/W-0h		R/W-0h		R/W-0h		R/W-0h	
7	6	5	4	3	2	1	0
SWI	SEL	IEL		QPEN	QCLM	UTE	WDE
R/W-0h	R/W-0h	R/W-0h		R/W-0h	R/W-0h	R/W-0h	R/W-0h

**Table 16-18. QEPCTL Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-14	FREE_SOFT	R/W	0h	<p>Emulation mode</p> <p>Reset type: SYSRSn</p> <p>0h (R/W) = QPOSCNT behavior</p> <p>Position counter stops immediately on emulation suspend</p> <p>QWDTMR behavior</p> <p>Watchdog counter stops immediately</p> <p>QUTMR behavior</p> <p>Unit timer stops immediately</p> <p>QCTMR behavior</p> <p>Capture Timer stops immediately</p> <p>1h (R/W) = QPOSCNT behavior</p> <p>Position counter continues to count until the rollover</p> <p>QWDTMR behavior</p> <p>Watchdog counter counts until WD period match roll over</p> <p>QUTMR behavior</p> <p>Unit timer counts until period rollover</p> <p>QCTMR behavior</p> <p>Capture Timer counts until next unit period event</p> <p>2h (R/W) = QPOSCNT behavior</p> <p>Position counter is unaffected by emulation suspend</p> <p>QWDTMR behavior</p> <p>Watchdog counter is unaffected by emulation suspend</p> <p>QUTMR behavior</p> <p>Unit timer is unaffected by emulation suspend</p> <p>QCTMR behavior</p> <p>Capture Timer is unaffected by emulation suspend</p> <p>3h (R/W) = Same as FREE_SOFT_2</p>
13-12	PCRM	R/W	0h	<p>Position counter reset</p> <p>Reset type: SYSRSn</p> <p>0h (R/W) = Position counter reset on an index event</p> <p>1h (R/W) = Position counter reset on the maximum position</p> <p>2h (R/W) = Position counter reset on the first index event</p> <p>3h (R/W) = Position counter reset on a unit time event</p>

**Table 16-18. QEPCTL Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
11-10	SEI	R/W	0h	<p>Strobe event init</p> <p>Reset type: SYSRSn</p> <p>0h (R/W) = Does nothing (action disabled)</p> <p>1h (R/W) = Does nothing (action disabled)</p> <p>2h (R/W) = Initializes the position counter on rising edge of the QEPS signal</p> <p>3h (R/W) = Clockwise Direction:</p> <p>Initializes the position counter on the rising edge of QEPS strobe</p> <p>Counter Clockwise Direction:</p> <p>Initializes the position counter on the falling edge of QEPS strobe</p>
9-8	IEI	R/W	0h	<p>Index event init of position count</p> <p>Reset type: SYSRSn</p> <p>0h (R/W) = Do nothing (action disabled)</p> <p>1h (R/W) = Do nothing (action disabled)</p> <p>2h (R/W) = Initializes the position counter on the rising edge of the QEPI signal (QPOSCNT = QPOSINIT)</p> <p>3h (R/W) = Initializes the position counter on the falling edge of QEPI signal (QPOSCNT = QPOSINIT)</p>
7	SWI	R/W	0h	<p>Software init position counter</p> <p>Reset type: SYSRSn</p> <p>0h (R/W) = Do nothing (action disabled)</p> <p>1h (R/W) = Initialize position counter (QPOSCNT=QPOSINIT). This bit is not cleared automatically</p>
6	SEL	R/W	0h	<p>Strobe event latch of position counter</p> <p>Reset type: SYSRSn</p> <p>0h (R/W) = The position counter is latched on the rising edge of QEPS strobe (QPOSSLAT = POSCCNT). Latching on the falling edge can be done by inverting the strobe input using the QSP bit in the QDECCTL register</p> <p>1h (R/W) = Clockwise Direction:</p> <p>Position counter is latched on rising edge of QEPS strobe</p> <p>Counter Clockwise Direction:</p> <p>Position counter is latched on falling edge of QEPS strobe</p>
5-4	IEL	R/W	0h	<p>Index event latch of position counter (software index marker)</p> <p>Reset type: SYSRSn</p> <p>0h (R/W) = Reserved</p> <p>1h (R/W) = Latches position counter on rising edge of the index signal</p> <p>2h (R/W) = Latches position counter on falling edge of the index signal</p> <p>3h (R/W) = Software index marker. Latches the position counter and quadrature direction flag on index event marker. The position counter is latched to the QPOSILAT register and the direction flag is latched in the QEPSTS[QDLF] bit. This mode is useful for software index marking.</p>
3	QPEN	R/W	0h	<p>Quadrature position counter enable/software reset</p> <p>Reset type: SYSRSn</p> <p>0h (R/W) = Reset the eQEP peripheral internal operating flags/read-only registers. Control/configuration registers are not disturbed by a software reset.</p> <p>1h (R/W) = eQEP position counter is enabled</p>

**Table 16-18. QEPCTL Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
2	QCLM	R/W	0h	QEP capture latch mode Reset type: SYSRSn 0h (R/W) = Latch on position counter read by CPU. Capture timer and capture period values are latched into QCTMRLAT and QCPRDLAT registers when CPU reads the QPOSCNT register. 1h (R/W) = Latch on unit time out. Position counter, capture timer and capture period values are latched into QPOSLAT, QCTMRLAT and QCPRDLAT registers on unit time out.
1	UTE	R/W	0h	QEP unit timer enable Reset type: SYSRSn 0h (R/W) = Disable eQEP unit timer 1h (R/W) = Enable unit timer
0	WDE	R/W	0h	QEP watchdog enable Reset type: SYSRSn 0h (R/W) = Disable the eQEP watchdog timer 1h (R/W) = Enable the eQEP watchdog timer

**16.10.2.14 QCAPCTL Register (Offset = 16h) [reset = 0h]**

QCAPCTL is shown in [Figure 16-34](#) and described in [Table 16-19](#).

Return to [Summary Table](#).

Qaudrature Capture Control

**Figure 16-34. QCAPCTL Register**

15	14	13	12	11	10	9	8
CEN	RESERVED						
R/W-0h				R-0h			
7	6	5	4	3	2	1	0
RESERVED	CCPS			UPPS			
R-0h		R/W-0h		R/W-0h			

**Table 16-19. QCAPCTL Register Field Descriptions**

Bit	Field	Type	Reset	Description
15	CEN	R/W	0h	Enable eQEP capture Reset type: SYSRSn 0h (R/W) = eQEP capture unit is disabled 1h (R/W) = eQEP capture unit is enabled
14-7	RESERVED	R	0h	Reserved
6-4	CCPS	R/W	0h	eQEP capture timer clock prescaler Reset type: SYSRSn 0h (R/W) = CAPCLK = SYSCLKOUT/1 1h (R/W) = CAPCLK = SYSCLKOUT/2 2h (R/W) = CAPCLK = SYSCLKOUT/4 3h (R/W) = CAPCLK = SYSCLKOUT/8 4h (R/W) = CAPCLK = SYSCLKOUT/16 5h (R/W) = CAPCLK = SYSCLKOUT/32 6h (R/W) = CAPCLK = SYSCLKOUT/64 7h (R/W) = CAPCLK = SYSCLKOUT/128
3-0	UPPS	R/W	0h	Unit position event prescaler Reset type: SYSRSn 0h (R/W) = UPEVNT = QCLK/1 1h (R/W) = UPEVNT = QCLK/2 2h (R/W) = UPEVNT = QCLK/4 3h (R/W) = UPEVNT = QCLK/8 4h (R/W) = UPEVNT = QCLK/16 5h (R/W) = UPEVNT = QCLK/32 6h (R/W) = UPEVNT = QCLK/64 7h (R/W) = UPEVNT = QCLK/128 8h (R/W) = UPEVNT = QCLK/256 9h (R/W) = UPEVNT = QCLK/512 Ah (R/W) = UPEVNT = QCLK/1024 Bh (R/W) = UPEVNT = QCLK/2048 Ch (R/W) = Reserved Dh (R/W) = Reserved Eh (R/W) = Reserved Fh (R/W) = Reserved



### 16.10.2.15 QPOSCTL Register (Offset = 17h) [reset = 0h]

QPOSCTL is shown in [Figure 16-35](#) and described in [Table 16-20](#).

Return to [Summary Table](#).

Position Compare Control

**Figure 16-35. QPOSCTL Register**

15		14		13		12		11		10		9		8	
PCSHDW		PCLOAD		PCPOL		PCE				PCSPW					
R/W-0h		R/W-0h		R/W-0h		R/W-0h				R/W-0h					
7		6		5		4		3		2		1		0	
										PCSPW					
										R/W-0h					

**Table 16-20. QPOSCTL Register Field Descriptions**

Bit	Field	Type	Reset	Description
15	PCSHDW	R/W	0h	Position compare of shadow enable Reset type: SYSRSn 0h (R/W) = Shadow disabled, load Immediate 1h (R/W) = Shadow enabled
14	PCLOAD	R/W	0h	Position compare of shadow load Reset type: SYSRSn 0h (R/W) = Load on QPOSCNT = 0 1h (R/W) = Load when QPOSCNT = QPOSCMP
13	PCPOL	R/W	0h	Polarity of sync output Reset type: SYSRSn 0h (R/W) = Active HIGH pulse output 1h (R/W) = Active LOW pulse output
12	PCE	R/W	0h	Position compare enable/disable Reset type: SYSRSn 0h (R/W) = Disable position compare unit 1h (R/W) = Enable position compare unit
11-0	PCSPW	R/W	0h	Select-position-compare sync output pulse width Reset type: SYSRSn 0h (R/W) = 1 * 4 * SYSCLKOUT cycles 1h (R/W) = 2 * 4 * SYSCLKOUT cycles FFFh (R/W) = 4096 * 4 * SYSCLKOUT cycles

**16.10.2.16 QEINT Register (Offset = 18h) [reset = 0h]**

QEINT is shown in [Figure 16-36](#) and described in [Table 16-21](#).

Return to [Summary Table](#).

QEP Interrupt Control

**Figure 16-36. QEINT Register**

15	14	13	12	11	10	9	8
RESERVED				UTO	IEL	SEL	PCM
R-0h				R/W-0h	R/W-0h	R/W-0h	R/W-0h
7	6	5	4	3	2	1	0
PCR	PCO	PCU	WTO	QDC	QPE	PCE	RESERVED
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R-0h

**Table 16-21. QEINT Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-12	RESERVED	R	0h	Reserved
11	UTO	R/W	0h	Unit time out interrupt enable Reset type: SYSRSn 0h (R/W) = Interrupt is disabled 1h (R/W) = Interrupt is enabled
10	IEL	R/W	0h	Index event latch interrupt enable Reset type: SYSRSn 0h (R/W) = Interrupt is disabled 1h (R/W) = Interrupt is enabled
9	SEL	R/W	0h	Strobe event latch interrupt enable Reset type: SYSRSn 0h (R/W) = Interrupt is disabled 1h (R/W) = Interrupt is enabled
8	PCM	R/W	0h	Position-compare match interrupt enable Reset type: SYSRSn 0h (R/W) = Interrupt is disabled 1h (R/W) = Interrupt is enabled
7	PCR	R/W	0h	Position-compare ready interrupt enable Reset type: SYSRSn 0h (R/W) = Interrupt is disabled 1h (R/W) = Interrupt is enabled
6	PCO	R/W	0h	Position counter overflow interrupt enable Reset type: SYSRSn 0h (R/W) = Interrupt is disabled 1h (R/W) = Interrupt is enabled
5	PCU	R/W	0h	Position counter underflow interrupt enable Reset type: SYSRSn 0h (R/W) = Interrupt is disabled 1h (R/W) = Interrupt is enabled
4	WTO	R/W	0h	Watchdog time out interrupt enable Reset type: SYSRSn 0h (R/W) = Interrupt is disabled 1h (R/W) = Interrupt is enabled

**Table 16-21. QEINT Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
3	QDC	R/W	0h	Quadrature direction change interrupt enable Reset type: SYSRSn 0h (R/W) = Interrupt is disabled 1h (R/W) = Interrupt is enabled
2	QPE	R/W	0h	Quadrature phase error interrupt enable Reset type: SYSRSn 0h (R/W) = Interrupt is disabled 1h (R/W) = Interrupt is enabled
1	PCE	R/W	0h	Position counter error interrupt enable Reset type: SYSRSn 0h (R/W) = Interrupt is disabled 1h (R/W) = Interrupt is enabled
0	RESERVED	R	0h	Reserved

**16.10.2.17 QFLG Register (Offset = 19h) [reset = 0h]**

QFLG is shown in [Figure 16-37](#) and described in [Table 16-22](#).

Return to [Summary Table](#).

QEP Interrupt Flag

**Figure 16-37. QFLG Register**

15	14	13	12	11	10	9	8
RESERVED				UTO	IEL	SEL	PCM
R-0h				R-0h	R-0h	R-0h	R-0h
7	6	5	4	3	2	1	0
PCR	PCO	PCU	WTO	QDC	PHE	PCE	INT
R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h

**Table 16-22. QFLG Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-12	RESERVED	R	0h	Reserved
11	UTO	R	0h	Unit time out interrupt flag Reset type: SYSRSn 0h (R/W) = No interrupt generated 1h (R/W) = Interrupt was generated
10	IEL	R	0h	Index event latch interrupt flag Reset type: SYSRSn 0h (R/W) = No interrupt generated 1h (R/W) = Interrupt was generated
9	SEL	R	0h	Strobe event latch interrupt flag Reset type: SYSRSn 0h (R/W) = No interrupt generated 1h (R/W) = Interrupt was generated
8	PCM	R	0h	eQEP compare match event interrupt flag Reset type: SYSRSn 0h (R/W) = No interrupt generated 1h (R/W) = Interrupt was generated
7	PCR	R	0h	Position-compare ready interrupt flag Reset type: SYSRSn 0h (R/W) = No interrupt generated 1h (R/W) = Interrupt was generated
6	PCO	R	0h	Position counter overflow interrupt flag Reset type: SYSRSn 0h (R/W) = No interrupt generated 1h (R/W) = Interrupt was generated
5	PCU	R	0h	Position counter underflow interrupt flag Reset type: SYSRSn 0h (R/W) = No interrupt generated 1h (R/W) = Interrupt was generated
4	WTO	R	0h	Watchdog timeout interrupt flag Reset type: SYSRSn 0h (R/W) = No interrupt generated 1h (R/W) = Interrupt was generated

**Table 16-22. QFLG Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
3	QDC	R	0h	Quadrature direction change interrupt flag Reset type: SYSRSn 0h (R/W) = No interrupt generated 1h (R/W) = Interrupt was generated
2	PHE	R	0h	Quadrature phase error interrupt flag Reset type: SYSRSn 0h (R/W) = No interrupt generated 1h (R/W) = Interrupt was generated
1	PCE	R	0h	Position counter error interrupt flag Reset type: SYSRSn 0h (R/W) = No interrupt generated 1h (R/W) = Interrupt was generated
0	INT	R	0h	Global interrupt status flag Reset type: SYSRSn 0h (R/W) = No interrupt generated 1h (R/W) = Interrupt was generated

**16.10.2.18 QCLR Register (Offset = 1Ah) [reset = 0h]**

 QCLR is shown in [Figure 16-38](#) and described in [Table 16-23](#).

 Return to [Summary Table](#).

QEP Interrupt Clear

**Figure 16-38. QCLR Register**

15	14	13	12	11	10	9	8
RESERVED				UTO	IEL	SEL	PCM
R=0h				R=0/W=1-0h	R=0/W=1-0h	R=0/W=1-0h	R=0/W=1-0h
7	6	5	4	3	2	1	0
PCR	PCO	PCU	WTO	QDC	PHE	PCE	INT
R=0/W=1-0h	R=0/W=1-0h	R=0/W=1-0h	R=0/W=1-0h	R=0/W=1-0h	R=0/W=1-0h	R=0/W=1-0h	R=0/W=1-0h

**Table 16-23. QCLR Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-12	RESERVED	R	0h	Reserved
11	UTO	R=0/W=1	0h	Clear unit time out interrupt flag Reset type: SYSRSn 0h (R/W) = No effect 1h (R/W) = Clears the interrupt flag
10	IEL	R=0/W=1	0h	Clear index event latch interrupt flag Reset type: SYSRSn 0h (R/W) = No effect 1h (R/W) = Clears the interrupt flag
9	SEL	R=0/W=1	0h	Clear strobe event latch interrupt flag Reset type: SYSRSn 0h (R/W) = No effect 1h (R/W) = Clears the interrupt flag
8	PCM	R=0/W=1	0h	Clear eQEP compare match event interrupt flag Reset type: SYSRSn 0h (R/W) = No effect 1h (R/W) = Clears the interrupt flag
7	PCR	R=0/W=1	0h	Clear position-compare ready interrupt flag Reset type: SYSRSn 0h (R/W) = No effect 1h (R/W) = Clears the interrupt flag
6	PCO	R=0/W=1	0h	Clear position counter overflow interrupt flag Reset type: SYSRSn 0h (R/W) = No effect 1h (R/W) = Clears the interrupt flag
5	PCU	R=0/W=1	0h	Clear position counter underflow interrupt flag Reset type: SYSRSn 0h (R/W) = No effect 1h (R/W) = Clears the interrupt flag
4	WTO	R=0/W=1	0h	Clear watchdog timeout interrupt flag Reset type: SYSRSn 0h (R/W) = No effect 1h (R/W) = Clears the interrupt flag

**Table 16-23. QCLR Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
3	QDC	R=0/W=1	0h	Clear quadrature direction change interrupt flag Reset type: SYSRSn 0h (R/W) = No effect 1h (R/W) = Clears the interrupt flag
2	PHE	R=0/W=1	0h	Clear quadrature phase error interrupt flag Reset type: SYSRSn 0h (R/W) = No effect 1h (R/W) = Clears the interrupt flag
1	PCE	R=0/W=1	0h	Clear position counter error interrupt flag Reset type: SYSRSn 0h (R/W) = No effect 1h (R/W) = Clears the interrupt flag
0	INT	R=0/W=1	0h	Global interrupt clear flag Reset type: SYSRSn 0h (R/W) = No effect 1h (R/W) = Clears the interrupt flag

**16.10.2.19 QFRC Register (Offset = 1Bh) [reset = 0h]**

QFRC is shown in [Figure 16-39](#) and described in [Table 16-24](#).

Return to [Summary Table](#).

QEP Interrupt Force

**Figure 16-39. QFRC Register**

15	14	13	12	11	10	9	8
RESERVED				UTO	IEL	SEL	PCM
R-0h				R/W-0h	R/W-0h	R/W-0h	R/W-0h
7	6	5	4	3	2	1	0
PCR	PCO	PCU	WTO	QDC	PHE	PCE	RESERVED
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R-0h

**Table 16-24. QFRC Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-12	RESERVED	R	0h	Reserved
11	UTO	R/W	0h	Force unit time out interrupt Reset type: SYSRSn 0h (R/W) = No effect 1h (R/W) = Force the interrupt
10	IEL	R/W	0h	Force index event latch interrupt Reset type: SYSRSn 0h (R/W) = No effect 1h (R/W) = Force the interrupt
9	SEL	R/W	0h	Force strobe event latch interrupt Reset type: SYSRSn 0h (R/W) = No effect 1h (R/W) = Force the interrupt
8	PCM	R/W	0h	Force position-compare match interrupt Reset type: SYSRSn 0h (R/W) = No effect 1h (R/W) = Force the interrupt
7	PCR	R/W	0h	Force position-compare ready interrupt Reset type: SYSRSn 0h (R/W) = No effect 1h (R/W) = Force the interrupt
6	PCO	R/W	0h	Force position counter overflow interrupt Reset type: SYSRSn 0h (R/W) = No effect 1h (R/W) = Force the interrupt
5	PCU	R/W	0h	Force position counter underflow interrupt Reset type: SYSRSn 0h (R/W) = No effect 1h (R/W) = Force the interrupt
4	WTO	R/W	0h	Force watchdog time out interrupt Reset type: SYSRSn 0h (R/W) = No effect 1h (R/W) = Force the interrupt



**Table 16-24. QFRC Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
3	QDC	R/W	0h	Force quadrature direction change interrupt Reset type: SYSRSn 0h (R/W) = No effect 1h (R/W) = Force the interrupt
2	PHE	R/W	0h	Force quadrature phase error interrupt Reset type: SYSRSn 0h (R/W) = No effect 1h (R/W) = Force the interrupt
1	PCE	R/W	0h	Force position counter error interrupt Reset type: SYSRSn 0h (R/W) = No effect 1h (R/W) = Force the interrupt
0	RESERVED	R	0h	Reserved

### 16.10.2.20 QEPSTS Register (Offset = 1Ch) [reset = 0h]

QEPSTS is shown in [Figure 16-40](#) and described in [Table 16-25](#).

Return to [Summary Table](#).

QEP Status

**Figure 16-40. QEPSTS Register**

15	14	13	12	11	10	9	8
RESERVED							
R-0h							
7	6	5	4	3	2	1	0
UPEVNT	FIDF	QDF	QDLF	COEF	CDEF	FIMF	PCEF
R/W-0h	R-0h	R-0h	R-0h	R/W-0h	R/W-0h	R/W-0h	R-0h

**Table 16-25. QEPSTS Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-8	RESERVED	R	0h	Reserved
7	UPEVNT	R/W	0h	Unit position event flag Reset type: SYSRSn 0h (R/W) = No unit position event detected 1h (R/W) = Unit position event detected. Write 1 to clear
6	FIDF	R	0h	Direction on the first index marker Status of the direction is latched on the first index event marker. Reset type: SYSRSn 0h (R/W) = Counter-clockwise rotation (or reverse movement) on the first index event 1h (R/W) = Clockwise rotation (or forward movement) on the first index event
5	QDF	R	0h	Quadrature direction flag Reset type: SYSRSn 0h (R/W) = Counter-clockwise rotation (or reverse movement) 1h (R/W) = Clockwise rotation (or forward movement)
4	QDLF	R	0h	eQEP direction latch flag Reset type: SYSRSn 0h (R/W) = Counter-clockwise rotation (or reverse movement) on index event marker 1h (R/W) = Clockwise rotation (or forward movement) on index event marker
3	COEF	R/W	0h	Capture overflow error flag Reset type: SYSRSn 0h (R/W) = Overflow has not occurred. 1h (R/W) = Overflow occurred in eQEP Capture timer (QEPCTMR).
2	CDEF	R/W	0h	Capture direction error flag Reset type: SYSRSn 0h (R/W) = Capture direction error has not occurred. 1h (R/W) = Direction change occurred between the capture position event.
1	FIMF	R/W	0h	First index marker flag  Note: Once this flag has been set, if the flag is cleared the flag will not be set again until the module is reset by a peripheral or system reset. Reset type: SYSRSn 0h (R/W) = First index pulse has not occurred. 1h (R/W) = Set by first occurrence of index pulse.

**Table 16-25. QEPSTS Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
0	PCEF	R	0h	Position counter error flag. This bit is not sticky and it is updated for every index event. Reset type: SYSRSn 0h (R/W) = No error occurred during the last index transition 1h (R/W) = Position counter error

**16.10.2.21 QCTMR Register (Offset = 1Dh) [reset = 0h]**

QCTMR is shown in [Figure 16-41](#) and described in [Table 16-26](#).

Return to [Summary Table](#).

QEP Capture Timer

**Figure 16-41. QCTMR Register**

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
QCTMR															
R/W-0h															

**Table 16-26. QCTMR Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-0	QCTMR	R/W	0h	This register provides time base for edge capture unit. Reset type: SYSRSn

**16.10.2.22 QCPRD Register (Offset = 1Eh) [reset = 0h]**

QCPRD is shown in [Figure 16-42](#) and described in [Table 16-27](#).

Return to [Summary Table](#).

QEP Capture Period

**Figure 16-42. QCPRD Register**

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
QCPRD															
R/W-0h															

**Table 16-27. QCPRD Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-0	QCPRD	R/W	0h	This register holds the period count value between the last successive eQEP position events Reset type: SYSRSn

**16.10.2.23 QCTMRLAT Register (Offset = 1Fh) [reset = 0h]**

QCTMRLAT is shown in [Figure 16-43](#) and described in [Table 16-28](#).

Return to [Summary Table](#).

QEP Capture Latch

**Figure 16-43. QCTMRLAT Register**

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
QCTMRLAT															
R-0h															

**Table 16-28. QCTMRLAT Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-0	QCTMRLAT	R	0h	The eQEP capture timer value can be latched into this register on two events viz., unit timeout event, reading the eQEP position counter. Reset type: SYSRSn

**16.10.2.24 QCPRDLAT Register (Offset = 20h) [reset = 0h]**

QCPRDLAT is shown in [Figure 16-44](#) and described in [Table 16-29](#).

Return to [Summary Table](#).

QEP Capture Period Latch

**Figure 16-44. QCPRDLAT Register**

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
QCPRDLAT															
R-0h															

**Table 16-29. QCPRDLAT Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-0	QCPRDLAT	R	0h	eQEP capture period value can be latched into this register on two events viz., unit timeout event, reading the eQEP position counter. Reset type: SYSRSn

## Serial Peripheral Interface (SPI)

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This chapter describes the serial peripheral interface (SPI) which is a high-speed synchronous serial input and output (I/O) port that allows a serial bit stream of programmed length (one to 16 bits) to be shifted into and out of the device at a programmed bit-transfer rate. The SPI is normally used for communications between the DSP controller and external peripherals or another controller. Typical applications include external I/O or peripheral expansion via devices such as shift registers, display drivers, and analog-to-digital converters (ADCs). Multi-device communications are supported by the master or slave operation of the SPI. The port supports a 16-level, receive and transmit FIFO for reducing CPU servicing overhead.

Topic	Page
<b>17.1 SPI Module Overview .....</b>	<b>2001</b>
<b>17.2 System-Level Integration .....</b>	<b>2002</b>
<b>17.3 SPI Operation .....</b>	<b>2006</b>
<b>17.4 Programming Procedure.....</b>	<b>2015</b>
<b>17.5 Registers .....</b>	<b>2020</b>



## 17.1 SPI Module Overview

### 17.1.1 Features

The SPI module features include:

- SPISOMI: SPI slave-output/master-input pin
- SPISIMO: SPI slave-input/master-output pin
- $\overline{\text{SPISTE}}$ : SPI slave transmit-enable pin
- SPICLK: SPI serial-clock pin

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**NOTE:** All four pins can be used as GPIO, if the SPI module is not used.

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- Two operational modes: Master and Slave
- Baud rate: 125 different programmable rates. The maximum baud rate that can be employed is limited by the maximum speed of the I/O buffers used on the SPI pins. See the device-specific data manual for more details.
- Data word length: one to sixteen data bits
- Four clocking schemes (controlled by clock polarity and clock phase bits) include:
  - Falling edge without phase delay: SPICLK active-high. SPI transmits data on the falling edge of the SPICLK signal and receives data on the rising edge of the SPICLK signal.
  - Falling edge with phase delay: SPICLK active-high. SPI transmits data one half-cycle ahead of the falling edge of the SPICLK signal and receives data on the falling edge of the SPICLK signal.
  - Rising edge without phase delay: SPICLK inactive-low. SPI transmits data on the rising edge of the SPICLK signal and receives data on the falling edge of the SPICLK signal.
  - Rising edge with phase delay: SPICLK inactive-low. SPI transmits data one half-cycle ahead of the rising edge of the SPICLK signal and receives data on the rising edge of the SPICLK signal.
- Simultaneous receive and transmit operation (transmit function can be disabled in software)
- Transmitter and receiver operations are accomplished through either interrupt- driven or polled algorithm
- 16-level transmit/receive FIFO
- DMA support
- High-speed mode
- Delayed transmit control
- 3-wire SPI mode
- $\overline{\text{SPISTE}}$  inversion for digital audio interface receive mode on devices with two SPI modules

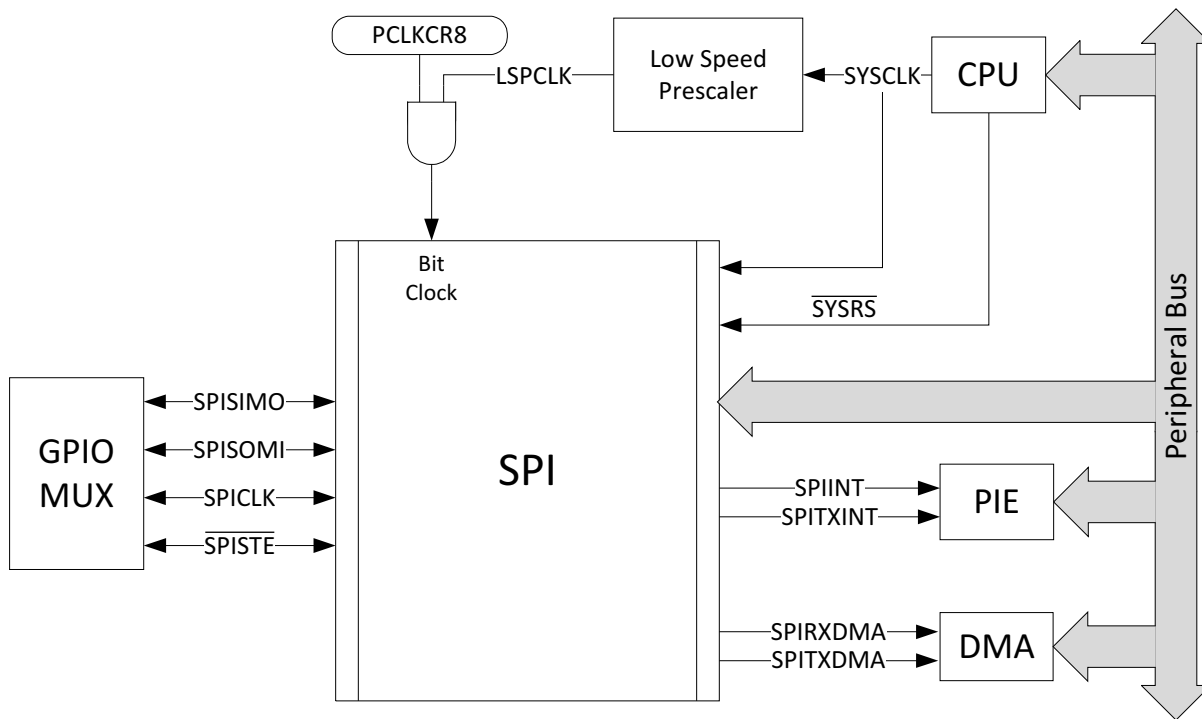
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**NOTE:** All registers in this module are 16-bit registers that are connected to Peripheral Frame 2. When a register is accessed, the register data is in the lower byte (7–0), and the upper byte (15–8) is read as zeros. Writing to the upper byte has no effect.

---

### 17.1.2 CPU Interface

Figure 17-1 shows the SPI CPU interfaces.

**Figure 17-1. SPI CPU Interface**


## 17.2 System-Level Integration

This section describes the various functionality that is applicable to the device integration. These features require configuration of other modules in the device that are not within the scope of this chapter.

### 17.2.1 SPI Module Signals

Table 17-1 classifies and provides a summary of the SPI module signals.

**Table 17-1. SPI Module Signal Summary**

Signal Name	Description
<b>External Signals</b>	
SPICLK	SPI clock
SPISIMO	SPI slave in, master out
SPISOMI	SPI slave out, master in
$\overline{\text{SPISTE}}$	SPI slave transmit enable
<b>Control</b>	
SPI Clock Rate	LSPCLK
<b>Interrupt Signals</b>	
SPIINT/SPIRXINT	Transmit interrupt/ Receive Interrupt in non FIFO mode (referred to as SPIINT) Receive interrupt in FIFO mode
SPITXINT	Transmit interrupt in FIFO mode
<b>DMA Triggers</b>	
SPITXDMA	Transmit request to DMA
SPIRXDMA	Receive request to DMA

## Special Considerations

The  $\overline{\text{SPISTE}}$  signal provides the ability to gate any spurious clock and data pulses when the SPI is in slave mode. An active  $\overline{\text{SPISTE}}$  will not allow the slave to receive data. This prevents the SPI slave from losing synchronization with the master. It is this reason that TI does not recommend that the  $\overline{\text{SPISTE}}$  always be tied to the active state.

If the SPI slave does ever lose synchronization with the master, toggling  $\text{SPISWRESET}$  will reset internal bit counter as well as the various status flags in the module. By resetting the bit counter, the SPI will interpret the next clock transition as the first bit of a new transmission. The register bits fields which are reset by  $\text{SPISWRESET}$  can be found in [Section 17.5](#)

## Configuring a GPIO to emulate $\overline{\text{SPISTE}}$

In many systems, a SPI master may be connected to multiple SPI slaves using multiple instances of  $\overline{\text{SPISTE}}$ . Though this SPI module does not natively support multiple  $\overline{\text{SPISTE}}$  signals, it is possible to emulate this behavior in software using GPIOs. In this configuration, the SPI must be configured as the master. Rather than using the GPIO Mux to select  $\overline{\text{SPISTE}}$ , the application would configure pins to be GPIO outputs, one GPIO per SPI slave. Before transmitting any data, the application would drive the desired GPIO to the active state. Immediately after the transmission has been completed, the GPIO chip select would be driven to the inactive state. This process can be repeated for many slaves which share the  $\text{SPICLK}$ ,  $\text{SPISIMO}$ , and  $\text{SPISOMI}$  lines.

### 17.2.2 Configuring Device Pins

The GPIO mux registers must be configured to connect this peripheral to the device pins. To avoid glitches on the pins, the  $\text{GPyGMUX}$  bits must be configured first (while keeping the corresponding  $\text{GPyMUX}$  bits at the default of zero), followed by writing the  $\text{GPyMUX}$  register to the desired value.

Some IO functionality is defined by GPIO register settings independent of this peripheral. For input signals, the GPIO input qualification should be set to asynchronous mode by setting the appropriate  $\text{GPxQSELn}$  register bits to 11b. The internal pullups can be configured in the  $\text{GPyPUD}$  register.

See the *GPIO* chapter for more details on GPIO mux and settings.

## GPIOs Required for High-Speed Mode

The high-speed mode of the SPI is only available on specific GPIO mux options. To enable the high-speed enhancements, set  $\text{SPICCR.HS\_MODE}$  to 1.

When not operating in high-speed mode,  $\text{SPICCR.HS\_MODE}$  should be set to 0. The high-speed capable GPIOs may still be used as standard SPI pins if  $\text{HS\_MODE}$  is not enabled. They are explained in [Table 17-2](#). Regardless of the configuration of the  $\text{HS\_MODE}$ , GPIO input qualification will be bypassed if the high-speed capable GPIOs are used

**Table 17-2. High-Speed SPI Capable GPIOs**

SPI pin	SPIA	SPIB	SPIC
$\text{SPISIMO}$	GPIO58	GPIO63	GPIO69
$\text{SPISOMI}$	GPIO59	GPIO64	GPIO70
$\text{SPICLK}$	GPIO60	GPIO65	GPIO71
$\overline{\text{SPISTE}}$	GPIO61	GPIO66	GPIO72

### 17.2.3 SPI Interrupts

This section includes information on the available interrupts present in the SPI module.

The SPI module contains two interrupt lines:  $\text{SPIINT}/\text{SPIRXINT}$  and  $\text{SPITXINT}$ . When the SPI is operating without FIFO mode, all available interrupts are routed together to generate the single  $\text{SPIINT}$  interrupt. When FIFO mode is used, both  $\text{SPIRXINT}$  and  $\text{SPITXINT}$  can be generated.

#### **$\text{SPIINT}/\text{SPIRXINT}$**

When the SPI is operating in non-FIFO mode, the interrupt generated is called SPIINT. If FIFO enhancements are enabled, the interrupt is called SPIRXINT. These interrupts share the same interrupt vector in the Peripheral Interrupt Expansion (PIE) block.

In non-FIFO mode, two conditions can trigger an interrupt: a transmission is complete (INT\_FLAG), or there is overrun in the receiver (OVERRUN\_FLAG). Both of these conditions share the same interrupt vector: SPIINT.

The transmission complete flag (INT\_FLAG) indicates that the SPI has completed sending or receiving the last bit and is ready to be serviced. At the same time this bit is set, the received character is placed in the receiver buffer (SPIRXBUF). The INT\_FLAG will generate an interrupt on the SPIINT vector if the SPIINTENA bit is set.

The receiver overrun flag (OVERRUN\_FLAG) indicates that a transmit or receive operation has completed before the previous character has been read from the buffer. The OVERRUN\_FLAG will generate an interrupt on the SPIINT vector if the OVERRUNINTENA bit is set and OVERRUN\_FLAG was previously cleared.

In FIFO mode, the SPI can interrupt the CPU upon a match condition between the current receive FIFO status (RXFFST) and the receive FIFO interrupt level (RXFFIL). If RXFFST is greater than or equal to RXFFIL, the receive FIFO interrupt flag (RXFFINT) will be set. SPIRXINT will be triggered in the PIE block if RXFFINT is set and the receive FIFO interrupt is enabled (RXFFIENA = 1).

### **SPITXINT**

The SPITXINT interrupt is not available when the SPI is operating in non-FIFO mode.

In FIFO mode, the SPITXINT behavior is similar to the SPIRXINT. SPITXINT is generated upon a match condition between the current transmit FIFO status (TXFFST) and the transmit FIFO interrupt level (TXFFIL). If TXFFST is less than or equal to TXFFIL, the transmit FIFO interrupt flag (TXFFINT) will be set. SPITXINT will be triggered in the PIE block if TXFFINT is set and the transmit FIFO interrupt is enabled in the SPI module (TXFFIENA = 1).

[Figure 17-2](#) and [Table 17-3](#) show how these control bits influence the SPI interrupt generation.

Figure 17-2. SPI Interrupt Flags and Enable Logic Generation

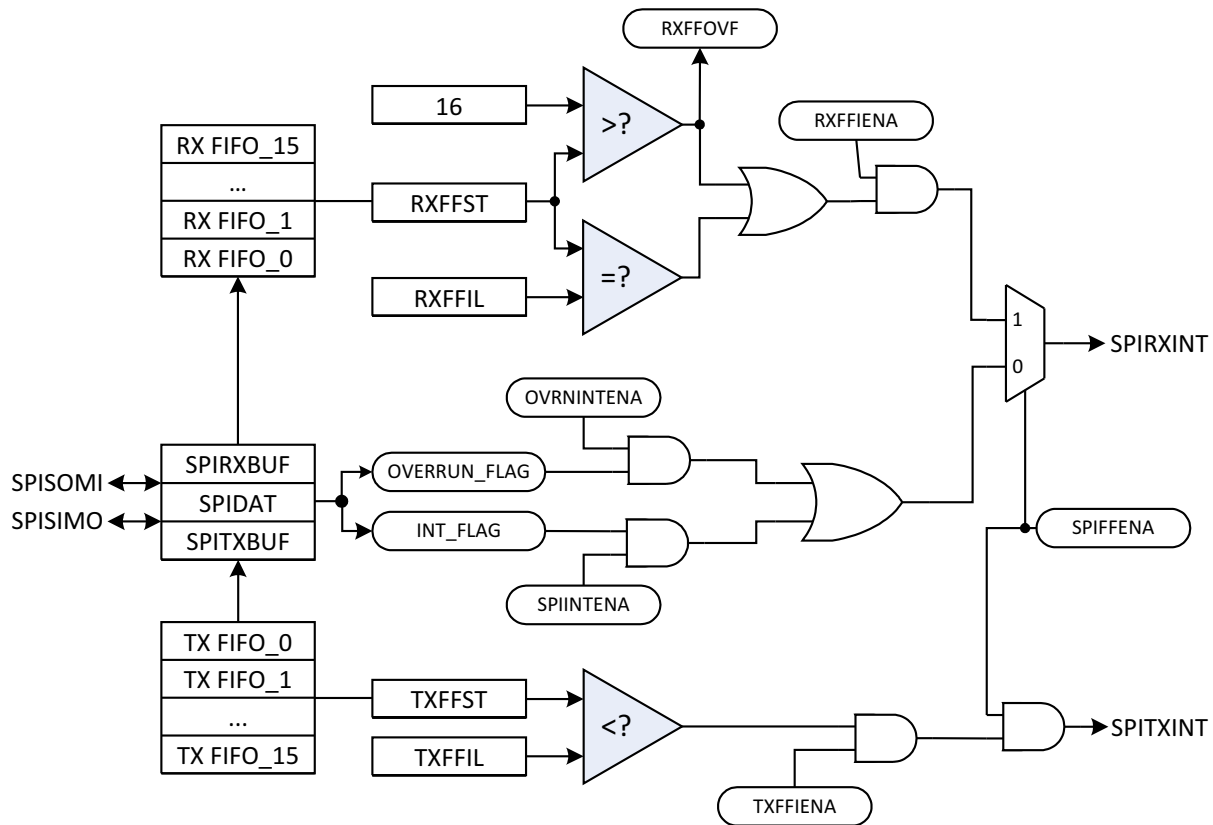


Table 17-3. SPI Interrupt Flag Modes

FIFO Options	SPI interrupt Source	Interrupt Flags	Interrupt Enables	FIFO Enable (SPIFFENA)	Interrupt <sup>(1)</sup> Line
<b>SPI without FIFO</b>					
	Receive overrun	RXOVRN	OVRNINTENA	0	SPIRXINT
	Data receive	SPIINT	SPIINTENA	0	SPIRXINT
	Transmit empty	SPIINT	SPIINTENA	0	SPIRXINT
<b>SPI FIFO mode</b>					
	FIFO receive	RXFFIL	RXFFIENA	1	SPIRXINT
	Transmit empty	TXFFIL	TXFFIENA	1	SPITXINT

<sup>(1)</sup> In non-FIFO mode, SPIRXINT is the same name as the SPIINT interrupt in 28x devices.

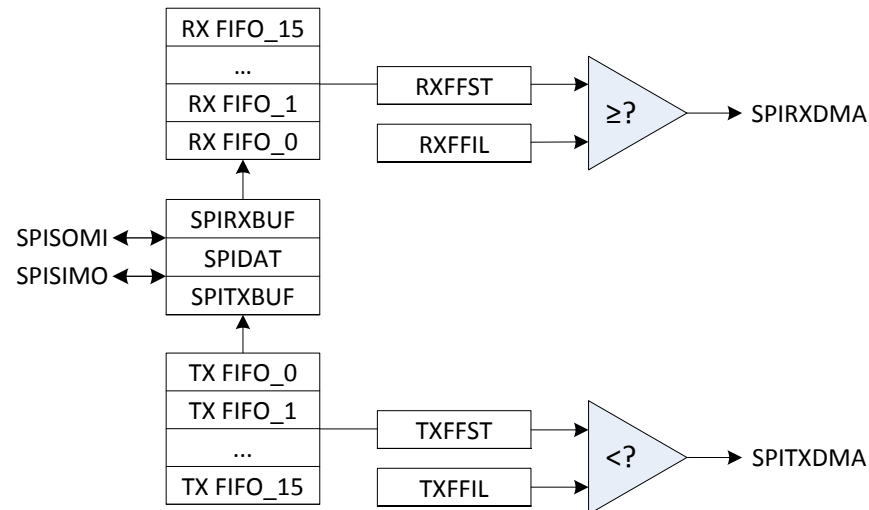
### 17.2.4 DMA Support

Both the CPU and DMA have access to the SPI data registers via the internal peripheral bus. This access is limited to 16-bit register read/writes. Each SPI module can generate two DMA events, SPITXDMA and SPIRXDMA. The DMA events are controlled by configuring the SPIFFTX.TXFFIL and SPIFFRX.RXFFIL appropriately. SPITXDMA activates when TXFFST is less than the interrupt level (TXFFIL). SPIRXDMA activates when RXFFST is greater than or equal to the interrupt level (RXFFIL).

The SPI must have FIFO enhancements enabled in order for the DMA triggers to be generated.

For more information on configuring the SPI for DMA transfers refer to [Section 17.3.8](#).

Figure 17-3 is a block diagram showing the DMA trigger generation from the SPI module.

**Figure 17-3. SPI DMA Trigger Diagram**


## 17.3 SPI Operation

This section describes the various modes of operation of the SPI. Included are explanations of the operational modes, interrupts, data format, clock sources, and initialization. Typical timing diagrams for data transfers are given.

### 17.3.1 Introduction to Operation

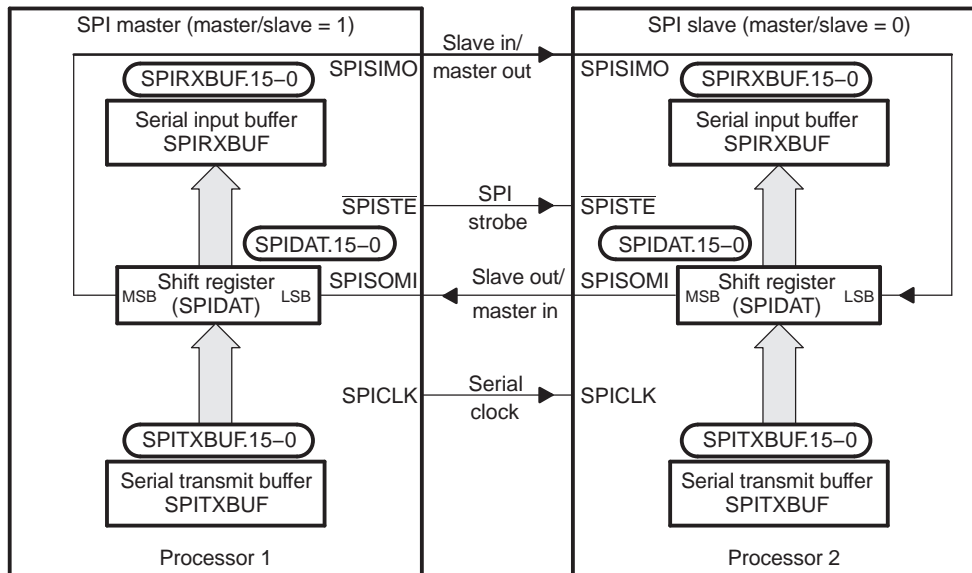
Figure 17-4 shows typical connections of the SPI for communications between two controllers: a master and a slave.

The master data transfer by sending the SPICLK signal. For both the slave and the master, data is shifted out of the shift registers on one edge of the SPICLK and latched into the shift register on the opposite SPICLK clock edge. If the CLK\_PHASE bit is high, data is transmitted and received a half-cycle before the SPICLK transition. As a result, both controllers send and receive data simultaneously. The application software determines whether the data is meaningful or dummy data. There are three possible methods for data transmission:

- Master sends data; slave sends dummy data.
- Master sends data; slave sends data.
- Master sends dummy data; slave sends data.

The master can initiate data transfer at any time because it controls the SPICLK signal. The software, however, determines how the master detects when the slave is ready to broadcast data.

Figure 17-4. SPI Master/Slave Connection



The SPI can operate in master or slave mode. The MASTER\_SLAVE bit selects the operating mode and the source of the SPICLK signal.

### 17.3.2 Master Mode

In master mode (MASTER\_SLAVE = 1), the SPI provides the serial clock on the SPICLK pin for the entire serial communications network. Data is output on the SPISIMO pin and latched from the SPISOMI pin.

The SPIBRR register determines both the transmit and receive bit transfer rate for the network. SPIBRR can select 125 different data transfer rates.

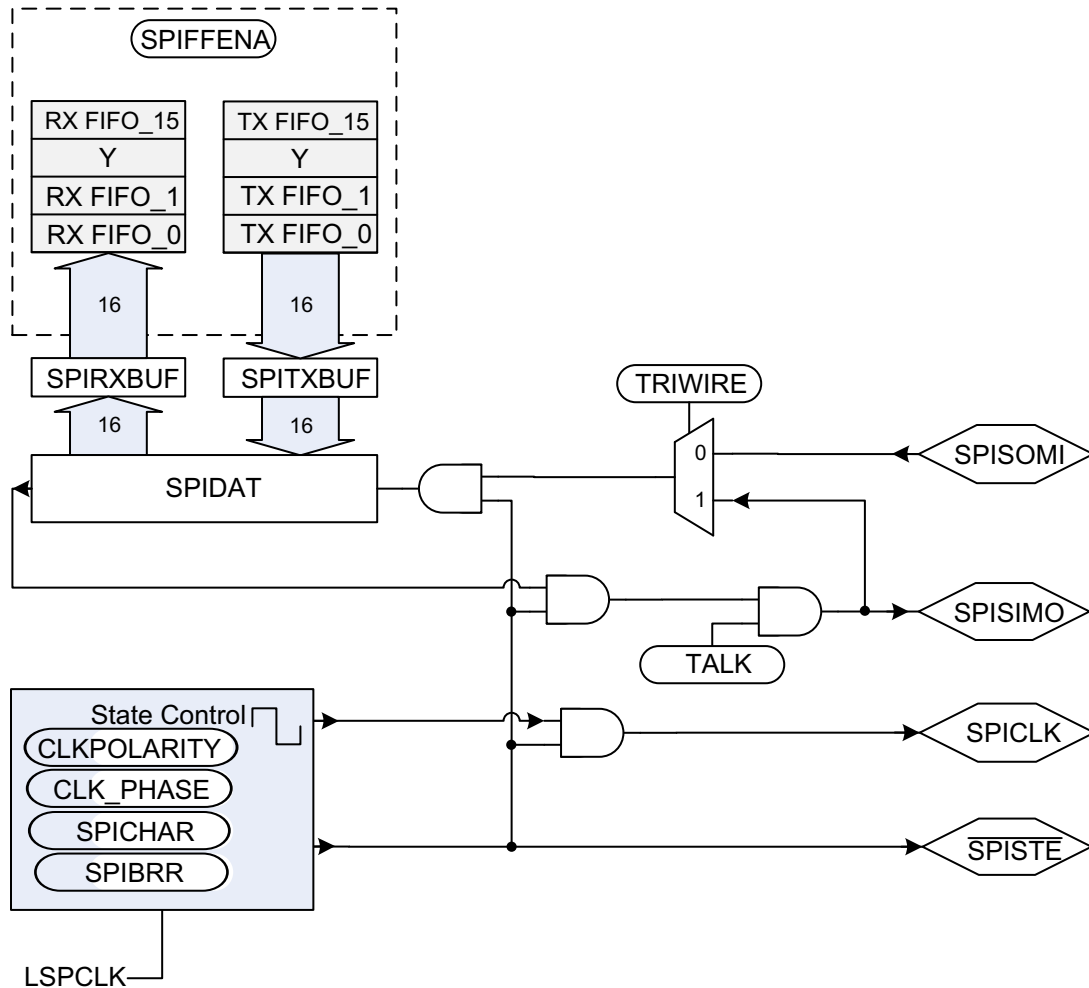
Data written to SPIDAT or SPITXBUF initiates data transmission on the SPISIMO pin, MSB (most significant bit) first. Simultaneously, received data is shifted through the SPISOMI pin into the LSB (least significant bit) of SPIDAT. When the selected number of bits has been transmitted, the received data is transferred to the SPIRXBUF (buffered receiver) for the CPU to read. Data is stored right-justified in SPIRXBUF.

When the specified number of data bits has been shifted through SPIDAT, the following events occur:

- SPIDAT contents are transferred to SPIRXBUF.
- INT\_FLAG bit s set to 1.
- If there is valid data in the transmit buffer SPITXBUF, as indicated by the Transmit Buffer Full Flag (BUFFULL\_FLAG), this data is transferred to SPIDAT and is transmitted; otherwise, SPICLK stops after all bits have been shifted out of SPIDAT.
- If the SPIINTENA bit is set to 1, an interrupt is asserted.

In a typical application, the  $\overline{\text{SPISTE}}$  pin serves as a chip-enable pin for a slave SPI device. This pin is driven low by the master before transmitting data to the slave and is taken high after the transmission is complete.

Figure 17-5 is a block diagram of the SPI in master mode. It shows the basic control blocks available in SPI master mode.

**Figure 17-5. SPI Module Master Configuration**


### 17.3.3 Slave Mode

In slave mode (`MASTER_SLAVE = 0`), data shifts out on the SPISOMI pin and in on the SPISIMO pin. The SPICLK pin is used as the input for the serial shift clock, which is supplied from the external network master. The transfer rate is defined by this clock. The SPICLK input frequency should be no greater than the LSPCLK frequency divided by 4.

Data written to SPIDAT or SPITXBUF is transmitted to the network when appropriate edges of the SPICLK signal are received from the network master. Data written to the SPITXBUF register will be transferred to the SPIDAT register when all bits of the character to be transmitted have been shifted out of SPIDAT. If no character is currently being transmitted when SPITXBUF is written to, the data will be transferred immediately to SPIDAT. To receive data, the SPI waits for the network master to send the SPICLK signal and then shifts the data on the SPISIMO pin into SPIDAT. If data is to be transmitted by the slave simultaneously, and SPITXBUF has not been previously loaded, the data must be written to SPITXBUF or SPIDAT before the beginning of the SPICLK signal.

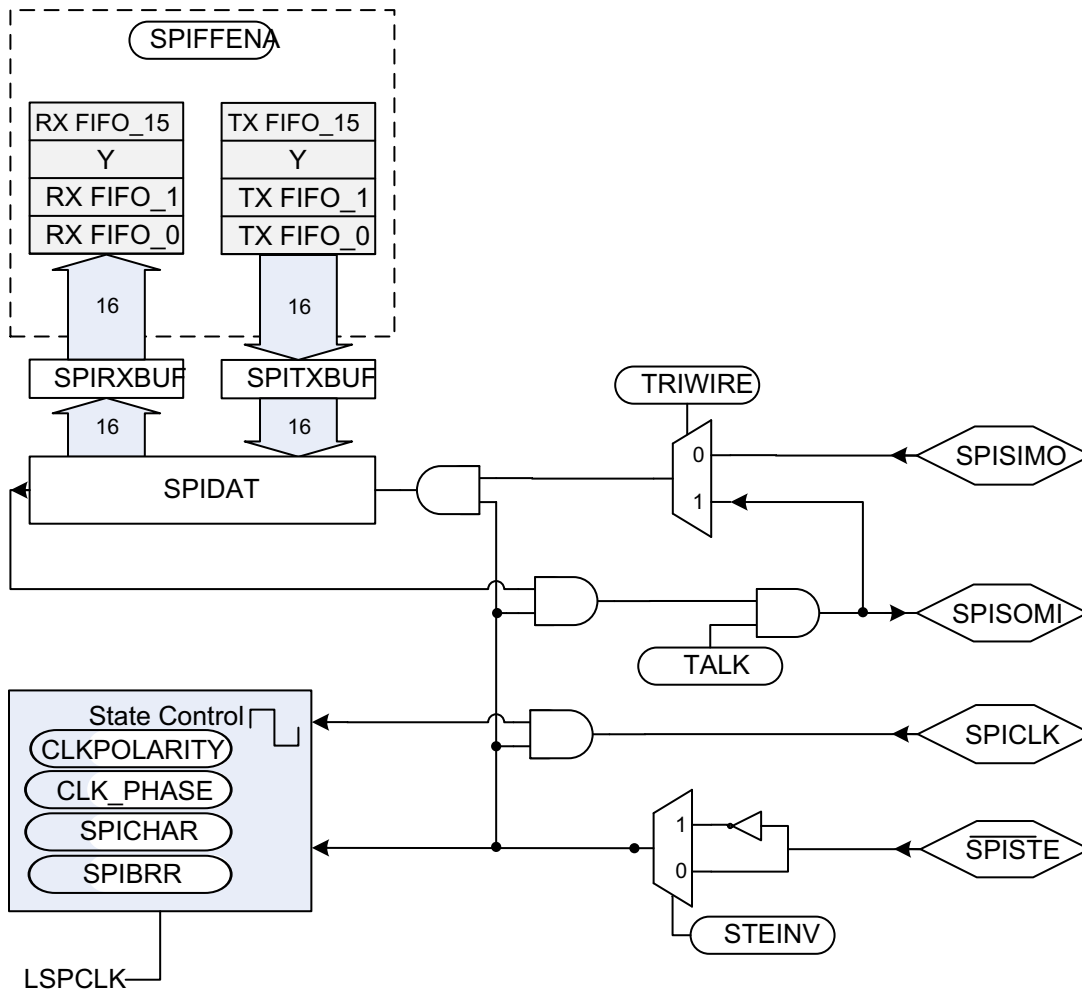
When the TALK bit is cleared, data transmission is disabled, and the output line (SPISOMI) is put into the high-impedance state. If this occurs while a transmission is active, the current character is completely transmitted even though SPISOMI is forced into the high-impedance state. This ensures that the SPI is still able to receive incoming data correctly. This TALK bit allows many slave devices to be tied together on the network, but only one slave at a time is allowed to drive the SPISOMI line.



The  $\overline{\text{SPISTE}}$  pin operates as the slave-select pin. An active-low signal on the  $\overline{\text{SPISTE}}$  pin allows the slave SPI to transfer data to the serial data line; an inactive-high signal causes the slave SPI serial shift register to stop and its serial output pin to be put into the high-impedance state. This allows many slave devices to be tied together on the network, although only one slave device is selected at a time.

Figure 17-6 is a block diagram of the SPI in slave mode. It shows the basic control blocks available in SPI slave mode.

Figure 17-6. SPI Module Slave Configuration



### 17.3.4 Data Format

The four-bit SPICHAIR register field specifies the number of bits in the data character (1 to 16). This information directs the state control logic to count the number of bits received or transmitted to determine when a complete character has been processed.

The following statements apply to characters with fewer than 16 bits:

- Data must be left-justified when written to SPIDAT and SPITXBUF.
- Data read back from SPIRXBUF is right-justified.
- SPIRXBUF contains the most recently received character, right-justified, plus any bits that remain from previous transmission(s) that have been shifted to the left (shown in Example 17-1).

#### Example 17-1. Transmission of Bit From SPIRXBUF

Conditions:

**Example 17-1. Transmission of Bit From SPIRXBUF (continued)**

1. Transmission character length = 1 bit (specified in bits SPICHR)
2. The current value of SPIDAT = 737Bh

SPIDAT (before transmission)																	
	0	1	1	1	0	0	1	1	0	1	1	1	1	0	1	1	
SPIDAT (after transmission)																	
(TXed) 0 ←	1	1	1	0	0	1	1	0	1	1	1	1	0	1	1	x <sup>(1)</sup>	← (RXed)
SPIRXBUF (after transmission)																	
	1	1	1	0	0	1	1	0	1	1	1	0	1	1	1	x <sup>(1)</sup>	

<sup>(1)</sup> x = 1 if SPISOMI data is high; x = 0 if SPISOMI data is low; master mode is assumed.

### 17.3.5 Baud Rate Selection

The SPI module supports 125 different baud rates and four different clock schemes. Depending on whether the SPI clock is in slave or master mode, the SPICLK pin can receive an external SPI clock signal or provide the SPI clock signal, respectively.

- In the slave mode, the SPI clock is received on the SPICLK pin from the external source, and can be no greater than the LSPCLK frequency divided by 4.
- In the master mode, the SPI clock is generated by the SPI and is output on the SPICLK pin, and can be no greater than the LSPCLK frequency divided by 4.

---

**NOTE:** The baud rate should be configured to not exceed the maximum rated GPIO toggle frequency. Refer to the device Data Manual for the maximum GPIO toggle frequency

---

Example 17-2 shows how to determine the SPI baud rates.

**Example 17-2. Baud Rate Determination**

For SPIBRR = 3 to 127:

$$\text{SPI Baud Rate} = \frac{\text{LSPCLK}}{(\text{SPIBRR} + 1)} \quad (5)$$

For SPIBRR = 0, 1, or 2:

$$\text{SPI Baud Rate} = \frac{\text{LSPCLK}}{4} \quad (6)$$

where:

LSPCLK = Low-speed peripheral clock frequency of the device

SPIBRR = Contents of the SPIBRR in the master SPI device

To determine what value to load into SPIBRR, you must know the device system clock (LSPCLK) frequency (which is device-specific) and the baud rate at which you will be operating.

The following example shows how to calculate the baud rate of the SPI module in standard SPI mode (HS\_MODE=0).

**Example 17-3. Baud Rate Calculation in Non-High Speed Mode (HS\_MODE=0)**

$$\begin{aligned}
 \text{SPI Baud Rate} &= \frac{\text{LSPCLK}}{\text{SPIBRR} + 1}, \quad \text{LSPCLK} = 50 \text{ MHz} \\
 &= \frac{50 \times 10^6}{3 + 1} \\
 &= 12.5 \text{ Mbps}
 \end{aligned}$$

(7)

### 17.3.6 SPI Clocking Schemes

The clock polarity select bit (CLKPOLARITY) and the clock phase select bit (CLK\_PHASE) control four different clocking schemes on the SPICLK pin. CLKPOLARITY selects the active edge, either rising or falling, of the clock. CLK\_PHASE selects a half-cycle delay of the clock. The four different clocking schemes are as follows:

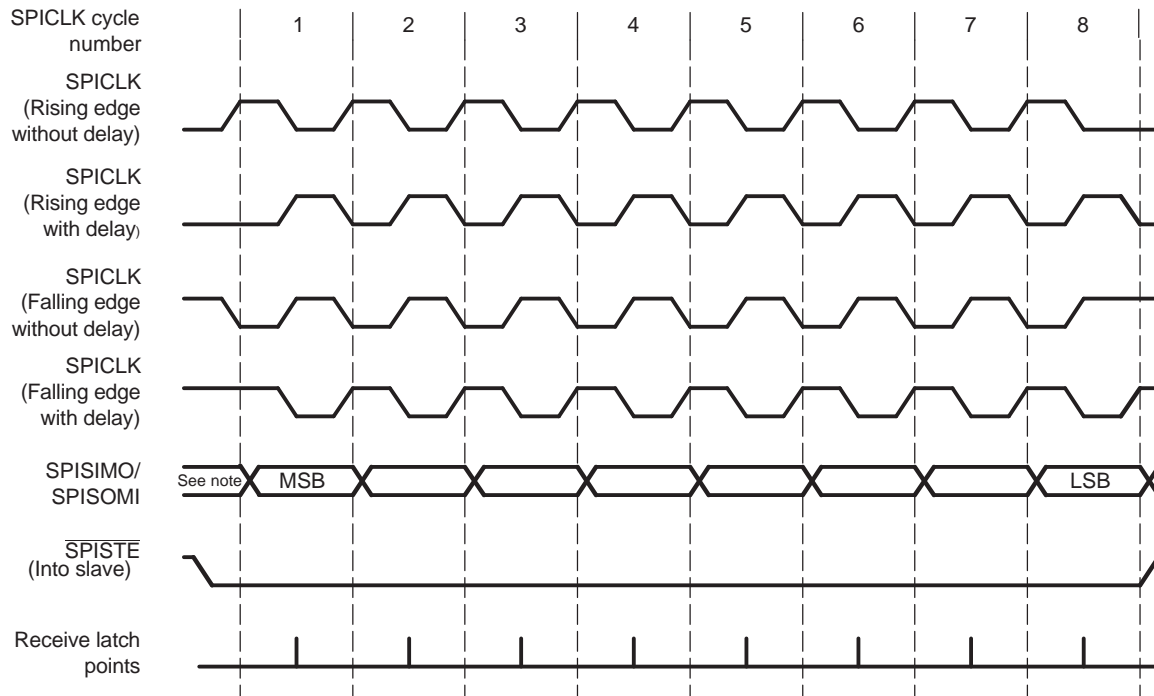
- **Falling Edge Without Delay.** The SPI transmits data on the falling edge of the SPICLK and receives data on the rising edge of the SPICLK.
- **Falling Edge With Delay.** The SPI transmits data one half-cycle ahead of the falling edge of the SPICLK signal and receives data on the falling edge of the SPICLK signal.
- **Rising Edge Without Delay.** The SPI transmits data on the rising edge of the SPICLK signal and receives data on the falling edge of the SPICLK signal.
- **Rising Edge With Delay.** The SPI transmits data one half-cycle ahead of the rising edge of the SPICLK signal and receives data on the rising edge of the SPICLK signal.

The selection procedure for the SPI clocking scheme is shown in [Table 17-4](#). Examples of these four clocking schemes relative to transmitted and received data are shown in [Figure 17-7](#).

**Table 17-4. SPI Clocking Scheme Selection Guide**

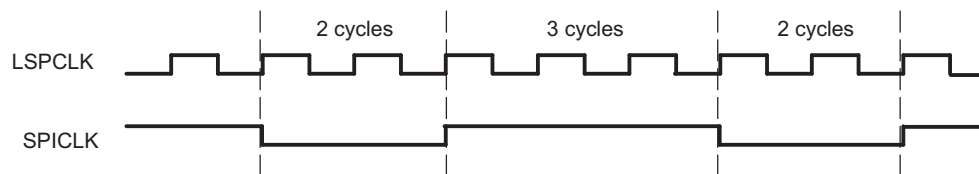
SPICLK Scheme	CLKPOLARITY	CLK_PHASE <sup>(1)</sup>
Rising edge without delay	0	0
Rising edge with delay	0	1
Falling edge without delay	1	0
Falling edge with delay	1	1

<sup>(1)</sup> The description of CLK\_PHASE and CLKPOLARITY differs between manufacturers. For proper operation, select the desired waveform to determine the clock phase and clock polarity settings.

**Figure 17-7. SPICLK Signal Options**


**Note:** Previous data bit

SPICLK symmetry is retained only when the result of  $(\text{SPIBRR}+1)$  is an even value. When  $(\text{SPIBRR} + 1)$  is an odd value and SPIBRR is greater than 3, SPICLK becomes asymmetrical. The low pulse of SPICLK is one LSPCLK cycle longer than the high pulse when CLKPOLARITY bit is clear (0). When CLKPOLARITY bit is set to 1, the high pulse of the SPICLK is one LSPCLK cycle longer than the low pulse, as shown in [Figure 17-8](#).

**Figure 17-8. SPI: SPICLK-LSPCLK Characteristic When  $(\text{BRR} + 1)$  is Odd,  $\text{BRR} > 3$ , and CLKPOLARITY = 1**


### 17.3.7 SPI FIFO Description

The following steps explain the FIFO features and help with programming the SPI FIFOs:

1. **Reset.** At reset the SPI powers up in standard SPI mode and the FIFO function is disabled. The FIFO registers SPIFFTX, SPIFFRX and SPIFFCT remain inactive.
2. **Standard SPI.** The standard 28x SPI mode will work with SPIINT/SPIRXINT as the interrupt source.
3. **Mode change.** FIFO mode is enabled by setting the SPIFFENA bit to 1 in the SPIFFTX register. SPIRST can reset the FIFO mode at any stage of its operation.
4. **Active registers.** All the SPI registers and SPI FIFO registers SPIFFTX, SPIFFRX, and SPIFFCT will be active.
5. **Interrupts.** FIFO mode has two interrupts one for the transmit FIFO, SPITXINT and one for the receive FIFO, SPIRXINT. SPIRXINT is the common interrupt for SPI FIFO receive, receive error and receive FIFO overflow conditions. The single SPIINT for both transmit and receive sections of the standard SPI will be disabled and this interrupt will service as SPI receive FIFO interrupt. For more information, refer to [Section 17.2.3](#)

6. **Buffers.** Transmit and receive buffers are each supplemented with a 16 word FIFO. The one-word transmit buffer (SPITXBUF) of the standard SPI functions as a transition buffer between the transmit FIFO and shift register. The one-word transmit buffer will be loaded from transmit FIFO only after the last bit of the shift register is shifted out.
7. **Delayed transfer.** The rate at which transmit words in the FIFO are transferred to transmit shift register is programmable. The SPIFFCT register bits (7–0) FFTXDLY7–FFTXDLY0 define the delay between the word transfer. The delay is defined in number SPI serial clock cycles. The 8-bit register could define a minimum delay of 0 SPICLK cycles and a maximum of 255 SPICLK cycles. With zero delay, the SPI module can transmit data in continuous mode with the FIFO words shifting out back to back. With the 255 clock delay, the SPI module can transmit data in a maximum delayed mode with the FIFO words shifting out with a delay of 255 SPICLK cycles between each words. The programmable delay facilitates glueless interface to various slow SPI peripherals, such as EEPROMs, ADC, DAC, and so on.
8. **FIFO status bits.** Both transmit and receive FIFOs have status bits TXFFST or RXFFST that define the number of words available in the FIFOs at any time. The transmit FIFO reset bit (TXFIFO) and receive reset bit (RXFIFO) will reset the FIFO pointers to zero when these bits are set to 1. The FIFOs will resume operation from start once these bits are cleared to zero.
9. **Programmable interrupt levels.** Both transmit and receive FIFOs can generate CPU interrupts and DMA triggers. The transmit interrupt (SPITXINT) is generated whenever the transmit FIFO status bits (TXFFST) match (less than or equal to) the interrupt trigger level bits (TXFFIL). The receive interrupt (SPIRXINT) is generated whenever the receive FIFO status bits (RXFFST) match (greater than or equal to) the interrupt trigger level RXFFIL. This provides a programmable interrupt trigger for transmit and receive sections of the SPI. The default value for these trigger level bits will be 0x11111 for receive FIFO and 0x00000 for transmit FIFO, respectively.

### 17.3.8 SPI DMA Transfers

#### 17.3.8.1 Transmitting Data Using SPI with DMA

When using the DMA with the TX FIFO, the DMA Burst Size (DMA\_BURST\_SIZE) should be no greater than 16 – TXFFIL in order to prevent the DMA from writing to an already full FIFO. This will lead to data loss and is not recommended.

For complete data transmission, please follow these steps:

1. Calculate the total number or words to be transmitted. [NUM\_WORDS]
2. Decide the transmit FIFO level. [TXFFIL]
3. Calculate the number of DMA transfers. [DMA\_TRANSFER\_SIZE]
4. Calculate the size of the DMA Burst. [DMA\_BURST\_SIZE]
5. Configure DMA using calculated values.
6. Configure SPI with FIFO using the calculated values.

To transfer 128 words to SPI using the DMA:

NUM\_WORDS: 128

TXFFIL: 8

DMA\_TRANSFER\_SIZE: (NUM\_WORDS / TXFFIL) – 1 = (128/8) – 1 = 15 (16 transfers)

DMA\_BURST\_SIZE: (16 – TXFFIL) – 1 = (16 – 8) – 1 = 7 (8 words per burst)

#### 17.3.8.2 Receiving Data Using SPI with DMA

When using the DMA with the RX FIFO, the DMA Burst Size (BURST\_SIZE) should be no greater than RXFFIL in order to prevent the DMA from reading from an empty FIFO. To ensure that the DMA correctly receives all data from the RX FIFO, the DMA Burst Size should equal RXFFIL and also be an integer divisor of the total number of SPI transmissions.

For complete data reception, please follow these steps:

1. Calculate the number of words to be received. [NUM\_WORDS]
2. Calculate the necessary FIFO level [RXFFIL]

3. Calculate the total number of DMA transfers. [DMA\_TRANSFER\_SIZE]
4. Calculate the size of the DMA Burst. [DMA\_BURST\_SIZE]
5. Configure DMA using the calculated values.
6. Configure SPI with FIFO using the calculated values.

To receive 200 words from SPI using the DMA:

NUM\_WORDS = 200

RXFFIL: 4

DMA\_TRANSFER\_SIZE: (NUM\_WORDS / RXFFIL) – 1 = (200/4) – 1 = 49 (50 transfers)

DMA\_BURST\_SIZE = RXFFIL-1 = 3 (4 words per burst)

### 17.3.9 SPI High-Speed Mode

The SPI module is capable of reaching full-duplex communication speeds up to LSPCLK/4 (where LSPCLK equals SYSCLK). For the maximum rated speed, refer the device Data Manual.

In order to achieve the maximum full-duplex speeds, two restrictions are placed on the design:

- High-speed capability is available on a single pin mux option
- Single master to single slave configuration is supported to limit the loading on the pins.

When configuring the GPIOs to support High-Speed mode, refer to [GPIOs Required for High-Speed Mode](#) for more information.

### 17.3.10 SPI 3-Wire Mode Description

SPI 3-wire mode allows for SPI communication over three pins instead of the normal four pins.

In master mode, if the TRIWIRE bit is set, enabling 3-wire SPI mode, SPISIMOMx becomes the bi-directional SPIMOMx (SPI master out, master in) pin, and SPISOMIx is no longer used by the SPI. In slave mode, if the TRIWIRE bit is set, SPISOMIx becomes the bi-directional SPISISOx (SPI slave in, slave out) pin, and SPISIMOMx is no longer used by the SPI.

[Table 17-5](#) indicates the pin function differences between 3-wire and 4-wire SPI mode for a master and slave SPI.

**Table 17-5. 4-wire vs. 3-wire SPI Pin Functions**

4-wire SPI	3-wire SPI (Master)	3-wire SPI(Slave)
SPICLKx	SPICLKx	SPICLKx
SPISTEx	SPISTEx	SPISTEx
SPISIMOMx	SPIMOMIx	Free
SPISOMIx	Free	SPISISOx

Because in 3-wire mode, the receive and transmit paths within the SPI are connected, any data transmitted by the SPI module is also received by itself. The application software must take care to perform a dummy read to clear the SPI data register of the additional received data.

The TALK bit plays an important role in 3-wire SPI mode. The bit must be set to transmit data and cleared prior to reading data. In master mode, in order to initiate a read, the application software must write dummy data to the SPI data register (SPIDAT or SPIRXBUF) while the TALK bit is cleared (no data is transmitted out the SPIMOMI pin) before reading from the data register.

[Figure 17-9](#) and [Figure 17-10](#) illustrate 3-wire master and slave mode.

Figure 17-9. SPI 3-wire Master Mode

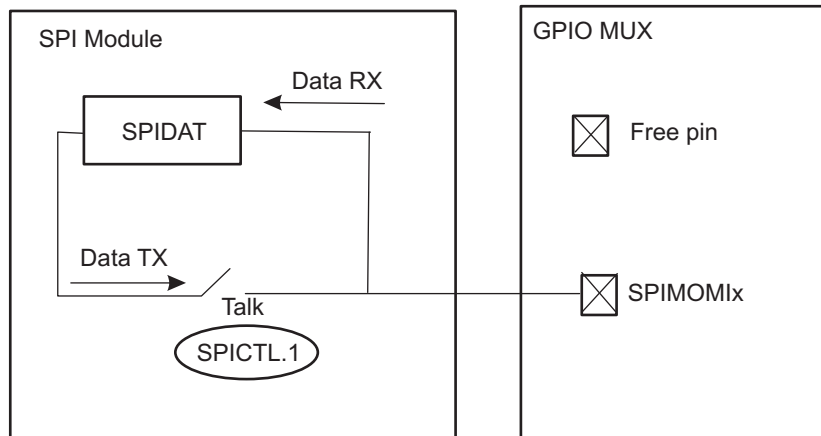


Figure 17-10. SPI 3-wire Slave Mode

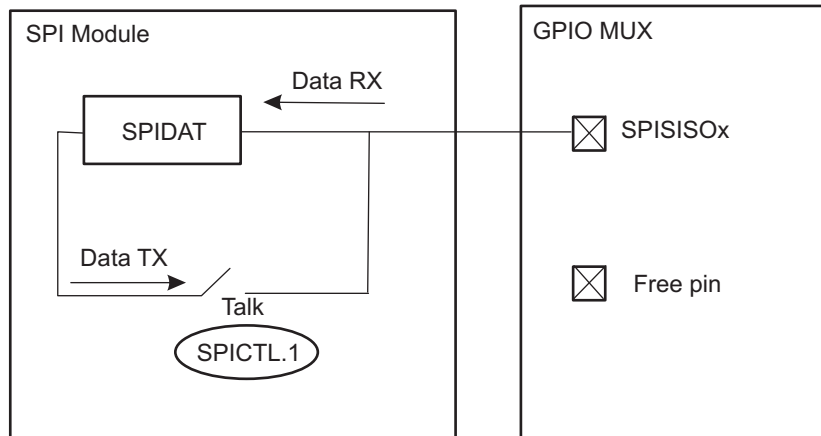


Table 17-6 indicates how data is received or transmitted in the various SPI modes while the TALK bit is set or cleared.

Table 17-6. 3-Wire SPI Pin Configuration

Pin Mode	SPIPRI[TRIWIRE]	SPICTL[TALK]	SPISIMO	SPISOMI
<b>Master Mode</b>				
4-wire	0	X	TX	RX
3-pin mode	1	0	RX	Disconnect from SPI
		1	TX/RX	
<b>Slave Mode</b>				
4-wire	0	X	RX	TX
3-pin mode	1	0	Disconnect from SPI	RX
		1		TX/RX

## 17.4 Programming Procedure

This section describes the procedure for configuring the SPI for the various modes of operation.

### 17.4.1 Initialization Upon Reset

A system reset forces the SPI peripheral into the following default configuration:

- Unit is configured as a slave module (MASTER\_SLAVE = 0)
- Transmit capability is disabled (TALK = 0)
- Data is latched at the input on the falling edge of the SPICLK signal
- Character length is assumed to be one bit
- SPI interrupts are disabled
- Data in SPIDAT is reset to 0000h

### 17.4.2 Configuring the SPI

This section describes the procedure in which to configure the SPI module for operation. To prevent unwanted and unforeseen events from occurring during or as a result of initialization changes, clear the SPISWRESET bit before making initialization changes, and then set this bit after initialization is complete. While the SPI is held in reset (SPISWRESET = 0), configuration may be changed in any order. The following list shows the the SPI configuration procedure in a logical order. However, the SPI registers can be written with single 16-bit writes, so the order is not required with the exception of SPISWRESET.

To change the SPI configuration:

- Step 1. Clear the SPI Software Reset bit (SPISWRESET) to 0 to force the SPI to the reset state.
- Step 2. Configure the SPI as desired:
  - Select either master or slave mode (MASTER\_SLAVE).
  - Choose SPICLK polarity and phase (CLKPOLARITY and CLK\_PHASE).
  - Set the desired baud rate (SPIBRR).
  - Enable high speed mode if desired (HS\_MODE).
  - Set the SPI character length (SPICHR).
  - Clear the SPI Flags (OVERRUN\_FLAG, INT\_FLAG).
  - Enable  $\overline{\text{SPISTE}}$  inversion (STEINV).
  - Enable 3-wire mode (TRIWIRE).
  - If using FIFO enhancements:
    - Enable the FIFO enhancements (SPIFFENA).
    - Clear the FIFO Flags (TXFFINTCLR, RXFFOVFCLR, and RXFFINTCLR).
    - Release transmit and receive FIFO resets (TXFIFO and RXFIFORESET).
    - Release SPI FIFO channels from reset (SPIRST).
- Step 3. If interrupts are used:
  - In non-FIFO mode, enable the receiver overrun and/or SPI interrupts (OVERRUNINTENA and SPIINTENA).
  - In FIFO mode, set the transmit and receive interrupt levels (TXFFIL and RXFFIL) then enable the interrupts (TXFFIENA and RXFFIENA).
- Step 4. Set SPISWRESET to 1 to release the SPI from the reset state.

---

**NOTE:** Do not change the SPI configuration when communication is in progress.

---

### 17.4.3 Configuring the SPI for High-Speed Mode

In order to achieve the maximum rated speeds, the following settings must be made. This example assumes that the device is operating at 200 MHz.

Set LSPCLK equal to SYSCLK:

```
ClkCfgRegs.LOSPCP.bit.LSPCLKDIV = 0;
```

Select the appropriate Pin Mux options in GPIO\_CTRL\_REGS.

During the SPI configuration procedure:



Set HS\_MODE to 1.

```
SpiaRegs.SPICCR.bit.HS_MODE = 0x1;
```

Set SPIBRR to 3. SPICLK = LSPCLK/(SPIBRR+1) = 50 MHz

```
SpiaRegs.SPIBRR = 0x3;
```

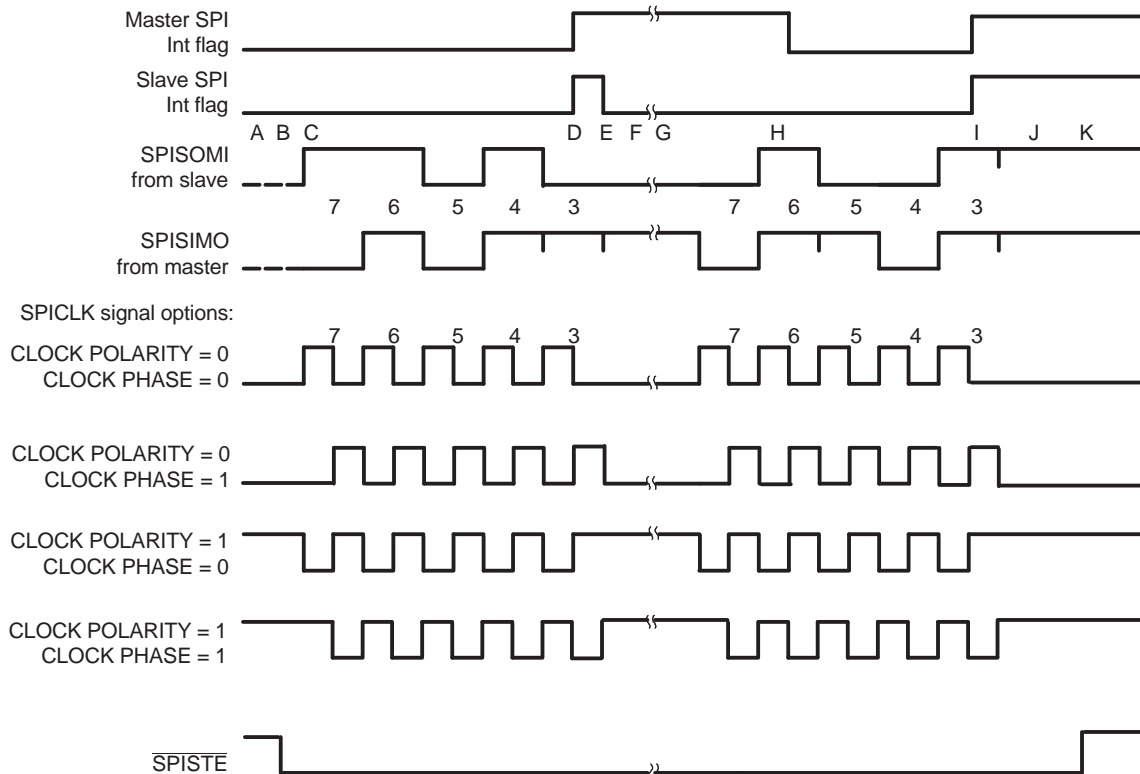
There are no other differences in the configuration from normal SPI operation. Sending and receiving data, interrupts, and DMA operation will operate without change.

#### 17.4.4 Data Transfer Example

The timing diagram shown in [Figure 17-11](#) illustrates an SPI data transfer between two devices using a character length of five bits with the SPICLK being symmetrical.

The timing diagram with SPICLK asymmetrical ([Figure 17-8](#)) shares similar characterizations with [Figure 17-11](#) except that the data transfer is one LSPCLK cycle longer per bit during the low pulse (CLKPOLARITY = 0) or during the high pulse (CLKPOLARITY = 1) of the SPICLK.

[Figure 17-11](#) is applicable for 8-bit SPI only and is not for 28x devices that are capable of working with 16-bit data. The figure is shown for illustrative purposes only.

**Figure 17-11. Five Bits per Character**


- A Slave writes 0D0h to SPIDAT and waits for the master to shift out the data.
- B Master sets the slave  $\overline{\text{SPISTE}}$  signal low (active).
- C Master writes 058h to SPIDAT, which starts the transmission procedure.
- D First byte is finished and sets the interrupt flags.
- E Slave reads 0Bh from its SPIRXBUF (right-justified).
- F Slave writes 04Ch to SPIDAT and waits for the master to shift out the data.
- G Master writes 06Ch to SPIDAT, which starts the transmission procedure.
- H Master reads 01Ah from the SPIRXBUF (right-justified).
- I Second byte is finished and sets the interrupt flags.
- J Master reads 89h and the slave reads 8Dh from their respective SPIRXBUF. After the user's software masks off the unused bits, the master receives 09h and the slave receives 0Dh.
- K Master clears the slave  $\overline{\text{SPISTE}}$  signal high (inactive).

### 17.4.5 SPI STEINV Bit in Digital Audio Transfers

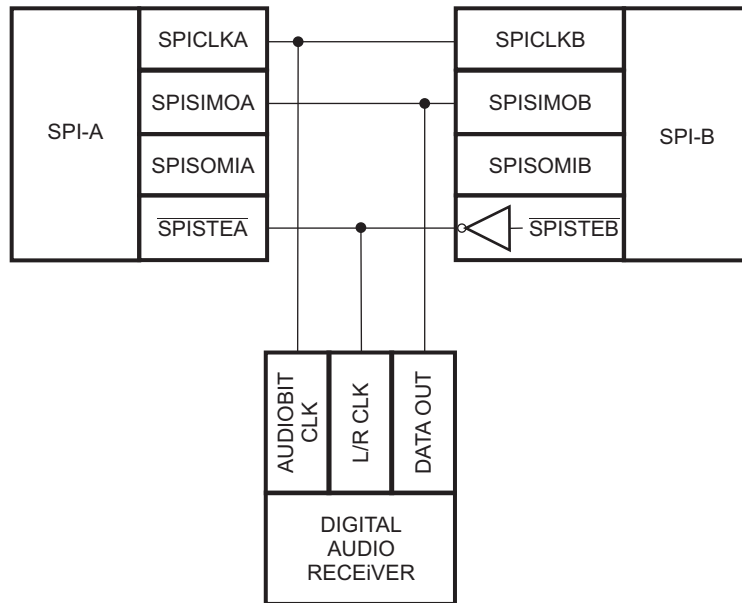
On those devices with two SPI modules, enabling the STEINV bit on one of the SPI modules allows the pair of SPIs to receive both left and right-channel digital audio data in slave mode. The SPI module that receives a normal active-low  $\overline{\text{SPISTE}}$  signal stores right-channel data, and the SPI module that receives an inverted active-high  $\overline{\text{SPISTE}}$  signal stores left-channel data from the master. To receive digital audio data from a digital audio interface receiver, the SPI modules can be connected as shown in [Figure 17-12](#).

---

**NOTE:** This configuration is only applicable to slave mode (MASTER\_SLAVE = 0). When the SPI is configured as master (MASTER\_SLAVE = 1), the STEINV bit will have no effect on the  $\overline{\text{SPISTE}}$  pin.

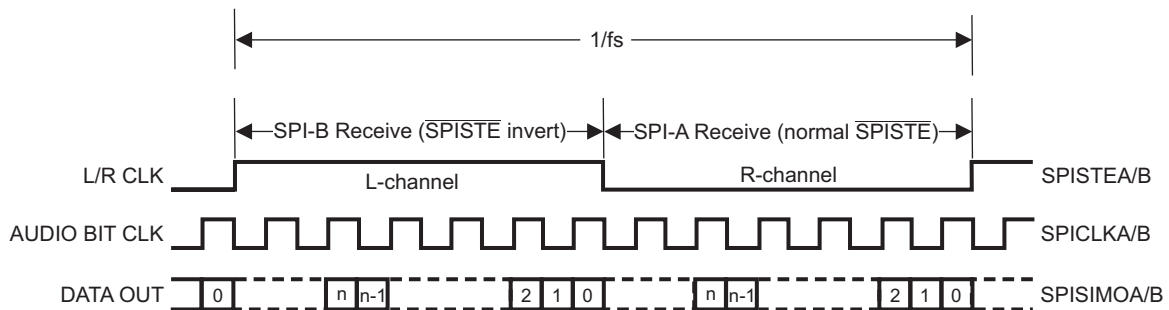
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**Figure 17-12. SPI Digital Audio Receiver Configuration Using 2 SPIs**



Standard 28x SPI timing requirements limit the number of digital audio interface formats supported using the 2-SPI configuration with the STEINV bit. See your device-specific data sheet electricals for SPI timing requirements. With the SPI clock phase configured such that the CLKPOLARITY bit is 0 and the CLK\_PHASE bit is 1 (data latched on rising edge of clock), standard right-justified digital audio interface data format is supported as shown in [Figure 17-13](#).

**Figure 17-13. Standard Right-Justified Digital Audio Data Format**



## 17.5 Registers

### 17.5.1 SPI Base Addresses

The base addresses for SPI are shown in [Table 17-7](#).

**Table 17-7. SPI Base Address Table**

Device Registers	Register Name	Start Address	End Address
SpiaRegs	SPI_REGS	0x0000_6100	0x0000_610F
SpibRegs	SPI_REGS	0x0000_6110	0x0000_611F
SpicRegs	SPI_REGS	0x0000_6120	0x0000_612F

## 17.5.2 SPI\_REGS Registers

Table 17-8 lists the memory-mapped registers for the SPI\_REGS. All register offset addresses not listed in Table 17-8 should be considered as reserved locations and the register contents should not be modified.

**Table 17-8. SPI\_REGS Registers**

Offset	Acronym	Register Name	Write Protection	Section
0h	SPICCR	SPI Configuration Control Register		<a href="#">Go</a>
1h	SPICTL	SPI Operation Control Register		<a href="#">Go</a>
2h	SPISTS	SPI Status Register		<a href="#">Go</a>
4h	SPIBRR	SPI Baud Rate Register		<a href="#">Go</a>
6h	SPIRXEMU	SPI Emulation Buffer Register		<a href="#">Go</a>
7h	SPIRXBUF	SPI Serial Input Buffer Register		<a href="#">Go</a>
8h	SPITXBUF	SPI Serial Output Buffer Register		<a href="#">Go</a>
9h	SPIDAT	SPI Serial Data Register		<a href="#">Go</a>
Ah	SPIFFTX	SPI FIFO Transmit Register		<a href="#">Go</a>
Bh	SPIFFRX	SPI FIFO Receive Register		<a href="#">Go</a>
Ch	SPIFFCT	SPI FIFO Control Register		<a href="#">Go</a>
Fh	SPIPRI	SPI Priority Control Register		<a href="#">Go</a>

Complex bit access types are encoded to fit into small table cells. Table 17-9 shows the codes that are used for access types in this section.

**Table 17-9. SPI\_REGS Access Type Codes**

Access Type	Code	Description
<b>Read Type</b>		
R	R	Read
RC	C R	to Clear Read
<b>Write Type</b>		
W	W	Write
W1C	1C W	1 to clear Write
<b>Reset or Default Value</b>		
-n		Value after reset or the default value
<b>Register Array Variables</b>		
i,j,k,l,m,n		When these variables are used in a register name, an offset, or an address, they refer to the value of a register array where the register is part of a group of repeating registers. The register groups form a hierarchical structure and the array is represented with a formula.
y		When this variable is used in a register name, an offset, or an address it refers to the value of a register array.

**17.5.2.1 SPICCR Register (Offset = 0h) [reset = 0h]**

 SPICCR is shown in [Figure 17-14](#) and described in [Table 17-10](#).

 Return to [Summary Table](#).

SPI Configuration Control Register

**Figure 17-14. SPICCR Register**

15	14	13	12	11	10	9	8
RESERVED							
R-0h							
7	6	5	4	3	2	1	0
SPISWRESET	CLKPOLARITY	HS_MODE	SPILBK	SPICCHAR			
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h			

**Table 17-10. SPICCR Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-8	RESERVED	R	0h	Reserved
7	SPISWRESET	R/W	0h	SPI Software Reset When changing configuration, you should clear this bit before the changes and set this bit before resuming operation. Reset type: SYSRSn 0h (R/W) = Initializes the SPI operating flags to the reset condition. Specifically, the RECEIVER OVERRUN Flag bit (SPISTS.7), the SPI INT FLAG bit (SPISTS.6), and the TXBUF FULL Flag bit (SPISTS.5) are cleared. SPISTE will become inactive. SPICLK will be immediately driven to 0 regardless of the clock polarity. The SPI configuration remains unchanged. 1h (R/W) = SPI is ready to transmit or receive the next character. When the SPI SW RESET bit is a 0, a character written to the transmitter will not be shifted out when this bit is set. A new character must be written to the serial data register. SPICLK will be returned to its inactive state one SPICLK cycle after this bit is set.
6	CLKPOLARITY	R/W	0h	Shift Clock Polarity This bit controls the polarity of the SPICLK signal. CLOCK POLARITY and POLARITY CLOCK PHASE (SPICTL.3) control four clocking schemes on the SPICLK pin. Reset type: SYSRSn 0h (R/W) = Data is output on rising edge and input on falling edge. When no SPI data is sent, SPICLK is at low level. The data input and output edges depend on the value of the CLOCK PHASE bit (SPICTL.3) as follows: - CLOCK PHASE = 0: Data is output on the rising edge of the SPICLK signal. Input data is latched on the falling edge of the SPICLK signal. - CLOCK PHASE = 1: Data is output one half-cycle before the first rising edge of the SPICLK signal and on subsequent falling edges of the SPICLK signal. Input data is latched on the rising edge of the SPICLK signal. 1h (R/W) = Data is output on falling edge and input on rising edge. When no SPI data is sent, SPICLK is at high level. The data input and output edges depend on the value of the CLOCK PHASE bit (SPICTL.3) as follows: - CLOCK PHASE = 0: Data is output on the falling edge of the SPICLK signal. Input data is latched on the rising edge of the SPICLK signal. - CLOCK PHASE = 1: Data is output one half-cycle before the first falling edge of the SPICLK signal and on subsequent rising edges of the SPICLK signal. Input data is latched on the falling edge of the SPICLK signal.

**Table 17-10. SPICCR Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
5	HS_MODE	R/W	0h	High Speed Mode Enable Bits This bit determines if the High Speed mode is enabled. The correct GPIOs should be selected in the GPxGMUX/GPxMUX registers. Reset type: SYSRSn 0h (R/W) = SPI High Speed mode disabled. This is the default value after reset. 1h (R/W) = SPI High Speed mode enabled,
4	SPI_LBK	R/W	0h	SPI Loopback Mode Select Loopback mode allows module validation during device testing. This mode is valid only in master mode of the SPI. Reset type: SYSRSn 0h (R/W) = SPI loopback mode disabled. This is the default value after reset. 1h (R/W) = SPI loopback mode enabled, SIMO/SOMI lines are connected internally. Used for module self-tests.
3-0	SPICHR	R/W	0h	Character Length Control Bits These four bits determine the number of bits to be shifted in or SPI CHAR0 out as a single character during one shift sequence. $SPICHR = \text{Word length} - 1$ Reset type: SYSRSn 0h (R/W) = 1-bit word 1h (R/W) = 2-bit word 7h (R/W) = 8-bit word Fh (R/W) = 16-bit word

### 17.5.2.2 SPICTL Register (Offset = 1h) [reset = 0h]

SPICTL is shown in [Figure 17-15](#) and described in [Table 17-11](#).

Return to [Summary Table](#).

SPI Operation Control Register

**Figure 17-15. SPICTL Register**

15	14	13	12	11	10	9	8
RESERVED							
R-0h							
7	6	5	4	3	2	1	0
RESERVED			OVERRUNINT ENA	CLK_PHASE	MASTER_SLA VE	TALK	SPIINTENA
R-0h			R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h

**Table 17-11. SPICTL Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-5	RESERVED	R	0h	Reserved
4	OVERRUNINTENA	R/W	0h	Overrun Interrupt Enable Overrun Interrupt Enable. Setting this bit causes an interrupt to be generated when the RECEIVER OVERRUN Flag bit (SPISTS.7) is set by hardware. Interrupts generated by the RECEIVER OVERRUN Flag bit and the SPI INT FLAG bit (SPISTS.6) share the same interrupt vector. Reset type: SYSRSn 0h (R/W) = Disable RECEIVER OVERRUN interrupts. 1h (R/W) = Enable RECEIVER_OVERRUN interrupts.
3	CLK_PHASE	R/W	0h	SPI Clock Phase Select This bit controls the phase of the SPICLK signal. CLOCK PHASE and CLOCK POLARITY (SPICCR.6) make four different clocking schemes possible (see clocking figures in SPI chapter). When operating with CLOCK PHASE high, the SPI (master or slave) makes the first bit of data available after SPIDAT is written and before the first edge of the SPICLK signal, regardless of which SPI mode is being used. Reset type: SYSRSn 0h (R/W) = Normal SPI clocking scheme, depending on the CLOCK POLARITY bit (SPICCR.6). 1h (R/W) = SPICLK signal delayed by one half-cycle. Polarity determined by the CLOCK POLARITY bit.
2	MASTER_SLAVE	R/W	0h	SPI Network Mode Control This bit determines whether the SPI is a network master or slave. SLAVE During reset initialization, the SPI is automatically configured as a network slave. Reset type: SYSRSn 0h (R/W) = SPI is configured as a slave. 1h (R/W) = SPI is configured as a master.



**Table 17-11. SPICTL Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
1	TALK	R/W	0h	<p>Transmit Enable</p> <p>The TALK bit can disable data transmission (master or slave) by placing the serial data output in the high-impedance state. If this bit is disabled during a transmission, the transmit shift register continues to operate until the previous character is shifted out. When the TALK bit is disabled, the SPI is still able to receive characters and update the status flags. TALK is cleared (disabled) by a system reset.</p> <p>Reset type: SYSRSn</p> <p>0h (R/W) = Disables transmission:</p> <ul style="list-style-type: none"> <li>- Slave mode operation: If not previously configured as a general-purpose I/O pin, the SPISOMI pin will be put in the high-impedance state.</li> <li>- Master mode operation: If not previously configured as a general-purpose I/O pin, the SPISIMO pin will be put in the high-impedance state.</li> </ul> <p>1h (R/W) = Enables transmission For the 4-pin option, ensure to enable the receiver's SPISTEn input pin.</p>
0	SPIINTENA	R/W	0h	<p>SPI Interrupt Enable</p> <p>This bit controls the SPI's ability to generate a transmit/receive interrupt. The SPI INT FLAG bit (SPISTS.6) is unaffected by this bit.</p> <p>Reset type: SYSRSn</p> <p>0h (R/W) = Disables the interrupt.</p> <p>1h (R/W) = Enables the interrupt.</p>

### 17.5.2.3 SPISTS Register (Offset = 2h) [reset = 0h]

SPISTS is shown in [Figure 17-16](#) and described in [Table 17-12](#).

Return to [Summary Table](#).

SPI Status Register

**Figure 17-16. SPISTS Register**

15	14	13	12	11	10	9	8
RESERVED							
R-0h							
7	6	5	4	3	2	1	0
OVERRUN_FL AG	INT_FLAG	BUFFULL_FL G	RESERVED				
W1C-0h	RC-0h	R-0h	R-0h				

**Table 17-12. SPISTS Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-8	RESERVED	R	0h	Reserved
7	OVERRUN_FLAG	W1C	0h	<p>SPI Receiver Overrun Flag</p> <p>This bit is a read/clear-only flag. The SPI hardware sets this bit when a receive or transmit operation completes before the previous character has been read from the buffer. The bit is cleared in one of three ways:</p> <ul style="list-style-type: none"> <li>- Writing a 1 to this bit</li> <li>- Writing a 0 to SPI SW RESET (SPICCR.7)</li> <li>- Resetting the system</li> </ul> <p>If the OVERRUN INT ENA bit (SPICTL.4) is set, the SPI requests only one interrupt upon the first occurrence of setting the RECEIVER OVERRUN Flag bit. Subsequent overruns will not request additional interrupts if this flag bit is already set. This means that in order to allow new overrun interrupt requests the user must clear this flag bit by writing a 1 to SPISTS.7 each time an overrun condition occurs. In other words, if the RECEIVER OVERRUN Flag bit is left set (not cleared) by the interrupt service routine, another overrun interrupt will not be immediately re-entered when the interrupt service routine is exited.</p> <p>Reset type: SYSRSn</p> <p>0h (R/W) = A receive overrun condition has not occurred.</p> <p>1h (R/W) = The last received character has been overwritten and therefore lost (when the SPIRXBUF was overwritten by the SPI module before the previous character was read by the user application).</p> <p>Writing a '1' will clear this bit. The RECEIVER OVERRUN Flag bit should be cleared during the interrupt service routine because the RECEIVER OVERRUN Flag bit and SPI INT FLAG bit (SPISTS.6) share the same interrupt vector. This will alleviate any possible doubt as to the source of the interrupt when the next byte is received.</p>

**Table 17-12. SPISTS Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
6	INT_FLAG	RC	0h	<p>SPI Interrupt Flag</p> <p>SPI INT FLAG is a read-only flag. Hardware sets this bit to indicate that the SPI has completed sending or receiving the last bit and is ready to be serviced. This flag causes an interrupt to be requested if the SPI INT ENA bit (SPICTL.0) is set. The received character is placed in the receiver buffer at the same time this bit is set. This bit is cleared in one of three ways:</p> <ul style="list-style-type: none"> <li>- Reading SPIRXBUF</li> <li>- Writing a 0 to SPI SW RESET (SPICCR.7)</li> <li>- Resetting the system</li> </ul> <p>Note: This bit should not be used if FIFO mode is enabled. The internal process of copying the received word from SPIRXBUF to the Receive FIFO will clear this bit. Use the FIFO status, or FIFO interrupt bits for similar functionality.</p> <p>Reset type: SYSRSn</p> <p>0h (R/W) = No full words have been received or transmitted. 1h (R/W) = Indicates that the SPI has completed sending or receiving the last bit and is ready to be serviced.</p>
5	BUFFULL_FLAG	R	0h	<p>SPI Transmit Buffer Full Flag</p> <p>This read-only bit gets set to 1 when a character is written to the SPI Transmit buffer SPITXBUF. It is cleared when the character is automatically loaded into SPIDAT when the shifting out of a previous character is complete.</p> <p>Reset type: SYSRSn</p> <p>0h (R/W) = Transmit buffer is not full. 1h (R/W) = Transmit buffer is full.</p>
4-0	RESERVED	R	0h	Reserved

### 17.5.2.4 SPIBRR Register (Offset = 4h) [reset = 0h]

SPIBRR is shown in [Figure 17-17](#) and described in [Table 17-13](#).

Return to [Summary Table](#).

SPI Baud Rate Register

**Figure 17-17. SPIBRR Register**

15	14	13	12	11	10	9	8
RESERVED							
R-0h							
7	6	5	4	3	2	1	0
RESERVED		SPI_BIT_RATE					
R-0h		R/W-0h					

**Table 17-13. SPIBRR Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-7	RESERVED	R	0h	Reserved
6-0	SPI_BIT_RATE	R/W	0h	<p>SPI Baud Rate Control</p> <p>These bits determine the bit transfer rate if the SPI is the network SPI BIT RATE 0 master. There are 125 data-transfer rates (each a function of the CPU clock, LSPCLK) that can be selected. One data bit is shifted per SPICLK cycle. (SPICLK is the baud rate clock output on the SPICLK pin.)</p> <p>If the SPI is a network slave, the module receives a clock on the SPICLK pin from the network master. Therefore, these bits have no effect on the SPICLK signal. The frequency of the input clock from the master should not exceed the slave SPI's LSPCLK signal divided by 4.</p> <p>In master mode, the SPI clock is generated by the SPI and is output on the SPICLK pin. The SPI baud rates are determined by the following formula:</p> <p>For SPIBRR = 3 to 127: SPI Baud Rate = LSPCLK / (SPIBRR + 1)</p> <p>For SPIBRR = 0, 1, or 2: SPI Baud Rate = LSPCLK / 4</p> <p>where: LSPCLK = Function of CPU clock frequency X low-speed peripheral clock of the device            SPIBRR = Contents of the SPIBRR in the master SPI device.</p> <p>Reset type: SYSRSn</p> <p>3h (R/W) = SPI Baud Rate = LSPCLK/4</p> <p>4h (R/W) = SPI Baud Rate = LSPCLK/5</p> <p>7Eh (R/W) = SPI Baud Rate = LSPCLK/127</p> <p>7Fh (R/W) = SPI Baud Rate = LSPCLK/128</p>

**17.5.2.5 SPIRXEMU Register (Offset = 6h) [reset = 0h]**

SPIRXEMU is shown in [Figure 17-18](#) and described in [Table 17-14](#).

Return to [Summary Table](#).

SPI Emulation Buffer Register

**Figure 17-18. SPIRXEMU Register**

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ERXBn															
R-0h															

**Table 17-14. SPIRXEMU Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-0	ERXBn	R	0h	<p>Emulation Buffer Received Data</p> <p>SPIRXEMU functions almost identically to SPIRXBUF, except that reading SPIRXEMU does not clear the SPI INT FLAG bit (SPISTS.6). Once the SPIDAT has received the complete character, the character is transferred to SPIRXEMU and SPIRXBUF, where it can be read. At the same time, SPI INT FLAG is set.</p> <p>This mirror register was created to support emulation. Reading SPIRXBUF clears the SPI INT FLAG bit (SPISTS.6). In the normal operation of the emulator, the control registers are read to continually update the contents of these registers on the display screen. SPIRXEMU was created so that the emulator can read this register and properly update the contents on the display screen. Reading SPIRXEMU does not clear the SPI INT FLAG bit, but reading SPIRXBUF clears this flag. In other words, SPIRXEMU enables the emulator to emulate the true operation of the SPI more accurately.</p> <p>It is recommended that you view SPIRXEMU in the normal emulator run mode.</p> <p>Reset type: SYSRSn</p>

### 17.5.2.6 SPIRXBUF Register (Offset = 7h) [reset = 0h]

SPIRXBUF is shown in [Figure 17-19](#) and described in [Table 17-15](#).

Return to [Summary Table](#).

SPI Serial Input Buffer Register

**Figure 17-19. SPIRXBUF Register**

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
RXBn															
R-0h															

**Table 17-15. SPIRXBUF Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-0	RXBn	R	0h	Received Data Once SPIDAT has received the complete character, the character is transferred to SPIRXBUF, where it can be read. At the same time, the SPI INT FLAG bit (SPISTS.6) is set. Since data is shifted into the SPI's most significant bit first, it is stored right-justified in this register. Reset type: SYSRSn

**17.5.2.7 SPITXBUF Register (Offset = 8h) [reset = 0h]**

SPITXBUF is shown in [Figure 17-20](#) and described in [Table 17-16](#).

Return to [Summary Table](#).

SPI Serial Output Buffer Register

**Figure 17-20. SPITXBUF Register**

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
TXBn															
R/W-0h															

**Table 17-16. SPITXBUF Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-0	TXBn	R/W	0h	Transmit Data Buffer  This is where the next character to be transmitted is stored. When the transmission of the current character has completed, if the TX BUF FULL Flag bit is set, the contents of this register is automatically transferred to SPIDAT, and the TX BUF FULL Flag is cleared. Writes to SPITXBUF must be left-justified.  Reset type: SYSRSn

### 17.5.2.8 SPIDAT Register (Offset = 9h) [reset = 0h]

SPIDAT is shown in [Figure 17-21](#) and described in [Table 17-17](#).

Return to [Summary Table](#).

SPI Serial Data Register

**Figure 17-21. SPIDAT Register**

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
SDATn															
R/W-0h															

**Table 17-17. SPIDAT Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-0	SDATn	R/W	0h	Serial Data Shift Register - It provides data to be output on the serial output pin if the TALK bit (SPICTL.1) is set. - When the SPI is operating as a master, a data transfer is initiated. When initiating a transfer, see the CLOCK POLARITY bit (SPICCR.6) described in Section 10.2.1.1 and the CLOCK PHASE bit (SPICTL.3) described in Section 10.2.1.2, for the requirements. In master mode, writing dummy data to SPIDAT initiates a receiver sequence. Since the data is not hardware-justified for characters shorter than sixteen bits, transmit data must be written in left-justified form, and received data read in right-justified form. Reset type: SYSRSn



### 17.5.2.9 SPIFFTX Register (Offset = Ah) [reset = A000h]

SPIFFTX is shown in [Figure 17-22](#) and described in [Table 17-18](#).

Return to [Summary Table](#).

SPI FIFO Transmit Register

**Figure 17-22. SPIFFTX Register**

15		14		13		12		11		10		9		8	
SPIRST		SPIFFENA		TXFIFO						TXFFST					
R/W-1h		R/W-0h		R/W-1h						R-0h					
7		6		5		4		3		2		1		0	
TXFFINT		TXFFINTCLR		TXFFIENA						TXFFIL					
R-0h		W-0h		R/W-0h						R/W-0h					

**Table 17-18. SPIFFTX Register Field Descriptions**

Bit	Field	Type	Reset	Description
15	SPIRST	R/W	1h	SPI Reset Reset type: SYSRSn 0h (R/W) = Write 0 to reset the SPI transmit and receive channels. The SPI FIFO register configuration bits will be left as is. 1h (R/W) = SPI FIFO can resume transmit or receive. No effect to the SPI registers bits.
14	SPIFFENA	R/W	0h	SPI FIFO Enhancements Enable Reset type: SYSRSn 0h (R/W) = SPI FIFO enhancements are disabled. 1h (R/W) = SPI FIFO enhancements are enabled.
13	TXFIFO	R/W	1h	TX FIFO Reset Reset type: SYSRSn 0h (R/W) = Write 0 to reset the FIFO pointer to zero, and hold in reset. 1h (R/W) = Release transmit FIFO from reset.
12-8	TXFFST	R	0h	Transmit FIFO Status Reset type: SYSRSn 0h (R/W) = Transmit FIFO is empty. 1h (R/W) = Transmit FIFO has 1 word. 2h (R/W) = Transmit FIFO has 2 words. 10h (R/W) = Transmit FIFO has 16 words, which is the maximum. 1Fh (R/W) = Reserved.
7	TXFFINT	R	0h	TX FIFO Interrupt Flag Reset type: SYSRSn 0h (R/W) = TXFIFO interrupt has not occurred, This is a read-only bit. 1h (R/W) = TXFIFO interrupt has occurred, This is a read-only bit.
6	TXFFINTCLR	W	0h	TXFIFO Interrupt Clear Reset type: SYSRSn 0h (R/W) = Write 0 has no effect on TXFIFINT flag bit, Bit reads back a zero. 1h (R/W) = Write 1 to clear SPIFFTX[TXFFINT] flag.
5	TXFFIENA	R/W	0h	TX FIFO Interrupt Enable Reset type: SYSRSn 0h (R/W) = TX FIFO interrupt based on TXFFIL match (less than or equal to) will be disabled. 1h (R/W) = TX FIFO interrupt based on TXFFIL match (less than or equal to) will be enabled.

**Table 17-18. SPIFFTX Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
4-0	TXFFIL	R/W	0h	Transmit FIFO Interrupt Level Bits Transmit FIFO will generate interrupt when the FIFO status bits (TXFFST4-0) and FIFO level bits (TXFFIL4-0) match (less than or equal to). Reset type: SYSRSn 0h (R/W) = A TX FIFO interrupt request is generated when there are no words remaining in the TX buffer. 1h (R/W) = A TX FIFO interrupt request is generated when there is 1 word or no words remaining in the TX buffer. 2h (R/W) = A TX FIFO interrupt request is generated when there is 2 words or fewer remaining in the TX buffer. 10h (R/W) = A TX FIFO interrupt request is generated when there are 16 words or fewer remaining in the TX buffer. 1Fh (R/W) = Reserved.

### 17.5.2.10 SPIFFRX Register (Offset = Bh) [reset = 201Fh]

SPIFFRX is shown in [Figure 17-23](#) and described in [Table 17-19](#).

Return to [Summary Table](#).

SPI FIFO Receive Register

**Figure 17-23. SPIFFRX Register**

15		14		13		12		11		10		9		8	
RXFFOVF		RXFFOVFCLR		RXFIFORESET						RXFFST					
R-0h		W-0h		R/W-1h						R-0h					
7		6		5		4		3		2		1		0	
RXFFINT		RXFFINTCLR		RXFFIENA						RXFFIL					
R-0h		W-0h		R/W-0h						R/W-1Fh					

**Table 17-19. SPIFFRX Register Field Descriptions**

Bit	Field	Type	Reset	Description
15	RXFFOVF	R	0h	Receive FIFO Overflow Flag Reset type: SYSRSn 0h (R/W) = Receive FIFO has not overflowed. This is a read-only bit. 1h (R/W) = Receive FIFO has overflowed, read-only bit. More than 16 words have been received in to the FIFO, and the first received word is lost.
14	RXFFOVFCLR	W	0h	Receive FIFO Overflow Clear Reset type: SYSRSn 0h (R/W) = Write 0 does not affect RXFFOVF flag bit, Bit reads back a zero. 1h (R/W) = Write 1 to clear SPIFFRX[RXFFOVF].
13	RXFIFORESET	R/W	1h	Receive FIFO Reset Reset type: SYSRSn 0h (R/W) = Write 0 to reset the FIFO pointer to zero, and hold in reset. 1h (R/W) = Re-enable receive FIFO operation.
12-8	RXFFST	R	0h	Receive FIFO Status Reset type: SYSRSn 0h (R/W) = Receive FIFO is empty. 1h (R/W) = Receive FIFO has 1 word. 2h (R/W) = Receive FIFO has 2 words. 10h (R/W) = Receive FIFO has 16 words, which is the maximum. 1Fh (R/W) = Reserved.
7	RXFFINT	R	0h	Receive FIFO Interrupt Flag Reset type: SYSRSn 0h (R/W) = RXFIFO interrupt has not occurred. This is a read-only bit. 1h (R/W) = RXFIFO interrupt has occurred. This is a read-only bit.
6	RXFFINTCLR	W	0h	Receive FIFO Interrupt Clear Reset type: SYSRSn 0h (R/W) = Write 0 has no effect on RXFIFINT flag bit, Bit reads back a zero. 1h (R/W) = Write 1 to clear SPIFFRX[RXFFINT] flag
5	RXFFIENA	R/W	0h	RX FIFO Interrupt Enable Reset type: SYSRSn 0h (R/W) = RX FIFO interrupt based on RXFFIL match (greater than or equal to) will be disabled. 1h (R/W) = RX FIFO interrupt based on RXFFIL match (greater than or equal to) will be enabled.

**Table 17-19. SPIFFRX Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
4-0	RXFFIL	R/W	1Fh	<p>Receive FIFO Interrupt Level Bits</p> <p>11111 Receive FIFO generates an interrupt when the FIFO status bits (RXFFST4-0) are greater than or equal to the FIFO level bits (RXFFIL4-0). The default value of these bits after reset is 11111. This avoids frequent interrupts after reset, as the receive FIFO will be empty most of the time.</p> <p>Reset type: SYSRSn</p> <p>0h (R/W) = A RX FIFO interrupt request is generated when there is 0 or more words in the RX buffer.</p> <p>1h (R/W) = A RX FIFO interrupt request is generated when there are 1 or more words in the RX buffer.</p> <p>2h (R/W) = A RX FIFO interrupt request is generated when there are 2 or more words in the RX buffer.</p> <p>10h (R/W) = A RX FIFO interrupt request is generated when there are 16 words in the RX buffer.</p> <p>1Fh (R/W) = Reserved.</p>

**17.5.2.11 SPIFFCT Register (Offset = Ch) [reset = 0h]**

SPIFFCT is shown in [Figure 17-24](#) and described in [Table 17-20](#).

Return to [Summary Table](#).

SPI FIFO Control Register

**Figure 17-24. SPIFFCT Register**

15	14	13	12	11	10	9	8
RESERVED							
R-0h							
7	6	5	4	3	2	1	0
TXDLY							
R/W-0h							

**Table 17-20. SPIFFCT Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-8	RESERVED	R	0h	Reserved
7-0	TXDLY	R/W	0h	<p>FIFO Transmit Delay Bits</p> <p>These bits define the delay between every transfer from FIFO transmit buffer to transmit shift register. The delay is defined in number SPI serial clock cycles. The 8-bit register could define a minimum delay of 0 serial clock cycles and a maximum of 255 serial clock cycles. In FIFO mode, the buffer (TXBUF) between the shift register and the FIFO should be filled only after the shift register has completed shifting of the last bit. This is required to pass on the delay between transfers to the data stream. In the FIFO mode TXBUF should not be treated as one additional level of buffer.</p> <p>Reset type: SYSRSn</p> <p>0h (R/W) = The next word in the TX FIFO buffer is transferred to SPITXBUF immediately upon completion of transmission of the previous word.</p> <p>1h (R/W) = The next word in the TX FIFO buffer is transferred to SPITXBUF1 serial clock cycle after completion of transmission of the previous word.</p> <p>2h (R/W) = The next word in the TX FIFO buffer is transferred to SPITXBUF 2 serial clock cycles after completion of transmission of the previous word.</p> <p>FFh (R/W) = The next word in the TX FIFO buffer is transferred to SPITXBUF 255 serial clock cycles after completion of transmission of the previous word.</p>

**17.5.2.12 SPIPRI Register (Offset = Fh) [reset = 0h]**

SPIPRI is shown in [Figure 17-25](#) and described in [Table 17-21](#).

Return to [Summary Table](#).

SPI Priority Control Register

**Figure 17-25. SPIPRI Register**

15	14	13	12	11	10	9	8
RESERVED							
R-0h							
7	6	5	4	3	2	1	0
RESERVED	RESERVED	SOFT	FREE	RESERVED		STEINV	TRIWIRES
R-0h	R-0h	R/W-0h	R/W-0h	R-0h		R/W-0h	R/W-0h

**Table 17-21. SPIPRI Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-7	RESERVED	R	0h	Reserved
6	RESERVED	R	0h	Reserved
5	SOFT	R/W	0h	Emulation Soft Run This bit only has an effect when the FREE bit is 0. Reset type: SYSRSn 0h (R/W) = Transmission stops after midway in the bit stream while TSUSPEND is asserted. Once TSUSPEND is deasserted without a system reset, the remainder of the bits pending in the DATBUF are shifted. Example: If SPIDAT has shifted 3 out of 8 bits, the communication freezes right there. However, if TSUSPEND is later deasserted without resetting the SPI, SPI starts transmitting from where it had stopped (fourth bit in this case) and will transmit 8 bits from that point. The SCI module operates differently. 1h (R/W) = If the emulation suspend occurs before the start of a transmission, (that is, before the first SPICLK pulse) then the transmission will not occur. If the emulation suspend occurs after the start of a transmission, then the data will be shifted out to completion. When the start of transmission occurs is dependent on the baud rate used. Standard SPI mode: Stop after transmitting the words in the shift register and buffer. That is, after TXBUF and SPIDAT are empty. In FIFO mode: Stop after transmitting the words in the shift register and buffer. That is, after TX FIFO and SPIDAT are empty.
4	FREE	R/W	0h	Emulation Free Run Reset type: SYSRSn 0h (R/W) = Emulation mode is selected by the SOFT bit 1h (R/W) = Free run, continue SPI operation regardless of suspend or when the suspend occurred.
3-2	RESERVED	R	0h	Reserved
1	STEINV	R/W	0h	SPISTEn Inversion Bit On devices with 2 SPI modules, inverting the SPISTE signal on one of the modules allows the device to receive left and right- channel digital audio data. This bit is only applicable to slave mode. Writing to this bit while configured as master (MASTER_SLAVE = 1) has no effect Reset type: SYSRSn 0h (R/W) = SPISTEn is active low (normal) 1h (R/W) = SPISTE is active high (inverted)

**Table 17-21. SPIPRI Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
0	TRIWIRE	R/W	0h	SPI 3-wire Mode Enable Reset type: SYSRSn 0h (R/W) = Normal 4-wire SPI mode. 1h (R/W) = 3-wire SPI mode enabled. The unused pin becomes a GPIO pin. In master mode, the SPISIMO pin becomes the SPIMOMI (master receive and transmit) pin and SPISOMI is free for non-SPI use. In slave mode, the SPISOMI pin becomes the SPISISO (slave receive and transmit) pin and SPISIMO is free for non-SPI use.

## Serial Communications Interface (SCI)

This chapter describes the features and operation of the serial communication interface (SCI) module. SCI is a two-wire asynchronous serial port, commonly known as a UART. The SCI modules support digital communications between the CPU and other asynchronous peripherals that use the standard non-return-to-zero (NRZ) format. The SCI receiver and transmitter each have a 16-level deep FIFO for reducing servicing overhead, and each has its own separate enable and interrupt bits. Both can be operated independently for half-duplex communication, or simultaneously for full-duplex communication.

To specify data integrity, the SCI checks received data for break detection, parity, overrun, and framing errors. The bit rate is programmable to different speeds through a 16-bit baud-select register.

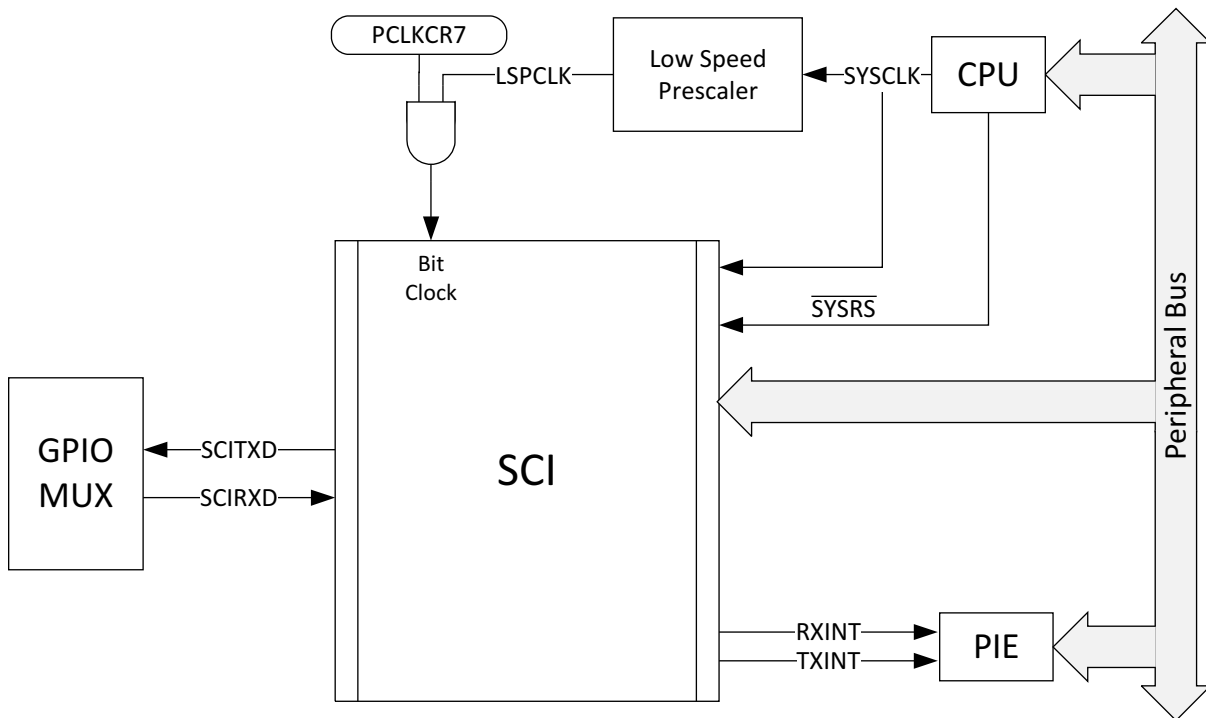
Topic	Page
<b>18.1 Enhanced SCI Module Overview .....</b>	<b>2041</b>
<b>18.2 Architecture .....</b>	<b>2042</b>
<b>18.3 SCI Module Signal Summary .....</b>	<b>2043</b>
<b>18.4 Configuring Device Pins .....</b>	<b>2043</b>
<b>18.5 Multiprocessor and Asynchronous Communication Modes .....</b>	<b>2043</b>
<b>18.6 SCI Programmable Data Format.....</b>	<b>2044</b>
<b>18.7 SCI Multiprocessor Communication .....</b>	<b>2044</b>
<b>18.8 Idle-Line Multiprocessor Mode .....</b>	<b>2045</b>
<b>18.9 Address-Bit Multiprocessor Mode.....</b>	<b>2047</b>
<b>18.10 SCI Communication Format .....</b>	<b>2048</b>
<b>18.11 SCI Port Interrupts .....</b>	<b>2050</b>
<b>18.12 SCI Baud Rate Calculations .....</b>	<b>2050</b>
<b>18.13 SCI Enhanced Features .....</b>	<b>2051</b>
<b>18.14 Registers .....</b>	<b>2054</b>



## 18.1 Enhanced SCI Module Overview

The SCI interfaces are shown in [Figure 18-1](#).

**Figure 18-1. SCI CPU Interface**



Features of the SCI module include:

- Two external pins:
  - SCITXD: SCI transmit-output pin
  - SCIRXD: SCI receive-input pin
 Both pins can be used as GPIO if not used for SCI.
- Baud rate programmable to 64K different rates
- Data-word format
  - One start bit
  - Data-word length programmable from one to eight bits
  - Optional even/odd/no parity bit
  - One or two stop bits
- Four error-detection flags: parity, overrun, framing, and break detection
- Two wake-up multiprocessor modes: idle-line and address bit
- Half- or full-duplex operation
- Double-buffered receive and transmit functions
- Transmitter and receiver operations can be accomplished through interrupt- driven or polled algorithms with status flags.
- Separate enable bits for transmitter and receiver interrupts (except BRKDT)
- NRZ (non-return-to-zero) format
- 13 SCI module control registers located in the control register frame beginning at address 7050h

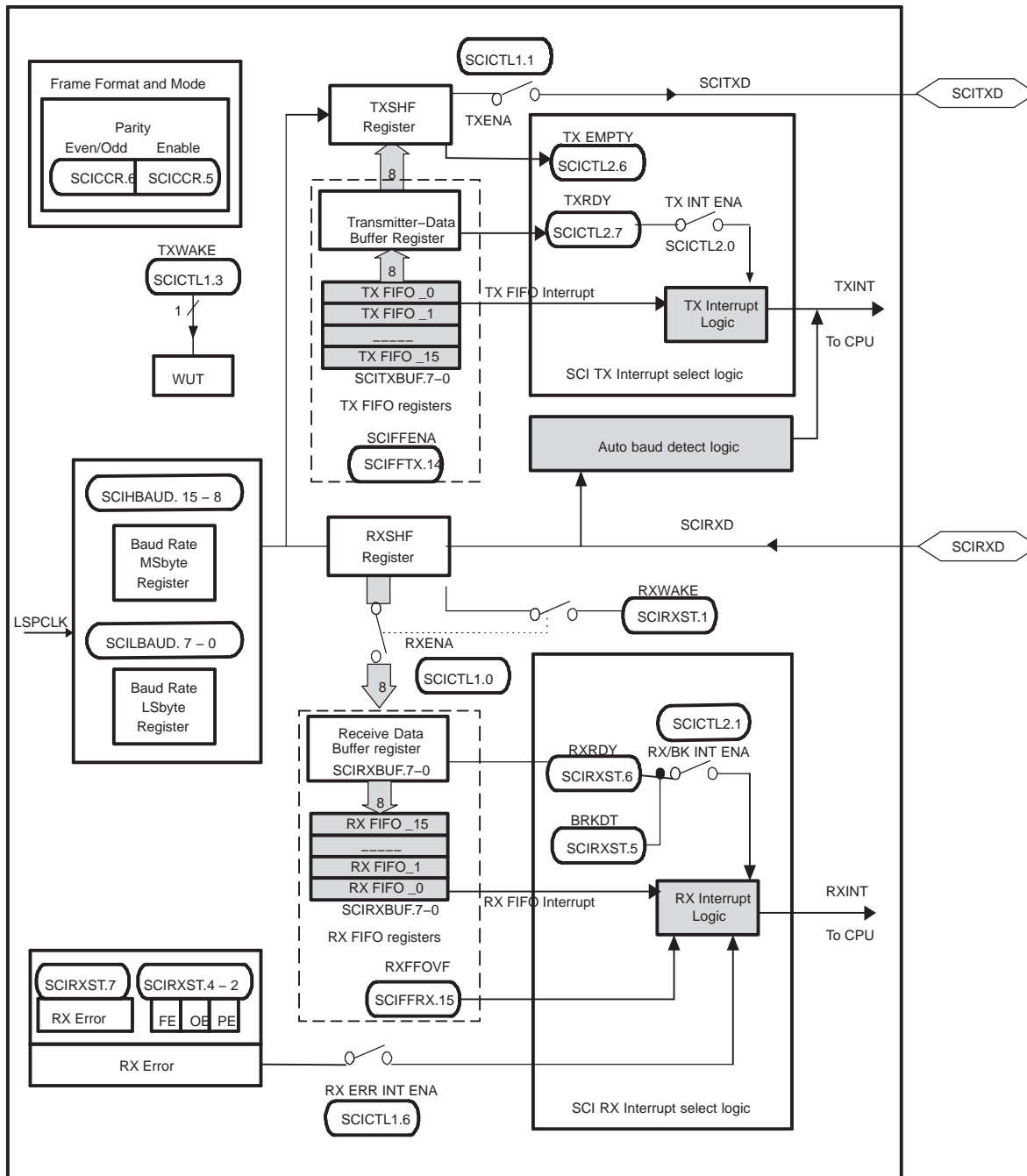
All registers in this module are 8-bit registers that are connected to Peripheral Frame 2. When a register is accessed, the register data is in the lower byte (7–0), and the upper byte (15–8) is read as zeros. Writing to the upper byte has no effect.

**Enhanced features:**

- Auto-baud-detect hardware logic
- 16-level transmit/receive FIFO

Figure 18-2 shows the SCI module block diagram. The SCI port operation is configured and controlled by the registers listed in Section 18.14 of this chapter.

**Figure 18-2. Serial Communications Interface (SCI) Module Block Diagram**



**18.2 Architecture**

The major elements used in full-duplex operation are shown in Figure 18-2 and include:

- A transmitter (TX) and its major registers (upper half of Figure 18-2)

- SCITXBUF — transmitter data buffer register. Contains data (loaded by the CPU) to be transmitted
- TXSHF register — transmitter shift register. Accepts data from register SCITXBUF and shifts data onto the SCITXD pin, one bit at a time
- A receiver (RX) and its major registers (lower half of [Figure 18-2](#))
  - RXSHF register — receiver shift register. Shifts data in from SCIRXD pin, one bit at a time
  - SCIRXBUF — receiver data buffer register. Contains data to be read by the CPU. Data from a remote processor is loaded into register RXSHF and then into registers SCIRXBUF and SCIRXEMU
- A programmable baud generator
- Data-memory-mapped control and status registers

The SCI receiver and transmitter can operate either independently or simultaneously.

### 18.3 SCI Module Signal Summary

**Table 18-1. SCI Module Signal Summary**

Signal Name	Description
<b>External signals</b>	
SCIRXD	SCI Asynchronous Serial Port receive data
SCITXD	SCI Asynchronous Serial Port transmit data
<b>Control</b>	
Baud clock	LSPCLK Prescaled clock
<b>Interrupt signals</b>	
TXINT	Transmit interrupt
RXINT	Receive Interrupt

### 18.4 Configuring Device Pins

The GPIO mux registers must be configured to connect this peripheral to the device pins. To avoid glitches on the pins, the GPyGMUX bits must be configured first (while keeping the corresponding GPyMUX bits at the default of zero), followed by writing the GPyMUX register to the desired value.

Some IO functionality is defined by GPIO register settings independent of this peripheral. For input signals, the GPIO input qualification should be set to asynchronous mode by setting the appropriate GPxQSELn register bits to 11b. The internal pullups can be configured in the GPyPUD register.

See the *GPIO* chapter for more details on GPIO mux and settings.

### 18.5 Multiprocessor and Asynchronous Communication Modes

The SCI has two multiprocessor protocols, the idle-line multiprocessor mode (see [Section 18.8](#)) and the address-bit multiprocessor mode (see [Section 18.9](#)). These protocols allow efficient data transfer between multiple processors.

The SCI offers the universal asynchronous receiver/transmitter (UART) communications mode for interfacing with many popular peripherals. The asynchronous mode (see [Section 18.10](#)) requires two lines to interface with many standard devices such as terminals and printers that use RS-232-C formats. Data transmission characteristics include:

- One start bit
- One to eight data bits
- An even/odd parity bit or no parity bit
- One or two stop bits

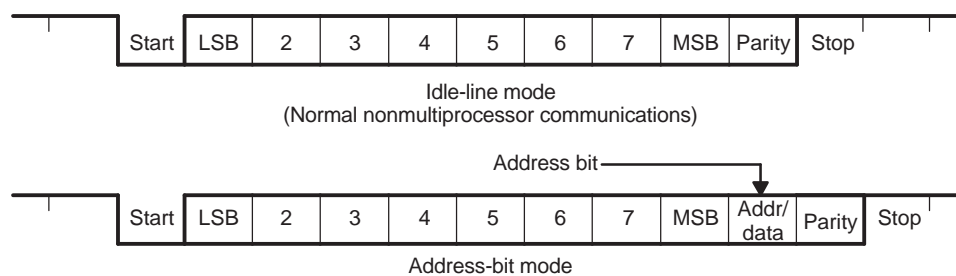
## 18.6 SCI Programmable Data Format

SCI data, both receive and transmit, is in NRZ (non-return-to-zero) format. The NRZ data format, shown in Figure 18-3, consists of:

- One start bit
- One to eight data bits
- An even/odd parity bit (optional)
- One or two stop bits
- An extra bit to distinguish addresses from data (address-bit mode only)

The basic unit of data is called a character and is one to eight bits in length. Each character of data is formatted with a start bit, one or two stop bits, and optional parity and address bits. A character of data with its formatting information is called a frame and is shown in Figure 18-3.

**Figure 18-3. Typical SCI Data Frame Formats**



To program the data format, use the SCICCR register. The bits used to program the data format are shown in Table 18-2.

**Table 18-2. Programming the Data Format Using SCICCR**

Bit(s)	Bit Name	Designation	Functions
2-0	SCI CHAR2-0	SCICCR.2:0	Select the character (data) length (one to eight bits).
5	PARITY ENABLE	SCICCR.5	Enables the parity function if set to 1, or disables the parity function if cleared to 0.
6	EVEN/ODD PARITY	SCICCR.6	If parity is enabled, selects odd parity if cleared to 0 or even parity if set to 1.
7	STOP BITS	SCICCR.7	Determines the number of stop bits transmitted—one stop bit if cleared to 0 or two stop bits if set to 1.

## 18.7 SCI Multiprocessor Communication

The multiprocessor communication format allows one processor to efficiently send blocks of data to other processors on the same serial link. On one serial line, there should be only one transfer at a time. In other words, there can be only one talker on a serial line at a time.

### Address Byte

The first byte of a block of information that the talker sends contains an address byte that is read by all listeners. Only listeners with the correct address can be interrupted by the data bytes that follow the address byte. The listeners with an incorrect address remain uninterrupted until the next address byte.

### Sleep Bit

All processors on the serial link set the SCI SLEEP bit (bit 2 of SCICTL1) to 1 so that they are interrupted only when the address byte is detected. When a processor reads a block address that corresponds to the CPU device address as set by your application software, your program must clear the SLEEP bit to enable the SCI to generate an interrupt on receipt of each data byte.

Although the receiver still operates when the SLEEP bit is 1, it does not set RXRDY, RXINT, or any of the receiver error status bits to 1 unless the address byte is detected and the address bit in the received frame is a 1 (applicable to address-bit mode). The SCI does not alter the SLEEP bit; your software must alter the SLEEP bit.

### 18.7.1 Recognizing the Address Byte

A processor recognizes an address byte differently, depending on the multiprocessor mode used. For example:

- The idle-line mode ([Section 18.8](#)) leaves a quiet space before the address byte. This mode does not have an extra address/data bit and is more efficient than the address-bit mode for handling blocks that contain more than ten bytes of data. The idle-line mode should be used for typical non-multiprocessor SCI communication.
- The address-bit mode ([Section 18.9](#)) adds an extra bit (that is, an address bit) into every byte to distinguish addresses from data. This mode is more efficient in handling many small blocks of data because, unlike the idle mode, it does not have to wait between blocks of data. However, at a high transmit speed, the program is not fast enough to avoid a 10-bit idle in the transmission stream.

### 18.7.2 Controlling the SCI TX and RX Features

The multiprocessor mode is software selectable via the ADDR/IDLE MODE bit (SCICCR, bit 3). Both modes use the TXWAKE flag bit (SCICTL1, bit 3), RXWAKE flag bit (SCIRXST, bit1), and the SLEEP flag bit (SCICTL1, bit 2) to control the SCI transmitter and receiver features of these modes.

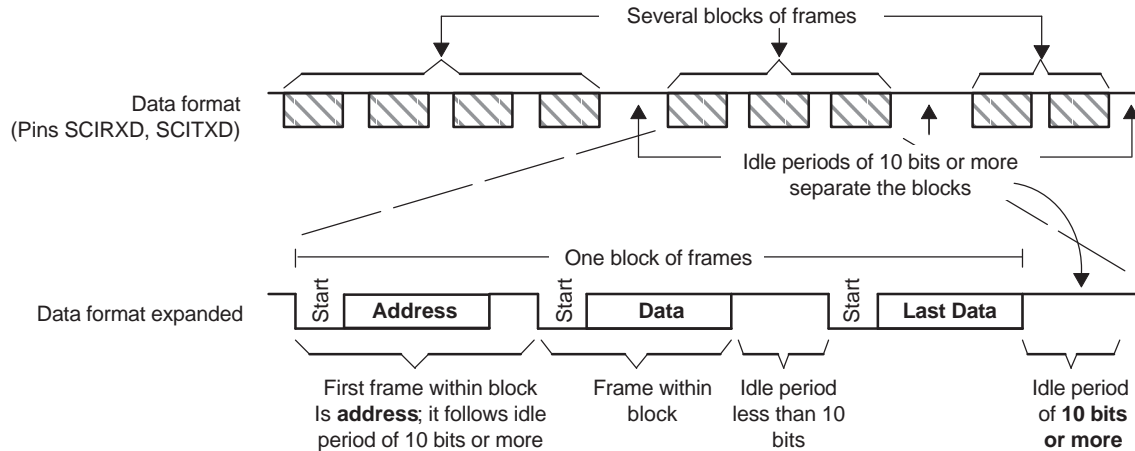
### 18.7.3 Receipt Sequence

In both multiprocessor modes, the receive sequence is as follows:

1. At the receipt of an address block, the SCI port wakes up and requests an interrupt (bit number 1 RX/BK INT ENA-of SCICTL2 must be enabled to request an interrupt). It reads the first frame of the block, which contains the destination address.
2. A software routine is entered through the interrupt and checks the incoming address. This address byte is checked against its device address byte stored in memory.
3. If the check shows that the block is addressed to the device CPU, the CPU clears the SLEEP bit and reads the rest of the block. If not, the software routine exits with the SLEEP bit still set, and does not receive interrupts until the next block start.

## 18.8 Idle-Line Multiprocessor Mode

In the idle-line multiprocessor protocol (ADDR/IDLE MODE bit=0), blocks are separated by having a longer idle time between the blocks than between frames in the blocks. An idle time of ten or more high-level bits after a frame indicates the start of a new block. The time of a single bit is calculated directly from the baud value (bits per second). The idle-line multiprocessor communication format is shown in [Figure 18-4](#) (ADDR/IDLE MODE bit is bit 3 of SCICCR).

**Figure 18-4. Idle-Line Multiprocessor Communication Format**


### 18.8.1 Idle-Line Mode Steps

The steps followed by the idle-line mode:

- Step 1. SCI wakes up after receipt of the block-start signal.
- Step 2. The processor recognizes the next SCI interrupt.
- Step 3. The interrupt service routine compares the received address (sent by a remote transmitter) to its own.
- Step 4. If the CPU is being addressed, the service routine clears the SLEEP bit and receives the rest of the data block.
- Step 5. If the CPU is not being addressed, the SLEEP bit remains set. This lets the CPU continue to execute its main program without being interrupted by the SCI port until the next detection of a block start.

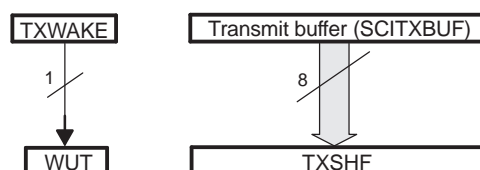
### 18.8.2 Block Start Signal

There are two ways to send a block-start signal:

1. **Method 1:** Deliberately leave an idle time of ten bits or more by delaying the time between the transmission of the last frame of data in the previous block and the transmission of the address frame of the new block.
2. **Method 2:** The SCI port first sets the TXWAKE bit (SCICTL1, bit 3) to 1 before writing to the SCITXBUF register. This sends an idle time of exactly 11 bits. In this method, the serial communications line is not idle any longer than necessary. (A don't care byte has to be written to SCITXBUF after setting TXWAKE, and before sending the address, so as to transmit the idle time.)

### 18.8.3 Wake-UP Temporary (WUT) Flag

Associated with the TXWAKE bit is the wake-up temporary (WUT) flag. WUT is an internal flag, double-buffered with TXWAKE. When TXSHF is loaded from SCITXBUF, WUT is loaded from TXWAKE, and the TXWAKE bit is cleared to 0. This arrangement is shown in [Figure 18-5](#).

**Figure 18-5. Double-Buffered WUT and TXSHF**


### Sending a Block Start Signal

To send out a block-start signal of exactly one frame time during a sequence of block transmissions:

1. Write a 1 to the TXWAKE bit.
2. Write a data word (content not important: a don't care) to the SCITXBUF register (transmit data buffer) to send a block-start signal. (The first data word written is suppressed while the block-start signal is sent out and ignored after that.) When the TXSHF (transmit shift register) is free again, SCITXBUF contents are shifted to TXSHF, the TXWAKE value is shifted to WUT, and then TXWAKE is cleared. Because TXWAKE was set to a 1, the start, data, and parity bits are replaced by an idle period of 11 bits transmitted following the last stop bit of the previous frame.
3. **Write a new address value to SCITXBUF**  
A don't-care data word must first be written to register SCITXBUF so that the TXWAKE bit value can be shifted to WUT. After the don't-care data word is shifted to the TXSHF register, the SCITXBUF (and TXWAKE if necessary) can be written to again because TXSHF and WUT are both double-buffered.

### 18.8.4 Receiver Operation

The receiver operates regardless of the SLEEP bit. However, the receiver neither sets RXRDY nor the error status bits, nor does it request a receive interrupt until an address frame is detected.

## 18.9 Address-Bit Multiprocessor Mode

In the address-bit protocol (ADDR/IDLE MODE bit=1), frames have an extra bit called an address bit that immediately follows the last data bit. The address bit is set to 1 in the first frame of the block and to 0 in all other frames. The idle period timing is irrelevant (see [Figure 18-6](#)).

### 18.9.1 Sending an Address

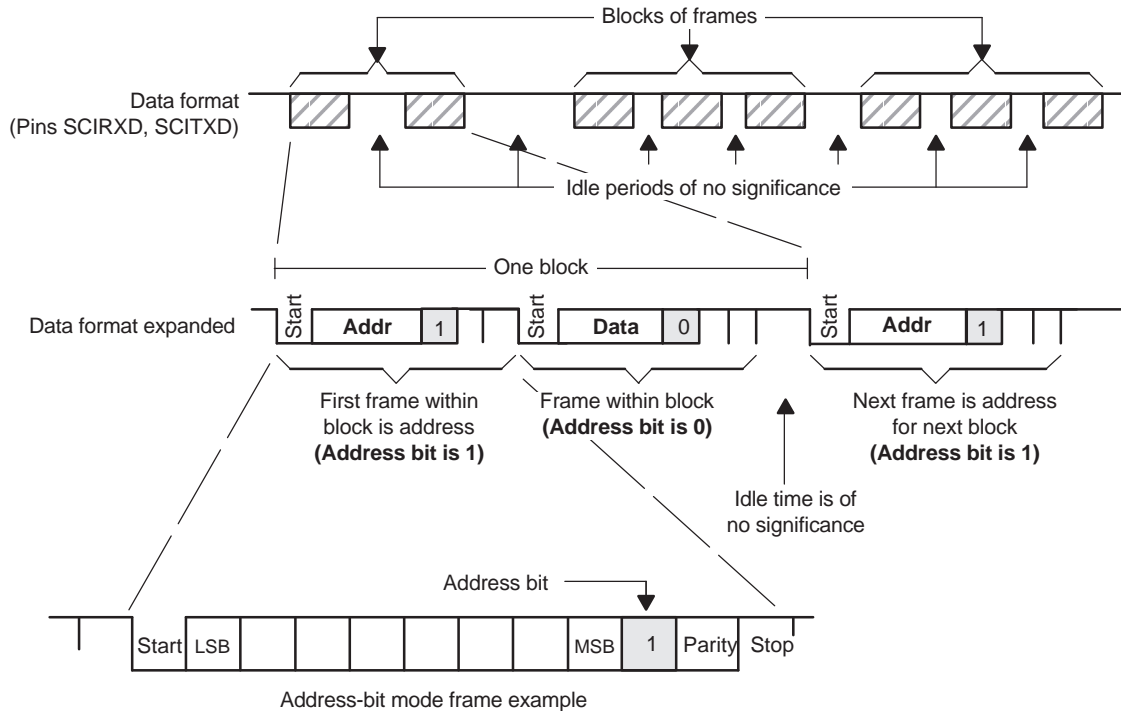
The TXWAKE bit value is placed in the address bit. During transmission, when the SCITXBUF register and TXWAKE are loaded into the TXSHF register and WUT respectively, TXWAKE is reset to 0 and WUT becomes the value of the address bit of the current frame. Thus, to send an address:

1. Set the TXWAKE bit to 1 and write the appropriate address value to the SCITXBUF register.  
When this address value is transferred to the TXSHF register and shifted out, its address bit is sent as a 1. This flags the other processors on the serial link to read the address.
2. Write to SCITXBUF and TXWAKE after TXSHF and WUT are loaded. (Can be written to immediately since both TXSHF and WUT are both double-buffered.)
3. Leave the TXWAKE bit set to 0 to transmit non-address frames in the block.

---

**NOTE:** As a general rule, the address-bit format is typically used for data frames of 11 bytes or less. This format adds one bit value (1 for an address frame, 0 for a data frame) to all data bytes transmitted. The idle-line format is typically used for data frames of 12 bytes or more.

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**Figure 18-6. Address-Bit Multiprocessor Communication Format**


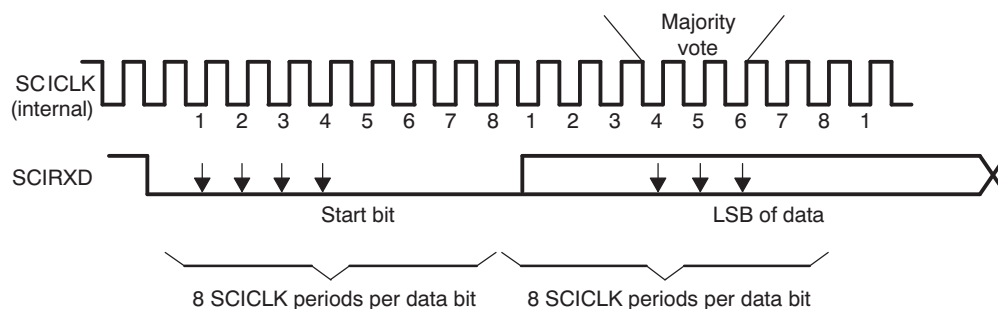
## 18.10 SCI Communication Format

The SCI asynchronous communication format uses either single line (one way) or two line (two way) communications. In this mode, the frame consists of a start bit, one to eight data bits, an optional even/odd parity bit, and one or two stop bits (shown in [Figure 18-7](#)). There are eight SCICLK periods per data bit.

The receiver begins operation on receipt of a valid start bit. A valid start bit is identified by four consecutive internal SCICLK periods of zero bits as shown in [Figure 18-7](#). If any bit is not zero, then the processor starts over and begins looking for another start bit.

For the bits following the start bit, the processor determines the bit value by making three samples in the middle of the bits. These samples occur on the fourth, fifth, and sixth SCICLK periods, and bit-value determination is on a majority (two out of three) basis. [Figure 18-7](#) illustrates the asynchronous communication format for this with a start bit showing where a majority vote is taken.

Since the receiver synchronizes itself to frames, the external transmitting and receiving devices do not have to use a synchronized serial clock. The clock can be generated locally.

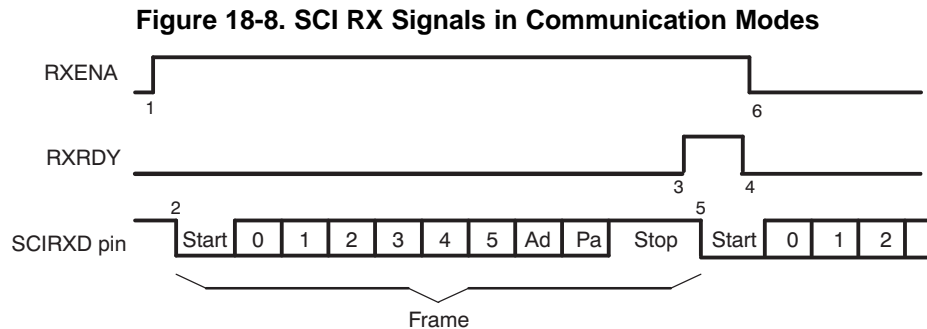
**Figure 18-7. SCI Asynchronous Communications Format**




### 18.10.1 Receiver Signals in Communication Modes

Figure 18-8 illustrates an example of receiver signal timing that assumes the following conditions:

- Address-bit wake-up mode (address bit does not appear in idle-line mode)
- Six bits per character



- (1) Data arrives on the SCIRXD pin, start bit detected.
- (2) Bit RXENA is brought low to disable the receiver. Data continues to be assembled in RXSHF but is not transferred to the receiver buffer register.

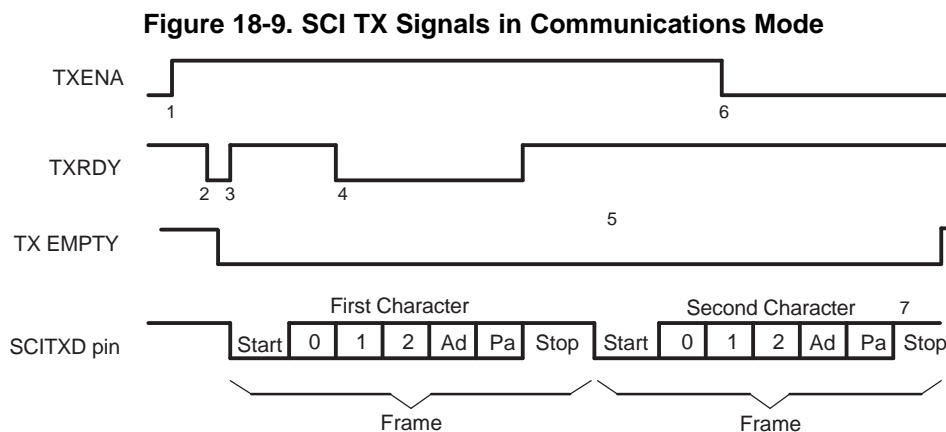
**Notes:**

1. Flag bit RXENA (SCICTL1, bit 0) goes high to enable the receiver.
2. Data arrives on the SCIRXD pin, start bit detected.
3. Data is shifted from RXSHF to the receiver buffer register (SCIRXBUF); an interrupt is requested. Flag bit RXRDY (SCIRXST, bit 6) goes high to signal that a new character has been received.
4. The program reads SCIRXBUF; flag RXRDY is automatically cleared.
5. The next byte of data arrives on the SCIRXD pin; the start bit is detected, then cleared.
6. Bit RXENA is brought low to disable the receiver. Data continues to be assembled in RXSHF but is not transferred to the receiver buffer register.

### 18.10.2 Transmitter Signals in Communication Modes

Figure 18-9 illustrates an example of transmitter signal timing that assumes the following conditions:

- Address-bit wake-up mode (address bit does not appear in idle-line mode)
- Three bits per character



**Notes:**

1. Bit TXENA (SCICTL1, bit 1) goes high, enabling the transmitter to send data.
2. SCITXBUF is written to; thus, (1) the transmitter is no longer empty, and (2) TXRDY goes low.
3. The SCI transfers data to the shift register (TXSHF). The transmitter is ready for a second character

(TXRDY goes high), and it requests an interrupt (to enable an interrupt, bit TX INT ENA — SCICTL2, bit 0 — must be set).

4. The program writes a second character to SCITXBUF after TXRDY goes high (item 3). (TXRDY goes low again after the second character is written to SCITXBUF.)
5. Transmission of the first character is complete. Transfer of the second character to shift register TXSHF begins.
6. Bit TXENA goes low to disable the transmitter; the SCI finishes transmitting the current character.
7. Transmission of the second character is complete; transmitter is empty and ready for new character.

## 18.11 SCI Port Interrupts

The SCI receiver and transmitter can be interrupt controlled. The SCICTL2 register has one flag bit (TXRDY) that indicates active interrupt conditions, and the SCIRXST register has two interrupt flag bits (RXRDY and BRKDT), plus the RX ERROR interrupt flag which is a logical OR of the FE, OE, BRKDT, and PE conditions. The transmitter and receiver have separate interrupt-enable bits. When not enabled, the interrupts are not asserted; however, the condition flags remain active, reflecting transmission and receipt status.

The SCI has independent peripheral interrupt vectors for the receiver and transmitter. Peripheral interrupt requests can be either high priority or low priority. This is indicated by the priority bits which are output from the peripheral to the PIE controller. When both RX and TX interrupt requests are made at the same priority level, the receiver always has higher priority than the transmitter, reducing the possibility of receiver overrun.

The operation of peripheral interrupts is described in the peripheral interrupt expansion controller section of the *External Peripheral Interface (ePIE)* chapter.

- If the RX/BK INT ENA bit (SCICTL2, bit 1) is set, the receiver peripheral interrupt request is asserted when one of the following events occurs:
  - The SCI receives a complete frame and transfers the data in the RXSHF register to the SCIRXBUF register. This action sets the RXRDY flag (SCIRXST, bit 6) and initiates an interrupt.
  - A break detect condition occurs (the SCIRXD is low for ten bit periods following a missing stop bit). This action sets the BRKDT flag bit (SCIRXST, bit 5) and initiates an interrupt.
- If the TX INT ENA bit (SCICTL2.0) is set, the transmitter peripheral interrupt request is asserted whenever the data in the SCITXBUF register is transferred to the TXSHF register, indicating that the CPU can write to SCITXBUF; this action sets the TXRDY flag bit (SCICTL2, bit 7) and initiates an interrupt.

---

**NOTE:** Interrupt generation due to the RXRDY and BRKDT bits is controlled by the RX/BK INT ENA bit (SCICTL2, bit 1). Interrupt generation due to the RX ERROR bit is controlled by the RX ERR INT ENA bit (SCICTL1, bit 6).

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## 18.12 SCI Baud Rate Calculations

The internally generated serial clock is determined by the low-speed peripheral clock (LSPCLK) and the baud-select registers. The SCI uses the 16-bit value of the baud-select registers to select one of the 64K different serial clock rates possible for a given LSPCLK.

See the SCIHBAUD register for the formula to use when calculating the SCI asynchronous baud rate. [Table 18-3](#) shows the baud-select values for common SCI bit rates.

**Table 18-3. Asynchronous Baud Register Values for Common SCI Bit Rates**

LSPCLK (MHz)	Ideal Baud	BRR	Actual Baud	% Error
50	2400	2603 (A2Bh)	2400.15	0.01
50	4800	1301(515h)	4800.31	0.01
50	9600	650 (28Ah)	9600.61	0.01
50	19200	325 (145h)	19171.78	-0.15

**Table 18-3. Asynchronous Baud Register Values for Common SCI Bit Rates (continued)**

LSPCLK (MHz)	Ideal Baud	BRR	Actual Baud	% Error
50	38400	162 (A2h)	38343.56	-0.15

LSPCLK/16 is the maximum baud rate. For example, if LSPCLK is 120MHz, then the maximum baud rate is 7.5Mbps.

## 18.13 SCI Enhanced Features

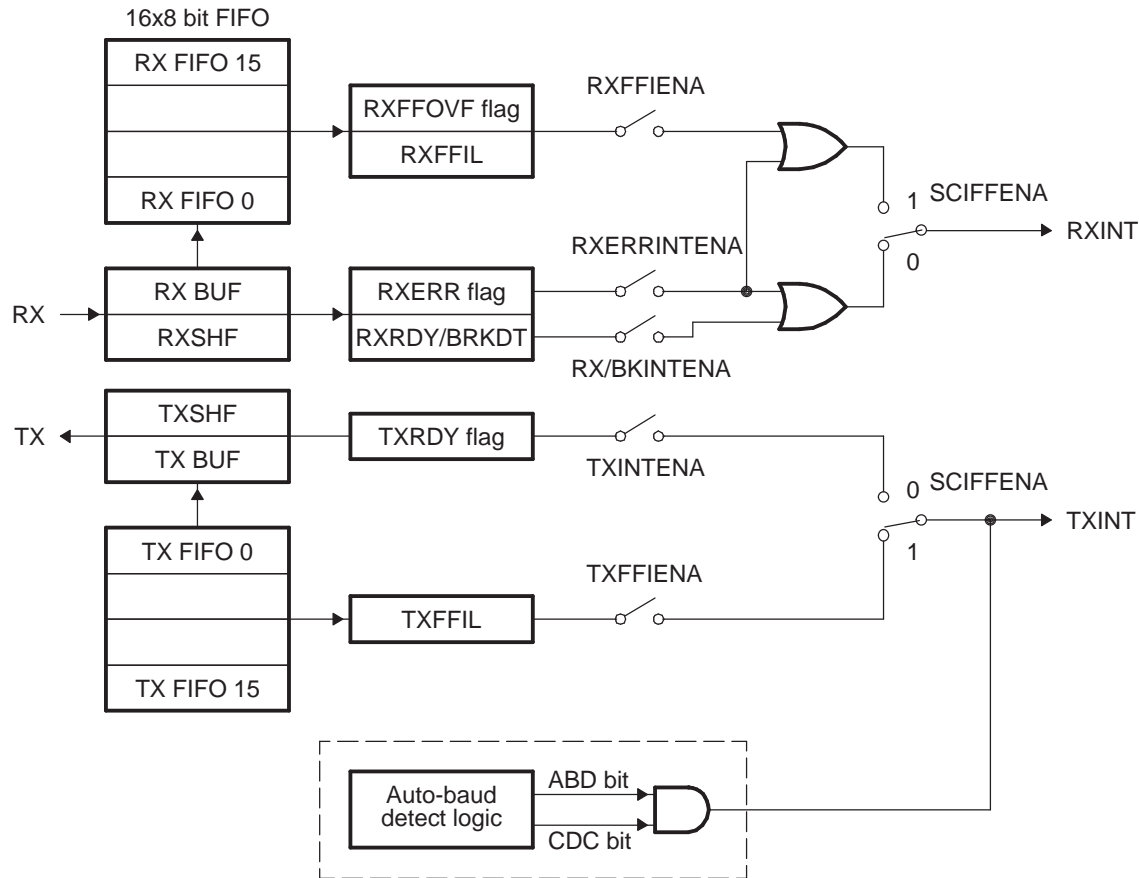
The 28x SCI features autobaud detection and transmit/receive FIFO. The following section explains the FIFO operation.

### 18.13.1 SCI FIFO Description

The following steps explain the FIFO features and help with programming the SCI with FIFOs.

1. *Reset.* At reset the SCI powers up in standard SCI mode and the FIFO function is disabled. The FIFO registers SCIFFTX, SCIFFRX, and SCIFFCT remain inactive.
2. *Standard SCI.* The SCI uses the TXINT/RXINT interrupts as the interrupt source for the module.
3. *FIFO enable.* FIFO mode is enabled by setting the SCIFFEN bit in the SCIFFTX register. SCIRST can reset the FIFO mode at any stage of its operation.
4. *Active registers.* All the SCI registers and SCI FIFO registers (SCIFFTX, SCIFFRX, and SCIFFCT) are active.
5. *Interrupts.* FIFO mode has two interrupts; one for transmit FIFO, TXINT and one for receive FIFO, RXINT. RXINT is the common interrupt for SCI FIFO receive, receive error, and receive FIFO overflow conditions. The TXINT of the standard SCI will be disabled and this interrupt will service as SCI transmit FIFO interrupt.
6. *Buffers.* Transmit and receive buffers are supplemented with two 16-level FIFOs. The transmit FIFO registers are 8 bits wide and receive FIFO registers are 10 bits wide. The one-word transmit buffer of the standard SCI functions as a transition buffer between the transmit FIFO and shift register. The one-word transmit buffer is loaded from the transmit FIFO only after the last bit of the shift register is shifted out. With the FIFO enabled, TXSHF is directly loaded after an optional delay value (SCIFFCT), TXBUF is not used. When FIFO mode is enabled for SCI, characters written to SCITXBUF are queued in to SCI-TXFIFO and the characters received in SCI-RXFIFO can be read using SCIRXBUF.
7. *Delayed transfer.* The rate at which words in the FIFO are transferred to the transmit shift register is programmable. The SCIFFCT register bits (7–0) FFXDLY7–FFXDLY0 define the delay between the word transfer. The delay is defined in the number SCI baud clock cycles. The 8 bit register can define a minimum delay of 0 baud clock cycles and a maximum of 256-baud clock cycles. With zero delay, the SCI module can transmit data in continuous mode with the FIFO words shifting out back to back. With the 256 clock delay the SCI module can transmit data in a maximum delayed mode with the FIFO words shifting out with a delay of 256 baud clocks between each words. The programmable delay facilitates communication with slow SCI/UARTs with little CPU intervention.
8. *FIFO status bits.* Both the transmit and receive FIFOs have status bits TXFFST or RXFFST (bits 12–8) that define the number of words available in the FIFOs at any time. The transmit FIFO reset bit TXFIFO and receive reset bit RXFIFO reset the FIFO pointers to zero when these bits are cleared to 0. The FIFOs resumes operation from start once these bits are set to one.
9. *Programmable interrupt levels.* Both transmit and receive FIFO can generate CPU interrupts. The interrupt trigger is generated whenever the transmit FIFO status bits TXFFST (bits 12–8) match (less than or equal to) the interrupt trigger level bits TXFFIL (bits 4–0 ). This provides a programmable interrupt trigger for transmit and receive sections of the SCI. Default value for these trigger level bits will be 0x11111 for receive FIFO and 0x00000 for transmit FIFO, respectively.

Figure 18-10 and Table 18-4 explain the operation/configuration of SCI interrupts in nonFIFO/FFO mode.

**Figure 18-10. SCI FIFO Interrupt Flags and Enable Logic**

**Table 18-4. SCI Interrupt Flags**

FIFO Options <sup>(1)</sup>	SCI Interrupt Source	Interrupt Flags	Interrupt Enables	FIFO Enable SCIFFENA	Interrupt Line
SCI without FIFO	Receive error	RXERR <sup>(2)</sup>	RXERRINTENA	0	RXINT
	Receive break	BRKDT	RX/BKINTENA	0	RXINT
	Data receive	RXRDY	RX/BKINTENA	0	RXINT
	Transmit empty	TXRDY	TXINTENA	0	TXINT
SCI with FIFO	Receive error and receive break	RXERR	RXERRINTENA	1	RXINT
	FIFO receive	RXFFIL	RXFFIENA	1	RXINT
	Transmit empty	TXFFIL	TXFFIENA	1	TXINT
Auto-baud	Auto-baud detected	ABD	Don't care	x	TXINT

<sup>(1)</sup> FIFO mode TXSHF is directly loaded after delay value, TXBUF is not used.

<sup>(2)</sup> RXERR can be set by BRKDT, FE, OE, PE flags. In FIFO mode, BRKDT interrupt is only through RXERR flag

### 18.13.2 SCI Auto-Baud

Most SCI modules do not have an auto-baud detect logic built-in hardware. These SCI modules are integrated with embedded controllers whose clock rates are dependent on PLL reset values. Often embedded controller clocks change after final design. In the enhanced feature set this module supports an autobaud-detect logic in hardware. The following section explains the enabling sequence for autobaud-detect feature.

### 18.13.3 Autobaud-Detect Sequence

Bits ABD and CDC in SCIFFCT control the autobaud logic. The SCIRST bit should be enabled to make autobaud logic work.

If ABD is set while CDC is 1, which indicates auto-baud alignment, SCI transmit FIFO interrupt will occur (TXINT). After the interrupt service CDC bit has to be cleared by software. If CDC remains set even after interrupt service, there should be no repeat interrupts.

1. Enable autobaud-detect mode for the SCI by setting the CDC bit (bit 13) in SCIFFCT and clearing the ABD bit (Bit 15) by writing a 1 to ABDCLR bit (bit 14).
2. Initialize the baud register to be 1 or less than a baud rate limit of 500 Kbps.
3. Allow SCI to receive either character "A" or "a" from a host at the desired baud rate. If the first character is either "A" or "a", the autobaud- detect hardware will detect the incoming baud rate and set the ABD bit.
4. The auto-detect hardware will update the baud rate register with the equivalent baud value hex. The logic will also generate an interrupt to the CPU.
5. Respond to the interrupt clear ADB bit by writing a 1 to ABD CLR (bit 14) of SCIFFCT register and disable further autobaud locking by clearing CDC bit by writing a 0.
6. Read the receive buffer for character "A" or "a" to empty the buffer and buffer status.
7. If ABD is set while CDC is 1, which indicates autobaud alignment, the SCI transmit FIFO interrupt will occur (TXINT). After the interrupt service CDC bit must be cleared by software.

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**NOTE:** At higher baud rates, the slew rate of the incoming data bits can be affected by transceiver and connector performance. While normal serial communications may work well, this slew rate may limit reliable autobaud detection at higher baud rates (typically beyond 100k baud) and cause the auto-baudlock feature to fail.

To avoid this, the following is recommended:

- Achieve a baud-lock between the host and 28x SCI boot loader using a lower baud rate.
  - The host may then handshake with the loaded 28x application to set the SCI baud rate register to the desired higher baud rate.
-

## 18.14 Registers

### 18.14.1 SCI Base Addresses

**Table 18-5. SCI Base Address Table**

Device Registers	Register Name	Start Address	End Address
SciaRegs	SCI_REGS	0x0000_7200	0x0000_720F
ScibRegs	SCI_REGS	0x0000_7210	0x0000_721F
ScicRegs	SCI_REGS	0x0000_7220	0x0000_722F
ScidRegs	SCI_REGS	0x0000_7230	0x0000_723F

### 18.14.2 SCI\_REGS Registers

Table 18-6 lists the memory-mapped registers for the SCI\_REGS. All register offset addresses not listed in Table 18-6 should be considered as reserved locations and the register contents should not be modified.

**Table 18-6. SCI\_REGS Registers**

Offset	Acronym	Register Name	Write Protection	Section
0h	SCICCR	Communications control register		<a href="#">Go</a>
1h	SCICTL1	Control register 1		<a href="#">Go</a>
2h	SCIHBAUD	Baud rate (high) register		<a href="#">Go</a>
3h	SCILBAUD	Baud rate (low) register		<a href="#">Go</a>
4h	SCICTL2	Control register 2		<a href="#">Go</a>
5h	SCIRXST	Receive status register		<a href="#">Go</a>
6h	SCIRXEMU	Receive emulation buffer register		<a href="#">Go</a>
7h	SCIRXBUF	Receive data buffer		<a href="#">Go</a>
9h	SCITXBUF	Transmit data buffer		<a href="#">Go</a>
Ah	SCIFFTX	FIFO transmit register		<a href="#">Go</a>
Bh	SCIFFRX	FIFO receive register		<a href="#">Go</a>
Ch	SCIFFCT	FIFO control register		<a href="#">Go</a>
Fh	SCIPRI	SCI Priority control		<a href="#">Go</a>

Complex bit access types are encoded to fit into small table cells. Table 18-7 shows the codes that are used for access types in this section.

**Table 18-7. SCI\_REGS Access Type Codes**

Access Type	Code	Description
<b>Read Type</b>		
R	R	Read
R=0	R	Read
<b>Write Type</b>		
W	W	Write
W=1	W	Write
<b>Reset or Default Value</b>		
-n		Value after reset or the default value
<b>Register Array Variables</b>		
i,j,k,l,m,n		When these variables are used in a register name, an offset, or an address, they refer to the value of a register array where the register is part of a group of repeating registers. The register groups form a hierarchical structure and the array is represented with a formula.
y		When this variable is used in a register name, an offset, or an address it refers to the value of a register array.

**18.14.2.1 SCICCR Register (Offset = 0h) [reset = 0h]**

SCICCR is shown in [Figure 18-11](#) and described in [Table 18-8](#).

Return to [Summary Table](#).

Communications control register

**Figure 18-11. SCICCR Register**

15	14	13	12	11	10	9	8
RESERVED							
R-0h							
7	6	5	4	3	2	1	0
STOPBITS	PARITY	PARITYENA	LOOPBKENA	ADDRIDLE_M ODE	SCICHAR		
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h		

**Table 18-8. SCICCR Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-8	RESERVED	R	0h	Reserved
7	STOPBITS	R/W	0h	SCI number of stop bits. This bit specifies the number of stop bits transmitted. The receiver checks for only one stop bit. Reset type: SYSRSn 0h (R/W) = One stop bit 1h (R/W) = Two stop bits
6	PARITY	R/W	0h	SCI parity odd/even selection. If the PARITY ENABLE bit (SCICCR, bit 5) is set, PARITY (bit 6) designates odd or even parity (odd or even number of bits with the value of 1 in both transmitted and received characters). Reset type: SYSRSn 0h (R/W) = Odd parity 1h (R/W) = Even parity
5	PARITYENA	R/W	0h	SCI parity enable. This bit enables or disables the parity function. If the SCI is in the addressbit multiprocessor mode (set using bit 3 of this register), the address bit is included in the parity calculation (if parity is enabled). For characters of less than eight bits, the remaining unused bits should be masked out of the parity calculation. Reset type: SYSRSn 0h (R/W) = Parity disabled no parity bit is generated during transmission or is expected during reception 1h (R/W) = Parity is enabled
4	LOOPBKENA	R/W	0h	Loop Back test mode enable. This bit enables the Loop Back test mode where the Tx pin is internally connected to the Rx pin. Reset type: SYSRSn 0h (R/W) = Loop Back test mode disabled 1h (R/W) = Loop Back test mode enabled



**Table 18-8. SCICCR Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
3	ADDRIDLE_MODE	R/W	0h	<p>SCI multiprocessor mode control bit.</p> <p>This bit selects one of the multiprocessor protocols. Multiprocessor communication is different from the other communication modes because it uses SLEEP and TXWAKE functions (bits SCICTL1, bit 2 and SCICTL1, bit 3, respectively). The idle-line mode is usually used for normal communications because the address-bit mode adds an extra bit to the frame. The idle-line mode does not add this extra bit and is compatible with RS-232 type communications.</p> <p>Reset type: SYSRSn            0h (R/W) = Idle-line mode protocol selected            1h (R/W) = Address-bit mode protocol selected</p>
2-0	SCICHAR	R/W	0h	<p>Character-length control bits 2-0.</p> <p>These bits select the SCI character length from one to eight bits. Characters of less than eight bits are right-justified in SCIRXBUF and SCIRXEMU and are padded with leading zeros in SCIRXBUF. SCITXBUF doesn't need to be padded with leading zeros.</p> <p>Reset type: SYSRSn            0h (R/W) = SCICHAR_LEGNTN_1            1h (R/W) = SCICHAR_LEGNTN_2            2h (R/W) = SCICHAR_LEGNTN_3            3h (R/W) = SCICHAR_LEGNTN_4            4h (R/W) = SCICHAR_LEGNTN_5            5h (R/W) = SCICHAR_LEGNTN_6            6h (R/W) = SCICHAR_LEGNTN_7            7h (R/W) = SCICHAR_LEGNTN_8</p>

**18.14.2.2 SCICTL1 Register (Offset = 1h) [reset = 0h]**

 SCICTL1 is shown in [Figure 18-12](#) and described in [Table 18-9](#).

 Return to [Summary Table](#).

Control register 1

**Figure 18-12. SCICTL1 Register**

15	14	13	12	11	10	9	8
RESERVED							
R-0h							
7	6	5	4	3	2	1	0
RESERVED	RXERRINTEN A	SWRESET	RESERVED	TXWAKE	SLEEP	TXENA	RXENA
R-0h	R/W-0h	R/W-0h	R-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h

**Table 18-9. SCICTL1 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-7	RESERVED	R	0h	Reserved
6	RXERRINTENA	R/W	0h	SCI receive error interrupt enable. Setting this bit enables an interrupt if the RX ERROR bit (SCIRXST, bit 7) becomes set because of errors occurring. Reset type: SYSRSn 0h (R/W) = Receive error interrupt disabled 1h (R/W) = Receive error interrupt enabled
5	SWRESET	R/W	0h	SCI software reset (active low). Writing a 0 to this bit initializes the SCI state machines and operating flags (registers SCICTL2 and SCIRXST) to the reset condition. The SW RESET bit does not affect any of the configuration bits. All affected logic is held in the specified reset state until a 1 is written to SW RESET (the bit values following a reset are shown beneath each register diagram in this section). Thus, after a system reset, re-enable the SCI by writing a 1 to this bit. Clear this bit after a receiver break detect (BRKDT flag, bit SCIRXST, bit 5). SW RESET affects the operating flags of the SCI, but it neither affects the configuration bits nor restores the reset values. Once SW RESET is asserted, the flags are frozen until the bit is deasserted. The affected flags are as follows: Value After SW SCI Flag Register Bit RESET 1 TXRDY SCICTL2, bit 7 1 TX EMPTY SCICTL2, bit 6 0 RXWAKE SCIRXST, bit 1 0 PE SCIRXST, bit 2 0 OE SCIRXST, bit 3 0 FE SCIRXST, bit 4 0 BRKDT SCIRXST, bit 5 0 RXRDY SCIRXST, bit 6 0 RX ERROR SCIRXST, bit 7 Reset type: SYSRSn 0h (R/W) = Writing a 0 to this bit initializes the SCI state machines and operating flags (registers SCICTL2 and SCIRXST) to the reset condition. 1h (R/W) = After a system reset, re-enable the SCI by writing a 1 to this bit.
4	RESERVED	R	0h	Reserved

**Table 18-9. SCICTL1 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
3	TXWAKE	R/W	0h	<p>SCI transmitter wake-up method select.</p> <p>The TXWAKE bit controls selection of the data-transmit feature, depending on which transmit mode (idle-line or address-bit) is specified at the ADDR/IDLE MODE bit (SCICCR, bit 3)</p> <p>Reset type: SYSRSn</p> <p>0h (R/W) = Transmit feature is not selected. In idle-line mode: write a 1 to TXWAKE, then write data to register SCITXBUF to generate an idle period of 11 data bits In address-bit mode: write a 1 to TXWAKE, then write data to SCITXBUF to set the address bit for that frame to 1</p> <p>1h (R/W) = Transmit feature selected is dependent on the mode, idle-line or address-bit: TXWAKE is not cleared by the SW RESET bit (SCICTL1, bit 5)</p> <p>it is cleared by a system reset or the transfer of TXWAKE to the WUT flag.</p>
2	SLEEP	R/W	0h	<p>SCI sleep.</p> <p>The TXWAKE bit controls selection of the data-transmit feature, depending on which transmit mode (idle-line or address-bit) is specified at the ADDR/IDLE MODE bit (SCICCR, bit 3). In a multiprocessor configuration, this bit controls the receiver sleep function. Clearing this bit brings the SCI out of the sleep mode. The receiver still operates when the SLEEP bit is set however, operation does not update the receiver buffer ready bit (SCIRXST, bit 6, RXRDY) or the error status bits (SCIRXST, bit 5-2: BRKDT, FE, OE, and PE) unless the address byte is detected. SLEEP is not cleared when the address byte is detected.</p> <p>Reset type: SYSRSn</p> <p>0h (R/W) = Sleep mode disabled</p> <p>1h (R/W) = Sleep mode enabled</p>
1	TXENA	R/W	0h	<p>SCI transmitter enable.</p> <p>Data is transmitted through the SCITXD pin only when TXENA is set. If reset, transmission is halted but only after all data previously written to SCITXBUF has been sent. Data written into SCITXBUF when TXENA is disabled will not be transmitted even if the TXENA is enabled later.</p> <p>Reset type: SYSRSn</p> <p>0h (R/W) = Transmitter disabled</p> <p>1h (R/W) = Transmitter enabled</p>
0	RXENA	R/W	0h	<p>SCI receiver enable.</p> <p>Data is received on the SCIRXD pin and is sent to the receiver shift register and then the receiver buffers. This bit enables or disables the receiver (transfer to the buffers).</p> <p>Clearing RXENA stops received characters from being transferred to the two receiver buffers and also stops the generation of receiver interrupts. However, the receiver shift register can continue to assemble characters. Thus, if RXENA is set during the reception of a character, the complete character will be transferred into the receiver buffer registers, SCIRXEMU and SCIRXBUF.</p> <p>Reset type: SYSRSn</p> <p>0h (R/W) = Prevent received characters from transfer into the SCIRXEMU and SCIRXBUF receiver buffers</p> <p>1h (R/W) = Send received characters to SCIRXEMU and SCIRXBUF</p>

### 18.14.2.3 SCIHBAUD Register (Offset = 2h) [reset = 0h]

SCIHBAUD is shown in [Figure 18-13](#) and described in [Table 18-10](#).

Return to [Summary Table](#).

Baud rate (high) register

**Figure 18-13. SCIHBAUD Register**

15	14	13	12	11	10	9	8
RESERVED							
R-0h							
7	6	5	4	3	2	1	0
BAUD							
R/W-0h							

**Table 18-10. SCIHBAUD Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-8	RESERVED	R	0h	Reserved
7-0	BAUD	R/W	0h	SCI 16-bit baud selection Registers SCIHBAUD (MSbyte).  The internally-generated serial clock is determined by the low speed peripheral clock (LSPCLK) signal and the two baud-select registers. The SCI uses the 16-bit value of these registers to select one of 64K serial clock rates for the communication modes.  The SCI baud rate is calculated using the following equation:  $\text{SCI Asynchronous Baud} = \text{LSPCLK} / ((\text{BRR} + 1) * 8)$  Alternatively,  $\text{BRR} = \text{LSPCLK} / (\text{SCI Asynchronous Baud} * 8) - 1$  Note that the above formulas are applicable only when $0 < \text{BRR} < 65536$ . If $\text{BRR} = 0$ , then  $\text{SCI Asynchronous Baud} = \text{LSPCLK} / 16$  Where: BRR = the 16-bit value (in decimal) in the baud-select registers  Reset type: SYSRSn

**18.14.2.4 SCILBAUD Register (Offset = 3h) [reset = 0h]**

SCILBAUD is shown in [Figure 18-14](#) and described in [Table 18-11](#).

Return to [Summary Table](#).

Baud rate (low) register

**Figure 18-14. SCILBAUD Register**

15	14	13	12	11	10	9	8
RESERVED							
R-0h							
7	6	5	4	3	2	1	0
BAUD							
R/W-0h							

**Table 18-11. SCILBAUD Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-8	RESERVED	R	0h	Reserved
7-0	BAUD	R/W	0h	See SCILBAUD Detailed Description Reset type: SYSRSn

**18.14.2.5 SCICTL2 Register (Offset = 4h) [reset = C0h]**

SCICTL2 is shown in [Figure 18-15](#) and described in [Table 18-12](#).

Return to [Summary Table](#).

Control register 2

**Figure 18-15. SCICTL2 Register**

15	14	13	12	11	10	9	8
RESERVED							
R-0h							
7	6	5	4	3	2	1	0
TXRDY	TXEMPTY	RESERVED				RXBKINTENA	TXINTENA
R-1h	R-1h	R-0h				R/W-0h	R/W-0h

**Table 18-12. SCICTL2 Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-8	RESERVED	R	0h	Reserved
7	TXRDY	R	1h	Transmitter buffer register ready flag. When set, this bit indicates that the transmit data buffer register, SCITXBUF, is ready to receive another character. Writing data to the SCITXBUF automatically clears this bit. When set, this flag asserts a transmitter interrupt request if the interrupt-enable bit, TX INT ENA (SCICTL2.0), is also set. TXRDY is set to 1 by enabling the SW RESET bit (SCICTL1.5) or by a system reset. Reset type: SYSRSn 0h (R/W) = SCITXBUF is full 1h (R/W) = SCITXBUF is ready to receive the next character
6	TXEMPTY	R	1h	Transmitter empty flag. This flag's value indicates the contents of the transmitter's buffer register (SCITXBUF) and shift register (TXSHF). An active SW RESET (SCICTL1.5), or a system reset, sets this bit. This bit does not cause an interrupt request. Reset type: SYSRSn 0h (R/W) = Transmitter buffer or shift register or both are loaded with data 1h (R/W) = Transmitter buffer and shift registers are both empty
5-2	RESERVED	R	0h	Reserved
1	RXBKINTENA	R/W	0h	Receiver-buffer/break interrupt enable. This bit controls the interrupt request caused by either the RXRDY flag or the BRKDT flag (bits SCIRXST.6 and .5) being set. However, RX/BK INT ENA does not prevent the setting of these flags. Reset type: SYSRSn 0h (R/W) = Disable RXRDY/BRKDT interrupt 1h (R/W) = Enable RXRDY/BRKDT interrupt

**Table 18-12. SCICTL2 Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
0	TXINTENA	R/W	0h	<p>SCITXBUF-register interrupt enable.</p> <p>This bit controls the interrupt request caused by the setting of TXRDY flag bit (SCICTL2.7). However, it does not prevent the TXRDY flag from being set (which indicates SCITXBUF is ready to receive another character).</p> <p>0 Disable TXRDY interrupt 1 Enable TXRDY interrupt.</p> <p>In non-FIFO mode, a dummy (or a valid) data has to be written to SCITXBUF for the first transmit interrupt to occur. This is the case when you enable the transmit interrupt for the first time and also when you re-enable (disable and then enable) the transmit interrupt. If TXINTENA is enabled after writing the data to SCITXBUF, it will not generate an interrupt.</p> <p>Reset type: SYSRSn 0h (R/W) = Disable TXRDY interrupt 1h (R/W) = Enable TXRDY interrupt</p>

**18.14.2.6 SCIRXST Register (Offset = 5h) [reset = 0h]**

SCIRXST is shown in [Figure 18-16](#) and described in [Table 18-13](#).

Return to [Summary Table](#).

Receive status register

**Figure 18-16. SCIRXST Register**

15	14	13	12	11	10	9	8
RESERVED							
R-0h							
7	6	5	4	3	2	1	0
RXERROR	RXRDY	BRKDT	FE	OE	PE	RXWAKE	RESERVED
R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h

**Table 18-13. SCIRXST Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-8	RESERVED	R	0h	Reserved
7	RXERROR	R	0h	SCI receiver error flag. The RX ERROR flag indicates that one of the error flags in the receiver status register is set. RX ERROR is a logical OR of the break detect, framing error, overrun, and parity error enable flags (bits 5-2: BRKDT, FE, OE, and PE). A 1 on this bit will cause an interrupt if the RX ERR INT ENA bit (SCICTL1.6) is set. This bit can be used for fast error-condition checking during the interrupt service routine. This error flag cannot be cleared directly it is cleared by an active SW RESET or by a system reset. Reset type: SYSRSn 0h (R/W) = No error flags set 1h (R/W) = Error flag(s) set
6	RXRDY	R	0h	SCI receiver-ready flag. When a new character is ready to be read from the SCIRXBUF register, the receiver sets this bit, and a receiver interrupt is generated if the RX/BK INT ENA bit (SCICTL2.1) is a 1. RXRDY is cleared by a reading of the SCIRXBUF register, by an active SW RESET, or by a system reset. Reset type: SYSRSn 0h (R/W) = No new character in SCIRXBUF 1h (R/W) = Character ready to be read from SCIRXBUF
5	BRKDT	R	0h	SCI break-detect flag. The SCI sets this bit when a break condition occurs. A break condition occurs when the SCI receiver data line (SCIRXD) remains continuously low for at least ten bits, beginning after a missing first stop bit. The occurrence of a break causes a receiver interrupt to be generated if the RX/BK INT ENA bit is a 1, but it does not cause the receiver buffer to be loaded. A BRKDT interrupt can occur even if the receiver SLEEP bit is set to 1. BRKDT is cleared by an active SW RESET or by a system reset. It is not cleared by receipt of a character after the break is detected. In order to receive more characters, the SCI must be reset by toggling the SW RESET bit or by a system reset. Reset type: SYSRSn 0h (R/W) = No break condition 1h (R/W) = Break condition occurred



**Table 18-13. SCIRXST Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
4	FE	R	0h	<p>SCI framing-error flag.</p> <p>The SCI sets this bit when an expected stop bit is not found. Only the first stop bit is checked. The missing stop bit indicates that synchronization with the start bit has been lost and that the character is incorrectly framed. The FE bit is reset by a clearing of the SW RESET bit or by a system reset.</p> <p>Reset type: SYSRSn            0h (R/W) = No framing error detected            1h (R/W) = Framing error detected</p>
3	OE	R	0h	<p>SCI overrun-error flag.</p> <p>The SCI sets this bit when a character is transferred into registers SCIRXEMU and SCIRXBUF before the previous character is fully read by the CPU or DMAC. The previous character is overwritten and lost. The OE flag bit is reset by an active SW RESET or by a system reset.</p> <p>Reset type: SYSRSn            0h (R/W) = No overrun error detected            1h (R/W) = Overrun error detected</p>
2	PE	R	0h	<p>SCI parity-error flag.</p> <p>This flag bit is set when a character is received with a mismatch between the number of 1s and its parity bit. The address bit is included in the calculation. If parity generation and detection is not enabled, the PE flag is disabled and read as 0. The PE bit is reset by an active SW RESET or a system reset.</p> <p>Reset type: SYSRSn            0h (R/W) = No parity error or parity is disabled            1h (R/W) = Parity error is detected</p>
1	RXWAKE	R	0h	<p>Receiver wake-up-detect flag</p> <p>Reset type: SYSRSn            0h (R/W) = No detection of a receiver wake-up condition            1h (R/W) = A value of 1 in this bit indicates detection of a receiver wake-up condition. In the address-bit multiprocessor mode (SCICCR.3 = 1), RXWAKE reflects the value of the address bit for the character contained in SCIRXBUF. In the idle-line multiprocessor mode, RXWAKE is set if the SCIRXD data line is detected as idle. RXWAKE is a read-only flag, cleared by one of the following:</p> <ul style="list-style-type: none"> <li>- The transfer of the first byte after the address byte to SCIRXBUF (only in non-FIFO mode)</li> <li>- The reading of SCIRXBUF</li> <li>- An active SW RESET</li> <li>- A system reset</li> </ul>
0	RESERVED	R	0h	Reserved

**18.14.2.7 SCIRXEMU Register (Offset = 6h) [reset = 0h]**

SCIRXEMU is shown in [Figure 18-17](#) and described in [Table 18-14](#).

Return to [Summary Table](#).

Receive emulation buffer register

**Figure 18-17. SCIRXEMU Register**

15	14	13	12	11	10	9	8
RESERVED							
R-0h							
7	6	5	4	3	2	1	0
ERXDT							
R-0h							

**Table 18-14. SCIRXEMU Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-8	RESERVED	R	0h	Reserved
7-0	ERXDT	R	0h	Receive emulation buffer data Reset type: SYSRSn

**18.14.2.8 SCIRXBUF Register (Offset = 7h) [reset = 0h]**

SCIRXBUF is shown in [Figure 18-18](#) and described in [Table 18-15](#).

Return to [Summary Table](#).

Recieve data buffer

**Figure 18-18. SCIRXBUF Register**

15	14	13	12	11	10	9	8
SCIFFFE	SCIFFPE	RESERVED					
R-0h	R-0h	R-0h					
7	6	5	4	3	2	1	0
SAR							
R-0h							

**Table 18-15. SCIRXBUF Register Field Descriptions**

Bit	Field	Type	Reset	Description
15	SCIFFFE	R	0h	SCIFFFE. SCI FIFO Framing error flag bit (applicable only if the FIFO is enabled) Reset type: SYSRSn 0h (R/W) = No frame error occurred while receiving the character, in bits 7-0. This bit is associated with the character on the top of the FIFO. 1h (R/W) = A frame error occurred while receiving the character in bits 7-0. This bit is associated with the character on the top of the FIFO.
14	SCIFFPE	R	0h	SCIFFPE. SCI FIFO parity error flag bit (applicable only if the FIFO is enabled) Reset type: SYSRSn 0h (R/W) = No parity error occurred while receiving the character, in bits 7-0. This bit is associated with the character on the top of the FIFO. 1h (R/W) = A parity error occurred while receiving the character in bits 7-0. This bit is associated with the character on the top of the FIFO.
13-8	RESERVED	R	0h	Reserved
7-0	SAR	R	0h	Receive Character bits Reset type: SYSRSn

**18.14.2.9 SCITXBUF Register (Offset = 9h) [reset = 0h]**

SCITXBUF is shown in [Figure 18-19](#) and described in [Table 18-16](#).

Return to [Summary Table](#).

Transmit data buffer

**Figure 18-19. SCITXBUF Register**

15	14	13	12	11	10	9	8
RESERVED							
R-0h							
7	6	5	4	3	2	1	0
TXDT							
R/W-0h							

**Table 18-16. SCITXBUF Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-8	RESERVED	R	0h	Reserved
7-0	TXDT	R/W	0h	Transmit data buffer Reset type: SYSRSn

### 18.14.2.10 SCIFFTX Register (Offset = Ah) [reset = A000h]

SCIFFTX is shown in [Figure 18-20](#) and described in [Table 18-17](#).

Return to [Summary Table](#).

FIFO transmit register

**Figure 18-20. SCIFFTX Register**

15		14		13		12		11		10		9		8	
SCIRST		SCIFFENA		TXFIFORESET						TXFFST					
R/W-1h		R/W-0h		R/W-1h						R-0h					
7		6		5		4		3		2		1		0	
TXFFINT		TXFFINTCLR		TXFFIENA						TXFFIL					
R-0h		R=0/W=1-0h		R/W-0h						R/W-0h					

**Table 18-17. SCIFFTX Register Field Descriptions**

Bit	Field	Type	Reset	Description
15	SCIRST	R/W	1h	SCI Reset 0 Write 0 to reset the SCI transmit and receive channels. SCI FIFO register configuration bits will be left as is. 1 SCI FIFO can resume transmit or receive. SCIRST should be 1 even for Autobaud logic to work. Reset type: SYSRSn
14	SCIFFENA	R/W	0h	SCI FIFO enable Reset type: SYSRSn 0h (R/W) = SCI FIFO enhancements are disabled 1h (R/W) = SCI FIFO enhancements are enabled
13	TXFIFORESET	R/W	1h	Transmit FIFO reset Reset type: SYSRSn 0h (R/W) = Reset the FIFO pointer to zero and hold in reset 1h (R/W) = Re-enable transmit FIFO operation
12-8	TXFFST	R	0h	FIFO status Reset type: SYSRSn 0h (R/W) = Transmit FIFO is empty 1h (R/W) = Transmit FIFO has 1 words 2h (R/W) = Transmit FIFO has 2 words 3h (R/W) = Transmit FIFO has 3 words 4h (R/W) = Transmit FIFO has 4 words 5h (R/W) = Transmit FIFO has 5 words 6h (R/W) = Transmit FIFO has 6 words 7h (R/W) = Transmit FIFO has 7 words 8h (R/W) = Transmit FIFO has 8 words 9h (R/W) = Transmit FIFO has 9 words Ah (R/W) = Transmit FIFO has 10 words Bh (R/W) = Transmit FIFO has 11 words Ch (R/W) = Transmit FIFO has 12 words Dh (R/W) = Transmit FIFO has 13 words Eh (R/W) = Transmit FIFO has 14 words Fh (R/W) = Transmit FIFO has 15 words 10h (R/W) = Transmit FIFO has 16 words
7	TXFFINT	R	0h	Transmit FIFO interrupt Reset type: SYSRSn 0h (R/W) = TXFIFO interrupt has not occurred, read-only bit 1h (R/W) = TXFIFO interrupt has occurred, read-only bit

**Table 18-17. SCIFFTX Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
6	TXFFINTCLR	R=0/W=1	0h	Transmit FIFO clear Reset type: SYSRSn 0h (R/W) = Write 0 has no effect on TXFIFINT flag bit, Bit reads back a zero 1h (R/W) = Write 1 to clear TXFFINT flag in bit 7
5	TXFFIENA	R/W	0h	Transmit FIFO interrupt enable Reset type: SYSRSn 0h (R/W) = TX FIFO interrupt based on TXFFIL match (less than or equal to) is disabled 1h (R/W) = TX FIFO interrupt based on TXFFIL match (less than or equal to) is enabled.
4-0	TXFFIL	R/W	0h	TXFFIL4-0 Transmit FIFO interrupt level bits.  The transmit FIFO generates an interrupt whenever the FIFO status bits (TXFFST4-0) are less than or equal to the FIFO level bits (TXFFIL4-0). The maximum value that can be assigned to these bits to generate an interrupt cannot be more than the depth of the TX FIFO. The default value of these bits after reset is 00000b. Users should set TXFFIL to best fit their application needs by weighing between the CPU overhead to service the ISR and the best possible usage of SCI bus bandwidth.  Reset type: SYSRSn

### 18.14.2.11 SCIFFRX Register (Offset = Bh) [reset = 201Fh]

SCIFFRX is shown in [Figure 18-21](#) and described in [Table 18-18](#).

Return to [Summary Table](#).

FIFO receive register

**Figure 18-21. SCIFFRX Register**

15		14		13		12		11		10		9		8	
RXFFOVF		RXFFOVRCLR		RXFIFORESET						RXFFST					
R-0h		R=0/W=1-0h		R/W-1h						R-0h					
7		6		5		4		3		2		1		0	
RXFFINT		RXFFINTCLR		RXFFIENA						RXFFIL					
R-0h		W-0h		R/W-0h						R/W-1Fh					

**Table 18-18. SCIFFRX Register Field Descriptions**

Bit	Field	Type	Reset	Description
15	RXFFOVF	R	0h	Receive FIFO overflow. This will function as flag, but cannot generate interrupt by itself. This condition will occur while receive interrupt is active. Receive interrupts should service this flag condition. Reset type: SYSRSn 0h (R/W) = Receive FIFO has not overflowed, read-only bit 1h (R/W) = Receive FIFO has overflowed, read-only bit. More than 16 words have been received in to the FIFO, and the first received word is lost
14	RXFFOVRCLR	R=0/W=1	0h	RXFFOVF clear Reset type: SYSRSn 0h (R/W) = Write 0 has no effect on RXFFOVF flag bit, Bit reads back a zero 1h (R/W) = Write 1 to clear RXFFOVF flag in bit 15
13	RXFIFORESET	R/W	1h	Receive FIFO reset Reset type: SYSRSn 0h (R/W) = Write 0 to reset the FIFO pointer to zero, and hold in reset. 1h (R/W) = Re-enable receive FIFO operation
12-8	RXFFST	R	0h	FIFO status Reset type: SYSRSn 0h (R/W) = Receive FIFO is empty 1h (R/W) = Receive FIFO has 1 words 2h (R/W) = Receive FIFO has 2 words 3h (R/W) = Receive FIFO has 3 words 4h (R/W) = Receive FIFO has 4 words 5h (R/W) = Receive FIFO has 5 words 6h (R/W) = Receive FIFO has 6 words 7h (R/W) = Receive FIFO has 7 words 8h (R/W) = Receive FIFO has 8 words 9h (R/W) = Receive FIFO has 9 words Ah (R/W) = Receive FIFO has 10 words Bh (R/W) = Receive FIFO has 11 words Ch (R/W) = Receive FIFO has 12 words Dh (R/W) = Receive FIFO has 13 words Eh (R/W) = Receive FIFO has 14 words Fh (R/W) = Receive FIFO has 15 words 10h (R/W) = Receive FIFO has 16 words

**Table 18-18. SCIFFRX Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
7	RXFFINT	R	0h	Receive FIFO interrupt Reset type: SYSRSn 0h (R/W) = RXFIFO interrupt has not occurred, read-only bit 1h (R/W) = RXFIFO interrupt has occurred, read-only bit
6	RXFFINTCLR	W	0h	Receive FIFO interrupt clear Reset type: SYSRSn 0h (R/W) = Write 0 has no effect on RXFIFINT flag bit. Bit reads back a zero. 1h (R/W) = Write 1 to clear RXFFINT flag in bit 7
5	RXFFIENA	R/W	0h	Receive FIFO interrupt enable Reset type: SYSRSn 0h (R/W) = RX FIFO interrupt based on RXFFIL match (greater than or equal to) will be disabled 1h (R/W) = RX FIFO interrupt based on RXFFIL match (greater than or equal to) will be enabled
4-0	RXFFIL	R/W	1Fh	Receive FIFO interrupt level bits  The receive FIFO generates an interrupt whenever the FIFO status bits (RXFFST4-0) are greater than or equal to the FIFO level bits (RXFFIL4-0). The maximum value that can be assigned to these bits to generate an interrupt cannot be more than the depth of the RX FIFO. The default value of these bits after reset is 11111b. Users should set RXFFIL to best fit their application needs by weighing between the CPU overhead to service the ISR and the best possible usage of received SCI data.  Reset type: SYSRSn



### 18.14.2.12 SCIFFCT Register (Offset = Ch) [reset = 0h]

SCIFFCT is shown in [Figure 18-22](#) and described in [Table 18-19](#).

Return to [Summary Table](#).

FIFO control register

**Figure 18-22. SCIFFCT Register**

15		14		13		12		11		10		9		8	
ABD		ABDCLR		CDC		RESERVED									
R-0h		W-0h		R/W-0h		R-0h									
7		6		5		4		3		2		1		0	
FFTXDLY															
R/W-0h															

**Table 18-19. SCIFFCT Register Field Descriptions**

Bit	Field	Type	Reset	Description
15	ABD	R	0h	Auto-baud detect (ABD) bit Reset type: SYSRSn 0h (R/W) = Auto-baud detection is not complete. "A", "a" character has not been received successfully. 1h (R/W) = Auto-baud hardware has detected "A" or "a" character on the SCI receive register. Auto-detect is complete.
14	ABDCLR	W	0h	ABD-clear bit Reset type: SYSRSn 0h (R/W) = Write 0 has no effect on ABD flag bit. Bit reads back a zero. 1h (R/W) = Write 1 to clear ABD flag in bit 15.
13	CDC	R/W	0h	CDC calibrate A-detect bit Reset type: SYSRSn 0h (R/W) = Disables auto-baud alignment 1h (R/W) = Enables auto-baud alignment
12-8	RESERVED	R	0h	Reserved
7-0	FFTXDLY	R/W	0h	FIFO transfer delay. These bits define the delay between every transfer from FIFO transmit bufferto transmit shift register. The delay is defined in the number of SCI serial baud clock cycles. The 8 bit register could define a minimum delay of 0 baud clock cycles and a maximum of 256 baud clock cycles  In FIFO mode, the buffer (TXBUF) between the shift register and the FIFO should be filled only after the shift register has completed shifting of the last bit. This is required to pass on the delay between transfers to the data stream. In FIFO mode, TXBUF should not be treated as one additional level of buffer. The delayed transmit feature will help to create an auto-flow scheme without RTS/CTS controls as in standard UARTS.  When SCI is configured for one stop-bit, delay introduced by FFTXDLY between one frame and the next frame is equal to number of baud clock cycles that FFTXDLY is set to.  When SCI is configured for two stop-bits, delay introduced by FFTXDLY between one frame and the next frame is equal to number of baud clock cycles that FFTXDLY is set to minus 1. Reset type: SYSRSn

**18.14.2.13 SCIPRI Register (Offset = Fh) [reset = 0h]**

SCIPRI is shown in [Figure 18-23](#) and described in [Table 18-20](#).

Return to [Summary Table](#).

SCI Priority control

**Figure 18-23. SCIPRI Register**

15	14	13	12	11	10	9	8
RESERVED							
R-0h							
7	6	5	4	3	2	1	0
RESERVED			FREESOFT			RESERVED	
R-0h			R/W-0h			R-0h	

**Table 18-20. SCIPRI Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-8	RESERVED	R	0h	Reserved
7-5	RESERVED	R	0h	Reserved
4-3	FREESOFT	R/W	0h	These bits determine what occurs when an emulation suspend event occurs (for example, when the debugger hits a breakpoint). The peripheral can continue whatever it is doing (free-run mode), or if in stop mode, it can either stop immediately or stop when the current operation (the current receive/transmit sequence) is complete. Reset type: SYSRSn 0h (R/W) = Immediate stop on suspend 1h (R/W) = Complete current receive/transmit sequence before stopping 2h (R/W) = Free run 3h (R/W) = Free run
2-0	RESERVED	R	0h	Reserved

## ***Inter-Integrated Circuit Module (I2C)***

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This chapter describes the features and operation of the inter-integrated circuit (I2C) module. The I2C module provides an interface between one of these devices and devices compliant with Philips Semiconductors Inter-IC bus (I2C-bus) specification version 2.1 and connected by way of an I2C-bus. External components attached to this 2-wire serial bus can transmit/receive 1 to 8-bit data to/from the device through the I2C module. This guide assumes the reader is familiar with the I2C-bus specification.

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**NOTE:** A unit of data transmitted or received by the I2C module can have fewer than 8 bits; however, for convenience, a unit of data is called a data byte throughout this document. The number of bits in a data byte is selectable via the BC bits of the mode register, I2CMDR.

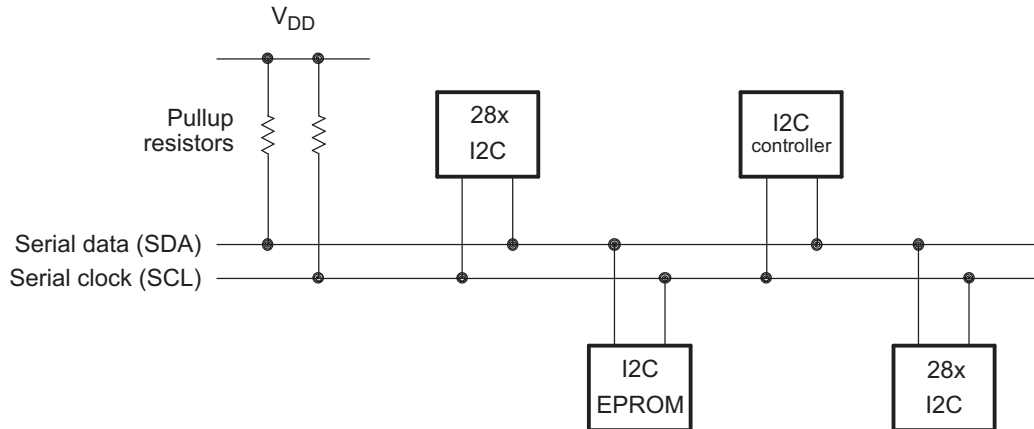
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Topic	Page
<b>19.1 Introduction to the I2C Module .....</b>	<b>2076</b>
<b>19.2 Configuring Device Pins .....</b>	<b>2080</b>
<b>19.3 I2C Module Operational Details.....</b>	<b>2080</b>
<b>19.4 Interrupt Requests Generated by the I2C Module.....</b>	<b>2087</b>
<b>19.5 Resetting or Disabling the I2C Module.....</b>	<b>2089</b>
<b>19.6 Registers .....</b>	<b>2090</b>

## 19.1 Introduction to the I2C Module

The I2C module supports any slave or master I2C-compatible device. Figure 19-1 shows an example of multiple I2C modules connected for a two-way transfer from one device to other devices.

**Figure 19-1. Multiple I2C Modules Connected**



### 19.1.1 Features

The I2C module has the following features:

- Compliance with the Philips Semiconductors I2C-bus specification (version 2.1):
  - Support for 8-bit format transfers
  - 7-bit and 10-bit addressing modes
  - General call
  - START byte mode
  - Support for multiple master-transmitters and slave-receivers
  - Support for multiple slave-transmitters and master-receivers
  - Combined master transmit/receive and receive/transmit mode
  - Data transfer rate of from 10 kbps up to 400 kbps (Philips Fast-mode rate)
- One 16-byte receive FIFO and one 16-byte transmit FIFO
- One interrupt that can always be used by the CPU. This interrupt can be generated as a result of one of the following conditions: transmit-data ready, receive-data ready, register-access ready, no-acknowledgment received, arbitration lost, stop condition detected, addressed as slave.
- An additional interrupt that can be used by the CPU when in FIFO mode
- Module enable/disable capability
- Free data format mode

### 19.1.2 Features Not Supported

The I2C module does not support:

- High-speed mode (Hs-mode)
- CBUS-compatibility mode

### 19.1.3 Functional Overview

Each device connected to an I2C-bus is recognized by a unique address. Each device can operate as either a transmitter or a receiver, depending on the function of the device. A device connected to the I2C-bus can also be considered as the master or the slave when performing data transfers. A master device is the device that initiates a data transfer on the bus and generates the clock signals to permit that transfer. During this transfer, any device addressed by this master is considered a slave. The I2C module supports the multi-master mode, in which one or more devices capable of controlling an I2C-bus can be connected to the same I2C-bus.

For data communication, the I2C module has a serial data pin (SDA) and a serial clock pin (SCL), as shown in the *Registers* section. These two pins carry information between the 28x device and other devices connected to the I2C-bus. The SDA and SCL pins both are bidirectional. They each must be connected to a positive supply voltage using a pull-up resistor. When the bus is free, both pins are high. The driver of these two pins has an open-drain configuration to perform the required wired-AND function.

There are two major transfer techniques: .

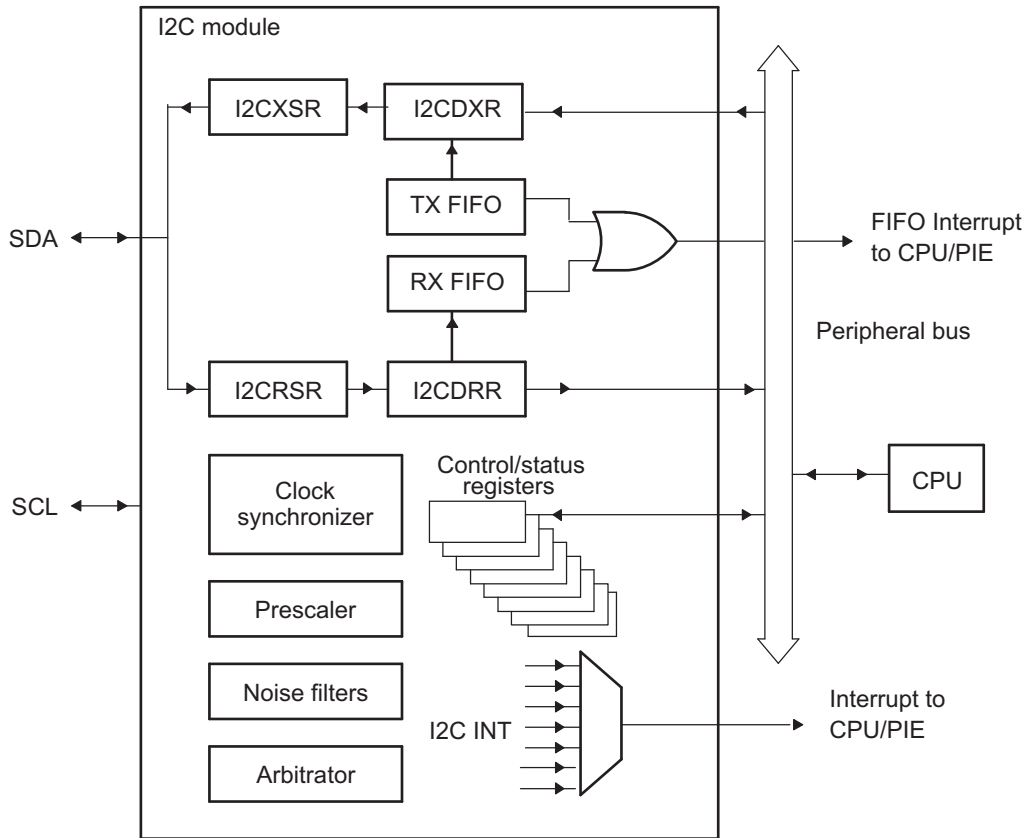
- Standard Mode: Send exactly n data values, where n is a value you program in an I2C module register. See the *Register* section for more information.
- Repeat Mode: Keep sending data values until you use software to initiate a STOP condition or a new START condition. See *Registers* for RM bit information.

The I2C module consists of the following primary blocks:

- A serial interface: one data pin (SDA) and one clock pin (SCL)
- Data registers and FIFOs to temporarily hold receive data and transmit data traveling between the SDA pin and the CPU
- Control and status registers
- A peripheral bus interface to enable the CPU to access the I2C module registers and FIFOs.
- A clock synchronizer to synchronize the I2C input clock (from the device clock generator) and the clock on the SCL pin, and to synchronize data transfers with masters of different clock speeds
- A prescaler to divide down the input clock that is driven to the I2C module
- A noise filter on each of the two pins, SDA and SCL
- An arbitrator to handle arbitration between the I2C module (when it is a master) and another master
- Interrupt generation logic, so that an interrupt can be sent to the CPU
- FIFO interrupt generation logic, so that FIFO access can be synchronized to data reception and data transmission in the I2C module

[Figure 19-2](#) shows the four registers used for transmission and reception in non-FIFO mode. The CPU writes data for transmission to I2CDXR and reads received data from I2CDRR. When the I2C module is configured as a transmitter, data written to I2CDXR is copied to I2CXSR and shifted out on the SDA pin one bit a time. When the I2C module is configured as a receiver, received data is shifted into I2CRSR and then copied to I2CDRR.

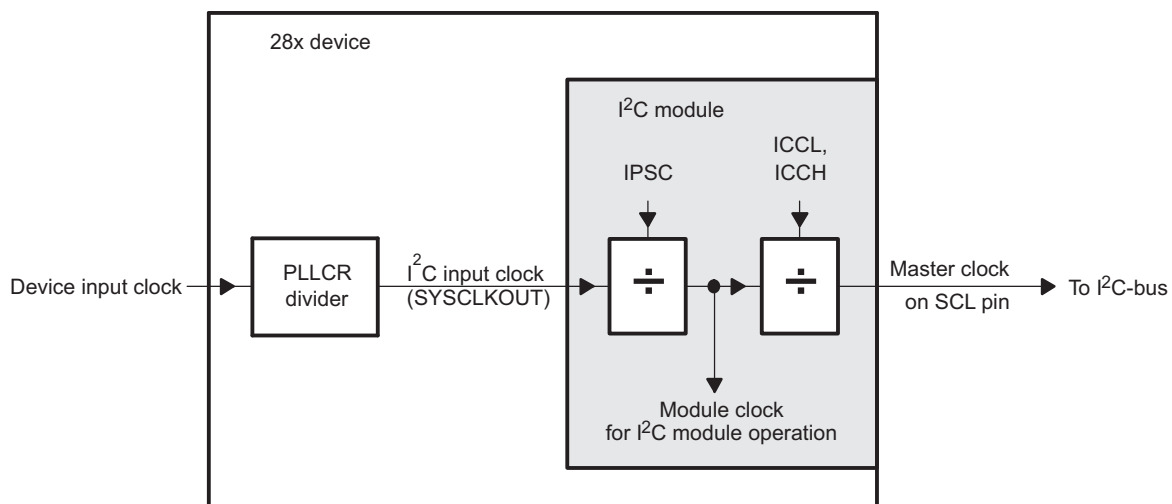
Figure 19-2. I2C Module Conceptual Block Diagram



### 19.1.4 Clock Generation

As shown in Figure 19-3, the device clock generator receives a signal from an external clock source and produces an I2C input clock with a programmed frequency. The I2C input clock is equivalent to the CPU clock and is then divided twice more inside the I2C module to produce the module clock and the master clock.

Figure 19-3. Clocking Diagram for the I2C Module



The module clock determines the frequency at which the I2C module operates. A programmable prescaler in the I2C module divides down the I2C input clock to produce the module clock. To specify the divide-down value, initialize the IPSC field of the prescaler register, I2CPSC. The resulting frequency is:

$$\text{module clock frequency} = \frac{\text{I2C input clock frequency}}{(\text{IPSC} + 1)}$$

**NOTE:** To meet all of the I2C protocol timing specifications, the module clock must be configured between 7 - 12 MHz.

The prescaler must be initialized only while the I2C module is in the reset state (IRS = 0 in I2CMDR). The prescaled frequency takes effect only when IRS is changed to 1. Changing the IPSC value while IRS = 1 has no effect.

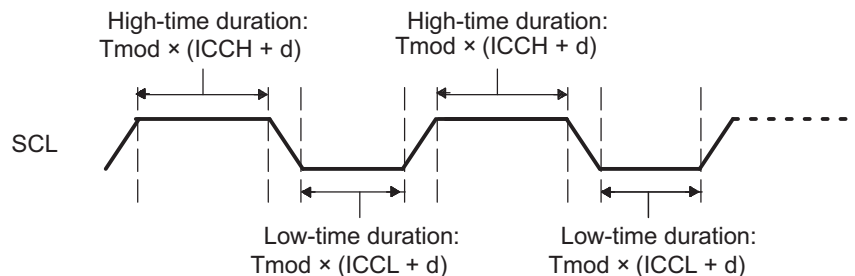
The master clock appears on the SCL pin when the I2C module is configured to be a master on the I2C-bus. This clock controls the timing of communication between the I2C module and a slave. As shown in Figure 19-3, a second clock divider in the I2C module divides down the module clock to produce the master clock. The clock divider uses the ICCL value of I2CCCLKL to divide down the low portion of the module clock signal and uses the ICCH value of I2CCCLKH to divide down the high portion of the module clock signal. See Section 19.1.5 for the master clock frequency equation.

### 19.1.5 I2C Clock Divider Registers (I2CCCLKL and I2CCCLKH)

As explained in Section 19.1.4, when the I2C module is a master, the module clock is divided down for use as the master clock on the SCL pin. As shown in Figure 19-4, the shape of the master clock depends on two divide-down values:

- ICCL in I2CCCLKL. For each master clock cycle, ICCL determines the amount of time the signal is low.
- ICCH in I2CCCLKH. For each master clock cycle, ICCH determines the amount of time the signal is high.

**Figure 19-4. The Roles of the Clock Divide-Down Values (ICCL and ICCH)**



#### 19.1.5.1 Formula for the Master Clock Period

The period of the master clock ( $T_{\text{mst}}$ ) is a multiple of the period of the module clock ( $T_{\text{mod}}$ ):

$$T_{\text{mst}} = T_{\text{mod}} \times [(\text{ICCL} + d) + (\text{ICCH} + d)]$$

$$T_{\text{mst}} = \frac{(\text{IPSC} + 1) [(\text{ICCL} + d) + (\text{ICCH} + d)]}{\text{I2C input clock frequency}}$$

where  $d$  depends on the divide-down value IPSC, as shown in Table 19-1. IPSC is described in the I2CPSC register.

**Table 19-1. Dependency of Delay  $d$  on the Divide-Down Value IPSC**

IPSC	$d$
0	7

**Table 19-1. Dependency of Delay d on the Divide-Down Value IPSC (continued)**

IPSC	d
1	6
Greater than 1	5

## 19.2 Configuring Device Pins

The GPIO mux registers must be configured to connect this peripheral to the device pins. To avoid glitches on the pins, the GPyGMUX bits must be configured first (while keeping the corresponding GPyMUX bits at the default of zero), followed by writing the GPyMUX register to the desired value.

Some IO functionality is defined by GPIO register settings independent of this peripheral. For input signals, the GPIO input qualification should be set to asynchronous mode by setting the appropriate GPxQSELn register bits to 11b. The internal pullups can be configured in the GPyPUD register.

See the *GPIO* chapter for more details on GPIO mux and settings.

## 19.3 I2C Module Operational Details

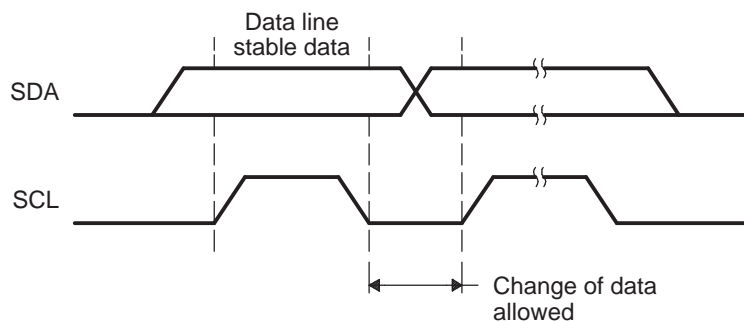
This section provides an overview of the I2C-bus protocol and how it is implemented.

### 19.3.1 Input and Output Voltage Levels

One clock pulse is generated by the master device for each data bit transferred. Due to a variety of different technology devices that can be connected to the I2C-bus, the levels of logic 0 (low) and logic 1 (high) are not fixed and depend on the associated level of  $V_{DD}$ . For details, see the data manual for your particular device.

### 19.3.2 Data Validity

The data on SDA must be stable during the high period of the clock (see [Figure 19-5](#)). The high or low state of the data line, SDA, should change only when the clock signal on SCL is low.

**Figure 19-5. Bit Transfer on the I2C-Bus**


### 19.3.3 Operating Modes

The I2C module has four basic operating modes to support data transfers as a master and as a slave. See [Table 19-2](#) for the names and descriptions of the modes.

If the I2C module is a master, it begins as a master-transmitter and typically transmits an address for a particular slave. When giving data to the slave, the I2C module must remain a master-transmitter. To receive data from a slave, the I2C module must be changed to the master-receiver mode.

If the I2C module is a slave, it begins as a slave-receiver and typically sends acknowledgment when it recognizes its slave address from a master. If the master will be sending data to the I2C module, the module must remain a slave-receiver. If the master has requested data from the I2C module, the module must be changed to the slave-transmitter mode.



**Table 19-2. Operating Modes of the I2C Module**

Operating Mode	Description
Slave-receiver modes	<p>The I2C module is a slave and receives data from a master.</p> <p>All slaves begin in this mode. In this mode, serial data bits received on SDA are shifted in with the clock pulses that are generated by the master. As a slave, the I2C module does not generate the clock signal, but it can hold SCL low while the intervention of the device is required (RSFULL = 1 in I2CSTR) after a byte has been received. See section <a href="#">Section 19.3.7</a> for more details.</p>
Slave-transmitter mode	<p>The I2C module is a slave and transmits data to a master.</p> <p>This mode can be entered only from the slave-receiver mode; the I2C module must first receive a command from the master. When you are using any of the 7-bit/10-bit addressing formats, the I2C module enters its slave-transmitter mode if the slave address byte is the same as its own address (in I2COAR) and the master has transmitted R/W = 1. As a slave-transmitter, the I2C module then shifts the serial data out on SDA with the clock pulses that are generated by the master. While a slave, the I2C module does not generate the clock signal, but it can hold SCL low while the intervention of the device is required (XSMT = 0 in I2CSTR) after a byte has been transmitted. See section <a href="#">Section 19.3.7</a> for more details.</p>
Master-receiver mode	<p>The I2C module is a master and receives data from a slave.</p> <p>This mode can be entered only from the master-transmitter mode; the I2C module must first transmit a command to the slave. When you are using any of the 7-bit/10-bit addressing formats, the I2C module enters its master-receiver mode after transmitting the slave address byte and R/W = 1. Serial data bits on SDA are shifted into the I2C module with the clock pulses generated by the I2C module on SCL. The clock pulses are inhibited and SCL is held low when the intervention of the device is required (RSFULL = 1 in I2CSTR) after a byte has been received.</p>
Master-transmitter modes	<p>The IC module is a master and transmits control information and data to a slave.</p> <p>All masters begin in this mode. In this mode, data assembled in any of the 7-bit/10-bit addressing formats is shifted out on SDA. The bit shifting is synchronized with the clock pulses generated by the I2C module on SCL. The clock pulses are inhibited and SCL is held low when the intervention of the device is required (XSMT = 0 in I2CSTR) after a byte has been transmitted.</p>

**Table 19-3. Master-Transmitter/Receiver Bus Activity Defined by the RM, STT, and STP Bits of I2CMDR**

RM	STT	STP	Bus Activity <sup>(1)</sup>	Description
0	0	0	None	No activity
0	0	1	P	STOP condition
0	1	0	S-A-D..(n)..D.	START condition, slave address, n data bytes (n = value in I2CCNT)
0	1	1	S-A-D..(n)..D-P	START condition, slave address, n data bytes, STOP condition (n = value in I2CCNT)
1	0	0	None	No activity
1	0	1	P	STOP condition
1	1	0	S-A-D-D-D.	Repeat mode transfer: START condition, slave address, continuous data transfers until STOP condition or next START condition
1	1	1	None	Reserved bit combination (No activity)

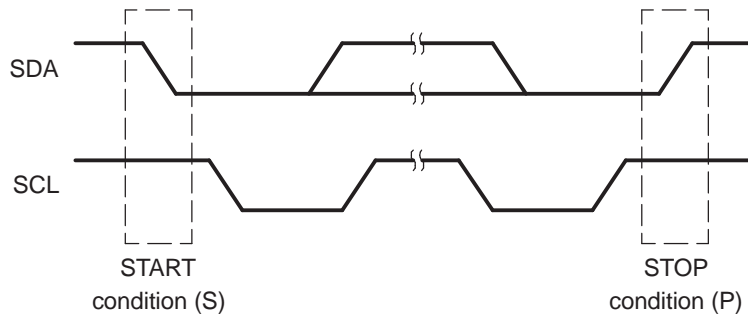
<sup>(1)</sup> S = START condition; A = Address; D = Data byte; P = STOP condition;

### 19.3.4 I2C Module START and STOP Conditions

START and STOP conditions can be generated by the I2C module when the module is configured to be a master on the I2C-bus. As shown in [Figure 19-6](#):

- The START condition is defined as a high-to-low transition on the SDA line while SCL is high. A master drives this condition to indicate the start of a data transfer.
- The STOP condition is defined as a low-to-high transition on the SDA line while SCL is high. A master drives this condition to indicate the end of a data transfer.

**Figure 19-6. I2C Module START and STOP Conditions**



After a START condition and before a subsequent STOP condition, the I2C-bus is considered busy, and the bus busy (BB) bit of I2CSTR is 1. Between a STOP condition and the next START condition, the bus is considered free, and BB is 0.

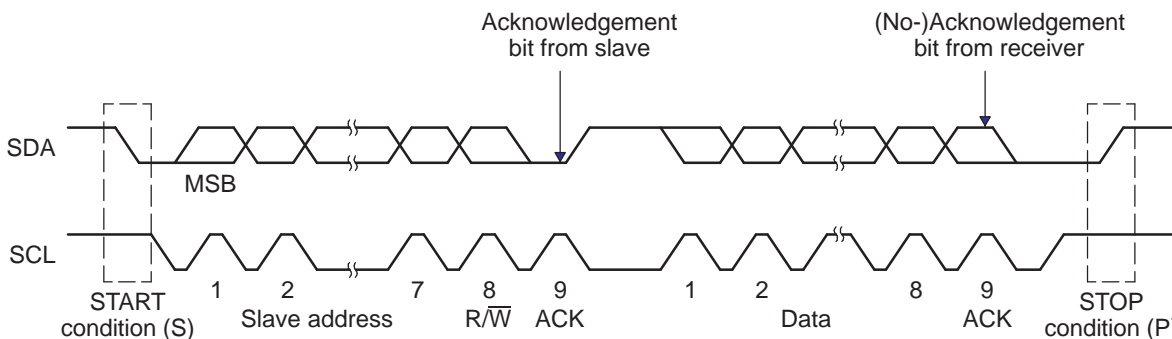
For the I2C module to start a data transfer with a START condition, the master mode bit (MST) and the START condition bit (STT) in I2CMDR must both be 1. For the I2C module to end a data transfer with a STOP condition, the STOP condition bit (STP) must be set to 1. When the BB bit is set to 1 and the STT bit is set to 1, a repeated START condition is generated. For a description of I2CMDR and its bits (including MST, STT, and STP), see *Registers*.

### 19.3.5 Serial Data Formats

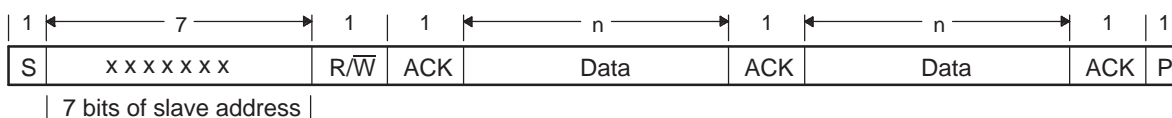
Figure 19-7 shows an example of a data transfer on the I2C-bus. The I2C module supports 1 to 8-bit data values. In Figure 19-7, 8-bit data is transferred. Each bit put on the SDA line equates to 1 pulse on the SCL line, and the values are always transferred with the most significant bit (MSB) first. The number of data values that can be transmitted or received is unrestricted. The serial data format used in Figure 19-7 is the 7-bit addressing format. The I2C module supports the formats shown in Figure 19-8 through Figure 19-10 and described in the paragraphs that follow the figures.

**NOTE:** In Figure 19-7 through Figure 19-10, n = the number of data bits (from 1 to 8) specified by the bit count (BC) field of I2CMDR.

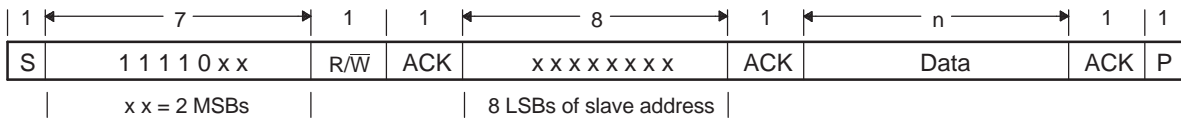
**Figure 19-7. I2C Module Data Transfer (7-Bit Addressing with 8-bit Data Configuration Shown)**



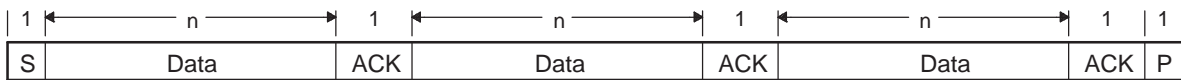
**Figure 19-8. I2C Module 7-Bit Addressing Format (FDF = 0, XA = 0 in I2CMDR)**



**Figure 19-9. I2C Module 10-Bit Addressing Format (FDF = 0, XA = 1 in I2CMDR)**



**Figure 19-10. I2C Module Free Data Format (FDF = 1 in I2CMDR)**



### 19.3.5.1 7-Bit Addressing Format

In the 7-bit addressing format (see [Figure 19-8](#)), the first byte after a START condition (S) consists of a 7-bit slave address followed by a R/W bit. R/W determines the direction of the data:

- R/W = 0: The master writes (transmits) data to the addressed slave.
- R/W = 1: The master reads (receives) data from the slave.

An extra clock cycle dedicated for acknowledgment (ACK) is inserted after each byte. If the ACK bit is inserted by the slave after the first byte from the master, it is followed by n bits of data from the transmitter (master or slave, depending on the R/W bit). n is a number from 1 to 8 determined by the bit count (BC) field of I2CMDR. After the data bits have been transferred, the receiver inserts an ACK bit.

To select the 7-bit addressing format, write 0 to the expanded address enable (XA) bit of I2CMDR, and make sure the free data format mode is off (FDF = 0 in I2CMDR).

### 19.3.5.2 10-Bit Addressing Format

The 10-bit addressing format (see [Figure 19-9](#)) is similar to the 7-bit addressing format, but the master sends the slave address in two separate byte transfers. The first byte consists of 11110b, the two MSBs of the 10-bit slave address, and R/W = 0 (write). The second byte is the remaining 8 bits of the 10-bit slave address. The slave must send acknowledgment after each of the two byte transfers. Once the master has written the second byte to the slave, the master can either write data or use a repeated START condition to change the data direction. For more details about using 10-bit addressing, see the Philips Semiconductors I2C-bus specification.

To select the 10-bit addressing format, write 1 to the XA bit of I2CMDR and make sure the free data format mode is off (FDF = 0 in I2CMDR).

### 19.3.5.3 Free Data Format

In this format (see [Figure 19-10](#)), the first byte after a START condition (S) is a data byte. An ACK bit is inserted after each data byte, which can be from 1 to 8 bits, depending on the BC field of I2CMDR. No address or data-direction bit is sent. Therefore, the transmitter and the receiver must both support the free data format, and the direction of the data must be constant throughout the transfer.

To select the free data format, write 1 to the free data format (FDF) bit of I2CMDR. The free data format is not supported in the digital loopback mode (DLB = 1 in I2CMDR).

**Table 19-4. How the MST and FDF Bits of I2CMDR Affect the Role of the TRX Bit of I2CMDR**

MST	FDF	I2C Module State	Function of TRX
0	0	In slave mode but not free data format mode	TRX is a don't care. Depending on the command from the master, the I2C module responds as a receiver or a transmitter.
0	1	In slave mode and free data format mode	The free data format mode requires that the I2C module remains the transmitter or the receiver throughout the transfer. TRX identifies the role of the I2C module: TRX = 1: The I2C module is a transmitter. TRX = 0: The I2C module is a receiver.

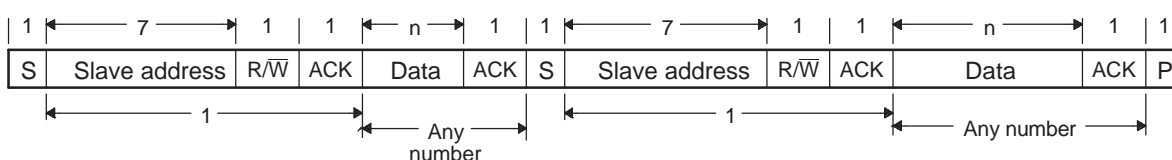
**Table 19-4. How the MST and FDF Bits of I2CMDR Affect the Role of the TRX Bit of I2CMDR (continued)**

MST	FDF	I2C Module State	Function of TRX
1	0	In master mode but not free data format mode	TRX = 1: The I2C module is a transmitter. TRX = 0: The I2C module is a receiver.
1	1	In master mode and free data format mode	TRX = 0: The I2C module is a receiver. TRX = 1: The I2C module is a transmitter.

### 19.3.5.4 Using a Repeated START Condition

At the end of each data byte, the master can drive another START condition. Using this capability, a master can communicate with multiple slave addresses without having to give up control of the bus by driving a STOP condition. The length of a data byte can be from 1 to 8 bits and is selected with the BC field of I2CMDR. The repeated START condition can be used with the 7-bit addressing, 10-bit addressing, and free data formats. Figure 19-11 shows a repeated START condition in the 7-bit addressing format.

**Figure 19-11. Repeated START Condition (in This Case, 7-Bit Addressing Format)**



**NOTE:** In Figure 19-11, n = the number of data bits (from 1 to 8) specified by the bit count (BC) field of I2CMDR.

### 19.3.6 NACK Bit Generation

When the I2C module is a receiver (master or slave), it can acknowledge or ignore bits sent by the transmitter. To ignore any new bits, the I2C module must send a no-acknowledge (NACK) bit during the acknowledge cycle on the bus. Table 19-5 summarizes the various ways you can tell the I2C module to send a NACK bit.

**Table 19-5. Ways to Generate a NACK Bit**

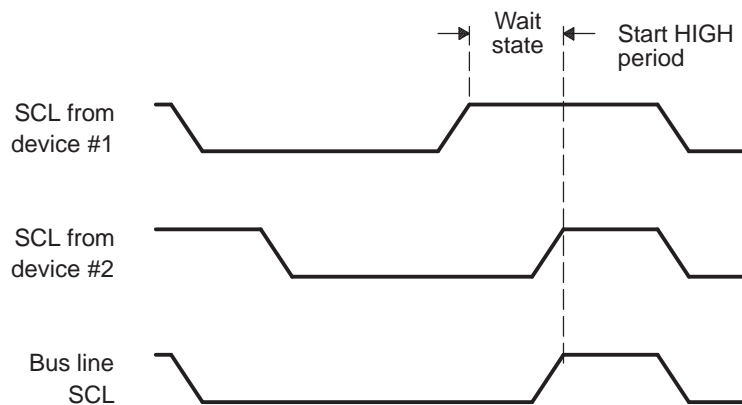
I2C Module Condition	NACK Bit Generation Options
Slave-receiver modes	<ul style="list-style-type: none"> <li>Allow an overrun condition (RSFULL = 1 in I2CSTR)</li> <li>Reset the module (IRS = 0 in I2CMDR)</li> <li>Set the NACKMOD bit of I2CMDR before the rising edge of the last data bit you intend to receive</li> </ul>
Master-receiver mode AND Repeat mode (RM = 1 in I2CMDR)	<ul style="list-style-type: none"> <li>Generate a STOP condition (STP = 1 in I2CMDR)</li> <li>Reset the module (IRS = 0 in I2CMDR)</li> <li>Set the NACKMOD bit of I2CMDR before the rising edge of the last data bit you intend to receive</li> </ul>
Master-receiver mode AND Nonrepeat mode (RM = 0 in I2CMDR)	<ul style="list-style-type: none"> <li>If STP = 1 in I2CMDR, allow the internal data counter to count down to 0 and thus force a STOP condition</li> <li>If STP = 0, make STP = 1 to generate a STOP condition</li> <li>Reset the module (IRS = 0 in I2CMDR). = 1 to generate a STOP condition</li> <li>Set the NACKMOD bit of I2CMDR before the rising edge of the last data bit you intend to receive</li> </ul>

### 19.3.7 Clock Synchronization

Under normal conditions, only one master device generates the clock signal, SCL. During the arbitration procedure, however, there are two or more masters and the clock must be synchronized so that the data output can be compared. Figure 19-12 illustrates the clock synchronization. The wired-AND property of SCL means that a device that first generates a low period on SCL overrules the other devices. At this high-to-low transition, the clock generators of the other devices are forced to start their own low period. The SCL is held low by the device with the longest low period. The other devices that finish their low periods must wait for SCL to be released, before starting their high periods. A synchronized signal on SCL is obtained, where the slowest device determines the length of the low period and the fastest device determines the length of the high period.

If a device pulls down the clock line for a longer time, the result is that all clock generators must enter the wait state. In this way, a slave slows down a fast master and the slow device creates enough time to store a received byte or to prepare a byte to be transmitted.

**Figure 19-12. Synchronization of Two I2C Clock Generators During Arbitration**



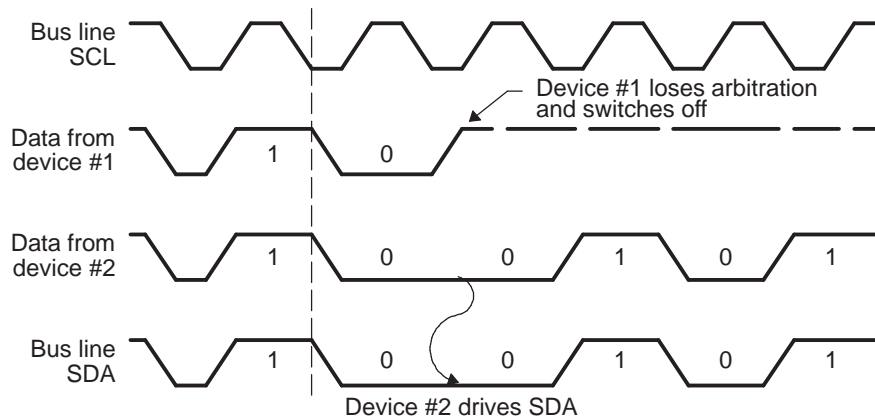
### 19.3.8 Arbitration

If two or more master-transmitters attempt to start a transmission on the same bus at approximately the same time, an arbitration procedure is invoked. The arbitration procedure uses the data presented on the serial data bus (SDA) by the competing transmitters. Figure 19-13 illustrates the arbitration procedure between two devices. The first master-transmitter that releases the SDA line high is overruled by another master-transmitter that drives the SDA low. The arbitration procedure gives priority to the device that transmits the serial data stream with the lowest binary value. Should two or more devices send identical first bytes, arbitration continues on the subsequent bytes.

If the I2C module is the losing master, it switches to the slave-receiver mode, sets the arbitration lost (AL) flag, and generates the arbitration-lost interrupt request.

If during a serial transfer the arbitration procedure is still in progress when a repeated START condition or a STOP condition is transmitted to SDA, the master-transmitters involved must send the repeated START condition or the STOP condition at the same position in the format frame. Arbitration is not allowed between:

- A repeated START condition and a data bit
- A STOP condition and a data bit
- A repeated START condition and a STOP condition

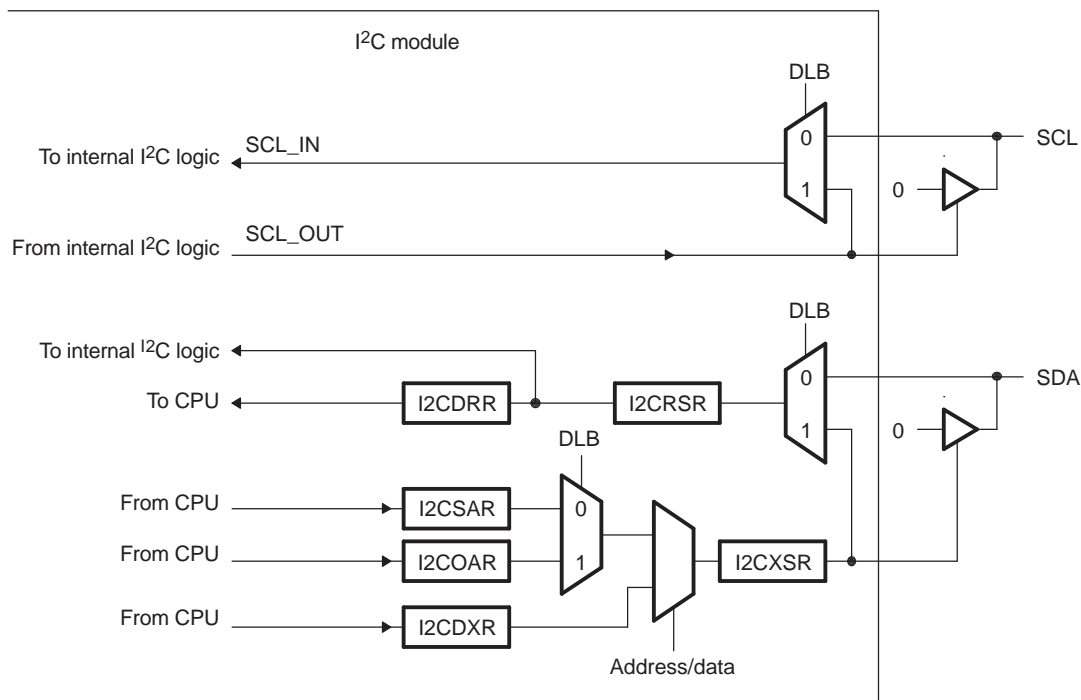
**Figure 19-13. Arbitration Procedure Between Two Master-Transmitters**


### 19.3.9 Digital Loopback Mode

The I2C module support a self-test mode called digital loopback, which is enabled by setting the DLB bit in the I2CMDR register. In this mode, data transmitted out of the I2CDXR register is received in the I2CDRR register. The data follows an internal path, and takes  $n$  cycles to reach I2CDRR, where:

$$n = 8 * (\text{I2C input clock frequency}) / (\text{Module clock frequency})$$

The transmit clock and the receive clock are the same. The address seen on the external SDA pin is the address in the I2COAR register. [Figure 19-14](#) shows the signal routing in digital loopback mode.

**Figure 19-14. Pin Diagram Showing the Effects of the Digital Loopback Mode (DLB) Bit**


**NOTE:** The free data format (I2CMDR.FDF = 1) is not supported in digital loopback mode.

## 19.4 Interrupt Requests Generated by the I2C Module

The I2C module can generate seven types of basic interrupt requests, which are described in [Section 19.4.1](#). Two of these can tell the CPU when to write transmit data and when to read receive data. If you want the FIFOs to handle transmit and receive data, you can also use the FIFO interrupts described in [Section 19.4.2](#). The basic I2C interrupts are combined to form PIE Group 8, Interrupt 1 (I2CINT1A\_ISR), and the FIFO interrupts are combined to form PIE Group 8, Interrupt 2 (I2CINT2A\_ISR).

### 19.4.1 Basic I2C Interrupt Requests

The I2C module generates the interrupt requests described in [Table 19-6](#). As shown in [Figure 19-15](#), all requests are multiplexed through an arbiter to a single I2C interrupt request to the CPU. Each interrupt request has a flag bit in the status register (I2CSTR) and an enable bit in the interrupt enable register (I2CIER). When one of the specified events occurs, its flag bit is set. If the corresponding enable bit is 0, the interrupt request is blocked. If the enable bit is 1, the request is forwarded to the CPU as an I2C interrupt.

The I2C interrupt is one of the maskable interrupts of the CPU. As with any maskable interrupt request, if it is properly enabled in the CPU, the CPU executes the corresponding interrupt service routine (I2CINT1A\_ISR). The I2CINT1A\_ISR for the I2C interrupt can determine the interrupt source by reading the interrupt source register, I2CISRC. Then the I2CINT1A\_ISR can branch to the appropriate subroutine.

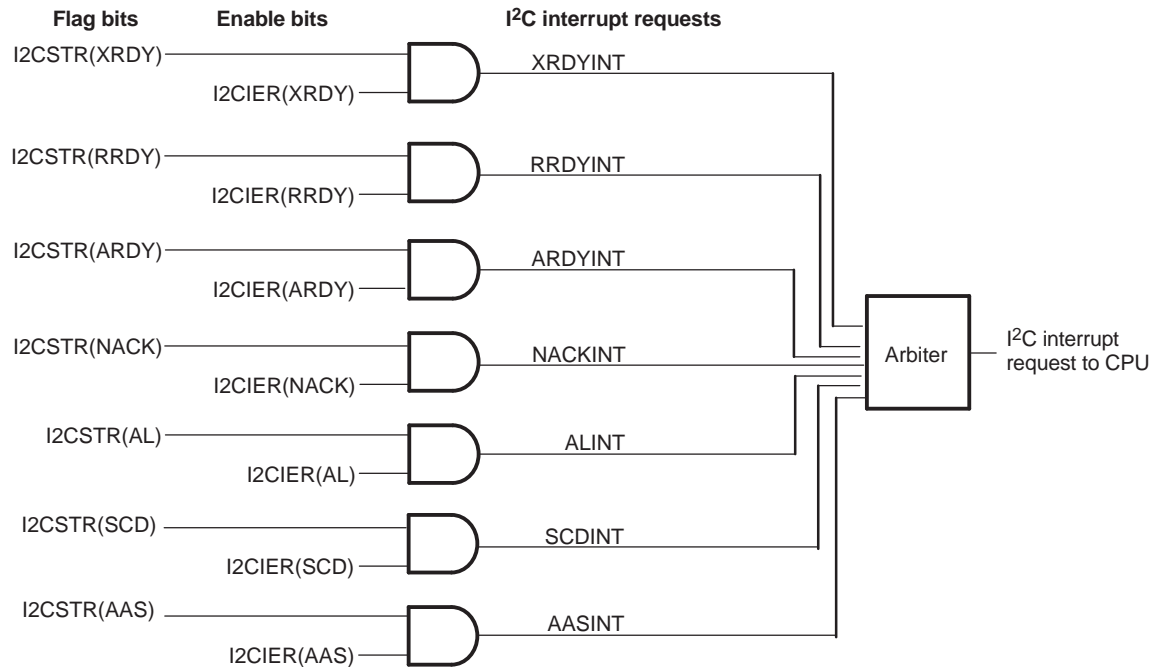
After the CPU reads I2CISRC, the following events occur:

1. The flag for the source interrupt is cleared in I2CSTR. Exception: The ARDY, RRDY, and XRDY bits in I2CSTR are not cleared when I2CISRC is read. To clear one of these bits, write a 1 to it.
2. The arbiter determines which of the remaining interrupt requests has the highest priority, writes the code for that interrupt to I2CISRC, and forwards the interrupt request to the CPU.

**Table 19-6. Descriptions of the Basic I2C Interrupt Requests**

I2C Interrupt Request	Interrupt Source
XRDYINT	<p>Transmit ready condition: The data transmit register (I2CDXR) is ready to accept new data because the previous data has been copied from I2CDXR to the transmit shift register (I2CXS).</p> <p>As an alternative to using XRDYINT, the CPU can poll the XRDY bit of the status register, I2CSTR. XRDYINT should not be used when in FIFO mode. Use the FIFO interrupts instead.</p>
RRDYINT	<p>Receive ready condition: The data receive register (I2CDRR) is ready to be read because data has been copied from the receive shift register (I2CRSR) to I2CDRR.</p> <p>As an alternative to using RRDYINT, the CPU can poll the RRDY bit of I2CSTR. RRDYINT should not be used when in FIFO mode. Use the FIFO interrupts instead.</p>
ARDYINT	<p>Register-access ready condition: The I2C module registers are ready to be accessed because the previously programmed address, data, and command values have been used.</p> <p>The specific events that generate ARDYINT are the same events that set the ARDY bit of I2CSTR.</p> <p>As an alternative to using ARDYINT, the CPU can poll the ARDY bit.</p>
NACKINT	<p>No-acknowledgment condition: The I2C module is configured as a master-transmitter and did not receive acknowledgment from the slave-receiver.</p> <p>As an alternative to using NACKINT, the CPU can poll the NACK bit of I2CSTR.</p>
ALINT	<p>Arbitration-lost condition: The I2C module has lost an arbitration contest with another master-transmitter.</p> <p>As an alternative to using ALINT, the CPU can poll the AL bit of I2CSTR.</p>
SCDINT	<p>Stop condition detected: A STOP condition was detected on the I2C bus.</p> <p>As an alternative to using SCDINT, the CPU can poll the SCD bit of the status register, I2CSTR.</p>
AASINT	<p>Addressed as slave condition: The I2C has been addressed as a slave device by another master on the I2C bus.</p> <p>As an alternative to using AASINT, the CPU can poll the AAS bit of the status register, I2CSTR.</p>



**Figure 19-15. Enable Paths of the I2C Interrupt Requests**


### 19.4.2 I2C FIFO Interrupts

In addition to the seven basic I2C interrupts, the transmit and receive FIFOs each contain the ability to generate an interrupt (I2CINT2A). The transmit FIFO can be configured to generate an interrupt after transmitting a defined number of bytes, up to 16. The receive FIFO can be configured to generate an interrupt after receiving a defined number of bytes, up to 16. These two interrupt sources are ORed together into a single maskable CPU interrupt. The interrupt service routine can then read the FIFO interrupt status flags to determine from which source the interrupt came. See the I2C transmit FIFO register (I2CFFTX) and the I2C receive FIFO register (I2CFFRX) descriptions.



## 19.5 Resetting or Disabling the I2C Module

You can reset or disable the I2C module in two ways:

- Write 0 to the I2C reset bit (IRS) in the I2C mode register (I2CMDR). All status bits (in I2CSTR) are forced to their default values, and the I2C module remains disabled until IRS is changed to 1. The SDA and SCL pins are in the high-impedance state.
- Initiate a device reset by driving the  $\overline{\text{XRS}}$  pin low. The entire device is reset and is held in the reset state until you drive the pin high. When the  $\overline{\text{XRS}}$  pin is released, all I2C module registers are reset to their default values. The IRS bit is forced to 0, which resets the I2C module. The I2C module stays in the reset state until you write 1 to IRS.

The IRS must be 0 while you configure or reconfigure the I2C module. Forcing IRS to 0 can be used to save power and to clear error conditions.

## 19.6 Registers

### 19.6.1 I2C Base Addresses

**Table 19-7. I2C Base Address Table**

Device Registers	Register Names	Start Address	End Address
I2caRegs	I2C_REGS	0x0000_7300	0x0000_733F
I2cbRegs	I2C_REGS	0x0000_7340	0x0000_737F

## 19.6.2 I2C\_REGS Registers

Table 19-8 lists the memory-mapped registers for the I2C\_REGS. All register offset addresses not listed in Table 19-8 should be considered as reserved locations and the register contents should not be modified.

**Table 19-8. I2C\_REGS Registers**

Offset	Acronym	Register Name	Write Protection	Section
0h	I2COAR	I2C Own address		<a href="#">Go</a>
1h	I2CIER	I2C Interrupt Enable		<a href="#">Go</a>
2h	I2CSTR	I2C Status		<a href="#">Go</a>
3h	I2CCLKL	I2C Clock low-time divider		<a href="#">Go</a>
4h	I2CCLKH	I2C Clock high-time divider		<a href="#">Go</a>
5h	I2CCNT	I2C Data count		<a href="#">Go</a>
6h	I2CDRR	I2C Data receive		<a href="#">Go</a>
7h	I2CSAR	I2C Slave address		<a href="#">Go</a>
8h	I2CDXR	I2C Data Transmit		<a href="#">Go</a>
9h	I2CMDR	I2C Mode		<a href="#">Go</a>
Ah	I2CISRC	I2C Interrupt Source		<a href="#">Go</a>
Bh	I2CEMDR	I2C Extended Mode		<a href="#">Go</a>
Ch	I2CPSC	I2C Prescaler		<a href="#">Go</a>
20h	I2CFFTX	I2C FIFO Transmit		<a href="#">Go</a>
21h	I2CFFRX	I2C FIFO Receive		<a href="#">Go</a>

Complex bit access types are encoded to fit into small table cells. Table 19-9 shows the codes that are used for access types in this section.

**Table 19-9. I2C\_REGS Access Type Codes**

Access Type	Code	Description
<b>Read Type</b>		
R	R	Read
<b>Write Type</b>		
W	W	Write
<b>Reset or Default Value</b>		
-n		Value after reset or the default value
<b>Register Array Variables</b>		
i,j,k,l,m,n		When these variables are used in a register name, an offset, or an address, they refer to the value of a register array where the register is part of a group of repeating registers. The register groups form a hierarchical structure and the array is represented with a formula.
y		When this variable is used in a register name, an offset, or an address it refers to the value of a register array.

### 19.6.2.1 I2COAR Register (Offset = 0h) [reset = 0h]

I2COAR is shown in [Figure 19-16](#) and described in [Table 19-10](#).

Return to [Summary Table](#).

I2C Own address

**Figure 19-16. I2COAR Register**

15	14	13	12	11	10	9	8
RESERVED						OAR	
R-0h						R/W-0h	
7	6	5	4	3	2	1	0
OAR							
R/W-0h							

**Table 19-10. I2COAR Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-10	RESERVED	R	0h	Reserved
9-0	OAR	R/W	0h	In 7-bit addressing mode (XA = 0 in I2CMDR): 00h-7Fh Bits 6-0 provide the 7-bit slave address of the I2C module. Write 0s to bits 9-7. In 10-bit addressing mode (XA = 1 in I2CMDR): 000h-3FFh Bits 9-0 provide the 10-bit slave address of the I2C module. Reset type: SYSRSn

**19.6.2.2 I2CIER Register (Offset = 1h) [reset = 0h]**

I2CIER is shown in [Figure 19-17](#) and described in [Table 19-11](#).

Return to [Summary Table](#).

I2C Interrupt Enable

**Figure 19-17. I2CIER Register**

15	14	13	12	11	10	9	8
RESERVED							
R-0h							
7	6	5	4	3	2	1	0
RESERVED	AAS	SCD	XRDY	RRDY	ARDY	NACK	ARBL
R-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h

**Table 19-11. I2CIER Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-7	RESERVED	R	0h	Reserved
6	AAS	R/W	0h	Addressed as slave interrupt enable Reset type: SYSRSn 0h (R/W) = Interrupt request disabled 1h (R/W) = Interrupt request enabled
5	SCD	R/W	0h	Stop condition detected interrupt enable Reset type: SYSRSn 0h (R/W) = Interrupt request disabled 1h (R/W) = Interrupt request enabled
4	XRDY	R/W	0h	Transmit-data-ready interrupt enable bit. This bit should not be set when using FIFO mode. Reset type: SYSRSn 0h (R/W) = Interrupt request disabled 1h (R/W) = Interrupt request enabled
3	RRDY	R/W	0h	Receive-data-ready interrupt enable bit. This bit should not be set when using FIFO mode. Reset type: SYSRSn 0h (R/W) = Interrupt request disabled 1h (R/W) = Interrupt request enabled
2	ARDY	R/W	0h	Register-access-ready interrupt enable Reset type: SYSRSn 0h (R/W) = Interrupt request disabled 1h (R/W) = Interrupt request enabled
1	NACK	R/W	0h	No-acknowledgment interrupt enable Reset type: SYSRSn 0h (R/W) = Interrupt request disabled 1h (R/W) = Interrupt request enabled
0	ARBL	R/W	0h	Arbitration-lost interrupt enable Reset type: SYSRSn 0h (R/W) = Interrupt request disabled 1h (R/W) = Interrupt request enabled

### 19.6.2.3 I2CSTR Register (Offset = 2h) [reset = 0h]

I2CSTR is shown in [Figure 19-18](#) and described in [Table 19-12](#).

Return to [Summary Table](#).

I2C Status

**Figure 19-18. I2CSTR Register**

15		14		13		12		11		10		9		8	
RESERVED		SDIR		NACKSNT		BB		RSFULL		XSMT		AAS		AD0	
R-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	
7		6		5		4		3		2		1		0	
RESERVED				SCD		XRDY		RRDY		ARDY		NACK		ARBL	
R/W-0h				R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	

**Table 19-12. I2CSTR Register Field Descriptions**

Bit	Field	Type	Reset	Description
15	RESERVED	R	0h	Reserved
14	SDIR	R/W	0h	Slave direction bit Reset type: SYSRSn 0h (R/W) = I2C is not addressed as a slave transmitter. SDIR is cleared by one of the following events: <ul style="list-style-type: none"> <li>- It is manually cleared. To clear this bit, write a 1 to it.</li> <li>- Digital loopback mode is enabled.</li> <li>- A START or STOP condition occurs on the I2C bus.</li> </ul> 1h (R/W) = I2C is addressed as a slave transmitter.
13	NACKSNT	R/W	0h	NACK sent bit. This bit is used when the I2C module is in the receiver mode. One instance in which NACKSNT is affected is when the NACK mode is used (see the description for NACKMOD in Reset type: SYSRSn 0h (R/W) = NACK not sent. NACKSNT bit is cleared by any one of the following events: <ul style="list-style-type: none"> <li>- It is manually cleared. To clear this bit, write a 1 to it.</li> <li>- The I2C module is reset (either when 0 is written to the IRS bit of I2CMDR or when the whole device is reset).</li> </ul> 1h (R/W) = NACK sent: A no-acknowledge bit was sent during the acknowledge cycle on the I2C-bus.
12	BB	R/W	0h	Bus busy bit. BB indicates whether the I2C-bus is busy or is free for another data transfer. See the paragraph following the table for more information Reset type: SYSRSn 0h (R/W) = Bus free. BB is cleared by any one of the following events: <ul style="list-style-type: none"> <li>- The I2C module receives or transmits a STOP bit (bus free).</li> <li>- The I2C module is reset.</li> </ul> 1h (R/W) = Bus busy: The I2C module has received or transmitted a START bit on the bus.

**Table 19-12. I2CSTR Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
11	RSFULL	R/W	0h	<p>Receive shift register full bit.</p> <p>RSFULL indicates an overrun condition during reception. Overrun occurs when new data is received into the shift register (I2CRSR) and the old data has not been read from the receive register (I2CDRR). As new bits arrive from the SDA pin, they overwrite the bits in I2CRSR. The new data will not be copied to ICDRR until the previous data is read.</p> <p>Reset type: SYSRSn</p> <p>0h (R/W) = No overrun detected. RSFULL is cleared by any one of the following events:</p> <ul style="list-style-type: none"> <li>- I2CDRR is read is read by the CPU. Emulator reads of the I2CDRR do not affect this bit.</li> <li>- The I2C module is reset.</li> </ul> <p>1h (R/W) = Overrun detected</p>
10	XSMT	R/W	0h	<p>Transmit shift register empty bit.</p> <p>XSMT = 0 indicates that the transmitter has experienced underflow. Underflow occurs when the transmit shift register (I2CXSR) is empty but the data transmit register (I2CDXR) has not been loaded since the last I2CDXR-to-I2CXSR transfer. The next I2CDXR-to-I2CXSR transfer will not occur until new data is in I2CDXR. If new data is not transferred in time, the previous data may be re-transmitted on the SDA pin.</p> <p>Reset type: SYSRSn</p> <p>0h (R/W) = Underflow detected (empty)</p> <p>1h (R/W) = No underflow detected (not empty). XSMT is set by one of the following events:</p> <ul style="list-style-type: none"> <li>- Data is written to I2CDXR.</li> <li>- The I2C module is reset</li> </ul>
9	AAS	R/W	0h	<p>Addressed-as-slave bit</p> <p>Reset type: SYSRSn</p> <p>0h (R/W) = In the 7-bit addressing mode, the AAS bit is cleared when receiving a NACK, a STOP condition, or a repeated START condition. In the 10-bit addressing mode, the AAS bit is cleared when receiving a NACK, a STOP condition, or by a slave address different from the I2C peripheral's own slave address.</p> <p>1h (R/W) = The I2C module has recognized its own slave address or an address of all zeros (general call).</p>
8	AD0	R/W	0h	<p>Address 0 bits</p> <p>Reset type: SYSRSn</p> <p>0h (R/W) = AD0 has been cleared by a START or STOP condition.</p> <p>1h (R/W) = An address of all zeros (general call) is detected.</p>
7-6	RESERVED	R/W	0h	Reserved

**Table 19-12. I2CSTR Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
5	SCD	R/W	0h	<p>Stop condition detected bit.</p> <p>SCD is set when the I2C sends or receives a STOP condition. The I2C module delays clearing of the I2CMDR[STP] bit until the SCD bit is set.</p> <p>Reset type: SYSRSn</p> <p>0h (R/W) = STOP condition not detected since SCD was last cleared. SCD is cleared by any one of the following events:</p> <ul style="list-style-type: none"> <li>- I2CISRC is read by the CPU when it contains the value 110b (stop condition detected). Emulator reads of the I2CISRC do not affect this bit.</li> <li>- SCD is manually cleared. To clear this bit, write a 1 to it.</li> <li>- The I2C module is reset.</li> </ul> <p>1h (R/W) = A STOP condition has been detected on the I2C bus.</p>
4	XRDY	R/W	0h	<p>Transmit-data-ready interrupt flag bit.</p> <p>When not in FIFO mode, XRDY indicates that the data transmit register (I2CDXR) is ready to accept new data because the previous data has been copied from I2CDXR to the transmit shift register (I2CXSR). The CPU can poll XRDY or use the XRDY interrupt request. When in FIFO mode, use TXFFINT instead.</p> <p>Reset type: SYSRSn</p> <p>0h (R/W) = I2CDXR not ready. XRDY is cleared when data is written to I2CDXR.</p> <p>1h (R/W) = I2CDXR ready: Data has been copied from I2CDXR to I2CXSR.</p> <p>XRDY is also forced to 1 when the I2C module is reset.</p>
3	RRDY	R/W	0h	<p>Receive-data-ready interrupt flag bit.</p> <p>When not in FIFO mode, RRDY indicates that the data receive register (I2CDRR) is ready to be read because data has been copied from the receive shift register (I2CRSR) to I2CDRR. The CPU can poll RRDY or use the RRDY interrupt request. When in FIFO mode, use RXFFINT instead.</p> <p>Reset type: SYSRSn</p> <p>0h (R/W) = I2CDRR not ready. RRDY is cleared by any one of the following events:</p> <ul style="list-style-type: none"> <li>- I2CDRR is read by the CPU. Emulator reads of the I2CDRR do not affect this bit.</li> <li>- RRDY is manually cleared. To clear this bit, write a 1 to it.</li> <li>- The I2C module is reset.</li> </ul> <p>1h (R/W) = I2CDRR ready: Data has been copied from I2CRSR to I2CDRR.</p>



**Table 19-12. I2CSTR Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
2	ARDY	R/W	0h	<p>Register-access-ready interrupt flag bit (only applicable when the I2C module is in the master mode).</p> <p>ARDY indicates that the I2C module registers are ready to be accessed because the previously programmed address, data, and command values have been used. The CPU can poll ARDY or use the ARDY interrupt request</p> <p>Reset type: SYSRSn</p> <p>0h (R/W) = The registers are not ready to be accessed. ARDY is cleared by any one of the following events:</p> <ul style="list-style-type: none"> <li>- The I2C module starts using the current register contents.</li> <li>- ARDY is manually cleared. To clear this bit, write a 1 to it.</li> <li>- The I2C module is reset.</li> </ul> <p>1h (R/W) = The registers are ready to be accessed.</p> <p>In the nonrepeat mode (RM = 0 in I2CMDR): If STP = 0 in I2CMDR, the ARDY bit is set when the internal data counter counts down to 0. If STP = 1, ARDY is not affected (instead, the I2C module generates a STOP condition when the counter reaches 0).</p> <p>In the repeat mode (RM = 1): ARDY is set at the end of each byte transmitted from I2CDXR.</p>
1	NACK	R/W	0h	<p>No-acknowledgment interrupt flag bit.</p> <p>NACK applies when the I2C module is a transmitter (master or slave). NACK indicates whether the I2C module has detected an acknowledge bit (ACK) or a noacknowledge bit (NACK) from the receiver. The CPU can poll NACK or use the NACK interrupt request</p> <p>Reset type: SYSRSn</p> <p>0h (R/W) = ACK received/NACK not received. This bit is cleared by any one of the following events:</p> <ul style="list-style-type: none"> <li>- An acknowledge bit (ACK) has been sent by the receiver.</li> <li>- NACK is manually cleared. To clear this bit, write a 1 to it.</li> <li>- The CPU reads the interrupt source register (I2CISRC) and the register contains the code for a NACK interrupt. Emulator reads of the I2CISRC do not affect this bit.</li> <li>- The I2C module is reset.</li> </ul> <p>1h (R/W) = NACK bit received. The hardware detects that a no-acknowledge (NACK) bit has been received.</p> <p>Note: While the I2C module performs a general call transfer, NACK is 1, even if one or more slaves send acknowledgment.</p>

**Table 19-12. I2CSTR Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
0	ARBL	R/W	0h	<p>Arbitration-lost interrupt flag bit (only applicable when the I2C module is a master-transmitter).</p> <p>AL primarily indicates when the I2C module has lost an arbitration contest with another mastertransmitter. The CPU can poll AL or use the AL interrupt request</p> <p>Reset type: SYSRSn</p> <p>0h (R/W) = Arbitration not lost. AL is cleared by any one of the following events:</p> <ul style="list-style-type: none"> <li>- AL is manually cleared. To clear this bit, write a 1 to it.</li> <li>- The CPU reads the interrupt source register (I2CISRC) and the register contains the code for an</li> </ul> <p>AL interrupt. Emulator reads of the I2CISRC do not affect this bit.</p> <ul style="list-style-type: none"> <li>- The I2C module is reset.</li> </ul> <p>1h (R/W) = Arbitration lost. AL is set by any one of the following events:</p> <ul style="list-style-type: none"> <li>- The I2C module senses that it has lost an arbitration with two or more competing transmitters that started a transmission almost simultaneously.</li> <li>- The I2C module attempts to start a transfer while the BB (bus busy) bit is set to 1.</li> </ul> <p>When AL becomes 1, the MST and STP bits of I2CMDR are cleared, and the I2C module becomes a slave-receiver.</p>

#### 19.6.2.4 I2CCLKL Register (Offset = 3h) [reset = 0h]

I2CCLKL is shown in [Figure 19-19](#) and described in [Table 19-13](#).

Return to [Summary Table](#).

I2C Clock low-time divider

**Figure 19-19. I2CCLKL Register**

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
I2CCLKL															
R/W-0h															

**Table 19-13. I2CCLKL Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-0	I2CCLKL	R/W	0h	<p>Clock low-time divide-down value.</p> <p>To produce the low time duration of the master clock, the period of the module clock is multiplied by (ICCL + d). d is an adjustment factor based on the prescaler. See the Clock Divider Registers section of the Introduction for details.</p> <p>Note: These bits must be set to a non-zero value for proper I2C clock generation.</p> <p>Reset type: SYSRSn</p>

### 19.6.2.5 I2CCLKH Register (Offset = 4h) [reset = 0h]

I2CCLKH is shown in [Figure 19-20](#) and described in [Table 19-14](#).

Return to [Summary Table](#).

I2C Clock high-time divider

**Figure 19-20. I2CCLKH Register**

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
I2CCLKH															
R/W-0h															

**Table 19-14. I2CCLKH Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-0	I2CCLKH	R/W	0h	Clock high-time divide-down value. To produce the high time duration of the master clock, the period of the module clock is multiplied by (ICCL + d). d is an adjustment factor based on the prescaler. See the Clock Divider Registers section of the Introduction for details. Note: These bits must be set to a non-zero value for proper I2C clock generation. Reset type: SYSRSn

**19.6.2.6 I2CCNT Register (Offset = 5h) [reset = 0h]**

I2CCNT is shown in [Figure 19-21](#) and described in [Table 19-15](#).

Return to [Summary Table](#).

I2C Data count

**Figure 19-21. I2CCNT Register**

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
I2CCNT															
R/W-0h															

**Table 19-15. I2CCNT Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-0	I2CCNT	R/W	0h	Data count value. ICDC indicates the number of data bytes to transfer or receive. The value in I2CCNT is a don't care when the RM bit in I2CMR is set to 1. The start value loaded to the internal data counter is 65536. The start value loaded to internal data counter is 1-65535. Reset type: SYSRSt

### 19.6.2.7 I2CDRR Register (Offset = 6h) [reset = 0h]

I2CDRR is shown in [Figure 19-22](#) and described in [Table 19-16](#).

Return to [Summary Table](#).

I2C Data receive

**Figure 19-22. I2CDRR Register**

15	14	13	12	11	10	9	8
RESERVED							
R-0h							
7	6	5	4	3	2	1	0
DATA							
R-0h							

**Table 19-16. I2CDRR Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-8	RESERVED	R	0h	Reserved
7-0	DATA	R	0h	Receive data Reset type: SYSRSn

**19.6.2.8 I2CSAR Register (Offset = 7h) [reset = 3FFh]**

I2CSAR is shown in [Figure 19-23](#) and described in [Table 19-17](#).

Return to [Summary Table](#).

I2C Slave address

**Figure 19-23. I2CSAR Register**

15	14	13	12	11	10	9	8
RESERVED						SAR	
R-0h						R/W-3FFh	
7	6	5	4	3	2	1	0
SAR							
R/W-3FFh							

**Table 19-17. I2CSAR Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-10	RESERVED	R	0h	Reserved
9-0	SAR	R/W	3FFh	<p>In 7-bit addressing mode (XA = 0 in I2CMDR): 00h-7Fh Bits 6-0 provide the 7-bit slave address that the I2C module transmits when it is in the master-transmitter mode. Write 0s to bits 9-7.</p> <p>In 10-bit addressing mode (XA = 1 in I2CMDR): 000h-3FFh Bits 9-0 provide the 10-bit slave address that the I2C module transmits when it is in the master transmitter mode. Reset type: SYSRSn</p>

**19.6.2.9 I2CDXR Register (Offset = 8h) [reset = 0h]**

I2CDXR is shown in [Figure 19-24](#) and described in [Table 19-18](#).

Return to [Summary Table](#).

I2C Data Transmit

**Figure 19-24. I2CDXR Register**

15	14	13	12	11	10	9	8
RESERVED							
R-0h							
7	6	5	4	3	2	1	0
DATA							
R/W-0h							

**Table 19-18. I2CDXR Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-8	RESERVED	R	0h	Reserved
7-0	DATA	R/W	0h	Transmit data Reset type: SYSRStn



### 19.6.2.10 I2CMDR Register (Offset = 9h) [reset = 0h]

I2CMDR is shown in [Figure 19-25](#) and described in [Table 19-19](#).

Return to [Summary Table](#).

I2C Mode

**Figure 19-25. I2CMDR Register**

15		14		13		12		11		10		9		8	
NACKMOD		FREE		STT		RESERVED		STP		MST		TRX		XA	
R/W-0h		R/W-0h		R/W-0h		R-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h	
7		6		5		4		3		2		1		0	
RM		DLB		IRS		STB		FDF		BC					
R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h		R/W-0h			

**Table 19-19. I2CMDR Register Field Descriptions**

Bit	Field	Type	Reset	Description
15	NACKMOD	R/W	0h	<p>NACK mode bit.</p> <p>This bit is only applicable when the I2C module is acting as a receiver.</p> <p>Reset type: SYSRSn</p> <p>0h (R/W) = In the slave-receiver mode: The I2C module sends an acknowledge (ACK) bit to the transmitter during each acknowledge cycle on the bus. The I2C module only sends a no-acknowledge (NACK) bit if you set the NACKMOD bit.</p> <p>In the master-receiver mode: The I2C module sends an ACK bit during each acknowledge cycle until the internal data counter counts down to 0. At that point, the I2C module sends a NACK bit to the transmitter. To have a NACK bit sent earlier, you must set the NACKMOD bit</p> <p>1h (R/W) = In either slave-receiver or master-receiver mode: The I2C module sends a NACK bit to the transmitter during the next acknowledge cycle on the bus. Once the NACK bit has been sent, NACKMOD is cleared.</p> <p>Important: To send a NACK bit in the next acknowledge cycle, you must set NACKMOD before the rising edge of the last data bit.</p>
14	FREE	R/W	0h	<p>This bit controls the action taken by the I2C module when a debugger breakpoint is encountered.</p> <p>Reset type: SYSRSn</p> <p>0h (R/W) = When I2C module is master:</p> <p>If SCL is low when the breakpoint occurs, the I2C module stops immediately and keeps driving SCL low, whether the I2C module is the transmitter or the receiver. If SCL is high, the I2C module waits until SCL becomes low and then stops.</p> <p>When I2C module is slave:</p> <p>A breakpoint forces the I2C module to stop when the current transmission/reception is complete.</p> <p>1h (R/W) = The I2C module runs free that is, it continues to operate when a breakpoint occurs.</p>
13	STT	R/W	0h	<p>START condition bit (only applicable when the I2C module is a master). The RM, STT, and STP bits determine when the I2C module starts and stops data transmissions (see Table 9-6). Note that the STT and STP bits can be used to terminate the repeat mode, and that this bit is not writable when IRS = 0.</p> <p>Reset type: SYSRSn</p> <p>0h (R/W) = In the master mode, STT is automatically cleared after the START condition has been generated.</p> <p>1h (R/W) = In the master mode, setting STT to 1 causes the I2C module to generate a START condition on the I2C-bus</p>

**Table 19-19. I2CMDR Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
12	RESERVED	R	0h	Reserved
11	STP	R/W	0h	<p>STOP condition bit (only applicable when the I2C module is a master).</p> <p>In the master mode, the RM,STT, and STP bits determine when the I2C module starts and stops data transmissions.</p> <p>Note that the STT and STP bits can be used to terminate the repeat mode, and that this bit is not writable when IRS=0. When in non-repeat mode, at least one byte must be transferred before a stop condition can be generated. The I2C module delays clearing of this bit until after the I2CSTR[SCD] bit is set. To avoid disrupting the I2C state machine, the user must wait until this bit is clear before initiating a new message.</p> <p>Reset type: SYSRSn</p> <p>0h (R/W) = STP is automatically cleared after the STOP condition has been generated</p> <p>1h (R/W) = STP has been set by the device to generate a STOP condition when the internal data counter of the I2C module counts down to 0.</p>
10	MST	R/W	0h	<p>Master mode bit.</p> <p>MST determines whether the I2C module is in the slave mode or the master mode. MST is automatically changed from 1 to 0 when the I2C master generates a STOP condition</p> <p>Reset type: SYSRSn</p> <p>0h (R/W) = Slave mode. The I2C module is a slave and receives the serial clock from the master.</p> <p>1h (R/W) = Master mode. The I2C module is a master and generates the serial clock on the SCL pin.</p>
9	TRX	R/W	0h	<p>Transmitter mode bit.</p> <p>When relevant, TRX selects whether the I2C module is in the transmitter mode or the receiver mode.</p> <p>Reset type: SYSRSn</p> <p>0h (R/W) = Receiver mode. The I2C module is a receiver and receives data on the SDA pin.</p> <p>1h (R/W) = Transmitter mode. The I2C module is a transmitter and transmits data on the SDA pin.</p>
8	XA	R/W	0h	<p>Expanded address enable bit.</p> <p>Reset type: SYSRSn</p> <p>0h (R/W) = 7-bit addressing mode (normal address mode). The I2C module transmits 7-bit slave addresses (from bits 6-0 of I2CSAR), and its own slave address has 7 bits (bits 6-0 of I2COAR).</p> <p>1h (R/W) = 10-bit addressing mode (expanded address mode). The I2C module transmits 10-bit slave addresses (from bits 9-0 of I2CSAR), and its own slave address has 10 bits (bits 9-0 of I2COAR).</p>
7	RM	R/W	0h	<p>Repeat mode bit (only applicable when the I2C module is a master-transmitter).</p> <p>The RM, STT, and STP bits determine when the I2C module starts and stops data transmissions</p> <p>Reset type: SYSRSn</p> <p>0h (R/W) = Nonrepeat mode. The value in the data count register (I2CCNT) determines how many bytes are received/transmitted by the I2C module.</p> <p>1h (R/W) = Repeat mode. A data byte is transmitted each time the I2CDXR register is written to (or until the transmit FIFO is empty when in FIFO mode) until the STP bit is manually set. The value of I2CCNT is ignored. The ARDY bit/interrupt can be used to determine when the I2CDXR (or FIFO) is ready for more data, or when the data has all been sent and the CPU is allowed to write to the STP bit.</p>

**Table 19-19. I2CMDR Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
6	DLB	R/W	0h	<p>Digital loopback mode bit.</p> <p>Reset type: SYSRSn</p> <p>0h (R/W) = Digital loopback mode is disabled.</p> <p>1h (R/W) = Digital loopback mode is enabled. For proper operation in this mode, the MST bit must be 1.</p> <p>In the digital loopback mode, data transmitted out of I2CDXR is received in I2CDRR after n device cycles by an internal path, where:</p> $n = ((I2C \text{ input clock frequency} / \text{module clock frequency}) \times 8)$ <p>The transmit clock is also the receive clock. The address transmitted on the SDA pin is the address in I2COAR.</p> <p>Note: The free data format (FDF = 1) is not supported in the digital loopback mode.</p>
5	IRS	R/W	0h	<p>I2C module reset bit.</p> <p>Reset type: SYSRSn</p> <p>0h (R/W) = The I2C module is in reset/disabled. When this bit is cleared to 0, all status bits (in I2CSTR) are set to their default values.</p> <p>1h (R/W) = The I2C module is enabled. This has the effect of releasing the I2C bus if the I2C peripheral is holding it.</p>
4	STB	R/W	0h	<p>START byte mode bit. This bit is only applicable when the I2C module is a master. As described in version 2.1 of the Philips Semiconductors I2C-bus specification, the START byte can be used to help a slave that needs extra time to detect a START condition. When the I2C module is a slave, it ignores a START byte from a master, regardless of the value of the STB bit.</p> <p>Reset type: SYSRSn</p> <p>0h (R/W) = The I2C module is not in the START byte mode.</p> <p>1h (R/W) = The I2C module is in the START byte mode. When you set the START condition bit (STT), the I2C module begins the transfer with more than just a START condition. Specifically, it generates:</p> <ol style="list-style-type: none"> <li>1. A START condition</li> <li>2. A START byte (0000 0001b)</li> <li>3. A dummy acknowledge clock pulse</li> <li>4. A repeated START condition</li> </ol> <p>Then, as normal, the I2C module sends the slave address that is in I2CSAR.</p>
3	FDF	R/W	0h	<p>Free data format mode bit.</p> <p>Reset type: SYSRSn</p> <p>0h (R/W) = Free data format mode is disabled. Transfers use the 7-/10-bit addressing format selected by the XA bit.</p> <p>1h (R/W) = Free data format mode is enabled. Transfers have the free data (no address) format described in Section 9.2.5.</p> <p>The free data format is not supported in the digital loopback mode (DLB=1).</p>

**Table 19-19. I2CMDR Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
2-0	BC	R/W	0h	<p>Bit count bits.</p> <p>BC defines the number of bits (1 to 8) in the next data byte that is to be received or transmitted by the I2C module. The number of bits selected with BC must match the data size of the other device. Notice that when BC = 000b, a data byte has 8 bits. BC does not affect address bytes, which always have 8 bits.</p> <p>Note: If the bit count is less than 8, receive data is right-justified in I2CDRR(7-0), and the other bits of I2CDRR(7-0) are undefined. Also, transmit data written to I2CDXR must be right-justified</p> <p>Reset type: SYSRSn</p> <p>0h (R/W) = 8 bits per data byte            1h (R/W) = 1 bit per data byte            2h (R/W) = 2 bits per data byte            3h (R/W) = 3 bits per data byte            4h (R/W) = 4 bits per data byte            5h (R/W) = 5 bits per data byte            6h (R/W) = 6 bits per data byte            7h (R/W) = 7 bits per data byte</p>

**19.6.2.11 I2CISRC Register (Offset = Ah) [reset = 0h]**

I2CISRC is shown in [Figure 19-26](#) and described in [Table 19-20](#).

Return to [Summary Table](#).

I2C Interrupt Source

**Figure 19-26. I2CISRC Register**

15	14	13	12	11	10	9	8
RESERVED				WRITE_ZEROS			
R-0h				R/W-0h			
7	6	5	4	3	2	1	0
RESERVED					INTCODE		
R-0h					R-0h		

**Table 19-20. I2CISRC Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-12	RESERVED	R	0h	Reserved
11-8	WRITE_ZEROS	R/W	0h	TI internal testing bits These reserved bit locations should always be written as zeros. Reset type: SYSRSn
7-3	RESERVED	R	0h	Reserved
2-0	INTCODE	R	0h	Interrupt code bits. The binary code in INTCODE indicates the event that generated an I2C interrupt.  A CPU read will clear this field. If another lower priority interrupt is pending and enabled, the value corresponding to that interrupt will then be loaded. Otherwise, the value will stay cleared.  In the case of an arbitration lost, a no-acknowledgment condition detected, or a stop condition detected, a CPU read will also clear the associated interrupt flag bit in the I2CSTR register.  Emulator reads will not affect the state of this field or of the status bits in the I2CSTR register. Reset type: SYSRSn 0h (R/W) = None 1h (R/W) = Arbitration lost 2h (R/W) = No-acknowledgment condition detected 3h (R/W) = Registers ready to be accessed 4h (R/W) = Receive data ready 5h (R/W) = Transmit data ready 6h (R/W) = Stop condition detected 7h (R/W) = Addressed as slave

**19.6.2.12 I2CEMDR Register (Offset = Bh) [reset = 0h]**

I2CEMDR is shown in [Figure 19-27](#) and described in [Table 19-21](#).

Return to [Summary Table](#).

I2C Extended Mode

**Figure 19-27. I2CEMDR Register**

15	14	13	12	11	10	9	8
RESERVED							
R-0h							
7	6	5	4	3	2	1	0
RESERVED							BC
R-0h							R/W-0h

**Table 19-21. I2CEMDR Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-1	RESERVED	R	0h	Reserved
0	BC	R/W	0h	Backwards compatibility mode. This bit affects the timing of the transmit status bits (XRDY and XSMT) in the I2CSTR register when in slave transmitter mode. Reset type: SYSRSn 0h (R/W) = See Figure 9-17 for details. 1h (R/W) = See Figure 9-17 for details.

**19.6.2.13 I2CPSC Register (Offset = Ch) [reset = 0h]**

I2CPSC is shown in [Figure 19-28](#) and described in [Table 19-22](#).

Return to [Summary Table](#).

I2C Prescaler

**Figure 19-28. I2CPSC Register**

15	14	13	12	11	10	9	8
RESERVED							
R-0h							
7	6	5	4	3	2	1	0
IPSC							
R/W-0h							

**Table 19-22. I2CPSC Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-8	RESERVED	R	0h	Reserved
7-0	IPSC	R/W	0h	<p>I2C prescaler divide-down value.</p> <p>IPSC determines how much the CPU clock is divided to create the module clock of the I2C module:</p> <p>module clock frequency = I2C input clock frequency/(IPSC + 1)</p> <p>Note: IPSC must be initialized while the I2C module is in reset (IRS = 0 in I2CMDR).</p> <p>Reset type: SYSRSn</p>

**19.6.2.14 I2CFFTX Register (Offset = 20h) [reset = 0h]**

 I2CFFTX is shown in [Figure 19-29](#) and described in [Table 19-23](#).

 Return to [Summary Table](#).

I2C FIFO Transmit

**Figure 19-29. I2CFFTX Register**

15		14		13		12		11		10		9		8	
RESERVED		I2CFFEN		TXFFRST						TXFFST					
R-0h		R/W-0h		R/W-0h						R-0h					
7		6		5		4		3		2		1		0	
TXFFINT		TXFFINTCLR		TXFFIENA						TXFFIL					
R-0h		R/W-0h		R/W-0h						R/W-0h					

**Table 19-23. I2CFFTX Register Field Descriptions**

Bit	Field	Type	Reset	Description
15	RESERVED	R	0h	Reserved
14	I2CFFEN	R/W	0h	I2C FIFO mode enable bit. This bit must be enabled for either the transmit or the receive FIFO to operate correctly. Reset type: SYSRSn 0h (R/W) = Disable the I2C FIFO mode. 1h (R/W) = Enable the I2C FIFO mode.
13	TXFFRST	R/W	0h	Transmit FIFO Reset Reset type: SYSRSn 0h (R/W) = Reset the transmit FIFO pointer to 0000 and hold the transmit FIFO in the reset state. 1h (R/W) = Enable the transmit FIFO operation.
12-8	TXFFST	R	0h	Contains the status of the transmit FIFO: xxxxx Transmit FIFO contains xxxxx bytes. 00000 Transmit FIFO is empty.  Note: Since these bits are reset to zero, the transmit FIFO interrupt flag will be set when the transmit FIFO operation is enabled and the I2C is taken out of reset. This will generate a transmit FIFO interrupt if enabled. To avoid any detrimental effects from this, write a one to the TXFFINTCLR once the transmit FIFO operation is enabled and the I2C is taken out of reset. Reset type: SYSRSn
7	TXFFINT	R	0h	Transmit FIFO interrupt flag. This bit cleared by a CPU write of a 1 to the TXFFINTCLR bit. If the TXFFIENA bit is set, this bit will generate an interrupt when it is set. Reset type: SYSRSn 0h (R/W) = Transmit FIFO interrupt condition has not occurred. 1h (R/W) = Transmit FIFO interrupt condition has occurred.
6	TXFFINTCLR	R/W	0h	Transmit FIFO Interrupt Flag Clear Reset type: SYSRSn 0h (R/W) = Writes of zeros have no effect. Reads return a 0. 1h (R/W) = Writing a 1 to this bit clears the TXFFINT flag.
5	TXFFIENA	R/W	0h	Transmit FIFO Interrupt Enable Reset type: SYSRSn 0h (R/W) = Disabled. TXFFINT flag does not generate an interrupt when set. 1h (R/W) = Enabled. TXFFINT flag does generate an interrupt when set.



**Table 19-23. I2CFFTX Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
4-0	TXFFIL	R/W	0h	<p>Transmit FIFO interrupt level.</p> <p>These bits set the status level that will set the transmit interrupt flag. When the TXFFST4-0 bits reach a value equal to or less than these bits, the TXFFINT flag will be set. This will generate an interrupt if the TXFFIENA bit is set. Because the I2C on these devices has a 16-level transmit FIFO, these bits cannot be configured for an interrupt of more than 16 FIFO levels.</p> <p>Reset type: SYSRSn</p>

**19.6.2.15 I2CFFRX Register (Offset = 21h) [reset = 0h]**

 I2CFFRX is shown in [Figure 19-30](#) and described in [Table 19-24](#).

 Return to [Summary Table](#).

I2C FIFO Receive

**Figure 19-30. I2CFFRX Register**

15	14	13	12	11	10	9	8
RESERVED		RXFFRST					RXFFST
R-0h		R/W-0h					R-0h
7	6	5	4	3	2	1	0
RXFFINT	RXFFINTCLR	RXFFIENA					RXFFIL
R-0h	R/W-0h	R/W-0h					R/W-0h

**Table 19-24. I2CFFRX Register Field Descriptions**

Bit	Field	Type	Reset	Description
15-14	RESERVED	R	0h	Reserved
13	RXFFRST	R/W	0h	I2C receive FIFO reset bit Reset type: SYSRSn 0h (R/W) = Reset the receive FIFO pointer to 0000 and hold the receive FIFO in the reset state. 1h (R/W) = Enable the receive FIFO operation.
12-8	RXFFST	R	0h	Contains the status of the receive FIFO:  xxxxx Receive FIFO contains xxxxx bytes 00000 Receive FIFO is empty. Reset type: SYSRSn
7	RXFFINT	R	0h	Receive FIFO interrupt flag. This bit cleared by a CPU write of a 1 to the RXFFINTCLR bit. If the RXFFIENA bit is set, this bit will generate an interrupt when it is set Reset type: SYSRSn 0h (R/W) = Receive FIFO interrupt condition has not occurred. 1h (R/W) = Receive FIFO interrupt condition has occurred.
6	RXFFINTCLR	R/W	0h	Receive FIFO interrupt flag clear bit. Reset type: SYSRSn 0h (R/W) = Writes of zeros have no effect. Reads return a zero. 1h (R/W) = Writing a 1 to this bit clears the RXFFINT flag.
5	RXFFIENA	R/W	0h	Receive FIFO interrupt enable bit. Reset type: SYSRSn 0h (R/W) = Disabled. RXFFINT flag does not generate an interrupt when set. 1h (R/W) = Enabled. RXFFINT flag does generate an interrupt when set.
4-0	RXFFIL	R/W	0h	Receive FIFO interrupt level. These bits set the status level that will set the receive interrupt flag. When the RXFFST4-0 bits reach a value equal to or greater than these bits, the RXFFINT flag is set. This will generate an interrupt if the RXFFIENA bit is set.  Note: Since these bits are reset to zero, the receive FIFO interrupt flag will be set if the receive FIFO operation is enabled and the I2C is taken out of reset. This will generate a receive FIFO interrupt if enabled. To avoid this, modify these bits on the same instruction as or prior to setting the RXFFRST bit. Because the I2C on these devices has a 16-level receive FIFO, these bits cannot be configured for an interrupt of more than 16 FIFO levels. Reset type: SYSRSn

## ***Multichannel Buffered Serial Port (McBSP)***

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This document describes the multichannel buffered serial port (McBSP) of this device.

Topic	Page
20.1 Overview.....	2116
20.2 Configuring Device Pins .....	2118
20.3 McBSP Operation.....	2118
20.4 McBSP Sample Rate Generator .....	2128
20.5 McBSP Exception/Error Conditions.....	2135
20.6 Multichannel Selection Modes .....	2143
20.7 SPI Operation Using the Clock Stop Mode .....	2150
20.8 Receiver Configuration .....	2157
20.9 Transmitter Configuration .....	2176
20.10 Emulation and Reset Considerations .....	2192
20.11 Data Packing Examples .....	2195
20.12 Interrupt Generation.....	2197
20.13 McBSP Modes .....	2199
20.14 McBSP Registers .....	2201

## 20.1 Overview

This device provides up to two high-speed multichannel buffered serial ports (McBSPs) that allow direct interface to codecs and other devices in a system. The McBSP consists of a data-flow path and a control path connected to external devices by six pins as shown in [Figure 20-1](#).

Data is communicated to devices interfaced with the McBSP via the data transmit (DX) pin for transmission and via the data receive (DR) pin for reception. Control information in the form of clocking and frame synchronization is communicated via the following pins: CLKX (transmit clock), CLKR (receive clock), FSX (transmit frame synchronization), and FSR (receive frame synchronization).

The CPU and the DMA controller communicate with the McBSP through 16-bit-wide registers accessible via the internal peripheral bus. The CPU or the DMA controller writes the data to be transmitted to the data transmit registers (DXR1, DXR2). Data written to the DXRs is shifted out to DX via the transmit shift registers (XSR1, XSR2). Similarly, receive data on the DR pin is shifted into the receive shift registers (RSR1, RSR2) and copied into the receive buffer registers (RBR1, RBR2). The contents of the RBRs is then copied to the DRRs, which can be read by the CPU or the DMA controller. This allows simultaneous movement of internal and external data communications.

DRR2, RBR2, RSR2, DXR2, and XSR2 are not used (written, read, or shifted) if the serial word length is 8 bits, 12 bits, or 16 bits. For larger word lengths, these registers are needed to hold the most significant bits.

The frame and clock loop-back is implemented at chip level to enable CLKX and FSX to drive CLKR and FSR. If the loop-back is enabled, the CLKR and FSR get their signals from the CLKX and FSX pads; instead of the CLKR and FSR pins.

### 20.1.1 Features of the McBSPs

The McBSPs feature:

- Full-duplex communication
- Double-buffered transmission and triple-buffered reception, allowing a continuous data stream
- Independent clocking and framing for reception and transmission
- The capability to send interrupts to the CPU and to send DMA events to the DMA controller
- 128 channels for transmission and reception
- Multichannel selection modes that enable or disable block transfers in each of the channels
- Direct interface to industry-standard codecs, analog interface chips (AICs), and other serially connected A/D and D/A devices
- Support for external generation of clock signals and frame-synchronization signals
- A programmable sample rate generator for internal generation and control of clock signals and frame-synchronization signals
- Programmable polarity for frame-synchronization pulses and clock signals
- Direct interface to:
  - T1/E1 framers
  - IOM-2 compliant devices
  - AC97-compliant devices (the necessary multiphase frame capability is provided)
  - I2S compliant devices
  - SPI devices
- A wide selection of data sizes: 8, 12, 16, 20, 24, and 32 bits

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**NOTE:** A value of the chosen data size is referred to as a *serial word* or *word* throughout the McBSP documentation. Elsewhere, *word* is used to describe a 16-bit value.

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- $\mu$ -law and A-law companding
- The option of transmitting/receiving 8-bit data with the LSB first
- Status bits for flagging exception/error conditions

- ABIS mode is not supported.

### 20.1.2 McBSP Pins/Signals

[Table 20-1](#) describes the McBSP interface pins and some internal signals.

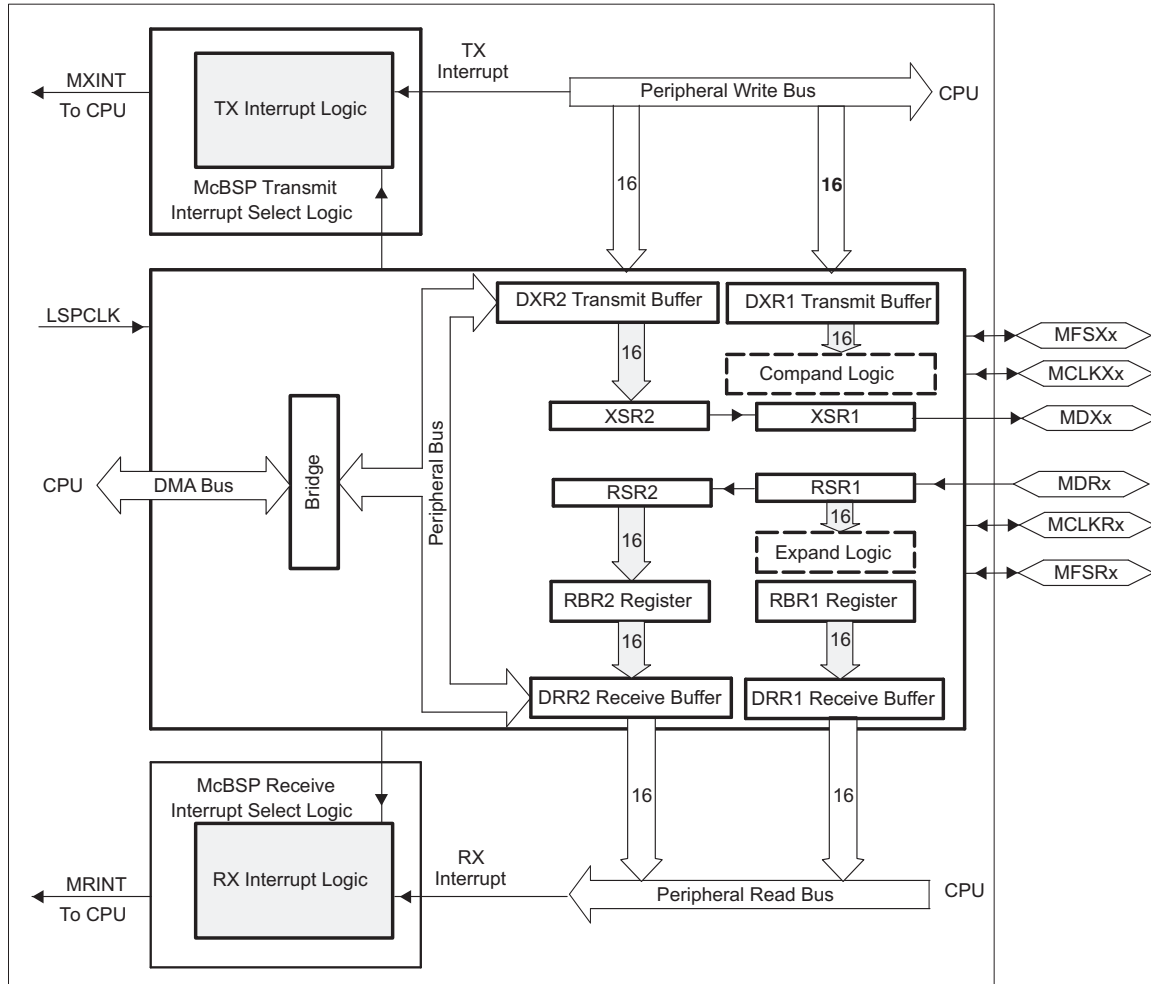
**Table 20-1. McBSP Interface Pins/Signals**

McBSP-A Pin	McBSP-B Pin	Type	Description
MCLKRA	MCLKRB	I/O	Supplying or reflecting the receive clock; supplying the input clock of the sample rate generator
MCLKXA	MCLKXB	I/O	Supplying or reflecting the transmit clock; supplying the input clock of the sample rate generator
MDRA	MDRB	I	Serial data receive pin
MDXA	MDXB	O	Serial data transmit pin
MFSRA	MFSRB	I/O	Supplying or reflecting the receive frame-sync signal; controlling sample rate generator synchronization for the case when GSYNC = 1 (see <a href="#">Section 20.4.3</a> )
MFSXA	MFSXB	I/O	Supplying or reflecting the transmit frame-sync signal
<b>CPU Interrupt Signals</b>			
MRINT			Receive interrupt to CPU
MXINT			Transmit interrupt to CPU
<b>DMA Events</b>			
REVT			Receive synchronization event to DMA
XEVT			Transmit synchronization event to DMA

### 20.1.2.1 McBSP Generic Block Diagram

The McBSP consists of a data-flow path and a control path connected to external devices by six pins as shown in Figure 20-1. The figure and the text in this section use generic pin names.

**Figure 20-1. Conceptual Block Diagram of the McBSP**



A Not available in all devices. See the device-specific data sheet

## 20.2 Configuring Device Pins

The GPIO mux registers must be configured to connect this peripheral to the device pins. To avoid glitches on the pins, the GPyGMUX bits must be configured first (while keeping the corresponding GPyMUX bits at the default of zero), followed by writing the GPyMUX register to the desired value.

Some IO functionality is defined by GPIO register settings independent of this peripheral. For input signals, the GPIO input qualification should be set to asynchronous mode by setting the appropriate GPxQSELn register bits to 11b. The internal pullups can be configured in the GPyPUD register.

See the *GPIO* chapter for more details on GPIO mux and settings.

## 20.3 McBSP Operation

This section addresses the following topics:

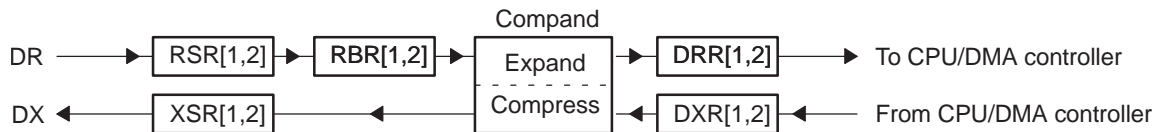
- Data transfer process
- Companding (compressing and expanding) data
- Clocking and framing data

- Frame phases
- McBSP reception
- McBSP transmission
- Interrupts and DMA events generated by McBSPs

### 20.3.1 Data Transfer Process of McBSPs

Figure 20-2 shows a diagram of the McBSP data transfer paths. The McBSP receive operation is triple-buffered, and transmit operation is double-buffered. The use of registers varies, depending on whether the defined length of each serial word is 16 bits.

Figure 20-2. McBSP Data Transfer Paths



#### 20.3.1.1 Data Transfer Process for Word Length of 8, 12, or 16 Bits

If the word length is 16 bits or smaller, only one 16-bit register is needed at each stage of the data transfer paths. The registers DRR2, RBR2, RSR2, DXR2, and XSR2 are not used (written, read, or shifted).

Receive data arrives on the DR pin and is shifted into receive shift register 1 (RSR1). Once a full word is received, the content of RSR1 is copied to receive buffer register 1 (RBR1) if RBR1 is not full with previous data. RBR1 is then copied to data receive register 1 (DRR1), unless the previous content of DRR1 has not been read by the CPU or the DMA controller. If the companding feature of the McBSP is implemented, the required word length is 8 bits and receive data is expanded into the appropriate format before being passed from RBR1 to DRR1. For more details about reception, see [Section 20.3.5](#).

Transmit data is written by the CPU or the DMA controller to data transmit register 1 (DXR1). If there is no previous data in transmit shift register (XSR1), the value in DXR1 is copied to XSR1; otherwise, DXR1 is copied to XSR1 when the last bit of the previous data is shifted out on the DX pin. If selected, the companding module compresses 16-bit data into the appropriate 8-bit format before passing it to XSR1. After transmit frame synchronization, the transmitter begins shifting bits from XSR1 to the DX pin. For more details about transmission, see [Section 20.3.6](#).

#### 20.3.1.2 Data Transfer Process for Word Length of 20, 24, or 32 Bits

If the word length is larger than 16 bits, two 16-bit registers are needed at each stage of the data transfer paths. The registers DRR2, RBR2, RSR2, DXR2, and XSR2 are needed to hold the most significant bits.

Receive data arrives on the DR pin and is shifted first into RSR2 and then into RSR1. Once the full word is received, the contents of RSR2 and RSR1 are copied to RBR2 and RBR1, respectively, if RBR1 is not full. Then the contents of RBR2 and RBR1 are copied to DRR2 and DRR1, respectively, unless the previous content of DRR1 has not been read by the CPU or the DMA controller. The CPU or the DMA controller must read data from DRR2 first and then from DRR1. When DRR1 is read, the next RBR-to-DRR copy occurs. For more details about reception, see [Section 20.3.5](#).

For transmission, the CPU or the DMA controller must write data to DXR2 first and then to DXR1. When new data arrives in DXR1, if there is no previous data in XSR1, the contents of DXR2 and DXR1 are copied to XSR2 and XSR1, respectively; otherwise, the contents of the DXRs are copied to the XSRs when the last bit of the previous data is shifted out on the DX pin. After transmit frame synchronization, the transmitter begins shifting bits from the XSRs to the DX pin. For more details about transmission, see [Section 20.3.6](#).

### 20.3.2 Companding (Compressing and Expanding) Data

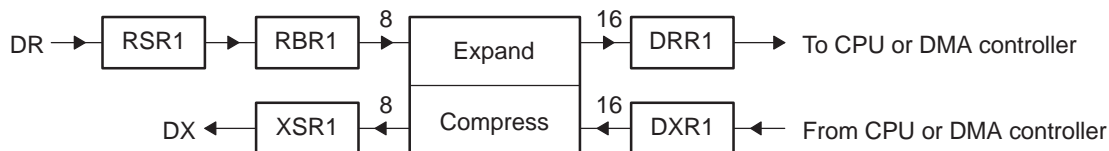
Companding (COMpressing and exPANDING) hardware allows compression and expansion of data in either  $\mu$ -law or A-law format. The companding standard employed in the United States and Japan is  $\mu$ -law. The European companding standard is referred to as A-law. The specifications for  $\mu$ -law and A-law log PCM are part of the CCITT G.711 recommendation.

A-law and  $\mu$ -law allow 13 bits and 14 bits of dynamic range, respectively. Any values outside this range are set to the most positive or most negative value. Thus, for companding to work best, the data transferred to and from the McBSP via the CPU or DMA controller must be at least 16 bits wide.

The  $\mu$ -law and A-law formats both encode data into 8-bit code words. Companded data is always 8 bits wide; the appropriate word length bits (RWDLEN1, RWDLEN2, XWDLEN1, XWDLEN2) must therefore be set to 0, indicating an 8-bit wide serial data stream. If companding is enabled and either of the frame phases does not have an 8-bit word length, companding continues as if the word length is 8 bits.

Figure 20-3 illustrates the companding processes. When companding is chosen for the transmitter, compression occurs during the process of copying data from DXR1 to XSR1. The transmit data is encoded according to the specified companding law (A-law or  $\mu$ -law). When companding is chosen for the receiver, expansion occurs during the process of copying data from RBR1 to DRR1. The receive data is decoded to two's-complement format.

**Figure 20-3. Companding Processes**

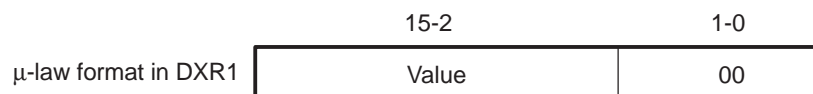


#### 20.3.2.1 Companding Formats

For reception, the 8-bit compressed data in RBR1 is expanded to left-justified 16-bit data in DRR1. The receive sign-extension and justification mode specified in RJUST is ignored when companding is used.

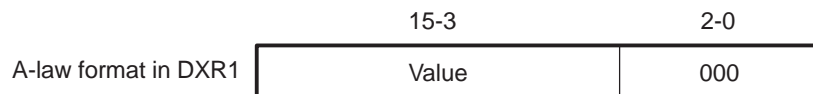
For transmission using  $\mu$ -law compression, the 14 data bits must be left-justified in DXR1 and that the remaining two low-order bits are filled with 0s as shown in Figure 20-4.

**Figure 20-4.  $\mu$ -Law Transmit Data Companding Format**



For transmission using A-law compression, the 13 data bits must be left-justified in DXR1, with the remaining three low-order bits filled with 0s as shown in Figure 20-5.

**Figure 20-5. A-Law Transmit Data Companding Format**



#### 20.3.2.2 Capability to Compand Internal Data

If the McBSP is otherwise unused (the serial port transmit and receive sections are reset), the companding hardware can compand internal data. This can be used to:

- Convert linear to the appropriate  $\mu$ -law or A-law format
- Convert  $\mu$ -law or A-law to the linear format
- Observe the quantization effects in companding by transmitting linear data and compressing and re-expanding this data. This is useful only if both XCOMPAND and RCOMPAND enable the same companding format.



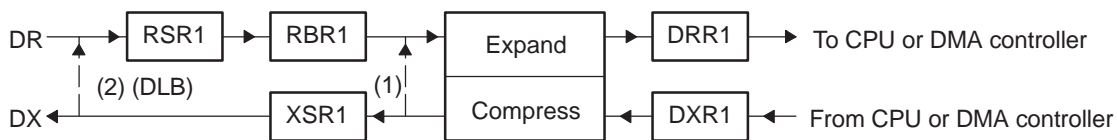
Figure 20-6 shows two methods by which the McBSP can compand internal data. Data paths for these two methods are used to indicate:

- When both the transmit and receive sections of the serial port are reset, DRR1 and DXR1 are connected internally through the companding logic. Values from DXR1 are compressed, as selected by XCOMPAND, and then expanded, as selected by RCOMPAND. RRDY and XRDY bits are not set. However, data is available in DRR1 within four CPU clocks after being written to DXR1.

The advantage of this method is its speed. The disadvantage is that there is no synchronization available to the CPU and DMA to control the flow. DRR1 and DXR1 are internally connected if the (X/R)COMPAND bits are set to 10b or 11b (compand using  $\mu$ -law or A-law).

- The McBSP is enabled in digital loopback mode with companding appropriately enabled by RCOMPAND and XCOMPAND. Receive and transmit interrupts (RINT when RINTM = 0 and XINT when XINTM = 0) or synchronization events (REVT and XEVT) allow synchronization of the CPU or DMA to these conversions, respectively. Here, the time for this companding depends on the serial bit rate selected.

**Figure 20-6. Two Methods by Which the McBSP Can Compand Internal Data**



### 20.3.2.3 Reversing Bit Order: Option to Transfer LSB First

Generally, the McBSP transmits or receives all data with the most significant bit (MSB) first. However, certain 8-bit data protocols (that do not use companded data) require the least significant bit (LSB) to be transferred first. If you set XCOMPAND = 01b in XCR2, the bit ordering of 8-bit words is reversed (LSB first) before being sent from the serial port. If you set RCOMPAND = 01b in RCR2, the bit ordering of 8-bit words is reversed during reception. Similar to companding, this feature is enabled only if the appropriate word length bits are set to 0, indicating that 8-bit words are to be transferred serially. If either phase of the frame does not have an 8-bit word length, the McBSP assumes the word length is eight bits, and LSB-first ordering is done.

## 20.3.3 Clocking and Framing Data

This section explains basic concepts and terminology important for understanding how McBSP data transfers are timed and delimited.

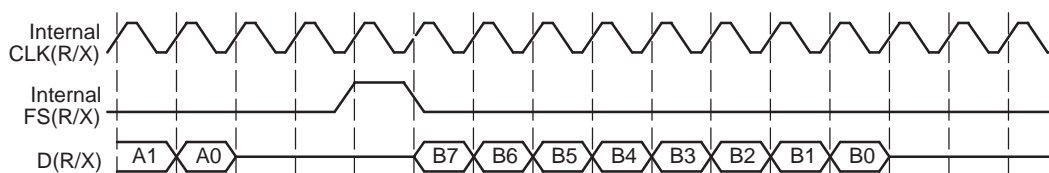
### 20.3.3.1 Clocking

Data is shifted one bit at a time from the DR pin to the RSR(s) or from the XSR(s) to the DX pin. The time for each bit transfer is controlled by the rising or falling edge of a clock signal.

The receive clock signal (CLKR) controls bit transfers from the DR pin to the RSR(s). The transmit clock signal (CLKX) controls bit transfers from the XSR(s) to the DX pin. CLKR or CLKX can be derived from a pin at the boundary of the McBSP or derived from inside the McBSP. The polarities of CLKR and CLKX are programmable.

In the example in Figure 20-7, the clock signal controls the timing of each bit transfer on the pin.

**Figure 20-7. Example - Clock Signal Control of Bit Transfer Timing**



---

**NOTE:** The McBSP cannot operate at a frequency faster than  $\frac{1}{2}$  the LSPCLK frequency. When driving CLKX or CLKR at the pin, choose an appropriate input clock frequency. When using the internal sample rate generator for CLKX and/or CLKR, choose an appropriate input clock frequency and divide down value (CLKDV) (i.e., be certain that  $\text{CLKX or CLKR} \leq \text{LSPCLK}/2$ ).

---

### 20.3.3.2 Serial Words

Bits traveling between a shift register (RSR or XSR) and a data pin (DR or DX) are transferred in a group called a serial word. You can define how many bits are in a word.

Bits coming in on the DR pin are held in RSR until RSR holds a full serial word. Only then is the word passed to RBR (and ultimately to the DRR).

During transmission, XSR does not accept new data from DXR until a full serial word has been passed from XSR to the DX pin.

In the example in [Figure 20-7](#), an 8-bit word size was defined (see bits 7 through 0 of word B being transferred).

### 20.3.3.3 Frames and Frame Synchronization

One or more words are transferred in a group called a frame. You can define how many words are in a frame.

All of the words in a frame are sent in a continuous stream. However, there can be pauses between frame transfers. The McBSP uses frame-synchronization signals to determine when each frame is received/transmitted. When a pulse occurs on a frame-synchronization signal, the McBSP begins receiving/transmitting a frame of data. When the next pulse occurs, the McBSP receives/transmits the next frame, and so on.

Pulses on the receive frame-synchronization (FSR) signal initiate frame transfers on DR. Pulses on the transmit frame-sync (FSX) signal initiate frame transfers on DX. FSR or FSX can be derived from a pin at the boundary of the McBSP or derived from inside the McBSP.

In the example in [Figure 20-7](#), a one-word frame is transferred when a frame-synchronization pulse occurs.

In McBSP operation, the inactive-to-active transition of the frame-synchronization signal indicates the start of the next frame. For this reason, the frame-synchronization signal may be high for an arbitrary number of clock cycles. Only after the signal is recognized to have gone inactive, and then active again, does the next frame synchronization occur.

### 20.3.3.4 Generating Transmit and Receive Interrupts

The McBSP can send receive and transmit interrupts to the CPU to indicate specific events in the McBSP. To facilitate detection of frame synchronization, these interrupts can be sent in response to frame-synchronization pulses. Set the appropriate interrupt mode bits to 10b (for reception, RINTM = 10b; for transmission, XINTM = 10b).

#### 20.3.3.4.1 Detecting Frame-Synchronization Pulses, Even in Reset State

Unlike other serial port interrupt modes, this mode can operate while the associated portion of the serial port is in reset (such as activating RINT when the receiver is in reset). In this case, FSRM/FSXM and FSRP/FSXP still select the appropriate source and polarity of frame synchronization. Thus, even when the serial port is in the reset state, these signals are synchronized to the CPU clock and then sent to the CPU in the form of RINT and XINT at the point at which they feed the receiver and transmitter of the serial port. Consequently, a new frame-synchronization pulse can be detected, and after this occurs the CPU can take the serial port out of reset safely.

### 20.3.3.5 Ignoring Frame-Synchronization Pulses

The McBSP can be configured to ignore transmit and/or receive frame-synchronization pulses. To have the receiver or transmitter recognize frame-synchronization pulses, clear the appropriate frame-synchronization ignore bit (RFIG = 0 for the receiver, XFIG = 0 for the transmitter). To have the receiver or transmitter ignore frame-synchronization pulses until the desired frame length or number of words is reached, set the appropriate frame-synchronization ignore bit (RFIG = 1 for the receiver, XFIG = 1 for the transmitter). For more details on unexpected frame-synchronization pulses, see one of the following topics:

- *Unexpected Receive Frame-Synchronization Pulse* (see [Section 20.5.3](#))
- *Unexpected Transmit Frame-Synchronization Pulse* (see [Section 20.5.6](#))

You can also use the frame-synchronization ignore function for data packing (for more details, see [Section 20.11.2](#)).

### 20.3.3.6 Frame Frequency

The frame frequency is determined by the period between frame-synchronization pulses and is defined as shown by Example 1.

#### Example 1: McBSP Frame Frequency

$$\text{Frame Frequency} = \frac{\text{Clock Frequency}}{\text{Number of Clock Cycles Between Frame-Sync Pulses}}$$

The frame frequency can be increased by decreasing the time between frame-synchronization pulses (limited only by the number of bits per frame). As the frame transmit frequency increases, the inactivity period between the data packets for adjacent transfers decreases to zero.

### 20.3.3.7 Maximum Frame Frequency

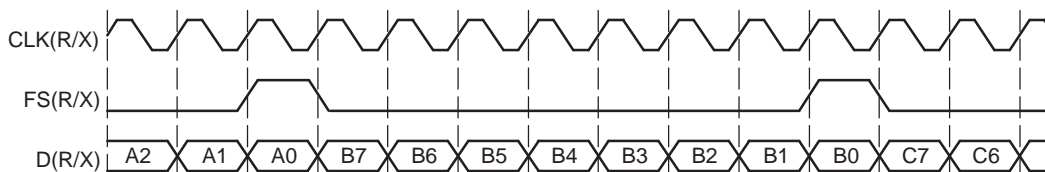
The minimum number of clock cycles between frame synchronization pulses is equal to the number of bits transferred per frame. The maximum frame frequency is defined as shown by Example 2.

#### Example 2: McBSP Maximum Frame Frequency

$$\text{Maximum Frame Frequency} = \frac{\text{Clock Frequency}}{\text{Number of Bits Per Frame}}$$

[Figure 20-8](#) shows the McBSP operating at maximum packet frequency. At maximum packet frequency, the data bits in consecutive packets are transmitted contiguously with no inactivity between bits.

**Figure 20-8. McBSP Operating at Maximum Packet Frequency**



If there is a 1-bit data delay as shown in this figure, the frame-synchronization pulse overlaps the last bit transmitted in the previous frame. Effectively, this permits a continuous stream of data, making frame-synchronization pulses redundant. Theoretically, only an initial frame-synchronization pulse is required to initiate a multipacket transfer.

The McBSP supports operation of the serial port in this fashion by ignoring the successive frame-synchronization pulses. Data is clocked into the receiver or clocked out of the transmitter during every clock cycle.

---

**NOTE:** For XDATDLY = 0 (0-bit data delay), the first bit of data is transmitted asynchronously to the internal transmit clock signal (CLKX). For more details, see [Section 20.9.12](#).

---

### 20.3.4 Frame Phases

The McBSP allows you to configure each frame to contain one or two phases. The number of words and the number of bits per word can be specified differently for each of the two phases of a frame, allowing greater flexibility in structuring data transfers. For example, you might define a frame as consisting of one phase containing two words of 16 bits each, followed by a second phase consisting of 10 words of 8 bits each. This configuration permits you to compose frames for custom applications or, in general, to maximize the efficiency of data transfers.

#### 20.3.4.1 Number of Phases, Words, and Bits Per Frame

Table 20-2 shows which bit-fields in the receive control registers (RCR1 and RCR2) and in the transmit control registers (XCR1 and XCR2) determine the number of phases per frame, the number of words per frame, and number of bits per word for each phase, for the receiver and transmitter. The maximum number of words per frame is 128 for a single-phase frame and 256 for a dual-phase frame. The number of bits per word can be 8, 12, 16, 20, 24, or 32 bits.

**Table 20-2. Register Bits That Determine the Number of Phases, Words, and Bits**

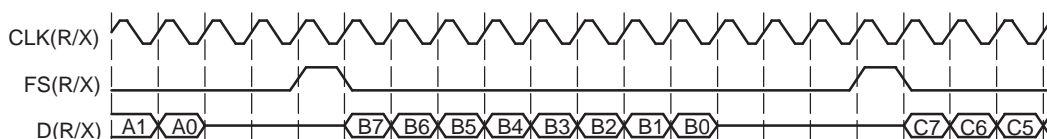
Operation	Number of Phases	Words per Frame Set With	Bits per Word Set With
Reception	1 (RPHASE = 0)	RFLEN1	RWDLEN1
Reception	2 (RPHASE = 1)	RFLEN1 and RFLEN2	RWDLEN1 for phase 1 RWDLEN2 for phase 2
Transmission	1 (XPHASE = 0)	XFLEN1	XWDLEN1
Transmission	2 (XPHASE = 1)	XFLEN1 and XFLEN2	XWDLEN1 for phase 1 XWDLEN2 for phase 2

#### 20.3.4.2 Single-Phase Frame Example

Figure 20-9 shows an example of a single-phase data frame containing one 8-bit word. Because the transfer is configured for one data bit delay, the data on the DX and DR pins are available one clock cycle after FS(R/X) goes active. The figure makes the following assumptions:

- (R/X)PHASE = 0: Single-phase frame
- (R/X)FLEN1 = 0b: 1 word per frame
- (R/X)WDLEN1 = 000b: 8-bit word length
- (R/X)FLEN2 and (R/X)WDLEN2 are ignored
- CLK(X/R)P = 0: Receive data clocked on falling edge; transmit data clocked on rising edge
- FS(R/X)P = 0: Active-high frame-synchronization signals
- (R/X)DATDLY = 01b: 1-bit data delay

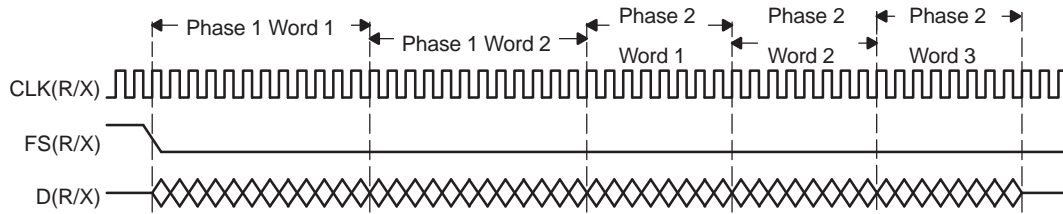
**Figure 20-9. Single-Phase Frame for a McBSP Data Transfer**



#### 20.3.4.3 Dual-Phase Frame Example

Figure 20-10 shows an example of a frame where the first phase consists of two words of 12 bits each, followed by a second phase of three words of 8 bits each. The entire bit stream in the frame is contiguous. There are no gaps either between words or between phases.

**Figure 20-10. Dual-Phase Frame for a McBSP Data Transfer**

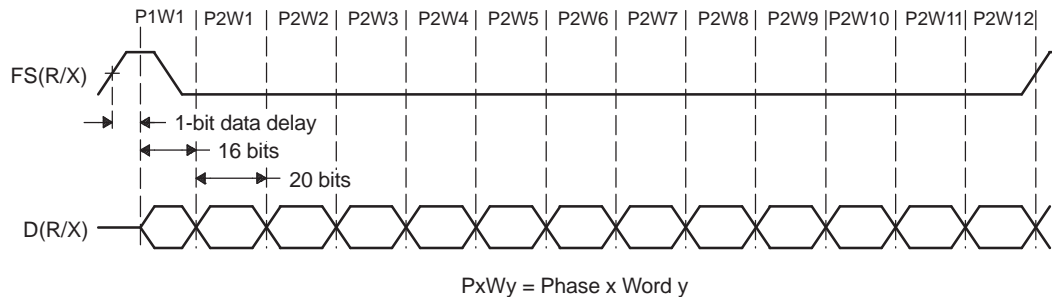


A XRDY gets asserted once per phase. So, if there are 2 phases, XRDY gets asserted twice (once per phase).

#### 20.3.4.4 Implementing the AC97 Standard With a Dual-Phase Frame

Figure 20-11 shows an example of the Audio Codec '97 (AC97) standard, which uses the dual-phase frame feature. Notice that words, not individual bits, are shown on the D(R/X) signal. The first phase (P1) consists of a single 16-bit word. The second phase (P2) consists of twelve 20-bit words. The phase configurations are listed after the figure.

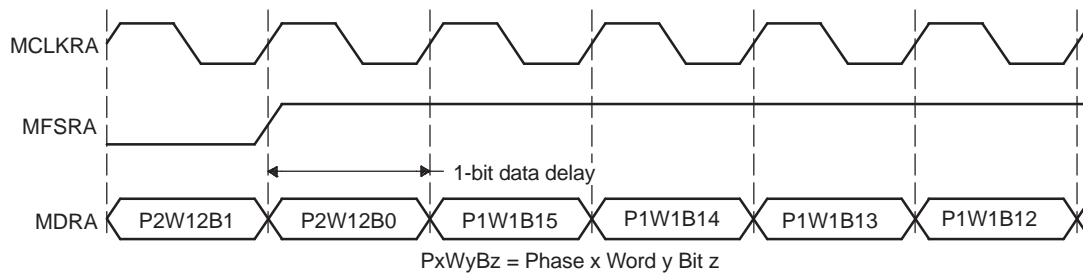
**Figure 20-11. Implementing the AC97 Standard With a Dual-Phase Frame**



- (R/X)PHASE = 1: Dual-phase frame
- (R/X)FRLLEN1 = 0000000b: 1 word in phase 1
- (R/X)WDLEN1 = 010b: 16 bits per word in phase 1
- (R/X)FRLLEN2 = 0001011b: 12 words in phase 2
- (R/X)WDLEN2 = 011b: 20 bits per word in phase 2
- CLKRP/CLKXP= 0: Receive data sampled on falling edge of internal CLKR / transmit data clocked on rising edge of internal CLKX
- FSRP/FSXP = 0: Active-high frame-sync signal
- (R/X)DATDLY = 01b: Data delay of 1 clock cycle (1-bit data delay)

Figure 20-12 shows the timing of an AC97-standard data transfer near frame synchronization. In this figure, individual bits are shown on D(R/X). Specifically, the figure shows the last two bits of phase 2 of one frame and the first four bits of phase 1 of the next frame. Regardless of the data delay, data transfers can occur without gaps. The first bit of the second frame (P1W1B15) immediately follows the last bit of the first frame (P2W12B0). Because a 1-bit data delay has been chosen, the transition on the frame-sync signal can occur when P2W12B0 is transferred.

**Figure 20-12. Timing of an AC97-Standard Data Transfer Near Frame Synchronization**

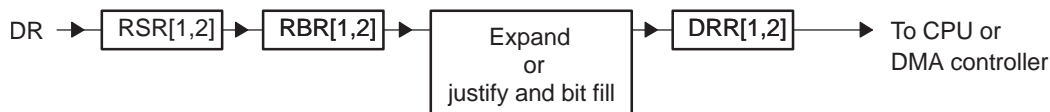


### 20.3.5 McBSP Reception

This section explains the fundamental process of reception in the McBSP. For details about how to program the McBSP receiver, see [Section 20.8](#).

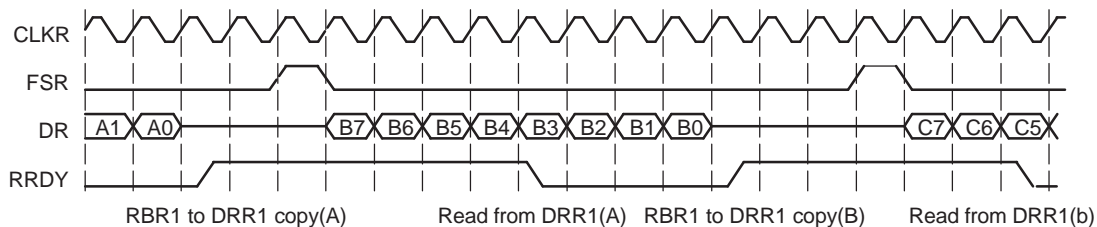
[Figure 20-13](#) and [Figure 20-14](#) show how reception occurs in the McBSP. [Figure 20-13](#) shows the physical path for the data. [Figure 20-14](#) is a timing diagram showing signal activity for one possible reception scenario. A description of the process follows the figures.

**Figure 20-13. McBSP Reception Physical Data Path**



- A RSR[1,2]: Receive shift registers 1 and 2
- B RBR[1,2]: Receive buffer registers 1 and 2
- C DRR[1,2]: Data receive registers 1 and 2

**Figure 20-14. McBSP Reception Signal Activity**



- A CLKR: Internal receive clock
- B FSR: Internal receive frame-synchronization signal
- C DR: Data on DR pin
- D RRDY: Status of receiver ready bit (high is 1)

The following process describes how data travels from the DR pin to the CPU or to the DMA controller:

1. The McBSP waits for a receive frame-synchronization pulse on internal FSR.
2. When the pulse arrives, the McBSP inserts the appropriate data delay that is selected with the RDATDLY bits of RCR2.  
In the preceding timing diagram, a 1-bit data delay is selected.
3. The McBSP accepts data bits on the DR pin and shifts them into the receive shift register(s).  
If the word length is 16 bits or smaller, only RSR1 is used. If the word length is larger than 16 bits, RSR2 and RSR1 are used and RSR2 contains the most significant bits. For details on choosing a word length, see [Section 20.8.8, Set the Receive Word Length\(s\)](#).
4. When a full word is received, the McBSP copies the contents of the receive shift register(s) to the receive buffer register(s), provided that RBR1 is not full with previous data.  
If the word length is 16 bits or smaller, only RBR1 is used. If the word length is larger than 16 bits,



RBR2 and RBR1 are used and RBR2 contains the most significant bits.

- The McBSP copies the contents of the receive buffer register(s) into the data receive register(s), provided that DRR1 is not full with previous data. When DRR1 receives new data, the receiver ready bit (RRDY) is set in SPCR1. This indicates that received data is ready to be read by the CPU or the DMA controller.

If the word length is 16 bits or smaller, only DRR1 is used. If the word length is larger than 16 bits, DRR2 and DRR1 are used and DRR2 contains the most significant bits.

If companding is used during the copy (RCOMPAND = 10b or 11b in RCR2), the 8-bit compressed data in RBR1 is expanded to a left-justified 16-bit value in DRR1. If companding is disabled, the data copied from RBR[1,2] to DRR[1,2] is justified and bit filled according to the RJUST bits.

- The CPU or the DMA controller reads the data from the data receive register(s). When DRR1 is read, RRDY is cleared and the next RBR-to-DRR copy is initiated.

**NOTE:** If both DRRs are required (word length larger than 16 bits), the CPU or the DMA controller must read from DRR2 first and then from DRR1. As soon as DRR1 is read, the next RBR-to-DRR copy is initiated. If DRR2 is not read first, the data in DRR2 is lost.

When activity is not properly timed, errors can occur. See the following topics for more details:

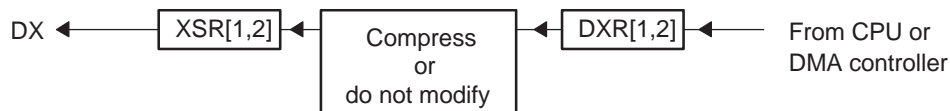
- Overflow in the Receiver* (see [Section 20.5.2](#))
- Unexpected Receive Frame-Synchronization Pulse* (see [Section 20.5.3](#))

### 20.3.6 McBSP Transmission

This section explains the fundamental process of transmission in the McBSP. For details about how to program the McBSP transmitter, see [Section 20.9](#).

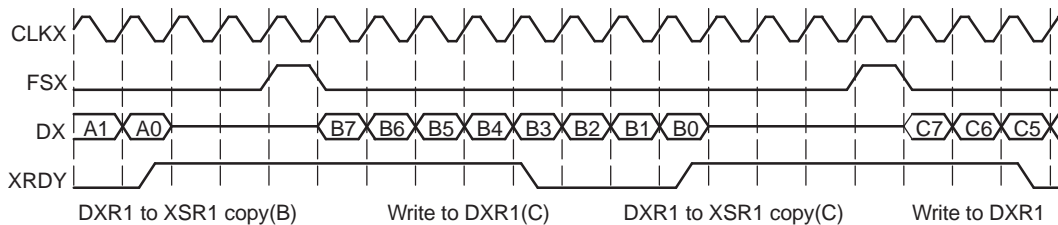
[Figure 20-15](#) and [Figure 20-16](#) show how transmission occurs in the McBSP. [Figure 20-15](#) shows the physical path for the data. [Figure 20-16](#) is a timing diagram showing signal activity for one possible transmission scenario. A description of the process follows the figures.

**Figure 20-15. McBSP Transmission Physical Data Path**



- A XSR[1,2]: Transmit shift registers 1 and 2
- B DXR[1,2]: Data transmit registers 1 and 2

**Figure 20-16. McBSP Transmission Signal Activity**



- A CLKX: Internal transmit clock
- B FSX: Internal transmit frame-synchronization signal
- C DX: Data on DX pin
- D XRDY: Status of transmitter ready bit (high is 1)

- The CPU or the DMA controller writes data to the data transmit register(s). When DXR1 is loaded, the transmitter ready bit (XRDY) is cleared in SPCR2 to indicate that the transmitter is not ready for new data.

If the word length is 16 bits or smaller, only DXR1 is used. If the word length is larger than 16 bits, DXR2 and DXR1 are used and DXR2 contains the most significant bits. For details on choosing a word

length, see [Section 20.9.8](#).

**NOTE:** If both DXRs are needed (word length larger than 16 bits), the CPU or the DMA controller must load DXR2 first and then load DXR1. As soon as DXR1 is loaded, the contents of both DXRs are copied to the transmit shift registers (XSRs), as described in the next step. If DXR2 is not loaded first, the previous content of DXR2 is passed to the XSR2.

2. When new data arrives in DXR1, the McBSP copies the content of the data transmit register(s) to the transmit shift register(s). In addition, the transmit ready bit (XRDY) is set. This indicates that the transmitter is ready to accept new data from the CPU or the DMA controller.  
If the word length is 16 bits or smaller, only XSR1 is used. If the word length is larger than 16 bits, XSR2 and XSR1 are used and XSR2 contains the most significant bits.  
If companding is used during the transfer (XCOMPAND = 10b or 11b in XCR2), the McBSP compresses the 16-bit data in DXR1 to 8-bit data in the  $\mu$ -law or A-law format in XSR1. If companding is disabled, the McBSP passes data from the DXR(s) to the XSR(s) without modification.
3. The McBSP waits for a transmit frame-synchronization pulse on internal FSX.
4. When the pulse arrives, the McBSP inserts the appropriate data delay that is selected with the XDATDLY bits of XCR2.  
In the preceding timing diagram ([Figure 20-16](#)), a 1-bit data delay is selected.
5. The McBSP shifts data bits from the transmit shift register(s) to the DX pin.

When activity is not properly timed, errors can occur. See the following topics for more details:

- *Overwrite in the Transmitter* ([Section 20.5.4](#))
- *Underflow in the Transmitter* ([Section 20.5.5](#))
- *Unexpected Transmit Frame-Synchronization Pulse* ([Section 20.5.6](#))

### 20.3.7 Interrupts and DMA Events Generated by a McBSP

The McBSP sends notification of important events to the CPU and DMA via the internal signals shown in [Table 20-3](#).

**Table 20-3. Interrupts and DMA Events Generated by a McBSP**

Internal Signal	Description
RINT	Receive interrupt The McBSP can send a receive interrupt request to CPU based upon a selected condition in the receiver of the McBSP (a condition selected by the RINTM bits of SPCR1).
XINT	Transmit interrupt The McBSP can send a transmit interrupt request to CPU based upon a selected condition in the transmitter of the McBSP (a condition selected by the XINTM bits of SPCR2).
REVT	Receive synchronization event An REVT signal is sent to the DMA when data has been received in the data receive registers (DRRs).
XEVT	Transmit synchronization event An XEVT signal is sent to the DMA when the data transmit registers (DXRs) are ready to accept the next serial word for transmission.

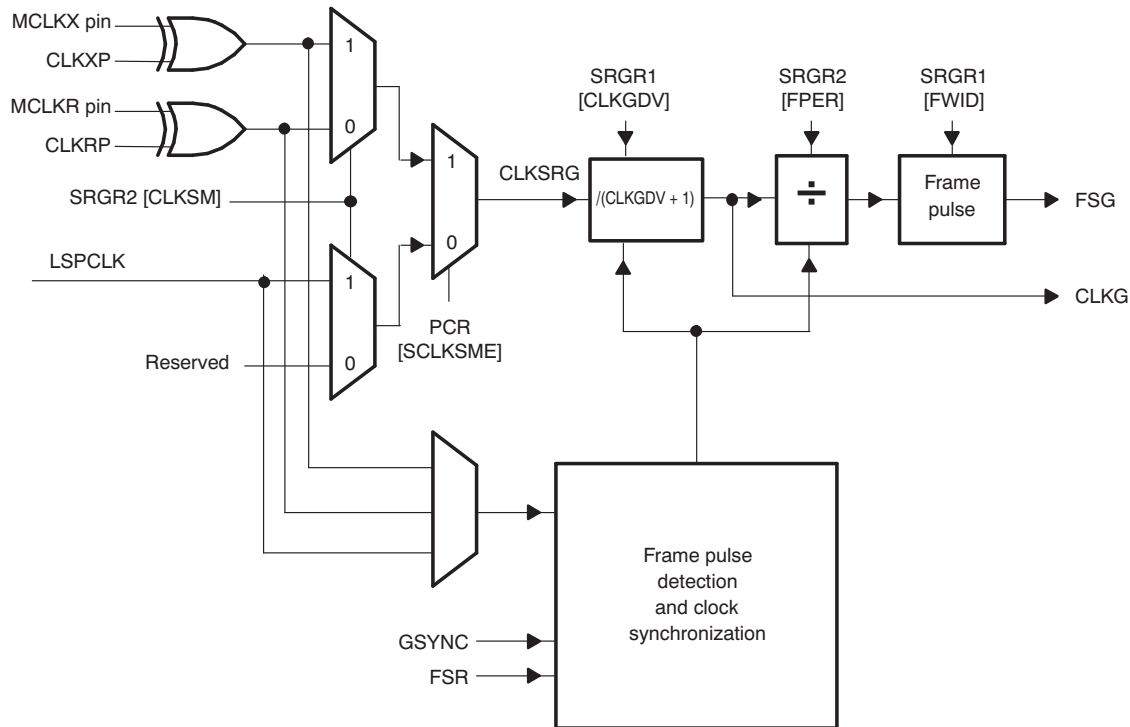
## 20.4 McBSP Sample Rate Generator

Each McBSP contains a sample rate generator (SRG) that can be programmed to generate an internal data clock (CLKG) and an internal frame-synchronization signal (FSG). CLKG can be used for bit shifting on the data receive (DR) pin and/or the data transmit (DX) pin. FSG can be used to initiate frame transfers on DR and/or DX. [Figure 20-17](#) is a conceptual block diagram of the sample rate generator.



### 20.4.1 Block Diagram

**Figure 20-17. Conceptual Block Diagram of the Sample Rate Generator**



The source clock for the sample rate generator (labeled CLKSRG in the diagram) can be supplied by the LSPCLK, or by an external pin (MCLKX or MCLKR). The source is selected with the SCLKME bit of PCR and the CLKSM bit of SRGR2. If a pin is used, the polarity of the incoming signal can be inverted with the appropriate polarity bit (CLKXP of PCR or CLKRP of PCR).

The sample rate generator has a three-stage clock divider that gives CLKG and FSG programmability. The three stages provide:

- Clock divide-down. The source clock is divided according to the CLKGDV bits of SRGR1 to produce CLKG.
- Frame period divide-down. CLKG is divided according to the FPER bits of SRGR2 to control the period from the start of a frame-pulse to the start of the next pulse.
- Frame-synchronization pulse-width countdown. CLKG cycles are counted according to the FWID bits of SRGR1 to control the width of each frame-synchronization pulse.

---

**NOTE:** The McBSP cannot operate at a frequency faster than  $\frac{1}{2}$  the source clock frequency. Choose an input clock frequency and a CLKGDV value such that CLKG is less than or equal to  $\frac{1}{2}$  the source clock frequency.

---

In addition to the three-stage clock divider, the sample rate generator has a frame-synchronization pulse detection and clock synchronization module that allows synchronization of the clock divide down with an incoming frame-synchronization pulse on the FSR pin. This feature is enabled or disabled with the GSYNC bit of SRGR2.

For details on getting the sample rate generator ready for operation, see [Section 20.4.4](#).

### 20.4.1.1 Clock Generation in the Sample Rate Generator

The sample rate generator can produce a clock signal (CLKG) for use by the receiver, the transmitter, or both. Use of the sample rate generator to drive clocking is controlled by the clock mode bits (CLKRM and CLKXM) in the pin control register (PCR). When a clock mode bit is set to 1 (CLKRM = 1 for reception, CLKXM = 1 for transmission), the corresponding data clock (CLKR for reception, CLKX for transmission) is driven by the internal sample rate generator output clock (CLKG).

The effects of CLKRM = 1 and CLKXM = 1 on the McBSP are partially affected by the use of the digital loopback mode and the clock stop (SPI) mode, respectively, as described in [Table 20-4](#). The digital loopback mode (described in [Section 20.8.4](#)) is selected with the DLB bit of SPCR1. The clock stop mode (described in [Section 20.7.2](#)) is selected with the CLKSTP bits of SPCR1.

When using the sample rate generator as a clock source, make sure the sample rate generator is enabled (GRST = 1).

**Table 20-4. Effects of DLB and CLKSTP on Clock Modes**

Mode Bit Settings		Effect
CLKRM = 1	DLB = 0 (Digital loopback mode disabled)	CLKR is an output pin driven by the sample rate generator output clock (CLKG).
	DLB = 1 (Digital loopback mode enabled)	CLKR is an output pin driven by internal CLKX. The source for CLKX depends on the CLKXM bit.
CLKXM = 1	CLKSTP = 00b or 01b (Clock stop (SPI) mode disabled)	CLKX is an output pin driven by the sample rate generator output clock (CLKG).
	CLKSTP = 10b or 11b (Clock stop (SPI) mode enabled)	The McBSP is a master in an SPI system. Internal CLKX drives internal CLKR and the shift clocks of any SPI-compliant slave devices in the system. CLKX is driven by the internal sample rate generator.

### 20.4.1.2 Choosing an Input Clock

The sample rate generator must be driven by an input clock signal from one of the three sources selectable with the SCLKME bit of PCR and the CLKSM bit of SRGR2 (see [Table 20-5](#)). When CLKSM = 1, the minimum divide down value in CLKGDV bits is 1. CLKGDV is described in [Section 20.4.1.4](#).

**Table 20-5. Choosing an Input Clock for the Sample Rate Generator with the SCLKME and CLKSM Bits**

SCLKME	CLKSM	Input Clock for Sample Rate Generator
0	0	Reserved
0	1	LSPCLK
1	0	Signal on MCLKR pin
1	1	Signal on MCLKX pin

### 20.4.1.3 Choosing a Polarity for the Input Clock

As shown in [Figure 20-18](#), when the input clock is received from a pin, you can choose the polarity of the input clock. The rising edge of CLKSRG generates CLKG and FSG, but you can determine which edge of the input clock causes a rising edge on CLKSRG. The polarity options and their effects are described in [Table 20-6](#).

Figure 20-18. Possible Inputs to the Sample Rate Generator and the Polarity Bits

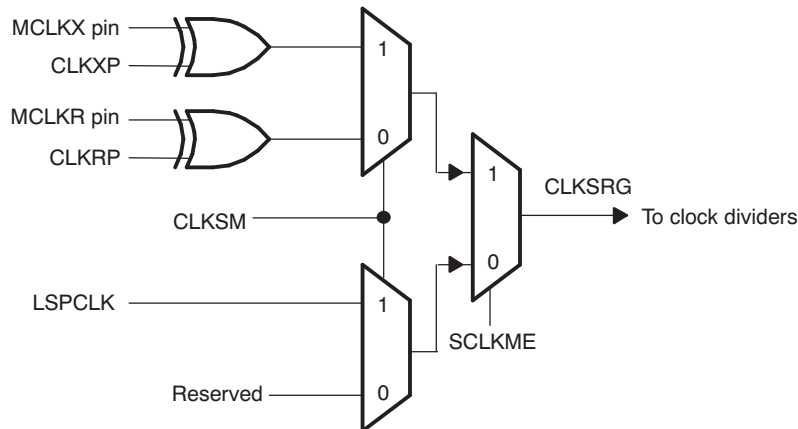


Table 20-6. Polarity Options for the Input to the Sample Rate Generator

Input Clock	Polarity Option	Effect
LSPCLK	Always positive polarity	Rising edge of CPU clock generates transitions on CLKG and FSG.
Signal on MCLKR pin	CLKRP = 0 in PCR	Falling edge on MCLKR pin generates transitions on CLKG and FSG.
	CLKRP = 1 in PCR	Rising edge on MCLKR pin generates transitions on CLKG and FSG.
Signal on MCLKX pin	CLKXP = 0 in PCR	Rising edge on MCLKX pin generates transitions on CLKG and FSG.
	CLKXP = 1 in PCR	Falling edge on MCLKX pin generates transitions on CLKG and FSG.

#### 20.4.1.4 Choosing a Frequency for the Output Clock (CLKG)

The input clock (LSPCLK or external clock) can be divided down by a programmable value to drive CLKG. Regardless of the source to the sample rate generator, the rising edge of CLKSRG (see Figure 20-1) generates CLKG and FSG.

The first divider stage of the sample rate generator creates the output clock from the input clock. This divider stage uses a counter that is preloaded with the divide down value in the CLKGDV bits of SRGR1. The output of this stage is the data clock (CLKG). CLKG has the frequency represented by the equation.

##### Equation 1: CLKG Frequency

$$\text{CLKG frequency} = \frac{\text{Input clock frequency}}{(\text{CLKGDV} + 1)}$$

##### 20.4.1.4.1 CLKG Frequency

Thus, the input clock frequency is divided by a value between 1 and 256. When CLKGDV is odd or equal to 0, the CLKG duty cycle is 50%. When CLKGDV is an even value, 2p, representing an odd divide down, the high-state duration is p+1 cycles and the low-state duration is p cycles.

#### 20.4.1.5 Keeping CLKG Synchronized to External MCLKR

When the MCLKR pin is used to drive the sample rate generator (see Section 20.4.1.2), the GSYNC bit in SRGR2 and the FSR pin can be used to configure the timing of the output clock (CLKG) relative to the input clock. Note that this feature is available only when the MCLKR pin is used to feed the external clock.

GSYNC = 1 ensures that the McBSP and an external device are dividing down the input clock with the same phase relationship. If GSYNC = 1, an inactive-to-active transition on the FSR pin triggers a resynchronization of CLKG and generation of FSG.

For more details about synchronization, see Section 20.4.3.

## 20.4.2 Frame Synchronization Generation in the Sample Rate Generator

The sample rate generator can produce a frame-synchronization signal (FSG) for use by the receiver, the transmitter, or both.

If you want the receiver to use FSG for frame synchronization, make sure FSRM = 1. (When FSRM = 0, receive frame synchronization is supplied via the FSR pin.)

If you want the transmitter to use FSG for frame synchronization, you must set:

- FSXM = 1 in PCR: This indicates that transmit frame synchronization is supplied by the McBSP itself rather than from the FSX pin.
- FSGM = 1 in SRGR2: This indicates that when FSXM = 1, transmit frame synchronization is supplied by the sample rate generator. (When FSGM = 0 and FSXM = 1, the transmitter uses frame-synchronization pulses generated every time data is transferred from DXR[1,2] to XSR[1,2].)

In either case, the sample rate generator must be enabled (GRST = 1) and the frame-synchronization logic in the sample rate generator must be enabled (FRST = 1).

### 20.4.2.1 Choosing the Width of the Frame-Synchronization Pulse on FSG

Each pulse on FSG has a programmable width. You program the FWID bits of SRGR1, and the resulting pulse width is (FWID + 1) CLKG cycles, where CLKG is the output clock of the sample rate generator.

### 20.4.2.2 Controlling the Period Between the Starting Edges of Frame-Synchronization Pulses on FSG

You can control the amount of time from the starting edge of one FSG pulse to the starting edge of the next FSG pulse. This period is controlled in one of two ways, depending on the configuration of the sample rate generator:

- If the sample rate generator is using an external input clock and GSYNC = 1 in SRGR2, FSG pulses in response to an inactive-to-active transition on the FSR pin. Thus, the frame-synchronization period is controlled by an external device.
- Otherwise, you program the FPER bits of SRGR2, and the resulting frame-synchronization period is (FPER + 1) CLKG cycles, where CLKG is the output clock of the sample rate generator.

### 20.4.2.3 Keeping FSG Synchronized to an External Clock

When an external signal is selected to drive the sample rate generator (see [Section 20.4.1.2](#) on page [Section 20.4.1.2](#)), the GSYNC bit of SRGR2 and the FSR pin can be used to configure the timing of FSG pulses.

GSYNC = 1 ensures that the McBSP and an external device are dividing down the input clock with the same phase relationship. If GSYNC = 1, an inactive-to-active transition on the FSR pin triggers a resynchronization of CLKG and generation of FSG.

See [Section 20.4.3](#) for more details about synchronization.

## 20.4.3 Synchronizing Sample Rate Generator Outputs to an External Clock

The sample rate generator can produce a clock signal (CLKG) and a frame-synchronization signal (FSG) based on an input clock signal that is either the CPU clock signal or a signal at the MCLKR or MCLKX pin. When an external clock is selected to drive the sample rate generator, the GSYNC bit of SRGR2 and the FSR pin can be used to control the timing of CLKG and the pulsing of FSG relative to the chosen input clock.

Make GSYNC = 1 when you want the McBSP and an external device to divide down the input clock with the same phase relationship. If GSYNC = 1:

- An inactive-to-active transition on the FSR pin triggers a resynchronization of CLKG and a pulsing of FSG.
- CLKG always begins with a high state after synchronization.
- FSR is always detected at the same edge of the input clock signal that generates CLKG, no matter how long the FSR pulse is.

- The FPER bits of SRGR2 are ignored because the frame-synchronization period on FSG is determined by the arrival of the next frame-synchronization pulse on the FSR pin.

If GSYNC = 0, CLKG runs freely and is not resynchronized, and the frame-synchronization period on FSG is determined by FPER.

### 20.4.3.1 Operating the Transmitter Synchronously with the Receiver

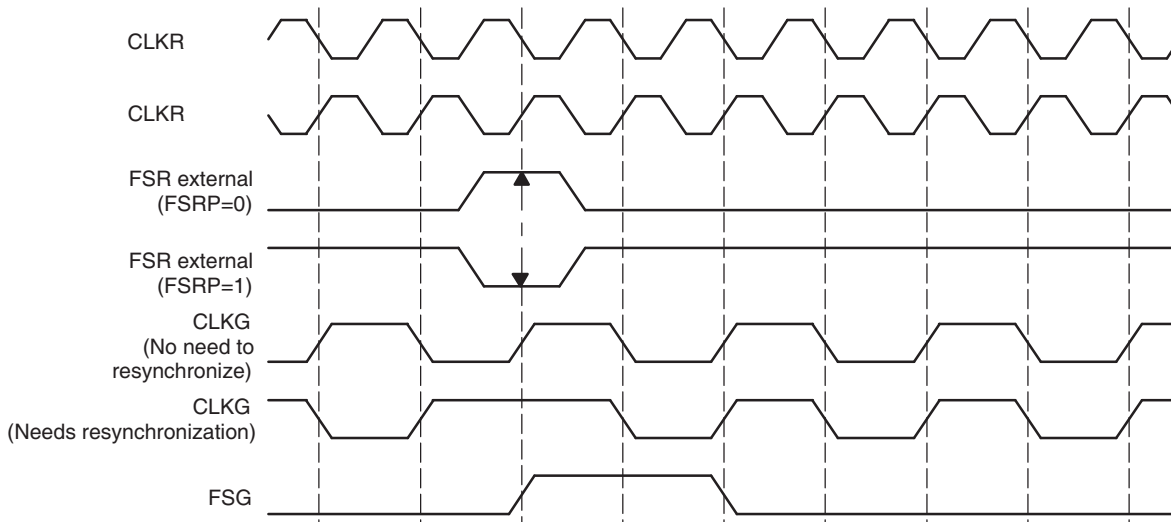
When GSYNC = 1, the transmitter can operate synchronously with the receiver, provided that:

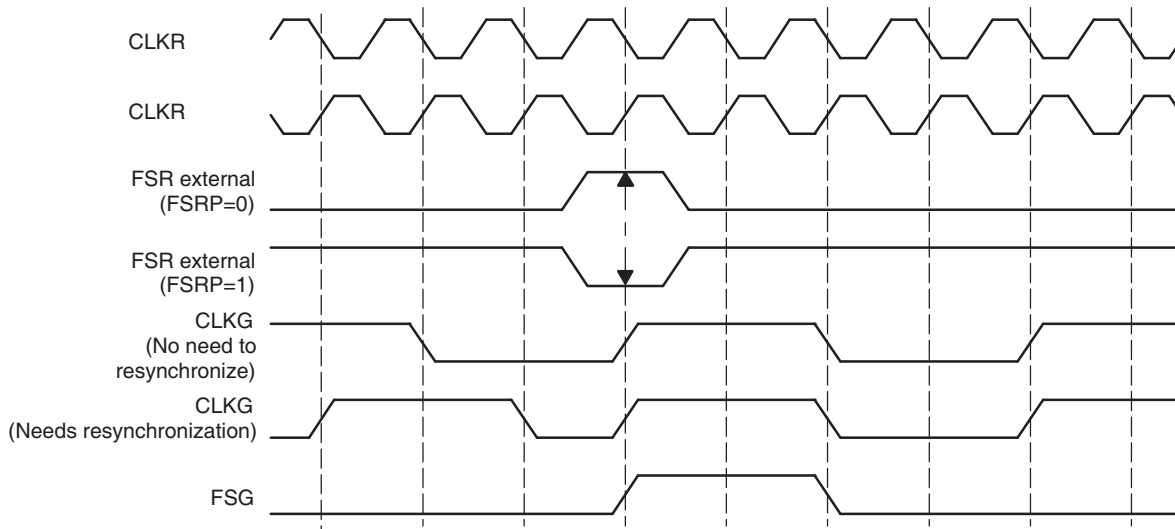
- FSX is programmed to be driven by FSG (FSGM = 1 in SRGR2 and FSXM = 1 in PCR). If the input FSR has appropriate timing so that it can be sampled by the falling edge of CLKG, it can be used, instead, by setting FSXM = 0 and connecting FSR to FSX externally.
- The sample rate generator clock drives the transmit and receive clocking (CLKRM = CLKXM = 1 in PCR).

### 20.4.3.2 Synchronization Examples

Figure 20-19 and Figure 20-20 show the clock and frame-synchronization operation with various polarities of CLKR and FSR. These figures assume FWID = 0 in SRGR1, for an FSG pulse that is one CLKG cycle wide. The FPER bits of SRGR2 are not programmed; the period from the start of a frame-synchronization pulse to the start of the next pulse is determined by the arrival of the next inactive-to-active transition on the FSR pin. Each of the figures shows what happens to CLKG when it is initially synchronized and GSYNC = 1, and when it is not initially synchronized and GSYNC = 1. The second figure has a slower CLKG frequency (it has a larger divide-down value in the CLKGDV bits of SRGR1).

**Figure 20-19. CLKG Synchronization and FSG Generation When GSYNC = 1 and CLKGDV = 1**



**Figure 20-20. CLKG Synchronization and FSG Generation When GSYNC = 1 and CLKGDV = 3**


#### 20.4.4 Reset and Initialization Procedure for the Sample Rate Generator

To reset and initialize the sample rate generator:

Step 1. Place the McBSP/sample rate generator in reset.

During a DSP reset, the sample rate generator, the receiver, and the transmitter reset bits (GRST, RRST, and XRST) are automatically forced to 0. Otherwise, during normal operation, the sample rate generator can be reset by making GRST = 0 in SPCR2, provided that CLKG and/or FSG is not used by any portion of the McBSP. Depending on your system you may also want to reset the receiver (RRST = 0 in SPCR1) and reset the transmitter (XRST = 0 in SPCR2).

If GRST = 0 due to a device reset, CLKG is driven by the CPU clock divided by 2, and FSG is driven inactive-low. If GRST = 0 due to program code, CLKG and FSG are driven low (inactive).

Step 2. Program the registers that affect the sample rate generator.

Program the sample rate generator registers (SRGR1 and SRGR2) as required for your application. If necessary, other control registers can be loaded with desired values, provided the respective portion of the McBSP (the receiver or transmitter) is in reset.

After the sample rate generator registers are programmed, wait 2 CLKSRG cycles. This ensures proper synchronization internally.

Step 3. Enable the sample rate generator (take it out of reset).

In SPCR2, make GRST = 1 to enable the sample rate generator.

After the sample rate generator is enabled, wait two CLKG cycles for the sample rate generator logic to stabilize.

On the next rising edge of CLKSRG, CLKG transitions to 1 and starts clocking with a frequency equal to the CLKG Frequency equation below.

**Table 20-7. Input Clock Selection for Sample Rate Generator**

SCLKME	CLKSM	Input Clock for Sample Rate Generator
0	0	Reserved
0	1	LSPCLK
1	0	Signal on MCLKR pin
1	1	Signal on MCLKX pin

Step 4. If necessary, enable the receiver and/or the transmitter.

If necessary, remove the receiver and/or transmitter from reset by setting RRST and/or XRST = 1.

Step 5. If necessary, enable the frame-synchronization logic of the sample rate generator.

After the required data acquisition setup is done (DXR[1,2] is loaded with data), set GRST = 1 in SPCR2 if an internally generated frame-synchronization pulse is required. FSG is generated with an active-high edge after the programmed number of CLKG clocks (FPER + 1) have elapsed.

### Equation 2: CLKG Frequency

$$\text{CLKG frequency} = \frac{\text{Input clock frequency}}{(\text{CLKGDV} + 1)}$$

where the input clock is selected with the SCLKME bit of PCR and the CLKSM bit of SRGR2 in one of the configurations shown in [Table 20-7](#).

## 20.5 McBSP Exception/Error Conditions

This chapter describes exception/error conditions and how to handle them.

### 20.5.1 Types of Errors

There are five serial port events that can constitute a system error:

- Receiver overrun (RFULL = 1)  
This occurs when DRR1 has not been read since the last RBR-to-DRR copy. Consequently, the receiver does not copy a new word from the RBR(s) to the DRR(s) and the RSR(s) are now full with another new word shifted in from DR. Therefore, RFULL = 1 indicates an error condition wherein any new data that can arrive at this time on DR replaces the contents of the RSR(s), and the previous word is lost. The RSRs continue to be overwritten as long as new data arrives on DR and DRR1 is not read. For more details about overrun in the receiver, see [Section 20.5.2](#).
- Unexpected receive frame-synchronization pulse (RSYNCERR = 1)  
This occurs during reception when RFIG = 0 and an unexpected frame-synchronization pulse occurs. An unexpected frame-synchronization pulse is one that begins the next frame transfer before all the bits of the current frame have been received. Such a pulse causes data reception to abort and restart. If new data has been copied into the RBR(s) from the RSR(s) since the last RBR-to-DRR copy, this new data in the RBR(s) is lost. This is because no RBR-to-DRR copy occurs; the reception has been restarted. For more details about receive frame-synchronization errors, see [Section 20.5.3](#).
- Transmitter data overwrite  
This occurs when the CPU or DMA controller overwrites data in the DXR(s) before the data is copied to the XSR(s). The overwritten data never reaches the DX pin. For more details about overwrite in the transmitter, see [Section 20.5.4](#).
- Transmitter underflow (XEMPTY = 0)  
If a new frame-synchronization signal arrives before new data is loaded into DXR1, the previous data in the DXR(s) is sent again. This procedure continues for every new frame-synchronization pulse that arrives until DXR1 is loaded with new data. For more details about underflow in the transmitter, see [Section 20.5.5](#).
- Unexpected transmit frame-synchronization pulse (XSYNCERR = 1)  
This occurs during transmission when XFIG = 0 and an unexpected frame-synchronization pulse occurs. An unexpected frame-synchronization pulse is one that begins the next frame transfer before all the bits of the current frame have been transferred. Such a pulse causes the current data transmission to abort and restart. If new data has been written to the DXR(s) since the last DXR-to-XSR copy, the current value in the XSR(s) is lost. For more details about transmit frame-synchronization errors, see [Section 20.5.6](#).

### 20.5.2 Overrun in the Receiver

RFULL = 1 in SPCR1 indicates that the receiver has experienced overrun and is in an error condition. RFULL is set when all of the following conditions are met:



1. DRR1 has not been read since the last RBR-to-DRR copy (RRDY = 1).
2. RBR1 is full and an RBR-to-DRR copy has not occurred.
3. RSR1 is full and an RSR1-to-RBR copy has not occurred.

As described in the [Section 20.3.5](#), data arriving on DR is continuously shifted into RSR1 (for word length of 16 bits or smaller) or RSR2 and RSR1 (for word length larger than 16 bits). Once a complete word is shifted into the RSR(s), an RSR-to-RBR copy can occur only if the previous data in RBR1 has been copied to DRR1. The RRDY bit is set when new data arrives in DRR1 and is cleared when that data is read from DRR1. Until RRDY = 0, the next RBR-to-DRR copy does not take place, and the data is held in the RSR(s). New data arriving on the DR pin is shifted into RSR(s), and the previous content of the RSR(s) is lost.

You can prevent the loss of data if DRR1 is read no later than 2.5 cycles before the end of the third word is shifted into the RSR1.

---

**NOTE:** If both DRRs are needed (word length larger than 16 bits), the CPU or the DMA controller must read from DRR2 first and then from DRR1. As soon as DRR1 is read, the next RBR-to-DRR copy is initiated. If DRR2 is not read first, the data in DRR2 is lost.

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After the receiver starts running from reset, a minimum of three words must be received before RFULL is set. Either of the following events clears the RFULL bit and allows subsequent transfers to be read properly:

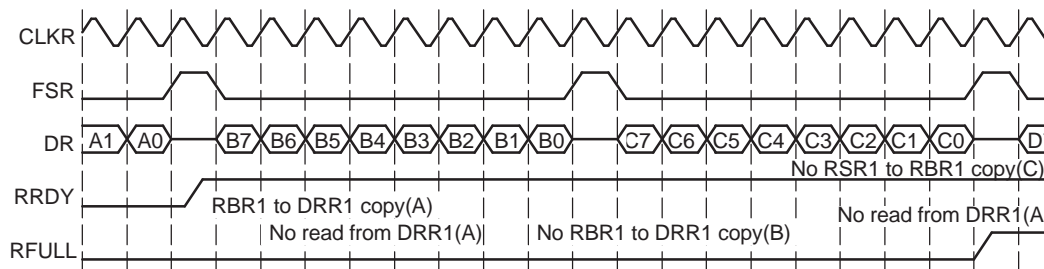
- The CPU or DMA controller reads DRR1.
- The receiver is reset individually (RRST = 0) or as part of a device reset.

Another frame-synchronization pulse is required to restart the receiver.

### 20.5.2.1 Example of Overrun Condition

[Figure 20-21](#) shows the receive overrun condition. Because serial word A is not read from DRR1 before serial word B arrives in RBR1, B is not transferred to DRR1 yet. Another new word ©) arrives and RSR1 is full with this data. DRR1 is finally read, but not earlier than 2.5 cycles before the end of word C. Therefore, new data (D) overwrites word C in RSR1. If DRR1 is not read in time, the next word can overwrite D.

**Figure 20-21. Overrun in the McBSP Receiver**

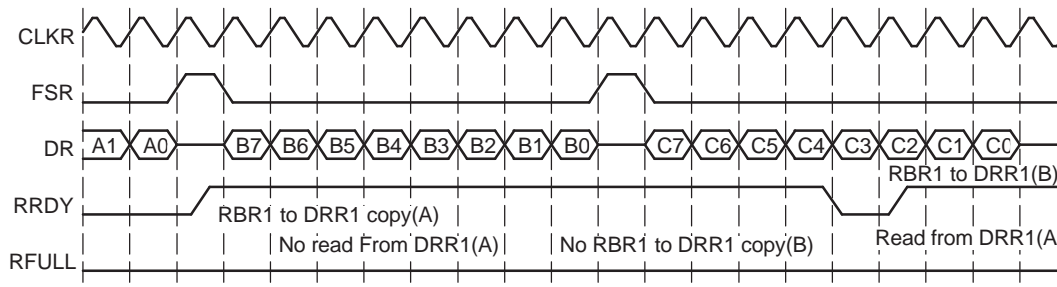


### 20.5.2.2 Example of Preventing Overrun Condition

[Figure 20-22](#) shows the case where RFULL is set, but the overrun condition is prevented by a read from DRR1 at least 2.5 cycles before the next serial word ©) is completely shifted into RSR1. This ensures that an RBR1-to-DRR1 copy of word B occurs before receiver attempts to transfer word C from RSR1 to RBR1.



**Figure 20-22. Overrun Prevented in the McBSP Receiver**



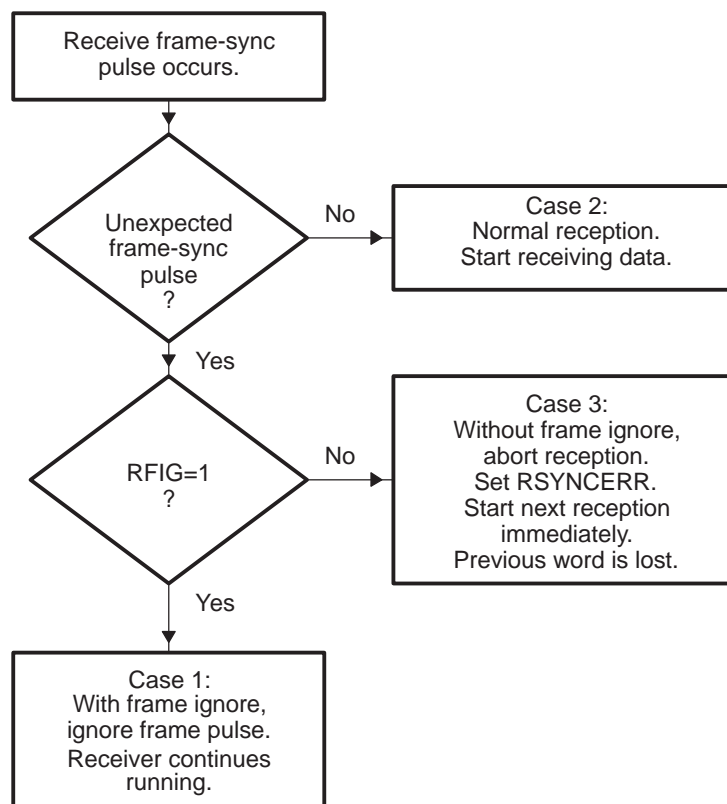
### 20.5.3 Unexpected Receive Frame-Synchronization Pulse

Section 20.5.3.1 shows how the McBSP responds to any receive frame-synchronization pulses, including an unexpected pulse. Section 20.5.3.2 and Section 20.5.3.3 show an examples of a frame-synchronization error and an example of how to prevent such an error, respectively.

#### 20.5.3.1 Possible Responses to Receive Frame-Synchronization Pulses

Figure 20-23 shows the decision tree that the receiver uses to handle all incoming frame-synchronization pulses. The figure assumes that the receiver has been started (RRST = 1 in SPCR1). Case 3 in the figure is the case in which an error occurs.

**Figure 20-23. Possible Responses to Receive Frame-Synchronization Pulses**



Any one of three cases can occur:

- Case 1: Unexpected internal FSR pulses with RFIG = 1 in RCR2. Receive frame-synchronization pulses are ignored, and the reception continues.
- Case 2: Normal serial port reception. Reception continues normally because the frame-synchronization

pulse is not unexpected. There are three possible reasons why a receive operation might *not* be in progress when the pulse occurs:

- The FSR pulse is the first after the receiver is enabled (RRST = 1 in SPCR1).
- The FSR pulse is the first after DRR[1,2] is read, clearing a receiver full (RFULL = 1 in SPCR1) condition.
- The serial port is in the interpacket intervals. The programmed data delay for reception (programmed with the RDATDLY bits in RCR2) may start during these interpacket intervals for the first bit of the next word to be received. Thus, at maximum frame frequency, frame synchronization can still be received 0 to 2 clock cycles before the first bit of the synchronized frame.
- Case 3: Unexpected receive frame synchronization with RFIG = 0 (frame-synchronization pulses not ignored). Unexpected frame-synchronization pulses can originate from an external source or from the internal sample rate generator.

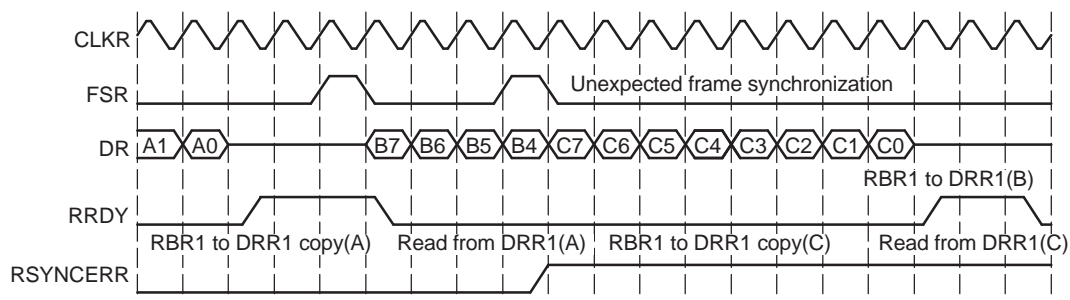
If a frame-synchronization pulse starts the transfer of a new frame before the current frame is fully received, this pulse is treated as an unexpected frame-synchronization pulse, and the receiver sets the receive frame-synchronization error bit (RSYNCERR) in SPCR1. RSYNCERR can be cleared only by a receiver reset or by a write of 0 to this bit.

If you want the McBSP to notify the CPU of receive frame-synchronization errors, you can set a special receive interrupt mode with the RINTM bits of SPCR1. When RINTM = 11b, the McBSP sends a receive interrupt (RINT) request to the CPU each time that RSYNCERR is set.

### 20.5.3.2 Example of Unexpected Receive Frame-Synchronization Pulse

Figure 20-30 shows an unexpected receive frame-synchronization pulse during normal operation of the serial port, with time intervals between data packets. When the unexpected frame-synchronization pulse occurs, the RSYNCERR bit is set, the reception of data B is aborted, and the reception of data C begins. In addition, if RINTM = 11b, the McBSP sends a receive interrupt (RINT) request to the CPU.

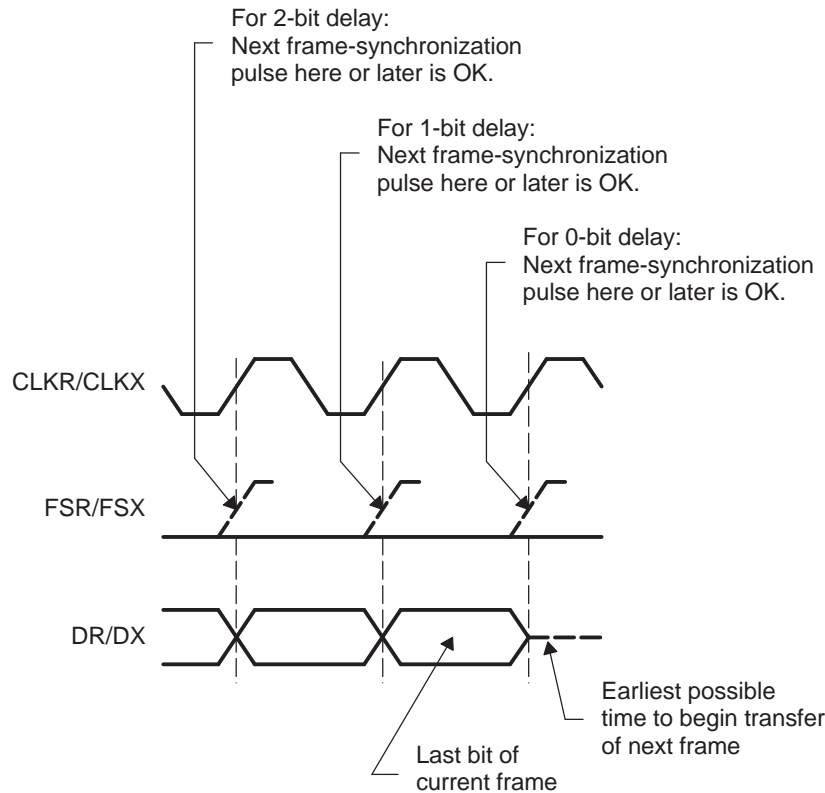
**Figure 20-24. An Unexpected Frame-Synchronization Pulse During a McBSP Reception**



### 20.5.3.3 Preventing Unexpected Receive Frame-Synchronization Pulses

Each frame transfer can be delayed by 0, 1, or 2 MCLKR cycles, depending on the value in the RDATDLY bits of RCR2. For each possible data delay, Figure 20-25 shows when a new frame-synchronization pulse on FSR can safely occur relative to the last bit of the current frame.

**Figure 20-25. Proper Positioning of Frame-Synchronization Pulses**



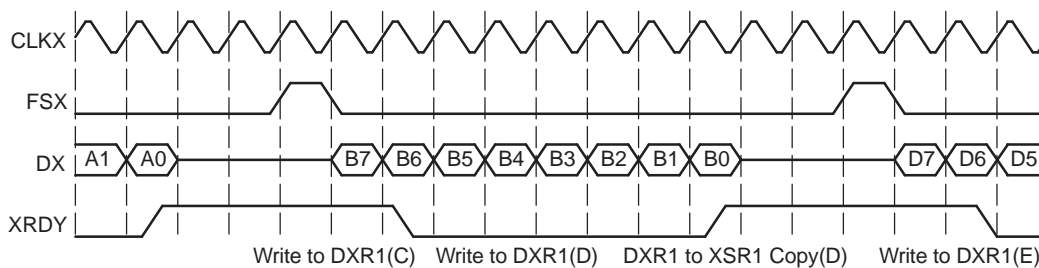
### 20.5.4 Overwrite in the Transmitter

As described in the section on McBSP transmission (page [Section 20.3.6](#)), the transmitter must copy the data previously written to the DXR(s) by the CPU or DMA controller into the XSR(s) and then shift each bit from the XSR(s) to the DX pin. If new data is written to the DXR(s) before the previous data is copied to the XSR(s), the previous data in the DXR(s) is overwritten and thus lost.

#### 20.5.4.1 Example of Overwrite Condition

[Figure 20-26](#) shows what happens if the data in DXR1 is overwritten before being transmitted. Initially, DXR1 is loaded with data C. A subsequent write to DXR1 overwrites C with D before C is copied to XSR1. Thus, C is never transmitted on DX.

**Figure 20-26. Data in the McBSP Transmitter Overwritten and Thus Not Transmitted**



#### 20.5.4.2 Preventing Overwrites

You can prevent CPU overwrites by making the CPU:

- Poll for XRDY = 1 in SPCR2 before writing to the DXR(s). XRDY is set when data is copied from DXR1 to XSR1 and is cleared when new data is written to DXR1.

- Wait for a transmit interrupt (XINT) before writing to the DXR(s). When XINTM = 00b in SPCR2, the transmitter sends XINT to the CPU each time XRDY is set.

You can prevent DMA overwrites by synchronizing DMA transfers to the transmit synchronization event XEVT. The transmitter sends an XEVT signal each time XRDY is set.

### 20.5.5 Underflow in the Transmitter

The McBSP indicates a transmitter empty (or underflow) condition by clearing the  $\overline{\text{XEMPTY}}$  bit in SPCR2. Either of the following events activates  $\overline{\text{XEMPTY}}$  ( $\overline{\text{XEMPTY}} = 0$ ):

- DXR1 has not been loaded since the last DXR-to-XSR copy, and all bits of the data word in the XSR(s) have been shifted out on the DX pin.
- The transmitter is reset (by forcing XRST = 0 in SPCR2, or by a device reset) and is then restarted.

In the underflow condition, the transmitter continues to transmit the old data that is in the DXR(s) for every new transmit frame-synchronization signal until a new value is loaded into DXR1 by the CPU or the DMA controller.

**NOTE:** If both DXRs are needed (word length larger than 16 bits), the CPU or the DMA controller must load DXR2 first and then load DXR1. As soon as DXR1 is loaded, the contents of both DXRs are copied to the transmit shift registers (XSRs). If DXR2 is not loaded first, the previous content of DXR2 is passed to the XSR2.

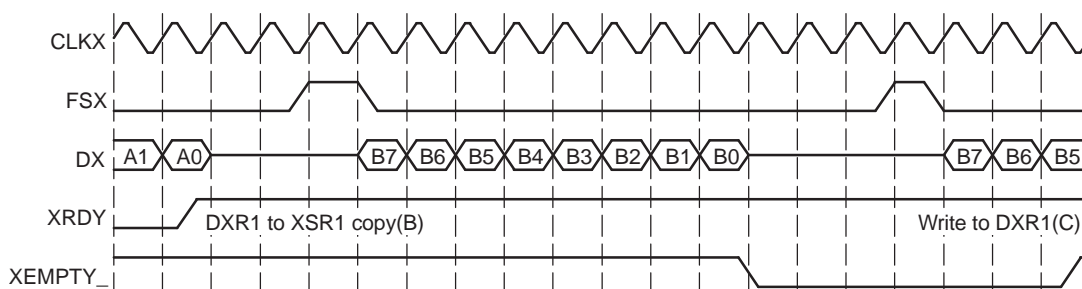
XEMPTY is deactivated ( $\overline{\text{XEMPTY}} = 1$ ) when a new word in DXR1 is transferred to XSR1. If FSXM = 1 in PCR and FSGM = 0 in SRGR2, the transmitter generates a single internal FSX pulse in response to a DXR-to-XSR copy. Otherwise, the transmitter waits for the next frame-synchronization pulse before sending out the next frame on DX.

When the transmitter is taken out of reset (XRST = 1), it is in a transmitter ready (XRDY = 1 in SPCR2) and transmitter empty ( $\overline{\text{XEMPTY}} = 0$ ) state. If DXR1 is loaded by the CPU or the DMA controller before internal FSX goes active high, a valid DXR-to-XSR transfer occurs. This allows for the first word of the first frame to be valid even before the transmit frame-synchronization pulse is generated or detected. Alternatively, if a transmit frame-synchronization pulse is detected before DXR1 is loaded, zeros are output on DX.

#### 20.5.5.1 Example of the Underflow Condition

Figure 20-27 shows an underflow condition. After B is transmitted, DXR1 is not reloaded before the subsequent frame-synchronization pulse. Thus, B is again transmitted on DX.

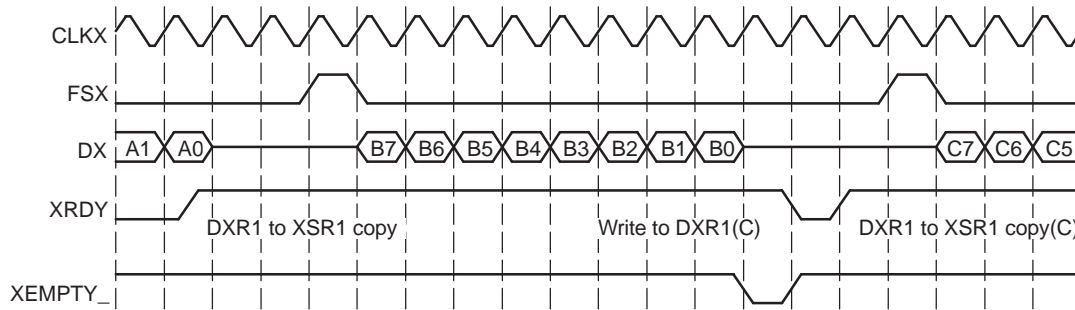
**Figure 20-27. Underflow During McBSP Transmission**



#### 20.5.5.2 Example of Preventing Underflow Condition

Figure 20-28 shows the case of writing to DXR1 just before an underflow condition would otherwise occur. After B is transmitted, C is written to DXR1 before the next frame-synchronization pulse. As a result, there is no underflow; B is not transmitted twice.

**Figure 20-28. Underflow Prevented in the McBSP Transmitter**



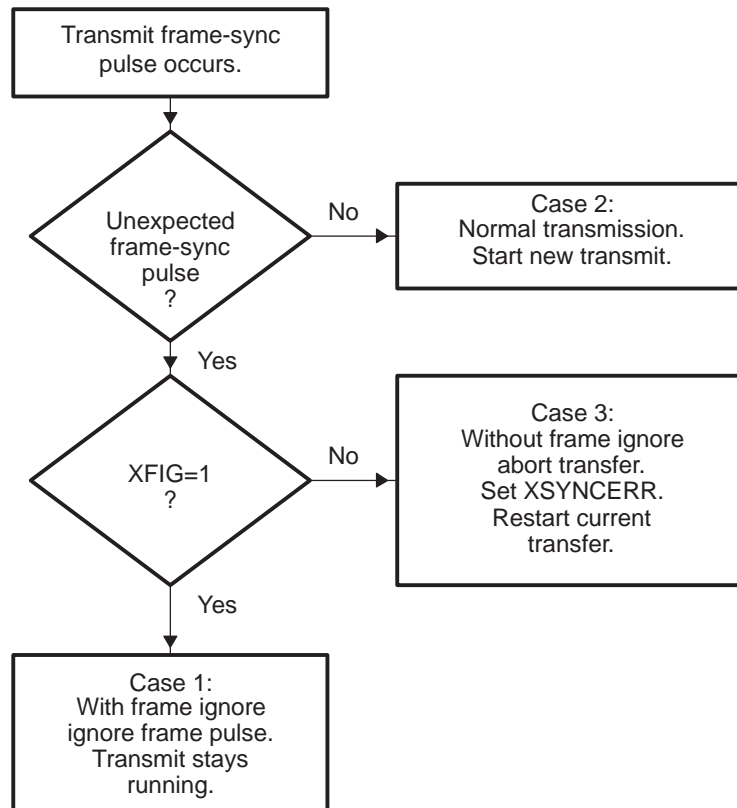
**20.5.6 Unexpected Transmit Frame-Synchronization Pulse**

Section 20.5.6.1 shows how the McBSP responds to any transmit frame-synchronization pulses, including an unexpected pulse. Section 20.5.6.2 and Section 20.5.6.3 show examples of a frame-synchronization error and an example of how to prevent such an error, respectively.

**20.5.6.1 Possible Responses to Transmit Frame-Synchronization Pulses**

Figure 20-29 shows the decision tree that the transmitter uses to handle all incoming frame-synchronization pulses. The figure assumes that the transmitter has been started (XRST = 1 in SPCR2). Case 3 in the figure is the case in which an error occurs.

**Figure 20-29. Possible Responses to Transmit Frame-Synchronization Pulses**



Any one of three cases can occur:

- Case 1: Unexpected internal FSX pulses with XFIG = 1 in XCR2. Transmit frame-synchronization pulses are ignored, and the transmission continues.
- Case 2: Normal serial port transmission. Transmission continues normally because the frame-

synchronization pulse is not unexpected. There are two possible reasons why a transmit operations might *not* be in progress when the pulse occurs:

This FSX pulse is the first after the transmitter is enabled (XRST = 1).

The serial port is in the interpacket intervals. The programmed data delay for transmission (programmed with the XDATDLY bits of XCR2) may start during these interpacket intervals before the first bit of the previous word is transmitted. Thus, at maximum packet frequency, frame synchronization can still be received 0 to 2 clock cycles before the first bit of the synchronized frame.

- Case 3: Unexpected transmit frame synchronization with XFIG = 0 (frame-synchronization pulses not ignored). Unexpected frame-synchronization pulses can originate from an external source or from the internal sample rate generator.

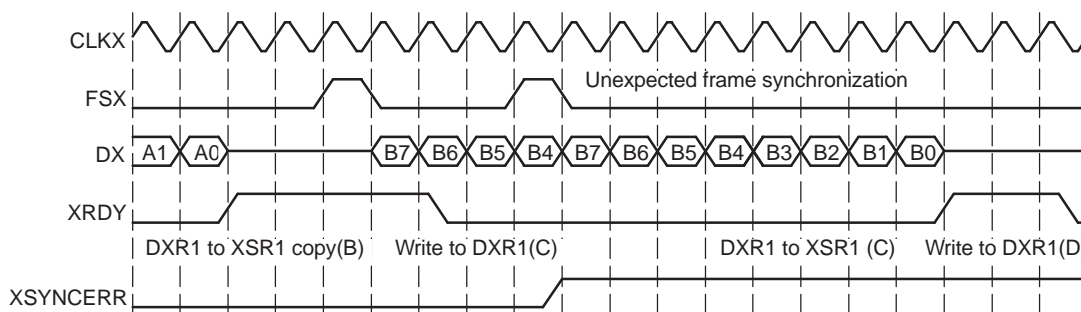
If a frame-synchronization pulse starts the transfer of a new frame before the current frame is fully transmitted, this pulse is treated as an unexpected frame-synchronization pulse, and the transmitter sets the transmit frame-synchronization error bit (XSYNCERR) in SPCR2. XSYNCERR can be cleared only by a transmitter reset or by a write of 0 to this bit.

If you want the McBSP to notify the CPU of frame-synchronization errors, you can set a special transmit interrupt mode with the XINTM bits of SPCR2. When XINTM = 11b, the McBSP sends a transmit interrupt (XINT) request to the CPU each time that XSYNCERR is set.

### 20.5.6.2 Example of Unexpected Transmit Frame-Synchronization Pulse

Section 20.5.3.2 shows an unexpected transmit frame-synchronization pulse during normal operation of the serial port with intervals between the data packets. When the unexpected frame-synchronization pulse occurs, the XSYNCERR bit is set and the transmission of data B is restarted because no new data has been passed to XSR1 yet. In addition, if XINTM = 11b, the McBSP sends a transmit interrupt (XINT) request to the CPU.

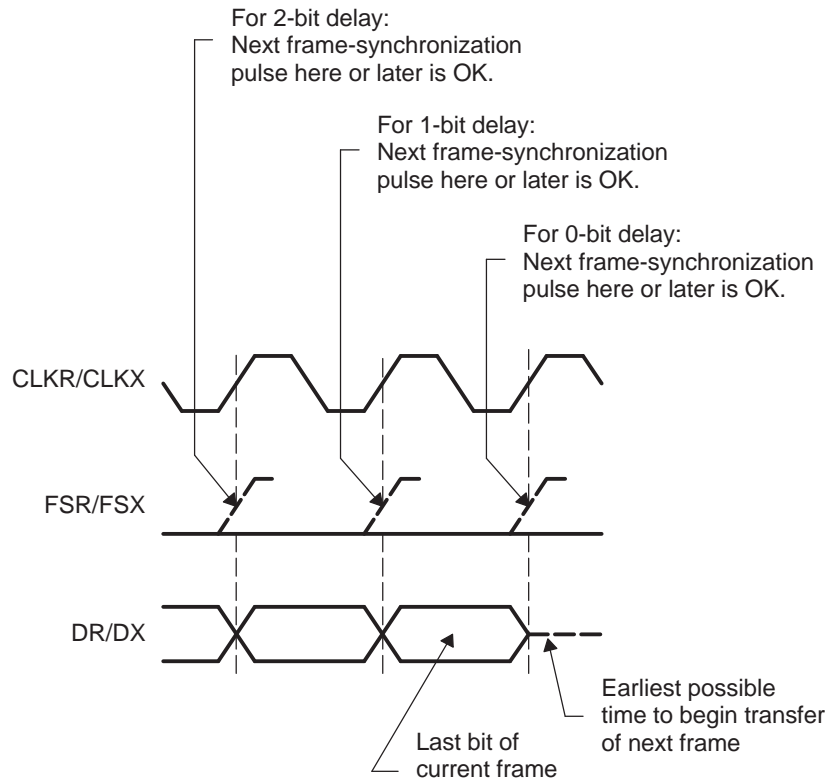
**Figure 20-30. An Unexpected Frame-Synchronization Pulse During a McBSP Transmission**



### 20.5.6.3 Preventing Unexpected Transmit Frame-Synchronization Pulses

Each frame transfer can be delayed by 0, 1, or 2 CLKX cycles, depending on the value in the XDATDLY bits of XCR2. For each possible data delay, Figure 20-31 shows when a new frame-synchronization pulse on FSX can safely occur relative to the last bit of the current frame.

**Figure 20-31. Proper Positioning of Frame-Synchronization Pulses**



## 20.6 Multichannel Selection Modes

This section discusses the multichannel selection modes for the McBSP.

### 20.6.1 Channels, Blocks, and Partitions

A McBSP channel is a time slot for shifting in/out the bits of one serial word. Each McBSP supports up to 128 channels for reception and 128 channels for transmission.

In the receiver and in the transmitter, the 128 available channels are divided into eight blocks that each contain 16 contiguous channels (see [Table 20-8](#) through [Table 20-10](#)) :

- It is possible to have two receive partitions (A & B) and 8 transmit partitions (A – H).
- McBSP can transmit/receive on selected channels.
- Each channel partition has a dedicated channel-enable register. Each bit controls whether data flow is allowed or prevented in one of the channels assigned to that partition.
- There are three transmit multichannel modes and one receive multichannel mode.

**Table 20-8. Block - Channel Assignment**

Block	Channels
0	0 - 15
1	16 - 31
2	32 - 47
3	48 - 63
4	64 - 79
5	80 - 95
6	96 - 111
7	112 - 127

The blocks are assigned to partitions according to the selected partition mode. In the two-partition mode (described in [Section 20.6.4](#)), you assign one even-numbered block (0, 2, 4, or 6) to partition A and one odd-numbered block (1, 3, 5, or 7) to partition B. In the 8-partition mode (described in [Section 20.6.5](#)), blocks 0 through 7 are automatically assigned to partitions, A through H, respectively.

**Table 20-9. 2-Partition Mode**

Partition	Blocks
A	0 or 2 or 4 or 6
B	1 or 3 or 5 or 7

**Table 20-10. 8-Partition mode**

Partition	Blocks	Channels
A	0	0 - 15
B	1	16 - 31
C	2	32 - 47
D	3	48 - 63
E	4	64 - 79
F	5	80 - 95
G	6	96 - 111
H	7	112 - 127

The number of partitions for reception and the number of partitions for transmission are independent. For example, it is possible to use two receive partitions (A and B) and eight transmit partitions (A-H).

## 20.6.2 Multichannel Selection

When a McBSP uses a time-division multiplexed (TDM) data stream while communicating with other McBSPs or serial devices, the McBSP may need to receive and/or transmit on only a few channels. To save memory and bus bandwidth, you can use a multichannel selection mode to prevent data flow in some of the channels.

Each channel partition has a dedicated channel enable register. If the appropriate multichannel selection mode is on, each bit in the register controls whether data flow is allowed or prevented in one of the channels that is assigned to that partition.

The McBSP has one receive multichannel selection mode (described in [Section 20.6.6](#)) and three transmit multichannel selection modes (described in [Section 20.6.7](#)).

## 20.6.3 Configuring a Frame for Multichannel Selection

Before you enable a multichannel selection mode, make sure you properly configure the data frame:

- Select a single-phase frame (RPHASE/XPHASE = 0). Each frame represents a TDM data stream.
- Set a frame length (in RFRLN1/XFRLN1) that includes the highest-numbered channel to be used. For example, if you plan to use channels 0, 15, and 39 for reception, the receive frame length must be at least 40 (RFRLN1 = 39). If XFRLN1 = 39 in this case, the receiver creates 40 time slots per frame but only receives data during time slots 0, 15, and 39 of each frame.

## 20.6.4 Using Two Partitions

For multichannel selection operation in the receiver and/or the transmitter, you can use two partitions or eight partitions (described in [Section 20.6.5](#)). If you choose the 2-partition mode (RMCME = 0 for reception, XMCME = 0 for transmission), McBSP channels are activated using an alternating scheme. In response to a frame-synchronization pulse, the receiver or transmitter begins with the channels in partition A and then alternates between partitions B and A until the complete frame has been transferred. When the next frame-synchronization pulse occurs, the next frame is transferred beginning with the channels in partition A.



### 20.6.4.1 Assigning Blocks to Partitions A and B

For reception, any two of the eight receive-channel blocks can be assigned to receive partitions A and B, which means up to 32 receive channels can be enabled at any given point in time. Similarly, any two of the eight transmit-channel blocks (up to 32 enabled transmit channels) can be assigned to transmit partitions A and B.

For reception:

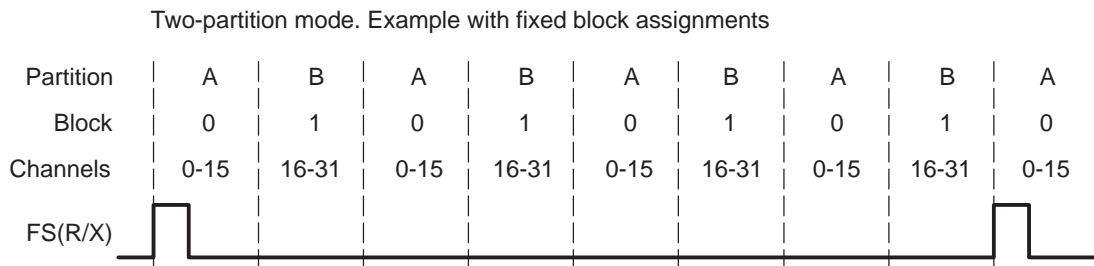
- Assign an even-numbered channel block (0, 2, 4, or 6) to receive partition A by writing to the RPABLK bits. In the receive multichannel selection mode (described in [Section 20.6.6](#)), the channels in this partition are controlled by receive channel enable register A (RCERA).
- Assign an odd-numbered block (1, 3, 5, or 7) to receive partition B with the RPBBLK bits. In the receive multichannel selection mode, the channels in this partition are controlled by receive channel enable register B (RCERB).

For transmission:

- Assign an even-numbered channel block (0, 2, 4, or 6) to transmit partition A by writing to the XPABLK bits. In one of the transmit multichannel selection modes (described in [Section 20.6.7](#)), the channels in this partition are controlled by transmit channel enable register A (XCERA).
- Assign an odd-numbered block (1, 3, 5, or 7) to transmit partition B with the XPBBLK bits. In one of the transmit multichannel selection modes, the channels in this partition are controlled by transmit channel enable register B (XCERB).

[Figure 20-32](#) shows an example of alternating between the channels of partition A and the channels of partition B. Channels 0-15 have been assigned to partition A, and channels 16-31 have been assigned to partition B. In response to a frame-synchronization pulse, the McBSP begins a frame transfer with partition A and then alternates between partitions B and A until the complete frame is transferred.

**Figure 20-32. Alternating Between the Channels of Partition A and the Channels of Partition B**



As explained in [Section 20.6.4.2](#), you can dynamically change which blocks of channels are assigned to the partitions.

### 20.6.4.2 Reassigning Blocks During Reception/Transmission

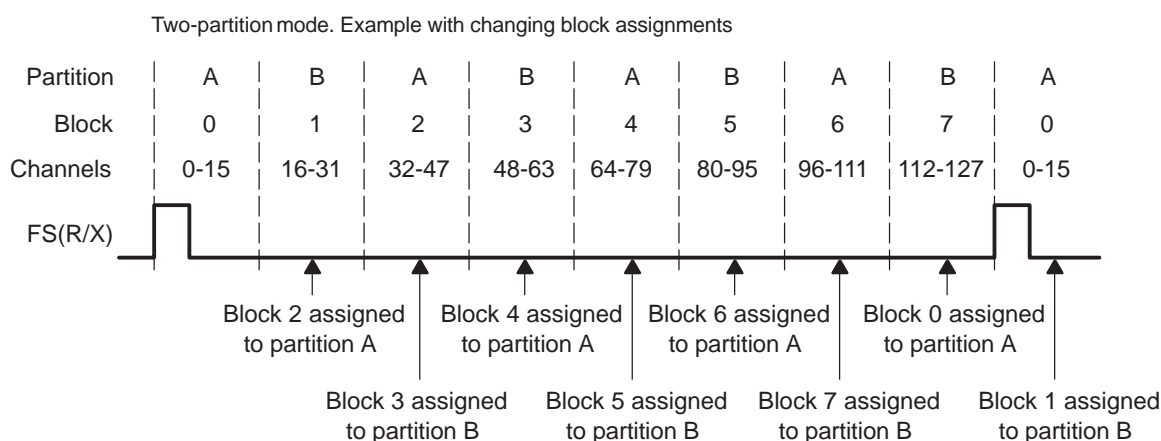
If you want to use more than 32 channels, you can change which channel blocks are assigned to partitions A and B during the course of a data transfer. However, these changes must be carefully timed. While a partition is being transferred, its associated block assignment bits cannot be modified and its associated channel enable register cannot be modified. For example, if block 3 is being transferred and block 3 is assigned to partition A, you can modify neither (R/X)PABLK to assign different channels to partition A nor (R/X)CERA to change the channel configuration for partition A.

Several features of the McBSP help you time the reassignment:

- The block of channels currently involved in reception/transmission (the current block) is reflected in the RCBLK/XCBLK bits. Your program can poll these bits to determine which partition is active. When a partition is not active, it is safe to change its block assignment and channel configuration.
- At the end of every block (at the boundary of two partitions), an interrupt can be sent to the CPU. In response to the interrupt, the CPU can then check the RCBLK/XCBLK bits and update the inactive partition. See [Section 20.6.8](#).

[Figure 20-33](#) shows an example of reassigning channels throughout a data transfer. In response to a frame-synchronization pulse, the McBSP alternates between partitions A and B. Whenever partition B is active, the CPU changes the block assignment for partition A. Whenever partition A is active, the CPU changes the block assignment for partition B.

**Figure 20-33. Reassigning Channel Blocks Throughout a McBSP Data Transfer**



### 20.6.5 Using Eight Partitions

For multichannel selection operation in the receiver and/or the transmitter, you can use eight partitions or two partitions (described in [Section 20.6.4](#)). If you choose the 8-partition mode (RMCME = 1 for reception, XMCME = 1 for transmission), McBSP channels are activated in the following order: A, B, C, D, E, F, G, H. In response to a frame-synchronization pulse, the receiver or transmitter begins with the channels in partition A and then continues with the other partitions in order until the complete frame has been transferred. When the next frame-synchronization pulse occurs, the next frame is transferred, beginning with the channels in partition A.

In the 8-partition mode, the (R/X)PABLK and (R/X)PBBLK bits are ignored and the 16-channel blocks are assigned to the partitions as shown in [Table 20-11](#) and [Table 20-12](#). These assignments cannot be changed. The tables also show the registers used to control the channels in the partitions.

**Table 20-11. Receive Channel Assignment and Control With Eight Receive Partitions**

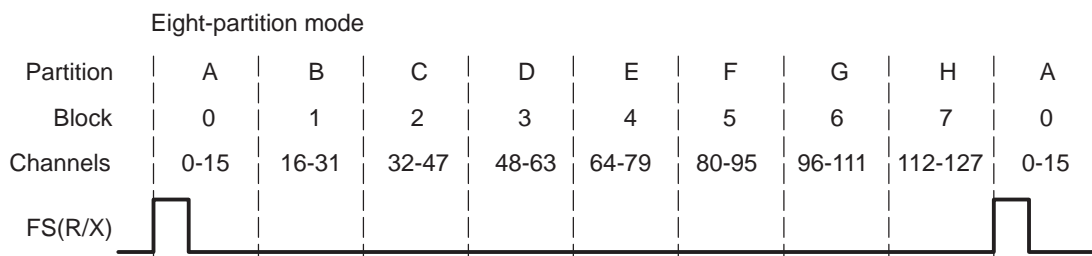
Receive Partition	Assigned Block of Receive Channels	Register Used For Channel Control
A	Block 0: channels 0 through 15	RCERA
B	Block 1: channels 16 through 31	RCERB
C	Block 2: channels 32 through 47	RCERC
D	Block 3: channels 48 through 63	RCERD
E	Block 4: channels 64 through 79	RCERE
F	Block 5: channels 80 through 95	RCERF
G	Block 6: channels 96 through 111	RCERG
H	Block 7: channels 112 through 127	RCERH

**Table 20-12. Transmit Channel Assignment and Control When Eight Transmit Partitions Are Used**

Transmit Partition	Assigned Block of Transmit Channels	Register Used For Channel Control
A	Block 0: channels 0 through 15	XCERA
B	Block 1: channels 16 through 31	XCERB
C	Block 2: channels 32 through 47	XCERC
D	Block 3: channels 48 through 63	XCERD
E	Block 4: channels 64 through 79	XCERE
F	Block 5: channels 80 through 95	XCERF
G	Block 6: channels 96 through 111	XCERG
H	Block 7: channels 112 through 127	XCERH

Figure 20-34 shows an example of the McBSP using the 8-partition mode. In response to a frame-synchronization pulse, the McBSP begins a frame transfer with partition A and then activates B, C, D, E, F, G, and H to complete a 128-word frame.

**Figure 20-34. McBSP Data Transfer in the 8-Partition Mode**



### 20.6.6 Receive Multichannel Selection Mode

The RMCM bit of MCR1 determines whether all channels or only selected channels are enabled for reception. When RMCM = 0, all 128 receive channels are enabled and cannot be disabled. When RMCM = 1, the receive multichannel selection mode is enabled. In this mode:

- Channels can be individually enabled or disabled. The only channels enabled are those selected in the appropriate receive channel enable registers (RCERs). The way channels are assigned to the RCERs depends on the number of receive channel partitions (2 or 8), as defined by the RMCME bit of MCR1.
- If a receive channel is disabled, any bits received in that channel are passed only as far as the receive buffer register(s) (RBR(s)). The receiver does not copy the content of the RBR(s) to the DRR(s), and as a result, does not set the receiver ready bit (RRDY). Therefore, no DMA synchronization event (REVT) is generated and, if the receiver interrupt mode depends on RRDY (RINTM = 00b), no interrupt is generated.

As an example of how the McBSP behaves in the receive multichannel selection mode, suppose you enable only channels 0, 15, and 39 and that the frame length is 40. The McBSP:

1. Accepts bits shifted in from the DR pin in channel 0
2. Ignores bits received in channels 1-14
3. Accepts bits shifted in from the DR pin in channel 15
4. Ignores bits received in channels 16-38
5. Accepts bits shifted in from the DR pin in channel 39

### 20.6.7 Transmit Multichannel Selection Modes

The XMCM bits of XCR2 determine whether all channels or only selected channels are enabled and unmasked for transmission. More details on enabling and masking are in Section 20.6.7.1. The McBSP has three transmit multichannel selection modes (XMCM = 01b, XMCM = 10b, and XMCM = 11b), which are described in the following table.

**Table 20-13. Selecting a Transmit Multichannel Selection Mode With the XMCM Bits**

XMCM	Transmit Multichannel Selection Mode
00b	No transmit multichannel selection mode is on. All channels are enabled and unmasked. No channels can be disabled or masked.
01b	All channels are disabled unless they are selected in the appropriate transmit channel enable registers (XCERs). If enabled, a channel in this mode is also unmasked. The XMCM bit of MCR2 determines whether 32 channels or 128 channels are selectable in XCERs.
10b	All channels are enabled, but they are masked unless they are selected in the appropriate transmit channel enable registers (XCERs). The XMCM bit of MCR2 determines whether 32 channels or 128 channels are selectable in XCERs.
11b	This mode is used for symmetric transmission and reception. All channels are disabled for transmission unless they are enabled for reception in the appropriate receive channel enable registers (RCERs). Once enabled, they are masked unless they are also selected in the appropriate transmit channel enable registers (XCERs). The XMCM bit of MCR2 determines whether 32 channels or 128 channels are selectable in RCERs and XCERs.

As an example of how the McBSP behaves in a transmit multichannel selection mode, suppose that XMCM = 01b (all channels disabled unless individually enabled) and that you have enabled only channels 0, 15, and 39. Suppose also that the frame length is 40. The McBSP:...

1. Shifts data to the DX pin in channel 0
2. Places the DX pin in the high impedance state in channels 1-14
3. Shifts data to the DX pin in channel 15
4. Places the DX pin in the high impedance state in channels 16-38
5. Shifts data to the DX pin in channel 39

### 20.6.7.1 Disabling/Enabling Versus Masking/Unmasking

For transmission, a channel can be:

- Enabled and unmasked (transmission can begin and can be completed)
- Enabled but masked (transmission can begin but cannot be completed)
- Disabled (transmission cannot occur)

The following definitions explain the channel control options:

<b>Enabled channel</b>	A channel that can begin transmission by passing data from the data transmit register(s) (DXR(s)) to the transmit shift registers (XSR(s)).
<b>Masked channel</b>	A channel that cannot complete transmission. The DX pin is held in the high impedance state; data cannot be shifted out on the DX pin. In systems where symmetric transmit and receive provides software benefits, this feature allows transmit channels to be disabled on a shared serial bus. A similar feature is not needed for reception because multiple receptions cannot cause serial bus contention.
<b>Disabled channel</b>	A channel that is not enabled. A disabled channel is also masked. Because no DXR-to-XSR copy occurs, the XRDY bit of SPCR2 is not set. Therefore, no DMA synchronization event (XEVT) is generated, and if the transmit interrupt mode depends on XRDY (XINTM = 00b in SPCR2), no interrupt is generated. The XEMPTY bit of SPCR2 is not affected.
<b>Unmasked channel</b>	A channel that is not masked. Data in the XSR(s) is shifted out on the DX pin.

### 20.6.7.2 Activity on McBSP Pins for Different Values of XMCM

Figure 20-35 shows the activity on the McBSP pins for the various XMCM values. In all cases, the transmit frame is configured as follows:

- XPHASE = 0: Single-phase frame (required for multichannel selection modes)
- XFRLEN1 = 0000011b: 4 words per frame

- XWDLEN1 = 000b: 8 bits per word
- XMCME = 0: 2-partition mode (only partitions A and B used)

In the case where XMCM = 11b, transmission and reception are symmetric, which means the corresponding bits for the receiver (RPHASE, RFRLLEN1, RWDLEN1, and RMCME) must have the same values as XPHASE, XFRLLEN1, and XWDLEN1, respectively.

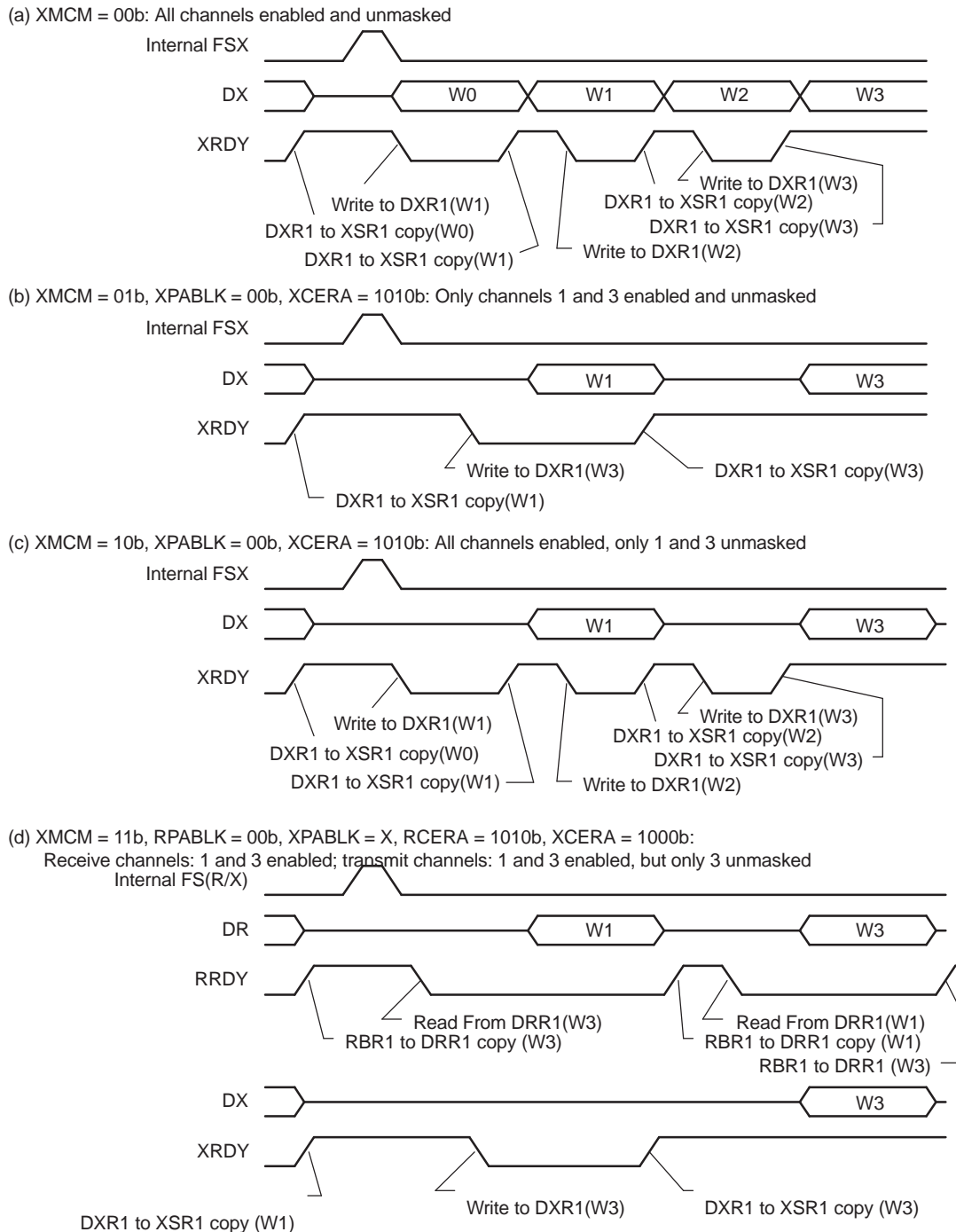
In the figure, the arrows showing where the various events occur are only sample indications. Wherever possible, there is a time window in which these events can occur.

### 20.6.8 Using Interrupts Between Block Transfers

When a multichannel selection mode is used, an interrupt request can be sent to the CPU at the end of every 16-channel block (at the boundary between partitions and at the end of the frame). In the receive multichannel selection mode, a receive interrupt (RINT) request is generated at the end of each block transfer if RINTM = 01b. In any of the transmit multichannel selection modes, a transmit interrupt (XINT) request is generated at the end of each block transfer if XINTM = 01b. When RINTM/XINTM = 01b, no interrupt is generated unless a multichannel selection mode is on.

These interrupt pulses are active high and last for two CPU clock cycles.

This type of interrupt is especially helpful if you are using the two-partition mode (described in [Section 20.6.4](#)) and you want to know when you can assign a different block of channels to partition A or B.

**Figure 20-35. Activity on McBSP Pins for the Possible Values of XMCM**


## 20.7 SPI Operation Using the Clock Stop Mode

This chapter explains how to use the McBSP in SPI mode.

### 20.7.1 SPI Protocol

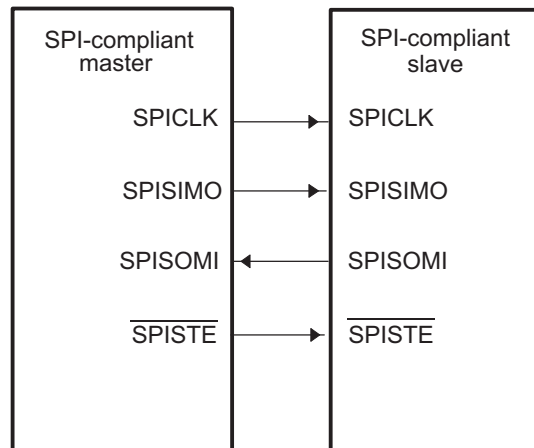
The SPI protocol is a master-slave configuration with one master device and one or more slave devices. The interface consists of the following four signals:

- Serial data input (also referred to as master in/slave out, or SPISOMI)

- Serial data output (also referred to as master out/slave in, or SPISIMO)
- Shift-clock (also referred to as SPICLK)
- Slave-enable signal (also referred to as  $\overline{\text{SPISTE}}$ )

A typical SPI interface with a single slave device is shown in [Figure 20-36](#).

**Figure 20-36. Typical SPI Interface**



The master device controls the flow of communication by providing shift-clock and slave-enable signals. The slave-enable signal is an optional active-low signal that enables the serial data input and output of the slave device (device not sending out the clock).

In the absence of a dedicated slave-enable signal, communication between the master and slave is determined by the presence or absence of an active shift-clock. When the McBSP is operating in SPI master mode and the  $\overline{\text{SPISTE}}$  signal is not used by the slave SPI port, the slave device must remain enabled at all times, and multiple slaves cannot be used.

### 20.7.2 Clock Stop Mode

The clock stop mode of the McBSP provides compatibility with the SPI protocol. When the McBSP is configured in clock stop mode, the transmitter and receiver are internally synchronized so that the McBSP functions as an SPI master or slave device. The transmit clock signal (CLKX) corresponds to the serial clock signal (SPICLK) of the SPI protocol, while the transmit frame-synchronization signal (FSX) is used as the slave-enable signal ( $\overline{\text{SPISTE}}$ ).

The receive clock signal (MCLKR) and receive frame-synchronization signal (FSR) are not used in the clock stop mode because these signals are internally connected to their transmit counterparts, CLKX and FSX.

### 20.7.3 Bits Used to Enable and Configure the Clock Stop Mode

The bits required to configure the McBSP as an SPI device are introduced in [Table 20-14](#). [Table 20-15](#) shows how the various combinations of the CLKSTP bit and the polarity bits CLKXP and CLKRP create four possible clock stop mode configurations. The timing diagrams in [Section 20.7.4](#) show the effects of CLKSTP, CLKXP, and CLKRP.

**Table 20-14. Bits Used to Enable and Configure the Clock Stop Mode**

Bit Field	Description
CLKSTP bits of SPCR1	Use these bits to enable the clock stop mode and to select one of two timing variations. (See also <a href="#">Table 20-15</a> .)
CLKXP bit of PCR	This bit determines the polarity of the CLKX signal. (See also <a href="#">Table 20-15</a> .)
CLKRP bit of PCR	This bit determines the polarity of the MCLKR signal. (See also <a href="#">Table 20-15</a> .)
CLKXM bit of PCR	This bit determines whether CLKX is an input signal (McBSP as slave) or an output signal (McBSP as master).



**Table 20-14. Bits Used to Enable and Configure the Clock Stop Mode (continued)**

Bit Field	Description
XPHASE bit of XCR2	You must use a single-phase transmit frame (XPHASE = 0).
RPHASE bit of RCR2	You must use a single-phase receive frame (RPHASE = 0).
XFRLLEN1 bits of XCR1	You must use a transmit frame length of 1 serial word (XFRLLEN1 = 0).
RFRLLEN1 bits of RCR1	You must use a receive frame length of 1 serial word (RFRLLEN1 = 0).
XWDLEN1 bits of XCR1	The XWDLEN1 bits determine the transmit packet length. XWDLEN1 must be equal to RWDLEN1 because in the clock stop mode. The McBSP transmit and receive circuits are synchronized to a single clock.
RWDLEN1 bits of RCR1	The RWDLEN1 bits determine the receive packet length. RWDLEN1 must be equal to XWDLEN1 because in the clock stop mode. The McBSP transmit and receive circuits are synchronized to a single clock.

**Table 20-15. Effects of CLKSTP, CLKXP, and CLKRP on the Clock Scheme**

Bit Settings	Clock Scheme
CLKSTP = 00b or 01b CLKXP = 0 or 1 CLKRP = 0 or 1	Clock stop mode disabled. Clock enabled for non-SPI mode.
CLKSTP = 10b CLKXP = 0 CLKRP = 0	Low inactive state without delay: The McBSP transmits data on the rising edge of CLKX and receives data on the falling edge of MCLKR.
CLKSTP = 11b CLKXP = 0 CLKRP = 1	Low inactive state with delay: The McBSP transmits data one-half cycle ahead of the rising edge of CLKX and receives data on the rising edge of MCLKR.
CLKSTP = 10b CLKXP = 1 CLKRP = 0	High inactive state without delay: The McBSP transmits data on the falling edge of CLKX and receives data on the rising edge of MCLKR.
CLKSTP = 11b CLKXP = 1 CLKRP = 1	High inactive state with delay: The McBSP transmits data one-half cycle ahead of the falling edge of CLKX and receives data on the falling edge of MCLKR.

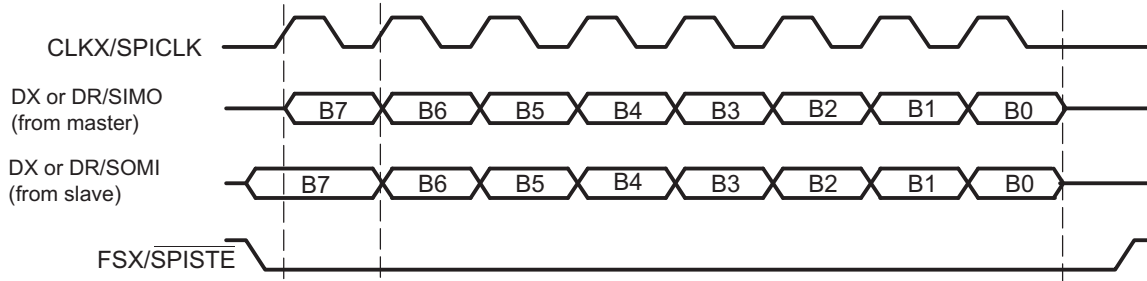
### 20.7.4 Clock Stop Mode Timing Diagrams

The timing diagrams for the four possible clock stop mode configurations are shown here. Notice that the frame-synchronization signal used in clock stop mode is active throughout the entire transmission as a slave-enable signal. Although the timing diagrams show 8-bit transfers, the packet length can be set to 8, 12, 16, 20, 24, or 32 bits per packet. The receive packet length is selected with the RWDLEN1 bits of RCR1, and the transmit packet length is selected with the XWDLEN1 bits of XCR1. For clock stop mode, the values of RWDLEN1 and XWDLEN1 must be the same because the McBSP transmit and receive circuits are synchronized to a single clock.

**NOTE:** Even if multiple words are consecutively transferred, the CLKX signal is always stopped and the FSX signal returns to the inactive state after a packet transfer. When consecutive packet transfers are performed, this leads to a minimum idle time of two bit-periods between each packet transfer.

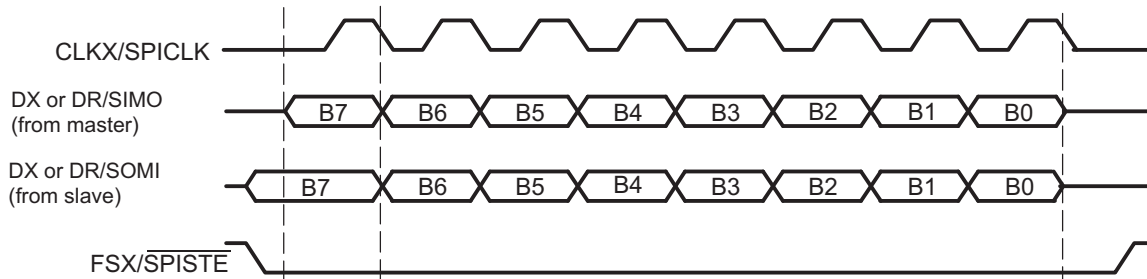


**Figure 20-37. SPI Transfer With CLKSTP = 10b (No Clock Delay), CLKXP = 0, and CLKRP = 0**



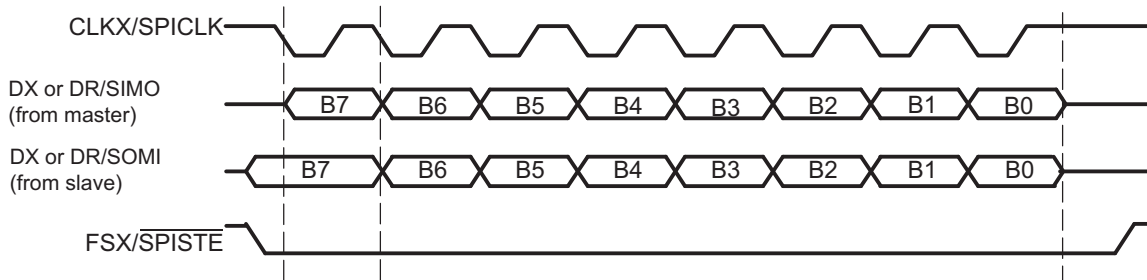
- A If the McBSP is the SPI master (CLKXM = 1), SIMO = DX. If the McBSP is the SPI slave (CLKXM = 0), SIMO = DR.
- B If the McBSP is the SPI master (CLKXM = 1), SOMI = DR. If the McBSP is the SPI slave (CLKXM = 0), SOMI = DX.

**Figure 20-38. SPI Transfer With CLKSTP = 11b (Clock Delay), CLKXP = 0, CLKRP = 1**



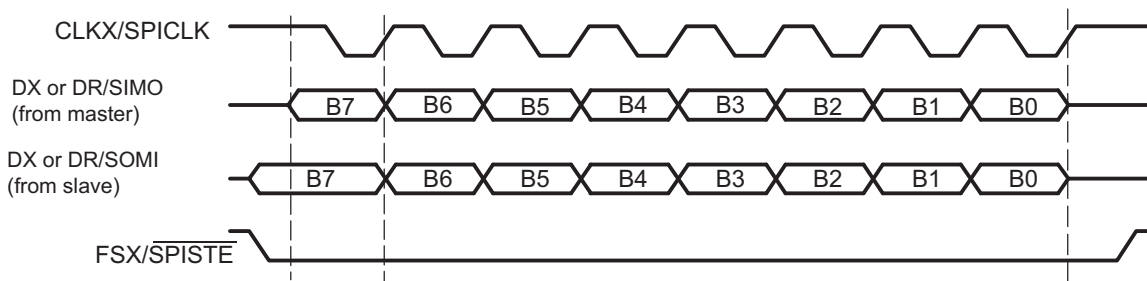
- A If the McBSP is the SPI master (CLKXM = 1), SIMO = DX. If the McBSP is the SPI slave (CLKXM = 0), SIMO = DR.
- B If the McBSP is the SPI master (CLKXM = 1), SOMI = DR. If the McBSP is the SPI slave (CLKXM = 0), SOMI = DX.

**Figure 20-39. SPI Transfer With CLKSTP = 10b (No Clock Delay), CLKXP = 1, and CLKRP = 0**



- A If the McBSP is the SPI master (CLKXM = 1), SIMO = DX. If the McBSP is the SPI slave (CLKXM = 0), SIMO = DR.
- B If the McBSP is the SPI master (CLKXM = 1), SOMI = DR. If the McBSP is the SPI slave (CLKXM = 0), SOMI = DX.

**Figure 20-40. SPI Transfer With CLKSTP = 11b (Clock Delay), CLKXP = 1, CLKRP = 1**



- A If the McBSP is the SPI master (CLKXM = 1), SIMO=DX. If the McBSP is the SPI slave (CLKXM = 0), SIMO = DR.
- B If the McBSP is the SPI master (CLKXM = 1), SOMI=DR. If the McBSP is the SPI slave (CLKXM = 0), SOMI = DX.

### 20.7.5 Procedure for Configuring a McBSP for SPI Operation

To configure the McBSP for SPI master or slave operation:

Step 1. Place the transmitter and receiver in reset.

Clear the transmitter reset bit (XRST = 0) in SPCR2 to reset the transmitter. Clear the receiver reset bit (RRST = 0) in SPCR1 to reset the receiver.

Step 2. Place the sample rate generator in reset.

Clear the sample rate generator reset bit (GRST = 0) in SPCR2 to reset the sample rate generator.

Step 3. Program registers that affect SPI operation.

Program the appropriate McBSP registers to configure the McBSP for proper operation as an SPI master or an SPI slave. For a list of important bits settings, see one of the following topics:

- *McBSP as the SPI Master* ( [Section 20.7.6](#) )
- *McBSP as an SPI Slave* ( [Section 20.7.7](#) )

Step 4. Enable the sample rate generator.

To release the sample rate generator from reset, set the sample rate generator reset bit (GRST = 1) in SPCR2.

Make sure that during the write to SPCR2, you only modify GRST. Otherwise, you modify the McBSP configuration you selected in the previous step.

Step 5. Enable the transmitter and receiver.

After the sample rate generator is released from reset, wait two sample rate generator clock periods for the McBSP logic to stabilize.

If the CPU services the McBSP transmit and receive buffers, then you can immediately enable the transmitter (XRST = 1 in SPCR2) and enable the receiver (RRST = 1 in SPCR1).

If the DMA controller services the McBSP transmit and receive buffers, then you must first configure the DMA controller (this includes enabling the channels that service the McBSP buffers). When the DMA controller is ready, make XRST = 1 and RRST = 1.

In either case, make sure you only change XRST and RRST when you write to SPCR2 and SPCR1. Otherwise, you modify the bit settings you selected earlier in this procedure.

After the transmitter and receiver are released from reset, wait two sample rate generator clock periods for the McBSP logic to stabilize.

Step 6. If necessary, enable the frame-synchronization logic of the sample rate generator.

After the required data acquisition setup is done (DXR[1,2] is loaded with data), set FRST = 1 if an internally generated frame-synchronization pulse is required (that is, if the McBSP is the SPI master).

#### 20.7.6 McBSP as the SPI Master

An SPI interface with the McBSP used as the master is shown in [Figure 20-41](#). When the McBSP is configured as a master, the transmit output signal (DX) is used as the SPISIMO signal of the SPI protocol and the receive input signal (DR) is used as the SPISOMI signal.

The register bit values required to configure the McBSP as a master are listed in [Table 20-16](#). After the table are more details about the configuration requirements.

Figure 20-41. SPI Interface with McBSP Used as Master

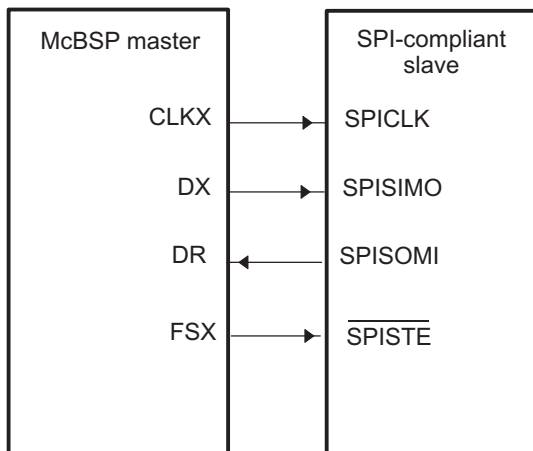


Table 20-16. Bit Values Required to Configure the McBSP as an SPI Master

Required Bit Setting	Description
CLKSTP = 10b or 11b	The clock stop mode (without or with a clock delay) is selected.
CLKXP = 0 or 1	The polarity of CLKX as seen on the MCLKX pin is positive (CLKXP = 0) or negative (CLKXP = 1).
CLKRP = 0 or 1	The polarity of MCLKR as seen on the MCLKR pin is positive (CLKRP = 0) or negative (CLKRP = 1).
CLKXM = 1	The MCLKX pin is an output pin driven by the internal sample rate generator. Because CLKSTP is equal to 10b or 11b, MCLKR is driven internally by CLKX.
SCLKME = 0	The clock generated by the sample rate generator (CLKG) is derived from the CPU clock.
CLKSM = 1	
CLKGDV is a value from 1 to 255	CLKGDV defines the divide down value for CLKG.
FSXM = 1	The FSX pin is an output pin driven according to the FSGM bit.
FSGM = 0	The transmitter drives a frame-synchronization pulse on the FSX pin every time data is transferred from DXR1 to XSR1.
FSXP = 1	The FSX pin is active low.
XDATDLY = 01b	This setting provides the correct setup time on the FSX signal.
RDATDLY = 01b	

When the McBSP functions as the SPI master, it controls the transmission of data by producing the serial clock signal. The clock signal on the MCLKX pin is enabled only during packet transfers. When packets are not being transferred, the MCLKX pin remains high or low depending on the polarity used.

For SPI master operation, the MCLKX pin must be configured as an output. The sample rate generator is then used to derive the CLKX signal from the CPU clock. The clock stop mode internally connects the MCLKX pin to the MCLKR signal so that no external signal connection is required on the MCLKR pin and both the transmit and receive circuits are clocked by the master clock (CLKX).

The data delay parameters of the McBSP (XDATDLY and RDATDLY) must be set to 1 for proper SPI master operation. A data delay value of 0 or 2 is undefined in the clock stop mode.

The McBSP can also provide a slave-enable signal (SS\_) on the FSX pin. If a slave-enable signal is required, the FSX pin must be configured as an output and the transmitter must be configured so that a frame-synchronization pulse is generated automatically each time a packet is transmitted (FSGM = 0). The polarity of the FSX pin is programmable high or low; however, in most cases the pin must be configured active low.

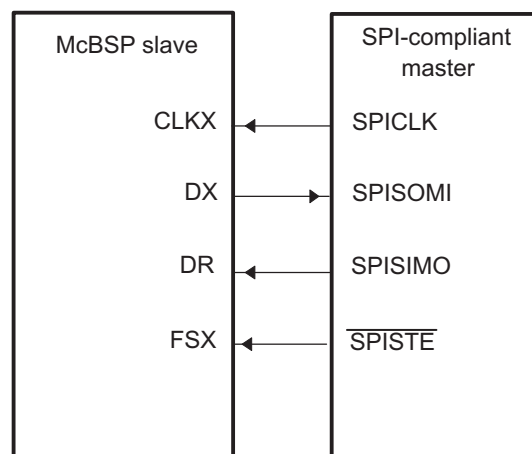
When the McBSP is configured as described for SPI-master operation, the bit fields for frame-synchronization pulse width (FWID) and frame-synchronization period (FPER) are overridden, and custom frame-synchronization waveforms are not allowed. To see the resulting waveform produced on the FSX pin, see the timing diagrams in [Section 20.7.4](#). The signal becomes active before the first bit of a packet transfer, and remains active until the last bit of the packet is transferred. After the packet transfer is complete, the FSX signal returns to the inactive state.

### 20.7.7 McBSP as an SPI Slave

An SPI interface with the McBSP used as a slave is shown in [Figure 20-42](#). When the McBSP is configured as a slave, DX is used as the SPISOMI signal and DR is used as the SPISIMO signal.

The register bit values required to configure the McBSP as a slave are listed in [Table 20-17](#). Following the table are more details about configuration requirements.

**Figure 20-42. SPI Interface With McBSP Used as Slave**



**Table 20-17. Bit Values Required to Configure the McBSP as an SPI Slave**

Required Bit Setting	Description
CLKSTP = 10b or 11b	The clock stop mode (without or with a clock delay) is selected.
CLKXP = 0 or 1	The polarity of CLKX as seen on the MCLKX pin is positive (CLKXP = 0) or negative (CLKXP = 1).
CLKRP = 0 or 1	The polarity of MCLKR as seen on the MCLKR pin is positive (CLKRP = 0) or negative (CLKRP = 1).
CLKXM = 0	The MCLKX pin is an input pin, so that it can be driven by the SPI master. Because CLKSTP = 10b or 11b, MCLKR is driven internally by CLKX.
SCLKME = 0	The clock generated by the sample rate generator (CLKG) is derived from the CPU clock. (The sample rate generator is used to synchronize the McBSP logic with the externally-generated master clock.)
CLKSM = 1	
CLKGDV = 1	The sample rate generator divides the CPU clock before generating CLKG.
FSXM = 0	The FSX pin is an input pin, so that it can be driven by the SPI master.
FSXP = 1	The FSX pin is active low.
XDATDLY = 00b	These bits must be 0s for SPI slave operation.
RDATDLY = 00b	

When the McBSP is used as an SPI slave, the master clock and slave-enable signals are generated externally by a master device. Accordingly, the CLKX and FSX pins must be configured as inputs. The MCLKX pin is internally connected to the MCLKR signal, so that both the transmit and receive circuits of the McBSP are clocked by the external master clock. The FSX pin is also internally connected to the FSR signal, and no external signal connections are required on the MCLKR and FSR pins.

Although the CLKX signal is generated externally by the master and is asynchronous to the McBSP, the sample rate generator of the McBSP must be enabled for proper SPI slave operation. The sample rate generator must be programmed to its maximum rate of half the CPU clock rate. The internal sample rate clock is then used to synchronize the McBSP logic to the external master clock and slave-enable signals.

The McBSP requires an active edge of the slave-enable signal on the FSX input for each transfer. This means that the master device must assert the slave-enable signal at the beginning of each transfer, and deassert the signal after the completion of each packet transfer; the slave-enable signal cannot remain active between transfers. Unlike the standard SPI, this pin cannot be tied low all the time.

The data delay parameters of the McBSP must be set to 0 for proper SPI slave operation. A value of 1 or 2 is undefined in the clock stop mode.

## 20.8 Receiver Configuration

To configure the McBSP receiver, perform the following procedure:

1. Place the McBSP/receiver in reset (see [Section 20.8.2](#)).
2. Program McBSP registers for the desired receiver operation (see [Section 20.8.1](#)).
3. Take the receiver out of reset (see [Section 20.8.2](#)).

### 20.8.1 Programming the McBSP Registers for the Desired Receiver Operation

The following is a list of important tasks to be performed when you are configuring the McBSP receiver. Each task corresponds to one or more McBSP register bit fields.

- Global behavior:
  - Set the receiver pins to operate as McBSP pins.
  - Enable/disable the digital loopback mode.
  - Enable/disable the clock stop mode.
  - Enable/disable the receive multichannel selection mode.
- Data behavior:
  - Choose 1 or 2 phases for the receive frame.
  - Set the receive word length(s).
  - Set the receive frame length.
  - Enable/disable the receive frame-synchronization ignore function.
  - Set the receive companding mode.
  - Set the receive data delay.
  - Set the receive sign-extension and justification mode.
  - Set the receive interrupt mode.
- Frame-synchronization behavior:
  - Set the receive frame-synchronization mode.
  - Set the receive frame-synchronization polarity.
  - Set the sample rate generator (SRG) frame-synchronization period and pulse width.
- Clock behavior:
  - Set the receive clock mode.
  - Set the receive clock polarity.
  - Set the SRG clock divide-down value.
  - Set the SRG clock synchronization mode.
  - Set the SRG clock mode (choose an input clock).
  - Set the SRG input clock polarity.

## 20.8.2 Resetting and Enabling the Receiver

The first step of the receiver configuration procedure is to reset the receiver, and the last step is to enable the receiver (to take it out of reset). [Table 20-18](#) describes the bits used for both of these steps.

**Table 20-18. Register Bits Used to Reset or Enable the McBSP Receiver Field Descriptions**

Register	Bit	Field	Value	Description
SPCR2	7	FRST	0	Frame-synchronization logic is reset. The sample rate generator does not generate frame-synchronization signal FSG, even if GRST = 1.
			1	If GRST = 1, frame-synchronization signal FSG is generated after (FPER + 1) number of CLKG clock cycles; all frame counters are loaded with their programmed values.
SPCR2	6	GRST	0	Sample rate generator is reset. If GRST = 0 due to a DSP reset, CLKG is driven by the CPU clock divided by 2, and FSG is driven low (inactive). If GRST = 0 due to program code, CLKG and FSG are both driven low (inactive).
			1	Sample rate generator is enabled. CLKG is driven according to the configuration programmed in the sample rate generator registers (SRGR[1,2]). If FRST = 1, the generator also generates the frame-synchronization signal FSG as programmed in the sample rate generator registers.
SPCR1	0	RRST	0	The serial port receiver is disabled and in the reset state.
			1	The serial port receiver is enabled.

### 20.8.2.1 Reset Considerations

The serial port can be reset in the following two ways:

1. The DSP reset ( $\overline{XRS}$  signal driven low) places the receiver, transmitter, and sample rate generator in reset. When the device reset is removed ( $\overline{XRS}$  signal released), GRST = FRST = RRST = XRST = 0 keep the entire serial port in the reset state, provided the McBSP clock is turned on.
2. The serial port transmitter and receiver can be reset directly using the RRST and XRST bits in the serial port control registers. The sample rate generator can be reset directly using the GRST bit in SPCR2.

[Table 20-19](#) shows the state of McBSP pins when the serial port is reset due to a device reset and a direct receiver/transmitter reset.

For more details about McBSP reset conditions and effects, see [Section 20.10.2](#).

**Table 20-19. Reset State of Each McBSP Pin**

Pin	Possible State(s)	State Forced By Device Reset	State Forced By Receiver Reset (RRST = 0 and GRST = 1)
MDRx	I	GPIO Input	Input
MCLKRx	I/O/Z	GPIO Input	Known state if input; MCLKR running if output
MFSRx	I/O/Z	GPIO Input	Known state if input; FSRP inactive state if output Transmitter reset (XRST = 0 and GRST = 1)
MDXx	O/Z	GPIO Input	Low impedance after transmit bit clock provided
MCLKXx	I/O/Z	GPIO Input	Known state if input; CLKX running if output
MFSXx	I/O/Z	GPIO Input	Known state if input; FSXP inactive state if output

### 20.8.3 Set the Receiver Pins to Operate as McBSP Pins

To configure a pin for its McBSP function, you should configure the bits of the GPxMUXn register appropriately. In addition to this, bits 12 and 13 of the PCR register must be set to 0. These bits are defined as reserved.

## 20.8.4 Enable/Disable the Digital Loopback Mode

The DLB bit determines whether the digital loopback mode is on. DLB is described in [Table 20-20](#).

**Table 20-20. Register Bit Used to Enable/Disable the Digital Loopback Mode**

Register	Bit	Name	Function	Type	Reset Value	
SPCR1	15	DLB	Digital loopback mode	R/W	0	
			DLB = 0			Digital loopback mode is disabled.
			DLB = 1			Digital loopback mode is enabled.

### 20.8.4.1 Digital Loopback Mode

In the digital loopback mode, the receive signals are connected internally through multiplexers to the corresponding transmit signals, as shown in [Table 20-21](#). This mode allows testing of serial port code with a single DSP device; the McBSP receives the data it transmits.

**Table 20-21. Receive Signals Connected to Transmit Signals in Digital Loopback Mode**

This Receive Signal	Is Fed Internally by This Transmit Signal
MDR (receive data)	MDX (transmit data)
MFSR (receive frame synchronization)	MFSX (transmit frame synchronization)
MCLKR (receive clock)	MCLKX (transmit clock)

## 20.8.5 Enable/Disable the Clock Stop Mode

The CLKSTP bits determine whether the clock stop mode is on. CLKSTP is described in [Table 20-22](#).

**Table 20-22. Register Bits Used to Enable/Disable the Clock Stop Mode**

Register	Bit	Name	Function	Type	Reset Value	
SPCR1	12-11	CLKSTP	Clock stop mode	R/W	00	
			CLKSTP = 0Xb			Clock stop mode disabled; normal clocking for non-SPI mode
			CLKSTP = 10b			Clock stop mode enabled, without clock delay
			CLKSTP = 11b			Clock stop mode enabled, with clock delay

### 20.8.5.1 Clock Stop Mode

The clock stop mode supports the SPI master-slave protocol. If you do not plan to use the SPI protocol, you can clear CLKSTP to disable the clock stop mode.

In the clock stop mode, the clock stops at the end of each data transfer. At the beginning of each data transfer, the clock starts immediately (CLKSTP = 10b) or after a half-cycle delay (CLKSTP = 11b). The CLKXP bit determines whether the starting edge of the clock on the MCLKX pin is rising or falling. The CLKRP bit determines whether receive data is sampled on the rising or falling edge of the clock shown on the MCLKR pin.

[Table 20-23](#) summarizes the impact of CLKSTP, CLKXP, and CLKRP on serial port operation. In the clock stop mode, the receive clock is tied internally to the transmit clock, and the receive frame-synchronization signal is tied internally to the transmit frame-synchronization signal.



**Table 20-23. Effects of CLKSTP, CLKXP, and CLKRP on the Clock Scheme**

Bit Settings	Clock Scheme
CLKSTP = 00b or 01b CLKXP = 0 or 1 CLKRP = 0 or 1	Clock stop mode disabled. Clock enabled for non-SPI mode.
CLKSTP = 10b CLKXP = 0 CLKRP = 0	Low inactive state without delay: The McBSP transmits data on the rising edge of CLKX and receives data on the falling edge of MCLKR.
CLKSTP = 11b CLKXP = 0 CLKRP = 1	Low inactive state with delay: The McBSP transmits data one-half cycle ahead of the rising edge of CLKX and receives data on the rising edge of MCLKR.
CLKSTP = 10b CLKXP = 1 CLKRP = 0	High inactive state without delay: The McBSP transmits data on the falling edge of CLKX and receives data on the rising edge of MCLKR.
CLKSTP = 11b CLKXP = 1 CLKRP = 1	High inactive state with delay: The McBSP transmits data one-half cycle ahead of the falling edge of CLKX and receives data on the falling edge of MCLKR.

### 20.8.6 Enable/Disable the Receive Multichannel Selection Mode

The RMCM bit determines whether the receive multichannel selection mode is on. RMCM is described in [Table 20-24](#). For more details, see [Section 20.6.6](#).

**Table 20-24. Register Bit Used to Enable/Disable the Receive Multichannel Selection Mode**

Register	Bit	Name	Function	Type	Reset Value
MCR1	0	RMCM	Receive multichannel selection mode	R/W	0
			RMCM = 0		The mode is disabled. All 128 channels are enabled.
			RMCM = 1		The mode is enabled. Channels can be individually enabled or disabled. The only channels enabled are those selected in the appropriate receive channel enable registers (RCERs). The way channels are assigned to the RCERs depends on the number of receive channel partitions (2 or 8), as defined by the RMCME bit.

### 20.8.7 Choose One or Two Phases for the Receive Frame

The RPHASE bit (see [Table 20-25](#)) determines whether the receive data frame has one or two phases.

**Table 20-25. Register Bit Used to Choose One or Two Phases for the Receive Frame**

Register	Bit	Name	Function	Type	Reset Value
RCR2	15	RPHASE	Receive phase number	R/W	0
			Specifies whether the receive frame has 1 or 2 phases.		
			RPHASE = 0		Single-phase frame
			RPHASE = 1		Dual-phase frame



### 20.8.8 Set the Receive Word Length(s)

The RWDLEN1 and RWDLEN2 bit fields (see [Table 20-26](#)) determine how many bits are in each serial word in phase 1 and in phase 2, respectively, of the receive data frame.

**Table 20-26. Register Bits Used to Set the Receive Word Length(s)**

Register	Bit	Name	Function	Type	Reset Value	
RCR1	7-5	RWDLEN1	Receive word length 1	R/W	000	
			Specifies the length of every serial word in phase 1 of the receive frame.			
			RWDLEN1 = 000			8 bits
			RWDLEN1 = 001			12 bits
			RWDLEN1 = 010			16 bits
			RWDLEN1 = 011			20 bits
			RWDLEN1 = 100			24 bits
			RWDLEN1 = 101			32 bits
		RWDLEN1 = 11X	Reserved			
RCR2	7-5	RWDLEN2	Receive word length 2	R/W	000	
			If a dual-phase frame is selected, RWDLEN2 specifies the length of every serial word in phase 2 of the frame.			
			RWDLEN2 = 000			8 bits
			RWDLEN2 = 001			12 bits
			RWDLEN2 = 010			16 bits
			RWDLEN2 = 011			20 bits
			RWDLEN2 = 100			24 bits
			RWDLEN2 = 101			32 bits
		RWDLEN2 = 11X	Reserved			

#### 20.8.8.1 Word Length Bits

Each frame can have one or two phases, depending on the value that you load into the RPHASE bit. If a single-phase frame is selected, RWDLEN1 selects the length for every serial word received in the frame. If a dual-phase frame is selected, RWDLEN1 determines the length of the serial words in phase 1 of the frame and RWDLEN2 determines the word length in phase 2 of the frame.

### 20.8.9 Set the Receive Frame Length

The RFRLLEN1 and RFRLLEN2 bit fields (see [Table 20-27](#)) determine how many serial words are in phase 1 and in phase 2, respectively, of the receive data frame.

**Table 20-27. Register Bits Used to Set the Receive Frame Length**

Register	Bit	Name	Function	Type	Reset Value	
RCR1	14-8	RFRLLEN1	Receive frame length 1	R/W	000 0000	
			(RFRLLEN1 + 1) is the number of serial words in phase 1 of the receive frame.			
			RFRLLEN1 = 000 0000			1 word in phase 1
			RFRLLEN1 = 000 0001			2 words in phase 1
		RFRLLEN1 = 111 1111	128 words in phase 1			

**Table 20-27. Register Bits Used to Set the Receive Frame Length (continued)**

Register	Bit	Name	Function	Type	Reset Value
RCCR2	14-8	RFRLN2	Receive frame length 2  If a dual-phase frame is selected, (RFRLN2 + 1) is the number of serial words in phase 2 of the receive frame.  RFRLN2 = 000 0000                      1 word in phase 2 RFRLN2 = 000 0001                      2 words in phase 2     RFRLN2 = 111 1111                      128 words in phase 2	R/W	000 0000

### 20.8.9.1 Selected Frame Length

The receive frame length is the number of serial words in the receive frame. Each frame can have one or two phases, depending on value that you load into the RPHASE bit.

If a single-phase frame is selected (RPHASE = 0), the frame length is equal to the length of phase 1. If a dual-phase frame is selected (RPHASE = 1), the frame length is the length of phase 1 plus the length of phase 2.

The 7-bit RFRLN fields allow up to 128 words per phase. See [Table 20-28](#) for a summary of how to calculate the frame length. This length corresponds to the number of words or logical time slots or channels per frame-synchronization pulse.

Program the RFRLN fields with [*w minus 1*], where *w* represents the number of words per phase. For the example, if you want a phase length of 128 words in phase 1, load 127 into RFRLN1.

**Table 20-28. How to Calculate the Length of the Receive Frame**

RPHASE	RFRLN1	RFRLN2	Frame Length
0	$0 \leq \text{RFRLN1} \leq 127$	Don't care	(RFRLN1 + 1) words
1	$0 \leq \text{RFRLN1} \leq 127$	$0 \leq \text{RFRLN2} \leq 127$	(RFRLN1 + 1) + (RFRLN2 + 1) words

### 20.8.10 Enable/Disable the Receive Frame-Synchronization Ignore Function

The RFIG bit (see [Table 20-29](#)) controls the receive frame-synchronization ignore function.

**Table 20-29. Register Bit Used to Enable/Disable the Receive Frame-Synchronization Ignore Function**

Register	Bit	Name	Function	Type	Reset Value
RCCR2	2	RFIG	Receive frame-synchronization ignore  RFIG = 0    An unexpected receive frame-synchronization pulse causes the McBSP to restart the frame transfer.  RFIG = 1    The McBSP ignores unexpected receive frame-synchronization pulses.	R/W	0

#### 20.8.10.1 Unexpected Frame-Synchronization Pulses and the Frame-Synchronization Ignore Function

If a frame-synchronization pulse starts the transfer of a new frame before the current frame is fully received, this pulse is treated as an unexpected frame-synchronization pulse.

When RFIG = 1, reception continues, ignoring the unexpected frame-synchronization pulses.

When RFIG = 0, an unexpected FSR pulse causes the McBSP to discard the contents of RSR[1,2] in favor of the new incoming data. Therefore, if RFIG = 0 and an unexpected frame-synchronization pulse occurs, the serial port:

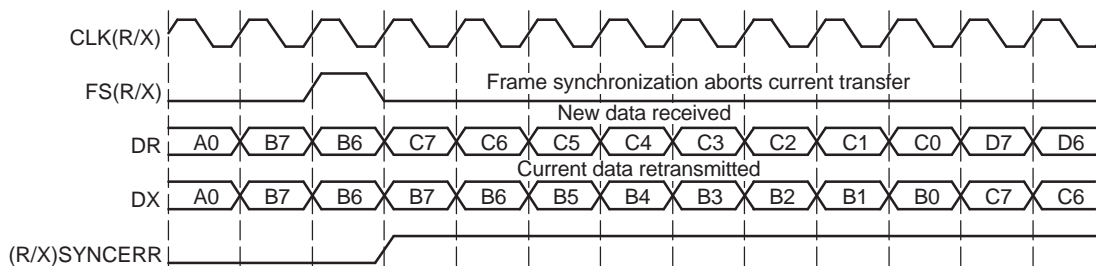
1. Aborts the current data transfer
2. Sets RSYNCERR in SPCR1 to 1
3. Begins the transfer of a new data word

For more details about the frame-synchronization error condition, see [Section 20.5.3](#).

### 20.8.10.2 Examples of Effects of RFIG

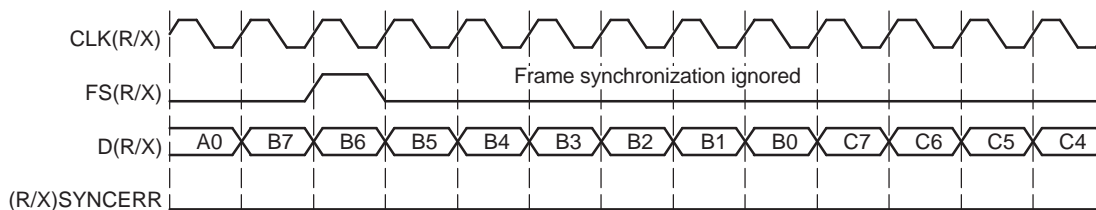
Figure 20-43 shows an example in which word B is interrupted by an unexpected frame-synchronization pulse when (R/X)FIG = 0. In the case of reception, the reception of B is aborted (B is lost), and a new data word © in this example) is received after the appropriate data delay. This condition is a receive synchronization error, which sets the RSYNCERR bit.

**Figure 20-43. Unexpected Frame-Synchronization Pulse With (R/X)FIG = 0**



In contrast with Figure 20-43, Figure 20-44 shows McBSP operation when unexpected frame-synchronization signals are ignored (when (R/X)FIG = 1). Here, the transfer of word B is not affected by an unexpected pulse.

**Figure 20-44. Unexpected Frame-Synchronization Pulse With (R/X)FIG = 1**



### 20.8.11 Set the Receive Companding Mode

The RCOMPAND bits (see [Table 20-30](#)) determine whether companding or another data transfer option is chosen for McBSP reception.

**Table 20-30. Register Bits Used to Set the Receive Companding Mode**

Register	Bit	Name	Function	Type	Reset Value
RCR2	4-3	RCOMPAND	Receive companding mode	R/W	00
Modes other than 00b are enabled only when the appropriate RWDLEN is 000b, indicating 8-bit data.					
RCOMPAND = 00 No companding, any size data, MSB received first					
RCOMPAND = 01 No companding, 8-bit data, LSB received first (for details, see <a href="#">Section 20.8.11.4</a> ).					
RCOMPAND = 10 $\mu$ -law companding, 8-bit data, MSB received first					
RCOMPAND = 11 A-law companding, 8-bit data, MSB received first					

### 20.8.11.1 Companding

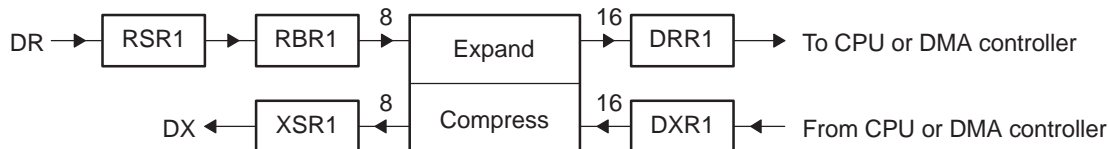
Companding (COMpressing and exPANDING) hardware allows compression and expansion of data in either  $\mu$ -law or A-law format. The companding standard employed in the United States and Japan is  $\mu$ -law. The European companding standard is referred to as A-law. The specifications for  $\mu$ -law and A-law log PCM are part of the CCITT G.711 recommendation.

A-law and  $\mu$ -law allow 13 bits and 14 bits of dynamic range, respectively. Any values outside this range are set to the most positive or most negative value. Thus, for companding to work best, the data transferred to and from the McBSP via the CPU or DMA controller must be at least 16 bits wide.

The  $\mu$ -law and A-law formats both encode data into 8-bit code words. Companded data is always 8 bits wide; the appropriate word length bits (RWDLEN1, RWDLEN2, XWDLEN1, XWDLEN2) must therefore be set to 0, indicating an 8-bit wide serial data stream. If companding is enabled and either of the frame phases does not have an 8-bit word length, companding continues as if the word length is 8 bits.

Figure 20-45 illustrates the companding processes. When companding is chosen for the transmitter, compression occurs during the process of copying data from DXR1 to XSR1. The transmit data is encoded according to the specified companding law (A-law or  $\mu$ -law). When companding is chosen for the receiver, expansion occurs during the process of copying data from RBR1 to DRR1. The receive data is decoded to 2's-complement format.

**Figure 20-45. Companding Processes for Reception and for Transmission**



### 20.8.11.2 Format of Expanded Data

For reception, the 8-bit compressed data in RBR1 is expanded to left-justified 16-bit data in DRR1. The RJUST bit of SPCR1 is ignored when companding is used.

### 20.8.11.3 Companding Internal Data

If the McBSP is otherwise unused (the serial port transmit and receive sections are reset), the companding hardware can compand internal data. See [Section 20.3.2.2](#).

### 20.8.11.4 Option to Receive LSB First

Normally, the McBSP transmits or receives all data with the most significant bit (MSB) first. However, certain 8-bit data protocols (that do not use companded data) require the least significant bit (LSB) to be transferred first. If you set RCOMPAND = 01b in RCR2, the bit ordering of 8-bit words is reversed during reception. Similar to companding, this feature is enabled only if the appropriate word length bits are set to 0, indicating that 8-bit words are to be transferred serially. If either phase of the frame does not have an 8-bit word length, the McBSP assumes the word length is eight bits and LSB-first ordering is done.

## 20.8.12 Set the Receive Data Delay

The RDATDLY bits (see [Table 20-31](#)) determine the length of the data delay for the receive frame.

**Table 20-31. Register Bits Used to Set the Receive Data Delay**

Register	Bit	Name	Function	Type	Reset Value	
RCR2	1-0	RDATDLY	Receive data delay	R/W	00	
			RDATDLY = 00			0-bit data delay
			RDATDLY = 01			1-bit data delay
			RDATDLY = 10			2-bit data delay
			RDATDLY = 11			Reserved

### 20.8.12.1 Data Delay

The start of a frame is defined by the first clock cycle in which frame synchronization is found to be active. The beginning of actual data reception or transmission with respect to the start of the frame can be delayed if required. This delay is called data delay.

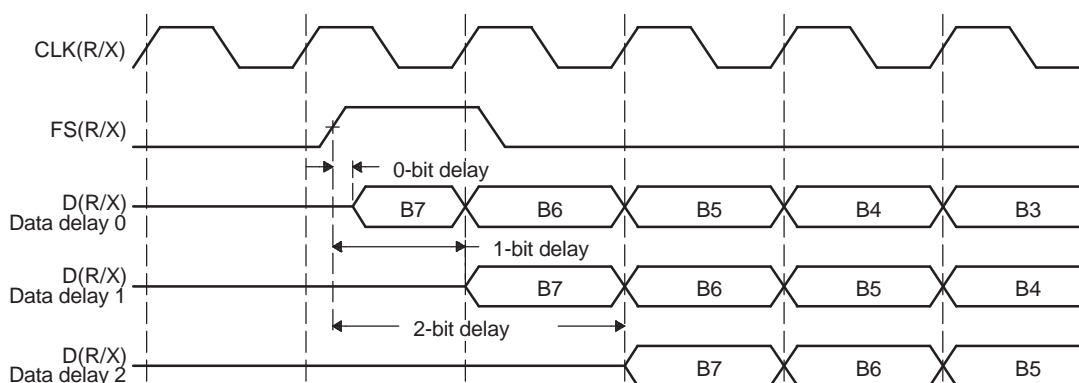
RDATDLY specifies the data delay for reception. The range of programmable data delay is zero to two bit-clocks (RDATDLY = 00b-10b), as described in Table 20-31 and shown in Figure 20-46. In this figure, the data transferred is an 8-bit value with bits labeled B7, B6, B5, and so on. Typically a 1-bit delay is selected, because data often follows a 1-cycle active frame-synchronization pulse.

### 20.8.12.2 0-Bit Data Delay

Normally, a frame-synchronization pulse is detected or sampled with respect to an edge of internal serial clock CLK(R/X). Thus, on the following cycle or later (depending on the data delay value), data may be received or transmitted. However, in the case of 0-bit data delay, the data must be ready for reception and/or transmission on the same serial clock cycle.

For reception, this problem is solved because receive data is sampled on the first falling edge of MCLKR where an active-high internal FSR is detected. However, data transmission must begin on the rising edge of the internal CLKX clock that generated the frame synchronization. Therefore, the first data bit is assumed to be present in XSR1, and thus on DX. The transmitter then asynchronously detects the frame-synchronization signal (FSX) going active high and immediately starts driving the first bit to be transmitted on the DX pin.

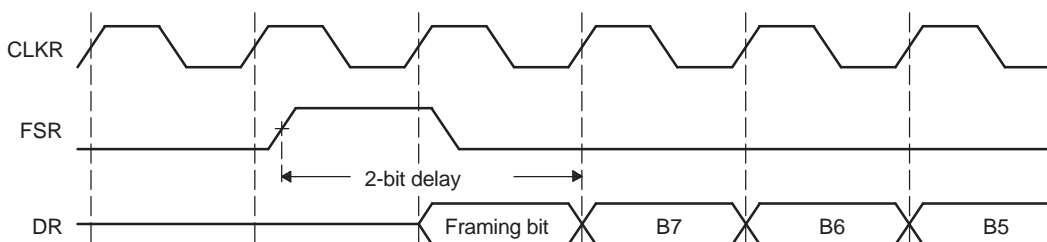
Figure 20-46. Range of Programmable Data Delay



### 20.8.12.3 2-Bit Data Delay

A data delay of two bit periods allows the serial port to interface to different types of T1 framing devices where the data stream is preceded by a framing bit. During reception of such a stream with data delay of two bits (framing bit appears after a 1-bit delay and data appears after a 2-bit delay), the serial port essentially discards the framing bit from the data stream, as shown in Figure 20-47. In this figure, the data transferred is an 8-bit value with bits labeled B7, B6, B5, and so on.

Figure 20-47. 2-Bit Data Delay Used to Skip a Framing Bit



### 20.8.13 Set the Receive Sign-Extension and Justification Mode

The RJUST bits (see [Table 20-32](#)) determine whether data received by the McBSP is sign-extended and how it is justified.

**Table 20-32. Register Bits Used to Set the Receive Sign-Extension and Justification Mode**

Register	Bit	Name	Function	Type	Reset Value
SPCR1	14-13	RJUST	Receive sign-extension and justification mode	R/W	00
			RJUST = 00      Right justify data and zero fill MSBs in DRR[1,2]		
			RJUST = 01      Right justify data and sign extend it into the MSBs in DRR[1,2]		
			RJUST = 10      Left justify data and zero fill LSBs in DRR[1,2]		
			RJUST = 11      Reserved		

#### 20.8.13.1 Sign-Extension and the Justification

RJUST in SPCR1 selects whether data in RBR[1,2] is right- or left-justified (with respect to the MSB) in DRR[1,2] and whether unused bits in DRR[1,2] are filled with zeros or with sign bits.

[Table 20-33](#) and [Table 20-34](#) show the effects of various RJUST values. The first table shows the effect on an example 12-bit receive-data value ABC<sub>h</sub>. The second table shows the effect on an example 20-bit receive-data value ABCDE<sub>h</sub>.

**Table 20-33. Example: Use of RJUST Field With 12-Bit Data Value ABC<sub>h</sub>**

RJUST	Justification	Extension	Value in DRR2	Value in DRR1
00b	Right	Zero fill MSBs	0000h	0ABC <sub>h</sub>
01b	Right	Sign extend data into MSBs	FFFFh	FABC <sub>h</sub>
10b	Left	Zero fill LSBs	0000h	ABC0 <sub>h</sub>
11b	Reserved	Reserved	Reserved	Reserved

**Table 20-34. Example: Use of RJUST Field With 20-Bit Data Value ABCDE<sub>h</sub>**

RJUST	Justification	Extension	Value in DRR2	Value in DRR1
00b	Right	Zero fill MSBs	000Ah	BCDE <sub>h</sub>
01b	Right	Sign extend data into MSBs	FFFAh	BCDE <sub>h</sub>
10b	Left	Zero fill LSBs	ABCDh	E000 <sub>h</sub>
11b	Reserved	Reserved	Reserved	Reserved

### 20.8.14 Set the Receive Interrupt Mode

The RINTM bits (see [Table 20-35](#)) determine which event generates a receive interrupt request to the CPU.

The receive interrupt (RINT) informs the CPU of changes to the serial port status. Four options exist for configuring this interrupt. The options are set by the receive interrupt mode bits, RINTM, in SPCR1.

**Table 20-35. Register Bits Used to Set the Receive Interrupt Mode**

Register	Bit	Name	Function	Type	Reset Value
SPCR1	5-4	RINTM	Receive interrupt mode	R/W	00
			RINTM = 00 RINT generated when RRDY changes from 0 to 1. Interrupt on every serial word by tracking the RRDY bit in SPCR1. Regardless of the value of RINTM, RRDY can be read to detect the RRDY = 1 condition.		
			RINTM = 01 RINT generated by an end-of-block or end-of-frame condition in the receive multichannel selection mode. In the multichannel selection mode, interrupt after every 16-channel block boundary has been crossed within a frame and at the end of the frame. For details, see <a href="#">Section 20.6.8</a> . In any other serial transfer case, this setting is not applicable and, therefore, no interrupts are generated.		
			RINTM = 10 RINT generated by a new receive frame-synchronization pulse. Interrupt on detection of receive frame-synchronization pulses. This generates an interrupt even when the receiver is in its reset state. This is done by synchronizing the incoming frame-synchronization pulse to the CPU clock and sending it to the CPU via RINT.		
			RINTM = 11 RINT generated when RSYNCERR is set. Interrupt on frame-synchronization error. Regardless of the value of RINTM, RSYNCERR can be read to detect this condition. For information on using RSYNCERR, see <a href="#">Section 20.5.3</a> .		

### 20.8.15 Set the Receive Frame-Synchronization Mode

The bits described in [Table 20-36](#) determine the source for receive frame synchronization and the function of the FSR pin.

#### 20.8.15.1 Receive Frame-Synchronization Modes

[Table 20-37](#) shows how you can select various sources to provide the receive frame-synchronization signal and the effect on the FSR pin. The polarity of the signal on the FSR pin is determined by the FSRP bit.

In digital loopback mode (DLB = 1), the transmit frame-synchronization signal is used as the receive frame-synchronization signal.

Also in the clock stop mode, the internal receive clock signal (MCLKR) and the internal receive frame-synchronization signal (FSR) are internally connected to their transmit counterparts, CLKX and FSX.

**Table 20-36. Register Bits Used to Set the Receive Frame Synchronization Mode**

Register	Bit	Name	Function	Type	Reset Value
PCR	10	FSRM	Receive frame-synchronization mode	R/W	0
			FSRM = 0 Receive frame synchronization is supplied by an external source via the FSR pin.		
			FSRM = 1 Receive frame synchronization is supplied by the sample rate generator. FSR is an output pin reflecting internal FSR, except when GSYNC = 1 in SRGR2.		



**Table 20-36. Register Bits Used to Set the Receive Frame Synchronization Mode (continued)**

Register	Bit	Name	Function	Type	Reset Value
SRGR2	15	GSYNC	<p>Sample rate generator clock synchronization mode</p> <p>If the sample rate generator creates a frame-synchronization signal (FSG) that is derived from an external input clock, the GSYNC bit determines whether FSG is kept synchronized with pulses on the FSR pin.</p> <p>GSYNC = 0      No clock synchronization is used: CLKG oscillates without adjustment, and FSG pulses every (FPER + 1) CLKG cycles.</p> <p>GSYNC = 1      Clock synchronization is used. When a pulse is detected on the FSR pin:</p> <ul style="list-style-type: none"> <li>• CLKG is adjusted as necessary so that it is synchronized with the input clock on the MCLKR pin.</li> <li>• FSG pulses FSG only pulses in response to a pulse on the FSR pin. The frame-synchronization period defined in FPER is ignored.</li> </ul> <p>For more details, see <a href="#">Section 20.4.3</a>.</p>	R/W	0
SPCR1	15	DLB	<p>Digital loopback mode</p> <p>DLB = 0      Digital loopback mode is disabled.</p> <p>DLB = 1      Digital loopback mode is enabled. The receive signals, including the receive frame-synchronization signal, are connected internally through multiplexers to the corresponding transmit signals.</p>	R/W	0
SPCR1	12-11	CLKSTP	<p>Clock stop mode</p> <p>CLKSTP = 0xb      Clock stop mode disabled; normal clocking for non-SPI mode.</p> <p>CLKSTP = 10b      Clock stop mode enabled without clock delay. The internal receive clock signal (MCLKR) and the internal receive frame-synchronization signal (FSR) are internally connected to their transmit counterparts, CLKX and FSX.</p> <p>CLKSTP = 11b      Clock stop mode enabled with clock delay. The internal receive clock signal (MCLKR) and the internal receive frame-synchronization signal (FSR) are internally connected to their transmit counterparts, CLKX and FSX.</p>	R/W	00

**Table 20-37. Select Sources to Provide the Receive Frame-Synchronization Signal and the Effect on the FSR Pin**

DLB	FSRM	GSYNC	Source of Receive Frame Synchronization	FSR Pin Status
0	0	0 or 1	An external frame-synchronization signal enters the McBSP through the FSR pin. The signal is then inverted as determined by FSRP before being used as internal FSR.	Input
0	1	0	Internal FSR is driven by the sample rate generator frame-synchronization signal (FSG).	Output. FSG is inverted as determined by FSRP before being driven out on the FSR pin.
0	1	1	Internal FSR is driven by the sample rate generator frame-synchronization signal (FSG).	Input. The external frame-synchronization input on the FSR pin is used to synchronize CLKG and generate FSG pulses.
1	0	0	Internal FSX drives internal FSR.	High impedance



**Table 20-37. Select Sources to Provide the Receive Frame-Synchronization Signal and the Effect on the FSR Pin (continued)**

DLB	FSRM	GSYNC	Source of Receive Frame Synchronization	FSR Pin Status
1	0 or 1	1	Internal FSX drives internal FSR.	Input. If the sample rate generator is running, external FSR is used to synchronize CLKG and generate FSG pulses.
1	1	0	Internal FSX drives internal FSR.	Output. Receive (same as transmit) frame synchronization is inverted as determined by FSRP before being driven out on the FSR pin.

### 20.8.16 Set the Receive Frame-Synchronization Polarity

The FSRP bit (see [Table 20-38](#)) determines whether frame-synchronization pulses are active high or active low on the FSR pin.

**Table 20-38. Register Bit Used to Set Receive Frame-Synchronization Polarity**

Register	Bit	Name	Function	Type	Reset Value
PCR	2	FSRP	Receive frame-synchronization polarity	R/W	0
			FSRP = 0		Frame-synchronization pulse FSR is active high.
			FSRP = 1		Frame-synchronization pulse FSR is active low.

#### 20.8.16.1 Frame-Synchronization Pulses, Clock Signals, and Their Polarities

Receive frame-synchronization pulses can be generated internally by the sample rate generator (see [Section 20.4.2](#)) or driven by an external source. The source of frame synchronization is selected by programming the mode bit, FSRM, in PCR. FSR is also affected by the GSYNC bit in SRGR2. For information about the effects of FSRM and GSYNC, see [Section 20.8.15](#). Similarly, receive clocks can be selected to be inputs or outputs by programming the mode bit, CLKRM, in the PCR (see [Section 20.8.17](#)).

When FSR and FSX are inputs (FSXM = FSRM = 0, external frame-synchronization pulses), the McBSP detects them on the internal falling edge of clock, internal MCLKR, and internal CLKX, respectively. The receive data arriving at the DR pin is also sampled on the falling edge of internal MCLKR. These internal clock signals are either derived from an external source via CLK(R/X) pins or driven by the sample rate generator clock (CLKG) internal to the McBSP.

When FSR and FSX are outputs, implying that they are driven by the sample rate generator, they are generated (transition to their active state) on the rising edge of the internal clock, CLK(R/X). Similarly, data on the DX pin is output on the rising edge of internal CLKX.

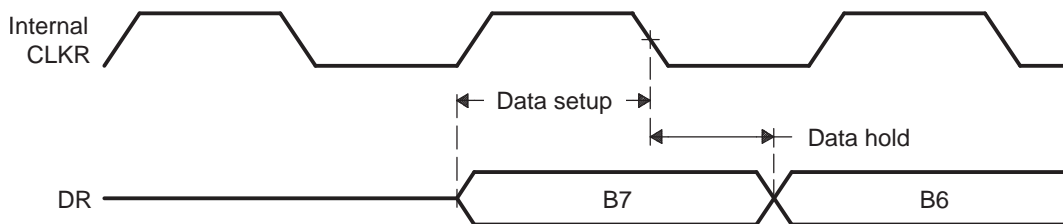
FSRP, FSXP, CLKRP, and CLKXP in the pin control register (PCR) configure the polarities of the FSR, FSX, MCLKR, and CLKX signals, respectively. All frame-synchronization signals (internal FSR, internal FSX) that are internal to the serial port are active high. If the serial port is configured for external frame synchronization (FSR/FSX are inputs to McBSP), and FSRP = FSXP = 1, the external active-low frame-synchronization signals are inverted before being sent to the receiver (internal FSR) and transmitter (internal FSX). Similarly, if internal synchronization (FSR/FSX are output pins and GSYNC = 0) is selected, the internal active-high frame-synchronization signals are inverted, if the polarity bit FS(R/X)P = 1, before being sent to the FS(R/X) pin.

On the transmit side, the transmit clock polarity bit, CLKXP, sets the edge used to shift and clock out transmit data. Data is always transmitted on the rising edge of internal CLKX. If CLKXP = 1 and external clocking is selected (CLKXM = 0 and CLKX is an input), the external falling-edge triggered input clock on CLKX is inverted to a rising-edge triggered clock before being sent to the transmitter. If CLKXP = 1, and internal clocking selected (CLKXM = 1 and CLKX is an output pin), the internal (rising-edge triggered) clock, internal CLKX, is inverted before being sent out on the MCLKX pin.

Similarly, the receiver can reliably sample data that is clocked with a rising edge clock (by the transmitter). The receive clock polarity bit, CLKRP, sets the edge used to sample received data. The receive data is always sampled on the falling edge of internal MCLKR. Therefore, if CLKRP = 1 and external clocking is selected (CLKRM = 0 and MCLKR is an input pin), the external rising-edge triggered input clock on MCLKR is inverted to a falling-edge triggered clock before being sent to the receiver. If CLKRP = 1 and internal clocking is selected (CLKRM = 1), the internal falling-edge triggered clock is inverted to a rising-edge triggered clock before being sent out on the MCLKR pin.

MCLKRP = CLKXP in a system where the same clock (internal or external) is used to clock the receiver and transmitter. The receiver uses the opposite edge as the transmitter to ensure valid setup and hold of data around this edge. Figure 20-48 shows how data clocked by an external serial device using a rising edge can be sampled by the McBSP receiver on the falling edge of the same clock.

**Figure 20-48. Data Clocked Externally Using a Rising Edge and Sampled by the McBSP Receiver on a Falling Edge**



Set the SRG Frame-Synchronization Period and Pulse Width

#### 20.8.16.2 Frame-Synchronization Period and the Frame-Synchronization Pulse Width

The sample rate generator can produce a clock signal, CLKG, and a frame-synchronization signal, FSG. If the sample rate generator is supplying receive or transmit frame synchronization, you must program the bit fields FPER and FWID.

On FSG, the period from the start of a frame-synchronization pulse to the start of the next pulse is (FPER + 1) CLKG cycles. The 12 bits of FPER allow a frame-synchronization period of 1 to 4096 CLKG cycles, which allows up to 4096 data bits per frame. When GSYNC = 1, FPER is a don't care value.

Each pulse on FSG has a width of (FWID + 1) CLKG cycles. The eight bits of FWID allow a pulse width of 1 to 256 CLKG cycles. It is recommended that FWID be programmed to a value less than the programmed word length.

The values in FPER and FWID are loaded into separate down-counters. The 12-bit FPER counter counts down the generated clock cycles from the programmed value (4095 maximum) to 0. The 8-bit FWID counter counts down from the programmed value (255 maximum) to 0. Table 20-39 shows settings for FPER and FWID.

Figure 20-49 shows a frame-synchronization period of 16 CLKG periods (FPER = 15 or 00001111b) and a frame-synchronization pulse with an active width of 2 CLKG periods (FWID = 1).

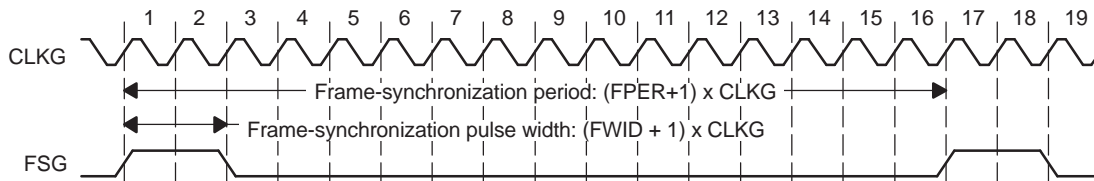
**Table 20-39. Register Bits Used to Set the SRG Frame-Synchronization Period and Pulse Width**

Register	Bit	Name	Function	Type	Reset Value
SRGR2	11-0	FPER	Sample rate generator frame-synchronization period  For the frame-synchronization signal FSG, (FPER + 1) determines the period from the start of a frame-synchronization pulse to the start of the next frame-synchronization pulse.  Range for (FPER + 1): 1 to 4096 CLKG cycles	R/W	0000 0000 0000
SRGR1	15-8	FWID	Sample rate generator frame-synchronization pulse width  This field plus 1 determines the width of each frame-synchronization pulse on FSG.	R/W	0000 0000

**Table 20-39. Register Bits Used to Set the SRG Frame-Synchronization Period and Pulse Width (continued)**

Register	Bit	Name	Function	Type	Reset Value
			Range for (FWID + 1): 1 to 256 CLKG cycles		

**Figure 20-49. Frame of Period 16 CLKG Periods and Active Width of 2 CLKG Periods**



When the sample rate generator comes out of reset, FSG is in its inactive state. Then, when GRST = 1 and FSGM = 1, a frame-synchronization pulse is generated. The frame width value (FWID + 1) is counted down on every CLKG cycle until it reaches 0, at which time FSG goes low. At the same time, the frame period value (FPER + 1) is also counting down. When this value reaches 0, FSG goes high, indicating a new frame.

### 20.8.17 Set the Receive Clock Mode

Table 20-40 shows the settings for bits used to set receive clock mode.

**Table 20-40. Register Bits Used to Set the Receive Clock Mode**

Register	Bit	Name	Function	Type	Reset Value
PCR	8	CLKRM	Receive clock mode	R/W	0
			Case 1: Digital loopback mode not set (DLB = 0) in SPCR1.		
			CLKRM = 0      The MCLKR pin is an input pin that supplies the internal receive clock (MCLKR).		
			CLKRM = 1      Internal MCLKR is driven by the sample rate generator of the McBSP. The MCLKR pin is an output pin that reflects internal MCLKR.		
SPCR1	15	DLB	Case 2: Digital loopback mode set (DLB = 1) in SPCR1.	R/W	00
			CLKRM = 0      The MCLKR pin is in the high impedance state. The internal receive clock (MCLKR) is driven by the internal transmit clock (CLKX). Internal CLKX is derived according to the CLKXM bit of PCR.		
			CLKRM = 1      Internal MCLKR is driven by internal CLKX. The MCLKR pin is an output pin that reflects internal MCLKR. Internal CLKX is derived according to the CLKXM bit of PCR.		
			DLB = 0      Digital loopback mode is disabled.		
			DLB = 1      Digital loopback mode is enabled. The receive signals, including the receive frame-synchronization signal, are connected internally through multiplexers to the corresponding transmit signals.		

**Table 20-40. Register Bits Used to Set the Receive Clock Mode (continued)**

Register	Bit	Name	Function	Type	Reset Value	
SPCR1	12-11	CLKSTP	Clock stop mode	R/W	00	
			CLKSTP = 0xb			Clock stop mode disabled; normal clocking for non-SPI mode.
			CLKSTP = 10b			Clock stop mode enabled without clock delay. The internal receive clock signal (MCLKR) and the internal receive frame-synchronization signal (FSR) are internally connected to their transmit counterparts, CLKX and FSX.
			CLKSTP = 11b		Clock stop mode enabled with clock delay. The internal receive clock signal (MCLKR) and the internal receive frame-synchronization signal (FSR) are internally connected to their transmit counterparts, CLKX and FSX.	

### 20.8.17.1 Selecting a Source for the Receive Clock and a Data Direction for the MCLKR Pin

Table 20-41 shows how you can select various sources to provide the receive clock signal and affect the MCLKR pin. The polarity of the signal on the MCLKR pin is determined by the CLKRP bit.

In the digital loopback mode (DLB = 1), the transmit clock signal is used as the receive clock signal.

Also, in the clock stop mode, the internal receive clock signal (MCLKR) and the internal receive frame-synchronization signal (FSR) are internally connected to their transmit counterparts, CLKX and FSX.

**Table 20-41. Receive Clock Signal Source Selection**

DLB in SPCR1	CLKRM in PCR	Source of Receive Clock	MCLKR Pin Status
0	0	The MCLKR pin is an input driven by an external clock. The external clock signal is inverted as determined by CLKRP before being used.	Input
0	1	The sample rate generator clock (CLKG) drives internal MCLKR.	Output. CLKG, inverted as determined by CLKRP, is driven out on the MCLKR pin.
1	0	Internal CLKX drives internal MCLKR. To configure CLKX, see <a href="#">Section 20.9.18</a> .	High impedance
1	1	Internal CLKX drives internal MCLKR. To configure CLKX, see <a href="#">Section 20.9.18</a> .	Output. Internal MCLKR (same as internal CLKX) is inverted as determined by CLKRP before being driven out on the MCLKR pin.

### 20.8.18 Set the Receive Clock Polarity

**Table 20-42. Register Bit Used to Set Receive Clock Polarity**

Register	Bit	Name	Function	Type	Reset Value	
PCR	0	CLKRP	Receive clock polarity	R/W	0	
			CLKRP = 0			Receive data sampled on falling edge of MCLKR
			CLKRP = 1			Receive data sampled on rising edge of MCLKR

### 20.8.18.1 Frame Synchronization Pulses, Clock Signals, and Their Polarities

Receive frame-synchronization pulses can be generated internally by the sample rate generator (see Section 20.4.2) or driven by an external source. The source of frame synchronization is selected by programming the mode bit, FSRM, in PCR. FSR is also affected by the GSYNC bit in SRGR2. For information about the effects of FSRM and GSYNC, see Section 20.8.15. Similarly, receive clocks can be selected to be inputs or outputs by programming the mode bit, CLKRM, in the PCR (see Section 20.8.17).

When FSR and FSX are inputs (FSXM = FSRM = 0, external frame-synchronization pulses), the McBSP detects them on the internal falling edge of clock, internal MCLKR, and internal CLKX, respectively. The receive data arriving at the DR pin is also sampled on the falling edge of internal MCLKR. These internal clock signals are either derived from external source via CLK(R/X) pins or driven by the sample rate generator clock (CLKG) internal to the McBSP.

When FSR and FSX are outputs, implying that they are driven by the sample rate generator, they are generated (transition to their active state) on the rising edge of internal clock, CLK(R/X). Similarly, data on the DX pin is output on the rising edge of internal CLKX.

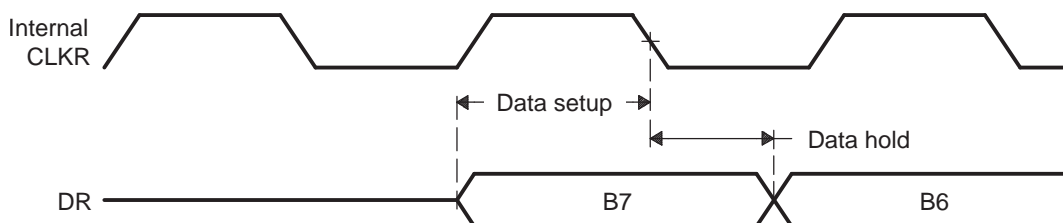
FSRP, FSXP, CLKRP, and CLKXP in the pin control register (PCR) configure the polarities of the FSR, FSX, MCLKR, and CLKX signals, respectively. All frame-synchronization signals (internal FSR, internal FSX) that are internal to the serial port are active high. If the serial port is configured for external frame synchronization (FSR/FSX are inputs to McBSP) and FSRP = FSXP = 1, the external active-low frame-synchronization signals are inverted before being sent to the receiver (internal FSR) and transmitter (internal FSX). Similarly, if internal synchronization (FSR/FSX are output pins and GSYNC = 0) is selected, the internal active-high frame-synchronization signals are inverted, if the polarity bit FS(R/X)P = 1, before being sent to the FS(R/X) pin.

On the transmit side, the transmit clock polarity bit, CLKXP, sets the edge used to shift and clock out transmit data. Data is always transmitted on the rising edge of internal CLKX. If CLKXP = 1 and external clocking is selected (CLKXM = 0 and CLKX is an input), the external falling-edge triggered input clock on CLKX is inverted to a rising-edge triggered clock before being sent to the transmitter. If CLKXP = 1 and internal clocking is selected (CLKXM = 1 and CLKX is an output pin), the internal (rising-edge triggered) clock, internal CLKX, is inverted before being sent out on the MCLKX pin.

Similarly, the receiver can reliably sample data that is clocked with a rising edge clock (by the transmitter). The receive clock polarity bit, CLKRP, sets the edge used to sample received data. The receive data is always sampled on the falling edge of internal MCLKR. Therefore, if CLKRP = 1 and external clocking is selected (CLKRM = 0 and MCLKR is an input pin), the external rising-edge triggered input clock on MCLKR is inverted to a falling-edge triggered clock before being sent to the receiver. If CLKRP = 1 and internal clocking is selected (CLKRM = 1), the internal falling-edge triggered clock is inverted to a rising-edge triggered clock before being sent out on the MCLKR pin.

CLKRP = CLKXP in a system where the same clock (internal or external) is used to clock the receiver and transmitter. The receiver uses the opposite edge as the transmitter to ensure valid setup and hold of data around this edge. Figure 20-50 shows how data clocked by an external serial device using a rising edge can be sampled by the McBSP receiver on the falling edge of the same clock.

**Figure 20-50. Data Clocked Externally Using a Rising Edge and Sampled by the McBSP Receiver on a Falling Edge**



## 20.8.19 Set the SRG Clock Divide-Down Value

**Table 20-43. Register Bits Used to Set the Sample Rate Generator (SRG) Clock Divide-Down Value**

Register	Bit	Name	Function	Type	Reset Value
SRGR1	7-0	CLKGDV	Sample rate generator clock divide-down value  The input clock of the sample rate generator is divided by (CLKGDV + 1) to generate the required sample rate generator clock frequency. The default value of CLKGDV is 1 (divide input clock by 2).	R/W	0000 0001

### 20.8.19.1 Sample Rate Generator Clock Divider

The first divider stage generates the serial data bit clock from the input clock. This divider stage utilizes a counter, preloaded by CLKGDV, that contains the divide ratio value.

The output of the first divider stage is the data bit clock, which is output as CLKG and which serves as the input for the second and third stages of the divider.

CLKG has a frequency equal to  $1/(\text{CLKGDV} + 1)$  of sample rate generator input clock. Thus, the sample generator input clock frequency is divided by a value between 1 and 256. When CLKGDV is odd or equal to 0, the CLKG duty cycle is 50%. When CLKGDV is an even value,  $2p$ , representing an odd divide-down, the high-state duration is  $p + 1$  cycles and the low-state duration is  $p$  cycles.

## 20.8.20 Set the SRG Clock Synchronization Mode

For more details on using the clock synchronization feature, see [Section 20.4.3](#).

**Table 20-44. Register Bit Used to Set the SRG Clock Synchronization Mode**

Register	Bit	Name	Function	Type	Reset Value
SRGR2	15	GSYNC	Sample rate generator clock synchronization  GSYNC is used only when the input clock source for the sample rate generator is external—on the MCLKR or MCLKX pin.  GSYNC = 0      The sample rate generator clock (CLKG) is free running. CLKG oscillates without adjustment, and FSG pulses every (FPER + 1) CLKG cycles.  GSYNC = 1      Clock synchronization is performed. When a pulse is detected on the FSR pin: <ul style="list-style-type: none"> <li>• CLKG is adjusted as necessary so that it is synchronized with the input clock on the MCLKR or MCLKX pin.</li> <li>• FSG pulses. FSG only pulses in response to a pulse on the FSR pin. The frame-synchronization period defined in FPER is ignored.</li> </ul>	R/W	0

## 20.8.21 Set the SRG Clock Mode (Choose an Input Clock)

**Table 20-45. Register Bits Used to Set the SRG Clock Mode (Choose an Input Clock)**

Register	Bit	Name	Function	Type	Reset Value
PCR	7	SCLKME	Sample rate generator clock mode	R/W	0
SRGR2	13	CLKSM		R/W	1
			SCLKME = 0 CLKSM = 0		Reserved
			SCLKME = 0 CLKSM = 1		Sample rate generator clock derived from LSPCLK (default)
			SCLKME = 1 CLKSM = 0		Sample rate generator clock derived from MCLKR pin
			SCLKME = 1 CLKSM = 1		Sample rate generator clock derived from MCLKX pin

### 20.8.21.1 SRG Clock Mode

The sample rate generator can produce a clock signal (CLKG) for use by the receiver, the transmitter, or both, but CLKG is derived from an input clock. [Table 20-45](#) shows the four possible sources of the input clock. For more details on generating CLKG, see [Section 20.4.1.1](#).



## 20.8.22 Set the SRG Input Clock Polarity

**Table 20-46. Register Bits Used to Set the SRG Input Clock Polarity**

Register	Bit	Name	Function	Type	Reset Value
PCR	1	CLKXP	MCLKX pin polarity	R/W	0
			CLKXP determines the input clock polarity when the MCLKX pin supplies the input clock (SCLKME = 1 and CLKSM = 1).		
			CLKXP = 0      Rising edge on MCLKX pin generates transitions on CLKG and FSG. CLKXP = 1      Falling edge on MCLKX pin generates transitions on CLKG and FSG.		
PCR	0	CLKRP	MCLKR pin polarity	R/W	0
			CLKRP determines the input clock polarity when the MCLKR pin supplies the input clock (SCLKME = 1 and CLKSM = 0).		
			CLKRP = 0      Falling edge on MCLKR pin generates transitions on CLKG and FSG. CLKRP = 1      Rising edge on MCLKR pin generates transitions on CLKG and FSG.		

### 20.8.22.1 Using CLKXP/CLKRP to Choose an Input Clock Polarity

The sample rate generator can produce a clock signal (CLKG) and a frame-synchronization signal (FSG) for use by the receiver, the transmitter, or both. To produce CLKG and FSG, the sample rate generator must be driven by an input clock signal derived from the CPU clock or from an external clock on the CLKX or MCLKR pin. If you use a pin, choose a polarity for that pin by using the appropriate polarity bit (CLKXP for the MCLKX pin, CLKRP for the MCLKR pin). The polarity determines whether the rising or falling edge of the input clock generates transitions on CLKG and FSG.

## 20.9 Transmitter Configuration

To configure the McBSP transmitter, perform the following procedure:

1. Place the McBSP/transmitter in reset (see [Section 20.9.2](#)).
2. Program the McBSP registers for the desired transmitter operation (see [Section 20.9.1](#)).
3. Take the transmitter out of reset (see [Section 20.9.2](#)).

### 20.9.1 Programming the McBSP Registers for the Desired Transmitter Operation

The following is a list of important tasks to be performed when you are configuring the McBSP transmitter. Each task corresponds to one or more McBSP register bit fields.

- Global behavior:
  - Set the transmitter pins to operate as McBSP pins.
  - Enable/disable the digital loopback mode.
  - Enable/disable the clock stop mode.
  - Enable/disable transmit multichannel selection.
- Data behavior:
  - Choose 1 or 2 phases for the transmit frame.
  - Set the transmit word length(s).
  - Set the transmit frame length.
  - Enable/disable the transmit frame-synchronization ignore function.
  - Set the transmit companding mode.
  - Set the transmit data delay.



- Set the transmit DXENA mode.
- Set the transmit interrupt mode.
- Frame-synchronization behavior:
  - Set the transmit frame-synchronization mode.
  - Set the transmit frame-synchronization polarity.
  - Set the SRG frame-synchronization period and pulse width.
- Clock behavior:
  - Set the transmit clock mode.
  - Set the transmit clock polarity.
  - Set the SRG clock divide-down value.
  - Set the SRG clock synchronization mode.
  - Set the SRG clock mode (choose an input clock).
  - Set the SRG input clock polarity.

### 20.9.2 Resetting and Enabling the Transmitter

The first step of the transmitter configuration procedure is to reset the transmitter, and the last step is to enable the transmitter (to take it out of reset). [Table 20-47](#) describes the bits used for both of these steps.

**Table 20-47. Register Bits Used to Place Transmitter in Reset Field Descriptions**

Register	Bit	Field	Value	Description
SPCR2	7	FRST	0	Frame-synchronization logic is reset. The sample rate generator does not generate frame-synchronization signal FSG, even if GRST = 1.
			1	Frame-synchronization is enabled. If GRST = 1, frame-synchronization signal FSG is generated after (FPER + 1) number of CLKG clock cycles; all frame counters are loaded with their programmed values.
SPCR2	6	GRST	0	Sample rate generator is reset. If GRST = 0 due to a device reset, CLKG is driven by the CPU clock divided by 2, and FSG is driven low (inactive). If GRST = 0 due to program code, CLKG and FSG are both driven low (inactive).
			1	Sample rate generator is enabled. CLKG is driven according to the configuration programmed in the sample rate generator registers (SRGR[1,2]). If FRST = 1, the generator also generates the frame-synchronization signal FSG as programmed in the sample rate generator registers.
SPCR2	0	XRST	0	The serial port transmitter is disabled and in the reset state.
			1	The serial port transmitter is enabled.

#### 20.9.2.1 Reset Considerations

The serial port can be reset in the following two ways:

1. A DSP reset ( $\overline{\text{XRS}}$  signal driven low) places the receiver, transmitter, and sample rate generator in reset. When the device reset is removed, GRST = FRST = RRST = XRST = 0, keeping the entire serial port in the reset state.
2. The serial port transmitter and receiver can be reset directly using the RRST and XRST bits in the serial port control registers. The sample rate generator can be reset directly using the GRST bit in SPCR2.
3. When using the DMA, the order in which McBSP events must occur is important. DMA channel and peripheral interrupts must be configured prior to releasing the McBSP transmitter from reset.

The reason for this is that an XRDY is fired when XRST = 1. The XRDY signals the DMA to start copying data from the buffer into the transmit register. If the McBSP transmitter is released from reset before the DMA channel and peripheral interrupts are configured, the XRDY signals before the DMA channel can receive the signal; therefore, the DMA does not move the data from the buffer to the

transmit register. The DMA PERINTFLG is edge-sensitive and will fail to recognize the XRDY, which is continuously high.

For more details about McBSP reset conditions and effects, see [Section 20.10.2](#).

### 20.9.3 Set the Transmitter Pins to Operate as McBSP Pins

To configure a pin for its McBSP function, you should configure the bits of the GPxMUXn register appropriately. In addition to this, bits 12 and 13 of the PCR register must be set to 0. These bits are defined as reserved.

### 20.9.4 Enable/Disable the Digital Loopback Mode

The DLB bit determines whether the digital loopback mode is on. DLB is described in [Table 20-48](#).

**Table 20-48. Register Bit Used to Enable/Disable the Digital Loopback Mode**

Register	Bit	Name	Function	Type	Reset Value
SPCR1	15	DLB	Digital loopback mode	R/W	0
			DLB = 0		Digital loopback mode is disabled.
			DLB = 1		Digital loopback mode is enabled.

#### 20.9.4.1 Digital Loopback Mode

In the digital loopback mode, the receive signals are connected internally through multiplexers to the corresponding transmit signals, as shown in [Table 20-49](#). This mode allows testing of serial port code with a single DSP device; the McBSP receives the data it transmits.

**Table 20-49. Receive Signals Connected to Transmit Signals in Digital Loopback Mode**

This Receive Signal	Is Fed Internally by This Transmit Signal
DR (receive data)	DX (transmit data)
FSR (receive frame synchronization)	FSX (transmit frame synchronization)
MCLKR (receive clock)	CLKX (transmit clock)

### 20.9.5 Enable/Disable the Clock Stop Mode

The CLKSTP bits determine whether the clock stop mode is on. CLKSTP is described in [Table 20-50](#).

**Table 20-50. Register Bits Used to Enable/Disable the Clock Stop Mode**

Register	Bit	Name	Function	Type	Reset Value
SPCR1	12-11	CLKSTP	Clock stop mode	R/W	00
			CLKSTP = 0Xb		Clock stop mode disabled; normal clocking for non-SPI mode.
			CLKSTP = 10b		Clock stop mode enabled without clock delay
			CLKSTP = 11b		Clock stop mode enabled with clock delay

### 20.9.5.1 Clock Stop Mode

The clock stop mode supports the SPI master-slave protocol. If you do not plan to use the SPI protocol, you can clear CLKSTP to disable the clock stop mode.

In the clock stop mode, the clock stops at the end of each data transfer. At the beginning of each data transfer, the clock starts immediately (CLKSTP = 10b) or after a half-cycle delay (CLKSTP = 11b). The CLKXP bit determines whether the starting edge of the clock on the MCLKX pin is rising or falling. The CLKRP bit determines whether receive data is sampled on the rising or falling edge of the clock shown on the MCLKR pin.

[Table 20-51](#) summarizes the impact of CLKSTP, CLKXP, and CLKRP on serial port operation. In the clock stop mode, the receive clock is tied internally to the transmit clock, and the receive frame-synchronization signal is tied internally to the transmit frame-synchronization signal.

**Table 20-51. Effects of CLKSTP, CLKXP, and CLKRP on the Clock Scheme**

Bit Settings	Clock Scheme
CLKSTP = 00b or 01b CLKXP = 0 or 1 CLKRP = 0 or 1	Clock stop mode disabled. Clock enabled for non-SPI mode.
CLKSTP = 10b CLKXP = 0 CLKRP = 0	Low inactive state without delay: The McBSP transmits data on the rising edge of CLKX and receives data on the falling edge of MCLKR.
CLKSTP = 11b CLKXP = 0 CLKRP = 1	Low inactive state with delay: The McBSP transmits data one-half cycle ahead of the rising edge of CLKX and receives data on the rising edge of MCLKR.
CLKSTP = 10b CLKXP = 1 CLKRP = 0	High inactive state without delay: The McBSP transmits data on the falling edge of CLKX and receives data on the rising edge of MCLKR.
CLKSTP = 11b CLKXP = 1 CLKRP = 1	High inactive state with delay: The McBSP transmits data one-half cycle ahead of the falling edge of CLKX and receives data on the falling edge of MCLKR.

### 20.9.6 Enable/Disable Transmit Multichannel Selection

For more details, see [Section 20.6.7](#).

**Table 20-52. Register Bits Used to Enable/Disable Transmit Multichannel Selection**

Register	Bit	Name	Function	Type	Reset Value
MCR2	1-0	XMCM	Transmit multichannel selection	R/W	00
			<p>XMCM = 00b No transmit multichannel selection mode is on. All channels are enabled and unmasked. No channels can be disabled or masked.</p> <p>XMCM = 01b All channels are disabled unless they are selected in the appropriate transmit channel enable registers (XCERs). If enabled, a channel in this mode is also unmasked.</p> <p>The XMCME bit determines whether 32 channels or 128 channels are selectable in XCERs.</p> <p>XMCM = 10b All channels are enabled, but they are masked unless they are selected in the appropriate transmit channel enable registers (XCERs).</p> <p>The XMCME bit determines whether 32 channels or 128 channels are selectable in XCERs.</p> <p>XMCM = 11b This mode is used for symmetric transmission and reception.</p> <p>All channels are disabled for transmission unless they are enabled for reception in the appropriate receive channel enable registers (RCERs). Once enabled, they are masked unless they are also selected in the appropriate transmit channel enable registers (XCERs).</p> <p>The XMCME bit determines whether 32 channels or 128 channels are selectable in RCERs and XCERs.</p>		

## 20.9.7 Choose One or Two Phases for the Transmit Frame

**Table 20-53. Register Bit Used to Choose 1 or 2 Phases for the Transmit Frame**

Register	Bit	Name	Function	Type	Reset Value
XCR2	15	XPHASE	Transmit phase number Specifies whether the transmit frame has 1 or 2 phases. XPHASE = 0      Single-phase frame XPHASE = 1      Dual-phase frame	R/W	0

## 20.9.8 Set the Transmit Word Length(s)

**Table 20-54. Register Bits Used to Set the Transmit Word Length(s)**

Register	Bit	Name	Function	Type	Reset Value
XCR1	7-5	XWDLEN1	Transmit word length of frame phase 1 XWDLEN1 = 000b      8 bits XWDLEN1 = 001b      12 bits XWDLEN1 = 010b      16 bits XWDLEN1 = 011b      20 bits XWDLEN1 = 100b      24 bits XWDLEN1 = 101b      32 bits XWDLEN1 = 11Xb      Reserved	R/W	000
XCR2	7-5	XWDLEN2	Transmit word length of frame phase 2 XWDLEN2 = 000b      8 bits XWDLEN2 = 001b      12 bits XWDLEN2 = 010b      16 bits XWDLEN2 = 011b      20 bits XWDLEN2 = 100b      24 bits XWDLEN2 = 101b      32 bits XWDLEN2 = 11Xb      Reserved	R/W	000

### 20.9.8.1 Word Length Bits

Each frame can have one or two phases, depending on the value that you load into the RPHASE bit. If a single-phase frame is selected, XWDLEN1 selects the length for every serial word transmitted in the frame. If a dual-phase frame is selected, XWDLEN1 determines the length of the serial words in phase 1 of the frame, and XWDLEN2 determines the word length in phase 2 of the frame.

## 20.9.9 Set the Transmit Frame Length

**Table 20-55. Register Bits Used to Set the Transmit Frame Length**

Register	Bit	Name	Function	Type	Reset Value	
XCR1	14-8	XFRLN1	Transmit frame length 1	R/W	000 0000	
			(XFRLN1 + 1) is the number of serial words in phase 1 of the transmit frame.			
			XFRLN1 = 000 0000			1 word in phase 1
			XFRLN1 = 000 0001			2 words in phase 1
XCR2	14-8	XFRLN2	Transmit frame length 2	R/W	000 0000	
			If a dual-phase frame is selected, (XFRLN2 + 1) is the number of serial words in phase 2 of the transmit frame.			
			XFRLN2 = 000 0000			1 word in phase 2
			XFRLN2 = 000 0001			2 words in phase 2
			XFRLN2 = 111 1111	128 words in phase 2		
			XFRLN2 = 111 1111			

### 20.9.9.1 Selected Frame Length

The transmit frame length is the number of serial words in the transmit frame. Each frame can have one or two phases, depending on the value that you load into the XPHASE bit.

If a single-phase frame is selected (XPHASE = 0), the frame length is equal to the length of phase 1. If a dual-phase frame is selected (XPHASE = 1), the frame length is the length of phase 1 plus the length of phase 2.

The 7-bit XFRLN fields allow up to 128 words per phase. See [Table 20-56](#) for a summary of how to calculate the frame length. This length corresponds to the number of words or logical time slots or channels per frame-synchronization pulse.

---

**NOTE:** Program the XFRLN fields with  $[w \text{ minus } 1]$ , where  $w$  represents the number of words per phase. For example, if you want a phase length of 128 words in phase 1, load 127 into XFRLN1.

---

**Table 20-56. How to Calculate Frame Length**

XPHASE	XFRLN1	XFRLN2	Frame Length
0	$0 \leq \text{XFRLN1} \leq 127$	Don't care	(XFRLN1 + 1) words
1	$0 \leq \text{XFRLN1} \leq 127$	$0 \leq \text{XFRLN2} \leq 127$	(XFRLN1 + 1) + (XFRLN2 + 1) words

### 20.9.10 Enable/Disable the Transmit Frame-Synchronization Ignore Function

**Table 20-57. Register Bit Used to Enable/Disable the Transmit Frame-Synchronization Ignore Function**

Register	Bit	Name	Function	Type	Reset Value
XCR2	2	XFIG	Transmit frame-synchronization ignore	R/W	0
			XFIG = 0		An unexpected transmit frame-synchronization pulse causes the McBSP to restart the frame transfer.
			XFIG = 1		The McBSP ignores unexpected transmit frame-synchronization pulses.

#### 20.9.10.1 Unexpected Frame-Synchronization Pulses and Frame-Synchronization Ignore

If a frame-synchronization pulse starts the transfer of a new frame before the current frame is fully transmitted, this pulse is treated as an unexpected frame-synchronization pulse.

When XFIG = 1, normal transmission continues with unexpected frame-synchronization signals ignored.

When XFIG = 0 and an unexpected frame-synchronization pulse occurs, the serial port:

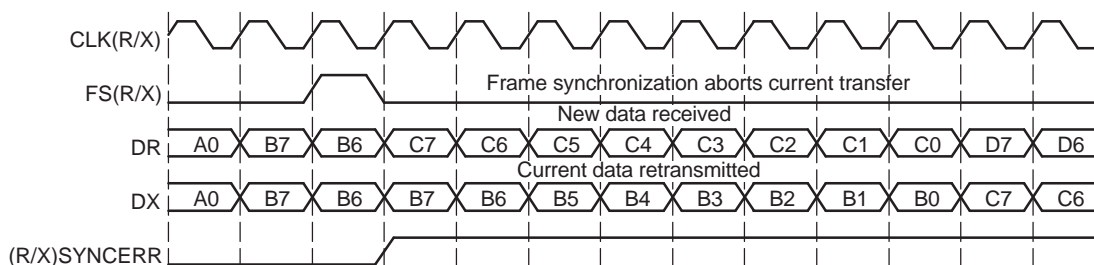
1. Aborts the present transmission
2. Sets XSYNCERR to 1 in SPCR2
3. Reinitiates transmission of the current word that was aborted

For more details about the frame-synchronization error condition, see [Section 20.5.6](#).

#### 20.9.10.2 Examples Showing the Effects of XFIG

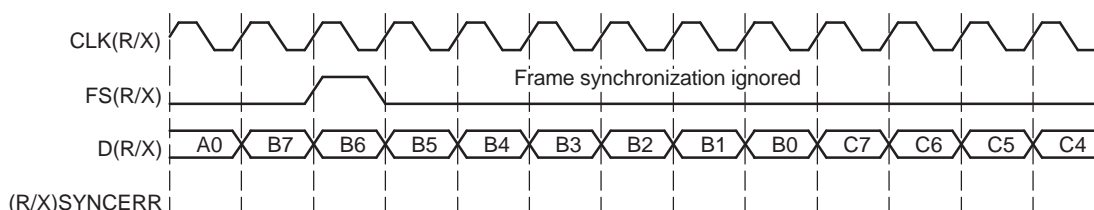
Figure 20-51 shows an example in which word B is interrupted by an unexpected frame-synchronization pulse when (R/X)FIG = 0. In the case of transmission, the transmission of B is aborted (B is lost). This condition is a transmit synchronization error, which sets the XSYNCERR bit. No new data has been written to DXR[1,2]; therefore, the McBSP transmits B again.

**Figure 20-51. Unexpected Frame-Synchronization Pulse With (R/X) FIG = 0**



In contrast with Figure 20-51, Figure 20-52 shows McBSP operation when unexpected frame-synchronization signals are ignored (when (R/X)FIG = 1). Here, the transfer of word B is not affected by an unexpected frame-synchronization pulse.

**Figure 20-52. Unexpected Frame-Synchronization Pulse With (R/X) FIG = 1**



### 20.9.11 Set the Transmit Companding Mode

**Table 20-58. Register Bits Used to Set the Transmit Companding Mode**

Register	Bit	Name	Function	Type	Reset Value
XCR2	4-3	XCOMPAND	Transmit companding mode  Modes other than 00b are enabled only when the appropriate XWDLEN is 000b, indicating 8-bit data.  XCOMPAND = 00b      No companding, any size data, MSB transmitted first  XCOMPAND = 01b      No companding, 8-bit data, LSB transmitted first (for details, see <a href="#">Section 20.8.11.4, Option to Receive LSB First</a> )  XCOMPAND = 10b $\mu$ -law companding, 8-bit data, MSB transmitted first  XCOMPAND = 11b      A-law companding, 8-bit data, MSB transmitted first	R/W	00

#### 20.9.11.1 Companding

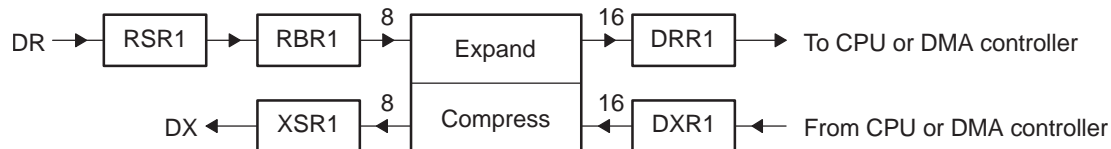
Companding (COMpressing and exPANDING) hardware allows compression and expansion of data in either  $\mu$ -law or A-law format. The companding standard employed in the United States and Japan is  $\mu$ -law. The European companding standard is referred to as A-law. The specifications for  $\mu$ -law and A-law log PCM are part of the CCITT G.711 recommendation.

A-law and  $\mu$ -law allow 13 bits and 14 bits of dynamic range, respectively. Any values outside this range are set to the most positive or most negative value. Thus, for companding to work best, the data transferred to and from the McBSP via the CPU or DMA controller must be at least 16 bits wide.

The  $\mu$ -law and A-law formats both encode data into 8-bit code words. Companded data is always 8 bits wide; the appropriate word length bits (RWDLEN1, RWDLEN2, XWDLEN1, XWDLEN2) must therefore be set to 0, indicating an 8-bit wide serial data stream. If companding is enabled and either of the frame phases does not have an 8-bit word length, companding continues as if the word length is 8 bits.

[Figure 20-53](#) illustrates the companding processes. When companding is chosen for the transmitter, compression occurs during the process of copying data from DXR1 to XSR1. The transmit data is encoded according to the specified companding law (A-law or  $\mu$ -law). When companding is chosen for the receiver, expansion occurs during the process of copying data from RBR1 to DRR1. The receive data is decoded to twos-complement format.

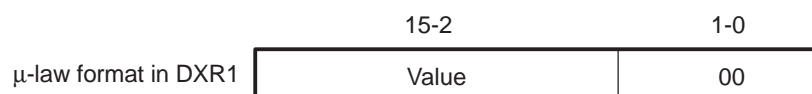
**Figure 20-53. Companding Processes for Reception and for Transmission**



#### 20.9.11.2 Format for Data To Be Compressed

For transmission using  $\mu$ -law compression, make sure the 14 data bits are left-justified in DXR1, with the remaining two low-order bits filled with 0s as shown in [Figure 20-54](#).

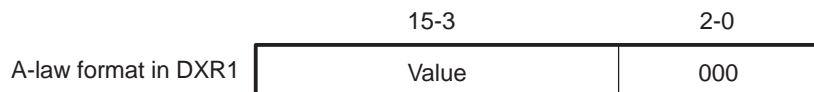
**Figure 20-54.  $\mu$ -Law Transmit Data Companding Format**





For transmission using A-law compression, make sure the 13 data bits are left-justified in DXR1, with the remaining three low-order bits filled with 0s as shown in [Figure 20-55](#).

**Figure 20-55. A-Law Transmit Data Companding Format**



### 20.9.11.3 Capability to Compand Internal Data

If the McBSP is otherwise unused (the serial port transmit and receive sections are reset), the companding hardware can compand internal data. See [Section 20.3.2.2, Capability to Compand Internal Data](#).

### 20.9.11.4 Option to Transmit LSB First

Normally, the McBSP transmit or receives all data with the most significant bit (MSB) first. However, certain 8-bit data protocols (that do not use companded data) require the least significant bit (LSB) to be transferred first. If you set XCOMPAND = 01b in XCR2, the bit ordering of 8-bit words is reversed (LSB first) before being sent from the serial port. Similar to companding, this feature is enabled only if the appropriate word length bits are set to 0, indicating that 8-bit words are to be transferred serially. If either phase of the frame does not have an 8-bit word length, the McBSP assumes the word length is eight bits and LSB-first ordering is done.

## 20.9.12 Set the Transmit Data Delay

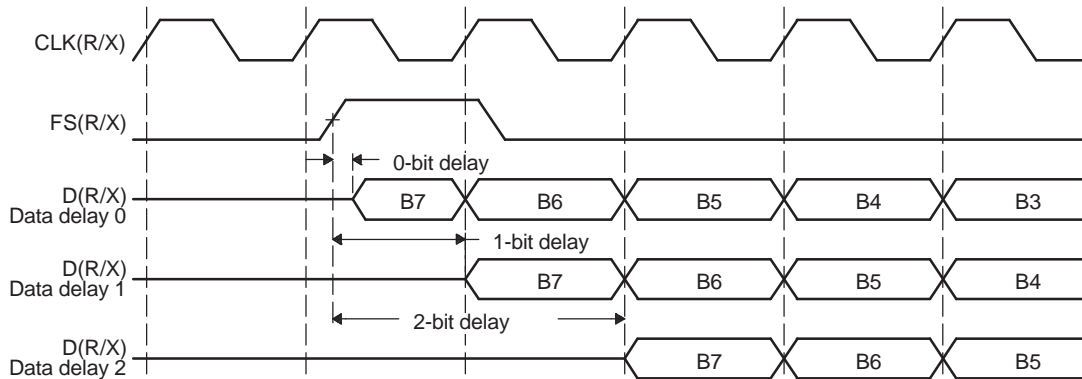
**Table 20-59. Register Bits Used to Set the Transmit Data Delay**

Register	Bit	Name	Function	Type	Reset Value
XCR2	1-0	XDATDLY	Transmitter data delay	R/W	00
			XDATDLY = 00		0-bit data delay
			XDATDLY = 01		1-bit data delay
			XDATDLY = 10		2-bit data delay
			XDATDLY = 11		Reserved

### 20.9.12.1 Data Delay

The start of a frame is defined by the first clock cycle in which frame synchronization is found to be active. The beginning of actual data reception or transmission with respect to the start of the frame can be delayed if necessary. This delay is called data delay.

XDATDLY specifies the data delay for transmission. The range of programmable data delay is zero to two bit-clocks (XDATDLY = 00b-10b), as described in [Table 20-59](#) and [Figure 20-56](#). In this figure, the data transferred is an 8-bit value with bits labeled B7, B6, B5, and so on. Typically a 1-bit delay is selected, because data often follows a 1-cycle active frame-synchronization pulse.

**Figure 20-56. Range of Programmable Data Delay**


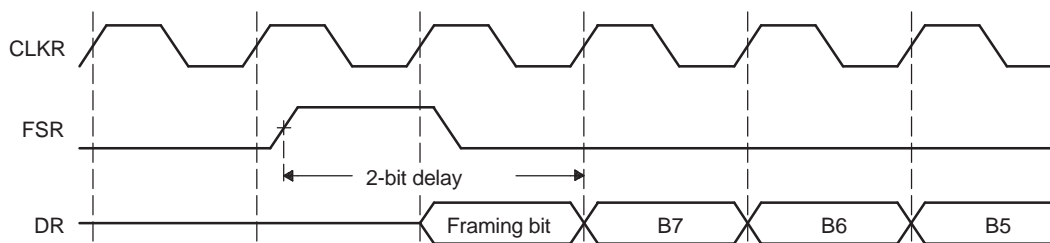
### 20.9.12.2 0-Bit Data Delay

Normally, a frame-synchronization pulse is detected or sampled with respect to an edge of serial clock internal CLK(R/X). Thus, on the following cycle or later (depending on the data delay value), data can be received or transmitted. However, in the case of 0-bit data delay, the data must be ready for reception and/or transmission on the same serial clock cycle.

For reception this problem is solved because receive data is sampled on the first falling edge of MCLKR where an active-high internal FSR is detected. However, data transmission must begin on the rising edge of the internal CLKX clock that generated the frame synchronization. Therefore, the first data bit is assumed to be present in XSR1, and thus DX. The transmitter then asynchronously detects the frame synchronization, FSX, going active high and immediately starts driving the first bit to be transmitted on the DX pin.

### 20.9.12.3 2-Bit Data Delay

A data delay of two bit-periods allows the serial port to interface to different types of T1 framing devices where the data stream is preceded by a framing bit. During reception of such a stream with data delay of two bits (framing bit appears after a 1-bit delay and data appears after a 2-bit delay), the serial port essentially discards the framing bit from the data stream, as shown in the following figure. In this figure, the data transferred is an 8-bit value with bits labeled B7, B6, B5, and so on.

**Figure 20-57. 2-Bit Data Delay Used to Skip a Framing Bit**


## 20.9.13 Set the Transmit DXENA Mode

**Table 20-60. Register Bit Used to Set the Transmit DXENA (DX Delay Enabler) Mode**

Register	Bit	Name	Function	Type	Reset Value
SPCR1	7	DXENA	DX delay enabler mode	R/W	0
			DXENA = 0		DX delay enabler is off.
			DXENA = 1		DX delay enabler is on.

### 20.9.13.1 DXENA Mode

The DXENA bit controls the delay enabler on the DX pin. Set DXENA to enable an extra delay for turn-on time. This bit does not control the data itself, so only the first bit is delayed.

If you tie together the DX pins of multiple McBSPs, make sure DXENA = 1 to avoid having more than one McBSP transmit on the data line at one time.

## 20.9.14 Set the Transmit Interrupt Mode

The transmitter interrupt (XINT) signals the CPU of changes to the serial port status. Four options exist for configuring this interrupt. The options are set by the transmit interrupt mode bits, XINTM, in SPCR2.

**Table 20-61. Register Bits Used to Set the Transmit Interrupt Mode**

Register	Bit	Name	Function	Type	Reset Value
SPCR2	5-4	XINTM	Transmit interrupt mode	R/W	00
			XINTM = 00		XINT generated when XRDY changes from 0 to 1.
			XINTM = 01		XINT generated by an end-of-block or end-of-frame condition in a transmit multichannel selection mode. In any of the transmit multichannel selection modes, interrupt after every 16-channel block boundary has been crossed within a frame and at the end of the frame. For details, see <a href="#">Section 20.6.8</a> . In any other serial transfer case, this setting is not applicable and, therefore, no interrupts are generated.
			XINTM = 10		XINT generated by a new transmit frame-synchronization pulse. Interrupt on detection of each transmit frame-synchronization pulse. This generates an interrupt even when the transmitter is in its reset state. This is done by synchronizing the incoming frame-synchronization pulse to the CPU clock and sending it to the CPU via XINT.
			XINTM = 11		XINT generated when XSYNCERR is set. Interrupt on frame-synchronization error. Regardless of the value of XINTM, XSYNCERR can be read to detect this condition. For more information on using XSYNCERR, see <a href="#">Section 20.5.6</a> .

## 20.9.15 Set the Transmit Frame-Synchronization Mode

**Table 20-62. Register Bits Used to Set the Transmit Frame-Synchronization Mode**

Register	Bit	Name	Function	Type	Reset Value	
PCR	11	FSXM	Transmit frame-synchronization mode	R/W	0	
			FSXM = 0			Transmit frame synchronization is supplied by an external source via the FSX pin.
			FSXM = 1			Transmit frame synchronization is supplied by the McBSP, as determined by the FSGM bit of SRGR2.
SRGR2	12	FSGM	Sample rate generator transmit frame-synchronization mode	R/W	0	
			Used when FSXM = 1 in PCR.			
			FSGM = 0			The McBSP generates a transmit frame-synchronization pulse when the content of DXR[1,2] is copied to XSR[1,2].
		FSGM = 1	The transmitter uses frame-synchronization pulses generated by the sample rate generator. Program the FWID bits to set the width of each pulse. Program the FPER bits to set the frame-synchronization period.			

### 20.9.15.1 Transmit Frame-Synchronization Modes

Table 20-63 shows how FSXM and FSGM select the source of transmit frame-synchronization pulses. The three choices are:

- External frame-synchronization input
- Sample rate generator frame-synchronization signal (FSG)
- Internal signal that indicates a DXR-to-XSR copy has been made

Table 20-63 also shows the effect of each bit setting on the FSX pin. The polarity of the signal on the FSX pin is determined by the FSXP bit.

**Table 20-63. How FSXM and FSGM Select the Source of Transmit Frame-Synchronization Pulses**

FSXM	FSGM	Source of Transmit Frame Synchronization	FSX Pin Status
0	0 or 1	An external frame-synchronization signal enters the McBSP through the FSX pin. The signal is then inverted by FSXP before being used as internal FSX.	Input
1	1	Internal FSX is driven by the sample rate generator frame-synchronization signal (FSG).	Output. FSG is inverted by FSXP before being driven out on FSX pin.
1	0	A DXR-to-XSR copy causes the McBSP to generate a transmit frame-synchronization pulse that is 1 cycle wide.	Output. The generated frame-synchronization pulse is inverted as determined by FSXP before being driven out on FSX pin.

### 20.9.15.2 Other Considerations

If the sample rate generator creates a frame-synchronization signal (FSG) that is derived from an external input clock, the GSYNC bit determines whether FSG is kept synchronized with pulses on the FSR pin. For more details, see [Section 20.4.3](#).

In the clock stop mode (CLKSTP = 10b or 11b), the McBSP can act as a master or as a slave in the SPI protocol. If the McBSP is a master and must provide a slave-enable signal (SPISTE) on the FSX pin, make sure that FSXM = 1 and FSGM = 0 so that FSX is an output and is driven active for the duration of each transmission. If the McBSP is a slave, make sure that FSXM = 0 so that the McBSP can receive the slave-enable signal on the FSX pin.

## 20.9.16 Set the Transmit Frame-Synchronization Polarity

**Table 20-64. Register Bit Used to Set Transmit Frame-Synchronization Polarity**

Register	Bit	Name	Function	Type	Reset Value
PCR	3	FSXP	Transmit frame-synchronization polarity	R/W	0
			FSXP = 0     Frame-synchronization pulse FSX is active high.		
			FSXP = 1     Frame-synchronization pulse FSX is active low.		

### 20.9.16.1 Frame Synchronization Pulses, Clock Signals, and Their Polarities

Transmit frame-synchronization pulses can be generated internally by the sample rate generator (see [Section 20.4.2](#)) or driven by an external source. The source of frame synchronization is selected by programming the mode bit, FSXM, in PCR. FSX is also affected by the FSGM bit in SRGR2. For information about the effects of FSXM and FSGM, see [Section 20.9.15](#)). Similarly, transmit clocks can be selected to be inputs or outputs by programming the mode bit, CLKXM, in the PCR (see [Section 20.9.18](#)).

When FSR and FSX are inputs (FSXM = FSRM = 0, external frame-synchronization pulses), the McBSP detects them on the internal falling edge of clock, internal MCLKR, and internal CLKX, respectively. The receive data arriving at the DR pin is also sampled on the falling edge of internal MCLKR. These internal clock signals are either derived from external source via CLK(R/X) pins or driven by the sample rate generator clock (CLKG) internal to the McBSP.

When FSR and FSX are outputs, implying that they are driven by the sample rate generator, they are generated (transition to their active state) on the rising edge of internal clock, CLK(R/X). Similarly, data on the DX pin is output on the rising edge of internal CLKX.

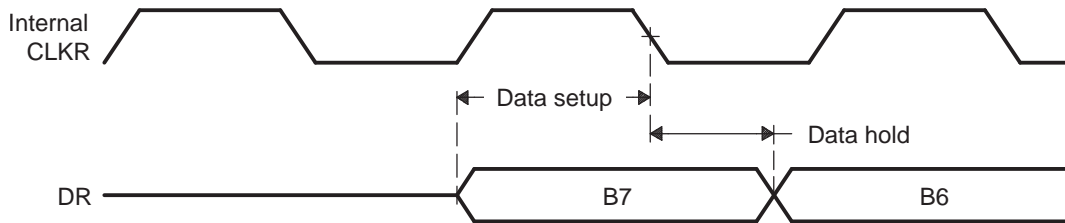
FSRP, FSXP, CLKRP, and CLKXP in the pin control register (PCR) configure the polarities of the FSR, FSX, MCLKR, and CLKX signals, respectively. All frame-synchronization signals (internal FSR, internal FSX) that are internal to the serial port are active high. If the serial port is configured for external frame synchronization (FSR/FSX are inputs to McBSP) and FSRP = FSXP = 1, the external active-low frame-synchronization signals are inverted before being sent to the receiver (internal FSR) and transmitter (internal FSX). Similarly, if internal synchronization (FSR/FSX are output pins and GSYNC = 0) is selected and the polarity bit FS(R/X)P = 1, the internal active-high frame-synchronization signals are inverted before being sent to the FS(R/X) pin.

On the transmit side, the transmit clock polarity bit, CLKXP, sets the edge used to shift and clock out transmit data. Data is always transmitted on the rising edge of internal CLKX. If CLKXP = 1 and external clocking is selected (CLKXM = 0 and CLKX is an input), the external falling-edge triggered input clock on CLKX is inverted to a rising-edge triggered clock before being sent to the transmitter. If CLKXP = 1, and internal clocking is selected (CLKXM = 1 and CLKX is an output pin), the internal (rising-edge triggered) clock, internal CLKX, is inverted before being sent out on the MCLKX pin.

Similarly, the receiver can reliably sample data that is clocked with a rising edge clock (by the transmitter). The receive clock polarity bit, CLKRP, sets the edge used to sample received data. The receive data is always sampled on the falling edge of internal MCLKR. Therefore, if CLKRP = 1 and external clocking is selected (CLKRM = 0 and MCLKR is an input pin), the external rising-edge triggered input clock on MCLKR is inverted to a falling-edge triggered clock before being sent to the receiver. If CLKRP = 1 and internal clocking is selected (CLKRM = 1), the internal falling-edge triggered clock is inverted to a rising-edge triggered clock before being sent out on the MCLKR pin.

CLKRP = CLKXP in a system where the same clock (internal or external) is used to clock the receiver and transmitter. The receiver uses the opposite edge as the transmitter to ensure valid setup and hold of data around this edge. [Figure 20-58](#) shows how data clocked by an external serial device using a rising edge can be sampled by the McBSP receiver on the falling edge of the same clock.

**Figure 20-58. Data Clocked Externally Using a Rising Edge and Sampled by the McBSP Receiver on a Falling Edge**



### 20.9.17 Set the SRG Frame-Synchronization Period and Pulse Width

**Table 20-65. Register Bits Used to Set SRG Frame-Synchronization Period and Pulse Width**

Register	Bit	Name	Function	Type	Reset Value
SRGR2	11-0	FPER	Sample rate generator frame-synchronization period  For the frame-synchronization signal FSG, (FPER + 1) determines the period from the start of a frame-synchronization pulse to the start of the next frame-synchronization pulse.  Range for (FPER + 1): 1 to 4096 CLKG cycles.	R/W	0000 0000 0000
SRGR1	15-8	FWID	Sample rate generator frame-synchronization pulse width  This field plus 1 determines the width of each frame-synchronization pulse on FSG.  Range for (FWID + 1): 1 to 256 CLKG cycles.	R/W	0000 0000

#### 20.9.17.1 Frame-Synchronization Period and Frame-Synchronization Pulse Width

The sample rate generator can produce a clock signal, CLKG, and a frame-synchronization signal, FSG. If the sample rate generator is supplying receive or transmit frame synchronization, you must program the bit fields FPER and FWID.

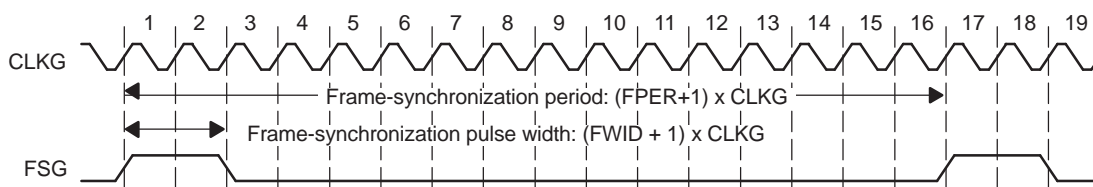
On FSG, the period from the start of a frame-synchronization pulse to the start of the next pulse is (FPER + 1) CLKG cycles. The 12 bits of FPER allow a frame-synchronization period of 1 to 4096 CLKG cycles, which allows up to 4096 data bits per frame. When GSYNC = 1, FPER is a don't care value.

Each pulse on FSG has a width of (FWID + 1) CLKG cycles. The eight bits of FWID allow a pulse width of 1 to 256 CLKG cycles. It is recommended that FWID be programmed to a value less than the programmed word length.

The values in FPER and FWID are loaded into separate down-counters. The 12-bit FPER counter counts down the generated clock cycles from the programmed value (4095 maximum) to 0. The 8-bit FWID counter counts down from the programmed value (255 maximum) to 0.

Figure 20-59 shows a frame-synchronization period of 16 CLKG periods (FPER = 15 or 00001111b) and a frame-synchronization pulse with an active width of 2 CLKG periods (FWID = 1).

**Figure 20-59. Frame of Period 16 CLKG Periods and Active Width of 2 CLKG Periods**



When the sample rate generator comes out of reset, FSG is in its inactive state. Then, when GRST = 1 and FSGM = 1, a frame-synchronization pulse is generated. The frame width value (FWID + 1) is counted down on every CLKG cycle until it reaches 0, at which time FSG goes low. At the same time, the frame period value (FPER + 1) is also counting down. When this value reaches 0, FSG goes high, indicating a new frame.

### 20.9.18 Set the Transmit Clock Mode

**Table 20-66. Register Bit Used to Set the Transmit Clock Mode**

Register	Bit	Name	Function	Type	Reset Value	
PCR	9	CLKXM	Transmit clock mode	R/W	0	
			CLKXM = 0			The transmitter gets its clock signal from an external source via the MCLKX pin.
			CLKXM = 1			The MCLKX pin is an output pin driven by the sample rate generator of the McBSP.

#### 20.9.18.1 Selecting a Source for the Transmit Clock and a Data Direction for the MCLKX pin

Table 20-67 shows how the CLKXM bit selects the transmit clock and the corresponding status of the MCLKX pin. The polarity of the signal on the MCLKX pin is determined by the CLKXP bit.

**Table 20-67. How the CLKXM Bit Selects the Transmit Clock and the Corresponding Status of the MCLKX pin**

CLKXM in PCR	Source of Transmit Clock	MCLKX pin Status
0	Internal CLKX is driven by an external clock on the MCLKX pin. CLKX is inverted as determined by CLKXP before being used.	Input
1	Internal CLKX is driven by the sample rate generator clock, CLKG.	Output. CLKG, inverted as determined by CLKXP, is driven out on CLKX.

#### 20.9.18.2 Other Considerations

If the sample rate generator creates a clock signal (CLKG) that is derived from an external input clock, the GSYNC bit determines whether CLKG is kept synchronized with pulses on the FSR pin. For more details, see Section 20.4.3.

In the clock stop mode (CLKSTP = 10b or 11b), the McBSP can act as a master or as a slave in the SPI protocol. If the McBSP is a master, make sure that CLKXM = 1 so that CLKX is an output to supply the master clock to any slave devices. If the McBSP is a slave, make sure that CLKXM = 0 so that CLKX is an input to accept the master clock signal.

### 20.9.19 Set the Transmit Clock Polarity

**Table 20-68. Register Bit Used to Set Transmit Clock Polarity**

Register	Bit	Name	Function	Type	Reset Value	
PCR	1	CLKXP	Transmit clock polarity	R/W	0	
			CLKXP = 0			Transmit data sampled on rising edge of CLKX.
			CLKXP = 1			Transmit data sampled on falling edge of CLKX.



### 20.9.19.1 Frame Synchronization Pulses, Clock Signals, and Their Polarities

Transmit frame-synchronization pulses can be either generated internally by the sample rate generator (see [Section 20.4.2](#)) or driven by an external source. The source of frame synchronization is selected by programming the mode bit, FSXM, in PCR. FSX is also affected by the FSGM bit in SRGR2. For information about the effects of FSXM and FSGM, see [Section 20.9.15](#)). Similarly, transmit clocks can be selected to be inputs or outputs by programming the mode bit, CLKXM, in the PCR (see [Section 20.9.18](#)).

When FSR and FSX are inputs (FSXM = FSRM = 0, external frame-synchronization pulses), the McBSP detects them on the internal falling edge of clock, internal MCLKR, and internal CLKX, respectively. The receive data arriving at the DR pin is also sampled on the falling edge of internal MCLKR. These internal clock signals are either derived from external source via CLK(R/X) pins or driven by the sample rate generator clock (CLKG) internal to the McBSP.

When FSR and FSX are outputs, implying that they are driven by the sample rate generator, they are generated (transition to their active state) on the rising edge of internal clock, CLK(R/X). Similarly, data on the DX pin is output on the rising edge of internal CLKX.

FSRP, FSXP, CLKRP, and CLKXP in the pin control register (PCR) configure the polarities of the FSR, FSX, MCLKR, and CLKX signals, respectively. All frame-synchronization signals (internal FSR, internal FSX) that are internal to the serial port are active high. If the serial port is configured for external frame synchronization (FSR/FSX are inputs to McBSP), and FSRP = FSXP = 1, the external active-low frame-synchronization signals are inverted before being sent to the receiver (internal FSR) and transmitter (internal FSX). Similarly, if internal synchronization (FSR/FSX are output pins and GSYNC = 0) is selected, the internal active-high frame-synchronization signals are inverted, if the polarity bit FS(R/X)P = 1, before being sent to the FS(R/X) pin.

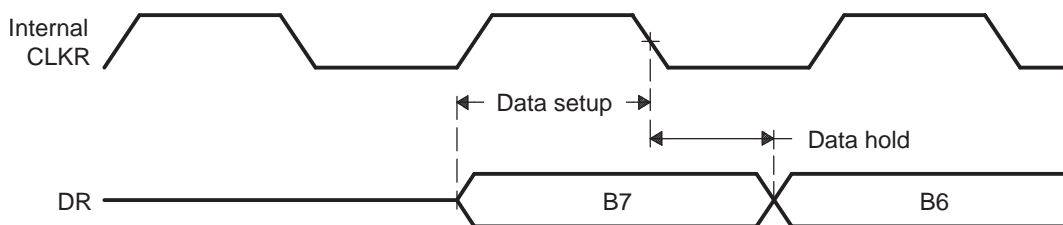
On the transmit side, the transmit clock polarity bit, CLKXP, sets the edge used to shift and clock out transmit data. Data is always transmitted on the rising edge of internal CLKX. If CLKXP = 1 and external clocking is selected (CLKXM = 0 and CLKX is an input), the external falling-edge triggered input clock on CLKX is inverted to a rising-edge triggered clock before being sent to the transmitter. If CLKXP = 1 and internal clocking is selected (CLKXM = 1 and CLKX is an output pin), the internal (rising-edge triggered) clock, internal CLKX, is inverted before being sent out on the MCLKX pin.

Similarly, the receiver can reliably sample data that is clocked with a rising edge clock (by the transmitter). The receive clock polarity bit, CLKRP, sets the edge used to sample received data. The receive data is always sampled on the falling edge of internal MCLKR. Therefore, if CLKRP = 1 and external clocking is selected (CLKRM = 0 and CLKR is an input pin), the external rising-edge triggered input clock on CLKR is inverted to a falling-edge triggered clock before being sent to the receiver. If CLKRP = 1 and internal clocking is selected (CLKRM = 1), the internal falling-edge triggered clock is inverted to a rising-edge triggered clock before being sent out on the MCLKR pin.

CLKRP = CLKXP in a system where the same clock (internal or external) is used to clock the receiver and transmitter. The receiver uses the opposite edge as the transmitter to ensure valid setup and hold of data around this edge (see [Figure 20-58](#)).

[Figure 20-60](#) shows how data clocked by an external serial device using a rising edge can be sampled by the McBSP receiver on the falling edge of the same clock.

**Figure 20-60. Data Clocked Externally Using a Rising Edge and Sampled by the McBSP Receiver on a Falling Edge**



## 20.10 Emulation and Reset Considerations

This section covers the following topics:



- How to program McBSP response to a breakpoint in the high-level language debugger (see [Section 20.10.1](#))
- How to reset and initialize the various parts of the McBSP (see [Section 20.10.2](#))

### 20.10.1 McBSP Emulation Mode

FREE and SOFT are special emulation bits in SPCR2 that determine the state of the McBSP when a breakpoint is encountered in the high-level language debugger. If FREE = 1, the clock continues to run upon a software breakpoint and data is still shifted out. When FREE = 1, the SOFT bit is a *don't care*.

If FREE = 0, the SOFT bit takes effect. If SOFT = 0 when breakpoint occurs, the clock stops immediately, aborting a transmission. If SOFT = 1 and a breakpoint occurs while transmission is in progress, the transmission continues until completion of the transfer and then the clock halts. These options are listed in [Table 20-69](#).

The McBSP receiver functions in a similar fashion. If a mode other than the immediate stop mode (SOFT = FREE = 0) is chosen, the receiver continues running and an overrun error is possible.

**Table 20-69. McBSP Emulation Modes Selectable with FREE and SOFT Bits of SPCR2**

FREE	SOFT	McBSP Emulation Mode
0	0	Immediate stop mode (reset condition) The transmitter or receiver stops immediately in response to a breakpoint.
0	1	Soft stop mode When a breakpoint occurs, the transmitter stops after completion of the current word. The receiver is not affected.
1	0 or 1	Free run mode The transmitter and receiver continue to run when a breakpoint occurs.

### 20.10.2 Resetting and Initializing McBSPs

#### 20.10.2.1 McBSP Pin States: DSP Reset Versus Receiver/Transmitter Reset

[Table 20-70](#) shows the state of McBSP pins when the serial port is reset due to direct receiver or transmitter reset on the 2833x device.

**Table 20-70. Reset State of Each McBSP Pin**

Pin	Possible State(s) <sup>(1)</sup>	State Forced by Device Reset	State Forced by Receiver/Transmitter Reset
<b>Receiver reset (RRST = 0 and GRST = 1)</b>			
MDRx	I	GPIO-input	Input
MCLKRx	I/O/Z	GPIO-input	Known state if input; MCLKR running if output
MFSRx	I/O/Z	GPIO-input	Known state if input; FSRP inactive state if output
<b>Transmitter reset (XRST = 0 and GRST = 1)</b>			
MDXx	O/Z	GPIO Input	High impedance
MCLKXx	I/O/Z	GPIO-input	Known state if input; CLKX running if output
MFSXx	I/O/Z	GPIO-input	Known state if input; FSXP inactive state if output

<sup>(1)</sup> In Possible State(s) column, I = Input, O = Output, Z = High impedance. In the 28x family, at device reset, all I/Os default to GPIO function and generally as inputs.

#### 20.10.2.2 Device Reset, McBSP Reset, and Sample Rate Generator Reset

When the McBSP is reset in either of the above two ways, the machine is reset to its initial state, including reset of all counters and status bits. The receive status bits include RFULL, RRDY, and RSYNCERR. The transmit status bits include XEMPTY, XRDY, and XSYNCERR.

- Device reset. When the whole DSP is reset ( $\overline{\text{XRS}}$  signal is driven low), all McBSP pins are in GPIO

mode. When the device is pulled out of reset, the clock to the McBSP modules remains disabled.

- **McBSP reset.** When the receiver and transmitter reset bits, RRST and XRST, are loaded with 0s, the respective portions of the McBSP are reset and activity in the corresponding section of the serial port stops. Input-only pins such as MDRx, and all other pins that are configured as inputs are in a known state. The MFSRx and MFSXx pins are driven to their inactive state if they are not outputs. If the MCLKR and MCLKX pins are programmed as outputs, they are driven by CLKG, provided that GRST = 1. Lastly, the MDXx pin is in the high-impedance state when the transmitter and/or the device is reset.

During normal operation, the sample rate generator is reset if the GRST bit is cleared. GRST must be 0 only when neither the transmitter nor the receiver is using the sample rate generator. In this case, the internal sample rate generator clock (CLKG) and its frame-synchronization signal (FSG) are driven inactive low.

When the sample rate generator is not in the reset state (GRST = 1), pins MFSRx and MFSXx are in an inactive state when RRST = 0 and XRST = 0, respectively, even if they are outputs driven by FSG. This ensures that when only one portion of the McBSP is in reset, the other portion can continue operation when GRST = 1 and its frame synchronization is driven by FSG.

- **Sample rate generator reset.** The sample rate generator is reset when GRST is loaded with 0. When neither the transmitter nor the receiver is fed by CLKG and FSG, you can reset the sample rate generator by clearing GRST. In this case, CLKG and FSG are driven inactive low. If you then set GRST, CLKG starts and runs as programmed. Later, if GRST = 1, FSG pulses active high after the programmed number of CLKG cycles has elapsed.

### 20.10.2.3 McBSP Initialization Procedure

The serial port initialization procedure is as follows:

1. Make XRST = RRST = GRST = 0 in SPCR[1,2]. If coming out of a device reset, this step is not required.
2. While the serial port is in the reset state, program only the McBSP configuration registers (not the data registers) as required.
3. Wait for two clock cycles. This ensures proper internal synchronization.
4. Set up data acquisition as required (such as writing to DXR[1,2]).
5. Make XRST = RRST = 1 to enable the serial port. Make sure that as you set these reset bits, you do not modify any of the other bits in SPCR1 and SPCR2. Otherwise, you change the configuration you selected in step 2.
6. Set FRST = 1, if internally generated frame synchronization is required.
7. Wait two clock cycles for the receiver and transmitter to become active.

Alternatively, on either write (step 1 or 5), the transmitter and receiver can be placed in or taken out of reset individually by modifying the desired bit.

The above procedure for reset/initialization can be applied in general when the receiver or transmitter must be reset during its normal operation and when the sample rate generator is not used for either operation.

**NOTE:**

1. The necessary duration of the active-low period of XRST or RREST is at least two MCLKR/CLKX cycles.
2. The appropriate bits in serial port configuration registers SPCR[1,2], PCR, RCR[1,2], XCR[1,2], and SRGR[1,2] must only be modified when the affected portion of the serial port is in its reset state.
3. In most cases, the data transmit registers (DXR[1,2]) must be loaded by the CPU or by the DMA controller only when the transmitter is enabled (XRST = 1). An exception to this rule is when these registers are used for companding internal data (see [Section 20.3.2.2](#)).
4. The bits of the channel control registers—MCR[1,2], RCER[A-H], XCER[A-H]—can be modified at any time as long as they are not being used by the current reception/transmission in a multichannel selection mode.

### 20.10.2.4 Resetting the Transmitter While the Receiver is Running

shows values in the control registers that reset and configure the transmitter while the receiver is running.

#### **Example 20-1. Resetting and Configuring McBSP Transmitter While McBSP Receiver Running**

```

SPCR1 = 0001h SPCR2 = 0030h
; The receiver is running with the receive interrupt (RINT) triggered by the
; receiver ready bit (RRDY). The transmitter is in its reset state
. The transmit interrupt (XINT) will be triggered by the transmit frame-sync
; error bit (XSYNCERR). PCR = 0900h
; Transmit frame synchronization is generated internally according to the
; FSGM bit of SRGR2.
; The transmit clock is driven by an external source.
; The receive clock continues to be driven by sample rate generator. The input clock
; of the sample rate generator is supplied by the CPU clock SRGR1 = 0001h SRGR2 = 2000h
; The CPU clock is the input clock for the sample rate generator. The sample
; rate generator divides the CPU clock by 2 to generate its output clock (CLKG).
; Transmit frame synchronization is tied to the automatic copying of data from
; the DXR(s) to the XSR(s). XCR1 = 0740h XCR2 = 8321h
; The transmit frame has two phases. Phase 1 has eight 16-bit words. Phase 2
; has four 12-bit words. There is 1-bit data delay between the start of a
; frame-sync pulse and the first data bit
; transmitted. SPCR2 = 0031h
; The transmitter is taken out of reset.

```

## 20.11 Data Packing Examples

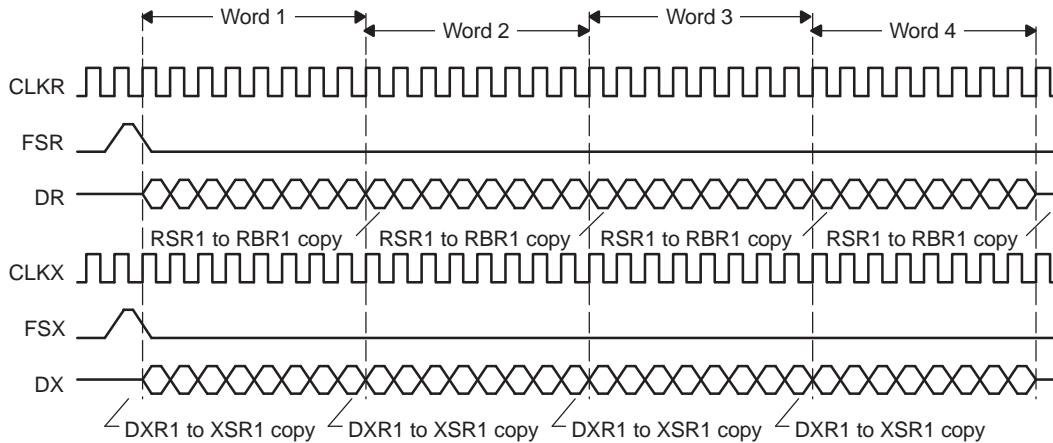
This section shows two ways to implement data packing in the McBSP.

### 20.11.1 Data Packing Using Frame Length and Word Length

Frame length and word length can be manipulated to effectively pack data. For example, consider a situation where four 8-bit words are transferred in a single-phase frame as shown in [Figure 20-61](#). In this case:

- (R/X)PHASE = 0: Single-phase frame
- (R/X)FRLLEN1 = 0000011b: 4-word frame
- (R/X)WDLEN1 = 000b: 8-bit words

Four 8-bit data words are transferred to and from the McBSP by the CPU or by the DMA controller. Thus, four reads from DRR1 and four writes to DXR1 are necessary for each frame.

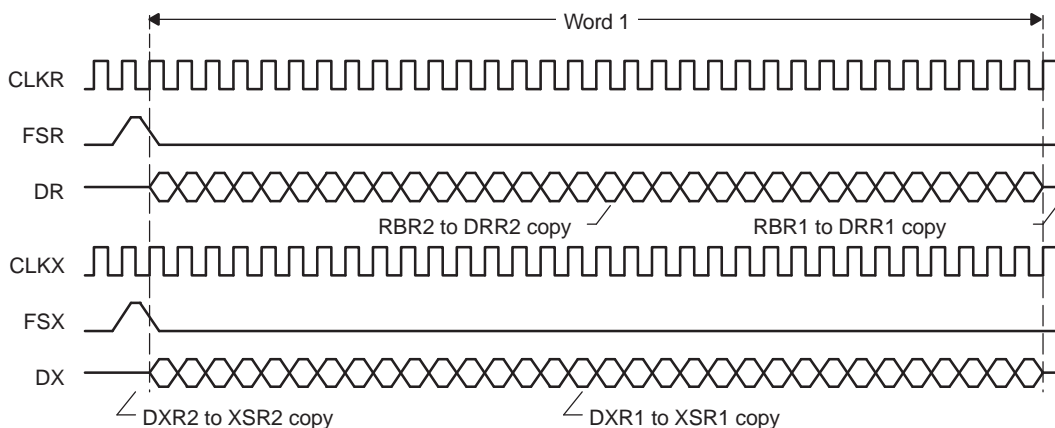
**Figure 20-61. Four 8-Bit Data Words Transferred To/From the McBSP**


This data can also be treated as a single-phase frame consisting of one 32-bit data word, as shown in [Figure 20-62](#). In this case:

- (R/X)PHASE = 0: Single-phase frame
- (R/X)FRLLEN1 = 0000000b: 1-word frame
- (R/X)WDLEN1 = 101b: 32-bit word

Two 16-bit data words are transferred to and from the McBSP by the CPU or DMA controller. Thus, two reads, from DRR2 and DRR1, and two writes, to DXR2 and DXR1, are necessary for each frame. This results in only half the number of transfers compared to the previous case. This manipulation reduces the percentage of bus time required for serial port data movement.

**NOTE:** When the word length is larger than 16 bits, make sure you access DRR2/DXR2 before you access DRR1/DXR1. McBSP activity is tied to accesses of DRR1/DXR1. During the reception of 24-bit or 32-bit words, read DRR2 and then read DRR1. Otherwise, the next RBR[1,2]-to-DRR[1,2] copy occurs before DRR2 is read. Similarly, during the transmission of 24-bit or 32-bit words, write to DXR2 and then write to DXR1. Otherwise, the next DXR[1,2]-to-XSR[1,2] copy occurs before DXR2 is loaded with new data.

**Figure 20-62. One 32-Bit Data Word Transferred To/From the McBSP**


### 20.11.2 Data Packing Using Word Length and the Frame-Synchronization Ignore Function

When there are multiple words per frame, you can implement data packing by increasing the word length (defining a serial word with more bits) and by ignoring frame-synchronization pulses. First, consider Figure 20-63, which shows the McBSP operating at the maximum packet frequency. Here, each frame only has a single 8-bit word. Notice the frame-synchronization pulse that initiates each frame transfer for reception and for transmission. For reception, this configuration requires one read operation for each word. For transmission, this configuration requires one write operation for each word.

Figure 20-63. 8-Bit Data Words Transferred at Maximum Packet Frequency

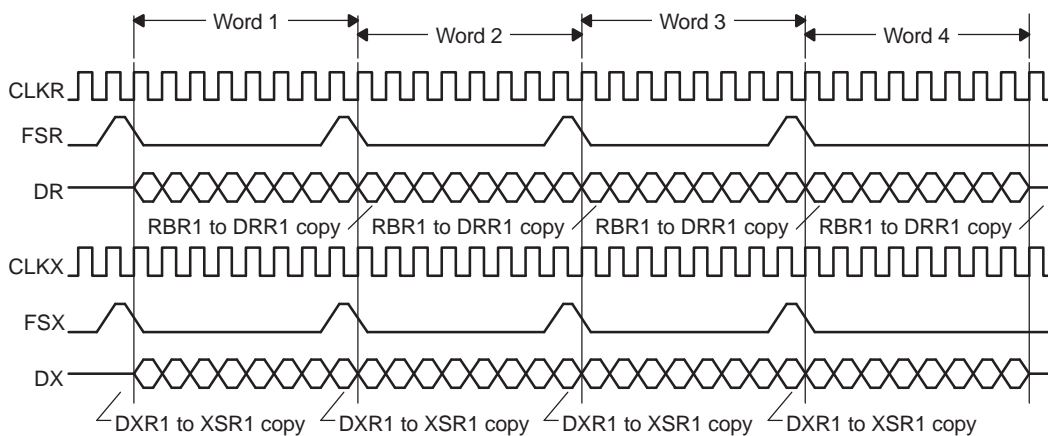
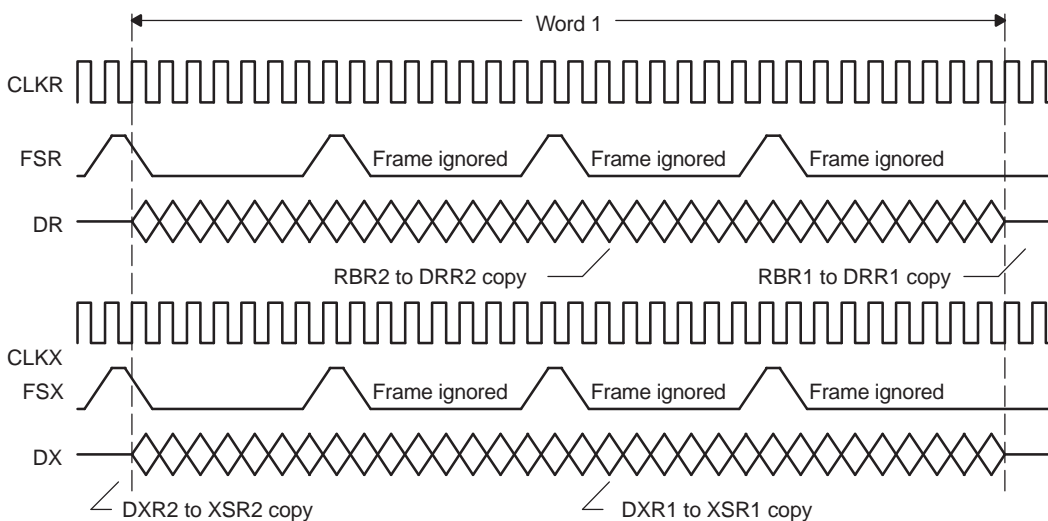


Figure 20-64 shows the McBSP configured to treat this data stream as a continuous 32-bit word. In this example, the McBSP responds to an initial frame-synchronization pulse. However, (R/X)FIG = 1 so that the McBSP ignores subsequent pulses. Only two read transfers or two write transfers are needed every 32 bits. This configuration effectively reduces the required bus bandwidth to half the bandwidth needed to transfer four 8-bit words.

Figure 20-64. Configuring the Data Stream of Figure 20-63 as a Continuous 32-Bit Word



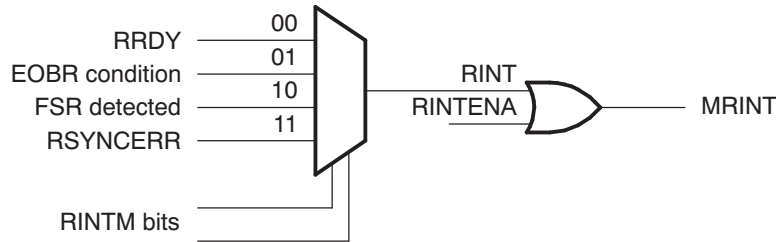
## 20.12 Interrupt Generation

McBSP registers can be programmed to receive and transmit data through DRR2/DRR1 and DXR2/DXR1 registers, respectively. The CPU can directly access these registers to move data from memory to these registers. Interrupt signals will be based on these register pair contents and its related flags. MRINT/MXINT will generate CPU interrupts for receive and transmit conditions.

### 20.12.1 McBSP Receive Interrupt Generation

In the McBSP module, data receive and error conditions generate two sets of interrupt signals. One set is used for the CPU and the other set is for DMA.

**Figure 20-65. Receive Interrupt Generation**



**Table 20-71. Receive Interrupt Sources and Signals**

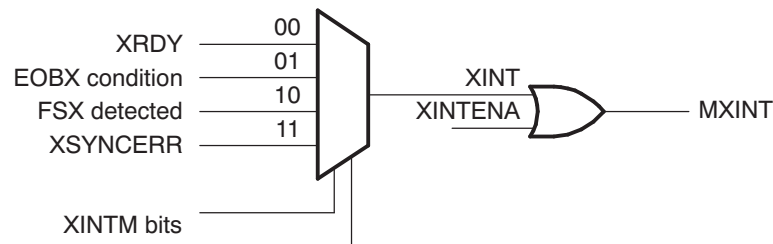
McBSP Interrupt Signal	Interrupt Flags	Interrupt Enables in SPCR1	Interrupt Enables	Type of Interrupt	Interrupt Line
		RINTM Bits			
RINT	RRDY	0	RINTENA	Every word receive	MRINT
	EOBR	1	RINTENA	Every 16 channel block boundary	
	FSR	10	RINTENA	On every FSR	
	RSYNCERR	11	RINTENA	Frame sync error	

**NOTE:** Since X/RINT, X/REVT, and X/RXFFINT share the same CPU interrupt, it is recommended that all applications use one of the above selections for interrupt generation. If multiple interrupt enables are selected at the same time, there is a likelihood of interrupts being masked or not recognized.

### 20.12.2 McBSP Transmit Interrupt Generation

McBSP module data transmit and error conditions generate two sets of interrupt signals. One set is used for the CPU and the other set is for DMA.

**Figure 20-66. Transmit Interrupt Generation**



**Table 20-72. Transmit Interrupt Sources and Signals**

McBSP Interrupt Signal	Interrupt Flags	Interrupt Enables in SPCR2	Interrupt Enables	Type of Interrupt	Interrupt Line
		XINTM Bits			
XINT	XRDY	0	XINTENA	Every word transmit	MXINT
	EOBR	1	XINTENA	Every 16-channel block boundary	

**Table 20-72. Transmit Interrupt Sources and Signals (continued)**

McBSP Interrupt Signal	Interrupt Flags	Interrupt Enables in SPCR2	Interrupt Enables	Type of Interrupt	Interrupt Line
	FSX	10	XINTENA	On every FSX	
	XSYNCERR	11	XINTENA	Frame sync error	

### 20.12.3 Error Flags

The McBSP has several error flags both on receive and transmit channel. [Table 20-73](#) explains the error flags and their meaning.

**Table 20-73. Error Flags**

Error Flags	Function
RFULL	Indicates DRR2/DRR1 are not read and RXR register is overwritten
RSYNCERR	Indicates unexpected frame-sync condition, current data reception will abort and restart. Use RINTM bit 11 for interrupt generation on this condition.
XSYNCERR	Indicates unexpected frame-sync condition, current data transmission will abort and restart. Use XINTM bit 11 for interrupt generation on this condition.

### 20.13 McBSP Modes

McBSP, in its normal mode, communicates with various types of Codecs with variable word size. Apart from this mode, the McBSP uses time-division multiplexed (TDM) data stream while communicating with other McBSPs or serial devices. The multichannel mode provides flexibility while transmitting/receiving selected channels or all the channels in a TDM stream.

[Table 20-74](#) provides a quick reference to McBSP mode selection.

**Table 20-74. McBSP Mode Selection**

No.	McBSP Word Size	Register Bits Used for Mode Selection				Mode and Function Description
		MCR1 bit 9,0		MCR2 bit 9,1,0		
		RMCME	RMCM	XMCME	XMCM	
1	8/12/16/20/24/32 bit words	0	0	0	0	<b>Normal Mode</b> All types of Codec interface will use this selection
2	8-bit words	0	1	0	1	<b>Multichannel Mode</b> 2 Partition or 32-channel Mode All channels are disabled, unless selected in X/RCERA/B
		0	1	0	10	All channels are enabled, but masked unless selected in X/RCERA/B
		0	1	0	11	Symmetric transmit, receive 8 Partition or 128 Channel Mode Transmit/Receive Channels selected by X/RCERA to X/RCERH bits
		1	1	1	1	<b>Multichannel Mode is ON</b> All channels are disabled, unless selected in XCERs
		1	1	1	10	All channels are enabled, but masked unless

**Table 20-74. McBSP Mode Selection (continued)**

No.	McBSP Word Size	Register Bits Used for Mode Selection				Mode and Function Description
		MCR1 bit 9,0		MCR2 bit 9,1,0		
		RMCME	RMCM	XMCME	XMCM	
		1	1	1	11	selected in XCERs Symmetric transmit, receive
		1	0	1	0	<b>Continuous Mode - Transmit</b> <b>Multi-Channel Mode is OFF</b> All 128 channels are active and enabled



## 20.14 McBSP Registers

This section describes the McBSP registers.

### 20.14.1 McBSP Base Addresses

**Table 20-75. McBSP Base Address Table**

Device Registers	Register Name	Start Address	End Address
McbspaRegs	MCBSP_REGS	0x0000_6000	0x0000_603F
McbspbRegs	MCBSP_REGS	0x0000_6040	0x0000_607F

Table 20-76 shows the registers accessible on each McBSP. Section 20.14.2 through Section 20.14.11 describe the register bits.

**Table 20-76. McBSP Register Summary**

Name	McBSP-A Address	McBSP-B Address	Type	Reset Value	Description
<b>Data Registers, Receive, Transmit</b>					
DRR2	0x6000	0x6040	R	0x0000	McBSP Data Receive Register 2
DRR1	0x6001	0x6041	R	0x0000	McBSP Data Receive Register 1
DXR2	0x6002	0x6042	W	0x0000	McBSP Data Transmit Register 2
DXR1	0x6003	0x6043	W	0x0000	McBSP Data Transmit Register 1
<b>McBSP Control Registers</b>					
SPCR2	0x6004	0x6044	R/W	0x0000	McBSP Serial Port Control Register 2
SPCR1	0x6005	0x6045	R/W	0x0000	McBSP Serial Port Control Register 1
RCR2	0x6006	0x6046	R/W	0x0000	McBSP Receive Control Register 2
RCR1	0x6007	0x6047	R/W	0x0000	McBSP Receive Control Register 1
XCR2	0x6008	0x6048	R/W	0x0000	McBSP Transmit Control Register 2
XCR1	0x6009	0x6049	R/W	0x0000	McBSP Transmit Control Register 1
SRGR2	0x600A	0x604A	R/W	0x0000	McBSP Sample Rate Generator Register 2
SRGR1	0x600B	0x604B	R/W	0x0000	McBSP Sample Rate Generator Register 1
<b>Multichannel Control Registers</b>					
MCR2	0x600C	0x604C	R/W	0x0000	McBSP Multichannel Register 2
MCR1	0x600D	0x604D	R/W	0x0000	McBSP Multichannel Register 1
RCERA	0x600E	0x604E	R/W	0x0000	McBSP Receive Channel Enable Register Partition A
RCERB	0x600F	0x604F	R/W	0x0000	McBSP Receive Channel Enable Register Partition B
XCERA	0x6010	0x6050	R/W	0x0000	McBSP Transmit Channel Enable Register Partition A
XCERB	0x6011	0x6051	R/W	0x0000	McBSP Transmit Channel Enable Register Partition B
PCR	0x6012	0x6052	R/W	0x0000	McBSP Pin Control Register
RCERC	0x6013	0x6053	R/W	0x0000	McBSP Receive Channel Enable Register Partition C
RCERD	0x6014	0x6054	R/W	0x0000	McBSP Receive Channel Enable Register Partition D
XCERC	0x6015	0x6055	R/W	0x0000	McBSP Transmit Channel Enable Register Partition C
XCERD	0x6016	0x6056	R/W	0x0000	McBSP Transmit Channel Enable Register Partition D
RCERE	0x6017	0x6057	R/W	0x0000	McBSP Receive Channel Enable Register Partition E
RCERF	0x6018	0x6058	R/W	0x0000	McBSP Receive Channel Enable Register Partition F
XCERE	0x6019	0x6059	R/W	0x0000	McBSP Transmit Channel Enable Register Partition E
XCERF	0x601A	0x605A	R/W	0x0000	McBSP Transmit Channel Enable Register Partition F
RCERG	0x601B	0x605B	R/W	0x0000	McBSP Receive Channel Enable Register Partition G
RCERH	0x601C	0x605C	R/W	0x0000	McBSP Receive Channel Enable Register Partition H
XCERG	0x601D	0x605D	R/W	0x0000	McBSP Transmit Channel Enable Register Partition G
XCERH	0x601E	0x605E	R/W	0x0000	McBSP Transmit Channel Enable Register Partition H

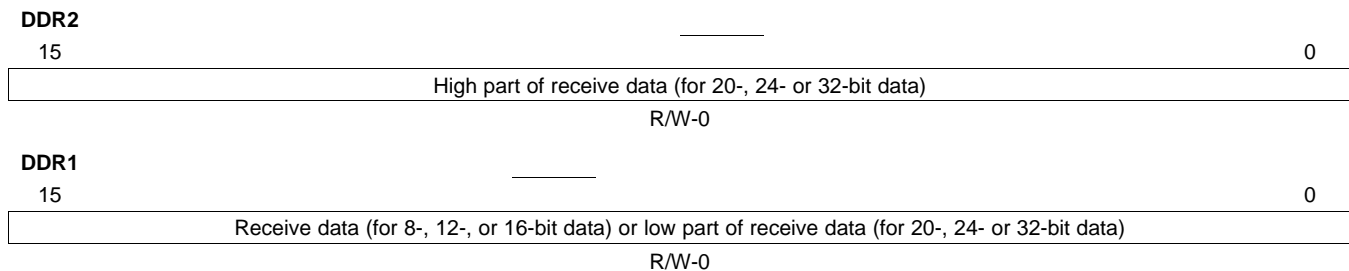
**Table 20-76. McBSP Register Summary (continued)**

Name	McBSP-A Address	McBSP-B Address	Type	Reset Value	Description
MFFINT	0x6023	0x6063	R/W	0x0000	McBSP Interrupt Enable Register

### 20.14.2 Data Receive Registers (DRR[1,2])

The CPU or the DMA controller reads received data from one or both of the data receive registers (see [Figure 20-67](#)). If the serial word length is 16 bits or smaller, only DRR1 is used. If the serial length is larger than 16 bits, both DRR1 and DRR2 are used and DRR2 holds the most significant bits. Each frame of receive data in the McBSP can have one phase or two phases, each with its own serial word length.

**Figure 20-67. Data Receive Registers (DRR2 and DRR1)**



LEGEND: R/W = Read/Write; R = Read only; -n = value after reset

#### 20.14.2.1 Data Travel From Data Receive Pins to the Registers

If the serial word length is 16 bits or smaller, receive data on the MDRx pin is shifted into receive shift register 1 (RSR1) and then copied into receive buffer register 1 (RBR1). The content of RBR1 is then copied to DRR1, which can be read by the CPU or by the DMA controller. The RSRs and RBRs are not accessible to the user.

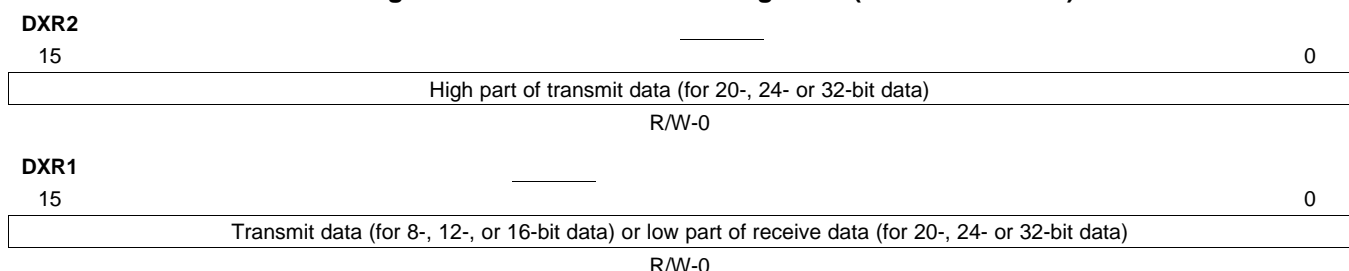
If the serial word length is larger than 16 bits, receive data on the MDRx pin is shifted into both of the receive shift registers (RSR2, RSR1) and then copied into both of the receive buffer registers (RBR2, RBR1). The content of the RBRs is then copied into both of the DRRs, which can be read by the CPU or by the DMA controller.

If companding is used during the copy from RBR1 to DRR1 (RCOMPAND = 10b or 11b), the 8-bit compressed data in RBR1 is expanded to a left-justified 16-bit value in DRR1. If companding is disabled, the data copied from RBR[1,2] to DRR[1,2] is justified and bit filled according to the RJUST bits.

### 20.14.3 Data Transmit Registers (DXR[1,2])

For transmission, the CPU or the DMA controller writes data to one or both of the data transmit registers (see [Figure 20-68](#)). If the serial word length is 16 bits or smaller, only DXR1 is used. If the word length is larger than 16 bits, both DXR1 and DXR2 are used and DXR2 holds the most significant bits. Each frame of transmit data in the McBSP can have one phase or two phases, each with its own serial word length.

**Figure 20-68. Data Transmit Registers (DXR2 and DXR1)**



LEGEND: R/W = Read/Write; R = Read only; -n = value after reset

### 20.14.3.1 Data Travel From Registers to Data Transmit (DX) Pins

If the serial word length is 16 bits or fewer, data written to DXR1 is copied to transmit shift register 1 (XSR1). From XSR1, the data is shifted onto the DX pin one bit at a time. The XSRs are not accessible.

If the serial word length is more than 16 bits, data written to DXR1 and DXR2 is copied to both transmit shift registers (XSR2, XSR1). From the XSRs, the data is shifted onto the DX pin one bit at a time.

If companding is used during the transfer from DXR1 to XSR1 (XCOMPAND = 10b or 11b), the McBSP compresses the 16-bit data in DXR1 to 8-bit data in the  $\mu$ -law or A-law format in XSR1. If companding is disabled, the McBSP passes data from the DXR(s) to the XSR(s) without modification.

### 20.14.4 Serial Port Control Registers (SPCR[1,2])

Each McBSP has two serial port control registers, SPCR1 (Table 20-77) and SPCR2 (Table 20-78). These registers enable you to:

- Control various McBSP modes: digital loopback mode (DLB), sign-extension and justification mode for reception (RJUST), clock stop mode (CLKSTP), interrupt modes (RINTM and XINTM), emulation mode (FREE and SOFT)
- Turn on and off the DX-pin delay enabler (DXENA)
- Check the status of receive and transmit operations (RSYNCERR, XSYNCERR, RFULL, XEMPTY, RRDY, XRDY)
- Reset portions of the McBSP (RRST, XRST, FRST, GRST)

#### 20.14.4.1 Serial Port Control 1 Register (SPCR1)

The serial port control 1 register (SPCR1) is shown in Figure 20-69 and described in Table 20-77.

**Figure 20-69. Serial Port Control 1 Register (SPCR1)**

15	14	13	12	11	10	8	
DLB	RJUST	CLKSTP	Reserved				
R/W-0	R/W-0	R/W-0	R-0				
7	6	5	4	3	2	1	0
DXENA	Reserved	RINTM	RSYNCERR	RFULL	RRDY	RRST	
R/W-0	R/W-0	R/W-0	R/W-0	R-0	R-0	R/W-0	

LEGEND: R/W = Read/Write; R = Read only; -n = value after reset

**Table 20-77. Serial Port Control 1 Register (SPCR1) Field Descriptions**

Bit	Field	Value	Description
15	DLB	0	<p>Digital loopback mode bit. DLB disables or enables the digital loopback mode of the McBSP:</p> <p>Disabled</p> <p>Internal DR is supplied by the MDRx pin. Internal FSR and internal MCLKR can be supplied by their respective pins or by the sample rate generator, depending on the mode bits FSRM and CLKRM.</p> <p>Internal DX is supplied by the MDXx pin. Internal FSX and internal CLKX are supplied by their respective pins or are generated internally, depending on the mode bits FSXM and CLKXM.</p>
		1	<p>Enabled</p> <p>Internal receive signals are supplied by internal transmit signals:</p> <p>MDRx connected to MDXx</p> <p>MFSRx connected to MFSXx</p> <p>MCLKR connected to MCLKXx</p> <p>This mode allows you to test serial port code with a single DSP. The McBSP transmitter directly supplies data, frame synchronization, and clocking to the McBSP receiver.</p>

**Table 20-77. Serial Port Control 1 Register (SPCR1) Field Descriptions (continued)**

Bit	Field	Value	Description
14-13	RJUST	0-3h	<p>Receive sign-extension and justification mode bits. During reception, RJUST determines how data is justified and bit filled before being passed to the data receive registers (DRR1, DRR2).</p> <p>RJUST is ignored if you enable a companding mode with the RCOMPAND bits. In a companding mode, the 8-bit compressed data in RBR1 is expanded to left-justified 16-bit data in DRR1.</p> <p>For more details about the effects of RJUST, see <a href="#">Section 20.8.13</a>.</p> <p>0 Right justify the data and zero fill the MSBs.</p> <p>1h Right justify the data and sign-extend the data into the MSBs.</p> <p>2h Left justify the data and zero fill the LSBs.</p> <p>3h Reserved (do not use)</p>
12-11	CLKSTP	0-3h	<p>Clock stop mode bits. CLKSTP allows you to use the clock stop mode to support the SPI master-slave protocol. If you will not be using the SPI protocol, you can clear CLKSTP to disable the clock stop mode.</p> <p>In the clock stop mode, the clock stops at the end of each data transfer. At the beginning of each data transfer, the clock starts immediately (CLKSTP = 10b) or after a half-cycle delay (CLKSTP = 11b).</p> <p>For more details, see <a href="#">Section 20.8.5</a>.</p>
		0-1h	Clock stop mode is disabled.
		2h	Clock stop mode, without clock delay
		3h	Clock stop mode, with half-cycle clock delay
10-8	Reserved	0	Reserved bits (not available for your use). They are read-only bits and return 0s when read.
7	DXENA	0	DX delay enabler mode bit. DXENA controls the delay enabler for the DX pin. The enabler creates an extra delay for turn-on time (for the length of the delay, see the device-specific data sheet). For more details about the effects of DXENA, see <a href="#">Section 20.9.13</a> .
		1	DX delay enabler on
6	Reserved	0	Reserved
5-4	RINTM	0-3h	<p>Receive interrupt mode bits. RINTM determines which event in the McBSP receiver generates a receive interrupt (RINT) request. If RINT is properly enabled inside the CPU, the CPU services the interrupt request; otherwise, the CPU ignores the request.</p> <p>0 The McBSP sends a receive interrupt (RINT) request to the CPU when the RRDY bit changes from 0 to 1, indicating that receive data is ready to be read (the content of RBR[1,2] has been copied to DRR[1,2]):</p> <p>Regardless of the value of RINTM, you can check RRDY to determine whether a word transfer is complete.</p> <p>The McBSP sends a RINT request to the CPU when 16 enabled bits have been received on the DR pin.</p> <p>1h In the multichannel selection mode, the McBSP sends a RINT request to the CPU after every 16-channel block is received in a frame.</p> <p>Outside of the multichannel selection mode, no interrupt request is sent.</p> <p>2h The McBSP sends a RINT request to the CPU when each receive frame-synchronization pulse is detected. The interrupt request is sent even if the receiver is in its reset state.</p> <p>3h The McBSP sends a RINT request to the CPU when the RSYNCERR bit is set, indicating a receive frame-synchronization error.</p> <p>Regardless of the value of RINTM, you can check RSYNCERR to determine whether a receive frame-synchronization error occurred.</p>
3	RSYNCERR	0	No error
		1	Receive frame-synchronization error. For more details about this error, see <a href="#">Section 20.5.3</a> .

**Table 20-77. Serial Port Control 1 Register (SPCR1) Field Descriptions (continued)**

Bit	Field	Value	Description
2	RFULL	0 1	<p>Receiver full bit. RFULL is set when the receiver is full with new data and the previously received data has not been read (receiver-full condition). For more details about this condition, see <a href="#">Section 20.5.2</a>.</p> <p>0 No receiver-full condition</p> <p>1 Receiver-full condition: RSR[1,2] and RBR[1,2] are full with new data, but the previous data in DRR[1,2] has not been read.</p>
1	RRDY	0 1	<p>Receiver ready bit. RRDY is set when data is ready to be read from DRR[1,2]. Specifically, RRDY is set in response to a copy from RBR1 to DRR1.</p> <p>If the receive interrupt mode is RINTM = 00b, the McBSP sends a receive interrupt request to the CPU when RRDY changes from 0 to 1.</p> <p>Also, when RRDY changes from 0 to 1, the McBSP sends a receive synchronization event (REVT) signal to the DMA controller.</p> <p>0 Receiver not ready</p> <p>When the content of DRR1 is read, RRDY is automatically cleared.</p> <p>1 Receiver ready: New data can be read from DRR[1,2].</p> <p>Important: If both DRRs are required (word length larger than 16 bits), the CPU or the DMA controller must read from DRR2 first and then from DRR1. As soon as DRR1 is read, the next RBR-to-DRR copy is initiated. If DRR2 is not read first, the data in DRR2 is lost.</p>
0	RRST	0 1	<p>Receiver reset bit. You can use RRST to take the McBSP receiver into and out of its reset state. This bit has a negative polarity; RRST = 0 indicates the reset state.</p> <p>To read about the effects of a receiver reset, see <a href="#">Section 20.10.2</a>.</p> <p>0 If you read a 0, the receiver is in its reset state.</p> <p>If you write a 0, you reset the receiver.</p> <p>1 If you read a 1, the receiver is enabled.</p> <p>If you write a 1, you enable the receiver by taking it out of its reset state.</p>

### 20.14.4.2 Serial Port Control 2 Register (SPCR2)

The serial port control 2 register (SPCR2) is shown in [Figure 20-70](#) and described in [Table 20-78](#).

**Figure 20-70. Serial Port Control 2 Register (SPCR2)**

15				10			9	8
Reserved							FREE	SOFT
R-0							R/W-0	R/W-0
7	6	5	4	3	2	1	0	
FRST	GRST	XINTM		XSYNCERR	XEMPTY	XRDY	XRST	
R/W-0	R/W-0	R/W-0		R/W-0	R-0	R-0	R/W-0	

LEGEND: R/W = Read/Write; R = Read only; -n = value after reset

**Table 20-78. Serial Port Control 2 Register (SPCR2) Field Descriptions**

Bit	Field	Value	Description
15-10	Reserved	0	Reserved bits (not available for your use). They are read-only bits and return 0s when read.
9	FREE		Free run bit. When a breakpoint is encountered in the high-level language debugger, FREE determines whether the McBSP transmit and receive clocks continue to run or whether they are affected as determined by the SOFT bit. When one of the clocks stops, the corresponding data transfer (transmission or reception) stops.
8	SOFT		Soft stop bit. When FREE = 0, SOFT determines the response of the McBSP transmit and receive clocks when a breakpoint is encountered in the high-level language debugger. When one of the clocks stops, the corresponding data transfer (transmission or reception) stops.
7	FRST	0 1	<p>Frame-synchronization logic reset bit. The sample rate generator of the McBSP includes frame-synchronization logic to generate an internal frame-synchronization signal. You can use FRST to take the frame-synchronization logic into and out of its reset state. This bit has a negative polarity; FRST = 0 indicates the reset state.</p> <p>If you read a 0, the frame-synchronization logic is in its reset state. If you write a 0, you reset the frame-synchronization logic. In the reset state, the frame-synchronization logic does not generate a frame-synchronization signal (FSG).</p> <p>If you read a 1, the frame-synchronization logic is enabled. If you write a 1, you enable the frame-synchronization logic by taking it out of its reset state. When the frame-synchronization logic is enabled (FRST = 1) and the sample rate generator as a whole is enabled (GRST = 1), the frame-synchronization logic generates the frame-synchronization signal FSG as programmed.</p>
6	GRST	0 1	<p>Sample rate generator reset bit. You can use GRST to take the McBSP sample rate generator into and out of its reset state. This bit has a negative polarity; GRST = 0 indicates the reset state.</p> <p>To read about the effects of a sample rate generator reset, see <a href="#">Section 20.10.2</a>.</p> <p>If you read a 0, the sample rate generator is in its reset state. If you write a 0, you reset the sample rate generator. If GRST = 0 due to a reset, CLKG is driven by the CPU clock divided by 2, and FSG is driven low (inactive). If GRST = 0 due to program code, CLKG and FSG are both driven low (inactive).</p> <p>If you read a 1, the sample rate generator is enabled. If you write a 1, you enable the sample rate generator by taking it out of its reset state. When enabled, the sample rate generator generates the clock signal CLKG as programmed in the sample rate generator registers. If FRST = 1, the generator also generates the frame-synchronization signal FSG as programmed in the sample rate generator registers.</p>

**Table 20-78. Serial Port Control 2 Register (SPCR2) Field Descriptions (continued)**

Bit	Field	Value	Description
5-4	XINTM	0-3h  0  1h  2h  3h	<p>Transmit interrupt mode bits. XINTM determines which event in the McBSP transmitter generates a transmit interrupt (XINT) request. If XINT is properly enabled, the CPU services the interrupt request; otherwise, the CPU ignores the request.</p> <p>0 The McBSP sends a transmit interrupt (XINT) request to the CPU when the XRDY bit changes from 0 to 1, indicating that transmitter is ready to accept new data (the content of DXR[1,2] has been copied to XSR[1,2]).</p> <p>Regardless of the value of XINTM, you can check XRDY to determine whether a word transfer is complete.</p> <p>The McBSP sends an XINT request to the CPU when 16 enabled bits have been transmitted on the DX pin.</p> <p>1h In the multichannel selection mode, the McBSP sends an XINT request to the CPU after every 16-channel block is transmitted in a frame.</p> <p>Outside of the multichannel selection mode, no interrupt request is sent.</p> <p>2h The McBSP sends an XINT request to the CPU when each transmit frame-synchronization pulse is detected. The interrupt request is sent even if the transmitter is in its reset state.</p> <p>3h The McBSP sends an XINT request to the CPU when the XSYNCERR bit is set, indicating a transmit frame-synchronization error.</p> <p>Regardless of the value of XINTM, you can check XSYNCERR to determine whether a transmit frame-synchronization error occurred.</p>
3	XSYNCERR	0 1	<p>Transmit frame-synchronization error bit. XSYNCERR is set when a transmit frame-synchronization error is detected by the McBSP. If XINTM = 11b, the McBSP sends a transmit interrupt (XINT) request to the CPU when XSYNCERR is set. The flag remains set until you write a 0 to it or reset the transmitter.</p> <p>If XINTM = 11b, writing a 1 to XSYNCERR triggers a transmit interrupt just as if a transmit frame-synchronization error occurred.</p> <p>For details about this error see <a href="#">Section 20.5.6</a>.</p> <p>0 No error</p> <p>1 Transmit frame-synchronization error</p>
2	XEMPTY	0 1	<p>Transmitter empty bit. XEMPTY is cleared when the transmitter is ready to send new data but no new data is available (transmitter-empty condition). This bit has a negative polarity; a transmitter-empty condition is indicated by XEMPTY = 0.</p> <p>0 Transmitter-empty condition</p> <p>Typically this indicates that all the bits of the current word have been transmitted but there is no new data in DXR1. XEMPTY is also cleared if the transmitter is reset and then restarted.</p> <p>For more details about this error condition, see <a href="#">Section 20.5.5</a>.</p> <p>1 No transmitter-empty condition</p>
1	XRDY	0 1	<p>Transmitter ready bit. XRDY is set when the transmitter is ready to accept new data in DXR[1,2]. Specifically, XRDY is set in response to a copy from DXR1 to XSR1.</p> <p>If the transmit interrupt mode is XINTM = 00b, the McBSP sends a transmit interrupt (XINT) request to the CPU when XRDY changes from 0 to 1.</p> <p>Also, when XRDY changes from 0 to 1, the McBSP sends a transmit synchronization event (XEVT) signal to the DMA controller.</p> <p>0 Transmitter not ready</p> <p>When DXR1 is loaded, XRDY is automatically cleared.</p> <p>1 Transmitter ready: DXR[1,2] is ready to accept new data.</p> <p>If both DXRs are needed (word length larger than 16 bits), the CPU or the DMA controller must load DXR2 first and then load DXR1. As soon as DXR1 is loaded, the contents of both DXRs are copied to the transmit shift registers (XSRs), as described in the next step. If DXR2 is not loaded first, the previous content of DXR2 is passed to the XSR2.</p>



**Table 20-78. Serial Port Control 2 Register (SPCR2) Field Descriptions (continued)**

Bit	Field	Value	Description
0	XRST	0 1	Transmitter reset bit. You can use XRST to take the McBSP transmitter into and out of its reset state. This bit has a negative polarity; XRST = 0 indicates the reset state. To read about the effects of a transmitter reset, see <a href="#">Section 20.10.2</a> . If you read a 0, the transmitter is in its reset state. If you write a 0, you reset the transmitter. If you read a 1, the transmitter is enabled. If you write a 1, you enable the transmitter by taking it out of its reset state.

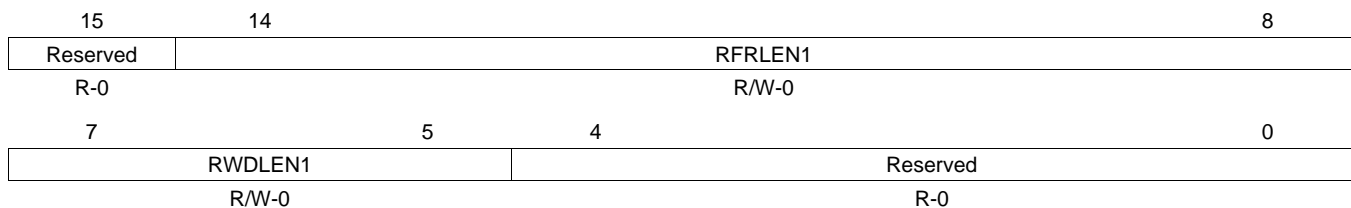
### 20.14.5 Receive Control Registers (RCR[1, 2])

Each McBSP has two receive control registers, RCR1 ([Table 20-79](#)) and RCR2 ([Table 20-81](#)). These registers enable you to:

- Specify one or two phases for each frame of receive data (RPHASE)
- Define two parameters for phase 1 and (if necessary) phase 2: the serial word length (RWDLEN1, RWDLEN2) and the number of words (RFRLN1, RFRLN2)
- Choose a receive companding mode, if any (RCOMPAND)
- Enable or disable the receive frame-synchronization ignore function (RFIG)
- Choose a receive data delay (RDATDLY)

#### 20.14.5.1 Receive Control Register 1 (RCR1)

The receive control register 1 (RCR1) is shown in [Figure 20-71](#) and described in [Table 20-79](#).

**Figure 20-71. Receive Control Register 1 (RCR1)**


LEGEND: R/W = Read/Write; R = Read only; -n = value after reset

**Table 20-79. Receive Control Register 1 (RCR1) Field Descriptions**

Bit	Field	Value	Description
15	Reserved	0	Reserved bits (not available for your use). They are read-only bits and return 0s when read.
14-8	RFRLN1	0-7Fh	Receive frame length 1 (1 to 128 words). Each frame of receive data can have one or two phases, depending on value that you load into the RPHASE bit. If a single-phase frame is selected, RFRLN1 in RCR1 selects the number of serial words (8, 12, 16, 20, 24, or 32 bits per word) in the frame. If a dual-phase frame is selected, RFRLN1 determines the number of serial words in phase 1 of the frame, and RFRLN2 in RCR2 determines the number of words in phase 2 of the frame. The 7-bit RFRLN fields allow up to 128 words per phase. See <a href="#">Table 20-80</a> for a summary of how you determine the frame length. This length corresponds to the number of words or logical time slots or channels per frame-synchronization period.  Program the RFRLN fields with $[w \text{ minus } 1]$ , where $w$ represents the number of words per phase. For example, if you want a phase length of 128 words in phase 1, load 127 into RFRLN1.



**Table 20-79. Receive Control Register 1 (RCR1) Field Descriptions (continued)**

Bit	Field	Value	Description
7-5	RWDLEN1	0-7h  0 1h 2h 3h 4h 5h 6h-7h	Receive word length 1. Each frame of receive data can have one or two phases, depending on the value that you load into the RPHASE bit. If a single-phase frame is selected, RWDLEN1 in RCR1 selects the length for every serial word received in the frame. If a dual-phase frame is selected, RWDLEN1 determines the length of the serial words in phase 1 of the frame, and RWDLEN2 in RCR2 determines the word length in phase 2 of the frame.  8 bits 12 bits 16 bits 20 bits 24 bits 32 bits Reserved (do not use)
4-0	Reserved	0	Reserved bits (not available for your use). They are read-only bits and return 0s when read.

**Table 20-80. Frame Length Formula for Receive Control 1 Register (RCR1)**

RPHASE	RFRLLEN1	RFRLLEN2	Frame Length
0	$0 \leq \text{RFRLLEN1} \leq 127$	Not used	$(\text{RFRLLEN1} + 1)$ words
1	$0 \leq \text{RFRLLEN1} \leq 127$	$0 \leq \text{RFRLLEN2} \leq 127$	$(\text{RFRLLEN1} + 1) + (\text{RFRLLEN2} + 1)$ words

### 20.14.5.2 Receive Control Register 2 (RCR2)

The receive control register 2 (RCR2) is shown in [Figure 20-72](#) and described in [Table 20-81](#).

**Figure 20-72. Receive Control Register 2 (RCR2)**

15	14					8
RPHASE		RFRLLEN2				
R/W-0		R/W-0				
7	5	4	3	2	1	0
RWDLEN2		RCOMPAND		RFIG	RDATDLY	
R/W-0		R/W-0		R/W-0	R/W-0	

LEGEND: R/W = Read/Write; R = Read only; -n = value after reset

**Table 20-81. Receive Control Register 2 (RCR2) Field Descriptions**

Bit	Field	Value	Description
15	RPHASE	0 1	Receive phase number bit. RPHASE determines whether the receive frame has one phase or two phases. For each phase you can define the serial word length and the number of serial words in the phase. To set up phase 1, program RWDLEN1 (word length) and RFRLLEN1 (number of words). To set up phase 2 (if there are two phases), program RWDLEN2 and RFRLLEN2.  0 Single-phase frame The receive frame has only one phase, phase 1.  1 Dual-phase frame The receive frame has two phases, phase 1 and phase 2.
14-8		0-7Fh	Receive frame length 2 (1 to 128 words). Each frame of receive data can have one or two phases, depending on value that you load into the RPHASE bit. If a single-phase frame is selected, RFRLLEN1 in RCR1 selects the number of serial words (8, 12, 16, 20, 24, or 32 bits per word) in the frame. If a dual-phase frame is selected, RFRLLEN1 determines the number of serial words in phase 1 of the frame, and RFRLLEN2 in RCR2 determines the number of words in phase 2 of the frame. The 7-bit RFRLLEN fields allow up to 128 words per phase. See <a href="#">Table 20-82</a> for a summary of how to determine the frame length. This length corresponds to the number of words or logical time slots or channels per frame-synchronization period.  Program the RFRLLEN fields with $[w \text{ minus } 1]$ , where $w$ represents the number of words per phase. For example, if you want a phase length of 128 words in phase 2, load 127 into RFRLLEN2.

**Table 20-81. Receive Control Register 2 (RCR2) Field Descriptions (continued)**

Bit	Field	Value	Description
7-5	RWDLEN2	0-7h  0 1h 2h 3h 4h 5h 6h-7h	Receive word length 2. Each frame of receive data can have one or two phases, depending on the value that you load into the RPHASE bit. If a single-phase frame is selected, RWDLEN1 in RCR1 selects the length for every serial word received in the frame. If a dual-phase frame is selected, RWDLEN1 determines the length of the serial words in phase 1 of the frame, and RWDLEN2 in RCR2 determines the word length in phase 2 of the frame.  8 bits 12 bits 16 bits 20 bits 24 bits 32 bits Reserved (do not use)
4-3	RCOMPAND	0-3h  0 1h 2h 3h	Receive companding mode bits. Companding (COMpress and exPAND) hardware allows compression and expansion of data in either $\mu$ -law or A-law format.  RCOMPAND allows you to choose one of the following companding modes for the McBSP receiver: For more details about these companding modes, see <a href="#">Section 20.3.2</a> .  0 No companding, any size data, MSB received first 1h No companding, 8-bit data, LSB received first 2h $\mu$ -law companding, 8-bit data, MSB received first 3h A-law companding, 8-bit data, MSB received first
2	RFIG	0  1	Receive frame-synchronization ignore bit. If a frame-synchronization pulse starts the transfer of a new frame before the current frame is fully received, this pulse is treated as an unexpected frame-synchronization pulse. For more details about the frame-synchronization error condition, see <a href="#">Figure 20-30</a> .  Setting RFIG causes the serial port to ignore unexpected frame-synchronization signals during reception. For more details on the effects of RFIG, see <a href="#">Section 20.8.10.1</a> .  0 Frame-synchronization detect. An unexpected FSR pulse causes the receiver to discard the contents of RSR[1,2] in favor of the new incoming data. The receiver: 1. Aborts the current data transfer 2. Sets RSYNCERR in SPCR1 3. Begins the transfer of a new data word  1 Frame-synchronization ignore. An unexpected FSR pulse is ignored. Reception continues uninterrupted.
1-0	RDATDLY	0-3h  0 1h 2h 3h	Receive data delay bits. RDATDLY specifies a data delay of 0, 1, or 2 receive clock cycles after frame-synchronization and before the reception of the first bit of the frame. For more details, see <a href="#">Section 20.8.12</a> .  0 0-bit data delay 1h 1-bit data delay 2h 2-bit data delay 3h Reserved (do not use)

**Table 20-82. Frame Length Formula for Receive Control 2 Register (RCR2)**

RPHASE	RFRLN1	RFRLN2	Frame Length
0	$0 \leq \text{RFRLN1} \leq 127$	Not used	$(\text{RFRLN1} + 1)$ words
1	$0 \leq \text{RFRLN1} \leq 127$	$0 \leq \text{RFRLN2} \leq 127$	$(\text{RFRLN1} + 1) + (\text{RFRLN2} + 1)$ words

### 20.14.6 Transmit Control Registers (XCR1 and XCR2)

Each McBSP has two transmit data control registers, XCR1 ([Table 20-83](#)) and XCR2 ([Table 20-85](#)). These registers enable you to:

- Specify one or two phases for each frame of transmit data (XPHASE)
- Define two parameters for phase 1 and (if necessary) phase 2: the serial word length (XWDLEN1,

XWDLEN2) and the number of words (XFRLEN1, XFRLEN2)

- Choose a transmit companding mode, if any (XCOMPAND)
- Enable or disable the transmit frame-sync ignore function (XFIG)
- Choose a transmit data delay (XDATDLY)

### 20.14.6.1 Transmit Control 1 Register (XCR1)

The transmit control 1 register (XCR1) is shown in [Figure 20-73](#) and described in [Table 20-83](#).

**Figure 20-73. Transmit Control 1 Register (XCR1)**

15	14	8
Reserved	XFRLEN1	
R-0	R/W-0	
7	5	4
XWDLEN1		Reserved
R/W-0		R-0
		0

LEGEND: R/W = Read/Write; R = Read only; -n = value after reset

**Table 20-83. Transmit Control 1 Register (XCR1) Field Descriptions**

Bit	Field	Value	Description
15	Reserved	0	Reserved bit. Read-only; returns 0 when read.
14-8	XFRLEN1	0-7Fh	Transmit frame length 1 (1 to 128 words). Each frame of transmit data can have one or two phases, depending on value that you load into the XPHASE bit. If a single-phase frame is selected, XFRLEN1 in XCR1 selects the number of serial words (8, 12, 16, 20, 24, or 32 bits per word) in the frame. If a dual-phase frame is selected, XFRLEN1 determines the number of serial words in phase 1 of the frame and XFRLEN2 in XCR2 determines the number of words in phase 2 of the frame. The 7-bit XFRLEN fields allow up to 128 words per phase. See <a href="#">Table 20-84</a> for a summary of how you determine the frame length. This length corresponds to the number of words or logical time slots or channels per frame-synchronization period.  Program the XFRLEN fields with $[w \text{ minus } 1]$ , where $w$ represents the number of words per phase. For example, if you want a phase length of 128 words in phase 1, load 127 into XFRLEN1.
7-5	XWDLEN1	0-3h	Transmit word length 1. Each frame of transmit data can have one or two phases, depending on the value that you load into the XPHASE bit. If a single-phase frame is selected, XWDLEN1 in XCR1 selects the length for every serial word transmitted in the frame. If a dual-phase frame is selected, XWDLEN1 determines the length of the serial words in phase 1 of the frame and XWDLEN2 in XCR2 determines the word length in phase 2 of the frame.  0      8 bits 1h     12 bits 2h     16 bits 3h     20 bits 4h     24 bits 5h     32 bits 6h-7h   Reserved (do not use)
4-0	Reserved	0	Reserved bits. They are read-only bits and return 0s when read.

**Table 20-84. Frame Length Formula for Transmit Control 1 Register (XCR1)**

XPHASE	XFRLEN1	XFRLEN2	Frame Length
0	$0 \leq \text{XFRLEN1} \leq 127$	Not used	$(\text{XFRLEN1} + 1)$ words
1	$0 \leq \text{XFRLEN1} \leq 127$	$0 \leq \text{XFRLEN2} \leq 127$	$(\text{XFRLEN1} + 1) + (\text{XFRLEN2} + 1)$ words

### 20.14.6.2 Transmit Control 2 Register (XCR2)

The transmit control 2 register (XCR2) is shown in [Figure 20-74](#) and described in [Table 20-85](#).

**Figure 20-74. Transmit Control 2 Register (XCR2)**

15	14						8
XPHASE		XFRLEN2					
R/W-0		R/W-0					
7	5	4	3	2	1	0	
XWDLEN2		XCOMPAND		XFIG	XDATDLY		
R/W-0		R/W-0		R/W-0	R/W-0		

LEGEND: R/W = Read/Write; R = Read only; -n = value after reset

**Table 20-85. Transmit Control 2 Register (XCR2) Field Descriptions**

Bit	Field	Value	Description
15	XPHASE	0  1	Transmit phase number bit. XPHASE determines whether the transmit frame has one phase or two phases. For each phase you can define the serial word length and the number of serial words in the phase. To set up phase 1, program XWDLEN1 (word length) and XFRLEN1 (number of words). To set up phase 2 (if there are two phases), program XWDLEN2 and XFRLEN2.  0 Single-phase frame The transmit frame has only one phase, phase 1.  1 Dual-phase frame The transmit frame has two phases, phase 1 and phase 2.
14-8	XFRLEN2	0-7Fh	Transmit frame length 2 (1 to 128 words). Each frame of transmit data can have one or two phases, depending on value that you load into the XPHASE bit. If a single-phase frame is selected, XFRLEN1 in XCR1 selects the number of serial words (8, 12, 16, 20, 24, or 32 bits per word) in the frame. If a dual-phase frame is selected, XFRLEN1 determines the number of serial words in phase 1 of the frame and XFRLEN2 in XCR2 determines the number of words in phase 2 of the frame. The 7-bit XFRLEN fields allow up to 128 words per phase. See <a href="#">Table 20-86</a> for a summary of how to determine the frame length. This length corresponds to the number of words or logical time slots or channels per frame-synchronization period.  Program the XFRLEN fields with $[w \text{ minus } 1]$ , where $w$ represents the number of words per phase. For example, if you want a phase length of 128 words in phase 1, load 127 into XFRLEN1.
7-5	XWDLEN2	0-7h  0 1h 2h 3h 4h 5h 6h-7h	Transmit word length 2. Each frame of transmit data can have one or two phases, depending on the value that you load into the XPHASE bit. If a single-phase frame is selected, XWDLEN1 in XCR1 selects the length for every serial word transmitted in the frame. If a dual-phase frame is selected, XWDLEN1 determines the length of the serial words in phase 1 of the frame and XWDLEN2 in XCR2 determines the word length in phase 2 of the frame.  0 8 bits 1h 12 bits 2h 16 bits 3h 20 bits 4h 24 bits 5h 32 bits 6h-7h Reserved (do not use)
4-3	XCOMPAND	0-3h  0 1h 2h 3h	Transmit companding mode bits. Companding (COMpress and exPAND) hardware allows compression and expansion of data in either $\mu$ -law or A-law format. For more details, see <a href="#">Section 20.3.2</a> .  XCOMPAND allows you to choose one of the following companding modes for the McBSP transmitter. For more details about these companding modes, see <a href="#">Section 20.3.2</a> .  0 No companding, any size data, MSB transmitted first 1h No companding, 8-bit data, LSB transmitted first 2h $\mu$ -law companding, 8-bit data, MSB transmitted first 3h A-law companding, 8-bit data, MSB transmitted first

**Table 20-85. Transmit Control 2 Register (XCR2) Field Descriptions (continued)**

Bit	Field	Value	Description
2	XFIG	0	<p>Transmit frame-synchronization ignore bit. If a frame-synchronization pulse starts the transfer of a new frame before the current frame is fully transmitted, this pulse is treated as an unexpected frame-synchronization pulse.</p> <p>Setting XFIG causes the serial port to ignore unexpected frame-synchronization pulses during transmission.</p> <p>Frame-synchronization detect. An unexpected FSX pulse causes the transmitter to discard the content of XSR[1,2]. The transmitter:</p> <ol style="list-style-type: none"> <li>1. Aborts the present transmission</li> <li>2. Sets XSYNCERR in SPCR2</li> <li>3. Begins a new transmission from DXR[1,2]. If new data was written to DXR[1,2] since the last DXR[1,2]-to-XSR[1,2] copy, the current value in XSR[1,2] is lost. Otherwise, the same data is transmitted.</li> </ol>
		1	Frame-synchronization ignore. An unexpected FSX pulse is ignored. Transmission continues uninterrupted.
1-0	XDATDLY	0-3h	<p>Transmit data delay bits. XDADLY specifies a data delay of 0, 1, or 2 transmit clock cycles after frame synchronization and before the transmission of the first bit of the frame. For more details, see <a href="#">Section 20.9.12</a>.</p>
		0	0-bit data delay
		1h	1-bit data delay
		2h	2-bit data delay
		3h	Reserved (do not use)

**Table 20-86. Frame Length Formula for Transmit Control 2 Register (XCR2)**

XPHASE	XFRLEN1	XFRLEN2	Frame Length
0	$0 \leq \text{XFRLEN1} \leq 127$	Not used	$(\text{XFRLEN1} + 1)$ words
1	$0 \leq \text{XFRLEN1} \leq 127$	$0 \leq \text{XFRLEN2} \leq 127$	$(\text{XFRLEN1} + 1) + (\text{XFRLEN2} + 1)$ words

### 20.14.7 Sample Rate Generator Registers (SRGR1 and SRGR2)

Each McBSP has two sample rate generator registers, SRGR1 ([Table 20-87](#)) and SRGR2 ([Table 20-88](#)). The sample rate generator can generate a clock signal (CLKG) and a frame-synchronization signal (FSG). The registers SRGR1 and SRGR2 enable you to:

- Select the input clock source for the sample rate generator (CLKSM, in conjunction with the SCLKME bit of PCR)
- Divide down the frequency of CLKG (CLKGDV)
- Select whether internally-generated transmit frame-synchronization pulses are driven by FSG or by activity in the transmitter (FSGM).
- Specify the width of frame-synchronization pulses on FSG (FWID) and specify the period between those pulses (FPER)

When an external source (via the MCLKR or MCLKX pin) provides the input clock source for the sample rate generator:

- If the CLKX/MCLKR pin is used, the polarity of the input clock is selected with CLKXP/CLKRP of PCR.
- The GSYNC bit of SRGR2 allows you to make CLKG synchronized to an external frame-synchronization signal on the FSR pin, so that CLKG is kept in phase with the input clock.

#### 20.14.7.1 Sample Rate Generator 1 Register (SRGR1)

The sample rate generator 1 register is shown in [Figure 20-75](#) and described in [Table 20-87](#).

**Figure 20-75. Sample Rate Generator 1 Register (SRGR1)**

15	FWID	8
R/W-0		
7	CLKGDV	0
R/W-1		

LEGEND: R/W = Read/Write; R = Read only; -n = value after reset

**Table 20-87. Sample Rate Generator 1 Register (SRGR1) Field Descriptions**

Bit	Field	Value	Description															
15-8	FWID	0-FFh	Frame-synchronization pulse width bits for FSG The sample rate generator can produce a clock signal, CLKG, and a frame-synchronization signal, FSG. For frame-synchronization pulses on FSG, (FWID + 1) is the pulse width in CLKG cycles. The eight bits of FWID allow a pulse width of 1 to 256 CLKG cycles: $0 \leq \text{FWID} \leq 255$ $1 \leq (\text{FWID} + 1) \leq 256$ CLKG cycles The period between the frame-synchronization pulses on FSG is defined by the FPER bits.															
7-0	CLKGDV	0-FFh	Divide-down value for CLKG. The sample rate generator can accept an input clock signal and divide it down according to CLKGDV to produce an output clock signal, CLKG. The frequency of CLKG is: $\text{CLKG frequency} = (\text{Input clock frequency}) / (\text{CLKGDV} + 1)$ The input clock is selected by the SCLKME and CLKSM bits: <table border="1" style="margin-left: 20px;"> <thead> <tr> <th>SCLKME</th> <th>CLKSM</th> <th>Input Clock For Sample Rate Generator</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>0</td> <td>Reserved</td> </tr> <tr> <td>0</td> <td>1</td> <td>LSPCLK</td> </tr> <tr> <td>1</td> <td>0</td> <td>Signal on MCLKR pin</td> </tr> <tr> <td>1</td> <td>1</td> <td>Signal on MCLKX pin</td> </tr> </tbody> </table>	SCLKME	CLKSM	Input Clock For Sample Rate Generator	0	0	Reserved	0	1	LSPCLK	1	0	Signal on MCLKR pin	1	1	Signal on MCLKX pin
SCLKME	CLKSM	Input Clock For Sample Rate Generator																
0	0	Reserved																
0	1	LSPCLK																
1	0	Signal on MCLKR pin																
1	1	Signal on MCLKX pin																

### 20.14.7.2 Sample Rate Generator 2 Register (SRGR2)

 The sample rate generator 2 register (SRGR2) is shown in [Figure 20-76](#) and described in [Table 20-88](#).

**Figure 20-76. Sample Rate Generator 2 Register (SRGR2)**

15	14	13	12	11	8
GSYNC	Reserved	CLKSM	FSGM	FPER	
R/W-0	R/W-0	R/W-1	R/W-0	R/W-0	
7	FPER				0
R/W-0					

LEGEND: R/W = Read/Write; R = Read only; -n = value after reset

**Table 20-88. Sample Rate Generator 2 Register (SRGR2) Field Descriptions**

Bit	Field	Value	Description																		
15	GSYNC	0 1	<p>Clock synchronization mode bit for CLKG. GSYNC is used only when the input clock source for the sample rate generator is external—on the MCLKR pin.</p> <p>When GSYNC = 1, the clock signal (CLKG) and the frame-synchronization signal (FSG) generated by the sample rate generator are made dependent on pulses on the FSR pin.</p> <p>No clock synchronization</p> <p>CLKG oscillates without adjustment, and FSG pulses every (FPER + 1) CLKG cycles.</p> <p>Clock synchronization</p> <ul style="list-style-type: none"> <li>• CLKG is adjusted as necessary so that it is synchronized with the input clock on the MCLKR pin.</li> <li>• FSG pulses. FSG only pulses in response to a pulse on the FSR pin.</li> </ul> <p>The frame-synchronization period defined in FPER is ignored.</p> <p>For more details, see <a href="#">Section 20.4.3</a>.</p>																		
14	Reserved		Reserved																		
13	CLKSM	0 1	<p>Sample rate generator input clock mode bit. The sample rate generator can accept an input clock signal and divide it down according to CLKGDV to produce an output clock signal, CLKG. The frequency of CLKG is:</p> $\text{CLKG frequency} = (\text{input clock frequency}) / (\text{CLKGDV} + 1)$ <p>CLKSM is used in conjunction with the SCLKME bit to determine the source for the input clock.</p> <p>A reset selects the CPU clock as the input clock and forces the CLKG frequency to ½ the LSPCLK frequency.</p> <p>The input clock for the sample rate generator is taken from the MCLKR pin, depending on the value of the SCLKME bit of PCR:</p> <table border="1"> <thead> <tr> <th>SCLKME</th> <th>CLKSM</th> <th>Input Clock For Sample Rate Generator</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>0</td> <td>Reserved</td> </tr> <tr> <td>1</td> <td>0</td> <td>Signal on MCLKR pin</td> </tr> </tbody> </table> <p>The input clock for the sample rate generator is taken from the LSPCLK or from the MCLKX pin, depending on the value of the SCLKME bit of PCR:</p> <table border="1"> <thead> <tr> <th>SCLKME</th> <th>CLKSM</th> <th>Input Clock For Sample Rate Generator</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>1</td> <td>LSPCLK</td> </tr> <tr> <td>1</td> <td>1</td> <td>Signal on MCLKX pin</td> </tr> </tbody> </table>	SCLKME	CLKSM	Input Clock For Sample Rate Generator	0	0	Reserved	1	0	Signal on MCLKR pin	SCLKME	CLKSM	Input Clock For Sample Rate Generator	0	1	LSPCLK	1	1	Signal on MCLKX pin
SCLKME	CLKSM	Input Clock For Sample Rate Generator																			
0	0	Reserved																			
1	0	Signal on MCLKR pin																			
SCLKME	CLKSM	Input Clock For Sample Rate Generator																			
0	1	LSPCLK																			
1	1	Signal on MCLKX pin																			
12	FSGM	0 1	<p>Sample rate generator transmit frame-synchronization mode bit. The transmitter can get frame synchronization from the FSX pin (FSXM = 0) or from inside the McBSP (FSXM = 1). When FSXM = 1, the FSGM bit determines how the McBSP supplies frame-synchronization pulses.</p> <p>If FSXM = 1, the McBSP generates a transmit frame-synchronization pulse when the content of DXR[1,2] is copied to XSR[1,2].</p> <p>If FSXM = 1, the transmitter uses frame-synchronization pulses generated by the sample rate generator. Program the FWID bits to set the width of each pulse. Program the FPER bits to set the period between pulses.</p>																		
11-0	FPER	0-FFFh	<p>Frame-synchronization period bits for FSG. The sample rate generator can produce a clock signal, CLKG, and a frame-synchronization signal, FSG. The period between frame-synchronization pulses on FSG is (FPER + 1) CLKG cycles. The 12 bits of FPER allow a frame-synchronization period of 1 to 4096 CLKG cycles:</p> $0 \leq \text{FPER} \leq 4095$ $1 \leq (\text{FPER} + 1) \leq 4096 \text{ CLKG cycles}$ <p>The width of each frame-synchronization pulse on FSG is defined by the FWID bits.</p>																		

### 20.14.8 Multichannel Control Registers (MCR[1,2])

Each McBSP has two multichannel control registers. MCR1 ([Table 20-89](#)) has control and status bits (with an R prefix) for multichannel selection operation in the receiver. MCR2 ([Table 20-90](#)) contains the same type of bits (bit with an X prefix) for the transmitter. These registers enable you to:



- Enable all channels or only selected channels for reception (RMCM)
- Choose which channels are enabled/disabled and masked/unmasked for transmission (XMCM)
- Specify whether two partitions (32 channels at a time) or eight partitions (128 channels at a time) can be used (RMCME for reception, XMCME for transmission)
- Assign blocks of 16 channels to partitions A and B when the 2-partition mode is selected (RPABLK and RPBBLK for reception, XPABLK and XPBBLK for transmission)
- Determine which block of 16 channels is currently involved in a data transfer (RCBLK for reception, XCBLK for transmission)

### 20.14.8.1 Multichannel Control 1 Register (MCR1)

The multichannel control 1 register (MCR1) is shown in [Figure 20-77](#) and described in [Table 20-89](#).

**Figure 20-77. Multichannel Control 1 Register (MCR1)**

15		Reserved				10	9	8
		R-0					RMCME	RPBBLK
							R/W-0	R/W-0
7	6	5	4	2	1	0		
RPBBLK	RPABLK		RCBLK		Reserved	RMCM		
R/W-0	R/W-0		R-0		R-0	R/W-0		

LEGEND: R/W = Read/Write; R = Read only; -n = value after reset

**Table 20-89. Multichannel Control 1 Register (MCR1) Field Descriptions**

Bit	Field	Value	Description
15-10	Reserved	0	Reserved bits (not available for your use). They are read-only bits and return 0s when read.
9	RMCME	0	Receive multichannel partition mode bit. RMCME is only applicable if channels can be individually enabled or disabled for reception (RMCM = 1). RMCME determines whether only 32 channels or all 128 channels are to be individually selectable. 2-partition mode Only partitions A and B are used. You can control up to 32 channels in the receive multichannel selection mode (RMCM = 1). Assign 16 channels to partition A with the RPABLK bits. Assign 16 channels to partition B with the RPBBLK bits. You control the channels with the appropriate receive channel enable registers: RCERA: Channels in partition A RCERB: Channels in partition B
		1	8-partition mode All partitions (A through H) are used. You can control up to 128 channels in the receive multichannel selection mode. You control the channels with the appropriate receive channel enable registers: RCERA: Channels 0 through 15 RCERB: Channels 16 through 31 RCERC: Channels 32 through 47 RCERD: Channels 48 through 63 RCERE: Channels 64 through 79 RCERF: Channels 80 through 95 RCERG: Channels 96 through 111 RCERH: Channels 112 through 127



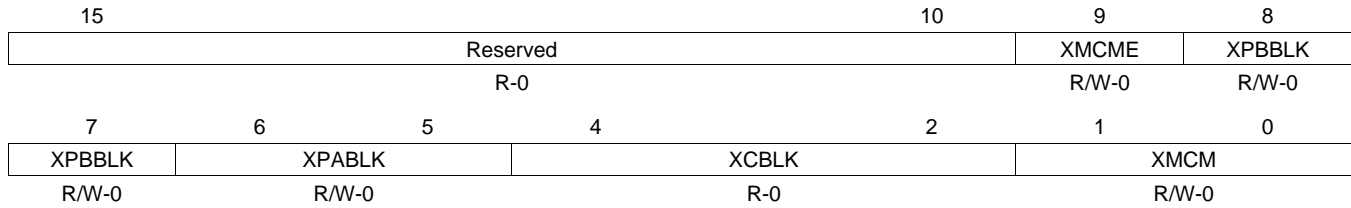
**Table 20-89. Multichannel Control 1 Register (MCR1) Field Descriptions (continued)**

Bit	Field	Value	Description
8-7	RPBBLK	0-3h	<p>Receive partition B block bits</p> <p>RPBBLK is only applicable if channels can be individually enabled or disabled (RMCM = 1) and the 2-partition mode is selected (RMCME = 0). Under these conditions, the McBSP receiver can accept or ignore data in any of the 32 channels that are assigned to partitions A and B of the receiver.</p> <p>The 128 receive channels of the McBSP are divided equally among 8 blocks (0 through 7). When RPBBLK is applicable, use RPBBLK to assign one of the odd-numbered blocks (1, 3, 5, or 7) to partition B. Use the RPABLK bits to assign one of the even-numbered blocks (0, 2, 4, or 6) to partition A.</p> <p>If you want to use more than 32 channels, you can change block assignments dynamically. You can assign a new block to one partition while the receiver is handling activity in the other partition. For example, while the block in partition A is active, you can change which block is assigned to partition B. The RCBLK bits are regularly updated to indicate which block is active.</p> <p>When XMCM = 11b (for symmetric transmission and reception), the transmitter uses the receive block bits (RPABLK and RPBBLK) rather than the transmit block bits (XPABLK and XPBBLK).</p> <p>0 Block 1: channels 16 through 31  1h Block 3: channels 48 through 63  2h Block 5: channels 80 through 95  3h Block 7: channels 112 through 127</p>
6-5	RPABLK	0-3h	<p>Receive partition A block bits</p> <p>RPABLK is only applicable if channels can be individually enabled or disabled (RMCM = 1) and the 2-partition mode is selected (RMCME = 0). Under these conditions, the McBSP receiver can accept or ignore data in any of the 32 channels that are assigned to partitions A and B of the receiver. See the description for RPBBLK (bits 8-7) for more information about assigning blocks to partitions A and B.</p> <p>0 Block 0: channels 0 through 15  1h Block 2: channels 32 through 47  2h Block 5: channels 64 through 79  3h Block 7: channels 96 through 111</p>
4-2	RCBLK	0-7h	<p>Receive current block indicator. RCBLK indicates which block for 16 channels is involved in the current McBSP reception:</p> <p>0 Block 0: channels 0 through 15  1h Block 1: channels 16 through 31  2h Block 2: channels 32 through 47  3h Block 3: channels 48 through 63  4h Block 4: channels 64 through 79  5h Block 5: channels 80 through 95  6h Block 6: channels 96 through 111  7h Block 7: channels 112 through 127</p>
1	Reserved	0	Reserved bits (not available for your use). They are read-only bits and return 0s when read.
0	RMCM	0 1	<p>Receive multichannel selection mode bit. RMCM determines whether all channels or only selected channels are enabled for reception:</p> <p>0 All 128 channels are enabled.  1 Multichanneled selection mode. Channels can be individually enabled or disabled.</p> <p>The only channels enabled are those selected in the appropriate receive channel enable registers (RCERs). The way channels are assigned to the RCERs depends on the number of receive channel partitions (2 or 8), as defined by the RMCME bit.</p>

### 20.14.8.2 Multichannel Control 2 Register (MCR2)

The multichannel control 2 register (MCR2) is shown in [Figure 20-78](#) and described in [Table 20-90](#).

**Figure 20-78. Multichannel Control 2 Register (MCR2)**



LEGEND: R/W = Read/Write; R = Read only; -n = value after reset

**Table 20-90. Multichannel Control 2 Register (MCR2) Field Descriptions**

Bit	Field	Value	Description
15-10	Reserved	0	Reserved bits (not available for your use). They are read-only bits and return 0s when read.
9	XMCME	0	Transmit multichannel partition mode bit. XMCME determines whether only 32 channels or all 128 channels are to be individually selectable. XMCME is only applicable if channels can be individually disabled/enabled or masked/unmasked for transmission (XMCM is nonzero).  2-partition mode. Only partitions A and B are used. You can control up to 32 channels in the transmit multichannel selection mode selected with the XMCM bits.  If XMCM = 01b or 10b, assign 16 channels to partition A with the XPABLK bits. Assign 16 channels to partition B with the XPBBLK bits.  If XMCM = 11b (for symmetric transmission and reception), assign 16 channels to receive partition A with the RPABLK bits. Assign 16 channels to receive partition B with the RPBBLK bits.  You control the channels with the appropriate transmit channel enable registers: XCERA: Channels in partition A XCERB: Channels in partition B
		1	8-partition mode. All partitions (A through H) are used. You can control up to 128 channels in the transmit multichannel selection mode selected with the XMCM bits.  You control the channels with the appropriate transmit channel enable registers: XCERA: Channels 0 through 15 XCERB: Channels 16 through 31 XCERC: Channels 32 through 47 XCERD: Channels 48 through 63 XCERE: Channels 64 through 79 XCERF: Channels 80 through 95 XCERG: Channels 96 through 111 XCERH: Channels 112 through 127

**Table 20-90. Multichannel Control 2 Register (MCR2) Field Descriptions (continued)**

Bit	Field	Value	Description																
8-7	XPBBLK	0-3h	<p>Transmit partition B block bits</p> <p>XPBBLK is only applicable if channels can be individually disabled/enabled and masked/unmasked (XMCM is nonzero) and the 2-partition mode is selected (XMCME = 0). Under these conditions, the McBSP transmitter can transmit or withhold data in any of the 32 channels that are assigned to partitions A and B of the transmitter.</p> <p>The 128 transmit channels of the McBSP are divided equally among 8 blocks (0 through 7). When XPBBLK is applicable, use XPBBLK to assign one of the odd-numbered blocks (1, 3, 5, or 7) to partition B, as shown in the following table. Use the XPBBLK bit to assign one of the even-numbered blocks (0, 2, 4, or 6) to partition A.</p> <p>If you want to use more than 32 channels, you can change block assignments dynamically. You can assign a new block to one partition while the transmitter is handling activity in the other partition. For example, while the block in partition A is active, you can change which block is assigned to partition B. The XCBLK bits are regularly updated to indicate which block is active.</p> <p>When XMCM = 11b (for symmetric transmission and reception), the transmitter uses the receive block bits (RPABLK and RPBBLK) rather than the transmit block bits (XPABLK and XPBBLK).</p> <table border="0"> <tr> <td>0</td> <td>Block 1: channels 16 through 31</td> </tr> <tr> <td>1h</td> <td>Block 3: channels 48 through 63</td> </tr> <tr> <td>2h</td> <td>Block 5: channels 80 through 95</td> </tr> <tr> <td>3h</td> <td>Block 7: channels 112 through 127</td> </tr> </table>	0	Block 1: channels 16 through 31	1h	Block 3: channels 48 through 63	2h	Block 5: channels 80 through 95	3h	Block 7: channels 112 through 127								
0	Block 1: channels 16 through 31																		
1h	Block 3: channels 48 through 63																		
2h	Block 5: channels 80 through 95																		
3h	Block 7: channels 112 through 127																		
6-5	XPABLK	0-3h	<p>Transmit partition A block bits. XPABLK is only applicable if channels can be individually disabled/enabled and masked/unmasked (XMCM is nonzero) and the 2-partition mode is selected (XMCME = 0). Under these conditions, the McBSP transmitter can transmit or withhold data in any of the 32 channels that are assigned to partitions A and B of the transmitter. See the description for XPBBLK (bits 8-7) for more information about assigning blocks to partitions A and B.</p> <table border="0"> <tr> <td>0</td> <td>Block 0: channels 0 through 15</td> </tr> <tr> <td>1h</td> <td>Block 2: channels 32 through 47</td> </tr> <tr> <td>2h</td> <td>Block 4: channels 64 through 79</td> </tr> <tr> <td>3h</td> <td>Block 6: channels 96 through 111</td> </tr> </table>	0	Block 0: channels 0 through 15	1h	Block 2: channels 32 through 47	2h	Block 4: channels 64 through 79	3h	Block 6: channels 96 through 111								
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2h	Block 4: channels 64 through 79																		
3h	Block 6: channels 96 through 111																		
4-2	XCBLK	0-7h	<p>Transmit current block indicator. XCBLK indicates which block of 16 channels is involved in the current McBSP transmission:</p> <table border="0"> <tr> <td>0</td> <td>Block 0: channels 0 through 15</td> </tr> <tr> <td>1h</td> <td>Block 1: channels 16 through 31</td> </tr> <tr> <td>2h</td> <td>Block 2: channels 32 through 47</td> </tr> <tr> <td>3h</td> <td>Block 3: channels 48 through 63</td> </tr> <tr> <td>4h</td> <td>Block 4: channels 64 through 79</td> </tr> <tr> <td>5h</td> <td>Block 5: channels 80 through 95</td> </tr> <tr> <td>6h</td> <td>Block 6: channels 96 through 111</td> </tr> <tr> <td>7h</td> <td>Block 7: channels 112 through 127</td> </tr> </table>	0	Block 0: channels 0 through 15	1h	Block 1: channels 16 through 31	2h	Block 2: channels 32 through 47	3h	Block 3: channels 48 through 63	4h	Block 4: channels 64 through 79	5h	Block 5: channels 80 through 95	6h	Block 6: channels 96 through 111	7h	Block 7: channels 112 through 127
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5h	Block 5: channels 80 through 95																		
6h	Block 6: channels 96 through 111																		
7h	Block 7: channels 112 through 127																		
1-0	XMCM	0-3h	<p>Transmit multichannel selection mode bits. XMCM determines whether all channels or only selected channels are enabled and unmasked for transmission. For more details on how the channels are affected, see <a href="#">Section 20.6.7</a>.</p> <table border="0"> <tr> <td>0</td> <td>No transmit multichannel selection mode is on. All channels are enabled and unmasked. No channels can be disabled or masked.</td> </tr> <tr> <td>1h</td> <td>All channels are disabled unless they are selected in the appropriate transmit channel enable registers (XCERs). If enabled, a channel in this mode is also unmasked. The XMCME bit determines whether 32 channels or 128 channels are selectable in XCERs.</td> </tr> <tr> <td>2h</td> <td>All channels are enabled, but they are masked unless they are selected in the appropriate transmit channel enable registers (XCERs). The XMCME bit determines whether 32 channels or 128 channels are selectable in XCERs.</td> </tr> <tr> <td>3h</td> <td>This mode is used for symmetric transmission and reception. All channels are disabled for transmission unless they are enabled for reception in the appropriate receive channel enable registers (RCERs). Once enabled, they are masked unless they are also selected in the appropriate transmit channel enable registers (XCERs). The XMCME bit determines whether 32 channels or 128 channels are selectable in RCERs and XCERs.</td> </tr> </table>	0	No transmit multichannel selection mode is on. All channels are enabled and unmasked. No channels can be disabled or masked.	1h	All channels are disabled unless they are selected in the appropriate transmit channel enable registers (XCERs). If enabled, a channel in this mode is also unmasked. The XMCME bit determines whether 32 channels or 128 channels are selectable in XCERs.	2h	All channels are enabled, but they are masked unless they are selected in the appropriate transmit channel enable registers (XCERs). The XMCME bit determines whether 32 channels or 128 channels are selectable in XCERs.	3h	This mode is used for symmetric transmission and reception. All channels are disabled for transmission unless they are enabled for reception in the appropriate receive channel enable registers (RCERs). Once enabled, they are masked unless they are also selected in the appropriate transmit channel enable registers (XCERs). The XMCME bit determines whether 32 channels or 128 channels are selectable in RCERs and XCERs.								
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3h	This mode is used for symmetric transmission and reception. All channels are disabled for transmission unless they are enabled for reception in the appropriate receive channel enable registers (RCERs). Once enabled, they are masked unless they are also selected in the appropriate transmit channel enable registers (XCERs). The XMCME bit determines whether 32 channels or 128 channels are selectable in RCERs and XCERs.																		

### 20.14.9 Pin Control Register (PCR)

Each McBSP has one pin control register (PCR). [Table 20-91](#) describes the bits of PCR. This register enables you to:

- Choose a frame-synchronization mode for the transmitter (FSXM) and for the receiver (FSRM)
- Choose a clock mode for transmitter (CLKXM) and for the receiver (CLKRM)
- Select the input clock source for the sample rate generator (SCLKME, in conjunction with the CLKSM bit of SRGR2)
- Choose whether frame-synchronization signals are active low or active high (FSXP for transmission, FSRP for reception)
- Specify whether data is sampled on the falling edge or the rising edge of the clock signals (CLKXP for transmission, CLKRP for reception)

The pin control register (PCR) is shown in [Figure 20-79](#) and described in [Table 20-91](#).

**Figure 20-79. Pin Control Register (PCR)**

15	12	11	10	9	8
Reserved		FSXM	FSRM	CLKXM	CLKRM
R-0		R/W-0	R/W-0	R/W-0	R/W-0
7	6	4	3	2	1
SCLKME	Reserved		FSXP	FSRP	CLKXP
R/W-0	R-0		R/W-0	R/W-0	R/W-0

LEGEND: R/W = Read/Write; R = Read only; -n = value after reset

**Table 20-91. Pin Control Register (PCR) Field Descriptions**

Bit	Field	Value	Description
15:12	Reserved	0	Reserved bit (not available for your use). It is a read-only bit and returns a 0 when read.
11	FSXM		Transmit frame-synchronization mode bit. FSXM determines whether transmit frame-synchronization pulses are supplied externally or internally. The polarity of the signal on the FSX pin is determined by the FSXP bit.
		0	Transmit frame synchronization is supplied by an external source via the FSX pin.
		1	Transmit frame synchronization is generated internally by the Sample Rate generator, as determined by the FSGM bit of SRGR2.
10	FSRM		Receive frame-synchronization mode bit. FSRM determines whether receive frame-synchronization pulses are supplied externally or internally. The polarity of the signal on the FSR pin is determined by the FSRP bit.
		0	Receive frame synchronization is supplied by an external source via the FSR pin.
		1	Receive frame synchronization is supplied by the sample rate generator. FSR is an output pin reflecting internal FSR, except when GSYNC = 1 in SRGR2.

**Table 20-91. Pin Control Register (PCR) Field Descriptions (continued)**

Bit	Field	Value	Description																		
9	CLKXM	<p>0</p> <p>1</p> <p>0</p> <p>1</p>	<p>Transmit clock mode bit. CLKXM determines whether the source for the transmit clock is external or internal, and whether the MCLKX pin is an input or an output. The polarity of the signal on the MCLKX pin is determined by the CLKXP bit.</p> <p>In the clock stop mode (CLKSTP = 10b or 11b), the McBSP can act as a master or as a slave in the SPI protocol. If the McBSP is a master, make sure that CLKX is an output. If the McBSP is a slave, make sure that CLKX is an input.</p> <p>Not in clock stop mode (CLKSTP = 00b or 01b):</p> <p>The transmitter gets its clock signal from an external source via the MCLKX pin.</p> <p>Internal CLKX is driven by the sample rate generator of the McBSP. The MCLKX pin is an output pin that reflects internal CLKX.</p> <p>In clock stop mode (CLKSTP = 10b or 11b):</p> <p>The McBSP is a slave in the SPI protocol. The internal transmit clock (CLKX) is driven by the SPI master via the MCLKX pin. The internal receive clock (MCLKR) is driven internally by CLKX, so that both the transmitter and the receiver are controlled by the external master clock.</p> <p>The McBSP is a master in the SPI protocol. The sample rate generator drives the internal transmit clock (CLKX). Internal CLKX is reflected on the MCLKX pin to drive the shift clock of the SPI-compliant slaves in the system. Internal CLKX also drives the internal receive clock (MCLKR), so that both the transmitter and the receiver are controlled by the internal master clock.</p>																		
8	CLKRM	<p>0</p> <p>1</p> <p>0</p> <p>1</p>	<p>Receive clock mode bit. The role of CLKRM and the resulting effect on the MCLKR pin depend on whether the McBSP is in the digital loopback mode (DLB = 1).</p> <p>The polarity of the signal on the MCLKR pin is determined by the CLKRP bit.</p> <p>Not in digital loopback mode (DLB = 0):</p> <p>The MCLKR pin is an input pin that supplies the internal receive clock (MCLKR).</p> <p>Internal MCLKR is driven by the sample rate generator of the McBSP. The MCLKR pin is an output pin that reflects internal MCLKR.</p> <p>In digital loopback mode (DLB = 1):</p> <p>The MCLKR pin is in the high impedance state. The internal receive clock (MCLKR) is driven by the internal transmit clock (CLKX). CLKX is derived according to the CLKXM bit.</p> <p>Internal MCLKR is driven by internal CLKX. The MCLKR pin is an output pin that reflects internal MCLKR. CLKX is derived according to the CLKXM bit.</p>																		
7	SCLKME	<p>0</p> <p>0</p> <p>1</p> <p>1</p>	<p>Sample rate generator input clock mode bit. The sample rate generator can produce a clock signal, CLKG. The frequency of CLKG is:</p> $\text{CLKG freq.} = (\text{Input clock frequency}) / (\text{CLKGDV} + 1)$ <p>SCLKME is used in conjunction with the CLKSM bit to select the input clock.</p> <table border="1"> <thead> <tr> <th>SCLKME</th> <th>CLKSM</th> <th>Input Clock For Sample Rate Generator</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>0</td> <td>Reserved</td> </tr> <tr> <td>0</td> <td>1</td> <td>LSPCLK</td> </tr> </tbody> </table> <p>The input clock for the sample rate generator is taken from the MCLKR pin or from the MCLKX pin, depending on the value of the CLKSM bit of SRGR2:</p> <table border="1"> <thead> <tr> <th>SCLKME</th> <th>CLKSM</th> <th>Input Clock For Sample Rate Generator</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>0</td> <td>Signal on MCLKR pin</td> </tr> <tr> <td>1</td> <td>1</td> <td>Signal on MCLKX pin</td> </tr> </tbody> </table>	SCLKME	CLKSM	Input Clock For Sample Rate Generator	0	0	Reserved	0	1	LSPCLK	SCLKME	CLKSM	Input Clock For Sample Rate Generator	1	0	Signal on MCLKR pin	1	1	Signal on MCLKX pin
SCLKME	CLKSM	Input Clock For Sample Rate Generator																			
0	0	Reserved																			
0	1	LSPCLK																			
SCLKME	CLKSM	Input Clock For Sample Rate Generator																			
1	0	Signal on MCLKR pin																			
1	1	Signal on MCLKX pin																			
6-4	Reserved		Reserved																		
3	FSXP	<p>0</p> <p>1</p>	<p>Transmit frame-synchronization polarity bit. FSXP determines the polarity of FSX as seen on the FSX pin.</p> <p>0 Transmit frame-synchronization pulses are active high.</p> <p>1 Transmit frame-synchronization pulses are active low.</p>																		
2	FSRP	<p>0</p> <p>1</p>	<p>Receive frame-synchronization polarity bit. FSRP determines the polarity of FSR as seen on the FSR pin.</p> <p>0 Receive frame-synchronization pulses are active high.</p> <p>1 Receive frame-synchronization pulses are active low.</p>																		

**Table 20-91. Pin Control Register (PCR) Field Descriptions (continued)**

Bit	Field	Value	Description
1	CLKXP	0	Transmit clock polarity bit. CLKXP determines the polarity of CLKX as seen on the MCLKX pin. Transmit data is sampled on the rising edge of CLKX.
		1	Transmit data is sampled on the falling edge of CLKX.
0	CLKRP	0	Receive clock polarity bit. CLKRP determines the polarity of CLKR as seen on the MCLKR pin. Receive data is sampled on the falling edge of MCLKR.
		1	Receive data is sampled on the rising edge of MCLKR.

**Table 20-92. Pin Configuration**

Pin	Selected as Output When ...	Selected as Input When ...
CLKX	CLKXM = 1	CLKXM = 0
FSX	FSXM = 1	FSXM = 0
CLKR	CLKRM = 1	CLKRM = 0
FSR	FSRM = 1	FSRM = 0

#### 20.14.10 Receive Channel Enable Registers (RCERA, RCERB, RCERC, RCERD, RCERE, RCERF, RCERG, RCERH)

Each McBSP has eight receive channel enable registers of the format shown in [Figure 20-80](#). There is one enable register for each of the receive partitions: A, B, C, D, E, F, G, and H. [Table 20-93](#) provides a summary description that applies to any bit x of a receive channel enable register.

These memory-mapped registers are only used when the receiver is configured to allow individual enabling and disabling of the channels (RMCM = 1). For more details about the way these registers are used, see [Section 20.14.10.1](#).

The receive channel enable registers (RCERA...RCERH) are shown in [Figure 20-80](#) and described in [Table 20-93](#).

**Figure 20-80. Receive Channel Enable Registers (RCERA...RCERH)**

15	14	13	12	11	10	9	8
RCE15	RCE14	RCE13	RCE12	RCE11	RCE10	RCE9	RCE8
R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0
7	6	5	4	3	2	1	0
RCE7	RCE6	RCE5	RCE4	RCE3	RCE2	RCE1	RCE0
R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0

LEGEND: R/W = Read/Write; R = Read only; -n = value after reset

**Table 20-93. Receive Channel Enable Registers (RCERA...RCERH) Field Descriptions**

Bit	Field	Value	Description
15-0	RCEx		Receive channel enable bit.
			<b>For receive multichannel selection mode (RMCM = 1):</b>
		0	Disable the channel that is mapped to RCEx.
		1	Enable the channel that is mapped to RCEx.

##### 20.14.10.1 RCERs Used in the Receive Multichannel Selection Mode

For multichannel selection operation, the assignment of channels to the RCERs depends on whether 32 or 128 channels are individually selectable, as defined by the RMCME bit. For each of these two cases, [Table 20-94](#) shows which block of channels is assigned to each of the RCERs used. For each RCER, the table shows which channel is assigned to each of the bits.

**Table 20-94. Use of the Receive Channel Enable Registers**

Number of Selectable Channels	Block Assignments		Channel Assignments				
	RCERx	Block Assigned	Bit in RCERx	Channel Assigned			
32 (RMCME = 0)	RCERA	Channels n to (n + 15)  The block of channels is chosen with the RPABLK bits.	RCE0	Channel n			
			RCE1	Channel (n + 1)			
			RCE2	Channel (n + 2)			
			:	:			
			RCE15	Channel (n + 15)			
			RCERB	Channels m to (m + 15)  The block of channels is chosen with the RPBBLK bits.	RCE0	Channel m	
					RCE1	Channel (m + 1)	
	RCE2	Channel (m + 2)					
	:	:					
	RCE15	Channel (m + 15)					
	128 (RMCME = 1)	RCERA			Block 0	RCE0	Channel 0
						RCE1	Channel 1
			RCE2	Channel 2			
			:	:			
RCE15			Channel 15				
RCERB		Block 1	RCE0	Channel 16			
			RCE1	Channel 17			
			RCE2	Channel 18			
			:	:			
			RCE15	Channel 31			
RCERC		Block 2	RCE0	Channel 32			
			RCE1	Channel 33			
			RCE2	Channel 34			
			:	:			
	RCE15		Channel 47				
RCERD	Block 3	RCE0	Channel 48				
		RCE1	Channel 49				
		RCE2	Channel 50				
		:	:				
		RCE15	Channel 63				
RCERE	Block 4	RCE0	Channel 64				
		RCE1	Channel 65				
		RCE2	Channel 66				
		:	:				
		RCE15	Channel 79				
RCERF	Block 5	RCE0	Channel 80				
		RCE1	Channel 81				
		RCE2	Channel 82				
		:	:				
		RCE15	Channel 95				
RCERG	Block 6	RCE0	Channel 96				
		RCE1	Channel 97				
		RCE2	Channel 98				
		:	:				
		RCE15	Channel 111				

**Table 20-94. Use of the Receive Channel Enable Registers (continued)**

Number of Selectable Channels	Block Assignments		Channel Assignments	
	RCERx	Block Assigned	Bit in RCERx	Channel Assigned
	RCERH	Block 7	RCE0	Channel 112
			RCE1	Channel 113
			RCE2	Channel 114
			:	:
			RCE15	Channel 127

**20.14.11 Transmit Channel Enable Registers (XCERA, XCERB, XCERC, XCERD, XCERE, XCERF, XCERG, X CERH)**

Each McBSP has eight transmit channel enable registers of the form shown in Figure 20-81. There is one for each of the transmit partitions: A, B, C, D, E, F, G, and H. Table 20-95 provides a summary description that applies to each bit XCE<sub>x</sub> of a transmit channel enable register.

The XCERs are only used when the transmitter is configured to allow individual disabling/enabling and masking/unmasking of the channels (XMCM is nonzero).

The transmit channel enable registers (XCERA...XCERH) are shown in Figure 20-81 and described in Table 20-95.

**Figure 20-81. Transmit Channel Enable Registers (XCERA...XCERH)**

15	14	13	12	11	10	9	8
XCE15	XCE14	XCE13	XCE12	XCE11	XCE10	XCE9	XCE8
R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0
7	6	5	4	3	2	1	0
XCE7	XCE6	XCE5	XCE4	XCE3	XCE2	XCE1	XCE0
R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0

LEGEND: R/W = Read/Write; R = Read only; -n = value after reset

**Table 20-95. Transmit Channel Enable Registers (XCERA...XCERH) Field Descriptions**

Bit	Field	Value	Description
15-0	XCE <sub>x</sub>		Transmit channel enable bit. The role of this bit depends on which transmit multichannel selection mode is selected with the XMCM bits.
			<b>For multichannel selection when XMCM = 01b (all channels disabled unless selected):</b>
		0	Disable and mask the channel that is mapped to XCE <sub>x</sub> .
		1	Enable and unmask the channel that is mapped to XCE <sub>x</sub> .
			<b>For multichannel selection when XMCM = 10b (all channels enabled but masked unless selected):</b>
		0	Mask the channel that is mapped to XCE <sub>x</sub> .
		1	Unmask the channel that is mapped to XCE <sub>x</sub> .
			<b>For multichannel selection when XMCM = 11b (all channels masked unless selected):</b>
		0	Mask the channel that is mapped to XCE <sub>x</sub> . Even if the channel is enabled by the corresponding receive channel enable bit, this channel's data cannot appear on the DX pin.
1	Unmask the channel that is mapped to XCE <sub>x</sub> . If the channel is also enabled by the corresponding receive channel enable bit, full transmission can occur.		



### 20.14.11.1 XCERs Used in a Transmit Multichannel Selection Mode

For multichannel selection operation, the assignment of channels to the XCERs depends on whether 32 or 128 channels are individually selectable, as defined by the XMCME bit. These two cases are shown in [Table 20-96](#). The table shows which block of channels is assigned to each XCER that is used. For each XCER, the table shows which channel is assigned to each of the bits.

**NOTE:** When XMCM = 11b (for symmetric transmission and reception), the transmitter uses the receive channel enable registers (RCERs) to enable channels and uses the XCERs to unmask channels for transmission.

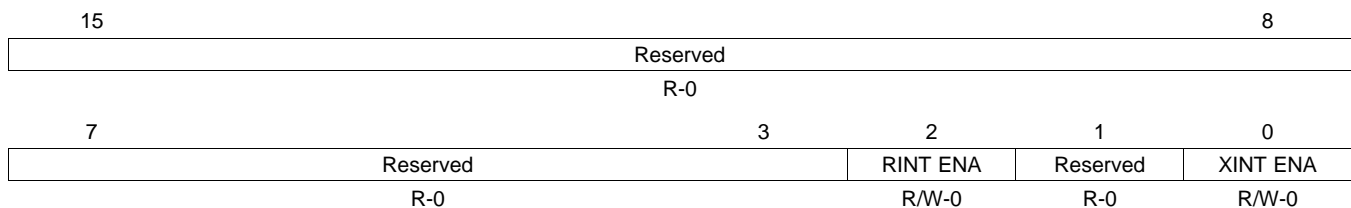
**Table 20-96. Use of the Transmit Channel Enable Registers**

Number of Selectable Channels	Block Assignments		Channel Assignments	
	XCERx	Block Assigned	Bit in XCERx	Channel Assigned
32 (XMCME = 0)	XCERA	Channels n to (n + 15)	XCE0	Channel n
			XCE1	Channel (n + 1)
			XCE2	Channel (n + 2)
			:	:
			XCE15	Channel (n + 15)
	XCERB	Channels m to (m + 15)	XCE0	Channel m
			XCE1	Channel (m + 1)
			XCE2	Channel (m + 2)
			:	:
			XCE15	Channel (m + 15)
128 (XMCME = 1)	XCERA	Block 0	XCE0	Channel 0
			XCE1	Channel 1
			XCE2	Channel 2
			:	:
			XCE15	Channel 15
	XCERB	Block 1	XCE0	Channel 16
			XCE1	Channel 17
			XCE2	Channel 18
			:	:
			XCE15	Channel 31
	XCERC	Block 2	XCE0	Channel 32
			XCE1	Channel 33
			XCE2	Channel 34
			:	:
			XCE15	Channel 47
XCERD	Block 3	XCE0	Channel 48	
		XCE1	Channel 49	
		XCE2	Channel 50	
		:	:	
		XCE15	Channel 63	

**Table 20-96. Use of the Transmit Channel Enable Registers (continued)**

Number of Selectable Channels	Block Assignments		Channel Assignments	
	XCERx	Block Assigned	Bit in XCERx	Channel Assigned
	XCERE	Block 4	XCE0	Channel 64
			XCE1	Channel 65
			XCE2	Channel 66
			:	:
			XCE15	Channel 79
	XCERF	Block 5	XCE0	Channel 80
			XCE1	Channel 81
			XCE2	Channel 82
			:	:
			XCE15	Channel 95
	XCERG	Block 6	XCE0	Channel 96
			XCE1	Channel 97
			XCE2	Channel 98
			:	:
			XCE15	Channel 111
	XCERH	Block 7	XCE0	Channel 112
			XCE1	Channel 113
			XCE2	Channel 114
			:	:
			XCE15	Channel 127

### 20.14.12 McBSP Interrupt Enable Register

**Figure 20-82. McBSP Interrupt Enable Register (MFFINT)**


LEGEND: R/W = Read/Write; R = Read only; -n = value after reset

**Table 20-97. McBSP Interrupt Enable Register (MFFINT) Field Descriptions**

Bit	Field	Value	Description
15:3	Reserved		Reserved
2	RINT ENA		Enable for Receive Interrupt
		0	Receive interrupt on RRDY is disabled.
		1	Receive interrupt on RRDY is enabled.
1	Reserved		
0	XINT ENA		Enable for transmit Interrupt
		0	Transmit interrupt on XRDY is disabled.
		1	Transmit interrupt on XRDY is enabled.

## Controller Area Network (CAN)

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This chapter contains a general description of the Controller Area Network (CAN) module. The CAN module is a serial communications protocol which efficiently supports distributed real-time control with a high level of reliability. The CAN module supports bit-rates up to 1 Mbit/s and is compliant with the ISO11898-1 (CAN 2.0B) protocol specification.

Topic	Page
21.1 Overview.....	2228
21.2 Configuring Device Pins .....	2230
21.3 Address/Data Bus Bridge.....	2230
21.4 Operating Modes .....	2231
21.5 Multiple Clock Source .....	2236
21.6 Interrupt Functionality .....	2236
21.7 Parity Check Mechanism .....	2237
21.8 Debug Mode .....	2237
21.9 Module Initialization .....	2238
21.10 Configuration of Message Objects .....	2238
21.11 Message Handling .....	2240
21.12 CAN Bit Timing .....	2244
21.13 Message Interface Register Sets .....	2252
21.14 Message RAM .....	2254
21.15 Registers .....	2259

## 21.1 Overview

This device uses the popular CAN IP known as D\_CAN.

### 21.1.1 Features

The CAN module implements the following features:

- CAN protocol version ISO11898-1 (CAN 2.0B)
- Bit rates up to 1 MBit/s
- Multiple clock sources
- 32 message objects (mailboxes)
- Individual identifier mask for each message object
- Programmable FIFO mode for message objects
- Programmable loop-back modes for self-test operation
- Suspend mode for debug support
- Software module reset
- Automatic bus-on after bus-off state by a programmable 32-bit timer
- Message-RAM parity-check mechanism
- Two interrupt lines

### 21.1.2 Functional Description

The CAN module performs CAN protocol communication according to ISO 11898-1 (identical to Bosch CAN protocol specification 2.0 A, B). The bit rate can be programmed to values up to 1 MBit/s. A CAN transceiver chip is required for the connection to the physical layer (CAN bus).

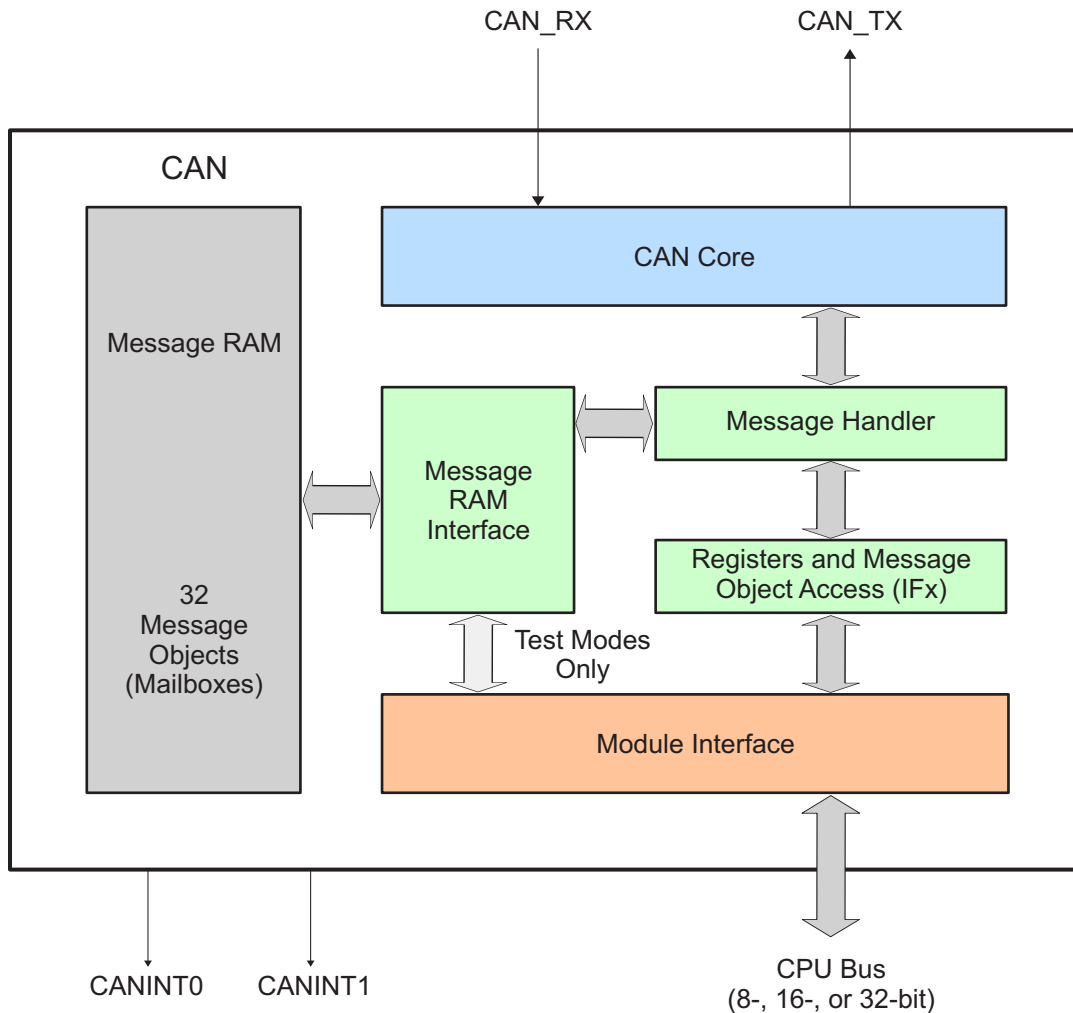
For communication on a CAN network, individual message objects can be configured. The message objects and identifier masks are stored in the Message RAM.

All functions concerning the handling of messages are implemented in the message handler. Those functions are acceptance filtering, the transfer of messages between the CAN Core and the Message RAM, and the handling of transmission requests.

The register set of the CAN may be accessed directly by the CPU via the module interface. These registers are used to control/configure the CAN core and the message handler, and to access the message RAM.

### 21.1.3 Block Diagram

Figure 21-1. CAN Block Diagram



#### 21.1.3.1 CAN Core

The CAN core consists of the CAN Protocol Controller and the Rx/Tx Shift register. It handles all ISO 11898-1 protocol functions.

#### 21.1.3.2 Message Handler

The message handler is a state machine which controls the data transfer between the single ported Message RAM and the CAN Core's Rx/Tx Shift register. It also handles acceptance filtering and the interrupt request generation as programmed in the control registers.

#### 21.1.3.3 Message RAM

The CAN message RAM enables the storage of 32 CAN messages.

#### 21.1.3.4 Registers and Message Object Access (IFx)

Data consistency is ensured by indirect accesses to the message objects. During normal operation, all CPU accesses to the message RAM are done through Interface registers.

Three Interface Register sets control the CPU read and write accesses to the Message RAM. There are two Interface register sets for read/write access (IF1 and IF2) and one Interface Register set for read access only (IF3). See also [Section 21.13](#). The Interface registers have the same word-length as the message RAM.

In a dedicated test mode, the message RAM is memory mapped and can be directly accessed.

## 21.2 Configuring Device Pins

The GPIO mux registers must be configured to connect this peripheral to the device pins. To avoid glitches on the pins, the GPyGMUX bits must be configured first (while keeping the corresponding GPyMUX bits at the default of zero), followed by writing the GPyMUX register to the desired value.

Some I/O functionality is defined by GPIO register settings independent of this peripheral. For input signals, the GPIO input qualification should be set to asynchronous mode by setting the appropriate GPxQSELn register bits to 11b. The internal pullups can be configured in the GPyPUD register.

See the *GPIO* chapter for more details on GPIO mux and settings.

## 21.3 Address/Data Bus Bridge

The CAN module uses a special addressing scheme to support byte accesses. This is the same addressing that is used on the USB module. It is recommended to only use 32-bit accesses to the CAN registers using the HWREG\_BP() macro which uses the \_\_byte\_peripheral\_32() intrinsic. If 16-bit accesses are to be used, the lower 16 bits should be written to the register's address, and the upper 16 bits should be written to the register's address plus 2.

Because of the bus bridge, the view of the CAN module's register space through a CCS memory windows does not always match the actual addressing. When the view mode is 32-bit or 16-bit, even addresses are effectively duplicated. Odd addresses should be ignored. When the view mode is 8-bit, even addresses from within the CAN module are duplicated into the odd addresses in the CCS memory view. Odd addresses from the module are not displayed.

**Table 21-1. CAN Register Access From Software**

CAN Register Space			C28x 8 Bit	
Address	Reg. Name	Data	Access	Data
0x00	CAN_CTL	0x33221100	__byte((int *)0x00,0)	0x0000
0x04	CAN_ES	0x77665544	__byte((int *)0x01,0)	0x0011
0x08	CAN_ERRC	0xbbaa9988	__byte((int *)0x02,0)	0x0022
0x0C	CAN_BTR	0xffeeddcc	__byte((int *)0x03,0)	0x0033
			__byte((int *)0x04,0)	0x0044
			__byte((int *)0x05,0)	0x0055
			__byte((int *)0x06,0)	0x0066
			__byte((int *)0x07,0)	0x0077
			__byte((int *)0x08,0)	0x0088
			__byte((int *)0x09,0)	0x0099
			__byte((int *)0x0A,0)	0x00AA
			__byte((int *)0x0B,0)	0x00BB
			__byte((int *)0x0C,0)	0x00CC
			__byte((int *)0x0D,0)	0x00DD
			__byte((int *)0x0E,0)	0x00EE
			__byte((int *)0x0F,0)	0x00FF
		<b>C28x 16 Bit</b>	<b>C28x 32 Bit</b>	
<b>Access</b>	<b>Data</b>		<b>Access</b>	<b>Data</b>
((short *)0x00))	0x1100		((long *)0x00))	0x33221100
((short *)0x01))	0x1100		((long *)0x01))	0x33221100

**Table 21-1. CAN Register Access From Software (continued)**

CAN Register Space		C28x 8 Bit	
*((short*)(0x02))	0x3322	*((long*)(0x02))	0x33221100
*((short*)(0x03))	0x3322	*((long*)(0x03))	0x33221100
*((short*)(0x04))	0x5544	*((long*)(0x04))	0x77665544
*((short*)(0x05))	0x5544	*((long*)(0x05))	0x77665544
*((short*)(0x06))	0x7766	*((long*)(0x06))	0x77665544
*((short*)(0x07))	0x7766	*((long*)(0x07))	0x77665544
*((short*)(0x08))	0x9988	*((long*)(0x08))	0xBBAA9988
*((short*)(0x09))	0x9988	*((long*)(0x09))	0xBBAA9988
*((short*)(0x0A))	0xBBAA	*((long*)(0x0A))	0xBBAA9988
*((short*)(0x0B))	0xBBAA	*((long*)(0x0B))	0xBBAA9988
*((short*)(0x0C))	0xDDCC	*((long*)(0x0C))	0xFFEEDDCC
*((short*)(0x0D))	0xDDCC	*((long*)(0x0D))	0xFFEEDDCC
*((short*)(0x0E))	0xFFEE	*((long*)(0x0E))	0xFFEEDDCC
*((short*)(0x0F))	0xFFEE	*((long*)(0x0F))	0xFFEEDDCC

**Table 21-2. CAN Register Access From CCS**

CCS 8 Bit		CCS 16 Bit		CCS 32 Bit	
Address	Displayed Data	Address	Displayed Data	Address	Displayed Data
0x00	0x00	0x00	0x1100	0x00	0x11001100
0x01	0x00	0x01	0x1100	0x02	0x33223322
0x02	0x22	0x02	0x3322	0x04	0x55445544
0x03	0x22	0x03	0x3322	0x06	0x77667766
0x04	0x44	0x04	0x5544	0x08	0x99889988
0x05	0x44	0x05	0x5544	0x0A	0xBBAABBAA
0x06	0x66	0x06	0x7766	0x0C	0xDDCCDDCC
0x07	0x66	0x07	0x7766	0x0E	0xFFEEFFEE
0x08	0x88	0x08	0x9988		
0x09	0x88	0x09	0x9988		
0x0A	0xAA	0x0A	0xBBAA		
0x0B	0xAA	0x0B	0xBBAA		
0x0C	0xCC	0x0C	0xDDCC		
0x0D	0xCC	0x0D	0xDDCC		
0x0E	0xEE	0x0E	0xFFEE		
0x0F	0xEE	0x0F	0xFFEE		

## 21.4 Operating Modes

### 21.4.1 Initialization

The initialization mode is entered either by software (by setting the Init bit in the CAN\_CTL register), by hardware reset, or by going bus-off. While the Init bit is set, the message transfer from and to the CAN bus is stopped, and the status of the CAN\_TX output is recessive (high). The CAN error counters are not updated. Setting the Init bit does not change any other configuration register.

To initialize the CAN Controller, the CPU has to configure the CAN Bit timing and those message objects which have to be used for CAN communication. Message objects which are not needed, can be deactivated with their MsgVal bits cleared.

The access to the Bit Timing register for the configuration of the bit timing is enabled when both Init and CCE bits in the CAN Control register are set.

Clearing the Init bit finishes the software initialization. Afterwards the bit stream processor (BSP), synchronizes itself to the data transfer on the CAN bus by waiting for the occurrence of a sequence of 11 consecutive recessive bits (= Bus Idle) before it can take part in bus activities and start the message transfer.

The initialization of the message objects is independent of the Init bit, however all message objects should be configured to particular identifiers or set to "not valid" before the message transfer is started.

It is possible to change the configuration of message objects during normal operation by the CPU. After setup and subsequent transfer of message object from interface registers to message RAM, the acceptance filtering will be applied to it, when the modified message object number is same or smaller than the previously found message object. This assures data consistency even when changing message objects, for example, while there is a pending CAN frame reception.

### 21.4.2 CAN Message Transfer (Normal Operation)

Once the CAN is initialized and the **Init** bit is reset to zero, the CAN Core synchronizes itself to the CAN bus and is ready for communication.

Received messages are stored into their appropriate message objects if they pass acceptance filtering. The whole message (MSGID, DLC, and up to eight data bytes) is stored into the message object. As a consequence, when, for example, the identifier mask is used, the MSGID bits which are masked to "don't care" may change in the message object when a received message is stored.

The CPU may read or write each message at any time via the Interface registers, as the message handler guarantees data consistency in case of concurrent accesses.

Messages to be transmitted can be updated by the CPU. If a permanent message object (MSGID and control bits set up during configuration and leaving unchanged for multiple CAN transfers) exists for the message, it is possible to only update the data bytes. If several transmit messages should be assigned to one message object, the whole message object has to be configured before the transmission of this message is requested.

The transmission of multiple message objects may be requested at the same time. They are subsequently transmitted, according to their internal priority. Messages may be updated or set to "not valid" at any time, even if a requested transmission is still pending. However, the data bytes will be discarded if a message is updated before a pending transmission has started.

Depending on the configuration of the message object, a transmission may be automatically requested by the reception of a remote frame with a matching identifier.

#### 21.4.2.1 Disabled Automatic Retransmission

According to the CAN Specification (see ISO11898, 6.3.3 Recovery Management), the CAN provides a mechanism to automatically retransmit frames which have lost arbitration or have been disturbed by errors during transmission. The frame transmission service will not be confirmed to the user before the transmission is successfully completed.

By default, this automatic retransmission is enabled. It can be disabled by setting bit DAR in the CAN Control register. Further details to this mode are provided in [Section 21.11.3](#).

#### 21.4.2.2 Auto-Bus-On

By default, after the CAN has entered bus-off state, the CPU can start a bus-off-recovery sequence by resetting Init bit. If this is not done, the module will stay in bus-off state.

The CAN provides an automatic auto-bus-on feature which is enabled by the ABO bit. If set, the CAN will automatically start the bus-off-recovery sequence. The sequence can be delayed by a user-defined number of clock cycles.



**NOTE:** If the CAN module goes Bus-Off due to massive occurrence of CAN bus errors, it stops all bus activities and automatically sets the Init bit. Once the Init bit is cleared by the application (or due to the auto-bus-on feature), the device will wait for 128 occurrences of Bus Idle (equal to 128 \* 11 consecutive recessive bits) before resuming normal operation. The Bus-Off recovery sequence cannot be shortened by setting or resetting Init bit. At the end of the bus-off recovery sequence, the error counters will be reset. After the Init bit is reset, each time when a sequence of 11 recessive bits is monitored, a Bit0 Error code is written to the Error and Status Register, enabling the CPU to check whether the CAN bus is stuck at dominant or continuously disturbed, and to monitor the proceeding of the Bus-Off recovery sequence.

### 21.4.3 Test Modes

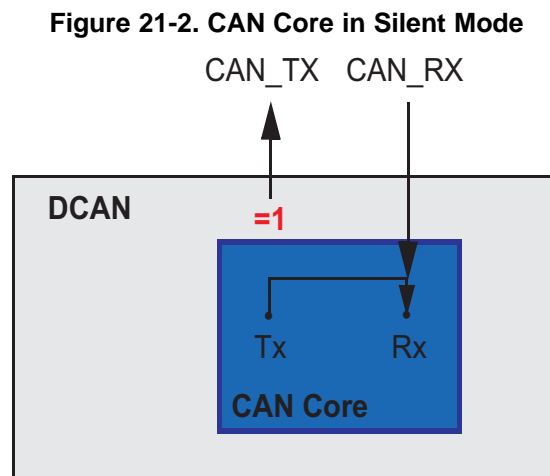
The CAN provides several test modes which are mainly intended for self-test purposes.

For all test modes, the Test bit in the CAN Control register needs to be set to 1. This enables write access to the Test register.

#### 21.4.3.1 Silent Mode

The silent mode may be used to analyze the traffic on the CAN bus without affecting it by sending dominant bits (for example, acknowledge bit, overload flag, active error flag). The CAN is still able to receive valid data frames and valid remote frames, but it will not send any dominant bits. However, the received frames are internally routed to the CAN core.

Figure 21-2 shows the connection of signals CAN\_TX and CAN\_RX to the CAN core in silent mode. Silent mode can be activated by setting the Silent bit in test register (CAN\_TEST) to 1. In ISO 11898-1, the silent mode is called the bus monitoring mode.



#### 21.4.3.2 Loopback Mode

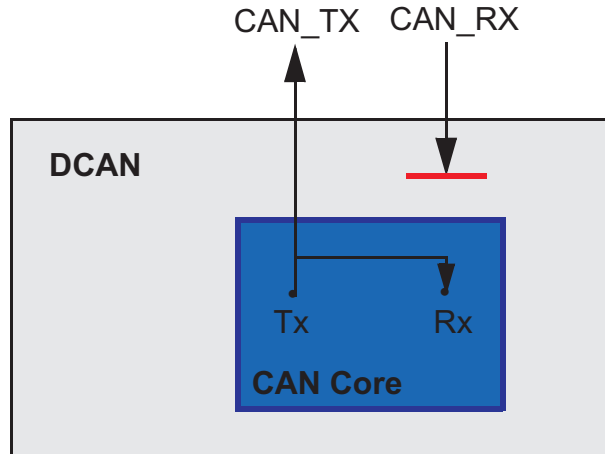
The loopback mode is mainly intended for hardware self-test functions. In this mode, the CAN core uses internal feedback from Tx output to Rx input. Transmitted messages are treated as received messages, and can be stored into message objects if they pass acceptance filtering. The actual value of the CAN\_RX input pin is disregarded by the CAN core. Transmitted messages still can be monitored at the CAN\_TX pin.

In order to be independent from external stimulation, the CAN core ignores acknowledge errors (recessive bit sampled in the acknowledge slot of a data/remote frame) in loopback mode.

Figure 21-3 shows the connection of signals CAN\_TX and CAN\_RX to the CAN core in loopback mode. Loopback mode can be activated by setting bit LBack in the CAN\_TEST register to one.

**NOTE:** In loopback mode, the signal path from CAN core to Tx pin, the Tx pin itself, and the signal path from Tx pin back to CAN Core are disregarded. For including these into the testing, see [Section 21.4.3.3](#).

**Figure 21-3. CAN Core in Loopback Mode**



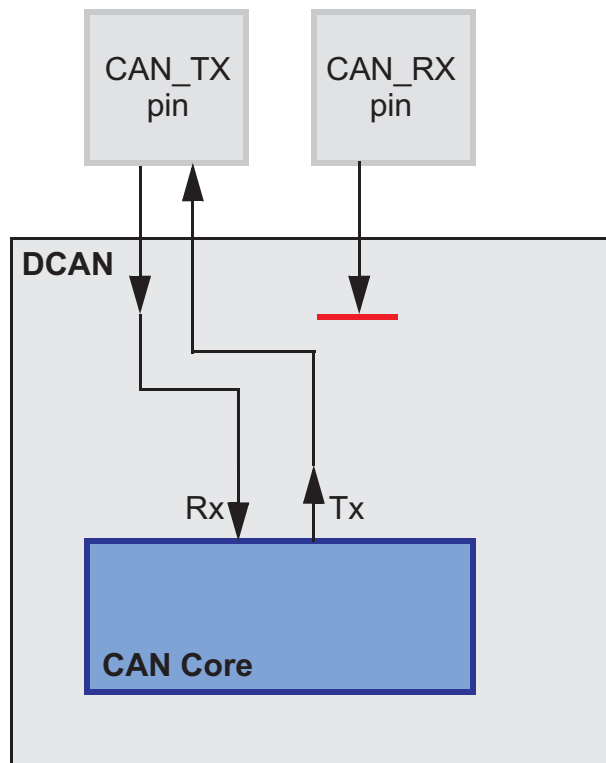
### 21.4.3.3 External Loopback Mode

The external loopback mode is similar to the loopback mode; however, it includes the signal path from CAN Core to Tx pin, the Tx pin itself, and the signal path from Tx pin back to the CAN Core. When the external loopback mode is selected, the CAN core is connected to the input buffer of the Tx pin. With this configuration, the Tx pin IO circuit can be tested. External loopback mode can be activated by setting bit **ExL** in Test Register to one.

[Figure 21-4](#) shows the connection of signals CAN\_TX and CAN\_RX to the CAN Core in external loopback mode.

**NOTE:** When loopback mode is active (LBack bit set), the ExL bit will be ignored.

Figure 21-4. CAN Core in External Loopback Mode

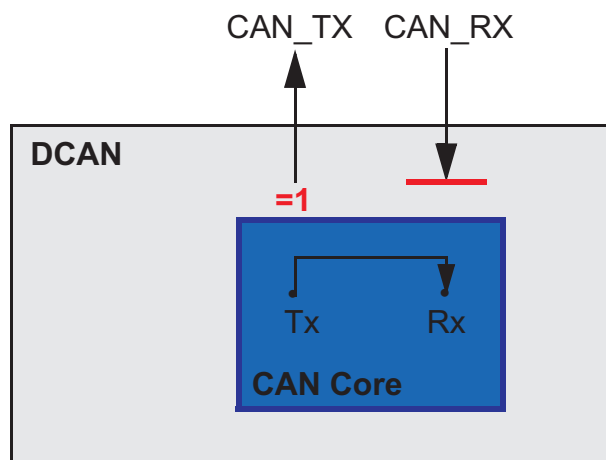


#### 21.4.3.4 Loopback Combined with Silent Mode

It is also possible to combine loopback mode and silent mode by setting bits LBack and Silent at the same time. This mode can be used for a "Hot Selftest;" that is, the CAN hardware can be tested without affecting the CAN network. In this mode, the CAN\_RX pin is disconnected from the CAN Core and no dominant bits will be sent on the CAN\_TX pin.

Figure 21-5 shows the connection of the signals CAN\_TX and CAN\_RX to the CAN Core in case of the combination of loopback mode with silent mode.

Figure 21-5. CAN Core in Loopback Combined with Silent Mode



## 21.5 Multiple Clock Source

Three clock domains are provided to the CAN module for generating the CAN bit timing: the external oscillator clock (X1/X2), the system clock, and the GPIO AUXCLKIN.

The system module reference guide and the device data manual provide for more information on how to configure the relevant clock source registers in the system module.

---

**NOTE:** The CAN core has to be programmed to at least eight clock cycles per bit time. To achieve a transfer rate of 1 Mbps an oscillator frequency of 8 MHz or higher has to be used.

---

## 21.6 Interrupt Functionality

Interrupts can be generated on two interrupt lines: CAN0INT and CAN1INT. These lines can be enabled by setting the IE0 and IE1 bits, respectively, in the CAN Control register.

The CAN provides three groups of interrupt sources: message object interrupts, status change interrupts and error interrupts. The source of an interrupt can be determined by the interrupt identifiers INT0ID or INT1ID in the CAN\_INT Interrupt register. When no interrupt is pending, the register will hold the value zero. Each interrupt line remains active until the dedicated field in the Interrupt register (INT0ID or INT1ID) again reaches zero (this means the cause of the interrupt is reset), or until IE0 or IE1 are reset. The value 0x8000 in the INT0ID field indicates that an interrupt is pending because the CAN Core has updated (not necessarily changed) the Error and Status register (Error Interrupt or Status Interrupt). This interrupt has the highest priority. The CPU can update (reset) the status bits RxOk, TxOk and LEC by reading the Error and Status Register, but a write access of the CPU will never generate or reset an interrupt.

Values between 1 and the number of the last message object indicates that the source of the interrupt is one of the message objects, INT0ID or INT1ID will point to the pending message interrupt with the highest priority. The Message Object 1 has the highest priority, the last message object has the lowest priority.

An interrupt service routine which reads the message that is the source of the interrupt, may read the message and reset the message object's IntPnd at the same time (ClrIntPnd bit in the IF1 or IF2 Command register). When IntPnd is cleared, the Interrupt register will point to the next message object with a pending interrupt.

The CAN module features a module-level interrupt enable and acknowledge mechanism. To enable the CAN0 and CAN1 interrupts, set the appropriate bits in the CAN\_GLB\_INT\_EN register. When handling an interrupt, the individual message or status change flag must be cleared prior to acknowledging the interrupt via CAN\_GLB\_INT\_CLR and PIEACK.

### 21.6.1 Message Object Interrupts

Message object interrupts are generated by events from the message objects. They are controlled by the flags IntPND, TxIE and RxIE which are described in [Section 21.14.1](#). Message object interrupts can be routed to either CAN0INT or CAN1INT line, controlled by the Interrupt Multiplexer register.

### 21.6.2 Status Change Interrupts

The events RxOk, TxOk and LEC in Error and Status register belong to the status change interrupts. The status change interrupt group can be enabled by bit SIE in the CAN Control register. If SIE is set, a status change interrupt will be generated at each CAN frame, independent of bus errors or valid CAN communication, and also independent of the Message RAM configuration. Status Change interrupts can only be routed to interrupt line CAN0INT which has to be enabled by setting IE0 in the CAN Control Register.

### 21.6.3 Error Interrupts

The events PER, BOff and EWarn, belong to the error interrupts. The error interrupt group can be enabled by setting bit EIE. Also, error interrupts can only be routed to interrupt line CAN0INT which has to be enabled by setting IE0 in the CAN\_CTL register.

## 21.6.4 PIE Nomenclature for DCAN Interrupts

Table 21-3 shows the PIE nomenclature for the interrupts.

**Table 21-3. PIE Nomenclature for Interrupts**

Interrupt	CANA	CANB
CANINT0	CANA_0	CANB_0
CANINT1	CANA_1	CANB_1

## 21.7 Parity Check Mechanism

The CAN provides a parity check mechanism to ensure data integrity of message RAM data. For each word (32 bits) in Message RAM, one parity bit will be calculated.

Parity information is stored in the Message RAM on write accesses and will be checked against the stored parity bit from Message RAM on read accesses.

The parity check functionality can be enabled or disabled by PMD bit field in CAN Control register. In case of disabled parity check, the parity bits in message RAM will be left unchanged on write access to data area and no check will be done on read access.

If parity checking is enabled, parity bits will be automatically generated and checked by the CAN. A parity bit will be set, if the modulo-2-sum of the data bits is 1. This definition is equivalent to: the parity bit will be set, if the number of 1 bits in the data is odd.

### 21.7.1 Behavior on Parity Error

On any read access to Message RAM, for example, during the start of a CAN frame transmission, the parity of the message object will be checked. If a parity error is detected, the PER bit in Error and Status register will be set. If error interrupts are enabled, an interrupt would also be generated. In order to avoid the transmission of invalid data over the CAN bus, the MsgVal bit of the message object will be reset.

The message object data can be read by the CPU, independently of parity errors. Thus, the application has to ensure that the read data is valid, for example, by immediately checking the Parity Error Code register on parity error interrupt.

## 21.8 Debug Mode

The module supports the usage of an external debug unit by providing functions like pausing CAN activities and making message RAM content accessible from the debugger. Debug mode is entered automatically when an external debugger is connected and the core is halted.

Before entering Debug mode, the circuit will either wait until a started transmission or reception will be finished and Bus idle state is recognized, or immediately interrupt a current transmission or reception. This is depending on bit IDS. Afterwards, the CAN enters Debug mode, indicated by the InitDbg flag, in the CAN Control register. During debug mode, all CAN registers can be accessed. Reading reserved bits will return '0'. Writing to reserved bits will have no effect. Also, the message RAM will be memory mapped. This allows the external debug unit to read the message RAM. For the memory organization, see [Section 21.14.3](#).

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**NOTE:** During debug mode, the Message RAM cannot be accessed via the IFx register sets.

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**NOTE:** Writing to control registers in Debug mode may influence the CAN state machine and further message handling.

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For debug support, the auto clear functionality of the following CAN registers is disabled:

- Error and Status register (clear of status flags by read)
- IF1 and IF2 Command registers

## 21.9 Module Initialization

After hardware reset, the Init bit in the CAN Control register is set and all CAN protocol functions are disabled. The configuration of the bit timing and of the message objects should be completed before the CAN protocol functions are enabled.

For the configuration of the message objects, see [Section 21.10](#).

For the configuration of the Bit Timing, see [Section 21.12.2](#).

The bits MsgVal, NewDat, IntPnd, and TxRqst of the message objects are reset to '0' by a hardware reset. The configuration of a message object is done by programming Mask, Arbitration, Control and Data bits of one of the IF1 or IF2 Interface register sets to the desired values. By writing the message object number to bits [7:0] of the corresponding IF1 or IF2 Command register, the IF1 or IF2 Interface Register content is loaded into the addressed message object in Message RAM.

The configuration of the bit timing requires that the CCE bit in the CAN Control register is set additionally to Init. This is not required for the configuration of the message objects.

When the Init bit in the CAN Control register is cleared, the CAN Protocol Controller state machine of the CAN Core and the message handler State Machine start to control the CAN's internal data flow. Received messages which pass the acceptance filtering are stored into the Message RAM; messages with pending transmission request are loaded into the CAN Core's Shift register and are transmitted via the CAN bus.

The CPU may enable the interrupt lines (setting IE0 and IE1 to '1') at the same time when it clears Init and CCE. The status interrupts EIE and SIE may be enabled simultaneously.

The CAN communication may be controlled in interrupt-driven or in polling mode. The Interrupt Register points to those message objects with IntPnd = '1'. It is updated even if the interrupt lines to the CPU are disabled (IE0 or IE1 are zero).

The CPU may poll all MessageObject's NewDat and TxRqst bits in parallel from the NewData registers and the Transmission Request registers. Polling can be made easier if all Transmit Objects are grouped at the low numbers, all Receive Objects are grouped at the high numbers.

## 21.10 Configuration of Message Objects

The entire Message RAM should to be configured before the end of the initialization; however, it is also possible to change the configuration of message objects during CAN communication.

### 21.10.1 Configuration of a Transmit Object for Data Frames

[Figure 21-6](#) shows how a transmit object can be initialized.

**Figure 21-6. Initialization of a Transmit Object**

MsgVal	Arb	Data	Mask	EoB	Dir	NewDat	MsgLst	RxlE	TxlE	IntPnd	RmtEn	TxRqst
1	appl.	appl.	appl.	1	1	0	0	0	appl.	0	appl.	0

- The arbitration bits (ID[28:0] and Xtd bit) are given by the application. They define the identifier and type of the outgoing message. If an 11-bit Identifier (standard frame) is used (Xtd = '0'), it is programmed to ID[28:18]. In this case, ID[17:0] can be ignored.
- The data registers (DLC[3:0] and Data0-7) are given by the application, TxRqst and RmtEn should not be set before the data is valid.
- If the TxIE bit is set, the IntPnd bit will be set after a successful transmission of the message object.
- If the RmtEn bit is set, a matching received remote frame will cause the TxRqst bit to be set; the remote frame will autonomously be answered by a data frame.
- The Mask bits (Msk[28:0], UMask, MXtd, and MDir bits) may be used (UMask='1') to allow groups of remote frames with similar identifiers to set the TxRqst bit. The Dir bit should not be masked. For details see [Section 21.11.8](#). Identifier masking must be disabled (UMask = '0') if no remote frames are allowed to set the TxRqst bit (RmtEn = '0').

### 21.10.2 Configuration of a Transmit Object for Remote Frames

It is not necessary to configure transmit objects for the transmission of remote frames. Setting TxRqst for a receive object will cause the transmission of a remote frame with the same identifier as the data frame for which this receive object is configured.

### 21.10.3 Configuration of a Single Receive Object for Data Frames

Figure 21-7 shows how a receive object for data frames can be initialized.

**Figure 21-7. Initialization of a single Receive Object for Data Frames**

MsgVal	Arb	Data	Mask	EoB	Dir	NewDat	MsgLst	RxIE	TxIE	IntPnd	RmtEn	TxRqst
1	appl.	appl.	appl.	1	0	0	0	appl.	0	0	0	0

- The arbitration bits (ID[28:0] and Xtd bit) are given by the application. They define the identifier and type of accepted received messages. If an 11-bit Identifier (Standard Frame) is used (Xtd = '0'), it is programmed to ID[28:18]. In this case, ID[17:0] can be ignored. When a data frame with an 11-bit Identifier is received, ID[17:0] will be set to '0'.
- The data length code (DLC[3:0]) is given by the application. When the message handler stores a data frame in the message object, it will store the received data length code and eight data bytes. If the data length code is less than 8, the remaining bytes of the message object may be overwritten by non specified values.
- The mask bits (Msk[28:0], UMask, MXtd, and MDir bits) may be used (UMask = '1') to allow groups of data frames with similar identifiers to be accepted. The Dir bit should not be masked in typical applications. If some bits of the Mask bits are set to "don't care", the corresponding bits of the Arbitration Register will be overwritten by the bits of the stored data frame.
- If the RxIE bit is set, the IntPnd bit will be set when a received data frame is accepted and stored in the message object.
- If the TxRqst bit is set, the transmission of a remote frame with the same identifier as actually stored in the Arbitration bits will be triggered. The content of the Arbitration bits may change if the Mask bits are used (UMask = '1') for acceptance filtering.

### 21.10.4 Configuration of a Single Receive Object for Remote Frames

Figure 21-8 shows how a receive object for remote frames can be initialized.

**Figure 21-8. Initialization of a single Receive Object for Remote Frames**

MsgVal	Arb	Data	Mask	EoB	Dir	NewDat	MsgLst	RxIE	TxIE	IntPnd	RmtEn	TxRqst
1	appl.	appl.	appl.	1	1	0	0	appl.	0	0	0	0

- Receive objects for remote frames may be used to monitor remote frames on the CAN bus. The remote frame stored in the receive object will not trigger the transmission of a data frame. Receive objects for remote frames may be expanded to a FIFO buffer, see [Section 21.10.5](#).
- UMask must be set to '1'. The Mask bits (Msk[28:0], UMask, MXtd, and MDir bits) may be set to "must-match" or to "don't care", to allow groups of remote frames with similar identifiers to be accepted. The Dir bit should not be masked in typical applications. For details see [Section 21.11.8](#).
- The arbitration bits (ID[28:0] and Xtd bit) may be given by the application. They define the identifier and type of accepted received remote frames. If some bits of the Mask bits are set to "don't care", the corresponding bits of the arbitration bits will be overwritten by the bits of the stored remote frame. If an 11-bit Identifier (standard frame) is used (Xtd = '0'), it is programmed to ID[28:18]. In this case, ID[17:0] can be ignored. When a remote frame with an 11-bit Identifier is received, ID[17:0] will be set to '0'.
- The data length code (DLC[3:0]) may be given by the application. When the message handler stores a remote frame in the message object, it will store the received data length code. The data bytes of the message object will remain unchanged.
- If the RxIE bit is set, the IntPnd bit will be set when a received remote frame is accepted and stored in the message object.



### 21.10.5 Configuration of a FIFO Buffer

With the exception of the EoB bit, the configuration of receive objects belonging to a FIFO buffer is the same as the configuration of a single receive object.

To concatenate multiple message objects to a FIFO buffer, the identifiers and masks (if used) of these message objects have to be programmed to matching values. Due to the implicit priority of the message objects, the message object with the lowest number will be the first message object of the FIFO buffer. The EoB bit of all message objects of a FIFO buffer except the last one have to be programmed to zero. The EoB bits of the last message object of a FIFO buffer is set to one, configuring it as the end of the block.

## 21.11 Message Handling

When initialization is finished, the CAN module synchronizes itself to the traffic on the CAN bus. It does acceptance filtering on received messages and stores those frames that are accepted into the designated message objects. The application has to update the data of the messages to be transmitted and to enable and request their transmission. The transmission is requested automatically when a matching remote frame is received.

The application may read messages which are received and accepted. Messages that are not read before the next messages is accepted for the same message object will be overwritten. Messages may be read interrupt-driven or after polling of NewDat.

### 21.11.1 Message Handler Overview

The message handler state machine controls the data transfer between the Rx/Tx Shift Register of the CAN Core and the Message RAM. It performs the following tasks:

- Data transfer from Message RAM to CAN Core (messages to be transmitted).
- Data transfer from CAN Core to the Message RAM (received messages).
- Data transfer from CAN Core to the Acceptance Filtering unit.
- Scanning of Message RAM for a matching message object (acceptance filtering).
- Scanning the same message object after being changed by IF1 or IF2 registers when priority is same or higher as message the object found by last scanning.
- Handling of TxRqst flags.
- Handling of interrupt flags.

The message handler registers contains status flags of all message objects grouped into the following topics:

- Transmission request flags
- New data flags
- Interrupt pending flags
- Message valid registers

Instead of collecting above listed status information of each message object via IFx registers separately, these message handler registers provide a fast and easy way to get an overview, for example, about all pending transmission requests.

All message handler registers are read-only.

### 21.11.2 Receive/Transmit Priority

The receive/transmit priority for the message objects is attached to the message number, not to the CAN identifier. Message object 1 has the highest priority, while message object 32 has the lowest priority. If more than one transmission request is pending, they are serviced due to the priority of the corresponding message object, so for example, messages with the highest priority can be placed in the message objects with the lowest numbers.



The acceptance filtering for received data frames or remote frames is also done in ascending order of message objects, so a frame that has been accepted by a message object cannot be accepted by another message object with a higher message number. The last message object may be configured to accept any data frame or remote frame that was not accepted by any other message object, for nodes that need to log the complete message traffic on the CAN bus.

### 21.11.3 Transmission of Messages in Event Driven CAN Communication

If the shift register of the CAN Core is ready for loading and if there is no data transfer between the IFx registers and Message RAM, the MsgVal bits in the Message Valid register and the TxRqst bits in the transmission request register are evaluated. The valid message object with the highest priority pending transmission request is loaded into the shift register by the message handler and the transmission is started. The message object's NewDat bit is reset.

After a successful transmission and if no new data was written to the message object (NewDat = '0') since the start of the transmission, the TxRqst bit will be reset. If TxIE is set, IntPnd will be set after a successful transmission. If the CAN has lost the arbitration or if an error occurred during the transmission, the message will be retransmitted as soon as the CAN bus is free again. If meanwhile the transmission of a message with higher priority has been requested, the messages will be transmitted in the order of their priority.

If automatic retransmission mode is disabled by setting the DAR bit in the CAN Control register, the behavior of bits TxRqst and NewDat in the Message Control register of the Interface register set is as follows:

- When a transmission starts, the TxRqst bit of the respective Interface register set is reset, while bit NewDat remains set.
- When the transmission has been successfully completed, the NewDat bit is reset.

When a transmission failed (lost arbitration or error) bit NewDat remains set. To restart the transmission, the application has to set TxRqst again.

Received remote frames do not require a receive object. They will automatically trigger the transmission of a data frame, if in the matching Transmit Object the RmtEn bit is set.

### 21.11.4 Updating a Transmit Object

The CPU may update the data bytes of a transmit object any time via the IF1 or IF2 interface registers, neither MsgVal nor TxRqst have to be reset before the update.

Even if only a part of the data bytes are to be updated, all four bytes in the corresponding IF1 or IF2 Data A register or the IF1 or /IF2 Data B register have to be valid before the content of that register is transferred to the message object. Either the CPU has to write all four bytes into the IF1 or IF2 Data register, or the message object is transferred to the IF1 or IF2 Data register before the CPU writes the new data bytes.

When only the data bytes are updated, first 0x87 can be written to bits [23:16] of the Command register and then the number of the message object is written to bits [7:0] of the Command register, concurrently updating the data bytes and setting TxRqst with NewDat.

To prevent the reset of TxRqst at the end of a transmission that may already be in progress while the data is updated, NewDat has to be set together with TxRqst in event driven CAN communication. For details see [Section 21.11.3](#).

When NewDat is set together with TxRqst, NewDat will be reset as soon as the new transmission has started.

### 21.11.5 Changing a Transmit Object

If the number of implemented message objects is not sufficient to be used as permanent message objects only, the transmit objects may be managed dynamically. The CPU can write the whole message (Arbitration,

Control, and Data) into the Interface register. The bits [23:16] of the Command register can be set to 0xB7 for the transfer of the whole message object content into the message object. Neither MsgVal nor TxRqst have to be reset before this operation.

If a previously requested transmission of this message object is not completed but already in progress, it will be continued; however it will not be repeated if it is disturbed.

To only update the data bytes of a message to be transmitted, bits [23:16] of the Command register should be set to 0x87.

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**NOTE:** After the update of the transmit object, the interface register set will contain a copy of the actual contents of the object, including the part that had not been updated.

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### 21.11.6 Acceptance Filtering of Received Messages

When the arbitration and control bits (Identifier + IDE + RTR + DLC) of an incoming message is completely shifted into the shift register of the CAN Core, the message handler starts to scan of the message RAM for a matching valid message object:

- The acceptance filtering unit is loaded with the arbitration bits from the CAN Core shift register.
- Then the arbitration and mask bits (including MsgVal, UMask, NewDat, and EoB) of Message Object 1 are loaded into the Acceptance Filtering unit and are compared with the arbitration bits from the shift register. This is repeated for all following message objects until a matching message object is found, or until the end of the Message RAM is reached.
- If a match occurs, the scanning is stopped and the message handler proceeds depending on the type of the frame (data frame or remote frame) received.

### 21.11.7 Reception of Data Frames

The message handler stores the message from the CAN Core shift register into the respective message object in the Message RAM. Not only the data bytes, but all arbitration bits and the data length code are stored into the corresponding message object. This ensures that the data bytes stay associated to the identifier even if arbitration mask registers are used.

The NewDat bit is set to indicate that new data (not yet seen by the CPU) has been received. The CPU should reset the NewDat bit when it reads the message object. If at the time of the reception the NewDat bit was already set, MsgLst is set to indicate that the previous data (supposedly not seen by the CPU) is lost. If the RxIE bit is set, the IntPnd bit is set, causing the Interrupt Register to point to this message object.

The TxRqst bit of this message object is reset to prevent the transmission of a remote frame, while the requested data frame has just been received.

### 21.11.8 Reception of Remote Frames

When a remote frame is received, three different configurations of the matching message object have to be considered:

1. Dir = '1' (direction = transmit), RmtEn = '1', UMask = '1' or '0'  
The TxRqst bit of this message object is set at the reception of a matching remote frame. The rest of the message object remains unchanged.
2. Dir = '1' (direction = transmit), RmtEn = '0', UMask = '0'  
The remote frame is ignored, this message object remains unchanged.
3. Dir = '1' (direction = transmit), RmtEn = '0', UMask = '1'  
The remote frame is treated similar to a received data frame. At the reception of a matching remote frame, the TxRqst bit of this message object is reset. The arbitration and control bits (Identifier + IDE + RTR + DLC) from the shift register are stored in the message object in the Message RAM and the NewDat bit of this message object is set. The data bytes of the message object remain unchanged

### 21.11.9 Reading Received Messages

The CPU may read a received message any time via the IFx interface registers, the data consistency is guaranteed by the message handler state machine.

Typically the CPU will write 0x7F to bits [23:16] and then the number of the message object to bits [7:0] of the Command Register. That combination will transfer the whole received message from the Message RAM into the Interface Register set. Additionally, the bits NewDat and IntPnd are cleared in the Message RAM (not in the Interface Register set). The values of these bits in the Message Control Register always reflect the status before resetting the bits.

If the message object uses masks for acceptance filtering, the arbitration bits show which of the different matching messages has been received.

The actual value of NewDat shows whether a new message has been received since last time when this message object was read. The actual value of MsgLst shows whether more than one message have been received since the last time when this message object was read. MsgLst will not be automatically reset.

#### 21.11.10 Requesting New Data for a Receive Object

By means of a remote frame, the CPU may request another CAN node to provide new data for a receive object. Setting the TxRqst bit of a receive object will cause the transmission of a remote frame with the receive object's identifier. This remote frame triggers the other CAN node to start the transmission of the matching data frame. If the matching data frame is received before the remote frame could be transmitted, the TxRqst bit is automatically reset.

Setting the TxRqst bit without changing the contents of a message object requires the value 0x84 in bits [23:16] of the Command Register.

#### 21.11.11 Storing Received Messages in FIFO Buffers

Several message objects may be grouped to form one or more FIFO Buffers. Each FIFO Buffer configured to store received messages with a particular (group of) Identifier(s). Arbitration and Mask registers of the FIFO Buffer's message objects are identical. The EoB (End of Buffer) bits of all but the last of the FIFO Buffer's message objects are '0', in the last one the EoB bit is '1'.

Received messages with identifiers matching to a FIFO Buffer are stored into a message object of this FIFO Buffer, starting with the message object with the lowest message number.

When a message is stored into a message object of a FIFO Buffer the NewDat bit of this message object is set. By setting NewDat while EoB is '0' the message object is locked for further write accesses by the message handler until the CPU has cleared the NewDat bit.

Messages are stored into a FIFO Buffer until the last message object of this FIFO Buffer is reached. If none of the preceding message objects is released by writing NewDat to '0', all further messages for this FIFO Buffer will be written into the last message object of the FIFO Buffer (EoB = '1') and therefore overwrite previous messages in this message object.

#### 21.11.12 Reading from a FIFO Buffer

Several messages may be accumulated in a set of message objects which are concatenated to form a FIFO Buffer before the application program is required (in order to avoid the loss of data) to empty the buffer. A FIFO Buffer of length N will store N-1 plus the last received message since last time it was cleared. A FIFO Buffer is cleared by reading and resetting the NewDat bits of all its message objects, starting at the FIFO Object with the lowest message number. This should be done in a subroutine following the example shown in [Figure 21-9](#).

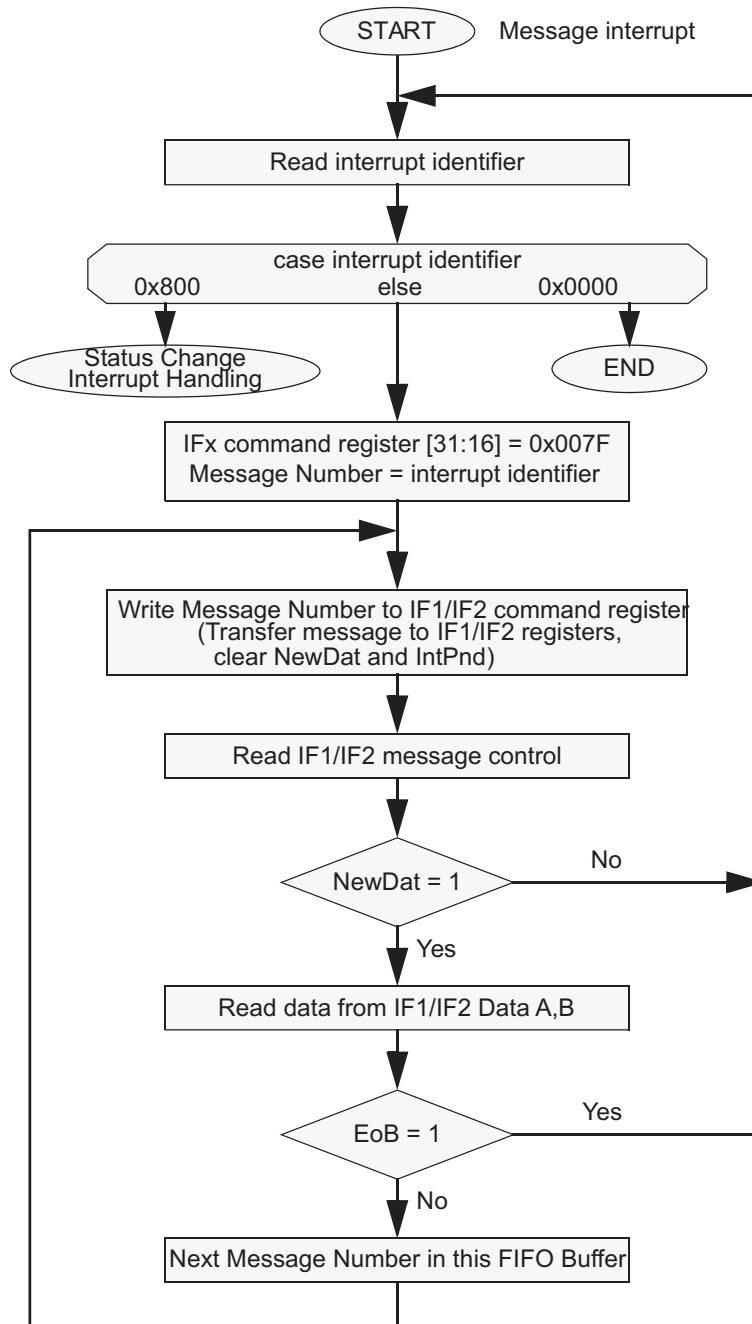
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**NOTE:** All message objects of a FIFO buffer needs to be read and cleared before the next batch of messages can be stored. Otherwise true FIFO functionality can not be guaranteed, since the message objects of a partly read buffer will be re-filled according to the normal (descending) priority.

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Reading from a FIFO Buffer message object and resetting its NewDat bit is handled the same way as reading from a single message object.

**Figure 21-9. CPU Handling of a FIFO Buffer (Interrupt Driven)**



## 21.12 CAN Bit Timing

The CAN supports bit rates between less than 1 kBit/s and 1000 kBit/s.

Each member of the CAN network has its own clock generator, typically derived from a crystal oscillator. The Bit timing parameters can be configured individually for each CAN node, creating a common Bit rate even though the CAN nodes' oscillator periods ( $f_{osc}$ ) may be different.

The frequencies of these oscillators are not absolutely stable. Small variations are caused by changes in temperature or voltage and by deteriorating components. As long as the variations remain inside a specific oscillator tolerance range ( $df$ ), the CAN nodes are able to compensate for the different bit rates by resynchronizing to the bit stream.

In many cases, the CAN bit synchronization will amend a faulty configuration of the CAN bit timing to such a degree that only occasionally an error frame is generated. In the case of arbitration however, when two or more CAN nodes simultaneously try to transmit a frame, a misplaced sample point may cause one of the transmitters to become error passive.

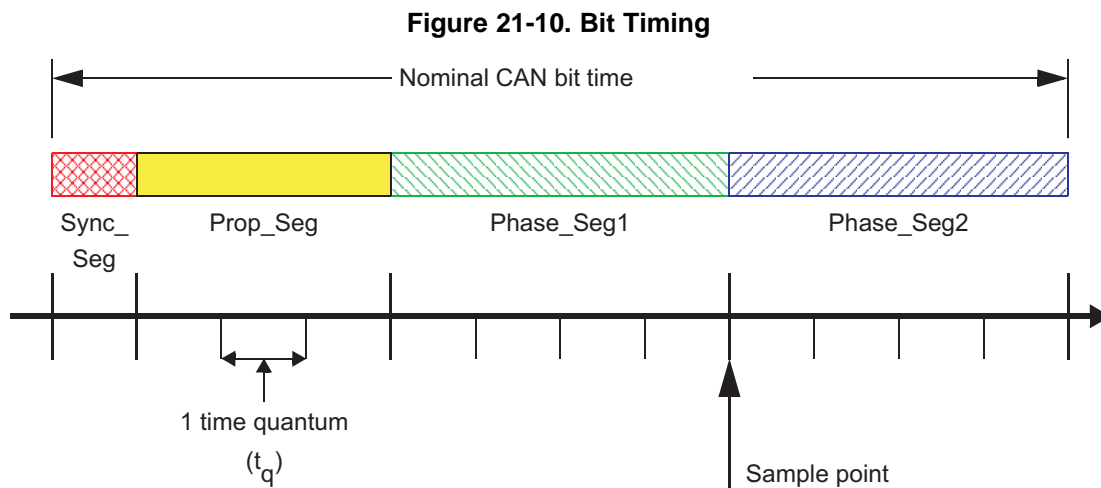
The analysis of such sporadic errors requires a detailed knowledge of the CAN bit synchronization inside a CAN node and of the CAN nodes' interaction on the CAN bus.

Even if minor errors in the configuration of the CAN bit timing do not result in immediate failure, the performance of a CAN network can be reduced significantly.

### 21.12.1 Bit Time and Bit Rate

According to the CAN specification, the Bit time is divided into four segments (see Figure 21-10):

- Synchronization Segment (Sync\_Seg)
- Propagation Time Segment (Prop\_Seg)
- Phase Buffer Segment 1 (Phase\_Seg1)
- Phase Buffer Segment 2 (Phase\_Seg2)



Each segment consists of a specific number of time quanta. The length of one time quantum ( $t_q$ ), which is the basic time unit of the bit time, is given by the CAN\_CLK and the Baud Rate Prescalers (BRPE and BRP). With these two Baud Rate Prescalers combined, divider values from 1 to 1024 can be programmed:

$$t_q = \text{Baud Rate Prescaler} / \text{CAN\_CLK}$$

Apart from the fixed length of the synchronization segment, these numbers are programmable. Table 21-4 describes the minimum programmable ranges required by the CAN protocol.

A given bit rate may be met by different bit time configurations.

**Table 21-4. Programmable Ranges Required by CAN Protocol**

Parameter	Range	Remark
Sync_Seg	1 $t_q$ (fixed)	Synchronization of bus input to CAN_CLK
Prop_Seg	[1 ... 8] $t_q$	Compensates for the physical delay times
Phase_Seg1	[1 ... 8] $t_q$	May be lengthened temporarily by synchronization
Phase_Seg2	[1 ... 8] $t_q$	May be shortened temporarily by synchronization
Synchronization Jump Width (SJW)	[1 ... 4] $t_q$	May not be longer than either Phase Buffer Segment

**NOTE:** For proper functionality of the CAN network, the physical delay times and the oscillator's tolerance range have to be considered.

### 21.12.1.1 Synchronization Segment

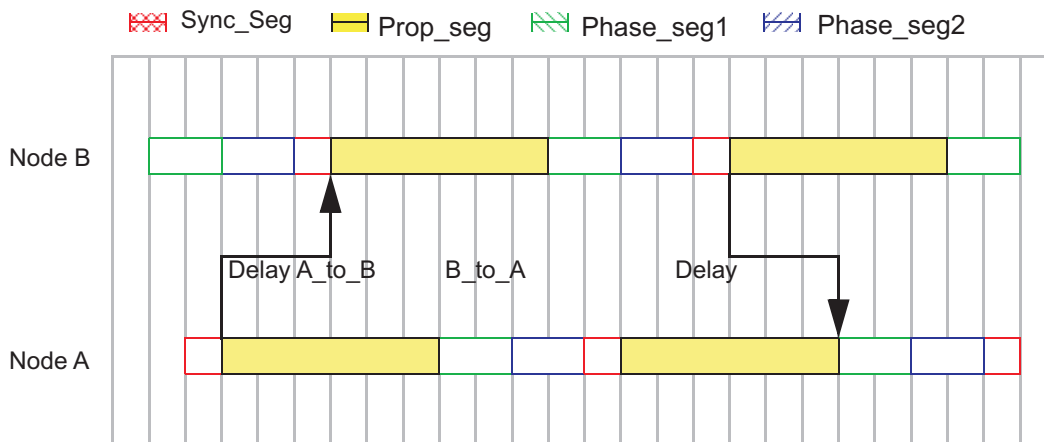
The Synchronization Segment (Sync\_Seg) is the part of the bit time where edges of the CAN bus level are expected to occur. If an edge occurs outside of Sync\_Seg, its distance to the Sync\_Seg is called the phase error of this edge.

### 21.12.1.2 Propagation Time Segment

This part of the bit time is used to compensate physical delay times within the CAN network. These delay times consist of the signal propagation time on the bus and the internal delay time of the CAN nodes.

Any CAN node synchronized to the bit stream on the CAN bus can be out of phase with the transmitter of the bit stream, caused by the signal propagation time between the two nodes. The CAN protocol's nondestructive bitwise arbitration and the dominant acknowledge bit provided by receivers of CAN messages require that a CAN node transmitting a bit stream must also be able to receive dominant bits transmitted by other CAN nodes that are synchronized to that bit stream. The example in [Figure 21-11](#) shows the phase shift and propagation times between two CAN nodes.

**Figure 21-11. The Propagation Time Segment**



$$\text{Delay A\_to\_B} \geq \text{node output delay(A)} + \text{bus line delay(A}\neq\text{B)} + \text{node input delay(B)}$$

$$\text{Prop\_Seg} \geq \text{Delay A\_to\_B} + \text{Delay B\_to\_A}$$

$$\text{Prop\_Seg} \geq 2 \cdot [\text{max}(\text{node output delay} + \text{bus line delay} + \text{node input delay})]$$

In this example, both nodes A and B are transmitters performing an arbitration for the CAN bus. The node A has sent its Start of Frame bit less than one bit time earlier than node B, therefore node B has synchronized itself to the received edge from recessive to dominant. Since node B has received this edge delay(A\_to\_B) after it has been transmitted, node B's bit timing segments are shifted with regard to node A. Node B sends an identifier with higher priority and so it will win the arbitration at a specific identifier bit when it transmits a dominant bit while node A transmits a recessive bit. The dominant bit transmitted by node B will arrive at node A after the delay(B\_to\_A).

Due to oscillator tolerances, the actual position of node A's Sample Point can be anywhere inside the nominal range of node A's Phase Buffer Segments, so the bit transmitted by node B must arrive at node A before the start of Phase\_Seg1. This condition defines the length of Prop\_Seg.

If the edge from recessive to dominant transmitted by node B would arrive at node A after the start of Phase\_Seg1, it could happen that node A samples a recessive bit instead of a dominant bit, resulting in a bit error and the destruction of the current frame by an error flag.



This error only occurs when two nodes arbitrate for the CAN bus which have oscillators of opposite ends of the tolerance range and are separated by a long bus line; this is an example of a minor error in the Bit timing configuration (Prop\_Seg too short) that causes sporadic bus errors.

Some CAN implementations provide an optional 3 Sample Mode. The CAN does not. In this mode, the CAN bus input signal passes a digital low-pass filter, using three samples and a majority logic to determine the valid bit value. This results in an additional input delay of  $1 t_q$ , requiring a longer Prop\_Seg.

### 21.12.1.3 Phase Buffer Segments and Synchronization

The phase buffer segments (Phase\_Seg1 and Phase\_Seg2) and the synchronization jump width (SJW) are used to compensate for the oscillator tolerance.

The phase buffer segments surround the sample point. The phase buffer segments may be lengthened or shortened by synchronization.

The synchronization jump width (SJW) defines how far the resynchronizing mechanism may move the sample point inside the limits defined by the phase buffer segments to compensate for edge phase errors.

Synchronizations occur on edges from recessive to dominant. Their purpose is to control the distance between edges and sample points.

Edges are detected by sampling the actual bus level in each time quantum and comparing it with the bus level at the previous sample point. A synchronization may be done only if a recessive bit was sampled at the previous sample point and if the actual time quantum's bus level is dominant.

An edge is synchronous if it occurs inside of Sync\_Seg, otherwise its distance to the Sync\_Seg is the edge phase error, measured in time quanta. If the edge occurs before Sync\_Seg, the phase error is negative, else it is positive.

Two types of synchronization exist: hard synchronization and resynchronizing. A hard synchronization is done once at the start of a frame; inside a frame only resynchronization is possible.

- Hard Synchronization

After a hard synchronization, the bit time is restarted with the end of Sync\_Seg, regardless of the edge phase error. Thus hard synchronization forces the edge which has caused the hard synchronization to lie within the synchronization segment of the restarted bit time.

- Bit Resynchronizations

Resynchronization leads to a shortening or lengthening of the bit time such that the position of the sample point is shifted with regard to the edge.

When the phase error of the edge which causes resynchronization is positive, Phase\_Seg1 is lengthened. If the magnitude of the phase error is less than SJW, Phase\_Seg1 is lengthened by the magnitude of the phase error, else it is lengthened by SJW.

When the phase error of the edge which causes Resynchronization is negative, Phase\_Seg2 is shortened. If the magnitude of the phase error is less than SJW, Phase\_Seg2 is shortened by the magnitude of the phase error, else it is shortened by SJW.

If the magnitude of the phase error of the edge is less than or equal to the programmed value of SJW, the results of hard synchronization and resynchronization are the same. If the magnitude of the phase error is larger than SJW, the resynchronization cannot compensate the phase error completely, and an error of (phase error - SJW) remains.

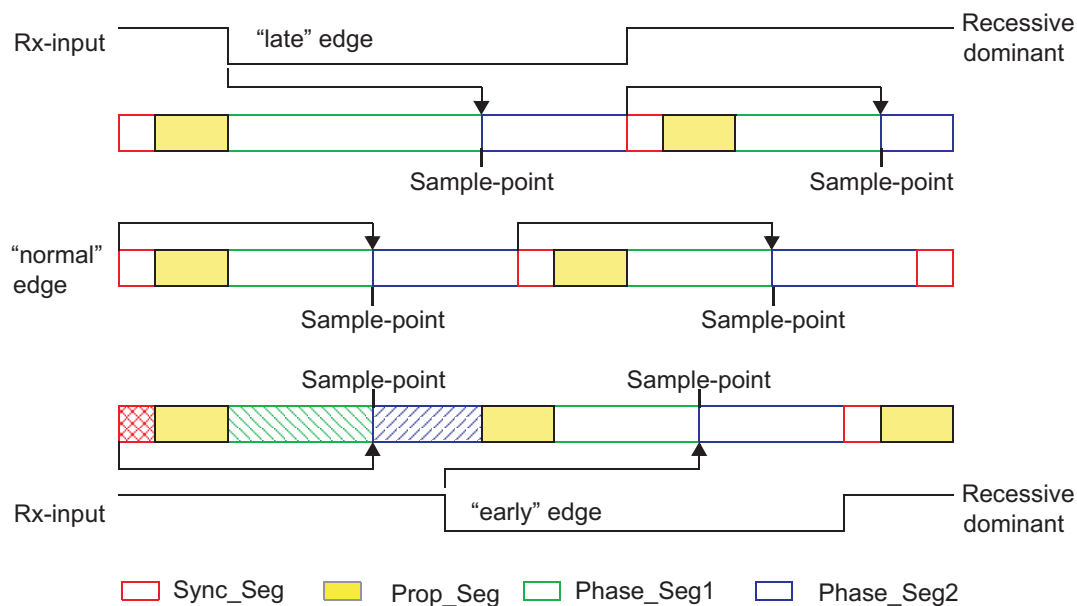
Only one synchronization may be done between two sample points. The synchronizations maintain a minimum distance between edges and sample points, giving the bus level time to stabilize and filtering out spikes that are shorter than (Prop\_Seg + Phase\_Seg1).

Apart from noise spikes, most synchronizations are caused by arbitration. All nodes synchronize "hard" on the edge transmitted by the "leading" transceiver that started transmitting first, but due to propagation delay times, they cannot become ideally synchronized. The "leading" transmitter does not necessarily win the arbitration, therefore the receivers have to synchronize themselves to different transmitters that subsequently "take the lead" and that are differently synchronized to the previously "leading" transmitter. The same happens at the acknowledge field, where the transmitter and some of the receivers will have to synchronize to that receiver that "takes the lead" in the transmission of the dominant acknowledge bit.

Synchronizations after the end of the arbitration will be caused by oscillator tolerance, when the differences in the oscillator's clock periods of transmitter and receivers sum up during the time between synchronizations (at most ten bits). These summarized differences may not be longer than the SJW, limiting the oscillator's tolerance range.

The examples in [Figure 21-12](#) show how the phase buffer segments are used to compensate for phase errors. There are three drawings of each two consecutive bit timings. The upper drawing shows the synchronization on a "late" edge, the lower drawing shows the synchronization on an "early" edge, and the middle drawing is the reference without synchronization.

**Figure 21-12. Synchronization on Late and Early Edges**



In the first example, an edge from recessive to dominant occurs at the end of Prop\_Seg. The edge is "late" since it occurs after the Sync\_Seg. Reacting to the "late" edge, Phase\_Seg1 is lengthened so that the distance from the edge to the sample point is the same as it would have been from the Sync\_Seg to the sample point if no edge had occurred. The phase error of this "late" edge is less than SJW, so it is fully compensated and the edge from dominant to recessive at the end of the bit, which is one nominal bit time long, occurs in the Sync\_Seg.

In the second example, an edge from recessive to dominant occurs during Phase\_Seg2. The edge is "early" since it occurs before a Sync\_Seg. Reacting to the "early" edge, Phase\_Seg2 is shortened and Sync\_Seg is omitted, so that the distance from the edge to the sample point is the same as it would have been from a Sync\_Seg to the sample point if no edge had occurred. As in the previous example, the magnitude of this "early" edge's phase error is less than SJW, so it is fully compensated.

The phase buffer segments are lengthened or shortened temporarily only; at the next bit time, the segments return to their nominal programmed values.

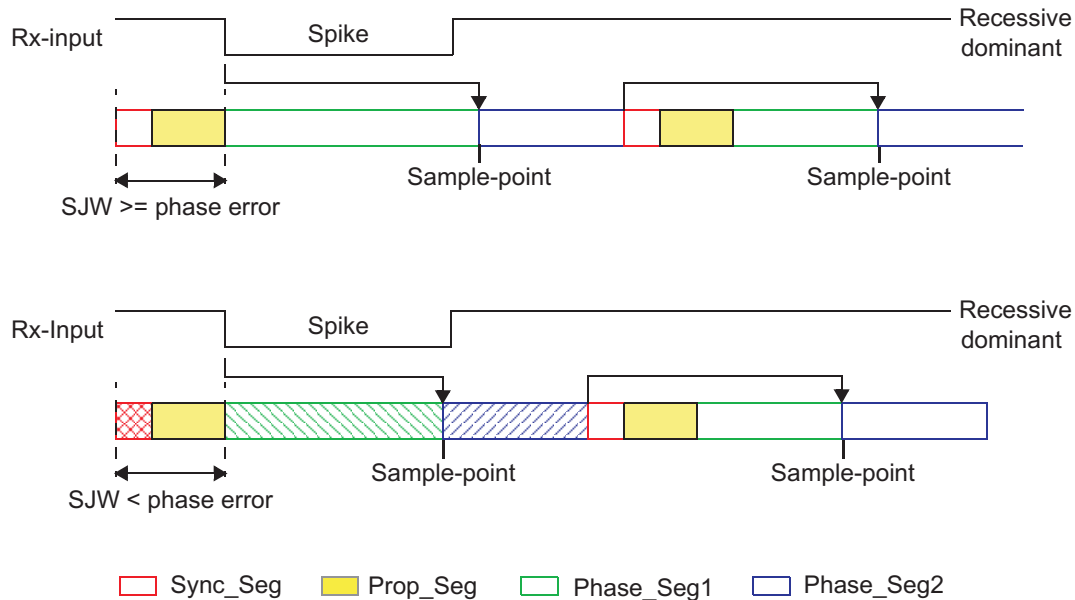
In these examples, the bit timing is seen from the point of view of the CAN implementation's state machine, where the bit time starts and ends at the sample points. The state machine omits Sync\_Seg when synchronizing on an "early" edge because it cannot subsequently redefine that time quantum of Phase\_Seg2 where the edge occurs to be the Sync\_Seg.

The examples in [Figure 21-13](#) show how short dominant noise spikes are filtered by synchronizations. In both examples, the spike starts at the end of Prop\_Seg and has the length of (Prop\_Seg + Phase\_Seg1). In the first example, the synchronization jump width is greater than or equal to the phase error of the spike's edge from recessive to dominant. Therefore the sample point is shifted after the end of the spike; a recessive bus level is sampled.

In the second example, SJW is shorter than the phase error, so the sample point cannot be shifted far enough; the dominant spike is sampled as actual bus level.



Figure 21-13. Filtering of Short Dominant Spikes



#### 21.12.1.4 Oscillator Tolerance Range

With the introduction of CAN protocol version 1.2, the option to synchronize on edges from dominant to recessive became obsolete. Only edges from recessive to dominant are considered for synchronization. The protocol update to version 2.0 (A and B) had no influence on the oscillator tolerance.

The tolerance range  $df$  for an oscillator's frequency  $f_{osc}$  around the nominal frequency  $f_{nom}$  with

$$(1 - df) \cdot f_{nom} \leq f_{osc} \leq (1 + df) \cdot f_{nom}$$

depends on the proportions of Phase\_Seg1, Phase\_Seg2, SJW, and the bit time. The maximum tolerance  $df$  is defined by two conditions (both shall be met):

(8)

$$df \leq \frac{\min(Tseg1, Tseg2)}{2((13 \times bit\ time) - Tseg2)}$$

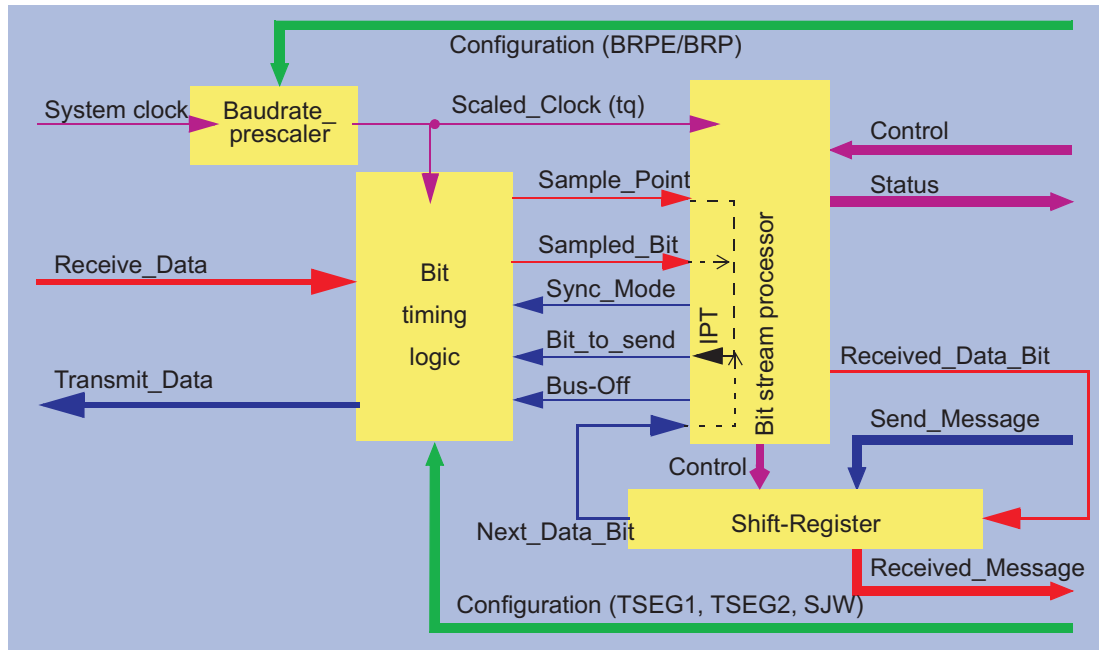
$$df \leq \frac{SJW}{20 \times bit\_time}$$

It has to be considered that SJW may not be larger than the smaller of the phase buffer segments and that the propagation time segment limits that part of the bit time that may be used for the phase buffer segments.

The combination Prop\_Seg = 1 and Phase\_Seg1 = Phase\_Seg2 = SJW = 4 allows the largest possible oscillator tolerance of 1.58%. This combination with a Propagation Time Segment of only 10% of the bit time is not suitable for short bit times; it can be used for bit rates of up to 125 kBit/s (bit time = 8  $\mu$ s) with a bus length of 40 m.

#### 21.12.2 Configuration of the CAN Bit Timing

In the CAN, the bit timing configuration is programmed in two register bytes, additionally a third byte for a baud rate prescaler extension of 4 bits (BRPE) is provided. The sum of Prop\_Seg and Phase\_Seg1 (as TSEG1) is combined with Phase\_Seg2 (as TSEG2) in one byte, SJW and BRP (plus BRPE in third byte) are combined in the other byte (see Figure 21-14).

**Figure 21-14. Structure of the CAN Core's CAN Protocol Controller**


In this bit timing register, the components TSEG1, TSEG2, SJW and BRP have to be programmed to a numerical value that is one less than its functional value; so instead of values in the range of [1...n], values in the range of [0...n-1] are programmed. That way, for example, SJW (functional range of [1...4]) is represented by only two bits.

Therefore the length of the Bit time is (programmed values)  $[TSEG1 + TSEG2 + 3] t_q$  or (functional values)  $[Sync\_Seg + Prop\_Seg + Phase\_Seg1 + Phase\_Seg2] t_q$ .

The data in the Bit Timing Register is the configuration input of the CAN protocol controller. The baud rate prescaler (configured by BRPE/BRP) defines the length of the time quantum (the basic time unit of the bit time); the bit timing logic (configured by TSEG1, TSEG2, and SJW) defines the number of time quanta in the bit time.

The processing of the bit time, the calculation of the position of the Sample Point, and occasional synchronizations are controlled by the Bit timing state machine, which is evaluated once each time quantum. The rest of the CAN protocol controller, the Bit Stream Processor (BSP) state machine, is evaluated once each bit time, at the Sample Point.

The Shift register serializes the messages to be sent and parallelizes received messages. Its loading and shifting is controlled by the BSP.

The BSP translates messages into frames and vice versa. It generates and discards the enclosing fixed format bits, inserts and extracts stuff bits, calculates and checks the CRC code, performs the error management, and decides which type of synchronization is to be used. It is evaluated at the sample point and processes the sampled bus input bit. The time after the sample point that is needed to calculate the next bit to be sent (for example, data bit, CRC bit, stuff bit, error flag, or idle) is called the Information Processing Time (IPT), which is  $0 t_q$  for the CAN.

Generally, the IPT is CAN controller specific, but may not be longer than  $2 t_q$ . The IPC length is the lower limit of the programmed length of Phase\_Seg2. In case of a synchronization, Phase\_Seg2 may be shortened to a value less than IPT, which does not affect bus timing.

### 21.12.2.1 Calculation of the Bit Timing Parameters

Usually, the calculation of the bit timing configuration starts with a desired bit rate or bit time. The resulting Bit time ( $1 / \text{Bit rate}$ ) must be an integer multiple of the CAN clock period.

**NOTE:** 8 MHz is the minimum CAN clock frequency required to operate the CAN at a bit rate of 1 MBit/s.

The bit time may consist of 8 to 25 time quanta. The length of the time quantum  $t_q$  is defined by the Baud Rate Prescaler with  $t_q = (\text{Baud Rate Prescaler}) / \text{CAN\_CLK}$ . Several combinations may lead to the desired bit time, allowing iterations of the following steps.

The first part of the bit time to be defined is the Prop\_Seg. Its length depends on the delay times measured in the system. A maximum bus length as well as a maximum node delay has to be defined for expandible CAN bus systems. The resulting time for Prop\_Seg is converted into time quanta (rounded up to the nearest integer multiple of  $t_q$ ).

The Sync\_Seg is 1  $t_q$  long (fixed), leaving  $(\text{bit time} - \text{Prop\_Seg} - 1) t_q$  for the two Phase Buffer Segments. If the number of remaining  $t_q$  is even, the Phase Buffer Segments have the same length, Phase\_Seg2 = Phase\_Seg1, else Phase\_Seg2 = Phase\_Seg1 + 1.

The minimum nominal length of Phase\_Seg2 has to be regarded as well. Phase\_Seg2 may not be shorter than any CAN controller's Information Processing Time in the network, which is device dependent and can be in the range of  $[0 \dots 2] t_q$ .

The length of the synchronization jump width is set to its maximum value, which is the minimum of 4 and Phase\_Seg1.

The oscillator tolerance range necessary for the resulting configuration is calculated by the formulas given in [Section 21.12.1.4](#).

If more than one configurations are possible to reach a certain Bit rate, it is recommended to choose the configuration which allows the highest oscillator tolerance range.

CAN nodes with different clocks require different configurations to come to the same bit rate. The calculation of the propagation time in the CAN network, based on the nodes with the longest delay times, is done once for the whole network.

The CAN system's oscillator tolerance range is limited by the node with the lowest tolerance range.

The calculation may show that bus length or bit rate have to be decreased or that the oscillator frequencies' stability has to be increased in order to find a protocol compliant configuration of the CAN bit timing.

The resulting configuration is written into the Bit Timing register:

```
(Phase_Seg2-1)&(Phase_Seg1+Prop_Seg-1)&
(SynchronizationJumpWidth-1)&(Prescaler-1)
```

### 21.12.2.2 Example for Bit Timing at High Baudrate

In this example, the frequency of CAN\_CLK is 10 MHz, BRP is 0, the bit rate is 1 MBit/s.

$t_q$	100 ns	=	$t_{\text{CAN\_CLK}}$
delay of bus driver	90 ns	=	
delay of receiver circuit	40 ns	=	
delay of bus line (40m)	220 ns	=	
$t_{\text{Prop}}$	700 ns	=	$2 \cdot \text{delays} = 7 \cdot t_q$
$t_{\text{SJW}}$	100 ns	=	$1 \cdot t_q$
$t_{\text{TSeg1}}$	800 ns	=	$t_{\text{Prop}} + t_{\text{SJW}}$
$t_{\text{TSeg2}}$	100 ns	=	Information Processing Time + $1 \cdot t_q$
$t_{\text{Sync-Seg}}$	100 ns	=	$1 \cdot t_q$
bit time	1000 ns	=	$t_{\text{Sync-Seg}} + t_{\text{TSeg1}} + t_{\text{TSeg2}}$

$$\begin{aligned}
 \text{tolerance for CAN\_CLK} \quad 0.43 \% &= \frac{\min(T_{seg1}, T_{seg2})}{2((13 \times \text{bit time}) - T_{seg2})} \\
 &= \frac{0.1 \mu\text{s}}{2((13 \times 1 \mu\text{s}) - 0.1 \mu\text{s})}
 \end{aligned}$$

In this example, the concatenated bit time parameters are  $(1-1)_3 \& (8-1)_4 \& (1-1)_2 \& (1-1)_6$ , so the Bit Timing Register is programmed to = 0x00000700.

### 21.12.2.3 Example for Bit Timing at Low Baudrate

In this example, the frequency of CAN\_CLK is 2 MHz, BRP is 1, the bit rate is 100 KBit/s.

$t_q$	1 $\mu\text{s}$	=	$2 \cdot t_{\text{CAN\_CLK}}$
delay of bus driver	200 ns	=	
delay of receiver circuit	80 ns	=	
delay of bus line (40m)	220 ns	=	
$t_{\text{Prop}}$	1 $\mu\text{s}$	=	$1 \cdot t_q$
$t_{\text{SJW}}$	4 $\mu\text{s}$	=	$4 \cdot t_q$
$t_{\text{TSeg1}}$	5 $\mu\text{s}$	=	$t_{\text{Prop}} + t_{\text{SJW}}$
$t_{\text{TSeg2}}$	4 $\mu\text{s}$	=	Information Processing Time + $4 \cdot t_q$
$t_{\text{Sync-Seg}}$	1 $\mu\text{s}$	=	$1 \cdot t_q$
bit time	10 $\mu\text{s}$	=	$t_{\text{Sync-Seg}} + t_{\text{TSeg1}} + t_{\text{TSeg2}}$
tolerance for CAN_CLK	3.08 %	=	$\frac{\min(T_{seg1}, T_{seg2})}{2((13 \times \text{bit time}) - T_{seg2})}$ $= \frac{4 \mu\text{s}}{2((13 \times 10 \mu\text{s}) - 4 \mu\text{s})}$

In this example, the concatenated bit time parameters are  $(4-1)_3 \& (5-1)_4 \& (4-1)_2 \& (2-1)_6$ , so the Bit Timing register is programmed to = 0x000034C1.

## 21.13 Message Interface Register Sets

The interface register sets control the CPU read and write accesses to the Message RAM. There are two interface register sets for read / write access (IF1 and IF2) and one Interface Register Set for read access only (IF3).

Due to the structure of the Message RAM, it is not possible to change single bits or bytes of a message object. Instead, always a complete message object in the Message RAM is accessed. Therefore the data transfer from the IF1 or IF2 registers to the Message RAM requires the message handler to perform a read-modifywrite cycle. First those parts of the message object that are not to be changed are read from the Message RAM into the Interface Register set, and after the update the whole content of the Interface Register set is written into the message object.

After the partial write of a message object, those parts of the Interface Register set which are not selected in the Command Register, will be set to the actual contents of the selected message object. After the partial read of a message object, those parts of the Interface Register set which are not selected in the Command Register, will be left unchanged.

By buffering the data to be transferred, the Interface Register sets avoid conflicts between concurrent CPU accesses to the Message RAM and CAN message reception and transmission. A complete message object (see [Section 21.14.1](#)) or parts of the message object may be transferred between the Message RAM and the IF1 or IF2 Register set in one single transfer. This transfer, performed in parallel on all selected parts of the message object, guarantees the data consistency of the CAN message.

That being said, there is one condition that can cause a write access to the message RAM to be lost. If  $MsgVal = 1$  for the message object which is accessed and CAN communication is ongoing, a transfer from the IFx register to message RAM may be lost. The reason for this is that it might happen that the IFx register write to the message RAM occurs in between a read-modify-write access of the Host Message Handler when it is in the process of receiving a message for the same message object.

To avoid this issue with receive mail boxes, reset  $MsgVal$  before changing any of the following: Id28-0, Xtd, Dir, DLC3-0, RxIE, TxIE, RmtEn, EoB, Umask, Msk28-0, MXtd, and MDir.

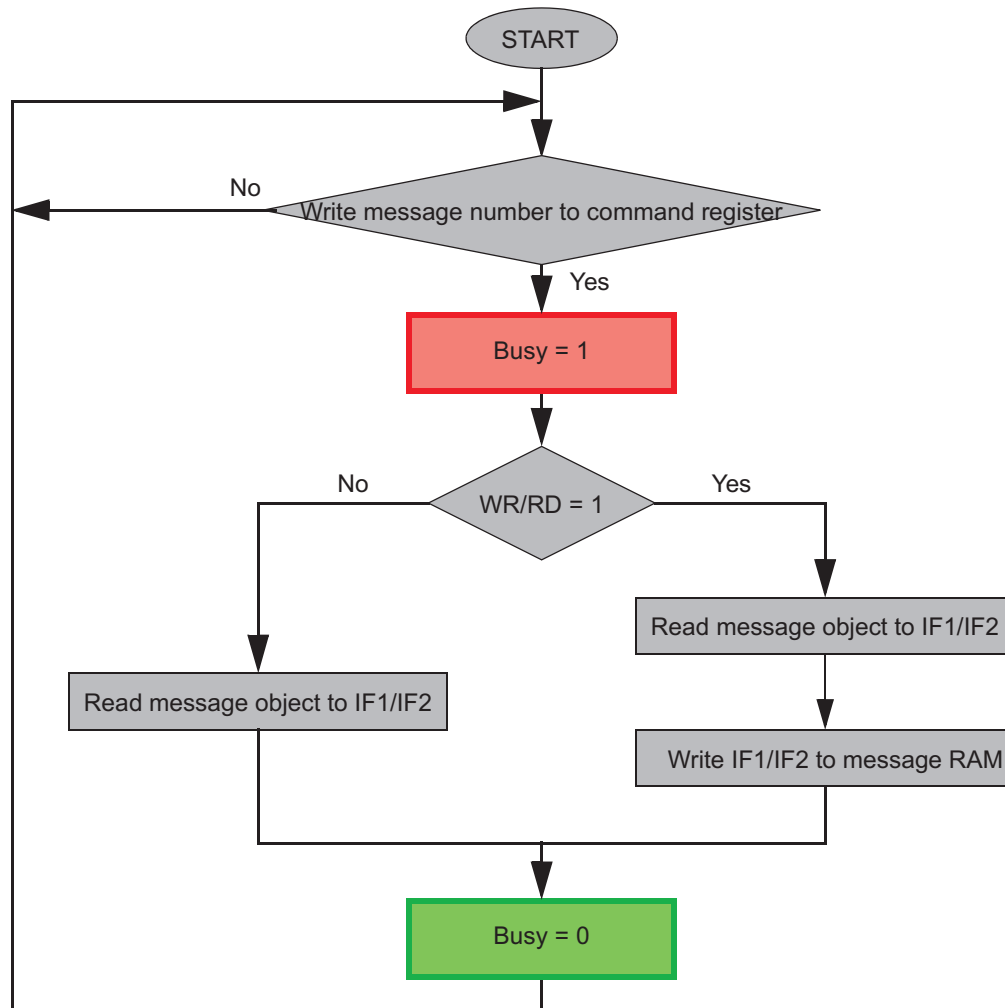
To avoid this issue with transmit mail boxes, reset  $MsgVal$  before changing any of the following: Dir, RxIE, TxIE, RmtEn, EoB, Umask, Msk28-0, MXtd, and MDir. Other fields not listed above, like Data, may be changed without fear of losing a write to the message RAM.

### 21.13.1 Message Interface Register Sets 1 and 2

The IF1 and IF2 registers Sets control the data transfer to and from the message object. The Command Register addresses the desired message object in the Message RAM and specifies whether a complete message object or only parts should be transferred. The data transfer is initiated by writing the message number to the bits [7:0] of the Command Register.

When the CPU initiates a data transfer between the IF1 or IF2 registers and Message RAM, the message handler sets the Busy bit in the respective Command Register to '1'. After the transfer has completed, the Busy bit is set back to '0' (see [Figure 21-15](#)).

Figure 21-15. Data Transfer Between IF1 / IF2 Registers and Message RAM



### 21.13.2 IF3 Register Set

The IF3 register set can automatically be updated with received message objects without the need to initiate the transfer from Message RAM by CPU. The automatic update functionality can be programmed for each message object (see IF3 Update Enable register).

All valid message objects in Message RAM which are configured for automatic update, will be checked for active NewDat flags. If such a message object is found, it will be transferred to the IF3 register, controlled by IF3 Observation register. If more than one NewDat flag is active, the message object with the lowest number has the highest priority for automatic IF3 update.

The NewDat bit in the message object will be reset by a transfer to IF3.

If CAN internal IF3 update is complete, an IF3 interrupt can also be generated.

---

**NOTE:** The IF3 register set cannot be used for transferring data into message objects.

---

### 21.14 Message RAM

The CAN Message RAM contains message objects and parity bits for the message objects. There are 32 message objects in the Message RAM.

During normal operation, accesses to the Message RAM are performed via the Interface Register sets, and the CPU cannot directly access the Message RAM.

The Interface Register sets IF1 and IF2 provide indirect read/write access from the CPU to the Message RAM. The IF1 and IF2 register sets can buffer control and user data to be transferred to and from the message objects.

The third Interface Register set IF3 can be configured to automatically receive control and user data from the Message RAM when a message object has been updated after reception of a CAN message. The CPU does not need to initiate the transfer from Message RAM to IF3 Register set.

The message handler avoids potential conflicts between concurrent accesses to Message RAM and CAN frame reception/transmission.

The message RAM can only be accessed in debug mode. The message RAM base address is 0x1000 above the base address of the CAN peripheral.

#### 21.14.1 Structure of Message Objects

Figure 21-16 shows the structure of a message object.

The grayed fields are those parts of the message object which are represented in dedicated registers. For example, the transmit request flags of all message objects are represented in centralized transmit request registers.

**Figure 21-16. Structure of a Message Object**

Message Object												
UMask	Msk[28:0]	MXtd	MDir	EoB	unused	NewDat	MsgLst	RxIE	TxIE	IntPnd	RmtEn	TxRqst
MsgVal	ID[28:0]	Xtd	Dir	DLC[3:0]	Data 0	Data 1	Data 2	Data 3	Data 4	Data 5	Data 6	Data 7

**Table 21-5. Message Object Field Descriptions**

Name	Value	Description
MsgVal		Message valid
	0	The message object is ignored by the message handler.
	1	The message object is to be used by the message handler.
		Note: This bit may be kept at level '1' even when the identifier bits ID[28:0], the control bits Xtd, Dir, or the data length code DLC[3:0] are changed. It should be reset if the Messages Object is no longer required.

**Table 21-5. Message Object Field Descriptions (continued)**

Name	Value	Description
UMask	0 1	Use Acceptance Mask Mask bits (Msk[28:0], MXtd and MDir) are ignored and not used for acceptance filtering. Mask bits are used for acceptance filtering. Note: If the UMask bit is set to one, the message object's mask bits have to be programmed during initialization of the message object before MsgVal is set to one.
ID[28:0]	ID[28:0] ID[28:18]	Message Identifier 29-bit ("extended") identifier bits 11-bit ("standard") identifier bits
Msk[28:0]	0 1	Identifier Mask Note: The bit functionality in DCAN module is the opposite of the "Local Acceptance Mask" bit functionality in the eCAN module found in older C28xx devices, where a "1" means the corresponding bit is NOT used for filtering and "0" means it is used. The corresponding bit in the message identifier is not used for acceptance filtering (don't care). The corresponding bit in the message identifier is used for acceptance filtering. Note: The bit functionality in DCAN module is the opposite of the "Local Acceptance Mask" bit functionality in the eCAN module found in older C28xx devices, where a "1" means the corresponding bit is NOT used for filtering and "0" means it is used.
Xtd	0 1	Extended Identifier The 11-bit ("standard") identifier will be used for this message object. The 29-bit ("extended") identifier will be used for this message object.
MXtd	0 1	Mask Extended Identifier The extended identifier bit (IDE) has no effect on the acceptance filtering. The extended identifier bit (IDE) is used for acceptance filtering. Note: When 11-bit ("standard") Identifiers are used for a message object, the identifiers of received data frames are written into bits ID[28:18]. For acceptance filtering, only these bits together with mask bits Msk[28:18] are considered.
Dir	0 1	Message Direction Direction = receive: On TxRqst, a remote frame with the identifier of this message object is transmitted. On reception of a data frame with matching identifier, the message is stored in this message object. Direction = transmit: On TxRqst, a data frame is transmitted. On reception of a remote frame with matching identifier, the TxRqst bit of this message object is set (if RmtEn = one).
MDir	0 1	Mask Message Direction The message direction bit (Dir) has no effect on the acceptance filtering. The message direction bit (Dir) is used for acceptance filtering.
EOB	0 1	End of Block The message object is part of a FIFO Buffer block and is not the last message object of this FIFO Buffer block. The message object is a single message object or the last message object in a FIFO Buffer Block. Note: This bit is used to concatenate multiple message objects to build a FIFO Buffer. For single message objects (not belonging to a FIFO Buffer), this bit must always be set to one.
NewDat	0 1	New Data No new data has been written into the data bytes of this message object by the message handler since the last time when this flag was cleared by the CPU. The message handler or the CPU has written new data into the data bytes of this message object.
MsgLst	0 1	Message Lost (only valid for Message Objects with direction = receive) No message was lost since the last time when this bit was reset by the CPU. The message handler stored a new message into this message object when NewDat was still set, so the previous message has been overwritten.
RxIE	0 1	Receive Interrupt Enable IntPnd will not be triggered after the successful reception of a frame. IntPnd will be triggered after the successful reception of a frame.



**Table 21-5. Message Object Field Descriptions (continued)**

Name	Value	Description
TxIE	0	Transmit Interrupt Enable IntPnd will not be triggered after the successful transmission of a frame.
	1	IntPnd will be triggered after the successful transmission of a frame.
IntPnd	0	Interrupt Pending This message object is not the source of an interrupt.
	1	This message object is the source of an interrupt. The Interrupt Identifier in the Interrupt Register will point to this message object if there is no other interrupt source with higher priority.
RmtEn	0	Remote Enable At the reception of a remote frame, TxRqst is not changed.
	1	At the reception of a remote frame, TxRqst is set. Note: See <a href="#">Section 21.11.8</a> for details on the setup of RmtEn and UMask for remote frames.
TxRqst	0	Transmit Request This message object is not waiting for a transmission.
	1	The transmission of this message object is requested and is not yet done.
DLC[3:0]	0-8	Data length code Data frame has 0-8 data bytes.
	9-15	Data frame has 8 data bytes. Note: The data length code of a message object must be defined to the same value as in the corresponding objects with the same identifier at other nodes. When the message handler stores a data frame, it will write the DLC to the value given by the received message.
Data 0		1st data byte of a CAN data frame
Data 1		2nd data byte of a CAN data frame
Data 2		3rd data byte of a CAN data frame
Data 3		4th data byte of a CAN data frame
Data 4		5th data byte of a CAN data frame
Data 5		6th data byte of a CAN data frame
Data 6		7th data byte of a CAN data frame
Data 7		8th data byte of a CAN data frame  Note: Byte Data 0 is the first data byte shifted into the shift register of the CAN Core during a reception, byte Data 7 is the last. When the message handler stores a data frame, it will write all the eight data bytes into a message object. If the data length code is less than 8, the remaining bytes of the message object may be overwritten by undefined values.

### 21.14.2 Addressing Message Objects in RAM

The starting location of a particular message object in RAM is:

Message RAM base address + (message object number) \* 0x20.

This means that Message Object 1 starts at offset 0x0020; Message Object 2 starts at offset 0x0040, etc.

---

**NOTE:** '0' is not a valid message object number. At address 0x0000, the last message object (32) (with the lowest priority) is located. Writing to the address of an unimplemented message object may overwrite an implemented message object.

---

Message Object number 1 has the highest priority.



**Table 21-6. Message RAM Addressing in Debug Mode**

Message Object Number	Offset From Base Address	Word Number	Debug Mode <sup>(1)</sup>
last implemented (here:32)	0x0000	1	Parity
	0x0004	2	MXtd,MDir,Mask
	0x0008	3	Xtd,Dir,ID
	0x000C	4	Ctrl
	0x0010	5	Data Bytes 3-0
	0x0014	6	Data Bytes 7-4
1	0x0020	1	Parity
	0x0024	2	MXtd,MDir,Mask
	0x0028	3	Xtd,Dir,ID
	0x002C	4	Ctrl
	0x0030	5	Data Bytes 3-0
	0x0034	6	Data Bytes 7-4
2	0x0040	1	Parity
	0x0044	2	MXtd,MDir,Mask
	0x0048	3	Xtd,Dir,ID
	0x004C	4	Ctrl
	0x0050	5	Data Bytes 3-0
	0x0054	6	Data Bytes 7-4
...	...	...	...
31	0x03E0	1	Parity
	0x03E4	2	MXtd,MDir,Mask
	0x03E8	3	Xtd,Dir,ID
	0x03EC	4	Ctrl
	0x03F0	5	Data Bytes 3-0
	0x03F4	6	Data Bytes 7-4

<sup>(1)</sup> See [Section 21.14.3](#).

### 21.14.3 Message RAM Representation in Debug Mode

In debug mode, the Message RAM will be memory mapped. This allows the external debug unit to access the Message RAM.

---

**NOTE:** During debug mode, the Message RAM cannot be accessed via the IFx register sets.

---

**Figure 21-17. Message RAM Representation in Debug Mode**

31/ 15	30/ 14	29/ 13	28/ 12	27/ 11	26/ 10	25/ 9	24/ 8	23/ 7	22/ 6	21/ 5	20/ 4	19/ 3	18/ 2	17/ 1	16/ 0						
<b>MsgAddr + 0x00</b>																					
Reserved																					
Reserved												Parity[4:0]									
<b>MsgAddr + 0x04</b>																					
MXtd			MDir			Rsvd			Msk[28:16]												
Msk[15:0]																					
<b>MsgAddr + 0x08</b>																					
Rsvd			Xtd			Dir			ID[28:16]												
ID[15:0]																					
<b>MsgAddr + 0x0C</b>																					
Reserved																					
Rsvd		MsgLs t		Rsvd		UMask		TxIE		RxIE		RmtEn		Rsvd		EOB		Reserved		DLC[3:0]	
<b>MsgAddr + 0x10</b>																					
Data 3								Data 2													
Data 1								Data 0													
<b>MsgAddr + 0x14</b>																					
Data 7								Data 6													
Data 5								Data 4													

## 21.15 Registers

### 21.15.1 CAN Base Addresses

**Table 21-7. CAN Base Addresses Table**

Device Registers	Register Name	Start Address	End Address
CanaRegs	CAN_REGS	0x0004_8000	0x0004_87FF
CanbRegs	CAN_REGS	0x0004_A000	0x0004_A7FF

## 21.15.2 CAN\_REGS Registers

Table 21-8 lists the memory-mapped registers for the CAN\_REGS. All register offset addresses not listed in Table 21-8 should be considered as reserved locations and the register contents should not be modified.

**Table 21-8. CAN\_REGS Registers**

Offset	Acronym	Register Name	Write Protection	Section
0h	CAN_CTL	CAN Control Register		<a href="#">Go</a>
4h	CAN_ES	Error and Status Register		<a href="#">Go</a>
8h	CAN_ERRC	Error Counter Register		<a href="#">Go</a>
Ch	CAN_BTR	Bit Timing Register		<a href="#">Go</a>
10h	CAN_INT	Interrupt Register		<a href="#">Go</a>
14h	CAN_TEST	Test Register		<a href="#">Go</a>
1Ch	CAN_PERR	CAN Parity Error Code Register		<a href="#">Go</a>
40h	CAN_RAM_INIT	CAN RAM Initialization Register		<a href="#">Go</a>
50h	CAN_GLB_INT_EN	CAN Global Interrupt Enable Register		<a href="#">Go</a>
54h	CAN_GLB_INT_FLG	CAN Global Interrupt Flag Register		<a href="#">Go</a>
58h	CAN_GLB_INT_CLR	CAN Global Interrupt Clear Register		<a href="#">Go</a>
80h	CAN_ABOTR	Auto-Bus-On Time Register		<a href="#">Go</a>
84h	CAN_TXRQ_X	CAN Transmission Request Register		<a href="#">Go</a>
88h	CAN_TXRQ_21	CAN Transmission Request 2_1 Register		<a href="#">Go</a>
98h	CAN_NDAT_X	CAN New Data Register		<a href="#">Go</a>
9Ch	CAN_NDAT_21	CAN New Data 2_1 Register		<a href="#">Go</a>
ACh	CAN_IPEN_X	CAN Interrupt Pending Register		<a href="#">Go</a>
B0h	CAN_IPEN_21	CAN Interrupt Pending 2_1 Register		<a href="#">Go</a>
C0h	CAN_MVAL_X	CAN Message Valid Register		<a href="#">Go</a>
C4h	CAN_MVAL_21	CAN Message Valid 2_1 Register		<a href="#">Go</a>
D8h	CAN_IP_MUX21	CAN Interrupt Multiplexer 2_1 Register		<a href="#">Go</a>
100h	CAN_IF1CMD	IF1 Command Register		<a href="#">Go</a>
104h	CAN_IF1MSK	IF1 Mask Register		<a href="#">Go</a>
108h	CAN_IF1ARB	IF1 Arbitration Register		<a href="#">Go</a>
10Ch	CAN_IF1MCTL	IF1 Message Control Register		<a href="#">Go</a>
110h	CAN_IF1DATA	IF1 Data A Register		<a href="#">Go</a>
114h	CAN_IF1DATB	IF1 Data B Register		<a href="#">Go</a>
120h	CAN_IF2CMD	IF2 Command Register		<a href="#">Go</a>
124h	CAN_IF2MSK	IF2 Mask Register		<a href="#">Go</a>
128h	CAN_IF2ARB	IF2 Arbitration Register		<a href="#">Go</a>
12Ch	CAN_IF2MCTL	IF2 Message Control Register		<a href="#">Go</a>
130h	CAN_IF2DATA	IF2 Data A Register		<a href="#">Go</a>
134h	CAN_IF2DATB	IF2 Data B Register		<a href="#">Go</a>
140h	CAN_IF3OBS	IF3 Observation Register		<a href="#">Go</a>
144h	CAN_IF3MSK	IF3 Mask Register		<a href="#">Go</a>
148h	CAN_IF3ARB	IF3 Arbitration Register		<a href="#">Go</a>
14Ch	CAN_IF3MCTL	IF3 Message Control Register		<a href="#">Go</a>
150h	CAN_IF3DATA	IF3 Data A Register		<a href="#">Go</a>
154h	CAN_IF3DATB	IF3 Data B Register		<a href="#">Go</a>
160h	CAN_IF3UPD	IF3 Update Enable Register		<a href="#">Go</a>

Complex bit access types are encoded to fit into small table cells. Table 21-9 shows the codes that are used for access types in this section.

**Table 21-9. CAN\_REGS Access Type Codes**

Access Type	Code	Description
<b>Read Type</b>		
R	R	Read
<b>Write Type</b>		
W	W	Write
W=1	W	Write
<b>Reset or Default Value</b>		
-n		Value after reset or the default value
<b>Register Array Variables</b>		
i,j,k,l,m,n		When these variables are used in a register name, an offset, or an address, they refer to the value of a register array where the register is part of a group of repeating registers. The register groups form a hierarchical structure and the array is represented with a formula.
y		When this variable is used in a register name, an offset, or an address it refers to the value of a register array.

**21.15.2.1 CAN\_CTL Register (Offset = 0h) [reset = 1401h]**

CAN\_CTL is shown in [Figure 21-18](#) and described in [Table 21-10](#).

Return to [Summary Table](#).

This register is used for configuring the CAN module in terms of interrupts, parity, debug-mode behavior etc.

**Figure 21-18. CAN\_CTL Register**

31	30	29	28	27	26	25	24
RESERVED						RESERVED	RESERVED
R-0h						R-0h	R-0h
23	22	21	20	19	18	17	16
RESERVED						IE1	INITDBG
R-0h						R/W-0h	R-0h
15	14	13	12	11	10	9	8
SWR	RESERVED	PMD				ABO	IDS
R/W-0h	R-0h	R/W-5h				R/W-0h	R/W-0h
7	6	5	4	3	2	1	0
Test	CCE	DAR	RESERVED	EIE	SIE	IE0	Init
R/W-0h	R/W-0h	R/W-0h	R-0h	R/W-0h	R/W-0h	R/W-0h	R/W-1h

**Table 21-10. CAN\_CTL Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-26	RESERVED	R	0h	Reserved
25	RESERVED	R	0h	Reserved
24	RESERVED	R	0h	Reserved
23-21	RESERVED	R	0h	Reserved
20	RESERVED	R	0h	Reserved
19	RESERVED	R	0h	Reserved
18	RESERVED	R	0h	Reserved
17	IE1	R/W	0h	Interrupt line 1 Enable 0 CANINT1 is disabled. 1 CANINT1 is enabled. Interrupts will assert CANINT1 line to 1 line remains active until pending interrupts are processed. Reset type: SYSRSn
16	INITDBG	R	0h	Debug Mode Status Bit: This bit indicates the internal init state for a debug access 0 Not in debug mode, or debug mode requested but not entered. 1 Debug mode requested and internally entered the CAN module is ready for debug accesses. Reset type: SYSRSn
15	SWR	R/W	0h	Software Reset Enable Bit: This bit activates the software reset. 0 Normal Operation. 1 Module is forced to reset state. This bit will get cleared automatically one clock cycle after execution of software reset.  Note: To execute software reset, the following procedure is necessary: 1. Set INIT bit to shut down CAN communication. 2. Set SWR bit. This bit is EALLOW protected. Note: This bit is write-protected by Init bit Reset type: SYSRSn

**Table 21-10. CAN\_CTL Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
14	RESERVED	R	0h	Reserved
13-10	PMD	R/W	5h	Parity on/off  0101 Parity function disabled  Any other value - Parity function enabled Reset type: SYSRSn
9	ABO	R/W	0h	Auto-Bus-On Enable  0 The Auto-Bus-On feature is disabled  1 The Auto-Bus-On feature is enabled Reset type: SYSRSn
8	IDS	R/W	0h	Interruption Debug Support Enable  0 When Debug mode is requested, the CAN module will wait for a started transmission or reception to be completed before entering Debug mode  1 When Debug mode is requested, the CAN module will interrupt any transmission or reception, and enter Debug mode immediately. Reset type: SYSRSn
7	Test	R/W	0h	Test Mode Enable  0 Disable Test Mode (Normal operation)  1 Enable Test Mode Reset type: SYSRSn
6	CCE	R/W	0h	Configuration Change Enable  0 The CPU has no write access to the configuration registers.  1 The CPU has write access to the configuration registers (when Init bit is set). Reset type: SYSRSn
5	DAR	R/W	0h	Disable Automatic Retransmission  0 Automatic Retransmission of "not successful" messages enabled.  1 Automatic Retransmission disabled. Reset type: SYSRSn
4	RESERVED	R	0h	Reserved
3	EIE	R/W	0h	Error Interrupt Enable  0 PER, BOff and EWarn bits cannot generate an interrupt.  1 Enabled- PER, BOff and EWarn bits can generate an interrupt at CANINT0 line and affect the Interrupt Register. Reset type: SYSRSn
2	SIE	R/W	0h	Status Change Interrupt Enable  0 RxOk, TxOk and LEC bits cannot generate an interrupt.  1 RxOk, TxOk and LEC can generate an interrupt on the CANINT0 line Reset type: SYSRSn
1	IE0	R/W	0h	Interrupt line 0 Enable 0 CANINT0 is disabled. 1 CANINT0 is enabled. Interrupts will assert CANINT0 line to 1 line remains active until pending interrupts are processed. Reset type: SYSRSn

**Table 21-10. CAN\_CTL Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
0	Init	R/W	1h	Initialization Mode  This bit is used to keep the CAN module inactive during bit timing configuration and message RAM initialization. It is set automatically during a bus off event. Clearing this bit will not shorten the bus recovery time.  0 CAN module processes messages normally 1 CAN module ignores bus activity Reset type: SYSRSn



**21.15.2.2 CAN\_ES Register (Offset = 4h) [reset = 7h]**

CAN\_ES is shown in [Figure 21-19](#) and described in [Table 21-11](#).

Return to [Summary Table](#).

This register indicates error conditions, if any, of the CAN module. Interrupts are generated by PER, BOff and EWarn bits (if EIE bit in CAN Control Register is set) and by RxOk, TxOk, and LEC bits (if SIE bit in CAN Control Register is set). A change of bit EPass will not generate an Interrupt.

Reading the Error and Status Register clears the PER, RxOk and TxOk bits and sets the LEC to value '7'. Additionally, the Status Interrupt value (0x8000) in the Interrupt Register will be replaced by the next lower priority interrupt value.

For debug support, the auto clear functionality of Error and Status Register (clear of status flags by read) is disabled when in Debug/Suspend mode.

**Figure 21-19. CAN\_ES Register**

31	30	29	28	27	26	25	24
RESERVED							
R-0h							
23	22	21	20	19	18	17	16
RESERVED							
R-0h							
15	14	13	12	11	10	9	8
RESERVED					RESERVED	RESERVED	PER
R-0h					R-0h	R-0h	R-0h
7	6	5	4	3	2	1	0
BOff	EWarn	EPass	RxOk	TxOk	LEC		
R-0h	R-0h	R-0h	R-0h	R-0h	R-7h		

**Table 21-11. CAN\_ES Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-11	RESERVED	R	0h	Reserved
10	RESERVED	R	0h	Reserved
9	RESERVED	R	0h	Reserved
8	PER	R	0h	Parity Error Detected: This bit will be reset after the CPU reads the register.  0 No parity error has been detected since last read access.  1 The parity check mechanism has detected a parity error in the Message RAM. Reset type: SYSRSn
7	BOff	R	0h	Bus-off Status Bit:  0 The CAN module is not Bus-Off state.  1 The CAN module is in Bus-Off state. Reset type: SYSRSn
6	EWarn	R	0h	Warning State Bit:  0 Both error counters are below the error warning limit of 96.  1 At least one of the error counters has reached the error warning limit of 96. Reset type: SYSRSn

**Table 21-11. CAN\_ES Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
5	EPass	R	0h	<p>Error Passive State</p> <p>0 On CAN Bus error, the CAN could send active error frames.</p> <p>1 The CAN Core is in the error passive state as defined in the CAN Specification.</p> <p>Reset type: SYSRSn</p>
4	RxOk	R	0h	<p>Reception status Bit: This bit indicates the status of reception. The bit will be reset after the CPU reads the register.</p> <p>0 No message has been successfully received since the last time when this bit was read by the CPU. This bit is never reset by CAN internal events.</p> <p>1 A message has been successfully received since the last time when this bit was reset by a read access of the CPU.</p> <p>Reset type: SYSRSn</p>
3	TxOk	R	0h	<p>Transmission status Bit: This bit indicates the status of transmission. The bit will be reset after the CPU reads the register.</p> <p>0 No message has been successfully transmitted since the last time when this bit was read by the CPU. This bit is never reset by CAN internal events.</p> <p>1 A message has been successfully transmitted (error free and acknowledged by at least one other node) since the last time when this bit was cleared by a read access of the CPU.</p> <p>Reset type: SYSRSn</p>
2-0	LEC	R	7h	<p>Last Error Code</p> <p>The LEC field indicates the type of the last error on the CAN bus. This field will be cleared to '0' when a message has been transferred (reception or transmission) without error. This field will be reset to '7' whenever the CPU reads the register.</p> <p>0 No Error</p> <p>1 Stuff Error: More than five equal bits in a row have been detected in a part of a received message where this is not allowed.</p> <p>2 Form Error: A fixed format part of a received frame has the wrong format.</p> <p>3 Ack Error: The message this CAN Core transmitted was not acknowledged by another node.</p> <p>4 Bit1 Error: During the transmission of a message (with the exception of the arbitration field), the device wanted to send a recessive level (bit of logical value '1'), but the monitored bus value was dominant.</p> <p>5 Bit0 Error: During the transmission of a message (or acknowledge bit, or active error flag, or overload flag), the device wanted to send a dominant level (logical value '0'), but the monitored bus level was recessive. During Bus-Off recovery, this status is set each time a sequence of 11 recessive bits has been monitored. This enables the CPU to monitor the proceeding of the Bus-Off recovery sequence (indicating the bus is not stuck at dominant or continuously disturbed).</p> <p>6 CRC Error: In a received message, the CRC check sum was incorrect. (CRC received for an incoming message does not match the calculated CRC for the received data).</p> <p>7 No CAN bus event was detected since the last time when CPU has read the Error and Status Register. Any read access to the Error and Status Register re-initializes the LEC to value '7'.</p> <p>Reset type: SYSRSn</p>

**21.15.2.3 CAN\_ERRC Register (Offset = 8h) [reset = 0h]**

CAN\_ERRC is shown in [Figure 21-20](#) and described in [Table 21-12](#).

Return to [Summary Table](#).

This register reflects the value of the Transmit and Receive error counters

**Figure 21-20. CAN\_ERRC Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
RESERVED															
R-0h															
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
RP		REC						TEC							
R-0h		R-0h						R-0h							

**Table 21-12. CAN\_ERRC Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R	0h	Reserved
15	RP	R	0h	Receive Error Passive  0 The Receive Error Counter is below the error passive level. 1 The Receive Error Counter has reached the error passive level as defined in the CAN Specification. Reset type: SYSRSn
14-8	REC	R	0h	Receive Error Counter  Actual state of the Receive Error Counter (values from 0 to 127). Reset type: SYSRSn
7-0	TEC	R	0h	Transmit Error Counter  Actual state of the Transmit Error Counter. (values from 0 to 255). Reset type: SYSRSn

**21.15.2.4 CAN\_BTR Register (Offset = Ch) [reset = 2301h]**

CAN\_BTR is shown in [Figure 21-21](#) and described in [Table 21-13](#).

Return to [Summary Table](#).

This register is used to configure the bit-timing parameters for the CAN module. This register is only writable if CCE and Init bits in the CAN Control Register are set.

The CAN bit time may be programmed in the range of 8 to 25 time quanta.

The CAN time quantum may be programmed in the range of 1 to 1024 CAN\_CLK periods.

**Figure 21-21. CAN\_BTR Register**

31	30	29	28	27	26	25	24
RESERVED							
R-0h							
23	22	21	20	19	18	17	16
RESERVED				BRPE			
R-0h				R/W-0h			
15	14	13	12	11	10	9	8
RESERVED		TSEG2			TSEG1		
R-0h		R/W-2h			R/W-3h		
7	6	5	4	3	2	1	0
SJW			BRP				
R/W-0h			R/W-1h				

**Table 21-13. CAN\_BTR Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-20	RESERVED	R	0h	Reserved
19-16	BRPE	R/W	0h	Baud Rate Prescaler Extension Valid programmed values are 0 to 15. By programming BRPE the Baud Rate Prescaler can be extended to values up to 1024. Note: This bit is Write Protected by CCE bit. Reset type: SYSRSn
15	RESERVED	R	0h	Reserved
14-12	TSEG2	R/W	2h	Time segment after the sample point Valid programmed values are 0 to 7. The actual TSeg2 value which is interpreted for the Bit Timing will be the programmed TSeg2 value + 1. Note: This bit is Write Protected by CCE bit. Reset type: SYSRSn
11-8	TSEG1	R/W	3h	Time segment before the sample point Valid programmed values are 1 to 15. The actual TSeg1 value interpreted for the Bit Timing will be the programmed TSeg1 value + 1. Note: This bit is Write Protected by CCE bit. Reset type: SYSRSn
7-6	SJW	R/W	0h	Synchronization Jump Width Valid programmed values are 0 to 3. The actual SJW value interpreted for the Synchronization will be the programmed SJW value + 1. Note: This bit is Write Protected by CCE bit. Reset type: SYSRSn

**Table 21-13. CAN\_BTR Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
5-0	BRP	R/W	1h	<p>Baud Rate Prescaler-</p> <p>Value by which the CAN_CLK frequency is divided for generating the bit time quanta. The bit time is built up from a multiple of this quanta.</p> <p>Valid programmed values are 0 to 63.</p> <p>The actual BRP value interpreted for the Bit Timing will be the programmed BRP value + 1.</p> <p>Note: This bit is Write Protected by CCE bit.</p> <p>Reset type: SYSRSn</p>

### 21.15.2.5 CAN\_INT Register (Offset = 10h) [reset = 0h]

CAN\_INT is shown in [Figure 21-22](#) and described in [Table 21-14](#).

Return to [Summary Table](#).

This register is used to identify the source of the interrupt(s).

**Figure 21-22. CAN\_INT Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
RESERVED								INT1ID								INT0ID															
R-0h								R-0h								R-0h															

**Table 21-14. CAN\_INT Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-24	RESERVED	R	0h	Reserved
23-16	INT1ID	R	0h	Interrupt 1 Cause  0x00 No interrupt is pending.  0x01-0x20 Number of message object (mailbox) which caused the interrupt.  0x21-0xFF Unused.  If several interrupts are pending, the CAN Interrupt Register will point to the pending interrupt with the highest priority.  Note: The CANINT1 interrupt line remains active until INT0ID reaches value 0 (the cause of the interrupt is reset) or until IE0 is cleared. A message interrupt is cleared by clearing the mailbox's IntPnd bit. Among the message interrupts, the mailbox's interrupt priority decreases with increasing message number.  Reset type: SYSRSn
15-0	INT0ID	R	0h	Interrupt 0 Cause  0x0000 - No interrupt is pending.  0x0001 - 0x0020 - Number of message object which caused the interrupt.  0x0021 - 0x7FFF - Unused.  0x8000 - Error and Status Register value is not 0x07.  0x8001 - 0xFFFF - Unused.  If several interrupts are pending, the CAN Interrupt Register will point to the pending interrupt with the highest priority.  Note: The CANINT0 interrupt line remains active until INT0ID reaches value 0 (the cause of the interrupt is reset) or until IE0 is cleared. The Status Interrupt has the highest priority. Among the message interrupts, the message object's interrupt priority decreases with increasing message number.  Reset type: SYSRSn

### 21.15.2.6 CAN\_TEST Register (Offset = 14h) [reset = 0h]

CAN\_TEST is shown in [Figure 21-23](#) and described in [Table 21-15](#).

Return to [Summary Table](#).

This register is used to configure the various test options supported. For all test modes, the Test bit in CAN Control Register needs to be set to one. If Test bit is set, the RDA, EXL, Tx1, Tx0, LBack and Silent bits are writable. Bit Rx monitors the state of CANRX pin and therefore is only readable. All Test Register functions are disabled when Test bit is cleared.

Note: Setting Tx[1:0] other than '00' will disturb message transfer.

Note: When the internal loop back mode is active (bit LBack is set), bit EXL will be ignored.

**Figure 21-23. CAN\_TEST Register**

31	30	29	28	27	26	25	24
RESERVED							
R-0h							
23	22	21	20	19	18	17	16
RESERVED							
R-0h							
15	14	13	12	11	10	9	8
RESERVED						RDA	EXL
R-0h						R/W-0h	R/W-0h
7	6	5	4	3	2	1	0
RX	TX		LBACK	SILENT	RESERVED		
R-0h	R/W-0h		R/W-0h	R/W-0h	R-0h		

**Table 21-15. CAN\_TEST Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-10	RESERVED	R	0h	Reserved
9	RDA	R/W	0h	RAM Direct Access Enable: 0 Normal Operation. 1 Direct access to the RAM is enabled while in Test Mode. Reset type: SYSRSn
8	EXL	R/W	0h	External Loop Back Mode: 0 Disabled. 1 Enabled. Reset type: SYSRSn
7	RX	R	0h	Monitors the actual value of the CANRX pin: 0 The CAN bus is dominant. 1 The CAN bus is recessive. Reset type: SYSRSn
6-5	TX	R/W	0h	Control of CANTX pin: 00 Normal operation, CANTX is controlled by the CAN Core. 01 Sample Point can be monitored at CANTX pin. 10 CANTX pin drives a dominant value. 11 CANTX pin drives a recessive value. Reset type: SYSRSn

**Table 21-15. CAN\_TEST Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
4	LBACK	R/W	0h	Loop Back Mode: 0 Disabled. 1 Enabled. Reset type: SYSRSn
3	SILENT	R/W	0h	Silent Mode: 0 Disabled. 1 Enabled. Reset type: SYSRSn
2-0	RESERVED	R	0h	Reserved



**21.15.2.7 CAN\_PERR Register (Offset = 1Ch) [reset = 100h]**

CAN\_PERR is shown in [Figure 21-24](#) and described in [Table 21-16](#).

Return to [Summary Table](#).

This register indicates the Word/Mailbox number where a parity error has been detected. If a parity error is detected, the PER flag will be set in the Error and Status Register. This bit is not reset by the parity check mechanism

it must be reset by reading the Error and Status Register. In addition to the PER flag, the Parity Error Code Register will indicate the memory area where the parity error has been detected. If more than one word with a parity error was detected, the highest word number with a parity error will be displayed. After a parity error has been detected, the register will hold the last error code until power is removed.

**Figure 21-24. CAN\_PERR Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
RESERVED															
R-0h															
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
RESERVED					WORD_NUM					MSG_NUM					
R-0h					R-1h					R-0h					

**Table 21-16. CAN\_PERR Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-11	RESERVED	R	0h	Reserved
10-8	WORD_NUM	R	1h	0x01-0x05 Word number where parity error has been detected. RDA word number (1 to 5) of the mailbox (according to the Message RAM representation in RDA mode). Reset type: SYSRSn
7-0	MSG_NUM	R	0h	0x01-0x21 Mailbox number where parity error has been detected Reset type: SYSRSn

**21.15.2.8 CAN\_RAM\_INIT Register (Offset = 40h) [reset = 5h]**

CAN\_RAM\_INIT is shown in [Figure 21-25](#) and described in [Table 21-17](#).

Return to [Summary Table](#).

This register is used to initialize the Mailbox RAM. It clears the entire mailbox RAM, including the MsgVal bits.

**Figure 21-25. CAN\_RAM\_INIT Register**

31	30	29	28	27	26	25	24
RESERVED							
R-0h							
23	22	21	20	19	18	17	16
RESERVED							
R-0h							
15	14	13	12	11	10	9	8
RESERVED							
R-0h							
7	6	5	4	3	2	1	0
RESERVED		RAM_INIT_DONE	CAN_RAM_INIT	KEY3	KEY2	KEY1	KEY0
R-0h		R-0h	R/W-0h	R/W-0h	R/W-1h	R/W-0h	R/W-1h

**Table 21-17. CAN\_RAM\_INIT Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-6	RESERVED	R	0h	Reserved
5	RAM_INIT_DONE	R	0h	CAN Mailbox RAM initialization status: 0 Read: Initialization is on-going or initialization not initiated. 1 Read: Initialization complete Reset type: SYSRSn
4	CAN_RAM_INIT	R/W	0h	Initiate CAN Mailbox RAM initialization: 0 Read: Initialization complete or initialization not initiated. Write: No action 1 Read: Initialization is on-going Write: Initiate CAN Mailbox RAM initialization. After initialization, this bit will be automatically cleared to 0. Reset type: SYSRSn
3	KEY3	R/W	0h	See Key 0 Reset type: SYSRSn
2	KEY2	R/W	1h	See Key 0 Reset type: SYSRSn
1	KEY1	R/W	0h	See Key 0 Reset type: SYSRSn
0	KEY0	R/W	1h	KEY3-KEY0 should be 1010 for any write to this register to be valid. These bits will be restored to their reset state after the CAN RAM initialization is complete. Reset type: SYSRSn

**21.15.2.9 CAN\_GLB\_INT\_EN Register (Offset = 50h) [reset = 0h]**

CAN\_GLB\_INT\_EN is shown in [Figure 21-26](#) and described in [Table 21-18](#).

Return to [Summary Table](#).

This register is used to enable the interrupt lines to the PIE.

**Figure 21-26. CAN\_GLB\_INT\_EN Register**

31	30	29	28	27	26	25	24
RESERVED							
R-0h							
23	22	21	20	19	18	17	16
RESERVED							
R-0h							
15	14	13	12	11	10	9	8
RESERVED							
R-0h							
7	6	5	4	3	2	1	0
RESERVED						GLBINT1_EN	GLBINT0_EN
R-0h						R/W-0h	R/W-0h

**Table 21-18. CAN\_GLB\_INT\_EN Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-2	RESERVED	R	0h	Reserved
1	GLBINT1_EN	R/W	0h	Global Interrupt Enable for CANINT1 0 CANINT1 does not generate interrupt to PIE 1 CANINT1 generates interrupt to PIE if interrupt condition occurs Reset type: SYSRSn
0	GLBINT0_EN	R/W	0h	Global Interrupt Enable for CANINT0 0 CANINT0 does not generate interrupt to PIE 1 CANINT0 generates interrupt to PIE if interrupt condition occurs Reset type: SYSRSn

**21.15.2.10 CAN\_GLB\_INT\_FLG Register (Offset = 54h) [reset = 0h]**

CAN\_GLB\_INT\_FLG is shown in [Figure 21-27](#) and described in [Table 21-19](#).

Return to [Summary Table](#).

This register indicates if and when the interrupt line to the PIE is active.

**Figure 21-27. CAN\_GLB\_INT\_FLG Register**

31	30	29	28	27	26	25	24
RESERVED							
R-0h							
23	22	21	20	19	18	17	16
RESERVED							
R-0h							
15	14	13	12	11	10	9	8
RESERVED							
R-0h							
7	6	5	4	3	2	1	0
RESERVED						INT1_FLG	INT0_FLG
R-0h						R-0h	R-0h

**Table 21-19. CAN\_GLB\_INT\_FLG Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-2	RESERVED	R	0h	Reserved
1	INT1_FLG	R	0h	CANINT1 Flag 0 No interrupt generated 1 Interrupt is generated due to CANINT1 (refer to CAN Interrupt Status Register for the condition) Reset type: SYSRSn
0	INT0_FLG	R	0h	CANINT0 Flag 0 No interrupt generated 1 Interrupt is generated due to CANINT0 (refer to CAN Interrupt Status Register for the condition) Reset type: SYSRSn

**21.15.2.11 CAN\_GLB\_INT\_CLR Register (Offset = 58h) [reset = 0h]**

CAN\_GLB\_INT\_CLR is shown in [Figure 21-28](#) and described in [Table 21-20](#).

Return to [Summary Table](#).

This register is used to clear the interrupt to the PIE.

**Figure 21-28. CAN\_GLB\_INT\_CLR Register**

31	30	29	28	27	26	25	24
RESERVED							
R-0h							
23	22	21	20	19	18	17	16
RESERVED							
R-0h							
15	14	13	12	11	10	9	8
RESERVED							
R-0h							
7	6	5	4	3	2	1	0
RESERVED						INT1_FLG_CLR	INT0_FLG_CLR
R-0h						W-0h	W-0h

**Table 21-20. CAN\_GLB\_INT\_CLR Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-2	RESERVED	R	0h	Reserved
1	INT1_FLG_CLR	W	0h	Global Interrupt flag clear for CANINT1  0 No effect  1 Write 1 to clear the corresponding bit of the Global Interrupt Flag Register and allow the PIE to receive another interrupt from CANINT1. Reset type: SYSRSn
0	INT0_FLG_CLR	W	0h	Global Interrupt flag clear for CANINT0  0 No effect  1 Write 1 to clear the corresponding bit of the Global Interrupt Flag Register and allow the PIE to receive another interrupt from CANINT0. Reset type: SYSRSn

**21.15.2.12 CAN\_ABOTR Register (Offset = 80h) [reset = 0h]**

CAN\_ABOTR is shown in [Figure 21-29](#) and described in [Table 21-21](#).

Return to [Summary Table](#).

This register is used to introduce a variable delay before the Bus-off recovery sequence is started.

**Figure 21-29. CAN\_ABOTR Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ABO_Time																															
R/W-0h																															

**Table 21-21. CAN\_ABOTR Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-0	ABO_Time	R/W	0h	Auto-Bus-On Timer  Number of clock cycles before a Bus-Off recovery sequence is started by clearing the Init bit. "Clock" refers to the input clock to the CAN module. This function has to be enabled by setting bit ABO in CAN Control Register.  The Auto-Bus-On timer is realized by a 32-bit counter which starts to count down to zero when the module goes Bus-Off. The counter will be reloaded with the preload value of the ABO Time register after this phase.  NOTE: On write access to the CAN Control register while Auto-Bus-On timer is running, the Auto-Bus-On procedure will be aborted.  NOTE: During Debug mode, running Auto-Bus-On timer will be paused.  Reset type: SYSRSn

### 21.15.2.13 CAN\_TXRQ\_X Register (Offset = 84h) [reset = 0h]

CAN\_TXRQ\_X is shown in [Figure 21-30](#) and described in [Table 21-22](#).

Return to [Summary Table](#).

With these bits, the CPU can detect if one or more bits in the CAN Transmission Request 21 Register (CAN\_TXRQ\_21) is set. Each bit in this register represents a group of eight mailboxes. If at least one of the TxRqst bits of these message objects is set, the corresponding bit in this register will be set.

**Figure 21-30. CAN\_TXRQ\_X Register**

31	30	29	28	27	26	25	24
RESERVED							
R-0h							
23	22	21	20	19	18	17	16
RESERVED							
R-0h							
15	14	13	12	11	10	9	8
RESERVED							
R-0h							
7	6	5	4	3	2	1	0
RESERVED				TxRqstReg2		TxRqstReg1	
R-0h				R-0h		R-0h	

**Table 21-22. CAN\_TXRQ\_X Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-4	RESERVED	R	0h	Reserved
3-2	TxRqstReg2	R	0h	Transmit Request Register 2 flag:  Bit 2 represents byte 2 of CAN_TXRQ_21. If one or more bits in that byte are set, then bit 2 will be set.  Bit 3 represents byte 3 of CAN_TXRQ_21 Register. If one or more bits in that byte are set, then bit 3 will be set. Reset type: SYSRSn
1-0	TxRqstReg1	R	0h	Transmit Request Register 1 flag:  Bit 0 represents byte 0 of CAN_TXRQ_21 Register. If one or more bits in that byte are set, then bit 0 will be set.  Bit 1 represents byte 1 of CAN_TXRQ_21 Register. If one or more bits in that byte are set, then bit 1 will be set. Reset type: SYSRSn

**21.15.2.14 CAN\_TXRQ\_21 Register (Offset = 88h) [reset = 0h]**

CAN\_TXRQ\_21 is shown in [Figure 21-31](#) and described in [Table 21-23](#).

Return to [Summary Table](#).

The bits in this register indicate if a transmission has been requested for a mailbox.

**Figure 21-31. CAN\_TXRQ\_21 Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
TxRqst																															
R-0h																															

**Table 21-23. CAN\_TXRQ\_21 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-0	TxRqst	R	0h	Transmission Request Bits (for all message objects) 0 No transmission has been requested for this message object. 1 The transmission of this message object is requested and is not yet done. Note: Bit 0 is for mailbox 1, Bit 1 is for mailbox 2, Bit 2 is for mailbox 3,..., Bit 31 is for mailbox 32 Reset type: SYSRSn



### 21.15.2.15 CAN\_NDAT\_X Register (Offset = 98h) [reset = 0h]

CAN\_NDAT\_X is shown in [Figure 21-32](#) and described in [Table 21-24](#).

Return to [Summary Table](#).

With these bits, the CPU can detect if one or more bits in the CAN New Data 21 Register (CAN\_NDAT\_21) is set. Each bit in this register represents a group of eight mailboxes. If at least one of the NewDat bits of these mailboxes are set, the corresponding bit in this register will be set.

**Figure 21-32. CAN\_NDAT\_X Register**

31	30	29	28	27	26	25	24
RESERVED							
R-0h							
23	22	21	20	19	18	17	16
RESERVED							
R-0h							
15	14	13	12	11	10	9	8
RESERVED							
R-0h							
7	6	5	4	3	2	1	0
RESERVED				NewDatReg2		NewDatReg1	
R-0h				R-0h		R-0h	

**Table 21-24. CAN\_NDAT\_X Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-4	RESERVED	R	0h	Reserved
3-2	NewDatReg2	R	0h	New Data Register 2 flag:  Bit 2 represents byte 2 of CAN_NDAT_21 Register. If one or more bits in that byte are set, then bit 2 will be set.  Bit 3 represents byte 3 of CAN_NDAT_21 Register. If one or more bits in that byte are set, then bit 3 will be set. Reset type: SYSRSn
1-0	NewDatReg1	R	0h	New Data Register 1 flag:  Bit 0 represents byte 0 of CAN_NDAT_21 Register. If one or more bits in that byte are set, then bit 0 will be set.  Bit 1 represents byte 1 of CAN_NDAT_21 Register. If one or more bits in that byte are set, then bit 1 will be set. Reset type: SYSRSn

**21.15.2.16 CAN\_NDAT\_21 Register (Offset = 9Ch) [reset = 0h]**

CAN\_NDAT\_21 is shown in [Figure 21-33](#) and described in [Table 21-25](#).

Return to [Summary Table](#).

The bits in this register indicate if the message handler or the CPU has written new data into the data portion of this mailbox.

**Figure 21-33. CAN\_NDAT\_21 Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
NewDat																															
R-0h																															

**Table 21-25. CAN\_NDAT\_21 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-0	NewDat	R	0h	New Data Bits (for all message objects)  0 No new data has been written into the data portion of this message object by the message handler since the last time when this flag was cleared by the CPU.  1 The message handler or the CPU has written new data into the data portion of this message object.  Note: Bit 0 is for mailbox 1, Bit 1 is for mailbox 2, Bit 2 is for mailbox 3,..., Bit 31 is for mailbox 32 Reset type: SYSRSn

### 21.15.2.17 CAN\_IPEN\_X Register (Offset = ACh) [reset = 0h]

CAN\_IPEN\_X is shown in [Figure 21-34](#) and described in [Table 21-26](#).

Return to [Summary Table](#).

With these bits, the CPU can detect if one or more bits in the CAN Interrupt Pending 21 Register (CAN\_IPEN\_21) is set. Each bit in this register represents a group of eight mailboxes. If at least one of the IntPnd bits of these mailboxes are set, the corresponding bit in this register will be set.

**Figure 21-34. CAN\_IPEN\_X Register**

31	30	29	28	27	26	25	24
RESERVED							
R-0h							
23	22	21	20	19	18	17	16
RESERVED							
R-0h							
15	14	13	12	11	10	9	8
RESERVED							
R-0h							
7	6	5	4	3	2	1	0
RESERVED				IntPndReg2		IntPndReg1	
R-0h				R-0h		R-0h	

**Table 21-26. CAN\_IPEN\_X Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-4	RESERVED	R	0h	Reserved
3-2	IntPndReg2	R	0h	Interrupt Pending Register 2 flag:  Bit 2 represents byte 2 of CAN_IPEN_21 Register. If one or more bits in that byte are set, then bit 2 will be set.  Bit 3 represents byte 3 of CAN_IPEN_21 Register. If one or more bits in that byte are set, then bit 3 will be set. Reset type: SYSRSn
1-0	IntPndReg1	R	0h	Interrupt Pending Register 1 flag:  Bit 0 represents byte 0 of CAN_IPEN_21 Register. If one or more bits in that byte are set, then bit 0 will be set.  Bit 1 represents byte 1 of CAN_IPEN_21 Register. If one or more bits in that byte are set, then bit 1 will be set. Reset type: SYSRSn

**21.15.2.18 CAN\_IPEN\_21 Register (Offset = B0h) [reset = 0h]**

CAN\_IPEN\_21 is shown in [Figure 21-35](#) and described in [Table 21-27](#).

Return to [Summary Table](#).

The bits in this register indicate if an interrupt is pending for the corresponding mailbox.

**Figure 21-35. CAN\_IPEN\_21 Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
IntPnd																															
R-0h																															

**Table 21-27. CAN\_IPEN\_21 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-0	IntPnd	R	0h	Interrupt Pending bits: This register contains the bits that indicate the pending interrupts in each one of the 32 mailboxes.  0 This mailbox is not the source of an interrupt.  1 This mailbox is the source of an interrupt.  Note: Bit 0 is for mailbox 1, Bit 1 is for mailbox 2, Bit 2 is for mailbox 3,..., Bit 31 is for mailbox 32 Reset type: SYSRSn

**21.15.2.19 CAN\_MVAL\_X Register (Offset = C0h) [reset = 0h]**

CAN\_MVAL\_X is shown in [Figure 21-36](#) and described in [Table 21-28](#).

Return to [Summary Table](#).

With these bits, the CPU can detect if one or more bits in the CAN Message Valid 2\_1 Register (CAN\_MVAL\_21) is set. Each bit in this register represents a group of eight mailboxes. If at least one of the MsgVal bits of these mailboxes are set, the corresponding bit in this register will be set.

**Figure 21-36. CAN\_MVAL\_X Register**

31	30	29	28	27	26	25	24
RESERVED							
R-0h							
23	22	21	20	19	18	17	16
RESERVED							
R-0h							
15	14	13	12	11	10	9	8
RESERVED							
R-0h							
7	6	5	4	3	2	1	0
RESERVED				MsgValReg2		MsgValReg1	
R-0h				R-0h		R-0h	

**Table 21-28. CAN\_MVAL\_X Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-4	RESERVED	R	0h	Reserved
3-2	MsgValReg2	R	0h	Message Valid Register 2 flag:  Bit 2 represents byte 2 of CAN_MVAL_21 Register. If one or more bits in that byte are set, then bit 2 will be set.  Bit 3 represents byte 3 of CAN_MVAL_21 Register. If one or more bits in that byte are set, then bit 3 will be set. Reset type: SYSRSn
1-0	MsgValReg1	R	0h	Message Valid Register 1 flag:  Bit 0 represents byte 0 of CAN_MVAL_21 Register. If one or more bits in that byte are set, then bit 0 will be set.  Bit 1 represents byte 1 of CAN_MVAL_21 Register. If one or more bits in that byte are set, then bit 1 will be set. Reset type: SYSRSn

**21.15.2.20 CAN\_MVAL\_21 Register (Offset = C4h) [reset = 0h]**

CAN\_MVAL\_21 is shown in [Figure 21-37](#) and described in [Table 21-29](#).

Return to [Summary Table](#).

The bits in this register are used to enable/disable mailboxes as needed.

**Figure 21-37. CAN\_MVAL\_21 Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
MsgValReg																															
R-0h																															

**Table 21-29. CAN\_MVAL\_21 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-0	MsgValReg	R	0h	Message Valid Bits (for all message objects) 0 This message object is ignored by the message handler. 1 This message object is configured and will be considered by the message handler. Note: Bit 0 is for mailbox 1, Bit 1 is for mailbox 2, Bit 2 is for mailbox 3,..., Bit 31 is for mailbox 32 Reset type: SYSRSn

**21.15.2.21 CAN\_IP\_MUX21 Register (Offset = D8h) [reset = 0h]**

CAN\_IP\_MUX21 is shown in [Figure 21-38](#) and described in [Table 21-30](#).

Return to [Summary Table](#).

The IntMux bit determines for each mailbox, which of the two interrupt lines (CANINT0 or CANINT1) will be asserted when the IntPnd bit of that mailbox is set. Both interrupt lines can be globally enabled or disabled by setting or clearing IE0 and IE1 bits in CAN Control Register. The IntPnd bit of a specific message object can be set or reset by the CPU via the IF1/IF2 Interface Register sets, or by the Message Handler after reception or successful transmission of a frame. This will also affect the Int0ID or Int1ID flags in the Interrupt Register.

**Figure 21-38. CAN\_IP\_MUX21 Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
																	IntMux														
R/W-0h																															

**Table 21-30. CAN\_IP\_MUX21 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-0	IntMux	R/W	0h	Interrupt Mux bits: 0 CANINT0 line is active if corresponding IntPnd flag is one. 1 CANINT1 line is active if corresponding IntPnd flag is one.  Note: Bit 0 is for mailbox 32, Bit 1 is for mailbox 1, Bit 2 is for mailbox 2,..., Bit 31 is for mailbox 31 Reset type: SYSRSn

**21.15.2.22 CAN\_IF1CMD Register (Offset = 100h) [reset = 1h]**

CAN\_IF1CMD is shown in [Figure 21-39](#) and described in [Table 21-31](#).

Return to [Summary Table](#).

The IF1/IF2 Command Registers configure and initiate the transfer between the IF1/IF2 Register sets and the Message RAM. It is configurable which portions of the message object should be transferred. A transfer is started when the CPU writes the message number to bits [7:0] of the IF1/IF2 Command Register. With this write operation, the Busy bit is automatically set to '1' to indicate that a transfer is in progress. After 4 to 14 clock cycles, the transfer between the Interface Register and the Message RAM will be completed and the Busy bit is cleared. The maximum number of cycles is needed when the message transfer coincides with a CAN message transmission, acceptance filtering, or message storage. If the CPU writes to both IF1/IF2 Command Registers consecutively (request of a second transfer while first transfer is still in progress), the second transfer will start after the first one has been completed.

Note: While Busy bit is one, IF1/IF2 Register sets are write protected.

Note: For debug support, the auto clear functionality of the IF1/IF2 Command Registers (clear of DMAActive flag by R/W, for devices with DMA support) is disabled during Debug/Suspend mode.

Note: If an invalid Message Number is written to bits [7:0] of the IF1/IF2 Command Register, the Message Handler may access an implemented (valid) message object instead.

**Figure 21-39. CAN\_IF1CMD Register**

31	30	29	28	27	26	25	24
RESERVED							
R-0h							
23	22	21	20	19	18	17	16
DIR	Mask	Arb	Control	ClrIntPnd	TXRQST	DATA_A	DATA_B
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
15	14	13	12	11	10	9	8
Busy		RESERVED					
R-0h		R-0h					
7	6	5	4	3	2	1	0
MSG_NUM							
R/W-1h							

**Table 21-31. CAN\_IF1CMD Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-24	RESERVED	R	0h	Reserved
23	DIR	R/W	0h	Write/Read  0 Direction = Read: Transfer direction is from the message object addressed by Message Number (Bits [7:0]) to the IF1/IF2 Register set.  1 Direction = Write: Transfer direction is from the IF1/IF2 Register set to the message object addressed by Message Number (Bits [7:0])  Note: This bit is write protected by Busy bit. Reset type: SYSRStn



**Table 21-31. CAN\_IF1CMD Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
22	Mask	R/W	0h	<p>Access Mask Bits</p> <p>0 Mask bits will not be changed</p> <p>1 Direction = Read: The Mask bits (Identifier Mask + MDir + MXtd) will be transferred from the message object addressed by Message Number (Bits [7:0]) to the IF1/IF2 Register set.</p> <p>Direction = Write: The Mask bits (Identifier Mask + MDir + MXtd) will be transferred from the IF1/IF2 Register set to the message object addressed by Message Number (Bits [7:0]).</p> <p>Note: This bit is write protected by Busy bit. Reset type: SYSRSn</p>
21	Arb	R/W	0h	<p>Access Arbitration Bits</p> <p>0 Arbitration bits will not be changed</p> <p>1 Direction = Read: The Arbitration bits (Identifier + Dir + Xtd + MsgVal) will be transferred from the message object addressed by Message Number (Bits [7:0]) to the corresponding IF1/IF2 Register set.</p> <p>1 Direction = Write: The Arbitration bits (Identifier + Dir + Xtd + MsgVal) will be transferred from the IF1/IF2 Register set to the message object addressed by Message Number (Bits [7:0]).</p> <p>Note: This bit is write protected by Busy bit. Reset type: SYSRSn</p>
20	Control	R/W	0h	<p>Access Control Bits</p> <p>0 Control bits will not be changed</p> <p>1 Direction = Read: The Message Control bits will be transferred from the message object addressed by Message Number (Bits [7:0]) to the IF1/IF2 Register set.</p> <p>Direction = Write: The Message Control bits will be transferred from the IF1/IF2 Register set to the message object addressed by Message Number (Bits [7:0]). If the TxRqst/NewDat bit in this register (Bit [18]) is set, the TxRqst/ NewDat bit in the IF1/IF2 Message Control Register will be ignored.</p> <p>Note: This bit is write protected by Busy bit. Reset type: SYSRSn</p>
19	ClrIntPnd	R/W	0h	<p>Clear Interrupt Pending Bit</p> <p>0 IntPnd bit will not be changed</p> <p>1 Direction = Read: Clears IntPnd bit in the message object.</p> <p>1 Direction = Write: This bit is ignored. Copying of IntPnd flag from IF1/IF2 registers to Message RAM can only be controlled by the Control flag (Bit [20]).</p> <p>Note: This bit is write protected by Busy bit. Reset type: SYSRSn</p>

**Table 21-31. CAN\_IF1CMD Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
18	TXRQST	R/W	0h	<p>Access Transmission Request Bit</p> <p>0 Direction = Read: NewDat bit will not be changed. 0 Direction = Write: TxRqst/NewDat bit will be handled according to the Control bit.</p> <p>1 Direction = Read: Clears NewDat bit in the message object. 1 Direction = Write: Sets TxRqst/NewDat in message object.</p> <p>Note: If a CAN transmission is requested by setting TxRqst/NewDat in this register, the TxRqst/NewDat bits in the message object will be set to one independent of the values in IF1/IF2 Message Control Register.</p> <p>Note: A read access to a message object can be combined with the reset of the control bits IntPnd and NewDat. The values of these bits transferred to the IF1/IF2 Message Control Register always reflect the status before resetting them.</p> <p>Note: This bit is write protected by Busy bit. Reset type: SYSRSn</p>
17	DATA_A	R/W	0h	<p>Access Data Bytes 0-3</p> <p>0 Data Bytes 0-3 will not be changed.</p> <p>1 Direction = Read: The Data Bytes 0-3 will be transferred from the message object addressed by the Message Number (Bits [7:0]) to the corresponding IF1/IF2 Register set.</p> <p>1 Direction = Write: The Data Bytes 0-3 will be transferred from the IF1/IF2 Register set to the message object addressed by the Message Number (Bits [7:0]).</p> <p>Note: The duration of the message transfer is independent of the number of bytes to be transferred.</p> <p>Note: This bit is write protected by Busy bit. Reset type: SYSRSn</p>
16	DATA_B	R/W	0h	<p>Access Data Bytes 4-7</p> <p>0 Data Bytes 4-7 will not be changed.</p> <p>1 Direction = Read: The Data Bytes 4-7 will be transferred from the message object addressed by Message Number (Bits [7:0]) to the corresponding IF1/IF2 Register set.</p> <p>1 Direction = Write: The Data Bytes 4-7 will be transferred from the IF1/IF2 Register set to the message object addressed by Message Number (Bits [7:0]).</p> <p>Note: The duration of the message transfer is independent of the number of bytes to be transferred.</p> <p>Note: This bit is write protected by Busy bit. Reset type: SYSRSn</p>
15	Busy	R	0h	<p>Busy Flag</p> <p>0 No transfer between IF1/IF2 Register Set and Message RAM is in progress. 1 Transfer between IF1/IF2 Register Set and Message RAM is in progress.</p> <p>This bit is set to one after the message number has been written to bits [7:0]. IF1/IF2 Register Set will be write protected. The bit is cleared after read/write action has been finished.</p> <p>Reset type: SYSRSn</p>
14	RESERVED	R	0h	Reserved

**Table 21-31. CAN\_IF1CMD Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
13-8	RESERVED	R	0h	Reserved
7-0	MSG_NUM	R/W	1h	Number of message object in Message RAM which is used for data transfer  0x00 Invalid message number  0x01-0x20 Valid message numbers  0x21-0xFF Invalid message numbers  Note: This bit is write protected by Busy bit. Reset type: SYSRSn

**21.15.2.23 CAN\_IF1MSK Register (Offset = 104h) [reset = FFFFFFFFh]**

CAN\_IF1MSK is shown in [Figure 21-40](#) and described in [Table 21-32](#).

Return to [Summary Table](#).

The bits of the IF1/IF2 Mask Registers mirror the mask bits of a message object.

Note: While Busy bit of IF1/IF2 Command Register is one, IF1/IF2 Register Set is write-protected.

**Figure 21-40. CAN\_IF1MSK Register**

31	30	29	28	27	26	25	24
MXtd	MDir	RESERVED	Msk				
R/W-1h	R/W-1h	R-1h	R/W-1FFFFFFFh				
23	22	21	20	19	18	17	16
Msk							
R/W-1FFFFFFFh							
15	14	13	12	11	10	9	8
Msk							
R/W-1FFFFFFFh							
7	6	5	4	3	2	1	0
Msk							
R/W-1FFFFFFFh							

**Table 21-32. CAN\_IF1MSK Register Field Descriptions**

Bit	Field	Type	Reset	Description
31	MXtd	R/W	1h	Mask Extended Identifier  0 The extended identifier bit (IDE) has no effect on the acceptance filtering.  1 The extended identifier bit (IDE) is used for acceptance filtering.  When 11-bit ("standard") identifiers are used for a message object, the identifiers of received data frames are written into bits ID[28:18]. For acceptance filtering, only these bits together with mask bits Msk[28:18] are considered.  Note: This bit is write protected by Busy bit. Reset type: SYSRSn
30	MDir	R/W	1h	Mask Message Direction  0 The message direction bit (Dir) has no effect on the acceptance filtering.  1 The message direction bit (Dir) is used for acceptance filtering.  Note: This bit is write protected by Busy bit. Reset type: SYSRSn
29	RESERVED	R	1h	Reserved
28-0	Msk	R/W	1FFFFFFFh	Identifier Mask-  0 The corresponding bit in the identifier of the message object is not used for acceptance filtering (don't care).  1 The corresponding bit in the identifier of the message object is used for acceptance filtering.  Note: This bit is write protected by Busy bit. Reset type: SYSRSn

### 21.15.2.24 CAN\_IF1ARB Register (Offset = 108h) [reset = 0h]

CAN\_IF1ARB is shown in [Figure 21-41](#) and described in [Table 21-33](#).

Return to [Summary Table](#).

The bits of the IF1/IF2 Arbitration Registers mirror the arbitration bits of a message object. The Arbitration bits ID[28:0], Xtd, and Dir are used to define the identifier and type of outgoing messages and (together with the Mask bits Msk[28:0], MXtd, and MDir) for acceptance filtering of incoming messages.

A received message is stored into the valid message object with matching identifier and Direction = receive (Data Frame) or Direction = transmit (Remote Frame).

Extended frames can be stored only in message objects with Xtd = one, standard frames in message objects with Xtd = zero.

If a received message (Data Frame or Remote Frame) matches more than one valid message objects, it is stored into the one with the lowest message number.

Note: While Busy bit of IF1/IF2 Command Register is one, IF1/IF2 Register Set is write-protected.

**Figure 21-41. CAN\_IF1ARB Register**

31	30	29	28	27	26	25	24
MsgVal	Xtd	Dir	ID				
R/W-0h	R/W-0h	R/W-0h	R/W-0h				
23	22	21	20	19	18	17	16
ID							
R/W-0h							
15	14	13	12	11	10	9	8
ID							
R/W-0h							
7	6	5	4	3	2	1	0
ID							
R/W-0h							

**Table 21-33. CAN\_IF1ARB Register Field Descriptions**

Bit	Field	Type	Reset	Description
31	MsgVal	R/W	0h	<p>Message Valid</p> <p>0 The mailbox is disabled. (The message object is ignored by the message handler).</p> <p>1 The mailbox is enabled. (The message object is to be used by the message handler).</p> <p>The CPU should reset the MsgVal bit of all unused Messages Objects during the initialization before it resets the Init bit in the CAN Control Register. This bit must also be reset before the identifier ID[28:0], the control bits Xtd, Dir or DLC[3:0] are modified, or if the messages object is no longer required.</p> <p>Note: This bit is write protected by Busy bit.</p> <p>Reset type: SYSRSn</p>
30	Xtd	R/W	0h	<p>Extended Identifier</p> <p>0 The 11-bit ("standard") Identifier is used for this message object.</p> <p>1 The 29-bit ("extended") Identifier is used for this message object.</p> <p>Note: This bit is write protected by Busy bit.</p> <p>Reset type: SYSRSn</p>

**Table 21-33. CAN\_IF1ARB Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
29	Dir	R/W	0h	Message Direction  0 Direction = receive: On TxRqst, a remote frame with the identifier of this message object is transmitted. On reception of a data frame with matching identifier, that message is stored in this message object.  1 Direction = transmit: On TxRqst, the respective message object is transmitted as a data frame. On reception of a remote frame with matching identifier, the TxRqst bit of this message object is set (if RmtEn = one).  Note: This bit is write protected by Busy bit. Reset type: SYSRSn
28-0	ID	R/W	0h	Message Identifier  ID[28:0] 29-bit Identifier ("Extended Frame")  ID[28:18] 11-bit Identifier ("Standard Frame")  Note: This bit is write protected by Busy bit. Reset type: SYSRSn

### 21.15.2.25 CAN\_IF1MCTL Register (Offset = 10Ch) [reset = 0h]

CAN\_IF1MCTL is shown in [Figure 21-42](#) and described in [Table 21-34](#).

Return to [Summary Table](#).

The bits of the IF1/IF2 Message Control Registers mirror the message control bits of a message object. This register has control/status bits pertaining to interrupts, acceptance mask, remote frames and FIFO option.

**Figure 21-42. CAN\_IF1MCTL Register**

31	30	29	28	27	26	25	24
RESERVED							
R-0h							
23	22	21	20	19	18	17	16
RESERVED							
R-0h							
15	14	13	12	11	10	9	8
NewDat	MsgLst	IntPnd	UMask	TxIE	RxIE	RmtEn	TxRqst
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
7	6	5	4	3	2	1	0
EoB	RESERVED			DLC			
R/W-0h	R-0h			R/W-0h			

**Table 21-34. CAN\_IF1MCTL Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R	0h	Reserved
15	NewDat	R/W	0h	<p>New Data</p> <p>0 No new data has been written into the data portion of this message object by the message handler since the last time when this flag was cleared by the CPU.</p> <p>1 The message handler or the CPU has written new data into the data portion of this message object.</p> <p>Note: This bit is write protected by Busy bit. Reset type: SYSRSn</p>
14	MsgLst	R/W	0h	<p>Message Lost (only valid for message objects with direction = receive)</p> <p>0 No message lost since the last time when this bit was reset by the CPU.</p> <p>1 The message handler stored a new message into this object when NewDat was still set, so the previous message has been overwritten.</p> <p>Note: This bit is write protected by Busy bit. Reset type: SYSRSn</p>
13	IntPnd	R/W	0h	<p>Interrupt Pending</p> <p>0 This message object is not the source of an interrupt.</p> <p>1 This message object is the source of an interrupt. The Interrupt Identifier in the Interrupt Register will point to this message object if there is no other interrupt source with higher priority.</p> <p>Note: This bit is write protected by Busy bit. Reset type: SYSRSn</p>

**Table 21-34. CAN\_IF1MCTL Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
12	UMask	R/W	0h	<p>Use Acceptance Mask</p> <p>0 Mask ignored</p> <p>1 Use Mask (Msk[28:0], MXtd, and MDir) for acceptance filtering</p> <p>If the UMask bit is set to one, the message object's mask bits have to be programmed during initialization of the message object before MsgVal is set to one.</p> <p>Note: This bit is write protected by Busy bit.</p> <p>Reset type: SYSRSn</p>
11	TxIE	R/W	0h	<p>Transmit Interrupt Enable</p> <p>0 IntPnd will not be triggered after the successful transmission of a frame.</p> <p>1 IntPnd will be triggered after the successful transmission of a frame.</p> <p>Note: This bit is write protected by Busy bit.</p> <p>Reset type: SYSRSn</p>
10	RxIE	R/W	0h	<p>Receive Interrupt Enable</p> <p>0 IntPnd will not be triggered after the successful reception of a frame.</p> <p>1 IntPnd will be triggered after the successful reception of a frame.</p> <p>Note: This bit is write protected by Busy bit.</p> <p>Reset type: SYSRSn</p>
9	RmtEn	R/W	0h	<p>Remote Enable</p> <p>0 At the reception of a remote frame, TxRqst is not changed.</p> <p>1 At the reception of a remote frame, TxRqst is set.</p> <p>Note: This bit is write protected by Busy bit.</p> <p>Reset type: SYSRSn</p>
8	TxRqst	R/W	0h	<p>Transmit Request</p> <p>0 This message object is not waiting for a transmission.</p> <p>1 The transmission of this message object is requested and is not yet done.</p> <p>Note: This bit is write protected by Busy bit.</p> <p>Reset type: SYSRSn</p>
7	EoB	R/W	0h	<p>End of Block</p> <p>0 The message object is part of a FIFO Buffer block and is not the last message object of the FIFO Buffer block.</p> <p>1 The message object is a single message object or the last message object in a FIFO Buffer Block.</p> <p>Note: This bit is used to concatenate multiple message objects to build a FIFO Buffer. For single message objects (not belonging to a FIFO Buffer), this bit must always be set to one.</p> <p>Note: This bit is write protected by Busy bit.</p> <p>Reset type: SYSRSn</p>
6-4	RESERVED	R	0h	Reserved



**Table 21-34. CAN\_IF1MCTL Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
3-0	DLC	R/W	0h	Data length code 0-8 Data frame has 0-8 data bytes. 9-15 Data frame has 8 data bytes. Note: The data length code of a message object must be defined the same as in all the corresponding objects with the same identifier at other nodes. When the message handler stores a data frame, it will write the DLC to the value given by the received message. Note: This bit is write protected by Busy bit. Reset type: SYSRSn

### 21.15.2.26 CAN\_IF1DATA Register (Offset = 110h) [reset = 0h]

CAN\_IF1DATA is shown in [Figure 21-43](#) and described in [Table 21-35](#).

Return to [Summary Table](#).

This register provides a window to the data bytes of the CAN message. The data bytes of CAN messages are stored in the IF1/IF2 registers in the following order. In a CAN Data Frame, Data 0 is the first, and Data 7 is the last byte to be transmitted or received. In CAN's serial bit stream, the MSB of each byte will be transmitted first. All bits in this register are write-protected by the Busy bit.

**Figure 21-43. CAN\_IF1DATA Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Data_3								Data_2								Data_1								Data_0							
R/W-0h								R/W-0h								R/W-0h								R/W-0h							

**Table 21-35. CAN\_IF1DATA Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-24	Data_3	R/W	0h	Data Byte 3 Reset type: SYSRSn
23-16	Data_2	R/W	0h	Data Byte 2 Reset type: SYSRSn
15-8	Data_1	R/W	0h	Data Byte 1 Reset type: SYSRSn
7-0	Data_0	R/W	0h	Data Byte 0 Reset type: SYSRSn

### 21.15.2.27 CAN\_IF1DATB Register (Offset = 114h) [reset = 0h]

CAN\_IF1DATB is shown in [Figure 21-44](#) and described in [Table 21-36](#).

Return to [Summary Table](#).

This register provides a window to the data bytes of the CAN message. The data bytes of CAN messages are stored in the IF1/IF2 registers in the following order. In a CAN Data Frame, Data 0 is the first, and Data 7 is the last byte to be transmitted or received. In CAN's serial bit stream, the MSB of each byte will be transmitted first. All bits in this register are write-protected by the Busy bit.

**Figure 21-44. CAN\_IF1DATB Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Data_7								Data_6								Data_5								Data_4							
R/W-0h								R/W-0h								R/W-0h								R/W-0h							

**Table 21-36. CAN\_IF1DATB Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-24	Data_7	R/W	0h	Data Byte 7 Reset type: SYSRSn
23-16	Data_6	R/W	0h	Data Byte 6 Reset type: SYSRSn
15-8	Data_5	R/W	0h	Data Byte 5 Reset type: SYSRSn
7-0	Data_4	R/W	0h	Data Byte 4 Reset type: SYSRSn

### 21.15.2.28 CAN\_IF2CMD Register (Offset = 120h) [reset = 1h]

CAN\_IF2CMD is shown in [Figure 21-45](#) and described in [Table 21-37](#).

Return to [Summary Table](#).

The IF1/IF2 Command Registers configure and initiate the transfer between the IF1/IF2 Register sets and the Message RAM. It is configurable which portions of the message object should be transferred. A transfer is started when the CPU writes the message number to bits [7:0] of the IF1/IF2 Command Register. With this write operation, the Busy bit is automatically set to '1' to indicate that a transfer is in progress. After 4 to 14 clock cycles, the transfer between the Interface Register and the Message RAM will be completed and the Busy bit is cleared. The maximum number of cycles is needed when the message transfer coincides with a CAN message transmission, acceptance filtering, or message storage. If the CPU writes to both IF1/IF2 Command Registers consecutively (request of a second transfer while first transfer is still in progress), the second transfer will start after the first one has been completed.

Note: While Busy bit is one, IF1/IF2 Register sets are write protected.

Note: For debug support, the auto clear functionality of the IF1/IF2 Command Registers (clear of DMAActive flag by R/W, for devices with DMA support) is disabled during Debug/Suspend mode.

Note: If an invalid Message Number is written to bits [7:0] of the IF1/IF2 Command Register, the Message Handler may access an implemented (valid) message object instead.

**Figure 21-45. CAN\_IF2CMD Register**

31	30	29	28	27	26	25	24
RESERVED							
R-0h							
23	22	21	20	19	18	17	16
DIR	Mask	Arb	Control	ClrIntPnd	TxRqst	DATA_A	DATA_B
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
15	14	13	12	11	10	9	8
Busy		RESERVED					
R-0h		R-0h					
7	6	5	4	3	2	1	0
MSG_NUM							
R/W-1h							

**Table 21-37. CAN\_IF2CMD Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-24	RESERVED	R	0h	Reserved
23	DIR	R/W	0h	Write/Read  0 Direction = Read: Transfer direction is from the message object addressed by Message Number (Bits [7:0]) to the IF1/IF2 Register set.  1 Direction = Write: Transfer direction is from the IF1/IF2 Register set to the message object addressed by Message Number (Bits [7:0])  Note: This bit is write protected by Busy bit. Reset type: SYSRSn

**Table 21-37. CAN\_IF2CMD Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
22	Mask	R/W	0h	<p>Access Mask Bits</p> <p>0 Mask bits will not be changed</p> <p>1 Direction = Read: The Mask bits (Identifier Mask + MDir + MXtd) will be transferred from the message object addressed by Message Number (Bits [7:0]) to the IF1/IF2 Register set.</p> <p>1 Direction = Write: The Mask bits (Identifier Mask + MDir + MXtd) will be transferred from the IF1/IF2 Register set to the message object addressed by Message Number (Bits [7:0]).</p> <p>Note: This bit is write protected by Busy bit. Reset type: SYSRSn</p>
21	Arb	R/W	0h	<p>Access Arbitration Bits</p> <p>0 Arbitration bits will not be changed</p> <p>1 Direction = Read: The Arbitration bits (Identifier + Dir + Xtd + MsgVal) will be transferred from the message object addressed by Message Number (Bits [7:0]) to the corresponding IF1/IF2 Register set.</p> <p>1 Direction = Write: The Arbitration bits (Identifier + Dir + Xtd + MsgVal) will be transferred from the IF1/IF2 Register set to the message object addressed by Message Number (Bits [7:0]).</p> <p>Note: This bit is write protected by Busy bit. Reset type: SYSRSn</p>
20	Control	R/W	0h	<p>Access Control Bits</p> <p>0 Control bits will not be changed</p> <p>1 Direction = Read: The Message Control bits will be transferred from the message object addressed by Message Number (Bits [7:0]) to the IF1/IF2 Register set.</p> <p>1 Direction = Write: The Message Control bits will be transferred from the IF1/IF2 Register set to the message object addressed by Message Number (Bits [7:0]). If the TxRqst/NewDat bit in this register (Bit [18]) is set, the TxRqst/ NewDat bit in the IF1/IF2 Message Control Register will be ignored.</p> <p>Note: This bit is write protected by Busy bit. Reset type: SYSRSn</p>
19	ClrIntPnd	R/W	0h	<p>Clear Interrupt Pending Bit</p> <p>0 IntPnd bit will not be changed</p> <p>1 Direction = Read: Clears IntPnd bit in the message object.</p> <p>1 Direction = Write: This bit is ignored. Copying of IntPnd flag from IF1/IF2 registers to Message RAM can only be controlled by the Control flag (Bit [20]).</p> <p>Note: This bit is write protected by Busy bit. Reset type: SYSRSn</p>

**Table 21-37. CAN\_IF2CMD Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
18	TxRqst	R/W	0h	<p>Access Transmission Request Bit</p> <p>0 Direction = Read: NewDat bit will not be changed. 0 Direction = Write: TxRqst/NewDat bit will be handled according to the Control bit.</p> <p>1 Direction = Read: Clears NewDat bit in the message object. 1 Direction = Write: Sets TxRqst/NewDat in message object.</p> <p>Note: If a CAN transmission is requested by setting TxRqst/NewDat in this register, the TxRqst/NewDat bits in the message object will be set to one independent of the values in IF1/IF2 Message Control Register.</p> <p>Note: A read access to a message object can be combined with the reset of the control bits IntPnd and NewDat. The values of these bits transferred to the IF1/IF2 Message Control Register always reflect the status before resetting them.</p> <p>Note: This bit is write protected by Busy bit. Reset type: SYSRSn</p>
17	DATA_A	R/W	0h	<p>Access Data Bytes 0-3</p> <p>0 Data Bytes 0-3 will not be changed.</p> <p>1 Direction = Read: The Data Bytes 0-3 will be transferred from the message object addressed by the Message Number (Bits [7:0]) to the corresponding IF1/IF2 Register set.</p> <p>1 Direction = Write: The Data Bytes 0-3 will be transferred from the IF1/IF2 Register set to the message object addressed by the Message Number (Bits [7:0]).</p> <p>Note: The duration of the message transfer is independent of the number of bytes to be transferred.</p> <p>Note: This bit is write protected by Busy bit. Reset type: SYSRSn</p>
16	DATA_B	R/W	0h	<p>Access Data Bytes 4-7</p> <p>0 Data Bytes 4-7 will not be changed.</p> <p>1 Direction = Read: The Data Bytes 4-7 will be transferred from the message object addressed by Message Number (Bits [7:0]) to the corresponding IF1/IF2 Register set.</p> <p>1 Direction = Write: The Data Bytes 4-7 will be transferred from the IF1/IF2 Register set to the message object addressed by Message Number (Bits [7:0]).</p> <p>Note: The duration of the message transfer is independent of the number of bytes to be transferred.</p> <p>Note: This bit is write protected by Busy bit. Reset type: SYSRSn</p>
15	Busy	R	0h	<p>Busy Flag</p> <p>0 No transfer between IF1/IF2 Register Set and Message RAM is in progress. 1 Transfer between IF1/IF2 Register Set and Message RAM is in progress.</p> <p>This bit is set to one after the message number has been written to bits [7:0]. IF1/IF2 Register Set will be write protected. The bit is cleared after read/write action has been finished.</p> <p>Reset type: SYSRSn</p>
14	RESERVED	R	0h	Reserved

**Table 21-37. CAN\_IF2CMD Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
13-8	RESERVED	R	0h	Reserved
7-0	MSG_NUM	R/W	1h	Number of message object in Message RAM which is used for data transfer  0x00 Invalid message number  0x01-0x20 Valid message numbers  0x21-0xFF Invalid message numbers Reset type: SYSRSn

**21.15.2.29 CAN\_IF2MSK Register (Offset = 124h) [reset = FFFFFFFFh]**

CAN\_IF2MSK is shown in [Figure 21-46](#) and described in [Table 21-38](#).

Return to [Summary Table](#).

The bits of the IF1/IF2 Mask Registers mirror the mask bits of a message object.

Note: While Busy bit of IF1/IF2 Command Register is one, IF1/IF2 Register Set is write-protected.

**Figure 21-46. CAN\_IF2MSK Register**

31	30	29	28	27	26	25	24
MXtd	MDir	RESERVED	Msk				
R/W-1h	R/W-1h	R-1h	R/W-1FFFFFFFh				
23	22	21	20	19	18	17	16
Msk							
R/W-1FFFFFFFh							
15	14	13	12	11	10	9	8
Msk							
R/W-1FFFFFFFh							
7	6	5	4	3	2	1	0
Msk							
R/W-1FFFFFFFh							

**Table 21-38. CAN\_IF2MSK Register Field Descriptions**

Bit	Field	Type	Reset	Description
31	MXtd	R/W	1h	Mask Extended Identifier  0 The extended identifier bit (IDE) has no effect on the acceptance filtering.  1 The extended identifier bit (IDE) is used for acceptance filtering.  When 11-bit ("standard") identifiers are used for a message object, the identifiers of received data frames are written into bits ID[28:18]. For acceptance filtering, only these bits together with mask bits Msk[28:18] are considered.  Note: This bit is write protected by Busy bit. Reset type: SYSRSn
30	MDir	R/W	1h	Mask Message Direction  0 The message direction bit (Dir) has no effect on the acceptance filtering.  1 The message direction bit (Dir) is used for acceptance filtering.  Note: This bit is write protected by Busy bit. Reset type: SYSRSn
29	RESERVED	R	1h	Reserved
28-0	Msk	R/W	1FFFFFFFh	Identifier Mask  0 The corresponding bit in the identifier of the message object is not used for acceptance filtering (don't care).  1 The corresponding bit in the identifier of the message object is used for acceptance filtering.  Note: This bit is write protected by Busy bit. Reset type: SYSRSn



### 21.15.2.30 CAN\_IF2ARB Register (Offset = 128h) [reset = 0h]

CAN\_IF2ARB is shown in [Figure 21-47](#) and described in [Table 21-39](#).

Return to [Summary Table](#).

The bits of the IF1/IF2 Arbitration Registers mirror the arbitration bits of a message object. The Arbitration bits ID[28:0], Xtd, and Dir are used to define the identifier and type of outgoing messages and (together with the Mask bits Msk[28:0], MXtd, and MDir) for acceptance filtering of incoming messages.

A received message is stored into the valid message object with matching identifier and Direction = receive (Data Frame) or Direction = transmit (Remote Frame).

Extended frames can be stored only in message objects with Xtd = one, standard frames in message objects with Xtd = zero.

If a received message (Data Frame or Remote Frame) matches more than one valid message objects, it is stored into the one with the lowest message number.

Note: While Busy bit of IF1/IF2 Command Register is one, IF1/IF2 Register Set is write-protected.

**Figure 21-47. CAN\_IF2ARB Register**

31	30	29	28	27	26	25	24
MsgVal	Xtd	Dir	ID				
R/W-0h	R/W-0h	R/W-0h	R/W-0h				
23	22	21	20	19	18	17	16
ID							
R/W-0h							
15	14	13	12	11	10	9	8
ID							
R/W-0h							
7	6	5	4	3	2	1	0
ID							
R/W-0h							

**Table 21-39. CAN\_IF2ARB Register Field Descriptions**

Bit	Field	Type	Reset	Description
31	MsgVal	R/W	0h	<p>Message Valid</p> <p>0 The mailbox is disabled. (The message object is ignored by the message handler).</p> <p>1 The mailbox is enabled. (The message object is to be used by the message handler).</p> <p>The CPU should reset the MsgVal bit of all unused Messages Objects during the initialization before it resets the Init bit in the CAN Control Register. This bit must also be reset before the identifier ID[28:0], the control bits Xtd, Dir or DLC[3:0] are modified, or if the messages object is no longer required.</p> <p>Note: This bit is write protected by Busy bit.</p> <p>Reset type: SYSRSn</p>
30	Xtd	R/W	0h	<p>Extended Identifier</p> <p>0 The 11-bit ("standard") Identifier is used for this message object.</p> <p>1 The 29-bit ("extended") Identifier is used for this message object.</p> <p>Note: This bit is write protected by Busy bit.</p> <p>Reset type: SYSRSn</p>

**Table 21-39. CAN\_IF2ARB Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
29	Dir	R/W	0h	Message Direction  0 Direction = receive: On TxRqst, a remote frame with the identifier of this message object is transmitted. On reception of a data frame with matching identifier, that message is stored in this message object.  1 Direction = transmit: On TxRqst, the respective message object is transmitted as a data frame. On reception of a remote frame with matching identifier, the TxRqst bit of this message object is set (if RmtEn = one).  Note: This bit is write protected by Busy bit. Reset type: SYSRSn
28-0	ID	R/W	0h	Message Identifier  ID[28:0] 29-bit Identifier ("Extended Frame") ID[28:18] 11-bit Identifier ("Standard Frame")  Note: This bit is write protected by Busy bit. Reset type: SYSRSn

### 21.15.2.31 CAN\_IF2MCTL Register (Offset = 12Ch) [reset = 0h]

CAN\_IF2MCTL is shown in [Figure 21-48](#) and described in [Table 21-40](#).

Return to [Summary Table](#).

The bits of the IF1/IF2 Message Control Registers mirror the message control bits of a message object. This register has control/status bits pertaining to interrupts, acceptance mask, remote frames and FIFO option.

**Figure 21-48. CAN\_IF2MCTL Register**

31	30	29	28	27	26	25	24
RESERVED							
R-0h							
23	22	21	20	19	18	17	16
RESERVED							
R-0h							
15	14	13	12	11	10	9	8
NewDat	MsgLst	IntPnd	UMask	TxE	RxE	RmtEn	TxRqst
R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
7	6	5	4	3	2	1	0
EoB	RESERVED			DLC			
R/W-0h	R-0h			R/W-0h			

**Table 21-40. CAN\_IF2MCTL Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R	0h	Reserved
15	NewDat	R/W	0h	<p>New Data</p> <p>0 No new data has been written into the data portion of this message object by the message handler since the last time when this flag was cleared by the CPU.</p> <p>1 The message handler or the CPU has written new data into the data portion of this message object.</p> <p>Note: This bit is write protected by Busy bit. Reset type: SYSRSn</p>
14	MsgLst	R/W	0h	<p>Message Lost (only valid for message objects with direction = receive)</p> <p>0 No message lost since the last time when this bit was reset by the CPU.</p> <p>1 The message handler stored a new message into this object when NewDat was still set, so the previous message has been overwritten.</p> <p>Note: This bit is write protected by Busy bit. Reset type: SYSRSn</p>
13	IntPnd	R/W	0h	<p>Interrupt Pending</p> <p>0 This message object is not the source of an interrupt.</p> <p>1 This message object is the source of an interrupt. The Interrupt Identifier in the Interrupt Register will point to this message object if there is no other interrupt source with higher priority.</p> <p>Note: This bit is write protected by Busy bit. Reset type: SYSRSn</p>

**Table 21-40. CAN\_IF2MCTL Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
12	UMask	R/W	0h	<p>Use Acceptance Mask</p> <p>0 Mask ignored</p> <p>1 Use Mask (Msk[28:0], MXtd, and MDir) for acceptance filtering</p> <p>If the UMask bit is set to one, the message object's mask bits have to be programmed during initialization of the message object before MsgVal is set to one.</p> <p>Note: This bit is write protected by Busy bit.</p> <p>Reset type: SYSRSn</p>
11	TxIE	R/W	0h	<p>Transmit Interrupt Enable</p> <p>0 IntPnd will not be triggered after the successful transmission of a frame.</p> <p>1 IntPnd will be triggered after the successful transmission of a frame.</p> <p>Note: This bit is write protected by Busy bit.</p> <p>Reset type: SYSRSn</p>
10	RxIE	R/W	0h	<p>Receive Interrupt Enable</p> <p>0 IntPnd will not be triggered after the successful reception of a frame.</p> <p>1 IntPnd will be triggered after the successful reception of a frame.</p> <p>Note: This bit is write protected by Busy bit.</p> <p>Reset type: SYSRSn</p>
9	RmtEn	R/W	0h	<p>Remote Enable</p> <p>0 At the reception of a remote frame, TxRqst is not changed.</p> <p>1 At the reception of a remote frame, TxRqst is set.</p> <p>Note: This bit is write protected by Busy bit.</p> <p>Reset type: SYSRSn</p>
8	TxRqst	R/W	0h	<p>Transmit Request</p> <p>0 This message object is not waiting for a transmission.</p> <p>1 The transmission of this message object is requested and is not yet done.</p> <p>Note: This bit is write protected by Busy bit.</p> <p>Reset type: SYSRSn</p>
7	EoB	R/W	0h	<p>End of Block</p> <p>0 The message object is part of a FIFO Buffer block and is not the last message object of the FIFO Buffer block.</p> <p>1 The message object is a single message object or the last message object in a FIFO Buffer Block.</p> <p>Note: This bit is used to concatenate multiple message objects to build a FIFO Buffer. For single message objects (not belonging to a FIFO Buffer), this bit must always be set to one.</p> <p>Note: This bit is write protected by Busy bit.</p> <p>Reset type: SYSRSn</p>
6-4	RESERVED	R	0h	Reserved

**Table 21-40. CAN\_IF2MCTL Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
3-0	DLC	R/W	0h	<p>Data length code</p> <p>0-8 Data frame has 0-8 data bytes.</p> <p>9-15 Data frame has 8 data bytes.</p> <p>Note: The data length code of a message object must be defined the same as in all the corresponding objects with the same identifier at other nodes. When the message handler stores a data frame, it will write the DLC to the value given by the received message.</p> <p>Note: This bit is write protected by Busy bit.</p> <p>Reset type: SYSRSn</p>

### 21.15.2.32 CAN\_IF2DATA Register (Offset = 130h) [reset = 0h]

CAN\_IF2DATA is shown in [Figure 21-49](#) and described in [Table 21-41](#).

Return to [Summary Table](#).

This register provides a window to the data bytes of the CAN message. The data bytes of CAN messages are stored in the IF1/IF2 registers in the following order. In a CAN Data Frame, Data 0 is the first, and Data 7 is the last byte to be transmitted or received. In CAN's serial bit stream, the MSB of each byte will be transmitted first. All bits in this register are write-protected by the Busy bit.

**Figure 21-49. CAN\_IF2DATA Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Data_3								Data_2								Data_1								Data_0							
R/W-0h								R/W-0h								R/W-0h								R/W-0h							

**Table 21-41. CAN\_IF2DATA Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-24	Data_3	R/W	0h	Data Byte 3 Reset type: SYSRSn
23-16	Data_2	R/W	0h	Data Byte 2 Reset type: SYSRSn
15-8	Data_1	R/W	0h	Data Byte 1 Reset type: SYSRSn
7-0	Data_0	R/W	0h	Data Byte 0 Reset type: SYSRSn

### 21.15.2.33 CAN\_IF2DATB Register (Offset = 134h) [reset = 0h]

CAN\_IF2DATB is shown in [Figure 21-50](#) and described in [Table 21-42](#).

Return to [Summary Table](#).

This register provides a window to the data bytes of the CAN message. The data bytes of CAN messages are stored in the IF1/IF2 registers in the following order. In a CAN Data Frame, Data 0 is the first, and Data 7 is the last byte to be transmitted or received. In CAN's serial bit stream, the MSB of each byte will be transmitted first. All bits in this register are write-protected by the Busy bit.

**Figure 21-50. CAN\_IF2DATB Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Data_7								Data_6								Data_5								Data_4							
R/W-0h								R/W-0h								R/W-0h								R/W-0h							

**Table 21-42. CAN\_IF2DATB Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-24	Data_7	R/W	0h	Data Byte 7 Reset type: SYSRSn
23-16	Data_6	R/W	0h	Data Byte 6 Reset type: SYSRSn
15-8	Data_5	R/W	0h	Data Byte 5 Reset type: SYSRSn
7-0	Data_4	R/W	0h	Data Byte 4 Reset type: SYSRSn

### 21.15.2.34 CAN\_IF3OBS Register (Offset = 140h) [reset = 0h]

CAN\_IF3OBS is shown in [Figure 21-51](#) and described in [Table 21-43](#).

Return to [Summary Table](#).

The IF3 register set can automatically be updated with received message objects without the need to initiate the transfer from Message RAM by CPU.

The observation flags (Bits [4:0]) in the IF3 Observation register are used to determine, which data sections of the IF3 Interface Register set have to be read in order to complete a DMA read cycle. After all marked data sections are read, the DCAN is enabled to update the IF3 Interface Register set with new data.

Any access order of single bytes or half-words is supported. When using byte or half-word accesses, a data section is marked as completed, if all bytes are read.

Note: If IF3 Update Enable is used and no Observation flag is set, the corresponding message objects will be copied to IF3 without activating the DMA request line and without waiting for DMA read accesses.

A write access to this register aborts a pending DMA cycle by resetting the DMA line and enables updating of IF3 Interface Register set with new data. To avoid data inconsistency, the DMA controller should be disabled before reconfiguring IF3 observation register. The status of the current read-cycle can be observed via status flags (Bits [12:8]).

With this, the observation status bits and the IF3Upd bit could be used by the application to realize the notification about new IF3 content in polling or interrupt mode

**Figure 21-51. CAN\_IF3OBS Register**

31	30	29	28	27	26	25	24
RESERVED							
R-0h							
23	22	21	20	19	18	17	16
RESERVED							
R-0h							
15	14	13	12	11	10	9	8
IF3Upd	RESERVED		IF3SDB	IF3SDA	IF3SC	IF3SA	IF3SM
R-0h	R-0h		R-0h	R-0h	R-0h	R-0h	R-0h
7	6	5	4	3	2	1	0
RESERVED			Data_B	Data_A	Ctrl	Arb	Mask
R-0h			R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h

**Table 21-43. CAN\_IF3OBS Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R	0h	Reserved
15	IF3Upd	R	0h	IF3 Update Data  0 No new data has been loaded since last IF3 read. 1 New data has been loaded since last IF3 read. Reset type: SYSRSn
14-13	RESERVED	R	0h	Reserved
12	IF3SDB	R	0h	IF3 Status of Data B read access  0 All Data B bytes are already read out, or are not marked to be read. 1 Data B section has still data to be read out. Reset type: SYSRSn



**Table 21-43. CAN\_IF3OBS Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
11	IF3SDA	R	0h	IF3 Status of Data A read access  0 All Data A bytes are already read out, or are not marked to be read. 1 Data A section has still data to be read out. Reset type: SYSRSn
10	IF3SC	R	0h	IF3 Status of Control bits read access  0 All Control section bytes are already read out, or are not marked to be read. 1 Control section has still data to be read out. Reset type: SYSRSn
9	IF3SA	R	0h	IF3 Status of Arbitration data read access  0 All Arbitration data bytes are already read out, or are not marked to be read. 1 Arbitration section has still data to be read out. Reset type: SYSRSn
8	IF3SM	R	0h	IF3 Status of Mask data read access  0 All Mask data bytes are already read out, or are not marked to be read. 1 Mask section has still data to be read out. Reset type: SYSRSn
7-5	RESERVED	R	0h	Reserved
4	Data_B	R/W	0h	Data B read observation  0 Data B section not to be read. 1 Data B section has to be read to enable next IF3 update. Reset type: SYSRSn
3	Data_A	R/W	0h	Data A read observation  0 Data A section not to be read. 1 Data A section has to be read to enable next IF3 update. Reset type: SYSRSn
2	Ctrl	R/W	0h	Ctrl read observation  0 Ctrl section not to be read. 1 Ctrl section has to be read to enable next IF3 update. Reset type: SYSRSn
1	Arb	R/W	0h	Arbitration data read observation  0 Arbitration data not to be read. 1 Arbitration data has to be read to enable next IF3 update. Reset type: SYSRSn
0	Mask	R/W	0h	Mask data read observation  0 Mask data not to be read. 1 Mask data has to be read to enable next IF3 update. Reset type: SYSRSn

**21.15.2.35 CAN\_IF3MSK Register (Offset = 144h) [reset = FFFFFFFFh]**

CAN\_IF3MSK is shown in [Figure 21-52](#) and described in [Table 21-44](#).

Return to [Summary Table](#).

This register provides a window to the acceptance mask for the chosen mailbox.

**Figure 21-52. CAN\_IF3MSK Register**

31	30	29	28	27	26	25	24
MXtd	MDir	RESERVED	Msk				
R-1h	R-1h	R-1h	R-1FFFFFFFh				
23	22	21	20	19	18	17	16
Msk							
R-1FFFFFFFh							
15	14	13	12	11	10	9	8
Msk							
R-1FFFFFFFh							
7	6	5	4	3	2	1	0
Msk							
R-1FFFFFFFh							

**Table 21-44. CAN\_IF3MSK Register Field Descriptions**

Bit	Field	Type	Reset	Description
31	MXtd	R	1h	Mask Extended Identifier  0 The extended identifier bit (IDE) has no effect on the acceptance filtering.  1 The extended identifier bit (IDE) is used for acceptance filtering.  Note: When 11-bit ("standard") identifiers are used for a message object, the identifiers of received data frames are written into bits ID[28:18]. For acceptance filtering, only these bits together with mask bits Msk[28:18] are considered.  Reset type: SYSRSn
30	MDir	R	1h	Mask Message Direction  0 The message direction bit (Dir) has no effect on the acceptance filtering.  1 The message direction bit (Dir) is used for acceptance filtering.  Reset type: SYSRSn
29	RESERVED	R	1h	Reserved
28-0	Msk	R	1FFFFFFFh	Identifier Mask Identifier Mask  0 The corresponding bit in the identifier of the message object is not used for acceptance filtering (don't care).  1 The corresponding bit in the identifier of the message object is used for acceptance filtering. Identifier Mask  Reset type: SYSRSn

### 21.15.2.36 CAN\_IF3ARB Register (Offset = 148h) [reset = 0h]

CAN\_IF3ARB is shown in [Figure 21-53](#) and described in [Table 21-45](#).

Return to [Summary Table](#).

The bits of the IF3 Arbitration Register mirrors the arbitration bits of a message object.

**Figure 21-53. CAN\_IF3ARB Register**

31	30	29	28	27	26	25	24
MsgVal	Xtd	Dir	ID				
R-0h	R-0h	R-0h	R-0h				
23	22	21	20	19	18	17	16
ID							
R-0h							
15	14	13	12	11	10	9	8
ID							
R-0h							
7	6	5	4	3	2	1	0
ID							
R-0h							

**Table 21-45. CAN\_IF3ARB Register Field Descriptions**

Bit	Field	Type	Reset	Description
31	MsgVal	R	0h	<p>Message Valid</p> <p>0 The message object is ignored by the message handler.</p> <p>1 The message object is to be used by the message handler.</p> <p>The CPU should reset the MsgVal bit of all unused Messages Objects during the initialization before it resets bit Init in the CAN Control Register. This bit must also be reset before the identifier ID[28:0], the control bits Xtd, Dir or DLC[3:0] are modified, or if the messages object is no longer required.</p> <p>Reset type: SYSRSn</p>
30	Xtd	R	0h	<p>Extended Identifier</p> <p>0 The 11-bit ("standard") Identifier is used for this message object.</p> <p>1 The 29-bit ("extended") Identifier is used for this message object.</p> <p>Reset type: SYSRSn</p>
29	Dir	R	0h	<p>Message Direction</p> <p>0 Direction = receive: On TxRqst, a remote frame with the identifier of this message object is transmitted. On reception of a data frame with matching identifier, that message is stored in this message object.</p> <p>1 Direction = transmit: On TxRqst, the respective message object is transmitted as a data frame. On reception of a remote frame with matching identifier, the TxRqst bit of this message object is set (if RmtEn = one).</p> <p>Reset type: SYSRSn</p>
28-0	ID	R	0h	<p>Message Identifier</p> <p>ID[28:0] 29-bit Identifier ("Extended Frame")</p> <p>ID[28:18] 11-bit Identifier ("Standard Frame")</p> <p>Reset type: SYSRSn</p>

**21.15.2.37 CAN\_IF3MCTL Register (Offset = 14Ch) [reset = 0h]**

CAN\_IF3MCTL is shown in [Figure 21-54](#) and described in [Table 21-46](#).

Return to [Summary Table](#).

The bits of the IF3 Message Control Register mirrors the message control bits of a message object.

**Figure 21-54. CAN\_IF3MCTL Register**

31	30	29	28	27	26	25	24
RESERVED							
R-0h							
23	22	21	20	19	18	17	16
RESERVED							
R-0h							
15	14	13	12	11	10	9	8
NewDat	MsgLst	IntPnd	UMask	TxE	RxE	RmtEn	TxRqst
R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h	R-0h
7	6	5	4	3	2	1	0
EoB	RESERVED				DLC		
R-0h	R-0h				R-0h		

**Table 21-46. CAN\_IF3MCTL Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R	0h	Reserved
15	NewDat	R	0h	New Data  0 No new data has been written into the data portion of this message object by the message handler since the last time when this flag was cleared by the CPU.  1 The message handler or the CPU has written new data into the data portion of this message object.  Reset type: SYSRSn
14	MsgLst	R	0h	Message Lost (only valid for message objects with direction = receive)  0 No message lost since the last time when this bit was reset by the CPU.  1 The message handler stored a new message into this object when NewDat was still set, so the previous message has been overwritten.  Reset type: SYSRSn
13	IntPnd	R	0h	Interrupt Pending  0 This message object is not the source of an interrupt.  1 This message object is the source of an interrupt. The Interrupt Identifier in the Interrupt Register will point to this message object if there is no other interrupt source with higher priority.  Reset type: SYSRSn
12	UMask	R	0h	Use Acceptance Mask  0 Mask ignored  1 Use Mask (Msk[28:0], MXtd, and MDir) for acceptance filtering  If the UMask bit is set to one, the message object's mask bits have to be programmed during initialization of the message object before MsgVal is set to one.  Reset type: SYSRSn

**Table 21-46. CAN\_IF3MCTL Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
11	TxE	R	0h	<p>Transmit Interrupt Enable</p> <p>0 IntPnd will not be triggered after the successful transmission of a frame.</p> <p>1 IntPnd will be triggered after the successful transmission of a frame.</p> <p>Reset type: SYSRSn</p>
10	RxE	R	0h	<p>Receive Interrupt Enable</p> <p>0 IntPnd will not be triggered after the successful reception of a frame.</p> <p>1 IntPnd will be triggered after the successful reception of a frame.</p> <p>Reset type: SYSRSn</p>
9	RmtEn	R	0h	<p>Remote Enable</p> <p>0 At the reception of a remote frame, TxRqst is not changed.</p> <p>1 At the reception of a remote frame, TxRqst is set.</p> <p>Reset type: SYSRSn</p>
8	TxRqst	R	0h	<p>Transmit Request</p> <p>0 This message object is not waiting for a transmission.</p> <p>1 The transmission of this message object is requested and is not yet done.</p> <p>Reset type: SYSRSn</p>
7	EoB	R	0h	<p>End of Block</p> <p>0 The message object is part of a FIFO Buffer block and is not the last message object of the FIFO Buffer block.</p> <p>1 The message object is a single message object or the last message object in a FIFO Buffer Block.</p> <p>Note: This bit is used to concatenate multiple message objects to build a FIFO Buffer. For single message objects (not belonging to a FIFO Buffer), this bit must always be set to one.</p> <p>Reset type: SYSRSn</p>
6-4	RESERVED	R	0h	Reserved
3-0	DLC	R	0h	<p>Data length code</p> <p>0-8 Data frame has 0-8 data bytes.</p> <p>9-15 Data frame has 8 data bytes.</p> <p>Note: The data length code of a message object must be defined the same as in all the corresponding objects with the same identifier at other nodes. When the message handler stores a data frame, it will write the DLC to the value given by the received message.</p> <p>Reset type: SYSRSn</p>

**21.15.2.38 CAN\_IF3DATA Register (Offset = 150h) [reset = 0h]**

CAN\_IF3DATA is shown in [Figure 21-55](#) and described in [Table 21-47](#).

Return to [Summary Table](#).

This register provides a window to the data bytes of the CAN message.

**Figure 21-55. CAN\_IF3DATA Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Data_3								Data_2								Data_1								Data_0							
R-0h								R-0h								R-0h								R-0h							

**Table 21-47. CAN\_IF3DATA Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-24	Data_3	R	0h	Data Byte 3 Reset type: SYSRSn
23-16	Data_2	R	0h	Data Byte 2 Reset type: SYSRSn
15-8	Data_1	R	0h	Data Byte 1 Reset type: SYSRSn
7-0	Data_0	R	0h	Data Byte 0 Reset type: SYSRSn

### 21.15.2.39 CAN\_IF3DATB Register (Offset = 154h) [reset = 0h]

CAN\_IF3DATB is shown in [Figure 21-56](#) and described in [Table 21-48](#).

Return to [Summary Table](#).

This register provides a window to the data bytes of the CAN message.

**Figure 21-56. CAN\_IF3DATB Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Data_7								Data_6								Data_5								Data_4							
R-0h								R-0h								R-0h								R-0h							

**Table 21-48. CAN\_IF3DATB Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-24	Data_7	R	0h	Data Byte 7 Reset type: SYSRSn
23-16	Data_6	R	0h	Data Byte 6 Reset type: SYSRSn
15-8	Data_5	R	0h	Data Byte 5 Reset type: SYSRSn
7-0	Data_4	R	0h	Data Byte 4 Reset type: SYSRSn

### 21.15.2.40 CAN\_IF3UPD Register (Offset = 160h) [reset = 0h]

CAN\_IF3UPD is shown in [Figure 21-57](#) and described in [Table 21-49](#).

Return to [Summary Table](#).

The automatic update functionality of the IF3 register set can be configured for each message object. A message object is enabled for automatic IF3 update, if the dedicated IF3UpdEn flag is set. This means that an active NewDat flag of this message object (e.g due to reception of a CAN frame) will trigger an automatic copy of the whole message object to IF3 register set. Note: IF3 Update enable should not be set for transmit objects.

**Figure 21-57. CAN\_IF3UPD Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
IF3UpdEn																															
R/W-0h																															

**Table 21-49. CAN\_IF3UPD Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-0	IF3UpdEn	R/W	0h	IF3 Update Enabled (for all message objects)  0 Automatic IF3 update is disabled for this message object.  1 Automatic IF3 update is enabled for this message object. A message object is scheduled to be copied to IF3 register set, if NewDat flag of the message object is active.  Reset type: SYSRSn



## Universal Serial Bus (USB) Controller

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This chapter discusses the features and functions of the universal serial bus (USB) controller.

Topic	Page
<b>22.1 Introduction</b> .....	<b>2322</b>
<b>22.2 Features</b> .....	<b>2322</b>
<b>22.3 Functional Description</b> .....	<b>2324</b>
<b>22.4 Initialization and Configuration</b> .....	<b>2333</b>
<b>22.5 Register Map</b> .....	<b>2334</b>
<b>22.6 Register Descriptions</b> .....	<b>2349</b>

## 22.1 Introduction

The USB controller operates as a full-speed function controller during point-to-point communications with the USB host. The controller complies with the USB 2.0 standard, which includes SUSPEND and RESUME signaling. It has thirty-two endpoints, sixteen for IN transactions and sixteen for OUT transactions. One IN and one OUT endpoint are fixed-function endpoints used for control transfers; the others are defined by firmware. A dynamically sizeable FIFO supports queuing multiple packets. Software-controlled connect and disconnect allow flexibility during USB device startup.

## 22.2 Features

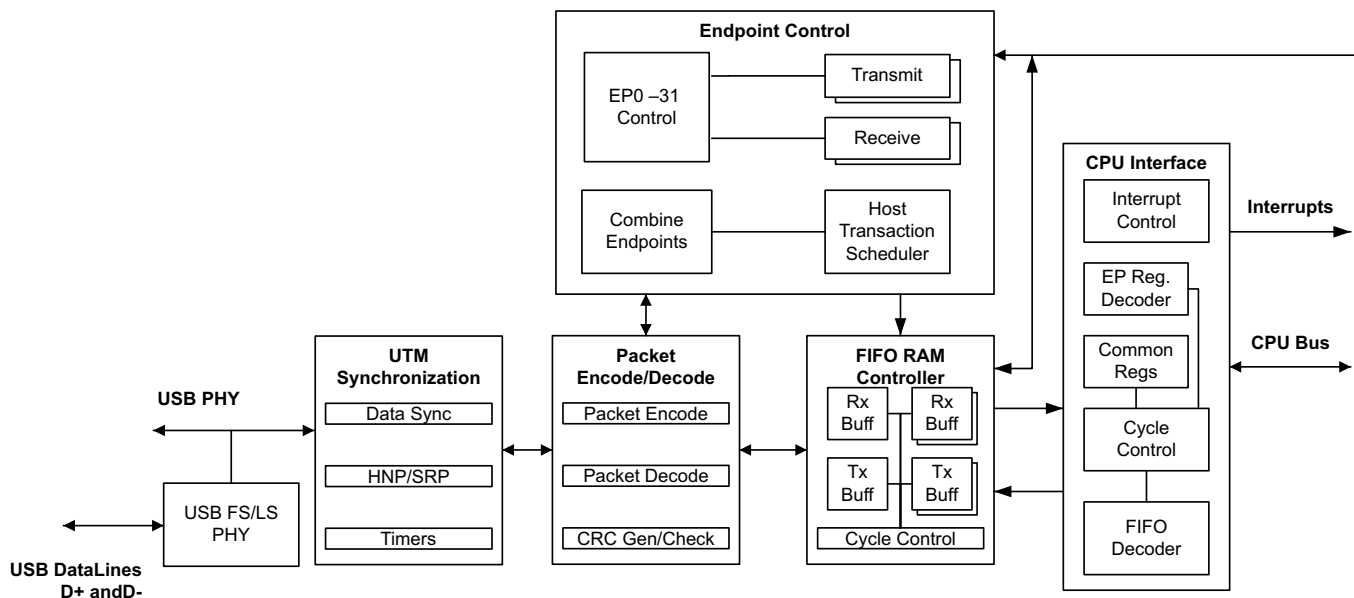
The USB module has the following features:

- Complies with USB-IF certification standards
- USB 2.0 full-speed (12 Mbps) operation in host and device modes as well as low-speed (1.5 Mbps) operation in host mode
- Integrated PHY
- Three transfer types: Control, Interrupt, and Bulk
- Thirty-two endpoints
  - One dedicated control IN endpoint and one dedicated control OUT endpoint
  - Fifteen configurable IN endpoints and fifteen configurable OUT endpoints
- Four KB dedicated endpoint memory

### 22.2.1 Block Diagram

The USB block diagram is shown in [Figure 22-1](#).

**Figure 22-1. USB Block Diagram**



## 22.2.2 Signal Description

The USB controller requires a total of three signals (D+, D-, and  $V_{BUS}$ ) to operate in device mode and two signals (D+, D-) to operate in embedded host mode. Because of the differential signaling needed for USB, the pins D+ and D- have special buffers to support USB. As such, their position on the chip is not user-selectable. These pins at reset are, by default, GPIOs. They must be configured before being used as USB function pins. Bits 10 and 11 in the GPIO B Analog Mode Select register (GPBAMSEL) should be set to choose the USB function. The signals USB bus voltage ( $V_{BUS}$ ), external power enable (EPEN), and power fault (PFLT) are not hardwired to any pin and some applications will require they be implemented in software via a GPIO. Software that implements these signals is available in the USB software library.

## 22.2.3 VBus Recommendations

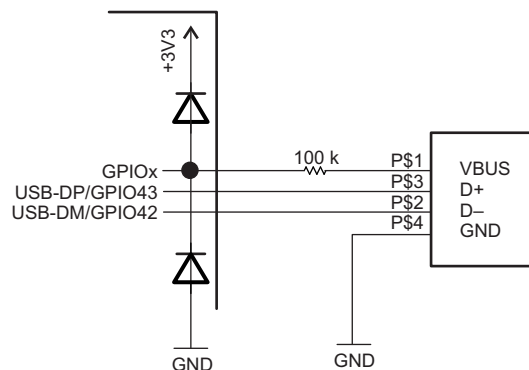
Most applications do not need to monitor  $V_{BUS}$ . Because of this, a dedicated  $V_{BUS}$  monitoring pin was not included on this microcontroller. If you are designing a bus-powered device application or an embedded host application, you do NOT need to monitor  $V_{BUS}$ . If you are designing a self-powered device, you will need to actively monitor the state of the  $V_{BUS}$  pin in order to ensure compliance with the USB specification. In Section 7.1.5 and Section 7.2.1 of the USB Specification Revision 2.0™ it is stated respectively that:

- "The voltage source on the [speed identification] pull-up resistor must be derived from or controlled by the power supplied on the USB cable such that when  $V_{BUS}$  is removed, the pull-up resistor does not supply current on the data line to which it is attached.
- When  $V_{BUS}$  is removed, the device must remove power from the D+/D- pull-up resistor within 10 seconds.
- Later in the timing tables (Section 7.3.2) of the USB Specification 2.0 it is also stated that the D+/D- pull-up resistor should be applied within 100ms of  $V_{BUS}$  reaching a valid level."

Meeting the above specification is easy because of the slow timing requirements. In this chapter we will discuss the hardware part of the  $V_{BUS}$  monitoring solution. The corresponding software will be discussed briefly, but for examples and an explanation, please consult the USB software guide.

The pins of this microcontroller are not 5V tolerant, and because of this, the  $V_{BUS}$  signal cannot be directly connected to a GPIO pin. Directly connecting 5V to a pin of the microcontroller will destroy the I/O buffer of the pin and possibly more of the chip. The most cost-effective way of making any pin capable of reading a 5V input is to use a series resistance in conjunction with the ESD diode clamps already present inside the device on every pin. It is recommended to use a 100k $\Omega$  series resistor between the  $V_{BUS}$  signal and the pin chosen to monitor it. A diagram of this setup is shown in [Figure 22-2](#).

Figure 22-2. USB Scheme



In the above diagram, if  $V_{BUS}$  is above or below 3.3V and 0V respectively, one of the ESD clamp diodes will be forward-biased, allowing current to flow through the 100k $\Omega$  resistor. The purpose of the diode clamps is to protect the pins of the microcontroller from very short overvoltage spikes of a high magnitude. They do this by clamping the voltage excursion to one of the supply rails. We are effectively requiring the ESD clamps to do the same thing they were designed to do, but instead of a short high magnitude pulse, we are giving them a long low magnitude static value via the 100k $\Omega$  resistor.

Any pin that has digital input/output functionality could potentially be used to monitor  $V_{BUS}$ , but the use of an interrupt-capable GPIO is recommended. A pin that does not have external interrupt capability may also be used, but the input state of the pin must be polled periodically by the application software to ensure appropriate action is taken whenever  $V_{BUS}$  is applied or removed. If an interrupt-capable GPIO is chosen, it should be configured to generate an interrupt on both the rising and falling edge. More information on external interrupts can be found in the *System Control and Interrupts* chapter. Example code that implements  $V_{BUS}$  monitoring using external interrupts and takes the appropriate actions is documented in the USB Software Guide and can be found in the associated USB software package.

## 22.3 Functional Description

The USB controller can be configured to act as either a dedicated host or device. However, when the USB controller is acting as a self-powered device, a GPIO input or analog comparator input must be connected to  $V_{BUS}$  and configured to generate an interrupt when the  $V_{BUS}$  level drops. This interrupt is used to disable the pullup resistor on the USB0DP signal.

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**NOTE:** When USB is used in the system, the minimum system frequency is 30 MHz.

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### 22.3.1 Operation as a Device

This section describes how the USB controller performs when it is being used as a USB device. IN endpoints, OUT endpoints, entry into and exit from SUSPEND mode, and recognition of start of frame (SOF) are all described.

When in device mode, IN transactions are controlled by the endpoint transmit interface and uses the transmit endpoint registers for the given endpoint. OUT transactions are handled with the endpoints receive interface and use the receive endpoint registers for the given endpoint. When configuring the size of the FIFOs for endpoints, take into account the maximum packet size for an endpoint. Note the following:

- Bulk endpoints should be the size of the maximum packet (up to 64 bytes) or twice the maximum packet size if double buffering is used (described further in the following section).
- Interrupt endpoints should be the size of the maximum packet (up to 64 bytes) or twice the maximum packet size if double buffering is used.
- It is also possible to specify a separate control endpoint for a USB device. However, in most cases the USB device should use the dedicated control endpoint on the USB controller's endpoint 0.

#### 22.3.1.1 Control and Configurable Endpoints

When operating as a device, the USB controller provides two dedicated control endpoints (IN and OUT) and thirty configurable endpoints (fifteen IN and fifteen OUT) that can be used for communications with a host controller. The endpoint number and direction associated with an endpoint is directly related to its register designation. For example, when the Host is transmitting to endpoint 1, all configuration and data is in the endpoint 1 transmit register interface. Endpoint 0 is a dedicated control endpoint used for all control transactions to endpoint 0 during enumeration or when any other control requests are made to endpoint 0. Endpoint 0 uses the first 64 bytes of the USB controller's FIFO RAM as a shared memory for both IN and OUT transactions. The remaining six endpoints can be configured as control, bulk, or interrupt endpoints. They should be treated as three configurable IN and three configurable OUT endpoints. The endpoint pairs are not required to have the same type for their IN and OUT endpoint configuration. For example, the OUT portion of an endpoint pair could be a bulk endpoint, while the IN portion of that endpoint pair could be an interrupt endpoint. The address and size of the FIFOs attached to each endpoint can be modified to fit the application's needs.

### 22.3.1.1.1 IN Transactions as a Device

When operating as a USB device, data for IN transactions is handled through the FIFOs attached to the transmit endpoints. The sizes of the FIFOs for the fifteen configurable IN endpoints are determined by the USB Transmit FIFO Start Address (USBTXFIFOADD) register. The maximum size of a data packet that may be placed in a transmit endpoint's FIFO for transmission is programmable and is determined by the value written to the USB Maximum Transmit Data Endpoint n (USBTXMAXPn) register for that endpoint. The endpoint's FIFO can also be configured to use double-packet or single-packet buffering. When double-packet buffering is enabled, two data packets can be buffered in the FIFO, which also requires that the FIFO is at least two packets in size. When double-packet buffering is disabled, only one packet can be buffered, even if the packet size is less than half the FIFO size.

**Note:** The maximum packet size set for any endpoint must not exceed the FIFO size. The USBTXMAXPn register should not be written to while data is in the FIFO as unexpected results may occur.

#### Single-Packet Buffering

If the size of the transmit endpoint's FIFO is less than twice the maximum packet size for this endpoint (as set in the USB Transmit Dynamic FIFO Sizing (USBTXFIFOSZ) register), only one packet can be buffered in the FIFO and single-packet buffering is required. When each packet is completely loaded into the transmit FIFO, the TXRDY bit in the USB Transmit Control and Status Endpoint n Low (USBTXCSRLn) register must be set. If the AUTOSSET bit in the USB Transmit Control and Status Endpoint n High (USBTXCSRHn) register is set, the TXRDY bit is automatically set when a maximum-sized packet is loaded into the FIFO. For packet sizes less than the maximum, the TXRDY bit must be set manually. When the TXRDY bit is set, either manually or automatically, the packet is ready to be sent. When the packet has been successfully sent, both TXRDY and FIFONE are cleared, and the appropriate transmit endpoint interrupt signaled. At this point, the next packet can be loaded into the FIFO.

#### Double-Packet Buffering

If the size of the transmit endpoint's FIFO is at least twice the maximum packet size for this endpoint, two packets can be buffered in the FIFO and double-packet buffering is allowed. As each packet is loaded into the transmit FIFO, the TXRDY bit in the USBTXCSRLn register must be set. If the AUTOSSET bit in the USBTXCSRHn register is set, the TXRDY bit is automatically set when a maximum-sized packet is loaded into the FIFO. For packet sizes less than the maximum, TXRDY must be set manually. When the TXRDY bit is set, either manually or automatically, the packet is ready to be sent. After the first packet is loaded, TXRDY is immediately cleared and an interrupt is generated. A second packet can now be loaded into the transmit FIFO and TXRDY set again (either manually or automatically if the packet is the maximum size). At this point, both packets are ready to be sent. After each packet has been successfully sent, TXRDY is automatically cleared and the appropriate transmit endpoint interrupt signaled to indicate that another packet can now be loaded into the transmit FIFO. The state of the FIFONE bit in the USBTXCSRLn register at this point indicates how many packets may be loaded. If the FIFONE bit is set, then another packet is in the FIFO and only one more packet can be loaded. If the FIFONE bit is clear, then no packets are in the FIFO and two more packets can be loaded.

**Note:** Double-packet buffering is disabled if an endpoint's corresponding EPn bit is set in the USB Transmit Double Packet Buffer Disable (USBTXDPKTBUFDIS) register. This bit is set by default, so it must be cleared to enable double-packet buffering.

### 22.3.1.1.2 Out Transactions as a Device

When in device mode, OUT transactions are handled through the USB controller receive FIFOs. The sizes of the receive FIFOs for the fifteen configurable OUT endpoints are determined by the USB Receive FIFO Start Address (USBRXFIFOADD) register. The maximum amount of data received by an endpoint in any packet is determined by the value written to the USB Maximum Receive Data Endpoint n (USBRXMAXPn) register for that endpoint. When double-packet buffering is enabled, two data packets can be buffered in the FIFO. When double-packet buffering is disabled, only one packet can be buffered even if the packet is less than half the FIFO size.

**Note:** In all cases, the maximum packet size must not exceed the FIFO size.

### Single-Packet Buffering

If the size of the receive endpoint FIFO is less than twice the maximum packet size for an endpoint, only one data packet can be buffered in the FIFO and single-packet buffering is required. When a packet is received and placed in the receive FIFO, the RXRDY and FULL bits in the USB Receive Control and Status Endpoint n Low (USBXCSRL[n]) register are set and the appropriate receive endpoint is signaled, indicating that a packet can now be unloaded from the FIFO. After the packet has been unloaded, the RXRDY bit must be cleared in order to allow further packets to be received. This action also generates the acknowledge signaling to the Host controller. If the AUTOCL bit in the USB Receive Control and Status Endpoint n High (USBXCSRH[n]) register is set and a maximum-sized packet is unloaded from the FIFO, the RXRDY and FULL bits are cleared automatically. For packet sizes less than the maximum, RXRDY must be cleared manually.

### Double-Packet Buffering

If the size of the receive endpoint FIFO is at least twice the maximum packet size for the endpoint, two data packets can be buffered and double-packet buffering can be used. When the first packet is received and loaded into the receive FIFO, the RXRDY bit in the USBXCSRL[n] register is set and the appropriate receive endpoint interrupt is signaled to indicate that a packet can now be unloaded from the FIFO.

**Note:** The FULL bit in USBXCSRL[n] is not set when the first packet is received. It is only set if a second packet is received and loaded into the receive FIFO.

After each packet has been unloaded, the RXRDY bit must be cleared to allow further packets to be received. If the AUTOCL bit in the USBXCSRH[n] register is set and a maximum-sized packet is unloaded from the FIFO, the RXRDY bit is cleared automatically. For packet sizes less than the maximum, RXRDY must be cleared manually. If the FULL bit is set when RXRDY is cleared, the USB controller first clears the FULL bit, then sets RXRDY again to indicate that there is another packet waiting in the FIFO to be unloaded.

**Note:** Double-packet buffering is disabled if an endpoint's corresponding EPn bit is set in the USB Receive Double Packet Buffer Disable (USBXDPKTBUFDIS) register. This bit is set by default, so it must be cleared to enable double-packet buffering.

#### 22.3.1.1.3 Scheduling

The device has no control over the scheduling of transactions as scheduling is determined by the Host controller. The USB controller can set up a transaction at any time. The USB controller waits for the request from the Host controller and generates an interrupt when the transaction is complete or if it was terminated due to some error. If the Host controller makes a request and the device controller is not ready, the USB controller sends a busy response (NAK) to all requests until it is ready.

#### 22.3.1.1.4 Additional Actions

The USB controller responds automatically to certain conditions on the USB bus or actions by the Host controller such as when the USB controller automatically stalls a control transfer or unexpected zero length OUT data packets.

##### Stalled Control Transfer

The USB controller automatically issues a STALL handshake to a control transfer under the following conditions:

1. The Host sends more data during an OUT data phase of a control transfer than was specified in the device request during the SETUP phase. This condition is detected by the USB controller when the Host sends an OUT token (instead of an IN token) after the last OUT packet has been unloaded and the DATAEND bit in the USB Control and Status Endpoint 0 Low (USBCSRL0) register has been set.
2. The Host requests more data during an IN data phase of a control transfer than was specified in the device request during the SETUP phase. This condition is detected by the USB controller when the Host sends an IN token (instead of an OUT token) after the CPU has cleared TXRDY and set DATAEND in response to the ACK issued by the Host to what should have been the last packet.
3. The Host sends more than USBRXMAXPn bytes of data with an OUT data token.
4. The Host sends more than a zero length data packet for the OUT STATUS phase.



### Zero Length OUT Data Packets

A zero-length OUT data packet is used to indicate the end of a control transfer. In normal operation, such packets should only be received after the entire length of the device request has been transferred. However, if the Host sends a zero-length OUT data packet before the entire length of device request has been transferred, it is signaling the premature end of the transfer. In this case, the USB controller automatically flushes any IN token ready for the data phase from the FIFO and sets the DATAEND bit in the USBCSRLO register.

### Setting the Device Address

When a Host is attempting to enumerate the USB device, it requests that the device change its address from zero to some other value. The address is changed by writing the value that the Host requested to the USB Device Functional Address (USBFADDR) register. However, care should be taken when writing to USBFADDR to avoid changing the address before the transaction is complete. This register should only be set after the SET\_ADDRESS command is complete. Like all control transactions, the transaction is only complete after the device has left the STATUS phase. In the case of a SET\_ADDRESS command, the transaction is completed by responding to the IN request from the Host with a zero-byte packet. Once the device has responded to the IN request, the USBFADDR register should be programmed to the new value as soon as possible to avoid missing any new commands sent to the new address.

**Note:** If the USBFADDR register is set to the new value as soon as the device receives the OUT transaction with the SET\_ADDRESS command in the packet, it changes the address during the control transfer. In this case, the device does not receive the IN request that allows the USB transaction to exit the STATUS phase of the control transfer because it is sent to the old address. As a result, the Host does not get a response to the IN request, and the Host fails to enumerate the device.

#### 22.3.1.1.5 Device Mode Suspend

When no activity has occurred on the USB bus for 3 ms, the USB controller automatically enters SUSPEND mode. If the SUSPEND interrupt has been enabled in the USB Interrupt Enable (USBIE) register, an interrupt is generated at this time. When in SUSPEND mode, the PHY also goes into SUSPEND mode. When RESUME signaling is detected, the USB controller exits SUSPEND mode and takes the PHY out of SUSPEND. If the RESUME interrupt is enabled, an interrupt is generated. The USB controller can also be forced to exit SUSPEND mode by setting the RESUME bit in the USB Power (USBPOWER) register. When this bit is set, the USB controller exits SUSPEND mode and drives RESUME signaling onto the bus. The RESUME bit must be cleared after 10 ms (a maximum of 15 ms) to end RESUME signaling. To meet USB power requirements, the controller can be put into Deep Sleep mode which keeps the controller in a static state.

#### 22.3.1.1.6 Start of Frame

When the USB controller is operating in device mode, it receives a Start-Of-Frame (SOF) packet from the Host once every millisecond. When the SOF packet is received, the 11-bit frame number contained in the packet is written into the USB Frame Value (USBFRAME) register, and an SOF interrupt is also signaled and can be handled by the application. Once the USB controller has started to receive SOF packets, it expects one every millisecond. If no SOF packet is received after 1.00358 ms, the packet is assumed to have been lost, and the USBFRAME register is not updated. The USB controller continues and resynchronizes these pulses to the received SOF packets when these packets are successfully received again.

#### 22.3.1.1.7 USB Reset

When the USB controller is in device mode and a RESET condition is detected on the USB bus, the USB controller automatically performs the following actions:

- Clears the USBFADDR register
- Clears the USB Endpoint Index (USBEPIDX) register
- Flushes all endpoint FIFOs
- Clears all control/status registers
- Enables all endpoint interrupts

- Generates a RESET interrupt

### 22.3.1.1.8 Connect/Disconnect

The USB controller connection to the USB bus is handled by software. The USB PHY can be switched between normal mode and non-driving mode by setting or clearing the SOFTCONN bit of the USBPOWER register. When the SOFTCONN bit is set, the PHY is placed in its normal mode, and the USB0DP/USB0DM lines of the USB bus are enabled. At the same time, the USB controller is placed into a state, in which it does not respond to any USB signaling except a USB RESET. When the SOFTCONN bit is cleared, the PHY is put into non-driving mode, USB0DP and USB0DM are tristated, and the USB controller appears to other devices on the USB bus as if it has been disconnected. The non-driving mode is the default so the USB controller appears disconnected until the SOFTCONN bit has been set. The application software can then choose when to set the PHY into its normal mode. Systems with a lengthy initialization procedure may use this to ensure that initialization is complete, and the system is ready to perform enumeration before connecting to the USB bus. Once the SOFTCONN bit has been set, the USB controller can be disconnected by clearing this bit.

**Note:** The USB controller does not generate an interrupt when the device is connected to the Host. However, an interrupt is generated when the Host terminates a session.

## 22.3.2 Operation as a Host

When the USB controller is operating in Host mode, it can either be used for point-to-point communications with another USB device or, when attached to a hub, for communication with multiple devices. Full-speed and low-speed USB devices are supported, both for point-to-point communication and for operation through a hub. The USB controller automatically carries out the necessary transaction translation needed to allow a low-speed or full-speed device to be used with a USB 2.0 hub. Control, bulk, and interrupt transactions are supported. This section describes the USB controller's actions when it is being used as a USB Host. Configuration of IN endpoints, OUT endpoints, entry into and exit from SUSPEND mode, and RESET are all described.

When in Host mode, IN transactions are controlled by an endpoint's receive interface. All IN transactions use the receive endpoint registers and all OUT endpoints use the transmit endpoint registers for a given endpoint. As in device mode, the FIFOs for endpoints should take into account the maximum packet size for an endpoint.

- Bulk endpoints should be the size of the maximum packet (up to 64 bytes) or twice the maximum packet size if double buffering is used (described further in the following section).
- Interrupt endpoints should be the size of the maximum packet (up to 64 bytes) or twice the maximum packet size if double buffering is used.
- It is also possible to specify a separate control endpoint to communicate with a device. However, in most cases the USB controller should use the dedicated control endpoint to communicate with a device's endpoint 0.

### 22.3.2.1 Endpoint Registers

The endpoint registers are used to control the USB endpoint interfaces which communicate with device(s) that are connected. The endpoints consist of a dedicated control IN endpoint, a dedicated control OUT endpoint, fifteen configurable OUT endpoints, and fifteen configurable IN endpoints.

The dedicated control interface can only be used for control transactions to endpoint 0 of devices. These control transactions are used during enumeration or other control functions that communicate using endpoint 0 of devices. This control endpoint shares the first 64 bytes of the USB controller's FIFO RAM for IN and OUT transactions. The remaining IN and OUT interfaces can be configured to communicate with control, bulk, or interrupt endpoints.

These USB interfaces can be used to simultaneously schedule as many as fifteen independent OUT and fifteen independent IN transactions to any endpoints on any device. The IN and OUT controls are paired in fifteen sets of registers. However, they can be configured to communicate with different types of endpoints and different endpoints on devices. For example, the first pair of endpoint controls can be split so that the OUT portion is communicating with a device's bulk OUT endpoint 1, while the IN portion is communicating with a device's interrupt IN endpoint 2.



Before accessing any device, whether for point-to-point communications or for communications via a hub, the relevant USB Receive Functional Address Endpoint  $n$  (USBRXFUNCADDR $n$ ) or USB Transmit Functional Address Endpoint  $n$  (USBTXFUNCADDR $n$ ) registers must be set for each receive or transmit endpoint to record the address of the device being accessed.

The USB controller also supports connections to devices through a USB hub by providing a register that specifies the hub address and port of each USB transfer. The FIFO address and size are customizable and can be specified for each USB IN and OUT transfer. Customization includes allowing one FIFO per transaction, sharing a FIFO across transactions, and allowing for double-buffered FIFOs.

### 22.3.2.2 IN Transactions as a Host

IN transactions are handled in a similar manner to the way in which OUT transactions are handled when the USB controller is in device mode except that the transaction first must be initiated by setting the REQPKT bit in the USBCSRL0 register, indicating to the transaction scheduler that there is an active transaction on this endpoint. The transaction scheduler then sends an IN token to the target device. When the packet is received and placed in the receive FIFO, the RXRDY bit in the USBCSRL0 register is set, and the appropriate receive endpoint interrupt is signaled to indicate that a packet can now be unloaded from the FIFO.

When the packet has been unloaded, RXRDY must be cleared. The AUTOCL bit in the USBRXCSRH $n$  register can be used to have RXRDY automatically cleared when a maximum-sized packet has been unloaded from the FIFO. The AUTORQ bit in USBRXCSRH $n$  causes the REQPKT bit to be automatically set when the RXRDY bit is cleared. When the RXRDY bit is cleared, the controller sends an acknowledge to the device. When there is a known number of packets to be transferred, the USB Request Packet Count in Block Transfer Endpoint  $n$  (USBRQPKTCOUNT $n$ ) register associated with the endpoint should be configured to the number of packets to be transferred. The USB controller decrements the value in the USBRQPKTCOUNT $n$  register following each request. When the USBRQPKTCOUNT $n$  value decrements to 0, the AUTORQ bit is cleared to prevent any further transactions being attempted. For cases where the size of the transfer is unknown, USBRQPKTCOUNT $n$  should be cleared. AUTORQ then remains set until cleared by the reception of a short packet (that is, less than the MAXLOAD value in the USBRXMAXP $n$  register) such as may occur at the end of a bulk transfer.

If the device responds to a bulk or interrupt IN token with a NAK, the USB Host controller keeps retrying the transaction until any NAK Limit that has been set has been reached. If the target device responds with a STALL, however, the USB Host controller does not retry the transaction but sets the STALLED bit in the USBCSRL0 register. If the target device does not respond to the IN token within the required time, or the packet contained a CRC or bit-stuff error, the USB Host controller retries the transaction. If after three attempts the target device has still not responded, the USB Host controller clears the REQPKT bit and sets the ERROR bit in the USBCSRL0 register.

### 22.3.2.3 OUT Transactions as a Host

OUT transactions are handled in a similar manner to the way in which IN transactions are handled when the USB controller is in device mode. The TXRDY bit in the USBTXCSRL $n$  register must be set as each packet is loaded into the transmit FIFO. Again, setting the AUTOSET bit in the USBTXCSRH $n$  register automatically sets TXRDY when a maximum-sized packet has been loaded into the FIFO.

If the target device responds to the OUT token with a NAK, the USB Host controller keeps retrying the transaction until the NAK Limit that has been set has been reached. However, if the target device responds with a STALL, the USB controller does not retry the transaction but interrupts the main processor by setting the STALLED bit in the USBTXCSRL $n$  register. If the target device does not respond to the OUT token within the required time, or the packet contained a CRC or bit-stuff error, the USB Host controller retries the transaction. If after three attempts the target device has still not responded, the USB controller flushes the FIFO and sets the ERROR bit in the USBTXCSRL $n$  register.

#### 22.3.2.4 Transaction Scheduling

Scheduling of transactions is handled automatically by the USB Host controller. The Host controller allows configuration of the endpoint communication scheduling based on the type of endpoint transaction. Interrupt transactions can be scheduled to occur in the range of every frame to every 255 frames in 1 frame increments. Bulk endpoints do not allow scheduling parameters, but do allow for a NAK timeout in the event an endpoint on a device is not responding.

The USB controller maintains a frame counter. If the target device is a full-speed device, the USB controller automatically sends an SOF packet at the start of each frame and increments the frame counter. If the target device is a low-speed device, a K state is transmitted on the bus to act as a keep-alive to stop the low-speed device from going into SUSPEND mode.

After the SOF packet has been transmitted, the USB Host controller cycles through all the configured endpoints looking for active transactions. An active transaction is defined as a receive endpoint for which the REQPKT bit is set or a transmit endpoint for which the TXRDY bit and/or the FIFONE bit is set.

An interrupt transaction is started if the transaction is found on the first scheduler cycle of a frame and if the interval counter for that endpoint has counted down to zero. As a result, only one interrupt transaction occurs per endpoint every  $n$  frames, where  $n$  is the interval set via the USB Host Transmit Interval Endpoint  $n$  (USBTXINTERVAL[ $n$ ]) or USB Host Receive Interval Endpoint  $n$  (USBRXINTERVAL[ $n$ ]) register for that endpoint.

An active bulk transaction starts immediately, provided sufficient time is left in the frame to complete the transaction before the next SOF packet is due. If the transaction must be retried (for example, because a NAK was received or the target device did not respond), then the transaction is not retried until the transaction scheduler has first checked all the other endpoints for active transactions. This process ensures that an endpoint that is sending a lot of NAKs does not block other transactions on the bus. The controller also allows the user to specify a limit to the length of time for NAKs to be received from a target device before the endpoint times out.

#### 22.3.2.5 USB Hubs

The following setup requirements apply to the USB Host controller only if it is used with a USB hub. When a full- or low-speed device is connected to the USB controller via a USB 2.0 hub, details of the hub address and the hub port also must be recorded in the corresponding USB Receive Hub Address Endpoint  $n$  (USBRXHUBADDR $n$ ) and USB Receive Hub Port Endpoint  $n$  (USBRXHUBPORT $n$ ) or the USB Transmit Hub Address Endpoint  $n$  (USBTXHUBADDR $n$ ) and USB Transmit Hub Port Endpoint  $n$  (USBTXHUBPORT $n$ ) registers. In addition, the speed at which the device operates (full or low) must be recorded in the USB Type Endpoint 0 (USBTYP0) (endpoint 0), USB Host Configure Transmit Type Endpoint  $n$  (USBTXTYP $n$ ), or USB Host Configure Receive Type Endpoint  $n$  (USBRXTYP $n$ ) registers for each endpoint that is accessed by the device.

For hub communications, the settings in these registers record the current allocation of the endpoints to the attached USB devices. To maximize the number of devices supported, the USB Host controller allows this allocation to be changed dynamically by simply updating the address and speed information recorded in these registers. Any changes in the allocation of endpoints to device functions must be made following the completion of any on-going transactions on the endpoints affected.

#### 22.3.2.6 Babble

The USB Host controller does not start a transaction until the bus has been inactive for at least the minimum inter-packet delay. The controller also does not start a transaction unless it can be finished before the end of the frame. If the bus is still active at the end of a frame, then the USB Host controller assumes that the target device to which it is connected has malfunctioned, and the USB controller suspends all transactions and generates a babble interrupt.

#### 22.3.2.7 Host SUSPEND

If the SUSPEND bit in the USBPOWER register is set, the USB Host controller completes the current transaction then stops the transaction scheduler and frame counter. No further transactions are started and no SOF packets are generated.

To exit SUSPEND mode, set the RESUME bit and clear the SUSPEND bit. While the RESUME bit is set, the USB Host controller generates RESUME signaling on the bus. After 20 ms, the RESUME bit must be cleared, at which point the frame counter and transaction scheduler start. The Host supports the detection of a remote wake-up.

### 22.3.2.8 USB RESET

If the RESET bit in the USBPOWER register is set, the USB Host controller generates USB RESET signaling on the bus. The RESET bit must be set for at least 20 ms to ensure correct resetting of the target device. After the CPU has cleared the bit, the USB Host controller starts its frame counter and transaction scheduler.

### 22.3.2.9 Connect/Disconnect

A session is started by setting the SESSION bit in the USB device Control (USBDEVCTL) register, enabling the USB controller to wait for a device to be connected. When a device is detected, a connect interrupt is generated. The speed of the device that has been connected can be determined by reading the USBDEVCTL register where the FSDEV bit is set for a full-speed device, and the LSDEV bit is set for a low-speed device. The USB controller must generate a RESET to the device, and then the USB Host controller can begin device enumeration. If the device is disconnected while a session is in progress, a disconnect interrupt is generated.

### 22.3.3 DMA Operation

The USB module's DMA trigger signals are not supported on this device. The DMA controller may be used to read and write the USB FIFOs via software triggering. see the Direct Memory Access (DMA) chapter for more details about programming the DMA controller.

### 22.3.4 Address/Data Bus Bridge

The USB controller on this device is the same controller that is on the Stellaris devices. This controller was originally designed to connect to an ARM AHB bus, but has been modified in order to function with the C28x device's bus architecture. The modifications made are largely invisible to the user application, but there are some things to note.

- The USB memory space is 8 bits wide, while the C28x memory space is 16 bits wide.
- 32 and 16 bit accesses (r/w) are completely transparent to the user application code, no changes need be made.
- The C28x core only supports 8 bit accesses through a byte intrinsic type. This can be used to perform 8 bit reads or writes to the USB controller.
  - `int &__byte(int *array, unsigned int byte_index);`
  - `*array = ptr to address to access, byte_index = always 0 (for USB)`  
See [Table 22-1](#) for example.
  - See the [TMS320C28x Optimizing C/C++ Compiler User's Guide \(SPRU514\)](#) and the [TMS320C28x Assembly Language Tools User's Guide \(SPRU513\)](#)
- Because of the bridge, the memory view of the USB controller memory space in CCS isn't a 1:1 representation of what is in the controller
  - When the view mode is
    - 32 bit or 16 bit, even address are effectively duplicated, ignore odd addresses.
    - 8 bit, Even addresses from within the controller are duplicated into odd address in the view window; old addresses from within the controller are not displayed.  
See [Table 22-2](#) for example.

**Table 22-1. USB Memory Access From Software**

USB Controller Memory			C28x 8 Bit	
Address	Reg. Name	Data	Access	Data
0x00	FADDR	0x00	<code>__byte((int *)0x00,0)</code>	0x0000

**Table 22-1. USB Memory Access From Software (continued)**

USB Controller Memory			C28x 8 Bit	
0x01	POWER	0x11	__byte((int *)0x01,0)	0x0011
0x02	TXIS (LSB)	0x22	__byte((int *)0x02,0)	0x0022
0x03	TXIS (MSB)	0x33	__byte((int *)0x03,0)	0x0033
0x04	RXIS (LSB)	0x44	__byte((int *)0x04,0)	0x0044
0x05	RXIS (MSB)	0x55	__byte((int *)0x05,0)	0x0055
0x06	TXIE (LSB)	0x66	__byte((int *)0x06,0)	0x0066
0x07	TXIE (MSB)	0x77	__byte((int *)0x07,0)	0x0077
0x08	RXIE (LSB)	0x88	__byte((int *)0x08,0)	0x0088
0x09	RXIE (MSB)	0x99	__byte((int *)0x09,0)	0x0099
0x0A	USBIS	0xAA	__byte((int *)0x0A,0)	0x00AA
0x0B	USBIE	0xBB	__byte((int *)0x0B,0)	0x00BB
0x0C	FRAME (LSB)	0xCC	__byte((int *)0x0C,0)	0x00CC
0x0D	FRAME (MSB)	0xDD	__byte((int *)0x0D,0)	0x00DD
0x0E	EPIDX	0xEE	__byte((int *)0x0E,0)	0x00EE
0x0F	TEST	0xFF	__byte((int *)0x0F,0)	0x00FF
C28x 16 Bit			C28x 32 Bit	
Access	Data		Access	Data
*((short *)0x00))	0x1100		*((long *)0x00))	0x33221100
*((short *)0x01))	0x1100		*((long *)0x01))	0x33221100
*((short *)0x02))	0x3322		*((long *)0x02))	0x33221100
*((short *)0x03))	0x3322		*((long *)0x03))	0x33221100
*((short *)0x04))	0x5544		*((long *)0x04))	0x77665544
*((short *)0x05))	0x5544		*((long *)0x05))	0x77665544
*((short *)0x06))	0x7766		*((long *)0x06))	0x77665544
*((short *)0x07))	0x7766		*((long *)0x07))	0x77665544
*((short *)0x08))	0x9988		*((long *)0x08))	0xBBAA9988
*((short *)0x09))	0x9988		*((long *)0x09))	0xBBAA9988
*((short *)0x0A))	0xBBAA		*((long *)0x0A))	0xBBAA9988
*((short *)0x0B))	0xBBAA		*((long *)0x0B))	0xBBAA9988
*((short *)0x0C))	0xDDCC		*((long *)0x0C))	0xFFEEDDCC
*((short *)0x0D))	0xDDCC		*((long *)0x0D))	0xFFEEDDCC
*((short *)0x0E))	0xFFEE		*((long *)0x0E))	0xFFEEDDCC
*((short *)0x0F))	0xFFEE		*((long *)0x0F))	0xFFEEDDCC

**Table 22-2. USB Memory Access From CCS**

CCS 8 Bit		CCS 16 Bit		CCS 32 Bit	
Address	Displayed Data	Address	Displayed Data	Address	Displayed Data
0x00	0x00	0x00	0x1100	0x00	0x11001100
0x01	0x00	0x01	0x1100	0x02	0x33223322
0x02	0x22	0x02	0x3322	0x04	0x55445544
0x03	0x22	0x03	0x3322	0x06	0x77667766
0x04	0x44	0x04	0x5544	0x08	0x99889988
0x05	0x44	0x05	0x5544	0x0A	0xBBAA9988
0x06	0x66	0x06	0x7766	0x0C	0xDDCCDDCC
0x07	0x66	0x07	0x7766	0x0E	0xFFEEFFEE
0x08	0x88	0x08	0x9988		

**Table 22-2. USB Memory Access From CCS (continued)**

CCS 8 Bit		CCS 16 Bit		CCS 32 Bit	
0x09	0x88	0x09	0x9988		
0x0A	0xAA	0x0A	0xBBAA		
0x0B	0xAA	0x0B	0xBBAA		
0x0C	0xCC	0x0C	0xDDCC		
0x0D	0xCC	0x0D	0xDDCC		
0x0E	0xEE	0x0E	0xFFEE		
0x0F	0xEE	0x0F	0xFFEE		

## 22.4 Initialization and Configuration

To use the USB controller, the peripheral clock must be enabled via the System Control module's PCLKCR11 register. In addition, the USB PHY signals must be connected to their respective pins via the GPIO module's GPBAMSEL register. Set bits 10 and 11 for USB0DM (GPIO42) and USB0DP (GPIO43).

Set up the auxiliary PLL so a 60 MHz output clock is provided to the USB module. This fixed frequency is required for all USB operations. See the *System Control* chapter for more details.

In host mode, the USB controller is responsible for supplying power to the bus. To avoid incorrectly supplying voltage to the bus, the external power control signal, USB0EPEN, should be kept inactive on start-up. This can be done by connecting the USB0EPEN and USB0PFLT pins to the USB controller as soon as possible.

### 22.4.1 Pin Configuration

In order to give the user more flexibility, the signals External Power Enable (EPEN) and Power Fault (PFLT) were not implemented in hardware. Instead, it is left up to the user to implement these signals in software. Examples of how to implement these signals in software can be found in the F2806x USB Software Guide.

When using the device controller portion of the USB controller in a system that also provides host functionality, the power to  $V_{BUS}$  must be disabled to allow the external host controller to supply power. Usually, the EPEN signal is used to control the external regulator and should be negated to avoid having two devices driving the  $V_{BUS}$  power pin on the USB connector.

When the USB controller is acting as a host, it is in control of two signals that are attached to an external voltage supply that provides power to  $V_{BUS}$ . The Host controller uses the EPEN signal to enable or disable power to the  $V_{BUS}$  pin on the USB connector. An input pin, PFLT, provides feedback when there has been a power fault on  $V_{BUS}$ . The PFLT signal can be configured to either automatically negate the EPEN signal to disable power, and/or it can generate an interrupt to the interrupt controller to allow software to handle the power fault condition. The polarity and actions related to both EPEN and PFLT are fully configurable in the USB controller. The controller also provides interrupts on device insertion and removal to allow the Host controller code to respond to these external events.

### 22.4.2 Endpoint Configuration

To start communication in Host or device mode, the endpoint registers must first be configured. In Host mode, this configuration establishes a connection between an endpoint register and an endpoint on a device. In device mode, an endpoint must be configured before enumerating to the Host controller.

In both cases, the endpoint 0 configuration is limited because it is a fixed-function, fixed-FIFO-size endpoint. In device and Host modes, the endpoint requires little setup but does require a software-based state machine to progress through the setup, data, and status phases of a standard control transaction. In device mode, the configuration of the remaining endpoints is done once before enumerating and then only changed if an alternate configuration is selected by the Host controller. In Host mode, the endpoints must be configured to operate as control, bulk, or interrupt mode. Once the type of endpoint is configured, a FIFO area must be assigned to each endpoint. In the case of bulk, control and interrupt endpoints, each has a maximum of 64 bytes per transaction. The maximum packet size for the given endpoint must be set prior to sending or receiving data.

Configuring each endpoint's FIFO involves reserving a portion of the overall USB FIFO RAM to each endpoint. The total FIFO RAM available is 4 Kbytes with the first 64 bytes reserved for endpoint 0. The endpoint's FIFO must be at least as large as the maximum packet size. The FIFO can also be configured as a double-buffered FIFO so that interrupts occur at the end of each packet and allow filling the other half of the FIFO.

If operating as a device, the USB device controller's soft connect must be enabled when the device is ready to start communications, indicating to the host controller that the device is ready to start the enumeration process. If operating as a Host controller, the device soft connect must be disabled and power must be provided to  $V_{BUS}$  via the USB0EPEN signal.

## 22.5 Register Map

Table 22-3 lists the registers. All addresses given are relative to the USB base address of 0x40000. Note that the USB controller clock must be enabled before the registers can be programmed (see the *System Control* chapter).

**Table 22-3. Universal Serial Bus (USB) Controller Register Map**

Offset	Name	Type	Reset	Description	Location
0x000	USBFADDR <sup>(1)</sup>	R/W	0x00	USB Device Functional Address	<a href="#">Section 22.6.1</a>
0x001	USBPOWER <sup>(1)(2)</sup>	R/W	0x20	USB Power	<a href="#">Section 22.6.2</a>
0x002	USBTXIS <sup>(1)(2)</sup>	RO	0x0000	USB Transmit Interrupt Status	<a href="#">Section 22.6.3</a>
0x004	USBRXIS <sup>(1)(2)</sup>	RO	0x0000	USB Receive Interrupt Status	<a href="#">Section 22.6.4</a>
0x006	USBTXIE <sup>(1)(2)</sup>	R/W	0xFFFF	USB Transmit Interrupt Enable	<a href="#">Section 22.6.5</a>
0x008	USBRXIE <sup>(1)(2)</sup>	R/W	0xFFFE	USB Receive Interrupt Enable	<a href="#">Section 22.6.6</a>
0x00A	USBIS <sup>(1)(2)</sup>	RO	0x00	USB General Interrupt Status	<a href="#">Section 22.6.7</a>
0x00B	USBIE <sup>(1)(2)</sup>	R/W	0x06	USB Interrupt Enable	<a href="#">Section 22.6.8</a>
0x00C	USBFRAME <sup>(1)(2)</sup>	RO	0x0000	USB Frame Value	<a href="#">Section 22.6.9</a>
0x00E	USBEPIDX <sup>(1)(2)</sup>	R/W	0x00	USB Endpoint Index	<a href="#">Section 22.6.10</a>
0x00F	USBTEST <sup>(1)(2)</sup>	R/W	0x00	USB Test Mode	<a href="#">Section 22.6.11</a>
0x020	USBFIFO0 <sup>(1)(2)</sup>	R/W	0x0000.0000	USB FIFO Endpoint 0	<a href="#">Section 22.6.12</a>
0x024	USBFIFO1 <sup>(1)(2)</sup>	R/W	0x0000.0000	USB FIFO Endpoint 1	<a href="#">Section 22.6.12</a>
0x028	USBFIFO2 <sup>(1)(2)</sup>	R/W	0x0000.0000	USB FIFO Endpoint 2	<a href="#">Section 22.6.12</a>
0x02C	USBFIFO3 <sup>(1)(2)</sup>	R/W	0x0000.0000	USB FIFO Endpoint 3	<a href="#">Section 22.6.12</a>
0x060	USBDEVCTL <sup>(2)</sup>	R/W	0x80	USB Device Control	<a href="#">Section 22.6.13</a>
0x062	USBTXFIFOSZ <sup>(1)(2)</sup>	R/W	0x00	USB Transmit Dynamic FIFO Sizing	<a href="#">Section 22.6.14</a>
0x063	USBRXFIFOSZ <sup>(1)(2)</sup>	R/W	0x00	USB Receive Dynamic FIFO Sizing	<a href="#">Section 22.6.15</a>
0x064	USBTXFIFOADD <sup>(1)(2)</sup>	R/W	0x0000	USB Transmit FIFO Start Address	<a href="#">Section 22.6.16</a>



**Table 22-3. Universal Serial Bus (USB) Controller Register Map (continued)**

Offset	Name	Type	Reset	Description	Location
0x066	USBRXFIFOADD <sup>(1)(2)</sup>	R/W	0x0000	USB Receive FIFO Start Address	<a href="#">Section 22.6.17</a>
0x07A	USBCONTIM <sup>(1)(2)</sup>	R/W	0x5C	USB Connect Timing	<a href="#">Section 22.6.18</a>
0x07D	USBFSEOF <sup>(1)(2)</sup>	R/W	0x77	USB Full-Speed Last Transaction to End of Frame Timing	<a href="#">Section 22.6.19</a>
0x07E	USBLSEOF <sup>(1)(2)</sup>	R/W	0x72	USB Low-Speed Last Transaction to End of Frame Timing	<a href="#">Section 22.6.20</a>
0x080	USBTXFUNCADDR0 <sup>(2)</sup>	R/W	0x00	USB Transmit Functional Address Endpoint 0	<a href="#">Section 22.6.21</a>
0x082	USBTXHUBADDR0 <sup>(2)</sup>	R/W	0x00	USB Transmit Hub Address Endpoint 0	<a href="#">Section 22.6.22</a>
0x083	USBTXHUBPORT0 <sup>(2)</sup>	R/W	0x00	USB Transmit Hub Port Endpoint 0	<a href="#">Section 22.6.23</a>
0x088	USBTXFUNCADDR1 <sup>(2)</sup>	R/W	0x00	USB Transmit Functional Address Endpoint 1	<a href="#">Section 22.6.21</a>
0x08A	USBTXHUBADDR1 <sup>(2)</sup>	R/W	0x00	USB Transmit Hub Address Endpoint 1	<a href="#">Section 22.6.22</a>
0x08B	USBTXHUBPORT1 <sup>(2)</sup>	R/W	0x00	USB Transmit Hub Port Endpoint 1	<a href="#">Section 22.6.23</a>
0x08C	USBRXFUNCADDR1 <sup>(2)</sup>	R/W	0x00	USB Receive Functional Address Endpoint 1	<a href="#">Section 22.6.24</a>
0x08E	USBRXHUBADDR1 <sup>(2)</sup>	R/W	0x00	USB Receive Hub Address Endpoint 1	<a href="#">Section 22.6.25</a>
0x08F	USBRXHUBPORT1 <sup>(2)</sup>	R/W	0x00	USB Receive Hub Port Endpoint 1	<a href="#">Section 22.6.26</a>
0x090	USBTXFUNCADDR2 <sup>(2)</sup>	R/W	0x00	USB Transmit Functional Address Endpoint 2	<a href="#">Section 22.6.21</a>
0x092	USBTXHUBADDR2 <sup>(2)</sup>	R/W	0x00	USB Transmit Hub Address Endpoint 2	<a href="#">Section 22.6.22</a>
0x093	USBTXHUBPORT2 <sup>(2)</sup>	R/W	0x00	USB Transmit Hub Port Endpoint 2	<a href="#">Section 22.6.23</a>
0x094	USBRXFUNCADDR2 <sup>(2)</sup>	R/W	0x00	USB Receive Functional Address Endpoint 2	<a href="#">Section 22.6.24</a>
0x096	USBRXHUBADDR2 <sup>(2)</sup>	R/W	0x00	USB Receive Hub Address Endpoint 2	<a href="#">Section 22.6.25</a>
0x097	USBRXHUBPORT2 <sup>(2)</sup>	R/W	0x00	USB Receive Hub Port Endpoint 2	<a href="#">Section 22.6.26</a>
0x098	USBTXFUNCADDR3 <sup>(2)</sup>	R/W	0x00	USB Transmit Functional Address Endpoint 3	<a href="#">Section 22.6.21</a>
0x09A	USBTXHUBADDR3 <sup>(2)</sup>	R/W	0x00	USB Transmit Hub Address Endpoint 3	<a href="#">Section 22.6.22</a>
0x09B	USBTXHUBPORT3 <sup>(2)</sup>	R/W	0x00	USB Transmit Hub Port Endpoint 3	<a href="#">Section 22.6.23</a>
0x09C	USBRXFUNCADDR3 <sup>(2)</sup>	R/W	0x00	USB Receive Functional Address Endpoint 3	<a href="#">Section 22.6.24</a>
0x09E	USBRXHUBADDR3 <sup>(2)</sup>	R/W	0x00	USB Receive Hub Address Endpoint 3	<a href="#">Section 22.6.25</a>
0x09F	USBRXHUBPORT3 <sup>(2)</sup>	R/W	0x00	USB Receive Hub Port Endpoint 3	<a href="#">Section 22.6.26</a>

**Table 22-3. Universal Serial Bus (USB) Controller Register Map (continued)**

Offset	Name	Type	Reset	Description	Location
0xA0	USBTXFUNCADDR4 <sup>(2)</sup>	R/W	0x00	USB Transmit Functional Address Endpoint 4	<a href="#">Section 22.6.21</a>
0xA2	USBTXHUBADDR4 <sup>(2)</sup>	R/W	0x00	USB Transmit Hub Address Endpoint 4	<a href="#">Section 22.6.22</a>
0xA3	USBTXHUBPORT4 <sup>(2)</sup>	R/W	0x00	USB Transmit Hub Port Endpoint 4	<a href="#">Section 22.6.23</a>
0xA4	USBRXFUNCADDR4 <sup>(2)</sup>	R/W	0x00	USB Receive Functional Address Endpoint 4	<a href="#">Section 22.6.24</a>
0xA6	USBRXHUBADDR4 <sup>(2)</sup>	R/W	0x00	USB Receive Hub Address Endpoint 4	<a href="#">Section 22.6.25</a>
0xA7	USBRXHUBPORT4 <sup>(2)</sup>	R/W	0x00	USB Receive Hub Port Endpoint 4	<a href="#">Section 22.6.26</a>
0xA8	USBTXFUNCADDR5 <sup>(2)</sup>	R/W	0x00	USB Transmit Functional Address Endpoint 5	<a href="#">Section 22.6.21</a>
0xAA	USBTXHUBADDR5 <sup>(2)</sup>	R/W	0x00	USB Transmit Hub Address Endpoint 5	<a href="#">Section 22.6.22</a>
0xAB	USBTXHUBPORT5 <sup>(2)</sup>	R/W	0x00	USB Transmit Hub Port Endpoint 5	<a href="#">Section 22.6.23</a>
0xAC	USBRXFUNCADDR4 <sup>(2)</sup>	R/W	0x00	USB Receive Functional Address Endpoint 5	<a href="#">Section 22.6.24</a>
0xAE	USBRXHUBADDR5 <sup>(2)</sup>	R/W	0x00	USB Receive Hub Address Endpoint 5	<a href="#">Section 22.6.25</a>
0xAF	USBRXHUBPORT5 <sup>(2)</sup>	R/W	0x00	USB Receive Hub Port Endpoint 5	<a href="#">Section 22.6.26</a>
0xB0	USBTXFUNCADDR6 <sup>(2)</sup>	R/W	0x00	USB Transmit Functional Address Endpoint 6	<a href="#">Section 22.6.21</a>
0xB2	USBTXHUBADDR6 <sup>(2)</sup>	R/W	0x00	USB Transmit Hub Address Endpoint 6	<a href="#">Section 22.6.22</a>
0xB3	USBTXHUBPORT6 <sup>(2)</sup>	R/W	0x00	USB Transmit Hub Port Endpoint 6	<a href="#">Section 22.6.23</a>
0xB4	USBRXFUNCADDR6 <sup>(2)</sup>	R/W	0x00	USB Receive Functional Address Endpoint 6	<a href="#">Section 22.6.24</a>
0xB6	USBRXHUBADDR6 <sup>(2)</sup>	R/W	0x00	USB Receive Hub Address Endpoint 6	<a href="#">Section 22.6.25</a>
0xB7	USBRXHUBPORT6 <sup>(2)</sup>	R/W	0x00	USB Receive Hub Port Endpoint 6	<a href="#">Section 22.6.26</a>
0xB8	USBTXFUNCADDR7 <sup>(2)</sup>	R/W	0x00	USB Transmit Functional Address Endpoint 7	<a href="#">Section 22.6.21</a>
0xBA	USBTXHUBADDR7 <sup>(2)</sup>	R/W	0x00	USB Transmit Hub Address Endpoint 7	<a href="#">Section 22.6.22</a>
0xBB	USBTXHUBPORT7 <sup>(2)</sup>	R/W	0x00	USB Transmit Hub Port Endpoint 7	<a href="#">Section 22.6.23</a>
0xBC	USBRXFUNCADDR7 <sup>(2)</sup>	R/W	0x00	USB Receive Functional Address Endpoint 7	<a href="#">Section 22.6.24</a>
0xBE	USBRXHUBADDR7 <sup>(2)</sup>	R/W	0x00	USB Receive Hub Address Endpoint 7	<a href="#">Section 22.6.25</a>
0xBF	USBRXHUBPORT7 <sup>(2)</sup>	R/W	0x00	USB Receive Hub Port Endpoint 7	<a href="#">Section 22.6.26</a>



**Table 22-3. Universal Serial Bus (USB) Controller Register Map (continued)**

Offset	Name	Type	Reset	Description	Location
0x0C0	USBTXFUNCADDR8 <sup>(2)</sup>	R/W	0x00	USB Transmit Functional Address Endpoint 8	<a href="#">Section 22.6.21</a>
0x0C2	USBTXHUBADDR8 <sup>(2)</sup>	R/W	0x00	USB Transmit Hub Address Endpoint 8	<a href="#">Section 22.6.22</a>
0x0C3	USBTXHUBPORT8 <sup>(2)</sup>	R/W	0x00	USB Transmit Hub Port Endpoint 8	<a href="#">Section 22.6.23</a>
0x0C4	USBRXFUNCADDR8 <sup>(2)</sup>	R/W	0x00	USB Receive Functional Address Endpoint 8	<a href="#">Section 22.6.24</a>
0x0C6	USBRXHUBADDR8 <sup>(2)</sup>	R/W	0x00	USB Receive Hub Address Endpoint 8	<a href="#">Section 22.6.25</a>
0x0C7	USBRXHUBPORT8 <sup>(2)</sup>	R/W	0x00	USB Receive Hub Port Endpoint 8	<a href="#">Section 22.6.26</a>
0xC8	USBTXFUNCADDR9 <sup>(2)</sup>	R/W	0x00	USB Transmit Functional Address Endpoint 9	<a href="#">Section 22.6.21</a>
0x0CA	USBTXHUBADDR9 <sup>(2)</sup>	R/W	0x00	USB Transmit Hub Address Endpoint 9	<a href="#">Section 22.6.22</a>
0x0CB	USBTXHUBPORT9 <sup>(2)</sup>	R/W	0x00	USB Transmit Hub Port Endpoint 9	<a href="#">Section 22.6.23</a>
0x0CC	USBRXFUNCADDR9 <sup>(2)</sup>	R/W	0x00	USB Receive Functional Address Endpoint 9	<a href="#">Section 22.6.24</a>
0x0CE	USBRXHUBADDR9 <sup>(2)</sup>	R/W	0x00	USB Receive Hub Address Endpoint 9	<a href="#">Section 22.6.25</a>
0x0CF	USBRXHUBPORT9 <sup>(2)</sup>	R/W	0x00	USB Receive Hub Port Endpoint 9	<a href="#">Section 22.6.26</a>
0x0D0	USBTXFUNCADDR10 <sup>(2)</sup>	R/W	0x00	USB Transmit Functional Address Endpoint 10	<a href="#">Section 22.6.21</a>
0x0D2	USBTXHUBADDR10 <sup>(2)</sup>	R/W	0x00	USB Transmit Hub Address Endpoint 10	<a href="#">Section 22.6.22</a>
0x0D3	USBTXHUBPORT10 <sup>(2)</sup>	R/W	0x00	USB Transmit Hub Port Endpoint 10	<a href="#">Section 22.6.23</a>
0x0D4	USBRXFUNCADDR10 <sup>(2)</sup>	R/W	0x00	USB Receive Functional Address Endpoint 10	<a href="#">Section 22.6.24</a>
0x0D6	USBRXHUBADDR10 <sup>(2)</sup>	R/W	0x00	USB Receive Hub Address Endpoint 10	<a href="#">Section 22.6.25</a>
0x0D7	USBRXHUBPORT10 <sup>(2)</sup>	R/W	0x00	USB Receive Hub Port Endpoint 10	<a href="#">Section 22.6.26</a>
0x0D8	USBTXFUNCADDR11 <sup>(2)</sup>	R/W	0x00	USB Transmit Functional Address Endpoint 11	<a href="#">Section 22.6.21</a>
0x0DA	USBTXHUBADDR11 <sup>(2)</sup>	R/W	0x00	USB Transmit Hub Address Endpoint 11	<a href="#">Section 22.6.22</a>
0x0DB	USBTXHUBPORT11 <sup>(2)</sup>	R/W	0x00	USB Transmit Hub Port Endpoint 11	<a href="#">Section 22.6.23</a>
0x0DC	USBRXFUNCADDR11 <sup>(2)</sup>	R/W	0x00	USB Receive Functional Address Endpoint 11	<a href="#">Section 22.6.24</a>
0x0DE	USBRXHUBADDR11 <sup>(2)</sup>	R/W	0x00	USB Receive Hub Address Endpoint 11	<a href="#">Section 22.6.25</a>
0x0DF	USBRXHUBPORT11 <sup>(2)</sup>	R/W	0x00	USB Receive Hub Port Endpoint 11	<a href="#">Section 22.6.26</a>

**Table 22-3. Universal Serial Bus (USB) Controller Register Map (continued)**

Offset	Name	Type	Reset	Description	Location
0x0E0	USBTXFUNCADDR12 <sup>(2)</sup>	R/W	0x00	USB Transmit Functional Address Endpoint 12	<a href="#">Section 22.6.21</a>
0x0E2	USBTXHUBADDR12 <sup>(2)</sup>	R/W	0x00	USB Transmit Hub Address Endpoint 12	<a href="#">Section 22.6.22</a>
0x0E3	USBTXHUBPORT12 <sup>(2)</sup>	R/W	0x00	USB Transmit Hub Port Endpoint 12	<a href="#">Section 22.6.23</a>
0x0E4	USBRXFUNCADDR12 <sup>(2)</sup>	R/W	0x00	USB Receive Functional Address Endpoint 12	<a href="#">Section 22.6.24</a>
0x0E6	USBRXHUBADDR12 <sup>(2)</sup>	R/W	0x00	USB Receive Hub Address Endpoint 12	<a href="#">Section 22.6.25</a>
0x0E7	USBRXHUBPORT12 <sup>(2)</sup>	R/W	0x00	USB Receive Hub Port Endpoint 12	<a href="#">Section 22.6.26</a>
0x0E8	USBTXFUNCADDR13 <sup>(2)</sup>	R/W	0x00	USB Transmit Functional Address Endpoint 13	<a href="#">Section 22.6.21</a>
0x0EA	USBTXHUBADDR13 <sup>(2)</sup>	R/W	0x00	USB Transmit Hub Address Endpoint 13	<a href="#">Section 22.6.22</a>
0x0EB	USBTXHUBPORT13 <sup>(2)</sup>	R/W	0x00	USB Transmit Hub Port Endpoint 13	<a href="#">Section 22.6.23</a>
0x0EC	USBRXFUNCADDR13 <sup>(2)</sup>	R/W	0x00	USB Receive Functional Address Endpoint 13	<a href="#">Section 22.6.24</a>
0x0EE	USBRXHUBADDR13 <sup>(2)</sup>	R/W	0x00	USB Receive Hub Address Endpoint 13	<a href="#">Section 22.6.25</a>
0x0EF	USBRXHUBPORT13 <sup>(2)</sup>	R/W	0x00	USB Receive Hub Port Endpoint 13	<a href="#">Section 22.6.26</a>
0x0F0	USBTXFUNCADDR14 <sup>(2)</sup>	R/W	0x00	USB Transmit Functional Address Endpoint 14	<a href="#">Section 22.6.21</a>
0x0F2	USBTXHUBADDR14 <sup>(2)</sup>	R/W	0x00	USB Transmit Hub Address Endpoint 14	<a href="#">Section 22.6.22</a>
0x0F3	USBTXHUBPORT14 <sup>(2)</sup>	R/W	0x00	USB Transmit Hub Port Endpoint 14	<a href="#">Section 22.6.23</a>
0x0F4	USBRXFUNCADDR14 <sup>(2)</sup>	R/W	0x00	USB Receive Functional Address Endpoint 14	<a href="#">Section 22.6.24</a>
0x0F6	USBRXHUBADDR14 <sup>(2)</sup>	R/W	0x00	USB Receive Hub Address Endpoint 14	<a href="#">Section 22.6.25</a>
0x0F7	USBRXHUBPORT14 <sup>(2)</sup>	R/W	0x00	USB Receive Hub Port Endpoint 14	<a href="#">Section 22.6.26</a>
0x0F8	USBTXFUNCADDR15 <sup>(2)</sup>	R/W	0x00	USB Transmit Functional Address Endpoint 15	<a href="#">Section 22.6.21</a>
0x0FA	USBTXHUBADDR15 <sup>(2)</sup>	R/W	0x00	USB Transmit Hub Address Endpoint 15	<a href="#">Section 22.6.22</a>
0x0FB	USBTXHUBPORT15 <sup>(2)</sup>	R/W	0x00	USB Transmit Hub Port Endpoint 15	<a href="#">Section 22.6.23</a>
0x0FC	USBRXFUNCADDR15 <sup>(2)</sup>	R/W	0x00	USB Receive Functional Address Endpoint 15	<a href="#">Section 22.6.24</a>
0x0FE	USBRXHUBADDR15 <sup>(2)</sup>	R/W	0x00	USB Receive Hub Address Endpoint 15	<a href="#">Section 22.6.25</a>
0x0FF	USBRXHUBPORT15 <sup>(2)</sup>	R/W	0x00	USB Receive Hub Port Endpoint 15	<a href="#">Section 22.6.26</a>

**Table 22-3. Universal Serial Bus (USB) Controller Register Map (continued)**

Offset	Name	Type	Reset	Description	Location
0x102	USBCSRL0 <sup>(1)(2)</sup>	W1C	0x00	USB Control and Status Endpoint 0 Low	<a href="#">Section 22.6.28</a>
0x103	USBCSRH0 <sup>(1)(2)</sup>	W1C	0x00	USB Control and Status Endpoint 0 High	<a href="#">Section 22.6.29</a>
0x108	USBCOUNT0 <sup>(1)(2)</sup>	R/o	0x00	USB Receive Byte Count Endpoint 0	<a href="#">Section 22.6.30</a>
0x10A	USBTYP0 <sup>(2)</sup>	R/W	0x00	USB Type Endpoint 0	<a href="#">Section 22.6.31</a>
0x10B	USBNAKLMT <sup>(2)</sup>	R/W	0x00	USB NAK Limit	<a href="#">Section 22.6.32</a>
0x110	USBTXMAXP1 <sup>(1)(2)</sup>	R/W	0x0000	USB Maximum Transmit Data Endpoint 1	<a href="#">Section 22.6.27</a>
0x112	USBTXCSRL1 <sup>(1)(2)</sup>	R/W	0x00	USB Transmit Control and Status Endpoint 1 Low	<a href="#">Section 22.6.33</a>
0x113	USBTXCSRH1 <sup>(1)(2)</sup>	R/W	0x00	USB Transmit Control and Status Endpoint 1 High	<a href="#">Section 22.6.34</a>
0x114	USBRXMAXP1 <sup>(1)(2)</sup>	R/W	0x0000	USB Maximum Receive Data Endpoint 1	<a href="#">Section 22.6.35</a>
0x116	USBRXCSRL1 <sup>(1)(2)</sup>	R/W	0x00	USB Receive Control and Status Endpoint 1 Low	<a href="#">Section 22.6.36</a>
0x117	USBRXCSRH1 <sup>(1)(2)</sup>	R/W	0x00	USB Receive Control and Status Endpoint 1 High	<a href="#">Section 22.6.37</a>
0x118	USBRXCOUNT1 <sup>(1)(2)</sup>	RO	0x0000	USB Receive Byte Count Endpoint 1	<a href="#">Section 22.6.38</a>
0x11A	USBTXTYPE1 <sup>(2)</sup>	R/W	0x00	USB Host Transmit Configure Type Endpoint 1	<a href="#">Section 22.6.39</a>
0x11B	USBTXINTERVAL1 <sup>(2)</sup>	R/W	0x00	USB Host Transmit Interval Endpoint 1	<a href="#">Section 22.6.40</a>
0x11C	USBRXTYPE1 <sup>(2)</sup>	R/W	0x00	USB Host Configure Receive Type Endpoint 1	<a href="#">Section 22.6.41</a>
0x11D	USBRXINTERVAL1 <sup>(2)</sup>	R/W	0x00	USB Host Receive Polling Interval Endpoint 1	<a href="#">Section 22.6.42</a>
0x120	USBTXMAXP2 <sup>(1)(2)</sup>	R/W	0x0000	USB Maximum Transmit Data Endpoint 2	<a href="#">Section 22.6.27</a>
0x122	USBTXCSRL2 <sup>(1)(2)</sup>	R/W	0x00	USB Transmit Control and Status Endpoint 2 Low	<a href="#">Section 22.6.33</a>
0x123	USBTXCSRH2 <sup>(1)(2)</sup>	R/W	0x00	USB Transmit Control and Status Endpoint 2 High	<a href="#">Section 22.6.34</a>
0x124	USBRXMAXP2 <sup>(1)(2)</sup>	R/W	0x0000	USB Maximum Receive Data Endpoint 2	<a href="#">Section 22.6.35</a>
0x126	USBRXCSRL2 <sup>(1)(2)</sup>	R/W	0x00	USB Receive Control and Status Endpoint 2 Low	<a href="#">Section 22.6.36</a>
0x127	USBRXCSRH2 <sup>(1)(2)</sup>	R/W	0x00	USB Receive Control and Status Endpoint 2 High	<a href="#">Section 22.6.37</a>

**Table 22-3. Universal Serial Bus (USB) Controller Register Map (continued)**

Offset	Name	Type	Reset	Description	Location
0x128	USBRXCOUNT2 <sup>(1)(2)</sup>	RO	0x0000	USB Receive Byte Count Endpoint 2	<a href="#">Section 22.6.38</a>
0x12A	USBTXTYPE2 <sup>(2)</sup>	R/W	0x00	USB Host Transmit Configure Type Endpoint 2	<a href="#">Section 22.6.39</a>
0x12B	USBTXINTERVAL2 <sup>(2)</sup>	R/W	0x00	USB Host Transmit Interval Endpoint 2	<a href="#">Section 22.6.40</a>
0x12C	USBRXTYPE2 <sup>(2)</sup>	R/W	0x00	USB Host Configure Receive Type Endpoint 2	<a href="#">Section 22.6.41</a>
0x12D	USBRXINTERVAL2 <sup>(2)</sup>	R/W	0x00	USB Host Receive Polling Interval Endpoint 2	<a href="#">Section 22.6.42</a>
0x130	USBTXMAXP3 <sup>(1)(2)</sup>	R/W	0x0000	USB Maximum Transmit Data Endpoint 3	<a href="#">Section 22.6.27</a>
0x132	USBTXCSRL3 <sup>(1)(2)</sup>	R/W	0x00	USB Transmit Control and Status Endpoint 3 Low	<a href="#">Section 22.6.33</a>
0x133	USBTXCSRH3 <sup>(1)(2)</sup>	R/W	0x00	USB Transmit Control and Status Endpoint 3 High	<a href="#">Section 22.6.34</a>
0x134	USBRXMAXP3 <sup>(1)(2)</sup>	R/W	0x0000	USB Maximum Receive Data Endpoint 3	<a href="#">Section 22.6.35</a>
0x136	USBRXCSRL3 <sup>(1)(2)</sup>	R/W	0x00	USB Receive Control and Status Endpoint 3 Low	<a href="#">Section 22.6.33</a>
0x137	USBRXCSRH3 <sup>(1)(2)</sup>	R/W	0x00	USB Receive Control and Status Endpoint 3 High	<a href="#">Section 22.6.36</a>
0x138	USBRXCOUNT3 <sup>(1)(2)</sup>	RO	0x0000	USB Receive Byte Count Endpoint 3	<a href="#">Section 22.6.38</a>
0x13A	USBTXTYPE3 <sup>(2)</sup>	R/W	0x00	USB Host Transmit Configure Type Endpoint 3	<a href="#">Section 22.6.39</a>
0x13B	USBTXINTERVAL3 <sup>(2)</sup>	R/W	0x00	USB Host Transmit Interval Endpoint 3	<a href="#">Section 22.6.40</a>
0x13C	USBRXTYPE3 <sup>(2)</sup>	R/W	0x00	USB Host Configure Receive Type Endpoint 3	<a href="#">Section 22.6.41</a>
0x13D	USBRXINTERVAL3 <sup>(2)</sup>	R/W	0x00	USB Host Receive Polling Interval Endpoint 3	<a href="#">Section 22.6.42</a>
0x140	USBTXMAXP4 <sup>(1)(2)</sup>	R/W	0x0000	USB Maximum Transmit Data Endpoint 4	<a href="#">Section 22.6.27</a>
0x142	USBTXCSRL4 <sup>(1)(2)</sup>	R/W	0x00	USB Transmit Control and Status Endpoint 4 Low	<a href="#">Section 22.6.33</a>
0x143	USBTXCSRH4 <sup>(1)(2)</sup>	R/W	0x00	USB Transmit Control and Status Endpoint 4 High	<a href="#">Section 22.6.34</a>
0x144	USBRXMAXP4 <sup>(1)(2)</sup>	R/W	0x0000	USB Maximum Receive Data Endpoint 4	<a href="#">Section 22.6.35</a>
0x146	USBRXCSRL4 <sup>(1)(2)</sup>	R/W	0x00	USB Receive Control and Status Endpoint 4 Low	<a href="#">Section 22.6.33</a>

**Table 22-3. Universal Serial Bus (USB) Controller Register Map (continued)**

Offset	Name	Type	Reset	Description	Location
0x147	USBRXCSRH4 <sup>(1)(2)</sup>	R/W	0x00	USB Receive Control and Status Endpoint 4 High	<a href="#">Section 22.6.36</a>
0x148	USBRXCOUNT4 <sup>(1)(2)</sup>	RO	0x0000	USB Receive Byte Count Endpoint 4	<a href="#">Section 22.6.38</a>
0x14A	USBTXTYPE4 <sup>(2)</sup>	R/W	0x00	USB Host Transmit Configure Type Endpoint 4	<a href="#">Section 22.6.39</a>
0x14B	USBTXINTERVAL4 <sup>(2)</sup>	R/W	0x00	USB Host Transmit Interval Endpoint 4	<a href="#">Section 22.6.40</a>
0x14C	USBRXTYPE4 <sup>(2)</sup>	R/W	0x00	USB Host Configure Receive Type Endpoint 4	<a href="#">Section 22.6.41</a>
0x14D	USBRXINTERVAL4 <sup>(2)</sup>	R/W	0x00	USB Host Receive Polling Interval Endpoint 4	<a href="#">Section 22.6.42</a>
0x150	USBTXMAXP5 <sup>(1)(2)</sup>	R/W	0x0000	USB Maximum Transmit Data Endpoint 5	<a href="#">Section 22.6.27</a>
0x152	USBTXCSSL5 <sup>(1)(2)</sup>	R/W	0x00	USB Transmit Control and Status Endpoint 5 Low	<a href="#">Section 22.6.33</a>
0x153	USBTXCSRH5 <sup>(1)(2)</sup>	R/W	0x00	USB Transmit Control and Status Endpoint 5 High	<a href="#">Section 22.6.34</a>
0x154	USBRXMAXP5 <sup>(1)(2)</sup>	R/W	0x0000	USB Maximum Receive Data Endpoint 5	<a href="#">Section 22.6.35</a>
0x156	USBRXCSSL5 <sup>(1)(2)</sup>	R/W	0x00	USB Receive Control and Status Endpoint 5 Low	<a href="#">Section 22.6.33</a>
0x157	USBRXCSRH5 <sup>(1)(2)</sup>	R/W	0x00	USB Receive Control and Status Endpoint 5 High	<a href="#">Section 22.6.36</a>
0x158	USBRXCOUNT5 <sup>(1)(2)</sup>	RO	0x0000	USB Receive Byte Count Endpoint 5	<a href="#">Section 22.6.38</a>
0x15A	USBTXTYPE5 <sup>(2)</sup>	R/W	0x00	USB Host Transmit Configure Type Endpoint 5	<a href="#">Section 22.6.39</a>
0x15B	USBTXINTERVAL5 <sup>(2)</sup>	R/W	0x00	USB Host Transmit Interval Endpoint 5	<a href="#">Section 22.6.40</a>
0x15C	USBRXTYPE5 <sup>(2)</sup>	R/W	0x00	USB Host Configure Receive Type Endpoint 5	<a href="#">Section 22.6.41</a>
0x15D	USBRXINTERVAL5 <sup>(2)</sup>	R/W	0x00	USB Host Receive Polling Interval Endpoint 5	<a href="#">Section 22.6.42</a>
0x160	USBTXMAXP6 <sup>(1)(2)</sup>	R/W	0x0000	USB Maximum Transmit Data Endpoint 6	<a href="#">Section 22.6.27</a>
0x162	USBTXCSSL6 <sup>(1)(2)</sup>	R/W	0x00	USB Transmit Control and Status Endpoint 6 Low	<a href="#">Section 22.6.33</a>
0x163	USBTXCSRH6 <sup>(1)(2)</sup>	R/W	0x00	USB Transmit Control and Status Endpoint 6 High	<a href="#">Section 22.6.34</a>
0x164	USBRXMAXP6 <sup>(1)(2)</sup>	R/W	0x0000	USB Maximum Receive Data Endpoint 6	<a href="#">Section 22.6.35</a>

**Table 22-3. Universal Serial Bus (USB) Controller Register Map (continued)**

Offset	Name	Type	Reset	Description	Location
0x166	USBRXCSSL6 <sup>(1)(2)</sup>	R/W	0x00	USB Receive Control and Status Endpoint 6 Low	<a href="#">Section 22.6.33</a>
0x167	USBRXCSRH6 <sup>(1)(2)</sup>	R/W	0x00	USB Receive Control and Status Endpoint 6 High	<a href="#">Section 22.6.36</a>
0x168	USBRXCOUNT6 <sup>(1)(2)</sup>	RO	0x0000	USB Receive Byte Count Endpoint 6	<a href="#">Section 22.6.38</a>
0x16A	USBTXTYPE6 <sup>(2)</sup>	R/W	0x00	USB Host Transmit Configure Type Endpoint 6	<a href="#">Section 22.6.39</a>
0x16B	USBTXINTERVAL6 <sup>(2)</sup>	R/W	0x00	USB Host Transmit Interval Endpoint 6	<a href="#">Section 22.6.40</a>
0x16C	USBRXTYPE6 <sup>(2)</sup>	R/W	0x00	USB Host Configure Receive Type Endpoint 6	<a href="#">Section 22.6.41</a>
0x16D	USBRXINTERVAL6 <sup>(2)</sup>	R/W	0x00	USB Host Receive Polling Interval Endpoint 6	<a href="#">Section 22.6.42</a>
0x170	USBTXMAXP7 <sup>(1)(2)</sup>	R/W	0x0000	USB Maximum Transmit Data Endpoint 7	<a href="#">Section 22.6.27</a>
0x172	USBTXCSSL7 <sup>(1)(2)</sup>	R/W	0x00	USB Transmit Control and Status Endpoint 7 Low	<a href="#">Section 22.6.33</a>
0x173	USBTXCSRH7 <sup>(1)(2)</sup>	R/W	0x00	USB Transmit Control and Status Endpoint 7 High	<a href="#">Section 22.6.34</a>
0x174	USBRXMAXP7 <sup>(1)(2)</sup>	R/W	0x0000	USB Maximum Receive Data Endpoint 7	<a href="#">Section 22.6.35</a>
0x176	USBRXCSSL7 <sup>(1)(2)</sup>	R/W	0x00	USB Receive Control and Status Endpoint 7 Low	<a href="#">Section 22.6.33</a>
0x177	USBRXCSRH7 <sup>(1)(2)</sup>	R/W	0x00	USB Receive Control and Status Endpoint 7 High	<a href="#">Section 22.6.36</a>
0x178	USBRXCOUNT7 <sup>(1)(2)</sup>	RO	0x0000	USB Receive Byte Count Endpoint 7	<a href="#">Section 22.6.38</a>
0x17A	USBTXTYPE7 <sup>(2)</sup>	R/W	0x00	USB Host Transmit Configure Type Endpoint 7	<a href="#">Section 22.6.39</a>
0x17B	USBTXINTERVAL7 <sup>(2)</sup>	R/W	0x00	USB Host Transmit Interval Endpoint 7	<a href="#">Section 22.6.40</a>
0x17C	USBRXTYPE7 <sup>(2)</sup>	R/W	0x00	USB Host Configure Receive Type Endpoint 7	<a href="#">Section 22.6.41</a>
0x17D	USBRXINTERVAL7 <sup>(2)</sup>	R/W	0x00	USB Host Receive Polling Interval Endpoint 7	<a href="#">Section 22.6.42</a>
0x180	USBTXMAXP8 <sup>(1)(2)</sup>	R/W	0x0000	USB Maximum Transmit Data Endpoint 8	<a href="#">Section 22.6.27</a>
0x182	USBTXCSSL8 <sup>(1)(2)</sup>	R/W	0x00	USB Transmit Control and Status Endpoint 8 Low	<a href="#">Section 22.6.33</a>
0x183	USBTXCSRH8 <sup>(1)(2)</sup>	R/W	0x00	USB Transmit Control and Status Endpoint 8 High	<a href="#">Section 22.6.34</a>

**Table 22-3. Universal Serial Bus (USB) Controller Register Map (continued)**

Offset	Name	Type	Reset	Description	Location
0x184	USBRXMAXP8 <sup>(1)(2)</sup>	R/W	0x0000	USB Maximum Receive Data Endpoint 8	<a href="#">Section 22.6.35</a>
0x186	USBRXCSSL8 <sup>(1)(2)</sup>	R/W	0x00	USB Receive Control and Status Endpoint 8 Low	<a href="#">Section 22.6.33</a>
0x187	USBRXCSSL8 <sup>(1)(2)</sup>	R/W	0x00	USB Receive Control and Status Endpoint 8 High	<a href="#">Section 22.6.36</a>
0x188	USBRXCOUNT8 <sup>(1)(2)</sup>	RO	0x0000	USB Receive Byte Count Endpoint 8	<a href="#">Section 22.6.38</a>
0x18A	USBTXTYPE8 <sup>(2)</sup>	R/W	0x00	USB Host Transmit Configure Type Endpoint 8	<a href="#">Section 22.6.39</a>
0x18B	USBTXINTERVAL8 <sup>(2)</sup>	R/W	0x00	USB Host Transmit Interval Endpoint 8	<a href="#">Section 22.6.40</a>
0x18C	USBRXTYPE8 <sup>(2)</sup>	R/W	0x00	USB Host Configure Receive Type Endpoint 8	<a href="#">Section 22.6.41</a>
0x18D	USBRXINTERVAL8 <sup>(2)</sup>	R/W	0x00	USB Host Receive Polling Interval Endpoint 8	<a href="#">Section 22.6.42</a>
0x190	USBTXMAXP9 <sup>(1)(2)</sup>	R/W	0x0000	USB Maximum Transmit Data Endpoint 9	<a href="#">Section 22.6.27</a>
0x192	USBTXCSSL9 <sup>(1)(2)</sup>	R/W	0x00	USB Transmit Control and Status Endpoint 9 Low	<a href="#">Section 22.6.33</a>
0x193	USBTXCSSL9 <sup>(1)(2)</sup>	R/W	0x00	USB Transmit Control and Status Endpoint 9 High	<a href="#">Section 22.6.34</a>
0x194	USBRXMAXP9 <sup>(1)(2)</sup>	R/W	0x0000	USB Maximum Receive Data Endpoint 9	<a href="#">Section 22.6.35</a>
0x196	USBRXCSSL9 <sup>(1)(2)</sup>	R/W	0x00	USB Receive Control and Status Endpoint 9 Low	<a href="#">Section 22.6.33</a>
0x197	USBRXCSSL9 <sup>(1)(2)</sup>	R/W	0x00	USB Receive Control and Status Endpoint 9 High	<a href="#">Section 22.6.36</a>
0x198	USBRXCOUNT9 <sup>(1)(2)</sup>	RO	0x0000	USB Receive Byte Count Endpoint 9	<a href="#">Section 22.6.38</a>
0x19A	USBTXTYPE9 <sup>(2)</sup>	R/W	0x00	USB Host Transmit Configure Type Endpoint 9	<a href="#">Section 22.6.39</a>
0x19B	USBTXINTERVAL9 <sup>(2)</sup>	R/W	0x00	USB Host Transmit Interval Endpoint 9	<a href="#">Section 22.6.40</a>
0x19C	USBRXTYPE9 <sup>(2)</sup>	R/W	0x00	USB Host Configure Receive Type Endpoint 9	<a href="#">Section 22.6.41</a>
0x19D	USBRXINTERVAL9 <sup>(2)</sup>	R/W	0x00	USB Host Receive Polling Interval Endpoint 9	<a href="#">Section 22.6.42</a>
0x1A0	USBTXMAXP10 <sup>(1)(2)</sup>	R/W	0x0000	USB Maximum Transmit Data Endpoint 10	<a href="#">Section 22.6.27</a>
0x1A2	USBTXCSSL10 <sup>(1)(2)</sup>	R/W	0x00	USB Transmit Control and Status Endpoint 10 Low	<a href="#">Section 22.6.33</a>

**Table 22-3. Universal Serial Bus (USB) Controller Register Map (continued)**

Offset	Name	Type	Reset	Description	Location
0x1A3	USBTXCSRH10 <sup>(1)(2)</sup>	R/W	0x00	USB Transmit Control and Status Endpoint 10 High	<a href="#">Section 22.6.34</a>
0x1A4	USBRXMAXP10 <sup>(1)(2)</sup>	R/W	0x0000	USB Maximum Receive Data Endpoint 10	<a href="#">Section 22.6.35</a>
0x1A6	USBRXCSSL10 <sup>(1)(2)</sup>	R/W	0x00	USB Receive Control and Status Endpoint 10 Low	<a href="#">Section 22.6.33</a>
0x1A7	USBRXCSRH10 <sup>(1)(2)</sup>	R/W	0x00	USB Receive Control and Status Endpoint 10 High	<a href="#">Section 22.6.36</a>
0x1A8	USBRXCOUNT10 <sup>(1)(2)</sup>	RO	0x0000	USB Receive Byte Count Endpoint 10	<a href="#">Section 22.6.38</a>
0x1AA	USBTXTYPE10 <sup>(2)</sup>	R/W	0x00	USB Host Transmit Configure Type Endpoint 10	<a href="#">Section 22.6.39</a>
0x1AB	USBTXINTERVAL10 <sup>(2)</sup>	R/W	0x00	USB Host Transmit Interval Endpoint 10	<a href="#">Section 22.6.40</a>
0x1AC	USBRXTYPE10 <sup>(2)</sup>	R/W	0x00	USB Host Configure Receive Type Endpoint 10	<a href="#">Section 22.6.41</a>
0x1AD	USBRXINTERVAL10 <sup>(2)</sup>	R/W	0x00	USB Host Receive Polling Interval Endpoint 10	<a href="#">Section 22.6.42</a>
0x1B0	USBTXMAXP11 <sup>(1)(2)</sup>	R/W	0x0000	USB Maximum Transmit Data Endpoint 11	<a href="#">Section 22.6.27</a>
0x1B2	USBTXCSSL11 <sup>(1)(2)</sup>	R/W	0x00	USB Transmit Control and Status Endpoint 11 Low	<a href="#">Section 22.6.33</a>
0x1B3	USBTXCSRH11 <sup>(1)(2)</sup>	R/W	0x00	USB Transmit Control and Status Endpoint 11 High	<a href="#">Section 22.6.34</a>
0x1B4	USBRXMAXP11 <sup>(1)(2)</sup>	R/W	0x0000	USB Maximum Receive Data Endpoint 11	<a href="#">Section 22.6.35</a>
0x1B6	USBRXCSSL11 <sup>(1)(2)</sup>	R/W	0x00	USB Receive Control and Status Endpoint 11 Low	<a href="#">Section 22.6.33</a>
0x1B7	USBRXCSRH11 <sup>(1)(2)</sup>	R/W	0x00	USB Receive Control and Status Endpoint 11 High	<a href="#">Section 22.6.36</a>
0x1B8	USBRXCOUNT11 <sup>(1)(2)</sup>	RO	0x0000	USB Receive Byte Count Endpoint 11	<a href="#">Section 22.6.38</a>
0x1BA	USBTXTYPE11 <sup>(2)</sup>	R/W	0x00	USB Host Transmit Configure Type Endpoint 11	<a href="#">Section 22.6.39</a>
0x1BB	USBTXINTERVAL11 <sup>(2)</sup>	R/W	0x00	USB Host Transmit Interval Endpoint 11	<a href="#">Section 22.6.40</a>
0x1BC	USBRXTYPE11 <sup>(2)</sup>	R/W	0x00	USB Host Configure Receive Type Endpoint 11	<a href="#">Section 22.6.41</a>
0x1BD	USBRXINTERVAL11 <sup>(2)</sup>	R/W	0x00	USB Host Receive Polling Interval Endpoint 11	<a href="#">Section 22.6.42</a>
0x1C0	USBTXMAXP12 <sup>(1)(2)</sup>	R/W	0x0000	USB Maximum Transmit Data Endpoint 12	<a href="#">Section 22.6.27</a>



**Table 22-3. Universal Serial Bus (USB) Controller Register Map (continued)**

Offset	Name	Type	Reset	Description	Location
0x1C2	USBTXCSRL12 <sup>(1)(2)</sup>	R/W	0x00	USB Transmit Control and Status Endpoint 12 Low	<a href="#">Section 22.6.33</a>
0x1C3	USBTXCSRH12 <sup>(1)(2)</sup>	R/W	0x00	USB Transmit Control and Status Endpoint 12 High	<a href="#">Section 22.6.34</a>
0x1C4	USBRXMAXP12 <sup>(1)(2)</sup>	R/W	0x0000	USB Maximum Receive Data Endpoint 12	<a href="#">Section 22.6.35</a>
0x1C6	USBRXCSRL12 <sup>(1)(2)</sup>	R/W	0x00	USB Receive Control and Status Endpoint 12 Low	<a href="#">Section 22.6.33</a>
0x1C7	USBRXCSRH12 <sup>(1)(2)</sup>	R/W	0x00	USB Receive Control and Status Endpoint 12 High	<a href="#">Section 22.6.36</a>
0x1C8	USBRXCOUNT12 <sup>(1)(2)</sup>	RO	0x0000	USB Receive Byte Count Endpoint 12	<a href="#">Section 22.6.38</a>
0x1CA	USBTXTYPE12 <sup>(2)</sup>	R/W	0x00	USB Host Transmit Configure Type Endpoint 12	<a href="#">Section 22.6.39</a>
0x1CB	USBTXINTERVAL12 <sup>(2)</sup>	R/W	0x00	USB Host Transmit Interval Endpoint 12	<a href="#">Section 22.6.40</a>
0x1CC	USBRXTYPE12 <sup>(2)</sup>	R/W	0x00	USB Host Configure Receive Type Endpoint 12	<a href="#">Section 22.6.41</a>
0x1CD	USBRXINTERVAL12 <sup>(2)</sup>	R/W	0x00	USB Host Receive Polling Interval Endpoint 12	<a href="#">Section 22.6.42</a>
0x1D0	USBTXMAXP13 <sup>(1)(2)</sup>	R/W	0x0000	USB Maximum Transmit Data Endpoint 13	<a href="#">Section 22.6.27</a>
0x1D2	USBTXCSRL13 <sup>(1)(2)</sup>	R/W	0x00	USB Transmit Control and Status Endpoint 13 Low	<a href="#">Section 22.6.33</a>
0x1D3	USBTXCSRH13 <sup>(1)(2)</sup>	R/W	0x00	USB Transmit Control and Status Endpoint 13 High	<a href="#">Section 22.6.34</a>
0x1D4	USBRXMAXP13 <sup>(1)(2)</sup>	R/W	0x0000	USB Maximum Receive Data Endpoint 13	<a href="#">Section 22.6.35</a>
0x1D6	USBRXCSRL13 <sup>(1)(2)</sup>	R/W	0x00	USB Receive Control and Status Endpoint 13 Low	<a href="#">Section 22.6.33</a>
0x1D7	USBRXCSRH13 <sup>(1)(2)</sup>	R/W	0x00	USB Receive Control and Status Endpoint 13 High	<a href="#">Section 22.6.36</a>
0x1D8	USBRXCOUNT13 <sup>(1)(2)</sup>	RO	0x0000	USB Receive Byte Count Endpoint 13	<a href="#">Section 22.6.38</a>
0x1DA	USBTXTYPE13 <sup>(2)</sup>	R/W	0x00	USB Host Transmit Configure Type Endpoint 13	<a href="#">Section 22.6.39</a>
0x1DB	USBTXINTERVAL13 <sup>(2)</sup>	R/W	0x00	USB Host Transmit Interval Endpoint 13	<a href="#">Section 22.6.40</a>
0x1DC	USBRXTYPE13 <sup>(2)</sup>	R/W	0x00	USB Host Configure Receive Type Endpoint 13	<a href="#">Section 22.6.41</a>
0x1DD	USBRXINTERVAL13 <sup>(2)</sup>	R/W	0x00	USB Host Receive Polling Interval Endpoint 13	<a href="#">Section 22.6.42</a>

**Table 22-3. Universal Serial Bus (USB) Controller Register Map (continued)**

Offset	Name	Type	Reset	Description	Location
0x1E0	USBTXMAXP14 <sup>(1)(2)</sup>	R/W	0x0000	USB Maximum Transmit Data Endpoint 14	<a href="#">Section 22.6.27</a>
0x1E2	USBTXCSRL14 <sup>(1)(2)</sup>	R/W	0x00	USB Transmit Control and Status Endpoint 14 Low	<a href="#">Section 22.6.33</a>
0x1E3	USBTXCSRH14 <sup>(1)(2)</sup>	R/W	0x00	USB Transmit Control and Status Endpoint 14 High	<a href="#">Section 22.6.34</a>
0x1E4	USBRXMAXP14 <sup>(1)(2)</sup>	R/W	0x0000	USB Maximum Receive Data Endpoint 14	<a href="#">Section 22.6.35</a>
0x1E6	USBRXCSRL14 <sup>(1)(2)</sup>	R/W	0x00	USB Receive Control and Status Endpoint 14 Low	<a href="#">Section 22.6.33</a>
0x1E7	USBRXCSRH14 <sup>(1)(2)</sup>	R/W	0x00	USB Receive Control and Status Endpoint 14 High	<a href="#">Section 22.6.36</a>
0x1E8	USBRXCOUNT14 <sup>(1)(2)</sup>	RO	0x0000	USB Receive Byte Count Endpoint 14	<a href="#">Section 22.6.38</a>
0x1EA	USBTXTYPE14 <sup>(2)</sup>	R/W	0x00	USB Host Transmit Configure Type Endpoint 14	<a href="#">Section 22.6.39</a>
0x1EB	USBTXINTERVAL14 <sup>(2)</sup>	R/W	0x00	USB Host Transmit Interval Endpoint 14	<a href="#">Section 22.6.40</a>
0x1EC	USBRXTYPE14 <sup>(2)</sup>	R/W	0x00	USB Host Configure Receive Type Endpoint 14	<a href="#">Section 22.6.41</a>
0x1ED	USBRXINTERVAL14 <sup>(2)</sup>	R/W	0x00	USB Host Receive Polling Interval Endpoint 14	<a href="#">Section 22.6.42</a>
0x1F0	USBTXMAXP15 <sup>(1)(2)</sup>	R/W	0x0000	USB Maximum Transmit Data Endpoint 15	<a href="#">Section 22.6.27</a>
0x1F2	USBTXCSRL15 <sup>(1)(2)</sup>	R/W	0x00	USB Transmit Control and Status Endpoint 15 Low	<a href="#">Section 22.6.33</a>
0x1F3	USBTXCSRH15 <sup>(1)(2)</sup>	R/W	0x00	USB Transmit Control and Status Endpoint 15 High	<a href="#">Section 22.6.34</a>
0x1F4	USBRXMAXP15 <sup>(1)(2)</sup>	R/W	0x0000	USB Maximum Receive Data Endpoint 15	<a href="#">Section 22.6.35</a>
0x1F6	USBRXCSRL15 <sup>(1)(2)</sup>	R/W	0x00	USB Receive Control and Status Endpoint 15 Low	<a href="#">Section 22.6.33</a>
0x1F7	USBRXCSRH15 <sup>(1)(2)</sup>	R/W	0x00	USB Receive Control and Status Endpoint 15 High	<a href="#">Section 22.6.36</a>
0x1F8	USBRXCOUNT15 <sup>(1)(2)</sup>	RO	0x0000	USB Receive Byte Count Endpoint 15	<a href="#">Section 22.6.38</a>
0x1FA	USBTXTYPE15 <sup>(2)</sup>	R/W	0x00	USB Host Transmit Configure Type Endpoint 15	<a href="#">Section 22.6.39</a>
0x1FB	USBTXINTERVAL15 <sup>(2)</sup>	R/W	0x00	USB Host Transmit Interval Endpoint 15	<a href="#">Section 22.6.40</a>
0x1FC	USBRXTYPE15 <sup>(2)</sup>	R/W	0x00	USB Host Configure Receive Type Endpoint 15	<a href="#">Section 22.6.41</a>

**Table 22-3. Universal Serial Bus (USB) Controller Register Map (continued)**

Offset	Name	Type	Reset	Description	Location
0x1FD	USBRXINTERVAL15 <sup>(2)</sup>	R/W	0x00	USB Host Receive Polling Interval Endpoint 15	<a href="#">Section 22.6.42</a>
0x304	USBRQPKTCOUNT1 <sup>(2)</sup>	R/W	0x0000 1	USB Request Packet Count in Block Transfer Endpoint 1	<a href="#">Section 22.6.43</a>
0x308	USBRQPKTCOUNT2 <sup>(2)</sup>	R/W	0x0000	USB Request Packet Count in Block Transfer Endpoint 2	<a href="#">Section 22.6.43</a>
0x30C	USBRQPKTCOUNT3 <sup>(2)</sup>	R/W	0x0000	USB Request Packet Count in Block Transfer Endpoint 3	<a href="#">Section 22.6.43</a>
0x310	USBRQPKTCOUNT4 <sup>(2)</sup>	R/W	0x0000	USB Request Packet Count in Block Transfer Endpoint 4	<a href="#">Section 22.6.43</a>
0x314	USBRQPKTCOUNT5 <sup>(2)</sup>	R/W	0x0000	USB Request Packet Count in Block Transfer Endpoint 5	<a href="#">Section 22.6.43</a>
0x318	USBRQPKTCOUNT6 <sup>(2)</sup>	R/W	0x0000	USB Request Packet Count in Block Transfer Endpoint 6	<a href="#">Section 22.6.43</a>
0x31C	USBRQPKTCOUNT7 <sup>(2)</sup>	R/W	0x0000	USB Request Packet Count in Block Transfer Endpoint 7	<a href="#">Section 22.6.43</a>
0x320	USBRQPKTCOUNT8 <sup>(2)</sup>	R/W	0x0000	USB Request Packet Count in Block Transfer Endpoint 8	<a href="#">Section 22.6.43</a>
0x324	USBRQPKTCOUNT9 <sup>(2)</sup>	R/W	0x0000	USB Request Packet Count in Block Transfer Endpoint 9	<a href="#">Section 22.6.43</a>
0x328	USBRQPKTCOUNT10 <sup>(2)</sup>	R/W	0x0000	USB Request Packet Count in Block Transfer Endpoint 10	<a href="#">Section 22.6.43</a>
0x32C	USBRQPKTCOUNT11 <sup>(2)</sup>	R/W	0x0000	USB Request Packet Count in Block Transfer Endpoint 11	<a href="#">Section 22.6.43</a>
0x330	USBRQPKTCOUNT12 <sup>(2)</sup>	R/W	0x0000	USB Request Packet Count in Block Transfer Endpoint 12	<a href="#">Section 22.6.43</a>
0x334	USBRQPKTCOUNT13 <sup>(2)</sup>	R/W	0x0000	USB Request Packet Count in Block Transfer Endpoint 13	<a href="#">Section 22.6.43</a>
0x338	USBRQPKTCOUNT14 <sup>(2)</sup>	R/W	0x0000	USB Request Packet Count in Block Transfer Endpoint 14	<a href="#">Section 22.6.43</a>
0x33C	USBRQPKTCOUNT15 <sup>(2)</sup>	R/W	0x0000	USB Request Packet Count in Block Transfer Endpoint 15	<a href="#">Section 22.6.43</a>
0x340	USBRXDPKTBUFDIS <sup>(1)(2)</sup>	R/W	0x0000	USB Receive Double Packet Buffer Disable	<a href="#">Section 22.6.44</a>
0x342	USBTXDPKTBUFDIS <sup>(1)(2)</sup>	R/W	0x0000	USB Transmit Double Packet Buffer Disable	<a href="#">Section 22.6.45</a>
0x400	USBEP <sup>(1)(2)</sup>	R/W	0x0000.0000	USB External Power Control	<a href="#">Section 22.6.46</a>
0x404	USBEP <sup>(1)(2)</sup> CRIS	RO	0x0000.0000	USB External Power Control Raw Interrupt Status	<a href="#">Section 22.6.47</a>
0x408	USBEP <sup>(2)(1)</sup> CIM	R/W	0x0000.0000	USB External Power Control Interrupt Mask	<a href="#">Section 22.6.48</a>

**Table 22-3. Universal Serial Bus (USB) Controller Register Map (continued)**

Offset	Name	Type	Reset	Description	Location
0x40C	USBEPICISC <sup>(1)(2)</sup>	R/W	0x0000.0000	USB External Power Control Interrupt Status and Clear	<a href="#">Section 22.6.49</a>
0x410	USBDRRIS <sup>(1)(2)</sup>	RO	0x0000.0000	USB Device RESUME Raw Interrupt Status	<a href="#">Section 22.6.50</a>
0x414	USBDRIM <sup>(1)(2)</sup>	R/W	0x0000.0000	USB Device RESUME Interrupt Mask	<a href="#">Section 22.6.51</a>
0x418	USBDRISC <sup>(1)(2)</sup>	W1C	0x0000.0000	USB Device RESUME Interrupt Status and Clear	<a href="#">Section 22.6.52</a>
0x41C	USBGPCS <sup>(1)(2)</sup>	R/W	0x0000.0000	USB General-Purpose Control and Status	<a href="#">Section 22.6.53</a>
0x450	USBDMASEL <sup>(1)(2)</sup>	R/W	0x0033.2211	USB DMA Select	<a href="#">Section 22.6.54</a>

- (1) This register is used in Device mode. Some registers are used for both Host and Device mode and may have different bit definitions depending on the mode.
- (2) This register is used in Host mode. Some registers are used for both Host and Device mode and may have different bit definitions depending on the mode. The USB controller is in Device mode upon reset, so the reset values shown for these registers apply to the Device mode definition.

## 22.6 Register Descriptions

### 22.6.1 USB Device Functional Address Register (USBFADDR), offset 0x000

The USB function address 8-bit register (USBFADDR) contains the 7-bit address of the device part of the transaction.

When the USB controller is being used in device mode (the HOST bit in the USBDEVCTL register is clear), this register must be written with the address received through a SET\_ADDRESS command, which is then used for decoding the function address in subsequent token packets.

**Mode(s):** Device

For special considerations when writing this register, see the *Setting the Device Address* in [Section 22.3.1.1.4](#).

USBFADDR is shown in [Figure 22-3](#) and described in [Table 22-4](#).

**Figure 22-3. Function Address Register (USBFADDR)**

7	6	0
Reserved	FUNCADDR	
R-0	R/W-0	

LEGEND: R/W = Read/Write; -n = value after reset

**Table 22-4. Function Address Register (USBFADDR) Field Descriptions**

Bit	Field	Value	Description
7	Reserved	0	Reserved
6-0	FUNCADDR	0-7Fh	Function Address of Device as received through SET_ADDRESS.



**Table 22-6. Power Management Register (USBPOWER) in Device Mode Field Descriptions (continued)**

Bit	Field	Value	Description
2	RESUME		RESUME signaling. The bit should be cleared by software 10 ms (a maximum of 15 ms) after being set.
		0	Ends RESUME signaling on the bus.
		1	Enables RESUME signaling when the Device is in SUSPEND mode.
1	SUSPEND		SUSPEND mode.
		0	This bit is cleared when software reads the interrupt register or sets the RESUME bit above.
		1	The USB controller is in SUSPEND mode.
0	PWRDNPHY		Power Down PHY
		0	No effect
		1	Powers down the internal USB PHY.





**Table 22-7. USB Transmit Interrupt Status Register (USBTXIS) Field Descriptions (continued)**

Bit	Field	Value	Description
7	EP7		TX Endpoint 7 Interrupt
		0	No interrupt
		1	The Endpoint 7 transmit interrupt is asserted.
6	EP6		TX Endpoint 6 Interrupt
		0	No interrupt
		1	The Endpoint 6 transmit interrupt is asserted.
5	EP5		TX Endpoint 5 Interrupt
		0	No interrupt
		1	The Endpoint 5 transmit interrupt is asserted.
4	EP4		TX Endpoint 4 Interrupt
		0	No interrupt
		1	The Endpoint 4 transmit interrupt is asserted.
3	EP3		TX Endpoint 3 Interrupt
		0	No interrupt
		1	The Endpoint 3 transmit interrupt is asserted.
2	EP2		TX Endpoint 2 Interrupt
		0	No interrupt
		1	The Endpoint 2 transmit interrupt is asserted.
1	EP1		TX Endpoint 1 Interrupt
		0	No interrupt
		1	The Endpoint 1 transmit interrupt is asserted.
0	EP0		TX and RX Endpoint 0 Interrupt
		0	No interrupt
		1	The Endpoint 0 transmit and receive interrupt is asserted.

## 22.6.4 USB Receive Interrupt Status Register (USBRIXIS), offset 0x004

**NOTE:** Use caution when reading this register. Performing a read may change bit status.

The USB receive interrupt status 16-bit read-only register (USBRIXIS) indicates which interrupts are currently active for receive endpoints 1–15.

**Note:** Bits relating to endpoints that have not been configured always return 0. All active interrupts are cleared when this register is read.

**Mode(s):** Host    Device

USBRIXIS is shown in [Figure 22-7](#) and described in [Table 22-8](#).

**Figure 22-7. USB Transmit Interrupt Status Register (USBRIXIS)**

15	14	13	12	11	10	9	8
EP15	EP14	EP13	EP12	EP11	EP10	EP9	EP8
R-0							
EP7	EP6	EP5	EP4	EP3	EP2	EP1	EP0
R-0							Reserved

**Table 22-8. USB Transmit Interrupt Status Register (USBRIXIS) Field Descriptions**

Bit	Field	Value	Description
15	EP15	0	RX Endpoint 15 Interrupt No interrupt
		1	The Endpoint 15 receive interrupt is asserted.
14	EP14	0	RX Endpoint 14 Interrupt No interrupt
		1	The Endpoint 14 receive interrupt is asserted.
13	EP13	0	RX Endpoint 13 Interrupt No interrupt
		1	The Endpoint 13 receive interrupt is asserted.
12	EP12	0	RX Endpoint 12 Interrupt No interrupt
		1	The Endpoint 12 receive interrupt is asserted.
11	EP11	0	RX Endpoint 11 Interrupt No interrupt
		1	The Endpoint 11 receive interrupt is asserted.
10	EP10	0	RX Endpoint 10 Interrupt No interrupt
		1	The Endpoint 10 receive interrupt is asserted.
9	EP9	0	RX Endpoint 9 Interrupt No interrupt
		1	The Endpoint 9 receive interrupt is asserted.
8	EP8	0	RX Endpoint 8 Interrupt No interrupt
		1	The Endpoint 8 receive interrupt is asserted.
7	EP7	0	RX Endpoint 7 Interrupt No interrupt
		1	The Endpoint 7 receive interrupt is asserted.

**Table 22-8. USB Transmit Interrupt Status Register (USBTXIS) Field Descriptions (continued)**

Bit	Field	Value	Description
6	EP6		RX Endpoint 6 Interrupt
		0	No interrupt
		1	The Endpoint 6 receive interrupt is asserted.
5	EP5		RX Endpoint 5 Interrupt
		0	No interrupt
		1	The Endpoint 5 receive interrupt is asserted.
4	EP4		RX Endpoint 4 Interrupt
		0	No interrupt
		1	The Endpoint 4 receive interrupt is asserted.
3	EP3		RX Endpoint 3 Interrupt
		0	No interrupt
		1	The Endpoint 3 receive interrupt is asserted.
2	EP2		RX Endpoint 2 Interrupt
		0	No interrupt
		1	The Endpoint 2 receive interrupt is asserted.
1	EP1		RX Endpoint 1 Interrupt
		0	No interrupt
		1	The Endpoint 1 receive interrupt is asserted.
0	EP0		Reserved

### 22.6.5 USB Transmit Interrupt Enable Register (USBTXIE), offset 0x006

The USB transmit interrupt enable 16-bit register (USBTXIE) provides interrupt enable bits for the interrupts in the USBTXIS register. When a bit is set, the USB interrupt is asserted to the interrupt controller when the corresponding interrupt bit in the USBTXIS register is set. When a bit is cleared, the interrupt in the USBTXIS register is still set but the USB interrupt to the interrupt controller is not asserted. On reset, all interrupts are enabled.

**Mode(s):** Host Device

USBTXIS is shown in [Figure 22-8](#) and described in [Table 22-9](#).

**Figure 22-8. USB Transmit Interrupt Status Enable Register (USBTXIE)**

15	14	13	12	11	10	9	8
EP15	EP14	EP13	EP12	EP11	EP10	EP9	EP8
R-0							
EP7	EP6	EP5	EP4	EP3	EP2	EP1	EP0
R-0				R/W-1	R/W-1	R/W-1	R/W-1

**Table 22-9. USB Transmit Interrupt Status Register (USBTXIE) Field Descriptions**

Bit	Field	Value	Description
15	EP15	0	TX Endpoint 15 Interrupt Enable The EP15 transmit interrupt is suppressed and not sent to the interrupt controller.
		1	An interrupt is sent to the interrupt controller when the EP15 bit in the USBTXIS register is set.
14	EP14	0	TX Endpoint 14 Interrupt Enable The EP14 transmit interrupt is suppressed and not sent to the interrupt controller.
		1	An interrupt is sent to the interrupt controller when the EP14 bit in the USBTXIS register is set.
13	EP13	0	TX Endpoint 13 Interrupt Enable The EP13 transmit interrupt is suppressed and not sent to the interrupt controller.
		1	An interrupt is sent to the interrupt controller when the EP13 bit in the USBTXIS register is set.
12	EP12	0	TX Endpoint 12 Interrupt Enable The EP12 transmit interrupt is suppressed and not sent to the interrupt controller.
		1	An interrupt is sent to the interrupt controller when the EP12 bit in the USBTXIS register is set.
11	EP11	0	TX Endpoint 11 Interrupt Enable The EP11 transmit interrupt is suppressed and not sent to the interrupt controller.
		1	An interrupt is sent to the interrupt controller when the EP11 bit in the USBTXIS register is set.
10	EP10	0	TX Endpoint 10 Interrupt Enable The EP10 transmit interrupt is suppressed and not sent to the interrupt controller.
		1	An interrupt is sent to the interrupt controller when the EP10 bit in the USBTXIS register is set.
9	EP9	0	TX Endpoint 9 Interrupt Enable The EP9 transmit interrupt is suppressed and not sent to the interrupt controller.
		1	An interrupt is sent to the interrupt controller when the EP9 bit in the USBTXIS register is set.
8	EP8	0	TX Endpoint 8 Interrupt Enable The EP8 transmit interrupt is suppressed and not sent to the interrupt controller.
		1	An interrupt is sent to the interrupt controller when the EP8 bit in the USBTXIS register is set.
7	EP7	0	TX Endpoint 7 Interrupt Enable The EP7 transmit interrupt is suppressed and not sent to the interrupt controller.
		1	An interrupt is sent to the interrupt controller when the EP7 bit in the USBTXIS register is set.
6	EP6	0	TX Endpoint 6 Interrupt Enable The EP6 transmit interrupt is suppressed and not sent to the interrupt controller.
		1	An interrupt is sent to the interrupt controller when the EP6 bit in the USBTXIS register is set.

**Table 22-9. USB Transmit Interrupt Status Register (USBTXIE) Field Descriptions (continued)**

Bit	Field	Value	Description
5	EP5		TX Endpoint 5 Interrupt Enable
		0	The EP5 transmit interrupt is suppressed and not sent to the interrupt controller.
		1	An interrupt is sent to the interrupt controller when the EP5 bit in the USBTXIS register is set.
4	EP4		TX Endpoint 4 Interrupt Enable
		0	The EP4 transmit interrupt is suppressed and not sent to the interrupt controller.
		1	An interrupt is sent to the interrupt controller when the EP4 bit in the USBTXIS register is set.
3	EP3		TX Endpoint 3 Interrupt Enable
		0	The EP3 transmit interrupt is suppressed and not sent to the interrupt controller.
		1	An interrupt is sent to the interrupt controller when the EP3 bit in the USBTXIS register is set.
2	EP2		TX Endpoint 2 Interrupt Enable
		0	The EP2 transmit interrupt is suppressed and not sent to the interrupt controller.
		1	An interrupt is sent to the interrupt controller when the EP2 bit in the USBTXIS register is set.
1	EP1		TX Endpoint 1 Interrupt Enable
		0	The EP1 transmit interrupt is suppressed and not sent to the interrupt controller.
		1	An interrupt is sent to the interrupt controller when the EP1 bit in the USBTXIS register is set.
0	EP0		TX and RX Endpoint 0 Interrupt Enable
		0	The EP0 transmit and receive interrupt is suppressed and not sent to the interrupt controller.
		1	An interrupt is sent to the interrupt controller when the EP0 bit in the USBTXIS register is set.

### 22.6.6 USB Receive Interrupt Enable Register (USBRIE), offset 0x008

The USB receive interrupt enable 16-bit register (USBRIE) provides interrupt enable bits for the interrupts in the USBRIS register. When a bit is set, the USB interrupt is asserted to the interrupt controller when the corresponding interrupt bit in the USBRIS register is set. When a bit is cleared, the interrupt in the USBRIS register is still set but the USB interrupt to the interrupt controller is not asserted. On reset, all interrupts are enabled.

**Mode(s):** Host Device

USBRIE is shown in [Figure 22-9](#) and described in [Table 22-10](#).

**Figure 22-9. USB Transmit Interrupt Status Enable Register (USBRIE)**

15	14	13	12	11	10	9	8
EP15	EP14	EP13	EP12	EP11	EP10	EP9	EP8
R-0							
EP7	EP6	EP5	EP4	EP3	EP2	EP1	EP0
R-0				R/W-1	R/W-1	R/W-1	Reserved

**Table 22-10. USB Transmit Interrupt Status Register (USBRIE) Field Descriptions**

Bit	Field	Value	Description
15	EP15	0	RX Endpoint 15 Interrupt Enable The EP15 transmit interrupt is suppressed and not sent to the interrupt controller.
		1	An interrupt is sent to the interrupt controller when the EP15 bit in the USBRIS register is set.
14	EP14	0	RX Endpoint 14 Interrupt Enable The EP14 transmit interrupt is suppressed and not sent to the interrupt controller.
		1	An interrupt is sent to the interrupt controller when the EP14 bit in the USBRIS register is set.
13	EP13	0	RX Endpoint 13 Interrupt Enable The EP13 transmit interrupt is suppressed and not sent to the interrupt controller.
		1	An interrupt is sent to the interrupt controller when the EP13 bit in the USBRIS register is set.
12	EP12	0	RX Endpoint 12 Interrupt Enable The EP12 transmit interrupt is suppressed and not sent to the interrupt controller.
		1	An interrupt is sent to the interrupt controller when the EP12 bit in the USBRIS register is set.
11	EP11	0	RX Endpoint 11 Interrupt Enable The EP11 transmit interrupt is suppressed and not sent to the interrupt controller.
		1	An interrupt is sent to the interrupt controller when the EP11 bit in the USBRIS register is set.
10	EP10	0	RX Endpoint 10 Interrupt Enable The EP10 transmit interrupt is suppressed and not sent to the interrupt controller.
		1	An interrupt is sent to the interrupt controller when the EP10 bit in the USBRIS register is set.
9	EP9	0	RX Endpoint 9 Interrupt Enable The EP9 transmit interrupt is suppressed and not sent to the interrupt controller.
		1	An interrupt is sent to the interrupt controller when the EP9 bit in the USBRIS register is set.
8	EP8	0	RX Endpoint 8 Interrupt Enable The EP8 transmit interrupt is suppressed and not sent to the interrupt controller.
		1	An interrupt is sent to the interrupt controller when the EP8 bit in the USBRIS register is set.
7	EP7	0	RX Endpoint 7 Interrupt Enable The EP7 transmit interrupt is suppressed and not sent to the interrupt controller.
		1	An interrupt is sent to the interrupt controller when the EP7 bit in the USBRIS register is set.
6	EP6	0	RX Endpoint 6 Interrupt Enable The EP6 transmit interrupt is suppressed and not sent to the interrupt controller.
		1	An interrupt is sent to the interrupt controller when the EP6 bit in the USBRIS register is set.

**Table 22-10. USB Transmit Interrupt Status Register (USBXIE) Field Descriptions (continued)**

Bit	Field	Value	Description
5	EP5		RX Endpoint 5 Interrupt Enable
		0	The EP5 transmit interrupt is suppressed and not sent to the interrupt controller.
		1	An interrupt is sent to the interrupt controller when the EP5 bit in the USBXIS register is set.
4	EP4		RX Endpoint 4 Interrupt Enable
		0	The EP4 transmit interrupt is suppressed and not sent to the interrupt controller.
		1	An interrupt is sent to the interrupt controller when the EP4 bit in the USBXIS register is set.
3	EP3		RX Endpoint 3 Interrupt Enable
		0	The EP3 transmit interrupt is suppressed and not sent to the interrupt controller.
		1	An interrupt is sent to the interrupt controller when the EP3 bit in the USBXIS register is set.
2	EP2		RX Endpoint 2 Interrupt Enable
		0	The EP2 transmit interrupt is suppressed and not sent to the interrupt controller.
		1	An interrupt is sent to the interrupt controller when the EP2 bit in the USBXIS register is set.
1	EP1		RX Endpoint 1 Interrupt Enable
		0	The EP1 transmit interrupt is suppressed and not sent to the interrupt controller.
		1	An interrupt is sent to the interrupt controller when the EP1 bit in the USBXIS register is set.
0	EP0		TX and RX Endpoint 0 Interrupt Enable
		0	The EP0 transmit and receive interrupt is suppressed and not sent to the interrupt controller.
		1	An interrupt is sent to the interrupt controller when the EP0 bit in the USBXIS register is set.

### 22.6.7 USB General Interrupt Status Register (USBIS), offset 0x00A

**NOTE:** Use caution when reading this register. Performing a Rread may change bit status.

The USB general interrupt status 8-bit read-only register (USBIS) indicates which USB interrupts are currently active. All active interrupts are cleared when this register is read.

**Mode(s):** Host Device

USBIS in Host Mode is shown in [Figure 22-10](#) and described in [Table 22-11](#).

**Figure 22-10. USB General Interrupt Status Register (USBIS) in Host Mode**

7	6	5	4	3	2	1	0
VBUSERR	SESREQ	DISCON	CONN	SOF	BABBLE	RESUME	Reserved
R-0	R-0	R-0	R-0	R-0	R-0	R-0	R-0

LEGEND: R/W = Read/Write; R = Read only; -n = value after reset

**Table 22-11. USB General Interrupt Status Register (USBIS) in Host Mode Field Descriptions**

Bit	Field	Value	Description
7	VBUSERR	0	No interrupt
		1	VBUS has dropped below the VBUS Valid threshold during a session.
6	SESREQ	0	No interrupt
		1	SESSION REQUEST signaling has been detected.
5	DISCON	0	No interrupt
		1	A Device disconnect has been detected.
4	CONN	0	No interrupt
		1	A Device connection has been detected.
3	SOF	0	No interrupt
		1	A new frame has started.
2	BABBLE	0	No interrupt
		1	Babble has been detected. This interrupt is active only after the first SOF has been sent.
1	RESUME	0	No effect
		1	RESUME signaling has been detected on the bus while the USB controller is in SUSPEND mode.
0	Reserved	0	Reserved



USBIS in Device Mode is shown in [Figure 22-11](#) and described in [Table 22-12](#).

**Figure 22-11. USB General Interrupt Status Register (USBIS) in Device Mode**

7	6	5	4	3	2	1	0
Reserved		DISCON	Reserved	SOF	RESET	RESUME	SUSPEND
R-0		R-0	R-0	R-0	R-0	R-0	R-0

LEGEND: R/W = Read/Write; R = Read only; -n = value after reset

**Table 22-12. USB General Interrupt Status Register (USBIS) in Device Mode Field Descriptions**

Bit	Field	Value	Description
7-6	Reserved	0	Reserved
5	DISCON	0	Session Disconnect No interrupt
		1	The device has been disconnected from the host.
4	Reserved	0	Reserved
3	SOF	0	Start of frame No interrupt
		1	A new frame has started.
2	RESET	0	RESET Signaling Detected No interrupt
		1	RESET signaling has been detected on the bus.
1	RESUME	0	RESUME Signaling Detected. This interrupt can only be used if the USB controller's system clock is enabled. If the user disables the clock programming, the USBDRRIS, USBDRIM, and USBDRISC registers should be used. No interrupt
		1	RESUME signaling has been detected on the bus while the USB controller is in SUSPEND mode.
0	SUSPEND	0	SUSPEND Signaling Detected No interrupt
		1	SUSPEND signaling has been detected on the bus.

## 22.6.8 USB Interrupt Enable Register (USBIE), offset 0x00B

**NOTE:** Use caution when reading this register. Performing a read may change bit status.

The USB interrupt enable 8-bit register (USBIE) provides interrupt enable bits for each of the interrupts in USBIS. At reset interrupts 1 and 2 are enabled in device mode.

**Mode(s):** Host                                      Device

USBIE in Host Mode is shown in [Figure 22-12](#) and described in [Table 22-13](#).

**Figure 22-12. USB Interrupt Enable Register (USBIE) in Host Mode**

7	6	5	4	3	2	1	0
VBUSERR	SESREQ	DISCON	CONN	SOF	BABBLE	RESUME	Reserved
R-W	R-W	R-W	R-W	R-W	R-W	R-W	R-0

LEGEND: R/W = Read/Write; R = Read only; -n = value after reset

**Table 22-13. USB Interrupt Enable Register (USBIE) in Host Mode Field Descriptions**

Bit	Field	Value	Description
7	VBUSERR	0	Enable VBUS Error Interrupt The VBUSERR interrupt is suppressed and not sent to the interrupt controller.
		1	An interrupt is sent to the interrupt controller when the VBUSERR bit in the USBIS register is set.
6	SESREQ	0	Enable Session Request The SESREQ interrupt is suppressed and not sent to the interrupt controller.
		1	An interrupt is sent to the interrupt controller when the SESREQ bit in the USBIS register is set.
5	DISCON	0	Enable Disconnect Interrupt The DISCON interrupt is suppressed and not sent to the interrupt controller.
		1	An interrupt is sent to the interrupt controller when the DISCON bit in the USBIS register is set.
4	CONN	0	Enable Connect Interrupt The CONN interrupt is suppressed and not sent to the interrupt controller.
		1	An interrupt is sent to the interrupt controller when the CONN bit in the USBIS register is set.
3	SOF	0	Start of Frame The SOF interrupt is suppressed and not sent to the interrupt controller.
		1	An interrupt is sent to the interrupt controller when the SOF bit in the USBIS register is set.
2	BABBLE	0	Babble Detected The BABBLE interrupt is suppressed and not sent to the interrupt controller.
		1	An interrupt is sent to the interrupt controller when the BABBLE bit in the USBIS register is set.
1	RESUME	0	RESUME Signaling Detected. This interrupt can only be used if the USB controller's system clock is enabled. If the user disables the clock programming, the USBDRRIS, USBDRIM, and USBDRISC registers should be used. The RESUME interrupt is suppressed and not sent to the interrupt controller.
		1	An interrupt is sent to the interrupt controller when the RESUME bit in the USBIS register is set.
0	Reserved	0	Reserved

USBIE in Device Mode is shown in [Figure 22-11](#) and described in [Table 22-12](#).

**Figure 22-13. USB Interrupt Enable Register (USBIE) in Device Mode**

7	6	5	4	3	2	1	0
Reserved		DISCON	Reserved	SOF	RESET	RESUME	SUSPEND
R-0		R/W-0	R-0	R/W-0	R/W-1	RW-1	R/W-0

LEGEND: R/W = Read/Write; R = Read only; -n = value after reset

**Table 22-14. USB Interrupt Enable Register (USBIE) in Device Mode Field Descriptions**

Bit	Field	Value	Description
7-6	Reserved	0	Reserved
5	DISCON	0	Enable Disconnect Interrupt The DISCON interrupt is suppressed and not sent to the interrupt controller.
		1	An interrupt is sent to the interrupt controller when the DISCON bit in the USBIS register is set.
4	Reserved	0	Reserved
3	SOF	0	Start of frame The SOF interrupt is suppressed and not sent to the interrupt controller.
		1	An interrupt is sent to the interrupt controller when the SOF bit in the USBIS register is set.
2	RESET	0	RESET Signaling Detected The RESET interrupt is suppressed and not sent to the interrupt controller.
		1	An interrupt is sent to the interrupt controller when the RESET bit in the USBIS register is set.
1	RESUME	0	RESUME Signaling Detected. This interrupt can only be used if the USB controller's system clock is enabled. If the user disables the clock programming, the USBDRRIS, USBDRIM, and USBDRISC registers should be used. The RESUME interrupt is suppressed and not sent to the interrupt controller.
		1	An interrupt is sent to the interrupt controller when the RESUME bit in the USBIS register is set.
0	SUSPEND	0	SUSPEND Signaling Detected The SUSPEND interrupt is suppressed and not sent to the interrupt controller.
		1	An interrupt is sent to the interrupt controller when the DISCON bit in the USBIS register is set.

### 22.6.9 USB Frame Value Register (USBFRAME), offset 0x00C

The frame number 16-bit read-only register (USBFRAME) holds the last received frame number.

**Mode(s):** Host Device

USBFRAME is shown in [Figure 22-14](#) and described in [Table 22-15](#).

**Figure 22-14. Frame Number Register (FRAME)**

15	11	10	0
Reserved		FRAME	
R-0		R-0	

LEGEND: R = Read only; -n = value after reset

**Table 22-15. Frame Number Register (FRAME) Field Descriptions**

Bit	Field	Value	Description
15-11	Reserved	0	Reserved
10-0	FRAME	0-7FFh	Last received frame number

### 22.6.10 USB Endpoint Index Register (USBEPIDX), offset 0x00E

Each endpoint buffer can be accessed by configuring a FIFO size and starting address. The endpoint index 16-bit register (USBEPIDX) is used with the USBTXFIFOSZ, USBRXFIFOSZ, USBTXFIFOADD, and USBRXFIFOADD registers.

**Mode(s):** Host Device

USBEPIDX is shown in [Figure 22-15](#) and described in [Table 22-16](#).

**Figure 22-15. USB Endpoint Index Register (USBEPIDX)**

7	4	3	0
Reserved		EPIDX	
R-0		R/W-0	

LEGEND: R/W = Read/Write; R = Read only; -n = value after reset

**Table 22-16. USB Endpoint Index Register (USBEPIDX) Field Descriptions**

Bit	Field	Value	Description
7-4	Reserved	0	Reserved
3-0	EPIDX	0-4h	Endpoint Index. This bit field configures which endpoint is accessed when reading or writing to one of the USB controller's indexed registers. A value of 0x0 corresponds to Endpoint 0 and a value of 0xF corresponds to Endpoint 15.

### 22.6.11 USB Test Mode Register (USBTEST), offset 0x00F

The USB test mode 8-bit register (USBTEST) is primarily used to put the USB controller into one of the four test modes for operation described in the USB Specification 2.0, in response to a SET FEATURE: USBTESTMODE command. This register is not used in normal operation.

**Note:** Only one of these bits should be set at any time.

**Mode(s):** Host Device

USBTEST in Host Mode is shown in [Figure 22-16](#) and described in [Table 22-17](#).

**Figure 22-16. USB Test Mode Register (USBTEST) in Host Mode**

7	6	5	4	0
FORCEH	FIFOACC	FORCEFS	Reserved	
R/W-0	R/W1S-0	R/W-0	R-0	

LEGEND: R/W = Read/Write; W = Write only; -n = value after reset

**Table 22-17. USB Test Mode Register (USBTEST) in Host Mode Field Descriptions**

Bit	Field	Value	Description
7	FORCEH	0	No effect
		1	Forces the USB controller to enter Host mode when the SESSION bit is set, regardless of whether the USB controller is connected to any peripheral. The state of the USB0DP and USB0DM signals is ignored. The USB controller then remains in Host mode until the SESSION bit is cleared, even if a Device is disconnected. If the FORCEH bit remains set, the USB controller re-enters Host mode the next time the SESSION bit is set.
6	FIFOACC	0	No effect
		1	Transfers the packet in the endpoint 0 transmit FIFO to the endpoint 0 receive FIFO.
5	FORCEFS	0	Force Full-Speed Mode The USB controller operates at Low Speed.
		1	Forces the USB controller into Full-Speed mode upon receiving a USB RESET.
4-0	Reserved	0	Reserved

USBTEST in Device Mode is shown in [Figure 22-17](#) and described in [Table 22-18](#).

**Figure 22-17. USB Test Mode Register (USBTEST) in Device Mode**

7	6	5	4	0
Reserved	FIFOACC	FORCEFS	Reserved	
R-0	R/W1S-0	R/W-0	R-0	

LEGEND: R/W = Read/Write; W = Write only; -n = value after reset

**Table 22-18. USB Test Mode Register (USBTEST) in Device Mode Field Descriptions**

Bit	Field	Value	Description
7	Reserved		Force Host Mode. While in this mode, status of the bus connection may be read using the DEV bit of the USBDEVCTL register. The operating speed is determined from the FORCEFS bit.
6	FIFOACC	0	No effect
		1	Transfers the packet in the endpoint 0 transmit FIFO to the endpoint 0 receive FIFO.

**Table 22-18. USB Test Mode Register (USBTEST) in Device Mode Field Descriptions (continued)**

Bit	Field	Value	Description
5	FORCEFS	0	Force Full-Speed Mode The USB controller operates at Low Speed.
		1	Forces the USB controller into Full-Speed mode upon receiving a USB RESET.
4-0	Reserved	0	Reserved

**22.6.12 USB FIFO Endpoint *n* Register (USBFIFO[0]-USBFIFO[15])**

**NOTE:** Use caution when reading these registers. Performing a read may change bit status.

The USB FIFO endpoint *n* 32-bit registers (USBFIFO[*n*]) provide an address for CPU access to the FIFOs for each endpoint. Writing to these addresses loads data into the Transmit FIFO for the corresponding endpoint. Reading from these addresses unloads data from the Receive FIFO for the corresponding endpoint.

Transfers to and from FIFOs can be 8-bit, 16-bit or 32-bit as required, and any combination of accesses is allowed provided the data accessed is contiguous. All transfers associated with one packet must be of the same width so that the data is consistently byte-, halfword- or word-aligned. However, the last transfer may contain fewer bytes than the previous transfers in order to complete an odd-byte or odd-word transfer.

Depending on the size of the FIFO and the expected maximum packet size, the FIFOs support either single-packet or double-packet buffering (see *Single-Packet Buffering* in Section 22.3.1.1.2). Burst writing of multiple packets is not supported as flags must be set after each packet is written.

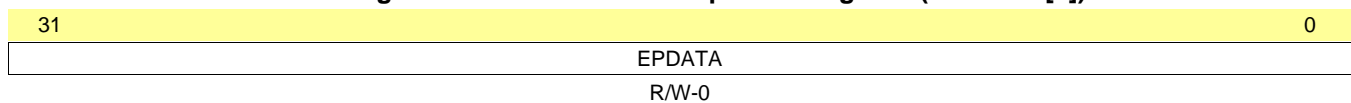
Following a STALL response or a transmit error on endpoint 1–3, the associated FIFO is completely flushed.

For the specific offset for each FIFO register see Table 22-3.

**Mode(s):** Host Device

USBFIFO0-15 are shown in Figure 22-18 and described in Table 22-19.

**Figure 22-18. USB FIFO Endpoint *n* Register (USBFIFO[*n*])**



LEGEND: R/W = Read/Write; R = Read only; -*n* = value after reset

**Table 22-19. USB FIFO Endpoint *n* Register (USBFIFO[*n*]) Field Descriptions**

Bit	Field	Reset	Description
31-0	EPDATA	0x0000.0000	Endpoint Data. Writing to this register loads the data into the Transmit FIFO and reading unloads data from the Receive FIFO.

### 22.6.13 USB Device Control Register (USBDEVCTL), offset 0x060

The USB device control 8-bit register (USBDEVCTL) is used for controlling and monitoring the USB  $V_{BUS}$  line. If the PHY is suspended, no PHY clock is received and the  $V_{BUS}$  is not sampled. In addition, in Host mode, USBDEVCTL provides the status information for the current operating mode (Host or Device) of the USB controller. If the USB controller is in Host mode, this register also indicates if a full- or low-speed Device has been connected.

**Mode(s):** Host                                  Device

USBDEVCTL is shown in Figure 22-19 and described in Table 22-20.

**Figure 22-19. USB Device Control Register (USBDEVCTL)**

7	6	5	4	3	2	1	0
DEV	FSDEV	LSDEV	VBUS		HOSTMODE	HOSTREQ	SESSION
R-1	R-0	R-0	R-0		R-0	R/W-0	R/W-0

LEGEND: R/W = Read/Write; R = Read only; -n = value after reset

**Table 22-20. USB Device Control Register (USBDEVCTL) Field Descriptions**

Bit	Field	Value	Description
7	DEV	0	Device mode The USB controller is operating on the OTG A side of the cable.
		1	The USB controller is operating on the OTG B side of the cable. Only valid while a session is in progress.
6	FSDEV	0	Full-Speed Device Detected A full-speed Device has not been detected on the port.
		1	A full-speed Device has been detected on the port.
5	LSDEV	0	Low-Speed Device Detected A low-speed Device has not been detected on the port.
		1	A low-speed Device has been detected on the port.
4-3	VBUS	0-3h	These read-only bits encode the current VBus level as follows:
		0	Below Session End. VBUS is detected as under 0.5 V.
		1h	Above Session End, below AValid. VBUS is detected as above 0.5 V and under 1.5 V.
		2h	Above AValid, below VBusValid. VBUS is detected as above 1.5 V and below 4.75 V.
3h	Above VBusValid. VBUS is detected as above 4.75 V.		
2	HOSTMODE	0	This read-only bit is set when the USB controller is acting as a Host. The USB controller is acting as a Device.
		1	The USB controller is acting as a Host. Only valid while a session is in progress.
1	HOSTREQ	0	When set, the USB controller will initiate the Host Negotiation when Suspend mode is entered. It is cleared when Host Negotiation is completed. No effect
		1	Initiates the Host Negotiation when SUSPENDmode is entered.



**Table 22-20. USB Device Control Register (USBDEVCTL) Field Descriptions (continued)**

Bit	Field	Value	Description
0	SESSION		<p>Session Start/End</p> <p>When operating as a Host:</p> <p>0 When cleared by software, this bit ends a session.</p> <p>1 When set by software, this bit starts a session.</p> <p>When operating as a Device:</p> <p>0 The USB controller has ended a session. When the USB controller is in SUSPEND mode, this bit may be cleared by software to perform a software disconnect.</p> <p>1 The USB controller has started a session. When set by software, the Session Request Protocol is initiated.</p> <p>Clearing this bit when the USB controller is not suspended results in undefined behavior.</p>

### 22.6.14 USB Transmit Dynamic FIFO Sizing Register (USBTXFIFOSZ), offset 0x062

The USB transmit dynamic FIFO sizing 8-bit register (USBTXFIFOSZ) allows the selected TX endpoint FIFOs to be dynamically sized. USBEPIDX is used to configure each transmit endpoint's FIFO size.

**Mode(s):** Host Device

USBTXFIFOSZ is shown in [Figure 22-20](#) and described in [Table 22-21](#).

**Figure 22-20. USB Transmit Dynamic FIFO Sizing Register (USBTXFIFOSZ)**

7	5	4	3	0
Reserved		DPB	SZ	
R-0		R/W-0	R-0	

LEGEND: R/W = Read/Write; R = Read only; -n = value after reset

**Table 22-21. USB Transmit Dynamic FIFO Sizing Register (USBTXFIFOSZ) Field Descriptions**

Bit	Field	Value	Description
7-5	Reserved	0	Reserved
4	DPB	0	Single packet buffering is supported.
		1	Double packet buffering is enabled.
3-0	SZ	0h	8
		1h	16
		2h	32
		3h	64
		4h	128
		5h	256
		6h	512
		7h	1024
	8h	2048	
	9-Fh	Reserved	

### 22.6.15 USB Receive Dynamic FIFO Sizing Register (USBXFIFOSZ), offset 0x063

The USB receive dynamic FIFO sizing 8-bit register (USBXFIFOSZ) allows the selected RX endpoint FIFOs to be dynamically sized.

**Mode(s):** Host Device

USBXFIFOSZ is shown in [Figure 22-21](#) and described in [Table 22-22](#).

**Figure 22-21. USB Receive Dynamic FIFO Sizing Register (USBXFIFOSZ)**

7	5	4	3	0
Reserved		DPB	SZ	
R-0		R/W-0	R-0	

LEGEND: R/W = Read/Write; R = Read only; -n = value after reset

**Table 22-22. USB Receive Dynamic FIFO Sizing Register (USBXFIFOSZ) Field Descriptions**

Bit	Field	Value	Description
7-5	Reserved	0	Reserved
4	DPB	0	Single packet buffering is supported.
		1	Double packet buffering is enabled.
3-0	SZ		Maximum packet size to be allowed. If DPB = 0, the FIFO also is this size; if DPB = 1, the FIFO is twice this size. Packet size in bytes:
		0h	8
		1h	16
		2h	32
		3h	64
		4h	128
		5h	256
		6h	512
		7h	1024
8h	2048		
9-Fh	Reserved		

**22.6.16 USB Transmit FIFO Start Address Register (USBTXFIFOADD), offset 0x064**

The USB transmit FIFO start address 16-bit register (USBTXFIFOADD) controls the start address of the selected transmit endpoint FIFOs.

**Mode(s):** Host Device

USBTXFIFOADDR is shown in [Figure 22-22](#) and described in [Table 22-23](#).

**Figure 22-22. USB Transmit FIFO Start Address Register (USBTXFIFOADDR)**

15	9	8	0
Reserved		ADDR	
R-0		R/W-0	

LEGEND: R/W = Read/Write; R = Read only; -n = value after reset

**Table 22-23. USB Transmit FIFO Start Address Register (USBTXFIFOADDR) Field Descriptions**

Bit	Field	Value	Description
15-9	Reserved	0	Reserved
8-0	ADDR	0h	0
		1h	8
		2h	16
		3h	24
		4h	32
		5h	40
		6h	48
		7h	56
		8h	64
		..	..
	1FFh	4095	

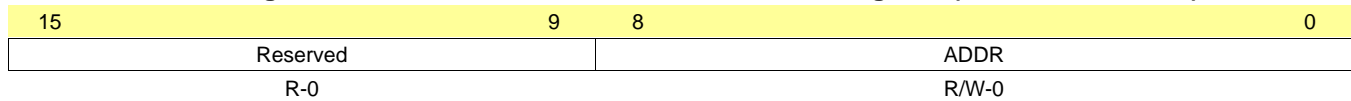
### 22.6.17 USB Receive FIFO Start Address Register (USBRXFIFOADD), offset 0x066

The USB receive FIFO start address 16-bit register (USBRXFIFOADD) controls the start address of the selected receive endpoint FIFOs.

**Mode(s):** Host Device

USBRXFIFOADDR is shown in [Figure 22-23](#) and described in [Table 22-24](#).

**Figure 22-23. USB Receive FIFO Start Address Register (USBRXFIFOADDR)**



LEGEND: R/W = Read/Write; R = Read only; -n = value after reset

**Table 22-24. USB Receive FIFO Start Address Register (USBRXFIFOADDR) Field Descriptions**

Bit	Field	Value	Description
15-9	Reserved	0	Reserved
8-0	ADDR		Start Address of the endpoint FIFO in units of 8 bytes.
		0h	0
		1h	8
		2h	16
		3h	24
		4h	32
		5h	40
		6h	48
		7h	56
		8h	64
		..	..
		1FFh	4095

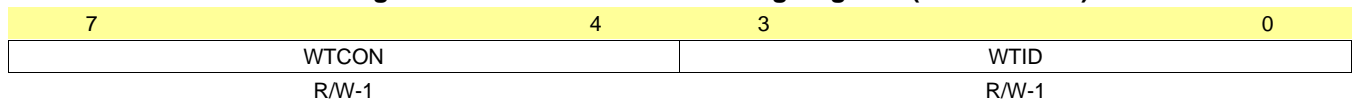
### 22.6.18 USB Connect Timing Register (USBCONTIM), offset 0x07A

The USB connect timing 8-bit configuration register (USBCONTIM) specifies connection and negotiation delays.

**Mode(s):** Host    Device

USBCONTIM is shown in [Figure 22-24](#) and described in [Table 22-25](#).

**Figure 22-24. USB Connect Timing Register (USBCONTIM)**



LEGEND: R/W = Read/Write; R = Read only; -n = value after reset

**Table 22-25. USB Connect Timing Register (USBCONTIM) Field Descriptions**

Bit	Field	Value	Description
7-4	WTCO N	5h	The connect wait field configures the wait required to allow for the user's connect/disconnect filter, in units of 533.3 ns. The default corresponds to 2.667 $\mu$ s.
3-0	WTID	Ch	The wait ID field configures the delay required from the enable of the ID detection to when the ID value is valid, in units of 4.369 ms. The default corresponds to 52.43 ms.

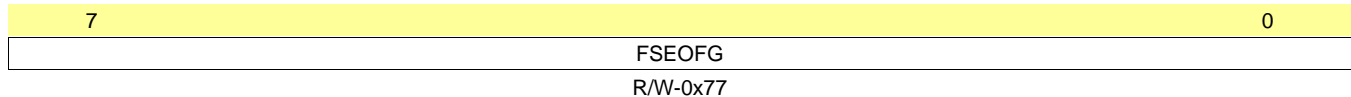
### 22.6.19 USB Full-Speed Last Transaction to End of Frame Timing Register (USBFSEOF), offset 0x07D

USB full-speed last transaction to end of frame timing 8-bit configuration register (USBFSEOF) specifies the minimum time gap allowed between the start of the last transaction and the EOF for full-speed transactions.

**Mode(s):** Host Device

USBFSEOF is shown in [Figure 22-25](#) and described in [Table 22-26](#).

**Figure 22-25. USB Full-Speed Last Transaction to End of Frame Timing Register (USBFSEOF)**



LEGEND: R/W = Read/Write; R = Read only; -n = value after reset

**Table 22-26. USB Full-Speed Last Transaction to End of Frame Timing Register (USBFSEOF) Field Descriptions**

Bit	Field	Reset	Description
7-0	FSEOFG	77h	The full-speed end-of-frame gap field is used during full-speed transactions to configure the gap between the last transaction and the End-of-Frame (EOF), in units of 533.3 ns. The default corresponds to 63.46 $\mu$ s.

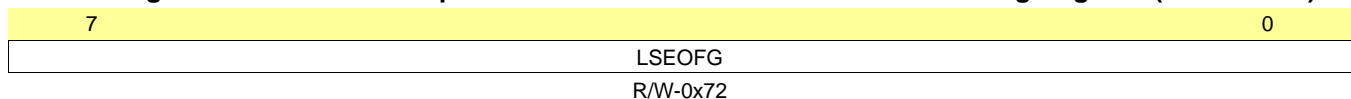
### 22.6.20 USB Low-Speed Last Transaction to End of Frame Timing Register (USBLSEOF), offset 0x07E

The USB low-speed last transaction to end of frame timing 8-bit configuration register (USBLSEOF) specifies the minimum time gap that is to be allowed between the start of the last transaction and the EOF for low-speed transactions.

**Mode(s):** Host Device

USBLSEOF is shown in [Figure 22-26](#) and described in [Table 22-27](#).

**Figure 22-26. USB Low-Speed Last Transaction to End of Frame Timing Register (USBLSEOF)**



LEGEND: R/W = Read/Write; R = Read only; -n = value after reset

**Table 22-27. USB Low-Speed Last Transaction to End of Frame Timing Register (USBLSEOF) Field Descriptions**

Bit	Field	Reset	Description
7-0	LSEOFG	72h	The low-speed end-of-frame gap field is used during low-speed transactions to set the gap between the last transaction and the End-of-Frame (EOF), in units of 1.067 $\mu$ s. The default corresponds to 121.6 $\mu$ s.

### 22.6.21 USB Transmit Functional Address Endpoint $n$ Registers (USBTXFUNCADDR[0]-USBTXFUNCADDR[15])

The transmit functional address endpoint  $n$  8-bit registers (USBTXFUNCADDR[ $n$ ]) record the address of the target function to be accessed through the associated endpoint (EP $n$ ). USBTXFUNCADDR $x$  must be defined for each transmit endpoint that is used.

**Note:** USBTXFUNCADDR0 is used for both receive and transmit for endpoint 0.

For the specific offset for each register see [Table 22-3](#).

**Mode(s):** Host

The USBTXFUNCADDR[ $n$ ] registers are shown in [Figure 22-27](#) and described in [Table 22-28](#).

**Figure 22-27. USB Transmit Functional Address Endpoint  $n$  Registers (USBTXFUNCADDR[ $n$ ])**

7	6	0
Reserved		ADDR
R-0		R/W-0

LEGEND: R/W = Read/Write; - $n$  = value after reset

**Table 22-28. USB Transmit Functional Address Endpoint  $n$  Registers (USBTXFUNCADDR[ $n$ ]) Field Descriptions**

Bit	Field	Value	Description
7	Reserved	0	Reserved
6-0	ADDR	0	Device Address specifies the USB bus address for the target Device.



### 22.6.22 USB Transmit Hub Address Endpoint $n$ Registers (USBTXHUBADDR[0]-USBTXHUBADDR[15])

The transmit hub address endpoint  $n$  8-bit read/write registers (USBTXHUBADDR[ $n$ ]), like USBTXHUBPORT[ $n$ ], must be written only when a USB device is connected to transmit endpoint EP $n$  via a USB 2.0 hub. This register records the address of the USB 2.0 hub through which the target associated with the endpoint is accessed.

**Note:** USBTXHUBADDR0 is used for both receive and transmit for endpoint 0.

For the specific offset for each register see [Table 22-3](#).

**Mode(s):** Host

The USBTXHUBADDR[ $n$ ] registers are shown in [Figure 22-27](#) and described in [Table 22-28](#).

**Figure 22-28. USB Transmit Hub Address Endpoint  $n$  Registers (USBTXHUBADDR[ $n$ ])**

7	6	0
Reserved		ADDR
R-0		R/W-0

LEGEND: R/W = Read/Write; - $n$  = value after reset

**Table 22-29. USB Transmit Hub Address Endpoint  $n$  Registers(USBTXHUBADDR[ $n$ ])  
Field Descriptions**

Bit	Field	Value	Description
7	Reserved	0	Reserved
6-0	ADDR	0	Device Address specifies the USB bus address for the target Device.

### 22.6.23 USB Transmit Hub Port Endpoint $n$ Registers (USBTXHUBPORT[0]-USBTXHUBPORT[15])

The transmit hub port endpoint  $n$  8-bit read/write registers (USBTXHUBPORT[ $n$ ]), like USBTXHUBADDR[ $n$ ], must be written only when a full- or low-speed Device is connected to transmit endpoint EP $n$  via a USB 2.0 hub. This register records the port of the USB 2.0 hub through which the target associated with the endpoint is accessed.

**Note:** USBTXHUBPORT0 is used for both receive and transmit for endpoint 0.

For the specific offset for each register see [Table 22-3](#).

**Mode(s):** Host

The USBTXHUBPORT $n$  registers are shown in [Figure 22-29](#) and described in [Table 22-30](#).

**Figure 22-29. USB Transmit Hub Port Endpoint  $n$  Registers (USBTXHUBPORT[ $n$ ])**

7	6	0
Reserved		PORT
R-0		R/W-0

LEGEND: R/W = Read/Write; - $n$  = value after reset

**Table 22-30. USB Transmit Hub Port Endpoint  $n$  Registers(USBTXHUBPORT[ $n$ ])  
Field Descriptions**

Bit	Field	Value	Description
7	Reserved	0	Reserved
6-0	PORT	0	Hub Port specifies the USB hub port number.

### 22.6.24 USB Receive Functional Address Endpoint $n$ Registers (USBXFUNCADDR[1]-USBXFUNCADDR[15])

The receive functional address endpoint  $n$  8-bit read/write registers (USBXFUNCADDR[ $n$ ]) record the address of the target function to be accessed through the associated endpoint (EP $n$ ). USBXFUNCADDR $x$  must be defined for each receive endpoint that is used.

**Note:** USBTXFUNCADDR0 is used for both receive and transmit for endpoint 0.

For the specific offset for each register see [Table 22-3](#).

**Mode(s):** Host

The USBXFUNCADDR[ $n$ ] registers are shown in [Figure 22-30](#) and described in [Table 22-31](#).

**Figure 22-30. USB Receive Functional Address Endpoint  $n$  Registers (USBFIFO[ $n$ ])**

7	6	0
Reserved		ADDR
R-0		R/W-0

LEGEND: R/W = Read/Write; - $n$  = value after reset

**Table 22-31. USB Receive Functional Address Endpoint  $n$  Registers(USBFIFO[ $n$ ]) Field Descriptions**

Bit	Field	Value	Description
7	Reserved	0	Reserved
6-0	ADDR	0	Device Address specifies the USB bus address for the target Device.

### 22.6.25 USB Receive Hub Address Endpoint $n$ Registers (USBRXHUBADDR[1]-USBRXHUBADDR[15])

The receive hub address endpoint  $n$  8-bit read/write registers (USBRXHUBADDR[ $n$ ]), like [ $n$ ], must be written only when a full- or low-speed Device is connected to receive endpoint EP $n$  via a USB 2.0 hub. Each register records the address of the USB 2.0 hub through which the target associated with the endpoint is accessed.

**Note:** USBTXHUBADDR0 is used for both receive and transmit for endpoint 0.

For the specific offset for each register see [Table 22-3](#).

**Mode(s):** Host

The USBRXHUBADDR[ $n$ ] registers are shown in [Figure 22-31](#) and described in [Table 22-32](#).

**Figure 22-31. USB Receive Hub Address Endpoint  $n$  Registers (USBRXHUBADDR[ $n$ ])**

7	6	0
MULTTRAN		ADDR
R/w-0		R/W-0

LEGEND: R/W = Read/Write; - $n$  = value after reset

**Table 22-32. USB Receive Hub Address Endpoint  $n$  Registers(USBRXHUBADDR[ $n$ ])  
Field Descriptions**

Bit	Field	Value	Description
7	MULTTRAN	0	Clear to indicate that the hub has a single transaction translator.
		1	Set to indicate that the hub has multiple transaction translators.
6-0	ADDR	0	Device Address specifies the USB bus address for the target Device.

### 22.6.26 USB Receive Hub Port Endpoint $n$ Registers (USBXHUBPORT[1]-USBXHUBPORT[15])

The receive hub port endpoint  $n$  8-bit read/write registers (USBXHUBPORT[ $n$ ]), like USBXHUBADDR[ $n$ ], must be written only when a full- or low-speed device is connected to receive endpoint EP $n$  via a USB 2.0 hub. Each register records the port of the USB 2.0 hub through which the target associated with the endpoint is accessed.

**Note:** USBTXHUBPORT0 is used for both receive and transmit for endpoint 0.

For the specific offset for each register see [Table 22-3](#).

**Mode(s):** Host

The USBXHUBPORT $n$  registers are shown in [Figure 22-32](#) and described in [Table 22-33](#).

**Figure 22-32. USB Transmit Hub Port Endpoint  $n$  Registers (USBXHUBPORT[ $n$ ])**

7	6	0
Reserved		PORT
R-0		R/W-0

LEGEND: R/W = Read/Write; - $n$  = value after reset

**Table 22-33. USB Transmit Hub Port Endpoint  $n$  Registers(USBXHUBPORT[ $n$ ])  
Field Descriptions**

Bit	Field	Value	Description
7	Reserved	0	Reserved
6-0	PORT	0	Hub Port specifies the USB hub port number.



## 22.6.28 USB Control and Status Endpoint 0 Low Register (USBCSRL0), offset 0x102

The USB control and status endpoint 0 low 8-bit register (USBCSRL0) provides control and status bits for endpoint 0.

**Mode(s):** Host Device

USBCSRL0 in Host mode is shown in [Figure 22-34](#) and described in [Table 22-35](#).

**Figure 22-34. USB Control and Status Endpoint 0 Low Register (USBCSRL0) in Host Mode**

7	6	5	4	3	2	1	0
NAKTO	STATUS	REQPKT	ERROR	SETUP	STALLED	TXRDY	RXRDY
R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0

LEGEND: R/W = Read/Write; -n = value after reset

**Table 22-35. USB Control and Status Endpoint 0 Low Register(USBCSRL0) in Host Mode Field Descriptions**

Bit	Field	Value	Description
7	NAKTO	0	NAK Timeout. Software must clear this bit to allow the endpoint to continue. No timeout
		1	Indicates that endpoint 0 is halted following the receipt of NAK responses for longer than the time set by the USBNAKLMT register.
6	STATUS	0	Status Packet. Setting this bit ensures that the DT bit is set in the USBCSRH0 register so that a DATA1 packet is used for the STATUS stage transaction. No transaction
		1	Initiates a STATUS stage transaction. This bit must be set at the same time as the TXRDY or REQPKT bit is set. This bit is automatically cleared when the STATUS stage is over.
5	REQPKT	0	Request Packet. This bit is cleared when the RXRDY bit is set. No request
		1	Requests an IN transaction.
4	ERROR	0	Error. Software must clear this bit. No error
		1	Three attempts have been made to perform a transaction with no response from the peripheral. The EP0 bit in the USBTXIS register is also set in this situation.
3	SETUP	0	Setup Packet. Setting this bit always clears the DT bit in the USBCSRH0 register to send a DATA0 packet. Sends an OUT token.
		1	Sends a SETUP token instead of an OUT token for the transaction. This bit should be set at the same time as the TXRDY bit is set.
2	STALLED	0	Endpoint Stalled. Software must clear this bit. No handshake has been received.
		1	A STALL handshake has been received.
1	TXRDY	0	Transmit Packet Ready. If both the TXRDY and SETUP bits are set, a setup packet is sent. If just TXRDY is set, an OUT packet is sent. No transmit packet is ready.
		1	Software sets this bit after loading a data packet into the TX FIFO. The EP0 bit in the USBTXIS register is also set in this situation.
0	RXRDY	0	Receive Packet Ready. Software must clear this bit after the packet has been read from the FIFO to acknowledge that the data has been read from the FIFO. No receive packet has been received.
		1	Indicates that a data packet has been received in the RX FIFO. The EP0 bit in the USBTXIS register is also set in this situation.

USBCSRL0 in Device mode is shown in [Figure 22-35](#) and described in [Table 22-36](#).

**Figure 22-35. USB Control and Status Endpoint 0 Low Register (USBCSRL0) in Device Mode**

7	6	5	4	3	2	1	0
SETENDC	RXRDYC	STALL	SETEND	DATAEND	STALLED	TXRDY	RXRDY
W1C-0	W1C-0	R/W-0	R-0	R/W-0	R/W-0	R/W-0	R-0

LEGEND: R/W = Read/Write; -n = value after reset

**Table 22-36. USB Control and Status Endpoint 0 Low Register (USBCSRL0) in Device Mode Field Descriptions**

Bit	Field	Value	Description
7	SETENDC	0	Setup End Clear No effect
		1	Writing a 1 to this bit clears the SETEND bit.
6	RXRDYC	0	RXRDY Clear No effect
		1	Writing a 1 to this bit clears the RXRDY bit.
5	STALL	0	Send Stall No effect
		1	Terminates the current transaction and transmits the STALL handshake. This bit is cleared automatically after the STALL handshake is transmitted.
4	SETEND	0	Setup end. A control transaction has not ended or ended after the DATAEND bit was set.
		1	A control transaction has ended before the DATAEND bit has been set. The EP0 bit in the USBTXIS register is also set in this situation. This bit is cleared by writing a 1 to the SETENDC bit.
3	DATAEND	0	Data end No effect
		1	Set this bit in the following situations: <ul style="list-style-type: none"> <li>• When setting TXRDY for the last data packet</li> <li>• When clearing RXRDY after unloading the last data packet</li> <li>• When setting TXRDY for a zero-length data packet</li> </ul> This bit is cleared automatically.
2	STALLED	0	Endpoint Stalled. Software must clear this bit. A STALL handshake has not been transmitted.
		1	A STALL handshake has been transmitted.
1	TXRDY	0	Transmit Packet Ready. If both the TXRDY and SETUP bits are set, a setup packet is sent. If just TXRDY is set, an OUT packet is sent. No transmit packet is ready.
		1	Software sets this bit after loading an IN data packet into the TX FIFO. The EP0 bit in the USBTXIS register is also set in this situation.
0	RXRDY	0	Receive Packet Ready No receive packet has been received.
		1	A data packet has been received. The EP0 bit in the USBTXIS register is also set in this situation. This bit is cleared by writing a 1 to the RXRDYC bit.



### 22.6.29 USB Control and Status Endpoint 0 High Register (USBCSRH0), offset 0x103

The USB control and status endpoint 0 high 8-bit register (USBCSRH0) provides control and status bits for endpoint 0.

**Mode(s):** Host Device

USBCSRH0 in Host mode is shown in [Figure 22-36](#) and described in [Table 22-37](#).

**Figure 22-36. USB Control and Status Endpoint 0 High Register (USBCSRH0) in Host Mode**

7	3	2	1	0
Reserved		DTWE	DT	FLUSH
R-0		R/W-0	R/W-0	R/W-0

LEGEND: R/W = Read/Write; R = Read only; -n = value after reset

**Table 22-37. USB Control and Status Endpoint 0 High Register (USBCSRH0) in Host Mode Field Descriptions**

Bit	Field	Value	Description
7-3	Reserved	0	Reserved
2	DTWE	0	Data Toggle Write Enable. This bit is automatically cleared once the new value is written. The DT bit cannot be written.
		1	Enables the current state of the endpoint 0 data toggle to be written (see DT bit).
1	DT		Data Toggle. When read, this bit indicates the current state of the endpoint 0 data toggle. If DTWE is set, this bit may be written with the required setting of the data toggle. If DTWE is Low, this bit cannot be written. Care should be taken when writing to this bit as it should only be changed to RESET USB endpoint 0.
0	FLUSH	0	Flush FIFO. This bit is automatically cleared after the flush is performed. No effect
		1	Flushes the next packet to be transmitted/read from the endpoint 0 FIFO. The FIFO pointer is reset and the TXRDY/RXRDY bit is cleared. <b>Note:</b> This bit should only be set when TXRDY/RXRDY is set. At other times, it may cause data to be corrupted.

USBCSRH0 in Device mode is shown in [Figure 22-37](#) and described in [Table 22-38](#).

**Figure 22-37. USB Control and Status Endpoint 0 High Register (USBCSRH0) in Device Mode**

7	1	0
Reserved		FLUSH
R-0		R/W-0

LEGEND: R/W = Read/Write; R = Read only; -n = value after reset

**Table 22-38. USB Control and Status Endpoint 0 High Register (USBCSRH0) in Device Mode Field Descriptions**

Bit	Field	Value	Description
7-1	Reserved	0	Reserved
0	FLUSH	0	Flush FIFO. This bit is automatically cleared after the flush is performed. No effect
		1	Flushes the next packet to be transmitted/read from the endpoint 0 FIFO. The FIFO pointer is reset and the TXRDY/RXRDY bit is cleared. <b>Note:</b> This bit should only be set when TXRDY/RXRDY is set. At other times, it may cause data to be corrupted.

### 22.6.30 USB Receive Byte Count Endpoint 0 Register (USBCOUNT0), offset 0x108

The USB receive byte count endpoint 0 8-bit read-only register (USBCOUNT0) indicates the number of received data bytes in the endpoint 0 FIFO. The value returned changes as the contents of the FIFO change and is only valid while the RXRDY bit is set.

**Mode(s):** Host Device

USBCOUNT0 is shown in [Figure 22-38](#) and described in [Table 22-28](#).

**Figure 22-38. USB Receive Byte Count Endpoint 0 Register (USBCOUNT0)**

7	6	0
Reserved	COUNT	
R-0	R/W-0	

LEGEND: R/W = Read/Write; -n = value after reset

**Table 22-39. USB Receive Byte Count Endpoint 0 Register (USBCOUNT0) Field Descriptions**

Bit	Field	Value	Description
7	Reserved	0	Reserved
6-0	COUNT	0	FIFO Count. COUNT is a read-only value that indicates the number of received data bytes in the endpoint 0 FIFO.

### 22.6.31 USB Type Endpoint 0 Register (USBTYPE0), offset 0x10A

The USB type endpoint 0 8-bit register (USBTYPE0) must be written with the operating speed of the targeted Device being communicated with using endpoint 0.

**Mode(s):** Host

USBTYPE0 is shown in [Figure 22-39](#) and described in [Table 22-40](#).

**Figure 22-39. USB Type Endpoint 0 Register (USBTYPE0)**

7	6	5	0
SPEED		Reserved	
R/W-0		R-0	

LEGEND: R/W = Read/Write; -n = value after reset

**Table 22-40. USB Type Endpoint 0 Register (USBTYPE0) Field Descriptions**

Bit	Field	Value	Description
7-6	SPEED	0 0-1h 2h 3h	Operating Speed specifies the operating speed of the target Device. If selected, the target is assumed to have the same connection speed as the USB controller. Reserved Full Low
5-0	Reserved	0	Reserved

### 22.6.32 USB NAK Limit Register (USBNAKLMT), offset 0x10B

The USB NAK limit 8-bit read-only register (USBNAKLMT) sets the number of frames after which endpoint 0 should time out on receiving a stream of NAK responses. (Equivalent settings for other endpoints can be made through their USBTXINTERVAL[*n*] and USBRXINTERVAL[*n*] registers.)

The number of frames selected is  $2^{(m-1)}$  (where *m* is the value set in the register, with valid values of 2–16). If the Host receives NAK responses from the target for more frames than the number represented by the limit set in this register, the endpoint is halted.

**Note:** A value of 0 or 1 disables the NAK timeout function.

**Mode(s):** Host

USBNAKLMT is shown in [Figure 22-40](#) and described in [Table 22-41](#).

**Figure 22-40. USB NAK Limit Register (USBNAKLMT)**

7	5	4	0
Reserved			
R-0	NAKLMT		
	R/W-0		

LEGEND: R/W = Read/Write; -*n* = value after reset

**Table 22-41. USB NAK Limit Register (USBNAKLMT) Field Descriptions**

Bit	Field	Value	Description
7-5	Reserved	0	Reserved
4-0	NAKLMT	0	EPO NAK Limit specifies the number of frames after receiving a stream of NAK responses.

### 22.6.33 USB Transmit Control and Status Endpoint *n* Low Register (USBTXCSRL[1]-USBTXCSRL[15])

The USB transmit control and status endpoint *n* low 8-bit registers (USBTXCSRL[*n*]) provide control and status bits for transfers through the currently selected transmit endpoint.

For the specific offset for each register see [Table 22-3](#).

**Mode(s):** Host Device

The USBTXCSRL[*n*] registers in Host Mode are shown in [Figure 22-41](#) and described in [Table 22-42](#).

**Figure 22-41. USB Transmit Control and Status Endpoint *n* Low Register (USBTXCSRL[*n*]) in Host Mode**

7	6	5	4	3	2	1	0
NAKTO	CLRDT	STALLED	SETUP	FLUSH	ERROR	FIFONE	TXRDY
R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0

LEGEND: R/W = Read/Write; -*n* = value after reset

**Table 22-42. USB Transmit Control and Status Endpoint *n* Low Register (USBTXCSRL[*n*]) in Host Mode Field Descriptions**

Bit	Field	Value	Description
7	NAKTO	0 1	NAK Timeout. Software must clear this bit to allow the endpoint to continue. No timeout Bulk endpoints only: Indicates that the transmit endpoint is halted following the receipt of NAK responses for longer than the time set by the NAKLMT field in the USBTXINTERVAL[ <i>n</i> ] register.
6	CLRDT	0 1	Clear DataToggle No effect Writing a 1 to this bit clears the DT bit in the USBTXCSRH[ <i>n</i> ] register.
5	STALLED	0 1	Endpoint Stalled. Software must clear this bit. A STALL handshake has not been received Indicates that a STALL handshake has been received. When this bit is set, any DMA request that is in progress is stopped, the FIFO is completely flushed, and the TXRDY bit is cleared.
4	SETUP	0 1	Setup Packet. No SETUP token is sent. Sends a SETUP token instead of an OUT token for the transaction. This bit should be set at the same time as the TXRDY bit is set. <b>Note:</b> Setting this bit also clears the DT bit in the USBTXCSRH[ <i>n</i> ] register.
3	FLUSH	0 1	Flush FIFO. This bit can be set simultaneously with the TXRDY bit to abort the packet that is currently being loaded into the FIFO. Note that if the FIFO is double-buffered, FLUSH may have to be set twice to completely clear the FIFO. No effect Flushes the latest packet from the endpoint transmit FIFO. The FIFO pointer is reset and the TXRDY bit is cleared. The EPn bit in the USBTXIS register is also set in this situation. <b>Note:</b> This bit should only be set when the TXRDY bit is set. At other times, it may cause data to be corrupted.
2	ERROR	0 1	Error. Software must clear this bit. No error Three attempts have been made to send a packet and no handshake packet has been received. The TXRDY bit is cleared, the EPn bit in the USBTXIS register is set, and the FIFO is completely flushed in this situation. <b>Note:</b> This bit is valid only when the endpoint is operating in Bulk or Interrupt mode.
1	FIFONE	0 1	FIFO Not Empty The FIFO is empty At least one packet is in the transmit FIFO.

**Table 22-42. USB Transmit Control and Status Endpoint n Low Register (USBTXCSRL[n])  
in Host Mode Field Descriptions (continued)**

Bit	Field	Value	Description
0	TXRDY		Transmit Packet Ready. This bit is cleared automatically when a data packet has been transmitted. The EPn bit in the USBTXIS register is also set at this point. TXRDY is also automatically cleared prior to loading a second packet into a double-buffered FIFO.
		0	No transmit packet is ready.
		1	Software sets this bit after loading a data packet into the TX FIFO.

The USBTXCSRL[n] registers in Device Mode are shown in [Table 22-42](#) and described in [Figure 22-42](#).

**Figure 22-42. USB Transmit Control and Status Endpoint n Low Register (USBTXCSRL[n])  
in Device Mode**

7	6	5	4	3	2	1	0
Reserved	CLRDT	STALLED	STALL	FLUSH	UNDRN	FIFONE	TXRDY
R-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0

LEGEND: R/W = Read/Write; -n = value after reset

**Table 22-43. USB Transmit Control and Status Endpoint n Low Register (USBTXCSRL[n])  
in Device Mode Field Descriptions**

Bit	Field	Value	Description
7	Reserved	0	Reserved
6	CLRDT	0	No effect
		1	Writing a 1 to this bit clears the DT bit in the USBTXCSRH[n] register.
5	STALLED	0	Endpoint Stalled. Software must clear this bit. A STALL handshake has not been transmitted.
		1	A STALL handshake has been transmitted. The FIFO is flushed and the TXRDY bit is cleared.
4	STALL	0	No effect
		1	Issues a STALL handshake to an IN token.
3	FLUSH		Flush FIFO. This bit may be set simultaneously with the TXRDY bit to abort the packet that is currently being loaded into the FIFO. Note that if the FIFO is double-buffered, FLUSH may have to be set twice to completely clear the FIFO. <b>Note:</b> This bit should only be set when the TXRDY bit is set. At other times, it may cause data to be corrupted.
		1	Flushes the latest packet from the endpoint transmit FIFO. The FIFO pointer is reset and the TXRDY bit is cleared. The EPn bit in the USBTXIS register is also set in this situation. This bit is cleared automatically.
2	UNDRN	0	No underrun
		1	An IN token has been received when TXRDY is not set.
1	FIFONE	0	FIFO Not Empty The FIFO is empty.
		1	At least one packet is in the transmit FIFO.

**Table 22-43. USB Transmit Control and Status Endpoint n Low Register (USBTXCSRL[n])  
in Device Mode Field Descriptions (continued)**

Bit	Field	Value	Description
0	TXRDY		Transmit Packet Ready. This bit is cleared automatically when a data packet has been transmitted. The EPn bit in the USBTXIS register is also set at this point. TXRDY is also automatically cleared prior to loading a second packet into a double-buffered FIFO.
		0	No transmit packet is ready.
		1	Software sets this bit after loading a data packet into the TX FIFO.
			This bit is cleared by writing a 1 to the RXRDYC bit.

## 22.6.34 USB Transmit Control and Status Endpoint *n* High Register (USBTXCSRH[1]-USBTXCSRH[15])

The USB transmit control and status endpoint *n* high 8-bit registers (USBTXCSRH[*n*]) provide additional control for transfers through the currently selected transmit endpoint.

For the specific offset for each register see [Table 22-3](#).

**Mode(s):** Host                                      Device

The USBTXCSRH[*n*] registers in Host Mode are shown in [Figure 22-43](#) and described in [Table 22-44](#).

**Figure 22-43. USB Transmit Control and Status Endpoint *n* High Register (USBTXCSRH[*n*]) in Host Mode**

7	6	5	4	3	2	1	0
AUTOSET	Reserved	MODE	DMAEN	FDT	DMAMOD	DTWE	DT
R/W-0	R-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0

LEGEND: R/W = Read/Write; -*n* = value after reset

**Table 22-44. USB Transmit Control and Status Endpoint *n* High Register (USBTXCSRH[*n*]) in Host Mode Field Descriptions**

Bit	Field	Value	Description
7	AUTOSET	0	Auto Set The TXRDY bit must be set manually.
		1	Enables the TXRDY bit to be automatically set when data of the maximum packet size (value in USBTXMAXP[ <i>n</i> ]) is loaded into the transmit FIFO. If a packet of less than the maximum packet size is loaded, then the TXRDY bit must be set manually.
6	Reserved	0	Reserved. Any writes to these bit(s) must always have a value of 0.
5	MODE		Mode <b>Note:</b> This bit only has an effect when the same endpoint FIFO is used for both transmit and receive transactions.
		0	Enables the endpoint direction as RX.
		1	Enables the endpoint direction as TX.
4	DMAEN		DMA Request Enable <b>Note:</b> Three TX and three /RX endpoints can be connected to the DMA module. If this bit is set for a particular endpoint, the DMAATX, DMABTX, or DMAXTX field in the USB DMA Select (USBDMASEL) register must be programmed correspondingly.
		0	Disables the DMA request for the transmit endpoint.
		1	Enables the DMA request for the transmit endpoint.
3	FDT	0	Force Data Toggle No effect
		1	Forces the endpoint DT bit to switch and the data packet to be cleared from the FIFO, regardless of whether an ACK was received. <b>Note:</b> This bit should only be set when the TXRDY bit is set. At other times, it may cause data to be corrupted.
2	DMAMOD		DMA Request Mode <b>Note:</b> This bit must not be cleared either before or in the same cycle as the above DMAEN bit is cleared.
		0	An interrupt is generated after every DMA packet transfer.
		1	An interrupt is generated only after the entire DMA transfer is complete. <b>Note:</b> This bit is valid only when the endpoint is operating in Bulk or Interrupt mode.
1	DTWE		Data Toggle Write Enable. This bit is automatically cleared once the new value is written.
		0	The DT bit cannot be written.
		1	Enables the current state of the transmit endpoint data to be written (see DT bit).

**Table 22-44. USB Transmit Control and Status Endpoint n High Register (USBTXCSRH[n])  
in Host Mode Field Descriptions (continued)**

Bit	Field	Value	Description
0	DT		Data Toggle. When read, this bit indicates the current state of the transmit endpoint data toggle. If DTWE is High, this bit can be written with the required setting of the data toggle. If DTWE is Low, any value written to this bit is ignored. Care should be taken when writing to this bit as it should only be changed to RESET the transmit endpoint.

The USBTXCSRH[n] registers in Device Mode are shown in [Figure 22-44](#) and described in [Table 22-45](#).

**Figure 22-44. USB Transmit Control and Status Endpoint n High Register (USBTXCSRH[n])  
in Device Mode**

7	6	5	4	3	2	1	0
AUTOSET	Reserved	MODE	DMAEN	FDT	DMAMOD	Reserved	
R/W-0	R-0	R/W-0	R/W-0	R/W-0	R/W-0	R-0	

LEGEND: R/W = Read/Write; -n = value after reset

**Table 22-45. USB Transmit Control and Status Endpoint n High Register (USBTXCSRH[n])  
in Device Mode Field Descriptions**

Bit	Field	Value	Description
7	AUTOSET	0	Auto Set The TXRDY bit must be set manually.
		1	Enables the TXRDY bit to be automatically set when data of the maximum packet size (value in USBTXMAXP[n]) is loaded into the transmit FIFO. If a packet of less than the maximum packet size is loaded, then the TXRDY bit must be set manually.
6	Reserved		Reserved. Should always have a value of 0.
5	MODE	0	Mode <b>Note:</b> This bit only has an effect when the same endpoint FIFO is used for both transmit and receive transactions. Enables the endpoint direction as RX.
		1	Enables the endpoint direction as TX.
4	DMAEN	0	DMA Request Enable <b>Note:</b> Three TX and three /RX endpoints can be connected to the DMA module. If this bit is set for a particular endpoint, the DMAATX, DMABTX, or DMACTX field in the USB DMA Select (USBDMASEL) register must be programmed correspondingly. Disables the DMA request for the transmit endpoint.
		1	Enables the DMA request for the transmit endpoint.
3	FDT	0	Force Data Toggle No effect
		1	Forces the endpoint DT bit to switch and the data packet to be cleared from the FIFO, regardless of whether an ACK was received.
2	DMAMOD	0	DMA Request Mode <b>Note:</b> This bit must not be cleared either before or in the same cycle as the above DMAEN bit is cleared. An interrupt is generated after every DMA packet transfer.
		1	An interrupt is generated only after the entire DMA transfer is complete.
0	Reserved	0	Reserved



### 22.6.35 USB Maximum Receive Data Endpoint $n$ Registers (USBXMAXP[1]-USBXMAXP[15])

The USB maximum receive data endpoint  $n$  16-bit registers (USBXMAXP[ $n$ ]) define the maximum amount of data that can be transferred through the selected receive endpoint in a single operation.

Bits 10:0 define (in bytes) the maximum payload transmitted in a single transaction. The value set can be up to 1024 bytes but is subject to the constraints placed by the *USB Specification* on packet sizes for bulk, interrupt transfers in full-speed operation.

The total amount of data represented by the value written to this register must not exceed the FIFO size for the transmit endpoint, and must not exceed half the FIFO size if double-buffering is required.

**Note:** USBXMAXP[ $n$ ] must be set to an even number of bytes for proper interrupt generation in DMA Basic Mode.

For the specific offset for each register see [Table 22-3](#).

**Mode(s):** Host Device

The USBXMAXP[ $n$ ] registers are shown in [Figure 22-45](#) and described in [Table 22-46](#).

**Figure 22-45. USB Maximum Receive Data Endpoint  $n$  Registers (USBXMAXP[ $n$ ])**

15	11	10	0
Reserved			MAXLOAD
R-0			R/W-000

LEGEND: R/W = Read/Write; R = Read only; - $n$  = value after reset

**Table 22-46. USB Maximum Receive Data Endpoint  $n$  Registers (USBXMAXP[ $n$ ]) Field Descriptions**

Bit	Field	Value	Description
15-11	Reserved	0	Reserved
10-0	MAXLOAD	00	Maximum Payload specifies the maximum payload in bytes per transaction.

### 22.6.36 USB Receive Control and Status Endpoint $n$ Low Register (USBRXCSRL[1]-USBRXCSRL[15])

The USB receive control and status endpoint  $n$  low 8-bit register (USBCSRL[ $n$ ]) provides control and status bits for transfers through the currently selected receive endpoint.

For the specific offset for each register see [Table 22-3](#).

**Mode(s):** Host Device

The USBCSRL[ $n$ ] registers in Host mode are shown in [Figure 22-46](#) and described in [Table 22-47](#).

**Figure 22-46. USB Receive Control and Status Endpoint  $n$  Low Register (USBCSRL[ $n$ ]) in Host Mode**

7	6	5	4	3	2	1	0
CLRDT	STALLED	REQPKT	FLUSH	DATAERR / NAKTO	ERROR	FULL	RXRDY
W1C-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0

LEGEND: R/W = Read/Write; - $n$  = value after reset

**Table 22-47. USB Control and Status Endpoint  $n$  Low Register(USBCSRL[ $n$ ]) in Host Mode Field Descriptions**

Bit	Field	Value	Description
7	NAKTO	0 1	Clear Data Toggle. No effect Writing a 1 to this bit clears the DT bit in the USBRXCSRH[ $n$ ] register.
6	STALLED	0 1	Endpoint Stalled. Software must clear this bit. No handshake has been received. A STALL handshake has been received. The EP $n$ bit in the USBRXIS register is also set.
5	REQPKT	0 1	Request Packet. This bit is cleared when the RXRDY bit is set. No request Requests an IN transaction.
4	FLUSH	0 1	Flush FIFO. If the FIFO is double-buffered, FLUSH may have to be set twice to completely clear the FIFO. <b>Note:</b> This bit should only be set when the RXRDY bit is set. At other times, it may cause data to be corrupted. No effect Flushes the next packet to be read from the endpoint receive FIFO. The FIFO pointer is reset and the RXRDY bit is cleared.
3	DATAERR / NAKTO	0 1	Data Error / NAK Timeout Normal operation Bulk endpoints only: Indicates that the receive endpoint is halted following the receipt of NAK responses for longer than the time set by the NAKLMT field in the USBRXINTERVAL[ $n$ ] register. Software must clear this bit to allow the endpoint to continue.
2	ERROR	0 1	Error. Software must clear this bit. <b>Note:</b> This bit is only valid when the receive endpoint is operating in Bulk or Interrupt mode. No error Three attempts have been made to receive a packet and no data packet has been received. The EP $n$ bit in the USBRXIS register is set in this situation.
1	FULL	0 1	FIFO Full The receive FIFO is not full. No more packets can be loaded into the receive FIFO.

**Table 22-47. USB Control and Status Endpoint  $n$  Low Register(USBCSRL[ $n$ ])  
in Host Mode Field Descriptions (continued)**

Bit	Field	Value	Description
0	RXRDY		Receive Packet Ready. If the AUTOCLR bit in the USBRXCSRH[ $n$ ] register is set, then the this bit is automatically cleared when a packet of USBRXMAXP[ $n$ ] bytes has been unloaded from the receive FIFO. If the AUTOCLR bit is clear, or if packets of less than the maximum packet size are unloaded, then software must clear this bit manually when the packet has been unloaded from the receive FIFO.
		0	No data packet has been received.
		1	Indicates that a data packet has been received. The EP $n$ bit in the USBTXIS register is also set in this situation.

USBCSRL0 in Device mode is shown in [Figure 22-47](#) and described in [Table 22-48](#).

**Figure 22-47. USB Control and Status Endpoint  $n$  Low Register (USBCSRL[ $n$ ])  
in Device Mode**

7	6	5	4	3	2	1	0
CLRDT	STALLED	STALL	FLUSH	Reserved		FULL	RXRDY
W1C-0	W1C-0	R/W-0	R-0	R/W-0	R/W-0	R/W-0	R-0

LEGEND: R/W = Read/Write; - $n$  = value after reset

**Table 22-48. USB Control and Status Endpoint 0 Low Register(USBCSRL[ $n$ ])  
in Device Mode Field Descriptions**

Bit	Field	Value	Description
7	CLRDT		Clear Data Toggle
		0	No effect
		1	Writing a 1 to this bit clears the DT bit in the USBRXCSRH[ $n$ ] register.
6	STALLED		Endpoint Stalled. Software must clear this bit.
		0	A STALL handshake has been transmitted.
		1	A STALL handshake has been transmitted.
5	STALL		Send Stall. Software must clear this bit to terminate the STALL condition.
		0	No effect
		1	Issues a STALL handshake.
4	FLUSH		Flush FIFO. The CPU writes a 1 to this bit to flush the next packet to be read from the endpoint receive FIFO. The FIFO pointer is reset and the RXRDY bit is cleared. Note that if the FIFO is double-buffered, FLUSH may have to be set twice to completely clear the FIFO.
		0	No effect
		1	Flushes the next packet from the endpoint receive FIFO. The FIFO pointer is reset and the RXRDY bit is cleared.
			<b>Note:</b> This bit should only be set when the RXRDY bit is set. At other times, it may cause data to be corrupted.
3	Reserved		Reserved
2	Reserved		Reserved
1	FULL		FIFO Full
		0	The receive FIFO is not full.
		1	No more packets can be loaded into the receive FIFO.
0	RXRDY		Receive Packet Ready. If the AUTOCLR bit in the USBRXCSRH[ $n$ ] register is set, then the this bit is automatically cleared when a packet of USBRXMAXP[ $n$ ] bytes has been unloaded from the receive FIFO. If the AUTOCLR bit is clear, or if packets of less than the maximum packet size are unloaded, then software must clear this bit manually when the packet has been unloaded from the receive FIFO.
		0	No data packet has been received.
		1	A data packet has been received. The EP $n$ bit in the USBTXIS register is also set in this situation.
			This bit is cleared by writing a 1 to the RXRDYC bit.

### 22.6.37 USB Receive Control and Status Endpoint $n$ High Register (USBRXCSRH[1]-USBRXCSRH[15])

The USB receive control and status endpoint  $n$  high 8-bit register (USBCSRL[ $n$ ]) provides additional control and status bits for transfers through the currently selected receive endpoint.

For the specific offset for each register see [Table 22-3](#).

**Mode(s):** Host Device

The USBCSRH[ $n$ ] registers in OTG A/Host mode are shown in [Figure 22-48](#) and described in [Table 22-49](#).

**Figure 22-48. USB Receive Control and Status Endpoint  $n$  High Register (USBCSRH[ $n$ ]) in Host Mode**

7	6	5	4	3	2	1	0
AUTOCL	AUTORQ	DMAEN	Reserved	DMAMOD	DTWE	DT	Reserved
W1C-0	R/W-0	R/W-0	R-0	R/W-0	R-0	R-0	R-0

LEGEND: R/W = Read/Write; - $n$  = value after reset

**Table 22-49. USB Control and Status Endpoint  $n$  High Register (USBCSRH[ $n$ ]) in Host Mode Field Descriptions**

Bit	Field	Value	Description
7	AUTOCL	0	Auto Clear No effect
		1	Enables the RXRDY bit to be automatically cleared when a packet of USBRXMAXP[ $n$ ] bytes has been unloaded from the receive FIFO. When packets of less than the maximum packet size are unloaded, RXRDY must be cleared manually. Care must be taken when using DMA to unload the receive FIFO as data is read from the receive FIFO in 4-byte chunks regardless of the value of the MAXLOAD field in the USBRXMAXP[ $n$ ] register, see <a href="#">Section 22.3.3</a> .
6	AUTORQ	0	Auto Request <b>Note:</b> This bit is automatically cleared when a short packet is received. No effect
		1	Enables the REQPKT bit to be automatically set when the RXRDY bit is cleared.
5	DMAEN	0	DMA Request Enable <b>Note:</b> Three TX and three RX endpoints can be connected to the DMA module. If this bit is set for a particular endpoint, the DMAARX, DMABRX, or DMACRX field in the USB DMA Select (USBDMASEL) register must be programmed correspondingly. Disables the DMA request for the receive endpoint.
		1	Enables the DMA request for the receive endpoint.
4	Reserved		Reserved
3	DMAMOD	0	DMAMOD <b>Note:</b> This bit must not be cleared either before or in the same cycle as the above DMAEN bit is cleared. An interrupt is generated after every DMA packet transfer.
		1	An interrupt is generated only after the entire DMA transfer is complete.
2	DTWE	0	Data Toggle Write Enable. This bit is automatically cleared once the new value is written. The DT bit cannot be written.
		1	Enables the current state of the receive endpoint data to be written (see DT bit).
1	DT		Data Toggle. When read, this bit indicates the current state of the receive data toggle. If DTWE is High, this bit may be written with the required setting of the data toggle. If DTWE is Low, any value written to this bit is ignored. Care should be taken when writing to this bit as it should only be changed to RESET the receive endpoint.
0	Reserved	0	Reserved

The USBCSRH[ $n$ ] registers in Device mode are shown in [Figure 22-49](#) and described in [Table 22-50](#).

**Figure 22-49. USB Control and Status Endpoint  $n$  High Register (USBCSRH[ $n$ ]) in Device Mode**

7	6	5	4	3	2	1	0
AUTOCL	Reserved	DMAEN	DISNYET / PIDERR	DMAMOD		Reserved	
R/W-0	R/W-0	R/W-0	R/W-0	R/W-0		R-0	

LEGEND: R/W = Read/Write; - $n$  = value after reset

**Table 22-50. USB Control and Status Endpoint 0 High Register(USBCSRH[ $n$ ]) in Device Mode Field Descriptions**

Bit	Field	Value	Description
7	AUTOCL		Auto Clear
		0	No effect
		1	Enables the RXRDY bit to be automatically cleared when a packet of USBRXMAXP[ $n$ ] bytes has been unloaded from the receive FIFO. When packets of less than the maximum packet size are unloaded, RXRDY must be cleared manually. Care must be taken when using DMA to unload the receive FIFO as data is read from the receive FIFO in 4-byte chunks regardless of the value of the MAXLOAD field in the USBRXMAXP[ $n$ ] register, see <a href="#">Section 22.3.3</a> .
6	Reserved		Reserved
5	DMAEN		DMA Request Enable <b>Note:</b> Three TX and three RX endpoints can be connected to the DMA module. If this bit is set for a particular endpoint, the DMAARX, DMABRX, or DMACRX field in the USB DMA Select (USBDMASEL) register must be programmed correspondingly.
		0	Disables the DMA request for the receive endpoint.
		1	Enables the DMA request for the receive endpoint.
4	DISNYET/PI DERR		Disable NYET / PID Error
		0	No effect
		1	For bulk or interrupt transactions: Disables the sending of NYET handshakes. When this bit is set, all successfully received packets are acknowledged, including at the point at which the FIFO becomes full.
3	DMAMOD		DMA Request Mode <b>Note:</b> This bit must not be cleared either before or in the same cycle as the above DMAEN bit is cleared.
		0	An interrupt is generated after every DMA packet transfer.
		1	An interrupt is generated only after the entire DMA transfer is complete.
0	Reserved	0	Reserved

### 22.6.38 USB Receive Byte Count Endpoint $n$ Registers (USBXCOUNT[1]-USBXCOUNT[15])

The USB receive byte count endpoint  $n$  16-bit read-only registers hold the number of data bytes in the packet currently in line to be read from the receive FIFO. If the packet is transmitted as multiple bulk packets, the number given is for the combined packet.

**Note:** The value returned changes as the FIFO is unloaded and is only valid while the RXRDY bit in the USBXCSSLn register is set.

For the specific offset for each register see [Table 22-3](#).

**Mode(s):** Host                                      Device

The USBXCOUNT[ $n$ ] registers are shown in [Figure 22-50](#) and described in [Table 22-51](#).

**Figure 22-50. USB Maximum Receive Data Endpoint  $n$  Registers (USBXCOUNT[ $n$ ])**

15	13	12	0
Reserved	COUNT		
R-0	R-0		

LEGEND: R/W = Read/Write; R = Read only; - $n$  = value after reset

**Table 22-51. USB Maximum Receive Data Endpoint  $n$  Registers (USBXCOUNT[ $n$ ])  
Field Descriptions**

Bit	Field	Value	Description
15-13	Reserved	0	Reserved
12-0	COUNT		Receive Packet Count indicates the number of bytes in the receive packet.

### 22.6.39 USB Host Transmit Configure Type Endpoint *n* Register (USBTXTYPE[1]-USBTXTYPE[15])

The USB host transmit configure type endpoint *n* 8-bit registers (USBTXTYPE[*n*]) must be written with the endpoint number to be targeted by the endpoint, the transaction protocol to use for the currently selected transmit endpoint, and its operating speed.

For the specific offset for each register see [Table 22-3](#).

**Mode(s):** Host

The USBTXTYPE[*n*] registers are shown in [Figure 22-51](#) and described in [Table 22-52](#).

**Figure 22-51. USB Host Transmit Configure Type Endpoint *n* Register (USBTXTYPE[*n*])**

7	6	5	4	3	0
SPEED		PROTO		TEP	
R/W-0		R/W-0		R/W-0	

LEGEND: R/W = Read/Write; -*n* = value after reset

**Table 22-52. USB Host Transmit Configure Type Endpoint *n* Register(USBTXTYPE[*n*]) Field Descriptions**

Bit	Field	Value	Description
7-6	SPEED	0h 1h 2h 3h	Operating Speed. This bit field specifies the operating speed of the target Device: Default. The target is assumed to be using the same connection speed as the USB controller. Reserved Full Low
5-4	PROTO	0h 1h 2h 3h	Protocol. Software must configure this bit field to select the required protocol for the transmit endpoint: Control Reserved Bulk Interrupt
3-0	TEP	0	Target Endpoint Number. Software must configure this value to the endpoint number contained in the transmit endpoint descriptor returned to the USB controller during Device enumeration.

### 22.6.40 USB Host Transmit Interval Endpoint $n$ Register (USBTXINTERVAL[1]USBTXINTERVAL[15])

The USB host transmit interval endpoint  $n$  8-bit registers (USBTXINTERVAL[ $n$ ]), for interrupt transfers, define the polling interval for the currently selected transmit endpoint. For bulk endpoints, this register defines the number of frames after which the endpoint should time out on receiving a stream of NAK responses.

The USBTXINTERVAL[ $n$ ] registers values define a number of frames, as follows:

**Table 22-53. USBTXINTERVAL[ $n$ ] Frame Numbers**

Transfer Type	Speed	Valid Values (m)	Interpretation
Interrupt	Low-speed or Full-speed	0x01-0xFF	The polling interval is $m$ frames.
Bulk	Full-speed	0x02-0x10	The NAK Limit is $2^{(m-1)}$ frames. A value of 0 or 1 disables the NAK timeout function.

For the specific offset for each register see [Table 22-3](#).

**Mode(s):** Host

The USBTXINTERVAL[ $n$ ] registers are shown in [Figure 22-51](#) and described in [Table 22-52](#).

**Figure 22-52. USB Host Transmit Interval Endpoint  $n$  Register (USBTXINTERVAL[ $n$ ])**

7	0
TXPOLL / NAKLMT	
R/W-0	

LEGEND: R/W = Read/Write; - $n$  = value after reset

**Table 22-54. USB Host Transmit Interval Endpoint  $n$  Register(USBTXINTERVAL[ $n$ ])  
Field Descriptions**

Bit	Field	Value	Description
7-0	TXPOLL / NAKLMT	0	TX Polling / NAK Limit The polling interval for interrupt transfers; the NAK limit for bulk transfers. See <a href="#">Table 22-53</a> for valid entries; other values are reserved.



### 22.6.41 USB Host Configure Receive Type Endpoint *n* Register (USBRXTYPE[1]-USBRXTYPE[15])

The USB host configure receive type endpoint *n* 8-bit registers (USBRXTYPE[*n*]) must be written with the endpoint number to be targeted by the endpoint, the transaction protocol to use for the currently selected receive endpoint, and its operating speed.

For the specific offset for each register see [Table 22-3](#).

**Mode(s):** Host

The USBRXTYPE[*n*] registers are shown in [Figure 22-53](#) and described in [Table 22-55](#).

**Figure 22-53. USB Host Configure Receive Type Endpoint *n* Register (USBRXTYPE[*n*])**

7	6	5	4	3	0
SPEED		PROTO		TEP	
R/W-0		R/W-0		R/W-0	

LEGEND: R/W = Read/Write; -*n* = value after reset

**Table 22-55. USB Host Configure Receive Type Endpoint *n* Register(USBRXTYPE[*n*]) Field Descriptions**

Bit	Field	Value	Description
7-6	SPEED	0h 1h 2h 3h	Operating Speed. This bit field specifies the operating speed of the target Device: Default. The target is assumed to be using the same connection speed as the USB controller. Reserved Full Low
5-4	PROTO	0h 1h 2h 3h	Protocol. Software must configure this bit field to select the required protocol for the receive endpoint: Control Reserved Bulk Interrupt
3-0	TEP	0	Target Endpoint Number. Software must configure this value to the endpoint number contained in the transmit endpoint descriptor returned to the USB controller during Device enumeration.

### 22.6.42 USB Host Receive Polling Interval Endpoint $n$ Register (USBXINTERVAL[1]-USBXINTERVAL[15])

The USB host receive polling interval endpoint  $n$  8-bit registers (USBXINTERVAL[ $n$ ]), for interrupt transfers, define the polling interval for the currently selected transmit endpoint. For bulk endpoints, this register defines the number of frames after which the endpoint should time out on receiving a stream of NAK responses.

The USBXINTERVAL[ $n$ ] registers values define a number of frames, as follows:

**Table 22-56. USBXINTERVAL[ $n$ ] Frame Numbers**

Transfer Type	Speed	Valid Values ( $m$ )	Interpretation
Interrupt	Low-speed or Full-speed	0x01-0xFF	The polling interval is $m$ frames.
Bulk	Full-speed	0x02-0x10	The NAK Limit is $2^{(m-1)}$ frames. A value of 0 or 1 disables the NAK timeout function.

For the specific offset for each register see [Table 22-3](#).

**Mode(s):** Host

The USBXINTERVAL[ $n$ ] registers are shown in [Figure 22-51](#) and described in [Table 22-52](#).

**Figure 22-54. USB Host Receive Polling Interval Endpoint  $n$  Register (USBXINTERVAL[ $n$ ])**

7	0
TXPOLL / NAKLMT	
R/W-0	

LEGEND: R/W = Read/Write; - $n$  = value after reset

**Table 22-57. USB Host Receive Polling Interval Endpoint  $n$  Register(USBXINTERVAL[ $n$ ])  
Field Descriptions**

Bit	Field	Value	Description
7-0	TXPOLL / NAKLMT	0	TX Polling / NAK Limit The polling interval for interrupt transfers, the NAK limit for bulk transfers. See <a href="#">Table 22-56</a> for valid entries; other values are reserved.

### 22.6.43 USB Request Packet Count in Block Transfer Endpoint *n* Registers (USBRQPKTCOUNT[1]-USBRQPKTCOUNT[15])

The USB receive packet count in block transfer endpoint *n* 16-bit read/writer registers are used in Host mode to specify the number of packets that are to be transferred in a block transfer of one or more bulk packets to receive endpoint *n*. The USB controller uses the value recorded in this register to determine the number of requests to issue where the AUTORQ bit in the USBRXCSRH[*n*] register has been set. For more information about IN transactions as a host, see [Section 22.3.2.2](#).

**Note:** Multiple packets combined into a single bulk packet within the FIFO count as one packet.

For the specific offset for each register see [Table 22-3](#).

**Mode(s):** Host

The USBRQPKTCOUNT[*n*] registers are shown in [Figure 22-55](#) and described in [Table 22-58](#).

**Figure 22-55. USB Request Packet Count in Block Transfer Endpoint *n* Registers  
(USBRQPKTCOUNT[*n*])**

15	13	12	0
Reserved			COUNT
R-0			R-0

LEGEND: R/W = Read/Write; R = Read only; -*n* = value after reset

**Table 22-58. USB Request Packet Count in Block Transfer Endpoint *n* Registers  
(USBRQPKTCOUNT[*n*]) Field Descriptions**

Bit	Field	Value	Description
15-13	Reserved	0	Reserved
12-0	COUNT		Block Transfer Packet Count sets the number of packets of the size defined by the MAXLOAD bit field that are to be transferred in a block transfer. <b>Note:</b> This is only used in Host mode when AUTORQ is set. The bit has no effect in Device mode or when AUTORQ is not set.

### 22.6.44 USB Receive Double Packet Buffer Disable Register (USBXDPKTBUFDIS), offset 0x340

The USB receive double packet buffer disable 16-bit register (USBTXIE) indicates which of the receive endpoints have disabled the double-packet buffer functionality (see *Double-Packet Buffering* in Section 22.3.1.1.1).

**Mode(s):** Host Device

USBXDPKTBUFDIS is shown in Figure 22-56 and described in Table 22-59.

**Figure 22-56. USB Receive Double Packet Buffer Disable Register (USBXDPKTBUFDIS)**

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
EP15	EP14	EP13	EP312	EP11	EP10	EP9	EP8	EP7	EP6	EP5	EP4	EP3	EP2	EP1	Rsvd
R/W-1														R-0	

LEGEND: R/W = Read/Write; R = Read only; -n = value after reset

**Table 22-59. USB Receive Double Packet Buffer Disable Register (USBXDPKTBUFDIS) Field Descriptions**

Bit	Field	Value	Description
15	EP15	0	EP15 RX Double-Packet Buffer Disable Enables double-packet buffering.
		1	Disables double-packet buffering.
14	EP14	0	EP14 RX Double-Packet Buffer Disable Enables double-packet buffering.
		1	Disables double-packet buffering.
13	EP13	0	EP13 RX Double-Packet Buffer Disable Enables double-packet buffering.
		1	Disables double-packet buffering.
12	EP12	0	EP12 RX Double-Packet Buffer Disable Enables double-packet buffering.
		1	Disables double-packet buffering.
11	EP11	0	EP11 RX Double-Packet Buffer Disable Enables double-packet buffering.
		1	Disables double-packet buffering.
10	EP10	0	EP10 RX Double-Packet Buffer Disable Enables double-packet buffering.
		1	Disables double-packet buffering.
9	EP9	0	EP9 RX Double-Packet Buffer Disable Enables double-packet buffering.
		1	Disables double-packet buffering.
8	EP8	0	EP8 RX Double-Packet Buffer Disable Enables double-packet buffering.
		1	Disables double-packet buffering.
7	EP7	0	EP7 RX Double-Packet Buffer Disable Enables double-packet buffering.
		1	Disables double-packet buffering.
6	EP6	0	EP6 RX Double-Packet Buffer Disable Enables double-packet buffering.
		1	Disables double-packet buffering.

**Table 22-59. USB Receive Double Packet Buffer Disable Register (USBXDPKTBUFDIS) Field Descriptions (continued)**

Bit	Field	Value	Description
5	EP5		EP5 RX Double-Packet Buffer Disable
		0	Enables double-packet buffering.
		1	Disables double-packet buffering.
4	EP4		EP4 RX Double-Packet Buffer Disable
		0	Enables double-packet buffering.
		1	Disables double-packet buffering.
3	EP3		EP3 RX Double-Packet Buffer Disable
		0	Enables double-packet buffering.
		1	Disables double-packet buffering.
2	EP2		EP2 RX Double-Packet Buffer Disable
		0	Enables double-packet buffering.
		1	Disables double-packet buffering.
1	EP1		EP1 RX Double-Packet Buffer Disable
		0	Enables double-packet buffering.
		1	Disables double-packet buffering.
0	EP0		Reserved

### 22.6.45 USB Transmit Double Packet Buffer Disable Register (USBTXDPKTBUFDIS), offset 0x342

The USB transmit double packet buffer disable 16-bit register (USBTXIE) indicates which of the transmit endpoints have disabled the double-packet buffer functionality (see *Double-Packet Buffering* in [Section 22.3.1.1.1](#)).

**Mode(s):** Host Device

USBTXDPKTBUFDIS is shown in [Figure 22-57](#) and described in [Table 22-60](#).

**Figure 22-57. USB Transmit Double Packet Buffer Disable Register (USBTXDPKTBUFDIS)**

15	4	3	2	1	0
Reserved		EP3	EP2	EP1	Rsvd
R-0		R/W-1	R/W-1	R/W-1	R-0

LEGEND: R/W = Read/Write; R = Read only; -n = value after reset

**Table 22-60. USB Transmit Double Packet Buffer Disable Register (USBTXDPKTBUFDIS) Field Descriptions**

Bit	Field	Value	Description
15-4	Reserved		Reserved
3	EP3	0	EP3 RX Double-Packet Buffer Disable Enables double-packet buffering.
		1	Disables double-packet buffering.
2	EP2	0	EP2 RX Double-Packet Buffer Disable Enables double-packet buffering.
		1	Disables double-packet buffering.
1	EP1	0	EP1 RX Double-Packet Buffer Disable Enables double-packet buffering.
		1	Disables double-packet buffering.
0	Reserved	0	Reserved

## 22.6.46 USB External Power Control Register (USBEPCC), offset 0x400

The USB external power control 32-bit register (USBEPCC) specifies the function of the two-pin external power interface (USB0EPEN and USB0PFLT). The assertion of the power fault input may generate an automatic action, as controlled by the hardware configuration registers. The automatic action is necessary because the fault condition may require a response faster than one provided by firmware.

**Mode(s):** Host Device

USBEPCC is shown in [Figure 22-58](#) and described in [Table 22-61](#).

**Figure 22-58. USB External Power Control Register (USBEPCC)**

31																16																									
Reserved																																									
R-0																																									
15															10										9					8											
Reserved																				PFLTACT																					
R-0																				R/W-0																					
7							6					5					4					3					2					1					0				
Reserved							PFLTAEN					PFLTSEN					PFLTEN					Reserved					EPENDE					EPEN									
R-0							R/W-0					R/W-0					R/W-0					R-0					R/W-0					R/W-0									

LEGEND: R/W = Read/Write; -n = value after reset

**Table 22-61. USB External Power Control Register (USBEPCC) Field Descriptions**

Bit	Field	Value	Description
31-10	Reserved	0	Reserved
9-8	PFLTACT		Power Fault Action. This bit field specifies how the USB0EPEN signal is changed when detecting a USB power fault.
		0h	Unchanged. USB0EPEN is controlled by the combination of the EPEN and EPENDE bits.
		1h	Tristate. USB0EPEN is undriven (tristate).
		2h	Low. USB0EPEN is driven Low.
		3h	High. USB0EPEN is driven High.
7	Reserved	0	Reserved
6	PFLTAEN		Power Fault Action Enable. This bit specifies whether a USB power fault triggers any automatic corrective action regarding the driven state of the USB0EPEN signal.
		0	Disabled. USB0EPEN is controlled by the combination of the EPEN and EPENDE bits.
		1	Enabled. The USB0EPEN output is automatically changed to the state specified by the PFLTACT field.
5	PFLTSEN		Power Fault Sense. This bit specifies the logical sense of the USB0PFLT input signal that indicates an error condition. The complementary state is the inactive state.
		0	Low Fault. If USB0PFLT is driven Low, the power fault is signaled internally (if enabled by the PFLTEN bit).
		1	High Fault. If USB0PFLT is driven High, the power fault is signaled internally (if enabled by the PFLTEN bit).
4	PFLTEN		Power Fault Input Enable. This bit specifies whether the USB0PFLT input signal is used in internal logic.
		0	Not Used. The USB0PFLT signal is ignored.
		1	Used. The USB0PFLT signal is used internally
3	Reserved	0	Reserved

**Table 22-61. USB External Power Control Register (USBEPCC) Field Descriptions (continued)**

Bit	Field	Value	Description
2	EPENDE	0 1	<p>EPEN Drive Enable. This bit specifies whether the USB0EPEN signal is driven or undriven (tristate). When driven, the signal value is specified by the EPEN field. When not driven, the EPEN field is ignored and the USB0EPEN signal is placed in a high-impedance state.</p> <p>The USB0EPEN signal is undriven at reset because the sense of the external power supply enable is unknown. By adding the high-impedance state, system designers can bias the power supply enable to the disabled state using a large resistor (100 kΩ) and later configure and drive the output signal to enable the power supply.</p> <p>0 Not Driven. The USB0EPEN signal is high impedance.</p> <p>1 Driven. The USB0EPEN signal is driven to the logical value specified by the value of the EPEN field.</p>
1-0	EPEN	0h 1h 2h 3h	<p>External Power Supply Enable Configuration. This bit field specifies and controls the logical value driven on the USB0EPEN signal.</p> <p>0h Power Enable Active Low. The USB0EPEN signal is driven Low if the EPENDE bit is set.</p> <p>1h Power Enable Active High. The USB0EPEN signal is driven High if the EPENDE bit is set.</p> <p>2h Power Enable High if VBUS Low. The USB0EPEN signal is driven High when the A device is not recognized.</p> <p>3h Power Enable High if VBUS High. The USB0EPEN signal is driven High when the A device is recognized.</p>







### 22.6.49 USB External Power Control Interrupt Status and Clear Register (USBEPICISC), offset 0x40C

The USB external power control interrupt status and clear 32-bit register (USBEPICISC) specifies the unmasked interrupt status of the two-pin external power interface.

**Mode(s):** Host Device

USBEPICISC is shown in [Figure 22-61](#) and described in [Table 22-64](#).

**Figure 22-61. USB External Power Control Interrupt Status and Clear Register (USBEPICISC)**

31	Reserved	1	0
	R-0		PF R-0

LEGEND: R/W = Read/Write; R = Read only; -n = value after reset

**Table 22-64. USB External Power Control Interrupt Status and Clear Register (USBEPICISC) Field Descriptions**

Bit	Field	Value	Description
31-1	Reserved	0	Reserved. Reset is 0x0000.000.
0	PF	0	USB Power Fault Interrupt Status and Clear. This bit is cleared by writing a 1. Clearing this bit also clears the PF bit in the USBEPICISC register.
		1	The PF bits in the USBEPCRIS and USBEPCIM registers are set, providing an interrupt to the interrupt controller.
		1	No interrupt has occurred or the interrupt is masked.





## 22.6.52 USB Device RESUME Interrupt Status and Clear Register (USBDRISC), offset 0x418

The USB device RESUME interrupt status and clear register (USBDRRIS) is the raw interrupt clear register. On a write of 1, the corresponding interrupt is cleared. A write of 0 has no effect.

**Mode(s):** Host Device

USBDRISC is shown in [Figure 22-64](#) and described in [Table 22-67](#).

**Figure 22-64. USB Device RESUME Interrupt Status and Clear Register (USBDRISC)**

31	1	0
Reserved		RESUME
R-0		R/W1C

LEGEND: R/W = Read/Write; R = Read only; -n = value after reset

**Table 22-67. USB Device RESUME Interrupt Status and Clear Register (USBDRISC)  
Field Descriptions**

Bit	Field	Value	Description
31-1	Reserved	0	Reserved. Reset is 0x0000.000.
0	RESUME	0	RESUME Interrupt Status and Clear. This bit is cleared by writing a 1. Clearing this bit also clears the RESUME bit in the USBDRCRIS register.
		0	The RESUME bits in the USBDRRIS and USBDRCIM registers are set, providing an interrupt to the interrupt controller.
		1	No interrupt has occurred or the interrupt is masked.



### 22.6.54 USB DMA Select Register (USBDMASEL), offset 0x450

The USB DMA select 32-bit register (USBDMASEL) specifies whether the unmasked interrupt status of the ID value is valid.

**Mode(s):** Host Device

USBDMASEL is shown in [Figure 22-66](#) and described in [Table 22-69](#).

**Figure 22-66. USB DMA Select Register (USBDMASEL)**

31	24	23	20	19	16
Reserved			DMACTX	DMACRX	
R/0			R/W-0	R/W-0	
15	12	11	8	7	0
DMABTX		DMABRX		DMAATX	
R/W-0		R/W-0		R/W-0	

LEGEND: R/W = Read/Write; R = Read only; -n = value after reset

**Table 22-69. USB DMA Select Register (USBDMASEL) Field Descriptions**

Bit	Field	Value	Description
31-24	Reserved	0	Reserved. Reset is 0x0000.000.
23-20	DMACTX	0h Reserved 1h Endpoint 1 TX 2h Endpoint 2 TX 3h Endpoint 3 TX 4h Endpoint 4 TX ... 15h Endpoint 15 TX	DMA C TX Select specifies the TX mapping of the third USB endpoint on DMA channel 5 (primary assignment).
19-16	DMACRX	0h Reserved 1h Endpoint 1 RX 2h Endpoint 2 RX 3h Endpoint 3 RX 4h Endpoint 4 TX ... 15h Endpoint 15 TX	DMA C RX Select specifies the RX and TX mapping of the third USB endpoint on DMA channel 4 (primary assignment).
15-12	DMABTX	0h Reserved 1h Endpoint 1 TX 2h Endpoint 2 TX 3h Endpoint 3 TX 4h Endpoint 4 TX ... 15h Endpoint 15 TX	DMA B TX Select specifies the TX mapping of the second USB endpoint on DMA channel 3 (primary assignment).



**Table 22-69. USB DMA Select Register (USBDMASEL) Field Descriptions (continued)**

Bit	Field	Value	Description
11-8	DMABRX		DMA B RX Select Specifies the RX mapping of the second USB endpoint on DMA channel 2 (primary assignment).
		0h	Reserved
		1h	Endpoint 1 RX
		2h	Endpoint 2 RX
		3h	Endpoint 3 RX
		4h	Endpoint 4 TX
		... 15h	... Endpoint 15 TX
7-4	DMAATX		DMA A TX Select specifies the TX mapping of the first USB endpoint on DMA channel 1 (primary assignment).
		0h	Reserved
		1h	Endpoint 1 TX
		2h	Endpoint 2 TX
		3h	Endpoint 3 TX
		4h	Endpoint 4 TX
		... 15h	... Endpoint 15 TX
3-1	DMAARX		DMA A RX Select specifies the RX mapping of the first USB endpoint on DMA channel 0 (primary assignment).
		0h	Reserved
		1h	Endpoint 1 RX
		2h	Endpoint 2 RX
		3h	Endpoint 3 RX
		4h	Endpoint 4 RX
		5h	Endpoint 5 RX
		6h	Endpoint 6 RX
		7h	Endpoint 7 RX
		8h	Endpoint 8 RX
		9h	Endpoint 9 RX
		10h	Endpoint 10 RX
		11h	Endpoint 11 RX
		12h	Endpoint 12 RX
		13h	Endpoint 13 RX
14h	Endpoint 14RX		
15h	Endpoint 15 RX		

## Universal Parallel Port (uPP)

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This chapter discusses the features and functions of the Universal Parallel Port module (uPP).

Topic	Page
<b>23.1 Introduction .....</b>	<b>2419</b>
<b>23.2 Configuring Device Pins .....</b>	<b>2420</b>
<b>23.3 Functional Description .....</b>	<b>2420</b>
<b>23.4 IO Interface and System Requirements .....</b>	<b>2423</b>
<b>23.5 Registers .....</b>	<b>2433</b>

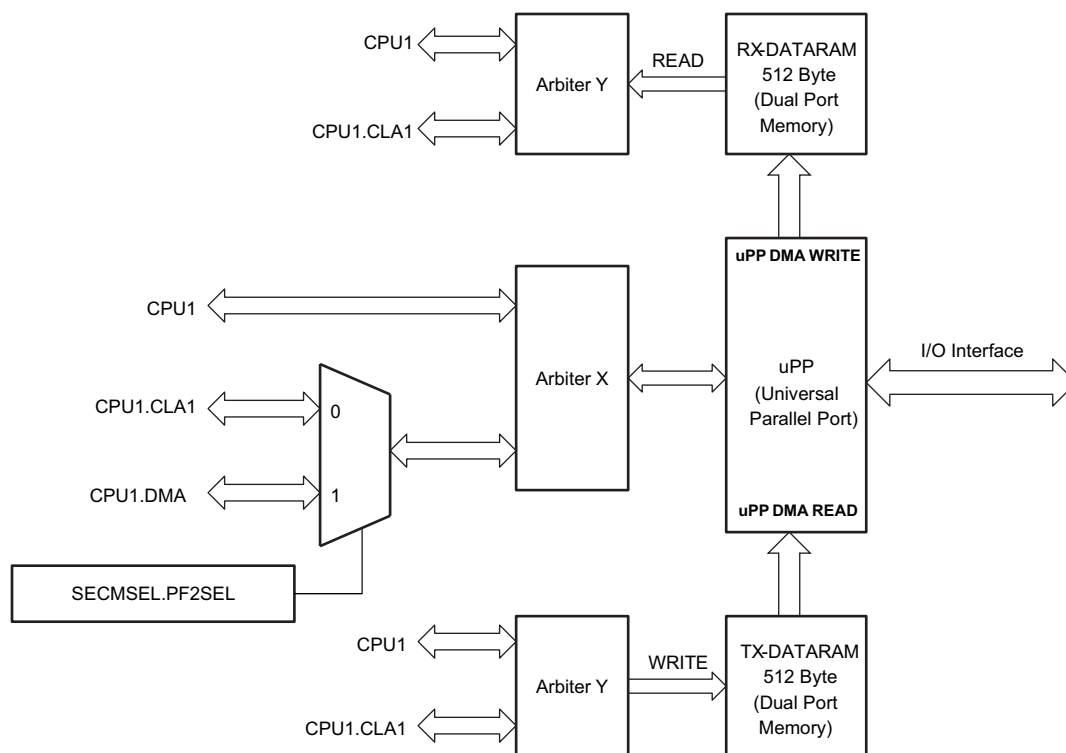
## 23.1 Introduction

The universal parallel port (uPP) peripheral is a high-speed parallel interface with dedicated data lines and minimal control signals. It is designed to interface cleanly with high-speed analog-to-digital converters (ADCs) or digital-to-analog converters (DACs) with 8-bit data width. It can also be interconnected with field-programmable gate arrays (FPGAs) or other uPP devices to achieve high-speed digital data transfer. It can operate in receive mode or transmit mode (simplex mode).

This peripheral includes an internal DMA controller to maximize throughput and minimize CPU overhead during high-speed data transmission. All uPP transactions uses internal DMA to feed data to or retrieve data from the I/O channels. Even though there is only one I/O channel, DMA controller includes two DMA channels to supports data interleave mode, in which all DMA resources service a single I/O channel.

On this device, uPP is dedicated resource for CPU1 subsystem and CPU1, CPU1.CLA1 and CPU1.DMA have access to this module. There are two dedicated DATA RAMs (also known as MSG RAMs), each of 512B, tightly coupled with uPP module (one for each, TX and RX). These DATA RAMs are used to store bulk of data to avoid frequent interruption to CPU. Only CPU1 and CPU1.CLA1 has access to these DATA RAMs. [Figure 23-1](#) shows the integration of uPP on this device.

**Figure 23-1. uPP Integration**



**NOTE:** In some other TI devices, uPP IP is also called the Radio Peripheral Interface (RPI) module.

### 23.1.1 Features Supported

- Supports mainstream high-speed data converters with parallel conversion interface.
- Supports mainstream high-speed streaming interface with frame START indication.
- Supports mainstream high-speed streaming interface with data ENABLE indication.
- Supports mainstream high-speed streaming interface with synchronization WAIT signal.
- Supports SDR (single-data-rate) or DDR (double-data-rate, interleaved) interface.
- Supports multiplexing of interleaved data in SDR transmit case.
- Supports de-multiplexing and multiplexing of interleaved data in DDR case.

- Supports I/O interface clock frequency up to 50 MHz for SDR case, and 25 MHz for DDR.
- Supports single-channel 8-bit input receive or output transmit mode.
- Max throughput is 50MB/s for pure read or pure write.
- Available as a DSP to FPGA general purpose streaming interface.

## 23.2 Configuring Device Pins

The GPIO mux registers must be configured to connect this peripheral to the device pins. To avoid glitches on the pins, the GPyGMUX bits must be configured first (while keeping the corresponding GPyMUX bits at the default of zero), followed by writing the GPyMUX register to the desired value.

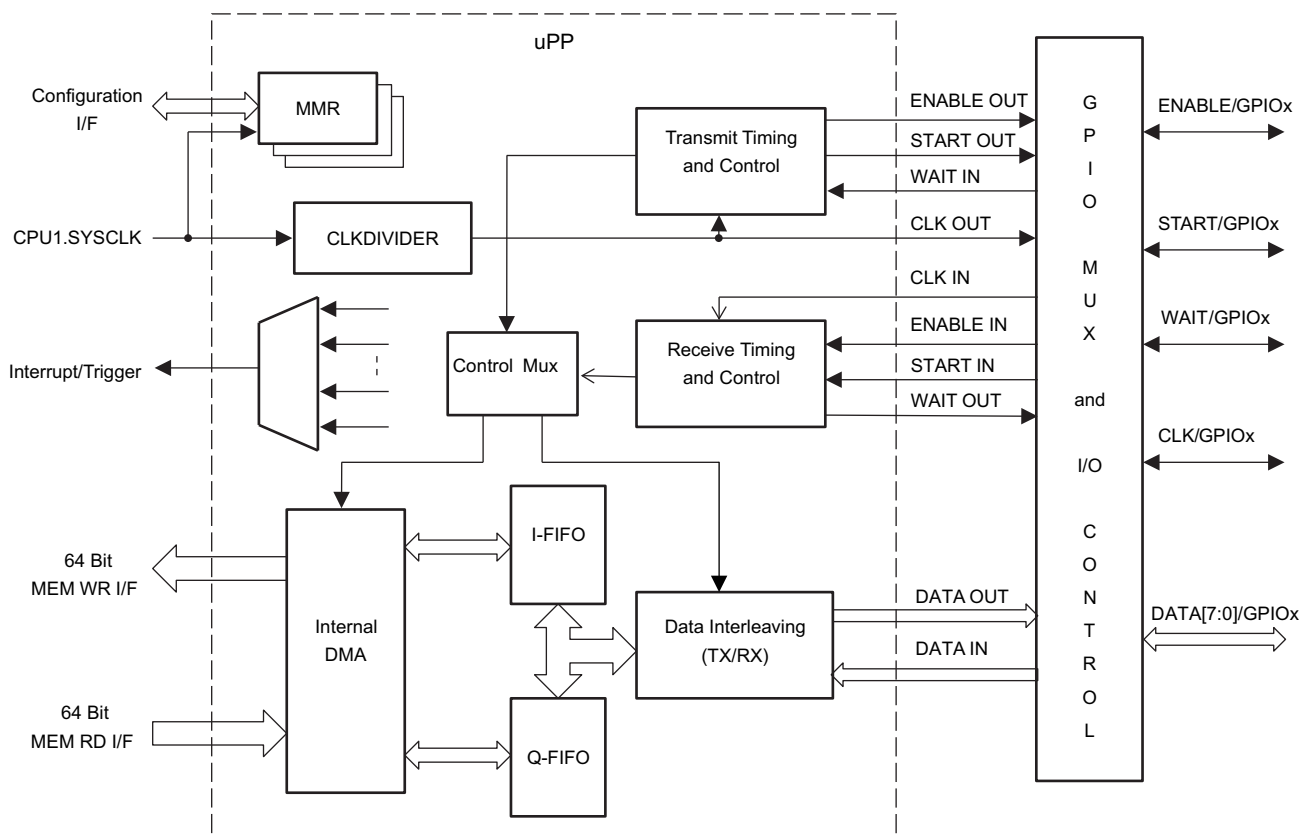
Some IO functionality is defined by GPIO register settings independent of this peripheral. For input signals, the GPIO input qualification should be set to asynchronous mode by setting the appropriate GPxQSELn register bits to 11b. The internal pullups can be configured in the GPyPUD register.

See the *GPIO* chapter for more details on GPIO mux and settings.

## 23.3 Functional Description

### 23.3.1 Functional Block Diagram

Figure 23-2. Functional Block Diagram



The uPP IP supports internal FIFO to store the data to and from IOs. To alleviate the load of data transfer from system memory to and from the uPP FIFOs, the IP supports internal DMA. The internal DMA has two channels: channel I and channel Q.

### 23.3.2 Data Flow

The following naming conventions are followed regarding channel numbering:

- It has only one I/O channel and that has been labeled as “channel A”
- DMA channel are labeled as “channel I and channel Q”.

Figure 23-3 explains the data flow for receive in SDR mode and DDR non-demux mode. In this case, only one DMA channel (channel I) get used.

**Figure 23-3. RX in SDR or DDR (non-demux) Mode**

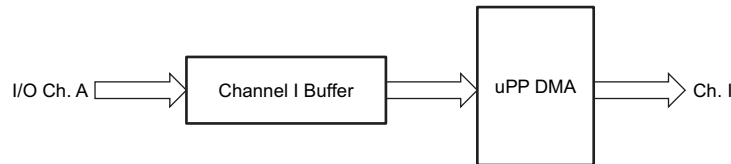


Figure 23-4 explains the data flow for receive in DDR demux mode. In this case, both DMA channels (channel I and channel Q) are used.

**Figure 23-4. RX in DDR (demux) Mode**

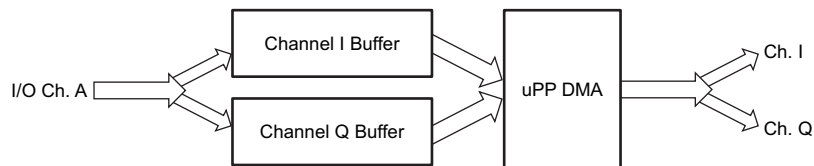


Figure 23-5 explains the data flow for transmit in SDR non-interleave or DDR non-demux mode. In this case, only one DMA channel (channel I) get used.

**Figure 23-5. TX in SDR (non-interleave) or DDR (non-demux) Mode**

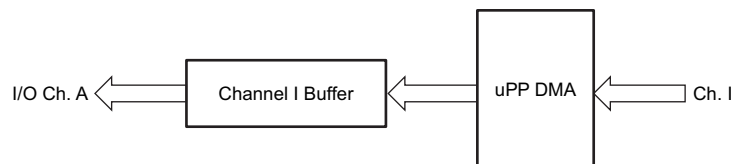
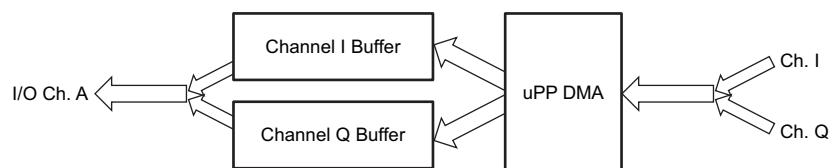


Figure 23-6 explains the data flow for transmit in SDR interleave or DDR demux mode. In this case, both DMA channels (channel I and channel Q) are used.

**Figure 23-6. TX in SDR (interleave) or DDR (demux) Mode**

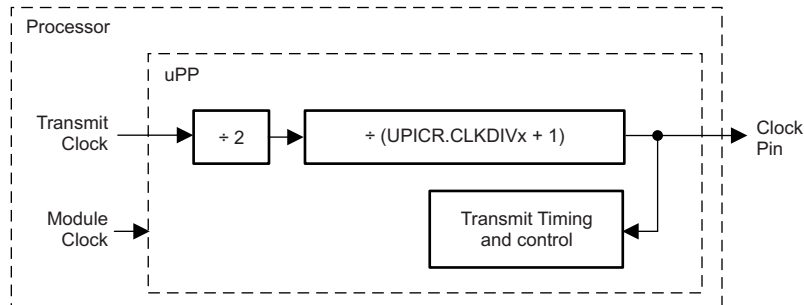


### 23.3.3 Clock Generation and Control

The uPP peripheral uses three different clocks:

- A module clock that controls its internal logic and CPU interface. This is driven by CPU1.SYSCLK.
- A transmit clock (internally divided clock from the module clock) that runs the interface channel and drives the CLK pin out in transmit mode.
- A receive clock (input via CLK pin) that runs the interface channel in receive mode.

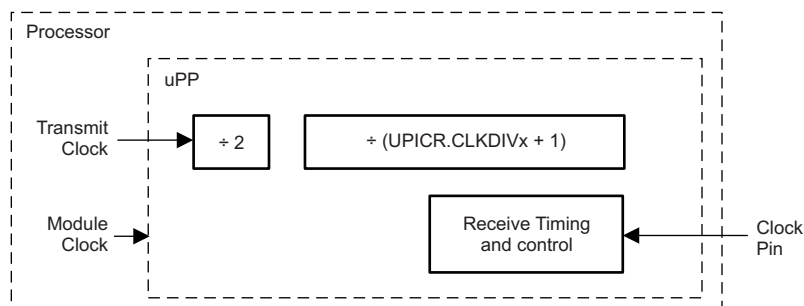
Figure 23-7 shows the output clock generation system in transmit mode.

**Figure 23-7. IO Output Clock Generation for TX Mode**


$$\text{Output Clock} = \text{Module Clock} / (2 \times (\text{CLKDIVn} + 1))$$

The fixed divisor restricts the maximum speed of the I/O clock to 1/2 the device CPU clock speed. For DDR mode operation, the CLK output frq must be one eighth (1/8) or less of module clock.

For receive mode, channel requires an external clock to drive its CLK pin. The incoming clock is not divided, and its maximum allowed speed is one fourth (1/4) the module clock speed for SDR mode and one eighth (1/8) the module clock speed for DDR mode. [Figure 23-8](#) shows the clock generation system for a channel configured in receive mode.

**Figure 23-8. IO Input clock for RX Mode**


## 23.4 IO Interface and System Requirements

The uPP module provides interfacing logic to external streaming data, both inbound and outbound flow of data are supported. The interface protocol is a simple streaming interface. It is build on top of the existing high-speed data converters, and captures most of the high-speed data converters protocol.

The input receive mode and output transmit mode protocol are symmetrical, and source synchronous, that is, clock is supplied by the transmitter and the same clock is used to receive the data.

[Table 23-1](#) describes the functionality of all the input/output (IO) signals of uPP module.

**Table 23-1. uPP Signal Description**

Signal	Description
CLK	<ul style="list-style-type: none"> <li>• Transmit or receive clock</li> <li>• Input in receive mode</li> <li>• Output in transmit mode (Clock divider programmable)</li> </ul>
START	<ul style="list-style-type: none"> <li>• Input in receive mode</li> <li>• Output in transmit mode</li> <li>• Polarity programmable</li> <li>• Indicates first data word of each line (frame)</li> <li>• This is optional signal and if this feature is not used, external receiver can ignore this signal.</li> </ul>
ENABLE	<ul style="list-style-type: none"> <li>• Input when in receive mode</li> <li>• Output in transmit mode</li> <li>• Polarity programmable</li> <li>• Indicates data received is valid, or data transmitted is valid</li> <li>• Can be programmed to be ignored in receive mode but in transmit mode always drive active in sync with valid data.</li> </ul>
WAIT	<ul style="list-style-type: none"> <li>• Input in transmit mode</li> <li>• Output in receive mode but always drive inactive by uPP in this case</li> <li>• Polarity programmable</li> <li>• In transmit mode when active, indicates that target is not ready to receive data. uPP will stop transmitting data at next clock cycle right after Wait signal is sampled as active. uPP module can be programmed to ignored this in transmit mode.</li> </ul> <p style="text-align: center;"><b>NOTE:</b> The WAIT needs to be asserted for one full cycle of IO clock by external device.</p>
DATA[7:0]	<ul style="list-style-type: none"> <li>• 8-bit inputs in receive mode</li> <li>• 8-bit output in transmit mode</li> </ul>

### 23.4.1 Pin Multiplexing

Extensive pin multiplexing is used to accommodate the largest number of peripheral functions in the smallest possible package. Pin multiplexing is controlled using a combination of hardware configuration at device reset and software programmable register settings. To determine how pin multiplexing affects the uPP peripheral, see the device-specific data manual.

### 23.4.2 Internal DMA Controller Description

The uPP peripheral includes an internal DMA controller separate from any device-level DMA. The internal DMA controller consists of two DMA channels, channel I and channel Q, which moves data to and from the uPP peripheral interface (I/O) channels in all operating modes. This section describes how to program the internal DMA channels.

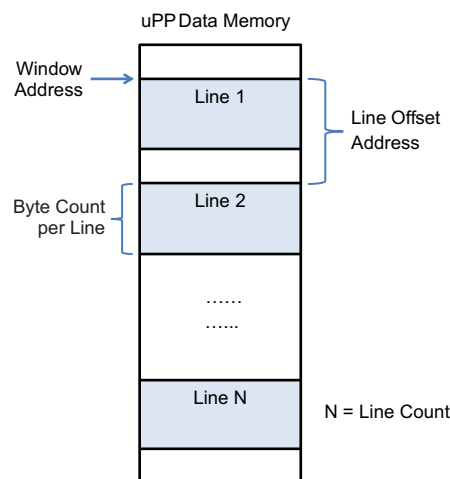
### 23.4.2.1 DMA Programming Concepts

The uPP internal DMA controller uses a simplified programming model similar to 2D transfers performed by any other DMA at system level. Each DMA channel may be configured with four parameters: window address, byte count, line count, and line offset address.

- Window Address (CHxDESC0.ADDR) - The location in uPP data memory of the first byte in the data buffer. When the uPP operates in receive mode, the DMA channel begins writing to this address as it takes incoming data from the uPP I/O channel. When the uPP operates in transmit mode, the DMA channel begins reading from this address and pass the data to the uPP I/O channel. The window address must be aligned to a 64-bit boundary (that is, the three LSBs must equal 0). Non-aligned addresses are automatically adjusted to a properly aligned value when written to configuration register.
- Byte Count (CHxDESC1.BCNT) - The number of bytes per line. The byte count must be an even number.
- Line Count (UPxDESC1.LCNT) - The number of lines per window. The total number of bytes transferred equals  $B \times L$ , where B is the byte count per line and L is the line count.
- Line Offset Address (CHxDESC2.LOFFSET) - The offset address between the first byte in successive Lines. The line offset address cannot exceed 65528 (FFF8h) bytes, and must be aligned to a 64-bit boundary in memory (that is, the three LSBs must equal 0).

Figure 23-9 shows a typical DMA window defined by these parameters.

**Figure 23-9. Structure of DMA Window and Lines in Memory**



Certain values of the line offset address have special implications on the structure of the data buffer:

- Line Offset Address = Byte Count : Data buffer is a contiguous block in memory with size equal to (Line Count) x (Byte Count).
- Line Offset Address = 0 : Data buffer consists of a single line, with total size equal to Byte Count. If the I/O channel is configured in transmit mode, this line is transmitted (Line Count) consecutive times before the DMA transfer completes. If the I/O channel is configured in receive mode, the buffer is repeatedly written and overwritten by incoming data.

To program a DMA transfer, write the appropriate fields in the DMA channel descriptor registers for DMA Channel I or for DMA Channel Q. If the associated I/O channel is initialized and idle, the DMA transfer and I/O transaction begins immediately. Section 23.4.10 describes a step-by-step process for configuring the I/O channel and DMA channels to start a uPP transfer.

Each DMA channel allows a second descriptor to be queued while the previously programmed DMA transfer is still running. The PEND status bit in channel status register reports whether a new set of DMA parameters may be written to the DMA descriptor registers. Each DMA channel can have at most one active transfer and one queued transfer. This allows each I/O channel to perform uninterrupted, consecutive transactions across DMA transfer boundaries.



This DMA controller does not support automatically reloading DMA transfer descriptors. Each successive descriptor set must be explicitly written to the configuration registers by software. All uPP interrupt events originate in the internal DMA controller. [Section 23.4.6](#) lists and explains all uPP interrupt events.

The internal DMA controller always writes data in bursts of 64 bytes. However, DMA read operations have configurable burst size, which may be set per channel using the RDSIZEI and RDSIZEQ bits in the uPP threshold configuration register. A DMA channel waits until the specified number of bytes leaves its internal buffer before performing another burst read from memory.

Note that the TXSIZEA bit in threshold configuration register is not DMA parameters; instead, it control transmit thresholds for the uPP interface channel.

### 23.4.2.2 Data Interleave Mode

The data interleave mode is a special configuration that maps both DMA channels to a single interface I/O channel. There are two variants on data interleave mode, each with special conditions:

- Single Data Rate (SDR) Interleave
  - Single Data Rate (DRA = 0)
  - Transmit Only (MODE = 1)
  - SDR Transmit interleave enabled (SDRTXILA = 1)
- Double Data Rate (DDR) Interleave
  - Double Data Rate (DRA = 1)
  - Transmit or Receive (MODE = 0/1)
  - SDR Transmit interleave disabled (SDRTXILA = 0)
  - DDR interleave enabled (DEMUXA = 1)

In data interleave mode, I/O channel is associated with two data buffers, each serviced by its own DMA channel (I and Q). In SDR interleave mode, the START signal is used as a buffer selection line: START = 1 indicates that the current word comes from DMA Channel I; START = 0 indicates that the current word comes from DMA Channel Q. In DDR Interleave mode, the data buffers alternate every word beginning with Channel I: Channel I Word 0, Channel Q Word 0, Channel I Word 1, Channel Q Word 1, and so forth. [Section 23.4.10](#) shows signal diagrams for both data interleave modes.

### 23.4.3 Protocol Description

The uPP peripheral on this device has one I/O channel with 8 data lines, which can be configured to run in transmit or receive mode. A channel may also be configured to ignore certain control signals using the uPP interface configuration register. By default it uses all four control signals, unless otherwise configured.

#### 23.4.3.1 DATA[7:0] Signals

DATA[7:0] comprise the channel's entire data bus. In transmit mode, these pins are outputs that transmit data supplied by the channel's associated DMA channel. While the channel is idle, their behavior depends on the TRISENA bit in IFCFG register. These pins can be configured to drive an idle value (TRISENA = 0, VALA field in the uPP interface idle value register (IFIVAL)) or be in a high-impedance state while idle (TRISENA = 1). In receive mode, these pins are inputs that provide data to the channel's associated DMA channel.

#### 23.4.3.2 START Signal

The uPP transmitter asserts the START signal when it transfers the first word of a data line. A line is defined in terms of the channel's associated DMA channel; for more on DMA programming concepts, see [Section 23.4.2](#). The START signal is active-high by default, but its polarity is controlled by the STARTPOLA bit in IFCFG register.

In transmit mode, START is an output signal and is always driven, in receive mode, START is an input signal and may be disabled using the STARTA bit in IFCFG register. When the channel is configured in transmit mode with data interleave enabled (SDRTXILA = 1 in CHCTL register), the START signal function changes completely. The START signal now asserts on every data word that is provided by DMA Channel I. For this alternative behavior, see [Section 23.4.3.6](#).

### 23.4.3.3 ENABLE

The uPP transmitter asserts the ENABLE signal when it transfers a valid data word. The ENABLE signal is active-high by default, but its polarity is controlled by the ENAPOLA bit in IFCFG register. In transmit mode, ENABLE is an output signal and is always driven; in receive mode, ENABLE is an input signal and may be disabled using the ENAA bit in IFCFG register.

### 23.4.3.4 WAIT Signal

The WAIT signal allows the receiver to request a temporary halt in data transmission. When the receiver asserts WAIT, the transmitter responds by stopping transmission (starting with the next word) until WAIT is released. The receiver ignores all incoming data until WAIT is released. Once WAIT is released, the transmitter can resume transmission on the next word. [Section 23.4.3](#) shows WAIT signal timing. The WAIT signal is active-high by default, but its polarity is controlled by the WAITPOLA bit in IFCFG register. In transmit mode, WAIT is an input signal and may be disabled using the WAITA bit in IFCFG register; in receive mode, WAIT is an output signal and always driven inactive by uPP.

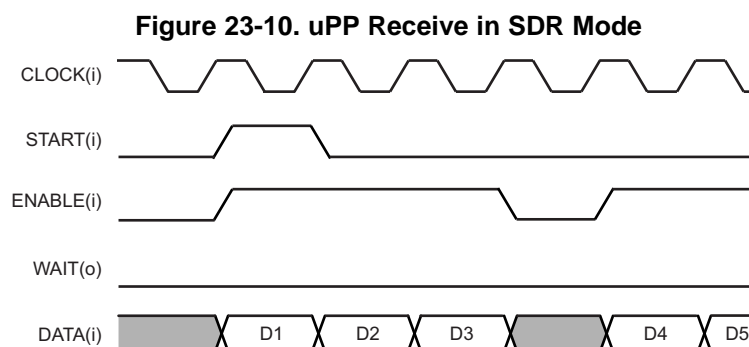
### 23.4.3.5 CLOCK Signal

The uPP transmitter drives the CLOCK signal to align all other uPP signals. By default, other signals align on the rising edge of CLOCK, but its polarity is controlled by the CLKINVA bit in IFCFG register. The active edge(s) of CLOCK should always slightly precede transitions of other uPP signals. In transmit mode, CLOCK is an output signal; in receive mode, CLOCK is an input signal. For more information on clock generation and allowed frequencies, see [Section 23.4.2](#).

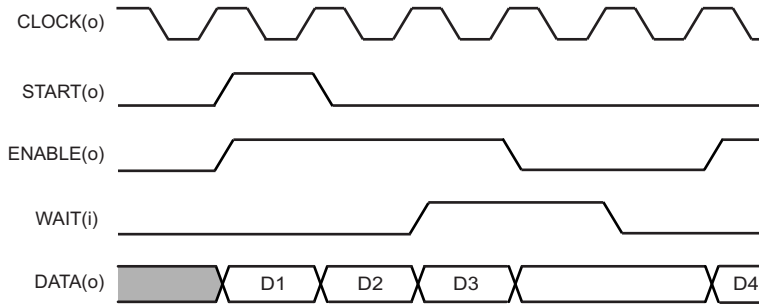
### 23.4.3.6 Signal Timing Diagrams

In the following diagrams, signals are marked (i) to indicate that they are inputs to the uPP peripheral and (o) to indicate that they are outputs from the uPP peripheral. Data words from a single DMA channel are designated Dx, while data words that must come from a specific DMA channel are designated Ix or Qx to indicate DMA Channel I or Q, respectively. For more information on DMA channels and data interleave mode, see [Section 23.4.2](#).

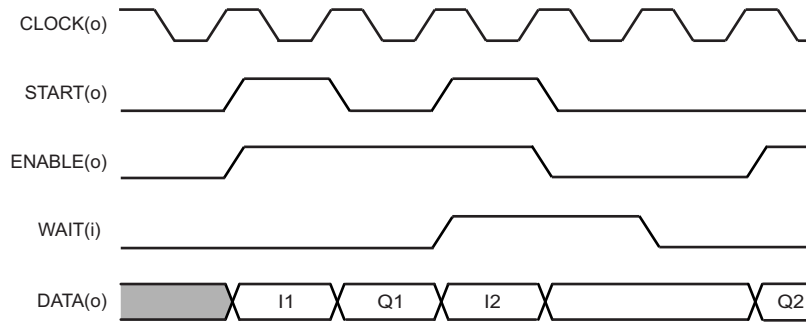
All signal diagrams are drawn with signal polarities in their default states. All signals except DATA are independently configurable in the uPP interface configuration register (IFCFG).



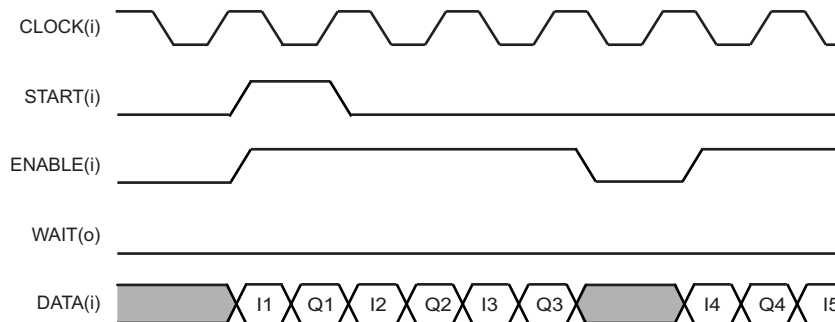
**Figure 23-11. uPP Transmit in SDR Mode**



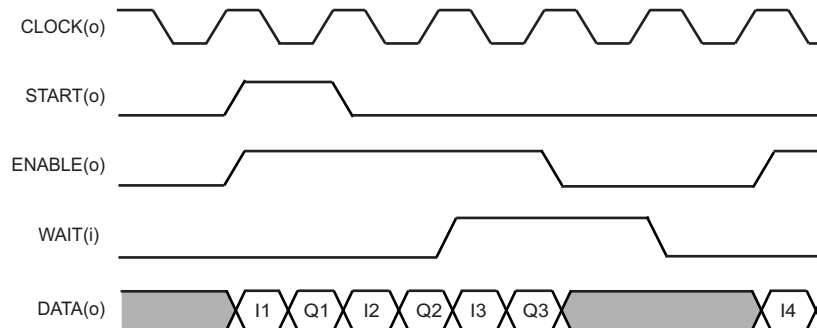
**Figure 23-12. uPP Transmit in SDR Mode – Interleaving**



**Figure 23-13. uPP Receive DDR Case**



**Figure 23-14. uPP Transmit DDR Case**



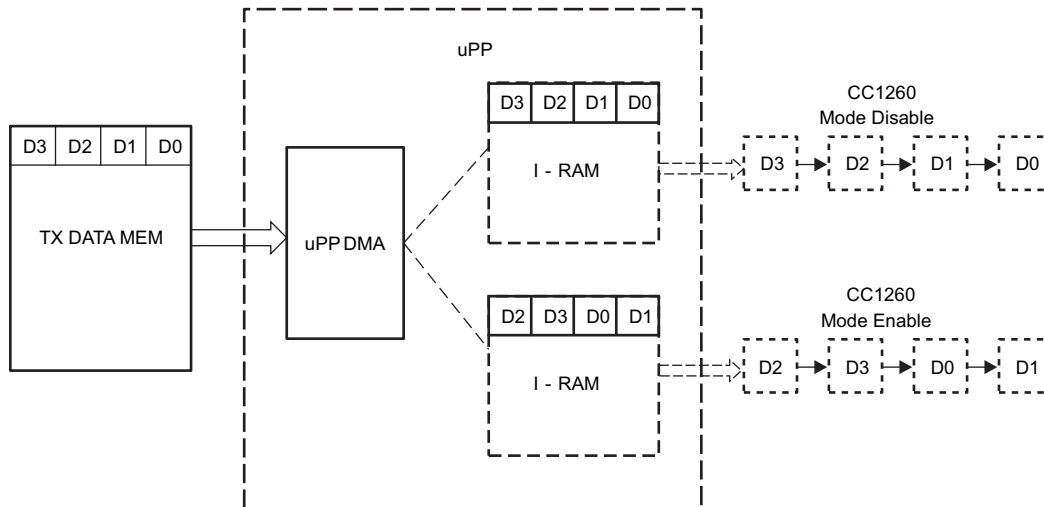
**NOTE:** START asserts on every data word from DMA Channel I in interleaving mode.

### 23.4.4 Data Format

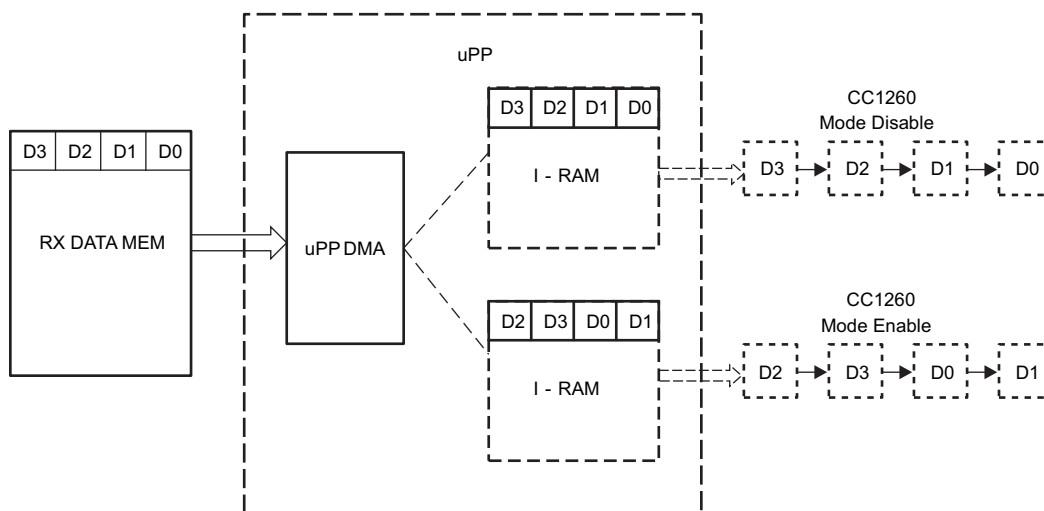
On this device, uPP only support 8-bit interface hence no data packing is performed. User in this case, will have to make appropriate connection externally, if needed. For example, if a 4-bit ADC is used, then the user would have to tie the upper 4-bit of the uPP data inputs to '0' or '1' as needed. If external FPGA is connected, then the user would have to make sure that 8-bit data (or appropriate tie-offs) is driven out from the FPGA. By default uPP supports little endian data format but to support the data format of one of the TI device (CC1260), a configuration bit is provided to select 16bit big endian mode also.

Figure 23-15 and Figure 23-16 describe how data goes out and comes in based on these modes.

**Figure 23-15. uPP Tx Data Pattern in Non-Interleaved Mode**



**Figure 23-16. uPP Rx Data Pattern in Non-Interleaved Mode**



### 23.4.5 Reset Considerations

#### 23.4.5.1 Software Reset

Software reset clears the uPP internal state machines but does not reset the contents of the uPP registers. The following procedure performs a software reset on the uPP peripheral:

1. Write the PEREN bit in the uPP PERCTL register to 0 (disables the uPP).
2. Poll the DMAST bit in uPP PERCTL register for activity; wait until DMA controller is inactive and idle.
3. Write the SOFTRST bit in uPP PERCTL register to 1 (places uPP in software reset).

4. Write the SOFTRST bit in uPP PERCTL register to 0 to (brings uPP out of software reset).

---

**NOTE:** In receive mode, uPP IO input clock must be running to have effect of soft reset.

---

### 23.4.5.2 Hardware Reset

When the processor XRSn (or CPU1.SYSRSn) pin is asserted, the entire processor is reset and is held in the reset state until the RESET pin is released. As part of a device reset, the uPP state machines are reset, and the uPP registers are forced to their default states. For default states, see the register section.

---

**NOTE:** There is no SW method to apply a hard reset to the UPP module on this device.

---

## 23.4.6 Interrupt Support

The uPP peripheral generates multiple interrupt events, all tied to internal DMA Channels I and Q. The uPP peripheral automatically combines all interrupt events into a single chip-level interrupt driven to CPU1 and CPU1.CLA1. Individual events may be enabled using the uPP interrupt enable set register (INTENSET) and disabled using the uPP interrupt enable clear register (INTENCLR). Only enabled events generate interrupts and assert bits in the enabled interrupt status register (ENINTST). Disabled events do not generate interrupts but do assert bits in the raw interrupt status register (RAWINTST). An interrupt service routine (ISR) may be assigned to handle uPP CPU-level interrupts using the interrupt controller module. If uPP events occur in close proximity to one another, a single CPU interrupt (and a single call to the ISR) may represent multiple interrupt events. Thus, the uPP ISR must meet certain structural requirements:

- The ISR must be able to handle multiple events before returning
- The ISR must handle any subsequent events that occur after it is called but before it returns

Like CPU ISR, CLA tasks can be assigned based on these interrupt events.

### 23.4.6.1 End of Line (EOL) Event

This event occurs each time when DMA channel reaches the end of a line in the data window. Note that if the associated uPP interface channel is operating in transmit mode, this event may occur before the line's final bytes are actually transmitted over the data pins.

For small line size and fast data transfer, it is possible to "miss" EOL events if they occur faster than the user's code can handle them. This does not hinder uPP operation; the uPP peripheral continue processing data uninterrupted until the EOW event or some error condition is encountered.

### 23.4.6.2 End of Window (EOW) Event

This event occurs when the DMA channel reaches the end of its current data window. Note that if the associated uPP interface channel is operating in transmit mode, this event may occur shortly before the window's final bytes are actually transmitted over the data pins.

When an EOW event occurs, the DMA channel automatically begins the next DMA transfer if one has been pre-programmed into the channel descriptor registers. If no new transfer is preprogrammed, the DMA channel becomes idle. For small window size and fast data transfer, code overhead may make it impossible to maintain a constant flow of data through the uPP interface channel. This problem can be solved by increasing the DMA window size or decreasing the peripheral clock speed.

### 23.4.6.3 Underrun or Overflow (UOR) Event

This event occurs when the DMA channel fails to keep up with incoming or outgoing data on its associated interface channel. Typically, this error indicates that background system activity has interfered with normal operation of the peripheral. It does not occur simply when a channel is allowed to idle. After encountering this error, the uPP peripheral should be reset when this event occurs.

This error should primarily occur when operating the uPP at high speed with significant system loading. To avoid this error, run the uPP at slower speeds or reduce background activity, such as non-uPP peripheral or DMA transactions. Additional tuning tips are given in [Section 23.4.10.1](#).

#### 23.4.6.4 DMA Programming Error (DPE) Event

This event occurs when the DMA channel descriptors are programmed while its PEND bit in the uPP DMA channel status register is set to 1. A channel's descriptors should only be programmed while the channel's PEND bit is cleared to 0.

### 23.4.7 Emulation Considerations

The uPP peripheral stops running if any of three conditions are met:

- Peripheral Disable - EN bit in the uPP peripheral control register (PERCTL) is 0.
- Clock Stop – Clock to uPP is disabled using PCLKCR.
- Emulation Suspend - JTAG emulator halts chip while FREE = 0 and SOFT = 1 in uPP PERCTL register.

For other settings of FREE and SOFT, the uPP peripheral continues running during emulation halt. When the uPP encounters a stop condition, it completes the current DMA burst transaction (if one is active) before stopping.

I/O channel, configured in transmit mode, immediately places its pins in a high-impedance state and preserves the state of its internal state machines. Unless some reset event occurs (see [Section 23.4.5](#)), the channel can resume where it left off when the stop condition is cleared. I/O channel configured in receive mode only captures one additional data word. Further incoming data words are ignored as long as the stop condition persists.

### 23.4.8 Transmit and Receive FIFOs

Each of the uPP peripheral I/O channels has a 512-byte FIFO. In receive mode, the FIFO is divided into eight 64-byte blocks. In transmit mode, the FIFO is divided into blocks that can be set to 64, 128, or 256 bytes, configured by the TXSIZEA field in the uPP threshold configuration register (THCFG).

Transmission will not begin until the channel has loaded enough data to fill at least one full FIFO block. The internal DMA channels may also be configured to use a read threshold of 64, 128, or 256 bytes using the RDSIZEI or RDSIZEQ field in uPP THCFG register. The DMA write threshold is fixed at 64 bytes.

### 23.4.9 Transmit and Receive Data (MSG) RAM

On this device, uPP internal DMA doesn't have access to system memories. Instead, there are two dedicated DATA RAMs (also called as MSGRAM) that have been provided: one for each RX and TX; each of these DATA RAMs are 512B. Since C28 CPU/CLA operates in 16-bit addressing mode, whereas, uPP internal DMA operates in byte addressing mode, the addresses for these RAMs are different for different views.

[Table 23-2](#) describes the addresses for these RAMs for two different views.

**Table 23-2. CPU/CLA/uPP-DMA Address Map**

Data (MSG)RAM	CPU/CLA Address		uPP DMA (programming) Address	
	Start Address	End Address	Start Address	End Address
TX DATA RAM	0x6C00	0x6CFF	0x6C00	0x6DFF
RX DATA RAM	0x6E00	0x6EFF	0x7000	0x71FF

[Table 23-3](#) describes the different access type for both the DATA(MSG) RAMs.

**Table 23-3. CPU/CLA/uPP-DMA Address Map**

Master/Data RAM	TX DATA(MSG) RAM		RX DATA(MSG) RAM	
	Read	Write	Read	Write
CPU1	Yes	Yes	Yes	Yes (Debug Mode Only)
CPU1.CLA1	Yes	Yes	Yes	No
uPP-DMA	Yes	No	No	Yes

---

**NOTE:** The message RAMs clocks are gated off when uPP clock is gated by the PCLKCR configuration. Thus, the message RAMs are not accessible by CPU/CLA when RPI clock is disabled by CPU.

---

### 23.4.10 Initialization and Operation

This section provides step-by-step instructions for initializing and running the uPP peripheral in various modes. These instructions are given assuming that the device has just come out of a power-on reset (POR) state.

1. Apply the appropriate pin multiplexing settings. For more information, see the device-specific data manual, and (or) pin multiplexing utility.
2. Enable the clocks to the uPP peripheral. For more information, see the Clock Control section of this TRM.
3. Wait for few (~32) device clock cycles, and then clear the “Soft Reset” bit to 0 to bring the module out of reset.
4. Program the following uPP configuration registers: CHCTL, IFCFG, IFIVAL, THCFG.
  - a. uPP Channel Control Register (data format, SDR/DDR, TX/RX, single/dual channel, interleave, demux)
  - b. uPP Interface configuration Register (IO signal enable, polarity, clock divisor)
  - c. uPP Interface idle value register (to drive value in idle mode for Tx)
  - d. uPP Threshold configuration register (TX Size, DMA read burst size)
5. Program the uPP interrupt enable set register to interrupt generation for the desired events. Register an interrupt service routine (ISR) if desired; otherwise, polling is required.
6. Set the “PerEn” bit in the uPP peripheral control register (PCR) to 1 to turn on the uPP peripheral.
7. Allocate or initialize data buffers for use with uPP.
8. Program the DMA channels with their first transfers using the uPP DMA channel descriptor register0, 1 and 2 (byte count, line count, line offset).
9. Once the DMA descriptors are written, the module will start to receive and transmit data, and perform DMA transfers. Below is a simple description of how the DMA works.
10. Watch for interrupt events. Reprogram the DMA as necessary. (check that the PEND bit in the uPP DMA channel status is ‘0’).
  - a. If polling, check uPP Interrupt enabled status register. Reading a bit as 1 indicates the corresponding event has occurred. Write the corresponding bit with 1 to clear.
  - b. If using ISR, check ENINTST inside your ISR

Once the channel is started, the initial latency between the time when the first data is received or transmitted on the pin, and the time when the first DMA burst is transferred on the CBA bus, is unpredictable. This initial latency is determined by several factors:

- Clock ratio between system clock and uPP clock
- Various threshold values being programmed
- Chip-level traffic activities level

However, once the data is moving, all subsequent data movement is continuous (streaming). If such data movement cannot be maintained, then DMA under-run or over-flow situation may occur.



### 23.4.10.1 System Tuning Tips

The uPP peripheral can operate at high speed and transfer data at a very high rate. When operating the uPP near its upper limits, tuning certain parameters can help decrease the incidence of errors and the software overhead incurred servicing uPP data. [Table 23-4](#) lists several parameters that can be useful in system tuning. A parameter is defined as a “coarse” adjustment, if changing the parameter directly alters the peripheral throughput. A “fine” adjustment does not change the peripheral throughput, but it does affect general system performance.

**Table 23-4. uPP Parameters Useful for System Tuning**

Parameter	Register	Register Field	Edge Value	Safe Value	Description
Data Rate	CHCTL	DRA	1	0	Double data rate increases data transfer by a factor of 2 and greatly increases system loading for the same clock divisor. This is a coarse adjustment and is probably fixed due to design constraints.
Clock Division	IFCFG	CLKDIVA	0	1+	Increasing clock division is the most straight-forward way to decrease system loading. This is a coarse adjustment; the difference between CLKDIVx = 0 and 1 is the same (in terms of data rate) as the difference between single and double data rate.
DMA Read Burst Size	THCFG	RDSIZEQ RDSIZEI	0	3h	Increasing the DMA read threshold decreases system loading by generating fewer, larger DMA events. This is a fine adjustment.
DMA Line Size, Count	CHxDESC 1	LCNT BCNT	0		<sup>(1)</sup> Condensing uPP transfers into fewer, larger lines generates fewer end-of-line interrupts and, thus, invokes fewer ISR calls. This is a fine adjustment.
Total Transfer Size	CHxDESC 1	LCNT BCNT	<sup>(1)</sup>	<sup>(1)</sup>	Performing many small uPP transfers can require excessive software overhead (programming DMA descriptors, handling interrupts, and so forth) at high data rates. This is a fine adjustment.

<sup>(1)</sup> (1) These values vary per application. One example could be a 16-KB transfer. The same total data could be transferred as 16 1-KB lines or 2 8-KB lines.



## 23.5 Registers

### 23.5.1 UPP Base Addresses

**Table 23-5. UPP Base Address Table**

Device Registers	Register Name	Start Address	End Address
UppRegs	UPP_REGS	0x0000_6200	0x0000_62FF

### 23.5.2 UPP\_REGS Registers

Table 23-6 lists the memory-mapped registers for the UPP\_REGS. All register offset addresses not listed in Table 23-6 should be considered as reserved locations and the register contents should not be modified.

**Table 23-6. UPP\_REGS Registers**

Offset	Acronym	Register Name	Write Protection	Section
0h	PID	Peripheral ID Register		<a href="#">Go</a>
2h	PERCTL	Peripheral Control Register		<a href="#">Go</a>
8h	CHCTL	General Control Register		<a href="#">Go</a>
Ah	IFCFG	Interface Configuration Register		<a href="#">Go</a>
Ch	IFIVAL	Interface Idle Value Register		<a href="#">Go</a>
Eh	THCFG	Threshold Configuration Register		<a href="#">Go</a>
10h	RAWINTST	Raw Interrupt Status Register		<a href="#">Go</a>
12h	ENINTST	Enable Interrupt Status Register		<a href="#">Go</a>
14h	INTENSET	Interrupt Enable Set Register		<a href="#">Go</a>
16h	INTENCLR	Interrupt Enable Clear Register		<a href="#">Go</a>
20h	CHIDESC0	DMA Channel I Descriptor 0 Register		<a href="#">Go</a>
22h	CHIDESC1	DMA Channel I Descriptor 1 Register		<a href="#">Go</a>
24h	CHIDESC2	DMA Channel I Descriptor 2 Register		<a href="#">Go</a>
28h	CHIST0	DMA Channel I Status 0 Register		<a href="#">Go</a>
2Ah	CHIST1	DMA Channel I Status 1 Register		<a href="#">Go</a>
2Ch	CHIST2	DMA Channel I Status 2 Register		<a href="#">Go</a>
30h	CHQDESC0	DMA Channel Q Descriptor 0 Register		<a href="#">Go</a>
32h	CHQDESC1	DMA Channel Q Descriptor 1 Register		<a href="#">Go</a>
34h	CHQDESC2	DMA Channel Q Descriptor 2 Register		<a href="#">Go</a>
38h	CHQST0	DMA Channel Q Status 0 Register		<a href="#">Go</a>
3Ah	CHQST1	DMA Channel Q Status 1 Register		<a href="#">Go</a>
3Ch	CHQST2	DMA Channel Q Status 2 Register		<a href="#">Go</a>
40h	GINTEN	Global Peripheral Interrupt Enable Register		<a href="#">Go</a>
42h	GINTFLG	Global Peripheral Interrupt Flag Register		<a href="#">Go</a>
44h	GINTCLR	Global Peripheral Interrupt Clear Register		<a href="#">Go</a>
46h	DLYCTL	IO clock data skew control Register		<a href="#">Go</a>

Complex bit access types are encoded to fit into small table cells. Table 23-7 shows the codes that are used for access types in this section.

**Table 23-7. UPP\_REGS Access Type Codes**

Access Type	Code	Description
<b>Read Type</b>		
R	R	Read
R=0	R	Read
<b>Write Type</b>		
W	W	Write
W1C	1C W	1 to clear Write
W=1	W	Write
<b>Reset or Default Value</b>		
-n		Value after reset or the default value
<b>Register Array Variables</b>		

**Table 23-7. UPP\_REGS Access Type Codes (continued)**

Access Type	Code	Description
i,j,k,l,m,n		When these variables are used in a register name, an offset, or an address, they refer to the value of a register array where the register is part of a group of repeating registers. The register groups form a hierarchical structure and the array is represented with a formula.
y		When this variable is used in a register name, an offset, or an address it refers to the value of a register array.

### 23.5.2.1 PID Register (Offset = 0h) [reset = 44231100h]

PID is shown in [Figure 23-17](#) and described in [Table 23-8](#).

Return to [Summary Table](#).

Peripheral ID Register

**Figure 23-17. PID Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
REVID																															
R-44231100h																															

**Table 23-8. PID Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-0	REVID	R	44231100h	Module revision id. Reset type: CPU1.SYSRSn

### 23.5.2.2 PERCTL Register (Offset = 2h) [reset = 0h]

PERCTL is shown in [Figure 23-18](#) and described in [Table 23-9](#).

Return to [Summary Table](#).

Peripheral Control Register

**Figure 23-18. PERCTL Register**

31	30	29	28	27	26	25	24
RESERVED							
R=0-0h							
23	22	21	20	19	18	17	16
RESERVED							
R=0-0h							
15	14	13	12	11	10	9	8
RESERVED							
R=0-0h							
7	6	5	4	3	2	1	0
DMAST	RESERVED		SOFTTRST	PEREN	RTEMU	SOFT	FREE
R-0h	R=0-0h		R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h

**Table 23-9. PERCTL Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-8	RESERVED	R=0	0h	Reserved
7	DMAST	R	0h	DMA state machine status. 0: Idle 1: DMA Burst transaction is active. Reset type: CPU1.SYSRSn
6-5	RESERVED	R=0	0h	Reserved
4	SOFTTRST	R/W	0h	This bit reset all the state machines and certain memory elements inside the RPI module immediately. Software can write this bit to '1', and later write '0' to bring the RPI module out of reset. Note that MMR are NOT reset, except for Interrupt-Raw-Status Register. This reset can be used to recover the RPI from an error condition.  To make sure that a graceful or fail-safe reset is performed, software can first disable the "PerEn" bit, then poll the DMAStatus bit to make sure that all pending VBUSP DMA burst are completed, then perform a software reset.  0: De-assert the reset (out of reset). 1: Assert the reset (in to reset). Reset type: CPU1.SYSRSn
3	PEREN	R/W	0h	This bit can be used to disable or suspend the RPI module. When this bit is programmed to be disabled, the RPI will be stopped (suspended) after all current DMA activity are completed.  0: Disable/Suspend the uPP module. 1: Enable/Resume the uPP module. Reset type: CPU1.SYSRSn
2	RTEMU	R/W	0h	0: Real Time emulation is disable. Module gets suspended when CPU is supended. 1: Real Time emulation is enable. Reset type: CPU1.SYSRSn

**Table 23-9. PERCTL Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
1	SOFT	R/W	0h	0: Hard Stop. 1: Soft Stop. Reset type: CPU1.SYSRSn
0	FREE	R/W	0h	0: Software controlled. 1: Free Running. Reset type: CPU1.SYSRSn

**23.5.2.3 CHCTL Register (Offset = 8h) [reset = 0h]**

CHCTL is shown in [Figure 23-19](#) and described in [Table 23-10](#).

Return to [Summary Table](#).

General Control Register

**Figure 23-19. CHCTL Register**

31	30	29	28	27	26	25	24
RESERVED		RESERVED					
R=0-0h		R/W-0h					
23	22	21	20	19	18	17	16
RESERVED							DRA
R/W-0h							R/W-0h
15	14	13	12	11	10	9	8
RESERVED							
R/W-0h							
7	6	5	4	3	2	1	0
RESERVED			DEMUXA	SDRTXILA	RESERVED	MODE	
R/W-0h			R/W-0h	R/W-0h	R/W-0h	R/W-0h	

**Table 23-10. CHCTL Register Field Descriptions**

Bit	Field	Type	Reset	Description
31	RESERVED	R=0	0h	Reserved
30-17	RESERVED	R/W	0h	Reserved
16	DRA	R/W	0h	Data rate control. 0: Single Data Rate (SDR). 1: Double Data Rate (DDR). Reset type: CPU1.SYSRSn
15-5	RESERVED	R/W	0h	Reserved
4	DEMUXA	R/W	0h	DDR de-multiplexing mode (This bit is only valid for DDR mode): 0: De-multiplexing is disable. 1: De-multiplexing is Enable (split data into 2 DMA channels). Reset type: CPU1.SYSRSn
3	SDRTXILA	R/W	0h	Tx SDR interleave mode (This bit is only valid for SDR mode): 0: Interleaving is disable. 1: Interleaving is Enable (split data into 2 DMA channels). Reset type: CPU1.SYSRSn
2	RESERVED	R/W	0h	Reserved
1-0	MODE	R/W	0h	Operating mode: 00: Pure input receive mode. 01: Pure output transmit mode. 10: Reserved. 11: Reserved. Reset type: CPU1.SYSRSn

### 23.5.2.4 IFCFG Register (Offset = Ah) [reset = 0h]

IFCFG is shown in [Figure 23-20](#) and described in [Table 23-11](#).

Return to [Summary Table](#).

Interface Configuration Register

**Figure 23-20. IFCFG Register**

31	30	29	28	27	26	25	24
RESERVED		RESERVED					
R=0-0h		R/W-0h					
23	22	21	20	19	18	17	16
RESERVED		RESERVED					
R=0-0h		R/W-0h					
15	14	13	12	11	10	9	8
RESERVED		TRISENA	CLKINVA	CLKDIVA			
R=0-0h		R/W-0h	R/W-0h	R/W-0h			
7	6	5	4	3	2	1	0
RESERVED		WAITA	ENAA	STARTA	WAITPOLA	ENAPOLA	STARTPOLA
R=0-0h		R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h

**Table 23-11. IFCFG Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-30	RESERVED	R=0	0h	Reserved
29-24	RESERVED	R/W	0h	Reserved
23-22	RESERVED	R=0	0h	Reserved
21-16	RESERVED	R/W	0h	Reserved
15-14	RESERVED	R=0	0h	Reserved
13	TRISENA	R/W	0h	Transmit mode output tri-state control: 0: Disable. RPI will not tri-state during idle time and will drive values from the Interface Idle Value Register. 1: Enable. RPI will tri-state during idle time.  Idle time is the time before and between Window transfers. Reset type: CPU1.SYSRSn
12	CLKINVA	R/W	0h	Clock inversion: 0: Clock is not inverted 1: Clock is inverted  When in Rx mode, the clock will be treated as inverted if enabled. When in Tx mode, the clock will be inverted before going out of the pin. Reset type: CPU1.SYSRSn
11-8	CLKDIVA	R/W	0h	Clock divider for transmit mode: $TX\_IOCLK = CHIP\_CLK / 2(N+1)$ Where 'N' is the value programmed into this field. Reset type: CPU1.SYSRSn
7-6	RESERVED	R=0	0h	Reserved



**Table 23-11. IFCFG Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
5	WAITA	R/W	0h	Enable Usage of WAIT signal: 0: Disable (Tx: ignore wait) 1: Enable (Tx: honor wait) This bit is only valid for transmit mode, receive mode always drive WAIT signal inactive (except for stop_run situation). Reset type: CPU1.SYSRSn
4	ENAA	R/W	0h	Enable Usage of ENABLE (WRITE) signal: 0: Disable (Rx: ignore enable) 1: Enable (Rx: honor enable) This bit is only valid for receive mode, transmit mode always drive ENABLE signal active. Reset type: CPU1.SYSRSn
3	STARTA	R/W	0h	Enable Usage of START (SELECT) signal: 0: Disable (Rx: ignore start) 1: Enable (Rx: honor start) This bit is only valid for receive mode, transmit mode always drive START signal active. Reset type: CPU1.SYSRSn
2	WAITPOLA	R/W	0h	Polarity of WAIT signal: 0: Active High. 1: Active Low. Reset type: CPU1.SYSRSn
1	ENAPOLA	R/W	0h	Polarity of ENABLE(WRITE) signal: 0: Active High. 1: Active Low. Reset type: CPU1.SYSRSn
0	STARTPOLA	R/W	0h	Polarity of START(SELECT) signal: 0: Active High. 1: Active Low. Reset type: CPU1.SYSRSn

### 23.5.2.5 IFIVAL Register (Offset = Ch) [reset = 0h]

IFIVAL is shown in [Figure 23-21](#) and described in [Table 23-12](#).

Return to [Summary Table](#).

Interface Idle Value Register

**Figure 23-21. IFIVAL Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
RESERVED															
R/W-0h															
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
RESERVED								VALA							
R/W-0h								R/W-0h							

**Table 23-12. IFIVAL Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R/W	0h	Reserved
15-9	RESERVED	R/W	0h	Reserved
8-0	VALA	R/W	0h	When in transmit mode, this field holds the value that will be driven out when the channel is idle. This includes both situations when TRISEN field of the RPI Interface Configuration Register is enabled, and when wait-state is inserted by the external receiver (WAIT asserted). Reset type: CPU1.SYSRSn

### 23.5.2.6 THCFG Register (Offset = Eh) [reset = 0h]

THCFG is shown in [Figure 23-22](#) and described in [Table 23-13](#).

Return to [Summary Table](#).

Threshold Configuration Register

**Figure 23-22. THCFG Register**

31	30	29	28	27	26	25	24
RESERVED						RESERVED	
R=0-0h						R/W-0h	
23	22	21	20	19	18	17	16
RESERVED						TXSIZEA	
R=0-0h						R/W-0h	
15	14	13	12	11	10	9	8
RESERVED						RDSIZEQ	
R=0-0h						R/W-0h	
7	6	5	4	3	2	1	0
RESERVED						RDSIZEI	
R=0-0h						R/W-0h	

**Table 23-13. THCFG Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-26	RESERVED	R=0	0h	Reserved
25-24	RESERVED	R/W	0h	Reserved
23-18	RESERVED	R=0	0h	Reserved
17-16	TXSIZEA	R/W	0h	I/O Transmit Threshold: 00: 64 Byte 01: 128 Byte 10: Reserved 11: 256 Byte The uPP will hold off transmitting until this threshold is reach in the transmit buffer. The following programming limitation applies: If TX_SIZE = 64B, there is no programming limitation. If TX_SIZE = 128B, descriptor Byte-Count must > 64B. If TX_SIZE = 256B, descriptor Byte-Count must > 192B Reset type: CPU1.SYSRSn
15-10	RESERVED	R=0	0h	Reserved
9-8	RDSIZEQ	R/W	0h	DMA Read Threshold for DMA Channel Q: 00: 64 Byte 01: 128 Byte 10: Reserved 11: 256 Byte DMA read burst is based on this value (same as FIFO block size). Note: DMA Write Threshold (write burst) is fixed at 64B. Reset type: CPU1.SYSRSn
7-2	RESERVED	R=0	0h	Reserved

**Table 23-13. THCFG Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
1-0	RDSIZEI	R/W	0h	DMA Read Threshold for DMA Channel I: 00: 64 Byte 01: 128 Byte 10: Reserved 11: 256 Byte DMA read burst is based on this value (same as FIFO block size). Note: DMA Write Threshold (write burst) is fixed at 64B. Reset type: CPU1.SYSRSn

### 23.5.2.7 RAWINTST Register (Offset = 10h) [reset = 0h]

RAWINTST is shown in [Figure 23-23](#) and described in [Table 23-14](#).

Return to [Summary Table](#).

Raw Interrupt Status Register

**Figure 23-23. RAWINTST Register**

31	30	29	28	27	26	25	24
RESERVED							
R=0-0h							
23	22	21	20	19	18	17	16
RESERVED							
R=0-0h							
15	14	13	12	11	10	9	8
RESERVED			EOLQ	EOWQ	RESERVED	UOEQ	DPEQ
R=0-0h			R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h
7	6	5	4	3	2	1	0
RESERVED			EOLI	EOWI	RESERVED	UOEI	DPEI
R=0-0h			R/W-0h	R/W-0h	R/W-0h	R/W-0h	R/W-0h

**Table 23-14. RAWINTST Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-13	RESERVED	R=0	0h	Reserved
12	EOLQ	R/W	0h	Interrupt raw status for end-of-line condition: 0: No event. 1: End Of Line event happened. Reset type: CPU1.SYSRSn
11	EOWQ	R/W	0h	Interrupt raw status for end-of-line condition: 0: No event. 1: End Of Window event happened. Reset type: CPU1.SYSRSn
10	RESERVED	R/W	0h	Reserved
9	UOEQ	R/W	0h	Interrupt raw status for DMA under-run or over-run : 0: No event. 1: Under-run/Over-run event happened. Over-run in receiving or Under-Run in transmitting. Reset type: CPU1.SYSRSn
8	DPEQ	R/W	0h	Interrupt raw status for DMA programming error: 0: No event. 1: DMA programming error (Writing of DMA descriptors while PENDING bit is active) occurred. Reset type: CPU1.SYSRSn
7-5	RESERVED	R=0	0h	Reserved
4	EOLI	R/W	0h	Interrupt raw status for end-of-line condition: 0: No event. 1: End Of Line event happened. Reset type: CPU1.SYSRSn

**Table 23-14. RAWINTST Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
3	EOWI	R/W	0h	Interrupt raw status for end-of-line condition: 0: No event. 1: End Of Window event happened. Reset type: CPU1.SYSRSn
2	RESERVED	R/W	0h	Reserved
1	UOEI	R/W	0h	Interrupt raw status for DMA under-run or over-run : 0: No event. 1: Under-run/Over-run event happened. Over-run in receiving or Under-Run in transmitting. Reset type: CPU1.SYSRSn
0	DPEI	R/W	0h	Interrupt raw status for DMA programming error: 0: No event. 1: DMA programming error (Writing of DMA descriptors while PENDING bit is active) occurred. Reset type: CPU1.SYSRSn

### 23.5.2.8 ENINTST Register (Offset = 12h) [reset = 0h]

ENINTST is shown in [Figure 23-24](#) and described in [Table 23-15](#).

Return to [Summary Table](#).

Enable Interrupt Status Register

**Figure 23-24. ENINTST Register**

31	30	29	28	27	26	25	24
RESERVED							
R=0-0h							
23	22	21	20	19	18	17	16
RESERVED							
R=0-0h							
15	14	13	12	11	10	9	8
RESERVED			EOLQ	EOWQ	RESERVED	UOEQ	DPEQ
R=0-0h			R/W1C-0h	R/W1C-0h	R/W1C-0h	R/W1C-0h	R/W1C-0h
7	6	5	4	3	2	1	0
RESERVED			EOLI	EOWI	RESERVED	UOEI	DPEI
R=0-0h			R/W1C-0h	R/W1C-0h	R/W1C-0h	R/W1C-0h	R/W1C-0h

**Table 23-15. ENINTST Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-13	RESERVED	R=0	0h	Reserved
12	EOLQ	R/W1C	0h	Interrupt enable status for end-of-line condition. Writing 1 will clear the interrupt status and writing 0 has no effect. 0: No event. 1: End Of Line event happened. Reset type: CPU1.SYSRSn
11	EOWQ	R/W1C	0h	Interrupt enable status for end-of-line condition. Writing 1 will clear the interrupt status and writing 0 has no effect. 0: No event. 1: End Of Window event happened. Reset type: CPU1.SYSRSn
10	RESERVED	R/W1C	0h	Reserved
9	UOEQ	R/W1C	0h	Interrupt enable status for DMA under-run or over-run. Writing 1 will clear the interrupt status and writing 0 has no effect. 0: No event. 1: Under-run/Over-run event happened. Over-run in receiving or Under-Run in transmitting. Reset type: CPU1.SYSRSn
8	DPEQ	R/W1C	0h	Interrupt enable status for DMA programming error. Writing 1 will clear the interrupt status and writing 0 has no effect. 0: No event. 1: DMA programming error (Writing of DMA descriptors while PENDING bit is active) occurred. Reset type: CPU1.SYSRSn
7-5	RESERVED	R=0	0h	Reserved
4	EOLI	R/W1C	0h	Interrupt enable status for end-of-line condition. Writing 1 will clear the interrupt status and writing 0 has no effect. 0: No event. 1: End Of Line event happened. Reset type: CPU1.SYSRSn

**Table 23-15. ENINTST Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
3	EOWI	R/W1C	0h	Interrupt enable status for end-of-line condition. Writing 1 will clear the interrupt status and writing 0 has no effect. 0: No event. 1: End Of Window event happened. Reset type: CPU1.SYSRSn
2	RESERVED	R/W1C	0h	Reserved
1	UOEI	R/W1C	0h	Interrupt enable status for DMA under-run or over-run. Writing 1 will clear the interrupt status and writing 0 has no effect. 0: No event. 1: Under-run/Over-run event happened. Over-run in receiving or Under-Run in transmitting. Reset type: CPU1.SYSRSn
0	DPEI	R/W1C	0h	Interrupt enable status for DMA programming error. Writing 1 will clear the interrupt status and writing 0 has no effect. 0: No event. 1: DMA programming error (Writing of DMA descriptors while PENDING bit is active) occurred. Reset type: CPU1.SYSRSn



### 23.5.2.9 INTENSET Register (Offset = 14h) [reset = 0h]

INTENSET is shown in [Figure 23-25](#) and described in [Table 23-16](#).

Return to [Summary Table](#).

Interrupt Enable Set Register

**Figure 23-25. INTENSET Register**

31	30	29	28	27	26	25	24
RESERVED							
R=0-0h							
23	22	21	20	19	18	17	16
RESERVED							
R=0-0h							
15	14	13	12	11	10	9	8
RESERVED			EOLQ	EOWQ	RESERVED	UOEQ	DPEQ
R=0-0h			R/W=1-0h	R/W=1-0h	R/W=1-0h	R/W=1-0h	R/W=1-0h
7	6	5	4	3	2	1	0
RESERVED			EOLI	EOWI	RESERVED	UOEI	DPEI
R=0-0h			R/W=1-0h	R/W=1-0h	R/W=1-0h	R/W=1-0h	R/W=1-0h

**Table 23-16. INTENSET Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-13	RESERVED	R=0	0h	Reserved
12	EOLQ	R/W=1	0h	Interrupt enable for end-of-line condition. Writing 1 will enable the interrupt and writing 0 has no effect. 0: Interrupt is disable. 1: Interrupt is enable. Reset type: CPU1.SYSRSn
11	EOWQ	R/W=1	0h	Interrupt enable for end-of-line condition. Writing 1 will enable the interrupt and writing 0 has no effect. 0: Interrupt is disable. 1: Interrupt is enable. Reset type: CPU1.SYSRSn
10	RESERVED	R/W=1	0h	Reserved
9	UOEQ	R/W=1	0h	Interrupt enable for DMA under-run or over-run. Writing 1 will enable the interrupt and writing 0 has no effect. 0: Interrupt is disable. 1: Interrupt is enable. Reset type: CPU1.SYSRSn
8	DPEQ	R/W=1	0h	Interrupt enable for DMA programming error. Writing 1 will enable the interrupt and writing 0 has no effect. 0: Interrupt is disable. 1: Interrupt is enable. Reset type: CPU1.SYSRSn
7-5	RESERVED	R=0	0h	Reserved
4	EOLI	R/W=1	0h	Interrupt enable for end-of-line condition. Writing 1 will enable the interrupt and writing 0 has no effect. 0: Interrupt is disable. 1: Interrupt is enable. Reset type: CPU1.SYSRSn

**Table 23-16. INTENSET Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
3	EOWI	R/W=1	0h	Interrupt enable for end-of-line condition. Writing 1 will enable the interrupt and writing 0 has no effect. 0: Interrupt is disable. 1: Interrupt is enable. Reset type: CPU1.SYSRSn
2	RESERVED	R/W=1	0h	Reserved
1	UOEI	R/W=1	0h	Interrupt enable for DMA under-run or over-run. Writing 1 will enable the interrupt and writing 0 has no effect. 0: Interrupt is disable. 1: Interrupt is enable. Over-run in receiving or Under-Run in transmitting. Reset type: CPU1.SYSRSn
0	DPEI	R/W=1	0h	Interrupt enable for DMA programming error. Writing 1 will enable the interrupt and writing 0 has no effect. 0: Interrupt is disable. 1: Interrupt is enable. Reset type: CPU1.SYSRSn

### 23.5.2.10 INTENCLR Register (Offset = 16h) [reset = 0h]

INTENCLR is shown in [Figure 23-26](#) and described in [Table 23-17](#).

Return to [Summary Table](#).

Interrupt Enable Clear Register

**Figure 23-26. INTENCLR Register**

31	30	29	28	27	26	25	24
RESERVED							
R=0-0h							
23	22	21	20	19	18	17	16
RESERVED							
R=0-0h							
15	14	13	12	11	10	9	8
RESERVED			EOLQ	EOWQ	RESERVED	UOEQ	DPEQ
R=0-0h			R/W=1-0h	R/W=1-0h	R/W=1-0h	R/W=1-0h	R/W=1-0h
7	6	5	4	3	2	1	0
RESERVED			EOLI	EOWI	RESERVED	UOEI	DPEI
R=0-0h			R/W=1-0h	R/W=1-0h	R/W=1-0h	R/W=1-0h	R/W=1-0h

**Table 23-17. INTENCLR Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-13	RESERVED	R=0	0h	Reserved
12	EOLQ	R/W=1	0h	Interrupt clear for end-of-line condition. Writing 1 will disable the interrupt and writing 0 has no effect. 0: Interrupt is disable. 1: Interrupt is enable. Reset type: CPU1.SYSRSn
11	EOWQ	R/W=1	0h	Interrupt clear for end-of-line condition. Writing 1 will disable the interrupt and writing 0 has no effect. 0: Interrupt is disable. 1: Interrupt is enable. Reset type: CPU1.SYSRSn
10	RESERVED	R/W=1	0h	Reserved
9	UOEQ	R/W=1	0h	Interrupt clear for DMA under-run or over-run. Writing 1 will disable the interrupt and writing 0 has no effect. 0: Interrupt is disable. 1: Interrupt is enable. Reset type: CPU1.SYSRSn
8	DPEQ	R/W=1	0h	Interrupt clear for DMA programming error. Writing 1 will disable the interrupt and writing 0 has no effect. 0: Interrupt is disable. 1: Interrupt is enable. Reset type: CPU1.SYSRSn
7-5	RESERVED	R=0	0h	Reserved
4	EOLI	R/W=1	0h	Interrupt clear for end-of-line condition. Writing 1 will disable the interrupt and writing 0 has no effect. 0: Interrupt is disable. 1: Interrupt is enable. Reset type: CPU1.SYSRSn

**Table 23-17. INTENCLR Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
3	EOWI	R/W=1	0h	Interrupt clear for end-of-line condition. Writing 1 will disable the interrupt and writing 0 has no effect. 0: Interrupt is disable. 1: Interrupt is enable. Reset type: CPU1.SYSRSn
2	RESERVED	R/W=1	0h	Reserved
1	UOEI	R/W=1	0h	Interrupt clear for DMA under-run or over-run. Writing 1 will disable the interrupt and writing 0 has no effect. 0: Interrupt is disable. 1: Interrupt is enable. Over-run in receiving or Under-Run in transmitting. Reset type: CPU1.SYSRSn
0	DPEI	R/W=1	0h	Interrupt clear for DMA programming error. Writing 1 will disable the interrupt and writing 0 has no effect. 0: Interrupt is disable. 1: Interrupt is enable. Reset type: CPU1.SYSRSn

**23.5.2.11 CHIDESC0 Register (Offset = 20h) [reset = 0h]**

CHIDESC0 is shown in [Figure 23-27](#) and described in [Table 23-18](#).

Return to [Summary Table](#).

DMA Channel I Descriptor 0 Register

**Figure 23-27. CHIDESC0 Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ADDR																															
R/W-0h																															

**Table 23-18. CHIDESC0 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-0	ADDR	R/W	0h	Starting address of the DMA Channel I transfer. It must be 64bit aligned. Reset type: CPU1.SYSRSn

**23.5.2.12 CHIDESC1 Register (Offset = 22h) [reset = 0h]**

CHIDESC1 is shown in [Figure 23-28](#) and described in [Table 23-19](#).

Return to [Summary Table](#).

DMA Channel I Descriptor 1 Register

**Figure 23-28. CHIDESC1 Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
LCNT																BCNT															
R/W-0h																R/W-0h															

**Table 23-19. CHIDESC1 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	LCNT	R/W	0h	Number of lines in a window for DMA Channel I transfer(number of packets in CPPI 4.1 terminology): 0: Line count of 0 (invalid programming) 1: Line count of 1 So on... Reset type: CPU1.SYSRSn
15-0	BCNT	R/W	0h	Number of bytes in a line for DMA Channel I transfer(number of bytes in a packet in CPPI 4.1 terminology): 0: Byte count of 0 (invalid programming) 1: Byte count of 1 So on... Reset type: CPU1.SYSRSn

**23.5.2.13 CHIDESC2 Register (Offset = 24h) [reset = 0h]**

CHIDESC2 is shown in [Figure 23-29](#) and described in [Table 23-20](#).

Return to [Summary Table](#).

DMA Channel I Descriptor 2 Register

**Figure 23-29. CHIDESC2 Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
RESERVED																LOFFSET															
R=0-0h																R/W-0h															

**Table 23-20. CHIDESC2 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R=0	0h	Reserved
15-0	LOFFSET	R/W	0h	Offset from the current line starting address to the next line starting address for DMA Channel I transfers. It must be 64bit aligned. Reset type: CPU1.SYSRSn

**23.5.2.14 CHIST0 Register (Offset = 28h) [reset = 0h]**

CHIST0 is shown in [Figure 23-30](#) and described in [Table 23-21](#).

Return to [Summary Table](#).

DMA Channel I Status 0 Register

**Figure 23-30. CHIST0 Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ADDR																															
R-0h																															

**Table 23-21. CHIST0 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-0	ADDR	R	0h	Current address of the DMA transfer. Reset type: CPU1.SYSRSn



**23.5.2.15 CHIST1 Register (Offset = 2Ah) [reset = 0h]**

CHIST1 is shown in [Figure 23-31](#) and described in [Table 23-22](#).

Return to [Summary Table](#).

DMA Channel I Status 1 Register

**Figure 23-31. CHIST1 Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
LCNT																BCNT															
R-0h																R-0h															

**Table 23-22. CHIST1 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	LCNT	R	0h	Current line number. Reset type: CPU1.SYSRSn
15-0	BCNT	R	0h	Current byte number. Reset type: CPU1.SYSRSn

**23.5.2.16 CHIST2 Register (Offset = 2Ch) [reset = 0h]**

 CHIST2 is shown in [Figure 23-32](#) and described in [Table 23-23](#).

 Return to [Summary Table](#).

DMA Channel I Status 2 Register

**Figure 23-32. CHIST2 Register**

31	30	29	28	27	26	25	24
RESERVED							
R=0-0h							
23	22	21	20	19	18	17	16
RESERVED							
R=0-0h							
15	14	13	12	11	10	9	8
RESERVED							
R=0-0h							
7	6	5	4	3	2	1	0
WM		RESERVED			PEND	ACT	
R-0h		R=0-0h			R-0h	R-0h	

**Table 23-23. CHIST2 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-8	RESERVED	R=0	0h	Reserved
7-4	WM	R	0h	Watermark for FIFO block count for DMA Channel I transfer. For RX, this is a recording of the maximum FIFO Block Occupancy ever reached for a continuous transaction. For TX, this is a simple capture of the FIFO Block Emptiness count every clock. Reset type: CPU1.SYSRSn
3-2	RESERVED	R=0	0h	Reserved
1	PEND	R	0h	Status of DMA: 0: OK to write a new set of DMA descriptor. 1: Writing of new DMA descriptor is disallowed/ignored. Reset type: CPU1.SYSRSn
0	ACT	R	0h	Status of DMA descriptor: 0: Descriptor is currently idle. 1: Descriptor is currently active (transferring data).  "PENDING" bit is used for descriptor programming allowance, while "ACTIVE" is used for indicating if a descriptor is being in use or not. Software should not use these bit to indicate "end-of-window" transfer condition (use the EOW status/interrupt instead). For RX mode, this bit reflects if any of the 2 pending descriptors on the CBA clock domain is currently running. For TX mode, this bit reflects if any of the 2 pending descriptors on the RPI clock domain is currently running.  A proper way to monitor this signal (after loading a descriptor) is to first wait for this ACTIVE signal to go active, then wait for this signal to go inactive. The deassertion of the ACTIVE signal indicates that the descriptor is completed.  Another side note is that the "DMA_STATUS" of PCR is a low-level monitoring signal for DMA VBUSP bus activity, while the PENDING, ACTIVE are higher-lever monitoring for descriptor status. Reset type: CPU1.SYSRSn

**23.5.2.17 CHQDESC0 Register (Offset = 30h) [reset = 0h]**

CHQDESC0 is shown in [Figure 23-33](#) and described in [Table 23-24](#).

Return to [Summary Table](#).

DMA Channel Q Descriptor 0 Register

**Figure 23-33. CHQDESC0 Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ADDR																															
R/W-0h																															

**Table 23-24. CHQDESC0 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-0	ADDR	R/W	0h	Starting address of the DMA Channel Q transfer. This must be 64bit aligned. Reset type: CPU1.SYSRSn

**23.5.2.18 CHQDESC1 Register (Offset = 32h) [reset = 0h]**

CHQDESC1 is shown in [Figure 23-34](#) and described in [Table 23-25](#).

Return to [Summary Table](#).

DMA Channel Q Descriptor 1 Register

**Figure 23-34. CHQDESC1 Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
LCNT																BCNT															
R/W-0h																R/W-0h															

**Table 23-25. CHQDESC1 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	LCNT	R/W	0h	Number of lines in a window for DMA Channel Q transfer(number of packets in CPPI 4.1 terminology): 0: Line count of 0 (invalid programming) 1: Line count of 1 So on... Reset type: CPU1.SYSRSn
15-0	BCNT	R/W	0h	Number of bytes in a line for DMA Channel Q transfer(number of bytes in a packet in CPPI 4.1 terminology): 0: Byte count of 0 (invalid programming) 1: Byte count of 1 So on... Reset type: CPU1.SYSRSn

**23.5.2.19 CHQDESC2 Register (Offset = 34h) [reset = 0h]**

CHQDESC2 is shown in [Figure 23-35](#) and described in [Table 23-26](#).

Return to [Summary Table](#).

DMA Channel Q Descriptor 2 Register

**Figure 23-35. CHQDESC2 Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
RESERVED																LOFFSET															
R=0-0h																R/W-0h															

**Table 23-26. CHQDESC2 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R=0	0h	Reserved
15-0	LOFFSET	R/W	0h	Offset from the current line starting address to the next line starting address for DMA Channel Q transfers. It must be 64bit aligned. Reset type: CPU1.SYSRSn

**23.5.2.20 CHQST0 Register (Offset = 38h) [reset = 0h]**

CHQST0 is shown in [Figure 23-36](#) and described in [Table 23-27](#).

Return to [Summary Table](#).

DMA Channel Q Status 0 Register

**Figure 23-36. CHQST0 Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ADDR																															
R-0h																															

**Table 23-27. CHQST0 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-0	ADDR	R	0h	Current address of the DMA transfer. Reset type: CPU1.SYSRSn

**23.5.2.21 CHQST1 Register (Offset = 3Ah) [reset = 0h]**

CHQST1 is shown in [Figure 23-37](#) and described in [Table 23-28](#).

Return to [Summary Table](#).

DMA Channel Q Status 1 Register

**Figure 23-37. CHQST1 Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
LCNT																BCNT															
R-0h																R-0h															

**Table 23-28. CHQST1 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	LCNT	R	0h	Current line number. Reset type: CPU1.SYSRSn
15-0	BCNT	R	0h	Current byte number. Reset type: CPU1.SYSRSn

**23.5.2.22 CHQST2 Register (Offset = 3Ch) [reset = 0h]**

 CHQST2 is shown in [Figure 23-38](#) and described in [Table 23-29](#).

 Return to [Summary Table](#).

DMA Channel Q Status 2 Register

**Figure 23-38. CHQST2 Register**

31	30	29	28	27	26	25	24
RESERVED							
R=0-0h							
23	22	21	20	19	18	17	16
RESERVED							
R=0-0h							
15	14	13	12	11	10	9	8
RESERVED							
R=0-0h							
7	6	5	4	3	2	1	0
WM		RESERVED			PEND	ACT	
R-0h		R=0-0h			R-0h	R-0h	

**Table 23-29. CHQST2 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-8	RESERVED	R=0	0h	Reserved
7-4	WM	R	0h	Watermark for FIFO block count for DMA Channel Q transfer.  For RX, this is a recording of the maximum FIFO Block Occupancy ever reached for a continuous transaction.  For TX, this is a simple capture of the FIFO Block Emptiness count every clock.  Reset type: CPU1.SYSRSn
3-2	RESERVED	R=0	0h	Reserved
1	PEND	R	0h	Status of DMA:  0: OK to write a new set of DMA descriptor.  1: Writing of new DMA descriptor is disallowed/ignored.  Reset type: CPU1.SYSRSn
0	ACT	R	0h	Status of DMA descriptor:  0: Descriptor is currently idle.  1: Descriptor is currently active (transferring data).  "PENDING" bit is used for descriptor programming allowance, while "ACTIVE" is used for indicating if a descriptor is being in use or not. Software should not use these bit to indicate "end-of-window" transfer condition (use the EOW status/interrupt instead).  For RX mode, this bit reflects if any of the 2 pending descriptors on the CBA clock domain is currently running.  For TX mode, this bit reflects if any of the 2 pending descriptors on the RPI clock domain is currently running.  A proper way to monitor this signal (after loading a descriptor) is to first wait for this ACTIVE signal to go active, then wait for this signal to go inactive. The deassertion of the ACTIVE signal indicates that the descriptor is completed.  Another side note is that the "DMA_STATUS" of PCR is a low-level monitoring signal for DMA VBUSP bus activity, while the PENDING, ACTIVE are higher-lever monitoring for descriptor status.  Reset type: CPU1.SYSRSn



**23.5.2.23 GINTEN Register (Offset = 40h) [reset = 0h]**

GINTEN is shown in [Figure 23-39](#) and described in [Table 23-30](#).

Return to [Summary Table](#).

Global Peripheral Interrupt Enable Register

**Figure 23-39. GINTEN Register**

31	30	29	28	27	26	25	24
RESERVED							
R=0-0h							
23	22	21	20	19	18	17	16
RESERVED							
R=0-0h							
15	14	13	12	11	10	9	8
RESERVED							
R=0-0h							
7	6	5	4	3	2	1	0
RESERVED							GINTEN
R=0-0h							R/W-0h

**Table 23-30. GINTEN Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-1	RESERVED	R=0	0h	Reserved
0	GINTEN	R/W	0h	0 = uPP does not generate interrupt. 1= uPP generates interrupt to if interrupt flag gets set. Reset type: CPU1.SYSRSn

**23.5.2.24 GINTFLG Register (Offset = 42h) [reset = 0h]**

GINTFLG is shown in [Figure 23-40](#) and described in [Table 23-31](#).

Return to [Summary Table](#).

Global Peripheral Interrupt Flag Register

**Figure 23-40. GINTFLG Register**

31	30	29	28	27	26	25	24
RESERVED							
R=0-0h							
23	22	21	20	19	18	17	16
RESERVED							
R=0-0h							
15	14	13	12	11	10	9	8
RESERVED							
R=0-0h							
7	6	5	4	3	2	1	0
RESERVED							GINTFLG
R=0-0h							R-0h

**Table 23-31. GINTFLG Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-1	RESERVED	R=0	0h	Reserved
0	GINTFLG	R	0h	0: No interrupt has been generated. 1: Interrupt has been generated. Reset type: CPU1.SYSRSn

**23.5.2.25 GINTCLR Register (Offset = 44h) [reset = 0h]**

GINTCLR is shown in [Figure 23-41](#) and described in [Table 23-32](#).

Return to [Summary Table](#).

Global Peripheral Interrupt Clear Register

**Figure 23-41. GINTCLR Register**

31	30	29	28	27	26	25	24
RESERVED							
R=0-0h							
23	22	21	20	19	18	17	16
RESERVED							
R=0-0h							
15	14	13	12	11	10	9	8
RESERVED							
R=0-0h							
7	6	5	4	3	2	1	0
RESERVED							GINTCLR
R=0-0h							R=0/W=1-0h

**Table 23-32. GINTCLR Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-1	RESERVED	R=0	0h	Reserved
0	GINTCLR	R=0/W=1	0h	Write '1' to this clears the flag in GINTFR. Read always returns '0'. Reset type: CPU1.SYSRSn

**23.5.2.26 DLYCTL Register (Offset = 46h) [reset = 1h]**

DLYCTL is shown in [Figure 23-42](#) and described in [Table 23-33](#).

Return to [Summary Table](#).

IO clock data skew control Register

**Figure 23-42. DLYCTL Register**

31	30	29	28	27	26	25	24
RESERVED							
R=0-0h							
23	22	21	20	19	18	17	16
RESERVED							
R=0-0h							
15	14	13	12	11	10	9	8
RESERVED							
R=0-0h							
7	6	5	4	3	2	1	0
RESERVED					DLYCTL		DLYDIS
R=0-0h					R/W-0h		R/W-1h

**Table 23-33. DLYCTL Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-3	RESERVED	R=0	0h	Reserved
2-1	DLYCTL	R/W	0h	Controls the delay on the input signals for uPP. 00: Data and control pins have 4 cycle dealy, clock pins have 2 cycle delay. 01: Data and control pins have 6 cycle dealy, clock pins have 2 cycle delay. 10: Data and control pins have 9 cycle dealy, clock pins have 2 cycle delay. 11: Data and control pins have 14 cycle dealy, clock pins have 2 cycle delay. Reset type: CPU1.SYSRSn
0	DLYDIS	R/W	1h	0: Dealy on pins are controlled by setting in DLYCTL field. 1: No extra dealy on pins. Reset type: CPU1.SYSRSn

## External Memory Interface (EMIF)

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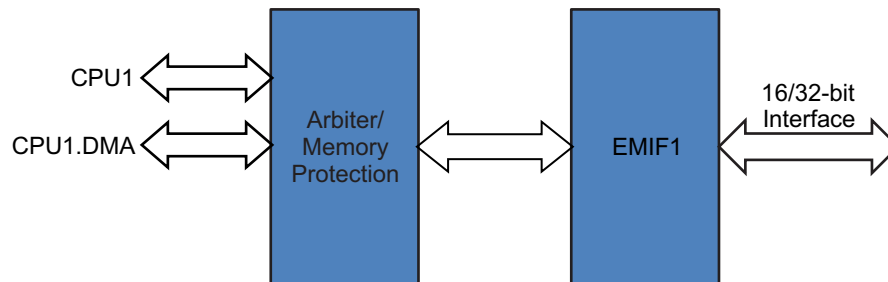
This chapter describes the external memory interface (EMIF).

Topic	Page
<b>24.1 Introduction</b> .....	<b>2470</b>
<b>24.2 Configuring Device Pins</b> .....	<b>2472</b>
<b>24.3 EMIF Module Architecture</b> .....	<b>2472</b>
<b>24.4 Example Configuration</b> .....	<b>2503</b>
<b>24.5 Registers</b> .....	<b>2511</b>

## 24.1 Introduction

This device supports one EMIF module — EMIF1. [Figure 24-1](#) represents the modules.

**Figure 24-1. EMIF Module Overview**



[Table 24-1](#) gives the configuration for the EMIF module .

**Table 24-1. Configuration for the EMIF1 Module**

EMIF1	
Max Data Width	32
Max Address Width	22 (Some of EMIF1 pins are muxed with each other. Please refer to the IO mux section for exact usage)
SDRAM CSx Support	1 (CS0)
ASRAM CSx Support	3 (CS2/CS3/CS4)

**NOTE:** On this device, if EMIF1 is chosen to have a 32-bit data width, EMIF2 cannot be used because EMIF2 data pins are muxed with EMIF1 MSB data pins.

### 24.1.1 Purpose of the Peripheral

This EMIF memory controller is compliant with the JESD21-C SDR SDRAM memories utilizing a 32-bit/16-bit data bus. The purpose of this EMIF is to provide a means for the CPU to connect to a variety of external devices including:

- Single data rate (SDR) SDRAM
- Asynchronous devices including NOR Flash and SRAM

A common use for the EMIF is to interface with both a flash device and an SDRAM device simultaneously. [Section 24.4](#) contains an example of operating the EMIF in this configuration.

### 24.1.2 Features

The EMIF controller includes many features to enhance the ease and flexibility of connecting to the external SDR SDRAM and asynchronous devices.

#### 24.1.2.1 Asynchronous Memory Support

The EMIF controller supports asynchronous:

- SRAM memories
- NOR Flash memories

There is an external wait input that allows slower asynchronous memories to extend the memory access. The EMIF module supports more than one chip select (enable). Each chip select has the following individually programmable attributes:

- Data bus width

- Read cycle timings: setup, hold, strobe
- Write cycle timings: setup, hold, strobe
- Bus turnaround time
- Extended wait option with programmable timeout
- Select strobe option

### 24.1.2.2 Synchronous DRAM Memory Support

The EMIF module supports 16-bit/32-bit SDRAM in addition to the asynchronous memories listed in [Section 24.1.2.1](#). It has a single SDRAM chip select. SDRAM configurations that are supported are:

- One, two and four bank SDRAM devices
- Devices with eight, nine, ten, and eleven column address
- CAS latency of two or three clock cycles
- 16-bit/32-bit data bus width
- 3.3V LVCMOS interface

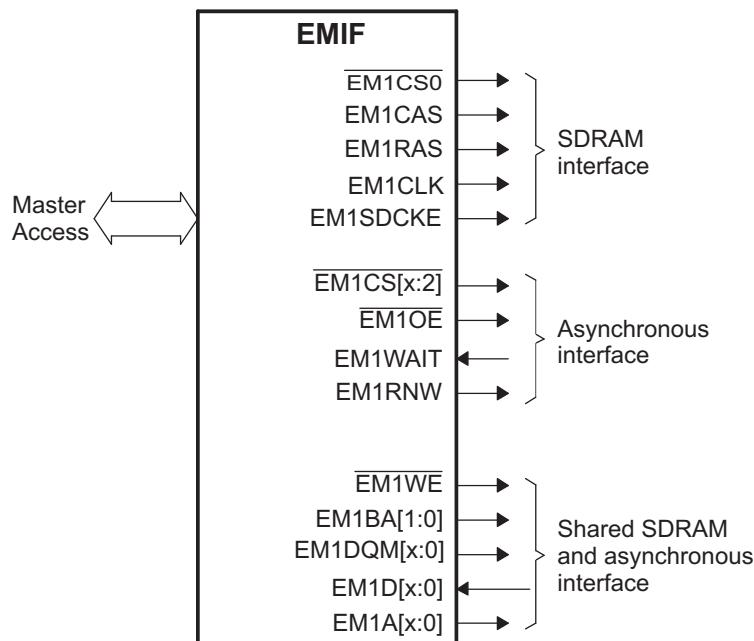
Additionally, the EMIF supports placing the SDRAM in self-refresh and power-down modes. The self-refresh mode allows the SDRAM to be put in a low-power state while still retaining memory contents, since the SDRAM will continue to refresh itself even without clocks from the microcontroller. The power-down mode achieves even lower power, except the microcontroller must periodically wake up and issue refreshes if data retention is required.

Note that the EMIF module does not support mobile SDRAM devices.

### 24.1.3 Functional Block Diagram

[Figure 24-2](#) illustrates the connections between the EMIF and its internal requesters, along with the external EMIF pins. [Section 24.3.2](#) contains a description of the entities internal to the MCU that can send requests to the EMIF, along with their prioritization. [Section 24.3.3](#) describes the EMIF external pins and summarizes their purpose when interfacing with the SDRAM and asynchronous devices.

**Figure 24-2. EMIF Functional Block Diagram**



## 24.2 Configuring Device Pins

The GPIO mux registers must be configured to connect this peripheral to the device pins. To avoid glitches on the pins, the GPyGMUX bits must be configured first (while keeping the corresponding GPyMUX bits at the default of zero), followed by writing the GPyMUX register to the desired value.

Some IO functionality is defined by GPIO register settings independent of this peripheral. For input signals, the GPIO input qualification should be set to asynchronous mode by setting the appropriate GPxQSELn register bits to 11b. The internal pullups can be configured in the GPyPUD register.

See the *GPIO* chapter for more details on GPIO mux and settings.

## 24.3 EMIF Module Architecture

This section provides details about the architecture and operation of the EMIF. Both the SDRAM and asynchronous interface are covered, along with other system-related configurations such as clock control.

### 24.3.1 EMIF Clock Control

The EMIF clock is output on the EM1CLK pin and should be used when interfacing to external SDRAM devices. The EMIF module gets the PLLSYSCLK clock domain as the input. The user can choose to run the EMIF at PLLSYSCLK/1 or PLLSYSCLK/2 clock frequency by configuring the EMIF1CLKDIV field in the PERCLKDIVSEL register in the *Clock Control* module.

### 24.3.2 EMIF Requests

Different sources within the MCU can make requests to the EMIF. These requests consist of accesses to the SDRAM memory, the asynchronous memory, and the EMIF registers. The EMIF can process only one request at a time. Therefore, a high performance master arbitration block exists within the MCU to provide prioritized requests from the different sources to the EMIF. The sources are:

- CPU1
- CPU1.DMA

If a request is submitted from two or more sources simultaneously, the crossbar switch will forward the highest priority request to the EMIF first. Upon completion of a request, the master arbitration block again evaluates the pending requests and forwards the highest priority pending request to the EMIF.

The master arbitration block always allows RD access from any of the masters. But for WR access (or execute access), the master arbitration block only allows access of masters from a CPU subsystem which grabs master ownership of the EMIF module based on the configuration in the EMIF1MSEL register in the *Memory Controller* module.

When the EMIF receives a request, it may or may not be immediately processed. In some cases, the EMIF will perform one or more auto refresh cycles before processing the request. For details on the EMIF's internal arbitration between performing requests and performing auto refresh cycles, see [Section 24.3.13](#).

### 24.3.3 EMIF Signal Descriptions

This section describes the function of each of the EMIF signals.

**Table 24-2. EMIF Pins Used to Access Both SDRAM and Asynchronous Memories**

Pins(s)	I/O	Description
EM1D[x:0]	I/O	<b>EMIF data bus.</b>
EM1A[x:0]	O	<b>EMIF address bus.</b> When interfacing to an SDRAM device, these pins are primarily used to provide the row and column address to the SDRAM. The mapping from the internal program address to the external values placed on these pins can be found in <a href="#">Table 24-14</a> . EM1A[10] is also used during the PRE command to select which banks to deactivate. When interfacing to an asynchronous device, these pins are used in conjunction with the EM1BA pins to form the address that is sent to the device. The mapping from the internal program address to the external values placed on these pins can be found in <a href="#">Section 24.3.6.1</a> .



**Table 24-2. EMIF Pins Used to Access Both SDRAM and Asynchronous Memories (continued)**

Pin(s)	I/O	Description
EM1BA[1:0]	O	<b>EMIF bank address.</b> When interfacing to an SDRAM device, these pins are used to provide the bank address inputs to the SDRAM. The mapping from the internal program address to the external values placed on these pins can be found in <a href="#">Table 24-14</a> . When interfacing to an asynchronous device, these pins are used in conjunction with the EM1A pins to form the address that is sent to the device. The mapping from the internal program address to the external values placed on these pins can be found in <a href="#">Section 24.3.6.1</a> .
EM1DQM[x:0]	O	<b>Active-low byte enables.</b> When interfacing to SDRAM, these pins are connected to the DQM pins of the SDRAM to individually enable/disable each of the bytes in a data access. When interfacing to an asynchronous device, these pins are connected to byte enables. See <a href="#">Section 24.3.6</a> for details.
EM1WE	O	<b>Active-low write enable.</b> When interfacing to SDRAM, this pin is connected to the nWE pin of the SDRAM and is used to send commands to the device. When interfacing to an asynchronous device, this pin provides a signal which is active-low during the strobe period of an asynchronous write access cycle.

**Table 24-3. EMIF Pins Specific to SDRAM**

Pin(s)	I/O	Description
EM1CS0	O	<b>Active-low chip enable pin for SDRAM devices.</b> This pin is connected to the chip-select pin of the attached SDRAM device and is used for enabling/disabling commands. By default, EMIF keeps this SDRAM chip select active, even if EMIF is not interfaced with an SDRAM device. This pin is deactivated when accessing the asynchronous memory bank and is reactivated on completion of the asynchronous access.
EM1RAS	O	<b>Active-low row address strobe pin.</b> This pin is connected to the nRAS pin of the attached SDRAM device and is used for sending commands to the device.
EM1CAS	O	<b>Active-low column address strobe pin.</b> This pin is connected to the nCAS pin of the attached SDRAM device and is used for sending commands to the device.
EM1SDCKE	O	<b>Clock enable pin.</b> This pin is connected to the CKE pin of the attached SDRAM device and is used for issuing the SELF REFRESH command which places the device in self-refresh mode. See <a href="#">Section 24.3.5.7</a> for details.
EM1CLK	O	<b>SDRAM clock pin.</b> This pin is connected to the CLK pin of the attached SDRAM device. See <a href="#">Section 24.3.1</a> for details on the clock signal.

**Table 24-4. EMIF Pins Specific to Asynchronous Memory**

Pin(s)	I/O	Description
EM1CS[4:2]	O	<b>Active-low chip enable pins for asynchronous devices.</b> These pins are meant to be connected to the chip-select pins of the attached asynchronous device. These pins are active only during accesses to the asynchronous memory.
EM1WAIT	I	<b>Wait input with programmable polarity.</b> A connected asynchronous device can extend the strobe period of an access cycle by asserting the EM1WAIT input to EMIF as described in <a href="#">Section 24.3.6.6</a> . To enable this functionality, the EW bit in the asynchronous 1 configuration register (ASYNC_CS2_CFG) must be set to 1. In addition, the WPO bit in ASYNC_CS2_CFG must be configured to define the polarity of the EM1WAIT pin.
EM1OE	O	<b>Active-low pin enable for asynchronous devices.</b> This pin provides a signal which is active-low during the strobe period of an asynchronous read access cycle.
EM1RNW	O	<b>EMIF asynchronous read/write control.</b> This pin stays high during reads and stays low during writes (same duration as CS).

### 24.3.4 EMIF Signal Multiplexing Control

Several EMIF signals are multiplexed with other functions on this microcontroller. Please refer to the multiplexing section of the *GPIO* chapter for more information on how to enable the output of these EMIF signals.

### 24.3.5 SDRAM Controller and Interface

The EMIF controller provides a glueless interface to most standard SDR SDRAM devices and supports features like self-refresh mode and prioritized refresh. In addition, it provides flexibility through programmable parameters such as the refresh rate, CAS latency, and many SDRAM timing parameters. The following sections include details on how to interface and properly configure the EMIF to perform read and write operations to externally connected SDR SDRAM devices. Also, [Section 24.4](#) provides a detailed example of interfacing the EMIF to a common SDRAM device.

#### 24.3.5.1 SDRAM Commands

The EMIF controller supports the SDRAM commands described in [Table 24-5](#). [Table 24-6](#) shows the truth table for the SDRAM commands, and an example timing waveform of the PRE command is shown in [Figure 24-3](#). EM1A[10] is pulled low in this example to deactivate only the bank specified by the EM1BA pins.

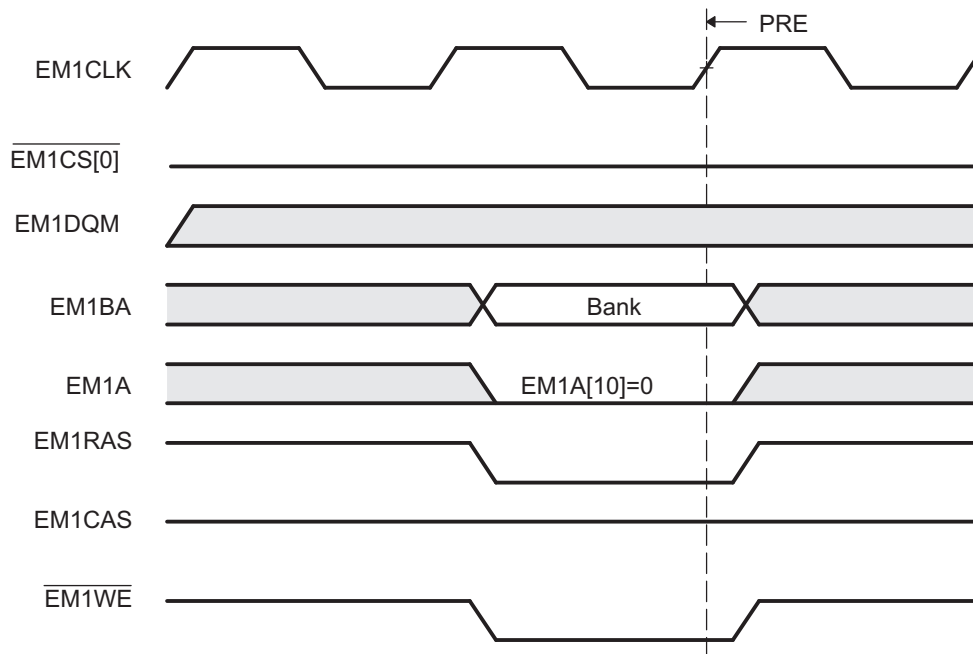
**Table 24-5. EMIF SDRAM Commands**

Command	Function
PRE	<b>Precharge.</b> Depending on the value of EM1A[10], the PRE command either deactivates the open row in all banks (EM1A[10] = 1) or only the bank specified by the EM1BA[1:0] pins (EM1A[10] = 0).
ACTV	<b>Activate.</b> The ACTV command activates the selected row in a particular bank for the current access.
READ	<b>Read.</b> The READ command outputs the starting column address and signals the SDRAM to begin the burst read operation. Address EM1A[10] is always pulled low to avoid auto precharge. This allows for better bank interleaving performance.
WRT	<b>Write.</b> The WRT command outputs the starting column address and signals the SDRAM to begin the burst write operation. Address EM1A[10] is always pulled low to avoid auto precharge. This allows for better bank interleaving performance.
BT	<b>Burst terminate.</b> The BT command is used to truncate the current read or write burst request.
LMR	<b>Load mode register.</b> The LMR command sets the mode register of the attached SDRAM devices and is only issued during the SDRAM initialization sequence described in <a href="#">Section 24.3.5.4</a> .
REFR	<b>Auto refresh.</b> The REFR command signals the SDRAM to perform an auto refresh according to its internal address.
SLFR	<b>Self refresh.</b> The self-refresh command places the SDRAM into self-refresh mode, during which it provides its own clock signal and auto refresh cycles.
NOP	<b>No operation.</b> The NOP command is issued during all cycles in which one of the above commands is not issued.

**Table 24-6. Truth Table for SDRAM Commands**

SDRAM Pins:	CKE	nCS	nRAS	nCAS	nWE	BA[1:0]	A[12:11]	A[10]	A[9:0]
EMIF Pins:	EM1SDCKE	EM1TCS[0]	EM1RAS	EM1CAS	EM1WE	EM1BA[1:0]	EM1A[12:11]	EM1A[10]	EM1A[9:0]
PRE	H	L	L	H	L	Bank/X	X	L/H	X
ACTV	H	L	L	H	H	Bank	Row	Row	Row
READ	H	L	H	L	H	Bank	Column	L	Column
WRT	H	L	H	L	L	Bank	Column	L	Column
BT	H	L	H	H	L	X	X	X	X
LMR	H	L	L	L	L	X	Mode	Mode	Mode
REFR	H	L	L	L	H	X	X	X	X
SLFR	L	L	L	L	H	X	X	X	X
NOP	H	L	H	H	H	X	X	X	X

Figure 24-3. Timing Waveform of SDRAM PRE Command



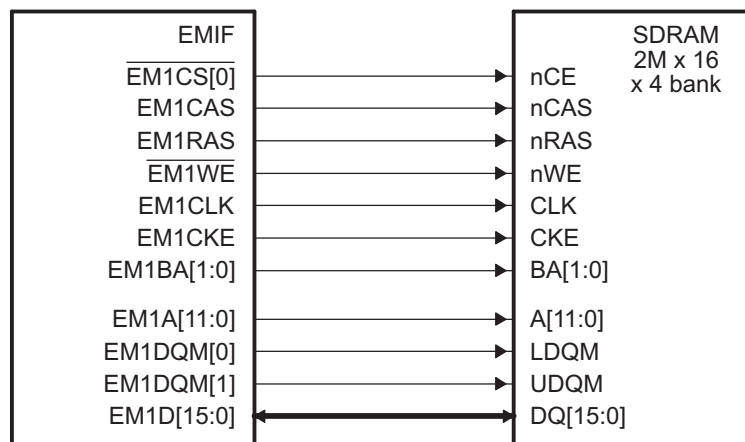
### 24.3.5.2 Interfacing to SDRAM

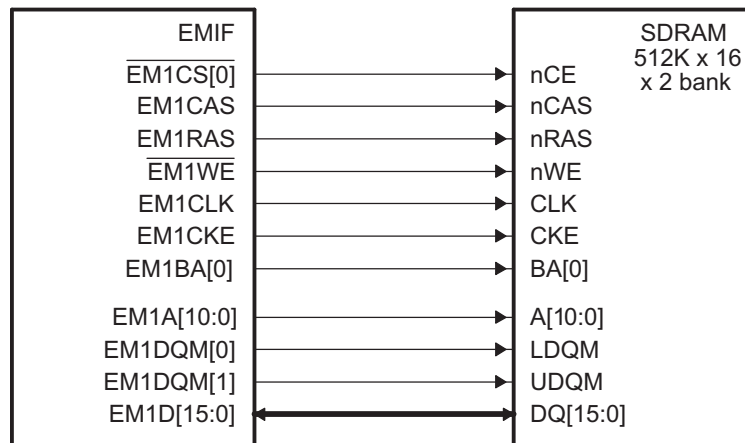
The EMIF supports a glueless interface to SDRAM devices with the following characteristics:

- Pre-charge bit is A[10]
- The number of column address bits is 8, 9, 10, or 11.
- The number of row address bits is 13, 14, 15, or 16.
- The number of internal banks is 1, 2, or 4.

Figure 24-4 shows an interface between the EMIF and a 2M x 16 x 4 bank SDRAM device, and Figure 24-5 shows an interface between the EMIF and a 512K x 16 x 2 bank SDRAM device. For devices supporting 16-bit interface, refer to Table 24-7 for list of commonly-supported SDRAM devices and the required connections for the address pins.

Figure 24-4. EMIF to 2M x 16 x 4 bank SDRAM Interface



**Figure 24-5. EMIF to 512K x 16 x 2 bank SDRAM Interface**

**Table 24-7. 16-bit EMIF Address Pin Connections**

SDRAM Size	Width	Banks	Device	Address Pins
16M bits	x16	2	SDRAM	A[10:0]
			EMIF	EM1A[10:0]
64M bits	x16	4	SDRAM	A[11:0]
			EMIF	EM1A[11:0]
128M bits	x16	4	SDRAM	A[11:0]
			EMIF	EM1A[11:0]
256M bits	x16	4	SDRAM	A[12:0]
			EMIF	EM1A[12:0]
512M bits	x16	4	SDRAM	A[12:0]
			EMIF	EM1A[12:0]

### 24.3.5.3 SDRAM Configuration Registers

The operation of the EMIF's SDRAM interface is controlled by programming the appropriate configuration registers. This section describes the purpose and function of each configuration register, but [Section 24.5](#) should be referred for a more detailed description of each register, including the default registers values and bit-field positions. The following tables list the four such configuration registers, along with a description of each of their programmable fields.

**NOTE:** Writing to any of the fields: NM, CL, IBANK, and PAGESIZE in the SDRAM configuration register (SDRAM\_CR) causes the EMIF to abandon whatever it is currently doing and trigger the SDRAM initialization procedure described in [Section 24.3.5.4](#).

**Table 24-8. Description of the SDRAM Configuration Register (SDRAM\_CR)**

Parameter	Description
SR	This bit controls entering and exiting of the self-refresh mode
PD	This bit controls entering and exiting of the power-down mode. If both SR and PD bits are set, the EMIF will go into self-refresh mode.
PDWR	Perform refreshes during power Down. Writing a 1 to this bit will cause the EMIF to exit the power down state and issue an AUTO REFRESH command every time Refresh May level is set. This bit should be set along with PD when entering power-down mode.
NM	<b>Narrow Mode.</b> This bit defines the width of the data bus between the EMIF and the attached SDRAM device. When set to 1, the data bus is set to 16-bits. When set to 0, the data bus is set to 32-bits.
CL	<b>CAS latency.</b> This field defines the number of clock cycles between when an SDRAM issues a READ command and when the first piece of data appears on the bus. The value in this field is sent to the attached SDRAM device via the LOAD MODE REGISTER command during the SDRAM initialization procedure as described in <a href="#">Section 24.3.5.4</a> . Only, values of 2h (CAS latency = 2) and 3h (CAS latency = 3) are supported and should be written to this field. While updating the CL field, BIT11_9LOCK bit field must be set to '1' simultaneously.
IBANK	<b>Number of Internal SDRAM Banks.</b> This field defines the number of banks inside the attached SDRAM devices in the following way: <ul style="list-style-type: none"> <li>When IBANK = 0, 1 internal bank is used</li> <li>When IBANK = 1h, 2 internal banks are used</li> <li>When IBANK = 2h, 4 internal banks are used</li> </ul> This field value affects the mapping of logical addresses to the SDRAM row, column, and bank addresses. See <a href="#">Section 24.3.5.11</a> for details.
PAGESIZE	<b>Page Size.</b> This field defines the internal page size of the attached SDRAM devices in the following way: <ul style="list-style-type: none"> <li>When PAGESIZE = 0, 256-word pages are used</li> <li>When PAGESIZE = 1h, 512-word pages are used</li> <li>When PAGESIZE = 2h, 1024-word pages are used</li> <li>When PAGESIZE = 3h, 2048-word pages are used</li> </ul> This field value affects the mapping of logical addresses to the SDRAM row, column, and bank addresses. See <a href="#">Section 24.3.5.11</a> for details.

**Table 24-9. Description of the SDRAM Refresh Control Register (SDRAM\_RCR)**

Parameter	Description
RR	<b>Refresh Rate.</b> This field controls the rate at which attached SDRAM devices will be refreshed. The following equation can be used to determine the required value of RR for an SDRAM device: <ul style="list-style-type: none"> <li><math>RR = f_{EM1CLK} / (\text{Required SDRAM Refresh Rate})</math></li> </ul> More information about the operation of the SDRAM refresh controller can be found in <a href="#">Section 24.3.5.6</a> .

**Table 24-10. Description of the SDRAM Timing Register (SDRAM\_TR)**

Parameter	Description
T_RFC	<b>SDRAM Timing Parameters.</b> These fields configure the EMIF to comply with the AC timing requirements of the attached SDRAM devices. This allows the EMIF to avoid violating SDRAM timing constraints and to more efficiently schedule its operations. More details about each of these parameters can be found in the SDRAM_TR register description. These parameters should be set to satisfy the corresponding timing requirements found in the SDRAM data sheet.
T_RP	
T_RCD	
T_WR	
T_RAS	
T_RC	
T_RRD	

**Table 24-11. Description of the SDRAM Self Refresh Exit Timing Register (SDR\_EXT\_TMNG)**

Parameter	Description
T_XS	<b>Self Refresh Exit Parameter.</b> The T_XS field of this register informs the EMIF about the minimum number of EM1CLK cycles required between exiting self-refresh and issuing any command. This parameter should be set to satisfy the $t_{XSR}$ value for the attached SDRAM device.

#### 24.3.5.4 SDRAM Auto-Initialization Sequence

The EMIF automatically performs an SDRAM initialization sequence, regardless of whether it is interfaced to an SDRAM device, when either of the following two events occur:

- The EMIF comes out of reset. No memory accesses to the SDRAM and asynchronous interfaces are performed until this auto-initialization is complete.
- A write is performed to any of the three least significant bytes of the SDRAM configuration register (SDRAM\_CR)

An SDRAM initialization sequence consists of the following steps:

1. If the initialization sequence is activated by a write to SDRAM\_CR, and if any of the SDRAM banks are open, the EMIF issues a PRE command with EM1A[10] held high to indicate all banks. This is done so that the maximum ACTV to PRE timing for an SDRAM is not violated.
2. The EMIF drives EM1SDCKE high and begins continuously issuing NOP commands until eight SDRAM refresh intervals have elapsed. An SDRAM refresh interval is equal to the value of the RR field of the SDRAM refresh control register (SDRAM\_RCR), divided by the frequency of EM1CLK ( $RR/f_{EM1CLK}$ ). This step is used to avoid violating the power-up constraint of most SDRAM devices that requires 200  $\mu$ s (sometimes 100  $\mu$ s) between receiving stable Vdd and CLK and the issuing of a PRE command. Depending on the frequency of EM1CLK, this step may or may not be sufficient to avoid violating the SDRAM constraint. See [Section 24.3.5.5](#) for more information.
3. After the refresh intervals have elapsed, the EMIF issues a PRE command with EM1A[10] held high to indicate all banks.
4. The EMIF issues eight AUTO REFRESH commands.
5. The EMIF issues the LMR command with the EM1A[9:0] pins set as described in [Table 24-12](#).
6. Finally, the EMIF performs a refresh cycle, which consists of the following steps:
  - a. Issuing a PRE command with EM1A[10] held high if any banks are open
  - b. Issuing an REF command

**Table 24-12. SDRAM LOAD MODE REGISTER Command**

EM1A[9:7]	EM1A[6:4]	EM1A[3]	EM1A[2:0]
0 (Write bursts are of the programmed burst length in EM1A[2:0])	These bits control the CAS latency of the SDRAM and are set according to CL field in the SDRAM configuration register (SDRAM_CR) as follows: <ul style="list-style-type: none"> <li>If CL = 2, EM1A[6:4] = 2h (CAS latency = 2)</li> <li>If CL = 3, EM1A[6:4] = 3h (CAS latency = 3)</li> </ul>	0 (Sequential Burst Type. Interleaved Burst Type not supported)	These bits control the burst length of the SDRAM and are set according to the NM field in the SDRAM configuration register (SDRAM_CR) as follows: <ul style="list-style-type: none"> <li>If NM = 0, EM1A[2:0] = 2h (Burst Length = 4)</li> <li>If NM = 1, EM1A[2:0] = 3h (Burst Length = 8)</li> </ul>

### 24.3.5.5 SDRAM Configuration Procedure

There are two different SDRAM configuration procedures. Although the EMIF automatically performs the SDRAM initialization sequence described in [Section 24.3.5.4](#) when coming out of reset, it is recommended to follow one of the procedures listed below before performing any EMIF memory requests. Procedure A should be followed if it is determined that the SDRAM power-up constraint was not violated during the SDRAM auto-initialization sequence detailed in [Section 24.3.5.4](#) on coming out of Reset. The SDRAM power-up constraint specifies that 200  $\mu$ s (sometimes 100  $\mu$ s) should exist between receiving stable V<sub>dd</sub> and CLK and the issuing of a PRE command. Procedure B should be followed if the SDRAM power-up constraint was violated. The 200  $\mu$ s (100  $\mu$ s) SDRAM power-up constraint will be violated if the frequency of EM1CLK is greater than 50 MHz (100 MHz for 100  $\mu$ s SDRAM power-up constraint) during SDRAM Auto-Initialization Sequence. Procedure B should be followed if there is any doubt that the power-up constraint was not met.

**Procedure A** — Following is the procedure to be followed if the SDRAM power-up constraint was NOT violated:

1. Place the SDRAM into self-refresh mode by setting the SR bit of SDRAM\_CR to 1. The SDRAM should be placed into self-refresh mode when changing the frequency of the EM1CLK to avoid incurring the 200  $\mu$ s power-up constraint again.
2. Configure the desired EMIF1 clock (EM1CLK) frequency. The frequency of the memory clock must meet the timing requirements in the SDRAM manufacturer's documentation and the timing limitations shown in the electrical specifications of the device data manual.
3. Remove the SDRAM from self-refresh Mode by clearing the SR bit of the SDRAM\_CR to 0.
4. Program SDRAM\_TR and SDR\_EXT\_TMNG to satisfy the timing requirements for the attached SDRAM device. The timing parameters should be taken from the SDRAM data sheet.
5. Program the RR field of SDRAM\_RCR to match that of the attached device's refresh interval. See [Section 24.3.5.6.1](#) details on determining the appropriate value.
6. Program the SDRAM\_CR to match the characteristics of the attached SDRAM device. This will cause the auto-initialization sequence in [Section 24.3.5.4](#) to be re-run. This second initialization generally takes much less time due to the increased frequency of EM1CLK.

**Procedure B** — Following is the procedure to be followed if the SDRAM power-up constraint was violated:

1. Configure the desired EM1CLK clock frequency. The frequency of the memory clock must meet the timing requirements in the SDRAM manufacturer's documentation and the timing limitations shown in the electrical specifications of the device data manual.
2. Program SDRAM\_TR and SDR\_EXT\_TMNG to satisfy the timing requirements for the attached SDRAM device. The timing parameters should be taken from the SDRAM data sheet.
3. Program the RR field of the SDRAM\_RCR such that the following equation is satisfied:  $(RR \times 8)/(f_{EM1CLK}) > 200 \mu\text{s}$  (sometimes 100  $\mu$ s). For example, an EM1CLK frequency of 100 MHz would require setting RR to 2501 (9C5h) or higher to meet a 200  $\mu$ s constraint.
4. Program the SDRAM\_CR to match the characteristics of the attached SDRAM device. This will cause the auto-initialization sequence in [Section 24.3.5.4](#) to be re-run with the new value of RR.



5. Perform a read from the SDRAM to assure that step 5 of this procedure will occur after the initialization process has completed. Alternatively, wait for 200  $\mu$ s instead of performing a read.
6. Finally, program the RR field to match that of the attached device's refresh interval. See [Section 24.3.5.6.1](#) details on determining the appropriate value.

After following the above procedure, the EMIF is ready to perform accesses to the attached SDRAM device.

### 24.3.5.6 EMIF Refresh Controller

An SDRAM device requires that each of its rows be refreshed at a minimum required rate. The EMIF can meet this constraint by performing auto refresh cycles at or above this required rate. An auto-refresh cycle consists of issuing a PRE command to all banks of the SDRAM device followed by issuing a REFR command. To inform the EMIF of the required rate for performing auto refresh cycles, the RR field of the SDRAM refresh control register (SDRAM\_RCR) must be programmed. The EMIF will use this value along with two internal counters to automatically perform auto refresh cycles at the required rate. The auto-refresh cycles cannot be disabled, even if the EMIF is not interfaced with an SDRAM. The remainder of this section details the EMIF's refresh scheme and provides an example for determining the appropriate value to place in the RR field of the SDRAM\_RCR.

The two counters used to perform auto-refresh cycles are a 13-bit refresh interval counter and a 4-bit refresh backlog counter. At reset and upon writing to the RR field, the refresh interval counter is loaded with the value from RR field and begins decrementing, by one, each EMIF clock cycle. When the refresh interval counter reaches zero, the following actions occur:

- The refresh interval counter is reloaded with the value from the RR field and restarts decrementing.
- The 4-bit refresh backlog counter increments unless it has already reached its maximum value.

The refresh backlog counter records the number of auto refresh cycles that the EMIF currently has outstanding. This counter is decremented by one each time an auto refresh cycle is performed and incremented by one each time the refresh interval counter expires. The refresh backlog counter saturates at the values of 0000b and 1111b. The EMIF uses the refresh backlog counter to determine the urgency with which an auto refresh cycle should be performed. The four levels of urgency are described in [Table 24-13](#). This refresh scheme allows the required refreshes to be performed with minimal impact on access requests.

**Table 24-13. Refresh Urgency Levels**

Urgency Level	Refresh Backlog Counter Range	Action Taken
Refresh May	1-3	An auto-refresh cycle is performed only if the EMIF has no requests pending and none of the SDRAM banks are open.
Refresh Release	4-7	An auto-refresh cycle is performed if the EMIF has no requests pending, regardless of whether any SDRAM banks are open.
Refresh Need	8-11	An auto-refresh cycle is performed at the completion of the current access unless there are read requests pending.
Refresh Must	12-15	Multiple auto-refresh cycles are performed at the completion of the current access until the Refresh Release urgency level is reached. At that point, the EMIF can begin servicing any new read or write requests.



### 24.3.5.6.1 Determining the Appropriate Value for the RR Field

The value that should be programmed into the RR field of the SDRAM\_RCR can be calculated by using the frequency of the EM1CLK signal ( $f_{EM1CLK}$ ) and the required refresh rate of the SDRAM ( $f_{Refresh}$ ). The following formula can be used:

$$RR = f_{EM1CLK} / f_{Refresh}$$

The SDRAM data sheet often communicates the required SDRAM Refresh Rate in terms of the number of REFR commands required in a given time interval. The required SDRAM Refresh Rate in the formula above can therefore be calculated by dividing the number of required cycles per time interval ( $n_{cycles}$ ) by the time interval given in the data manual ( $t_{Refresh\ Period}$ ):

$$f_{Refresh} = n_{cycles} / t_{Refresh\ Period}$$

Combining these formulas, the value that should be programmed into the RR field can be computed as:

$$RR = f_{EM1CLK} \times t_{Refresh\ Period} / n_{cycles}$$

The following example illustrates calculating the value of RR. Given that:

- $f_{EM1CLK} = 100\text{ MHz}$  (frequency of EMIF clock)
- $t_{Refresh\ Period} = 64\text{ ms}$  (required refresh interval of the SDRAM)
- $n_{cycles} = 8192$  (number of cycles in a refresh interval for the SDRAM)

RR can be calculated as:

$$RR = 100\text{ MHz} \times 64\text{ ms} / 8192$$

$$RR = 781.25$$

$$RR = 782\text{ cycles} = 30\text{Eh cycles}$$

### 24.3.5.7 Self-Refresh Mode

The EMIF can be programmed to enter the self-refresh state by setting the SR bit of SDRAM\_CR to 1. This will cause the EMIF to issue the SLFR command after completing any outstanding SDRAM access requests and clearing the refresh backlog counter by performing one or more auto refresh cycles. This places the attached SDRAM device into self-refresh mode in which it consumes a minimal amount of power while performing its own refresh cycles.

While in the self-refresh state, the EMIF continues to service asynchronous bank requests and register accesses as normal, with one caveat. The EMIF will not park the data bus following a read to asynchronous memory while in the self-refresh state. Instead, the EMIF tri-states the data bus. Therefore, it is not recommended to perform asynchronous read operations while the EMIF is in the self-refresh state, in order to prevent floating inputs on the data bus. More information about data bus parking can be found in [Section 24.3.7](#).

The EMIF will exit from the self-refresh state if either of the following events occur:

- The SR bit of SDRAM\_CR is cleared to 0.
- An SDRAM accesses is requested.

The EMIF exits from the self-refresh state by driving EM1SDCKE high and performing an auto refresh cycle.

The attached SDRAM device should also be placed into self-refresh mode when changing the frequency of EM1CLK. If the frequency of EM1CLK changes while the SDRAM is not in self-refresh mode, Procedure B in [Section 24.3.5.5](#) should be followed to reinitialize the device.

### 24.3.5.8 Power Down Mode

To support low-power modes, the EMIF can be requested to issue a POWER DOWN command to the SDRAM by setting the PD bit in the SDRAM configuration register (SDRAM\_CR). When this bit is set, the EMIF will continue normal operation until all outstanding memory access requests have been serviced and the SDRAM refresh backlog (if there is one) has been cleared. At this point the EMIF will enter the power-down state. Upon entering this state, the EMIF will issue a POWER DOWN command (same as a NOP command but driving the EM1SDCKE low on the same cycle). The EMIF then maintains the EM1SDCKE low until it exits the power-down state.

Since the EMIF services the refresh backlog before it enters the power-down state, all internal banks of the SDRAM are closed (precharged) prior to issuing the POWER DOWN command. Therefore, the EMIF only supports precharge power-down. The EMIF does not support active power-down, where internal banks of the SDRAM are open (active) before the POWER DOWN command is issued.

During the power-down state, the EMIF services the SDRAM, asynchronous memory, and register accesses as normal, returning to the power-down state upon completion.

The PDWR bit in the SDRAM\_CR indicates whether the EMIF should perform refreshes in power-down state. If the PDWR bit is set, the EMIF exits the power-down state every time the Refresh Must level is set, performs AUTO REFRESH commands to the SDRAM, and returns back to the power-down state. This evenly distributes the refreshes to the SDRAM in power-down state. If the PDWR bit is not set, the EMIF does not perform any refreshes to the SDRAM. Therefore, the data integrity of the SDRAM is not assured upon power-down exit if the PDWR bit is not set.

If the PD bit is cleared while in the power-down state, the EMIF will come out of the power-down state. The EMIF:

- Drives EM1SDCKE high
- Enters its idle state

### 24.3.5.9 SDRAM Read Operation

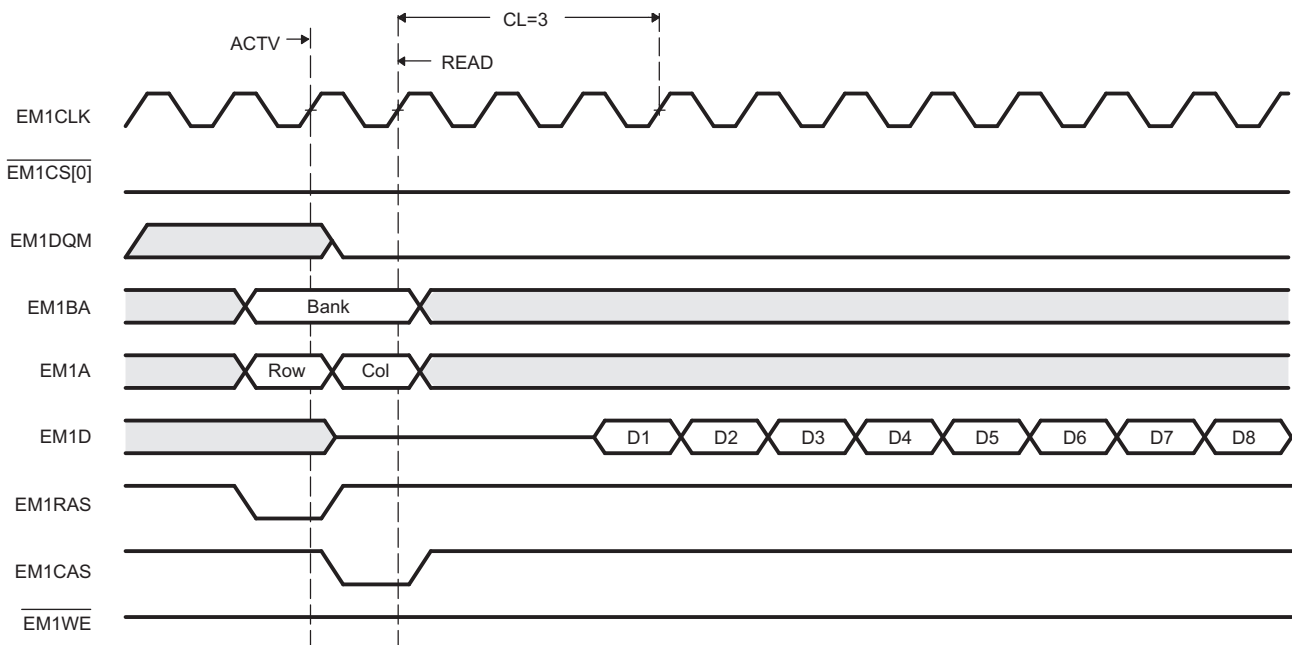
When the EMIF receives a read request to the SDRAM from one of the requesters listed in [Section 24.3.2](#), it performs one or more read access cycles. A read access cycle begins with the issuing of the ACTV command to select the desired bank and row of the SDRAM device. After the row has been opened, the EMIF proceeds to issue a READ command while specifying the desired bank and column address. EM1A[10] is held low during the READ command to avoid auto-precharging. The READ command signals the SDRAM device to start bursting data from the specified address while EMIF issues NOP commands. Following a READ command, the CL field of the SDRAM configuration register (SDRAM\_CR) defines how many delay cycles will be present before the read data appears on the data bus. This is referred to as the CAS latency.

[Figure 24-6](#) shows the signal waveforms for a basic SDRAM read operation in which a burst of data is read from a single page. When the EMIF SDRAM interface is configured to 16-bit by setting the NM bit of the SDRAM configuration register (SDRAM\_CR) to 1, a burst size of eight is used. [Figure 24-6](#) shows a burst size of eight.

The EMIF will truncate a series of bursting data if the remaining addresses of the burst are not required to complete the request. The EMIF can truncate the burst in three ways:

- By issuing another READ to the same page in the same bank.
- By issuing a PRE command in order to prepare for accessing a different page of the same bank.
- By issuing a BT command in order to prepare for accessing a page in a different bank.

**Figure 24-6. Timing Waveform for Basic SDRAM Read Operation**



Several other pins are also active during a read access. The EM1DQM[x:0] pins are driven low during the READ commands and are kept low during the NOP commands that correspond to the burst request. The state of the other EMIF pins during each command can be found in [Table 24-6](#).

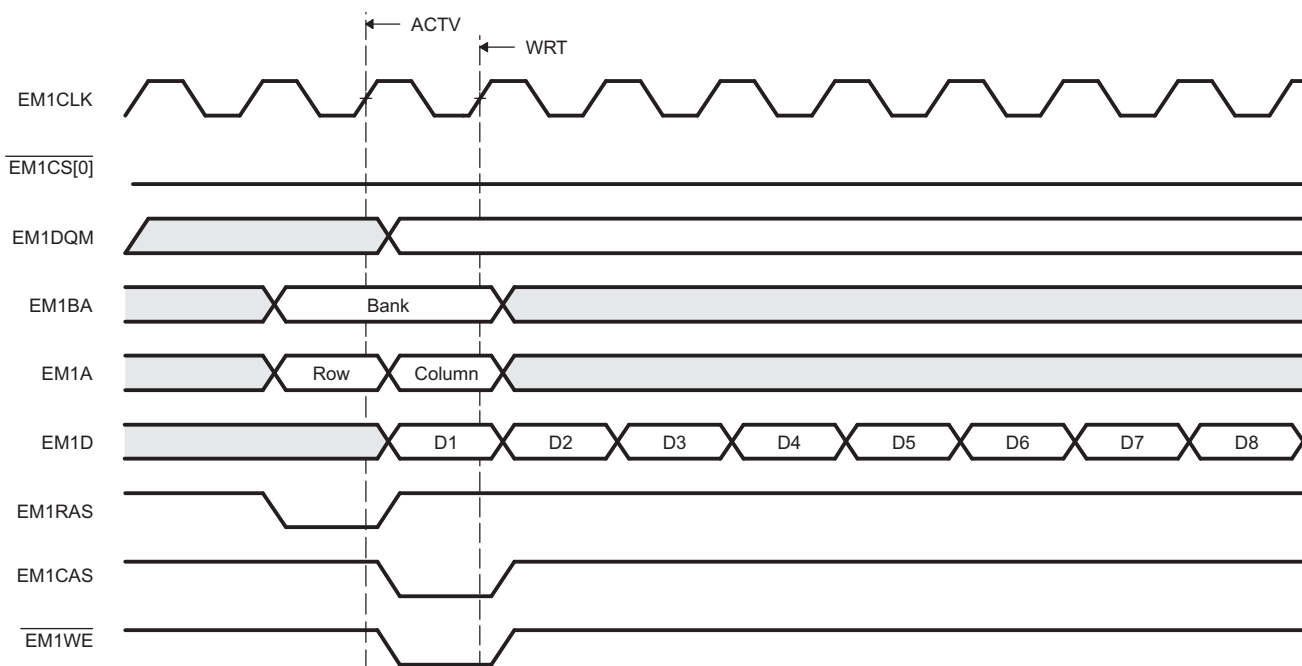
The EMIF schedules its commands based on the timing information that is provided to it in the SDRAM timing register (SDRAM\_TR). The values for the timing parameters in this register should be chosen to satisfy the timing requirements listed in the SDRAM data manual. The EMIF uses this timing information to avoid violating any timing constraints related to issuing commands. This is commonly accomplished by inserting NOP commands between various commands during an access. Refer to the register description of SDRAM\_TR in the SDTIMER register for more details on the various timing parameters.

### 24.3.5.10 SDRAM Write Operations

When the EMIF receives a write request to SDRAM from one of the requesters listed in [Section 24.3.2](#), it performs one or more write-access cycles. A write-access cycle begins with the issuing of the ACTV command to select the desired bank and row of the SDRAM device. After the row has been opened, the EMIF proceeds to issue a WRT command while specifying the desired bank and column address. EM1A[10] is held low during the WRT command to avoid auto-precharging. The WRT command signals the SDRAM device to start writing a burst of data to the specified address while the EMIF issues NOP commands. The associated write data will be placed on the data bus in the cycle concurrent with the WRT command and with subsequent burst continuation NOP commands.

[Figure 24-7](#) shows the signal waveforms for a basic SDRAM write operation in which a burst of data is read from a single page. When the EMIF SDRAM interface is configured to 16-bit by setting the NM bit of the SDRAM configuration register (SDRAM\_CR) to 1, a burst size of eight is used. [Figure 24-7](#) shows a burst size of eight.

**Figure 24-7. Timing Waveform for Basic SDRAM Write Operation**



The EMIF will truncate a series of bursting data if the remaining addresses of the burst are not part of the write request. The EMIF can truncate the burst in three ways:

- By issuing another WRT to the same page
- By issuing a PRE command in order to prepare for accessing a different page of the same bank
- By issuing a BT command in order to prepare for accessing a page in a different bank

Several other pins are also active during a write access. The EM1DQM[x:0] pins are driven to select which bytes of the data word will be written to the SDRAM device. They are also used to mask out entire undesired data words during a burst access. The state of the other EMIF pins during each command can be found in [Table 24-6](#).

The EMIF schedules its commands based on the timing information that is provided to it in the SDRAM timing register (SDRAM\_TR). The values for the timing parameters in this register should be chosen to satisfy the timing requirements listed in the SDRAM data sheet. The EMIF uses this timing information to avoid violating any timing constraints related to issuing commands. This is commonly accomplished by inserting NOP commands during various cycles of an access. Refer to the register description of SDRAM\_TR in the SDTIMR register for more details on the various timing parameters.

### 24.3.5.11 Mapping from Logical Address to EMIF Pins: Changed EM1DQM[1:0] to ED

When the EMIF receives an SDRAM access request, it must convert the address of the access into the appropriate signals to send to the SDRAM device. The details of this address mapping are shown in [Table 24-14](#) for 16-bit operation. Using the settings of the IBANK and PAGESIZE fields of the SDRAM configuration register (SDRAM\_CR), the EMIF determines which bits of the logical address will be mapped to the SDRAM row, column, and bank addresses.

As the logical address is incremented by one halfword (16-bit operation), the column address is likewise incremented by one until a page boundary is reached. When the logical address increments across a page boundary, the EMIF moves into the same page in the next bank of the attached device by incrementing the bank address EM1BA and resetting the column address. The page in the previous bank is left open until it is necessary to close it. This method of traversal through the SDRAM banks helps maximize the number of open banks inside of the SDRAM and results in an efficient use of the device. There is no limitation on the number of banks that can be open at one time, but only one page within a bank can be open at a time.

The EMIF uses the EM1DQM[3:0] pins during a WRT command to mask out selected bytes or entire words. The EM1DQM[3:0] pins are always low during a READ command.

**Table 24-14. Mapping from Logical Address to EMIF Pins for 32-bit SDRAM**

IBANK	PAGESIZE	Logical Address													
		31:27	26	25	24	23	22	21:14	13	12	11	10	9	8:1	0
0	0	Row Address											Col Address	EM1DQM[0]/EM1DQM[1]	
1	0	Row Address											EM1BA[0]	Col Address	EM1DQM[0]/EM1DQM[1]
2	0	Row Address											EM1BA[1:0]	Col Address	EM1DQM[0]/EM1DQM[1]
0	1	Row Address											Column Address		EM1DQM[0]/EM1DQM[1]
1	1	Row Address											EM1BA[0]	Column Address	EM1DQM[0]/EM1DQM[1]
2	1	Row Address											EM1BA[1:0]	Column Address	EM1DQM[0]/EM1DQM[1]
0	2	Row Address											Column Address		EM1DQM[0]/EM1DQM[1]
1	2	Row Address											EM1BA[0]	Column Address	EM1DQM[0]/EM1DQM[1]
2	2	Row Address											EM1BA[1:0]	Column Address	EM1DQM[0]/EM1DQM[1]
0	3	Row Address											Column Address		EM1DQM[0]/EM1DQM[1]
1	3	Row Address											EM1BA[0]	Column Address	EM1DQM[0]/EM1DQM[1]
2	3	Row Address											EM1BA[1:0]	Column Address	EM1DQM[0]/EM1DQM[1]

**Table 24-15. Mapping from Logical Address to EMIF Pins for 16-bit SDRAM**

IBANK	PAGESIZE	Logical Address												
		31:26	25	24	23	22	21	20:13	12	11	10	9	8	7:0
0	0	Row Address											Col Address	
1	0	Row Address											EM1BA[0]	Col Address
2	0	Row Address											EM1BA[1:0]	Col Address
0	1	Row Address											Column Address	
1	1	Row Address											EM1BA[0]	Column Address
2	1	Row Address											EM1BA[1:0]	Column Address
0	2	Row Address											Column Address	
1	2	Row Address											EM1BA[0]	Column Address
2	2	Row Address											EM1BA[1:0]	Column Address
0	3	Row Address											Column Address	
1	3	Row Address											EM1BA[0]	Column Address
2	3	Row Address											EM1BA[1:0]	Column Address

**NOTE:** The upper bit of the row address is used only when addressing 256-Mbit and 512-Mbit SDRAM memories.

### 24.3.6 Asynchronous Controller and Interface

The EMIF easily interfaces to a variety of asynchronous devices including NOR Flash and SRAM. It can be operated in two major modes (see [Table 24-16](#)):

- Normal Mode
- Select Strobe Mode

**Table 24-16. Normal Mode vs. Select Strobe Mode**

Mode	Function of EM1DQM pins	Operation of $\overline{\text{EM1CS}}[4:2]$
Normal Mode	Byte enables	Active during the entire asynchronous access cycle
Select Strobe Mode	Byte enables	Active only during the strobe period of an access cycle

The first mode of operation is normal mode, in which the EM1DQM pins of the EMIF function as byte enables. In this mode, the  $\overline{\text{EM1CS}}[4:2]$  pins behave as typical chip select signals, remaining active for the duration of the asynchronous access. See [Section 24.3.6.1](#) for an example interface with multiple 8-bit devices.

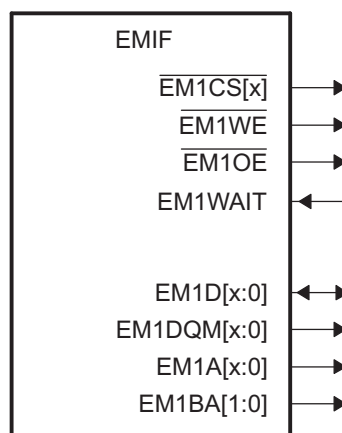
The second mode of operation is select strobe mode, in which the  $\overline{\text{EM1CS}}[4:2]$  pins act as a strobe, active only during the strobe period of an access. In this mode, the EM1DQM pins of the EMIF function as standard byte enables for reads and writes. A summary of the differences between the two modes of operation are shown in [Table 24-16](#). Refer to [Section 24.3.6.4](#) for the details of asynchronous operations in normal mode, and to [Section 24.3.6.5](#) for the details of asynchronous operations in select strobe mode. The EMIF hardware defaults to normal mode, but can be manually switched to select strobe mode by setting the SS bit in the asynchronous  $m$  ( $m = 1, 2, 3, \text{ or } 4$ ) configuration register (CENCFG) ( $n = 2, 3, \text{ or } 4$ ). Throughout the chapter,  $m$  can hold the values 1, 2, 3 or 4; and  $n$  can hold the values 2, 3, or 4.

The EMIF also provides configurable cycle timing parameters and an extended wait mode that allows the connected device to extend the strobe period of an access cycle. The following sections describe the features related to interfacing with external asynchronous devices.

#### 24.3.6.1 Interfacing to Asynchronous Memory

[Figure 24-8](#) shows the EMIF's external pins used in interfacing with an asynchronous device. In  $\overline{\text{EM1CS}}[n]$ ,  $n = 2, 3, \text{ or } 4$ .

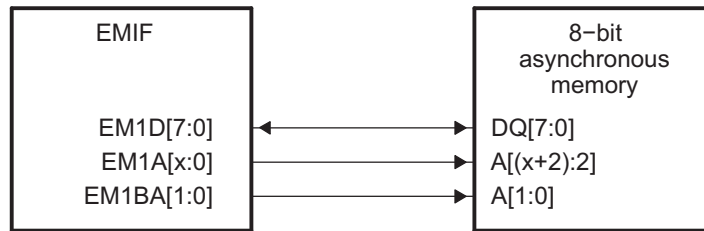
**Figure 24-8. EMIF Asynchronous Interface**



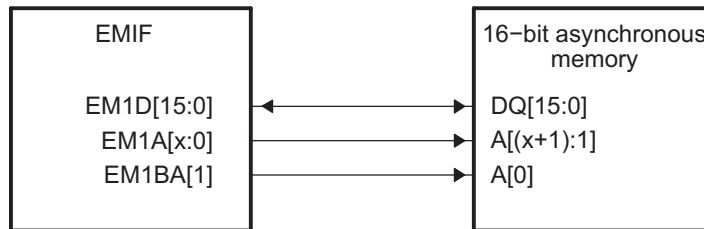
Of special note is the connection between the EMIF and the external device's address bus. The EMIF address pin EM1A[0] always provides the least significant bit of a 32-bit word address. Therefore, when interfacing to a 16-bit or 8-bit asynchronous device, the EM1BA[1] and EM1BA[0] pins provide the least-significant bits of the halfword or byte address, respectively. Figure 24-9 and Figure 24-10 show the mapping between the EMIF and the connected device's data and address pins for various programmed data bus widths. The data bus width may be configured in the asynchronous  $n$  configuration register (ASYNC\_CS $n$ \_CR).

Figure 24-10 shows an interface between the EMIF and an external memory with byte enables. The EMIF should be operated in either normal mode or select strobe mode when using this interface, so that the EM1DQM signals operate as byte enables.

**Figure 24-9. EMIF to 8-bit/16-bit Memory Interface**

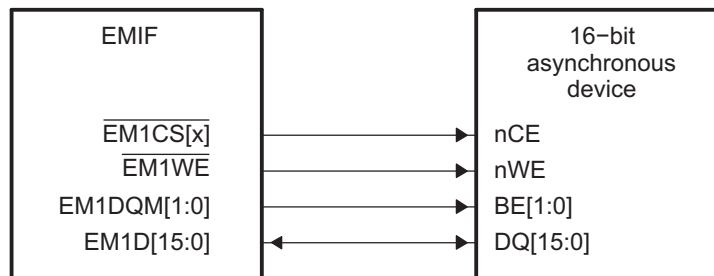


a) EMIF to 8-bit memory interface



b) EMIF to 16-bit memory interface

**Figure 24-10. Common Asynchronous Interface**





### 24.3.6.2 Accessing Larger Asynchronous Memories

If a device such as a large asynchronous flash needs to be attached to the EMIF, then GPIO pins may be used to control the flash device's upper address lines.

### 24.3.6.3 Configuring EMIF for Asynchronous Accesses

The operation of the EMIF's asynchronous interface can be configured by programming the appropriate register fields. The reset value and bit position for each register field can be found in [Section 24.5](#). The following tables list the register fields that can be programmed and describe the purpose of each field. These registers can be programmed prior to accessing the external memory, and the transfer following a write to these registers will use the new configuration.

**Table 24-17. Description of the Asynchronous *m* Configuration Register (ASYNC\_CS*n*\_CR)**

Parameter	Description
SS	<p><b>Select Strobe mode.</b> This bit selects the EMIF's mode of operation in the following way:</p> <ul style="list-style-type: none"> <li>• SS = 0 selects Normal Mode <ul style="list-style-type: none"> <li>– EM1DQM pins function as byte enables</li> <li>– EM1CS[4:2] active for duration of access</li> </ul> </li> <li>• SS = 1 selects Select Strobe Mode <ul style="list-style-type: none"> <li>– EM1DQM pins function as byte enables</li> <li>– EM1CS[4:2] acts as a strobe.</li> </ul> </li> </ul>
EW	<p><b>Extended Wait Mode enable.</b></p> <ul style="list-style-type: none"> <li>• EW = 0 disables extended wait mode</li> <li>• EW = 1 enables extended wait mode</li> </ul> <p>When set to 1, the EMIF enables its extended wait mode in which the strobe width of an access cycle can be extended in response to the assertion of the EM1WAIT pin. The WP<i>n</i> bit in the asynchronous wait cycle configuration register (ASYNC_WCCR) controls the polarity of the EM1WAIT pin. See <a href="#">Section 24.3.6.6</a> for more details on this mode of operation.</p>
W_SETUP/R_SETUP	<p><b>Read/Write setup widths.</b></p> <p>These fields define the number of EMIF clock cycles of setup time for the address pins (EM1A), byte enables (EM1DQM), and asynchronous chip enable (EM1CS[4:2]) before the read strobe pin (EM1O3) or write strobe pin (EM1WE) falls, minus one cycle. For writes, the W_SETUP field also defines the setup time for the data pins (EM1D). Refer to the asynchronous device's data sheet to determine the appropriate setting for this field.</p>
W_STROBE/R_STROBE	<p><b>Read/Write strobe widths.</b></p> <p>These fields define the number of EMIF clock cycles between the falling and rising of the read strobe pin (EM1O3) or write strobe pin (EM1WE<i>n</i>), minus one cycle. If Extended Wait Mode is enabled by setting the EW field in the asynchronous <i>n</i> configuration register (ASYNC_CS<i>n</i>_CR), these fields must be set to a value greater than zero. Refer to the data manual of the external asynchronous device to determine the appropriate setting for this field.</p>
W_HOLD/R_HOLD	<p><b>Read/Write hold widths.</b></p> <p>These fields define the number of EMIF clock cycles of hold time for the address pins (EM1A and EM1BA), byte enables (EM1DQM), and asynchronous chip enable (EM1CS[4:2]) after the read strobe pin (EM1O3) or write strobe pin (EM1WE) rises, minus one cycle. For writes, the W_HOLD field also defines the hold time for the data pins (EM1D). Refer to the data manual of the external asynchronous device to determine the appropriate setting for this field.</p>
TA	<p><b>Minimum turnaround time.</b></p> <p>This field defines the minimum number of EMIF clock cycles between asynchronous reads and writes, minus one cycle. The purpose of this feature is to avoid contention on the bus. The value written to this field also determines the number of cycles that will be inserted between asynchronous accesses and SDRAM accesses. Refer to the data manual of the external asynchronous device to determine the appropriate setting for this field.</p>
ASIZE	<p><b>Asynchronous Device Bus Width.</b></p> <p>This field determines the data bus width of the asynchronous interface in the following way:</p> <ul style="list-style-type: none"> <li>• ASIZE = 0 selects an 8-bit bus</li> <li>• ASIZE = 1 selects a 16-bit bus</li> <li>• ASIZE = 2 selects a 32-bit bus</li> </ul> <p>The configuration of ASIZE determines the function of the EM1A and EM1BA pins as described in <a href="#">Section 24.3.6.1</a>. This field also determines the number of external accesses required to fulfill a request generated by one of the sources mentioned in <a href="#">Section 24.3.2</a>. For example, a request for a 32-bit word would require four external access when ASIZE = 0. Refer to the data manual of the external asynchronous device to determine the appropriate setting for this field.</p>



**Table 24-18. Description of the Asynchronous Wait Cycle Configuration Register (ASYNC\_WCCR)**

Parameter	Description
WP <sub>n</sub>	<p><b>EM_WAIT Polarity.</b></p> <ul style="list-style-type: none"> <li>WP<sub>n</sub> = 0 selects active-low polarity</li> <li>WP<sub>n</sub> = 1 selects active-high polarity</li> </ul> <p>When set to 1, the EMIF will wait if the EM1WAIT pin is high. When cleared to 0, the EMIF will wait if the EM1WAIT pin is low. The EMIF must have the Extended Wait Mode enabled for the EM1WAIT pin to affect the width of the strobe period.</p>
MAX_EXT_WAIT	<p><b>Maximum Extended Wait Cycles.</b></p> <p>This field configures the number of EMIF clock cycles the EMIF will wait for the EM1WAIT pin to be deactivated during the strobe period of an access cycle. The maximum number of EMIF clock cycles it will wait is determined by the following formula:</p> <p>Maximum Extended Wait Cycles = (MAX_EXT_WAIT + 1) × 16</p> <p>If the EM1WAIT pin is not deactivated within the time specified by this field, the EMIF resumes the access cycle, registering whatever data is on the bus and proceeding to the hold period of the access cycle. This situation is referred to as an Asynchronous Timeout. An Asynchronous Timeout generates an interrupt, if it has been enabled in the EMIF interrupt mask set register (INT_MASK_SET). Refer to <a href="#">Section 24.3.9.1</a> for more information about EMIF interrupts.</p>

**Table 24-19. Description of EMIF Interrupt Mask Set Register (INT\_MSK\_SET)**

Parameter	Description
WR_MASK_SET	<p><b>Wait Rise Mask Set.</b></p> <p>Writing a 1 enables an interrupt to be generated when a rising edge on EM1WAIT occurs.</p>
AT_MASK_SET	<p><b>Asynchronous Timeout Mask Set.</b></p> <p>Writing a 1 to this bit enables an interrupt to be generated when an Asynchronous Timeout occurs.</p>

**Table 24-20. Description of EMIF Interrupt Mast Clear Register (INT\_MSK\_CLR)**

Parameter	Description
WR_MASK_CLR	<p><b>Wait Rise Mask Clear.</b></p> <p>Writing a 1 to this bit disables the interrupt, clearing the WR_MASK_SET bit in EMIF interrupt mask set register (INT_MASK_SET).</p>
AT_MASK_CLR	<p><b>Asynchronous Timeout Mask Clear.</b></p> <p>Writing a 1 to this bit prevents an interrupt from being generated when an Asynchronous Timeout occurs.</p>

**NOTE:** The EMIF performs SDRAM refreshes even if the SDRAM interface is not used. If the user is using only the ASRAM interface, then SDRAM refreshes will impact the ASRAM performance. To avoid this, the user must set PD=1 in the SDRAM\_CR register (Emif1Regs.SDRAM\_CR.bit.PD=1). This bit can be updated only if there are no pending EMIF accesses.

#### 24.3.6.4 Read and Write Operations in Normal Mode

Normal mode is the asynchronous interface's default mode of operation. It is selected when the SS bit in the asynchronous *n* configuration register (ASYNC\_CS<sub>n</sub>\_CR) is cleared to 0. In this mode, the EM1DQM pins operate as byte enables. [Section 24.3.6.4.1](#) and [Section 24.3.6.4.2](#) explain the details of read and write operations while in normal mode.

### 24.3.6.4.1 Asynchronous Read Operations (Normal Mode)

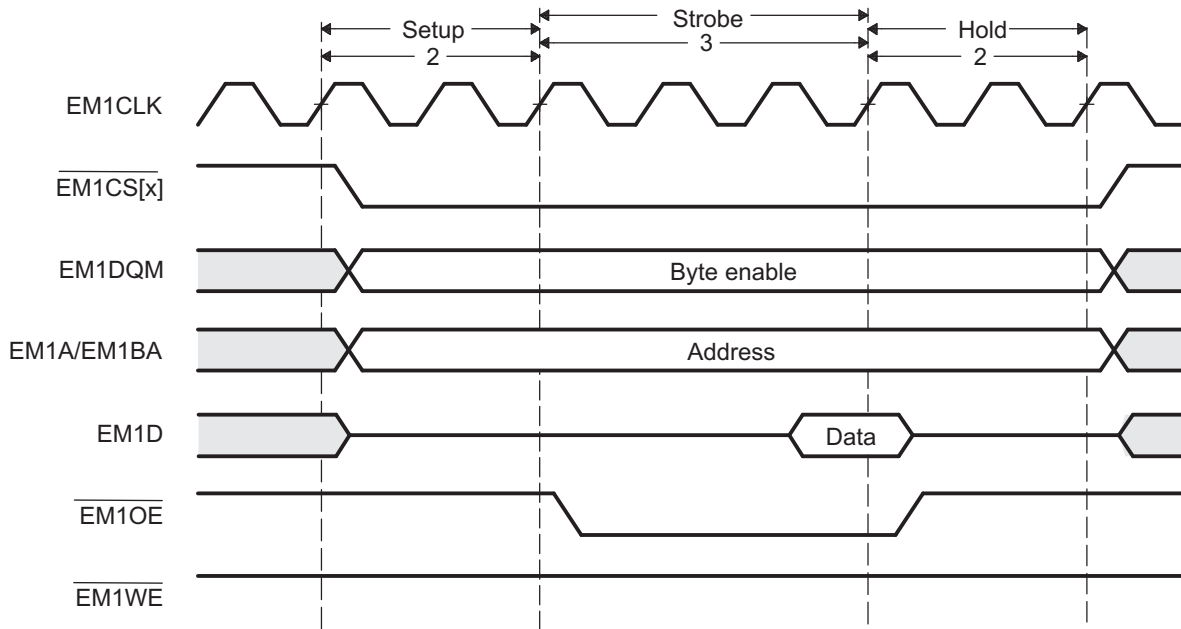
**NOTE:** During an entire asynchronous read operation, the  $\overline{\text{EM1WE}}$  pin is driven high.

An asynchronous read is performed when any of the requesters mentioned in [Section 24.3.2](#) request a read from the attached asynchronous memory. After the request is received, a read operation is initiated once it becomes the EMIF's highest priority task, according to the priority scheme detailed in [Section 24.3.13](#). In the event that the read request cannot be serviced by a single access cycle to the external device, multiple access cycles will be performed by EMIF until the entire request is fulfilled. The details of an asynchronous read operation in normal mode are described in [Table 24-21](#). Also, [Figure 24-11](#) shows an example timing diagram of a basic read operation.

**Table 24-21. Asynchronous Read Operation in Normal Mode**

Time Interval	Pin Activity in Normal Mode
Turnaround period	Once the read operation becomes the highest priority task for EMIF, the EMIF waits for the programmed number of turn-around cycles before proceeding to the setup period of the operation. The number of wait cycles is taken directly from the TA field of the asynchronous <i>n</i> configuration register (ASYNC_CS <i>n</i> _CR). Between each access (write or read) EMIF inserts two cycles of delay even though TA field is programmed as 0. After the EMIF has waited for the turnaround cycles to complete, it again checks to make sure that the read operation is still its highest priority task. If so, the EMIF proceeds to the setup period of the operation. If it is no longer the highest priority task, the EMIF terminates the operation.
Start of the setup period	The following actions occur at the start of the setup period: <ul style="list-style-type: none"> <li>The setup, strobe, and hold values are set according to the R_SETUP, R_STROBE, and R_HOLD values in ASYNC_CS<i>n</i>_CR.</li> <li>The address pins EM1A and EM1BA become valid and carry the values described in <a href="#">Section 24.3.6.1</a>.</li> <li><math>\overline{\text{EM1TCS}}[4:2]</math> falls to enable the external device (if not already low from a previous operation)</li> </ul>
Strobe period	The following actions occur during the strobe period of a read operation: <ol style="list-style-type: none"> <li><math>\overline{\text{EM1TOE}}</math> falls at the start of the strobe period</li> <li>On the rising edge of the clock which is concurrent with the end of the strobe period: <ul style="list-style-type: none"> <li><math>\overline{\text{EM1TOE}}</math> rises</li> <li>The data on the EM1D<i>x</i> bus is sampled by EMIF.</li> </ul> </li> </ol> <p>In <a href="#">Figure 24-11</a>, EM1WAIT is inactive. If EM1WAIT is instead activated, the strobe period can be extended by the external device to give it more time to provide the data. <a href="#">Section 24.3.6.6</a> contains more details on using the EM1WAIT pin.</p>
End of the hold period	At the end of the hold period: <ul style="list-style-type: none"> <li>The address pins EM1A and EM1BA become invalid</li> <li><math>\overline{\text{EM1TCS}}[4:2]</math> rises (if no more operations are required to complete the current request)</li> </ul> <p>The EMIF may be required to issue additional read operations to a device with a small data bus width in order to complete an entire word access. In this case, the EMIF immediately re-enters the setup period to begin another operation without incurring the turn-round cycle delay. The setup, strobe, and hold values are not updated in this case. If the entire word access has been completed, the EMIF returns to its previous state unless another asynchronous request has been submitted and is currently the highest priority task. If this is the case, EMIF instead enters directly into the turnaround period for the pending read or write operation.</p>

**Figure 24-11. Timing Waveform of an Asynchronous Read Cycle in Normal Mode**



### 24.3.6.4.2 Asynchronous Write Operations (Normal Mode)

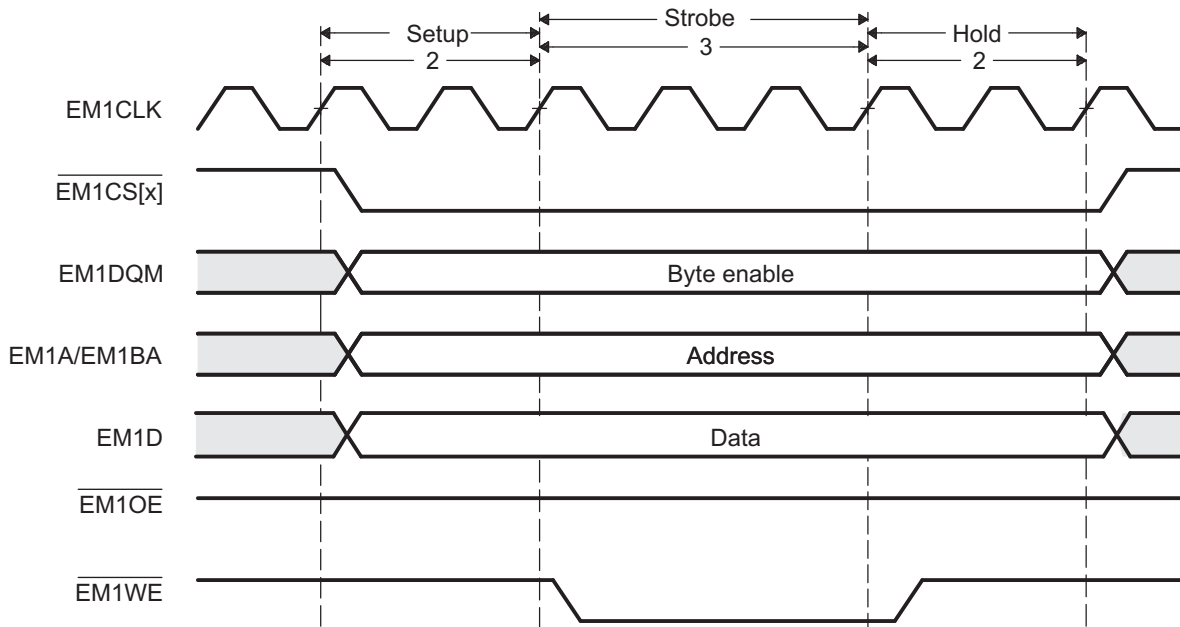
**NOTE:** During an entire asynchronous write operation, the  $\overline{\text{EM1OE}}$  pin is driven high.

An asynchronous write is performed when any of the requesters mentioned in [Section 24.3.2](#) request a write to memory in the asynchronous bank of EMIF. After the request is received, a write operation is initiated once it becomes the EMIF's highest priority task, according to the priority scheme detailed in [Section 24.3.13](#). In the event that the write request cannot be serviced by a single access cycle to the external device, multiple access cycles will be performed by the EMIF until the entire request is fulfilled. The details of an asynchronous write operation in normal mode are described in [Table 24-22](#). Also, [Figure 24-12](#) shows an example timing diagram of a basic write operation.

**Table 24-22. Asynchronous Write Operation in Normal Mode**

Time Interval	Pin Activity in Normal Mode
Turnaround period	Once the write operation becomes the highest priority task for the EMIF, the EMIF waits for the programmed number of turn-around cycles before proceeding to the setup period of the operation. The number of wait cycles is taken directly from the TA field of the asynchronous <i>n</i> configuration register (ASYNC_CS <i>n</i> _CR). Between each access (write or read) EMIF inserts two cycles of delay even though TA field is programmed as 0. After the EMIF has waited for the turn-around cycles to complete, it again checks to make sure that the write operation is still its highest priority task. If so, the EMIF proceeds to the setup period of the operation. If it is no longer the highest priority task, EMIF terminates the operation.
Start of the setup period	The following actions occur at the start of the setup period: <ul style="list-style-type: none"> <li>The setup, strobe, and hold values are set according to the W_SETUP, W_STROBE, and W_HOLD values in ASYNC_CS<i>n</i>_CR.</li> <li>The address pins EM1A and EM1BA and the data pins EM1D<i>x</i> become valid. The EM1A and EM1BA pins carry the values described in <a href="#">Section 24.3.6.1</a>.</li> <li><math>\overline{\text{EM1TCS}}[4:2]</math> falls to enable the external device (if not already low from a previous operation).</li> </ul>
Strobe period	The following actions occur at the start of the strobe period of a write operation: <ol style="list-style-type: none"> <li><math>\overline{\text{EM1WE}}</math> falls</li> <li>The EM1DQM pins become valid as byte enables.</li> </ol> The following actions occur on the rising edge of the clock which is concurrent with the end of the strobe period: <ol style="list-style-type: none"> <li><math>\overline{\text{EM1WE}}</math> rises</li> <li>The EM1DQM pins deactivate</li> </ol> In <a href="#">Figure 24-12</a> , EM1WAIT is inactive. If EM1WAIT is instead activated, the strobe period can be extended by the external device to give it more time to accept the data. <a href="#">Section 24.3.6.6</a> contains more details on using the EM1WAIT pin.
End of the hold period	At the end of the hold period: <ul style="list-style-type: none"> <li>The address pins EM1A<i>x</i> and EM1BA<i>x</i> become invalid</li> <li>The data pins become invalid</li> <li><math>\overline{\text{EM1TCS}}[n]</math> (<i>n</i> = 2, 3, or 4) rises (if no more operations are required to complete the current request)</li> </ul> The EMIF may be required to issue additional write operations to a device with a small data bus width in order to complete an entire word access. In this case, the EMIF immediately re-enters the setup period to begin another operation without incurring the turnaround cycle delay. The setup, strobe, and hold values are not updated in this case. If the entire word access has been completed, the EMIF returns to its previous state unless another asynchronous request has been submitted and is currently the highest priority task. If this is the case, the EMIF instead enters directly into the turnaround period for the pending read or write operation.

**Figure 24-12. Timing Waveform of an Asynchronous Write Cycle in Normal Mode**



### 24.3.6.5 Read and Write Operation in Select Strobe Mode

Select Strobe Mode is the EMIF's second mode of operation. It is selected when the SS bit of the asynchronous  $n$  configuration register (ASYNC\_CS $_n$ \_CR) is set to 1. In this mode, the EM1DQM pins operate as byte enables and the  $\overline{\text{EM1CS}}[n]$  ( $n = 2, 3, \text{ or } 4$ ) pin is only active during the strobe period of an access cycle. [Section 24.3.6.4.1](#) and [Section 24.3.6.4.2](#) explain the details of read and write operations while in select strobe mode.

#### 24.3.6.5.1 Asynchronous Read Operations (Select Strobe Mode)

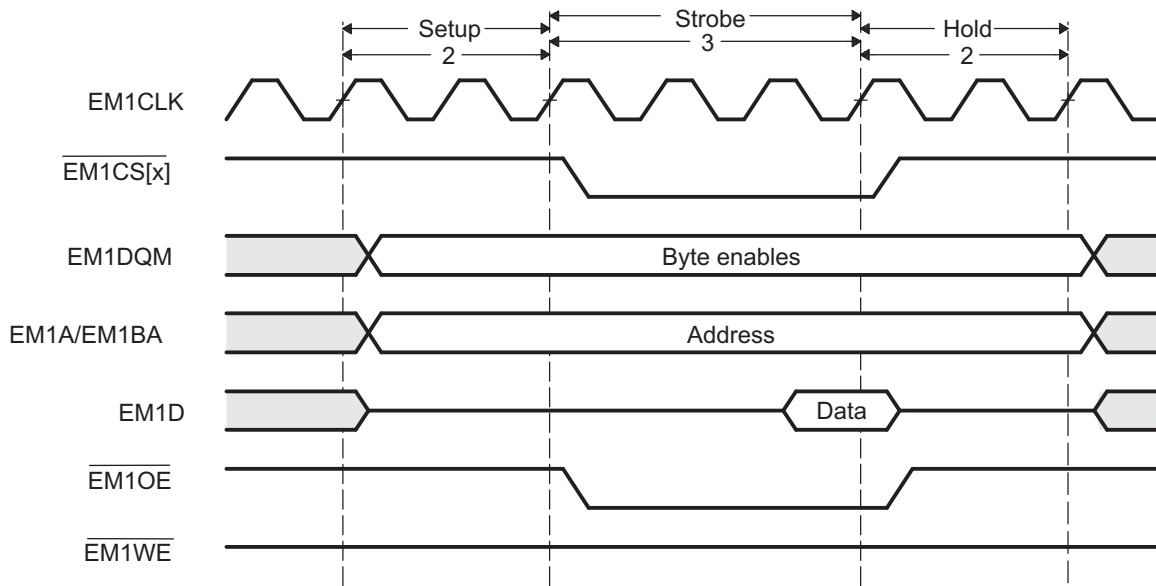
**NOTE:** During the entirety of an asynchronous read operation, the EM1WEn pin is driven high.

An asynchronous read is performed when any of the requesters mentioned in [Section 24.3.2](#) request a read from the attached asynchronous memory. After the request is received, a read operation is initiated once it becomes the EMIF's highest priority task, according to the priority scheme detailed in [Section 24.3.13](#). In the event that the read request cannot be serviced by a single access cycle to the external device, multiple access cycles will be performed by the EMIF until the entire request is fulfilled. The details of an asynchronous read operation in select strobe mode are described in [Table 24-23](#). Also, [Figure 24-13](#) shows an example timing diagram of a basic read operation.

**Table 24-23. Asynchronous Read Operation in Select Strobe Mode**

Time Interval	Pin Activity in Select Strobe Mode
Turnaround period	Once the read operation becomes the highest priority task for the EMIF, the EMIF waits for the programmed number of turnaround cycles before proceeding to the setup period of the operation. The number of wait cycles is taken directly from the TA field of the asynchronous $n$ configuration register (ASYNC_CS $_n$ _CR). Between each access (Write or Read) EMIF inserts two cycles of delay even though TA field is programmed as 0. After the EMIF has waited for the turn-around cycles to complete, it again checks to make sure that the read operation is still its highest priority task. If so, the EMIF proceeds to the setup period of the operation. If it is no longer the highest priority task, the EMIF terminates the operation.
Start of the setup period	The following actions occur at the start of the setup period: <ul style="list-style-type: none"> <li>The setup, strobe, and hold values are set according to the R_SETUP, R_STROBE, and R_HOLD values in ASYNC_CS<math>_n</math>_CR.</li> <li>The address pins EM1A and EM1BA become valid and carry the values described in <a href="#">Section 24.3.6.1</a>.</li> <li>The EM1DQM pins become valid as byte enables.</li> </ul>
Strobe period	The following actions occur during the strobe period of a read operation: <ol style="list-style-type: none"> <li><math>\overline{\text{EM1CS}}[n]</math> (<math>n = 2, 3, \text{ or } 4</math>) and <math>\overline{\text{EM1OE}}</math> fall at the start of the strobe period</li> <li>On the rising edge of the clock which is concurrent with the end of the strobe period: <ul style="list-style-type: none"> <li><math>\overline{\text{EM1CS}}[n]</math> (<math>n = 2, 3, \text{ or } 4</math>) and <math>\overline{\text{EM1OE}}</math> rise</li> <li>The data on the EM1D bus is sampled by EMIF.</li> </ul> </li> </ol> In <a href="#">Figure 24-13</a> , EM1WAIT is inactive. If EM1WAIT is instead activated, the strobe period can be extended by the external device to give it more time to provide the data. <a href="#">Section 24.3.6.6</a> contains more details on using the EM1WAIT pin.
End of the hold period	At the end of the hold period: <ul style="list-style-type: none"> <li>The address pins EM1A and EM1BA become invalid</li> <li>The EM1DQM pins become invalid</li> </ul> The EMIF may be required to issue additional read operations to a device with a small data bus width in order to complete an entire word access. In this case, the EMIF immediately re-enters the setup period to begin another operation without incurring the turnaround cycle delay. The setup, strobe, and hold values are not updated in this case. If the entire word access has been completed, the EMIF returns to its previous state unless another asynchronous request has been submitted and is currently the highest priority task. If this is the case, the EMIF instead enters directly into the turnaround period for the pending read or write operation.

**Figure 24-13. Timing Waveform of an Asynchronous Read Cycle in Select Strobe Mode**



### 24.3.6.5.2 Asynchronous Write Operations (Select Strobe Mode)

**NOTE:** During the entirety of an asynchronous write operation, the  $\overline{\text{EM1OE}}$  pin is driven high.

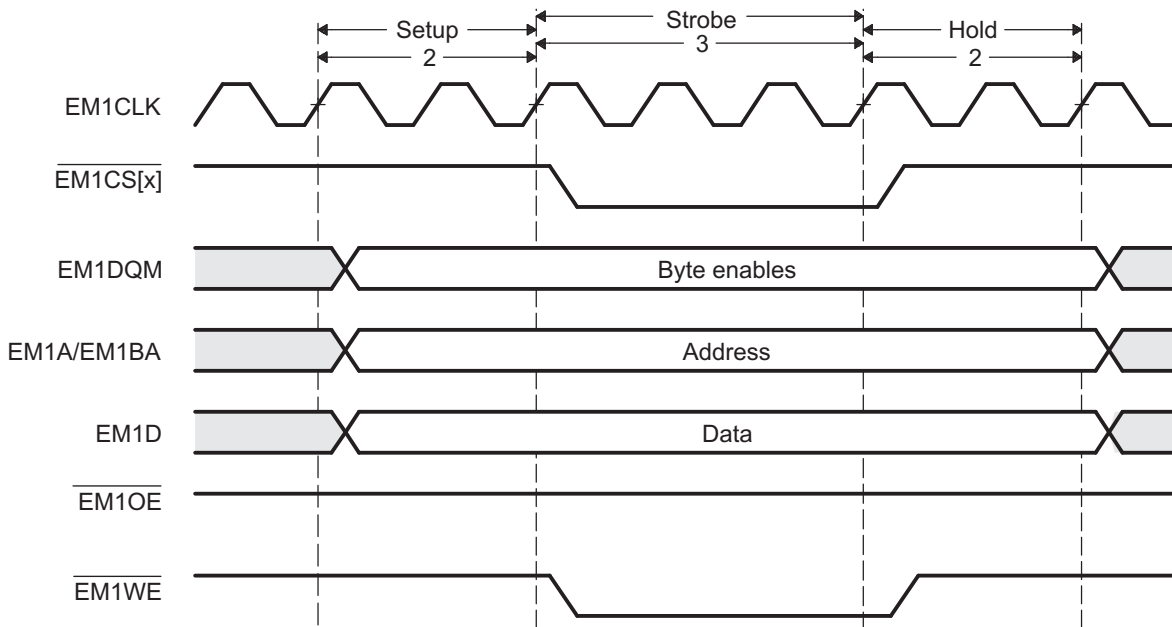
An asynchronous write is performed when any of the requesters mentioned in [Section 24.3.2](#) request a write to memory in the asynchronous bank of EMIF. After the request is received, a write operation is initiated once it becomes the EMIF's highest priority task, according to the priority scheme detailed in [Section 24.3.13](#). In the event that the write request cannot be serviced by a single access cycle to the external device, multiple access cycles will be performed by the EMIF until the entire request is fulfilled. The details of an asynchronous write operation in select strobe mode are described in [Table 24-24](#). Also, [Figure 24-14](#) shows an example timing diagram of a basic write operation.

**Table 24-24. Asynchronous Write Operation in Select Strobe Mode**

Time Interval	Pin Activity in Select Strobe Mode
Turnaround period	Once the write operation becomes the highest priority task for the EMIF, the EMIF waits for the programmed number of turnaround cycles before proceeding to the setup period of the operation. The number of wait cycles is taken directly from the TA field of the asynchronous <i>n</i> configuration register (ASYNC_CS <sub>n</sub> _CR). Between each access (Write or Read) EMIF inserts two cycles of delay even though TA field is programmed as 0.  After the EMIF has waited for the turnaround cycles to complete, it again checks to make sure that the write operation is still its highest priority task. If so, the EMIF proceeds to the setup period of the operation. If it is no longer the highest priority task, the EMIF terminates the operation.
Start of the setup period	The following actions occur at the start of the setup period: <ul style="list-style-type: none"> <li>The setup, strobe, and hold values are set according to the W_SETUP, W_STROBE, and W_HOLD values in ASYNC_CS<sub>n</sub>_CR.</li> <li>The address pins EM1A and EM1BA and the data pins EM1D become valid. The EM1A and EM1BA pins carry the values described in <a href="#">Section 24.3.6.1</a>.</li> <li>The EM1DQM pins become active as byte enables.</li> </ul>
Strobe period	The following actions occur at the start of the strobe period of a write operation: <ul style="list-style-type: none"> <li><math>\overline{\text{EM1CS}}[n]</math> (<i>n</i> = 2, 3, or 4) and <math>\overline{\text{EM1WE}}</math> fall</li> </ul> The following actions occur on the rising edge of the clock which is concurrent with the end of the strobe period: <ul style="list-style-type: none"> <li><math>\text{EM1CS}[n]</math> (<i>n</i> = 2, 3, or 4) and <math>\text{EM1WE}</math> rise</li> </ul> In <a href="#">Figure 24-14</a> , EM1WAIT is inactive. If EM1WAIT is instead activated, the strobe period can be extended by the external device to give it more time to accept the data. <a href="#">Section 24.3.6.6</a> contains more details on using the EM1WAIT pin.
End of the hold period	At the end of the hold period: <ul style="list-style-type: none"> <li>The address pins EM1A and EM1BA become invalid</li> <li>The data pins become invalid</li> <li>The EM1DQM pins become invalid</li> </ul> The EMIF may be required to issue additional write operations to a device with a small data bus width in order to complete an entire word access. In this case, the EMIF immediately re-enters the setup period to begin another operation without incurring the turnaround cycle delay. The setup, strobe, and hold values are not updated in this case. If the entire word access has been completed, the EMIF returns to its previous state unless another asynchronous request has been submitted and is currently the highest priority task. If this is the case, the EMIF instead enters directly into the turnaround period for the pending read or write operation.



**Figure 24-14. Timing Waveform of an Asynchronous Write Cycle in Select Strobe Mode**



#### 24.3.6.6 Extended Wait Mode and the EM1WAIT Pin

The EMIF supports the extend wait mode. This is a mode in which the external asynchronous device may assert control over the length of the strobe period. The extended wait mode can be entered by setting the EW bit in the asynchronous  $n$  configuration register (ASYNC\_CS $n$ \_CR ( $n = 2, 3, \text{ or } 4$ )). When this bit is set, the EMIF monitors the EM1WAIT pin to determine if the attached device wishes to extend the strobe period of the current access cycle beyond the programmed number of clock cycles.

When the EMIF detects that the EM1WAIT pin has been asserted, it will begin inserting extra strobe cycles into the operation until the EM1WAIT pin is deactivated by the external device. The EMIF will then return to the last cycle of the programmed strobe period and the operation will proceed as usual from this point. Please refer to the device data manual for details on the timing requirements of the EM1WAIT signal.

The EM1WAIT pin cannot be used to extend the strobe period indefinitely. The programmable MAX\_EXT\_WAIT field in the asynchronous wait cycle configuration register (AWCC) determines the maximum number of EM1CLK cycles the strobe period may be extended beyond the programmed length. When the counter expires, the EMIF proceeds to the hold period of the operation regardless of the state of the EM1WAIT pin. The EMIF can also generate an interrupt upon expiration of this counter. See [Section 24.3.9.1](#) for details on enabling this interrupt.

For the EMIF to function properly in the extended wait mode, the WP $n$  bit of AWCC must be programmed to match the polarity of the EM1WAIT pin. In its reset state of 1, the EMIF will insert wait cycles when the EM1WAIT pin is sampled high. When set to 0, the EMIF will insert wait cycles only when EM1WAIT is sampled low. This programmability allows for a glueless connection to larger variety of asynchronous devices.

Finally, a restriction is placed on the strobe period timing parameters when operating in extended wait mode. Specifically, the sum of the W\_SETUP and W\_STROBE fields must be greater than 4, and the sum of the R\_SETUP and R\_STROBE fields must be greater than four for the EMIF to recognize the EM1WAIT pin has been asserted. The W\_SETUP, W\_STROBE, R\_SETUP, and R\_STROBE fields are in ASYNC\_CS $n$ \_CR.

### 24.3.7 Data Bus Parking

The EMIF always drives the data bus to the previous write data value when it is idle. This feature is called data bus parking. Only when the EMIF issues a read command to the external memory does it stop driving the data bus. After the EMIF latches the last read data, it immediately parks the data bus again.

The one exception to this behavior occurs after performing an asynchronous read operation while the EMIF is in the self-refresh state. In this situation, the read operation is not followed by the EMIF parking the data bus. Instead, the EMIF tri-states the data bus. Therefore, it is not recommended to perform asynchronous read operations while the EMIF is in the self-refresh state, in order to prevent floating inputs on the data bus. External pull-ups, such as 10kΩ resistors, should be placed on the 16 EMIF data bus pins (which do not have internal pull-ups) if it is required to perform reads in this situation. The precise resistor value should be chosen so that the worst case combined off-state leakage currents do not cause the voltage levels on the associated pins to drop below the high-level input voltage requirement.

For information about the self-refresh state, see [Section 24.3.5.7](#).

### 24.3.8 Reset and Initialization Considerations

The EMIF memory controller has two active-low reset signals, `CHIP_RST_n` and `MOD_G_RST_n`. Both these reset signals are driven by the device system reset signal. This device does not offer the flexibility to reset just the EMIF state machine without also resetting the EMIF controller's memory-mapped registers. As soon as the device system reset is released (driven high), the EMIF memory controller immediately begins its initialization sequence. Command and data stored in the EMIF memory controller FIFOs are lost. Refer to [Section 24.3](#) for more information on conditions that can cause a device system reset to be asserted.

When system reset is released, the EMIF automatically begins running the SDRAM initialization sequence described in [Section 24.3.5.4](#). Even though the initialization procedure is automatic, a special procedure, found in [Section 24.3.5.5](#) must still be followed.

### 24.3.9 Interrupt Support

The EMIF supports a single interrupt to the CPU. [Section 24.3.9.1](#) details the generation and internal masking of EMIF interrupts.

#### 24.3.9.1 Interrupt Events

There are three conditions that may cause the EMIF to generate an interrupt to the CPU. These conditions are:

- A rising edge on the EM1WAIT signal (wait rise interrupt)
- An asynchronous time out
- Usage of unsupported addressing mode (line trap interrupt)

The wait rise interrupt occurs when a rising edge is detected on EM1WAIT signal. This interrupt generation is not affected by the `WPn` bit in the asynchronous wait cycle configuration register (`ASYNC_WCCR`). The asynchronous time out interrupt condition occurs when the attached asynchronous device fails to deassert the EM1WAIT pin within the number of cycles defined by the `MAX_EXT_WAIT` bit in `AWCC` (this happens only in extended wait mode). The EMIF supports only linear incrementing and cache line wrap addressing modes. If an access request for an unsupported addressing mode is received, the EMIF will set the `LT` bit in the EMIF interrupt raw register (`INTRAW`) and treat the request as a linear incrementing request.

Only when the interrupt is enabled by setting the appropriate bit (`WR_MASK_SET/AT_MASK_SET/LT_MASK_SET`) in the EMIF interrupt mask set register (`INT_MASK_SET`) to 1, will the interrupt be sent to the CPU. Once enabled, the interrupt may be disabled by writing a 1 to the corresponding bit in the EMIF interrupt mask clear register (`INT_MASK_CLR`). The bit fields in both the `INT_MASK_SET` and `INT_MASK_CLR` may be used to indicate whether the interrupt is enabled. When the interrupt is enabled, the corresponding bit field in both the `INT_MASK_SET` and `INT_MASK_CLR` will have a value of 1; when the interrupt is disabled, the corresponding bit field will have a value of 0.

The EMIF interrupt raw register (INTRAW) and the IF interrupt mask register (INTMSK) indicate the status of each interrupt. The appropriate bit (WR/AT/LT) in INTRAW is set when the interrupt condition occurs, whether or not the interrupt has been enabled. However, the appropriate bit (WR\_MASKED/AT\_MASKED/LT\_MASKED) in INTMSK is set only when the interrupt condition occurs and the interrupt is enabled. Writing a 1 to the bit in INTRAW clears the INTRAW bit as well as the corresponding bit in INTMSK. [Table 24-25](#) contains a brief summary of the interrupt status and control bit fields. See [Section 24.5](#) for complete details on the register fields.

**Table 24-25. Interrupt Monitor and Control Bit Fields**

Register Name	Bit Name	Description
EMIF interrupt raw register (INTRAW)	WR	This bit is set when a rising edge on the EM1WAIT signal occurs. Writing a 1 clears the WR bit as well as the WR_MASKED bit in INTMSK.
	AT	This bit is set when an asynchronous timeout occurs. Writing a 1 clears the AT bit as well as the AT_MASKED bit in INTMSK.
	LT	This bit is set when an unsupported addressing mode is used. Writing a 1 clears LT bit as well as the LT_MASKED bit in INTMSK.
EMIF interrupt mask register (INTMSK)	WR_MASKED	This bit is set only when a rising edge on the EM1WAIT signal occurs and the interrupt has been enabled by writing a 1 to the WR_MASK_SET bit in INT_MASK_SET.
	AT_MASKED	This bit is set only when an asynchronous timeout occurs and the interrupt has been enabled by writing a 1 to the AT_MASK_SET bit in INT_MASK_SET.
	LT_MASKED	This bit is set only when line trap interrupt occurs and the interrupt has been enabled by writing a 1 to the LT_MASK_SET bit in INT_MASK_SET.
EMIF interrupt mask set register (INT_MASK_SET)	WR_MASK_SET	Writing a 1 to this bit enables the wait rise interrupt.
	AT_MASK_SET	Writing a 1 to this bit enables the asynchronous timeout interrupt.
	LT_MASK_SET	Writing a 1 to this bit enables the line trap interrupt.
EMIF interrupt mask clear register (INT_MASK_CLR)	WR_MASK_CLR	Writing a 1 to this bit disables the wait rise interrupt.
	AT_MASK_CLR	Writing a 1 to this bit disables the asynchronous timeout interrupt.
	LT_MASK_CLR	Writing a 1 to this bit disables the line trap interrupt.

### 24.3.10 DMA Event Support

The EMIF memory controller is a DMA slave peripheral and therefore does not generate DMA events. Data read and write requests may be made directly, by masters and the DMA.

### 24.3.11 EMIF Signal Multiplexing

For details on the EMIF signal multiplexing, see the *GPIO* chapter, I/O Multiplexing Module section, of this technical reference manual.

### 24.3.12 Memory Map

For information describing the device memory-map, see your device-specific data manual.

### 24.3.13 Priority and Arbitration

[Section 24.3.2](#) describes the external prioritization and arbitration among requests from different sources within the microcontroller. The result of this external arbitration is that only one request is presented to the EMIF at a time. Once the EMIF completes a request, the external arbiter then provides the EMIF with the next pending request.

Internally, the EMIF undertakes memory device transactions according to a strict priority scheme. The highest priority events are:

- A device reset.
- A write to any of the three least significant bytes of the SDRAM configuration register (SDRAM\_CR).

Either of these events will cause the EMIF to immediately commence its initialization sequence as described in [Section 24.3.5.4](#).

Once the EMIF has completed its initialization sequence, it performs memory transactions according to the following priority scheme (highest priority listed first):

1. If the EMIF's backlog refresh counter is at the Refresh Must urgency level, the EMIF performs multiple SDRAM auto-refresh cycles until the Refresh Release urgency level is reached.
2. If an SDRAM or asynchronous read has been requested, the EMIF performs a read operation.
3. If the EMIF's backlog refresh counter is at the Refresh Need urgency level, the EMIF performs an SDRAM auto refresh cycle.
4. If an SDRAM or asynchronous write has been requested, the EMIF performs a write operation.
5. If the EMIF's backlog refresh counter is at the Refresh May or Refresh Release urgency level, the EMIF performs an SDRAM auto refresh cycle.
6. If the value of the SR bit in SDRAM\_CR has been set to 1, the EMIF will enter the self-refresh state as described in [Section 24.3.5.7](#).

After taking one of the actions listed above, the EMIF then returns to the top of the priority list to determine its next action.

Because the EMIF does not issue auto-refresh cycles when in the self-refresh state, the above priority scheme does not apply when in this state. See [Section 24.3.5.7](#) for details on the operation of the EMIF when in the self-refresh state.

### 24.3.14 System Considerations

This section describes various system considerations to keep in mind when operating the EMIF.

#### 24.3.14.1 Asynchronous Request Times

In a system that interfaces to both SDRAM and asynchronous memory, the asynchronous requests must not take longer than the smaller of the following two values:

- $t_{\text{RAS}}$  (typically 120  $\mu\text{s}$ ) - to avoid violating the maximum time allowed between issuing an ACTV and PRE command to the SDRAM.
- $t_{\text{Refresh Rate}} \times 11$  (typically 15.7  $\mu\text{s} \times 11 = 172.7 \mu\text{s}$ ) - to avoid refresh violations on the SDRAM.

The length of an asynchronous request is controlled by multiple factors, the primary factor being the number of access cycles required to complete the request. For example, an asynchronous request for 4 bytes will require four access cycles using an 8-bit data bus and only two access cycle using a 16-bit data bus. The maximum request size that the EMIF can be sent is 16 words, therefore the maximum number of access cycles per memory request is 64 when the EMIF is configured with an 8-bit data bus. The length of the individual access cycles that make up the asynchronous request is determined by the programmed setup, strobe, hold, and turnaround values, but can also be extended with the assertion of the EM1WAIT input signal up to a programmed maximum limit. It is up to the user to make sure that an entire asynchronous request does not exceed the timing values listed above when also interfacing to an SDRAM device. This can be done by limiting the asynchronous timing parameters.

### 24.3.15 Power Management

Power dissipation from the EMIF memory controller may be managed by following methods:

- Self-refresh mode
- Power-down mode
- Gating input clocks to the module off

Gating input clocks off to the EMIF memory controller achieves higher power savings when compared to the power savings of self-refresh or power down mode. The input clock to EMIF can be turned off through the use of the Global Clock Module (GCM). Before gating clocks off, the EMIF memory controller must place the SDR SDRAM memory in self-refresh mode. If the external memory requires a continuous clock, the VCLK3 clock domain must not be turned off because this may result in data corruption. See the following subsections for the proper procedures to follow when stopping EMIF memory controller clocks.

#### 24.3.15.1 Power Management Using Self-Refresh Mode

The EMIF memory controller can be placed into a self-refresh state in order to place the attached SDRAM devices into self-refresh mode, which consumes less power for most SDRAM devices. In this state, the attached SDRAM device uses an internal clock to perform its own auto refresh cycles. This maintains the validity of the data in the SDRAM without the need for any external commands. Refer to [Section 24.3.5.7](#) for more details on placing the EMIF into the self-refresh state.

#### 24.3.15.2 Power Management Using Power Down Mode

In the power down mode, the EMIF drives EM1SDCKE low to lower the power consumption. EM1SDCKE goes high when there is a need to send refresh (REFR) commands, after which EM1SDCKE is again driven low. EM1SDCKE remains low until any request arrives. Refer to [Section 24.3.5.8](#) for more details on placing the EMIF in power-down mode.

### 24.3.16 Emulation Considerations

The EMIF remains fully functional during emulation halts in order to allow emulation access to external memory.

## 24.4 Example Configuration

This section presents an example of interfacing the EMIF1 to both an SDR SDRAM device and an asynchronous flash device.

### 24.4.1 Hardware Interface

Figure 24-15 shows the hardware interface between the EMIF, a Samsung K4S641632H-TC(L)70 64Mb SDRAM device, and a SHARP LH28F800BJE-PTTL90 8Mb Flash memory. The connection between EMIF and the SDRAM is straightforward, but the connection between the EMIF and the flash deserves a detailed look.

The address inputs for the flash are provided by three sources. The A[18:0] address inputs are provided by a combination of the EM1A and EM1BA pins according to Section 24.3.6.1, and a set of GPIO pins. The RD/nBY signal from flash is connected to EM1WAIT pin of the EMIF.

Finally, this example configuration connects the  $\overline{\text{EM1WE}}$  pin to the nWE input of the flash and operates the EMIF in select strobe mode.

### 24.4.2 Software Configuration

The following sections describe how to configure the EMIF registers and bit fields to interface the EMIF with the Samsung K4S641632H-TC(L)70 SDRAM and the SHARP LH28F800BJE-PTTL90 8Mb Flash memory.

#### 24.4.2.1 Configuring the SDRAM Interface

This section describes how to configure the EMIF to interface with the Samsung K4S641632H-TC(L)70 SDRAM with a clock frequency of  $f_{\text{EM1CLK}} = 100$  MHz. Procedure A described in Section 24.3.5.5 is followed which assumes that the SDRAM power-up timing constraints were met during the SDRAM auto-initialization sequence after reset.

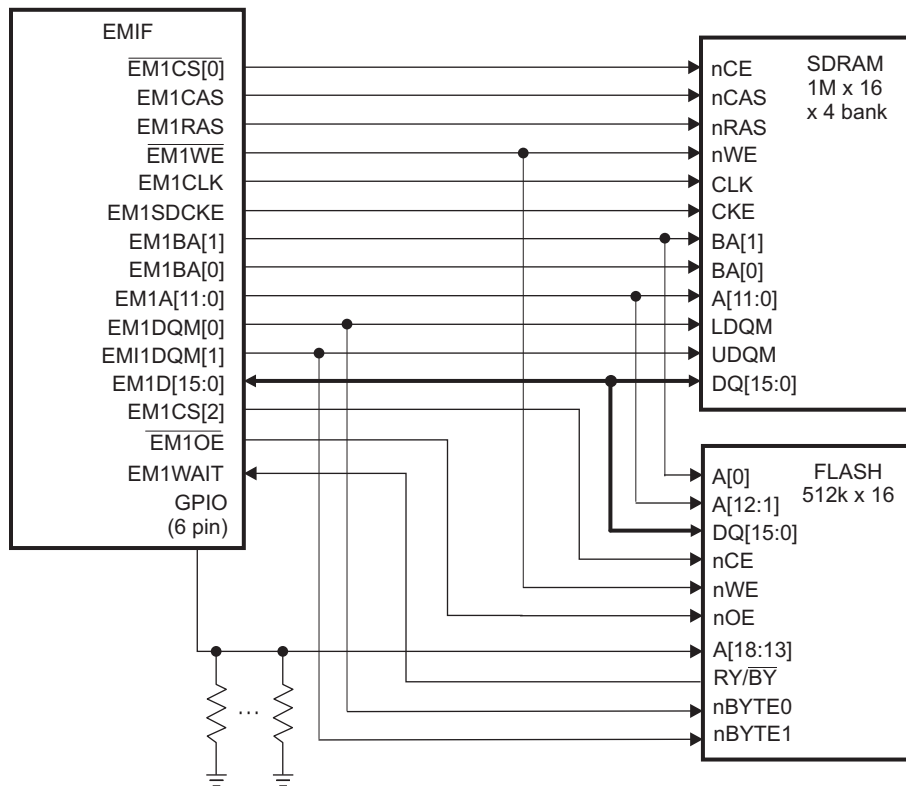
##### 24.4.2.1.1 PLL Programming for EMIF to K4S641632H-TC(L)70 Interface

If the user has programmed the system PLL to provide SYSCLK frequency > 100 MHz, then the user must configure the EMIF1CLKDIV field in the PERSYSCLKDIVSEL register to make EM1CLK = SYSCLK/2 (default configuration). Before doing this, the SDRAM should be placed in self-refresh mode by setting the SR bit in the SDRAM configuration register. Once the EM1CLK frequency has been configured, remove the SDRAM from self-refresh by clearing the SR bit in SDRAM\_CR.

**Table 24-26. SR Field Value For EMIF to K4S641632H-TC(L)70 Interface**

Field	Value	Purpose
SR	1 then 0	To place the EMIF into the self-refresh state

Figure 24-15. Example Configuration Interface





### 24.4.2.1.2 SDRAM Timing Register (SDRAM\_TR) Settings for EMIF to K4S641632H-TC(L)70 Interface

The fields of the SDRAM timing register (SDRAM\_TR) should be programmed first as described in [Table 24-27](#) to satisfy the required timing parameters for the K4S641632H-TC(L)70. Based on these calculations, a value of 6111 4610h should be written to the SDRAM\_TR. [Figure 24-16](#) shows a graphical description of how the SDRAM\_TR should be programmed.

**Table 24-27. SDRAM\_TR Field Calculations for EMIF to K4S641632H-TC(L)70 Interface**

Field Name	Formula	Value from K4S641632H-TC(L)70 Datasheet	Value Calculated for Field
T_RFC	$T\_RFC \geq (t_{RFC} \times f_{EM1CLK}) - 1$	$t_{RC} = 68 \text{ ns (min)}^{(1)}$	6
T_RP	$T\_RP \geq (t_{RP} \times f_{EM1CLK}) - 1$	$t_{RP} = 20 \text{ ns (min)}$	1
T_RCD	$T\_RCD \geq (t_{RCD} \times f_{EM1CLK}) - 1$	$t_{RCD} = 20 \text{ ns (min)}$	1
T_WR	$T\_WR \geq (t_{WR} \times f_{EM1CLK}) - 1$	$t_{RDL} = 2 \text{ CLK} = 20 \text{ ns (min)}^{(2)}$	1
T_RAS	$T\_RAS \geq (t_{RAS} \times f_{EM1CLK}) - 1$	$t_{RAS} = 49 \text{ ns (min)}$	4
T_RC	$T\_RC \geq (t_{RC} \times f_{EM1CLK}) - 1$	$t_{RC} = 68 \text{ ns (min)}$	6
T_RRD	$T\_RRD \geq (t_{RRD} \times f_{EM1CLK}) - 1$	$t_{RRD} = 14 \text{ ns (min)}$	1

<sup>(1)</sup> The Samsung datasheet does not specify a  $t_{RFC}$  value. Instead, Samsung specifies  $t_{RC}$  as the minimum auto refresh period.

<sup>(2)</sup> The Samsung datasheet does not specify a  $t_{WR}$  value. Instead, Samsung specifies  $t_{RDL}$  as last data in to row precharge minimum delay.

**Figure 24-16. SDRAM Timing Register (SDRAM\_TR)**

31	30	29	28	27	26	24	23	22	21	20	19	18	17	16	
0 0110				001		0	001		0	001					
T_RFC				T_RP		Rsvd	T_RCD		Rsvd	T_WR					
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0100				0110		0	001		0000						
T_RAS				T_RC		Rsvd	T_RRD		Reserved						

### 24.4.2.1.3 SDRAM Self Refresh Exit Timing Register (SDR\_EXT\_TMNG) Settings for EMIF to K4S641632H-TC(L)70 Interface

The SDRAM self-refresh exit timing register (SDSRETR) should be programmed second to satisfy the  $t_{XSR}$  timing requirement from the K4S641632H-TC(L)70 datasheet. Table 24-28 shows the calculation of the proper value to program into the T\_XS field of this register. Based on this calculation, a value of 6h should be written to the SDSRETR. Figure 24-17 shows how the SDSRETR should be programmed.

**Table 24-28. RR Calculation for EMIF to K4S641632H-TC(L)70 Interface**

Field Name	Formula	Value from K4S641632H-TC(L)70 Datasheet	Value Calculated for Field
T_XS	$T\_XS \geq (t_{XSR} \times f_{EM1CLK}) - 1$	$t_{RC} = 68 \text{ ns (min)}^{(1)}$	6

<sup>(1)</sup> The Samsung datasheet does not specify a  $t_{XSR}$  value. Instead, Samsung specifies  $t_{RC}$  as the minimum required time after CKE going high to complete self-refresh exit.

**Figure 24-17. SDRAM Self Refresh Exit Timing Register (SDR\_EXT\_TMNG)**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
0000 0000 0000 0000															
Reserved															
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
000 0000 0000											0 0110				
Reserved											T_XS				

### 24.4.2.1.4 SDRAM Refresh Control Register (SDRAM\_RCR) Settings for EMIF to K4S641632H-TC(L)70 Interface

The SDRAM refresh control register (SDRAM\_RCR) should next be programmed to satisfy the required refresh rate of the K4S641632H-TC(L)70. Table 24-29 shows the calculation of the proper value to program into the RR field of this register. Based on this calculation, a value of 61Ah should be written to the SDRAM\_RCR. Figure 24-18 shows how the SDRAM\_RCR should be programmed.

**Table 24-29. RR Calculation for EMIF to K4S641632H-TC(L)70 Interface**

Field Name	Formula	Values	Value Calculated for Field
RR	$RR \leq f_{EM1CLK} \times t_{Refresh \text{ Period}} / n_{cycles}$	From SDRAM datasheet: $t_{Refresh \text{ Period}} = 64 \text{ ms}$ ; $n_{cycles} = 4096 \text{ EMIF clock rate}$ ; $f_{EM1CLK} = 100 \text{ MHz}$	RR = 1562 cycles = 61Ah cycles

**Figure 24-18. SDRAM Refresh Control Register (SDRAM\_RCR)**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
0 0000 0000 0000												000			
Reserved												Reserved			
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
000			0 0110 0001 1010 (61Ah)												
Reserved			RR												

#### 24.4.2.1.5 SDRAM Configuration Register (SDRAM\_CR) Settings for EMIF to K4S641632H-TC(L)70 Interface

Finally, the fields of the SDRAM configuration register (SDRAM\_CR) should be programmed as described in [Table 24-26](#) to properly interface with the K4S641632H-TC(L)70 device. Based on these settings, a value of 4720h should be written to the SDRAM\_CR. [Figure 24-19](#) shows how the SDRAM\_CR should be programmed. The EMIF is now ready to perform read and write accesses to the SDRAM.

**Table 24-30. SDRAM\_CR Field Values For EMIF to K4S641632H-TC(L)70 Interface**

Field	Value	Purpose
SR	0	To avoid placing the EMIF into the self-refresh state
NM	1	To configure the EMIF for a 16-bit data bus
CL	011b	To select a CAS latency of 3
BIT11_9LOCK	1	To allow the CL field to be written
IBANK	010b	To select 4 internal SDRAM banks
PAGESIZE	0	To select a page size of 256 words

**Figure 24-19. SDRAM Configuration Register (SDRAM\_CR)**

31	30	29	28	27	26	25	24	
0	0	0	0 0000					
SR	Reserved	Reserved	Reserved					
23	22	21	20	19	18	17	16	
00 0000						0	0	
Reserved						Reserved	Reserved	
15	14	13	12	11	10	9	8	
0	1	0	0	011		1		
Reserved	NM	Reserved	Reserved	CL		BIT11_9LOCK		
7	6	5	4	3	2	1	0	
0	010		0		000			
Reserved	IBANK		Reserved		PAGESIZE			

### 24.4.2.2 Configuring the Flash Interface

This section describes how to configure the EMIF to interface with the SHARP LH28F800BJE-PTTL90 8Mb Flash memory with a clock frequency of  $f_{EM1CLK} = 100$  MHz.

#### 24.4.2.2.1 Asynchronous 1 Configuration Register (ASYNC\_CS2\_CFG) Settings for EMIF to LH28F800BJE-PTTL90 Interface

The asynchronous 1 configuration register (ASYNC\_CS2\_CFG) is the only register that is necessary to program for this asynchronous interface. The SS bit should be set to 1 to enable select strobe command the ASIZE field should be set to 1 to select a 16-bit interface. The other fields in this register control the shaping of the EMIF signals, and the proper values can be determined by referring to the AC Characteristics in the Flash data manual and the device data manual. Based on the following calculations, a value of 8862 25BDh should be written to ASYNC\_CS2\_CFG. [Table 24-31](#) and [Table 24-32](#) show the pertinent AC Characteristics for reads and writes to the Flash device, and [Figure 24-20](#) and [Figure 24-21](#) show the associated timing waveforms. Finally, [Figure 24-22](#) shows programming the ASYNC\_CS2\_CFG with the calculated values.

**Table 24-31. AC Characteristics for a Read Access**

AC Characteristic	Device	Definition	Min	Max	Unit
$t_{SU}$	EMIF	Setup time, read EM1D before EM1CLK high	6.5		ns
$t_H$	EMIF	Data hold time, read EM1D after EM1CLK high	1		ns
$t_D$	EMIF	Output delay time, EM1CLK high to output signal valid		7	ns
$t_{ELQV}$	Flash	nCE to Output Delay		90	ns
$t_{EHQZ}$	Flash	nCE High to Output in High Impedance		55	ns

**Table 24-32. AC Characteristics for a Write Access**

AC Characteristic	Device	Definition	Min	Max	Unit
$t_{AVAV}$	Flash	Write Cycle Time	90		ns
$t_{ELEH}$	Flash	nCE Pulse Width Low	50		ns
$t_{EHEL}$	Flash	nCE Pulse Width High (not shown in <a href="#">Figure 24-21</a> )	30		ns

**Figure 24-20. LH28F800BJE-PTTL90 to EMIF Read Timing Waveforms**

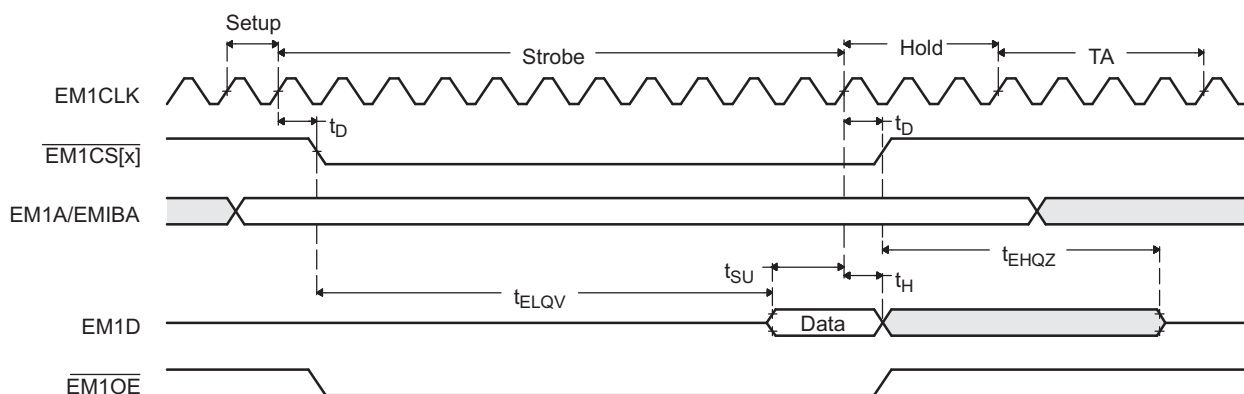
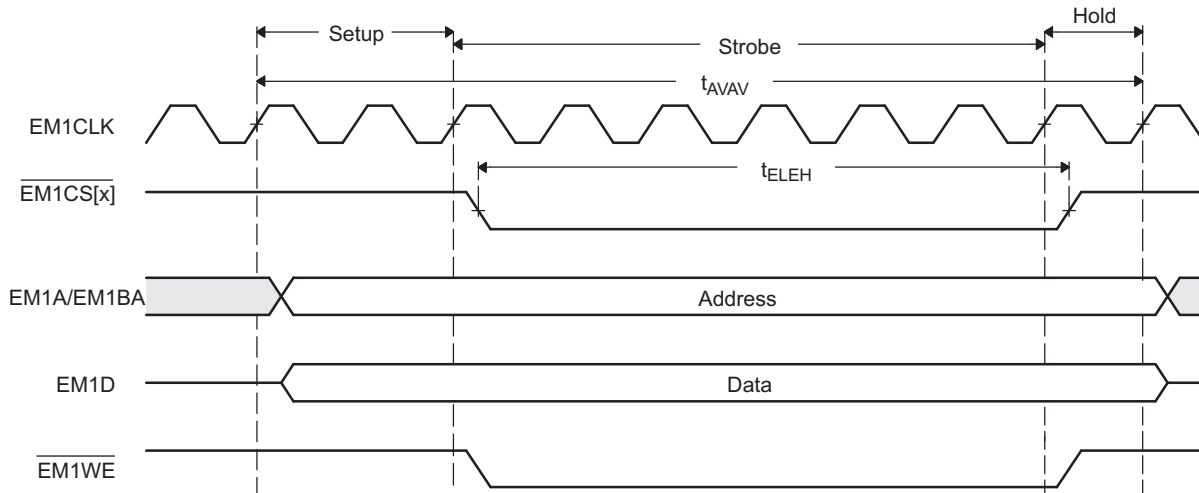


Figure 24-21. LH28F800BJE-PTTL90 to EMIF Write Timing Waveforms



The R\_STROBE field should be set to meet the following equation:

$$R\_STROBE \geq (t_D + t_{ELQV} + t_{SU}) \times f_{EM1CLK} - 1$$

$$R\_STROBE \geq (7 \text{ ns} + 90 \text{ ns} + 6.5 \text{ ns}) \times 100 \text{ MHz} - 1$$

$$R\_STROBE \geq 9.35$$

$$R\_STROBE = 10$$

The R\_HOLD field must be large enough to satisfy EMIF Data hold time,  $t_H$ :

$$R\_HOLD \geq t_H \times f_{EM1CLK} - 1$$

$$R\_HOLD \geq 1 \text{ ns} \times 100 \text{ MHz} - 1$$

$$R\_HOLD \geq -0.9$$

The R\_HOLD field must also combine with the TA field to satisfy the Flash's nCE High to Output in High Impedance time,  $t_{EHQZ}$ :

$$R\_HOLD + TA \geq (t_D + t_{EHQZ}) \times f_{EM1CLK} - 2$$

$$R\_HOLD + TA \geq (7 \text{ ns} + 55 \text{ ns}) \times 100 \text{ MHz} - 2$$

$$R\_HOLD + TA \geq 4.2$$

The largest value that can be programmed into the TA field is 3h, therefore the following values can be used:

$$R\_HOLD = 2$$

$$TA = 3$$

For Writes, the W\_STROBE field should be set to satisfy the Flash's nCE Pulse Width constraint,  $t_{ELEH}$ :

$$W\_STROBE \geq t_{ELEH} \times f_{EM1CLK} - 1$$

$$W\_STROBE \geq 50 \text{ ns} \times 100 \text{ MHz} - 1$$

$$W\_STROBE \geq 4$$

The W\_SETUP and W\_HOLD fields should combine to satisfy the Flash's nCE Pulse Width High constraint,  $t_{EHEL}$ :

$$W\_SETUP + W\_HOLD \geq t_{EHEL} \times f_{EM1CLK} - 2$$

$$W\_SETUP + W\_HOLD \geq 30 \text{ ns} \times 100 \text{ MHz} - 2$$

$$W\_SETUP + W\_HOLD \geq 1$$

In addition, the entire Write access length must satisfy the Flash's minimum Write Cycle Time,  $t_{AVAV}$ :

$$W\_SETUP + W\_STROBE + W\_HOLD \geq t_{AVAV} \times f_{EM1CLK} - 3$$

$$W\_SETUP + W\_STROBE + W\_HOLD \geq 90 \text{ ns} \times 100 \text{ MHz} - 3$$

$$W\_SETUP + W\_STROBE + W\_HOLD \geq 6$$

Solving the above equations for the Write fields results in the following possible solution:

$$W\_SETUP = 1$$

$$W\_STROBE = 5$$

$$W\_HOLD = 0$$

Adding a 10 ns (1 cycle) margin to each of the periods (excluding TA which is already at its maximum) in this example produces the following recommended values:

$$W\_SETUP = 2h$$

$$W\_STROBE = 6h$$

$$W\_HOLD = 1h$$

$$R\_SETUP = 1h$$

$$R\_STROBE = 8h$$

$$R\_HOLD = 3h$$

$$TA = 3h$$

**Figure 24-22. Asynchronous  $m$  Configuration Register ( $m = 1, 2$ ) (ASYNC\_CS $n$ \_CR( $n = 2, 3$ ))**

31		30		29		28		27		26		25		24																	
1		0		0010						00																					
SS		EW		W_SETUP						W_STROBE																					
23		22		21		20		19		18		17		16																	
0110						001						0																			
W_STROBE						W_HOLD						R_SETUP																			
15		14		13		12		11		10		9		8		7		6		5		4		3		2		1		0	
001				001011								011				11				01											
R_SETUP				R_STROBE								R_HOLD				TA				ASIZE											

## 24.5 Registers

### 24.5.1 EMIF Base Addresses

**Table 24-33. EMIF Base Address Table**

Device Registers	Register Name	Start Address	End Address
Emif1Regs	EMIF_REGS	0x0004_7000	0x0004_77FF
Emif2Regs	EMIF_REGS	0x0004_7800	0x0004_7FFF
Emif1ConfigRegs	EMIF1_CONFIG_REGS	0x0005_F480	0x0005_F49F
Emif2ConfigRegs	EMIF2_CONFIG_REGS	0x0005_F4A0	0x0005_F4BF

## 24.5.2 EMIF\_REGS Registers

Table 24-34 lists the memory-mapped registers for the EMIF\_REGS. All register offset addresses not listed in Table 24-34 should be considered as reserved locations and the register contents should not be modified.

**Table 24-34. EMIF\_REGS Registers**

Offset	Acronym	Register Name	Write Protection	Section
0h	RCSR	Revision Code and Status Register		<a href="#">Go</a>
2h	ASYNC_WCCR	Async Wait Cycle Config Register		<a href="#">Go</a>
4h	SDRAM_CR	SDRAM (EMxCS0n) Config Register		<a href="#">Go</a>
6h	SDRAM_RCR	SDRAM Refresh Control Register		<a href="#">Go</a>
8h	ASYNC_CS2_CR	Async 1 (EMxCS2n) Config Register		<a href="#">Go</a>
Ah	ASYNC_CS3_CR	Async 2 (EMxCS3n) Config Register		<a href="#">Go</a>
Ch	ASYNC_CS4_CR	Async 3 (EMxCS4n) Config Register		<a href="#">Go</a>
10h	SDRAM_TR	SDRAM Timing Register		<a href="#">Go</a>
18h	TOTAL_SDRAM_AR	Total SDRAM Accesses Register		<a href="#">Go</a>
1Ah	TOTAL_SDRAM_ACTR	Total SDRAM Activate Register		<a href="#">Go</a>
1Eh	SDR_EXT_TMNG	SDRAM SR/PD Exit Timing Register		<a href="#">Go</a>
20h	INT_RAW	Interrupt Raw Register		<a href="#">Go</a>
22h	INT_MSK	Interrupt Masked Register		<a href="#">Go</a>
24h	INT_MSK_SET	Interrupt Mask Set Register		<a href="#">Go</a>
26h	INT_MSK_CLR	Interrupt Mask Clear Register		<a href="#">Go</a>

Complex bit access types are encoded to fit into small table cells. Table 24-35 shows the codes that are used for access types in this section.

**Table 24-35. EMIF\_REGS Access Type Codes**

Access Type	Code	Description
<b>Read Type</b>		
R	R	Read
R=0	R	Read
<b>Write Type</b>		
W	W	Write
W=1	W	Write
<b>Reset or Default Value</b>		
-n		Value after reset or the default value
<b>Register Array Variables</b>		
i,j,k,l,m,n		When these variables are used in a register name, an offset, or an address, they refer to the value of a register array where the register is part of a group of repeating registers. The register groups form a hierarchical structure and the array is represented with a formula.
y		When this variable is used in a register name, an offset, or an address it refers to the value of a register array.



### 24.5.2.1 RCSR Register (Offset = 0h) [reset = 40000205h]

RCSR is shown in [Figure 24-23](#) and described in [Table 24-36](#).

Return to [Summary Table](#).

Revision Code and Status Register

**Figure 24-23. RCSR Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
BE	FR	MODULE_ID													
R-0h	R-1h	R-0h													
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
MAJOR_REVISION								MINOR_REVISION							
R-2h								R-5h							

**Table 24-36. RCSR Register Field Descriptions**

Bit	Field	Type	Reset	Description
31	BE	R	0h	EMIF endian mode. 0: Little Endian. 1: Big Endian. Reset type: SYSRSn
30	FR	R	1h	EMIF operating rate. 0: Half Rate. 1: Full Rate. Reset type: SYSRSn
29-16	MODULE_ID	R	0h	EMIF module ID. 0x0000: EMIF_24. 0x000E: EMIF_24 SDRAM. 0x000F: EMIF_24 ASYNC. Reset type: SYSRSn
15-8	MAJOR_REVISION	R	2h	Major Revision. EMIF code revisions are indicated by a revision code taking the format major_revision.minor_revision. Reset type: SYSRSn
7-0	MINOR_REVISION	R	5h	Minor Revision. See major_revision field description. Reset type: SYSRSn

### 24.5.2.2 ASYNC\_WCCR Register (Offset = 2h) [reset = F000080h]

ASYNC\_WCCR is shown in [Figure 24-24](#) and described in [Table 24-37](#).

Return to [Summary Table](#).

Async Wait Cycle Config Register

**Figure 24-24. ASYNC\_WCCR Register**

31	30	29	28	27	26	25	24
RESERVED	RESERVED	RESERVED	WP0	RESERVED			
R-0h	R-0h	R-0h	R/W-1h	R-0h			
23	22	21	20	19	18	17	16
RESERVED		RESERVED		RESERVED		RESERVED	
R-0h		R-0h		R-0h		R-0h	
15	14	13	12	11	10	9	8
RESERVED							
R-0h							
7	6	5	4	3	2	1	0
MAX_EXT_WAIT							
R/W-80h							

**Table 24-37. ASYNC\_WCCR Register Field Descriptions**

Bit	Field	Type	Reset	Description
31	RESERVED	R	0h	Reserved
30	RESERVED	R	0h	Reserved
29	RESERVED	R	0h	Reserved
28	WP0	R/W	1h	Defines the polarity of the EMxWAIT port.: 0: Wait if EMxWAIT port is low. 1: Wait if EMxWAIT port is high. Reset type: SYSRSn
27-24	RESERVED	R	0h	Reserved
23-22	RESERVED	R	0h	Reserved
21-20	RESERVED	R	0h	Reserved
19-18	RESERVED	R	0h	Reserved
17-16	RESERVED	R	0h	Reserved
15-8	RESERVED	R	0h	Reserved
7-0	MAX_EXT_WAIT	R/W	80h	The EMIF will wait for (max_ext_wait + 1) * 16 clock cycles before an extended asynchronous cycle is terminated. Reset type: SYSRSn

### 24.5.2.3 SDRAM\_CR Register (Offset = 4h) [reset = 620h]

SDRAM\_CR is shown in [Figure 24-25](#) and described in [Table 24-38](#).

Return to [Summary Table](#).

SDRAM (EMxCS0n) Config Register

**Figure 24-25. SDRAM\_CR Register**

31		30		29		28		27		26		25		24	
SR		PD		PDWR		RESERVED				RESERVED					
R/W-0h		R/W-0h		R/W-0h		R-0h				R-0h					
23		22		21		20		19		18		17		16	
RESERVED		RESERVED				RESERVED		RESERVED		RESERVED		RESERVED		RESERVED	
R-0h		R-0h				R-0h		R-0h		R-0h		R-0h		R-0h	
15		14		13		12		11		10		9		8	
RESERVED		NM		RESERVED		RESERVED		CL				BIT_11_9_LOCK		K	
R-0h		R/W-0h		R-0h		R-0h		R/W-3h				R=0/W=1-0h		R=0/W=1-0h	
7		6		5		4		3		2		1		0	
RESERVED		IBANK				RESERVED		PAGESIZE				RESERVED		RESERVED	
R-0h		R/W-2h				R-0h		R/W-0h				R/W-0h		R/W-0h	

**Table 24-38. SDRAM\_CR Register Field Descriptions**

Bit	Field	Type	Reset	Description
31	SR	R/W	0h	Self Refresh. Writing a 1 to this bit will cause connected SDRAM devices to be placed into Self Refresh mode and the EMIF to enter the self refresh state. In this state the EMIF will service all asynchronous memory accesses immediately but any SDRAM access will take at least $t_{ras} + 1$ cycles due to the time required for the SDRAM devices to out of Self Refresh mode. If an SDRAM access immediately follows the setting of the sr bit, the access will take $t_{ras} + t_{xs} + 2$ cycles. If both sr and pd bits are set, the EMIF will go into Self Refresh. Reset type: SYSRSn
30	PD	R/W	0h	Power Down. Writing a 1 to this bit will cause connected SDRAM devices to be placed into Power Down mode. If both sr and pd bits are set, the EMIF will go into Self Refresh. Reset type: SYSRSn
29	PDWR	R/W	0h	Perform refreshes during Power Down. Writing a 1 to this bit will cause the EMIF to exit the power down state and issue an AUTO REFRESH command every time Refresh May level is set. Reset type: SYSRSn
28-26	RESERVED	R	0h	Reserved
25-23	RESERVED	R	0h	Reserved
22-20	RESERVED	R	0h	Reserved
19	RESERVED	R	0h	Reserved
18-17	RESERVED	R	0h	Reserved
16	RESERVED	R	0h	Reserved
15	RESERVED	R	0h	Reserved
14	NM	R/W	0h	Narrow mode. Set to 1 when system bus width to memory bus width is 2:1 for SDR SDRAM. Set to 0 when system bus width to memory bus width is 1:1 for SDR SDRAM. A write to this field will cause the EMIF to start the SDRAM initialization sequence. Reset type: SYSRSn
13	RESERVED	R	0h	Reserved

**Table 24-38. SDRAM\_CR Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
12	RESERVED	R	0h	Reserved
11-9	CL	R/W	3h	The value of this field defines the CAS latency to be used when accessing connected SDRAM devices. Only CAS latencies of 2 (cl = 2) and 3 (cl = 3) are supported. A write to this field will cause the EMIF to start the SDRAM initialization sequence. Reset type: SYSRSn
8	BIT_11_9_LOCK	R=0/W=1	0h	Bits 11 to 9 can only be written if this bit is set to 1. Reset type: SYSRSn
7	RESERVED	R	0h	Reserved
6-4	IBANK	R/W	2h	Defines number of banks inside connected SDRAM devices: 000: 1 bank SDRAM devices. 001: 2 bank SDRAM devices. 010: 3 bank SDRAM devices. 011: 4 bank SDRAM devices. 1xx: Reserved. A write to this field will cause the EMIF to start the SDRAM initialization sequence. Reset type: SYSRSn
3	RESERVED	R	0h	Reserved
2-0	PAGESIZE	R/W	0h	Defines the internal page size of connected SDRAM devices: 000: 256-word pages requiring 8 column address bits. 001: 512-word pages requiring 9 column address bits. 010: 1024-word pages requiring 10 column address bits. 011: 2048-word pages requiring 11 column address bits. 1xx: Reserved. A write to this field will cause the EMIF to start the SDRAM initialization sequence. Reset type: SYSRSn

#### 24.5.2.4 SDRAM\_RCR Register (Offset = 6h) [reset = 80h]

SDRAM\_RCR is shown in [Figure 24-26](#) and described in [Table 24-39](#).

Return to [Summary Table](#).

SDRAM Refresh Control Register

**Figure 24-26. SDRAM\_RCR Register**

31	30	29	28	27	26	25	24
RESERVED							
R-0h							
23	22	21	20	19	18	17	16
RESERVED				RESERVED			
R-0h				R-0h			
15	14	13	12	11	10	9	8
RESERVED			REFRESH_RATE				
R-0h			R/W-80h				
7	6	5	4	3	2	1	0
REFRESH_RATE							
R/W-80h							

**Table 24-39. SDRAM\_RCR Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-19	RESERVED	R	0h	Reserved
18-16	RESERVED	R	0h	Reserved
15-13	RESERVED	R	0h	Reserved
12-0	REFRESH_RATE	R/W	80h	Value in this field is used to define the rate at which connected SDRAM devices will be refreshed, as follows: SDRAM refresh rate = EMIF rate/refresh_rate where EMIF rate=clk rate when full_rate=1, or EMIF rate=1/2 clk rate when full_rate=0. Writing a value < 0x0020 to this field will cause it to be loaded with (2 * t_rfc) + 1 value from SDRAM Timing register. Reset type: SYSRSn

**24.5.2.5 ASYNC\_CS2\_CR Register (Offset = 8h) [reset = 3FFFFFFDh]**

 ASYNC\_CS2\_CR is shown in [Figure 24-27](#) and described in [Table 24-40](#).

 Return to [Summary Table](#).

Async 1 (EMxCS2n) Config Register

**Figure 24-27. ASYNC\_CS2\_CR Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
SS	EW	W_SETUP				W_STROBE						W_HOLD		R_SETUP	
R/W-0h	R/W-0h	R/W-Fh				R/W-3Fh						R/W-7h		R/W-Fh	
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
R_SETUP			R_STROBE						R_HOLD			TA	ASIZE		
R/W-Fh			R/W-3Fh						R/W-7h			R/W-3h		R/W-1h	

**Table 24-40. ASYNC\_CS2\_CR Register Field Descriptions**

Bit	Field	Type	Reset	Description
31	SS	R/W	0h	Select Strobe mode. Set to 1 if chip selects need to have write or read strobe timing. Reset type: SYSRSn
30	EW	R/W	0h	Extend Wait mode. Set to 1 if extended asynchronous cycles are required based on EMxWAIT. Reset type: SYSRSn
29-26	W_SETUP	R/W	Fh	Write Strobe Setup cycles. Number of EMxCLK cycles from EMxAy, EMxBay, EMxDQMy, and EMxCS2n being set to EMxWEn asserted, minus one cycle. The reset value is 16 cycles. Reset type: SYSRSn
25-20	W_STROBE	R/W	3Fh	Write Strobe Duration cycles. Number of EMxCLK cycles for which EMxWEn is held active, minus one cycle. The reset value is 64 cycles. This field cannot be zero when ew = 1. Reset type: SYSRSn
19-17	W_HOLD	R/W	7h	Write Strobe Hold cycles. Number of EMxCLK cycles for which EMxAy, EMxBay, EMxDQMy, and EMxCS2n are held after EMxWEn has been deasserted, minus one cycle. The reset value is 8 cycles. Reset type: SYSRSn
16-13	R_SETUP	R/W	Fh	Read Strobe Setup cycles. Number of EMxCLK cycles from EMxAy, EMxBay, EMxDQMy, and EMxCS2n being set to EMxOEn asserted, minus one cycle. The reset value is 16 cycles. Reset type: SYSRSn
12-7	R_STROBE	R/W	3Fh	Read Strobe Duration cycles. Number of EMxCLK cycles for which EMxOEn is held active, minus one cycle. The reset value is 64 cycles. This field cannot be zero when ew = 1. Reset type: SYSRSn
6-4	R_HOLD	R/W	7h	Read Strobe Hold cycles. Number of EMxCLK cycles for which EMxAy, EMxBay, EMxDQMy, and EMxCS2n are held after EMxOEn has been deasserted, minus one cycle. The reset value is 8 cycles. Reset type: SYSRSn
3-2	TA	R/W	3h	Turn Around cycles. Number of EMxCLK cycles between the end of one asynchronous memory access and the start of another asynchronous memory access, minus one cycle. This delay is not incurred between a read followed by a read, or a write followed by a write to the same chip select. The reset value is 4 cycles. Reset type: SYSRSn

**Table 24-40. ASYNC\_CS2\_CR Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
1-0	ASIZE	R/W	1h	Asynchronous Memory Size. Defines the width of the asynchronous device's data bus : 00: 8 Bit data bus. 01: 16 Bit data bus. 10: 32 Bit data bus. 11: Reserved. Reset type: SYSRSn

**24.5.2.6 ASYNC\_CS3\_CR Register (Offset = Ah) [reset = 3FFFFFFDh]**

 ASYNC\_CS3\_CR is shown in [Figure 24-28](#) and described in [Table 24-41](#).

 Return to [Summary Table](#).

Async 2 (EMxCS3n) Config Register

**Figure 24-28. ASYNC\_CS3\_CR Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
SS	EW	W_SETUP				W_STROBE				W_HOLD			R_SETUP		
R/W-0h	R/W-0h	R/W-Fh				R/W-3Fh				R/W-7h			R/W-Fh		
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
R_SETUP			R_STROBE				R_HOLD			TA	ASIZE				
R/W-Fh			R/W-3Fh				R/W-7h			R/W-3h		R/W-1h			

**Table 24-41. ASYNC\_CS3\_CR Register Field Descriptions**

Bit	Field	Type	Reset	Description
31	SS	R/W	0h	Select Strobe mode. Set to 1 if chip selects need to have write or read strobe timing. Reset type: SYSRSn
30	EW	R/W	0h	Extend Wait mode. Set to 1 if extended asynchronous cycles are required based on EMxWAIT. Reset type: SYSRSn
29-26	W_SETUP	R/W	Fh	Write Strobe Setup cycles. Number of EMxCLK cycles from EMxAy, EMxBay, EMxDQMy, and EMxCS3n being set to EMxWEn asserted, minus one cycle. The reset value is 16 cycles. Reset type: SYSRSn
25-20	W_STROBE	R/W	3Fh	Write Strobe Duration cycles. Number of EMxCLK cycles for which EMxWEn is held active, minus one cycle. The reset value is 64 cycles. This field cannot be zero when ew = 1. Reset type: SYSRSn
19-17	W_HOLD	R/W	7h	Write Strobe Hold cycles. Number of EMxCLK cycles for which EMxAy, EMxBay, EMxDQMy, and EMxCS3n are held after EMxWEn has been deasserted, minus one cycle. The reset value is 8 cycles. Reset type: SYSRSn
16-13	R_SETUP	R/W	Fh	Read Strobe Setup cycles. Number of EMxCLK cycles from EMxAy, EMxBay, EMxDQMy, and EMxCS3n being set to EMxOEn asserted, minus one cycle. The reset value is 16 cycles. Reset type: SYSRSn
12-7	R_STROBE	R/W	3Fh	Read Strobe Duration cycles. Number of EMxCLK cycles for which EMxOEn is held active, minus one cycle. The reset value is 64 cycles. This field cannot be zero when ew = 1. Reset type: SYSRSn
6-4	R_HOLD	R/W	7h	Read Strobe Hold cycles. Number of EMxCLK cycles for which EMxAy, EMxBay, EMxDQMy, and EMxCS3n are held after EMxOEn has been deasserted, minus one cycle. The reset value is 8 cycles. Reset type: SYSRSn
3-2	TA	R/W	3h	Turn Around cycles. Number of EMxCLK cycles between the end of one asynchronous memory access and the start of another asynchronous memory access, minus one cycle. This delay is not incurred between a read followed by a read, or a write followed by a write to the same chip select. The reset value is 4 cycles. Reset type: SYSRSn



**Table 24-41. ASYNC\_CS3\_CR Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
1-0	ASIZE	R/W	1h	Asynchronous Memory Size. Defines the width of the asynchronous device's data bus : 00: 8 Bit data bus. 01: 16 Bit data bus. 10: 32 Bit data bus. 11: Reserved. Reset type: SYSRSn

**24.5.2.7 ASYNC\_CS4\_CR Register (Offset = Ch) [reset = 3FFFFFFDh]**

 ASYNC\_CS4\_CR is shown in [Figure 24-29](#) and described in [Table 24-42](#).

 Return to [Summary Table](#).

Async 3 (EMxCS4n) Config Register

**Figure 24-29. ASYNC\_CS4\_CR Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
SS	EW	W_SETUP				W_STROBE				W_HOLD			R_SETUP		
R/W-0h	R/W-0h	R/W-Fh				R/W-3Fh				R/W-7h			R/W-Fh		
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
R_SETUP			R_STROBE				R_HOLD			TA	ASIZE				
R/W-Fh			R/W-3Fh				R/W-7h			R/W-3h		R/W-1h			

**Table 24-42. ASYNC\_CS4\_CR Register Field Descriptions**

Bit	Field	Type	Reset	Description
31	SS	R/W	0h	Select Strobe mode. Set to 1 if chip selects need to have write or read strobe timing. Reset type: SYSRSn
30	EW	R/W	0h	Extend Wait mode. Set to 1 if extended asynchronous cycles are required based on EMxWAIT. Reset type: SYSRSn
29-26	W_SETUP	R/W	Fh	Write Strobe Setup cycles. Number of EMxCLK cycles from EMxAy, EMxBay, EMxDQMy, and EMxCS4n being set to EMxWEn asserted, minus one cycle. The reset value is 16 cycles. Reset type: SYSRSn
25-20	W_STROBE	R/W	3Fh	Write Strobe Duration cycles. Number of EMxCLK cycles for which EMxWEn is held active, minus one cycle. The reset value is 64 cycles. This field cannot be zero when ew = 1. Reset type: SYSRSn
19-17	W_HOLD	R/W	7h	Write Strobe Hold cycles. Number of EMxCLK cycles for which EMxAy, EMxBay, EMxDQMy, and EMxCS4n are held after EMxWEn has been deasserted, minus one cycle. The reset value is 8 cycles. Reset type: SYSRSn
16-13	R_SETUP	R/W	Fh	Read Strobe Setup cycles. Number of EMxCLK cycles from EMxAy, EMxBay, EMxDQMy, and EMxCS4n being set to EMxOEn asserted, minus one cycle. The reset value is 16 cycles. Reset type: SYSRSn
12-7	R_STROBE	R/W	3Fh	Read Strobe Duration cycles. Number of EMxCLK cycles for which EMxOEn is held active, minus one cycle. The reset value is 64 cycles. This field cannot be zero when ew = 1. Reset type: SYSRSn
6-4	R_HOLD	R/W	7h	Read Strobe Hold cycles. Number of EMxCLK cycles for which EMxAy, EMxBay, EMxDQMy, and EMxCS4n are held after EMxOEn has been deasserted, minus one cycle. The reset value is 8 cycles. Reset type: SYSRSn
3-2	TA	R/W	3h	Turn Around cycles. Number of EMxCLK cycles between the end of one asynchronous memory access and the start of another asynchronous memory access, minus one cycle. This delay is not incurred between a read followed by a read, or a write followed by a write to the same chip select. The reset value is 4 cycles. Reset type: SYSRSn

**Table 24-42. ASYNC\_CS4\_CR Register Field Descriptions (continued)**

Bit	Field	Type	Reset	Description
1-0	ASIZE	R/W	1h	Asynchronous Memory Size. Defines the width of the asynchronous device's data bus : 00: 8 Bit data bus. 01: 16 Bit data bus. 10: 32 Bit data bus. 11: Reserved. Reset type: SYSRSn

### 24.5.2.8 SDRAM\_TR Register (Offset = 10h) [reset = 19214610h]

SDRAM\_TR is shown in Figure 24-30 and described in Table 24-43.

Return to [Summary Table](#).

SDRAM Timing Register

**Figure 24-30. SDRAM\_TR Register**

31	30	29	28	27	26	25	24
T_RFC				T_RP			
R/W-3h				R/W-1h			
23	22	21	20	19	18	17	16
RESERVED	T_RCD			RESERVED	T_WR		
R-0h		R/W-2h		R-0h		R/W-1h	
15	14	13	12	11	10	9	8
T_RAS				T_RC			
R/W-4h				R/W-6h			
7	6	5	4	3	2	1	0
RESERVED	T_RRD			RESERVED			
R-0h		R/W-1h		R-0h			

**Table 24-43. SDRAM\_TR Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-27	T_RFC	R/W	3h	Minimum number of EMxCLK cycles from Refresh or Load Mode to Refresh or Activate, minus one. Reset type: SYSRSn
26-24	T_RP	R/W	1h	Minimum number of EMxCLK cycles from Precharge to Activate or Refresh, minus one. Reset type: SYSRSn
23	RESERVED	R	0h	Reserved
22-20	T_RCD	R/W	2h	Minimum number of EMxCLK cycles from Activate to Read or Write, minus one. Reset type: SYSRSn
19	RESERVED	R	0h	Reserved
18-16	T_WR	R/W	1h	For SDR, this is equal to minimum number of EMxCLK cycles from last Write transfer to Precharge, minus one. Reset type: SYSRSn
15-12	T_RAS	R/W	4h	Minimum number of EMxCLK cycles from Activate to Precharge, minus one. $t_{ras} \geq t_{rcd}$ . Reset type: SYSRSn
11-8	T_RC	R/W	6h	Minimum number of EMxCLK cycles from Activate to Activate minus one. Reset type: SYSRSn
7	RESERVED	R	0h	Reserved
6-4	T_RRD	R/W	1h	Minimum number of EMxCLK cycles from Activate to Activate for a different bank, minus one. Reset type: SYSRSn
3-0	RESERVED	R	0h	Reserved

**24.5.2.9 TOTAL\_SDRAM\_AR Register (Offset = 18h) [reset = 0h]**

TOTAL\_SDRAM\_AR is shown in [Figure 24-31](#) and described in [Table 24-44](#).

Return to [Summary Table](#).

Total SDRAM Accesses Register

**Figure 24-31. TOTAL\_SDRAM\_AR Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
TOTAL_SDRAM_AR																															
R-0h																															

**Table 24-44. TOTAL\_SDRAM\_AR Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-0	TOTAL_SDRAM_AR	R	0h	Indicates the total number of accesses to SDRAM from a master (CPUx/CPUX.DMA). This counter is incremented by two for a single access crossing page boundaries. Reset type: SYSRSn

**24.5.2.10 TOTAL\_SDRAM\_ACTR Register (Offset = 1Ah) [reset = 0h]**

TOTAL\_SDRAM\_ACTR is shown in [Figure 24-32](#) and described in [Table 24-45](#).

Return to [Summary Table](#).

Total SDRAM Activate Register

**Figure 24-32. TOTAL\_SDRAM\_ACTR Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
TOTAL_SDRAM_ACTR																															
R-0h																															

**Table 24-45. TOTAL\_SDRAM\_ACTR Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-0	TOTAL_SDRAM_ACTR	R	0h	Indicates the total number of SDRAM accesses which require an activate command. Reset type: SYSRSn

**24.5.2.11 SDR\_EXT\_TMNG Register (Offset = 1Eh) [reset = 7h]**

SDR\_EXT\_TMNG is shown in [Figure 24-33](#) and described in [Table 24-46](#).

Return to [Summary Table](#).

SDRAM SR/PD Exit Timing Register

**Figure 24-33. SDR\_EXT\_TMNG Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
RESERVED																RESERVED										T_XS					
R-0h																R-0h										R/W-7h					

**Table 24-46. SDR\_EXT\_TMNG Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R	0h	Reserved
15-5	RESERVED	R	0h	Reserved
4-0	T_XS	R/W	7h	This is equal to minimum number of EMxCLK cycles from Self Refresh exit to any command, minus one. For SDR SDRAM, this count should satisfy tXSR. Reset type: SYSRSn

**24.5.2.12 INT\_RAW Register (Offset = 20h) [reset = 0h]**

INT\_RAW is shown in [Figure 24-34](#) and described in [Table 24-47](#).

Return to [Summary Table](#).

Interrupt Raw Register

**Figure 24-34. INT\_RAW Register**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
RESERVED															
R-0h															
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
RESERVED										WR			LT	AT	
R-0h										R/W=1-0h			R/W=1 -0h	R/W=1 -0h	

**Table 24-47. INT\_RAW Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R	0h	Reserved
15-6	RESERVED	R	0h	Reserved
5-2	WR	R/W=1	0h	Wait Rise. Set to 1 by hardware to indicate rising edge on the corresponding EMxWAIT has been detected. The WPx bits in the Async Wait Cycle Config register has no effect on these bits. Writing a 1 will clear these bits as well as the wr_masked bits in the Interrupt Masked register. Writing a 0 has no effect. Reset type: SYSRSn
1	LT	R/W=1	0h	Line Trap. Set to 1 by hardware to indicate illegal memory access type or invalid cache line size. Writing a 1 will clear this bit as well as the lt_masked bit in the Interrupt Masked register. Writing a 0 has no effect. Reset type: SYSRSn
0	AT	R/W=1	0h	Asynchronous Timeout. Set to 1 by hardware to indicate that during an extended asynchronous memory access cycle, the EMxWAIT signal did not go inactive within the number of cycles defined by the max_ext_wait field in Async Wait Cycle Config register. Writing a 1 will clear this bit as well as the at_masked bit in the Interrupt Masked register. Writing a 0 has no effect. Reset type: SYSRSn



**24.5.2.13 INT\_MSK Register (Offset = 22h) [reset = 0h]**

 INT\_MSK is shown in [Figure 24-35](#) and described in [Table 24-48](#).

 Return to [Summary Table](#).

Interrupt Masked Register

**Figure 24-35. INT\_MSK Register**

31	30	29	28	27	26	25	24
RESERVED							
R-0h							
23	22	21	20	19	18	17	16
RESERVED							
R-0h							
15	14	13	12	11	10	9	8
RESERVED							
R-0h							
7	6	5	4	3	2	1	0
RESERVED		WR_MASKED				LT_MASKED	AT_MASKED
R-0h		R/W=1-0h				R/W=1-0h	R/W=1-0h

**Table 24-48. INT\_MSK Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R	0h	Reserved
15-6	RESERVED	R	0h	Reserved
5-2	WR_MASKED	R/W=1	0h	Masked Wait Rise. Set to 1 by hardware to indicate rising edge on the corresponding EMxWAIT has been detected, only if the wr_mask_set bit in the Interrupt Mask Set register is set to 1. The WPx bits in the Async Wait Cycle Config register has no effect on these bits. Writing a 1 will clear these bits as well as the wr bits in the Interrupt Raw register. Writing a 0 has no effect. Reset type: SYSRSn
1	LT_MASKED	R/W=1	0h	Masked Line Trap. Set to 1 by hardware to indicate illegal memory access type or invalid cache line size, only if the lt_mask_set bit in the Interrupt Mask Set register is set to 1. Writing a 1 will clear this bit as well as the lt bit in the Interrupt Raw register. Writing a 0 has no effect. Reset type: SYSRSn
0	AT_MASKED	R/W=1	0h	Masked Asynchronous Timeout. Set to 1 by hardware to indicate that during an extended asynchronous memory access cycle, the EMxWAIT signal did not go inactive within the number of cycles defined by the max_ext_wait field in Async Wait Cycle Config register, only if the at_mask_set bit in the Interrupt Mask Set register is set to 1. Writing a 1 will clear this bit as well as the at bit in the Interrupt Raw register. Writing a 0 has no effect. Reset type: SYSRSn

**24.5.2.14 INT\_MSK\_SET Register (Offset = 24h) [reset = 0h]**

INT\_MSK\_SET is shown in [Figure 24-36](#) and described in [Table 24-49](#).

Return to [Summary Table](#).

Interrupt Mask Set Register

**Figure 24-36. INT\_MSK\_SET Register**

31	30	29	28	27	26	25	24	
RESERVED								
R-0h								
23	22	21	20	19	18	17	16	
RESERVED								
R-0h								
15	14	13	12	11	10	9	8	
RESERVED								
R-0h								
7	6	5	4	3	2	1	0	
RESERVED		WR_MASK_SET				LT_MASK_SET	AT_MASK_SET	
R-0h		R/W=1-0h				R/W=1-0h	R/W=1-0h	

**Table 24-49. INT\_MSK\_SET Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R	0h	Reserved
15-6	RESERVED	R	0h	Reserved
5-2	WR_MASK_SET	R/W=1	0h	Mask set for wr_masked bits in the Interrupt Masked Register. Writing a 1 will enable the interrupts, and set these bits as well as the wr_mask_clr bits in the Interrupt Mask Clear register. Writing a 0 has no effect. Reset type: SYSRSn
1	LT_MASK_SET	R/W=1	0h	Mask set for lt_masked bit in the Interrupt Masked Register. Writing a 1 will enable the interrupt, and set this bit as well as the lt_mask_clr bit in the Interrupt Mask Clear register. Writing a 0 has no effect. Reset type: SYSRSn
0	AT_MASK_SET	R/W=1	0h	Mask set for at_masked bit in the Interrupt Masked Register. Writing a 1 will enable the interrupt, and set this bit as well as the at_mask_clr bit in the Interrupt Mask Clear register. Writing a 0 has no effect. Reset type: SYSRSn

**24.5.2.15 INT\_MSK\_CLR Register (Offset = 26h) [reset = 0h]**

 INT\_MSK\_CLR is shown in [Figure 24-37](#) and described in [Table 24-50](#).

[Return to Summary Table.](#)

Interrupt Mask Clear Register

**Figure 24-37. INT\_MSK\_CLR Register**

31	30	29	28	27	26	25	24	
RESERVED								
R-0h								
23	22	21	20	19	18	17	16	
RESERVED								
R-0h								
15	14	13	12	11	10	9	8	
RESERVED								
R-0h								
7	6	5	4	3	2	1	0	
RESERVED		WR_MASK_CLR				LT_MASK_CLR	AT_MASK_CLR	
R-0h		R/W=1-0h				R/W=1-0h	R/W=1-0h	

**Table 24-50. INT\_MSK\_CLR Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R	0h	Reserved
15-6	RESERVED	R	0h	Reserved
5-2	WR_MASK_CLR	R/W=1	0h	Mask clear for wr_masked bits in the Interrupt Masked Register. Writing a 1 will disable the interrupts, and clear these bits as well as the wr_mask_set bits in the Interrupt Mask Set register. Writing a 0 has no effect. Reset type: SYSRSn
1	LT_MASK_CLR	R/W=1	0h	Mask clear for lt_masked bit in the Interrupt Masked Register. Writing a 1 will disable the interrupt, and clear this bit as well as the lt_mask_set bit in the Interrupt Mask Set register. Writing a 0 has no effect. Reset type: SYSRSn
0	AT_MASK_CLR	R/W=1	0h	Mask clear for at_masked bit in the Interrupt Masked Register. Writing a 1 will disable the interrupt, and clear this bit as well as the at_mask_set bit in the Interrupt Mask Set register. Writing a 0 has no effect. Reset type: SYSRSn

### 24.5.3 EMIF1\_CONFIG\_REGS Registers

Table 24-51 lists the memory-mapped registers for the EMIF1\_CONFIG\_REGS. All register offset addresses not listed in Table 24-51 should be considered as reserved locations and the register contents should not be modified.

**Table 24-51. EMIF1\_CONFIG\_REGS Registers**

Offset	Acronym	Register Name	Write Protection	Section
0h	EMIF1LOCK	EMIF1 Config Lock Register	EALLOW	<a href="#">Go</a>
2h	EMIF1COMMIT	EMIF1 Config Lock Commit Register	EALLOW	<a href="#">Go</a>
8h	EMIF1ACCPROT0	EMIF1 Config Register 0	EALLOW	<a href="#">Go</a>

Complex bit access types are encoded to fit into small table cells. Table 24-52 shows the codes that are used for access types in this section.

**Table 24-52. EMIF1\_CONFIG\_REGS Access Type Codes**

Access Type	Code	Description
<b>Read Type</b>		
R	R	Read
R=0	R	Read
<b>Write Type</b>		
W	W	Write
WSOnce	SOnce W	Set once Write
<b>Reset or Default Value</b>		
-n		Value after reset or the default value
<b>Register Array Variables</b>		
i,j,k,l,m,n		When these variables are used in a register name, an offset, or an address, they refer to the value of a register array where the register is part of a group of repeating registers. The register groups form a hierarchical structure and the array is represented with a formula.
y		When this variable is used in a register name, an offset, or an address it refers to the value of a register array.

### 24.5.3.1 EMIF1LOCK Register (Offset = 0h) [reset = 0h]

EMIF1LOCK is shown in [Figure 24-38](#) and described in [Table 24-53](#).

Return to [Summary Table](#).

EMIF1 Config Lock Register

**Figure 24-38. EMIF1LOCK Register**

31	30	29	28	27	26	25	24
RESERVED							
R-0h							
23	22	21	20	19	18	17	16
RESERVED							
R-0h							
15	14	13	12	11	10	9	8
RESERVED							
R-0h							
7	6	5	4	3	2	1	0
RESERVED							LOCK_EMIF1
R-0h							R/W-0h

**Table 24-53. EMIF1LOCK Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R	0h	Reserved
15-1	RESERVED	R	0h	Reserved
0	LOCK_EMIF1	R/W	0h	Locks the write to access protection and master select fields for EMIF1: 0: Write to ACCPROT and Mselect fields are allowed. 1: Write to ACCPROT and Mselect fields are blocked. Reset type: SYSRSn

### 24.5.3.2 EMIF1COMMIT Register (Offset = 2h) [reset = 0h]

EMIF1COMMIT is shown in [Figure 24-39](#) and described in [Table 24-54](#).

Return to [Summary Table](#).

EMIF1 Config Lock Commit Register

**Figure 24-39. EMIF1COMMIT Register**

31	30	29	28	27	26	25	24
RESERVED							
R-0h							
23	22	21	20	19	18	17	16
RESERVED							
R-0h							
15	14	13	12	11	10	9	8
RESERVED							
R-0h							
7	6	5	4	3	2	1	0
RESERVED							COMMIT_EMIF 1
R-0h							R/WSONce-0h

**Table 24-54. EMIF1COMMIT Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R	0h	Reserved
15-1	RESERVED	R	0h	Reserved
0	COMMIT_EMIF1	R/WSONce	0h	Permanently Locks the write to access protection and master select fields for EMIF1: 0: Write to ACCPROT and Mselect fields are allowed based on value of lock field in EMIF1LOCK register. 1: Write to ACCPROT and Mselect fields are permanently blocked. Reset type: SYSRSn

### 24.5.3.3 EMIF1ACCPROT0 Register (Offset = 8h) [reset = 0h]

EMIF1ACCPROT0 is shown in [Figure 24-40](#) and described in [Table 24-55](#).

Return to [Summary Table](#).

EMIF1 Config Register 0

**Figure 24-40. EMIF1ACCPROT0 Register**

31	30	29	28	27	26	25	24
RESERVED							
R-0h							
23	22	21	20	19	18	17	16
RESERVED							
R-0h							
15	14	13	12	11	10	9	8
RESERVED							
R-0h							
7	6	5	4	3	2	1	0
RESERVED					DMAWRPROT_	CPUWRPROT_	FETCHPROT_
R-0h					_EMIF1	EMIF1	EMIF1
					R/W-0h	R/W-0h	R/W-0h

**Table 24-55. EMIF1ACCPROT0 Register Field Descriptions**

Bit	Field	Type	Reset	Description
31-16	RESERVED	R	0h	Reserved
15-3	RESERVED	R	0h	Reserved
2	DMAWRPROT_EMIF1	R/W	0h	DMA WR Protection For EMIF1: 0: CPU Writes are allowed. 1: CPU Writes are blocked. Reset type: SYSRSn
1	CPUWRPROT_EMIF1	R/W	0h	CPU WR Protection For EMIF1: 0: CPU Writes are allowed. 1: CPU Writes are blocked. Reset type: SYSRSn
0	FETCHPROT_EMIF1	R/W	0h	Fetch Protection For EMIF1: 0: CPU Fetches are allowed. 1: CPU Fetches are blocked. Reset type: SYSRSn

## Revision History

Changes from January 1, 2017 to September 15, 2017	Page
• <b>Chapter 1: C28x Processor:</b> No changes in this revision. ....	79
• <b>Chapter 2: System Control</b> .....	82
• <b>Table 2-4:</b> Changed description for PIE Group 9 Vectors INT9.5 - INT9.8. ....	92
• <b>Table 2-10:</b> Removed 'unless unlocked' from the end of the sentence beginning with "Master select and access protection".. ....	120
• <b>Section 2.12.2:</b> Added the last bullet indicating "Users much install updates for Flash Plugin and UniFlash tools...."; replaced reference guide links. ....	126
• <b>Section 2.12.5:</b> Replaced links to references. ....	127
• <b>Section 2.13.1.6:</b> Reworded the last sentence in the first paragraph of this section. ....	144
• <b>Section 2.14:</b> Added this new section. ....	150
• <b>Chapter 3: ROM code and Peripheral Booting</b> .....	546
• <b>Figure 3-2:</b> Figure has been revised. ....	551
• <b>Figure 3-4:</b> Added Enable Watchdog to the figure. ....	553
• <b>Table 3-19:</b> Added the note following the table.....	568
• <b>Chapter 4: Direct Memory Access (DMA)</b> .....	576
• <b>Section 4.4 :</b> Reworded the sentence beginning "In the case of a bulk DMA transfer.." ....	585
• <b>Table 4-8:</b> Added the note to bit 10, ONESHOT description. ....	599
• <b>Chapter 5: Control Law Accelerator (CLA)</b> .....	611
• <b>Section 5.4.2:</b> Changed references of PCLKCR3 to PCLKCR0.....	620
• <b>Table 5-9:</b> The text preceding the table beginning with "for instructions that use MRx" and the operand encoding table have been added. ....	632
• <b>Chapter 6: General-Purpose Input/Output (GPIO)</b> .....	785
• <b>Chapter 7 Crossbar (X-BAR)</b> .....	1013
• <b>Table 7-2:</b> Added the note to ADCSOCAO and ADCSOCBO. ....	1017
• <b>Table 7-3:</b> Added the note to ADCSOCAO and ADCSOCBO. ....	1019
• <b>Chapter 8: Analog Subsystem</b> .....	1248
• <b>Section 8.1.1:</b> Revised the features list. ....	1249
• <b>Chapter 9: Analog-to-Digital Converter (ADC)</b> .....	1263
• <b>Section 9.1.3.2:</b> Revised the text in this section for better clarity.....	1266
• <b>Section 9.1.3.4:</b> Revised this section. ....	1266
• <b>Table 9-3:</b> Changed when ADCINyP - ADCINyN ≥ VREFHI to when ADCINyP - ADCINyN ≤ -VREFHI. ....	1268
• <b>Section 9.1.5:</b> Removed reference to SOCC and SOCD. ....	1272
• <b>Figure 9-9:</b> Revised the block diagram. ....	1280
• <b>Section 9.1.10:</b> Added this new section.....	1282
• <b>Chapter 10: Buffered Digital to Analog Converter (DAC) -</b> No changes in this revision .....	1457
• <b>Chapter 11: Comparator Subsystem (CMPSS)</b> .....	1468
• <b>Section 11.5:</b> Inserted step 4 in the bulleted list. ....	1473
• <b>Chapter 12: Sigma Delta Filter Module (SDFM):</b> No changes in this revision. ....	1500
• <b>Chapter 13: Enhanced Pulse Width Modulator (ePWM)</b> .....	1550
• <b>Section 13.1:</b> Added Type0 to Type1 Enhancements section. ....	1552
• <b>Figure 13-54:</b> Figure has been updated. ....	1618
• <b>Section 13.11.4.3</b> Included: this new section. ....	1619
• <b>Figure 13-57:</b> Changed the output signals for CMPSS1 and CMPSS8 from CTRIPOUTH to CTRIPH and CTRIOUTL to CTRIPL. ....	1621
• <b>Figure 13-72:</b> Removed the last BLANKWDW section. ....	1636
• <b>Chapter 14: High-Resolution Pulse Width Modulator (HRPWM):</b> No changes in this revision. ....	1877
• <b>Enhanced Capture (eCAP)</b> <b>Chapter 15:</b> .....	1904
• <b>Section 15.3:</b> Changed instances of OUTPUTXBARn to OUTPUTXBARx. ....	1905
• <b>Figure 15-11:</b> Included the new figure.....	1915
• <b>Chapter 16: : Enhanced QEP (eQEP)</b> .....	1944



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• <a href="#">Section 16.5.1.1</a> : Revised the final sentence int his section. ....	1954
• <a href="#">Section 16.5.1.2</a> : Revised the second paragraph, beginning "The first index marker..." .....	1954
• <a href="#">Section 16.5.1.3</a> : Revised the second paragraph beginning "The first index marker..." .....	1955
• <a href="#">Section 16.8</a> : Modified the text of the first paragraph.....	1963
• <a href="#">Chapter 17 Serial Peripheral Interface (SPI)</a> : No changes in this revision. ....	2000
• <a href="#">Chapter 18: Serial Communications Interface (SCI)</a> .....	2040
• <a href="#">Section 18.12</a> : Revised the text in the second paragraph. ....	2050
• <a href="#">Table 18-3</a> : Revised the table. ....	2050
• <a href="#">Chapter 19: Inter-Integrated Circuit Module (I2C)</a> : No changes in this revision. ....	2075
• <a href="#">Chapter 20: Multichannel Buffered Serial Port (McBSP)</a> .....	2115
• <a href="#">Chapter 21: Controller Area Network (CAN)</a> : Removed the Global Power-down Mode section. ....	2227
• <a href="#">Section 21.3</a> : Added this new section. ....	2230
• <a href="#">Section 21.4.1</a> : Deleted the note. ....	2231
• <a href="#">Section 21.4.2.2</a> : Revised the Note.....	2233
• <a href="#">Section 21.4.3.2</a> : Changed 'setting bit LBack in the TTST register" to "setting bit LBack in the CAN_TEST register." ..	2233
• <a href="#">Section 21.6.3</a> : Changed the last sentence from 'this register' to "the CAN_CTL register." .....	2236
• <a href="#">Section 21.6.4</a> : Created this new section. ....	2237
• <a href="#">Section 21.8</a> : Deleted "clear of DMAActive..." from the last bullet) .....	2237
• <a href="#">Section 21.13</a> : Deleted the note at the end of the section.....	2252
• <a href="#">Table 21-5</a> : In the IntPnd Description, deleted the incorrect second line indicating the message object <b>is</b> the source of an interrupt. Also, added a note in the descriptions for Msd[28:0]. ....	2254
• <a href="#">Chapter 22: Universal Serial Bus (USB) Controller</a> .....	2321
• <a href="#">Section 22.3.1</a> : Deleted the bullet beginning "Isochronous endpoints..." .....	2324
• <a href="#">Section 22.3.2</a> : Deleted the bullet beginning "Isochronous endpoints..." .....	2328
• <a href="#">Table 22-6</a> : Bit 7 is now reserved; .....	2350
• <a href="#">Section 22.6.27</a> : Removed 'isochronous ' from the second paragraph. ....	2382
• <a href="#">Table 22-43</a> : Deleted the note in the bit 4, Stall description. ....	2389
• <a href="#">Table 22-44</a> : Revised the description for bit 3, FDT, value 1. ....	2391
• <a href="#">Table 22-45</a> : Revised bit 6 to Reserved; revised text for the FDT bit.....	2392
• <a href="#">Section 22.6.35</a> : Deleted 'and isochronous' from the second paragraph.....	2393
• <a href="#">Table 22-47</a> : Revised text in bits 3 and 2.....	2394
• <a href="#">Table 22-48</a> : Changed bits 2 and 3 to Reserved. ....	2395
• <a href="#">Table 22-49</a> : Changed bit 4 to Reserved. ....	2396
• <a href="#">Table 22-50</a> : Changed bit 6 to Reserved; Removed paragraph re "isochronous" from bit 4 description. ....	2397
• <a href="#">Table 22-52</a> : Removed 'isochronous' from bits 5-4 description.....	2399
• <a href="#">Section 22.6.40</a> : Removed 'isochronous' from this entire section. ....	2400
• <a href="#">Table 22-55</a> : Replaced Isochronous in bits 5-4 with Reserved. ....	2401
• <a href="#">Chapter 23: Universal Parallel Port (uPP)</a> - No changes for this revision.....	2418
• <a href="#">Chapter 24: External Memory Interface (EMIF)</a> .....	2469
• <a href="#">Section 24.3</a> : Replaced 'system-related issues' with 'system-related configurations.' .....	2472
• <a href="#">Section 24.3.5.11</a> : Changed EM1DQM[1:0] to EM1DQM[3:0]. ....	2485
• <a href="#">Table 24-19</a> : Deleted "while in NAND Flash Mode" .....	2489

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