1 Introduction

This document provides a checklist to help users review OSD335x-BAS/IND or OSD335x-BSM/ISM designs. Going through this checklist before or during the schematic design phase will help avoid some common pitfalls. This checklist targets a generic embedded system designed using the OSD335x family of devices and is not exhaustive.

	ITEM	SECTION	SCHEMATIC CHECKLIST TOPIC
☑	1	3	**Prepared to check your Power Design?** Minimum Signals - Power Budget - Test Points - Clamping Circuit - Power Input - I/O Pin Group - Level Shifters
☑	2	4	**Adding an Oscillator?** Does your design have clock design that satisfies this section on Clocks? Main Oscillator - RTC Oscillator
☑	3	5	**Ready to Reset?** Check your Reset circuit against three Best Practices. WARMRESETN as input - WARMRESETN driven by PWRONRSTN - WARMRESTN as output
☑	4	6	**Prepping for Pinmux?** Leaving off some peripherals? Let's check your IO in this section. Pinmux Settings - Unused IO - ADC unused - USB unused
☑	5	7	**Planning for Peripheral Success?** Check your I2C, UART, SPI, USB and more in this section. MMC - I2C - UART - SPI - USB_ID - USBx_DP or _DM - USBx_CE - USBx_DRVVBUS - USBx_VBUS - TX & RX Resistors - Cape Headers
☑	6	7.1	**Best Boot Configuration Settings?** Walk through these steps to check everything. Boot Configuration - Resistors - Muxing Boot Pins - Boot Interface
☑	7	7.2	**Enabling eMMC?** Check to make sure you are following the standards for your circuitry.
☑	8	7.3	**Ready to Juggle JTAG?** Check for a properly connected JTAG to be a great debug resource. Connecting JTAG - JTAG Header
☑	9	7.4	**Excited about EEPROM?** Let's check your EEPROM WP pin.
☑	10	7.5	**Have you used your good-luck charm?** (Having ten things on a list made marketing happy.)

Note that this checklist covers both OSD335x-BAS/IND and OSD335x-BSM/ISM devices. Unless a specific device is mentioned, the checklist item relates to both devices. A pin mapping between OSD335x-

BAS/IND, OSD335x-BSM/ISM and AM335x can be found in the application note: OSD335x-SM Pin Assignments Mapped to AM335x (https://octavosystems.com/app_notes/osd335x-family-pin-assignments/)

OSD335x Schematic Checklist
Rev.1 5/18/18

Table of Contents

2 Revision History

Revision Number	Revision Date	Changes	Author
1	5/10/2018	Initial Release	Neeraj Dantu

3 Essential Signals and Power Design

1. There is a minimum set of connections that are required for the OSD335x family of devices to function properly. These signals are the interface between the TPS65217C PMIC and AM335x processor and are used to properly configure and sequence the voltage rails. There are two use cases for hooking up these signals. First, the minimum connections required when the RTC subsystem within the AM335x needs to be enabled is shown in Figure 1. Second, the set of connections when the RTC subsystem within the AM335x is disabled is shown in Figure 2. Most designs use the connections shown in Figure 1 even when the RTC subsystem is not used by the system. This is done to future proof designs and will enable the internal AM335x 1.8V LDO instead of providing power directly from the PMIC.

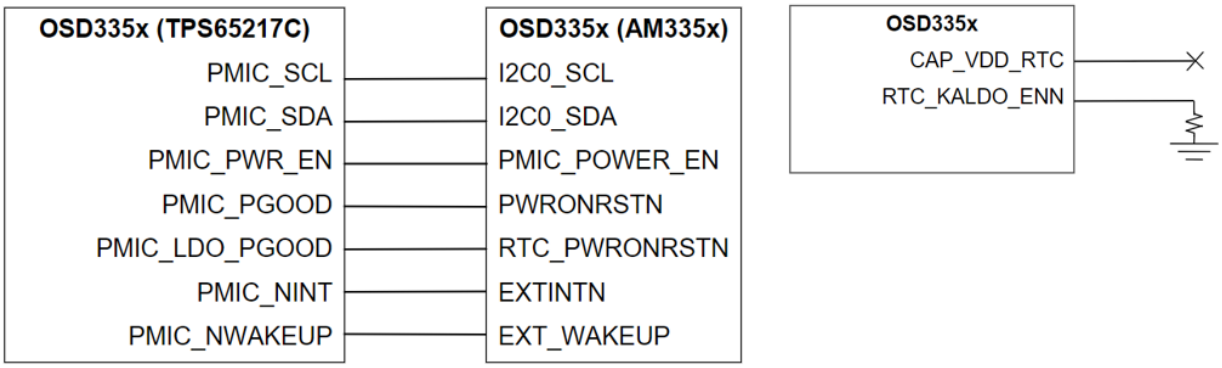

Figure 1. Minimum set of connections when RTC subsystem is enabled

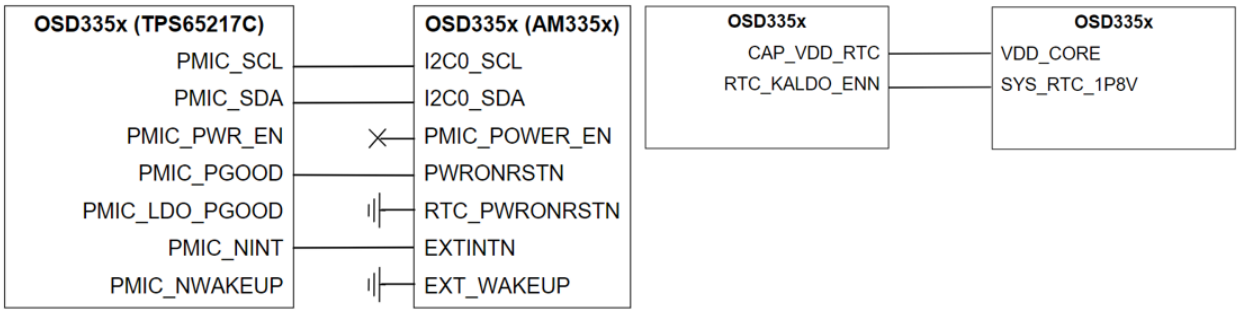

Figure 2. Minimum set of connections when RTC Subsystem is disabled

2. Make a power budget that balances power consumption against the various voltage supply rails. Please refer to the following resources:
   - Power Application Note for OSD335x-BSM/ISM: https://octavosystems.com/app_notes/osd335x-sm-power-application-note/
   - Power Application Note for OSD335x-BAS/IND: http://octavosystems.com/app_notes/osd335x-power-application-note/
3. If there is space in layout, put test points on each power rail and each signal between the PMIC and AM335x processor. This will provide good visibility for board debug during bring-up. An example is shown in Figure 3. A list of recommended pins and signals are give below:
   - Boot Signals: PMIC_POWER_EN, RTC_PWRONRSTN, EXT_WAKEUP, and EXTINTN
   - Reset Signals: PWRONRSTN, and WARMRSTN

- Output Power Rails: SYS_VOUT, SYS_VDD1_3P3V, SYS_VDD2_3P3V, SYS_RTC_1P8V, SYS_VDD3_3P3V and SYS_VDD_1P8V

- Internal Power Rails: VDDS_DDR, VDD_CORE, VDDS_PLL, and VDD_MPU

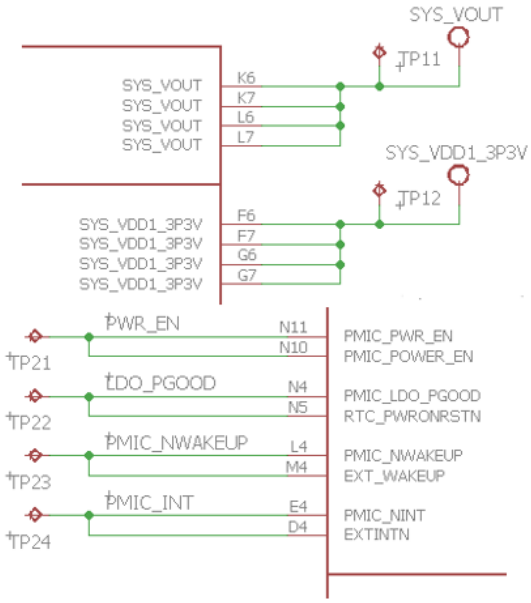

Figure 3: Example test points for signals involved in bootup and power rails

4. Based on the application, a clamping circuit may be needed between the VDDS and the VDDSHVx signals (see documentation in the application note https://octavosystems.com/app_notes/osd335x-design-tutorial/bare-minimum-boot/clamping-circuit/). VDDS is internally connected to SYS_RTC_1P8V on the OSD335x/OSD335x-SM. The VDDSHVx signals are internally connected to VDDSHV_3P3V on the OSD335x but are external pins on the OSD335x-SM and could potentially be connected to SYS_VDD3_3P3V. If included, make sure that clamping circuit is between the correct voltage rails and has the correct components. Figure 4 shows the clamping circuit design on OSD3358-SM-RED.

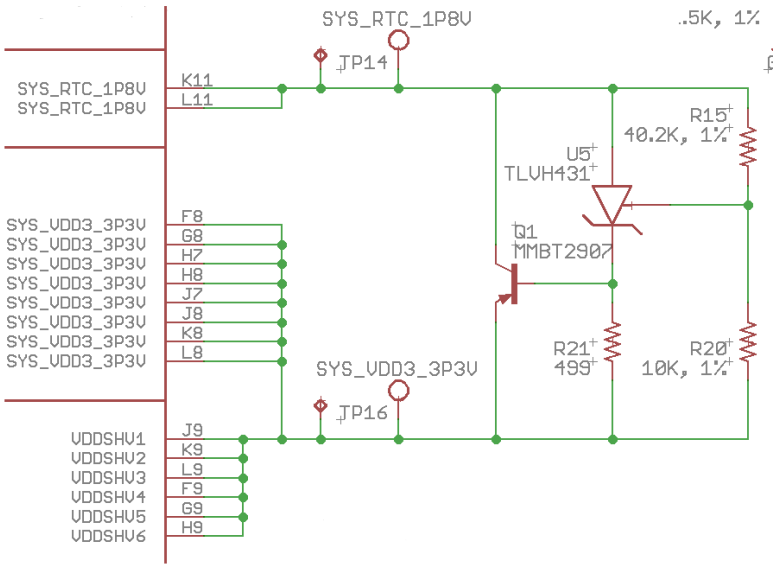

Figure 4: Clamping circuit between SYS_RTC_1P8V and SYS_VDD3_3P3V in OSD3358-SM-RED schematic

5. If you do not plan to use VIN_USB/VIN_BAT power inputs, you can follow section 9.2.2.2 “5-V Operation Without a Battery” in the TPS65217 datasheet (http://www.ti.com/product/TPS65217). The connections for this use case are listed below:
    - Ground VIN_USB
    - Connect VIN_BAT and PMIC_BAT_SENSE together; and
    - Leave PMIC_TS unconnected
6. The I/O pins of the OSD335x-BSM/ISM are divided into 6 voltage domains. Each I/O pin group can be set as either a 3.3 Volt level I/O or a 1.8 Volt level I/O. Each of the VDDSHVx pins need to be connected either a 3.3V or a 1.8V rail depending on the application. An example where all the I/O pin groups are set to a 3.3V level I/O is shown in Figure 5.
7. For OSD335x-BAS/IND devices, the IO voltage level is set to 3.3V internally. So, level shifters would be necessary if a different IO voltage level is required.

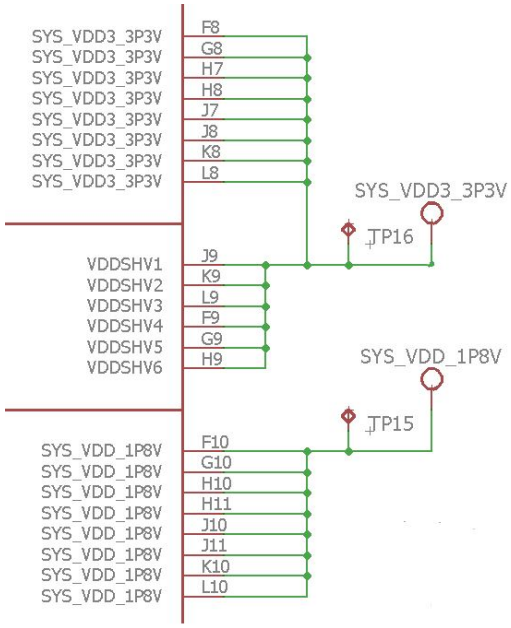

Figure 5: Setting Voltage level for IO pin groups

More information regarding power design can be found in the following places:

- OSD335x-BAS/IND Datasheet: https://octavosystems.com/docs/osd335x-datasheet/
- OSD335x Design Tutorial: https://octavosystems.com/docs/osd335x-design-tutorial/OSD335x-BSM/ISM Datasheet: https://octavosystems.com/docs/osd335x-sm-datasheet/
- OSD335x-SM Design Tutorial: https://octavosystems.com/app_notes/osd335x-sm-design-tutorial/
- OSD335x Power Management: https://octavosystems.com/app_notes/osd335x-design-tutorial/bare-minimum-boot/power-management/

4 Clocks

1. The recommended oscillator circuit is shown in the following figure. This will allow tuning of the crystal oscillator if needed and ensure proper operation.

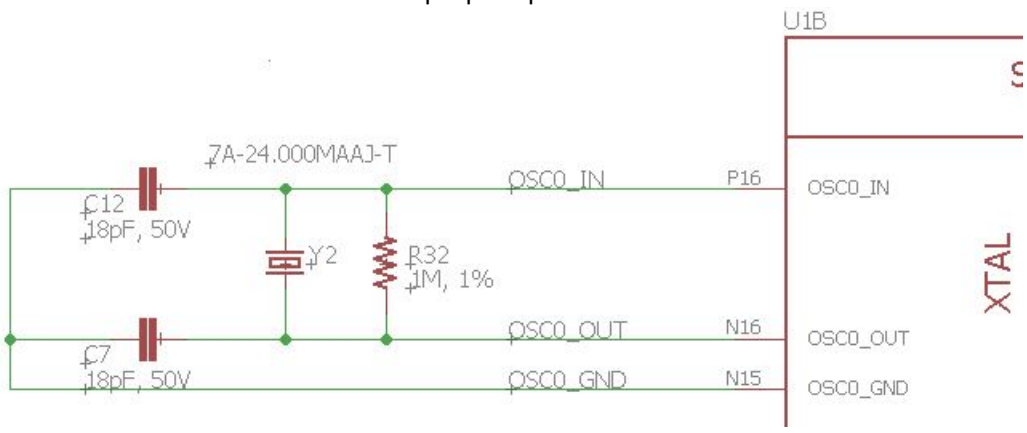

Figure 6: Example crystal circuit

2. If the RTC within the AM335x is not used, pins OSC1_IN, OSC1_OUT can be left unconnected while OSC1_GND should be connected system ground.

More information regarding clock circuit can be found in the following places:

- OSD335x-SM design tutorial – Clock Circuitry: https://octavosystems.com/app_notes/osd335x-design-tutorial/bare-minimum-boot/clock-circuitry/
- Section "Clock Specifications" in AM335x Datasheet: http://www.ti.com/lit/ds/symlink/am3358.pdf

5 Reset Circuit

1. There are in general, 3 ways to build the reset mechanism for OSD335x devices covering a majority of use cases. They are described below:
    - WARMRESETN used as input and to be asserted after stable power up: In this use case, the WARMRESETN signal is pulled up to a stable 3.3V rail that will allow pulling the processor out of reset once the voltage rail is alive.
    - WARMRESETN used as input driven by PWRONRSTN: In this use case, either an open drain buffer to translate between 1.8V and 3.3V or a reset supervisor are used. Additionally, a reset button with filter debounce can be added for user input reset function. This is demonstrated on OSD3358-SM-RED and is shown in Figure 7.

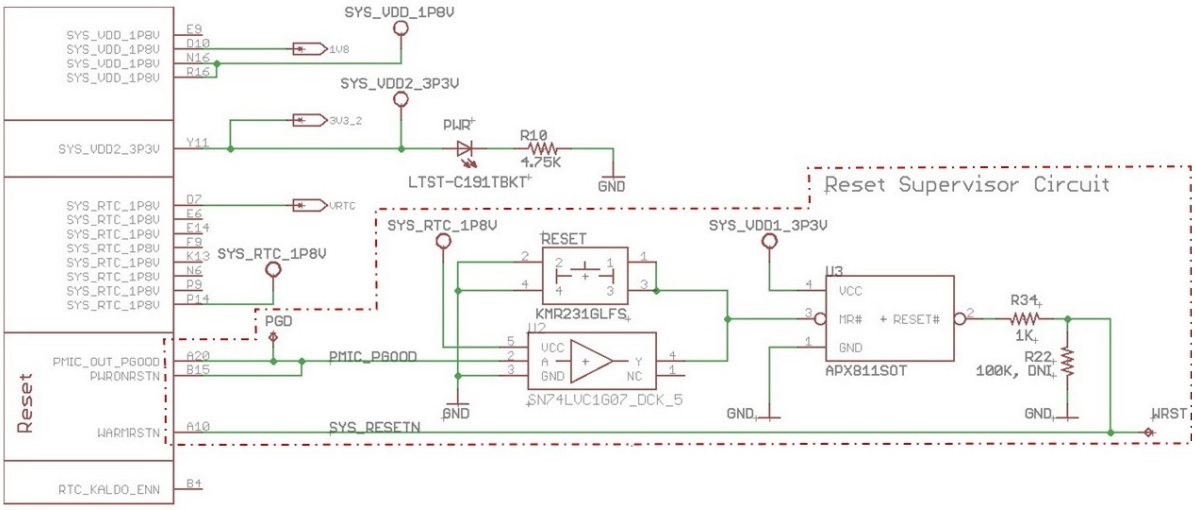

Figure 7: OSD3358-SM-RED reset mechanism

    - WARMRESTN used as output: In this use case, the WARMRESETN pin can be used as an output to reset external devices. The signal output is held low for a period of time after cold reset. So, it can be used to hold external devices in reset a little longer than the processor.

6 Other General Recommendations

1. All pinmux settings should be verified. Not all pin combinations are valid for a given peripheral. To ensure proper operation, all the pins of a peripheral must belong to the same I/O set. The pinmux settings can be verified using the pinmux tool from Texas Instruments (http://www.ti.com/tool/pinmuxtool). While a given I/O has the same functionality between the

AM335x and OSD335x family of device, the location of the I/O may be different. The location mapping between the AM335x, the OSD335x-BSM and the OSD335x-BAS can be found in the application note : OSD335x-SM Pin Assignments Mapped to AM335x (https://octavosystems.com/app_notes/osd335x-family-pin-assignments/)

2. Unused IO peripheral pins can generally be left unconnected unless specified in the datasheet.
3. If the ADC module is not used, connect VREFP, VREFN, AIN[7:0] and VSSA_ADC terminals to system ground.
4. If a USB interface is not used, the corresponding VBUS, ID, DP, and DM terminals may be connected to ground or left floating. The CE terminal should be left floating.

7 Peripherals

1. It is recommended to include a 22ohm series resistor on MMCx_CLK signals, where "x" indicates which MMC interface is used, 0, 1 or 2. The resistor should be placed as close to the processor as possible. The MMCx_CLK signal is used as an input on read transactions and the resistor will eliminate possible reflections on the signal which can cause false clock transitions. Also the RXACTIVE bit in the pinmux configuration for the MMC_CLK signal should be set to '1'. When connecting a device, such as an SD card or eMMC, 10k pullups should be included on RST#, CMD, and all DAT signals. Additional information regarding eMMC connections is provided in Section 3.5.2 "eMMC".
2. All I2C busses should be pulled up. Exception: The I2C0 pins that must be connected to the PMIC I2C bus have 4.7K Ohm pullups internal to the OSD335x. If there are more than 2 or 3 external devices on the I2C0 bus, it is recommended to put external pull up resistor footprints in case the pull up needs to be stronger.
3. UART / RS232 busses should have a Null Modem implemented between the devices (i.e. TX -> RX; RX -> TX; CTS -> RTS; RTS -> CTS; DTR -> DSR; DSR -> DTR)
4. SPI busses should have the MISO lines connected together and the MOSI lines connected together. Each SPI device should have its own chip select (CS).
5. The USB_ID pin should either be pulled low to ground (host mode), left unconnected (peripheral/client mode) or connected to a USB connector (OTG mode).
6. The USBx_DP and USBx_DM should never have any series resistors or capacitance on these signals. These signals should be length matched traces to the connector or device with no stubs or test points.
7. USBx_CE can be used if the device is a peripheral/client that supports charging. This signal would be connected to the enable of a charging source for the battery.
8. In host mode, if an external power regulator is being used to provide power to the USB peripherals, then the USBx_DRVVBUS should be connected to the enable of the regulator so that it can be controlled by the processor.
9. USBx_VBUS should be connected to a 5V power rail for the USB peripheral to be used as USB host.
10. While no series resistors are required for MII/RMII/RGMII, it is prudent include Zero-Ohm options for the TX and RX lines. Ideally, these optional resistors should be as small as possible (0402 or smaller recommended) and should be placed as close to the transmitter as possible.
11. If a design does not need to be compatible with the BeagleBoard.org® BeagleBone® Cape Headers, there is no need to the resistor MUXes on GPMC_A0 and GPMC_CSN3 or ECAP0_IN_PWM0_OUT and MCASP0_ACLKR.

7.1 Boot Configuration Settings

1. Validate Boot configuration settings
    a. SYSBOOT[15:14] should be set to match the oscillator frequency of OSC0
    b. SYSBOOT[5] should be pulled high if CLKOUT1 is used. Otherwise it should be pulled low to disable CLKOUT1 by default and reduce system noise.
    c. SYSBOOT[4:0] should be set to select a boot mode for the given boot peripheral connections within the design
    d. Other SYSBOOT pins should be set based on whether they are needed. All un-needed SYSBOOT pins should be pulled low and not left floating.
2. Boot configuration pins should be generally pulled high or low with weak (~100K Ohm) resistors. However, stronger resistors are ok if needed by the design.
3. If SYSBOOT pins are used as general purpose IO to control other aspects of the design, check
    a. There are no stronger pull-ups / pull-downs in the opposite direction on other parts of the design..
    b. That the default value generated by the pull-up / pull-down does not cause system issues.
4. Verify that the boot interface set by the boot configuration pins uses the peripheral pins specified by AM335x Technical Reference Manual Section Initialization. Example boot configuration using SYSBOOT pins is shown in Figure 8.

More information about boot configuration can be found in the following places:

- AM335x TRM “SYSBOOT Configuration Pins”: https://www.ti.com/lit/ug/spruh73p/spruh73p.pdf
- OSD335x Peripheral Circuitry tutorial: https://octavosystems.com/app_notes/osd335x-design-tutorial/bare-minimum-boot/power-management/

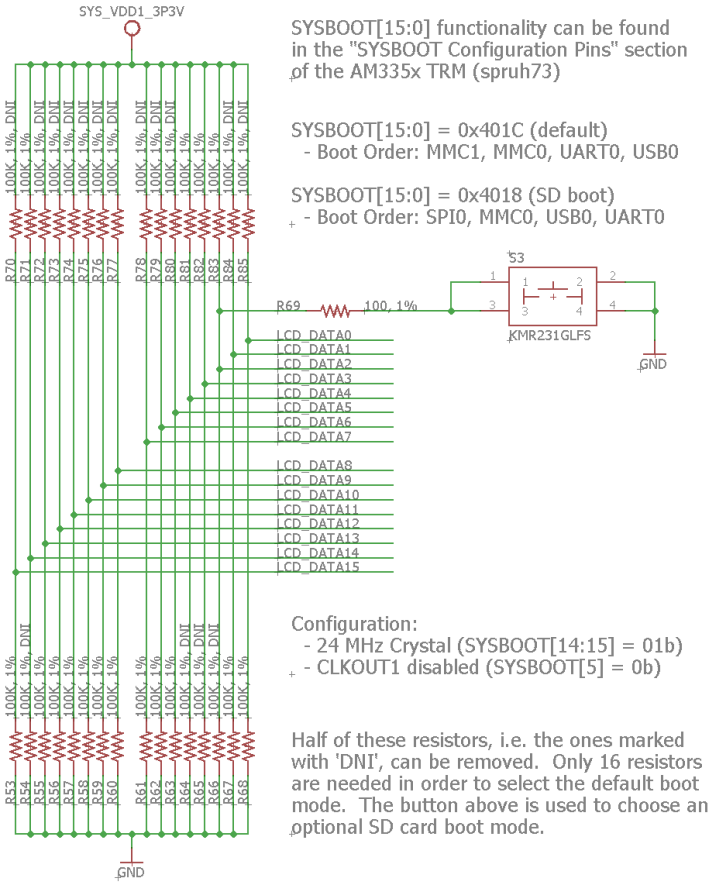

Figure 8: Boot configuration example(OSD3358-SM-RED)

7.2 eMMC

1. The AM335x has a MMC v4.3 interface. While there are still eMMC modules that support MMC v4.x, it is more common to see eMMC modules that support the newer MMC v5.x standard, which is backward compatible with v4.x. The MMC v4.x standard declared some pins as “Reserved for Future Use” (RFU). Unfortunately, in many eMMC v4.x symbols, the RFU pins are marked as “No Connect” (NC), which have no electrical connection and can be routed through in layout. Given the scarcity in the eMMC market, it is recommended to use the eMMC v5.x pinout (see the yellow and orange pins in Figure 9) and only connect the MMC v4.x signals so that layout can be done to support both eMMC types (i.e. all MMC v5.x and RFU signals are not routed through).

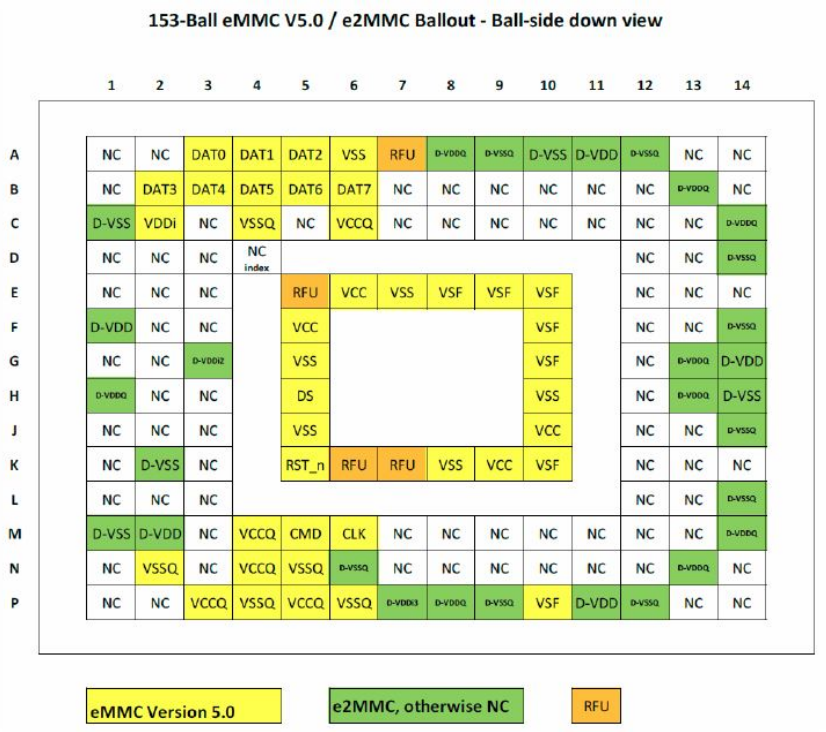

Figure 9 eMMC v5.x pinout

More information about eMMC hook-up is provided in the following places:

- OSD335x eMMC Application Note: https://octavosystems.com/app_notes/designing-for-flexibility-around-emmc/
- OSD335x Design Tutorial Lesson 2: Adding Non-Volatile Storage: https://octavosystems.com/app_notes/osd335x-lesson-2-adding-non-volatile-storage/

7.3 JTAG

1. To properly connect JTAG, EMU0 and EMU1 pins must be connected to the JTAG emulator.
2. For the standard 20 pin compact JTAG header, it is recommended to only connect EMU2, EMU3 and EMU4 if you plan to use advanced JTAG features (HS-RTDX, Core Trace, System Trace, etc.) of higher end debuggers.

More information on JTAG can be found at the following places:

- OSD335x Peripheral Circuitry tutorial: https://octavosystems.com/app_notes/osd335x-design-tutorial/bare-minimum-boot/peripheral-circuitry/
- Texas Instruments JTAG resource: http://dev.ti.com/tirex/#/?link=Development%20Tools%2FDebug%20Probes%2FXDS%2FDocuments%2FJTAG%20Connectors

7.4 EEPROM WP (OSD335x-SM only)

1. The EEPROM WP pin is pulled high within the OSD335x-SM. To program the EEPROM, the EEPROM_WP pin must be pulled low. Therefore, this pin should be connected to a controller or brought out to a test point or to a header.

8 References

For additional information, please refer to the following links:

1. OSD335x Datasheet: https://octavosystems.com/docs/osd335x-datasheet/
2. OSD335x-SM Datasheet: https://octavosystems.com/docs/osd335x-sm-datasheet/
3. AM335x Schematic Checklist: http://processors.wiki.ti.com/index.php/AM335x_Schematic_Checklist
4. OSD335x Power Application Note: https://octavosystems.com/app_notes/osd335x-sm-power-application-note/
5. OSD335x Design Tutorial Series: https://octavosystems.com/app_notes/osd335x-design-tutorial/
6. AM335x Datasheet: http://www.ti.com/lit/ds/symlink/am3358.pdf
7. TPS65217C PMIC Datasheet: http://www.ti.com/lit/ds/symlink/tps65217.pdf
8. Powering AM335x with TPS65217x: http://www.ti.com/lit/ug/slvu551i/slvu551i.pdf
9. Designing for Flexibility around eMMC: https://octavosystems.com/app_notes/designing-for-flexibility-around-emmc/

Please contact us on the forums for assistance with any checklist items.
https://octavosystems.com/forums/

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