Product Technical Specification & Customer Design Guidelines

AirPrime SL5011

SIERRA WIRELESS

Important Notice

Due to the nature of wireless communications, transmission and reception of data can never be guaranteed. Data may be delayed, corrupted (i.e., have errors) or be totally lost. Although significant delays or losses of data are rare when wireless devices such as the Sierra Wireless modem are used in a normal manner with a well-constructed network, the Sierra Wireless modem should not be used in situations where failure to transmit or receive data could result in damage of any kind to the user or any other party, including but not limited to personal injury, death, or loss of property. Sierra Wireless accepts no responsibility for damages of any kind resulting from delays or errors in data transmitted or received using the Sierra Wireless modem, or for failure of the Sierra Wireless modem to transmit or receive such data.

Safety and Hazards

Do not operate the Sierra Wireless modem in areas where blasting is in progress, where explosive atmospheres may be present, near medical equipment, near life support equipment, or any equipment which may be susceptible to any form of radio interference. In such areas, the Sierra Wireless modem **MUST BE POWERED OFF**. The Sierra Wireless modem can transmit signals that could interfere with this equipment. Do not operate the Sierra Wireless modem in any aircraft, whether the aircraft is on the ground or in flight. In aircraft, the Sierra Wireless modem **MUST BE POWERED OFF**. When operating, the Sierra Wireless modem can transmit signals that could interfere with various onboard systems.

Note: *Some airlines may permit the use of cellular phones while the aircraft is on the ground and the door is open. Sierra Wireless modems may be used at this time.*

The driver or operator of any vehicle should not operate the Sierra Wireless modem while in control of a vehicle. Doing so will detract from the driver or operator's control and operation of that vehicle. In some states and provinces, operating such communications devices while in control of a vehicle is an offence.

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Consult our website for up-to-date product descriptions, documentation, application notes, firmware upgrades, troubleshooting tips, and press releases: www.sierrawireless.com

Document History

Version	Date	Updates
001	February 15, 2011	Creation

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1. Introduction

The AirPrime SL5011 is a 74-pin soldered-down module based on the Intel pin-out specification proposal for the standard JEDEC LGA packaging form factor. Its wireless modem provides CDMA and 1xEV-DO wireless data connectivity for eBooks, portable navigation devices, mobile Internet devices, point-of-sale devices, industrial handhelds and other machine-to-machine and vertical applications. The SL5011 is part of a family of embedded wireless engines spanning a number of air interface technologies and wide area networking protocols. It has a dual-band diversity radio supporting the 800 MHz cellular and 1900 MHz PCS bands as well as GPS frequency band. The modem is based on QUALCOMM's MDM6085 integrated processor. The purpose of this document is to describe the features and specifications of the module and to provide our OEM partners/customers with the information required to integrate the SL5011 into their products. Application and hardware interface requirements are discussed at a high level only; for more details, visit www.sierrawireless.com.

1.1. Physical Features

- Small form factor – Based on the 74-pin LGA Intel Moorestown form factor specification (25mm x 30mm x 2.47mm (nominal))

1.2. Electrical Features

The SL5011 has one supply voltage:

- VCC – Min 3.3 V, Max 4.3 V

The SL5011 is self-shielded; no additional shielding is required.

1.3. Environmental Features

Temperature operating range:

- Normal use (3GPP compliant): -30°C to +70°C
- Industry extended temperature range (non-3GPP compliant): <tbd>

1.4.   RF Features

- Dual-band support for both the 800 MHz cellular and 1.9 GHz PCS bands
- Receive diversity support for the 800 MHz cellular and 1.9 GHz PCS bands
- Adheres to CDMA authentication as specified in CDMA 1X
- Support for IS-95A/B and CDMA 1X Release 0/A
- Support for IS-856 1xEV-DO Revision A
- Support for gpsOne™ and stand-alone GPS

1.5.   Application Interface Features

- NDIS supported for Windows Vista, Windows XP, and Windows 2000 platforms
- USB supporting multiple logical channels over the USB MUX protocol
- USB selective suspend supported for maximum power savings
- Wakeup Enable – the module can be set to wake the host device upon ring, restoration of radio coverage, and/or receipt of SMS
- One UART port and one USB port
- AT command interface
- Limited RUIM feature for 1st release
- Sierra Wireless proprietary Control and Status (CnS) language interface
- Available Software Development Kit (SDK including an Application Program Interface (API) for Windows-based applications

1.6.   EMConnect Features

The SL5011 supports EMConnect™ – a robust set of firmware features that enables original equipment manufacturers (OEMs) to reduce their development time, platform costs and dependence on host processors.

The SL5011 supports these EMConnect features:

- Enhanced serial (UART) interface
- PAD (Packet Assembler Dis-assembler)
- Connection Watchdog to ensure connectivity
- Enhanced GPIO
- Modem configuration persistence

For more information on EMConnect, refer to document [44] EMConnect Guide.

1.7.   Packet Mode Features

- IS-2000 data rates up to 153* kbps, simultaneous forward and reverse channel.
- IS-856 (1xEV-DO Rev. A) data rates up to 3.1 Mbps forward channel and 1.8 Mbps reverse channel.

Note: *   *Data rate supported depends on network implementation.*

1.8.   IS-95 Circuit-Switched Features

- V.34 data rates to 14.4 kbps
- G3 facsimile receive and transmit
- Quick Net Connect (QNC) support

1.9.   Short Message Service (SMS) Features

- Send and receive
- Notification of new messages

2. Standards Compliance

This section describes the compliance of the SL5011 to the standards described in section 6 References. Many of these features require the support of the host device for full compliance. These cases are noted.

2.1. General Compliance

2.1.1. Mobile Station Class

The output power and band class features of the SL5011 are summarized in the following table.

Table 1.   Band and Power Class Features

Band Class	Mobile Station Class	Supported?
0 (North American Cellular)[1]	Class III	Yes
1 (North American PCS) [2]	Class II	Yes
2 (TACS)	N/A	No
3 (JTACS)	N/A	No
4 (Korean PCS)	N/A	No
5 (NMT 450)	N/A	No
6 (IMT-2000)	N/A	No

1   Band Class 0 also supports cellular bands in other regions including Asia Pacific, Latin America and the Middle East.

2   Band Class 1 also supports PCS bands in other regions including Asia Pacific and Latin America.

2.1.2. Protocol Revision Support

The SL5011 supports all protocol revisions through P_REV 6. Detailed protocol revision feature compliance is described in the next two sections.

2.2. TIA/EIA-95B

The SL5011 is compliant with TIA/EIA-95-B, including all protocol revisions through P_REV 4. Feature support for P_REV 5 is defined in the following table.

Table 2.   Support for P_REV 5 Features

Feature	Supported?
Access Entry Handoff	Yes
Access Probe Handoff	Yes
Channel Assignment into Soft Handoff	Yes
Mobile Assisted Hard Handoff	Yes
Network Directed System Selection	Yes
Calling Name Presentation (CNAP)	Yes[1]

Feature	Supported?
Priority Access and Channel Assignment (PACA)	No
Power-Up Function (PUF)	No
AMPS Improvements (IS-553-A)	N/A
Supplemental Code Channels (MDR)	Yes[2]
Hopping Pilot Beacon	No
IS-95B Wireless Local Loop (WLL) Features	No

1 Host support is required for this feature

2 Only F-SCCH is supported. Up to seven F-SCCH supported.

2.3. TIA/EIA/IS-2000

The SL5011 support for TIA/EIA/IS-2000 features is defined by the capabilities of the QUALCOMM MDM6085 hardware and AMSS6085 software.

2.3.1. Radio Configurations

The SL5011 supports all mandatory radio configurations. Detailed channel and radio configuration support is shown in the following table.

The following table also outlines the data rates supported by each radio configuration. The maximum data rate supported by 1X is 153 kbps simultaneously on the forward and reverse link. The maximum data rate supported for IS-856 (1xEV-DO Rev. A) is 3.1 Mbps on the forward link and 1.8 Mbps on the reverse link.

Table 3.   Channel and Radio Configuration Support[1]

Feature	Supported	Simultaneous Data Rate (kbps)	
		Forward Link	**Reverse Link**
Quick Paging Channel (F-QPCH)	Yes		
Fundamental Channel (FCH)			
Rate Set 1 RCs (fwd: 1,3,4; rev: 1,3)	Yes	9.6	9.6
Rate Set 2 RCs (fwd: 2,5; rev: 2,4)	Yes	14.4	14.4
Supplemental Channel (SCH)			
Rate Set 1 RCs (fwd: 3,4; rev: 3)	Yes	9.6/19.2/38.4/76.8/153.6/307.2	9.6/19.2/38.4/76.8/153.6/307.2
Rate Set 2 RCs (fwd: 5; rev: 4)	Yes	14.4/28.8/57.6/115.2/230.4	14.4/28.8/57.6/115.2/230.4
Dedicated Control Channel (DCCH)[2]			
Rate Set 1 RCs (fwd: 3,4; rev: 3)	Yes	9.6	9.6
Rate Set 2 RCs (fwd: 5; rev: 4)	Yes	14.4	14.4
Reverse Pilot Channel (R-PICH)	Yes		

1 Support of maximum data rates is dependent on MSM supplier software, memory speed grade availability and network implementation.

2 20 ms frames only

2.3.2. Release A Feature Support

The SL5011 supports all mandatory P_REV 6 features. Additional support for P_REV 6 features is described in the following table. Note that not all Release A features may be supported by carriers or network equipment.

Table 4. Support for P_REV 6 Feature

Optional P_REV 6 Feature	Supported?
Simultaneous Maximum Data rates on Forward and Reverse Channels	Yes
Quasi Orthogonal Functions (QOF)	Yes
Turbo encoding/decoding	Yes
Quick Paging Channel	Yes
Slotted Mode Timer	Yes
Orthogonal Transmit Diversity (OTD)	Yes
Reverse Pilot Gating	Yes
1/8 Rate Traffic Channel Gating	Yes
Mobile Assisted Burst Operation (MABO)	No
Traffic Channel Control Hold	Yes
Short Data Bursts	Yes
5 ms, 10 ms Frame sizes	No

2.4. TIA/EIA/IS-856 (1xEV-DO)

The SL5011 supports TIA/EIA/IS-856-A (1xEV-DO) features as defined by the capabilities of the QUALCOMM MDM6085 hardware and AMSS6085 software.

Table 5. Support for 1xEV-DO

Feature	Supported?
Air Interface as defined by IS-856	Yes
Packet Data Service in Relay Mode	Yes
Support for Test Application Specification (IS-890)	Yes
Dual RF Receive Diversity	Yes
1X/1xEV Hybrid Terminal Operation	Yes
Connected State Off-Frequency Neighbor Search	Yes
Slotted Mode (Sleep) Operation	Yes
High Speed Broadcast Services (HSBS)	Yes
Handoff Between IS-2000 and IS-856 Systems	Yes
Quality of Service (QoS) Enhancements	Yes
Data rates up to 3.1 Mbps on the forward channel and 1.8 Mbps on the reverse channel.	Yes

2.5. CDMA Data Services

The SL5011 supports the data features of IS-707-A as shown in the following table. Actual data speeds supported by the SL5011 are shown in Table 3. The following table outlines support for additional data features that are not part of IS-707-A.

Table 6.   IS-707-A Data Features

CDMA Data Service	IS-707-A Section	Supported?
RLP	IS-707.2	Yes*
AT Command Set	IS-707.3	Yes
Asynchronous Data and Fax at 9.6 kbps and 14.4 kbps	IS-707.4	Yes
Packet Data Service	IS-707.5	Yes
STU-III	IS-707.6	No
Analog Fax	IS-707.7	No
Radio Link Protocol Type 2 (RLP2)	IS-707.8	Yes
High Speed Packet Data (MDR - Medium Data Rate)	IS-707.9	Yes
Radio Link Protocol Type 3 (RLP3)	IS-707.10	Yes
CDMA High Speed Packet Data	IS-707.12	Yes

∗ Encrypted mode and non-transparent modes are NOT supported.

Table 7.   Data Features Supported

Features	Supported?
Quick Net Connect	Yes
Pre-arrangement for incoming Async data or fax	Yes
In-Band DCE Control (TIA/EIA-617)	Yes
Facsimile Digital Interfaces (TIA/EIA/IS-134)	Yes
Asynchronous facsimile DCE Control Standard (TIA/EIA-592)	Yes
Simple IP	Yes
Mobile IP (TIA/EIA/IS-835-A)	Yes

2.6. CDMA Short Message Service (SMS)

The following table summarizes the SL5011 compliance with SMS features per TIA/EIA/637-B. Note that not all of these features are available on all carrier networks, and host device support is required for compliance with these features. The SL5011 also complies with specific carrier requirements for SMS as defined by each CDMA carrier.

Table 8.   SMS Features

Feature	Supported?
Mobile Terminated SMS	Yes
Mobile Originated SMS	Yes
Point-to-Point Messaging	Yes
Broadcast Messaging	Yes
Acknowledge Messaging	Yes
Analog Mode SMS	No
Wireless Paging Teleservice	Yes
Wireless Messaging Teleservice	Yes
Voice Mail Notification	Yes
Wireless Application Teleservice	Yes
Service Category Programming Teleservice	Yes

2.7. Over-The-Air Service Provisioning (OTASP)

2.7.1. IS-683 Features

The SL5011 supports TIA/EIA/IS-683-A for Over-the-Air Service-Provisioning (OTASP) and Parameter Administration (OTAPA) as summarized in the following table. The SL5011 also complies with carrier specific OTASP and OTAPA requirements.

Table 9.   OTASP/OTAPA Features

Feature	Supported?
OTASP (user initiated)	Yes*
OTAPA (network initiated)	Yes
NAM Parameter Download	Yes
Preferred Roaming List (PRL) Download	Yes
A-Key Exchange	Yes
OTAPA NAM Lock	Yes
Re-Authenticate Messaging	Yes
Protocol Capability Messaging	Yes

∗ Host support is required for this feature.

2.7.2.   Internet Over The Air (IOTA) Features

The SL5011 firmware includes an embedded IOTA client that includes the following support:

- Automatically initiates and attempts to complete an IOTA session in the SL5011 when the network initiates an IOTA session.
- Provides an interface to the host to request the SL5011 to initiate and attempt a client initiated IOTA session.
- Provides notifications to the host of status and results of the current IOTA session in the SL5011.
- Provides an interface to the host to cancel, at any time, an active IOTA session running in the SL5011.

IOTA feature support is defined in the following table.

Table 10.   IOTA Features

Feature	Supported?
Bootstrap Provisioning	Yes*
Network Initiated Provisioning using WAP Push	Yes
Reassembly of Multiple IOTA Trigger Messages	Yes
HTTP and SSL Support (Download Agent)	Yes
MMC XML and MIME Parser / Assembler	Yes
IS-683-A/B Tunneling	Yes
WBXML Parser / Assembler	Yes
Bearer Selection Table Provisioning	Yes
User NAI Profiles and CDMA Objects	Yes

∗ Host support is required for this feature.

2.8.   Position Location

The SL5011 supports position location features as specified in the following table.

Table 11.   Position Location Features

Feature	Supported?
TIA/EIA/IS-801.1 Compliant	Yes
FCC E911 Phase II Position Determination Compliance	Yes
TIA/EIA/IS-J-STD-036 Enhanced Wireless 9-1-1 Phase II	Yes
TIA/EIA/IS-801.1 Compliant Data Burst Messaging Transport	Yes
TIA/EIA/IS-801.1 Messaging Compliant TCP/IP Transport	Yes
Mobile initiated, PDE calculated position	Yes
PDE initiated, PDE calculated position (Mobile terminated request)	Yes
Mobile calculated position	Yes
Advanced Forward Link Trilateration (AFLT)	Yes
Compliant with Snap Track Sensor Interface Application and Position Determination Entity (SIA/PDE)	Yes

2.9. Additional Standards

The following additional standards, required for CDMA operation, are also supported:

- **TIA/EIA-126-D**, **Mobile Station Loop back Service Options Standard** – Specifies loop back service options used during testing and certification.
- **TIA/EIA TSB 50**, **User Interface for Authentication Key Entry** – Specifies the method for A-Key Entry from the device user interface.

Note: Requires host support for compliance.

- **TIA/EIA TSB 58-C**, **Parameter Value Assignments for TIA/EIA Wideband Spread Spectrum Standards** – Assigns values to reserved parameters and specifies which are standard and which may be used for proprietary (manufacturer specific) values.
- **CDG 36**, **Markov Service Options for Wideband Spread Spectrum Systems Communications Systems** – Specifies the function of specific service options used for one-way, over-the-air testing of mobiles.
- **TIA/EIA/IS-870**, **Test Data Service Option (TDSO) for CDMA2000$^®$ Spread Spectrum Systems** – Defines a test data service option for testing of CDMA2000$^®$ mobile units.

2.10. CDMA Certification Requirements

The SL5011 is designed to be fully compliant with the requirements below. However, final product certification requires a fully integrated host device (that incorporates the SL5011).

Tests that require features not supported by the SL5011 (as defined in this document) are not supported.

2.10.1. CDMA Parametric Performance

The SL5011 meets or exceeds TIA/EIA/IS-98D/E specifications for performance for CDMA2000$^®$. The SL5011 also meets or exceeds IS−866 for 1xEV-DO specifications for performance.

2.10.2. Interoperability

The SL5011 complies with the following interoperability standards:

- CDG 22 – Stage 2 Interoperability Tests (TIA/EIA/IS-95A)
- CDG 53 – Stage 2 Interoperability Tests (TIA/EIA-95-B)
- C.S0031-0 – Signaling Conformance Tests for CDMA2000$^®$ Spread Spectrum Systems (Stage 2 for TIA/EIA/IS-2000)
- CDG 64 – Stage 3 Testing for CDMA2000$^®$
- C.S0032 – Recommended Minimum Performance Standards for CDMA2000$^®$ High Rate Packet Data Access Terminal (TIA/EIA/IS-866)

2.10.3. FCC and Industry Canada Type Acceptance

The SL5011 complies with the agency certifications specified in the following table.

Table 12.   US and Industry Canada Compliance Requirements

Compliance Area	US Regulation	Industry Canada Regulation
Licensed transmission	FCC Part 22, 24	RSS-132, RSS-133

Final product certification depends on the OEM host device and particularly the OEM antenna implementation. Regulatory agency compliance testing is required for final product certification.

3. Electrical Specifications

3.1. Host Interface

The SL5011 host I/O connector provides pins for power, serial communications and control. The details of these interfaces are described in the sections that follow.

3.1.1. Pin Assignments

The SL5011's host connector provides the power, LED and USB communications through a single connector. Detailed pin assignments are shown in the table below.

Table 13.   Connector Pin Assignments

Pin #	Signal Name	Description	Direction to Module	Active State	Voltage Levels (V)*		
					Min	Typ	Max
1	GPIO_3	General purpose I/O	Input High		1.69	-	2.9
			Input Low		-0.3		0.91
			Output High		2.15		2.6
			Output Low		0		0.45
2	GPIO_2	General purpose I/O	Input High		1.69	-	2.9
			Input Low		-0.3		0.91
			Output High		2.15		2.6
			Output Low		0		0.45
3	GPIO_1	General purpose I/O	Input High		1.69	-	2.9
			Input Low		-0.3		0.91
			Output High		2.15		2.6
			Output Low		0		0.45
4	GPIO_4	General purpose I/O	Input High		1.69	-	2.9
			Input Low		-0.3		0.91
			Output High		2.15		2.6
			Output Low		0		0.45
5	GPIO_5	General purpose I/O	Input High		1.69	-	2.9
			Input Low		-0.3		0.91
			Output High		2.15		2.6
			Output Low		0		0.45
6	VREG_USIM	USIM VCC supply	Output (1.8 V)	Power	1.60	1.80	1.90
			Output (3.0_V)		2.70	3.00	3.30
7	USIM_RESET_CONN	USIM reset	Output High (1.8V)	Low	1.44	1.80	2.10
			Output Low (1.8V)		0		0.40
			Output High (3.0V)		2.40	3.00	3.30

Pin #	Signal Name	Description	Direction to Module	Active State	Voltage Levels (V)*		
					Min	Typ	Max
			Output Low (3.0V)		0		0.60
8	USIM_DATA_CONN	USIM I/O pin	Input High (1.8 V)		1.26		2.10
			Input Low (1.8 V)		0.00		0.40
			Output High (1.8 V)		1.26	1.80	2.10
			Output Low (1.8 V)		0		0.40
			Input High (3.0 V)		2.10		3.30
			Input Low (3.0 V)		0.00		0.60
			Output High (3.0 V)		2.10	3.00	3.30
			Output Low (3.0 V)		0.00		0.60
9	USIM_CLK_CONN	USIM clock	Output High (1.8V)	High	1.26	1.80	2.10
			Output Low (1.8V)		0.00		0.40
			Output High (3.0V)		2.10	3.00	3.30
			Output Low (3.0V)		0.00		0.60
10	VREG_ 2V6	2.6 V LDO	Output	High (when module is on)	2.52	2.6	2.68
11	NC	Not connected					
12	NC	Not connected					
13	NC	Not connected					
14	NC	Not connected					
15	NC	Not connected					
16	NC	Not connected					
17	ADC_1	Analog/Digital conversion Input	Input		0	-	2.1
18	ADC_2	Analog/Digital conversion Input	Input		0	-	2.1
19	GND	Ground	GND	GND	-	-	-
20	GND	Ground	GND	GND	-	-	-
21	GND	Ground	GND	GND	-	-	-
22	ANT_DIV	Diversity antenna			tbd	tbd	tbd
23	GND	Ground	GND	GND	-	-	-
24	NC	Not connected					
25	NC	Not connected					
26	NC	Not connected					

Pin #	Signal Name	Description	Direction to Module	Active State	Voltage Levels (V)*		
					Min	Typ	Max
27	NC	Not connected					
28	GND	Ground	GND	GND	-	-	-
29	ANT_PRM	Main (primary) antenna			tbd	tbd	tbd
30	GND	Ground	GND	GND	-	-	-
31	NC	Not connected					
32	NC	Not connected					
33	NC	Not connected					
34	NC	Not connected					
35	GND	Ground	GND	GND	-	-	-
36	ANT_GPS	GPS antenna			tbd	tbd	tbd
37	GND	Ground	GND	GND	-	-	-
38	GND	Ground	GND	GND	-	-	-
39	GND	Ground	GND	GND	-	-	-
40	NC	Not connected					
41	NC	Not connected					
42	VCC_3V6	3.6 V supply	Input	Power	3.3	3.6	4.3
43	POWER_ON_N	Power on	Input		0		2.6
44	VCC_3V6	3.6 V supply	Input	Power	3.3	3.6	4.3
45	UART1_RXD	UART Receive Data	Input High		1.69	-	2.9
			Input Low		-0.3		0.91
46	UART1_TXD	UART Transmit Data	Output High		2.15		2.6
			Output Low		0		0.45
47	UART1_RTS_N	UART Request To Send	Output High		2.15		2.6
			Output Low		0		0.45
48	UART1_CTS_N	UART Clear To Send	Input High		1.69	-	2.9
			Input Low		-0.3		0.91
49	NC	Not connected					
50	USB_D+	USB data positive (Low/Full speed)	Input High		2.00	3.30	3.60
			Input Low		0.00		0.80
			Output High		2.80	3.30	3.60
			Output Low				0.30
51	USB_D-	USB data negative (Low/Full speed)	Input High		2.00	3.30	3.60
			Input Low		0.00		0.80
			Output High		2.80	3.30	3.60
			Output Low				0.30
52	GND	Ground	GND	GND	-	-	-
53	NC	Not connected					
54	NC	Not connected					
55	NC	Not connected					
56	NC	Not connected					
57	NC	Not connected					

Pin #	Signal Name	Description	Direction to Module	Active State	Voltage Levels (V)*		
					Min	Typ	Max
58	NC	Not connected	Input High		1.69	-	2.9
			Input Low		-0.3		0.91
			Output High		2.15		2.6
			Output Low		0		0.45
59	NC	Not connected					
60	LED_FLASH	LED driver	Output High		2.15		2.6
			Output Low		0		0.45
61	WAKE_N	Wake Host Interface	Output High		2.15		2.6
			Output Low		0		0.45
62	W_DISABLE_N	Wireless disable	Input High		1.69	-	2.9
			Input Low		-0.3		0.91
63	SYSTEM_RESET_N	Reset	Input High		1.17	-	2.1
			Input Low		-0.3		0.63
64	NC	Not connected					
65	NC	Not connected					
66	NC	Not connected					
67	NC	Not connected					
68	BUZZER_EN	General purpose I/O	Output High		2.15		2.6
			Output Low		0		0.45
69	TDI	Test Data Input	Input High		1.69	-	2.9
			Input Low		-0.3		0.91
			Output High		2.15		2.6
			Output Low		0		0.45
70	TMS	Test Mode Select	Input High		1.69	-	2.9
			Input Low		-0.3		0.91
			Output High		2.15		2.6
			Output Low		0		0.45
71	TCK	Test Clock	Input High		1.69	-	2.9
			Input Low		-0.3		0.91
			Output High		2.15		2.6
			Output Low		0		0.45
72	TRST_N	Test Reset	Input High		1.69	-	2.9
			Input Low		-0.3		0.91
			Output High		2.15		2.6
			Output Low		0		0.45
73	TDO	Test Data Output	Input High		1.69	-	2.9
			Input Low		-0.3		0.91
			Output High		2.15		2.6
			Output Low		0		0.45
74	RTCK	Return TCK	Input High		1.69	-	2.9
			Input Low		-0.3		0.91
			Output High		2.15		2.6

Pin #	Signal Name	Description	Direction to Module	Active State	Voltage Levels (V)*		
					Min	Typ	Max
			Output Low		0		0.45

    *   All values are preliminary.

3.1.2. Host Interface Descriptions

This section and the sections that follow provide additional detail on each portion of the host connector interface.

Each pin has a type code as part of its description. The type code is one of the following:

- **A** – Analog Pin
- **I** – Input
- **NP** – No pull
- **O** – Output
- **PU** – Digital Pin, Internal Pull Up
- **PD** – Digital Pin, Internal Pull Down
- **V** – Power or Ground Pin

3.1.3. Power Supply

Power is provided to the SL5011 through multiple power and ground pins as described in the following table.

Table 14.   Power and Ground Specifications

Signal Name	Pin #	Type	Specification	Parameter	Min	Typ	Max	Unit
VCC_3V6*	42, 44	V	Voltage Range	VCC	3.3	3.6	4.3	V
			Ripple Voltage		-	-	100	mVpp
VREG_ 2V6	10	V	Maximum supply current = 10 mA		2.52	2.6	2.68	V
GND	19, 20, 21,23, 28, 39,35, 37, 38,39, 52	V			-	0	-	V

    * Host-provided input voltage should provide 3 A instantaneous (lasting 5 ms) and 1.5 A continuous current, while staying within specified min/max range.

3.2. RF Specifications

The SL5011 supports cell, PCS and GPS.

Table 15.   Main Antenna Specifications [1, 2]

Parameter	Min*	Typ*	Max*	Unit	Notes
Cable loss	-	-	0.5	dB	Maximum loss to antenna

Parameter	Min*	Typ*	Max*	Unit	Notes
Impedance	-	50	-	Ω	Antenna load impedance
VSWR	-	-	2.5:1		Maximum allowed VSWR of antenna

1 Sierra Wireless provides detailed antenna requirements in device integration guides (for example, document [45] Hardware Integration Guide). Contact Sierra Wireless for further information.

2 Main antenna connects to pin 29

* Preliminary values

Table 16.   RF Performance

Parameter	Min	Typ	Max	Unit	Notes
Maximum output power	+23.0	+24.0	+25.0	dBm	+25.0 dBm is the maximum output power for IS-95, IS-2000, 1xEV-DO Revision 0, and 1xEV-DO Revision A.
RX sensitivity (US Cell)	-	-107	-	dBm	IS-2000 SO2
RX sensitivity (US PCS)	-	-107	-	dBm	IS-2000 SO2
RX sensitivity (US Cell)	-	-110	-	dBm	1xEV-DO Revision 0, DRC4
RX sensitivity (US PCS)	-	-109	-	dBm	1xEV-DO Revision 0, DRC4

Table 17.   Diversity Antenna Specifications

Parameter	Min	Typ	Max	Unit	Notes
Cable loss	-	-	0.5	dB	Maximum loss to antenna
Impedance	-	50	-	Ω	Antenna load impedance
VSWR	-	-	2.5:1		Maximum allowed VSWR of antenna
Isolation between main and diversity antenna	10	-	-	dB	Minimum isolation

If the antenna connection is shorted or open, the radio module will not sustain permanent damage. For additional information, see document [45] Hardware Integration Guide.

Table 18.   GPS Sensitivity

Parameter	Typical	Unit	Notes
Single-satellite sensitivity w/SA	-155	dBm	Sensitivity is where 50% of the visible satellites can be acquired

Table 19.   GPS Specifications

Parameter/Feature	Description
Satellite channels	12 channel, continuous tracking
Protocols	NMEA 0183 V3.0
Acquisition time	Re-acquisition: 2 sec. Hot start: 9 sec. Warm start: 35 sec. Cold start: 39 sec.
Accuracy	Horizontal: < 3 m (50%); < 8 m (90%) Altitude: < 10 m (50%); < 16 m (90%) Velocity: 0.06 m/sec.
Sensitivity	Acquisition: –158 dBm Tracking: –160 dBm Cold-start: –145 dBm
Operational limits	Altitude < 18,000 m or velocity: 515 m/sec (either limit may be exceeded, but not both)

3.2.1.   Recommended GPS Antenna Specifications

Table 20.   Recommended GPS Antenna Specifications

Parameter/Feature	Description
Gain	Maximum gain and uniform coverage in high-angle elevation and zenith. Gain in the azimuth plane is not desired.
Average 3D gain	> -5 dBi
VSWR	Typical value < 2:1
Isolation (GPS ↔ Main)	> 10 dB in all related bands
Polarization	Any, other than LHCP (left-hand circular polarized)

4. Mechanical and Environmental Specifications

Note: *After performing the non-operational tests (for example, vibration, shock, and drop), the SL5011 meets all operating parameters.*

The SL5011 complies with the mechanical and environmental specifications in this section. Final product conformance to these specifications depends on the OEM device implementation.

Table 21.   Mechanical and Environmental Specifications

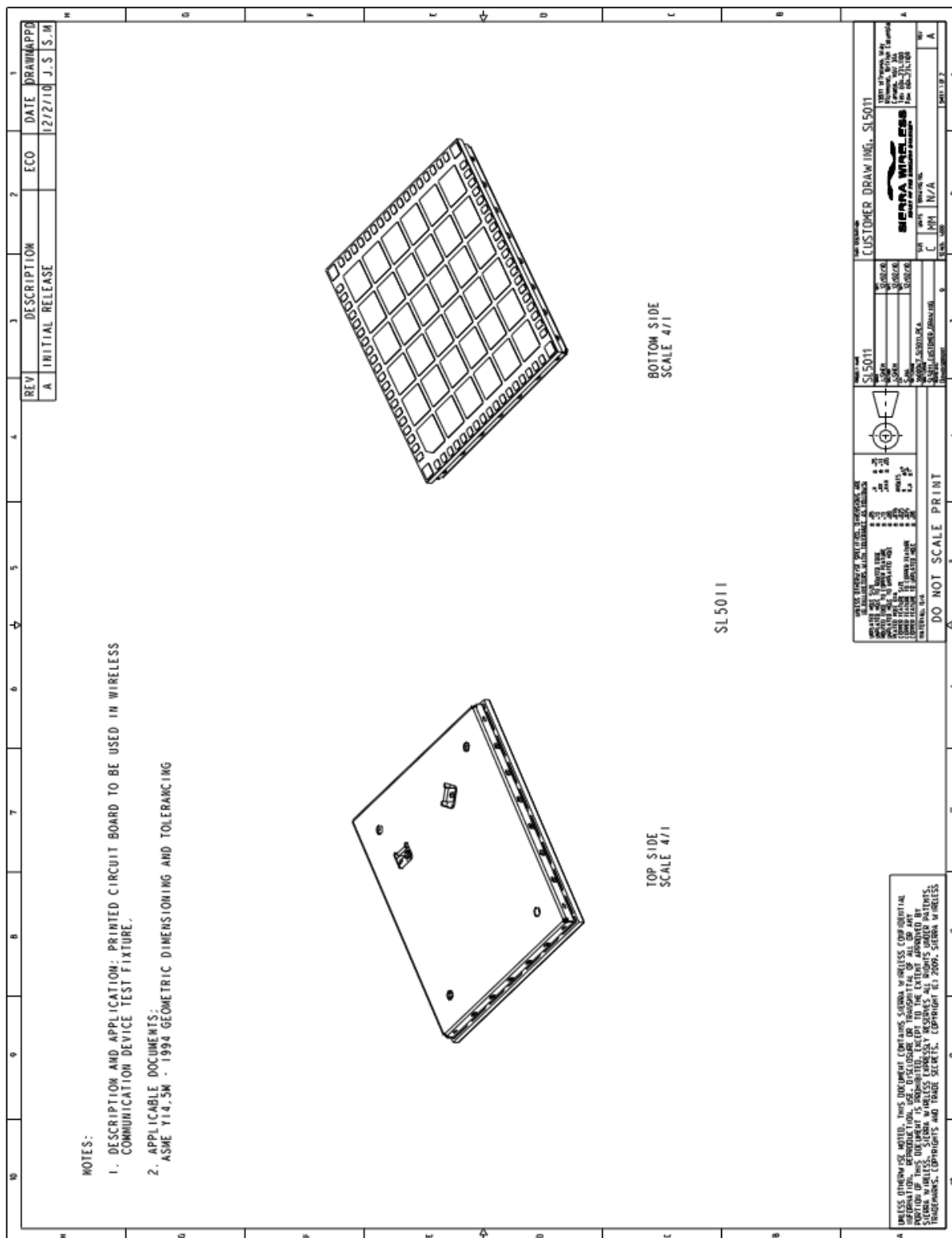| Parameter	Mode	Details
Temperature	Operational	-30ºC to +70ºC – Full RF compliance -45°C to +85°C – Function work +70ºC to +85ºC – Reduced RF performance
	Non-operational	-40ºC to +85ºC, 96 hours (from MIL-STD 202 Method 108)
Relative Humidity	Non-operational	Temperature: 65ºC Relative humidity (non-condensing): 95% Test duration: 10 days Recover time: 1 hour Ref Std IEC 60068-2-3 DUT op state toggled every 15 minutes (on/off)
Vibration	Non-operational	Random vibration, 10 to 1000 Hz, nominal 6 G rms in each of three mutually perpendicular axes. Test duration of 60 minutes for each axis, for a total test time of three hours.
Shock	Non-operational	Half sine shock, 2 ms, 180 in/sec (375 g). Tested in each of three mutually perpendicular axes, positive and negative (5 x 6, 30 bumps total).
Drop	Non-operational	1 m on concrete on each of 6 faces, 2 times (module only).
Electrostatic discharge	Operational	The RF port (antenna launch and RF connector) complies with the IEC 61000-4-2 standard: Electrostatic Discharge Immunity: Test: Level3 Contact Discharge: ±6 kV Air Discharge: ±8 kV
	Non-operational	The host connector Interface complies with the following standards only (unless otherwise specified for individual interfaces): • ±2 kV Human Body Model (JESD22-A114-B) • ±300 V Charged Device Model (JESD22-C101)
Form factor		The SL5011 is a 74-pin LGA soldered-down module with a two-piece shielded case. The device is based on the LGA Intel Moorestown specification.
Dimensions	Length: 30 mm	
	Width: 25 mm	
	Thickness: 2.47 mm	
	Weight: Approximately 3.5g	

Figure 1.   Top and Bottom View (Preliminary)
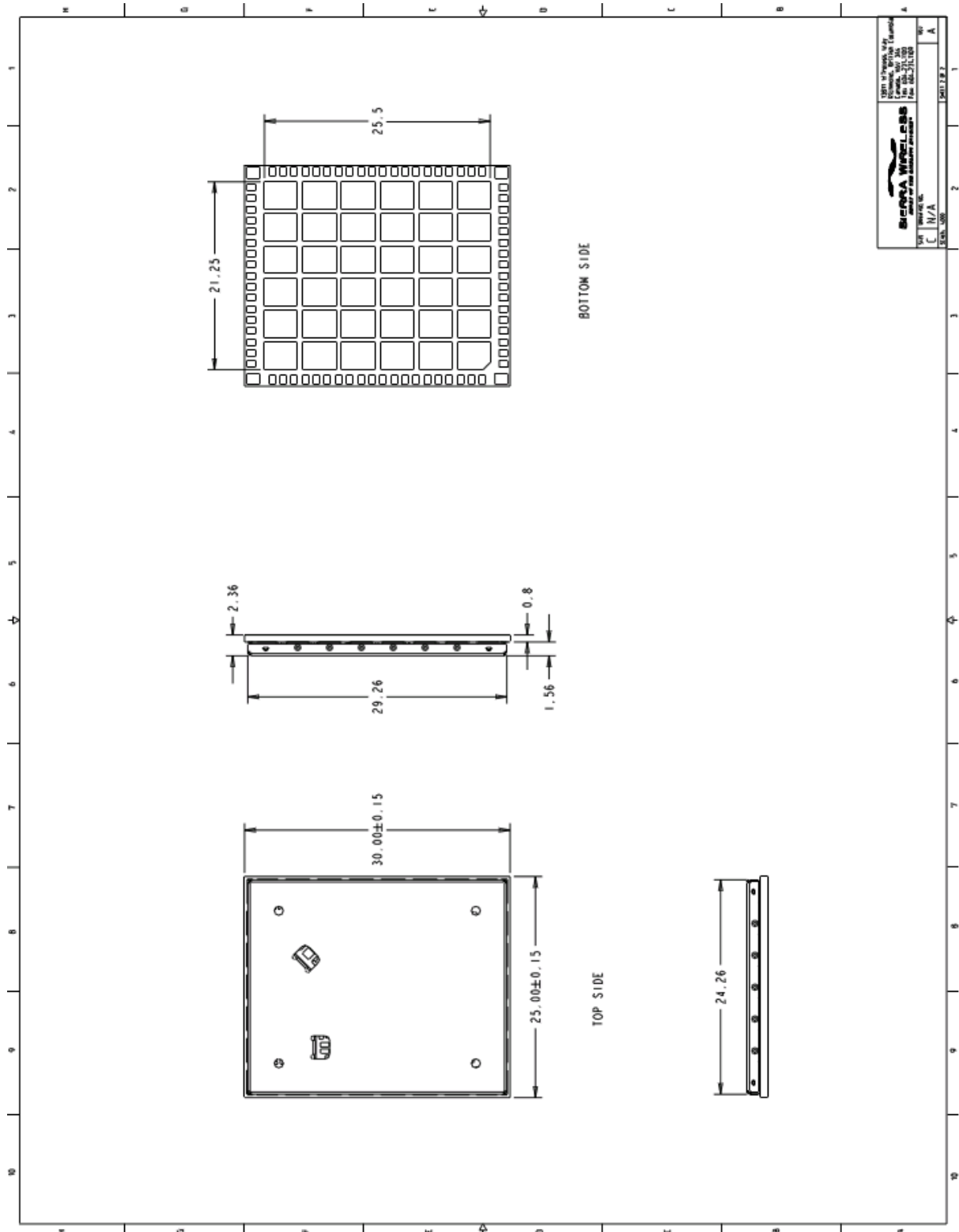
Figure 2.   Dimensioned View (Preliminary)

4.1.   Labeling

Figure 3.   SL5011 Unit Label

The SL5011 label is 28 mm x 23 mm. It is non-removable and contains:

- Sierra Wireless logo and product name (SL5011)
- SKU number (when required)
- Factory Serial Number (FSN) in alphanumeric format (also incorporates the Manufacturing date code)
- IMEI number in Code-128 barcode format
- FCC and IC certifications

Note: The SL5011 supports OEM partner specific label requirements.

5. Regulatory Approval

Important Notice

Because of the nature of wireless communications, transmission and reception of data can never be guaranteed. Data may be delayed, corrupted (i.e., have errors) or be totally lost.

Although significant delays or losses of data are rare when wireless devices such as the Sierra Wireless modem are used in a normal manner with a well-constructed network, the Sierra Wireless modem should not be used in situations where failure to transmit or receive data could result in damage of any kind to the user or any other party, including but not limited to personal injury, death, or loss of property. Sierra Wireless and its affiliates accept no responsibility for damages of any kind resulting from delays or errors in data transmitted or received using Sierra Wireless modem, or for failure of the Sierra Wireless modem to transmit or receive such data.

Safety and Hazards

Do not operate you SL5011 modem:

- In areas where blasting is in progress
- Where explosive atmospheres may be present including refueling points, fuel depots, and chemical plants
- Near medical equipment, life support equipment, or any equipment which may be susceptible to any form of radio interference. In such areas, the SL5011 modem **MUST BE POWERED OFF**. Otherwise, the SL5011 modem can transmit signals that could interfere with this equipment
- In an aircraft, the SL5011 modem **MUST BE POWERED OFF.** Otherwise, the SL5011 modem can transmit signals that could interfere with various onboard systems and may be dangerous to the operation of the aircraft or disrupt the cellular network. Use of cellular phone in aircraft is illegal in some jurisdictions. Failure to observe this instruction may lead to suspension or denial of cellular telephone services to the offender, or legal action or both.
- Some airlines may permit the use of cellular phones while the aircraft is on the ground and the door is open. The SL5011 modem may be used normally at this time.

Important Compliance Information for USA OEM Integrators

The SL5011 modem is granted with a modular approval for mobile applications. Integrators may use the SL5011 modem in their final products without additional FCC/IC (Industry Canada) certification if they meet the following conditions. Otherwise, additional FCC/IC approvals must be obtained.

1. At least 20cm separation distance between the antenna and the user's body must be maintained at all times.
2. To comply with FCC/IC regulations limiting both maximum RF output power and human exposure to RF radiation, the maximum antenna gain including cable loss in a mobile-only exposure condition must not exceed 5dBi for Cellular band and 4dBi for CDMA PCS band.
3. The SL5011 modem and the antenna must not be co-located or operating in conjunction with any other transmitter or antenna within a host device.

4. The RF signal must be routed on the application board using tracks with a 50 characteristic impedance.
   Basically, the characteristic impedance depends on the dielectric, the track width and the ground plane spacing.
   In order to respect this constraint, Sierra Wireless recommends using MicroStrip or StripLine structure and computing the Tracks width with a simulation tool (like AppCad shown in the figure below and that is available free of charge at http://www.agilent.com).
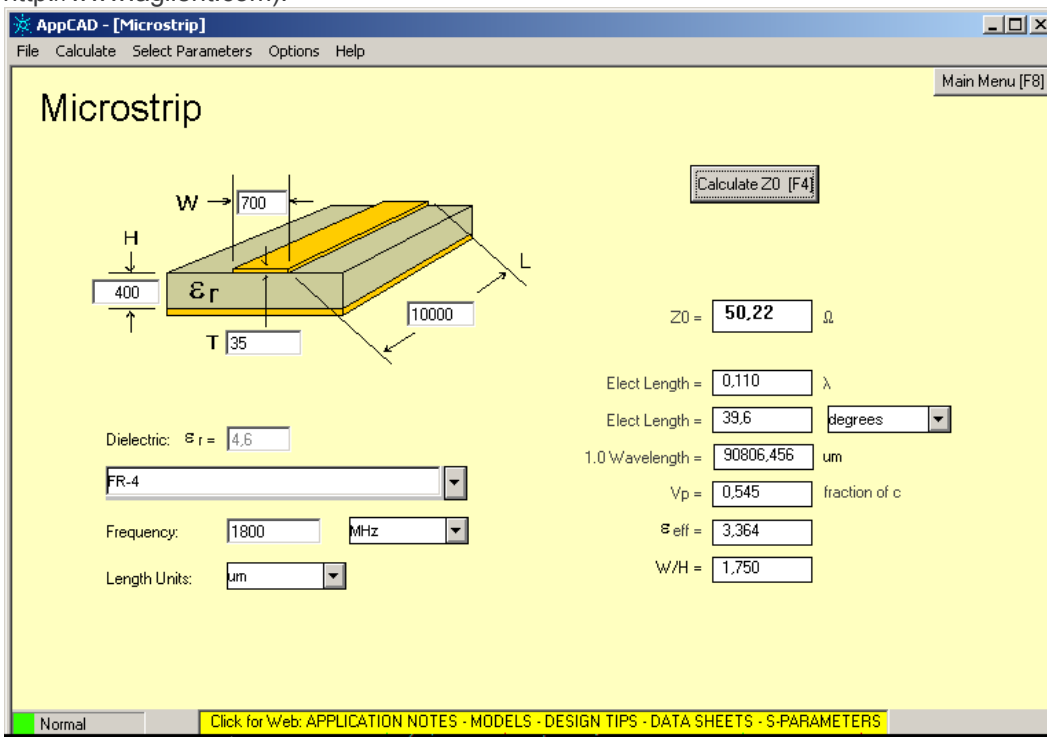
AppCad screenshot for MicroStrip design

If a multi-layered PCB is used, the RF path on the board must not cross any signal (digital, analog or supply).
If necessary, use StripLine structure and route the digital line(s) "outside" the Fstructure as shown in the figure below.

50Ω line

LGA pin for ANT
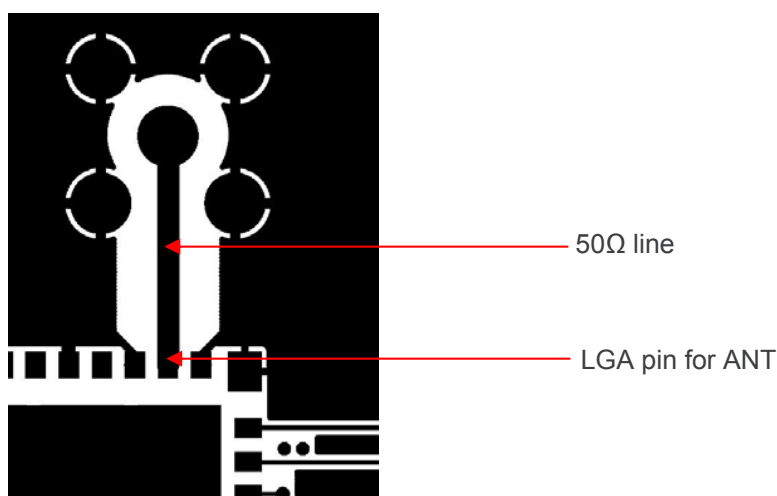
Routing examples

Stripline and Coplanar design requires having a correct ground plane at both sides. Consequently, it is necessary to add some vias along the RF path.

It is recommended to use Stripline design if the RF path is fairly long (more than 3cm), since MicroStrip design is not shielded. Consequently, the RF signal (when transmitting) may interfere with neighboring electronics (AF amplifier, etc.). In the same way, the neighboring electronics (micro-controllers, etc.) may degrade the reception performances.

The CDMA connector is intended to be directly connected to a 50 antenna and no matching is needed.

5. A label must be affixed to the outside of the end product into which the SL5011 modem is incorporated, with a statement similar to the following:

This device contains FCC ID: N7NSL5011

Contains transmitter module IC: 2417C-SL5011

where 2417C-SL5011 is the module's certification number.

A user manual with the end product must clearly indicate the operating requirements and conditions that must be observed to ensure compliance with current FCC/IC RF exposure guidelines.

The end product with an embedded SL5011 modem may also need to pass the FCC Part 15 unintentional emission testing requirements and be properly authorized.

Note: If this module is intended for use in a portable device, you are responsible for separate approval to satisfy the SAR requirements of FCC Part 2.1093 and IC RSS-102.

6. References

6.1. Standards

6.1.1. TIA/EIA Standards

TIA standards are available at www.tiaonline.org.

- [1] TIA/EIA/IS-2000.1 through .6. CDMA2000® Standards for Spread Spectrum Systems. Release 0. April 2000.
- [2] TIA/EIA/IS-2000.1-1 through .6-1. CDMA2000® Addendum 1. April 2000.
- [3] TIA/EIA/IS-2000.1-2 through .6-2. CDMA2000® Addendum 2. June 2001.
- [4] TIA/EIA-95-B. Mobile Station-Base Station Compatibility Standard for Dual-Mode Spread Spectrum Systems. December 4, 1998.
- [5] TIA/EIA/IS-707-A. Data Service Options for Wideband Spread Spectrum Systems. March 2000.
- [6] TIA/EIA/IS-134. Facsimile Digital Interfaces - Amendments to TIA/EIA-592 to Support ITU-T T.30-1993. October 1994.
- [7] TIA/EIA-592. Asynchronous Facsimile DCE Control Standard - Service Class 2. April 1998.
- [8] TIA/EIA-617. Data Transmission Systems and Equipment for In-Band DCE Control. January 1996.
- [9] TIA/EIA/IS-733-1. High Rate Speech Service Option 17 for Wideband Spread Spectrum Communication Systems. September 1999.
- [10] TIA/EIA/IS-736. Recommended Minimum Performance Standard for the High Rate Speech Service Option 17 for Spread Spectrum Communication Systems. August 2000.
- [11] TIA/EIA/IS-127-2. Enhanced Variable Rate Codec, Speech Service Option 3 for Wideband Spread Spectrum Digital Systems - Addendum 2. September 1999.
- [12] TIA/EIA/IS-718. Minimum Performance Specification for the Enhanced Variable Rate Codec, Speech Service Option 3 for Spread Spectrum Digital Systems. July 1998.
- [13] TIA/EIA-637-B. Short Message Service for Wideband Spread Spectrum Cellular Systems. January 2002.
- [14] TIA/EIA/IS-683-A. Over-the-Air Service Provisioning of Mobile Stations in Spread Spectrum Systems. June 1998.
- [15] TIA/EIA/IS-835-A. Wireless IP Network Standard. May 2001.
- [16] TIA/EIA/IS-870. Test Data Service Option (TDSO) for CDMA2000® Spread Spectrum Systems. 2001.
- [17] TIA/EIA/IS-98D/E. Recommended Minimum Performance Standards for Dual-Mode Spread Spectrum Mobile Stations.
- [18] TIA/EIA/IS-866. Recommended Minimum Performance Standards for CDMA2000® High Rate Packet Data Access Terminal.
- [19] TIA/EIA-126-D. Mobile Station Loop back Service Options Standard. 2001.
- [20] TIA/EIA TSB 58-C. Administration of Parameter Value Assignments for TIA/EIA Wideband Spread Spectrum Standards. May 2000.
- [21] TIA/EIA TSB 50. User Interface for Authentication Key Entry. March 1993.

[22] TIA/EIA/IS-801.1. Location Service Standard for Dual-Mode Spread Spectrum Systems. March 2001.

[23] C.S0031-0. Signaling Conformance Tests for CDMA2000[®] Spread Spectrum Systems, Ballot Resolution. Version 3GPP2 TSG- C v2.0

[24] C.S0036-0. Recommended Minimum Performance Specification for C.S0022-0 Spread Spectrum Mobile Stations. 3GPP2 C.S0036-0 v1.0.

[25] TIA/EIA/IS-J-STD-036. Enhanced Wireless 9-1-1 Phase II. January 2001.

[26] TIA/EIA/IS-856. CDMA2000[®] High Rate Packet Data Air Interface Specification. November 2000.

6.1.2. CDG Standards

[27] CDG 22. Stage 2 Interoperability Tests (TIA/EIA/IS-95A). Ver. 8.0. September 2000.

[28] CDG 53. Stage 2 Interoperability Tests (TIA/EIA/95B). Ver. 2.0. June 2000.

[29] CDG 57. Stage 2 Interoperability Tests (TIA/EIA/IS-2000). Ver. 0.7. February 2001.

[30] CDG 36. Markov Service Options for Wideband Spread Spectrum Systems Communications Systems. March 11, 1996.

[31] CDG 64. CDG Stage 3 Testing for CDMA2000®. Ver. 1.0. August 2002.

6.1.3. Agency Standards

[32] FCC 47 CFR - Part 15. Radio Frequency Devices. January 2001.

[33] FCC 47 CFR - Part 22. Cellular Radiotelephone Services. October 1998.

[34] FCC 47 CFR - Part 24. Personal Communications Services. October 1998.

[35] Industry Canada ICES-003. Interference-Causing Equipment Standard - Digital Apparatus. November 22, 1997.

[36] Industry Canada RSS-132. Cellular Telephones Employing New Technologies Operating in the Bands 824-849 MHz and 869-894 MHz. Issue 2. September 2005.

[37] Industry Canada RSS-133. 2 GHz Personal Communications Services. September 25, 1999.

[38] IEC 61000-4-2. Electrostatic Discharge Immunity Test.

[39] JESD22-A114-B. +/- 1 kV Human Body Model.

[40] JESD22-C101. +/- 125 V Charged Device Model.

[41] FCC 47 CFR - Part 2. Frequency allocations and radio treaty matters; general rules and regulations.

6.1.4. Other Standards

[42] Openwave_IOTA_Protocol_v2.0_Specifications_doc_v2.04. February 2002.

[43] Universal Serial Bus Specification. Revision 2.0. www.usb.org/developers/docs.

6.2. Sierra Wireless Documentation

[44] EMConnect Guide

Reference: 2131177

[45] Hardware Integration Guide

Reference: 2130114

[46] AT Command Reference Guide

Reference: 2130620

[47] CnS Reference

Reference: 2130754

7. Acronyms

Table 22.   Acronyms

Acronym or Term	Definition
1xEV-DO	Single Carrier (1X) EVolution – Data Only. A high-speed standard for cellular packet data communications. Supports Internet connections with data rates up to 3.1 Mbps (downlink from the network) and 1.8 Mbps (uplink to the network). Average data rates are roughly: for Rev. A: 600-1300 kbps (downlink from the network) and 300-400 kbps (uplink to the network); for Rev. 0: 400-700 kbps (downlink from the network) and 40-80 kbps (uplink to the network). Actual speed depends on the network conditions. Compare to 1X.
1X	Single Carrier (1X) Radio Transmission Technology. A high-speed standard for cellular packet data communications. Supports Internet connections with data rates up to 153 kbps (simultaneously in each direction—downlink and uplink). Actual speed depends on the network conditions. Compare to 1xEV-DO.
API	Application Programming Interface
AT	A set of modem commands, preceded by "AT," originally developed by Hayes, Inc. for their modems. The structure (but not the specific commands, which vary greatly from manufacturer to manufacturer) is a de facto modem industry standard.
CDG	CDMA Development Group
CDMA	Code Division Multiple Access. A wideband spread spectrum technique used in digital cellular, personal communications services, and other wireless networks. Wide channels (1.25 MHz) are obtained through spread spectrum transmissions, thus allowing many active users to share the same channel. Each user is assigned a unique digital code, which differentiates the individual conversations on the same channel.
CDMAOne	The IS-95 CDMA standard developed by QUALCOMM Inc.
CnS	Sierra Wireless proprietary Control and Status language interface
DCE	Data Communications Equipment
EIA	Electronics Industry Association
ERP	Effective Radiated Power
ESN	Electronic Serial Number—The unique first-generation serial number assigned to the SL5011 for use on the wireless network. Compare to MEID.
FCC	Federal Communications Commission. The U.S. federal agency that is responsible for interstate and foreign communications. The FCC regulates commercial and private radio spectrum management, sets rates for communications services, determines standards for equipment, and controls broadcast licensing. Consult www.fcc.gov.
firmware	Software stored in ROM or EEPROM; essential programs that remain even when the system is turned off. Firmware is easier to change than hardware but more permanent than software stored on disk.
FSN	Factory Serial Number—A unique serial number assigned to the SL5011 during manufacturing.
GPS	Global Positioning System A system that uses a series of 24 geosynchronous satellites to provide navigational data.
IOTA	Internet Over The Air—an automated feature, supported by some service providers, to perform account setup for you by making a connection to the CDMA network and using a secure Internet connection to download account parameters to your device.
IS	Interim Standard. After receiving industry consensus, the TIA forwards the standard to ANSI for approval.

Acronym or Term	Definition
kbps	kilobits per second – Actually 1000, not 1024, as used in computer memory size measurements of kilobytes.
LED	Light Emitting Diode. A semiconductor diode that emits visible or infrared light.
Mbps	Millions of bits per second, or Megabits per second.
MEID	Mobile Equipment IDentifier—The unique second-generation serial number assigned to the SL5011 for use on the wireless network. Compare to ESN.
NAM	Number Assignment Module Semi-permanent information stored in the modem's non-volatile memory, including the modem's Mobile Identification Number, the station class mark, carrier code, and other cellular identifiers. Essentially the phone number, it should be treated as confidential information and should not be disclosed to anyone other than the cellular service provider.
NV	Non-Volatile (memory)
OEM	Original Equipment Manufacturer A company that manufactures a product and sells it to a reseller.
OTAPA	Over the Air Parameter Administration
OTASP	Over the Air Service Provisioning
PCS	Personal Communications Services A cellular communication infrastructure that uses a different frequency range than AMPS.
PPP	Point to Point Protocol. An alternative communications protocol used between computers, or between computers and routers on the Internet. PPP is an enhanced SLIP.
PRI	Product Release Instructions—a file that contains the settings used to configure modems for a particular service provider, customer, or purpose.
QAM	Quadrature Amplitude Modulation. This form of modulation uses amplitude, frequency, and phase to transfer data on the carrier wave.
RF	Radio Frequency
RLP	Radio Link Protocol. This protocol improves the error characteristics of the wireless link, thereby reducing the need for transport layer retransmission due to lost data.
Rx	Receive
SAR	Specific Absorption Rate
SKU	Stock Keeping Unit—identifies an inventory item: a unique code, consisting of numbers or letters and numbers, assigned to a product by a retailer for purposes of identification and inventory control.
SMS	Short Message Service. A feature that allows users of a wireless device on a wireless network to receive or transmit short electronic alphanumeric messages (up to 160 characters, depending on the service provider).
TIA/EIA	Telecommunications Industry Association / Electronics Industry Association. Telecommunications Industry Association – A standards setting trade organization, whose members provide communications and information technology products, systems, distribution services and professional services in the United States and around the world. Consult www.tiaonline.org.
Tx	Transmit
USB	Universal Serial Bus