Product Technical Specification & Customer Design Guidelines

AirPrime SL808xT, SL808xBT and SL808xBTA

SIERRA WIRELESS®

4115145
5.1
October 09, 2015

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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.

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Document History

Version	Date	Updates
1.0	February 28, 2014	Created re-spin document based on SL808x PTS Rev 8.3
2.0	April 15, 2014	Updated: • Updated voltage range from 3.3-4.3V to 3.2-4.2V throughout the document • 4.9 I^2C Bus • 5.4 Wake Signal (WAKE_N) • Table 79 Power State Transitions (including voltage / temperature trigger levels)
	April 25, 2014	Updated reset states in the following tables: • Table 10 SL808xT, SL808xBT and SL808xBTA LGA Pad Pin Assignments • Table 16 GPIO Pin Description • Table 17 SPI 1V8 • Table 32 I^2C Pin Description • Table 60 Wake Signal Pin Description • Table 62 Wireless Disable Signal Pin Description • Table 65 Buzzer Output Pin Description • Table 67 LED_FLASH Pin Description • Table 70 External Interrupt Pin Description
2.1	May 13, 2014	Updated voltage range from 3.2-4.3V to 3.3-4.2V throughout the document
	August 01, 2014	Updated: • 3.5 Labeling • 6.3 Thermal Considerations • Table 9 Available Interfaces and Signals • Table 10 SL808xT, SL808xBT and SL808xBTA LGA Pad Pin Assignments • Table 16 GPIO Pin Description • 4.5 Main Serial Interface (UART1) • 4.6 USIM Interface • 4.8 ADC Interface • 4.10 RF Interface • 5.2 Power ON/OFF (Signal POWER_ON_N) • 5.9 Power Rail (VREF_1V8) • 6 Power
		Added: • Table 12 Electrical Characteristics for Other Interfaces • 8.7.3 USB Interface
		Deleted 3.6 Embedded SIM (eSIM)
2.2	August 05, 2014	Updated 4.7.3.2 Host Driver Requirements
2.3	August 11, 2014	Updated Table 74 Standby DC Power Consumption

Version	Date	Updates
3.0	November 07, 2014	Added 3.8 Conformance with ATEX
		Updated: • Table 4 VBATT Power Supply Requirements • Figure 8 PCB Footprint • Table 10 SL808xT, SL808xBT and SL808xBTA LGA Pad Pin Assignments • Table 14 Reset State Definition • Table 17 SPI 1V8 Pin Description • 4.10.3 RF Performance • 5.2.2.1 Power ON/OFF Signal Timing • 5.3.2.1 Reset Signal Timing • 6 Power • 8.8 EMC and ESD Recommendations • Table 91 Handling Resistance Stress Tests
3.1	November 10, 2014	Added a note in section 3.1 Power Supply
		Updated Table 75 Averaged Call Mode Data DC Power Consumption
3.2	November 17, 2014	Updated section 11.3.3 Corrosive Resistance Stress Tests
4.0	January 09, 2015	Updated: • Table 10 SL808xT, SL808xBT and SL808xBTA LGA Pad Pin Assignments • 4.2.1 Digital I/O Electrical Characteristics • Table 53 POWER_ON_N Signal Timing Parameters • Table 83 Standards Conformity for the SL808xT, SL808xBT and SL808xBTA Module • 15 Signals Reference Schematics
4.1	January 12, 2015	Updated 14.2.1 Sierra Wireless Documents
5.0	September 07, 2015	Added: • Figure 3 Power Supply Requirements • 4.2.2 Other Electrical Characteristics • 4.9.2 I^2C Application • Table 81 Supported GSM / GPRS Specifications
		Updated: • 6.3 Thermal Considerations • 3.8 Conformance with ATEX • 4.1.2 Pin Description • Table 15 GPIO Interface Features • 4.4 Serial Peripheral Interface (SPI) • 4.5.1 UART1 Pin Description • 4.7 USB 2.0 Device Interface • 4.11.1 Analog Audio Interface • 4.12 JTAG Interface • 5.3 Reset Signal (SYSTEM_RESET_N) • 5.4 Wake Signal (WAKE_N) • 5.7 LED_FLASH • Table 74 Standby DC Power Consumption • Table 75 Averaged Call Mode Data DC Power Consumption • Table 89 Thermal Resistance Cycle Stress Tests

Version	Date	Updates
5.0	September 07, 2015	Deleted: • 4.10.4.3 A-GPS Features • 4.10.4.3 OMA SUPL 1.0 User Plane • 4.11.1.4.5. Recommended Characteristics • 5.10 Reserved • Figure 40 Automatic Power State Transitions • 9.4 Module Testing Recommendations • 14 Connector and Peripheral Device References • 15 Signal Reference Schematics
5.1	October 09, 2015	Updated section 6 Power

Contents

List of Figures

List of Tables

1. Introduction

The AirPrime SL808xT, SL808xBT and SL808xBTA modules are 74-pin soldered-down modules. Their wireless UMTS-based modem provides (as listed in Table 1 Supported Bands/Connectivity) data connectivity on HSDPA, WCDMA, EDGE, and GPRS networks, and, for specific devices, GPS functionality.

Also, the AirPrime SL808xT, SL808xBT and SL808xBTA modules support the Open AT Application Framework, the world's most comprehensive cellular development environment which allows embedded standard ANSI C applications to be natively executed directly on the module. For more information about the Open AT Application Framework, refer to the references listed in section 14 References.

Note that this document only covers the AirPrime SL808xT, SL808xBT and SL808xBTA modules and does not cover the programmable capabilities available through the Open AT Application Framework.

Table 1. Supported Bands/Connectivity

Supported Bands	SL8080T	SL8080BT, SL8080BTA*	SL8082T	SL8082BT, SL8082BTA*	SL8084T	SL8084BT, SL8084BTA*
GSM850	✓	✓	✓	✓	✓	✓
EGSM900	✓	✓	✓	✓	✓	✓
DCS1800	✓	✓	✓	✓	✓	✓
PCS1900	✓	✓	✓	✓	✓	✓
Band 1 (UMTS2100)	-	-	✓	✓	✓	✓
Band 2 (UMTS1900)	✓	✓	-	-	-	-
Band 5 (UMTS850)	✓	✓	-	-	✓	✓
Band 6 (UMTS800)	-	-	-	-	✓	✓
Band 8 (UMTS900)	-	-	✓	✓	-	-
GPS (1575.42)	✓	-	✓	-	✓	-
Voice	✓	✓	✓	✓	✓	✓

* Automotive version

1.1. General Features

The following table lists several AirPrime SL808xT, SL808xBT and SL808xBTA module features.

Table 2. Module Features

Feature	Description
Physical	• Small form factor (74-pin solderable pad LGA) – 25mm x 30mm x 2.35mm (nominal) • Complete body shielding • RF connection pads – Tx/Rx (all modems) and GPS (Voice/GPS modems only) • Baseband signals connection
Electrical	• Single supply voltage (VBATT): +3.3V to +4.2V • Complete body shielding – No additional shielding required
SMS	• Send and receive (mobile originate and mobile terminate) ▪ Mobile-originated / terminated over CS and PS channels ▪ Mobile-originated SMS over PS falls back to CS if PS service is not available, or there is a PS network failure. • New message notification • Message sorting • Multiple recipients • Return voice call • Save contact details • Mobile-originated SMS e-mail • Mobile-originated / terminated SMS concatenation • Mobile-originated SMS e-mail concatenation • Receipt notification
Application Interface	• NDIS NIC interface support (Windows XP, Windows Vista, Windows 7, Windows CE*, Linux) • Multiple non-multiplexed USB channel support • Dial-up networking • USB selective suspend to maximize power savings • AT command interface – (non-voice) 27.007 standard, plus proprietary extended AT commands • CnS – Sierra Wireless' proprietary Control and Status host interface protocol • Software Development Kits (SDK) including APIs (Application Program Interfaces) and drivers (core, device) for Windows, Windows CE, and Linux • Optional eSIM support
Phonebook	Supports Release 99 phone book features

Feature	Description
Packet Mode	• Dual-mode UMTS (WCDMA) / HSDPA / EDGE / GPRS operation • GPRS class B, multislot class 10 operation – Supports CS1–CS4 coding schemes • EGPRS multislot class 12 operation – Supports MCS1–MCS9 coding schemes ▪ GPRS for MCS1 to MCS5 (GMSK 33dBm max) ▪ EDGE for MCS6 to MCS9 (8PSK 27dBm max) • UMTS (WCDMA) R99 data rates – 384 kbps downlink, 384 kbps uplink • HSDPA ▪ Category 5/6 data rate – 3.6 Mbps (peak rate) ▪ Category 12 data rate – 1.8 Mbps • Circuit-switched data bearers – 64 kbps (maximum) uplink and downlink
Connectivity/GSM	• Multiple (up to 16) cellular packet data profiles • Traditional modem COM port support for DUN, CSD, and AT commands (concurrent with NDIS) • Suspend / Resume • Sleep mode for minimum idle power draw • SIM application toolkit with proactive SIM commands • Enhanced Operator Name String (EONS) • Automatic GPRS attach at power-up • GPRS detach • Combined GPRS / IMSI detach; MS-initiated and network-initiated detach • Mobile-originated PDP context activation/deactivation • Support QoS profile ▪ Release 99 QoS negotiation – Background, Interactive, and Streaming ▪ Release 97 – Precedence Class, Reliability Class, Delay Class, Peak Throughput, Mean Throughput • Static and Dynamic IP address. The network may assign a fixed IP address or dynamically assign one using DHCP (Dynamic Host Configuration Protocol). • PAP and CHAP support • PDP context type (IPv4). IP Packet Data Protocol context • RFC1144 TCP/IP header compression • Interaction with existing GSM services (MO/MT SMS voice calls) while: • GPRS is attached, or • In a GPRS data session (class B GPRS suspend / resume procedures) • Support for EAP-SIM authentication and PC / SC. EAP-SIM is available through: ▪ The API ▪ AT commands ▪ The PC / SC interface

Feature	Description
Voice	Supports: • All GSM vocoders, Enhanced Full Rate (EFR), Full Rate (FR), and WCDMA Adaptive Multirate (AMR) encoders • MO and MT calling • Echo cancellation and noise reduction • Emergency calls (112, 110, 911, etc.) • Incoming call notification • TTY/TDD compatibility through microphone/speaker connections using the audio interface
Supplementary Services	• Call Barring • Call Forwarding • Call Hold • Caller ID • Call Waiting • Multi-party service • USSD
GPS**	Provides: • Standalone GPS functionality • gpsOneXTRA™ • A-GPS features • NMEA support
Network Selection	• Network selection procedures described in 3G 22.011, R5 (June 2005), 3G 23.122 (June 2005), and 3G 43.022, R4 • RRC connection reject message to redirect from a 3G system to a 2G system, according to 25.331, R5 (June 2004) • A CPHS Customer Service Profile-like feature [PLMN Mode bit] on a USIM/SIM that hides network selection related menus • Initial HPLMN scan at two minutes after power on • An HPLMN rescan irrespective of the serving MCC • Selective disabling of any 2G or 3G frequency band • Equivalent PLMN • Network selection generally within 30 seconds of power up • Enhanced network selection (ENS)
RF	• Quad-band GSM/GPRS/EDGE (850 MHz, 900 MHz, 1800 MHz, 1900 MHz) • Dual-band UMTS WCDMA FDD ▪ SL8080T/SL8080BT/SL8080BTA: 850 MHz, 1900 MHz ▪ SL8082T/SL8082BT/SL8082BTA: 900 MHz, 2100 MHz • Tri-band UMTS WCDMA FDD ▪ SL8084T/SL8084BT/SL8084BTA: 800 MHz, 850 MHz, 2100 MHz • GPS (1575.42 MHz) (SL8080T/SL8082T/SL8084T only)
Environmental	Operating temperature ranges • Class A (3GPP compliant): -30°C to +70°C • Class B (operational, non-3GPP compliant): -40°C to +85°C • Setup for thermal qualification (module soldered on socket board, VT4002 Vötsch Temperature Test Chamber, VBATT typ, VSWR 1:1 on CMU200)

Feature	Description
Interfaces	• 1.8 V digital GPIO • 3 V/1.8 V SIM interface • Serial (UART1) • Audio – Analog and digital (PCM) • SIM • USB 2.0 slave
Operating System	Open AT Application Framework

* Contact Sierra Wireless for platform-specific Windows CE support details.

** GPS on SL808xT

1.2. Support Features

The SL808xT, SL808xBT and SL808xBTA offer enabling software for Windows Mobile 6.5, Windows CE 6.0 and Linux SDK.

1.3. Support Tools

The SL808xT, SL808xBT and SL808xBTA are compatible with the following support tools from Sierra Wireless and authorized third parties:

- Sierra Wireless's Developer Studio and SWIlog
- QXDM from Qualcomm

1.4. Accessories

The AirPrime SL Development Kit includes:

- 1 SL Mechanical Development Kit Board
- 1 SL8080T sample
- 1 SL8082T sample
- 1 SL8084T sample
- 1 SL6087 sample
- 1 GSM Antenna
- 1 GPS Antenna
- 1 Headset
- 1 Telephone handset
- 1 RJ9 cable
- 1 USB cable
- 1 RS232 cable
- 1 Set of board to board connectors
- 1 Power supply
- 1 USB Flash disk

1.5. Hardware Development Components

Sierra Wireless manufactures a development kit to facilitate the hardware integration process.

For more information regarding the development kit, please visit the development kit information page on the Source.

1.6. Ordering Information

To order, contact the Sierra Wireless Sales Desk at +1 (604) 232-1488 between 8 AM and 5 PM Pacific Time.

1.7. Environmental Issues

1.7.1. RoHS Directive Compliant

The AirPrime SL808xT, SL808xBT and SL808xBTA module is compliant with RoHS Directive 2011/65/EU which sets limits for the use of certain restricted hazardous substances. This directive states that "from 1st July 2006, new electrical and electronic equipment put on the market does not contain lead, mercury, cadmium, hexavalent chromium, polybrominated biphenyls (PBB) or polybrominated diphenyl ethers (PBDE)".

1.7.2. Disposing of the Product

This electronic product is subject to the EU Directive 2012/19/EU for Waste Electrical and Electronic Equipment (WEEE). As such, this product must not be disposed of at a municipal waste collection point. Please refer to local regulations for directions on how to dispose of this product in an environmental friendly manner.

2. Functional Specifications

2.1. Functional Architecture

The global architecture of the AirPrime SL808xT, SL808xBT and SL808xBTA module is described in the following figure.

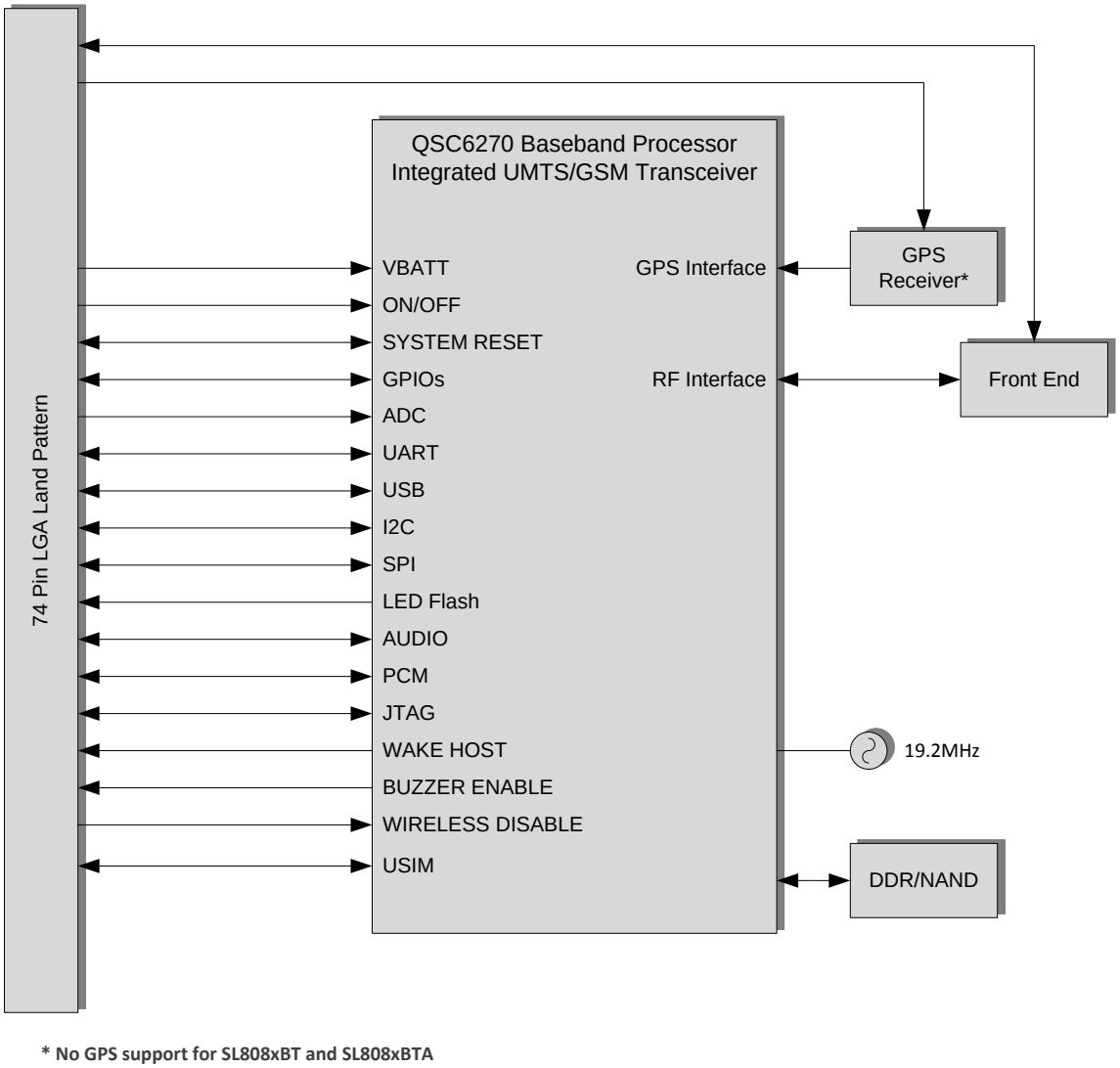


Figure 1. Functional Architecture

2.1.1. Chipsets

SL808xT, SL808xBT and SL808xBTA modems are based on Qualcomm QSC6270 single chip solution (integrated baseband processor, RF transceiver, and power management IC).

2.2. User Interface

2.2.1. Extended AT Commands

Several proprietary AT commands are available for AirPrime modules to use in hardware integration design and testing. For the list of all available commands and description of their functionality, refer to documents [2] AT Commands Interface Guide for Firmware 7.52/7.53 and [3] ADL User Guide for Open AT Application Framework OS 6.52.

2.2.2. Operating System (Open AT Application Framework Support)

Because the AirPrime SL808xT, SL808xBT and SL808xBTA module supports the Open AT Application Framework, customers can embed their own applications with the AirPrime SL808xT, SL808xBT and SL808xBTA and turn it into a solution for their specific market need.

3. Technical Specifications

3.1. Power Supply

Power is provided to the SL808xT, SL808xBT and SL808xBTA through power and ground pins as detailed in the following table.

Table 3. Power and Ground Specifications

Signal Name	Pin Numbers	Type	Specification	Min	Typ	Max	Units
VBATT	42, 44	V	Voltage range	3.30	3.60	4.20	V
VREF_1V8	10	V	Maximum supply current = 1 mA	-3%	1.80	+3%	V
GND	19, 20, 21, 23, 28, 30, 35, 37, 38, 39, 52	V		-	0	-	V

The host device must provide power to the AirPrime soldered-down module over pins 42 and 44 (VBATT) as detailed in the following table.

Note: Wait 2 seconds after pin 10 (VREF_1V8) becomes low before cutting down the module's power to prevent EFS corruption issues.

Table 4. VBATT Power Supply Requirements

Requirement Type	Value
Power supply	3.6 V (nominal)
Voltage range (Vmin–Vmax)	3.3 – 4.2 V
Absolute maximum voltage rating	4.6 V
Peak current (Max)	2.2 A
Current (continuous)	See Table 75 Averaged Call Mode Data DC Power Consumption for band-specific values.
Power input capacitor(s)	• Add capacitance (≥ 100 µF) to keep module operational with Vin in range. • Capacitors are recommended close to the power input for decoupling (for details, refer to Figure 3 Power Supply Requirements)

Note: The module has sensitive electrical components and should be protected against electrical overstress.

3.1.1. Burst Transmission Current Requirements

The power supply must be able to deliver high current peaks in a short time due to the burst transmission nature of GSM. For supply filtering recommendations please refer to Section 3.3 Decoupling of Power Supply Signals.

The following table describes radio burst rates in connected mode. For detailed power consumption figures, see Table 75 Averaged Call Mode Data DC Power Consumption for band-specific values.

Table 5. Radio Burst Rates – Connected Mode

GSM/GPRS Multislot Class	RF Power Amplifier Current	Slot Duration	Period	Rising Time
Class 10	2.2A peak	577 µs	4.615 ms	10 µs
Class 12				

The corresponding radio burst rates in connected mode are as follows:

- GSM/GPRS class 2 terminals emit 577 µs radio bursts every 4.615 ms
- GPRS class 10 terminals emit 1154 µs radio bursts every 4.615 ms
- GPRS class 12 terminals emit 2308 µs radio bursts every 4.615 ms

In connected mode, the RF Power Amplifier current (2.2A peak in GSM /GPRS mode) flows with a ratio of:

- 1/8 of the time (around 577 µs every 4.615 ms for GSM /GPRS cl 2 – 2RX/1TX) and
- 4/8 of the time (around 2308 µs every 4.615 ms for GSM /GPRS cl 12 – 4RX/1TX) with the rising time at around 10 µs.

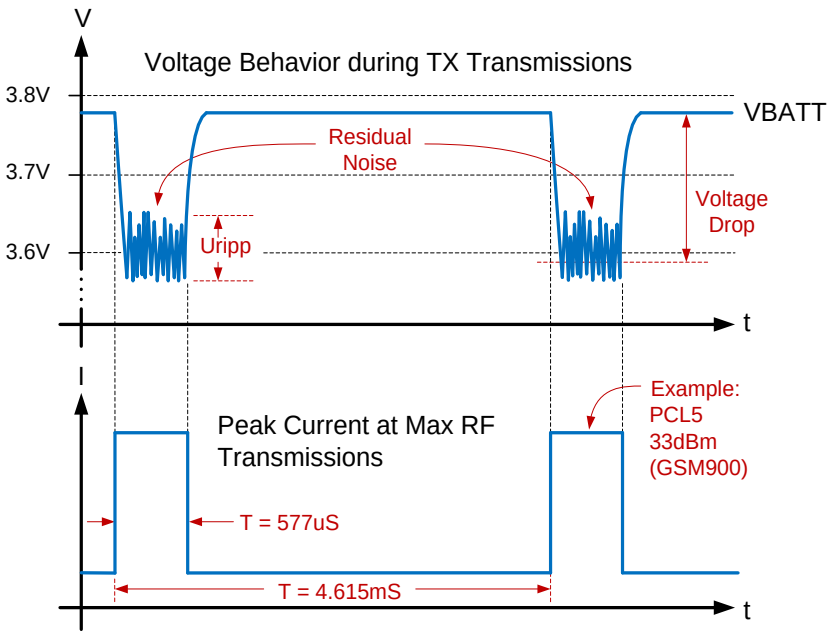


Figure 2. Power Supply During Burst Transmission

3.1.2. Power Input (VBATT)

An external power supply uses the VBATT pins to:

- Supply the AirPrime SL808xT, SL808xBT and SL808xBTA module.
- Directly supply the RF components.
  - It is essential to keep the voltage ripple to a minimum at this connection to avoid any phase error or spectrum modulation degradation.
  - An inadequate power supply can significantly affect RF performance (TX power, modulation spectrum, EMC performance, spurious emission, frequency error, etc.).
- Provide reference voltage VREF_1V8 (through several internal regulators) for the baseband signals. The host should draw less than 1 mA on this rail.

When the AirPrime SL808xT, SL808xBT and SL808xBTA module is supplied with a battery, the total impedance (battery + protections + PCB) should be such that the supply will be >= 3.3 V during GSM burst mode operation drawing a maximum peak current of 2.2 A for 577 µs (one slot) or 1154 µs (two slots) TX.

3.1.3. Start-Up Current

During the first second following Power ON, a current peak occurs. This current peak ($t_{Startup}$) has a duration of about 165ms (typical).

The following table indicates the expected peak current range.

Table 6. Start-Up Current Peak Range

Current Peak at Ambient Temperature (25°C)	$VBATT_{min}$ (3.3V)	$VBATT_{typ}$ (3.6V)	$VBATT_{max}$ (4.2V)
$t_{Startup}$	190 mA	180 mA	170 mA

3.2. Ground Connection

The AirPrime SL808xT, SL808xBT and SL808xBTA module shielding case is the grounding. The ground must be connected on the motherboard through a complete layer on the PCB.

The ground connection is made by soldering the LGA ground pins and rectangular ground pad to the ground plane of the application board. For more information about ground connection, see section 8.7.1.1 Ground Plane and Shielding Connection.

3.3. Decoupling of Power Supply Signals

The ETSI standard defines specific requirements for phase error and spectrum modulation. Both are mandatory and can be affected by the choice of power supply filtering. It is highly recommended to provide multiple capacitor values to solve an eventual Amplitude and Phase Modulation issue.

AirPrime SL808xT, SL808xBT and SL808xBTA module already has embedded decoupling capacitors on the VBATT lines, but additional external decoupling may be required.

- EMI/RFI issues – Add a capacitor (10pF – 33pF) close to the VBATT pins (a ferrite bead can also be added on the power line before this capacitor).

Note: When selecting a ferrite bead, pay special care about the DC current (>2A), DC resistance and thermal rating. Also be aware of possible anti-resonance peaks and LC tank oscillation.

- TDMA noise (217 Hz) – Place a low ESR decoupling capacitors (at least 100 µF) as close to the module as possible to reduce noise.

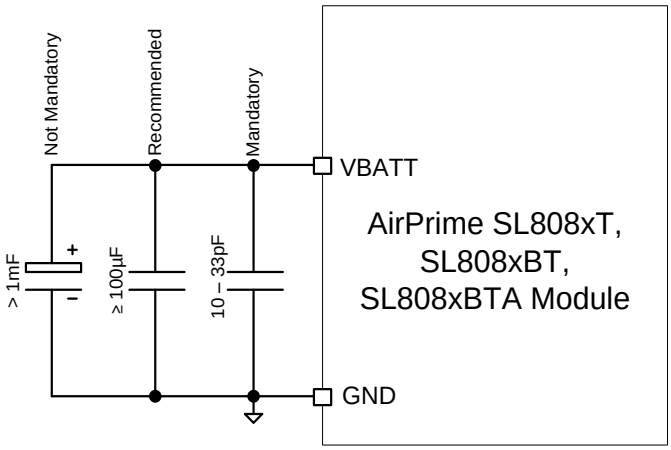


Figure 3. Power Supply Requirements

The figure below shows the power supply voltage drops shapes during 2G GSM transmission.

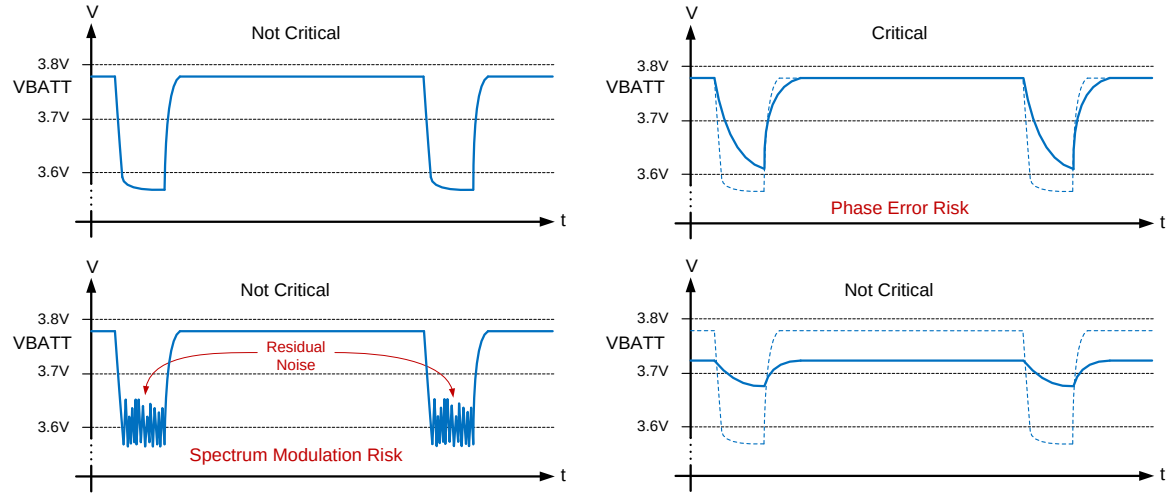


Figure 4. Power Supply Voltage Drops Shapes During Burst Transmission

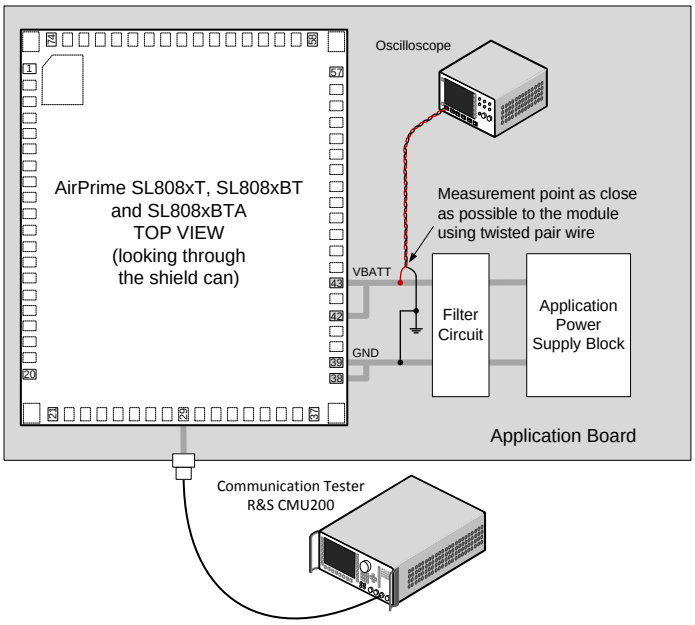


Figure 5. AirPrime SL808xT, SL808xBT and SL808xBTA Power Supply Voltage Measurement Point

3.4. Mechanical Specifications

This section describes mechanical specifications for the AirPrime SL808xT, SL808xBT and SL808xBTA module. For additional mechanical and environmental specifications, refer to document [4] Sierra Wireless Reliability Specification.

Table 7. Mechanical Specifications

Specification	Details
Form factor	The SL808xT, SL808xBT and SL808xBTA are 74-pin LGA soldered-down modules with a two-piece shielded case.
Dimensions (nominal)	Length: 30 mm Width: 25 mm Thickness: 2.40 mm (nominal) Weight: approximately 3.5 g

3.4.1. Mechanical Illustrations

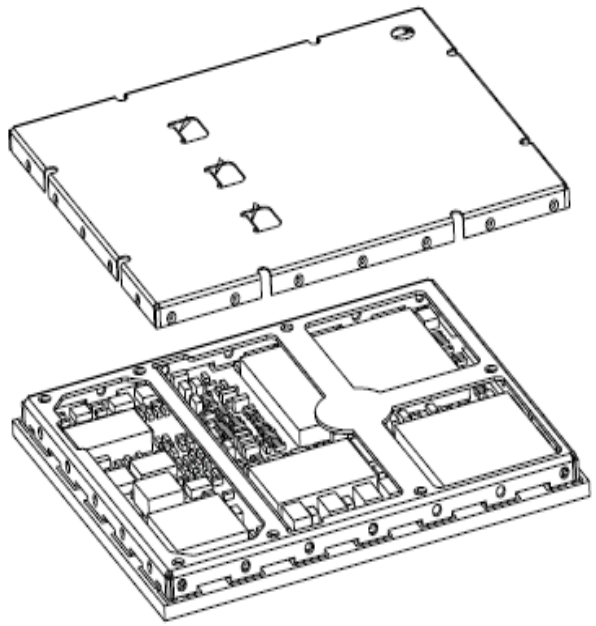


Figure 6. Exploded View

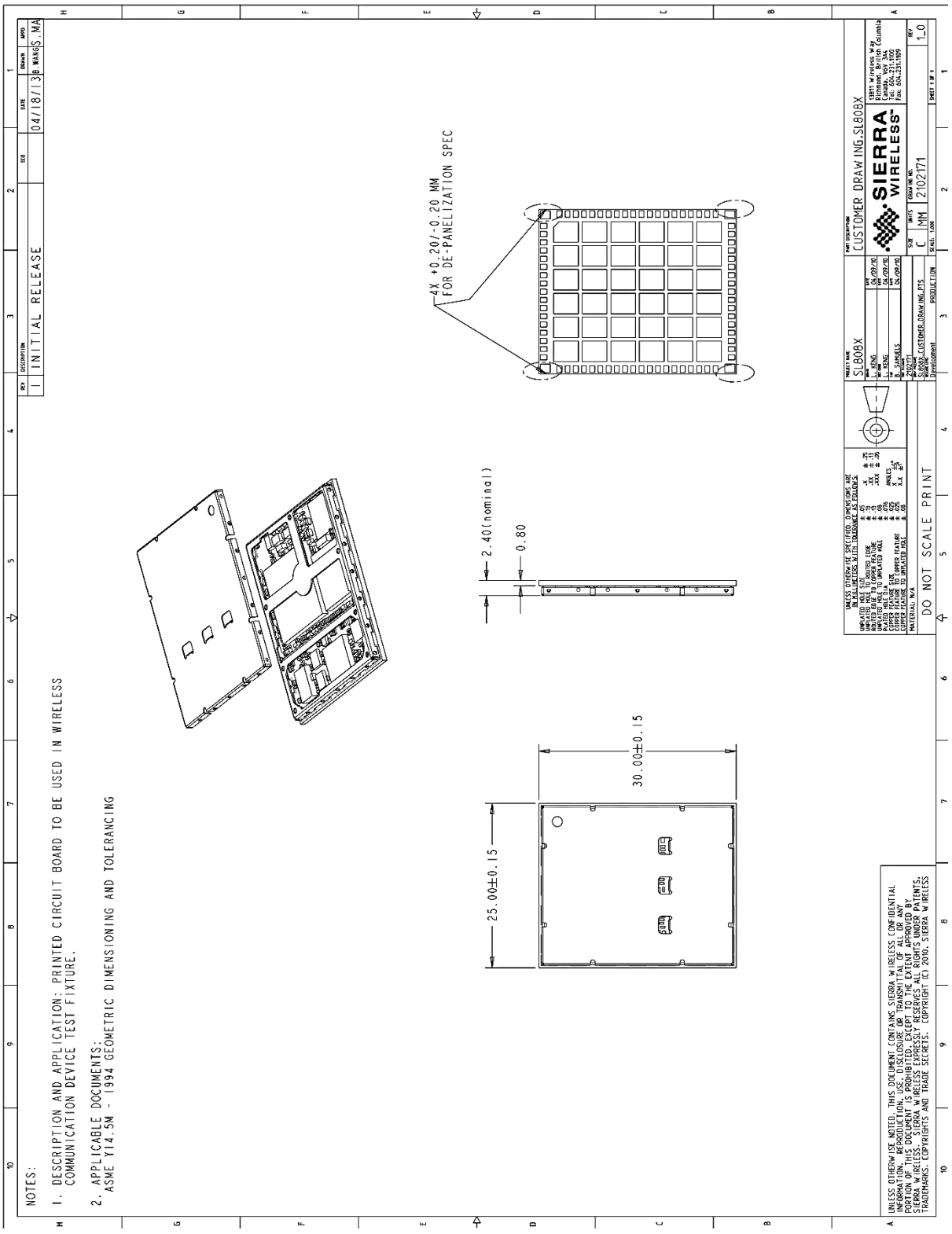


Figure 7. Dimensioned View

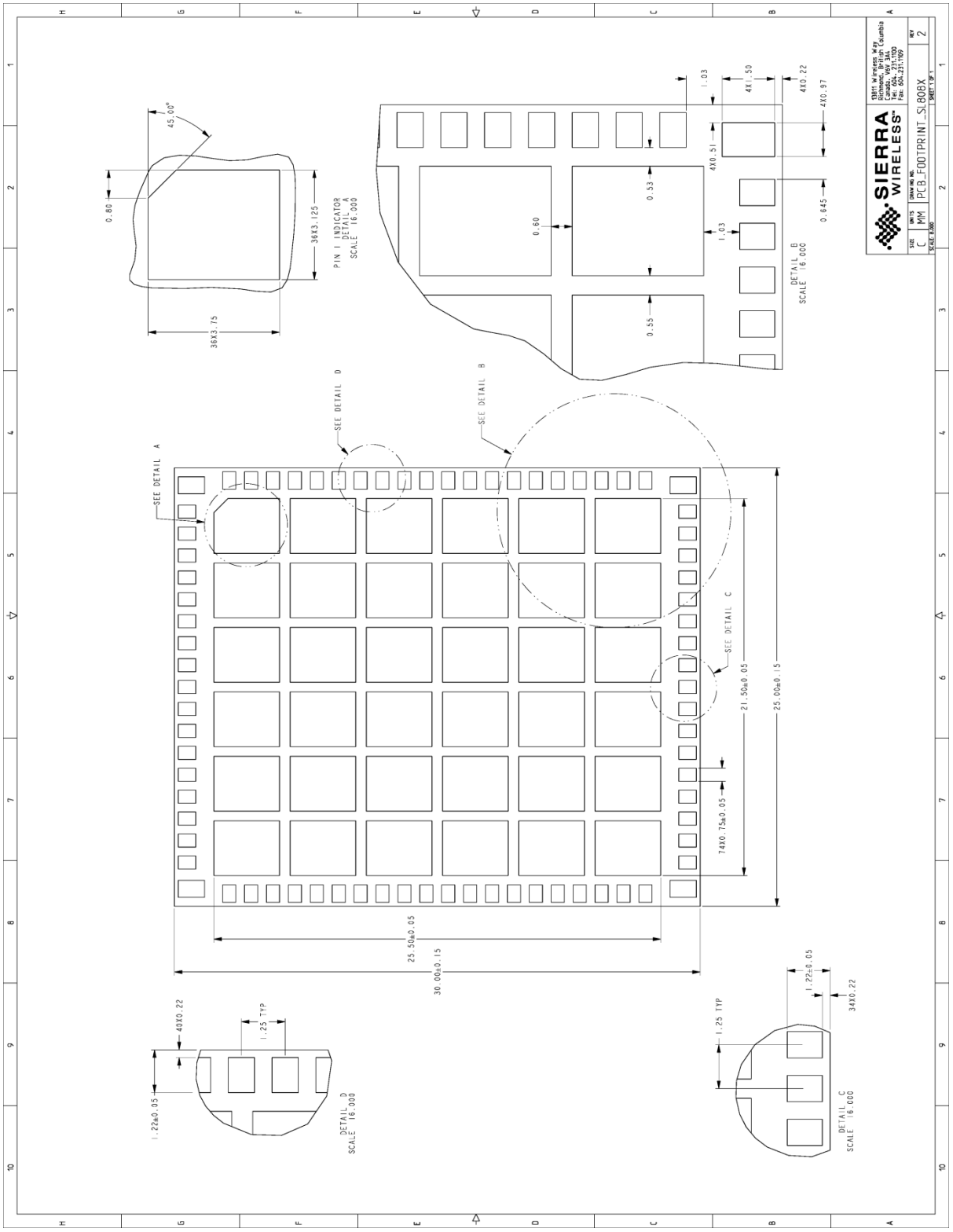


Figure 8. PCB Footprint

3.5. Labeling

Figure 9. SL808xT Unit Label

Note: The displayed label is an example only. The production label will vary by SKU.

The SL808xT, SL808xBT and SL808xBTA label is non-removable and contains:

- Sierra Wireless logo and product name. (The figures above uses 'X' to represent the actual product name. For example, SL8080T, SL8082BT, SL8084BTA, etc.)
- Open AT logo
- MFG PN
- Carrier Name
- Customer Product Number
- Qualcomm® 3G
- CE logo
- Serial number and barcode
- IMEI or ESN number and barcode
- FCC ID
- IC number
- JRF/JPA logo and numbers

Note: The SL808xT, SL808xBT and SL808xBTA support OEM partner specific label requirements.

3.6. SED (Smart Error Detection)

The AirPrime SL808xT, SL808xBT and SL808xBTA modules use a form of SED to track premature modem resets. In such cases, the module automatically forces a pause in boot-and-hold mode at power-on to accept an expected firmware download to resolve the problem.

1. Module tracks consecutive resets within 30 seconds of power-on.
2. After six (6) consecutive resets, the module waits in boot-and-hold mode for a firmware download to resolve the power-cycle problem.

3.7. Firmware Upgrade

Firmware upgrades are downloaded to the modem over the USB or UART interfaces. Contact your Sierra Wireless account representative for assistance.

With Sierra Wireless AirVantage Management Service, users can perform FOTA (firmware over the air) updates with Firmware 7.52 or newer. Visit the AirVantage Management Service website for more details.

3.8. Conformance with ATEX

The AirPrime SL808xT and SL808xBT are intended for use in telecommunication equipment.

Table 8. ATEX Conformance

Module	2G Bands	3G Bands	GPS	Sum of All Capacitors*	Sum of All Inductors*
SL8084T	GSM850/EGSM/DCS/PCS	Band I, Band V, Band VI	x	200µF	20µH
SL8084BT				190µF	20µH
SL8082T	GSM850/EGSM/DCS/PCS	Band I, Band VIII	x	200µF	20µH
SL8082BT				190µF	20µH
SL8080T	GSM850/EGSM/DCS/PCS	Band II, Band V	x	200µF	20µH
SL8080BT				190µF	20µH

* Including worst case tolerance rating 20%

The AirPrime SL808xT and SL808xBT modules have a maximum potential difference, internally generated, of 30 V. This voltage may be reached under fault conditions, for example on the RF feed in 850 and 900 MHz bands when the module is emitting at its maximum power, and only under certain circumstances (for instance very poor VSWR).

There are no cells, batteries or piezo electric devices (with the exception of commonly used radio parts such as quartz filters and SAW filters) inside the module.

The maximum RF output is 2W/1W in bands 850/900 and 1800/1900 at the RF output of the module when connected to a 50 Ω load.

Note: The AirPrime SL808xBTA is not certified for ATEX environment usage.

4. Interfaces

4.1. System Design

This chapter describes the AirPrime SL808xT, SL808xBT and SL808xBTA module's LGA pad configuration (see section 4.1.1 Pin Configuration) and supported interfaces (Table 9 Available Interfaces and Signals).

Table 9. Available Interfaces and Signals

Name	AT Command Support	Open AT Interface
General Purpose Input / Output	✓	✓
Main Serial Interface (UART1)	✓	✓
USIM Interface	✓	✓
USB 2.0 Device Interface	✓	✓
RF Interface		
Analog Audio Interface	✓	✓
Digital Audio Interface (PCM)	✓	✓
JTAG Interface		
I^2C Bus (from Firmware 2.53)		✓
ADC Interface (from Firmware 2.53)	✓	✓
Serial Peripheral Interface (SPI)		✓

The SL808xT, SL808xBT and SL808xBTA have two main interface areas – the host I/O perimeter I/O ports (pins) and the RF ports. These interface areas are identified in the following system block diagrams: Figure 10 (SL8080T/SL8080BT), Figure 11 (SL8082T/SL8082BT/SL8082BTA), and Figure 12 (SL8084T/SL8084BT/SL8084BTA).

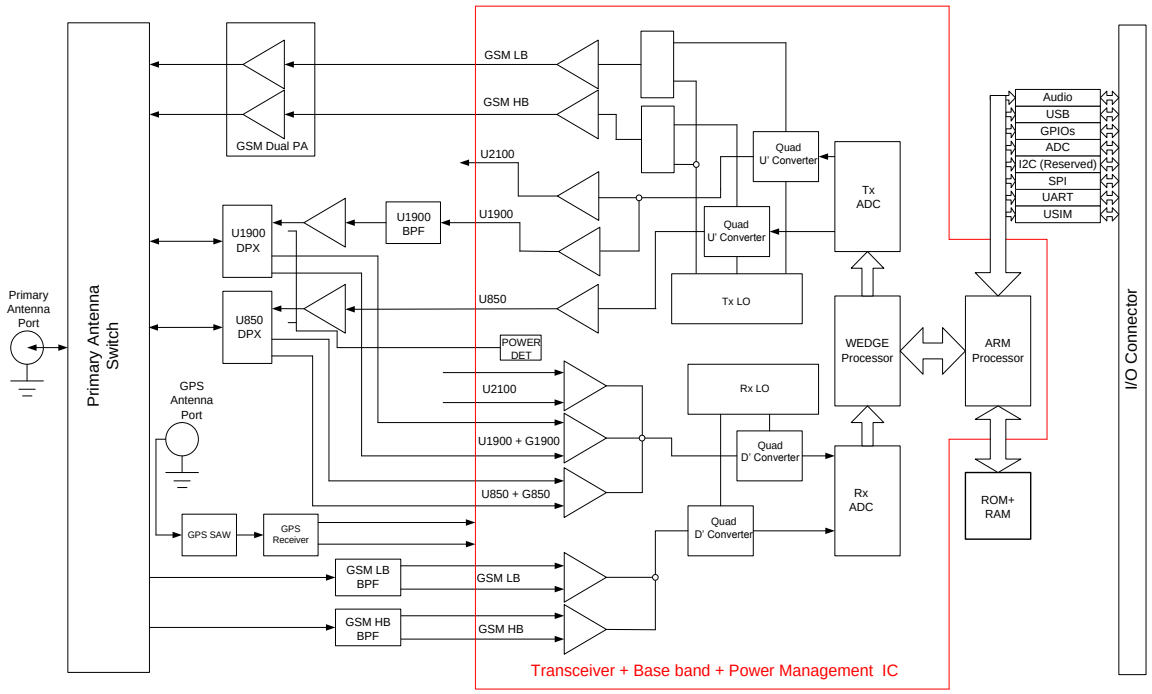


Figure 10. SL8080T, SL8080BT and SL8080BTA System Block

Note: SL8080BT and SL8080BTA do not support GPS.

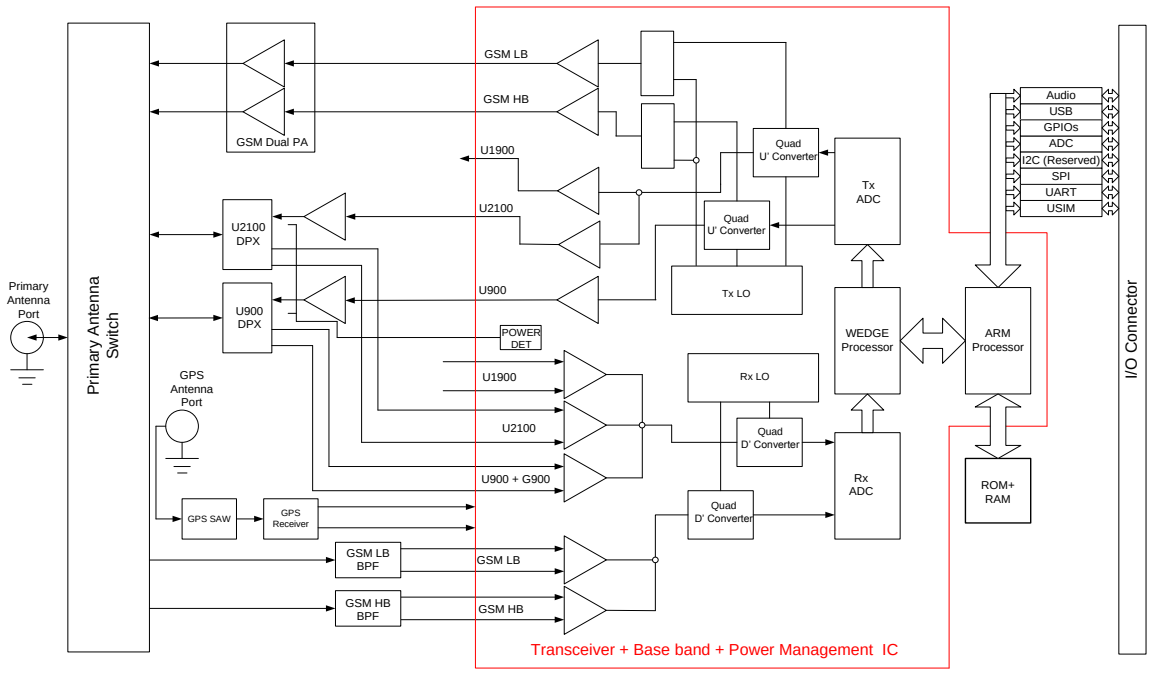


Figure 11. SL8082T, SL8082BT and SL8082BTA System Block

Note: SL8082BT and SL8082BTA do not support GPS.

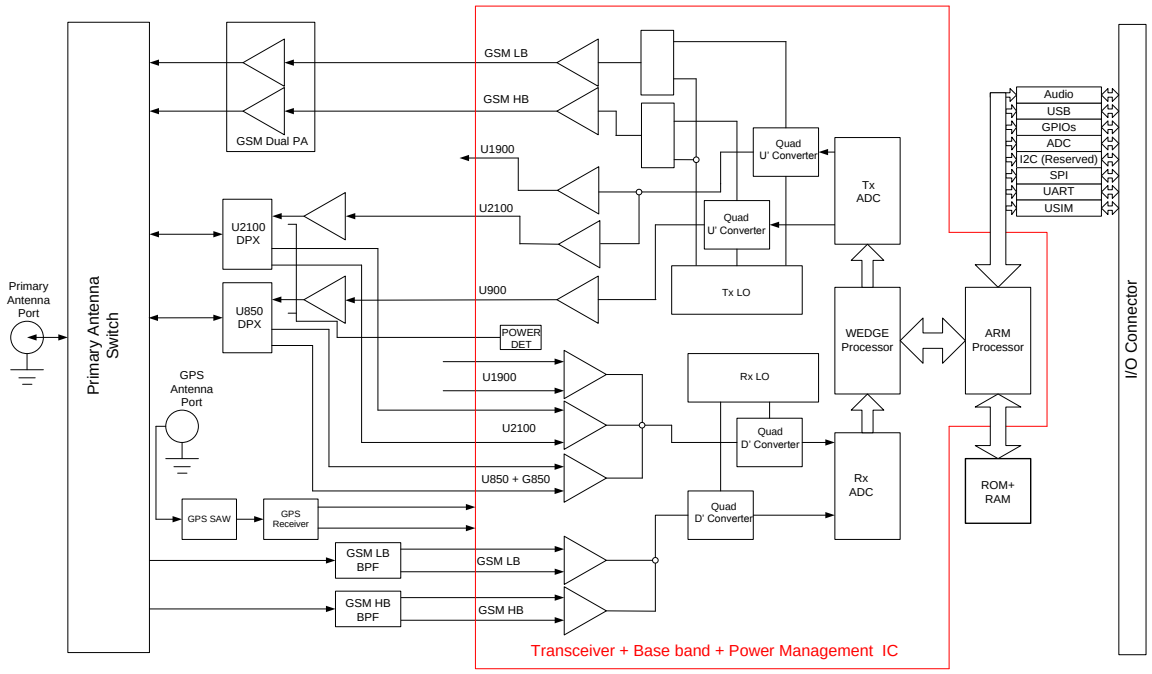
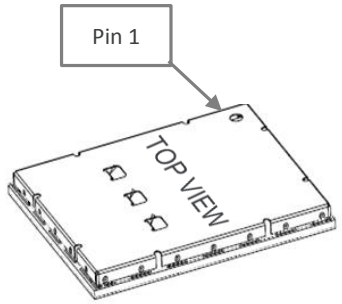


Figure 12. SL8084T, SL8084BT and SL8084BTA System Block

Note: SL8084BT and SL8084BTA do not support GPS.

4.1.1. Pin Configuration

The following figure illustrates the pin configuration of the SL808xT, SL808xBT and SL808xBTA modules. Table 10 SL808xT, SL808xBT and SL808xBTA LGA Pad Pin Assignments provides details for each of the module's pins.



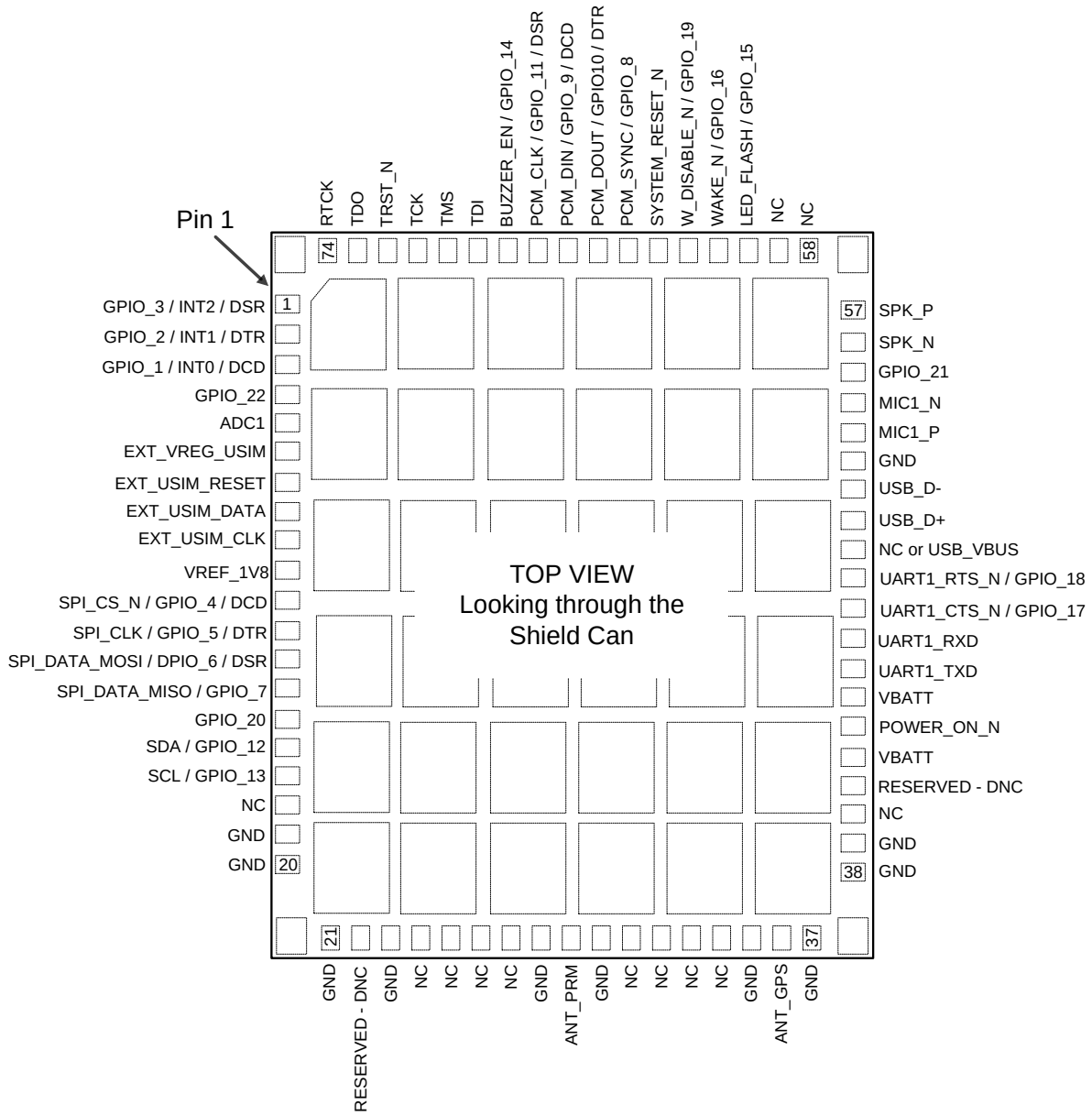


Figure 13. SL808xT, SL808xBT and SL808xBTA Device Pinouts (Top View Looking Through Shield Can)

4.1.2. Pin Description

The following table describes the LGA pad pin assignments.

See section 4.2 Electrical Information for 1V8 voltage characteristics.

Table 10. SL808xT, SL808xBT and SL808xBTA LGA Pad Pin Assignments

Pin #	Signal Name			Description	I/O State During Reset		I/O State After Software Boot		Dealing with Unused Pins
	Default	MUX1	MUX2		Direction	Value	Direction	Value	
1	GPIO_3/INT2	DSR		General purpose I/O or External interruption	I	PD	I	PD	NC
2	GPIO_2/INT1	DTR		General purpose I/O or External interruption	I	PD	I	PD	NC
3	GPIO_1/INT0	DCD		General purpose I/O or External interruption	I	PD	I	PD	NC
4	GPIO_22 (from Firmware 2.53)			General purpose I/O	I	PU	I	PU	NC
5	ADC1 (from Firmware 2.53)			Analog to Digital converter					NC
6	EXT_VREG_USIM			USIM VCC supply					
7	EXT_USIM_RESET			USIM reset					NC
8	EXT_USIM_DATA			USIM I/O pin					NC
9	EXT_USIM_CLK			USIM clock					NC
10	VREF_1V8			1.8 V LDO					Add test point for debugging. Refer to section 4.12 JTAG Interface for more information
11	SPI_CS_N	GPIO_4*	DCD	SPI chip select or General purpose I/O	I	PU	I	PD	NC
12	SPI_CLK	GPIO_5*	DTR	SPI clock or General purpose I/O	I	PD	I	PD	NC

Pin #	Signal Name			Description	I/O State During Reset		I/O State After Software Boot		Dealing with Unused Pins
	Default	MUX1	MUX2		Direction	Value	Direction	Value	
13	SPI_DATA_MOSI	GPIO_6*	DSR	SPI Master Output / Slave Input data pin or General purpose I/O	I	PD	I	PD	NC
14	SPI_DATA_MISO	GPIO_7*		SPI Master Input / Slave Output data pin or General purpose I/O	I	PD	I	PD	NC
15	GPIO_20* (from Firmware 2.53)			General purpose I/O	I	PU	I	PU	NC
16	SDA (from Firmware 2.53)	GPIO_12*		I^2C Data or General purpose I/O	I	PU	I	PD	NC
17	SCL (from Firmware 2.53)	GPIO_13*		I^2C Clock or General purpose I/O	I	PU	I	PD	NC
18	NC			No connect					NC
19	GND			Ground					
20	GND			Ground					
21	GND			Ground					
22	Reserved – DNC			No connect					NC
23	GND			Ground					
24	NC			No connect					NC
25	NC			No connect					NC
26	NC			No connect					NC
27	NC			No connect					NC
28	GND			Ground					
29	ANT_PRM			Main (primary) antenna					
30	GND			Ground					
31	NC			No connect					NC
32	NC			No connect					NC

Pin #	Signal Name			Description	I/O State During Reset		I/O State After Software Boot		Dealing with Unused Pins
	Default	MUX1	MUX2		Direction	Value	Direction	Value	
33	NC			No connect					NC
34	NC			No connect					NC
35	GND			Ground					
36	ANT_GPS			GPS antenna					NC
37	GND			Ground					
38	GND			Ground					
39	GND			Ground					
40	NC			No connect					NC
41	Reserved – DNC			No connect					NC
42	VBATT			3.6 V supply					
43	POWER_ON_N			Power on					
44	VBATT			3.6 V supply					
45	UART1_TXD			UART Transmit Data					Add test point in case firmware download is needed
46	UART1_RXD			UART Receive Data					Add test point in case firmware download is needed
47	UART1_CTS_N	GPIO_17*		UART Clear To Send or General purpose I/O	I	PU	I	PD	Add test point in case firmware download is needed
48	UART1_RTS_N	GPIO_18*		UART Request To Send or General purpose I/O	I	PD	I	PU	Add test point in case firmware download is needed
49	USB_VBUS**			USB VBUS					Add test point in case firmware download or debugging is needed
50	USB_D+			USB data positive (Full speed/High speed)					Add test point in case firmware download or debugging is needed
51	USB_D-			USB data negative (Full speed/High speed)					Add test point in case firmware download or debugging is needed

Pin #	Signal Name			Description	I/O State During Reset		I/O State After Software Boot		Dealing with Unused Pins
	Default	MUX1	MUX2		Direction	Value	Direction	Value	
52	GND			Ground					
53	MIC1_P			Microphone positive in series with 0.1µF DC blocking capacitor (Differential input across MIC1_P/MIC1_N)					NC
54	MIC1_N			Microphone negative in series with 0.1µF DC blocking capacitor (Differential input across MIC1_P/MIC1_N)					NC
55	GPIO_21 (from Firmware 2.53)			General purpose I/O	I	PD	I	PD	NC
56	SPK_N			Speaker negative (Differential output across SPK_P/SPK_N)					NC
57	SPK_P			Speaker positive (Differential output across SPK_P/SPK_N)					NC
58	NC			No connect					NC
59	NC			No connect					NC
60	LED_FLASH	GPIO_15*		LED driver or General purpose I/O	I	PD	I	PD	NC
61	WAKE_N (from Firmware 2.53)	GPIO_16*		Wake Host Interface or General purpose I/O	I	PD	I	PD	NC
62	W_DISABLE_N	GPIO_19*		Wireless disable or General purpose I/O	I	PD	I	PU	NC
63	SYSTEM_RESET_N			Reset					Add test point for debugging. Refer to section 4.12 JTAG Interface for more information
64	PCM_SYNC	GPIO_8*		PCM Sync Out	I	PD	I	PD	NC

Pin #	Signal Name			Description	I/O State During Reset		I/O State After Software Boot		Dealing with Unused Pins
	Default	MUX1	MUX2		Direction	Value	Direction	Value	
65	PCM_DOUT	GPIO_10	DTR	PCM Data Out	I	PD	I	PD	NC
66	PCM_DIN	GPIO_9	DCD	PCM Data In	I	PD	I	PD	NC
67	PCM_CLK	GPIO_11*	DSR	PCM Clock	I	PD	I	PD	NC
68	BUZZER_EN	GPIO_14*		Buzzer enable or General purpose I/O	I	PD	I	PD	NC
69	TDI			Test Data Input					Add test point for debugging. Refer to section 4.12 JTAG Interface for more information
70	TMS			Test Mode Select					Add test point for debugging. Refer to section 4.12 JTAG Interface for more information
71	TCK			Test Clock					Add test point for debugging. Refer to section 4.12 JTAG Interface for more information
72	TRST_N			Test Reset					Add test point for debugging. Refer to section 4.12 JTAG Interface for more information
73	TDO			Test Data Output					Add test point for debugging. Refer to section 4.12 JTAG Interface for more information
74	RTCK			Return TCK					Add test point for debugging. Refer to section 4.12 JTAG Interface for more information

* Not recommended to be used in an application if a specific state is required at reset. These pins may toggle during reset.

** This pin is only available on the SL808xBTA; not connected on the SL808xT and SL808xBT.

4.2. Electrical Information

The AirPrime SL808xT, SL808xBT and SL808xBTA module uses 1.8 V CMOS for digital I/O. For digital I/O electrical characteristics, see Table 1 Electrical Characteristics – 1.8V Type (1V8) Digital I/O; for other electrical characteristics, see Table 12 Electrical Characteristics for Other Interfaces.

4.2.1. Digital I/O Electrical Characteristics

Table 11. Electrical Characteristics – 1.8V Type (1V8) Digital I/O for GPIO, SPI, I²C and UART1

Parameter		I/O Type	Minimum	Typical	Maximum	Condition
Internal 1.8V Power Supply		VREF_1V8	-3%	1.8V	+3%	
Input/Output Pin	V_{IL}	CMOS	-0.30 V		0.60 V	
	V_{IH}	CMOS	1.2 V		2.10 V	
	V_{OL}	CMOS	0.00 V		0.45 V	I_{OL} = -1.5mA
	V_{OH}	CMOS	1.3 V		1.85 V	I_{OH} = 1.5mA
	I_{OH}				1.5mA	
	I_{OL}				-1.5mA	

'IL'—Input Low; 'IH'—Input High; 'OL'—Output Low; 'OH'—Output High

4.2.2. Other Electrical Characteristics

Table 12. Electrical Characteristics for Other Interfaces

Interface/Signal	Input / Output	Min Voltage (V)	Typ Voltage (V)	Max Voltage (V)
ADC	Input	0	-	2
SIM_VCC	Output (1.8V)	1.74	1.8	1.85
	Output (3.0V)	2.76	2.85	3
EXT_USIM_RESET	Output High (1.8V)	1.55	-	1.85
	Output Low (1.8V)	0	-	0.45
	Output High (3.0V)	2.5	-	3
	Output Low (3.0V)	0		0.45
EXT_USIM_DATA	Input High (1.8 V)	1.3		1.85
	Input Low (1.8 V)	-0.3		0.65
	Output High (1.8 V)	1.4	-	1.85
	Output Low (1.8 V)	0		0.45
	Input High (3.0 V)	2.1		3
	Input Low (3.0 V)	-0.3		1.05
	Output High (3.0 V)	2.2	-	3
	Output Low (3.0 V)	0		0.45

Interface/Signal	Input / Output	Min Voltage (V)	Typ Voltage (V)	Max Voltage (V)
EXT_USIM_CLK	Output High (1.8V)	1.55	-	1.85
	Output Low (1.8V)	0		0.45
	Output High (3.0V)	2.5	-	3
	Output Low (3.0V)	0		0.45
VREF_1V8	Output	1.76	-	1.85
ANT_PRM / ANT_GPS	Input/Output	Refer to section 4.10 RF Interface		
VBATT	Input	3.3	3.6	4.2
USB_VBUS	Input High	2	-	5.25
	Input Low	0	-	1
USB data (Full speed)	Input High	2	3.3	3.6
	Input Low	0	-	0.8
	Output High	2.8	3.3	3.6
	Output Low	-	-	0.3
USB data (High speed)	Input High	0.3	-	0.44
	Input Low	0	-	0.01
	Output High	0.36	0.38	0.44
	Output Low	0	-	0.01

4.2.3. Pin Types

Several tables in this chapter include pin types as part of their description. Table 14 Reset State Definition describes these pin types.

Table 13. Pin Type Codes

Type	Definition
I	Digital Input
O	Digital output
NP	No pull
PU	Digital input, internal pull up
PD	Digital input, internal pull down

4.2.4. Signal Reset States

Each interface described in this chapter includes a pin description table, which identifies each signal's reset state. Table 14 Reset State Definition describes these reset states.

Table 14. Reset State Definition

Parameter	Definition
0	Set to GND
1	Set to supply 1V8

Parameter	Definition
Pull-down	Internal pull-down with ~100 kΩ resistor
Pull-up	Internal pull-up with ~100 kΩ resistor to supply 1V8
Z	High impedance
Undefined	The output states of the port/s are undetermined during the reset period. **Caution:** *Not recommended to be used in an application if a specific state is required at reset. These pins may toggle during reset.*

4.3. General Purpose Input / Output

The AirPrime SL808xT, SL808xBT and SL808xBTA module includes twenty-two (22) general purpose I/O (GPIO) pins. Table 15 GPIO Interface Features describes the purpose and features of this interface.

Table 15. GPIO Interface Features

Feature	Details
Purpose	• OEM-configurable general purpose I/O (control, signaling, monitoring, etc.)
Implementation	• Defaults to digital output
Power	• 1.8 V (use VREF_1V8 as logic reference. If an external 1.8V LDO is used, refer to Figure 41) • Output drive current up to 1.5 mA.

4.3.1. Pin Description

The following table describes the GPIO interface pins.

Table 16. GPIO Pin Description

Pin Number	Signal Name	I/O	Voltage	Multiplexed with
3	GPIO_1	I/O	1V8	INT0
2	GPIO_2	I/O	1V8	INT1
1	GPIO_3	I/O	1V8	INT2
11	GPIO_4	I/O	1V8	SPI_CS_N
12	GPIO_5	I/O	1V8	SPI_CLK
13	GPIO_6	I/O	1V8	SPI_DATA_MOSI
14	GPIO_7	I/O	1V8	SPI_DATA_MISO
64	GPIO_8	I/O	1V8	PCM_SYNC
66	GPIO_9	I/O	1V8	PCM_DIN
65	GPIO_10	I/O	1V8	PCM_DOUT
67	GPIO_11	I/O	1V8	PCM_CLK
16	GPIO_12	I/O	1V8	SDA
17	GPIO_13	I/O	1V8	SCL

Pin Number	Signal Name	I/O	Voltage	Multiplexed with
68	GPIO_14	I/O	1V8	BUZZER_EN
60	GPIO_15	I/O	1V8	LED_FLASH
61	GPIO_16	I/O	1V8	WAKE_N
47	GPIO_17	I/O	1V8	UART1_CTS_N
48	GPIO_18	I/O	1V8	UART1_RTS_N
62	GPIO_19	I/O	1V8	W_DISABLE_N
15	GPIO_20 (from Firmware 2.53)	I/O	1V8	
55	GPIO_21 (from Firmware 2.53)	I/O	1V8	
4	GPIO_22 (from Firmware 2.53)	I/O	1V8	

See Table 14 Reset State Definition for state definitions and Table 10 SL808xT, SL808xBT and SL808xBTA LGA Pad Pin Assignments for additional pin-specific details.

4.4. Serial Peripheral Interface (SPI)

The AirPrime SL808xT, SL808xBT and SL808xBTA module may be connected to an external chip through the SPI bus. If the SPI interface is not used, these pins may also be reconfigured as GPIO pins with the Open AT Application Framework. In case a 3-wire SPI interface is used, SPI_DATA_MISO also cannot be reconfigured as a GPIO.

The SPI bus interface includes:

- A CLK signal (SPI_CLK)
- An I/O signal (SPI_DATA_MOSI)
- An I signal (SPI_DATA_MISO)
- A CS (Chip Select) signal complying with the standard SPI bus (SPI_CS_N)

Features available on the SPI bus are:

- Master mode only operation
- SPI speed is from 102Kbit/s to 26Mbit/s
- 4-wire interface
- 1 to 16 bits data length

4.4.1. SPI Pin Description

The following table describes the SPI interface pins.

Table 17. SPI 1V8 Pin Description

Pin Number	Signal Name	I/O Direction	Voltage	Multiplexed with
11	SPI_CS_N	O	1V8	GPIO_4
12	SPI_CLK	O	1V8	GPIO_5

Pin Number	Signal Name	I/O Direction	Voltage	Multiplexed with
13	SPI_DATA_MOSI	I/O	1V8	GPIO_6
14	SPI_DATA_MISO	I	1V8	GPIO_7

See Table 14 Reset State Definition for state definitions and Table 10 SL808xT, SL808xBT and SL808xBTA LGA Pad Pin Assignments for additional pin-specific details.

4.4.2. Electrical Characteristics

The following table describes the SPI interface's electrical characteristics.

Table 18. SPI Interface Electrical Characteristics

Signal	Description	Minimum	Typical	Maximum	Unit
CLK-cycle	SPI clock frequency	0.102		26	MHz
Data-OUT delay	Data out ready delay time			5	ns
Data-IN-setup	Data in setup time	0		3	ns
Data-OUT-hold	Data out hold time	0		3	ns

4.4.3. SPI Configuration

Table 19. SPI Bus Configuration

Operation	Maximum Speed	SPI-Mode	Duplex	3-wire Type	4-wire Type
Master	26 Mb/s	0, 1, 2, 3	Half	SPI_CLK; SPI_DATA_MOSI; SPI_CS_N	SPI_CLK; SPI_DATA_MOSI; SPI_DATA_MISO; SPI_CS_N

Refer to section 4.4.5 Application for more information on the signals used and their corresponding configurations.

4.4.4. SPI Waveforms

The figure below shows the waveforms for SPI transfers with a 4-wire configuration in master mode 0.

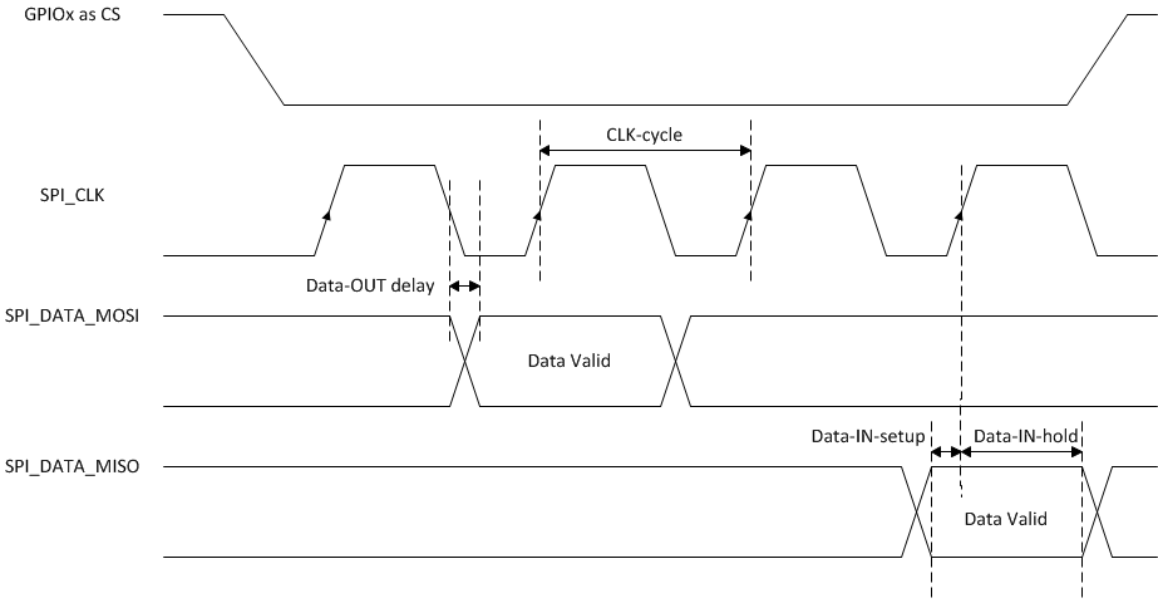


Figure 14. SPI Timing Diagram (Mode 0, Master, 4wires)

4.4.5. Application

For the 4-wire configuration, the input and output data lines are dissociated. SPI_DATA_MOSI is used as output only and SPI_DATA_MISO is used as input only.

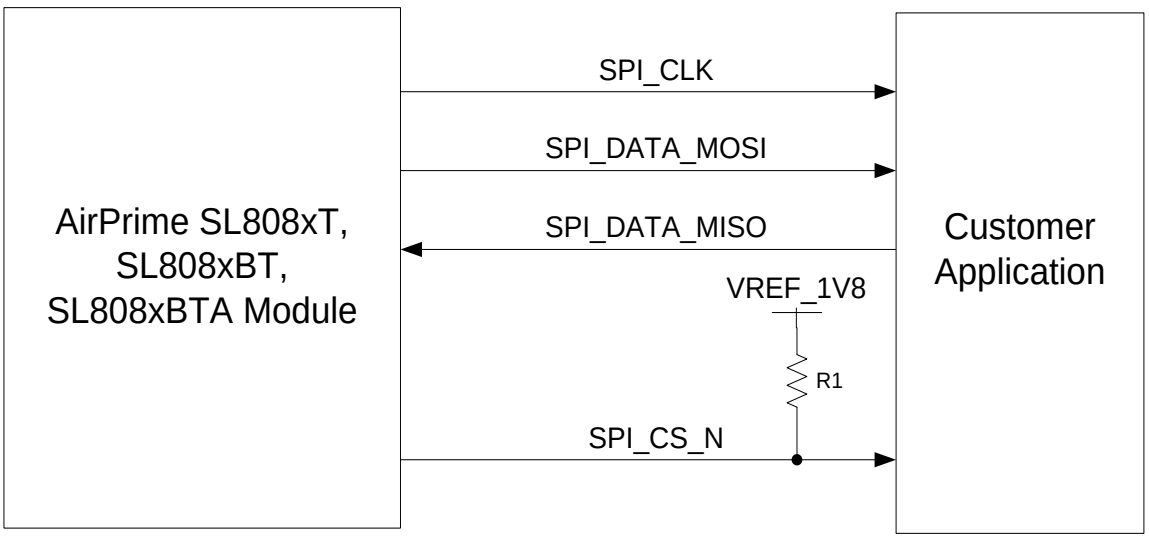


Figure 15. Example of a 4-wire SPI Bus Application

One pull-up resistor, R1 (10 kΩ), is needed to set the SPI_CS_N level during the reset state. Except for R1, no other external component is needed if the electrical specifications of the customer application comply with the AirPrime SL808xT, SL808xBT and SL808xBTA module SPI interface electrical specifications.

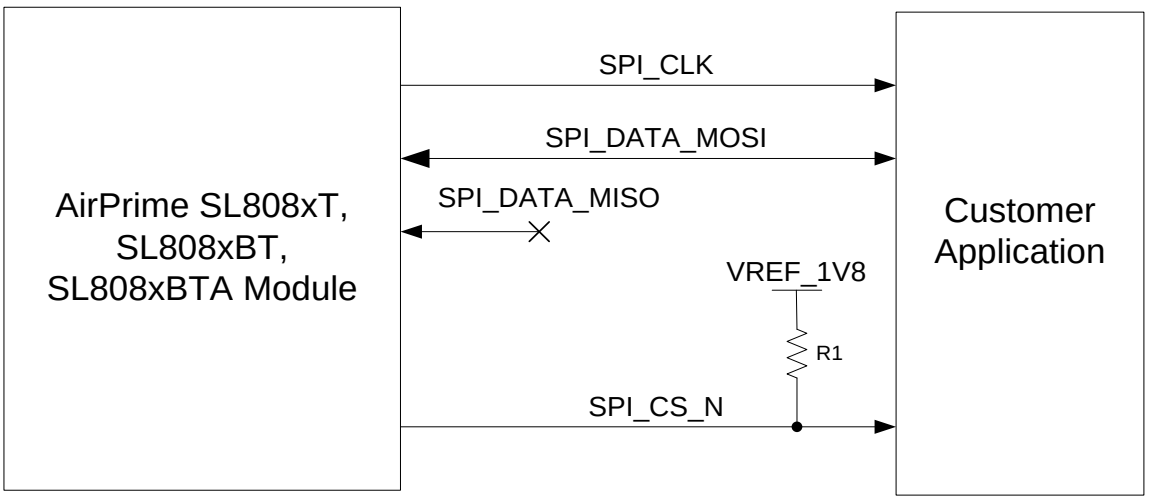


Figure 16. Example of a 3-wire SPI Bus Application

4.5. Main Serial Interface (UART1)

The AirPrime SL808xT, SL808xBT and SL808xBTA module includes a serial interface (UART1) for host–module communication.

The SL808xT, SL808xBT and SL808xBTA can be configured as either 4-wire UART or 8-wire UART (using reconfigured GPIO, PCM, or SPI pins).

The following table describes the purpose and features of this interface.

See Figure 17 Example of a 4-wire UART Application and Figure 18 Example of an 8-wire UART Application for sample implementation of the UART1 interface.

Table 20. UART1 Interface Features

Feature	Details
Purpose	• Serial host – module communication • Dependent on provisioning, communication with peripheral devices. Contact Sierra Wireless for further information.
Implementation	• Four-wire/eight-wire serial interface based on TIA-232 (RS232 protocol) • An RS-232 level shifter device may be required
Data rates supported	• High speed up to 921kbps (115K, 230K, 460.8K, 921.6K,)
Optional functionality	• Dependent on provisioning, module may be able to communicate with peripheral devices. Contact Sierra Wireless to discuss possible firmware support.

4.5.1. UART1 Pin Description

The following table describes the UART1 interface pins.

Table 21. Serial Port High-Speed UART1 Interface

Signal	Direction from Module	Pin*	UART Wires		Multiplexed with	Direction from Host	Description/Notes
			4	8			
UART1_TXD	Input	45	✓	✓		Output	Transmit Data: UART1 serial data transmit line (modem input)
UART1_RXD	Output	46	✓	✓		Input	Receive Data: UART1 serial data receive line (modem output)
UART1_CTS_N	Output	47	✓	✓	GPIO_17	Input	Clear To Send
UART1_RTS_N	Input	48	✓	✓	GPIO_18	Output	Request To Send
For 8-wire UART (only supported from Firmware 2.53), the DCD, DTR, and DSR signals are duplexed over GPIO, PCM, or SPI lines. See section 4.5.4 Configure the UART Interface for details.							
DTR	Input		See note	✓		Output	Data Terminal Ready: DTR may be used to support low power operation of 4-wire UART. See section 4.5.4 Configure the UART Interface for details.
DCD	Output			✓		Input	Data Carrier Detect
DSR	Output			✓		Input	Data Set Ready
WAKE_N	Output	61		✓		Input	Similar to standard UART RI (Ring Indicator) • Continues to function regardless of UART service mapping • For example, can be generated when SMS is received • Active low signal

* All pins are 1V8.

See Table 10 SL808xT, SL808xBT and SL808xBTA LGA Pad Pin Assignments for additional pin-specific details.

Table 22. Duplexed (Reconfigured) UART Interface Signal Groups

Signal Group	DCD	DTR	DSR
GPIO	GPIO_1 (Pin 3)	GPIO_2 (Pin 2)	GPIO_3 (Pin 1)
PCM	PCM_DIN (Pin 66)	PCM_DOUT (Pin 65)	PCM_CLK (Pin 67)

Signal Group	DCD	DTR	DSR
SPI	SPI_CS_N (Pin 11)	SPI_CLK (Pin 12)	SPI_DATA_MOSI (Pin 13)

4.5.2. 4-Wire Serial Interface

The signals used in this interface are listed in Table 21 Serial Port High-Speed UART1 Interface.

Note: It is recommended to add resistors for isolation and test points in case debugging or direct firmware download to the module is required on each UART line.

It's also recommended to disable the DTR feature when using a 4-wire serial interface.

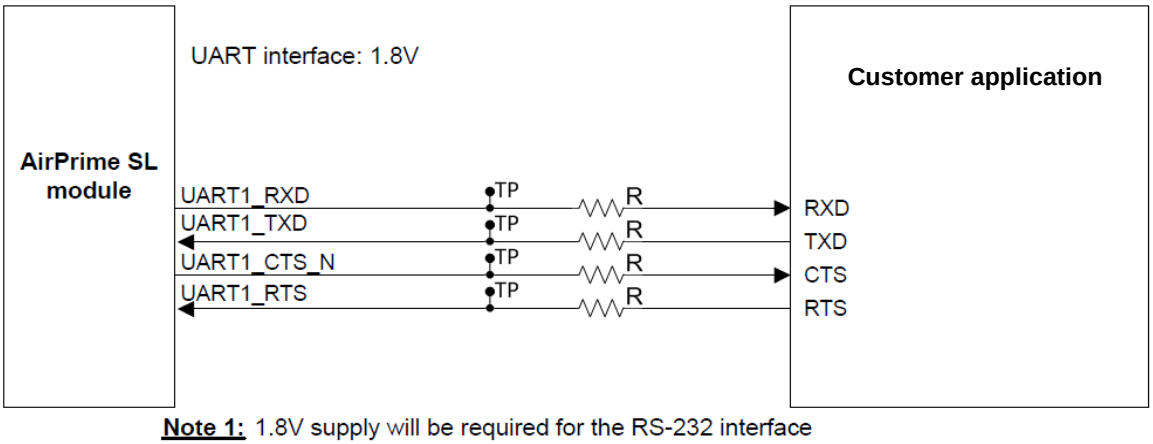


Figure 17. Example of a 4-wire UART Application

4.5.3. 8-Wire Serial Interface

The signals used in this interface are listed in Table 21 Serial Port High-Speed UART1 Interface and Table 22 Duplexed (Reconfigured) UART Interface Signal Groups.

The interface uses dedicated signals from the 4-wire interface, and the DCD, DTR, and DSR signals from the reconfigured GPIO, PCM, or SPI pins. The RI is provided by the WAKE_N signal.

Note: It is recommended to add resistors for isolation and test points in case debugging or direct firmware download to the module is required on each UART line.

8-wire serial interface is supported starting from Firmware 2.53.

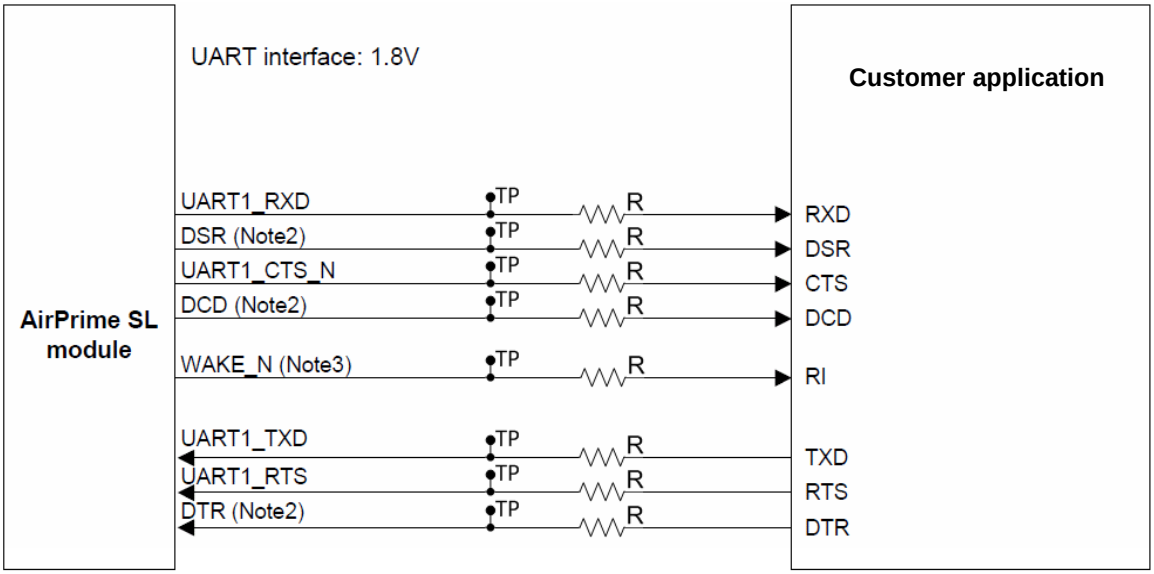


Figure 18. Example of an 8-wire UART Application

4.5.4. Configure the UART Interface

For the list of AT commands needed to configure the UART, refer to sections 6 Global Configuration Commands and 8 Serial Port Commands of document [2] AT Commands Interface Guide for Firmware 7.52/7.53.

4.6. USIM Interface

The AirPrime SL808xT, SL808xBT and SL808xBTA module includes a 4-wire USIM interface that allows a SIM to be directly connected. The following table describes the purpose and features of this interface.

Table 23. USIM Interface Features

Feature	Details
Purpose	• Communicate with USIM socket on host device • Supports regular SIMs
Implementation	• Four-wire interface • Voltage levels comply with 3GPP standards
Power	• 1.8 V or 3.0 V operation. Compliant with GSM 11.11 recommendations concerning SIM functions. • Host must keep current draw ≤ 10mA

4.6.1. USIM Pin Description

The following table describes the USIM interface pins.

Table 24. USIM Interface Signals

Pin #	Signal Name	I/O Type*	Description	Notes
6	EXT_VREG_USIM	O	USIM power supply	1.8 V or 3 V Maximum allowed current draw = 10 mA.
7	EXT_USIM_RESET	O	USIM reset signal	
8	EXT_USIM_DATA	I/O	USIM data	A shunt capacitor may be needed. (PCB provision for capacitor is recommended) Signal rise/fall times must be < 1 µs.
9	EXT_USIM_CLK	O	USIM clock	Typically 4 MHz at EXT_VREG_USIM level. Host should minimize rise time (<50 ns) by adjusting trace capacitance and filtering needs as required

* See Table 13 Pin Type Codes for type description.

See Table 10 SL808xT, SL808xBT and SL808xBTA LGA Pad Pin Assignments for additional pin-specific details.

4.6.2. Application Notes

4.6.2.1. USIM Reference Schematic

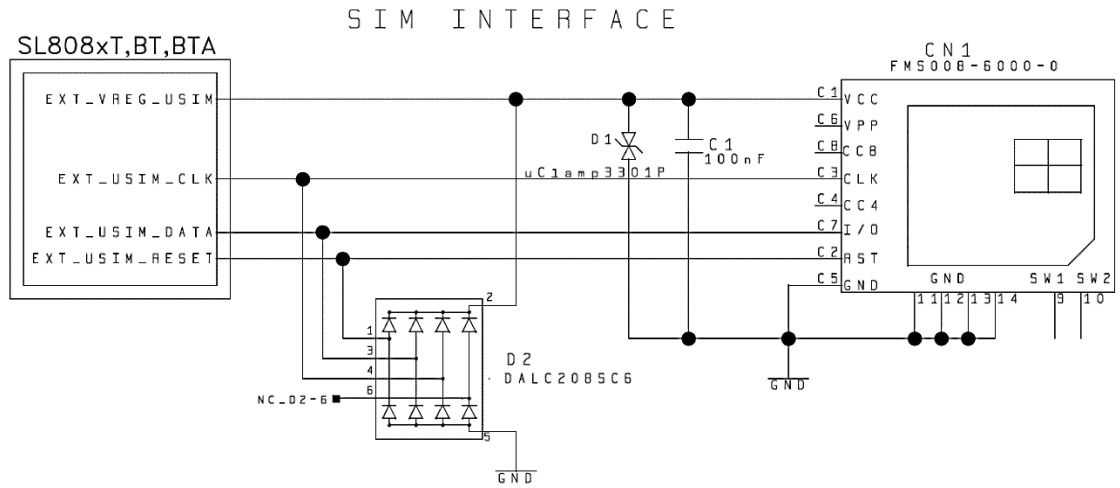


Figure 19. Example of SIM Application

Note that C1, D1 and D2 have to be placed close to CN1.

4.6.2.2. USIM Socket Pin Description

The following table describes the required USIM socket pins.

Table 25. USIM Socket Pin Description

Pin	Signal	Description
1	VCC	EXT_VREG_USIM
2	RST	EXT_USIM_RESET
3	CLK	EXT_USIM_CLK
4	-	-
5	GND	GROUND
6	-	-
7	I/O	EXT_USIM_DATA
8	-	-

4.7. USB 2.0 Device Interface

The AirPrime SL808xT, SL808xBT and SL808xBTA module features a USB 2.0 interface for data transfer, modem control, and diagnostic information. Note that if the customer application doesn't use this interface, USB signals USB_D+ and USB_D- must remain accessible (via test points).

Table 26. USB 2.0 Interface Features

Feature	Details
Standards compliance	Universal Serial Bus Specification, Rev 2.0 (full compliance is only on BTA variants with a USB_VBUS pin)
Performance	• Optimized for high speed (480 Mbps) Throughput rates may vary significantly based on packet size, host interface, and firmware revision. • Support for Full speed (12 Mbps) Throughput performance is on an "as-is" basis and must be characterized by the OEM.
Additional features	• Firmware download over USB

Note: USB_VBUS should never be powered on when VBATT is tied to GND.

4.7.1. USB Pin Description

The following table describes the USB interface pins.

Table 27. USB Interface Pins

Pin Number	Signal Name	Description	Notes
49	USB_VBUS	USB VBUS	• ESD suppressor with shunt capacitance is recommended. • This pin is only available on the SL808xBTA; not connected on the SL808xT and SL808xBT.

Pin Number	Signal Name	Description	Notes
50	USB_D+	HS-USB data +	• Protected against ±500V Human Body Model ESD. • ESD suppressor with shunt capacitance <1 pF is recommended. • Host must ensure D+ and D- traces are well matched and of differential impedance of 90 Ω. All high-speed differential routing techniques should be applied. • Allocate room to accommodate a common mode choke filter (90 Ω impedance) between the module and destination. • Refer to section 8 Design Guidelines for PCB layout recommendations.
51	USB_D-	HS-USB data -	

See Table 10 SL808xT, SL808xBT and SL808xBTA LGA Pad Pin Assignments for additional pin-specific details.

4.7.2. Electrical Characteristics

The following table describes the USB interface's electrical characteristics.

Table 28. USB Interface Electrical Characteristics

Parameter	Description	Minimum	Maximum	Unit
USB_VBUS	Current		1	mA
USB_VBUS	Voltage	2	5.25	V
USB_D+ USB_D-	High speed	360	440	mV
	Full speed	2.8	3.6	V

4.7.3. Reference Schematics

Note that to enter Sleep Mode, the USB cable has to be disconnected; and that ESD has to be placed close to CN1.

Pin 49 USB_VBUS is only available on the SL808xBTA, and not connected on the SL808xT and SL808xBT.

4.7.3.1. For SL808xT and SL808xBT

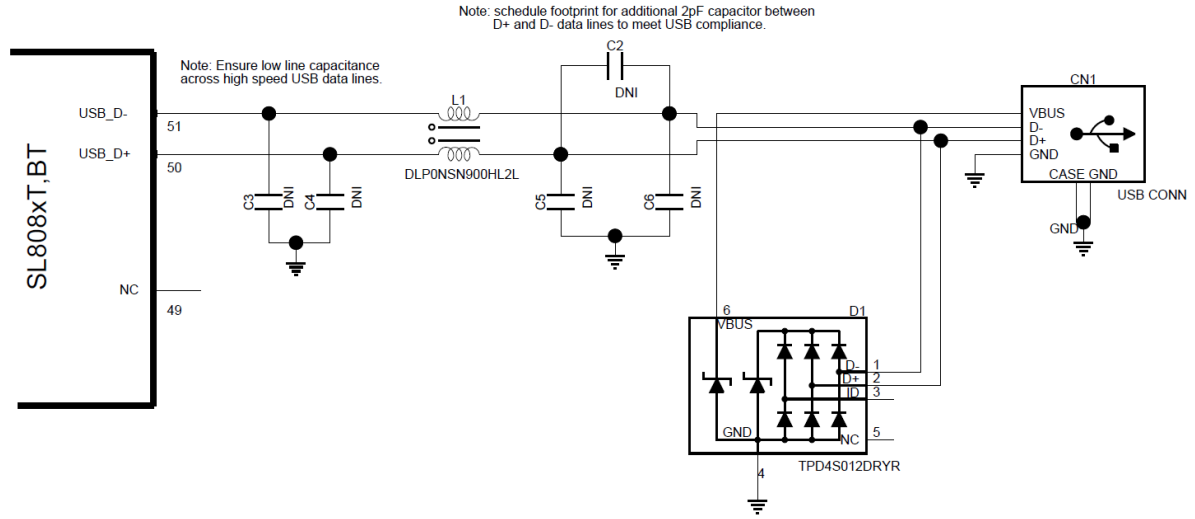


Figure 20. Example of an SL808xT and SL808xBT USB Application

4.7.3.1. For SL808xBTA

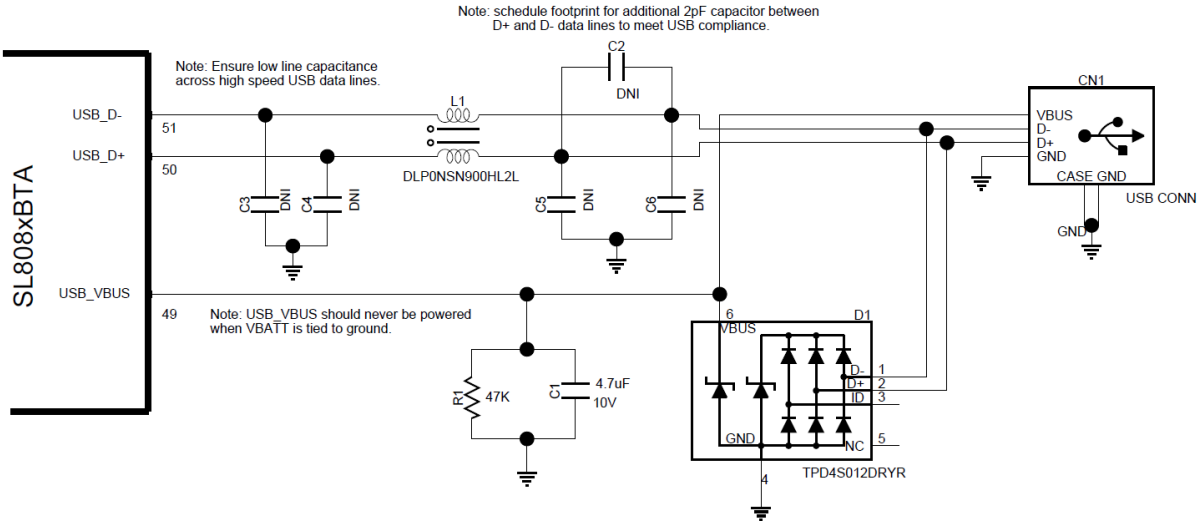


Figure 21. Example of an SL808xBTA USB Application

To enter Sleep Mode, the host has to send the USB SUSPEND command. In case the host is not USB2.0 compliant, the following figure provides a workaround.

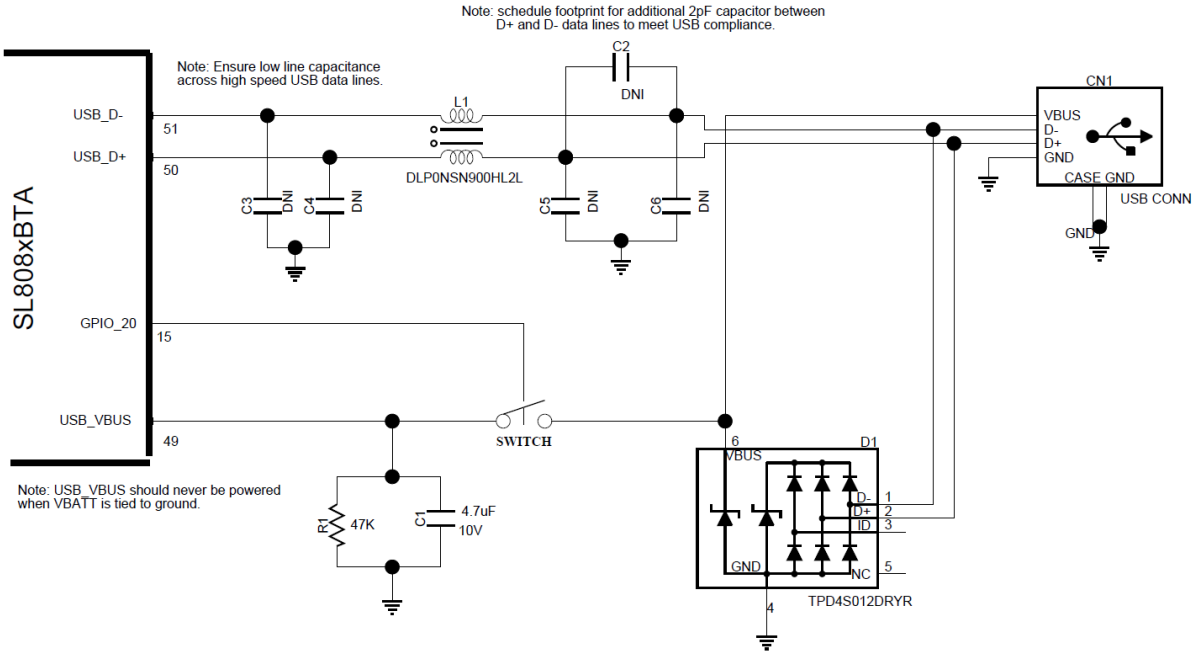


Figure 22. Example of an SL808xBTA USB Application with a VBUS Switch

4.7.3.2. Host Driver Requirements

The host driver must support USB host in order to interface with the module.

The host driver may optionally support Low Power Mode – where the USB suspends, resumes, and remote wakeup as described in document [10] Universal Serial Bus Specification, Rev 2.0.

Depending on module USB configuration, the host may support following USB classes:

- CDC-ACM
- OBEX
- CDC-EEM

4.8. ADC Interface

One Analog to Digital Converter input, ADC1, is provided by the AirPrime SL808xT, SL808xBT and SL808xBTA embedded module (from 2.53 FW). This converter is 12-bit resolution (10-bit accuracy) ADCs ranging from 0V to 2.0V.

The ADC1 input can be used for customer specific applications.

4.8.1. Pin Description

Refer to the following table for the pin description of the ADC.

Table 29. ADC Pin Description

Pin Number	Signal	I/O	I/O Type	Description
5	ADC1	I	Analog	A/D converter

4.8.2. Electrical Characteristics

Refer to the following table for the electrical characteristics of the ADC.

Table 30. Electrical Characteristics of the ADC

Parameter	Minimum	Typical	Maximum	Unit
Sampling Clock	---	2.4	---	MHz
Sampling Time	---	9.6	19.2	µs
Input signal range	0		2.0	V
INL (Integral non linearity)	-8	---	8	LSB
DNL (Differential non linearity)	-4	---	4	LSB
Offset error	-4	---	40	LSB
Input impedance	---	2K	5K	Ω
Input capacitor	---	53	72	pF

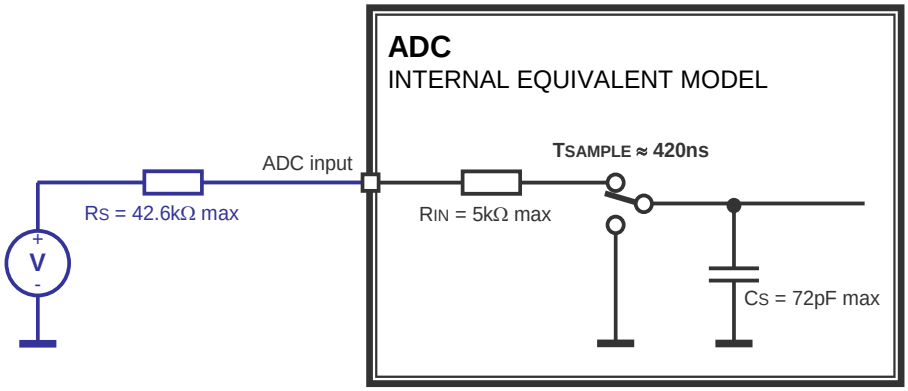


Figure 23. ADC1 Input Schematic

4.8.3. ADC Measurements Using AT Command

The AT command **AT+ADC** may be used to retrieve measures of the various ADCs available on the embedded module. The following table enumerates the ADC IDs linked to the AT command and the corresponding signal or interface that they measure.

Table 31. ADC ID Mapping

ADCIdx	Signal or Interface Being Measured
ADC1	External ADC interface

For more information about the **ADC** AT command, refer to document [2] AT Commands Interface Guide for Firmware 7.52/7.53.

4.9. I²C Bus

Note: This feature is only available with the Open AT Application Framework 2.53.

The I²C interface includes a clock signal (SCL) and data signal (SDA) complying with a 100kbit/s-standard interface (standard mode: s-mode). The maximum speed transfer range is 400kbit/s (fast mode: f-mode).

The I²C bus is always in master mode operation.

If the I²C interface is not used, these pins may also be reconfigured as GPIO pins with the Open AT Application Framework.

4.9.1. I²C Pin Description

Refer to the following table for the pin description of the I²C interface.

Table 32. I²C Pin Description

Pin Number	Signal Name	I/O	Voltage	Description	Multiplex
16	SDA	I/O	1V8	Serial Data	GPIO_12
17	SCL	O	1V8	Serial Clock	GPIO_13

See Table 14 Reset State Definition for state definitions and section 4.2 Electrical Information for 2V8, 1V8, open drain voltage characteristics and reset state definition.

4.9.2. I²C Application

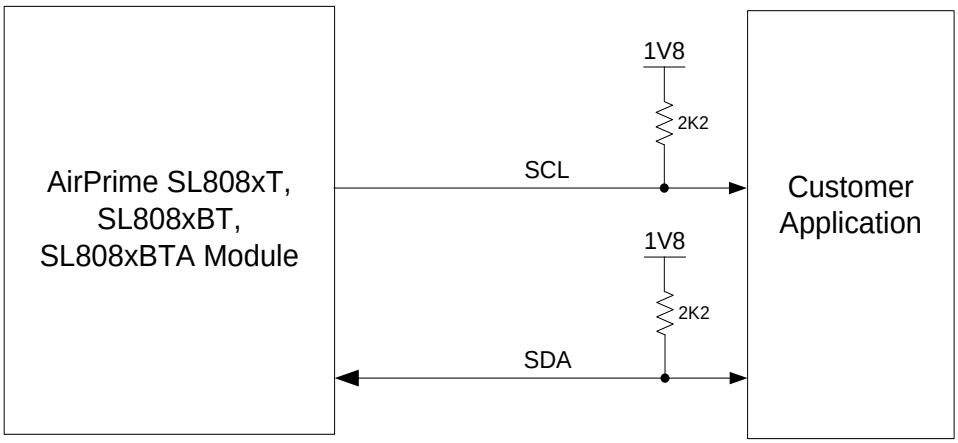


Figure 24. Example of I2C Bus Application

4.10. RF Interface

The AirPrime SL808xT, SL808xBT and SL808xBTA module's RF (radio frequency) interface uses two antenna ports for Tx/Rx and GPS. The following table describes the purpose and features of this interface.

Table 33. RF Interface Features

Feature	Details
Purpose	• Primary antenna – Rx/Tx • GPS antenna – GPS functionality
Impedance	• Nominal: 50 Ω • DC: High Impedance

4.10.1. RF Connections

To protect the antenna lines from baseband signal noise:

- Connection from each antenna port (RF) to the antenna should use a coax cable or a good microstrip/strip line.
- RF trace should be 50 Ω to avoid mismatch and load pull effects.
- RF connection must be isolated from other high voltage and noisy signals to ensure a good Rx sensitivity level.
- RF traces on the host PCB could have high attenuation, so should be kept as short as possible.

For more information, see Figure 50 RF Routing Examples.

4.10.2. RF Pin Description

The following table describes the RF interface pins.

Table 34. RF Interface Pins

Pin	Signal	Description	Notes
Rx/Tx Antenna			
28	Ground		
29	ANT_PRM	Main (primary) antenna	ESD protected – See document [4] Sierra Wireless Reliability Specification.
30	Ground		
GPS Antenna			
35	Ground		
36	ANT_GPS	GPS antenna	
37	Ground		

4.10.3. RF Performance

The module's radio transceiver meets the requirements of 3GPP Release 5.

The following parameters describe supported GSM, WCDMA, and GPS bands, conducted Tx power, and conducted Rx sensitivity.

Circuit switched Reference Sensitivity (2.44% BER, ambient temperature)

- GSM850 = -107.5 dBm
- E-GSM900 = -108 dBm
- DCS1800 = -108.5 dBm
- PCS1900 = -108 dBm

WCDMA Reference Sensitivity (RMC DL 12.2 kbps; 0.1% BER)

- Band I (2100) = -109.5 dBm
- Band II (1900) = -107.5 dBm
- Band V (850) = -109.5 dBm
- Band VI (800) = -109.5 dBm
- Band VIII (900) = -110 dBm

Table 35. Band Support, Conducted Tx Power

Band	Frequencies (MHz)	SL8080T/ SL808BT/ SL8080BTA	SL8082T/ SL8082BT/ SL8082BTA	SL8084T/ SL8084BT/ SL8084BTA	Conducted Tx Power	
					Average (dBm)	Notes
GSM Bands						
GSM 850	Tx: 824–849 Rx: 869–894	✓	✓	✓	+33 ± 2	GMSK (Class 4)
					+27 ± 3	8PSK (Class E2)
EGSM 900	Tx: 880–915 Rx: 925–960	✓	✓	✓	+33 ± 2	GMSK (Class 4)
					+27 ± 3	8PSK (Class E2)
DCS 1800	Tx: 1710–1785 Rx: 1805–1880	✓	✓	✓	+30 ± 2	GMSK (Class 1)
					+26 ± 3	8PSK (Class E2)
PCS 1900	Tx: 1850–1910 Rx: 1930–1990	✓	✓	✓	+30 ± 2	GMSK (Class 1)
					+26 ± 3	8PSK (Class E2)
WCDMA Bands						
Band I WCDMA 2100	Tx: 1920–1980 Rx: 2110–2170		✓	✓	+24 +1/-3	(Class 3) Nominal conditions
Band II WCDMA 1900	Tx: 1850–1910 Rx: 1930–1990	✓				
Band V WCDMA 850	Tx: 824–849 Rx: 869–894	✓		✓		
Band VI WCDMA 800	Tx: 830–840 Rx: 875–885			✓		
Band VIII WCDMA 900	Tx: 880–915 Rx: 925–960		✓			

Band	Frequencies (MHz)	SL8080T/ SL808BT/ SL8080BTA	SL8082T/ SL8082BT/ SL8082BTA	SL8084T/ SL8084BT/ SL8084BTA	Conducted Tx Power	
					Average (dBm)	Notes
GPS						
GPS	1575.42	(Only available on the SL8080T, SL8082T and SL8084T) Noise Figure = 4.5dB				

Note: The GPS input is not designed to support high external gains provided by an additional external LNA. In case of active antenna usage, the power gain of the total external chain should be close to zero.

4.10.4. GPS Specifications

Note: Actual GPS functionality depends on the firmware version and module configuration.

The module provides the following GPS features.

4.10.4.1. Standalone GPS

- -145 dBm cold start sensitivity
- -153 dBm hot start sensitivity
- -157 dBm navigation sensitivity
- Cold start TTFF: < 39 seconds
- Hot start TTFF: < 2 seconds
- Reacquisition Time: < 2 seconds
- 2D position accuracy: < 8 m

Note: Time To First Fix and 2D position accuracy results in 95% of cases, with simulator and GPS RF signal at -130dBm. Values are provided in typical voltage and temperature conditions.

Optimum performance is reached when there is no active data or voice call.

4.10.4.2. gpsOneXTRA™

- Enables enhanced standalone GPS operation by downloading < 40 kB file from a server on the Internet
- Performance closer to UE-based operation than traditional standalone GPS operation
- Best if downloaded once every 1 – 2 days, but valid for up to 7 days with some accuracy degradation

4.10.4.3. NMEA

Refer to documents [8] Location Library for Open AT Framework AT Command Interface Guide and [9] Location Library for Open AT Framework Development Guide.

4.10.4.4. Software

The AirPrime SL808xT embed an integrated and high-sensitivity Global Navigation Satellite System (GNSS) solution and come with GNSS software, which offers a wide range of GNSS features, best performances and resources optimization in a fully integrated solution. GNSS features can be accessed easily through various interfaces which includes AT commands and Open AT Application Framework APIs (through Location Library).

4.10.5. Antenna Specifications

The antenna shall meet the requirements specified in the following table.

The optimum operating frequency depends on the application. A dual-band, triband or quad-band antenna should operate in these frequency bands and have the described characteristics.

Table 36. Main Antenna (ANT_PRM) Specification

Parameter	Min	Typ	Max	Units	Notes
Connection loss	-	-	0.5	dB	Maximum loss to antenna
Impedance	-	50	-	Ω	Antenna load impedance
VSWR	-	-	3:1		Maximum allowed VSWR of antenna

4.10.5.1. Application Notes

The following are suggested guidelines for the two antenna ports:

- The antenna should be isolated as much as possible from analog and digital circuitry (including interface signals).
- On applications with an embedded antenna, poor shielding could dramatically affect the receiving sensitivity. Moreover, the power radiated by the antenna could affect the application (TDMA noise, for instance).
- As a general recommendation, all components or chips operated at high frequencies (microprocessors, memories, DC/DC converter) or other active RF parts should not be placed too close to the AirPrime SL808xT, SL808xBT and SL808xBTA module. In the event that this happens, the correct power supply layout and shielding should be designed and validated.
- Components near RF connections or unshielded feed lines must be prohibited.
- RF lines must be kept as short as possible to minimize loss.
- Primary path common for Tx and Rx should be routed on the host PCB using a 240 micron wide trace with (to withstand high power up to 2W RF) 50 Ω as impedance up to the antenna connector or launch point.

Note: If the impedance of the module is mismatched, RF performance is reduced significantly.

- Should be protected for ESD using a 8 kV-rated suppressor to avoid damage during antenna assembly, etc. (semiconductors are forbidden on the ANT_PRM antenna). Capacitance should be < 0.2 pF.
- RF trace and cable connecting the pin to the antenna should be of low loss (<0.3 dB)
- Antenna connected on the ANT_PRM port should offer 3:1 or better VSWR in order to maintain RF performances.
- Antenna connected on the ANT_GPS port should offer 3:1 or better VSWR in order to maintain radiated sensitivity.

- Antenna location may affect RF performance. Although the module is shielded to prevent interference in most applications, the placement of the antenna is still very important—if the host device is insufficiently shielded, high levels of broadband or spurious noise can degrade the module's performance.
- Antenna cables should be routed, if possible, away from noise sources (switching power supplies, LCD assemblies, etc.). If the cables are near the noise sources, the noise may be coupled into the RF cable and into the antenna.

4.11. Audio Interfaces

The AirPrime SL808xT, SL808xBT and SL808xBTA module supports two audio interfaces (analog and PCM digital) and allows dynamic run-time selection of the appropriate interface:

- Analog Audio Interface
- Digital Audio Interface (PCM)

4.11.1. Analog Audio Interface

The AirPrime SL808xT, SL808xBT and SL808xBTA module analog audio interface supports one microphone input and one speaker output.

Table 37 Analog Audio Interface Features describes the purpose and features of this interface.

Table 37. Analog Audio Interface Features

Feature	Details
Implementation	• Supports analog audio processing • Does not provide on-board filtering (except for 0.1 µF blocking capacitors on microphone lines) • Host must provide bias and signal filters • Host should float the SPK_N, SPK_P, MIC1_P and MIC1_N lines if not used. If the customer uses single-end mode, then the audio lines should be connected as shown in Figure 26, 0, or Figure 29. • ESD protection may be required on audio interface lines
Features	• Echo cancellation and noise reduction • TTY/TDD compatibility through the microphone/speaker connections (Note: TTY/TDD is not supported by the PCM interface.) • On-board FIR/IIR (Finite and Infinite Impulse Response) digital filtering (also through AT) • AGC (Automatic Gain Control) • AVC (Automatic Volume Control) • RVE (Received Voice Enhancement) processing block control via AT command

4.11.1.1. Pin Description

The following table describes the analog audio interface pins.

Table 38. Analog Audio Interface Connections

Pin Number	Signal Name	Description	Notes
53	MIC1_P	Line audio input	Differential audio input, line level. In series with 0.1µF DC blocking capacitor.
54	MIC1_N	Line audio input	Differential audio input, line level. In series with 0.1µF DC blocking capacitor.
56	SPK_N	Main speaker	Differential audio output, line level
57	SPK_P	Main speaker	Differential audio output, line level

See Table 10 SL808xT, SL808xBT and SL808xBTA LGA Pad Pin Assignments for additional pin-specific details.

4.11.1.2. Microphone Features

The microphone can be connected in either differential or single-ended mode:

- Differential mode – Default method (recommended). Rejects common mode noise and TDMA noise.
- Single-ended mode – Requires good ground plane, filtering and shielding to avoid audio path disturbances. Note that the audio input signal is decreased by 6 dB compared to differential mode.

The gain of both MIC inputs are internally adjusted and can be tuned using AT commands. For more information on AT commands, refer to document [2] AT Commands Interface Guide for Firmware 7.52/7.53.

4.11.1.3. MIC Microphone Input

The microphone input has the following features:

- Default mode – Differential. (But can also be configured in single-ended mode.)
- Has embedded AC coupling.
- For electrical characteristics, see the following table.

Table 39. MIC Input Electrical Characteristics

Parameter	Condition	Minimum	Typical	Maximum	Unit
Mic bias voltage*			1.8		V
Full-scale input voltage (across MIC1_P and MIC1_N)	VGT=1	0.51	0.57	0.64	Vrms
		1.44	1.61	1.81	Vpp
Gain error (absolute)		-1	0.2	1	dB

Parameter	Condition	Minimum	Typical	Maximum	Unit
Output referred noise	VGT≤ 11		-88.92	-88.91	dBFS
	VGT≥ 12		-83.92	-83.92	
Input impedance	Differential mode	16	20	24	kΩ
	Single-ended mode	8	10	12	kΩ
THD+N ratio	VGT≤ 11 Input frequency=1.02 kHz Output=-1dBFS	40	90.84		dB
	VGT≥ 12 Input frequency=1.02 kHz Output=-1dBFS	40	82.43		dB
Input capacitance	At each pin			5	pF
Input offset voltage		-5		5	mV

* Host must provide 1.8 V supply to bias the MIC lines. Voltage accuracy should be ±3%.

Caution: *The voltage input value for MIC cannot exceed the maximum working voltage; otherwise, clipping will appear.*

4.11.1.3.1. MIC Differential Connection Example

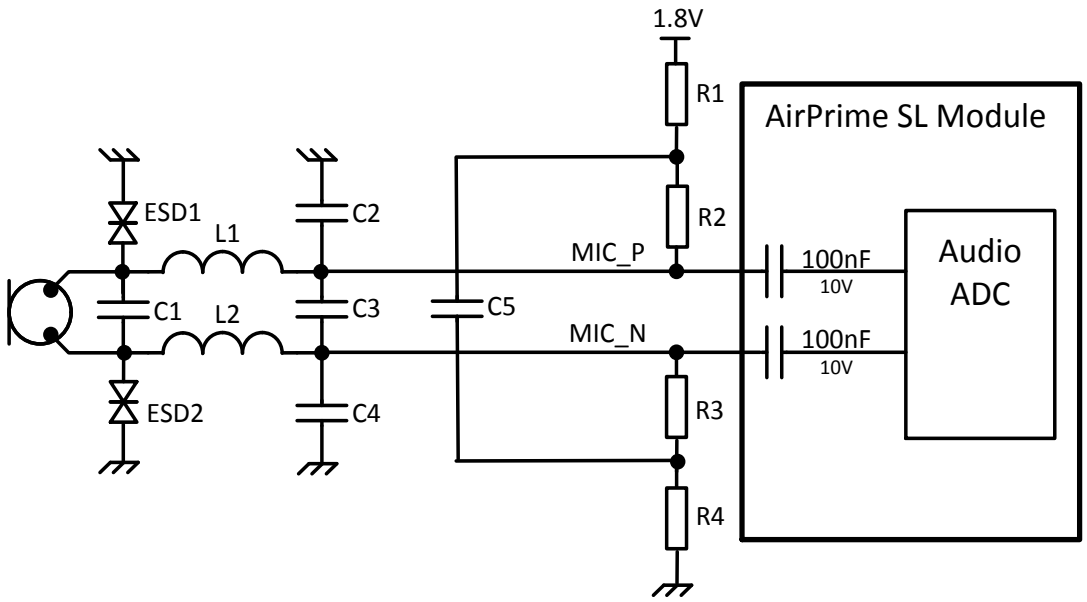


Figure 25. Example – MIC Differential Connection

The host must provide a power supply to bias the MIC lines (the example above is given with a 1.8V power supply but depend of the microphone choice).

LC filter (L1, L2, C2, C3, C4) considerations:

- Filter is not mandatory. Audio quality may be good enough without it, depending on the design.
- Filter may be used to reduce TDMA noise (from EMI perturbation).

Capacitor C1 is highly recommended to eliminate TDMA noise and it must be connected close to the microphone.

The following table lists the recommended components to use in creating the LC filter.

Table 40. Recommended Components for a MIC Differential Connection

Component	Value	Notes
C1	12–33 pF	Must be tuned depending on the design
C2, C3, C4*	47 pF	Must be tuned depending on the design
L1, L2*	100 nH	Must be tuned depending on the design
C5	2.2µF	
R1,R2,R3,R4	1kΩ	
ESD1, ESD2	TPD1E6B06DPL	

* Filtering components are not mandatory.

4.11.1.3.2. MIC Single-Ended Connection Example

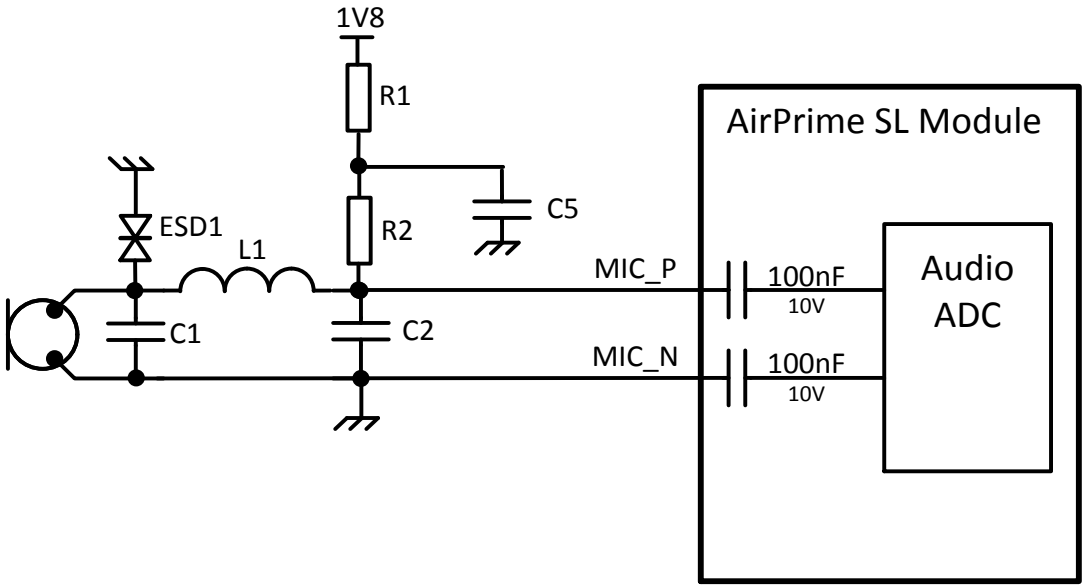


Figure 26. Example – MIC Single-Ended Connection with LC Filter

Single-ended connection considerations:

- Not recommended for improving TDMA noise rejection as it is usually difficult to eliminate TDMA noise from a single-ended design.
- LC filter (L1 and C2) is recommended (but not mandatory) to eliminate TDMA noise.

Capacitor C1 is highly recommended to eliminate TDMA noise and it must be connected close to the microphone.

The following table lists the recommended components to use in creating the LC filter.

Table 41. Recommended Components for a MIC Single-Ended Connection

Component	Value	Notes
C1	12–33 pF	Must be tuned depending on the design

Component	Value	Notes
C2*	47 pF	Must be tuned depending on the design
L1*	100 nH	Must be tuned depending on the design
C5	2.2µF	Must be tuned depending on the design
R1, R2	1K	
ESD1	TPD1E6B06DPL	

* Filtering components are not mandatory.

4.11.1.4. Speaker Features

The speaker can be connected in either differential or single-ended mode:

- Differential mode – Default method (recommended). Rejects common mode noise and TDMA noise.
- Single-ended mode – Requires good ground plane, filtering, and shielding to avoid audio path disturbances. Experiences power loss (power is divided by 4 in a single-ended connection) compared to differential connection.

The gain of each speaker output channel is internally adjusted and can be tuned using AT commands. For more information on AT commands, see document [2] AT Commands Interface Guide for Firmware 7.52/7.53.

Discreet components (for example, resistors and capacitors) are not needed for this interface.

The following table lists the typical values of both speaker outputs.

Table 42. Speaker Information

Parameter	Typical	Unit	Connection
Z (SPK_P, SPK_N)	32	Ω	Differential mode

4.11.1.4.1. Speakers Output Power

Because SPK can provide more power, it can be connected in differential mode. The maximal specifications given below are available with the maximum power output configuration values set by AT command, and the typical values are recommended.

Caution: *It is mandatory not to exceed the maximal speaker output power and the speaker load must be in accordance with the gain selection (gain is controlled by AT command). Exceeding beyond the specified maximal output power may damage the AirPrime SL808xT, SL808xBT and SL808xBTA module.*

If an amplifier is added, add a GPIO control for the amplifier power ON/OFF.

4.11.1.4.2. SPK Speaker Output

SPK can have either a single-ended or a differential connection.

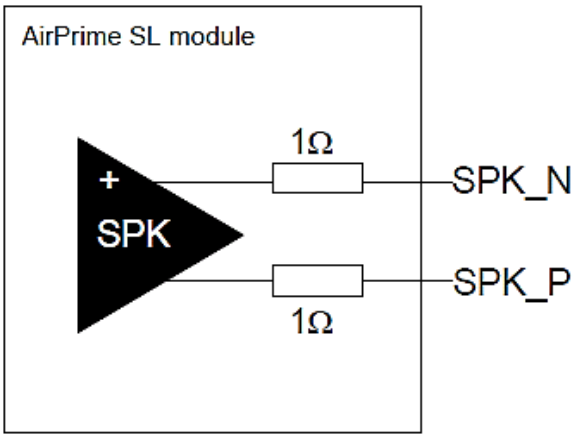


Figure 27. SPK Equivalent Circuit

The following table describes the speaker's electrical characteristics.

Table 43. SPK (Receive) Path Characteristics

Parameter	Condition	Minimum	Typical	Maximum	Unit
DAC to SPK_P/SPK_N full-scale output	f=1.02 kHz, 0 dBFS input	1.127	1.265	1.419	Vrms_diff
Load impedance		25.6	32		Ω
Gain error (absolute)	f=1.02 kHz, -13 dBFS input	-1		1	dB
SPK_P/SPK_N output power, 4% or less THD+N	f=1.02 kHz, 0 dBFS	39.7	50	63	mW
DAC to SPK_P/SPK_N gain error relative to gain at -13 dBFS input level	f=1.02 kHz, -60 dBFS	-1.2		1.2	dB
DAC to SPK_P/SPK_N output noise level	Input=-999 dBFS Fs*=8 kHz or 16 kHz; A-weighted			51	µVrms
DAC to SPK_P/SPK_N signal-to-noise ratio	Ratio of full-scale output to output noise level	86.8			dB
DAC to SPK_P/SPK_N power-supply rejection	0<f<20 kHz	65			dB
DAC + SPK_P/SPK_N Supply current	Rx DAC left enabled; Rx DAC right disabled; SPK_P/SPK_N enabled; input=-999 dBFS; Fs*=8 kHz			7	mA
DAC + SPK_P/SPK_N Supply current	Rx DAC left enabled; Rx DAC right disabled; SPK_P/SPK_N enabled; input=-999 dBFS; Fs*=16 kHz			8	mA

Parameter	Condition	Minimum	Typical	Maximum	Unit
SPK	Output impedance without load		1		Ω
SPK DC level	Output		1	1.35	V

* Fs is the sampling frequency

If a single-ended connection is used, only one of either SPK outputs has to be chosen. The result is a maximal output power divided by 4.

4.11.1.4.3. Differential Connection Example

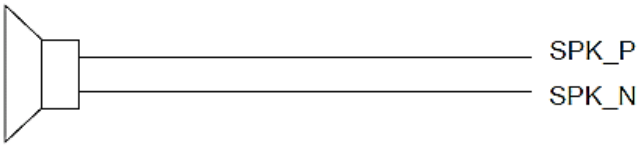


Figure 28. Example – SPK Differential Connection

The impedance of the speaker amplifier output in differential mode is R ≤ 1 Ω ± 10%.

Note that the connection between the speaker and the AirPrime SL808xT, SL808xBT and SL808xBTA module pins must be designed to keep the serial impedance lower than 3 Ω when it is connected in differential mode.

4.11.1.4.4. Single-Ended Connection Example

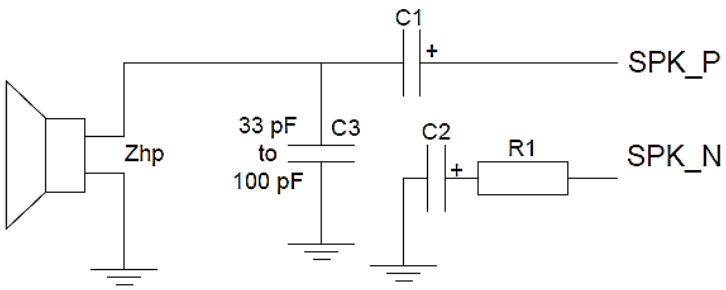


Figure 29. Example – SPK Single-Ended Connection

Take note of the following when connecting the speaker in single-ended mode:

- 6.8 µF < C1 < 47 µF (depending on the characteristics of the speaker and the output power)
- C1 = C2
- R1 = Zhp

Again, note that using a single-ended connection includes losing power (-6dB) as compared to a differential connection.

In the case of a 32 Ω speaker, a cheaper and smaller solution can be implemented where R1 = 82 Ω and C2 = 6.8 µF (ceramic).

Also note that the connection between the speaker and the AirPrime SL808xT, SL808xBT and SL808xBTA module pins must be designed to keep the serial impedance lower than 1.5 Ω when it is connected in single-ended mode.

4.11.1.5. Supported Voice Features

The AirPrime SL808xT, SL808xBT and SL808xBTA module modem supports the voice-related features listed in the following table; and Table 45 Supported Supplementary Services details its support for supplementary services.

Table 44. Supported Voice Features

Item	Comments
USSD (Unstructured Supplementary Services Data)	This is a GSM-specific capability that supports transmitting information over GSM network signaling channels.
Voice encryption	Both A5/1 and A5/2 voice encryption are supported.
SIM Application Tool Kit with proactive SIM commands (compliant to R96)	3GPP TS 11.14 SIM Application Toolkit commands are stored on the SIM. These commands enable the SIM card to proactively drive the GSM host device and support interactions between the network and the end user.
User-configurable audio prompts	Several audio features, such as 'Incoming Call' and 'New SMS message', can be configured in Watcher.
Multi-party calling	Up to 5 remote parties are supported on a single call, plus an additional party on hold (on a separate call).

Table 45. Supported Supplementary Services

Service	CnS	GSM Service Code	AT Command
Calling Line Identification Presentation (Caller ID)	Yes	Yes	Yes
Calling Line Identification Restriction (hides your ID on outgoing calls)	Yes	Yes	Yes
Call Waiting	Yes	Yes	Yes
Call Hold	Yes	Yes	Yes
Multi-party service	Yes	Yes	Yes
Call Forwarding			
Unconditional	Yes	Yes	Yes
on Mobile Subscriber Busy	Yes	Yes	Yes
on No Reply	Yes	Yes	Yes
on Mobile Subscriber Not Reachable	Yes	Yes	Yes
Call Barring			
All outgoing calls	Yes	Yes	Yes
Outgoing international calls	Yes	Yes	Yes
Outgoing international calls (except those directed to the home PLMN country)	Yes	Yes	Yes
All incoming calls	Yes	Yes	Yes
Incoming calls when roaming outside the home PLMN country	Yes	Yes	Yes

4.11.2. Digital Audio Interface (PCM)

The SL808xT, SL808xBT and SL808xBTA module's PCM audio interface features the following characteristics:

- Runs in master mode
- Supports Linear (13-bit), A-Law (8-bit), and µ-Law (8-bit) companding algorithms
- Supports 2.048 MHz short frame sync (PCM) and 128 kHz long frame sync (AUX_PCM) operation

Note: The PCM interface is not AC97-compliant.

Table 46. PCM Digital Audio Interface Connections

Pin Number	Signal Name	Type*	Description	Notes
64	PCM_SYNC	PD	PCM sync	8 KHz pulse that synchronizes frame data in/out.
65	PCM_DOUT	O	PCM output	Frame 'data out' relies on selected configuration mode.
66	PCM_DIN	PD	PCM input	Frame 'data in' relies on selected configuration mode.
67	PCM_CLK	O	PCM clock	2 MHz for primary PCM mode. Controls data transfer with the audio peripheral.

* See Table 13 Pin Type Codes for type description.

See Table 10 SL808xT, SL808xBT and SL808xBTA LGA Pad Pin Assignments for additional pin-specific details.

4.11.2.1. PCM Interface (Short Frame Sync, 2.048 MHz)

The following figures and Table 47 describe the short frame sync (2.048 MHz) PCM interface.

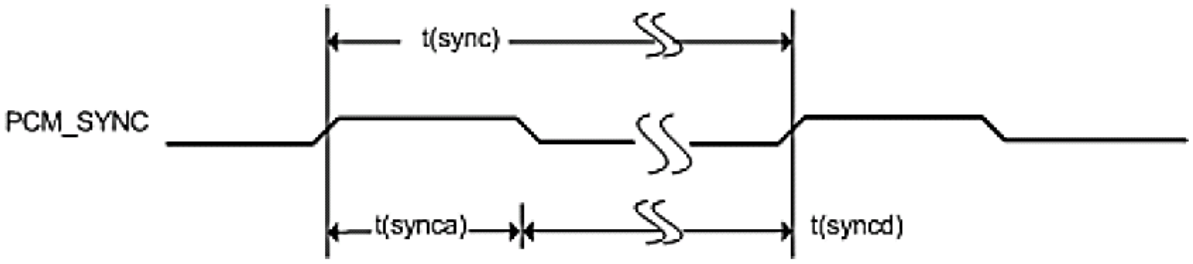


Figure 30. Timing Diagram – Short Frame Sync (PCM_SYNC)

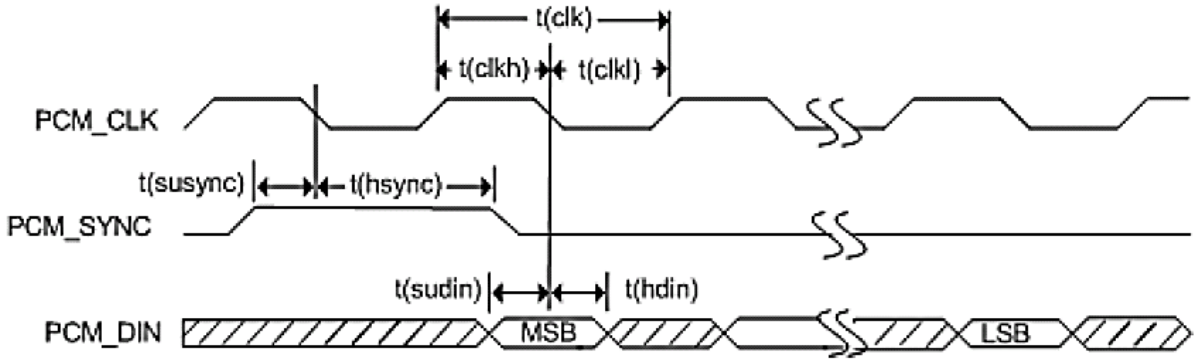


Figure 31. Timing Diagram – PCM_CODEC to SL808xT, SL808xBT and SL808xBTA

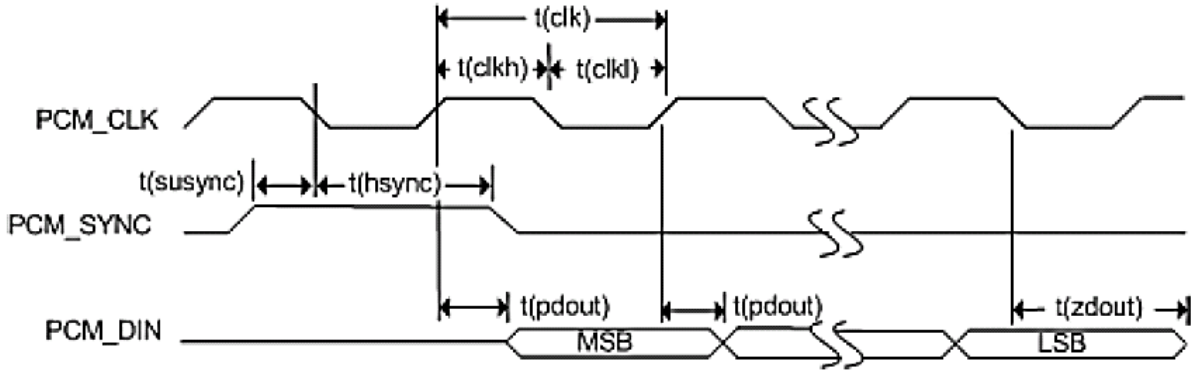


Figure 32. Timing Diagram – SL808xT, SL808xBT and SL808xBTA to External PCM_CODEC

Table 47. PCM_CODEC Short Frame Sync (2.048 MHz) Timing Parameters

Parameter	Condition	Minimum	Typical	Maximum	Unit
t(sync)	PCM_SYNC cycle time (PCM_SYNC_DIR=1)		125		µs
t(synca)	PCM_SYNC asserted time (PCM_SYNC_DIR=1)	400	500		ns
t(syncd)	PCM_SYNC de-asserted time (PCM_SYNC_DIR=1)		124.5		µs
t(clk)	PCM_CLK cycle time (PCM_CLK_DIR=1)		488		ns
t(clkh)	PCM_CLK high time (PCM_CLK_DIR=1)		244		ns
t(clkl)	PCM_CLK low time (PCM_CLK_DIR=1)		244		ns
t(susync)	PCM_SYNC setup time to PCM_CLK falling (PCM_SYNC_DIR = 1, PCM_CLK_DIR = 1)	60			ns
t(hsync)	PCM_SYNC hold time after PCM_CLK falling (PCM_SYNC_DIR = 1, PCM_CLK_DIR = 1)	60			ns
t(sudin)	PCM_DIN setup time to PCM_CLK falling	50			ns
t(hdin)	PCM_DIN hold time after PCM_CLK falling	10			ns
t(pdout)	Delay from PCM_CLK rising to PCM_DOUT valid			350	ns
t(zdout)	Delay from PCM_CLK falling to PCM_DOUT HIGH-Z		160		ns

4.11.2.2. Auxiliary PCM (Long Frame Sync, 128 kHz)

The following figures and Table 48 describe the long frame sync (128 kHz) PCM interface.

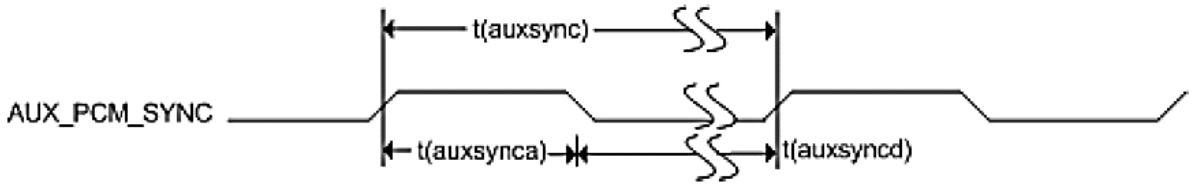


Figure 33. Timing Diagram – Long Frame Sync (AUX_PCM_SYNC)

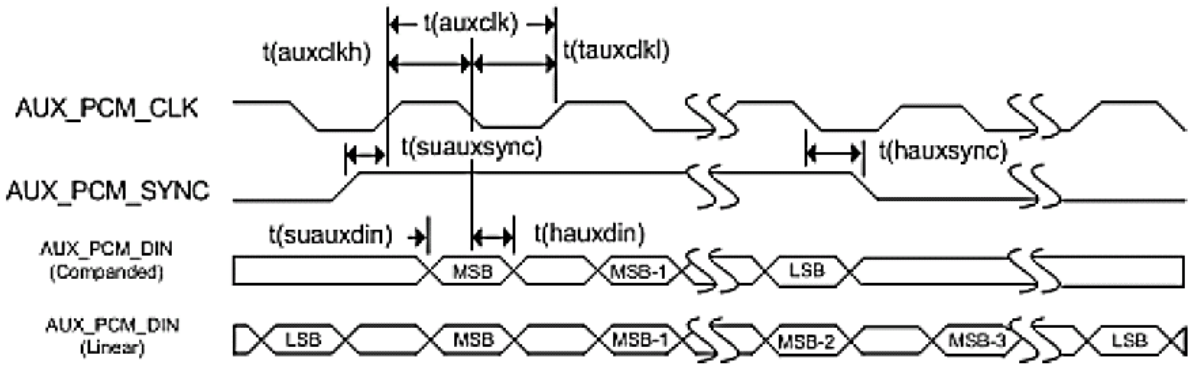


Figure 34. Timing Diagram – AUX_PCM_CODEC to SL808xT, SL808xBT and SL808xBTA

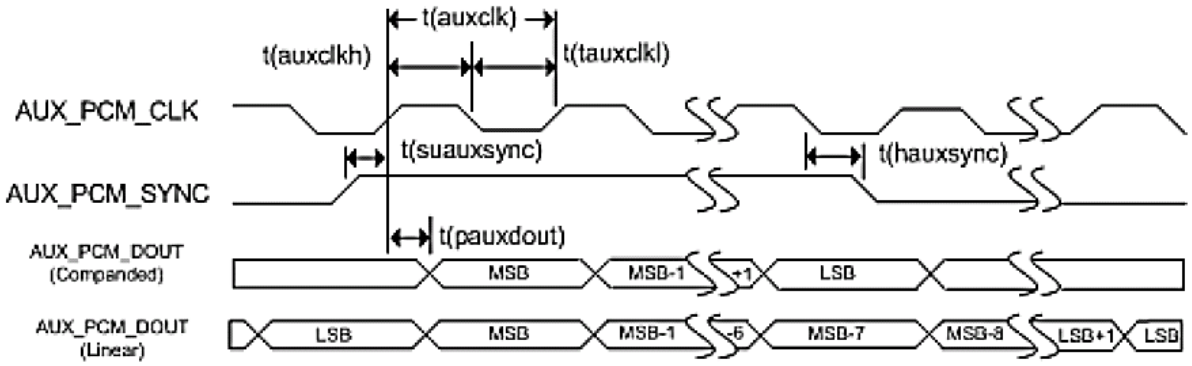


Figure 35. Timing Diagram – SL808xT, SL808xBT and SL808xBTA to AUX_PCM_CODEC

Table 48. AUX_PCM_CODEC Timing Parameters

Parameter	Condition	Minimum	Typical	Maximum	Unit
t(auxsync)	AUX_PCM_SYNC cycle time		125		µs
t(auxsynca)	AUX_PCM_SYNC asserted time	62.4	62.5		µs
t(auxsyncd)	AUX_PCM_SYNC de-asserted time	62.4	62.5		µs
t(auxclk)	AUX_PCM_CLK cycle time		7.8		µs
t(auxclkh)	AUX_PCM_CLK high time	3.8	3.9		µs
t(auxclkl)	AUX_PCM_CLK low time	3.8	3.9		µs
t(suauxsync)	AUX_PCM_SYNC setup time to AUX_PCM_CLK rising	1.95			µs
t(hauxsync)	AUX_PCM_SYNC hold time after AUX_PCM_CLK rising	1.95			µs

Parameter	Condition	Minimum	Typical	Maximum	Unit
t(suauxdin)	AUX_PCM_DIN setup time to AUX_PCM_CLK falling	70			ns
t(hauxdin)	AUX_PCM_DIN hold time after AUX_PCM_CLK falling	20			ns
t(pauxdout)	Propagation delay from AUX_PCM_CLK AUX_PCM_DOUT valid			50	ns

4.12. JTAG Interface

4.12.1. Description

The AirPrime SL808xT, SL808xBT and SL808xBTA module includes a JTAG interface.

JTAG access is strongly recommended to be provided to allow Sierra Wireless for debugging/testing and failure analysis.

If platform issues arise, contact Sierra Wireless for assistance.

4.12.2. Reference Schematic

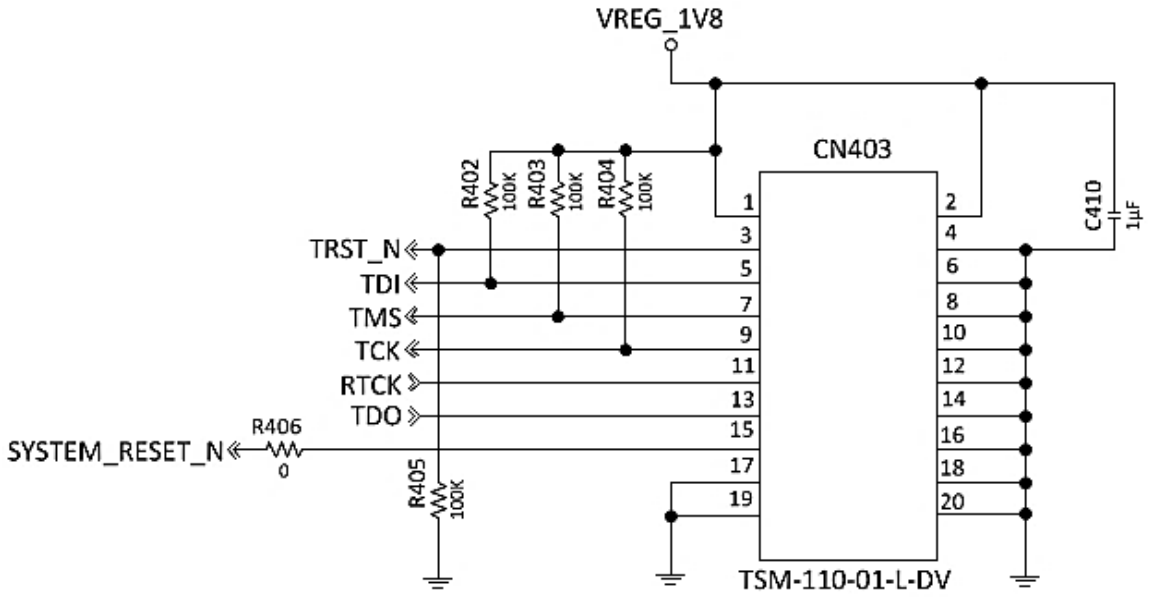


Figure 36. JTAG Connection

4.13. Short Message Service (SMS)

The following table summarizes the SL808xT, SL808xBT and SL808xBTA module's compliance with specific SMS features:

Table 49. SMS Features

Feature	Supported
Mobile-terminated SMS	✓
Mobile-originated SMS	✓
Point-to-Point messaging	✓
Cell Broadcast messaging	×

4.14. UMTS Radio Access Bearers Supported

The SL808xT, SL808xBT and SL808xBTA modem supports the majority of the radio access bearers specified in 3GPP TS 34.108. If you require a detailed list, contact Sierra Wireless.

5. Signals and Indicators

5.1. Overview

This chapter describes signals for control and handshaking of the AirPrime SL808xT, SL808xBT and SL808xBTA module from the host (Table 50 Available Signals), and describes how the system implements Smart Error Detection using those signals.

Table 50. Available Signals

Name	AT Command Support	Open AT Interface
Power ON/OFF (Signal POWER_ON_N)		
Reset Signal (SYSTEM_RESET_N)	✓	
Wake Signal (WAKE_N)	✓	
Disable Signal (W_DISABLE_N)	✓	
Buzzer Output (BUZZER_EN)	✓	
LED_FLASH	✓	
Power Rail (VREF_1V8)		
External Interrupt	✓	✓

5.2. Power ON/OFF (Signal POWER_ON_N)

The POWER_ON_N signal is an active-low input that controls the module's power state.

Table 51. POWER_ON_N Signal Features

Feature	Details
Purpose	Power modem on/off
Implementation	• Digital input with internal pull up. • 1.8 V logic • Active low • Signal driven only by open-drain output from the host.

5.2.1. Pin Description

The following table describes the POWER_ON_N signal pins.

See section 4.2 Electrical Information for 1V8 voltage characteristics.

Table 52. POWER_ON_N Signal Pin Description

Pin #	Signal Name	I/O	Internal Pull-up Resistor			I/O Type	Description
			Min	Typ	Max		
43	POWER_ON_N	I	200kΩ	250kΩ	300kΩ	CMOS	Module power-on

5.2.2. Electrical Characteristics

Caution: *All external signals must be inactive when the AirPrime SL808xT, SL808xBT and SL808xBTA module is OFF to avoid any damage when starting and to allow the module to start and stop correctly.*

Refer to Table 10 SL808xT, SL808xBT and SL808xBTA LGA Pad Pin Assignments for basic characteristics (type, voltage).

5.2.2.1. Signal Timing

Figure 37 and Table 53 describe the timing sequence for powering the device ON and OFF.

From Firmware 2.53, POWER_ON_N has two management modes (configurable using the **AT+WHCNF** command) that could be used to either:

- control the ON and OFF state (OFF mode is hardware-controlled),
- or as a trigger to initiate the power ON sequence (OFF mode is software-controlled).

Note: Firmware 2.52 only supports "OFF mode is hardware-controlled" mode.

For further information, refer to document [2] AT Commands Interface Guide for Firmware 7.52/7.53.

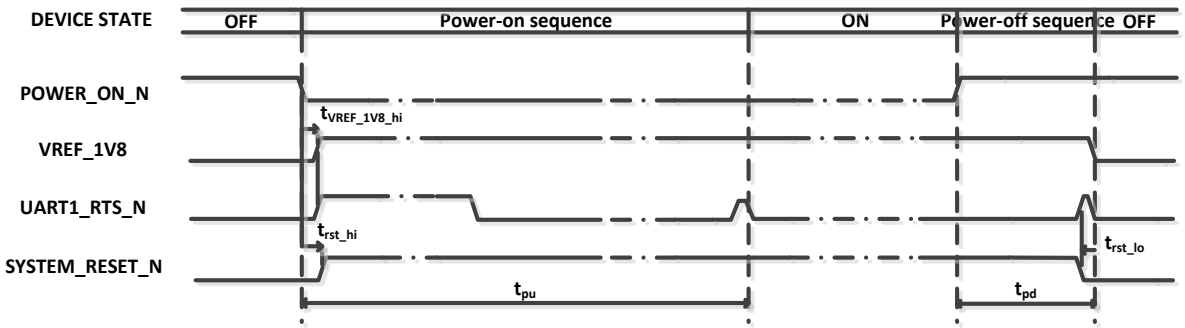


Figure 37. POWER_ON_N Configured with "OFF Mode is Hardware-Controlled" Mode

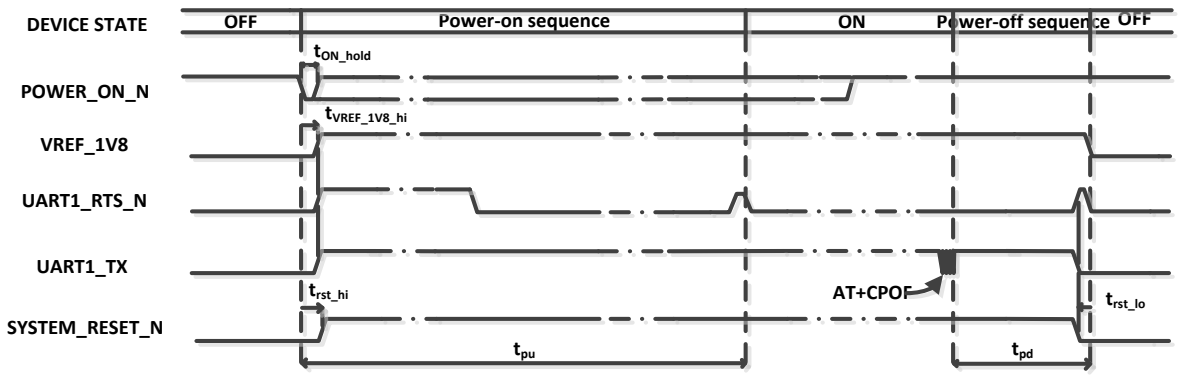


Figure 38. POWER_ON_N Configured with "OFF Mode is Software-Controlled" Mode

Table 53. POWER_ON_N Signal Timing Parameters

Parameter	Description	Period		
		Min	Typ	Max
t_pu	Power up – Time required to boot device and reach device ready state (UART AT command ready: Wind:3 notification).		10 s	30 s*
t_pd	Power down (hardware control) – Time required to power the device OFF after POWER_ON_N is deasserted (do not include variable deregistration time).	800 ms		1.1 s
	Power down (software control) – Time required to power the device OFF after switch OFF software command received (do not include variable deregistration time).	500 ms		600 ms
$t_{VREF\_1V8\_hi}$	Delay between POWER_ON_N falling edge and VREF_1V8 regulator enable. This time doesn't include VREF_1V8 rising edge that is dependent on load capacitor.		80 ms	
t_{ON_hold}	Minimum time required with POWER_ON_N low to switch ON the module.	300 ms		
t_{RST_hi}	Reset high – Time between POWER_ON_N assertion and internal SYSTEM_RESET_N deassertion.	-	100 ms	-
t_{RST_lo}	Reset low – Time between internal SYSTEM_RESET_N assertion and VREF_1V8 switch OFF.	-	13 ms	-
	Time required for SIM initialization (from POWER_ON_N low to Wind:4 notification on UART)		40 s**	3 m*
	Time required for module registration on the network (from POWER_ON_N low to CREG notification on UART)		15 s***	

* Maximum time depends on the file-system (full/empty) and flash object

** Phonebook and SIM card dependent

*** Network dependent

In case of "OFF Mode is Software-Controlled" mode, if POWER_ON_N is low when the switch OFF command is sent, the module is automatically restarted after 30ms of VREF_1V8 being switched OFF.

Caution: *VBATT should only be removed after VREF_1V8 has been set to low level.*

5.3. Reset Signal (SYSTEM_RESET_N)

The SYSTEM_RESET_N signal is a bi-directional line that initiates a modem reset or indicates the modem's reset condition.

Table 54. Reset Signal Features

Feature	Details
Purpose	Reset modem • Used by host to reset the modem.
Implementation	• Digital input/output • Initiates modem reset when driven externally. • Indicates modem processor reset condition when not driven externally. (1.8V Output) • Internally driven. Logic high state may be overridden by pulling it low via an open drain sink that is capable of ≥ 10 mA. *Note: This pin is also required for JTAG programming.*

5.3.1. Pin Description

The following table describes the SYSTEM_RESET_N signal pin.

Table 55. Reset Signal Pin Description

Pin Number	Signal Name	I/O	I/O Type	Description
63	SYSTEM_RESET_N	I/O	Digital	Module reset

See Table 10 SL808xT, SL808xBT and SL808xBTA LGA Pad Pin Assignments for additional pin-specific details.

5.3.2. Electrical Characteristics

The following table describes the reset signal's electrical characteristics.

Refer to Table 10 SL808xT, SL808xBT and SL808xBTA LGA Pad Pin Assignments for basic characteristics (type, voltage).

Table 56. Reset Signal Electrical Characteristics

Parameter	Minimum	Typical	Maximum	Unit
V_{IL}	0		0.57	V
V_{IH}	1.33			V

5.3.2.1. Signal Timing

Figure 39 and Table 57 describe the timing sequence for resetting the device.

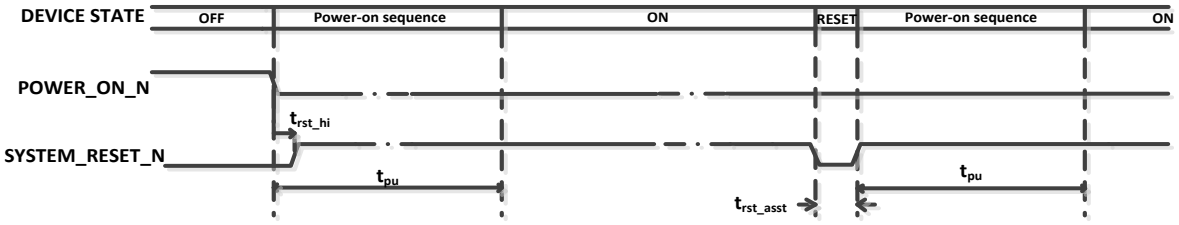


Figure 39. SYSTEM_RESET_N Signal Timing with "OFF Mode is Hardware-Controlled" Mode

Table 57. SYSTEM_RESET_N Signal Timing Parameters

Parameter	Description	Period		
		Min	Typ	Max
t_rst_hi	Reset high – Time between POWER_ON_N assertion and internal SYSTEM_RESET_N deassertion.	-	100 ms	-
t_rst_asst	Reset assert – Time required to initiate a reset by holding SYSTEM_RESET_N low externally.	100ms		-

Note: An operating system reset is preferred to a hardware reset.

5.3.2.2. General Notes

An open collector or open drain transistor should be used. If an open collector is chosen, T1 can be a ROHM DTC144EE.

Table 58. Reset Settings

Reset Command	SYSTEM_RESET_N (Pin 63)	Operating Mode
1	0	Reset activated
0	1	Reset inactive

5.4. Wake Signal (WAKE_N)

Note: This feature is only available with the Open AT Application Framework 2.53 or newer.

This signal is used by the AirPrime SL808xT, SL808xBT and SL808xBTA module to wake the host when a predetermined condition is satisfied (such as when a call is received).

Table 59. Wake Signal Features

Feature	Details
Purpose	Wake Host interface • Wake host when a predetermined condition is satisfied (for example, when a call is received).
Implementation	• Inactive state = High (1.8V) • Active state = Low (0V) • When used, add a 10kΩ pull up resistor

5.4.1. Pin Description

The following table describes the wake signal pin.

Table 60. Wake Signal Pin Description

Pin #	Signal Name	Multiplexed with	I/O	I/O Type	Description
61	WAKE_N	GPIO_16	O	Digital	Wake Host interface

See Table 10 SL808xT, SL808xBT and SL808xBTA LGA Pad Pin Assignments for additional pin-specific details.

5.4.2. Electrical Characteristics

Refer to Table 10 SL808xT, SL808xBT and SL808xBTA LGA Pad Pin Assignments for basic characteristics (type, voltage).

5.5. Disable Signal (W_DISABLE_N)

This signal is used by the host to disable (or enable) the AirPrime SL808xT, SL808xBT and SL808xBTA module's RF connection.

Table 61. Wireless Disable Signal Features

Feature	Details
Purpose	Wireless disable • Used by host to disable or enable low power mode ("standby mode").
Implementation	• Active = Low (0V), places module in standby mode • Inactive = High (1.8V)

5.5.1. Pin Description

The following table describes the wireless disable signal pin.

Table 62. Wireless Disable Signal Pin Description

Pin Number	Signal Name	Multiplexed with	I/O	I/O Type	Description
62	W_DISABLE_N	GPIO_19	I	Digital	Wireless disable

See Table 10 SL808xT, SL808xBT and SL808xBTA LGA Pad Pin Assignments for additional pin-specific details.

5.5.2. Electrical Characteristics

Refer to Table 10 SL808xT, SL808xBT and SL808xBTA LGA Pad Pin Assignments for basic characteristics (type, voltage).

5.5.3. Signal Timing

Figure 40 and Table 63 describe the timing sequence for entering/exiting low power mode (standby mode).

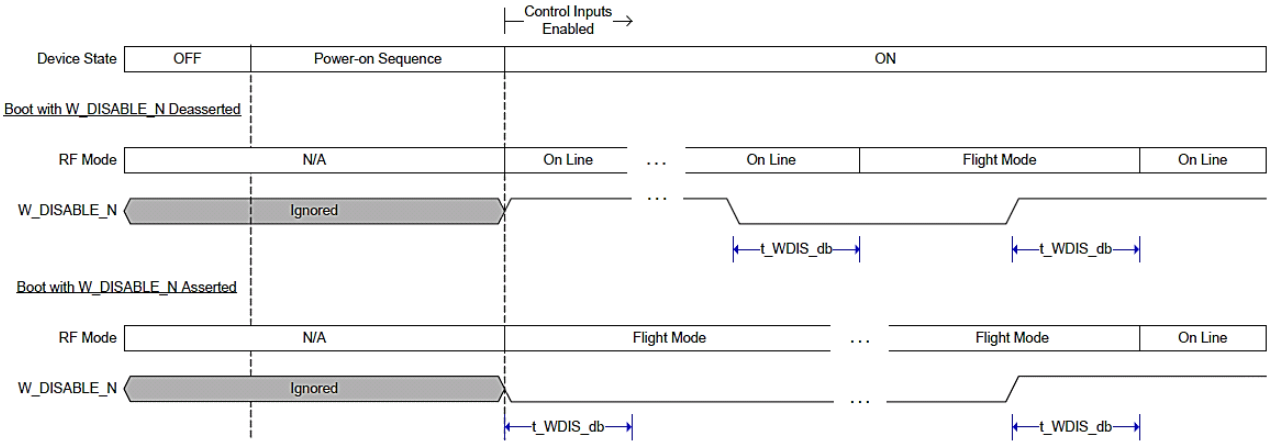


Figure 40. W_DISABLE_N Signal Timing

Table 63. W_DISABLE_N Signal Timing Parameters

Parameter	Description	Period		
		Min	Typ	Max
t_WDIS_db	W_DISABLE_N Debounce—Time between changing W_DISABLE_N logic level and RF mode changing.	5 s	-	7 s

5.6. Buzzer Output (BUZZER_EN)

This signal is used in the implementation of a buzzer circuit.

Table 64. Buzzer Signal Features

Feature	Details
Purpose	Enable off-board buzzer
Implementation	Binary I/O used by host as a buzzer enable line

5.6.1. Pin Description

The following table describes the wireless disable signal pin.

Table 65. Buzzer Output Pin Description

Pin Number	Signal Name	Multiplexed with	I/O	I/O Type	Description
68	BUZZER_EN	GPIO_14	O	Digital	Buzzer enable

See Table 10 SL808xT, SL808xBT and SL808xBTA LGA Pad Pin Assignments for additional pin-specific details.

5.6.2. Electrical Characteristics

Refer to Table 10 SL808xT, SL808xBT and SL808xBTA LGA Pad Pin Assignments for basic characteristics (type, voltage).

5.7. LED_FLASH

This digital output may be used to drive a general purpose LED.

Table 66. LED Signal Features

Feature	Details
Purpose	• LED_FLASH output • Used by host to control LED status by controlling LED diode bias.
Implementation	• Digital output. 1.8 V logic • Source/sink maximum – 4 mA • LED behavior can be configured by adjusting software settings. • LED pattern can be used to indicate network connection status. • Blink rate up to 10 Hz supported

5.7.1. Pin Description

The following table describes the LED signal pin.

Table 67. LED_FLASH Pin Description

Pin Number	Signal Name	Multiplexed with	I/O	I/O Type	Description
60	LED_FLASH	GPIO_15	O	Digital	LED driving

See Table 10 SL808xT, SL808xBT and SL808xBTA LGA Pad Pin Assignments for additional pin-specific details.

5.7.2. Electrical Characteristics

The following table describes the LED_FLASH signal's electrical characteristics.

Refer to Table 10 SL808xT, SL808xBT and SL808xBTA LGA Pad Pin Assignments for basic characteristics (type, voltage).

Table 68. LED_FLASH Signal Electrical Characteristics

Parameter	Condition	Minimum	Typical	Maximum	Unit
V_{OL}		0		0.45	V
V_{OH}		1.3		1.85	V
I_{OUT}				4	mA

5.7.3. LED Status

The following table describes the status of the embedded module based on the status of the flash LED.

Table 69. LED_FLASH Status

LED_FLASH Status	Embedded Module Status
Permanently ON	The embedded module is switched ON, but not registered on the network.
Slow flash – LED is ON for 200ms, then OFF for 2s	The embedded module is switched ON and registered on the network.
Quick flash – LED is ON for 200ms, then OFF for 600ms	The embedded module is switched ON and, registered on the network and communication is in progress.

For more information about enabling or disabling the flash LED, refer to document [2] AT Commands Interface Guide for Firmware 7.52/7.53.

5.8. External Interrupt

The AirPrime SL808xT, SL808xBT and SL808xBTA module provides three external interrupt inputs, which can be activated on the:

- High to low level transition
- Low to high level transition
- Low to high and high to low level transitions

When used, the interrupt inputs must not be left open; and when they are not used, they must be configured as GPIOs.

5.8.1. Pin Description

The following table describes the external interrupt pins.

Table 70. External Interrupt Pin Description

Pin Number	Signal Name	Multiplexed with	I/O Type	Description
1	INT2	GPIO_3	1V8	External interrupt
2	INT1	GPIO_2	1V8	External interrupt
3	INT0	GPIO_1	1V8	External interrupt

See Table 14 Reset State Definition for state definitions and Table 10 SL808xT, SL808xBT and SL808xBTA LGA Pad Pin Assignments for additional pin-specific details.

5.8.2. Electrical Characteristics

Refer to Table 10 SL808xT, SL808xBT and SL808xBTA LGA Pad Pin Assignments for basic characteristics (type, voltage).

5.8.3. Application Notes

The external interrupt pins are high impedance input types so it is important to set the interrupt input signals with pull-up or pull-down resistors if they are driven by an open drain, an open collector or by a switch. If the interrupt signals are driven by a push-pull transistor, then no pull-up or pull-down resistors are necessary.

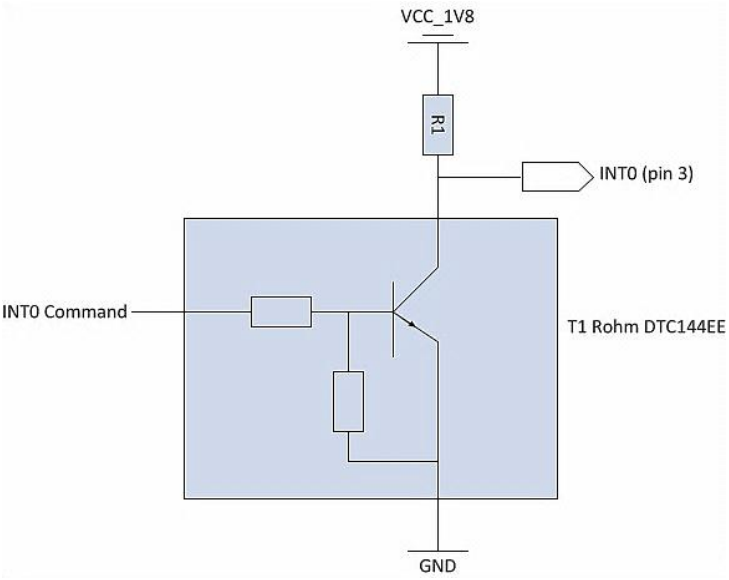


Figure 41. Example of INT0 Driven by an Open Collector

Where:

- The value of R1 can be 10kΩ
- T1 can be a ROHM DTC144EE open collector transistor

5.9. Power Rail (VREF_1V8)

The AirPrime SL808xT, SL808xBT and SL808xBTA module includes a rail that the host uses to provide a 1.8 V logic reference.

5.9.1. Pin Description

The following table describes the Power Rails (VREF_1V8) signal pin.

Table 71. VREF_1V8 Signal Pin Description

Pin Number	Signal Name	I/O	I/O Type	Description
10	VREF_1V8	O	Supply	1.8 V digital supply

5.9.2. Electrical Characteristics

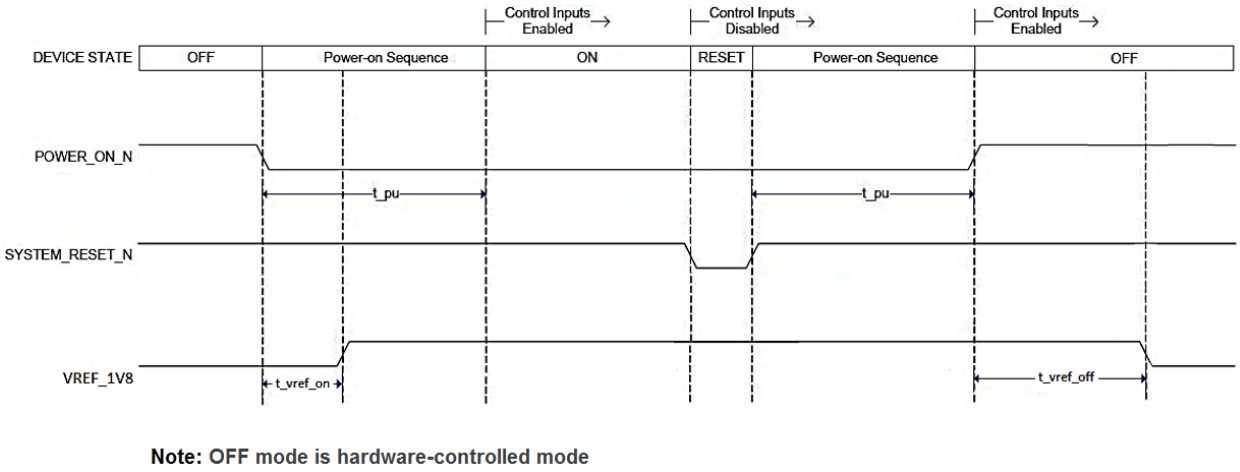
The following table describes the power rail signal's electrical characteristics.

Table 72. VREF_1V8 Signal Electrical Characteristics

Parameter		Minimum	Typical	Maximum	Unit
VREF_1V8	Output voltage	-3%	1.8	+3%	V
	Output current			1	mA

5.9.2.1. Signal Timing

Figure 42 and Table 73 describe the timing sequence for powering VREF_1V8 at on and off.



Note: OFF mode is hardware-controlled mode

Figure 42. VREF_1V8 Signal Timing

Table 73. VREF_1V8 Signal Timing Parameters

Parameter	Description	Period		
		Min	Typ	Max
t_pu	Power up – Time required to boot device and reach device ready state.	5 s	-	7 s
t_vref_on	Power up – Time required to VREF_1V8 is switch ON.	-	80 ms	-
t_vref_off	Power down – Time required to VREF_1V8 is switch OFF.	-	980 ms	-

5.9.3. VREF_1V8 – 1.8 V Logic Reference

Note: VREF_1V8 is only available when the AirPrime SL808xT, SL808xBT and SL808xBTA module is ON.

The following are good design practices to consider:

- Total current draw must be < 1 mA.
- If used as a reference only (host provides its own pull-up voltage rail), a 100 Ω resistor should be put in series.
- Depending on the host PCB trace length for this signal, PCB provision for decoupling capacitors may be required.

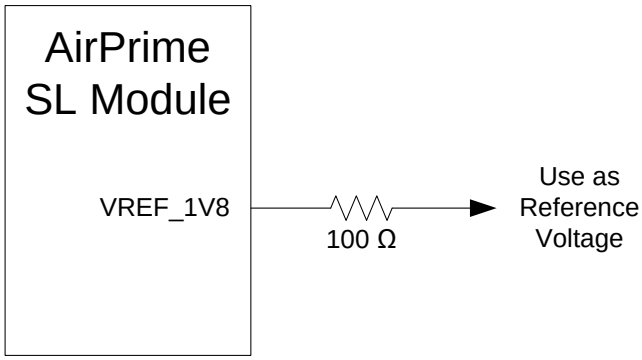


Figure 43. Example of a Power Rail (VREF_1V8) Implementation

Caution: *If LDO_1V8 is provided by the host, this must be switched OFF when the module is OFF. VREF_1V8 from the module can be used for enabling/disabling the external LDO_1V8.*

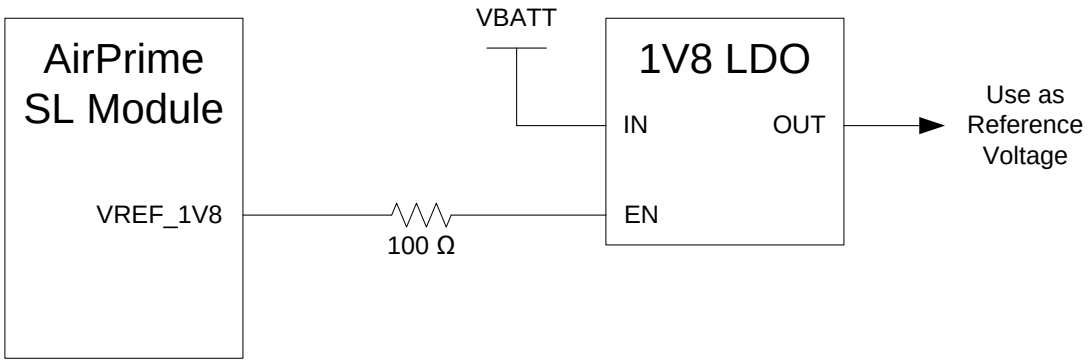


Figure 44. Example of VREF_1V8 Enabling or Disabling an External LDO_1V8

6. Power

6.1. Power Consumption

Typical values are measured at ambient temperature, and maximum values are measured over the entire operating temperature range (The measurements are done with a CMU200 and with a 50Ω Load). For a description of input voltage requirements, see section 3.1 Power Supply.

Table 74. Standby DC Power Consumption

Signal	Description	Bands	Avg		Peak	Units	Notes/Configuration
			Typ	Over Temp and Voltage			
VBATT	**Current consumption with Sleep mode activated**						
	HSDPA / WCDMA	B1 / B2	2.8	5	140	mA	DRX cycle = 8 (2.56 s)
		B5 / B6 / B8	3.3	5	140	mA	DRX cycle = 8 (2.56 s)
	GSM / GPRS / EDGE	850 / 900 / 1800 / 1900	3.5	4.5	145	mA	MFRM = 9 (2 s)
			5	6	145	mA	MFRM = 2 (0.5 s)
	Current consumption with Sleep mode deactivated						
	HSDPA / WCDMA	UMTS bands	40	55	160	mA	• DRX cycle = 8 (2.56 s) • Module power up and idle (Assumes sleep mode is never entered)
	GSM / GPRS / EDGE	850 / 900 / 1800 / 1900	40	55	165	mA	• MFRM = 2 (0.5 s) • Module power up and idle (Assumes sleep mode is never entered)
	Standby mode (RF OFF)						
	RF disabled, sleep mode deactivated (Fast Standby)		35	50	100	mA	
	RF disabled, sleep mode activated (Slow Standby)		2.7	5	13	mA	

Table 75. Averaged Call Mode Data DC Power Consumption

Signal	Description		Bands	Tx Power	Avg		Peak*	Units
					Typ	Over Temp and Voltage		
VBATT	WCDMA**		Band 1 / 2	+22	450	555	600	mA
			Band 5 / 6 / 8	+22	465	650	700	mA
	HSDPA**		Band 1 / 2	+22	450	555	600	mA
			Band 5 / 6 / 8	+22	465	650	700	mA
	GSM***		850	+32.5	230	300	1600	mA
			900	+32.5	230	300	1600	mA
			1800	+29.5	175	230	1000	mA
			1900	+29.5	175	230	1000	mA
	GPRS*** Class 10 (3Rx/2Tx)		850	+32.5	370	450	1600	mA
			900	+32.5	370	450	1600	mA
			1800	+29.5	285	320	1000	mA
			1900	+29.5	285	320	1000	mA
	EGPRS	GPRS (MCS1 to MCS5) Class 12 (1Rx/4Tx)	850	+31.5	650	850	1600	mA
			900	+31.5	650	850	1600	mA
			1800	+28.5	485	650	1000	mA
			1900	+28.5	485	650	1000	mA
		EDGE (MCS6 to MCS9) Class 12 (1Rx/4Tx)	850	+27	385	480	950	mA
			900	+27	385	480	950	mA
			1800	+26	330	410	700	mA
			1900	+26	330	410	700	mA

* Peak consumption averaged over 100 µs.

** Current consumption increases by 50 mA with a 6 dB return loss on antenna pad

*** GSM mode peak current increases to 2.2A with 6 dB return loss (VSWR 3:1) on antenna pad

Table 76. Miscellaneous DC Power Consumption

Signal	Description	Band	Typ	Units	Notes/Configuration
VBATT	Module OFF leakage current	All bands	110	µA	Ambient temperature
	USB active	All bands	10	mA	Full speed USB connection, CL = 50 pF on D+ and D- signals

Table 77. Supported GPRS / EDGE Power Classes

Feature	Notes
EGSM 900/GSM 850 Power Class 4	2 W 33 dBm
GSM 1800/1900 Power Class 1	1 W 30 dBm
EDGE Power Class for 850/900 MHz	Class E2*; 27 dBm, 0.5 W
EDGE Power Class for 800/1900 MHz	Class E2*; 26 dBm, 0.4 W

* E2 power class applies to 8PSK modulation.

6.2. Power States

The SL808xT, SL808xBT and SL808xBTA module has five power states as detailed in the following table.

Table 78. Supported SL808xT, SL808xBT and SL808xBTA Power States

State	Description	VBATT	Baseband Running	USB Interface Active	RF Enabled
Normal	• Capable of placing/receiving calls or establishing data connections on network • USB interface is fully active • Current consumption in a call or data connection is affected by: ▪ Radio band in use ▪ Tx power ▪ Receive gain settings ▪ Data rate ▪ Number of active Tx time slots • Module defaults to Normal state when VBATT is first applied, if POWER_ON_N is held low.	✓	✓	✓	✓
Fast Standby Mode (RF off)	• Standby mode – Rx/Tx are disabled; USB interface is active • State entered automatically when critical voltage/temperature thresholds are exceeded. Host should consider powering off module to prevent damage to unit.	✓	✓	✓	×
Slow Standby Mode (RF off)	Standby mode – Rx/Tx are disabled; baseband	✓	×	×	×
Sleep (Idle Mode)	• Normal module state between RF activity • Module cycles between wake (polling the network) and sleep, at network provider-determined interval.	✓	✓	×	×
Off	• VBATT is connected • Module is powered down (drawing minimal current from host power supply)	✓	×	×	×
Disconnected	• VBATT is disconnected from module • All module-related voltages are at 0 V.	×	×	×	×

6.2.1. Power State Transitions

The module monitors supply voltage and operating temperature and notifies the host when critical threshold limits are exceeded. (Refer to the table below for details.)

For more information about the temperature monitoring feature, refer to the +WTMR command in document [2] AT Commands Interface Guide for Firmware 7.52/7.53.

Power state transitions may occur:

- Automatically, when critical supply voltage or module temperature trigger levels are encountered.
- Under host control, using available AT or CnS commands in response to user choices (for example, opting to switch to standby mode) or operating conditions.

Table 79. Power State Transitions (including voltage / temperature trigger levels)

Transition	Voltage		Temperature*		Notes
	Trigger	V	Trigger	°C	
Normal to Fast Standby	VOLT_HI_CRIT	4.35	TEMP_LO_CRIT	-45	• RF suspended • Notification issued if triggered by temperature
	VOLT_LO_CRIT	3.00	TEMP_HI_CRIT	110	
Fast Standby to Normal	VOLT_HI_NORM	3.90	TEMP_LO_NORM	-40	• RF resumed • Notification issued if triggered by temperature
	VOLT_LO_NORM	3.60	TEMP_HI_NORM	85	

* Setup for thermal qualification: module is soldered on the socket board, VT4002 Vötsch Temperature Test Chamber, VBATT typ, VSWR 1:1 on CMU200.

Note: ***AT+WAPT*** *can be used to deactivate the transitions to Fast Standby mode when critical temperatures are exceeded. It should be used with caution as it may damage the module. Refer to document [2] AT Commands Interface Guide for Firmware 7.52/7.53 for more information about this command.*

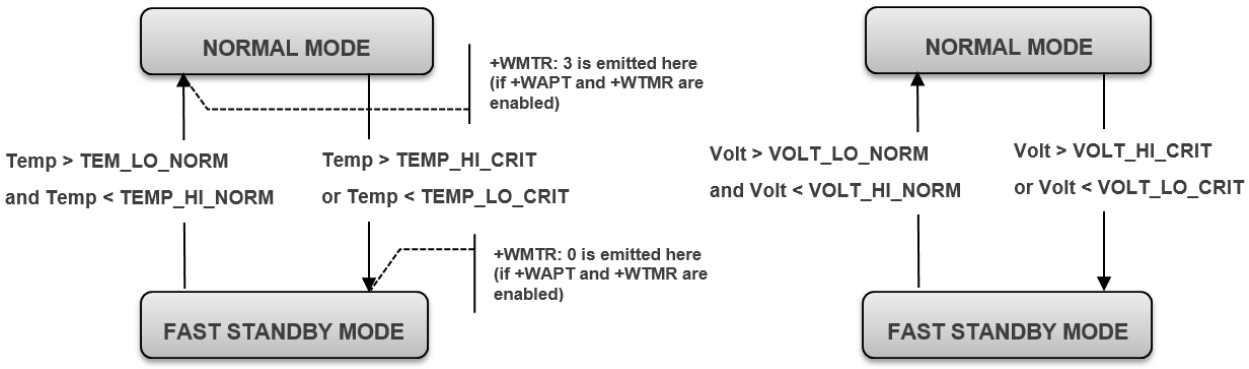


Figure 45. Power State Transition Diagram

6.3. Thermal Considerations

It is important during customer design to aim for a low thermal resistance to drain out thermal power from AirPrime SL808XT, SL808XBT and SL808XBTA module and keep the module in its temperature specifications in all conditions, including in a hot environment with a module transmitting at full power. Below SL8 bare module thermal model with still air conditions will help designers to do so.

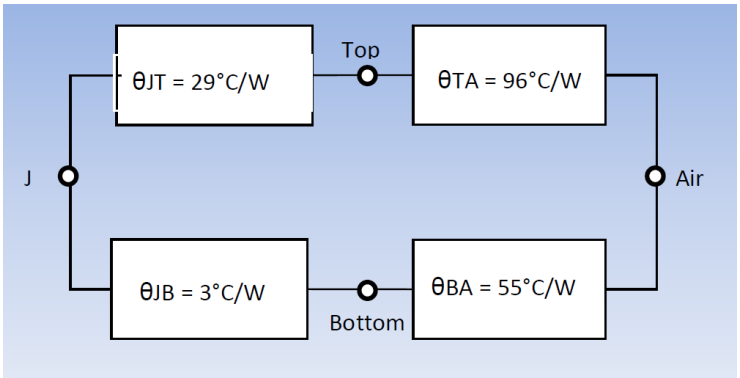


Figure 46. Bare Module Thermal Model

Parameters used in the figure above are described below:

- J Inner thermistor
- T Top shielding cover
- B Bottom bare copper side of the module
- A Air; ambient temperature measured around 50mm beside the module
- θJT Thermal resistance from J to the top cover
- θTA Thermal resistance from top cover to air, dependent on cover surface area
- θJB Thermal resistance from J to the bottom external copper layer
- θBA Thermal resistance from copper layer to air, dependent on this layer surface area

Note that θBA is the intrinsic thermal resistance from the module copper bottom. With the module soldered on a PCB, the PCB's own thermal resistance from the soldering area to air will substitute for this value.

As with other temperature parameters, some margin needs to be considered to cover the different thermal constants tolerances and approximations.

Document [7] AirPrime SL808xT, SL808xBT and SL808xBTA Thermal Model provides a simple thermal model that is useful to carry out thermal simulations at end-product level.

`AT+WTEMP` can be used to return the module's current temperature. See document [2] AT Commands Interface Guide for Firmware 7.52/7.53 for details about using this command.

7. Network Technology Specifications

7.1. UMTS WCDMA FDD Specifications

The SL808xT, SL808xBT and SL808xBTA supports the common WCDMA FDD specifications listed in the following table.

Table 80. Supported WCDMA FDD Specifications

Item
Physical layer specifications
DL Channels: BCH, PCH, FACH, DCH, AICH, CPICH
UL Channels: RACH, DCH
Measurement for PCCPCH RSCP RSCP/SIR
BTFD
CCTrCH as defined by examples in 25.944
Multifinger support
Cell reselection
Soft handover
Power control
PICH / DRX
Measurement for SFN / CFN timing, SFN / SFN timing
Cell selection
RLC specifications
TM / UM / AM
Max AM entities (4) • 3 for signaling • 1 for user data
Only timer based polling for AM
No timer based SDU discard for TM / UM / AM
Poll PU polling for AM
Poll prohibit
Polling options: Last ReTX PU Poll, Poll Window, Poll SDU
Status report transfer: Timer Status, Status Prohibit, Missing PU indicator
Reset procedure: Indication to RRC
Suspend / Resume
Timer based SDU discard (UM / AM / TM)
Status report transfer: Piggybacked Status PDUs, EPC based transfer
SUFIs: Sending BITMAP and RLIST
Start / stop for all three modes
RRC Specifications
Cell selection
RRC connection establishment

Item
RRC connection release
System information processing
Idle mode paging
Dedicated mode paging
Initial direct transfer
Uplink direct transfer
Downlink direct transfer
Signaling connection release
Signaling connection release request
Radio bearer establishment
Radio bearer release
Cell update
UE capability enquiry
Transmission of UE capability
Cell reselection
Measurement control
Measurement reporting
Soft HO/Active Set update
DRX mode
NV support for RRC channel scan
Radio bearer reconfiguration
Transport channel reconfiguration
Physical channel reconfiguration
UTRAN mobility information
Integrity protection
Security mode control
Encryption: UEA1
Integrity algorithm: U1A11

7.2. Supported Specifications

The SL808xT, SL808xBT and SL808xBTA supports the specifications listed in Table 81 Supported GSM / GPRS Specifications, as well as Enhanced Network Selection (ENS), and Enhanced Operator Name String (EONS).

EONS allows the operator to define the operator name displayed for any registered network based on the MCC, MNC, and LAI on which the MS is currently registered. Strings that can be displayed when a MS is registered on a network are:

- Enhanced Operator Name String (EONS) from SIM
- Operator Name String (ONS) from SIM
- Service Provider Name (SPN) from SIM
- Network Identity and Time Zone (NITZ) as broadcast by network
- String from internal lookup table in UE

Table 81. Supported GSM / GPRS Specifications

Item	Comments
8PSK modulation	Octagonal Phase Shift Keying Coding schemes MCS5-9
GPRS header compression	Data packet header compression supported
3GPP compliance	Protocol stack supports the requirements of: • GPRS/EDGE: 3GPP Release 99 and GERAN Feature Package #1 • WCDMA: Release 5
GPRS operation mode class B	Class B terminals support either circuit-switched or packet switched traffic (with simultaneous network attachment) but do not support both kinds of traffic simultaneously.
Link Adaptation (LA)	Together with IR (next table entry), LA adapts the EGPRS transmission to meet changing radio link conditions.
EGPRS Incremental Redundancy (IR)	IR adjusts the physical layer code rate to actual channel conditions by incrementally transmitting redundant information until decoding is successful. Automatic Repeat Request (ARQ) protocol takes care of requesting and retransmitting incorrectly received blocks. ARQ enables both dynamic RLC window management (to avoid window stalling) and dynamic RLC polling frequency (to minimize retransmission delay and save radio bandwidth).
GPRS multislot class 10	Multislot class 10 and 12 allow for dynamic allocation of time slots.
EGPRS multislot class 12	
NC0	NC0 is the normal mode of control for a GPRS mobile in which the MS (Mobile Station) performs autonomous cell reselection.
DPC	Downlink Power Control Allows the network to adjust the downlink power of any dedicated channels on the BTS based on measurement reports sent by the mobile. This allows the network to reduce interference between multiple mobiles while still maintaining adequate signal quality for the individual mobiles.
One-phase packet access for GPRS	In establishing a TBF (Temporary Block Flow) connection, the MS (Mobile Station) requests either one-phase or two-phase packet access. In one-phase access, the network responds to a packet channel request by sending a packet uplink assignment message and reserving resources for uplink transfer of a number of radio blocks. In two-phase access, a packet resource request is sent on receipt of the packet uplink assignment.
One-phase packet access for EGPRS	
Two-phase packet access for GPRS	
Two-phase packet access for GPRS	
RLC-acknowledged operation mode	The RLC-acknowledged and LLC-acknowledged modes are used to ensure the integrity of received data where QoS requires it. RLC (Radio Link Control) acknowledgment is typically the default (depending on the network and user profile). LLC-acknowledgment is optional and ensures that all LLC (Logical Link Control) frames are received without error. Since LLC-acknowledged mode requires acknowledgement of all LLC frames, the mode has an impact on throughput.
RLC-unacknowledged operation mode	
LLC-acknowledged transmission mode	
LLC-unacknowledged transmission mode	
GSM network operation mode I and II	The Network Operating Mode specifies the coordination of paging for circuit-switched and packet-switched services. Mode I – The mobile can receive circuit-switched pages while in a packet-switched call. Mode II – The mobile cannot receive a circuit-switched page while in a packet-switched call, as it would force the mobile to constantly monitor its CCCH channel.

Item	Comments
PBCCH / PCCCHI	Packet Broadcast Control Channel PBCCH is a packet data signaling channel that can supplement the BCCH GSM control channel, allowing decoupling of voice and packet control channels to set up data calls. PBCCH broadcasts GPRS / EGPRS specific cell re-selection parameters for serving and neighbor cells used in cell selection / re-selection for packet services.
GPRS test modes (ETSI test mode A and B)	The European Telecommunications Standards Institute (ETSI) defines standards and requirements for testing of GSM mobile equipment. In test mode A, the mobile requests an uplink TBF and transmits random data on a designated number of timeslots. This causes a device to transmit data without using upper layer protocols. Once the transmission has started, the downlink TBF halts. The device remains in this mode until the testing equipment terminates it. In test mode B, the mobile is prompted to receive data on a number of specified downlink timeslots and re-transmit the same data back on the corresponding uplink timeslots. Test mode B allows tests to be performed on both the transmitter and receiver within a single session.
NACC (R4 GERAN Feature Set 1)	Network Assisted Cell Change Enables the network to provide additional information about neighbor cells to the mobile while in a packet data session, which decreases the experienced service delays caused by cell re-selection.
MAIO	Mobile Allocation Index Offset MAIO and Hopping Sequence Number (HSN) are used in conjunction with Frequency Hopping to determine the hopping sequence used in each frame. The MAIO supports as many values as there are frequencies in the hopping list, and these are used to indicate the offset within the hopping list that identifies the frequency used.
Packet enhanced measurement report (PEMR)	Packet Enhanced Measurement Report (PEMR) is one of the RLC / MAC (Radio Link Control and Medium Access Control) control messages that include a carrier identifier. This message is a requirement of supporting multicarrier TBF.
Delayed TBF Release	Delayed Temporary Block Flow Release (also called Extended Uplink TBF) Delayed TBF Release reduces latency between uplink data transfers and reduced signaling on the network by maintaining a connection for brief periods when the network is temporarily inactive and the mobile station has no radio link control information to send. For this feature to work properly, the mobile station must support delayed TBF release.
Extended Dynamic Allocation	Radio blocks can be transmitted on up to four different PDCHs. Permits full class 12 operation.
Single Antenna Interference Cancellation (SAIC)	SAIC mitigates code-channel interference from neighboring cells resulting in fewer dropped calls, and faster download rates for e-mail and websites.
Circuit-switched data bearers	These circuit-switched data bearers are supported on 2G networks: • Asynchronous 9,600 bps • Asynchronous 14,400 bps

Item	Comments
Security	
Encryption support	GPRS / EGPRS support GEA1, GEA2, and GEA3 data ciphering. GSM CSD and SMS use A5/1 and A5/3 encryption.
PAP for RADIUS authentication - GPRS / EGPRS	PAP (Password Authentication Protocol) is a method of authenticating usernames and passwords against a database on a RADIUS (Remote Authentication Dial-In User Service) server. In a standard login, the service provider prompts for a username and password. In PAP authentication, the username and password are entered in the client's dialing software and sent as one data package, rather than the server sending a login prompt and waiting for a response.
CHAP for RADIUS authentication – GPRS / EGPRS	CHAP (Challenge Handshake Authentication Protocol) is a more secure method for connecting to a system than PAP. After a link is established, the server sends a challenge message to the client. The client responds with a value calculated using a one-way hash function. The server compares its own calculation of the expected hash value to the client's response. If the values match, the authentication is acknowledged; otherwise the connection is terminated.
Support for encryption algorithm UEA1 (Kasumi)	UEA1 (UMTS Encryption Algorithm) generates the keystream as a function of a cipher key that is re-synchronized to every MAC / RLC frame. UEA is based on the Kasumi algorithm.
Support for integrity algorithm UIA1 (Kasumi)	UIA1 (UMTS Integrity Algorithm) is the algorithm used to compute the IK (Integrity Key) used in message authentication. UIA is based on the Kasumi algorithm.
UMTS	
WCDMA-to-GPRS reselection in CELL_FACH	CELL_FACH is an RRC (Radio Resource Control) service state in which cell reselection is performed. This feature prevents dropping of RRC connections.
Inter-frequency reselection in Cell_FACH	
Radio link failure	Radio link failure is a procedure that indicates an 'out-of-synch' state on one or more radio links. Node B of the RNC (Radio Network Controller) reports this event before attempting resynchronization. The radio link restoration procedure indicates restoration of the 'synchronized' state.
SIB scheduling	SIB (System Information Block) scheduling controls the broadcasting of information to user equipment in a cell. The user equipment retrieves the schedule, and is then able to change to sleep mode, receiving only those blocks that it needs.
SIB modification	
Re-establishment procedure	Following a radio link failure, the RNC maintains the RRC connection, waiting for re-establishment.
VT + PS call (subject to network availability)	Simultaneous VT (Video Terminal) and PS (Packet Switched) calls are supported.
Packet Cell Change Order from GSM→UTRAN	Call transfer between GSM-based and UTRAN-based cells is supported.
Background PLMN search	Improved algorithm for Higher Priority PLMN (HPPLMN) search while camped on a 3G cell.
Configurable Release 5 or Release 99 support	

Item	Comments
Circuit-switched data bearers	
Data bearers	These circuit-switched data bearers are supported on 3G networks: • Synchronous transparent mode = 64000 bps • Synchronous transparent mode = 56000 bps • Asynchronous V110 UDI = 14400 bps • Asynchronous V110 UDI = 28800 bps • Asynchronous V110 UDI = 38400 bps • Asynchronous V120 = 14400 bps • Asynchronous V120 = 28800 bps • Asynchronous V120 = 56000 bps
HSDPA	
Data rates	The following data rates are supported: • Category 12 (1.8 Mbps) • Category 5/6 (3.6 Mbps)
HSDPA logical channels	These HSDPA logical channels are supported: • HS-SCCH • HS-DPCCH • HS-PDSCH—Up to ten HS-PDSCH channels are supported.
HSDPA transport channels	HS-DSCH is supported at these rates: • 120 kbps • 240 kbps • 360 kbps
Incremental redundancy	IR adjusts the physical layer code rate to actual channel conditions by incrementally transmitting redundant information until decoding is successful. Automatic Repeat Request (ARQ) protocol takes care of requesting and retransmitting incorrectly received blocks. ARQ enables both dynamic RLC window management (to avoid window stalling) and dynamic RLC polling frequency (to minimize retransmission delay and save radio bandwidth).
Chase combining retransmission scheme	The Chase combining retransmission scheme is the simplest HARQ (Hybrid Automatic Request) link adaptation technique. HARQ techniques are used to enhance system performance.
HSDPA Compressed Mode	Allows the user equipment to interrupt transmission and reception during a call for brief periods in order to measure the signal strength of neighboring cells that use different frequencies.
HSDPA Indicator	Allows user interface to display an indicator when HSDPA data transfer is in progress.
Receiver equalizer support	
Miscellaneous	
Fast link adaptation	The data rate is adapted to radio conditions.
Vary the effective code rate	The effective code rate is varied based on code space resources.
HARQ, MAC-HS disassembly	MAC-HS (High Speed MAC) is the base station MAC (Medium Access Control) protocol. MAC-HS enables fast radio resource allocation.
MAC-HS reordering queue distribution and processing support	

Item	Comments
Cell change	These cell change methods are supported: • Synchronous and non-synchronous • Intra-Node B (softer repointing) • Inter-Node B (soft repointing)
Up-switching and down-switching of PS RAB between HS-PDSCH and DPCH	RAB (Radio Access Bearer) and channel mappings between the HS-PDSCH (High Speed Physical Downlink Shared Channel) and DPCH (Dedicated Physical Channel) are reallocated according to volume thresholds and inactivity timers.
Ciphering on the HS channel	Ciphering on high-speed channels protects radio-transmitted data against unauthorized third parties.
Support to not resume the HS channel if inter-RAT handover fails, but save the RB mapping information	RB (Radio Bearer) mapping information is preserved if a highspeed channel is dropped due to the failure of an inter-RAT (Radio Access Technology) transfer.
Support to not resume the HS channel if a radio link failure occurs, but save the RB mapping information	RB (Radio Bearer) mapping information is preserved if a highspeed channel is dropped due to a radio link failure.
WINS address support primary and secondary	Primary and secondary IP addresses can be assigned for WINS (Windows Internet Name Service) name servers.
Voice support	Analog and PCM digital
Unstructured supplementary services data (USSD)	USSD provides support for transmitting information over the GSM network signaling channels. It provides fast session-based communication between the user and an application, enabling use of text messaging, prepaid roaming, chat, etc.
Supplementary services	Support for supplementary voice services such as Call Hold, Call Forward, Call Waiting, Multi-party Calls, Caller ID, Fixed Number Dialing, Service Dialing Numbers, etc.
Cell reselection/handover	Supports InterRat and InterFrequency cell-reselection and handover between supported frequency bands.
Security – IMEI Security	
SIM lock	The device can be ‘MEP locked’ to a particular PLMN.
SIM security	Both CHV1 and CHV2 are supported (unlock and unblock).

7.2.1. UMTS (WCDMA) / GSM Specifications

The following table details the SL808xT, SL808xBT and SL808xBTA modem’s support for common UMTS (WCDMA) and GSM specifications.

Table 82. UMTS (WCDMA) / GSM Specifications

✓ - Supported; × - Not supported; N/A – Not applicable

Item	GSM	UMTS
Mobility management		
Automatic PLMN selection / reselection	✓	✓
Location updating procedure	✓	✓
IMSI attach procedure	✓	✓
IMSI detach procedure	✓	✓
Periodic location update	✓	✓
Authentication procedure	✓	✓

Item	GSM	UMTS
CM connection establishment from MS or network	✓	✓
CM connection release	✓	✓
Encryption key management	✓	✓
TMSI reallocation	✓	✓
Paging response	✓	✓
Abort procedure	✓	✓
Identification	✓	✓
CN system information	✓	✓
Call re-establishment	✓	✓
MM connection establishment emergency calls	✓	✓
Inter-RAT change procedure	✓	✓
CS follow-on procedure	✓	✓
Access class barring	✓	✓
Resumption procedure for Class B operation in GPRS	✓	✓
Handling of domain change CS to CS/PS and other combinations	✓	✓
MM information	✓	✓
Network mode of operation I, II	✓	✓
GPRS mobility management		
GPRS attach	✓	✓
GPRS detach	✓	✓
Routing area update	✓	✓
GPRS authentication	✓	✓
GPRS identification	✓	✓
GMM status	✓	✓
Periodic routing area update	✓	✓
Ciphering	✓	✓
Access class barring	✓	✓
GMM status	✓	✓
Combined GPRS attach	✓	✓
Combined GPRS detach	✓	✓
Combined routing location / area update	✓	✓
PS SMS	✓	✓
Network initiated combined GPRS detach	✓	✓
Network mode of operation change	✓	✓
RAB management		
QoS-based activation, network offers lower / higher QoS	✓	✓
Primary PDP context activation	✓	✓
PDP context deactivation	✓	✓
Data services		
AT commands	✓	✓
MS PS data calls	✓	✓
Single PDP context	✓	✓
PDP type PPP	×	×

Item	GSM	UMTS
PDP type IP	✓	✓
9.6 / 14.4 CS transparent data	✓*	N/A
9.6 / 14.4 CS nontransparent data	✓*	N/A
Fax	×	×
MT Sync CS data calls	✓ *	✓*
MO Sync CS data calls	✓ *	✓*
V.80	N/A	✓
,V.42bis	×	N/A
Multiple PDP context profiles (up to 16)	✓	✓
SMS specifications		
CS domain MT SMS point-to-point	✓	✓
CS domain MO SMS point-to-point	✓	✓
SMMA	✓	✓
Dedicated mode	✓	✓
Message classes 0, 1, 2, 3, none	✓	✓
SMS / SMSP / SMSS access from SIM / USIM	✓	✓
Reply path	✓	✓
Validity period	✓	✓
PS domain MT SMS point-to-point	✓	✓
PS domain MO SMS point-to-point	✓	✓
SMS status reports	✓	✓
SMS commands	✓	✓

* Not supported by the Open AT Application Framework

8. Design Guidelines

This chapter provides general design guidelines for the AirPrime SL808xT, SL808xBT and SL808xBTA module.

Caution: *This list is non-exhaustive, and the developer is responsible for deciding whether to implement these guidelines.*

For industrial assembly guidelines, refer to document [6] AirPrime SL Series Customer Process Guidelines, available from your Sierra Wireless account representative.

8.1. General Rules and Constraints

Clock and other high frequency digital signals (e.g. serial buses) should be routed as far as possible from the AirPrime SL808xT, SL808xBT and SL808xBTA module analog signals.

If the application design makes it possible, all analog signals should be separated from digital signals by a ground line on the PCB.

Tip: *It is recommended to avoid routing any signals under the AirPrime SL808xT, SL808xBT and SL808xBTA module on the application board.*

8.2. PCB Layout Recommendations

Ground slugs should be reflowed on to the host PCB with < 30% voiding to allow effective heat dissipation.

8.3. Power Supply

The power supply is one of the key issues in the design of a GSM terminal.

A weak power supply design could, in particular, affect:

- EMC performance
- The emission spectrum
- The phase error and frequency error

When designing the power supply, careful attention should be paid to the following:

- The quality of the power supply – low ripple, PFM or PSM systems should be avoided; linear regulation or PWM converters are preferred for low noise.
- The capacity to deliver high current peaks in a short time (pulsed radio emission).
- The VBATT line must support peak currents with an acceptable voltage drop which guarantees a minimal VBATT value of 3.3 V (lower limit of VBATT)

8.4. Antenna

Another key issue in the design of a GSM terminal is the mechanical and electrical antenna adaptation. Sierra Wireless strongly recommends working with an antenna manufacturer either to develop an antenna adapted to the application or to adapt an existing solution to the application.

For more information on routing constraints for the RF circuit, see section 8.7.5 RF Circuit.

8.5. PCB Specifications for the Application Board

In order to save costs for simple applications, a cheap PCB structure can be used for the application board of the AirPrime SL808xT, SL808xBT and SL808xBTA module. A 4-layer through-hole type PCB structure can be used.

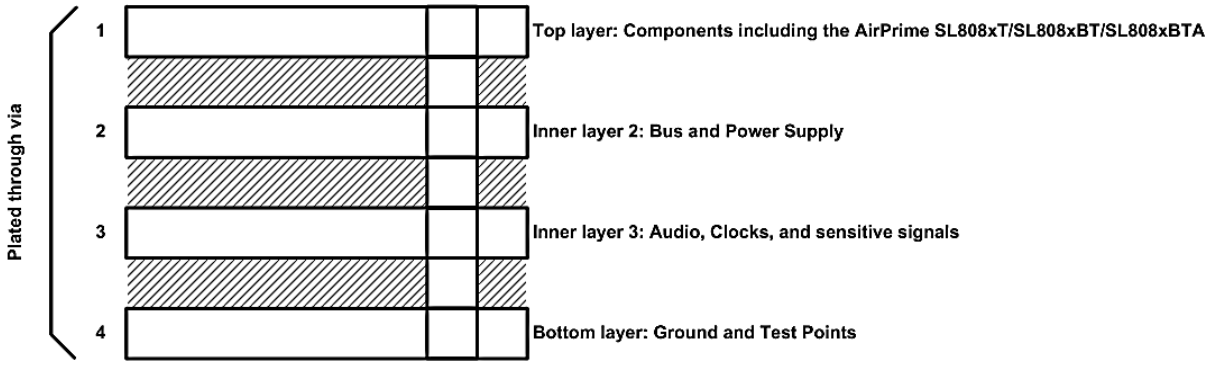


Figure 47. PCB Structure Example for the Application Board

Note: Due to the limited layers of 4-layer PCBs, sensitive signals like audio, SIM and clocks cannot be protected by 2 adjacent ground layers. As a result, care must be taken during PCB layout for these sensitive signals by avoiding coupling to noisy baseband through adjacent layers.

8.6. Recommended PCB Landing Pattern

Refer to document [6] AirPrime SL Series Customer Process Guidelines.

8.7. Routing Constraints

8.7.1. Power Supply

Since the maximum peak current can reach 2 A, Sierra Wireless strongly recommends having a large width for the layout of the power supply signal (to avoid voltage loss between the external power supply and the AirPrime SL808x module supply).

Pins 42 and 44 of the AirPrime SL808xT, SL808xBT and SL808xBTA module should be gathered in the same piece of copper, as shown in the figure below. Apply the use of distributed power tracks routed in the star which allows more control of current flow circulation

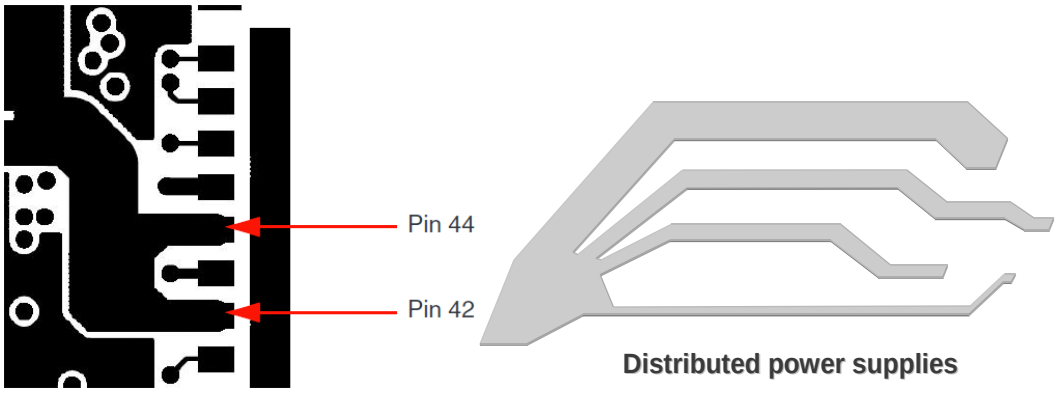


Figure 48. Power Supply Routing Example

Filtering capacitors near the AirPrime SL808xT, SL808xBT and SL808xBTA module power supply are also recommended (22 µF to 100 µF).

Attention should be paid to the ground track or the ground plane on the application board for the power supply which supplies the AirPrime SL808xT, SL808xBT and SL808xBTA module. The ground track or the ground plane on the application board must support current peaks as well as with the VBATT track.

If the ground track between the AirPrime SL808xT, SL808xBT and SL808xBTA module and the power supply is a copper plane, it must not be parceled out.

The same care should be taken when routing the ground supply.

If these design rules are not followed, phase error (peak) and power loss could occur.

8.7.1.1. Ground Plane and Shielding Connection

The AirPrime SL808xT, SL808xBT and SL808xBTA module has LGA ground pads linked to the ground. The ground has to be connected to the application board through a complete layer on the PCB.

A ground plane must be available on the application board to provide efficient connection to the bottom ground of the AirPrime SL808xT, SL808xBT and SL808xBTA module. The bottom side shielding of the AirPrime SL808xT, SL808xBT and SL808xBTA module is achieved by soldering the ground plane of the application board and the AirPrime SL808xT, SL808xBT and SL808xBTA module.

The best shielding performance is achieved when the application ground plane is a complete layer of the application PCB. To ensure good shielding of the AirPrime SL808xT, SL808xBT and SL808xBTA module, a complete ground plane layer on the application board must be available, with no tradeoffs. Please refer to document [6] AirPrime SL Series Customer Process Guidelines.

Without this ground plane, external spurious TX or RX blockings could appear.

For more information, see section 8.6 Recommended PCB Landing Pattern.

8.7.2. SIM Interface

The length of the tracks between the AirPrime SL808xT, SL808xBT and SL808xBTA module and the SIM socket should be as short as possible. Maximum recommended length is 10cm.

ESD protection is mandatory on the SIM lines if access from outside of the SIM socket is possible.

8.7.3. USB Interface

The USB data lines should be routed as differential pair.

Based on specific board stack-up definition, USB data trace spacing and USB trace width should be calculated to achieve an impedance of 90Ω differential impedance between the two data lines.

The mismatch of USB data lines length should be no greater than 150mils.

To avoid crosstalk issue, other high speed signals should be routed as far as possible from USB lines.

ESD protection and common mode choke should be placed as close as possible from USB connector.

8.7.4. Audio Circuit

To get better acoustic performances, the basic recommendations are as follows:

- The speaker lines (SPK) must be routed in parallel without any wires in between
- The microphone lines (MIC) must be routed in parallel without any wires in between

All the filtering components (RLC) must be placed as close as possible to the associated MIC and SPK pins.

8.7.5. RF Circuit

The RF signal must be routed on the application board using tracks with a 50 Ω 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 Coplanar Waveguide structure and computing the tracks width with a simulation tool (like AppCad shown in the figure below, available free of charge at http://www.agilent.com).

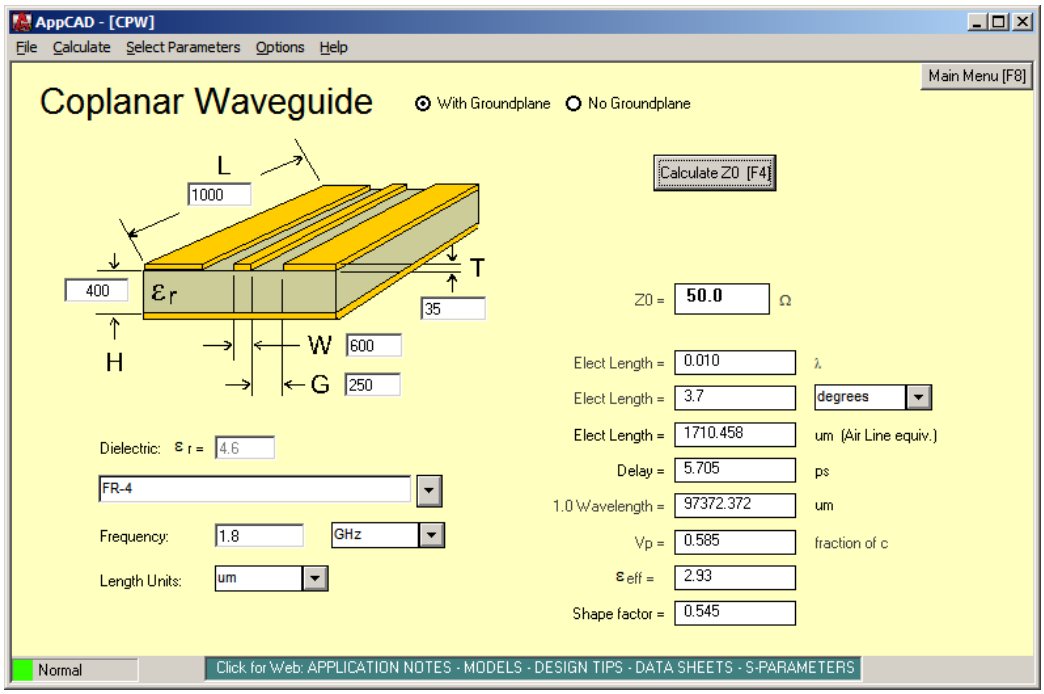


Figure 49. AppCad Screenshot for Coplanar Waveguide Design

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 Coplanar Waveguide structure and route the digital line(s) "outside" the RF structure as shown in the figure below.

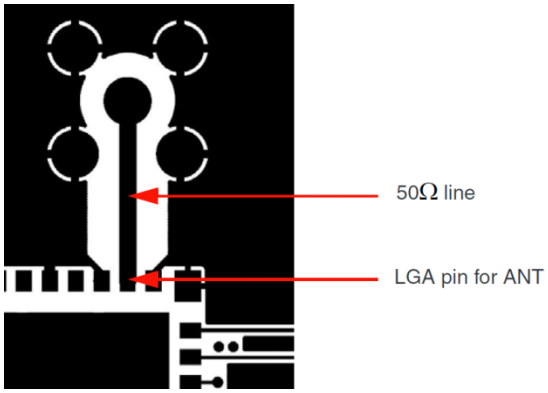


Figure 50. RF Routing Examples

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.

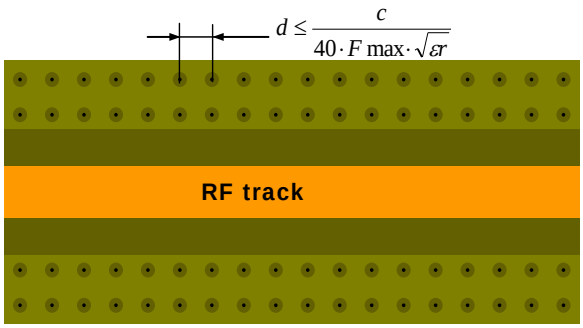


Figure 51. RF Routing – Vias Minimum Distance Example

8.8. EMC and ESD Recommendations

EMC tests have to be performed on the application as soon as possible to detect any potential problems.

When designing, special attention should be paid to:

- Possible spurious emissions radiated by the application to the RF receiver in the receiver band
- ESD protection is mandatory on all signals which are externally accessible. Typically, ESD protection is mandatory for the:
  - SIM (if accessible from outside)
  - Serial interface
  - USB
  - Antenna Port

  The ESD diode on the antenna port is intended to prevent any degradation in RF performance. The following device is recommended for SL808xT, SL808xBT and SL808xBTA modules:

  Manufacturer: INPAQ Technology Co.

  Part Number: EGA10402V05A2

- Length of the SIM interface lines (preferably <10 cm)
- EMC protection on audio input/output (filters against 900 MHz emissions)
- Biasing of the microphone inputs
- Ground plane: Sierra Wireless recommends a common ground plane for analog/digital/RF grounds
- A metallic case or plastic casing with conductive paint are recommended, except area around the antenna

Note: *The AirPrime SL808xT, SL808xBT and SL808xBTA module does not include any protection against over voltage.*

ESD reliability qualification summary is defined in section 11 Reliability Specification.

8.9. Mechanical Integration

Attention should be paid to:

- Antenna cable integration (bending, length, position, etc)
- Leads of the AirPrime SL808xT, SL808xBT and SL808xBTA module to be soldered to the ground plane

9. Embedded Testability

9.1. Testing Assistance Provided by Sierra Wireless

Extended AT commands have been implemented to assist with performing FTA GCF tests and portions of CE Mark tests requiring radio module access. These are documented in documents [2] AT Commands Interface Guide for Firmware 7.52/7.53 and [3] ADL User Guide for Open AT Application Framework OS 6.52.

Sierra Wireless offers optional professional services based assistance to OEMs with regulatory approvals.

9.2. Integration Requirements

When integrating the SL808xT, SL808xBT and SL808xBTA module, the following items must be addressed:

- Mounting – Effect on temperature, shock, and vibration performance
- Power supply – Impact on battery drain and possible RF interference
- Antenna location and type – Impact on RF performance
- Regulatory approvals – As discussed in section 10 Certification Compliance and Recommended Standards.
- Service provisioning – Manufacturing process

Sierra Wireless provides guidelines for successful SL808xT, SL808xBT and SL808xBTA module integration with the document suite and offers integration support services as necessary.

9.3. IOT / Operator

Interoperability and Operator/Carrier testing of the finished system is the responsibility of the OEM. The test process will be determined with the chosen network operator(s) and will be dependent upon your business relationship with them, as well as the product's application and sales channel strategy.

Sierra Wireless offers assistance to OEMs with the testing process, if required.

9.4. Serial Interface Access

Direct access to the UART1 serial interface is useful for:

- Testability operations
- Firmware download (for more information on firmware upgrade, see section 3.7 Firmware Upgrade)

To allow direct access to the UART1 interface, the serial interface access designs shown in Figure 17 Example of a 4-wire UART Application and Figure 18 Example of an 8-wire UART Application are recommended.

Either of the following should be used:

- Split-supply RS-232 transceiver. For example, Linear Technology LTC2804 or Texas Instruments TRS3253E.

  or

- Single-supply transceiver plus a level translator. For example, Analog Devices ADM3307E for the RS232 transceiver, and ST Microelectronics ST2378E for the level translator.

When it is necessary to download firmware into the AirPrime SL808xT, SL808xBT and SL808xBTA module without going through the RS232 interface, access to the module is forced via the debug connector.

9.5. RF Output Accessibility

During the integration phase of the AirPrime SL808xT, SL808xBT and SL808xBTA module, it can be helpful to connect the AirPrime SL808xT, SL808xBT and SL808xBTA module to a GSM/GPRS simulator in order to check critical RF TX parameters and power behavior.

Although the AirPrime SL808xT, SL808xBT and SL808xBTA module has been certified, some parameters may have degraded due to some basic precautions not having been followed (poor power supply, for example). This will not affect the functionality of the product, but the product will not comply with GSM specifications.

The following TX parameters can be checked using a GSM/GPRS simulator:

- Phase & Frequency Error
- Output Power and GSM Burst Time
- Output Spectrum (Modulation and Switching)

Listed below are available typical GSM/GPRS simulators:

- CMU200 from Rhode & Schwarz
- 8960 from Agilent

Because of the high prices associated with GSM/GPRS simulators and the necessary GSM know-how to perform simulations, customers can check their applications in the Sierra Wireless laboratories. Contact the Sierra Wireless support team for more information.

10. Certification Compliance and Recommended Standards

10.1. UMTS Compliance Acceptance and Certification

The SL808xT, SL808xBT and SL808xBTA module is designed to be compliant with the 3GPP Release 5 UMTS Specification for Mobile Terminated Equipment. Final regulatory and operator certification requires regulatory agency testing and approval with the fully integrated UMTS UE host device incorporating the SL808xT, SL808xBT and SL808xBTA module.

The OEM host device and, in particular, the OEM antenna design and implementation will affect the final product functionality, RF performance, and certification test results.

Note: Tests that require features not supported by the SL808xT, SL808xBT and SL808xBTA (as defined by this document) are not supported.

10.2. Certification Compliance

The AirPrime SL808xT, SL808xBT and SL808xBTA module installed on a development kit socket board application is compliant with the requirements in the following table.

Table 83. Standards Conformity for the SL808xT, SL808xBT and SL808xBTA Module

Domain	Applicable Standard	SL8080T, SL8080BT	SL8082T, SL8082BT	SL8084T, SL8084BT	SL8080BTA	SL8082BTA	SL8084BTA
CE	Directive 1999/5/EC		✓	✓		✓	✓
Efficient use of the radio frequency spectrum	EN 301 511 (V 9.0.2)		✓			✓	
EMC	EN 301 489-1 (v1.9.2) EN 301 489-3 (v1.6.1) EN 301 489-7 (v1.3.1) EN 301 489-24 (v1.5.1) EN 301908-1 (v6.2.1) EN 300 440-1 (v1.6.1) EN 300 440-2 (v1.4.1)		✓			✓	
FCC/IC	FCC Part 22H: Oct, 2013 FCC Part 24H: Oct, 2013 RSS-132 Issue 3: Jan. 2013 RSS-133 Issue 6: Jan 2013 ANSI/TIA-603-C-2004	✓		✓	✓		✓
GCF	GCF-CC v3.55 3GPP TS 51.010-1 (v12.2.0) 3GPP TS 34.121-1 (v11.4.0) 3GPP TS 34.123-1 (v11.3.0)		✓	✓		✓	✓
PTCRB	NAPRD.03 v5.16 or later	✓			✓		

Domain	Applicable Standard	SL8080T, SL8080BT	SL8082T, SL8082BT	SL8084T, SL8084BT	SL8080BTA	SL8082BTA	SL8084BTA
JRF/JPA			✓	✓			✓
North America carriers	AT&T, Rogers	✓			✓		
Japan carriers	NTT Docomo			✓			✓

10.3. Applicable Standards

For queries concerning specific industry standards and certifications not described in this chapter, contact your Sierra Wireless account representative.

10.3.1. 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 the Sierra Wireless modem, or for failure of the Sierra Wireless modem to transmit or receive such data.

10.3.2. Safety and Hazards

Do not operate your AirPrime SL808xT, SL808xBT and SL808xBTA module modem:

- In areas where blasting is in progress
- Where explosive atmospheres may be present including refuelling 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 SL808xT, SL808xBT and SL808xBTA modem **MUST BE POWERED** OFF. Otherwise, the SL808xT, SL808xBT and SL808xBTA modem can transmit signals that could interfere with this equipment.

In an aircraft, the SL808xT, SL808xBT and SL808xBTA modem **MUST BE POWERED OFF**. Otherwise, the SL808xT, SL808xBT and SL808xBTA 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 a cellular phone in an 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 SL808xT, SL808xBT and SL808xBTA modem may be used normally at this time.

10.3.3. Important Compliance Information for North American Users

The AirPrime SL8080T, SL8080BT and SL8080BTA modules have been granted FCC (Federal Communications Commission) modular approval for use in mobile applications. Module integrators may use these devices in their final products without attaining additional FCC/IC (Industry Canada) certifications, provided they meet specific design conditions in their platform. Otherwise, additional FCC/IC approvals must be obtained.

Please contact your Sierra Wireless representative for more information.

10.3.4. EU Regulatory Conformity

Sierra Wireless hereby declares that the SL8082T, SL8082BT and SL8082BTA modem conforms with all essential requirements of Directive 1999/5/EC.

The Declaration of Conformity made under Directive 1999/5/EC is available for viewing at the following location in the EU community:

Sierra Wireless (UK) Limited
Suite 5, the Hub
Fowler Avenue
Farnborough Business Park
Farnborough, United Kingdom GU14 7JP

11. Reliability Specification

AirPrime SL808XT, SL808XBT AND SL808XBTA are tested against the Sierra Wireless Automotive Reliability Specification defined below.

11.1. Reliability Compliance

The AirPrime SL808XT, SL808XBT AND SL808XBTA embedded modules connected on a development kit board application is compliant with the following requirements.

Table 84. Standards Conformity for the AirPrime SL808XT, SL808XBT AND SL808XBTA Embedded Modules

Abbreviation	Definition
IEC	International Electro technical Commission
ISO	International Organization for Standardization

11.2. Applicable Standards

The table below gives the basic list of standards applicable to the AirPrime SL808XT, SL808XBT AND SL808XBTA.

Note: References to any features can be found from these standards.

Table 85. Applicable Standards and Requirements

Document	Current Version	Title
IEC6006826	7.0	Environmental testing - Part 2.6: Test FC: Sinusoidal Vibration.
IEC60068234	73	Basic environmental testing procedures part 2: Test FD: random vibration wide band - general requirements Cancelled and replaced by IEC60068-2-64. For reference only.
IEC60068264	2.0	Environmental testing - part 2-64: Test FH: vibration, broadband random and guidance.
IEC60068232	2.0	Basic environmental testing procedures - part 2: Test ED: (procedure 1) (withdrawn and replaced by IEC60068-2-31).
IEC60068231	2.0	Environmental testing part 2-31: Test EC: rough handling shocks, primarily for equipment-type specimens.
IEC60068229	2.0	Basic environmental testing procedures - part 2: Test EB and guidance: bump Withdrawn and replaced by IEC60068-2-27. For reference only.
IEC60068227	4.0	Environmental testing - part 2-27: Test EA and guidance: shock.
IEC60068214	6.0	Environmental testing - part 2-14: Test N: change of temperature.
IEC6006822	5.0	Environmental testing - part 2-2: Test B: dry heat.
IEC6006821	6.0	Environmental testing - part 2-1: Test A: cold.
IEC60068230	3.0	Environmental testing - part 2-30: Test DB: damp heat, cyclic (12 h + 12 h cycle).
IEC6006823	69 w/A1	Basic environmental testing procedures part 2: Test CA: damp heat, steady State Withdrawn and replaced by IEC60068-2-78. For reference only.

Document	Current Version	Title
IEC60068278	1.0	Environmental testing part 2-78: Test CAB: damp heat, steady state.
IEC60068238	2.0	Environmental testing - part 2-38: Test Z/AD: composite temperature/humidity cyclic test.
IEC60068240	1.0 w/A1	Basic environmental testing procedures - part 2: Test Z/AM combined cold/low air pressure tests.
ISO167501	2ND	Road vehicles - environmental conditions and testing for electrical and electronic equipment - part 1: general.
ISO167502	2ND	Road vehicles - environmental conditions and testing for electrical and electronic equipment - part 2: electrical loads.
ISO167503	2ND	Road vehicles - environmental conditions and testing for electrical and electronic equipment - part 3: mechanical loads.
ISO167504	2ND	Road vehicles - environmental conditions and testing for electrical and electronic equipment - part 4: climatic loads.
IEC60529	2.1 w/COR2	Degrees of protection provided by enclosures (IP code).
IEC60068217	4.0	Basic environmental testing procedures - part 2: Test Q: sealing.
IEC60068218	2.0	Environmental testing - part 2-18: Tests - R and guidance: water.
IEC60068270	1.0	Environmental testing - part 2: tests - test XB: abrasion of markings and letterings caused by rubbing of fingers and hands.
IEC60068268	1.0	Environmental testing - part 2: tests - test l: dust and sand.
IEC60068211	3.0	Basic environmental testing procedures, part 2: test KA: salt mist.
IEC60068260	2.0	Environmental testing - part 2: Test KE: flowing mixed gas corrosion test.
IEC60068252	2.0 w/COR	Environmental testing - part 2: Test KB: salt mist, cyclic (sodium chloride solution).

11.3. Reliability Prediction Model

11.3.1. Life Stress Test

The following tests the AirPrime SL808xT, SL808xBT and SL808xBTA's product performance.

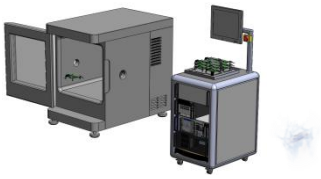
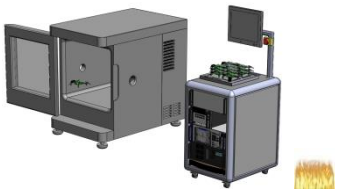
Table 86. Life Stress Test

Designation	Condition
Performance Test PT3T° & PT 	Standard: N/A
	Special conditions: • Temperature: ▪ Class A: -30°C to +75°C ▪ Class B: -40°C to +85°C ▪ Rate of temperature change: ± 3°C/min • Recovery time: 3 hours
	Operating conditions: Powered
	Duration: 14 days

11.3.2. Environmental Resistance Stress Tests

The following tests the AirPrime SL808xT, SL808xBT and SL808xBTA's resistance to extreme temperature.

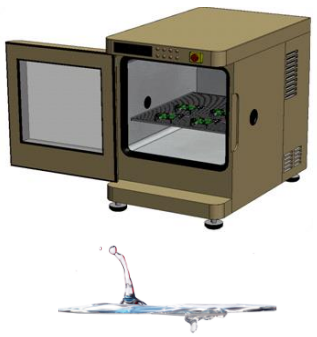
Table 87. Environmental Resistance Stress Tests

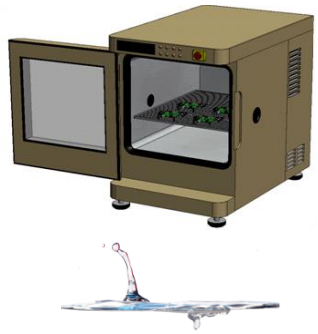
Designation	Condition
Cold Test Active **COTA** 	Standard: IEC 680068-2-1, Test Ad
	Special conditions: • Temperature: -40°C • Temperature variation: 1°C/min
	Operating conditions: Powered On a duty cycle, Idle 1hr/Tx full power 1hr
	Duration: 3 days
Resistance to Heat Test **RH** 	Standard: IEC 680068-2-2, Test Bb
	Special conditions: • Temperature: +90°C • Temperature variation: 1°C/min
	Operating conditions: Powered On a duty cycle, Idle 1hr/Tx full power 1hr
	Duration: 60 days

11.3.3. Corrosive Resistance Stress Tests

The following tests the AirPrime SL808xT, SL808xBT and SL808xBTA's resistance to corrosive atmosphere.

Table 88. Corrosive Resistance Stress Tests

Designation	Condition
Humidity Test HUT 	Standard: IEC 60068-2-3
	Special conditions: • Temperature: +65°C • RH: 95% • Temperature variation: 3 +/- 0.6°C/min
	Operating conditions: Powered on, DUT is powered up for 15 minutes and OFF for 15 minutes
	Duration: 10 days

Designation	Condition
Moist Heat Cyclic Test **MHCT** 	Standard: IEC 60068-2-30, Test Db
	Special conditions: • Upper temperature: +40 ± 2°C • Lower temperature: +25 ± 5°C • RH: ▪ Upper temperature: 93% ▪ Lower temperature: 95% • Number of cycles: 21 (1 cycle/24 hours) • Temperature Variation: 3 +/- 0.6°C/min
	Operating conditions: Un-powered
	Duration: 21 days

11.3.4. Thermal Resistance Cycle Stress Tests

The following tests the AirPrime SL808xT, SL808xBT and SL808xBTA's resistance to extreme temperature cycling.

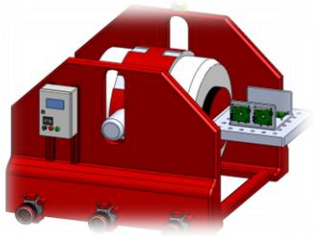
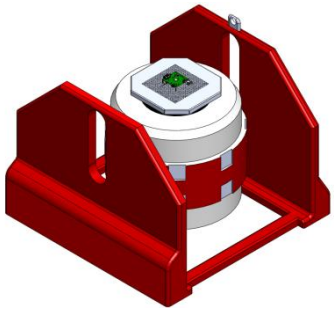
Table 89. Thermal Resistance Cycle Stress Tests

Designation	Condition
Thermal Shock Test **TSKT** 	Standard: IEC 60068-2-14, Test Na
	Special conditions: • Temperature: -40°C to +85°C • Temperature Variation: less than 30s • Number of cycles: 1000 • Dwell Time: 10 minutes
	Operating conditions: Un-powered
	Duration: 14 days
Temperature Change **TCH** 	Standard: IEC 60068-2-14, Test Nb
	Special conditions: • Temperature: -40°C to +95°C • Temperature Variation: 3 +/- 0.6°C/min • Number of cycles: 400 • Dwell Time: 10 minutes
	Operating conditions: Un-powered
	Duration: 29 days

11.3.5. Mechanical Resistance Stress Tests

The following tests the AirPrime SL808xT, SL808xBT and SL808xBTA's resistance to vibrations and mechanical shocks.

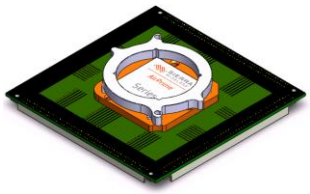
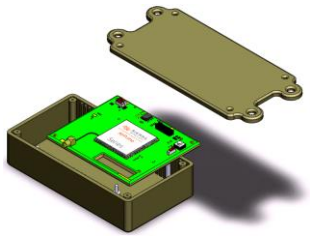
Table 90. Mechanical Resistance Stress Tests

Designation	Condition
Sinusoidal Vibration Test SVT 	Standard: IEC 60068-2-6, Test Fc
	Special conditions: • Frequency range: 30 Hz to 500 Hz • Displacement: 0.35mm (peak-peak) • Acceleration: ▪ 5G from 30 to 62 Hz ▪ 3G from 62 to 200 Hz ▪ 1G from 200 to 500 Hz • Sweep rate: 15 minute / cycle • Number of Sweep: 36 sweeps/axis • Sweep direction: +/- X,+/- Y, +/- Z
	Operating conditions: Un-powered
	Duration: 4 days
Random Vibration Test RVT 	Standard: IEC 60068-2-64
	Special conditions: • Frequency range: 10 Hz – 2000 Hz • Power Spectral Density in $[(m/s^2)^2/Hz]$ ▪ 0.1 g2/Hz at 10Hz ▪ 0.01 g2/Hz at 250Hz ▪ 0.005 g2/Hz at 1000Hz ▪ 0.005 g2/Hz at 2000Hz • Peak factor : 3 • Duration per Axis : 8hrs / axis
	Operating conditions: Un-powered
	Duration: 3 to 4 days
Mechanical Shock Test MST 	Standard: IEC 60068-2-27, Test Ea
	Special conditions: • Shock Test 1: ▪ Wave form: Half sine ▪ Peak acceleration: 30g ▪ Duration: 11ms ▪ Number of shocks: 8 ▪ Direction: ±X, ±Y, ±Z • Shock Test 2: ▪ Wave form: Half sine ▪ Peak acceleration: 100g ▪ Duration: 6ms ▪ Number of shocks: 3 ▪ Direction: ±X, ±Y, ±Z
	Operating conditions: Un-powered
	Duration: 72 hours

11.3.6. Handling Resistance Stress Tests

The following tests the AirPrime SL808xT, SL808xBT and SL808xBTA's resistance to handling malfunctions and damage.

Table 91. Handling Resistance Stress Tests

Designation	Condition
ESDC Test 	Standard: JESD22-A114, JESD22-A115, JEDEC JESD 22 – C101C
	Special conditions: • HBM (Human Body Model) : 2KV (Class 2) except USB_D+ (pin 50) / USB_D- (pin 51) : 500V • MM (Machine Model) : 200V (Class B) • CDM (Charged Device Model) : 500V (Class III)
	Operating conditions: Powered
	Duration: 3 days
Free Fall Test **FFT 1** 	Standard : IEC 60068-2-32, Test Ed
	Special conditions: • Number of drops: 2 drops per unit and per axis (total 12 drops) • Height: 1m
	Operating conditions: Un-powered
	Duration: 6 hours
Free Fall Test **FFT 2** 	Standard : Standard Sierra Wireless Methodology
	Special conditions: • Number of drops: 2 drops per unit and per axis (total 12 drops) • Height: 1.5m
	Operating conditions: Un-powered
	Duration: 6 hours

12. Customization

Subject to commercial terms, Sierra Wireless can supply custom-configured modems to facilitate a carrier's network and performance requirements. Sierra Wireless also offers a standard configuration for each country.

Custom configurations are entered into a selector spreadsheet that Sierra supplies. A unique part number is assigned to each custom configuration to facilitate customer ordering.

Table 92. Customizable Features

Name	Description	Default
Voice functionality	When enabled, supports voice calls and displays the Watcher 'voice' tab.	Enabled
MEP network locked	Mobile Equipment Personalization network locked to only allow use with specific preconfigured PLMNs (SIMs). MMI supports the entry of an unlock code subject to permanent locking feature below.	Off
MEP service provider locked		
Permanent MEP locked	Can block deactivation of MEP locked feature	Off
Roaming indicator disable*	Watcher never shows the onscreen roaming indicator.	Indicator enabled
Service indicator disable*	Watcher never shows the onscreen indicator. (For example, "HSDPA", "GPRS", "3G")	Indicator enabled
Data counter disable*	Watcher never shows Rx and Tx data counters.	Rx and Tx data counters enabled
Disable advanced profile menu (QoS)*	If disabled Watcher never shows advanced profile's QoS menus and user cannot change the minimum and requested QoS parameters.	Advance profile menu disabled
SIM PUK prompt enable	If enabled, Watcher shows the message "SIM blocked please enter PIN code".	Disabled, Watcher displays "Contact Service Provider" when SIM PIN is blocked.
GPRS attach on start-up*	If disabled, modem attaches when GPRS connection is required.	The modem GPRS attaches at start-up.
Disable Auto Connect	If disabled, the Auto Connect feature is blocked and cannot be enabled by the user. If blocked, the "Auto Connect" button on the profile edit menu is greyed out and cannot be selected.	The auto-connect feature menu item is enabled with the default state set to manual (not auto-connect).
Scan for profile	The modem scans through all its programmed profiles to find successful GPRS connection.	Not scanning. Only the selected profile is used for connection.
IMEI/TAC	Configured at factory to one of the following values: • Sierra Wireless IMEI • Customer-specified IMEI • No IMEI	Sierra Wireless IMEI

* Features only available if supported in the user interface.

13. Safety Recommendations

(For Information Only)

For the efficient and safe operation of your GSM application based on the AirPrime SL808xT, SL808xBT and SL808xBTA module, please read the following information carefully.

13.1. RF Safety

13.1.1. General

Your GSM terminal is based on the GSM standard for cellular technology. The GSM standard is spread all over the world. It covers Europe, Asia and some parts of America and Africa. This is the most used telecommunication standard.

Your GSM terminal is actually a low power radio transmitter and receiver. It sends out as well as receives radio frequency energy. When you use your GSM application, the cellular system which handles your calls controls both the radio frequency and the power level of your cellular modem.

13.1.2. Exposure to RF Energy

There has been some public concern about possible health effects of using GSM terminals. Although research on health effects from RF energy has focused on the current RF technology for many years, scientists have begun research regarding newer radio technologies, such as GSM. After existing research had been reviewed, and after compliance to all applicable safety standards had been tested, it has been concluded that the product was fitted for use.

If you are concerned about exposure to RF energy, there are things you can do to minimize exposure. Obviously, limiting the duration of your calls will reduce your exposure to RF energy. In addition, you can reduce RF exposure by operating your cellular terminal efficiently by following the guidelines below.

13.1.3. Efficient Terminal Operation

For your GSM terminal to operate at the lowest power level, consistent with satisfactory call quality:

If your terminal has an extendable antenna, extend it fully. Some models allow you to place a call with the antenna retracted. However your GSM terminal operates more efficiently with the antenna when it is fully extended.

Do not hold the antenna when the terminal is "IN USE". Holding the antenna affects call quality and may cause the modem to operate at a higher power level than needed.

13.1.4. Antenna Care and Replacement

Do not use the GSM terminal with a damaged antenna. If a damaged antenna comes into contact with the skin, a minor burn may result. Replace a damaged antenna immediately. You may repair antenna to yourself by following the instructions provided to you. If so, use only a manufacturer-approved antenna. Otherwise, have your antenna repaired by a qualified technician.

Buy or replace the antenna only from the approved suppliers list. Using unauthorized antennas, modifications or attachments could damage the terminal and may contravene local RF emission regulations or invalidate type approval.

13.2. General Safety

13.2.1. Driving

Check the laws and the regulations regarding the use of cellular devices in the area where you have to drive as you always have to comply with them. When using your GSM terminal while driving, please:

- give full attention to driving,
- pull off the road and park before making or answering a call if driving conditions so require.

13.2.2. Electronic Devices

Most electronic equipment, for example in hospitals and motor vehicles is shielded from RF energy. However, RF energy may affect some improperly shielded electronic equipment.

13.2.3. Vehicle Electronic Equipment

Check with your vehicle manufacturer representative to determine if any on-board electronic equipment is adequately shielded from RF energy.

13.2.4. Medical Electronic Equipment

Consult the manufacturer of any personal medical devices (such as pacemakers, hearing aids, etc...) to determine if they are adequately shielded from external RF energy.

Turn your terminal OFF in health care facilities when any regulations posted in the area instruct you to do so. Hospitals or health care facilities may be using RF monitoring equipment.

13.2.5. Aircraft

Turn your terminal OFF before boarding any aircraft.

- Use it on the ground only with crew permission.
- Do not use it in the air.

To prevent possible interference with aircraft systems, Federal Aviation Administration (FAA) regulations require you should have prior permission from a crew member to use your terminal while the aircraft is on the ground. To prevent interference with cellular systems, local RF regulations prohibit using your modem while airborne.

13.2.6. Children

Do not allow children to play with your GSM terminal. It is not a toy. Children could hurt themselves or others (by poking themselves or others in the eye with the antenna, for example). Children could damage the modem, or make calls that increase your modem bills.

13.2.7. Blasting Areas

To avoid interfering with blasting operations, turn your unit OFF when you are in a "blasting area" or in areas posted: "turn off two-way radio". Construction crew often uses remote control RF devices to set off explosives.

13.2.8. Potentially Explosive Atmospheres

Turn your terminal OFF when in any area with a potentially explosive atmosphere. Though it is rare, but your modem or its accessories could generate sparks. Sparks in such areas could cause an explosion or fire resulting in bodily injuries or even death.

Areas with a potentially explosive atmosphere are often, but not always, clearly marked. They include fuelling areas such as petrol stations; below decks on boats; fuel or chemical transfer or storage facilities; and areas where the air contains chemicals or particles, such as grain, dust, or metal powders.

Do not transport or store flammable gas, liquid, or explosives, in the compartment of your vehicle which contains your terminal or accessories.

Before using your terminal in a vehicle powered by liquefied petroleum gas (such as propane or butane) ensure that the vehicle complies with the relevant fire and safety regulations of the country in which the vehicle is used.

14. References

14.1. Web Site Support

For additional documents describing module design, usage, and integration issues, visit the Source.

Content	Web Site
General information about AirPrime SL Series	http://www.sierrawireless.com/productsandservices/airprime_wireless_modules/smart_modules/sl_series/
Open AT Application Framework Introduction	http://www.sierrawireless.com/productsandservices/airprime_wireless_modules/smart_modules/application_framework/
Developer support for software and hardware	http://forum.sierrawireless.com/

14.2. Reference Documents

14.2.1. Sierra Wireless Documents

The following Sierra Wireless documents are provided in your documentation package, or are available from the Source.

[1] AirPrime SL Series Mechanical Socket Development Kit User Guide
Reference: 4112314

[2] AT Commands Interface Guide for Firmware 7.52/7.53
Reference: 4111843

[3] ADL User Guide for Open AT Application Framework OS 6.52
Reference: 4111844

[4] Sierra Wireless Reliability Specification
Reference: 4110485

[5] AirCard/AirPrime USB Driver Developer's Guide
Reference: 2130634

[6] AirPrime SL Series Customer Process Guidelines
Reference: 4114416

[7] AirPrime SL808xT, SL808xBT and SL808xBTA Thermal Model
Reference: 4117933

[8] Location Library for Open AT Framework AT Command Interface Guide
Reference: 4112808

[9] Location Library for Open AT Framework Development Guide
Reference: 4112809

14.2.2. Industry / Other Documents

The following non-Sierra Wireless references are not included in your documentation package.

[10] Universal Serial Bus Specification, Rev 2.0

[11] 3GPP TS 34.108

14.3. Abbreviations / Acronyms

Table 93. List of Abbreviations / Acronyms

Abbreviation	Definition
3GPP	3rd Generation Partnership Project
A-GPS	Assisted GPS
API	Application Programming Interface
AT	Attention (prefix for modem commands)
CHAP	Challenge Handshake Authentication Protocol
CnS	Control and Status (Sierra Wireless' proprietary host interface protocol)
CPHS	Common PCN Handset Specification
CS	Circuit-switched
CSD	Circuit-switched Data
DHCP	Dynamic Host Configuration Protocol
DNI	Do Not Implement
DUN	Dial-Up Networking
EAP-SIM	Extensible Authentication Protocol Method for GSM Subscriber Identity
EDGE	Enhanced Data rates for GSM Evolution
EFR	Enhanced Full Rate
EONS	Enhanced Operator Name String
FR	Full Rate
GPRS	General Packet Radio Service
GPS	Global Positioning System
GSM	Global System for Mobile Communications
HPLMN	Home PLMN
HR	Half Rate
HSDPA	High Speed Downlink Packet Access
IMSI	International Mobile Subscriber Identity
LGA	Land Grid Array
MO	Modem Originated
MT	Modem Terminated
NDIS	Network Driver Interface Specification
NIC	Network Interface Card
NMEA	National Marine Electronics Association
PAP	Password Authentication Protocol
PC/SC	PC / Smart Card
PDP	Packet Data Protocol

Abbreviation	Definition
PLMN	Public Land Mobile Network
PS	Packet-switched
QoS	Quality of Service
RF	Radio Frequency
RTC	Real Time Clock
Rx	Receive
SDK	Software Development Kit
SIM	Subscriber Identity Module
SMS	Short Message Service
TDD	Telecommunications Device for the Deaf
TTY	Teletypewriter
Tx	Transmit
UMTS	Universal Mobile Telecommunications System
USB	Universal Serial Bus
USIM	Universal Subscriber Identity Module (UMTS)
USSD	Unstructured Supplementary Services Data
VCC	Collector Common Voltage
WCDMA	Wideband Code Division Multiple Access

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