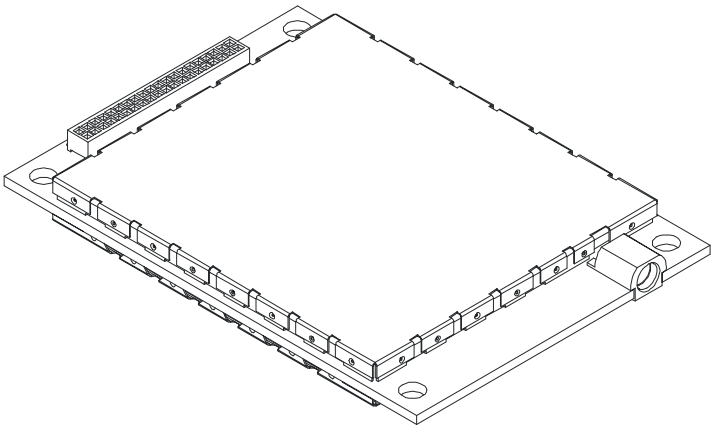
SB555 Embedded Modem

Product Specification

Proprietary and Confidential



2130072
Rev 1.5

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

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

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5,515,013	5,617,106	5,629,960	5,682,602
5,748,449	5,845,216	5,847,553	5,878,234
5,890,057	5,929,815	6,169,884	6,191,741
6,199,168	6,327,154	6,339,405	D367,062
D372,248	D372,701	D416,857	D442,170
D452,495	D452,496 and other patents pending.		

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Web:	www.sierrawireless.com	

Your comments and suggestions on improving this documentation are welcome and appreciated. Please e-mail your feedback to documentation@sierrawireless.com. Thank you.

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

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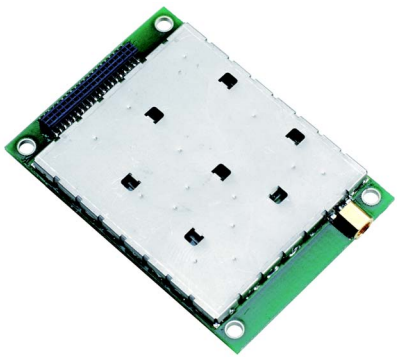
Table of Contents

1: Introduction

- Specification summary
- Ordering information
- CDMA2000 1X primer

The Sierra Wireless SB555 embedded modem is a compact, lightweight, wireless modem that provides CDMA2000 1X connectivity for portable and handheld computers, point of sale devices, and telemetry applications. It has a dual-band radio supporting both the 800 MHz cellular and 1900 MHz PCS bands.

The purpose of this document is to provide interested OEMs with the necessary technical information to understand the high level features and specifications of the modem and what is necessary to integrate it into your product. Application and hardware interface requirements are discussed at a high level only; for more detail refer to the Sierra Wireless technical references available in the SB555 Embedded Modem Development Kit.



Specifications at a glance

This section outlines the critical high-level features of the Sierra Wireless SB555 Embedded Modem for CDMA2000 1X. More detailed specifications are provided in following sections.

Physical features

- Small form factor compatible with other Sierra Wireless modules
- MMCX RF connector jack
- Single host connector
- Top or bottom mounting
- Four mounting holes

Packet mode features

- Data rates up to 153.6 kbps (forward channel) and 76.8 kbps (reverse channel)

Short Message Service (SMS) features

- Send and Receive
- Notification of new messages

Voice mode features

- Call origination up to 32 digits
- Silent retry call origination protocol
- Echo cancellation
- E911 support
- Internal IS-127 and IS-733 vocoders
- Incoming call notification

Electrical features

- 3.3 VDC supply voltage (3.2–4.2 V input)
  Current drain:
  Max: 900 mA (full power transmit)
  Min: < 1 mA (sleep)
- Self-shielded, no additional shielding required

Application interface features

- Dual serial ports: one for data and one for device control
- PPP on the data port
- AT Commands
- Sierra Wireless proprietary Control and Status language (CnS)
- Software Development Kit (SDK) available including an Application Program Interface (API) for Windows® OS-based applications.

IS-95 circuit-switched features

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

Environmental features

- Operating ranges:
  Temperature: -30° to +60°C
  Humidity: MIL-STD-202F
- Vibration: MIL-STD-810E and PC Card Standard
- Shock: MIL-STD-202F

RF features

- 224 mW RF output (+23.5 dBm)
- Full duplex transceiver
- Dual-band support for both 800 MHz cellular and 1.9 GHz PCS bands
- Slotted mode operation
- Adheres to CDMA authentication as specified in CDMA2000 1X
- Wake on radio in-coverage notification

Support features

- Standard 1-year warranty
- Extended warranties of 1 or 2 additional years available
- Enabling software for Windows® operating systems: 98, Me, 2000, XP, CE 3.00 and above
- Host-assisted over-the-air firmware upgrades
- Over-The-Air Service Provisioning (OTASP)

Supporting documents

- Project Planning Guide
- Design Guide
- Hardware Integration Guide
- Software Integration Guide
- AT Command Reference
- API Reference
- CnS Reference
- Enabling Software Guide
- Verification and Configuration Guide

Accessories

- SB555 Development Kit including:
  - Embedded Modem Interface Kit
  - Antennas
  - MMCX to SMA Adapter
  - Documentation Suite
  - Initial allotment of support hours
- Embedded Modem Simulator Kit

Ordering information

All orders can be made by contacting the Sierra Wireless Sales Desk at +1 (604) 232-1488 between 8am and 5pm Pacific Time.

Table 1-1: Ordering information

Product	Part number
SB555 Embedded Modem for CMDA2000 1X	Contact your sales agent
Embedded Modem Interface Kit • Multi-Purpose Interface Board-II • Power supply • Serial cables (2) • Interface Kit User Guide	6000160
Embedded Modem Simulator Kit • Modem Simulator • Simulator Kit User Guide (Embedded Modem Interface Kit recommended)	6000159

Table 1-1: Ordering information

Product	Part number

SB555 Modem Development Kit
• Embedded Modem Interface Kit (6000160)
• Dual-band desktop antenna
• Dual-band stubby antenna
• MMCX–SMA Antenna adapter
• Documentation Suite
  • Product Specification (this book)
  • Project Planning Guide
  • Design Guide
  • Hardware Integration Guide
  • Enabling Software Guide
  • Software Integration Guide
  • AT Command References
  • API Reference
  • CnS Reference
  • Verification and Configuration Guide
• Initial allotment of support hours
	6000161

SB555 Extended Warranty - 1-Year	6000109
SB555 Extended Warranty - 2-Year	6000110
Software Development Kit (SDK) • Support for Windows® 98, Me, 2000, XP, and PPC, PPC2002	Via Sierra Wireless Developer's Central

CDMA2000 1X primer

The marketplace has been demanding faster wireless data services and the industry has been working at developing third generation wireless systems. 3G systems are intended to provide users with high-speed Internet services for improved performance of new multimedia content delivery, and to improve network capacity to support more subscribers. The International Telecommunications Union (ITU) initiated the IMT-2000 program to develop standards for 3G systems, and completed them in late 1999. The IMT-2000 program defined several standards; CDMA2000 1X is one of them. For additional information on the IMT-2000 program visit the ITU web site at www.itu.int/imt/. For additional information on CDMA in general, consult the CDMA Development Group web site at www.cdg.org.

CDMA2000 3G services are intended to appeal to a wide range of carriers. There have been commercial deployments beginning in October 2000. Lucent, Nortel Networks, Hitachi, CommWorks, Ericsson, Motorola, and Samsung all have infrastructure products in use or development.

Fundamental and supplemental channels

CDMA2000 1X achieves higher speeds for packet services by making use of supplemental channels to provide additional bandwidth.

The modem first connects in a circuit-switched fashion, using a fundamental channel. When there is a requirement for a burst of packet data at high speed, the modem can request a supplemental channel to carry the traffic. When the burst is finished, the supplemental channel is released for other network users.

Allocation of supplemental channels is managed by the network. In particularly busy networks, this means that throughput could be reduced when many users request the supplemental channel resource. If a supplemental channel is unavailable, the modem continues to move traffic over the fundamental channel.

1xRTT and IS-95A

The type of data connection made at any given time depends on the services available from the carrier in the given coverage area. If 1xRTT packet services are not available, the modem can connect using circuit-switched data over the IS-95A technology. The modem can automatically select the fastest connection mode available when a data call is connecting.

When roaming, the modem *does not* automatically change connection modes. If the modem connects using 1xRTT and then roams outside of the packet service area, the connection is dropped. A new connection using IS-95A has to be created to resume data communication. Similarly, an IS-95A call established in one area does not automatically speed up to 1xRTT when the unit enters the 3G coverage area.

2: Feature Specifications

2

- Standards
- Packet data
- Circuit-switched data
- Voice
- SMS
- Provisioning
- Application interface
- Enabling software
- Special features

Communication standards

The cited specifications apply, however not all features in all standards may be fully supported.

CDMA and cellular standards

- CDMA2000 1X Release 0 (plus ballot resolution version of addendum)
- CDG1, 2, and 3 for CDMA2000 1X
- IS-95A and B: Mobile Station-Base Station Compatibility Standard for Wideband Spread Spectrum Cellular Systems
- IS-98C and D: Recommended Minimum Performance Standards for Dual-Mode Spread Spectrum Mobile Stations
  - The SB555 has a relaxed specification for Single Tone Desensitization of -33 dBm level of interference tone in both the PCS and Cellular bands (the IS-98D specification 3.5.2 is -30 dBm).

- Telecommunications Systems Bulletin (TSB2000): Capabilities Requirements Mapping for CDMA2000 Standards (TIA/EIA/TSB2000)

Voice standards

- TIA/EIA IS-96A: Speech Service Option 1 Standard for Dual Mode Wide Band Spread Spectrum Cellular Systems
- TIA/EIA IS-96A+: Qualcomm enhanced IS-96A
- TIA/EIA IS-125: Recommended Minimum Performance Standards for Digital Cellular Wideband Spread Spectrum Speech Service Option 1
- TIA/EIA IS-127-1, 127-2, and 733-2 to support EVRC and 13K vocoders to reliably carry the TTY 45.545 Bauddot codes over the air interface
- CDG Reference Document #27: High Rate Speech Service Option for Wide Band Spread Spectrum Cellular Mobile Stations

Data and fax standards

- IS-707-A, Data Service Options for Wideband Spread Spectrum Systems
- IS-707A-1.10, Data Service Options for Spread Spectrum Systems: Radio Link Protocol Type 3
- IS-707A-1.12, Data Service Options for Spread Spectrum Systems: cdma2000 High Speed Data Service Option 33
- IS-707A.2, Data Service Options for Spread Spectrum Systems: Radio Link Protocol

- IS-707A.3, Data Service Options for Spread Spectrum Systems: AT Command Processing and the R_m Interface
- IS-707A.4 Data Service Options for Spread Spectrum Systems: Async Data and Fax Services (async data portion only)
- IS-707A.8 Data Service Options for Spread Spectrum Systems: Radio Link Protocol Type 2
- TIA/EIA/IS-134, Facsimile Digital Interfaces (Amendments to TIA/EIA-592 to Support ITU-T T.30-1993 - Interim Standard)
- TIA/EIA-592, Asynchronous facsimile DCE Control Standard
- TIA/EIA-602, Data transmission Systems and Equipment - Serial Asynchronous Automatic Dialling and Control
- TIA/EIA-617, Data transmission Systems and Equipment In-Band DCE Control

Network and administration standards

- TIA/EIA/IS-126A, Mobile Station Loopback Service Options Standard
- IS-835, Wireless IP Network Standards (Simple IP only in this phase due to Qualcomm and infrastructure implementation limitations)
- TSB-58C, Administration of Parameter Value Assignments for TIA/EIA Spread Spectrum Standards
- TIA/EIA/IS-683A, Over-the-Air Service Provisioning of Mobile Stations in Wideband Spread Spectrum Systems

Short Message Service (SMS) standards

- TIA/EIA/IS-637, Short Message Services for Wideband Spread Spectrum PCS Cellular Systems

Handoffs

The SB555 modem adheres to all types of CDMA handoffs as specified in CDMA2000 1X. The SB555 modem does not support CDMA to analog (or vice versa) handoffs.

Packet data specifications

The SB555 modem supports maximum data rates of:

- 153.6 kbps on the forward channel (network to modem)
- 76.8 kbps on the reverse channel (modem to network)

The network base station sets the actual data rates achievable at any given time.

Convolutional Codes are used for forward error correction (as negotiated with the network). The modem does not support the use of Turbo Codes.

Circuit-switched data specifications

Circuit-switched data connections support data rates up to 14.4 kbps. Actual data rates are determined by the network. Quick Net Connect (QNC) is supported.

Facsimile

Standard G3 facsimile call origination and termination requires user intervention. There is no ability within the CDMA network infrastructure to notify the modem of an incoming facsimile call. The user must set the modem to either answer the next call or all incoming calls with the facsimile service option negotiation. To originate a call, the facsimile application sets up the modem to negotiate a facsimile service option from the network.

Voice specifications

The SB555 modem operates as an integrated dual-band phone, operating in both the 800 MHz and 1900 MHz CDMA bands. AMPS service is *not* supported.

The SB555 modem host connector provides connections to internal analog audio vocoders, allowing simple integration with standard mobile headsets.

The SB555 modem depends on a user application running on the host device to provide the phone keypad support. Key-presses are relayed to the modem through the Control and Status (CnS) interface or through AT commands.

These features are also supported:

- Caller ID (via messages to a host application) is supported for in-progress voice calls. Support when a data call is active depends on the carrier.
- Call forwarding
- Call transfer (as defined in IS-664 via the Voice API)
- Voice mail notification via SMS (messages are sent to a host application)
- Call alert (messages to a host application can be used to provide audio/video alerts to the user) even when in a prior voice or data call.
- Voice call origination, including star code dialing and silent retry.
- Voice call origination (dialing) and termination (answering) are supported while the modem is idle or has a packet data call dormant: however, the current implementation of the Watcher enabling software requires a current packet data call to end before connecting the voice call. Voice call connection is *not* supported while an async data or QNC call is active; the data call must be disconnected first.
- DTMF tone generation
- TDD/TTY is supported in firmware but requires the host device to support the audio/mic jack and cabling to interface to the TTY terminal and support voice carry-over.

- Voice privacy (where supported by the CDMA provider).
- 3-Way calling is supported when the flash-with-information feature is available on the network infrastructure.

E911

The SB555 modem supports the E911 phase 1 standard (does not provide GPS support). It is possible for the modem to initiate an emergency call regardless of its activation state, lock state, or system acquisition state, provided there is a channel available. The modem supports:

- Three hard-coded emergency numbers (911, *911, #911)
- Five carrier-defined numbers set in the PRI
- Three user-defined numbers

Analog voice

The host connector provides analog signals for a standard mono hands-free headset to be connected. The analog signals can also be configured, via AT command, to deliver line level to the host device for alternate integration options.

Circuitry to control the volume of the headset's earpiece and microphone are selected through the modem control interface (using CnS) or on the data port using AT commands.

Echo cancellation functions are provided.

The SB555 includes both an 8k EVRC (Enhanced Variable Rate Coder) and a PureVoice™ QCELP 13k vocoder. The carrier's settings (PRI) determine which is used.

Analog voice quality

For radio transmission, the voice service uses a 3400 Hz low-pass filter. There is no filtering applied to voice signals received by the radio.

The quality of a voice signal is evaluated using a scale from 1–5 called the Mean-Opinion Score (MOS). It is calculated as an average of a large number of samples of speech data using differing speakers and listeners. The five points of quality are: bad (1), poor, fair, good, and excellent (5). Quality scores of 3.5 or higher generally imply high levels of intelligibility, speaker recognition, and naturalness.

Table 2-1: SB555 internal vocoders

Vocoder	Ref.	MOS
8k EVRC	IS-127	3.62
PureVoice™ QCELP 13k	IS-733	4.01

Short Message Service (SMS)

The SB555 modem complies with IS-637 for both message origination and reception.

Events are passed across the modem control interface using CnS (Control and Status) messages to notify the user of the arrival of new SMS messages. The modem is capable of providing the status and summary information (e.g. time, date, urgency, text, call back number) supplied by the network as part of the message.

Messages can be sent and received using either the CnS interface or AT commands.

Service provisioning

Provisioning Support Tool (PST)

Sierra Wireless makes available a product support utility that allows an authorized integrator to perform the following functions:

- Manually provision the SB555 modem for a specific carrier:
  - Manually select a PRI image and upgrade the existing PRI (Product Release Instructions)
  - Manually select a PRL image and upgrade the existing PRL (Preferred Roaming List)
- Manually select a flash image (firmware) and upgrade the existing firmware

IS-683A is supported for Over-The-Air Service Provisioning (OTASP).

Sierra Wireless provides assistance to integrators in accessing current PRI and PRL files, and returning provisioning data to the carriers in preparation for unit activation.

NAM

The SB555 modem supports two Number Assignment Modules (NAM). The modem supports programming of:

- Directory Number
- International Mobile Subscriber Identity (IMSI) (based on the Directory Number unless otherwise programmed)

To change any of the NAM programming parameters, the Master Subsidy Lock (MSL) code is required. The MSL is also known as the Service Programming Code (SPC) and is the same code that is used in activation (including via OTASP) as defined in IS-683A. The NAM memory is protected and does not display until after the MSL has been successfully entered.

Each SB555 modem can also be assigned a 6-digit one-time subsidy lock (OTSL) code, as used by some carriers. This code is used to access authorized functionality such as manual provisioning. Once the user gains access to protected functionality, the one-time lock is considered consumed and will no longer be valid regardless of whether provisioning or other access is successful.

The modem only requires one MIN (Mobile Identification Number) per NAM.

PRI

The Product Release Instruction (PRI) contain modem configuration default information. Information stored in the PRI can be modified through use of an upgrade tool provided by Sierra Wireless.

PRL

The SB555 modem supports System Selection for Preferred Roaming. The System Selection priority is based on a Preferred Roaming List (PRL) provided by the CDMA carrier. The PRL is stored in non-volatile memory and is re-programmable.

Application interface specification

Table 2-2: Application interfaces

Serial interface	9600 – 230400 bps
PPP interface	RFC 1661, RFC 1662, RFC 1332
AT command interface	Qualcomm subset of IS-707 Sierra Wireless proprietary extensions
Control and Status	Sierra Wireless proprietary

Software Development Kit (SDK)

To enable third party application development, a software development toolkit (for Windows® 98, Me, 2000, XP, and Pocket PC, Pocket PC 2002) is

available. It provides a comprehensive set of API commands to enable integrators to develop their own host applications.

Some supported features:

- Status Reporting: report such information as: caller ID, signal strength, and call progress indication.
- Provisioning: activate the modem for both IS-95 and CDMA2000 1X services.
- SMS: send, receive, and manage SMS messages.
- Voice Call Support: originate, terminate, and manage a voice call.

Sierra Wireless enabling software

The Sierra Wireless Watcher™ enabling software is available to support the SB555 modem. This software is supported on the following Windows® operating systems:

- 98, 98SE
- Me
- 2000 Professional
- XP
- PPC and PPC2002

The applications interface provides a graphical means to access the following functionality:

- Connection management
- Voice call dialer
- SMS management
- User preference settings
- Manual provisioning
- Help/On-line documentation

The Watcher graphical panel displays the following information:

- Received signal strength
- In-service indication
- Home/Roaming indication
- Packet, circuit-switched data, or voice connection indication
- Bytes in/out
- Data compression indication
- Privacy/Encryption indication
- Voice mail notification
- SMS message indication
- Incoming call alert
- Call progress indication
- Headset connection indication

There is also functionality for technical support (hidden from the consumer) including:

- Product Support Tool Window (for account provisioning)

Special features

Security

The SB555 modem supports a 4-digit device passcode that enables the end-user to control use of the modem. The setting from the factory is "0000". The value is automatically set to the last four digits of the phone number with activation of a NAM. The user can change the passcode to any desired value.

When the lockout feature is enabled (it is off by factory default), the passcode is required to enable access to:

- Issue AT commands over the modem interface
- Gain full control and status information (CnS)
- Change the passcode to some other value

When locked, the modem permits only a limited control interface—enough to enter a passcode to unlock the device. E911 service is still available even when the unit is locked.

The master subsidy lock also unlocks the device to give service technicians the ability to unlock and reset a forgotten passcode back to factory defaults.

Field Upgradability

There is a firmware upgrade tool that allows the user to replace the firmware in the modem, the PRI, and the PRL. This software can update a modem directly on supported Windows platforms, or from a supported Windows device through a standard serial connection (passthrough) for other devices.

The Sierra Wireless firmware loader compares the current modem firmware version against the version number of a new firmware image. If the new firmware is older than the current firmware revision, the user is warned and the upgrade process can be aborted, although the user may force the new load to revert to older firmware. If the new firmware version is the same as the current firmware version, the user is warned but is allowed to force an upgrade if desired.

Windows OS suspend / resume support

The SB555 modem meets most of the power management requirements of the Windows operating system Advanced Configuration and Power Interface (ACPI) standard. The host may or may not remove power from the modem during a suspend. If power to the modem remains on, the modem is capable of notifying the host of incoming voice calls, SMS messages, or a return to radio coverage, by use of the RI signal.

CAIT support

Qualcomm® has available a software tool called the CDMA Air Interface Tester (CAIT). This software is supported by the Sierra Wireless SB555 Embedded Modem.

The CAIT application:

- Displays and records call information going over the air between the modem and the CDMA network.
- Gives you access to the operating parameters and messages used for network housekeeping.
- Collects call performance statistics
- Scripts automated testing routines

The program runs on a PC under Windows 95, 98, NT, or 2000. It connects via a serial link to the modem.

CAIT is not provided by Sierra Wireless. Contact Qualcomm for ordering and support information: www.qualcomm.com.

3: Electrical Specifications

- Block diagram
- Host pinouts
- Electrical characteristics
- Serial interface
- Voice interface
- Control signals
- Power specifications
- RF specifications
- System timing

Modem block diagram

The SB555 modem presents several interfaces on the host connector (shown on the right of the diagram below) and an RF antenna interface (at the connector shown on the left side of the figure).

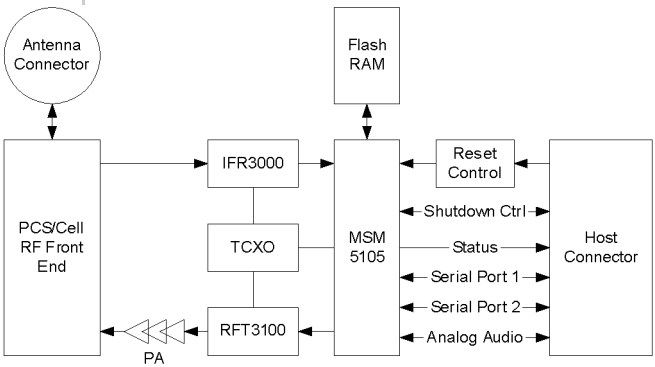


Figure 3-1: SB555 embedded modem block diagram

Host interface

The SB555 modem provides a single 40-pin (2x20) header with a 1.0 mm pin spacing that delivers five interfaces:

- Power
- Serial data and AT command interface (Serial 1)
- Voice interface
- Control and Status (CnS) interface (Serial 2)
- Control line interface (Status, Shutdown, and Reset)

The connector pinouts are specified in the table below. Electrical characteristics are specified in Table 3-2 on page 36. Signal type indicates if the signal is an input to the modem or output from the modem.

Table 3-1: Host interface connector pinouts

Pin	Description	Active	Type
1, 2	3.3 VDC power supply	--	Power
3, 4	Ground	--	Power
5	Status 1	Low	Output
6	Reserved		
7	Status 2	Low	Output
8	Reserved		
9	Status 3	Low	Output
10	Reserved		

Table 3-1: Host interface connector pinouts (cont.)

Pin	Description	Active	Type
11	Status 4	Low	Output
12	Reserved		
13	Voice Mic+	Diff.	Input
14	Voice Speaker+		Output
15	Voice Mic-	Diff.	Input
16	Audio Common (GND)	--	Power
17	Serial 2 – CTS	Low	Output
18	Serial 2 – RTS	Low	Input
19	Serial 2 – TX	High	Input
20	Serial 2 – RX	High	Output
21	Serial 1 – DCD	Low	Output
22	Serial 1 – RX	High	Output
23	Serial 1 – TX	High	Input
24	Serial 1 – DTR	Low	Input
25	Ground	--	Power
26	Serial 1 – DSR	Low	Output
27	Serial 1 – RTS	Low	Input
28	Serial 1 – CTS	Low	Output
29	Serial 1 – RI	Low	Output
30	Ground	--	Power

Table 3-1: Host interface connector pinouts (cont.)

Pin	Description	Active	Type
31–36	Reserved		
37	Shutdown Acknowledge	Low	Output
38	Shutdown Request	Low	Input
39	Reset	Low	Input
40	Reserved		

All pins noted "Reserved" should be left *unconnected*, with the exception of pin 33, which must be grounded.

Table 3-2: Host interface electrical characteristics

Parameter		Test Conditions	Min	Typ.	Max	Units
Power						
V_{cc}	DC supply	Max ripple 100 mV_{p-p}	3.15	3.3	4.2	V
Digital Interface						
V_{IH}	HI threshold		2.1	3.0	3.3	V
V_{IL}	LO threshold		0	0	0.8	V
I_{IH}	Input current	3 V applied to input	0		120	µA
I_{IL}	Input current	0 V applied to input	0		-120	µA

Table 3-2: Host interface electrical characteristics (cont.)

Parameter		Test Conditions	Min	Typ.	Max	Units
V_{OH}	HI output	I_{OH} = 2.0 mA	2.4		3.0	V
V_{OL}	LO output	I_{OL} = -2.0 mA	0		0.4	V
I_{OH}	Output current	V_{OH} > 2.0 V			3.0	mA
I_{OL}	Output current	V_{OL} < 1.0 V			-3.0	mA
Microphone Input						
Z_{IN}	Input impedance	Differential	4	4.2	4.5	kΩ
V_I	Input level	mic sens. = -58 dBV / µBar 1 kHz sine wave		-44	-21.8	dBV
				88	110.2	dB SPL
0dBm0	Reference level	Amp Gain = 26 dB		45.5		mV_{RMS}
ΔA_V	Gain error	-30 dBm0 to +3 dBm0 input	-1.5	0	+1.5	dB
	Transmit noise	C-message weighted			10	μV_{RMS}
SINAD	S:(THD+N)	-45 dBm0 to +3 dBm0 input	25	45		dB
I_{MIC}	Mic DC current	Electret condenser Source = 1.8 VDC @ 2200 Ω		220	500	µA

Table 3-2: Host interface electrical characteristics (cont.)

Parameter		Test Conditions	Min	Typ.	Max	Units
Speaker Output						
Z_L	Load impedance	Single-ended	32			Ω
P_O	Speaker output power	32Ω load digital input = +3 dBm0 @ 1020 Hz			8.8	mW
THD	Total harmonic distortion	Maximum output level into 32 Ω @ 498 Hz			5	%
	MUTE	Digital input = +3 dBm0 @ 1020 Hz	-80			dB
ΔA_V	Gain error	-30 dBm0 to +3 dBm0 input	-1.5	0	+1.5	dB
	Receive noise	Digital input = 0x0000 A-weighted			200	μV_{RMS}
SINAD	S:(THD+N)	-45 dBm0 to +3 dBm0 input	25	42		dB
IMD	Intermod. distortion	498 Hz & 2020 Hz equal level	50			dB
V_O	DC on speaker out	AC-coupled		0		VDC
Line Input						
Z_{IN}	Input impedance	Differential	4	4.2	4.5	kΩ
V_I	Maximum input level	MIC+ or MIC- single-ended			2.28	V_{P-P}
0dBm0	Reference level	Amp Gain = -2 dB		1.14		V_{RMS}

Table 3-2: Host interface electrical characteristics (cont.)

Parameter		Test Conditions	Min	Typ.	Max	Units
ΔA_V	Gain error	-30 dBm0 to +3 dBm0 input	-1.5	0	+1.5	dB
SINAD	S:(THD+N)	-45 dBm0 to +3 dBm0 input	25	45		dB
Line Output						
Z_L	Load impedance	Single-ended		600		Ω
V_O	Reference signal level	digital input 0 dBm0 @ 1020 Hz		375		mV_{RMS}
$V_O$max	Maximum output level	digital input +3 dBm0 @ 1020 Hz		1.5		V_{P-P}
THD	Total harmonic distortion	Maximum output level into 600 Ω @ 498 Hz			5	%
	MUTE	Digital input = +3 dBm0 @ 1020 Hz	-80			dB
ΔA_V	Gain error	-30 dBm0 to +3 dBm0 input	-1.5	0	+1.5	dB
	Receive noise	Digital input = 0x0000 A-weighted			200	μV_{RMS}
SINAD	S:(THD+N)	-45 dBm0 to +3 dBm0 input	25	42		dB
IMD	Intermod. distortion	498 Hz & 2020 Hz equal level	50			dB
V_O	DC on speaker out	AC-coupled		0		VDC

ESD

The integrator is responsible for ensuring all exposed interfaces have sufficient protection from electro-static discharge.

Serial data interface

The serial port pins comprise a standard set of serial data and handshaking lines for the data port (Serial 1) and a reduced set (TX, RX, RTS, CTS) for the control port (Serial 2). All signals are negative assertion (except TX and RX), 3 V, HCMOS logic compatible. These signals must be terminated properly if they are not used. Refer to the SB555 Modem Hardware Integration Guide for detail on terminating unused lines.

The serial ports are configured for 8 data bits, no parity, and 1 stop bit. The DTE host data-rate on the primary serial port can be from 9600 bps to 230.4 kbps, configured by an AT command. The modem does not support automatic baud rate detection. It is shipped with a setting of 115.2 kbps.

Hardware handshaking should be enabled using CTS and RTS on the data port. The control port can use only the minimum connection (Rx, Tx, GND). The remaining primary port control lines (DCD, DTR, DSR, and RI) are, strictly speaking, not needed; however they are supported for any applications that may require them. Their operation is as follows:

RTS / CTS Used as standard hardware flow control lines. RTS is asserted by the host when it is capable of receiving data from the modem, and deasserted to prevent overflow. CTS is asserted

by the modem when it is capable of receiving data from the host, and deasserted when the modem's buffers are full (or the modem is not ready to receive commands from the host).

DTR Indicates to the modem that the host device is active and able to receive data. The modem answers packet calls when this is asserted. This line may also be configured to drop the traffic channel (close the connection) when deasserted.

Voice calls can be disconnected using a timed cycle of DTR. If DTR is deasserted for a minimum 10 ms, then asserted for a period of more than 10 ms and less than 100 ms, the modem disconnects an active voice call.

DTR is also required to control the modem's transition between power-saving modes. It determines whether or not the modem keeps the logic system powered when the radio is off.

If DTR is to be used for shutdown, and power is removed from the modem, then you must drive DTR via an open collector or open drain circuit; otherwise DTR back-powers the modem when its supply power is removed. In addition, it is necessary to set DTR low prior to applying power to the modem, otherwise it goes into shutdown mode upon startup.

The functionality of DTR is set by AT commands.

DCD This asserts when the modem is on the CDMA traffic channel. It can also be set to remain on at all times except to "wink" off when the traffic channel is dropped.

DSR This signal is asserted following successful completion of the modem's self-test and initialization.

Note: The cadence of the RI signal is not the standard 1-second on, 3-seconds off used by standard modems. The SB555 uses a shorter duty cycle.

RI This line toggles when there is an incoming voice call (telephone is ringing) or new SMS message. The signal may be used to wake up the host. It can also be set to assert when the radio detects a return to coverage after being out of coverage; this feature is known as "wake on radio".

Voice interface

For voice services, the SB555 modem provides conventional analog microphone and speaker pins. These can be connected, via the host 40-pin connector, to a headphone and microphone as desired by the integrator.

Using AT commands, the microphone and speaker signals can be configured for line level connections instead of transducer devices. Setting the audio mode to line level changes total microphone amplifier gain by 28 dB. The exact values for audio and line levels depend on integration calibration settings made by you.

The speaker output level and microphone input sensitivity can be adjusted using either AT commands or CnS.

Microphone input

The microphone input is a capacitively connected differential input, with input impedance greater than 4 kΩ. Microphone signals should be -44 dBV (18 mV_{p-p}) nominal. Microphone level control is available via both AT commands on the data port, and through Control and Status (CnS) on the secondary port.

If a single-ended drive is desired, the MIC- input must be connected to the Audio Common ground as close to the microphone, or its connector, as possible. Do not use a general system ground, but rather the Audio Common provided by the modem. When using a single-ended drive, the input impedance is reduced by 50%.

The modem provides a microphone DC bias of just under 1 mA of current for a standard microphone.

When using line level differential drive, both pins must be AC-coupled via 100 nF capacitors. The input signal is -21 dBV (250 mV_{p-p}) nominal from a 600 Ω source.

Speaker output

The speaker output is a single-ended, AC-coupled signal used to interface to an earphone or speaker amplifier. It can provide up to 8.8 mW into a 32 Ω earpiece. The speaker's output level can be controlled via both AT commands on the data port, and CnS on the secondary port.

Modem control interface

The control interface is a second serial port (Serial 2) over which the proprietary Control and Status (CnS) protocol is used to convey control and status information. This protocol is defined in a document provided as part of the SB555 Embedded Modem Development Kit.

Control line interface

There are several control lines for input and output signaling. This interface is comprised of:

- Four status output signals, described in the following sub-section.
- A Shutdown Request input signal, used to force the modem to disconnect any active call and de-register from the network. When the modem has achieved this, it is safe to reset or power-down the modem.
- A Shutdown Acknowledge output signal, used to indicate that the modem can be safely powered off or reset.
- A Reset input, used to issue a hardware reset to the modem.

Status output signals

Note: All status signals are active low.

There are four status outputs provided to control LED displays or to signal application software.

By default from the factory, these outputs are defined for a human interface presuming connection to LED indicators by the integrator (blinking patterns are used). Direct connection to LEDs supports up to 2 mA sinking or sourcing. Higher current can be supported but not within the output voltage levels specified.

There is an alternate configuration (set using an AT command) for a machine interface in which the outputs provide two-state operation for polling or edge-detection interrupts.

The application of the outputs is noted in the table below.

Table 3-3: Status signal interpretation

Signal	Human interface	Machine interface
Pin 5 - Status 1 (Coverage / Available for Use)	Off = No power 2 Hz = Channel scanning 0.5 Hz = In-coverage On = Registered	Off = No coverage On = In-coverage
Pin 7 - Status 2 (Registered)	Undefined	Off = Not registered On = Registered
Pin 9 - Status 3 (Tx data)	Off = Not transmitting On = Transmitting (RF)	Off = Not transmitting On = Transmitting (RF)
Pin 11 - Status 4 (Rx data)	Off = No incoming data On = Receive data (host)	Off = No incoming data On = Receive data (host)

There is a “damping” applied to Status 3 and 4 (pins 9 and 11). When triggered active (on) they remain on for a minimum of 50 ms. This is to provide a definite visual signal on an LED and to prevent unduly frequent triggering of interrupts on the machine interface.

Power specifications

The SB555 modem requires +3.3 VDC provided on pins 1 and 2, and ground provided on pins 3 and 4. The supply voltage range from 3.2–4.2 VDC allows for direct connection to a Li-ion battery using an under/over voltage protection circuit. Electrical requirements and current specifications are identified in Table 3-4 on page 47.

Conditions related to the various modes of operation are detailed in subsections following the table. These specifications identify the maximum current drain; typical use should result in less drain, depending on the application.

Note 1—Transmitting The transmit current is dependent on the radio band in use and the network's control of the modem output power. Transmit power ratings for the three columns are:

- Minimum: -35 dBm
- Typical: +3 dBm
- Maximum: +23.5 dBm

Voice call current consumption use varies based on the amount of silent (listening time). A model of 40% full rate and 60% 1/8th rate over -35 to +23.5 dBm is common.

Note 2—Sleep The SB555 modem supports slotted mode operation and Quick Paging Channel. Both of these features enable reduced sleep current. The default Slot Cycle Index (SCI) for slotted mode operation is 1, but the value in any given situation is determined by the carrier's PRI. While in slotted mode, the modem turns off the radio. To achieve the lowest current consumption, the DTR signal must be deasserted to allow the modem to also turn off some logic. For sleep modes, the figures are given for the actual sleep state. The modem wakes at intervals to control timing and check for traffic. At those moments the current consumption is higher.

Table 3-4: Power and Current Specifications

	Condition	Min	Typ.	Max	Units
V_{CC} Supply Voltage	Max noise: 100 mV_{p-p} from 1 Hz – 100 kHz	3.2	3.3	4.2	VDC
I_{CC} DC Supply Current (instantaneous)					
PCS Transmitting	Full rate	350	370	900	mA
	1/8 rate	230	270	300	mA
PCS Receiving		170	180	200	mA
Cellular Transmitting	Full rate	320	350	850	mA
	1/8 rate	190	200	270	mA
Cellular Receiving		140	150	180	mA
Sleep, Dormant, and Deep Sleep	DTR asserted		35	40	mA
	DTR deasserted	0.5	0.7	1.5	mA
Shutdown		0.5	0.7	1.5	mA

Power States

The SB555 operates in several different modes and states that have a significant impact on current consumption.

Modes

Shutdown Shutdown mode is the state of the modem when the shutdown request is asserted, or DTR is deasserted (based on your configuration) and the modem is shut down. This mode can also be entered via AT or CnS command. The modem gracefully disconnects any call and

is ready to power down. This is the state entered via Windows power management (ACPI suspend state).

Slotted mode sleep and dormant mode The CDMA2000 1X specification describes a reduced power mode in which the modem cycles between wake and sleep on a defined interval; the Slot Cycle Index (SCI). Slotted mode sleep is the normal state of the modem between calls.

Dormant mode behaves in the same way as slotted mode sleep, but it keeps an active PPP session open at both ends—even when there is no physical link (channel resource) in place.

Current consumption in sleep/dormant mode follows a pattern based on use of the DTR signal, the Slot Cycle Index (SCI), and on the networks use of standard or Quick Paging Channel.

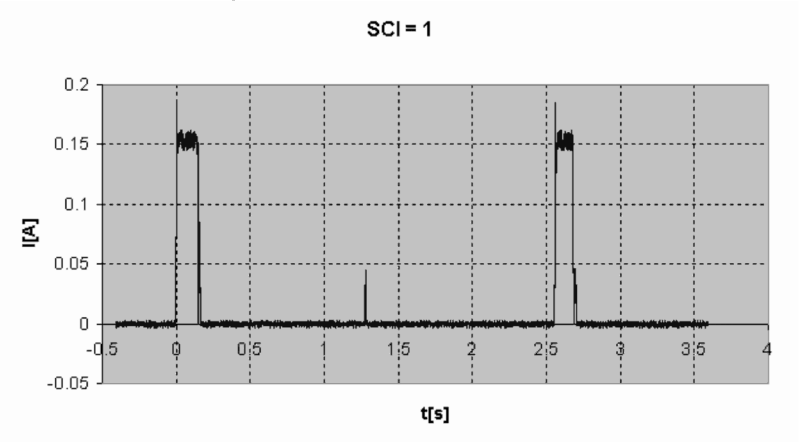


Figure 3-2: Current measurement in slotted mode (using standard paging channel and deasserting DTR)

The current consumption has a small spike at each slot cycle interval (1.28 s). This is when the modem turns on logic to manage the timing functions and possibly issue CnS notifications. If DTR is asserted while in slotted mode sleep, the current consumption stays at this higher level (35 mA).

When the index value is reached, both the modem logic and radio come on to check the paging channel. The receiver's on-time is approximately 135 msec for standard and 80 ms when Quick Paging Channel is supported by the network.

Note: If there is a call request or incoming data, the modem stays active to handle it.

The average current consumption of the SB555 during slotted mode sleep is dependent on the SCI. Using higher value SCI settings means longer intervals between the receiver being enabled, therefore lower current consumption. The default slot cycle index from the factory is 1, but the actual setting implemented is determined by the carrier's PRI setting.

Table 3-5: Typical current consumption in slotted mode sleep (standard paging)

SCI	Cycle duration (seconds)	Typical current (mA)
0	1.28	16.56
1	2.56	8.64
2	5.12	4.84
3	10.24	2.89
4	20.48	1.92
5	40.96	1.43

Table 3-5: Typical current consumption in slotted mode sleep (standard paging)

SCI	Cycle duration (seconds)	Typical current (mA)
6	81.92	1.18
7	163.84	1.06

Where Quick Paging Channel is implemented, typical current is reduced by more than 40%.

Deep Sleep The modem enters deep sleep mode after failing to acquire service on a CDMA channel within a duration determined by the carrier's PRL—typically less than 15 minutes. The modem exits deep sleep every three minutes to look for a pilot signal (return to coverage). If a viable channel is detected, the modem attempts to register, increasing the power consumption for the duration of the attempt, thus bringing up the average consumption. Current consumption in deep sleep mode follows a pattern as illustrated in the figure below.

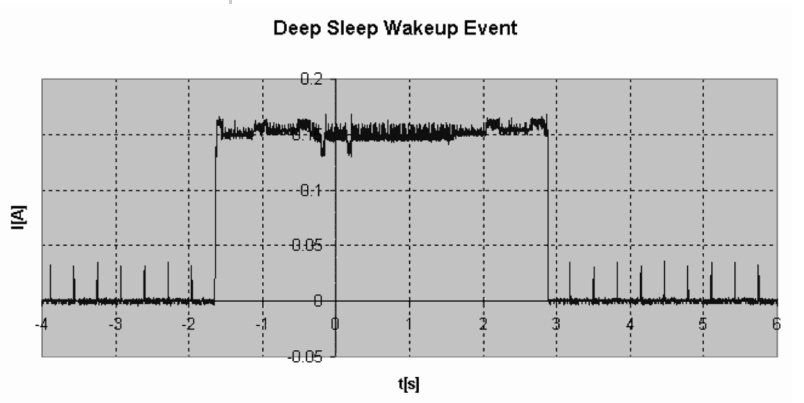


Figure 3-3: Current measurement for a wakeup event from deep sleep

There are small spikes at the SCI unit interval for the modem timing tasks. A wakeup to check for coverage (pilot signal) takes about 4.5 seconds, and requires about 150 mA.

Usage models

To calculate actual current consumption (and anticipated battery life) a usage model is needed. As applications of the SB555 embedded modem can vary widely, we can only provide samples here. Sierra Wireless provides a calculation tool with the Development Kit to help you arrive at current consumption figures based on your unique usage model.

PDA The SB555 is integrated into a PDA providing voice, e-mail, and web browsing applications.

Table 3-6: PDA with voice application

Upload (modem Tx)	20 e-mails / day, avg 5 kB each
Download (modem Rx)	40 e-mails / day, avg 5 kB each 500 kB web browsing
Voice calls	10 / day, avg 3 minutes each
Sleep assumptions	Slotted mode sleep when idle (not actively receiving or transmitting) (SCI = 1) Standard paging (not Quick Paging Channel)
Coverage / data rate	1xRTT / 80 kbps
Transmit power	+3 dBm
Hours of operation	16 / day (off 8 hrs / day)
Total power consumed over 24 hours (typical)	**300 mAh**

Field worker A rugged laptop has the SB555 integrated to provide field service staff with an application to send remote data to a managing office and receive dispatch assignments.

Table 3-7: Field worker data only application

Upload (modem Tx)	1000 kB / day
Download (modem Rx)	500 kB / day
Sleep assumptions	Slotted mode sleep when idle (SCI = 2) Standard paging (not Quick Paging Channel)
Coverage / data rate	1xRTT / 80 kbps
Transmit power	+3 dBm
Hours of operation	8 / day (off 16 hrs / day)
Total power consumed over 24 hours (typical)	**60 mAh**

Remote data logging A remote telemetry unit is integrated with the SB555 to send data logs at regular intervals and receive parameter settings.

Table 3-8: Remote data logging application

Upload (modem Tx)	40 kB / hr
Download (modem Rx)	100 kB / day
Sleep assumptions	Slotted mode sleep when idle (SCI = 2) Standard paging (not Quick Paging Channel)
Coverage / data rate	IS-95 / 14.4 kbps
Transmit power	+3 dBm
Hours of operation	24 / day
Total power consumed over 24 hours (typical)	**200 mAh**

Power requirements

To support a short burst power surge when the modem's transmitter is turned on, the power supply should be filtered by a 100 μF low-ESR capacitor between the 3.3 V supply and ground. This should be located as close as possible to the modem connector.

All inputs to the modem must be either high impedance (>20 kΩ), or driven low, when the modem is powered off. This is required to prevent back-powering the modem. This is particularly important if the DTR signal on Serial Port 1 is used for Windows ACPI control.

Ground connection

The *only* ground connection to the modem must be through the 40-pin host connector. No ground connection to the modem shields must be made. This is to avoid degrading the RF performance of the modem through ground loops. The SB555 modem is fully shielded to protect against EMI and to ensure FCC regulatory compliance. To maintain the shield effectiveness the modem shields must not be connected to the host ground.

RF specifications

Table 3-9: Radio specifications

Transmitter power	Maximum 224 mW into 50 Ω (+23.5 dBm)
Receiver sensitivity - PCS	-104 dBm
Receiver sensitivity - Cellular	-104 dBm

All electronic computing devices generate radio frequency (RF) interference. The integrator should pay particular attention to RF noise as it can impact the sensitivity of the SB555 modem radio receiver.

The SB555 modem radio circuits use a number of Intermediate Frequency (IF) stages. The following specific frequencies should be avoided or suppressed in the host in order to maintain the best sensitivity performance:

- 183.6 MHz
- 228.6 MHz
- 263.6 MHz

Antenna interface

The SB555 modem provides an MMCX RF connector jack for the antenna connection. It ships without an antenna.

For proper matching, the antenna should be 50 ohms with a return loss $|\Gamma| \leq -10$ dB between 824 – 894 MHz and 1850 – 1990 MHz. Overall system antenna gain, with cable loss, should be ≥ -2 dBi.

System timing

Power-up

The modem holds in reset until power reaches 2.55–2.925 volts. This power level must be held for at least 10 µs to start a timer. The modem continues to hold in reset for 140–560 ms to ensure power is stable. If power slips below 2.7 V for a few micro-seconds, the timer must restart.

Reset timing

After release from reset, the modem performs a self test and then begins normal operation within 5–15 seconds.

The modem is ready to use when both /DSR1 and /CTS1 are asserted.

Serial interface timing

Table 3-10: Serial interface specification

Signal	Min	Max	Default
Serial Port 1	9600 bps	230.4 kbps	115.2 kbps
Serial Port 2	9600 bps	115.2 kbps	115.2 kbps

The ring cadence on the RI signal is set to a 50% duty cycle of approximately 200 ms on and 200 ms off. The RI signal asserts three times to advise of an incoming SMS message or a return to coverage. It continues to cycle for incoming voice calls until either: the call is answered, the call is dismissed, or the call is dropped.

Mode switching

From active to sleep/dormant The modem goes into slotted sleep mode within milliseconds of when a call is terminated. Sleeping (or dormancy) while a packet data call is active depends on a traffic inactivity timer that is governed by the network.

From active to deep sleep If the modem loses coverage, it can go into deep sleep after a period ranging from 3–15 minutes, depending on the PRL (the number of channels the modem needs to check); a typical value being near 11 minutes.

From sleep to active Whether deep sleep, slotted mode sleep, or dormant mode, the transition from the low-power state to active for a host-initiated action is 9.15 ms. A host initiated action is determined by asserting DTR on the primary port or initiating a CnS message on the secondary port.

While in low-power state (DTR deasserted), the modem temporarily reconfigures the secondary port Rx line as an edge-triggered interrupt to control waking. The CnS protocol supports a control character sequence prior to the message that can give the modem time to wake up.

The primary flow control lines do not indicate the completion of the transition; the host must time a delay of at least 9.15 ms.

Shutdown

The time required to transition from any state to shutdown mode is dependent on the modem's mode and state. With an active call the modem gracefully closes the connection.

From any mode to shutdown The modem enters shutdown (based on AT configuration) when the Shutdown Request signal is asserted or DTR is deasserted. The modem can also be shutdown by an AT or CnS command. The transition is complete when the Shutdown Acknowledge is asserted by the modem.

The time needed to shutdown gracefully depends on the activity of the modem at the time the shutdown request is issued. It the modem must disconnect a call or deregister from the network, more time is needed. Typical shutdown time, measured from the assertion of the request to the acknowledgement from the modem is given the table below.

Table 3-11: Shutdown timing

Modem activity	Typical time to shutdown (seconds)
Voice call connected	3.25
Data call connected	2.3
Registered but no call active	2.9
Modem in process of registering	1.45
Modem is not registered	1.3
Modem in deep sleep (no coverage)	0.75

From shutdown to active The modem can be returned to active mode when the DTR signal is asserted or Shutdown Request is deasserted based on the configuration of shutdown control. The transition to active involves the modem performing a reset, typically taking from 5–15 seconds.

4: Mechanical Specifications

- Physical description
- Mounting
- Connectors
- Environmental specifications
- Reliability

Physical description

The SB555 modem comes in a Sierra Wireless proprietary package, illustrated on the next page.

There are two connectors: a 40-pin header for the host interface, and an MMCX connector jack for the antenna. Both are mounted offset from the module centerline to prevent orientation errors during integration assembly.

Weight

The module has a total weight under 14 grams (0.49 ounces). Typical weight is 13.5 grams (0.48 ounces).

Labeling

Each modem is labeled with the following information:

- Sierra Wireless logo and Qualcomm 3G CDMA logo
- Model number and Sierra Wireless part number

- ESN (Electronic Serial Number) with bar code
- FSN (Factory Serial Number) with bar code

Dimensions

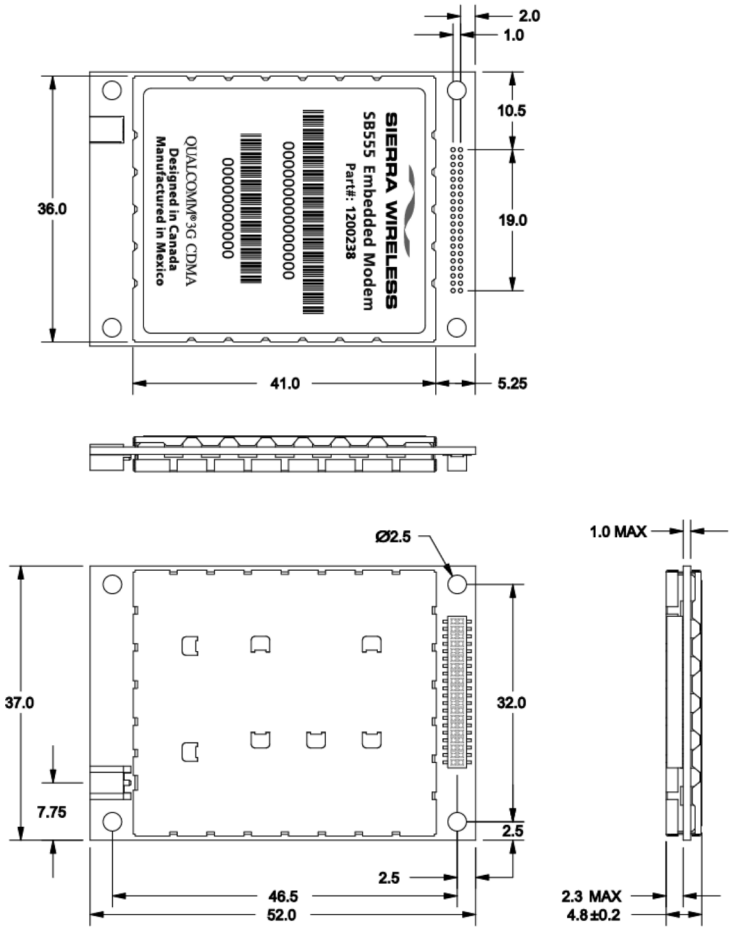


Figure 4-1: Physical dimensions (in mm)

Shields

The SB555 comes with shields on both top and bottom. These shields are attached to a fence surrounding the circuitry.

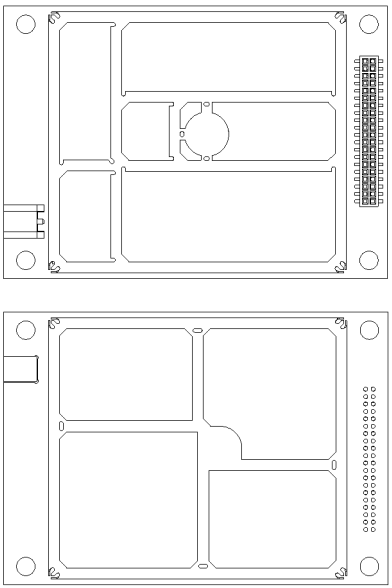


Figure 4-2: Shield fence frame

The internal webbing of the fence frame may be removed in some units to permit factory rework. This webbing is used for automated pick-and-place only. The product is fully qualified mechanically and electrically with and without the webbing.

Mounting

The SB555 modem has four (4) mounting holes of 2.5 mm diameter, one located at each corner of the module (as seen in Figure 4-1). The mounting holes are sized to accommodate a #2 screw (metric M2).

The 40-pin host connector allows for either bottom or top entry, to permit mounting in any orientation. Sierra Wireless does not provide mounting hardware.

The sample illustration does not show standoffs.

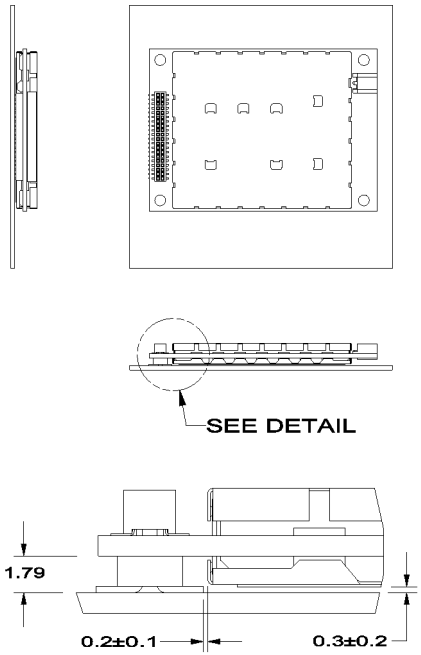


Figure 4-3: Sample bottom entry connection (mm)

Connectors

Host interface connector

The host connector is a 40-pin, 1 mm pitch, 2-row header: Samtec part #CLM-120-02-F-n-BE (with bottom entry option). The host connector is capable of accepting either a top or bottom entry mating header connector (suitable mating connectors are Samtec MW, FTM or FTMH series) with a recommended exposed pin length of:

- 1.4 mm for top entry
- 3.2 mm for bottom entry

Pin 1 location

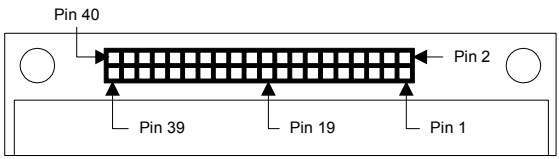


Figure 4-4: Pin 1 location (connector side)

The connector is offset from the module centerline to prevent assembly orientation errors.

Antenna connector

The antenna connector is an MMCX connector jack oriented in line with the module longitudinal axis. Mating connectors can be either straight or right-angle plugs.

Environmental specifications

Enhanced specifications may be achieved through appropriate mounting.

Table 4-1: Environmental specifications

Temperature range	Operating: -30 to +60°C (-22 to +140°F) (modem ambient*) Storage: -40 to +85°C (-40 to +185°F)
Humidity	MIL-STD-202F 95% non-condensing @ 65°C (149°F)
Vibration (random)**	MIL-STD-810E 0.04 g^2/Hz, 10 – 2000 Hz
Vibration (sine wave)**	PC Card Standard 15 g (147 m/s^2), 10 – 2000 Hz
Shock**	MIL-STD-202F 50 g (490 m/s^2), 11 ms, 6 pulses/axis
Drop (unpackaged)**	PC Card Standard 0.75 meter drop onto non-cushioned vinyl (2 drops on each axis, 6 drops total)

* A thermistor inside the modem (monitored by the modem CPU firmware) causes flow control to be activated should the internal temperature reach 75ºC (167ºF) as measured at the radio. Flow control is released when the temperature falls below 75ºC. Should the temperature of the radio reach 80ºC (176ºF), the modem terminates the connection in order to protect components and avoid drifting outside radio specifications.

** Vibration, shock, and drop tests are performed for survivability. The modem is not in operation during the test. Cosmetic damage is ignored.

Thermal dissipation

Determination of thermal dissipation depends heavily on the usage model of the modem. The SB555 modem generates more heat when actively transmitting. However the transmitter is not on at all times, nor is the transmit power constant.

Table 4-2 provides a guideline of the energy to be dissipated when the modem is in various states of activity.

Table 4-2: Energy dissipation (typical)

Mode	Current consumption	Energy to dissipate
Shutdown	3.3 V @ 0.7 mA	2.3 mW
Slotted sleep (SCI = 2) (DTR deasserted)	3.3 V @ 5 mA	16.5 mW
Slotted sleep (SCI = 2) (DTR asserted)	3.3 V @ 40 mA	132 mW
Receive	3.3 V @ 160 mA	528 mW
Transmit (typical at +3 dBm)	3.3 V @ 370 mA	1219 mW
Transmit (worst case) (full power +23.5 dBm)	4.2 V @ 900 mA	3376 mW

Transmit cases are usually short duration bursts.

Reliability

MIL-HDBK-217F and Bellcore are two widely accepted electronics reliability prediction models. Sierra Wireless has calculated Mean Time Between Failure (MTBF) figures using both models.

Table 4-3: SB555 MTBF

Model	MTBF (Hours)
MIL-HDBK-217F	25,000
Bellcore	39,000

These calculations are based on constant operation (24 hours per day, seven days a week). If your application has the modem running 12 hr/day then expect the MTBF for your integration to be 78,000 hours (almost 9 years).

Warranty

Sierra Wireless provides a standard one-year warranty, and offers one- and two-year extended warranties.

The standard warranty begins when the unit is shipped to you and has a term of 15 months, allowing three months to integrate and ship with your host device.

The extended warranties add an additional 12 or 24 months of coverage to the original term.

5: Additional Requirements

- Regulatory approvals
- Integration requirements

Regulatory approvals

The SB555 modem meets appropriate regulatory requirements, including FCC Parts 2, 15, 22, and 24. Formal testing and approval is still needed based on your particular integration. You are also responsible to obtain any other required regulatory approvals in your target markets for your finished product.

FCC

For North American operation, your integration is required to meet appropriate regulatory approvals for stand-alone operation, including FCC parts 2, 15, 22, and 24 approvals.

The SB555 embedded modem itself does not have an FCC ID. However, the modem has been tested and approved by a test laboratory for conductive tests for FCC parts 22 and 24.

Radiated tests (SAR, ERP, spurious harmonics) are dependent on the antenna configuration and cannot be done by Sierra Wireless. These tests can only be performed using your own antenna design.

FCC Part 15 tests must be performed on the "whole device" and are therefore your responsibility.

Assistance provided by Sierra Wireless

Extended AT commands have been implemented to assist with performing the FCC tests.

A list of test houses familiar with Sierra Wireless products is included in the Verification and Configuration Guide (document 2130078).

Sierra Wireless offers additional assistance to integrators with the FCC approvals process, if required.

CDG

CDG-1 The SB555 modem has been proven against CDG 1 at Qualcomm and Sierra Wireless labs.

CDG-2 The SB555 modem has completed testing on Nortel, Lucent, and Motorola carrier infrastructure. Future testing for Ericcson and Samsung is planned. Sierra Wireless will provide to integrators the CDG 2 modem test reports for you to provide to carriers as part of CDG 3. Some carriers may require regression testing of your finished unit at one or more infrastructure vendors.

CDG-3 Testing of the finished system is the responsibility of the integrator. The test process will be determined with the chosen carrier(s) and will be dependent upon your business relationship with the carrier(s) and your product's application. Sierra Wireless can offer assistance to integrators with the CDG-3 testing process, if required.

Integration requirements

When integrating the SB555 modem, the following items need to be addressed:

- **Mounting**, and its effect on temperature, shock, and vibration performance
- **Power supply**, and the impact on battery drain and possible RF interference
- **Antenna location and type**, and their impact on RF performance
- **Regulatory approvals**, as discussed in the previous section
- **Service provisioning**, manufacturing process

Sierra Wireless provides guidelines for successful SB555 modem integration with the document suite included in the SB555 Embedded Modem Development Kit, and can offer integration support services as necessary.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