Sierra Wireless
SB300 Series OEM Modems

User's Guide

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.

Safety and Hazards

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

Do not operate the Sierra Wireless modem in any aircraft, whether the aircraft is on the ground or in flight. In aircraft, the Sierra Wireless modem **MUST BE TURNED OFF**. When operating, the Sierra Wireless modem can transmit signals that could interfere with various onboard systems.

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

Patents

Portions of this product are covered by some or all of the following US patents: D367062, D372248, D372701, 5515013, 5617106, 5629960, 5682602, 5748449, and other patents pending.

Copyright

Trademarks

Regulatory Information

The equipment certifications appropriate to your device are marked on the device and the accompanying product specific information. Where appropriate, the use of the equipment is subject to the following conditions:

⚠ *CAUTION*

Unauthorized modifications or changes not expressly approved by Sierra Wireless, Inc. could void compliance with regulatory rules, and thereby your authority to use this equipment.

⚠⚠ *WARNING (EMI) - United States FCC Information*

This equipment has been tested and found to comply with the Class B limits pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in an appropriate installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communication. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- *Reorient or relocate the receiving antenna*

- *Increase the separation between the equipment and receiver*

- *Connect the equipment into an outlet on a circuit different from that to which the receiver is connected*

- *Consult the dealer or an experienced radio/TV technician for help*

⚠⚠ *WARNING (EMI) – Canada*

This digital apparatus does not exceed the Class B limits for radio noise emissions from digital apparatus as set out in the interference causing equipment standard entitled 'Digital Apparatus', ICES-003 of the Department of Communications.

Cet appareil numérique respecte les limites de bruits radioélectriques applicables aux appareils numériques de Classe B prescrites dans la norme sur le matériel brouilleur: 'Appareils Numériques', NHB-003 édictée par le ministre des Communications.

RSA Licensee

If you have purchased this product under a United States Government contract, it shall be subject to restrictions as set forth in subparagraph (c)(1)(ii) of Defense Federal Acquisitions Regulations (DFARs) Section 252.227-7013 for Department of Defense contracts, and as set forth in Federal Acquisitions Regulations (FARs) Section 52.227-19 for civilian agency contracts or any successor regulations. If further government regulations apply, it is your responsibility to ensure compliance with such regulations.

Contact Information

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Customer Service

Help Desk

Open between 6:00 a.m. and 5:00 p.m. Pacific Time

(604) 231-1128

Warranty and Service Desk

Open between 8:00 a.m. and 5:00 p.m. PT

(604) 231-1157

support@SierraWireless.com

Sales Desk

Open between 8:00 a.m. and 5:00 p.m. PT

(604) 231-1100

sales@SierraWireless.com

Web

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

www.SierraWireless.com

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Contents

1. About this Guide

1.1. Introduction

This guide is intended to assist application software developers with the setup, installation, testing, and design of applications for the Sierra Wireless SB300 Series OEM modems. You should be familiar with the use of modems, communication media (PSTN and Cellular), protocols, and the use of AT commands.

This guide describes the full feature set, so some sections may not apply to the particular model you are using. Consult the Product Descriptions below for a summary of the features available on each product.

1.1.1. Hardware

This guide provides product descriptions of the SB300 Series OEM modems. More complete information for the physical integration of the modem is provided in the Sierra Wireless SB300 Series OEM Modems *Integrator's Guide,* document number 2110052.

A full description of the Multipurpose Interface Board provided with the OEM Developer's Toolkit is included in this guide.

1.1.2. Software

Installation and use of the application software Watcher™ and WirelessExpert™ is described in this guide.

Use of a terminal application for initial setup and testing of a modem may be required. Terminal emulation software is not provided nor described in this guide.

1.2. References

For information on the physical installation and integration of an SB300 Series modem, consult the Sierra Wireless SB300 Series OEM Modems *AT Command Reference,* document number 2110031. For details of specific uses for these commands, refer to *Sierra Wireless Application Notes* available on our Internet site at www.sierrawireless.com.

Details on the physical integration of the SB300 Series modems is provided in the Sierra Wireless SB300 Series OEM Modems *Integrator's Guide,* document number 2110052.

1.3. Currency

This document is current with modem firmware version <???>. For updates to firmware, consult our Internet site at www.sierrawireless.com.

1.4. Document Structure

This document covers the hardware view first in two chapters, one describing the modem products and one describing the Multipurpose Interface Board (MIB) used to test and configure the modem during product development.

Two more chapters get you started with preliminary setup, connections and testing. This section also covers the basics of the Watcher and Wireless Expert software provided with the toolkit.

Finally there are several chapters covering modem operation in each of the possible modes with sample configurations.

An appendix provides some background information on the communication modes.

1.4.1. Modem Operations

The various modes, states, and conditions the modem can be placed in are described in the chapter on Basic Modem Operations. That chapter also discusses the communication interface between the host (DTE) and the modem.

The types of protocols supported in each mode are described but examples of configuring the modem will be found in the chapters on operations for each specific mode.

1.5. Conventions Used in this Reference

Result Code – This is a numeric or text code that is returned after all commands (except resets).

Response – This term indicates a response from the modem which is issued prior to a return code. Reading registers or issuing commands that report information will provide a response followed by a return code unless the command generates an error.

Hexadecimal values are shown with a prefix of 0x, i.e. in the form 0x3F.

Character codes which are described with words or standard abbreviations are shown within angle brackets: such as <CR> for Carriage Return and <space> for a blank space character.

AT Command and register syntax is noted using an alternate font:

AT+WS46=4

2. Product Descriptions

The SB300 Series modems are designed for integration into devices that require wireless communications such as PC's, portable and handheld devices, metering and monitoring equipment, and point of sale terminals.

This chapter provides descriptions and specifications for the family. Individual modems are described in separate sections below.

The SB300 and SB320 share common physical and interface characteristics. The SB300, 301, and 302 share common functional characteristics.

2.1. Specifications Common to All Modems

The follow specifications provide information on all SB300 Series modems.

2.1.1. Application Interface Specifications

Serial Interface (DTE)	1200-57,600 bps
SLIP Interface	RFC1055
PPP Interface	RFC1661, RFC1662, RFC1332
AT-Command Interface	Hayes Compatible with PCCA Wireless Extensions
UDP PAD Interface	PCCA STD-101 Compliant
TCP PAD Interface	PCCA STD-101 Compliant
Object Management Interface	Sierra Wireless Inc. Proprietary

2.1.2. RF Features

Transmitter Power	Nominal 600 mW into 50 ohms
Transmitter Performance	Meets or exceeds CDPD V1.1 FCC, Industry Canada, IS19B/C
Receiver Sensitivity	Data: -108dBm 5% BLER Voice: -116cBm 12dB SINAD **(SB320 only)**

2.1.3.   Special Features

Feature	Benefit
Sleep Mode	Reduces current drain for improved battery life.
TCP and UPD PAD Ping Reply	Confirm network connectivity to the modem.
Broadcast Message Support	Broadcast to all modems in geographic area.
TCP Session Time-out	Permits reconnection of failed TCP session.
"Friends-only" modem access	Provides device security.
AutoDial at Startup	Modem automatically establishes communications.
Software-controlled Reboot	Quick problem recovery.
Autobaud	Flexible interface
MultiCast	Broadcast to defined subset of all modems.
Configurable Listening Port	Modem can listen on any port the host prefers.
Escape from PAD modes	Non-DTR controlled Escape.

2.1.4.   Environmental Specifications

	SB300	SB301	SB302	SB320
Operating Temp.	-30 to +60°C	-30 to +60°C	-30 to +60°C	-30 to +60°C
Storage Temp.	-40 to +85°C	-40 to +85°C	-40 to +85°C	-40 to +85°C
Humidity	5% to 95% non-condensing	5% to 95% non-condensing	5% to 95% non-condensing	5% to 95% non-condensing
Vibration	Operational: IS-19C Survivability: Mil-STD202			Operational: IS-19C Survivability: Mil-STD202
Shock	1 metre drop to a hard surface			1 metre drop to a hard surface

2.2. SB300 CDPD Modem

Part number 1100034

2.2.1. Mechanical

2.2.1.1. Physical Description

The SB300 comes in a Type III package, and includes a
30-pin, 0.5mm pitch ZIF connector for the host interface,
a MMCX connector for the antenna, and a status LED. Dimensions in millimetres are as follows:
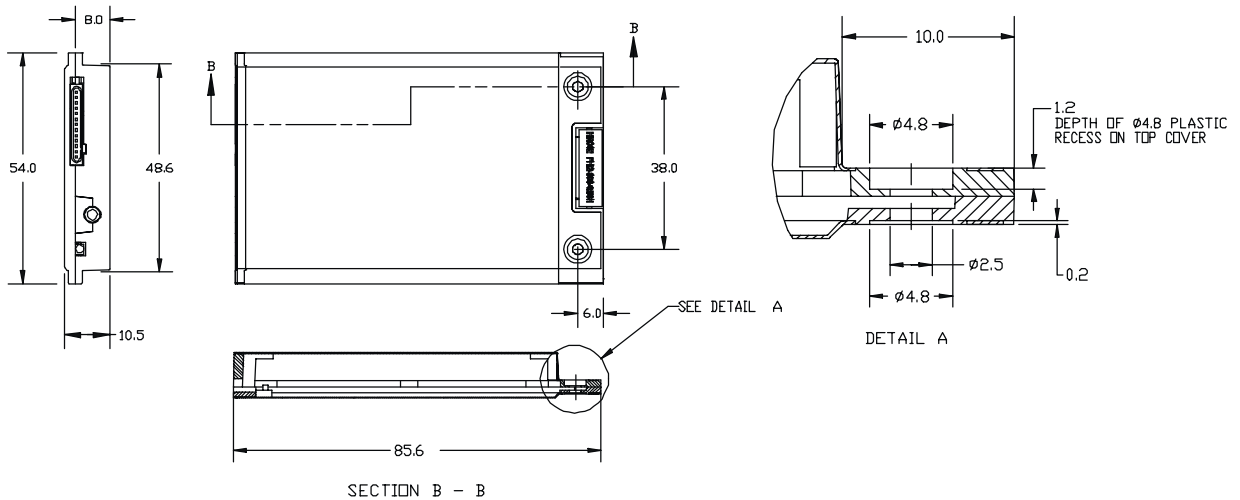
2.2.1.2. Mounting

The SB300 uses an industry standard Type III frame-kit, and as such will fit into PC Card rails.
Alternatively, two clips or a bracket may be used to secure the module. There are also two
mounting holes provided on either side of the ZIF serial connector.
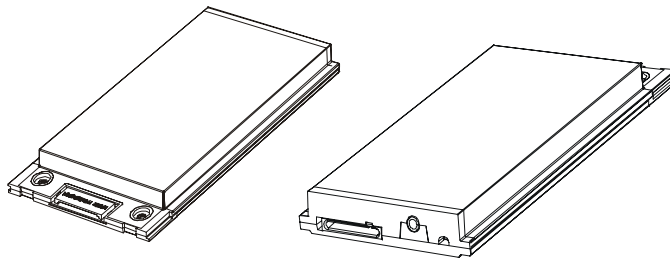
2.2.2. Connectors

2.2.2.1. Antenna Connector

The SB300 provides an MMCX type RF connector (Huber & Suhner 85 MMCX-50-0-1) for the
antenna connection. For proper matching the antenna should be 50 ohms with a return loss of
10 dB or better between 824 - 894 MHz. System antenna gain should be 0 dB.

2.2.2.2. Host (DTE) Connector

The SB300 provides a single 30-pin ZIF connector with 0.5mm pin spacing (Hirose FH12-30S).

2.2.3. Power Specifications

The SB300 requires +5V provided on pins 23-24, and ground provided on pins 23-28. Electrical requirements and current specifications are identified below.

Table 2-1: Power and Current Specifications

Power Supply Requirements	+5Vdc ±5% Maximum noise dc to 100 kHz: 10 mV$_{pp}$
Current Drain	Sleep: 20 mA Receive: 150 mA Transmit (Full Power): 850 mA

2.2.4. Electrical

2.2.4.1. Host (DTE) Interface

The SB300 provides a single 30-pin ZIF connector with 0.5mm pin spacing (Hirose FH12-30S). This connector provides four interfaces:

1. Serial host interface
2. Modem control interface
3. Power
4. Status line interface

The connector pinouts are specified in Table 2-2, and electrical characteristics are specified in Table 2-3 Serial Interface Electrical Characteristics. Signal types are with respect to the modem (DCE).

Table 2-2: Host Interface Connector Pinouts

Pin Number	Pin Label	Type	Description
1	\DCD	Output	Data Carrier Detect
2	RxD	Output	Receive Data
3	TxD	Input	Transmit Data
4	\DTR	Input	Data Terminal Ready
5	GND	Ground	Ground
6	\DSR	Output	Data Set Ready
7	\RTS	Input	Ready To Send
8	\CTS	Output	Clear To Send
9	\RI	Output	Ring Indicator
10	\RESET		Hardware Reset
11	RESERVED		Leave unconnected
12	\SHDN	Input	Graceful modem shutdown.
13	STATUS_OUT1	Output	Power + RF Channel Status
14	STATUS_OUT2	Output	Transmitter
15	STATUS_OUT3	Output	Power Down OK
16	STATUS_IN1	Input	
17	STATUS_IN2	Input	
18	STATUS_IN3	Input	
19	STATUS_IN4	Input	
20 - 22	UNUSED		
23 – 24	VBAT	Input	+5V
25 – 28	GND	Ground	Ground
29	UNUSED		
30	RESERVED		Leave unconnected

Table 2-3: Serial Interface Electrical Characteristics

Characteristic	Min.(V)	Max.(V)
Input Low Voltage	-0.3	0.8
Input High Voltage	2.5	5.0
Output High Voltage (Ioh=400 μA)	2.4	–
Output Low Voltage (Iol=3.2 mA)	–	0.5

Serial Port Interface

The serial port pins comprise a standard set of serial data and handshaking lines. All signals are negative assertion, HCMOS logic compatible. These signals must be terminated properly if they are not used. Refer to the SB300 Series OEM Modems *Integrator's Guide* for detail on terminating unused lines.

Hardware handshaking should be enabled using CTS and RTS as the primary flow control signals. The remaining handshaking lines (DCD, DTR, DSR, and RI) are, strictly speaking, not needed; however they are desirable for TCP/IP stack usage and are supported for any applications that may require them. Operation in each mode is as follows:

- **RTS, CTS**
  Used as standard hardware flow control lines.
- **DTR**
  Indicates to the modem that the host device is active. This line may also be configured to switch the modem from data to command state or reset the modem (**AT&D**), and to enable host wake-up. See the RI description below.
- **DCD**
  This line is asserted while online. Behaviour options are set with the command **AT&C**.
- **DSR**
  Always active when the modem is on; it is tied to logic GND.
- **RI**
  If DTR is inactive (high), RI toggles when there is data for the host. This may be used to wake-up the host.

The serial port should be configured for 8-data bits, no parity bits, and 1-stop bit. The default DTE configuration will auto-baud to the host serial baud rate (based on speed of the 'A' in an AT command). Host data rates of up to 57.6 kbps are supported. AT commands may be used to fix the baud rate from 1200 bps to 57.6 kbps.

In command state, a terminal emulation program may be used to communicate with the modem and change the configuration.

Modem Control Interface

Modem control is comprised of two inputs:

1.   **\SHDN**: Graceful Shutdown

   This is an active-low input. When activated this signal instructs the modem to de-register from the network, and power down. When this activity is completed the STATUS_OUT3 line is pulled indicating to the host that power may be removed from the device.

2.   **\RESET**: Hardware Reset

   This is a hardware reset of the modem. This input should be externally pulled high and driven low to reset.

Status Signal Interface

Status Outputs

There are three status outputs provided, defined as follows:

1. **STATUS_OUT1**: Power, RF Channel Status
   - Permanently low when power is on but no CDPD channel is visible.
   - Pulses low once per second with 10% duty cycle if modem is locked onto a CDPD channel.
   - Pulses low twice per second with 10% duty cycle if modem is registered on a CDPD channel.

2. **STATUS_OUT2**: Transmitter
   - Low when the transmitter is keyed.

3. **STATUS_OUT3**: Power Down OK
   - When low, this indicates it is safe to remove power to the modem. See Section 0 Modem Control Interface.

Status Inputs

There are four TTL-level status input lines provided. There are currently no features that use these inputs.

2.3. SB301 Specifications

Part number 1100029

To Be Determined.

2.4. SB302 Specifications

Part number 1100043
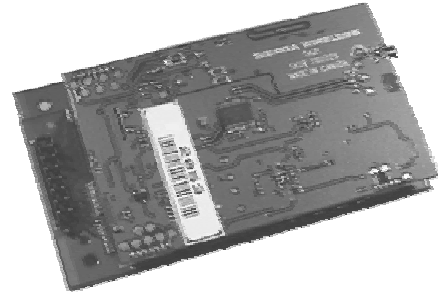
2.4.1. Mechanical

2.4.1.1. Physical Description

The SB302 comes as a board stack of two circuit boards. It includes a 16-pin, 0.1" dual-row header for the host interface and an MMCX style RF connector for the antenna. Dimensions in millimetres are as follows:
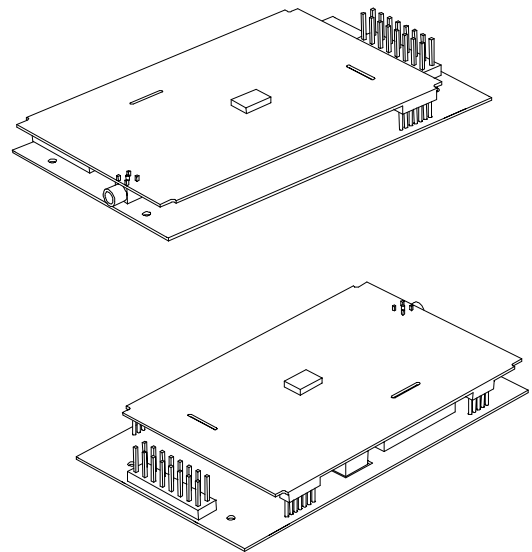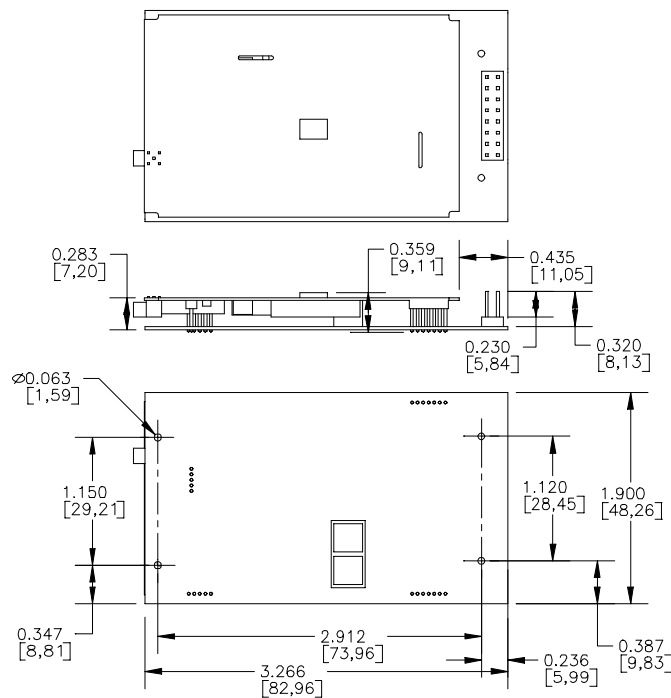
Figure 2-1: Physical dimensions shown in inches [mm].   Figure 2-2: Assembly View.

2.4.2. Connectors

2.4.2.1. Antenna Connector

The SB302 provides an MMCX type RF connector (Huber & Suhner 85 MMCX-50-0-1) for the antenna connection. For proper matching the antenna should be 50 ohms with a return loss of 10 dB or better between 824 - 894 MHz. System antenna gain should be 0 dB.

2.4.2.2. Host (DTE) Connector

The SB302 provides a single (2 x 8) 16-pin connector (AMP 103186-8).

2.4.3. Power Specifications

The SB302 requires +5V provided on pins 1 and 2, and ground provided on pins 3 and 4. Electrical requirements and current specifications are identified below.

Table 2-4: Power and Current Specifications

Power Supply Requirements	+5Vdc ±5% Maximum noise dc to 100 kHz: 10 mV$_{pp}$
Current Drain	Sleep: 20 mA Receive: 150 mA Transmit (Full Power): 850 mA

2.4.4. Electrical

2.4.4.1. Host (DTE) Interface

The SB302 provides a single 16-pin connector (Samtec HMTSW-108-22-T-D-440) that provides four interfaces:

1. Serial host interface
2. Modem control interface
3. Power
4. Status line interface

The connector pinouts are specified in Table 2-5, and electrical characteristics are specified in Table 2-6 Serial Interface Electrical Characteristics. Signal types are with respect to the modem (DCE).

Table 2-5: Host Interface Connector Pinouts

Pin Number	Pin Label	Type	Description
1 – 2	VBAT	Input	+5V
3 – 4	GND	Ground	Ground
5	TxD	Input	Transmit Data
6	RxD	Output	Receive Data
7	\DTR	Input	Data Terminal Ready
8	\DCD	Output	Data Carrier Detect
9	\DSR	Output	Data Set Ready
10	\CTS	Output	Clear To Send
11	\RTS	Input	Ready To Send
12	\RI	Output	Ring Indicator
13	\SHDN	Input	Graceful modem shutdown.
14	STATUS_OUT1	Output	Power + RF Channel Status
15	STATUS_OUT2	Output	Transmitter
16	STATUS_OUT3	Output	Power Down OK

Table 2-6: Serial Interface Electrical Characteristics

Characteristic	Min.(V)	Max.(V)
Input Low Voltage	-0.3	0.8
Input High Voltage	2.5	5.0
Output High Voltage (Ioh=400 μA)	2.4	–
Output Low Voltage (Iol=3.2 mA)	–	0.5

Serial Port Interface

The serial port pins comprise a standard set of serial data and handshaking lines. All signals are negative assertion, HCMOS logic compatible. These signals must be terminated properly if they are not used. Refer to the SB300 Series OEM Modems *Integrator's Guide* for detail on terminating unused lines.

Hardware handshaking should be enabled using CTS and RTS as the primary flow control signals. The remaining handshaking lines (DCD, DTR, DSR, and RI) are, strictly speaking, not needed; however they are desirable for TCP/IP stack usage and are supported for any applications that may require them. Operation in each mode is as follows:

- **RTS, CTS**
  Used as standard hardware flow control lines.
- **DTR**
  Indicates to the modem that the host device is active. This line may also be configured to switch the modem from data to command state or reset the modem (**AT&D**), and to enable host wake-up. See the RI description below.
- **DCD**
  This line is asserted while online. Behaviour options are set with the command **AT&C**.
- **DSR**
  Always active when the modem is on; it is tied to logic GND.
- **RI**
  If DTR is inactive (high), RI toggles when there is data for the host. This may be used to wake-up the host.

The serial port should be configured for 8-data bits, no parity bits, and 1-stop bit. The default DTE configuration will auto-baud to the host serial baud rate (based on speed of the 'A' in an AT command). Host data rates of up to 57.6 kbps are supported. AT commands may be used to fix the baud rate from 1200 bps to 57.6 kbps.

In command state, a terminal emulation program may be used to communicate with the modem and change the configuration.

Modem Control Interface

Modem control is comprised of one input:

1.   **\SHDN**: Graceful Shutdown

      This is an active-low input. When activated this signal instructs the modem to de-register from the network, and power down. When this activity is completed the STATUS_OUT3 line is pulled indicating to the host that power may be removed from the device.

Status Signal Interface

Status Outputs

There are three status outputs provided, defined as follows:

1.   **STATUS_OUT1**: Power, RF Channel Status
   - Permanently low when power is on but no CDPD channel is visible.
   - Pulses low once per second with 10% duty cycle if modem is locked onto a CDPD channel.
   - Pulses low twice per second with 10% duty cycle if modem is registered on a CDPD channel.

2.   **STATUS_OUT2**: Transmitter
   - Low when the transmitter is keyed.

3.   **STATUS_OUT3**: Power Down OK
   - When low, this indicates it is safe to remove power to the modem. See Section 0 Modem Control Interface.
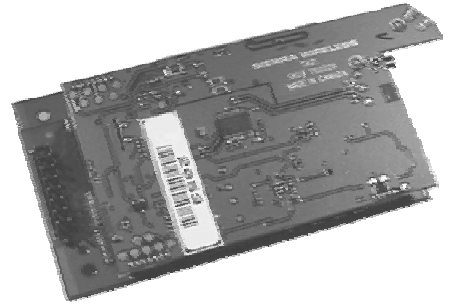
2.5. SB320 Specifications

Part number 1100033

2.5.1. Mechanical

2.5.1.1. Physical Description

The SB320 comes in a Type III package, and includes a 30-pin, 0.5mm pitch ZIF connector for the host interface, a 13-pin PCMCIA I/O connector for the wireline interface, a MMCX connector for the antenna, and a status LED. Dimensions in millimetres are as follows:
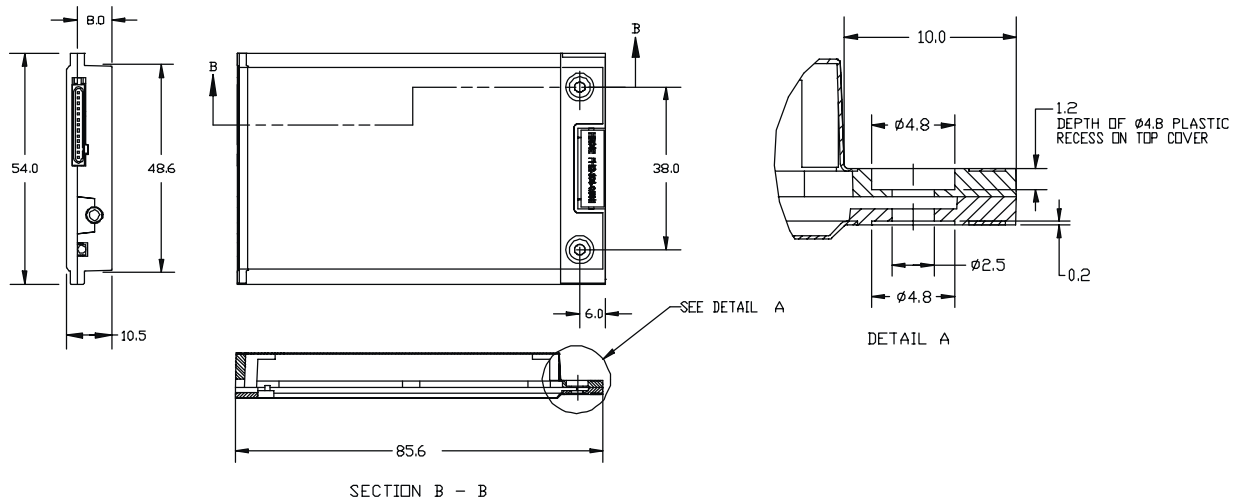
2.5.1.2. Mounting

The SB320 uses an industry standard Type III frame-kit, and as such will fit into PC Card rails. Alternatively, two clips or a bracket may be used to secure the module. There are also two mounting holes provided on either side of the ZIF serial connector.
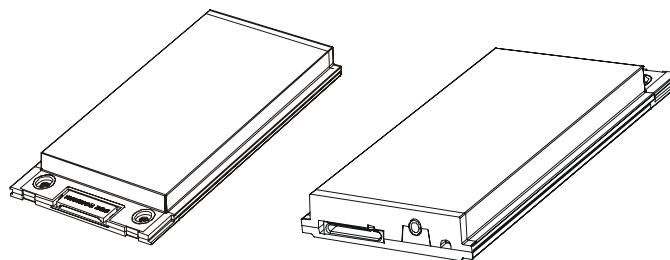
2.5.2. Connectors

2.5.2.1. Antenna Connector

The SB320 provides an MMCX type RF connector (Huber & Suhner 85 MMCX-50-0-1) for the antenna connection. For proper matching the antenna should be 50 ohms with a return loss of 10 dB or better between 824 - 894 MHz. System antenna gain should be 0 dB.

2.5.2.2. Host (DTE) Connector

The SB320 provides a single 30-pin ZIF connector with 0.5mm pin spacing (Hirose FH12-30S).

2.5.2.3. Wireline Connector

The SB320 provides a single 13-pin PCMCIA I/O connector (ITT-Cannon CA112112-1) next to the antenna connector on the side opposite the host (DTE) connector.

2.5.3. Power Specifications

The SB320 requires +5V provided on pins 23-24, and ground provided on pins 23-28. Electrical requirements and current specifications are identified below.

Table 2-7: Power and Current Specifications

Power Supply Requirements	+5Vdc ±5% Maximum noise dc to 100 kHz: 10 mV$_{pp}$	
Current Drain Wireline Mode	Inactive: Data/Fax Transmit: Voice Transmit:	20 mA 220 mA 250 mA
Current Drain CSC Mode	Receive: Transmit (Full Power):	100 mA 850 mA
Current Drain CDPD Mode	Sleep: Receive: Transmit (Full Power):	20 mA 190 mA 760 mA

2.5.4. Electrical

2.5.4.1. Host (DTE) Interface

The SB320 provides a single 30-pin ZIF connector with 0.5mm pin spacing (Hirose FH12-30S). This connector provides four interfaces:

1. Serial host interface
2. Modem control interface
3. Power
4. Status line interface

The connector pinouts are specified in Table 2-8, and electrical characteristics are specified in Table 2-9 Serial Interface Electrical Characteristics. Signal types are with respect to the modem (DCE).

Table 2-8: Host Interface Connector Pinouts

Pin Number	Pin Label	Type	Description
1	\DCD	Output	Data Carrier Detect
2	RxD	Output	Receive Data
3	TxD	Input	Transmit Data
4	\DTR	Input	Data Terminal Ready
5	GND	Ground	Ground
6	\DSR	Output	Data Set Ready
7	\RTS	Input	Ready To Send
8	\CTS	Output	Clear To Send
9	\RI	Output	Ring Indicator
10	\RESET		Hardware Reset
11	RESERVED		Leave unconnected
12	\SHDN	Input	Graceful modem shutdown.
13	STATUS_OUT1	Output	Power + RF Channel Status
14	STATUS_OUT2	Output	Transmitter
15	STATUS_OUT3	Output	Power Down OK
16	STATUS_IN1	Input	
17	STATUS_IN2	Input	
18	STATUS_IN3	Input	
19	STATUS_IN4	Input	
20 – 22	UNUSED		
23 – 24	VBAT	Input	+5V
25 – 28	GND	Ground	Ground
29	UNUSED		
30	RESERVED		Leave unconnected

Table 2-9: Serial Interface Electrical Characteristics

Characteristic	Min.(V)	Max.(V)
Input Low Voltage	-0.3	0.8
Input High Voltage	2.5	5.0
Output High Voltage (Ioh=400 µA)	2.4	–
Output Low Voltage (Iol=3.2 mA)	–	0.5

Serial Port Interface

The serial port pins comprise a standard set of serial data and handshaking lines. All signals are negative assertion, HCMOS logic compatible. These signals must be terminated properly if they are not used. Refer to the SB300 Series OEM Modems *Integrator's Guide* for detail on terminating unused lines.

Hardware handshaking should be enabled using CTS and RTS as the primary flow control signals. The remaining handshaking lines (DCD, DTR, DSR, and RI) are, strictly speaking, not needed; however they are desirable for TCP/IP stack usage and are supported for any applications that may require them. Operation in each mode is as follows:

- **RTS, CTS**
  Used as standard hardware flow control lines.
- **DTR**
  Indicates to the modem that the host device is active. This line may also be configured to switch the modem from data to command state or reset the modem (**AT&D**), and to enable host wake-up. See the RI description below.

- **DCD**
  This line is asserted while online. Behaviour options are set with the command **AT&C**.
- **DSR**
  Always active when the modem is on; it is tied to logic GND.
- **RI**
  In Wireline and CSC modes, this line toggles when there is an incoming call (the telephone is ringing). In CDPD mode, if DTR is inactive (high), then RI toggles when there is data for the host. This may be used to wake-up the host.

The serial port should be configured for 8-data bits, no parity bits, and 1-stop bit. The default DTE configuration will auto-baud to the host serial baud rate (based on speed of the 'A' in an AT command). Host data rates of up to 57.6 kbps are supported. AT commands may be used to fix the baud rate from 1200 bps to 57.6 kbps.

In Circuit-Switched mode data state and any mode's command state, a terminal emulation program may be used to communicate with the modem and change the configuration.

Modem Control Interface

Modem control is comprised of two inputs:

1.   **\SHDN**: Graceful Shutdown

   This is an active-low input. When activated this signal instructs the modem to de-register from the network, and power down. When this activity is completed the STATUS_OUT3 line is pulled indicating to the host that power may be removed from the device.

2.   **\RESET**: Hardware Reset

   This is a hardware reset of the modem. This input should be externally pulled high and driven low to reset.

Status Signal Interface

Status Outputs

There are three status outputs provided, defined as follows:

1.   **STATUS_OUT1**: Power, RF Channel Status
      - Permanently low when power is on but no CDPD channel is visible.
      - Pulses low once per second with 10% duty cycle if modem is locked onto a CDPD channel.
      - Pulses low twice per second with 10% duty cycle if modem is registered on a CDPD channel.

2.   **STATUS_OUT2**: Transmitter
      - Low when the transmitter is keyed.

3.   **STATUS_OUT3**: Power Down OK
      - When low, this indicates it is safe to remove power to the modem. See Section 0 Modem Control Interface.

Status Inputs

There are four TTL-level status input lines provided. There are currently no features that use these inputs.

2.5.4.2.   Wireline and Voice Interface

The SB320 provides a 13-pin connector (ITT-Cannon CA112112-1) for its wireline and voice interface. The connector is positioned on the opposite end of the housing from the serial host (DTE) connector. This connector provides four interfaces:

1. Telephone Line Interface
2. Voice Interface
3. Debug Serial Port
4. Status Outputs

The connector pinouts are specified in Table 2-10. Specific configuration detail for the different interfaces follow. Signal types are with respect to the modem (DCE).

Table 2-10: Pinout of Wireline and Voice Connector

Pin number	Signal Name	Type	Description
1	Reserved		Leave Unconnected
2	SPKR–	Output	Speaker Interface negative
3	SPKR+	Output	Speaker Interface positive
4	MIC+	Input	Microphone input positive
5	MIC–	Input	Microphone input negative
6	Reserved	Input	Leave Unconnected
7	Reserved	Input	Leave Unconnected
8	STATUS1	Output	Status Output 1
9	STATUS2	Output	Status Output 2
10	GROUND	Ground	Signal Ground
11	RESERVED		Leave Unconnected
12	RING	Input	Wireline Connection
13	TIP	Input	Wireline Connection

Telephone Line Interface

The telephone line interface consists of two signals: TIP and RING. These two lines should be routed via a twisted pair of wire to a panel-mounted RJ11 connector.

Voice Interface

Microphone Input

The microphone input is a capacitively connected differential input, with an input impedance greater than 10 kohm. Microphone signals should be 90 mV$_{pp}$ nominal. Software volume control is available. If a single-ended drive is desired, the MIC– input may be connected to ground.

Speaker Output

The speaker output is a differential signal used to interface to a speaker amplifier. The output signal is ac-coupled 2 Vp-p nominal into a 150-ohm load. In circuit-switched and wireline data and FAX modes this signal is used to indicate call progress.

Debug Serial Port

This interface is shown as reserved pins on the connector pinout table. The interface is designed to work through the Multipurpose Interface Board described in chapter <???>.

Status Outputs

These signals are the status outputs from the host interface brought out on the wireline/voice connector. They are described in Section 0 Status Signal Interface.

2.5.5. SB320 Communication Mode Specifications

2.5.5.1. Wireline Specifications

Wireline Data	CCITT V.34: 33600 – 2400 bps CCITT V.32*bis*: 14400, 12000, 7200 bps CCITT V.32: 9600, 4800 bps CCITT V.22*bis*: 2400 bps CCITT V.22: 1200 bps CCITT V.21: 300 bps Bell 212A/103: 1200, 300 bps V.42 error correction (LAPM and MNP) V.42*bis* and MNP5 data compression
Wireline FAX	Command Set: EIA/TIA 578 Class 1 CCITT V.17: 14400, 12000, 9600, 7200 bps CCITT V.29: 9600, 7200 bps CCITT V.27ter: 4800, 2400 bps CCITT V.21 Channel 2: 300 bps
Wireline Voice	

2.5.5.2. Circuit-Switched Data Specifications

CSC Data	CCITT V.34: 16800 – 2400 bps CCITT V.32*bis*: 7200 bps CCITT V.32: 9600, 4800 bps CCITT V.22*bis*: 2400 bps CCITT V.22: 1200 bps CCITT V.21: 300 bps Bell 212A/103: 1200, 300 bps V.42 error correction (LAPM and MNP) V.42*bis* and MNP5 data compression ETC
CSC FAX	Command Set: EIA/TIA 578 Class 1 CCITT V.29: 9600, 7200 bps CCITT V.27ter: 4800, 2400 bps CCITT V.21 Channel 2: 300 bps
CSC General	IS-91
CSC Voice	IS-19C

2.5.5.3. CDPD Specifications

CDPD Version	CDPD 1.1

3. Multipurpose Interface Board

3.1. Introduction

The Multipurpose Interface Board (MIB) is a development aid to facilitate testing and configuration of the SB300 Series modems by allowing communication using a standard RS-232 serial connection. It also provides monitoring LEDs, test points, connections for a protocol analyzer, and connections for wireline (PSTN) hookup.

Although the MIB provides support for the full SB Series of modems, it is not intended to support more than one modem at a time.

For a quick initial setup go to Section 3.8.1. To get a fuller understanding of the board's connections and capabilities sections are provided as follows:

- Section 3.2 Board Description with schematic and parts layout reference.
- Section 3.3 Power Supply including voltage control and supplying power from a host device.
- Section 3.4 Connections describing the various host, modem, and analyzer connectors.
- Section 3.5 Jumpers details options and setups.
- Section 3.6 Serial Breakout Box describes cross wiring correction and signal checking
- Section 3.7 Test Points identifies what is offered and where to find it

3.1.1. Features

The MIB offers these features:
- Supports SB220, SB300, SB301, SB302, SB320
- RS232 to 5V HCMOS conversion
- Interception of 5V HCMOS control signals from host to modem to verify syntax and levels
- Intercepted signals are converted to RS-232 for observation by standard serial port
- Supports wireline access
- Supports voice headset
- Serial port breakout box to resolve cabling difficulties
- Serial port status LEDs
- Status line LEDs and pullup down
- Current, DISC and KEY test points
- Annunciator to hear dial tones
- Comm Analyzer connectors - 25 pin protocol analyzer
- Debug port serial connector
- Uses wall adapter for power

3.2. Board Description

3.2.1. Schematic

<Image(s) to be inserted>

3.2.2. Parts Layout

<Image to be inserted>

3.3. Power Supply

The MIB requires a 12Vdc, 1 Amp power supply. An AC adapter (part number 1900000) is provided with the OEM Developer's Toolkit.

This power is converted by the MIB into the 5V and 7V supplies needed by the modem. It is not designed to support more than one modem connected to the MIB at any time.

There is a power switch on the MIB that controls delivery of both the 5V and 7V supplies to the modem connectors but DOES NOT control the 5V supply to the MIB's own logic. The MIB's logic is on whenever the 12V supply is connected.

The normal initial setup has jumper J21 (Power Select) set on pins 1 and 2 which will deliver power to the modem from the MIB's power source.

3.3.1. Voltage Adjustment

A trim-pot is provided to make fine adjustments to the 5V supply in order to both regulate and test the modem under various power conditions. The 7V supply does not have adjustment controls.

The 5V supply can be measured at pin 1 of the power select jumper (J21).

NOTE: At this time the 5V power adjustment will also affect the 5V supply to the MIB's own logic. Extreme settings may cause failures of the MIB that should not be interpreted as failures of the modem.

3.3.2. Using Power from Host (DTE)

For users testing a host connection to a SB301 or SB302, it is possible to power the modem from the host (DTE) device rather than the MIB. To do this, connect the host to the 2x8-pin block (J9 SB301/302 To Host) and set jumper J21 (Power Select) to pins 2 – 3 (+5V Host).

At this time, there is no provision for a similar host connection to the SB300 or SB320. These modems do however derive power from the source set by jumper J21 (Power Select) so this must be set to pins 1 – 2 for normal operation. A workaround to allow host power to supply the modem is to patch the host power to pins 1 and 2 of the SB301/302 host connector block (J9) and set the power select jumper (J21) to pins 2 – 3.

The MIB's 12V power supply must remain on to deliver power to the RS-232 / HCMOS conversion logic. The DTE/DCE serial lines are converted to RS-232, made available at the Serial Breakout Box, and then converted back to HCMOS at each end.

3.4. Connections

This section provides information on the use of the various connectors on the MIB.

3.4.1. PC Host (DTE) RS-232 Serial Connection

There are two 9-pin D connectors (female) provided on the MIB to connect to standard RS-232 serial ports on a host terminal, usually a PC.

PC Serial Port

This connection is for a PC host device running a terminal emulation program. Communication to and from this port is delivered via the Serial Breakout Box, to and from the modem.

Debug Port

The second 9-pin D connector is for factory level testing only.

3.4.2.   Host (DTE) Connection for SB301 / SB302

An alternative to the 9-pin RS-232 serial connector (PC Serial Port) is provided for connecting a host (DTE) device to a SB301 or SB302 via the 2x8-pin block at J9 (SB301/302 To Host). This connector allows you to insert the MIB between the host and the modem for testing and monitoring communications.

Although there is not currently an equivalent 30-pin ZIF host connector for the SB300 and SB320, the pins of this connector are also delivered to the SB300 / SB320 modem connectors.

This connector is HCMOS level.

Serial Signals

The MIB converts the serial communication signals to RS-232 level, presents them at the Serial Breakout Box and then converts them back to HCMOS level before passing them to the DTE/DCE ends.

NOTE: In order for this signal conversion to work, the host device MUST supply +5V on pins 1and 2. It is this power which enables the conversion logic on the MIB for the host side.

Input Signals

The modem 's three STATUS_OUT signals are passed directly between the modem and the host. They can also be monitored by the three LEDs (SO1, SO2, SO3)

Output Signals

The host Shutdown signal is passed to the modem via an enabling jumper (HOSTSHDN EN) on the main jumper block. With the jumper removed, the shutdown signal is disabled.

Power from the host can be used to power the modem by setting jumper J21 (Power Select) to pins 2 –3 (+5V Host). With the jumper in the original position (pins 1 – 2) the modem is powered from the MIB. See Section 3.3.2 for details.

3.4.3.   Protocol Analyzer Connection

Two 25-pin D connectors are available to connect a protocol analyzer in the serial signal path. The female connector is on the PC side of the Serial Breakout Box; the male connector is on the modem side.

To monitor the communication signals between the host and modem, simply connect the analyzer to the MIB.

3.4.3.1.   Analyzer DCE Emulation

If needed to test the host side, the modem can be disabled and the analyzer allowed to function as the modem (DCE) device. The setup for DCE emulation is still to be determined.

3.4.3.2.   Analyzer DTE Emulation

The protocol analyzer can be used to emulate the host (DTE). The setup to do this is still to be determined.

3.4.4.   SB300 / SB320 Modem Connection

Both the SB300 and SB320 use a 30-pin ZIF connector. The connector uses the flex ribbon (part number 2000068) provided with the OEM Developer's Toolkit.

The connection provides all defined pinouts (see the Product Descriptions in Chapter 1 for details) plus a DISC output from the modem on pin 30 which is made available at test point TP1 (DISC) just beside the connector.

Use care when attaching the ribbon to the connector. There is a cover clamp that hinges up to open the connector. Slide the ribbon into the connector with covered (black) side of the ribbon facing up. Close the connector clamp by pressing down at the ends rather than the centre of clamp. The modem has an identical clamp connector.

This connector is HCMOS level.

Serial Signals

The MIB converts the serial communication signals to RS-232 level, presents them at the Serial Breakout Box and then passes them to the DTE/DCE ends.

The DCE (modem) side of this conversion can be disabled, effectively disconnecting the modem from the MIB by placing a jumper on the MODEM DISBL pins of the main jumper block. This can be useful if you are using a protocol analyzer to emulate the DCE device.

Input Signals

The 5V power comes from the MIB via the jumper J21 (Power Select). Pins 1 – 2 will connect the MIB adjustable 5V supply.

All other input signals (Shutdown (/SHDN) and Status 1 – 4) to the modem are supplied from the main jumper block. Placing a jumper on the pins will make the signal active.

Output Signals

The three modem STATUS_OUT signals are indicated by the three LEDs (SO1, SO2, SO3). These are lit when the output signal is active.

3.4.5.   SB301 / SB302 Modem Connection

The SB301 and SB302 use a 2x8 pin connector block. A strap with connectors at each end (part number 2000067) is provided with the OEM Developer's Kit. This strap allows connection of the modem to the MIB at J7 (To SB301/302).

This connector is HCMOS level.

Serial Signals

The MIB converts the serial communication signals to RS-232 level, presents them at the Serial Breakout Box and then passes them to the DTE/DCE ends.

The DCE (modem) side of this conversion can be disabled, effectively disconnecting the modem from the MIB by placing a jumper on the MODEM DISBL pins of the main jumper block. This can be useful if you are using a protocol analyzer to emulate the DCE device.

Input Signals

The 5V power and Shutdown (/SHDN) signal to the modem can be supplied from the Host (DTE) connection, not the PC Host RS-232 connection.

Modem power can be drawn from either the MIB or the host (DTE) by setting the jumper J21 (Power Select). Pins 1 – 2 will connect the MIB adjustable 5V supply. Pins 2 –3 (+5V Host) will connect the host power to the modem. See Section 3.3.2 for details.

The Shutdown (/SHDN) signal must originate from the Host (DTE) connection (not the PC Host RS-232 connection). It can be enabled or disabled via a jumper (HOSTSHDN EN). With the jumper connector in, the shutdown signal will be passed to the modem.

The Shutdown signal can also be originated at the MIB using the SB3XX SHDN jumper on the main jumper block. Placing a jumper on the pins will make the signal active.

Output Signals

The three modem STATUS_OUT signals are passed directly between the modem and the Host (DTE) connector. Their status is also be indicated by the three LEDs (SO1, SO2, SO3). These are lit when the output signal is active.

3.4.6.   SB220 Modem Conneciton

This is provided for factory testing of older model modems.

3.5.   Jumpers

There are three jumper blocks provided on the MIB. The main jumper block is located next to the modem power switch and has eight pairs of pins. There is also a 3-pin jumper block for power selection, and a 2-pin jumper block to enable or disable the built-in speaker.

3.5.1.   Main Jumper Block

The main jumper block (J24) has eight pairs of pins, all labelled. The first four pairs are to activate the four input signals of the SB320 (not currently implemented by the modem). Two pairs are for direct MIB activation of the Shutdown (/SHDN) signal to the modems and to enable the SB301/302 host interface to trigger this signal. There is one pair of pins for activating TP3 and the last pair is to disable the modem side of the RS-232 / HCMOS serial signal conversion.

3.5.1.1.   ST INx – Status Inputs

Placing a jumper on one of these pins will force the signal active. At this time none of the status input signals are used by the SB320.

3.5.1.2.   HOSTSHDN EN – Host Shutdown Enable

This jumper will enable the Shutdown (/SHDN) signal from the SB301/302 host interface to be passed to the modem. Without the jumper installed, the signal will not reach the modem.

3.5.1.3.   SB3XX SHDN – Shutdown

The modem's Shutdown (/SHDN) input can be forced active by placing a jumper on this pair of pins. This will work regardless of the setting on the HOSTSHDN EN jumper.

3.5.1.4.   TP CTRL

Test Point 3 is tied to this jumper. Application TBD.

3.5.1.5.   MODEM DISBL

Placing a jumper on this pair of pins will disable the MIB's conversion of the modem serial connection from HCMOS level to RS-232 level, effectively disconnecting the modem from the Serial Breakout Box and the host. Power and control signals remain intact.

This can be used to disable the modem's serial connection while using a protocol analyzer to emulate the modem.

3.5.2.   Power Select

A 3-pin block is provided to select the source of the +5V power supply to the modems. Placing the jumper on pins 1 and 2 will connect the MIB's regulated +5V supply. Placing the jumper on pins 2 and 3 will connect the modem to power from the SB301/302 Host connection.

The modem power switch comes AFTER the power selection jumper and can be used to control power to the modems regardless of the source of the power.

3.5.3. SPK EN – Speaker Enable

A 2-pin block is provided near the status indicator LEDs to allow you to disable the speaker in situations where you would prefer to mute the output. Placing the jumper on the pins will enable the SB320 to drive the speaker, provided the SB320 I/O connector is in place.

The SB300/301/302 modems do not provide speaker output.

3.6. Serial Breakout Box

One of the main functions of the MIB is to provide a means of monitoring the serial connection between a host and the modem. The MIB converts HCMOS level signals at the modem (and at the SB301/302 Host connection) to RS-232 level for monitoring on the LEDs and with a protocol analyzer.

In addition, the two rows of pins on each side of the DIP switch provide test points and connections to each individual signal. This allows you to cross connect pins to correct cabling or connector faults.

3.6.1. DIP Switch

The DIP switch is used to make or break the connection between the host and modem for each of the serial communication signals. When switched to the open side, the connection is broken.

Should there be a cross connection error in the host / modem serial connection, switch off the affected signals and use the breakout pins to bridge the signal correctly.

The last two switches are not connected.

3.6.2. Serial Connection Indicators

The LED indicators show the status of the serial communication on the modem side of the breakout box. Red indicates an inactive signal, green indicates an active one. All LEDs are labelled.

3.7. Test Points

There are four test points plus a pair of pins for current measurement.

3.7.1. TP1 DISC

This test point receives its signal from pin 30 of the SB320 modem connector and pin 1 of the SB320 I/O connector. It presents the discriminator output of the radio modem.

3.7.2. TP2

Connected to the SB320 pins 20, 21, and 22, these signals are currently unused.

3.7.3. TP3

This is connected to the TP CTRL jumper of the main jumper block. Application to be determined.

3.7.4.   TP4 KEY

All modem connectors provide the transmitter key indicator here. This signal is also indicated by the S02 status LED.

3.7.5.   Current Measurement

Two pins are made available at J26 (Current Measurement) to allow connection of an ammeter to measure the current drawn by the modem.

3.8.   Applications

To Be Determined.

3.8.1.   Initial Setup

As shipped the MIB is configured as follows:
- Serial communication DIP switches are closed and the two spare switches are left open.
- Power select is on pins 1 and 2 to use MIB power for the modem.
- All main jumpers are removed.
- The speaker is enabled.

4. Getting Started

4.1. Introduction

This chapter guides you through the initial physical setup of a host terminal (usually a PC), the Multipurpose Interface Board (MIB), and a modem. Related start-up issues such as cellular activation are also covered.

After completing this setup, you should be able to communicate with the modem with AT commands.

The following chapter (Software Installation) will deal with the software installation on a host PC of Watcher™ and WirelessExpert™ which make further configuration of the modem and testing on a CDPD network (if applicable) much simpler.

4.2. Registration

In order to use your modem for wireless communication you must register it with a cellular service provider. This section describes what they will need to know and what information they will provide to you.

Contact your service provider to get the registration process started. While the service provider is getting your account configured, you can install and configure your modem. Record the information provided by your carrier for configuring the modem later.

In any coverage area there can be two providers, each assigned to a "side" (A or B) of the cellular waveband. Each provider is also assigned a Service Provider Network Identifier (SPNI) number.

4.2.1. CDPD

In order to use your modem in CDPD mode it must be activated on a CDPD network by a service provider. To register your modem for Wireless IP activation on CDPD networks, contact your local CDPD service provider.

CDPD Service Providers	Toll-free Number
AmeriTech	888 – 907 – 3282
AT&T Wireless	800 – 552 – 3373
Bell Atlantic Mobile	800 – 308 – 3282
Go America	888 – 462 – 4600
GTE Wireless	800 – 483 – 6625

Sierra Wireless, Inc. does not recommend or endorse any particular provider.

Give the CDPD service provider the Equipment Identifier (**EID**). This is the identification number of the radio/modem. The EID has the following format: 00-A0-D5-xx-xx-xx. Look for this number on the back of your modem and on a label affixed to the outside of the package that the modem was shipped in. The number is also available by querying the modem with the **AT+WPEID** command.

The CDPD service provider supplies the following:

5. Modem address, sometimes referred to as a Network Entity Identifier (**NEI**). This may also be referred to as your Internet Protocol (**IP**) address. This identifies your modem on a CDPD network and on the Internet.

6. IP address of a router or server to ping when testing the connection.

   Both of the above items are in the form of an IP number. This is made up of four numbers ranging in value from 0 to 255, separated with periods (sample: 192.168.0.9)

7. Side designator, A or B. This determines the channels used by your CDPD service provider.

8. SPNI number of the provider.

This information will be required when configuring your modem for CDPD registration either with WirelessExpert or AT commands.

4.2.2. CSC (AMPS)

In order to use your modem in CSC mode it must be activated with a cellular phone service provider. To register your modem for CSC activation, contact your local cellular carrier.

Give the service provider the Electronic Serial Number (**ESN**). This is the identification number of the radio/modem. The ESN has the following format: 206-xxxxxxxx. Look for this number on the back of your modem and on a label affixed to the outside of the package that the modem was shipped in. The number is also available by querying the modem with the **AT+WPEID** command.

The cellular service provider supplies the following:

1. A Number Assignment Module (**NAM**). This is your cellular telephone number and Home cellular System Identifier (**SID**).

2. Side designator, A or B. This determines the channels used by your service provider.

This information will be required when configuring your modem for CSC mode use either with WirelessExpert or AT commands.

4.3. Setup Considerations

4.3.1. Host Computer Terminal

You will require a PC with a communications program capable of operating in ASCII terminal emulation mode. This allows the PC to function as a terminal attached to the modem and permits the entering of AT commands required for modem setup and diagnostics. It is recommended that the program chosen be capable of logging terminal communications activity to a file for later analysis or printout in the event that technical support is required.

For IBM PC-compatibles, Windows Terminal, Hyperterminal, Procomm, and Kermit are all acceptable.

A 9-pin D connector RS-232 serial cable (part number 006.0011) is provided with the OEM Developer's Kit for connecting the PC host to the Multipurpose Interface Board.

4.3.2. Physical considerations

The MIB and modem can be sensitive to static so the setup should be in a static controlled environment.

4.3.3. Antenna considerations

The SB300 Series modem uses standard mobile cellular radio signals. An antenna (part number 1810009) is provided with the OEM Developer's Kit. Along with this antenna is a connector adapter (part number 2000066) to convert the antenna connector (Female SMA) to match the modem requirement (Male MMCX).

You can use an antenna of your own if you choose. Any standard cellular antenna of good quality with a maximum gain of 3 dB (FCC requirement) will function properly provided you have a suitable connector.

Antenna performance is subject to the following guidelines:

Location – Locate the antenna as far away from personnel as possible to minimize signal blocking. For optimum reception, in indoor fixed location applications, position the antenna above the height of personnel and nearby equipment or structures. Locate the antenna as close to a window as possible.

Cabling – Select a low loss, high quality, 50-ohm, coaxial cable with the appropriate connectors. The cable can be any length, but lengths greater than 3.7 metres (12 feet) increase cable loss and offset the antenna's nominal gain. If longer length cables are required, use a heavier wire gauge to reduce the dB loss/m and to minimize the effect of the cable loss on antenna gain.

Ground Plane – For installations where a good antenna ground plane (metal surface) is not available, use a non-ground plane type of antenna to help maximize signal reception.

Proximity to Other Antennas – In general, do not locate the SB300 Series modem and its antenna closer than 1.5 metres (5 feet) to another antenna. In certain cases even more separation is required. The effect of the interference from two-way transmitters varies from slowing down response times to blocking modem transmission.

4.4. MIB Presets

The Multipurpose Interface Board has several switches and jumpers which should be configured as follows for the initial setup.
- DIP Switch in the Serial Breakout Box:
  Switches 1 through 8 should be closed
  Switches 9 and 10 open.
- Power Select (J21) should be on pins 1 – 2 (+5V).
- Jumpers on J24 should all be off.
- Speaker Enable should be on.

4.5. Connections

This section describes the steps to connect the PC host, MIB, and modem. At the end of this procedure you should be ready to configure and use the modem. If results at any step are not as described, consult the chapter on troubleshooting.

To connect follow these steps:
3. Attach the RS-232 serial cable from the host to the MIB **PC Serial Port** connector (J1). The Serial Breakout Box indicators for DTR, TxD, and RTS should all light (powered from the RS-232 connection).
4. Start the terminal application on the host PC. Configure the application for the port connected to the MIB. We recommend a setting of 19200 bps, 8 data, no parity, 1 stop, with hardware (RTS/CTS) flow control.
5. Instruct the terminal application to connect. The DTR and RTS indicators should be green. The TxD indicator should be red.
6. Attach the appropriate modem connector strap to the MIB port for the modem to be used.
   - 2x8-pin ribbon with connectors for the SB301 and SB302

     <photo>

   - 30-pin 5mm flex strap (without connectors) for the SB300 and SB320.
     To make the SB300/320 connection:

    i.   Open the hinged SB300/SB320 connector on the MIB by lifting it away from the edge of the board. <mark>\<photo\></mark>

    ii.   Slide the strap into the connector with the contact side down (black side up). Be sure it is fully inserted. <mark>\<photo\></mark>

    iii.   Close the connector by pressing down on the ends of the connector rather than the centre. <mark>\<photo\></mark>

7.   Attach the modem to the connector strap.

NOTE: The MIB is not designed to support more than one modem connected at any time. Connecting more than one modem may damage the modem or MIB.

8.   Place the antenna is a suitable location, attach the antenna connector adapter to the antenna cable, and attach the cable to the modem.

9.   Connect the 12Vdc power supply to the MIB.

10.   Switch on the modem power using the POWER switch on the MIB.
The remaining Serial Breakout Box indicators should light.
The Status indicators will come on in turn as the modem firmware starts up
The modem should send an OK prompt to the host PC.

11.   Type **AT\<enter\>** at the host terminal. The modem should reply with **OK**.

The modem is now ready to be used with the host computer.

5. Software Installation

5.1. Introduction

This chapter provides instructions for installing Watcher™ and WirelessExpert™ on a host PC and using these programs to configure and use the modem.

Running WirelessExpert is required to install necessary drivers on the host PC.

Watcher

Watcher is a Windows application that configures and monitors Sierra Wireless modems for CDPD, Circuit Switched Cellular (CSC), and Wireline operation. It also allows you to set the NEI and NAM registrations for your modem and test the host connection. This chapter explains how to install Watcher and describes basic Watcher operations and important screen elements.

WirelessExpert

Installation of the drivers required for modem operations is performed with an installation wizard called WirelessExpert. This can be run at any time to view and edit the cellular activation settings (NAMs, NEIs, etc.)

5.2. Installing Software on the Host

On the host PC:

1. Insert the diskette.
2. Select **Start > Run…** from the Windows taskbar.
3. Enter **A:\Setup**
   An installation wizard will guide you through the process.

A menu entry is added to the Start > Programs menu:
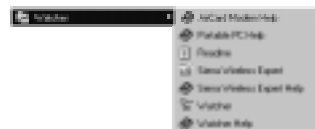
5.2.1. Configuration using WirelessExpert

WirelessExpert will locate the modem on a COM port, interrogate it for features, and install the required drivers on your host PC. It will then allow you to set or alter the cellular activation settings.

In order for the drivers to be available to the Windows operating system, the PC will be restarted part way through the execution of WirelessExpert. This is done automatically but does require that no other programs are running on the PC at the time.

Preparation:

1. Close any open applications on the host PC including any communication program connected to the modem. The system restart supervised by WirelessExpert may fail if other programs are running.
2. Ensure the host serial connection to the modem via the MIB is in place and the modem power is on. The full set of serial communication LED indicators should be on.

Installation:

3. Select **Start > Programs > Watcher > WirelessExpert** from the Windows taskbar.

4. Select the modem being used from the list:
    SB320 – OR – **SB300 Series** for the SB300, 301, 302

5. Click **Next >** and then **Next >** again to skip the page regarding setup of other modem products. WirelessExpert then locates the com port connected to the modem and finds the related registry entries for it. The results are shown.

6. Click **Next >** to have WirelessExpert install the appropriate drivers for the modem.

7. A message appears advising of the need to restart the computer. Click **OK**. WirelessExpert shutsdown the computer and restarts it for you.

8. Click **Next >** until you pass the section on connectivity components. WirelessExpert now examines the modem for cellular network activation.

9. The next page allows you to set the level of access to the configuration settings which will be allowed to the Watcher program. Setting full access will allow Watcher to alter the NAM / NEI settings, read-only will allow Watcher to display the settings but you will have to use WirelessExpert or direct AT commands to alter settings.

10. For SB320 installations, the NAM entries for CSC activation will be presented for entry and editing. This screen is skipped for CDPD only modems.

11. The CDPD settings of the modem are displayed for entry and editing. A radio button sets the active NEI for use. A pull-down menu allows setting of the channel side preference.

12. The CDPD settings can be tested by WirelessExpert and setup in the Windows Dial-up Networking Connection facility. A pull-down menu allows you to select the NEI for testing. If you select one different from the radio button selection on the previous screen, the new setting will become the default. The test can be skipped if desired.

13. Click Finish to complete the WirelessExpert configuration. The modem should now be ready for use.

5.3.   Using Watcher for Remote Connections

Starting Watcher will open a connection using the settings in the Dial-up Networking facility of Windows. To start Watcher:

> Select **Start > Programs > Watcher > Watcher** from the Windows taskbar.

Watcher will locate and initialize the modem.

5.3.1.   Configuring Watcher

Watcher has a setup dialog that lets you verify the Sierra Wireless modem connection to the COM port, and the basic configuration strings for Circuit Switched Cellular and Wireline operation.

To set up Watcher:

14. Make sure the modem is powered on and is communicating with your PC.

15. Select **Options > Setup Watcher** from the Watcher main menu
    This will open the Setup Watcher dialog.
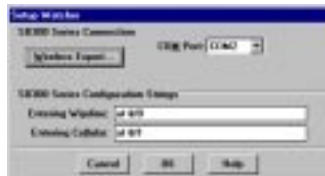
16. Click the **WirelessExpert…** button to activate the installation wizard described above or make changes to the settings manually.

17. If specialized setup strings are required for your installation, you can enter them here. The modem uses configuration strings to optimize its operation in certain modes. The modem comes preset with the most common configuration strings. See <???> for more information.

CDPD mode does not offer special setups. To control CDPD mode use **Options > Setup CDPD…** described below.

18. Click **OK** to save the configuration and return to the Watcher program window.

5.3.2.   Configuring Cellular Settings using Watcher

WirelessExpert must be run initially to properly install and register the required connectivity components with Windows. If you have not run WirelessExpert on the host PC to be used with the modem it must be done **before** using Watcher.

Watcher's ability to manage the cellular activation settings of the modem are set by WirelessExpert. If WirelessExpert has set the access level for Watcher to anything but full access, then Watcher cannot be used to configure the settings.

5.3.2.1.   CDPD Settings

To edit the modem configuration with Watcher:

19. Select **Start > Programs > Watcher > Watcher** from the Windows taskbar.

20. Select **Options > Setup CDPD…** from the Watcher main menu.
    The following window will open to allow configuration changes:

21. To change an NEI address you must click the Unlock button.

The SPNI box enables Friends Only operation. Sleep mode and Friends Only are discussed in the CDPD Operations chapter.

5.3.2.2.   CSC Settings

TBD.

5.3.3.   Starting and Quitting Watcher

To monitor the state of the modem, you can leave Watcher running all the time. In some instances you may need to close or disable Watcher before you can access the modem from another application (e.g., Windows Terminal).

To start Watcher:

22. Select **Start > Programs > Watcher > Watcher** – or double-click the Watcher icon.
    The Watcher program window will open.

To quit Watcher:

23. Click the close box in the top left corner of the Watcher program window. Watcher may take a moment to close while it gracefully disconnects the modem.

5.3.4.   About the Watcher Program Window

The Watcher program window looks like this:

5.3.5.   Watcher Menus and Commands

The Watcher program window contains the following menus:

Settings   Options   Window   Help

These are described below.

5.3.5.1.   Settings Menu

Any dimmed options are not available on the modem being used.

Wireline	Switches the modem to Wireline mode.
Cellular	Switches the modem to Circuit Switched Cellular (CSC) mode.
CDPD	Switches the modem to CDPD mode.
Register	Registers the modem on a CDPD network.
Set Radio Channel…	Displays options for setting the radio channel automatically or manually.
Disable Transmitter	Turns the transmitter off so the modem can only receive data. When selected a checkmark will appear beside it and the status line will indicate the transmitter is disabled. Select the option again to re-enable the transmitter.
Exit	Exits Watcher after gracefully shutting down the modem connection.

5.3.5.2.   Options Menu

Any dimmed options are not available on the modem being used.

Setup Watcher…	Displays the dialog box for configuring the Watcher modem connection and the startup strings for the wireline and CSC modes of operations. See 5.3.1 Configuring Watcher for details.
Setup Cellular…	Displays a dialog box for configuring Circuit Switched Cellular mode. You must be in Wireline or Circuit Switched Cellular mode to select this command. See 5.3.2.2 CSC Settings for details
Setup CDPD…	Displays a dialog box for configuring CDPD mode. You must be in CDPD mode to select this command. See 5.3.2.1 CDPD Settings for details.

5.3.5.3.   Window Menu

Refresh	**F5**	Updates the signal strength, and channel status indicators as appropriate.
Allways On Top		Displays the Watcher program window on top of any currently active application window. When selected a checkmark will appear beside it. Select the option again to disable the feature.

5.3.5.4.   <u>Help Menu</u>

Pressing **F1** will open the main Watcher Help window. Other access to help features are:

<u>C</u>ontents…	Displays the main Help topics.
<u>S</u>earch…	Lets you search for keywords in Help.
<u>C</u>urrent…	Opens Watcher Help to a context sensitive page.
<u>W</u>arranty Regisrtaion..	Displays a form for automated product registration via the Internet.
<u>A</u>bout…	Displays important information about the Watcher version; the modem version, EID, hardware and firmware revision, transmitter temperature, and the connectivity drivers.

5.3.6.   Toolbar Buttons

The Watcher program window contains three buttons for selecting the operating mode, a button for registering and de-registering your modem in CDPD mode. These buttons are described below. If a button is dimmed, the option is not available on the current modem.

Click to switch to Wireline mode.

Click to switch to Circuit Switched Cellular mode.

Click to switch to CDPD mode.

Click to register the modem in CDPD mode. When the cables appear joined, the modem is registered.

Click the button again to de-register the modem.

5.3.7.   Status Indicators

O	Appears to the left of the Wireline button and indicates that Watcher is actively communicating with the modem in a non-packet mode (Wireline or Circuit Switched Cellular).
•	Appears to the left of the Wireline button and indicates that Watcher is actively communicating with the modem in a packet mode (CDPD).
	Shows the Received Signal Strength Indication (RSSI). Double-click on the gauge to display the value in dBm.
"---" (flashing)	Indicates that the modem is not locked onto a CDPD channel.
228	Displays the current radio channel.

5.3.8.   Updating Status Indicators

To update the status indicators, select **Window > Refresh** in the main menu or press **F5**. Depending on the operating mode, the status indicators may take a few seconds to update.

5.3.9. Icon Status

When Watcher is minimized, the shape of the icon indicates the current operating mode and service status.

Indicates the modem is registered in CDPD mode.

Indicates the modem is unregistered in CDPD mode.

Indicates the modem is in Circuit Switched Cellular (CSC) mode.

Indicates the modem is in Wireline mode.

Indicates the modem is not responding.

6. Basic Modem Operation

6.1. Introduction

This chapter provides some fundamentals to the operation of Sierra Wireless OEM modems and some configuration elements of the host (DTE) to modem communication. Specific techniques for setting up the modem for various remote operations are provided in chapters on each mode of operation.

6.2. Modem Modes and States

The SB320 modem supports multiple modes of operation and various states within each mode. The commands and registers used depend on the modem's operating mode. The state of the modem and its condition also determine how the modem will behave in any given situation.

Depending on the product, the exact options available can differ. If a mode or state is not available on the product, commands related to those modes and states will return the ERROR result code.

The modes, states, and conditions of the modem are described in sub-sections below.

6.2.1. Modes

The SB320 supports all of these modes while the SB30x family are CDPD mode only.

- **Wireline** – connected to the Public Switched Telephone Network (PSTN) using a cable (usually with RJ-11 connectors).
- **Circuit Switched Cellular** (CSC) – connected to a cellular network using the Advanced Mobile Phone Service (AMPS).
- **Cellular Digital Packet Data** (CDPD) – connected to a cellular packet switched data network.

6.2.2. States

All modes support at least two states:

- **Command** – the modem exchanges data with the host (DTE) as AT commands and replies.
- **Data** – communication is passed between the host and remote terminal as computer data.

The SB320 may also support:

- **Fax** – communication is passed between the host and remote terminal as fax data.
- **Voice** – communication is treated as voice messages.

The modem's state, in conjunction with its condition, will govern how the modem handles traffic to and from the host and to and from a remote modem.

6.2.3. Conditions

In addition to mode and state the modem can be in one of two conditions:

- **On-line** – actively connected to a remote terminal.
- **Off-line** – disconnected from any remote terminal.

While in off-line condition the modem can only be in command state.

In the on-line condition, the modem can be:
- In a data (data, fax, or voice) state which passes data through the modem between the host (DTE) and the remote terminal.
- In command state which exchanges data between the host (DTE) and the modem (DCE) without passing it through the active connection to the remote terminal.

6.3. Modem Communications with the Host (DTE)

Communication between the host (DTE) and the Sierra Wireless SB300 Series modems is currently fixed at:

bps:	19200
Data Bits:	8
Parity:	None
Stop Bits:	1

Any application being used to issue AT commands must be configured this way.

Local flow control is implemented in hardware (RTS / CTS).

Autobaud support will be implemented soon.

6.4. DTE Communication Options

As shipped the modem is configured with these settings:
- Echo enabled (**E1**) which will cause the modem to echo characters received from the host back to it while in command state. The backspace is echoed as <backspace> <space> <backspace>.
- Quiet result codes disabled (**Q0**) which enables the modem to issue result codes following commands.
- Verbose result codes (**V1**) provide results in English text appended with <CR><LF>.
- SB320 Speaker Control is set to be on until carrier detected (**M1**).

This setting means that a host running a terminal emulation program for communication with the modem should have this configuration:
- Emulation – TTY
- ASCII character

Sending:
- No line ends with line feeds
- No local character echo

Receiving:
- Do not append line feeds to incoming line ends
- Do not force incoming data to 7-bit.
- Wrap lines if necessary

Commands may be entered in upper or lower case.

6.4.1. DTR Signal Handling

The modem can be configured to handle the DTR signal from the host in several ways. The AT command **&D** sets the method. The factory default is to hang up any remote connection and enter command state with auto-answer disabled (setting 2).

If you experience difficulty entering command state from a data state you may wish to have the modem reset on DTR transition.

The available options are:

&D0   Ignore DTR

&D1   Enter command state without changing on/off-line status

&D2   Hang up and enter command state with auto-answer disabled.

&D3   Reset immediately (no reply is issued).

6.4.2.   DSR Signal Control

CDPD mode will leave the DSR signal active whenever the modem is powered on. There is no control of this signal.

In Wireline and CDPD modes of the SB320 the DSR signal can be controlled using the **&S** command. The factory default is to leave DSR active whenever the modem is powered on.

6.4.3.   Local Flow Control

The modem currently handles only hardware flow control (RTS/CTS). This is the factory default as well. The SB320 in non-CDPD modes also supports the **&K** command to adjust this in future firmware revisions. The options are:

&K0   Disable local flow control

&K3   Use RTS/CTS hardware control

&K4   Use XON/OFF software flow control. Don't use this if these characters can be part of the data stream.

There is also an impact to flow control with the use of the Communication Mode command (**&Q**) available on the SB320 in non-CDPD modes. This command effects the use of internal data buffering at the modem. If buffering is disabled, so is flow control.

6.5. Result Code Formats

The modems normally issue result codes on completion of an AT command. This can be disabled with quite mode (**Q1**). The default is to issue results in verbose (English text) form. Numeric codes can be selected by disabling the verbose option (**V0**).

If echo is enabled (**E1**) the modem will append a <LF> to the echoed <CR> from the host. If echo is off, then there is no <CR> or <LF> prior to the response to the command.

Verbose result codes are returned with a trailing <CR><LF>.

Numeric result codes are returned with a trailing <CR> without the line feed.

Where the modem issues a response (data) prior to the result code, the response will have a <CR> and <LF> appended regardless of the echo, quiet, and verbose settings.

NOTE: Allow the modem a few seconds to respond to some commands. Where mode changes are involved the modem may require several seconds to reconfigure before responding. On power up, following initial internal configuration, the modem will issue the **OK** result code to the host whether the host is actively receiving or not.

7. CDPD Mode

This section provides information on configuring and using the modem in CDPD mode.

7.1. CDPD Introduction

CDPD is a standard in wide area, wireless data communications that provides two-way, 19.2kbps packet data transmission for fast and reliable communications over existing cellular channels. See the Appendix for more information on the nature of CDPD communication.

The role of the Sierra Wireless modem in CDPD mode is:

24. Accept commands and digital data from the end-user application equipment (DTE) through the serial connection.
25. Assemble the data into packets.
26. Encrypt the packets.
27. Transmit the encrypted data packet to the network.
28. Receive packet data from the network.
29. Decrypt the packets.
30. Disassemble the packets to extract the application data.
31. Pass the serial data to the end-user's application equipment through the RS-232 port.

Note that the built-in encryption is for the airlink only (between the modem and the cellular service base station). If end-to-end data security is desired it must be implemented or otherwise provided by the end-user.

7.2. Configuring NEI Entries

In order for the modem to register on a CDPD network it must have a unique Network Entity Identifier (NEI). This is an Internet Protocol (IP) address assigned by your CDPD network service provider. Section <???> contains information on activating this service.

The service provider must assign you an NEI and channel side preference. They should also provide their Service Provider Network Identifier (SPNI) number. In order to do this, the service provider will need to know the Equipment Identifier (EID) of the modem which can be reported by the modem by issuing the **+WPEID** command.

This information is recorded within the modem either by using the WirelessExpert configuration program or through direct entry using AT commands. To use WirelessExpert please consult section <???>.

If you need to access the Internet, a Domain Name Server (DNS) address is also required. The modem does not manage this layer of the Internet connection but WirelessExpert will record the DNS address in the Windows networking facility for use at the application level.

7.2.1. NEI Table

The modem can store up to four NEIs. One of these is the active NEI entry. The active entry is the one on which most NEI related commands act. It can be different from the auto-register NEI or a currently registered NEI. The active NEI is indicated by a pointer stored in register **+WS197**.

Although it is recommended, it is not necessary to de-register from the CDPD network before making changes to the table. If you alter the NEI entry that is currently registered, the modem will

de-register the old value. If auto-register is enabled, the modem will then attempt to register the new one.

7.2.1.1.   NEI Configuration With AT Commands

To store the NEI and related CDPD activation parameters using AT Commands enter the following commands (the AT is omitted for brevity):

32. **+WPNEILIST** to display the NEI table and indicate if one is registered. The auto-register NEI is indicated with an asterisk (*) but the active NEI is not indicated.

33. **+WS197=n** where **n** is the entry you wish to edit. This will make that the active NEI.

34. **+WPNEI=ip** where **ip** is the NEI address assigned to you. You do not need leading 0s in the individual elements of the address. When you press <enter> the modem will respond with a prompt to confirm the change in the table. The old and new values are both shown.
Press Y (case insensitive) to confirm the change, or
Press N (or any key other than Y) to cancel the command.

    The modem will respond with OK if the NEI is in a valid IP form.

35. **+WPNEILIST** to display the list and verify the new entry.

36. **+WS174=n** where **n** indicates the channel side preference. Values are:
    0 – A side preferred,
    1 – B side preferred,
    2 – A side only,
    3 – B side only.

    NOTE that this preference is stored in a register not associated with a particular entry in the NEI table. The preference will be used for all NEI registrations.

If you want use the Friends Only feature, the SPNI will also have to be entered. See section <???> for instruction on doing this.

7.3.   CDPD Network Registration

The modem can be set to register manually (on command) or automatically when it enters CDPD mode. The NEI address used for registration is determined differently for each method.

The mode of registration is set in register **+WS173** (Registration Mode). A value of **0** indicates manual registration and **1** indicates automatic. The modem is shipped with a value of 0 but the modem will always default to the last method used.

7.3.1.   Active and Auto-register NEI Indices

The modem keeps two separate index entries to the NEI table. These indices have an intricate inter-relationship that you should understand.

Auto-registration uses the index at **+WS176** (Auto-register NEI Index). Manual registration and manipulation of the NEI table are based on an index at **+WS197** (Active NEI Index).

When the modem registers an NEI, the index of the NEI used (manually or automatically) will be stored in the Auto-register NEI Index (+WS176). This means that auto-registration will always use the last registered NEI unless the Auto-register NEI Index is changed while the modem is de-registered in manual (**+WS173=0**) mode.

Changing the setting in the Auto-register NEI Index while the modem is registered causes the modem to de-register the old NEI address. This happens in both manual and auto-register modes. If the modem is set to auto-register (**+WS173=1**) then the modem will go on to attempt to register the new NEI.

Register **+WS197** (Active NEI Index) is quite independent of any currently registered NEI and can be changed freely. This allows access to other table entries while registered without affecting the registration status.

The manual registration command (+WPREG) will use the Active NEI Index (+WS197) as the address to register. It will also store the value of the Active NEI Index (+WS197) into the Auto-register NEI Index (+WS176) so that it becomes the default address for auto-registration. This copying of the index takes place even if the manual registration fails.

In summary, the Auto-register NEI Index value *will follow* the Active NEI Index value if there is an attempt to register manually. The Active NEI Index can change freely and is *not influenced* by changes in the Auto-register NEI Index.

7.3.2.   Manual Registration

When the modem is set for manual registration (**+WS173=0**) it will not attempt to locate a CDPD channel until commanded to register (**+WPREG**) or the command to set a channel (**+WPCHAN**) is set to **0** (automatic selection). You may select a channel first if desired. If you do not assign a channel, or force automatic channel selection, the modem will scan for one when the registration command is issued.

7.3.2.1.   Select a Channel

If you assign a channel, the modem will use that channel for registration attempts. If registration fails on the assigned channel no automatic attempts to locate another channel are made.

Assign a Channel

To assign a channel for use by the modem issue the AT command **+WPCHAN=n** where **n** is the channel number to assign. The modem will go to that channel. Subsequent use of +WPRSSI will report the strength of signal and if the channel has been acquired.

Changing the channel assignment while the modem is registered will not change the registration status. The modem may lose connectivity if the new channel does not present sufficient signal.

Where the carrier forces CDPD channel hopping the modem will follow the hops regardless of the user assigned channel.

Auto-locate a Channel

To have the modem locate a channel without registering issue the AT command +WPCHAN=0. The modem will then scan for a channel. RSSI requests will reflect the status of the channel found. The channel number will also be available by querying register **+WS200** (Current Channel Number).

7.3.2.2.   Register Manually

To register an NEI manually:
37. **+WS197=n** where **n** is the index to the NEI you wish to register.
38. **+WPREG** to register the NEI. If the NEI is already currently registered the modem takes no action and returns the registration result code. Otherwise, the modem will:
    De-register any currently registered NEI
    Locate a channel if necessary
    Attempt to register the NEI and authenticate credentials

The modem will terminate the process on one of three conditions:
- **Success** – The modem will report the Registered result code.
- **Failure** – The CDPD network failed to register the NEI for reasons given in the result code (i.e. Denied NEI Not Authorized).
- **Time-out** – The register **+WS198** (Registration Wait Time) allows settings from 1 to 255 seconds (default 30) for the registration process. If this time elapses without successful registration the modem will return the Timeout Expired result code.

7.3.3.   Automatic Registration

The modem can be set to register the NEI indexed by **+WS176** (Auto-register NEI Index) automatically. Register **+WS173** (Registration Mode) controls this feature. When this register is set to 1 the modem will immediately attempt to register and will subsequently attempt to register automatically on entry to CDPD mode (startup on CDPD only modems).

Automatic registeration will retry indefinitely should attempts fail.

Setting the Registration Mode to 0 will de-register the current NEI if it successfully auto-registered earlier.

7.3.4.   De-registration

The modem will de-register on any of several events.

If the modem is in manual registration mode it will de-register if:
- The De-register command (**+WPDEREG**) is issued for the registered NEI. Note that this command will reference the NEI indexed by register **+WS197** (Active NEI Index). It is possible that this register has been changed s(by command) after the NEI was registered and no longer points to the registered address; in which case, the registered NEI remains registered and no action is taken by the modem. The Active NEI Index must point to the registered address for this command to work.
- The registered NEI is overwritten with a new value using **+WPNEI=**.

If the modem is in automatic registration mode it will de-register if:
- The method is changed to manual (**+WS173=0**).
- The value of the Auto-register NEI Index (**+WS176**) is changed.
- The registered NEI is overwritten with a new value using **+WPNEI=**.

7.4.   Monitoring the Connection

Prior to finding a channel, the modem many query items will return 0. Once locked onto a CDPD channel, the modem can provide several pieces of information about the connection. Additional information is available regarding the registration of the modem.

7.4.1.   Radio Signal Monitors

7.4.1.1.   Signal Strength

There are two primary monitors of signal strength.

A "percentage" value can be read from register **+WS50** (Normalized Signal Strength). It reports a value from 0 to 100 where 0 is imperceptible and 100 is full signal.

The Receive Signal Strength Indication (RSSI) is more informative. It is read with the RSSI and Channel State command (**+WPRSSI**). It reports:
- Signal strength in dBm (-113 to -30),
- State of the channel (Scanning, Acquired, Sleeping),
- Registration Status (0 no, 1 yes)
- Channel number (0 if scanning)

7.4.1.2.   Current Channel

The channel number is available from register **+WS200**. A value of 0 indicates the modem is not connected to a channel.

7.4.1.3.   SPNI of the Connected Carrier

When the modem has locked onto a channel (whether registered or not) the Service Provider Network Identifier (SPNI) can be read with the command **+WCID**.

7.4.1.4.   Cell Number

Although not important in most circumstances, the number of the current CDPD base station is available from register **+WS210**.

7.4.2.   Registration Status

The status of the modem's registration can be read at register **+WS56** (Network Registration Status). A value of 1 indicates the modem is registered. A value of 0 indicates that it is not registered.

7.4.2.1.   Registration Mode

The current setting of Auto-registration is found in register **+WS173**. A value of 1 indicates automatic registration is enabled, 0 indicates manual registration mode.

7.5.   Serial Line Interface Protocol (SLIP)

Serial Line Interface Protocol (SLIP) is one method for encapsulating packet data over dedicated and/or switched serial lines. It is a useful and reliable way to allow mixes of hosts and routers to communicate with one another in various combinations.

When operating in SLIP mode, the modem's internal Packet Assembly / Disassembly (PAD) services are bypassed and the modem acts as a router passing data between the host's protocol stack, and the CDPD network. All protocol headers are the responsibility of the host. The modem will only provide SLIP framing to the packets.

7.5.1.   Configuring a SLIP Session

The modem's session state is set in register **+WS45** (Packet Service). Setting the value to **3** will place the modem in SLIP mode.

This can be done before or after registration on the network.

7.5.2.   Using a SLIP Session

To send data over the network in SLIP mode the user must enter a data state connection to the network with one of these commands:

Dial (**D**) – This command will cause the modem to register (if not already done) and go into data state. The result code to the host can come as either an immediate CONNECT (**+WS170=0**) prior to establishing the registration, or the modem can wait until registration succeeds or fails and report either CONNECT or NO CARRIER (**+WS170=1**). In the former case, the host will not know if the modem successfully registered on the CDPD network.

On-line (**O**) – This command will switch the modem to data state regardless of the registration condition. This should only be used if you know the modem has successfully registered on the CDPD network.

Once in data state, the modem acts as a pipe through which data passes.

7.5.2.1.   Transmitting

Data packets received from the host are forwarded to the network in 128 byte segments. They can be buffered on the modem up to 14 segments (1792 bytes). Beyond this, there is local hardware flow control (RTS/CTS) with the host to prevent overflow.

7.5.2.2.   Receiving

Incoming data from the network is buffered (up to 14 x 128 bytes) and is passed to the host as it arrives. If the modem has been placed in command state but is still in on-line condition, incoming data will be buffered. There is an automatic remote flow control between the modem and the network to prevent overflow.

7.5.2.3.   Escaping Data State

To escape data state in SLIP mode, the host can issue **<0xC0>+++<0xC0>** to modem. The hexadecimal value 0xC0 is the SLIP frame character. The modem will enter command state but remain registered.

If data arrives at the modem while registered and in command state, the data will is buffered as described in section 7.5.2.2 Receiving above.

An alternative is to pre-set the DTR Options (**&D**) to either 1 or 2 and then switch DTR off to escape data state. If the option is set to 1, the modem will enter command state the same as if the escape sequence was issued; it will remain registered. If the DTR Option is 2 then the modem will de-register and return to command state. Note that if Auto-registration is enabled, the modem will switch off DCD but will remain registered.

7.5.3.   Ending a SLIP Session

To end a SLIP session, escape data state and hang-up (**H1**). This will de-register the modem even if auto-registration is enabled. The modem will remain de-registered. Although auto-registration remains enabled, the modem will not resume auto-registration until the register is reset (**+WS173=1**) or the modem itself re-enters CDPD mode (a modem reset or power cycle on CDPD-only modems).

7.6. User Datagram Protocol (UDP)

User Datagram Protocol (UDP) is the most basic transmission protocol provided by the modem. It is a thin protocol, adding only a port specification to the underlying Internet Protocol (IP). It has the same features as IP, that is a best effort, connectionless delivery service with the chief benefit being minimum overhead.

UDP is not considered reliable because packet delivery is not guaranteed. Packets can be lost, duplicated, delayed, or delivered out of sequence. These conditions are not detected, and the sender or receiver is not informed.

UDP is connectionless because sender and receiver are never logically connected. If the intended receiver is not active *the message is lost*. It is a best effort delivery, because the IP software makes an earnest attempt to deliver the packets, failing only if system resources are overloaded or the underlying networks fail.

Application programs using UDP must accept full responsibility for handling the problems of reliability, including message loss, duplication, delay, out-of-order delivery, and loss of connectivity.

These problems are often treated casually by programmers. Testing done when using highly reliable, low delay local networks may not expose potential failures. This explains why many applications that use UDP work well in a local environment but often fail in dramatic ways on a more global network.

7.6.1.   Configuring a UDP Session

7.6.2.   Using a UDP Session

7.6.3.   Broadcast and Multicast

Broadcast and multicast are CDPD functions that support sending the same data to a large group of IP Addresses with a single transmission to the CDPD network. This capability is implemented through Mobile Data Intermediate System (MDIS) software. Check with your carrier to determine if these capabilities are offered before planning to use it as part of your application.

Broadcast and multicast transmissions are point-to-multi-point and provide a one-way UDP connectionless service. The operational considerations are:

- Protocol restrictions prevent broadcast or multicast messages from being encrypted.
- Broadcast or multicast data packets will not be received by a SB300 Series modem with an active TCP PAD session.
- If a UDP PAD session is active the broadcast and multicast messages will be interspersed with the application data packets and must be separated by the application.
- In the case of SLIP, the disposition of the broadcast and multicast messages is a function of the support provided by the software stack and end-user applications (one must be UDP) operating on the Mobile Application Subsystem (MAS). If a UDP session is not active, the messages will be lost.

7.6.3.1.   Broadcast

The Broadcast function is used on a geographic coverage basis. To support this function the MDIS is set up with a Broadcast NEI that includes a list of the Mobile Data Base Stations (MDBSs) in the desired broadcast area in its definition. There can be multiple broadcast areas within the coverage area of a single MDIS. A message is transmitted to a Broadcast NEI at the MDIS that replicates the message, puts a special broadcast header on it, and sends it to the cells indicated by the broadcast list.

For most applications broadcast is not appropriate, because broadcast messages are sent to all the CDPD modems in the covered geography. It is more useful to be able to specify that messages only go to all, or a subset of the IP Addresses associated with a specific customer; a capability offered by multicast.

Broadcast Setup

The SB300 Series modems do not currently support UDP broadcast.

7.6.3.2.   Multicast

Multicast is set up similarly to broadcast, except that the MDIS is set up with a Multicast NEI and a list of the terminals that belong to that specific group rather than a list of cells, as used by the broadcast function. The message to be multicast is sent to the Multicast NEI at the MDIS, which replicates the message and sends individual messages to the terminals indicated in its multicast group list.

A terminal can be a member of any number of multicast groups, however it can only be active in one at any given time. A terminal wishing to receive multicast messages indicates its readiness by registering a Multicast NEI and by being ready to receive UDP datagrams. The latter can be accomplished by having the UDP Server function set to active, or if in SLIP mode, by having a UDP application set to ready. In all of the preceding cases the MAS is assumed to be ready to process any incoming multicast datagrams.

Contact the service provider for information on the availability and use of multicast service in your area.

Multicast Setup

The SB300 Series modems do not currently support UDP multicast.

7.6.4. Ending a UDP Session

7.7. Transmission Control Protocol (TCP)

Transmission Control Protocol (TCP) is an advanced transmission protocol that adds substantial functionality to the underlying Internet Protocol it is built on. Because of this structure it is often referred to as TCP/IP. The advantage of TCP is reliability of data transmission; achieved by using positive acknowledgements with retransmission if required. The main disadvantage is the overhead needed to provide this reliability under various conditions.

Unlike UDP, TCP offers both reliable and connected data transmission service. Lost, delayed, duplicated, or out of sequence packets are detected and automatically corrected. A logical **point-to-point connection** is established and maintained throughout the communications session. It requires very little other than session establishment, sending data over the serial port, and session termination to get a basic application operational.

The price for this reliability is the number of extra data packets used and the time required to process them. Both need to be considered when selecting an application protocol.

7.7.1. SB300 Series TCP Capability

The SB300 Series software stack offers industry standard client-server capability where the client originates communications and the server waits for incoming requests. In server mode it includes auto answer capability and an optional Friends Only mode. Friends Only mode restricts the devices the server can receive calls from to help prevent unauthorized access to applications or devices.

7.7.2. Friends Only

Friends Only mode permits communication with the modem to be restricted (for security reasons) to a predefined group of addresses (friends). Friends Only mode is controlled by <???>, that enables and disables the comparison of packet source addresses against a list stored in the modem.

When the connection is established actively (by an **ATD** command), incoming packets are accepted from the destination address specified in the dial command regardless of whether or not it is contained in the friends list.

In both modes of operations, the source address (IP Address and port number) of the last accepted packet is saved in a temporary variable for use as the current destination address for all packets being sent by the modem during the current session. This source address information is also saved in register <???> where it can be queried.

7.7.3. Configuring a TCP Session

7.7.4. Using a TCP Session

7.7.5. Ending a TCP Session

7.8. Auto-answer

7.9. Sleep Mode

8. CSC Mode

8.1. Introduction

8.2. Configuring the Modem for CSC

8.2.1. Programming the modem phone number

Call local cellular provider, and ask for an account. Give them your ESN; marked on modem, or electronically queriable. Make sure carrier gives you - 10-digit NAM (area code plus phone number), Home System ID, side (A or B).

Enter the NAM - Watcher or AT command (eg. AT+WPNAM=5553331212, 16200, 0)

8.2.2. Confirm that modem is registered with cellular carrier

Make sure you are in cellular mode - Watcher or AT+WS46

Make a phone call to a phone number and check that it rings

8.3. Make a modem call

Configure for 4800bps (Aircard AT&F0S37=7), others AT&F1

Make a modem call to a local landline modem (preferably with ETC).

Then tweak the data rate depending on your application - see next sections

8.4. Optimizing Data Performance (for experienced user's)

Determine what your needs are:

Data transfers over 50K, configure for Best Performance. Note that it is necessary to have a cellularly aware modem (or modem pool) at the far end of the connection.

8.4.1. CSC Configuration

All Sierra Wireless modems can be configured for excellent cellular performance. The AT&T Paradyne Comsphere product line is recommended as the landline side. Alternatively cellular modem pools are sometimes supplied by the cellular service provider. These are normally good for performance, although they too need to be properly configured by the cellular carrier to optimize the performance.

Even with optimal configuration, modems will have a tendency to attempt to communicate at a data rate that is faster than optimal. For this reason it is recommended that register **S37** (Desired DCE Speed) be used to limit the maximum data communications rate. This register can be set as part of the initialization string eg. **ATS37=7**

Based on field experience, the following limits are recommeneded:

- V.32bis talking to cellularly aware landline modem – 9600 bps (S37=9)
- V.32bis talking to standard wireline modem – 4800 bps (S37=7)
- V.34 talking to cellularly aware modem – 12000 bps (S37=10)
- V.34 talking to standard wireline modem – 9600 bps. (S37=9)

If only a small amount of data is being transferred, it is recommended that a data rate of 4800bps (S37=7) is used. This will give optimal performance and coverage area. Error Correction should always be enabled. Flow control should be used (hardware recommended).

For situations where even 4800 bps does not hold a connection, the last suggestion is to try a data link at 1200 bps (s37=5).

8.4.1.1. Enhanced Throughput Cellular (ETC)

Enhanced Throughput Cellular (ETC) is a 'protocol' designed to optimize cellular data communications. It is described in the Appendix.
- Small frame size \A4,
- Do not allow non error-corrected link \N4,
- Wait for carrier 90 seconds S7=90
- Lost carrier hang-up set to 10 seconds, S10=100

Use of small frame size does reduce throughput by 10%, but gives a more robust connection.

The policy of 'start slow and train up' guarantees that the initial negotiation phase has more chance of success. Start-up speeds of 4800 bps and 9600 bps may be used. In addition if a connection has not been established after 60 seconds, the modems will fall back to 1200 bps.

Even with all this it is best to limit the maximum speed using register S37.

8.4.2. Landline Side

Recommended modem and settings.

If you do not have optimal modem. - limit to 4800bps. If you do not have much data to send, limit speed to 4800bps.

8.4.3. SB220

Speed optimization use AT&&R4A and AT&&R4C to check out the levels. Then use file transfers to check performance. mention S92, S91, S37.

Most robust AT&F1

Best Performance AT&F5 starts at 9600bps, max 9600bps. possibly use s37=10 (12000bps)

Settings may be saved such that they are restored on every power up (or ATZ command) by writing them to NOVRAM using AT&W.

8.4.4. Test set-up

AT&T Paradyne Comsphere V.32bis, AT&F6&I16 using test script from SWI.

8.4.4.1. Test Case 1

A-side, B-side

8.4.4.2.   Test Case 2

Test Setup and Design

The data was collected using a ProComm for Windows script that repeatedly calls a BBS host, logs on, and alternatively uploads or downloads a 10K zip file, then logs off. The two units under test were running at the same time, calling two AT&T Comsphere modems connected to laptops running PCPLUS for DOS in host mode. The position of the two units under test was swapped about every ten calls. The hosts being called was swapped after 80 calls (the trend was the same on the last 50 calls). Both had their display and antenna vertical. Both had external vehicle chargers connected. I drove in and out of coverage, trying to linger near the fringe, but within some level of coverage (RSSI< -95dB and > -105dB). Zero busy signals were detected by the script/modems as the cause of connection failure, so it appears the network was lightly loaded. The SB220 modem init. string was AT!ACM0&F5M3&W+FCLASS=0, at 38,400Baud, N,8,1 and then an ATZ was sent by the script before each call. Both host modems were initialized with AT&F6&I16S0=1 at 9600, N,8,1. 9600 was used to avoid what appeared to be flow control problems when talking to the Comsphere modem at higher speeds. By default, the maximum Sierra cellular data rate is 9600. The weather was and clear 70+ degrees.

Data was collected from about 11:00 AM to 5:30 PM.

Field Test Results

RF Transaction Reliability (file transferred and log off complete):

   Unit 1 => 108 out of 130 calls completed => 83% success rate

   Unit 2 => 95 out of 130 calls completed   => 73% success rate

Average File Transfer Time for 10K Zip file:

   Unit 1 => 40.5 seconds   .

   Unit 2 => 43.0 seconds

The file transfer times were usually longer for downloads then they were for uploads. The fastest transfer times were 16 seconds for uploads and 18 seconds for downloads. There appears to be about 6 seconds of overhead in that transfer time. The average transfer times from the field testing was over two times this potential performance. The cellular connection baud rate was 9600 in about 2 out of 3 of the successful calls, the rest were all at 4800, except for only one 1200 baud connection that went to completion.

8.4.4.3.   Test Case 3

A/B side comparison

CHR-I-A	A	18	20	0.90	59	66	145
CON-I-A	A	18	20	0.90	60	72	130
GES-I-A	A	19	20	0.95	67	99	180
Sum/Average	A	55	60	0.92	62		
CHR-I-B	B	15	20	0.75	54	88	200
CON-I-B	B	18	20	0.90	66	89	200
GES-I-B	B	9	16	0.56	65	98	250
Sum/Average		42	56	0.75	62		

Lunch time calls vs similar off lunch calls

Ber-E-C	5	10	0.50	55	73	400
BER-RSMBigS-C	9	18	0.50	263	74	100

BER-SLCBigS-C	2	8	0.25	264	85	150
	16	36	0.42	194	77	216.67
SAB-E-C	7	9	0.78	69	86	360
CAR-RSMBigS-C	15	18	0.83	289	88	150
CAR-SLCBigS-C	8	11	0.73	254	81	100
	30	38	0.79	204	85	203.33

8.5. Modem Pools

9. Wireline Operation

9.1. Introduction

Wireline mode is that most commonly associated with computer communications: the modem is connected via a telephone line. Only the SB320 supports this mode.

9.1.1. Hardware

To connect the SB320 to a telephone line <???>.

For testing purposes, the MIB supports connection of the SB320 to a telephone line with an RJ-11 connector (PSTN).

NOTE: The telephone connection must be to a standard analogue telephone line. Locations which have an internal PBX telephone system may use digital telephone lines internally. <???>

9.2. Configuring with Watcher

9.3. Internet, TCP, UDP connections

10. Troubleshooting

10.1. Introduction

Some solutions to common problems are described here. They are grouped along the lines of the four operations chapters. General problems communicating with the modem in the first section and issues which are specific to particular modes in subsequent sections.

If you cannot resolve a problem after reading this chapter, please contact the Sierra Wireless help desk at (604) 231-1128 (between 06:00 and 17:00 Pacific Time) or e-mail us at support@SierraWireless.com

10.2. General Modem Problems

The SB300 Series modems are thoroughly inspected during manufacture. There are no end-user access items within the case or on the circuit boards of the modem. If problems occur, check the following:

Problem Description	Suggestions
WirelessExpert fails to setup Windows Dial-up Networking Connection Watcher fails to locate the modem.	Use the Windows **Start > Settings > Control Panel > Modems** to install the Sierra Wireless modem.
Modem fails when transmitting. The LED indicator (SB300/320) does not light.	Check that the power source has adequate voltage and current. The modem requires regulated 5 Vdc at 850 mA. If the power is marginal it can be the problem. The SB300 Series modems draw up to 850 mA under maximum power output. The power output is a function of the modem's distance from the Mobile Data Base Station. It is possible for the modem to work well with a particular power supply in a location requiring low power output (low current draw), and yet to fail using the same power supply in a location requiring a high power output. Check the amperage rating of the power supply to verify that it is adequate for all situations. Check the fuse (if any) in the power source and as a final test use a voltmeter to check for an open cable.

10.3. General Communication Problems

Problem Description	Suggestions
Fails to respond to **AT** command.	Try typing the command **ATE1Q0**<enter>. This will enable the modem echo of your keystrokes (in following commands) and disable the quiet mode (suppression of return codes). Try typing **AT&F**<enter>. Try resetting the modem.

10.4. CDPD Problems

This table lists problems specifically related to CDPD use.

Problem Description	Suggestions
Fails to lock onto a CDPD channel.	
Fails to register on a CDPD channel.	
Registers but data transfer fails.	Check that the host serial cable is properly attached. There may be a flow control problem.

10.5. CSC Problems

This table lists problems specifically related to CSC use.

Problem Description	Suggestions

10.6. Wireline Problems

This table lists problems specifically related to wireline use.

Problem Description	Suggestions

11. Appendix A – Wireless Communication

11.1. Introduction

This section provides a primer on the two wireless communication methods (CDPD and CSC). It is not intended as a technical reference.

11.2. Cellular Digital Packet Data (CDPD)

CDPD is a wireless radio frequency (RF) packet switched data communications service which provides two-way, 19.2 kbps packet data networking services to mobile hosts. It is simply a wireless extension of traditional networks, providing the user with seamless access to data applications on these networks.

Instead of using a dedicated cellular channel or telephone line to transmit data, CDPD devices, like the Sierra Wireless modem, are able to send data over cellular voice channels (the **airlink**) during the time periods when these radio channels are not used for standard cellular voice communications. When a channel becomes overloaded or used by a cellular voice call, the CDPD devices "hop" to an unused or idle channel. Since this initial design, many areas now dedicate specific channels to only CDPD traffic.

The cellular radio channel is only used when actual data is being sent or received and not when the user application is idle. CDPD provides the following airlink support:

- Compression of packet header and information fields transmitted over the wireless channel to reduce the amount of the airlink resource used.
- Support of many users on the same cellular RF channel at the same time.
- Error correction of data sent over the airlink.
- Movement of the user from one cell site to another.
- Delivery of properly sequenced data between user applications over the airlink.

The CDPD network operates as a collection of CDPD service provider networks, with the service provider networks being operated by cellular carriers who provide services such as:

- Data connection to other networks
- Application services
- Network management
- Network security
- Accounting and billing

11.2.1. Security

With data exchanged over a broadcast radio link, security is required to prevent eavesdropping. Airlink security is automatically provided by encrypting the data packets between the SB300 Series modem and the service provider's Mobile Data Intermediate System (where the radio signal is routed to a wireline public or private data network). If end-to-end data security is desired it must be implemented or otherwise provided by the end-user.

11.2.2. Architecture

The major cellular carriers and equipment manufacturers created a trade group called the Wireless Data Forum (formerly the CDPD Forum), that develops and publishes the governing technical specifications for, and promotes the use of CDPD technology.

The CDPD network provides a Connectionless Network Service (CLNS), one in which the network routes each packet individually within the network based on the destination address carried in the packet and knowledge of the current network topology. It is often referred to as a

datagram service. From the user's point of view, only the destination address is known, since the CDPD network manages the packet routing required to reach the destination.

11.2.3. Modem Registration

11.2.3.1. The Network Entity Identifier (NEI)

Each user on the CDPD network is identified by a distinct Network Entity Identifier (**NEI**) which is used by the CDPD network to route messages to the user. This is like an account on the network.

Each NEI has a single home subdomain, where it is normally expected to be located within the network. For example, a user's home may be Las Vegas. Each modem may support more than one NEI, each of which has a home subdomain which may or may not be the same.

For example, you may wish to have three NEIs for the same modem; with these NEIs having home subdomains in Las Vegas, New York, and Dallas (cities to which you travel regularly). You may want to use the NEI corresponding to the city you are currently in. Alternatively, you may want to support two separate NEIs which have the same subdomain, such as one for business use and the other for personal use.

You may travel from a subdomain registered as the home area to a new serving area. The mobility management functions provided within the CDPD network handles the routing of packets for visiting modems in a manner which is transparent to you. If you have pre-arranged with your service provider, you may obtain service in a serving area supported by another service provider.

The NEI used in the Sierra Wireless modem is the address assigned to the subscriber by the CDPD network service provider. IP Addresses are 32-bit numbers that uniquely identify a given machine (or end system) running the TCP/IP protocol suite. You need to have a unique address before you can link in with the rest of the networked world.

The NEI for the Sierra Wireless modem may be installed using the WirelessExpert application provided with the modem. Up to four unique NEIs can be supported in the Sierra Wireless modem. The CDPD service provider will have a unique Service Provider Network Identifier (SPNI). The CDPD service provider must supply the SPNI in numeric format to the CDPD subscriber for entry into the WirelessExpert application.

11.2.3.2. Equipment Identifier (EID)

One parameter that the CDPD service providers require from the CDPD subscriber registering their modem is the Equipment Identifier (EID). The EID is unique to each modem. Essentially, it represents a unique electronic serial number for the subscriber device. No two devices in CDPD can have the same EID.

The format used in representing this 48-bit EID is hex bytes separated by hyphens (e.g., 00-A0-D5-00-00-7B). This is programmed into each Sierra Wireless modem at the factory, and the subscriber can view the EID at any time using the Watcher or WirelessExpert applications supplied with the modem, or the AT command **AT+WPEID**.

When a user initially signs up for service with a CDPD service provider, they will be required to provide the service provider with the EID. This EID then becomes part of the CDPD Subscriber Directory Profile maintained for each subscriber on that CDPD network by the CDPD service provider.

11.2.3.3. Authentication

Each NEI (network account) is mated to an EID (modem device). One NEI cannot be used with different devices (EIDs). One device (EID) can have more than one associated NEI (account).

One of the functions performed by the CDPD network is NEI authentication and verification. This service provides corroboration to ensure that the source of the data received from a user is as claimed and not from a cloned CDPD subscriber device. In other words, only the authorized

owner of the NEI (the modem) is using the NEI. *As a result of this authentication procedure, once a user has registered an NEI and an modem, they cannot use that NEI for data communication over the CDPD network on a new or different modem.*

11.2.4. CDPD Radio Coverage

The subscriber should obtain information from the service provider about what CDPD service coverage is available in the required areas.

In most cases, the subscriber will not be aware of the quality of service provided over the CDPD airlink. Watcher does provide a feature which gives the user an indication of the airlink quality for their Sierra Wireless modem. This quality metric is based on the strength of the signal that is being received by the modem.

Received Signal Strength Indication (RSSI) is a measure of the strength of the RF signal received by the modem. It is expressed either by an analog thermometer or a logarithmic scale, in decibels relative to one milliWatt (dBm). A strong signal level has a less negative number (i.e., -50 dBm) and a weak signal level has a more negative number (i.e., -100 dBm).

The CDPD service provider attempts to ensure that the signal level is fairly strong throughout the coverage area (i.e., -80 dBm or stronger), but due to shielding of the signal by man-made structures, the signal may be less than this desired value.

Examples of locations where a signal could be weaker than desired is in underground parking garages, tunnels, buildings with all metal construction, old concrete buildings with large amounts of steel reinforcing bars, etc. In such cases, the CDPD subscriber may be able to get a stronger signal by locating the antenna near an opening or window. The effect of this repositioning on the RSSI can be observed in the signal strength window of the Watcher application.

11.3. Circuit Switched Cellular (CSC)

The SB320 modem provides Circuit Switched Cellular mode. This is a wireless mode of communication in which the data link connection between the user modem and the remote modem is made over the circuit switched voice cellular network. This voice cellular network is based on the Advanced Mobile Phone Service (AMPS).

Data and Fax communications are carried on over this link as if a standard landline telephone connection is being used. Circuit Switched Cellular is perhaps the most familiar form of wireless data and voice communications. This mode works like normal wireline communication except that the modem link is over a cellular phone call rather than a landline phone call. Like cellular phones, cellular modems have their own telephone number and require a dedicated channel for the duration of the call.

11.3.1. Modem Registration

11.3.1.1. Cellular Phone Number

Using the modem over the cellular network requires that the modem be assigned a Number Assignment Module (NAM). This is essentially the phone number associated with your modem. This is assigned to you when you register your modem with a cellular carrier. The cellular carrier requires the unique Electronic Serial Number (ESN) which is assigned to your modem at the factory.

The unit is capable of retaining two NAMs, with each NAM being assignable to any cellular service provider.

As with your credit card number, bank machine number, or any other private password, you should safeguard the NAM and keep it private.

Calls made with the Sierra Wireless modem using CSC mode are not possible until the NAM has been programmed. The NAM data consists of the cellular phone number as well as other subscriber and cellular service provider information.

11.3.1.2. Electronic Serial Number (ESN)

The Sierra Wireless modem stores the ESN internally. You can display it through the Watcher application by choosing **Help > About** from the main menu when the modem is operating in Circuit Switched Cellular mode. You can also display the ESN by using the **AT+WPEID** command. The ESN is displayed in text form for both NAMs.

11.3.2. CSC Radio Coverage

Because the cellular radio channel is an inherently noisy channel (unlike the public switched telephone network), the remote modem to which the Sierra Wireless modem places a call should as a minimum, support the V.42 error correction standard. This will correct the errors in data transmission that occur over the radio channel.

These errors result from various forms of electrical interference, noise generated by other cellular subscribers (especially during peak usage periods), and the user being located in areas of poor cellular coverage such as remote locations or inside buildings. The use of any cellular device inside a building suffers from varying degrees of signal loss due to losses in the building walls and office materials inside the building. Better signals can be achieved by locating the modem near a window or other opening and by ensuring that the modem antenna is deployed in the vertical position.

Within any cellular network, there will be regions of poor signal coverage. In these areas, noise will affect communications. In addition, an effect known as co-channel interference can be heard on the cellular channel. This is interference from a cellular phone in a different cell. These effects will sporadically limit the communications link, leading to momentary loss of data, or a dropped call.

11.3.3. Enhanced Throughput Cellular (ETC)

Enhanced Throughput Cellular (ETC) is a 'protocol' designed to optimize cellular data communications. It uses a number of techniques to improve the robustness of the data link. Although it is preferred that both sides of the modem link support ETC, one of the attributes is that even if only one side supports ETC significant benefits will be gained.

ETC is built around the LAPM error correction protocol, and includes the following specific settings to improve immunity to the co-channel interference effects mentioned earlier.
- Small frame size
- Do not allow non error-corrected links,
- Wait for carrier 90 seconds
- Lost carrier hang-up set to 10 seconds

Use of small frame size does reduce throughput by 10%, but gives a more robust connection.

The policy of 'start slow and train up' guarantees that the initial negotiation phase has more chance of success. Start-up speeds of 4800 bps and 9600 bps may be used. In addition if a connection has not been established after 60 seconds, the modems will fall back to 1200 bps.

Noise effects due to voice processing are overcome either by reducing the 'baseband transmit level', or by a technique licensed by Celeritas known as 'Tx-Cel'. This technique is typically included with modems that support ETC.

Even with all this it is best to limit the maximum DCE speed.

11.3.4. Modem Pools

Modem pools were developed to overcome the need to have a 'cellularly aware' modem at the landline side of a cellular data link. The end to end link actually consists of two back to back modem connections. The cellular modem initiates a connection with the cell-side modem, while at the same time the land-side modem initiates a connection with the landline modem. The two modems within the modem pool pass data between themselves using a buffered digital link. The cell-side modem typically supports the necessary features to ensure a robust modem link.

To use a modem pool for a call, involves prefixing the called phone number with *DATA (*3282).

There are a few disadvantages to this configuration:
- Call initiation time is long, and there can be long delays in end to end character echo.
- Calls to mobile modems cannot be made through a modem pool.
- Configuration is unique from base-station to base-station, it is not always optimized.