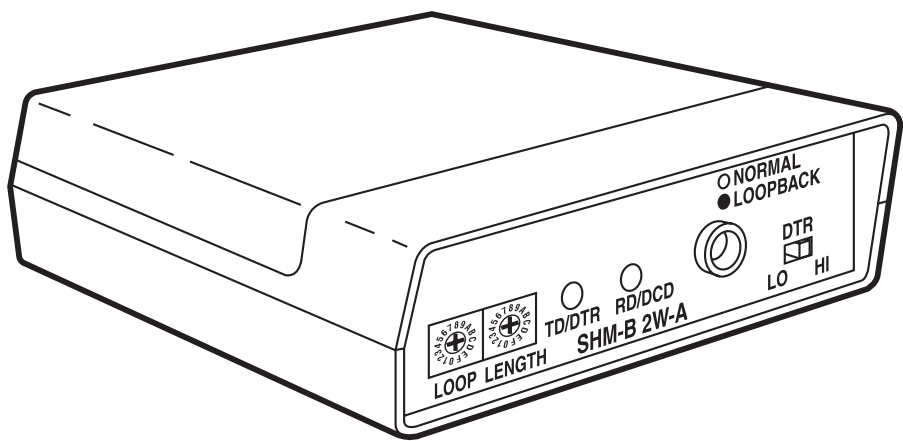




Short-Haul Modem (2-Wire)



**CUSTOMER
SUPPORT
INFORMATION**

Order toll-free in the U.S.: Call **877-877-BBOX** (outside U.S. call **724-746-5500**)
FREE technical support 24 hours a day, 7 days a week: Call **724-746-5500** or fax **724-746-0746**
Mailing address: **Black Box Corporation**, 1000 Park Drive, Lawrence, PA 15055-1018
Web site: www.blackbox.com • E-mail: info@blackbox.com

**FEDERAL COMMUNICATIONS COMMISSION
AND
INDUSTRY CANADA
RADIO FREQUENCY INTERFERENCE STATEMENTS**

This equipment generates, uses, and can radiate radio-frequency energy, and if not installed and used properly, that is, in strict accordance with the manufacturer's instructions, may cause interference to radio communication. It has been tested and found to comply with the limits for a Class A computing device in accordance with the specifications in Subpart B of Part 15 of FCC rules, which are designed to provide reasonable protection against such interference when the equipment is operated in a commercial environment. Operation of this equipment in a residential area is likely to cause interference, in which case the user at his own expense will be required to take whatever measures may be necessary to correct the interference.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

This digital apparatus does not exceed the Class A limits for radio noise emission from digital apparatus set out in the Radio Interference Regulation of Industry Canada.

Le présent appareil numérique n'émet pas de bruits radioélectriques dépassant les limites applicables aux appareils numériques de la classe A prescrites dans le Règlement sur le brouillage radioélectrique publié par Industrie Canada.

**NORMAS OFICIALES MEXICANAS (NOM)
ELECTRICAL SAFETY STATEMENT**

INSTRUCCIONES DE SEGURIDAD

1. Todas las instrucciones de seguridad y operación deberán ser leídas antes de que el aparato eléctrico sea operado.
2. Las instrucciones de seguridad y operación deberán ser guardadas para referencia futura.
3. Todas las advertencias en el aparato eléctrico y en sus instrucciones de operación deben ser respetadas.
4. Todas las instrucciones de operación y uso deben ser seguidas.
5. El aparato eléctrico no deberá ser usado cerca del agua—por ejemplo, cerca de la tina de baño, lavabo, sótano mojado o cerca de una alberca, etc..
6. El aparato eléctrico debe ser usado únicamente con carritos o pedestales que sean recomendados por el fabricante.
7. El aparato eléctrico debe ser montado a la pared o al techo sólo como sea recomendado por el fabricante.
8. Servicio—El usuario no debe intentar dar servicio al equipo eléctrico más allá a lo descrito en las instrucciones de operación. Todo otro servicio deberá ser referido a personal de servicio calificado.
9. El aparato eléctrico debe ser situado de tal manera que su posición no interfiera su uso. La colocación del aparato eléctrico sobre una cama, sofá, alfombra o superficie similar puede bloquea la ventilación, no se debe colocar en libreros o gabinetes que impidan el flujo de aire por los orificios de ventilación.
10. El equipo eléctrico deber ser situado fuera del alcance de fuentes de calor como radiadores, registros de calor, estufas u otros aparatos (incluyendo amplificadores) que producen calor.
11. El aparato eléctrico deberá ser conectado a una fuente de poder sólo del tipo descrito en el instructivo de operación, o como se indique en el aparato.

12. Precaución debe ser tomada de tal manera que la tierra física y la polarización del equipo no sea eliminada.
13. Los cables de la fuente de poder deben ser guiados de tal manera que no sean pisados ni pellizcados por objetos colocados sobre o contra ellos, poniendo particular atención a los contactos y receptáculos donde salen del aparato.
14. El equipo eléctrico debe ser limpiado únicamente de acuerdo a las recomendaciones del fabricante.
15. En caso de existir, una antena externa deberá ser localizada lejos de las líneas de energía.
16. El cable de corriente deberá ser desconectado del cuando el equipo no sea usado por un largo periodo de tiempo.
17. Cuidado debe ser tomado de tal manera que objetos líquidos no sean derramados sobre la cubierta u orificios de ventilación.
18. Servicio por personal calificado deberá ser provisto cuando:
 - A: El cable de poder o el contacto ha sido dañado; u
 - B: Objetos han caído o líquido ha sido derramado dentro del aparato; o
 - C: El aparato ha sido expuesto a la lluvia; o
 - D: El aparato parece no operar normalmente o muestra un cambio en su desempeño; o
 - E: El aparato ha sido tirado o su cubierta ha sido dañada.

SHORT-HAUL MODEM (2-WIRE)

TRADEMARKS USED IN THIS MANUAL

Any trademarks mentioned in this manual are acknowledged to be the property of the trademark owners.

Contents

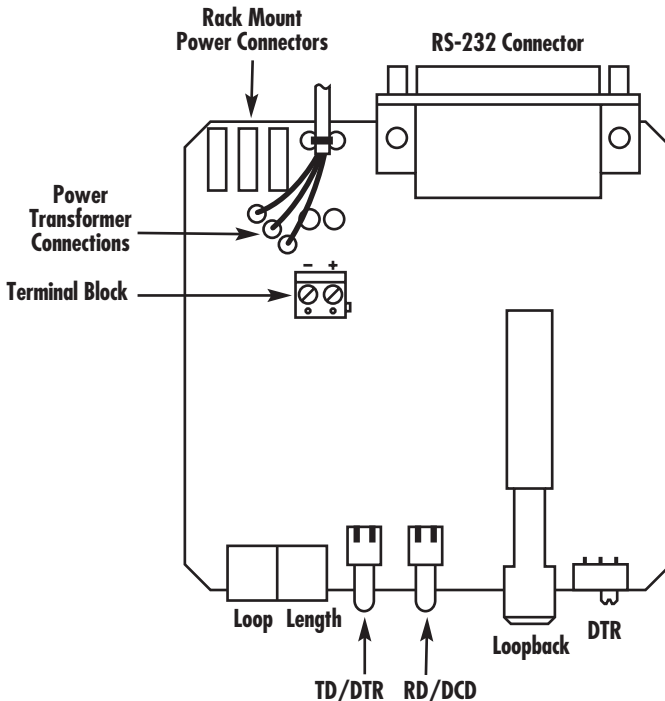
Chapter	Page
1. Overview	6
2. Installation	7
2.1 Step One: Connect the Two-Wire Cable	7
2.1.1 Modular Connection	8
2.1.2 Terminal Block Connection	9
2.2 Step Two: Test the Cabling	10
2.3 Step Three: Set the Loop-Length Switches	10
2.4 Step Four: Connect Your PC or Terminal Equipment	11
2.5 Rack Mounting	13
3. Operation	14
4. Specifications	16
5. Troubleshooting	18

1. Overview

The Short-Haul Modem (2-Wire) is an asynchronous, full-duplex line driver and receiver which requires only two wires to transmit data. A pair of SHMs enables two RS-232 devices to communicate at distances of up to two miles (3.2 km) and at bit rates of up to 19,200 bps, while fully supporting hardware handshaking. The SHM operates over a two-wire metallic circuit. Optimum performance is obtained with 22 to 26 AWG twisted-pair telephone cable. (See **Chapter 4** for more information.) However, nearly any twisted-pair cable can be used, with little or no performance degradation.

In addition to the transmitter and receiver circuits, the modem includes RS-232 control-line interfaces, status monitor LEDs, and a loopback switch.

The SHM is available in a standalone version and a rackmount version. Both versions are identical; however, the standalone version is packaged in a plastic case, from which it can be removed and installed in a chassis, if desired.



2. Installation

Before installing your modem, be certain that it is not plugged into the power source, and that the RS-232 equipment is turned off.

Installation is accomplished in four steps:

1. Connect the two-wire cable.
2. Test the connections.
3. Set the Loop-Length switches.
4. Connect your PC or terminal equipment.

The following instructions apply to both the standalone model and the rackmount model. Refer to **Section 2.5** for installation of the card chassis into a standard 19-inch panel.

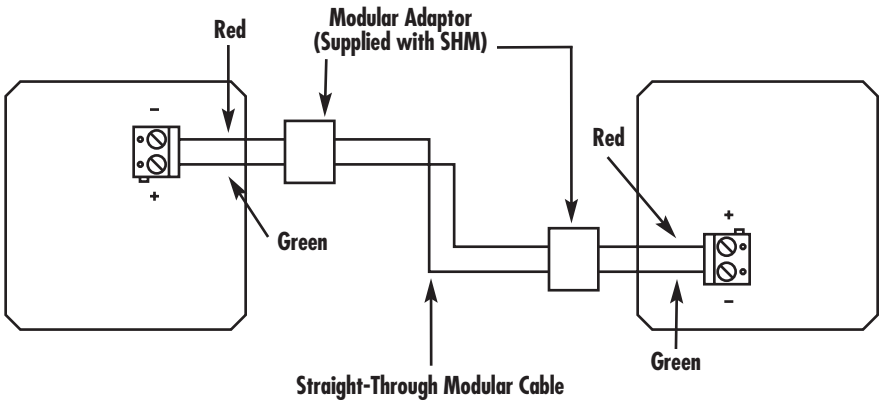
2.1 Step One: Connect the Two-Wire Cable

The standalone model SHM is shipped with the faceplate and a modular connector adapter installed. All switches are accessible on the back panel, so access to the printed circuit card shouldn't be necessary. If the installation does not require using modular connections, it may be necessary to access the card. To remove the faceplate and expose the card, apply pressure at the front of the unit to separate the top and the bottom halves of the case, then push on the rear connector to force out the front panel and printed circuit assembly.

SHORT-HAUL MODEM (2-WIRE)

2.1.1 MODULAR CONNECTION

Installing the SHM requires that the positive (+) terminal on one SHM is connected to the positive (+) terminal of the other SHM, and that the negative (-) terminal is wired directly to the negative (-) terminal.

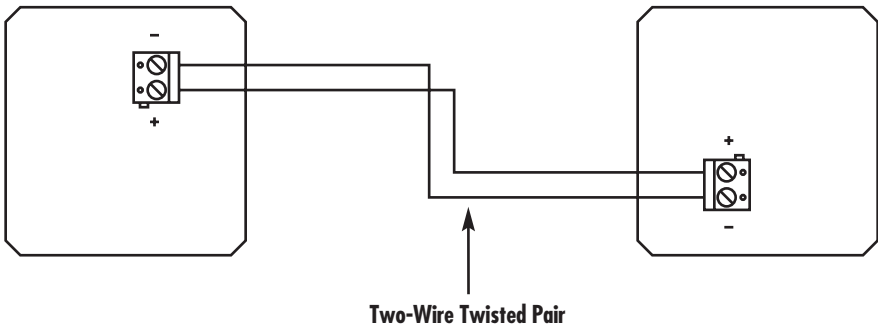


NOTE: A modular cable with a twisted connection may be used but will require changing the red/green polarity on one SHM.

2.1.2 TERMINAL BLOCK CONNECTION

Installing the SHM requires that the positive (+) terminal of one SHM is wired directly to the positive (+) terminal of the other SHM and that the negative (-) terminal is wired directly to the negative (-) terminal.

Remove the modular connector from the terminal block and route the new wires through the same hole in the rear of the case. Strip approximately $\frac{1}{8}$ " to $\frac{3}{16}$ " of the insulation from the ends of both wires before inserting the wires into the terminal block. Tighten the screw terminals. After you have made the connections, wrap the nylon cable tie (provided) around the wires and pull tightly until the cable tie has secured the wires to the printed circuit board. Remove the excess nylon tie with a pair of wire cutters or scissors.



2.2 Step Two: Test the Cabling

Apply power to both of the modems. The front-panel switches should be in the following positions:

- Loopback Switch: Normal position (center of button is black);
- DTR Switch: HI position;
- Loop-Length Switches: Rotary switches set to 0 (zero).

Observe the two LEDs on the front panel of both of the modems. They should be GREEN. If the RD/DCD indicator is RED on both modems, the wire polarity is reversed. Correct the wiring and re-test. If either or both indicators are off, check to make sure that power is applied and that your cable connections are making good contact. When both LEDs on each SHM are GREEN, you are ready to set the Loop-Length switches.

2.3 Step Three: Set the Loop-Length Switches

In order for the SHM to function properly, it is necessary to adjust these rotary switches for each installation. The setting procedure should be necessary only once, when you install the units. To establish the proper settings, both of the SHMs should have power applied, but should not be connected to any RS-232 equipment. By following the above test procedure, the cable connections have been verified and both LED indicators should be GREEN.

Begin with both Loop-Length switches set to 0. Turn the DTR switch to LO on the near-end SHM. The TD/DTR indicator should go off. Go to the far-end SHM and observe the status of the RD/DCD indicator, making sure that the DTR switch at that end is in the HI position. If the distance between the modems is extremely short (less than 100 feet), the RD/DCD indicator should be off. If so, no adjustments are necessary. Normally it will be on, and an adjustment will be necessary. Begin by turning the left rotary switch (red actuator) one position at a time using a small Phillips or straight-blade screwdriver. Keep advancing one position at a time until the RD/DCD indicator goes off. This is now the correct position for the red switch. See Table 2-1 for the correct setting for the orange switch.

Repeat this procedure for the near-end SHM by placing the DTR switch in the LO Position on the far-end SHM (the one you just calibrated). Go back to the near-end SHM and place the DTR switch in the HI position and follow the above procedure to get the RD/DCD indicator to turn off. The settings obtained for both ends should be the same.

Table 2-1. Loop-Length Settings for 24 or 26 AWG Non-Shielded Cable.

Red Switch	Orange Switch
0	0
1	0
2	1
3	2
4	3
5	4
6	5
7	6
8	7
9	8
A	9
B	A
C	B
D	C
E	D

NOTE: Do not use the "F" position on the RED Loop-Length switch.

After completing the installation procedure, slide the printed circuit card back into the case (if necessary) while pulling the data and power cables through the holes in the back. The front panel will snap into the front of the case when the printed circuit board has been completely pushed to the back of the case.

The final step is to set the DTR switches at both ends to the HI position.

2.4 Step Four: Connect Your PC or Terminal Equipment

Connect the SHM to your computer or terminal with standard RS-232 cable and DB25 connectors. Refer to your PC or terminal equipment manual if you need more information on the exact RS-232 signals required by the equipment. If your equipment does not require hardware flow control, use only the Transmit Data (TD), Receive Data (RD), and ground lines. The table on the next page describes the pin connection at the SHM.

SHORT-HAUL MODEM (2-WIRE)

FLOW CONTROL

The SHM uses the Data Terminal Ready (DTR) control signal to turn the transmitter off and on. Normally the attached RS-232 equipment will control the state of DTR. If the attached RS-232 equipment is disconnected or turned off, the DTR switch on the SHM's front panel controls the state of DTR.

Pin	Signal Name	Direction
1	Protective Ground	_____
2	Transmit Data (TD)	From attached RS-232C equipment
3	Receive Data (RD)	To attached RS-232C equipment
4	Request to Send (RTS)	From attached RS-232C equipment (tied to CTS and pulled high)
5	Clear to Send (CTS)	To attached RS-232C equipment (tied to RTS and pulled high)
6	Data Set Ready (DSR)	To attached RS-232C equipment (pulled high)
7	Signal Ground	_____
8	Data Carrier Detect (DCD)	To attached RS-232C equipment (flow control output)
20	Data Terminal Ready (DTR)	From attached RS-232C equipment (flow control input)

The SHM on the other end of the loop detects the presence or absence of the transmitted signal and reflects that condition with the Data Carrier Detect (DCD) control signal. If the far transmitter is on, DCD at the near end will be high, giving an "all systems go" status to the attached RS-232 equipment. Another common flow-control method is X-ON/X-OFF flow control. In this case, hardware flow-control lines are generally not needed. If your equipment uses X-ON/X-OFF flow control, do not connect the DCD and DTR lines to your RS-232 equipment. You must also set the DTR switch to the HI position at both SHMs.

2.5 Rack Mounting

The SHM rackmount version mounts in either an 8-card desktop chassis or a 16-card chassis which mounts in a standard 19-inch (48.3-cm) panel. This 16-card chassis will occupy 5.25" (13.3 cm) of vertical rack space and is 9" (22.9 cm) deep.

To install the 16-card chassis into a 19-inch rack, first remove the acrylic front panel by pulling out the six plunger latches on the front of the panel, then pulling on opposite-side plungers to loosen and remove the panel.

Locate the four 10-32 Phillips-head mounting screws that were shipped with the chassis. Fasten the chassis to your rack using these screws.

Do not attempt to use screws that are not countersunk, as this will result in damage to the front panel when it is installed.

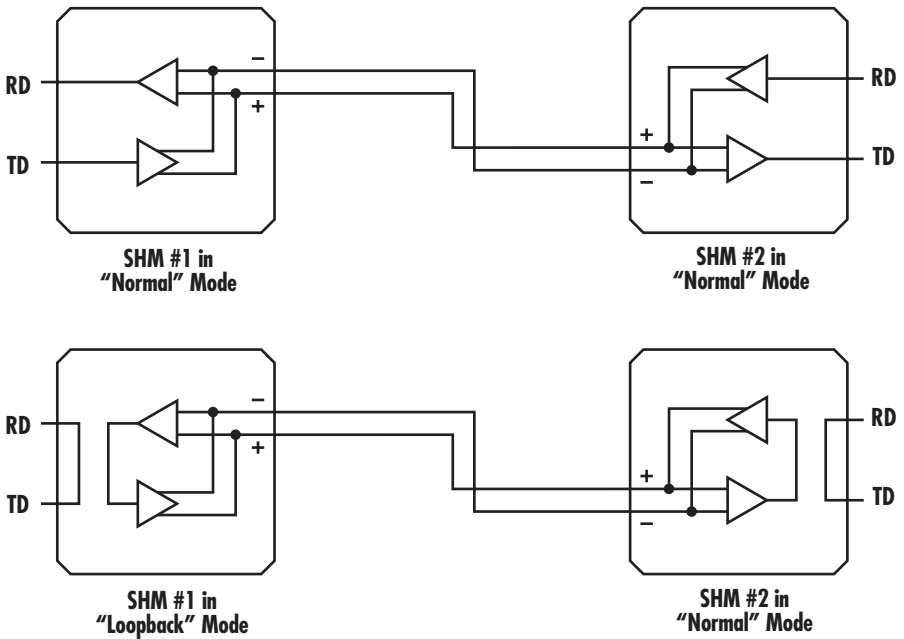
Wire each SHM board according to the procedures in this manual. It is usually easier to feed all of the necessary wires and cables through the chassis, then work with the circuit boards in front of the chassis to make the connections. After each board is wired, it can then be inserted into an open slot in the SHM chassis. Be certain that the board has mated with the power pins on the SHM chassis before applying force to fully seat the board; otherwise damage to the board and power pins could result. When all boards have been wired and plugged into the chassis, plug the wall transformer into its power source.

Proceed with the installation according to instructions given in this chapter. When all channels are operating, attach the plunger latches with their respective holes in the chassis. Press on the top and bottom of the panel to properly seat it, then firmly press in all six of the plunger latches to retain the panel.

3. Operation

Connect the SHM to your equipment, then plug the wall transformer into its power source. As a first step to checking the communication link, place the far-end SHM into loopback by pressing its loopback switch. When in loopback mode, the switch button indicator will appear white. In loopback mode, any data sent to the SHM will be echoed to the sender. If a CRT terminal is connected to the SHM, typing characters on the keyboard should result in the same characters appearing on the CRT screen. If your terminal is configured for local echo, two of each character should appear on the CRT screen. If no characters appear, check your RS-232 connections. See the diagram below for a description of the loopback mode.

The TD/DTR and RD/DCD LED indicators on the SHM's front panel indicate the status of the SHM transmitter and receiver, respectively. GREEN indicates a low RS-232 level, and RED indicates a high RS-232 level. The LEDs will modulate as data is transmitted and received by the SHM. Remember that these LEDs are monitoring the actual received and transmitted signals, not the TD and RD lines of the RS-232 interface.



When the loopback test is completed, press the loopback switch again to return the SHM to the normal mode. The switch button indicator will become black. Data transmission between the two modems will now be possible.

If you still encounter difficulty, refer to **Chapter 5**.

4. Specifications

Distance/Bit Rate Table

Bit Rate (bps):	19.2K	9600	4800	≤ 2400
Distance (miles):	1.1	1.5	1.9	2.3

NOTE: These specifications are valid for unshielded twisted-pair telephone cable having 24 or 26 AWG conductors insulated by polyethylene and a mutual capacitance of 0.083 $\mu\text{F}/\text{mile}$. Shielded twisted-pair cable will reduce the distance to one-third of the table value. This is due to additional capacitance contributed by the shield.

Line Interface—Balanced 2-wire current loop

Equipment Interface—RS-232 interface (DCE configured)

Loopback—Digital loopback on RS-232 interface provided by front-panel switch

Idle Status (DTR) Control—DTR may be pulled either high (true/on) or low (false/off) using a front-panel switch. When active RS-232 equipment is attached, the status of the DTR signal is controlled by the equipment

Status Indication—Two bi-color LEDs indicate the status of the transmitter and receiver. Green indicates a “low” logic level (-3 to -25V) on the RS-232 interface. Red indicates a “high” logic level (+3 to +25V). Off indicates the associated control signal is “low.” The control signal that controls the transmitter is DTR. The control signal that shows the status of the receiver is DCD

Power—120 VAC $\pm 10\%$, 60 Hz, wall-mounted transformer (230 Vrms $\pm 10\%$, 50/60 Hz for 230-volt version option available)

Rackmount—The SHM is available as a standalone unit in a plastic enclosure, or as a rackmount unit. SHM boards may be removed from the plastic case and used as a rackmount unit by simply removing the printed circuit card from the case and desoldering the three transformer lines from the board, then inserting the card into the chassis.

Physical Specifications

Parameter	SHM	16-Card Chassis
Size	1.5"H x 4.3"W x 4.5"D (3.8 x 10.9 x 11.4 cm)	5.25"H x 17"W x 9"D (13.3 x 43.2 x 22.9 cm)
Weight	1.3 lb. (0.6 kg) with transformer	3.7 lb. (1.7 kg) with transformer
Housing Material	High-impact plastic	Aluminum alloy with acrylic faceplate
Operating Temperature	32 to 112°F (0 to 44°C)	Same
Operating Humidity	Max 95% relative humidity noncondensing	Same

5. Troubleshooting

LEDs do not light when power transformer is plugged into the wall outlet.

1. Loose power connections; try moving or wiggling the wall transformer.
2. Broken power leads; remove the SHM printed circuit board and check the three leads from the transformer for continuity.
3. Rackmount Version: be sure the printed circuit board is properly inserted and fully seated against the motherboard.

RD/DCD indicator does not light (no receive carrier).

1. Far-end SHM is not plugged-in; correct as necessary.
2. Loop-Length switches are not set correctly; recalibrate using the described procedure.
3. DTR isn't HI at far-end SHM; make sure that the attached RS-232 equipment is wired properly. If DTR (Pin 20) is not being used, make sure that the DTR switch on the front panel is in the HI position.
4. Improper wiring; recheck the circuit.

No data transfer in one or both directions.

1. Improper wiring; recheck the circuit.
2. Try local test using loopback mode. If there's no transfer, check the RS-232 cable. If local loopback works, try far-end loopback, if there's no transfer, check the twisted pair and Loop-Length switch settings.
3. RS-232 control signals at the wrong levels; check the RS-232 interface using a breakout box. Pins 4, 5, 6, 8, and 20 should all be high to enable communication. If Pin 8 (DCC) is low, this indicates a defective transmission line or connection, or a far-end SHM without power.

TD/DTR and RD/DCD LEDs indicate data activity, but no data communication.

1. Check wiring of the RS-232 port.

Garbled data (all data erroneous).

1. Check for reversal of polarity on the two-wire connection.
2. Incorrect setting of Loop-Length switches; recalibrate.

Occasional data errors.

1. Distance/bit rate capability exceeded. See **Chapter 4**.
2. Poor quality loop (2-wire circuit); try using another 2-wire circuit or rewire the circuit.
3. Extremely noisy environment or extreme crosstalk in cable between modems; reroute cable away from noise sources such as lighting fixtures, motors, etc.
4. Marginal AC power source; check your AC power at the wall socket and confirm that it is within the range given in **Chapter 4**.



© Copyright 1989. Black Box Corporation. All rights reserved.

1000 Park Drive • Lawrence, PA 15055-1018 • 724-746-5500 • Fax 724-746-0746