Mini Sync/Async Short-Haul Modem (SHM-8V)

DECLARATION OF CONFORMITY

The manufacturer certifies that the SHM-8V conforms to the following standards:

EN 55022 (1994): Limits and methods of measurement of radio disturbance characteristics of information technology equipment.

EN 50082-1 (1992): Electromagnetic compatibility – Generic immunity standards for residential, commercial, and light industry.

The SHM-8V herewith complies with the requirements of the EMC Directive 89/336/EEC. It was tested in a typical configuration.

$$C\ \epsilon$$

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 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 connectado 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 fisica 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 lineas de energia.

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 objectos liquidos 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: Objectos 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.

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. Specifications

Compliance — CE (EN55022 Class B); FCC Part 15
Subpart B Class A, IC Class/classe A

Interface — Digital: ITU-T V.24/V.28 (EIA/TIA RS-232),
DTE or DCE (user-selectable—
see Tables 3-1 and 3-2);
Line: Proprietary 4-wire

Protocol — Synchronous or asynchronous, user-selectable

Clock Source— Internal, receive (from other SHM-8V), or
external (from DTE), user-selectable

Data Format — Async only: Any combination of start bits,
data bits, parity bits, and stop bits that adds
up to a total word length of 8, 9, 10, or
11 bits (user-selectable, see Table 3-4)

**Frequency
Allowance —** Async only: Stop bits are shortened by up
to 12.5% or 25% (user-selectable) on the
receive end so the SHM-8V can match the
attached device's frequency more easily:
12.5%: Can compensate for differences
of –2.5% to +1%;
25%: Can compensate for differences
of –2.5% to +2.3%

Flow Control — RTS/CTS (hardware), fixed (although unit is

transparent to software flow control); RTS/CTS delay of 0, 4, 34, or 273 milliseconds, user-selectable

Carrier— Constantly ON or controlled by RTS, user-selectable

Operation — 2-wire half-duplex or 4-wire half- or full-duplex, user-selectable

Data Rate — Sync or async: 2.4, 4.8, 7.2, 9.6, 14.4, 19.2, or 38.4 kbps, user-selectable

Transmission Level — –6 dBm

Maximum Distance — 19 km (11.7 mi.) at 2.4 kbps on 19 AWG wire; see Table 3-3

User Controls — (1) Top-mounted slide switch for activating loopback tests;
(2) Internal slide switches for selecting DTE or DCE;
(1) Internal screwdial for selecting data rate;
(1) 5-position and (2) 4-position internal DIP switches for various configuration options;
If enabled, loopback control with Pins 18 and/or Pin 21 of the V.24 interface

Diagnostics —   V.54 loopback testing with loop 2 (remote digital loopback) or loop 3 (local analog loopback); these tests are user-controlled with a switch or (if enabled) signals from the DTE

Indicators —   (5) Top-mounted LEDs: RTS, TD, RD, CD, and TST (test); can be enabled or disabled by user

Connectors —   Digital:
    Models with "-M" in their product codes:
        (1) Front-mounted DB25 male;
    Models with "-F" in their product codes:
        (1) Front-mounted DB25 female;
    Line (both rear-mounted):
    All models: (1) 5-screw terminal block;
    ME9007 models: (1) RJ-45 female;
    ME9008 models: (1) RJ-12 ("6-wire RJ-11") female

Temperature Tolerance—   32 to 122˚F (0 to 50˚C)

Humidity Tolerance—   Up to 90% noncondensing

Power —   From V.24 interface (voltage levels must be at least 6V on at least two of the tapped leads): If set as DTE: Pins 3, 6, 8, 9, 10, and 17

(RD, DSR, CD, +V, –V, and RSETC
signals respectively);
If set as DCE: Pins 2, 4, 9, 10, 20, and 24
(TD, RTS, +V, –V, DTR, and TSETT
signals respectively);
Consumption (if power is supplied at +6V
level on V.24 interface): 45 mW if LEDs
are disabled, 55 mW if LEDs are enabled

Size —   0.9"H x 2.1"W x 4.3"D
        (2.2 x 5.3 x 11 cm)

Weight —   90 g (3.3 oz.)

2. Introduction

The Mini Sync/Async Short-Haul Modem (SHM-8V) is used for local data distribution, connecting full- or half-duplex sync or async DTE devices (PCs, terminals, etc.) to servers, host computers, muxes, etc. over unconditioned 2-wire or 4-wire lines. The SHM-8V operates at data rates up to 38.4 kbps, and at distances up to 19 km (11.7 mi.) depending on the wire gauge and data rate (see Table 3-3).

The SHM-8V performs diagnostic loopback testing in compliance with the ITU-T's V.54 standard. Two V.54 loops are available: local analog loopback (V.54 Loop 3) and remote digital loopback (V.54 Loop 2). These loops are normally activated with the SHM-8V's top-mounted 3-position switch, but you can also enable the unit to respond to control signals from the V.24 interface: Circuit 141 (Pin 18) for the analog loop or Circuit 140 (Pin 21) for the digital loop. The unit's TEST LED lights when any of the diagnostic loopbacks are in progress.

Asynchronous transmission is handled by internally converting sync to async as prescribed in the ITU-T's V.22 bis standard. You can select any of several async data formats.

Synchronous transmission can use any of the three normal clock sources: internal (from the SHM-8V's own oscillator), external (from an attached DTE), or receive (recovered from the signal sent by the remote SHM-8V).

You can also set the SHM-8V's carrier to be constantly ON (for point-to-point operation) or controlled by RTS (for multipoint operation or for passing control signals end-to-end). Figures 2-1 and 2-2 show a pair of SHM-8V applications.

And you can set the SHM-8V to be either a DCE or a DTE as well, which means you don't have to worry about cross-pinned cable. (However, when the SHM-8V is set to be a DTE, you should make sure that the loopback signaling on Pins 18 and 21 is disabled—see Table 3-1 and **Section 5.1**.)

The low transmit level minimizes crosstalk onto adjacent circuits within the same cable. Data is transmitted and received at a balanced impedance, ensuring high immunity to circuit noise. Additionally, the SHM-8V is coupled to the line through isolation transformers that protect it and the attached equipment against AC or DC overvoltages.

MINI SYNC/ASYNC SHORT-HAUL MODEM (SHM-8V)

   The SHM-8V can operate without an external power supply. This is because it can draw all the power it needs—a meager 55 milliwatts—from the standard V.24 data and control signals. If the attached device can't supply even this much power, you can even disable the SHM-8V's LEDs to reduce its consumption almost 20% further, to 45 milliwatts.

   The line interface consists of two independent connectors. One is a 5-screw terminal block (for four data lines plus a signal ground), the other is either an RJ-45 jack (ME9007 models) or an RJ-12 ("6-wire RJ-11") jack (ME9008 models).

   If they're enabled, five LEDs will provide you with information about the status of the link and the attached devices: TST (lights when the SHM-8V is in a loopback test mode), RTS (lights when Request to Send is active), TD (lights when Transmit Data is active), RD (lights when Receive Data is active), and CD (lights when Carrier Detect is active).
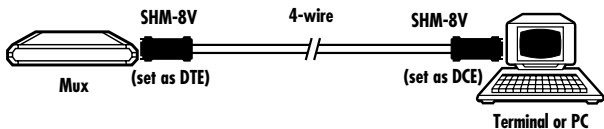
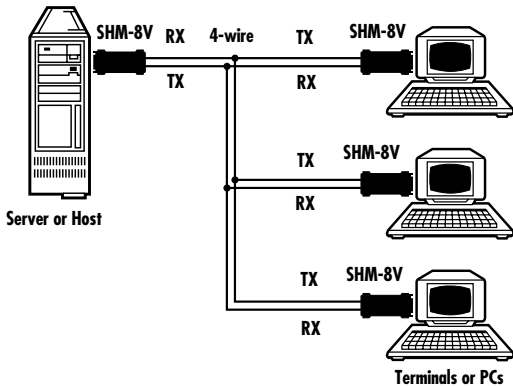**Figure 2-1. A point-to-point SHM-8V application.**

Figure 2-2. A multipoint SHM-8V application.

3. Configuration

When you configure the SHM-8V, there are a few general settings that you should always make sure are correct, as detailed in **Section 3.1**. Other settings will depend on your application, as described in **Section 3.2**. When you are ready to open your SHM-8V and set its internal controls, refer to **Section 3.3** for all of the possible settings.

3.1 General Settings

- No matter what your application is, you need to make sure that the SHM-8V's V.24 interface is set properly as a DTE or a DCE with the internal slide switches SW1 and SW2. (Both of these switches must be set the same way.) See Table 3-2.

- If you set the SHM-8V to DCE, and the attached DTE outputs the Local Loopback (LL) signal on Pin 18, and the cable between the DTE and the SHM-8V carries this lead, you can set the ANA jumper (SW7-2) to EN (enable) if you'd like to be able to trigger local analog loopback from the DTE. Otherwise, set this jumper to DIS (disable).

- Similarly, if you set the SHM-8V to DCE, and the attached DTE outputs the Remote Loopback (RL) signal on Pin 21, and the cable between the DTE and the SHM-8V carries this lead, you can set the REM jumper (SW7-3) to EN (enable) if you'd like to be able to trigger remote digital loopback from the DTE. Otherwise, set this jumper to DIS (disable).

- For normal operation, make sure that the loopback switch on the SHM-8V's top panel (SW4) is set to NOR (the center position).

3.2 Applications

3.2.1 FOUR-WIRE POINT-TO-POINT SYNC OPERATION

In this situation, you'll need to set the data rate (with dial SW3), the RTS/CTS delay (with switches SW5-1 and SW5-2), the clock source (with switches SW5-3, SW5-4 and SW5-5), and the carrier handling (with switch SW6-4) to meet your requirements. See Tables 3-1 and 3-2.

3.2.2 FOUR-WIRE POINT-TO-POINT ASYNC OPERATION

In this situation, you'll need to set the data rate (with dial SW3), the RTS/CTS delay (with switches SW5-1 and SW5-2), the async stop-bit shortening and word length

(with switches SW6-1, SW6-2, and SW6-3), and the carrier handling (with switch SW6-4) to meet your requirements. You'll also need to set the clocking to async using switches SW5-3, SW5-4, and SW5-5. See Tables 3-1, 3-3, and 3-4.

3.2.3 FOUR-WIRE MULTIPOINT OPERATION (SYNC OR ASYNC)

In this situation, you'll need to set the carrier handling (with switch SW6-4) to "controlled by RTS." You'll also need to set RTS/CTS delay (with switches SW5-1 and SW5-2) as follows:

- For data rates of 9.6 kbps and above: 4, 38, or 273 milliseconds.

- For data rates of 4.8 kbps and below: 38 or 273 milliseconds.

3.2.4 TWO-WIRE HALF-DUPLEX OPERATION

In this situation, you'll need to set the carrier handling (with switch SW6-4) to "controlled by RTS." You'll also need to set the 2-wire/4-wire switch (SW7-1) to the 2-wire position. (One other thing: When you run your cable between the SHM-8V units, make sure to break out and connect the two wires as shown in Figure 4-1).

3.3 Setting the SHM-8V's Internal Controls

CAUTION!

The SHM-8V is a delicate instrument. Be extra careful when you perform the procedures described in this section, so that you do not loosen or damage any of the unit's components.

To set the SHM-8V's internal controls, take these steps:

1. Open the unit (separate the two halves of its plastic cover) by pressing the marked places on the cover's sides, starting at the line-cable end.

2. Configure the SHM-8V by referring as necessary to the illustrations of the board layout and controls in Figures 3-1 and 3-2, and to the information about various control settings in Tables 3-1 through 3-4.

3. Double-check the settings one last time, then replace the unit's cover by pressing its two halves back together.

Your unit should be ready to install; proceed to **Chapter 4**.
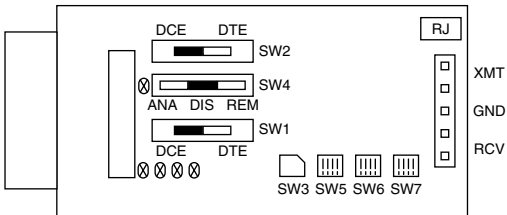
Figure 3-1. Layout of the SHM-8V's circuit board.

Figure 3-2. Dial SW3 and DIP switches SW5, SW6, and SW7.

Table 3-1. Control Settings

Control	Function	Possible Settings
SW1 and SW2	Determine whether V.24 port is DTE or DCE (both switches must be set the same way)—see Table 3-2.	DCE (default) DTE
SW3	Determines data rate.	0 = 38.4 kbps 1 = (Reserved, do not use) 2 = 19.2 kbps 3 = 14.4 kbps 4 = 9.6 kbps (default) 5 = 7.2 kbps 6 = 4.8 kbps 7 = 2.4 kbps
SW4	Determines operating mode (see **Section 5.1**).	ANA = Local analog loop NOR (external) or DIS (internal) = Normal operation (default) REM = Remote digital loop
SW5-1 and SW5-2	Determine RTS/CTS delay.	<u>5-1</u> <u>5-2</u> <u>Delay</u> OFF OFF None OFF ON 4 ms (default) ON OFF 34 ms ON ON 273 ms

Table 3-1. Control Settings (continued)

Control	Function	Possible Settings
SW5-3, SW5-4, and SW5-5	Determine clock source or async mode.	<u>5-3</u> <u>5-4</u> <u>5-5</u> <u>Clock</u> OFF ON OFF Async OFF OFF ON Receive OFF OFF OFF Internal (default) ON OFF OFF External
SW6-1	Determines async stop-bit shortening	ON = 25% OFF = 12.5% (default)
SW6-2 and SW6-3	Determine async word length—see Table 3-3.	<u>6-2</u> <u>6-3</u> <u>Bits</u> OFF OFF Eight OFF ON Nine ON OFF Ten (default) ON ON Eleven
SW6-4	Determines carrier handling.	ON = Constantly ON OFF = Controlled by RTS.
SW7-1	Determines 2-wire or 4-wire operation.	ON = 2-wire operation OFF = 4-wire operation (default)
SW7-2	Determines if DTE can control local loop with LL signal on Pin 18.	ON = Pin 18 enabled OFF = Pin 18 disabled (default)
SW7-3	Determines if DTE can control remote loop with RL sgl. on Pin 21.	ON = Pin 21 enabled OFF = Pin 21 disabled (default)
SW7-4	Determines if SHM-8V's LEDs are enabled or not.	ON = Enabled (default) OFF = Disabled

Table 3-2. DTE Vs. DCE Signal Handling

When SW1 and SW2 are in the DTE position:

Pin	Signal	Direction*
2	TD	Output
3	RD	Input
4	RTS	Output
5	CTS	Not connected
6	DSR	Input
8	CD	Input
15	TC	Not connected
17	RC	Input
18	LL	Not connected
20	DTR	Output
21	RL	Not connected
24	EXTC	Output
25	TM	Not connected

When SW1 and SW2 are in the DCE position:

Pin	Signal	Direction*
2	TD	Input
3	RD	Output
4	RTS	Input
5	CTS	Output
6	DSR	Output
8	CD	Output
15	TC	Output
17	RC	Output
18	LL	Input
20	DTR	Input
21	RL	Input
24	EXTC	Input
25	TM	Output

*"Input" = input to SHM-8V; "Output" = output from SHM-8V.

Table 3-3. Distance vs. wire gauge and data rate.

Data Rate (kbps)	19 AWG km (mi.)		22 AWG km (mi.)		24 AWG km (mi.)		26 AWG km (mi.)	
38.4	10.5	(6.5)	6.5	(4)	4.5	(2.7)	3	(1.8)
19.2	15	(9.3)	8.5	(5.2)	6	(3.7)	4	(2.4)
14.4	16.5	(10.2)	9.8	(6)	7	(4.3)	5	(3.1)
9.6	16.5	(10.2)	9.8	(6)	7	(4.3)	5	(3.1)
7.2	18	(11.1)	11.8	(7.3)	9	(5.5)	7	(4.3)
4.8	18	(11.1)	11.8	(7.3)	9	(5.5)	7	(4.3)
2.4	19	(11.7)	12.8	(7.9)	10	(6.2)	7.8	(4.8)

Table 3-4. Async word length.

Start Bits	Data Bits	Parity	Stop Bits	Total Length
1	5	None	1	(Not supported)
1	5	None	1.5, 2	Eight bits
1	5	Odd, Even	1	Eight bits
1	5	Odd, Even	1.5, 2	Nine bits
1	6	None	1	Eight bits
1	6	None	1.5, 2	Nine bits
1	6	Odd, Even	1	Nine bits
1	6	Odd, Even	1.5, 2	Ten bits
1	7	None	1	Nine bits
1	7	None	1.5, 2	Ten bits
1	7	Odd, Even	1	Ten bits
1	7	Odd, Even	1.5, 2	Eleven bits
1	8	None	1	Ten bits
1	8	None	1.5, 2	Eleven bits
1	8	Odd, Even	1	Eleven bits
1	8	Odd, Even	1.5, 2	(Not supported)

4. Installation

To install a pair or set of SHM-8Vs, take these steps:

1. Make sure you are using the right cable for your dedicated line. It should be unshielded twisted pair (or shielded twisted pair in noisy environments) containing two or four 19-to-26-AWG wires. (Note that if you're using two-wire cable, it needs to be broken out into four leads at either end, with signals connected end to end as shown in Figure 4-1.)

2. Attach this cable to the SHM-8V's line connector:

    • If you're using the terminal block, connect each of the cable's four leads to the appropriate screw terminal.

    • If you're using the RJ-12 or RJ-45 jack, plug the cable right into it. (The cable and its plugs should be pinned as shown in Figure 4-2 or 4-3.)

3. Run this cable to the next/other SHM-8V and repeat step 2, making sure that the two SHM-8Vs are connected so that local XMT is attached to remote RCV, local RCV is attached to remote XMT, and shield—if the cable is shielded—is attached to GND *at one end of the cable only.*

4. *Multipoint applications:* Repeat step 3 as often as necessary. (In this case, "local" is always refers to the central/master unit and "remote" always refers to the distributed/slave units. Make sure your wiring resembles that shown in Figure 2-2.)

5. Plug each SHM-8V directly into the DB25 serial port of the V.24 device you want to hook into the system and fasten the screws. If the device has a DB9 male serial port instead, as is sometimes the case with today's computers, you'll need a DB25 male to DB9 female adapter such as our product code FA520A-R2.

Your SHM-8V system should begin operating immediately; the units draw their power from the attached devices and do not have ON/OFF switches. Proceed to **Chapter 5**.
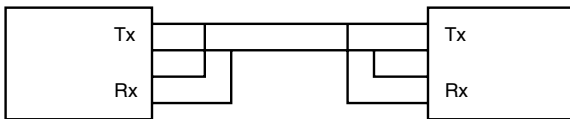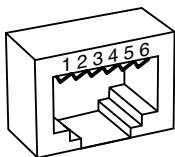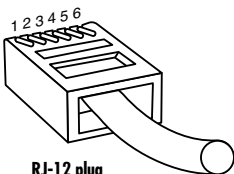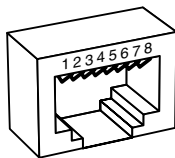

Figure 4-1. Two-wire cable pinning.

Plugs should be wired:
1 GND
2 RCV–
3 XMT–
4 XMT+
5 RCV+
6 N/C

Cable should be wired:
2 to 3, 3 to 2
4 to 5, 5 to 4
Shield to GND (Pin 1)
at one end only

**RJ-12 jack
(external view)**

RJ-12 plug

Figure 4-2. RJ-12 pinout and cable pinning.

Plugs should be wired:
1 N/C
2 GND
3 RCV–
4 XMT–
5 XMT+
6 RCV+
7 N/C
8 N/C

Cable should be wired:
3 to 4, 4 to 3
5 to 6, 6 to 5
Shield to GND (Pin 2)
at one end only

**RJ-45 jack
(external view)**

RJ-45 plug

Figure 4-3. RJ-45 pinout and cable pinning.

5. Operation and Troubleshooting

5.1 The Loopback Tests

The SHM-8V is designed to operate unattended. If its LEDs are enabled, the four on the right of the unit will show you activity on these four signals: Request to Send (RTS), Transmit Data (TD), Receive Data (RD), and Carrier Detect (CD). By watching the interplay of these signals, you can monitor basic system operation.

However, there might be times when the system behaves abnormally, or when you just want to test its components. The SHM-8V performs two types of ITU V.54-compliant loopback tests: local analog loopback (V.54 Loop 3) and remote digital loopback (V.54 Loop 2). Local analog loopback only tests the SHM-8V where the test is initiated, as shown in Figure 5-1, by running the unit's own XMT signal back through its RCV circuits:

Figure 5-1. Local analog loopback.

Remote digital loopback (supported for point-to-point applications *only*) tests the SHM-8V where the test is initiated, the SHM-8V at the other end of the cable, and the cable itself, as shown in Figure 5-2. It does so by signaling the unit at the other end to retransmit its own RCV signal back out of its XMT leads:

Figure 5-2. Remote digital loopback.

Both loops can be controlled with the slide switch on the SHM-8V's top panel (the one identified as SW4 on the circuit board): On the unit where you're initiating the test *only* (not on any other unit), move this switch from the central NOR (normal operation) position to ANA (to start analog loopback) or REM (to start remote loopback). When the test is over, move this switch back to NOR.

Alternatively, if you've set a SHM-8V to DCE and enabled interface control of these loops from the attached DTE (see Tables 3-1 and 3-2), you can start and end the corresponding loopback test by raising

and lowering the Local Loopback signal (circuit 141) on Pin 18 and the Remote Loopback signal (circuit 140) on Pin 21.

While either of these tests is in progress, the involved SHM-8V units will light their TST LEDs. Those that are set as DCEs will also transmit the Test Mode signal (circuit 142) on Pin 25. The LED will go dark, and the signal will stop, when the SHM-8Vs are returned to normal operation.

5.2 Calling Black Box

If your SHM-8V seems to be malfunctioning, *do not attempt to alter or repair the unit.* It contains no user-serviceable parts. Call Black Box Technical Support at 724-746-5500; the problem might be solvable over the phone.

Before you call, make a record of the history of the problem. We will be able to provide more efficient and accurate assistance if you have a complete description, including:

- the nature and duration of the problem;

- when the problem occurs;

- the components involved in the problem;

- any particular application that, when used, appears to create the problem or make it worse; and

- the results of any tests you might have already performed.

5.2 Shipping and Packaging

If you need to transport or ship your SHM-8V:

- Package it carefully. We recommend that you use the original container.

- If you are returning the unit, make sure to include everything you received with it. Before you return the unit or ship it for repair, contact Black Box to get a Return Authorization (RA) number.

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