BLACK BOX®
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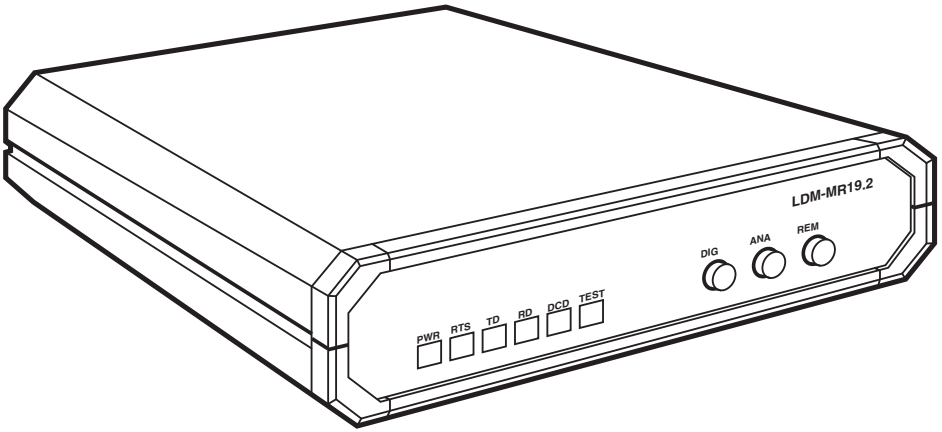
JULY 2000
ME760A-R2
ME760AE-R2
ME760C

19.2 kbps RS-232 Line Driver (LDM-MR19.2)



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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 J 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 parato 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.

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Contents

1. Specifications

Compliance — FCC Part 15 Subpart J Class A, DOC Class/MDC classe A

Cable Required — Between ME760 units: Unloaded twisted pair, 19 to 26 gauge; 4 wires for full duplex, at least 2 wires for half-duplex; DC continuity not required;
Between standalone ME760 unit and DTE: TIA RS-232 cable with DB25 male connector on ME760 end

Interface — Serial EIA RS-232-D/CCITT V.24, DCE

Protocol — Synchronous or asynchronous

Clock Source — Either internal, external from local DTE, or recovered from remote LDM-MR19.2

Data Format — 5, 6, 7, or 8 data bits; 1, 1.5, or 2 stop bits; even, odd, or no parity (but see Table 3-3 on page 26)

Operation — 2– or 4-wire half-duplex or 4-wire full-duplex; point-to-point or multipoint

Data Rate — Sync: 1.2, 2.4, 3.6, 4.8, 7.2, 9.6, 14.4, or 19.2 Kbps;
Async: Up to 19.2 Kbps

RTS/CTS Delay — 0, 8, or 64 ms (user-selectable)

Modulation — Differential diphase Eurocom Standard D1

Transmit Level — 0, –3, –6, or –9 dBm (user-selectable)

Transmit Impedance — 600, 300, or 150 ohms or "LOW" (user-selectable)

Receive Impedance — 150, 300, or 600 ohms or "HIGH" (user-selectable)

Return Loss — Greater than 15 dB

Carrier — Controlled by RTS or constantly ON (user-selectable)

Maximum Transmission Distance — See Table 1-1 on page 11

User Controls — (3 or 4) Front-mounted pushbuttons:
DIG (local digital loopback);
ANA (local analog loopback);
REM (remote digital loopback);
ME760C only: RPF (reset after remote power failure);
(15 or 16) Internal:
(1) Dial for data rate;
(1) Four-position DIP switch for async character length and stop-bit shortening;
(13 or 14) Jumpers:
Transmit timing;
2- or 4-wire operation;
CTS delay;
Carrier control;
Transmit level;
Transmit-line impedance;
Receive-line impedance;
Enable/disable analog-loopback command on Pin 18;
Enable/disable remote-loopback command on Pin 21;
Enable/disable front-panel pushbuttons;
Connect/disconnect signal ground and chassis ground;
AGC control;
Activate/deactivate V.54 delay;
ME760A(E)-R2 only: Enable/disable RPF tone

Diagnostics — Comply with V.54 standard:
Local analog loopback, mechanically or electrically user-controllable;
Local digital loopback, mechanically user-controllable;
Remote digital loopback, mechanically or electrically user-controllable

Indicators — (6 or 7) Front-mounted LEDs: PWR (power), RTS, TD, RD, DCD, TEST, and *(ME760C only)* RPF (remote power failure)

Connectors — (2) Rear-mounted: (1) DB25 for cable to DTE, (1) 4-wire terminal block for modem-to-modem line

Power — Directly from outlet through detachable 5-ft. (1.5-m) line cord and rear-mounted IEC 320 male inlet:
ME760A: 115 VAC, 47 to 63 Hz, 3 watts; input cord terminated with N. American standard NEMA 5-15P plug;
ME760AE: 230 VAC, 47 to 63 Hz, 3 watts; input cord unterminated when shipped, terminated by user

Protection — AC/DC overvoltage-protection circuits connected through transformers to transmit and receive lines

Mean Time Between Failures — 163,000 hours

Temperature Tolerance — 32 to 158˚ F (0 to 70˚ C)

Humidity Tolerance — 0 to 90% noncondensing

Enclosure — High-impact plastic

Size — 1.6"H x 9.6"W x 7.6"D (4 x 24.4 x 19.3 cm)

Weight — 3.1 lb. (1.4 kg)

Table 1-1. Maximum Transmission Distance

SPEED (bps)	19 AWG	24 AWG	26 AWG
19,200	14 mi. (22.5 km)	6.2 mi. (10 km)	4.6 mi. (7.5 km)
14,400	15.2 mi. (24.5 km)	6.8 mi. (11 km)	5.1 mi. (8.2 km)
9,600	18 mi. (29 km)	8 mi. (13 km)	5.9 mi. (9.5 km)
7,200	20.5 mi. (33 km)	9.3 mi. (15 km)	6.9 mi. (11 km)
4,800	22.3 mi. (36 km)	9.9 mi. (16 km)	7.4 mi. (12 km)
3,600	24.8 mi. (40 km)	11.1 mi. (18 km)	8.3 mi. (13.5 km)
2,400	29.2 mi. (47 km)	13 mi. (21 km)	9.7 mi. (15.7 km)
1,200	34.1 mi. (55 km)	17.4 mi. (28 km)	13 mi. (21 km)

2. Introduction

The 19.2 kbps RS-232 Line Driver (LDM-MR19.2 for short) is a short-range modem which operates at full- or half-duplex with synchronous or asynchronous transmission over unconditioned telephone lines. With an extended range of up to 34 miles (55 km), the LDM-MR19.2 operates at any of eight selectable data rates, up to 19,200 bps.

By using conditioned differential diphase modulation (Eurocom Std. D1), the LDM-MR19.2 provides immunity from background noise, eliminates normal line distortion, and enables efficient transmission and reception of serial data over twisted-pair cable.

The LDM-MR19.2 is coupled to the telephone line through isolation transformers. The transformers and electronic circuitry protect against AC or DC overvoltages. The protection circuitry allows operation even when DC is connected to the line, because of the following features:

- Transmit Level and Transmit and Receive Impedances are independently selectable.
- Transmit timing is provided internally, derived externally from the data terminal, or regenerated from the Receive signal.
- Receive timing is regenerated from the Receive signal.

Line communication is always synchronous. When you set the LDM-MR19.2 to asynchronous mode, it performs an async-to-sync conversion in compliance with the CCITT V.22 bis standard.

The LDM-MR19.2 also features V.54 diagnostic capabilities for performing local analog loopback and local and remote digital loopback. In the digital loopback mode, the operator at either end of the line may test both of the modems and the line. The operator can control the loopback with either the front-panel pushbuttons or Pins 18 and 21 of the V.24/RS-232 interface.

2.1 Functional Description

This section contains functional descriptions of the LDM-MR19.2's circuit blocks (primarily the circuits required for correctly configuring the unit).

2.1.1 Encoder

The encoder modulates the input data from the DTE using the "conditional diphase modulation" technique. You can configure the encoder to operate in one of five modes:

- 4-wire full-duplex
- 4-wire half-duplex
- 2-wire half-duplex
- 4-wire multipoint
- 2-wire multipoint

2.1.2 Modulation Timing

The modulation-timing circuit supplies the Transmit clock to the encoder. Four clock sources are available:

- **INT.CK** (internal clock—from the modem's internal crystal oscillator)
- **EXT.CK** (external clock—from DTE, Pin 24)
- **RCV.CK** (receive clock—recovered from Receive signal)
- **ASYNC** (asynchronous timing for working with the async-to-sync converter in an async application)

Setting the XMT TIMING jumpers determines the timing option.

2.1.3 Async-to-Sync Converter

The LDM-MR19.2 provides internal conversion from async to sync in compliance with CCITT V.22 bis. According to this standard, frequency deviation between the modem and the DTE is compensated for by shortening or lengthening the stop bit of the async character. When the modem's frequency is higher than the DTE's, the local converter extends the stop bit. When the modem's frequency is lower than the DTE's, the local converter may delete one stop bit every four or eight characters. The remote converter adds a shorter stop bit before sending the data to the remote DTE.

For frequency deviations of up to 1.1%, the stop bits should be shortened every eight characters (12.5%). For frequency deviations of 1.2% to 2.3%, the stop bits should be shortened every four characters (25%).

Use switch position 2 (S2) of the "ASYNC LENGTH" DIP switch to select 25% or 12.5% frequency deviation. For proper operation of the async-to-sync converter, set the async character length by adjusting switch positions 3 and 4 (S3 and S4) of the "ASYNC LENGTH" DIP switch. See Table 3-3 on page 26 for detailed settings.

2.1.4 XMT Level

Four options are available for the XMT level (signal level): 0, –3, –6, or –9 dBm. XMT level is controlled by the XMT LEVEL jumper.

2.1.5 Receiver

The receiver contains several circuits (shown in Figure 2-1 below):

- The RECEIVE FILTER removes all the out-of-band frequencies.
- The AUTOMATIC EQUALIZER is made up of several equalizers activated according to data rate.
- The digital AGC (automatic gain control) automatically compensates for the attenuation of the line. You can choose between the two modes of AGC operations by setting the AGC jumper:

  ON: The AGC operates continuously.

  CNTR: The AGC is active only when DCD is ON. When DCD is OFF, the AGC will remain in the state to which it was most recently set.

In full-duplex point-to-point applications, there is no difference between the two AGC modes of operation.

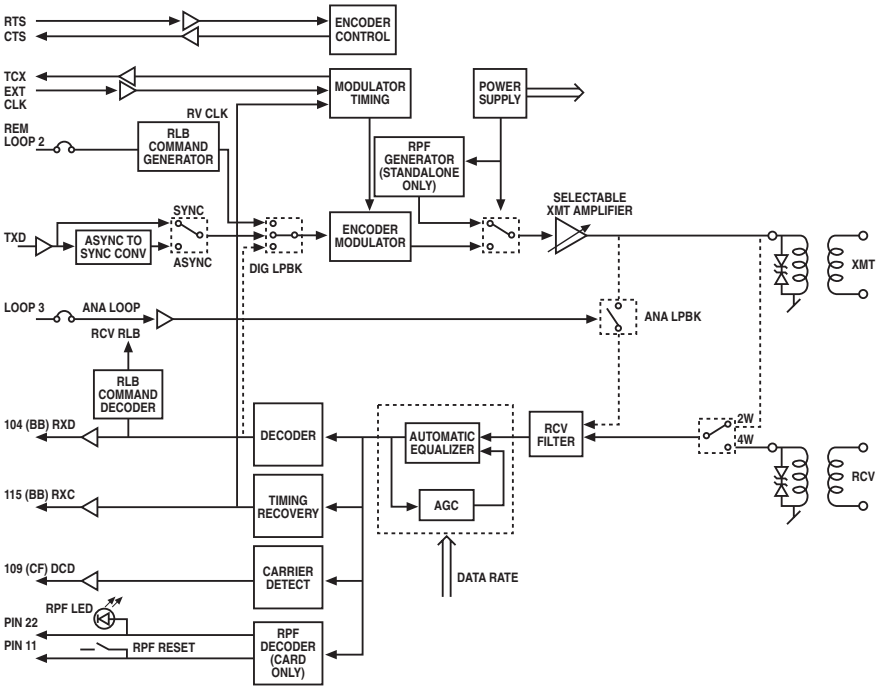

Figure 2-1. Block diagram for the LDM-MR19.2.

However, there is a difference in multipoint applications, where the master modem communicates with modems at different distances. When the master modem is set to AGC-ON, the master can communicate across long distances (up to its maximum range) to the slave modems. However, this setting increases the RTS-to-CTS delay. For example, under AGC-ON, the CTS delay of all slaves must be set to 64 ms when the data rate is less than 9.6 Kbps.

When the master modem is set to AGC-CNTR, it can't transmit or receive across as much distance. However, the polling goes faster. For example, under AGC-CNTR, the CTS delay of all units can be set to 8 ms when the data rate is greater than or equal to 4.8 Kbps.

Table 2-1, below, contains general guidelines for choosing AGC and CTS-delay settings. Each application is unique, however; you might find that your LDM-MR19.2 system works better when the units are set slightly differently.

Table 2-1. Recommended Multipoint AGC and CTS-Delay Settings

Distance Between Modems*	Data Rate	Master AGC	Master CTS Delay	Slave AGC	Slave CTS Delay
Short range	≤2.4 Kbps	CNTR	64 ms	CNTR	64 ms
Short range	>2.4 Kbps, <4.8 Kbps	CNTR	8 or 64 ms	ON	64 ms
Short range	≥4.8 Kbps	CNTR	8 or 64 ms	ON	8 or 64 ms
Long range	<9.6 Kbps	ON	8 or 64 ms	ON	64 ms
Long range	≥9.6 Kbps	ON	8 or 64 ms	ON	8 or 64 ms

* "Short range" = up to 2.8 mi. (4.5 km) for data rates of 9.6 or 19.2 Kbps or up to 3.7 mi. (6 km) for data rates of 3.6 to 7.2 Kbps. "Long range" represents distances greater than these.

2.1.6 V.54 Diagnostics

You can activate V.54 loops with either the front-panel pushbuttons or Pins 18 and 21 of the V.24/ RS-232 interface. The pushbuttons, Pin 18, and Pin 21 can be enabled or disabled separately by the SWITCH, PIN 18, and PIN 21 jumpers, respectively.

When you use the LDM-MR19.2 as a tail end to a DDS network, set the V.54 DELAY jumpers of the modems located close to the DDS network to ON to prevent multiple loopbacks. The DELAY switch prevents the last modem from receiving the complete V.54 data sequence and being induced into a loop. V.54 is required only for operation in synchronous mode.

NOTE

The V.54 DELAY jumper must be set to OFF when you operate in asynchronous mode.

2.2 Applications

Figures 2-2 through 2-5 on the next two pages illustrate the LDM-MR19.2 in various configurations.

(text continues on page 18)

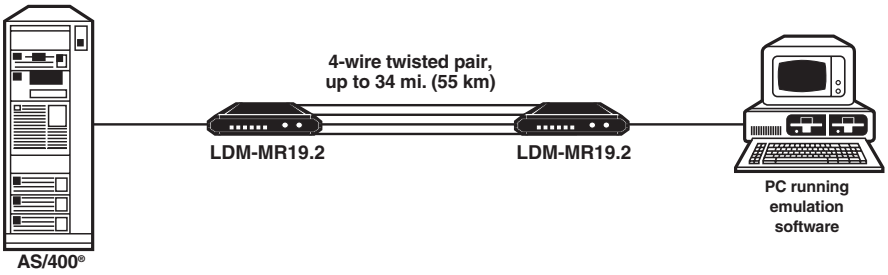

Figure 2-2. Point-to-point application.

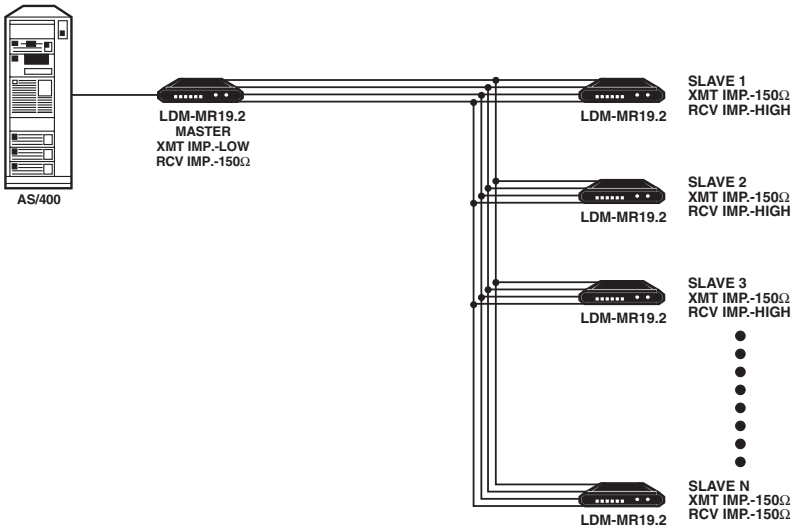

Figure 2-3. Multipoint application.

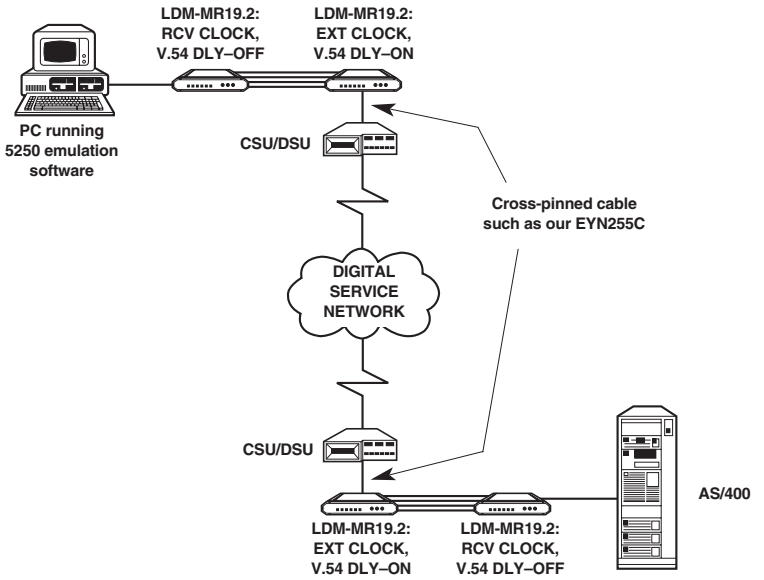

Figure 2-4. Tail circuit for DDS application.

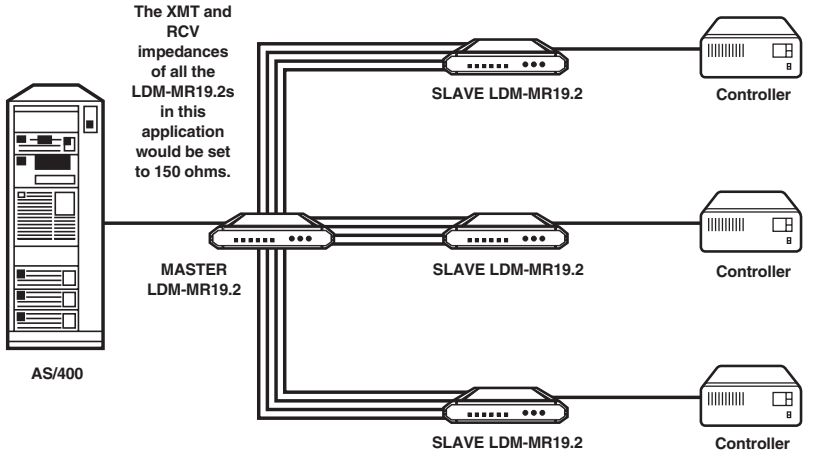

Figure 2-4. Star application.

3. Standalone Installation

Follow the directions in this chapter to install the standalone version of the LDM-MR19.2. Once you've done this, see **Chapter 5** for operating information.

3.1 Complete Package

With your LDM-MR19.2 order, you should have received (1) LDM-MR19.2, (1) detachable 5-ft. (1.5-m) AC power cord, and (1) copy of this manual. The LDM-MR19.2 is fully assembled at the factory. You don't have to assemble any part of the unit. However, you will have to attach an appropriate plug to the power cord if your unit is a 230-VAC (ME760AE-R2) model.

3.2 Physical Placement

Place the LDM-MR19.2 on a tabletop or bench within 5 feet (1.5 m) of a grounded 3-wire AC outlet and within 50 feet (15.2 m) of the associated data terminal. The unit is not designed to be bolted down.

Allow at least 36 inches (90 cm) of clearance in front of the unit so you can operate and maintain it. Be sure to leave 4 inches (10 cm) of clearance behind the unit for signal lines and interface cables.

3.3 Data Cables

The LDM-MR19.2's data-communication connectors (a five-crimp terminal block and a DB25 connector) are on its rear panel (see **Figure 3-1** below).

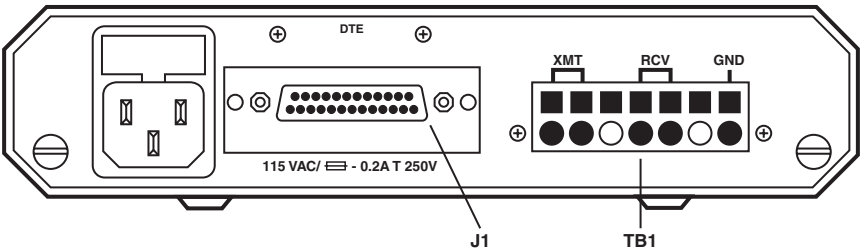

Figure 3-1. The LBM-MR19.2's rear panel (ME760A-R2 model shown).

The terminal block holds five crimp-style contact positions for connecting the Transmit (XMT) and Receive (RCV) telephone lines. The Transmit and Receive pairs are not polarity-sensitive. Using a screwdriver to gently lever open the contacts, connect the Transmit pair to the XMT terminals; for 2-wire operation, this is all you need. For 4-wire operation, connect the Receive pair to the RCV terminals, making sure that local XMT is connected to remote RCV and local RCV is connected to remote XMT. If you are using shielded cable, there is also a fifth terminal for optional ground connection (at one end only!).

For detailed information on the pinout of the DB25 connector, see **Table 3-1** below and on the next page.

Table 3-1. DB25 Pinout and Interface-Signal List

CCITT V.24	EIA RS-232-C	DTE PIN	SIGNAL NAME	DESCRIPTION
101	AA	1	Protective Ground	Chassis ground. Can be isolated from Signal Ground (refer to GND Strap in Table 3-2).
102	AB	7	Signal Ground	Common signal; DC-power-supply ground.
N/A	N/A	9 10	+8 volts –8 volts	Output +8 VDC Output –8 VDC
103	BA	2	Transmitted Data	Serial digital data received from (sent by) the local DTE. See the Note on the next page.
104	BB	3	Received Data	Serial digital data sent to (received by) the local DTE. See the Note on the next page.
105	CA	4	Request to Send	Local DTE sends a “high” (positive) level to the LDM-MR19.2 when it wants to send data.
106	CB	5	Clear to Send	After receiving a Request to Send from the local DTE, the LDM-MR19.2 waits for a user-selectable period, then sends a “high” (positive) level to the DTE to signal that it is ready to receive data.
107	CC	6	Data Set Ready	The LDM-MR19.2 always sends a “high” (positive) level to the local DTE except when the LDM-MR19.2 is in local or remote digital loopback.

Table 3-1. DB25 Pinout and Interface-Signal List (continued)

CCITT V.24	EIA RS-232-C	DTE PIN	SIGNAL NAME	DESCRIPTION
109	CF	8	Receive Line Signal Detector (Carrier Detect)	The LDM-MR19.2 always sends a "high" (positive) level to the local DTE except when the LDM-MR19.2 detects carrier loss or is in local or remote digital loopback.
113	DA	24	External Trans. Signal Element Timing	Synchronous data-rate-clock input received from the local DTE. Governs the Transmitted Data signal. See the Note below.
114	DB	15	Transmitter Signal Element Timing	Synchronous data-rate-clock output sent to the local DTE. Governs the Transmitted Data signal. See the Note below.
115	DD	17	Receiver Signal Element Timing	Synchronous data-rate-clock output sent to the local DTE. Governs the Received Data signal. See the Note below.
142		25	Test Indicator	The LDM-MR19.2 sends a "high" (positive) level to the local DTE during any test mode.
141		18	Loop 3 Test Command	When it receives this control signal from the local DTE, the LDM-MR19.2 goes into Local Analog Loopback.
140		21	Loop 2 Test Command	When it receives this control signal from the local DTE, the LDM-MR19.2 forces the remote modem into Remote Digital Loopback.

NOTE: When the LDM-MR19.2 is operating synchronously, transitions of the Transmitted Data and Received Data signals happen at the same time as positive-going ("rising edge") transitions of the active clock signal.

3.4 Setting the Internal Controls

After you install the cabling, you'll need to configure the LDM-MR19.2 for your application by setting its internal straps (jumpers) and switches as necessary. The numbers listed under the "Strap Identity" column in Table 3-2 on the next two pages correspond to the numbered strap locations in Figure 3-2 on page 27.

CAUTION!

Be sure the LDM-MR19.2 is unplugged before you open it.

To set internal jumpers and switches, follow the steps below.

1. Loosen the screw holding the top cover in place (located at the top of the rear panel).
2. Remove the top cover.
3. Adjust the jumpers and switches for the configuration you want.
4. Replace the top cover and tighten the retaining screw.

3.5 AC Power Cord

Plug the LDM-MR19.2's power cord into a grounded 3-wire AC outlet. Your LDM-MR19.2 should now be ready for continuous operation.

(text continues on page 26)

Table 3-2. Strap Selection, Standalone Version

Strap Identity	Function	Possible Settings	Standard Factory Settings
No. 1 DATA RATE (Kbps)	Determines the data rate.	0 = 19.2 Kbps 1 = 14.4 Kbps 2 = 9.6 Kbps 3 = 7.2 Kbps 4 = 4.8 Kbps 5 = 3.6 Kbps 6 = 2.4 Kbps 7 = 1.2 Kbps	2 = 9.6 Kbps
No. 2 XMT TIMING	Determines whether the transmit-timing signal comes from the internal clock, external clock, or receive clock, or whether the unit operates in async.	INT EX RCV ASY	INT (internal clock)
No. 3 2W/4W	Determines whether the unit uses 2 wires or 4 wires.	2W 4W	4W (4 wires)
No. 4 CTS DELAY	Determines the RTS-to-CTS delay.	0 ms 8 ms 64 ms	8 ms
No. 5 CARRIER	Determines the transmit carrier mode. ON: Transmit carrier is constantly ON. CTRL: Transmit carrier is ON only when RTS is high. CTRL should be used in multipoint applications.	ON CTRL	ON
No. 6 XMT LEVEL	Determines transmit-output level to the line.	0 dBm –3 dBm –6 dBm –9 dBm	0 dBm
No. 7 XMT IMPD	Determines transmit-line impedance. For multipoint applications, set the master modem to LOW.	600 300 150 LOW	150 [ohms]
No. 8 RCV IMPD	Determines receive-line impedance. For multipoint applications, set the master modem and the last modem in line to 150; set all others to HIGH.	150 300 600 HIGH	150 [ohms]
No. 9 PIN 18	Enables/disbales analog-loopback command from the DTE on Pin 18.	EN DIS	EN
No. 10 PIN 21	Enables/disables remote-loopback command from the DTE on Pin 21.	RLB EN RLB DIS	RLB EN

Table 3-2. Strap Selection, Standalone Version (continued)

Strap Identity	Function	Possible Settings	Standard Factory Settings
No. 11 SWITCH	Enables/disables control of the DIG, ANA, and REM loopbacks with the front-panel pushbuttons.	DIS EN	EN
No. 12 CHAS GND	CONN.: Connects Signal Ground to Chassis Ground. DIS.: Isolates grounds from each other.	CONNECT DIS CONN	CONNECT
No. 13 AGC	ON: AGC always ON. CTRL: AGC ON if DCD is ON, remains at last level of amplification if DCD goes OFF.	ON CTRL	ON
No. 14 V.54-DLY	ON: Activates V.54 delay, preventing multiple loopback of tail-end circuits. OFF: No delay.	ON OFF	OFF
No. 15 ASYNC LENGTH	S3 and S4 determine character lengths when unit is in async mode. See Table 3-3 on the next page. S2 determines amount of stop-bit shortening for async mode. (S1 is not used)	S3 S4 # bits OFF OFF = 8 OFF ON = 9 ON OFF = 10 ON ON = 11 ON = 25% OFF = 12.5%	10 bits 12.5%
No. 16 RPF	ON: If it stops receiving power, the unit sends a special alert tone to the unit at the other end of the line. OFF: The unit does not send a tone when it stops receiving power. RPF should be set to OFF in multipoint applications.	ON OFF	ON

Table 3-3. Async Character-Length Setting

Start Bit	Data Bits	Parity	Stop Bit(s)	Total Bits
Always 1	5	NONE	2	8
		ODD OR EVEN	1 or 1.5	8
			2	9
	6	NONE	1 or 1.5	8
			2	9
		ODD OR EVEN	1 or 1.5	9
			2	10
	7	NONE	1 or 1.5	9
			2	10
		ODD OR EVEN	1 or 1.5	10
			2	11
	8	NONE	1 or 1.5	10
			2	11
		ODD OR EVEN	1 or 1.5	11

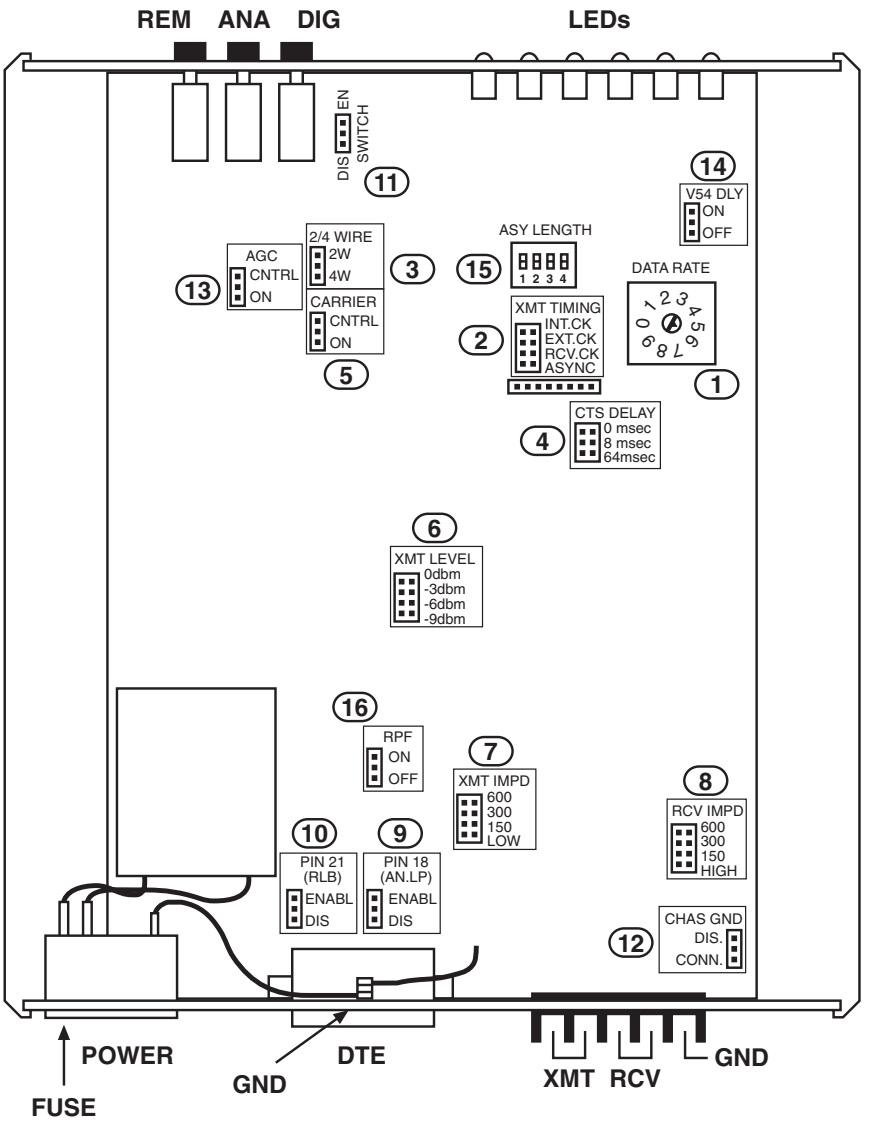

Figure 3-2. The standalone LDM-MR19.2's board layout.

4. Card Installation

The ME760C is a card version of the LDM-MR19.2 that can be easily installed in our RackNest 2/14. Its front-panel indicators and controls are arranged vertically rather than horizontally, but (with the exception of its "extra" RPF LED and reset button) they work exactly the same way as the indicators and controls with the same names on the front panels of the standalone ME760A-R2 and ME760AE-R2 units; refer to **Section 5.1**. The controls on the card's circuit board also function the same way as those on the circuit boards of the standalone units, although the card doesn't have the RPF jumper; compare Table 3-3 and Figure 3-2 on pages 24, 25, and 27 with Table 4-2 and Figure 4-3 on pages 34 through 36. The main difference between the card and standalone versions is that where the standalone units have their own DTE and line connectors on their rear panels, the cards plug into the RackNest 2/14 and use its connectors instead.

4.1 The RackNest 2/14

The RackNest 2/14 is a special 19" rack component designed to host a number of our short-haul modems and line drivers. As shown in Figures 4-1 (on page 30) and 4-2 (on page 31), it consists of a rack chassis (with one or two power supplies) into which you can plug as many as 14 modem or driver cards.

The Nest's rear panel consists of fourteen five-screw terminal blocks ("TB1") for line interfaces and fourteen DB25 connectors ("J1") for DTE interfaces.

Each terminal block ("TB1") provides four screws for connecting the Nest-to-Nest G.703 transmit and receive lines—the transmit line or pair can be connected to (one of) the terminals marked XMT, and the receive line or pair can be connected to (one of) the terminals marked RCV—plus a fifth screw for optional ground connection.

Each DTE connector ("J1") is a DB25 female. The pinning of this connector depends on the type of card installed in the corresponding slot, because cards designed for different native DTE interfaces will present and expect different signals on different pins. For the ME760C LDM-MR19.2 card, the pinning is standard TIA RS-232-D.

4.2 The RackNest 2/14's Power Supply

The 115-VAC RackNest 2/14 (our product code RM110A) uses the PS1000A power supply, which accepts 115-VAC input power. The 230-VAC RackNest 2/14 (our product code RM110AE) uses power supply PS1000AE, which accepts 230-VAC input power. Each of these power supplies consists of a power-line transformer, a fuse, and an operating switch. The 115-VAC Nest can also be ordered with dual power supplies (our product code RM110A-2PS); either of these power supplies can be hot-swapped if it fails.

All power-regulating circuitry for the RackNest 2/14 is located on the card modems/drivers themselves. Each card has two fuses which protect the entire system against power failure due to a short circuit in one card. Primary power needed is 115 or 230 VAC ±10%, 47 to 63 Hz, at 24 VA maximum.

AC power should be supplied to the RackNest 2/14 through a standard power cable run between the AC mains socket on the rear of the Nest's power-supply module—an IEC 320 male power inlet which contains an integral fuse—and a standard, grounded, easily accessible AC outlet. (If your Nest is an RM110A, you can use the power cord supplied with it; if your Nest is an RM110AE, use a power cord appropriate for your site's mains outlets.)

The Nest begins operating and supplying power to the installed Cards as soon as it is plugged into a mains outlet, and will continue operating until it is unplugged.

WARNING!

The RackNest 2/14 unit should always be grounded through the protective earth lead of the power cable. To connect AC power to this unit, the mains plug should only be inserted into a socket outlet provided with protective earth contact. The protective action must not be negated by use of an extension cord without a grounding conductor.

Whenever it is likely that the unit's fuse (located in a bayonet-type fuse holder on the unit's rear panel) has been blown or damaged, make the unit inoperative and secure it against unintended operation until the fuse can be replaced. Make sure that only fuses of the required rating, as marked on the rear panel, are used for replacement. Do not use repaired fuses or short-circuit the fuse holder. Always disconnect the mains cable before removing or replacing the fuse.

Interrupting the grounding conductor, inside or outside the unit, or disconnecting the protective earth contact, can make this unit dangerous!

4.3 The RackNest 2/14 Illustrated

You will be installing the LDM-MR19.2 card in the RackNest 2/14 as shown in Figure 4-1 below. The front and rear panels of the Nest are shown in **Figure 4-2** on the next page; the numbered connectors, controls, and indicators are described in Table 4-1 on page 32.

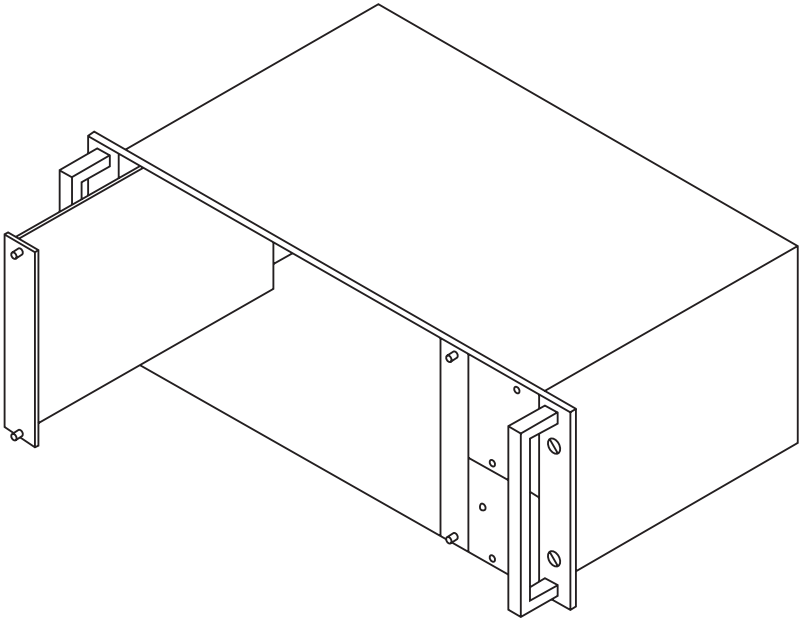

Figure 4-1. The RackNest 2/14: Card installation.

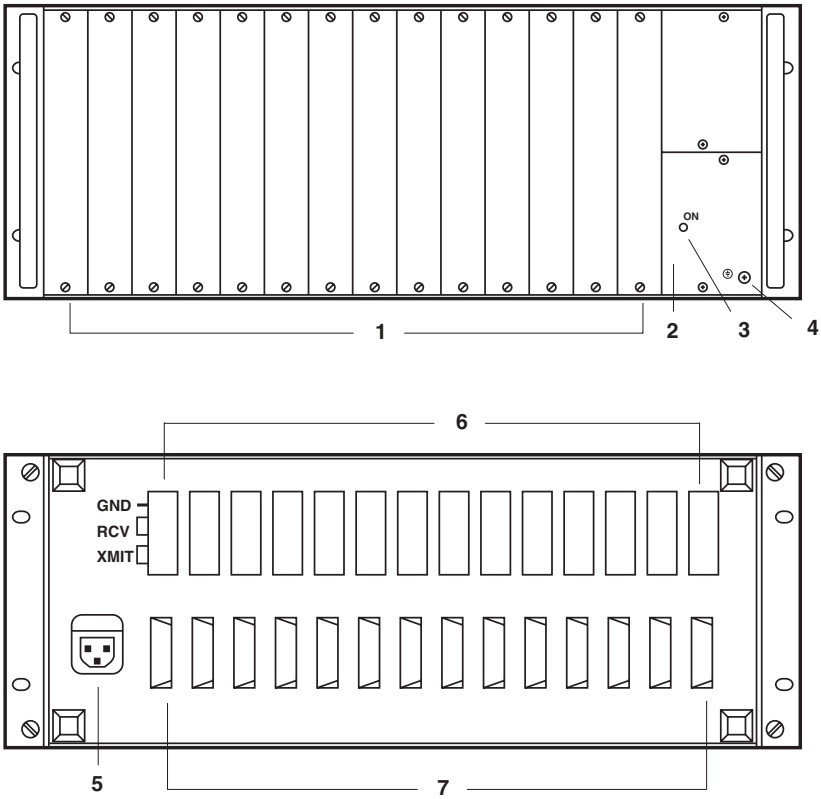

Figure 4-2. The RackNest 2/14 illustrated.

Table 4-1. Descriptions of RackNest 2/14 Components

Item	Control, Indicator, or Connector	Function
1	Card Slots	Slots for installation of compatible cards (slot no. 1 located at the left-hand side). Unused slots are closed with blank panels.
2	Power-Supply Module	Provides power to modules installed in the enclosure.
3	ON Indicator	Lights when power supply is operating.
4	Chassis-Ground Terminal	Connector for attaching other grounds, devices, etc., to the Nest's chassis ground (optional).
5	Power Connector	Power connector with integral fuse.
6	Main Channel Connectors (J1)	DB25 connectors for the module DTE connection.
7	4-Wire Terminal Blocks (TB1)	For connection of 4-wire lines. Each modem card has a separate terminal-block connector.

4.4 Card-Configuration Procedure

Before putting the LDM-19.2 card in the RackNest 2/14 or attaching anything to the Card, determine which data rate you're going to use and how you want to set all of the other user-configurable options on the Card. (Refer to Table 4-2 on the next two pages for a list of all of these options; the SW*n* and J*n* numbers in the table's "Element" column correspond to the locations with the same numbers in Figure 4-1 on page 36.)

When you have everything at least tentatively decided, identify the control(s) on the Card whose settings you want to change (refer to Figure 4-1), then move the control(s) to your desired position(s).

CAUTION!

Make sure the Card is disconnected from the RackNest 2/14 and from all sources of electric power.

WARNING: HIGH VOLTAGE!

Any adjustment, maintenance, and repair of the Card under voltage should be avoided as much as possible, and, when inevitable, should be carried out only by a skilled person who is aware of the hazard involved. Capacitors on the Card may still be charged even after the Card has been disconnected from the power source.

Table 4-2. Strap Selection, Card Version

Strap Identity	Function	Possible Settings	Standard Factory Settings
No. 1 DATA RATE (Kbps)	Determines the data rate.	0 = 19.2 Kbps 1 = 14.4 Kbps 2 = 9.6 Kbps 3 = 7.2 Kbps 4 = 4.8 Kbps 5 = 3.6 Kbps 6 = 2.4 Kbps 7 = 1.2 Kbps	2 = 9.6 Kbps
No. 2 XMT TIMING	Determines whether the transmit-timing signal comes from the internal clock, external clock, or receive clock, or whether the unit operates in async.	INT EX RCV ASY	INT (internal clock)
No. 3 2W/4W	Determines whether the unit uses 2 wires or 4 wires.	2W 4W	4W (4 wires)
No. 4 CTS DELAY	Determines the RTS-to-CTS delay.	0 ms 8 ms 64 ms	8 ms
No. 5 CARRIER	Determines the transmit carrier mode. ON: Transmit carrier is constantly ON. CTRL: Transmit carrier is ON only when RTS is high. CTRL should be used in multipoint applications.	ON CTRL	ON
No. 6 XMT LEVEL	Determines transmit-output level to the line.	0 dBm –3 dBm –6 dBm –9 dBm	0 dBm
No. 7 XMT IMPD	Determines transmit-line impedance. For multipoint applications, set the master modem to LOW.	600 300 150 LOW	150 [ohms]
No. 8 RCV IMPD	Determines receive-line impedance. For multipoint applications, set the master modem and the last modem in line to 150; set all others to HIGH.	150 300 600 HIGH	150 [ohms]
No. 9 PIN 18	Enables/disbales Analog loopback command from the DTE on Pin 18.	EN DIS	EN
No. 10 PIN 21	Enables/disables Remote loopback command from the DTE on Pin 21.	RLB EN RLB DIS	RLB EN

Table 4-2. Strap Selection, Card Version (continued)

Strap Identity	Function	Possible Settings	Standard Factory Settings
No. 11 SWITCH	Enables/disables control of the DIG, ANA, and REM loopbacks with the front-panel pushbuttons.	DIS EN	EN
No. 12 GND	CONNECT: Connects Signal Ground to Chassis Ground. DIS: Isolates grounds from each other.	CONNECT DIS CONN	CONNECT
No. 13 AGC	ON: AGC always ON. CTRL: AGC ON if DCD is ON, remains at last level of amplification if DCD goes OFF.	ON CTRL	ON
No. 14 V.54-DLY	ON: Activates V.54 delay, preventing multiple loopback of tail-end circuits. OFF: No delay.	ON OFF	OFF
No. 15 ASYNC LENGTH	S3 and S4 determine character lengths when unit is in async mode. See Table 3-3 on page 26. S2 determines amount of stop-bit shortening for async mode. (S1 is not used)	S3 S4 # bits OFF OFF = 8 OFF ON = 9 ON OFF = 10 ON ON = 11 ON = 25% OFF = 12.5%	10 bits 12.5%

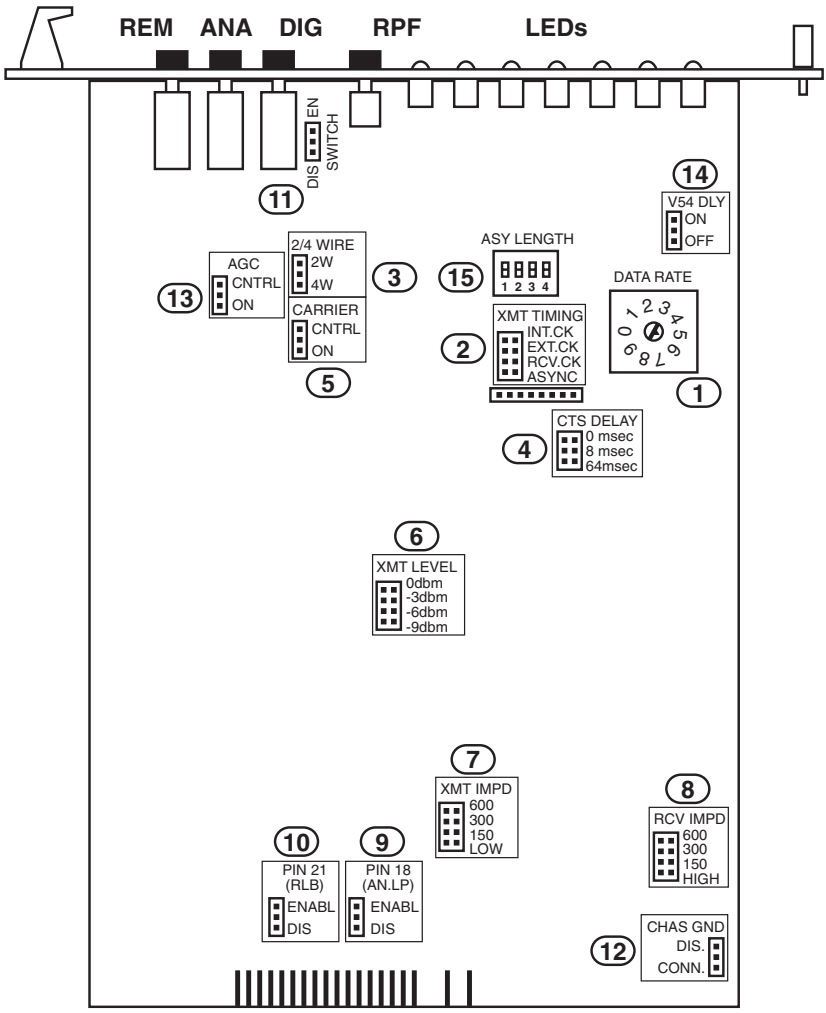

Figure 4-3. The LDM-MR19.2 card's board layout.

4.5 Card-Installation Procedure

After you install the RackNest 2/14 in your 19" rack (refer to the Nest's manual), take these steps to install an LDM-MR19.2 card in the Nest:

1. Insert the Card into an empty slot on the Nest (see Figure 4-1 on page 30). Do not use excessive force. If the Card does not go in easily, remove the Card, realign it with the Nest's enclosure guides, and push it into place.

NOTE

When the RackNest 2/14 is ON, personnel are not exposed to any voltage over 30V on any card or accessible area of the Nest. Still, take all reasonable precautions to avoid electric shock.

2. Tighten the nut on the top of the Card.
3. Push the bottom of the Card as far into the Nest as it will comfortably go, to ensure that its card-edge connector makes full contact with the Nest's.
4. Run an appropriate cable from your DTE to the corresponding DB25 connector ("J1") on the back of the Nest. For detailed information on the pinout of the DB25 connector, see Table 3-1 on pages 21 and 22.
5. If you haven't already done so, install the remote RackNest 2/14, then repeat steps 1 through 4 at the remote site.
6. Run twisted-pair cable between the local and remote cards.
   - *If you're running a 2-wire line:* Run one wire pair between the XMT terminals ("TB1") on the back of each Nest. If you're using shielded cable, attach the ground wire to the GND terminal on one Nest (not both of them!).
   - *If you're running a 4-wire line:* Attach one pair of wires to the corresponding XMT terminals ("TB1") on the back of the local Nest and the corresponding RCV terminals on the remote Nest; attach the other pair of wires to the RCV terminals on the local Nest and the XMT terminals on the remote Nest. (It doesn't matter which wire in each pair goes to which terminal in each pair; the cards autosense parity.) If you're using shielded cable, attach the ground wire to the GND terminal on one Nest (not both of them!).

5. Operation

This chapter describes the LDM-19.2's controls and indicators, operating procedures, and strapping information. Be sure you finish installing the LDM-MR19.2 (refer to **Chapter 3** for the standalone or **Chapter 4** for the card version) before you attempt to operate it.

5.1 Controls and Indicators

All of the LDM-MR19.2's external controls and LED indicators are located on the unit's front panel, as shown in **Figure 5-1** below (standalone) or **Figure 5-2** on the next page (card). The numbers and letters under the "Item" heading in **Tables 5-1** and **5-2** on page 40 correspond to the numbers and letters in Figures 5-1 and 5-2.

Figure 5-1. The standalone LDM-MR19.2's front panel.

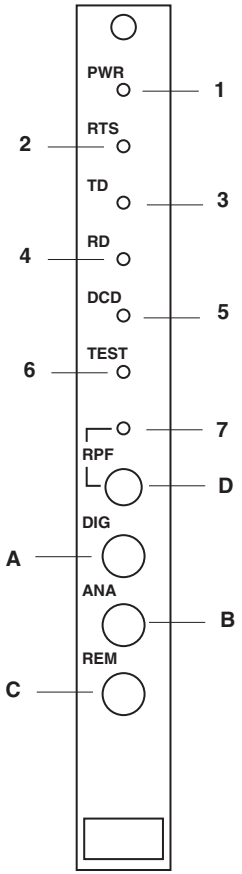

Figure 5-2. The LDM-MR19.2 card's front panel.

Table 5-1. Controls

ITEM	CONTROL	FUNCTION
A	DIG	Pressng the Digital Loopback button causes the local LDM-MR19.2 to loop received data and clock to its transmitter. Data Set Ready goes low.
B	ANA	Pressing the Analog Loopback (V.54 Loop) button causes the local LDM-MR19.2 to loop its transmitter output back to its receiver. This loopback can also be activated from the terminal when the Pin 18 strap (strap #9) is set to EN (see **Section 3.4**).
C	REM	Pressing the Remote Digital Loopback (V.54 Loop 2) button causes the remote LDM-MR19.2 to loop received data and clock to its transmitter. Data Set Ready goes low. This loopback can also be activated from the terminal when the Pin 21 strap (strap #10) is set to RLB EN (see **Section 3.4)**.
D	RPF	*ME760C only:* Turn OFF the RPF LED and reset the RPF circuitry (see **Section 5.4**).

Table 5-2. Indicators

ITEM	INDICATOR	CCITT V.24 CIRCUIT	FUNCTION
1	PWR		Green LED is ON when power is present.
2	RTS	105	Yellow LED is ON when DTE activates Request to Send.
3	TD	103	Yellow LED is ON when steady SPACE is being transmitted. It flickers when data is transmitted.
4	RD	104	Yellow LED is ON when steady SPACE is being received. It flickers when data is received.
5	DCD	109	Yellow LED is ON when a valid Receive signal is present.
6	TEST	142	Red LED is ON when the LDM-MR19.2 is in any of the three loopback modes.
7	RPF	N/A	*ME760C only:* Red LED is ON when the local card detects a power-fail tone from the remote standalone.

5.2 Turning the Unit ON

If you haven't already, plug the AC power cord of the LDM-MR19.2 itself (for standalone units) or the RackNest 2/14 (for card units) into a working AC outlet. The PWR LED should light to indicate that the LDM-MR19.2 is ON. If the local and remote LDM-MR19.2 units are both operating and passing data, the LEDs should look like this:

- PWR — ON
- TD — Flashing or OFF
- RD — Flashing or OFF
- RTS — ON or Flashing
- DCD — ON or Flashing
- TEST — OFF
- RPF *(ME760C only)* — OFF

If the LEDs don't look like this, make sure the unit is receiving power and that none of the three front-panel pushbuttons are pushed in. If the RPF LED is on, check the remote site (see **Section 5.4**).

5.3 Operating Procedure

The LDM-MR19.2 can operate entirely unattended. However, you should check the unit's LED indicators once in a while to make sure that everything is OK.

While the unit is ON, operating personnel are not exposed to voltages in excess of 30 volts on its circuit board or on any accessible area of the unit's DC power supply. Regardless of this, do not open the unit while it is ON.

5.4 Remote Power Failure (RPF)

The RPF (Remote Power Failure) feature could prove very useful if your application involves a point-to-point connection between an LDM-MR19.2 card in a wiring closet or other administrative center and a standalone unit at the source or destination site. As long as the standalone unit's internal RPF jumper is set to ON (the default setting), when a power failure occurs at its site, the unit will use its last reserves of power to send a special tone to the card at the other end of the line.

The card's RPF circuitry will detect this tone, light the card's RPF LED, and stop the card from making any further attempts to communicate with the standalone. When you see that the card's RPF LED is lit, check the remote site; when power has been restored, push the card's RPF button to turn the LED off and to reset the card for normal operation.

Only point-to-point, standalone-to-card applications can benefit from this feature; even if RPF is enabled in card-to-card or standalone-to-standalone applications, it will have no effect. RPF should be disabled in multipoint applications, because it can take down the whole LDM-MR19.2 network without pinpointing where the failure has occurred.

5.5 Turning the Unit OFF

To turn OFF the LDM-MR19.2, unplug its AC power cord (standalone units) or turn OFF or unplug the RackNest 2/14 (card units).

5.6 Reconfiguration

If at some point you need to reconfigure the LDM-MR19.2 to operate differently—with a new data rate or new clock source, for example—you can change the settings of the unit's configuration controls. *Standalones:* Unplug the unit, then follow the procedure in **Section 3.4**. Refer to Table 3-2 on pages 24 and 25 for the possible settings of these controls. *Cards:* Turn OFF or unplug the RackNest 2/14, slide the card out of the Nest, then follow the procedure in **Section 4.4**. Refer to Table 4-2 on pages 34 and 35 for the possible settings of these controls

6. Troubleshooting

This chapter contains information about how to test your system, how to isolate faults, and what to do when you find problems.

6.1 Loopback Testing

With the LDM-MR19.2's test switches and LEDs, you can rapidly check the unit itself and its attached data terminals and telephone lines. Use the checkout procedures described in this section to verify normal system operation and isolate faulty equipment in the event of failure.

Before you test the operation of your equipment and line circuits, be sure all units are ON and configured normally.

6.1.1 Modem Test: Analog Loopback

This test checks the performance of the local modem, the local data terminal, and the cables between these two devices (see Figure 6-1 on the next page). Perform the test separately at the local and remote sites.

1. Press the ANA (Analog Loopback) pushbutton on the front panel of the unit you want to test. The TEST LED should light. The LDM-MR19.2's transmit output is now connected to its own receiver.

2. Verify that the data-terminal equipment (DTE) is operating properly and can be used for testing. If you find a fault, call a technician or replace the unit.

3. Set the DTE equipment to half-duplex to get an "echo" through the system, or use a special Bit Error Rate Tester (BERT).

4. If BERT equipment indicates no faults, but the data terminal itself does indicate one, follow the manufacturer's checkout procedures for the data terminal. Also check the interconnecting cabling between the data terminal and the LDM-MR19.2.

5. After completing the test at both ends, press the ANA pushbutton again to restore it to the OFF position. Proceed with the Communication-Link Tests.

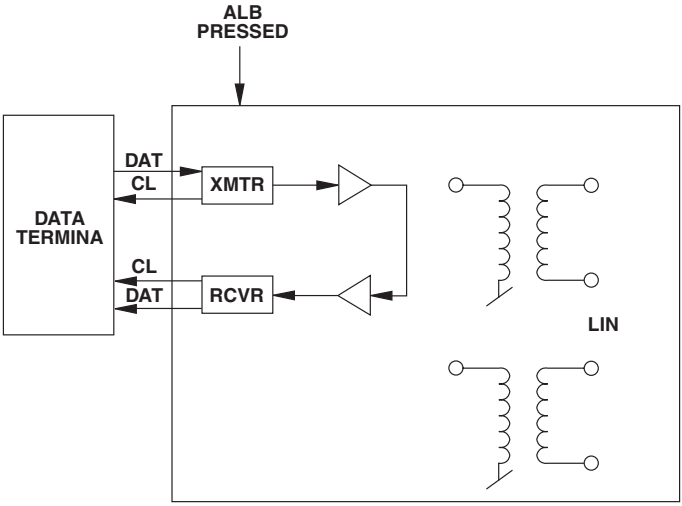

Figure 6-1. A local LDM-MR19.2 in analog loopback.

6.1.2 Communication-Link Tests: Digital Loopback

6.1.2.A Remote Digital Loopback

Use the Remote Digital Loopback test to check the performance of both the local and the remote LDM-MR19.2 and the lines between them (see Figure 6-2 on the next page). Take these steps:

1. Press the REM (Remote Loopback) pushbutton on the front panel of the unit you want to test. The TEST LED should light. Pressing the local unit's REM button causes a loopback at the remote LDM-MR19.2.

2. Perform a terminal test or BERT (see **Section 6.1.1**).

3. If Step 2 indicates a fault, and if the modem test described in **Section 6.1.1** was successful for both modems, the telephone-line circuits are not operating properly.

6.1.2.B Local Digital Loopback

To activate this test, press the DIG pushbutton. Pressing the local unit's DIG button causes it to loop the received data back to the remote unit (see Figure 6-3 on the next page). The operator at the remote end can check the performance of both the local and remote LDM-MR19.2s and the telephone lines between them.

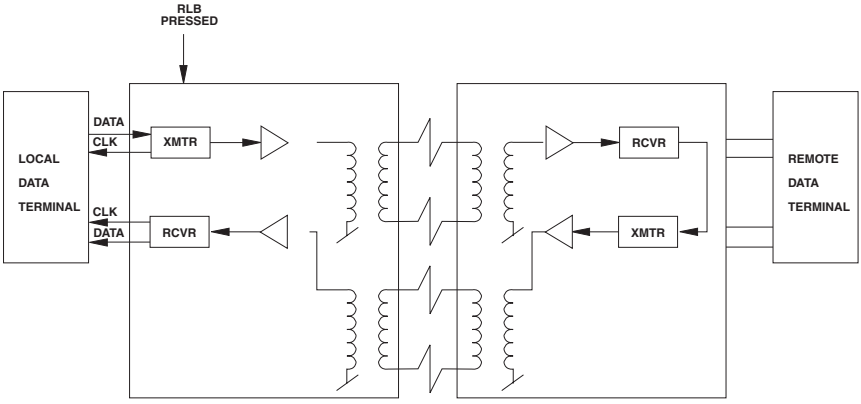

Figure 6-2. A remote LDM-MR19.2 in digital loopback.

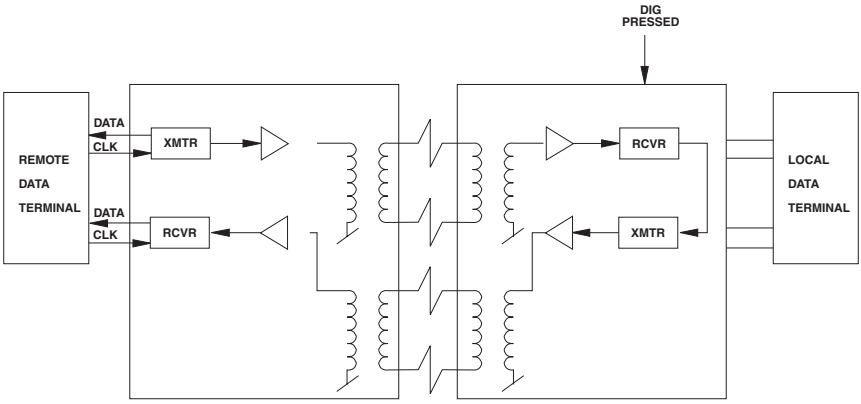

Figure 6-3. A local LDM-MR19.2 in digital loopback.

6.2 Calling Black Box

If you determine that your LDM-MR19.2 is malfunctioning, *do not attempt to alter or repair the unit.* It contains no user-serviceable parts. Contact Black Box Technical Support at 724-746-5500.

Before you do, 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.
- the results of any testing you've already done.

6.3 Shipping and Packaging

If you need to transport or ship your LDM-MR19.2:

- Package it carefully. We recommend that you use the original container.
- If you are returning the LDM-MR19.2, make sure you include its manual. Before you ship the unit back to us for whatever reason, contact Black Box to get a Return Materials Authorization (RMA) number.

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