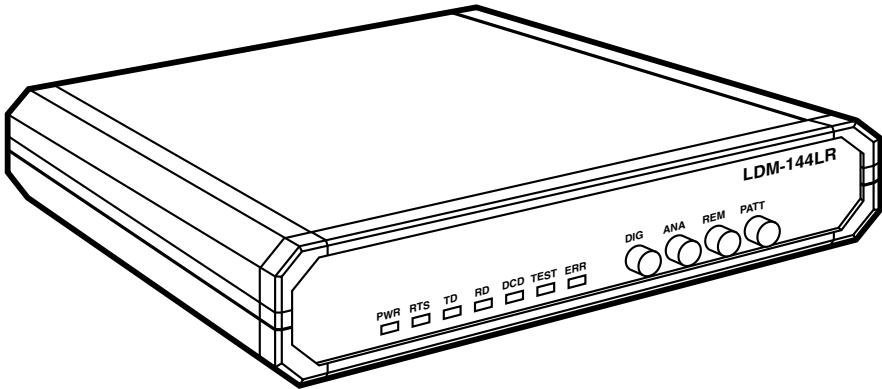




MARCH 1997  
ME447A  
ME447AE  
ME447C-232  
ME447C-35  
MED447C-530

# LDM-144LR

## LDM-144LR Card



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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.

**TRADEMARKS USED IN THIS MANUAL**

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

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# 1. Specifications

## 1.1 Transmission Line

**Line Type**—Unloaded twisted pair 19 to 26 gauge; DC continuity is not required

**Range**—Refer to **Table 1-1**

**Level**—0 dBm or -6 dBm (jumper-selectable)

**Transmit Impedance**—LOW or HIGH (jumper-selectable)

**Receive Impedance**—150  $\Omega$  or HIGH (jumper-selectable)

**Return Loss**—Greater than 15 dB

**Carrier**—RTS controlled (CNTRL) or permanently ON; in the X.21 mode, the carrier is controlled by CONT signal (pins 3 and 10)

**Modulation**—Partial Response, Class IV (PR4)

## 1.2 Digital Interface

**Type**—When ordering, three options are available:

1. V.24/RS-232 via a DB25 female connector (ME447C-232)
2. V.35 via a 34-pin female connector (ME447AE-35, ME447C-35)
3. RS-530 via a DB25 female connector (ME447C-530)

The interfaces are modular and field-interchangeable.

**Baud Rates**—Selectable to 48, 56, 64, 72, 96, 112, 128, and 144 kbps; 48-128 kbps for V.24

**RTS/CTS Delay**—Jumper selectable: 8 or 70 ms

## 1.3 Diagnostics (V.54 Standard Compliant)

**Digital Loopback**—Local (DIG): activated by front-panel pushbutton, Remote (REM): activated by front-panel pushbutton, or by control signal from the digital interface.



**Analog Loopback**—Local (ANA): activated by front-panel pushbutton or by control signal from the digital interface

**Pattern**—Test pattern (PATT): activated by a manual switch. The received pattern is compared to the transmitted pattern; if unequal, ERR LED flashes.

## **NOTE**

**The X.21 and G.703 interfaces do not support the activation of Digital and Analog loopbacks via the interface connector.**

## **1.4 Timing Elements**

**Receive Clock**—Derived from the Receive signal

**Transmit Clock**—Derived from one of three alternative sources:

1. External oscillator
2. External from the DTE
3. Loop clock derived from the receive signal

## **NOTE**

**When the X.21 interface is set to EXT CLK, the modem receives clocking signals from the digital side using unassigned pins of the X.21 interface.**

## **1.5 Indicators**

**TD (yellow)**—Transmit Data

**RD (yellow)**—Receive Data

**RTS (yellow)**—Request to Send

**DCD (yellow)**—Data Carrier Detect

**TEST (red)**—Test

**PWR (green)**—Power

**ERR (yellow)**—Error

## 1.6 Physical

**Size**—ME447AE: 1.75"H x 8.6"W x 10.6"D (4.4 x 21.5 x 26.5 cm);  
ME447C: 0.9"H x 6.2"W x 9"D (2.5 x 15.7 x 23 cm)

**Weight**—ME447AE: 2.6 lb. (1.2 kg); ME447C: 10 oz. (0.36 kg)

## 1.7 Electrical

**Power Supply**—100 VAC, 115 VAC, or 230 VAC ( $\pm 10\%$ , 47 to 63 Hz,  
5 watts), -48 VDC ( $\pm 10\%$ )

## 1.8 Protection

AC/DC overvoltage protection circuits are connected in-line,  
preceding the transformer, to the transmit and receive lines.

## 1.9 Environment

**Temperature**—32 to 122°F (0 to 50°C)

**Humidity**—Up to 90%, non-condensing

## 2. Introduction

### 2.1 General

The LDM-144LR is a short-range modem for synchronous transmission, full or half duplex, over unconditioned lines. The LDM-144LR has a range of up to 26.5 km (16.5 miles) and operates at selectable data rates from 48 kbps to 144 kbps.

The modem uses a unique modulation technique named Partial Response, Class IV (PR4) in order to:

- Provide background noise immunity
- Eliminate normal line distortion
- Enable efficient transmission and reception of serial data over a twisted pair cable
- Provide extended range

The LDM-144LR is coupled to the line through isolation transformers, which in conjunction with protective circuitry, safeguard against AC or DC overvoltages. The protective circuitry enables operation even when DC is connected to the line.

The LDM-144LR transmit timing is internally provided, or externally derived either from the data terminal or from the receive signal. The receive timing is always regenerated from the receive signal.

The LDM-144LR features V.54 diagnostic capabilities for performing local analog loopbacks and local and remote digital loopbacks. In the digital loopback mode, the operator at either end of the line may test both modems and the line. The loopback is controlled either by the front-panel pushbuttons or through the DTE interface. Three DTE digital interface options are available:

- RS-232/V.24 (up to 128 kbps)
- V.35
- RS-530

An RS-422/V.36 terminal can be connected through the RS-530 interface using an adaptive cable, as detailed in **Appendix B**.

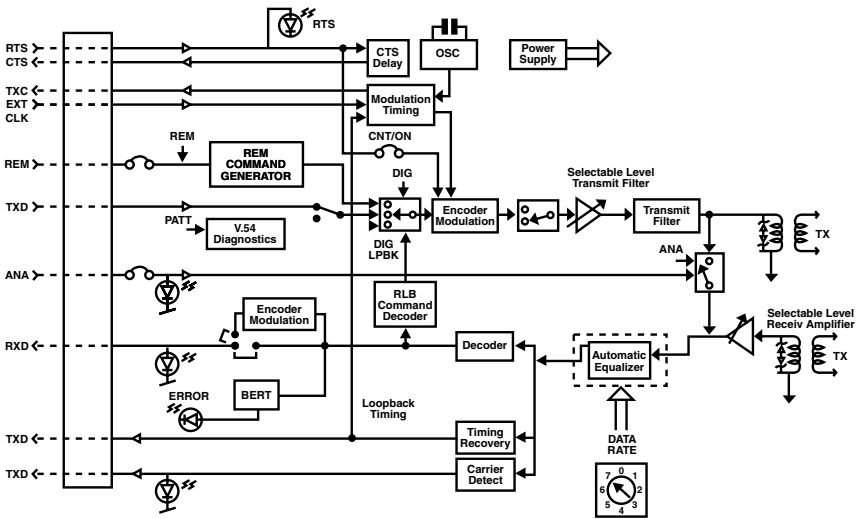
The LDM-144LR incorporates a built-in Bit Error Rate Tester (BERT). The internal BERT enables complete testing of both modems and the line without external test equipment. A CCITT/V.52, 511-bit pseudo-random test pattern is generated through a front-panel switch for testing end-to-end connectivity. When a bit error is encountered, the ERR indicator flashes.

## 2.2 Physical Description

The LDM-144LR is available as a standalone unit (LDM-144LR), or as a rack-mounted unit (LDM-144LR Card) within a 19" rack. A 19" rack can carry up to 14 cards and provides DB25 connectivity to digital interfaces. Optional V.35 and X.21 interface adapters are available.

## 2.3 Functional Description

This section contains the functional descriptions of the LDM-144LR circuit blocks, primarily those circuits that are required to set the correct configuration of the modem. For the block diagram, see **Figure 2-1**.



**Figure 2-1. LDM-144LR Block Diagram.**

### 2.3.1 ENCODER MODULATOR

The Encoder Modulator receives data from the DTE and modulates it by means of the partial-response modulation technique. The Encoder Modulator can operate in one of the following modes:

- 4-wire full-duplex
- 4-wire half-duplex

### 2.3.2 MODULATION TIMING

This circuit supplies the transmit clock to the Encoder Modulator. Three clock sources are available:

- The modem's internal crystal oscillator, INT
- The DTE clock, EXT
- The receive signal recovered clock, RCV

Setting the transmit clock jumper (J1) determines the timing mode of the LDM-144LR.

### 2.3.3 SELECTABLE LEVEL TRANSMIT AMPLIFIER

Two options are available for the transmit signal level: 0 and -6 dBm. The transmit signal level is controlled by the XMT LEVEL jumper (J11). Receive signal gain is controlled by the RCV LVL jumper (J9) and has two selectable options: 0 and -6 dBm.

### 2.3.4 V.54 DIAGNOSTICS

V.54 loops are activated either by the manual front panel push-buttons or through the DTE interface. The push-button controlled loopbacks can be enabled or disabled by the SWITCH jumper (J2), while the DTE controlled remote and analog loopbacks are enabled and disabled by the RLB (J6) and the ALB (J5) jumpers respectively. When the LDM-144LR is used as a tail-end to a digital network, the V.54 DLY jumper (J7) in the modem closest to the network is set to ON to prevent other equipment from receiving the V.54 data sequence and inducing it into the loop.

### 2.3.5 TEST PATTERN GENERATOR AND RECEIVER

The Test Pattern Generator enables easy and quick testing of the local modem and the communication link. When the PATT pushbutton on the front panel is activated, the circuit sends a standard 511-bit pseudo-random pattern and checks its response. If errors are detected, the ERR indicator remains ON or blinks.

The test can be carried out in local analog loopback, in remote digital loopback, or in normal point-to-point operation opposite a remote LDM-144LR. For the latest test to take place, press the PATT pushbutton on the remote unit or connect a Bit Error Rate Tester BERT, which generates and receives a standard pseudo-random 511-bit pattern.

### 2.3.6 SELECTABLE CARRIER DETECT SENSITIVITY

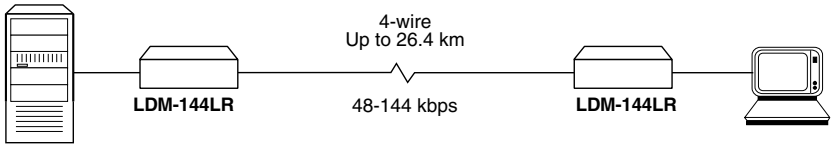
Carrier Detect Sensitivity is controlled by the CD SENS jumper (J4). Setting J4 to LOW will activate DCD over short ranges. Setting J4 to HIGH will activate DCD up to the ranges in **Table 2-1**.

**Table 2-1. Typical Range.**

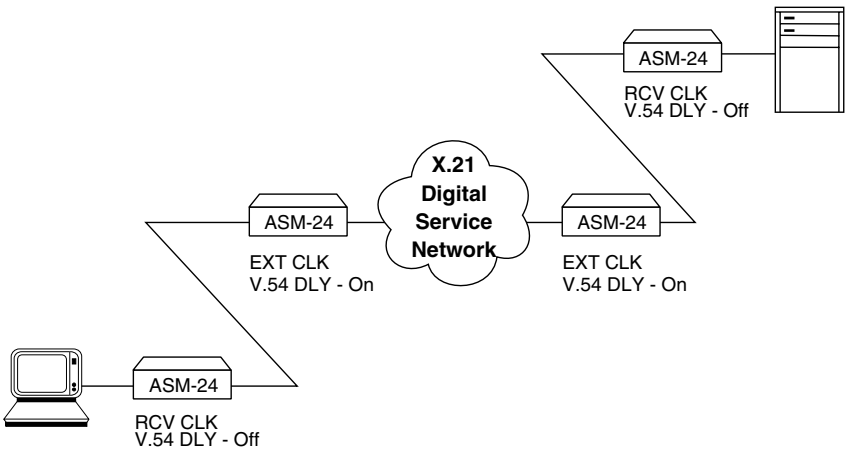
<b>Data Rate (kbps)</b>	<b>19AWG (0.9 mm)</b>		<b>22 AWG (0.6 mm)</b>		<b>24 AWG (0.5 mm)</b>		<b>26 AWG (0.4 mm)</b>	
	<b>km</b>	<b>miles</b>	<b>km</b>	<b>miles</b>	<b>km</b>	<b>miles</b>	<b>km</b>	<b>miles</b>
48	26.4	16.5	16	10	11	6.8	8	5
56	25.2	15.7	15.2	9.5	10.5	6.5	7.5	4.5
64	24	15	14.5	9	10	6.2	7.3	4.7
72	21.6	14.6	13	8.1	9	7	7	4.6
96	20.4	14.2	12.3	7.7	8.5	5.3	6.8	4.5
112	19.2	12	11.5	7.2	8	4.9	5.7	3.4
128	18	11.2	10.8	6.8	7.5	4.7	5	3.3
144	16.8	10.5	10.1	6.4	7	4.3	4.8	3.2

## 2.4 Applications

Figures 2-2 and 2-3 illustrate the LDM-144LR in a variety of configurations, each suitable for a particular application.



**Figure 2-2. Point-to-Point Configuration.**



**Figure 2-3. X.21 Digital Network Tail-end.**



## 3. Standalone Installation

### 3.1 General

The standalone version can be either set on a flat surface or mounted in a rack. The height of the unit is 1U (1.75"H), the width of the unit is slightly less than half the available mounting width. A rack adapter kit is available for installing either a single unit or two units side by side in the 19" rack. This chapter provides the information required to install the standalone LDM-144LR unit. To install the rack-mounted unit (ME447C), see **Chapter 3**. After the installation has been completed, refer to **Chapter 4** for operating information and system checkout to assume normal operation.

### 3.2 Site Preparation

The LDM-144LR is installed within 5 ft. (1.5 m) of a grounded AC outlet and must be situated within 50 ft. (15 m) of the associated data terminal (for the V.35 model, the unit should be even closer to the terminal).

Allow at least 36 in. (90 cm) of frontal clearance for accessibility during operations and maintenance. Ensure at least 4 in. (10 cm) clearance at the rear of the unit for signal lines and interface cables.

### 3.3 Mechanical Assembly

The LDM-144LR standalone version is designed to be placed on a table top or bench, and is delivered in a completely assembled format. No provision is made for bolting the LDM-144LR to the table top.

### 3.4 Electrical Installation

#### 3.4.1 POWER CONNECTION

AC power is supplied to the LDM-144LR through a standard 3-prong plug with integral fuse holder (see **Figure 3-1**).

The rated fuse for the unit is 250/.0.125A slow-blow for 230 volts live voltage, or 250/0.250 A slow-blow for 115 volts live voltage.

DC power is supplied to the LDM-144LR via a 3-pin male connector. A male to female adapter is supplied with the product (see **Figure 3-2**).

## WARNING

**GROUNDING:** This unit should always be grounded through the protective earth lead of the power cable.

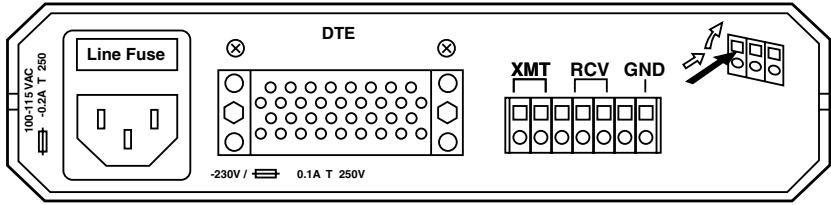
When connecting AC power to this unit, the mains plug should only be inserted in a socket outlet provided with a protective earth contact. The protective action must not be negated by use of an extension cord (power cable) without a protective conductor (grounding). Interrupting the protective (grounding) conductor (inside or outside the unit), or disconnecting the protective earth terminal can make this unit dangerous.

The line fuse is located in an integral-type fuse holder located on the rear panel (as shown in Figure 3-1). 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.

Whenever it is likely that fuse protection has been damaged, make the unit inoperative and secure it against unintended operation.

### 3.4.2 REAR PANEL CONNECTORS

The rear panel connectors located on the LDM-144LR are shown in **Figure 3-1**. The connectors comprise the DTE interface connector and the line connector. The DTE interface is a field-changeable module and has a true-type connector. The line connector is a terminal block.



**Figure 3-1. LDM-144LR Rear Panel Connectors.**

### 3.4.3 DTE INTERFACE SIDE

The DTE side provides interfaces for input/output data, clock, and control signals between the LDM-144LR and the DTE.

## NOTE

**Detailed information on the DTE Interface Signal Assignments is given in Appendix B.**

### *V.24/RS-232*

The V.24/RS-232 interface connector, D-type has a standard 25-pin, pinout configuration.

### *V.35 Interface*

The V.35 interface connector has a standard 34-pin pinout configuration.

*RS-530/RS-449*

The RS-530/RS-449 D-type connector has a standard 25-pin pinout. For a description of the cabling connection between the RS-530 interface and the RS-449/RS-442 (V.36) 37-pin, D-type connector (see **Appendix C**). The cable is provided with the product.

**3.4.4 STRAP SELECTION**

Although most of the modem configuration can be monitored and changed via the front panel, there are straps that have to be set before you use the modem. When the electrical installation has been completed and checked, determine the required configuration of the LDM-144LR and position the straps accordingly. The PCB strap locations of **Figure 3-5** correspond to the numbers listed under "PCB Name" in **Table 3-1**.

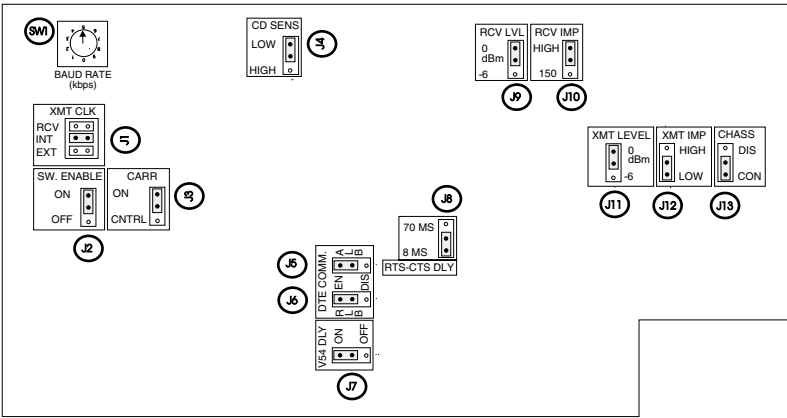
**WARNING**

**Disconnect the AC power cord before removing the unit's cover. Installation, operation, and maintenance should be performed by an experienced technician.**

**3.4.5 INSTALLATION OF INTERNAL JUMPERS AND SWITCHES**

Before electrical installation, the LDM-144LR's internal jumpers and switches should be set according to the application. To access the internal jumpers and switches:

1. Disconnect the AC power cord.
2. Lay the unit upside-down on a soft surface. (At the ends of both the left and right sides, the plastic locking clips can be seen.)
3. With the tip of a flat screwdriver (or similar object), depress the plastic housing-locking clips in turn, while gently prying the two halves apart.
4. Now separate the halves completely, taking care not to lose the two black plastic side-strips.



**Figure 3-2. LDM-144LR Switch and Jumper Settings.**

Table 3-1. LDM-144LR Switch and Jumper Settings.

PCB Name	Function	Details	Option	Factory Setting
J1	XMT CLK	Selects the transmit timing signal from either internal clock, external clock, or receive clock.	RCV INT	INT
J2	SW, ENABLE	When set to ON, enables activation of Diagnostics through the front-panel pushbuttons.	SWITCH: ON SWITCH: OFF	ON
J3	CARR	When set to ON, the transmit carrier is permanently activated.	CARR: ON CARR: CNTRL	ON
J4	CD SENS	Controls Carrier detect sensitivity level. LOW: for short ranges. HIGH: for ranges up to the product limitation.	CD SENS: LOW CD SENS: HIGH	HIGH
J5	[DTE COMM.] ALB	When set to ENabled, the Analog Loopback signal from the DTE is enabled.	ALB: EN ALB: DIS	EN
J6	[DTE COMM.] RLB	When set to ENabled, the Remote Loopback signal from the DTE is enabled.	RLB: EN RLB: DIS	EN

**Table 3-1. LDM-144LR Switch and Jumper Settings (continued).**

<b>PCB Name</b>	<b>Function</b>	<b>Details</b>	<b>Option</b>	<b>Factory Setting</b>
J7	V54 DLY	When set to ON, the V.54 is activated to prevent multiple loopback to tail-end circuits.	V54 DLY: ON V54 DLY: OFF	ON
J8	RTS-CTS DLY	Selects the delay between RTS and CTS.	DLY: 70 ms DLY: 8 ms	8 ms
J9	RCV LVL	Selects receive level into the modem. 0 dBm for ranges up to the product limitation. -6 dBm for short ranges.	RCV LVL: 0 dBm RCV LVL: -6 dBm	0 dBm
J10	RCV IMP	Selects the receive-line impedance.	RCV IMP: 150Ω RCV IMP: HIGH	150Ω
J11	XMT LEVEL	Selects the transmit output level to the line. 0 dBm for ranges up to the product limitation. -6 dBm for short ranges.	XMT LEVEL: 0 dBm XMT LEVEL: -6 dBm	0 dBm
J12	XMT IMP	Selects the transmit line LOW: Up to 150 Ω HIGH: Higher than 150 Ω	XMT IMP: HIGH XMT IMP: LOW	LOW
J13	CHASS	When set to CONnect, the the Signal Ground is connected to the Chassis Ground.	CHAS GND: DIS CHAS GND: CON	CON

Table 3-1. LDM-144LR Switch and Jumper Settings (continued).

PCB Name	Function	Details	Option	Factory Setting
SW1	BAUD RATE (kbps)	Selects the data rate in kbps	0-144 kbps 1-128 kbps 2-112 kbps 3-96 kbps 4-72 kbps 5-64 kbps 6-56 kbps 7-48 kbps	64 kbps

### NOTE

We recommend configuring the Transmit Timing (XMT CLK) of one unit to the receive clock (RCV), and the other unit to either internal (INT) or external (EXT) clock.

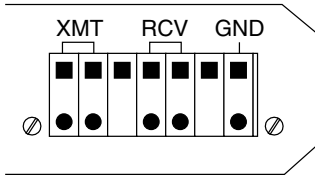
#### 3.4.6 LINE SIDE

The terminal block provides four connecting points to the transmit and receive twisted-pair lines, and a fifth for ground connection. The transmit and receive pairs are polarity-insensitive.

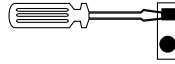
The transmit pair is connected to the terminals marked XMT (data output of the modem), and the receive pair is connected to the terminals marked RCV (data input to the modem).



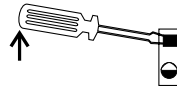
### Wire Insertion Details



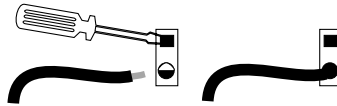
- 1) Insert screwdriver into square hole.



- 2) Raise inserted screwdriver, putting pressure on the ramp within the square hole. The wire clamp within the round hole will open.



- 3) Insert the stripped end of the wire and remove the screwdriver.



**Figure 3-3. Wire Insertion Details.**

## 4. Standalone Operation

### 4.1 General

This chapter provides the necessary information to operate the LDM-144LR unit. For information specific to the rack-mounted unit, see **Chapter 6**.

### 4.4 Controls and Indicators

All control (pushbutton) switches and indicators (LEDs) are located on the front panel, as shown in **Figure 4-1**. The control and indicator functions are described in **Table 4-2**.

### 4.3 Operating Procedure

#### NOTE

**When the unit power is turned on, operating personnel are exposed to voltages below 30 volts on the card or any accessible area of the modem except the mains power socket.**

#### 4.3.1 POWERING ON

To apply AC power:

1. Connect the AC power cable to the LDM-144LR mains socket and to an approved AC source. Check that the green PWR indicator is turned on.
2. If the local and remote LDM-144LR units are operational and passing data, check that the following indication states exist:

**Table 4-1. Indication States.**

<b>Indicator</b>	<b>State</b>
PWR	On
RTS	On or Flashing
TD	Flashing or Off
RD	Flashing or Off
DCD	On or Flashing
TEST	Off
ERR	Off

3. If the above indications are not obtained as a result of the initial powering up, verify that the three test pushbuttons, DIG, ANA and REM, are not depressed.

Table 4-2. Controls and Indicators.

<b>Designation</b>	<b>Control/Indicator</b>	<b>Function</b>
PWR	Indicator, green	When turned on, indicates that the unit is powered.
RTS	Indicator, yellow	When turned on, indicates that an active RTS signal is issued by the DTE.
TD	Indicator, yellow	When turned on, indicates that a steady “space” signal is being transmitted. When data is transmitted, the indicator flickers.
RD	Indicator, yellow	When turned on, indicates that a steady “space” is being received. When data is received, the indicator flickers.
DCD	Indicator, yellow	When turned on, indicates a valid receive signal according to the detected carrier.
TEST	Indicator, red	When turned on, indicates that the LDM-144LR is set to one of the three loopback modes or that the internal BER test is activated.
ERR	Indicator, yellow	The ERR LED is active only when the internal BER tester is activated. If errors are detected in the test pattern, the ERR indicator blinks or remains in the on state.

Table 4-2. Controls and Indicators (continued).

DIG	Control	When depressed, loops the local LDM-144LR receiver output back to its transmitter, as shown in <b>Figure 5-3</b> . The looped data is synchronized to the transmit clock. The DSR signal is set to the low state.
ANA	Control	When depressed, loops the local LDM-144LR transmitter output back to its receiver, as shown in <b>Figure 5-1</b> (Analog Loopback per V.54, loop 3) This loopback may also be activated from the DTE when “DTE Command ALB” jumper is set to EN.
REM	Control	When depressed, loops the remote LDM-144LR receiver output back to its transmitter, as shown in <b>Figure 5-2</b> (Remote Digital Loopback per V.54, loop 2). The looped data is synchronized to the transmit clock. This loopback may also be activated from the DTE when “DTE Command RLB” jumper is set to RLB EN.
PATT	Control	When depressed, the LDM-144LR transmits and receives a 511-bit test pattern. If errors are detected in the received pattern, the ERR indicator is turned on or blinks. The Receive Data and CTS signals are set to the low state.

### 4.3.2 SELF TEST

In order to verify that the LDM-144LR is operating correctly, perform the internal BERT and analog loopback tests detailed in **Section 5-2** and **Section 5-3** respectively.

### 4.3.3 OPERATION

With the exception of occasional monitoring of indicators, the LDM-144LR is operated unattended.

### 4.3.4 TURNING OFF POWER

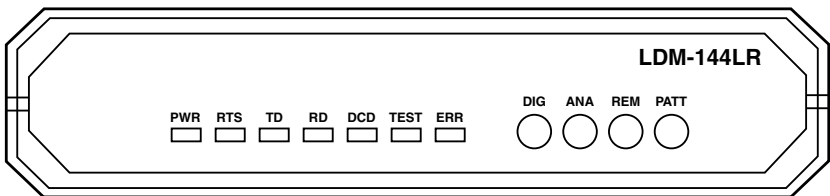
To turn off the AC power, simply remove the AC power cable from the AC source.

## 4.4 Field Settings of Jumpers and Switches

### WARNING

**Disconnect the AC power cord before removing the unit's cover. Installation, operation and maintenance of the unit should be performed by an experienced technician.**

Before re-configuring the LDM-144LR to a different operation mode, set the board switches and jumpers to the corresponding states. Resetting of switches and jumpers according to **Table 3-1** should be performed by an experienced technician.



**Figure 4-1. Front Panel.**

## 5. Tests and Diagnostics

### 5.1 General

This chapter contains procedures for performing system diagnostics and fault-isolation for both the LDM-144LR and LDM-144LR Card units.

- The LDM-144LR features CCITT V.54 diagnostic capabilities for performing local analog loopback and local and remote digital loopbacks.
- The loopbacks can be activated by either the front-panel push buttons or by control signal from the digital interface.
- The LDM-144LR has a built in BER tester and pattern generator which can be activated via the front panel switches.

### 5.2 V.54 Loop Tests

The LDM-144LR supports three types of loopbacks for checking the communication between the attached equipment and the local modem, and the communication between the modems. Use the test procedures provided in this chapter to verify normal system operation and to isolate faulty equipment in the event of failure.

#### NOTE

**Before testing the operation of the data-system equipment and its line circuits, make sure that all units are turned on and configured correctly. Loop tests are best performed in the order presented here.**

#### 5.2.1 LOCAL TEST—LOCAL ANALOG LOOPBACK (ANA)

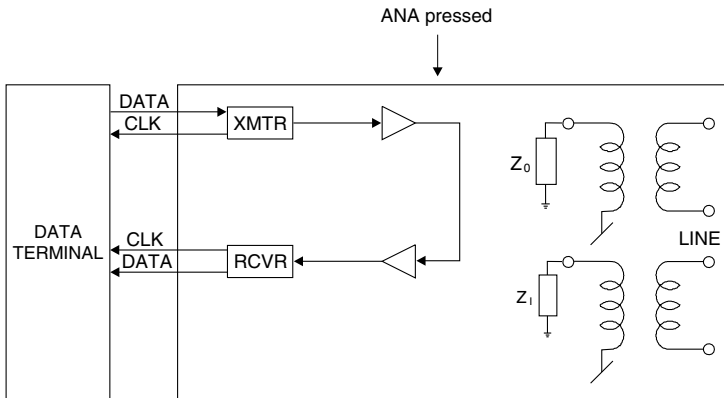
The local Analog loopback (ANA) test checks the performance of the local LDM-144LR modem, the local data terminal and the connections between them as shown in **Figure 5-1**. It is performed separately at the local and the remote site.

1. Activate the ANA loopback (see **Table 4.1** for activation instructions). The TEST indicator should light. The LDM-144LR digital interface is now connected to its own DTE data output via most of the modem circuits. (This test can also be activated via the appropriate pin on the digital interface.)

## NOTE

Activation of ANA loopback via the appropriate pin on the digital interface is not available when using X.21 interface.

2. Verify that the data terminal equipment is operating properly and can be used for a test. Do not perform tests with faulty equipment. Before performing a test, either have the equipment repaired or replace it with a functioning unit.
3. Execute the test with one of the methods described below:
  - Using the DTE and checking the echoed data stream.
  - Using an external Bit Error Rate Tester (BERT) unit.
4. Perform Step 3 above at both ends. If the BERT test indicates correct operation, but the data terminal indicates a fault, follow the manufacturer's test procedures for the data terminal and verify the cable connection between the terminal and the LDM-144LR. After completion of the test (or when the fault has been corrected), de-activate the ANA loopback test.



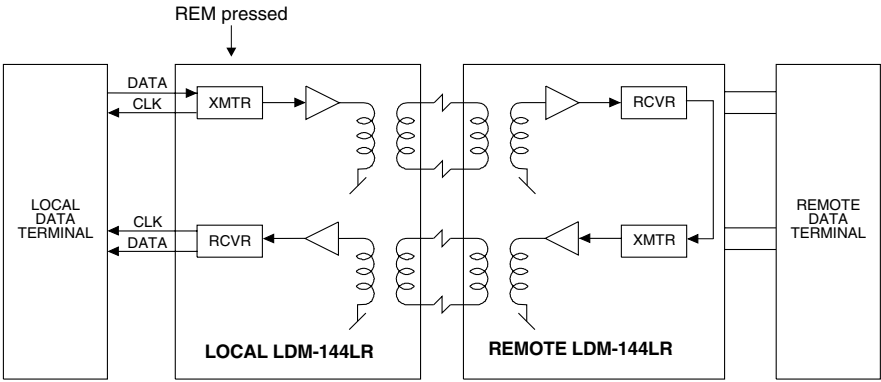
**Figure 5-1. Local LDM-144LR in Analog Loopback.**



**5.2.2 REMOTE DIGITAL LOOPBACK (REM)**

The Remote digital loopback (REM) test determines the performance of both the local and the remote LDM-144LR units, as well as their connecting lines. The Remote Digital Loopback test consists of providing a loopback at the remote modem, as shown in **Figure 5-2**.

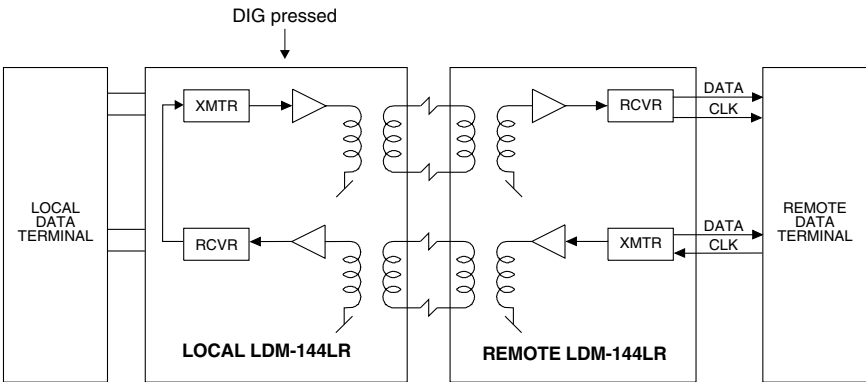
1. Activate the REM loopback (see **Table 4-1** for activation instructions) to provide a loopback at the remote LDM-144LR. The TEST indicator should light at both the local and remote unit. (This test can also be activated via the appropriate pin on the digital interface.)
2. Perform the BERT test as explained in **Section 5.2.1**, steps 3 and 4.
3. If step 2 indicates a fault, while the local analog loopback test described in **Section 5.2.1** was successful for both the local and remote modems, then the line or the line circuits of the local or the remote unit are not functioning properly. To verify that the LDM-144LR is operating correctly, follow the instructions below:
  - Press the ANA (Analog Loopback) pushbutton on the front panel and check that both the TEST and DCD indicators are turned on.
  - If the DCD indicator is not turned on, check that the Carrier jumper J3 (CARR), is set to ON or that the RTS signal is high.
  - Press the PATT pushbutton and check the following indications:
    - If the ERR indicator remains turned on or blinks, then the LDM-144LR is faulty; replace it.
    - If the indications are as specified in step 3 above, restore the push-buttons to the operation mode.



**Figure 5-2. LDM-144LR in Remote Digital Loopback.**

### 5.2.3 LOCAL DIGITAL LOOPBACK (DIG)

The Local digital loopback (DIG) consists of looping the received data back to the remote LDM-144LR, as shown in **Figure 5-3**. Using this test, the operator at the remote end can determine the performance of the local and remote LDM-144LR units, and the communication lines interconnecting them.



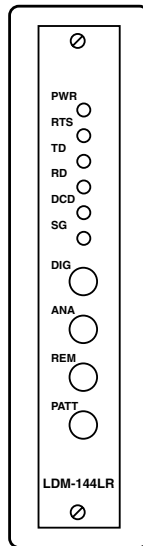
**Figure 5-3. Local LDM-144LR in Digital Loopback.**

## 6. Card Version

### 6.1 RM110A Description

The RM110A consists of one or two power supplies and up to 14 plug-in cards. The card types can be LDM-144LR or other modem cards, (any mix of up to 14 plug-in cards). The rear panel consists of a snap connector and a DB25 D-type connector. The snap connector provides for connecting the transmit and receive lines. The transmit pair is connected to the terminals marked XMT, the receive pair is connected to the terminals marked RCV, and an optional ground connection is the fifth screw.

The interface connector is a 25-pin female connector, which provides all interface signals for the digital interfaces. Two optional interface attachments, the CIA/V.35 and CIA/X.21 are available, providing two V.35 34-pin connectors or two X.21 15-pin connectors respectively (see **Figure 6-3**).



**Figure 6-1. Front Panel of the Card Version.**

## 6.2 LDM-144LR Card Version

The LDM-144LR Card is a card version of the LDM-144LR medium-range modem. The card indicator LEDs and test push-buttons of each LDM-144LR Card are conveniently located on the front panel, shown in **Figure 6-1**, enabling indicator LEDs to be clearly visible. See **Chapter 3** for card jumper setting and **Chapter 4** for card operation information.

## 6.3 Power Supply

### 6.3.1 AC SUPPLY (110 OR 230 VAC)

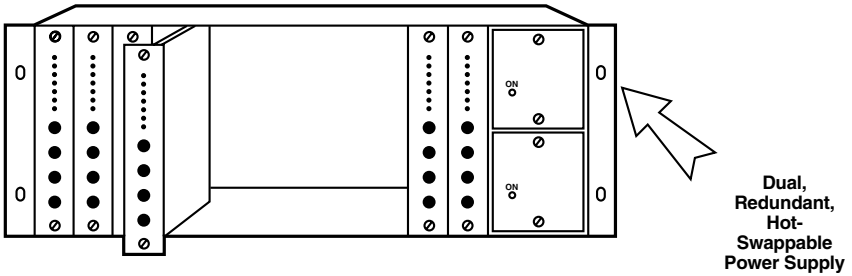
The power supply accepts 110 or 230 volts AC,  $\pm 10\%$ , 47 to 63 Hz, and consists of a power switcher, AC plug, operating switch and indicator LEDs. The indicator LEDs show activity when the AC power supply is connected to the mains plug, and the switch is on. Each LDM-144LR Card has two fuses which protect the entire system against power failure in the event of a short circuit in one of the cards.

### 6.3.2 DC SUPPLY (-48 VDC)

The power supply accepts 36–72 volts DC and consists of a DC/DC converter module that provide the power required for the cards. This power supply supports a full card cage with any combination of cards.

### 6.3.3 POWER SUPPLY WITH REDUNDANCY

This special ordering option power supply is equipped with two separate power supplies, operating together and sharing the load of the whole card cage. If either one of the power supplies fails, the other will continue to supply power for a full card cage. The redundant power supply can be AC or DC and can operate with AC or DC main power supply. LED indicators shows activity of each power supply. The LED should light when mains power is provided.



**Figure 6-2. RM110A Card Cage.**

## **NOTE**

It is possible to combine AC and DC power supplies in the same cage.

## **6.4 Installation**

### **6.4.1 ELECTRICAL INSTALLATION**

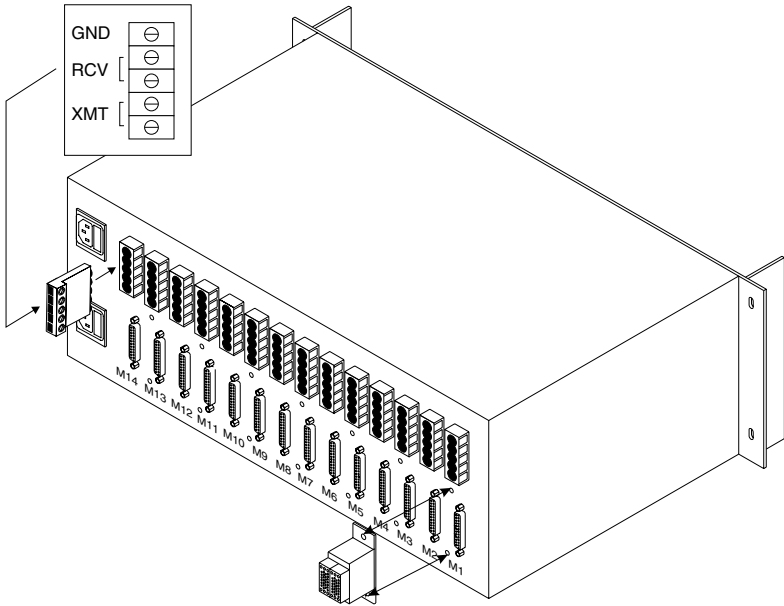
Follow the jumper set-up procedures in **Section 3.4.5**. The rear panel is shown in **Figure 6-3**.

### **6.4.2 MECHANICAL INSTALLATION**

After installing the RM110A in the 19" rack, the LDM-144LR cards should be inserted into it. Once the cards have been inserted, the nut on the top and bottom of each card should be tightened to ensure that it is fully inserted into the edge connector, inside the rack.

## 6.5 Operation

The power supply is controlled from the power module on the left-hand side of the rear panel of the RM110A (see **Figure 6-3**).



**Figure 6-3. RM110A Rear Panel.**

# Appendix A: IR-G.703 Co-Directional 64-kbps Interface

## IR-G.703 Co-Directional Interface

The IR-G.703 is an interface module for modems, converting G.703 co-directional signals to TTL levels. The converted data is sent over the modem link using the modem's modulation technique and is converted back at the other end into G.703 64-kbps co-directional signals, or any other possible digital interface signals.

The module is available in two versions: for stand-alone modems and for rack modems. The stand-alone version fits into a stand-alone modem, and is available with two types of physical connections: terminal block or RJ-45. The rack version mounts on the rack-version modem card, and uses the modem's edge connector for communication. The edge connector is wired on the motherboard of the card cage to a DB25 connector on the back panel.

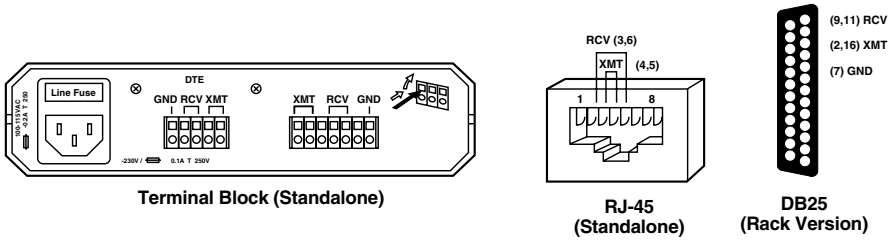
**Figure A-1** illustrates the pinout of the different connectors.

### NOTE

**Rcv**, in **Figure A-1** refers to the input signals to the IR module, **XMT** refers to the output signals from the module.

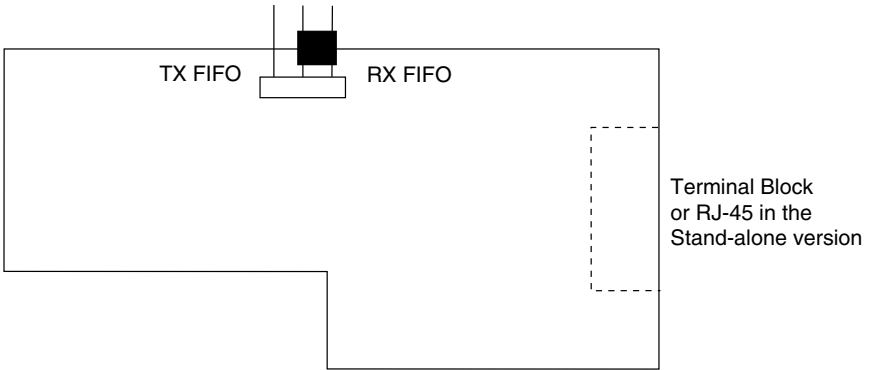
**The approximate range between the IR G.703 module and the attached G.703 equipment is up to 500 meters over 24 AWG cable (depending on cable quality used).**

The G.703 interface module has two operation modes, TX-FIFO and RX-FIFO, which are strap-selectable on the board (see **Figure A-1**).



**Figure A-1. IR G.703 Connector Options.**

The G.703 interface module has two operation modes, TX-FIFO and RX-FIFO, which are strap-selectable on the board (see **Figure A-2**).

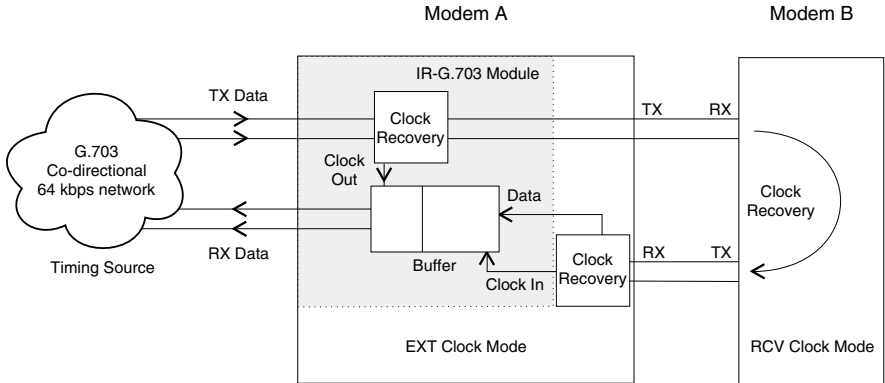


**Figure A-2. Strap-Selectable Operation Modes.**



**MODE A: TX-FIFO**

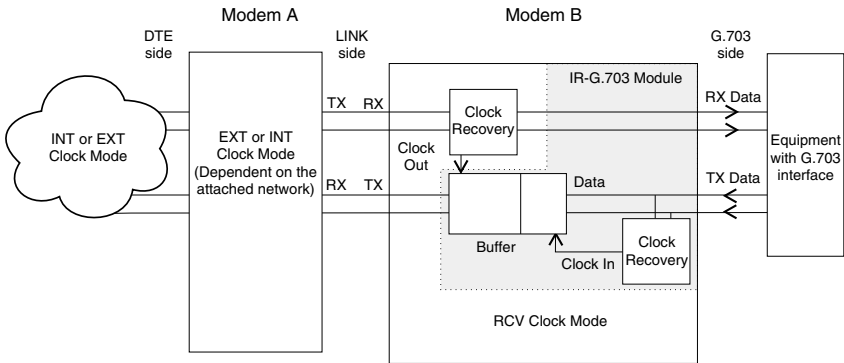
This mode is used in tail-end applications of G.703 co-directional networks. In this application, system timing is provided by the G.703 network. The IR-G.703 module has an internal buffer to compensate for the phase delay introduced to the system by the line delay occurring between the two modems. The buffer is a 2-bit FIFO buffer and is connected as shown in **Figure A-3**.



**Figure A-3. TX-FIFO Block Diagram.**

## MODE B: RX-FIFO

This mode is used in applications where the G.703 co-directional 64-kbps side recovers the clock from the modem link. This mode is used mainly when the attached equipment has a G.703 co-directional interface, but no ability to produce clock. The module has a 2-bit FIFO buffer for compensating for the phase delay introduced by the G.703 device. **Figure A-4** illustrates the buffer connection and the required application set-up. Other clock modes are available in addition to the one shown in **Figure A-4**. The only restriction is that the clock source must be MODEM B, or the clock should be recovered by MODEM B from the DTE side.



**Figure A-4. RX-FIFO Block Diagram.**

# Appendix B: RS-422 Interfacing Pinout

**Table B-1. LDM-144LR EIA 530 Pinout Connection (Digital Interface to DTE RS-422 [V.36] DTE Interface).**

<b>Function</b>	<b>DTE RS-422/423 (RS-499) 37 Pin Connector Pin            Circuit</b>		<b>LDM-144LR SD DB25 Female Connector Pin            Circuit</b>	
Protective Ground	1	Shield	1	
Signal Ground	19, 37, 20		7	AB
Transmitted Data	4	SD (A)	2	BA (A)
	22	SD (B)	14	BA (B)
Received Data	6	RD (A)	3	BB (A)
	24	RD (B)	16	BB (B)
Request to Send	7	RS (A)	4	CA (A)
	25	RS (B)	19	CA (B)
Clear to Send	9	CS (A)	5	CB (A)
	27	CS (B)	13	CB (B)
Data Set Ready	11	DM (A)	6	CC (A)
	29	DM (B)	22	CC (B)
Data Terminal Ready	12	TR (A)	20	CD (A)
	30	TR (B)	23	CD (B)
Carrier Detect	13	RR (A)	8	CF (A)
	31	RR (B)	10	CF (B)

**Table B-1. LDM-144LR EIA 530 Pinout Connection (continued).**

<b>Function</b>	<b>DTE RS-422/423 (RS-499) 37 Pin Connector</b>		<b>LDM-144LR SD DB25 Female Connector</b>	
	<b>Pin</b>	<b>Circuit</b>	<b>Pin</b>	<b>Circuit</b>
External Transmit Clock	17	TT (A)	24	DA (A)
	35	TT (B)	11	DA (B)
Transmit Clock	5	ST (A)	15	DB (A)
	23	ST (B)	12	DB (B)
Receive Clock	8	RT (A)	17	DD (A)
	26	RT (B)	9	DD (B)
Local Analog Loopback	10	LL	18	LL
Remote Loopback	14	RL	21	RL
Test Indicator	18	TM	25	TM

# Appendix C: Unit Case Assembly

## Installation of the Unit Case into a 19" Rack

### GENERAL

The height of the unit is 1U (1.75"); the width of the unit is slightly less than half the available mounting width. Rack adapter kits, RM516-RM523, are available for installing either a single unit or two units side by side in the 19" rack.

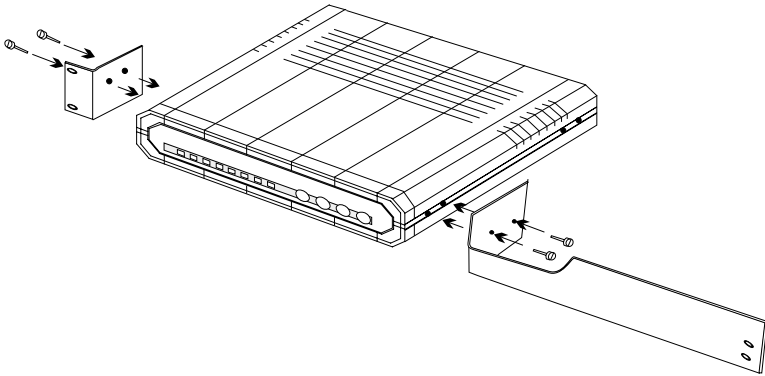
### NOTE

**Disconnect AC power before opening the unit. Installation, operation and maintenance of this unit should only be performed by an experienced technician.**

### INSTALLATION OF A SINGLE UNIT

Rack-adapter components for installing a single unit include one short bracket and one long bracket. Each bracket is fastened to the side walls of the unit by two screws, which are inserted into the two front holes on the side wall. (The unit is supplied with nuts already in place on the inner side wall.) Note that the short bracket fastens to the left side of the unit, and the long bracket to the right side of the unit (see **Figure D-1**).

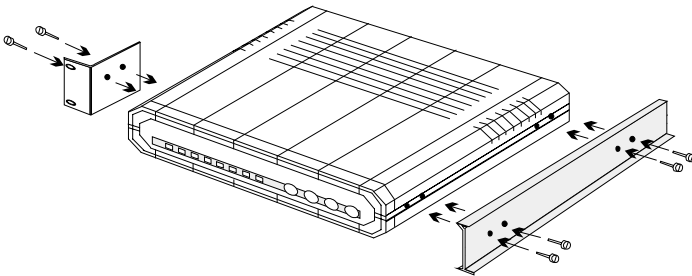
Once the brackets are fastened to the side walls, the unit is ready for installation in the 19" rack. Place the unit in the rack and fasten the brackets to the side rails of the rack by means of the two screws situated on each side (not included in the kit).



**Figure D-1. Installation of a Single Unit.**

#### INSTALLATION OF TWO UNITS

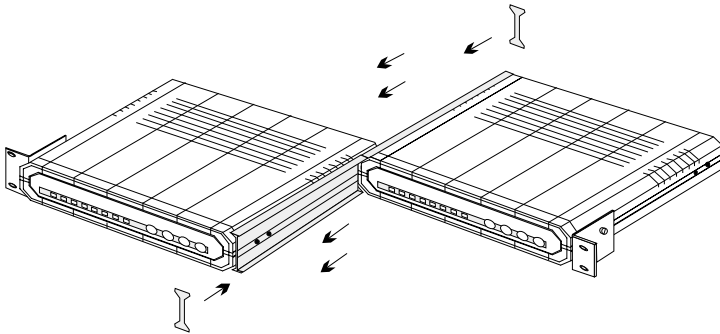
Rack-adaptor components for installing two units include two long side rails (one for each unit), which slide one into the other, fastening the two units together; and two short side brackets, which hold the two units in the 19" rack (see **Figure D-2**).



**Figure D-2. Installation of Two Units, Part 1.**

*Two-unit installation instructions*

1. Fasten one long side rail to each unit (one to the right side of one unit, the other to the left side of the other unit) using the four screws and flatwashers supplied. The side rails must be attached in opposing fashion, the narrow flange of the first rail opposite the wide flange of the second rail.
2. Attach one short bracket opposite the side rail on each unit using the four screws supplied.
3. Slide the side rail of one unit into the side rail of the other unit, fastening the two units together (see **Figure D-3**).
4. Secure the supplied plastic caps to the ends of the rails, to prevent the units moving and to protect the rail ends.
5. Place the assembled units in the rack and fasten the brackets to the side rails of the rack, by means of the four screws situated on each side (not included in the kit).

**Figure D-3. Installation of Two Units, Part 2.**



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