BLACK BOX

**LDM-MR 19.2**

PWR   RTS   TD   RD   DCD   TEST

DIG   ANA   REM

REM   ANA   DIG

EN
ENABLE /
DISABLE
SWITCHES
DIS

TEST   DCD   RD   TD   RTS   PWR

AGC
CTRL
ON

2/4 WIRE
2 W
4 W

CARRIER
CTRL
ON

ASY LENGTH
ON
1 2 3 4

XMT TIMING
INT. CLK
EXT. CLK
RCV. CLK
ASYNC

DATA RATE
SELECTION

XMT LEVEL
0 dbm
-3 dbm
-6 dbm
-9 dbm

CTS DELAY
0 msec
8 msec
64 msec

RPF
ON
OFF

XMT IMPD
600
300
150
LOW

PIN 21
(RLB)
EN
DIS

PIN 18
AN. LP
EN
DIS

RCV IMPD
150
300
600
HIGH

DB25 CONNECTOR

XMT   RCV   GND

**ME760A**

## SPECIFICATIONS:

Cable Required:  Between ME760A 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 ME760A unit and DTE:  EIA RS-232 cable with DB25 male connector on ME760A end.

Interface:  Serial EIA RS-232D/CCITT V.24, DCE; RTS/CTS delay 0,8 or 64 ms (user-selectable).

Protocol:  Synchronous or Asynchronous

Clock Source:  Either internal, external from local DTE, or recovered from remote DTE.

Data Format:  5, 6, 7 or 8 data bits;  1, 1.5, or 2 stop bits;  even, odd, or no parity.

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.

Modulation:  Differential diphase Eurocom Standard D1

Transmit Level:  0, -3, -6, or -9 dBm (user-selectable).

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

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

Return Loss:  Greater than 15 dB.

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

User Controls:  (21) Total:  (3) Front-mounted pushbuttons:
DIG (local digital loopback)
ANA (local analog loopback)
REM (remote digital loopback)
(18) Internal:
(1) Dial:  Data Rate;
(5) Single-position DIP switches:
(1) Enable/Disable front-panel pushbuttons;
(1) Async character length;
(1) Not used:
(12) 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; Connect/
Disconnect signal ground and chassis ground
AGC control; Activate/Deactivate V.54 delay.

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

Indicators:  (6) Front-mounted LED's:  PWR, RTS, TD, RD, DCD, TEST.

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 attached 5-ft. (1.5m) line cord:
ME760A:  115 VAC, 47 to 63 Hz, 3 watts.

# INTRODUCTION:

The LDM-MR19.2 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:

> Transmit Level and Transmit Receive impedance's 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 modem to asynchronous mode, it performs as 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.

## FUNCTIONAL DESCRIPTION:

### 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:

1. 4-wire full-duplex
2. 4-wire half-duplex
3. 2-wire half-duplex
4. 4-wire multipoint
5. 2-wire multipoint

### MODULATION TIMING:

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

1. INT. CLK.= internal clock--from the modem's internal crystal oscillator.
2. EXT. CLK. = external clock--from DTE, Pin 24.
3. RCV. CLK = receive clock recovered from Receive signal.
4. ASYNC = asynchronous timing for working with the async-to-sync converter in an async application.

Setting the XMT TIMING jumpers determines the timing option.

### ASYNC-TO-SYNC CONVERTER:

The LDM-MR19.2 provides internal conversion from async to sync in compliance with CCITT V.2 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%). User 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.

### 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.

### RECEIVER:

The receiver contains several circuits.

1. The RECEIVE FILTER removes all the out-of-band frequencies.
2. The AUTOMATIC EQUALIZER is made up of several equalizers activated according to data rate.
3. The digital AGC (automatic gain control) automatically compensates for the attenuation of the line. You may 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. 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.

### V.54 DIAGNOSTICS:

You can activate V.54 loops with either the front-panel pushbuttons or Pins 18 and 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.

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

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## INSTALLATION:

***Data Cables***:

The LDM-MR19.2's data-communication connectors (a four-screw terminal block and a DB25 connector) are on its rear panel. The terminal block holds four screws for connecting the Transmit (XMT) and Receive (RCV) telephone lines. The Transmit and Receive pairs are polarity insensitive. 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. A nut for optional ground connection is located on the right side of the rear panel.

***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. To set internal jumpers and switches, follow these 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.

## OPERATION:

***Controls and Indicators:***

All of the LDM-MR19.2's external controls and LED indicators are located on the LDM-MR19.2's front panel.

A. **DIG:** Pressing 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 is set to EN.
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 is set to RLB EN.

1. **PWR:** Green LED is ON when power is present.
2. **RTS:** Yellow LED is ON when DTE activates Request to Send.
3. **TD:** Yellow LED is ON when steady SPACE is being transmitted. It flickers when data is transmitted.
4. **RD:** Yellow LED is ON when steady SPACE is being received. It flickers when data is received.
5. **DCD:** Yellow LED is ON when a valid Receive signal is present.
6. **TEST:** Red LED is ON when the LDM-MR19.2 is in any of the three loopback modes.

***Turning the Unit ON:***

If you haven't already, plug the LDM-MR19.2's AC power cord into a working AC outlet. The PWR LED should light to indicate that the unit is ON. If the local and remote units are both operating and passing data, the LED's should look like this:

**PWR:** ON
**TD:** Flashing or OFF
**RD:** Flashing or OFF
**RTS:** ON or Flashing
**DCD:** ON or Flashing
**TEST:** OFF

If the LED's don't look like this, make sure none of the three front-panel pushbuttons are pushed in.

***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 any card or accessible area of the unit's DC power supply. Regardless of this, DO NOT open the unit while it is ON.
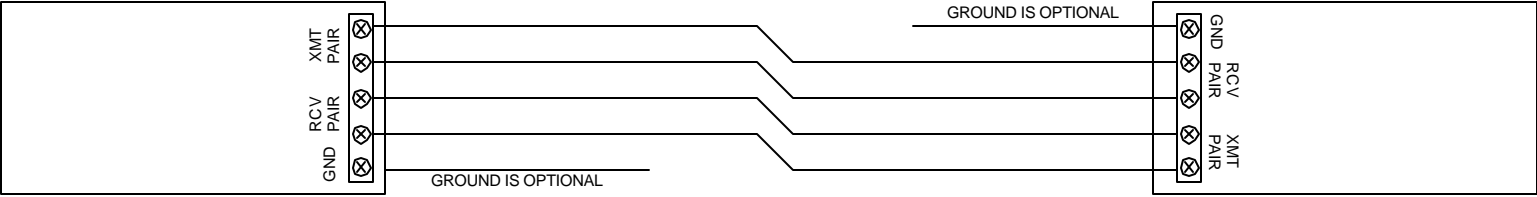
***Reconfiguration:***

If at some point you need to reconfigure the unit to operate differently, with a new data rate or new clock source, for example--you can change the settings of the unit's internal controls. Unplug the unit, then follow the procedure for possible settings of the controls.

| STRAP IDENTITY | FUNCTION | POSSIBLE SETTINGS | FACTORY SETTINGS |
|---|---|---|---|
| Data Rate (Kbps) | Determines the data rate. | 0 = 19.2 Kbps<br>1 = 14.4 Kbps<br>2 = 9.6 Kbps<br>3 = 7.2 Kbps<br>4 = 4.8 Kbps<br>5 = 3.6 Kbps<br>6 = 2.4 Kbps<br>7 = 1.2 Kbps | 2 = 9.6 Kbps |
| 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<br>EXT<br>RCV<br>ASY | INT (Internal Clock) |
| 2W/4W | Determines whether the unit uses 2 wires or 4 wires. | 2W<br>4W | 4W (4 wires) |
| CTS DELAY | Determines the RTS-to-CTS delay | 0 ms<br>8 ms<br>64 ms | 8 ms |
| CARRIER | Determines the transmit carrier mode.<br>ON: Transmit carrier is constantly ON.<br>CTRL: Transmit carrier is ON only when RTS is high.<br>CTRL should be used in multipoint applications. | ON<br>CTRL | ON |
| XMT LEVEL | Determines transmit-output level to the line. | 0 dBm<br>-3 dBm<br>-6 dBm<br>-9 dBm | 0 dBm |
| XMT IMPEDANCE | Determines transmit-line impedance.<br>For Multi-point applicatoins, set the master modem to<br>LOW | 600<br>300<br>150<br>LOW | 150 [ohms] |
| RCV IMPEDANCE | Determines receive-line impedance.<br>For Multi-point applications, set the master modem and the last modem in line 10 150; set all others to HIGH. | 150<br>300<br>600<br>HIGH | 150 [ohms] |
| PIN 18 | Enables/Disables Analog loopback command from the DTE on Pin 18 | EN<br>DIS | EN |
| PIN 21 | Enables/Disables Remote loopback command from the DTE on Pin 21. | RLB EN<br>RLB DIS | RLB EN |

| STRAP IDENTITY | FUNCTION | POSSIBLE SETTINGS | FACTORY SETTINGS |
|---|---|---|---|
| SWITCH | Enables/Disables control of the DIG, ANA, and REM loopbacks with the front-panel pushbuttons. | EN<br>DIS | EN |
| GND | Connect: Connects Signal Ground to Chassis Ground.<br>DIS: Isolates grounds from each other. | CONNECT<br>DIS CONN | CONNECT |
| AGC | ON: AGC always ON.<br>CTRL: AGC ON if DCD is ON, remains at last level of amplification if DCD goes OFF. | ON<br>CTRL | ON |
| V.54 Delay | ON: Activates V.54 delay, preventing multiple loopback of tail-end circuits.<br>OFF: No delay | ON<br>OFF | OFF |
| ASYNC LENGTH | S3 and S4 determine character lengths when unit is in async mode. | S3    S4    BITS<br>OFF  OFF   8<br>OFF  ON    9<br>ON   OFF  10<br>ON   ON    11 | 10 Bits |
| | S2 determines amount of stop-bit shortening for async mode. | ON = 25%<br>OFF = 12.5% | 12.5% |
| | S1 is not used. | | |

# Point-to-Point Application

GROUND IS OPTIONAL

XMT PAIR

RCV PAIR

GND

GND

RCV PAIR

XMT PAIR

GROUND IS OPTIONAL

## 4-Wire Twisted Pair up to 34 mi. (55 km)

# Multipoint Application

XMT IMP - LOW
RCV IMP - 150 ohm

GROUND IS OPTIONAL

Slave 1
XMT IMP - 150 ohm
RCV IMP - HIGH

XMT PAIR

RCV PAIR

GND

GROUND IS OPTIONAL

GND

RCV PAIR

XMT PAIR

Slave 2
XMT IMP - 150 ohm
RCV IMP - HIGH

GND

RCV PAIR

XMT PAIR

Slave 3
XMT IMP - 150 ohm
RCV IMP - 150 ohm

GND

RCV PAIR

XMT PAIR