MOORE INDUSTRIES

USER'S MANUAL
LCM/LFM

Link Converter Module
Link-to-Fiber Module

No. 296-701-00 A

August 1989

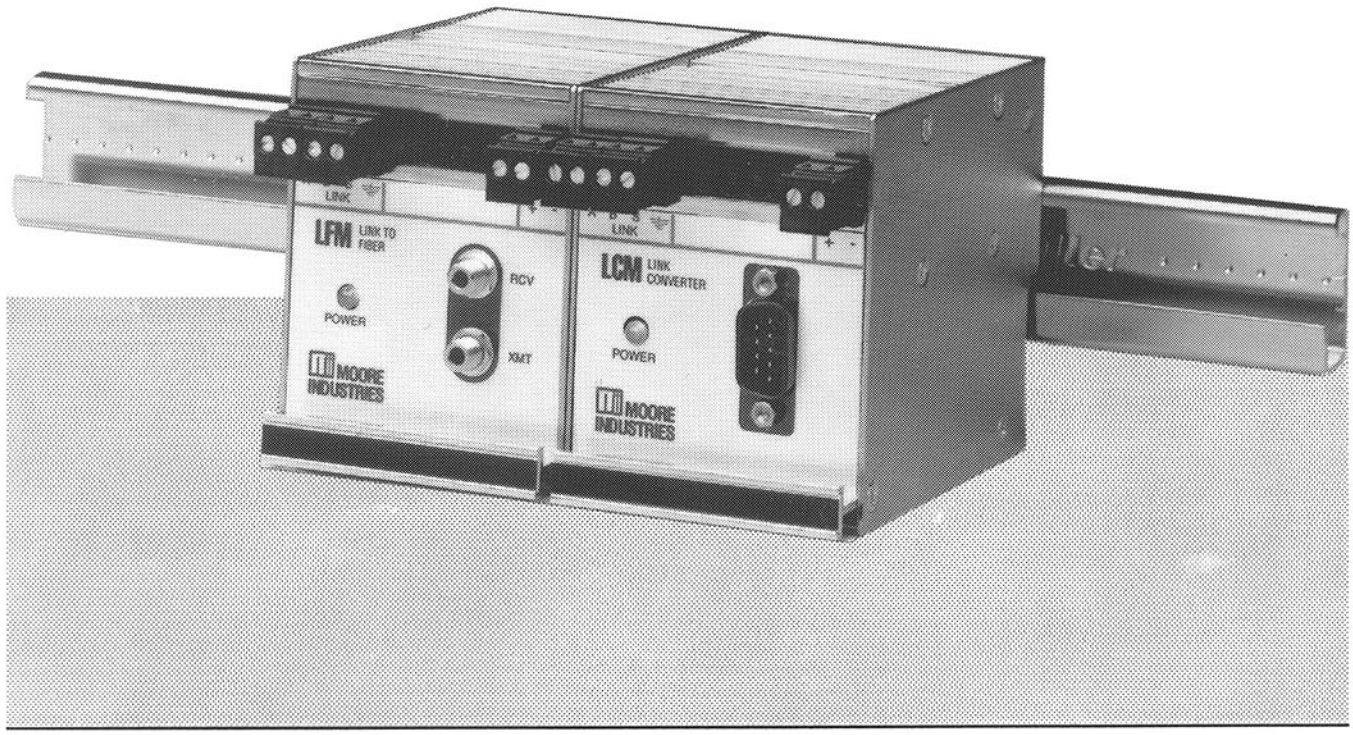


Table of Contents

Introduction

This manual contains user information on the bench check and installation of Moore Industries' Link Converter Module (LCM) and Link-to-Fiber Module (LFM). A product description, a simplified theory of operation, and related tables and illustrations for the LCM and LFM are also contained in this publication.

This manual contains notes and cautions that must be observed to avoid equipment damage and minor inconveniences while configuring or installing the LCM or LFM. The following definitions describe the content of these captions:

A ***NOTE*** shall contain technical or literary information of a helpful nature. This information is intended to aid the reader's understanding of the subject being discussed and/or minimize inconveniences while performing technical tasks.

A ***CAUTION*** shall contain technical information of a serious nature, which if ignored may cause equipment damage.

Description

The LCM and LFM are interface modules that convert RS-485, asynchronous, byte-wide data to either RS-232C, RS-422, or fiber optic interface standards. The converted data signal is then interfaced to other communication devices (such as computers, modems, or similar interface modules) that accept RS-232C, RS-422, or fiber optic interface standards.

The RS-485 interface standard is the preferred method of field communications. The LCM and LFM are capable of interfacing RS-485 data signals over cable lengths of up to 2 miles (3.2 km). However, unlike the RS-232C, RS-422, and fiber optic interfaces, the RS-485 communication link is a half-duplex system. To avoid data collisions and preserve system timing, full-duplex communications are used elsewhere in the system.

LCM. Each LCM is factory-configured for either RS-232C or RS-422 operation. RS-232C modules convert RS-485 data and transmit this data to devices that accept RS-232C standards (such as modems). Likewise, RS-232C data received by the same LCM is converted to RS-485 standards. The RS-422 modules are ideal for interfacing RS-485 data to computers that accept RS-422 interface standards.

The RS-232C and RS-422 input and output ports are 9-pin, D-type, male interface connectors. Pin assignments for these connectors are given in the Installation Section of this manual.

The RS-485 communication link is transparent to the user's software, so the LCM can be used in communication systems without modifying existing RS-232C or RS-422 software.

LFM. The LFM accepts RS-485 data, converts it and transmits it per fiber optic communication standards. One LFM converts the RS-485, asynchronous signal into light signals and transmits this signal through a fiber optic cable. If the light signal is supplied to a second LFM, or a similar fiber optic device, the signal is converted back to an RS-485 asynchronous signal.

The major advantage in using fiber optics as the communication medium is that light signals are impervious to electrical noise. Electromagnetic interference (EMI), radio frequency interference (RFI), and electrostatic discharge (ESD) have no affect on fiber optic transmissions. Using 50/125 fiber optic cables, the LFM communicates over cable lengths of up to 1.55 miles (2.5 km).

The LCM and LFM are packaged in all-aluminum, DIN-style housings. These interface modules snap directly onto standard DIN rails, which makes them ideal for high-density installations.

Both the LCM and LFM feature user-selectable options for baud rate and character length. One of nine baud rates, between 300 and 76.8 K, may be jumper selected (refer to table 1). Character lengths of 9, 10, 11, or 12 bits are also jumper-selectable. The character length is comprised of a start bit, data bits, and stop bit(s).

The LCM and LFM require a power source of either 24 Vac (nominal) or 18-30 Vdc for normal operation. An LED on the front panel illuminates when power is applied to the module.

Table 1 lists the equipment specifications for the LCM and LFM. Connector pin assignments and physical dimensions are contained in the Installation Section of this manual.

Model Number. The LCM and LFM model numbers identify the type interface (LCM or LFM) and the type communication standard for which the module is configured (RS-232C, RS-422 or fiber optics). This number is located on a label attached to the left-side panel (when viewing front panel) of the module.

Serial Number. Moore Industries maintains a complete history on every unit we sell and service. This information is keyed to the serial number. When service information is required about an LCM or an LFM, it is necessary to provide the factory with this number. The serial number is located adjacent to the model number.

Table 1. LCM/LFM Equipment Specifications

Characteristic	Specifications
Input/Output Ports	**LCM & LFM:** RS-485 (connects to terminals A, B, & S)
	LCM: RS-232C or RS-422 Interface (requires 9-pin, D-type female cable connector) **LFM:** Fiber Optic Interface (requires two SMA-LP-type connectors per module for bidirectional communications)
Field Options	**Baud Rate (jumper-selectable):** 300, 600, 1200, 2400, 4800, 9600, 19200, 38400, or 76800 **Character Length (jumper-selectable):** 9, 10, 11, or 12 bits
Performance	**Allowable Transmission Length:** LCM, up to 2 miles (3.2 km) (RS-485); LFM, up to 1.55 miles (2.5 km) (fiber link) **Power Isolation:** Up to 750 Vdc (500 Vrms) **Peak Optical Output Power (LFM):** 40 µW, minimum; 45 µW, maximum **Optical Receiver Sensitivity (LFM):** 1 µW, typical; 2 µW, maximum at 820 nanometers **Maximum Allowed Attenuation Between Modules (LFM):** 11 dB for 50/125 fiber optic cable
Power	24 Vac, +10%/–20% 18-30 Vdc
Operating Temperature	32 to 158 °F (0 to 70 °C)
Weight	14 ounces (397 grams)

NOTE: See Installation Section for physical dimensions.

Configuration Options

Once installed, the LCM or LFM are part of a communication system. Since the transmission baud rate and character length of the system are determined by a control device, the interface module(s) selected must conform to system parameters. To configure an LCM or LFM to these parameters, solderless jumpers are used to match the baud rate and character length required within the system. Solderless jumpers are also used to set each module for either normal operation or self-test mode.

Each LCM and LFM have two primary printed circuit (PC) boards. The Power Supply PC board (PC1) is common to both the LCM and LFM. PC2 is different for each application. In the LCM, PC2 differs slightly for RS-232C and RS-422 interface modules. In the LFM, PC2 is designed specifically for fiber optic communications. In each case, all jumpers for setting field-selectable options are contained on PC2.

To access PC2, the right-side panel of the DIN-style housing must be removed. Six Phillips-head screws, securing the panel, must be removed to free the panel from the case. No further disassembly is required. All jumpers are accessible with the right-side panel removed.

Baud Rate. To set the baud rate of the LCM or the LFM, a solderless jumper must be slid onto two adjacent pins. While viewing PC2 (of either module) in the upright position, the jumper would be placed vertically across two corresponding jumper pins. That is, one pin on the upper row and the pin directly below it, on the lower row, are connected with a single jumper. ONLY ONE JUMPER is used to set the baud rate.

The available baud rates and the jumper required to select a specific baud rate are listed in table 2. The baud rate selected for the module must be the same as that of the system. The baud rate jumper set is J203 on PC2 of both the LCM and LFM (see figures 1 and 2).

Character Length. Two jumpers are required to select one of four available character lengths. The character length jumper set is J204 for both the LCM and LFM. Jumper set J204 contains jumpers A, B, C, and D. Table 3 lists the available character lengths and the jumpers required to select a specific character length. When setting these jumpers, contact must be made between the two pins on both sides of the letter designators shown in figures 1 and 2.

Normal Operation/Self-test. For normal operation, J201 of the LCM and LFM must be installed. For self testing, J202 of the LCM and LFM must be installed. J205 of the LFM must remain installed at all times. While in normal operation, J202 must be removed; while in self-test mode, J201 must be removed.

Figure 1 illustrates the jumper locations for the LCM (PC2). Both the RS-232C and RS-422 interface modules have the same physical jumper locations and designations. Figure 2 illustrates the jumper locations for the LFM (PC2).

Table 2. *Baud Rate Jumpers (J203)*

Baud Rate	Jumper
300	A
600	B
1200	C
2400	D
4800	E
9600	F
19200	G
38400	H
76800	I

Table 3. *Character Length Jumpers (J204)*

Character Length	Jumpers
9 bits	B and D
10 bits	A and D
11 bits	B and C
12 bits	A and C

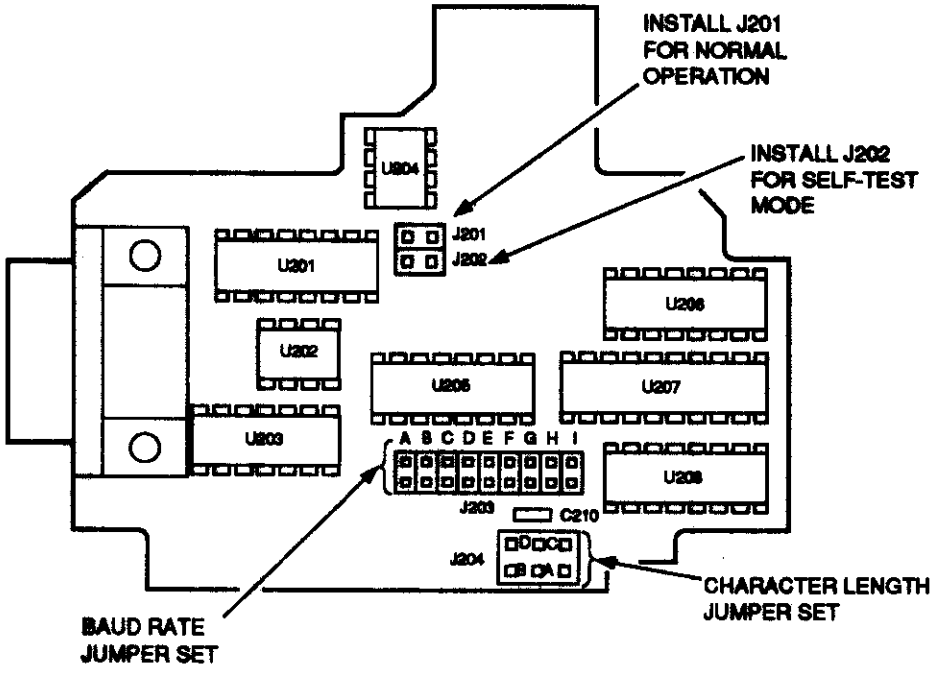


Figure 1. *LCM Jumper Locations, PC2*

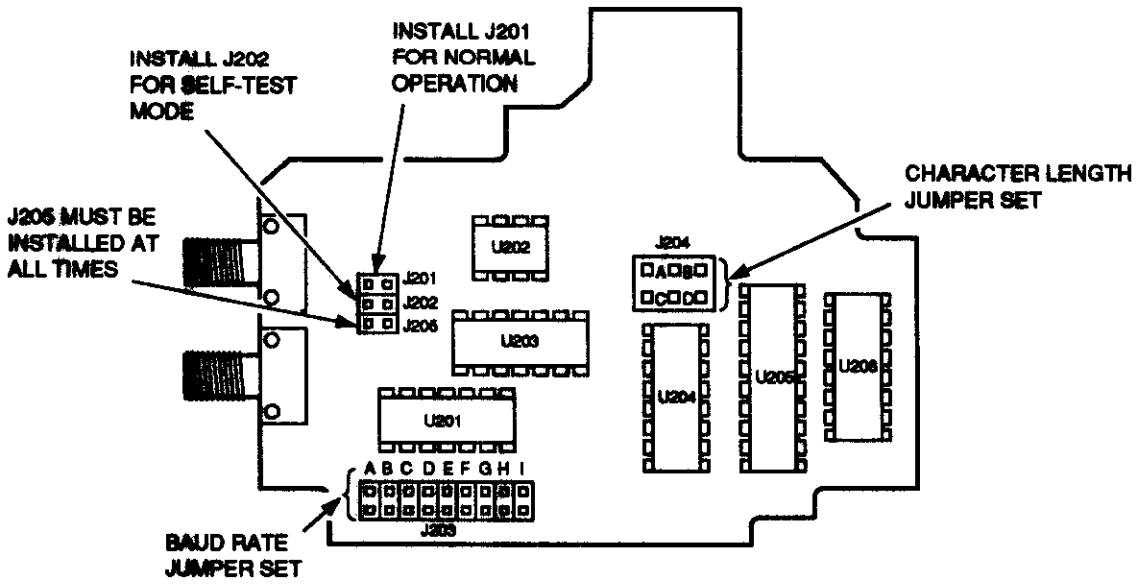


Figure 2. *LFM Jumper Locations, PC2*

Bench Check

Before installing an LCM or LFM in a communication system, a bench check should be performed on each module. Performing the prescribed bench check verifies that each module is transmitting and receiving data properly. As part of the bench check, each module must have its baud rate and character length jumpers set, as described in the Configuration Options Sections of this manual.

Test Equipment

Table 4 lists the test equipment required to bench check the LCM and/or LFM. When two similar modules are being bench checked, the equipment required includes a shop-quality, dual-channel oscilloscope (with probes); a 24 volt (nominal) power source; an RS-485 data source; and the proper interface cable.

It is important to ensure that the cables used for the bench check are properly wired. Each LCM requires a 9-pin, D-type, female cable connector to mate with the interface connector on the module (two connectors per cable required). Pin assignments for the RS-232C and RS-422 interfaces differ. Table 5 lists the pin assignments required between one connector and the other for an RS-232C interface cable. Table 6 lists the pin assignments required between one connector and the other for an RS-422 interface cable. The transmit pin(s) from each module must be connected to the receive pin(s) of the other module. For the LFM, the fiber optic cable must be connected from the transmit (XMT) connector to the receive (RCV) connector from one module to the other.

Table 4. Bench Check Equipment

Equipment	Characteristic
Oscilloscope	Shop-quality, dual-channel o'scope for two-module bench check; single-channel (minimum) o'scope required for single-module bench check
Power Source	24 Vac/Vdc (nominal)
RS-485 Signal Source	Half-duplex, asynchronous, byte-wide data source (e.g., Moore Industries' Cable Concentrator System – CCS)
Interface Cable	Required for testing two similar modules. LCM modules require 9-pin, D-type, female connectors, wired for RS-232C or RS-422 (see tables 5 or 6); LFM modules require fiber optic cables with SMA-LP-type connectors (e.g., AMP P/N 501055-1)
Shorting Wires	Typical jumper wire for shorting connector pins together

Table 5. RS-232C Cable Connections

First Connector (LCM #1)		Second Connector (LCM #2)
Pin 2	to	Pin 3
Pin 3	to	Pin 2
Pin 5	to	Pin 5

Table 6. RS-422 Cable Connections

First Connector (LCM #1)		Second Connector (LCM #2)
Pin 4	to	Pin 8
Pin 5	to	Pin 9
Pin 8	to	Pin 4
Pin 9	to	Pin 5

When only one module is being bench checked, the test equipment required consists of a single-channel oscilloscope and a 24 volt (nominal) power source. Also, shorting wires are required to connect the transmit pin(s) to the receive pin(s) at the LCM interface connector. One shorting wire is required for the RS-232C interface and two wires for the RS-422 interface. If an unwired 9-pin, D-type, female connector is available, the user may find it easier to connect it to the interface connector on the LCM and then connect the shorting wires to the pins of the female connector. For the LFM, a fiber optic cable must be connected from the transmit connector (XMT) to the receive connector (RCV).

An internal jumper (J202) must be installed for the LCM and LFM to generate a self-test signal for bench checking a single interface module. J201 must be moved to J202 during this type bench check. (See figures 1 and 2 for jumper locations.)

Bench Check Hookup – Two Modules

Figure 3 is the hookup diagram for bench checking two similar interface modules. In all cases, an RS-485 signal source is required. This signal must be asychronous, byte-wide data supplied to the interface module over twisted-pair wires. As illustrated in figure 3, only one signal source is required. Once the interface modules are checked out in one direction, they are swapped and checked out in the other direction. This verifies the conversion, transmission, and reception of data in both directions.

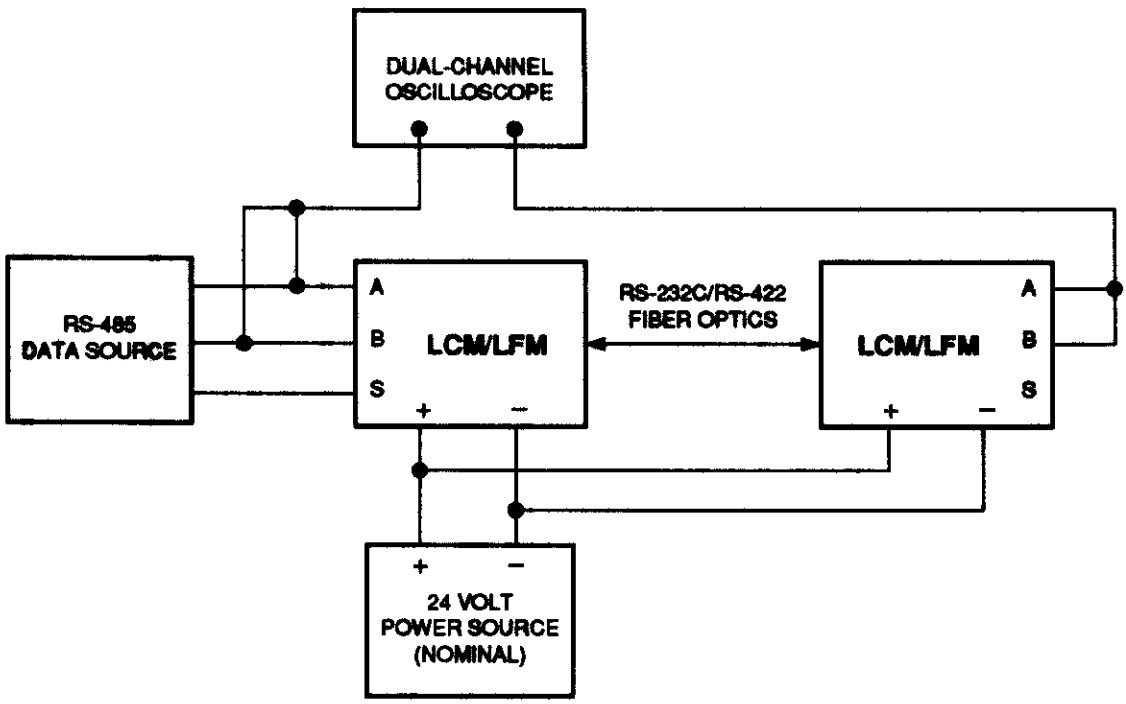
The objective of this bench check method (using two similar modules) is to confirm that the RS-485 data signal input to one interface module is the same as the output from the second module. Using a dual-channel oscilloscope allows for this comparison.

Bench Check Procedure – Two Modules

1. Ensure that modules being bench checked are of similar interface types and that they are set to the baud rate and character length of the RS-485 data source.
2. Connect interface modules as shown in figure 3.

NOTE

Ensure that the interface cable between modules have the transmit pin(s) from one connector wired to the receive pin(s) of the other (in both directions), and the grounds pins connected to one another. For the LCM, see tables 5 and 6.



NOTE: CONNECT O'SCOPE PROBES TO TERMINAL A OF THE MODULES AND PROBE GROUND LEADS TO TERMINAL B.

Figure 3. *Bench Check Hookup Diagram – Two Modules*

3. Connect channel 1 probe of oscilloscope to terminal A of first module and connect probe ground to terminal B.

NOTE
An effective means of connecting probes to module terminals is to remove about 0.5 inch of insulation from the end of the RS-485 wires, and once terminated, clip the probes onto the exposed portion of the wires.

4. Connect channel 2 probe of oscilloscope to terminal A of second module and connect probe ground to terminal B.

5. Set channels 1 and 2 of oscilloscope for same display settings. Trigger on channel 1.

6. Apply power and RS-485 data signal.

7. Monitor oscilloscope, compare channel 1 to channel 2. Signals should be similar.

NOTE
If channel 1 and 2 are not similar, verify jumper configuration and cable connections of both modules.

8. Remove RS-485 data source from first module and connect it to second module.

9. Repeat steps 3 through 7 to verify process in opposite direction.

Bench Check Hookup – Single Module

Figure 4 is the hookup diagram for bench checking a single interface module. In all cases, the self-test jumper inside each module must be installed and the normal operation jumper removed before bench checking a module. Once the bench check is complete, the self-test jumpers should be removed and the normal operation jumper reinstalled.

The objective of the bench check for a single interface module is to measure the time period of an internally generated signal. These conditions are described in the following procedure.

Bench Check Procedure – Single Module

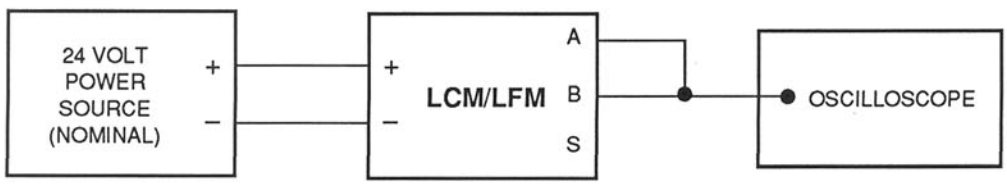
1. Remove right-side panel of module to expose PC board.

2. Move J201 to J202 (see figures 1 and 2).

3. Remove baud rate jumper from jumper set J203 (A through I).

4. Set the following wrap-arounds (shorting wires), as applicable:

   For RS-232C interface modules: at the 9-pin, D-type connector, with a shorting wire connect pin 2 to pin 3.



NOTES: 1. UNIT MUST BE JUMPERED FOR SELF-TEST.
2. CONNECT O'SCOPE PROBE BETWEEN TERMINALS A AND B.

Figure 4. *Bench Check Hookup Diagram – Single Module*

For RS-422 interface modules: at the 9-pin, D-type connector, with shorting wires connect pin 4 to pin 8 and pin 5 to pin 9.

For LFM modules: using a fiber optic cable, connect transmit (XMT) terminal to receive (RCV) terminal.

5. Connect interface module as shown in figure 4.

6. Connect oscilloscope probe, and probe ground, across terminals A and B of the interface module (RS-485 link terminals).

7. Apply power.

8. Monitor oscilloscope for square wave with a frequency of 9600 Hz. One cycle should have a time period of 0.104 milliseconds.

NOTE

Before placing a module into service, move the self-test jumper (J202) back to the normal operation position (J201), and install the appropriate baud rate jumper.

Installation

The LCM and LFM are packaged in all-aluminum, DIN-style housings that mount directly on standard DIN rails. Both the LCM and LFM require a power source of 24 Vac (nominal) or 18-30 Vdc for normal operation. Before connecting the power source and signal lines to either of these modules, the LCM or LFM should be mounted so that wiring can be properly routed and measured.

Mounting

Clips at the rear of each module are used to snap the modules onto standard DIN rails (15 mm x 32 mm). The DIN-style packaging allows for these interface modules to be mounted immediately adjacent to other DIN-style instruments for high-density installations.

The LCM and LFM housings are identical in size and shape (except for the interface connector). Figure 5 illustrates the mounting dimensions for both modules.

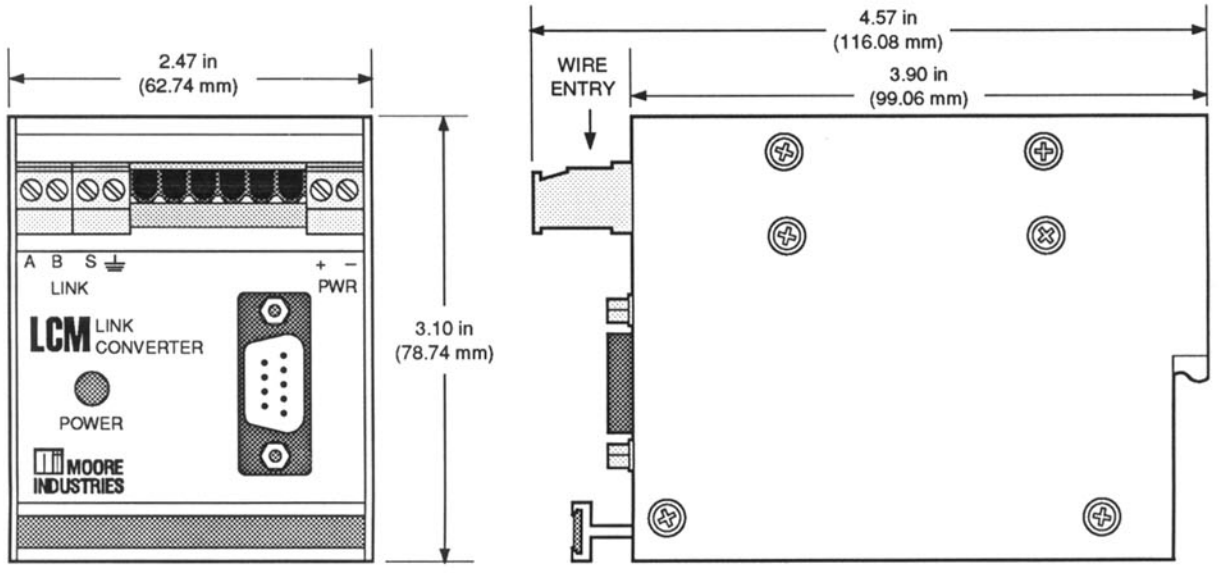


Figure 5. *LCM/LFM Mounting Dimensions*

Electrical Connections

The RS-485 and the power source connections for the LCM and LFM are made to removable terminal blocks, which plug into receptacles on the front panel of each module. Signal and power lines are secured to the terminal blocks with compression screws. The terminal blocks mate with appropriately marked terminals on the front panel. Figures 6 and 7 illustrate the terminal locations for the LCM and LFM, respectively.

The RS-485 connections are labeled A, B, and S. The A and B terminals are for connecting the half-duplex data signal. The S terminal is used only as a tie point for the cable shield. The S terminal is not connected internally. Grounding of signal-line shields must be completed elsewhere in the system.

CAUTION

When connecting terminal blocks to an LCM or LFM, ensure that the blocks are connected to properly designated terminals only.

The earth ground terminal is connected to the case of the module. This terminal may be used to connect a module to a station earth ground providing a path for undesirable transients.

Power is applied to the LCM and LFM at terminals marked + (positive) and – (negative). A power source of either 24 Vac (+10%/–20%) or 18-30 Vdc is required for normal operation. When power is applied, the red LED on the front of each module illuminates.

The LCM transmits and receives RS-232C or RS-422 data through the 9-pin, D-type (male) connector located on the front panel. Table 7 lists the connector pin assignments for both connector types. Pin designations (numbers) for these 9-pin connectors are shown in figure 6.

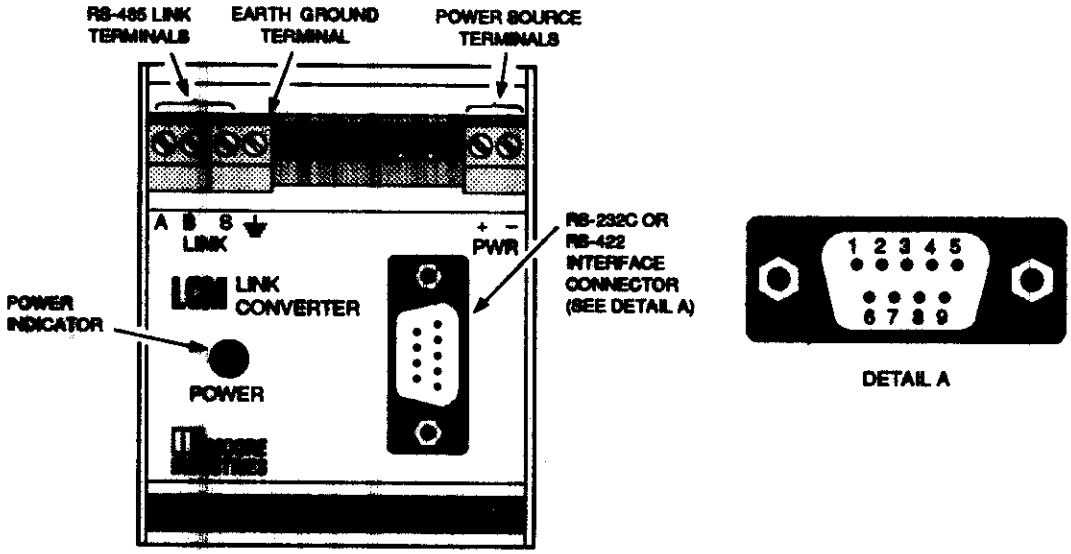


Figure 6. *LCM Terminal Locations*

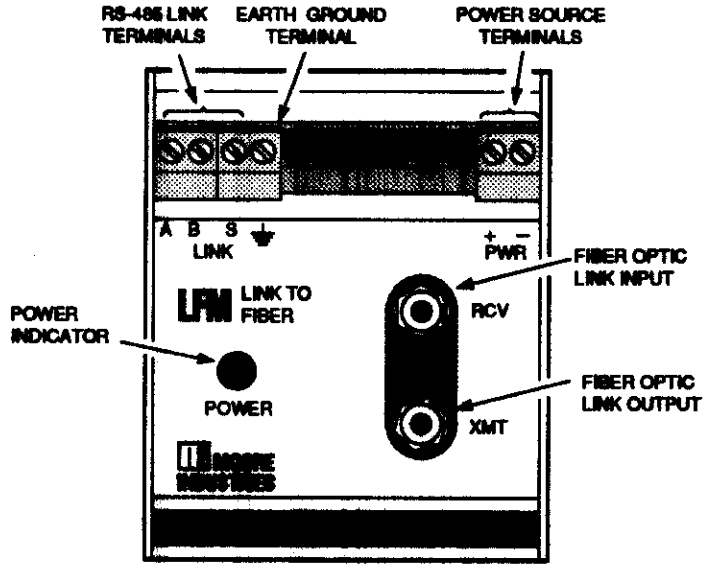


Figure 7. LFM Terminal Locations

Table 7. LCM Interface Connector Pin Designations

Interface Type	Pin Number								
	1	2	3	4	5	6	7	8	9
RS-232C		RXD	TXD	DTR*	GND		RTS*		
RS-422	GND		GND	TX+	TX–			RX+	RX–

* DTR (Data Terminal Ready) and RTS (Request to Send) signals are pulled up with 1000-ohm resistors inside the interface module.

Figures 8, 9, and 10 illustrate the LCM installed in communication systems requiring an RS-232C communication link. Figure 8 includes short-haul modems that communicate over standard telephone lines. Figure 9 includes dial-up modems that require interfacing through telephone company (TELCO) switching equipment. Figure 10 includes radio transceivers that transmit and receive data through the atmosphere.

Figure 11 illustrates two RS-485, asynchronous, byte-wide data devices with a computer that monitors data transmissions. An LCM with RS-422 interface standards is required to convert the RS-485 signal into an acceptable communication standard for the computer.

The LFM transmits and receives light signals through the SMA-LP-type connectors (e.g., AMP P/N 501055-1; Amphenol P/N 905-138-5002) located on the front panel. One connector is for transmit data (XMT) and the other for receive data (RCV). Both connectors are clearly marked on the module.

Figure 12 illustrates an LFM installed in a communication system. This illustration is a typical hookup diagram, however, other applications where conversion of RS-485, asynchronous, byte-wide data to fiber optic communication standards may also be considered.

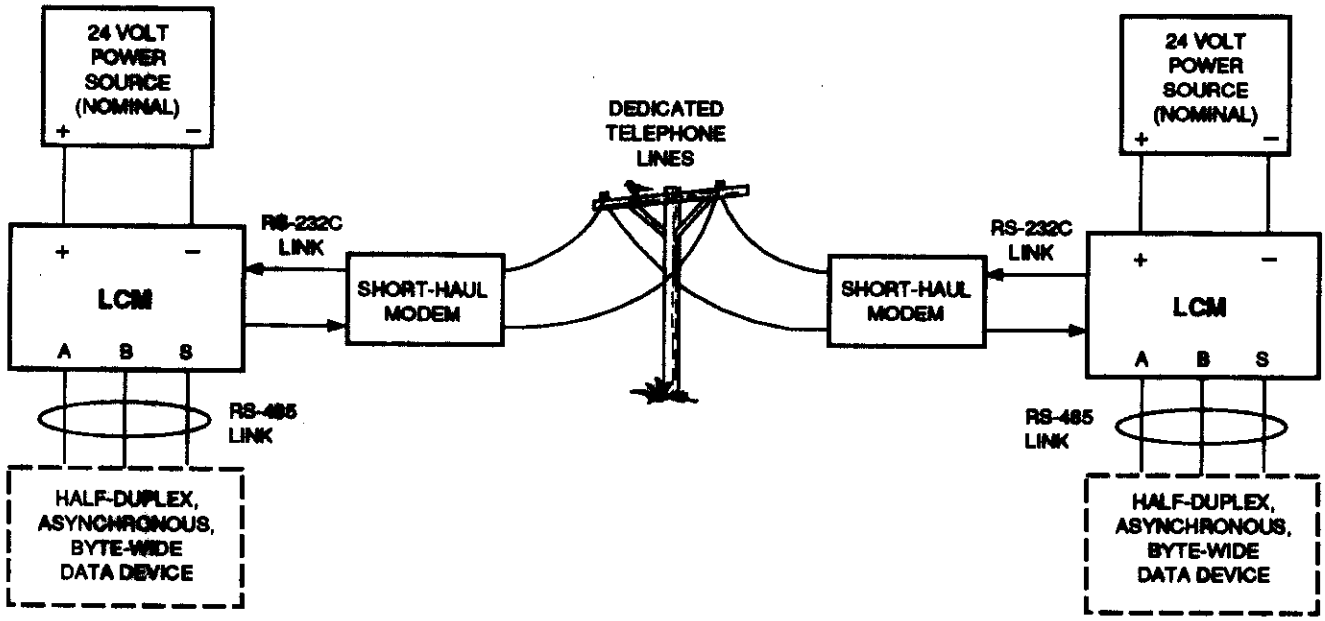


Figure 8. LCM, Typical Short-haul Modem Hookup Diagram

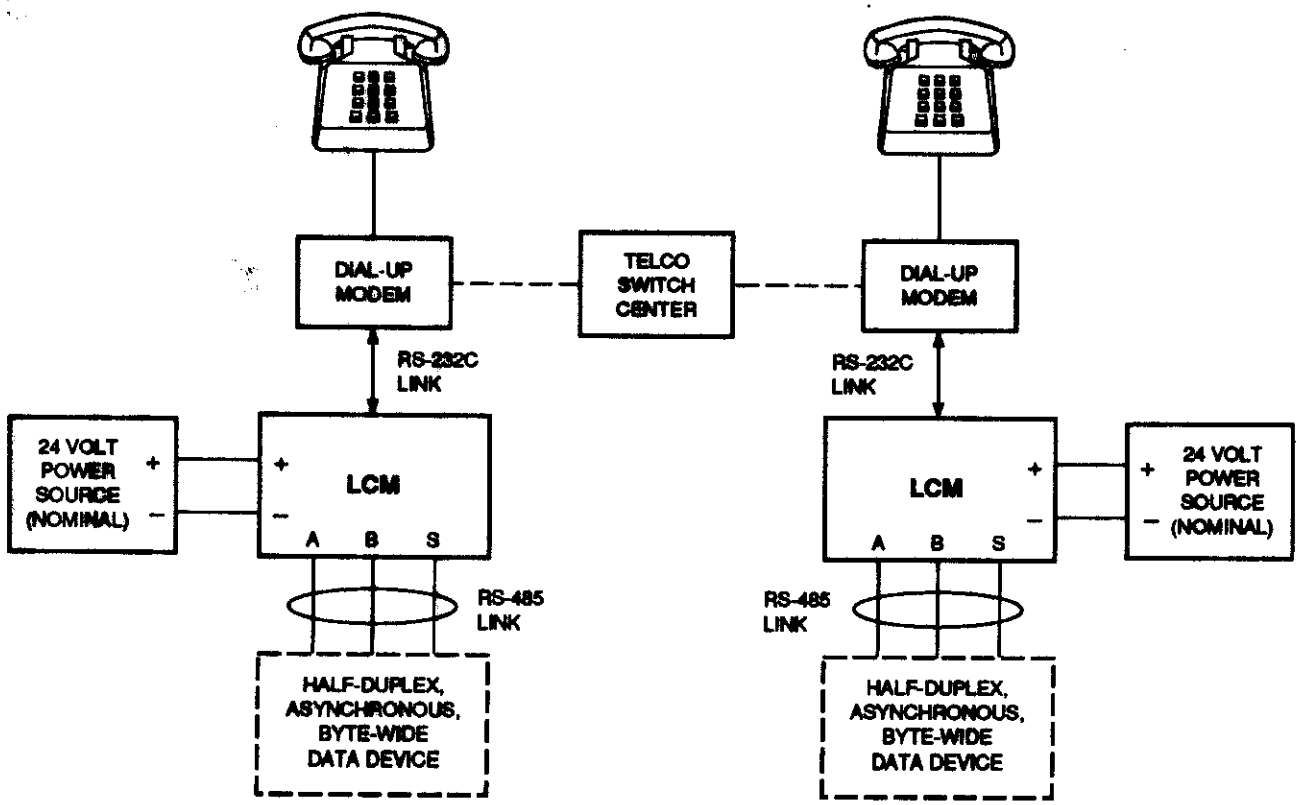


Figure 9. LCM, Typical Dial-up Modem Hookup Diagram

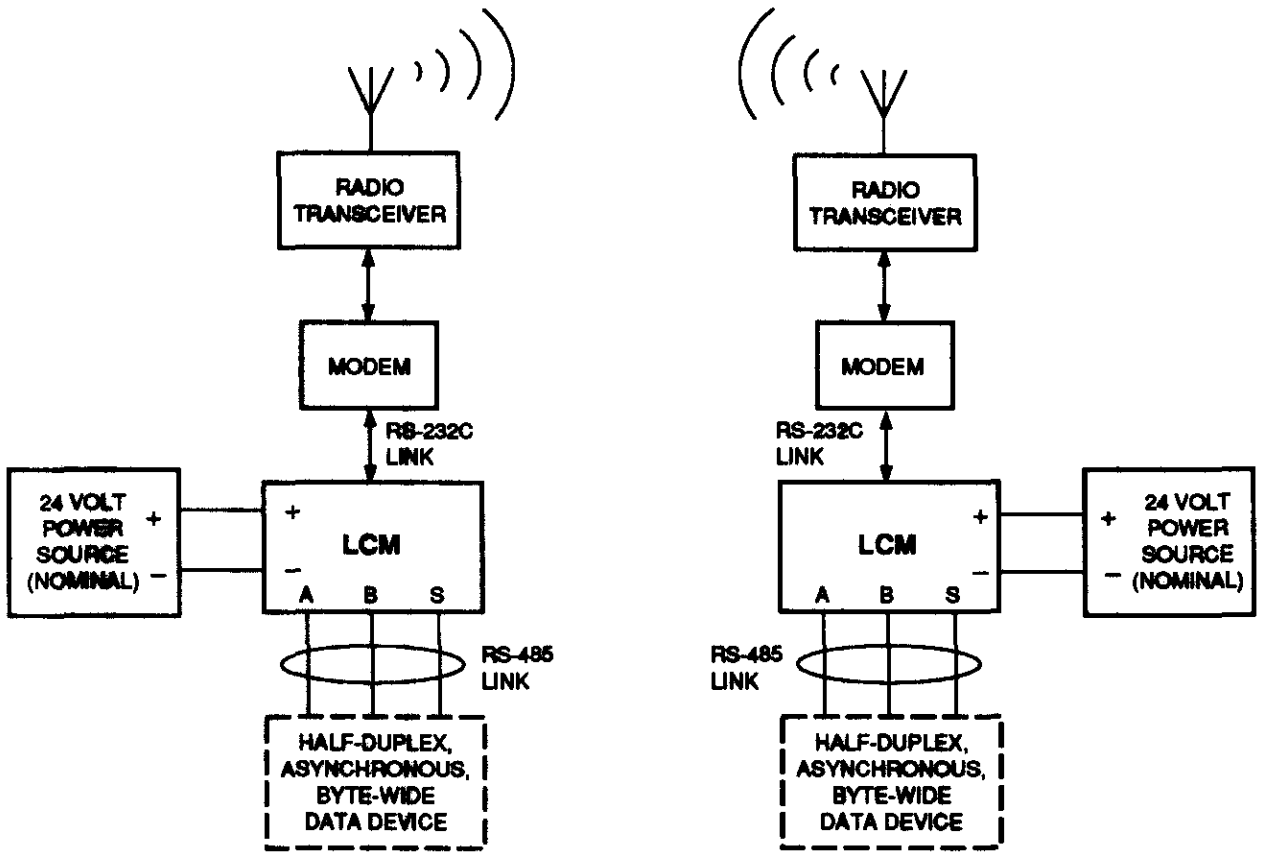


Figure 10. *LCM, Typical Radio-link Hookup Diagram*

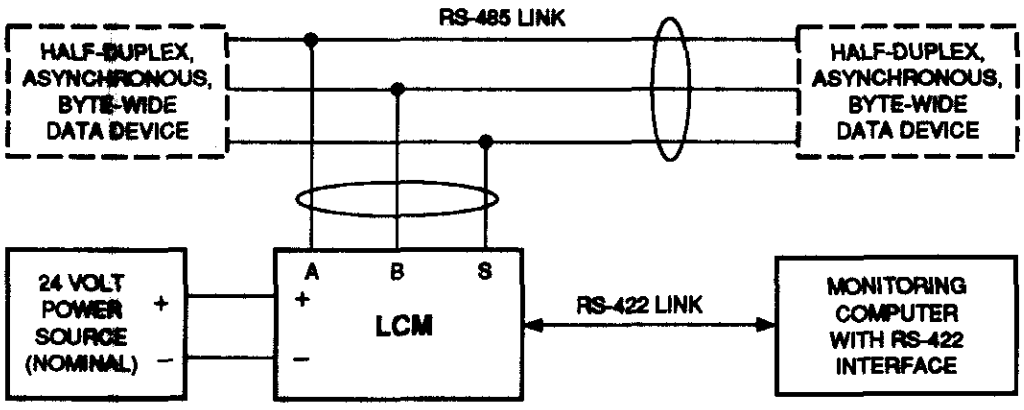
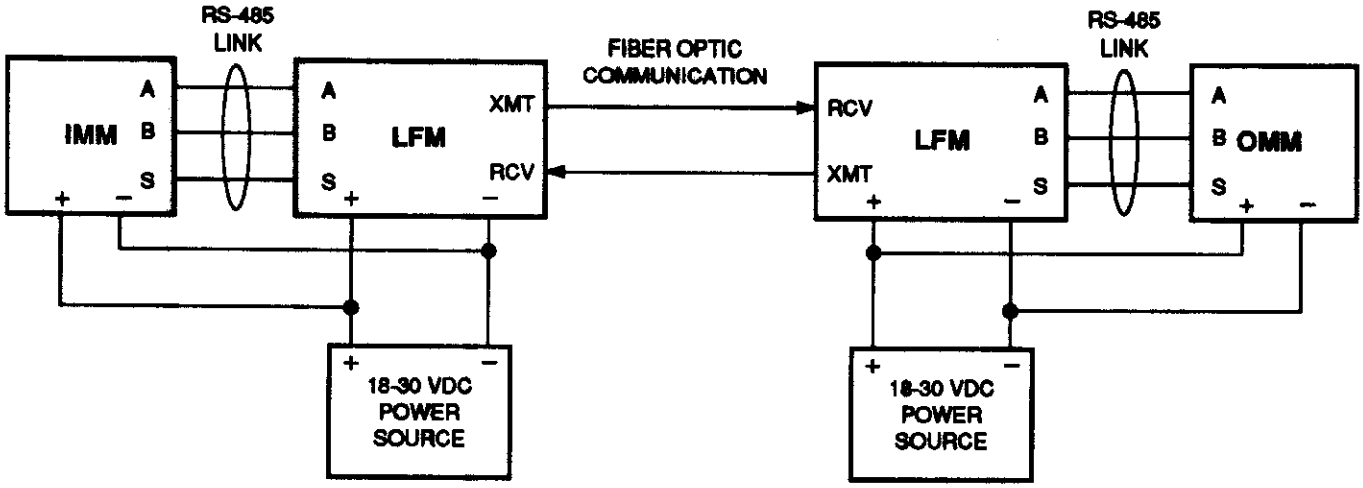


Figure 11. *LCM, RS-422 Interface Hookup Diagram*



NOTES: 1. THE IMM AND OMM REPRESENT MOORE INDUSTRIES' CABLE CONCENTRATOR SYSTEM.
2. FIBER OPTIC COMMUNICATIONS CAN BE CONDUCTED OVER CABLE LENGTHS OF UP TO 1.55 MILES (2.5 KM).

Figure 12. LFM, Typical Hookup Diagram

Theory of Operation

Presented here is a brief description of the theory of operation for the LCM and LFM. Figure 13 is a simplified block diagram upon which this theory of operation is based. The description and illustration are applicable for both interface modules.

The LCM converts an RS-485 communication link input into either an RS-232C or RS-422 communications standard. The LFM converts an RS-485 communication link input into a fiber optic communications standard. Data transmitted over the RS-485 must be asynchronous, byte-wide data to work successfully with these interface modules.

The RS-485 link is connected to the interface module at terminals A, B, and S. The S terminal is used to physically, but not functionally, terminate the cable shield. The RS-485 is a half-duplex system. Since it can not transmit and receive simultaneously, a control circuit is used to direct traffic to and from the interface module through the RS-485 driver. The module automatically controls the direction of transmissions without handshaking from the host. (The RS-485 link is transparent to the user's software.)

Upon power up and in the absence of data from the RS-232C, RS-422, or fiber optic interface, the RS-485 transceiver is enabled to allow data to pass from the RS-485 side to the RS-232C, RS-422, or fiber optic side.

When data is detected from the RS-232C, RS-422, or fiber optic side, the control circuit enables the RS-485 to allow data to go from the RS-232C, RS-422 or fiber optic side to the RS-485 side.

An oscillator circuit is used to provide the timing for the user-selectable baud rate generator and the control circuit.

The Data Terminal Ready (DTR) and Request to Send (RTS) signals of the RS-232C interface are pulled up with 1000-ohm resistors contained in the interface module.

A protection circuit, at the input of the RS-485 link, provides a path for transients to pass to the case. The earth ground terminal on the front panel is connected to the case. If the earth ground terminal is externally connected to an appropriate ground, transients are passed from the module.

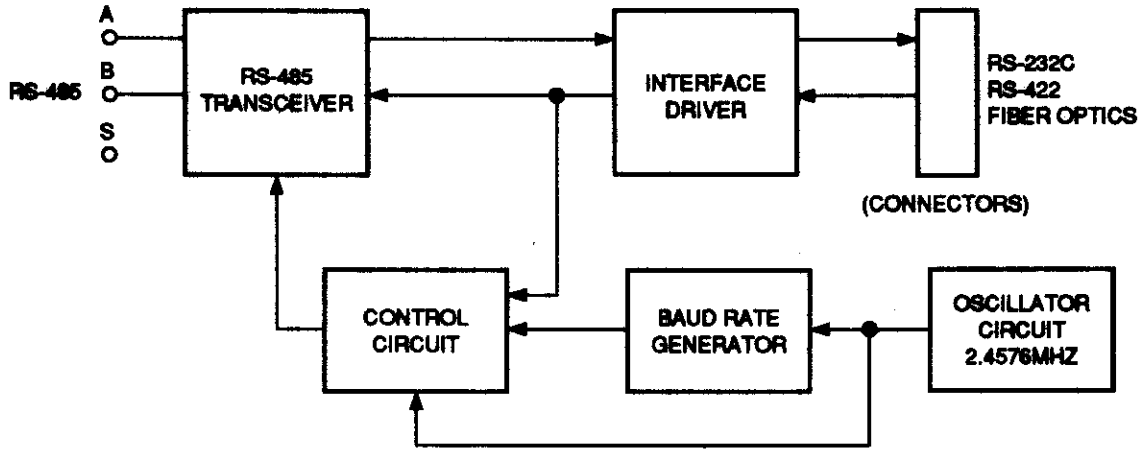


Figure 13. Simplified Block Diagram

LCM Supplement

This supplement applies to LCM/LFM Users' Manual No. 296-701-00 A, dated August 1989. The following information will be incorporated into the next revision of the LCM manual.

Item 1

On page 4, Table 3 of this manual, it should be noted that a start bit (as well as parity, data, and stop bits) should be included when determining the character length. For example, your instrument communicates with no parity bit, 8 data bits, and 1 stop bit. The *start bit is implied* in the specification and therefore the character length configuration for the LCM would be 10 bits.

Item 2

On page 6, table 4 of this manual, the recommended cables are incorrect. The interface cable required for LFM modules must have FSMA-I or FSMA-II type connectors. (i.e. AMP P/N 501029-1I)

Item 3

On page 10, paragraph 2 of this manual should read:

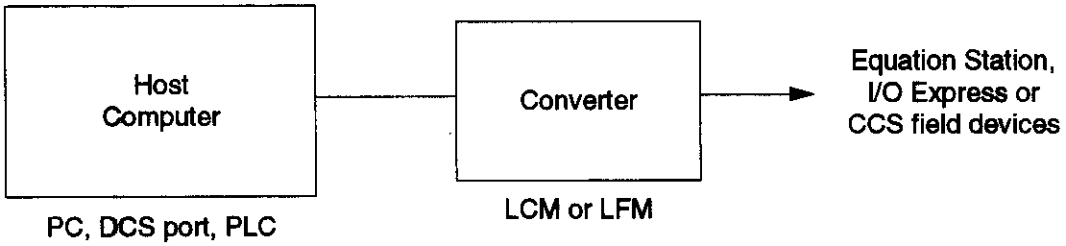
The RS-485 connections are labeled A, B, and S. A and B are for connecting the half-duplex data signal. The A terminal is for + data and the B terminal is for - data. The S terminal is used only as a tie point for the cable shield. The S terminal is not connected internally. Grounding of signal-line shields must be completed elsewhere in the system.

Item 4

The following information regarding serial communication cables should be noted when installing the LCM:

A common problem area when trying to establish serial communication between a host computer and a field device, or between peer-to-peer field devices, is the cable interconnections. Figure S-1 shows the cable requirements for typical systems.

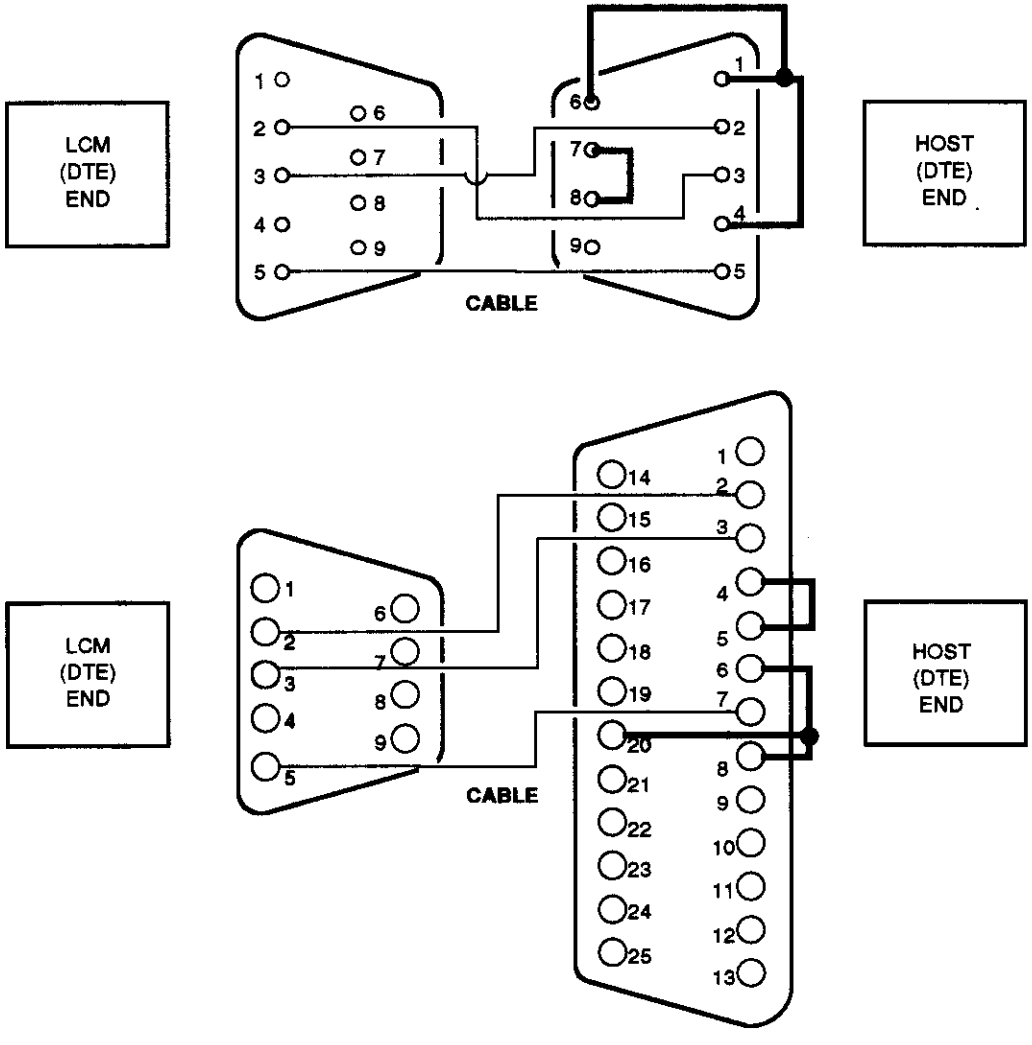
Figure S-1. *RS-232 Between Host and LCM or LFM (DTE Device)*



LCM Supplement

The LCM converts RS485 to RS232 or RS232 to RS485. It uses only 3 wires from the RS232 cable: Rx, Tx and GND. The host may require data control line connections. Figure S-2 shows the schematic of a cable that satisfies the data control requirements to allow successful communication between a host and an LCM.

Figure S-2. *Cable Schematic for an LCM and Host*



Cables that work with the LCM are available from Moore Industries as accessories:

25-pin female to 9-pin female	part number: **803-030-26**
9-pin female to 9-pin female	part number: **803-031-26**

***NOTICE:** This manual is complete as of its issue date; however, subsequent product changes may be incorporated in later editions.*

RETURN PROCEDURES

To return equipment to Moore Industries for repair, follow these four steps:

1. Call Moore Industries and request a Returned Material Authorization (RMA) number.

   Warranty Repair –
   If you are unsure if your unit is still under warranty, we can use the unit's serial number to verify the warranty status for you over the phone. Be sure to include the RMA number on all documentation.

   Non-Warranty Repair –
   If your unit is out of warranty, be prepared to give us a Purchase Order number when you call. In most cases, we will be able to quote you the repair costs at that time. The repair price you are quoted will be a "Not To Exceed" price, which means that the actual repair costs may be less than the quote. Be sure to include the RMA number on all documentation.

2. Provide us with the following documentation:
   a) A note listing the symptoms that indicate the unit needs repair
   b) Complete shipping information for return of the equipment after repair
   c) The name and phone number of the person to contact if questions arise at the factory

3. Use sufficient packing material and carefully pack the equipment in a sturdy shipping container.

4. Ship the equipment to the Moore Industries location nearest you.

The returned equipment will be inspected and tested at the factory. A Moore Industries representative will contact the person designated on your documentation if more information is needed. The repaired equipment, or its replacement, will be returned to you in accordance with the shipping instructions furnished in your documentation.

MOORE INDUSTRIES

WORLDWIDE • www.miinet.com

United States • info@miinet.com
Tel: (818) 894-7111 • FAX: (818) 891-2816

Belgium • info@mooreind.be
Tel: 03/448.10.18 • FAX: 03/440.17.97

China • sales@mooreind.sh.cn
Tel: 86-21-62491499 • FAX: 86-21-62490635

Australia • sales@mooreind.com.au
Tel: (02) 8536-7200 • FAX: (02) 9525-7296

The Netherlands • sales@mooreind.nl
Tel: (0)344-617971 • FAX: (0)344-615920

United Kingdom • sales@mooreind.com
Tel: 01293 514488 • FAX: 01293 536852