DATA-LINC GROUP

USER GUIDE

INDUSTRIAL DATA COMMUNICATIONS

MDL500/MR
MDL500/LR

Two-Wire and Four-Wire
Private Line FSK Modems
Full and Half-Duplex Operation

GE Fanuc

It is essential that all instructions contained in the User Guide are followed precisely to ensure proper operation of equipment.

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Introduction

The Data-Linc Group MDL500/MR is a two-wire private line modem. The MDL500/MR allows 9600 baud full and half-duplex RS232 data communications over a single dedicated wire pair and across sliding contacts. The MDL500/MR operates using pure Frequency Shift Key (FSK) at high carrier frequencies (100 KHz, 106.5 KHz to 150 KHz, 156.5 KHz) making the MDL500/MR particularly immune to cross-talk and outside noise interference. This provides highly reliable, continuous data transmission over distances of several miles in harsh industrial environments.

The Data-Linc MDL500/LR is a four-wire private line, long range 9600 baud full-duplex modem. In four wire LR operation, the typical range on 22 gauge communication wire is 8 to 10 miles.

Transmission

The MDL500 performs data communication by converting digital signals to modulated high frequency sine-wave carrier signals that can be transmitted much longer distances with greater noise immunity on wires than square wave digital signals. The digital Space and Mark (or 0 and 1) are converted in the transmitter to carrier signals having two slightly different frequencies which are identified by the receiver and reconverted to the digital signals. The MDL500s are either Master or Remote units and can be used for either point-to-point or multi-point communications. The MDL500s are asynchronous serial data communication devices, data rate transparent from DC to 9600 baud.

In multi-drop installations, the modems can be connected in a star or daisy-chained. The master modem can be located at any of the connection points.

RS232 Interface

The MDL500 connects to the user provided equipment via an industry standard, female DB25 connector conforming to the IEEE RS232C standard. The modem can be configured to function as either a DCE or DTE interface.

Data-Linc Group provides cables and/or pinouts for connecting the MDL500 to a wide variety of electronic devices. Contact our technical support staff for cable specifics.

MDL500 Master Units

The MDL500 Master unit transmits at 106.5/100 KHz (Space/Mark) and receives at 156.5/150 KHz. A pluggable two position terminal block at the back of the unit is used for non-polarized connection to the transmission line.

MDL500 Remote Units

The MDL500 Remote unit transmits at 156.5/150 KHz and receives at 106.5/100 KHz. It has the same data line connector as the Master unit.

Power Source

The MDL500 is powered by nominal 24 volts DC which is supplied to a black barrel jack on the rear panel. The units are delivered from the factory with 120 VAC to 24 DC wall transformers, which have a black plug attached. An external 24 VDC supply can also be used to power the MDL. The current draw is 250 mA.

Caution: Ensure the unit is disconnected from power before removing the cover.

Operating Modes

The MDL500 can be operated in either point-to-point or multi-point polling modes. In point-to-point, the modems can be operated in full-duplex.

For multi-point data communications, the MDL500 can be operated with one Master and up to eight Remote units. The connected intelligent device controls the transmitter in each Remote unit. The Master unit's transmitter remains on at all time; however, only one slave transmitter can be active at any given time. Multi-point systems must e operated in a half-duplex mode.

For four wire MDL500 operation, see the section on MDL500/MR/LR Four-Wire Special Instructions.

Installation

The MDL500 factory configuration is set for full **or** half-duplex point-to-point operation with P4 in the B-C position. The Master and Remote units are both factory configured as DCEs (Data Communications Equipment) with the jumpers on headers P1 and P2 in the B-C position. Data into the DB25 is on pin 2 and data out is on pin 3. (Also see section 5.0, entitled Jumper Settings.)

Prior to installation, it is important to ensure that the digital devices to be connected to the MDL500/MR units are capable of communicating with each other as if connected with a conventional three-wire RS232 data cable. Once this has been established, the devices can be connected to the MDL500/MR units and RS232 data communications will take place transparently.

Note: It is important the wire pair to be used for data communications between the MDL500/MR units:

a) Is connected only to those units.

b) Has no branches and no attached inductance, capacitance or resistance.

c) Has no loading coals, filters or any other load.

d) And all connections must be clean and solid.

Note: Since the data line is transformer isolated from the rest of the circuit, neither leg of the data carrying twisted pair should be grounded.

Field Configuration Procedure

The field configuration procedure is as follows:

1. Remove the unit's cover by removing the four screws on top of the modem.

2. Set the Remote units for either full or half-duplex operation by positioning the jumper on header P4, located behind the DB25 connector. For full-duplex operation, the jumper should be in the B-C position; for half-duplex, multi-point operation using RTS line carrier control, the jumper should be in the A-B position.

3. Confirm that the jumpers on locations P1 and P2 are in the B-C position.

4. Replace the cover.

5. Connect the RS232 communications port of the Data Terminal Equipment (DTE) (PC, PLC, etc.) to the MDL500 unit with an appropriate cable.

6. Connect the transmission line to the unit at the pluggable terminal block. There is no polarity requirement.

Connect the unit's power cord to the barrel jack in the rear panel of the modem and plug the modular transformer into a convenient 120VAC outlet. Plugging the power in will power up the units; there is no "On/Off" switch.

Operation

Point-to-point, full or half-duplex operation is usually conducted with the both the Master and Remote MDL carriers on all the time. This is achieved by placing the P4 jumper in the B-C position, which causes the MDL to ignore the RTS line.

In half-duplex, multi-drop, operating mode, with the P4 jumper in the A-B position, the RTS line of the intelligent device that a Remote MDL is connected to (PC, PLC or RTU) is used to control the MDL's transmitted carrier. When logic low, the carrier is turned off; when logic high, the carrier is turned on. If the RS232 cable is disconnected, the RTS connection on the MDL is biased low and the carrier remains off. (If the P4 jumper is in the B-C position, the RTS connection is biased high and the carrier will stay on.)

When properly configured, the MDL500 is capable of half or full-duplex data transmission at rates up to 9600 baud. MDL's require no settings for data rate and will operate transparently as data is fed to them. They will begin communicating data as soon as connections are made and they are powered up.

Jumper Settings

There are several configuration options that can be selected by jumpers as described below. The jumper pins are internal and are identified by lettering on the circuit board. Jumper pins are accessed by removing the four retaining screws on the top cover of the enclosure and removing the cover.

> **Note:** The header position locations are described with the MDL board oriented with the LED's to the left and the connectors to the right.

DCE and DTE Settings

Both the MDL500 Master and Remote units are configured at the factory as DCE (Data Communication Equipment) for connection to DTE (Data Terminal Equipment). A PC, PLC or Multiplexer is usually configured as DTE. If either the Master or Remote DTE/DCE must be changed, this is accomplished by moving the jumpers on blocks "P1" and "P2" which are located directly behind the DB25 RS232 connector on the rear panel. For example, as delivered, the Master unit P1 and P2 jumpers are both set in the B-C position (DCE setting). To change to a DTE, move both jumpers to the A-B position. In DTE, data into the DB25 will be on pin 3 and data out on pin 2.

Transmitter Output Level

The MDL500 allows the selection of either Normal or High Power (HP) transmitter output. The High Power output has six times greater peak-to-peak transmitted signal and provides correspondingly greater signal to noise ratio. High Power transmitter operation is generally preferred in applications involving sliding contacts or in very noisy EMI environments. However, caution is advised in some cases since High Power carrier signals will result in more cross-talk to adjacent conductors.

The jumper to select Normal or High Power is located at position TP2. High Power is selected when the jumper is positioned center to left; Normal output is selected with center to right. When using the HP setting, the receiver gain should be set to low. (See Receiver Gain below.) The factory setting is Normal, center to right. This header is positioned slightly below the TOKO Coil marked "T5."

Receiver Gain

The MDL500 incorporates a receiver amplifier on the circuit board. This amplifier has low, normal and high gain settings configured by a "T" shaped pin block near the center of the circuit board with pins marked "G1," "G2" and "G3" (the leg of the "T"). G1/G2 is the high gain setting; G2, the normal medium gain; and G3/G2, the low gain. The units are delivered from the factory set at normal gain because the transmitter has been factory set at normal output. The low gain setting should be used on the receiver whenever the high power transmitter option is selected on the transmitter to avoid onboard cross-talk.

Carrier Detect

The Carrier Detect signal to the RS232 connector is enabled or disabled by Jumper Matrix P3. The MDL units are shipped with the Carrier Detect enabled (jumper on).

Chassis Ground

Chassis ground can be connected to signal ground via Jumper P5. This is generally not recommended. A separate chassis ground wire may be connected to the MDL's metal enclosure by means of any of the cover mounting screws as desired to avoid a possible shock hazard.

Half-Duplex Operation/Carrier Control

The MDL500 can be operated in multi-drop/half-duplex mode by controlling the transmitter's carrier on/off using external signals. The most common external carrier control signal is through the RS232 port RTS line (pin 4). Jumper P4, A-B, selects this line. When an external RTS logic high is asserted, the MDL carrier is turned on, and a logic low or ground, turns the carrier off. The MDL RTS line is biased low so that if the RS232 cable is disconnected or the external controlling device is turned off, the carrier will go off. Selecting jumper P4, B-C, turns the transmitter on and blocks RTS carrier control. The B-C setting is used in full-duplex operation. Usually only the Remote units have their carriers controlled by the devices they are connected to (setting A-B). The Master unit's carrier is left on all the time (setting B-C). (There is no interference since the Master and Remote carrier frequencies are different.) The factory setting for both MDL Masters and Remotes is P4, B-C, for full or half-duplex, point-to-point operation.

MDL500/MR/LR Four-Wire Special Instructions

The standard instruction “MDL500 Industrial Modem Half and Full-Duplex Versions” are applicable with the following modifications:

MDL500/MR/LR Four-Wire Long Range Transmitter & Receiver Jumpers

The transmitter output is set to high by placing the jumper located on the three pin mail header marked “TP2” in the left and center position (left side on the marking TP2). The receiver gain is set on medium by placing the jumper on the four pin male header (inverted T-shape) located above T5 and C35 on the bottom center (marked G2) and pin between R53 and R55.

> **Note:** The header position locations described are with the MDL board oriented with the LED’s to the left, the connectors to the right.

MDL500/MR/LR Four-Wire Long Range Carrier Signal Connectors

The four-wire MDL has a second I/O isolation coil and a second two-position pluggable terminal block for the transmitted carrier. Facing the connectors, the pluggable terminal block on the left is the transmitted carrier and the pluggable terminal block on the right is the received carrier.

For proper operation, both modems must be set to the same four-wire configuration.

Front Panel LEDs

There are four LED’s on the front panel of the MDL. From left to right:

Marking	Function
CD	Carrier Detect
RX	Data flowing out of the MDL500 RS-232 port
TX	Data flowing into the MDL500 RS-232 port
PWR	Power Connected

The first diagnostic LED is Carrier Detect. In full-duplex mode, the CD LED must be lighted on both units. In half-duplex operation with the Master carrier on and the carrier control mode with RS232 cables connected, the CD LED will be lighted on all Remote MDL500/MR’s and OFF on the Master MDL500/MR. (The Master CD LED will blink during operation as each Remote MDL500/MR turns on its carrier to answer back to the Master). If the correct CD LED’s are not ON, a carrier cable problem is likely.

Assuming that the CD indication is correct, a Loop Back test is recommended as described on the next page.

General Operating Notes

The MDL500/MR utilizes tuned circuits to achieve high performance. These circuits have been carefully adjusted at the factory to operate over several miles of transmission line. In order not to degrade performance, it is important not to disturb these adjustments. In particular, coils T1, T2, T3, T4 and T5 and potentiometers R18, R20, R31 and R57 should not be adjusted. If these adjustments have been inadvertently changed, please contact the factory.

Non-Loaded Transmission Line

Proper operation of MDL500/MR requires that the transmission line be non-loaded (free from inductors and capacitors on the line). The presence of inductors, capacitors or excessive resistance (i.e., bad connections) or shorts between the wires can seriously degrade performance or render the data transmission inoperable.

Loop Back Test

A Loop Back test is suggested to confirm the proper operation of MDL500/MR's in point-to-point operation, as follows:

A PC running a communication program in full-duplex can be connected to one of the MDL500/MR'S in a point-to-point configuration. A jumper wire (a bent paper clip works very well) is placed between pin sockets 2 and 3 of the DB25 on the other MDL500/MR. Data sent to the first MDL500/MR will be looped back from the second and appear on the PC screen. If the characters are correct, the MDL500/MR's are functioning.

AE485 Interface

The MDL500 is also available with an RS485 interface for connection to multiple Remote devices. All operating functions and instructions are the same as for the RS232 full-duplex version, except that the digital interface through the DB25 connector uses pin 12 as the -DO/RI connection and pin 13 as the +DO/RI connection. The RS232 connections (pins 2, 3 and 7) are not functional.

> **Note:** Do not connect anything except an RS485 signal to positions 12 and 13 on the DB25 or damage to the circuit could occur.

The Data-Linc Group AE485 (Auto Enable) circuit contains a special feature that eliminates the need for a separate enable signal or line to command the 485 transmit and receive functions. Data will pass through the MDL500 RS485 port transparently in either direction. The MDL500s are operated in full-duplex point-to-point mode (no carrier control) when using the AE-485 interface. Up to 32 Remote RS485 devices can be multi-dropped off the MDL500 AE485 port at distances of up to 4000 feet and at data rates of 9600 baud. A 100 ohm termination resistor should be connected at the ends of the 485 line.

Technical Specifications

Data Format	RS-232C (RS-422/485 optional)
Operation	2 wire, full duplex or half duplex controlled carrier, asynchronous data
Mode	Point to Point or multi-drop option
Data Transmission Speed	Up to 9600 baud
Modulation	Frequency shift key (FSK); carrier signal inductively and capacitively isolated
Distance	Up to 48,000 feet on single twisted pair
Operating Temperature	32^0 - 140^0 F (0^0 - 60^0 C)
Power Requirements	24 VDC
Interface	DTE/DCE jumper selectable; Female DB25 connector for RS-232C; two position pluggable terminal block for carrier; 2.5mm x 5.5mm barrel jack (center positive) for 24 VDC power.
LED Indicators	Carrier Detect, Receive Data, Trasmit Data, Power
Dimensions	1.75" H x 7.5" W x 10.5" L (4.45cm H x 19.05cm W x 26.67cm L); all metal enclosure, 16 gauge steel; polyurethance paint.

Technical Support

Data-Linc Group maintains a fully trained staff of service personnel who are capable of providing complete product assistance. They can provide you with technical, application and troubleshooting, spare parts and warranty assistance. Our technical staff is based in Bellevue, Washington USA and may be reached at (425) 882-2206 or e-mail support@data-linc.com

Product Warranty

Data-Linc Group warrants equipment of its own manufacture to be free from defects in material and workmanship for one year from date of shipment to original user. Data-Linc Group will replace or repair, at our option, any part found to be defective. Buyer must return any part claimed defective to Data-Linc Group, transportation prepaid.

Return Material Authorization

If a part needs to be sent to the factory for repair, contact Data-Linc Group's corporate office and request a Return Material Authorization (RMA) number. The RMA number identifies the part and the owner and must be included with the part when shipped to the factory.

Contact Information

Corporate Office

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3535 Factoria Blvd. SE
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Bellevue, Washington 98006 USA

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E-mail: info@data-linc.com
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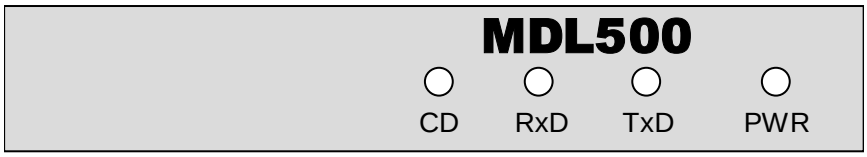
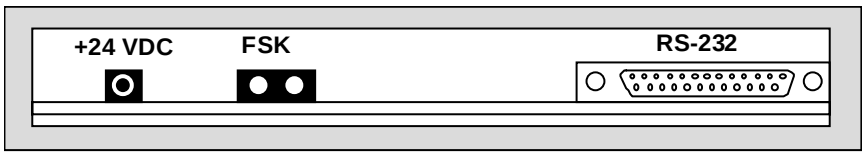
Appendix A
Diagrams

Diagram 1
Drawing of the two-wire MDL500/MR enclosure depicting the location of connectors and LEDs.



MDL500 front



MDL500 rear

Diagram 2
Schematic of the RS232 port with pin functions and pinout.

RS232 Pin Assignment	Description	Signal Direction
1	Protective Ground	Computer ↔ modem
2	Receive Data	Computer → modem
3	Transmit Data	Computer ← modem
4	Request to Send	Computer → modem
5	Clear to Send	Not connected
6	Data Set Ready	Not connected
7	Signal Ground	Computer ↔ modem
8	Carrier Detect	Computer ← modem
20	Data Terminal Ready	Not connected

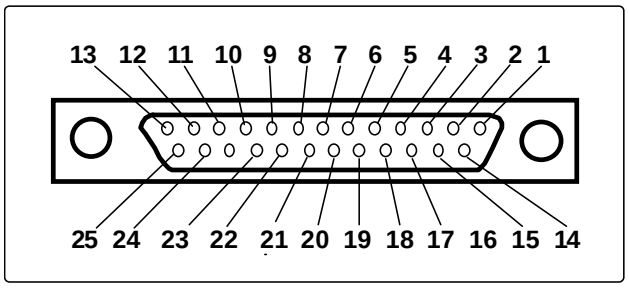
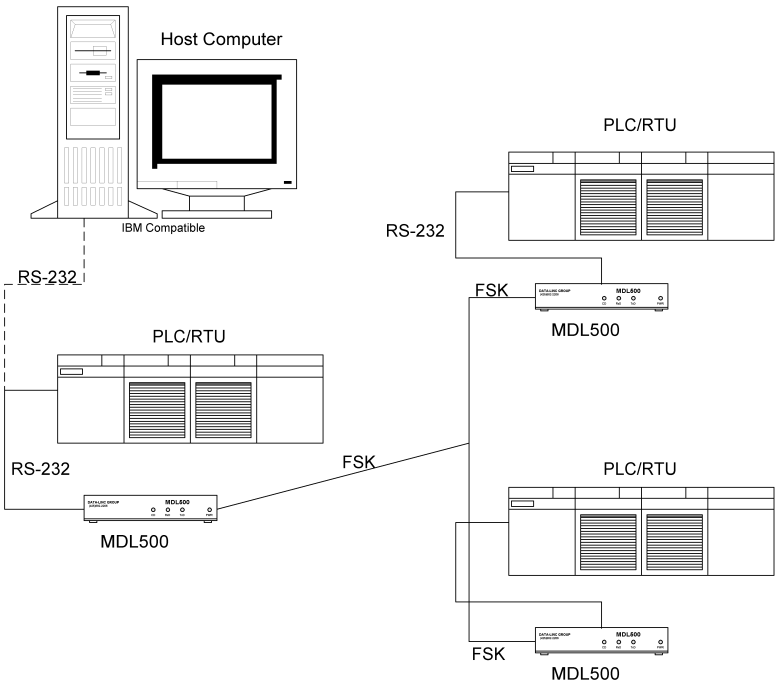


Diagram 3
Illustration of a typical full-duplex and half-duplex, multi-drop application connections.



Diagran. →
MDL500/MR two-wire board layout illustrating Jumper settings and test points. (Not to scale.)