BLACK BOX®
NETWORK SERVICES

▐▌▐▌▐▌▐▌▐▌▐▌▐▌▐▌▐▌▐▌▐▌▐▌▐▌▐

SEPTEMBER 1999

ME837A-R2	**ME837AE**
ME837C-R2	**ME838A-R2**
ME838AE	**ME838C-R2**
BC00702	**FA520A-R2**

LD485A-HS
LD485A-HS Card
LD485A-HS Opto-Isolated
LD485A-HS Isolated Card
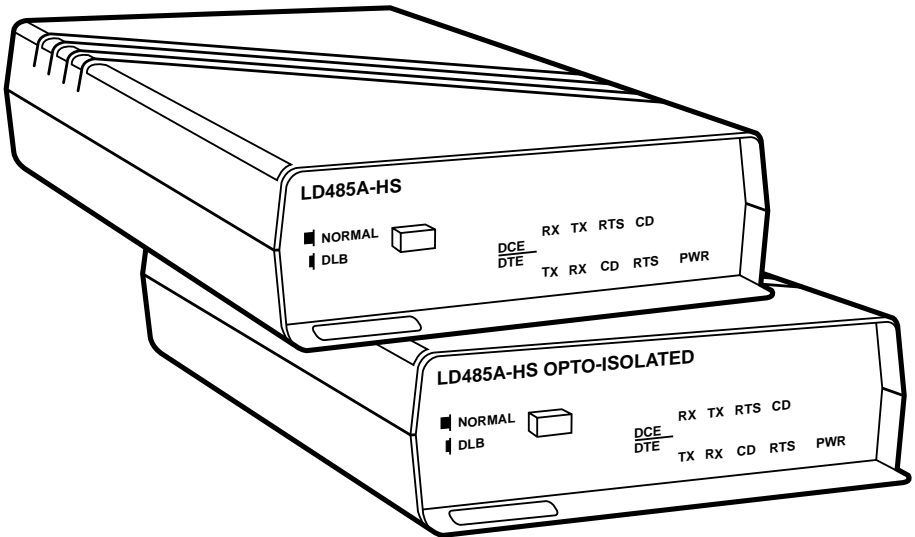
FEDERAL COMMUNICATIONS COMMISSION
AND
INDUSTRY CANADA
RADIO FREQUENCY INTERFERENCE STATEMENTS

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 J of Part 15 of FCC rules, which are designed to provide reasonable protection against such interference when the equipment is operated in a commercial environment. Operation of this equipment in a residential area is likely to cause interference, in which case the user at his own expense will be required to take whatever measures may be necessary to correct the interference.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

This digital apparatus does not exceed the Class A limits for radio noise emission from digital apparatus set out in the Radio Interference Regulation of Industry Canada.

Le présent appareil numérique n'émet pas de bruits radioélectriques dépassant les limites applicables aux appareils numériques de la classe A prescrites dans le Règlement sur le brouillage radioélectrique publié par Industrie Canada.

Contents

1. Specifications

Optical Isolation: ME838A-R2, ME838AE, ME838C-R2 only

Interface — (1) asynchronous RS-232 port (DTE/DCE selectable);
(1) asynchronous RS-485 port with improved surge protection and
switch-selectable line termination or line bias

Connectors — (1) DB25, female—RS-232 port;
(1) four-wire terminal block (TB1)—RS-485 port

Pins Supported — RS-232 port: TD, RD, RTS, CTS, CD, DTR, DSR, SG,
and FG; RS-485 port: TXA, TXB, RXA, RXB

Data Rate — 0 to 115 Kbps, transparent to data

Indicators — (5) LEDs: TX, RX, RTS, CD, and PWR

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

    Storage — -4 to 158° F (-20 to 70° C)

Humidity — 0 to 95% relative humidity, noncondensing

MTBF — Approximately 180,000 hours (ground benign environment)

Power — PS154 (for use with ME837A-R2, ME838A-R2): Input—120V, 60 Hz,
20W; Output—AC 17VCT, 0.7A; PS154E (for use with ME837AE, ME838AE):
Input—230V, 50 Hz, 20W; Output—AC 17VCT, 750 mA

Size — Standalone Unit: 1.8"H x 5.5"W x 8.5"D (4.6 x 14 x 21.6 cm)
Rackmount Card: 7.4"L x 4.7"W (18.8 x 11.9 cm); 0.6 inches thick (1.6 cm)

Weight — Standalone Unit: 1 lb. (0.5 kg);
Power supply only: PS154—0.4 lb. (0.2 kg), PS154E—1.1 lb. (0.5 kg)

Operation —   Point to Point or Multipoint
Half or Full Duplex
Transparent to data
Selectable RTS-to-CTS delay with option to
inhibit CTS if CD is present (DCE)
DTE or DCE configurable RS-232 port
Normal or loopback operation

Timeout Delay — 0.15, 0.7, 2, 7, or 70 msec (for the RS-485 driver enabled by data feature)

Typical Speed Versus Distance — (4-wire point-to-point 26-AWG twisted pair)

SPEED	DISTANCE
1200 bps	4 miles (6.4 km)
2400 bps	3 miles (4.8 km)
4800 bps	2.3 miles (3.7 km)
9600 bps	1.7 miles (2.7 km)
19,200 bps	1.2 miles (1.9 km)
38,400 bps	0.9 mile (1.4 km)
64,000 bps	0.75 mile (1.2 km)
115 Kbps	0.4 mile (0.6 km)
NOTE: Speed and distances will depend on actual operating conditions.	

2. Introduction

The LD485A-HS is an RS-232-to-RS-485 interface converter that operates in the same manner as a modem. It allows an RS-232 device to transmit data over much longer distances than is normally possible (up to 4 miles—6.4 km—at 1200 bps). The advantage of the LD485A-HS over other line drivers and modems is that it can also operate in multipoint applications. Depending on the operating environment, as many as 64 devices can be linked together using twisted-pair cable.

The opto-isolating models (ME838A-R2, ME838AE, ME838C-R2) protect one segment of your extended network from problems that arise on the other. Inside the RS-232↔485/422 Opto-Isolator/Converter, optical isolation circuitry converts electrical signals to light and back again, to keep signal noise and ground loops from crossing between segments of your RS-485 installation. That means the electrical noise from your factory floor won't affect your office communications, and the difference in ground potential between buildings won't damage your sensitive equipment.

Additional features include a manual loopback test to check the system wiring for both the RS-232 and RS-485 interfaces, and transient protection on the RS-485 interface to help prevent damage due to voltage transients on the data line.

Although designed specifically to connect to other LD485A-HS line drivers, the RS-485 port may be connected to any device with an RS-422 or RS-485 interface. For example, this would be useful in an industrial application where RS-485 and RS-422 devices would be connected to the same LD485A-HS.

The LD485A-HS is available in standalone and rackmount versions. The rackmount cards (part numbers ME837C-R2 and ME838C-R2) are designed to be installed in the multi-function rack (part number RM005).

A 6-ft. DB25 male/DB25 female extension cable and a serial AT adapter (DB9 female/DB25 male) are included with the ME837A-R2, ME837C-R2, ME838A-R2, and ME838C-R2.

3. Installation

This section describes the jumper and switch functions for configuring the LD485A-HS. See Figure 1 (page 6) for the component locations.

To install your LD485A-HS:

1. Set each of the ten jumpers/switches for your application.

2. Connect the LD485A-HS devices together as shown in Figures 5 through 8 (pages 19–22).

3. Apply power. (PS154 or PS154E, depending on which LD485A-HS you have. See **Chapter 1** for more information.)

3.1 Jumper and Switch Configuration

NOTE

As you read this section, refer to Tables 1 and 2. Table 1 (page 11) lists DCE jumper settings, and Table 2 (page 16) lists DTE jumper settings.

3.1.1 DTE/DCE CONFIGURATION

A DIP shunt is used to select DTE or DCE configuration. For the LD485A-HS to appear as a DTE device, put the DIP shunt jumper in socket XW1B. For the LD485A-HS to appear as a DCE device, put the DIP shunt jumper in socket XW1A.

3.1.2 FRAME GROUND/SIGNAL GROUND

Jumper W7 ties signal ground to frame ground. The position is left open at the factory. If signal ground is to be connected to frame ground, solder a 100-ohm, 1/2-watt resistor in location W7. A wire jumper may also be used. Care must be taken to ensure that ground circulating currents are limited to acceptable levels.

3.1.3 HALF/FULL-DUPLEX OPERATION

Jumper W8 selects half-duplex or full-duplex operation. Set W8 to the HALF position for half-duplex operation. Set W8 to the FULL position for full-duplex operation.

NOTE

When the jumper W9 is in the ON position and jumper W15 is in the A-B position, the RS-485 driver is always turned on to enable transmission of data. Therefore, half-duplex transmission cannot be performed. See Section 3.1.5 for an explanation of the RS-485 driver.
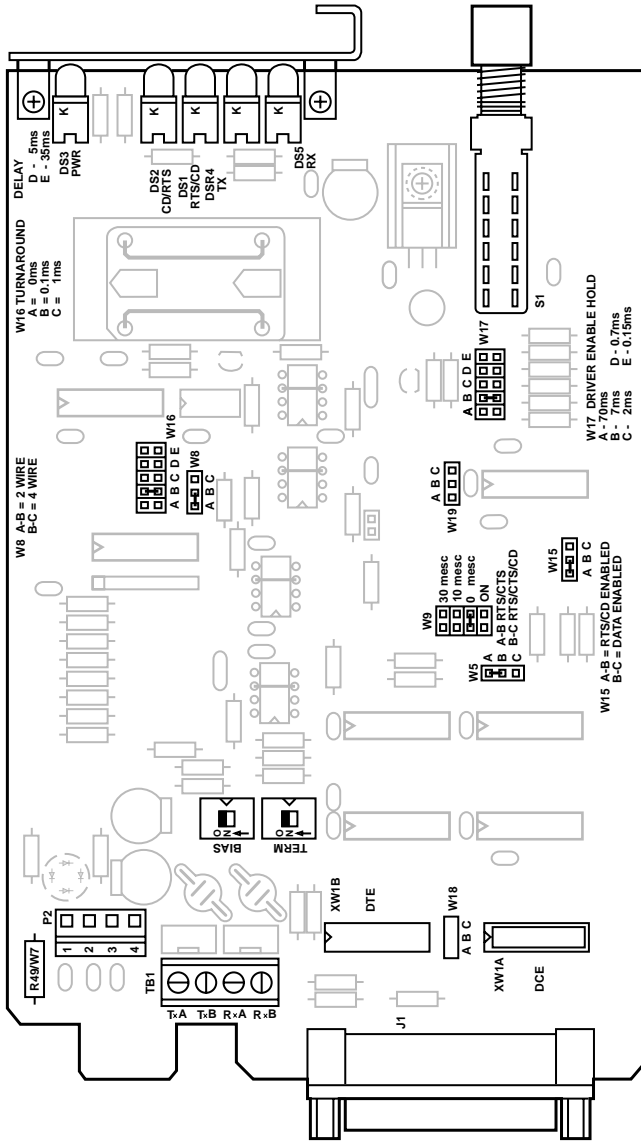
Figure 1. Layout of the Printed Circuit Board.

3.1.4 CTS DELAY

When the transmitter of a device is first turned on, an unstable carrier signal is transmitted for several milliseconds. If data was sent during this period, it would be received as distorted information. Setting a CTS delay on the LD485A-HS allows the communications link to settle down before data can be sent.

LD485A-HS as DCE

When the LD485A-HS is configured as a DCE device (DIP shunt in position XW1A), jumper W9 controls the amount of delay from the time RTS (jumper W5 in the A-B position) is received true until CTS is asserted true. If W5 is in the B-C position, CTS will be inhibited if an RS-485 carrier is present when RTS is raised. To select a CTS delay period, set jumper W9 to the 0-, 10-, or 30-msec position. Regardless of the delay setting selected, when RTS goes false, CTS will immediately go false. If jumper W9 is in the "ON" position, CTS will follow RTS.

LD485A-HS as DTE

When the LD485A-HS is configured as a DTE device (DIP shunt in position XW1B), CTS is not supported.

3.1.5 RS-485 DRIVER ENABLE

The LD485A-HS's RS-485 driver can be set to be enabled one of three ways: by RS-232 control signals, by data, or constantly on.

Driver Enabled by RS-232 Control Leads

If your equipment raises CD or RTS, you can set the RS-485 driver to be enabled by one of these leads. If your equipment does not have the capability to raise CD or RTS, you will need to set the RS-485 driver to be enabled by data or constantly enabled.

In order for an RS-232 control lead to enable the RS-485 driver, W15 must be in position A-B and W9 must be set for 0, 10, or 30 ms.

- When the RS-232 port is selected as DTE (DIP shunt in the XW1B position), the RS-485 driver will be enabled when CD (pin 8 of the RS-232 connector) goes true.

- When the RS-232 port is selected as DCE (DIP shunt in the XW1A position), RTS enables the driver.

Driver Enabled by Data

The RS-485 driver can also be enabled without requiring an RS-232 control lead to be asserted. When jumper W15 is placed in the B-C position, the driver is enabled when data is received on the RS-232 port of the LD485A-HS. As soon as the first bit of the first character is received at the RS-232 port, the RS-485 driver is enabled and an internal timer is started. The time begins its "time out" on a low (0) to high (1) transition of data. When the timer times out, the RS-485 driver is disabled. Jumper W17 allows this timeout delay to be set for 0.15, 0.7, 2, 7, or 70 msec.

NOTE

There is a limitation to using this "DATA ENABLES DRIVER" feature. At data rates above 64 Kbps, the first character in the data stream will be garbled by the LD485A-HS. If higher data rates are required, transmit a <break> if possible, or a <nul> character before each message. This will enable the RS-485 driver, activate the timer, and allow the message to be transmitted without errors. The receiving device will need to ignore the first character received.

Driver Constantly Enabled (4 Wire Only)

The RS-485 driver can be constantly enabled by setting jumper W9 to the ON position.

3.1.6 HALF-DUPLEX TURNAROUND DELAY

When operating in half-duplex mode (jumper W8 in the HALF position), the LD485A-HS adds a small delay each time it stops transmitting data and prepares to receive data. This delay allows the RS-485 interface and transmission line time to stabilize, thus reducing the possibility of garbled data being received at the end of a message.

The turnaround delays are 0 (W16 in position A), 0.1 msec (W16 in position B), 1 msec (W16 in position C), 5 msec (W16 in position D), and 35 msec (W16 in position E).

3.1.7 RS-485 INTERFACE TERMINATED OR UNTERMINATED

Some distortion on the twisted-pair line may be caused by impedance mismatch from the different devices connected to the line. To help eliminate this type of distortion, the RS-485 interface can be terminated with a resistor network at the receiver input pins (RXA and RXB) via switch S2. When S2 is placed in the "TERM" position, the resistor network is connected across the line. When S2 is placed in the "UNTERM" position, no connection to the

resistor network is made and the line is not terminated.

Point-to-Point

When only two devices are connected to the line in a point-to-point application, each device should have the termination network connected to the line. Set switch S2 to the "TERM" position.

Multipoint

For multipoint applications, switch S2 should be in the "UNTERM" position on all the LD485A-HS devices in the network except for the two units at the extreme opposite locations on the line. The extreme opposite devices are the two devices that have the greatest cable length between them, which may not necessarily be the devices that are physically located the farthest apart. These two units should be set in the "TERM" position (see Figures 5 and 6). If any of the other LD485A-HSs were configured as "terminated," the amount of distortion could increase—possibly causing errors in the data being transmitted.

3.1.8 NORMAL/LOOPBACK OPERATION

The Normal/Loopback switch (S1) is a two-position pushbutton switch extending through the front panel. The Normal position permits normal operation of the LD485A-HS. The Loopback position allows data coming into the LD485A-HS to be sent back out the same port. This is for testing the connection between the LD485A-HS and the device attached to each port.

Normal

When this switch is in the normal mode, data is passed through the LD485A-HS from the RS-232 port to the RS-485 port and vice versa.

Loopback

When set to the loopback mode, any data received at the RS-485 port will be transmitted back out the RS-485 port and any data received at the RS-232 port will be transmitted back out the RS-232 port.

3.1.9 RS-485 INTERFACE LINE BIASED (FAIL-SAFE)

If S3 is in the Off position, there is no line bias. If S3 is in the On position, there is line bias.

3.2 DCE/DTE Configuration

This section contains block diagrams (**Figures 2** and **4**) and jumper and switch settings (**Tables 1** and **2**) for DCE/DTE operation. For a detailed description of the jumpers and switches, see **Section 3.1**.
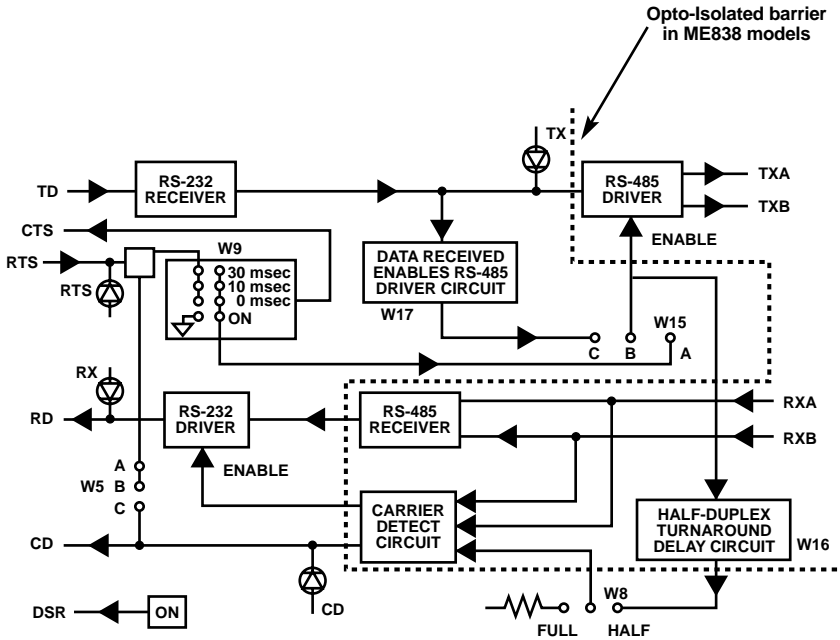

Figure 2. Simplified Functional Block Diagram (DCE Operation).

Table 1. DCE Jumper Settings

NOTE
For additional information on the jumper requirements, see Section 3.1.

| FUNCTION	JUMPER REQUIREMENTS
1. Configure RS-232 port as DCE	XW1 in A position
2. Signal ground connected to frame ground •Connected •Not connected	 W7 is IN (solder your own 100-ohm, 1/2-watt resistor in place) W7 is OUT
3. Half- or full-duplex operation •Full duplex •Half duplex	 W8 in FULL position (4 wire, A-B) W8 in HALF position (2 wire, B-C)
4. CTS delay •Yes •No	 W9 in 0-ms position W9 in 10-ms position W9 in 30-ms position W9 in ON position (no delay, CTS follows RTS)

Table 1. DCE Jumper Settings (continued)

FUNCTION	JUMPER REQUIREMENTS

5. Enable RS-485 driver
    a. RS-485 driver enabled by RS-232
    control leads
        •by RTS
	W15 in A-B position *and*
	W9 in 0-ms position
	W9 in 10-ms position
	W9 in 30-ms position

b. RS-485 driver enabled by data •Disable timeout delay	W15 in B-C position *and* <u>W17</u> <u>msec</u> A 70 B 7 C 2 D 0.7 E 0.15
c. RS-485 driver constantly enabled	W9 in ON position
6. Half-duplex turnaround delay •0-msec turnaround delay	W8 in HALF position *and* W16 in position A
•0.1-msec turnaround delay	W16 in position B
•1-msec turnaround delay	W16 in position C
•5-msec turnaround delay	W16 in position D
•35-msec turnaround delay	W16 in position E

Table 1. DCE Jumper Settings (continued)

FUNCTION	JUMPER REQUIREMENTS
7. RS-485 interface terminated or unterminated •Terminated •Unterminated	 S2 in TERM position S2 in UNTERM position
8. Normal or loopback operation •Normal mode •Loopback mode	 S1 in Normal position S1 in Loopback position
9. RS-485 Interface Line Biased (Fail-Safe), Receive	S3 Off No line bias S3 On Line biased **NOTE: If line bias is on, the RS-485 CD will ALWAYS be on.**
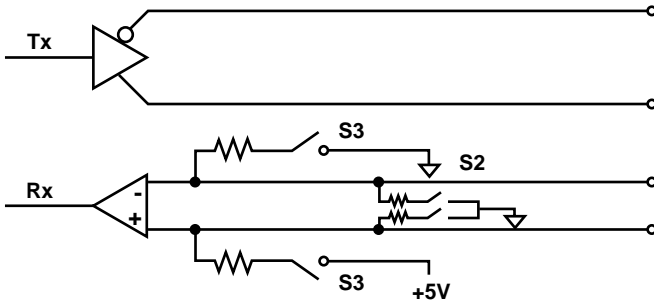
Figure 3. Line Bias. S2 shows the line termination when "Term" is selected. S3 shows line bias when "Bias" is selected.

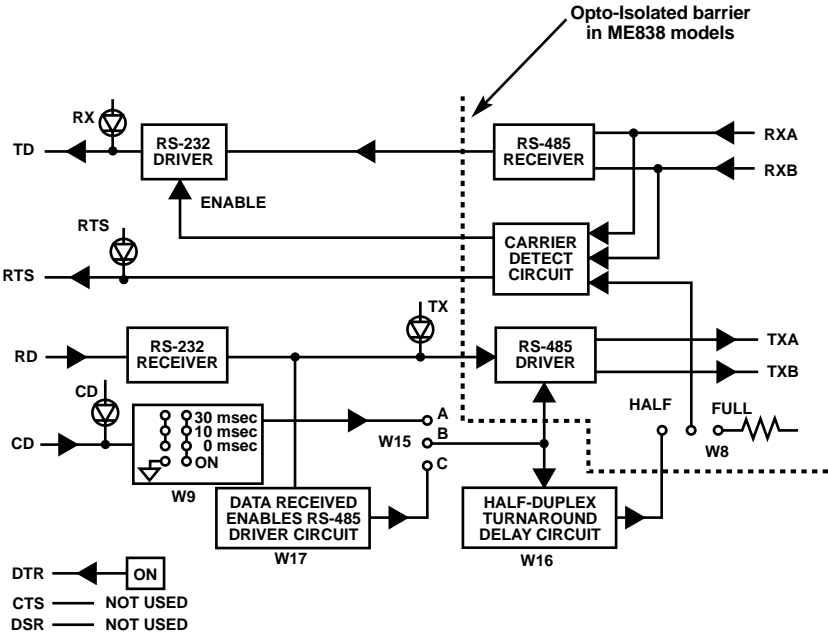**Figure 4. Simplified Functional Block Diagram (DTE Operation).**

NOTE

The delay settings for W9 apply only to the CTS output of the LD485A-HS. Since CTS is not used when the LD485A-HS is configured as a DTE device, placing jumper W9 in either the 0-, 10-, or 30-msec position will allow the CD input to enable the RS-485 driver. When jumper W9 is in the ON position, the CD input has no affect on the RS-485 driver.

Table 2. DTE Jumper Settings

NOTE

For additional information on the jumper requirements, see Section 3.1.

FUNCTION	JUMPER REQUIREMENTS
1. Configure RS-232 port as DTE	XW1 in B position
2. Signal ground connected to frame ground •Connected •Not connected	 W7 is IN (100-ohm, 1/2-watt resistor soldered in place) W7 is OUT
3. Half- or full-duplex operation •Full duplex •Half-duplex	 W8 in FULL position (4 wire, A-B) W8 in HALF position (2 wire, B-C)
4. CTS delay	CTS not supported

5. Enable RS-485 driver
    a. RS-485 driver enabled by
    RS-232 lead CD
	
	W15 in A-B position *and*
	W9 in 0-ms position
	W9 in 10-ms position
	W9 in 30-ms position

Table 2. DTE Jumper Settings (continued)

FUNCTION	JUMPER REQUIREMENTS
b. RS-485 driver enabled by data •Disable timeout delay	W15 in B-C position *and* W17 msec A 70 B 7 C 2 D 0.7 E 0.15
c. RS-485 driver constantly enabled	W9 in ON position
6. Half-duplex turnaround delay •0-msec turnaround delay •0.1-msec turnaround delay •1-msec turnaround delay •5-msec turnaround delay •35-msec turnaround delay	W8 in HALF position *and* W16 in position A W16 in position B W16 in position C W16 in position D W16 in position E
7. RS-485 interface terminated or unterminated •Terminated •Unterminated	 S2 in TERM position S2 in UNTERM position
8. Normal or loopback operation a. Normal mode b. Loopback mode	 S1 in Normal position S2 in Loopback position

Table 2. DTE Jumper Settings (continued)

FUNCTION	JUMPER REQUIREMENTS	
9. RS-485 Interface Line Biased (Fail-Safe), Receive	S3 Off	No line bias
	S3 On	Line biased
	NOTE: If line bias is on, the RS-485 CD will ALWAYS be on.	

3.3 Typical Applications

This section describes some typical applications where the LD485A-HS might be used. The connections shown in the figures are for the RS-485 port.

Figure 5 shows a typical point-to-point, 4-wire, full- or half-duplex connection with both LD485A-HSs terminated by setting switch S2 to the TERM position. Figure 6 shows a typical point-to-point, 2-wire, half-duplex connection with both LD485A-HSs terminated by setting switch S2 to the TERM position.

In a 4-wire, point-to-point application, each of the drivers on the two LD485A-HSs may always be enabled without any adverse effects.

In a 2-wire, point-to-point or multipoint application, only one driver may be enabled at any one time. If more than one driver is turned ON, a situation known as contention occurs and the data from one driver interferes with the data from the other driver. This results in both sets of data being unintelligible.
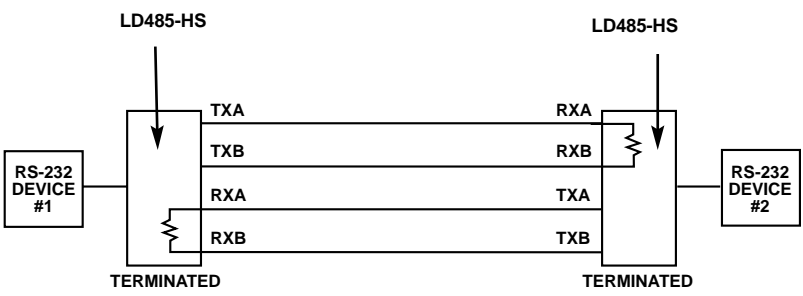
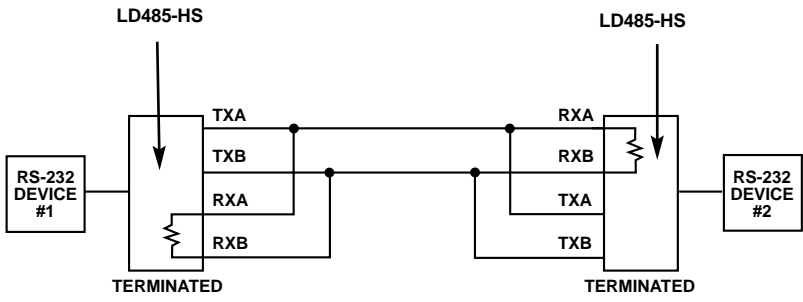**Figure 5. Point-To-Point, 4-Wire (Full- or Half-Duplex).**

Figure 6. Point-to-Point, 2-Wire (Half-Duplex).

Figure 7 shows a typical multipoint, 4-wire, full- or half-duplex connection. Figure 8 shows a typical multipoint, 2-wire, half-duplex connection. In the multipoint applications depicted in **Figures 7** and **8**, the devices at the extreme opposite ends of the installation are terminated by setting switch S2 to the TERM position. These devices are the two devices that have the greatest cable length between them, not necessarily the devices that are physically located the farthest apart. (See **Figures 7** and **8**.) A resistor shown in the circuit indicates that the termination resistor has been selected via switch S2. Note that although **Figures 7** and **8** show only four LD485A-HS devices networked together, up to 64 units can be connected in the manner shown in **Figure 7**, and up to 32 units as shown in **Figure 8**.
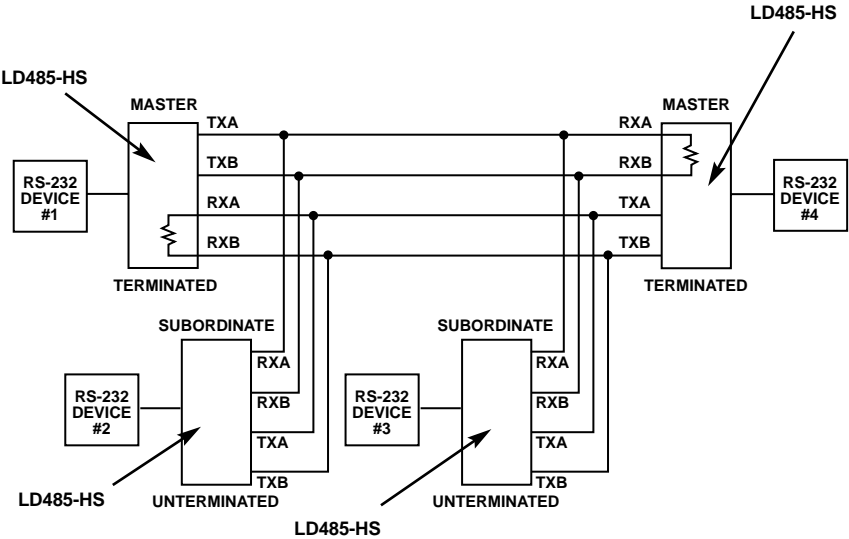
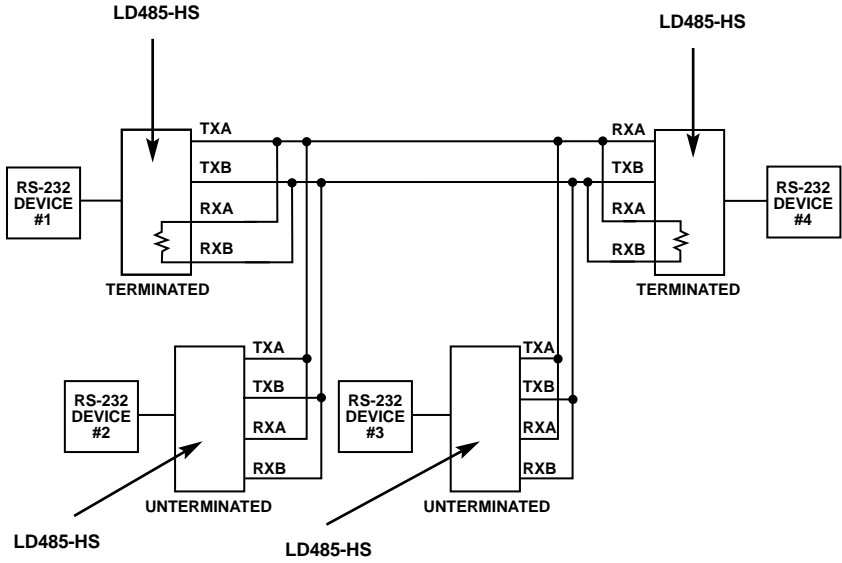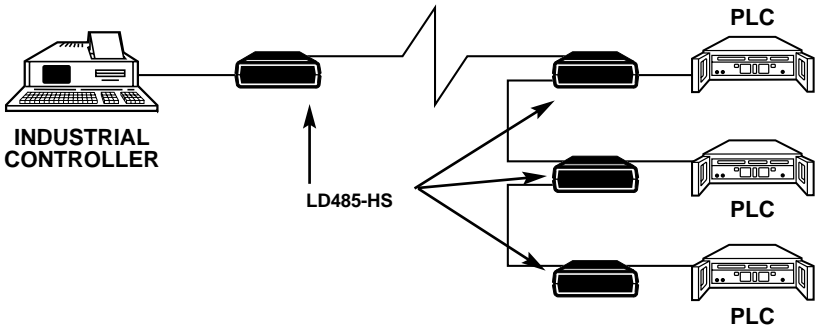**Figure 7. Multipoint, 4-Wire (Half- or Full-Duplex).**

Figure 8. Multipoint, 2-Wire (Half-Duplex).

Figure 9. Sample Multipoint Operation.

Sample Multipoint Configuration
In the following application, an industrial controller is used to gather information from several remote programmable logic controller (PLC) stations (see **Figure 9**). A system protocol has been defined such that all the programmable logic controllers receive the information sent by the industrial controller, but only the remote station specifically addressed will respond. In this system, the industrial controller and all the remote stations are DTE devices. The step-by-step installation procedure follows **Figure 9**.

Installation Procedure for the Multipoint Application in Figure 9

1.   Set all the LD485A-HSs for DCE operation (jumper XW1 in position A).

2.   Connect a straight-through cable from the RS-232 port on each LD485A-HS to the RS-232 port on each of the PLCs.

3.   Set all the LD485A-HSs for normal operation (switch S1 in the "Normal" position).

4.   After a remote station has been addressed, two-way data transmission can occur between that station and the industrial controller until the industrial controller sends a "CLEAR" command. This command causes the remote PLC to resume data logging while waiting to be addressed again. Therefore, set each LD485A-HS for full-duplex operation (jumper W8 in the "FULL" position).

5.   Connect the LD485A-HSs together via a 4-wire twisted-pair cable (see **Figure 7**).

6.   Terminate (switch S2 in the TERM position) the two LD485A-HSs that have the greatest cable run between them and leave the others unterminated (switch S2 in the UNTERM position).

7.   Since all the remote PLC stations must be inactive until addressed, the RS-485 driver of each remote LD485A-HS must not be constantly enabled (W9 of each remote LD485A-HS must be set to a position other than ON). The remote PLCs are fairly far from the industrial controller in our example, so it would be wise to set the CTS Delay (jumper W9) for 10 msec. This allows the line to stabilize after a remote PLC becomes active but before it starts to transmit.

8.   Set jumper W9 on the LD485A-HS connected to the industrial controller to the ON position. This allows the industrial controller to transmit to the remote PLCs without having to wait for any delay period.

9.   Set jumper W15 of each remote LD485A-HS and the master LD485A-HS to the A-B position. This allows the RS-485 driver to be enabled via the RS-232 control lead.

10.   Jumpers W16 and W17 are not used in this application and may be set in any position without affecting the operation of the unit.

11.   This completes the configuration procedure. The system can now be activated.

Appendix A: Pinning

Table 3. RS-232 Interface
(* Denotes pins that are used)

Pin	Circuit	Description	Signal Type	Direction
1*	AA	Protective Ground	Ground	—
2*	BA	Transmitted Data	Data	To DCE
3*	bb	Receive Data	Data	From DCE
4*	CA	Request To Send	Control	To DCE
5*	CB	Clear To Send	Control	From DCE
6*	CC	Data Set Ready	Control	From DCE
7*	AB	Signal Ground	Ground	—
8*	CF	Data Carrier Detect	Control	From DCE
9	—	+ DC Test Voltage	—	—
10	—	- DC Test Voltage	—	—
11	—	Unassigned	—	—
12	SCF	Secondary Data Carrier Detect	Control	From DCE
13	SCB	Secondary Clear To Send	Control	From DCE

Table 3. RS-232 Interface (continued)
(* Denotes pins that are used)

Pin	Circuit	Description	Signal Type	Direction
14	SBA	Secondary Transmit Data	Data	To DCE
15	DB	Transmit Signal Element Timing (DCE)	Timing	From DCE
16	SBB	Secondary Receive Data	Data	From DCE
17	DD	Receiver Signal Element Timing	Timing	From DCE
18	—	Local Loopback	Test	To DCE
19	SCA	Secondary Request To Send	Control	To DCE
20*	CD	Data Terminal Ready	Control	To DCE
21	CG	Signal Quality Detector	Control	From DCE
22	CE	Ring Indicator	Control	From DCE

Table 3. RS-232 Interface (continued)
(* Denotes pins that are used)

Pin	Circuit	Description	Signal Type	Direction
23	CH	Data Signal Rate Selector (DTE)	Control	To DCE
		or		
	CI	Data Signal Rate Selector (DCE)	Control	From DCE
24	DA	Transmitter Signal Element Timing (DTE)	Timing	To DCE
25	—	Test Mode	No Signal	—

Table 4. RS-485 Pinning Chart

Pin Name	Description
TXA and TXB	Data received by the LD485A-HS at the RS-232 port is transmitted out of the unit over twisted-pair wires via these two outputs. The "TX" LED indicates the state of these two leads. When the TXA lead is positive with respect to the TXB lead (a "zero" is being transmitted), the "TX" LED is lit.
RXA and RXB	These are the received data inputs for the RS-485 port. The status of these leads is monitored by the "RX" LED. When the RXA lead is positive with respect to the RXB lead (a "zero" is being received), the "RX" LED is lit.

Quick Reference: User-Selectable Options

Use this list as a quick-reference guide when you need to change the jumper settings.

An asterisk (*) designates the factory-preset jumper settings.

XW1A	DCE*	
XW1B	DTE	
W8	A-B*	4-wire
	B-C	2-wire
W15	A-B*	RTS/CD enabled
	B-C	Data enabled (Maximum speed is 64K.)
W5	A-B*	RTS/CTS* delay (normal)
	B-C	RTS/CTS/CD delay (CTS inhibited if CD is present when RTS is raised.)

W9   RTS/CTS delay (The time before the RS-485 driver is enabled and CTS is asserted after RTS is asserted. The RS-485 driver is *always* enabled.)

A	30 msec
B	10 msec
C*	0 msec
D	ON

W17   When W15 is in the B-C (Data Enabled) position, this is the time the RS-485 driver remains enabled *after* a low-to-high transition on the DATA line to prevent disabling the driver in the middle of a character.

A	70 msec
B*	7 msec
C	2 msec
D	0.7 msec
E	0.15 msec

W16   Turnaround delay (When W8 is in the B-C [2 wire] position, this is the time after the driver is disabled and *before* the receiver is enabled.)

A	0 msec
B*	0.1 msec
C	1 msec
D	5 msec
E	35 msec

NOTE: **If the LD485A is configured Data Enabled (W15, position B-C) and 2-wire (W8 position B-C), then delays from W17 and W16 are cumulative.**

S1   OUT*   Normal
          IN   Loopback

S2   OFF*   RS-485 Receiver Unterminated
          ON   RS-485 Receiver Terminated

S3   OFF*   Line Bias Off
          ON   Line Bias On (The Carrier Detect light will come on. Default is +5 volts.)

TB1   4-wire terminal block
          1................Rx................B$^+$
          2................Rx................A$^-$
          3................Tx................B$^+$
          4................Tx................A$^-$

BLACK BOX®
NETWORK SERVICES