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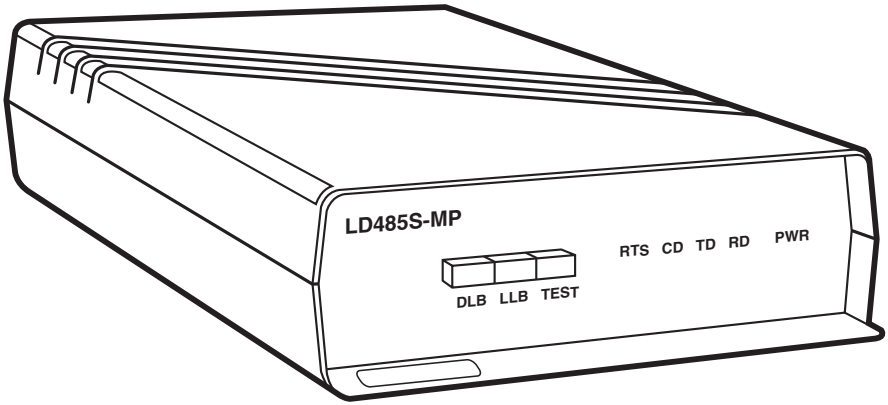
DECEMBER 2001
ME742A-R4
ME742C-R4
BC00703
FA520A-R2

RS-232/RS-485 Synchronous Multipoint Line Driver (LD485S-MP)



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This equipment generates, uses, and can radiate radio frequency energy and if not installed and used properly, that is, in strict accordance with the manufacturer's instructions, may cause interference to radio communication. It has been tested and found to comply with the limits for a Class A computing device in accordance with the specifications in Subpart B of Part 15 of FCC rules, which are designed to provide reasonable protection against such interference when the equipment is operated in a commercial environment. Operation of this equipment in a residential area is likely to cause interference, in which case the user at his own expense will be required to take whatever measures may be necessary to correct the interference.

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

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

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

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INSTRUCCIONES DE SEGURIDAD

1. Todas las instrucciones de seguridad y operación deberán ser leídas antes de que el aparato eléctrico sea operado.
2. Las instrucciones de seguridad y operación deberán ser guardadas para referencia futura.
3. Todas las advertencias en el aparato eléctrico y en sus instrucciones de operación deben ser respetadas.
4. Todas las instrucciones de operación y uso deben ser seguidas.
5. El aparato eléctrico no deberá ser usado cerca del agua—por ejemplo, cerca de la tina de baño, lavabo, sótano mojado o cerca de una alberca, etc..
6. El aparato eléctrico debe ser usado únicamente con carritos o pedestales que sean recomendados por el fabricante.
7. El aparato eléctrico debe ser montado a la pared o al techo sólo como sea recomendado por el fabricante.
8. Servicio—El usuario no debe intentar dar servicio al equipo eléctrico más allá a lo descrito en las instrucciones de operación. Todo otro servicio deberá ser referido a personal de servicio calificado.
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10. El equipo eléctrico deber ser situado fuera del alcance de fuentes de calor como radiadores, registros de calor, estufas u otros aparatos (incluyendo amplificadores) que producen calor.
11. El aparato eléctrico deberá ser connectado a una fuente de poder sólo del tipo descrito en el instructivo de operación, o como se indique en el aparato.

12. Precaución debe ser tomada de tal manera que la tierra fisica y la polarización del equipo no sea eliminada.

13. Los cables de la fuente de poder deben ser guiados de tal manera que no sean pisados ni pellizcados por objetos colocados sobre o contra ellos, poniendo particular atención a los contactos y receptáculos donde salen del aparato.

14. El equipo eléctrico debe ser limpiado únicamente de acuerdo a las recomendaciones del fabricante.

15. En caso de existir, una antena externa deberá ser localizada lejos de las lineas de energia.

16. El cable de corriente deberá ser desconectado del cuando el equipo no sea usado por un largo periodo de tiempo.

17. Cuidado debe ser tomado de tal manera que objectos liquidos no sean derramados sobre la cubierta u orificios de ventilación.

18. Servicio por personal calificado deberá ser provisto cuando:

    A: El cable de poder o el contacto ha sido dañado; u

    B: Objectos han caído o líquido ha sido derramado dentro del aparato; o

    C: El aparato ha sido expuesto a la lluvia; o

    D: El aparato parece no operar normalmente o muestra un cambio en su desempeño; o

    E: El aparato ha sido tirado o su cubierta ha sido dañada.

Contents

1. Specifications

Terminal Interface —	EIA RS-232-C (CCITT V.24/V.28) configured as DCE serial synchronous internal/external/recovered TX data clock
Line Interface —	EIA RS-485 twisted pair (26 AWG minimum), DC continuity required
Data Rates —	1200, 2400, 4800, 9600, 19,200, 38,400, 56,000, 64,000, 112,000, or 128,000 bps
Operating Modes —	2-wire half duplex, 4-wire full or half duplex; point-to-point or multipoint; normal or line/digital loopback; Constant Carrier or Switched Mode
Pins Supported —	RS-232-C: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 15, 17, 20, 24; RS-485: TX A, TX B, RX A, RX B
RTS/CTS Delay —	0, 11, 50, or 160 ms
Connectors —	(1) DB25 female, (1) 4-screw terminal block
Indicators —	5 LEDs: TX, RX, RTS, CD, PWR
MTBF —	100,000 hours (approximately)
Operating Temperature —	32 to 122°F (0 to 50°C)
Storage Temperature —	-4 to +158°F (-20 to +70°C)
Humidity —	15 to 90% relative humidity, non-condensing
Power —	Wallmount transformer, 115 VAC/100 mA or 230 VAC/50 mA
Size —	Standalone: 1.8"H x 5.5"W x 8.5"D (4.5 x 13.9 x 21.5 cm); Rackmount: 4.7"W x 7.4"D (11.9 x 18.8 cm)
Weight —	Standalone, unit only: 1 lb. (0.45 kg); Standalone, including transformer: 1.5 lb. (0.68 kg); Rackmount: 0.5 lb. (0.23 kg)

Transmission Distance — (4-wire point-to-point, 26-AWG twisted pair)

Speed (bps)	Distance
1200	4 miles (6.4 km)
2400	3 miles (4.8 km)
4800	2.3 miles (3.68 km)
9600	1.7 miles (2.72 km)
19,200	1.2 miles (1.92 km)
38,400	0.9 mile (1.44 km)
56,000	0.8 mile (1.28 km)
64,000	0.75 mile (1.2 km)
112,000	0.55 mile (0.88 km)
128,000	0.35 mile (0.56 km)

Interface Pinouts —

RS-485

Pin	Name
TX A	Transmit Data Pair
TX B	
RX A	Receive Data Pair
RX B	

RS-232-C

Pin	Name
1	Protective Ground (FG)
2	Transmit Data (TD)
3	Receive Data (RD)
4	Request To Send (RTS)
5	Clear To Send (CTS)
6	Data Set Ready (DSR)
7	Signal Ground (SG)
8	Receive Line Signal Detector (CD)
9	Aux + power (+12V through 560 ohms)
10	Aux - power (-12V through 560 ohms)
15	Transmitter Signal Element Timing (TC)
17	Receiver Signal Element Timing (RC)
20	Data Terminal Ready (DTR)
24	DTE Transmitter Signal Element Timing

2. Introduction

The RS-232 Synchronous Multipoint Line Driver provides short-haul synchronous data communication over customer-owned twisted-pair cable. It's available as a standalone unit (Part Number ME742A-R4) or a rackmount card (Part Number ME742C-R4). The rackmount version is functionally identical to the standalone unit, but it fits in a rackmount chassis that holds up to 16 cards. Each Line Driver comes with a 6-ft. DB25 male to DB25 male RS-232 extension cable and a DB9 female to DB25 male adapter.

The LD485S has an RS-232 port (configured as DCE) that connects to a host computer or terminal (DTE), and a 4-screw terminal block for RS-485 communication over a 2- or 4-wire line. Transmission can be two-wire half duplex, or four-wire half/full duplex. There are a variety of switch-selectable baud rates ranging from 1200 to 128,000 bps.

A group of LEDs on the unit's front panel indicate flow-control status (TX, RX, RTS, CD). Three pushbuttons on the front panel are used to perform line and digital loopback testing. A number of options are configurable via internal switches or jumpers:

- Data rate
- Constant Carrier/Switched Mode with selectable RTS/CTS delay
- Full/half duplex
- TX data clock select
- Node termination
- Frame ground/signal ground

2.1 Application

Two or more Line Drivers can be set up for point-to-point or multipoint applications as shown in Figures 2-1 and 2-2. A multidrop network can accommodate up to 64 devices.

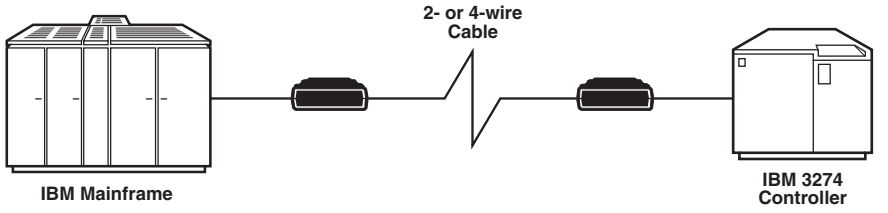

Figure 2-1. Point-To-Point Synchronous Application.

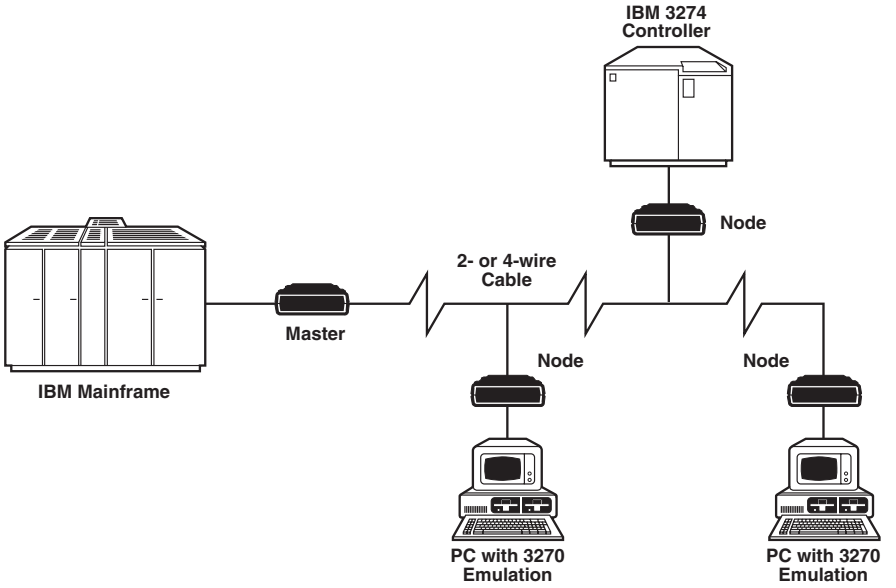

Figure 2-2. Multipoint Synchronous Application.

2.2 Front-Panel Indicators and Buttons

The front panel of the RS-232 Synchronous Multipoint Line Driver has five status indicators (LEDs) as follows:

TD Will light when data is transmitted by the local attached RS-232 device (pin 2 is active).

RD Will toggle as data is received from the remote RS-232 device (pin 3 is active).

RTS Will light when RS-232 device raises RTS to request data transmission (pin 4 is active).

In Constant Carrier Mode the RTS LED will always be on, causing the remote Line Driver's CD light to always be on.

NOTE

Constant Carrier Mode pertains to full duplex or simplex operation only.

In Switched Mode the RTS LED will only be on if RTS is asserted, causing the remote Line Driver's CD LED to light.

CD Indicates status of remote Line Driver's RTS signal.

If the remote Line Driver is in Constant Carrier Mode, the local Line Driver's CD LED will always be on.

If the remote Line Driver is in Switched Mode, the local Line Driver's CD LED will light when the remote device asserts RTS.

PWR Indicates the presence of power.

Three pushbuttons are located on the front panel used for various testing operations as follows:

TST End-To-End Continuity Test (button provides test pattern for all test operations)

LLB Line Loopback Test

DLB Digital Loopback Test

See **Chapter 5** for instructions on performing each test.

2.3 Back-Panel Connectors

Two connectors are located on the LD485S's rear panel:

- One DB25 female connector, configured as DCE; connects the line driver to an RS-232 DTE device.
- One 4-screw terminal block: for RS-485 communication between two or more Line Drivers over two or four wires.

3. Configuration

Before you install the Line Driver, configure it to work in your application.

Figure 3-2 shows a layout of the printed circuit board and the location of the jumpers and switches. Each option is discussed in detail in **Sections 3.1** and **3.2**.

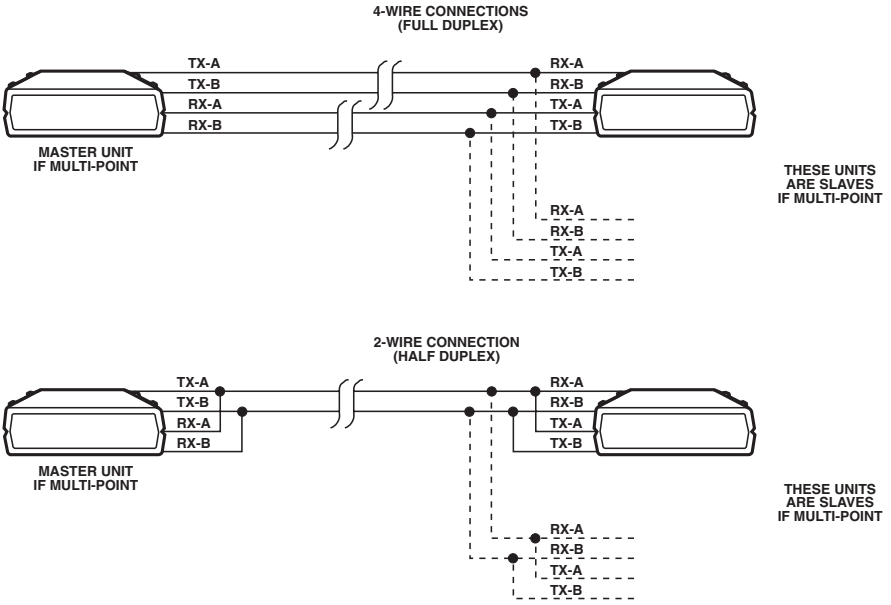

Figure 3-1. Inter-Connect Wiring Diagram.

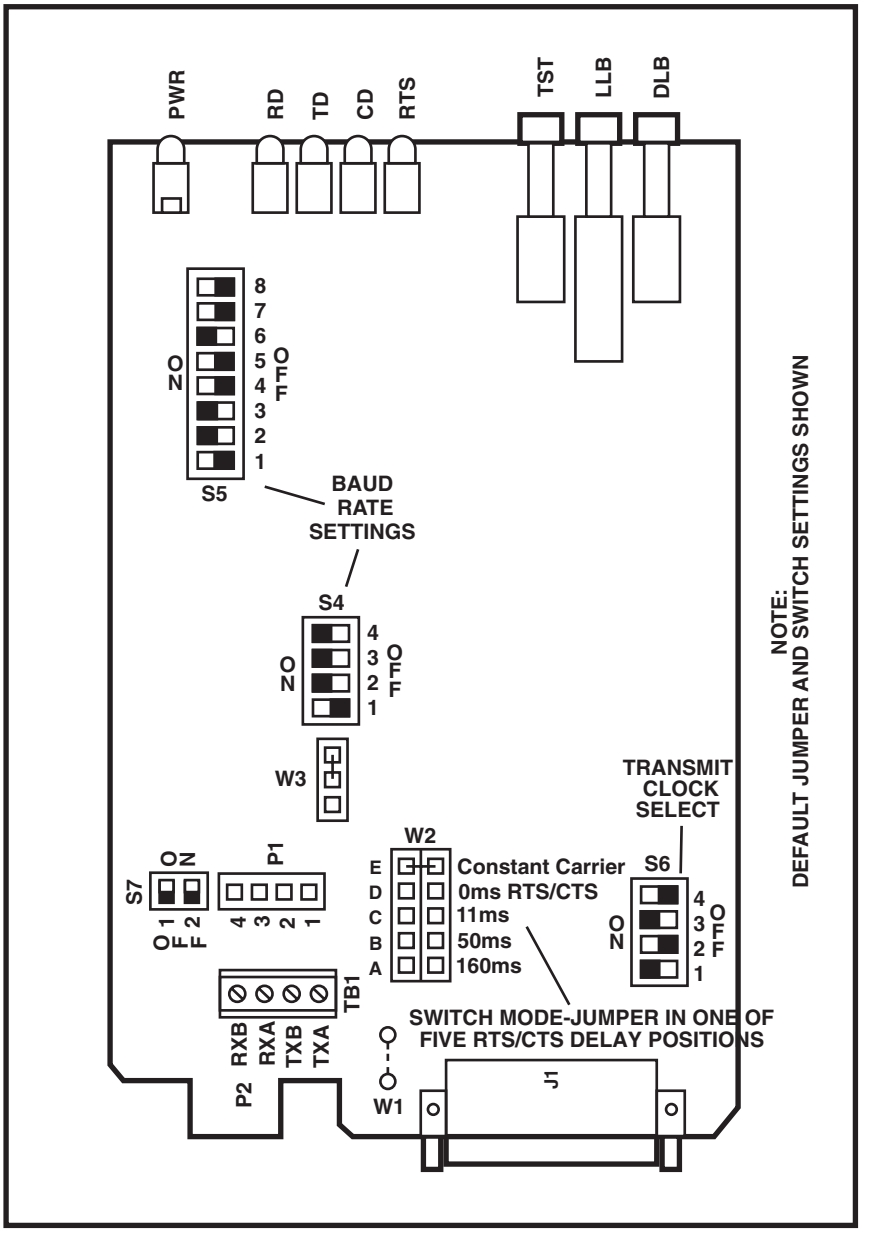

Figure 3-2. Printed Circuit Board Layout.

3.1 Switches

Three options are user-configurable via the internal switches:

- Baud rate
- Transmit data clock
- Node termination

3.1.1 Baud Rate

Ten switch-selectable data rates are available: 1200, 2400, 4800, 9600 (factory setting), 19,200, 38,400, 56,000, 64,000, 112,000, or 128,000 bps.

The maximum transmission distance is dependent on the data rate selected. The typical range for data transmission is 4 miles at 1200 bps and 0.35 miles at 12,800 bps. Refer to the table in **Chapter 1** for a list of baud rates and maximum transmission distances.

NOTE

The baud rate should be set to match the rate of the attached DTE.

Table 3-1. Baud Rate Settings (Switches 4 & 5)

Baud	Switch 4, Position				Switch 5, Position							
Rate (bps)	4	3	2	1	8	7	6	5	4	3	2	1
1200	ON	OFF	OFF	ON	ON	ON	ON	ON	ON	ON	OFF	ON
2400	OFF	ON	ON	ON	ON	ON	OFF	ON	ON	OFF	OFF	ON
4800	OFF	OFF	ON	ON	ON	ON	OFF	ON	ON	OFF	OFF	ON
9600*	OFF	OFF	OFF	ON	ON	ON	OFF	ON	ON	OFF	OFF	ON
19,200	OFF	OFF	OFF	OFF	ON	ON	OFF	ON	ON	OFF	OFF	ON
38,400	OFF	OFF	OFF	OFF	ON	ON	OFF	ON	OFF	ON	OFF	OFF
56,000	OFF	OFF	OFF	OFF	ON	ON	ON	ON	OFF	OFF	ON	OFF
64,000	OFF	OFF	OFF	OFF	ON	ON	OFF	ON	OFF	OFF	ON	OFF
112,000	OFF	OFF	OFF	OFF	ON	OFF	ON	ON	OFF	OFF	OFF	ON
128,000	OFF	OFF	OFF	OFF	OFF	ON	ON	OFF	OFF	OFF	ON	OFF

* factory setting

3.1.2 Transmit Data Clock

Data timing is synchronized among all connected devices in one of three ways:

- Internal Clock (factory setting)
- Recovered Clock
- External Clock

Internal Clock — Line Driver generates transmit data clock and presents clock to attached DTE via Pin 15. The DTE then presents synchronized data to the LD485S on Pin 2.

Recovered Clock — Transmit data clock is presented to the DTE on Pin 15, synchronized with timing of data received from the remote device. The DTE then presents synchronized data to the LD485S on Pin 2.

External Clock — Clocking is determined by local DTE. The clock is presented to the Line Driver on Pin 24, and returned on Pin 15. The DTE then presents synchronized data to the LD485S on Pin 2.

Table 3-2. Transmit Clock Options (Switch 6)

Pin 15 Clock Source	Switch 6, Position			
	4	3	2	1
Internal*	ON	OFF	ON	OFF
Recovered	ON	OFF	OFF	ON
External	ON	ON	OFF	OFF
Pin 15 Disabled	OFF	—	—	—

*factory setting

To achieve a master clock, one of the Line Drivers should be set to internal or external clocking and the other Line Driver(s) set to recovered clock.

3.1.3 Node Termination (Switch 7)

You can select whether or not the termination network for the receiver is connected to the line. Terminating the devices on the extreme ends of the line reduces distortion and improves overall signal quality in most applications. The factory setting is with Switch 7 in the TERM position.

In point-to-point applications, both devices should have the node termination option enabled.

In multipoint applications, only the two devices at the extreme ends of the line should be terminated. Configuring any of the other devices on the line for node termination would result in an increase in the amount of distortion and possible data errors.

3.2 Jumpers

Four options are user-configurable via internal jumpers:

- Constant Carrier/Switched Mode - Jumper W2
- RTS/CTS Delay (for Switched Mode) - Jumper W2
- Full/Half Duplex - Jumper W3
- Frame Ground/Signal Ground - Jumper W1

3.2.1 Constant Carrier or Switched Mode

Jumper W2 is used to select Constant Carrier or Switched Mode. This option determines the use of the Request To Send signal, with selection dependent on your particular application. When the jumper block is in the Constant Carrier position, Constant Carrier Mode is selected. If Switched Mode is desired, the jumper block would be placed in one of the four RTS/CTS delay positions. See Figure 4-1 for the jumper's location on the printed circuit board. Each mode is discussed below.

In Constant Carrier Mode, the unit functions as if RTS is constantly asserted. The EIA 485 transmitter is always on, and the unit CTS signal remains high. Any data sent by the attached RS-232 device is automatically transmitted by the Line Driver. The RTS LED on the unit's front panel will always be on, and the CD indicator of the remote Line Driver(s) will remain lit. Constant Carrier Mode is most commonly used in multipoint applications that have a "master" device communicating with two or more "slaves." The master DTE is configured for Constant Carrier Mode, while the slave devices are set to Switched Mode.

NOTE

Constant Carrier Mode pertains to full duplex or simplex operation only. Half duplex does not apply since the RTS signal is constantly held high in this mode, preventing any other signals from being raised in the sequential fashion required by half duplex operation.

In Switched Mode, the Line Driver's transmitter isn't activated until the DTE device asserts RTS. (Unlike Constant Carrier Mode, RTS is not held in a pseudo-asserted state.) When the attached DTE device raises RTS, the Line Driver's RTS LED will light. The remote unit's CD LED will light, indicating that a transmission link has been established. Once the device drops RTS, the RTS and remote CD lights will go out.

Table 3-3 provides a general guide to selecting Constant Carrier or Switched Mode according to your specific operation (half or full duplex; point-to-point or multipoint).

Table 3-3. Guide for Selecting Constant Carrier or Switched Mode

Operating Mode	Constant Carrier or Switched Mode
2-Wire/Point-to-Point	Both Line Drivers in Switched Mode
4-Wire/Point-to-Point	User's option for both units (normally both units configured for Switched Mode)
2-Wire/Multipoint	All units in Switched Mode
4-Wire/Multipoint	All nodes in Switched Mode. Master unit is user's option (normally Constant Carrier Mode)

3.2.2 RTS/CTS Delay

If desired, the user can have a delay inserted after the RS-232 device raises RTS. It will delay the return of CTS from the Line Driver to the DTE. This feature is useful in applications that require time for the remote driver's Carrier Detect (CD) signal to activate the link between both RS-232 devices before CTS is raised. If CD hasn't been asserted before CTS, the link is considered inactive and data transmission should not be attempted by the attached DTE.

In half duplex operation, the RTS/CTS delay is useful because it allows time to establish which Line Driver will have control of the line to transmit data.

NOTE

RTS/CTS delay applies to Switched Mode only.

RTS/CTS Delay Options (Jumper W2)

- Constant carrier
- 0 msec (no delay)
- 11-msec delay (factory setting)
- 50-msec delay
- 160-msec delay

3.2.3 Full or Half-Duplex Operation

Figure 3-2 shows the location of Jumper W3. This jumper allows you to select 2- or 4-wire operation. The factory setting is full duplex.

3.2.4 Tying Signal Ground to Frame Ground

Jumper W1 provides the option of tying signal ground to frame ground. The position is left open at the factory. If signal ground is to be connected to frame ground, it is recommended that a 100-ohm ½-watt resistor be soldered in location W1. A hardwire jumper may also be used; however, a measurement showing minimal difference between signal and frame ground should be made to ensure that ground circulating currents are limited to acceptable levels.

4. Installation

1. Make sure the Line Driver is configured to suit your particular application. **Chapter 3** describes the options available for each jumper and switch.

2. To verify that the Line Driver is functioning correctly, power on the unit and perform the Line Loopback Test (see **Chapter 5**). Repeat this procedure for each unit in your configuration.

3. Power down the LD485S. Connect the Line Driver to the RS-485 line via the 4-screw terminal block on the unit's rear panel. Refer to the Inter-Connect Wiring Diagram in **Chapter 3**.

4. To verify the communications link, power on the unit and perform the Digital Loopback Test (see **Chapter 5**). For multipoint applications, repeat the test for each connection.

5 Power off the unit. Connect the DTE to the Line Driver's DB25 female connector via an RS-232 cable (male connector).

6. If desired, power on the unit and perform the End-To-End Continuity Test to verify the integrity of each segment of the link. This test allows you to isolate a defective circuit.

7. Test the installation as described in **Chapter 5**.

5. Test Modes

Test configurations are set up by using the front-panel pushbuttons. These tests should be performed when the unit is first installed or when a problem occurs.

The TST pushbutton enables the line driver's transmitter circuitry and injects marking data into the scrambled carrier bit pattern (after resetting the scrambling circuitry). If the link is operating properly, the RD indicator on any unit receiving this pattern will flash and then go off. This indicates the correct reception and decoding of marking data.

The two loopback switches, DLB (digital loopback) and LLB (line loopback), loop transmit data to receive data on the RS-232 interface. They also loop receive data to transmit data on the RS-485 interface. The only difference between the two tests is the circuitry of the line driver that is tested. See Figures 5-1 and 5-2 for an illustration of these tests.

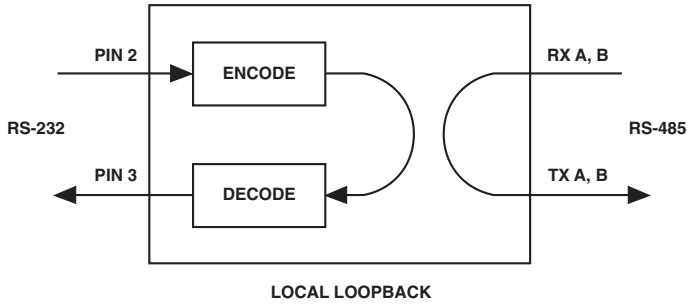

Figure 5-1. Line Loopback Test.

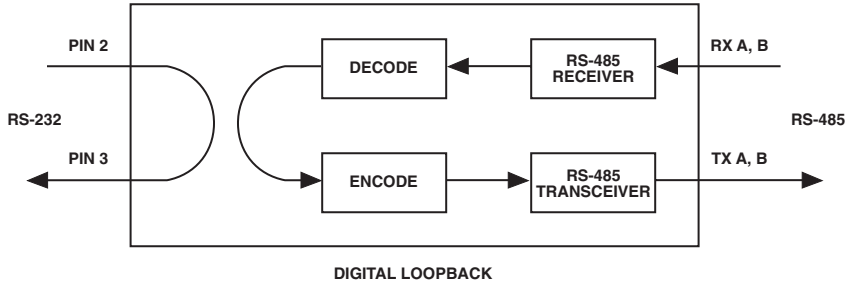

Figure 5-2. Digital Loopback Test.

In the line loopback mode, the RS-485 receive data is not actively received and retransmitted. In effect, the length of the line is doubled. This may cause cause reception of errors. If you suspect that the length of the line is the source of the errors, press the DLB pushbutton at the remote end.

Test Procedure

Proceed as follows to perform a test:

1. Check for the simple problems first: Is power applied? Are the line drivers configured correctly?

2. Press the LLB button on the units that are not operating properly. Press the Test button. As each unit's Test button is pressed, the RD indicator should flash, then go off. This tests the internal circuitry of the line driver. If a unit does not pass this test, it is defective.

3. In a point to point application, observe the indicators at the local unit. In a Multipoint configuration, observe the indicators at the master unit. Have someone press the DLB pushbutton only at the remote unit(s) in question. The RD indicator on the local unit should flash, then go off. If the RD indicator remains lit or flickers, any of the following could be causing the problem:

    - The baud rates of the local and remote units do not match.

    - Incorrect RS-232 connections.

- Incorrect RS-485 connections. The TXA lead of the local unit should be wired to the RXA lead of the remote unit. The TXB lead of the local unit should be wired to the RXB lead of the remote unit. The RXA lead of the local unit should be wired to the TXA lead of the remote unit. The RXB lead of the local unit should be wired to the TXB lead of the remote unit. Polarity (A to A, B to B) must be observed.

- The maximum link distance has been exceeded. Check by selecting a lower baud rate. If the units function at a lower baud rate, the distance has been exceeded.

- Unsuitable link termination in multipoint configurations. Switch the present terminated slave unit to the unterminated state and select another slave unit for termination. In some configurations (especially those having a large number of slaves with widely varying distances), the selection of the best slave unit for link termination can be a trial-and-error process.

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