

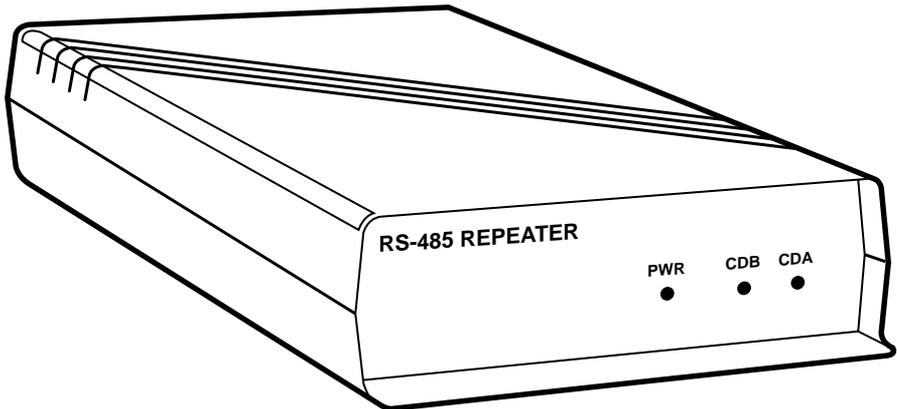


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RS-485 Repeater and RS-485 Repeater (Opto-Isolated)



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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 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.

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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.
9. El aparato eléctrico debe ser situado de tal manera que su posición no interfiera su uso. La colocación del aparato eléctrico sobre una cama, sofá, alfombra o superficie similar puede bloquea la ventilación, no se debe colocar en libreros o gabinetes que impidan el flujo de aire por los orificios de ventilación.
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 conectado 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 física 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 líneas de energía.
 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 objetos líquidos 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: Objetos 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.

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1.0 Specifications

Speed — Transparent to baud rate up to 128 Kbps

Maximum distance — 4000 ft. (1.2 km)

Operation — Full- or half-duplex

Leads supported — Both ports: TDA-, TDB+, RDA-, RDB+

Indicators — Both ports: CD (Carrier Detect); Power

Flow control — Transparent to flow control. (**NOTE:** Repeater does not support hardware flow control.)

Interface — RS-485

Connectors — (2) 4-screw terminal block; (2) RJ-45, (1) edge card connector

Power — Primary: 115 VAC \pm 10%/60 Hz model or 230 VAC \pm 10%/50 Hz model; Secondary: 17 VAC center tap, 750 mA

Size — 1.8"H x 5.5"W x 8.5"D (4.6 x 14 x 21.6 cm)

Weight — 2 lb. (0.9 kg)

2.0 Introduction

The RS-485 Repeaters extend your RS-485 communications beyond the 4000-foot limit. Even located 5000 feet from your master device, they'll take your RS-485 communications signals and shoot them out another 4000 feet.

And they let you add more devices to your network—up to 32 more unit loads per Repeater. The RS-485 Repeaters are perfect for connecting multiple RS-485 segments located in different rooms, on different floors, or in different buildings.

They support either 2- or 4-wire applications, in full- or half-duplex operation. Plus they come with a 4-screw terminal-block, RJ-45 connectors, and an edge card connector, so they fit right in with any RS-485 wiring scheme.

2.1 Optical Isolation (IC158A only)

The opto-isolating model protects one segment of your extended network from problems that arise on the other. Inside the Repeater, 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.

2.2 Indicators and Connectors

Three LEDs are visible through the Repeater's translucent front panel: one Power LED and two Carrier Detect (CD) LEDs. The power LED lets you know the Repeater is on, while the CD LEDs indicate when a transmitter is enabled on the RS-485 line.

Five connectors are accessible through the Repeater back panel: the Power connector, two RJ-45 connectors, and two 4-screw terminal blocks. The Port A terminal block and the RJ-45 connector are wired in parallel to each other. Thus the A and B ports of the repeater can be accessed through either a terminal-block connector or an RJ-45 connector. (See Figs. 3-1 and 3-2 for the position of these components on the Repeater circuit board.)

Chapter 3.0 covers installation of the RS-485 Repeaters in your setup.

NOTE: The RS-485 Repeater has no collision detection. It is up to the addressable devices on the RS-485 network to ensure that only one transmitter is enabled at any one time.

3.0 Installation

Installing the RS-485 Repeater in your setup is simple: Just set internal jumpers and switches to your application, connect your devices to the Repeater, power up the Repeater, and power up the rest of your RS-485 network.

NOTE: Refer to Figs. 3-1 and 3-2 for the location of components on your repeater model.

3.1 Setting Jumpers and Switches

Here's how to set the Repeater's jumpers and DIP switches for your application:

1. Use jumpers W3 and W4 to configure the RS-485 Repeater for either 2- or 4-wire cabling.

When both are in the BC position, the Repeater is set for 4-wire cabling and either half- or full-duplex operation. When both are in the AB position, the Repeater is set for 2-wire, half-duplex operation.

2. Jumpers W1 and W2 have no effect when the Repeater is set for 4-wire, full-duplex mode, but in half-duplex operation they determine the turnaround delay for the Repeater's receiver.

W1 and W2 set the delay between the time that the

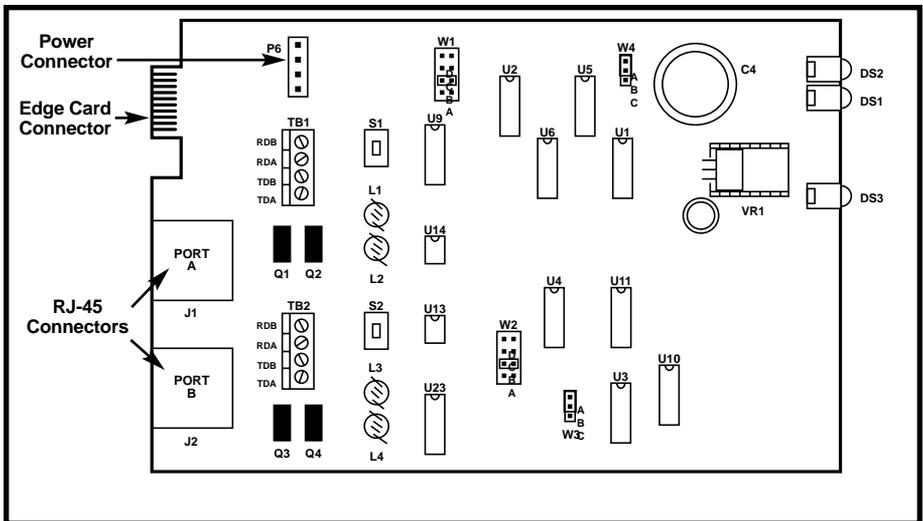


Fig. 3-1. The RS-485 Repeater Circuit Board.

RS-485 Repeater and RS-485 Repeater (Opto-Isolated)

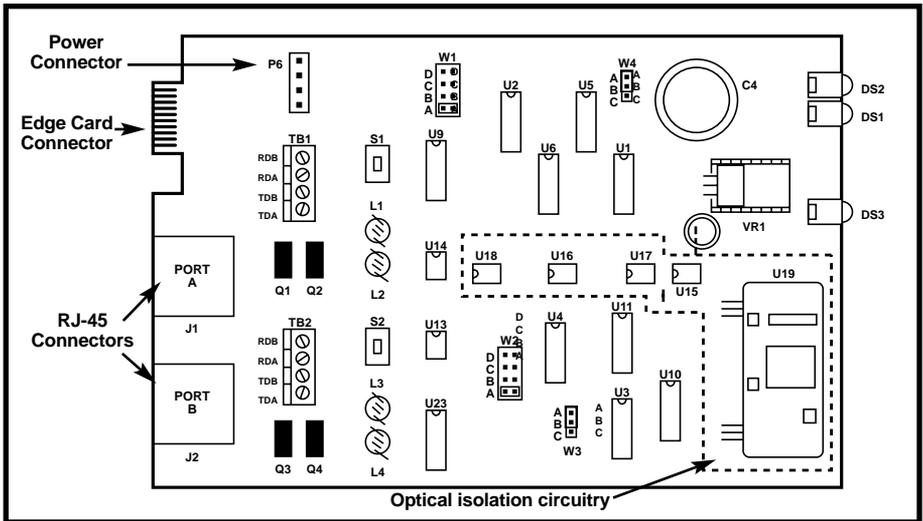


Fig. 3-2. The Opto-Isolated Repeater Circuit Board.

Repeater's transmitter is turned off after sending a signal, and the Repeater's receiver (tied to that transmitter) is enabled. Some delay is necessary, since after the Repeater's transmitter is turned off, the line still remains charged for a period of time. If the receiver were immediately enabled in a 2-wire, half-duplex setup, the Repeater could mistake the still-charged line for incoming data, and send that signal to the transmitter on its other side.

See Table 3-1 for the setting that's right for your application. And see the **Appendix** in this manual for more on the RS-485 Repeater delay circuitry.

Table 3-1. Setting W1 and W2

If your application...	set W1 and W2 to position...
has long line-lengths and/or many device drops	D (35 msec)
has moderate line-lengths and many device drops	C (5 msec)
has short line-lengths and/or few device drops	B (1 msec)
is used infrequently	A (0.1 msec)

NOTE: The greater the length of the RS-485 line and/or the larger the number of drops on the network, the longer the line will remain charged after the transmitter has been disabled. A rule of thumb governing how long to set the delay: The longer the line/larger the number of devices, the longer the delay should be.

3. Switches S1 and S2 set the Repeater's ports for terminated or unterminated operation.

To determine if a port should be terminated or not, consider where the Repeater's ports will operate in your network. If the port is located at the extreme end of a network, it should be terminated. If a port is in the middle of a network, it should be left unterminated.

In the ON position, S1 terminates Port A. In the OFF position, Port A is unterminated. Termination is 100 ohms.

When S2 is in the ON position, Port B is terminated. In the OFF position, the associated port is left unterminated. (See Fig. 3-5 for an illustration.)

3.2 Connecting the Repeater to Your Network.

After the RS-485 Repeater has been configured for your application, connect it to your RS-485 network via either the Repeater's RJ-45 modular connectors (J1 and J2 in Figs. 3-1 and 3-2) or the screw-block terminals (TB1 and TB2 in Figs. 3-1 and 3-2).

The rest of this chapter describes how to cable your repeater for either 2- or 4-wire operation, and what types of cable you can use. (See Figs. 3-5 and 3-6 for examples of how to cable the Repeater correctly for your network.)

Two- or Four-Wire Operation

To set the Repeater for 2-wire operation, use a short loop of wire to connect RDA- to TDA- (this will be your negative line) and RDB+ to TDB+ (this will be your positive line) on the repeater's 4-screw terminal blocks (See Fig. 3-3 for receive and transmit pins, and for connecting master and slave devices in a 2-wire RS-485 network.) Then cable your network together.

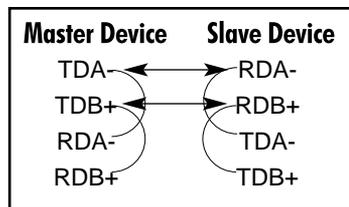


Fig. 3-3. Two-Wire Cabling.

RS-485 Repeater and RS-485 Repeater (Opto-Isolated)

To set the Repeater for 4-wire operation, follow the steps under *Cabling to Your Network*. (See Fig. 3-4 for general information on connecting master and slave devices in a 4-wire network.)

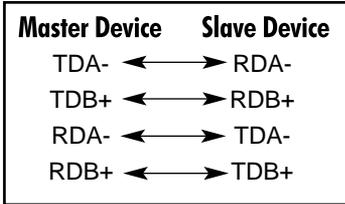


Fig. 3-4. 4-Wire Cabling.

Cabling to Your Network

Here are three of the most common ways to connect the Repeater to your network:

1. To connect the Repeater to your network via the terminal blocks (TB1 and TB2), use unshielded twisted-pair cable. (Category 3, 4, or 5 cable is recommended.) Follow the 4-screw terminal-block pinning given in Table A-1 (in the **Appendix**) of this manual and refer to **Fig. 3-6** for proper cabling to make sure you connect each cable to the correct pin so the Repeater will communicate properly.

2. To connect the Repeater to your network via the modular connectors (J1 and J2), use either RJ-45 or RJ-11 cables. Make sure these cables are pinned both to the repeater specifications given in Table A-2 (in the **Appendix**), and to the specifications of your RS-485 equipment.

3. If the rest of your RS-485 network conforms to the RS-530 interface-pinning standard, you can convert the repeater's RJ-45 connector to RS-530 with the optional adapters listed in Table 3-2. These are available separately.

Just attach RJ-45 or RJ-11 cable from the modular connectors on the Repeater (J1 and J2) to the adapter's modular connector. Then attach the RS-530 cable from the rest of your network to the other side of the adapter. Make sure that the RJ cable you use is straight-through pinned (that is, Pin 1 at one end of the cable is connected to Pin 1 on the other end, Pin 2 to Pin 2, etc.).

Contact our technical support staff for more information on using these adapters.

Table 3-2. Available RJ-45 to RS-530 Adapters

Description of RS-530 side	Quote number
DCE female	C1CB11564
DCE male	C1CB11565
DTE female	C1CB11566
DTE male	C1CB11567

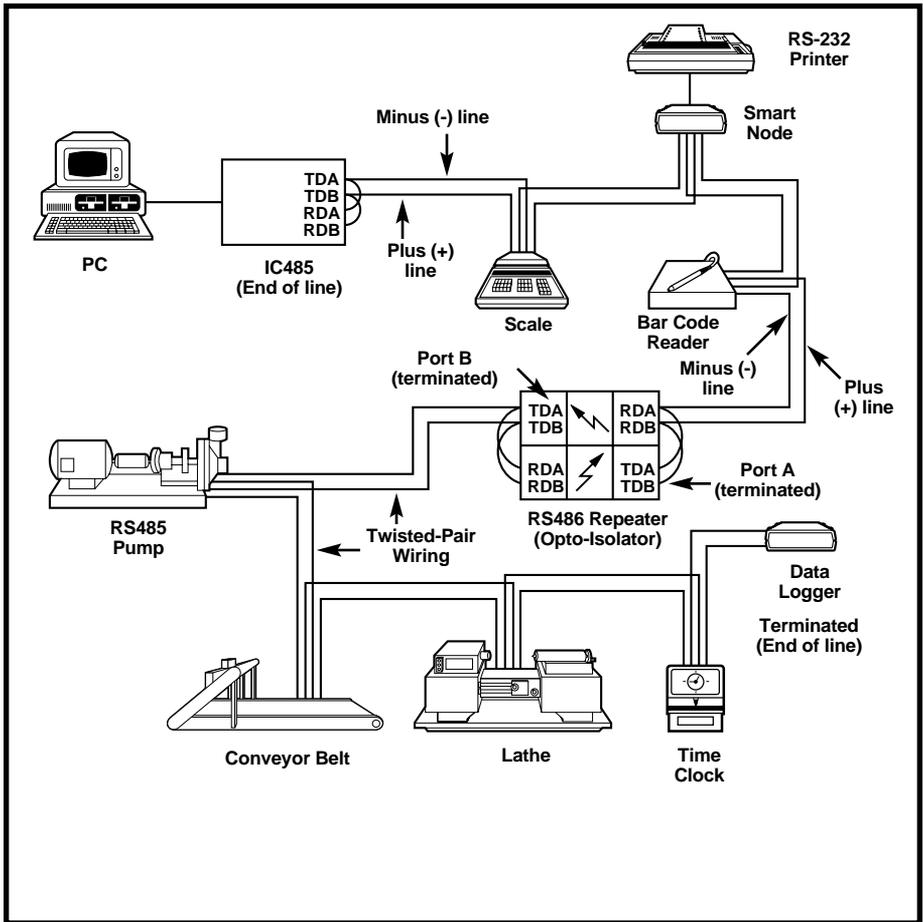


Fig. 3-5. The RS-485 Repeater in a 2-Wire, Half-Duplex Application.

NOTE: For more information on RS-485 network performance (signal speed versus length of the network), refer to Table A-3 in the **Appendix** to this manual.

RS-485 Repeater and RS-485 Repeater (Opto-Isolated)

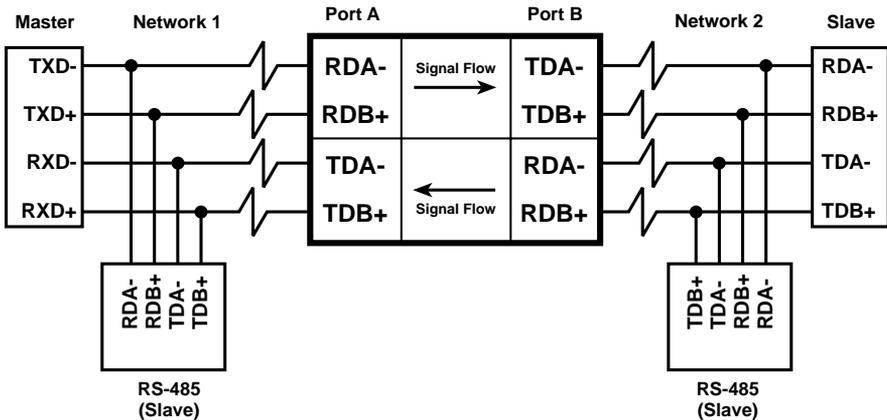


Fig. 3-6. Cabling and Signal Flow in Four-Wire, Full-Duplex Operation

NOTE: As shown in Fig. 3-6, the Repeater is considered a slave device on the Network 1 side, but the master device on the Network 2 side: By repeating the signals sent from the master on Network 1, it looks like a master to the slave devices on Network 2. That's why on Network 2, the Repeater's data leads are matched up with those of the slave device, but on Network 1, its receive-data leads are attached to the slave's transmit leads, and its transmit-data leads are attached to the slave's receive leads.

Appendix

A.1 The RS-485 Repeater Delay Circuitry

The Repeater uses three different types of delays: a Turn-around delay (discussed in **Chapter 3.1**), a turn-ON delay, and a turn-OFF delay. See Fig. A-1 for an illustration of how delay circuitry operates in the Repeater.

The turn-ON delay prevents noise on the RS-485 line from enabling

the Repeater transmitter and being passed as data. Typically, noise on the RS-485 line is an electrical signal of very short duration. If noise should reach the RS-485 receiver on Port A in Fig. A-1, it must pass through the carrier detect, opto-isolation, and delay circuitry to get to the RS-485 transmitter on Port B. The delay circuitry has been set at the factory to delay the enabling of the Repeater's transmitter long enough for the Repeater's transmitter to delay the enabling of the Repeater's transmitter long enough for most noise to dissipate before

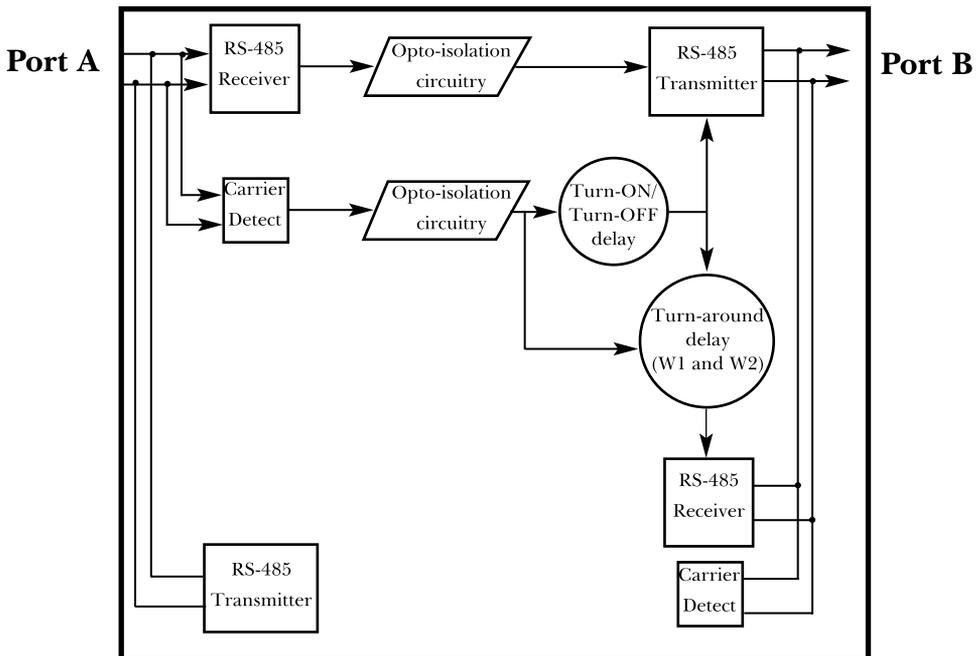


Fig. A-1. Repeater Delay Circuitry: A Signal Received at Port A Propagates Through the Receiver to Port B.

RS-485 Repeater and RS-485 Repeater (Opto-Isolated)

the transmitter is ready to send. Thus the delay circuitry keeps noise from being passed along by the Repeater. The turn-ON delay for the RS-485 Repeater has been factory-set to @3.3 μ sec.

The turn-OFF delay keeps the RS-485 transmitter enabled long enough for the input data to have time to propagate through the Repeater after the sending device drops the carrier signal. This delay is 6 μ sec.

Here's what happens: when the transmitting device stops sending, the Repeater's carrier-detect circuitry will sense a loss of carrier and disable the Repeater's transmitter. At high baud rates, the transmitter may be disabled before all the data can propagate through. Delaying the transmitter-disable for approximately 6 μ sec, ensures that all of the data propagates through the Repeater before the transmitter is disabled.

A.2 Connector Pinning

Table A-1 shows the pinning for the Repeater's four-screw terminal-block connectors. Table A-2 shows the pinning for the repeater's RJ-45 connectors.

Table A-1. Terminal Block Pinning

Pins	Signal
1	RDB+
2	RDA-
3	TDB+
4	TDA-

Table A-2. RJ45 Connector Pinning

Pins	Signal
1	Not connected
2	Not connected
3	RDB+
4	TDB+
5	TDA-
6	RDA-
7	Not connected
8	Not connected

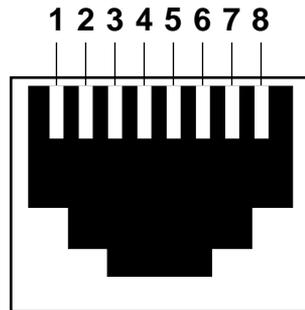


Fig. A-2. RJ-45 Connector.

Table A-3 shows the edge card connector pinouts. See pages 5 and 6 for the board layouts.

Table A-3. Edge Card Connector Pinning

Pins	Signal
1	AC voltage in
2	AC voltage in
3	Signal Ground
4	Frame Ground
A	TXA
B	TXB
E	RXA
F	RXB

A.3 Network Performance

Signal speed on any communication line is directly dependent on the distance the signal must travel.

Table A-3 shows speed versus distance characteristics for a 4-wire point-to-point application using 24 AWG twisted-pair wiring.

Table A-4. Data Communication Rates

Speed in bps	Distance in miles (km)
1200	4.0 (6.4)
2400	3.0 (4.8)
4800	2.3 (3.7)
9600	1.7 (2.7)
19,200	1.2 (1.9)
38,400	0.9 (1.4)
64,000	0.8 (1.2)

Quick Setup Guide

This chapter is designed to help the experienced user get the RS-485 Repeater installed and running as quickly as possible. (Figure 3-1 or 3-2 show the location of components on the Repeater circuit board.)

Follow these steps for *half-duplex* operation:

- To set the Repeater to half-duplex operation:

Set...	to position...
W3	A-B
W4	A-B

NOTE: Half-duplex is the factory-set default position for these components.

- Next, set the turn-around signal-response delay with W1 and W2.

If your application...	set W1 and W2 to position...
has long line-lengths and/or many device drops	D (35 msec)
has moderate line-lengths and/or many device drops	C (5 msec)
has short line-lengths and/or few device drops	B (1 msec)
is used infrequently	A (0.1 msec)

Follow these steps for *full-duplex* operation:

- To set the Repeater to full-duplex operation:

Set...	to position...
W3	B-C
W4	B-C

- To terminate/unterminate Ports:

Port	Terminated	Unterminated
A	S1=ON	S1=OFF
B	S2=ON	S2=OFF

- Attach your cables to the Repeater (see **Chapter 3-2** for information on cabling).

- Power up the Repeater.
- Power up your RS-485 network.

You're ready to go.