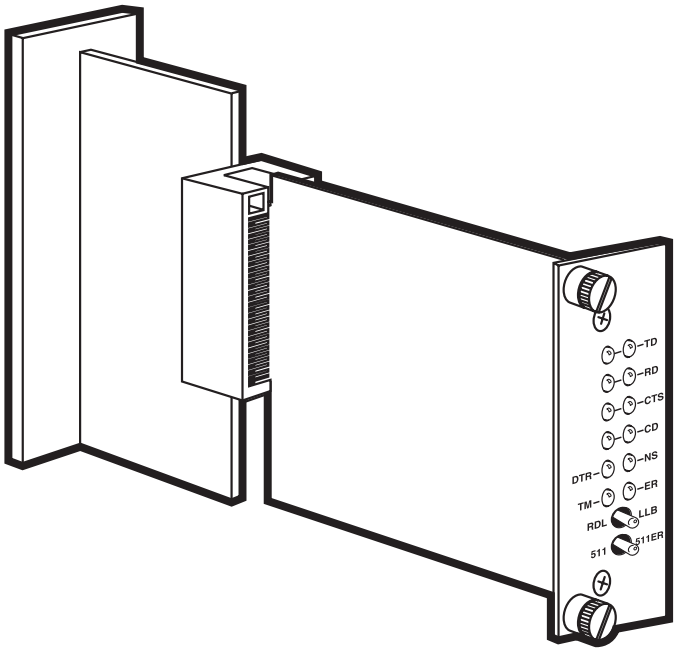
BLACK BOX®
NETWORK SERVICES

NOVEMBER 2001
ME0004C-10BT
ME0004C-G703
ME0004C-RS530
ME0004C-V24
ME0004C-V35
ME0004C-X21

High-Speed 2-Wire Short-Range DSL Line Driver (mDSL Rack Card)



CUSTOMER SUPPORT INFORMATION

Order **toll-free** in the U.S.: Call **877-877-BBOX** (outside U.S. call **724-746-5500**)
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Mailing address: **Black Box Corporation**, 1000 Park Drive, Lawrence, PA 15055-1018
Web site: **www.blackbox.com** • E-mail: **info@blackbox.com**

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 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.

EUROPEAN UNION DECLARATION OF CONFORMITY

This equipment complies with the requirements of the European EMC Directive 89/336/EEC.

CE

NORMAS OFICIALES MEXICANAS (NOM)
ELECTRICAL SAFETY STATEMENT

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 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.

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Contents

Chapter **Page**

1. Specifications

Transmission Format: Synchronous

Transmission Line: Two-wire unconditioned twisted pair

Clocking: Internal, external, or receive recovered clock

Interface Modules: 10BASE-T, G.703/G.704, RS-530, V.24, V.35, X.21

Line Rates: 144, 272, 400, 528, 784, 1040, 1552, 2064, and 2320 kbps

DTE Rates: 64, 128, 192, 256, 320, 384, 448, 512, 576, 640, 704, 768, 832, 896, 960, 1024, 1088, 1152, 1216, 1280, 1344, 1408, 1472, 1536, 1600, 1664, 1728, 1792, 1856, 1920, 1984, 2048, 2112, 2176, 2240, and 2304 kbps

Diagnostics: V.52-compliant bit error rate pattern (511/511E pattern) generator and detector with error injection mode; Local Line Loopback and Remote Digital Loopback, activated by front-panel switch or via serial interface

LED Status Indicators: TD, RD, CTS, CD, DTR, NS (no signal), ER (error), and TM (test mode)

Connectors: RJ-45 or terminal block on line side; DB25 female, M/34 female, DB15 female, or dual BNC on serial interface side, depending upon which interface module is installed

Temperature Range: 32 to 122°F (0 to 50°C)

Altitude: Up to 15,000 feet (4572 m)

Humidity: 5 to 95% noncondensing

Power: 90 to 264 VAC, 50–60 Hz (universal input), 10 watts

Size: Front Card: 3.1"H x 0.95"W x 4.8"D (7.9 x 2.4 x 12.2 cm); Rear Card: 2.8"H x 0.95"W x 3.3"D (7.1 x 2.4 x 8.4 cm)

Weight: Front Card: 0.22 lb. (0.1 kg); Rear Card (M/34 with V.35 interface): 0.16 lb. (0.07 kg); Rear Card (DB25/RS-232 interface): 0.12 lb. (0.05 kg); Rear Card (Dual BNC): 0.2 lb. (0.09 kg); Rear Card (DB15): 0.12 lb. (0.05 kg)

2. Introduction

2.1 Description

The High-Speed 2-Wire Short-Range DSL Line Driver Rack Card provides high-speed 2-wire connectivity to ISPs, PTTs, and corporations using mDSL (Multi-rate Digital Subscriber Line) technology. Multi-rate DSL offers the ability to deliver the maximum bit rate that a twisted-pair line can accommodate. Supporting multiple line rates from 144 kbps to 2.320 Mbps, the mDSL Rack Card provides "megabit" speeds to leased-line, LAN-to-LAN interconnection, and WAN access networks over 3.6 miles/5.8 km (1.054 Mbps on 24-AWG/0.5-mm wire).

The mDSL Rack Card allows DTE speeds from 64 kbps to 2.3 Mbps in 64-kbps increments. Features include loopback diagnostics, out-of-band SNMP/HTTP remote management capabilities when using the SNMP Management Module (part number RM261C-SNMP), and externally accessible configuration switches.

As a symmetric DSL NTU, the mDSL Rack Card offers the same data rates in both directions over a single pair of regular telephone lines using Carrierless Amplitude and Phase (CAP) modulation. The mDSL Rack Card is designed to fit into Black Box's 2U-high rack chassis (part number RM260). This chassis uses a mid-plane architecture, allowing front cards to be plugged into different rear cards. Please see the RM260 manual for more information on the power-supply options that are available.

The mDSL Rack Card Plug-and-Play feature allows you to configure the DTE rate for the link from the rack card at the central office. The standalone unit at the customer premise site will automatically configure itself to the DTE rate of the rack card. Other configuration parameters fall to the default state. This allows changes in the configuration to be handled from a single end of the link.

2.2 Features

- DSL distances on just two wires using mDSL technology.
- DTE speeds from 64 kbps to 2.3 Mbps.
- 2-wire operation.
- Fits in the 2U Rackmount Chassis (part number RM260).
- Plug-and-Play master capable.

- SNMP network management with in-band management of remote units plus advanced diagnostics and statistics using the RM261C-SNMP.
- Internal, external, or receive recovered clocking options.
- LED indicators for TD, RD, CTS, CD, DTR, TM, ER, and NS.

3. Configuration

3.1 Configuring the Hardware Switches

The mDSL Rack Card front card uses hardware switches for configuration. An interface driver board strap and three eight-position DIP switches are positioned on the bottom side of the front card (see Figure 3-1).

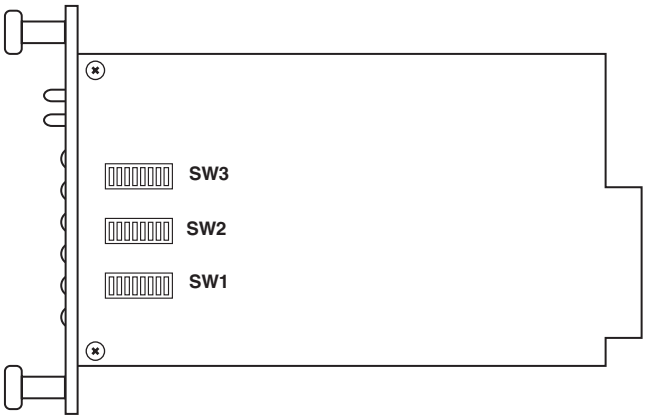

Figure 3-1. The mDSL Rack Card's configuration switches.

Figure 3-2 shows the orientation of the DIP switches with respect to the ON and OFF positions.

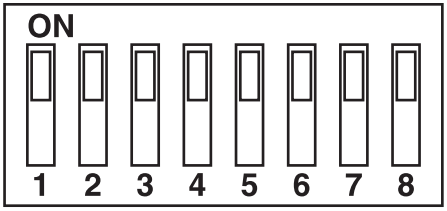

Figure 3-2. Close-up of configuration switches (all switches are identical in appearance).

3.1.1 Reversible Interface Driver Board

The mDSL Rack Card features switchable interface driver boards that allow a wide range of DTE interface connections. Figure 3-3 shows the interface driver board on the top of the mDSL Rack Card PC board.

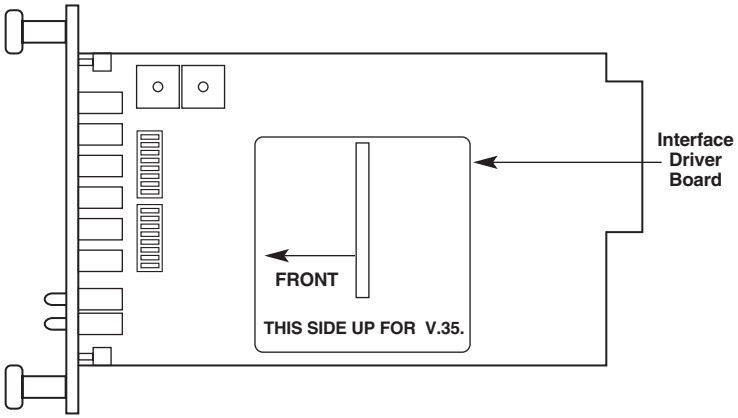

Figure 3-3. Close-up of the interface driver board.

Follow the instructions below to select the correct interface for your application:

1. With the mDSL front card pulled out of the rack chassis, locate the driver board on the top of the mDSL front card.

2. Lift the interface board gently off of the PC board.

3. Locate the correct interface on the bottom of the driver board. For example, the RS-232/V.35 interface board is marked “THIS SIDE UP FOR RS-232” on one side and “THIS SIDE UP FOR V.35” on the other side. Other “single” interface boards are marked with “FRONT” on one side of the board.

4. Re-orient the interface board into the socket with the appropriate interface pointed UP and with the arrow pointing toward the front panel of the mDSL Rack Card PC board.

5. Push the interface driver board gently onto the socket and re-install into the rack system.

3.1.2 Connecting to a DTE Device

The serial port on most interface modules (all except the X.21 module) is hard-wired as a DCE. Therefore these modules "want" to plug into a DTE such as a terminal, PC, or host. When making the connection to your DTE device, use a straight-through cable of the shortest possible length—we recommend 6 feet (1.8 m) or less. When purchasing or constructing an interface cable, please refer to the pin diagrams in **Appendix A** as a guide.

3.1.3 Connecting to a DCE Device

If the mDSL Rack Card interface module is hard-wired as a DCE (all except the X.21 module), you must use a null-modem cable when connecting to a modem, multiplexor, or other DCE device. This cable should be of the shortest possible length—we recommend 6 feet (1.8 m) or less. When purchasing or constructing a null-modem interface cable, use the pin diagrams in **Appendix A** as a guide.

NOTE

Pinout requirements for null-modem applications vary widely between manufacturers. If you have any questions about a specific application, call Black Box Technical Support at 724-746-5500.

3.1.4 Configuring the X.21 Interface Module

The serial port on the X.21 interface module is default wired as a DCE, but may be switched to a DTE. This is done by reversing the orientation of the DCE/DTE strap, as described below:

To reverse DCE/DTE orientation, remove the interface module according to the instructions in **Section 3.1.1**. The DCE/DTE strap is located on the top side of the interface module's PC board. The arrows on the top of the strap indicate the configuration of the X.21 port (for example, if the DCE arrows are pointing toward the rear card connector, the X.21 port is wired as a DCE). Reverse the DCE/DTE orientation by pulling the strap out of its socket, rotating it 180°, then plugging the strap back into the socket. You will see that the DCE/DTE arrows now point in the opposite directions, showing the new configuration of the X.21 port. Reinstall the module according to the instructions in **Section 3.1.1**.

3.1.5 Configuring DIP-Switch Set S1

Switch S1 is used to set the address of the card in the SNMP Management Module. When the mDSL Rack Card is installed with a SNMP Management Module, the cards and their remote units can be SNMP managed using a standard Network Management Station (NMS) or a standard Web browser (Netscape® Navigator or Internet Explorer®). For more information about setting the address, refer to the *SNMP Management Module Users' Manual* (part number RM261C-SNMP).

NOTE

If you are not using your mDSL Rack Card in a network-managed environment, please set all S1 switches to the ON position.

3.1.6 Configuring DIP-Switch Set S2

The configuration switches on S2 allow you to specify the clocking mode and response to DTE loop enable. Default settings of S2 are shown in Table 3-1.

Table 3-1. S2 summary.

Position	Function	Factory Default
S2-1	Reserved	Off
S2-2	Reserved	Off
S2-3	Reserved	Off
S2-4	Reserved	Off
S2-5	Reserved	Off
S2-6	Clock Mode	On } Internal
S2-7	Clock Mode	On } Internal
S2-8	Enable Loop from DTE	Off Disable

Switches S2-1, S2-2, S2-3, S2-4, and S2-5: These switches are reserved for future use and should remain in the OFF position.

Switches S2-6 and S2-7: Clock Mode

Use Switches S2-6 and S2-7 to configure the mDSL Rack Card for internal, external, or receive recover clock mode.

Table 3-2. Clock mode.

CO/CP Unit	S2-6	S2-7	Clock Mode	Description
CO	On	On	Internal	Transmit clock generated internally
CO	Off	On	External (DTE)	Transmit clock derived from the terminal interface
CP	On	Off	Receive Recover	Transmit clock derived from the receive line
	Off	Off		Reserved

Switch S2-8: Enable/Disable Loop Tests from DTE

Use Switch S2-8 to allow the mDSL Rack Card to enter loopback tests when the DTE raises the appropriate loop request pin.

Table 3-3. Enable/disable loop tests.

S2-8	Setting
On Off	Response to DTE Loopback Request Enabled Response to DTE Loopback Request Disabled

3.1.7 Configuring DIP-Switch Set S3

Use the eight DIP switches in Switch S3 to enable the DTE connection rate. The following table summarizes default positions of DIP-Switch S3. Detailed descriptions of each switch follow the table.

Table 3-4. S3 summary.

Position	Function	Factory Default
S3-1	DTE Rate	On
S3-2	DTE Rate	Off
S3-3	DTE Rate	Off
S3-4	DTE Rate	Off
S3-5	DTE Rate	On
S3-6	DTE Rate	On
S3-7	Reset Software Defaults	On — Normal operation
S3-8	Transmit Data Sample Point	On — Normal operation

Switch S3-1: DTE Rate

Use Switches S3-1 through S3-6 to set the rate-adaptive DTE bit rate.

Table 3-5. DTE bit rate.

S3-1	S3-2	S3-3	S3-4	S3-5	S3-6	DTE Rate (kbps)
Off	Off	On	On	On	On	64
On	On	Off	On	On	On	128
Off	On	Off	On	On	On	192
On	Off	Off	On	On	On	256
Off	Off	Off	On	On	On	320
On	On	On	Off	On	On	384
Off	On	On	Off	On	On	448
On	Off	On	Off	On	On	512
Off	Off	On	Off	On	On	576
On	On	Off	Off	On	On	640
Off	On	Off	Off	On	On	704
On	Off	Off	Off	On	On	768
Off	Off	Off	Off	On	On	832

Table 3-5 (continued). DTE bit rate.

S3-1	S3-2	S3-3	S3-4	S3-5	S3-6	DTE Rate (kbps)
On	On	On	On	Off	On	896
Off	On	On	On	Off	On	960
On	Off	On	On	Off	On	1024
Off	Off	On	On	Off	On	1088
On	On	Off	On	Off	On	1152
Off	On	Off	On	Off	On	1216
On	Off	Off	On	Off	On	1280
Off	Off	Off	On	Off	On	1344
On	On	On	Off	Off	On	1408
Off	On	On	Off	Off	On	1472
On	Off	On	Off	Off	On	1536
On	On	Off	Off	Off	On	1600
Off	On	Off	Off	Off	On	1664
On	Off	Off	Off	Off	On	1728
Off	Off	Off	Off	Off	On	1792
On	On	On	On	On	Off	1856
Off	On	On	On	On	Off	1920
On	Off	On	On	On	Off	1984
Off	Off	On	On	On	Off	2048
On	On	Off	On	On	Off	2112
Off	On	Off	On	On	Off	2176
On	Off	Off	On	On	Off	2240
Off	Off	Off	On	On	Off	2304

NOTE

The actual line rates of the line driver is determined by the selection of the DTE rate. To see the line rate associated with various DTE rates, refer to the distance chart in Appendix B.

Switch S3-7: Reset Software Defaults

Switch S3-7 allows the user to reset the software-configured factory defaults. This will only be needed when using the SNMP Management Module (part number RM261C-SNMP) to SNMP manage your units. For more information, please refer to the *SNMP Management Module Users' Manual*.

Table 3-6. Reset software defaults.

S3-7	Setting
On Off	Normal Operation Reset

Switch S3-8: Transmit Data (TD) Sampling Point

Table 3-7. Transmit data sampling point.

S3-8	Setting	Description
On	Normal	TD sampled on the falling edge of the mDSL Rack Card Transmit Clock (TC)
Off	Invert	TD sampled on the rising edge of the mDSL Rack Card Transmit Clock

3.2 mDSL Rack Card Plug-and-Play

The mDSL Rack Card Plug-and-Play application allows ISPs and PTTs to quickly upgrade the link speed for a customer without re-configuring the customer premise (CP) unit (such as the ME0008A or ME0005A). It will also allow ISPs and PTTs to set up all of the configurations at the central office (on the rack cards) before installation of the standalone units, thus saving time spent configuring and re-configuring DIP-switch settings.

The mDSL Rack Card Plug-and-Play feature allows you to configure the DTE rate for the link from the rack card at the Central Office (CO). The standalone unit at the Customer Premise (CP) site will automatically configure itself to the DTE rate of the rack card. Other configuration parameters fall to the default state. This allows changes in the configuration to be handled from a single end of the link.

When installing a CO/CP-style application, the local end of the link is comprised of a CO unit (mDSL Rack Card) set to either internal or external clocking mode and a CP unit (such as the ME0008A, ME0005A, or another ME0004C) set as a Plug-and-Play unit. The Plug-and-Play CP standalone will have all of its DIP switches set to the ON position (as indicated in Figure 3-4).

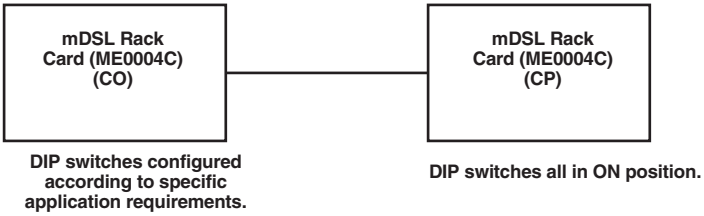

Figure 3-4. Typical Plug-and-Play application.

When the units are connected, the CP will come up with a predefined default configuration (Receive Recovered clocking). During the handshaking process between the units, the CO unit will set the DTE rate/line rate of the CP unit to match its DIP-switch configuration settings. If the DTE rate for the link requires a change, the change is needed only at the CO side of the link.

The mDSL Rack Card Plug-and-Play application will also work in the managed system using the SNMP Management Module and mDSL Rack Cards installed in the 2U rack system. In this application, the system administrator can configure the entire rack through the Network Management Station (NMS) before the standalone (CP) units are installed. For more information on the SNMP management of your rack, please refer to the *SNMP Management Module Operations Manual*.

3.3 Configuring the Rear Interface Cards

The mDSL Rack Card has five interface card options: 10BASE-T, G.703, RS-530, V.35, and X.21. Each of these options supports one DTE interface connection and one 2-wire line connection.

NOTE

The ME0004C rear cards are specifically designed to operate with the ME0004C function card and must not be swapped with other function cards.

Before installation, examine the rear card you have selected to be sure it is properly configured for your application. Each rear card is configured by setting straps located on the PC board. To configure the rear cards, set the configuration straps. Figure 3-5 shows the orientation of these straps. Each strap can either be on pegs 1 and 2 or on pegs 2 and 3.

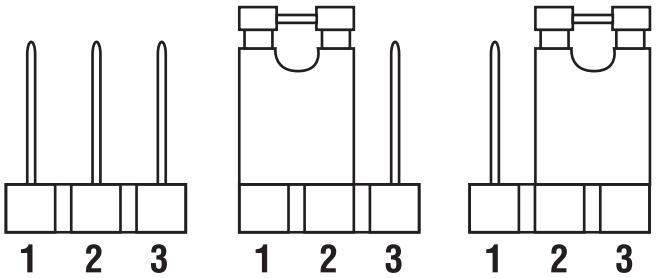

Figure 3-5. Orientation of interface card straps.

Sections 3.3.1, **3.3.2**, and **3.3.3** describe the strap locations and possible settings for each rear card.

3.3.1 DB25 (RS-530 and V.24) Rear Card Strap Settings

Figure 3-6 shows strap locations for the DB25 rear cards. These straps determine various grounding characteristics for the terminal interface and twisted-pair lines. JB3 and JB4 are user-configurable.

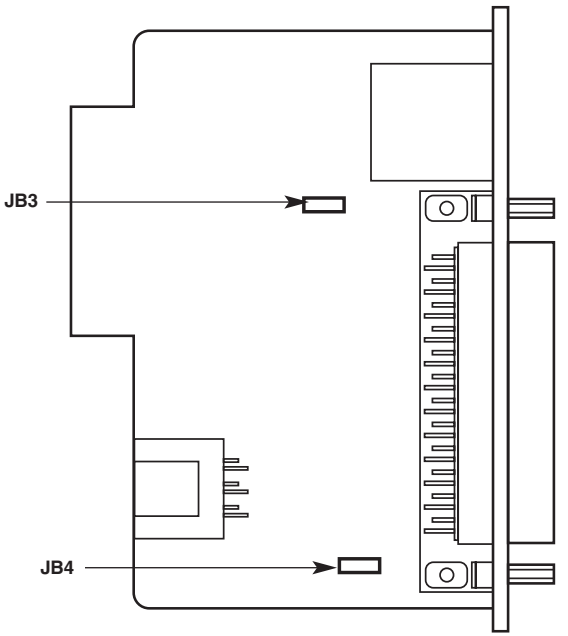

Figure 3-6. Strap locations.

Table 3-8 provides an overview of interface strap functions for the rear interface cards. Following the table overview are detailed descriptions of each strap's function.

Table 3-8. Interface card strap summary.

Strap	Function	Position 1 and 2	Position 2 and 3
JB3	DTE Shield (Pin 1) and FRGND	Connected	Open*
JB4	FRGND and SGND	Connected	Open*

*Default setting

DTE Shield (DB25 Pin 1) and FRGND (JB3)

In the connected position, this strap links DB25 pin 1 and frame ground. In the open position, pin 1 is disconnected from frame ground.

Table 3-9. DTE shield and FRGND.

JB3
Position 1 & 2 = DTE Shield (Pin 1) and FRGND connected Position 2 & 3 = DTE Shield (Pin 1) and FRGND not connected

FRGND and SGND (JB4)

In the connected position, this strap links DB25 pin 7 (signal ground) and frame ground through a 100-ohm resistor. In the open position, pin 7 is connected directly to frame ground.

Table 3-10. FRGND and SGND.

JB4
Position 1 & 2 = SGND (Pin 7) and FRGND connected through a 100-ohm resistor
Position 2 & 3 = SGND (Pin 7) and FRGND directly connected

3.3.2 M/34 (V.35) Rear Card Strap Settings

Figure 3-7 shows the strap location for the M/34 rear card. This strap determines whether signal ground and frame ground will be connected.

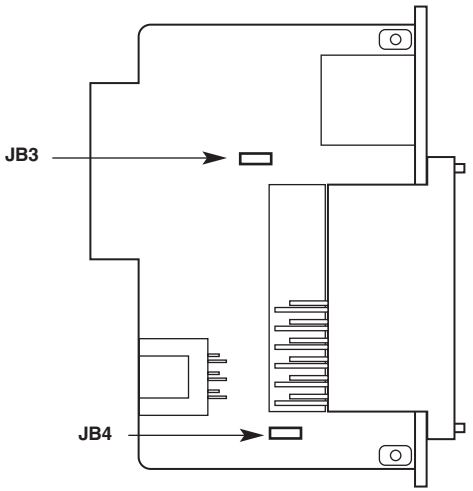

Figure 3-7. Strap locations.

Table 3-11 provides an overview of interface strap functions for the rear interface cards. Following the table overview are detailed descriptions of each strap's function.

Table 3-11. Interface card strap summary.

Strap	Function	Position 1 and 2	Position 2 and 3
JB3	DTE Shield (Pin A) and FRGND	Connected	Open*
JB4	FRGND and SGND (Pin B)	Connected	Open*

*Default setting

DTE Shield (M/34 Pin A) and FRGND (JB3)

In the connected position, this strap links M/34 pin A and frame ground. In the open position, pin A is disconnected from frame ground.

Table 3-12. DTE shield and FRGND.

JB3
Position 1 & 2 = DTE Shield (Pin A) and FRGND connected Position 2 & 3 = DTE Shield (Pin A) and FRGND not connected

FRGND and SGND (JB4)

In the connected position, this strap links signal ground and frame ground through a 100-ohm resistor. In the open position, signal ground is disconnected from frame ground.

Table 3-13. FRGND and SGND.

JB4
Position 1 & 2 = FRGND and SGND connected Position 2 & 3 = FRGND and SGND not connected

3.3.3 DB15 (X.21) Rear Card Strap Settings

Figure 3-8 shows strap locations for the DB15 rear cards. These straps determine various grounding characteristics for the terminal interface and twisted-pair lines. JB3 and JB4 are user-configurable.

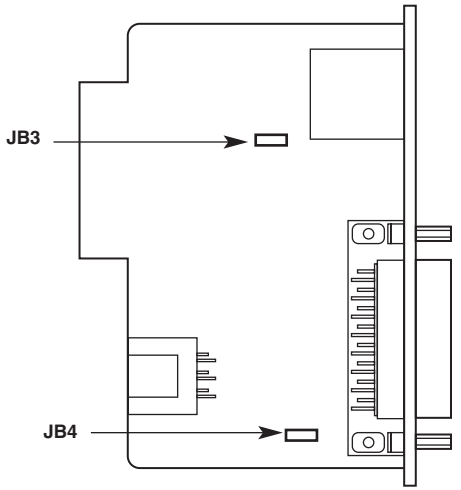

Figure 3-8. Strap locations.

Table 3-14 provides an overview of interface strap functions for the rear interface cards. Following the table overview are detailed descriptions of each strap's function.

Table 3-14. Interface card strap summary.

Strap	Function	Position 1 and 2	Position 2 and 3
JB3	DTE Shield (Pin 1) and FRGND	Connected	Open
JB4	FRGND and SGND (Pin 8)	Connected	Open*

DTE Shield (DB15 Pin 1) and FRGND (JB3)

In the connected position, this strap links DB15 pin 1 and frame ground. In the open position, pin 1 is disconnected from frame ground.

Table 3-15. DTE shield and FRGND.

JB3
Position 1 & 2 = DTE Shield (Pin 1) and FRGND connected Position 2 & 3 = DTE Shield (Pin 1) and FRGND not connected

FRGND and SGND (JB4)

In the connected position, this strap links DB15 pin 8 (signal ground) and frame ground through a 100-ohm resistor. In the open position, pin 8 is connected directly to frame ground.

Table 3-16. FRGND and SGND.

JB4
Position 1 & 2 = SGND (Pin 8) and FRGND connected through a 100-ohm resistor
Position 2 & 3 = SGND (Pin 8) and FRGND directly connected

Installing the X.21 Daughterboard onto the X.21 Line Driver Card

Figure 3-9 shows the X.21 daughterboard, DCE/DTE selector, and jumper (JP1) location with respect to the rack card. Following Figure 3-9 are guidelines for the installation of the X.21 daughterboard, setting for DCE/DTE, and a brief description of Jumper JP1.

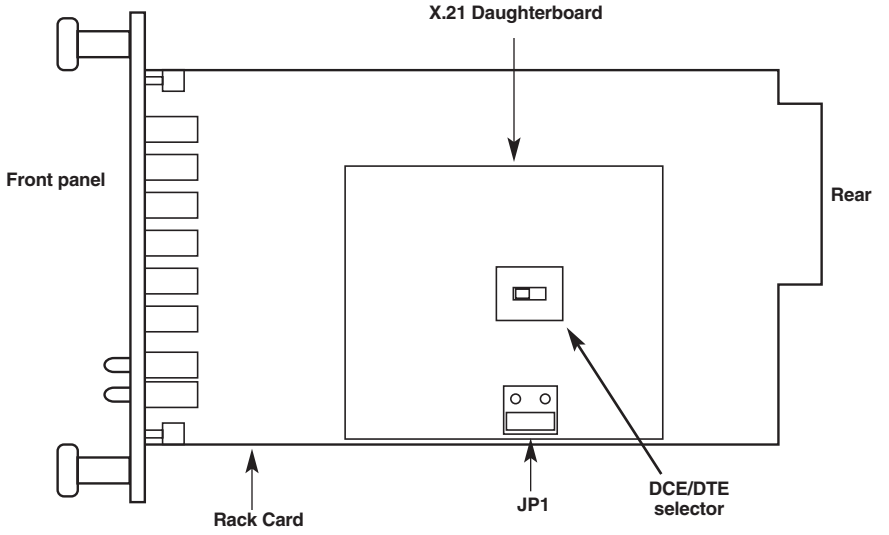

Figure 3-9. View of the X.21 daughterboard, DCE/DTE selector, and JP1.

Follow the steps below for proper installation of the X.21 daughterboard.

WARNING

The X.21 daughterboard connector is not keyed and can be installed incorrectly.

1. On the top side of the X.21 daughterboard, locate the designator shown:

   ← **Front X.21**

2. Install the X.21 daughterboard onto the front card with the "Front X.21" arrow pointing to the front panel of the rack card (see Figure 3-9).

DCE/DTE Selector for the X.21 Daughterboard

The X.21 daughterboard can be set up as a DCE (default) or DTE device. The DCE/DTE selector must be installed in the X.21 daughterboard for any configuration. The following information describes the setting for DCE/DTE.

- DCE setting (default): To set a rack card as a DCE device, install the DCE/DTE selector with the DCE arrows pointing toward the front panel.
- DTE setting: To set a rack card as a DTE device, install the DCE/DTE selector with the DTE arrows pointing toward the front panel.

Jumper (JP1) Setting

The X.21 daughterboard operates at speeds up to 2.3 Mbps. When using the daughterboard at data rates of 2 Mbps or higher, clocking issues may introduce bit errors. Bit errors can also occur when long cables are used to interconnect the modem to an X.21 terminal device (router, multiplexor, etc.). To solve bit error problems due to speed and/or long cables, the X.21 daughterboard is equipped with a jumper selector (JP1) that changes the sampling edge of the transmit clock. Refer to Figure 3-9 for jumper JP1 location.

The following is a brief description of JP1 setting and function.

- Normal setting: The jumper shorts the two outer pins of JP1. Figure 3-9 shows the default position. This position is selected when operating at low data rate (less than 2 Mbps) and using a short X.21 terminal cable.
- Invert setting: The jumper shorts the two inner pins of JP1. This setting is selected when operating at data rates of 2 Mbps or higher or when using long X.21 terminal cables.

NOTE

The G.703/G.704 Rear Card module is covered in Appendix D. The 10BASE-T Ethernet Rear Card module is covered in Appendix E.

4. Installation

This chapter describes the functions of the rack chassis, explains installation of front and rear mDSL Rack Cards into the chassis, and explains how to connect to the twisted-pair interface and the serial interface.

4.1 The Rack Chassis

The rack chassis (Figure 4-1) has fourteen short-range modem card slots, plus its own power supply. Measuring only 3.5" high, the rack is designed to occupy only 2U in a 19" rack. Sturdy front handles allow the rack chassis to be extracted and transported conveniently.

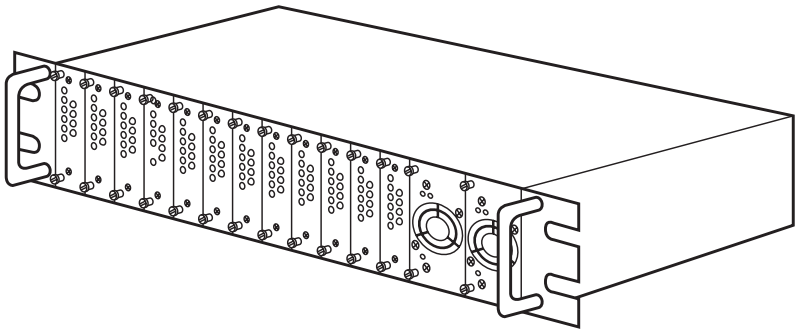

Figure 4-1. The rack chassis.

The Rack Power Supply

The power supply included in the rack uses the same mid-plane architecture as the modem cards. The front card of the power supply slides in from the front, and the rear card slides in from the rear. They plug into one another in the middle of the rack. The front card is then secured by thumbscrews, and the rear card by conventional metal screws.

WARNING

There are no user-serviceable parts in the power-supply section of the rack chassis. Voltage-setting changes and fuse replacement should only be performed by qualified service personnel. Contact Black Box Technical Support at 724-746-5500 for details.

Powering Up Your Rack

The power supplies that come with your rack system are equipped with a power-entry connector on the rear card. The power supplies are hot-swappable, so you are not required to remove the cards from the rack while applying power to the system.

The power switch is located on the front panel. When plugged in and switched on, a red front-panel LED will glow. Since the rack chassis is a "hot-swappable" rack, it is not necessary for any cards to be installed before switching on the power supply. The power supply may be switched off at any time without harming the installed cards.

4.2 Installing the mDSL Rack Card into the Chassis

The mDSL Rack Card is composed of a front card and a rear card. The two cards meet inside the rack chassis and plug into each other by way of mating 50-pin card-edge connectors. Use the following steps as a guideline for installing each mDSL Rack Card into the rack chassis:

1. Slide the rear card into the back of the chassis along the metal rails provided.
2. Secure the rear card using the metal screws provided.
3. Slide the front card into the front of the chassis. It should meet the rear card when it's almost all the way into the chassis.
4. Push the front card gently into the card-edge receptacle of the rear card. It should "click" into place.
5. Secure the front card using the thumbscrews.

4.3 Wiring the mDSL Rack Card

Each of the rear interface cards compatible with the mDSL Rack Card has one terminal interface port and one 2-wire (twisted-pair) port. For specific interface pinouts, refer to the diagrams in **Appendix A**.

4.3.1 Connection to the Twisted-Pair Interface

The mDSL Rack Card supports communication between two DTE devices at distances to 5 miles (8 km) over 24-AWG (0.5-mm) twisted-pair wire. There are two essential requirements for installing the mDSL Rack Card:

1. These units work in pairs. Therefore, you must have one mDSL Rack Card (or a compatible model) at each end of a single twisted-pair interface.

2. To function properly, the mDSL Rack Card needs one twisted pair of metallic wire. This twisted pair must be unconditioned, dry, metallic wire, between 19 (0.9 mm) and 26 AWG (0.4 mm); the higher-number gauges may limit distance some what. Standard dial-up telephone circuits, or leased circuits that run through signal-equalization equipment, or standard, flat modular telephone-type cable are not acceptable.

4.3.2 Two-Wire Cable Connection via RJ-45

The RJ-45 connector on the mDSL Rack Card's twisted-pair interface is polarity insensitive and is wired for a two-wire interface.The signal/pin relationships are shown in Figure 4-2.

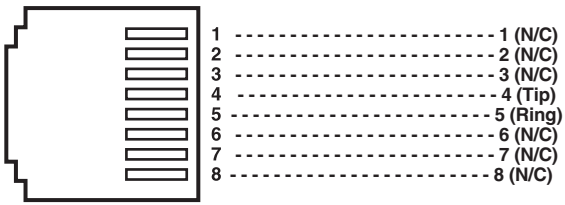

Figure 4-2. Twisted-pair line interface.

5. Operation

Once the mDSL Rack Card is properly configured and installed, it should operate transparently. This chapter describes functions of the LED status indicators and the use of the built-in loopback test modes.

5.1 LED Status Indicators

The mDSL Rack Card features twelve front-panel LEDs that monitor power, the DTE signals, network connection, and test modes. Figure 5-1 shows the location of each LED. Following Figure 5-1 is a description of each LED's function.

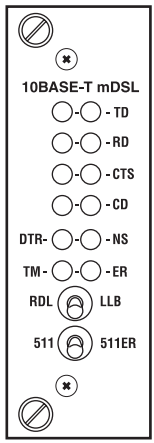

Figure 5-1. Front-panel LEDs.

- TD and RD: Glows yellow to indicate an idle condition of Binary "1" data on the respective terminal interface signals. Green indicates Binary "0" data.
- CTS: Consists of two LEDs (one yellow, one green). CTS glows green to indicate that the Clear to Send signal from the modem is active. Yellow indicates inactive CTS.
- CD: Consists of two LEDs (one yellow, one green). CD glows yellow if no carrier signal is being received from the remote modem. Green indicates that the remote modem's carrier is being received.
- DTR: Glows green to indicate that the Data Terminal Ready signal from the terminal is active.

- ER: Blinks ON/OFF after a 511/511E test has timed out. See **Section 5.2.4** for more information.

  Flashes once to indicate that a CRC error has occurred (during normal operation) or bit errors have occurred (during 511/511E test).

  Only at power up, blinks once every 200 ms if the DTE rate is set to an unsupported setting.

- TM: Glows yellow to indicate that the mDSL Rack Card has been placed in test mode. The unit can be placed in test mode by the local user or by the remote user. The TM LED will flash for 400 msec when a valid packet is received from the SNMP Management Module.

- NS: (No Signal) glows red to indicate that the local mDSL Rack Card is not connected with the remote mDSL Rack Card. The TM LED will flash for 400 msec when a valid packet is received from the SNMP Management Module.

5.2 Test Modes

The mDSL Rack Card offers two proprietary loopback test modes, plus a built-in V.52 BER test-pattern generator to evaluate the condition of the modems and the communication link. These tests can be activated physically from the front panel or via the interface.

5.2.1 Overview

Figure 5-2 shows the major elements used in the loopback and pattern tests available in the mDSL Rack Card. Each block has several functions. Following Figure 5-2 are descriptions that show how the elements are used during test modes.

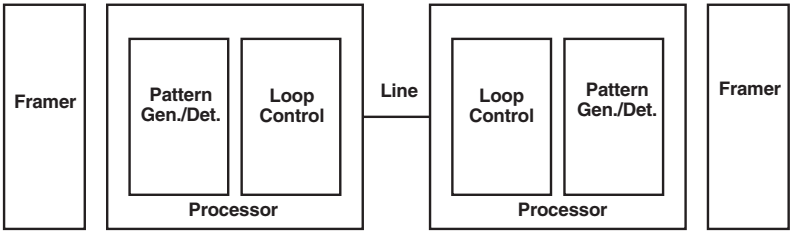

Figure 5-2. Major elements used in the loopback and pattern tests.

- Framer: The framer is used to determine the status of the line. In normal operation, the framer transmits and expects to receive framed packets from the far end. If the framer receives framed packets from the far end, CTS and CD will be active. If framed packets are not received, CTS and CD will be inactive. The restart procedure uses this information to determine if a valid connection is made (cable disconnect, poor cable quality, etc). In normal Data Mode, if the box receives four seconds of unframed packets, it will restart the box and begin trying to re-establish a connection with the far end. The distinction between framed packets and unframed packets becomes important when we discuss the pattern generator.

- Pattern Gen./Det.: This part of the processor generates and detects the 511/511E patterns. When transmitting 511 patterns, the information is unframed (because it originates after the framer) and is intended to be evaluated only by another processor. If the units are in Data Mode and the pattern generator is enabled on one end of the link, the far end will begin receiving unframed packets and assume that the line has gone down. During test modes, we force the pattern generator to time out before it can cause the link to be killed.

- Loop Control: This part of the processor is used to control loopbacks. In a Local Loop, the data is looped back towards the local DTE. In a Remote Loop, the data is looped back to the line, but it is also allowed to pass through to the framer and to the remote DTE.

5.2.2 Restart Procedure and Timeouts

The restart procedure is in place to allow the units to re-establish a connection after the framer begins seeing unframed packets. The Test Mode timing chart on the next page shows the amount of time the framer must see consecutive unframed packets before the unit will restart and try to establish a new line connection. The reason that there are different Restart Times will become apparent after reading the rest of the document. The 511/511E timeout shown refers to the amount of time the 511/511E pattern will be valid. At the end of this time, the pattern will automatically turn itself off and the normal data path will be re-established. The ER LED will flash, indicating to the user that the test has timed out. The ER LED will stop flashing once the 511/511E switch is placed into the normal position.

Table 5-1. Test mode timing.

Item	Elapsed Time (seconds)
Startup	50
Data Mode	4
511/511E Generator Enabled	60 (The generator will stop after 45 seconds.)
Remote End of an RDL	60
511/511E Timeout	45 (The pattern generator will automatically turn off after 45 seconds. The ER LED will flash until you turn off the 511/511E switch.)

Symbol Indicators

☐ This symbol designates the origination or the termination of a data path. The direction of the arrow connected distinguishes the two data paths.

☒ This symbol designates an invalid data path. If there is data present, it should be ignored.

5.2.3 Loops and Patterns

The following section describes the test modes used in the mDSL Rack Card. At the bottom of each test mode, a figure is included to show the data path.

Local Loop

There are two different modes of operation for a local loop, depending on the status of the units at the time that the local loop is initiated. If the units are not linked (NS LED on) and the local loop is initiated either by the front-panel switch or the DTE interface, the unit will enter mode 1. If the units are linked, NS LED off, then the unit will enter a mode 2 local loop.

A mode 1 local loop is shown in Figure 5-3. When the local loop is initiated, either by the front-panel switch or the DTE interface, the loop will be activated within the local DSP (Digital Signal Processor). The data present at the local DTE interface

will be looped back to the local DTE by the loop control block within the processor. Any data present on the line or at the far-end DTE interface is invalid. The remote unit will remain in the startup mode, NS LED off, CTS LED yellow, and CD LED yellow, until the local unit is taken out of the local loop mode. After the local loop is deselected, the units will both be in startup mode and the link will be established.

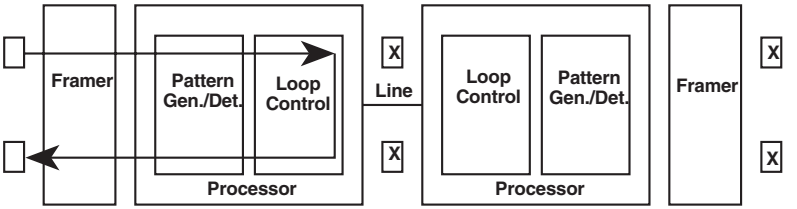

Figure 5-3. Local loop mode 1.

A mode 2 local loop is shown in Figure 5-4. When the local loop is initiated, either by the front-panel switch or the DTE interface, two separate loop paths will be started. In the first path, data presented to the local DTE interface will be looped back to the local DTE within the framer. In the second path, data presented at the far-end DTE will be transmitted to the local DTE, then looped back within the local DTE loop control block with the processor. After the local loop is deselected, the units will be placed back into data mode and the normal data paths will be re-established.

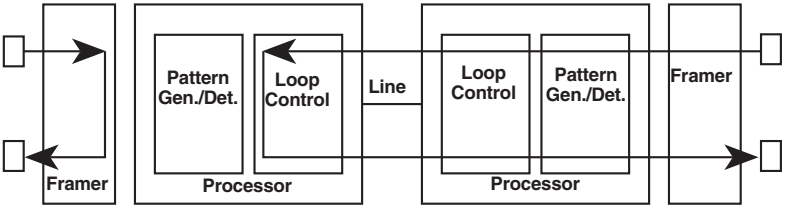

Figure 5-4. Local loop mode 2.

Local Loop with 511/511E

When the unit is placed into a mode 1 local loop and the 511/511E pattern generator is activated, the local pattern generator begins sending out a 511/511E pattern to the loop control block. The loop control block will loop this data back to the 511/511E pattern detector block, which will evaluate the data for errors. Because the 511/511E pattern generator is contained within the processor, the data is unframed, so the framer will begin seeing unframed packets. The framer receives this unframed data and cannot distinguish this information from a line disconnection (this would cause the unit's restart procedure to start). What we have done to allow this mode to work is to add timeouts for the pattern generators. When the 511/511E is initiated, the line-restart procedure is changed to one minute. The 511/511E pattern will timeout after 45 seconds. So if the 511/511E is turned on during a local loop, the restart procedure is set to one minute, but the 511/511E pattern will timeout after 45 seconds, allowing the framer to begin seeing framed packets (and not restart the box). After the 511/511E pattern times out, the ER LED will begin flashing.

It will remain this way until the pattern-generator switch is turned off. Note that the data at the local DTE and the remote DTE are not valid. Because the data is unframed, there is no way for the framer to send this data out to the DTE. This is an important distinction because other Black Box units will send out the 511 pattern.

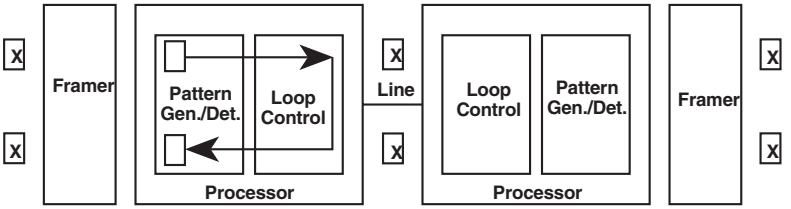

Figure 5-5. Local loop mode 1 with 511/511E.

When the unit is placed into a mode 2 local loop, the 511/511E pattern generator on the local unit is unavailable for transmission. As shown in Figure 5-6, the 511/511E pattern generator has no data path connections available. The 511/511E pattern generator is still available on the remote unit. For more information on the proper operation of this pattern generator, please refer to the *Remote Digital Loop with 511/511E* section.

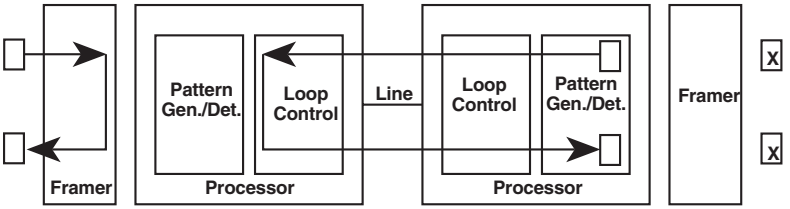

Figure 5-6. Local loop mode 2 with 511/511E.

Remote Digital Loop

The remote loop uses the EOC channel (an out-of-band signaling channel) to establish the remote link. Upon the RDL switch being thrown or DTE initiation, a RDL_ON request signal is sent to the remote unit. The remote unit then responds with an RDL acknowledge command, and the link is established. Data originates at the local DTE and is looped at the remote DSP back to the local DTE. Note that the data is also passed through to the remote DTE and is not squelched. When a remote unit enters RDL, it changes its restart timeout to one minute (the reason will be explained in the *RDL with 511/511E* section). If the line is disconnected, the local unit will restart (NS LED activated) after 4 to 6 seconds, but the remote unit will wait for one minute before it restarts. Note that the transmit data at the remote DTE is ignored. When the switch is thrown or the DTE removes the RDL request, the local unit will transmit an RDL_OFF request to the remote unit. The local unit will keep its TM LED active until this request has been completely sent out. If the switch is thrown again before the completion of the termination phase, the switch will be ignored until it is placed back into the normal position.

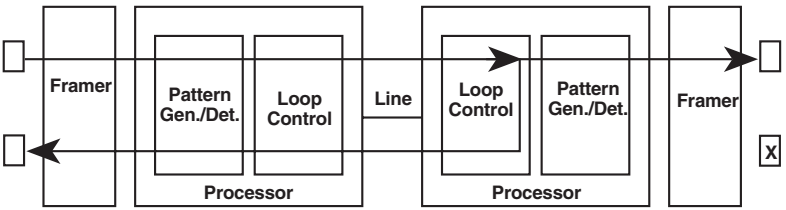

Figure 5-7. Remote loop.

Remote Digital Loop with 511/511E

The Remote Digital Loop with 511/511E is shown below. After RDL is established, the remote unit's restart timer is set to one minute. This is because when the 511/511E generator is started on the local unit, the remote framer begins seeing unframed packets. The remote unit cannot distinguish the 511/511E pattern from the line being disconnected, so the restart timer has been lengthened to allow the pattern generator to function. Once the 511/511E test is started, the local unit changes its restart timer to one minute. The pattern originates within the DSP and is sent to the remote unit. It is then looped back to the local unit where it is evaluated for errors. After 45 seconds, the pattern generator will timeout and stops sending the pattern. The ER LED will begin blinking until the user turns off the 511/511E switch.

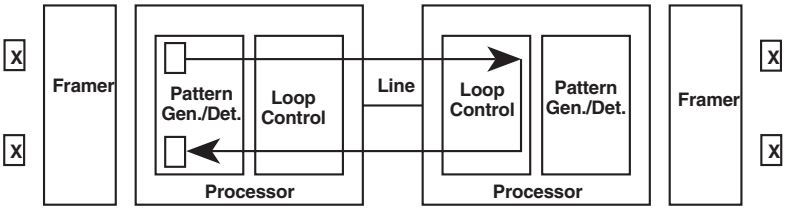

Figure 5-8. Remote loop with 511/511E.

Data Mode with 511/511E Pattern Generators

When the units enter Data Mode, you can turn on the 511/511E pattern generators on both ends of the link. Once a 511/511E pattern is selected on one end of the link, the pattern generator will begin transmitting unframed 511/511E through the line to the remote end. A possible problem with this test can occur due to the restart procedure. Once the local 511/511E is turned on, the remote unit begins receiving an unframed 511 pattern. If the remote unit does not turn on the 511/511E pattern generator within four seconds, the remote unit will restart and enter the startup mode. Note that once the 511/511E pattern generator is started, the restart timer is changed to one minute (only on the unit which has the pattern enabled). If both units enable the 511/511E pattern within four seconds of each other, both units will be transmitting and receiving the 511/511E pattern. Both framers are now receiving unframed data and will restart after one minute. The 511/511E pattern generators will timeout after 45 seconds, re-enabling the normal data path. The ER LED will begin flashing until the user terminates the test.

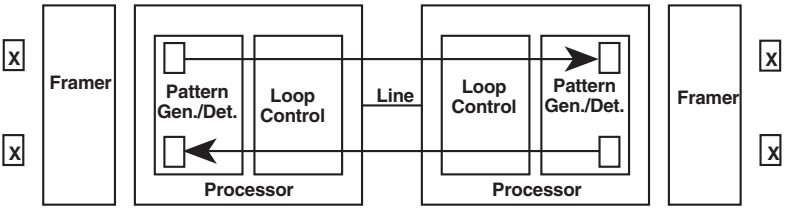

Figure 5-9. Data mode with 511/511E.

5.2.4 Using the V.52 (BER) Test-Pattern Generator

To use the V.52 BER tests in conjunction with the Remote Digital Loopback tests (or with Local Line Loopback tests), follow these instructions:

1. Locate the 511/511E toggle switch on the mDSL Rack Card's front panel and move it to the left. This activates the V.52 BER test mode and transmits a 511 test pattern into the loop. If any errors are present, the local modem's red ER LED will blink sporadically.

2. If the above test indicates that no errors are present, move the V.52 toggle switch to the right, activating the 511E test with errors present. If the test is working properly, the local modem's red ER LED will glow. A successful 511E test will confirm that the link is in place, and that the mDSL Rack Card's built-in 511 generator and detector are working properly.

NOTE

The V.52 BER tests can be used independently of the Remote Digital Loopback tests. This requires two operators: (one) to initiate and monitor the tests at the local mDSL Rack Card, and (one) to do the same at the remote mDSL Rack Card. In this case, the test pattern sent by each Rack Card will not be looped back, but will be transmitted down the line to the other mDSL Rack Card.

Appendix A. Terminal Interface Pin Assignments

Table A-1. V.35 interface pin assignments, M/34 female connector (DCE configuration).

Pin #	Signal
B	SGND (Signal Ground)
C	RTS (Request to Send)
D	CTS (Clear to Send)
E	DSR (Data Set Ready)
F	CD (Carrier Detect)
H	DTR (Data Terminal Ready)
L	LLB (Local Line Loop)
M	TM (Test Mode)
N	RDL (Remote Digital Loop)
P	TD (Transmit Data-A)
R	RD (Receive Data-A)
S	TD/ (Transmit Data-B)
T	RD/ (Receive Data-B)
U	XTC (External Transmit Clock-A)
V	RC (Receive Timing-A)
W	XTC/ (External Transmit Clock-B)
X	RC/ (Receive Timing-B)
Y	TC (Transmit Clock-A)
AA	TC/ (Transmit Clock-B)

Table A-2. RS-232, RS-530 interface pin assignments, DB25 female connector (DCE configuration).

Pin #	Signal
1	FG (Frame Ground)
2	TD (Transmit Data-A)
3	RD (Receive Data-A)
4	RTS (Request to Send-A)
5	CTS (Clear to Send-A)
6	DSR (Data Set Ready-A)
7	SGND (Signal Ground)
8	CD (Carrier Detect-A)
9	RC/ (Receive Timing-B)
10	CD/ (Carrier Detect-B)
11	XTC/ (External Transmit Clock-B)
12	TC/ (Test Control-B)
13	CTS/ (Clear to Send-B)
14	TD/ (Transmit Data-B)
15	TC (Test Control)
16	RD (Receive Data-A)
17	RC (Receive Timing-A)
18	LLB (Local Line Loop)
19	RTS/ (Request to Send-B)
20	DTR (Data Transfer Rate-A)
21	DL (Remote Digital Loop)
22	DSR/ (Data Set Ready-B)
23	DTR/ (Data Transfer Rate-B)
24	XTC (External Transmit Clock-A)
25	TM (Test Mode)

Table A-3. X.21 interface pin assignments, DB15 female connector (DTE /DCE configuration).

Pin #	Signal
1	Frame Ground
2	T (Transmit Data-A)
3	C (Control-A)
4	R (Receive Data-A)
5	I (Indication-A)
6	S (Signal Element Timing-A)
7	BT (Byte Timing-A, Not Used)
8	SGND (Signal Ground)
9	T/ (Transmit Data-B)
10	C/ (Control-B)
11	R/ (Receive Data-B)
12	I/ (Indication-B)
13	S/ (Signal Element Timing-B)
14	BT/ (Byte Timing-B, Not Used)

Appendix B. Distance Tables

Table B-1. No crosstalk.

Line Rate (kbps)	DTE Rates (kbps)	26 AWG (0.4 mm)			24 AWG (0.5 mm)		
		feet	miles	km	feet	miles	km
144	64, 128	21,400	4	6.5	30,700	5.8	9.4
272	192, 256	20,300	3.8	6.2	30,600	5.8	9.4
400	320, 384	18,600	3.5	5.7	29,100	5.5	8.9
528	448, 512	17,400	3.3	5.3	26,100	4.9	8
784	576, 640, 704, 768	15,800	3	4.8	22,600	4.3	6.9
1040	832, 896, 960, 1024	15,500	2.9	4.7	22,100	4.2	6.7
1552	1088–1536	13,600	2.6	4.2	19,200	3.6	5.9
2064	1600–2048	12,200	2.3	3.7	17,200	3.3	5.2
2320	2112–2304	11,500	2.2	3.5	15,800	3	4.8

Table B-2. Crosstalk (49 adjacent CAP pairs).

Line Rate (kbps)	DTE Rates (kbps)	26 AWG (0.4 mm)			24 AWG (0.5 mm)		
		feet	miles	km	feet	miles	km
144	64, 128	16,992	3.2	5.2	25,000	4.7	7.6
272	192, 256	15,088	2.9	4.6	22,000	4.2	6.7
400	320, 384	13,264	2.5	4	20,000	3.8	6.1
528	448, 512	12,300	2.3	3.8	18,000	3.4	5.5
784	576, 640, 704, 768	10,216	1.9	3.1	14,000	2.6	4.3
1040	832, 896, 960, 1024	8417	1.6	2.6	12,000	2.3	3.7
1552	1088–1536	7107	1.4	2.2	10,000	1.9	3.1
2064	1600–2048	5920	1.1	1.8	8000	1.5	2.4
2320	2112–2304	5416	1	1.7	7300	1.4	2.2

Appendix C. Line Interface Pin Assignments

Table C-1. RJ-45 connector pinout.

Pin Number	Signal
1	N/C (No connection)
2	N/C (No connection)
3	N/C (No connection)
4	Tip
5	Ring
6	N/C (No connection)
7	N/C (No connection)
8	N/C (No connection)

Appendix D. G.703/G.704 Rear Card Module

D.1 Description

The G.703/G.704 Rear Card Module provides E1/Fractional E1 termination and extension capabilities to the IDSL Line Drivers and Rack Cards. When used with an IDSL Rack Card or Line Driver, a G.703/G.704 line can be terminated or extended to a remote site up to 10 km (6.2 mi.) away.

Two separate applications can be employed when using the modules: network termination or network extension. In a network termination application, the G.703/G.704 line is terminated at the module, and the clock and data is sent to the far end of the link. At the remote site, an IDSL Rack Card or Line Driver with a serial/Ethernet interface will be running the nx64 DTE rate. This application allows the remote user without a G.703/G.704 interface to extend the serial interface that is available to the G.703/G.704 access point without the need for a separate G.703/G.704 to serial converter. In the G.703/G.704 network extension application, two modules are used, one at each end of the link. This application allows you to extend the G.703/G.704 network over 10 km (6.2 mi.) away.

The module supports switch-selectable AMI or HDB3 encoding, all nx64 kbps bit rates, and both dual coaxial (75-ohm) and RJ-48C (120-ohm) G.703/G.704 terminations.

D.2 Typical Applications

D.2.1 Network Termination Application

Network termination mode is used to connect a local site Line Driver using a G.703/G.704 module to a remote-site Line Driver using a V.35, X.21, or RS-530 Ethernet Module (see Figure D-1). Transmitter clocking is derived from the G.703/G.704 network and carried through the system to all system devices.

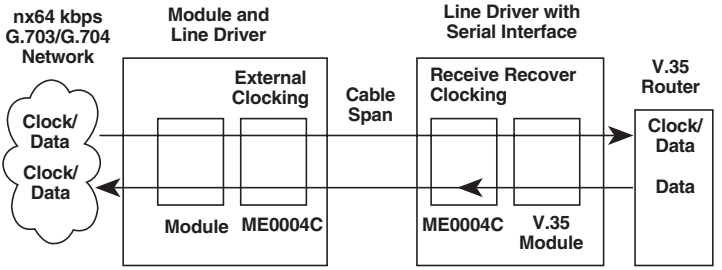

Figure D-1. Clocking settings in a network termination application.

D.2.2 Network Extension Application

Network extension mode is used to extend nx64 to 2.048-Mbps G.703/G.704 service across a DSL link, providing an nx64 G.703/G.704 link at the remote site. Transmitter clocking is derived from the G.703/G.704 network and is transmitted over the baseband line driver link (see Figure D-2).

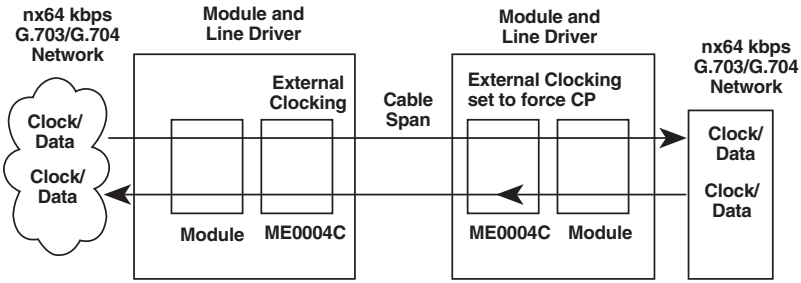

Figure D-2. Clock settings in a network extension application.

D.3 Configuration

The G.703/G.704 Rear Card module can be configured via hardware switches and jumpers. **Sections D.3.1** and **D.3.2** describe all switch and jumper configurations.

D.3.1 DIP-Switch Configuration

The module has eight internal DIP switches (S1-1 through S1-8). The DIP switches can be configured as either On or Off. Figure D-3 shows the location of the DIP switches on top of the Rear Card printed circuit board.

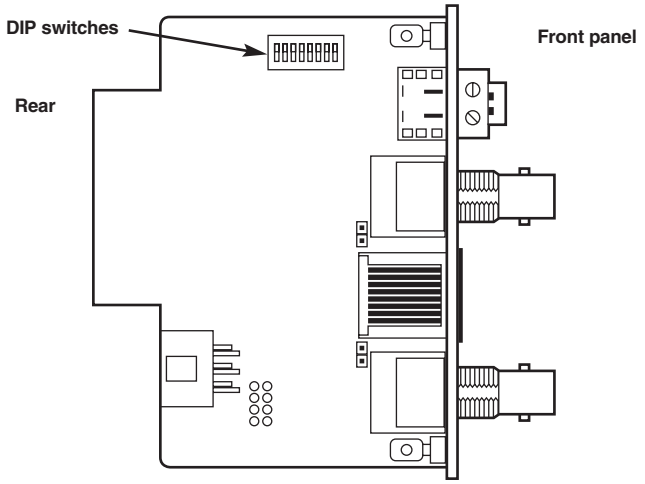

Figure D-3. Top view of the Rear Card, showing the location of the DIP switches.

Switch S1-1: Line Coding

Use switch S1-1 to control the network line-coding options. Set these options to the same as the line coding that has been provided by your service provider.

Table D-1. Line coding.

S1-1	Line Framing and Coding
Off	HDB3
On	AMI

Line Coding Options

High Density Bipolar 3 (HDB3): In HDB3 coding, the transmitter deliberately inserts a bipolar violation when excessive zeros in the data stream are detected. The receiver recognizes these special violations and decodes them as zeros. This method enables the network to meet minimum pulse-density requirements. Use HDB3 unless AMI is required in your application.

Alternate Mark Inversion (AMI): AMI coding does not inherently account for ones density. To meet this requirement, you should make sure that the data inherently meets pulse density requirements.

Switch S1-2: CRC-4 Multiframe

CRC-4 multiframe uses time slot zero to carry CRC-4 information. When CRC-4 is enabled (ON), the unit synchronizes to the CRC-4 multiframe protocol.

Table D-2. CRC-4 multiframe.

S1-2	Option
Off	Disabled
On	Enabled

NOTE

When the data rate is set to 2048 kbps, the module transmits user data on all 32 timeslots, ignoring framing information. In this case, switch S1-2 will be ignored.

Switch S1-3: Clear Channel Mode

When S1-3 is in the Off position, the module is running in G.703 clear channel mode. When S1-3 is in the On position, the module is running in G.704 framed mode. When the module is set to framed mode, channel 0 will be used to pass G.704 framing information that results in a maximum bandwidth of 1984 kbps for user data.

Table D-3. Clear channel mode.

S1-3	Option
Off	Clear Channel Mode (G.703)
On	Framed Mode (G.704)

Switches S1-4 through S1-8: Reserved

These switches are reserved for future use and should be set to OFF.

D.3.2 Jumper Configuration

The module has four jumpers (two position headers): JP4, JP5, JP6, and JP7. These jumpers are used to select input and output impedance matching between the module and external line. Figure D-4 shows the jumper locations.

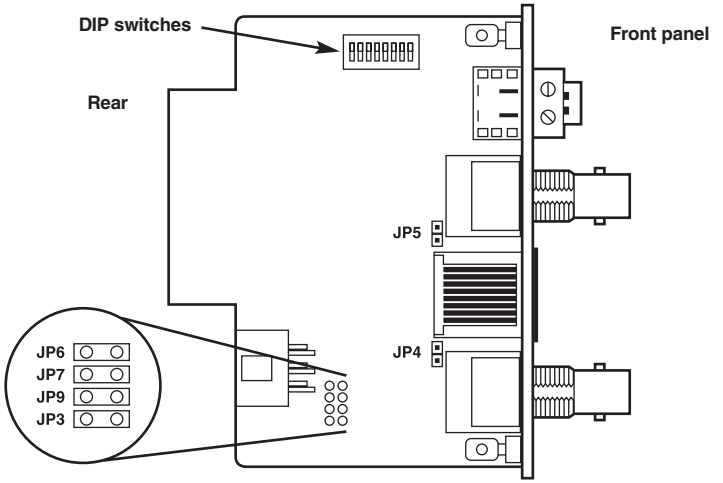

Figure D-4. Top view of the rear card module, showing the location of the jumpers.

The following is a description of the jumper settings with respect to the front-panel connectors.

1. For a 75-ohm connection (coax), install JP4–JP7 (default).
2. For a 120-ohm connection (RJ-48C), remove JP4–JP7.

D.4 Installing the Rear Card and Front Function Card

See **Section 4.2**.

D.5 Making Interface Connections

The module may be connected to G.703/G.704 ports using a single 120-ohm RJ-48C or a dual 75-ohm coax (BNC) connector. The module rear panels and the location of these connectors are shown in Figure D-5.

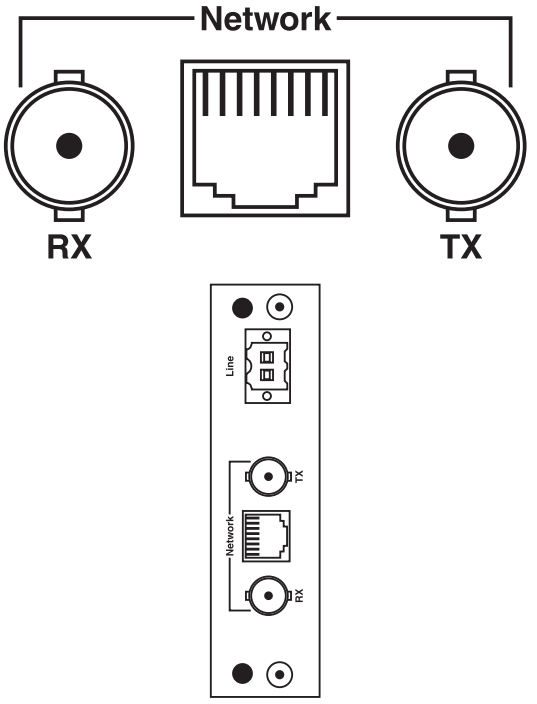

Figure D-5. Module rear panels, showing the location of the connectors.

D.5.1 Connect Twisted Pair (120 ohm) to G.703/G.704 Network

The module is equipped with a single RJ-48C jack for connections to a 120-ohm twisted-pair G.703/G.704 network interface. If your G.703/G.704 network terminates via RJ-48C, use Figure D-6 and Table D-4 to make the proper connections. The connector pinout and signals are shown in Figure D-6. Use Figure D-7 to connect the 120-ohm G.703/G.704 network channel.

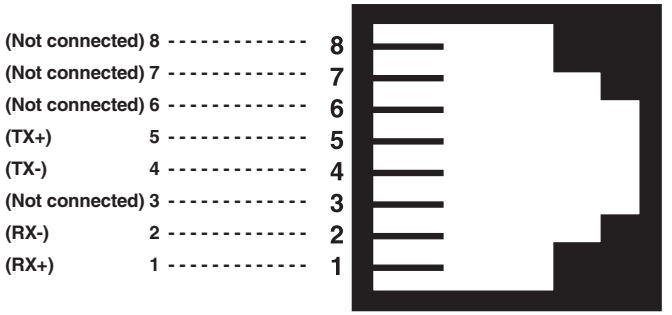

Figure D-6. 120-ohm RJ-48C G.703/G.704 interface.

Table D-4. RJ-48C cable (8-wire).

Module Signal	Pin #	G.703/G.704 Network Signal
RX+	1	TX+
RX-	2	TX-
TX+	5	RX+
TX-	4	RX-
Shield	3	Shield
Shield	6	Shield

D.5.2 Connect Dual Coaxial Cable (75 ohm) to G.703/G.704 Network

The module is also equipped with dual female BNC connectors (TX and RX) for connector to a 75-ohm dual coax G.703/G.704 network interface. If your G.703/G.704 network terminates via dual coaxial cable, use Figure D-7 to make the proper connections. The connector pinout and signals are also shown.

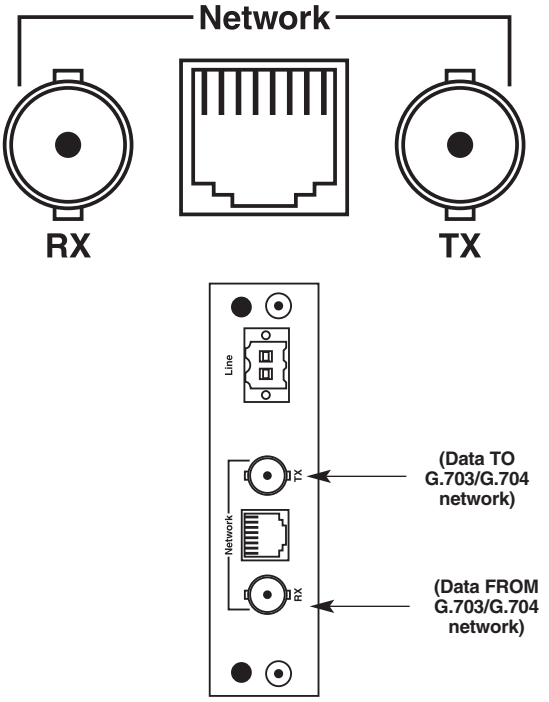

Figure D-7. 75-ohm dual coaxial G.703 interface.

NOTE

The outer conductor of the coax cables are isolated from system earth ground.

Appendix E. 10BASE-T Ethernet Rear Card Module

E.1 Description

The Ethernet Bridge Module installs in the Managed Micro Rack system to provide seamless Ethernet LAN extension. The Module bridges two physically separate Ethernet LANs at the MAC level. Operation of the Module is transparent to higher network level protocols such as TCP/IP, DECnet™, NetBIOS®, and IPX™. The Ethernet Bridge Module is 802.3 compliant and supports PPP (RFC 1661) with Bridging Control Protocol (RFC 1638).

Once installed in the local Managed Micro Rack, the Ethernet Bridge Module works in a plug-and-play manner to forward LAN broadcasts, multicasts, and frames destined for the peered Ethernet LAN at the remote end (the base unit at the remote end must be equipped with an Ethernet Module). Using the Ethernet Bridge Module, peered Ethernet LANs can be linked over leased 2-wire/4-wire, DDS, PCM, and campus fiber circuits.

The Ethernet Bridge Module plugs directly into the rear of a Rack Card Line Driver (ME0001C or ME0004C). The Bridge Modules must be used in pairs. Figure E-1 shows a typical installation.

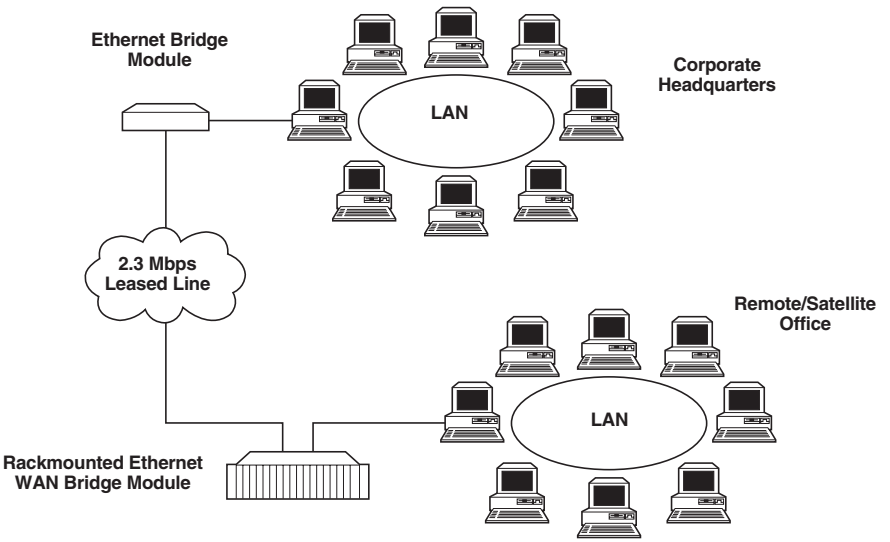

Figure E-1. Typical application.

E.2 Configuration

The 10BASE-T Ethernet Rear Card Module plugs into the ME0001C and ME0004C Line Drivers to provide Ethernet LAN extension. The Ethernet Card has no switches or jumpers and does not need to be configured. However, factors such as the type of medium, throughput across the link, and clocking mode must be determined by the settings of the baseband Line Drivers (ME0001C and ME0004C).

1. Bit rate: The DTE rate setting of your base unit corresponds with the throughput of your Ethernet Bridge Module. Use higher speeds to allow maximum throughput to your extended LAN. Use lower speeds to limit the access of your extended LAN.

NOTE

The Ethernet Bridge Module only supports synchronous speeds.

2. Clocking mode: Set the clocking modes on the base units so that one unit is configured for internal clocking mode and the other unit is set for receive recover clocking mode.

Table E-1. Base unit clock modes.

Unit A	Unit B
Internal clock setting	Receive recover clock setting

NOTE

Unit A and B are chosen arbitrarily. It does not matter which unit is A and which is B.

3. When using the Ethernet Bridge Module, disable the Enable Loop from the DTE switch on the front function card (ME0003C or ME0004C).

4. All other base settings depend upon your application and on the application medium (twisted-pair or coaxial cable).

E.3 Connecting the Interface Driver Board

Included in your 10BASE-T Ethernet Bridge Module package is an interface driver board that allows you to configure your front function card for Ethernet operation. Figure E-2 shows the interface driver board connected to a ME0003C or ME0004C front function card.

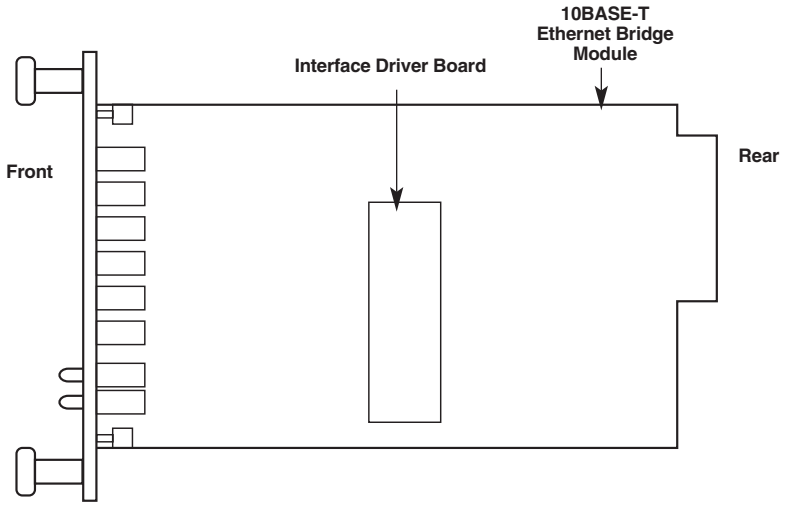

Figure E-2. Interface driver board mounted on a ME0003C or ME0004C front card.

Follow the instructions below to connect the interface driver board to the front function card.

1. With the function card pulled out of the Managed Micro Rack, locate the driver board to be replaced on the top of the base unit front card.

2. Lift the old interface board gently off the printed circuit board.

3. Position the interface driver board on top of the function card's PC board with the sockets oriented toward the male pins. Be sure that the label marked

   ← FRONT

   is pointed toward the front of the function card (toward the LEDs).

4. Push the interface driver board gently onto the socket and re-install the function card into the rack.

E.4 Installing the Rear Interface Card and the Front Function Card

See **Section 4.2**.

E.5 Connecting to the 10BASE-T Ethernet Port

The 10BASE-T Ethernet Rear Card module provides line side connections through an RJ-45 connector. Figure E-3 shows the rear panel and the locations of the connectors.

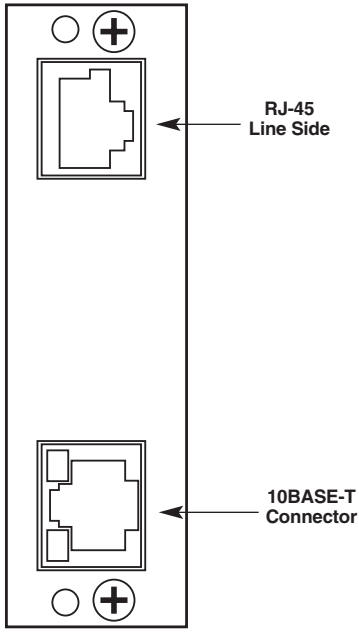

Figure E-3. Rear-panel RJ-45 connectors.

The RJ-45 Ethernet port on the rear card connects directly to a 10BASE-T network. Figure E-4 shows the 10BASE-T RJ-45 port pin description. You may make connections up to 330 feet (100 m) using Type 4 or 5 cable.

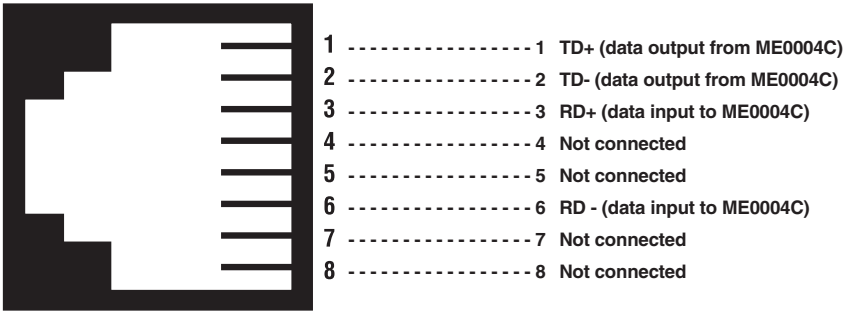

Figure E-4. Ethernet connector pinout.

E.5.1 Connecting the 10BASE-T Ethernet Port to a Hub

The 10BASE-T Ethernet rear card's 10BASE-T interface is configured as a DTE (Data Terminal Equipment), just like a 10BASE-T network interface card in a PC. Therefore, it expects to connect to a 10BASE-T hub using a straight-through RJ-45 cable. Use Figure E-5 to construct a cable to connect the rear card to a 10BASE-T hub.

Rear Card RJ-45 Pin No.		10BASE-T Hub RJ-45 Pin No.
1 (TD+)	- - - - - - - - - - - - - - - - - - - -	1 (RD+)
2 (TD-)	- - - - - - - - - - - - - - - - - - - -	2 (RD-)
3 (RD+)	- - - - - - - - - - - - - - - - - - - -	3 (TD+)
6 (RD-)	- - - - - - - - - - - - - - - - - - - -	6 (TD-)

Figure E-5. Straight-through cabling.

E.5.2 Connecting the 10BASE-T Ethernet Port to a PC (DTE)

The rear card interface is configured as DTE (Data Terminal Equipment). If you wish to connect the rear card to another DTE device such as a 10BASE-T network interface card in a PC, you must construct a 10BASE-T crossover cable as shown in Figure E-6.

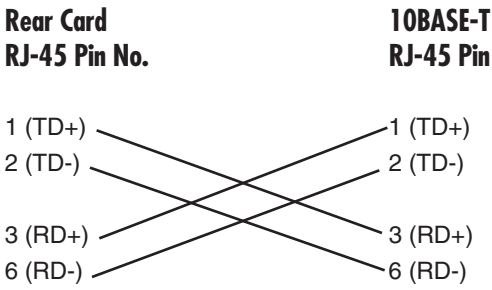

Figure E-6. Crossover cabling.

E.5.3 Connecting the Line Interface

The 10BASE-T Ethernet rear card must be used with a front function card. There are two essential requirements for connecting the line interface on the rear card.

1. These units work in pairs with one rear card connected to another rear card over 2- or 4-wire twisted pair (2- or 4-wire operation is determined by the front function card).

2. To function properly, the rear card needs one or two twisted pairs of metallic wire (2- or 4-wire). The twisted pairs must be unconditioned, dry, metallic wire, between 19 (0.9 mm) and 26 AWG (0.4 mm). Standard dial-up telephone circuits that run through signal equalization equipment, or standard, flat modular telephone type cable are *not* acceptable. See Figure E-7.

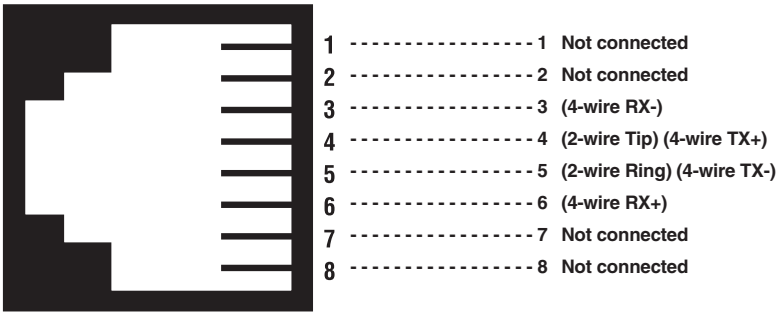

Figure E-7. RJ-45 line interface.

NOTE

Two-wire line drivers use RJ-45 pins 4 and 5.

E.6 Operation

In order to operate, the rear card must be connected to a front function card and installed in the rack unit. It also requires a 10BASE-T connection. After power is applied, the rear card automatically starts performing the bridging function without further user intervention. MAC addresses discovered are automatically loaded into the MAC address table. They are automatically deleted from the MAC address table if they experience an inactivity of 8 minutes.

E.6.1 Power-Up

The rear card is hot-swappable. It receives power from the rack power bus. Therefore, it is powered up as soon as it is plugged into the rack and the rack power supply is turned on.

E.6.2 LED Status Monitors

The 10BASE-T Ethernet rear card features two LEDs that monitor general operating status and the 10BASE-T twisted-pair link integrity. Figure E-8 shows the LEDs located directly beneath the RJ-45 jack. Following Figure E-8 is a description of each LED's function.

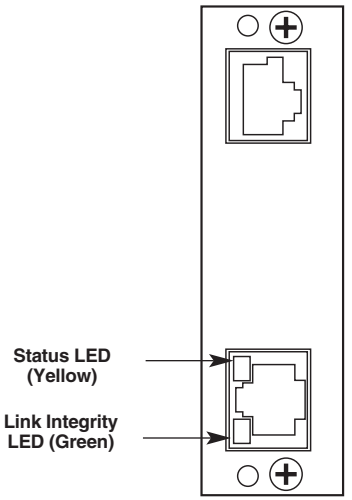

Figure E-8. 10BASE-T Ethernet Rear Card LED locations.

- Status: Blinks yellow from one to eleven times to indicate system status. Each pulse pattern is separated by a 2 second "off" period. Greater pulse patterns have higher priority (buffer saturation has greater priority than an empty MAC table). Valid system statuses are:

  1 pulse = system status OK
  2 pulses = no MAC entries in the MAC address table
  3 pulses = Clear to Send (CTS) or Carrier Detect (CD) from base unit are not asserted
  4 pulses = Rear card buffer is saturated
  5 pulses = WAN receive frame(s) too large
  6 pulses = WN receive frame(s) not Octet aligned
  7 pulses = WAN receive frame(s) aborted
  8 pulses = Detected WAN receive frame(s) with bad CRC
  9 pulses = Detected LAN receive frame(s) too large
  10 pulses = Detected LAN receive frame(s) not Octet aligned
  11 pulses = Detected LAN receive frame(s) with bad CRC

  After a status code is displayed eight times and the associated condition is removed, the status code will no longer appear.

- Link: Glows green to indicate good link integrity on the 10BASE-T twisted-pair line.

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