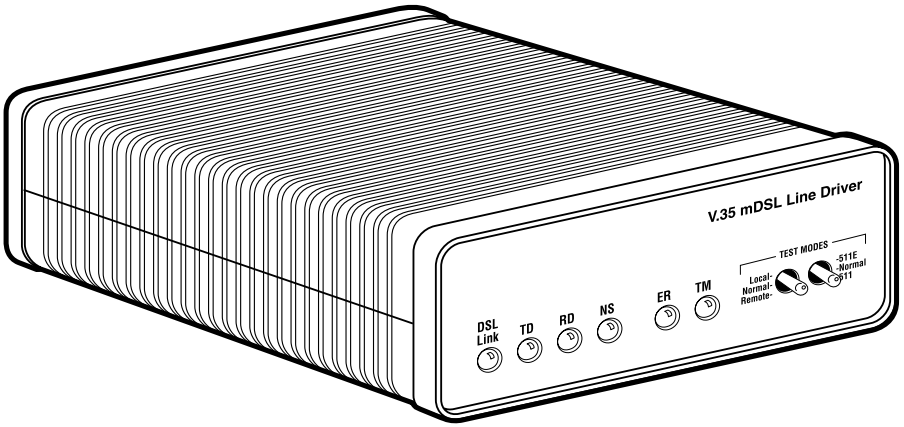
BLACK BOX®
NETWORK SERVICES

NOVEMBER 2001
ME0005A-V35
ME0005A-X21

2-Wire Short-Range DSL Line Driver (mDSL with V.35) (mDSL with X.21)



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Order **toll-free** in the U.S.: Call **877-877-BBOX** (outside U.S. call **724-746-5500**)
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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 of 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.

TRADEMARKS USED IN THIS MANUAL

Any trademarks mentioned in this manual are acknowledged to be the property of the trademark owners.

Contents

1. Specifications

Clocking Modes: Internal, External, or Receive Recovered

DTE Rate: All 64-kbps increments from 64 to 2304 kbps

DTE Interface: ME0005A-V35: DCE orientation; ME0005A-X21: DCE or DTE; Orientation depends upon orientation of PC-board-mounted daughterboard

Connectors: ME0005A-V35: M/34 female; ME0005A-X21: DB15 female

Diagnostics: V.52-compliant (511/511E) pattern generator and detector with error injection mode controlled by front-panel switch, Local and Remote Loopback control by either a front-panel switch or from the DTE interface

Indicators: LEDs: (1) DSL Link (green active); (1) TD (yellow/green) idle yellow; (1) RD (yellow/green) idle yellow; (1) NS (red active) no signal DSL link; (1) ER (flashing red) CRC error during normal operation, bit error during pattern-generation test; TM (active yellow) test mode enabled

Configuration: Externally accessible DIP switches or SNMP managed through mDSL Rack Card (part number ME0004C)

Transmission Line: Single twisted pair

Line Coding: CAP (Carrierless Amplitude and Phase Modulation)

Line Rates (DSL Line): 144, 272, 400, 528, 784, 1040, 1552, 2064, 2320 kbps

Line Interface: Transformer coupled, 1500-VAC isolation

mDSL Physical Connection: RJ-45, 2-wire, polarity insensitive pins 4 and 5

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

Humidity: 5 to 95%, noncondensing

Altitude: Up to 15,000 ft. (4572 m)

Power: +5 VDC external desktop power supply, 100- to 240-VAC, 50 to 60 Hz (universal input), 10 W

Size: 1.6"H x 4.7"W x 5"D (4.1 x 11.9 x 12.7 cm)

Weight: 0.58 lb. (0.26 kg)

2. Introduction

2.1 Description

The 2-Wire Short-Range DSL Line Driver (mDSL) provides high-speed 2-wire connectivity to ISPs, PTTs, and corporations using mDSL (Multi-rate Symmetric 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 modem provides "megabyte" 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 ME0005A-V35 provides a V.35 interface on an M/34 female connector. The ME0005A-X21 provides an X.21 interface on a DB15 female connector. Features include loopback diagnostics, SNMP/HTTP remote management capabilities using Plug-and-Play, and inband externally accessible configuration switches. All versions of the mDSL Line Driver are compatible with other standalone mDSL Line Drivers and mDSL Rack Cards.

As a symmetric DSL NTU, mDSL offers the same data rates in both directions over a single pair of regular telephone lines using Carrierless Amplitude and Phase (CAP) modulation. Line connection is via an RJ-45 jack. Standard versions of the mDSL Line Driver are powered by a 100- to 240-VAC universal power supply.

2.2 Features

- Multi-rate symmetric DSL
- CAP (Carrierless Amplitude and Phase) modulation
- Data rates up to 2.304 Mbps
- V.35 and X.21 interfaces
- Interoperable with the mDSL Rack Card (ME0004C)
- SNMP manageable via Managed Micro Rack SNMP/HTTP Card (part number RM261C-SNMP)
- Plug-and-Play for easy installations
- Universal power supply
- Front-panel status indicators

- Small, convenient desktop unit
- CE marked

3. Configuration

The mDSL Line Driver is equipped with two sets of eight DIP switches. This chapter describes switch locations and explains all possible configurations.

3.1 Configuring the Hardware DIP Switches

The 16 external switches are grouped into two eight-switch sets, and they're externally accessible from the underside of the mDSL Line Driver (see Figure 3-1).

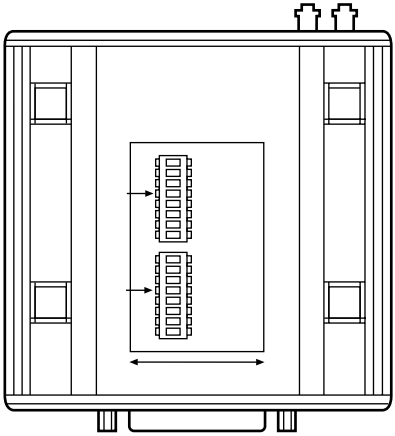

Figure 3-1. Underside of the mDSL Line Driver, showing the location of the DIP switches.

The two sets of DIP switches on the underside of the mDSL Line Driver are called S2 and S3. As Figure 3-2 shows, the orientation of all DIP switches is the same with respect to ON and OFF positions.

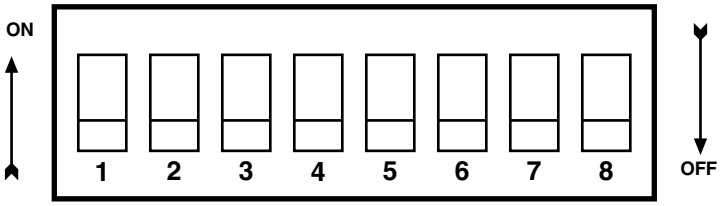

Figure 3-2. Close-up of configuration switches (all sets are identical in appearance).

3.1.1 DIP-Switch S2

The configuration switches on S2 allow you to specify the clocking mode and to enable/disable local and remote loop requests from the V.35 DTE. 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 } Receive Recover
S2-7	Clock Mode	Off } Receive Recover
S2-8	Enable Loop from DTE	Off Disabled

Switch S2-1, S2-2, S2-3, S2-4, and S-5:

These switches are reserved for factory use and must remain in the OFF Position.

Switches S2-6 and S2-7: Clock Mode

Use Switches S2-6 and S2-7 to configure the mDSL Line Driver 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 terminal interface
CP	On	Off	Receive Recover	Transmit clock derived from the received line
	Off	Off		Reserved

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

Switch S2-8 may be used to allow the ME0005A-V35 (or ME0005A-X21) to enter loopback diagnostic tests (Local or Remote) when the V.35 DTE raises the appropriate loop request pin (LLB: Pin L or RDL: Pin N). When Switch S2-8 is in the On position, the ME0005A-V35 will enter Local Loopback or Remote Loopback at the request of the DTE. When Switch S2-8 is in the Off position, the ME0005A-V35 ignores DTE loop requests. In the Off position, loop requests may still be initiated by the front-panel switch.

Table 3-3. DTE loop tests.

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

3.1.2 DIP-Switch S3

Use the six DIP switches in Switch S3 to enable the DTE bit rate. Table 3-4 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

768 kbps

Switches S3-1 through S3-6: DTE Rate

Use Switches S3-1 through S3-6 to set the 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

*Default setting.

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 rate 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 charts in Appendix C.

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 Managed Micro Rack SNMP/HTTP Card (part number RM261C-SNMP) to SNMP manage your units. For more information, please refer to the *Managed Micro Rack SNMP/HTTP Card Users' Manual.*

Table 3-6. Reset software defaults.

S3-7	Setting
On	Normal Operation
Off	Reset

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

Table 3-7. Transmit Data (TD) sampling point.

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

3.2 Plug-and-Play

The Plug-and-Play feature allows ISPs, carriers, and PTTs to quickly upgrade the link speed for a customer without requiring the customer to re-configure the Customer Premise (CP) mDSL Line Driver. This feature also allows service providers to set up all of the configurations at the Central Office (on the rack cards) before installing the standalone units, saving time spent configuring or re-configuring DIP switches.

The Plug-and-Play feature allows you to configure the DTE rate (bandwidth allocation; see Switches S3-1 through S3-6) of the CP unit 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 (bandwidth allocation) of the rack card. Other configuration parameters remain in the default setting.

NOTE

Plug-and-Play is only available with Black Box's other managed mDSL products, such as the ME0004C.

Follow the instructions below to activate Plug-and-Play between CO (mDSL Rack Card, ME0004C) and CP (mDSL Line Driver, ME0005A) units:

1. Set the mDSL Rack Card (CO) to either internal or external clocking mode as defined by the application.

2. Set the mDSL Line Driver (CP) to "Plug-and-Play CP" by setting all S2 and S3 DIP switches in the ON position as described in Figure 3-3.

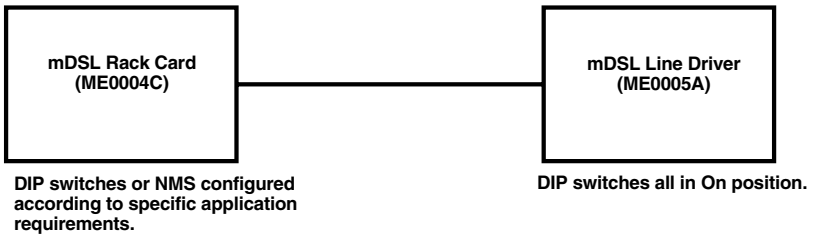

Figure 3-3. Typical Plug-and-Play application.

When the CO and CP units connect over DSL, the CP will enter a predefined default configuration (Receive Recovered Clocking). During the negotiation process between the units, the CO unit will configure the DTE rate/line rate on the CP unit as defined by the settings of the CO unit. When additional bandwidth is required, only the configuration of the CO unit should be changed. This feature gives ISPs, LECs, and PTTs the ability to provision bandwidth on an as-needed basis to customers.

4. Installation

Once the mDSL Line Driver is properly configured, it is ready to connect to the twisted-pair interface, to the serial port, and to the power source. This chapter tells you how to make these connections.

4.1 Connecting the Twisted-Pair Interface

The mDSL Line Driver supports communication between two DTE devices at distances to 5 miles (8 km) over 24-AWG (0.5-mm) twisted-pair wire. Two things are essential:

1. These units work in pairs. Both units at the end of the twisted-pair DSL span must be set for the same DTE rate.

2. To function properly, the mDSL Line Driver 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 will limit distance. Standard dial-up telephone circuits, leased circuits that run through signal equalization equipment, or standard, flat modular telephone type cable are not acceptable.

The RJ-45 connector on the mDSL Line Driver's twisted-pair interface is polarity insensitive and is wired for a two-wire interface. The signal/pin relationships are shown in Figure 4-1.

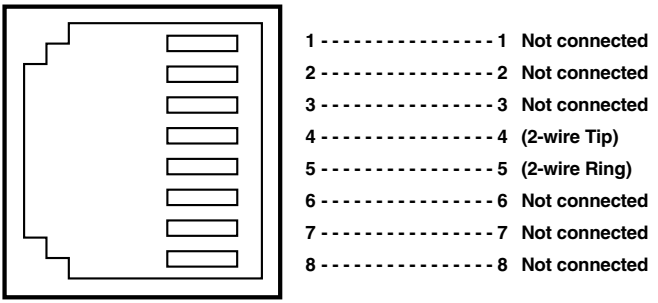

Figure 4-1. RJ-45 twisted-pair line interface.

4.2 Connecting the mDSL Line Driver V.35 Serial Interface

The ME0005A-V35 supports V.35 serial port connections. This section describes how to connect the serial ports to your V.35 equipment.

4.2.1 Connecting the mDSL Line Driver V.35 to a DTE Device

The ME0005A-V35 provides a V.35 DCE (Data Circuit Terminating Equipment) interface on an M/34 female connector. As a DCE, this interface is designed to connect to DTE equipment (such as a router). When connecting the V.35 interface of the mDSL Line Driver to your DTE device, use a V.35 straight-through cable (see Figure 4-2). **Appendix A** describes pin assignments and signal sources for the mDSL Line Driver V.35 interface. When purchasing or constructing an interface cable, please refer to the pin diagrams in **Appendix A** as a guide.

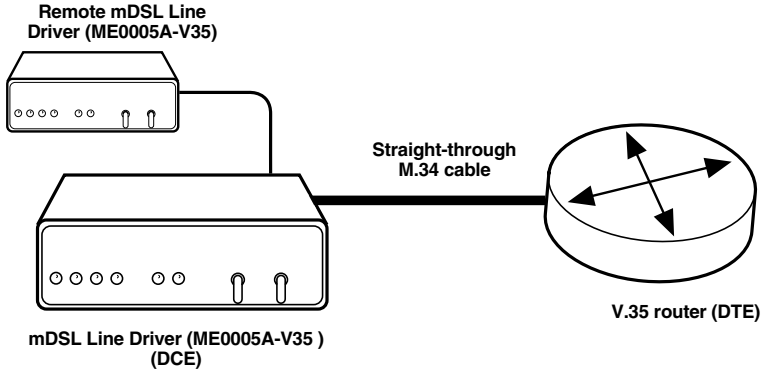

Figure 4-2. Connecting the Line Driver to a V.35 serial DTE.

4.2.2 Connecting the mDSL Line Driver V.35 to a DCE Device

The ME0005A-V35 provides a V.35 DCE (Data Circuit Terminating Equipment) interface on an M/34 female connector. As a DCE, this interface is designed to connect to DTE equipment (such as a router). However, tail-circuit applications require connection to another piece of DCE equipment, such as a multiplexor. When connecting the V.35 interface of the mDSL Line Driver to your DCE device, use a V.35 null-modem cable. Some applications may also require the installation of a V.35 tail-circuit buffer to account for small differences in clock frequency between the ME0005A-V35 and the V.35 DCE (multiplexor).

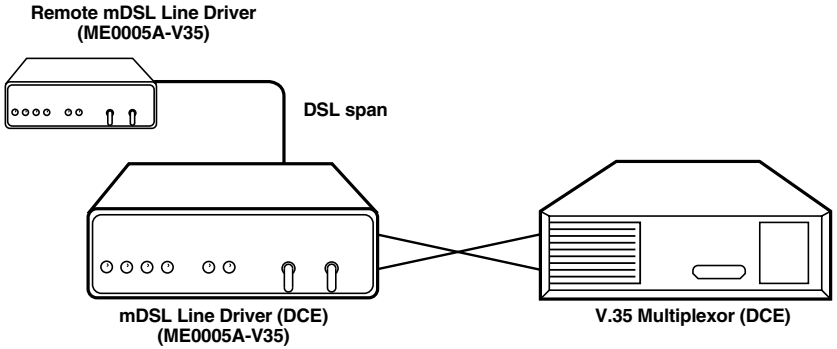

Figure 4-3. Connecting the Line Driver to a V.35 serial DCE.

4.3 Connecting the mDSL Line Driver X.21 Serial Interface

The ME0005A-X21 supports X.21 serial port connections. This section describes how to connect the serial ports to your X.21 equipment.

4.3.1 Connecting the mDSL Line Driver X.21 to a DCE or DTE Device

The ME0005A-X21 provides an X.21 interface on a DB15 female connector. The X.21 interface default configuration is DCE (Data Circuit Terminating Equipment) for connection to DTE (Data Terminal Equipment). However, the X.21 interface on the mDSL Line Driver may be configured as DTE (Data Terminal Equipment) for connection to DCE. When connecting the X.21 interface of the ME0005A-X21 to your DTE device, use a X.21 straight-through cable (see Figure 4-4).

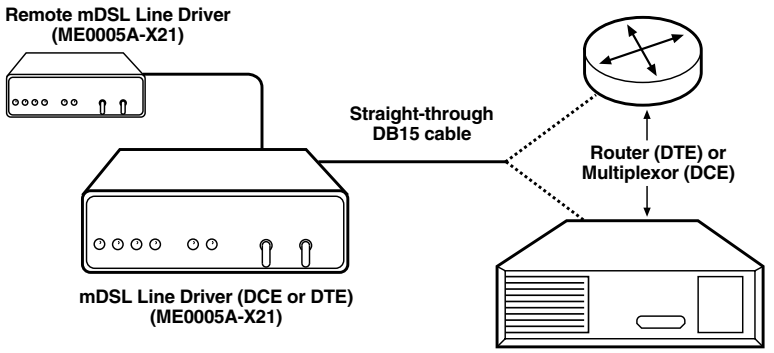

Figure 4-4. Connecting the Line Driver to a X.21 DTE or DCE.

To change the DCE/DTE orientation from the default position (DCE), you must open the mDSL Line Driver's case.

4.3.2 Opening the Case

To open the mDSL Line Driver's case, insert a flat-head screwdriver into an open slot on both sides of the case, as shown in Figure 4-5. Twist the screwdriver head slightly, and the top half of the case will separate from the lower half (see Figure 4-5). Take caution not to damage the PC-board-mounted components.

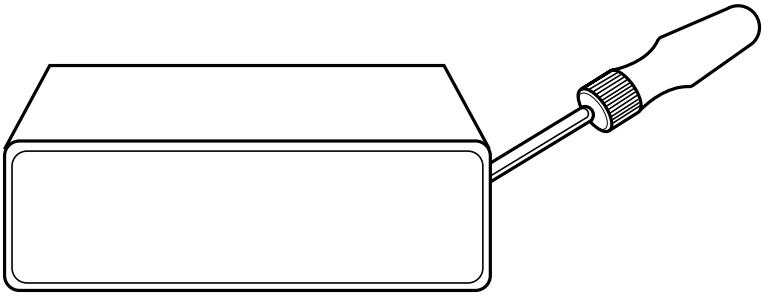

Figure 4-5. Opening the case with a small screwdriver.

The DCE/DTE strap is located on the top side of the ME0005A-X21 PC board (see Figure 4-6). 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 DB15 connector, the X.21 port is wired as a DCE). Change the DCE/DTE orientation by pulling the strap out of its socket, rotating it 180º, then plugging the strap back into the socket. You will see that the DCE/DTE arrows now point in the opposite direction, showing the new configuration of the X.21 port. To close the case, fit the two halves together snugly and snap them back in place.

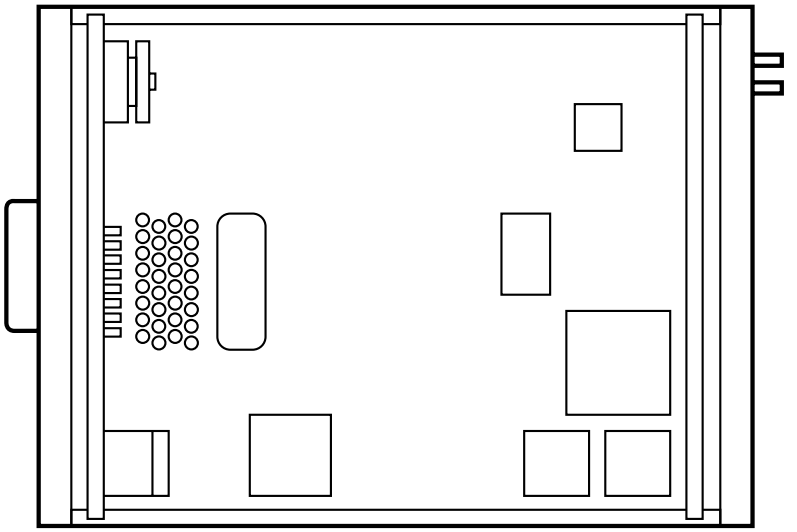

Figure 4-6. Setting the DCE/DTE strap.

4.4 Connecting Power

The mDSL Line Driver uses a 5-VDC, 2-A universal-input 100- to 240-VAC power supply. The power supply has a male IEC-320 power entry connector. The supply connects to the mDSL Line Driver via a barrel jack (center pin is +5V) on the rear panel. The mDSL Line Driver powers up as soon as it is plugged into an AC outlet; there is no power switch.

5. Operation

Once the mDSL Line Driver is properly configured and installed, it should operate transparently. This chapter describes power-up, reading the LED status indicators, and using the built-in loopback test modes.

5.1 Power-Up

To apply power to the mDSL Line Driver, first be sure that you have read **Section 4.4**. Next, make sure that the unit is connected to the appropriate power source. Finally, power-up the unit.

5.2 LED Status Indicators

The mDSL Line Driver features six 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. See also Table 5-1.

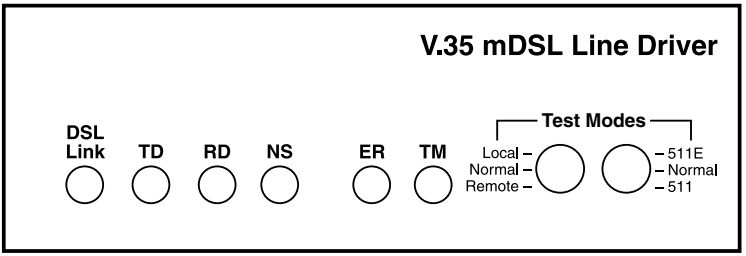

Figure 5-1. Front panel.

- DSL Link: (Active Green) Solid green (On) indicates that the end-to-end DSL Framer Link is up, signifying that the link across the DSL span is active. The DSL Link LED is Off when the link is down.
- 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
- NS: (No Signal) glows red to indicate that the local mDSL Line Driver is not connected with the remote mDSL Line Driver.

- ER: blinks On/Off after a 511/511E test has timed out. See **Section 5.3** for more information.

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

  ER, only at power up, blinks once every 200 ms if the DTE rate is set to an unsupported settings

- TM: glows yellow to indicate that the mDSL Line Driver 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 Managed Micro Rack SNMP/HTTP Card (part number RM261C-SNMP).

LED DESCRIPTIONS CHART

Table 5-1. LED descriptions.

	Clock (CO) Internal 768 kbps No DTE						Clock (CP) R/R No DTE					
	TD	**RD**	**DSL**	**NS**	**ER**	**TM**	**TD**	**RD**	**DSL**	**NS**	**ER**	**TM**
Power On	G	O	Off	On	Off	Off	O	O	Off	On	Off	Off
DSL Link	G	O	G	Off	Off	Off	O	G	G	Off	Off	Off
Link Brk	G	O	Off	Off	Off	Off	O	O	Off	Off	Off	Off
Brk + 10s	G	G	Off	On	Off	Off	O	O	Off	On	Off	Off
RDL	G	G	G	Off	Off	On	O	G	G	Off	Off	On
RDL + 511	O	G	Off	Off	Off	On	G	G	Off	Off	Off	On
	With DTE Connected						**With DTE Connected**					
Mark	Y	Y	G	Off	Off	Off	Y	Y	G	Off	Off	Off
Space	G	G	G	Off	Off	Off	G	G	G	Off	Off	Off
Data	GO	GO	G	Off	Off	Off	GO	GO	G	Off	Off	Off

Link Brk = DSL Link Broken

Brk + 10s = 10 seconds following link break

G = Green

O = Orange

Y = Yellow

5.3 Test Modes

The mDSL Line Driver offers two proprietary loopback test modes. It also has 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 DTE interface.

5.3.1 Overview

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

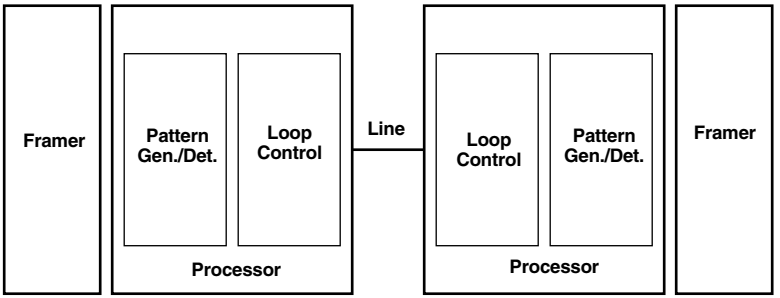

Figure 5-2. Block diagram: two mDSL Line Drivers communicating over the DSL span.

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 mDSL Line Driver receives four seconds of unframed packets, it will restart 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.

5.3.2 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. Table 5-2 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 5-2. 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.

5.3.3 Loops and Patterns

The following section describes the test modes used in the mDSL Line Driver. 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 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 on, 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.

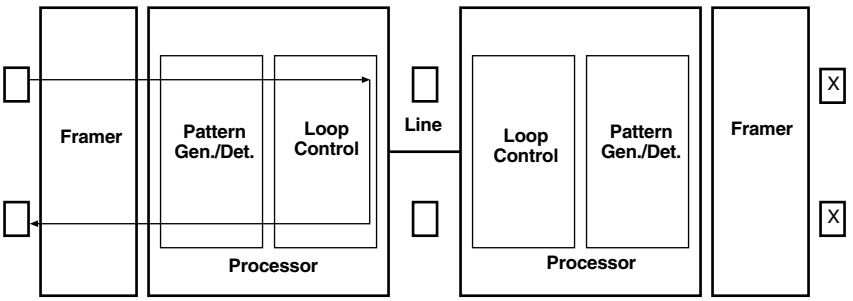

Figure 5-3. Block diagram local loop mode 1.

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 and 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.

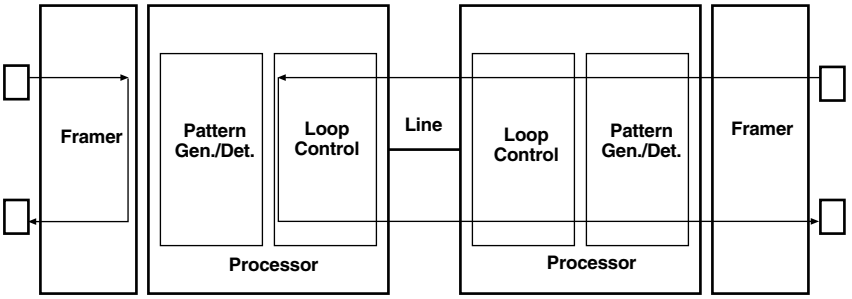

Figure 5-4. Block diagram local loop mode 2.

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 time outs 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 time out 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.

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 can be seen from 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.

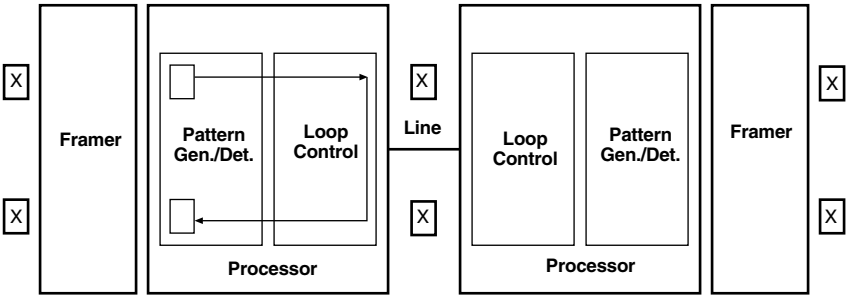

Figure 5-5. Block diagram local loop mode 1 with 511/511E.

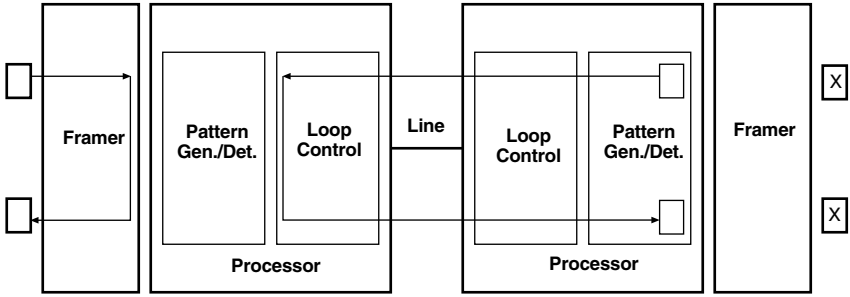

Figure 5-6. Block diagram local loop mode 2 with 511/511E.

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 processor 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 4–6 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.

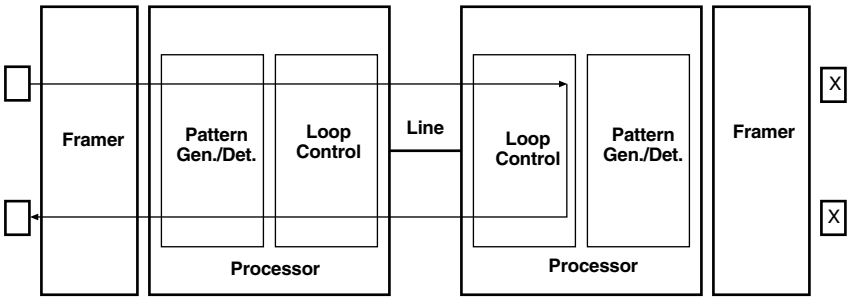

Figure 5-7. Block diagram remote loop.

Remote Digital Loop with 511/511E

The Remote Digital Loop with 511/511E is shown in Figure 5-8. After RDL is established, the remote unit's restart timer is set to one minute. This has been done 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 processor 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.

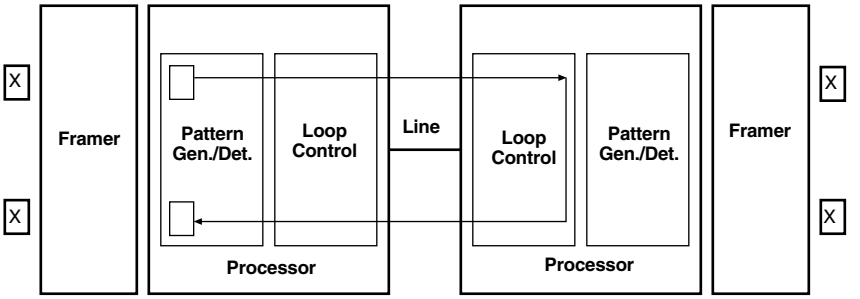

Figure 5-8. Block diagram remote loop with 511/511E.

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 4 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.

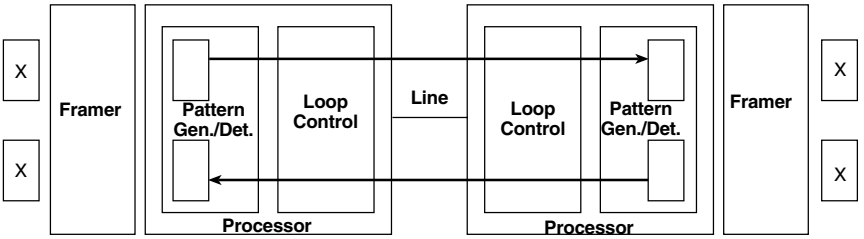

Figure 5-9. Block diagram data mode with 511/511E.

5.3.4 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 Line Driver's front panel and move it UP. 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 DOWN, activating the 511/E 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 Line Driver's built-in 511 generator and detector are working properly.

NOTE

The above V.52 BER tests can be used independently of the remote digital loopback tests. This requires two operators: (1) to initiate and monitor the tests at the local Line Driver and (2) to do the same at the remote Line Driver. In this case, the test pattern sent by each Line Driver will not be looped back, but will be transmitted down the line to the other Line Driver. While one operator initiates the test, the other monitors for errors.

Appendix A. V.35 Interface Pin Assignments

Listed below are the pin assignments for the V.35 interface (M/34 female connector) with a DCE orientation.

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

Appendix B. X.21 Interface Pin Assignments

Listed below are the pin assignments for the X.21 interface (DB15 female connector) with DTE/DCE orientation.

Pin #	Signal
1	Frame Ground
2	T (Transmit Data-A) (DTE Source)
3	C (Control-A) (DTE Source)
4	R (Receive Data-A) (DCE Source)
5	I (Indication-A) (DCE Source)
6	S (Signal Element Timing-A) (DCE Source)
7	BT (Byte Timing-A) (DCE Source)
8	SGND (Signal Ground)
9	T/ (Transmit Data-B) (DTE Source)
10	C/ (Control-B) (DTE Source)
11	R/ (Receive Data-B) (DCE Source)
12	I/ (Indication-B) (DCE Source)
13	S/ (Signal Element Timing-B) (DCE Source)
14	BT/ (Byte Timing-B) (DCE Source)

Appendix C. Transmission Distance Charts

Table C-1. Transmission distance mDSL Line Driver, no crosstalk.

Line Rate (kbps)	DTE Rates (kbps)	26 AWG (0.4 mm)			24 AWG (0.5 mm)		
		ft.	mi.	km	ft.	mi.	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 C-2. Transmission distance mDSL Line Driver, crosstalk (49 adjacent CAP pairs).

Line Rate (kbps)	DTE Rates (kbps)	26 AWG (0.4 mm)			24 AWG (0.5 mm)		
		ft.	mi.	km	ft.	mi.	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

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