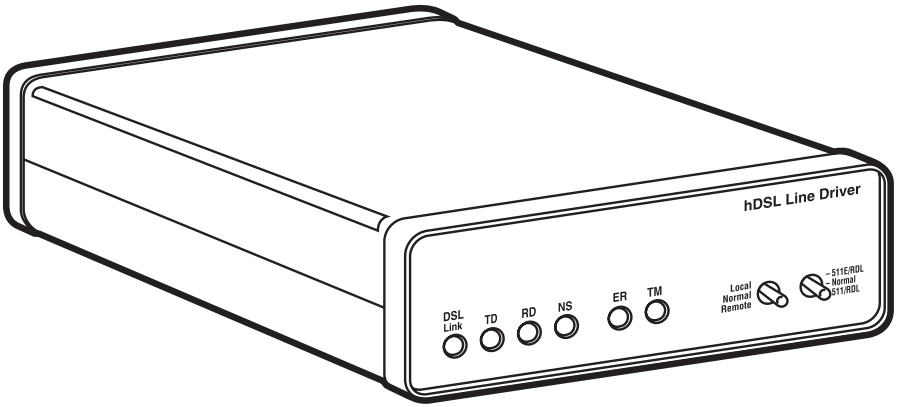
NOVEMBER 2001
ME0006A-V35
ME0006A-X21

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



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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.

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 1152 kbps

DTE Interface: ME0006A-V.35: DCE orientation; ME0006A-X.21: DCE or DTE

DTE Connector: ME0006A-V.35: M/34 female; ME0006A-X21: DB15 female

Diagnostics: V.52-compliant (511/511E) pattern generator and detector with error injection mode controlled by a front-panel switch; local and remote loopback controlled by either a front-panel switch or from the DTE interface

Indicators: LEDs: DSL Link (green active); TD (yellow/green) idle yellow; RD (yellow/green) idle yellow; NS (red active); No signal DSL Link; 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 ME0003C

Transmission Line: Single twisted pair

Line Coding: 2B1Q

Line Rates (DSL Line): 144, 272, 400, 528, 784, 1040, 1168 kbps

Line Interface: Transformer coupled, 1500-VAC isolation

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: External desktop transformer, 100 to 240 VAC, 50 to 60 Hz (universal input), 10 W

Size: 1.6"H x 4.7"W x 6"D (4.1 x 11.9 x 15.2 cm)

Weight: 0.58 lb. (0.26 kg)

2. Introduction

2.1 Description

The 2-Wire Short-Range DSL Line Driver (HDSL) V.35 or X.21 provides high-speed 2-wire connectivity to ISPs, PTTs, and corporations using HDSL (High Bit-Rate Digital Subscriber Line) technology. Supporting multiple line rates from 144 kbps to 1.168 Mbps, the Line Driver 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 HDSL Line Driver V.35 (ME0006A-V35) provides a V.35 interface on an M/34 female connector. The HDSL Line Driver X.21 (ME0006A-X21) provides an X.21 interface on a DB15 female connector. Features include loopback diagnostics, and inband SNMP/HTTP remote management capabilities through a DSL Line Driver Rack Card (ME0003C) CO and externally accessible configuration switches. Both versions of the Line Driver are compatible with the popular QuikConnect HDSL Line Driver (ME0007A-HDSL) standalone and DSL Line Driver Rack Card (ME0003C) as well as the HDSL Line Driver 10BASE-T (ME0006A-10BT).

As a symmetric DSL NTU, the HDSL Line Driver offers the same data rates in both directions over a single pair of regular telephone lines using 2B1Q modulation. Line connection is made by an RJ-45 jack. The Line Driver is powered by a 100- to 240-VAC universal power supply.

2.2 Features

- High bit-rate DSL.
- 2B1Q modulation.
- DTE rates up to 1.152 Mbps.
- V.35 and X.21 interfaces.
- Interoperable with ME0003C and ME0007A.
- SNMP Manageable via Managed Micro Rack SNMP/HTTP Card (RM261C-SNMP) through ME0003C/CO.
- Universal power supply.
- Front-panel status indicators.
- Small, convenient desktop unit.
- CE marked.

3. Configuration

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

Configuring the Hardware DIP Switches

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

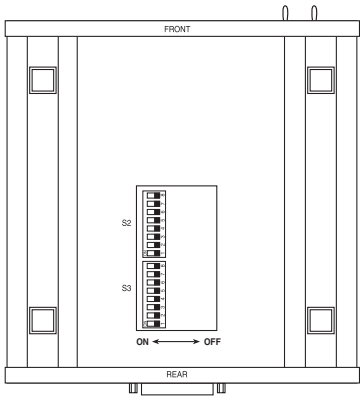

Figure 3-1. Underside of the HDSL Line Driver, showing the location of the DIP switches.

The two sets of DIP switches on the underside of the HDSL 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.

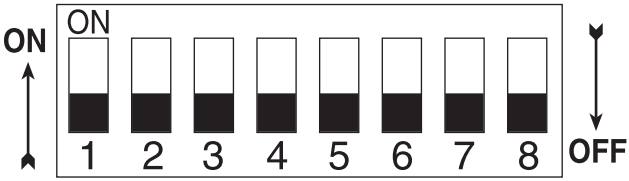

Figure 3-2. Close-up of configuration switches (all sets are identical in appearance).

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 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 }
S2-8	Enable loop from DTE	Off Disabled

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

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 HDSL 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 HDSL Line Driver 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 HDSL Line Driver will enter local loopback or remote loopback at the request of the DTE. When Switch S2-8 is in the Off position, the HDSL Line Driver ignores DTE loop requests. In the Off position, loop requests may still be initiated by the front-panel switch.

Table 3-3. Enable/disable loop tests.

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

DIP-SWITCH S3

Use the eight DIP Switches in Switch S3 to enable the DTE bit rate. Table 3-4 summarizes the default positions. 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 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
On	On	On	On	Off	On	896

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

S3-1	S3-2	S3-3	S3-4	S3-5	S3-6	DTE Rate (kbps)
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

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 you 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 sampling point.

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

4. Installation

Once the HDSL 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 HDSL 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 HDSL 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, or leased circuits that run through signal equalization equipment, or standard, flat modular telephone type cable are not acceptable.

IMPORTANT!

The HDSL Line Driver has been optimized for performance at high bit rates (DTE rates greater than 512 kbps). To ensure accurate performance at these rates, please use twisted-pair line interface cable that is at least 330 ft. (100.6 m) long.

The RJ-45 connector on the HDSL 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.

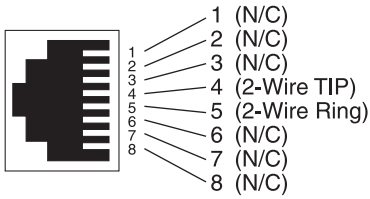

Figure 4-1. RJ-45 twisted-pair line interface.

4.2 Connecting the HDSL Line Driver's V.35 Serial Interface

The HDSL Line Driver 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 V.35 Line Driver to a DTE Device

The HDSL Line Driver V.35 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 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 Line Driver's V.35 interface. When purchasing or constructing an interface cable, please refer to the pin diagrams in **Appendix A** as a guide.

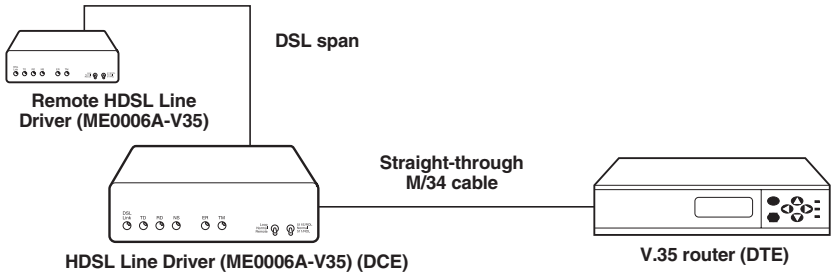

Figure 4-2. Connecting the Line Driver to a V.35 serial DTE.

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

The Line Driver provides a V.35 (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 DCE equipment, such as a multiplexor. When connecting the V.35 interface of the Line Driver to your DCE device, use a V.35 null-modem cable. Some applications may also required the installation of a V.35 tail-circuit buffer to account for small differences in clock frequency between the Line Driver and the V.35 DCE (multiplexor).

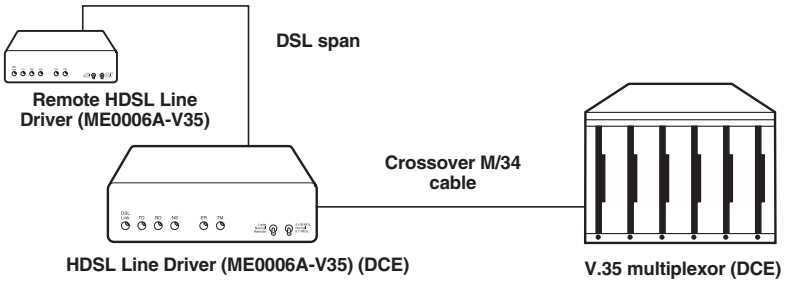

Figure 4-3. Connecting the Line Driver to a V.35 serial DCE.

4.3 Connecting the Line Driver's X.21 Serial Interface

The Line Driver 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 X.21 Line Driver to a DCE or DTE Device

The Line Driver 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), such as a router. However, the X.21 interface on the Line Driver may be configured as DTE (Data Terminal Equipment) for connection to DCE, such as a modem or multiplexor. When connecting the X.21 interface of the Line Driver to your DTE device, use a X.21 straight-through cable (see Figure 4-4).

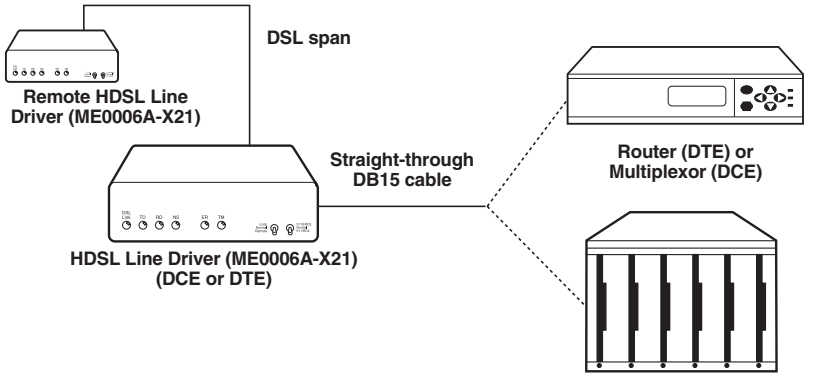

Figure 4-4. Connecting the Line Driver to a X.21 DTE or DCE.

To modify the DCE/DTE orientation from the default position (DCE), you must open the X.21 Line Driver's case.

4.3.2 Opening the Case

To open the Line Driver's case, insert a flat-head screwdriver into an open slot on both sides of the case, as 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 of the PC-board mounted components.

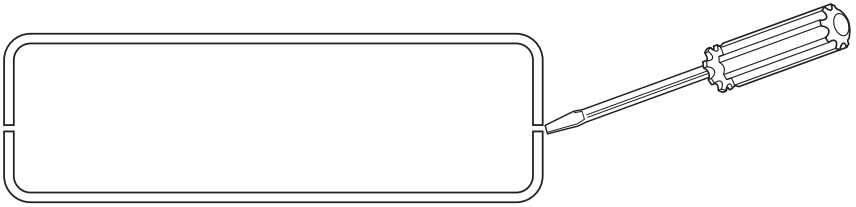

Figure 4-5. Opening the case with a small screwdriver.

The DCE/DTE strap is located on the top side of the Line Driver's 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 directions, 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.

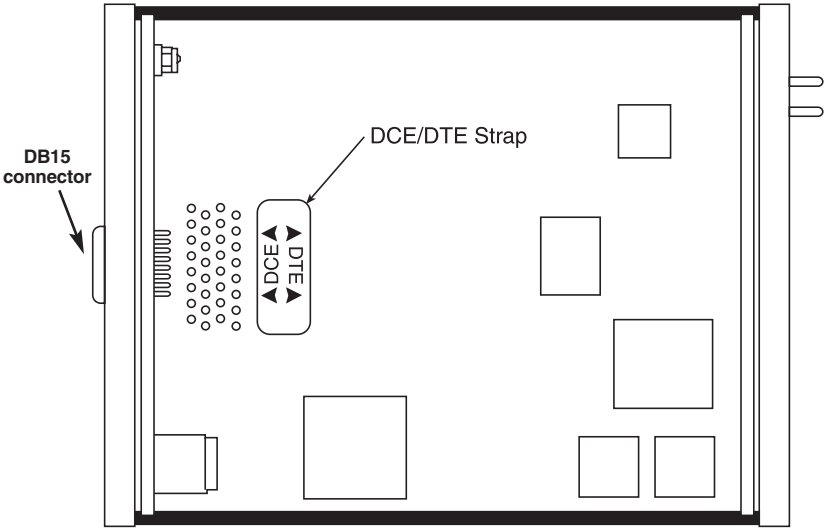

Figure 4-6. Setting the DCE/DTE strap.

4.4 Connecting Power

The Line Driver V.35 and X.21 models use a 5-VDC, 2-A universal input 100- to 240-VAC power supply (center pin is +5V). The power supply has a male IEC 320 power entry connector. Connect the power supply to the Line Driver via a barrel jack on the rear panel. The Line Driver powers up as soon as it is plugged into an AC outlet; there is no power switch.

WARNING

There are no user-serviceable parts in the power supply. Only qualified service personnel should replace the fuse. Contact Black Box Technical Support at 724-746-5500 for details.

5. Operation

Once the 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 Line Driver, first be sure that you have read **Section 4.4**. The unit powers up when it is plugged into the power source.

5.2 LED Status Indicators

The 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.

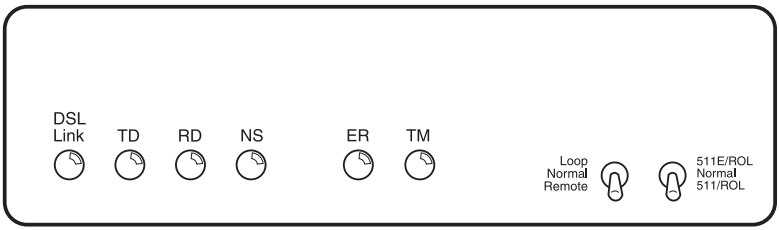

Figure 5-1. Front panel.

- 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 Line Driver is not connected with the remote 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).

  Only at power up, ER blinks once every 200 ms if the DTE Rate is set to unsupported settings.

- TM: glows yellow to indicate that the 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).

5.3 Test Modes

The Line Driver 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 DTE interface.

5.3.1 Overview

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

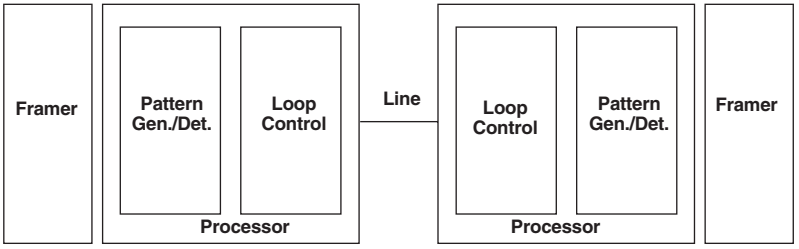

Figure 5-2. The major elements used in loopback and pattern tests in the Line Driver.

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 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 5-1 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 Time Out 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 in Figures 5-3 through 5-9 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 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.

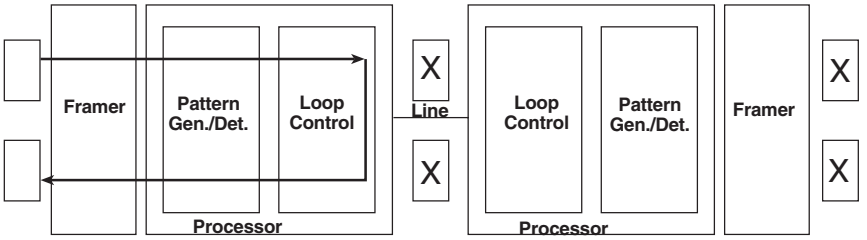

Figure 5-3. Local loop mode 1.

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.

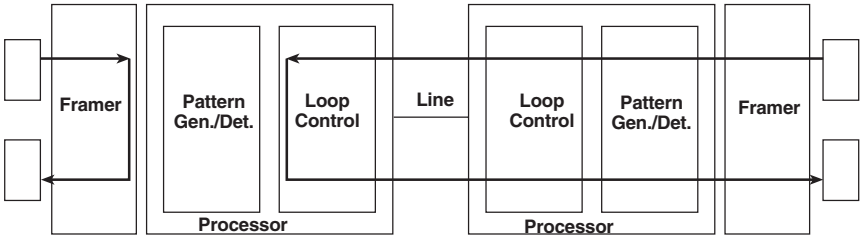

Figure 5-4. Local loop mode 2.

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 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 units will send out the 511 pattern.

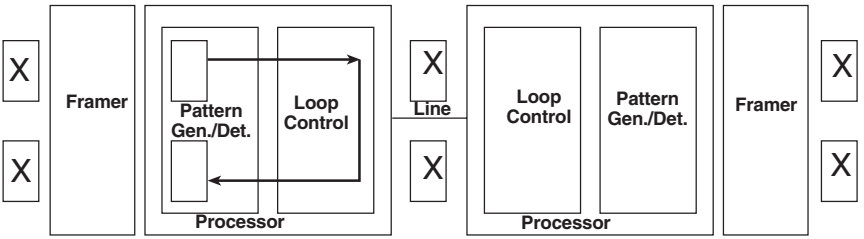

Figure 5-5. Local loop mode 1 with 511/511E.

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 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.

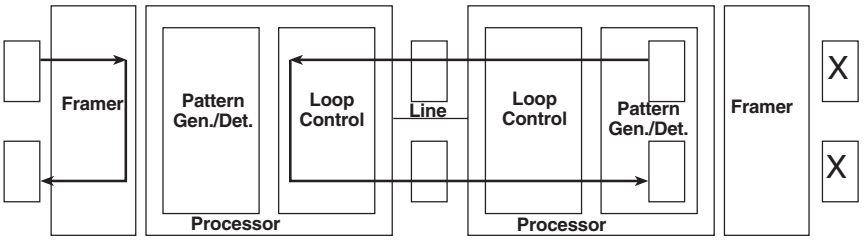

Figure 5-6. Local loop mode 2 with 511/511E.

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 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.

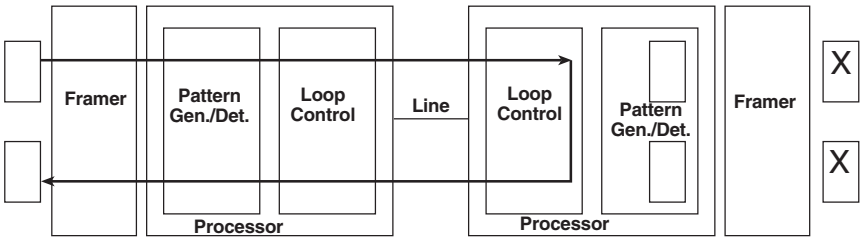

Figure 5-7. Remote loop.

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.

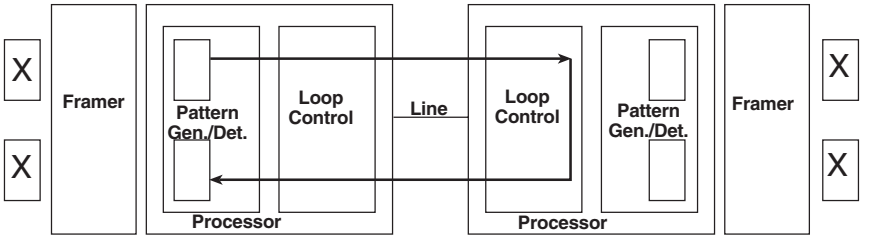

Figure 5-8. Remote loop with 511/511E.

Data Mode with 511/511E Pattern Generators

When the units enter data mode, you can turn on the 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 start-up 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.

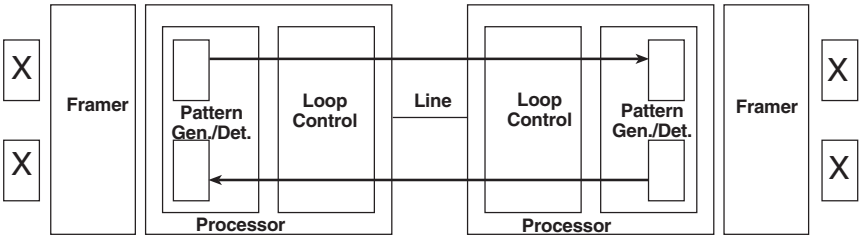

Figure 5-9. Data mode with 511/511E.

5.3.4 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 front panel of the Line Driver 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 no errors are present, move the V.52 toggle switch DOWN, 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 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: one to initiate and monitor the tests at the local Line Driver and one 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 tests, the other monitors for errors.

Appendix A. V.35 Interface Pin Assignments

Shown below are the pin assignments for the V.35 interface (M/34 female connector), 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

Shown below are the pin assigments for the X.21 interface (DB15 female connector), 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 HDSL 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	20,700	3.9	6.3	24,500	4.6	7.5
272	192, 256	17,400	3.3	5.3	24,200	4.6	7.4
400	320, 384	15,100	2.9	4.6	22,600	4.3	6.9
528	448, 512	14,900	2.8	4.5	21,000	4	6.4
784	576, 640, 704, 768	13,500	2.6	4.1	18,000	3.4	5.5
1040	832, 896, 960, 1024	11,900	2.2	3.6	15,500	2.9	4.7
1168	1088, 1152	11,000	2.1	3.3	15,200	2.9	4.6

Table C-2. Transmission distance HDSL 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	18,600	3.5	5.7	22,100	4.2	6.7
272	192, 256	15,700	3	4.8	21,800	4.1	6.6
400	320, 384	12,800	2.4	3.9	19,200	3.6	5.9
528	448, 512	13,000	2.5	4	18,300	3.5	5.6
784	576, 640, 704, 768	12,200	2.3	3.7	16,200	3.1	4.9
1040	832, 896, 960, 1024	10,500	2	3.2	13,600	2.6	4.1
1168	1088, 1152	9400	1.8	2.9	12,900	2.4	3.9

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