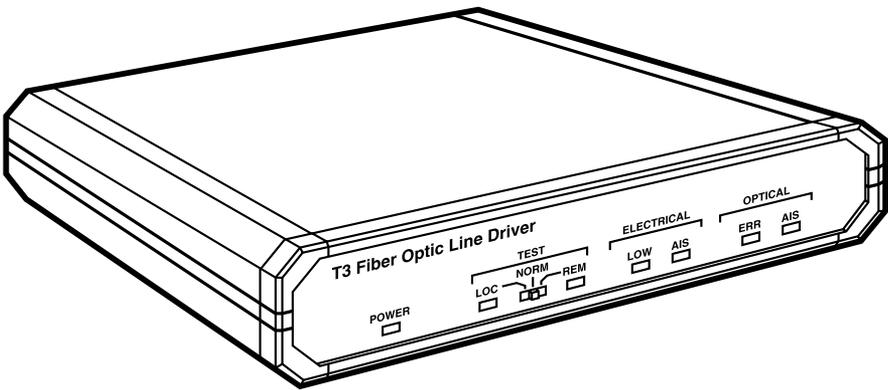




T3 Fiber Optic Line Driver



**CUSTOMER
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INFORMATION**

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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.

**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 conectado a una fuente de poder sólo del tipo descrito en el instructivo de operación, o como se indique en el aparato.

12. Precaución debe ser tomada de tal manera que la tierra física y la polarización del equipo no sea eliminada.
13. Los cables de la fuente de poder deben ser guiados de tal manera que no sean pisados ni pellizcados por objetos colocados sobre o contra ellos, poniendo particular atención a los contactos y receptáculos donde salen del aparato.
14. El equipo eléctrico debe ser limpiado únicamente de acuerdo a las recomendaciones del fabricante.
15. En caso de existir, una antena externa deberá ser localizada lejos de las líneas de energía.
16. El cable de corriente deberá ser desconectado del cuando el equipo no sea usado por un largo periodo de tiempo.
17. Cuidado debe ser tomado de tal manera que objetos líquidos no sean derramados sobre la cubierta u orificios de ventilación.
18. Servicio por personal calificado deberá ser provisto cuando:
 - A: El cable de poder o el contacto ha sido dañado; u
 - B: Objetos han caído o líquido ha sido derramado dentro del aparato; o
 - C: El aparato ha sido expuesto a la lluvia; o
 - D: El aparato parece no operar normalmente o muestra un cambio en su desempeño; o
 - E: El aparato ha sido tirado o su cubierta ha sido dañada.

TRADEMARKS USED IN THIS MANUAL

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Quick Start Guide

If you're familiar with the T3 Fiber Optic Line Driver, use this guide to prepare the unit for operation.

Installation

Open the T3 Fiber Optic Line Driver's case by unscrewing the two rear-panel screws and sliding out the unit's printed circuit board (PCB).

SETTING THE INTERNAL JUMPERS

Set the main board jumper according to the following table:

Jumper	Description	Values	Factory Setting
JP2	Controls the AIS transmission to the electrical or optical interface when a minor alarm is detected.	On—AIS is transmitted.	On
		Off—AIS is not transmitted.	

SELECTING THE T3 CABLE LENGTH

Refer to the table below and select the cable length.

T3 Cable Length	Jumper Positions		
	JP1	JP2	JP3
Up to 225 ft.	Pins 2, 3*	Pins 1, 2*	Pins 2, 3*
226 ft. to 450 ft.	Pins 1, 2	Pins 1, 2	Pins 1, 2
More than 450 ft.	Pins 1, 2	Pins 2, 3	Pins 1, 2

*Factory settings.

NOTE

The maximum cable length complies with ITU-T G.703.

Slide the circuit board back into the case and replace and tighten the screws.

CONNECTING THE CABLES

1. Connect the T3 electrical interface.
2. Connect the fiberoptic interface.
3. Connect the power cable (first to the modem, then to the mains supply).
Operation starts when the power is applied to the rear-panel power connector.

Operation

1. Check that the TEST switch is set to the NORM position.
2. Verify LED status. The POWER LED should be on; all other indicators should be off.
3. If there is an indication of a malfunction or fault, run a diagnostic test.

1. Specifications

T3 Electrical Interface

Transmission Rates: 44.736 Mbps

Impedance: 75 Ω unbalanced

Zero Suppression: B3ZS

Connectors: (2) BNC

Fiberoptic Interface

Operating Wavelength: MT619A-ST-R2: 850 nm (multimode);
MT618A-ST-R2: 1310 nm (single-mode)

Line Coding: CDP

Connectors: (2) ST®

Typical Power: See Table 2-1

Receiver Sensitivity: See Table 2-1

Range: See Table 2-1

Diagnostics

Loopbacks: Local loopback (LLB), activated via front-panel slide switch;
Remote loopback (RLB), activated via front-panel slide switch

AIS Signaling: Frequency of ± 25 ppm is sent to the electrical interface at the local unit in the event of an optical signal loss; when the electrical interface input level is "LOW," "All 1s" signaling is sent to the optical output

Alarm Relay Port

Connector: (1) DB9 female

Alarms: Major: T3 electrical input becomes lower than G.703 electrical levels, or bit error rate at the fiberoptic interface is 10^{-6} or worse; Minor: Alarm Indication Signal (AIS) is received at the T3 electrical or fiberoptic interfaces

Operation: Normally Open and Normally Closed, using different pins

Indicators

POWER: Power

LOC: A local loopback is active

REM: A remote loopback is active

ELECTRICAL LOW: T3 electrical input is below G.703

ELECTRICAL AIS: T3 electrical interface received “All 1s” string

OPTICAL ERR: Bit error rate of the signal received from the optical interface is 10^6 or worse

OPTICAL AIS: Fiberoptic interface received “All 1s” string

Power

AC Source: 100 to 240 VAC, 50/60 Hz

Physical

Size: 1.7"H x 7.6"W x 9.6"D (4.3 x 19.3 x 24.4 cm)

Environment

Temperature: 32 to 113°F (0 to 45°C)

Humidity: Up to 90%, noncondensing

2. Introduction

2.1 Overview

The T3 Fiber Optic Line Drivers are fiberoptic modems for transmission of T3 (44.736 Mbps) over multimode or single-mode fiberoptic media. The line drivers are transparent to framing and can transmit data using any framing pattern with B3ZS coded signals.

Conversion of the electrical signal into an optical signal is achieved using an infrared light-emitting diode. At the opposite end of the fiber, the optical signal is converted back into an electrical signal and amplified to the required level.

The T3 Fiber Optic Line Drivers use a Phase Locked Loop (PLL) circuit electrical interface (on BNC connectors with 75 Ω impedance) to recover data and clock from the signal.

Diagnostic and alarm features include LED status indicators, V.54 loopback activated from the front panel, and supervisory port for reporting system status.

2.1.1 VERSIONS

Two versions are available:

- T3 Fiber Optic Line Driver ST, 1310-nm Single-Mode (MT618A-ST-R2)
- T3 Fiber Optic Line Driver ST, 850-nm Multimode (MT619A-ST-R2)

2.1.2 APPLICATION

In the application shown in Figure 2-1, each line driver receives T3 signals, which are equalized to overcome electrical link distortion. The line driver converts the T3 signal into an optical signal.

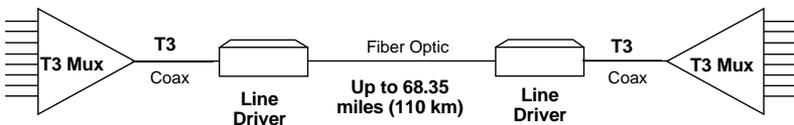


Figure 2-1. Typical application.

2.1.3 FEATURES

- Extend the range of T3 signals over fiberoptic cable up to 68.35 miles (110 km).
- Transparent to T3 signals.
- Conform with all relevant ITU series standards.
- Supports single-mode or multimode fiber.
- LED status indicators.
- V.54 loopbacks activated from the front panel.
- An alarm relay port for reporting the status of the system.
- Immunity to electrical interference such as EMI, RFI, spikes, and differential ground loops.
- Secure data transfer (no tapping on the transmitted information).
- Protection from sparks and lightning.
- Secure link in hazardous or hostile environment.

Table 2-1. Fiberoptic interface options.

Wave-length [nm]	Fiber Type [μm]	Transmitter Type	Typical Power	Receiver Sensitivity [dBm]	Maximum Range [km/miles]
850	62.5/125 multimode	LED	-18	-28	2.5/1.5
1310	9/125 single-mode	LED	-15	-31	27/16.8

2.1.4 ALARMS

When the T3 Fiber Optic Line Driver detects that electrical interface levels are below G.703 electrical levels, it transmits an “All 1s” signal (AIS) to the optical interface.

When an AIS is detected at the optical or electrical interface, the line driver transparently converts the signal and alerts the user via the front-panel LEDs and the alarm relay port.

Likewise, an alarm is relayed if a high bit-error rate is detected at the fiberoptic interface.

2.2 Physical Description

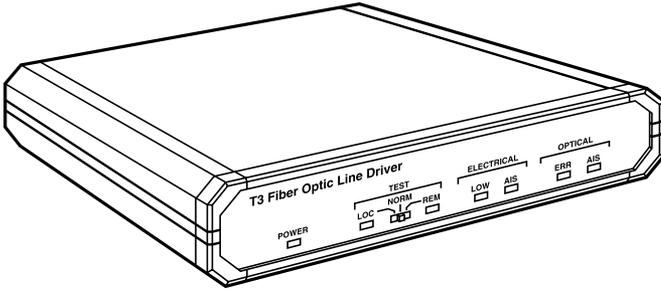


Figure 2-2. The front panel.

The line driver's front panel features LEDs that display T3 electrical and fiberoptic interface status. The front panel also includes a POWER LED and a TEST slide switch for local- and remote-loopback activation. For details, refer to **Chapter 4**.

The rear panel has an AC power connector, a T3 electrical interface connector, fiberoptic connectors, and an alarm relay connector. The rear panel is shown in Figure 3-3 (in **Chapter 3**).

2.3 Functional Description

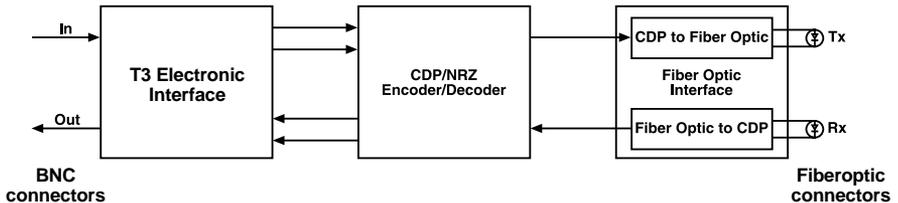


Figure 2-3. T3 Fiber Optic Line Driver block diagram.

The T3 Fiber Optic Line Driver has the following signal-processing modules:

- Signal conversion (see **Section 2.3.1**)
- Data/clock recovery (see **Section 2.3.2**)
- Data transfer (see **Section 2.3.3**)

2.3.1 SIGNAL CONVERSION

Conversion of the electrical NRZ (non-return to zero) signal into an optical CDP signal is performed by an infrared light-emitting diode. At the opposite end of the fiber, the optical signal is converted back into an electrical signal and amplified to the required level.

2.3.2 DATA/CLOCK RECOVERY

To recover data and clock from the signal, a Phase Locked Loop (PLL) circuit is used. The line driver provides internal selection for the T3, 75Ω balanced, B3ZS line coding electrical interface.

2.3.3 DATA TRANSFER

The optical signal is linked to the fiberoptic media and transmitted via the optical link to the remote unit. A high-sensitivity pre-amplifier and an AGC (Automatic Gain Control) circuit enable the remote unit to receive the optical signal. The output of the receiver is applied to the clock recovery circuit and data regeneration circuit, which in turn applies it to the electrical interface driving circuit.

3. Installation and Setup

WARNING

Internal settings, adjustment, maintenance, and repairs should be performed only by a skilled technician who is aware of the hazards involved.

Always observe standard safety precautions during installation, operation, and maintenance of this product.

3.1 Site Requirements and Prerequisites

Install the line driver within 5 ft. (1.5 m) of an easily-accessible grounded AC outlet capable of furnishing the required supply voltage.

Allow at least 36" (91.4 cm) of frontal clearance for operator access and at least 4" (10.2 cm) clearance at the rear of the unit for interface cable connections.

The ambient operating temperature of the line driver should be 32 to 113°F (0 to 45°C) at a relative humidity of up to 90%, noncondensing.

3.2 What the Package Includes

Your package should include the following items:

- T3 Fiber Optic Line Driver
- AC power cord
- This users' manual

If anything is missing or damaged, please contact Black Box at 724-746-5500.

3.3 Installation

The line driver is a standalone device intended for tabletop or bench installation. It is delivered completely assembled. No provision is made for bolting the line driver to the tabletop.

To install the line driver, you will:

1. Determine the required configuration of the line driver according to your application. Set the internal jumpers and switches accordingly (see **Section 3.3.1**).

2. Connect the T3 electrical interface (see **Section 3.3.2**).
3. Connect the fiberoptic interface (see **Section 3.3.2**).
4. Connect power to the line driver.

3.3.1 SETTING THE INTERNAL JUMPERS

This section provides information on the functions of the line driver's jumpers and gives step-by-step instructions for performing the internal settings. The default settings are also listed.

Locations of jumpers and switches

The T3 Fiber Optic Line Driver includes three printed circuit boards: the main board, the T3 interface board, and the fiberoptic interface board (see Figures 3-1 and 3-2).

The main board contains the common signal-processing circuits. One jumper (JP2) is provided for user settings.

The T3 interface board provides connection to the T3 link. The T3 board contains jumpers for selecting the T3 cable length.

The fiberoptic interface board provides connection to the fiberoptic cable. The fiberoptic board does not contain any jumpers or switches.

Opening the case

To reach the line driver's internal jumper and switch, you'll need to open its case.

WARNING

Only authorized and qualified service personnel should open the line driver.

To avoid accidental electric shock, always disconnect the interface cables and the power cord before opening the line driver.

Line voltages are present inside the line driver when it is connected to power and/or to the lines. Moreover, under external fault conditions, dangerous voltages may appear on the lines connected to the units.

Any adjustment, maintenance, and repair of the opened equipment under voltage should be avoided as much as possible and, when absolutely necessary, should be carried out only by a skilled technician who is aware of the hazard involved. Capacitors inside the instruments may still be charged even after the instruments have been disconnected from their power source.

CAUTION

The T3 Fiber Optic Line Driver contains components sensitive to electrostatic discharge (ESD). To prevent ESD damage, avoid touching the internal components. Before moving jumpers, touch the line driver's frame.

To open the line driver's case, unscrew the two rear-panel screws and slide out the line driver's printed circuit board.

Setting the main board internal jumpers

The internal jumper located on the line driver's main board is shown in Figure 3-1. The jumper settings are described in Table 3-1.

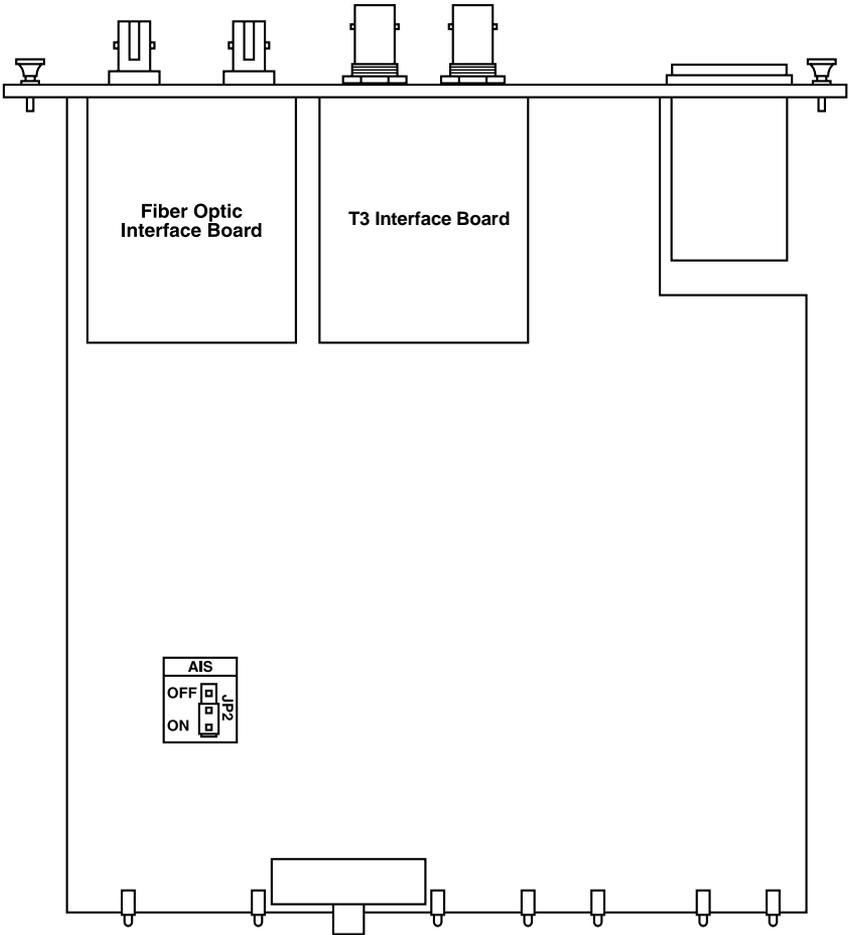


Figure 3-1. Main board layout.

Table 3-1. Main board jumper settings.

Jumper	Description	Values	Factory Setting
JP2	Controls the AIS transmission to the electrical or optical interface when a minor alarm is detected.	On—AIS is transmitted.	On
		Off—AIS is not transmitted.	

Setting the T3 interface board jumpers

The line driver’s T3 interface board features jumpers (JP1–JP3) that are used for selecting the T3 cable length. See Figure 3-2 and Table 3-2.

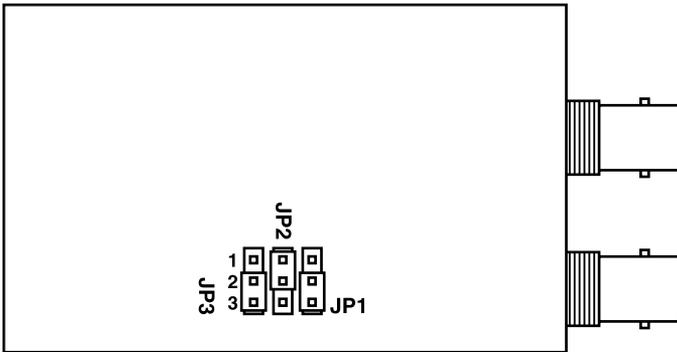


Figure 3-2. T3 interface board layout.

Table 3-2. Selecting the T3 interface cable.

T3 Cable Length	Jumper Positions		
	JP1	JP2	JP3
Up to 225 ft.	Pins 2, 3*	Pins 1, 2*	Pins 2, 3*
226 ft. to 450 ft.	Pins 1, 2	Pins 1, 2	Pins 1, 2
More than 450 ft.	Pins 1, 2	Pins 2, 3	Pins 1, 2

*Factory settings.

NOTE

The maximum cable length complies with ITU-T G.703.

Closing the case

Once you finish the internal settings, close the line driver's case.

1. Slide the printed circuit board back into the case.
2. Screw in the two rear-panel screws that fasten the main board to the case.

3.3.2 CONNECTING THE INTERFACES

Figure 3-3 shows the line driver's rear panel.

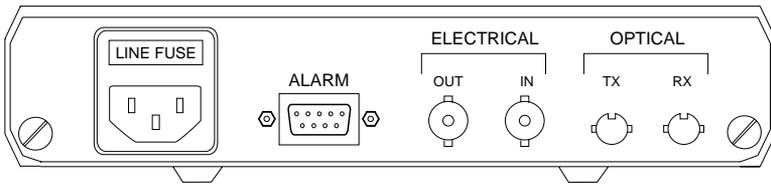


Figure 3-3. Rear panel.

Connecting the T3 interface

The line driver's T3 interface is terminated in two BNC coax connectors, designated In and Out.

1. Connect the receive line by attaching a 75 Ω coaxial cable to the BNC connector labeled In.
2. Connect the transmit line by attaching a 75 Ω coaxial cable to the BNC connector labeled Out.

Connecting the fiber optic interface

The line driver's fiberoptic interface is terminated in ST connectors (TX and RX).

1. Remove the connectors' protective caps and store them in a safe place for later use.
2. Connect the transmit fiber to the TX connector and the receive fiber to the RX connector.
3. At the remote unit, connect the transmit fiber to the RX connector and the receive fiber to the TX connector.

3.3.3 CONNECTING THE POWER

WARNING

The line driver has no power switch. Operation begins when the power is applied to the Power connector.

Before switching on the line driver and connecting any other cable, the line driver's protective earth terminals must be connected to the mains power cord's protective ground conductor. If you are using an extension cord (power cable), make sure it is grounded as well.

Any interruption of the protective (grounding) conductor (inside or outside the instrument) or disconnecting of the protective earth terminal can make this unit dangerous. Intentional interruption is prohibited.

Make sure that only fuses of the required rating (as marked on the rear panel) are used for replacement. Do not use repaired fuses or short-circuit the fuse holder. Always disconnect the mains cable before removing or replacing the fuse. Whenever it is likely that the fuse protection has been damaged, make the unit inoperative and secure it against unintended operation.

Connecting the AC power

AC power should be supplied to the line driver through the included 5-ft. (1.5-m) standard power cable terminated by a standard 3-prong plug.

Connect the power cable first to the connector on the line driver's rear panel, then to the mains outlet.

The line driver will power on automatically upon connection to the mains.

4. Operation

4.1 Front-Panel Indicators and Controls

The indicators on the front panel can be seen in Figure 4-1. The functions of these indicators are described in Table 4-1. LEDs are called out with numbers and switches are called out with letters.

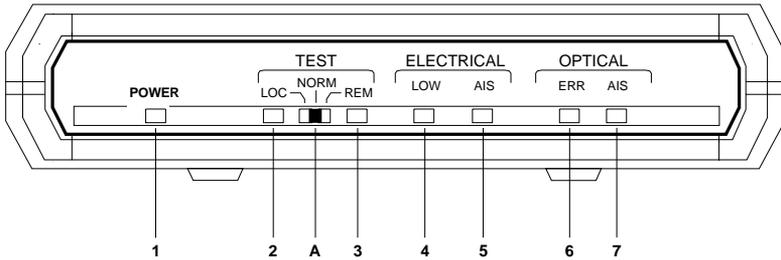


Figure 4-1. Front-panel indicators.

Table 4-1. Indicator functions.

Name	Type	Function
1. Power	Green LED	On—Line driver is powered up.
2. Loc	Yellow LED	On—A local loopback is active.
3. REM	Yellow LED	On—A remote loopback is active.
A. Test	Slide switch	Controls the local and remote loopbacks.
4. ELECTRICAL Low	Red LED	On—T3 electrical input is below G.703.
5. ELECTRICAL AIS	Yellow LED	On—T3 electrical interface received “All 1s” string.

Table 4-1 (continued). Indicator functions.

Name	Type	Function
6. OPTICAL ERR	Red LED	On—Bit-error rate of the signal received from the optical interface is 10^{-6} or worse.
7. OPTICAL AIS	Yellow LED	On—Fiberoptic interface received “All 1s” string.

4.2 Operating the Line Driver

4.2.1 POWERING ON

The line driver starts operating as soon as it is connected to the power source. The POWER LED turns On and remains lit as long as the line driver is connected to the mains.

4.2.2 NORMAL OPERATING INSTRUCTIONS

1. Check that the TEST switch is set to the NORM position.
2. Verify LED status. During normal operation, the POWER indicator should be On; all others should be Off.

NOTE

Some of the LEDs may turn on when the line driver is powered up, indicating that other communication equipment is not functioning properly.

3. If there is an indication of a malfunction or fault, run a diagnostic test.

4.2.3 POWERING OFF

Turn the line driver off by disconnecting the power cord from the mains.

5. Diagnostics and Troubleshooting

5.1 Alarm Relay

The T3 Fiber Optic Line Driver includes a dry-contact alarm-relay port for most major and minor alarms.

- Major alarms are initiated when a) T3 electrical input becomes lower than G.703 electrical levels or b) bit-error rate at the fiberoptic interface is 10^6 or worse.
- Minor alarms occur when an Alarm Indication Signal (AIS) is received at the T3 electrical or fiberoptic interfaces.

The dry-contact port operates as Normally Open or Normally Closed. See the pinout below.

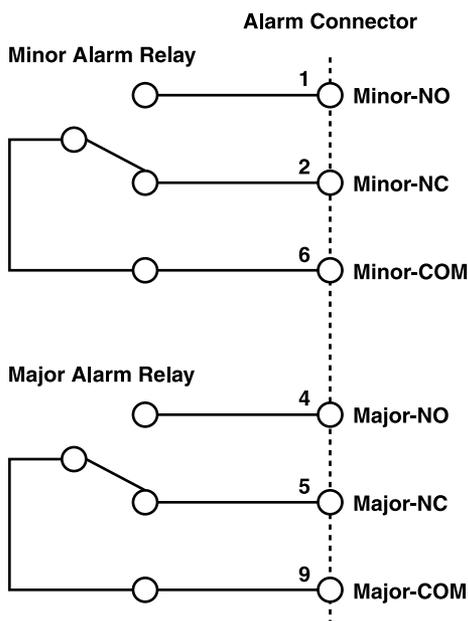


Figure 5-1. Alarm relay connector pinout.

NOTE

The relay positions are shown in the non-energized state (alarm active).

5.2 Diagnostic Loopbacks

5.2.1 LOCAL LOOPBACK (LLB)

Local loopback tests the performance of the T3 electrical interface of the local line driver and the equipment attached to it.

The data received at the T3 electrical interface is looped back to the line driver attached to it (see Figure 5-2).

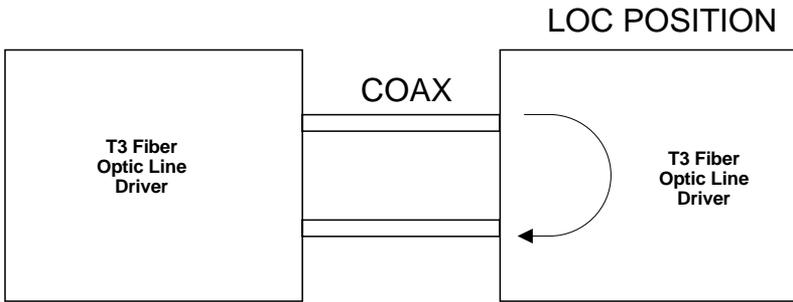


Figure 5-2. Local loopback illustrated.

To activate local loopback, slide the TEST switch to the LOC position. The LOC indicator turns On and remains lit as long as the local loopback is active.

5.2.2 REMOTE LOOPBACK (RLB)

Remote loopback tests the performance of the local line driver's T3 electrical and optical interfaces and the remote line driver's optical interface.

The data received at the remote line driver's optical interface is transmitted to the electrical interface and is simultaneously looped back to the local line driver (see Figure 5-3).

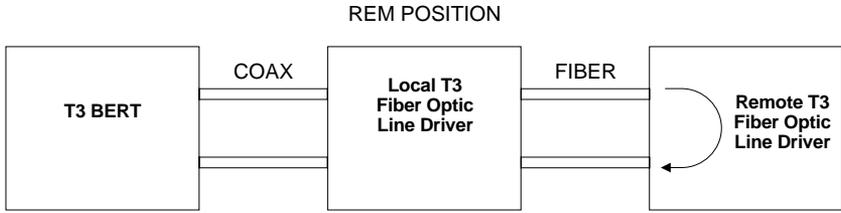


Figure 5-3. Remote loopback illustrated.

To activate remote loopback, slide the local line driver’s TEST switch to the REM position.

The remote line driver’s LOC indicator turns On and remains lit as long as the remote loopback is active.

5.3 Troubleshooting

If a problem occurs, refer to Table 5-1 for troubleshooting procedures. Perform the actions listed under Corrective Measures in the order given in the table until the problem is corrected. If the problem is still not resolved, call Technical Support as described in Section 5.4.

Table 5-1. Troubleshooting chart.

Trouble Symptoms	Probable Cause	Corrective Measures
POWER indicator is Off.	No AC power.	Verify that the power outlet is providing the required power.
		Make sure that both ends of the power cable are connected properly.
	Blown fuse.	Replace with a fuse of the correct rating.

Table 5-1 (continued). Troubleshooting chart.

Trouble Symptoms	Probable Cause	Corrective Measures
ELECTRICAL LOW indicator is On.	One of the T3 coaxial cables is defective or disconnected.	Make sure that both ends of the T3 coaxial cables are connected correctly and that the cables function properly.
	Attached equipment outputs do not comply with G.703 electrical levels.	Verify that the output levels of the equipment attached to the T3 interface comply with G.703.
	JP2 is set incorrectly.	Check the JP2 settings (see Table 3-1).
ELECTRICAL AIS indicator is On.	Attached equipment transmits "All 1s."	Check the equipment attached to the T3 electrical interface; make sure that the line driver is transmitting real data.
OPTICAL ERR indicator is On.	No optical connection.	Make sure that both transmit and receive fiber cables are properly connected to the local and remote units.
	The optical budget is low.	Measure the optical loss over the fiber link and check that it meets the product specifications.
OPTICAL AIS is On.	The equipment attached to the remote unit transmits "All 1s" string.	Check the equipment attached to the remote line driver.

Table 5-1 (continued). Troubleshooting chart.

Trouble Symptoms	Probable Cause	Corrective Measures
TEST LOC indicator is On.	The unit is in the local-loopback mode.	Set the TEST switch to the NORM position.
TEST REM indicator.	The unit is in the remote-loopback mode.	Set the TEST switch to the NORM position.

5.4 Calling Black Box

If you determine that your T3 Fiber Optic Line Driver is malfunctioning, do not attempt to alter or repair the unit. It contains no user-serviceable parts. Contact Black Box at 724-746-5500.

Before you do, make a record of the history of the problem. We will be able to provide more efficient and accurate assistance if you have a complete description, including:

- the nature and duration of the problem.
- when the problem occurs.
- the components involved in the problem.
- any particular application that, when used, appears to create the problem or make it worse.

5.5 Shipping and Packaging

If you need to transport or ship your T3 Fiber Optic Line Driver:

- Package it carefully. We recommend that you use the original container.
- If you are shipping the T3 Fiber Optic Line Driver for repair, make sure you include everything that came in the original package. Before you ship, contact Black Box to get a Return Authorization (RA) number.



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