



January 2004

MT618A-ST-R3 MT619A-ST-R2

MT620AE-R2

## T3/E3 Fiber Optic Line Drivers

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# Quick Start Guide

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If you are familiar with MT618A-ST-R3, MT619A-ST-R2 and MT620AE-R2 fiber optic line drivers, use this guide to prepare the units for operation.

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## 1. Installing Line Drivers

Open the unit's case by releasing the two rear panel screws and sliding out the PCB interior of the unit.

### Setting the Internal Jumpers

#### Setting the Main Board Jumpers

Set the main board jumper according to the following table:

Jumper	Description	Values	Factory Setting
AIS, JP2	Controls the AIS transmission to the electrical or optical interface, when a minor alarm is detected	<b>ON</b> – AIS is transmitted <b>OFF</b> – AIS is not transmitted	ON

#### Selecting the E3/T3 Cable Length

Refer to the tables below and select the cable length, depending on your unit's interface type: E3 or T3.

Jumper	Description	Values	Factory Setting
E3 Cable Length Jumper, JP2	Selects the E3 cable length	<b>Pins 1, 2</b> – Cable length is from 0 to 300 ft <b>Pins 2, 3</b> – Cable length is more than 300 ft	Pins 1, 2

**Note:** The maximum possible cable length complies with ITU-T G.703.

T3 Cable Length	Jumper Positions		
	JP1	JP2	JP3
0 ft – 225 ft	Pins 2, 3*	Pins 1, 2*	Pins 2, 3*
225 ft – 450 ft	Pins 1, 2	Pins 1, 2	Pins 1, 2
More than 450 ft	Pins 1, 2	Pins 2, 3	Pins 1, 2

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

\* – Factory settings

## Connecting the Cables

► **To connect cables:**

1. Connect the E3 or T3 electrical interface.
2. Connect the fiber optic 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.

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## 2. Operating the Line Drivers

1. Check that the TEST switch is set to the NORM position.
2. Verify LED status. All the LED indicators should be OFF, except for the PWR indicator.
3. If there is an indication of a malfunction or fault, run a diagnostic test.

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# Chapter 1

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## Introduction

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### 1.1 Overview

#### General

MT618A-ST-R3, MT619A-ST-R2, MT620AE-R2 are T3/E3 fiber optic line drivers for transmission of E3 (34.368 Mbps) or T3 (44.736 Mbps) over multimode or single mode fiber optic media.

The units are transparent to framing, and can transmit data using any framing pattern with HDB3 or B3ZS coded signals.

The electrical signal is converted into an optical signal using an infrared light emitting diode or laser diode transmitter. At the opposite end of the fiber, the optical signal is converted back into an electrical signal and amplified to the required level. The line drivers utilize a Phase Locked Loop (PLL) circuit to recover data and clock from the signal and provide electrical interface of two BNC connectors with 75Ω impedance.

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

When the line drivers detects electrical interface levels below G.703 electrical levels, the modem transmits an "all 1s" signal (AIS) to the optical interface. When an "all 1s" (AIS) signal is detected at the optical or electrical interface, the modem converts this signal transparently and alerts the user via front panel LEDs and the supervisory port.

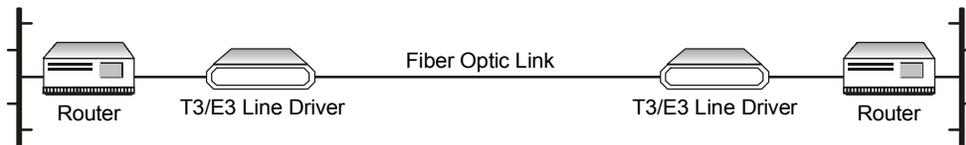
The electrical interface meets requirements of ITU G.703, G.921 and G.935 standards for E3 and T3.

#### Versions

- MT618A-ST-R3 – T3 fiber optic line driver ST, 1310 nm single mode laser
- MT619A-ST-R2 – T3 fiber optic line driver ST, 850 nm multimode LED
- MT620AE-R2 – E3 fiber optic line driver ST, 1310 nm single mode laser

## Application

In the application illustrated in *Figure 1-1*, each line driver receives E3 or T3 signals, which are equalized to overcome electrical link distortion. The units then convert the E3 or T3 signals into an optical signal. The optical signal is coupled to the fiber optic 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 then applied to the clock recovery and data regeneration circuit, which in turn applies it to the electrical interface driving circuit.



*Figure 1-1. Typical Application*

## Features

- Transparent to E3, T3 signals
- Conform with all relevant ITU series standards
- Multimode or single mode fiber supported
- Laser diode option for extended distances, including long haul and WDM laser option.

MT618A-ST-R3, MT619A-ST-R2 and MT620AE-R2 also feature:

- LED status indicators
- V.54 loopbacks activated from the front panel
- An alarm relay port for reporting the status of the system.

The line drivers are designed to operate with several different grades and sizes of fiber optic cable and provide the user with:

- Extended high rate range transmission
- 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 1-1. Fiber Optic Interface Options

Wavelength [nm]	Fiber Type [μm]	Transmitter Type	Typical Power [dBm]	Receiver Sensitivity [dBm]	Connector	Typical Max. Range [km/miles]
850	62.5/125 multimode	LED	-18	-28	ST	2.5/1.55
1310	9/125 single mode	Laser	-12	-31	ST	38/23.6

### Alarms

When the line drivers detect that electrical interface levels are below G.703 electrical levels, the modem transmits an "all 1s" signal (AIS) to the optical interface.

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

Likewise, an alarm is relayed if high bit error rate detected at the fiber optic interface.

## 1.2 Functional Description

This section provides a functional description (*Figure 1-2*) of the line drivers in the form of block diagrams.

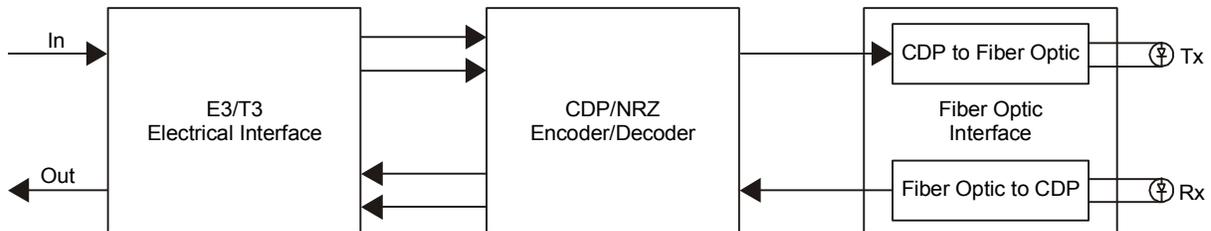


Figure 1-2. Block Diagram

The line drivers have the following signal processing modules:

- Signal conversion
- Data/clock recovery
- Data transfer.

### Signal Conversion

Conversion of the electrical NRZ signal into an optical CDP signal is performed by an infrared light emitting diode or laser transmitter. At the opposite end of the fiber, the optical signal is converted back into an electrical signal and amplified to the required level.

## Data/Clock Recovery

To recover data and clock from the signal, a Phase Locked Loop (PLL) circuit is utilized. The units provide internal selection for the following electrical interfaces:

- E3, 75Ω unbalanced, HDB3 line coding
- T3, 75Ω balanced, B3ZS line coding.

## Data Transfer

The optical signal is linked to the fiber-optic 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 the data regeneration circuit, which in turn apply it to the electrical interface driving circuit.

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### 1.3 Technical Specifications

#### E3/T3 Electrical Interface

*Transmission Rates*

- E3: 34.368 Mbps
- T3: 44.736 Mbps

*Impedance* 75Ω, unbalanced

*Zero Suppression*

- E3: HDB3
- T3: B3ZS

*Connectors* Two BNC connectors

#### Fiber Optic Interface

*Operating Wavelength* 850 nm, 1310 nm (see [Table 1-1](#))

*Line Coding* CDP

*Connectors* ST

*Output Power* See [Table 1-1](#)

*Receiver Sensitivity* See [Table 1-1](#)

*Range* See [Table 1-1](#)

#### 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

<b>Alarm Relay Port</b>	<i>Connector</i>	9-pin, D-type, female
	<i>Alarms</i>	<ul style="list-style-type: none"> <li>• Major – E3/T3 electrical input becomes lower than G.703 electrical levels, or bit error rate at the fiber optic interface is <math>10^{-6}</math> or worse</li> <li>• Minor – Alarm Indication Signal is received at the E3/T3 electrical or fiber optic interfaces</li> </ul>
	<i>Operation</i>	Normally Open and Normally Closed, using different pins
<b>Indicators</b>	<i>PWR</i>	Power
	<i>LOC</i>	A local loopback is active
	<i>REM</i>	A remote loopback is active
	<i>ELECTRICAL LOW</i>	E3/T3 electrical input is below G.703
	<i>ELECTRICAL AIS</i>	E3/T3 electrical interface received "All 1s" string
	<i>OPTICAL ERR</i>	Bit error rate of the signal received from the optical interface is $10^{-6}$ or worse
	<i>OPTICAL AIS</i>	Fiber optic interface received "All 1s" string
<b>Power</b>	<i>AC Source</i>	100–240 VAC, 50/60 Hz
<b>Physical</b>	<i>Height</i>	4.4 cm / 1.7 in
	<i>Width</i>	19.4 cm / 7.6 in
	<i>Depth</i>	24.3 cm / 9.6 in
	<i>Weight</i>	1.4 kg / 3.0 lb
<b>Environment</b>	<i>Temperature</i>	0 to 45°C (32 to 113°F)
	<i>Humidity</i>	Up to 90%, non-condensing



# Chapter 2

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## Installation and Setup

This chapter describes installation procedures for the MT618A-ST-R3, MT619A-ST-R2 and MT620AE-R2 devices.

After installing the unit, refer to [Chapter 3](#) for the system operation information.

Refer to [Chapter 4](#) for troubleshooting and diagnostics information.



**Warning**

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**Internal settings, adjustment, maintenance, and repairs may 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.**

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### 2.1 Site Requirements and Prerequisites

The MT618A-ST-R3, MT619A-ST-R2 and MT620AE-R2 units should be installed within 1.5m (5 ft) of an easily-accessible grounded AC outlet capable of furnishing the required supply voltage, in the range of 100 to 240 VAC.

Allow at least 90 cm (36 in) of frontal clearance for operator access and at least 10 cm (4 in) clearance at the rear of the unit for interface cable connections.

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

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### 2.2 Installation and Setup

The line drivers are standalone devices intended for tabletop or bench installation. They are delivered completely assembled. No provision is made for bolting the unit on the tabletop.

► **To install the line driver:**

1. Determine the required configuration of the unit, according to your application, and set the internal jumpers and switches accordingly.
2. Connect the E3/T3 electrical interface.
3. Connect fiber optic interface.
4. Connect power to the unit.

## Setting the Internal Jumpers

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

### Locations of Jumpers and Switches

The line drivers include three printed circuit boards (PCBs): the main board, E3/T3 interface board, and fiber optic interface board (see [Figure 2-1](#), [Figure 2-2](#) and [Figure 2-3](#)).

The **main board** contains the common signal processing circuits. One jumper, JP2, is provided for user settings.

The **E3/T3 interface boards** provide connection to the E3/T3 links. The E3/T3 boards contain jumpers for selecting the E3/T3 cable length.

The **fiber optic interface board** provides connection to the fiber optic plant. The fiber optic board does not contain any jumpers or switches.

### Opening the Case

To reach the internal jumper and switch of the line driver, it is necessary to open its case.



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**Access to the inside of the units is permitted only to authorized and qualified service personnel.**

**To avoid accidental electric shock, always disconnect the interface cables and the power cord before removing the units from their casing.**

**Line voltages are present inside when the units are 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.**

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**Caution** The line drivers contain components sensitive to electrostatic discharge (ESD). To prevent ESD damage, avoid touching the internal components. Before moving jumpers, touch the unit's frame.

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➤ **To open the unit case:**

1. Disconnect all the cables connected to the line driver.
2. Release the two rear panel screws and use them as levers to slide out the PCB interior of the unit.

### Setting the Main Board Internal Jumpers

The internal jumper located on the main board is identified in [Figure 2-1](#). The jumper settings are described in [Table 2-1](#).

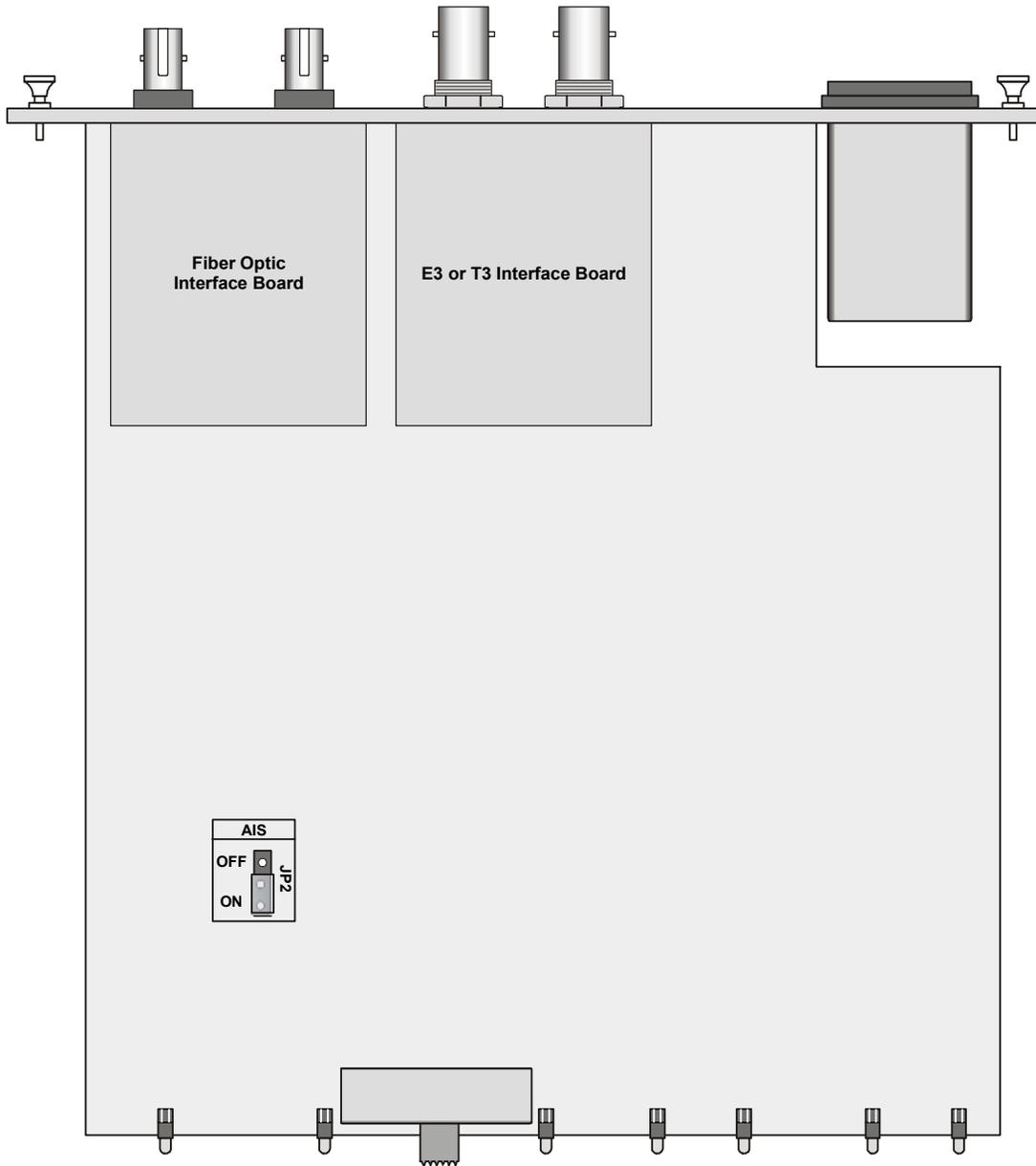


Figure 2-1. Main Board Layout

Table 2-1. Main Board Jumper Settings

Jumper	Description	Values	Factory Setting
AIS, JP2	Controls the AIS transmission to the electrical or optical interface, when a minor alarm is detected	<b>ON</b> – AIS is transmitted <b>OFF</b> – AIS is not transmitted	ON

### Setting the E3/T3 Interface Board Jumpers

E3 interface board features the JP2 jumper, which is used for selection of the E3 cable length (see [Figure 2-2](#) and [Table 2-2](#)).

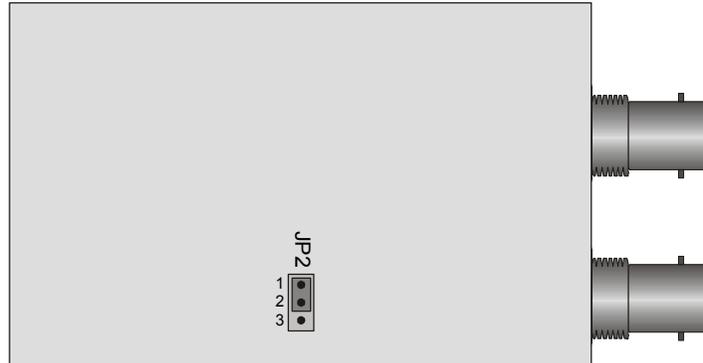


Figure 2-2. E3 Interface Board Layout

Table 2-2. Selecting the E3 Interface Cable

Jumper	Description	Values	Factory Setting
E3 Cable Length Jumper, JP2	Selects the E3 cable length	<b>Pins 1, 2</b> – Cable length is from 0 to 300 ft <b>Pins 2, 3</b> – Cable length is more than 300 ft	Pins 1, 2

**Note:** The maximum possible cable length complies with ITU-T G.703.

T3 interface board features the JP1, JP2 and JP3 jumpers, which are used for selection of the T3 cable length (see [Figure 2-1](#) and [Table 2-3](#)).

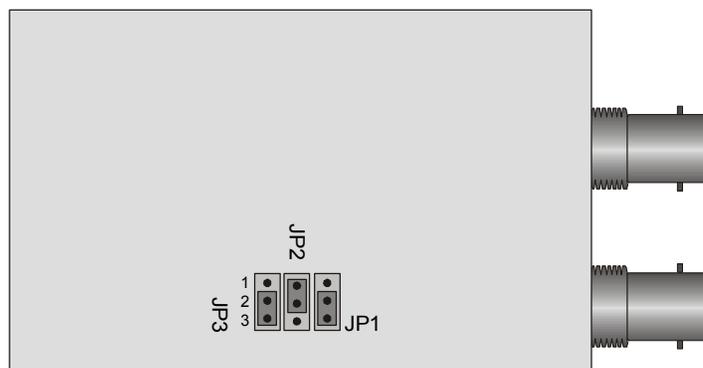


Figure 2-3. T3 Interface Board Layout

Table 2-3. Selecting the T3 Interface Cable

T3 Cable Length	Jumper Positions		
	JP1	JP2	JP3
0 ft – 225 ft	Pins 2, 3*	Pins 1, 2*	Pins 2, 3*
225 ft – 450 ft	Pins 1, 2	Pins 1, 2	Pins 1, 2
More than 450 ft	Pins 1, 2	Pins 2, 3	Pins 1, 2

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

\* – Factory settings

## Closing the Case

Once you finish the internal settings, you have to close the unit's case.

► **To close the unit's case:**

1. Slide the PCB interior back into the case.
2. Screw in the two rear panel screws to fasten the main board in the case.

## Connecting the Interfaces

Figure 2-4 shows a typical rear panel of a typical unit.

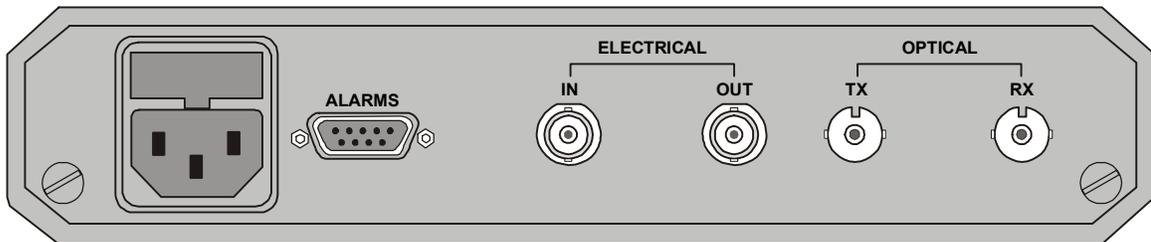


Figure 2-4. Typical Rear Panel

### Connecting the E3/T3 Interface

The E3/T3 interface of the line drivers terminates in two BNC coax connectors, designated IN and OUT.

► **To connect E3/T3 interface:**

1. Connect the receive line, using a 75 $\Omega$  coaxial cable to the BNC connector labeled IN.
2. Connect the transmit line, using a 75 $\Omega$  coaxial cable to the BNC connector labeled OUT.

### Connecting the Fiber Optic Interface

The fiber optic interface of the line drivers terminates in ST connectors, designated TX and RX.

► **To connect the fiber optic interface:**

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



This product may be equipped with a laser diode. In such a case, this laser warning symbol label will be attached near the optical transmitter. Please observe the following precautions:

- Do not attempt to adjust the laser drive current.
- Do not use broken or unterminated fiber-optic cables/connectors or stare at the laser beam.
- The use of optical equipment with this product will increase eye hazard.
- Use of controls, adjustments or performing procedures other than those specified herein, may result in hazardous radiation exposure.

**ATTENTION:** The laser beam is invisible!

## Connecting the Power



The units have no power switch. Operation starts when the power is applied to the rear panel POWER connector.

Before switching on this unit and connecting any other cable, the protective earth terminals of this unit must be connected to the protective ground conductor of the mains power cord. 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.

For the AC version, 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.

AC power should be supplied to the line drivers through the 5 ft (1.5m) standard power cable terminated by a standard 3-prong plug (see [Figure 2-4](#)). The cable is provided with the unit.

➤ **To connect AC power:**

- Connect the power cable first to the connector on the unit's rear panel, and then to the mains outlet.

The unit will be turned on automatically upon connection to the mains.

# Chapter 3

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# Operation

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## 3.1 Front Panel Indicators and Controls

Figure 3-1 shows a typical front panel. Table 3-1 lists the functions of the line driver controls, connectors and indicators, located on the front panel.

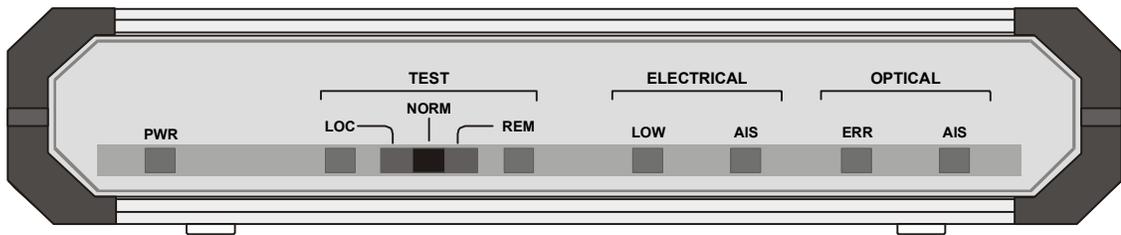


Figure 3-1. Typical Front Panel

Table 3-1. Controls and Indicators

Name	Type	Function
PWR	Green LED	ON – The unit is powered up
LOC	Yellow LED	ON – A local loopback is active
REM	Yellow LED	ON – A remote loopback is active
TEST	Slide Switch	Controls the local and remote loopbacks
ELECTRICAL LOW	Red LED	ON – E3/T3 electrical input is below G.703
ELECTRICAL AIS	Yellow LED	ON – E3/T3 electrical interface received "All 1s" string
OPTICAL ERR	Red LED	ON – Bit error rate of the signal received from the optical interface is $10^{-6}$ or worse
OPTICAL AIS	Yellow LED	ON – Fiber optic interface received "All 1s" string

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## 3.2 Operating Instructions

### Turning On

The line drivers start operating as soon as they are connected to the power source. The PWR LED turns ON and remains lit as long as the units are connected to the mains.

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## Normal Operating Instructions

During normal operation all indicators should be OFF, except for the PWR indicator.

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**Note** *Some of LEDs may turn on upon the power-up, indicating that other communication equipment is not functioning properly.*

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## Turning Off

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

# Chapter 4

## Diagnostics and Troubleshooting

### 4.1 Alarm Relay

MT618A-ST-R3, MT619A-ST-R2 and MT620AE-R2 include a dry contact alarm relay port supported via 9-pin connector for major and minor alarms.

- Major alarms are initiated when E3/T3 electrical input becomes lower than G.703 electrical levels, or bit error rate at the fiber optic interface is  $10^{-6}$  or worse.
- Minor alarms occur when an Alarm Indication Signal is received at the E3/T3 electrical or fiber optic interfaces.

The dry contact port operates as Normally Open or Normally Closed, using different pins of the alarm relay port connector (see [Figure 4-1](#)).

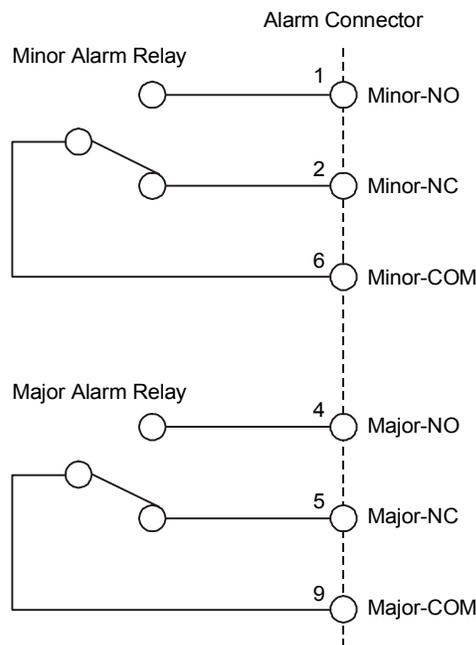


Figure 4-1. Alarm Relay Connector Pinout

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

## 4.2 Diagnostic Loopbacks

### Local Loopback (LLB)

The line drivers support activation of a local loopback, which tests the performance of E3/T3 electrical interface of the local unit and equipment attached to it.

The data received at the E3/T3 electrical interface is looped back to the equipment attached to it (see [Figure 4-2](#)).

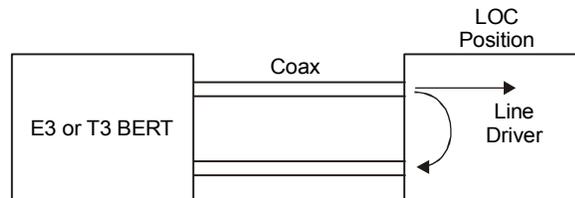


Figure 4-2. Local Loopback

► **To activate local loopback:**

- Slide the front panel TEST switch to the LOC position.

The TEST LOC indicator lights up and remains lit as long as the local loopback is active.

### Remote Loopback (RLB)

The line drivers support activation of a remote loopback, which tests the performance of the local unit's E3/T3 electrical and optical interfaces and the remote unit's optical interface.

The data received at the optical interface of the remote unit is transmitted to the electrical interface and at the same time is looped back to the local unit (see [Figure 4-3](#)).

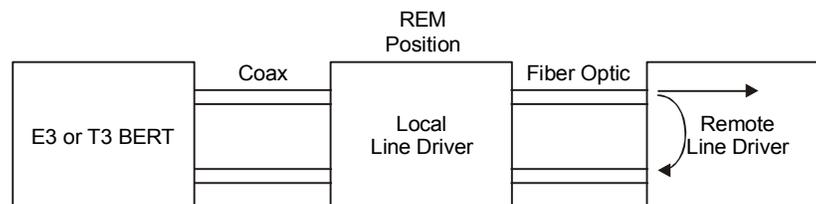


Figure 4-3. Remote Loopback

► **To activate remote loopback:**

- Slide the TEST switch of the local line driver to the REM position.

The TEST LOC indicator of the remote unit lights up and remains lit as long as the remote loopback is active.

## 4.3 Troubleshooting Instructions

In case a problem occurs, refer to [Table 4-1](#) for the troubleshooting procedures. Perform the actions listed under *Corrective Measures* in the order given in the table, until the problem is corrected.

Table 4-1. Troubleshooting Chart

Trouble Symptoms	Probable Cause	Corrective Measures
PWR indicator is OFF	No AC power	<ul style="list-style-type: none"> <li>Verify that the power outlet is providing the required power.</li> <li>Ensure that the both ends of the power cable are connected properly.</li> </ul>
	Blown fuse	Replace with a fuse of correct rating
ELECTRICAL LOW indicator is ON	One of the E3/T3 coaxial cables is defective or disconnected	Ensure that both ends of the E3/T3 coaxial cables are connected correctly and that the cables function properly.
	Attached equipment outputs do not comply with G.703 electrical levels	Check that the output levels of the equipment attached to the E3/T3 interface comply with G.703.
	JP2 is set incorrectly	Correct the JP2 settings according to <a href="#">Table 2-1</a> .
ELECTRICAL AIS indicator is ON	Attached equipment transmits "All 1s" string	Check the equipment attached to E3/T3 electrical interface, ensure that it transmits real data.
Optical ERR indicator is ON	No optical connection	Ensure 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
TEST LOC indicator is ON	The unit is in the local loopback mode	Set the front panel TEST slide switch to NORM position.
TEST REM indicator is ON	The unit is in the remote loopback mode	Set the front panel TEST slide switch to NORM position.

