RAD
data communications

Installation and Operation Manual

FOM-E1/T1

E1/T1 Fiber Optic Modem

FOM-E1/T1

E1/T1 Fiber Optic Modem
Installation and Operation Manual

Notice

For further information contact RAD at the address below or contact your local distributor.

International Headquarters
RAD Data Communications Ltd.

24 Raoul Wallenberg St.
Tel Aviv 69719 Israel
Tel: 972-3-6458181
Fax: 972-3-6498250
E-mail: rad@rad.co.il

U.S. Headquarters
RAD Data Communications Inc.

900 Corporate Drive
Mahwah, NJ 07430 USA
Tel: (201) 529-1100, Toll free: 1-800-444-7234
Fax: (201) 529-5777
E-mail: market@radusa.com

 Publication No. 284-200-01/03

Limited Warranty

RAD warrants to DISTRIBUTOR that the hardware in the FOM-E1/T1 to be delivered hereunder shall be free of defects in material and workmanship under normal use and service for a period of twelve (12) months following the date of shipment to DISTRIBUTOR.

If, during the warranty period, any component part of the equipment becomes defective by reason of material or workmanship, and DISTRIBUTOR immediately notifies RAD of such defect, RAD shall have the option to choose the appropriate corrective action: a) supply a replacement part, or b) request return of equipment to its plant for repair, or c) perform necessary repair at the equipment's location. In the event that RAD requests the return of equipment, each party shall pay one-way shipping costs.

RAD shall be released from all obligations under its warranty in the event that the equipment has been subjected to misuse, neglect, accident or improper installation, or if repairs or modifications were made by persons other than RAD's own authorized service personnel, unless such repairs by others were made with the written consent of RAD.

The above warranty is in lieu of all other warranties, expressed or implied. There are no warranties which extend beyond the face hereof, including, but not limited to, warranties of merchantability and fitness for a particular purpose, and in no event shall RAD be liable for consequential damages.

RAD shall not be liable to any person for any special or indirect damages, including, but not limited to, lost profits from any cause whatsoever arising from or in any way connected with the manufacture, sale, handling, repair, maintenance or use of the FOM-E1/T1, and in no event shall RAD's liability exceed the purchase price of the FOM-E1/T1.

DISTRIBUTOR shall be responsible to its customers for any and all warranties which it makes relating to FOM-E1/T1 and for ensuring that replacements and other adjustments required in connection with the said warranties are satisfactory.

Software components in the FOM-E1/T1 are provided "as is" and without warranty of any kind. RAD disclaims all warranties including the implied warranties of merchantability and fitness for a particular purpose. RAD shall not be liable for any loss of use, interruption of business or indirect, special, incidental or consequential damages of any kind. In spite of the above RAD shall do its best to provide error-free software products and shall offer free Software updates during the warranty period under this Agreement.

RAD's cumulative liability to you or any other party for any loss or damages resulting from any claims, demands, or actions arising out of or relating to this Agreement and the FOM-E1/T1 shall not exceed the sum paid to RAD for the purchase of the FOM-E1/T1. In no event shall RAD be liable for any indirect, incidental, consequential, special, or exemplary damages or lost profits, even if RAD has been advised of the possibility of such damages.

This Agreement shall be construed and governed in accordance with the laws of the State of Israel.

General Safety Instructions

The following instructions serve as a general guide for the safe installation and operation of telecommunications products. Additional instructions, if applicable, are included inside the manual.

Safety Symbols

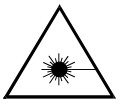
Warning

This symbol may appear on the equipment or in the text. It indicates potential safety hazards regarding product operation or maintenance to operator or service personnel.

Danger of electric shock! Avoid any contact with the marked surface while the product is energized or connected to outdoor telecommunication lines.

.

Protective earth: the marked lug or terminal should be connected to the building protective earth bus.



Warning

Some products may be equipped with a laser diode. In such cases, a label with the laser class and other warnings as applicable will be attached near the optical transmitter. The laser warning symbol may be also attached. Please observe the following precautions:

- **Before turning on the equipment, make sure that the fiber optic cable is intact and is connected to the transmitter.**
- **Do not attempt to adjust the laser drive current.**
- **Do not use broken or unterminated fiber-optic cables/connectors or look straight at the laser beam.**
- **The use of optical devices with the equipment 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 may be invisible!

Always observe standard safety precautions during installation, operation and maintenance of this product. Only qualified and authorized service personnel should carry out adjustment, maintenance or repairs to this product. No installation, adjustment, maintenance or repairs should be performed by either the operator or the user.

Handling Energized Products

General Safety Practices

Do not touch or tamper with the power supply when the power cord is connected. Line voltages may be present inside certain products even when the power switch (if installed) is in the OFF position or a fuse is blown. For DC-powered products, although the voltages levels are usually not hazardous, energy hazards may still exist.

Before working on equipment connected to power lines or telecommunication lines, remove jewelry or any other metallic object that may come into contact with energized parts.

Unless otherwise specified, all products are intended to be grounded during normal use. Grounding is provided by connecting the mains plug to a wall socket with a protective earth terminal. If an earth lug is provided on the product, it should be connected to the protective earth at all times, by a wire with a diameter of 18 AWG or wider. Rack-mounted equipment should be mounted only in earthed racks and cabinets.

Always make the ground connection first and disconnect it last. Do not connect telecommunication cables to ungrounded equipment. Make sure that all other cables are disconnected before disconnecting the ground.

Connection of AC Mains

Make sure that the electrical installation complies with local codes.

Always connect the AC plug to a wall socket with a protective ground.

The maximum permissible current capability of the branch distribution circuit that supplies power to the product is 16A. The circuit breaker in the building installation should have high breaking capacity and must operate at short-circuit current exceeding 35A.

Always connect the power cord first to the equipment and then to the wall socket. If a power switch is provided in the equipment, set it to the OFF position. If the power cord cannot be readily disconnected in case of emergency, make sure that a readily accessible circuit breaker or emergency switch is installed in the building installation.

Connection of DC Mains

Unless otherwise specified in the manual, the DC input to the equipment is floating in reference to the ground. Any single pole can be externally grounded.

Due to the high current capability of DC mains systems, care should be taken when connecting the DC supply to avoid short-circuits and fire hazards.

DC units should be installed in a restricted access area, i.e. an area where access is authorized only to qualified service and maintenance personnel.

Make sure that the DC supply is electrically isolated from any AC source and that the installation complies with the local codes.

The maximum permissible current capability of the branch distribution circuit that supplies power to the product is 16A. The circuit breaker in the building installation should have high breaking capacity and must operate at short-circuit current exceeding 35A.

Before connecting the DC supply wires, ensure that power is removed form the DC circuit. Locate the circuit breaker of the panel board that services the equipment and switch it to the OFF position. When connecting the DC supply wires, first connect the ground wire to the corresponding terminal, then the positive pole and last the negative pole. Switch the circuit breaker back to the ON position.

A readily accessible disconnect device that is suitably rated and approved should be incorporated in the building installation.

Connection of Data and Telecommunications Cables

Data and telecommunication interfaces are classified according to their safety status.

The following table lists the status of several standard interfaces. If the status of a given port differs from the standard one, a notice will be given in the manual.

Ports	Safety Status	
V.11, V.28, V.35, V.36, RS-530, X.21, 10 BaseT, 100 BaseT, Unbalanced E1, E2, E3, STM, DS-2, DS-3, S-Interface ISDN, Analog voice E&M	SELV	Safety Extra Low Voltage: Ports which do not present a safety hazard. Usually up to 30 VAC or 60 VDC.
xDSL (without feeding voltage), Balanced E1, T1, Sub E1/T1	TNV-1	Telecommunication Network Voltage-1: Ports whose normal operating voltage is within the limits of SELV, on which overvoltages from telecommunications networks are possible.
FXS (Foreign Exchange Subscriber)	TNV-2	Telecommunication Network Voltage-2: Ports whose normal operating voltage exceeds the limits of SELV (usually up to 120 VDC or telephone ringing voltages), on which overvoltages from telecommunication networks are not possible. These ports are not permitted to be directly connected to external telephone and data lines.
FXO (Foreign Exchange Office), xDSL (with feeding voltage), U-Interface ISDN	TNV-3	Telecommunication Network Voltage-3: Ports whose normal operating voltage exceeds the limits of SELV (usually up to 120 VDC or telephone ringing voltages), on which overvoltages from telecommunication networks are possible.

Always connect a given port to a port of the same safety status. If in doubt, seek the assistance of a qualified safety engineer.

Always make sure that the equipment is grounded before connecting telecommunication cables. Do not disconnect the ground connection before disconnecting all telecommunications cables.

Some SELV and non-SELV circuits use the same connectors. Use caution when connecting cables. Extra caution should be exercised during thunderstorms.

When using shielded or coaxial cables, verify that there is a good ground connection at both ends. The earthing and bonding of the ground connections should comply with the local codes.

The telecommunication wiring in the building may be damaged or present a fire hazard in case of contact between exposed external wires and the AC power lines. In order to reduce the risk, there are restrictions on the diameter of wires in the telecom cables, between the equipment and the mating connectors.

Caution

To reduce the risk of fire, use only No. 26 AWG or larger telecommunication line cords.

Attention

Pour réduire les risques s'incendie, utiliser seulement des conducteurs de télécommunications 26 AWG ou de section supérieure.

Some ports are suitable for connection to intra-building or non-exposed wiring or cabling only. In such cases, a notice will be given in the installation instructions.

Do not attempt to tamper with any carrier-provided equipment or connection hardware.

Electromagnetic Compatibility (EMC)

The equipment is designed and approved to comply with the electromagnetic regulations of major regulatory bodies. The following instructions may enhance the performance of the equipment and will provide better protection against excessive emission and better immunity against disturbances.

A good earth connection is essential. When installing the equipment in a rack, make sure to remove all traces of paint from the mounting points. Use suitable lock-washers and torque. If an external grounding lug is provided, connect it to the earth bus using braided wire as short as possible.

The equipment is designed to comply with EMC requirements when connecting it with unshielded twisted pair (UTP) cables. However, the use of shielded wires is always recommended, especially for high-rate data. In some cases, when unshielded wires are used, ferrite cores should be installed on certain cables. In such cases, special instructions are provided in the manual.

Disconnect all wires which are not in permanent use, such as cables used for one-time configuration.

The compliance of the equipment with the regulations for conducted emission on the data lines is dependent on the cable quality. The emission is tested for UTP with 80 dB longitudinal conversion loss (LCL).

Unless otherwise specified or described in the manual, TNV-1 and TNV-3 ports provide secondary protection against surges on the data lines. Primary protectors should be provided in the building installation.

The equipment is designed to provide adequate protection against electro-static discharge (ESD). However, it is good working practice to use caution when connecting cables terminated with plastic connectors (without a grounded metal hood, such as flat cables) to sensitive data lines. Before connecting such cables, discharge yourself by touching earth ground or wear an ESD preventive wrist strap.

FCC-15 User Information

This equipment has been tested and found to comply with the limits of the Class A digital device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the Installation and Operation manual, may cause harmful interference to the radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

Canadian Emission Requirements

This Class A digital apparatus meets all the requirements of the Canadian Interference-Causing Equipment Regulation.

Cet appareil numérique de la classe A respecte toutes les exigences du Règlement sur le matériel brouilleur du Canada.

Warning per EN 55022 (CISPR-22)

Warning	This is a class A product. In a domestic environment, this product may cause radio interference, in which case the user will be required to take adequate measures.
Avertissement	Cet appareil est un appareil de Classe A. Dans un environnement résidentiel, cet appareil peut provoquer des brouillages radioélectriques. Dans ces cas, il peut être demandé à l'utilisateur de prendre les mesures appropriées.
Achtung	Dieses ist ein Gerät der Funkstörgrenzwertklasse A. In Wohnbereichen können bei Betrieb dieses Gerätes Rundfunkströrungen auftreten, in welchen Fällen der Benutzer für entsprechende Gegenmaßnahmen verantwortlich ist.

Declaration of Conformity

Manufacturer's Name: RAD Data Communications Ltd.

Manufacturer's Address: 24 Raoul Wallenberg St.
Tel Aviv 69719
Israel

declares that the product:

Product Name: FOM-E1/T1

conforms to the following standard(s) or other normative document(s):

EMC:	EN 55022 (1994)	Limits and methods of measurement of radio disturbance characteristics of information technology equipment.
	EN 50082-1 (1992)	Electromagnetic compatibility – Generic immunity standards for residential, commercial and light industry.
Safety:	EN 60950 (1992/93)	Safety of information technology equipment, including electrical business equipment.

Supplementary Information:

The product herewith complies with the requirements of the EMC Directive 89/336/EEC and the Low Voltage Directive 73/23/EEC. The product was tested in a typical configuration.

Tel Aviv, October 3rd, 1996

Haim Karshen
VP Quality

European Contact: RAD Data Communications GmbH, Otto-Hahn-Str. 28-30,
85521 Ottobrunn-Riemerling, Germany

Quick Start Guide

Installation of FOM-E1/T1 should be carried out only by an experienced technician. If you are familiar with FOM-E1/T1, use this quick start guide to set it up for operation.

This guide describes the standalone version of the modem.

Perform the installation procedures for both the local and the remote units.

1. Installing FOM-E1/T1

Configuring FOM-E1/T1

1. Open the modem's case.
2. Select the E1/T1 electrical interface (JP2, JP4, JP5, JP6, JP7 and JP8).
3. If using E1 unbalanced interface, connect the BNC shield to the chassis ground. If you are using balanced E1/T1, leave the shield floating (SW1 and SW2).
4. Close the modem's case.

Table below provides details on the functions of the internal jumpers and switches, and their default settings.

Jumper/Switch	Function	Possible Settings	Factory Setting
SW3, AIS	When a major alarm is detected, AIS is transmitted to either the electrical or optical interface.	ON – Transmit AIS OFF – Do not transmit AIS	ON
SW2, INPUT Ground SW1, OUTPUT Ground	Controls connection of the BNC shield to the chassis ground	CONNECTED – BNC shield is connected to the chassis ground (for E1 unbalanced) FLOATING – BNC shield is disconnected from the chassis ground (for E1/T1 balanced)	FLOATING
JP2, JP4, JP5, JP6, JP7, JP8, INTERFACE	Selects the E1/T1 electrical interface	100 ohm BAL T1 – T1 100Ω balanced (DB-15 connector) 120 ohm BAL CEPT – E1 120Ω balanced (DB-15 connector) 75 ohm UNBAL CEPT – E1 75Ω unbalanced (BNC connectors)	120 ohm BAL CEPT

***Note**: For FOM-E1/T1 units with 115 VAC, factory setting is 100Ω BAL T1.*

Connecting the Cables

➤ **To connect cables:**

1. Connect the E1/T1 electrical interface.
2. Connect the fiber optic interface.
3. Connect the power cable (first to the modem, then to the mains).

   Operation starts when the power is applied to the rear panel power connector.

2. Operating FOM-E1/T1

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.

Contents

List of Figures

List of Tables

Chapter 1
Introduction

1.1 Overview

This manual provides information on the technical characteristics, installation and operation of the FOM-E1/T1 fiber optic modem as a standalone unit, and as FOM-E1/T1/R rack-mount card for the ASM-MN-214 modem rack.

FOM-E1/T1 is a fiber optic modem for transmission of E1 (2.048 Mbps) or T1 (1.544 Mbps) over multimode or single-mode fiber optic media. The communication equipment is connected to FOM-E1/T1 according to the ITU G.703 standard. The modem is designed to operate with several types of fiber optic cables and connectors. The electrical signals are connected through BNC connectors or a DB-15 connector. LED indicators show the operational status of the modem on the front panel. Alarms indicating faults in modem operation are provided to a supervisory port. Local and remote loopback tests are available for diagnostics.

Versions

The following versions of the FOM-E1/T1 modem are available:

- FOM-E1/T1 – standalone unit
- FOM-E1/T1/R – a plug-in card for installation in the ASM-MN-214, 19-inch modem rack, holding up to 14 cards (see C*hapter 5* for the FOM-E1/T1/R description).

Power Supply Options

The following power supply options are available:

- AC source: 115 VAC or 230 VAC
- DC source: 24 VDC or -48 VDC.

Application

In the application illustrated, each FOM-E1/T1 receives E1 or T1 signals that are equalized to overcome electrical link distortion. FOM-E1/T1 then converts the E1 or T1 signals into an optical signal.

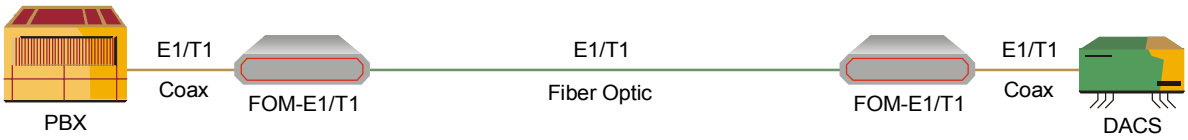


Figure 1-1 FOM-E1/T1 Application

Features

Fiber Optic Interface

Table 1-1 details fiber optic interface types supported by FOM-E1/T1.

Table 1-1. Fiber Optic Interface Types

Wavelength	Fiber Type	Transmitter Type	Power	Receiver Sensitivity	Typical Max. Range
[nm]	[µm]		[dBm]	[dBm]	[km/miles]
850	62.5/125 multimode	VCSEL	-18	-38	5/3
1310	9/125 single mode	LED	-18	-40	38/24
1310	9/125 single mode	Laser	-12	-40	50/31
1550	9/125 single mode	Laser	-12	-40	100/62

E1/T1 Interface

- The electrical interface meets requirements of ITU G.703, G.824, G.921 and G.935 standards for E1 and T1.
- FOM-E1/T1 supports both balanced and unbalanced interfaces.
- FOM-E1/T1 conforms to all relevant ITU standards.

When FOM-E1/T1 detects electrical interface levels below G.703 electrical levels, the modem transmits an “All 1 signal” (AIS) to the optical interface.

Test and Diagnostics Capabilities

- FOM-E1/T1’s built-in diagnostics comply with the V.54 standard.
- FOM-E1/T1 features a dry contact alarm port for attaching an external alert device.
- 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.

1.2 Physical Description

FOM-E1/T1 is a compact unit, intended for installation on desktops or shelves. An optional rack-mount adapter kit enables FOM-E1/T1 installation into a 19-inch rack. *Figure 1-2* shows a 3D view of FOM-E1/T1.

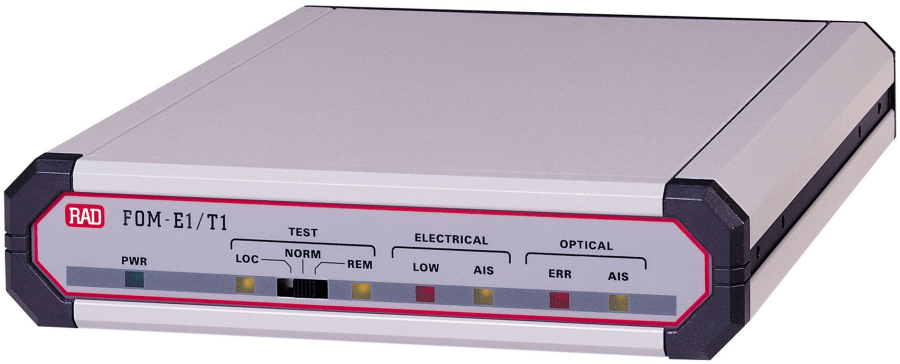


Figure 1-2 FOM-E1/T1 3D View

The front panel indicates modem status. The front panel indicators and controls are described in *Chapter 3*.

The rear panel connectors and internal jumpers are described in *Chapter 2*.

1.3 Functional Description

This section describes the functional circuitry of the FOM-E1/T1 fiber optic modem. FOM-E1/T1 is used for transmission of E1 (2.048 Mbps) and T1 (1.544 Mbps) over multimode or single-mode fiber optic media. The unit is transparent to framing and can transmit data using any framing pattern with HDB3 or B8ZS coded signals.

Figure 1-3 illustrates the FOM-E1/T1 block diagram.

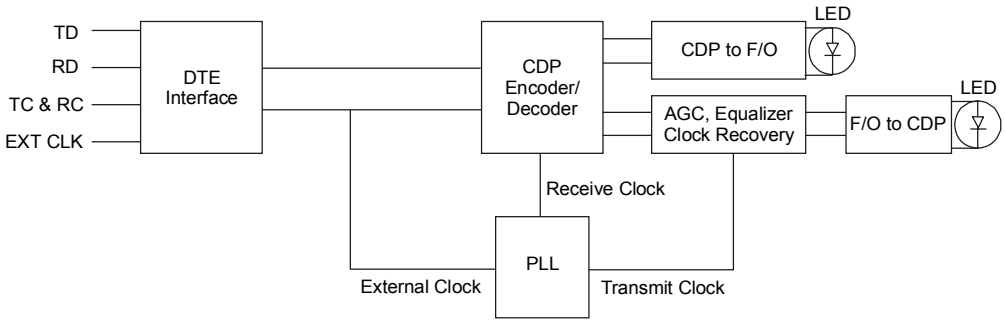


Figure 1-3 FOM-E1/T1 Block Diagram

FOM-E1/T1 comprises the following signal processing stages:

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

Signal Conversion

Conversion of the electrical signal into an optical signal takes place by using 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. FOM-E1/T1 provides internal selection for the E1/T1 electrical interfaces.

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.

1.4 Technical Specifications

E1/T1 Interface	*Transmission Rates*	E1: 2.048 Mbps T1: 1.544 Mbps
	Interface	User-selectable: • E1: 120Ω balanced or 75Ω unbalanced • T1: 100Ω balanced
	Zero Suppression	E1: HDB3 T1: B8ZS
	Connectors	Balanced: 15-pin D-type, female Unbalanced: two BNC
Optical Interface	*Operating Wavelength*	See *Table 1-1*
	Receiver Sensitivity	For BER 10^{-9}: • -38 dBm at 850 nm • -40 dBm at 1310 nm or 1550 nm
	Connectors	ST, SC or FC
	Dynamic Range	28 dB for all types of optical interfaces
	Budget (Max)	20 dB for 850 nm over 62.5/125 22 dB for 1310 nm over 9/125 28 dB for 1310 nm or 1550 nm laser over 9/125
Alarm	*Operation*	Normally Open and Normally Closed, using different pins
	Connector	15-pin, D-type, female
Indicators	*POWER*	ON – The unit is powered
	TEST LOC	ON – The unit is in local loopback mode
	TEST REM	ON – The unit is in remote loopback mode
	ELECTRICAL LOW	ON – The electrical interface input is below G.703 electrical levels
	ELECTRICAL AIS	ON – An “All 1s” string is received at the electrical interface
	OPTICAL ERR	ON – Bit error rate of the received signal from the optical interface is 10^{-6} or worse
	OPTICAL AIS	ON – An “All 1s” string is received at the optical interface

Physical	*Height*	44 mm / 1.7 in (1U)
	Width	179 mm / 7.0 in
	Depth	203 mm / 8.0 in
	Weight	1.1 kg / 3.0 lb
Power	*AC Voltage*	115 or 230 VAC (±10%), 50 or 60 Hz, 6W
	DC Voltage	24 VDC (18 to 36 VDC) or -48 VDC (-36 to -72 VDC)
	Fuses	FOM-E1/T1: • 115 VAC supply: 0.2A T 250V • 230 VAC supply: 0.1A T 250V FOM-E1/T1/R: • 1A 250V and 50 mA 250V
Environment	*Temperature*	0°–50°C / 32°–122°F
	Humidity	Up to 90%, non–condensing

Chapter 2

Installation and Setup

This chapter describes installation and setup procedures for the standalone FOM-E1/T1 modem.

FOM-E1/T1 is delivered completely assembled. It is designed for tabletop or 19-inch rack installation. For instructions on installation of a single unit or two units in a 19-inch rack, refer to the rack mounting kit for 19-inch racks guide that comes with the RM kit.

After installing the unit, refer to *Chapter 3* to assure normal operation.

In case a problem is encountered, refer to *Chapter 4* for test instructions.

Warning

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.

2.1 Site Requirements and Prerequisites

An AC-powered FOM-E1/T1 should be installed within 1.5m (5 ft) of an easily accessible grounded AC outlet. The outlet should furnish 115 VAC or 230 VAC (depending on rated voltage of unit).

A DC-powered FOM-E1/T1 unit requires -48 VDC or 24 VDC power source, which must be adequately isolated from the mains supply. In order to prevent a fire hazard, a suitable fuse should be installed in the DC line.

Allow at least 90 cm (36 in) of frontal clearance for operating and maintenance accessibility. Allow at least 10 cm (4 in) clearance at the rear of the unit for signal lines and interface cables.

The ambient operating temperature of FOM-E1/T1 is 0° to 50°C (32° to 122°F) at relative humidity of 90%, non-condensing.

2.2 Package Contents

The package of the standalone FOM-E1/T1 modem includes:

- One FOM-E1/T1 unit or FOM-E1/T1/R card
- Last Mile Access and Intelligent Modems CD
- AC power cord or DC power supply connector kit
- CBL-FOME1T1/RJ-45 cable for the balanced E1/T1 and alarm relay connection (if ordered).
- RM-9 rack installation kit (if ordered).

2.3 Installation and Setup

FOM-E1/T1 is a standalone device intended for tabletop or bench installation. It is delivered completely assembled. No provision is made for bolting the unit on the tabletop.

➤ **To install FOM-E1/T1:**

1. Determine the required configuration of FOM-E1/T1 and set the internal jumpers accordingly (see *Configuring FOM-E1/T1* below).
2. Connect the line (see *Connecting the Fiber Optic Interface* below).
3. Connect the DTE (see *Connecting the E1/T1 Interface* below).
4. Connect power to the unit (see *Connecting the Power* below).

Warning

Access to the inside of the equipment 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 unit from its casing.
Line voltages are present inside FOM-E1/T1 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 unit.
Any adjustment, maintenance, and repair of the opened instrument under voltage should be avoided as much as possible and, when inevitable, should be carried out only by a skilled technician who is aware of the hazard involved.
Capacitors inside the instrument may remain charged even after the instrument has been connected from its power supply source.

Caution

FOM-E1/T1 contains components sensitive to electrostatic discharge (ESD). To prevent ESD damage, avoid touching the internal components. Before moving jumpers, touch the FOM-E1/T1 frame.

Configuring FOM-E1/T1

This section describes how to configure FOM-E1/T1 for a typical application. *Figure 2-1* illustrates the layout of the FOM-E1/T1 printed-circuit board. *Table 2-1* provides details on the functions of the internal jumpers and switches, and their default settings.

➤ **To configure FOM-E1/T1:**

1. Disconnect all the cables connected to FOM-E1/T1.
2. Release the two rear panel screws and use them as levers to slide out the PCB interior of the unit.
3. Select the E1/T1 electrical interface: E1 balanced, E1 unbalanced or T1 balanced by setting the JP2, JP4, JP5, JP6, JP7 and JP8 jumpers to appropriate position.
4. If using E1 unbalanced interface, connect the BNC shield to the chassis ground by setting the SW1 and SW2 switches to the CONNECTED position.
   If you are using balanced E1/T1 connection, set the SW1 and SW2 switches to the FLOATING position.

Note *Setting the SW1 and SW2 switches to CONNECTED is valid for coaxial cables only. When using 4-wire connection, set these switches to FLOATING.*

5. Slide the PCB interior back into the case.
6. Screw in the two rear panel screws to secure the PCB in the case.

   Now you can proceed with the line, DTE and power connections as described below.

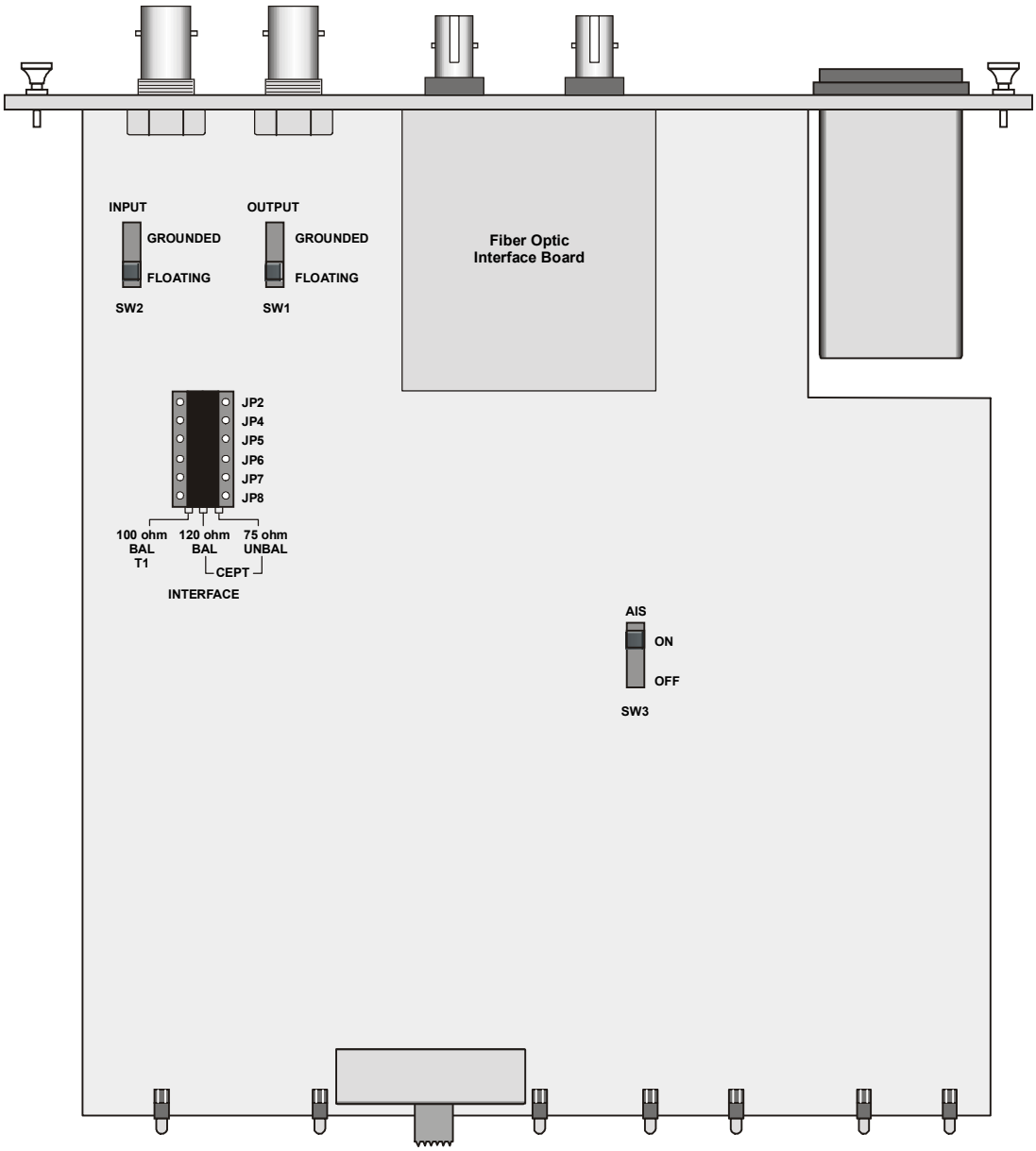


Figure 2-1 FOM-E1/T1 PCB Layout

Table 2-1 FOM-E1/T1 Internal Jumpers and Switches

Jumper/Switch	Function	Possible Settings	Factory Setting
SW3, AIS	When a major alarm is detected, AIS is transmitted to either the electrical or optical interface.	ON – Transmit AIS OFF – Do not transmit AIS	ON
SW2, INPUT Ground SW1, OUTPUT Ground	Controls connection of the BNC shield to the chassis ground	CONNECTED – BNC shield is connected to the chassis ground (for E1 unbalanced)	
		FLOATING – BNC shield is disconnected from the chassis ground (for E1/T1 balanced)	FLOATING
JP2, JP4, JP5, JP6, JP7, JP8, INTERFACE	Selects the E1/T1 electrical interface	100 ohm BAL T1 – T1 100Ω balanced (DB-15 connector)	
		120 ohm BAL CEPT – E1 120Ω balanced (DB-15 connector)	120 ohm BAL CEPT
		75 ohm UNBAL CEPT – E1 75Ω unbalanced (BNC connectors)	

***Note**: For FOM-E1/T1 units with 115 VAC, factory setting is 100Ω BAL T1.*

Connecting the Interfaces

Figure 2-2 illustrates the AC-powered FOM-E1/T1 unit rear panel.

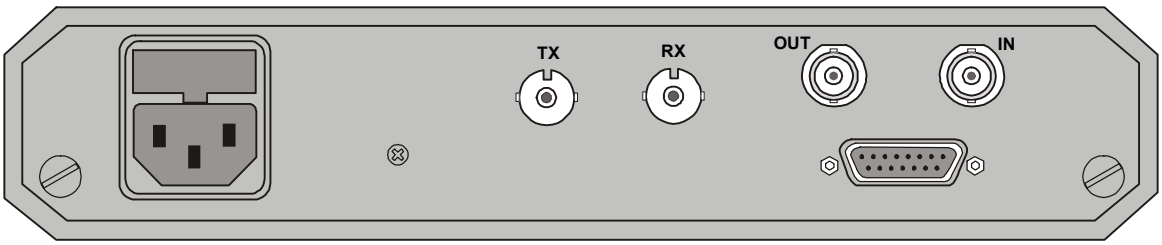


Figure 2-2 FOM-E1/T1 Rear Panel, AC-Powered Unit

Connecting the Fiber Optic Interface

Two fiber optic ST, SC or FC connectors are located on the rear panel and marked TX and RX.

➤ **To connect the fiber optic cables**

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 RX and the receive fiber to TX.

Connecting the E1/T1 Interface

The rear-panel E1/T1 connector provides interface for data input/output, clock reference and control signal exchange between FOM-E1/T1 and E1/T1 equipment.

Balanced E1/T1 interface terminates in DB-15 female connector, which also serves as an alarm relay (see *Appendix A* for the connector pinout).

Unbalanced E1 interface terminates in two coaxial BNC connectors, designated as IN and OUT. IN refers to the FOM-E1/T1 input signal. OUT refers to a signal transmitted from FOM-E1/T1 to the attached equipment.

Note *RAD offers an optional splitter cable for connecting the DB-15 port to the balanced E1/T1 equipment and alarm device (refer to Appendix A for further details).*

Warning

The E1 and T1 ports should be connected to SELV (Safety Extra Low Voltage) links only.

Connecting the Power

To connect the power to FOM-E1/T1, refer to the appropriate section below, depending on your version of the unit (AC or DC).

Warning

Before switching on this unit and connecting or disconnecting 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.

The line fuse is located in an integral-type fuse holder located on the rear panel. 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 AC Power

AC power should be supplied to FOM-E1/T1 through the 1.5m (5 ft) standard power cable terminated by a standard 3-prong plug. The cable is provided with the unit.

➤ **To connect AC power:**

1. Connect the power cable to the power connector on the FOM-E1/T1 rear panel.
2. Connect the power cable to the mains outlet.

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

Connecting DC Power

➤ **To connect DC power:**

- Refer to DC power supply connection supplement.

Chapter 3

Operations

This chapter provides the following information for the FOM-E1/T1 standalone modem:

- FOM-E1/T1 front-panel indicators and controls
- Operating procedures (turn-on, front-panel indications, performance monitoring and turn-off).
- Installation procedures given in *Chapter 2* must be completed and checked before attempting to operate FOM-E1/T1.

3.1 Front Panel Controls and Indicators

Figure 3-1 shows the FOM-E1/T1 front panel. *Table 3-1* lists the FOM-E1/T1 controls and indicators.

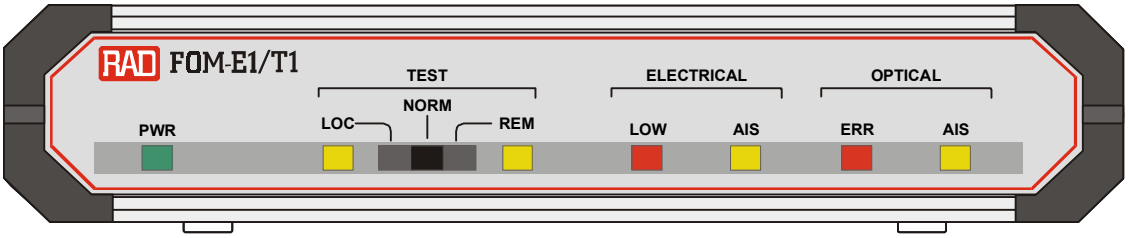


Figure 3-1. FOM-E1/T1 Front Panel

Table 3-1. FOM-E1/T1 Front Panel Controls and Indicators

Name	Type	Function
PWR	Green LED	ON – FOM-E1/T1 is powered up
LOC	Yellow LED	ON – A local loopback is active
REM	Yellow LED	ON – A remote loopback is active
TEST	Slide switch	LOC – Activates local analog loopback REM – Activates remote digital loopback NORM – Normal operation (no loopbacks are active)
ELECTRICAL LOW	Red LED	ON – E1/T1 electrical input is below G.703 level
ELECTRICAL AIS	Yellow LED	ON – E1/T1 electrical interface received "All 1s" string
OPTICAL ERR	Red LED	ON – Bit error rate of the signal received from at the optical interface is 10^{-6} or worse
OPTICAL AIS	Yellow LED	ON – Fiber optic interface received "All 1s" string

3.2 Operating Instructions

Turning On

FOM-E1/T1 starts operating as soon as it is connected to the power source. The PWR LED turns ON and remains lit as long as the units are connected to the mains.

Normal Operating Instructions

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

Note *Some of LEDs may turn on upon the FOM-E1/T1 power-up, indicating that other communication equipment is not functioning properly.*

Turning Off

Turn FOM-E1/T1 off by disconnecting the power cord from the mains.

Chapter 4

Testing and Diagnostics

This chapter describes the FOM-E1/T1 diagnostics functions, which include:

- Front panel LED indicators
- Alarm relay
- Diagnostic loopbacks.

In addition, this chapter provides some tips on troubleshooting and frequently asked questions.

4.1 Status Indicators and Alarm Relay

Front Panel LEDs

The status of FOM-E1/T1 is indicated by the front panel LED indicators. For description of LED indicators and their functions, refer to *Chapter 3*.

Alarm Relay

FOM-E1/T1 supports dry contact alarm relay via reserved pins of the DB-15 female connector. The following fault conditions trigger relay of the major and minor alarms:

- Major alarms are initiated when E1/T1 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 E1/T1 electrical or fiber optic interfaces.

Table 4-1 lists the DB-15 connector pins used for the alarm relay.

Table 4-1. DB-15 Connector, Alarm Relay Pins

Pin	Contact	Alarm Type
7, 8	Normally Closed	Minor
15, 8	Normally Open	
5, 6	Normally Closed	Major
13, 6	Normally Open	

4.2 Diagnostic Tests

Local Analog Loopback (LLB)

FOM-E1/T1 supports activation of a local loopback, which tests the performance of the E1/T1 electrical interface of the local unit and equipment attached to it.

The data received at the E1/T1 electrical interface is looped back to the equipment attached to it (see *Figure 4-1*).

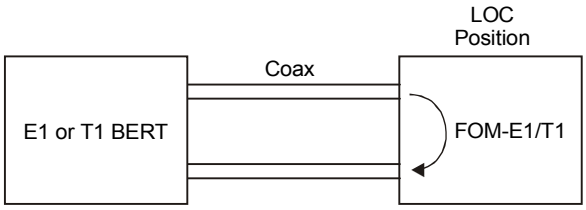


Figure 4-1. Local Analog Loopback

➤ **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 Digital Loopback (RLB)

FOM-E1/T1 supports activation of a remote loopback, which tests the performance of the local unit's E1/T1 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 remote electrical interface and at the same time is looped back to the local unit (see *Figure 4-2*).

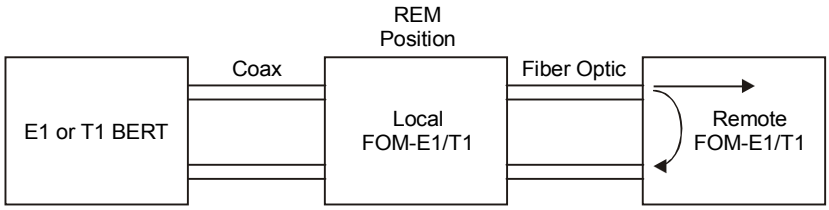


Figure 4-2. Remote Digital Loopback

➤ **To activate remote loopback:**

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

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

4.3 Troubleshooting Instructions

Table 4-2 provides troubleshooting details. Perform the actions listed under *Corrective Measures* in the order given in the table, until the problem is corrected.

Table 4-2. Troubleshooting Chart

Symptom	Probable Cause(s)	Corrective Measures
PWR LED is OFF	No AC power	Verify that the power outlet is providing the required power. Ensure that both ends of the AC power cord are connected properly.
	Blown fuse	Replace with fuse of proper rating.
ELECTRICAL LOW LED is ON	One of the four wires is disconnected from the DB-15 connector of FOM-E1/T1	Ensure all the wires are connected properly to the DB-15 connector.
	One of coaxial cables is disconnected or defective	Ensure that both ends of the coaxial cables are connected properly and that the cables operate properly.
	The attached equipment outputs are not according to G.703 electrical levels	Check that the output levels of equipment attached to FOM-E1/T1 comply with G.703 electrical levels.
	The SW1, SW2 switches are set incorrectly	Verify that the SW1, SW2 switch positions correspond to the E1/T1 interface type.
ELECTRICAL AIS LED is ON	The attached equipment is transmitting “All 1s" string	Ensure that the equipment attached to the FOM-E1/T1 transmits real data (not “all 1s").
OPTICAL ERR LED is ON	No optical connection.	Ensure that both transmit and receive fiber connections on the local and remote units are connected properly.
	Optical budget is too low	Measure the optical loss over the fiber link and verify that it meets the product specifications.
OPTICAL AIS LED is ON	The equipment attached to the remote unit is transmitting “All 1s" string	Check the remote attached equipment transmission.
	The remote unit detected Electrical Low alert	Check the remote unit and the remote attached equipment for possible fault.

4.4 Frequently Asked Questions

Q: Does FOM-E1/T1 operate opposite FOM-40?

A: No. The fiber optic interfaces of these modems are not compatible.

Q: Can I connect FOM-E1/T1 with a balanced interface to FOM-E1/T1 with an unbalanced interface?

A: Yes

Q: What is the maximal distance between FOM-E1/T1 and end equipment (E1 link)?

A: The FOM-E1/T1 output conforms to the G.703 standard: the coding is bipolar ±3V (CDP) with the maximum attenuation of 6 dB. This gives us a range of approximately 300 meters for a balanced 24 AWG (0.5 mm) line. The range for a coax cable is about 150 meters.

Chapter 5

FOM-E1/T1/R Card Version

This chapter describes the card cage version of FOM-E1/T1. It discusses the following topics:

- ASM-MN-214 card cage
- FOM-E1/T1/R plug-in card for the ASM-MN-214 cage
- Cage and card power supply
- Installation of cage and card.

5.1 ASM-MN-214 Card Cage

The ASM-MN-214 card cage contains one or two power supplies and up to 14 plug-in cards. The card types can be FOM-E1/T1/R or other RAD rack version modems/converters – any combination of up to 14 plug-in cards.

For each of the 14 cards, the rear panel (see *Figure 5-1*) contains a male connector for the terminal block and a DB-25 connector. A protection cover protects the terminal block connectors.

The terminal block contains screws for connecting the transmit and receive pairs and ground, for the balanced E1/T1 interface. The transmit pair is connected to the terminals marked XMT, the receive pair – to the terminals marked RCV, while the fifth screw is a terminal for optional ground connection. When operating FOM-E1/T1/R with unbalanced E1 interface, use a CIA/TB-BNC/214 adapter, which converts the terminal block connector into two coaxial BNC connectors.

The 25-pin D-type female connector serves as an alarm relay port (see *Appendix A* for the connector pinout).

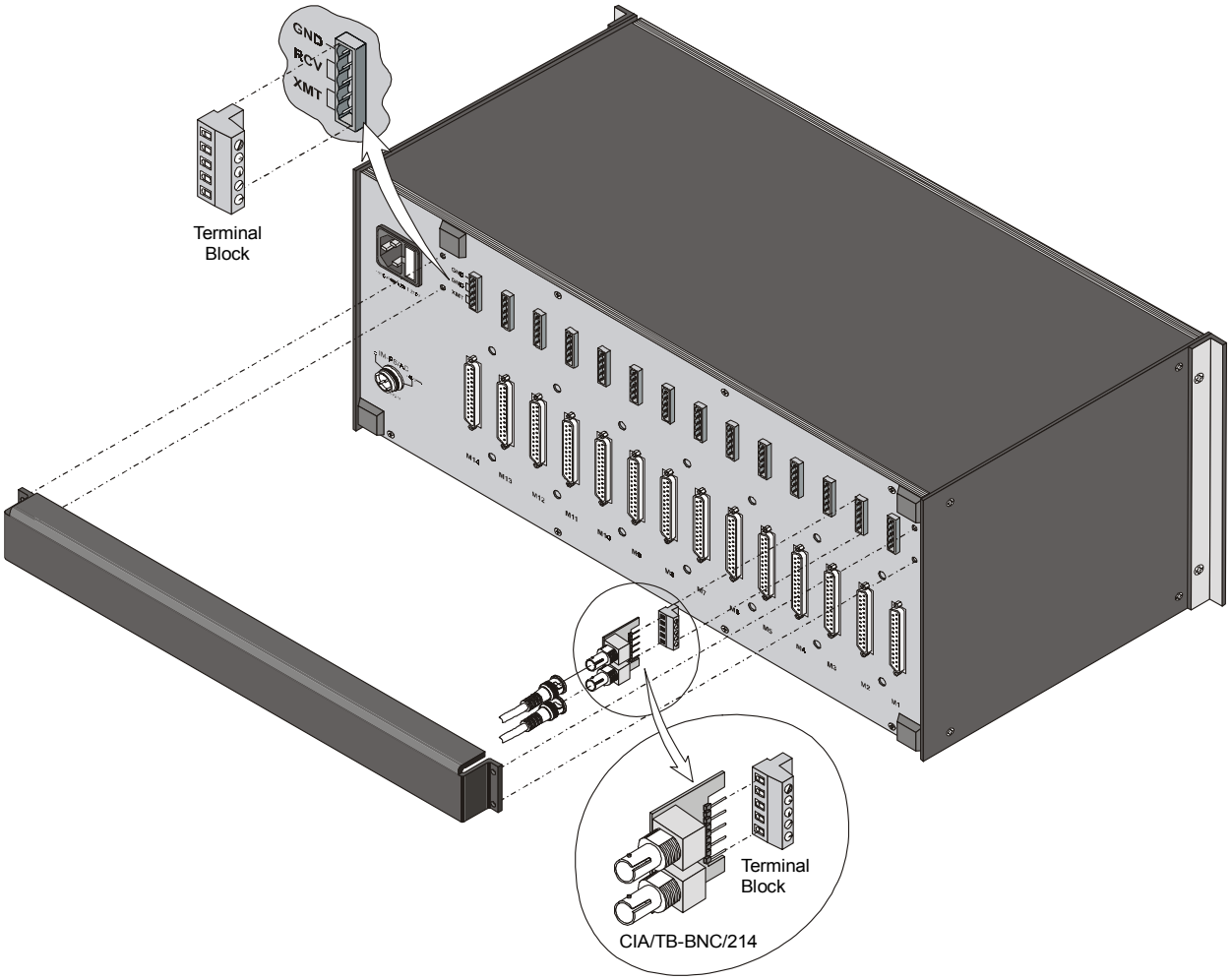


Figure 5-1 ASM-MN-214 Rear Panel

5.2 Power Supply

The FOM-E1/T1/R card is powered from the ASM-MN-214 power supply via its chassis. Each FOM-E1/T1/R card has two fuses that protect the entire system against power failure due to a short circuit in one card (see *Figure 5-4*). The ratings of the fuses are 1A, 250V and 50 mA 250V.

The ASM-MN-214 card cage can accept both AC and DC power supplies. LED indicators located on the ASM-MN-214 front panel (see *Figure 5-2*) show activity when the power supply is connected to the mains plug. The power supply supports the full card cage with any combination of cards.

AC Supply

The AC power supply of the ASM-MN-214 is 100, 115, or 230 VAC, ±10%, 47 to 63 Hz.

DC Supply

The DC power supply is -48 VDC (-36 to -72 VDC) or 24 VDC (18 to 32 VDC). It uses a DC/DC converter module to provide the power required for the cards.

Power Supply Redundancy

This special ordering option is equipped with two separate power supplies, operating together and sharing the load of the whole card cage. If either of the power supplies fails, the other one will continue to supply power to the full card cage.

Two LED indicators show activity of each power supply. They should both light when mains power is provided.

Note *It is possible to combine AC and DC power supplies in the same cage.*

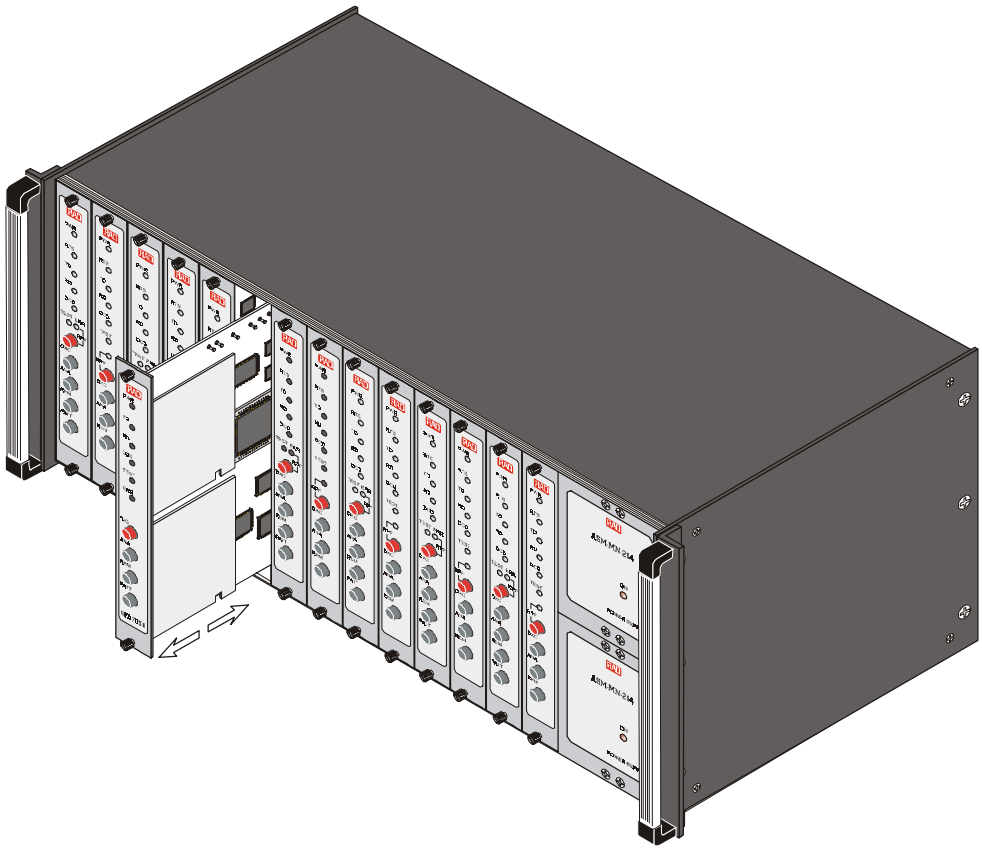


Figure 5-2 ASM-MN-214 Front Panel

5.3 FOM-E1/T1/R Front Panel

Figure 5-3 shows the FOM-E1/T1/R card front panel. The front panel of FOM-E1/T1/R includes fiber optic connectors, loopback initiation switch and LED indicators. The front panel LEDs of the card version are identical in their functionality to those of the standalone device. For this information, refer to the *Front Panel Controls and Indicators* section in *Chapter 3*.

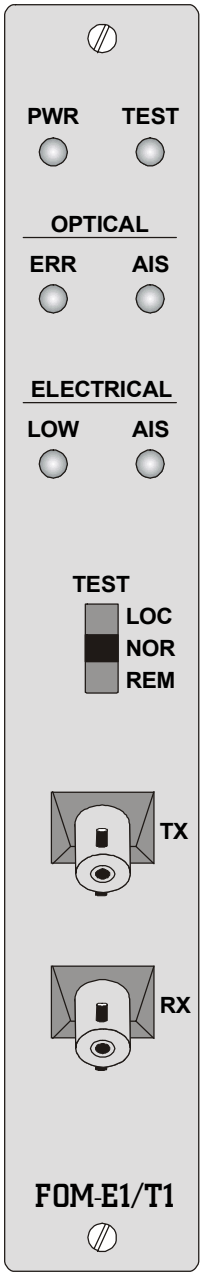


Figure 5-3 FOM-E1/T1/R Front Panel

5.4 Installing the FOM-E1/T1/R Card

Setting Internal Jumpers and Switches

The FOM-E1/T1/R internal jumpers and switches are similar in their functionality to those of the standalone unit, as detailed *Table 5-1*.

Figure 5-4 illustrates the FOM-E1/T1/R PCB layout.

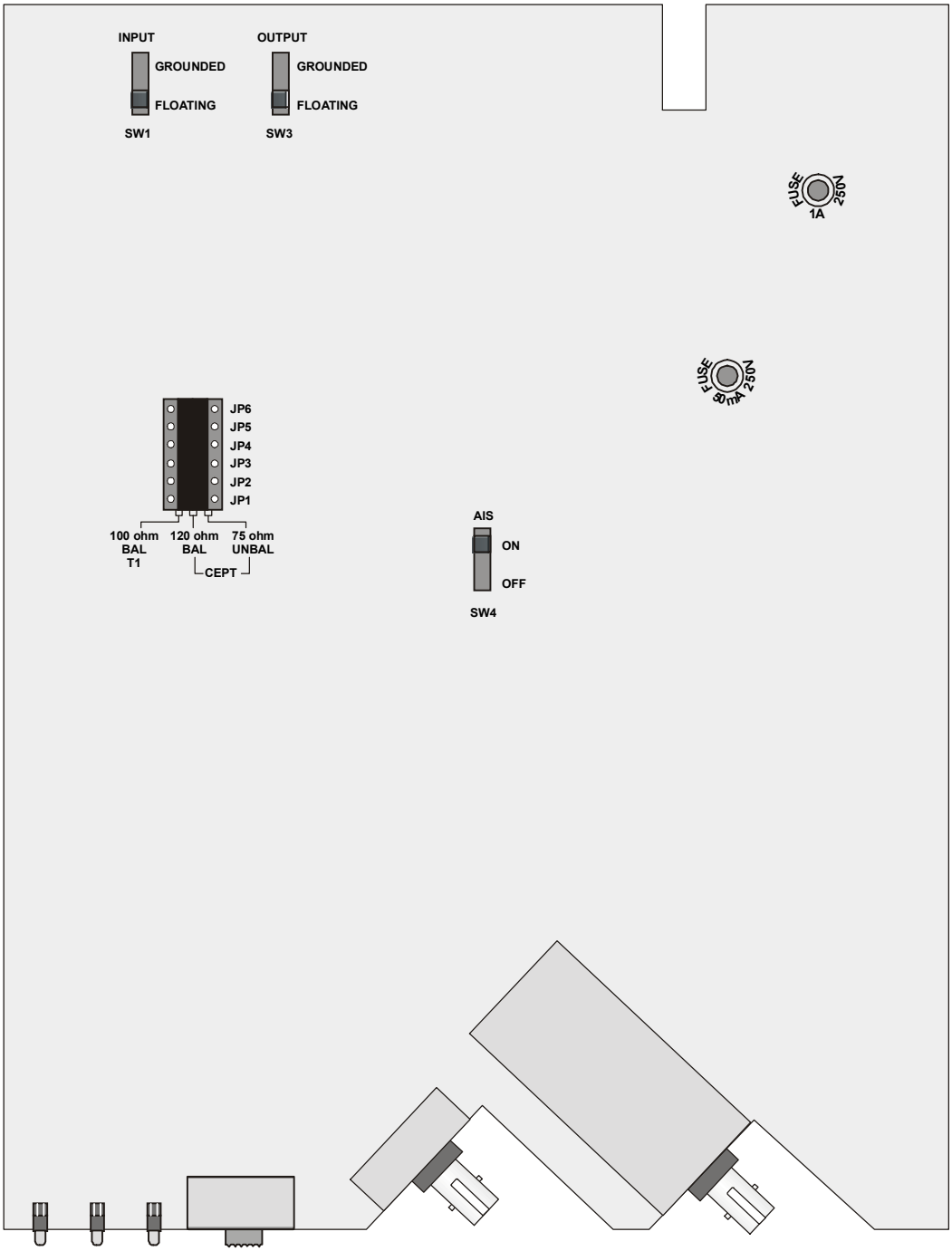


Figure 5-4 FOM-E1/T1/R PCB Layout

Table 5-1. FOM-E1/T1/R Internal Jumpers and Switches

Jumper/Switch	Function	Possible Settings	Factory Setting
SW4, AIS	When a major alarm is detected, AIS is transmitted to either the electrical or optical interface.	ON – Transmit AIS OFF – Do not transmit AIS	ON
SW1, INPUT Ground SW3, OUTPUT Ground	Controls connection of the BNC shield to the chassis ground	CONNECTED – BNC shield is connected to the chassis ground (for E1 unbalanced)	
		FLOATING – BNC shield is disconnected from the chassis ground (for E1/T1 balanced)	FLOATING
JP1, JP2, JP3, JP4, JP5, JP6	Selects the E1/T1 electrical interface	100 ohm BAL T1 – T1 100Ω balanced 120 ohm BAL CEPT – E1 120Ω balanced 75 ohm UNBAL CEPT – E1 75Ω unbalanced	120 ohm BAL CEPT

Installing FOM-E1/T1/R into the ASM-MN-214 Card Cage

➤ **To install FOM-E1/T1/R into ASM-MN-214:**

1. Install the ASM-MN-214 card cage in the 19-inch rack.
2. Insert the FOM-E1/T1/R card into one of the ASM-MN-214 slots.
3. Push the card into the cage until it is fully inserted into the edge connector inside the rack.
4. Tighten the screws on the front panel of the card.

Connecting the Interfaces

FOM-E1/T1/R uses the ASM-MN-214 rear panel terminal block ports for the E1/T1 connections. The 25-pin D-type female connector serves as an alarm relay port.

Balanced E1/T1

The two TX screws of the terminal block serve as the E1/T1 electrical signal outputs of the modem. The RX screws serve of the terminal block as the electrical signal inputs to the modem.

Unbalanced E1

When operating FOM-E1/T1/R with unbalanced E1 interface, use CIA/TB-BNC/214 adapter, which converts the terminal block connector into two coaxial BNC connectors.

Fiber Optic

The ST, SC or FC fiber optic connectors are located on the front panel of the modem card.

Alarm Relay

The ASM-MN-214 DB-25 connector serves as an alarm relay port (see *Appendix A* for the connector pinout).

Appendix A
Interface Connector Specifications

A.1 Standalone FOM-E1/T1

DB-15 Connector

Balanced E1/T1 interface terminates in DB-15 female connector, which also serves as an alarm relay. *Table A-1* describes the DB-15 pins that serve for the E1/T1 connection. *Table A-2* describes the DB-15 pins that serve for the alarm relay.

Table A-1. DB-15 Pin Assignment, E1/T1 Pins

Pin	Designation	Function
3	Send Data (TTIP)	Transmit Data, A-wire (FOM-E1/T1 output)
11	Send Data (TRING)	Transmit Data, B-wire (FOM-E1/T1 output)
1	Receive Path (RTIP)	Receive Data, A-wire (FOM-E1/T1 input)
9	Receive Path (RRING)	Receive Data, B-wire (FOM-E1/T1 input)

Table A-2. DB-15 Pin Assignment, Alarm Relay Pins

Pin	Contact	Alarm Type
7, 8	Normally Closed	Minor
15, 8	Normally Open	
5, 6	Normally Closed	Major
13, 6	Normally Open	

CBL-E1T1/RJ45 Cable

RAD offers an optional splitter cable, CBL-E1T1/RJ45, which connects the DB-15 female connector of the standalone unit to the balanced E1/T1 device and alarm equipment.

The CBL-E1T1/RJ45 cable includes two DB-15 connectors (male and female) and one RJ-45 connector. *Figure A-1* illustrates the cable schematics.

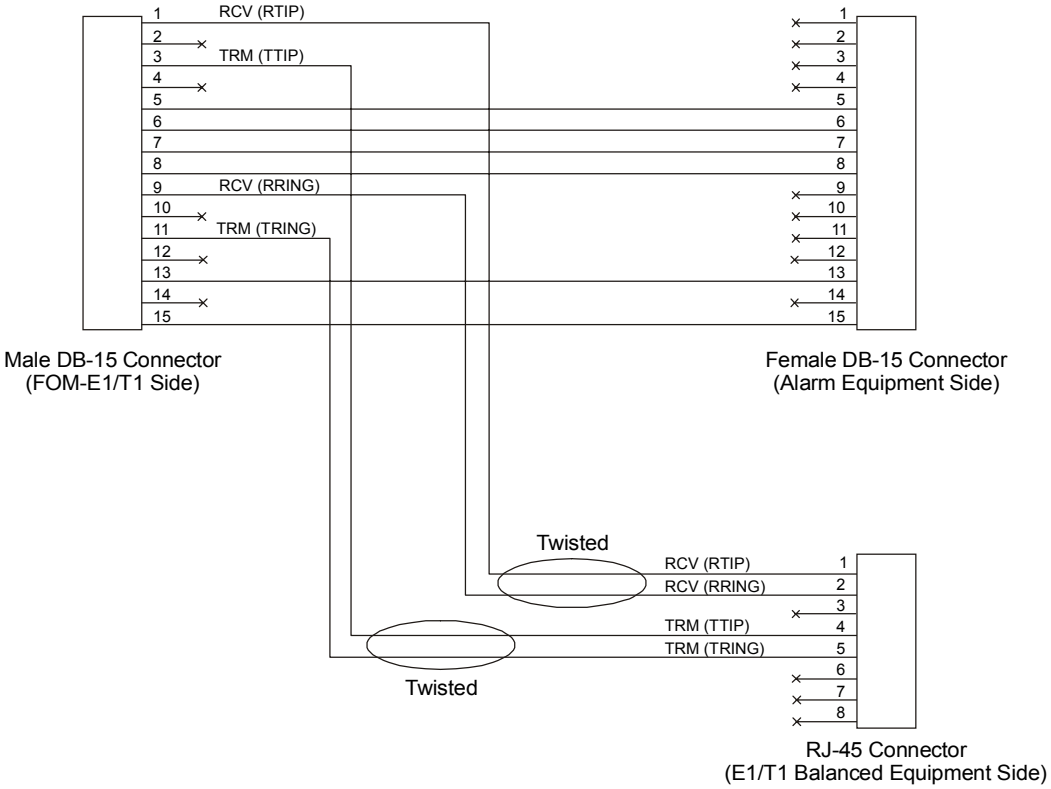


Figure A-1. CBL-FOME1T1/RJ45 Scheme

A.2 FOM-E1/T1/R Modem Card

The 25-pin D-type female connector located on the rear panel of the ASM-MN-214 modem rack serves as an alarm relay port. *Table A-3* lists the functions of the DB-25 pins.

Table A-3 ASM-MN-214, DB-25 Pin Assignment

Pin	Contact	Alarm Type
10, 22	Normally Closed	Minor
10, 21	Normally Open	
13, 25	Normally Closed	Major
13, 24	Normally Open	

RAD
data communications

24 Raoul Wallenberg St., Tel Aviv 69719, Israel
Tel: +972-3-6458181, Fax: +972-3-6483331, +972-3-6498250
E-mail: erika_y@rad.co.il, Web site: www.rad.com

Customer Response Form

RAD Data Communications would like your help in improving its product documentation. Please complete and return this form by mail or by fax or send us an e-mail with your comments.

Thank you for your assistance!

Manual Name: FOM-E1/T1

Publication Number: 284-200-01/03

Please grade the manual according to the following factors:

	Excellent	*Good*	*Fair*	*Poor*	*Very Poor*
Installation instructions	❒	❒	❒	❒	❒
Operating instructions	❒	❒	❒	❒	❒
Manual organization	❒	❒	❒	❒	❒
Illustrations	❒	❒	❒	❒	❒
The manual as a whole	❒	❒	❒	❒	❒

What did you like about the manual?

_____

_____

_____

_____

_____

Error Report

Type of Error(s) or Problem(s):

- ❒ Incompatibility with product
- ❒ Difficulty in understanding text
- ❒ Regulatory information (Safety, Compliance, Warnings, etc.)
- ❒ Difficulty in finding needed information
- ❒ Missing information
- ❒ Illogical flow of information
- ❒ Style (spelling, grammar, references, etc.)
- ❒ Appearance
- ❒ Other _____

Please list the exact page numbers with the error(s), detail the errors you found (information missing, unclear or inadequately explained, etc.) and attach the page to your fax, if necessary.

_____

_____

_____

_____

Please add any comments or suggestions you may have.

_____

_____

_____

You are:

- ❒ Distributor
- ❒ End user
- ❒ VAR
- ❒ Other _____

Who is your distributor? _____

Your name and company: _____

Job title: _____

Address: _____

Direct telephone number and extension: _____

Fax number: _____

E-mail: _____

data communications

www.rad.com

INTERNATIONAL HEADQUARTERS:

24 Raoul Wallenberg Street, Tel Aviv 69719, Israel, Tel: 972-3-6458181
Fax: 972-3-6498250, 972-3-6474436, Email: rad@rad.co.il

U.S. HEADQUARTERS:

900 Corporate Drive, Mahwah, N.J. 07430, Tel: (201) 529-1100
Toll Free: 1-800-444-7234, Fax: (201) 529-5777, Email: market@radusa.com

Publication No. 284-200-01/03