FOM-40

High Speed Fiber Optic Modem
Installation and Operation Manual

Notice

No representation or warranties for fitness for any purpose other than what is specifically mentioned in this manual is made either by RAD Data Communications or its agents.

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Warranty

This RAD product is warranted against defects in material and workmanship for a period of one year from date of shipment. During the warranty period, RAD will, at its option, either repair or replace products which prove to be defective. For warranty service or repair, this product must be returned to a service facility designated by RAD. Buyer shall prepay shipping charges to RAD and RAD shall pay shipping charges to return the product to Buyer. However, Buyer shall pay all shipping charges, duties and taxes for products returned to RAD from another country.

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The foregoing warranty shall not apply to defects resulting from improper or inadequate maintenance by Buyer, Buyer-supplied firmware or interfacing, unauthorized modification or misuse, operation outside of the environmental specifications for the product, or improper site preparation or maintenance.

Exclusive Remedies

The remedies provided herein are the Buyer's sole and exclusive remedies. RAD shall not be liable for any direct, indirect special, incidental, or consequential damages, whether based on contract, tort, or any legal theory.

Safety Warnings

The exclamation point within a triangle is intended to warn the operator or service personnel of operation and maintenance factors relating to the product and its operating environment which could pose a safety hazard.

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

Laser Warnings

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.

Telecommunication Safety

The safety status of each of the ports on the FOM-40 is declared according to EN 41003 and is detailed in the table below:

Ports	**Safety Status**	
V.24, V.35, V.36, X.21, LAN, Unbalanced E1	SELV	Circuit operating with Safety Extra-Low Voltage
Balanced E1, T1	TNV-1	Circuit whose normal operating voltage is within the limits of SELV, on which overvoltages from Telecommunications Networks *are* possible.

Regulatory Information

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 instruction 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.

Warning per EN 55022

This is a Class A product. In a domestic environment, this product may cause radio interference, in which case the user may be required to take adequate measures.

Declaration of Conformity

Manufacturer's Name: RAD Data Communications Ltd.

Manufacturer's Address: 12 Hanechoshet St.
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Israel

declares that the product:

Product Name: **FOM-40**

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 6th, 1996

Haim Karshen
VP Quality

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Quickstart Guide

Installation of FOM-40 should be carried out only by an experienced technician. If you are familiar with fiber optic modems, use this guide to prepare FOM-40 for operation. If you are not familiar with fiber-optic modems, please read *Chapter 2* and *Chapter 3*.

This guide is for the standalone version of the modem. For the card version, see *Chapter 5*.

QS.1 Installing FOM-40

Switch and Jumper Settings

Confirm that the following switches and jumpers, mounted on the board, are set correctly for the chosen operating mode.

Warning

Make sure that the power cord is disconnected before removing the unit's cover.

- Jumper J1:
  Set the transmit timing signal mode: EXT, INT RCV.
  Default is INT.

- Selector switch SW1:
  Set the BAUD RATE: 56, 64, 112, 128, 256, 384, 512, 768, 1024, 1536, 1544, 2048 kbps.
  Default is 64 kbps.
  For the E1 interface option, default is 2048 kbps.

Connections

DTE connection

- Connect the Data Terminal Equipment to the appropriate DTE connector on the rear panel of FOM-40.

Fiber optic connection

- Connect the fiber optic cables to the respective Rx-Tx and Tx-Rx connectors on the rear panel of FOM-40.

Power connection

- AC power
  Connect the power cable to the AC input jack on the rear panel of the modem.

- DC power

1. Connect the three wires (-24 VDC, +24 VDC or -48 VDC, +48 VDC and Chassis Gnd) to the RAD-supplied adapter plug from the DC power source.
   Follow the instructions on the ***Wiring Instructions*** sheet, supplied in the shipping carton.
2. Attach the DC adapter plug to the DC input jack on the rear panel of the modem.

- Connect FOM-40 to an AC power source (AC power mains outlet) or DC source (Ringer).
  The PWR LED lights to indicate that FOM-40 is on.

QS.2 Operating FOM-40

Verifying Performance

When data is being transferred, observe that the following front panel LEDs light or blink:

- PWR Lights
- RTS Blinks or Not lit
- TD Blinks or Not lit
- RD Lights
- DCD Lights
- TEST Not lit
- ERR Not lit

After powering up the modem, if the modem does not operate properly, see *Chapter 2, Installation* for more information on FOM-40 initial functional tests.

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Chapter 1

Introduction

This chapter:

- Provides a general introduction to the FOM-40 modem, its versions and various modem options.
- Gives a short physical description of the modem.
- Lists the detailed specifications for the unit.

1.1 Overview

General

FOM-40 is a synchronous High Speed Fiber Optic Modem that provides a secure, long range data link between computers, routers, multiplexers and other data communication (DTE) devices.
FOM-40 functions include:

- Extension of high speed transmission of up to 2048 Mbps
- Immunity against electrical interference
- Protection from sparking and lighting
- Secure data transfer
- Prevention of differential ground loops problems.

Versions

FOM-40 is available as a 1U standalone unit or as a rack-mount card which fits in a 19" rack. The standard ASM-MN-214 rack holds up to 14 cards.

Applications

Figure 1-1 illustrates a point-to-point application using FOM-40. Two FOM-40 units are connected by a single mode fiber (up to 110 km / 68 miles). Each of the units is connected to a router.

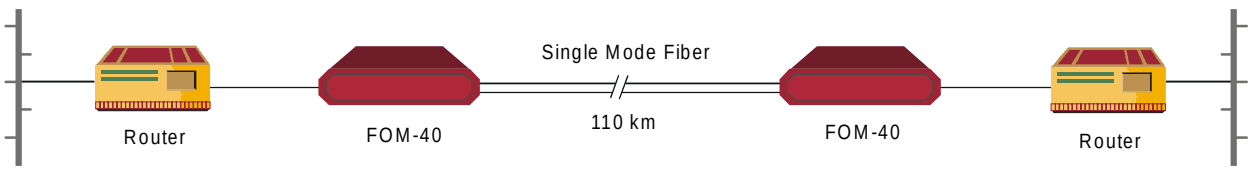

Figure 1-1 Point-to-Point Application

Figure 1-2 illustrates a DDS service application, in which an AS-400 system is connected to a FOM-40 unit by a V.24 protocol. The FOM-40 unit is connected to another FOM-40 over a G.703 link. One of the FOM-40 units is synchronized by an external clock, while the other is synchronized to the RCV clock. The distant FOM-40 is connected to a digital service network. On the other side of the network, a similar setup of FOM-40 units is connected to a workstation by a V.24 protocol.

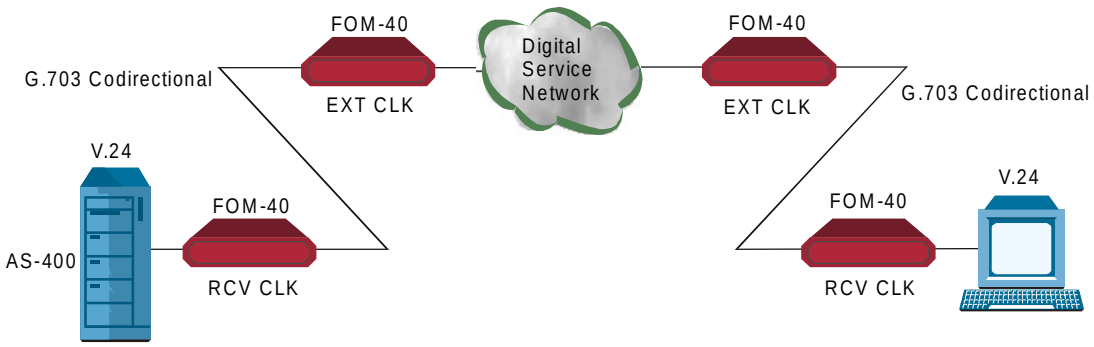

Figure 1-2 Tail-end for DDS Service Application

Features

FOM-40 operates at twelve selectable data rates from 56 kbps to 2048 kbps. FOM-40 can operate over single or multimode fibers, with 850 nm, 1300 nm or 1550 nm wavelength and, as an option, includes a laser diode for extending the transmission range.

Transmission Range

FOM-40 can transmit in the following ranges:

- Up to 5 km / 3 miles for an 850 nm LED over multimode fiber
- Up to 20 km / 12 miles for a 1300 nm LED over single mode fiber
- Up to 50 km / 31 miles for a 1300 nm laser diode over single mode fiber
- Up to 110 km / 68 miles for a 1550 nm laser diode over single mode fiber.

Interface

The following DTE interface options are available:

- RS-530 (RS-422/V.11 on 25-pin connector)
- V.35
- X.21
- V.24/RS-232 (for rates up to 64 kbps only)
- G.703 co-directional (64 kbps)
- G.703 E1
- V.36 (ETH)

Diagnostic Tests

FOM-40 features V.54 diagnostic capabilities, an internal 511-bit pseudo-random pattern generator and a BER tester.
Built-in diagnostics (complying with the V.54 standard) include Local Digital (DIG) loopback, Remote (REM) and Local Analog (ANA) loopback.
Diagnostics are activated either from the front panel push buttons or via the DTE interface.

Timing

The timing elements of the unit include different clock sources:

- Internal - internal crystal is the clock source
- External - clock received from the attached DTE
- Received - clock recovered from the received signal.

1.2 Physical Description

FOM-40 is compact unit, intended for tabletop or 19" rack installation.
Figure 1-4 illustrates the 3-D view of FOM-40.

Figure 1-3 FOM-40 3-D View

Front Panel

All controls (push buttons) and LED indicators are located on the FOM-40 front panel. Front panel indicators and controls are described in greater detail in *Chapter 3, Operation*.

Rear Panel

All input/output and power connectors are located on the rear panel of FOM-40. The AC power connector has an integrated fuse holder. The correct rating of the replaceable fuse is printed on the FOM-40's rear panel. The FOM-40's rear panel is described in greater detail in *Chapter 2, Installation*.

Jumpers

The jumpers and switches are located on the FOM-40 board. Jumper location and strap selection are described in greater detail in *Section 2.5 Installation and Setup, Chapter 2*.

1.3 Functional Description

General

This section describes the functional circuitry of the FOM-40 fiber optic modem (see *Figure 1-4)*.
FOM-40 provides a high speed data link between computers, routers or multiplexers. The electrical signals from the DTE unit are converted into an optical signal using an infrared light emitting diode. At the opposite end of the fiber, the optical signal is converted back into an electrical signal in compliance with the appropriate interface.
The twelve selectable data rates are: 56, 64, 112, 128, 256, 384, 512, 768, 1024, 1536, 1544, and 2048 kbps. This includes the 1544 kbps rate for T1 and 2048 kbps rate for CEPT transmission.

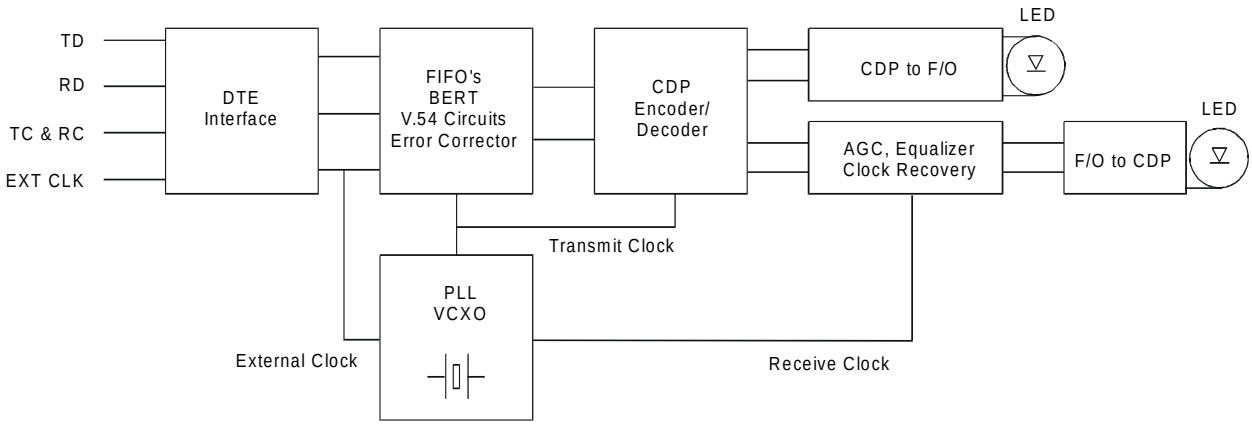

Figure 1-4 FOM-40 Block Diagram

Timing

The modulation timing circuit supplies the transmit clock timing signal to the encoder. Three timing sources are available:

- Internal- clock recovered from the modem's internal crystal oscillator
- External- clock recovered from the DTE
- Receive Loopback- clock recovered from the receive signal, looped back as a transmit clock.

FOM-40 utilizes a Phase Locked Loop (PLL) circuit to recover jitter-free data and clock from the optical signal.

Diagnostics

The delay jumper prevents multiple loopbacks upon activation of RLB and prevents the digital modems at the remote network side from receiving the complete V.54 data sequence and, in turn, being induced into a loop.

Test Pattern Generator and Receiver

The pattern generator/receiver provides the testing of the local modem and the communication link. When the PATT button on the front panel is pressed, the circuit sends out a standard 511 bit pseudo-random pattern. If any errors are encountered, the ERROR LED lights up.
The test can be carried out in local analog loopback, in remote digital loopback or in normal point-to-point operation opposite a remote FOM-40 modem. To perform the test, press the PATT push button on the remote unit or connect a Bit Error Rate Tester which uses the standard 511 bit pattern.

1.4 Technical Specifications

Electrical

Transmission Rates	56, 64, 112, 128, 256, 384, 512, 768, 1024, 1536, 1544, 2048 kbps
Interface	RS-530 via 25-pin D-type, female, V.35 via 34-pin, female X.21 via 15-pin D-type, female V.36/RS-449 via 37-pin D-type, female (RS-530 interface with mechanical adapter cable) V.24 25-pin D-type, female G.703 co-directional terminal block or RJ-45, 8-pin G.703 E1-1550 nm for single mode operation Ethernet: 10BT - RJ-45 connector (UTP) 10B2 - BNC connector (BNC)

Optical	*Operating Wavelength*	850 nm for multimode operation 1300 nm for single mode operation 1300 nm for the laser diode option 1550 nm for the laser diode option
	Transmission Line	Dual fiber optical cable
	Output Power	-18 dBm for 850 nm; 62.5/125 -18 dBm for 1300 nm; 62.5/125 -18 dBm for 1300 nm; 9/125 -12 dBm for laser; 9/125
	Receiver Sensitivity	-39 dBm for 850 nm -40 dBm for 1300 nm and 1550 nm
	Dynamic Range	28 dB
	Fiber Optic Interface	Optical connectors SMA, ST or FC (SMA connector is not available in the single mode version)
Diagnostics	*Digital Loopback*	Local (DIG): activated by a front panel push button Remote (REM): activated by a front panel push button or via the DTE interface
	Analog Loopback	Local (ANA): activated by a front panel push button or via the DTE interface
	Test Pattern (PATT)	Activated by a front panel push button
Timing Elements	*Receive Clock*	Derived from the receive signal
	Transmit Clock	Derived from three alternative sources: 1. Internal oscillator 2. External from the DTE 3. Loop clock derived from the receive signal, looped back as a transmit clock
Indicators	*PWR*	Power
	RTS	Request to Send
	TD	Transmit Data
	RD	Receive Data
	DCD	Data Carrier Detected
	TEST	Loopback Mode or BER
	ERR	BER Test Error

Power Supply	*Voltage*	100, 115 or 230 VAC (±10%) -24 VDC (±10%) -48 VDC (±10%)
	AC Frequency	47-63 Hz
	Power	5 VA
Physical	*FOM-40 Standalone*	Height: 44.0 mm / 1.7 in Width: 240.0 mm / 9.6 in Depth: 193.0 mm / 7.6 in Weight: 1.4 kg / 3.1 lb
	FOM-40/R Card	Dimensions to fit ASM-MN-214 Rack
	ASM-MN-214 Rack	Height: 178.0 mm / 7.0 in Width: 480.0 mm / 19.0 in Depth: 216.0 mm / 8.5 in Weight: 4.0 kg / 8.8 lb
Environment	*Temperature*	0 to 50°C (-32 to 122°F)
	Humidity	0 to 90%, non-condensing

Chapter 2

Installation

This chapter:

- Explains the site prerequisites for FOM-40 installation.
- Describes FOM-40 mechanical installation.
- Details the procedures for setting the various internal jumpers and switches and making electrical connections.
- Lists functional tests to be performed on the unit upon installation.

2.1 Introduction

FOM-40 is supplied as a fully assembled standalone unit or as a card version for the ASM-MN-214 rack. For instructions on installation of one or two units in a 19" rack, see *Appendix G*.

In case a problem is encountered, refer to *Chapter 4* for Test and Diagnostics instructions.

After completing installation, see *Chapter 3*, *Operation,* to assure normal operation.

2.2 Site Requirements and Prerequisites

Power

AC-powered FOM-40 units should be installed within 1.5 m (5 ft) of an easily accessible grounded AC outlet. The outlet should furnish 100 VAC, 115 VAC or 230 VAC depending on the rated voltage of unit.

DC-powered FOM-40 units require a -24 VDC or -48 VDC power source, which must be adequately isolated from the mains supply.

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

Ambient Requirements

The ambient operating temperature of FOM-40 is 0-50°C (32-122°F) at relative humidity of up to 90%, non-condensing.

2.3 Package Contents

FOM-40

The package of the standalone FOM-40 modem includes:

AC version:

- One FOM-40 standalone unit (protected by adequate cushioning)
- AC power cord
- FOM-40 ***Installation and Operation Manual***
- RM-9 kit (if ordered)

DC version:

- FOM-40 standalone unit (protected by adequate cushioning)
- 3-Pin 24V/48V adapter plug and ***Wiring Instructions*** sheet
- FOM-40 ***Installation and Operation Manual***
- RM-9 kit (if ordered)

FOM-40/R

The package of FOM-40 modem card version includes:

- FOM-40/R unit (protected by adequate cushioning)
- FOM-40 ***Installation and Operation Manual***

2.4 Equipment Needed

To operate the FOM-40 standalone version on a desktop or shelf, no additional equipment is required.

To install the standalone version of the FOM-40 modem in a 19" rack (either single or in side by side configuration when a couple is needed), a rack adapter kit, RM-9 is required (see *Appendix G* for rack installation instructions).

2.5 Installation and Setup

Mechanical Installation

FOM-40 is designed for tabletop or 19" rack installation, and is delivered completely assembled. No provisions are made for bolting FOM-40 to the tabletop.

For mounting FOM-40/Standalone unit in a 19" rack, follow the instructions in *Appendix G, Unit Case Assembly*.

For mounting FOM-40/R (card version) in the ASM-MN-214 modem rack, follow the instructions in *Chapter 5, FOM-40 Card Version*.

Strap Selection

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 power cord before removing the unit from its casing.

Line voltages are present inside FOM-40 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 still be charged even after the instrument has been disconnected from its power supply source.

Opening the FOM-40 Case

➤ **To open the FOM-40 case:**

1. Disconnect all cables connected to FOM-40.
2. Release the two rear panel screws and use them as levers to slide out the PCB interior of the unit.

Setting the Internal Jumpers and Switches

The internal jumpers and switches located on the FOM-40 PCB are identified in *Figure 2-1*. The functions of jumpers and switches are described in *Table 2-1*.

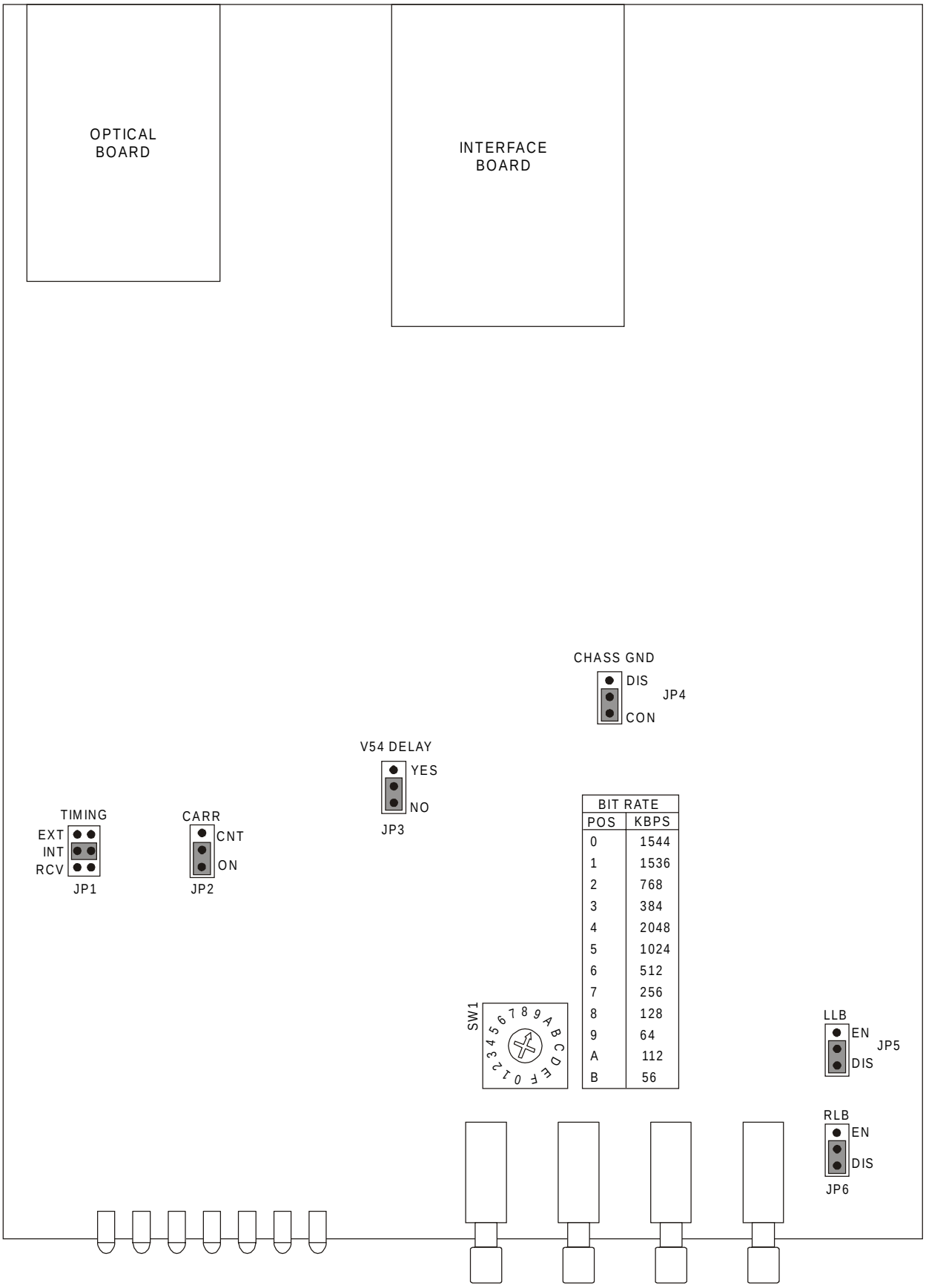

Figure 2-1 FOM-40/Standalone PCB Layout

Table 2-1 FOM-40 Strap Selection

Strap Identity	Function	Possible Settings	Factory Setting
BIT RATE (kbps) Rotary switch	Selects the data rate.	1544, 1536, 768, 384, 2048, 1024, 512, 256, 128, 64, 112, 56	64 (for E1 option - 2048)
TIMING Jumper 1	Selects the transmit timing signal from either: internal clock, external clock or receive clock (see *Note*).	EXT INT RCV	INT
CARRIER Jumper 2	Selects the transmit carrier mode. "ON" when transmit carrier is constantly "ON". "CNT", when transmit carrier in "ON" only when RTS is high.	ON CNT	ON
V.54 DELAY Jumper 3	When set to YES the V.54 delay is activated, preventing multiple loopback of tail-end circuits (see Section 1.3, *Diagnostics*, in Chapter 1)*.	YES NO	NO
CHASSIS GND Jumper 4	In CON position, signal ground is connected to chassis ground. In DIS position, signal ground is isolated from chassis ground.	DIS CON	CON
LLB Jumper 5	Enables LLB test from the DTE interface pins.	EN DIS	DIS
RLB Jumper 6	Enables RLB test from the DTE interface pins.	EN DIS	DIS

**When using FOM-40 in a tail-end application with a digital network or multiplexer, set the V.54 DELAY jumper (in the modems located close to the digital network) to ON to prevent multiple loopbacks upon activation of RLB.*

Note *When two modems are used, one unit should be configured as RCV clock and the other as INT or EXT clock.*

Closing the FOM-40 Case

➤ **To close the FOM-40 case:**

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

2.6 Interfaces and Connections

Figure 2-2 and *Figure 2-3* illustrate rear panels of FOM-40 standalone versions; connector locations for the AC and DC versions, respectively, are identified. The rear panel of FOM-40/Standalone contains an AC, or DC, input power connector; a DTE interface connector; and TX and RX fiber optic connectors.

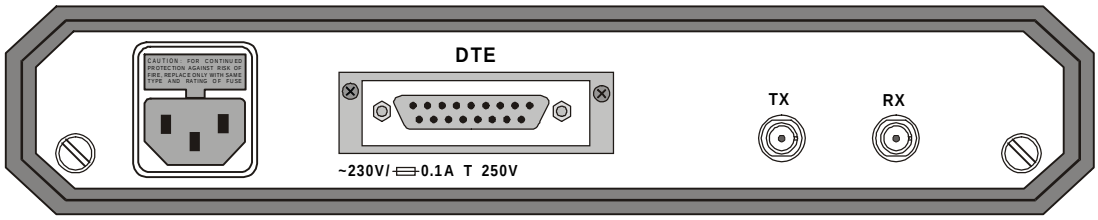

Figure 2-2 FOM-40/Standalone Rear Panel (AC-Powered Unit)

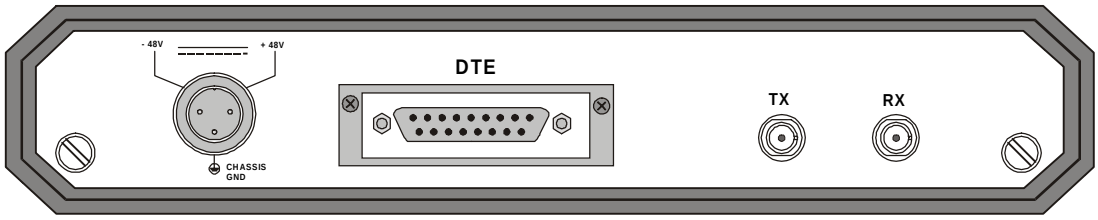

Figure 2-3 FOM-40/Standalone Rear Panel (DC-Powered Unit)

Connecting the Fiber Optic Cables

Two fiber optic SMA, ST 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 to the DTE

Note *RAD recommends using a shielded twisted pair cable between FOM-40 and the DTE (mainly for higher frequencies). The line receivers in FOM-40 are 100 Ω terminated (for X.21B and RS-530).*

➢ **To connect all DTE interface connections except G.703/TB:**

- Press the end of the connector into the DTE interface connection on FOM-40.

For more information on a particular DTE interface, see the appropriate appendix in this manual.

If problems arise when connecting to the DTE interface, first check that the DTE interface is properly terminated.

G.703 Connection

➢ **To connect the G.703 interface:**

On the FOM-40/Standalone - G.703/TB version the data wires must be connected to the terminal block:

1. Strip off about 1 cm of insulation from the wire and twist the loose wire ends together.
2. Insert a screwdriver into the square upper hole on the terminal block.
3. Raise the handle of the screwdriver to open the round lower hole.
4. Insert the stripped end of the wire into the round lower hole and then remove the screwdriver.

Warning

For safety reasons, it is advisable to connect the CHASSIS GND to the SIGNAL GND when using the G.703 interface.

Connecting the Power

To connect the power to FOM-40, refer to the appropriate section below, depending on your version of the unit (DC or AC).

Warning

The unit has no power switch. Operation starts when the power is applied to the rear panel POWER connector. When applying power, first connect the plug of the power cord to the FOM-40 POWER connector and then to the mains power source (outlet).

Grounding

Before switching on this instrument, connect the protective earth terminals of this instrument to the protective conductor of the (mains) power cord. Insert the mains plug only into a socket outlet with a protective earth contact. Use only an extension cord (power cord) with protective conductor (grounding).

The 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 FOM-40 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.

For you protection, FOM-40 must always be grounded. Any interruption of the protective (grounding) conductor (inside or outside the instrument) or disconnection of the protective earth terminal can make this instrument dangerous. Intentional interruption is prohibited.

AC Power Connection

AC power should be supplied to FOM-40 through the 1.5m (5 ft) standard power cable terminated by a standard 3-prong plug (see *Figure 2-2*). The cable is provided with the unit.

➢ **To connect AC power to FOM-40:**

- Connect the power cable to the connector on the FOM-40 rear panel and then to the mains outlet.

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

DC Power Connection

➢ **To connect DC power:**

- Refer to *DC Power Connection Supplement*

Chapter 3

Operation

This chapter:

- Describes the FOM-40 modem controls and indicators and their functions.
- Explains how to operate FOM-40.

3.1 General

This chapter describes the FOM-40 controls and indicators and their functions, explains the operating procedures, and provides instructions for making changes in field strapping.

Installation procedures given in *Chapter 2* must be completed and checked before attempting to operate FOM-40.

3.2 Front Panel Controls and Indicators

All push buttons and LED indicators are located on the FOM-40 front panel, as seen in *Figure 3-1*. Their numbers under the heading "Item" in the *Table 3-1* correspond to the identification numbers shown in the figure.

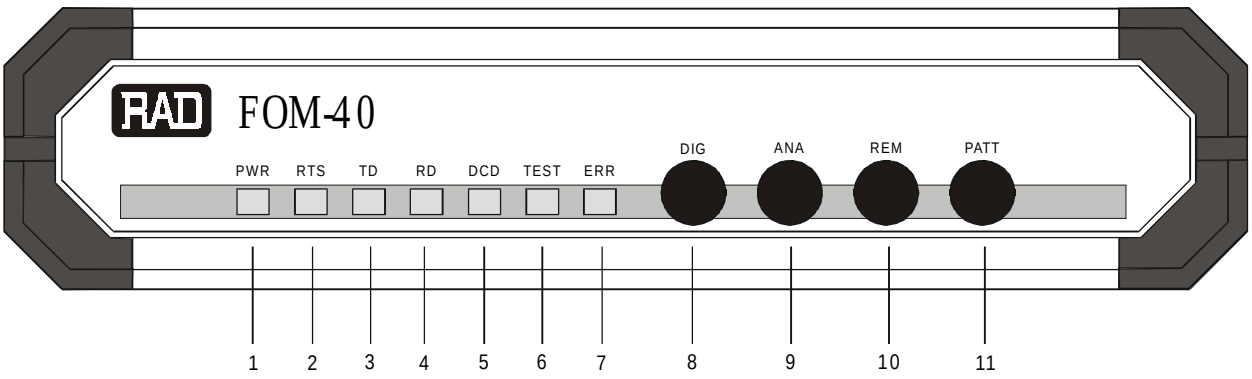

Figure 3-1 FOM-40 Front Panel

Table 3-1 FOM-40 Front Panel Controls and Indicators

Item	Name	Type	Function
1	PWR	Green LED	On when power is on.
2	RTS	Yellow LED	On when terminal activates Request to Send.
3	TD	Yellow LED	On when steady SPACE is being transmitted. Flickers when data is being transmitted.
4	RD	Yellow LED	On when steady SPACE is being received. Flickers when data is received.
5	DCD	Yellow LED	On when a valid receive signal is present.
6	TEST	Yellow LED	On when FOM-40 is in any of the three loopback modes, or when the PATT push button is pressed.
7	ERR	Red LED	On and then dims, when PATT push button is pressed. On when the alarm buffer is not empty. Flickers whenever an error is detected in BER tests.
8	DIG	Push button	The DIG (Digital) loopback push button causes the local FOM-40 to loop the received data to its transmitter. Data Set Ready (DSR) turns “low” (see *Figure 4-3*).
9	ANA	Push button	The ANA (Analog) loopback (V.54 Loop 3) push button causes the local FOM-40 to loop its transmitter output back to its receiver (see *Figure 4-1*). This loopback may also be activated from the DTE when the LLB strap is set to EN.
10	REM	Push button	The REM (Remote) Digital Loopback (V.54 Loop 2) push button causes the remote FOM-40 to loop received data and clock to its transmitter (see *Figure 4-2*). Data Set Ready (DSR) turns “low”. This loopback may also be activated from the terminal when RLB strap is set to EN.
11	PATT	Push button	The PATT push button causes FOM-40 to send and receive a 511 test pattern. If errors are encountered, the ERROR LED turns ON or blinks.

Note *The “CARRIER” jumper should be set to ON when FOM-40 is set to DTE. If set to "CNT" the RTS signal should be high.*

3.3 Initial Operation and Basic Checks

Power-On Procedure

FOM-40 is turned on as soon as power is connected. When power is connected, the PWR indicator lights up and remains lit as long as FOM-40 receives power.

Note *Verify that none of the front panel push buttons are pressed (down).*

Running a Self-Test

Verify that FOM-40 is functioning properly by running the following tests.

1. Press the ANA push button on the front panel.
2. Press the PATT push button. Check that the:
   - DCD LED lights up
   - TEST LED lights up
   - RD LED turns off
   - ERR LED turns off.
3. If the test executes correctly, restore all the push buttons to their previous settings. If the test does not execute properly, refer to *Chapter 4, Troubleshooting and Diagnostics.*

Running a BER Test

➤ **To check the link between the two DTEs:**

- Press the PATT push button on the front panel of FOM-40.

If any errors encountered, the ERR LED will dim continuously (for any continuous errors) or blink (for intermittent errors). Refer to *Chapter 4, Troubleshooting and Diagnostics* for more help.

Chapter 4

Troubleshooting and Diagnostics

This chapter contains:

- Details of ITU V.54 diagnostic capabilities for performing local analog loopbacks and local and remote digital loopbacks.
- Procedures for internal BERT circuitry and tests used to verify normal system operation.
- Procedures for performing analog loopback diagnostic tests using the built-in BER tester (with pattern generator).
- Procedures for checking the quality of the communication link between FOM-40 modems.

4.1 General

Test Pattern Generator and Receiver

The pattern generator/receiver provides for the testing of the local modem and the communication link. When the PATT button on the front panel is pressed, the pattern generator circuit sends out a standard 511-bit pseudo-random pattern. If any errors are encountered, the ERROR LED lights up.

The test can be carried out in local analog loopback, in remote digital loopback or in normal point-to-point operation opposite a remote FOM-40 modem (by pressing the PATT push button on the remote unit or by connecting a Bit Error Rate Tester, which uses the standard 511-bit pattern).

FOM-40 supports several types of tests for evaluating the operation of the data equipment, FOM-40 and its line circuits.

- Loopbacks: test the communication between the data equipment and the internal circuitry of both local and remote modems.
- BERT circuit: consists of a pattern generator and a pattern tester, and work in conjunction with the V.54 diagnostic loops and the remote BERT to verify normal system operation and identify faulty equipment in the event of system failure.
- Analog Loopback: checks the performance of the local modem, the local data terminal equipment and the cables between them.

- Communication Link: determines the performance of both the local and remote FOM-40 and of the link between the local and remote units.

Tests are activated by push buttons and monitored via LED indicators on the front panel of FOM-40. For a description of the FOM-40 controls and indicators and their functions, see *Chapter 3, Operation*.

4.2 Loopback Tests

Loopback tests are best performed in the order presented in this section.

Note

Before running the loopback tests:

- *Verify that the DTE is operating properly and can be used for the test. Do not perform any tests using faulty equipment.*
- *Ensure that all units are powered ON and are configured correctly.*

Local Test - Local Analog Loopback (LLB) Standard V.54

The Local Analog Loopback (LLB) test checks the performance of the local FOM-40, the local DTE, and the connections between them. The LLB test is performed separately at the local and at the remote site (see *Figure 4-1*).

➢ **To run an LLB:**

1. Press the ANA push button on the front panel to activate the LLB loopback.
2. When LLB loopback is initiated, the TEST LED lights up to indicate that the FOM-40 digital interface is now operationally connected to the adjacent DTE via most of the modem circuits. This test can also be activated via the appropriate pin on the digital interface.

Note

Activation of an LLB via the appropriate pin on the digital interface is not available when using X.21B, G.703 or IR-ETH interfaces.

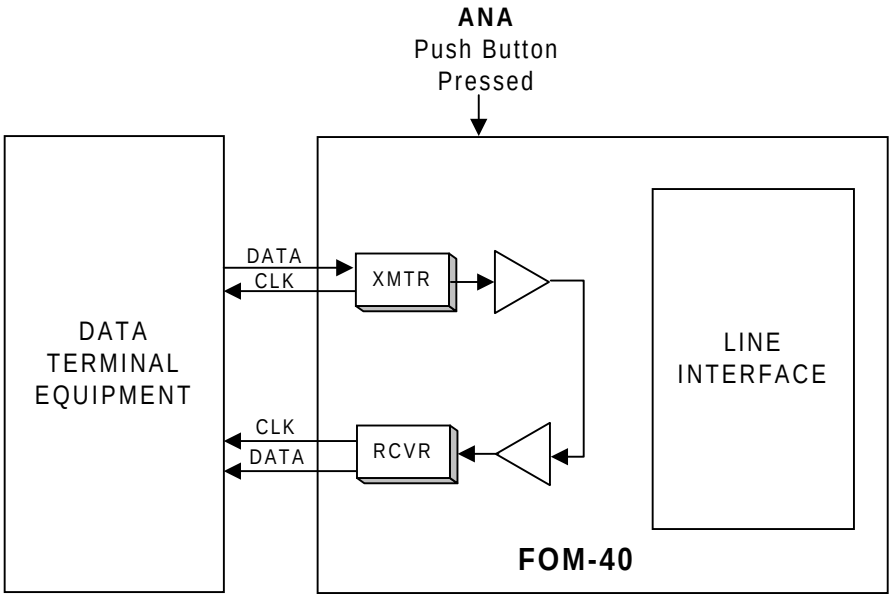

Figure 4-1 Local FOM-40 in Analog Loopback (LLB)

If a fault is detected, repeat the LLB test using external BERT equipment. If the BERT test indicates an error-free data stream, but the test using DTE indicates a fault, verify that the cable between the DTE and the FOM-40 is not faulty or improperly connected. If the problem persists, follow the DTE manufacturer's test procedures to isolate the fault.

➢ **To identify a problem in the communication line:**

- Perform the LLB loopback at the remote end of the line.
  If both LLB tests are error-free, the fault is in the communication link or in the line interfaces.

After completing the test or correcting the fault, return the ANA push button to the OFF (up) position.

Remote Digital Loopback (RLB) Standard V.54

The Remote Digital Loopback (RLB) test determines the performance of the local and the remote FOM-40 units as well as their interconnecting lines. The Remote Digital Loopback sets a loop at the remote FOM-40 modem from the terminal coupled to the local unit (see *Figure 4-2*).

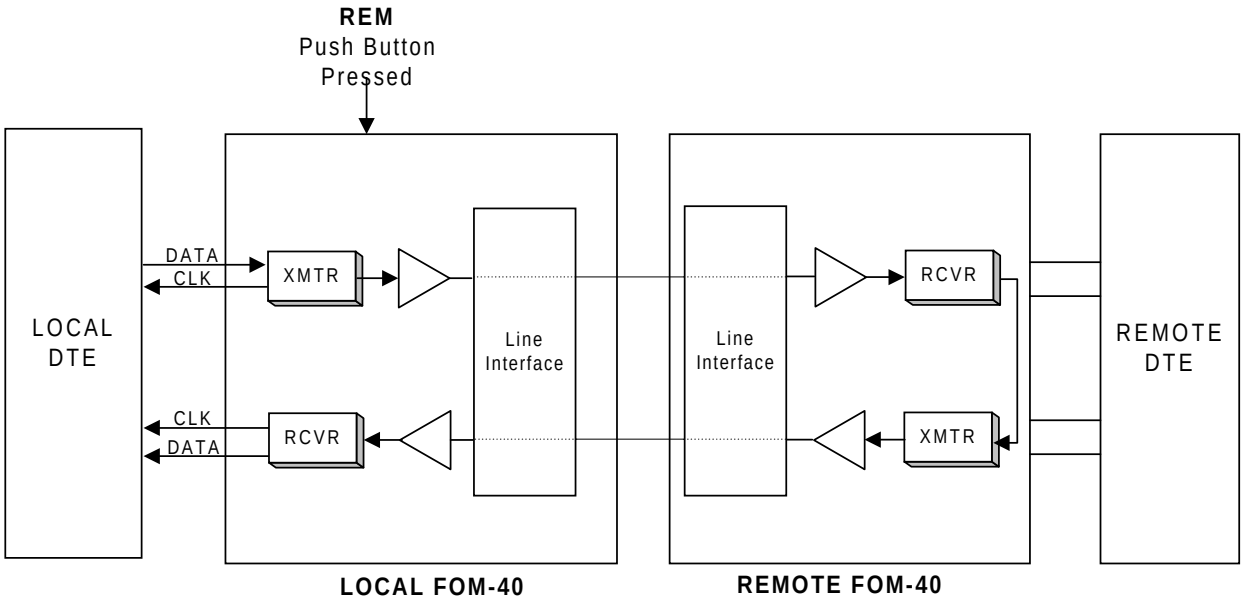

Figure 4-2 FOM-40 in Remote Digital Loopback (RLB)

➢ **To perform the test, proceed as follows:**

- Press the REM push button on the front panel to activate the RLB loopback.
  This test causes the TEST LED to light on the front panel of both local and remote modems.
  This test can also be activated via the appropriate pin on the digital interface.

Note *Activation of an RLB loopback via the appropriate pin on the digital interface is not available when using X.21B, G.703 or IR-ETH interfaces.*

If the RLB test indicates a fault, but the LLB test (see above) was successful in both local and remote modems, then the line or line circuits on one side of the line are not functioning properly.

Local Digital Loopback (DIG) Non-Standard

This test loops the received data back to the remote FOM-40, as shown in *Figure 4-3*. The operator at the remote end uses this test to determine the performance of the local and remote FOM-40 units and the communication link.

➢ **To initiate the Local Digital Loopback test:**

- Press the **DIG** push button on the front panel to initiate the test.

Note *Confirm first that the timing (clock) strap is set to RCV.*

The Local Digital Loopback test is equivalent to activating the remote loopback from a remote FOM-40.

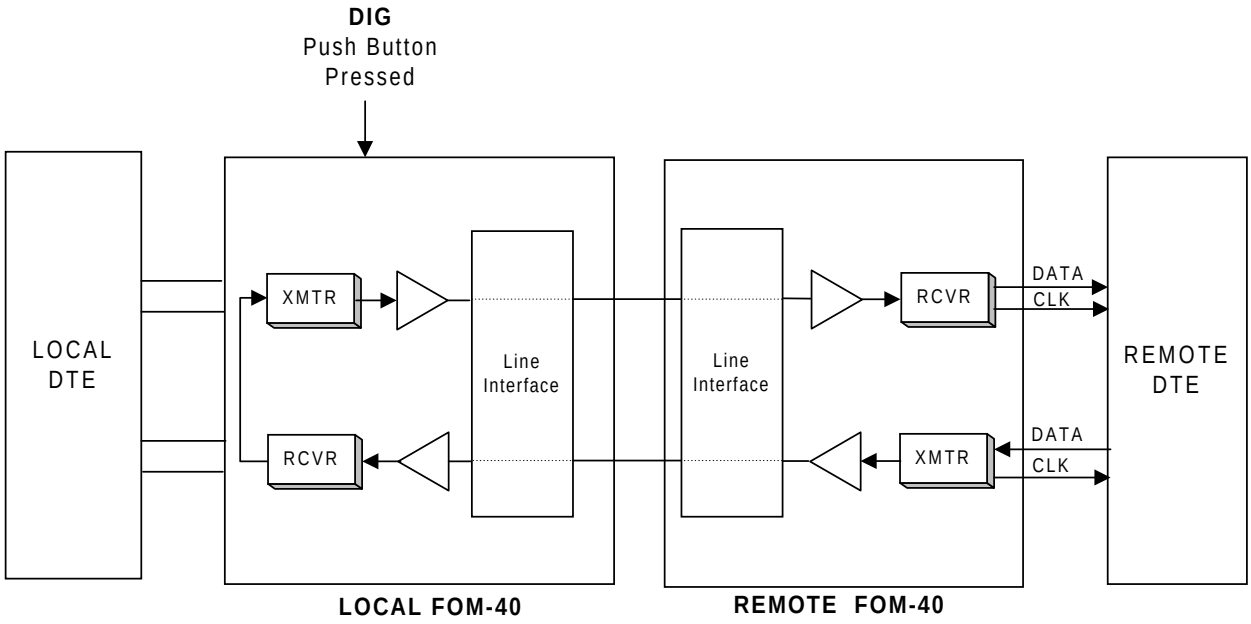

Figure 4-3 Activation of RLB at the Remote Modem (Local FOM-40 in a Digital Loopback)

4.3 Internal BERT Circuit Test

FOM-40 has a built-in BERT circuit, consisting of a pattern generator and a pattern tester. This circuit works in conjunction with the V.54 diagnostic loops and the remote BERT to verify normal system operation and identify faulty equipment in the event of system failure.

The pattern transmitted is a RAD-proprietary, pseudo-random pattern.

The pattern transmitted by the BERT can be received by another FOM-40 modem (a two-BERT test) or looped back to the BERT for comparison (modem self-test).

When used opposite another FOM-40, the complete link can be tested either with the PATT push button pressed, or with an external BERT transmitting the same 511-bit pattern (per V.52).

Modem Self-Test

This test verifies that the modem is operating correctly (see *Figure 4-4*).

➢ **To perform the modem self-test:**

1. Press the **ANA** push button on the front panel. The TEST and DCD LEDs will light up.

Note: *If the DCD LED does not light up, verify that the CARRIER jumper is set to ON, or that the RTS signal is High.*

2. Press the **PATT** push button. Verify that:
   - DCD TEST and RTS LEDs light up
   - RD LED is Off
   - ERR LED is Off

If errors are encountered, the ERR LED lights (for continuous errors) or blinks (for intermittent errors), the FOM-40 unit is faulty and should be replaced. If the test executes correctly, restore all push buttons and jumpers to their normal position.

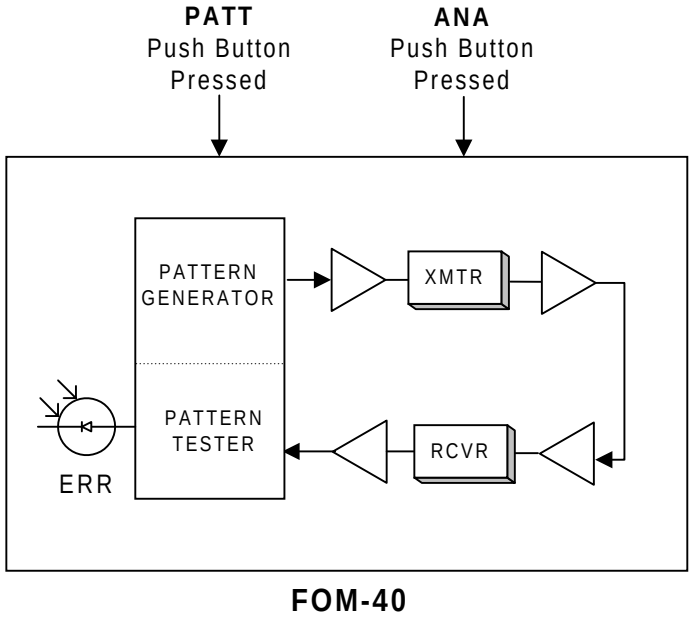

Figure 4-4 FOM-40 Self-Test

Two-BERT Test

The Two-BERT test (see *Figure 4-5*) checks the link between the two DTEs.

➤ **To perform the test, proceed as follows:**

1. Press the **PATT** push button on the front panel. If errors are encountered, the ERR LED will go Off (for continuous errors) or blink (for intermittent errors).

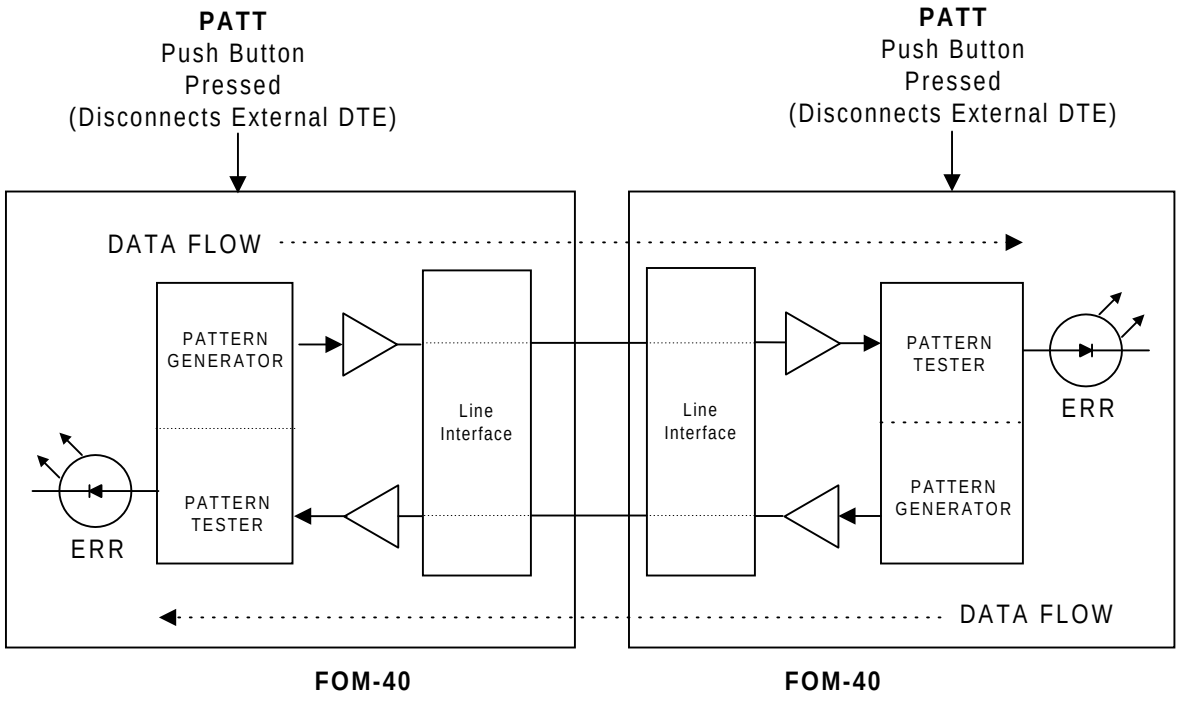

Figure 4-5 FOM-40 BER System Test (Two-BERT Test)

4.4 (Local) Analog Loopback Test

This test checks the performance of the local modem, the local data terminal equipment and the cables between them. It is performed separately at the local and remote sites.

➢ **To run an (Local) Analog Loopback Test:**

1. Press the ANA push button on the front panel. (This test can also be activated via the pin on the DTE interface.) The TEST LED should light. The FOM-40 transmit output is now connected to its own receiver.
2. Verify that the data terminal equipment is operating properly and can be used for the test. If it is faulty, call a technician to replace the unit.
3. Execute the test using one of the following methods:
   - Use the DTE and check the echoed data stream.
   - Use an external Bit Error Rate Tester (BERT) unit.
   - Use the internal BERT. Press the **PATT** push button on the front panel; the TEST and RTS LEDs light constantly while the ERR LED lights briefly to indicate that the lamp is functioning. If a bit error is encountered, the LED blinks or remains lit.
4. Perform Step 3 at both ends.

If BERT test equipment shows no fault, but the data terminal is faulty, follow the manufacturer's test procedures for the data terminal. Check the cable connecting the DTE to FOM-40.

5. After completing the test (or when the fault has been corrected), reset the **ANA** push button to the OFF position (Up). Then perform the Communication Link Tests (see *Section 4.5*).

Loopback Function

The Local Loopback command is activated by the DTE interface or by the push button on the front panel.
FOM-40 sends "MARK" level or "OFF" state to the Transmit LED when the command "LLB" is activated, but the signal is directed only to the Receive input (see *Figure 4-6*). This is an internal test only, with no external transmission. At the far end, the remote FOM-40 functions as if it is in "Loss-of-Signal State", which is DCD "OFF" and RX data "OFF" or "MARK".

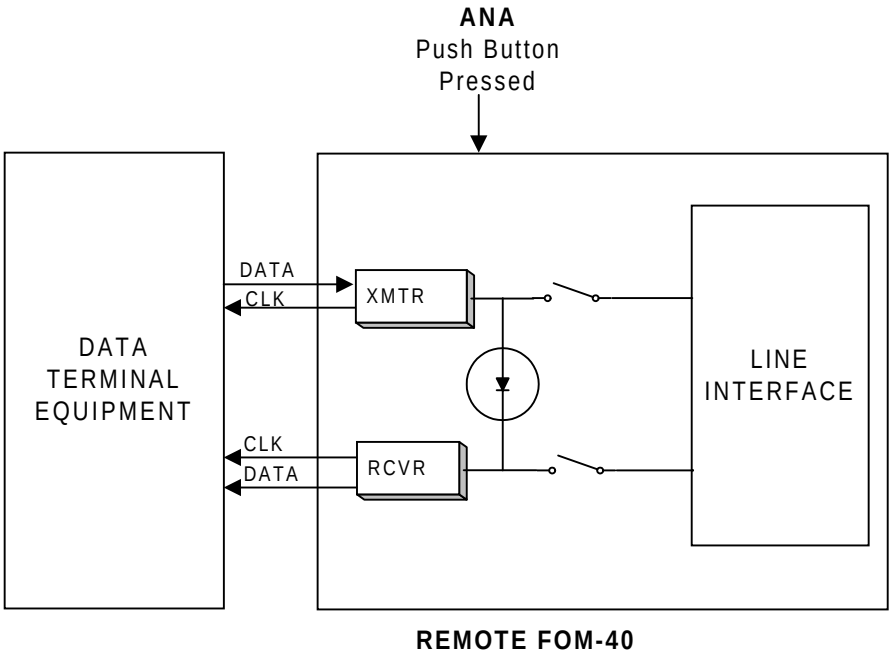

Figure 4-6 Local Analog Loopback

4.5 Communication Link Test

Remote Digital Loopback

The remote digital loopback test determines the performance of both the local and remote FOM-40, and the quality of the link between the local and remote units.

➢ **To perform the Remote Digital Loopback test:**

1. Press the REM push button on the front panel to provide a loopback at the remote FOM-40 (see *Figure 4-2*). (This test can also be activated via the pin on the DTE interface.) The TEST LED lights at both the local and remote units.
2. Perform the BERT test as explained in *Section 4.3*.
3. If Step 2 indicates a fault, and if the modem test described in *Section 4.4* was successful for both the local and remote modems, the line circuits are not operating properly.

Local Digital Loopback

The test loops the received data back to the remote FOM-40. (This test is equivalent to activating remote loopback from the remote FOM-40, as seen in *Figure 4-7*). The operator at the remote end can determine the performance of the local and remote FOM-40 units and of the links between them.

➢ **To activate this test**

- Press the **DIG** push button on the front panel.

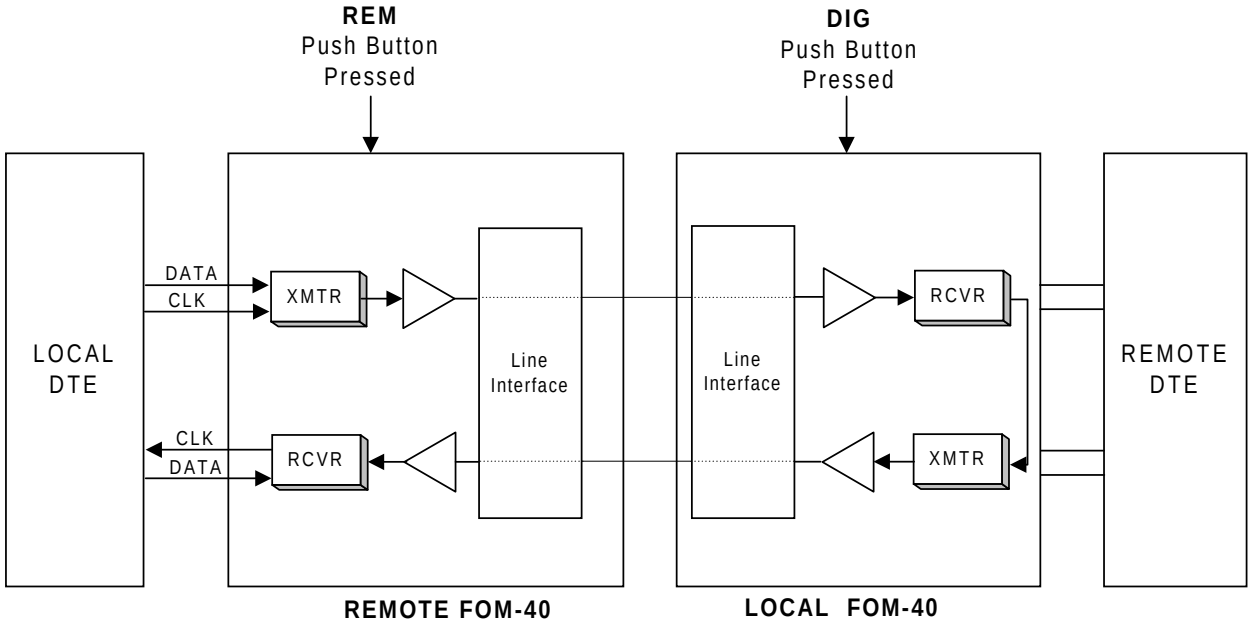

Figure 4-7 Local FOM-40 in Digital Loopback

Chapter 5

Card Cage Version

This chapter:

- Gives a description of the ASM-MN-214 modem rack and power supplies.
- Describes FOM-40/R - card version.
- Explains how to install FOM-40/R in the ASM-MN-214 modem rack and operate the unit.

5.1 ASM-MN-214 Modem Rack

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-40/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 (see *Figure 5-1*) is to be attached to the rear panel terminal block connectors. It contains screws for connecting the transmit and receive pairs and ground, if present.

The 25-pin D-type female interface connector provides all interface signals for the digital interfaces. Modems with X.21 or V.35 interface require an external mechanical adapter. Two optional interface attachments, CIA/V.35/1 and CIA/X.21, can be ordered separately from RAD. CIA/X.21 converts two adjacent DB-25 connectors to two X.21 15-pin connectors. CIA/V.35/1 converts one DB-25 connector to a V.35 34-pin connector. To convert the DB-25 connector to a V.36 37-pin connector, an optional RAD adapter cable (CBL 530/449/F) can be ordered separately. The adapter cable and two interface attachments are also shown in *Figure 5-1*.

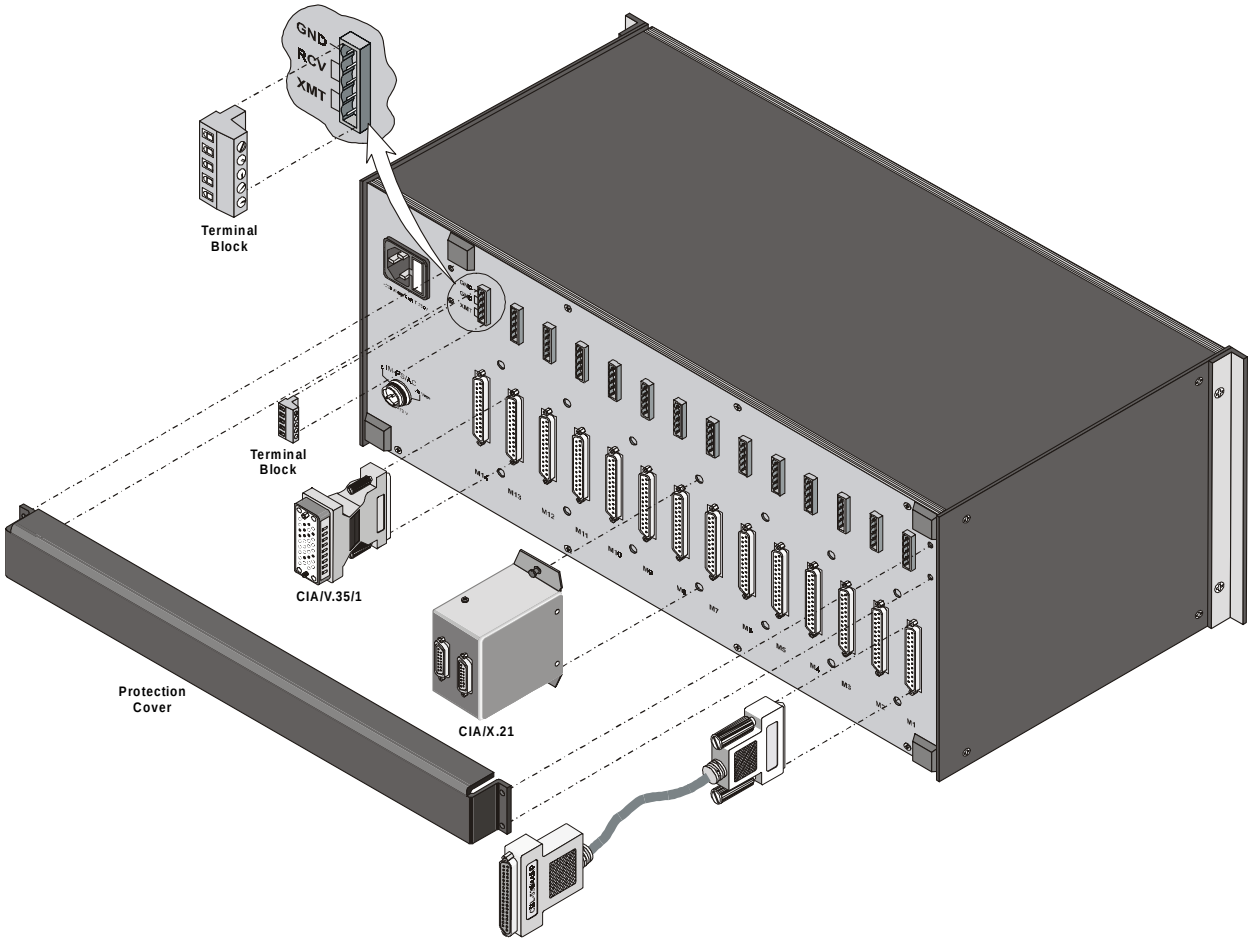

Figure 5-1 ASM-MN-214 Rack Rear Panel

5.2 FOM-40/R Card Version

FOM-40/R is a rack version of FOM-40/Standalone. FOM-40/R has the same features, strap selection and operation procedures as FOM-40. The only differences are board layout and front panel organization. The board layout of the card is shown in *Figure 5-2*.

For strap selection instructions of FOM-40, refer to *Chapter 2*, *Section 2.5* *Chapter 3* gives information on how to operate the FOM-40 modem.

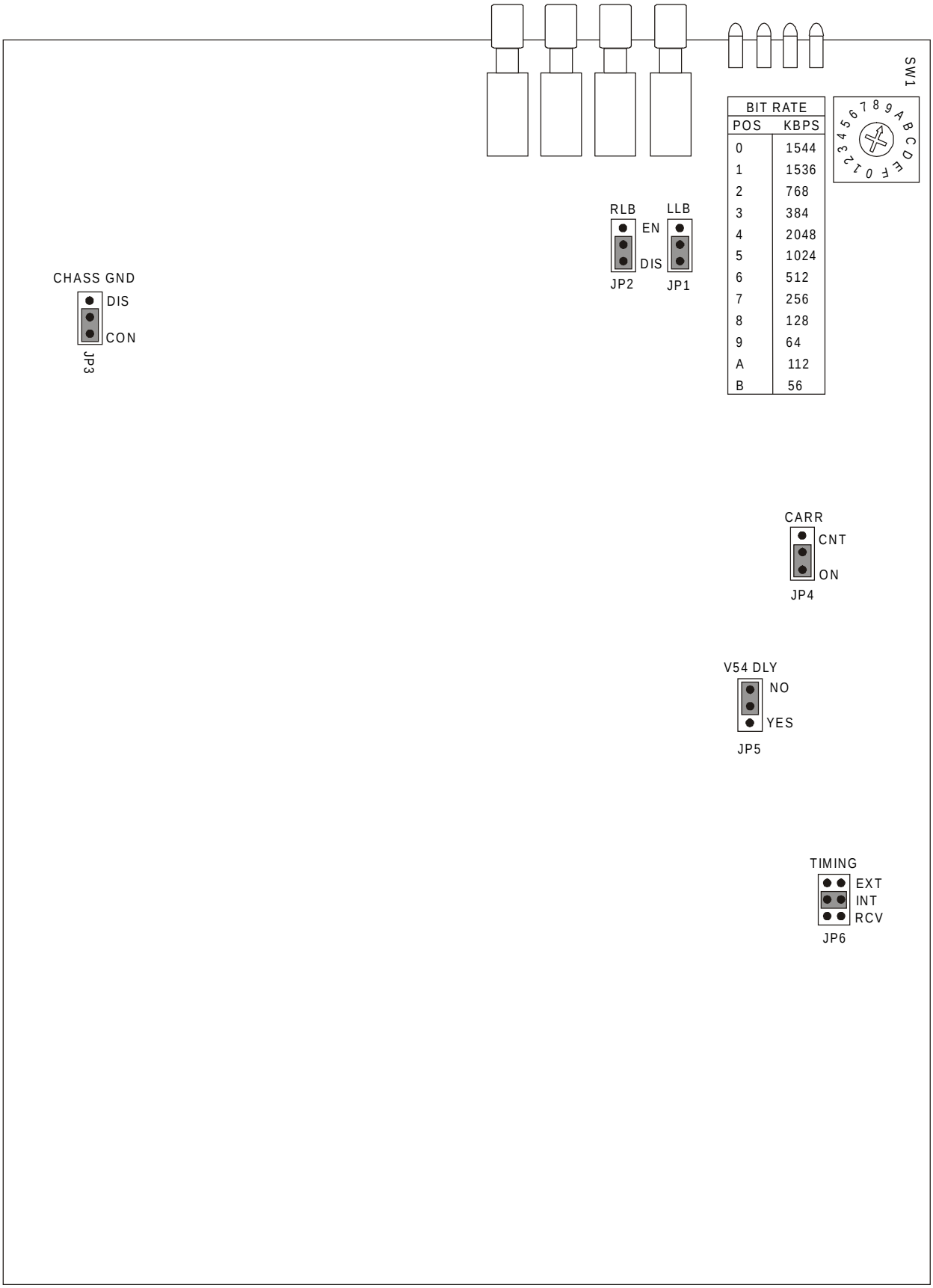

Figure 5-2 FOM-40/R Card, Layout Diagram

Figure 5-3 shows the front panel of FOM-40.

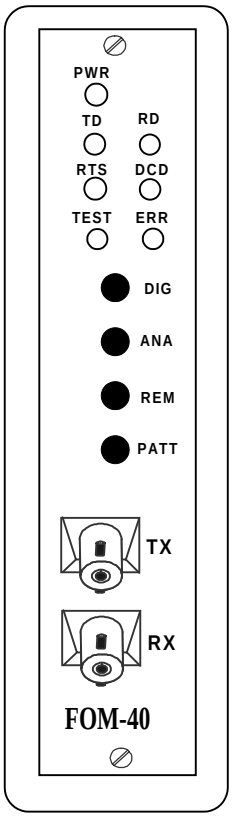

Figure 5-3 FOM-40/R Front Panel

5.3 Power Supply

Power is supplied to the FOM-40/R card from the ASM-MN-214 power supply via the chassis. Each FOM-40/R has two fuses, which protect the entire system against power failure resulting from a short circuit in one card.

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 5-4*) 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 (100, 115 or 230 VAC)

The AC power supply of ASM-MN-214 accepts 100, 115 or 230 VAC, ±10%, 50 or 60 Hz.

DC Supply (24 VDC or 48 VDC)

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 with 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.

The activity of each of these two power supplies is indicated by a LED. They should both light when mains power is provided.

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

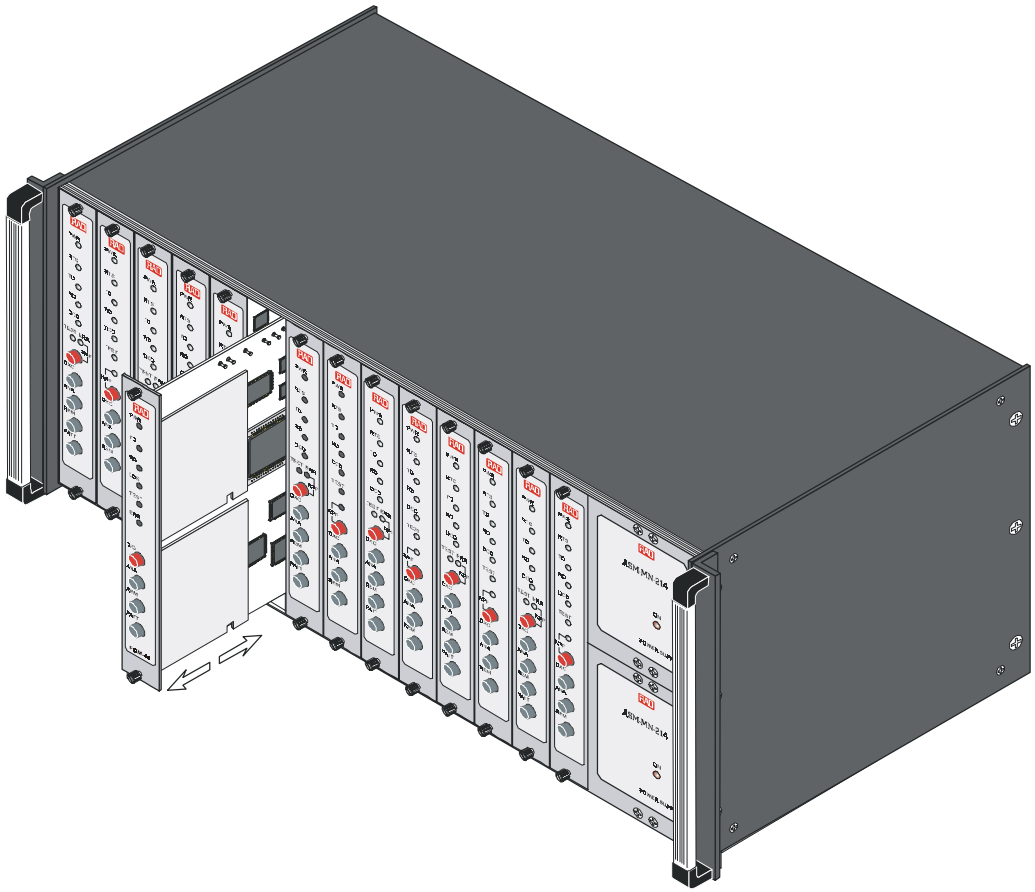

Figure 5-4 ASM-MN-214 Front Panel

5.4 Installation

➤ **To install the FOM-40/R card in the ASM-MN-214 card cage:**

1. Install the ASM-MN-214 card cage in the 19" rack.
2. Adjust the jumpers on the card as required (see *Table 2-1* and *Figure 5-2*).
3. Insert the FOM-40/R card into one of the ASM-MN-214 slots. Push the bottom of the card into the cage to until it is fully inserted into the edge connector inside the rack. Tighten the screws on the top and on the bottom of each card.
4. Remove the protection cover from the terminal block connectors.
5. Connect the terminal block to the ASM-MN-214 terminal block connector.
6. Connect the line to the terminal block as follows: connect transmit pair to the terminals marked XMT, the receive pair to the terminals marked RCV, and the fifth screw to ground (optional).
7. If required, attach the appropriate CIA (CIA/X.21 or CIA/V.35/1) or V.36 adapter cable to the DB-25 connector on the card cage rear panel.
8. Connect the DTE cable to the DB-25 connector, other side of CIA or adapter cable (depending on your card interface).
9. Connect power to the ASM-MN-214 card cage:
   - To connect AC power, connect the power cable to the mains supply.
   - To connect DC power, refer to *DC Power Supply Connection Supplement*.

Appendix A
Ethernet Interface

A.1 General Description

IR-ETH is an interface module for RAD modems, used for converting the Ethernet (10BaseT or 10Base2) electrical levels to the modem TTL levels. It also converts the Ethernet protocol to HDLC to enable long-distance transmission and avoid the Ethernet collision limitation.

IR-ETH includes an internal, self-learning Ethernet bridge, which enables a high performance link between two Ethernet segments at a low transmission rate. The low-speed HDLC transmission is sent over the link using the modem modulation technique. It is converted back to an Ethernet signal at the remote modem.

Figure A-1 shows a typical application using an Ethernet interface bridge. Each modem is connected to an Ethernet network via the Ethernet Interface bridge.

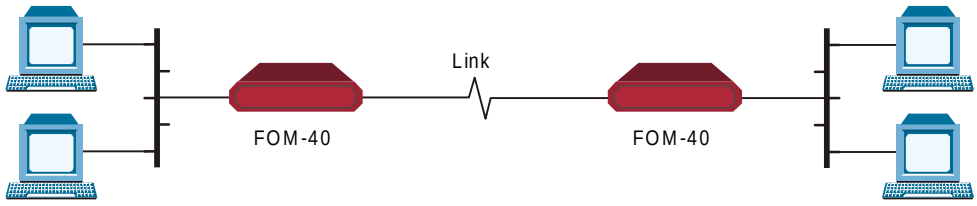

Figure A-1 Ethernet Interface Typical Application

A.2 IR-ETH Connector Options

Figure A-2 and Figure A-3 show the rear panel of FOM-40 with the IR-ETH connector options. The IR-ETH connector for the FOM-40/R card is shown in *Figure A-4*.

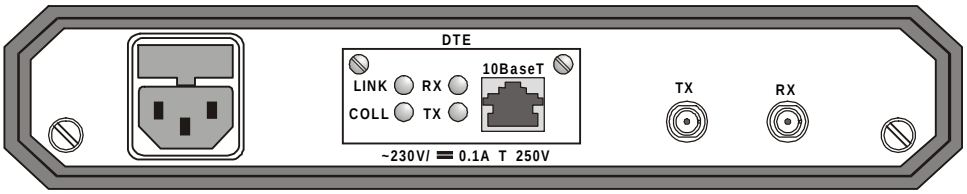

Figure A-2 FOM-40 Rear Panel with IR-ETH/UTP Connector Option

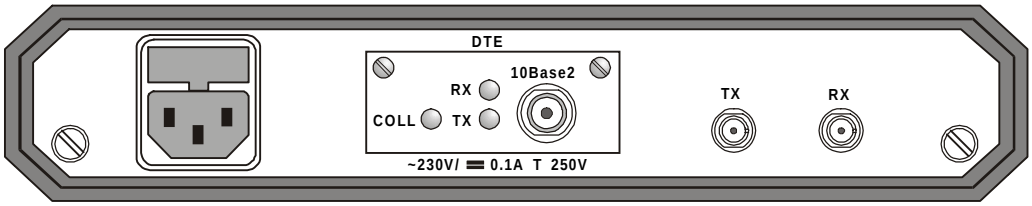

Figure A-3 FOM-40 Rear Panel with IR-ETH/BNC Connector Option

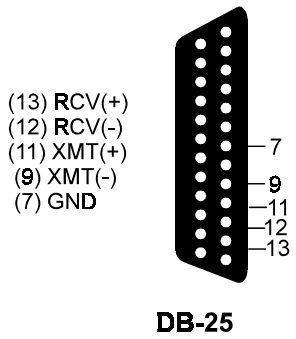

Figure A-4 IR-ETH Connector for the FOM-40/R Card

When using the RJ-45 connector, the customer must prepare a mechanical cable for adapting the DB-25 pinout to that of RJ-45. The pinouts of the DB-25 and RJ-45 connectors are given in *Table A-1*.

Table A-1 DB-25 and RJ-45 Pin Assignment for IR-ETH Connection

Signal	Pin	
	DB-25	RJ-45
RCV (+)	13	3
RCV (-)	12	6
XMT (+)	11	1
XMT (-)	9	2

A.3 Ethernet Bridge Specifications

General	*LAN Table*	10,000 addresses
	Filtering and Forwarding	15,000 pps
	Buffer	256 frames
	Delay	1 frame
LAN	*Standard*	Conforms to IEEE 802.3/Ethernet
	Data Rate	10 Mbps (20 Mbps 10BaseT FDX)
	Connectors:	10BaseT (UTP): Shielded RJ-45 10Base2: BNC connector
WAN	*Protocol:*	HDLC
	Data Rate	According to the modem transmission rate

A.4 Installation and Operation

Figure A-5 and *Figure A-6* show the Ethernet bridge layout, the locations of the DIP switches, and the rear panel components for the UTP and the BNC versions, respectively.

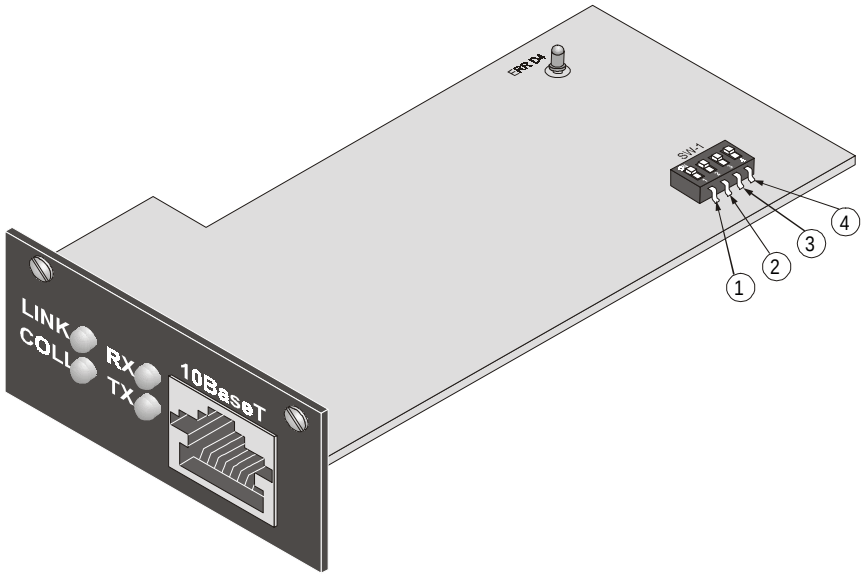

Figure A-5 Ethernet Bridge Layout (UTP Option)

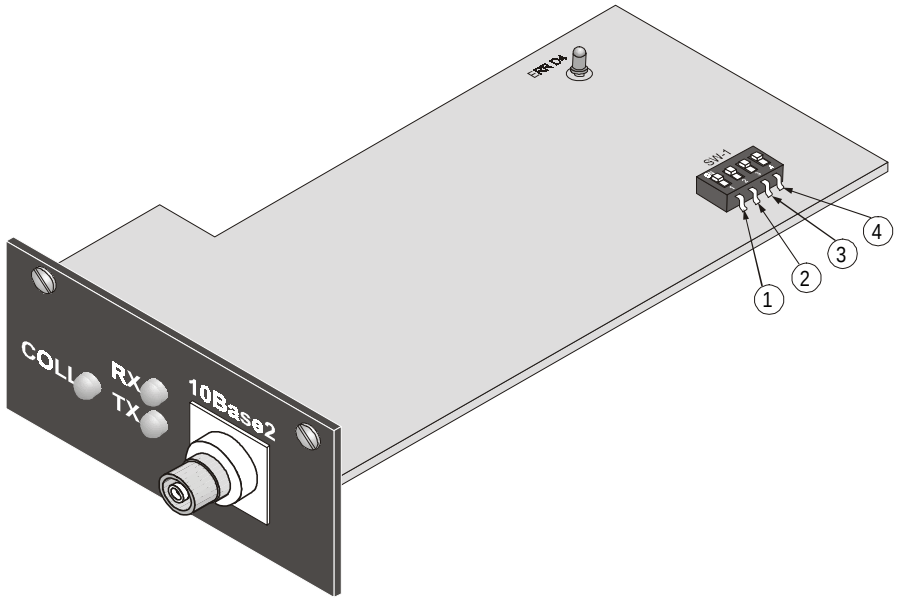

Figure A-6 Ethernet Bridge Layout (BNC option)

LAN Installation

For 10BaseT installation, either a straight cable or a cross-cable may be required. Use a cross-cable when connecting to a port that does not implement the crossover function internally. Otherwise, use a straight cable. (Hubs usually do implement the crossover function internally while NICs and other devices do not).

Switch Settings

Set switches according to *Table A-2*.

Table A-2 DIP Switches Settings

Switch Number	Name	Description	Default Setting
1	SQ/FD	ON: Ethernet full-duplex mode OFF: Ethernet half-duplex mode	OFF
2	CMP	ON: Strips padding bits inserted in 64-byte frame OFF: Transmits frames over WAN as is	ON
3	FIL	ON: Passes only frames destined for another LAN OFF: LAN filter; passes all frames transparently	ON
4	(nc)		

Note *The SQ/FD switch is not used in the Ethernet bridge with the BNC connector option*

LED Indicators

Table A-3 lists the IR-ETH LED indicators and describes their functions.

Table A-3 IR-ETH Bridge LED Indicators

LED Name	Color	Location	Description
LINK	Green	Panel	ON indicates good link integrity (available only in the 10BaseT version)
COLL	Yellow	Panel	ON indicates collision on the attached Ethernet segment
RX	Yellow	Panel	ON when data is received from the Ethernet attached segment
TX	Yellow	Panel	ON when data is transmitted from the modem to the Ethernet segment
ERR D4	Red	On board	Bridge buffer overrun

Appendix B
G.703 Interface (64 kbps)

B.1 General

IR-G.703 is an interface module for RAD modems, converting G.703 codirectional signals to TTL levels. The converted data is sent over the modem link using the modem modulation technique and converted back at the other end into G.703 64 kbps codirectional signals, or into any other digital interface signal.

The module is available in the following two versions:

- **Standalone version** fits into a standalone modem and is available with two types of physical connections: either a terminal block or an RJ-45 connector (see *Ordering*).
- **Modem card version** is mounted on the rack-version modem card and uses the modem edge connector for communication interface. The edge connector is hard-wired on the motherboard of the modem rack, to the DB-25 connector on the back plane of the ASM-MN-214 modem rack.

Figure B-1 shows the rear panel of FOM-40 with IR-G.703 option.
Figure B-2 illustrates the pinout of the different connectors.

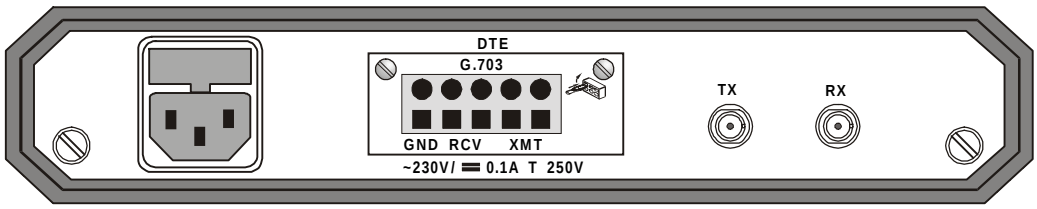

Figure B-1 FOM-40/Standalone, Rear Panel with IR G.703 Terminal Block

Note *In Figure B-1, RCV refers to the input signals to the IR module; XMT refers to the output signals from the module.*

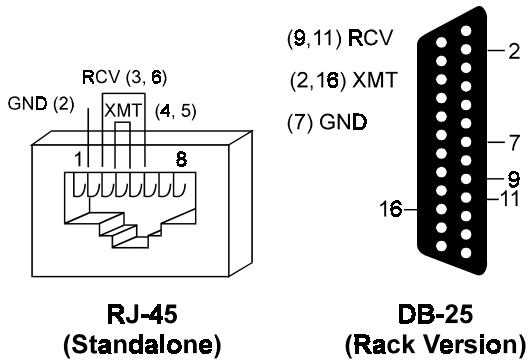

Figure B-2 IR G.703 Connector Options

The IR-G.703 interface module has two operation modes, EXT and INT/RCV, which are strap-selectable on the board. The selection is made by the JP1 jumper located in the module as shown in *Figure B-3*.

The EXT mode is described in *Section B.2*. The INT/RCV mode is described in *Section B.3*.

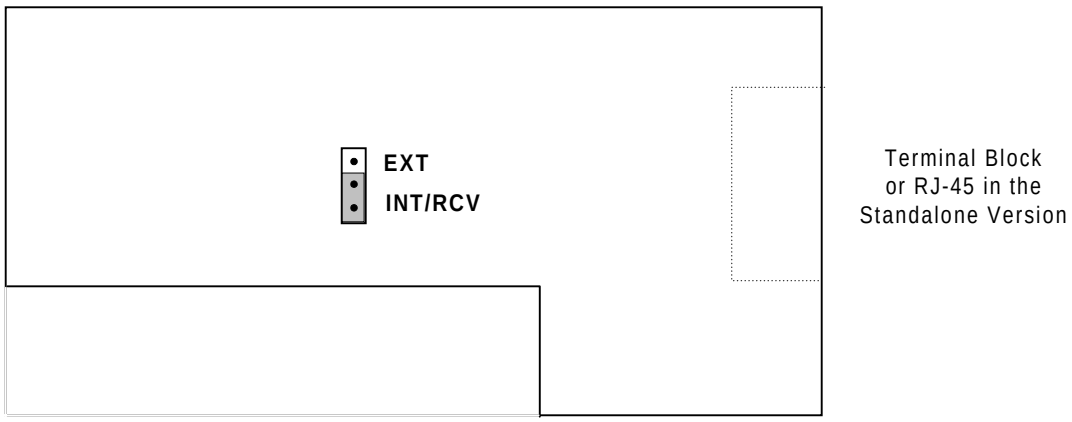

Figure B-3 Strap-Selectable Operation Modes (using Jumper JP1)

B.2 EXT Mode

This mode is used in tail-end applications, where the system timing is provided by the G.703 network. The IR-G.703 module has an internal buffer to compensate for the phase delay introduced to the system by the line delay between the two modems. The buffer is a 8-bit FIFO connected as shown in *Figure B-4*.

This mode corresponds to the modem clock working in the EXT mode.

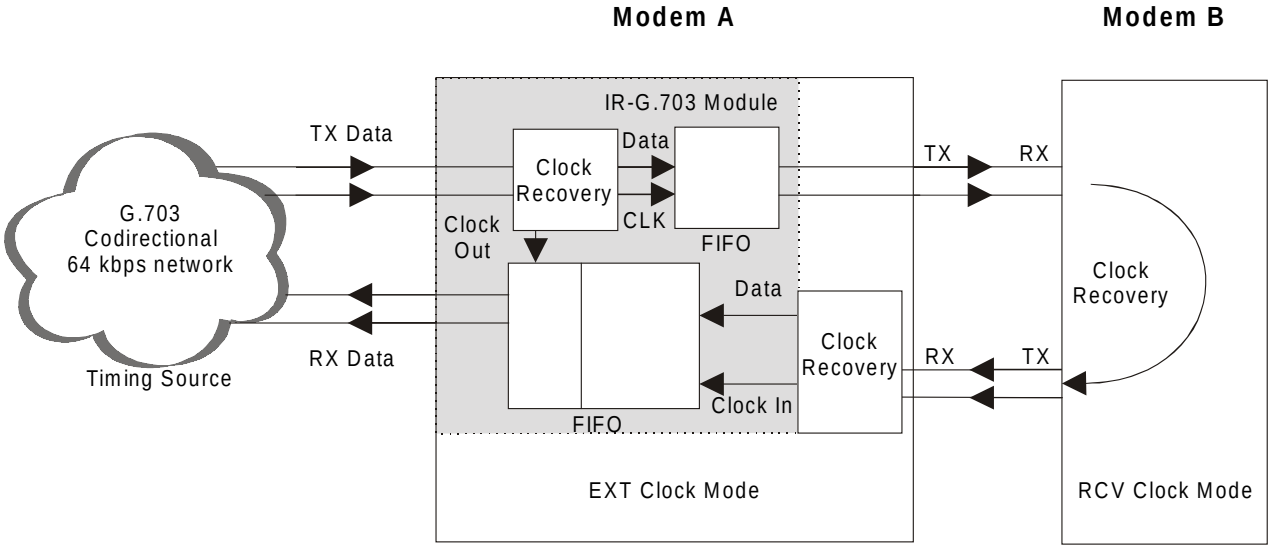

Figure B-4 EXT Mode Timing Block

B.3 INT/RCV Mode

The INT/RCV mode is used in applications in which the G.703 codirectional 64 kbps equipment connected to the modem recovers the clock signal from the modem link. This mode is used mainly when the attached equipment has a G.703 codirectional interface, but is unable to produce clock signals. The module has a 8-bit FIFO buffer to compensate for the phase delay introduced by the G.703 device. *Figure B-5* illustrates the buffer connection and the required application setup.

This mode corresponds to the modem clock working in the INT or RCV mode.

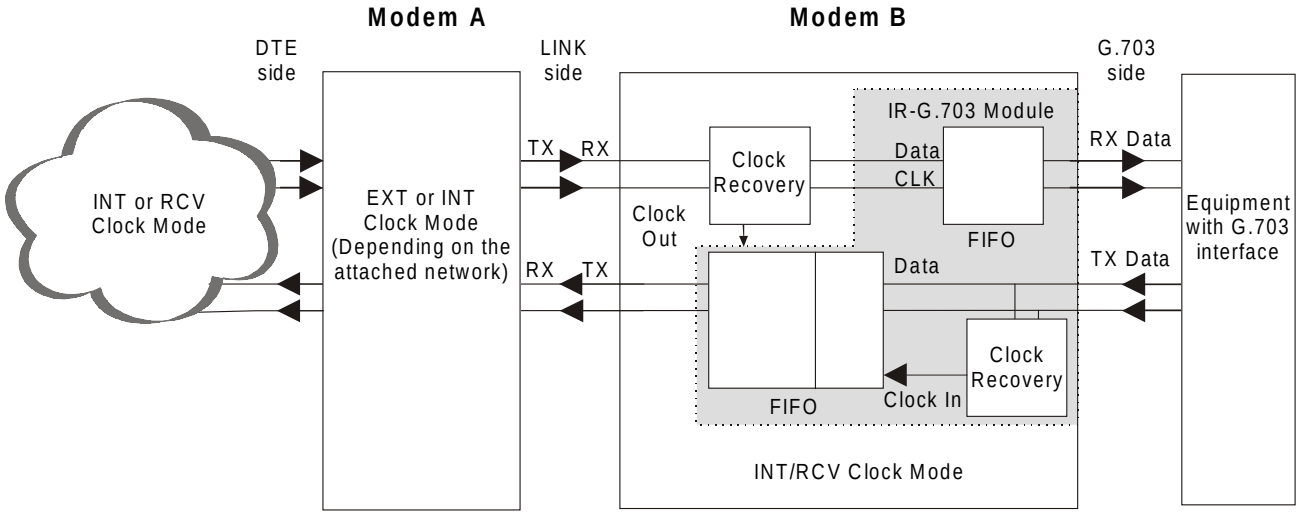

Figure B-5 INT/RCV Mode Timing Block

Appendix C

IR-E1 2048 kbps Unframed Interface

C.1 IR-E1 2048 kbps Unframed Interface

The IR-E1 is an interface module for the FOM-40 modems, converting G.703 E1 signals to TTL levels. The converted data is sent over the modem link using the modem's modulation technique and is converted back at the other end into G.703 E1 signals, or any other possible digital interface signals, at 2048 kbps signals.

The module is available in the following two versions:

- **Standalone version** fits into a standalone modem, and is available with two types of physical connections: RJ-45 for balanced twisted pair connection and BNC for unbalanced Coaxial connection (see *Ordering*).
- **Modem card version** is mounted on the rack-version modem card and uses the modem's edge connector for communication. The edge connector is wired on the motherboard of the card cage to the DB-25 connector on the back plane.
  Figure C-1 illustrates the rear panel of FOM-40 with IR-E1 2028 kbps interface and pinout of the different connectors.

Note *RCV, in Figure C-1., refers to the input signals to the IR module, XMT refers to the output signals from the module.*

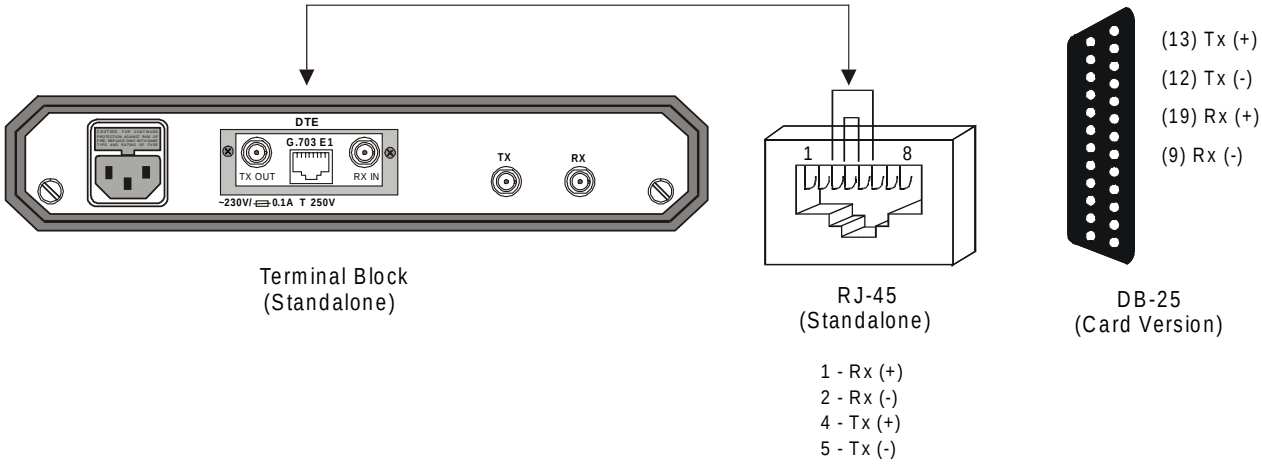

Figure C-1 IR E1 Connector Options

The G.703 E1 interface module has two clock modes, which are user-selectable according to the modem location in the application. *Figure C-2* shows the user jumper location for selecting the clock mode.

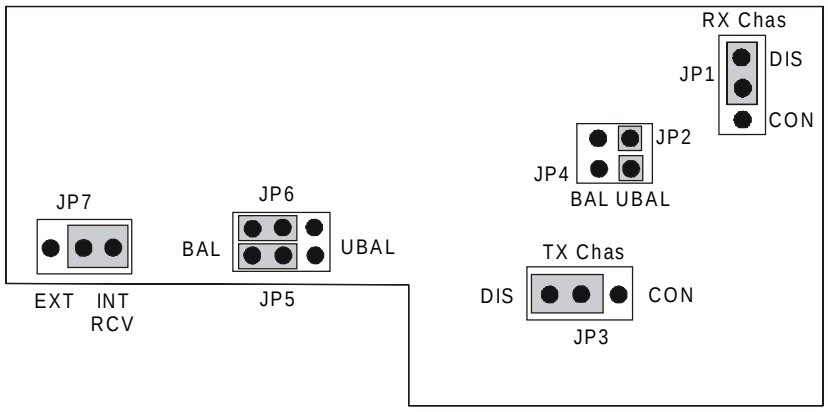

Figure C-2 Module Layout - Jumper Location

Table C-1 Module Strap Options

Jumper No and Identification	Function	Possible Settings	Factory Setting
JP1 RX Chas	Enables connection between the RX BNC connection shield and the chassis	CON DIS	DIS
JP3 TX Chas	Enables connection between the TX BNC connection shield and the chassis GND	CON DIS	DIS
JP2, JP4, JP5, JP6 BAL/UBAL	Selects between the balanced 120 Ω RJ-45 connection and the unbalanced 75Ω BNC connection	BAL UBAL	BAL
JP7 Clock Mode	Selects the clock source for the modem: clock comes from the modem or E1 network	INT/RCV EXT	INT/RCV

Note *The default bit rate setting for the G.703 E1 interface is 2048 kbps, see Section 2.5, Installation abd Setup, Chapter 2.*

Module Clock Modes

The G.703 E1 module has two clock modes: INT/RCV and EXT. When set to INT/RCV mode, the modem provides the G.703 E1 module with the clock for transmitting and receiving data from the E1 attached equipment. *Figure C-3* illustrates a typical application where INT/RCV clock mode is used.

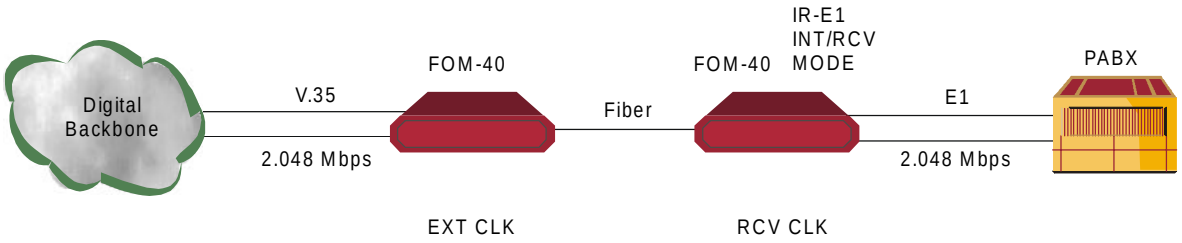

Figure C-3 INT/RCV Clock Mode Application

When set to EXT mode, the G.703 E1 module recovers the clock from the received E1 signal. The recovered clock is passed to the modem for transmitting and receiving data from the remote modem. *Figure C-4* illustrates a typical application where EXT clock has been used.

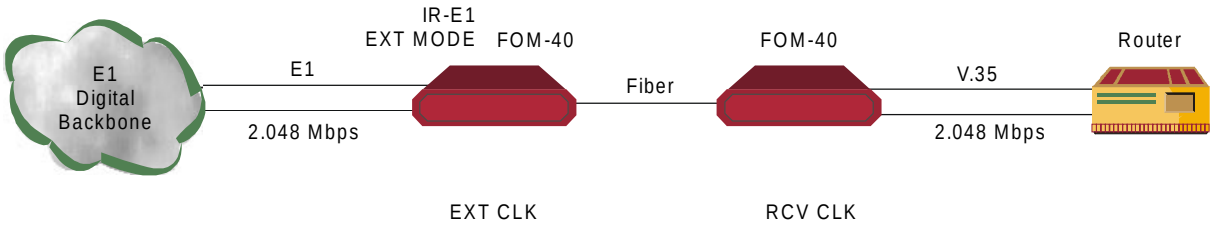

Figure C-4 EXT Clock Mode Application

Appendix D
X.21B Interface

D.1 General

IR-X.21B is an interface module for RAD modems, which converts X.21 signals to TTL levels. The converted data is sent over the modem link, using the modem modulation technique, and is converted back at the other end into X.21 signals, or into any other digital interface signal.

Figure D-1 shows a typical application of the FOM-40 standalone modem with the IR-X.21B interface module.

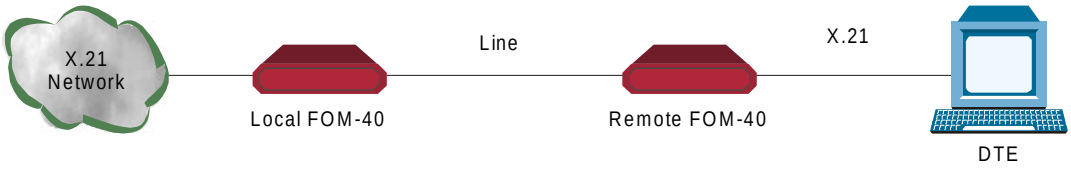

Figure D-1 Typical FOM-40 X.21B Application

D.2 X.21B Connector

Figure D-2 shows the rear panel of a standalone FOM-40 with the X.21B connector option.

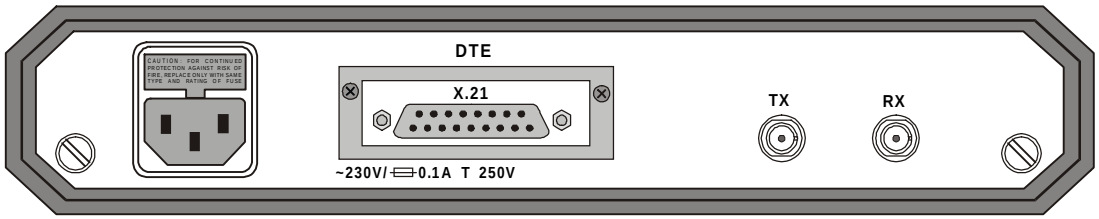

Figure D-2 FOM-40 Rear Panel with X.21B Connector

The FOM-40/R card version requires an additional adapter to connect between the DB-15 connector (on the X.21B equipment) to the DB-25 connector (on ASM-MN-214 rack). The optional DB-15 attachment kit CIA/X.21B, can be ordered separately from RAD, and connects to the ASM-MN-214 rear rack panel.

Pin Assignment *Table D-1* shows the X.21B DB-15 connector pin assignment.

Table D-1 IR-X.21B DB-15 (RS-422) Connector Pin Assignment

Pin	ID	Function
1	Shield	Chassis connection
2	A	Transmit signal A
3	A	Control A
4	A	Receive A
5	A	Indication A
6	A	Signal timing A
7	A	External Timing A
8	GND	Common
9	B	Transmit B
10	B	Control B
11	B	Receive B
12	B	Indication B
13	B	Signal Timing B
14	B	External Timing B

D.3 IR-X.21B Interface Module

The IR-X.21B interface module layout is shown in *Figure D-3*. The module has two operating modes, EXT and INT/RCV, which are strap-selectable. The selection is made using the JP2 jumper on the printed board in the module. The EXT mode is described in *Section D.4*. The INT/RCV mode is described in *Section D.5*.

Note *The X.21B interface strapping should conform to the modem clock mode. For example, if the modem is in EXT mode, then JP2 should be set to the EXT position.*

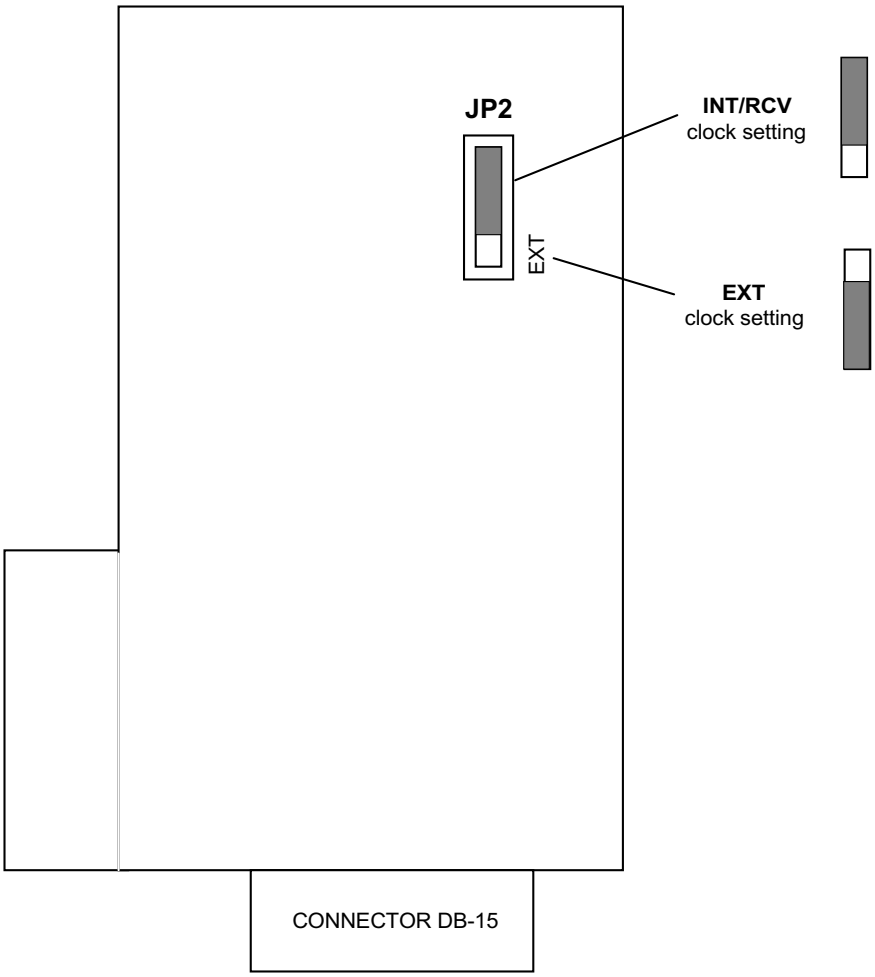

Figure D-3 Jumper JP2 Location in the IR-X.21B Interface Module

D.4 EXT Mode

The EXT mode is used in X.21 network applications, where the system timing is provided by the X.21 network. The IR-X.21B module uses an internal buffer to compensate for the phase delay introduced into the system by a line delay between the two modems. The buffer is a 16-bit FIFO connected as shown in *Figure D-4*. When the modem is working in the EXT mode, the JP2 jumper must be set to EXT (see *Figure D-3*).

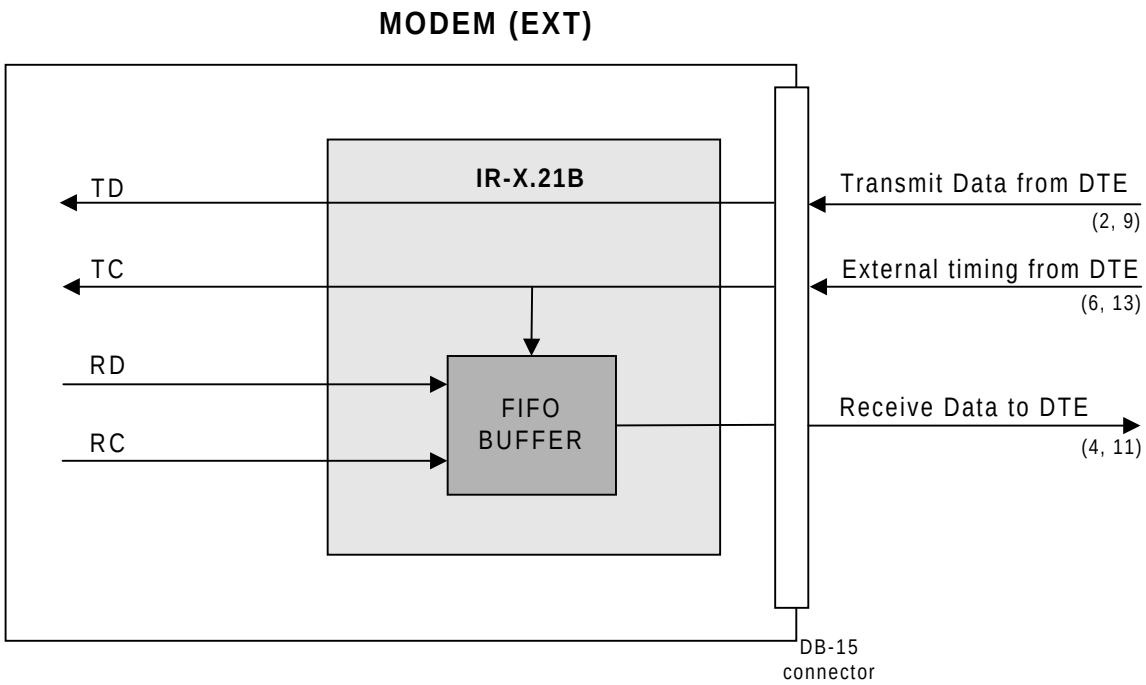

Figure D-4 EXT Mode Timing Block

D.5 INT/RCV Mode

The INT/RCV mode is used in applications where the IR-X.21B side uses the clock signal from the modem link. This mode is used mainly when the attached data equipment has an IR-X.21B interface, and not able to generate clock signals. The module has a 16-bit FIFO buffer to compensate for any phase delay introduced by the X.21B device. *Figure D-5* illustrates the buffer connection and the required application setup. When the modem is working in the INT or RCV mode, the JP2 jumper must be set to INT/RCV (see *Figure D-3)*.

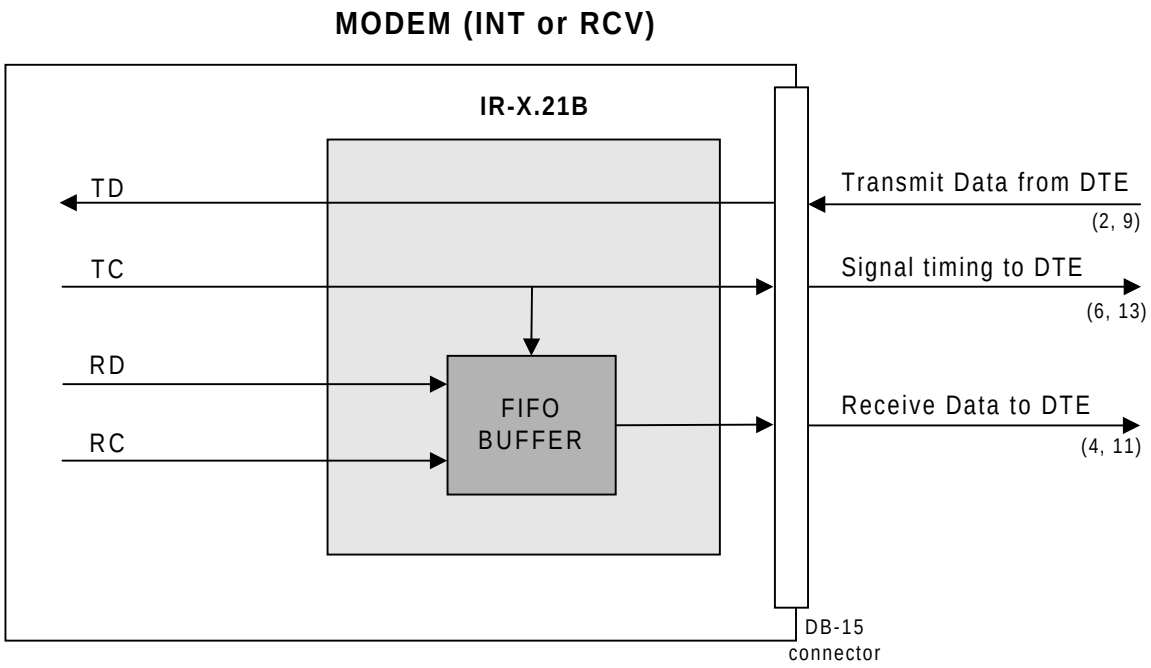

Figure D-5 INT/RCV Mode Timing Block

Appendix E
DTE Interface Signal Assignments

E.1 DTE Interface Signal Assignments

Table E-1 DTE Interface Signal Assignments

Signal Function	RS-232	V.35			EIA-530		X.21			Description
	DB-25 Standalone and Frame	DB-25 Frame	34-Pin Standalone		DB-25 Standalone and Frame		DB-25 Frame	DB-15 Standalone		
			PIN	CIRCUIT	PIN	CIRCUIT		PIN	CIRCUIT (FUNCTION)	
Protective Ground	1	1	A	Frame 101	1		1	1	---- (Shield)	Chassis Ground. May be isolated from Signal Ground.
Signal Ground	7	7	B	Signal 102 GND	7	AB	7	8	---- (GND)	Common signal and DC power supply ground.
Transmitted Data	2	9 11	P S	TD(A) 103 TD(B) 103	2 14	BA(A) BA(B)	2 14	2 9	T(A) T(B) (Transmit)	Serial digital data from DTE. In sync applications, the data translations must occur on the rising edge of the transmit clock.
Received Data	3	12 13	R T	RD(A) 104 RD(B) 104	3 16	BB(A) BB(B)	3 16	4 11	R(A) R(B) (Receive)	Serial output from the modem receiver. In sync applications, the data translations occur on the rising edge of the clock.
Request to Send	4	4	C	RTS 105	4 19	CA(A) CA(B)	4 19	3 10	CA(A) CA(B) (Control)	A positive level to FOM-40 when data transmission is desired.

Table E-1 DTE Interface Signal Assignments (Cont.)

Signal Function	RS-232	V.35		EIA-530		X.21		Description
	DB-25 Standalone and Frame	DB-25 Frame	34-Pin Standalone	DB-25 Standalone and Frame		DB-25 Frame	DB-15 Standalone	
			PIN CIRCUIT	PIN	CIRCUIT		PIN CIRCUIT (FUNCTION)	
Clear to Send	5	5	D CTS 106	5 13	CB(A) CB(B)			A positive level from FOM-40 with delay, after receipt of Request to Send, and when FOM-40 is ready to transmit.
Data Set Ready	6	6	E DSR 107	6 22	CC(A) CC(B)			A positive level from FOM-40 when power is on, and the FOM-40 is (a) not in DIGITAL LOOP mode, or (b) has not received a REMOTE LOOPBACK signal from the remote unit.
Data Terminal Ready	20	20	H DTR 108	20 23	CD(A) CD(B)			Not used
Carrier Detect	8	8	F DCD 109	8 10	CF(A) CF(B)	8 10	5 I(A) 12 I(B) (Indication)	A positive level from FOM-40, except when a loss of the received signal is detected or when Data Set Ready is negative.
External Transmit Clock	24	19 16	U SCTE(A) 113 W SCTE(B) 113	24 11	DA(A) DA(B)	24 11	7 (A) 14 (B)	A serial data rate clock input from the data source. Positive clock translations must correspond to data transmissions.
Transmit Clock	15	14 10	Y SCT(A) 114 a SCT(B) 114	15 12	DB(A) DB(B)	15 12	6 S(A) 13 S(B) (Signal Timing)	A transmit data rate clock for use by an external data source. Positive clock translations correspond to data translations.

Table E-1 DTE Interface Signal Assignments (Cont.)

Signal Function	RS-232	V.35		EIA-530		X.21		Description
	DB-25 Standalone and Frame	DB-25 Frame	34-Pin Standalone	DB-25 Standalone and Frame		DB-25 Frame	DB-15 Standalone	
			PIN CIRCUIT	PIN	CIRCUIT		PIN CIRCUIT (FUNCTION)	
Receive Clock	17	23 22	V SCR(A) 115 X SCR(B) 115	17 9	DD(A) DD(B)			A receive data rate clock output used by an external data sink. Positive clock translations correspond to data translations.
Local Analog Loop	18	18	L and j	18	LL			A control signal input, which, when on, sets FOM-40 into Local Analog Loopback (V.54 Loop 3).
Remote Digital Loop	21	21	N and h	21	RL			A control signal input which, when on, commands FOM-40 to send a remote Loopback command (V.54 Loop 2) to the remote FOM-40.
Test Indicator	25	25	NN and k	25	TM			A Control Signal output from the FOM-40; positive during any test mode.

Appendix E
DTE Interface Signal Assignments

E.1 DTE Interface Signal Assignments

Table E-1 DTE Interface Signal Assignments

Signal Function	RS-232	V.35			EIA-530		X.21			Description
	DB-25 Standalone and Frame	DB-25 Frame	34-Pin Standalone		DB-25 Standalone and Frame		DB-25 Frame	DB-15 Standalone		
			PIN	CIRCUIT	PIN	CIRCUIT		PIN	CIRCUIT (FUNCTION)	
Protective Ground	1	1	A	Frame 101	1		1	1	---- (Shield)	Chassis Ground. May be isolated from Signal Ground.
Signal Ground	7	7	B	Signal 102 GND	7	AB	7	8	---- (GND)	Common signal and DC power supply ground.
Transmitted Data	2	9 11	P S	TD(A) 103 TD(B) 103	2 14	BA(A) BA(B)	2 14	2 9	T(A) T(B) (Transmit)	Serial digital data from DTE. In sync applications, the data translations must occur on the rising edge of the transmit clock.
Received Data	3	12 13	R T	RD(A) 104 RD(B) 104	3 16	BB(A) BB(B)	3 16	4 11	R(A) R(B) (Receive)	Serial output from the modem receiver. In sync applications, the data translations occur on the rising edge of the clock.
Request to Send	4	4	C	RTS 105	4 19	CA(A) CA(B)	4 19	3 10	CA(A) CA(B) (Control)	A positive level to FOM-40 when data transmission is desired.

Table E-1 DTE Interface Signal Assignments (Cont.)

Signal Function	RS-232	V.35		EIA-530		X.21		Description
	DB-25 Standalone and Frame	DB-25 Frame	34-Pin Standalone	DB-25 Standalone and Frame		DB-25 Frame	DB-15 Standalone	
			PIN CIRCUIT	PIN	CIRCUIT		PIN CIRCUIT (FUNCTION)	
Clear to Send	5	5	D CTS 106	5 13	CB(A) CB(B)			A positive level from FOM-40 with delay, after receipt of Request to Send, and when FOM-40 is ready to transmit.
Data Set Ready	6	6	E DSR 107	6 22	CC(A) CC(B)			A positive level from FOM-40 when power is on, and the FOM-40 is (a) not in DIGITAL LOOP mode, or (b) has not received a REMOTE LOOPBACK signal from the remote unit.
Data Terminal Ready	20	20	H DTR 108	20 23	CD(A) CD(B)			Not used
Carrier Detect	8	8	F DCD 109	8 10	CF(A) CF(B)	8 10	5 I(A) 12 I(B) (Indication)	A positive level from FOM-40, except when a loss of the received signal is detected or when Data Set Ready is negative.
External Transmit Clock	24	19 16	U SCTE(A) 113 W SCTE(B) 113	24 11	DA(A) DA(B)	24 11	7 (A) 14 (B)	A serial data rate clock input from the data source. Positive clock translations must correspond to data transmissions.
Transmit Clock	15	14 10	Y SCT(A) 114 a SCT(B) 114	15 12	DB(A) DB(B)	15 12	6 S(A) 13 S(B) (Signal Timing)	A transmit data rate clock for use by an external data source. Positive clock translations correspond to data translations.

Table E-1 DTE Interface Signal Assignments (Cont.)

Signal Function	RS-232	V.35		EIA-530		X.21		Description
	DB-25 Standalone and Frame	DB-25 Frame	34-Pin Standalone	DB-25 Standalone and Frame		DB-25 Frame	DB-15 Standalone	
			PIN CIRCUIT	PIN	CIRCUIT		PIN CIRCUIT (FUNCTION)	
Receive Clock	17	23 22	V SCR(A) 115 X SCR(B) 115	17 9	DD(A) DD(B)			A receive data rate clock output used by an external data sink. Positive clock translations correspond to data translations.
Local Analog Loop	18	18	L and j	18	LL			A control signal input, which, when on, sets FOM-40 into Local Analog Loopback (V.54 Loop 3).
Remote Digital Loop	21	21	N and h	21	RL			A control signal input which, when on, commands FOM-40 to send a remote Loopback command (V.54 Loop 2) to the remote FOM-40.
Test Indicator	25	25	NN and k	25	TM			A Control Signal output from the FOM-40; positive during any test mode.

Appendix F

Connecting RS-530 to RS-422

Table F-1 Interface List for Connecting FOM-40 (RS-530) to RS-422 (V.36) DTE

Signal Function	RS-449 (RS-422/423) 37 Pins		EIA 530 DB-25 Female Standalone & Frame	
	Pin	Circuit	Pin	Circuit
Protective Ground	1	Shield	1	
Signal Ground	19, 37 20		7	AB
Transmitted Data	4 22	SD(A) SD(B)	2 14	BA(A) BA(B)
Received Data	6 24	RD(A) RD(B)	3 16	BB(A) BB(B)
Request to Send	7 25	RS(A) RS(B)	4 19	CA(A) CA(B)
Clear to send	9 27	CS(A) CS(B)	5 13	CB(A) CB(B)
Data set Ready	11 29	DM(A) DM(B)	6 22	CC(A) CC(B)
Data Terminal Ready	12 30	TR(A) TR(B)	20 23	CD(A) CD(B)
Carrier Detect	13 31	RR(A) RR(B)	8 10	CF(A) CF(B)
External Transmit Clock	17 35	TT(A) TT(B)	24 11	DA(A) DA(B)
Transmit Clock	5 23	ST(A) ST(B)	15 12	DB(A) DA(B)
Receive Clock	8 26	RT(A) RT(B)	17 9	DD(A) DD(B)
Local Analog Loopback	10	LL	18	LL
Remote Loopback	14	RL	21	RL
Test Indicator	18	TM	25	TM

Appendix G
Unit Case Assembly

G.1 Installation of the Unit Case into a 19" Rack

General

The height of the unit is 1U (1.75"); the width of the unit is slightly less than half the available mounting width. A rack adapter kit, RM-9, is available for installing either a single unit or two units side by side in the 19" rack.

Warning

Disconnect AC power before opening the unit.

Installation of a Single Unit

Rack adapter components for installing a single unit include one short bracket and one long bracket.

➤ **To install a single unit:**

1. Fasten each bracket to the side walls of the unit by two screws which are inserted into the two front holes on the side wall. (The unit is supplied with nuts already in place on the inner side wall). Note that the short bracket fastens to the left side of the unit, and the long bracket to the right side of the unit (see *Figure G-1*).

   Once the brackets are fastened to the side walls, the unit is ready for installation in the 19" rack.

2. Place the unit in the rack and fasten the brackets to the side rails of the rack using two screws on each side (not included in the kit).

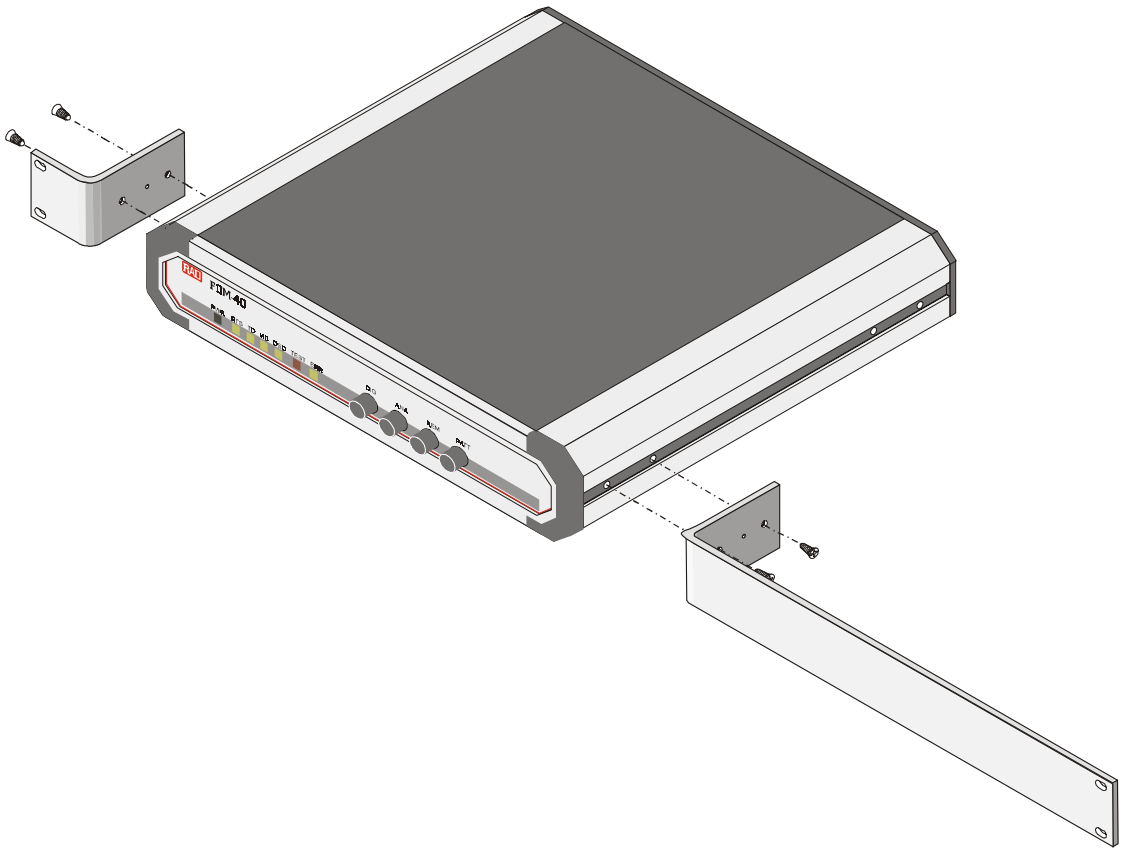

Figure G-1 Installation of a Single Unit

Installation of Two Units

Rack adapter components for installing two units include two long side rails (one for each unit) which slide one into the other fastening the two units together, and two short side brackets which hold the two units in the 19" rack (see *Figure G-2*).

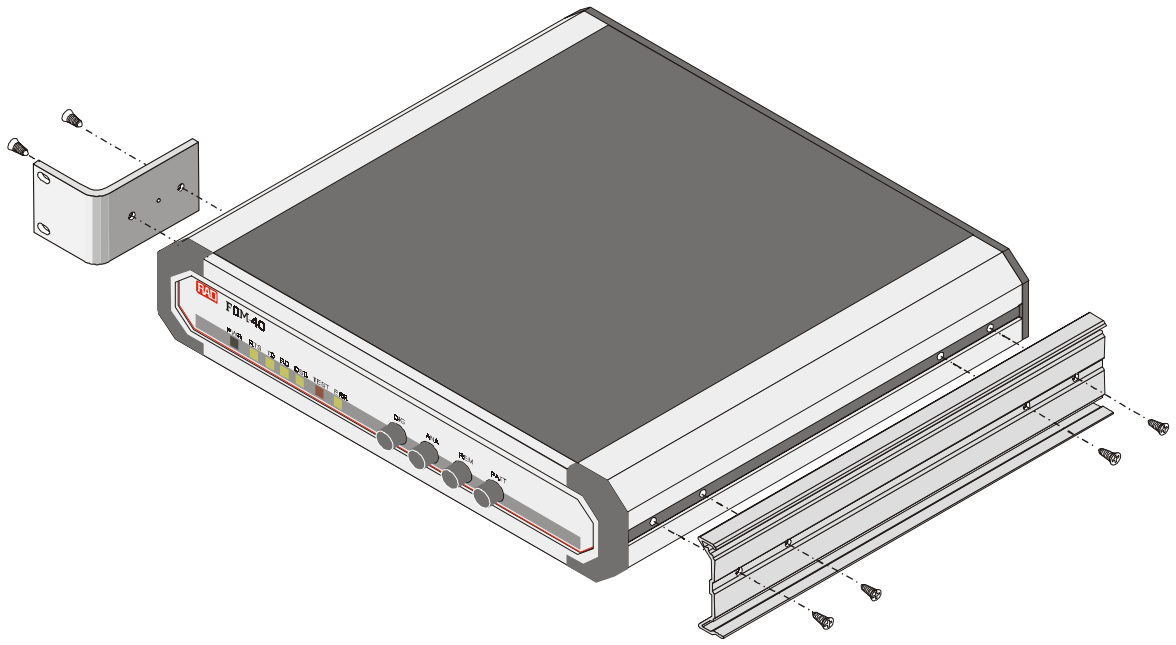

Figure G-2 Installation of Two Units

➤ **To install two units:**

1. Fasten one long side rail to each unit (right side to one unit, left side to the other unit) using the four screws supplied. The side rails must be attached in opposing fashion, the narrow flange of the first rail opposite the wide flange of the second rail.
2. Attach one short bracket opposite the side rail on each unit using the 4 screws supplied.
3. Slide the side rail of one unit into the side rail of the other unit, fastening the two units together (see *Figure G-3*).
4. Secure the supplied plastic caps to the ends of the rails, to prevent the units moving and to protect the rail ends.

The assembled units can now be fastened to the side rails of the 19" rack by means of four screws to each side(not included in the kit).

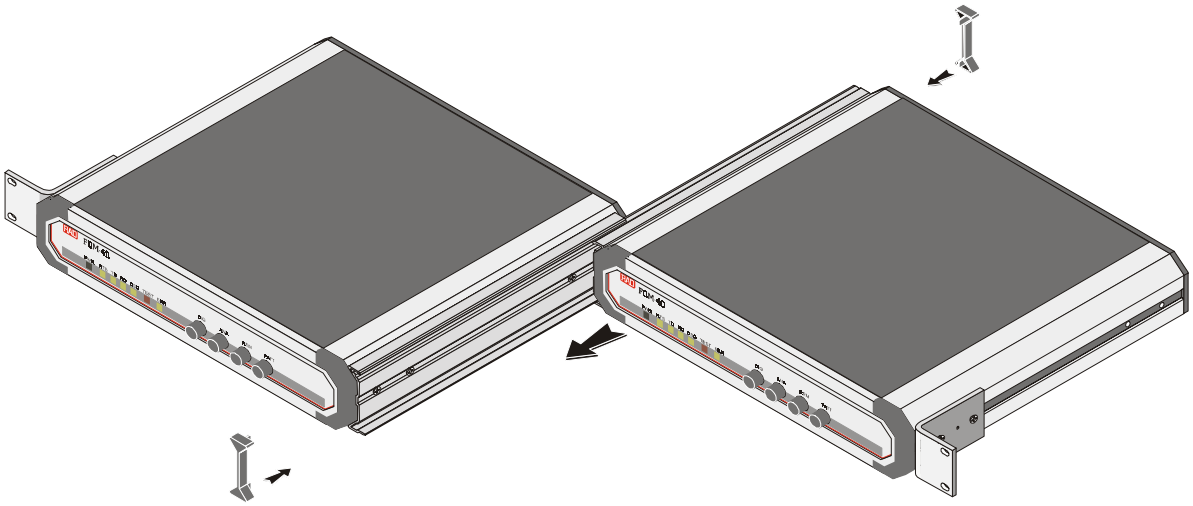

Figure G-3 Fastening Two Units Together