

FOM-20

Fiber Optic Modem Installation and Operation Manual

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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.

Telecommunication Safety

The safety status of each of the ports on FOM-20 is declared according to EN 41003 and is detailed in the table below:

Safety Status	Ports
SELV*	Ethernet, RS-530, V.35, X.21B, V.24, V.36
TNV-1**	G.703

*SELV = Safety Extra-Low Voltage

**TNV-1 = Telecommunications Network Voltage in the limits of SELV and subject to overvoltage.



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.

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 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/her 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: 24 Raoul Wallenberg St.
Tel Aviv 69719
Israel

declares that the product:

Product Name: FOM-20

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, November 4th, 1996



Haim Karshen
VP Quality

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Quickstart Guide

Installation of FOM-20 should be carried out only by an experienced technician. If you are familiar with fiber-optic modems, use this guide to prepare FOM-20 for operation. If you are not familiar with fiber-optic modems, read *Chapter 2* and *Chapter 3*.

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

Setting the Jumpers/Switches



1. Starting up

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

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

- Jumper J3:
Set the XMT CLOCK mode: INT, EXT, RCV, ASY
Default is INT.
- Selector switch SW3:
Set the BAUD RATE: 19.2, 28.8, 32, 38.4, 48, 56, 57.6, 64, 72, 96, 112, 115.2, 128, 144, 192, 256 kbps.
Default is 64 kbps.
- Jumper J6:
Set SW EN to On or OFF.
Default is ON.

Connecting the Interfaces

- Connect the Data Terminal Equipment to the appropriate DTE connector on the rear panel of FOM-20.
- Connect the fiber optic cables to the respective Rx-Tx and Tx-Rx connectors on the rear panel of FOM-20.

Connecting the Power**FOM-20, AC Version**

1. Connect the power cable to the AC input jack on the rear panel of the modem.
2. Connect FOM-20 to a power source.

The PWR LED lights to indicate that FOM-20 is on.

FOM-20, DC Version

1. Connect the three wires (-48 VDC, +48 VDC, CHASSIS GND) to the RAD-supplied adapter plug from the DC power source.
Follow the instructions in the *DC Power Supply supplement* at the end of the manual.
2. Attach the DC adapter plug to the DC input jack on the rear panel of the modem.
3. Connect FOM-20 to a power source.

The PWR LED lights to indicate that FOM-20 is on.

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

2. Testing Performance

Verifying Modem Operation

After powering up the modem, if the modem does not operate properly, see *Chapter 4* for more information on the FOM-20 functional tests.

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Chapter 1

Introduction

This chapter:

- Provides a general introduction to the FOM-20 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-20 is a fiber optic modem that provides a secure, long range data link between computers, routers, multiplexers and other data communication (DTE) devices at output power ranges from 12 to 18 dB.

FOM-20 operates either half or full duplex over sixteen selectable synchronous/asynchronous data rates from 19.2 kbps to 256 kbps enabling transmission up to 70 km (140 km over laser diode).

FOM-20 uses an infrared light emitting diode or a laser to convert electrical signals into optical signals. The optical signal is converted back into an electrical signal in compliance with the appropriate interface on the receive end.

Transmit clock timing is provided either internally, derived externally from the DTE, or recovered from the receive signal.

FOM-20 features V.54 diagnostic capabilities for performing local analog and local and remote digital loopbacks.

FOM-20 is available with six DTE interface options.

Applications

The following diagrams illustrate the integration of the FOM-20 in a variety of practical configurations:

- Point-to-point application (see *Figure 1-1*):
Two FOM-20 units are connected by a single mode fiber (up to 70 km). Each unit is connected to a workstation or an AS-400 system.

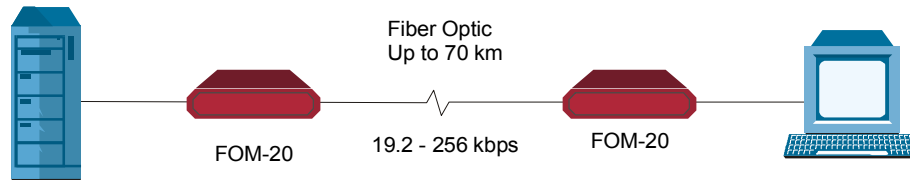


Figure 1-1 Point-to-Point Application

- Tail-end application, for digital networks (see *Figure 1-2*):
An AS-400 system is connected to a FOM-20 unit by a V.24 protocol. Another FOM-20 unit connects to the first FOM-20 over a G.703 link and attaches to a digital service network. One FOM-20 is synchronized by an external clock; the other by the RCV clock. On the other end, a workstation is connected to a FOM-20 by V.24 protocol.

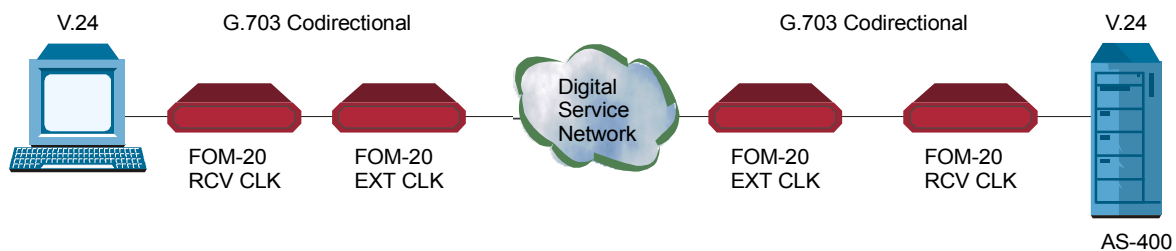


Figure 1-2 Tail End for Digital Network Application

- G.703 modem link application (see *Figure 1-3*). Two FOM-20 units are connected between a workstation and a network node over a G.703 modem link.

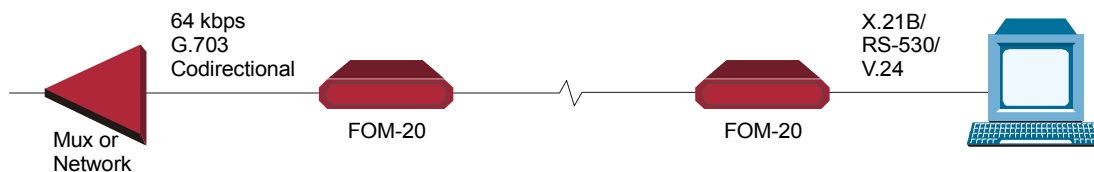


Figure 1-3 Extension of G-703 Codirectional Network

Versions

FOM-20 is available as a standalone unit or as a card (FOM-20/R) for use in the ASM-MN-214 19" card cage.

The standalone unit is supplied in a compact case that can be mounted on a desktop or shelf or mounted in a 19-inch rack

FOM-20/R is the card version to be used in the ASM-MN-214, 19-inch modem rack. (The ASM-MN-214 rack can accommodate up to 14 cards.)

FOM-20 can be ordered with a wide selection of optical interfaces and power supply voltages.

A 115/230VAC, or -48 VDC power supply is needed to operate FOM-20.

FOM-20 can be ordered with different light sources (Light Emitting Diode or Injection Laser diode) and different DTE interfaces. The type of light source and fiber optic used determine the maximum transmission range.

Features**Fiber Optics**

FOM-20's fiber optic technology permits high immunity against electrical interference such as EMI, RFI, spikes and differential ground loops; protection from sparking and lightning and a secure link in hazardous or hostile environments; point-to-point data links at ranges longer than a conventional copper wire modem over noisy environments; high data security, minimizing the risk of eavesdropping.

Interfaces

Six DTE interface options are available: RS-232/V.24 (up to 64 kbps), V.35, built-in Ethernet bridge, RS-530, X.21B and G.703 (64 kbps codirectional). Connection to an RS-449/V.36 interface is accomplished via the RS-530 interface (see *Appendix D*).

Timing

FOM-20 receives clock timing from three variable sources: Internal, External or Receive clock. FOM-20 utilizes a phase locked loop (PLL) circuit to recover jitter-free data and clock sync from the optical signal.

Test and Diagnostic Capabilities

FOM-20 features V.54 diagnostic capabilities for performing local analog and local and remote digital loopbacks.

1.2 Physical Description

FOM-20 is a compact unit, intended for installation on desktops or shelves. The unit height is 4.4 cm (1.7") (see *Figure 1-4*).

An optional rack-mount adapter kit enables FOM-20 installation into a 19-inch rack.

Figure 1-4 shows a 3D view of FOM-20.

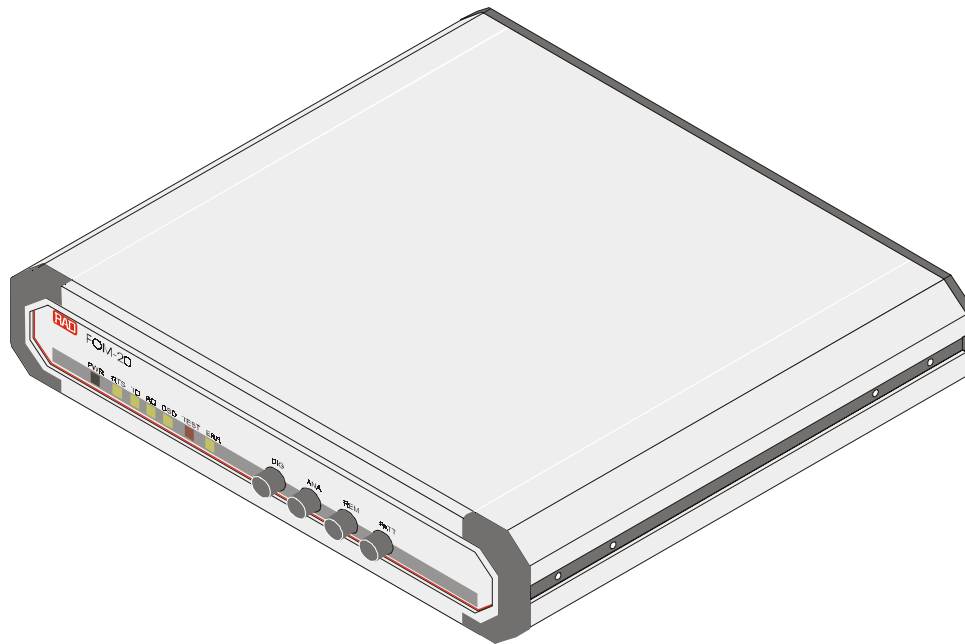


Figure 1-4 FOM-20 Front View

Front Panel

All controls (push button switches) and LED indicators are located on the front panel of FOM-20. Front panel indicators and controls are described in greater detail in *Chapter 3, Operation*.

Rear Panel

All input/output connectors and power connections are accessed on the rear panel of FOM-20. The AC power connector has an integrated fuse holder. The correct rating of the replaceable fuse is printed on the rear panel of FOM-20. FOM-20's rear panel is described in greater detail in *Chapter 2, Installation*.

1.3 Functional Description

General

This section describes the functional circuitry of the FOM-20 fiber-optic modem (see *Figure 1-4*). FOM-20 uses an infrared light emitting diode or a laser, to convert electrical signals into optical signals. The optical signal is converted back into an electrical signal in compliance with the appropriate interface on the receive end.

Interface

Six DTE interface options are available: RS-232/V.24 (up to 64 kbps), V.35, built-in Ethernet bridge, RS-530, X.21B and G.703 (64 kbps codirectional). Connection to an RS-449/V.36 interface is accomplished via the RS-530 interface (see *Appendix D*).

Timing

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

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

FOM-20 utilizes a phase locked loop (PLL) circuit to recover jitter-free data and clock sync from the optical signal.

X.21B Buffer (for X.21B Interface)

An external clock input is available for the X.21B interface by using pins on the DB-15 connector (pins 7 and 14).

To allow for the tail-end connection of an X-21B interface, a buffer is provided on the received data.

When FOM-20 works in external clock mode (EXT), jumper X.21B EX.CK is set to EXT. When internal (INT) or receive (RCV) clock mode is chosen, the X.21B jumper is set to INT.

Async-to-Sync Converter

FOM-20 has an internal Async-to-Sync converter. Asynchronous transmission is handled by the internal conversion of the data signal from asynchronous to synchronous (in compliance with ITU V.22 bis). For this standard, the modem compensates for any frequency deviation between the modem and the DTE by adjusting the length of the stop bit of the async character.

The operation mode of the Async-to-Sync converter is chosen by setting the proper character length and frequency deviation (via dipswitch bank).

Diagnostics

Built-in diagnostics (complying with the V.54 standard) enable digital loopback, remote and local analog loopback. Diagnostics are activated either from the front panel push buttons or via the DTE interface. The push buttons and the DTE interface are enabled (or disabled) by the SW EN, REM and ANA straps on the printed board.

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.

Tests can be carried out from the remote FOM-20 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.

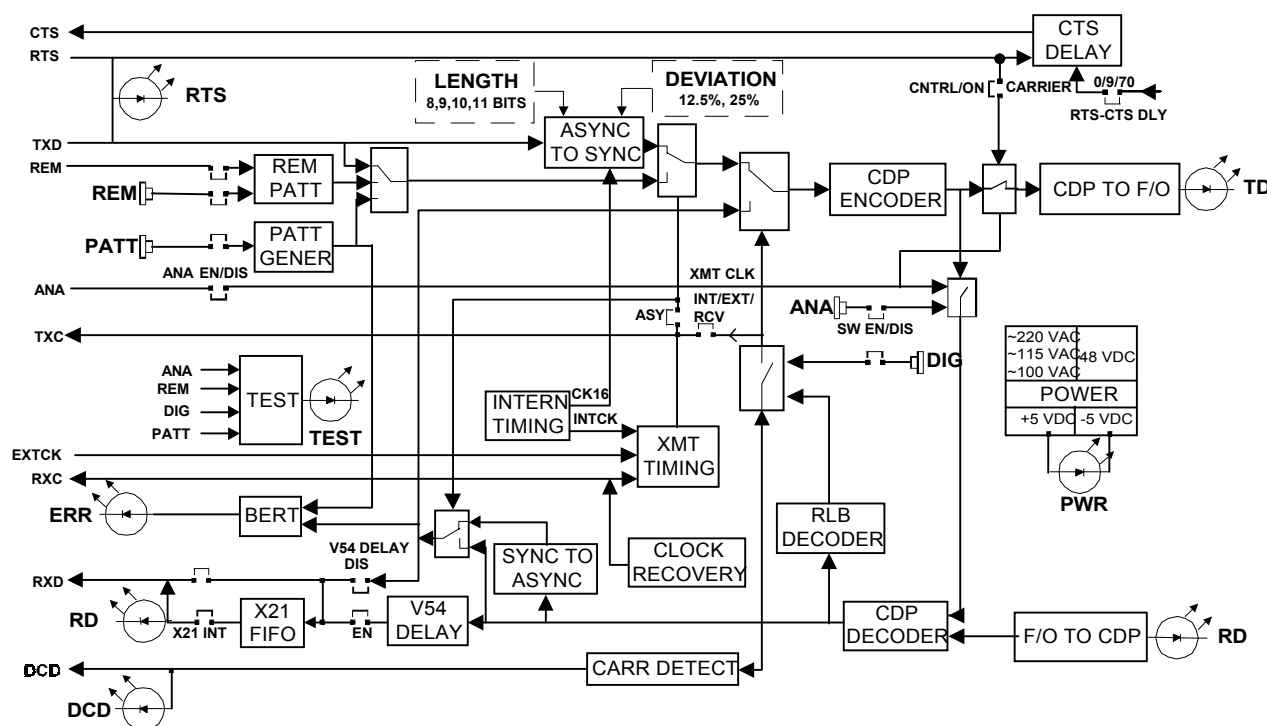


Figure 1-5 FOM-20 Block Diagram

1.4 Technical Specifications

Electrical Interface	<i>Transmission Rates:</i>	
	<i>Asynchronous</i>	19.2, 28.8, 38.4, 57.6, and 115.2 kbps
	<i>Synchronous</i>	19.2, 32, 48, 56, 64, 72, 96, 112, 128, 144, 192, and 256 kbps
	<i>Connectors</i>	V.24 via 25-pin D-type, female V.35 via 34-pin, female V.36/RS-449 via 37-pin D-type node using a cable adapter RS-530 via 25-pin D-type, female X.21B via 15-pin D-type, female Built-in Ethernet bridge via RJ-45 (10BT) or BNC (C10-32) connectors G.703 Codirectional via terminal block or RJ-45 connector
Optical Interface	<i>Operating Wavelength</i>	850 nm for multimode fiber 1300 nm for single mode fiber 1300 nm for single mode fiber using laser diode (for extended range) 1550 nm for single mode fiber using laser diode (for extended range)
	<i>Transmission Line</i>	Dual fiber optic cable
	<i>Budget (Max)</i>	-18 dBm for 850 nm; 62.5/125 fiber -18 dBm for 1300 nm; 9/125, 62.5/125 (LED) fiber -13 dBm for laser diode; (1300/1550 nm) 9/125 fiber
	<i>Receiver Sensitivity</i>	-48 dBm for 850 nm (LED) -50 dBm for 1300 and 1550 nm (laser diode)
	<i>Dynamic Range</i>	36 dB
Note	<i>The ranges specified above were calculated according to the following typical attenuation rates (with a 3 dBm margin):</i>	
	<i>3.5 dB/km for 850 nm multimode</i>	
	<i>0.4 dB/km for 1300 nm single mode</i>	
	<i>0.25 dB/km for 1550 nm single mode.</i>	
	<i>Connectors</i>	SMA, ST, SC or FC-PC
	<i>Transmitter</i>	LED or laser
	<i>Maximum Range</i>	850 nm (multimode) up to 7 km 1300 nm (Single mode - LED) up to 70 km 1300 nm (Single mode - laser diode) up to 85 km 1550 nm (Single mode - laser diode) up to 140 km

Diagnostics	<i>Digital Loopback</i>	Local - activated by front panel switch (DIG) Remote - activated by front panel switch (REM) or by the DTE interface signals (V.35/RS-530 and V.24/RS-232)
	<i>Analog Loopback</i>	Local - activated by front panel switch (ANA) or by DTE interface signal (excluding X.21B and G.703)
	<i>Test Pattern</i>	Activated by front panel switch (PATT)
Timing Elements	<i>Receive Clock</i>	Derived from the Receive signal
	<i>Transmit Clock</i>	Derived from three alternative sources: 1. Internal oscillator (INT) 2. External - from the DTE (EXT) 3. Received from receive signal, looped back as transmit clock (RCV)
Indicators	<i>TD</i>	Transmit Data
	<i>RD</i>	Receive Data
	<i>RTS</i>	Request to Send
	<i>DCD</i>	Data Carrier Detect
	<i>ERR BER</i>	Test Error
	<i>PWR</i>	Power
	<i>TEST</i>	Loopback mode or BER
Power Supply	<i>Voltage</i>	100, 115 or 230 VAC ($\pm 10\%$), or 48 VDC ($\pm 20\%$),
	<i>AC Frequency</i>	47 to 63 Hz
	<i>Power</i>	5 VA
Physical	<i>FOM-20 Standalone</i>	Height: 4.4 cm / 1.7 in Width: 24 cm / 9.6 in Depth: 19.3 cm / 7.6 in Weight: 1.4 kg / 3.1 lb
	<i>FOM-20/R Rack-Mount Card</i>	Dimensions to fit ASM-MN-214 Rack Weight 360 g / 0.1 lb
Environment	<i>Temperature</i>	0-50°C / 32-122°F
	<i>Humidity</i>	Up to 90%, non-condensing

Chapter 2

Installation and Setup

This chapter provides mechanical and electrical installation procedures for FOM-20. If a problem is encountered, refer to *Chapter 4* for troubleshooting instructions.

FOM-20 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-inch rack, refer to the *Rack Mounting Kit for 19-inch Racks* guide that comes with the RM kit.

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



Warning

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

HIGH VOLTAGE - Any adjustment, maintenance, and repair of the opened instrument under voltage should be thoroughly avoided and should be carried out only by an experienced technician who is aware of the hazard involved. Capacitors inside the instrument may remain charged even after the instrument has been disconnected from its power supply.

2.1 Site Requirements and Prerequisites

Power

AC-powered FOM-20 units should be installed within 1.5m (5 ft) of an easily accessible, grounded AC outlet capable of furnishing the required supply voltage of the unit (100, 115, 230 VAC).

In order to prevent a fire hazard, the (negative) supply line must contain a suitable fuse or a circuit breaker.

DC-powered FOM-20 units require a -48 VDC power source which must be adequately isolated from the mains supply.

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.

Ambient Requirements

The ambient operating temperature of FOM-20 is 0-50°C (32-122°F) at a relative humidity of up to 90%, non-condensing.

2.2 Package Contents

FOM-20

The package of the standalone FOM-20 modem includes:

AC version:

- FOM-20 unit
- AC power cord
- FOM-20 Installation and Operation Manual

DC version:

- FOM-20 unit (protected by adequate cushioning)
- DC power supply connector kit
- FOM-20 Installation and Operation Manual

FOM-20/R

The package of the card version of the FOM-20 modem includes:

- FOM-20/R
- FOM-20 Installation and Operation Manual

If any part is missing or defective, notify your RAD technical support representative.

2.3 Installation and Setup

Perform the following steps to correctly install the FOM-20:

For mounting the FOM-20/R (Card version) in an equipment rack, follow the instructions in *Chapter 5, Card Cage Version*.

Setting the Internal Jumpers and Switches

Before installing the FOM-20, set the jumpers/switches according to the intended configuration. The jumper/switch locations are shown on the board layout diagram, as shown in *Figure 2-1* and are listed in *Table 2-1*.



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-20 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 disconnected from its power supply source.

➤ **To open the FOM-20 case:**

1. Disconnect the power cord from the mains outlet.
2. Release the two rear panel screws and use them as levers to slide out the PCB interior of the unit.

➤ **To set switches and jumpers:**

1. Identify the switches according to the configuration diagram (*Figure 2-1*) (for FOM-20/R refer to *Figure 5-4* in *Chapter 5*).
2. Set the switches for the desired operation (see *Table 2-1*).
3. Replace the FOM-20 PCB interior.

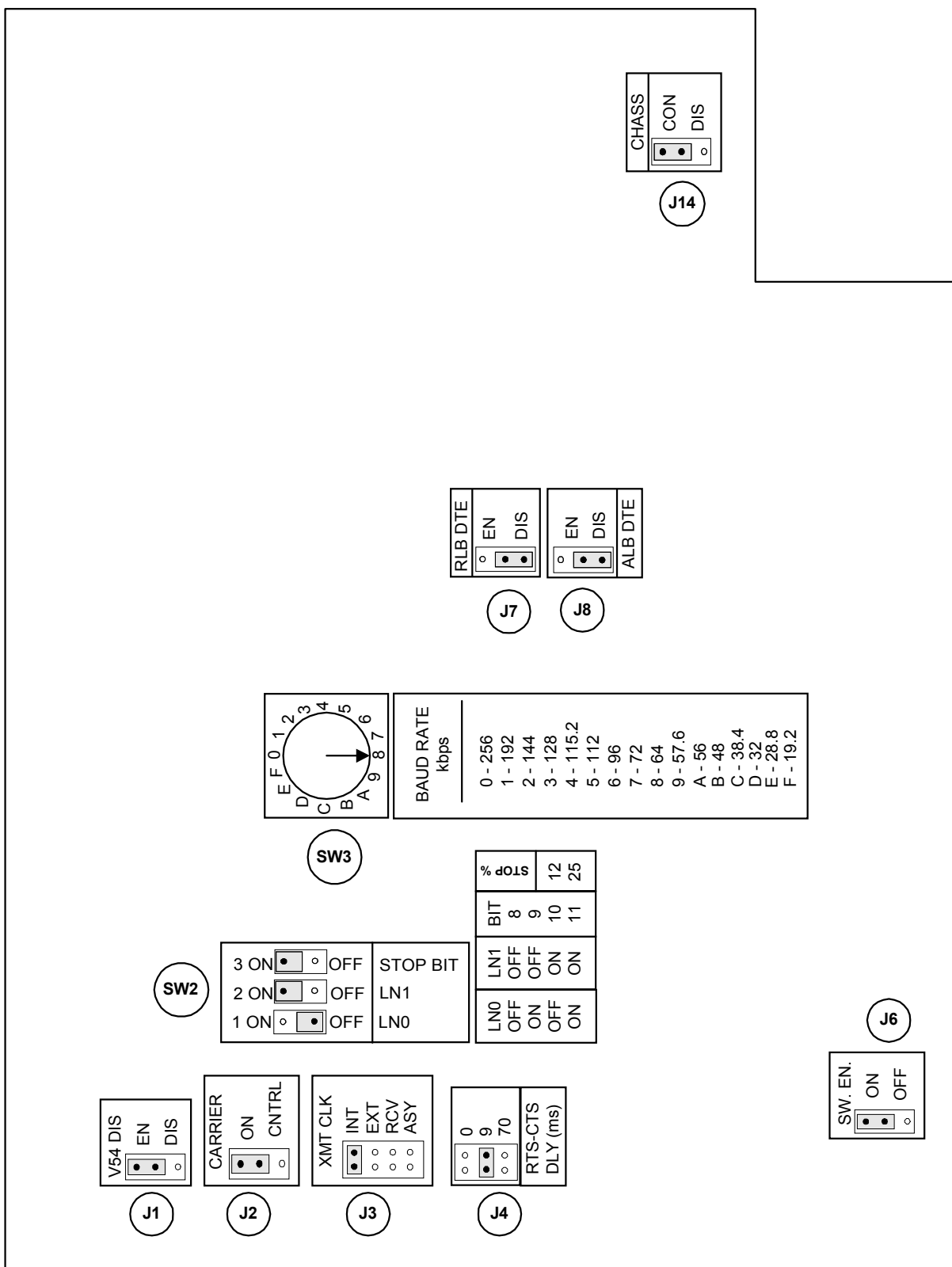


Figure 2-1 FOM-20 Main Board Layout

Table 2-1 FOM-20 Strap Selection

Strap Identity	Function	Possible Settings	Factory Setting
J1 V54 DIS	Enables or disables DIG.LOOP from remote pattern	EN DIS	EN
J2 CARRIER	Selects the transmit carrier mode. When "ON", transmit carrier is constantly "ON". When "CNT", transmit carrier is "ON" only when RTS is high.	ON CNTRL	ON
J3 XMT CLK	Selects the transmit timing signal from either: internal clock, external clock or receive clock.*	EXT INT RCV ASY	INT
J4 RTS-CTS DLY (ms)	Selects the delay time (in ms) between RTS and CTS.	0 9 70	9 ms
J6 SW EN	Enables activation of PATT, REM, ANA, DIG push buttons on the front panel	ON OFF	ON
J7 RLB DTE	Enables RLB test from the DTE interface pins.	EN DIS	DIS
J8 ALB DTE	Enables LLB test from the DTE interface pins.	EN DIS	DIS
J14 CHASS (Chassis Ground)	In CON position, signal ground is connected to chassis ground. In DIS position, the signal ground is isolated from the chassis ground.	CON DIS	CON
SW3 BAUD RATE (kbps)	Selects the data rate.	19.2, 28.8, 32, 38.4, 48, 56, 57.6, 64, 72, 96, 112, 115.2, 128, 144, 192, 256	64
In asynchronous operation (refer to Table 2-2 for async characters length settings):			
SW2 LN0, LN1	Selects the character length	8 bit 10 bit 9 bit 11 bit	10 bit
SW2 STOP BIT	Selects the frequency deviation setting	12 25	12

* When two FOM-20 modems are used, one modem should be configured as RCV clock and the other as INT or EXT clock.

Table 2-2 Async Character Length Setting

Start Bit	Data Bits	Parity	Stop Bit	No. of Bits
1	5	NONE	2	8
1	6	NONE	1, 1.5, 2	8 9
1	6	ODD, EVEN	1, 1.5, 2	9 10
1	7	NONE	1, 1.5, 2	9 10
1	7	ODD, EVEN	1, 1.5, 2	10 11
1	8	NONE	1, 1.5, 2	10 11
1	8	ODD, EVEN	1, 1.5, 2	11

► **To return FOM-20 to its case:**

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

Connecting the Interfaces

Figure 2-2 shows rear panels of FOM-20 standalone unit. The rear panel of the FOM-20/Standalone contains an AC, or DC, input power connector; a DTE interface connector; and TX and RX fiber optic connectors.

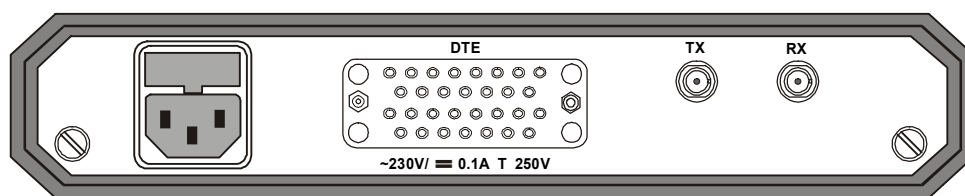


Figure 2-2 FOM-20/Standalone Rear Panel (AC-Powered Version)

Connecting the Fiber Optic Cables

Two fiber optic 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 DTE

Note

RAD recommends using a shielded twisted pair cable between FOM-20 and the DTE (mainly for higher frequencies). The line receivers in FOM-20 are 100 Ω terminated (for X.21B and RS-530).

For all DTE interface connections except G.703:

- Press the end of the connector into the DTE interface connection on FOM-20.

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

On the FOM-20/Standalone - G.703 version, connect the data wires to the terminal block.

1. Strip off about 1 cm of insulation from the wire end 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



Warning

To connect the power to FOM-20, refer to the appropriate section below, depending on your version of the unit (DC or AC).

The unit has no power switch. Operation starts when power is applied to the rear panel POWER connector. When applying power, first connect the plug of the power cord to the FOM-20 POWER connector and then to the mains power source (outlet).



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. Only use an extension cord (power cord) with a protective conductor (grounding).

Replace fuses only with fuses of the same current and voltage rating as indicated on the unit. Do not short-circuit fuse holders. Whenever it is likely that the protection offered by fuses has been impaired, the instrument must be made inoperative and secured against any unintended operation.

For your protection, FOM-20 must always be grounded. Any interruption of the protective (grounding) conductor (inside or outside the instrument) or disconnection of the protective earth terminal can render this instrument dangerous. Intentional interruption is prohibited.

AC Power Connection

AC power should be supplied to FOM-20 through the 5 ft (1.5m) 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-20:**

- Connect the power cable to the connector on the FOM-20 rear panel and then to the mains outlet.

The unit turns on automatically upon connection to the mains.

DC Power Connection

➤ **To connect DC power to FOM-20:**

- Refer to *DC Power Supply Connection Supplement*.

Chapter 3

Operation

This chapter:

- Describes the FOM-20 modem controls and indicators and their functions.
- Explains how to operate the FOM-20.

3.1 General

This chapter describes FOM-20 controls and indicators and their functions, explains the operating procedures, and supplies instructions for making changes in field strapping. All of the installation procedures given in *Chapter 2* must be completed and checked before attempting to operate FOM-20.

3.2 Front Panel Controls and Indicators

All pushbutton switches and LED indicators are located on the FOM-20 front panel, as seen in *Figure 3-1*. Their functions are described in *Table 3-1*. The numbers under the heading "Item No." in the table correspond to the identification numbers shown in the figure.

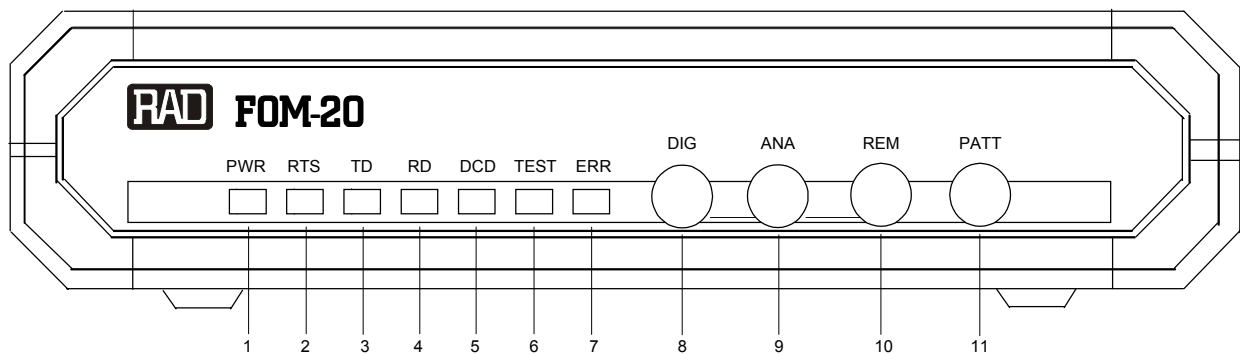


Figure 3-1 FOM-20 Front Panel

Table 3-1 FOM-20 Front Panel, Controls and Indicators

Item No.	Name	Type	Function
1	PWR	Green LED	On when the Power is on.
2	RTS	Yellow LED	On when the terminal activates Request to Send.
			Note: <i>The CARRIER jumper should be set to ON; if set to CNTRL, the RTS signal should be high.</i>
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 being received.
5	DCD	Yellow LED	On when a valid receive signal is present.
6	TEST	Red LED	On when the FOM-20 is in a loopback mode or when the PATT switch is pressed.
7	ERR	Red LED	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 switch causes the local FOM-20 to loop the received data back to its transmitter (see <i>Figure 4-3</i>).
9	ANA	Push button	The ANA (Analog) loopback (V.54 Loop 3) switch causes the local FOM-20 to loop its transmitter output back to its receiver (see <i>Figure 4-1</i>). 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) switch causes the remote FOM-20 to loop received data and clock signal back to its transmitter (see <i>Figure 4-2</i>). This loopback may also be activated from the DTE when the RLB strap is set to EN.
11	PATT	Push button	The PATT (Pattern) switch causes FOM-20 to send and receive a 511 test pattern. If errors are encountered, the ERROR LED lights up or blinks.

3.3 Initial Operation and Basic Checks

Power-on Procedure

FOM-20 is turned on as soon as power is connected. When power is connected, the POWER indicator lights up and remains lit as long as FOM-20 receives power.

Note

Check first that none of the front panel pushbuttons are pressed (down).

Running Self Test

➤ Verify that FOM-20 is functioning properly by running the following tests.

1. Press the ANA switch on the front panel to the On position (down).
2. Press the PATT pushbutton. Check that the:
 - DCD lamp lights up
 - TEST lamp lights up
 - RD lamp turns off
 - ERR lamp 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 BER Test

➤ To check the link between the two DTEs:

- Press the **PATT** pushbutton on the front panel of FOM-20.

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

3.4 Operating Instructions

FOM-20 operates unattended after installation. For more information, see *Chapter 2, Installation*.

Operator intervention is required when either:

- FOM-20 must be adapted for a new operating mode.
- Diagnostic loops are required.

Changing Field Strapping

If it is necessary to reconfigure FOM-20 for a different mode of operation, follow the procedures described in *Chapter 2, Installation*, for changing jumper/switch settings.

Running Diagnostic Loops

Refer to *Chapter 4, Troubleshooting and Diagnostics* for more information on running diagnostic loops.

Power-off Procedure

To power down FOM-20, remove the AC or DC power cord from the AC or DC mains supply.

Chapter 4

Troubleshooting & Diagnostics

This chapter contains:

- Description of the ITU V.54 diagnostic capabilities for performing local analog loopbacks and local and remote digital loopbacks.
- Description of the 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-20 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-20 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-20 supports several types of tests for evaluating the operation of the data equipment, FOM-20 and its line circuits.

- Loopbacks: test the communication between the data equipment and the internal circuitry of both local and remote modems.
- BERT circuit: consist 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-20 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-20. For a description of the FOM-20 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-20, 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*).

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 to indicate that the FOM-20 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.

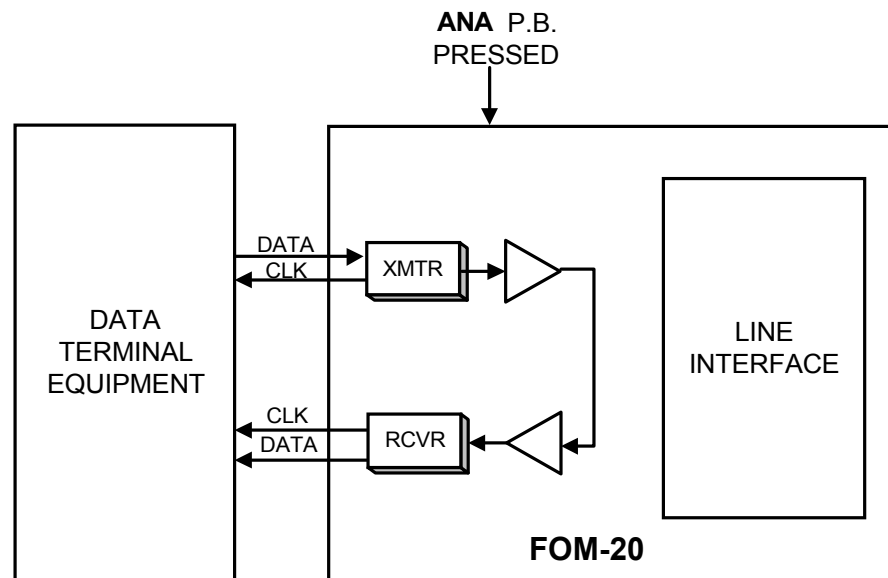


Figure 4-1 Local FOM-20 in Analog Loopback (LLB)

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-20 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-20 units as well as their interconnecting lines. The Remote Digital Loopback sets a loop at the remote FOM-20 modem from the terminal coupled to the local unit (see *Figure 4-2*).

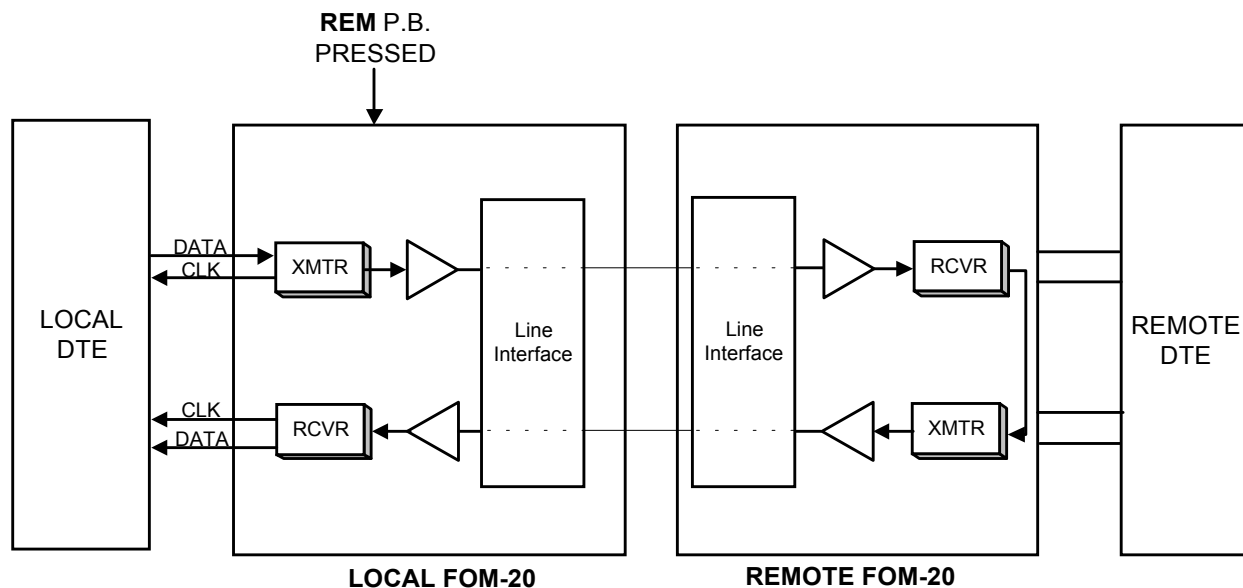


Figure 4-2 FOM-20 in Remote Digital Loopback (RLB)

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-20, 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-20 units and the communication link.

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-20.

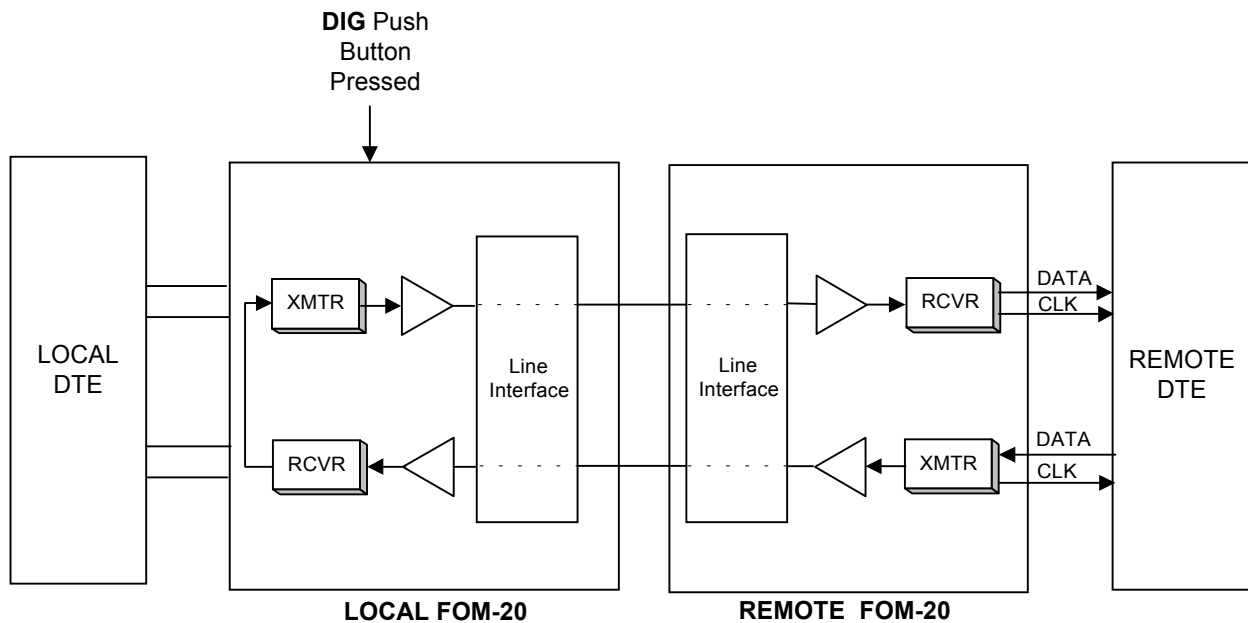


Figure 4-3 Activation of RLB at the Remote Modem (Local FOM-20 in a Digital Loopback)

4.3 Internal BERT Circuit Test

FOM-20 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, psuedo-random pattern.

The pattern transmitted by the BERT can be received by another FOM-20 modem (a two-BERT test) or looped back to the BERT for comparison (modem self-test).

When used opposite another FOM-20, 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 test, proceed as follows:

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-20 unit is faulty and should be replaced. If the test executes correctly, restore all push buttons and jumpers to their normal position.

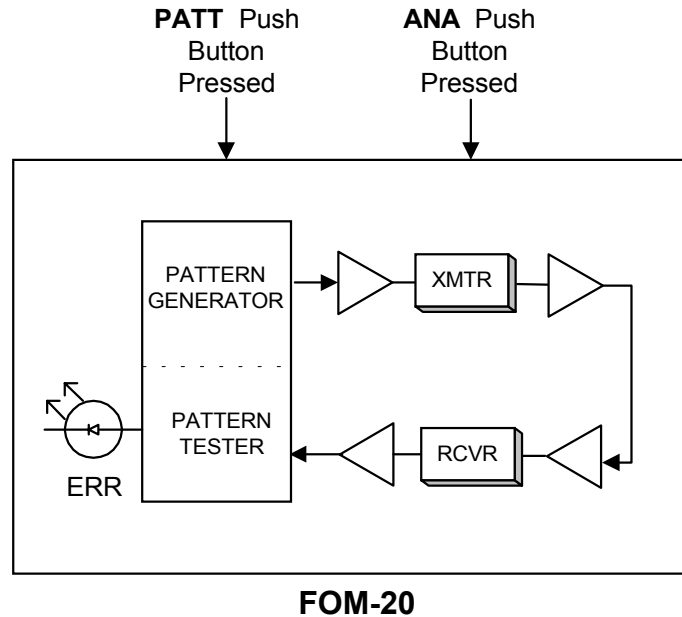


Figure 4-4 FOM-20 Self-Test

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 SQ LED will go Off (for continuous errors) or blink (for intermittent errors).

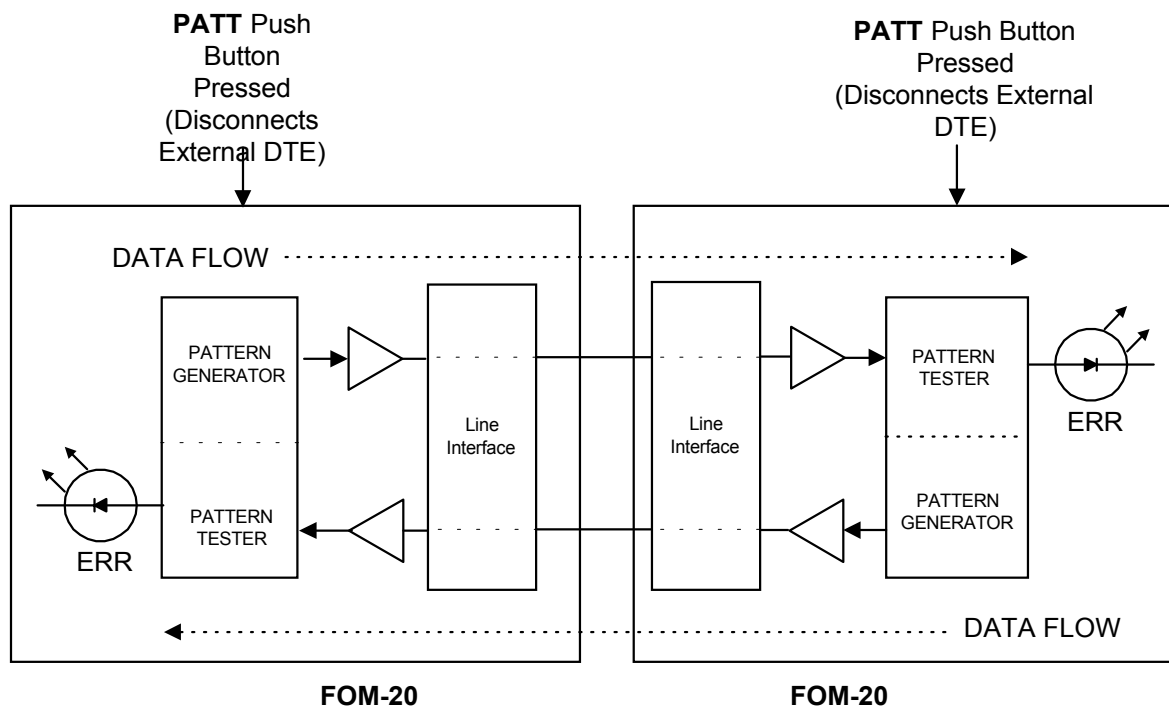


Figure 4-5 FOM-20 BER System Test (Two-BERT Test)

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.

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-20 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-20.

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-20 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-20 functions as if it is in "Loss-of-Signal State", which is DCD "OFF" and RX data "OFF" or "MARK".

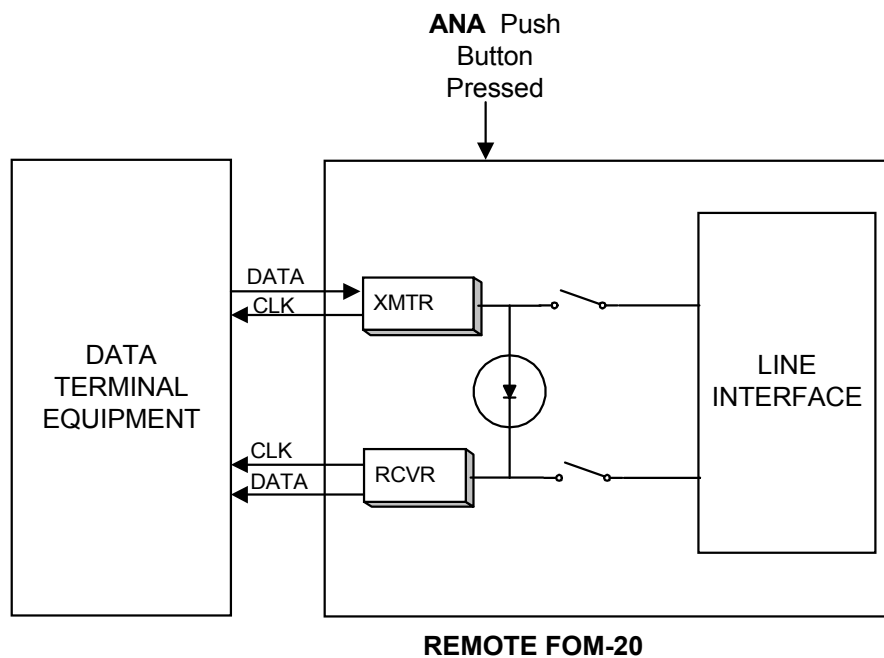


Figure 4-6 Local Analog Loopback

4.5 Communication Link Test

Remote Digital Loopback

The remote digital loopback test determines the performance of both the local and remote FOM-20, and the quality of the link between the local and remote units.

1. Press the REM push button on the front panel to provide a loopback at the remote FOM-20 (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-20. (This test is equivalent to activating remote loopback from the remote FOM-20, as seen in *Figure 4-7*). The operator at the remote end can determine the performance of the local and remote FOM-20 units and of the links between them.

► To activate this test, press the **DIG** push button on the front panel.

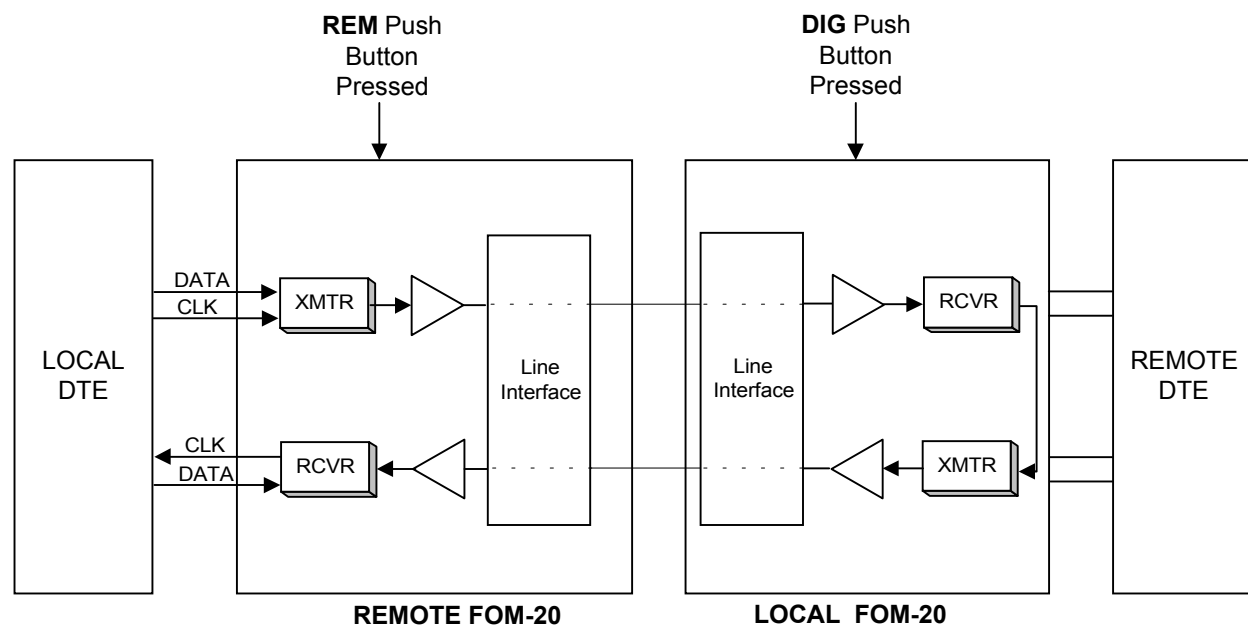


Figure 4-7 Local FOM-20 in Digital Loopback

4.6 Troubleshooting Instructions

Problem

When a FOM-20 unit is powered up and its RCV fiber optic connector is exposed (cap is removed and fiber optic line is not connected), the DCD and RD indicators may flicker.

Solution

The flickering may occur due to the high sensitivity of the modem's receive circuits. Connect FOM-20 to the fiber optic line or replace the RCV connector cap.

Chapter 5

Card Cage Version

This chapter:

- Gives a description of the ASM-MN-214 card cage and power supplies.
- Describes the FOM-20/R - card version.
- Explains how to install the FOM-20 in the ASM-MN-214 card cage and operate the unit.

5.1 ASM-MN-214 Card Cage

The ASM-MN-214 card cage holds up to 14 plug-in cards and one or two power supplies. The card types can be the FOM-20/R or other RAD rack version modems (any combination of up to 14 plug-in cards). On the rear panel, behind each card mounting slot (see *Figure 5-1*) is a snap-on connector five-screw terminal block and a DB-25 connector.

The terminal block contains screws to connect the transmit and receive fiber optic pairs (and ground, if present). The transmit pair is connected to the terminal marked XMT, the receive pair - to the terminal marked RCV. The fifth screw is a terminal for an optional ground connection.

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*.

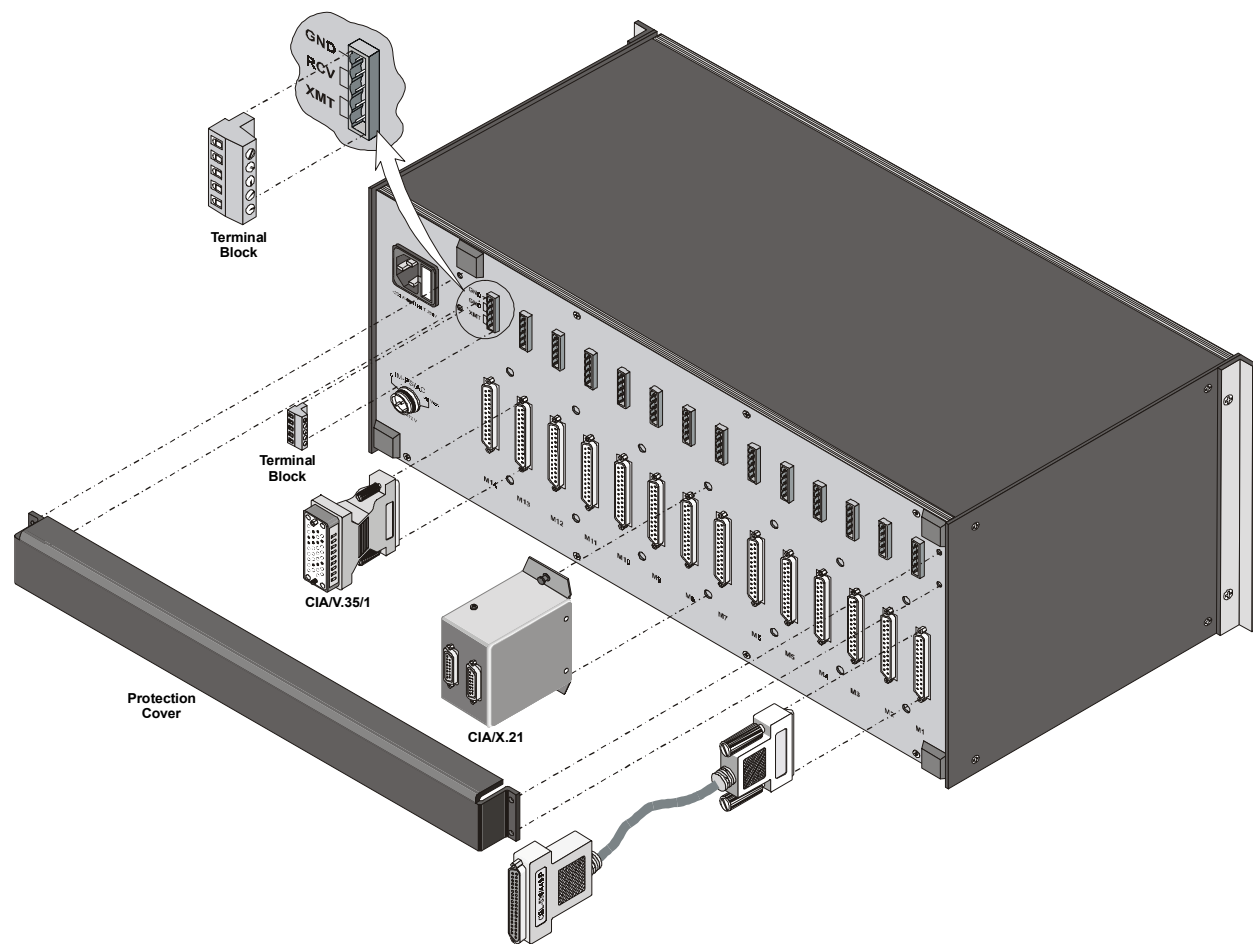


Figure 5-1 ASM-MN-214 Cage, Rear View

5.2 FOM-20/R Card Version

The FOM-20/R is a rack version of the FOM-20. LED indicators and test switches are conveniently located on the front panel, as shown in *Figure 5-2*, enabling simple fiber optic connections and easily-accessible LED indicators and switches.

Chapter 2 explains how to configure the FOM-20 jumpers. *Chapter 3* gives information on how to operate the FOM-20 card version.

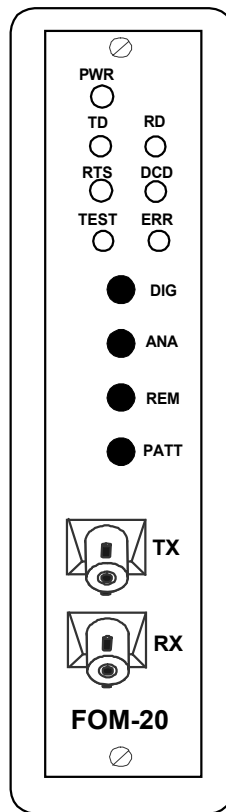


Figure 5-2 FOM-20/R, Front Panel Features

5.3 Power Supply

The ASM-MN-214 card cage can accommodate both AC and DC power supplies. A LED indicator located on the front panel of the ASM-MN-214 (see Figure 5-3) show when each power supply is operating. The power supply can support a full set of 14 cards, in any combination.

The FOM-20/R card is powered from the power supply via the ASM-MN-214 chassis. Each FOM-20/R card has two fuses to protect the system against power failure due to a short circuit in any card.

Note *An AC and a DC power supply can be used together in the same cage.*

AC Supply (100, 115 or 230 VAC)

The AC power supply of the ASN-MN-214 accepts 100, 115 or 230 VAC, $\pm 10\%$ (47 to 63 Hz) input AC current.

DC Supply (-48 VDC)

The DC power supply accepts from -36 to -72 VDC at its input. It uses a DC/DC converter module to supply the DC output power required for the cards.

Power Supply with Redundancy

This special ordering option gives the card cage two separate power supplies, which operate together to share the load of the entire card cage. If either power supplies fail, the other continues supplying DC power to drive the cards. A LED indicator on each power supply shows when mains power is provided.

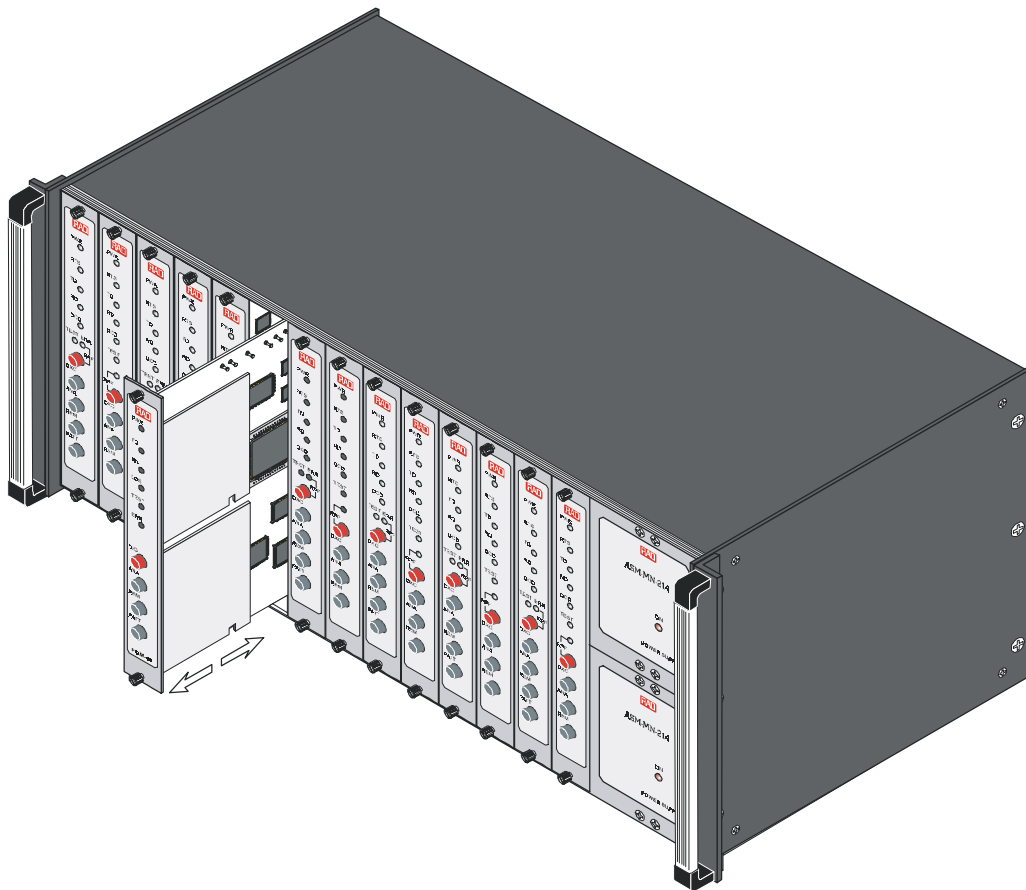


Figure 5-3 ASM-MN-214 Front Panel

5.4 Installation

Jumper Settings

Follow the jumper setup procedures listed in *Table 2.1* (see *Figure 5-4* for the FOM-20/R card layout diagram).

Mechanical Installation

After the ASM-MN-214 has been installed in the 19" equipment rack, insert each FOM-20/R card (or other modem type) into the card cage. Push the bottom of each card firmly into the rack to ensure that it makes contact with the edge connector inside the rack, and then tighten the screws on the top and on the bottom of each card.

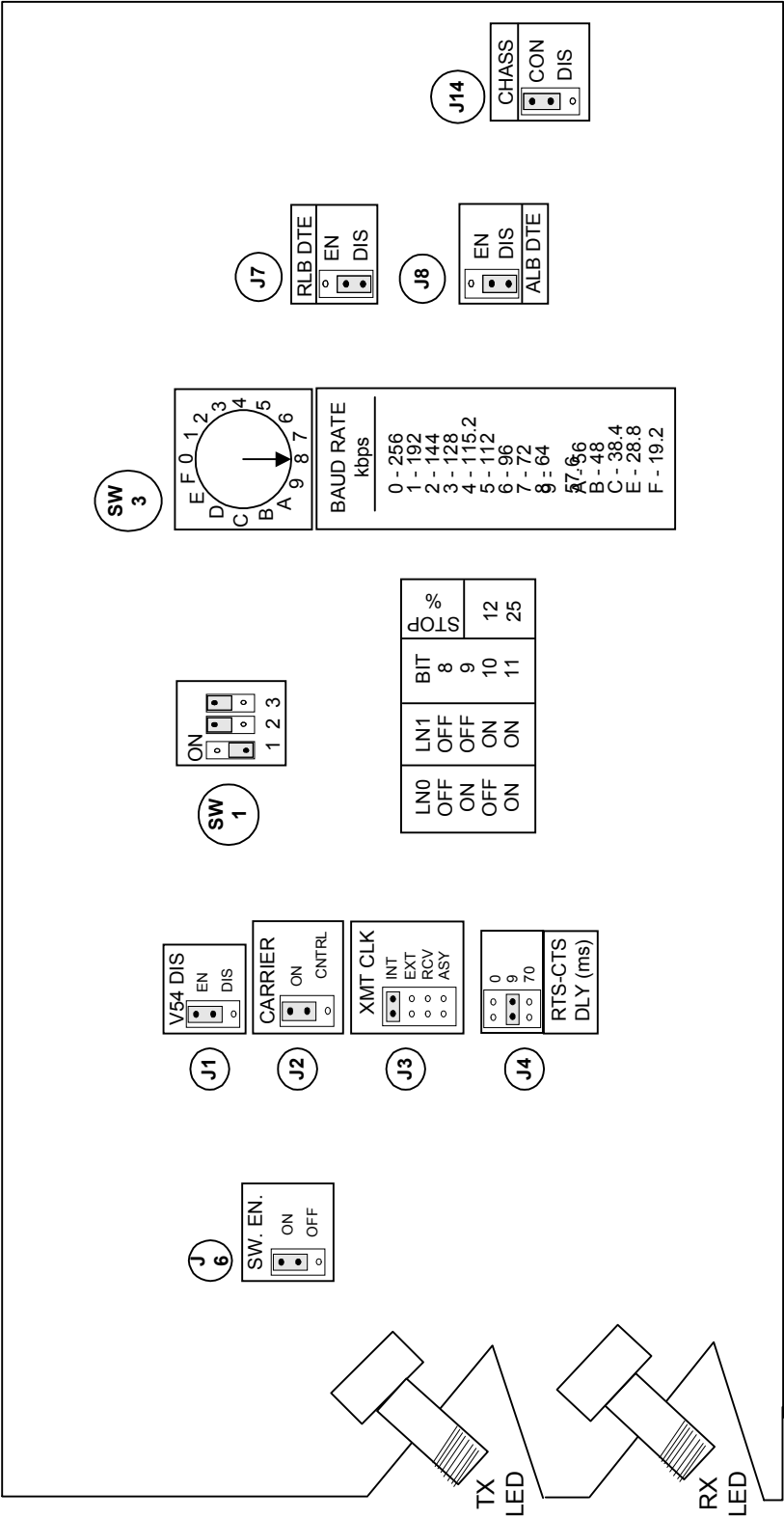


Figure 5-4 FOM-20/R Card, Layout Diagram

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.

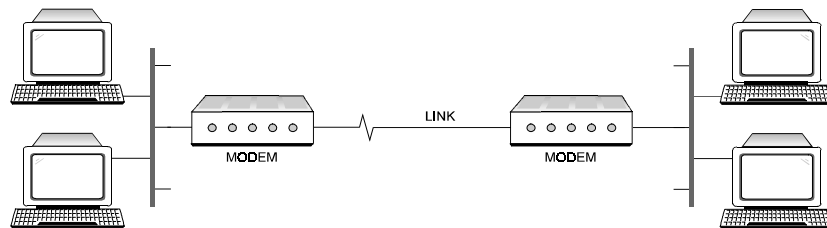


Figure A-1 Ethernet Interface Typical Application

A.2 IR-ETH Connector Options

Figures A-2 and A-3 show the rear panel of FOM-20 with the IR-ETH connector options. The IR-ETH connector for the FOM-20/R card (rack-mount version) is shown in Figure A-4.

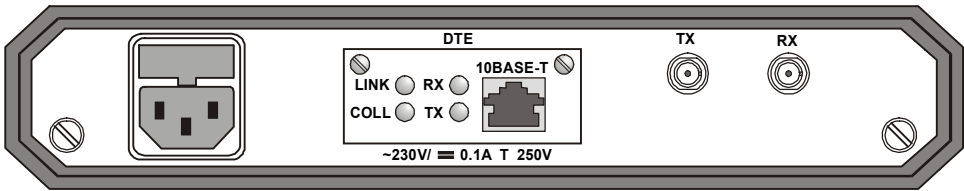


Figure A-2 FOM-20 Rear Panel with IR-ETH/UTP Connector Option

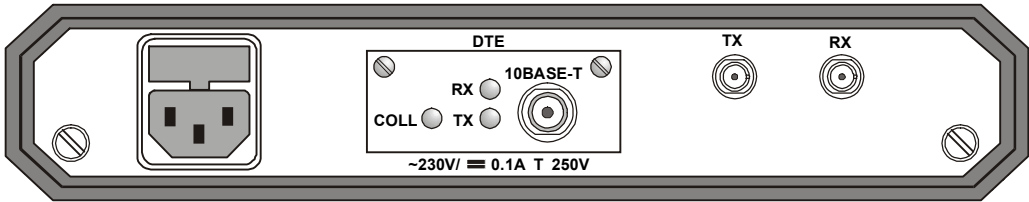


Figure A-3 FOM-20 Rear Panel with IR-ETH/BNC Connector Option

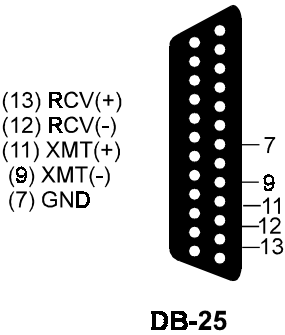


Figure A-4 IR-ETH Connector for the FOM-20 Rack-Mount Version

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
GND	7	

A.3 Ethernet Bridge Specifications

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

A.4 Installation and Operation

Figures A-5 and 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.

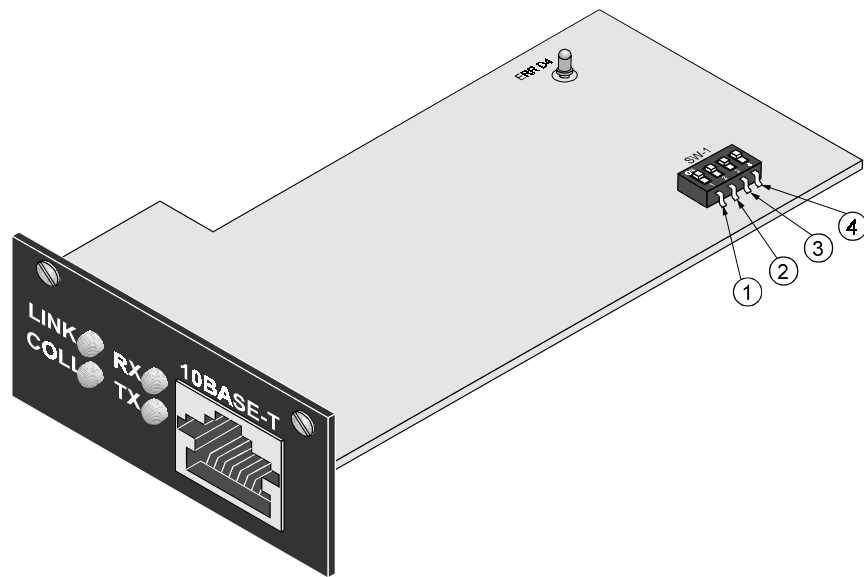


Figure A-5 Ethernet Bridge Layout (UTP Option)

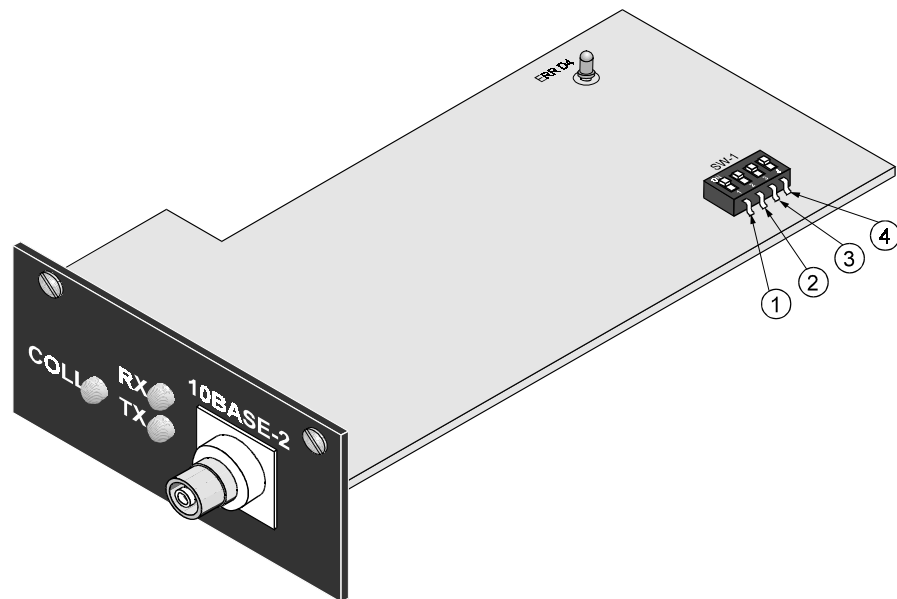


Figure A-6 Ethernet Bridge Layout (BNC Option)

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

Appendix B

G.703 Interface (64 kbps)

B.1 General

The IR-G.703 is an interface module for RAD modems used to convert 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 two versions:

- **Standalone version** – fits into a standalone modem and is available with two types of physical connections: a terminal block or an RJ-45 connector (see *Ordering Options*).
- **Rack version** – mounts in the rack and uses the edge connector for communication interface. The edge connector is hard-wired on the motherboard of the card cage to the DB-25 connector on the back plane of the card cage. Figure B-1 shows the rear panel of the FOM-20 with the IR-G.703 option. Figure B-2 illustrates the pinout of the different connectors.

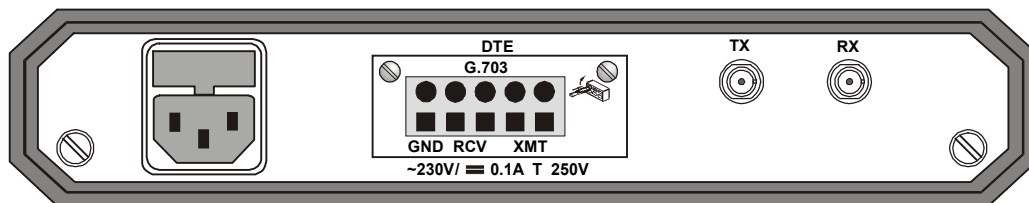


Figure B-1 FOM-20/Stand-alone, Rear Panel with G.703 Terminal Block

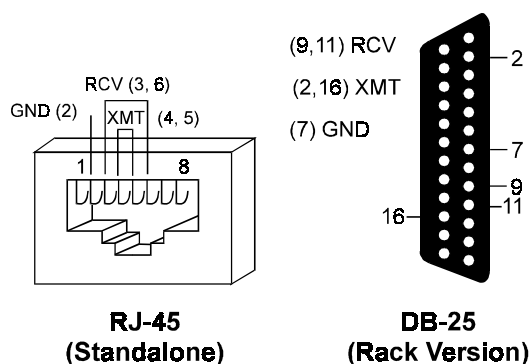


Figure B-2 IR G.703 Connector Options

Note In Figure B-2, RCV refers to the input signals to the IR module; XMT refers to the output signals from the module.

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.

Note The G.703 interface strapping should be done according to the clock mode. For example, if the modem is in EXT mode, then JP1 should be set to the EXT position.

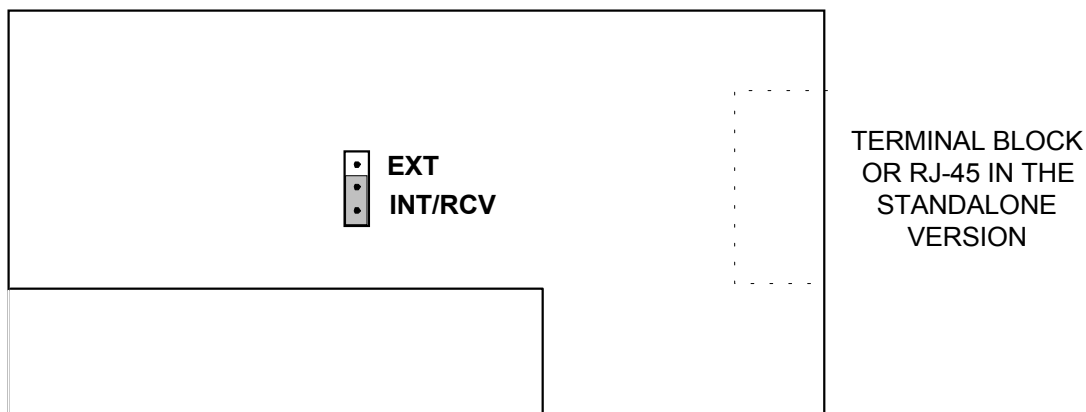


Figure B-3 Strap-Selectable Operation Modes (using Jumper JP1)

B.2 EXT Mode

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

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

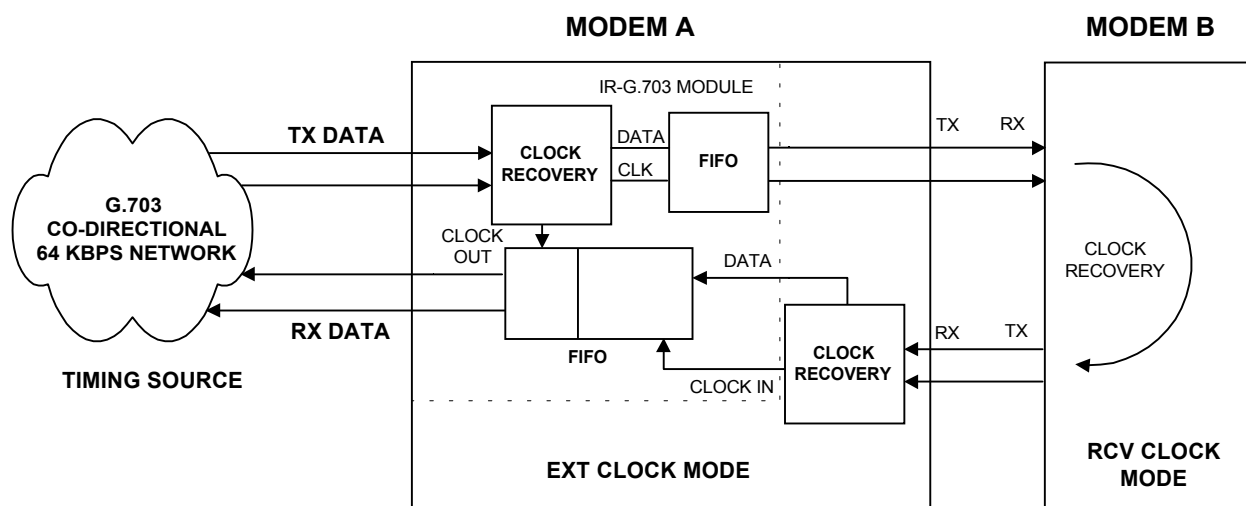


Figure B-4 EXT Mode Timing Block

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 operation mode is used mainly when the attached equipment has a G.703 codirectional interface, but is unable to produce clock signals. The module has an 8-bit FIFO buffer to compensate for any 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/RCV mode. Additional clock modes are available provided that either the clock source is MODEM B or the clock is recovered by MODEM B from the DTE side.

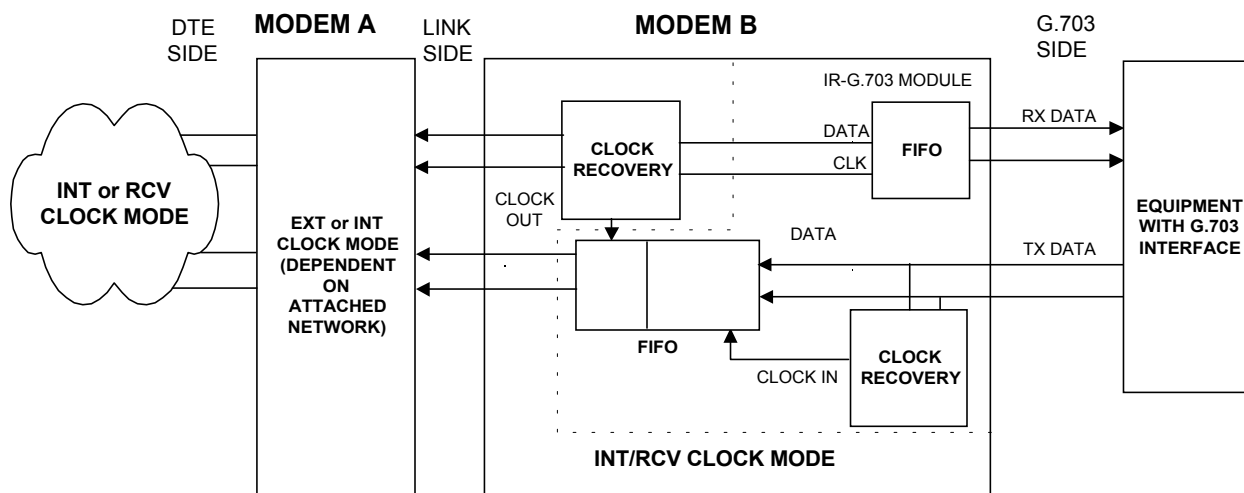


Figure B-5 INT/RCV Mode Timing Block

Appendix C

X.21B Interface

C.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 C-1 shows a typical application of the FOM-20 standalone modem with the IR-X.21B interface module.

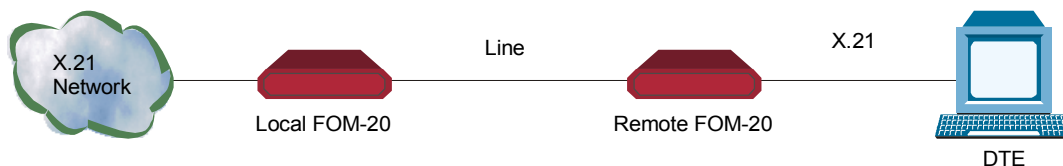


Figure C-1 Typical FOM-20 X.21B Application

C.2 X.21B Connector

Figure C-2 shows the rear panel of a standalone FOM-20 with the X.21B connector option.

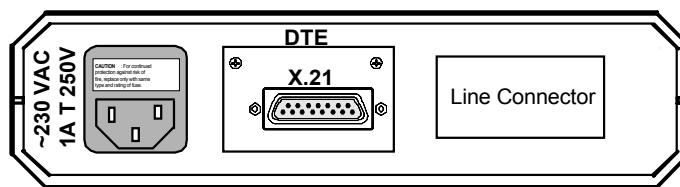


Figure C-2 FOM-20 Rear Panel with X.21B Connector

The FOM-20 modem rack version requires an additional adapter to connect between the DB-15 connector (on the X.21B equipment) to the DB-25 connector (on the 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 C-1 shows the X.21B DB-15 connector pin assignment.

Table C-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

C.3 IR-X.21B Interface Module

The IR-X.21B interface module layout is shown in *Figure C-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 C.4*. The INT/RCV mode is described in *Section C.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.*

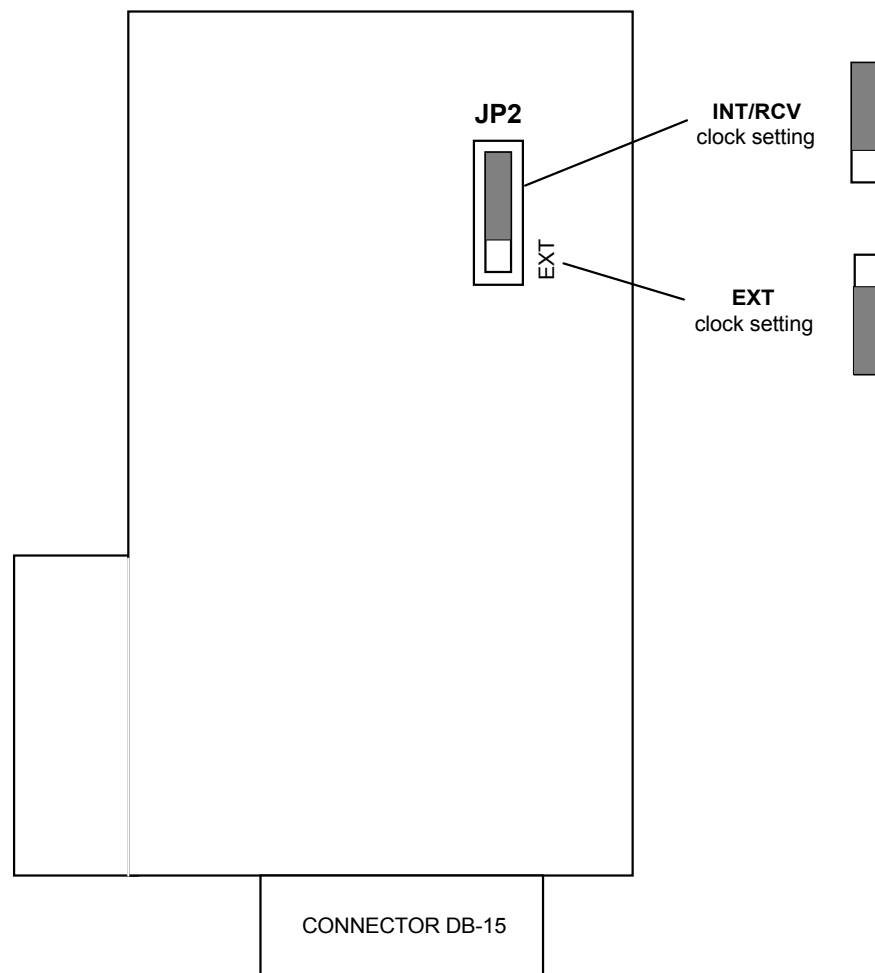


Figure C-3 Jumper JP2 Location in the IR-X.21B Interface Module

C.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 has an internal buffer to compensate for phase delay produced in the system by the delay between the two modem lines. The buffer is a 16-bit FIFO connected as shown in *Figure C-4*. When the modem's clock mode is EXT, the JP2 jumper must be set to EXT (see *Figure C-3*).

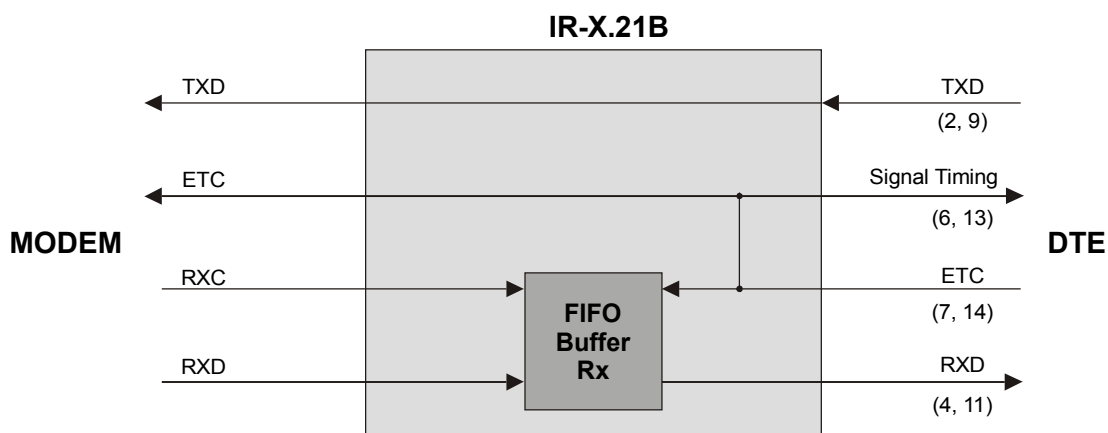


Figure C-4 EXT Mode Timing Block

C.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 equipment has an IR-X.21 interface, but no ability to produce clock signals. The module has a 16-bit FIFO buffer to compensate for the phase delay introduced by the X.21 device. *Figure C-5* illustrates the buffer connection and the required application setup. When the modem's clock mode is INT or RCV, the JP2 jumper must be set to INT/RCV (see *Figure C-3*).

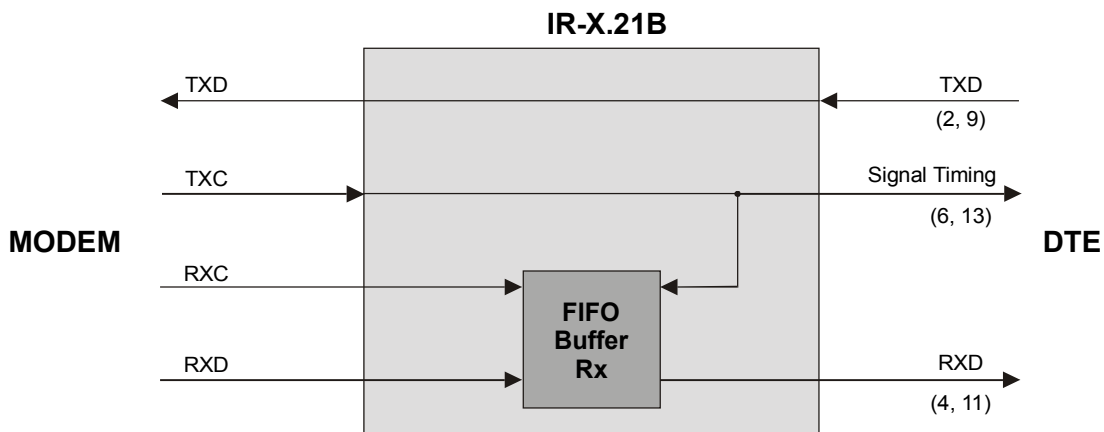


Figure C-5 INT/RCV Mode Timing Block

Appendix D

DTE Interface Signal Assignments

Table D-1 Interface Signal List (Female Connectors), Pins and Standard Signal Names

Signal Function	V.24/ RS-232, DB-25	V.35, 34-pin		RS-530, DB-25		X.21B, DB-15		Description
		Pin	Circuit	Pin	Circuit	Pin	Circuit	
Protective Ground	1	A	Frame101	1		1	SHIELD	Chassis ground. May be isolated from Signal Ground (refer to Table 2-1)
Signal Ground	7	B	Signal102 GND	7	AB	8	GND	Common Signal and DC power supply ground.
Transmitted Data	2	P S	TD(A)103 TD(B)103	2 14	BA(A) BA(B)	2 9	TRANSMIT (A) TRANSMIT (B)	Serial digital data from DTE. The data transitions must occur on the rising edge of the transmit clock, in Sync applications.
Received Data	3	R T	RD(A)104 RD(B)104	3 BB 16	(A) BB(B)	4 11	RECEIVE (A) RECEIVE (B)	Serial digital data at the output of the modem receiver. The data transitions occur on the rising edge of the transmit clock, in sync applications.
Request to Send	4	C	RTS105	4 19	CA(A) CA(B)	3 10	CONTROL (A) CONTROL (B)	A positive level to FOM-20 when data transmission is desired.

Table D-1 Interface Signal List (Female Connectors), Pins and Standard Signal Names (Cont.)

Signal Function	V.24/ RS-232, DB-25	V.35, 34-pin		RS-530, DB-25		X.21B, DB-15		Description
		Pin	Circuit	Pin	Circuit	Pin	Circuit	
Clear to Send	5	D	CTS106	5 13	CB(A) CB(B)			A positive level from FOM-20 with delay, after receipt of Request to Send, and when FOM-20 is ready to transmit.
Data Set Ready	6	E	DSR107	6 22	CC(A) CC(B)			A positive level from FOM-20 when the power is on, and FOM-20 is: - not in a DIGITAL LOOP mode, or - has not received a REMOTE LOOPBACK signal from the remote unit.
Data Terminal Ready	20	H	DTR108	20 23	CD(A) CD(B)			
Carrier Detect	8	F	DCD109	8 10	CF(A) CF(B)	5 (A) 12	INDICATION INDICATION (B)	A positive level from FOM-20, except when a loss of the received signal is detected or when Data Set Ready is negative.
External Transmit Clock	19 16	U W	SCTE(A)113 SCTE(B)113	24 11	DA (A) DA (B)	7 (A) 14	 (B)	A serial data rate clock input from the data source. Positive clock transitions must correspond to data transitions.
Transmit Clock	14 10	Y A	SCT(A)114 SCT(B)114	15 12	DB(A) DB(B)	6 13	SIGNAL TIMING (A) SIGNAL TIMING (B)	A transmit data rate clock for use by an external data source. Positive clock transitions correspond to data transitions.

Table D-1 Interface Signal List (Female Connectors), Pins and Standard Signal Names (Cont.)

Signal Function	V.24/ RS-232, DB-25	V.35, 34-pin		RS-530, DB-25		X.21B, DB-15		Description
		Pin	Circuit	Pin	Circuit	Pin	Circuit	
Receive clock	23	V	SCT(A)115	17	DD(A)			A receive data rate clock output for use by an external data sync. Positive clock transitions correspond to data transitions.
	22	X	SCT(B)115	9	DD(B)			
Local Analog Loop	18	J		18	LL			A control signal, which, when on, instructs FOM-20 to send a Local Analog Loopback (V.54 Loop 3).
Remote Digital Loop	21	H		21	RL			A control signal which, when on, instructs FOM-20 to send a remote Loopback command (V.54 Loop 2) to the remote FOM-20.
Test Indicator	25	K		25	TM			A control signal output from FOM-20; positive during any test mode.

Appendix E

Connecting RS-530 to RS-422

Table E-1 Interface List for Connecting FOM-20 (RS-530) to V.36 DTE (RS-422)

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

