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NETWORK SERVICES

JUNE 2000
ME555A
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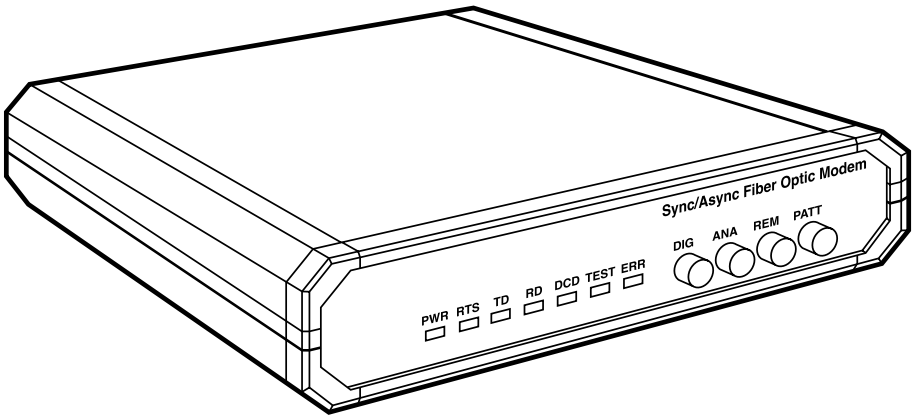
Sync/Async Fiber Optic Modem



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FEDERAL COMMUNICATIONS COMMISSION
AND
INDUSTRY CANADA
RADIO FREQUENCY INTERFERENCE STATEMENTS

This equipment generates, uses, and can radiate radio frequency energy and if not installed and used properly, that is, in strict accordance with the manufacturer's instructions, may cause interference to radio communication. It has been tested and found to comply with the limits for a Class A computing device in accordance with the specifications in Subpart J of Part 15 of FCC rules, which are designed to provide reasonable protection against such interference when the equipment is operated in a commercial environment. Operation of this equipment in a residential area is likely to cause interference, in which case the user at his own expense will be required to take whatever measures may be necessary to correct the interference.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

This digital apparatus does not exceed the Class A limits for radio noise emission from digital apparatus set out in the Radio Interference Regulation of Industry Canada.

Le présent appareil numérique n'émet pas de bruits radioélectriques dépassant les limites applicables aux appareils numériques de la classe A prescrites dans le Règlement sur le brouillage radioélectrique publié par Industrie Canada.

FCC REQUIREMENTS FOR TELEPHONE-LINE EQUIPMENT

1. The Federal Communications Commission (FCC) has established rules which permit this device to be directly connected to the telephone network with standardized jacks. This equipment should not be used on party lines or coin lines.

2. If this device is malfunctioning, it may also be causing harm to the telephone network; this device should be disconnected until the source of the problem can be determined and until the repair has been made. If this is not done, the telephone company may temporarily disconnect service.

3. If you have problems with your telephone equipment after installing this device, disconnect this device from the line to see if it is causing the problem If it is, contact your supplier or an authorized agent.

4. The telephone company may make changes in its technical operations and procedures. If any such changes affect the compatibility or use of this device, the telephone company is required to give adequate notice of the changes.

5. If the telephone company requests information on what equipment is connected to their lines, inform them of:

a. The telephone number that this unit is connected to.

b. The ringer equivalence number.

c. The USOC jack required: RJ-11C.

d. The FCC registration number.

Items (b) and (d) can be found on the unit's FCC label. The ringer equivalence number (REN) is used to determine how many devices can be connected to your telephone line. In most areas, the sum of the RENs of all devices on any one line should not exceed five (5). If too many devices are attached, they may not ring properly.

6. In the event of an equipment malfunction, all repairs should be performed by your supplier or an authorized agent. It is the responsibility of users requiring service to report the need for service to the supplier or to an authorized agent.

CERTIFICATION NOTICE FOR EQUIPMENT USED IN CANADA

The Canadian Department of Communications label identifies certified equipment. This certification means that the equipment meets certain telecommunications-network protective, operation, and safety requirements. The Department does not guarantee the equipment will operate to the user's satisfaction.

Before installing this equipment, users should ensure that it is permissible to be connected to the facilities of the local telecommunications company. The equipment must also be installed using an acceptable method of connection. In some cases, the company's inside wiring associated with a single-line individual service may be extended by means of a certified connector assembly (extension cord). The customer should be aware that compliance with the above conditions may not prevent degradation of service in some situations.

Repairs to certified equipment should be made by an authorized Canadian maintenance facility—in this case, your supplier. Any repairs or alterations made by the user to this equipment, or equipment malfunctions, may give the telecommunications company cause to request the user to disconnect the equipment.

Users should ensure for their own protection that the electrical ground connections of the power utility, telephone lines, and internal metallic water pipe system, if present, are connected together. This precaution may be particularly important in rural areas.

CONFORMANCE

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.

TELECOMMUNICATION SAFETY

The safety status of each of the ports on the Sync/Async Fiber Optic Modem is declared according to EN 41003 and is detailed in the table below:

Safety Status	Ports
SELV*	RS-530

*SELV=Safety Extra-Low Voltage

LASER WARNINGS

This product may be equipped with a laser diode. The laser warning symbol 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.

NORMAS OFICIALES MEXICANAS (NOM)
ELECTRICAL SAFETY STATEMENT

INSTRUCCIONES DE SEGURIDAD

1. Todas las instrucciones de seguridad y operación deberán ser leídas antes de que el aparato eléctrico sea operado.
2. Las instrucciones de seguridad y operación deberán ser guardadas para referencia futura.
3. Todas las advertencias en el aparato eléctrico y en sus instrucciones de operación deben ser respetadas.
4. Todas las instrucciones de operación y uso deben ser seguidas.
5. El aparato eléctrico no deberá ser usado cerca del agua—por ejemplo, cerca de la tina de baño, lavabo, sótano mojado o cerca de una alberca, etc..
6. El aparato eléctrico debe ser usado únicamente con carritos o pedestales que sean recomendados por el fabricante.
7. El aparato eléctrico debe ser montado a la pared o al techo sólo como sea recomendado por el fabricante.
8. Servicio—El usuario no debe intentar dar servicio al equipo eléctrico más allá a lo descrito en las instrucciones de operación. Todo otro servicio deberá ser referido a personal de servicio calificado.
9. El aparato eléctrico debe ser situado de tal manera que su posición no interfiera su uso. La colocación del aparato eléctrico sobre una cama, sofá, alfombra o superficie similar puede bloquea la ventilación, no se debe colocar en libreros o gabinetes que impidan el flujo de aire por los orificios de ventilación.
10. El equipo eléctrico deber ser situado fuera del alcance de fuentes de calor como radiadores, registros de calor, estufas u otros aparatos (incluyendo amplificadores) que producen calor.
11. El aparato eléctrico deberá ser connectado a una fuente de poder sólo del tipo descrito en el instructivo de operación, o como se indique en el aparato.

12. Precaución debe ser tomada de tal manera que la tierra fisica y la polarización del equipo no sea eliminada.

13. Los cables de la fuente de poder deben ser guiados de tal manera que no sean pisados ni pellizcados por objetos colocados sobre o contra ellos, poniendo particular atención a los contactos y receptáculos donde salen del aparato.

14. El equipo eléctrico debe ser limpiado únicamente de acuerdo a las recomendaciones del fabricante.

15. En caso de existir, una antena externa deberá ser localizada lejos de las lineas de energia.

16. El cable de corriente deberá ser desconectado del cuando el equipo no sea usado por un largo periodo de tiempo.

17. Cuidado debe ser tomado de tal manera que objectos liquidos no sean derramados sobre la cubierta u orificios de ventilación.

18. Servicio por personal calificado deberá ser provisto cuando:

    A: El cable de poder o el contacto ha sido dañado; u

    B: Objectos han caído o líquido ha sido derramado dentro del aparato; o

    C: El aparato ha sido expuesto a la lluvia; o

    D: El aparato parece no operar normalmente o muestra un cambio en su desempeño; o

    E: El aparato ha sido tirado o su cubierta ha sido dañada.

TRADEMARKS USED IN THIS MANUAL

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Any other trademarks mentioned in this manual are acknowledged to be the property of the trademark owners.

Contents

Quick Start Guide

Only an experienced technician should install the Sync/Async Fiber Optic Modem. If you are familiar with fiberoptic modems, use this Quick Start Guide to prepare the Modem for operation. If you are not familiar with fiberoptic modems, please read the entire manual.

Starting up

Setting the Jumpers/Switches

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 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.

Interface and Connections

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

Connecting Power Cord

Fiber Optic Modem, AC Version:

- Power is supplied to the Fiber Optic Modem by a 5-foot (1.5-m) long power cable, terminated by an appropriate wall plug (see **Figure 3-2**). Connect the power cable to the AC input jack on the rear panel of the modem.

Connecting to Power Source

Connect the Fiber Optic Modem to an AC power source (AC power mains outlet) or DC source (Ringer). The PWR LED lights to indicate that the Fiber Optic Modem 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

Testing Performance

Verifying Modem Operation

After powering up the modem, if the modem does not operate properly, see **Chapter 4** for more information on Fiber Optic Modem initial functional tests.

1. Specifications

Electrical Interface

Transmission Rates—Asynchronous: 19.2, 28.8, 38.4, 57.6, and 115.2 kbps; Synchronous: 19.2, 32, 48, 56, 64, 72, 96, 112, 128, 144, 192, and 256 kbps

Connectors—RS530 via DB25 female

Optical Interface

Operating Wavelength—850 nm for multimode fiber; 1300 nm for single-mode fiber

Transmission Line—Dual fiber optic cable

Budget (Maximum)— -18 dBm for 850 nm, 62.5/125 fiber; -18 dBm for 1300 nm; 9/125, 62.5/125 (LED) fiber

Receiver Sensitivity— -48 dBm for 850 nm (LED); -50 dBm for 1300 and 1550 nm (laser diode)

Dynamic Range—36 dB

NOTE

The ranges specified above were calculated according to the following typical attenuation rates (with a 3-dBm margin):

3.5 dB/km for 850 multimode
0.4 dB/km for 1300 nm single mode

Connectors—ST®

Transmitter—LED

Maximum Range—850 nm (multimode) up to 7 km; 1300 nm (single mode) up to 70 km

Diagnostics

Digital Loopback—Local, activated by front-panel switch (DIG); Remote, activated by front-panel switch (REM) or by the DTE interface signals (RS-530)

Analog Loopback—Local, activated by front-panel switch (ANA) or by DTE interface signal

Test Pattern—Activated by front-panel switch (PATT)

Timing Elements

Receive Clock—Derived from the Receive signal

Transmit Clock—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

LEDs—Transmit Data (TD), Receive Data (RD), Request to Send (RTS), Data Carrier Detect (DCD), Test Error (ERR), Power (PWR), Loopback mode or BER (TEST)

Environment

Temperature—32 to 122°F (0 to 50°C)

Humidity—Up to 90%, noncondensing

Power Supply

Voltage—110, 115, or 230 VAC (±10%)

AC Frequency—47 to 63 Hz

Power—5 VA

Physical

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

Weight—3.1 lb. (1.4 kg)

2. Introduction

2.1 Overview

2.1.1 General

The Sync/Async Fiber Optic Modem provides a secure, long-range data link between computers, routers, multiplexors, and other data communication (DTE) devices at output power ranges from 12 to 18 dB.

The Modem operates in either half- or full-duplex mode over sixteen selectable synchronous/asynchronous data rates ranging from 19.2 kbps to 256 kbps, enabling transmission up to 43.5 miles (70 km).

The Modem uses an infrared light-emitting diode 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.

The Fiber Optic Modem features V.54 diagnostic capabilities for performing local analog and local and remote digital loopbacks.

2.1.2 Applications

You can use the Fiber Optic Modem in a point-to-point application (see **Figure 2-1**): Two Fiber Optic Modems are connected by a single-mode fiber (up to 43.5 miles [70 km]). Each unit is connected to a workstation or an AS/400® system.

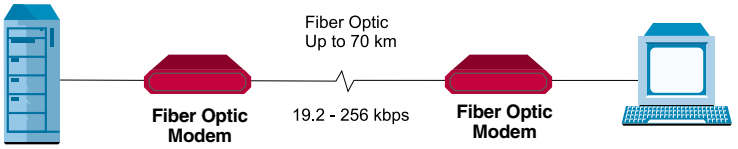

Figure 2-1. Point-to-Point Application.

2.1.3 Versions

Four standalone versions of the Fiber Optic Modem are available.

- Sync/Async Fiber Optic Modem, ST connectors, 1300-nm single-mode fiber, RS-530, 115-VAC power supply (part number ME555A).
- Sync/Async Fiber Optic Modem, ST connectors, 1300-nm single-mode fiber, RS-530, 230-VAC power supply (part number ME555AE).
- Sync/Async Fiber Optic Modem, ST connectors, 850-nm multimode fiber, RS-530, 115-VAC power supply (part number ME556A).
- Sync/Async Fiber Optic Modem, ST connectors, 850-nm multimode fiber, RS-530, 230-VAC power supply (part number ME556AE).

The standalone unit is supplied in a compact case that can be mounted on a desktop or shelf, or in a 19" rack.

The Fiber Optic Modem comes with a Light Emitting Diode (LED) light source.

2.1.4 Features

- ***Fiber Optics:*** Fiber optic technology permits high immunity against electrical interference such as electromagnetic interference (EMI), radio-frequency interference (RFI), spikes, and differential ground loops. It also provides protection from sparking and lightning and gives you a secure link in hazardous or hostile environments. It protects point-to-point data links at ranges longer than a conventional copper wire modem over noisy environments. It also provides high data security, minimizing the risk of eavesdropping.
- ***Interface:*** The Fiber Optic Modem has an RS-530 interface.
- ***Timing:*** The Fiber Optic Modem receives clock timing from three variable sources: Internal, External, or Receive clock. The Modem uses a phase locked loop (PLL) circuit to recover jitter-free data and clock sync from the optical signal.
- ***Test and Diagnostic Capabilities:*** The Fiber Optic Modem features V.54 diagnostic capabilities for performing local analog and local and remote digital loopbacks.

2.2 Physical Description

The Fiber Optic Modem is a compact unit, intended for installation on desktops or shelves. The unit height is 1.7 inches (4.3 cm).

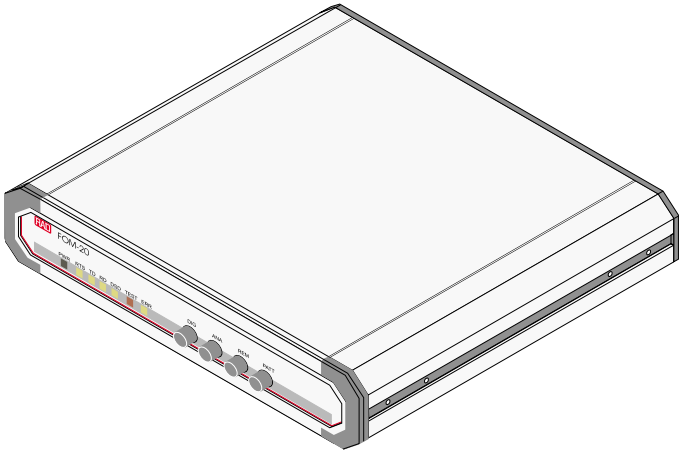

Figure 2-2. Fiber Optic Modem.

2.2.1 Front Panel

All controls (pushbutton switches) and LED indicators are located on the front panel. These indicators and controls are described in greater detail in **Chapter 4**.

2.2.2 Rear Panel

You can access all input/output connectors and power connections from the Fiber Optic Modem's rear panel. The AC power connector has an integrated fuse holder. The correct rating of the replaceable fuse is printed on the rear panel of the Modem. The Fiber Optic Modem's rear panel is described in greater detail in **Chapter 3**.

2.3 Functional Description

2.3.1 General

This section describes the functional circuitry of the Fiber Optic Modem. The Fiber Optic Modem uses an infrared light-emitting diode 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.

2.3.2 Interface

The Fiber Optic Modem has an RS-530 interface.

2.3.3 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.

The Fiber Optic Modem uses a phase locked loop (PLL) circuit to recover jitter-free data and clock sync from the optical signal.

2.3.4 Async-to-Sync Converter

The Fiber Optic Modem 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 the DIP-switch bank).

2.3.5 Diagnostics

Built-in diagnostics (complying with the V.54 standard) enable digital loopback, remote loopback, and local analog loopback. You can activate diagnostics either from the front-panel pushbuttons or via the DTE interface. The pushbuttons 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 ERR LED lights up.

Tests can be carried out from the remote Fiber Optic Modem by pressing the PATT pushbutton on the remote unit or by connecting a Bit Error Rate Tester, which uses the standard 511-bit pattern.

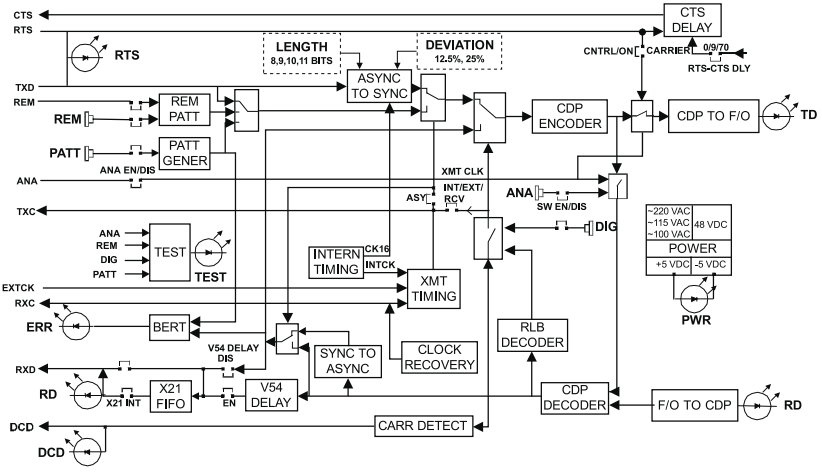

Figure 2-3. Block Diagram.

3. Installation and Setup

3.1 Introduction

This chapter provides mechanical and electrical installation procedures for the Fiber Optic Modem. It is a fully assembled standalone unit.

If you encounter a problem, refer to **Chapter 5** 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.

3.2 Site Requirements and Prerequisites

3.2.1 Power

Install the Fiber Optic Modems within 5 ft. (1.5 m) of an easily accessible, grounded AC outlet capable of furnishing the required supply voltage of the unit (100, 115, 230 VAC).

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

- Allow at least 36 in. (91.4 cm) of frontal clearance for operating and maintenance accessibility.
- Allow at least 4 in. (10.2 cm) clearance at the rear of the unit for signal lines and interface cables.

3.2.2 Ambient Requirements

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

3.3 What the Package Includes

- Fiber Optic Modem (protected by adequate cushioning)
- AC power cord
- This users' manual

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

3.4 What You Need to Supply

To operate the Fiber Optic Modem on a desktop or shelf, no additional equipment is required.

3.5 Jumper and Switch Settings

3.5.1 Strap Selection

Before installing the Fiber Optic Modem, set the jumpers/switches according to the intended configuration. The jumper/switch locations are shown on the board layout diagram (see **Figure 3-1** and **Table 3-1**).

WARNING

Only authorized and qualified service personnel should access the inside of the equipment.

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 the Fiber Optic Modem 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.

Avoid any adjustment, maintenance, and repair of the opened instrument under voltage as much as possible and, when inevitable, only a skilled technician who is aware of the hazard involved should open the unit. Capacitors inside the instrument may remain charged even after the instrument has been disconnected from its power supply source.

To open the Fiber Optic Modem's 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 printed circuit board interior.

To set switches and jumpers:

1. Identify the switches according to the configuration diagram (**Figure 3-1**).
2. Set the switches for the desired operation (see **Table 3-1**).
3. Replace the Fiber Optic Modem PCB interior.

Table 3-1. Fiber Optic Modem 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 "CNTRL," 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 pushbuttons 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

* When two Fiber Optic Modems are used, one modem should be configured as RCV clock and the other as INT or EXT clock.

Table 3-1 (continued). Fiber Optic Modem Strap Selection

Strap Identity	Function	Possible Settings	Factory Setting
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
NOTE **In Asynchronous Operation (refer to Table 3-2 for async characters length settings):**			
SW2 LN0, LN1	Selects the character.	8 bit 10 bit 9 bit 11 bit	10 bit
SW2 STOP BIT	Selects the frequency deviation setting.	12 25	12

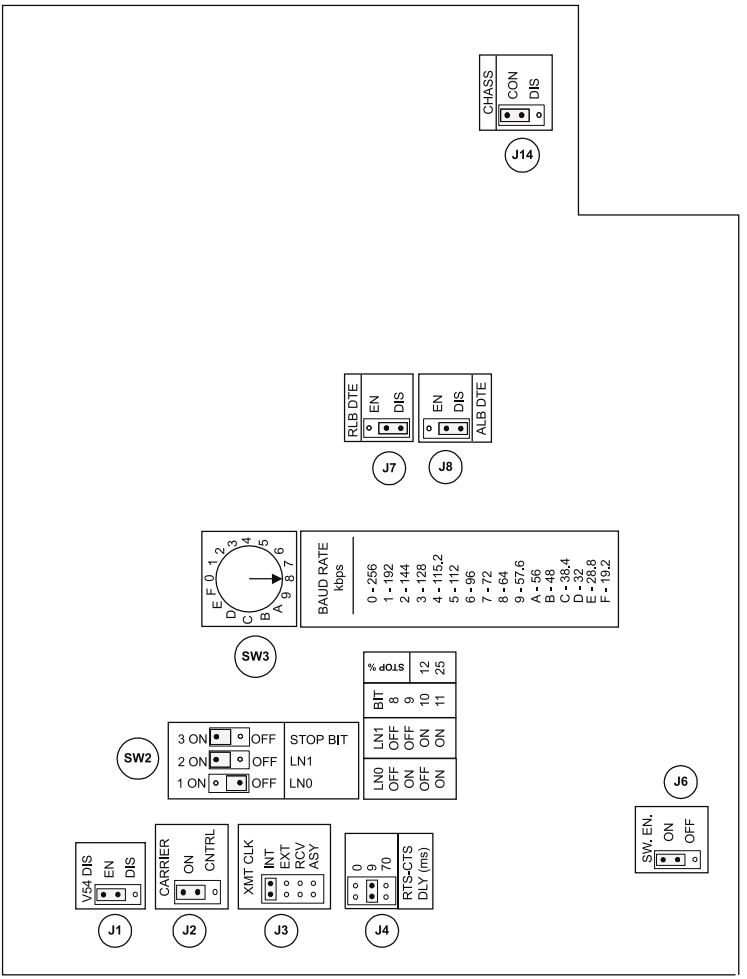

Figure 3-1. Fiber Optic Modem Configuration Diagram.

Table 3-2. 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 the Fiber Optic Modem to its case:

- Slide the PCB interior back into the case.
- Screw in the two rear-panel screws to affix the printed circuit board in the case.

3.5.2 Connecting the Interfaces

The rear panel of the Fiber Optic Modem contains an AC input power connector, a DTE interface connector, and TX and RX fiber optic connectors.

Connecting the Fiber Optic Cables

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

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

We recommend using a shielded twisted-pair cable between the Fiber Optic Modem and the DTE (mainly for higher frequencies). The line receivers in the Fiber Optic Modem are 100-ohm terminated.

- Press the end of the connector into the DTE interface connection on the Fiber Optic Modem.

For more information on the RS-530 DTE interface, see **Appendices A** and **B**.

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

3.5.3 Connecting the Power

WARNING

The Fiber Optic Modem has no power switch. Operation starts when you apply power to the rear panel POWER connector. First, connect the plug of the power cord to the Fiber Optic Modem POWER connector and then to the mains power source (outlet).

Grounding

Before switching on the Fiber Optic Modem, connect its protective earth terminals 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 Modem. Do not short-circuit fuse holders. Whenever it is likely that the protection offered by fuses has been impaired, make the Modem inoperative and secure it against any unintended operation.

For your protection, the Fiber Optic Modem must always be grounded. Interrupting the protective (grounding) conductor (inside or outside the Modem) or disconnecting the protective earth terminal can make the modem dangerous. Intentionally interrupting the Modem is prohibited.

AC Power Connection

Supply AC power to the Fiber Optic Modem through the 5-ft. (1.5-m) standard power cable (included) terminated by a standard 3-prong plug (see **Figure 3-2**).

Connect the power cable to the connector on the Fiber Optic Modem's rear panel and then to the mains outlet. The unit will power on automatically when you connect the cable to the mains.

4. Operation

4.1 General

This chapter describes the Fiber Optic Modem's controls and indicators and their functions, explains the operating procedures, and supplies instructions for making changes in field strapping. Complete and check all of the installation procedures given in **Chapter 3** before attempting to operate the Fiber Optic Modem.

4.2 Front-Panel Controls and Indicators

All pushbutton switches and LED indicators are located on the Fiber Optic Modem's front panel, as shown in **Figure 4-1**. Their functions are described in **Table 4-1**. The numbers under the heading "Item No." in **Table 4-1** correspond to the identification numbers shown in **Figure 4-1**.

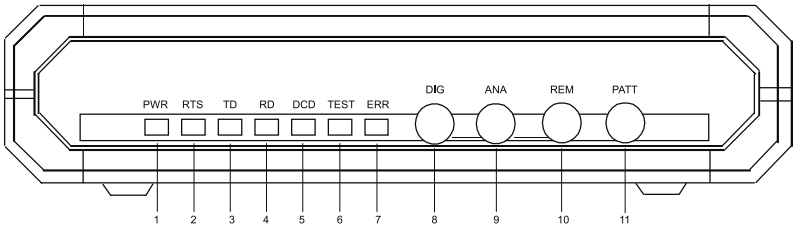

Figure 4-1. The Modem's Front Panel.

Table 4-1. Fiber Optic Modem's 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: The CARRIER jumper should be set to ON; if set to CNTRL, the RTS signal should be high.
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 Fiber Optic Modem 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	Pushbutton	The DIG (Digital) loopback switch causes the local Fiber Optic Modem to loop the received data back to its transmitter (see **Figure 5-3**).

Table 4-1 (continued). Fiber Optic Modem's Front-Panel Controls and Indicators

Item No.	Name	Type	Function
9	ANA	Pushbutton	The ANA (Analog) loopback (V.54 Loop 3) switch causes the local FOM-20 to loop its transmitter output back to its receiver (see **Figure 5-1**). This loopback may also be activated from the DTE when the LLB strap is set to EN.
10	REM	Pushbutton	The REM (Remote) digital loopback (V.54 Loop 2) switch causes the remote Fiber Optic Modem to loop received data and clock signal back to its transmitter (see **Figure 5-2**). This loopback may also be activated from the DTE when the RLB strap is set to EN.
11	PATT	Pushbutton	The PATT (Pattern) switch causes the Fiber Optic Modem to send and receive a 511 test pattern. If errors are encountered, the ERR LED lights up or blinks.

4.3 Initial Operation and Basic Checks

4.3.1 Power-On Procedure

The Fiber Optic Modem turns on as soon as you connect power. The POWER indicator lights up and remains lit as long as the Fiber Optic Modem receives power.

NOTE

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

4.3.2 Running Self-Test

Verify that Fiber Optic Modem 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, and
- ERR lamp turns off.

3. If the test executes correctly, restore all the pushbuttons to their previous settings. If the test does not execute properly, refer to **Chapter 5**.

Running BER Test

To check the link between the two DTEs:

- Press the PATT pushbutton on the Fiber Optic Modem's front panel.

If any errors are encountered, the SQ LED will dim continuously (for continuous errors) or blink (for intermittent errors). Refer to **Chapter 5** for more help.

4.4 Operating Instructions

The Fiber Optic Modem operates unattended after installation. For more information, see **Chapter 3**.

Operator intervention is required when either:

- The Fiber Optic Modem must be adapted for a new operating mode.
- Diagnostic loops are required.

4.4.1 Changing Field Strapping

If you need to reconfigure the Fiber Optic Modem for a different mode of operation, follow the procedures described in **Chapter 3**, for changing jumper/switch settings.

4.4.2 Running Diagnostic Loops

Refer to **Chapter 5** for more information on running diagnostic loops.

4.4.3 Power-Off Procedure

To power down the Fiber Optic Modem, remove the AC power cord from the AC mains supply.

5. Troubleshooting and Diagnostics

This chapter contains:

- A description of the ITU V.54 diagnostic capabilities for performing local analog loopbacks and local and remote digital loopbacks.
- A 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 Fiber Optic Modems.

5.1 General

Test-Pattern Generator and Receiver

The pattern generator/receiver provides for the testing of the local modem and the communication link. When you press the PATT button on the front panel, the pattern-generator circuit sends out a standard 511-bit pseudo-random pattern. If it encounters any errors, the ERR LED lights.

You can run the test in local analog loopback, in remote digital loopback, or in normal point-to-point operation opposite a remote Fiber Optic Modem (by pressing the PATT pushbutton on the remote unit or by connecting a Bit Error Rate Tester, which uses the standard 511-bit pattern).

The Fiber Optic Modem supports several types of tests for evaluating the operation of the data equipment, Fiber Optic Modem, 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 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.
- 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 Fiber Optic Modems and of the link between them.

Tests are activated by pushbuttons and monitored via LED indicators on the front panel of Fiber Optic Modem. For a description of the Fiber Optic Modem's controls and indicators and their functions, see **Chapter 4**.

5.2 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 run any tests using faulty equipment.

• Make sure that all units are powered ON and are configured correctly.

5.2.1 Local Test—Local Analog Loopback (LLB) Standard V.54

The Local Analog Loopback (LLB) test checks the performance of the local Fiber Optic Modem, the local DTE, and the connections between them. The LLB test runs separately at the local and at the remote site (see **Figure 5-1**).

1. Press the ANA pushbutton on the front panel to activate the LLB loopback.

2. When LLB loopback is initiated, the TEST LED lights to indicate that the Fiber Optic Modem's digital interface is now operationally connected to the adjacent DTE via most of the modem circuits. You can also activate this test via the appropriate pin on the digital interface.

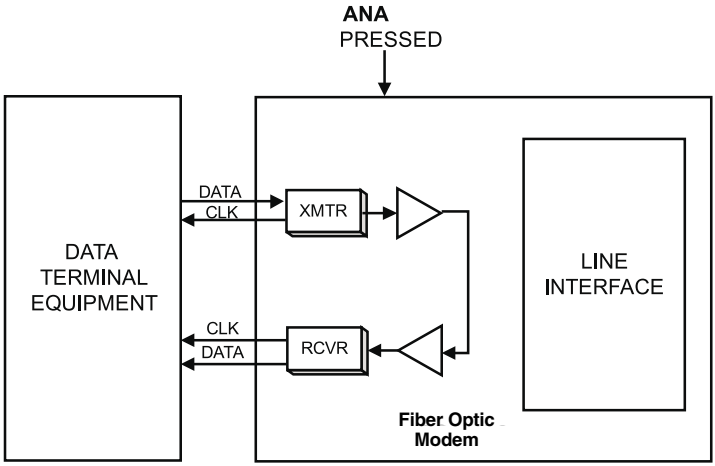

Figure 5-1. Local Fiber Optic Modem in Analog Loopback (LLB).

If the test detects a fault, 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 Fiber Optic Modem 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 pushbutton to the OFF (up) position.

5.2.2 Remote Digital Loopback (RLB) Standard V.54

The Remote Digital Loopback (RLB) test determines the performance of the local and the remote Fiber Optic Modems as well as their interconnecting lines. The Remote Digital Loopback sets a loop at the remote Fiber Optic Modem from the terminal coupled to the local unit (see **Figure 5-2**).

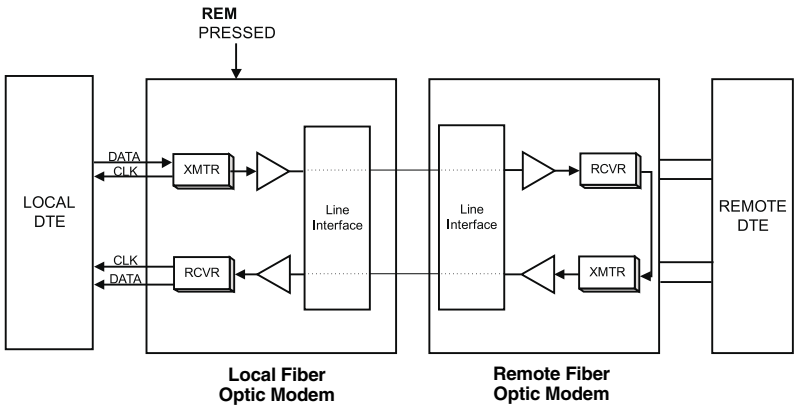

Figure 5-2. Fiber Optic Modem in Remote Digital Loopback (RLB).

Press the REM pushbutton 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. You can also activate this test via the appropriate pin on the digital interface.

If the RLB test indicates a fault, but the LLB test (see **Section 5.2.1**) was successful in both local and remote modems, then the line or line circuits on one side of the line are not functioning properly.

5.2.3 Local Digital Loopback (DIG) Non-Standard

This test loops the received data back to the remote Fiber Optic Modem, as shown in **Figure 5-3**. The operator at the remote end uses this test to determine the performance of the local and remote Fiber Optic Modems and the communication link.

NOTE

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

Press the DIG pushbutton on the front panel to start the test.

The Local Digital Loopback test is equivalent to activating the remote loopback from a remote Fiber Optic Modem.

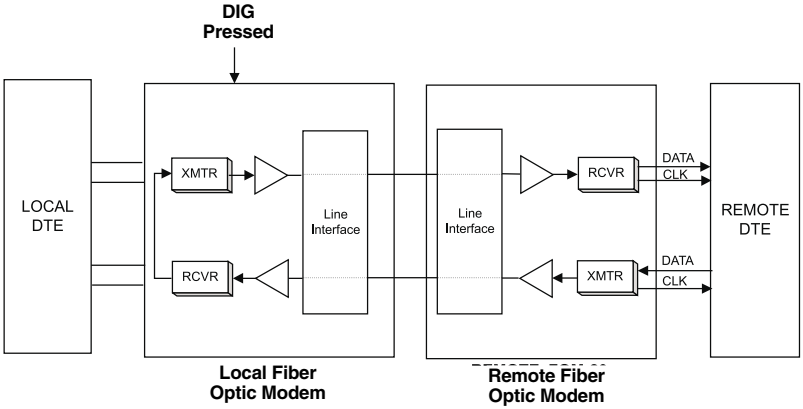

Figure 5-3. Activating RLB at the Remote Modem (Local Fiber Optic Modem in a Digital Loopback).

5.3 Internal BERT Circuit Test

The Fiber Optic Modem 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 if the system fails.

The pattern transmitted is a proprietary, random pattern.

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

When used opposite another Fiber Optic Modem, the complete link can be tested either with the PATT pushbutton pressed, or with an external BERT transmitting the same 511-bit pattern (per V.52).

5.3.1 Modem Self-Test

This test verifies that the modem is operating correctly (see **Figure 5-4**).

To perform the test, proceed as follows:

1. Press the ANA pushbutton 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 pushbutton. 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 Fiber Optic Modem is faulty and should be replaced. If the test executes correctly, restore all pushbuttons and jumpers to their normal position.

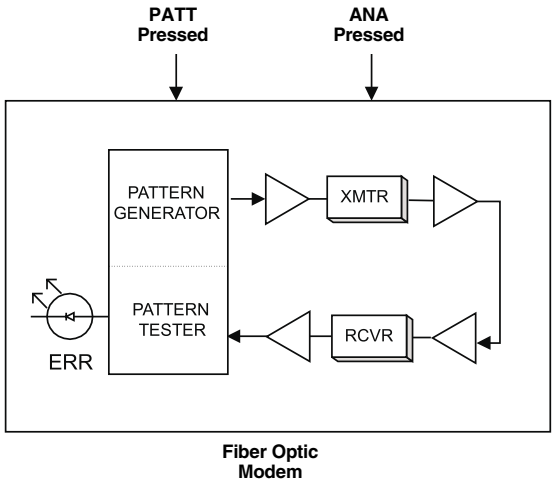

Figure 5-4. Fiber Optic Modem Self-Test.

5.3.2 TWO-BERT TEST

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

To perform the test, proceed as follows:

Press the PATT pushbutton on the front panel. If errors are encountered, the ERR LED will go Off for continuous errors or blink for intermittent errors.

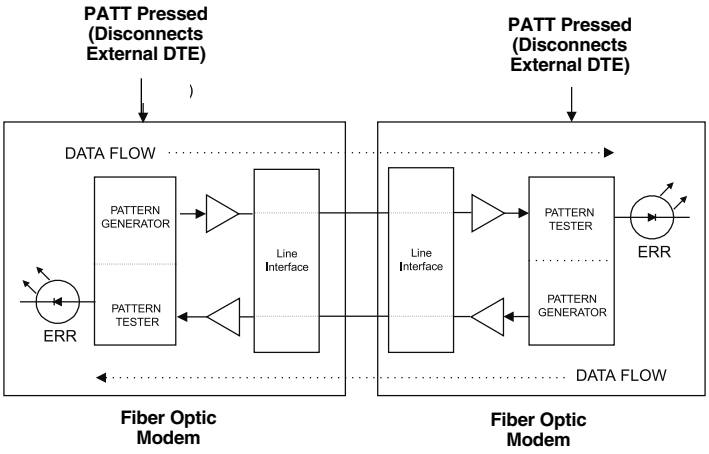

Figure 5-5. Fiber Optic Modem BER System Test (Two-BERT Test).

5.4 (Local) Analog Loopback Test

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

1. Press the ANA pushbutton on the front panel. (This test can also be activated via the pin on the DTE interface.) The TEST LED should light. The Fiber Optic Modem 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 pushbutton 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 the Fiber Optic Modem.

5. After completing the test (or when the fault has been corrected), reset the ANA pushbutton to the OFF position (Up). Then perform the Communication Link Tests (see **Section 5.5**).

LOOPBACK FUNCTION

The Local Loopback command is activated by the DTE interface or by the pushbutton on the front panel.

The Fiber Optic Modem 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 5-6**). This is an internal test only, with no external transmission. At the far end, the remote Fiber Optic Modem functions as if it is in "Loss-of-Signal State," which is DCD "OFF" and RX data "OFF" or "MARK."

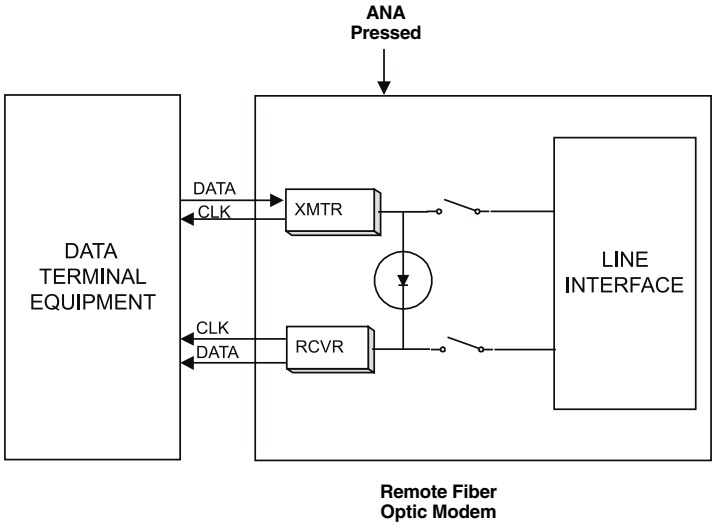

Figure 5-6. Local Analog Loopback.

5.5 Communication Link Test

5.5.1 Remote Digital Loopback

The remote digital loopback test determines the performance of both the local and remote Fiber Optic Modem, and the quality of the link between the local and remote units.

1. Press the REM pushbutton on the front panel to provide a loopback at the remote Fiber Optic Modem (see **Figure 5-2**). (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 5.3**.

3. If Step 2 indicates a fault, and if the modem test described in **Section 5.4** was successful for both the local and remote modems, the line circuits are not operating properly.

5.5.2 Local Digital Loopback

The test loops the received data back to the remote Fiber Optic Modem. (This test is equivalent to activating remote loopback from the remote Fiber Optic Modem, as shown in **Figure 5-7**). The operator at the remote end can determine the performance of the local and remote Fiber Optic Modems and of the links between them.

To activate this test, press the DIG pushbutton on the front panel.

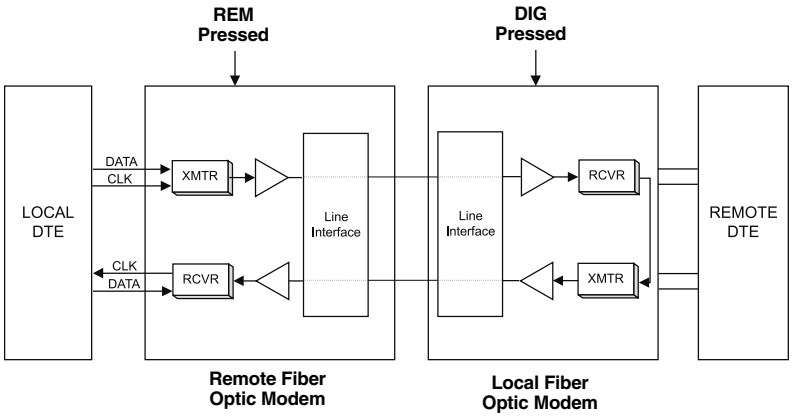

Figure 5-7. Local Fiber Optic Modem in Digital Loopback.

Appendix A. DTE Interface Signal Assignments

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

Signal Function	RS-530 DB25		Description
	Pin	Circuit	
Protective Ground	1		Chassis ground. May be isolated from Signal Ground (refer to Table 3-1).
Signal Ground	7	AB	Common signal and DC power supply ground.
Transmitted Data	2	BA(A)	Serial digital data from DTE. The data transitions must occur on the rising edge of the transmit clock in sync applications.
Received Data	3	BB(A)	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	CA(A)	A positive level to the Fiber Optic Modem when data transmission is desired.
Clear to Send	5 13	CB(A) CB(B)	A positive level from the Fiber Optic Modem with delay, after receipt of Request to Send, and when Fiber Optic Modem is ready to transmit.

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

Signal Function	RS-530 DB25		Description
	Pin	Circuit	
Data Set Ready	6 22	CC(A) CC(B)	A positive level from the Fiber Optic Modem when the power is on, and the Fiber Optic Modem is: not in a DIGITAL LOOP mode; has not received a REMOTE LOOPBACK signal from the remote unit.
Data Terminal Ready	20 23	CD(A) CD(B)	
Carrier Detect	8 10	CF(A) CF(B)	A positive level from the Fiber Optic Modem, except when a loss of the received signal is detected or when Data Set Ready is negative.
External Transmit Clock	24 11	DA(A) DA(B)	A serial data rate clock input from the data source. Positive clock transitions must correspond to data transitions.
Transmit Clock	15 12	DB(A) DB(B)	A transmit data rate clock for use by an external data source. Positive clock transitions correspond to data transitions.
Receive Clock	17 9	DD(A) DD(B)	A receive data rate clock output for use by an external data sync. Positive clock transitions correspond to data transitions.

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

Signal Function	RS-530 DB25		Description
	Pin	Circuit	
Local Analog Loop	18	LL	A control signal, which when on, instructs the Fiber Optic Modem to send a Local Analog Loopback (V.54 Loop 3).
Remote Digital Loop	21	RL	A control signal which, when on, instructs the Fiber Optic Modem to send a remote Loopback command (V.54 Loop 2) to the remote Fiber Optic Modem.
Test Indicator	25	TM	A control signal output from the Fiber Optic Modem; positive during any test mode.

Appendix B. Connecting RS-530 to RS-422

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

Signal Function	RS-449 (RS-422/423) 37-Pin		EIA 530 DB25 Female Standalone and Frame	
	Pin	Circuit	Pin	Circuit
Protective Ground	1	Shield	1	
Signal Ground	19,37, 20		7	AB
Transmitted Data	22 4	SD(B) SD(A)	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)

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

Signal Function	RS-449 37-Pin (RS-422/423)		EIA 530 DB25 Female Standalone and Frame	
	Pin	Circuit	Pin	Circuit
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) DB(B)
Receive Clock	26 8	RT(B) RT(A)	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

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