

**F282x  
FOM II Series  
Fiber Optic Modem  
Technical Manual**

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## SECTION 1 DESCRIPTION OF EQUIPMENT

### 1.1 INTRODUCTION

This manual provides general and detailed information on the installation and operation of the Model F282X FOM II Series Fiber-optic Modems. Section 1 contains a general description of the equipment. Section 2 covers installation instructions. Section 3 contains operating instructions. Section 4 provides the theory of operation. Section 5 contains maintenance and troubleshooting information. Figure 1 is an overall view of the Model F282X products.

<b>Model Number</b>	<b>Part Number</b>	<b>Description</b>
F2822	19932-02	RS-530, 0-76.8 Kbps, multimode, 850nm, ST connectors, 2 Km operational distance.
F2824	19932-04	RS-530, 0-76.8 Kbps, multimode, 1300nm, ST connectors, 6 Km operational distance.
F2825	19932-05	RS-530, 0-76.8 Kbps, multimode, 1300nm, ST connectors, 14 Km operational distance.

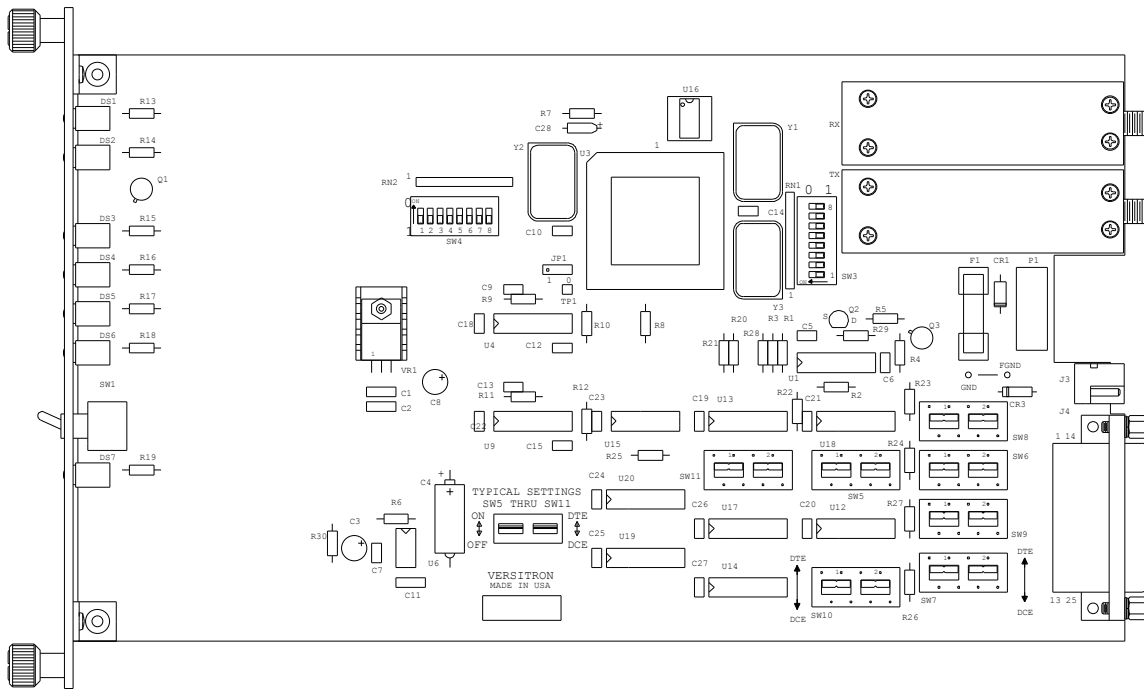
### 1.2 DESCRIPTION OF EQUIPMENT

#### 1.2.1 Functional Characteristics

The Model F282X products are fiber-optic links designed for use as an RS-530 interface extender (See Figure 2) or a modem link (See Figure 3). These units are DTE/DCE switch selectable and interface with other VERSITRON FOM II series F282X Fiber Optic Modems. Model F2822 uses multimode fiber-optic cable of up to 2 Km (6,560 ft.), Model F2824 uses multimode fiber optic cable of up to 6 Km (19,680 ft.) and Model F2825 uses single mode fiber optic cable of up to 14 Km (45,920 ft.). The link has a maximum data rate of 76.8 Kbps, providing synchronous, asynchronous or isochronous full-, half-duplex, or simplex data transmission with fully transparent operation. The unit has internal clock generation for 18 set frequencies. The Model F282X FOM II modems fully support the interface control signals associated with the EIA RS-530 and MIL-STD-188-114 standards. This is accomplished by multiplexing the control signals along with clock and data signals and transmitting this serialized signal to the remote unit. At the remote unit the signal is demultiplexed and applied to the interface.

#### 1.2.2 Physical Characteristics

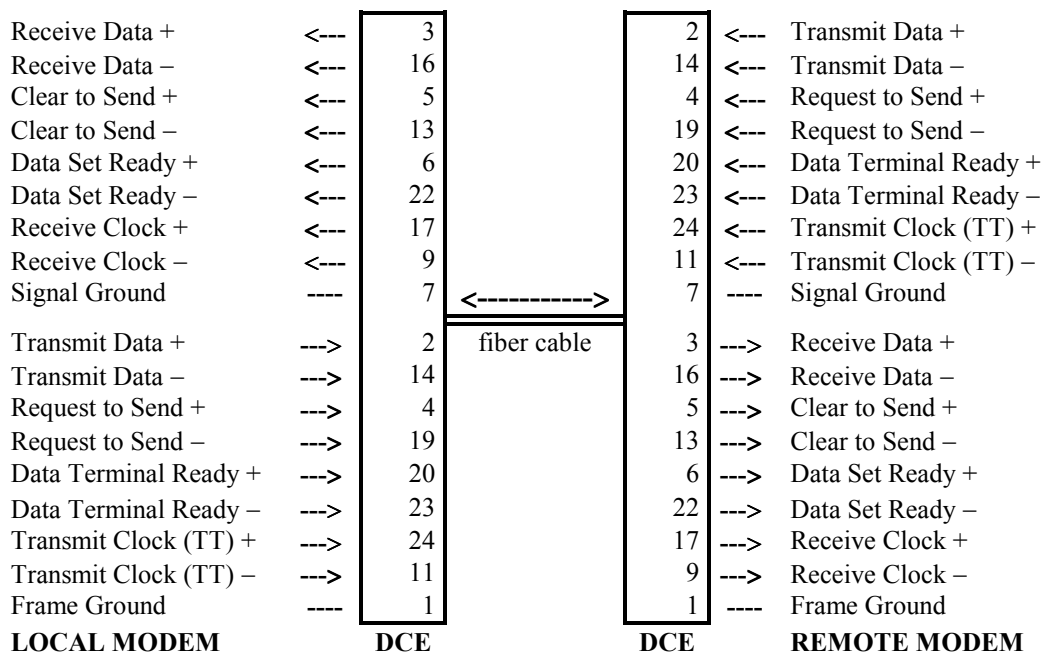
The Model F282X FOM II products measure 7.0" wide x 0.84" high x 11.6" deep and are designed to be placed in a variety of VERSITRON enclosures and chassis (see Table 1 for dimensions of enclosures and chassis). "Desktop" options include both single- and dual-card enclosures. Rack-mount options include a 2-card and 20-card chassis. The Unit requires a wall transformer for desktop or 2-card rack mount operation, with a one-pin connector for electrical input on the back of the card. There is a female DB25 connector for the RS-530 interface and two ST connectors for the fiber-optic interface, also on the back of the card. The unit requires a VERSITRON Model AC150W rack-mount power supply for 20-card operation. Two power supplies are required for redundancy. The unit has seven indicators: power (PWR), alarm (ALM), transmit data (TXD), receive data (RXD), transmit clock (TXC), receive clock (RXC), and loopback (LB).



**FIGURE 1. OVERALL VIEW, F282X MODEMS**

Transmit Data +	<---	2		2	<---	Transmit Data +
Transmit Data -	<---	14		14	<---	Transmit Data -
Request to Send +	<---	4		4	<---	Request to Send +
Request to Send -	<---	19		19	<---	Request to Send -
Data Terminal Ready +	<---	20		20	<---	Data Terminal Ready +
Data Terminal Ready -	<---	23		23	<---	Data Terminal Ready -
Transmit Clock (TT) +	<---	24		24	<---	Transmit Clock (TT) +
Transmit Clock (TT) -	<---	11		11	<---	Transmit Clock (TT) -
Receive Data +	-->	3		3	-->	Receive Data +
Receive Data -	-->	16		16	-->	Receive Data -
Clear to Send +	-->	5		5	-->	Clear to Send +
Clear to Send -	-->	13		13	-->	Clear to Send -
Data Set Ready +	-->	6	<----->	6	-->	Data Set Ready +
Data Set Ready -	-->	22	fiber cable	22	-->	Data Set Ready -
Signal Ground	---	7		7	---	Signal Ground
Carrier Detect +	-->	8		8	-->	Carrier Detect +
Carrier Detect -	-->	10		10	-->	Carrier Detect -
Transmit Clock +	-->	15		15	-->	Transmit Clock +
Transmit Clock -	-->	12		12	-->	Transmit Clock -
Receive Clock +	-->	17		17	-->	Receive Clock +
Receive Clock -	-->	9		9	-->	Receive Clock -
Local Loopback	-->	18		18	<---	Local Loopback
Remote Loopback	-->	21		21	<---	Remote Loopback
Test Mode	-->	25		25	-->	Test Mode
Frame Ground	----	1		1	----	Frame Ground
<b>LOCAL MODEM</b>		<b>DTE</b>		<b>DCE</b>		<b>REMOTE MODEM</b>

**FIGURE 2. INTERFACE EXTENDER CONFIGURATION**



**FIGURE 3. MODEM LINK CONFIGURATION**

Model Number	Dimensions	Description	Power Supply Required
<b>HF-1</b>	1.31" H x 7.12" W x 11.6" D	Single Card Standalone Enclosure	<b>PSAC08</b> (US) or <b>PSAC09</b> (Eur)
<b>HF-2</b>	2.31" H x 7.12" W x 11.6" D	Dual Card Standalone Enclosure	<b>PSAC08</b> (US) or <b>PSAC09</b> (Eur)
<b>HF-2SS</b>	1.72" H x 19" W x 13.75" D	2-Slot Rack Mount Chassis	<b>PSAC08</b> (US) or <b>PSAC09</b> (Eur)
<b>HF-20</b>	7" H x 19" W x 11.6" D	20-Slot Rack Mount Chassis	<b>AC150W</b> (US & Eur)

**TABLE 1. ENCLOSURES / CHASSIS**

## 1.3 SPECIFICATIONS

**Data Rate:** Any data rate from 50 Bps to 76.8 Kbps; synchronous/asynchronous/isochronous. DTE source timing applications above 56 Kbps may be dependent upon cable length. Consult factory to discuss your specific application and configuration requirements.

**Operating Mode/Range:** Simplex, Half- or Full-duplex operation over fiber-optic cable pair. Maximum operating range is 2 Km (6,560 ft.) with 850nm optics or 6 Km (19,680 ft.) with 1300nm optics.

**Optical Interface:** ST connectors compatible with 50/125  $\mu\text{M}$ , 62.5/125  $\mu\text{M}$  or 100/140  $\mu\text{M}$  fiber-optic cable for 850nm multimode operation, 62.5/125  $\mu\text{M}$  fiber-optic cable for 1300nm multimode operation and 8/125  $\mu\text{M}$ , 9/125  $\mu\text{M}$  or 10/125  $\mu\text{M}$  fiber optic cable for 1300nm single mode operation.

**Digital Interface:** Signal levels and format conform to EIA RS-530 / MIL-STD-188-114. The F282X has a female DB25 connector for connecting to a terminal, with a gender changer available for connecting to a modem. The unit is switch-selectable between DCE and DTE operation.

**Sample Rate:** Control signals are sampled at an 18.75 kHz rate. If an asynchronous data signal is used instead of a control signal the sample rate will result in 5% distortion at 1 Kbps. Data and clock signals are sampled at 300 kHz.

**Dimensions:** 7.0" W x 0.84" H x 11.6" D.

**Power Requirements:** 120 VAC with available DC wall transformer (VERSITRON Model: PSAC08 US, PSAC09 EUR) providing 12 VDC, 1 A.

**Environment:** 0° to +50°C (32° to +122°F) operating temperature; up to 95% relative humidity (non-condensing); up to 10,000 feet altitude; storage temperature -40° to +70° C.

## SECTION 2 INSTALLATION

### 2.1 GENERAL

This section contains detailed information on the installation and initial checkout of the Model F282X FOM II Series Modems. Paragraph 2.2 contains general information on site selection and rack mounting. Paragraphs 2.3 and 2.4 provide instructions for connecting Model F282X products to your system and selecting the different options. Paragraph 2.5 has the initial checkout procedures.

### 2.2 SITE SELECTION

The Model F282X FOM II products are designed to connect to the serial port (DB25 Connector) of the terminal equipment with a cable (customer supplied). The Modem is designed to be placed in a VERSITRON Model HF-1 or HF-2 desktop enclosure, or rack mounted in a VERSITRON Model HF-2SS or Model HF-20 19-inch standard chassis. The enclosure and chassis dimensions are provided in Table 1 in the previous section. When placed in a desktop enclosure, space for the transformer must also be provided.

### 2.3 POWER REQUIREMENTS

The Model F282X FOM II products are designed to operate from an AC power transformer or a DC power source with a DC voltage of +12 VDC. Before inserting the power transformer (VERSITRON Model PSAC08 US, PSAC09 EUR) into an AC power source, the plug should be connected to the Modem. There are no special tools required. DC power may be used instead of the power transformer if available. This requires a 2.5 mm socket with the positive voltage on the center and the common on the concentric using +12 VDC at 1 A.

### 2.4 SWITCH SETTINGS

There are a number of switches on the circuit card of the Model F282X modem, used to select between DTE/DCE operation, internal/external clock selection, the internal clock data rate, and several loopback functions. Figure 4 shows the physical location of all of the switches, labeled SW1 through SW11. With the exception of the loopback switch (SW1), which is on the front panel of the modem card, **all of the switches should be set to the desired position prior to applying power to the modem**, and then left in those positions unless the overall link characteristics change.

Switch 3 (SW3), located between the optical modules and the XILINX field programmable gate array (FPGA) chip, contains 8 ON-OFF switch positions. The first three positions determine the interface standard that is expected as an input. Since the complete family of F2800 Series Low-Speed Modems includes products that operate per the RS-232 standard, there are switch positions for settings that are irrelevant to the Model F282X products, as they operate only with RS-530 standard inputs. For the same reason, there is no Switch 2 (SW2) on a Model F282X product. For SW3, Position 2 is set to ON for DCE operation, and OFF for DTE operation. Positions 1 and 3 must remain OFF.

Positions 4 through 8 of SW3 are used to set the clock rate for internal-timing operation. As listed in Table 2, there are 18 different clock rates that may be chosen by the settings of SW3, Positions 4 through 8.



SWITCH	POSITION	ON	OFF	Description
1	Front Panel	X		Loopback enabled
1	Front Panel		X	Loopback function disabled
2	---	---	---	Does not exist on this modem
3	1	X		Circuits set for RS-232 signals (Do not change)
3	1		X	Circuits set for RS-530 signals (Do not change)
3	2	X		Interface set for DCE
3	2		X	Interface set for DTE
3	3		X	NOT used for RS-530, set to OFF (Do not change)
3	4 - 8	---	---	Internal Clock rate settings, see Table 2
4	1	X		Internal Timing (Clock Generated Internal to Modem)
4	1		X	External Timing (Clock Received Externally)
4	2	X		Terminal Timing (External clock on pins 24 & 11)
4	2		X	Source Timing (External clock on pins 15 & 12)
4	3	X		Remote/Local Loopback Circuit ON (Set to REMOTE: CTSin = RTSout, RTSin = CTSout)
4	3		X	Remote/Local Loopback Circuit OFF (Set to LOCAL: CTSin = CTSout, RTSin = RTSout)
4	4 - 8		X	NOT used, set to OFF (Do not change)
5,6,7,8,9,10,11	1 - 2	X		Interface set for DTE
5,6,7,8,9,10,11	1 - 2		X	Interface set for DCE

**TABLE 3. MODEL F282X SWITCH SETTINGS**

## 2.5 TIMING MODE

Model F282x Modems can operate in three different timing modes: Source Timing, Terminal Timing, and Internal Timing. All timing modes are application specific and can be configured using Switch 4, Position 1 as listed in Table 3. As shown in Figure 4, Switch 4 (SW4), located to the left of the FPGA, also contains 8 ON-OFF switch positions. Positions 4 through 8 are not used for the Model F282x products and should be left in the **OFF** position.

### 2.5.1 Source Timing

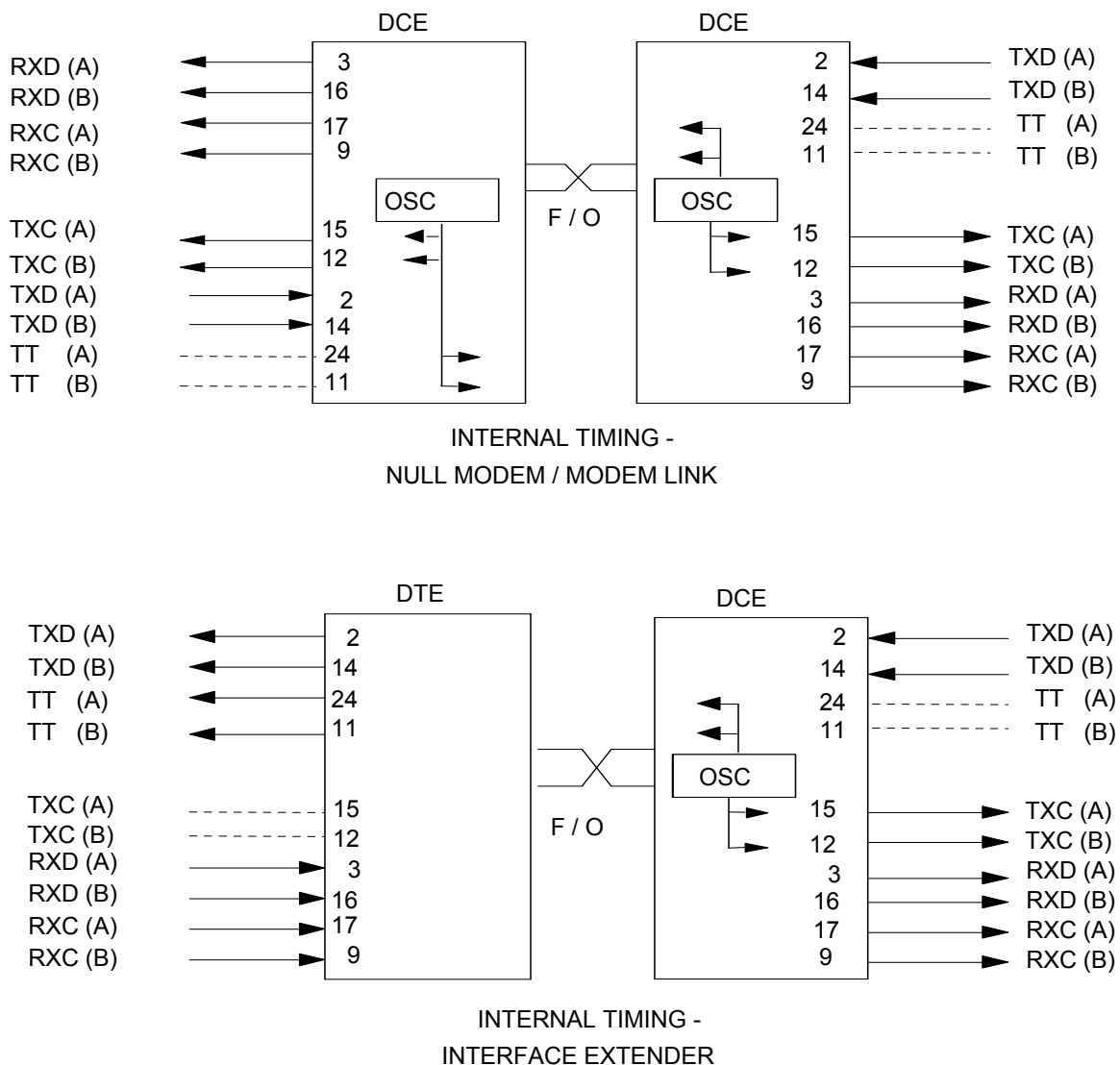
A realignment circuit is needed in the Source (external) Timing configuration to account for the inherent delays and jitter introduced by noise and asynchronous sampling at all frequencies. The realignment circuit is only used on the DTE units. A clock detection circuit checks for a clock signal on input pins 12 and 15 of the DB25 interface. Without clock signals on pins 12 and 15, no realignment takes place and data is output from the unit as it was received from the fiber-optic input. With clock signals present, the realignment circuit processes the data signal recovered from the fiber-optic receiver before it is output onto pins 2 and 14. In Source Timing mode, the F282X modem supports transmitted and received data, transmitted and received clocks, and eight control signals. The unit shall transmit and receive balanced signals at a data rate between 50 Bps and 76.8 Kbps with a bit error rate of  $1 \times 10^{-9}$ . Switch 4, Position 2 should be **OFF** for source timing.

### 2.5.2 Terminal Timing

The Terminal (external) Timing mode is the basic mode of operation for the Model F282X FOM II Series Modems. There is no circuit needed for data realignment. In Terminal Timing mode, the Model F282X supports transmitted and received data, transmitted and received clocks, and eight control signals. Balanced signals, at a data rate from 50 Bps to 76.8 Kbps, are processed transparently by the modem, with a bit error rate of  $1 \times 10^{-9}$ . Switch 4, Position 2 should be **ON** for terminal timing.

## 2.5.3 Internal Timing

Model F282X modems can supply clock frequencies internally while configured as an RS-530 DCE. SW3, Positions 4 through 8 allow the user to select 18 different clock frequencies, as listed in Table 2. The internal timing mode is set by turning on SW4, Position 1. When SW4, Position 1 is in the **ON** position, the board is configured as a null modem. In this configuration, the terminal timing (TT) clock signals on input pins 11 and 24 of the DB25 interface and the transmit clock signals (TXC), input on pins 12 and 15 of a DTE unit, are disconnected and replaced with the internally generated clock. In a null modem configuration, the internal clock is used throughout the circuit. In the interface extender configuration, the internal clock generated by the DCE modem is output on pins 11 and 24 of the DTE modem (See Figure 5). When SW4, Position 1 is in the **OFF** position the internal clock is off.



**FIGURE 5. INTERNAL TIMING MODES**

## 2.6 LOOPBACK

The Model F282X has two loopback features. The first loopback feature allows the user to test the fiber-optic circuitry of the unit, the fiber-optic circuitry of the unit at the receiving end, the copper circuitry of the unit, and the copper circuitry of the unit at the receiving end. The second loopback feature loops the control signals RTS and CTS.

### 2.6.1 Fiber / Copper Loopback

This loopback feature of the Model F282X allows the user to test the fiber-optic circuitry of the unit and the fiber-optic circuitry of the unit at the receiving end. The fiber-optic input and outputs are connected to a multiplexer. The multiplexer is controlled by the front-panel switch (SW1). When SW1 is **ON**, the multiplexer control bit goes high, the fiber-optic input data is looped to the fiber-optic output and sent back to the source. The copper signal enters the board through the interface circuitry to the multiplexer circuit. The signals get multiplexed, demultiplexed and transmitted back to their source. This is true for all data, clock, and control signals. If the fiber-optic output and input signals match, and the copper signals match, the optical and interface circuits of both units are working properly. When SW1 is **OFF**, the multiplexer control bit goes low, and the unit functions normally.

### 2.6.2 Remote / Local Loopback

The Remote / Local Switch, SW4, Position 3, is used to loop control signals RTS and CTS. This is to accommodate equipment that lacks the ability to respond to an RTS signal. When SW4, Position 3 is **ON**, a CTS input signal is connected to RTS output and an RTS input is connected to CTS output. When SW4, Position 3 is **OFF**, CTS-IN is connected to CTS-OUT and RTS-OUT is connected to RTS-IN. See Table 3.

## 2.7 INITIAL CHECKOUT PROCEDURE

The Model F282X FOM II Series products contain no power on/off switch. Once the unit is properly installed and power is applied it may be considered fully operational. The power indicator should remain on as long as power is supplied to the unit

Before beginning system operation the following items should be checked to verify proper installation:

1. Verify that the power plug is seated fully into the modem or the modem is seated firmly in the rack-mount enclosure.
2. Verify that the fiber-optic cable is crossed transmit to receive from unit one to unit two.
3. Verify that the alarm LED goes out when the signal is applied to the optical receiver of the F282X.
4. Verify the switch settings for the circuit configuration (i.e. internal/external timing).

If a malfunction is detected during the initial checkout procedure, refer to Chapter 5 for information on isolating the malfunction in the unit.

## **SECTION 3 OPERATION**

### **3.1 INTRODUCTION**

This chapter contains a description of the operating controls and indicators associated with the Model F282X FOM II Series modems. Since the Model F282X is designed for continuous and uninterrupted operation, there are no operating requirements. Once the Model F282X is powered up it should remain in service as long as required.

### **3.2 STATUS INDICATORS/AUDIBLE ALARM**

There are 7 indicators on the Model F282X: power (PWR), alarm (ALM), transmit data (TXD), receive data (RXD), transmit clock (TXC), receive clock (RXC), and Loopback (LOOP). No audible alarm is available.

### **3.3 OPERATING CONTROLS**

The only operating controls associated with the Model F282X modems are those used to select between DTE/DCE, internal/external clock selection, internal clock data rate, and the two loopback functions. These selections are normally made only at the time of installation. Further changes are not required unless the system requirements change.

## **SECTION 4 THEORY OF OPERATION**

### **4.1 INTRODUCTION**

Basic operation of the Model F282X is similar to a four-channel, full duplex multiplexer. The first channel is used for data. The next two channels are used for transmit and receive clock, while the fourth multiplexer channel is used for aggregated control signals. This technique provides full transparency for the link, even when both clocks originate at the modem. The modem supplies both transmit and receive clocks to the Model F282X, which are transmitted through the link and applied directly to the terminal.

The interface control signals are processed in a similar manner. The Request to Send signal from the terminal is transmitted through the link and applied to the modem. When the modem responds with Clear to Send, it will be transmitted through the link and applied to the terminal. With this technique, the terminal will see the RTS/CTS delay established by the modem. The unit is also capable of looping RTS/CTS for interface equipment that does not support control signals.

If a fully transparent synchronous link is not required, the clock and control paths may be used as additional asynchronous data paths. The transmit and receive clock inputs will handle data rates from 0 to 76.8 Kbps asynchronously; the control paths will handle data rates up to 1 Kbps with 5% distortion.

## SECTION 5 MAINTENANCE AND TROUBLESHOOTING

### 5.1 INTRODUCTION

This chapter contains general information designed to isolate a malfunction in the Model F282X to a replaceable unit. These units are not equipped with redundancy. Therefore, a failure in one of these units would interrupt service.

### 5.2 FAULT ISOLATION

The steps in Table 4 should be taken to check a non-operating modem.

STATUS INDICATOR	PROBABLE CAUSE	CORRECTIVE ACTION
POWER (PWR) LED is off.	No AC power.	Check that both ends of the Transformer are connected.
	Blown Fuse.	Replace with 250V 1A slo-blo fuse.
	Other power supply circuit problem.	Contact VERSITRON Customer Service for assistance.
LOSS of OPTICAL POWER (LOP) LED is on.	Incorrect optical signal level received at receiver input.	<ol style="list-style-type: none"> <li>1. Check that fiber-optic cable is properly connected to RX connector.</li> <li>2. Check that the remote unit power is on and the TX fiber-optic connector is connected properly.</li> <li>3. Measure the optical levels on both ends (if possible) in order to check the optical link.</li> <li>4. Contact VERSITRON Customer Service for assistance.</li> </ol>
DATA and CLOCK (TXD, RXD, TXC, RXC) LEDs are off or not responding as expected.	Switches/Jumpers in wrong position.	Check that the switch/jumper is set for the correct electrical interface.
	No input on the electrical interface connector.	Check that the interface connector is connected securely.
DATA AND CLOCK signal inverted.	Switches/Jumpers in wrong position.	Check that the switch/jumper is set for the correct electrical interface.
DATA signal inverted.	Inverted input on the electrical interface connector.	Check that the interface connector is wired per interface standard RS-530.

**TABLE 4. NON-OPERATIONAL INDICATORS**