

F280X
FOM II Series
RS-232 / MIL-STD-188C
Fiber Optic Modem
Technical Manual

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VERSITRON, Inc.
83 Albe Drive / Suite C
Newark, DE 19702
www.versitron.com

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Comment [.1]:

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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 F280X FOM II Series RS-232 Fiber Optic Modem. Section 1 contains a general description of the equipment. Section 2 contains 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 F280X.

Model Number	Part Number	Description
F2802	19931-02	RS-232 standard, 0-76.8 Kbps, multimode 850nm optics, ST connectors, 2 Km operational distance.
F2804	19931-04	RS-232 standard, 0-76.8 Kbps, multimode 1300nm optics, ST connectors, 8 Km operational distance.
F2805	19931-05	RS-232 standard, 0-76.8 Kbps, single mode 1300nm optics, ST connectors, 14 Km operational distance.

1.2 DESCRIPTION OF EQUIPMENT

1.2.1 Functional Characteristics

Model F280X are fiber optic products designed for use as a RS-232 interface extender (see Figure 2) or a modem link (see Figure 3). These units are DTE/DCE switch selectable and interface with other F280X Modems in VERSITRON's FOM II series. F280X Modems use multimode fiber optic cable up to 2 Km (6,560 ft.) for 850nm multimode optics, 8 Km (26,240 ft.) for 1300nm multimode optics, and single mode fiber optic cable up to 14 Km (45,920 ft.) for 1300nm single mode optics. F280X Modems have a maximum data rate of 76.8 Kbps and appear fully transparent in both directions. The unit can generate 18 internal clock frequencies. F280X Modems fully support the interface control signals associated with the EIA RS-232 and MIL-STD-188C 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

F280X Modems measure 7.0" wide x 0.84" high x 11.6" deep and are designed to be mounted in VERSITRON HF series enclosures or chassis (Ref. Table 1 for dimensions). Standalone options include single- (HF-1) and dual-card (HF-2) enclosures. Rack mount options include 2-slot side-by-side (HF-2SS) and 20-slot (HF-20) chassis. For HF-1, HF-2, or HF-2SS installations, each F280X Modem requires a power adapter. The adapter plugs into a one-pin connector on the back of the card to provide power. A female DB25 connector provides the RS-232 interface and two ST connectors provide the fiber optic interface. Both connectors are located on the back of the card. When using the HF-20 chassis, VERSITRON AC150W power supply / system monitors are used to provide power to the chassis. One AC150W utilizes two slots in the HF-20. Two AC150W units are recommended for power redundancy. F280X Modems have seven indicators: power (PWR), alarm (ALM), transmit data (TXD), receive data (RXD), transmit clock (TXC), receive clock (RXC), and Loopback (LOOP).



FIGURE 1. OVERALL VIEW, F280X MODEM

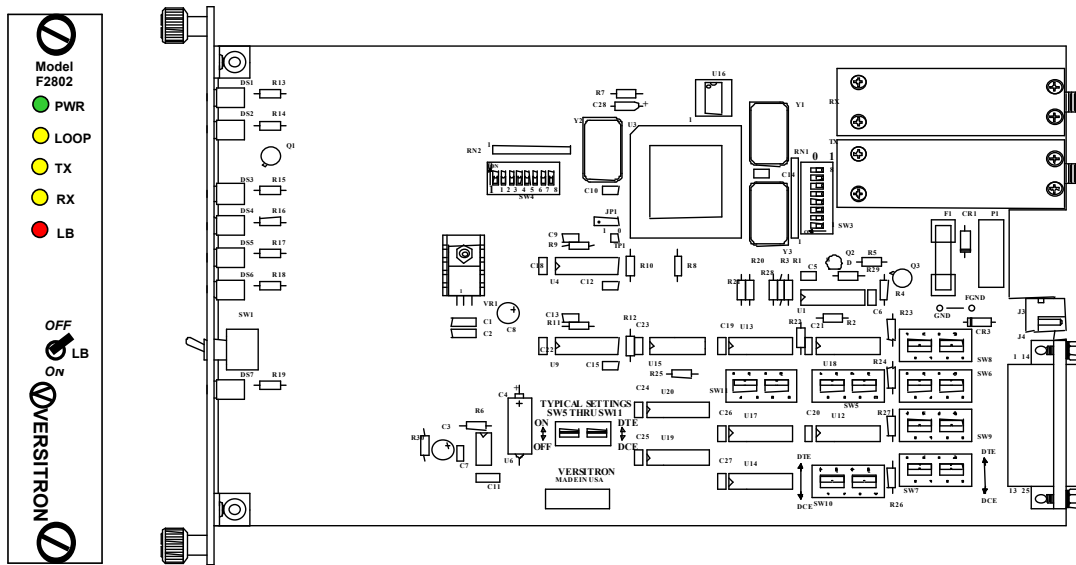


FIGURE 2. CIRCUIT CARD LAYOUT, F280X MODEM

Model Number	Part Number	Dimensions (H x W x D)	Description	Power Supply Required
HF-1	19052	1.3" x 7.1" x 11.6"	Single Card Standalone Enclosure	PSAC08 (115VAC) or PSAC09 (230VAC)
HF-2*1	19053	2.3" x 7.1" x 11.6"	Dual Card Standalone Enclosure	PSAC08 (115VAC) or PSAC09 (230VAC)
HF-2SS*1	19629	1.7" x 19.0" x 13.8"	2-Slot Rack Mount Chassis	PSAC08 (115VAC) or PSAC09 (230VAC)
HF-20	19032	7.0" x 19.0" x 11.6"	20-Slot Rack Mount Chassis	AC150W (115 or 230 VAC)

*1 Note: One Power Adapter per Modem required.

TABLE 1. ENCLOSURES / CHASSIS

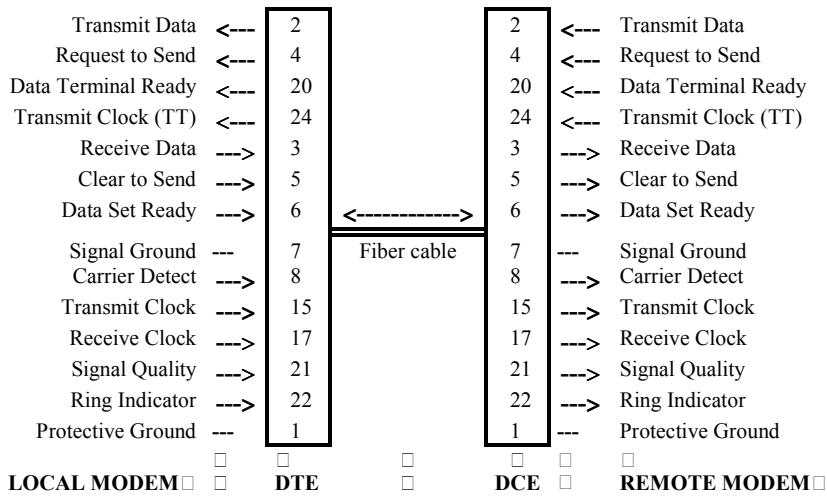


FIGURE 3. INTERFACE EXTENDER CONFIGURATION

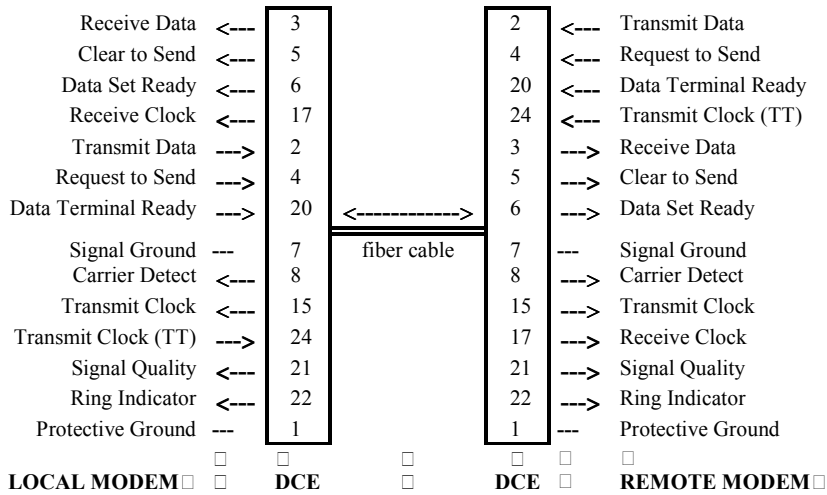


FIGURE 4. MODEM LINK CONFIGURATION

1.3 SPECIFICATIONS

Data Rate: Continuously variable from 0 Bps to 76.8 Kbps synchronous (source or terminal timing), asynchronous, or isochronous (Clock must be supplied externally). 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. Maximum operating range is 2 Km (6,560 ft.) with 850nm multimode optics or 8 Km (26,240 ft.) with 1300nm multimode optics on multimode fiber optic cable, and 14 Km (45,920 ft.) with 1300nm single mode optics on single mode fiber optic cable.

Optical Interface: ST connectors, compatible with 50/125, 62.5/125 or 100/140µm multimode fiber optic cable for 850nm or 1300nm multimode operation, or 8/125, 9/125, or 10/125µm single mode fiber optic cable for 1300nm single mode operation.

Digital Interface: Signal levels and format conform to EIA RS-232 / MIL-STD-188C. The F280X has a female DB25 connector for connecting to a terminal, with a gender changer required for connecting to a modem. The unit is switch selectable between DCE/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" (17.8 cm) W x 0.84" (2.1 cm) H x 11.6" (29.5 cm) D.

Weight: 16.0 oz. (0.45 kg).

Power Requirements: VAC source with AC-to-DC power adapter (VERSITRON Model PSAC08 US, PSAC09 EUR) providing 12 VDC, 1A; or + 12 VDC source.

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.

Model	F2802	F2804	F2805
Wavelength	Multimode 850nm	Multimode 1300nm	Single Mode 1300nm
Connector	ST	ST	ST
Transmit Power	-7 ± 1 dBm	-9 ± 1 dBm	-10 ± 1 dBm
Link Budget	26 ± 1 dB	28 ± 1 dB	30 ± 1 dB
Fiber Optic Cable	50,62.5,100/125µM	50,62.5,100/125µM	8,9,10/125µM
Maximum Range	2km/1.25mi/6,560ft	8km/5mi/26,240ft	14km/8.75mi/45,920ft

*Note: Multimode tests were performed on 62.5/125µM multimode fiber optic cable.
Single Mode tests were performed on 9/125µM single mode fiber optic cable.

SECTION 2 INSTALLATION

2.1 GENERAL

This section contains information on the installation and initial checkout of the F280X Modems. Section 2.2 contains general information on site selection and mounting. Section 2.3 describes power requirements. Section 2.4 describes switch settings. Section 2.5 describes timing modes. Section 2.6 describes loopback features. Section 2.7 contains initial checkout procedures.

2.2 SITE SELECTION AND MOUNTING

F280X Modems are designed to connect to the serial port (DB25 Connector) of terminal equipment with a customer supplied cable. F280X Modems are designed to be installed in either VERSITRON HF-1 or HF-2 standalone enclosures, or to be rack mounted in a VERSITRON HF-2SS or HF-20 19-inch standard chassis (Ref. Table 1 for enclosure and chassis dimensions). When installed in a HF-1, HF-2, or HF-2SS, space for the power adapter must also be provided.

2.3 POWER REQUIREMENTS

F280X Modems are designed to operate from an AC power adapter or a +12 VDC power source.

2.3.1 Installation with AC Power

Before inserting the VERSITRON power adapter, PSAC08 (US) or PSAC09 (EUR), into an AC power source, the plug should be connected to the Modem. There are no special tools required.

2.3.2 Installation with DC Power

DC power may be used instead of a power adapter. This requires a 2.5 mm socket, J3 (location shown in figure 1.5) with the positive voltage on the center and the common on the concentric supplying 12VDC at 1A as shown below:

Center = + 12VDC, 1A
Clip = Ground



FIGURE 5. DC POWER SUPPLY CONNECTIONS

SW3 POSITION SETTINGS:					
DATA RATE (Hz):	8	7	6	5	4
75	OFF	OFF	OFF	OFF	OFF
150	OFF	OFF	OFF	OFF	ON
300	OFF	OFF	OFF	ON	OFF
600	OFF	OFF	OFF	ON	ON
1200	OFF	OFF	ON	OFF	OFF
2400	OFF	OFF	ON	OFF	ON
3600	OFF	OFF	ON	ON	OFF
4800	OFF	OFF	ON	ON	ON
7200	OFF	ON	OFF	OFF	OFF
9600	OFF	ON	OFF	OFF	ON
14.4K	OFF	ON	OFF	ON	OFF
19.2K	OFF	ON	OFF	ON	ON
28.8K	OFF	ON	ON	OFF	OFF
38.4K	OFF	ON	ON	OFF	ON
56K	ON	OFF	OFF	OFF	OFF
57.6K	OFF	ON	ON	ON	OFF
64K	ON	OFF	OFF	OFF	ON
76.8K	OFF	ON	ON	ON	ON

TABLE 2. SW3 SETTINGS FOR INTERNAL TIMING

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		180° phase inversion (MIL-STD-188C)
3	3		X	0° phase inversion (RS-232)
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 pin 24)
4	2		X	Source Timing (External clock on pin 15)
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. F280X SWITCH SETTINGS

2.5 TIMING MODE

F280X 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 F280X Modems and should be left in the **OFF** position. The following sections describe the operation and associated required switch settings for each mode.

2.5.1 Source Timing

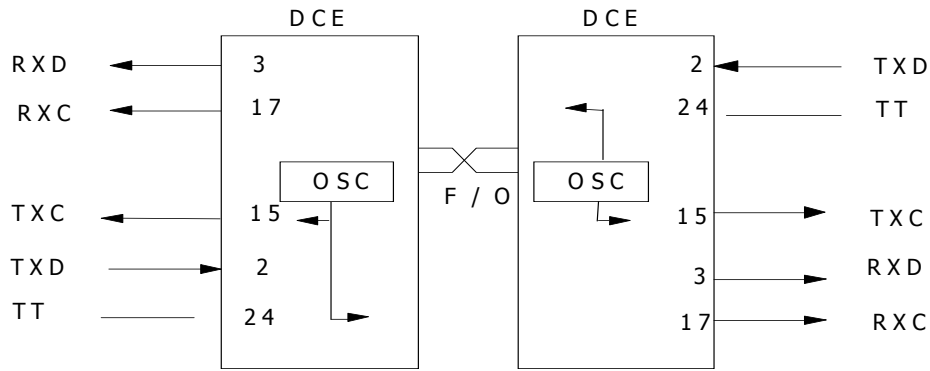
A realignment circuit is needed in the Source (external) Timing configuration to account for the inherent delays and jitter introduced by noise and asynchronous sampling at all frequencies. The realignment circuit is only used on the DTE units. A clock detection circuit checks for a clock signal on input pin 15 of the DB25 interface. If there is no clock signal on pin 15, no realignment takes place and data is output from the unit as it was received from the fiber optic input. If there is a clock signal present, the realignment circuit processes the data signal recovered from the fiber optic receiver before it is output onto pin 2. In Source Timing mode, the F280X Modems support transmitted and received data, transmitted and received clocks, and eight control signals. The unit shall transmit and receive signals at a data rate between 50 Bps and 76.8 Kbps with a bit error rate of 1×10^{-9} . Switch 4, Position 2 should be **OFF** for source timing.

2.5.2 Terminal Timing

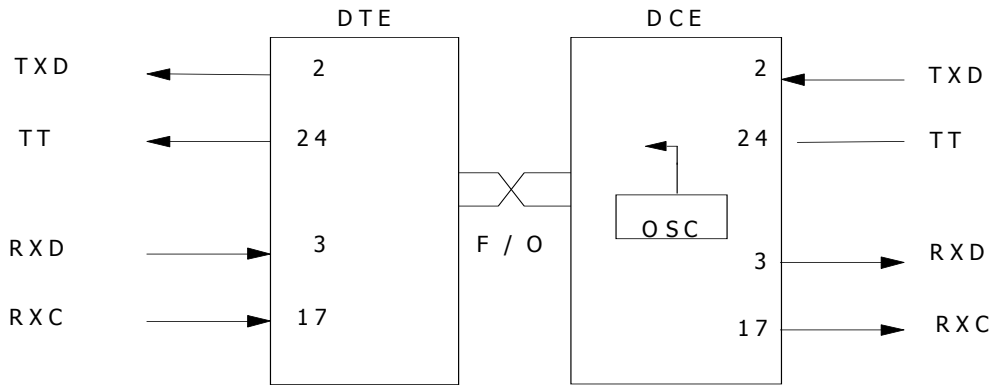
The Terminal (external) Timing mode is the basic mode of operation for the F280X Modems. There is no circuit needed for data realignment. In Terminal Timing mode, the F280X Modems support transmitted and received data, transmitted and received clocks, and eight control signals. Data signals at a data rate from 50 Bps to 76.8 Kbps are processed transparently by the Modem, with a bit error rate of 1×10^{-9} . Switch 4, Position 2 should be **ON** for terminal timing.

2.5.3 Internal Timing

F280X Modems can supply clock frequencies internally while configured as an RS-232 DCE. SW3, Positions 4 through 8 allow the user to select 18 different clock frequencies (Ref. Table 2). The internal timing mode is set by turning SW4, Position 1 **ON**. 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 signal on input pin 24 of the DB25 interface and the transmit clock signal (TXC), input on pin 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 pin 24 of the DTE Modem. Both configurations are illustrated in Figure 6. When SW4, Position 1 is in the **OFF** position the internal clock is off.



INTERNAL TIMING -
NULL MODEM / MODEM LINK



INTERNAL TIMING -
INTERFACE EXTENDER

FIGURE 7. INTERNAL TIMING MODES

2.6 LOOPBACK

F280X Modems have 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 F280X Modems allow 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 (Ref. Table 3).

2.7 INITIAL CHECKOUT PROCEDURE

F280X Modems 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 rackmount 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 F280X.
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 F280X Modems. Since the F280X Modems are designed for continuous and uninterrupted operation, there are no operating requirements. Once the F280X Modem is powered up it should remain in service as long as required.

3.2 STATUS INDICATORS/AUDIBLE ALARM

There are 7 indicators on the F280X Modem: 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 F280X Modems are those used to select between DTE/DCE, internal clock selection, or remote/local (CTS/RTS loop) (Ref. Figure 5). This selection is normally done 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 F280X Modems 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 F280X Modem supplies both transmit and receive clocks 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 F280X Modem 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 800mA 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"> 1. Check that fiber optic cable is properly connected to RX connector. 2. Check that the remote unit power is on and the TX fiber optic connector is connected properly. 3. Measure the optical levels on both ends (if possible) in order to check the optical link. 4. Contact VERSITRON Customer Service for assistance.
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-232.

TABLE 4. NON-OPERATIONAL INDICATORS