F2238 / F2240 / F2245
FOM II Series
RS-530
High-Speed
Fiber Optic Modem
Technical Manual

June 2004

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E040619643

PROPRIETARY DATA

WARRANTY

All VERSITRON products are warranted against defects in materials and workmanship for a period of one year from date of delivery. VERSITRON reserves the right to repair or, at our option, replace parts which during normal usage prove to be defective during the warranty period provided that:

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2. Shipping charges are pre-paid.

No other warranty is expressed or implied and we are not liable for consequential damages. For repairs outside of the warranty period, the same procedure must be followed.

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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 Model F22XX FOM II Series RS-530 High-Speed Fiber Optic Modems. 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 F22XX circuit card assembly.

Model Number	Part Number	Description
F2238	19643-02	RS-530 High-Speed Fiber Optic Modem, duplex, multimode, 850 nM, ST connectors, 250 Bps – 10 Mbps, distances to 2 Km*.
F2240	19643-04	RS-530 High-Speed Fiber Optic Modem, duplex, multimode, 1300 nM, ST connectors, 250 Bps – 10 Mbps, distances to 6 Km*.
F2245	19643-05	RS-530 High-Speed Fiber Optic Modem, duplex, single mode, 1300 nM, ST connectors, 250 Bps – 10 Mbps, distances to 15 Km*.

* **Note**: Multimode tests performed @ 100 Kbps on 62.5/125 µM fiber optic cable.
Single mode tests performed @ 100 Kbps on 10/125 µM fiber optic cable.

1.2 DESCRIPTION OF EQUIPMENT

1.2.1 Functional Characteristics

Model F22XX modems are high-speed modems that allow the full duplex transmission of data, clock and a control signal (data terminal ready (DTR), data set ready/data carrier detect (DSR/DCD)) over fiber optic cable. Figure 2 shows the modem link configuration. The fiber circuit consists of two modems connected by two fiber optic strands with data rates and electrical signal characteristics that conform to EIA RS-530 and MIL-STD-188-114 balanced/unbalanced standards. The modems provide synchronous or asynchronous data transmission at speeds up to 10 Mbps. The link is fully transparent in both directions and is data agile. Model F2238 modems are installed with 850 nM multimode optics and operate at distances of up to 2 Km (1.25 mi./6,600 ft.) on multimode fiber cable. Model F2240 modems installed with 1300 nM multimode optics operate at distances of up to 6 Km (3.7 mi./19,680 ft.) on multimode fiber cable. Model F2245 modems installed with 1300 nM single mode optics operate at distances of up to 15 Km (9.3 mi./49,100 ft.) on single mode fiber cable. Basically, model F22XX modems operate as two channel multiplexers/modems. For high-speed synchronous operation the first channel is used for data and the second for transmit clock. Both channels may be used for data in low-speed, asynchronous operation at less than 100 Kbps.

1.2.2 Physical Characteristics

Model F22XX modems measure 7 x 1 x 11 in. WxHxL (17.8 x 2.5 x 27.9 cm). They are designed to be mounted in VERSITRON's FOM II Series HF enclosures and chassis (see Table 1). Model HF-1 (single card) desktop enclosures are available for standalone applications. Standard 19" rack mountable options include models HF-2SS (2-slot) and HF-20A (20-slot) chassis. *Each* modem installed in models HF-1 or HF-2SS requires its own VAC to VDC power adapter. Each power adapter uses the one-pin connector on the back of the modem for power input. (Customer provided power may be supplied to the modem using the same one-pin connector.) When installed into the HF-20A chassis model AC300WR power supply is used to provide power to the chassis and to the modems. Power is provided from the AC300WR power supply to the HF-20A chassis via model HF-CA3 power interface cable where it is then distributed to *any* FOM II Series modem installed in the chassis. Power redundany is included with the AC300WR power supply with two separate AC input cables provided for power input from separate VAC sources. The RS-530 copper interface is a female DB25 connector and is located on the back of the modem. The fiber optic interface, also located on the back of the modem, consists of two ST connectors (one transmit; one receive). Model F22XX Modems have five indicator LEDs: power on (PWR), loop indicator (LOOP), transmit data present (TX), receive data present (RX), and loopback mode indicator (LB).

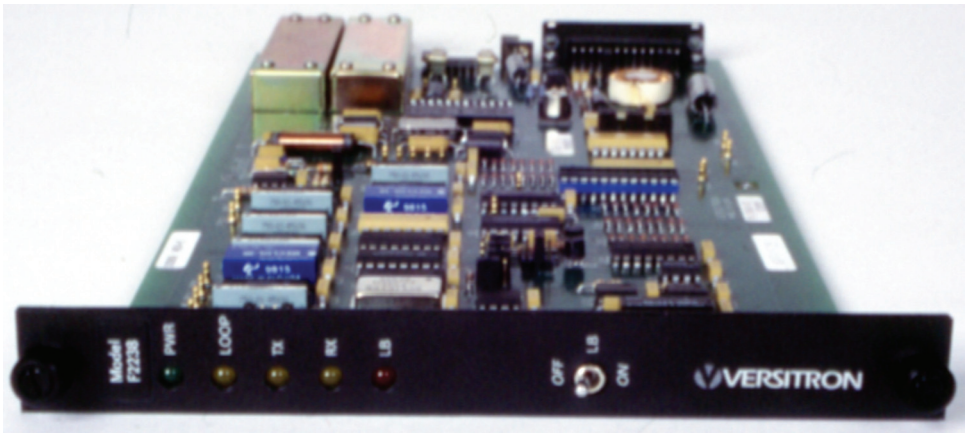
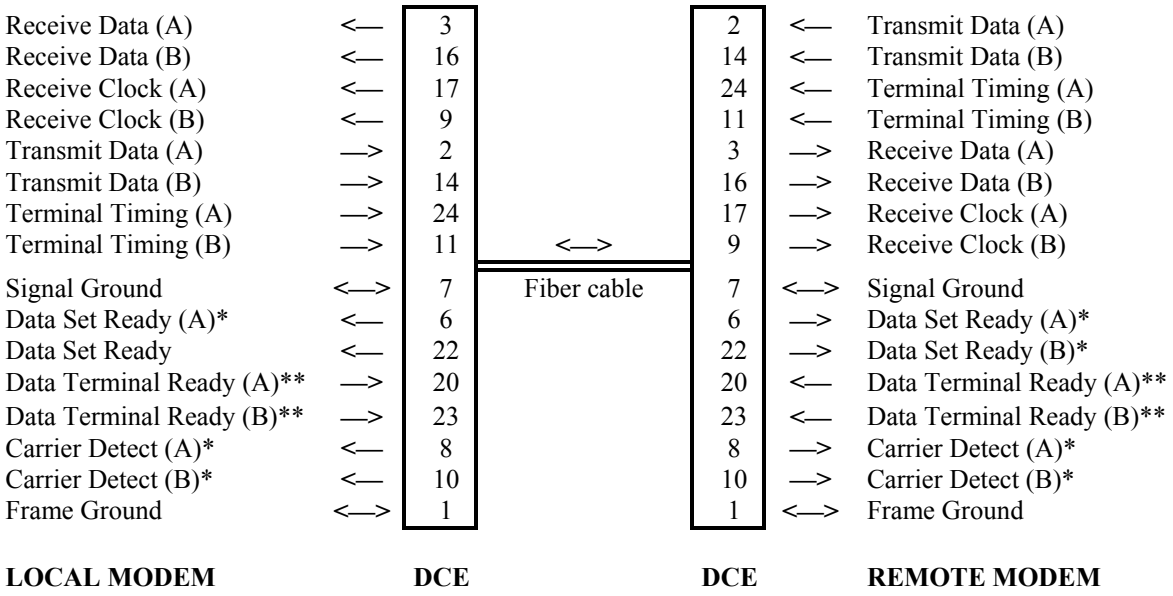


FIGURE 1. OVERALL VIEW, F22XX MODEMS



* Produced by local modem, not received from remote modem.
** Signal not physically passed, used to control signal flow through local modem.

FIGURE 2. F22XX MODEM LINK CONFIGURATION

Model / Part Number	Dimensions	Description	Power Supply Required
HF-1* / 19052	7.1 in. wide (18.0 cm) x 1.3 in. high (3.3 cm) x 11.6 in. deep (29.5 cm)	Single Card Standalone Enclosure	**PSAC15 /** LTWPD1215PLX (US) **PSAC09** / LTWPD1210EPL (VDE)
HF-2SS / 19629	19.0 in. wide (48.3 cm) x 1.7 in. high (4.3 cm) x 13.8 in. deep (35.1 cm)	2-Slot Rack Mount Chassis	**PSAC15 /** LTWPD1215PLX (US) **PSAC09** / LTWPD1210EPL (VDE)
HF-20A / 32406	19.0 in. wide (48.3 cm) x 7.1 in. high (18.0 cm) x 11.6 in. deep (29.5 cm)	20-Slot Rack Mount Chassis	**AC300WR /** 32410 (Universal)

* One Power Adapter per Modem is required when installed in these Models.

TABLE 1. ENCLOSURES / CHASSIS

1.3 SPECIFICATIONS

Data Rate: Any data rate from 250 Bps to 10.0 Mbps, synchronous; 100 Kbps, asynchronous.

Operating Mode: Simplex, Half or Full duplex operation over fiber optic cable pair.

Optical Interface: ST connectors.

Digital Interface: Signal levels and format conform to EIA RS-530 (synchronous and asynchronous) and MIL-STD 188-114 Balanced and Unbalanced.

Electrical Interface: Female DB25 (DCE) connector.

Bit Error Rate: Better than 10^{-9}.

MTBF: 96,428 hrs.

Dimensions: 7 x 1 x 11 in. WxHxL (17.8 x 2.5 x 27.9 cm).

Weight: 12.0 oz. (0.34 kg).

Power Requirements: 12 VDC @ 1.5A, 18 watts; optional VAC to VDC wall transformer:
(VERSITRON Model PSAC15, 120 VAC ~ 60 Hz to 12 VDC, 1.5A)
(VERSITRON Model PSAC09, 230 VAC ~ 50 Hz to 12 VDC, 1A)

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	F2238	F2240	F2245
Connector	ST	ST	ST
Wavelength	850 nm Multimode	1300 nm Multimode	1300 nm Single Mode
Link Budget*	18 ± 1 dB	16 ± 1 dB	22 ± 1 dB
Maximum Range*	2 Km (1.24 mi./6,560 ft)	6 Km (3.7 mi./19,680 ft)	15 Km (9.3 mi./49,100 ft)
Fiber Cables	50 or 62.5/125 µM 100/140 µM	62.5/125 µM	8 or 9 or 10/125 µM

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

SECTION 2
INSTALLATION

2.1 GENERAL

This section contains information on the installation and initial checkout of the Model F22XX modems. Paragraph 2.2 contains general information on site selection and mounting. Paragraphs 2.3 through 2.6 contain detailed instructions for connecting F22XX modems and selecting the available options. Paragraph 2.7 contains initial checkout procedures.

2.2 SITE SELECTION AND MOUNTING

The Model F22XX modems are designed to connect directly to the serial port (DB25 Connector) of terminal equipment with a customer-supplied cable. Mounting options include single card (HF-1) standalone enclosures and 2-slot (HF-2SS) or 20-slot (HF-20A) rack mount chassis.

2.3 POWER REQUIREMENTS

Model F22XX modems operate from an AC power source or a DC power source with a DC voltage of +12 VDC, 1.5A. The power supplies used when installed in a HF-1 enclosure or HF-2SS chassis are VERSITRON Model PSAC15 (US) providing +12 VDC, 1.5A or PSAC09 (European) providing +12 VDC, 1A. Connect the power adapter to the F22XX modem before inserting its plug into an AC power source. No special tools are required. DC power may be used instead of an AC adapter, if available. This requires a 2.5 mm socket with positive on the center and common on the concentric, and providing +12 VDC, 1.5A. When modem installations utilize the Model HF-20A 20-slot chassis the AC300WR Power Supply / System Monitor is used to provide power to all modems installed. The AC300WR is designed with power redundancy and requires one unit of rack space above the HF-20A.

2.4 SWITCH SETTINGS

2.4.1 Polarity Straps

The input/output polarity straps should be set as specified in Table 2. The locations of the jumpers and test points on the F22XX circuit board are shown in Figure 3.

I/O	JUMPER	NONINVERTED (TRUE) POLARITY	INVERTED POLARITY
CH. 1 (TX DATA) INPUT	JP6	A: 3-4, B: 1-2	A: 1-3, B: 2-4
CH. 2 (TX CLOCK) INPUT	JP8	A: 3-4, B: 1-2	A: 1-3, B: 2-4
DTR INPUT	JP10	A: 3-4, B: 1-2	A: 1-3, B: 2-4
CH. 1 (RX DATA) OUTPUT	JP4	2-3	1-2
CH. 2 (RX CLOCK) OUTPUT	JP5	2-3	1-2
DCD/DSR OUTPUT	JP2	1-2	2-3
LOOPBACK CIRCUIT	JP12	OPEN - ENABLED	1-2 - DISABLED

TABLE 2. F22XX MODEM JUMPER SETTINGS

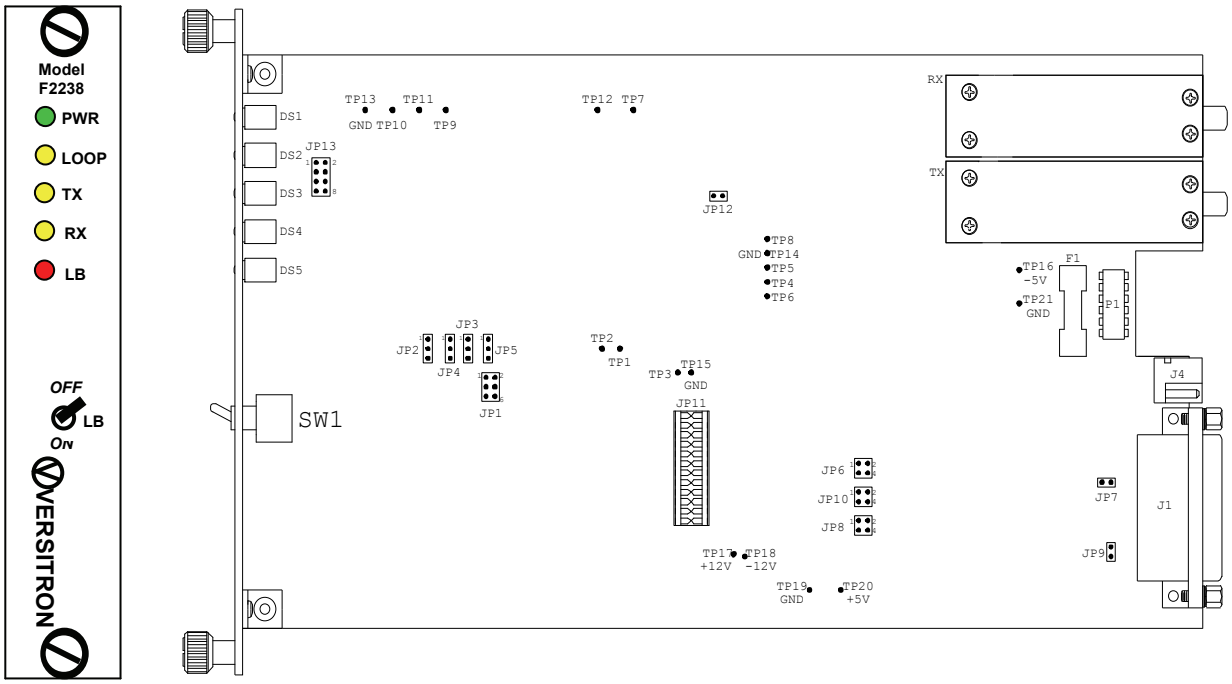


FIGURE 3. F22XX MODEM JUMPER AND TEST POINT LOCATIONS

2.4.2 Jumpers for Input Impedance Selection

Channel 1 (Transmit Data) and Channel 2 (Synchronous Transmit Clock or Asynchronous Data #2) will be set for high impedance when jumpers JP7 and JP9 are not inserted. If JP7 and JP9 are present, the input impedance is 100 ohm. The 100 ohm termination is not available on the DTR input.

2.4.3 Jumpers for Transmit Clock Selection

The transmitter operating mode is controlled by jumper JP1. For automatic, rate-dependent selection of transmitted synchronous clock and data, set JP1 = 3-4. To have the input data stream synchronized to the internal 10 MHz clock while being processed ("forced sync"), set JP1 = 1-2. For fixed over-sampling of asynchronous data ("forced async"), set JP1 = 5-6. On the circuit board, pins 1, 3, and 5 are tied together, so the jumper appears as follows:

```
1o-----3o-----5o
2o      4o      6o
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2.4.4 Jumpers for Receive Clock Selection

For automatic mode (receiver tracking transmitter, full duplex operation) receive clock and data, set JP3 = 2-3 and JP13 = 1-2, 7-8. For forced synchronous mode (data clocked by internal 10 MHz clock), set JP3 = 2-3 and JP13 = 5-6, 7-8. For forced asynchronous mode, if the receiver is being used with no transmit clock, or for two asynchronous data channels, set JP3 = 1-2 and JP13 = 1-2, 7-8.

2.4.5 Settings for Balanced/Unbalanced Outputs

The conversion from Balanced to Unbalanced output data streams is accomplished using jumper JP11, which is a 24-pin jumper network. For MIL-STD-188-114 Balanced (RS-422 compatible) output, JP11 connects the following pins together: 2-23, 4-21, 6-19, 8-17, 10-15, and 12-13. When a change to MIL-STD-188-114 Unbalanced (RS-423 compatible) output is desired, JP11 must be removed, rotated 180 degrees, and reinserted so that the following pins are connected: 1-24, 3-22, 5-20, 7-18, 9-16, and 11-14.

2.5 Output Connections

The F22XX Modem uses a standard DB25 Female connector for the electrical signal interface. The pinout for this is given in Table 3.

SIGNAL	PIN	INTERFACE
TX D (A)	2	INPUT
TX D (B)	14	INPUT
TX CLK (A)	24	INPUT
TX CLK (B)	11	INPUT
DTR (A)	20	INPUT
DTR (B)	23	INPUT
RX D (A)	3	OUTPUT
RX D (B)	16	OUTPUT
RX CLK (A)	17	OUTPUT
RX CLK (B)	9	OUTPUT
DSR (A)	6	OUTPUT
DSR (B)	22	OUTPUT
DCD (A)	8	CONNECTED INTERNALLY TO DSR (A)
DCD (B)	10	CONNECTED INTERNALLY TO DSR (B)

TABLE 3. MODEL F22XX ELECTRICAL SIGNAL INTERFACE (DB25F) PINOUT

2.6 LOOPBACK

The F22XX Modem has a loopback mode to facilitate the testing of the unit in a system environment. When the Loopback switch on the front panel of the circuit card is in the ON position, the line encoder is routed directly to the line decoder, and the fiber optic receiver output is connected directly to the fiber optic transmitter input. This achieves a loopback of the transmit data to the receive data output, the transmit clock to the receive clock output, the DTR input to the DCD/DSR output, and the received optical input to the transmit optical output. Therefore the loopback mode tests virtually 100% of the Modem.

2.7 INITIAL CHECKOUT PROCEDURE

The F22XX Modem contains no power on/off switch. Once properly installed and powered, the unit is fully operational. The power indicator should remain on as long as power is supplied to the unit.

Before beginning system operation, to ensure proper installation, verify that:

1. The power plug is seated fully into the Modem or seated firmly in the rack-mount chassis.
2. The fiber optic cable is crossed transmit to receive from unit one to unit two and vice versa.
3. The LOOP LED illuminates when a link is established to the remote optical receiver of the F22XX. Note that the LOOP LED will illuminate regardless if there is data flowing to indicate a valid link between the two modems over fiber optic cable.
4. The jumper settings for the circuit configuration are correct (e.g. non-inverted/inverted signal polarity, clock selection, balanced/unbalanced outputs).

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 F22XX FOM II series Modems. Since the Model F22XX is designed for continuous and uninterrupted operation, there are no changes required during operation. Once powered up the Model F22XX should remain in service as long as required.

3.2 STATUS INDICATORS

Five LED indicators on the Model F22XX FOM II products provide the operational status of the unit. When illuminated, the green power (PWR) LED indicates that all DC power supply voltages are present. The next indicator, labeled loop (LOOP) will illuminate when the optical receiver detects an input. The transmit data (TX) and receive data (RX) indicators show the presence of data activity. The red LED for loopback (LB) indicates that the circuit board is in loopback mode when illuminated. There is no audible alarm with the F22XX Modems.

3.3 BIT RATE MONITOR

The bit-rate-monitor circuit measures the transmit clock period and is used to control the code time base when the Modem is in the automatic mode. At low clock rates, or when no clock is present, the unit selects an internal 10 MHz oscillator as the code time base. This high sampling rate minimizes jitter caused by sampling within the transmit circuit. At higher clock rates, the transmit clock itself is selected as the code time base. This has the advantage that the code is synchronous with the transmitted data, so there is no sampling-induced jitter.

When the input data rate increases from below 50 Kbps, the bit-rate-monitor circuit will switch from the 10 MHz oscillator to the transmit clock at a data rate of about 120 Kbps. It will switch in the opposite direction when the data rate falls below about 60 Kbps. The hysteresis in the switching circuit protects against the modem switching time bases incorrectly if operating close to the switching threshold.

3.4 CLOCK SELECT OPTIONS

The only controls with the Model F22XX FOM II Series Modems are those jumpers that configure the operation in one of three modes: Automatic, Forced Synchronous, and Forced Asynchronous. The Automatic mode is appropriate for use with full duplex data transmission. One of the two Forced modes should be used if the transmit and received sections of the circuit board are operated independently of each other. The jumper settings are described in Section 2.4 and selection is normally done at the time of installation. Further changes are not required unless the overall system requirements change.

THEORY OF OPERATION

4.1 INTRODUCTION

Basic operation of the Model F22XX is similar to a two-channel, full duplex multiplexer. The first channel is used for high-speed synchronous data. The second channel is used for transmit clock, or for an asynchronous second data channel. Both channels may be used for low-speed (less than 100 Kbps), asynchronous operation.

The first of the three operating modes of the F22XX Modems permits data transparency. In the Automatic mode a data rate from 250 Bps to 10 Mbps is accepted and the data rate may be variable, as is sometimes seen in high-speed telemetry systems. An internal bit rate monitor circuit selects the source of the transmit clock. At clock rates of less than 100 Kbps, or when no external clock is present, an internal 10 MHz reference signal is utilized as the clock. This assures a sufficiently large number of samples for minimum end-to-end timing jitter. The actual clock signal is used at clock frequencies greater than 100 kHz.

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.

SECTION 5

MAINTENANCE AND TROUBLESHOOTING

5.1 INTRODUCTION

This chapter contains general information designed to isolate a malfunction in the Model F22XX 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 for assistance.
LOOP (LOOP) LED is off or not responding.	Incorrect optical signal level received at receiver input.	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 for assistance.
DATA (TX or RX) LEDs are off or not responding.	Jumpers in wrong position.	Check that the 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.	Jumpers in wrong position.	Check that the jumper is set for the correct electrical interface.
	Inverted input on the electrical interface connector.	Check that the interface connector is wired per interface standard RS-530.

TABLE 4. NON-OPERATIONAL INDICATORS