F2400
FOM II Series
Fiber Optic Modem
Technical Manual

T1

Revision B

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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 information on the installation and operation of the Model F2400 FOM II Series T1 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.

Model Number	Part Number	Description
F2402	30283-02	T1 fiber modem, duplex or simplex, 850nm MM LED, ST, 3km
F2404	30283-04	T1 fiber modem, duplex or simplex, 1300nm MM LED, ST, 15km
F2405	30283-05	T1 fiber modem, duplex or simplex, 1300nm SM LED, ST, 30km

1.2 DESCRIPTION OF EQUIPMENT

1.2.1 Functional Characteristics

F2400 modems operate as point-to-point converters for copper-to-fiber T1-standard interface extenders. F2400 modems transmit over fiber optic cable up to 3km (1.85mi/9,800ft) with multimode 850nm LEDs, up to 15km (9.3mi/49,000ft) for multimode 1300nm LEDs or up to 30km (18.5mi/98,000ft) for single mode 1300nm LEDs. The fiber optic circuit (two F2400 modems connected by fiber cable) has data rates and electrical signal characteristics that conform to ANSI T1.403, AT&T Pub. TR54016 and TR62411 standards. Electrical signals on copper cable are converted to fiber optic signals by the F2400 modem, and AMI or B8ZS data protocols are decoded.

1.2.2 Physical Characteristics

F2400 modems measure 7.0W x 0.84H x 11.6L in. (17.8 x 21. X 28.9 cm) and are designed for mounting in a variety of VERSITRON enclosures. Table 1 lists dimensions of enclosures and chassis. Standalone options include single card enclosures (HF-1) and dual card enclosures (HF-2). 19" rack mount options include 2-slot chassis (HF-2SS) and 20-slot chassis (HF-20). Each F2400 modem installed in a HF-1, HF-2 or HF-2SS requires a power adapter Model PSAC08 (US) or PSAC09 (European) providing 12 VDC, 1A with a one-pin connector for electrical input on the back of the card. There is a female DB15 connector for the digital interface and two ST connectors for the fiber optic interface, also on the back of the card. F2400 modems installed in a HF-20 require a Model AC150W Power Supply / System Monitor. Each AC150W installed into the chassis requires two slots. Two AC150W supplies are recommended for power redundancy. F2400 Modems have six LED indicators on the front panel: power on (PWR), alarm (ALM), transmit data present (TXD), receive data present (RXD), bipolar violation (BPV), and loopback mode indicator (LOOP). No audible alarm is available.

FIGURE 1. OVERALL VIEW, F2400 FIBER OPTIC MODEMS

Model # (Part #)	Dimensions	Description	Power Supply Required*1
HF-1 (19052)	7.1" W x 1.3" H x 11.6" L	Single Card Standalone Enclosure	**PSAC08** (LTWPD1210PLX) **PSAC09** (LTWPD1210EPL)
HF-2 *2 (19053)	7.1" W x 2.3" H x 11.6" L	Dual Card Standalone Enclosure	**PSAC08** (LTWPD1210PLX) **PSAC09** (LTWPD1210EPL)
HF-2SS *2 (19629)	19" W x 1.7" H x 13.8" L	2-Slot Rack Mount Chassis	**PSAC08** (LTWPD1210PLX) **PSAC09** (LTWPD1210EPL)
HF-20 (19032)	19" W x 7.1" H x 11.6" L	20-Slot Rack Mount Chassis	**AC150W** (19320-03)

*1 Note: US Model - PSAC08; European Model - PSAC09

*2 Note: One Power Supply per Modem required.

TABLE 1. ENCLOSURES / CHASSIS

1.3 SPECIFICATIONS

Protocol: Synchronous

Data Rate: (N x 64 Kbps) 1.544 Mbps.

Operation: Full duplex or simplex.

Optical Interface: ST connectors.

Digital Interface: Signal levels conform to ANSI T1.403, AT&T Pub. TR54016 and TR62411 standards.

Electrical Interface: Female DB15.

Dimensions: 7.0" wide x 0.84" high x 11.6" deep (17.8 x 2.1 x 28.9 cm).

Weight: 16.0 oz. (0.45 kg).

Power Requirements: 120 VAC, 1.4 Watts, with optional DC wall transformer (VERSITRON Model PSAC08, providing 12 VDC, 1 A, US; VERSITRON Model PSAC09, European).

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	F2402	F2404	F2405
Wavelength	Multimode 850nm	Multimode 1300nm	Single Mode 1300nm
Link Budget*	26 ± 1 dB	29 ± 1 dB	30 ± 1 dB
Operating Range	3km / 1.85mi / 9,800ft	15km / 9.3mi / 49,000ft	30km / 18.5mi / 98,000ft
Fiber Optic Cable	50/125,62.5/125,100/140	50/125, 62.5/125, 100/140	8/125, 9/125,10/125

*Note: Multimode tests were performed on 62.5/125 µM fiber optic cable.
Single Mode tests were performed on 10/125 µM fiber optic cable.

Format	ESF (Extended Super Frame)	D4 (Super Frame)
AMI	Yes	Yes
B8ZS	Yes	Yes

SECTION 2
INSTALLATION

2.1 GENERAL

This section contains detailed information on the installation and initial checkout of the F2400 modems. Paragraph 2.2 contains general information on site selection and rack mounting. Paragraphs 2.3 through 2.6 contain detailed instructions for connecting the modems to your system and selecting the different options. Paragraph 2.7 contains initial checkout procedures.

2.2 SITE SELECTION AND MOUNTING

F2400 modems are designed to connect directly to the serial port (DB15F Connector) of PBX or multiplexer equipment with a cable (customer supplied). Mounting options include standalone single card (HF-1) or dual card (HF-2) enclosures and 2-slot (HF-2SS) or 20-slot (HF-20) rack mount chassis.

2.3 POWER REQUIREMENTS

F2400 modems operate from an AC power source or a DC power source with a DC voltage of +12 VDC, 1A. The power supplies used when installed in a HF-1, HF-2, or HF-2SS are VERSITRON Model PSAC08 (US) or Model PSAC09 (European) providing 12 VDC, 1A. Connect the power transformer to the F2400 unit before inserting its plug into an AC power source. No special tools are required. DC power may be used instead of an AC transformer, if available. This requires a 2.5 mm socket with positive on the center and common on the concentric, and providing +12 VDC at 1A When installed in a HF-20, the AC150W Power Supply / System Monitor is used to supply power for all FOM II series circuit cards installed into the chassis. The AC150W requires two slots in a HF-20. For power redundancy, two AC150W units are recommended.

2.4 SWITCH SETTINGS

F2400 modems have one 8-position switch onboard the circuit card. This switch is located near the DB15 connector, as shown in Figure 2. The switch is labeled "SW3" on the circuit card, and is positioned such that the "ON" setting of each of the 8 switch positions is towards the front panel of the circuit card. The settings of the 8 switch positions are as specified in Tables 2 and 3.

Position 1 on the switch, RCODE, is used to set the protocol for the data received on the T1 link. Position 8, TCODE, likewise is used to set the protocol for the data transmitted on the T1 link. Both of these may be set for AMI or B8ZS protocols. These switches must be set properly prior to operation, and if the encoder or decoder settings do not agree with the input data, the unit may not function properly. Two loopback settings may be changed using switch positions 6 and 7. Position 6, RLOOP, allows for loopback of the copper interface, and Position 7, LLOOP, permits the loopback of the fiber interface. The local loopback is controlled from the front panel of the F2400 while in operation. Position 2 is not used, and Positions 3-5 are set on the basis of the cable length of the copper interface.

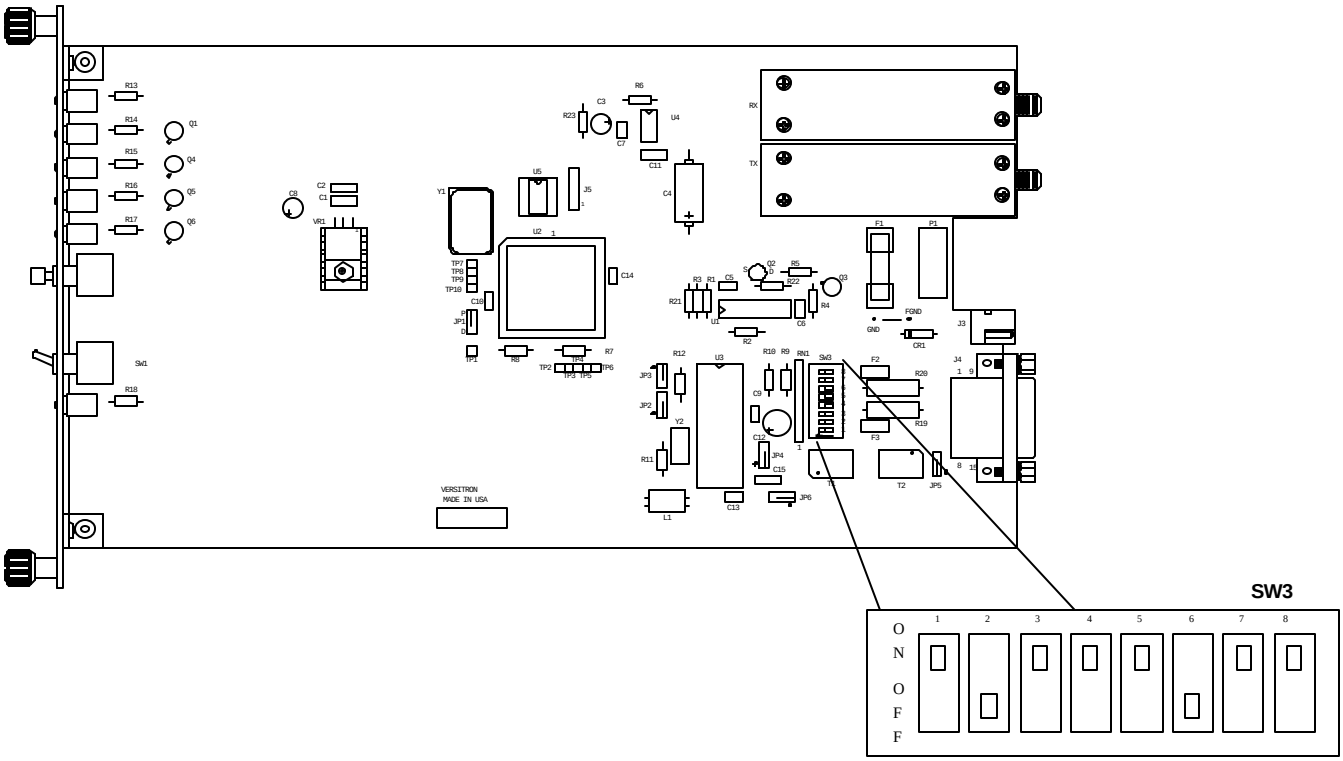

FIGURE 2. CIRCUIT DETAIL SHOWING SWITCH LOCATION

SWITCH 3	NAME	FUNCTION ON	FUNCTION OFF
POSITION 1	RCODE	AMI	B8ZS
POSITION 2	NOT USED	N/A	N/A
POSITION 3	LEN 0	Cable Length Settings: See Table 3.	
POSITION 4	LEN 1		
POSITION 5	LEN 2		
POSITION 6	RLOOP	Remote Loop ON	Remote Loop OFF
POSITION 7	LLOOP	Local Loop ON	Local Loop OFF
POSITION 8	TCODE	AMI	B8ZS

TABLE 2. SWITCH SETTINGS

2.4 SWITCH SETTINGS (Cont.)

Positions 3, 4 and 5 of the switch are set based on the length of cable used for the copper interface to the F2400 modem. As shown in Table 3, the modem may be configured to handle cable lengths up to 655 feet. The five-partition selection meets T1 DSX-1 cross-connect standards ANSI T1.102 and AT&T CB-119 requirements when using #22 ABAM cable. Two additional options are available for T1 Network Interface applications.

There are six jumpers on the F2400. None of the other jumpers should be changed from the positions set in the factory. They are used for test and diagnostic purposes only and are not to be reset by the user.

POSITION 3 (LEN 0)	POSITION 4 (LEN 1)	POSITION 5 (LEN 2)	CABLE LENGTH	APPLICATION
ON	ON	OFF	< 133 FT	DSX-1 ABAM (AT&T 600B OR 600C)
OFF	OFF	ON	133-266 FT	
ON	OFF	ON	266-399 FT	
OFF	ON	ON	399-533 FT	
ON	ON	ON	533-655 FT	
OFF	ON	OFF	FCC PART 68	NETWORK INTERFACE
ON	ON	OFF	ECSAT1C1.2	

TABLE 3. SWITCH SETTINGS VS. COPPER INTERFACE CABLE LENGTH

2.5 OUTPUT CONNECTIONS

F2400 modems use a standard 15-pin D sub miniature connector (female) for the electrical signal interface. Only four of the pins are used, however. Receive data is input on Pins 1 and 9 and transmit data is output on Pins 3 and 11.

2.6 LOOPBACK

F2400 modems have two loopback features. The first Loopback feature allows the user to test the fiber optic circuitry of the local unit, the fiber optic circuitry of the remote unit, the copper circuitry of the local unit, and the copper circuitry of the remote unit. The second Loopback feature loops the interface circuitry only.

2.6.1 Fiber/Copper Loopback

The fiber optic inputs and outputs of the F2400 modems are connected to a multiplexer. When the front panel loopback switch (LB) is switched ON, the multiplexer control bit is set high and fiber optic input data is looped to the output and back to the source. The copper signals entering through the interface circuitry are encoded and decoded by the multiplexer and likewise looped back to their source. If both the fiber and copper input and output signals match, then the optical and interface circuitry of both units is operating properly.

2.6.2 Interface Loopback

As listed in Table 2, RLOOP and LLOOP, switch positions 6 and 7, are used to loop the bipolar data signals at the interface. This allows for testing of the copper and fiber inputs and outputs between connected devices without going through the copper-to-fiber conversion circuitry.

2.7 INITIAL CHECKOUT PROCEDURE

F2400 modems contain no power on/off switch. Once the unit is properly installed and power is applied it is considered fully operational. The power indicator (PWR) should remain on as long as power is supplied to the unit. Upon initial power up, with no signal connections made, the PWR, alarm (ALM) and bipolar violation (BPV) LED indicators should be on. When signal connections are properly made, the transmit data (TXD) and receive data (RXD) LED indicators should be on and the ALM and BPV LEDs should go off.

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 F2400 or 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 ALM and BPV LEDs go out when the signals are applied to the F2400.

4. Verify that the LOOP LED comes on and goes out with the LB switch on the front panel.

5. Verify the switch settings are correct for the circuit configuration.

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 F2400 modems. Since the modem is designed for continuous and uninterrupted operation, there are no operating requirements. Once powered up, it should remain in service as long as required.

3.2 STATUS INDICATORS AND ALARM CIRCUITS

There are six LED indicators on the F2400: power (PWR), alarm (ALM), transmit data (TXD), receive data (RXD), bipolar violation (BPV), and loopback (LOOP). No audible alarm is available. The F2400 modems contain a standard FOM II alarm circuit to monitor the optical connection and power supplies. The ALM LED is activated when no signal is present at the fiber optic interface. When AMI signals are decoded, bipolar violation circuitry checks the signal. The BPV LED is activated when a violation is detected and remains on until turned off by the RESET switch on the front panel.

3.3 OPERATING CONTROLS

The only operating controls associated with the F2400 modems are two front panel switches. The LB switch is used to enable the loopback capability of the circuit. This is described in Section 2.6 and is normally only used for diagnostic purposes when initializing or reconfiguring the system using the F2400. The reset push-button switch is only used if a bipolar violation occurs. The switch settings onboard the circuit card are described in Tables 2 and 3 in Section 2.4 and are set prior to first using the modem. Further changes are not required unless the system requirements change.

SECTION 4
THEORY OF OPERATION

4.1 INTRODUCTION

F2400 modems provide a transparent, synchronous path for T1-standard signals. By converting to fiber optic signaling, a distance of 3km (1.85mi/9,800ft) for 850nm multimode LEDs, 15km (9.3mi/49,000ft) for 1300nm multimode LEDs, or 30km (18.5mi/98,000ft) for 1300nm single mode LEDs may be traversed without the need for a repeater or amplifier. In addition, the use of fiber optic cable as the transmission medium provides EMI/RFI protection and data security.

In the F2400 transmitter circuitry, the data is received via Pins 1 and 9 of the DB15 connector. The signal is decoded for AMI or B8ZS protocol, and then Manchester encoded (which embeds a clock signal) with a Field Programmable Gate Array (FPGA). Next the signal is converted into an optical signal. The optical signal transmitter then sends the signal out onto the fiber optic cable.

Through the receiver circuitry of the F2400 the same process occurs in reverse. First the optical signal is received and converted back to an electrical signal. The FPGA decodes the Manchester data and clock signals. The data signal is then encoded for the AMI or B8ZS protocol and output to Pins 3 and 11 of the DB15 electrical signal interface. To the multiplexer or PBX terminal equipment connected to the F2400 pair, the transition from copper to fiber and back is transparent.

SECTION 5
MAINTENANCE AND TROUBLESHOOTING

5.1 INTRODUCTION

This chapter contains general information designed to isolate a malfunction in the F2400 modems 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. Contact VERSITRON Customer Service for additional diagnostic assistance or to arrange for repair as necessary.

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 800 mA, 5 x 20 mm Slo-Blo fuse.
	Other power supply circuit problem.	Contact VERSITRON Customer Service for assistance.
ALARM (ALM) LED is on.	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 RX fiber on one end is connected to the TX fiber on the other end. 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 (TXD, RXD) LEDs are off or not responding as expected.	Switches in wrong position.	Check that the switch is set for the correct electrical interface protocol.
	No input on the electrical interface connector.	Check that the interface connector is connected securely.
BPV LED continuously on.	Switches in wrong position.	Check that the switch is set for the correct AMI or B8ZS protocol.
	Inverted input on the electrical interface connector.	Check that the interface connector is wired correctly.

TABLE 4. NON-OPERATIONAL INDICATORS