

**F271X  
Fiber-Optic  
Tele/Data Modem  
Technical Manual**

Revision B

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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 F271X FOM II Series Fiber-Optic Tele/Data Modems. Section 1 provides a general description of the equipment. Section 2 provides installation instructions. Section 3 provides operating instructions. Section 4 provides the theory of operation. Section 5 provides maintenance and troubleshooting information. Figures 1.1 and 1.2 provide an overall view of the Model F271X Tele/Data Modems.

| <b>Model Number</b> | <b>Part Number</b> | <b>Description</b>                                                                                                 |
|---------------------|--------------------|--------------------------------------------------------------------------------------------------------------------|
| F2712               | 19686-02           | Audio, RJ11 and/or Data, RJ45 transmission, multimode, 850nm optics, ST connectors, 2 Km operational distance.     |
| F2714               | 19686-04           | Audio, RJ11 and/or Data, RJ45 transmission, multimode, 1300nm optics, ST connectors, 8 Km operational distance.    |
| F2715               | 19686-05           | Audio, RJ11 and/or Data, RJ45 transmission, single mode, 1300nm optics, ST connectors, 14 Km operational distance. |

#### 1.2 DESCRIPTION OF EQUIPMENT

##### 1.2.1 Functional Characteristics

The Model F271X products are fiber-optic Modems used as an interface extender from a single-line subscriber telephone. These units are designed to be used with Model F270X Modems that provide an interface to the exchange or central office, or a pair of F271X can be used in a ring down or intercom application (see figure 1.4 for details). These Modems are designed to transmit audio (Telephone) and/or data (RS-485 or RS-422) together on duplex fiber-optic cable or 4-wire twisted pair cable (depending on the application). The main characteristics of Model F271X Modems are:

- Multiplexes data (RS-485 or RS-422) and analog (Telephone audio signal), if desired
- Transmits multiplexed data/audio signal on fiber-optic or copper interface cables
- Offers ring down or intercom applications when using a pair of F271X subscriber Modems

Model F270X and F271X Modem pairs use multimode fiber-optic cable of up to 2 Km (6,560 ft/1.2 mi) for 850nm LED optics, up to 8 Km (26,240 ft/5 mi) for 1300nm LED optics, or single mode fiber-optic cable of up to 14 Km (46,200 ft/8.7 mi) for 1300nm ELED optics. If a copper interface is used then up to 1 Km (3,300 ft/.625 mi) 4-wire twisted pair cable may be used to complete the circuit between the exchange (F270X) and subscriber (F271X) side Modems, or a pair of subscriber (F271X) Modems.

## 1.2.2 Audio and Data Transmission Characteristics

The F271X series operates by accepting the audio signal at the RJ11 connector from the subscriber telephone and digitizing it, using an A/D converter. This signal is then multiplexed with data (RS-485 or RS-422) signals coming from the RJ45. The combined signal is applied to a light pulse and transmitted over fiber-optic or 4-wire twisted pair copper cable to the remote F270X or F271X series unit.

The remote F270X or F271X series unit converts the light pulse (in cases of fiber-optic network connection) back into an electrical signal, demultiplexes the combined data/audio signal and applies the digitized signal to an A/D converter to recover the audio signal. The separated data and audio signals are then sent to their respective destinations. The outgoing signal path (exchange-to-subscriber or subscriber-to-subscriber) is similar. The audio signal is digitized and multiplexed together along with the data (RS-485 or RS-422) signals and transmitted to the F271X series unit. Finally, the F271X Modem recovers the audio and data signals.

The Model F270X/F271X transmits analog signals of 300 to 3400Hz and full duplex asynchronous / isochronous RS-485 or RS-422 data signals up to 64Kbps and is transparent in both directions.

## 1.2.3 Physical Characteristics

Model F270X/F271X FOM II Series Tele/Data Modems measure 7.0" wide x 0.84" high x 11.6" deep (17.8 x 2.1 x 28.9 cm) and are designed to be mounted 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 19" standard rack-mountable chassis. For either desktop enclosure or 2-card rack-mount chassis, each F270X/F271X unit requires a wall transformer, VERSITRON Model PSAC08 (US) or PSAC09 (European), providing 12 VDC, 1A. The one-pin power connector for electrical input is on the back of the card. There are two RJ11 jacks for the telephone and copper interface (used in applications where there is no fiber-optic cable), a RJ45 jack for EIA RS-485 or RS-422 data connection and two ST connectors for the fiber-optic interface, also on the back of the card as shown in Figure 1.3. For HF20 chassis installations, power is provided by VERSITRON Model AC150W Power Supply / System Monitor. One AC150W utilizes two slots in the HF20. Two AC150W units are recommended for power redundancy. Both F270X and F271X models have six indicator LEDs: power (PWR), off-hook (HOOK), ring signal (RING), loop detection (LOOP), reverse battery signal (RBAT), and alarm (ALM). No audible alarm is available.

**TABLE #1 DIMENSIONS OF ENCLOSURES AND CHASSIS**

| <b>Model #<br/>(Part #)</b> | <b>Dimensions</b>                                     | <b>Description</b>                                | <b>Power Supply Required*1</b>                               |
|-----------------------------|-------------------------------------------------------|---------------------------------------------------|--------------------------------------------------------------|
| <b>HF1</b><br>(19052)       | 1.3" H x 7.1" W x 11.6" D<br>(3.3 x 18.0 x 29.5 cm)   | Single Card Desktop Enclosure                     | <b>PSAC08</b> <b>PSAC09</b><br>(LTWPD1210PLX) (LTWPD1210EPL) |
| <b>HF2</b><br>(19053)       | 2.3" H x 7.1" W x 11.6" D<br>(5.9 x 18.0 x 29.5 cm)   | Dual Card Desktop Enclosure*2                     | <b>PSAC08</b> <b>PSAC09</b><br>(LTWPD1210PLX) (LTWPD1210EPL) |
| <b>HF2SS</b><br>(19629)     | 1.7" H x 19.0" W x 13.8" D<br>(4.3 x 48.0 x 35.0 cm)  | Dual Card Rack-Mount Chassis *2<br>(Side-by-Side) | <b>PSAC08</b> <b>PSAC09</b><br>(LTWPD1210PLX) (LTWPD1210EPL) |
| <b>HF20</b><br>(19032)      | 7.0" H x 19.0" W x 11.6" D<br>(17.8 x 48.0 x 29.5 cm) | 20 Card Rack-Mount Chassis                        | <b>AC150W</b><br>(19320-03)                                  |

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

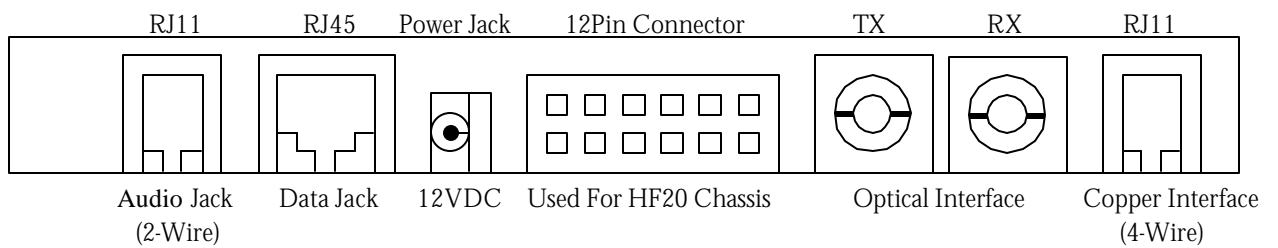
\*2 **Note:** One Power Supply per Isolator required.



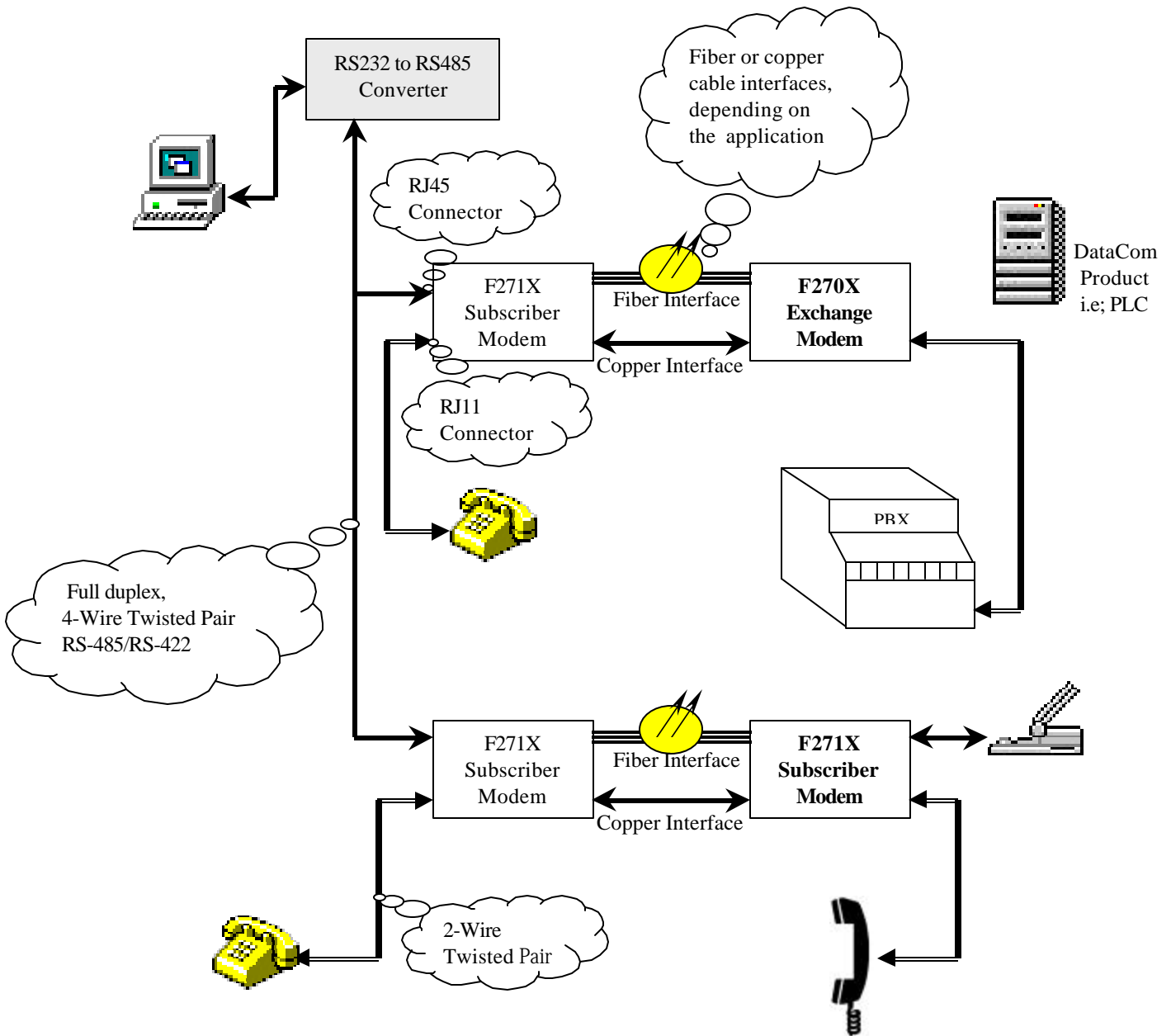
**FIGURE 1.1 FRONT VIEW, F271X MODEM**



**FIGURE 1.2 FRONT VIEW, F271X MODEM**



**FIGURE 1.3 BACK PANEL, F271X MODEM**



Where,

↔ 2-Wire Twisted Pair For Analog Signal

↔ 4-Wire Twisted Pair For Digital Signal

 Duplex Fiber-optic Cable

**FIGURE 1.4 APPLICATION EXAMPLE**

### 1.3 Tele/Data Modem Specification:

#### General Specifications :

|                              |                                                |
|------------------------------|------------------------------------------------|
| <b>Models</b>                | F270X /F271X* <sup>1</sup>                     |
| <b>Dimensions</b>            | (7" H x 7/8" W x 11" L) (17.8 x 2.1 x 27.9 cm) |
| <b>Weight</b>                | 0.34 kg (12 oz)                                |
| <b>Operating Temperature</b> | 0° to 50°C (32° to 100°F)                      |
| <b>Humidity</b>              | Up to 95% relative humidity (noncondensing)    |
| <b>Altitude</b>              | Up to 10,000 ft                                |

**Note:** \*<sup>1</sup> X is replaced with 2, 4, or 5 for 850nm MM, 1300nm MM, or 1300nm SM, respectively.

#### Electrical Interface:

|                                           |                                              |
|-------------------------------------------|----------------------------------------------|
| <b>Models</b>                             | F270X /F271X* <sup>1</sup>                   |
| <b>Power Requirements</b>                 | 12VDC, 1Amp                                  |
| <b>Connector (Tip &amp; Ring)</b>         | RJ11, 2-Wire Twisted Pair                    |
| <b>Copper Interface Connector</b>         | RJ11, 4-Wire Twisted Pair                    |
| <b>Data Transmission Connector</b>        | RJ45, CAT 5 UTP                              |
| <b>Audio Signal</b>                       | Analog, 300 to 3400Hz                        |
| <b>Data Signal</b>                        | RS-485 or RS-422 asynchronous or isochronous |
| <b>Data Rate</b>                          | Up to 64Kbps                                 |
| <b>Idle Channel Noise</b>                 | -55dBm                                       |
| <b>In-Band Spurious</b>                   | -40dBm                                       |
| <b>Out-Band Spurious</b>                  | -30dBm                                       |
| <b>Talk Battery</b>                       | 45 to 55 VDC                                 |
| <b>Loop Current</b>                       | 20mA max (off hook)                          |
| <b>Ring Signal</b>                        | 80-150VAC, 15 to 68Hz                        |
| <b>Line Impedance (Jumper selectable)</b> | 600 Ω or 900 Ω                               |

**Note:** \*<sup>1</sup> X is replaced with 2, 4, or 5 for 850nm MM, 1300nm MM, or 1300nm SM, respectively.

#### Fiber-optic Interface:

| <b>Models</b>                 | F2702/F2712               | F2704/F2714               | F2705/F2715          |
|-------------------------------|---------------------------|---------------------------|----------------------|
| <b>Wavelength</b>             | Multimode 850nm           | Multimode 1300nm          | Single Mode 1300nm   |
| <b>Connector</b>              | ST                        | ST                        | ST                   |
| <b>Transmit Output Power</b>  | -10 ± 1 dBm               | -12 ± 1 dBm               | -20 ± 1 dBm          |
| <b>Receiver Sensitivity</b>   | -30 ± 1 dBm               | -32 ± 1 dBm               | -34 ± 1 dBm          |
| <b>Maximum Range</b>          | Up to 2 Km                | Up to 8 Km                | Up to 14 Km          |
| <b>Fiber-optic Cable Size</b> | 50/125, 62.5/125, 100/140 | 50/125, 62.5/125, 100/140 | 8/125, 9/125, 10/125 |

#### Major Features:

|                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> <li>• Intercom or Ring Down Application with two Subscribers, F271X</li> <li>• Copper-to-Copper Option (Applications which don't require fiber, maximum distance up to 1000 feet)</li> <li>• Copper-to-Fiber Network Application Option</li> <li>• 850nm Multimode, 1300nm Multimode and 1300nm Single Mode Options</li> <li>• Data and Audio Multiplexing</li> <li>• Line Impedance Option of 600 Ω or 900 Ω</li> </ul> |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

## SECTION 2

### INSTALLATION

#### 2.1 GENERAL

This section contains detailed information on the installation and initial checkout of the Model F271X FOM II Series Modems. Paragraph 2.2 contains general information on site selection and rack mounting. Paragraph 2.3 contains the description for selecting different options on the Modem. Paragraph 2.4 and 2.5 contain detailed instructions for connecting Model F271X products to your system. Paragraph 2.6 contain initial checkout procedures.

#### 2.2 SITE SELECTION AND MOUNTING

The Model F271X FOM II products are designed as a single line Modem, providing one telephone interface. This particular series can also be connected directly to the serial port (RS-485 or RS-422) of the terminal or data communication equipment with a CAT-5 UTP cable (customer supplied). When attaching the F271X Modem to a PC, Fax, or STU III, the copper and fiber-optic cable should be securely installed so as to prevent accidental disconnection. Care should be taken to ensure that the copper and fiber-optic cables are not mechanically separated from the Modem during operation. Space for the power transformer must also be provided.

#### 2.3 SWITCH AND JUMPER SETTINGS

Internal switches and jumpers are provided to select between available options on the F271X. Switch and jumper locations are shown in figure 1.5. Switch and jumper settings are as follows:

##### 2.3.1 RS-485/RS-422 Data Transmission Settings

The F271X Modem has an option of changing the polarity of the transmit or receive data signals at the RJ45 jack. This eliminates a need to reterminate the UTP cable and change the wiring in a RJ45 plug.

**TABLE 2: SW1 SWITCH SETTINGS**

| Positions                                           | On                                                                   | Off                                                                 |
|-----------------------------------------------------|----------------------------------------------------------------------|---------------------------------------------------------------------|
| <b>SW1-1</b>                                        | Factory setting*                                                     | Factory setting*                                                    |
| <b>SW1-2</b>                                        | Inverts the phase/polarity for the RS-485/RS-422 receiver inputs     | Normal phase/polarity for the RS-485/RS-422 receiver inputs         |
| <b>SW1-3</b>                                        | Inverts the phase/polarity for the RS-485/RS-422 transmitter outputs | Normal the phase/polarity for the RS-485/RS-422 transmitter outputs |
| <b>SW1-4</b>                                        | Subscriber-to-Subscriber, Ring down or Intercom application          | Subscriber-to-Exchange, Normal operation                            |
| * <i>Note: Factory setting for SW1-1 is Off.</i>    |                                                                      |                                                                     |
| * <i>Note: Do not set SW1-1 in the On position.</i> |                                                                      |                                                                     |

### 2.3.1 RS-485/RS-422 Data Transmission Settings (cont'd)

Slew rate for the data being transmitted:

**TABLE 3: JP5 JUMPER SETTINGS**

|                                                | <b>Jumped*</b> | <b>Functional Description</b> |
|------------------------------------------------|----------------|-------------------------------|
| <b>JP5</b>                                     | 2 & 3          | Slew rate set to 10Mbps       |
| <i>* Note: Factory setting. Do not change.</i> |                |                               |

### 2.3.2 Fiber-Optic or Copper Transceiver Network Settings

A new feature to the VERSITRON class of Modems is the ability of the F270X and F271X Series Modems to multiplex data (RS-485 or RS-422) and analog (Telephone audio signal) onto a fiber OR copper network, depending on the application. Figure 1.4 shows an example for a copper and fiber network circuit. The selection for a copper (4-wire twisted pair) or a fiber-optic interface is accomplished by the following dip switch settings:

**TABLE 4: SW2 SWITCH SETTINGS**

| <b>Positions</b> | <b>Copper Interface</b> | <b>Fiber Interface</b> |
|------------------|-------------------------|------------------------|
| <b>SW2-1</b>     | On                      | Off                    |
| <b>SW2-2</b>     | Off                     | On                     |
| <b>SW2-3</b>     | On                      | Off                    |
| <b>SW2-4</b>     | Off                     | On                     |

### 2.3.3 Interface Impedance Selection

The telephone/analog frequencies look into impedance known as the line impedance. In the USA and North America it is about 600Ω. In Europe and the Far East it is usually 900Ω. F270X and F271X comply with both standards, depending on the jumper settings. These settings are as follow:

**TABLE 5: LINE IMPEDANCE JUMPER SETTINGS**

| <b>Jumpers</b>                                                                    | <b>Jumped</b>      | <b>Functional Description</b> |
|-----------------------------------------------------------------------------------|--------------------|-------------------------------|
| <b>JP2</b>                                                                        | 1 & 2              | 900 Ω line impedance          |
| <b>JP2</b>                                                                        | 2 & 3              | 600 Ω line impedance          |
| <b>JP3</b>                                                                        | Jumper off/removed | 900 Ω line impedance          |
| <b>JP3</b>                                                                        | Jumper on/in       | 600 Ω line impedance          |
| <i>Note: Factory Setting: JP2: (2 &amp; 3 are jumped) and JP3: (Jumper on/in)</i> |                    |                               |

### 2.3.4 Ring Down Circuit Selection

The new subscriber Modem, F271X, has been upgraded to include a ring down circuit. This circuit allows two subscribers to be connected together in pair. The following settings need to be made before connecting a pair of F271X:

**TABLE 6: RING DOWN SETTINGS**

| Jumper/Switch | Normal Settings | Ring Down Settings |
|---------------|-----------------|--------------------|
| <b>JP7</b>    | Jump 2 & 3      | Jump 1 & 2         |
| <b>JP8</b>    | Jump 1 & 2      | Jump 2 & 3         |
| <b>SW1-4</b>  | Off             | On                 |

**Note:** Refer to figure 1.5 for the locations of JP7, JP8 and SW1 -4

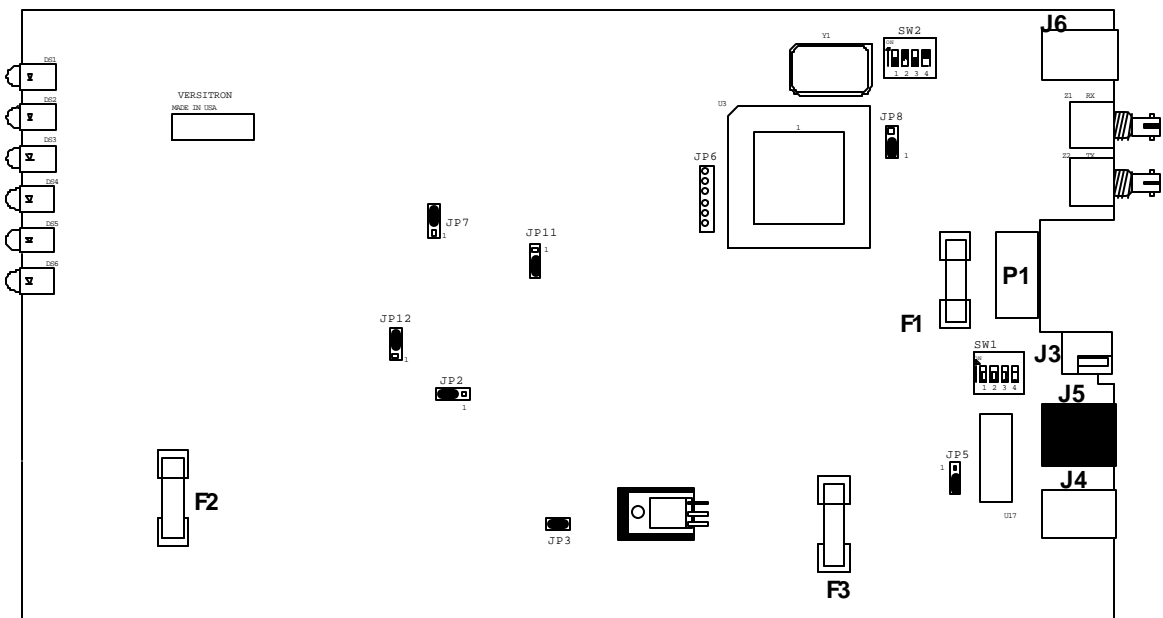
In a ring down configuration, whenever a telephone attached to one of the F271X Modems goes off-hook, the F271X Modem on the other end starts ringing the telephone attached to it. When the receiver is picked up, the ringing stops and a conversation is possible. Application examples for this type of setup would be for 911 emergency or intercom applications. (*Note: If a F271X Modem is set up in a ring down or intercom application, it will not operate with a F270X exchange side Modem.*)

### 2.3.5 Default Jumper Settings

**TABLE 7: DEFAULT SETTINGS**

| Jumpers     | Factory Settings | NOTE          |
|-------------|------------------|---------------|
| <b>JP11</b> | Jump 2 & 3       | DO NOT CHANGE |
| <b>JP12</b> | Jump 2 & 3       | DO NOT CHANGE |

**Note:** Refer to figure 1.5 for the locations of JP11 and JP12



**FIGURE 1.5 SWITCH AND JUMPER SETTINGS**

## 2.4 POWER REQUIREMENTS

The Model F271X FOM II products are designed to operate from an AC power transformer or a DC power source in the range of +12 to +18 VDC.

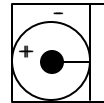
### 2.4.1 Installation with AC Power

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

### 2.4.2 Installation with DC Power

DC power may be used instead of a power transformer. 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 1.6 DC POWER SUPPLY CONNECTIONS**

## 2.5 INTERFACE WIRING

Tables 7, 8, 9 and 10 list the interface wiring for Model F271X FOM II Series Modems. The RJ11 (J4) is used with a single line 2-wire telephone. Wiring for (J4) is shown in Table 7. The modular connector (J3) is wired in parallel with the 12-pin connector (P1) for power. When installing the telephone Modem as a standalone unit, a power transformer modular jack (J3). When installing the telephone Modem in a 20-card rack-mount chassis (Model HF20) with optional power supplies (AC150W) the 12 pin connector (P1) is used. Wiring for the 12-pin connector is shown in Table 8. RJ45 (J5) is used for RS-485/RS-422 data transmission. Wiring for J5 is shown in Table 9. RJ11 (J6) is used in applications where data/audio or both are meant to transmit on a copper, instead of fiber-optic network. Settings for the copper interface are previously explained in section 2.3.2. Wiring for the copper interface is shown in Table 10. Figure 1.5 identifies the locations for RJ11 jack (J4), 12-pin power connector (P1), modular power jack (J3), RJ45 (J5) and RJ11 (J6) jacks.

**TABLE 8: (J4) TELEPHONE/ANALOG WIRING**

| RJ11 Pin Numbers | Signal Designation | Color |
|------------------|--------------------|-------|
| 1                | Not Used           | —     |
| 2                | Not Used           | —     |
| 3                | Ring               | Green |
| 4                | Tip                | Red   |
| 5                | Not Used           | —     |
| 6                | Not Used           | —     |

**TABLE 9: (P1) CHASSIS POWER/ALARM WIRING**

| Pin Numbers | Signal Designation     |
|-------------|------------------------|
| 1           | +12 VDC                |
| 2           | +12 VDC                |
| 3           | Signal Ground          |
| 4           | Signal Ground          |
| 5           | Signal Ground          |
| 6           | Frame Ground (Chassis) |
| 7           | System Alarm Interface |
| 8           | Signal Ground          |
| 9           | Signal Ground          |
| 10          | +12 VDC                |
| 11          | +12 VDC                |
| 12          | +12 VDC                |

**TABLE 10: (J5) RS-485/RS-422 DATA TRANSMISSION WIRING**

| Interface               | SW1-2 Setting | SW1-3 Setting | RJ-45 Pin Numbers | Signal Designation | Color                |
|-------------------------|---------------|---------------|-------------------|--------------------|----------------------|
| Normal Phase/Polarity   | Off           | Off           | 1                 | RX+                | Orange w/ White Line |
|                         |               |               | 2                 | RX-                | Orange               |
|                         |               |               | 3                 | TX-                | Green w/ White Line  |
|                         |               |               | 6                 | TX+                | Green                |
| Inverted Phase/Polarity | On            | On            | 1                 | RX-                | Orange w/ White Line |
|                         |               |               | 2                 | RX+                | Orange               |
|                         |               |               | 3                 | TX+                | Green w/ White Line  |
|                         |               |               | 6                 | TX-                | Green                |

**TABLE 11: (J6) COPPER INTERFACE WIRING**

| RJ11 Pin Numbers | Signal Designation | Color  |
|------------------|--------------------|--------|
| 1                | Not Used           | —      |
| 2                | RX-                | Yellow |
| 3                | RX+                | Green  |
| 4                | TX+                | Red    |
| 5                | TX-                | Black  |
| 6                | Not Used           | —      |

### **2.5.1 Fiber-Optic Cable Installation**

After the electrical and digital interface cables have been wired according to paragraphs 2.4 and 2.5, the fiber-optic cable may be attached to the F271X. The transmitter module of each unit should be connected to the receiver module of the other unit. That is, the transmitter optic of the exchange side Modem, F270X, should be connected to the receiver optic of the subscriber side Modem, F271X. On the other hand, the transmitter of the subscriber side Modem, F271X, should be connected to the receiver optic of the exchange side Modem, F270X. Similarly, when a pair of subscriber Modems, F271X, are used in a ring down application, the same kind of fiber-optic connections are required.

### **2.6 INITIAL CHECKOUT PROCEDURE**

The Model F271X FOM II Series Modems contain no power on/off switch. Once the unit is properly installed and power is applied it should be 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 seated firmly in the rack-mount chassis.
2. Verify that the fiber cable is crossed transmit to receive from unit one to two and unit two to one.
3. Verify that the alarm LED goes out when the signal is applied to the optical receiver of the F271X, or when 4-wire UTP is connected between F270X and F271X in a copper network application.
4. Verify the switch settings for the circuit configuration. (i.e. copper or fiber-optic network interface).

If a malfunction is detected during the initial checkout procedure, refer to Section 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 F271X FOM II Series Modems. Since the Model F271X is designed for continuous and uninterrupted operation, there are no setting requirements after the unit is operational. Once the Modem is powered up it should remain in service as long as required.

#### 3.2 STATUS INDICATORS/AUDIBLE ALARM

There are 6 indicators on the Model F271X: power (PWR), off-Hook (HOOK), ring detect (RING), loop detect (LOOP), reverse battery (RBAT), alarm (ALM). No audible alarm is available.

**TABLE 12: STATUS INDICATORS**

| LEDs | Color | Function                                                                                                                                                                                                          |
|------|-------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| PWR  | Green | Indicates operating voltage is present at the power interface connector                                                                                                                                           |
| HOOK | Red   | Indicates that the telephone set has gone OFF-HOOK, when lit                                                                                                                                                      |
| RING | Red   | Indicates RING signal coming from the exchange side Modem, F270X or from the subscriber side Modem F271X, in a ring down application, when lit or blinking                                                        |
| LOOP | Red   | Indicates the successful loop closure on the exchange side Modem upon receiving an OFF-HOOK signal from the subscriber side Modem, when lit                                                                       |
| RBAT | Red   | Indicates Reverse Battery condition of the exchange side Modem F270X, when lit                                                                                                                                    |
| ALM  | Red   | Indicates the following when lit:<br>1. +5V power supply circuit is not working<br>2. -5V charge pump circuit is not working<br>3. +12V Power supply is not working<br>4. A problem exists with data transmission |

## SECTION 4

### THEORY OF OPERATION

#### 4.1 INTRODUCTION

The F271X is a subscriber side Tele/Data Modem with ST single or multimode fiber-optic connectors. These Modems are designed to work with F270X subscriber side Modems in pair and interface with audio and RS-485/RS-422 data grade signals. These units can also work in pairs when used in ring down or intercom applications. These units are housed in VERSITRON FOM-II chassis: HF1, HF2, HF2SS and HF20. Chassis descriptions are in paragraph 1.2.3.

#### 4.2 POWER SUPPLY AND ALARM CIRCUITRY

##### 4.2.1 Power Supply Circuit

When 12VDC is applied to the circuit, the unit should draw between 100mA and 130mA depending on the Modem state. The unit has a switching power supply circuit, which converts 12V to 5VDC and a charge pump circuit, which converts 5V to -5VDC. The switching power supply has a switching frequency of 44.4Khz determined by a single capacitor C49 (1800pF) and an under voltage lockout feature. This feature is produced by CR5 (1N755) and CR6 (1N4148). The under voltage lockout is accomplished as follows:

When the input voltage becomes lower than the zener breakdown voltage, the output transistor is turned off. This occurs because diode CR6 at that time becomes forward bias, allowing resistor R43 to sink a greater current from the non-inverting input than is sunk by the parallel combination of R44 and R45 at the inverting terminal.

##### 4.2.2 Alarm Circuit

Alarm LED goes off when one of the following occurs:

1. +5V power supply circuit is not working
2. -5V charge pump circuit is not working
3. +12V Power supply is not working
4. A problem exists with data transmission and a mux clock is not present at U5 (HC123)

These conditions activate the base of Q3, which activates the base of Q4 and starts current flowing through DS6, the alarm LED. When Q4 is activated this also changes the voltage level of connector P1 pin 7 that activates the system alarm circuit on the power supply.

## **4.3 FUNCTIONAL DESCRIPTION**

The unit consists of the following circuits:

- 4.3.1 Ring detection
- 4.3.2 Ring down circuit
- 4.3.3 Off-Hook detection circuit
- 4.3.4 Analog to digital conversion
- 4.3.5 CPLD (Mux/Demux)
- 4.3.6 RS-485/RS-422 data transmission circuit
- 4.3.7 Fiber-Optic/Copper transceiver circuit

### **4.3.1 Ring Detection**

The optical receiver detects the ring signal coming from the exchange side Modem F270X. Then it is fed to the CPLD, which separates the signal from rest of the multiplexed data and sends it to the subscriber's telephone set. The ring voltage at the subscriber side Modem, F271X is about 100VAC @ 20Hz  $\pm$  3Hz.

### **4.3.2 Ring Down Circuit**

The ring down circuit is used when two F271X, subscriber Modems are connected together. F271X Modems have a 556 Timer IC, which basically produces a 20Hz  $\pm$  3Hz clock pulse. This clock pulse is then used to ring the telephone attached to the Modem. Settings for ring down circuit are explained in paragraph 2.3.4.

### **4.3.3 Off-Hook Detection Circuit**

When the telephone set that is attached to the Modem goes Off-Hook, current flows through the Tip and Ring of the circuit. U14 optocoupler detects the current and triggers a signal indicating Off-Hook condition. The ring battery of -48VDC with respect to the Tip is provided by the Modem, which is the source of the current. The current may vary from 17mA to 25mA.

### **4.3.4 Analog-to-Digital Conversion**

A 2W/4W Hybrid circuit is used before the A/D circuit, this signal is then digitized and band limited for the digital system. On the reverse path the digital data stream is reconstructed into an analog audio signal. The sampling rate on the audio signal is 256Khz to ensure signal quality.

### **4.3.5 CPLD (Mux/Demux)**

The CPLD is used to perform the mux/demux of the digitized audio and RS-485/RS-422 digital data signal. In essence, it is an asynchronous-to-synchronous converter encoded using proprietary VHDL programing designed at VERSITRON. A 20MHz Oscillator, Y1, provides the clock input to the CPLD.

#### **4.3.6 RS-485/RS-422 Data Transmission Circuit**

In the data transmission circuit, a RS-485/RS-422 interface IC, U17, is used. This IC takes in a balanced data signal and converts it into a TTL signal. Then the TTL data signal is fed to the CPLD, where it is multiplexed with the digitized audio signal. During the data reception, the TTL signal is obtained from the CPLD, which then enters the interface IC. Here the data is reformatted to a RS-485 or RS-422 signal and is transmitted out of the RJ45 connector.

#### **4.3.7 Fiber-Optic/Copper Transceiver Circuit**

This design has an option of multiplexing data (RS-485 or RS-422) and analog (Telephone audio signal) onto either a fiber or copper network. The selection for copper (4-wire twisted pair) or fiber interface is accomplished by dip switch settings as described in paragraph 2.3.2.

When the multiplexed audio and data signals are transmitted out of the CPLD, it goes into the JFET, Q1 (VN10KM). By turning on and off Q1 JFET VN10KM, the fiber-optic transmitter Z2 is turned on and off respectively. This is how the optical signal is transmitted out of the Modem. On the receive side, optical receiver Z1 takes the optical signal from the fiber and converts it into a low voltage current. This current signal is fed into the fiber-optic quantizer IC, through 0.01 $\mu$ F coupling capacitor, C63. This chip converts the low voltage signal into a TTL signal, which then goes into the CPLD where the multiplexed audio and data signals are de-multiplexed and sent to their respective destinations.

When a copper-to-copper interface is selected, the multiplexed audio and data signal is transmitted out of the CPLD, which then goes into U22, a full duplex RS-485/RS-422 interface IC. This chip converts the TTL data signal into a RS-485/RS-422 signal, which is transmitted on a 4-wire twisted pair telephone wire. On the reception side, U22 a full duplex RS-485/RS-422 interface IC receives the signal from a 4-wire UTP wire. The RS-485/RS-422 data signal is converted into a TTL data signal and transmitted to the CPLD, U3. Here the multiplexed audio and data signals are de-multiplexed and sent to their respective destinations.

## **SECTION 5**

### **MAINTENANCE AND TROUBLESHOOTING**

#### **5.1 INTRODUCTION**

This chapter contains general information designed to isolate a malfunction in the Model F270X 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 12 should be taken to check a nonoperating Modem. Contact VERSITRON Customer Service for additional diagnostic assistance or to arrange for repair as necessary.

**TABLE 13: NONOPERATIONAL INDICATORS**

| 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                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| ALARM (ALM) LED is ON                                                                  | Incorrect optical signal level received at receiver input                                                     | <ol style="list-style-type: none"> <li>1. Check that fiber-optic cables are properly connected</li> <li>2. Check that the remote unit power is on and the fiber-optic connectors are properly attached</li> <li>3. Measure the optical levels on both ends (if possible) in order to check the optical link</li> <li>4. Contact VERSITRON for assistance</li> </ol>                                                                                                                |
| HOOK LED is ON                                                                         | Possible problems ranging from a telephone set in an Off-Hook position to a problem with the Off-Hook circuit | Check if the telephone set receiver is seated in cradle correctly. If this is not the case, contact VERSITRON for assistance                                                                                                                                                                                                                                                                                                                                                       |
| LOOP LED is ON                                                                         | The current supplied by the central office is fluctuating from 17mA to 25mA                                   | Check the exchange side Modem on the other end and check the exchange line coming from the central office or the Switch                                                                                                                                                                                                                                                                                                                                                            |
| RBAT LED is ON                                                                         | Voltage between Tip and Ring are reversed                                                                     | Check that the Tip and Ring on the 2-wire UTP are not reversed on the exchange side Modem, F270X. That is, Tip wire is not connected to the Ring on the Modem's RJ11 connector and vice versa                                                                                                                                                                                                                                                                                      |
| Modem is not working in a subscriber, F271X to exchange, F270X application             | Jumpers and switch settings are not set for this application                                                  | <ol style="list-style-type: none"> <li>1. Check if SW1-1 is OFF</li> <li>2. Check if SW2 is properly set for the desired interface (i.e. copper or fiber network application, see table 4)</li> <li>3. Check if SW1-4 is in Off position</li> <li>4. Check if JP8 is jumped between pin-1 and 2</li> <li>5. Check if JP7 is jumped between pin-2 and 3</li> <li>6. Contact VERSITRON for assistance</li> </ol>                                                                     |
| Modem is not working in a subscriber, F271X to subscriber, F271X ring down application | Jumpers and switch settings are not set for this application                                                  | <ol style="list-style-type: none"> <li>1. Check if SW1-1 is OFF</li> <li>2. Check if SW2 is properly set for the desired interface (i.e. copper or fiber network application, see table 4)</li> <li>3. Check if SW1-4 is in On position</li> <li>4. Check if JP7 is jumped between pin-1 and 2</li> <li>5. Check if JP8 is jumped between pin-2 and 3</li> <li>6. Check if JP11 and JP12 have jumpers between pins 2 and 3</li> <li>7. Contact VERSITRON for assistance</li> </ol> |

