

F290X / F293X
FOM II Series
Fiber Optic Isolator
Technical Manual

Revision F

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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 F290X / F293X FOM II Series Fiber Optic Isolators. 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 F290X / F293X.

Model Number	Part Number	Description
F2902	30243-08	Dual Channel Fiber Optic Isolator, Transmitter, simplex, multimode, 850nm, ST optics, 50bps – 10Mbps (balanced), 50bps – 100Kbps (unbalanced), distances to 6km*.
F2904	30243-10	Dual Channel Fiber Optic Isolator, Transmitter, simplex, multimode, 1300nm, ST optics, 50bps – 10Mbps (balanced), 50bps – 100Kbps (unbalanced), distances to 18km*.
F2905	30243-11	Dual Channel Fiber Optic Isolator, Transmitter, simplex, single mode, 1300nm, ST optics, 50bps – 10Mbps (balanced), 50bps – 100Kbps (unbalanced), distances to 30km*.
F2932	30243-20	Dual Channel Fiber Optic Isolator, Receiver, simplex, multimode, 850nm, ST optics, 50bps – 10Mbps (balanced), 50bps – 100Kbps (unbalanced), distances to 6km*.
F2934	30243-22	Dual Channel Fiber Optic Isolator, Receiver, simplex, multimode, 1300nm, ST optics, 50bps – 10Mbps (balanced), 50bps – 100Kbps (unbalanced), distances to 18km*.
F2935	30243-23	Dual Channel Fiber Optic Isolator, Receiver, simplex, single mode, 1300nm, ST optics, 50bps – 10Mbps (balanced), 50bps – 100Kbps (unbalanced), distances to 30km*.

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

1.2 DESCRIPTION OF EQUIPMENT

1.2.1 Functional Characteristics

F290X / F293X Isolators are transmitters and receivers designed to transmit simplex information channels over a pair of fiber optic cables. Using both channels the unit may be configured as one synchronous data and one clock circuit or as dual asynchronous data channels. F290X / F293X Isolators use fiber optic cable up to 6km (3.7mi/19,680ft) with multimode 850nm optics, up to 18km (11.2mi/59,040ft) with multimode 1300nm optics, or 30km (18.6mi/98,400ft) with single mode 1300nm optics. The link is fully transparent and data agile from 50bps – 10Mbps for balanced signals and from 50bps – 100Kbps for unbalanced signals. F290X / F293X Isolators fully support the interface control signals associated with the RS-422, RS-423, RS-449, RS-530, MIL-STD-188-114 balanced / unbalanced, TTL and NRZ standards.

1.2.2 Physical Characteristics

F290X / F293X Isolators measure 7.0W x 0.84H x 11.6L in. (17.8 x 2.1 x 28.9 cm.) and are designed to be mounted in a variety of FOM II enclosures and chassis. Table 1 lists dimensions of available enclosures and chassis. Standalone options include single card enclosures (HF-1) and dual card enclosures (HF-2). 19" rack mount options include 2-slot (HF-2SS) and 20-slot chassis (HF-20). Each F290X / F293X installed in a HF-1, HF-2 or HF-2SS requires a PSAC08 (US) or PSAC09 (European) power adapter providing 12 VDC, 1A with a one-pin connector for electrical input on the back of the card. There is a female DB25 connector for the digital interface and two ST connectors for the fiber optic interface, also on the back of the card. F290X / F293X Isolators installed in a HF-20 require an AC150W Power Supply / System Monitor. Each AC150W installed into the chassis requires two slots. Two AC150W supplies are recommended for power redundancy. The F290x Transmitters have four LED indicators on the front panel: DC power on (PWR), loss of signal (ALM), transmit Ch. 1 data present (TXC1), and transmit Ch. 2 data present (TXC2). The F293x Receivers also have four LED indicators on the front panel: DC power on (PWR), loss of signal (ALM), receive Ch. 1 data present (RXC1), and receive Ch. 2 data present (RXC2). No audible alarm is available.

Model # (Part #)	Dimensions	Description	Power Supply Required*1
HF-1 (19052)	1.3" H x 7.1" W x 11.6" D	Single Card Standalone Enclosure	PSAC08 PSAC09 (LTWPD1210PLX) (LTWPD1210EPL)
HF-2*2 (19053)	2.3" H x 7.1" W x 11.6" D	Dual Card Standalone Enclosure	PSAC08 PSAC09 (LTWPD1210PLX) (LTWPD1210EPL)
HF-2SS*2 (19629)	1.7" H x 19.0" W x 13.8" D	2-Slot Rack Mount Chassis	PSAC08 PSAC09 (LTWPD1210PLX) (LTWPD1210EPL)
HF-20 (19032)	7.0" H x 19.0" W x 11.6" D	20-Slot Rack Mount Chassis	AC150W (19320-03)

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

*2 **Note:** One Power Adapter per Isolator required.

TABLE 1. ENCLOSURES / CHASSIS



FIGURE 1. OVERALL VIEW, F290X TRANSMITTER

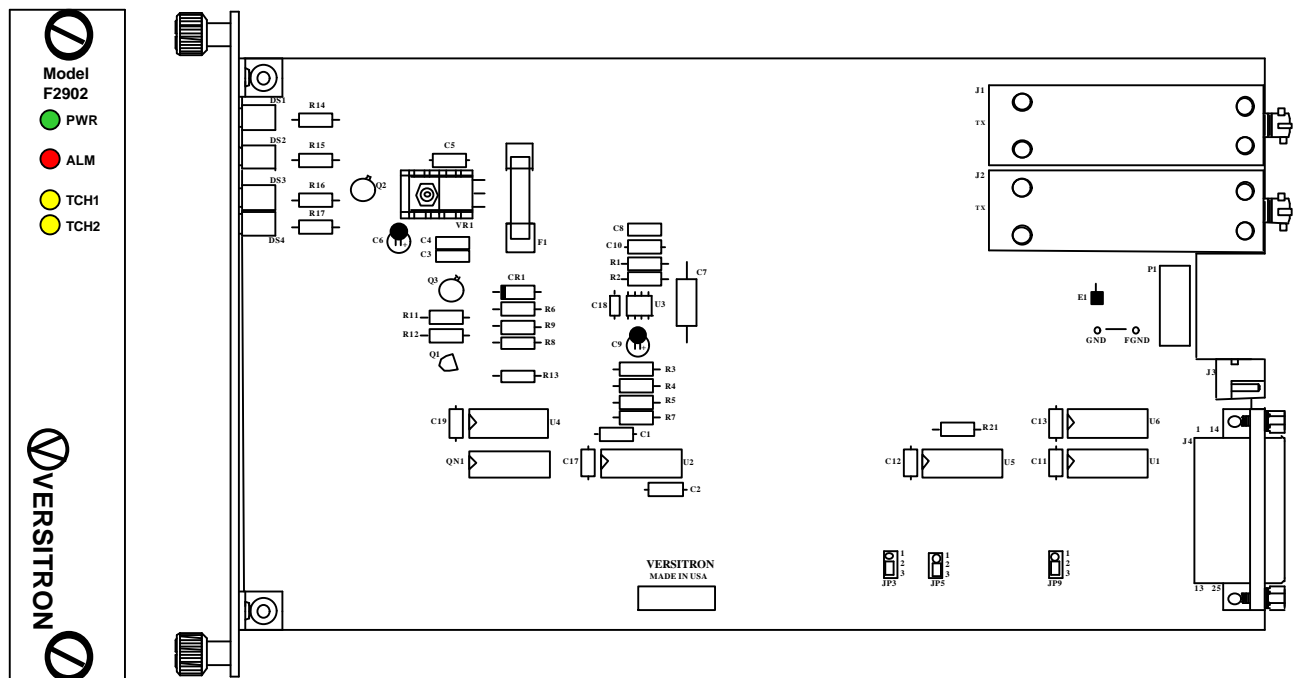


FIGURE 2. CIRCUIT CARD LAYOUT, F290X TRANSMITTER

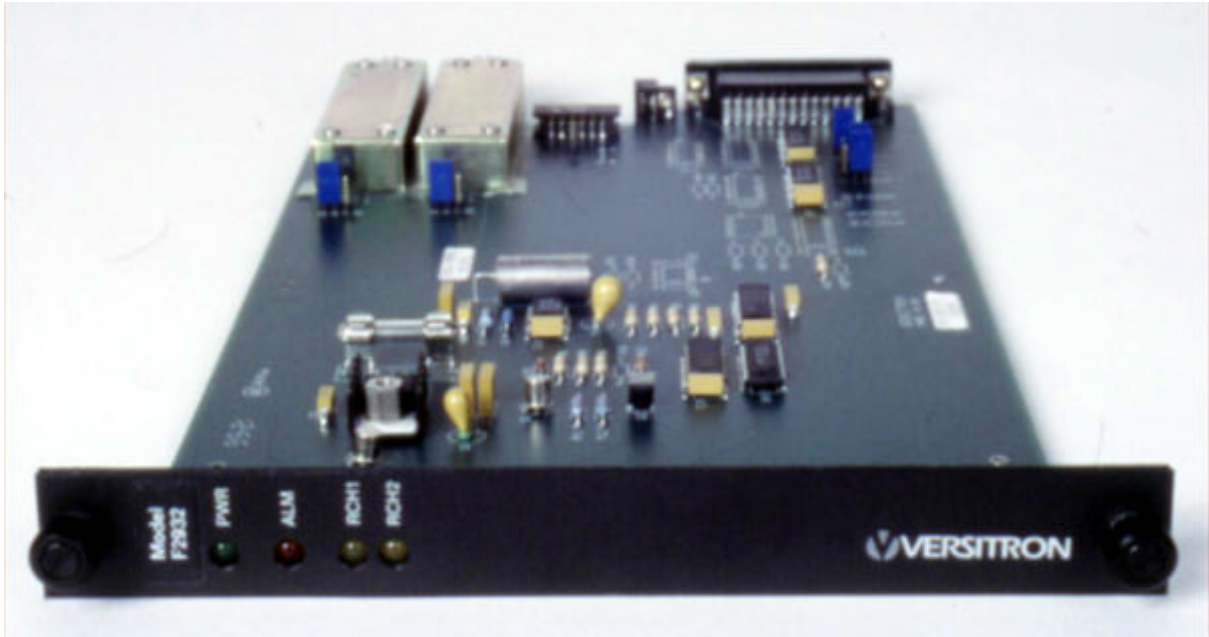


FIGURE 3. OVERALL VIEW, F293X RECEIVER

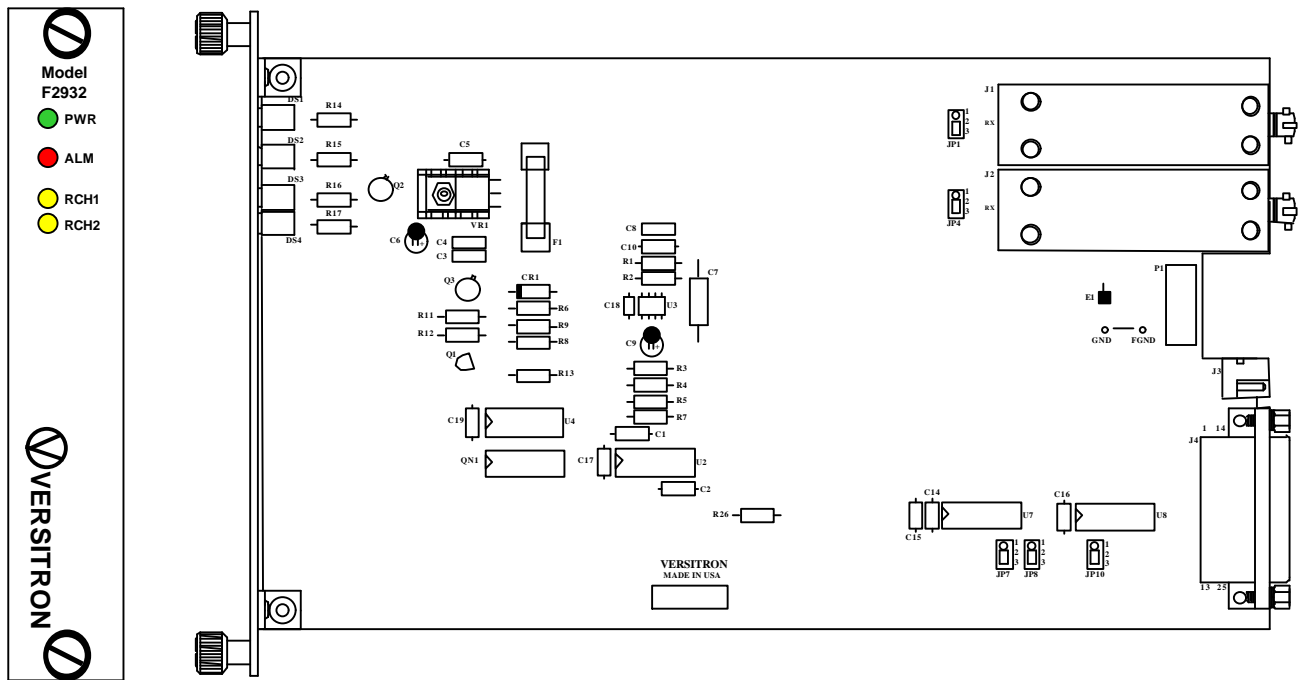


FIGURE 4. CIRCUIT CARD LAYOUT, F293X RECEIVER

1.3 SPECIFICATIONS

Data Rate: Any data rate from 50bps – 10Mbps (balanced), from 50bps – 100Kbps (unbalanced).

Operation: Dual channel Simplex over a fiber optic cable pair.

Optical Interface: ST connectors.

Digital Interface: Signal levels and format conform to EIA RS-422, RS-423, RS-449, RS-530, MIL-STD-188-114 Balanced/Unbalanced, TTL and NRZ standards.

Electrical Interface: DB25 Female.

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

MTBF: F290X – 98,120 hrs; F293X – 98,585 hrs.

Dimensions: 7.0W x 0.84H x 11.6L in. (17.8 x 2.3 x 31.0 cm.).

Weight: 12.0 oz (0.34 kg).

Power Requirements: HF-1, HF-2, or HF-2SS Installation: VAC source with optional PSAC08 (US) or PSAC09 (European) power adapter providing 12 VDC, 1A. HF-20 Installation: Model AC150W Power Supply / System Monitor (110/250 VAC, $\pm 10\%$; 47-63 Hz (auto-selecting)).

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	F2902 / F2932	F2904 / F2934	F2905 / F2935
Connector	ST	ST	ST
Wavelength	Multimode 850nm	Multimode 1300nm	Single Mode 1300nm
Link Budget*	25 \pm 1dB	26 \pm 1dB	26 \pm 1dB
Maximum Range*	6km (3.7mi/19,680ft)	18km (11.2mi/59,040ft)	30km (18.6mi/98,400ft)
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 μ M fiber optic cable @ 2Kbps.
Single Mode tests were performed on 10/125 μ M fiber optic cable @ 2Kbps.

SECTION 2 INSTALLATION

2.1 GENERAL

This section contains detailed information on the installation and initial checkout of the F290X / F293X Isolators. Paragraph 2.2 contains general information on site selection and rack mounting. Paragraph 2.3 contains instructions for connecting an F290X / F293X to your system and selecting the different options. Paragraph 2.4 contains initial checkout procedures.

2.2 SITE SELECTION AND MOUNTING

F290X / F293X Isolators are designed to connect directly to the serial port (DB25 Connector) with a customer-supplied cable. Mounting options include single card (HF-1) or dual card (HF-2) standalone enclosures and 2-slot (HF-2SS) or 20-slot (HF-20) rack mount chassis.

2.2.1 Signal Interface

Table 2 lists the signal interface pinout for the F290X Transmitters and Table 3 lists the signal interface pinout for the F293X Receivers. Both products have a female DB25 (J4) connector.

2.2.2 User Selected Options

Jumpers are provided to select various EIA standard operations to include balanced vs unbalanced and nonphase-shifted vs 180° phase-shifted. By selecting RS-422 on one unit and RS-423 on the other, F290X / F293X Isolators can become interface converters. F290x are transmit only. F293x are receive only. The jumper configurations are shown in Tables 4, 5, 6 and 7. Jumper JP9 on the F290x and JP10 on the F293x allow for the option of using only one of the two channels.

2.3 POWER REQUIREMENTS

The F290X / F293X Isolators operate from an AC power source or a DC power source providing +12 VDC, 1A. The power adapters used when installed in a HF-1, HF-2, or HF-2SS are Model PSAC08 (US) or Model PSAC09 (European). Connect the power adapter to the F290X / F293X 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. When installed in a HF-20, the AC150W Power Supply / System Monitor supplies power to all FOM II Series circuit cards installed in the chassis. The AC150W requires two slots in the HF-20. Two AC150Ws are recommended for power redundancy.

2.4 INITIAL CHECKOUT PROCEDURE

F290X / F293X Isolators contain no power on/off switch. Once you install and apply power to the unit, it is fully operational. The power indicator should remain on as long as power is supplied to the unit. To ensure proper operation, before beginning system operation verify:

1. Power plug is seated into the Isolator or the Isolator is seated firmly in the HF-20 chassis.
2. Fiber optic cables are connected from transmit channel 1 to receive channel 1, and transmit channel 2 to receive channel 2.
3. Alarm LED goes out when a signal is applied to the electrical DB25 interface of the F290x.
4. Alarm LED on the F293x goes out when a signal is applied to the electrical DB25 interface of the F290x and fiber is connected between the two Isolators.

If a malfunction is detected refer to Chapter 5 for isolating the malfunction in the unit.

F290X	
DB25F Pin	Signal Function
1	Frame Ground
2	Not Used
3	Not Used
4	Not Used
5	Not Used
6	Input Active
7	Signal Ground
8	Not Used
9	Balanced Data In 2-
10	Frame Ground
11	Not Used
12	Balanced Data In 1+
13	Frame Ground
14	Not Used
15	Balanced Data In 1-
16	Not Used
17	Balanced Data In 2+
18	Not Used
19	Not Used
20	Unbalanced Data In 1
21	Frame Ground
22	Not Used
23	Unbalanced Data In 2
24	Frame Ground
25	Not Used

TABLE 2

F293X	
DB25F Pin	Signal Function
1	Frame Ground
2	Not Used
3	Normally Open
4	Output Common
5	Normally Closed
6	Not Used
7	Signal Ground
8	Not Used
9	Balanced Data Out 2-
10	Frame Ground
11	Not Used
12	Balanced Data Out 1+
13	Frame Ground
14	Not Used
15	Balanced Data Out 1-
16	Not Used
17	Balanced Data Out 2+
18	Not Used
19	Not Used
20	Unbalanced Data Out 1
21	Frame Ground
22	Not Used
23	Unbalanced Data Out 2
24	Frame Ground
25	Not Used

TABLE 3

DB25F (J4) CONNECTOR PIN ALLOCATIONS

2.5 SINGLE CHANNEL MODE

When running a single channel on the F290X / F293X Isolators, the alarm LED will be on, indicating signals are not present on both channels, unless the jumper settings shown in Tables 4 & 5 are used. Tables 4 & 5 show jumper configurations to run only one channel on a dual channel isolator. Basically, the single channel input is propagated on both channels simultaneously. Both output channels on the F293X receivers will receive the single input signal. However, please note that both channels must be connected with fiber optic cable even when running a single channel.

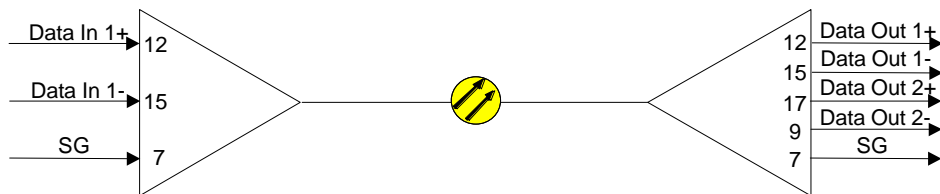
2.5.1 Single Channel ‘Balanced’ Interface

When running a single channel balanced interface reference Table 4 for jumper configurations. Data rates for single channel balanced operation are from 50bps to 10Mbps. On the F290X transmitters the copper interface channel one inputs are applied to J4 pin 12 (positive) and pin 15 (negative). There will not be a channel two input. On the F293X receivers the copper interface outputs are on J4 pin 12 (positive) and pin 15 (negative) and on J4 pin 17 (positive) and pin 9 (negative). This configuration can also be used as a distribution amplifier.

	F290X	F293X
JP3	1-2	
JP5	2-3	
JP7		1-2
JP8		1-2
JP9	2-3	
JP10		2-3

**TABLE 4. JUMPER CONFIGURATIONS,
SINGLE CHANNEL ‘BALANCED’ INTERFACE**

Following is an example diagram showing pinouts for a single channel balanced interface:



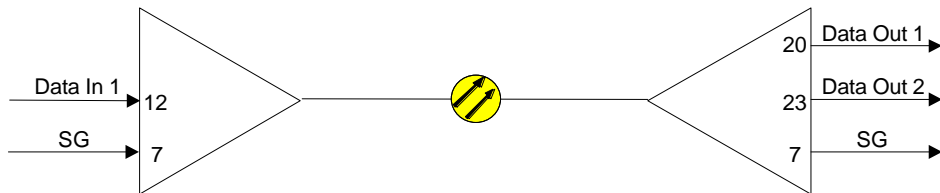
2.5.2 Single Channel ‘Unbalanced’ Interface

Reference Table 5 for jumper configurations. Data rates for single channel unbalanced operations are from 50bps to 100Kbps. When running only a single unbalanced data or clock signal on the F290X / F293X Isolators, the inputs must be applied to channel 1 J4-12. Although this input is normally the balanced input, the driver configuration requires that when running one signal on both channels this input be used. The outputs will be on channel 1 (J4-20) and channel 2 (J4-23). Signal ground will be on J4-7 for both the F290X and F293X. This configuration can also be used as a distribution amplifier.

	F290X	F293X
JP3	1-2	
JP5	2-3	
JP7		2-3
JP8		2-3
JP9	2-3	
JP10		2-3

**TABLE 5. JUMPER CONFIGURATIONS,
SINGLE CHANNEL ‘UNBALANCED’ INTERFACE**

Following is an example diagram showing pinouts for a single channel unbalanced interface:



2.6 DUAL CHANNEL MODE

When running dual channels on the F290X / F293X Isolators, the alarm LED will be off, indicating signals are present for both channels. Tables 6 and 7 show jumper configurations to run dual channels.

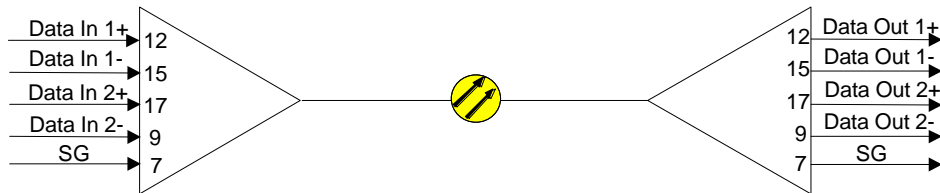
2.6.1 Dual Channel 'Balanced' Interface

When running dual channel balanced refer to Table 6 for jumper configurations. The data rate for dual channel balanced operation is 50bps to 10Mbps. A female DB25 connector provides the copper interface for data channel inputs and outputs. F290X transmitter channel inputs are J4 pin 12 (positive) and pin 15 (negative) for channel one; and J4 pin 17 (positive) and pin 9 (negative) for channel two. F293X receiver outputs are the same as F290X inputs.

	F290X	F293X
JP3	1-2	
JP5	1-2	
JP7		1-2
JP8		1-2
JP9	1-2	
JP10		1-2

**TABLE 6. JUMPER CONFIGURATIONS,
DUAL CHANNEL 'BALANCED' INTERFACE**

Following is an example diagram showing pinouts for a dual channel balanced interface:



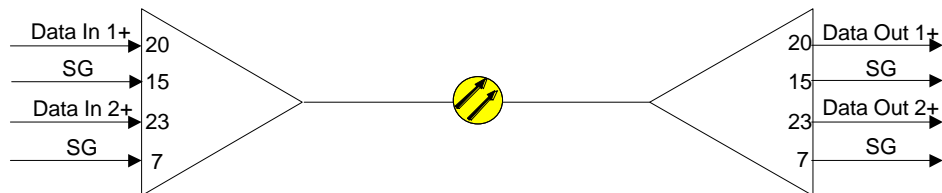
2.6.2 Dual Channel ‘Unbalanced’ Interface

When running dual channel unbalanced refer to Table 7 for jumper configurations. The data rate for dual channel unbalanced operation is 50bps to 100Kbps. A female DB25 connector provides the copper interface for data channel inputs and outputs. F290X transmitter channel inputs are J4 pin 20 (positive) and pin 15 (signal ground) for channel one; and J4 pin 23 (positive) and pin 7 (signal ground) for channel two. F293X receiver outputs are the same as F290X inputs.

	F290X	F293X
JP3	2-3	
JP5	2-3	
JP7		2-3
JP8		2-3
JP9	1-2	
JP10		1-2

**TABLE 7. JUMPER CONFIGURATIONS,
DUAL CHANNEL ‘UNBALANCED’ INTERFACE**

Following is an example diagram showing pinouts for a dual channel unbalanced interface:



2.7 SPECIAL SIGNALING CONFIGURATIONS

2.7.1 NRZ Signaling

A NRZ (non-return to zero) signal can be passed by the F290X / F293X Isolators by the following set-up. Apply the signal to a positive balanced channel input and the ground for that signal to the negative balanced input of the same channel. Example: For channel 1 apply the signal to J4-12 and the ground to J4-15. For channel 2 apply the signal to J4-17 and the ground to J4-9. The Isolator should be in either the single channel balanced interface mode or the dual channel balanced interface mode. The signal can be seen with an oscilloscope on the receiver board by adding channel 1 (J4-12) and channel 2 (J4-15) with the scope inverting one channel. The Isolators shall pass a NRZ data or clock signal with a BER of 10^{-9} across the bandwidth of 50bps to 10Mbps. The link budget shall not be less than -19 dB on 100/140 μ M fiber optic cable. The slew rate shall not be less than 60 seconds from 50bps to 10Mbps, without a pattern slip or bit error.

2.7.2 TTL Signaling

A TTL (transistor-transistor logic) signal can be passed by the F290X / F293X Isolators by the following set-up. Apply the signal to a positive balanced channel input and the ground for that signal to the signal ground pin J4-7. Example: For channel 1 apply the signal to J4-12 and the ground to J4-7. For channel 2 apply the signal to J4-17 and the ground to the J4-7. The Isolator should be in either the single channel balanced interface mode (refer to section 2.5.1 for settings) or the dual channel balanced interface mode (refer to section 2.6.1 for settings). The output will be the positive balanced output with respect to signal ground pin 7 for the same channel as the input. The Isolators shall pass a TTL data or clock signal with a BER of 10^{-9} , across the bandwidth of 50bps to 10Mbps. The link budget shall not be less than -19dB on 100/140 μ M fiber optic cable. The slew rate shall be less than 60 seconds from 50bps to 10Mbps, without a pattern slip or bit error.

2.7.3 Data Channel Phase Shifting

The output data signal of channels 1 or 2 can be shifted 180° out of phase with the input data signal. Refer to Table 8 for jumper configurations.

	1-2	2-3
JP1	Ch. 1 Data w/ NO Phase Shift	Ch. 1 Data w/ 180° Phase Shift
JP4	Ch. 2 Data w/ NO Phase Shift	Ch. 2 Data w/ 180° Phase Shift

**TABLE 8. F293X RECEIVER JUMPER CONFIGURATIONS
DATA CHANNEL PHASE SHIFTING**

SECTION 3 OPERATION

3.1 INTRODUCTION

This chapter contains a description of the operating controls and indicators associated with the F290X / F293X Isolators. Since the isolators are designed for continuous and uninterrupted operation, there are no operating requirements.

3.2 STATUS INDICATORS/AUDIBLE ALARM

There are four LED status indicators on the F290X Transmitter: DC power ON (PWR), Alarm (loss of signal) (ALM), Transmit Ch. 1 (TXC1), and Transmit Ch. 2 (TXC2). There are also four status indicators on the F293X Receiver: DC power ON (PWR), Alarm (loss of signal) (ALM), Receive Ch. 1 (RXC1), and Receive Ch. 2 (RXC2). No audible alarm is available.

3.3 OPERATING CONTROLS

The operating controls associated with the F290X / F293X Isolators are those used to select between EIA RS-422, RS-423, MIL-STD-188-114, TTL, and NRZ, as shown in the the tables of the previous section. 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

F290X / F293X Isolators are capable of transmitting and receiving two independent simplex signals at a balanced data rate of 50bps to 10Mbps or an unbalanced data rate of 50bps to 100Kbps. Balanced or unbalanced signals may be isolated with full transparency for the links.

4.2 DUAL CHANNEL TRANSMITTER F290X

The F290X Transmitter provides two dedicated simplex channels. Each channel independently handles a digital clock or data signal. The user has the option of inputting a balanced signal as specified in the EIA RS-422 digital interface specification, or an unbalanced signal as per EIA RS-423 specifications. The circuit board contains separate device drivers, user selectable by jumpers as described in Section 2, for both signal types. Control signals are processed in a similar manner. Both balanced and unbalanced inputs are converted to TTL (+5V or Ground) prior to input to the optic modules. The optic modules convert the TTL digital data stream to light and provide the connection to the fiber optic cable.

4.3 DUAL CHANNEL RECEIVER F293X

The F293X Receiver provides the inverse process of the transmitter. Light signals are received by two optic modules. Isolation is maintained between the two channels as well as between electrical interfaces by the two independent optical paths. Like the transmitter, the receiver circuit contains user-selectable options for balanced or unbalanced signals. Setting the receiver jumpers the same as the transmitter enables a “transparent” path from the input to the transmitter to the output of the receiver. However, signal translation from balanced to unbalanced or vice versa is also possible.

4.4 POWER SUPPLY AND ALARM CIRCUITRY

Power options for the F290X / F293X Isolators include the AC150W Power Supply / System Monitor providing regulated +12VDC for HF-20 chassis installations or an unregulated +12VDC from a Model PSAC08 (US) or PSAC09 (European) power adapter. The source power is directed through a slo-blo fuse, filtered and re-regulated to furnish +5V and - 5V supplies throughout the circuit card. If either the +5V or -5V supplies fail, or if the +12V supply fails, an alarm condition occurs. Standard FOM II alarm circuitry monitors both data channels in addition to the power supplies. LED indicators are triggered on the circuit card and on the AC150W by the alarm circuitry.

SECTION 5 MAINTENANCE AND TROUBLESHOOTING

5.1 INTRODUCTION

This chapter contains general information designed to isolate a malfunction in the F290X / F293X Isolator 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

Steps in Table 9 should be taken to troubleshoot a non-operating modem. Contact VERSITRON Customer Service for diagnostic assistance or to arrange for repair.

STATUS INDICATOR	PROBABLE CAUSE	CORRECTIVE ACTION
POWER (PWR) LED is OFF.	No AC power.	Check that both ends of the transformer are connected.
	Blown Fuse.	Replace with 250V 1A slo-blo fuse.
	Other power supply circuit problem.	Contact VERSITRON Customer Service for assistance.
ALARM (ALM) LED is ON.	Incorrect optical signal level received at receiver input.	<ol style="list-style-type: none"> 1. Check that fiber optic cables are properly connected to connectors. 2. Check that the remote unit power is on and the fiber optic connectors are properly attached. 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 (TXC1, RXC1, TXC2, RXC2) LEDs are OFF.	Jumpers in wrong position.	Check that the jumpers are set for the correct electrical interface.
	No input on the electrical interface connector.	Check that the interface connector is connected securely.
DATA signal inverted.	Jumpers in wrong position.	Check that the jumpers are set for the correct electrical interface.
	Inverted input on the electrical interface connector.	Check that the interface connector is wired per intended interface standard.

TABLE 9. NON-OPERATIONAL INDICATORS