

#### Features

##### Converts multiple fire alarm communications signals into a single fiber optic link to:

- Multiplex audio signals (analog and/or digital) AND digital communications into full-duplex transmission over a single fiber optic cable
- Improve noise rejection due to the inherent nature of fiber optic communications
- Communicate from a Fire Alarm Control Panel to a Transponder, or provide Network communications
- Provide Network communication support for Ring, Hub, and Star Topologies, and their combinations, by performing the function of a Physical Bridge without slowing data rates

##### Laser optical transmitters provide:

- Increased transmission distances compared to copper wiring (over 20 miles (32 km) may be possible with low-loss single-mode fiber)
- Designs are optimized for fiber type; *select models for single mode fiber, or models for multi-mode fiber*

##### Enhanced Analog Audio (EAA) feature:

- Provides a decoded analog audio signal at the receiving modem for local use; AND also provides the original digitally encoded signal for connection to the next modem in the communications link
- With EAA, total system distance is essentially unlimited

##### Communication combinations include:

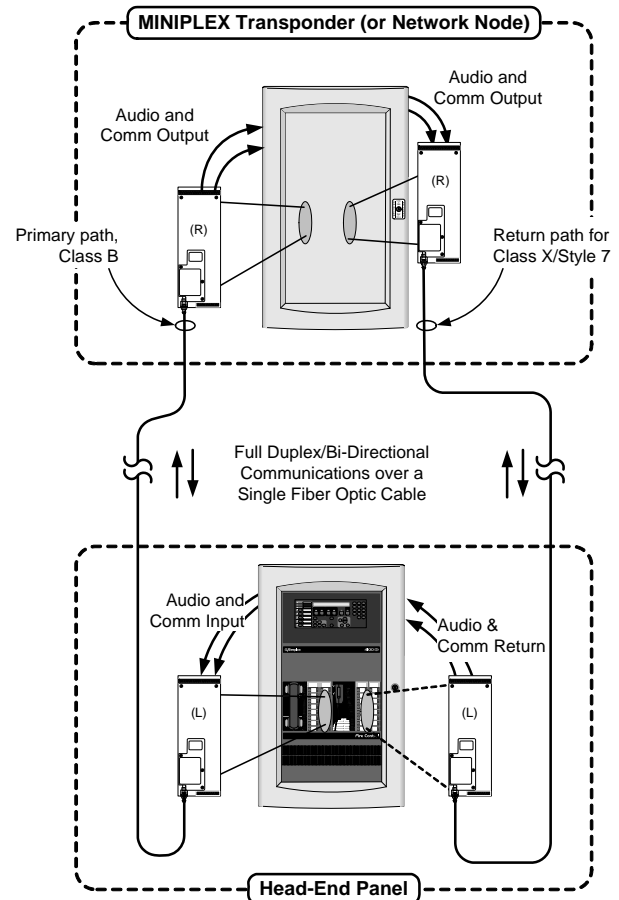
- Digital Audio Riser + Analog Audio Riser #2 + Network Communications
- Digital Audio Riser + Analog Audio Riser #2 + RUI (Remote Unit Interface) Communications
- Both Analog Audio Risers + Network Communications
- Both Analog Audio Risers + RUI Communications
- Or, any of the signals individually; refer to application references on pages 4 and 6 for more details

##### Panel mounted applications:

- Standard two-Slot module for 4100ES and 4100U Fire Alarm Control Panel or 4100ES/4100U MINIPLEX Transponder mounting
- A separate mounting plate is available for 4100/4120 panel mount or utility cabinet mounting
- Note: Fiber Modems communicate in pairs; a Left-Port Modem only communicates with a Right-Port Modem

##### Fiber Modem remote cabinet mounting:

- Available in beige or red; includes a Left-Port Fiber Modem; space is provided for a Right-Port Fiber Modem (ordered separately)
- Compatible with Simplex® control panel model Series 4100ES, 4100U, 4010ES, 4010, 4190 Series TrueSite Workstation, RUI compatible equipment, and legacy 4100/4100+/4120



4100ES System Reference with  
Audio & Data Fiber Modems

#### Features (Continued)

##### Optional Audio Expansion Modules:

- Provide an interface to 25 VRMS and 70.7 VRMS audio levels from 4100/4120 fire alarm control panels

##### UL Listed to Standard 864

#### Description

**Multiple Signal Fiber Optic Modems** combine multiple system communications signals and converts them to fiber optic communications for transmission via a single, full duplex fiber optic cable connection that simplifies field wiring and increases transmission distances. Communications can be sent individually or combined.

**Additional Information.** For additional application information, refer to Installation Instructions 579-831.

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## Operation

**Bi-Directional Communications.** Fiber optic communications are accomplished by transmitting and receiving over two different light wavelengths (refer to diagram on page 3). In order to complete a fiber optic link, complementary receive/transmit modem pairs are required. The two required modem versions are identified as Left-Port Modems and Right-Port Modems (refer to list below for model numbers). One of each is required to complete the fiber optic communications link. (“Right” and “Left” are designated for reference purposes only and do not refer to actual physical locations.)

**Multiple Connections.** Each modem has field wiring connections for the Digital Audio Riser, Analog Audio Risers, RUI, and Network communications (see page 5 for terminal reference information). Configurations are determined by on-board switch and jumper selections. Modem operation is essentially transparent to the connected equipment. However, Fiber Modems are entered into the system programmer for current calculations and mounting allocations.

## Fiber Modem Terms

**Enhanced Analog Audio.** (For systems only using one Analog Audio Riser). At the Head-End audio control panel, the Riser 1 analog audio signal is digitally encoded and transmitted via fiber optics to the receiving Fiber Modem. At the receiving modem, the digital signal is decoded back to analog for local use, but when selected for Enhanced Analog Audio (EAA), the digitized signal is also available, routed to the DAR (Digital Audio Riser) terminals. It can then be **wired** to the next Fiber Modem in the

communications link without requiring additional signal conversion. (**Note:** The next modem in the link must be in the same cabinet or in a close-nipped cabinet.) With EAA, Riser 1 distances are limited to system distances; **without EAA**, Riser 1 signals can be passed through a **maximum of six (6)** Fiber Modem pairs which is also the limit for systems using both Analog Audio Risers 1 and 2. (DAR connections for digital audio are not available since those terminals are used for EAA.) Refer to the diagram on page 3 for more detail.

**Generic Modem.** Fiber Modems in a stand-alone system or in a Network loop have specific functions and internal settings depending on whether they are (for Class X/Style 7 systems) the first modem (Head-End) or the last modem (Tail-End), or a modem between the first and last. For identification, “Generic” modem will be used for Class B connected modems and for those modems located within a Class X fiber loop and not functioning as the Head-End or Tail-End modem.

**Head-End Modem.** For Class X communications, a “Head-End” modem is the **first** fiber optic modem in a fiber optic communications loop and is typically connected to the primary side of the communications channel in the head-end cabinet. A modem with wired connections to Network nodes or system transponders between itself and the head-end cabinet, is still considered to be the head-end modem if it is the **first** fiber optic modem in the communications path.

**Local Side.** The “Local Side” of a wiring link has direct (non-isolated) electrical connection to the head-end cabinet. (*terms are continued next page*)

## Product Selection (see page 8 for product dimensions except as noted)

### Fiber Modems for Internal Mounting in Fire Alarm Control Panels

Model	Fiber Type	Description	Application
4100-6072	Single Mode	Left-Port Fiber Modem Assembly	For direct mounting onto a 4100ES/4100U expansion bay; Fiber Modems are required to be ordered in pairs (Left-Port Fiber Modems communicate only to Right-Port Fiber Modems)
4100-6074	Multi-Mode		
4100-6073	Single Mode	Right-Port Fiber Modem Assembly	
4100-6075	Multi-Mode		
4100-9840	Single Fiber Modem Mounting Bracket; not required for 4100ES/4100U internal mounting; order Fiber Modems separately		Use for internal mounting in a 4100/4120 Series fire alarm control panel or in a compatible utility cabinet
4100-9841	Audio Expansion Module Assembly, with mounting bracket		Use for internal mounting in a 4100/4120 Series fire alarm control panel; converts two analog audio input channels at 25 VRMS or 70.7 VRMS to 10 VRMS for compatibility with the Fiber Modem Audio Input requirements; mounts next to Fiber Modem
4100-9842	Audio Expansion Module only, mounts onto bracket of 4100-9841		

### Expansion Cabinet and Related Modem Assemblies for Remote Mounting

Model	Fiber Type	Description		Application
4190-9021	Single Mode	Red	Expansion Cabinet with Left-Port Fiber Modem Assembly (see page 7 for product details)	Cabinets mount external to compatible panels where internal mounting space is not available; typical applications are for 4010ES/4010 Fire Alarm Control Panels or 4100/4120 or 4100ES/4100U cabinets without internal available space
4190-9024	Multi-Mode			
4190-9022	Single Mode	Beige		
4190-9025	Multi-Mode			
4190-9023	Single Mode	Right-Port Fiber Modem Assembly; for Expansion Cabinet Mounting		Select if required; one maximum
4190-9026	Multi-Mode			
4190-9018	Audio Expansion Module; for Expansion Cabinet Mounting only			Operation is same as for Audio Expansion Modules above, select as required; two maximum per cabinet; two are required for Class A Audio Riser connections

## Fiber Modem Terms (Continued)

**NIC.** Network Interface Card.

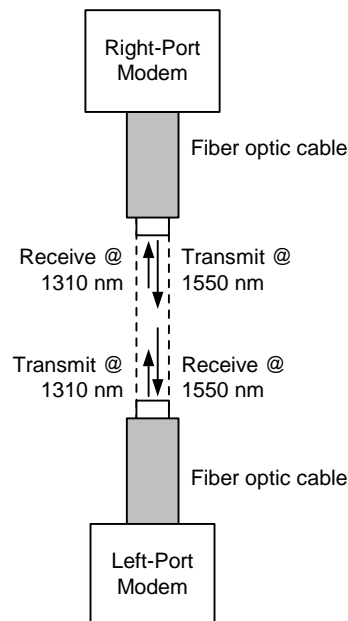
**Remote Side.** The “remote side” of a wiring link refers to wiring that is electrically isolated from the connections to the Head-End cabinet by passing through a Fiber Modem pair.

**RIC.** Riser Interface Card, typically located in a MINIPLEX transponder cabinet.

**Tail-End Modem.** A “Tail-End” modem is the **last** fiber optic modem in a Class X fiber optic communications loop and is typically connected to the secondary (return) side of the communications channel in the head-end cabinet. A modem with wired connections to Network nodes or system transponders between itself and the return connection, is still considered to be a tail-end modem if it is the **last** fiber optic modem in the communications path.

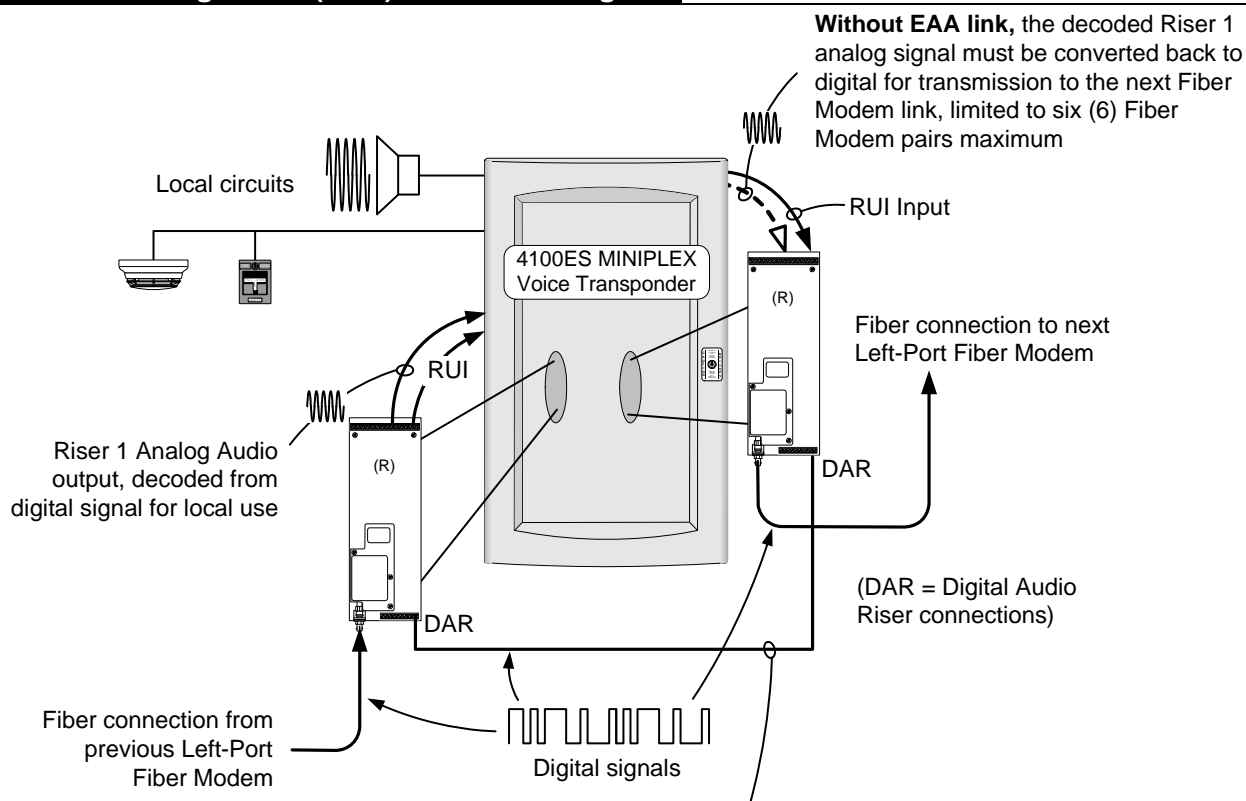
**X-Link Connection.** For **Class X RUI communications** or **Class A Analog Audio Risers**, these wired connections complete the primary-to-secondary supervision path. It provides a non-isolated electrical connection between the primary and secondary sides of the local-side wiring loop and connects between the Head-End and Tail-End modems or Audio Expansion Modules. In the event of a wiring fault, the Fiber Modems separate the x-link connection initiating Class X fiber optic communications. Digital Audio and Network communications do not require x-link connections. Note: X-Link wiring can be run external to the cabinets. (Refer to diagram on page 7.)

## Fiber Modem Operation Reference



Fiber Optic Transmission Reference;  
Full Duplex/Bi-Directional Communications

## Enhanced Analog Audio (EAA) Reference Diagram



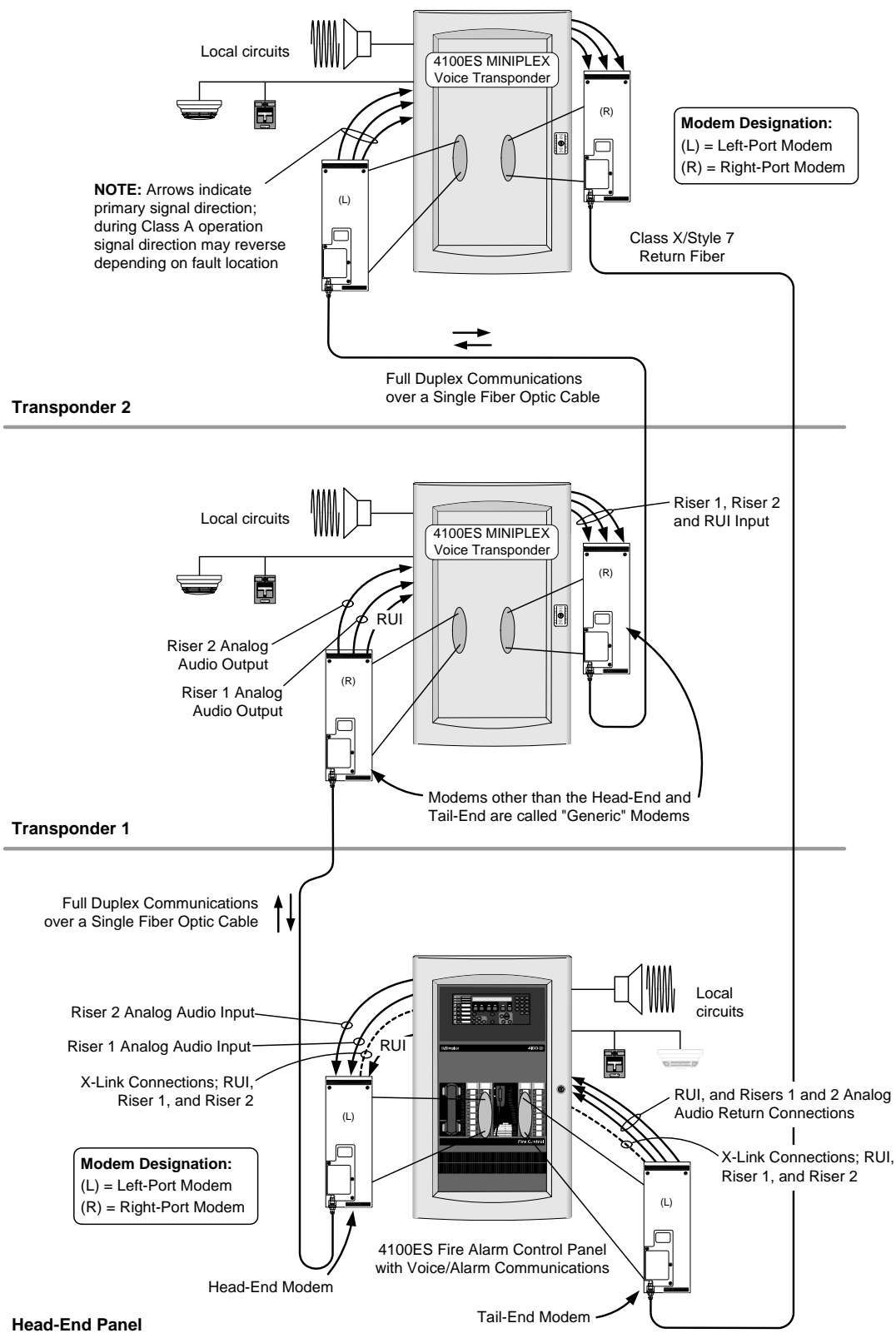
**Enhanced Analog Audio (EAA)** connection maintains Riser 1 digital format; no need to convert back to digital for retransmission to next Fiber Modem

## Application Reference 1, MINIPLEX Transponders

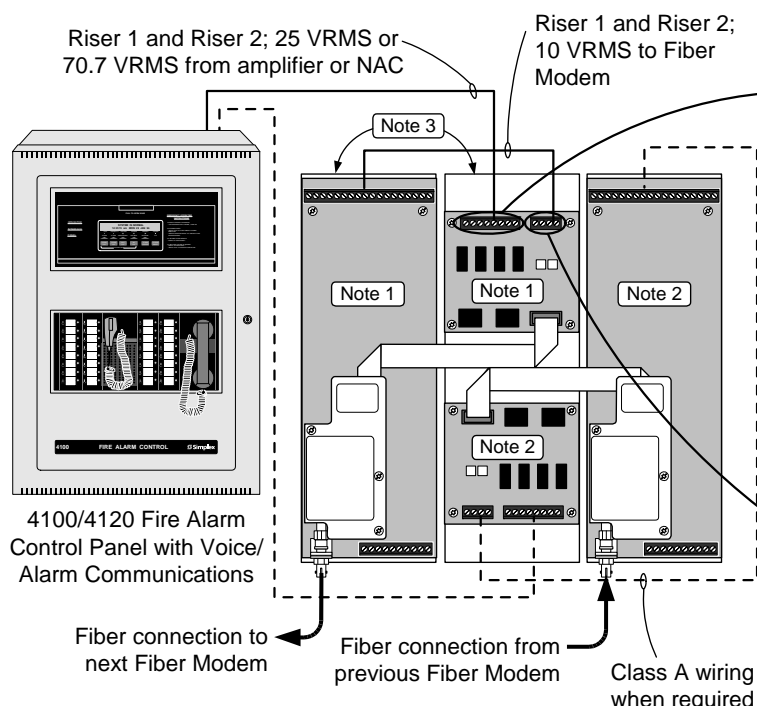
This diagram represents a 4100ES Emergency Voice/Alarm System with two, 4100ES MINIPLEX Transponders. Communications between the panel and the Transponders are Class X/Style 7 using a fiber loop.

Communications include Remote Unit Interface (RUI), Analog Audio Riser 1 and Analog Riser 2. For detailed installation instructions and additional applications information, refer to document 579-831.

**Note:** RUI Communications are limited to up to eight (8) modem pairs.



## Audio Expansion Module Reference



**TB1 Terminal Description**

Pos.	Label	Function
1	RISER 1 +	Analog Audio Riser 1 INPUT; 25 VRMS or 70.7 VRMS
2	RISER 1 -	
3	RISER 1, XLINK +	Analog Audio Riser 1 X-Link connections; wiring that connects between head-end and tail-end for Class A fiber link systems; connect here instead of at Fiber Modem
4	RISER 1, XLINK -	
5	RISER 2 +	Analog Audio Riser 2 INPUT; 25 VRMS or 70.7 VRMS
6	RISER 2 -	
7	RISER 2, XLINK +	Analog Audio Riser 2 X-Link connections; wiring that connects between head-end and tail-end for Class A fiber link systems; connect here instead of at Fiber Modem
8	RISER 2, XLINK -	

**TB2 Terminal Description**

Pos.	Label	Function
1	RISER 1 +	Analog Audio Riser 1 OUTPUT; 10 VRMS
2	RISER 1 -	
3	RISER 2 +	Analog Audio Riser 2 OUTPUT; 10 VRMS
4	RISER 2 -	

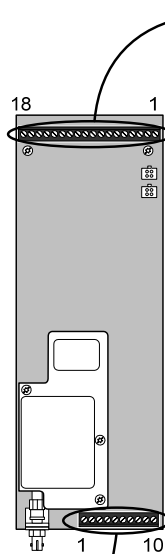
### Notes:

1. A single Audio Expansion Module (4100-9841, with bracket) and a single internal mount Fiber Modem Assembly are required for Class B operation. (Audio Expansion Modules include harness that connects to the modem assembly.)
2. Class A connections require an additional Audio Expansion Module (4100-9842) and an additional Fiber Modem Assembly. For this application, X-Link connections (not shown) are made between Audio Expansion Modules, not at the Fiber Modems.
3. When mounted in a 4100/4120 cabinet, 4100-9840 Mounting Brackets are required for each Fiber Modem. (Audio Expansion Module model 4100-9841 includes a mounting bracket that accommodates two modules.) If internal space is not available, use Expansion Cabinets with options as required.

## Fiber Modem Terminal Descriptions

**TB2 Terminal Description**

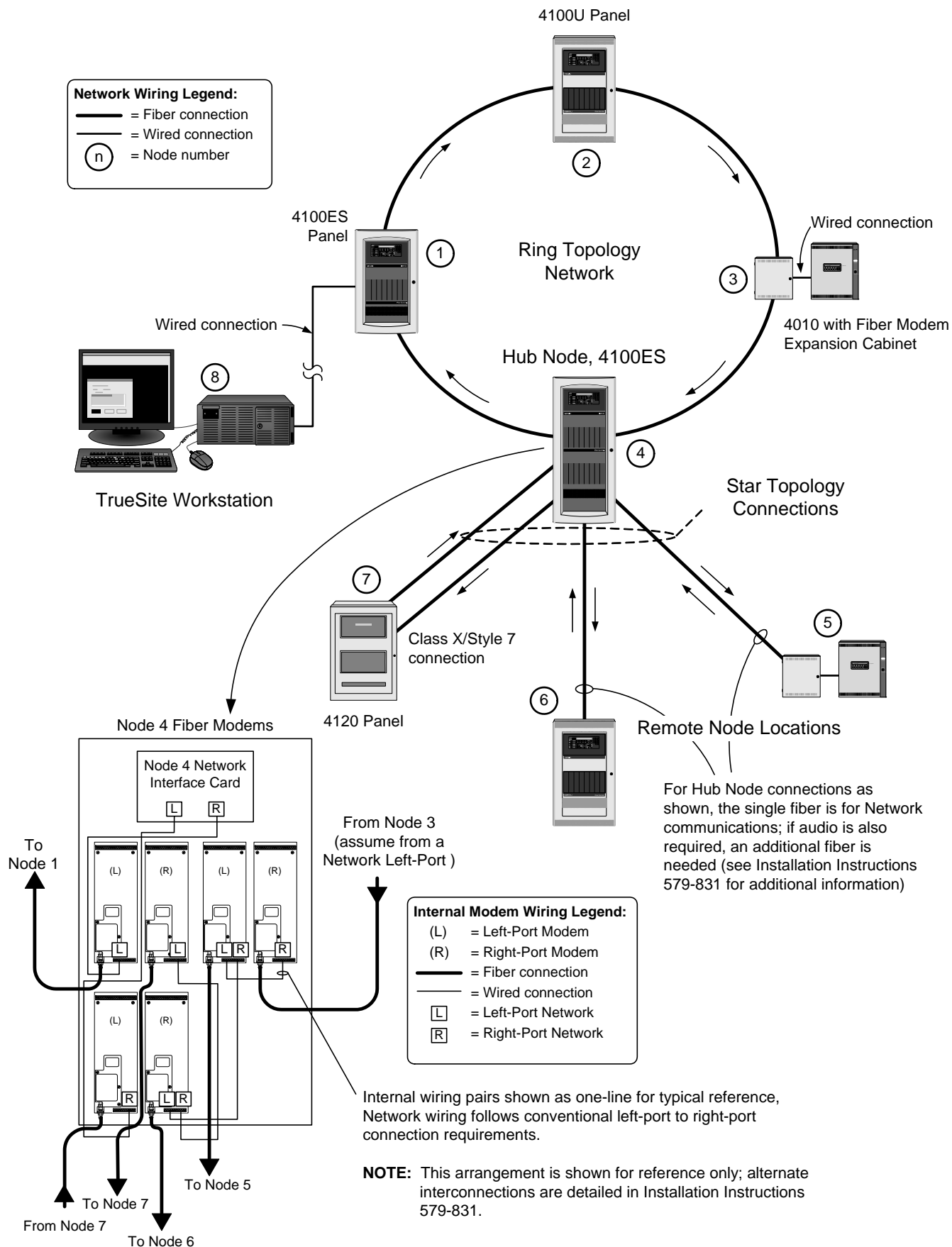
Pos.	Label	Function
1	INV -	Network Left-Port terminals; input OR output depending on modem operation
2	NON INV +	
3	EARTH	Earth (ground) connection
4	5C	5 VDC common (-) connection
5	INV -	Network Right-Port terminals; input OR output depending on modem operation
6	NON INV +	
7	EARTH	Earth (ground) connection
8	0V ISO	Isolated common (-) 0 V connection
9	DAR -	Digital Audio Riser terminals; input OR output depending on modem operation
10	DAR +	



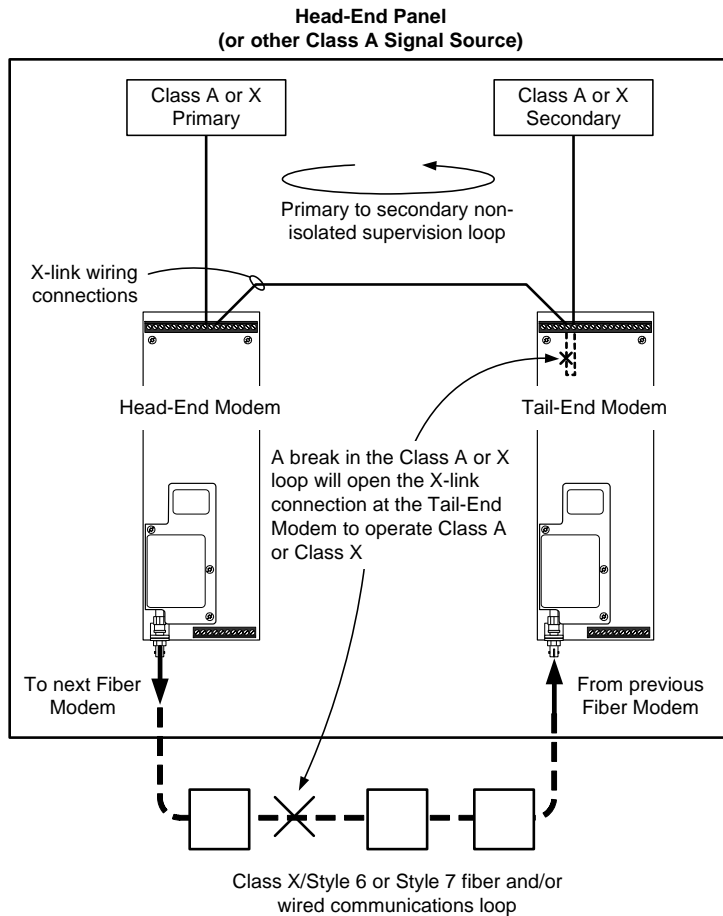
**TB1 Terminal Description**

Pos.	Label	Function
1	24V IN	Input power connections; also available at two separate on-board connectors for Fiber Modem use only
2	24C IN	
3	RUI +	Remote Unit Interface (RUI) terminals; input OR output depending on modem operation
4	RUI -	
5	RUI, XLINK +	RUI X-Link connections; wiring that connects between head-end and tail-end for Class X/Style 7 fiber link systems
6	RUI, XLINK -	
7	24C	Additional 24 VDC common and earth (ground) connection
8	EARTH	
9	RISER 1 +	Analog Audio Riser 1 input OR output depending on modem operation
10	RISER 1 -	
11	RISER 1, XLINK +	Analog Audio Riser 1 X-Link connections; wiring that connects between head-end and tail-end for Class X fiber link systems
12	RISER 1, XLINK -	
13	24C	Additional 24 VDC common and earth (ground) connection
14	EARTH	
15	RISER 2 +	Analog Audio Riser 2 input OR output depending on modem operation
16	RISER 2 -	
17	RISER 2, XLINK +	Analog Audio Riser 2 X-Link connections; wiring that connects between head-end and tail-end for Class X fiber link systems
18	RISER 2, XLINK -	

## Application Reference 2, Network with Hub Node



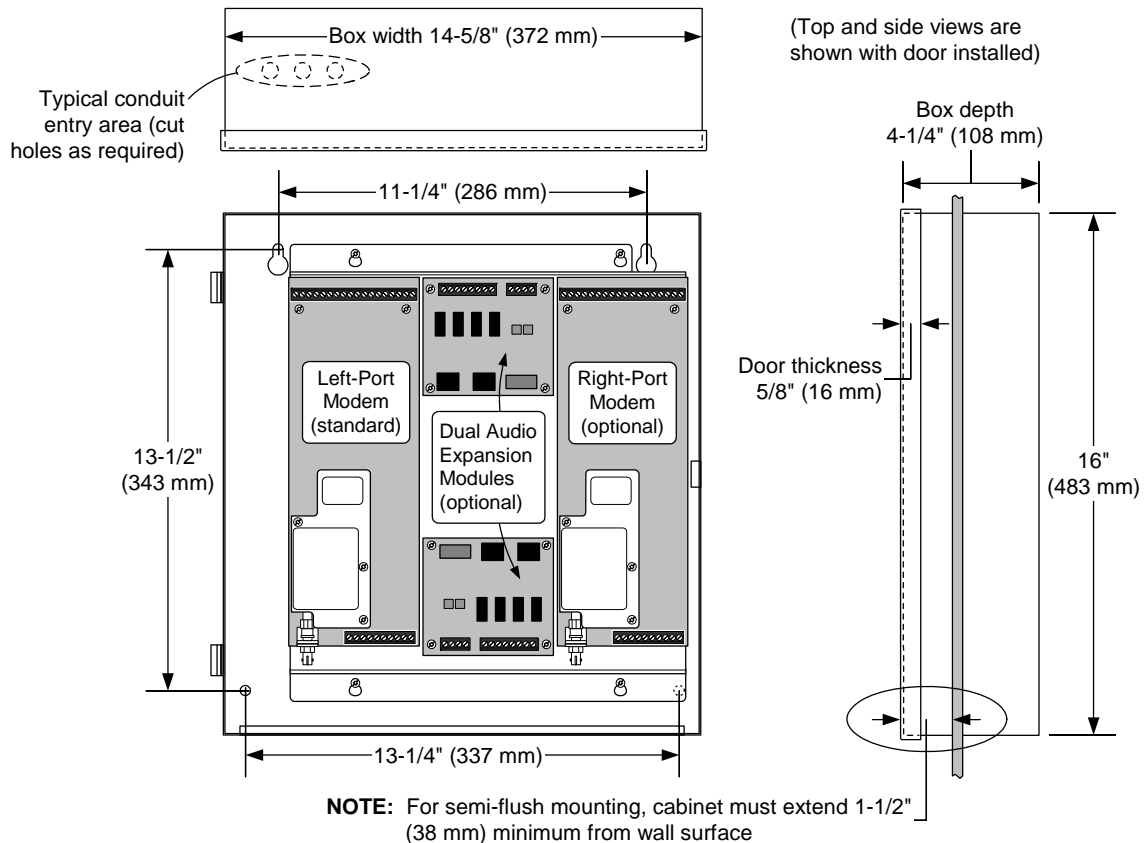
## X-Link Connection Reference Diagram



### Notes:

1. X-link connections are only required for Class X RUI and Class A Analog Audio Riser Fiber Modem applications.
2. It is recommended that Head-End and Tail-End Fiber Modems be located in the same cabinet.
3. Loop devices with non-isolated supervision (MINIPLEX transponders, etc.) are allowed between Modems and Head-End Panel and on X-link wiring.
4. X-link wiring can be extended between cabinets if required. Indoor wiring is recommended for system simplicity. Wiring between buildings must be equipped with proper suppression.

## Remote Cabinet Mounting Reference



## Specifications

### Fiber Modem Electrical Specifications

Voltage	18 to 33 VDC, from control panel
Current, Standby and Alarm	360 mA @ 24 VDC; <b>with</b> Analog Channels enabled 190 mA @ 24 VDC; <b>without</b> Analog Channels Enabled
Analog Audio Riser Input and Output Levels	Three levels: 10 VRMS (standard); 1 Vp-p (0.35 VRMS); 0.707 VRMS
Network Input Wiring	Optimized for 18 AWG (0.82 mm <sup>2</sup> ) or 24 AWG (0.2 mm <sup>2</sup> )

### Audio Expansion Module Electrical Specifications

Current	20 mA, Standby and Alarm
Audio Input Voltage	25 VRMS or 70.7 VRMS
Audio Output Voltage	10 VRMS
Operation Reference	Each input is transformer isolated to output

### Fiber Optics Specifications

**Important Installation Note:** An initial acceptance test of each fiber link shall be performed in accordance with NFPA 72, the *National Fire Alarm and Signaling Code*

Compatible Fiber	General Note	Fiber backbone components must meet or exceed standard EIA/TIA 568-B (Electronic Industries Alliance/Telecommunications Industry Association) for maximum power losses; single-mode fiber is preferred; attenuation should be measured at 1310 nm
	Single-Mode	Nominal 9/125 $\mu$ m
	Multi-Mode	50/125 $\mu$ m or 62.5/125 $\mu$ m graded index
Fiber Connector		Type ST
Allowed Fiber Connections	Single Mode Fiber	No limit
	Multi-Mode Fiber	Three (3) external connections maximum per link (does not include connectors on modems)
Transmit and Receive Wavelengths	Left-Port Modems	Transmit = 1310 nm; Receive = 1550 nm
	Right-Port Modems	Transmit = 1550 nm; Receive = 1310 nm
Transmission Distances for <b>Single-Mode Fiber</b> (preferred fiber type)		Maximum total attenuation = 15 dB
		<b>Example 1 (low loss fiber):</b> Assume fiber with attenuation of 0.34 db/km; a target distance of 35,000 ft (10.7 km); connector loss totaling 6 dB attenuation; calculate the safety margin: (10.7 km) x (0.34 db/km) = 3.68 dB fiber loss 15 dB - 3.68 dB - 6 dB = > <b>5 dB safety margin</b>
		<b>Example 2 (higher loss fiber):</b> Assume fiber with attenuation of 0.6 db/km; a target distance of 25,000 ft (7.7 km); and connector loss totaling 5 dB attenuation; calculate the safety margin: (7.7 km) x (0.6 db/km) = 4.62 dB fiber loss 15 dB - 4.62 dB - 5 dB = > <b>5 dB safety margin</b>
Transmission Distances for <b>Multi-Mode Fiber</b>		5000 ft (1.6 km) maximum distance Maximum total attenuation = 6 dB 50 $\mu$ m or 62.5 $\mu$ m GRIN (graded-index fiber)

### Mounting/Environmental Specifications

4010ES		External Cabinet Only
4100ES/4100U Chassis Mounted		Two Vertical Block Module; 4" W x 11-5/16" H (102 mm x 287 mm)
4100-9840 Mounting Bracket		4" W x 11-9/16" H x 0.064" Thick (102 mm x 294 mm x 1.6 mm)
Remote Cabinets: 4190-9021, 4190-9022, 4190-9024, and 4190-9025		14-5/8" W x 16" H x 4-1/4" D (372 mm x 483 mm x 108 mm); see page 7 for additional details
4100-9842 Dual Transformer Audio Expansion Assembly	Mounting bracket	4" W x 11-1/2" H x 0.064" Thick (102 mm x 292 mm x 1.6 mm); mounts internal to 4100/4120 control panel
	Module size	4" W x 3-5/8" H (102 mm x 91 mm)
Environmental Specifications	Operating Temperature Range	32° to 120°F (0° to 49° C)
	Operating Humidity Range	Up to 93% RH, non-condensing @ 100° F (38° C)

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