Fiber-Span

Fiber Optic RF Repeater System

FS31 Series User Manual

1 Introduction

This manual outlines the operation and setup for Fiber-Span Fiber Optic Based RF Repeaters.

2 Warnings

Figure 1. Laser Warning Label

Warning: Invisible radiation exits from areas labeled “Aperture”

AC power is used to supply power up the system modules. Use precautions to prevent electrical shock hazards. Always terminate the RF connections before applying power to the unit.

3 Product Overview

Fiber-Span provides product to enable RF signal to be distributed via optical fiber cable. RF signal sources can be used from over the air (OTA) from a Radio Base Station (BS), OTA from handheld devices, or directly from a BS radio. RF signals are converted to modulated light for transport through optical fiber media to remote locations. Modulated light is converted back to the original RF signal where it is processed through filtering and amplification to allow the RF signal to be re-radiated in the remote location. In a bi-directional RF system, the process is the same resulting in remote RF signals that are sent back simultaneously.

Fiber-Span product functionality

OTA system - RF signals from a remote base station are interchanged usually from a roof top antenna that is connected to an Integrated Head-end Unit (IHU). The IHU receives downlink signals from the base station and sends uplink signals back to the base station. The IHU distributes signals via fiber optics to remote location and also is capable of simultaneously interfacing with a Distributed Antenna System (DAS) for short range RF distribution.

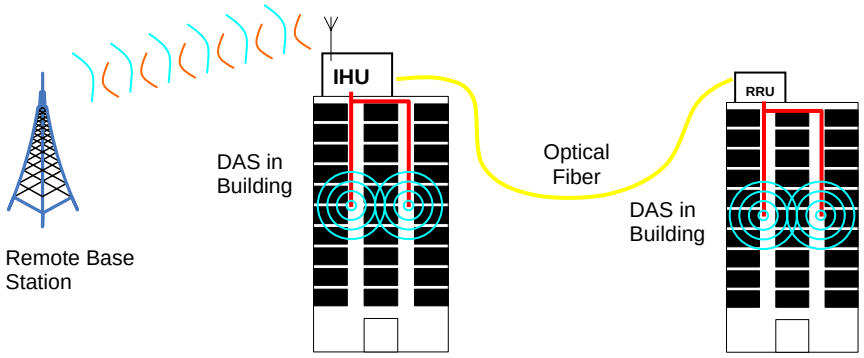

Figure 2. Typical OTA Optical RF distribution System

Local Base Station System – Signals from a local base station interface to optical distribution equipment through Base Station Units (BSU), or directly to a Fiber Transceiver Unit (FTU). The BSU sometimes interfaces the Base Station to the FTU. The BSU is used to passively condition RF levels or serve as RF filters when applicable. The FTU performs bi-directional optical-RF conversions. Optical signals are sent to the Remote Repeater Unit (RRU). The RRU is designed for use as a remote end of a bi-directional RF distribution system. The RRU RF port works with a direct connected RF antenna or to a Distributed Antenna System (DAS). The RRU is connected via optical fibers to a Fiber Transceiver Unit (FTU) to complete a point to point RF link.

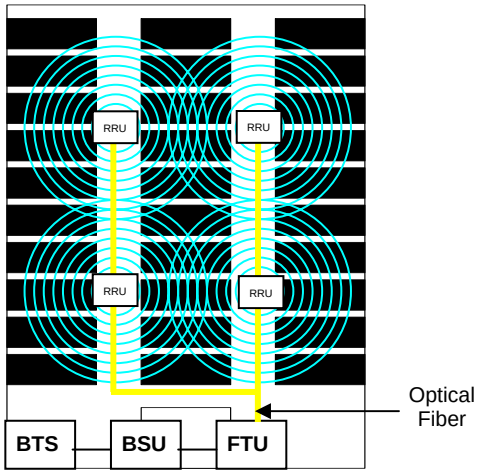

Figure 3. Local Base Station System

4 Product Diagrams

RRU Block Diagram

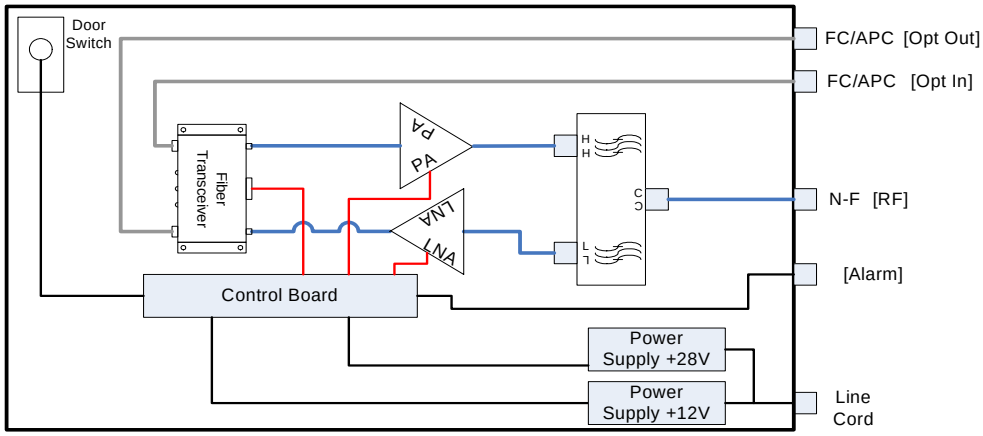

Figure 4. Simplified Block Diagram of RRU

FTU Block Diagram

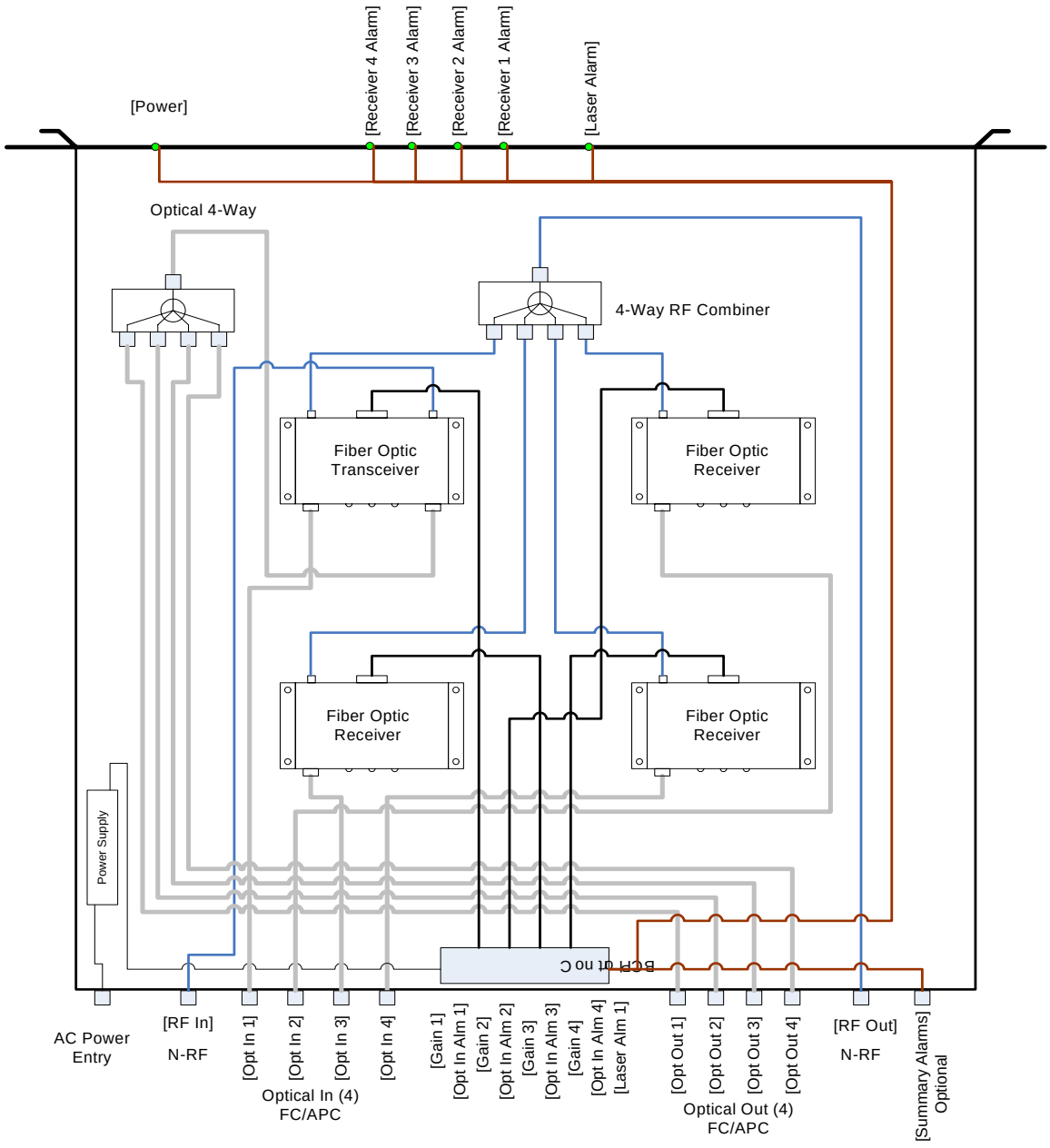

Figure 5. FTU Block Diagram (4-Way FTU Shown)

5 RF Path Definitions

The RF paths are defined as follows:

Downlink – Originates at the FTU or and IHU, over fiber to the RRU to the RF Port. The Downlink generally is defined by the RF output power the RRU can deliver.

Uplink – Originates at the RRU, over the fiber to the FTU or IHU to the RF Out Port. The Uplink is generally defined by RF input sensitivity.

6 Installation Guide

6.1 General

All unused RF Terminals must be terminated with a 50 Ohm load. All unused Optical Terminals must be protected using dust cover cap. When installing fiber optic cables, remove dust covers, clean optical connector with optical grade alcohol, align FC/APC connector **KEY** and hand tighten. Do not over tighten. Keep fiber bend radiuses greater than 1.5 inches.

6.2 Fiber Transceiver Unit (FTU)

The Fiber Transceiver Unit (FTU) is a 19" standard 1U sub-rack. The FTU requires AC Power (90 to 220 VAC, 50-60 Hz). The AC interface is a standard IEC Power socket. A US 120V AC Line Cord is supplied with each FTU.

Mount Fiber Transceiver Unit away from excessive heat sources. Make all RF connections and terminate all unused RF connections before applying AC Power. User interface information can be found in attached outline drawing.

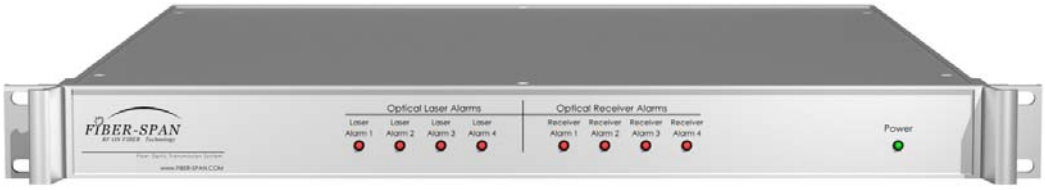

Figure 6. FTU Front View

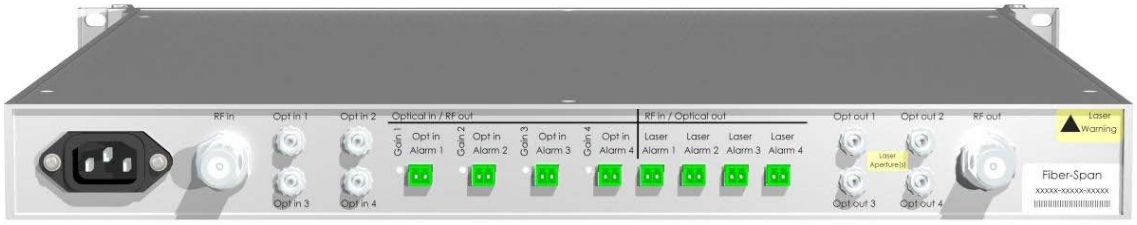

Figure 7. FTU Rear View

Alarms

The Opt in Alarm interface uses a wire contact header (supplied) that will plug into the Opt in Alarm sockets. Connection of alarm wires to the wire contact header requires a small standard flathead screwdriver. The connections are dry contact relay terminals. The alarm LED's on the front panel indicate alarm conditions for each individual uplink optical receiver and downlink optical transmitter. An optional Summary alarm is available.

A receiver alarm is triggered by excessive optical loss. The transmitter alarm is triggered when the laser transmitter runs over bias. Normal operation leaves the contacts normally open (NO). In the event of an alarm condition, the corresponding contacts close.

RF Levels

For the uplink, each receiver has a gain control that is accessed using a small standard screwdriver on the FTU rear.

For Uplink, disconnect the downlink optical fiber on the FTU side to ensure that there is no RF output at the RRU RF port. Turn down the gain on ALL FTU receivers (if FTU is more than a 1-Way) using gain control by turning CCW at least 12 turns. On the RRU side, connect a RF tone generator set to an RF level of -50 dBm at the center of the uplink frequency. On the FTU, set RF output to the desired level at the FTU RF output by adjusting corresponding FTU receiver gain control. Repeat for other Uplinks individually if applicable and leave gain settings of previous calibrated uplinks unchanged. The goal is to balance the uplink gains to be all equal.

For downlink, provide composite RF level into FTU transceiver at 0 dBm.

All unused RF Terminals must be terminated with a 50 Ohm load. All unused Optical Terminals must be protected using dust cover cap. When installing fiber optic cables, remove dust covers, clean optical connector with optical grade alcohol, align FC/APC connector **KEY** and hand tighten. Do not over tighten. Keep fiber bend radiuses greater than 1.5 inches.

6.3 Remote Repeater Unit (RRU) and Integrated Head-end Unit (IHU)

The RRU/IHU requires AC Power (90 to 220 VAC, 50-60 Hz). Connect RRU to earth ground using Earth Ground Lug on the external side of RRU. If the unit is a wall mount type, use the dimensional information provided with the Outline Drawing (example attached). Mount on a sturdy location keeping clear vent holes and heat-sink. If the unit is a rack mount type, mount the unit to allow air passage from front to back. Space the units to allow convection air flow. If the unit is mounted inside a larger enclosure, air ventilation must be used to keep the RRU in proper temperature

range. Make all RF connections and terminate all unused RF connections before applying AC Power.

Figure 8. RRU/IHU (Wall Mount Version) Bottom Side

Figure 9. RRU/IHU (Rack Mount Version)

Alarms

The alarm interface uses a circular connector. The connections are dry contact relay terminals. The alarm LED's on the Control Board indicate the alarm conditions for each individual parameter as:

Downlink Optical Receiver
Uplink Optical Transmitter
PA Alarm
Door Alarm (Wall Mount) / Fan Alarm (Rack Mount)

See LED alarm indicator locations in Figure 10.

A receiver alarm is triggered by excessive optical loss. The transmitter alarm is triggered when the laser transmitter runs over bias. The PA alarm indicates that the PA is overdriven. The Door / Fan alarm indicates when the door is left open or if a cooling fan fails. The alarm output is summarized which makes one set of contacts available on the circular alarm connector. Normal operation leaves the contacts normally open (NO). In the event of an alarm condition, the corresponding contacts close.

RF Levels

The Downlink Output level is factory set to meet the RF maximum output level that is compatible with FCC requirements. The uplink Gain level is factory set to optimize noise levels for the optical system. RF output levels and gain levels are adjustable using in-line RF pads. The important In-Line Pad Locations are:

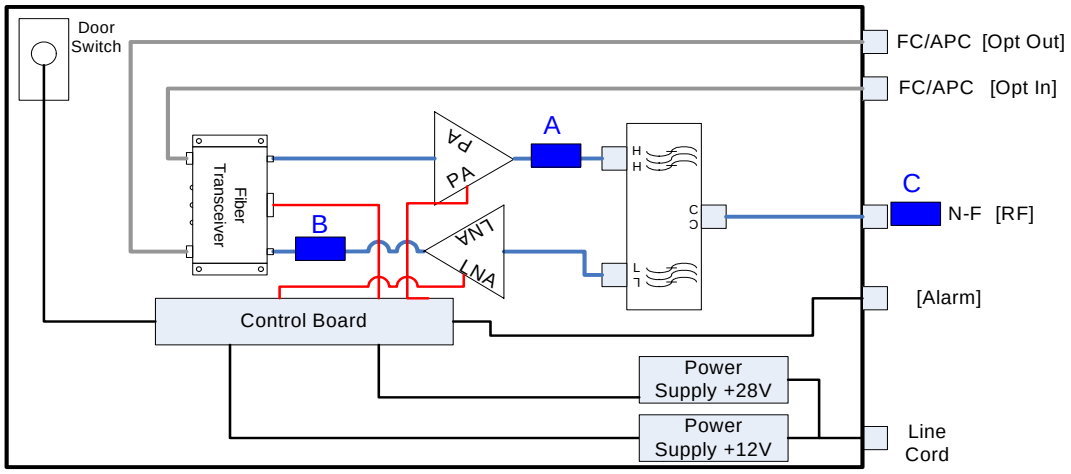

Figure 10. RF pad locations for RRU

Pad location

A – Used to lower Downlink RF power without affecting the uplink parameters
B – Used to lower Uplink RF level into the optical transmitter without affecting Downlink parameters
C – Used to lower Uplink and Downlink levels simultaneously

Parameter to be controlled	Attenuator	Comments
Lower Downlink RF Output Power	Pad A SMA-Female to SMA-Male	Power Handling Wattage indicated in Table 2.
Lower Uplink RF into Optical Transceiver	Pad B SMA-Female to SMA-Male	Lowers Uplink Sensitivity, Maximum Composite RF input to Transceiver is 5 dBm, input P1 = 17 dBm.

		Maximum Composite RF into LNA (No Damage) +10 dBm, input P1 = -6 dBm, LNA gain is 27 dB
Lower Both Uplink and Downlink	Pad C N-Female to N-Male	External in-line attenuator

Table 1. Attenuator Configurations

IHU RF Levels

The IHU downlink has a high gain to boost weak received signals to levels to drive the optical components. Do not allow a composite RF level greater than 0 dBm into the optical transceiver. See the IHU rear RF INPUT MAX information. Uplink power settings can be done as the RRU instructions.

RRU RF power Considerations

The RRU is available with many RF power outputs. For each product, there are considerations for pad power dissipation. Product power levels are the Output P1 dB compression point.

Model Series	Minimum Attenuator Dissipation
FS31RX-A, ½ Watt	1 Watt
FS31RX-B, 1 Watt	2 Watts
FS31RX-C, 5 Watt	10 Watts
FS31RX-D, 10 Watt	20 Watts
FS31RX-E, 20 Watt	50 Watts

Table 2. Attenuator Power Dissipation Recommendations For Attenuator A or D

RRU Photographs

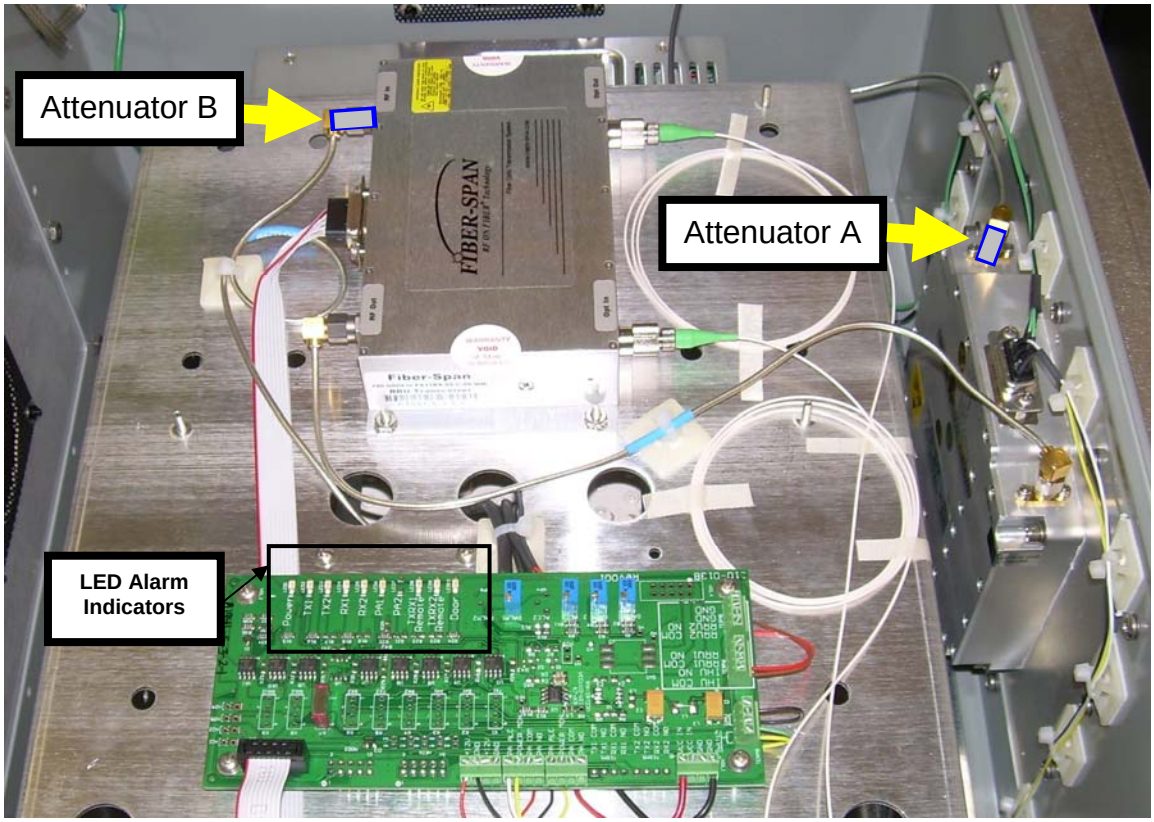

Figure 11. RRU Attenuator Locations Pad A and Pad B (SMA-Female to SMA-Male)

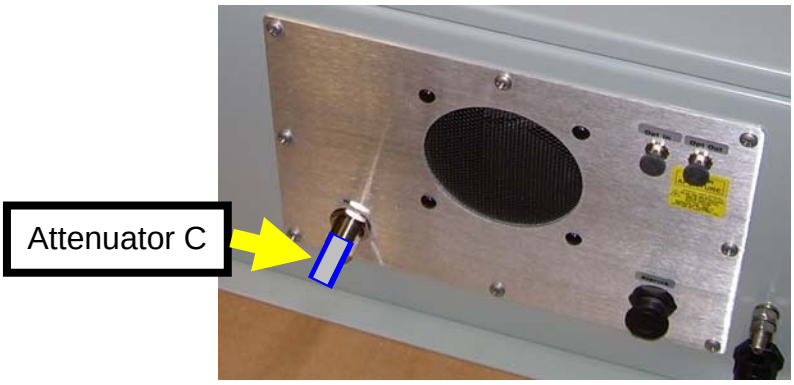

Figure 12. RRU Attenuator Location for Pad C (N-Female to N-Male)

6.3.1 Recommended System Start up Procedure

- Verify all RF cables are connected and all unused RF connections terminated with 50 Ohm terminations.
- Verify all Alarm and AC connections are properly made
- Connect fiber optic cables.
- Apply AC power to system components.

6.4 Caution

RRU has internal AC power connections that can cause shock if operator is not careful. Always verify the AC Power area is clear of all objects. Do not leave objects inside the RRU that can cause dangerous shock hazard.

7 Maintenance

This Fiber Optic repeater system does not require scheduled maintenance. However, use precautions while installing optical fibers to keep connector surfaces clean. An unclean optical connector surface can damage the internal transceiver connector which can degrade system performance and violate Fiber-Span warranty. Keep heat dissipating surfaces or vents clean and clear.

8 Company Information

Fiber-Span designs and manufactures fiber optic modules and systems used in the transmission and distribution of RF and wireless signals. Fiber-Span's fiber optic transmitters, receivers and transceivers are widely used in wireless and RF systems worldwide by wireless systems OEM's, systems integrators and military systems designers to capitalize on the inherent advantages of fiber. Fiber has extremely low RF attenuation (< 1dB/km), very high bandwidth, immunity to EMI, no signal egress, flat broadband delay characteristics plus a cable design that is light weight and small size.

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9 Reference Documents

Example Document Title	Example Document Description
FS31FS-04-LM-OUT	4-Way FTU Transceiver
FS31RS-90-C-06-WM-OUT	RRU Transceiver, SMR-900, 5W
FS31X-1.9-60-2-RM-OUT	IHU Transceiver, PCS, 5W

FIBER-SPAN
RF ON FIBER® Technology

Dwg. No. FS31FS-04-LM-OUT Rev:1

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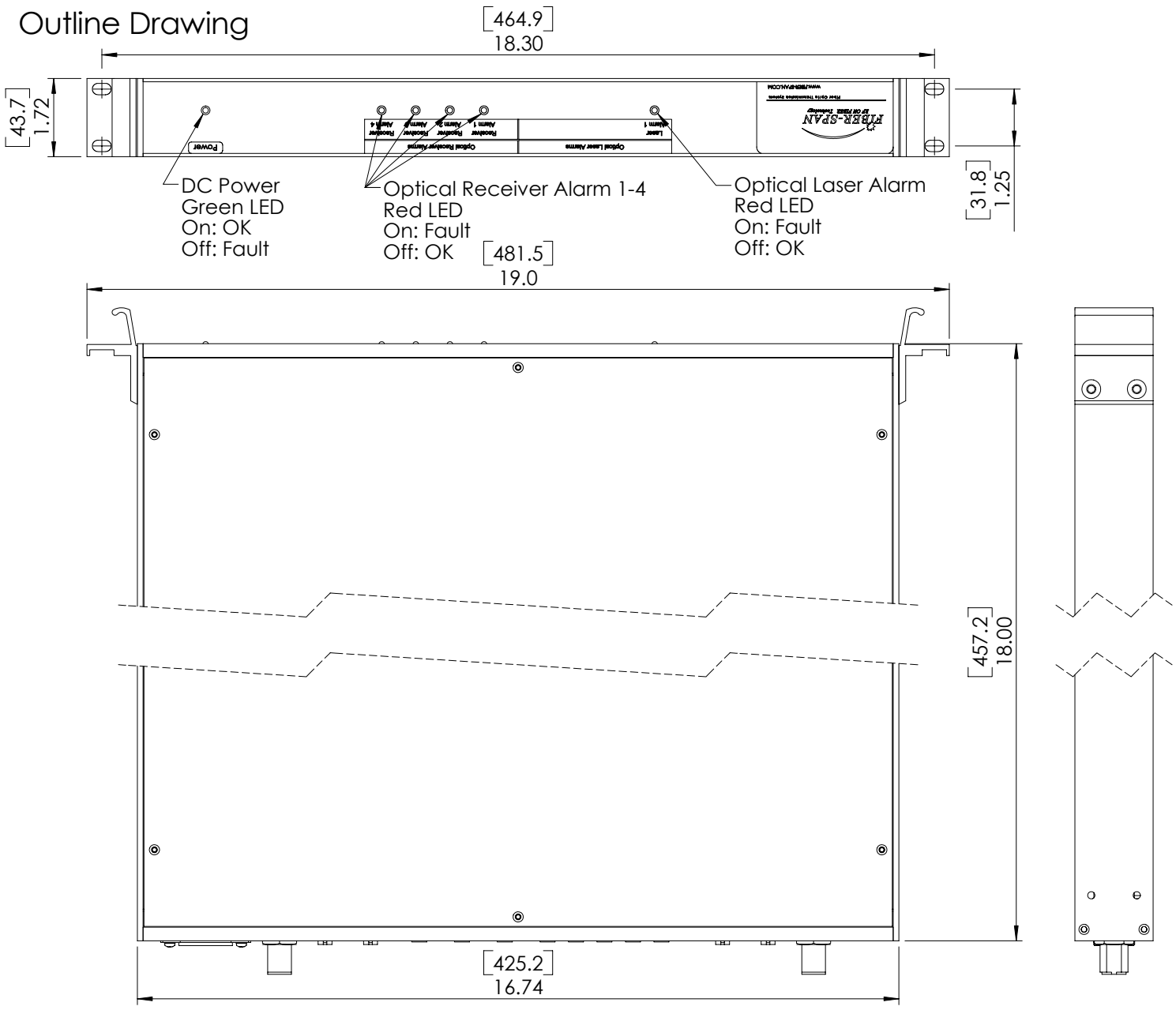
S. Plainfield, NJ 07080
www.fiber-span.com

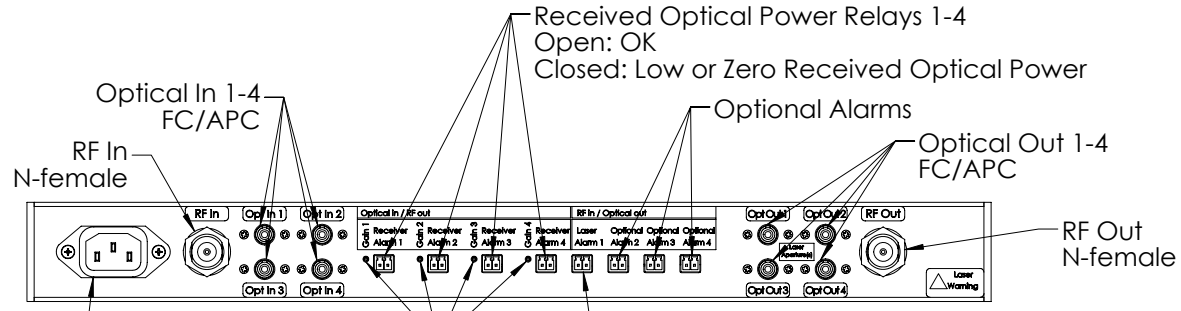
Units: [millimeters] inches

Third Angle Projection

FS31FS-04-LM, Fiber Transceiver Unit, 4-Way with Local Alarms, 1U Rackmount

Outline Drawing





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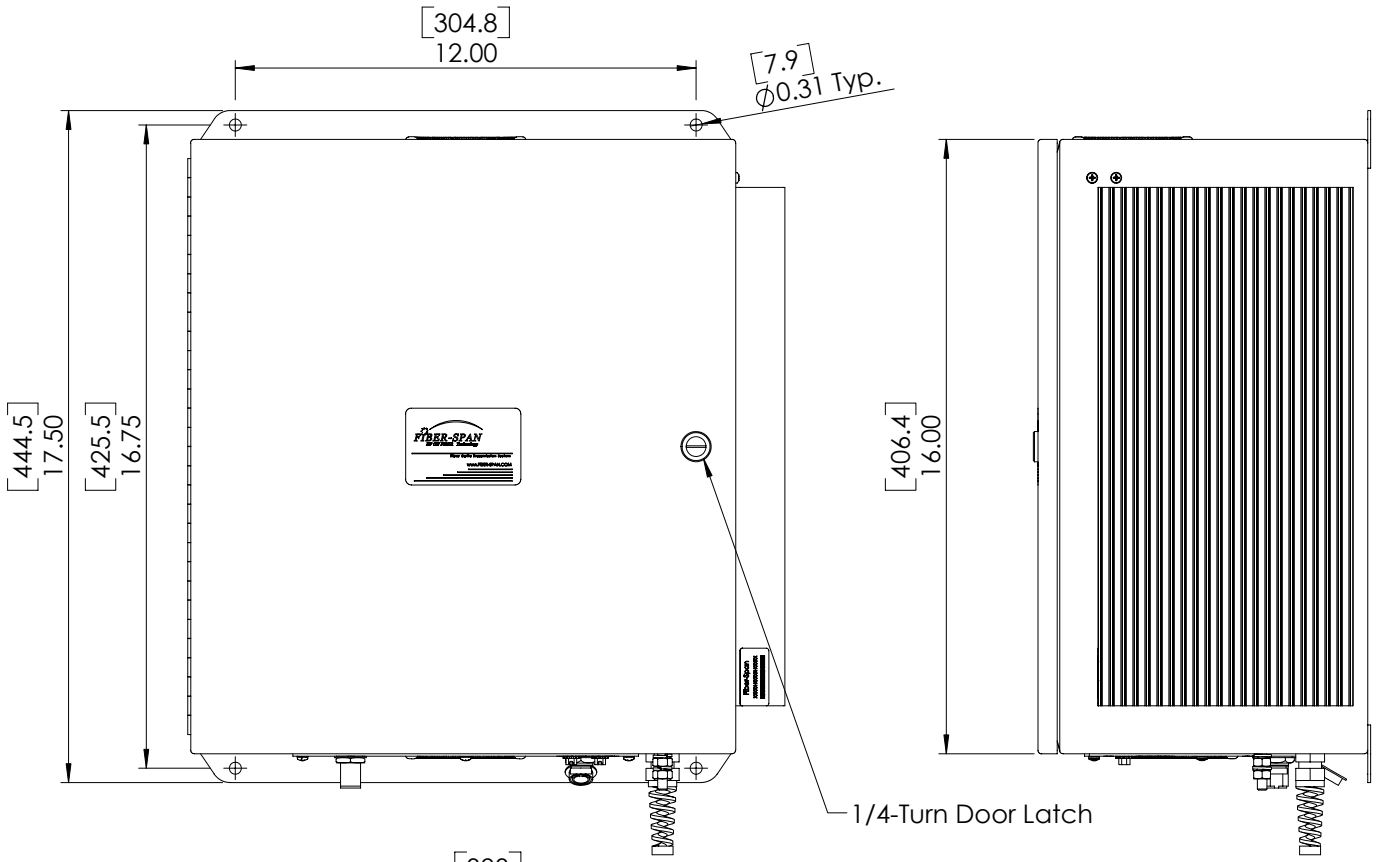
Dwg. No. FS31RS-90-C-06-WM-OUT Rev:1

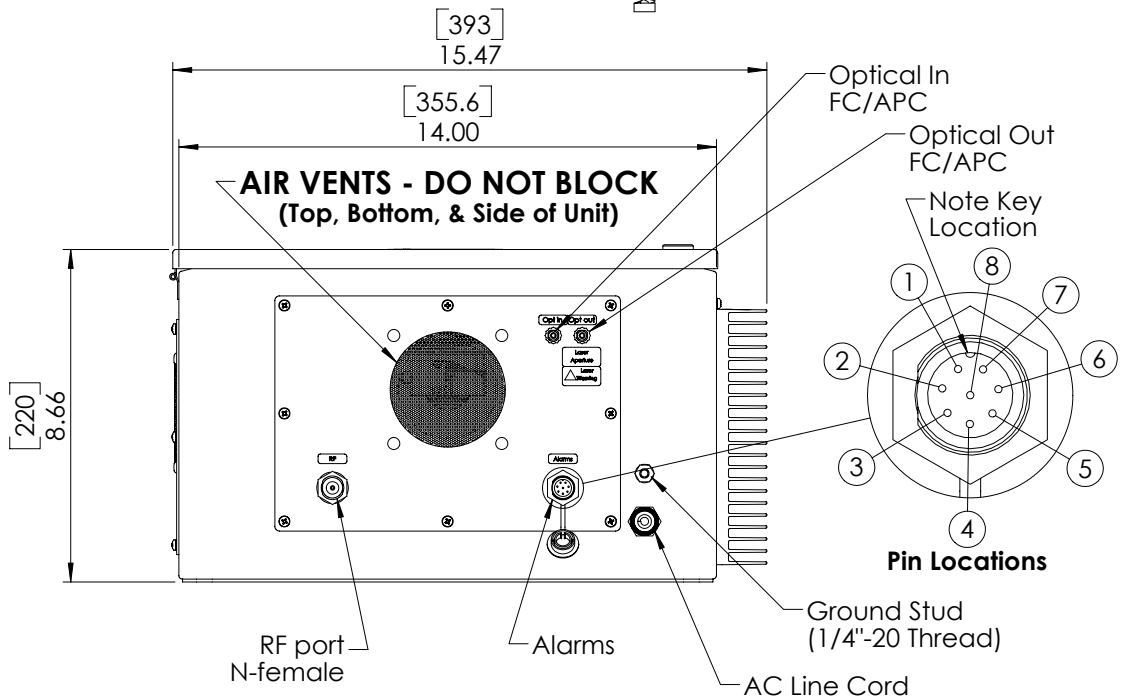
Units: [millimeters] inches

Third Angle Projection

FS31RS-90-C-06-WM, Remote Repeater Unit, Wall-Mount Enclosure

Outline Drawing





Pin	Function
1	Summary Alarm
2	Summary Alarm
3	No Connect
4	No Connect
5	No Connect
6	No Connect
7	No Connect
8	No Connect
Dry Contact Normally Open when Status is OK	

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Dwg. No. FS31X-1.9-60-2-RM-OUT Rev:1

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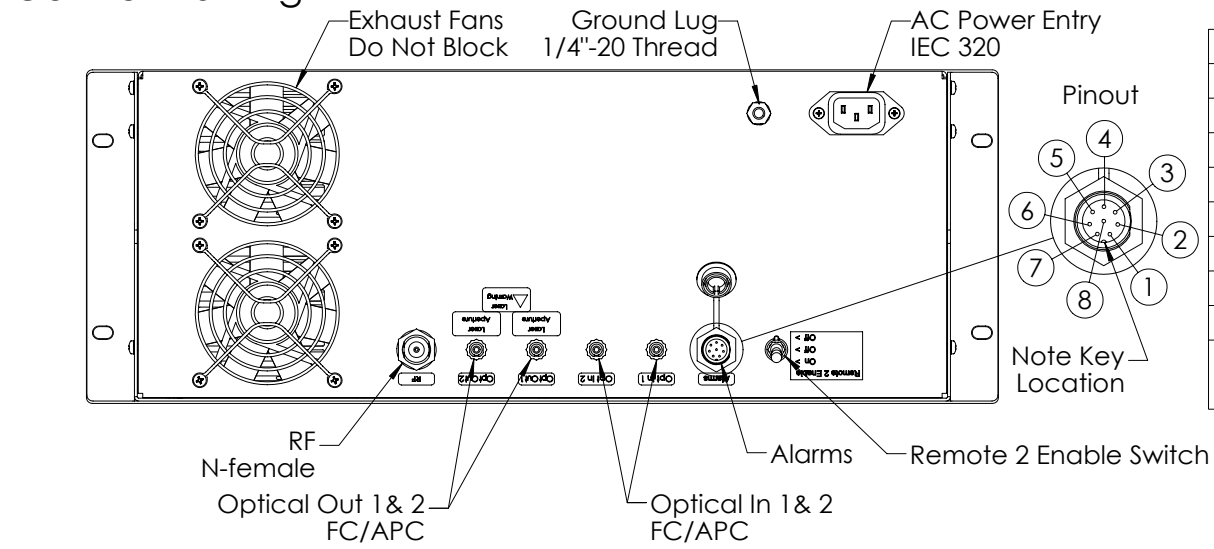
www.fiber-span.com

Units: [millimeters] inches

Third Angle Projection

FS31X-1.9-60-2-RM, IHU, 1850-1990 MHz, 5W
4U Rackmount

Outline Drawing



Pin	Desc.	Function
1	N.O.	Local Summary Alarm
2	Com.	
3	N.O.	Remote 1 Summary Alarm
4	Com.	
5	N.O.	Remote 2 Summary Alarm
6	Com.	
7	-	-
8	-	-
Dry Contact Normally Open when Status is OK