FIBER-SPAN
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Fiber-Span

Installation Guide and User Manual

FS31LX-XX and FS31X-85-C
Fiber Optic RF Repeater System

This devices complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Part 15.21
Changes or modifications not expressly approved by the party responsible for the compliance could void the user's authority to operate the equipment.

NOTE: The manufacturer is not responsible for any radio or TV interference caused by unauthorized modifications to this equipment. Such modifications could void the user's authority to operate the equipment.

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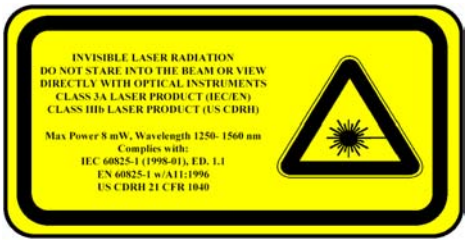
1 Introduction

This high performance Analog RF Fiber Optic Transmission Repeater System converts RF signals into intensity modulated light to be carried through standard single mode optical fiber to an Optical Receiver. The Receiver converts the modulated light back to the original RF signal. Fiber-Span uses high performance optical components and patented technology to ensure maximum dynamic range.

2 Warnings

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

The fiber optic repeater system is designed to transport and distribute Public Safety & Private Land-Mobile Radio Frequencies signals through fiber optic medium. The Downlink has high Power to drive Distributed Antenna Systems (DAS). The Uplink has Low Noise figure to receive low signals over the air antenna.

The purpose for this system is to expand radio coverage for an In-Building System which is between the 806-824 MHz Uplink and 851-869 MHz MHz Downlink range. This is done by sending and receiving the RF signals from the basestation and distributing the radio signals over fiber, to a remote fiber optic transceiver to interface to a remote antenna. The system design is for single or up to 32 remote optical repeaters.

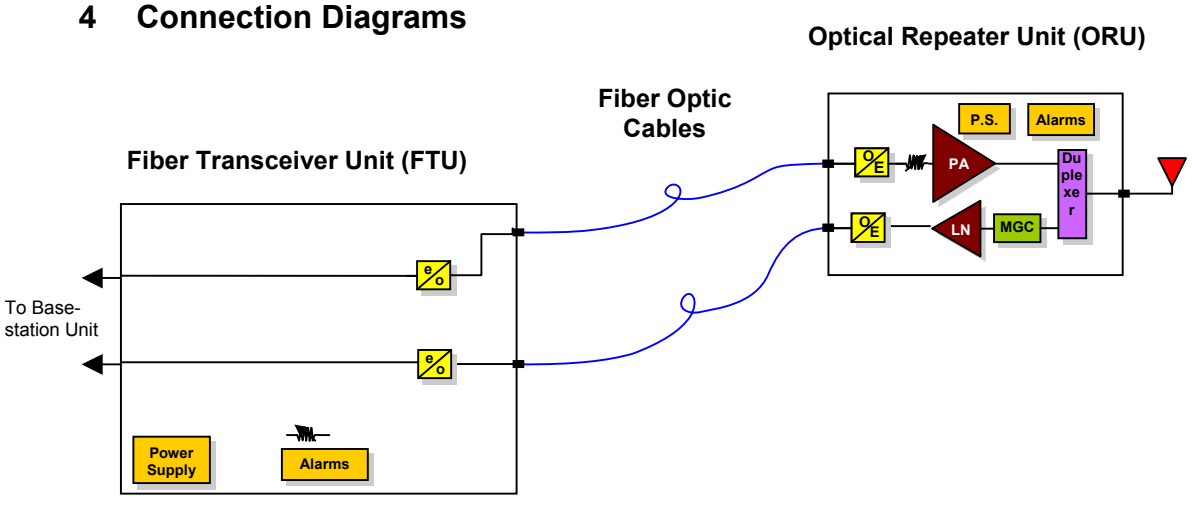
The FS31LM-01-LMC is a subrack fiber optic transceiver, which can contain from one to four transceivers. These transceivers provide the optical connections to the FS31HM-85-C-18-65 Remote Repeater. The FS31LM-01-LMC is AC powered and offers transceiver alarm LED indicators, Dry contact (NO) alarm terminals, and RF gain control for each receiver for uplink signals.

The FS31HM-85-C-18-65 interfaces with the fibers from the FS31LM-01-LMC and connects the remote antenna to a single RF port. The FS31HM-85-C-18-65 is AC powered and offers Dry contact (NO) alarm terminals for the transceiver, door open, and PA alarms.

System Components and Descriptions

Model	Function	Description
FS31HM-85-C-18-65	Optical Repeater Unit	Transmitter and Receiver Amplifier Single RF, Dual Optical Port
FS31LM-01-LMC	Fiber Transceiver Unit	Transmitter and Receiver Dual RF Port, Dual Optical Port

4 Connection Diagrams



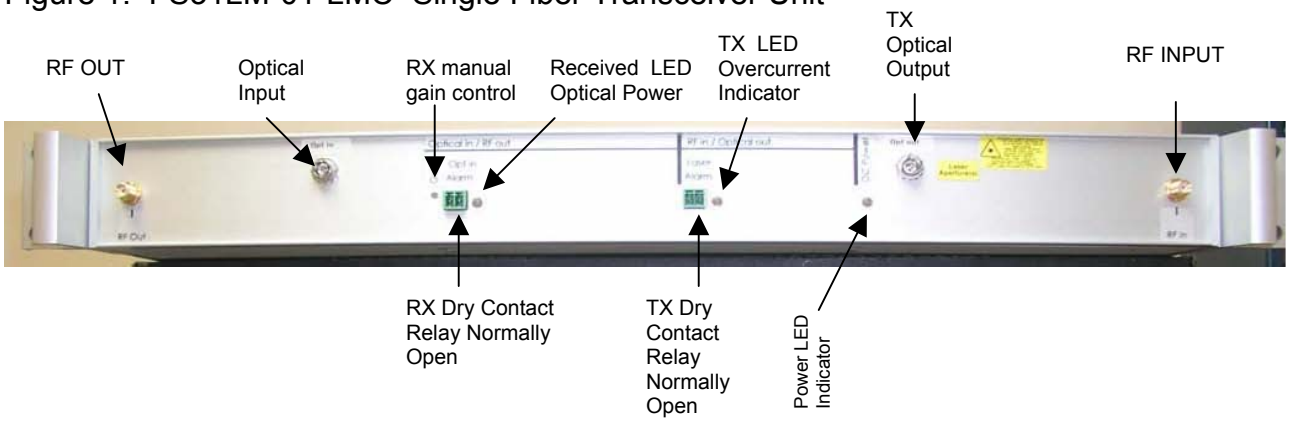
5 Installation Procedure

5.1 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.

5.2 FS31LM-01-LMC, Fiber Transceiver Unit (FTU)

Figure 1. FS31LM-01-LMC Single Fiber Transceiver Unit



The FS31LM-01-LMC Fiber Transceiver Unit (FTU) is a 19" standard 1U subrack. 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 in close proximity to the BSU interfaces to minimize cable lengths.

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

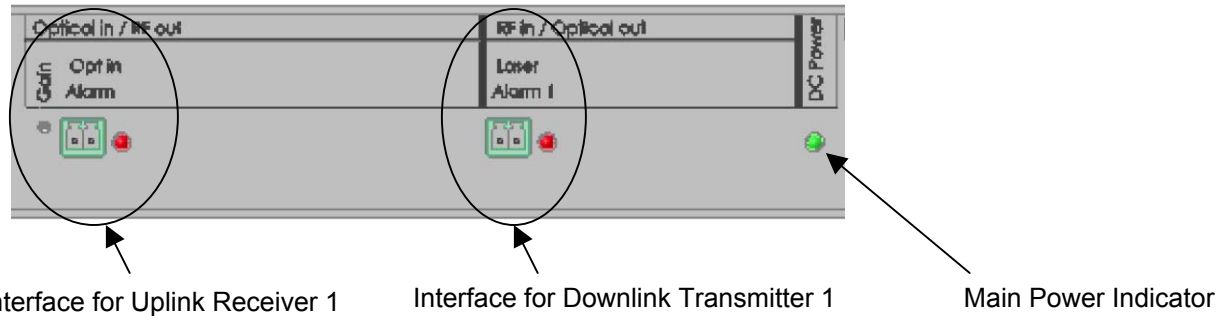


Figure 2. Fiber Transceiver Unit User Alarms and Control Interface (FS31LM-01-LMC)

The user alarms and controls are organized by link type. The Optical in / RF out section is for the uplink optical receivers and the RF in / Optical out section if for the downlink optical transmitters. For uplink optical receivers, each receiver has a gain control that is accessed using a small standard screwdriver.

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 Optical In alarm LED on the right side of the alarm header indicates an alarm condition for each individual uplink optical receiver.

For Downlink optical transmitters, each 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 screwdriver. The alarm LED on the right side of the alarm header indicates an alarm condition for each individual downlink optical transmitter.

Connect fiber optic cables last. Use fiber optic connector cleaning precautions to get the highest performance from the system. Do not make optical connector tip contact with any hard surface. Be sure the FC/APC **KEY** is aligned before tightening. Do not over tighten.

5.3 FS31HM-85-C-18-65, Optical Repeater Unit (ORU)

Also known as BDA.
Below is a diagram of the inside of the ORU.

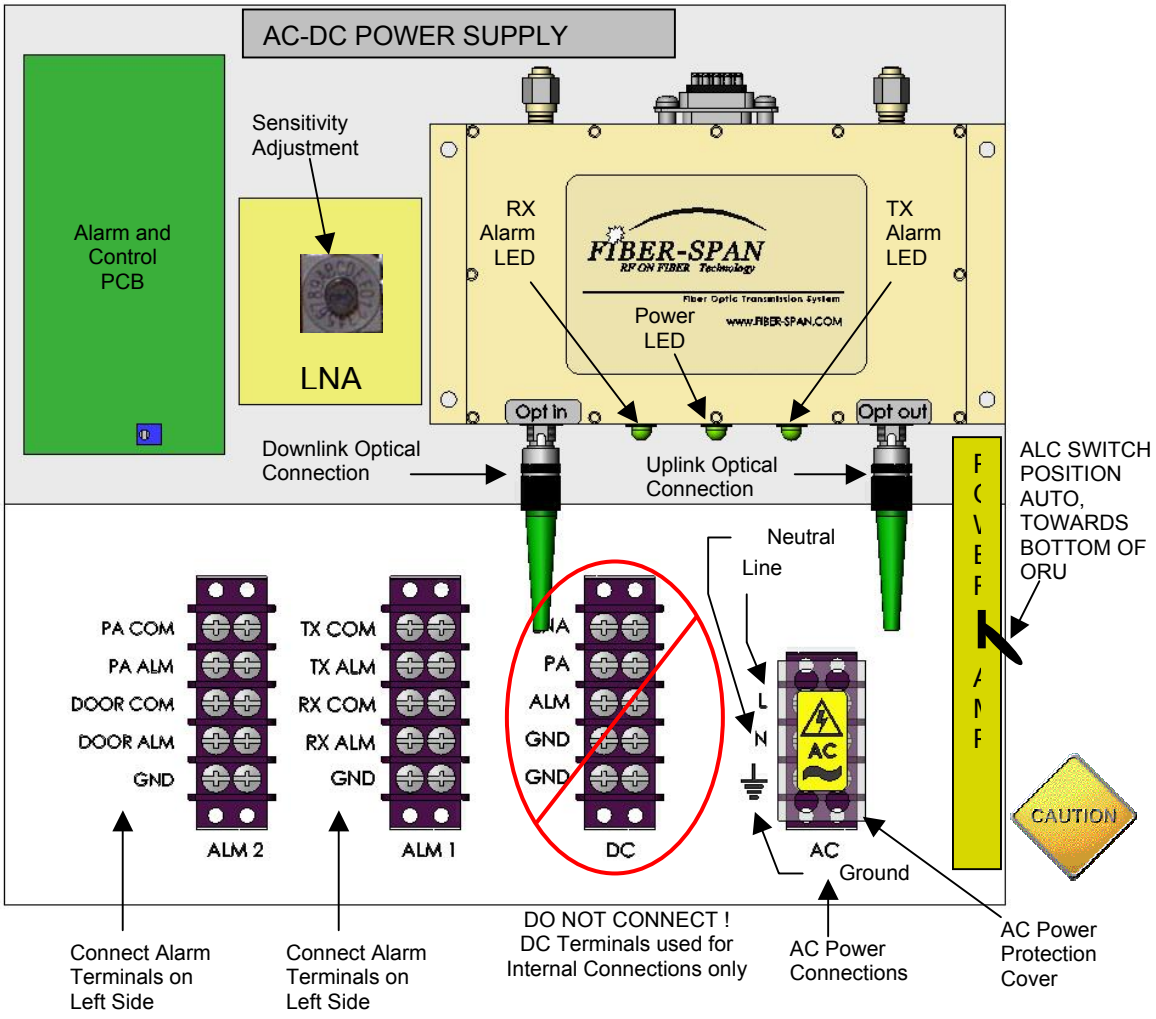


Figure 3. ORU Interface Internal View.

The BDA enclosure is IP65 rated for outdoor use. The BDA is to be mounted ONLY IN UPRIGHT POSITION (See Figure 4). When installing cable conduits, use standard practices to keep enclosure weatherproof. The BDA requires AC Power (90 to 220 VAC, 50-60 Hz). The AC interface requires the power wires to have a standard ¼" fork terminal termination for HOT (H), Neutral (N), and Ground connections. Connect BDA to earth ground using Earth Ground Lug on the external side of BDA. Power amplifier Automatic Level Control (ALC) switch must be in Auto Mode.

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

The Alarm interface requires the wire connections to have a standard ¼" fork terminal terminations. Connect terminals as indicated in figure 5. Do not over tighten terminals.

Remove AC Power Protection Cover, loosen screw terminal to allow fork terminal connection. Connect the corresponding Hot, Neutral, and Ground connections. Do not over tighten terminals. Replace AC Power Protection Cover for safety.

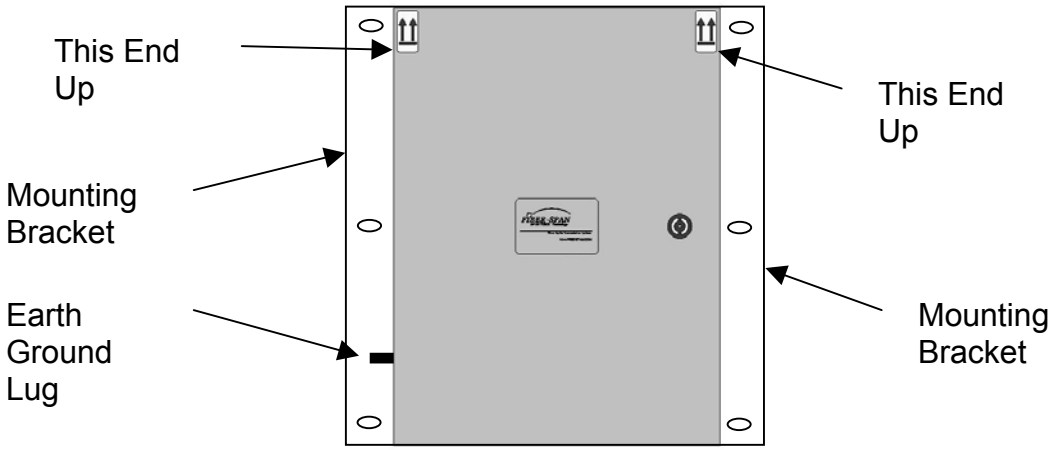
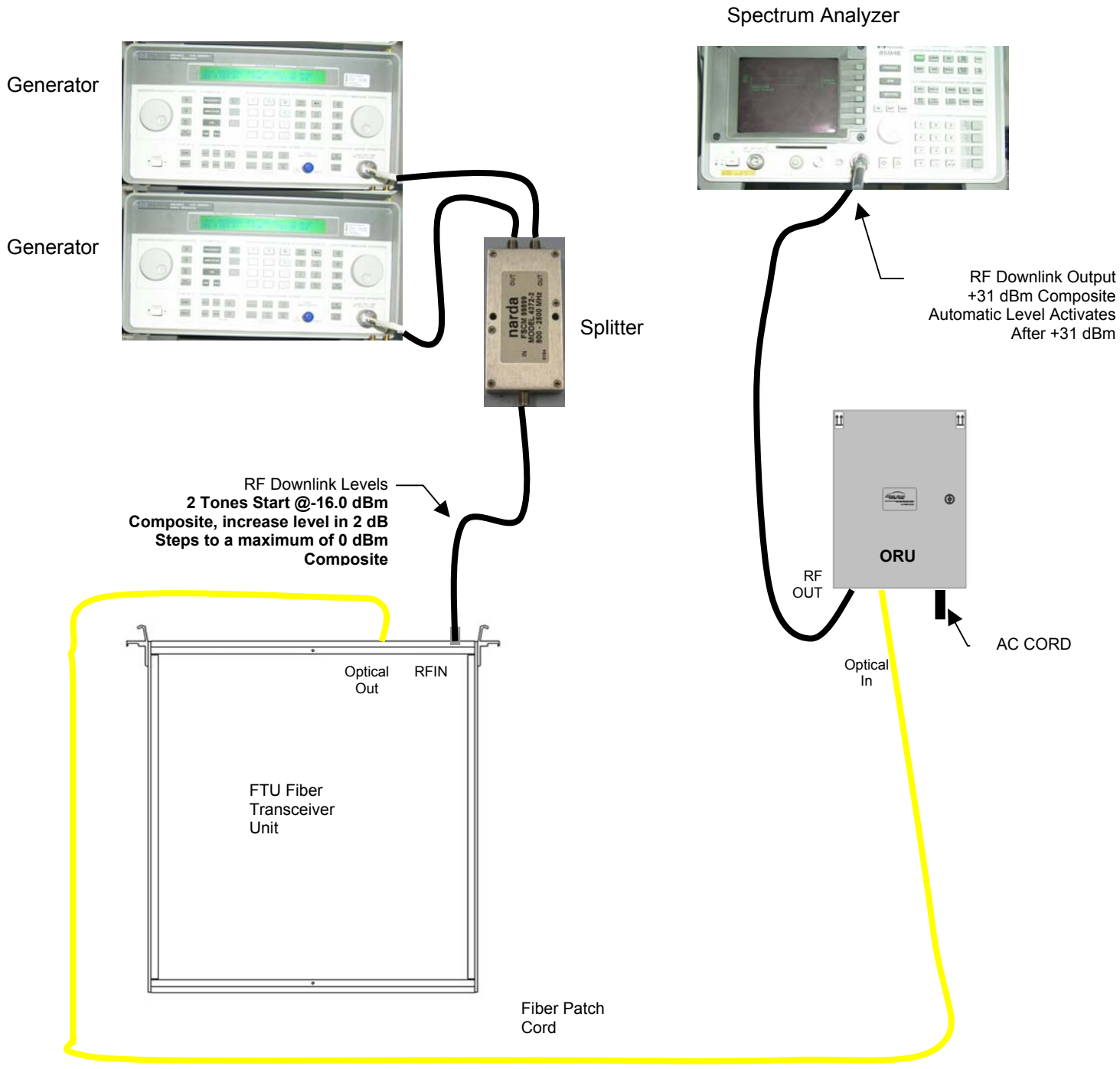


Figure 4. Upright Mounting View.

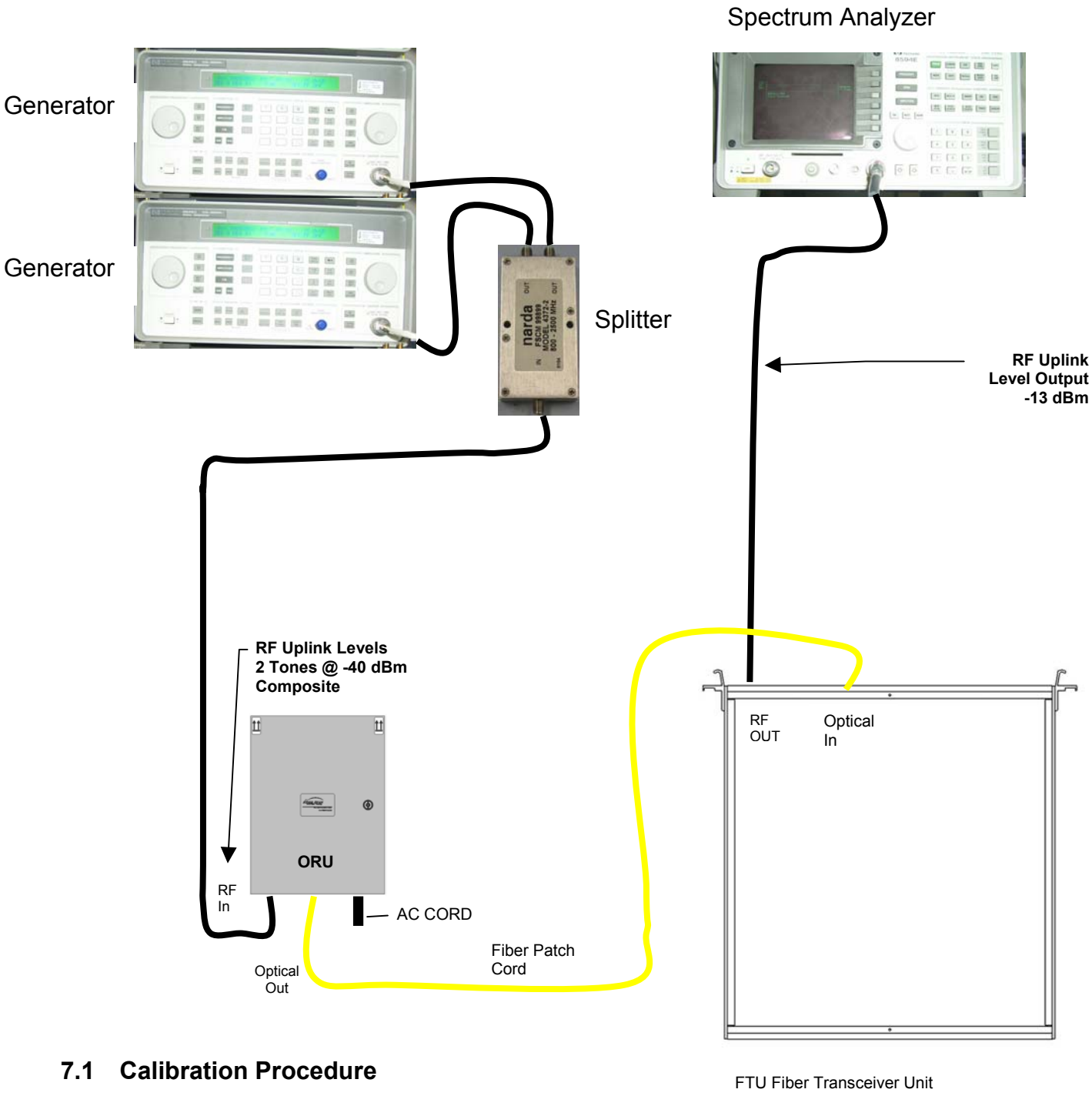
Connect fiber optic cables last. Use fiber optic connector cleaning precautions to get the highest performance from the system. Do not make optical connector tip contact with any hard surface. Be sure the FC/APC **KEY** is aligned before tightening. Do not over tighten.

The Downlink Output level adjust is factory set to meet the typical RF output level. The system is optimize to absorb optical loss via the medium.

6 System Equipment Setup Downlink



7 System Equipment Setup Uplink



7.1 Calibration Procedure

7.1.1 Equipment Requirements

- RF Spectrum Analyzer capable of Marker Noise per Hz measurements in 800 to 900 MHz band and power measurements up to +30 dBm. (Equivalent Model is HP 8594E)
- Low Noise Pre-Amplifier 806 to 869 MHz Band pass with 20 to 30 dB Gain and Noise figure less than 10 dB. (Equivalent Model is Agilent 8447D, 25dB, 8.5 dB NF)

- RF cables and adapters as required
- Small Screwdriver Flathead
- Optical grade cleaning alcohol (99.6% pure)
- Fiber Optic Connector Cleaner

7.1.2 Measurement Setup Diagrams

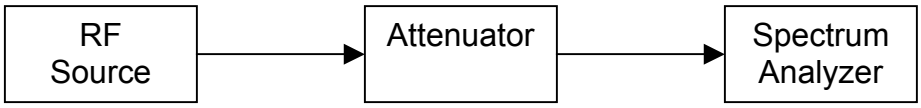


Figure 5. RF Signal Measurements

Attenuator is for high power RF measurements. The attenuator is not required for low power measurements (about 0 dBm RF Levels). For high RF power measurements, use a 10 dB, 2 Watt attenuator pad when maximum RF level into Spectrum Analyzer is at **+30 dBm**, set the analyzer input attenuator set to 50 dB.

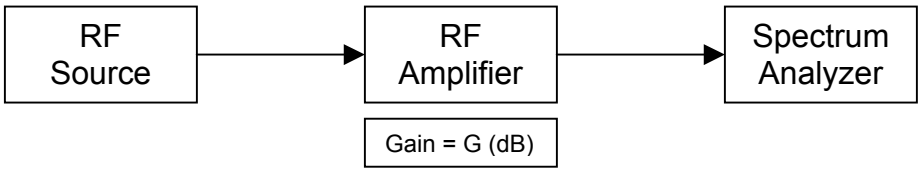


Figure 6. RF Noise Measurements

RF Amplifier is for low power RF Noise measurements. Analyzer input attenuator set to 0 dB. Spectrum Analyzer is set for marker noise mode to give noise per Hz display. The marker must be positioned on the noise floor and not on any spurious signals in the RF frequency band. Noise of RF source is analyzer noise measurement is:

$$RFnoise = Nsa - G \qquad (dBm/Hz) \qquad eq.1$$

Where, *RFnoise* is the RF Source noise in dBm/Hz, *Nsa* is noise measured on the spectrum analyzer in dBm/Hz, and G is the amplifier Gain in dB. Using the gain control of the FTU front panel potentiometer adjusts noise level to be compatible with the basestation requirements. LNA has uplink sensitivity level capability.

7.1.3 Start up Conditions

- 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
- Apply AC power to system components.
- Connect fiber optic cables.

- Use fiber optic connector cleaning precautions to get the highest performance from the system. Do not make optical connector tip contact with any hard surface. Be sure the FC/APC key is aligned before tightening. Do not over tighten.

  Do Not exceed the Maximum Rf input level to units, FTU downlink is RF input 0 dBm Composite. ORU Uplink RF input is (-) 40 dBm Composite.

7.2 Downlink Results

The ORU has high output power and provides 1.26 Watts of RF Power (+31 dBm). The ORU has constant automatic level when the output reaches 31 dBm Composite. See Heading 6 for equipment setup. Inside the ORU the rf gain is factory adjust with a potentiometer and does not need to be adjusted.

7.3 Uplink Results

The Uplink rf gain is set to 27 dB with a 1 meter fiber patch cord. See Heading 7 for equipment setup. The noise figure is 4dB. Use the test configuration shown in part 7. Connect the spectrum analyzer to the RF out port corresponding to the transceiver being calibrated. Adjust the gain on the front panel of the Fiber Transceiver Unit (FTU) for the transceiver being calibrated to give an RF level required at the basestation.

7.4 Caution

BDA has internal AC power connections that can cause shock if operator is not careful. Always verify the AC Power Protection Cover is protecting the AC line connections on the terminal block connector. Do not leave tools inside of BDA that can cause dangerous shock hazard.

8 Maintenance

This Fiber Optic repeater system does not require 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 will degrade system performance and void Fiber-Span warranty.

9 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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10 Reference Documents

Document Title	Document Description
7109-0705-OUT	FS31HM-85-C-18-65 ORU Optical Repeater Unit
7109-0713-OUT	FS31LM-01-LMC FTU Fiber Transceiver Unit