Fiber Connection™ Radio
60 GHz
Sonet OC-3 or OC-12
Product Manual

This device complies with Part 15 of the FCC Rules (1). This device may n cause harmful interference and (2). This device must accept any interferen received including interference that may cause undesired operation.
FCC ID # 0433260

3260-9901 Rev.1.0

About this manual

This document describes the architecture, installation, operation and commissioning of the Fiber Connection™ 60 GHz Microwave Radio.

Organization – Table of Contents

Proprietary Notice

SierraCom has made every effort to ensure that the instructions contained in this document are adequate and free of errors and omissions. SierraCom will, if necessary, explain issues, which may not be covered by this document. SierraCom liability for any errors in this document is limited to the correction of errors and the aforementioned advisory services.

This document has been prepared for professional and properly trained personnel and the customer assumes all responsibility when using this document. SierraCom welcomes customer comments as part of the process of continual development and improvement of the documentation in the best way possible from the user's viewpoint. Please submit your comments to your SierraCom sales representative at the following address:

To allow for the introduction of design improvements, specifications are subject to change without notice.

Document History

Release Number	Reason for Change	Release Date	Authorization Signature
1.0	First Time Release	Aug 01, 2001	

Product Safety

Safety points you should know about this product.

- ☞ ***Read all of these instructions***
- ☞ ***Adhere to all notes, warnings, cautions and instructions within this document.***

1. Read Instructions

All safety, note, warning and caution statements should be read before operating product.

2. Retain Instructions

The safety and installation instructions should be retained for future reference.

3. Heed Warnings

All notes, warning and caution statements in this document should be adhered to.

4. Follow Instructions

All notes, cautions and warnings should be followed**.**

5. ESD Warning

The radio terminal contains ESD (Electrostatic Discharge) sensitive devices. Avoid direct contact with interface connector pins.

6. Cleaning

Do not use liquid cleaners or aerosol cleaners. Use a damp cloth for cleaning.

7. Attachments

Do not use attachments which are not listed within this document or which are not recommended by SierraCom.

8. Water and Moisture

The Radio Terminal is designed to withstand moisture conditions typically encountered when installed outdoors. It is not designed for operation under water or to withstand water or moisture beyond the limits noted in the product specifications.

9. Mounting Equipment and Accessories

Do not place this product on an unstable cart, stand, tripod, bracket or table. The product could fall, causing serious injury to personnel, and serious damage to the product. Any mounting of the radio should follow the manufacturer's instructions, and should use a mounting accessory recommended by SierraCom.

10. Power Sources

This product should be operated only from the type of power source indicated in this document.

11. Damage Requiring Service

Unplug the product from its power source and refer to service personnel under the following conditions:

a. When the power supply cord or plug is damaged.

b. If liquid has been spilled or objects have fallen into the product.

c. If the product does not operate normally, adjust only those controls that are covered by this document. Improper adjustment of any other controls may result in damage and will often require extensive work by a qualified technician to restore the product to its normal operation.

d. When the product exhibits a distinct change in performance. Such a significant change indicates the need for service.

12. Replacement Parts

When replacement parts are required, ensure that parts are specified by SierraCom. Unauthorized substitutions could result in improper operation or other hazards and will invalidate the warranty.

13. Keep Away From Live Circuits

Service personnel must at all times observe safety regulations. Do not replace components or make adjustments at all. All repairs are to be performed at SierraCom factory.

14. Do Not Work In Front Of An Energized Antenna

Prior to working on the Radio Terminal, ensure that the Radio Terminal is not radiating energy. When power is applied to the Radio Terminal, proper precautions must be made to avoid placing any part of the human body within 3 meters from radio terminal.

Warranty and Service Information

SierraCom's standard warranty is two years from date of delivery, provided that the warranty labels have not been broken. Removing the radome or opening the radio terminal without the expressed, written consent of SierraCom will automatically void the warranty.

SierraCom's liability for a warranty failure applies only to the equipment provided by SierraCom and excludes all other remedies, including, without limitation, incidental consequential damages. SierraCom is not responsible for any lost data, revenue, or any other consequential damages associated with a warranty or non-warranty failure.

In the event of a defect in / or failure of the SierraCom product, the customer shall contact SierraCom regarding the warranty claim. SierraCom warrants to rework or repair the product at the SierraCom facility in Hopkinton, Massachusetts once it has been properly returned by the customer.

To process a warranty claim or to obtain technical support please contact SierraCom Customer Service at either of the following numbers:

Telephone Number: 1-508-435-2400

Fax Number: 1-508-435-2022

System Description and Overview

1.0 Overview

This document describes the Fiber Connection™ Series Product that operate in the 60GHz (57 to 64 GHz) unlicensed band. The Fiber Connection™ Radio Product is designed to carry Synchronous based (SONET: OC-3 or OC-12) data traffic. The radio uses Binary Phase Shift Keying (BPSK) modulation scheme to carry traffic of 155 Mb/s or 622 Mb/sec.

1.4 System Applications

The Fiber Connection™ Radio is designed to support a variety of short-range applications (distances up to one km) and to operate in environments where frequency congestion is problematic. The signal absorption by oxygen gas (O_2) and the use of the narrow beam-width antennas allow for frequency re-use factor of one, thereby eliminating the need for costly frequency coordinations.

The following applications are suitable for use with the Fiber Connection™ Radio Product.

1.1.1 Fiber ConnectionÔ as Hot Standby Radio for Free-Space Optical Radios

The Fiber Connection™ Radios in conjunction with the Free-Space Optical Radios provide a robust point-to-point communication link that is relatively immune to environmental conditions. The dust and fog that adversely affect the Free-Space Optical Radios do not appreciably hinder communication using the 60 GHz radio product. On the other hand, the rain and snow that affect 60 GHz radio do not cause appreciable degradation of the Free-Space Optical communications.

1.1.2 Fiber ConnectionÔ Radio as a Fiber Cable Bridge Across Obstacle

The Fiber Connection™ radio is designed to interface to a Fiber Terminal that carry OC-3/OC-12 traffic. In applications where obstacles such as highways, rivers, parking lots or Municipal by law etc prevent extension of the Fiber cable the Fiber Connection™ Radio provides means to overcome this.

1.1.3 Fiber ConnectionÔ Radio Eliminates the Building Rise Congestion

Building risers were originally designed to carry AC power, coax and telephone cables. In general, these risers are congested already and as such adding new cables results in major construction costs. These costs can be avoided by using the Fiber Connection™ Radio installed on the side of the walls of the building.

1.1.4 Campus High Speed Data Connections

Businesses with High speed LAN data (100 Mb or 1 GigaBit Ethernet) networks that need to be connected to other buildings are limited to connections that LECs can provide. Generally, these access connections are limited to several T1s and in some cases to OC-3 capacity if a dark fiber already exists or a new one can be built. The Fiber Connection™ Radio can provide the capacity and connectivity as an alternative or compliment to the existing LEC connections.

1.1.5 Micro/Pico Cell Base Station Interconnection

As the traffic density on cellular networks increases, more and more Base Stations are generally added to accommodate this need. The added Base Stations need to be interconnected by wireless backhaul equipment. Traditionally, this backhaul equipment operates in the licensed bands (13 to 38 GHz) that require frequency coordination and licensing. The Fiber Connection™ product eliminates frequency coordination and licensing problems.

1.4 System Features

The Fiber Connection™ Radio provides:

- Low Installation Cost (Single Outdoor Unit)
- Reliable Operation (Uses Robust Forward Error Correction FEC)
- Variety of Traffic Interface (Copper, Single, or Multi-mode Fiber Cable)
- Data Rates and Protocols
  - OC-3
  - OC-12
- Management and Configuration
  - SNMP Version 1

1.4 Equipment Layout and Main Assemblies

The Fiber Connection™ Series Radio consists of an outdoor unit with an integrated antenna/mounting assembly. The traffic interface cable connects the ODU to an Optional Indoor Unit (IDU) or customer supplied termination block.

1.3.1 Outdoor Unit:

The outdoor unit contains the RF Assembly, the Processor Assembly, the RF Diplexer Modem/Interface Assembly (See Figure 1.3.2).

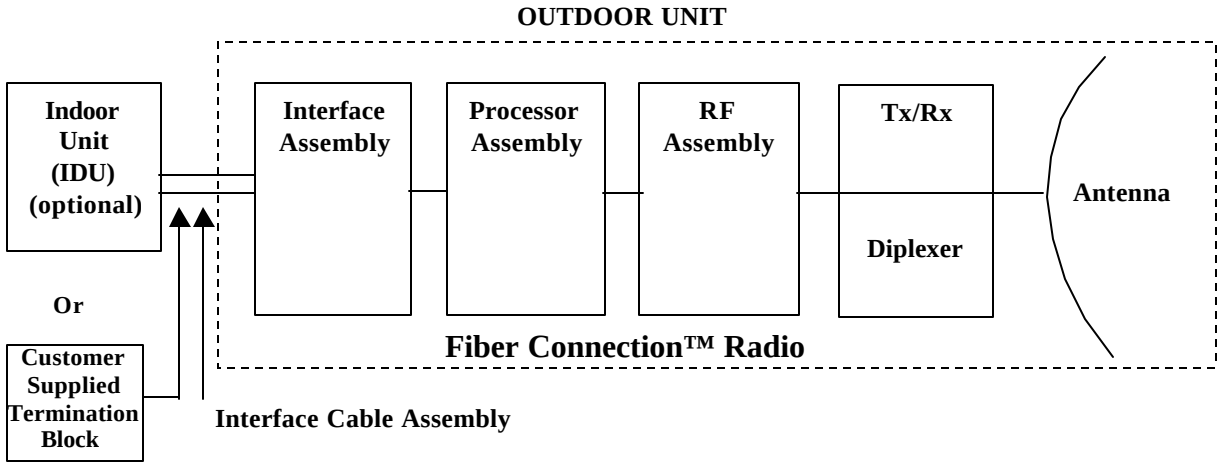
1.3.2 Optional Indoor Unit (IDU):

An Optional Indoor Unit may be used to facilitate connection to the outdoor unit and to allow access to customer network interconnections, as well as accommodate a variety of customer supply voltages. This unit is not an integral part of the Fiber Connection Radio. Customer access connections can also be done via customer supplied termination block.

1.3.3 Antenna Mount Assembly:

The Fiber Connection™ Radio includes a mounting assembly designed to hold the ODU and the antenna sub-assemblies. The mount assembly provides for elevation (90°) and azimuth adjustments (45°).

Figure 1.3.2 Overall Block Diagram of Fiber Connection™ Radio



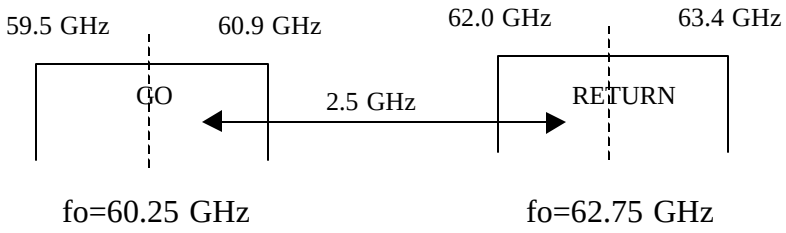
1.4 Outdoor Unit Signal Flow

This section covers the signal flow of the Fiber Connection™ Outdoor Unit.

1.4.1 Diplexer Assembly

The Diplexer consists of two waveguide filters, one each for the transmitter and the receiver. The diplexer function is to separate the transmitter and receiver signals and to provide adequate noise suppression of the Transmit SSPA from affecting the receiver. The diplexer is wideband and has a T/R spacing of 2.5 GHz and usable bandwidth of 1.4 GHz. Figure 1.4.1 shows the diplexer bandwidth and T/R spacing.

Figure 1.4.1 Diplexer Bandwidth and T/R Spacing

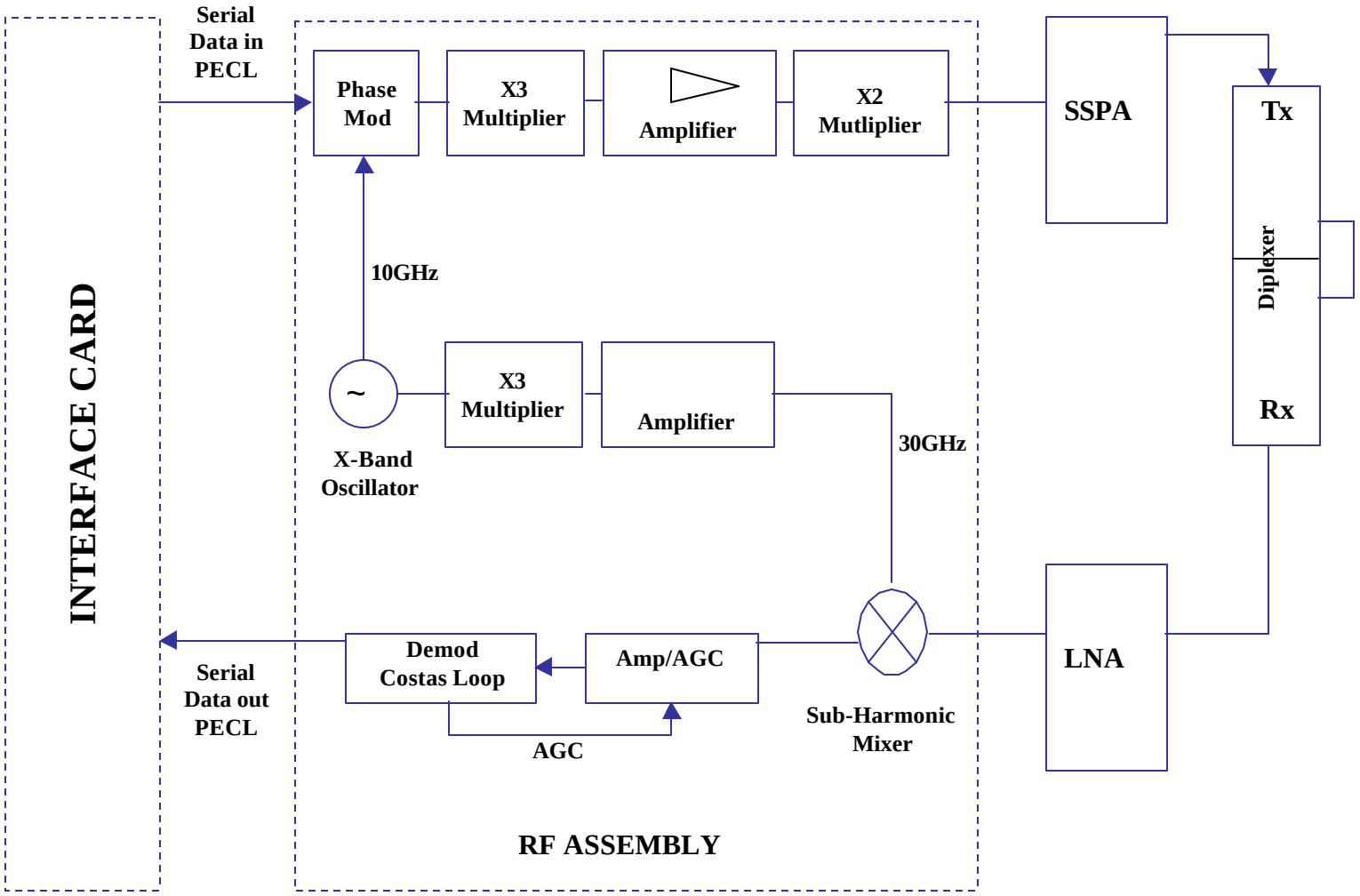


1.4.2 RF Assembly

Figure 1.4.2 is a block diagram describing the functions contained on this assembly. The ECL data signal from the Interface board (155 Mb/s or 622 Mb/s) is phase modulated on to an x-band Dielectric Resonant Oscillator (DRO). The signal from the phase modulator is fed into a times three multiplier, amplified, filtered and again multiplied by two to a signal frequency of 60GHz. The solid state amplifier contained with the waveguide performs the necessary signal amplification.

On the receiver side, the RF signal from the diplexer is fed into the Low Noise Amplifier. The output of the LNA is sub-harmonically converted to baseband. The output of the sub-harmonic mixer is fed into the AGC amplifier that adjusts the received signal level to a constant output. The Costas Loop detector recovers the serial bit stream.

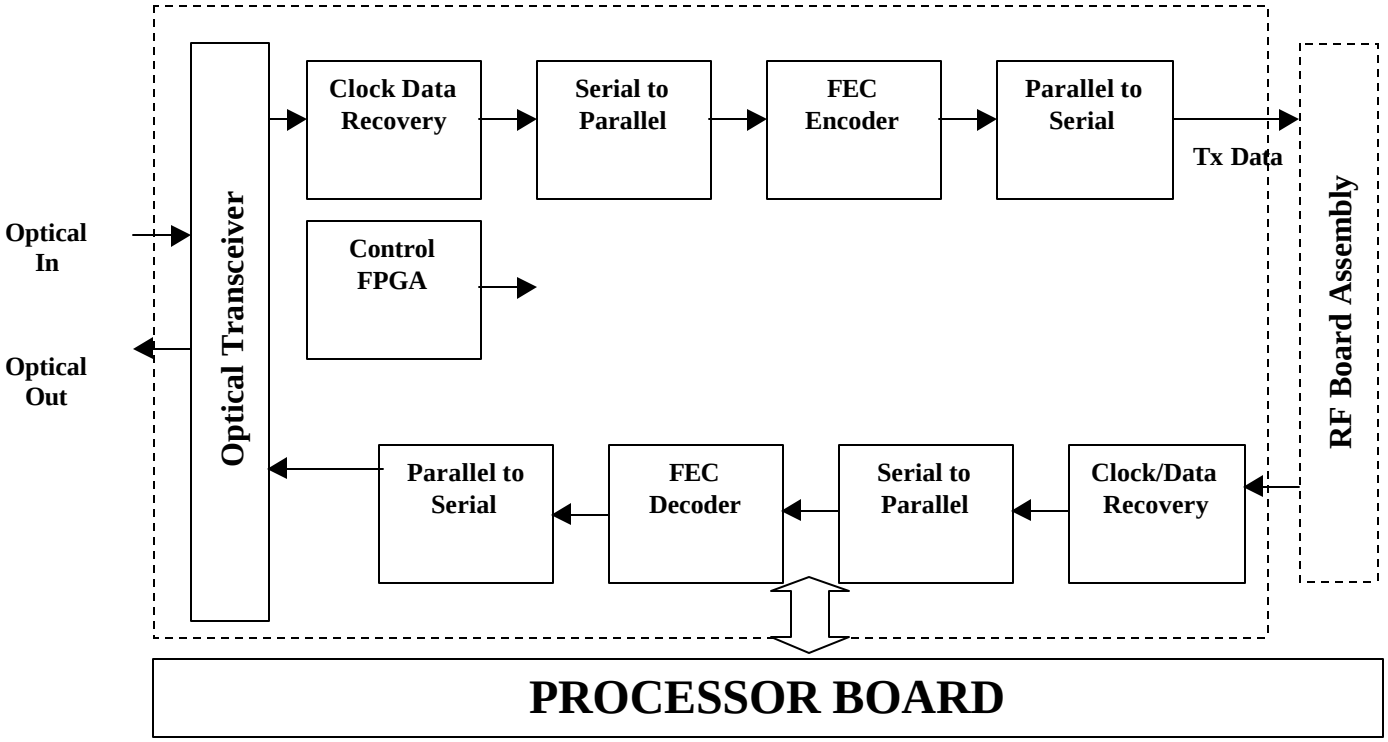
Figure 1.4.2 The RF Assembly Functions



1.4.3 Sonet Interface Assembly Board

Figure 1.4.3 is a block diagram of the Sonet Interface Assembly Board. The optical signal from the Indoor Unit or Customer Interface Panel is received by the Optical Transceiver and then processed through the Forward Error Correction (FE). The serial data from the RF Assembly is fed to a clock/data recovery circuit. This data is then fed into an FEC decoder. The output of the FEC encoder is passed to the RF Assembly for transmission. The output is then fed into the optical transceiver whereby the digital data is again converted to an optical signal for transmission to the Indoor Unit or customer Interface panel. The Control Field Programmable Gate Array (FPGA) provides control signals to the various chip sets on board.

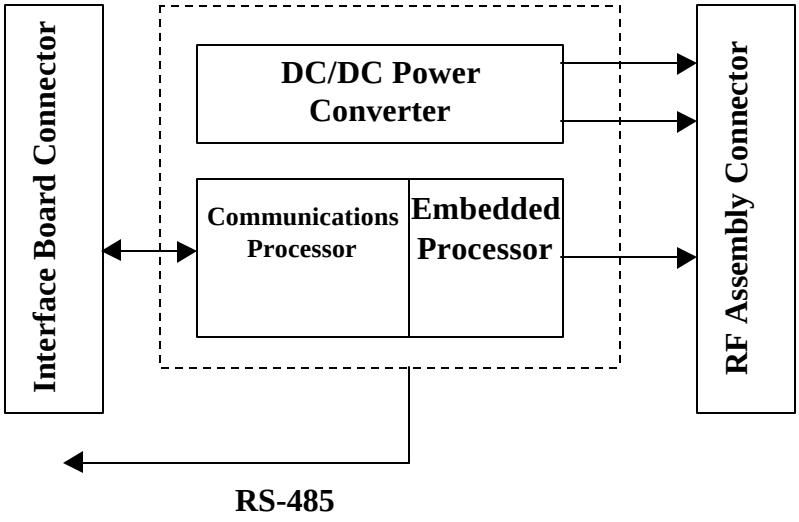
Figure 1.4.3 Sonet Interface Card



1.4.4 Processor Assembly Board

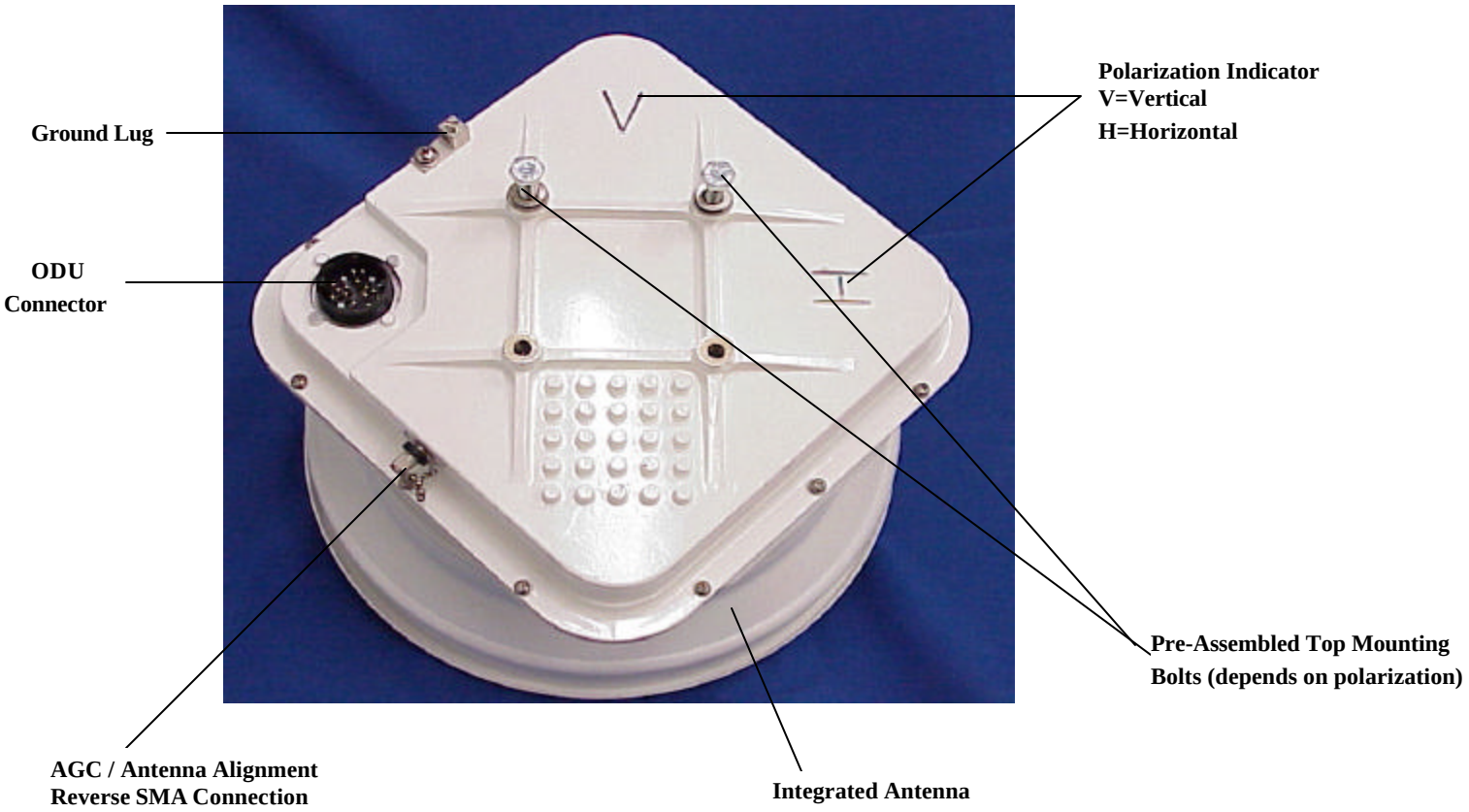
Figure 1.4.4 is a top-level block diagram of the Processor Assembly. The assembly consists of a Communication Processor and an embedded processor. The communication processor uses the Linux Operating System (OS) and is responsible for performance monitoring and running of the various optional applications such as SNMP, web browser etc. The embedded processor performs lower level tasks that are time sensitive, such as the AGC control. A DC/DC converter provides all the power supply rails needed to operate the ODU. Two connectors are provided to connect the processor board to the RF and the Interface Board Assemblies; the RS-485 Craft Port is connected to the embedded processor and serves as a communication channel to the Optional Indoor Unit or customer interface panel.

Figure 1.4.4 Processor Assembly Board



1.5 System Interfaces

Figure 1.5.1 Outdoor Unit Interfaces



1.5.1 ODU Interface Cable Connector

The ODU interface connector allows for mating of the multi-conductor. The pin-outs for this connector as shown in Figure 1.5.2.

Figure 1.5.2 ODU Interface I/O Connector

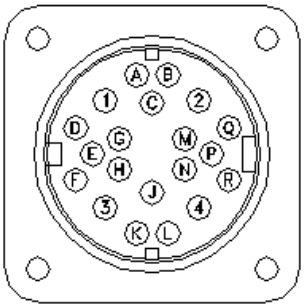


Table 1.5.1 Outdoor Unit Interface Cable Connector Pin-Outs

ODU Cable Connector Pins	Function
3	Spare Fiber
4	Spare Fiber
1	ODU Tx – Fiber
2	ODU Rx – Fiber
G	+V
D	-V
H	Chassis Gnd
F	Chassis Gnd
Q	RS485+
R	RS485-
P	Drain Gnd
M	Gnd
N	Gnd
J	ETH/LAN Rx+
B	ETH/LAN Rx-
L	ETH/LAN Tx+
A	ETH/LAN Tx-
C	Drain Gnd
E	Gnd
K	Gnd

1.5.2 AGC Connector

A reverse SMA connector is used to provide an AGC voltage for antenna alignment.

1.5.3 Ground Lug

To ground the ODU, use the ground lug provided on the rear side of the Radio ODU.

Technical Specifications

2.1 Overview

The North American family of products uses BPSK Modulation to carry OC-3 (155Mb/s) and OC-12 (622 Mb/s) signals in the 60GHz band. The terminal is provided in an unprotected configuration.

The radio equipment is housed in an enclosure with an integrated antenna. An indoor unit (IDU) provides the customer interface.

2.2 Configuration

The ODU equipment is provided in an unprotected version (1+0). The radio is configurable into either an OC-3 or OC-12.

2.3 Requirements

2.3.1 General Performance Requirements

In addition to the requirements specified herein, the Radio Terminal meets FCC Part 15, subpart C, 15.255

2.3.2 System Requirements

2.3.2.1 Frequency Plan

Frequencies are in accordance with the current FCC, Part 15, Subpart C,15.255. The radio operates in the 59 to 64GHz band.

2.3.2.2 Interface & Capacities

Interfaces	Capacity
OC-3	155Mb
OC-12	622Mb

2.3.2.3 Modulation

The radio uses binary Phase Shift Keying BPSK modulation scheme.

2.3.2.4 Residual Bit Error Ratio

The residual BER is ≤ 10^{-13} with the FEC "on".

2.3.2.5 Forward Error Correction

The radio employs Reed-Solomon forward error correction.

2.3.2.6 Receiver Thresholds

Receiver thresholds specified herein are typical values measured at the antenna interface.

Receiver Threshold (dBm)	**BPSK**	
	BER 10^{-3}	BER 10^{-6}
OC-3	<-64	<-63
OC-12	<-58	<-57

2.3.2.7 ODU-IDU Cable Assembly

The ODU-IDU cable is constructed of multiple category 5 twisted pairs having a characteristic impedance of 100ohms +/- 15%, #16 gauge wire for the power and chassis ground and the multi mode optic fibers for OC-3 or OC-12 signals. The bundled pairs are wrapped in a foil shield with internal drain wire and covered with a wire braid and insulating jacket. The maximum recommended cable length is 150 m.

2.4 RF Performance Requirements

2.4.1 RF Frequency

Transmitter Type	BPSK Modulation with Multipliers
RF Carrier Generation	Dielectric Resonator Oscillator
Transmit Center Frequency	60.25 or 62.75 GHz

2.4.2 Transmit RF Output

The output powers specified herein are measured at the antenna interface

Output power at antenna interface (over the sub-band frequency range)	+ 10 dBm ± 2dB

2.4.3 Transmitter Spurious Emissions

The transmitter spurious emissions are in accordance with FCC Part 15, Sub-part C 15.255.

2.4.4 Receiver AGC

For ease of antenna alignment the Receiver AGC voltage is accessible at the radio ODU via a reverse SMA connector. The AGC voltage can be measured with a DMM and ranges from +5 to 0V with increasing signal strength.

2.4.5 Receiver Overload Levels

The receiver overload level for a BER < 10^{-3} is greater than –20 dBm. The receiver can withstand input signal of up to 0 dBm without permanent damage to the equipment.

2.5 Power Requirements

2.5.1 Power Consumption

The maximum power consumption of the ODU is less than 35W.

2.5.2 Supply Voltage

The ODU meets all the performance specifications when the supply voltage is from ±36 to ±72V as measured at the ODU connector.

The ODU shall cause no error in the tributary traffic when it is subjected to a supply voltage step change of up to +/- 8 VDC with a rate of change up to 1 V/msec.

2.6 Environmental Requirements

2.6.1 Operational Conditions

Under the following environmental conditions, the equipment will start up and will meet all the performance specifications described in Section 2.5 and 2.6.

	ODU
Temperature Range	-33ºC to +55ºC
Temperature rate of change	20ºC / hour
Relative Humidity	Up to 100% all weather
Altitude, AMSL (m)	-150 to +5000
Wind Velocity (km/h)	110
Ice Loading, accretion (mm)	Vertical 64 / Horizontal 36
Corrosion	Non-corroding when used in salt air and industrial areas

All connections with the indoor equipment are lightning and transient surge protected.

2.6.2 Storage, Handling and Transportation

The equipment will not suffer any permanent damage or change in the performance parameters when properly packaged and when subjected to the following storage and transportation conditions.

Temperature Range	-40ºC to +70ºC
Relative Humidity	Up to 100%
Thermal Shock	Refer to Section 5.1.9
Shock and Vibration	Refer to Section 5.1.9
Altitude	15,000 m

2.7 Mechanical Requirements

2.7.1 Mechanical Dimensions (Including Antenna) – Note 1

Depth (max	≤ 13 in
Width/Diameter (max)	≤ 14 in
Weight (max)	≤ 11.5 lbs

Note 1: Excluding the Antenna Mounting

2.7.2 ODU Interface

Interface Description	Interface on ODU
Signal/Power/Alarms connector on ODU	Fiber Optic/Electrical Special Connector
AGC voltage	Reverse SMA
ODU Grounding	Ground Cable Lug

2.7.3 ODU Assembly

The design of the ODU and antenna mount assembly allows for polarization change in the field by rotating the ODU on its mount.

2.7.4 Earthquake Protection

The equipment meets seismic (zone 4 earthquake) requirements as specified in TR-NWT-000063, Appendix A.4.

2.8 Optional Indoor Unit (IDU)

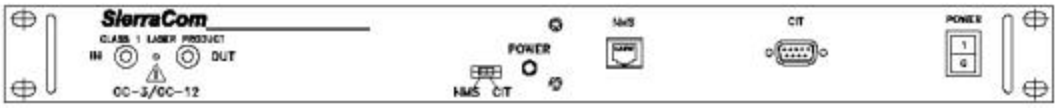
2.8.1 General Specifications

The optional indoor unit allows for customer interface connections. The unit is one rack mounting space high and will mount on a 19" rack. Mounting on 23" can be provided on request.

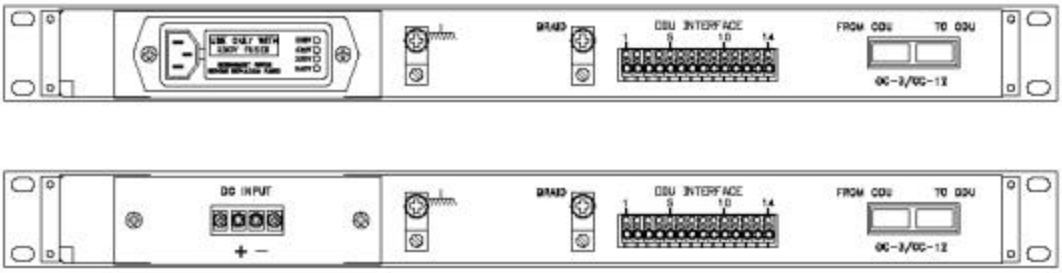
2.8.2 Interface Description

Figure 2.8.1 shows the general interface connections to/from the customer and to/from the Fiber Connection ODU.

Figure 2.8.1 Electrical Connections to IDU



Indoor Unit Front Panel Marking



Indoor Unit Rear Panel Marking

2.8.3 Optical Fiber Connections to the ODU

Optical connections to the ODU are terminated on the rear of the IDU by an SC-type connector. The optical signals are "passed" through directly to the front of the IDU

Customer Fiber connections are to be made at the front of the IDU via the ST-type connector.

2.8.4 AC or DC Connections and Switch

The IDU can be equipped to accept DC volts ± 20 to 36V with a DC/AC converter, ± 36 to 72V directly or AC input voltage with an AC/DC converter. The options have to be specified at the time of purchase.

The AC inputs voltage range is selectable at the rear.

A DC or AC switch in the front panel provides On/Off function to the indoor/outdoor units.

2.8.5 Input/Output Terminal Strip

All twisted pairs are terminated at the rear of the IDU. For termination pin-outs refer to the installation Section 3.

2.8.6 Network Management Connection

The IDU provides SNMP connection via a RJ45 connector to the computer Network Manager. The protocol is standard SNMP Version 1.

2.8.7 Craft Interface Tool Connection

The IDU allows for local (on site) monitoring/management and control of the Fiber Connection Radio using a laptop PC.

To use this option, an external RS485/232 protocol connector box, supplied by SierraCom is required. Refer to Section 5.0 of this manual.

2.8.8 The NMS/CIT Slide

To access the CIT connection, the slide switch must be set to "CIT". In this mode, the radio monitoring/control is via the CIT connector. For Network/Management connection the toggle switch must be set to NMS position.

2.9 Reliability

The Radio MTBF is at least 15 years, calculated in accordance with the following assumptions:

- Empirical analysis procedure from Bellcore (Technical Reference TR-NWT-000332, Issue 4, 9/92) based solely on the parts count technique.
- Assume constant failure rates for devices during their useful operating lifetime.
- Devices operating at 50% of rated electrical stress
- Outdoor environment for ODU (30° C)

The ODU Mean Time To Repair is less than 30 minutes for any fault or failure condition, excluding travel time but, including time for diagnosis, replacement and software reprovisioning, if required.

2.9.1 Regulatory & Product Integrity Requirements

The North American regulatory and product integrity requirements for the radio product are summarized in Appendix A.

Radio Outdoor Unit (ODU) Installation, Operation & Commissioning

About this section

This section is contains information and instructions on installation, operation and commissioning of the Fiber Connection™ Radio Terminal consisting of an Outdoor Unit (ODU) and Indoor Unit (IDU).

3.1 Unpacking and Handling the Radio System

Each product is completely assembled, tested and then shipped in its appropriate packaging. Care should be taken when removing equipment from the container to prevent damage to the units. Ensure that all parts and accessories are removed from the container and packaging material before they are discarded.

CAUTION!

Use caution when unpacking the radio terminal from its shipping carton. The radio terminal and integrated antenna has been formed to a very close tolerance.

Please DO NOT discard the container or any packing material until mechanical inspection has been satisfactorily completed. This material must be available if a damage claim is to be made with the carrier.

3.2 Mechanical Inspection, Inventory and Matching the Radios

3.2.1 Mechanical Inspection

☞ Inspect the equipment for damage that may have occurred during shipment. Make sure the equipment is clean and damage free. Should any damage be discovered after unpacking the system, immediately file a claim with the carrier. A full report of the damage should be made and a copy forwarded to SierraCom.

3.2.2 Inventory the Radio Terminal Components

☞ Verify that the items listed on the SierraCom Shipping Order have been received. If a copy of the shipping order is not available, Table 3-1 provides a list of common items, accessories and options that make up a typical radio terminal. If you have any questions please contact your local sales agent or regional sales manager.

Table 3-1 Radio Terminal Components

Qty	Item	Remarks
1	FiberConnection Radio ODU	Includes Antenna
1	Indoor Unit	Optional
1	Multi-Conductor Cable	Length Specified by user
1	Pole Mount Interface Bracket	Includes Hardware

3.2.3 Radio ODU Identification and Matching

The RF channel plan for the radio terminal is divided into two sub-bands. Each radio terminal is equipped with a specific band-pass filter. The near-end and the far-end radios need to be matched as shown in table 3-2.1.

☞ *Since the architecture of the radio and the installed band-pass filters do not allow field frequency changes, it is critical that the operator identify the intended frequencies that the radio will be expected to operate. The bandwidth of the radio (band-pass filters) cannot be changed in the field. The radio must be returned to the factory to perform this task.*

☞ ***To match an "A" radio ODU with a "B" radio ODU refer to Table 3-2.1***

Table 3-2.1(a) Options for Outdoor Unit (OC-3)

Radio A (ODU)			Radio B (ODU)		
Tx Center Frequency	**Rx Center Frequency**	**Part Number**	**Tx Center Frequency**	**Rx Center Frequency**	**Part Number**
60.25 GHz	62.75 GHz	3261-0000-100	62.75 GHz	60.25 GHz	3261-0000-200

Table 3-2.1(b) Options for Outdoor Unit (OC-12)

Radio A (ODU)			Radio B (ODU)		
Tx Center Frequency	**Rx Center Frequency**	**Part Number**	**Tx Center Frequency**	**Rx Center Frequency**	**Part Number**
60.25 GHz	62.75 GHz	3264-0000-100	62.75 GHz	60.25 GHz	3264-0000-200

A system (Radio-Link) consists of two radio terminals; one terminal is configured with its transmitter frequency, 2500MHz above it mating duplex receiver. The other radio terminal is configured with its transmitter 2500MHz below its mating duplex receiver. A system consists of an "A" and "B" radio ODU (refer to table 3-2).

3.3 Radio ODU Installation Prerequisites

3.3.1 Tools Required for Antenna Installation

The following tools, usually found in a basic electrician's tool kit, are required to install the radio ODU.

- 11mm/7/16" open end wrench or nut driver
- 13mm/1/2" open end wrench or nut driver
- Phillips screwdriver (Medium)

3.3.2.1 Test Equipment Required for Radio ODU Installation and Test

- *Digital or Analog Voltmeter (>100k ohms/v Impedance)*

3.3.3 The Multi-Conductor Interface Cable

The multi-conductor interface cable is supplied in standard lengths with one end terminated. Refer to Table 3.7.1 for cable pin-outs and terminations. The cables with fiber terminations at the IDU end can be special ordered.

3.4 Radio ODU Installation Procedures

This section describes the tasks and procedures to install the radio ODU consisting of the RF unit, the integrated antenna and interface-mounting bracket.

3.4.1 Attaching the Interface Mounting Bracket to the Radio ODU

The interface-mounting bracket is typically shipped from the factory attached to the radio terminal. If the need arises, the following procedure provides instruction to attach the interface-mounting bracket to the RF unit.

☞ ***Refer to Figures 3-4.1 and 3-4.2 while performing this procedure.***

☞ Loosen elevation-locking bolts. (Several turns)

☞ Loosen the azimuth locking bolt. (Several turns)

☞ Back off the front and back locking nuts on the elevation fine adjustment rod.

☞ Back off the front and back locking nuts on the azimuth fine adjustment rod.

☞ Position both the elevation and azimuth brackets at mid range and hand tighten all hardware to secure in place.

☞ Secure the Interface Mounting Bracket to the Radio ODU. Prior to attaching the radio terminal interface-mounting bracket to the Radio ODU, first determine the radio-link polarization. To set the radio terminal polarization refer to Figure 3-4.3. Polarization is set by rotating the Radio ODU to position the desired polarization indicator facing upward. Next, secure the interface-mounting bracket to the RF unit using the four 8mm bolts and hardware provided.

Important

Figure 3-4.1 Pole Mount Interface Bracket (Right View)

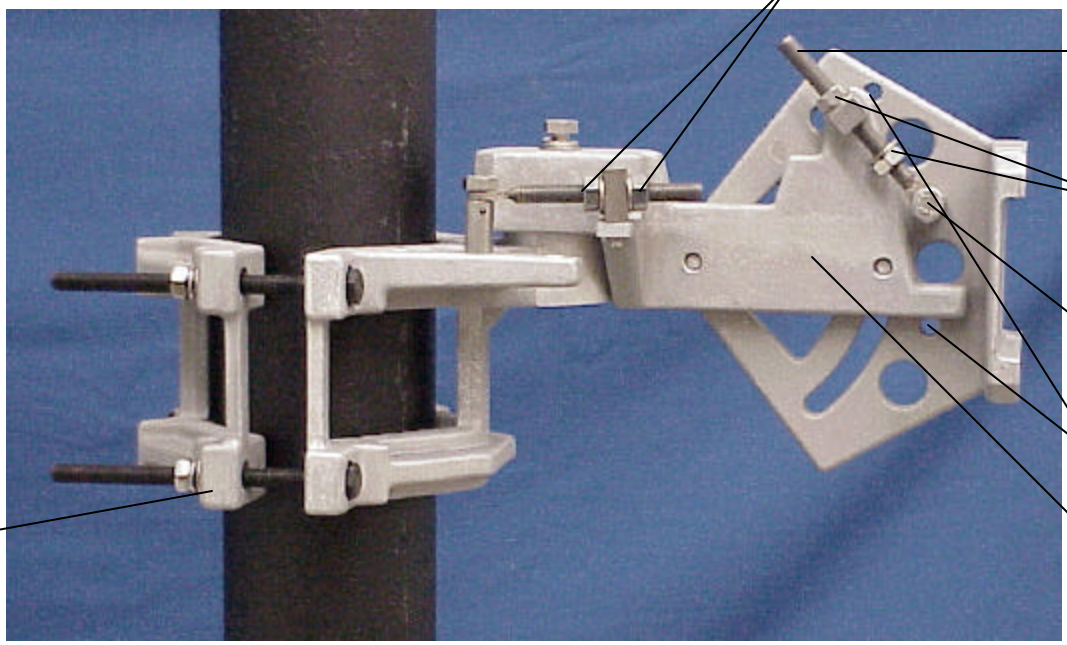
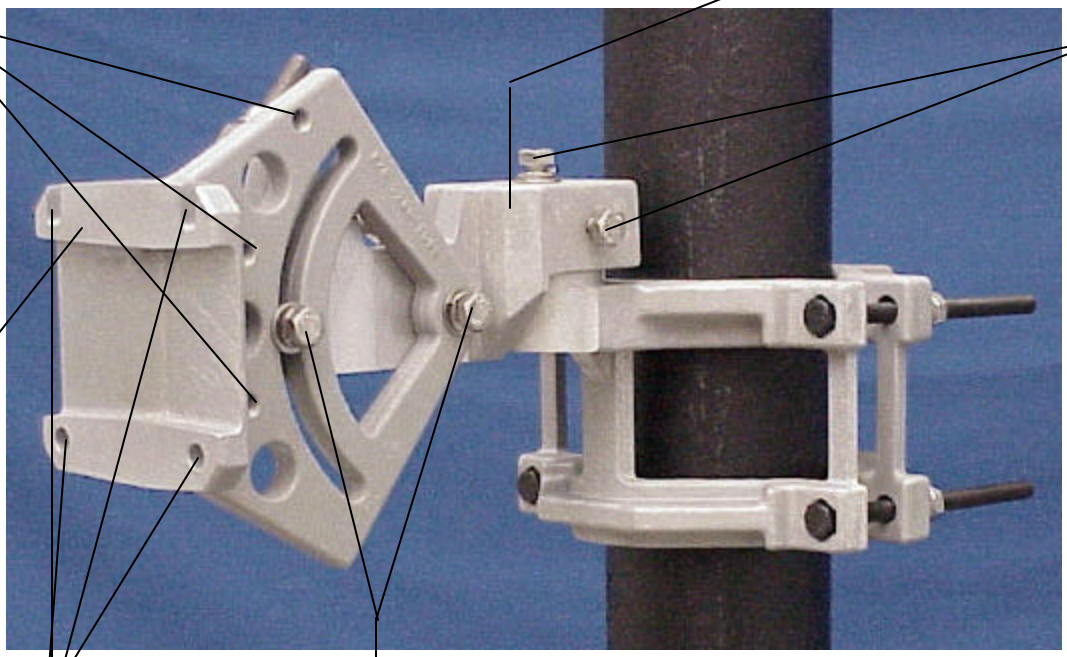
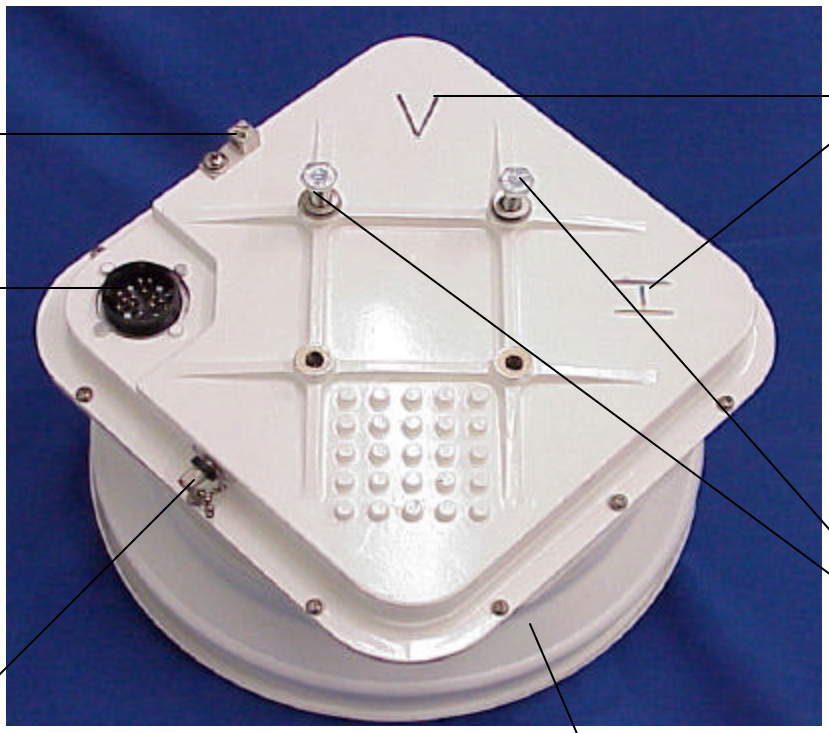


Figure 3-4.2 Pole Mount Interface Bracket (Left View)



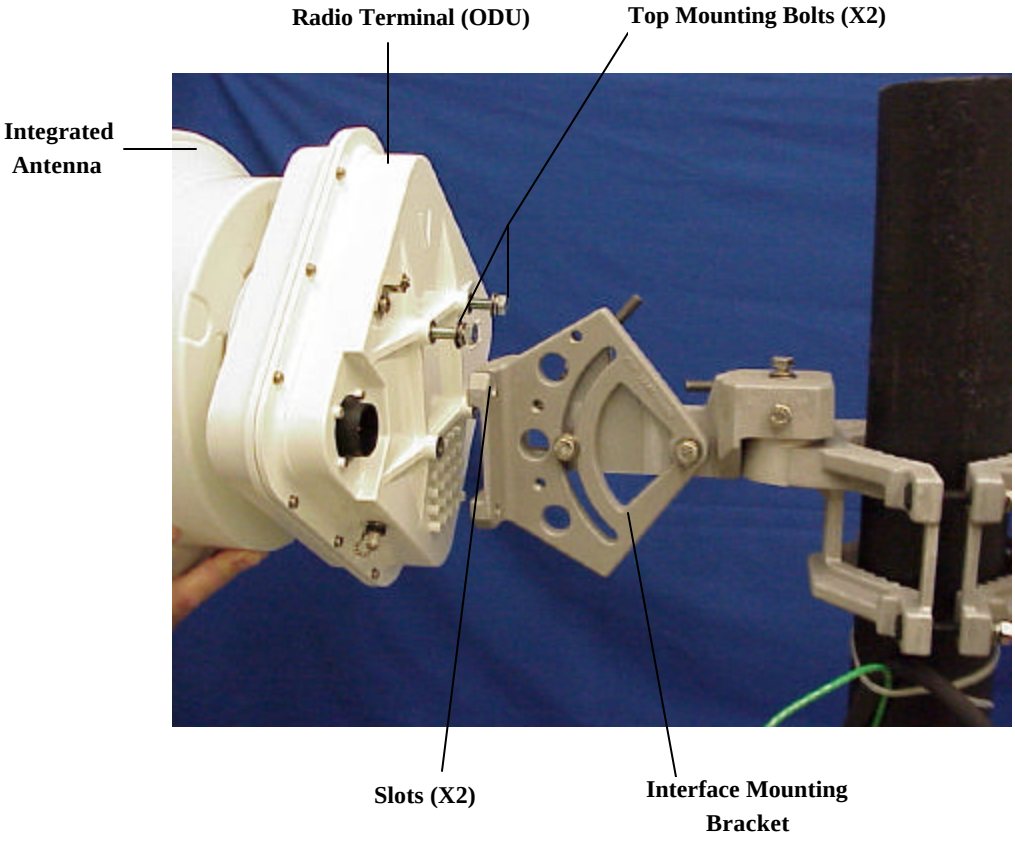
☞ For ease of assembly-insert top 2 bolts in loose first and hang radio in place. Then install bottom 2 bolts and tighten all in place. (See Figure 3-4.4)

Figure 3-4.3 Radio ODU (with Integrated Antenna)



☞ ***Note: The letters "V" (Vertical) and "H" (Horizontal) are located on the rear of the RF unit. Position the desired polarization indicator facing upward as shown in the shaded box below***

Figure 3-4.4 Attaching the Radio ODU to the Interface Mounting Bracket

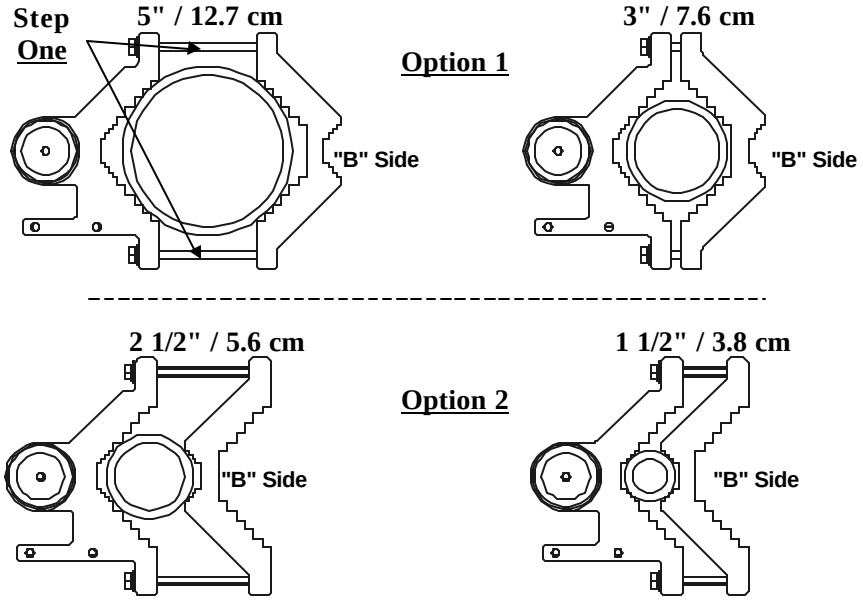


3.4.1.1 Attaching the Radio ODU / Mount Interface Bracket to a Pole

(Refer to Figure 3-4.5 while performing this procedure)

☞ ***Selecting the Proper Interface Mounting Bracket Configuration.*** Review the options shown in Figure 3-4.4. To set the selected configuration, first remove the four 8mm bolts along with the lock and flat washers from the pipe interface mounting bracket.

Figure 3-4.5 Selecting the Interface Bracket Configuration



☞ Position side "B" (clamp) to accommodate the pipe / pole dimension. *(See Figure 3-4.4)*

Important

Note: Position the Radio ODU and interface-mounting bracket as close to the assigned path azimuth as possible. This will facilitate the antenna alignment process described in Section 3.5.

☞ Now secure the Radio ODU and pipe interface-mounting bracket to the pipe mount using the hardware removed (4x8mm bolts, lock and flat washers).

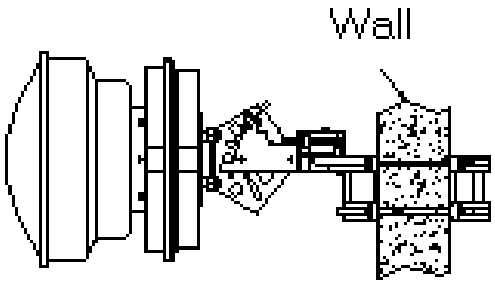
3.4.2 Preparing the Radio ODU for Wall Mounting

☞ *Refer to Figure 3-4.5. This Figure shows a typical wall-mounting configuration using front and back support plates secured in place with threaded rod and hardware.*

Note: This procedure does not describe the mounting process. Based on the wall structure, wall design and building structure, a mounting design using sound engineering practices must be developed.

Note: The Radio ODU and interface-mounting bracket can be attached directly to a flat wall surface. When attaching to a wall surface the "B" side clamp shown in Figure 3-4 is not used.

Figure 3-4.6 Wall Mount Configuration



☞ Remove the four 8mm along with the lock and flat washers from the interface mounting bracket.

Important ☞ Remove "B" side clamp. This piece is not required to secure the interface mount directly to a flat wall surface.

Note: *Position the Radio ODU and interface-mounting bracket as close to the assigned path azimuth as possible. This will facilitate the antenna alignment process.*

☞ The Radio ODU and pipe interface-mounting bracket can now be directly mounted to a flat wall surface.

3.4.3 Attaching Radio ODU Interface Cable and Grounding Cable

☞ *Refer to Figure 3-4.6 and Figure 3-4.7 while performing this procedure.*

Review the following guidelines prior to installing or attaching the radio ODU interface cable.

a) When cutting the cable length, ensure that extra length is added for the service loop.

b) Ensure that a strain relief is added to each cable connection.

c) Ensure that the cable external connector is sealed and waterproofed after assembly.

d) When running the interface cable between the indoor equipment and the radio ODU, follow standard installation practices. Avoid sharp corners. Secure the interface cable to the tower members or cable runways using hanger kits or tie-wraps at one-meter (three-foot) intervals.

Note: *When routing the interface cable, route the interface cable in a manner to avoid blocking the wireless antenna pattern.*

☞ Connect the I/O interface cable female connector to the chassis mounted male connector located on the radio ODU. When attaching the interface cable, first align the connector guide pins and rotate to set in place. ***Do not force the cable connector onto the Radio ODU.***

☞ Tighten the cable connector collar to ensure proper o-ring seal to the Radio ODU connector.

☞ Prior to securing the cable assemblies in place, form an 18" service loop (as shown) and secure the cable assemblies to the pipe mount (as shown) using commercially available UV protected tie-wraps or cable clamps. The service loop allows ease of antenna alignment, channels water away from the radio ODU, and allows ease of service.

WARNING	**Fiber Cables require a minimum bend radius greater than 12 inches.** **Care must be taken to prevent dirt/debris/moisture from entering the optical connector. Degradation in performance will result.**

Figure 3-4.7 Radio ODU Interface Connections

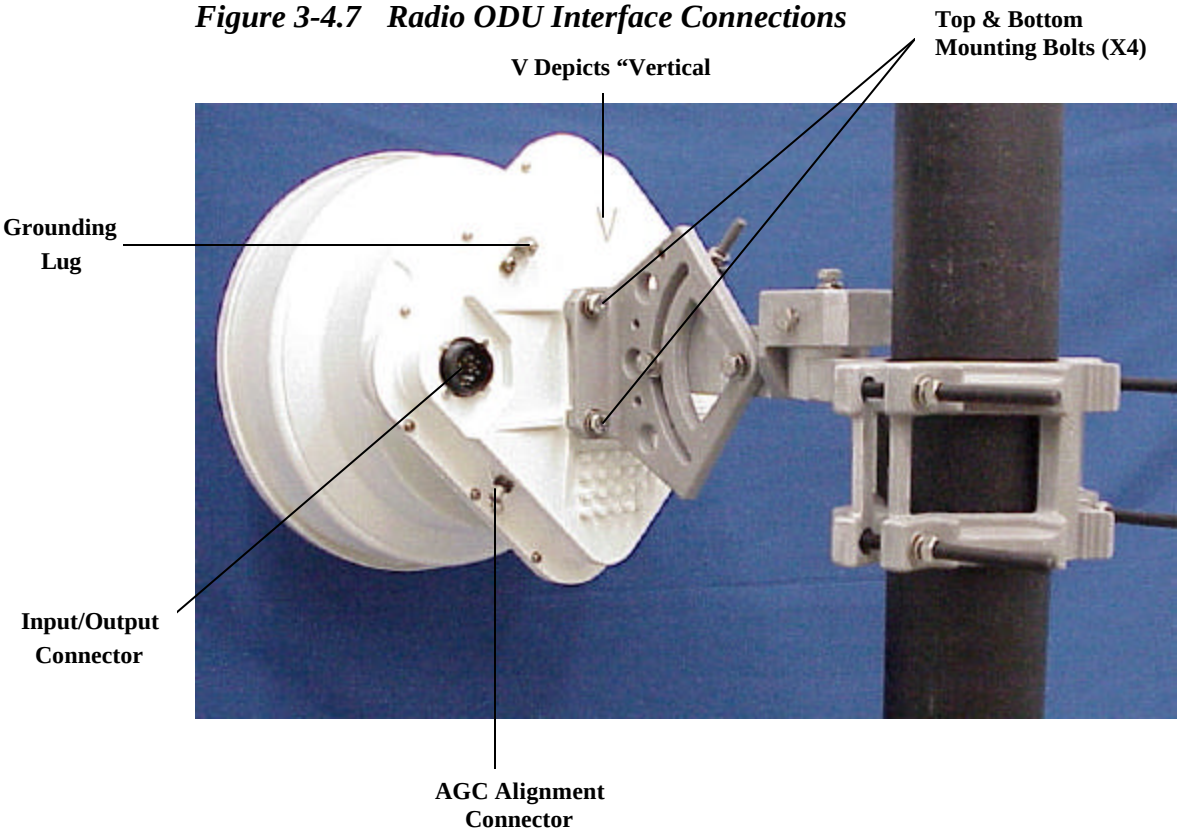
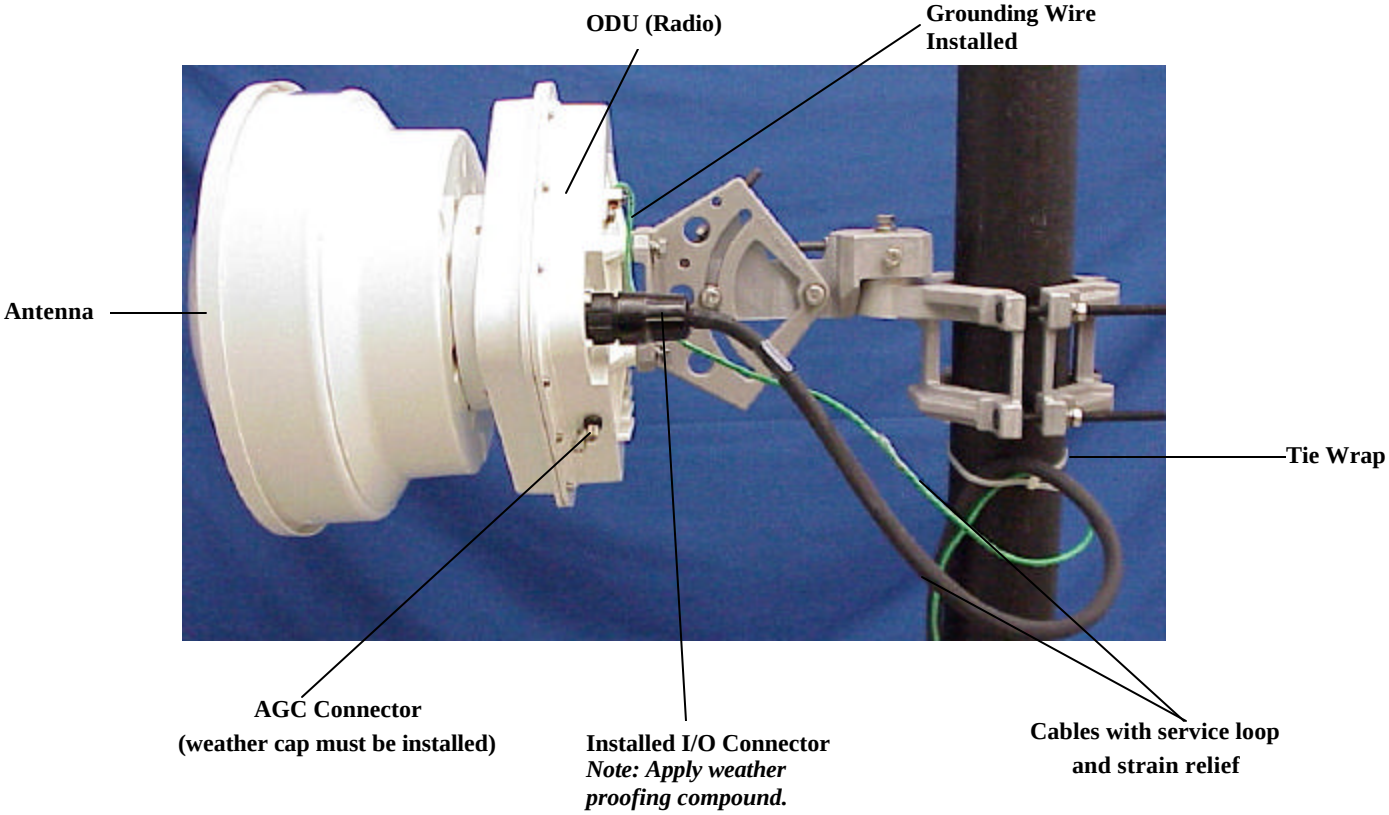


Figure 3-4.8 Attaching I/O Cable & Grounding Cable to the Radio ODU



3.4.5 Grounding and Weather Proofing

Note: *The accessories / materials listed in the following procedure are not supplied by SierraCom. These items must be purchased separately from a qualified vendor.*

WARNING	*Failure to properly ground the Radio ODU as well as the mounting structure may cause poor performance as well as increase the chance of damage from lightning.*

☞ **Ground the Radio ODU.** Attach a #6 copper cable between the grounding post on the rear of the radio terminal to the tower or structure grounding system.

☞ Attach a cable grounding kit to the radio unit end of the interface cable. Attach the cable grounding kit to the tower or site ground following instructions provided by the supplier of the grounding kit. The grounding kit should be placed within three feet of the connection to the radio unit.

☞ If the radio terminal is tower mounted, repeat step 2 at the base of the tower prior to entering the building or shelter.

☞ Apply a weatherproof compound to all outside connections. At a minimum, apply water resistance tape to all outside connectors.

Table 3.3 Common Installation Components

Component	Qty	Part Number	Description
Angle Adapter Kit	*	Andrew p/n 31768A	Mounting ½" cable hangers to angle tower members up to $^{7}/_{8}$" OD.
Hanger Kit	*	Andrew p/n 43211	Up to ½" cable OD.
Tower Stand off Kit	*	Round Member Adapters	Mounting ½" cable hangers to round member towers.
		30848-4	1.5"-3.0" (4.0-7.5cm)
		30848-1	3.0"-4.0" (7.5-10.0cm)
		30848-2	4.0"-5.0" (10.0-12.5cm)
		30848-3	5.0"-6.0" (12.5-15.5cm)
Wall Feed Through	**	Andrew p/n 40656-3	Single Entrance for ½" cable
Ground Kit	***	Andrew p/n 204989-1	
Cable Tie Kit	****	Andrew p/n 40417	(1) per every 3'

Note* Qty 10 per kit. Spacing per manufacturer's specifications.
Note** Qty 1 per multi-conductor cable.
Note*** If tower mount, Qty 3 per multi-conductor cable.
-If building mount, Qty 2 per multi-conductor cable.
Note****** Qty 50 per kit. Spacing per manufacturer's specification.

3.5 Align the Radio ODU with Integrated Antenna

This section describes how to align the Radio Terminal with integrated antenna. Alignment of the antennas is accomplished by monitoring the radio Automatic Gain Control (AGC) voltage during the antenna alignment process.

Note: *The AGC voltage can be monitored on the center conductor of the Radio ODU AGC Alignment Reverse SMA connector. The level that should be expected is path length dependent and will vary between 1 and 5 volts. Refer to Figure 3-4.3.*

☞ *Table 3-4 provides a list of tools, test cables and connectors necessary to align the antennas.*

Table 3-4 Tools, Test Cables and Connectors

Description	Remarks
Digital Voltage Meter	
BNC (M) to Reverse SMA (F) test cable	Alignment Accessory Kit
Reverse SMA (F) to Reverse SMA (F) test cable	Alignment Accessory Kit
11mm / 7/16" open end wrench	Or nut driver
13mm / ½" open end wrench	Or nut driver

☞ Refer to Figures 3-4.3. The AGC voltage should be adjusted for maximum using the antenna elevation and azimuth adjustments.

3.5.1 Antenna Coarse Adjustment Alignment Procedure

Note: Prior to aligning the antennas, first establish communications with colleagues on the far-end of the link. Antenna coarse and fine adjustments should only be performed at one end of the link at a time.

The Radio ODU interface mount has been designed to provide three 30º increments of elevation adjustment range for a total of 90º. This is accomplished by inserting the elevation coarse adjustment bolt that secures the elevation fine adjustment rod into one of three tapped holes located on the interface mount. Refer to Figure 3-4.1.

The Radio ODU interface mount has been designed to provide two 45º increments of azimuth adjustment range for a total of 90º. This is accomplished by inserting the azimuth coarse adjustment bolt that secures the azimuth fine adjustment rod into one of two tapped holes located on the interface mount. Refer to Figure 3-4.1.

To initially position the Radio ODU azimuth, first remove the azimuth coarse adjustment bolt from the interface-mounting bracket to disengage the azimuth fine adjustment rod. Next, loosen the azimuth-locking bolt on the Radio ODU interface-mounting bracket and move the Radio ODU to the estimated bearing. A compass should be used to set the initial azimuth bearing. When complete, hand tighten the azimuth locking bolt.

To initially position the Radio ODU elevation, first remove the elevation coarse adjustment bolt from the interface mounting bracket to disengage the elevation fine adjustment rod. Next, loosen the elevation locking bolts on the Radio ODU interface mounting bracket and position the Radio ODU at the estimated elevation angle. When complete, hand tighten the elevation locking bolts.

3.5.2 Antenna Alignment Procedures

- Connect a DVM to the AGC connector. (Refer to Figure 3-4.3)
- Apply DC power to the radio ODU.

☞ While monitoring the AGC Voltage (Meter), slightly loosen the elevation locking bolts and slowly move the Radio Terminal assembly through the complete coarse adjustment range. The goal is to identify the antenna main and side lobes.

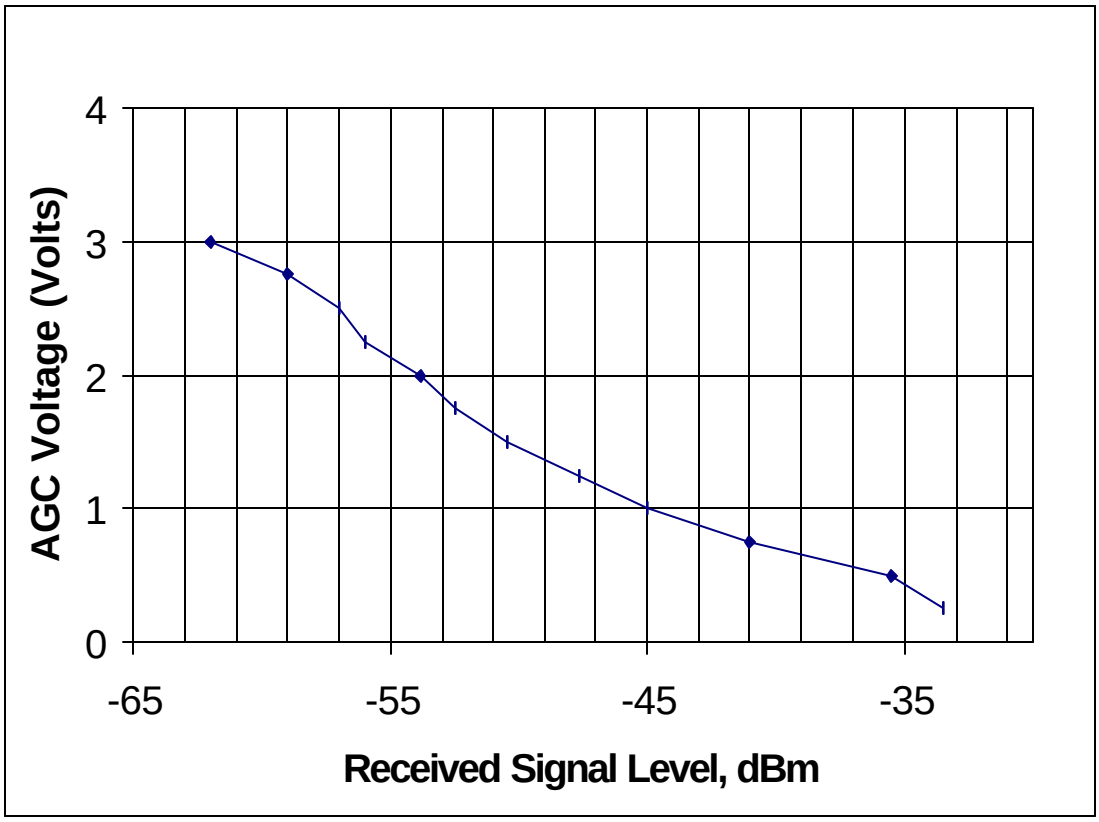
☞ During this process, place tick marks on the side of the interface-mounting bracket (with reference to the elevation locking bolts) to mark where the main and side lobes were observed.

☞ ***Care should be taken to identify the main lobe versus a ground reflection.***

☞ When both the main lobe and side lobes have been identified, return the Radio ODU assembly back to the main lobe tick mark and hand tighten the elevation locking bolts.

☞ Refer to Figure 3-4.4. Based on the preset elevation angle, insert the elevation coarse adjustment bolt into one of the three optional tapped holes to re-attach the elevation fine adjustment rod to the interface bracket. Next, back the nuts on the elevation fine adjustment rod to the end of the rod.

Figure 3-5.5 Typical AGC Voltage versus Received Signal Level



Note: *The AGC Voltage versus RSSI Curve is representative of typical readings using a Voltmeter with >100kΩ/v impedance.*

☞ White monitoring the AGC Voltage slightly loosen the azimuth locking bolt and slowly move the Radio ODU assembly through the complete coarse adjustment range. Again, the goal is to identify the antenna main and side lobes.

☞ During this process, place tick marks on the side of the interface-mounting bracket (with reference to the azimuth locking bolt) to mark where the main and side lobes were observed.

☞ When both the main lobe and side lobes have been identified, return the Radio ODU assembly back to the main lobe tick mark and hand tighten the azimuth locking bolt.

☞ Refer to Figure 3-5.2. Based on the preset azimuth bearing, insert the azimuth coarse adjustment bolt into one of the two optional tapped holes to re-attach the azimuth fine adjustment rod to the interface bracket. Next, back the nuts on the azimuth fine adjustment rod to the end of the rod.

☞ Repeat this procedure at the other end of the radio link. Several passes at both ends may be required to obtain the point of maximum signal strength.

Note 1: *As the radio nears the maximum signal strength, it is useful to alternate (loosening one and tightening the other) the elevation and azimuth locking bolts to minimize AGC voltage indication. When complete, hand tighten both sets of adjustment bolts.*

Note 2: *The antenna side lobes are typically 12 to 20 dB down. If the antenna peaks 20dB below the expected level, you most likely are on a side lobe or have crossed polarized the antennas.*

3-5.6 Antenna Fine Adjustment Alignment Procedure

Refer to Figure 3-4.1, Elevation and Azimuth Adjustments

Fine adjustments of the Radio ODU assembly is accomplished by turning the adjustment nuts along the fine adjustment rods. Again, only pan one antenna at a time.

☞ Using a ½" / 13mm open end wrench, move the elevation and azimuth fine adjustment nuts to pan the antenna in the azimuth then in elevation to maximize the AGC Voltage. The antenna should be slowly panned up and down and side to side until maximum signal level is obtained. It is recommended, as before, that when the maximum signal level is approached, engage both adjustment nuts against the mount and play one off against the other in quarter-turn steps until the maximum RSSI indication (or minimum AGC voltage) is achieved.

☞ Once the AGC Voltage has been optimized, tighten the elevation and azimuth locking bolts and fine adjustment nuts. This action is best accomplished by tightening the bolts and nuts equally in repetitive steps until all are secure. This procedure will help prevent the antenna from moving its elevation position during the tightening of the hardware. The AGC Voltage reading should be monitored during this process and the elevation adjusted, if necessary, to ensure that the Radio ODU assembly is aligned in the optimum position.

☞ Repeat this section for the far-end radio.

3.6 Removing the Radio ODU from the Mount Assembly

(Refer to Figure 3-4.4 and 3-4.7)

This section outlines the procedure to remove the RF unit from the interface-mounting bracket.

Note 1: *Prior to removing the RF unit from the interface-mounting bracket, remove DC power from the Radio ODU.*

Note 2: *Do not loosen any of the antenna azimuth and elevation adjustments..*

☞ Loosen the top (2) 8mm bolts (top of radio).

☞ Remove the bottom (2) 8mm bolts that secure the Radio ODU to the interface-mounting bracket. As shown in Figure 3-6.2.

☞ Slowly lift the Radio ODU straight up, separating it from the interface-mounting bracket.

☞ Carefully secure the Radio ODU.

☞ For safe keeping, re-insert the 8mm bolts into the tapped holes on the rear of the Radio ODU.

3.7 Optional Indoor Unit Installation

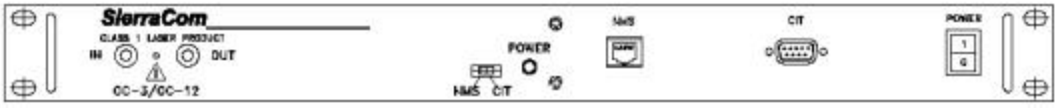
3.7.1 Mechanical Inspection of the Indoor Unit (IDU)

☞ Inspect the Indoor Unit for damage that may have occurred during shipments. Should any damage be discovered after unpacking, immediately file a claim with the carrier. A full report of damage should be forwarded to SierraCom.

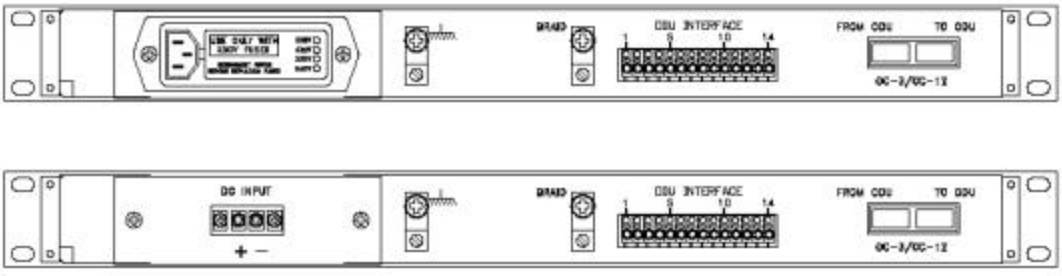
3.7.2 Indoor Unit and Interface Cable

☞ Install the 1U 19" Indoor Unit to the customer provided rack or cabinet using standard bolts, lock and flat washers.

Figure 3.7.1 Optional Indoor Unit Front and Rear Panel



Indoor Unit Front Panel Marking



Indoor Unit Rear Panel Marking

Table 3.7.1 Indoor Unit Rear Interface Connectors Pin-Outs

Optional Indoor Unit Rear Panel Marking	Multi-Conductor Cable Wire Designations	Function
Braid Screw	Cable Braid	GND
Power		
1	Black	+48V in
2	White	-48V in
3	Red	GND
4	Blue	GND
Blue Jacket Cable		
5	Blue Wire	RS485+
6	White / Blue Wire	RS485-
7	Drain	RS485 GND
8	Orange Wire	GND
9	White / Orange Wire	GND
Gray Jacket Cable		
10	Orange Wire	ERX+
11	White / Orange Wire	ERX-
12	Blue Wire	ETX+
13	White / Blue Wire	ETX-
14	Drain	GND
Fibers		
	Brown	SPARE
	Green	SPARE
From ODU	Blue	Output From ODU
To ODU	Orange	Input to ODU

☞ At the rear of the Indoor Unit, connect the Interface Cable to the assigned terminations on the Indoor Unit rear panel. Refer to Figure 3.7.1 and Table 3.7.1.

☞ Connect the ODU Interface cable fiber connections to the Indoor Unit input / output connector.

☞ Connect DC or AC to the Indoor Unit dependent on the purchased option.

3.8 Radio Link Commissioning

3.8.1 Test Equipment Requirements

The following test equipment is required to test a complete link consisting of two Fiber Connection™ radio terminals.

- Sonet Analyzer
  - Agilent Omni BER 718 or equivalent
  - Anritsu MP 1570A or equivalent
- 2x Test Fiber cables e.g. L-Comm SFOST-FC-03

3.8.2 Commissioning Procedure

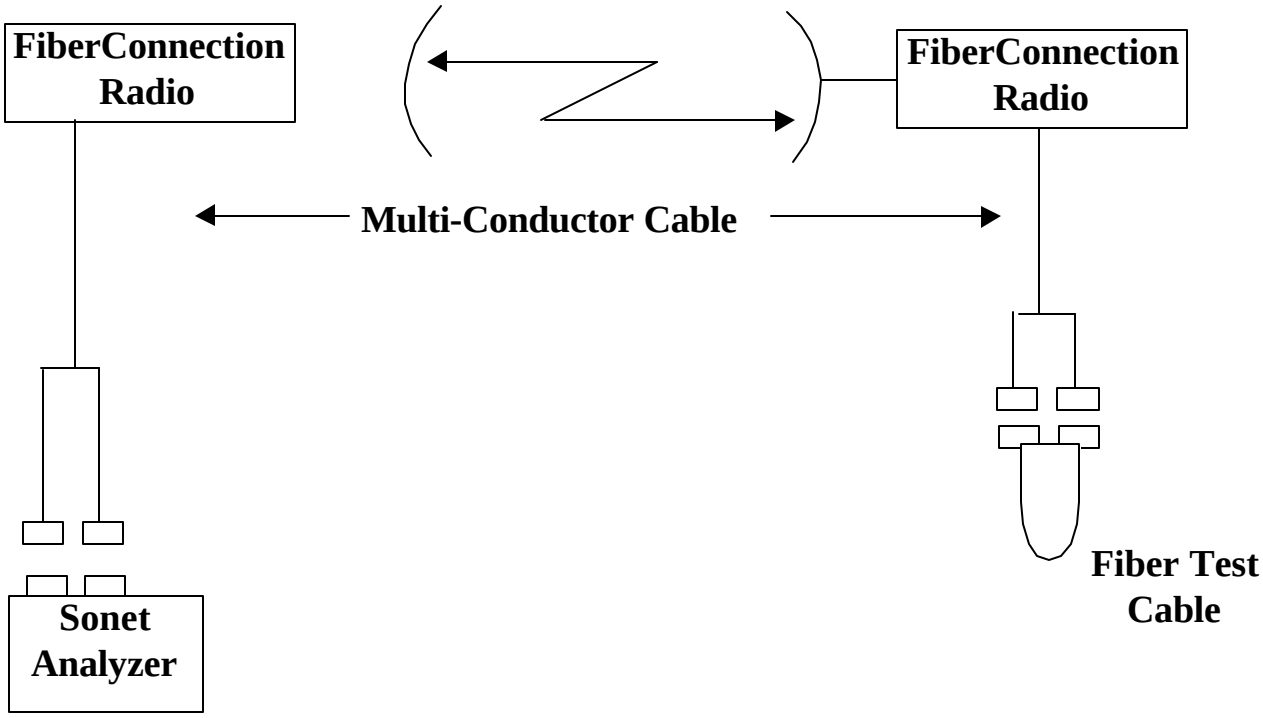
Note: Ensure that Section 3.7 is completed prior to commissioning the link.

☞ Apply the DC power to both Terminals (Refer to Section 3.0).

☞ Connect the Radio Terminals as shown in Figure 3.8.1.

☞ Observe the link BER performance for a period of 30 minutes.

Figure 3.8.1 Link Commissioning Connections



Section Four

Using the Wireless Remote to Configure and Monitor Radio

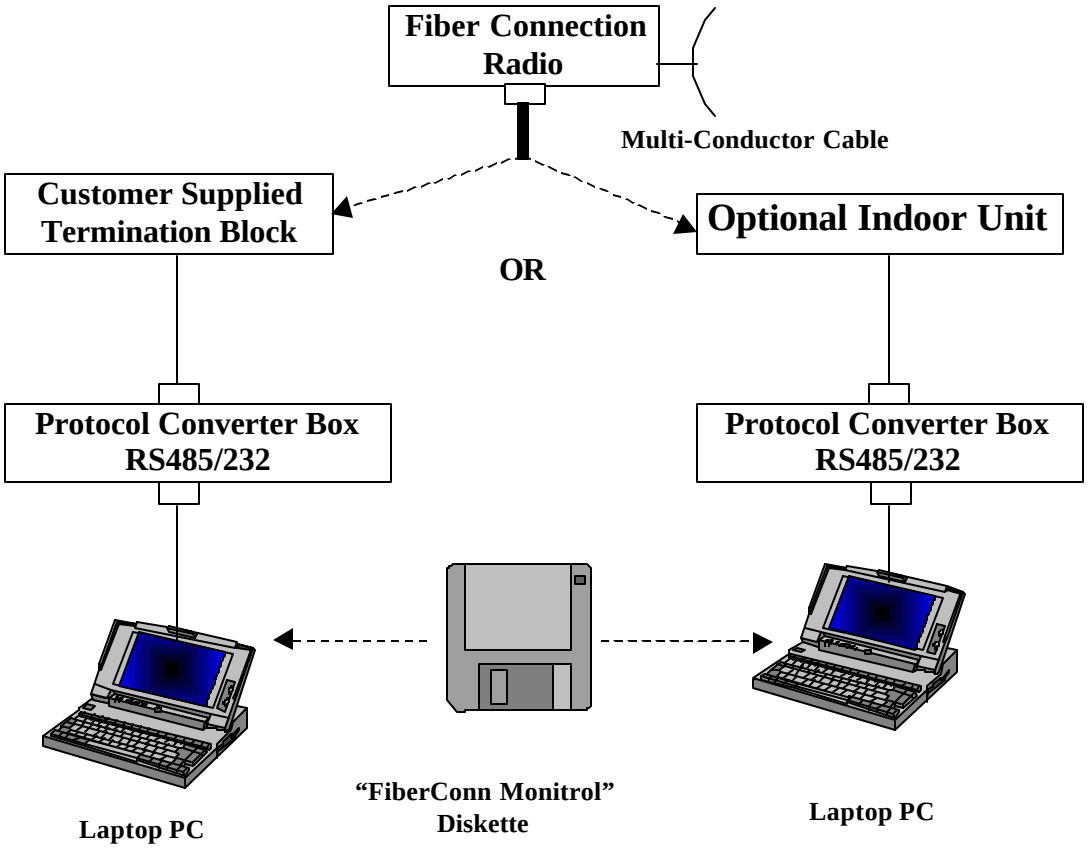
This option is currently not provided

Using the "FiberConn Monitrol" Software Craft Interface Tool (CIT)

5.1 About this Section

This section provides instructions to facilitate user familiarity and operational functionality of configuring and monitoring of the Fiber Connection 2 Radio via the RS-485 Communication Channel. The RS-485 channel can be accessed directly off the ODU interface cable twisted pair via an RS-485/RS-232 Interface Box optionally supplied by SierraCom. A software application called "FiberConn Monitrol" is provided on a diskette.

Figure 5.2.1 Hardware Connections to Use "FiberConn Monitrol" Software



Note: For pin-out information of the Multi-Conductor Cable, Refer to Table 3.7.1.

5.2 Functionality

The "FiberConn Monitrol" software is provided with the radio equipment accessories. It allows for easy configuration and monitoring of the Fiber Connection Series Radios. Using a PC or desktop computers. Figure 5.2.1 shows the required hardware and connections to allow for use of this application. The application is distributed on a diskette labeled "FiberConn Monitrol".

5.3 Installing "FiberConn Monitrol" Software

To use the "FiberConn Monitrol" application, the PC must meet the following minimum hardware configuration:

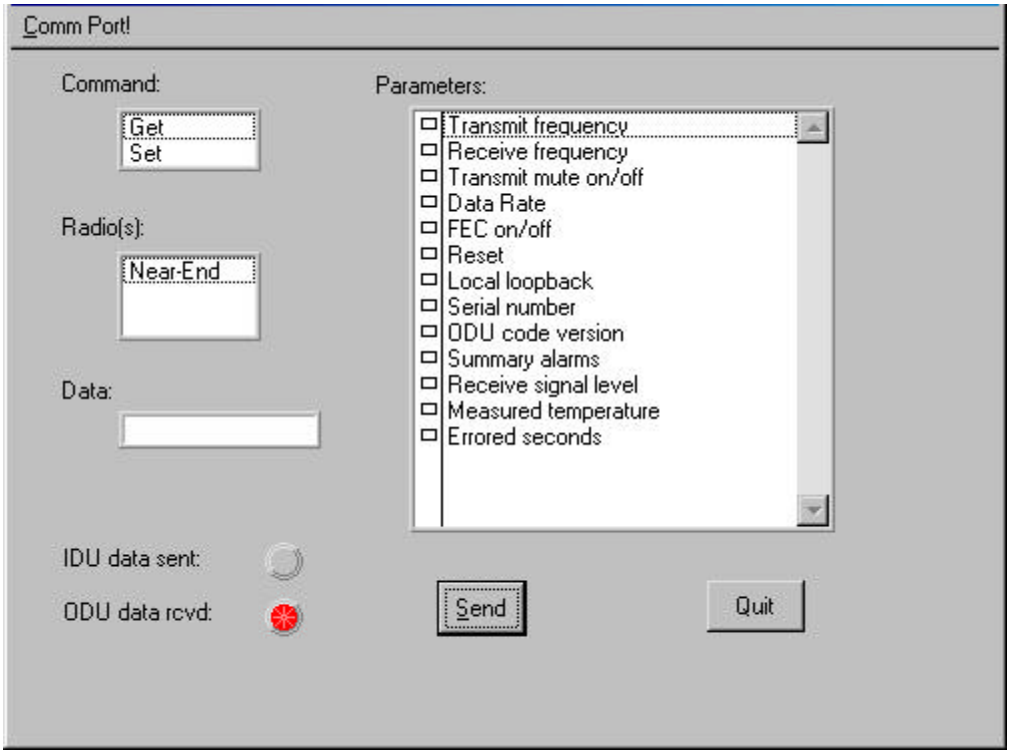
- Windows 95/98 required
- Serial RS-232 Comm Port
- 16 Mb RAM

☞ If the optional Indoor Unit is used, set the CIT/NMS switch to CIT position.
☞ Insert the diskette labeled "FiberConn Monitrol" into the floppy drive.
☞ Double-click on the Setup.exe.file.
☞ Insert the second diskette labeled "FiberConn Monitrol" when prompted by the application.

5.4 Using the "FiberConn Monitrol" Software

The application has a simple, understandable graphical interface. With just a few boxes and buttons, the user can interrogate or change any of the 10 or more parameters supported by the radios.

Figure 5.4.1 Example of the Graphical User Interface Display



5.4.1 Setting the Comm Port! Parameters

☞ Set the NMS/CIT Switch to CIT position to allow the Laptop PC to communicate with the Radio Terminal.

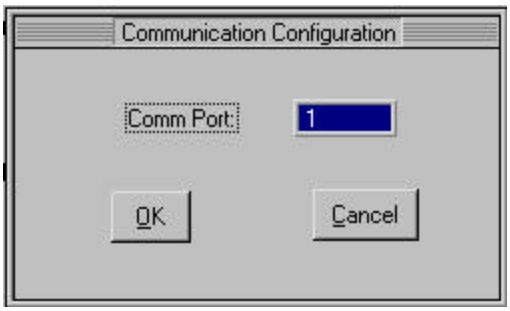
☞ Click on the Comm Port! Box to configure the command parameter. The PC displays the window shown in Figure 5.4.2.

☞ In order to operate with the RS-485 to RS-232 Interface Kit installed between the PC and the Indoor Unit, the application's communication parameters must be set to select the Comm port to which the cable is connected.

Baud Rate:	38400
Data Bits:	9
Stop Bits:	1
Parity Bit:	None

☞ Press the “OK” button when finished.

Figure 5.4.2 Communication Configuration Parameters



5.4.2.3 The Graphical User Interface Boxes and Buttons

The Graphical User Interface has two buttons and four boxes that allow the user to configure and view status of parameters.

5.4.2.1 Box

The Command Box supports the Get (Read or View) and the set (write or change) operations.

5.4.2.2 Data Box

This box will display the current or new value of the parameter selected or entered.

5.4.2.3 Parameter Box

This box displays the applicable parameters that can be viewed or changed only one parameter can be selected at a time. Figure 5.4.3 lists all the parameters that can be viewed or changed.

5.4.2.4 Send Button

The Send Button instructs the application to send an appropriate data packet over the Comm Port.

Note: The Send Button must be clicked to complete the commands.

5.4.2.5 Quit Button

The Quit Button shuts down the "FiberConn Monitrol" application software.

5.4.2.6 IDU Data Sent and ODU Data Received

These LED identify the status of the communication channel. After a packet is sent from the PC serial port, the **IDU Data Sent** LED turns red. After the PC receives the radio response, the **IDU Data Sent** LED turns gray and the **ODU Data Received** turns red.

Figure 5.4.3 Parameters Supported

Command		Parameters
Get		Transmit frequency
Get		Tx/Rx frequency spacing
Get	Set	Transmit mute on/off
Get	Set	FEC on/off
Get		Errored Seconds
Get	Set	Reset
Get		ODU code version
Get		Summary alarms
Get		ODU temperature

5.5 Procedure When Using "FiberConn Monitrol"

The steps below apply generically to any of the selected parameters.

☞ From the **Command** Box, select **Get** or **Set**.
☞ From the **Parameters** Box, highlight the parameter of interest.
☞ Click on the **Send** button.

Note: The screen will prompt the operator with values to enter.

☞ Using the keyboard, enter the values of the selected parameter.
☞ Click on **Send** to complete the operator.

SNMP MIB Installation Procedure

6.1 About this Section

The following sections provide basic information necessary to install various components of SierraCom's Fiber Connection SNMP proxy agent. To properly configure and operate the system consisting of a management station and one or more agents, the installer must perform the following: install hardware, configure agent's Network Parameters and add/compile the Fiber Connection Series MIB at the management station. Note that an Optional Indoor Unit is required.

Note: If a PC or laptop is not available at the radio site, the following procedure must be completed off site. Prior to the final installation, all but steps 6.2 and 6.3 of this section must be completed. After final installation at the radio site, complete Section6.4.

6.2 Configure the Indoor Unit SNMP Agent

This procedure is required to assign the necessary network parameters to the Indoor Unit SNMP Agent.

- ☞ Ensure that the radio terminal is installed and aligned as per Section 3 of this manual.
- ☞ Route / connect the Ethernet cable to the NMS Connector located on the front of the Indoor Unit.
- ☞ Route / connect the serial cable to the PC comm port. The PC must have a terminal emulator application installed but does not need to be an SNMP management station.
- ☞ From the PC connected to the agent's serial port, open a terminal emulator application, such as HyperTerminal. The application's settings for the selected PC port must be:
  - Bits per second = 38400
  - Data bits = 8
  - Stop bit = 1
  - Parity = None
  - Flow Control = None
- ☞ Apply power to the Indoor Unit. Use the PWR switch located in the front. If the serial interface cable and port parameters are correctly configured, SNMP configuration information will be displayed on the PC's monitor when power is applied.

Note: If information does not scroll on the terminal emulator window, corrective action is necessary. Re-examine the port number, port parameters, and cabling. Once the problem has been remedied, it is not necessary to re-power the unit to establish communications. Simply, type "HELP" (capitalized) to display the information about configuring the SNMP network parameters.

Syntax:	Uppercases only	COMMAND, PARAMETER, VALUE
COMMAND	GET	Retrieves stored parameter
	SET	Updates stored parameter
	HELP	Displays this information
PARAMETER	MAC	Ethernet hardware address, (GET commands only)
	IP	Ethernet IP Address
	MASK	Subnet Mask
	GATE	Gateway Address
VALUE		SET commands only. xxx.xxx.xxx.xxx

☞ When communication is established, change the necessary network parameters for your specific network. At a minimum the IP address will need to be changed for each agent. Record the IP address since it will be used again further in the procedure.

☞ Depending upon your network topology, it may be necessary to change the default subnet and gateway addresses.

6.3 Add and Compile the "Sierra FiberConn MIB" to the Management Station

Note: The actual methods by which new files are loaded, complied and configured vary from one management application to the next. The following is a general overview that highlights a typical procedure. The specific management application software determines the actual step by step process.

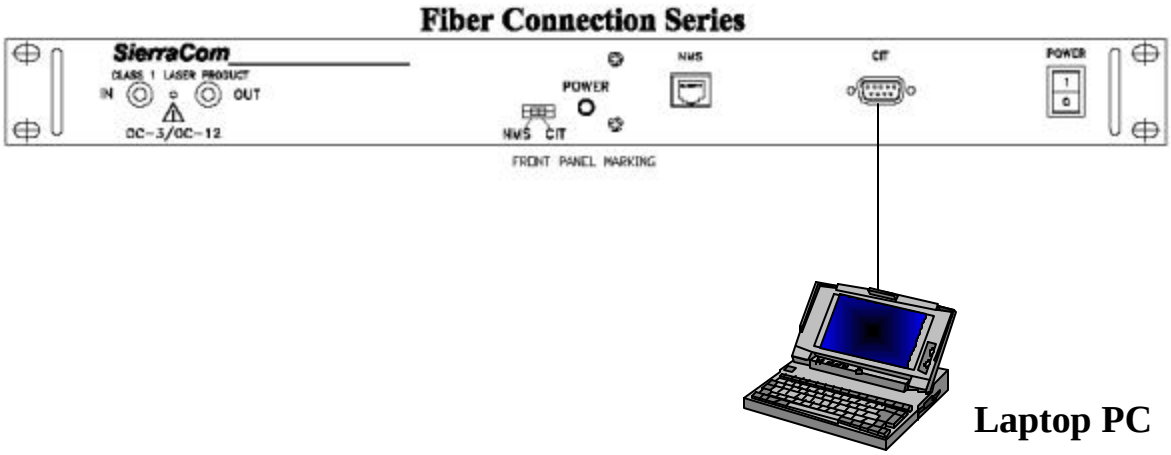
☞ Open Windows Explorer and copy the file "Sierra FiberConn.Mib" from the floppy drive to the management application's MIB directory.

☞ Open the Network Management application.

☞ Add the Mib files and compile from within the application.

- ☞ Create a new agent profile for each radio site.
- ☞ Under each agent profile, change the SET COMMUNITY parameter from netman to private.
- ☞ Include the IP address assigned to each agent in to the corresponding profile.

Figure 6.2.1 Configuring the Indoor Unit SNMP Agent



Appendix A – North American Standards

Requirement	North American Compliancy Specification
EMC, ESD	FCC Part 15 (Class B), Part 101 Bellcore GR-1089-CORE
Environmental, Mechanical	TR-NWT-000063 TA-NWT-000487
Safety	UL 1950, ULC, CSA

A.1 EMC and ESD

	North American	
Test	**Compliancy Specification**	**Test Method**
Radiated Emissions	FCC Part 15, Class B	ANSI std C63.4
Conducted Emissions	FCC Part 15	ANSI std C63.4
Radiated Susceptibility	Bellcore GR-1089-CORE, section 3.3	Bellcore GR-1089-CORE, section 3.5
Conducted Susceptibility/Fast Transient Common Mode	Bellcore GR-1089-CORE, section 3.3	Bellcore GR-1089-CORE, section 3.5
RF Common Mode	Not required	Not required
ESD Direct	Bellcore GR-1089-CORE	IEC 801-2
ESD Indirect	Bellcore GR-1089-CORE	IEC 801-2
Lightning Surge	Bellcore GR-1089-CORE, section 4.5.7	Bellcore GR-1089-CORE, section 4.5.7

A.2 Environmental-Storage, Handling & Transportation

	North American	
Test ¦	**Compliancy Specification**	**Test Method**
Low Temp	TR-NWT-000063, section 4.4.3 (-40ºC)	TR-NWT-000063, section 5.4.2
High Temp	TR-NWT-000063, section 4.4.3 (+65ºC)	TR-NWT-000063, section 5.4.2
Thermal Shock & Cyclic Variations	TR-NWT-000063, section 4.4.3 (10% to 95% -40ºC to +65ºC)	TR-NWT-000063, section 5.4.2
Humidity	TR-NWT-000063, section 4.4.3 (10% to 95%)	TR-NWT-000063, section 5.4.2

¦ Following the storage/transport tests, the equipment shall meet all functional performance specifications described in Section 2.0.

A.3 Environmental-Operational (Outdoor, non-weather protected)

Test	Compliancy Specification	Test Method
Low Temp	TA-NWT-000487, section 4.1 (-33ºC)	TA-NWT-000487, section 4.1
High Temp	TA-NWT-000487, section 4.1 (+46ºC)	TA-NWT-000487, section 4.1
Humidity	TA-NWT-000487, section 4.1 (5% to 95%)	TA-NWT-000487, section 4.1

A.4 Mechanical-Handling, Transportation

	North American	
Test	**Compliancy Specification**	**Test Method**
Vibration Storage, Transport	TR-NWT-000063, section 4.4	TR-NWT-000063, section 5.4
Shock Transport (packaged)	TR-NWT-000063, section 4.4	TR-NWT-000063, section 5.4
Shock Installation (unpackaged)	TR-NWT-000063, section 4.4	TR-NWT-000063, section 5.4
Bounce (packaged)		IEC 68-2-55

A.5 Mechanical - Handling, Transportation

	North American	
Test	**Compliancy Specification**	**Test Method**
Vibration Operation	TA-NWT-000487, section 4.19	TA-NWT-000487, section 4.19
Seismic (Zone 4)	TR-NWT-000063, section 4.5	TR-NWT-000063, section 5.5

A.6 Other Requirements

Test	Compliancy Specification	Test Method
Low Pressure (Altitude)	TR-NET-000063, section 4.2.2	IEC 68-2-13, Test M
Acoustic Noise	TR-NWT-000063, section 4.7	TR-NWT-000063, section 5.7
Safety	UL 1950, ULC, CSA	

Glossary

1 + 0	Radio Terminal configured for unprotected operation
BPSK	Binary Phase Shift Keying
A/D	Analog to Digital
AGC	Automatic Gain Control
AIS	Alarm Indication Signal (all "1" bit pattern)
Asynchronous	A term generally used to describe occurrences that are repetitions but do not have a constant repetition period. In communications, a data transmission format in which each character is defined with a "start bit" at its beginning and a "stop bit" at its end. This allows the receiving device to recognize and to synchronize to each individual character in a transmission, even though the time interval between characters may vary.
Baseband	Baseband is a range of frequencies, which encompasses the particular frequency, or frequencies used to modulate a carrier.
Baud	The unit of digital modulation rate measured in transitions per second. Only in binary transmissions are baud and bit synonymous
BER	Bit Error Rate
BERT	Bit Error Rate Tester
C/I	Carrier / Interference Ratio
CLK	Clock
CW	Continuous Wave
FREQ	Frequency
Fs	Symbol Rate
FSL	Free Space Loss
Hz	Hertz (cycles per second)
IC	Integrated Circuit
IF	Intermediate Frequency
I/O	Input / Output Connector, Device or Port
kHz	Kilohertz, Hz x 10^{-3}
LCD	Liquid Crystal Display
LO	Local Oscillator
LOS	Line of Sight
Mbits/s	Megabits per Second

MMIC	Microwave Monolithic IC
Modem	Modulator/Demodulator
MTBF	Mean Time Between Failure
MUX	Multiplexer. Multiplex: To combine individual data streams into one composite data stream.
NC	Normally Closed Relay Contact
NF	Noise Figure
NMS	Network Management System
NO	Normally Open “Relay Contact”
NRZ	Non-Return to Zero
OOK	On/Off Keying
P/S	Parallel-to-Serial (Data Stream Conversion) or Power Supply
RF	Radio Frequency
RS-232	DTE-DCE interface standard. Defines electromechanical interface, with several related standards, define signal level, conditions and polarity at each interface connection.
RS-422	DTE-DCE interface standard. Specifies the functional and mechanical characteristics of the interface between DTE-DCE.
RSSI	Received Signal Strength Indication
RX	Receive(r)
S/N	Signal to Noise
SYM	Symbol
Symbol Rate of Frequency (fs)	The rates (frequency) at which symbols are generated. Since Symbols represent any of 3,5 or 7 bits (for 8, 32 and 128 QAM respectively), the system bit rate is 3, 5 or 7 times higher than the symbol rate.
T1	Transmission medium capable of carrying a TDM signal at 1.544 Mbit/s
T/R	Transmit / Receive
TX	Transmitter
VCO	Voltage Controlled Oscillator
XO	Crystal Oscillator
XTL	Crystal