# *N2-X Ethernet Extender*
# *Installation and Operation Manual*

Part Number 281-104101-201
Version 1.0
December 1999

Wireless, Inc.
5452 Betsy Ross Drive
Santa Clara, CA 95054-1101

## Notice

Information in this document is subject to change without notice. No part of this document may be reproduced or transmitted in any form or by any means, electronic or mechanical, for any purpose, without the express written permission of Wireless, Inc.



N2-X Ethernet Extender™ and ACCESS™ Series are trademarks of Wireless, Inc.

# Table of Contents

# Figures

## Tables

# Welcome!

Welcome to the Wireless, Inc. N2-ACCESS™ Series product family. This manual is designed to introduce you to the N2-X Ethernet Extender™, and to provide you with information necessary to plan, install, operate and maintain a N2-X Ethernet Extender wireless communication system.

The N2-X Ethernet Extender is intended for **professional installation only**. This manual, however, is also designed for personnel who plan, operate and administrate the N2-X Ethernet Extender communication system. Please review the entire manual before powering up or deploying any N2-X Ethernet Extender.

Updates to this manual will be posted on the Wireless, Inc. Customer Service Website at *http://www.wire-less-inc.com*. Registered Wireless customers can access Wireless' on-line information and support service, available 24 hours a day, 7 days a week. Our on-line service provides users with a wealth of up-to-date information, with documents being added or updated each month.

# Radiation Warnings

## Microwave Radio Radiation Warning

Under normal operating conditions, N2-X Ethernet Extender radio equipment complies with the limits for human exposure to radio frequency (RF) fields adopted by the Federal Communications Commission (FCC). All Wireless, Inc. microwave radio equipment is designed so that under normal working conditions, microwave radiation directly from the radio is negligible when compared with the permissible limit of continuous daily exposure recommended in the United States by ANSI/IEEE C95.1-1991 (R1997), Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz.

Microwave signal levels that give rise to hazardous radiation levels can exist within transmitter power amplifiers, associated RF multiplexers, and antenna systems.

**Never look into the open end of a Waveguide** as eyes are particularly vulnerable to radiation.

**Do not** disconnect RF coaxial connectors, open microwave units, or break down any microwave screening while the radio equipment is operating.

## Microwave Antenna Radiation Warning

Designed for point-to-point operation, an N2-X Ethernet Extender microwave radio system will use directional antennas to transmit and receive microwave signals. These directional antennas are usually circular or rectangular in shape, are generally located outdoors, and are usually mounted on a tower or mast.

Referencing OET Bulletin 65 (Edition 97-01, August 1997) from the Federal Communication Commission's Office of Engineering & Technology, limits for maximum permissible exposure (MPE) to microwave signals have been adopted by the FCC for both Occupational/Controlled environments and General Population/Uncontrolled environments. These limits are 5.0 mW/$cm^2$ and 1.0 mW/$cm^2$, respectively, with averaging times of six-minutes and thirty-minutes, respectively.

The closer you are to the front center-point of a microwave antenna, the greater the power density of its transmitted microwave signal. Unless you are very close, however, microwave exposure levels will fall far below the MPE limits. To determine how close to a microwave antenna you can be and still remain below the MPE limits noted above, "worst case" predictions of the field strength and power density levels in the vicinity of an N2-X Ethernet Extender™ microwave antenna can be made from the following calculations. The equation is generally accurate in the far-field of an antenna, and will **over-predict** power density in the near-field (i.e. close to the antenna).

$$S = PG/4\pi R^2$$

where:
- S = power density (in mW/$cm^2$)
- P = power input to the antenna (mW)
- G = power gain of the antenna in the direction of interest relative to an isotropic radiator
- R = distance to the center of radiation of the antenna (cm)

Note that G, the power gain factor, is usually expressed in logarithmic terms (i.e., dB), and must be converted using the following equation:

$$G = 10^{dB/10}$$

For example, a logarithmic power gain of 24 dB is equal to a numeric gain of 251.19.

Assuming (1) maximum output power from the N2-X Ethernet Extender (+3.5 dBm [2.238 mW]), (2) no signal loss in the cable connecting the N2-X Ethernet Extender to the antenna, and (3) the use of a 27 dBi gain parabolic antenna, the 5.0 mW/$cm^2$ and 1.0 mW/$cm^2$ MPE power density limits would be reached at distances of approximately 4.22 cm and 9.44 cm, respectively.

Wireless, Inc. fully supports the FCC's adopted MPE limits, and recommends that personnel maintain appropriate distances from the front of all directional microwave antennas. Should you have questions about N2-X Ethernet Extender™ microwave signal radiation, please contact the Wireless, Inc. Customer Service Department.

## Notice Regarding Operation pursuant to FCC part 15 Rules

This equipment has been tested and found to comply with the limits for a Class A digital device pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

# 1.0 General Overview

## 1.1 N2-ACCESS Series Product Family

All N2-X Ethernet Extender radios are members of the N2-ACCESS Series radio product family. The N2-ACCESS Series is designed to provide an economical wireless solution for local access telecommunication requirements.

This manual addresses, in detail, the operation of the N2-X Ethernet Extender. For detailed information on other members of the N2-ACCESS Series, please refer to the appropriate Operation Manual(s).

## 1.2 Introduction to the N2-X Ethernet Extender

The N2-X Ethernet Extender is a digital radio using spread spectrum modulation techniques designed for use as a point-to-point communications system. The N2-X Ethernet Extender is used in the following applications: point-to-point (building to building), ISPs, CLECs, Wireless Local Loop (WLL), Backup Solutions and Temporary Links.

The N2-X Ethernet Extender radio is designed for operation in two of the Unlicensed National Infrastructure at frequencies of 5.250 - 5.350 GHz or 5.725 - 5.825 GHz.

Each N2-X Ethernet Extender is comprised of a pole mounted RF/antenna unit. Each link is powered by means of a DC power supply (optional AC-DC power supply available) which is fed to the unit through an optional power/data cable. The system has a total data transmission capacity of 16 Mb/s. Refer to the N2-X Ethernet Extender data sheets for detailed information relating to product offerings and specifications.

## 1.3 Regulatory Information

In January 1997, the FCC made available 300 MHz of spectrum for Unlicensed National Information Infrastructure (U-NII) devices. The FCC believes that the creation of the U-NII band will stimulate the development of new unlicensed digital products which will provide efficient and less expensive solutions for local access applications.

The U-NII band is divided into three sub bands at 5.15 - 5.25, 5.25 - 5.35 and 5.725 - 5.825 GHz. The first band is strictly allocated for indoor use and is consistent with the European High Performance Local Area Network (HIPERLAN). The second and third bands are intended for high speed digital local access products for “campus” and “short haul” microwave applications.

***Table 1.1 - FCC U-NII Bands***

| | **Band 1** | **Band 2** | **Band 3** |
|---|---|---|---|
| **Frequency** | 5.15 to 5.25 GHz | 5.25 to 5.35 GHz | 5.725 to 5.825 GHz |
| **Power (Max)** | 200 milliwatts EIRP | 1 watt EIRP | 4 watts (EIRP)* |
| **Intended Use** | Indoor Use Only | Campus | Approx 10 miles |

WL035901

* Note: A recent FCC memorandum opinion and order (M00) revised on June 24, 1998 allows the use of a directional antenna with 23 dBi gain and a maximum transmitter output power of 1 watt in the 5.725 - 5.825 U-NII band.

# 2.0 N2-X Ethernet Extender Product Profile

## 2.1 General Overview

The N2-X Ethernet Extender series of microwave radio products provides digital capacities for 16 Mb/s data rates for short-haul applications up to 10 km. The radio terminal operates in the Unlicensed National Information Infrastructure (U-NII) spectrum with a revolutionary Split Modulation system architecture that provides full duplex operation in the 5.3/5.7 GHz U-NII frequency bands.

The N2-X Ethernet Extender series provides the unique advantage of a very robust digital transmission scheme.

The product uses two separate 100 MHz bands within the U-NII frequency spectrum. Within these bands, the N2-X Ethernet Extender series operates in one of many independent channels providing for frequency reuse and network flexibility, ideal for dense network applications.

Synthesized RF channel selection is field configurable, as are the power output options for the selection of antenna sizes. Frequency coordination and installation guidelines are provided in the appendix section of this manual.

Complying with all aspects of FCC Rules Subpart 15.401-15.407, the transmission characteristics of the N2-X Ethernet Extender series are ideally suited to meet the peak power spectral density requirements of the U-NII 5.250 - 5.350 and 5.725 - 5.825 GHz bands.

The N2-X Ethernet Extender has been designed for easy access to all interfaces, controls, and displays. Information in this manual will familiarize you with all of these items. Figure 2.1 illustrates two (2) N2-X Ethernet Extender terminals in a point-to-point configuration.

***This Page Left Blank Intentionally***

***Figure 2.1 Z-fold (WL035902) goes here***

***Figure 2.1 Z-fold (WL035902) goes here***

## 2.2 Specifications

### 2.2.1 General Specifications

| | |
|---|---|
| Frequency Range: | 5.250 - 5.350 GHz and 5.725 - 5.825 GHz |
| RF Channel Bandwidth: | 12 MHz |
| Channel Increments: | 10.24 MHz |
| Radio Operation: | Full duplex |
| Antenna Port Impedance: | 50 Ω nominal |
| Antenna Port Return Loss: | ≥ 10 dB |
| Ethernet Data Rate: | 16 Mbps full duplex, 8 Mbps half duplex |

### 2.2.2 Transmitter Specifications

| | |
|---|---|
| Frequency Range: | 5.250 - 5.350 GHz and 5.725 - 5.825 GHz |
| Channel Increments: | 10.24 MHz |
| Modulation: | BPSK |
| Power Output: | 0, +4, +8, and +12 dBm Avg. |
| Transmit Duty Cycle: | 100% |
| Emission Mask: | Per FCC 15.407 |
| Frequency Stability: | ± 5 ppm |
| Spurious and Harmonic Output: | ≤ -60 dBc |
| Data Rate: | 8 Mbps |

### 2.2.3 Receiver Specifications

| | |
|---|---|
| Type: | Coherent Detection |
| Sensitivity: | ≤ -84 dBm @ $1x10^{-6}$ BER = $1x10^{-2}$ Packet Error Rate |
| Maximum RF Input: | -20 dBm |
| Data Rate: | 8 Mbps |
| Channel Increments: | 10.24 MHz |
| Frequency Stability: | ± 5 ppm |
| Receiver Saturation: | ≥ -20 dBm |
| 1st Image Rejection: | ≥ 60 dB |
| Other Spurious Rejection: | ≥ 50 dB |
| *Tolerance of Interferers (on adjacent channels): | |
| Channels N-1, N+1 | +30 dBc |
| Channels N-2, N+2 | +50 dBc |
| Channels N-3, N+3 | +70 dBc |

***Note:** Measured at 10 to 40 dB above threshold with similar radio as interferer. Ratio of power from same power boresight remotes in adjoining 60 degree sectors with 1:8 range differential is -25 dB for the standard Gabriel 2 foot dish.

| | |
|---|---|
| 1st Image Rejection: | ≥ 60 dB |
| Other Spurious Rejection: | ≥ 50 dB |

### 2.2.4 Digital Interface

**Ethernet Interference on ODU**

The 8-pin CircularMil (10Base-T Ethernet interface/ODU status signals) connector pin assignments are shown in Table 2.1. Note that the functions of pins 4, 5 ,7, and 8 are non-standard, are presently used for proprietary purposes only and should be disabled by switching position 7 of the 10 position switch to the “On” position.

***Table 2.1 - Connector Pin Assignment, 10 Base T Connector on ODU***

| Pin | LEAD | Function |
|---|---|---|
| 1 | TX+ | Twisted Pair Transmit + |
| 2 | TX- | Twisted Pair Transmit - |
| 3 | RX+ | Twisted Pair Receive + |
| 4 | Pwr/Local Alarm | Signal that drives "Power/Local Alarm" LED on IDU |
| 5 | RF Link | Signal that drives "RF Link" LED on IDU |
| 6 | RX- | Twisted Pair Receive - |
| 7 | TPLIL | Signal that drives "Ethernet Integrity" LED on IDU |
| 8 | Gnd. | Ground |

WL196903

### 2.2.5 Power Supply Input Connector on ODU

The 4-pin CircularMil power supply input connector pin assignments are shown in Table 2.2.

**Note:** The white lead of the power side of the optional Data/Power cable connects to Pin 1, thus it should be connected to the negative lead of the power source. The red lead of the power side of the optional Data/Power cable connects to Pin 2, thus it should be connected to the positive lead of the power source.

***Table 2.2 - Connector Pin Assignment, Power Supply Input Connector on ODU***

| Pin | Lead | Function |
|---|---|---|
| 1 | Negative Input (-) | Connection to negative lead of power supply. |
| 2 | Positive Input (+) | Connection to positive lead of power supply. |
| 3 | Not Used | |
| 4 | Not Used | |

WL294901

### 2.2.6 Antennas

The antennas shown in Table 2.3 are recommended for use with N2-X. With the exception of the 4' dishes, all antennas have been tested with N2-X to verify compliance with applicable FCC rules. Data sheets for antennas can be found in Appendix B.

***Table 2.3 - Recommended Antennas***

| Type | Manufacturer and Part Number |
|---|---|
| 2' diameter dish, Plane Polerized, 28.1 dBi | Gabriel SSP2-52ARI |
| 2' diameter dish, Dual Polerized, 28.1 dBi | Gabriel SSD2-52ARI |
| *4' diameter dish, Plane Polerized, 33.5 dBi | Gabriel SSP4-52A |
| *4' diameter dish, Dual Polerized, 33.5 dBi | Gabriel SSD4-52A |
| 6" Flat Panel, Plane Polerized, 17.5 dBi | Gabriel DFPS.5-52 |
| 12" Flat Panel, Plane Polerized, 23 dBi | Gabriel DFPS1-52 |
| 24" Flat Panel, Plane Polerized, 27.5 dBi | Gabriel DFPS2-52 |

* Not FCC compliant.

WL196902

### 2.2.7 Power Requirements

| | |
|---|---|
| Primary power supply | |
| DC | ±20 to ±56 V |
| AC | 100 to 240V 50/60 Hz with optional external power supply. |
| Power Consumption | Maximum 17 Watts |

### 2.2.8 Environmental Specifications

| | |
|---|---|
| Outdoor Unit | Operating Temperature Range: -30°C to +60°C<br>Storage Temperature Range: -40°C to +85°C<br>Altitude: 4,500 meters max.<br>Humidity: Outdoor, all-weather enclosure |

### 2.2.9 Mechanical

**Dimensions**

| | |
|---|---|
| ODU | 310mm x 351mm x 73mm (HxWxD) |

**Weight**

| | |
|---|---|
| ODU | 5 kg |

## 2.3 User Interfaces

The N2-X Ethernet Extender provides user interfaces for fused DC power connection, electrical grounding, radio frequency (RF) antenna connection, Ethernet connection, configuration and RSSI output. The following provides information on each interface.

*Outdoor Unit*

- **Data/Power Cable** - Siamesed CAT-5 Ethernet and power cables.
- **RSSI** - BNC type connector used for RSSI measurement.
- **Antenna (RF) Connector** - N-type female connector used for connection with antenna.
- **Main Power** - The N2-X Ethernet Extender is designed to work from a power input of 20 to 56 VDC.
- **Grounding Connector** - The front panel of the N2-X Ethernet Extender is equipped with an M5 ground screw and associated washers. This ground screw serves as the proper chassis-ground connection point for an external ground source. The N2-X Ethernet Extender must be grounded in accordance with the electrical codes, standards, and practices governing the local installation.

- **Configuration Switch -** Configuration of the N2-X Ethernet Extender is performed via a DIP switch on the ODU. The 10-position DIP switch is accessible by removing the water-tight dust cap on the ODU. Once exposed, each of the 10 switches can be manipulated using a fine point instrument such as a small-tipped screwdriver. The function of each switch is explained in Table 2.6. **Note:** Primary power must be cycled off, then on, for changes in DIP switch settings to take affect.

Per Table 2.4, in the 5.3 GHz band the highest power setting (approximately +12 dBm) can only be installed with the lowest gain antenna which is the 6” Flat Panel Plane Polarized (DFPD.5-52) with 17.5 dBi. Each radio is shipped from the factory with a standard 6’ coaxial cable for connection between the radio and the antenna. The cable has a nominal loss of approximately 2.6 dB.

UNII radios are covered under CFR 47 FCC part 15, 15.407 Subpart E. 15.407.a.2 which states Ptransmit = 11 dBm + 10 log B where B is the -26 dB BW with a 6 dBi antenna. Above 6 dBi antenna gain there is a 1:1 reduction in Ptransmit to maintain the same Maximum EIRP. This is accomplished by the changes in output power setting for the alternative antennas.

The FCC EIRP limit for the 5.3 GHz band with our transmitter bandwidth is +28 dBm. With the transmit power set to +12 dBm, the EIRP with the 6” Flat Panel antenna, and standard 6’ coaxial cable will be:

12 dBm + 17.5 dBi - 2.6 dB = 26.9 dBm

***Table 2.4 - Maximum Transmit Power Level Setting vs. Antenna Type (for compliance with FCC EIRP limits) in the 5.3 GHz Band***

| Antenna Type | Manufacturer P/N | Maximum Transmit Power Setting (dBm) |
|---|---|---|
| 2' diameter dish with radome, Plane Polarized, 28.1 dBi | Gabriel SSP2-52ARI | 0 |
| 2' diameter dish with radome, Dual Polarized, 28.1 dBi | Gabriel SSD2-52ARI | 0 |
| 6" Flat Panel, Plane Polarized, 17.5 dBi | Gabriel DFPD.5-52 | +12 |
| 12" Flat Panel, Plane Polarized, 23 dBi | Gabriel DFPD1-52 | +4 |
| 24" Flat Panel, Plane Polarized, 27.5 dBi | Gabriel DFPD2-52 | 0 |

WL201921

Per Table 2.5, in the 5.7 GHz band the highest power setting (approximately +12 dBm) can only be installed with the lowest gain antenna which is the 6" Flat Panel Plane Polarized (DFPD.5-52) with 17.5 dBi. Each radio is shipped from the factory with a standard 6' coaxial cable for connection between the radio and the antenna. The cable has a nominal loss of approximately 2.6 dB.

UNII radios are covered under CFR 47 FCC part 15, 15.407 Subpart E. 15.407.a.3 which states Ptransmit = 17 dBm + 10 log B where B is the -26 dB BW with a 6 dBi antenna. Above 6 dBi antenna gain there is a 1:1 reduction in Ptransmit to maintain the same Maximum EIRP. This is accomplished by the changes in output power setting for the alternative antennas.

The original FCC EIRP limit for the 5.7 GHz band with our transmitter bandwidth is +33 dBm. With the transmit power set to +12 dBm, the EIRP with the 6" Flat Panel antenna, and standard 6' coaxial cable will be:

12 dBm + 17.5 dBi - 2.6 dB = 26.9 dBm

The corresponding settings are included in Table 2.5.

***Table 2.5 - Maximum Transmit Power Level Setting vs. Antenna Type (for compliance with FCC EIRP limits) in the 5.7 GHz Band, Original and July 31, 1998 rules***

| Antenna Type | Manufacturer P/N | Maximum Transmit Power Setting (dBm) |
|---|---|---|
| 2' diameter dish with radome, Plane Polarized, 28.1 dBi | Gabriel SSP2-52ARI | 0 |
| 2' diameter dish with radome, Dual Polarized, 28.1 dBi | Gabriel SSD2-52ARI | 0 |
| 6" Flat Panel, Plane Polarized, 17.5 dBi | Gabriel DFPD.5-52 | +12 |
| 12" Flat Panel, Plane Polarized, 23 dBi | Gabriel DFPD1-52 | +8 |
| 24" Flat Panel, Plane Polarized, 27.5 dBi | Gabriel DFPD2-52 | +4 |

WL201922

The FCC will also allow higher EIRP for point to point links with higher gain antennas. Page 703 of the FCC document, CFR 47 FCC part 15, 15.407 Subpart E, FR 40836, July 31, 1998 has the provisions for these power limits. The path length is not increased, since the 5.3 GHz transmitter is not allowed the higher EIRP. **We recommend the higher power settings only when absolutely necessary.**

This rule states "fixed pt-pt U-NII devices operating in this band may employ transmitting antennas with directional gain up to 23 dBi without the corresponding reduction in transmitter peak output power or peak power spectral density." Also above 23 dBi antenna gain there is a 1:1 reduction in Pout to maintain the same Max EIRP.

We are in compliance even at the maximum antenna gain and transmitter power, since the corresponding output power is over +27 dBm in our BW and the resulting EIRP for a 6 dBi antenna is +33 dBm. This EIRP limit is further extended to +44 dBm by a +23 dBi antenna. Our EIRP with a 23 dBi antenna at maximum output power is 12 dBm + 23 dBi - 2.6 dB = +32.4 dBm. With the highest gain antenna and maximum output power the EIRP would be 12 dBm + 28.1 dBi - 2.6 dB = +37.5 dBm.

***Table 2.6 - Configuration Switch***

<table>
<tr><td>Switch</td><td colspan="6">Function</td></tr>
<tr><td rowspan="10">1,2, and 3</td><td colspan="6">Frequency and Channel Selection</td></tr>
<tr><td>Switch 1</td><td>Switch 2</td><td>Switch 3</td><td>Ch.</td><td colspan="2">Frequency Pair (GHz)</td></tr>
<tr><td>Off</td><td>Off</td><td>Off</td><td>1</td><td>5.26080</td><td>5.73568</td></tr>
<tr><td>Off</td><td>Off</td><td>On</td><td>2</td><td>5.27104</td><td>5.74592</td></tr>
<tr><td>Off</td><td>On</td><td>Off</td><td>3</td><td>5.28128</td><td>5.75616</td></tr>
<tr><td>Off</td><td>On</td><td>On</td><td>4</td><td>5.29152</td><td>5.76640</td></tr>
<tr><td>On</td><td>Off</td><td>Off</td><td>5</td><td>5.30176</td><td>5.77664</td></tr>
<tr><td>On</td><td>Off</td><td>On</td><td>6</td><td>5.31200</td><td>5.78688</td></tr>
<tr><td>On</td><td>On</td><td>Off</td><td>7</td><td>5.32224</td><td>5.79712</td></tr>
<tr><td>On</td><td>On</td><td>On</td><td>8</td><td>5.33248</td><td>5.80736</td></tr>
<tr><td rowspan="6">4 and 5</td><td colspan="6">Transmit Power Control</td></tr>
<tr><td>Switch 4</td><td>Switch5</td><td colspan="4">Tx Power at Antenna Port 5.3 GHz/5.7 GHz</td></tr>
<tr><td>Off</td><td>Off</td><td colspan="4">+12 dBm</td></tr>
<tr><td>Off</td><td>On</td><td colspan="4">+8 dBm</td></tr>
<tr><td>On</td><td>Off</td><td colspan="4">+4 dBm</td></tr>
<tr><td>On</td><td>On</td><td colspan="4">+0 dBm</td></tr>
<tr><td>6</td><td colspan="6">Ethernet Mode<br>Off = Half Duplex<br>On = Full Duplex</td></tr>
<tr><td>7</td><td colspan="6">IDU Disable<br>Off = ODU will be connected to IDU<br>On = ODU will <u>not</u> be connected to IDU<br>Note: In order to prevent potential damage to external equipment, it is imperative that switch 7 be set to the On position.</td></tr>
<tr><td>8</td><td colspan="6">Packet Filtering<br>Off = Packet Filtering enabled<br>On = Packet Filtering disabled</td></tr>
<tr><td>9 and 10</td><td colspan="6">Not used</td></tr>
</table>

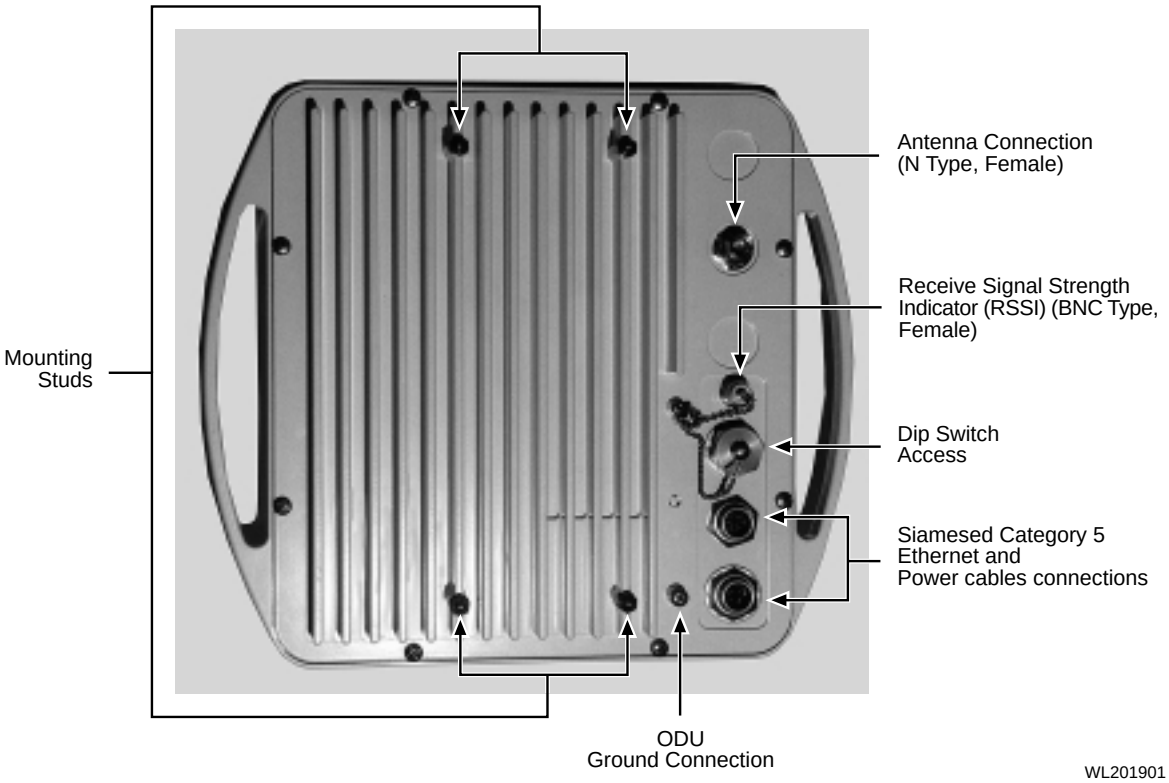
**Note:** Factory default DIP switch settings are shown in **bold** typeface.

WL197901

***Figure 2.2a - Outdoor Unit, Front View***


WL201906

***Figure 2.2b - Outdoor Unit, Back View***




WL201901

## 2.4 ODU Performance Monitoring

RSSI - A voltage provided through a BNC connector on the outside of the ODU. The RSSI port is used for antenna alignment during installation and for periodic measurement of Receiver/ Path performance. The RSSI voltage in proportion to the receive signal level ranges from -30 dBm to -90 dBm.

## 2.5 Theory of Operation

**General Overview**

The N2-X is a point to point Wireless Ethernet Extension operating in the 5.3/5.7 GHz UNII band as authorized in rule sections 15.401 through 15.407. The unit is enclosed in a weather proof outdoor enclosure and is intended to provide data links over distances up to 10 km. The radio in the unit operates full duplex, transmitting and receiving data at the rate of 8.192 Mbps. The radio is modulated using BPSK.

**Circuit Description**

The following circuit description is intended to explain the operation of the radio at the block diagram level. This text is written with the idea that the reader has the block diagram readily available, as it will aid in understanding the signal flow in the radio.

### 2.5.1 N2-X Ethernet Extender Transmitter

The input to the radio consists of 10 Mbps Ethernet packets that are routed to the Ethernet bridge chip. The bridge chip stores the data packets, and then converts them into a synchronous 8.192 Mbps data stream that is fed into the transmitter.

The data is differentially encoded and scrambled before it is routed through the transmit baseband filter to provide spectral shaping. The baseband filter is a five pole low pass filter. After amplification, the baseband signal is fed to the modulator consisting of a doubly balanced mixer. The modulator is running directly at the transmitter frequency of 5.775 GHz $\pm$ 50 MHz. The local oscillator signal of the mixer is supplied from the frequency synthesizer section, with the frequency dependant on the RF channel selected. Operation of the frequency synthesizer will be detailed later in this document.

From the output of the modulator, the signal is amplified and then passed through a 150 MHz wide bandpass filter to remove any local oscillator products from the output spectrum. After filtering, the signal is passed through a series of amplifier and attenuator stages that are used to control the output power level. With a combination of fixed and variable attenuation the output power can be set to one of four different levels to accommodate different antennas used with the product.

The power setting is maintained by an active ALC circuit that samples the transmitter output power and then adjusts the variable attenuator to keep the output power constant over the operating temperature of the unit. The power level is controlled to within +1/-2 dB of the set point.

Following the attenuators the signal is fed through additional amplification to bring the output level to a maximum of +14 dBm at the output of power amplifier. A lowpass matching section follows the power amplifier to aid in filtering harmonics of the signal. After passing through the duplexer, the power level at the antenna port is a maximum of +12 dBm.

### 2.5.2 N2-X Ethernet Extender Receiver

The receiver in the N2-X is a conventional dual conversion design with IF frequencies of 474.88 MHz and 70 MHz.

From the receive port of the duplexer, the low level input signal is passed through a low noise preamplifier that provides 25 dB of gain. Following the preamplifier the signal is passed through a 200 MHz wide bandpass filter to provide image rejection for the first mixer.

The signal is then mixed with the first LO to convert the signal to 474.88 MHz. Following further amplification the signal is passed through a five pole, 20 MHz wide bandpass filter. This filter provides image filtering for the second mixer, and also helps attenuate signals on the adjacent receive channels. After filtering, the signal is further amplified and then passed through a variable attenuator stage before it is applied to the second mixer.

The output of the second mixer is at 70 MHz. The 70 MHz IF stages provide additional gain along with two sections of variable attenuation for the AGC function. The primary adjacent channel filtering is also at 70 MHz where the signal is passed through a 12 MHz wide SAW filter. The combination of filters provide a minimum of 47 dB of attenuation at the adjacent receive channels (±10.24 MHz).

At the end of the 70 MHz IF chain the signal is fed into a quadrature demodulator. The carrier recovery loop consists of a four quadrant multiplier that multiplies I and Q baseband signals to create an error voltage. This error voltage is then amplified and fed back to the 70 MHz VCO. This forms a phase locked loop that is locked to the received carrier frequency.

The 70 MHz output is also fed into a wide band logarithmic amplifier that provides a DC voltage output proportional to the 70 MHz signal strength. The DC voltage is then integrated and fed back to the variable attenuator stages to form an AGC control loop. This control loop keeps the signal level at the input to the demodulator chip constant over the entire operating range of the receiver.

Data recovery from the I baseband signal begins by passing the I signal through a slicer. The output of the slicer is a digital signal that contains both data and clocking information. A clock recovery circuit recovers receive timing information that is needed to clock the data through the descrambler, and differential decoder.

The recovered data stream is then formatted into Ethernet packets and sent out the 10 base-T Ethernet connector.

### 2.5.3 Synthesizer

The FPGA provides four 22-bit streams in a serial format loaded to the synthesizer. This data provides all of the possible frequencies at which the system can operate. Depending upon the dip switch settings selected, the actual frequency being used is selected. When the reset button is pressed, the FPGA will reload this data to the synthesizer.

**Frequency Synthesis**

The local oscillator frequencies used in the N2-X are all synthesized from a 19.2 MHz, ± 2.5 PPM reference oscillator. The overall frequency stability of the radio is ± 2.5 PPM, directly reflecting the reference oscillator stability.

A dual frequency synthesizer chip is used to control both the first and second local oscillator loops. This chip supports one high frequency oscillator, up to 1.5 GHz, and one lower frequency oscillator to be used as a second LO.

The first local oscillator VCO operates at one half the transmitter output frequency, and changes with the transmit channel selected. The first LO consists of a bipolar VCO operating at 2.887 GHz ±25 MHz. The output of this VCO is buffered and then passed through a X2 prescaler chip before being fed back to the synthesizer chip. The phase comparison frequency for the first LO is 320 kHz.

After amplification the 2.887 GHz signal is passed through a frequency doubler to create the 5.775 GHz signal that is applied to the mixer stages.

The second local oscillator consists of a VCO that is phase locked to 404.88 MHz. This auxiliary synthesizer is operating with a phase comparison frequency of 240 kHz.

***This page left blank intentionally***

***Figure 2-3 Block Diagram (WL196901) goes here***

***Figure 2-3 Block Diagram (WL196901) goes here***

# 3.0 Equipment Installation and Commissioning

## 3.1 Installation

The N2-X Ethernet Extender has been specifically designed for ease of installation. The following installation instructions should be followed.

1. **Plan the installation** - Decide where each component of the N2-X Ethernet Extender will be placed prior to commencement of any installation activity. Installation considerations for each component in general are as follows:

   a. **Outdoor RF Unit** - Mount as close as practical to the Antenna assembly. The maximum distance is determined by the included interconnect cable which is 2 meters maximum in length. Determine pole mounting details for the Outdoor Unit and Antenna.

      Table 3.1 identifies the maximum transmit power level setting that can be used with each antenna while maintaining compliance with FCC EIRP regulations. Power levels are referenced to the antenna port of the radio and are average power levels indicating what would be measured using an average power meter. The FCC expresses limits as peak power numbers. To convert from the average power numbers to peak power numbers, add 1.8 dB to the average power numbers.

      If the product is being deployed in a country not governed by FCC regulations, the installer should select a transmit power level setting appropriate for the antenna that is deployed to maintain compliance with regulations employed by that country.

      Refer to Table 2.6 for Configuration Switch setting information.

   b. **Antenna Unit -** See Appendix B.

Per Table 3.1, in the 5.3 GHz band the highest power setting (approximately +12 dBm) can only be installed with the lowest gain antenna which is the 6” Flat Panel Polarized (DFPD.5-52) with 17.5 dBi. Each radio is shipped from the factory with a standard 6’ coaxial cable for connection between the radio and the antenna. The cable has a nominal loss of approximately 2.6 dB.

UNII radios are covered under CFR 47 FCC part 15, 15.407 Subpart E 15.407.a.2 which states Ptransmit = 11 dBm + 10 log B where B is the -26 dB BW with a 6 dBi antenna. Above 6 dBi antenna gain there is a 1:1 reduction in Ptransmit to maintain the same Maximum EIRP. This is accomplished by the changes in output power setting for the alternative antennas.

The FCC EIRP limit for the 5.3 GHz band with our transmitter bandwidth is +28 dBm. With the transmit power set to +12 dBm, the EIRP with the 6” Flat Panel antenna, and standard 6’ coaxial cable will be:

12 dBm + 17.5 dBi - 2.6 dB = 26.9 dBm

***Table 3.1 - Maximum Transmit Power Level Setting vs. Antenna Type (for compliance with FCC EIRP limits) in the 5.3 GHz Band***

| Antenna Type | Manufacturer P/N | Maximum Transmit Power Setting (dBm) |
|---|---|---|
| 2' diameter dish with radome, Plane Polarized, 28.1 dBi | Gabriel SSP2-52ARI | 0 |
| 2' diameter dish with radome, Dual Polarized, 28.1 dBi | Gabriel SSD2-52ARI | 0 |
| 6" Flat Panel, Plane Polarized, 17.5 dBi | Gabriel DFPD.5-52 | +12 |
| 12" Flat Panel, Plane Polarized, 23 dBi | Gabriel DFPD1-52 | +4 |
| 24" Flat Panel, Plane Polarized, 27.5 dBi | Gabriel DFPD2-52 | 0 |

WL201921

Per Table 3.2, in the 5.7 GHz band the highest power setting (approximately +12 dBm) can only be installed with the lowest gain antenna which is the 6" Flat Panel Polarized (DFPD.5-52) with 17.5 dBi. Each radio is shipped from the factory with a standard 6' coaxial cable for connection between the radio and the antenna. The cable has a nominal loss of approximately 2.6 dB.

UNII radios are covered under CFR 47 FCC part 15, 15.407 Subpart E 15.407.a.3 which states Ptransmit = 17 dBm + 10 log B where B is the -26 dB BW with a 6 dBi antenna. Above 6 dBi antenna gain there is a 1:1 reduction in Ptransmit to maintain the same Maximum EIRP. This is accomplished by the changes in output power setting for the alternative antennas.

The original FCC EIRP limit for the 5.7 GHz band with our transmitter bandwidth is +33 dBm. With the transmit power set to +12 dBm, the EIRP with the 6" Flat Panel antenna, and standard 6' coaxial cable will be:

12 dBm + 17.5 dBi - 2.6 dB = 26.9 dBm

The corresponding settings are included in Table 3.2.

***Table 3.2 - Maximum Transmit Power Level Setting vs. Antenna Type (for compliance with FCC EIRP limits) in the 5.7 GHz Band, Orignial and July 31, 1998 rules***

| Antenna Type | Manufacturer P/N | Maximum Transmit Power Setting (dBm) |
|---|---|---|
| 2' diameter dish with radome, Plane Polarized, 28.1 dBi | Gabriel SSP2-52ARI | 0 |
| 2' diameter dish with radome, Dual Polarized, 28.1 dBi | Gabriel SSD2-52ARI | 0 |
| 6" Flat Panel, Plane Polarized, 17.5 dBi | Gabriel DFPD.5-52 | +12 |
| 12" Flat Panel, Plane Polarized, 23 dBi | Gabriel DFPD1-52 | +8 |
| 24" Flat Panel, Plane Polarized, 27.5 dBi | Gabriel DFPD2-52 | +4 |

WL201922

The FCC will also allow higher EIRP for point to point links with higher gain antennas. Page 703 of the FCC document, CFR 47 FCC part 15, 15.407 Subpart E, FR 40836, July 31, 1998 has the provisions for these power limits. The path length is not increased, since the 5.3 GHz transmitter is not allowed the higher EIRP. **We recommend the higher power settings only when absolutely necessary.**

This rule states "fixed pt-pt U-NII devices operating in this band may employ transmitting antennas with directional gain up to 23 dBi without the corresponding reduction in transmitter peak output power or peak power spectral density". Also above 23 dBi antenna gain there is a 1:1 reduction in Pout to maintain the same Max EIRP.

We are in compliance even at the maximum antenna gain and transmitter power, since the corresponding output power is over +27 dBm in our BW and the resulting EIRP for a 6 dBi antenna is +33 dBm. This EIRP limit is further extended to +44 dBm by a +23 dBi antenna. Our EIRP with a 23 dBi antenna at maximum output power is 12 dBm + 23 dBi - 2.6 dB = +32.4 dBm. With the highest gain antenna and maximum output power the EIRP would be 12 dBm + 28.1 dBi - 2.6 dB = +37.5 dBm.

2. **Inventory your equipment and installation materials.**
   To install one (1) terminal you should have the items shown in Table 3.3.

3. **The following tools should be on hand:**

| Tool | Purpose |
|---|---|
| Wire Stripper/Cutter | General wire stripping and cutting purposes |
| Hand-Held Voltmeter (DMM) | Confirm magnitude, polarity, continuity with standard probes |
| 2 Adjustable Wrenches | Antenna mounting, Outdoor Unit up to 1.5 cm |
| #2 Phillips Screwdriver | Outdoor Unit Grounding |

***Table 3.3 - Inventory of Equipment and Installation Materials***

| Qty | Description |
|---|---|
| 1 | N2-X Ethernet Extender |
| 1 | Pole or Wall Mounted Bracket and associated fasteners |
| 1 | Siamesed Ethernet/Power Cable |
| 1 | N-Male to N-Male Coaxial Cable Assembly |

WL035956

## *3.2 Ethernet Data Connectors*

The Ethernet connections are made to the data side of the power/data cable assembly, normally it is supplied with an RJ45 connector.

## 3.3 Connect the Power Supply

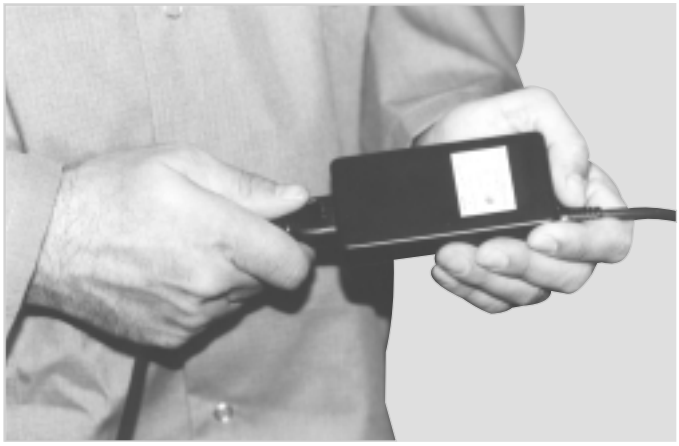
### 3.3.1 DC Power Supply

The white lead of the power side of the optional Data/Power cable connects to Pin 1, thus it should be connected to the negative lead of the power source. The red lead of the power side of the optional Data/Power cable connects to Pin 2, thus it should be connected to the positive lead of the power source.

### 3.3.2 Optional AC Power Supply

The AC-DC power supply is connected to an AC outlet by means of an IEC type power cord. Connect the power cord to the supply as shown in Figure 3.1. The output of the supply should be connected to the power side of the optional Data/Power cable using guidelines shown in Table 2.2.

***Figure 3.1- Power Cord Connection***



WL035907

## 3.4 Outdoor RF Unit Installation

### General

The outdoor unit is installed by means of a pole mount adaptor bracket (wall mount optional) that is secured to the pole using two metal hose type clamps. Figure 3.2 shows the hardware provided to mount the Outdoor RF Unit.

1. Install the outdoor unit pole mount adaptor bracket using the supplied metal hose type clamps. See Figure 3.3.
2. Align the four mounting studs on the outdoor unit with the bracket holes (See Figure 3.4) and secure to the bracket by pushing down the latches as shown in Figures 3.5a and 3.5b.
3. Connect the Siamesed Category 5 Ethernet/power cable, the N-type antenna and the ground connections as shown in Figures 3.6a and 3.6b.

***Figure 3.2 - Outdoor Unit Mounting Hardware***

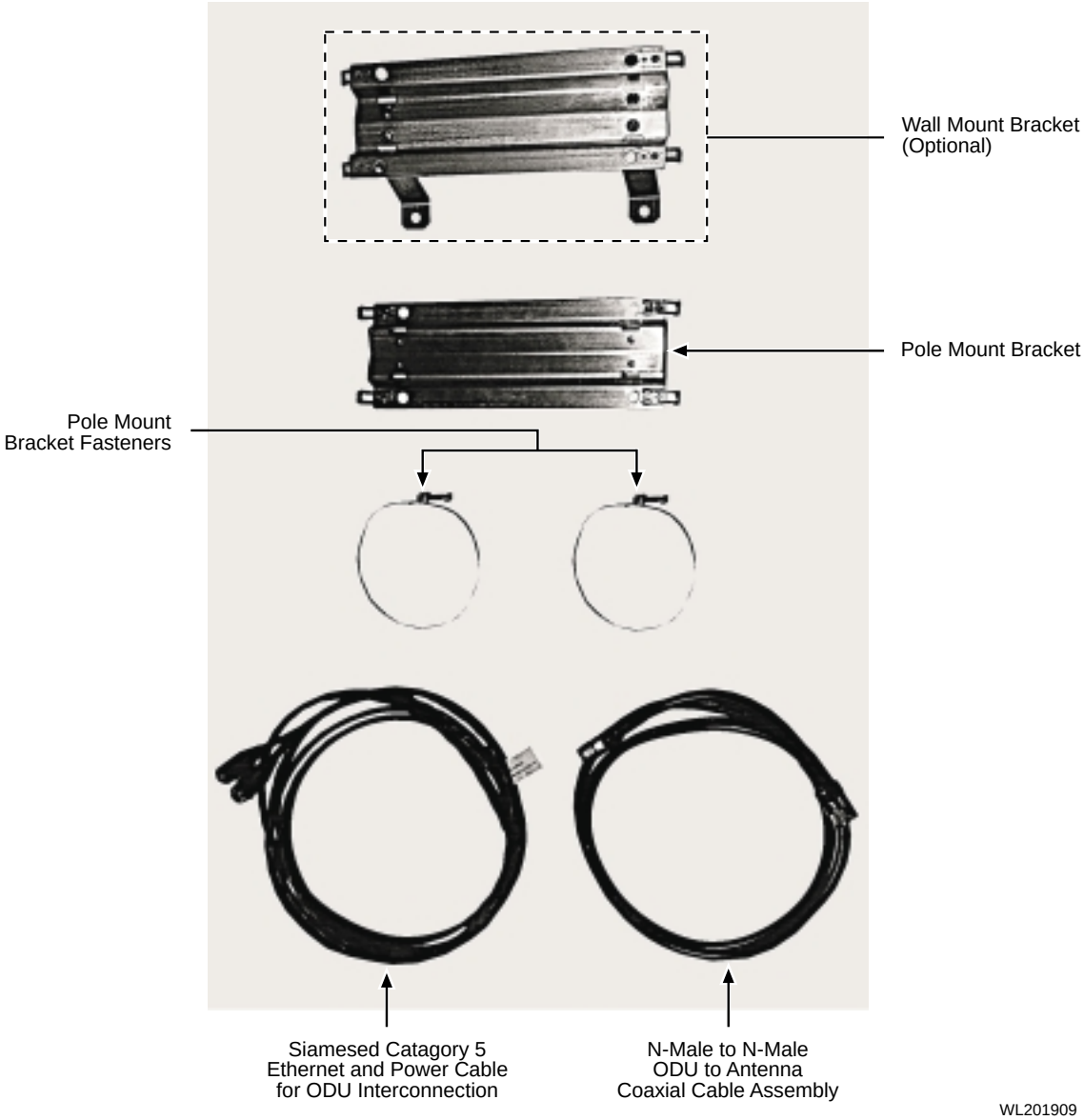


***Figure 3.3 - Attaching the Pole Mount Adaptor Bracket***

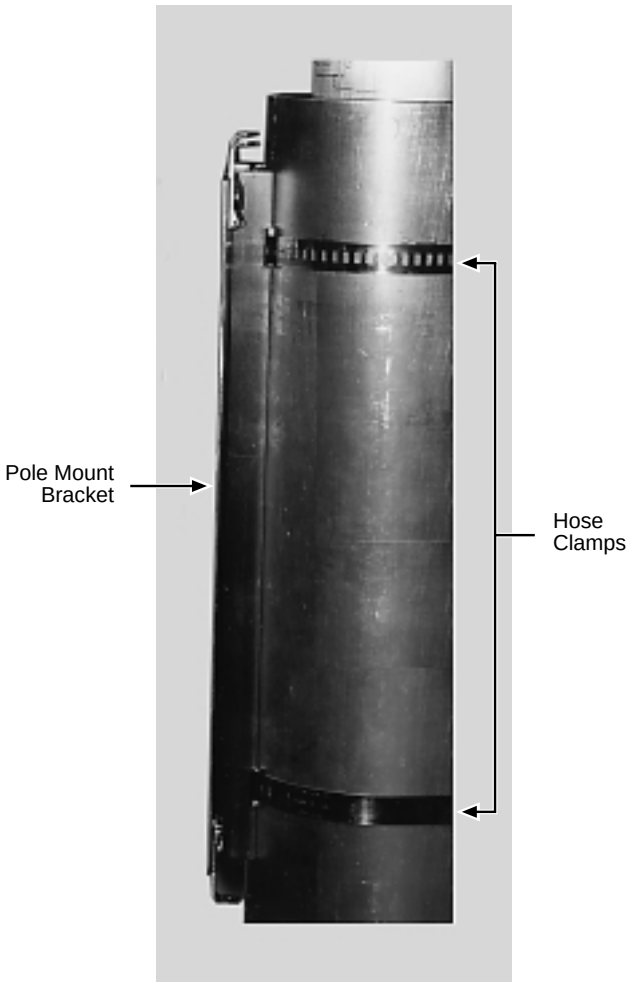


***Figure 3.4 - Mounting the Outdoor RF Unit to the Bracket***

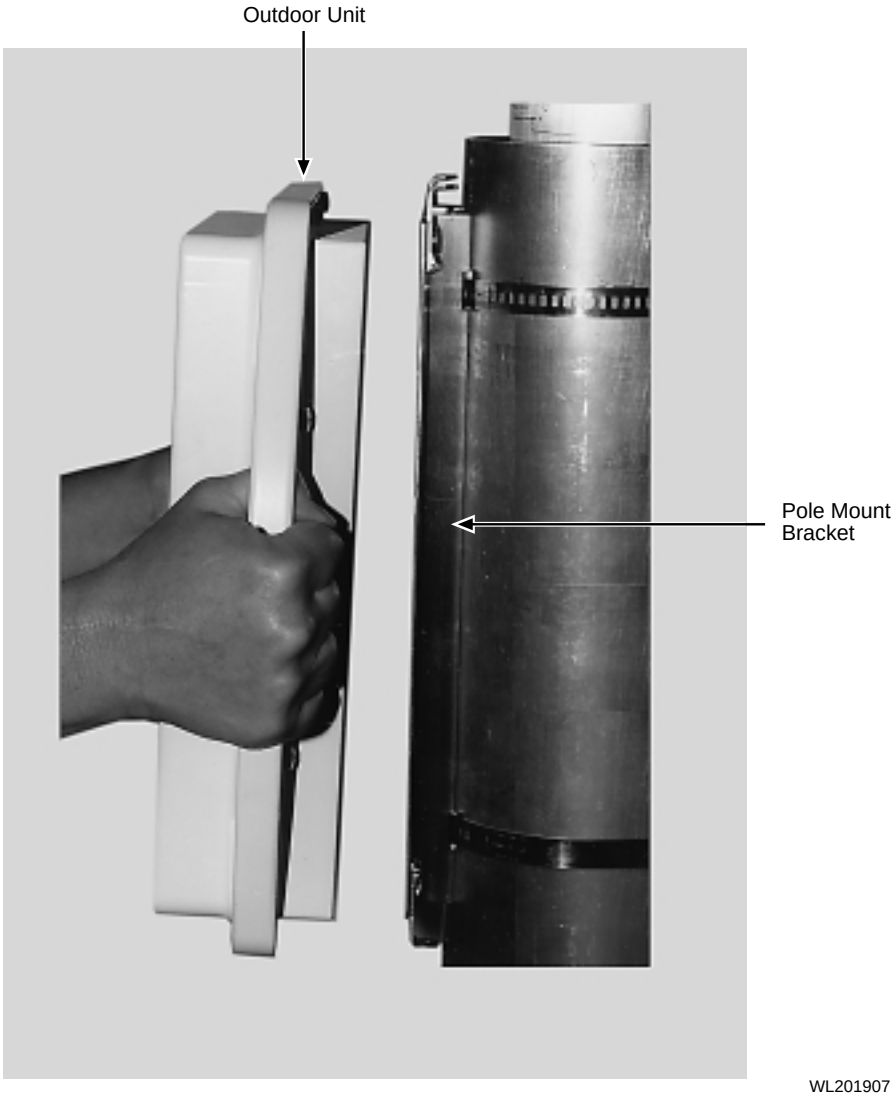


***Figure 3.5a - Mounting Bracket Latch and Stud Mount Detail***

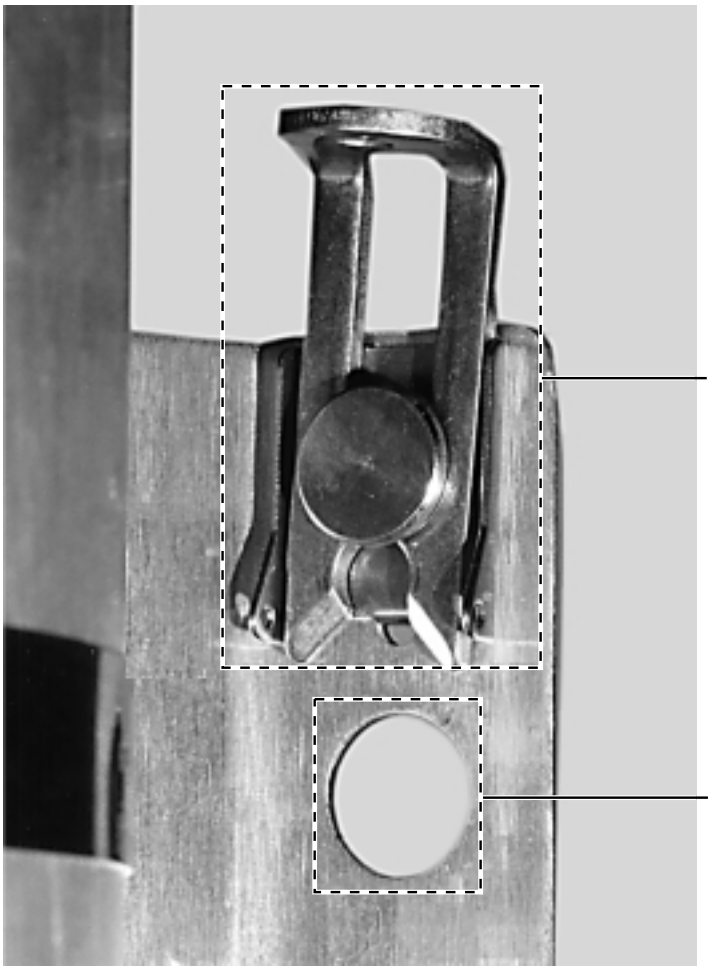


***Figure 3.5b - Locking the Mounting Hardware***

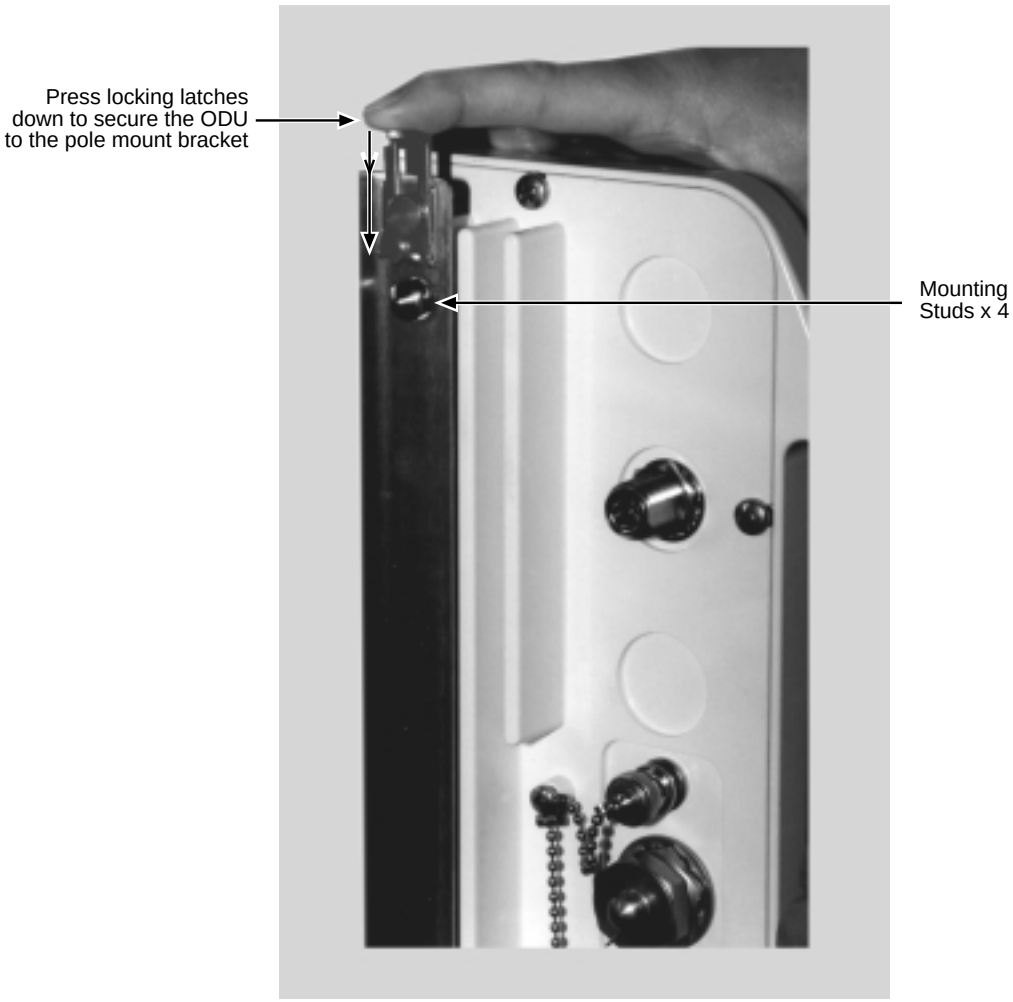


***Figure 3.6a - N-Type Antenna and Siamesed Ethernet/Power Connections***

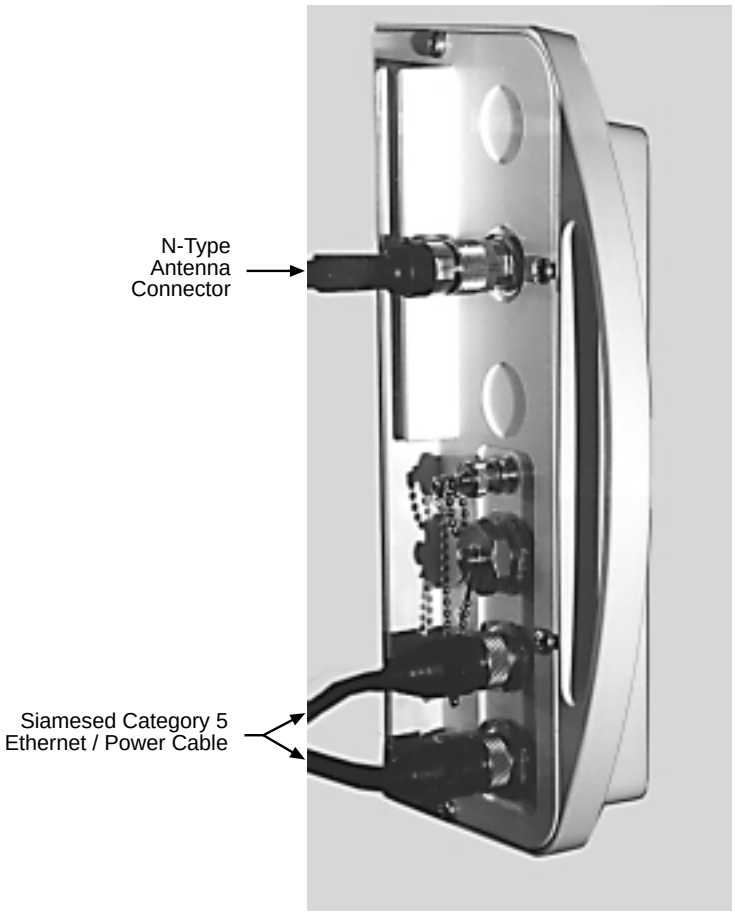


***Figure 3.6b - Ground Connection***


WL201902

## 3.5 Commissioning

1. Visually verify that the N2-X Ethernet Extender is properly mounted.
2. Verify that the DC power input to the N2-X Ethernet Extender is on.

Refer to Table 3.4.

### 3.5.1 Configuring N2-X Ethernet Extender System Antennas

The antennas used on an N2-X Ethernet Extender radio system are generally configurable for either vertical or horizontal polarization. It is extremely important to verify that both antennas are configured for the same polarization, and that the appropriate antenna polarization has been selected for the specific radio link.

***Table 3.4 - Installation Checklist***

| **Installation Checklist** | |
|---|---|
| Is the rack mounting hardware secure? | |
| Is the unit properly grounded? | |
| Is the antenna properly connected? | |
| Are the data connections in place and correct? | |

WL035915

### 3.5.2 Aligning the N2-X Ethernet Extender System Antennas

With the N2-X Ethernet Extender at each site properly configured for operation, antenna alignment must be performed at both sites. Proper antenna alignment is crucial to the proper operation of an N2-X Ethernet Extender radio system, and should only be accomplished by experienced professionals.

The N2-X Ethernet Extender is equipped with a ODU mounted BNC-(f) RSSI connector to which an analog or digital voltmeter can be connected. The voltage range at the test point, between the center conductor of the connector and ground, varies from approximately two VDC to four VDC, serving as a receive signal strength indicator (RSSI). The stronger the receive signal, the higher the RSSI voltage. Refer to Table 3.5.

***Table 3.5 - RSSI vs. Receive Signal Level***

| **Receive Signal Level (dBm)** | **-30** | **-40** | **-50** | **-60** | **-70** | **-80** | **-90** |
|---|---|---|---|---|---|---|---|
| RSSI (VDC) | 4.45 | 3.70 | 3.00 | 2.35 | 1.60 | 1.10 | 0.85 |

WL201923

Emanating from a microwave antenna is a main beam (or lobe) of RF energy, surrounded by RF side lobes. The beamwidth of the main beam varies with the size and type of antenna, as well as the specific frequency of the RF signal, and is generally defined by the nominal total width of the main beam at the half-power (-3 dB) points. Side lobes surround the main beam at specific angle distances, and will be lower in power than the main beam.

When aligning an antenna system, it is extremely important to verify that the antennas are both aligned on the main beam, not on a side lobe. Referencing Table 3.6, the first side lobe will generally be located at an angle slightly less than twice the antenna beamwidth.

Following the course alignment of an antenna system, a common practice when performing a fine alignment is to slowly swing each antenna (one at a time!) in both vertical (elevation) and horizontal (azimuth) planes to verify that the main beam and first side lobe can be accurately identified. This insures that accurate alignment of the antenna system on the main beam has been accomplished.

Each N2-X Ethernet Extender is shipped with an RSSI test sheet, showing the relationship between the receive signal strength level (in dBm) and the RSSI level (in VDC). These RSSI test sheets are often referred to as AGC Curves. The RSSI test sheets can be used to verify that the calculated receive signal levels match up with the actual receive signal levels. Substantial differences between calculated and actual levels could point to transmission system problems, side lobe alignment, path obstructions, etc.

***Table 3.6 - Approximation Table***

| Antenna Diameter and Style | Gain (dBi) | 3 dB Beamwidth (degrees) |
|---|---|---|
| 2-foot parabolic | 28.1 | 6.1 |
| 4-foot parabolic | 30.2 | 3.1 |
| 6-foot flat panel | 17.5 | 19.0 |
| 12-foot flat panel | 23 | 9.4 |
| 24-foot flat panel | 27.5 | 4.7 |

WL035916

# 4.0 Maintenance and Troubleshooting

The N2-X Ethernet Extender contains static sensitive components, and has no user-serviceable parts.

## 4.1 N2-X Ethernet Extender Maintenance

The N2-X Ethernet Extender is designed to operate with no scheduled maintenance activities. From a precautionary perspective, a regular check of power supply input voltages and RSSI voltages should be planned by the user.

### 4.1.1 RSSI Voltage

The Wireless Customer Service department recommends a monthly check of the N2-X Ethernet Extender's RSSI voltage. Variations in the RSSI voltage could be an indicator of antenna or antenna feed movement, loose or improper RF cabling or connectorization, path obstructions or reflections, etc.

## 4.2 Identifying and Resolving Receive Signal Strength Issues

There are a great number of items which can affect the transmission of a microwave signal from one site to another. Every microwave path is unique, and must be evaluated for performance before a radio link is installed.

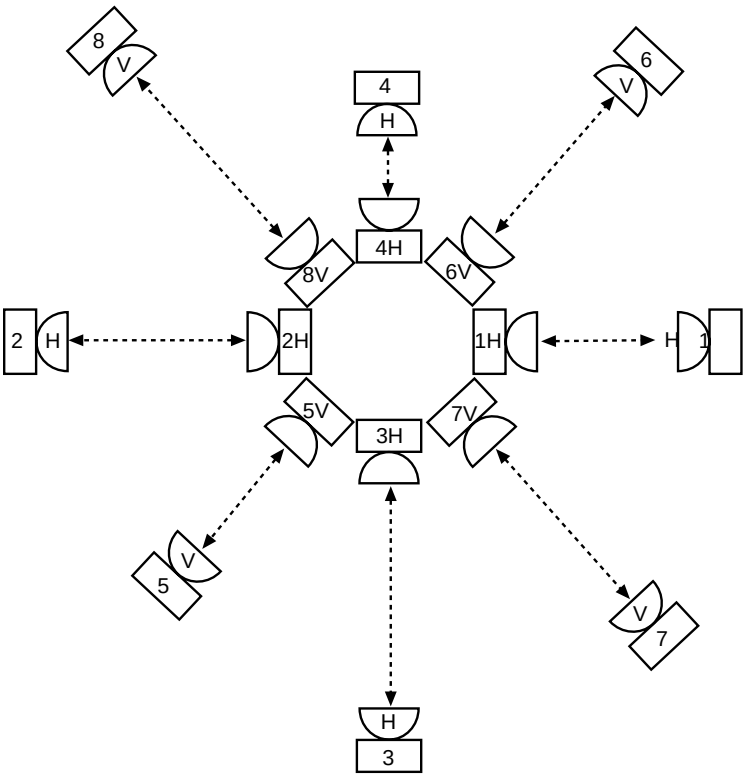
Outside of radio equipment issues, antenna alignment, RF signal blockage, and multipath fading are among the most common transmission problems experienced in the field.

### 4.2.1 N2-X Ethernet Extender Equipment Issues

*Frequency Selection*

1. Verify the transmit/receive frequency selection for each N2-X Ethernet Extender radio is set appropriately, and that a “matched pair” of radios has been selected for the system. Each N2-X Ethernet Extender terminal can be set to the frequencies listed in Table 4.1.
2. To reduce the possibility of co -adjacent channel interference, proper frequency coordination and antenna polarization is used to isolate each channel. The concept is to achieve maximum RF isolation between link channels by means of frequency spacing and antenna polarization. In a “star” configuration an optimum frequency and antenna polarization plan is provided to demonstrate an example of maximum isolation between links (See Figure 4.1).

***Figure 4.1 - Frequency Selection for the N2-X Ethernet Extender Radio***




H = Horizontal Antenna Polarization
V = Vertical Antenna Polarization

WL035917

***Table 4.1 - Frequencies***

| Channel No. | Frequency |
|---|---|
| 1 | 5.2608 |
| 1' | 5.733568 |
| 2 | 5.27104 |
| 2' | 5.74592 |
| 3 | 5.28128 |
| 3' | 5.75616 |
| 4 | 5.29152 |
| 4' | 5.7664 |
| 5 | 5.30176 |
| 5' | 5.77664 |
| 6 | 5.31200 |
| 6' | 5.78688 |
| 7 | 5.32224 |
| 7' | 5.79712 |
| 8 | 5.33248 |
| 8' | 5.80736 |

WL035918

## 4.3 Dip Switch Function and Configuration

Refer to Table 4.2 below. Switches 1, 2 and 3 control Frequency and Channel selection. Switches 4 and 5 are used for Transmit Power control. Switch 6 selects Ethernet Mode and switch 8 controls Packet Filtering. Switches 9 and 10 are not used. Also refer to Figure 4.2 for dip switch location information.

**Note:** Primary power must be cycled off, then on, for changes in DIP switch settings to take affect.

***Table 4.2 - Dip Switch Configuration***

| Switch | Function | | | | | |
|---|---|---|---|---|---|---|
| 1,2, and 3 | Frequency and Channel Selection | | | | | |
| | Switch 1 | Switch 2 | Switch 3 | Ch. | Frequency Pair (GHz) | |
| | **Off** | **Off** | **Off** | **1** | **5.26080** | **5.73568** |
| | Off | Off | On | 2 | 5.27104 | 5.74592 |
| | Off | On | Off | 3 | 5.28128 | 5.75616 |
| | Off | On | On | 4 | 5.29152 | 5.76640 |
| | On | Off | Off | 5 | 5.30176 | 5.77664 |
| | On | Off | On | 6 | 5.31200 | 5.78688 |
| | On | On | Off | 7 | 5.32224 | 5.79712 |
| | On | On | On | 8 | 5.33248 | 5.80736 |
| 4 and 5 | Transmit Power Control | | | | | |
| | Switch 4 | Switch5 | Tx Power at Antenna Port 5.3 GHz/5.7 GHz | | | |
| | Off | Off | +12 dBm | | | |
| | Off | On | +8 dBm | | | |
| | On | Off | +4 dBm | | | |
| | **On** | **On** | **+0 dBm** | | | |
| 6 | Ethernet Mode<br>Off = Half Duplex<br>**On = Full Duplex** | | | | | |
| 7 | IDU Disable<br>Off = ODU will be connected to IDU<br>**On = ODU will <u>not</u> be connected to IDU**<br>**Note:** In order to prevent potential damage to external equipment, it is imperative that switch 7 be set to the **On** position. | | | | | |
| 8 | Packet Filtering<br>**Off = Packet Filtering enabled**<br>On = Packet Filtering disabled | | | | | |
| 9 and 10 | Not used | | | | | |

**Note:** Factory default DIP switch settings are shown in **bold** typeface.

WL197901

***Figure 4.2 - Dip Switch Access and Configuration Information***


WL201908

## 4.4 Where To Get Further Assistance

Your primary source of assistance is the support staff of the organization from which you purchased this product. The Wireless, Inc. support staff should only be contacted directly if you purchased this product directly from Wireless, Inc., or if you are unable to obtain sufficient assistance from your primary support contact.

*General Product and Company Information*

Wireless, Inc.
5452 Betsy Ross Drive
Santa Clara, CA 95454-1101
USA
Tel.: +408 727 8383
Fax: +408 727 1259
E-mail: info@wire-less-inc.com
Website: www.wire-less-inc.com

*Detailed Product Information, Sales/Pricing Information and Pre-Sales Technical Support*

Wireless, Inc.
Sales Department
5452 Betsy Ross Drive
Santa Clara, CA 95054-1101
USA
Tel: +408 727 8383
Fax: +408 727 0990
E-mail: sales@wire-less-inc.com
Website: www.wire-less-inc.com

*Post-Sales Technical Support (Customer Service)*

To assist you with field issues and, if necessary, to arrange for repair services, Wireless, Inc.'s Customer Service department can be reached via telephone, facsimile, e-mail, mail, or through our Website.

## 4.5 Return Procedure

All material returned to Wireless, Inc. must be accompanied by a Return Material Authorization (RMA) number from Wireless, Inc.'s Customer Service department. If you purchased your Wireless, Inc. product through a distributor, the Wireless RMA number should be obtained through the distributor. An RMA number is necessary to assure proper tracking and handling of returned material at the factory. Wireless, Inc. reserves the right to refuse shipments not accompanied by an RMA number. Refused shipments will be returned to the shipper via collect freight.

To obtain an RMA number, contact Wireless, Inc. as follows:

Telephone: +408 727 8383
Fax: +408 727 1259
E-mail: customerservice@wire-less-inc.com

The following information will be required to issue an RMA number:

- Part Number
- Serial Number
- Failure Description
- Contact person, telephone, and fax numbers
- Ship-to address
- Bill-to address*
- Customer purchase order* (P.O.) or reference number

* Required for non-warranty repair services. For non-warranty repair services, an RMA number will be issued when Wireless, Inc. acknowledges the purchase order.

Important - All non-U.S. returns must include 5 copies of proforma/customs invoice for each shipment which lists:

- RMA number
- Value of items
- Description of items (including the Wireless model or part number)

Please send all returns to:

Wireless, Inc.
Attn: RMA Department
5452 Betsy Ross Drive
Santa Clara, CA 95054-1101
USA
RMA No. _____

The customer is responsible to properly label and package repairs and prepay shipping to Wireless, Inc. If possible, the original packaging material should be used to return electronic parts. The RMA number must be visible on the outside of all packages returned. Unless other arrangements have been made, all repairs are shipped back to the customer prepaid via ground carrier.

# Appendix A Grounding Practices and Lightning Protection Information

## General

Good grounding ("earthing") practices, when used in telecommunications, have some direct benefits which can help you maximize the up time of your system as well as ensure the safety of those people working on the system. Among these benefits are:

1. Protection of personnel from electric shock and fire hazards.
2. Reduction of radiated and conducted electromagnetic susceptibility.
3. Improved system tolerance to discharge of electrostatic energy and lightning interference.
4. Minimized service interruptions and service damage.

There is no practice or formula which can completely eliminate the above risks, but we at Wireless, Inc. believe that good grounding and bonding practices can significantly reduce the risk of many of these hazards. We have included a bibliography at the end of this appendix which contains several publications that are readily available and contain detailed information on many aspects of grounding systems and their design, implementation, measurement, and maintenance.

Please note that every telecommunication site is unique, and must be evaluated accordingly. The following information is provided for generic reference and educational purposes only. The grounding plans and practices for a given site should only be established and accomplished by trained professionals, working in accordance with local practices and regulations.

## Ground Connections

There should be a grounding plan designed at the outset of site design in order to provide the best grounding procedures and to minimize ground loop currents. This should be achieved by connecting the outer conductors of the cables through a large section copper strap to a central grounding point and the size of the conductor should be increased as each branch path is added. The final conductor should be connected directly to the grounding system. For a radio site a single copper grounding rod is insufficient because its impedance is likely to be too high.

## Lightning Protection

Radio sites can be particularly prone to lightning strikes by virtue of their normally exposed locations and the presence of relatively tall antenna support structures.

It is not possible to provide and guarantee complete protection from the effects of lightning; however, they can be significantly reduced by careful attention to grounding, protection devices, and the layout of the site itself.

Reference should also be made to various publications, some of which are listed in the Bibliography. Where any site owner or user is in doubt about the protection requirements for any particular location, the appropriate authority should be consulted.

## Protection Arrangements

The purpose of any protection arrangement should be to provide a suitable path to ground for the lightning current, to ensure adequate bonding between structures and all metalwork on the site and the common grounding system in order to reduce the side flashing, and to attempt to prevent the entry of flashes or surges into the building.

The resistance to ground should be kept to a minimum and a value of less than 10-ohms is recommended. The most important feature is that the system should ideally be at equal potential across the entire site.

Certain authorities and service providers have their own particular practices which have to be followed where applicable.

Arrangements will vary considerably from very simple sites to complicated sites with multiple buildings, antenna support structures and associated equipment, and may involve integration with existing systems. Such systems may require upgrading.

## Lightning conductors

Down conductors, bonding interconnections, ground rings and radial tapes should be of uninsulated 000 AWG copper cable or solid copper tape with a minimum cross section of 25 x 3 mm with all connections protected by non reactive paste.

Protected test points should be included if appropriate, and sacrificial ground lugs should be clearly marked and easily accessible for periodic inspection.

## Grounding of antenna support structures

A structure will generally act as its own lightning conductor and therefore will not require an additional conductor from the top to the base. A lightning rod may be required to extend the zone of protection to protect equipment mounted on the top of the structure. The lightning rod should extend 2.5-meters above the highest equipment.

Ground mounted support structures should be connected at their base to a ground ring via sacrificial ground lugs. Towers should have a connection from each leg.

A ground ring should consist of copper cable or solid copper tape with ground rods equally spaced at 2-meter intervals around the base of the structure as close to it as possible, buried approximately 0.6-meters deep where soil conditions allow. An alternative method using radials rather than rings is detailed in “The ‘Grounds’ for Lightning and EMP Protection”, second edition, published by PolyPhaser Corporation.

The ground ring should be connected to the main building ground by the most direct route, buried as appropriate.

Roof mounted structures should be connected to the main building ground by the most direct route using sacrificial lugs and copper cable or tape as appropriate. Tower guy wires should be directly bonded at their lowest point to a suitable ground electrode or connected to the site ground by the most direct route.

## Grounding of feeders

All antenna feeders should be bonded to the tower at the upper and lower ends and grounded at the point of entry into the building. Weatherproof grounding kits are available from antenna manufacturers.

**Note:** Many of the cables used by Wireless, Inc. have braided rather than solid outer conductors; this type of grounding is not appropriate. In these cases we recommend the use of Wireless, Inc. approved lightning arrestors. For information on lightning arrestors, please contact Wireless, Inc.'s Customer Service department.

## Grounding of buildings

A ground ring ideally should surround the building and be connected to individual grounds associated with feeder entry, antenna support structure, building lightning conductor, equipment room, main AC supply and other facilities. Each connection should be made by the most direct route in order to minimize interaction between the different grounding functions.

The ground ring should consist of copper cable or tape with electrodes 2- meters or greater in length, buried to a depth of 0.6-meters and at a distance from the building not to exceed 1-meter.

Buildings may require lightning rods where they are not within the zone of another protected structure.

## BIBLIOGRAPHY


| | |
|---|---|
| ITU - T K.40 | Protection against LEMP in telecommunications centres |
| ITU - T K.27 | Bonding configurations and earthing inside a telecommunication building |
| ITU - T K.35 | Bonding configurations and earthing at remote electronic sites |
| ITU - T K.39 | Risk assessment of damages to telecommunications sites due to lightning discharges |
| ITU - T Lightning Handbook | The protection of telecommunication lines and equipment against lightning discharges |

IEEE Emerald Book - Powering and Grounding

The "Grounds" for Lightning and EMP Protection, second edition
Published by PolyPhaser Corporation

# Appendix B Installation Instructions

Read the instructions completely before assembling or installing the antenna. This installation can be dangerous and requires qualified personnel familiar with microwave assembly and installation.

## Site Planning

1. For antenna mounting and planning dimensions, see Figure B.1 and Table B.1.
2. The antenna is normally assembled with an elevation adjustment range of +50 degrees to -5 degrees. By inverting the mount, it can be assembled with a +5 degree to -50 degree range. In either configuration, the antenna centerline can be offset right or left, relative to the vertical mast pipe (See Figure B.2) by inverting the Horizontal Tube Assembly.

***Figure B.1 - Two Foot Diameter Antenna***

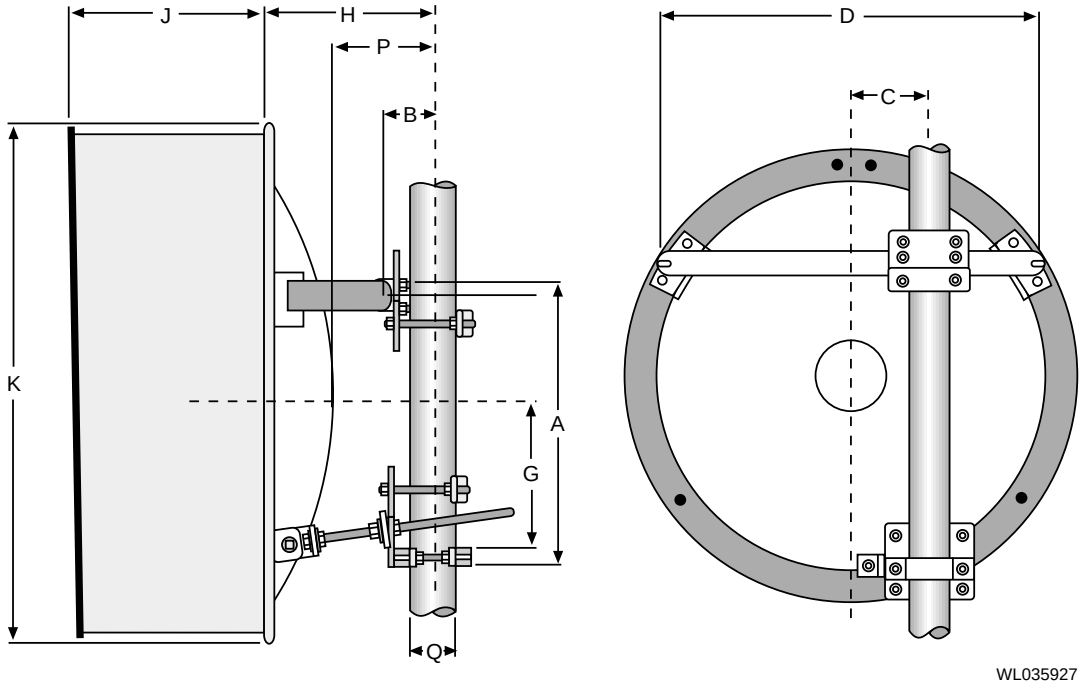
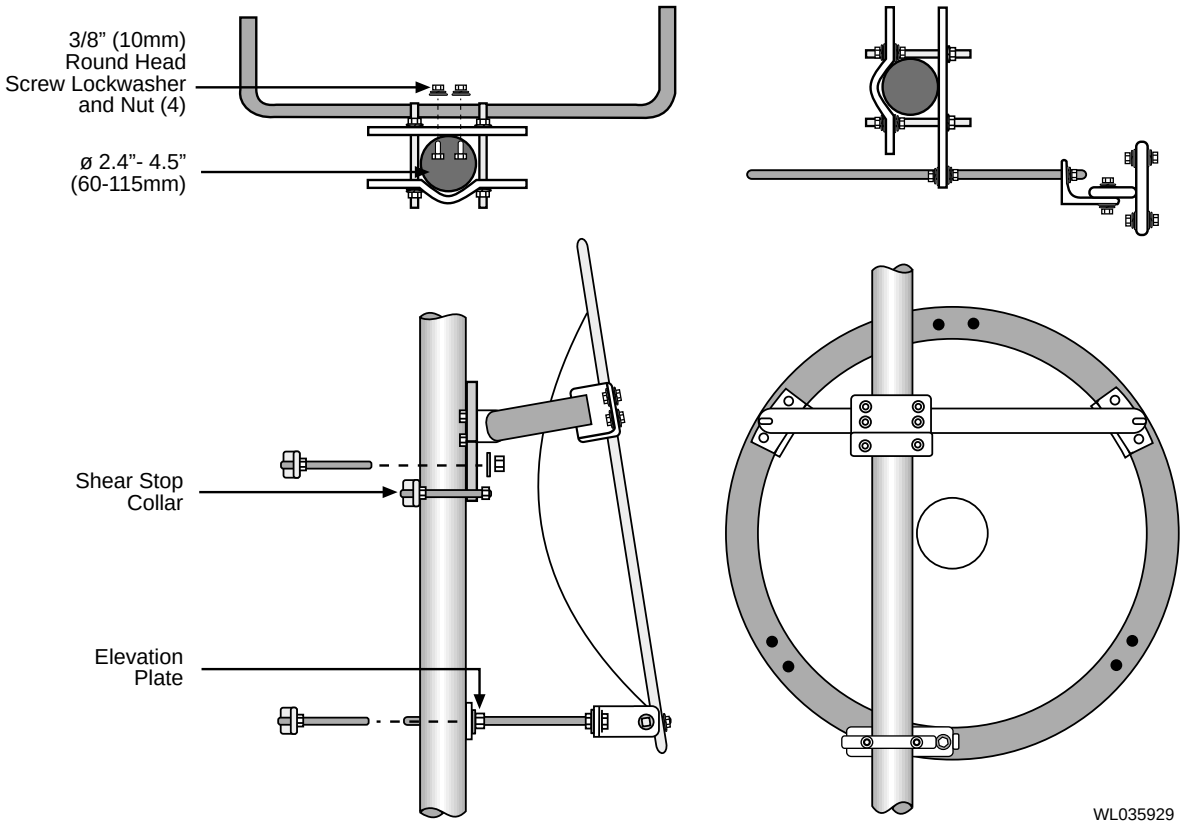


***Table B.1 - Two Foot Diameter Antenna Dimensions***

| Dimension | Description | 2ft. (0.6mm) Antenna | 2.5ft. (0.8mm) Antenna |
|---|---|---|---|
| A | Mount Length | 22.4" (570mm) | 27.9" (710mm) |
| B | Pivot Point | 4.2" (105mm) | 4.2" (105mm) |
| C | Center Line Offset | 5.0" (125mm) | 5.0" (125mm) |
| D | Horizontal Mount Strut | N/A | N/A |
| E | Pvt. Pt. Vertical Mount Strut | 8.8" (175mm) | 8.3" (210mm) |
| F | Horizontal Fixed Side Strut | N/A | N/A |
| G | Antenna Centerline | 13.6" (345mm) | 16.8" (425mm) |
| H | Reflector Length | 12.3" (315mm) | 14.3" (360mm) |
| J | Short Shroud Length | 12.5" (320mm) | 14.3" (360mm) |
| | Long Shroud Length | 15.1" (385mm) | 15.8" (350mm) |
| K | Antenna Diameter | 29.0" (735mm) | 35" (890mm) |
| L | Radome Length (Standard) | 13.4" (340mm) | 16.8" (425mm) |
| N | Mount Strut Depth | N/A | N/A |
| P | Reflector Vertex | 7.6" (190mm) | 8.7" (220mm) |
| Q | Mast Diameter | 2.4" 4.5" (60-115mm) | 2.4" 4.5" (60-115mm) |
| | Azimuth Adjustable Range | +/- 5° | +/- 5° |
| | Elevation Adjustment Ranges | +50° /-5° | +50° /-5° |

WL035928

***Figure B.2 - Mount Configuration***



*Unpacking and Preparation*

1. Carefully unpack the reflector, mount, shroud (if any), radome (if any) and feed from the crate. For correct antenna performance, handle all components with care. Set aside the packaged feed and any shroud or radome. See Figures B.3 through B.6.

**Caution:** The reflector spinning has been formed to a very close-toleranced parabolic shape. Careful handling and assembly is required to avoid denting or deforming the reflector, which would degrade the antenna's performance.

2. Inspect for any damaged parts. See Tables B.2a-B.2d for an inventory of the parts and hardware shipped with the antenna.

*Shroud Attachment*

Attach the shroud assembly that is provided with high-performance antennas to the reflector. The installation procedure is covered by another instruction sheet supplied with the shroud.

**Note:** Some models have the shroud factory installed.

***Table B.2a - Contents List, Reflector Assembly***

| Part Number | Description | Qty. | Check |
|---|---|---|---|
| 23832-3 | Refl. Assy. SE 2' Open-2A | 1 | |

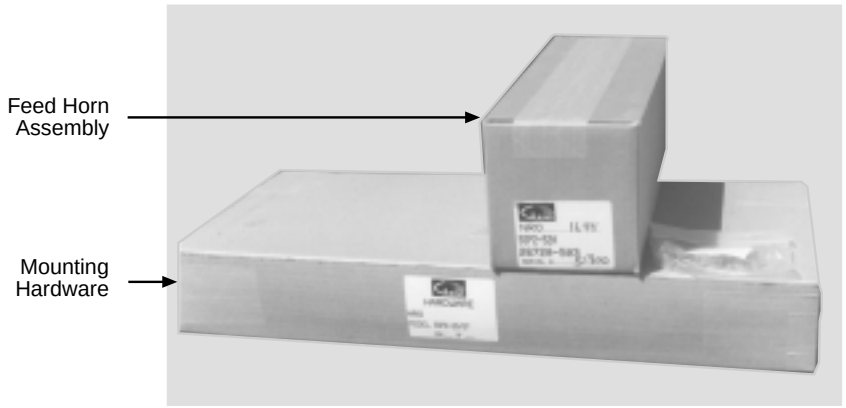
WL035930

***Table B.2b - Contents List, Feed Assembly***

| Part Number | Description | Qty. |
|---|---|---|
| 25736-1 | Feed Mounting Clamp | 4 |
| 26716-503 | Feed S/A 5.250-5.850 | 1 |
| AD T5170 | RR Track Butyl 3/16x7//8x40'DSS170 | 1 |
| FW X0050 | Washer 1/4" W 0.734x.065 | 4 |
| II-221 | Installation Instructions | 1 |
| NU X0060 | Hex Nut | 4 |
| SW X0050 | Split Washer | 4 |

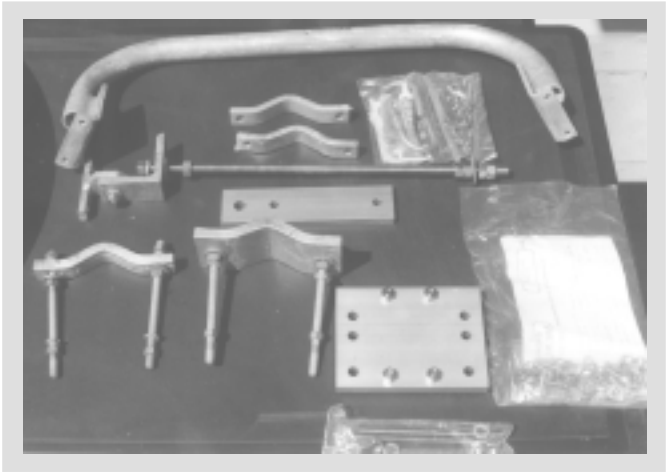
WL035931

***Figure B.3 - Mounting Hardware Packed***




WL035932

***Figure B.4 - Mounting Hardware Unpacked***



WL035933

***Table B.2c - Contents List, Mount Assembly***

| Part Number | Description | Qty |
|---|---|---|
| **25675-501** | **Horizontal Pipe Assembly** | 1 |
| **25725-505** | **Mast Clamping Assembly** | 1 |
| 22316-2 | Threaded Rod Galv | 2 |
| 24525-5 | Mast Clamp Half 1" | 1 |
| FW G0120 | Washer Galv | 2 |
| NU G0121 | Washer Galv | 6 |
| SW G0090 | Split Washer Galv | 4 |
| **23725-509** | **Mast Clamping Assy** | 1 |
| 22316-2 | Threaded Rod Galv | 2 |
| 24525-8 | Mast Clamp Half | 1 |
| FW G0120 | Washer Galv | 2 |
| NU G0120 | Hex Nut | 6 |
| SW G0090 | Split Washer Galv | 4 |
| **25727-504** | **Shear Stop Assy** | 1 |
| 23285-3 | Threaded Rod | 2 |
| 24525-2 | AZ Clamp Half-Short | 2 |
| NU X0130 | Hex Nut | 6 |
| SW G0090 | Split Washer Galv | 4 |
| **25730-503** | **Elevation Rod Assy** | 1 |
| 23611-6 | Elevation Rod | 1 |
| 23842-501 | Elevation Rod Brkt Assy | 1 |
| 25666-1 | Elevation Support Angle | 1 |
| BO G0080 | Hex Bolt Galv | 1 |
| FW G0120 | Washer Galv | 1 |
| FW G0140 | Washer Galv | 1 |
| NU G0120 | Hex Nut Galv | 1 |
| NU X0195 | Hex Nut SS | 4 |
| SW G0090 | Split Washer Galv | 1 |
| SW G0100 | Split Washer Galv | 1 |

WL035934

***Table B.2d - Contents List, Mount Assembly***

| Part Number | Description | Qty. |
|---|---|---|
| **25733-501** | Mount Hardware Kit | 1 |
| 10749-54 | U-Bolt Galv. | 2 |
| 23561-2 | Spacer | 2 |
| AD M0005 | Anti-Seize 1 oz. Tube | 1 |
| BO X0921 | Hex Bolt | 6 |
| FW G0120 | Washer | 4 |
| FW X00050 | Washer | 12 |
| NU G0120 | Hex Nut Galv. | 4 |
| NU X0060 | Hex Nut Galv. | 6 |
| PN G0090 | Palnut | 4 |
| SW X0050 | Split Washer Galv. | 6 |
| **26590-1** | Elevation Plate | 1 |
| **26591-1** | Azimuth Plate | 1 |
| **BO X1186** | RND HD Screw | 4 |
| **NU X0130** | Hex Nut | 4 |
| **SW X0080** | Split Washer | 4 |
| **II-232** | Installation Instructions | 1 |

WL035935

***Figure B.5 - Parabolic Reflector***


WL035936

***Figure B.6 - Unpacking the Radome***

WL035937

*Mount Assembly and Attachment*

1. The reflector should be placed face down, either on the shroud or blocked up on packing lumber. Locate the Top and Bottom markings stenciled onto the back of the reflector.
2. Loosely attach Top Support Angles to the Horizontal Tube Assembly as shown in Figure B.7 and B.8.
3. For desired mount configuration (refer to Figure B.2), attach the Vertical Tube Assembly to the Horizontal Tube Assembly as shown in Figure B.7 and B.8.
4. Verify proper assembly of the elevation rod hardware as shown in Figure B.9. Remove outer hardware and insert rod through elevation plate.

**Important**: For elevation angles grater than ±20°, Beveled Washers, shown in Figure B.9, must be used. However, beveled washers may be used for elevation angles greater than ±10°.

5. Carefully place mount assembly onto antenna backring, taking care not to damage the reflector. Loosely fasten the Top Support Angles and the Elevation Support Angle to the antenna backring using 1/2" hardware as shown in Figure B.7.
6. Verify alignment of the Vertical Assembly with the vertical axis of the reflector and secure the Top Support Angles and the Elevation Support Angle to the ring.

***Figure B.7 - Antenna Mount Assembly***

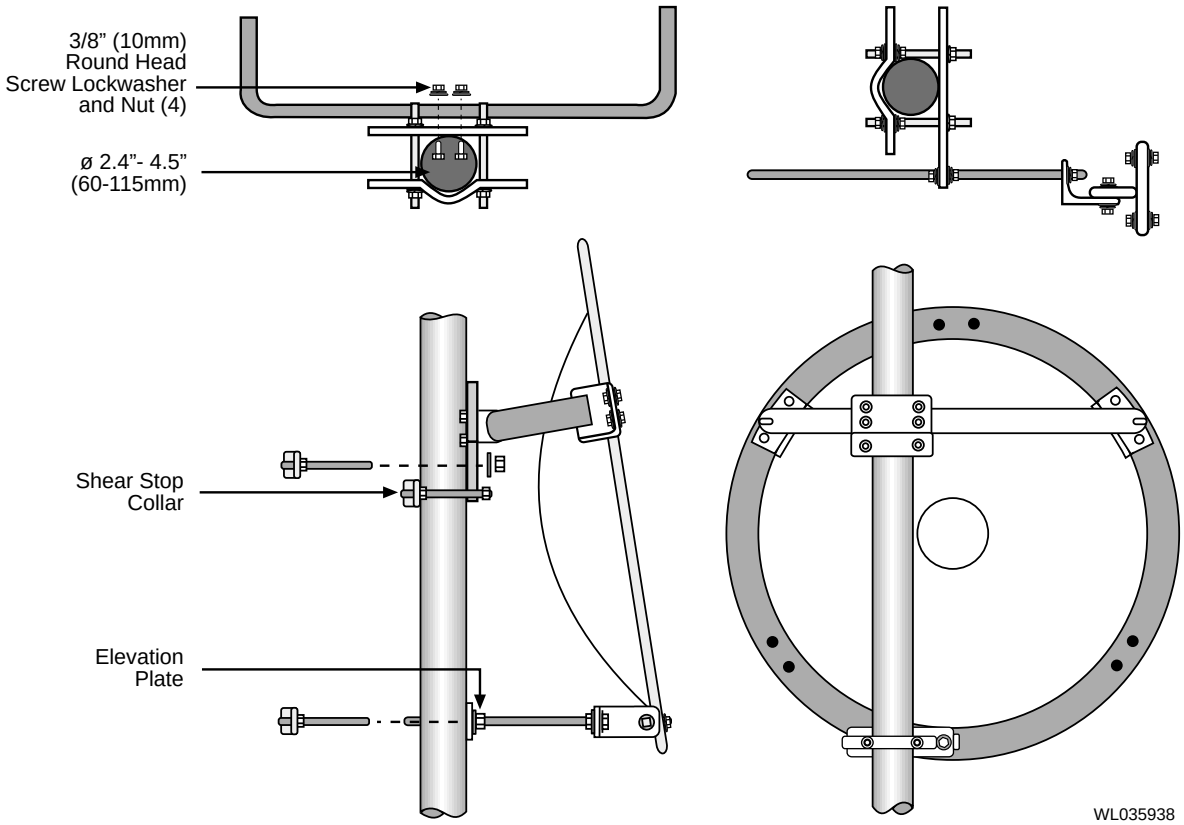
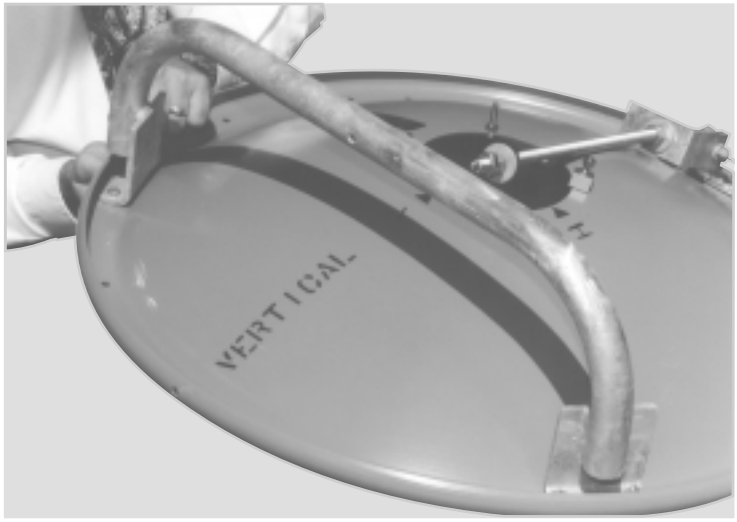
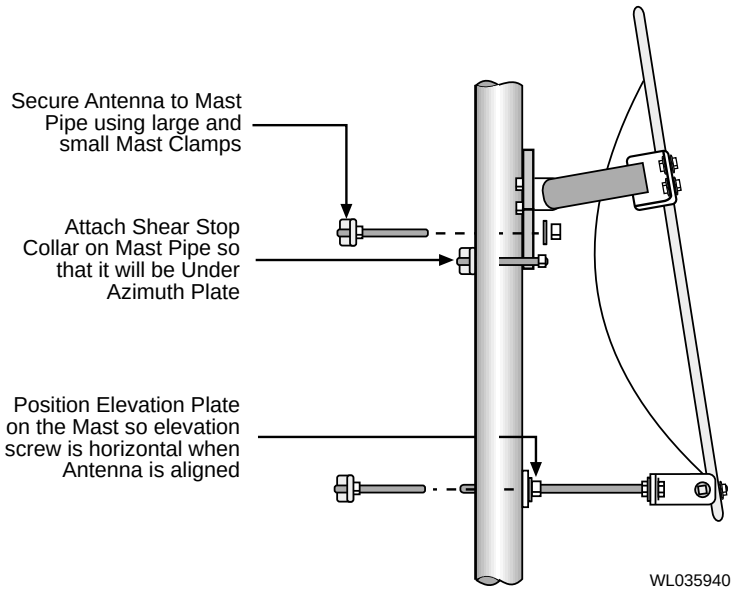


***Figure B.8 - Antenna Mount Assembly***




WL035939

***Figure B.9 - Elevation Rod Assembly***




WL035940

## Feed Installation

Following the instructions provided with the feed assembly, install the feed in the reflector. Refer to Figures B.10 through B.14.

***Figure B.10 - Feed Horn Installation***

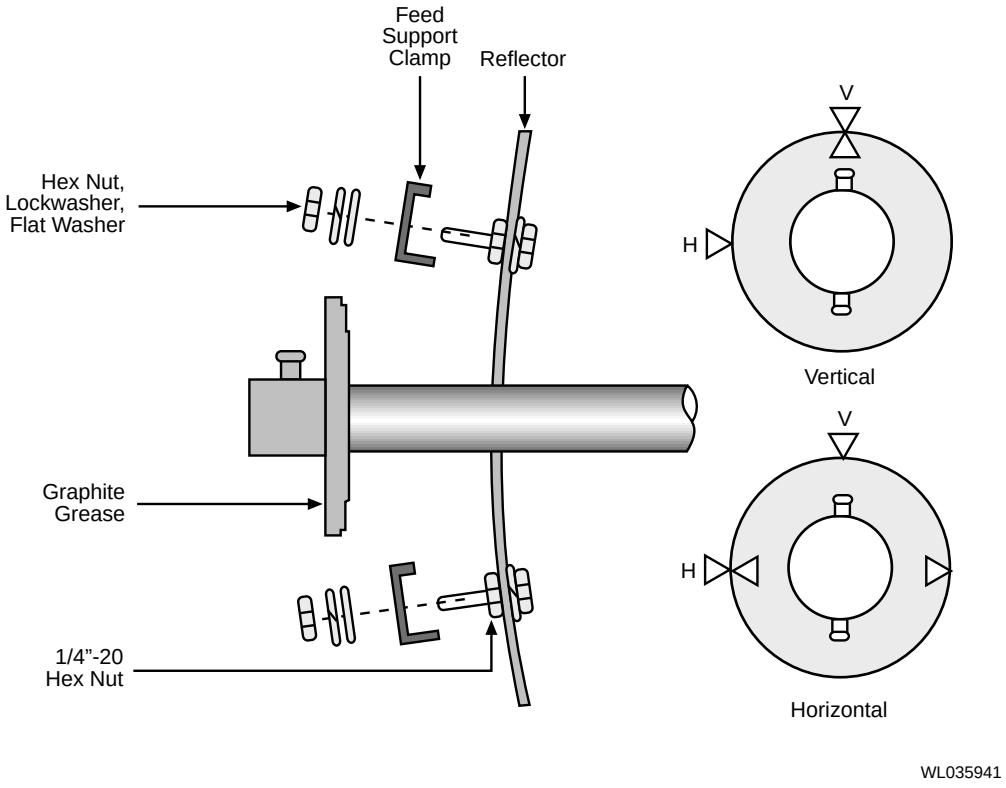
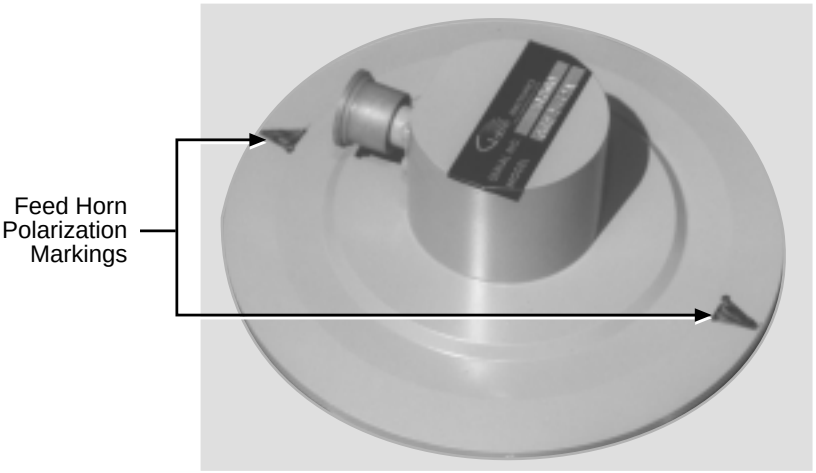
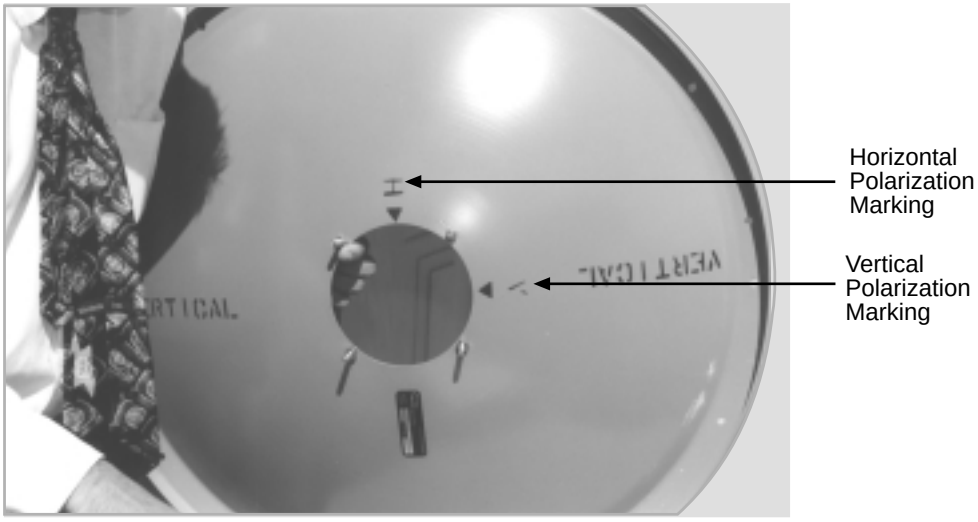


***Figure B.11 - Feed Horn Polarization Markings***




WL035942

***Figure B.12 - Parabola Rear View Showing Polarization Reference Markers***




WL035943

***Figure B.13 - Feed Horn Installation***


WL035944

***Figure B.14 - Feed Horn Installation for Vertical Polarized Operation***


WL035945

*Radome Installation*

Molded Radomes (normally optional on standard antennas) should be installed following the instructions provided.

*Azimuth Adjustment Clamp/Shear Stop Installation*

1. Verify proper assembly of the azimuth clamp/shear stop clamp as shown in Figure B.15 and B.16. Securely attach the shear stop clamp to the mast pipe as shown, orienting it as nearly as possible to the antenna boresight direction, and square to the mast axis. Note that the shear stop clamp used on the two foot antennas also provides the azimuth adjustment.
2. Refer to Figure B.1 for the position of the antenna centerline relative to the shear stop clamp. The clamp must be mounted to provide support during installation and azimuth adjustment.

***Figure B.15 - Azimuth Clamp/Shear Stop Assembly***

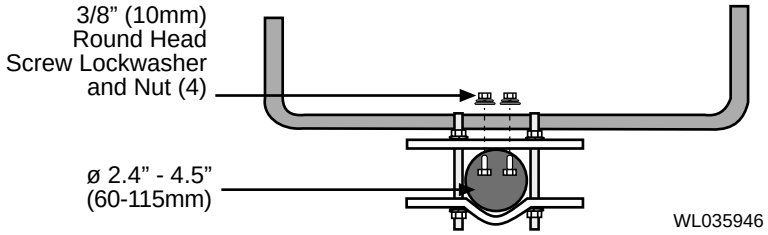
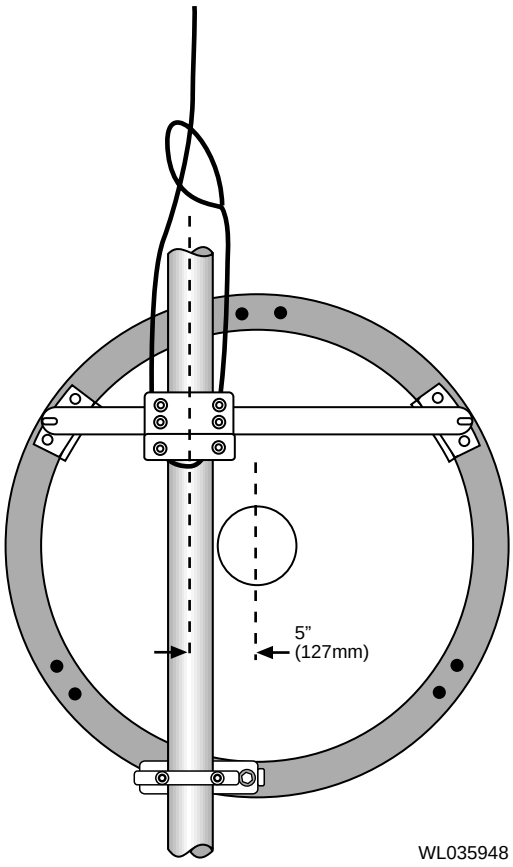



***Figure B.16 - Azimuth Adjustment Clamp Assembly***

WL035947

1. Attach a hoist strap around the vertical assembly or the horizontal assembly as shown in Figure B.17. Do not hoist by the elevation rod. Make sure that the vertical assembly is unobstructed where it will mount against the mast pipe.
2. Attach tag lines and carefully lift the antenna into position, resting the vertical assembly on the shear stop clamp.
3. Fasten the mount to the mast pipe with 1/2” U-bolts. The antenna must be free to rotate during azimuth adjustment, so tighten only enough to close the gap between the mast and vertical channel. Do not leave the antenna loose for any extended period of time, i.e. overnight.

***Figure B.17 - Hoisting the Antenna***



*General Antenna Alignment Procedures*

Normally the antenna is aligned by performing azimuth and elevation adjustments and elevation adjustments as necessary until the peak signal is obtained. It may be helpful to re-peak one adjustment before finalizing or locking down the other.

**Warning:** Damage to the antenna can occur if azimuth or elevation adjustments are attempted without loosening the proper connections as described in the following steps.

*Azimuth Adjustment*

1. Be sure the mast pipe U-bolts are just loose enough to allow mount rotation while maintaining complete contact between the mount and the mast pipe.
2. Turn the long stainless steel azimuth screws against the mounting channel. By alternately turning one azimuth adjustment screw out and the other in, the antenna can be rotated to the desired azimuth angle. Approximately 1 turn changes the azimuth direction by 1°. Avoid adjusting the antenna beyond the ±5° provided by the azimuth clamp as this can damage the adjusting hardware. Fasten the antenna to the mast pipe and reposition the clamp if needed.

**Note:** By securing the mount to the mast pipe and realigning the azimuth clamp with the antenna boresight, more reliable and precise azimuth adjustments can be achieved.

After all adjustments are made, tighten both of the azimuth screws against the channel and secure with the lock nuts provided.

3. Tighten the mast pipe U-bolts while maintaining the peak signal by alternating from left to right in 1/4 turn intervals.

*Elevation Adjustment*

1. Insure that both of the bolts connecting the mount to the Top Support Angles and the pivoting Elevation Angle (refer to Figures B.7 and B.9) are just loose enough to allow resisted rotation.
2. Back the outer nuts on the elevation rod away from the bottom mount plate to allow some fine adjustment range.
3. Turn the inside nut (with flat washer) on the elevation rod to adjust the elevation angle. Approximately 5 turns changes the elevation by 1°. Remember, for elevation greater than 20°, install the two beveled washers as shown in Figure B.9.
4. After all adjustments are made, lock the nut against the bottom mount plate. Tighten the angle pivot bolt and support bracket bolts.

**Important:** Be sure to tighten all hardware after final adjustments and insure that split lockwashers, palnuts, or jam nuts are used where provided.

*Inspection and Maintenance*

1. Before leaving the installation, check that all hardware on the mount, shroud, radome, and feed is tight and that nuts are locked in place.
2. Inspection of the antenna should be performed at lease once a year to check its condition and to insure safe operation and maintenance. Qualified personnel, knowledgeable and experienced in antenna installations, are required for this inspection.

*Supplemental Information*

Table B.3 is provided for installers unfamiliar with adequate nut tightening procedures for use on stainless steel bolts, U-bolts, galvanized bolts or any bolts without the ASTM-"A325" marking on the head. Disregard these recommendations when specific tightening requirements are given.

**Note:** It is not recommended to reuse a palnut that has already been fully tightened or deformed in any way. It should be replaced by a new palnut.

*Weather Proofing the Type N Female Connector on Feeds*

Remove the protective cover from the end of the feed and mate the connectors, screwing the male connector firmly onto the feed.

**Important:** After connecting the coaxial cable, wrap the Type N connector with the gray butyl rubber, squeezing it firmly around all joints to make a continuous seal. Finish the weatherproofing by wrapping the butyl rubber with several layers of black PVC tape (not supplied).

***Table B.3 - Nut Tightening Procedures***

| Nominal Bolt Size | Nut Torque | Palnut Locknut Torque |
|---|---|---|
| 1/4 " | 50 in./lb. | 40 in./lb. |
| 5/16 " | 102 in./lb. | 60 in./lb. |
| 3/8 " | 15 ft./lb. | 85 in./lb. |
| 7/16 " | 24 ft./lb. | 15 ft./lb. |
| 1/2 " | 37 ft./lb. | 16 ft./lb. |
| 5/8 " | 74 ft./lb. | 28 ft./lb. |
| 3/4" | 175 ft./lb. | 44 ft./lb. |
| 7/8 " | 212 ft./lb. | 51 ft./lb. |
| 1 " | 318 ft./lb. | 59 ft./lb. |

WL035950

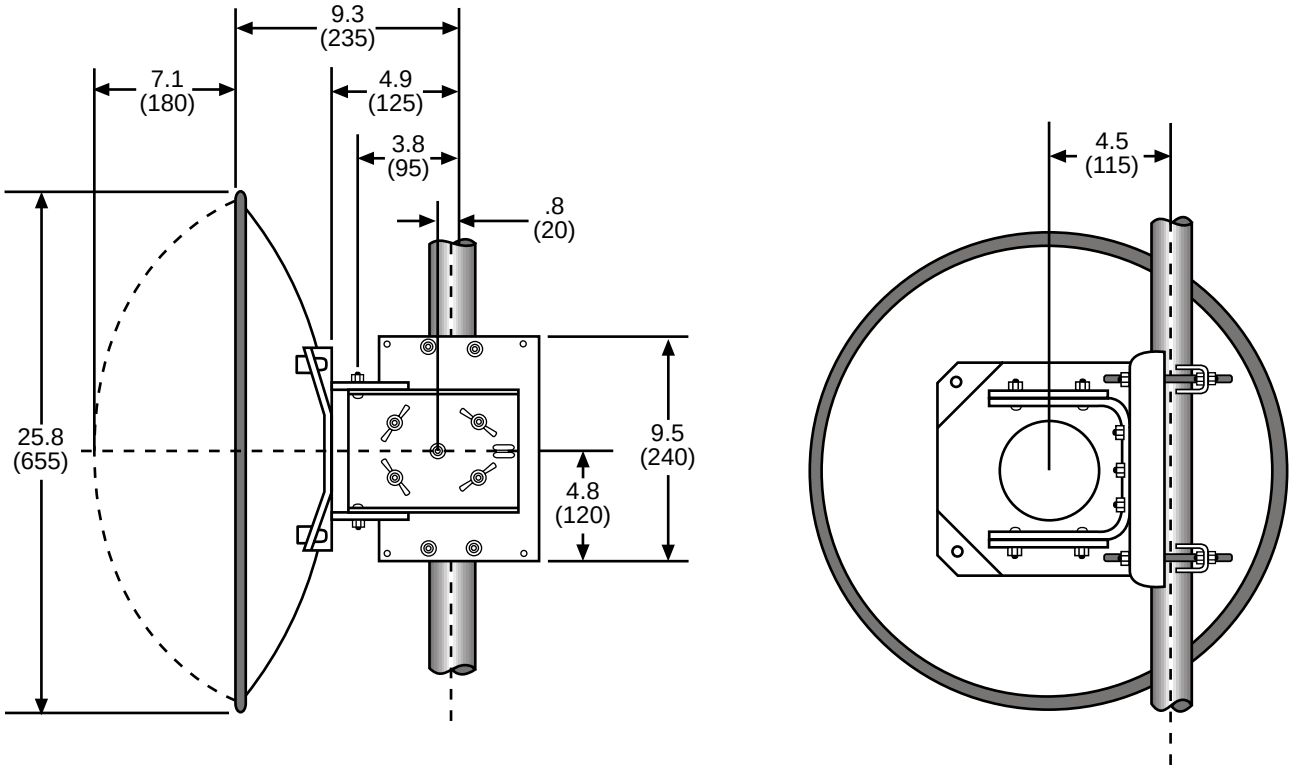
# Appendix C Quick Align Antenna Mount Installation

Read the instructions completely before assembling or installing the antenna. This installation can be dangerous and requires qualified personnel familiar with microwave assembly and installation.

## Site Planning

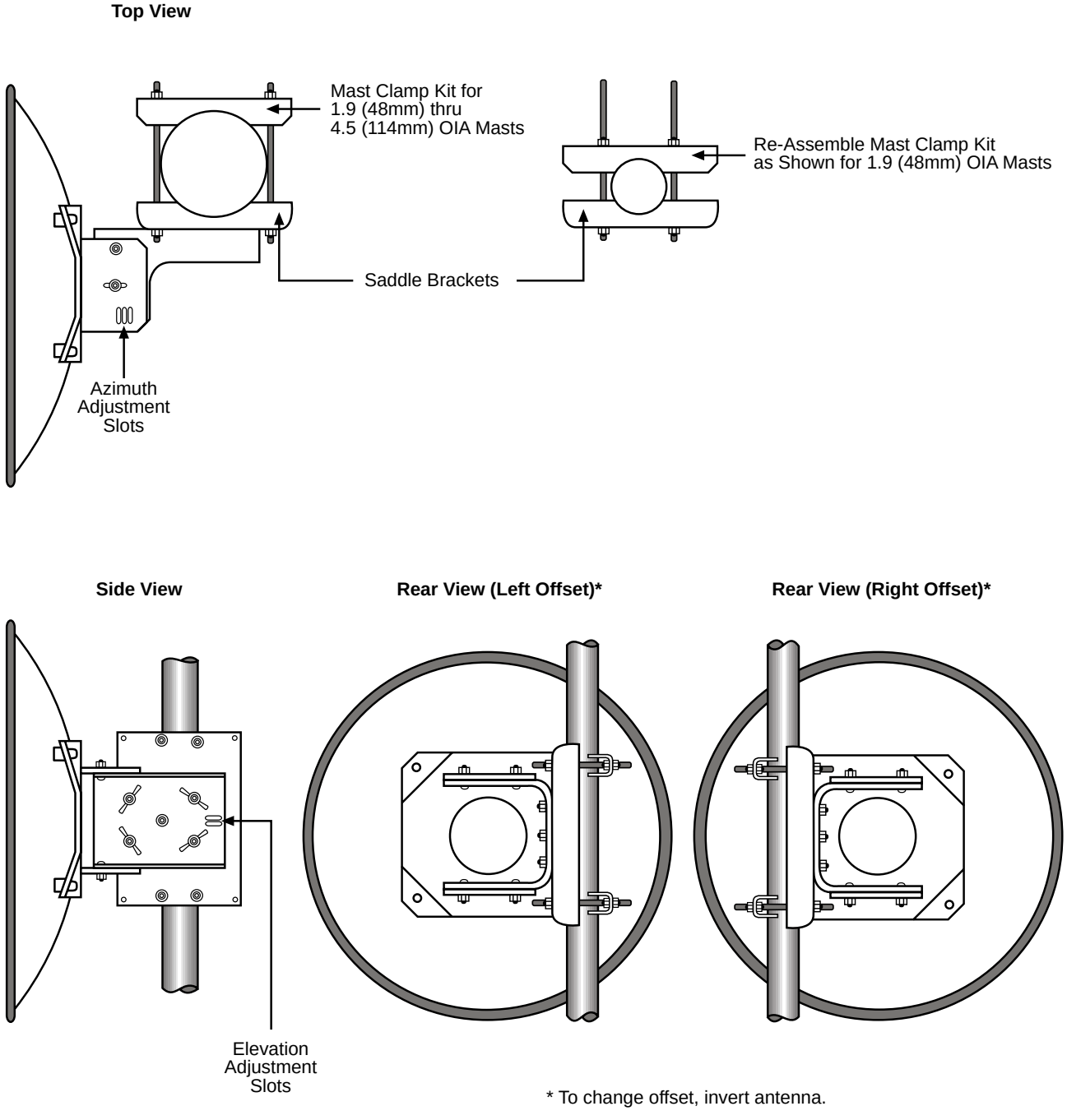
1. For antenna mounting and planning dimensions, see Figure C.1.
2. The antenna is normally assembled with an elevation adjustment range of +50 degrees to -5 degrees. By inverting the mount, it can be assembled with a +5 degree to -50 degree range. In either configuration, the antenna centerline can be offset right or left, relative to the vertical mast pipe (See Figure C.2) by inverting the Horizontal Tube Assembly.

***Figure C.1 - Quick Align Antenna***




WL340902

***Figure C.2 - Mount Configuration***




* To change offset, invert antenna.

WL340901

## Unpacking and Preparation

1. Carefully unpack the reflector, mount, shroud (if any), radome (if any) and feed from the crate. For correct antenna performance, handle all components with care. Set aside the packaged feed and any shroud or radome.

**Caution:** The reflector spinning has been formed to a very close-toleranced parabolic shape. Careful handling and assembly is required to avoid denting or deforming the reflector, which would degrade the antenna's performance.

2. Inspect for any damaged parts. See Tables C.1 and C.2 for an inventory of the parts and hardware shipped with the antenna.

***Table C.1 - Contents List, Quick Align Mount***

| Part Number | Description | Qty. |
|---|---|---|
| 25725-511 | Mount Clamp Assembly | 2 |
| 26724-001 | Pivot Bracket | 1 |
| 26725-001 | Saddle Bracket | 1 |
| BO X0862 | Rnd Hd Car Bolt 1/4-20 x 1" SS | 9 |
| FW X0050 | Washer 1/4" W 0.734x.065 SS | 9 |
| II-238A | Installation Instructions | 1 |
| NU X0060 | Hex Nut 1/4-20 SS | 9 |
| SW X0050 | Split Washer 1/4 SS | 9 |
| 26481-1 | Patent Pending Label | 1 |

WL201924

***Table C.2 - Contents List, Reflector Assembly***

| Part Number | Description | Qty. |
|---|---|---|
| 26774-503 | Reflector Assembly 2' | 1 |

WL201925

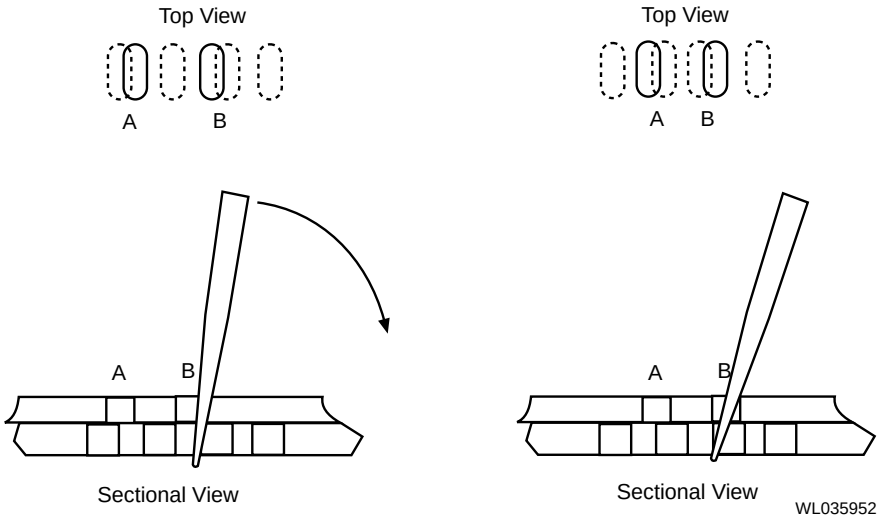
## Mount Assembly and Attachment

Assemble the panel mount according to Figure C.2. Orient Antenna using instructions supplied with the antenna. Antenna models used with this mount may be circular, square or diamond shaped. To change the offset of the antenna, unbolt the mount from the antenna, invert the mount and reattach to the antenna.

Loosen the azimuth or elevation locking hardware while maintaining sufficient friction to prevent unwanted slippage. See Figure C.3.

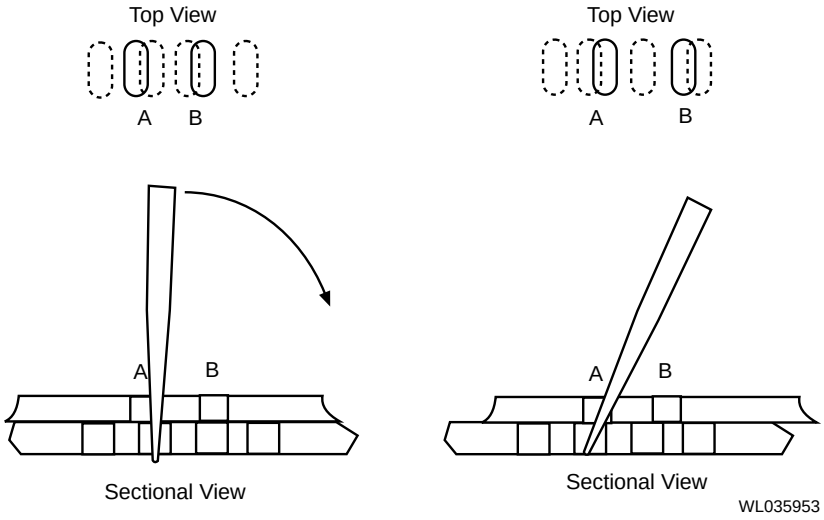
Insert flat blade screw driver into slot “B” and pry in direction of the arrow or into slot “A” and pry in opposite direction, as shown in Figure C.3. Stop prying approximately at position shown as new overlapping slot in bottom plate becomes sufficiently visible when viewed through slot “A”.

***Figure C.3 - Azimuth and Elevation Planning***



Insert Screw Driver into slot “A” and pry in direction of the arrow, as shown in Figure C.4. Stop prying approximately at position shown as new slot in bottom plate becomes sufficiently visible when viewed through slot “B”. Continue alternating slots and prying in either direction until desired alignment is obtained. Lock down hardware securely before leaving the site.

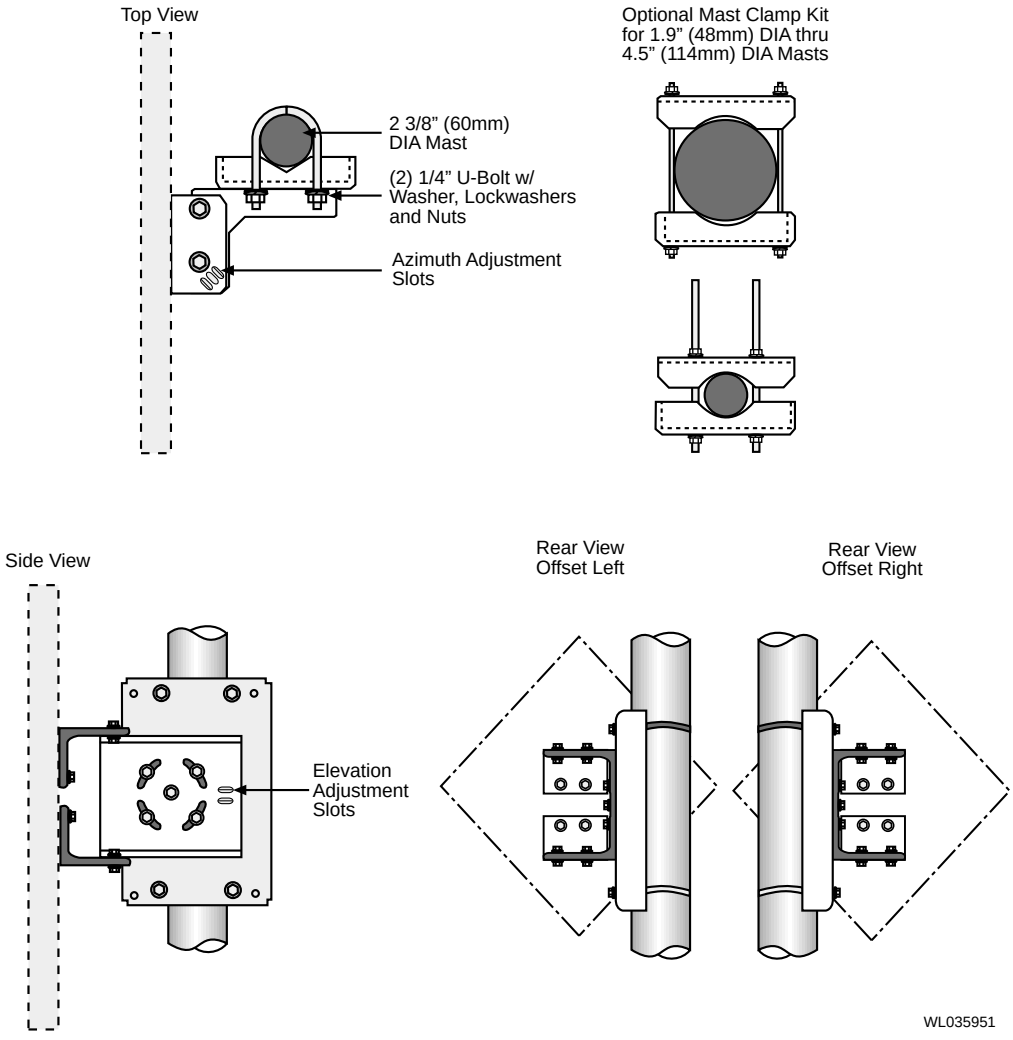
***Figure C.4 - Azimuth and Elevation Planning***



# Appendix D Adjustable Panel Antenna Mount

Assemble the panel mount according to Figure D.1. Orient Antenna using instructions supplied with the antenna. Antenna models used with this mount may be circular, square or diamond shaped. To change the offset of the antenna, unbolt the mount from the antenna, invert the mount and reattach to the antenna.

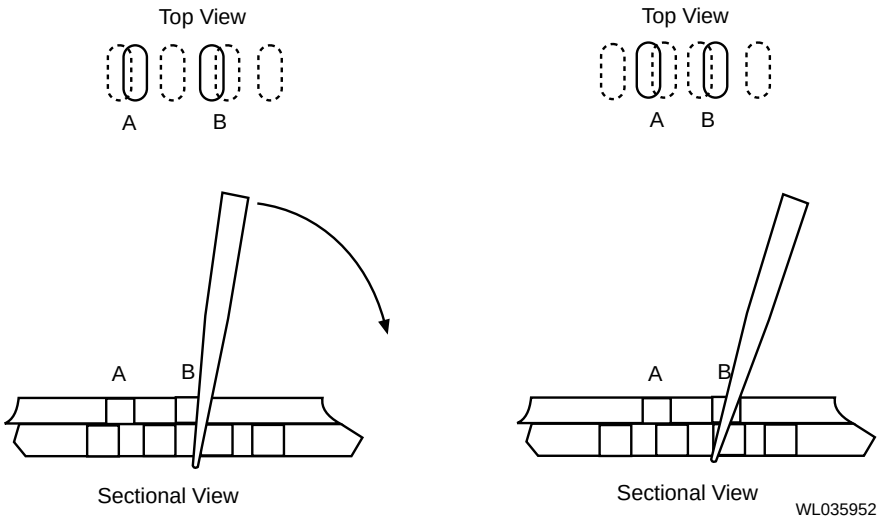
***Figure D.1 - Antenna Mount***



Loosen the azimuth or elevation locking hardware while maintaining sufficient friction to prevent unwanted slippage. See Figure D.2.

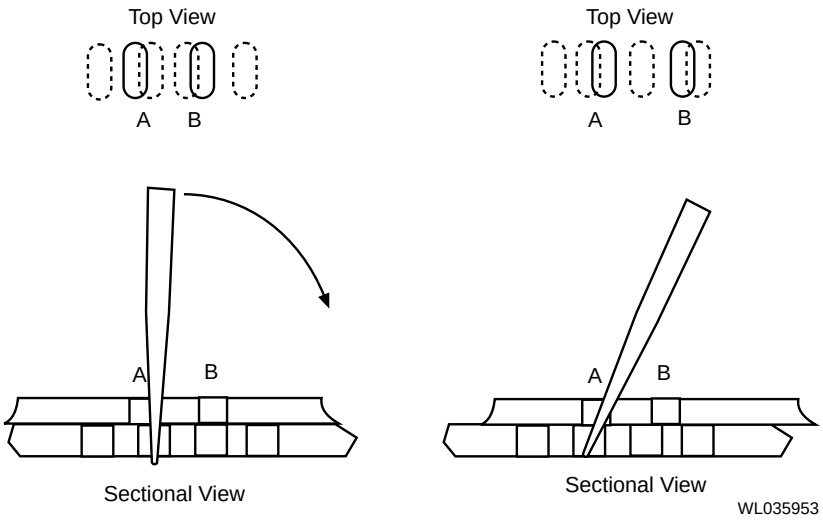
Insert flat blade screw driver into slot “B” and pry in direction of the arrow or into slot “A” and pry in opposite direction, as shown in Figure D.2. Stop prying approximately as new overlapping slot in bottom plate becomes sufficiently visible when viewed through slot “A”.

***Figure D.2 - Azimuth and Elevation Planning***



Insert Screw Driver into slot “A” and pry in direction of the arrow, as shown in Figure D.3. Stop prying approximately as new slot in bottom plate becomes sufficiently visible when viewed through slot “B”. Continue alternating slots and prying in either direction until desired alignment is obtained. Lock down hardware securely before leaving the site.

***Figure D.3 - Azimuth and Elevation Planning***



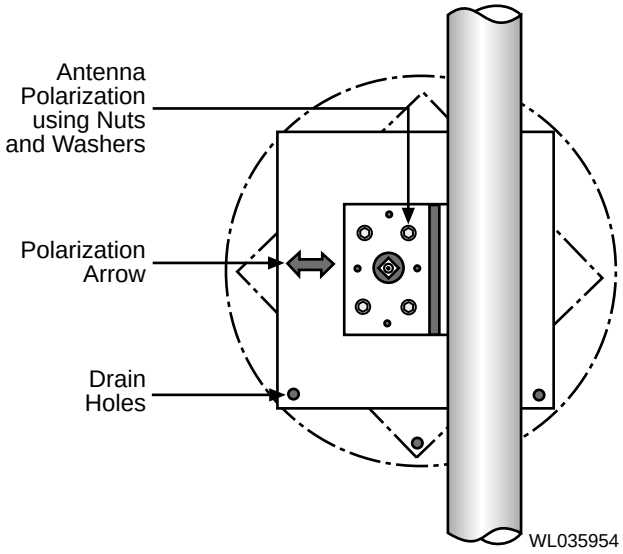
Attach the antenna to the mount as shown in Figure D.4. For antenna polarization, assemble the antenna to the mount using four sets of nuts and washers after desired polarization is selected. In horizontal polarization the arrow sticker should be pointed in a horizontal direction. Likewise, in vertical polarization the arrow sticker should be pointed in a vertical position.

**Important:** After cable connection is completed, wrap connection with Butyl or other waterproof tape, supplied by the customer.

Each panel antenna has four factory sealed drain holes located on the back of the antenna. After orienting the antenna to its proper polarization, the lower most sealed drain hole(s) must be punctured with a pointed tool. See Figure D.4.

**Caution:** Do not allow the tool to protrude into the drain hole more than 1/4" (7mm) or damage to the antenna may result.

***Figure D.4 - Flat Panel Antenna***



Aim the antenna according to Figure D.5. Orient the antenna using instructions supplied with the antenna. Antenna models used with this mount may be circular, square or diamond shaped. To change the offset, unbolt the mount from the antenna, then invert the mount and reattach in the antenna.

***Figure D.5 - Adjustable Panel Antenna Mount***