



UNIVERSITY OF MICHIGAN  
COLLEGE OF ENGINEERING  
THE RADIATION LABORATORY  
DEPARTMENT OF ELECTRICAL ENGINEERING  
AND COMPUTER SCIENCE

3228 EECS BUILDING  
1301 BEAL AVENUE  
ANN ARBOR, MICHIGAN 48109-2122  
734 764-0500 FAX 734 647-2106  
<http://www.eecs.umich.edu/RADLAB/>

Re: Certification for Hyperlink IN2401 Radio  
Model: IN2401  
FCC ID: MYF-H9PLA4121  
CANADA: to be provided by IC

### USER'S MANUAL INFORMATION

**(PRELIMINARY)**

The User's Manual is in preparation. The following material will be contained in the manual:

FCC ID: MYF-H9PLA4121

CANADA: to be provided by IC

This device complies with Part 15 of the FCC Rules and with RSS-210 of Industry Canada. Operation is subject to the following two conditions:

- (1) This device may not cause harmful interference, and
- (2) This device must accept any interference received, including interference that may cause undesired operation.

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

# **Hyperlink / Intel PRO Wireless Professional Extended-Range Antenna Kits**

**Featuring Intel Spread Spectrum Radio Technology**

## **Installation Manual**

**NOTE:** The antenna system shall be installed **ONLY** by experienced antenna installers who are familiar with local building and safety codes, and wherever necessary have been licensed by appropriate government regulatory bodies. Failure to do so may void the Product Warranty, as well as expose the end-user to legal and/or financial liabilities. Hyperlink Technologies, its agents, resellers or distributors, are not liable for injury, damage, or violation of government regulations that may arise from failing to comply with the guidelines described in this document.

Disclaimer: The diagrams used in this manual are for illustrative purposes only. They should not be confused with the Intel end-user installed antenna options. When these diagrams are used the transceiver will be installed in conjunction with the specific Professionally-Installed Antenna Kits including DC Injector/Lightning Protector, Amplifier, cables and antennas listed in this manual.

Copyright © 2001, Hyperlink Technologies, Inc.. All rights reserved. No part of the contents of this document may be transmitted or reproduced in any form or by any means without the written permission of Hyperlink Technologies, Inc.

HyperGain and HyperAmp are trademarks or registered trademarks of Hyperlink Technologies, Inc. in the United States and/or other countries.

## **USA- Federal Communications Commission (FCC)**

### Interference Statement

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

### Information to the user

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy. If not installed and used in accordance with the instructions, it may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try and correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the distance between the equipment and the receiver.
- Connect the equipment to an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Any changes or modifications of equipment not expressly approved by the manufacturer could void the user's authority to operate the equipment and the company's warranty.

**NOTE: The antenna system shall be installed ONLY by experienced antenna installers who are familiar with local building and safety codes, and wherever necessary have been licensed by appropriate government regulatory bodies. Failure to do so may void the Product Warranty, as well as expose the end-user to legal and/or financial liabilities. Hyperlink Technologies, its agents, resellers or distributors, are not liable for injury, damage, or violation of government regulations that may arise from failing to comply with the guidelines described in this document.**

**Caution: Exposure to Radio Frequency Radiation.**

The radiated output power of this product is below the FCC radio exposure limits. Nevertheless, this product shall be used in such a manner that the potential for human contact during normal operation is minimized.

Antenna shall be mounted in such a manner as to minimize the potential for human contact during normal operation. In order to avoid the possibility of exceeding the FCC radio frequency exposure limits, human proximity to the antenna shall not be less than 71 cm during normal operation.

Hyperlink Technologies is not responsible for any radio or television interference caused by unauthorized modification of this device or the substitution or attachment of connecting cables and equipment other than specified by Hyperlink Technologies. The correction of interference caused by such unauthorized modification, substitution or attachment will be the responsibility of the user.

Antenna System	Specified Antenna Gain (dBi)	Maximum Output Power at Antenna Terminal (dBm)	Total EIRP (dBm)	Minimum RF Exposure Separation Distance (cm)
HG2408U	8.0	16.0	24.0	4.5
HG2410U	10.0	16.0	26.0	5.6
HG2415U	15.0	16.0	31.0	10
HG2408P	8.0	16.0	24.0	4.5
HG2409P	8.0	16.0	24.0	5.0
HG2412P	12.0	16.0	28.0	7.1
HG2414P	14.0	16.0	30.0	8.9
HG2415Y	14.5	16.0	30.5	8.9
HG2415P	15.0	16.0	31.0	10.0
HG2415G	15.0	16.0	31.0	10.0
HG2417P	17.0	16.0	33.0	12.6
HG2420P	19.5	16.0	35.5	17.8
HG2424G	23.5	16.0	39.5	28.3
HG2403MU	3.0	24.0	27.0	6.3
HG2403MU1	3.0	30.0	33.0	12.6
HG2405MU	5.0	24.0	29.0	7.9
HG2405MU1	5.0	30.0	35.0	15.9
HG2408UA	8.0	20.0	28.0	7.1
HG2410UA	10.0	20.0	30.0	8.9
HG2415UA	15.0	20.0	35.0	15.9
HG2408PA	8.0	20.0	28.0	7.1
HG2409PA	8.0	20.0	28.0	8.0
HG2414PA	14.0	20.0	34.0	14.1
HG2415YA	14.5	23.0	37.5	14.1
HG2419GA	19.0	24.0	43.0	39.8
HG2424GA	23.5	24.0	47.5	70.7

**WARNING:** It is the responsibility of the professional installer to ensure that when using the outdoor antenna kits in the United States (or where the FCC rules apply), only these antenna configurations shown in the table above and which are described in this document are used. The use of any other than those listed is expressly forbidden in accordance to FCC rules CFR47 part 15.204.

## **Professional Antenna Kit Overview**

In addition to the standard Stratum MP end-user installable antenna options there are 12 additional Professional Extended-Range Antenna Kits that are available for Professional Installation Only.

### **Omnidirectional Antenna Kits:**

HG2408U	HG2408UA
HG2410U	HG2410UA
HG2415U	HG2415UA
HG2403MU	HG2405MU
HG2403MUA	HG2405MUA

### **Directional Antenna Kits:**

HG2408P	HG2409P	HG2414PA
HG2412P	HG2414P	HG2415YA
HG2415Y	HG2424G	HG2408PA
HG2415G	HG2415P	HG2409PA
HG2417P	HG2420P	

### **Directional Point-to-Point Only Antenna Kits:**

HG2415YA  
HG2419GA  
HG2424GA

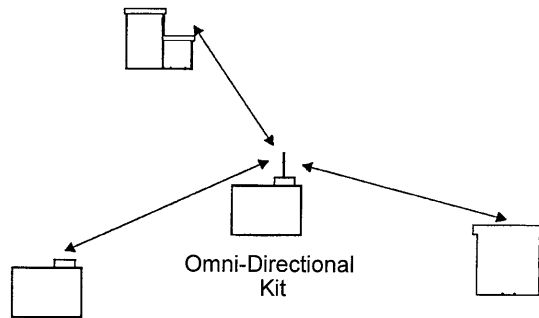
## Types of Installations

The type of application will determine which type of kit to install:

### Multipoint Network

This type of installation typically requires an Omni Directional Kit at the central node for 360-degree coverage.

For the central node use any of the omni-directional antenna kits:  
HG2408U, HG2410U, HG2415U, HG2408UA, HG2410UA, HG2415UA  
For remote nodes use any multipoint directional antenna kit:  
HG2414P, HG2415Y, HG2424G, HG2414PA



### Point-to-Point Network

*Building-to-Building or Tower-to-Tower:* Typically these installations will typically require directional Yagi, Panel or Grid Antenna kits.

For each node use any of the directional antenna kits:  
HG2414P, HG2415Y, HG2424G, HG2414PA, HG2415YA, HG2424GA



**HYPERLINK / INTEL EXTENDED RANGE ANTENNA SYSTEMS****Operating Frequencies / Channel Settings**

Hyperlink / Intel PRO-Wireless Extended Range Antenna Systems are approved for operation in different operating frequency channels. These channels are based upon the eleven standard IEEE 802.11 channels.

**NOTE: This equipment authorized for operation according to the tables below. This system may not be operated in a configuration or on any channels or frequencies other than those shown in the tables:**

OMNIDIRECTIONAL ANTENNA SYSTEMS										
CENTER FREQ	NON-AMPLIFIED			AMPLIFIED						
	HG2408U	HG2410U	HG2415U	HG2403UA	HG2403UA1	HG2405UA	HG2405UA1	HG2408UA	HG2410UA	HG2415UA
2412	M	M	M							
2417	M	M	M					M	M	M
2422	M	M	M	M		M		M	M	M
2425	M	M	M	M	M	M	M	M	M	M
2427	M	M	M	M	M	M	M	M	M	M
2432	M	M	M	M	M	M	M	M	M	M
2437	M	M	M	M	M	M	M	M	M	M
2442	M	M	M	M	M	M	M	M	M	M
2447	M	M	M	M	M	M	M	M	M	M
2449	M	M	M	M	M	M	M	M	M	M
2452	M	M	M	M		M		M	M	M
2457	M	M	M					M	M	M
2462	M	M	M							

DIRECTIONAL ANTENNA SYSTEMS										
CENTER FREQ	NON-AMPLIFIED									
	HG2408P	HG2409P	HG2412P	HG2414P	HG2415Y	HG2415G	HG2415P	HG2417P	HG2420P	HG2424G
2412	M	M	M	M	M			M		
2417	M	M	M	M	M	M	M	M	M	
2422	M	M	M	M	M	M	M	M	M	
2425	M	M	M	M	M	M	M	M	M	
2427	M	M	M	M	M	M	M	M	M	
2432	M	M	M	M	M	M	M	M	M	
2437	M	M	M	M	M	M	M	M	M	M
2442	M	M	M	M	M	M	M	M	M	
2447	M	M	M	M	M	M	M	M	M	
2449	M	M	M	M	M	M	M	M	M	
2452	M	M	M	M	M	M	M	M	M	
2457	M	M	M	M	M	M	M	M	M	
2462	M	M	M	M	M			M		



CENTER FREQ	DIRECTIONAL ANTENNA SYSTEMS									
	AMPLIFIED									
	HG2408PA	HG2409PA	HG2414PA	HG2415YA	HG2419GA	HG2424GA				
2412										
2417	M	M	M	M						
2422	M	M	M	M						
2425	M	M	M	M						
2427	M	M	M	M	P					
2432	M	M	M	M	P	P				
2437	M	M	M	M	P	P				
2442	M	M	M	M	P	P				
2447	M	M	M	M	P					
2449	M	M	M	M						
2452	M	M	M	M						
2457	M	M	M	M						
2462										

**NOTES:**

**M** - These systems are authorized for Point-to-Point as well as Multipoint operation.

**P**- These systems are authorized for Point-to-Point installations only. Operation in a Multipoint system is prohibited.

**WARNING:** It is the responsibility of the professional installer to ensure that when using the outdoor antenna kits in the United States (or where the FCC rules apply), only these antenna configurations shown in the table above and which are described in this document are used. The use of any other than those listed is expressly forbidden in accordance to FCC rules CFR47 part 15.204.

## Antenna SYSTEM CONNECTION

**NOTE: THE ANTENNA SYSTEM SHALL BE INSTALLED ONLY BY EXPERIENCED ANTENNA INSTALLERS WHO ARE FAMILIAR WITH LOCAL BUILDING AND SAFETY CODES, AND WHEREVER NECESSARY HAVE BEEN LICENSED BY APPROPRIATE GOVERNMENT REGULATORY BODIES. FAILURE TO DO SO MAY VOID THE PRODUCT WARRANTY, AS WELL AS EXPOSE THE END-USER TO LEGAL AND/OR FINANCIAL LIABILITIES. HYPERLINK TECHNOLOGIES, ITS AGENTS, RESELLERS OR DISTRIBUTORS, ARE NOT LIABLE FOR INJURY, DAMAGE, OR VIOLATION OF GOVERNMENT REGULATIONS THAT MAY ARISE FROM FAILING TO COMPLY WITH THE GUIDELINES DESCRIBED IN THIS DOCUMENT.**

### **Surveying the Antenna Site**

Before beginning system installation, emphasis should be placed on system planning. It is important that no large obstructions exist near the antenna, such as retaining walls, chimneys, air-conditioning units or other antenna masts. These types of objects can have an impact on the antenna system performance.

Plan to mount the antenna as high as possible. You will need enough mast to elevate the antenna approximately 10-15 feet above the roof or above any obstruction that might be in the antenna's signal path.

You will need to identify the location where the antenna cable will be routed. If you run the antenna cable through the roof, a water-proof fitting will be required. Consult a building contractor or licensed electrician to help you with the routing if necessary. Take note of the length of the mast you will need and the type of mounting hardware required. The amplified antenna kit is shipped with U-Bolt mounting hardware which should be ideal for mounting the antenna and amplifier to most types of mast. Also, make plans on how you are going to talk to the person at the remote antenna while you are going through the antenna alignment procedure. For example, cellular phones or walkie-talkies can be used.

## Preparing for Antenna System Installation

***Warning: These antennas are designed to be mounted in open areas such as rooftops or building exterior walls. They are designed to be installed at least 6 feet away from areas occupied by people. During system operation, always keep the antenna at least 1 foot away from your head.***

***Warning: Before performing the following steps make certain that there are not any power lines within 50 ft. If the mast should fall, either while installing or during operation, contact with any power lines will be fatal or result in a fire.***

The Antennas are designed to be mounted on an aluminum or steel mast with a diameter from 1-1/4 inches to 3 inches. A larger diameter mast would be suggested for a more durable installation. This system includes a 50 foot antenna cable.

In addition to the kit contents, you will need a ground wire and wire ties.

## Installing Non-Amplified Antenna Systems

Follow these instructions for the following kits:

HG2408U

HG2414P

HG2410U

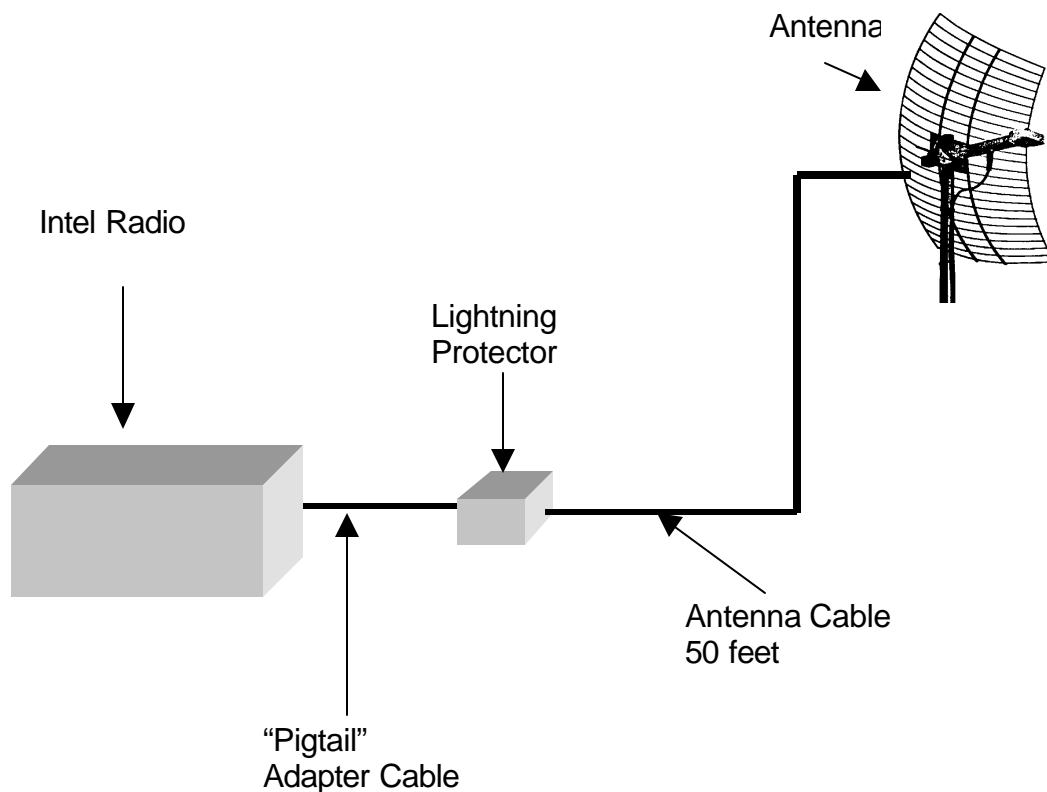
HG2415Y

HG2415U

HG2424G

### Overall System Configuration

The overall system configuration is shown below. Refer to this diagram while reading the section which follows, and during system installation.



## **Mounting and Cabling the Non-Amplified Antenna System:**

***Note: Different model antenna kits have different mounting requirements and procedures. Refer to Appendix A in this manual for antenna mounting details.***

1. Attach the mast mounting hardware to a solid structure on your building (e.g., the roof itself, concrete bulkhead, vent pipe).
2. Using the included mounting hardware, secure the antenna to the top section of the mast (see Appendix A for details) included hardware.
3. Attach one end of the 50 foot Antenna Cable to the connector on the antenna. Then connect the antenna to the bulkhead connector on the lightning protector.
4. Apply sealant tape around the joined connectors to prevent corrosion from the weather. Wrap the entire connection, overlapping each layer slightly to ensure a weather-tight seal.
5. Ground the antenna by connecting a suitable ground cable between the antenna mounting bracket and the building ground.
6. Very carefully raise the mast and loosely secure it with the mast mounting hardware. Use the plastic wire ties to tie the antenna cable to the mast every six to twelve inches.
7. Aim the directional antenna in the direction of the building you will be linked to. The omni-directional antennas should be mounted vertically and do not need to be aimed as they radiate in a 360 degree pattern.
8. Tighten the mast mounting screws. Do not do anything that would make it difficult to change the position of the antenna. It may be necessary to reposition the antennas while aiming them.
9. Route the antenna cable along the roof to the point where it enters the building. From the inside, pull the cable through the hole and take up any excess slack.
10. The Lightning Protector must be installed at the radio-end of the Antenna Cable. The Lightning Protector can be wall-mounted using the included bracket if desired. Attach the short adapter cable between the Lightning Protector and the Intel radio. Attach a ground wire to the ground lug on the Lightning Protector and to a good building ground.

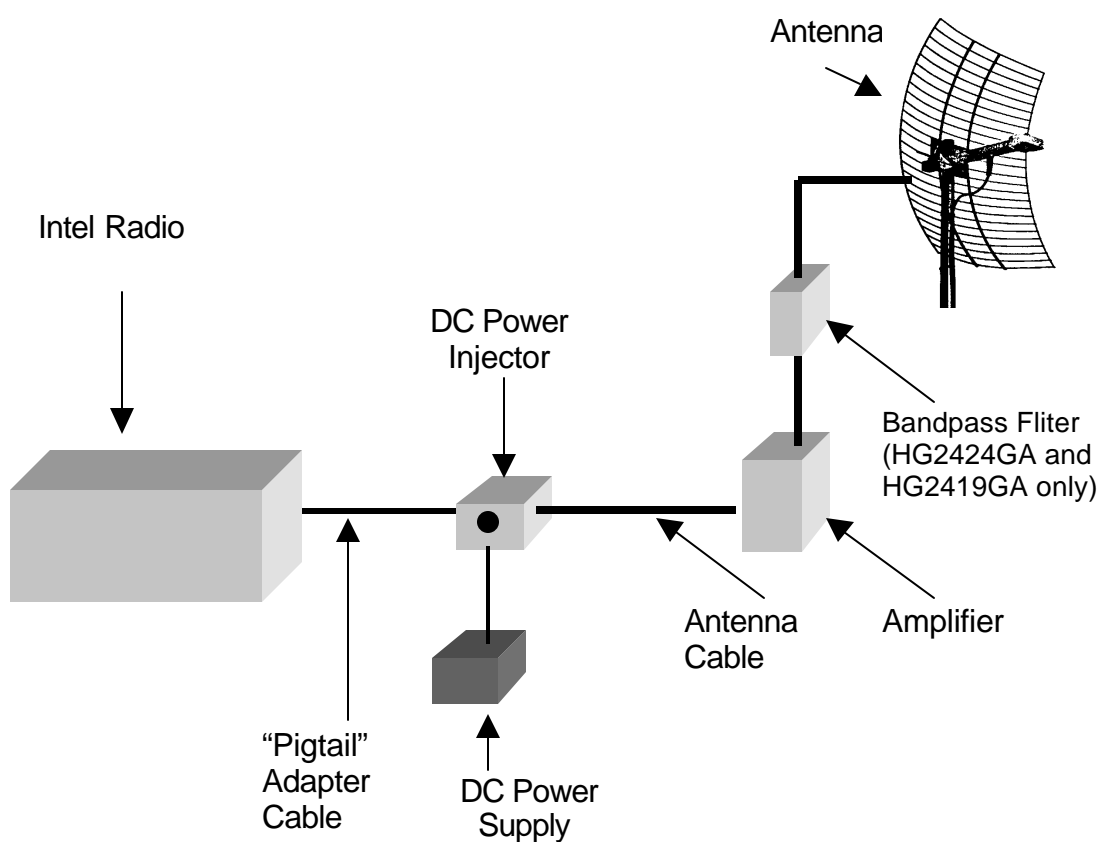
Refer to the National Electric Code for proper grounding recommendations.

## Installing Amplified Antenna Systems

Follow these instructions for the amplified antenna kits.

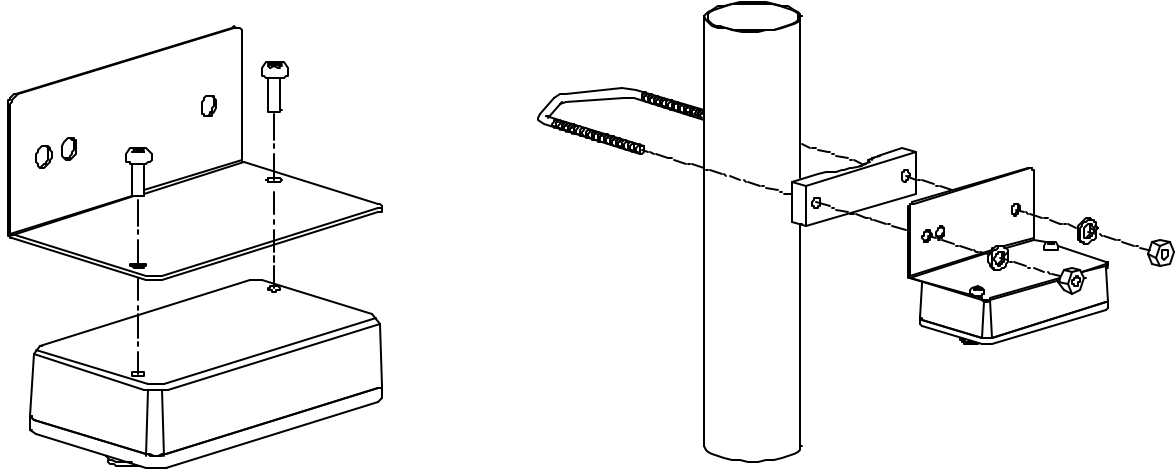
### Overall System Configuration

The overall amplified system configuration is shown below. Refer to this diagram while reading the section which follows, and during system installation.



**Installing the Amplifier Bracket for mast-mounting:**

Install the right angle bracket as shown above using two (2) #10-32 screws and split lock washers as shown. Note the orientation of the label relative to the 90 degree bend in the bracket. Proper positioning will ensure better visibility of the indicator LEDs when installed on the mast.



**Connections and Features of the Amplifier**

**Receive Indicator LED:**

This LED illuminates green in receive mode.

**Power Indicator LED:**

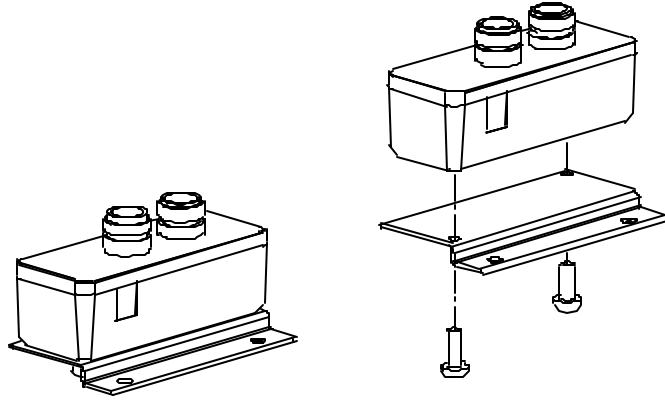
This LED illuminates red in transmit mode.

**Radio Connection:**

This connection attaches to the DC Power Injector via the antenna feed cable, and provides both signal and DC coupled power.

### **Installing the DC Injector Mounting Bracket:**

Install the bracket as shown above using two (2) self-tapping screws and split lock washers as shown. For optimal lightning protection, it is recommended that one screw also be used for attachment of a suitable ground wire.



### **Connections and Features of The DC Power Injector/ Lightning Protector**

The DC Power Injector (also known as a "Bias-T") is an in-line device which couples DC power onto a coaxial cable, enabling the cable to carry both RF (radio frequency) signals and DC power. The amplifier is powered remotely through the coaxial antenna feed cable by the way of this device. The DC Power Injector included with the kit also provides integral lightning protection.

In addition to a POWER indicator LED, the DC Power Injector provides a Transmit indicator LED. The Power LED indicates that the DC Power Supply is functioning. The Remote Transmit indicator LED detects changes in the DC current traveling through the antenna feed cable supplying the amplifier. When the amplifier enters the transmit mode the Transmit LED will be illuminated. This provides positive indication that the amplifier is functioning properly.



## Mounting and Cabling the Amplified Antenna System:

***Note: Different model antenna kits have different mounting requirements and procedures. Refer to Appendix A in this manual for antenna mounting details.***

1. Attach the mast mounting hardware to a solid structure on your building (e.g., the roof itself, concrete bulkhead, vent pipe).
2. Using the included mounting hardware, secure the antenna to the top section of the mast (see Appendix A for details) and similarly, install the amplifier directly beneath the antenna using the included V-bolts.
3. Attach one end of the Antenna Cable to the connector labeled "TO DC INJECTOR" on the amplifier. Connect the antenna to the connector labeled "TO ANTENNA" on the amplifier. For HG2419GA and HG2424GA systems only: connect the Bandpass Filter between the antenna and the "TO ANTENNA" port on the using the adapters included.
4. Wrap the entire connection with sealant tape, overlapping each layer slightly to ensure a weather-tight seal.
5. Ground the antenna by connecting a suitable ground cable between the antenna mounting bracket and the building ground.
6. Very carefully raise the mast and loosely secure it with the mast mounting hardware. Use the plastic wire ties to tie the antenna cable to the mast every six to twelve inches.
7. Aim the directional antenna in the direction of the building you will be linked to. The omni-directional antennas should be mounted vertically and do not need to be aimed as they radiate in a 360 degree pattern.
8. Tighten the mast mounting screws. Do not do anything that would make it difficult to change the position of the antenna. It may be necessary to reposition the antennas while aiming them.
9. Route the antenna cable along the roof to the point where it enters the building. From the inside, pull the cable through the hole and take up any excess slack.
10. The DC Power Injector and Power Supply must be installed indoors near the radio. The Injector unit can be wall-mounted using the included bracket if desired. Attach the end of the Antenna Cable to the "TO AMPLIFIER" connector on the DC Power Injector/Lightning Protector. Attach the 0.5 meter adapter cable between the DC Power Injector's "TO RADIO" connector and the Intel radio.

Attach a ground wire to the ground lug on the DC Power Injector/Lightning Protector and to a good building ground.

First, plug the 12 VDC power supply into the DC Power injector and then into the building's AC power. Never use a power supply other than the one shipped with the system as it may cause damage to the radio and/or amplifier. It is recommended that the AC connections be made through a commercially available "surge" protector power strip.