PROGRAMMING EXAMPLE

Listed in this chapter we will give you an overview programming the most common use of the Model 195Eg, as a wireless Access Point Bridge to a hardwired LAN with Repeater Enabled. In these examples we will program the Model 195Eg from the unit's Web Configuration Manager's Setup.

Access Point Bridge with Repeater Enabled

1. Review the Access Point Bridge diagram. See Figure 1.

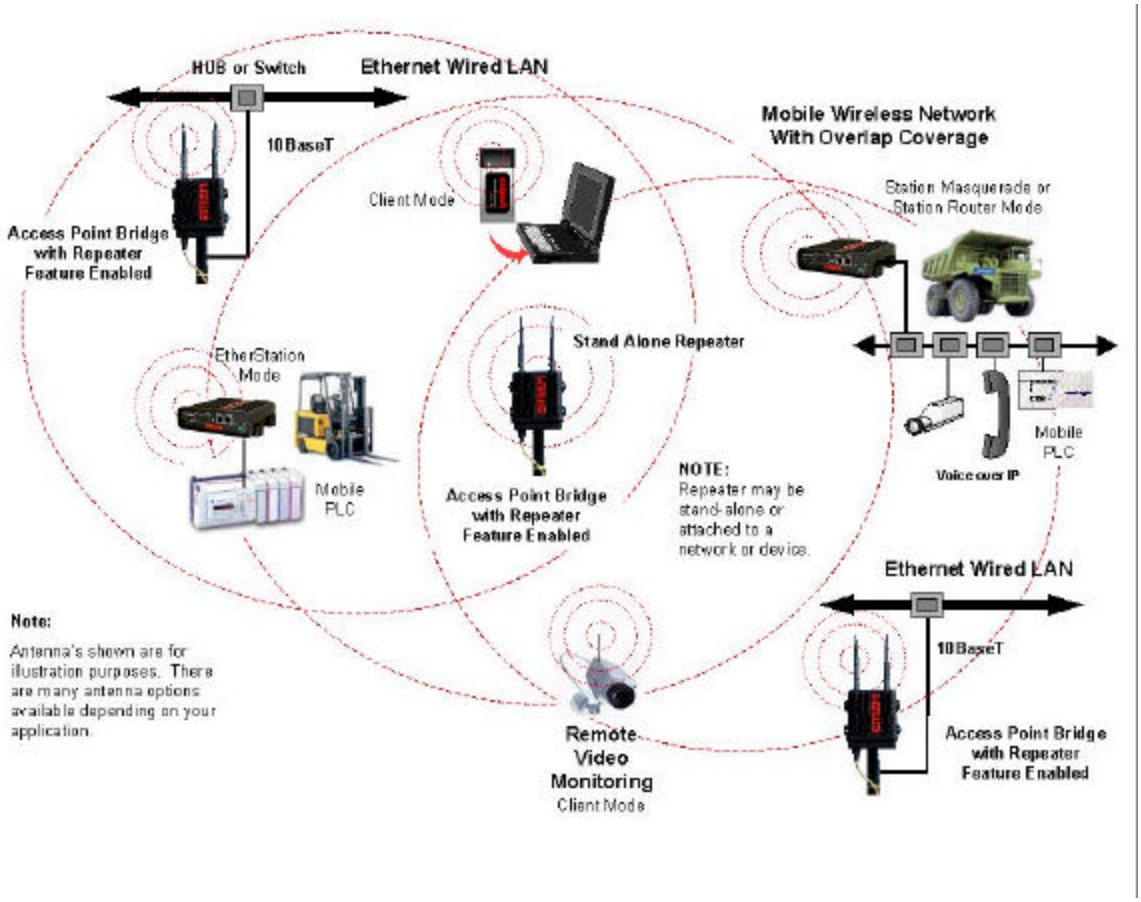


Figure 1: Access Point Bridge Diagram

2. Refer to the top left corner of Figure 1 to the Model 195Eg that is interfaced to the Hub or Switch. This unit is configured as a wireless Access Point Bridge to the hardwired LAN. In this example the Model 195Eg will have to be programmed in the Access Point Bridge Mode described in Chapter 1. This Model 195Eg will serve as the base node for 802.11g clients.

3. If you have not defined the IP address of the Model 195Eg then follow the instructions in Chapter 2.

4. Access the ESTeem Web page using your computer's Web Browser as per instructions in Chapter 3 under Logging On To the ESTeem Web Configuration Manager.

5. From the Model 195Eg Top menu select Setup. From the Select Mode of Operation pull down box , select AP Bridge and push the Next button below the pull down box. You will now see the screen shown in Figure 2. ***Note: Throughout the Configuration Manager are Help Screens that can accessed for further information on each item.***

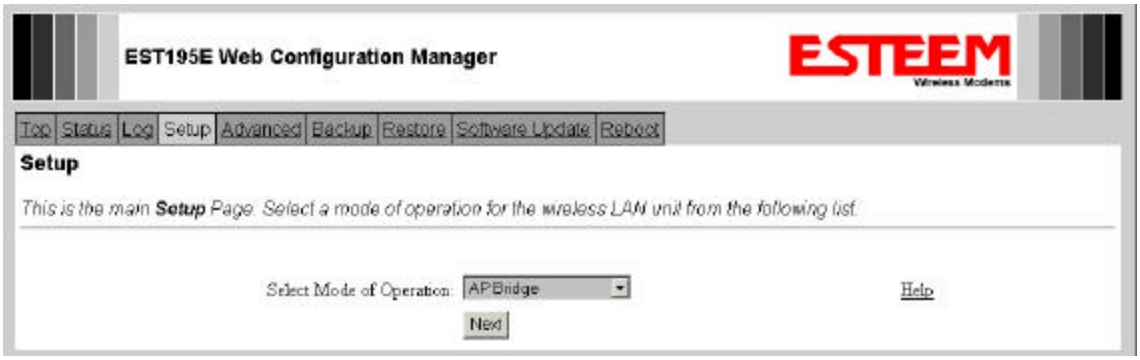


Figure 2: Access Point Bridge Setup Screen

6. Select Yes if you want to use Dynamic Host Configuration Protocol (DHCP) client services. If you want to enter a static IP address for the Model 195Eg, select No and press the Next button. Reference Figure 3.

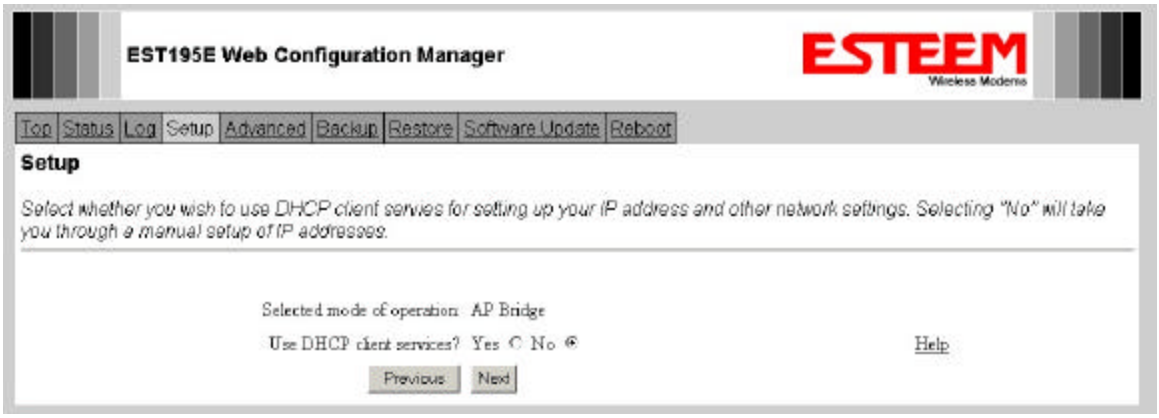


Figure 3: DHCP Client Setup Screen

7. Enter the IP Address and IP Netmask for the Model 195Eg. If you want to be able to access the Model 195Eg over the Ethernet network for diagnostics and updates the IP address must be on the same network as the other Ethernet devices. Reference Figure 4.

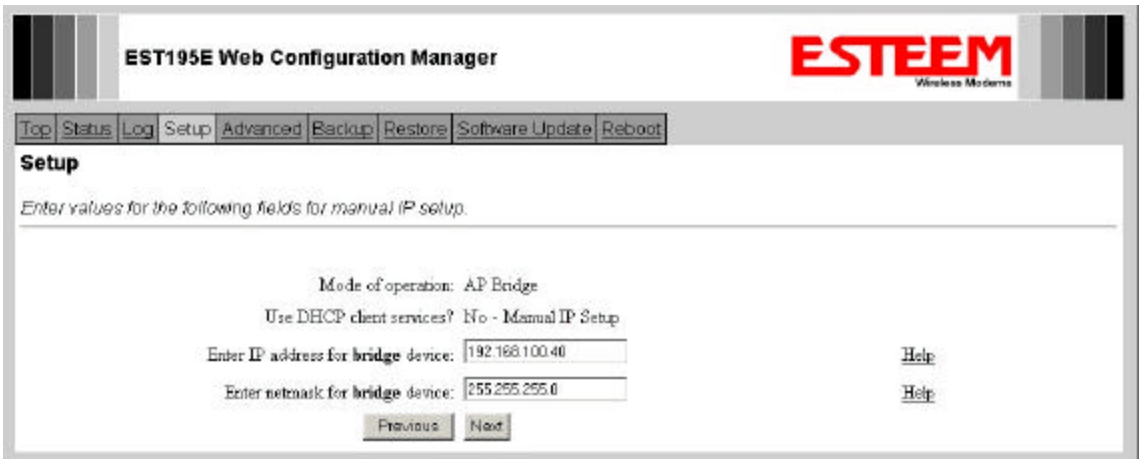


Figure 4: IP Address Setup Screen

8. Enter the DNS server information. If you are not connecting the Model 195Eg to the Internet, leave blank and press the Next button. Figure 5.

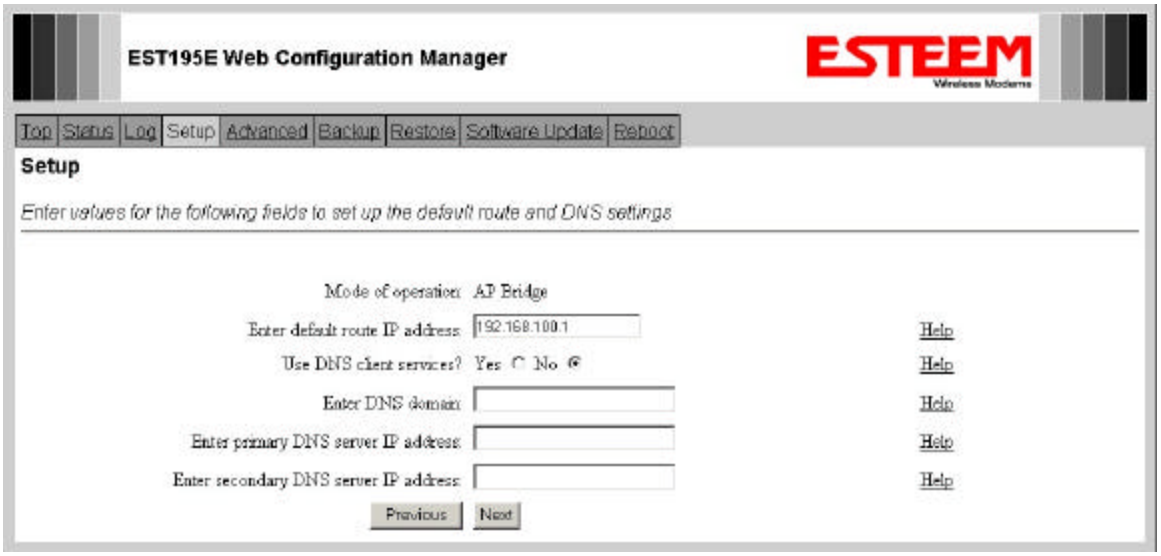


Figure 5: DHCP Setup Screen

9. Select if you will be using security for your wireless network. Enter the SSID for you 802.11g network. The SSID is the unique identification for your wireless network and all 802.11g devices that share a wireless network MUST have the same SSID code. This identification code is case sensitive and must NOT contain spaces. Reference Figure 6.

Figure 6: SSID Setup Screen

10. Select the encryption level for the wireless network. If you would like to hide the SSID from broadcasting from the Access Point select **Yes**. If Yes is selected the Model 195Eg will not send out periodic SSID radio beacons that can be identified with 802.11b network scanning software. The users of the network will have to know the SSID to enter the network and security is increased, but if you want the SSID to be broadcasted to the network for easy identification then select **No**. Reference Figure 7.

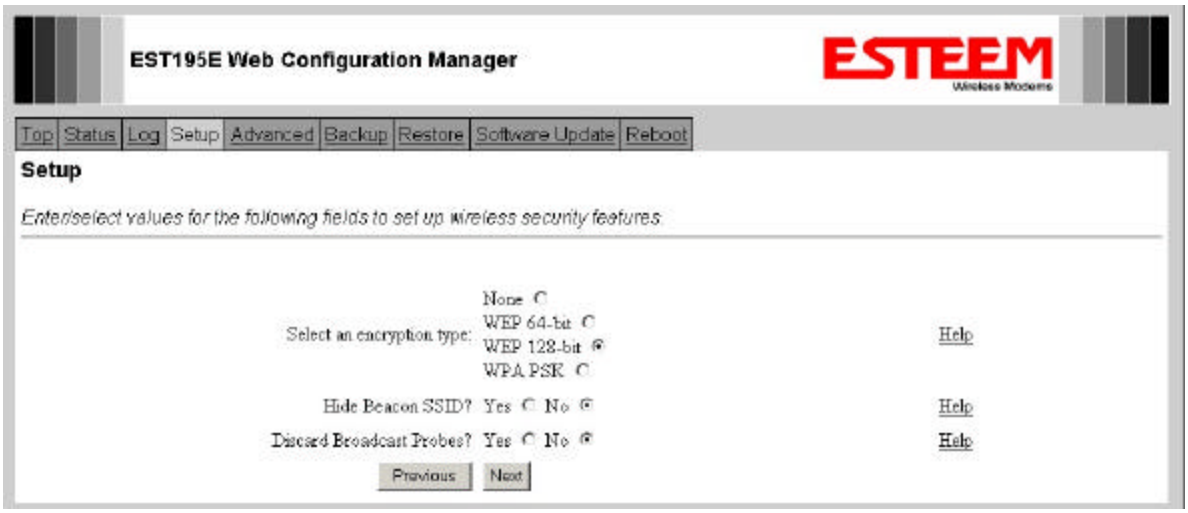


Figure 7: Encryption Setup Screen

11. Continue through the configuration screens using the Help menus for further questions until you reach the Commit Changes menu screen. Press the Commit Changes button and Model 195Eg will save your configuration, reboot the unit, and operate with the commands you have selected. Reference Figure 8.

Figure 8: Commit Changes Menu Screen

The Repeating Feature in the Model 195Eg is used to increase the wireless network area of coverage for both indoor and outdoor applications without the cost of hardwiring the Access Points to a common LAN. This custom feature is unique to the Model 195Eg because conventional 802.11b/g Access Points have to be interfaced to a common network either by hardwire, see Figure 1, or a dedicated point to point RF backbone.

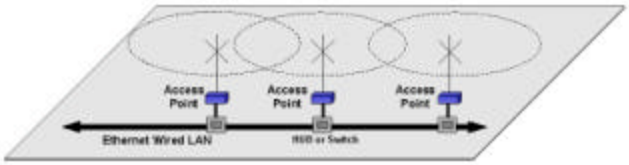


Figure 1: Conventional Access Point Diagram

When programmed in the Access Point (AP) Repeater Mode, the Model 195Eg will automatically create a wireless network with other Model 195Eg units in radio range that are programmed in AP Repeater mode and setup with matching configurations. This feature adds the increased functionality of repeaters to the typical Ethernet Bridge configuration.

AutoRouting

One of the most powerful features of the Repeater Feature mode is the Model 195Eg's ability to automatically calculate all possible communication routes in the network. The AutoRoute feature will automatically establish wireless Ethernet communication paths to each Model 195Eg that has a matching setup configuration. This automatic routing greatly simplifies network configuration and also creates a "self healing" network by sending data on an alternate route, if available, upon failure of the primary path.

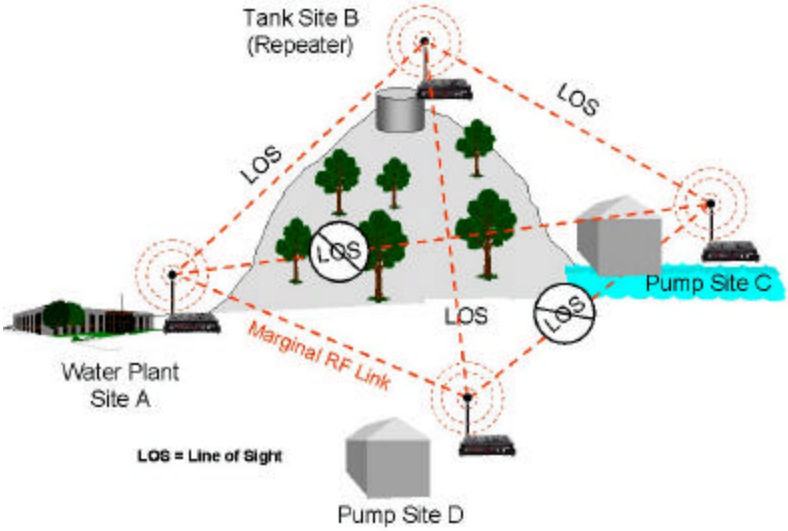


Figure 2: AP Repeater Diagram

AutoRouting Process

Listening Phase. Once a modem is configured for Access Point Repeater mode and reset, the Model 195Eg will begin to search out all modems that have a matching configuration setup (SSID, Frequency Channel, AP Repeater Mode = ON and Security Codes). The first step in the routing process is sending out and listening for "repeater beacons". A repeater beacon is a special radio packet that is sent from the Model 195Eg that contains the unit's MAC address. When a repeater beacon is received by another Model 195Eg, the MAC address of the originating modem is added to its own repeater beacons. A route between two Model 195Eg units can be established when they receive a repeater beacon that contains their own address.

For example let's look at Figure 2 and the repeater beacons and the route created from Pump Site C and Tank Site B(Repeater). Pump Site C sends a repeater beacon containing its MAC address over the radio network. The only site that receives this repeater beacon is Tank Site B (Note – there is no Line-of-sight (LOS) between from Pump Site C to the other sites in the network). When Tank Site B receives the repeater beacon it adds the MAC address from Pump Site C to its own repeater beacon and sends it out. This new repeater beacon from Tank Site B (Now containing Pump Site C's MAC address) is received at Pump Site C and a route is established. Pump Site C then adds the MAC address for Tank Site B in its repeater beacon, which is eventually received by Tank Site B.

Repeater beacons will continually be sent from a Model 195Eg every 2 seconds as long as it is configured in AP Repeater mode. This will allow the Model 195Eg to recognize new sites into the network and any changes to the radio paths. These continued updates in the repeater beacons give the AP Repeater network the "self-healing" characteristic.

Learning Phase. After an approximate 10-second period after no further additions to the Mac addresses in the repeater beacons, the Model 195Eg goes into the learning phase. In this phase all Model 195Eg units calculate their routes to the other Model 195Eg units in the network using the lowest "path cost", meaning shortest number of hops, back to the Root Bridge. *Note: The Root Bridge in a network should be the Model 195Eg where the majority of the data flow is processed.* In Figure 2, the Root Bridge will be the Water Plant that is transmitting and receiving data from all three remote sites. The user can program the Root Bridge manually. If the user does not define the Root Bridge, and if there are multiple candidates for the Route Bridge, Model 195Eg units in the network will pick the unit with the lowest MAC address. See the following section on Root Bridge for further details.

Blocking and Forwarding Phase. This last phase in the auto-routing process will eliminate any Ethernet data "loops" that can double the information received at any remote site. For example, looking at Figure 2, Pump Site D has two routes to the Root Bridge (Water Plant – Site A). The first Route is direct from the Water Plant and the second Route is via the Tank Site B (Repeater site). In this example the direct link between the two sites is the shortest route (lowest Path Cost) and will be selected as the primary route or Forward route. The second route (one with the higher Path Cost) that uses the repeater will be "Blocked". All routes to the Root Bridge will be evaluated for the site and be Forwarded or Blocked. The average time to complete all routing phases in a network is approximately 30 seconds.

Root Bridge

For any Access Point Repeater application that has more than two sites, the user needs to set one of the Model 195Eg's as the Root Bridge. The Root Bridge should be the Model 195Eg where the majority of the Ethernet data flow is processed. This site may be the Master location in a SCADA network or could be configured at a repeater site. Selection is important because, all the Model 195Eg's that are "NOT" configured as the Root Bridge will select their routing based upon where the Root Bridge is defined in the network.

The Root Bridge will be selected in one of two ways:

1. Manually by the users. The Root Bridge can be manually set (recommended) during the configuration at AP Repeater mode. Reference Chapter 4 – AP Repeater Configuration.
2. Automatically by the Model 195Eg. The Model 195Eg units will automatically configure the Root Bridge by selecting the lowest MAC address of all the Model 195Eg units in the network. This is usually not recommended in large networks, because adding a new site to the network could adversely change the entire site's routing scheme.

If you have any question establishing Route Bridges in your network, contact ESTeem Customer Support at 509-735-9092 or e-mail your application to support@esteem.com.

Using the Access Control List (ACL) In Network Design

As mentioned above, the shortest route to the Root Bridge may not be the best radio path. As seen in Figure 2 the radio path from Pump Site D to the Water Plant – Site A has a marginal link. Although the shortest route from Pump Site D to the Water Plant is direct, the best **radio** path is using the repeater site at Tank Site B. To force the radio path through the repeater is as simple as setting the ACL in the Pump Site D Model 195Eg to Deny the Mac address of the Water Plant. This will force all communications from Pump Site D to the Water Plant via Tank Site B.

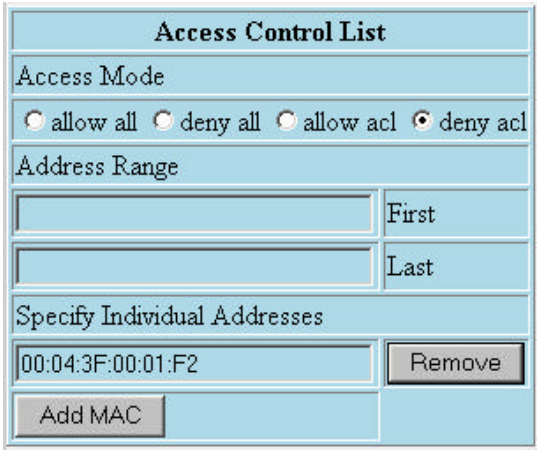


Figure 3: ACL Configuration Example

ANTENNA AND CABLE CONFIGURATIONS

Warning: Only the tested cable lengths and antennas provided by EST meet the FCC maximum peak output power requirements. Any other combination of antennas or coax cables is not authorized.

EST offers different types of antennas for both indoor and outdoor configurations.

Part Number: AA01S
- Omni-directional, rubber duck, direct mount, unity gain antenna.
- Indoors and short range outdoor applications.
- There must be a minimum separation distance of 20 cm. from the antenna to the user. ***See Warnings.***

Part Number: AA20DMg
- Omni-directional direct mount antenna, 3 dBd gain.
- Indoor and outdoor applications.
- There must be a minimum separation distance of 20 cm. from the antenna to the user. ***See Warnings.***

Part Number: AA20Eg
- Omni-directional external pole mount antenna, 6 dBd gain with 3-ft. integral feedline and connector.
- Outdoor applications.
- Antenna port B is not used in this configuration.
- There must be a minimum separation distance of 20 cm. from the antenna to the user. ***See Warnings.***

Part Number: AA203Eg
- Directional pole mount antenna, 8 dBd gain with 3-ft. integral feedline and connector.
- Point to point and point to multi-point outdoor applications.
- Antenna port B is not used in this configuration.
- There must be a minimum separation distance of 20 cm. from the antenna to the user. ***See Warnings.***

Part Number: AA204Eg
- Directional pole mount antenna, 17 dBd gain with 3-ft. integral feedline and connector.
- Point to point applications only.
- Antenna port B is not used in this configuration.
- There must be a minimum separation distance of 50 cm. from the antenna to the user. ***See Warnings.***

Antenna Port A **Antenna Port B**

Notes:

Antenna Port A is a transmit and receive port for use in all applications.

Antenna Port B is a receive only port and is used for dual diversity antennas applications only. This port is not used for point to point applications.

Warnings:

Only pre-made coax cables from the factory used in conjunction with either the AA20Eg omni-directional and AA203Eg or AA204Eg directional antennas meet all FCC Section 15.247(b) EIRP maximum power requirements.

Use of the AA204Eg, directional antenna is limited to fixed point to point applications only. In accordance FCC Section 15.247(b)iii, the operator or installer is responsible for ensuring the systems is used exclusively for fixed, point-to-point applications.

COAXIAL CABLE ATTENUATION

Listed below are representative cable losses in db/100 ft at the 2.4 GHz frequency range:

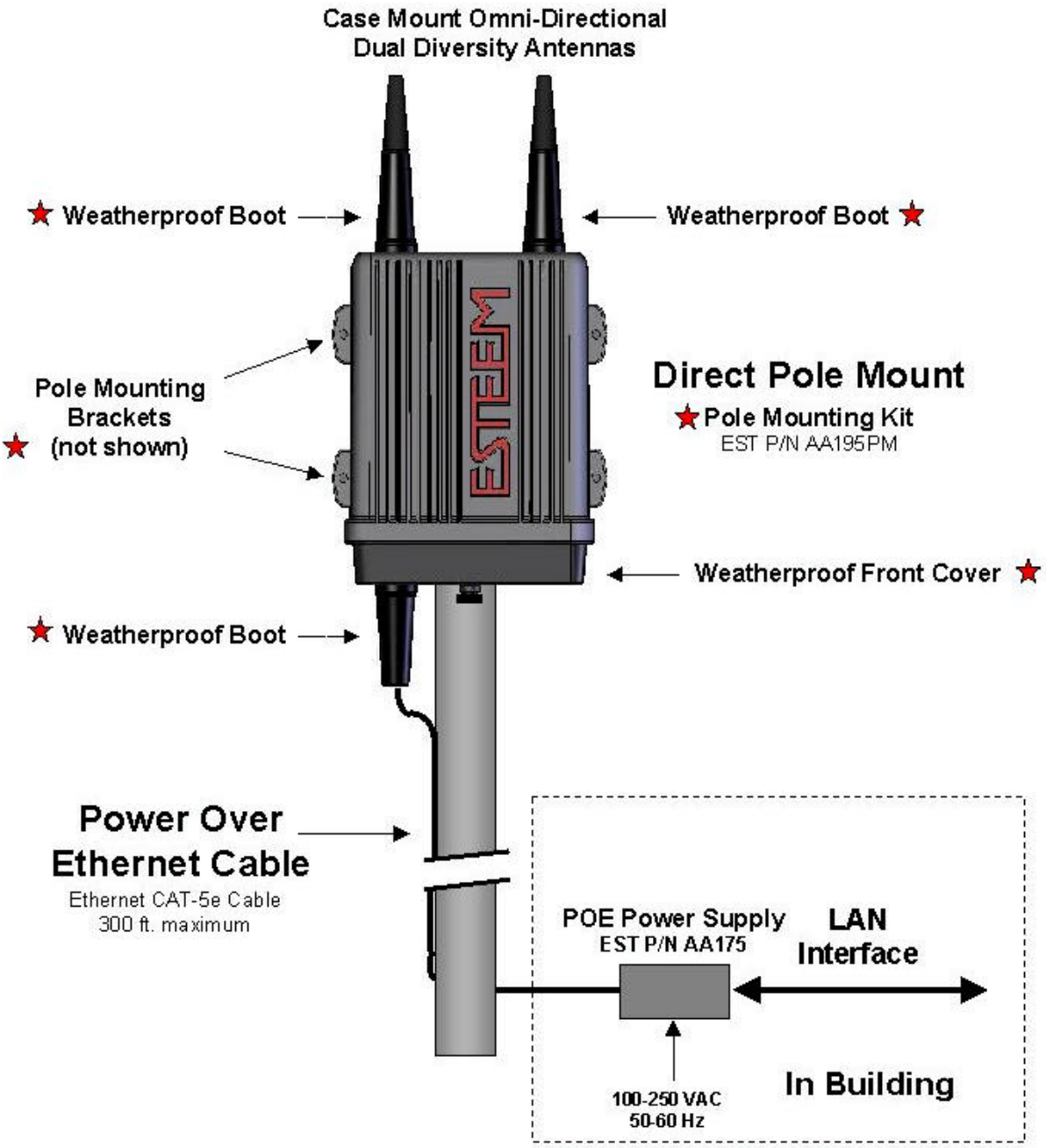
Feedline Type	Attenuation (dB/100 ft.) @ 2.4 GHz
RG-8 (Solid)	7
LMR 600	4.4
3/8" Heliax	6.5
1/2" Heliax	3.5
7/8" Heliax	2
1.25" Heliax	1.6

Note: *A -3 dB loss means you have lost 1/2 of your signal or transmitter power. A +3 dB gain means you have doubled (x2) your signal or transmitter power.*

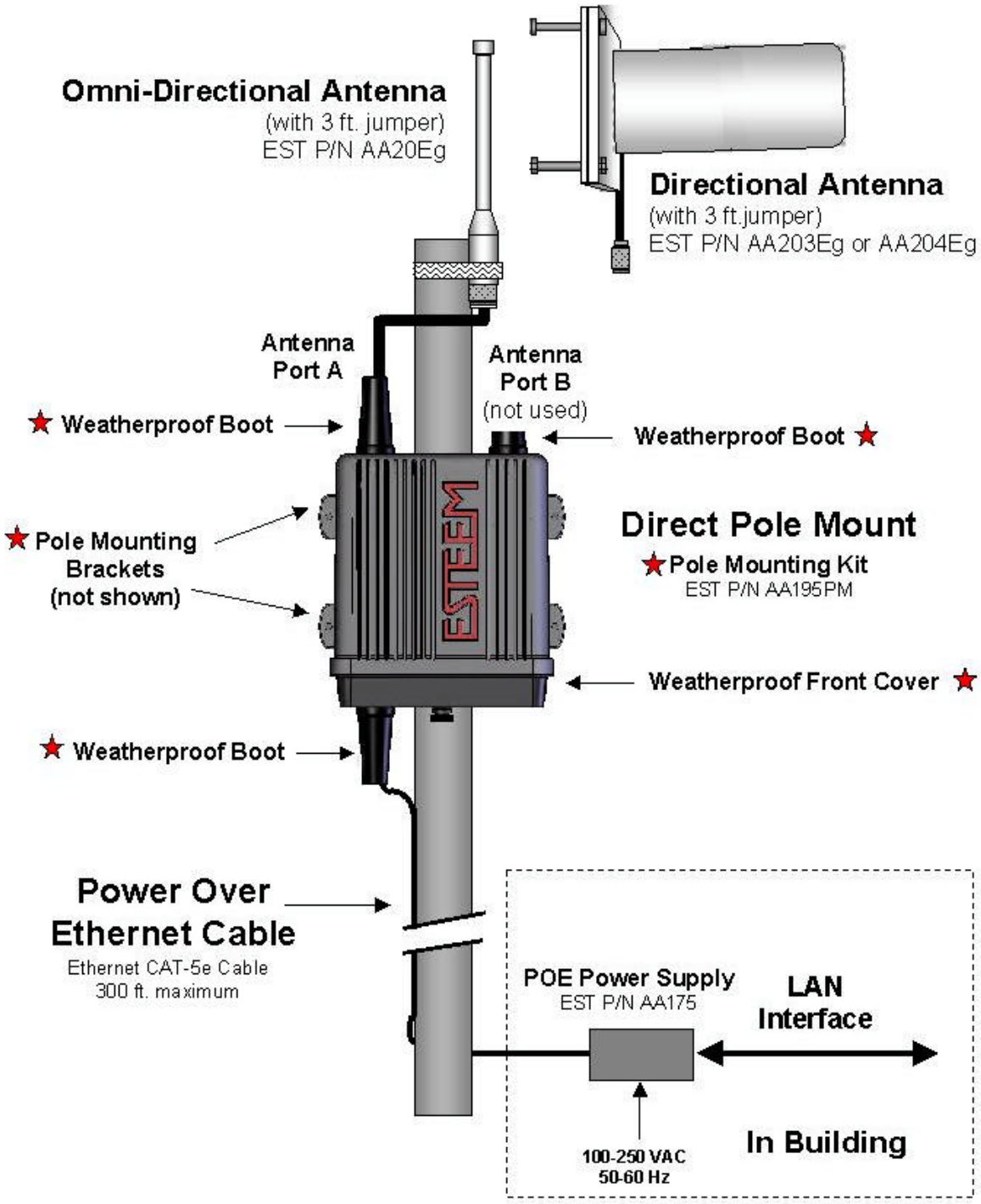
Example:

A 6 dB antenna will increase the radiated output power of a 1 watt transmitter to 4 watts {times 4 = 3 dB (x2) + 3 dB (x2)} and increase the received signal strength to receiver times 4

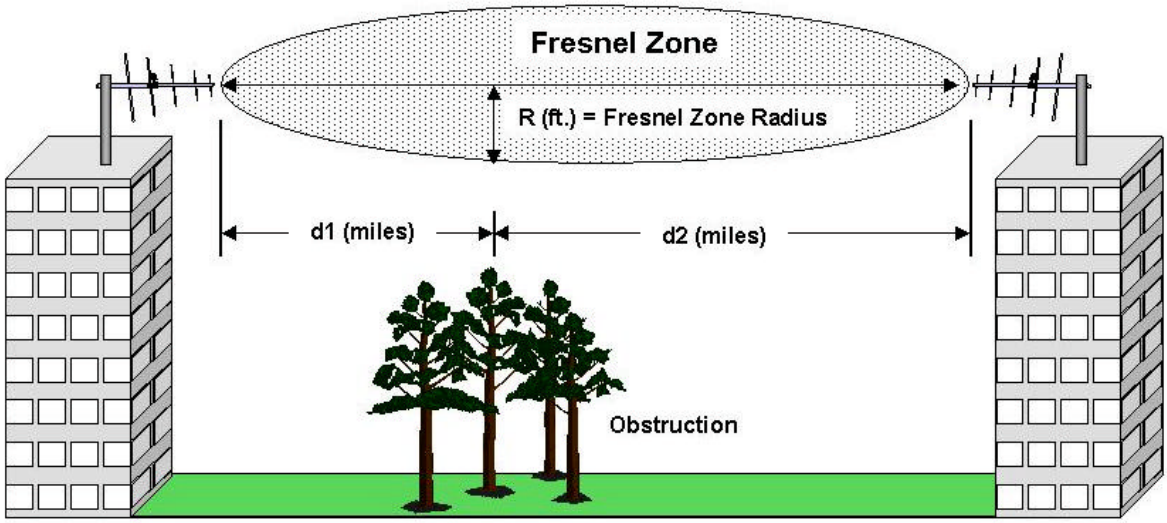
Model 195E Series with Direct Mount Dual Diversity Antennas



Model195E Series with External Mount Antennas



FRESNEL ZONE



The Fresnel zone shows the ellipsoid spread of the radio waves around the visual line-of-sight after they leave the antenna (see figure above). This area must be clear of obstructions or the signal strength will be reduced due to signal blockage. Typically, 20% Fresnel Zone blockage introduces little signal loss to the link. Beyond 40% blockage, signal loss will become significant. This calculation is based on a *flat earth.* It does not take into account the curvature of the earth. It is recommended for RF path links greater than 7 miles to have a microwave path analysis done that takes the curvature of the earth and the topography of the terrain into account.

Fresnel Zone Radius = 72.1 SQRT [(d1d2) / (F(d1 + d2)]

Units
Fresnel Zone Radius in feet.
d1 and d2 in statue miles
F in GHz

APPENDIX A
FCC INFORMATION

INFORMATION TO USERS

The ESTeem Model 195Eg 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.

Note to User:

Changes or modifications to this equipment not expressly approved by Electronic Systems Technology for compliance could void the user's authority to operate the equipment.

Other Information

Model 195Eg

Direct Sequence
FCC Type Acceptance No: ENPESTEEM195EG

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.

FEDERAL COMMUNICATIONS COMMISSION FIELD OFFICES

ALASKA
1011 E. Tudor Rd.
Rm 240 Box 2955
Anchorage, AK 99510

CALIFORNIA
Interstate Office Park
4542 Ruffner St., Room 370
San Diego, CA 92111-2216

Los Angeles Office (LA)
Ceritos Corporate Tower
18000 Studebaker Rd., Room 660
Cerritos, CA 90701-3684

San Francisco Office (SF)
5653 Stoneridge Drive, Suite 105
Pleasanton, CA 94588-8543

COLORADO
Denver Office (DV)
215 S. Wadsworth Blvd., Suite 303
Lakewood, CO 80226-1544

FLORIDA
919 Federal Bldg
51 SE First Ave.
Miami, FL 33130

Tampa Office (TP)
2203 N. Lois Ave., Room 1215
Tampa, FL 33607-2356

GEORGIA
Atlanta Office (AT)
3575 Koger Blvd., Suite 320
Duluth, GA 30096-4958

HAWAII
7304 Prince Kuhi
Federal Building
Honolulu, HI

ILLINOIS
Chicago Office (CG)
Park Ridge Office Ctr., Room 306
1550 Northwest Highway
Park Ridge, IL 60068-1460

LOUISIANA
New Orleans Office (OR)
2424 Edenborn Ave. Suite 460
Metarie, LA 70001

MARYLAND
1017 Geo. Fallon
Building 31
Hopkins Plaza
Baltimore, MD

MASSACHUSETTS
Boston Office (BS)
1 Batterymarch Park
Quincy, MA 02169-7495

MICHIGAN
Detroit Office (DT)
24897 Hathaway Street
Farmington Hills, MI 48335-1552

MINNESOTA
691 Federal Building
316 N Robert St.
St. Paul, MN

MISSOURI
Kansas City Office (KC)
520 NE Colbern Road
Second Floor
Lee's Summit, MO 64086

NEW YORK
1307 Federal Building
111 W. Huron
Buffalo, NY 14202

NEW YORK
New York Office (NY)
201 Varick Street, Suite 1151
New York, NY 10014-4870

OREGON
1782 Federal Building
1220 SW 3rd Avenue
Portland, OR 97204

PENNSYLVANIA
Philadelphia Office (PA)
One Oxford Valley Office Bld.
Room 404
2300 E. Lincoln Hwy
Langhorne, PA 19047-1859

PUERTO RICO
747 Federal Building
Carlo Chardon Ave.
Hato Rey, PR 00918

TEXAS
Dallas Office (DL)
9330 LBJ Freeway, Room 1170
Dallas, TX 75243-3429

5636 Federal Building
515 Rusk Avenue
Houston, TX 77002

WASHINGTON DC
Columbia Office (CF)
9300 East Hampton Drive
Capitol Heights, MD 20743

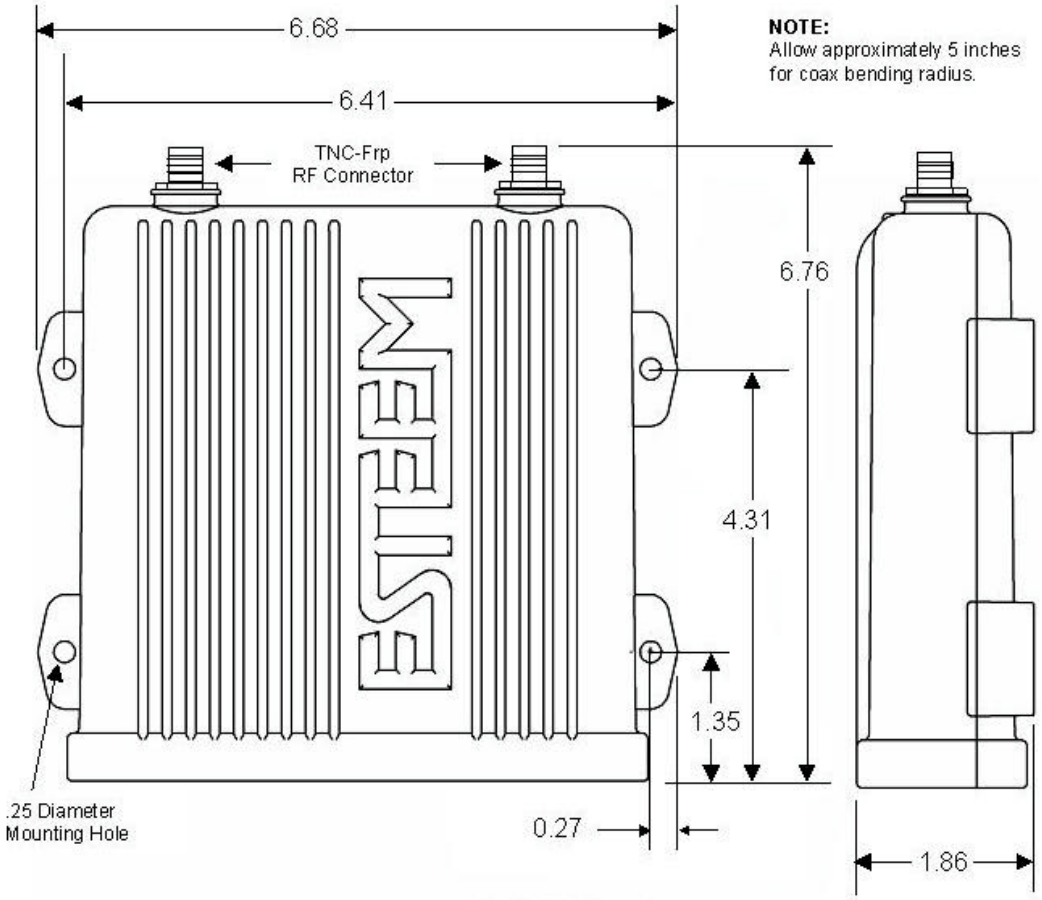
WASHINGTON
Seattle Office (ST)
11410 NE 122nd Way
Room 312
Kirkland, WA 98034-6927

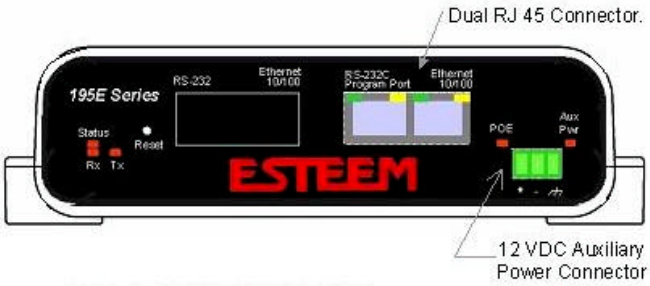
Model 195Eg Specifications

LED Indicators	
Power On/Off	Receiver On/Off
Carrier Detect On/Off	Transmitter On/Off
Link Status On/Off	
I/O Connectors	
Ethernet 10/100Base T	RJ-45
RS-232C Programming Port	RJ-45
Dual Antenna input/Outputs	TNC Reverse Female
Remote Input Power	Power Over Ethernet Cable
Direct Input Power	Optional, Header Screw Connector
Transmiter	
Frequency of Operation	2.412 to 2.462 GHz Software Selectable in 11 Channels
RF Data Rates	1,2,5.5,6,9,11,12,18,24,36,48, & 54 Mbps Fixed or Auto Scaling
Tx Output Power	1 Watt
RF Output Impedance	50 ohms
Receiver	
Rx Sensitivity	-68 dBm @54 Mbps to –89 dBm @ 1 Mbps Frame Error Rate <10%
Power	
Power over Ethernet	IEEE 802.3af Standard Power Supply, 48 VDC @ 13 Watts
Power Connector on Unit	10 to 16 VDC
Receive	320 ma @ 12 VDC
Transmit	1000 ma @ 12 VDC
Case	
Dimensions	1.9 in. H x 6.7 in. W x 6.2 in. L
Weight	1.25 lbs.
Outdoor Pole Mounting Kit	Optional, EST P/N 195PM
Other	
Warranty	1 Year
Temperature Range	-30° to +60° C
Humidity	95% Non-condensing
FCC Type Acceptance	Pending
Industry Canada Type Acceptance	Pending

Specifications Subject to Change Without Notice

Model 195Eg Case Specifications





Note:

Left connector is used for RS-232C programming port.

Right side is the Ethernet interface port.

Note:

Auxiliary Power Plug with screw termination for wiring is available.

Note: All dimensions are in inches.

Antenna Specifications

Model No: AA01S
Antenna Type: Omni-Directional, variable angle rubber duck
Applications: Direct mount
Frequency: 2400 to 2485 MHz
Polarization: Vertical
Impedance: 50 ohms
Gain: Unity
VSWR: < 1.5
Front to Back Ratio: n/a
Horizontal Beamwidth: n/a
Vertical Beamwidth: n/a
Antenna Material: Rubber duct whip.
Mounting Hardware: n/a
Antenna Connector: TNC-R Male
Antenna Envelope: 4.25 in. length by 1.75 in width
Weight: .08 lbs.

Caution

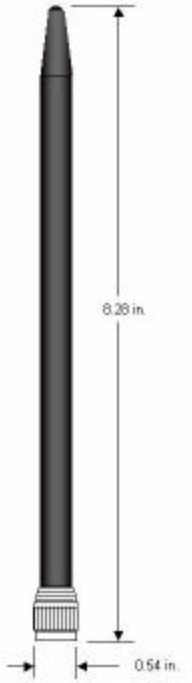
Omni-directional antenna should not be located within 20 cm of personnel.

Model AA01S

Model: AA20DMEg
Applications: Model 195Eg direct case mount
Antenna Type: Omni-Directional, Sleeve dipole
Frequency: 2400 to 2485 MHz
Polarization: Vertical
Impedance: 50 ohms
Gain: 5 dBi (3 dBd)
VSWR: < 2:1
Power: 10 W
Front To Back Ratio: n/a
Horizontal Beamwidth: n/a
Vertical Beamwidth: n/a
Antenna Material: Polyurethane Plastic Radome
Recommended Mounting Hardware: n/a
Antenna Connector: TNC-R Male
Flexibility: +/- 20 °
Antenna Envelope: 8.28 in. length by .54 in. width
Temperature: -40 to +70 C°
Weight: 33 grams

Caution

Omni-directional antenna should not be located within 20 cm of personnel.



Model AA20DMEg

Antenna Specifications

Model No:	AA20Eg
Antenna Type:	Omni Directional, DC Grounded
Applications:	Fixed base
Frequency:	2400 to 2483.5 MHz
Polarization:	Vertical
Impedance:	50 ohms
Gain:	4dBd (6 dBi)
VSWR:	< 1.5
Front to Back Ratio:	n/a
Horizontal Beamwidth:	n/a
Vertical Beamwidth:	20 degrees @ ½ power
Antenna Material:	Copper alloy radiator, UV inhibited fiberglass enclosed
Mounting Hardware:	Aluminum bracket for mounting to 1 ¼ to 2 in. diameter mast included.
Antenna Connector:	TNC-R Male with 36in. pig-tail.
Antenna Envelope:	11.6 in. length by 1.25 in. diameter
Weight:	.4 lbs.

Caution

To comply with the FCC exposure compliance requirements, a separation distance of at least 20 cm must be maintained between the antenna and all persons.

Mounting Bracket

Model AA20Eg

Antenna Specifications

Model No:	AA203Eg
Antenna Type:	Directional, DC grounded
Applications:	Fixed base.
Frequency:	2400 to 2485 MHz
Polarization:	Vertical or Horizontal
Impedance:	50 ohms
Gain:	8 dBd (10 dBi)
VSWR:	< 1.5
Front to Back Ratio:	23 dB
Horizontal Beamwidth:	55 degrees @ ½ power
Vertical Beamwidth:	55 degrees @ ½ power
Antenna Material:	Sealed in UV stable fiberglass enclosed radome
Mounting Hardware:	Stainless steel U bolts (included) for mounting up to 1 5/8 in. diameter pipe.
Antenna Connector:	TNC-R Male with 36in. pig tail
Maximum Power Input:	5 Watts
Antenna Envelope:	4.5 in. length by 3 in. diameter
Windload (RWV):	125 mph
Lateral Thrust at Rated Wind:	5.8 lbs.
Wind Surface Area:	0.060 ft^2
Weight:	1 lbs.

Caution

To comply with the FCC exposure compliance requirements, a separation distance of at least 20 cm must be maintained between the antenna and all persons.

Model AA203Eg

Antenna Specifications

Model No:	AA204Eg
Applications:	Fixed base mounting
Antenna Type:	2.4 GHz ISM, Directional, DC Grounded, Parabolic Grid
Frequency:	2400-2485 MHz
Polarization:	Vertical or Horizontal
Impedance:	50 ohms
Gain:	17 dBd (19 dBi) nominal
VSWR:	< 1.5:1 nominal
Front to Back Ratio:	>24 dB
Horizontal Beamwidth:	16 degrees @ ½ power
Vertical Beamwidth:	11 degrees @ ½ power
Antenna Material:	Zinc plated cold rolled steel with polyester power coat finish
Recommended Mounting Hardware:	Standard U-bolt steel mast clamp complete with mounting hardware. Designed for masts of up to 2.5 in. O.D.
Antenna Connector:	TNC-R Male with 36 in. pig-tail
Maximum Power Input:	10 Watts
Wind Survival:	100 mph
Wind Load:	16 mph
Antenna Envelope:	34 in. length by 17 in. width by 11 in. height
Weight:	3 lbs.

Caution

To comply with the FCC exposure compliance requirements, a separation distance of at least 50 cm must be maintained between the antenna and all persons.

Model AA204Eg

Use of the AA204Eg, directional antenna is limited to fixed point to point applications only. In accordance FCC Section 15.247(b)iii, the operator or installer is responsible for ensuring the systems is used exclusively for fixed, point-to-point applications.