

determine routing and which paths will be blocked. On a wired Ethernet network, the location of the Root Bridge is not really important, but in a wireless network selection of the Root Bridge is critical to the wireless network routing. Let's use one of the Example network diagrams from Chapter 3 to continue the discussion (Figure 4).

STP Phases

The following sections describe the process of the STP in the ESTeem Model 195C/M as how it would happen in the above example.

Learning Phase - Once properly configured, each Model 195C/M will begin to search out the other Model 195C/M units in radio range that are programmed in the AP Repeater Peer table. All Model 195C/M's will calculate their routes to every Model 195C/M in the network based upon the lowest "path length" to the Root Bridge. Path length is the total number of wireless links (repeater peer links) to transmit a packet through the wireless network to the Root Bridge. **Note: The Root Bridge in a network should be the Model 195C/M where the majority of the data flow is processed.** In every wireless network of two or more radios, the Root Bridge should be user defined. If not defined, the ESTeem 195C/M with the lowest MAC address will be designated as the Root Bridge.

In Figure 4, the Plant network (Example 1) is the most logical location for the Root Bridge based upon the amount of data flow. Setting this site as the root bridge is discussed below in Root Bridge.

Blocking and Forwarding Phase – To ensure you do not have a network loop situation due to redundant paths in your wireless network, the Model 195C/M will recognize and disable (block) one or more redundant links and provide back up links should the primary link fail. This establishes a wireless mesh network with a series of forwarding links, based upon the shortest path length to the Root Bridge.

For example, looking at Figure 4, the Remote Building has two routes to the Root Bridge (Plant Network – Example #1); directly to the site and through the repeater. The direct link between the two sites is the shortest route (lowest Path Length) and will be selected as the primary route unless overridden by manually changing the Path Length in the configuration.

Path Length

If more than one communication path to the Root Bridge is found, the 195C/M must determine which route to take based upon the lowest Path Length. The default path length to all links in the 195C/M network is 1. If the Path Lengths are equal then the lowest MAC address will determine the priority route. In the ESTeem Mesh Network we want to directly control all data flow so do **not** want the routes to be automatically determined.

Looking again at our Example in Figure 4, if we made no changes to the default path length of 1 (note values in Figure 3) the lowest path cost would be direct from the Remote Building to the Root Bridge (Plant Network).

Link Description	Total Path Length
Direct from Remote Building	1
Remote Building to Root Bridge Through Repeater	2 (Length 1 to repeater + Length 1 to Master = 2)

To configure the 195C/M to select the repeater as the primary radio path, set the path length value for the direct link greater than 2 (such as a value of 3) to make this the primary radio path. The lowest path length will identify the highest priority. The Model 195C/M will use this routing, but also switch to direct communication if the repeater were to disappear.

Root Bridge

In any Access Point Repeater network consisting of more than two sites, one Model 195C/M should be designated as the Root Bridge. Only one Model 195C/M can be designated as the Root Bridge in a given network and should be located 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 Model 195C/M's **NOT** configured as the Root Bridge will choose routing based upon the Path Length to the Root Bridge. If you have any question as to which site in your AP Repeater application should be the Root Bridge, contact ESTeem Customer Support at 509-735-9092 or e-mail your application to support@esteem.com.

The Root Bridge will be selected in one of two ways: the Root Bridge can be manually set (recommended) during the configuration of the Repeater Peer table (Figure 3) **or** the Root Bridge designation will default to the lowest MAC address of all the Model 195C/M's in the network. The manual Root Bridge configuration is located in the "Advanced Settings" section.

Redundant Backup

The ESTeem Model 195C/M configured in Access Point Repeater mode will automatically function as a redundant backup if two Model 195C/M's are installed at the same location (Figure 4). If two Model 195C/M's are connected to the same switch, one of the Model 195C/M's will be **Blocked** when the Spanning Tree Protocol is completed. The network will continue to use this route until any problem with the original Model 195C/M is detected and the second Model 195C/M will begin operation at that site.

Redundant Master Configuration

The configuration in Figure 4 will also provide a redundant backup for the Master Site (Root Bridge). Configure both Model 195C/M's as Root Bridges (see above) giving the primary Root Bridge a value of 1 and the secondary Root Bridge a value of 2.

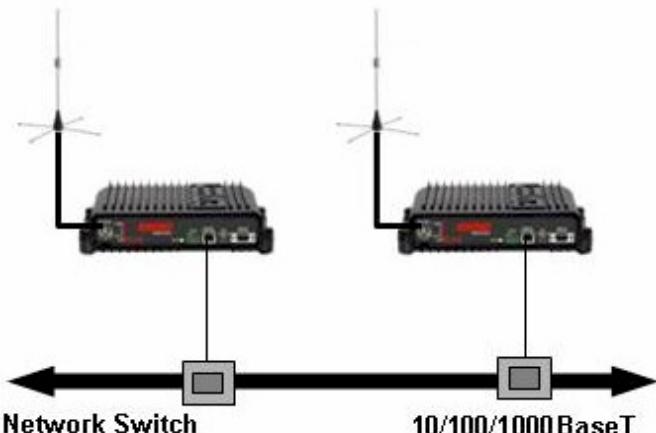


Figure 4: Redundant Backup Diagram

ESTeem offers different types of antennas ranging from $\frac{1}{4}$ wave to $\frac{5}{8}$ wave in physical size. The user choice is dependent on the application.

Communications in the VHF and UHF bands are normally over "*Line of Sight (LOS)*". Looking from the antenna of one wireless modem you must be able to see the antenna of the wireless modem you wish to communicate with. If a large object obstructs the line of sight view it is unlikely that satisfactory communications will result. This means you must relocate the antennas or use the REPEATER FEATURE and a second modem to go over or around the object.

The Model 195C/MC products are allowed by the FCC to use high gain directional antennas.

It is noted that a $\frac{1}{4}$ wave antenna that does not have ground plane radials requires a ground plane to operate at maximum efficiency. This can simply be a conducting surface under the antenna that is a $\frac{1}{4}$ wavelength in diameter. For the Model 195C (450-470 MHz) this is approximately 6.5 inches. A conducting surface can be anything from the rooftop of an automobile to a file cabinet.

COAXIAL CABLES

To minimize signal loss, the overall length of the coaxial cable should be as short as possible. To avoid corrosion select coaxial cable manufacturers with tinned copper braid, where possible. Listed below are representative cable losses in db/100ft at the VHF and UHF frequencies:

Frequency (MHz)	RG-58u	LMR 195	RG-8 (solid)	LMR600	1/2" Heliax
150-174	-5.2	-4.4	-1.7	-0.964	-0.88
402-420	-8.4	-7.8	-2.9	-1.72	-1.36
450-470	-9	-7.8	-3	-1.72	-1.45

In a severe noise environment it may be desirable to use a double shield type of coax cable such as RG-214/U.

Note: *Pre-made coax cables can be purchased from the factory. A -3 dB loss means you have lost 1/2 of your signal. A +3 dB gain means you have doubled (x2) your signal.*

Keep the antenna feedline as short as possible to minimize losses.

Extreme care must be taken when attaching coax connectors to the antenna feedlines. If there is any error in making this connection the output of the transmitter will be greatly reduced.

WEATHER PROOFING COAX CONNECTIONS

1. Lightly coat the threads of the connectors with silicone lubricant prior to assembly (See Note 1) and hand tighten. Make sure to use the silicon sparingly so when assembled, any excess does not get on center conductor. Care should be taken not to get any lubricant on the center conductor.
2. Wrap the connector assembly with a non-adhesive silicone tape, EST part number AA243, for weather proofing (See Note 2 and instructions below).
 - a) Clean surface to be wrapped. Cut off length to be used.
 - b) Peel back a short length of protective film. Keep tape clean and dry.
 - c) Begin with one complete overlap of tape onto itself.
 - d) STRETCH CoaxWrap while continuing to wrap object with "half-laps", removing clear film as you go (Figure 1). For greater pressure resistance, use 2 or more tightly wrapped layers.
 - e) End of tape at final wrap should be completely positioned onto itself.

Note: CoaxWrap's bond begins to cure immediately upon contact with itself. Repositioning or removal is not recommended after 2 minutes of wrapping.

3. Apply an electrical coating (sealing agent), over the vapor barrier patch for added protection (See Note 3).

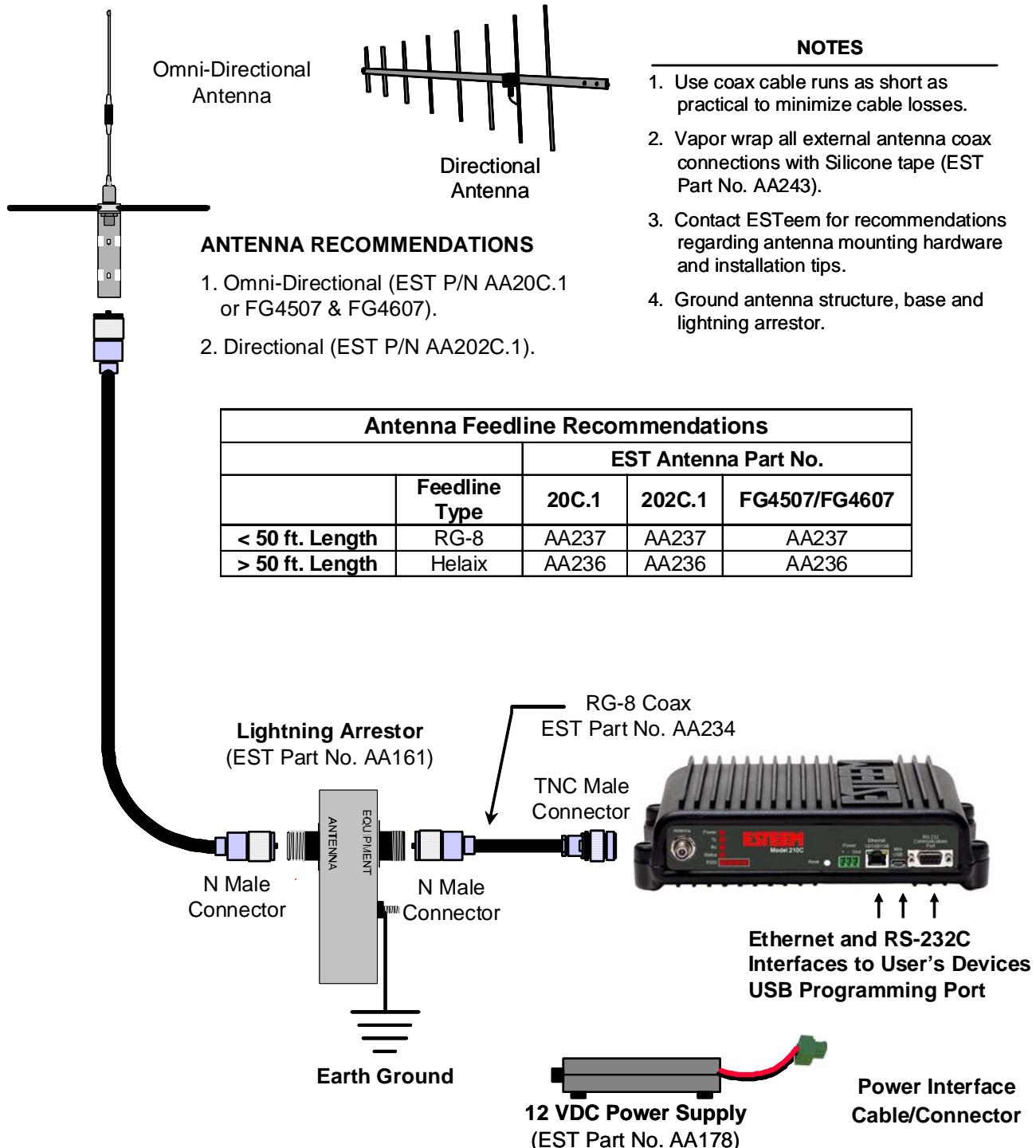
NOTES:

1. Dow Corning RTV-3140 or equivalent.
2. CoaxWrap, CW10B or equivalent.
3. SCOTCHKOTE, 3-M Company, or equivalent.



Figure 1: Installation Example

Model 210C Outdoor Fixed Base Hardware Diagram



INFORMATION TO USERS

WARNING: 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 generated, 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 their expense.

To insure compliance to FCC non-interference regulations, peripherals attached to this modem require shielded I/O cables.

If this equipment does cause interference to radio or television, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

1. Re-orient the radio/TV-receiving antenna.
2. Re-orient the modem antenna.
3. Relocate the modem with respect to the radio/TV-receiving antenna.
4. Plug the power supply for the modem into a different outlet so that the modem and radio/TV receiver are on different branch circuits.
5. Verify that the modem chassis is connected to an earth ground.
6. Attach a split bead (FAIR-RITE PN 2643164251) to the RS-232 cable.

If necessary, the user should consult the dealer or an experienced radio/TV technician for additional suggestions. The user may find the following booklet prepared by the FCC helpful.

"How to Identify and Resolve Radio-TV Interference Problems"

This booklet is available from the U.S. Government Printing Office, Washington, D.C. 20402 - Stock No. 004-000-00245-4. Application forms for the license are available from the nearest office of the FCC.

Electronic Systems Technology maintains a list of consultants that provide professional services at a reasonable cost to assist the users in licensing.

RF EXPOSURE WARNING: A minimum separation must be maintained between the user and nearby antenna at the following distances:

Antenna AA19C: 1 meter (40 inches)
Antenna AA20C.1: 1.25 meters (50 inches)
Antenna AA202C: 2.5 meters (100 inches)

Antenna AA19M: 1 meter (40 inches)
Antenna AA20M: 2 meters (80 inches)
Antenna AA202M: 2 meters (80 inches)

Type Acceptance and RF Emissions Information

Model 195C

12.5 KHz Channel Spacing, 9,600 bps

FCC Type Acceptance No: ENPESTEEM195C

12.5 KHz Channel Emissions Designator: 10K8F1D

6.25 KHz Channel Emissions Designator: 5K4F1D

Industry Canada Type Acceptance: 2163A-192195C

12.5 KHz Channel Emissions Designator: 10K8F1DDN

6.25 KHz Channel Emissions Designator: 5K4F1DDN

Model 195M

12.5 KHz Channel Spacing, 9,600 bps

FCC Type Acceptance No: ENPESTEEM195M

12.5 KHz Channel Emissions Designator: 10K8F1D

6.25 KHz Channel Emissions Designator: 5K4F1D

Industry Canada Type Acceptance: 2163A-192195M

12.5 KHz Channel Emissions Designator: 10K8F1DDN

6.25 KHz Channel Emissions Designator: 5K4F1DDN

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Dallas, TX 75243-3429

5636 Federal Building

515 Rusk Avenue
Houston, TX 77002

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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

ETHERNET INTERFACE

The ESTeem Model 195C/M's Ethernet Port is a Full and Half-Duplex Auto-negotiation interface supporting 10 Mbps, 100 Mbps and 1Gbps (10/100/1000BaseT). The port is compatible with TIA/EIA-568B cable configuration (Figure 1).



Figure 1: Ethernet Pin Layout

RJ45 Pin No.	Wire Color	Wire Diagram	10Base-T Signal 100Base-TX Signal
1	White/Orange		Transmit +
2	Orange		Transmit -
3	White/Green		Receive +
4	Blue		+ Power
5	White/Blue		+ Power
6	Green		Receive -
7	White/Brown		- Power
8	Brown		- Power

RS-232C DATA PORT CONFIGURATION

The ESTeem Model 195C/M has a 9-pin RS-232C data interface on the front panel. See Chapter 6 for further information on serial data port configuration. To interface the 195C/M to the serial port on the computer, you need serial cable with the following pin-out:

ESTeem Model 195C/M RS-232C Port Pin-Out Table

Function	DB-9 Pin No.
Data Set Ready (DSR)	6
Data Carrier Detect (DCD)	1
Data Terminal Ready (DTR)	4
Signal Ground (GND)	5
Receive Data (RxD)	2
Transmit Data (TxD)	3
Clear to Sent (CTS)	8
Request to Sent (RTS)	7

195C/M FREQUENCIES OF OPERATION

In a wireless Ethernet network all of the ESTeem Model 195C/M must be set to the same radio frequency of operation. The frequency of operation is selectable when configuring the mode of operation of the 195C/M (reference Chapter 3).

SETTING RF POWER LEVEL

The ESTeem Model 195C/M peak power is adjustable in output power from the advanced configuration menu. The output power is adjusted on the **Advanced Menu>Wireless LAN Settings>Wlan0 Device** screen (Figure 4) of the Web Configuration Manager. Select the value and press the *Save Settings* button.

Max (Maximum)	Full Power
Hi (High)	75% Power
Lo (Low)	50% Power
Min (Minimum)	25% Power

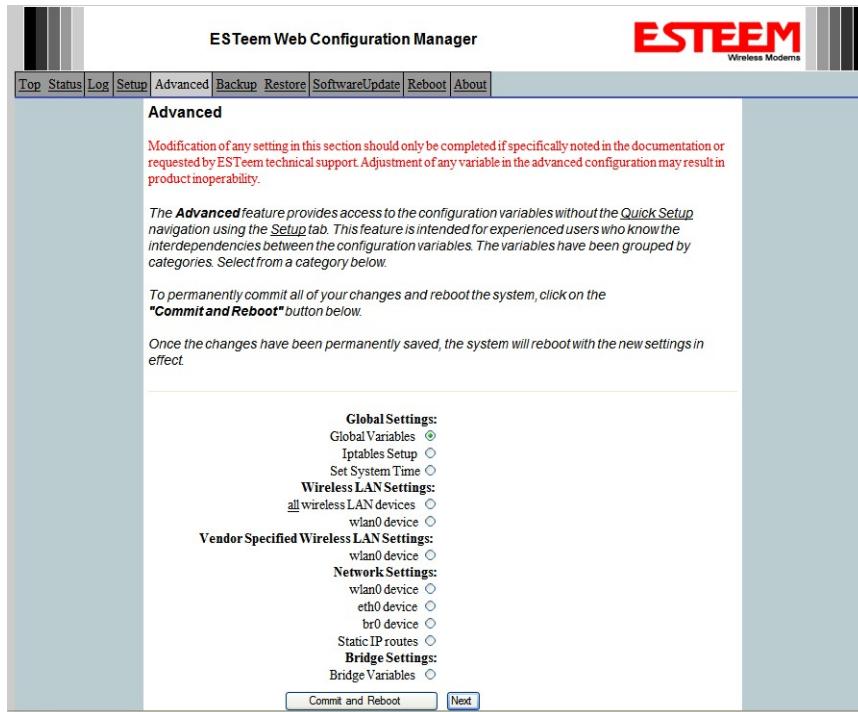


Figure 1: Advanced Global Variables

wlan0_POWER_LEVEL	Max <input checked="" type="radio"/>	Select power level for wlan0 attenuator
	High <input type="radio"/>	
	Low <input type="radio"/>	
	Min <input type="radio"/>	
wlan0 Radio On	<input type="checkbox"/> On	Turn transmitter on continuously. The device will automatically reboot after the transmitter has been on for 10 seconds.
<input type="button" value="Return to Advanced"/> <input type="button" value="Save Settings"/>		

Figure 2: Power Level Settings

TESTING COMMUNICATION LINK

After you have configured at least two of the Model 195C/M wireless Ethernet modems for operation, you can verify communication with each the following steps:

Status Light

The quickest source of link status is to view the Status Light on the face of the 195C/M (Figure 1). If the Status light is solid, the Model 195C/M has a connection to another Model 195C/M listed in the Peer Table.



Figure 1: Connection Status Light

Status Screen/Peer Table

To view detailed information on the status of the communication link (such as connection speed, signal strength and last update time) you can open the Status Screen from the Web Interface. After press the Status tab at the top of the screen the Status: Summary will be displayed showing the status of all ports and memory in the 195C/M. Under the Wireless Status heading click on the View Peer Table (Figure 2). The Peer Table will list all other Wifi (195C/Mg and 195C/Ma only) or mobile client wireless activity seen by the 195C/M and how it is classified.

Note: The data rate displayed is *not necessarily* indicative of the RF data rate between the ESTEEMS. The rate show in the Repeater Peer table will be the last RF packet, which could consist of either data, repeater beacon or network

Opposite Modem's Wireless MAC				
Associated Stations				
None				
Repeater Peers				
MAC Addr	Signal	LastRx (sec@kbps)	Modem ID	
00:04:3f:00:09:66	-36	0@11000	Remote	Peer Modem ID

Access Points				
MAC Addr	Signal	LastRx (sec@kbps)	Enc	SSID
00:02:2d:03:2a:78	-70	0@2000	y	
00:02:2d:3f:7d:d3	-89	8@2000	y	
00:04:3f:00:09:66	-36	0@11000	y	ESTEEM

Figure 2: Repeater Peer Table

probes.

Repeater Peers - The Peer Table will display all connected 195C/Ms configured to repeat to this ESTeem by their Wireless (WLAN) MAC address.

Received Signal Strength – This is the first of the two numbers listed in the block. This signal strength value is listed in dBm.

Last RX – This is the time of the last received data packet. When monitoring the status menu, it is important to note the time the last transmission was updated so you are not looking at “stale” data.

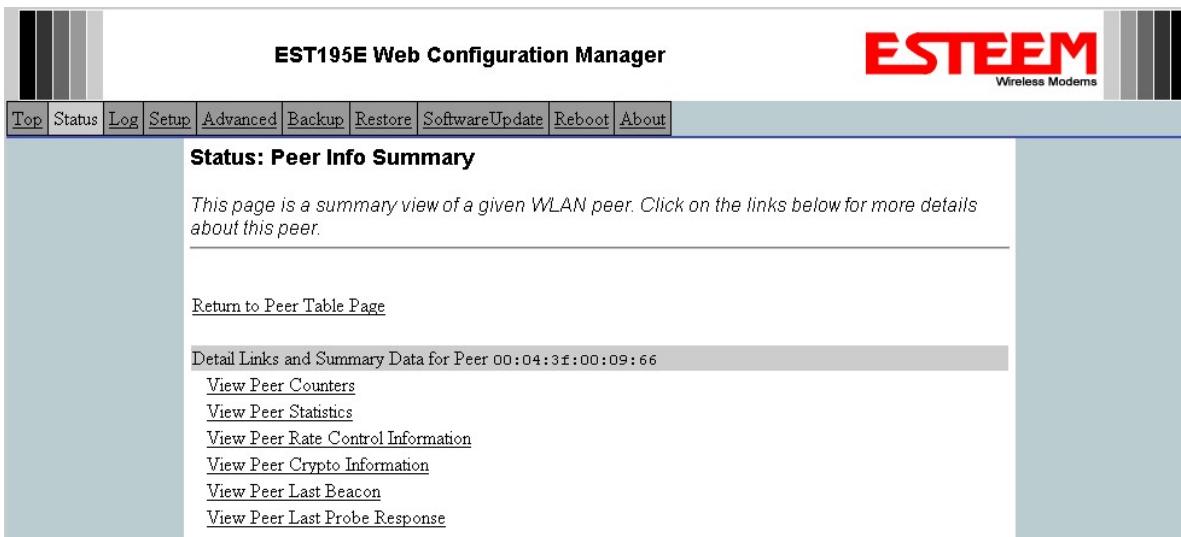
Current Data Rate – This is the current speed the last data packet received by the Model 195C/M. This may not be the data rate between the radio modems. Note that the speed is listed in kbps, so that 11000 kbps is equal to 11 Mbps.

Note: The ESTeem Model 195C/M uses spread spectrum technology that analyzes each data packet for signal strength and data quality (strength vs. noise). The higher your signal, the more background noise you can sustain without causing degradation in the data transfer. This is also true for lower signal strengths with a very low background noise. These values are provided for guidance and if you have any questions about the values in your application, please contact ESTeem Customer Support at 509-735-9092 or e-mail your application to support@esteem.com.

Modem ID – This is Modem ID for the opposite repeater peer.

Viewing RF Data Rates

The value shown on the Peer Status Screen for data rate may not be the actual rate of the RF link. To view the link information, click on the Opposite Modems WLAN MAC address in the Repeater Peer list (Figure 2) and further link status information will be displayed (Figure 3).



EST195E Web Configuration Manager

Status: Peer Info Summary

This page is a summary view of a given WLAN peer. Click on the links below for more details about this peer.

[Return to Peer Table Page](#)

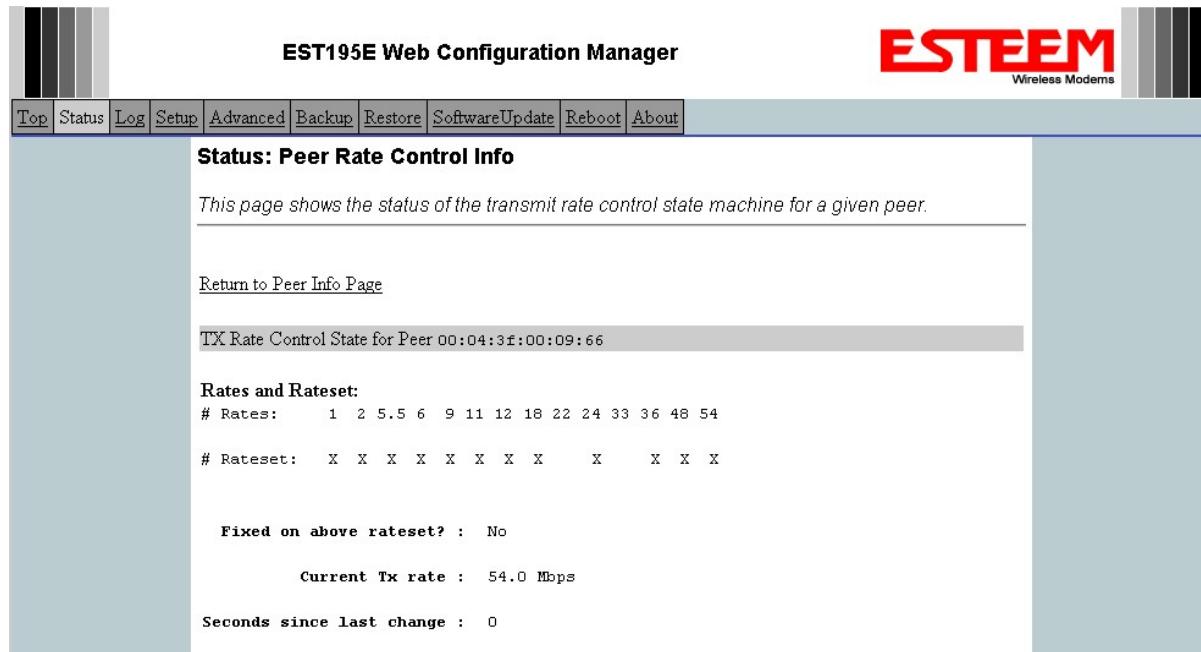
Detail Links and Summary Data for Peer 00:04:3f:00:09:66

[View Peer Counters](#)
[View Peer Statistics](#)
[View Peer Rate Control Information](#)
[View Peer Crypto Information](#)
[View Peer Last Beacon](#)
[View Peer Last Probe Response](#)

Figure 3: Peer Summary Table

Once loaded, click on View Peer Rate Control Information. (Figure 4)

The value of the Current TX rate is the RF data rate between the two ESTeem Model 195C/M.



EST195E Web Configuration Manager

Status: Peer Rate Control Info

This page shows the status of the transmit rate control state machine for a given peer.

[Return to Peer Info Page](#)

TX Rate Control State for Peer 00:04:3f:00:09:66

Rates and Rateset:

# Rates:	1	2	5.5	6	9	11	12	18	22	24	33	36	48	54
# Rateset:	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Fixed on above rateset? : No

Current Tx rate : 54.0 Mbps

Seconds since last change : 0

Figure 4: Rate Control Information

SIGNAL STRENGTH VS DATA RATE

The average signal strength required to maintain a specific data rate will vary by ESTeem 195C/M model and bandwidth. To review the required signal level and its effect from distance and hardware selected, please use the ESTeem RF Design program available from our web site (www.esteem.com). Please note that the data rates can be greatly affected by overall activity on the radio channel and the total background noise. These values should be used as a guide, but testing after installation is required.

LONG RANGE POINT TO POINT APPLICATIONS

The factory configuration on the 195C/M is optimized for distances up to 10 miles. If your application has an RF link with a range greater than 10 miles, you will need to set the maximum range value on both ESTeem 195C/M's on this communication link. To access the Maximum Distance value select **Advanced** from the top Menu then **Wireless LAN Settings>wlan0 device** and press the **Next** button (Figure 5).

Scroll down the menu list until you find the Maximum Distance variable (Figure 6). Enter the maximum distance of the connection in miles. At the bottom of the screen press **Return to Advanced** button and then **Commit and Reboot** button (Figure 5) to save the information.

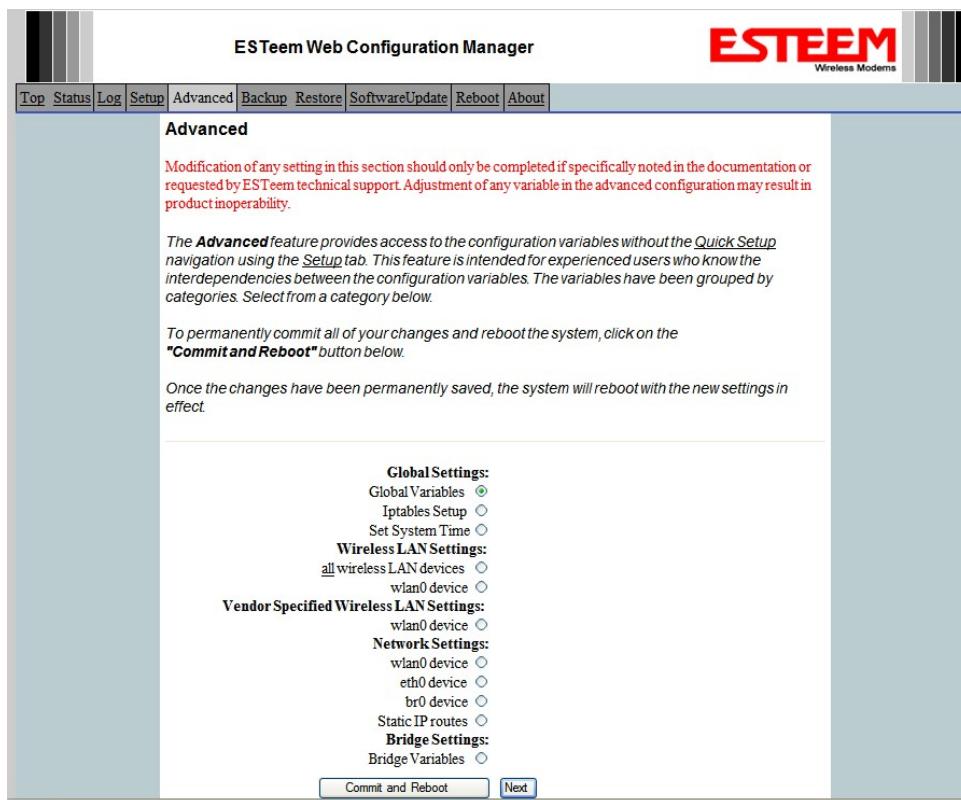


Figure 5: Advanced Features Screen

wlan0_MAX_DISTANCE: <input type="text" value="10"/>	Enter the max distance between nodes in miles (0-17)
---	--

Figure 6: Maximum Distance Value Entry

TROUBLESHOOTING TIPS**General (Applicable to All Modes of Operation)**

Where do I find the latest firmware version number? – We have the latest version number of the Model 195C/M firmware listed on the ESTeem Web site (www.esteem.com) under the Model 195C/M product page.

How and when do I update the Model 195C/M firmware? - You should only update the Model 195C/M firmware if you are having a specific problem and it is recommended that you do so by ESTeem Customer Support personnel. All the update instructions and files are located on the ESTeem FTP site at the following address:

<ftp://www.esteem.com/195C/M>

Do all firmware versions have to be the same to communicate between the Model 195C/M? – It is not necessary for all the firmware versions to be the same revision to communicate, but the later version may have added features that the other versions will not recognize.

What characters are valid for WEP Key entry? - Only the Hexadecimal characters 0-9 and A-F are valid for key entry.

What ESTeem Utility version is required to program the Model 195C/M? – The ESTeem Utility program is not required to program the Model 195C/M. The 195C/M can be programmed using any Terminal Emulation program (such as Windows HyperTerminal) and any web browser program.

What is the speed and duplex configuration on the Model 195C/M? – The Model 195C/M is an auto-negotiation full/half-duplex 10/100 Base-T interface. Ether a cross-over or patch cable is supported.

Access Point Mode

Wireless LAN cards are not connecting – Verify that the wireless LAN cards are set to Infrastructure Mode, have a matching SSID (or ESSID) set the same as the Model 195C/M and that all encryption codes are the same.

My Wireless LAN card shows a solid connection, but I can not pass any data – Verify the encryption and the ACL setting on the Model 195C/M match the wireless LAN card.

Access Point Repeater Mode

How long does it take to re-establish the Wireless Ethernet Network? - If a communication link is lost and the Wireless Network needs to re-establish the repeater routes, the time can take up to 10 seconds.

Should the AP Repeater Mode be used on mobile equipment? - The AP Repeater mode should be used on equipment that will not change the Repeater Route as it moves. For example, if a mobile device such as a crane can communicate directly to another ESTeem and will not loose the link in its travel, the AP Repeater Mode could be used. If the device requires two ESTeem Model 195C/M's (Base and Repeater) to maintain communication across its complete travel, the Station Modes should be used on the mobile device. The problem will be in the time that the mobile ESTeem will take to transfer between the two sites. In Access Point Repeater mode the transfer can take up to 30 seconds, while the EtherStation mode will transfer without a packet loss.

Does WEP have to be used? – The WEP does not have to be enabled for the modems to communicate, but all modems must be configured the same way.

Correct configuration, but cannot establish communications. – In addition to the network configuration, all 195C/M modems configured in the AP mode must share the same SSID and be on the same frequency channel. The most likely cause of the error is the WLAN MAC address is not configured in **both** 195C/M's repeater tables. If only one side is configured, everything will appear to be correct but no communication will function.

EtherStation

How do I access the Model 195C/M web page in EtherStation Mode? The Model 195C/M does not have an active web browser when configured in EtherStation mode. You must access the ESTeem with the ESTeem Discovery Program or through the RS-232 port after configuration in this mode. To monitor the link status, you can use the EtherStation Status program.

What IP address do I configure the ESTeem in EtherStation mode? – The Model 195C/M will not have an IP address in EtherStation mode.

I can not link my device into the wireless network – Verify that the MAC address of the device is **exactly** the same as configured in the Model 195C/M. The MAC address must have colons between the values.

Can I connect my Model 195C/M in EtherStation mode to a HUB or Ethernet Switch? – No. The modem must be connected directly to the Ethernet device for which it is programmed. In EtherStation mode the Model 195C/M can only service ONE Ethernet device.

ESTeem 195C Specifications	
Transmitter/Receiver	
Frequency of Operation (Software Selectable)	450 to 470 Mhz (6.25Khz / 12.5 Khz Channel Spacing)
Frequency Stability, -30C to +60C	+/- 1.5ppm
RF Data Rate @ 6.25Khz channel spacing	4.8Kbps
RF Data Rate @ 12.5Khz channel spacing	9.6Kbps
Tx Output Power (Software Adjustable)	0.5 to 4 Watts
Tx Output Impedance	50 ohms
Rx Sensitivity	-110 dBm
Rx Adjacent Channel Rejection	> 55 dB
Modulation	4-Level GFSK
Forward Error Correction	TCM, Coding Rate 3/4
Data Error Detection	32-Bit Cyclic Redundancy Check
FCC ID	ENPESTEEM195C
Industry Canada Type Acceptance	2163 192 195C
LED Indicators	Power (48VDC, 12V-Aux), Status Multi-Color LED (Tx, Rx, Rx-Valid, Rx-Error), RS-232 Tx/Rx, RS-485 Tx/Rx, RS-422 Tx/Rx, Ethernet Activity / Link
Data Packet Information	
Radio Addressing	1-254 Total Units, Digi-repeating allows up to 3 repeaters between end-points
Data Packet Size	1-2000 Bytes
Serial Data Interface Buffer Size	8Kbytes Tx / 8Kbytes Rx
Data Retry	Software Adjustable
Power Requirements	
Receive / Without Ethernet Link	120 ma @ 12 VDC
Receive / With Ethernet Link	160 ma @ 12 VDC
Transmit @ 4 Watts RF Output	1540 ma @ 12 VDC
External 48 VDC Power Supply, EST P/N (tba)	30 Watts, RJ-45 Connector, Cat 5 Cable (300 Ft Maximum)
External DC Power Input	10.8 to 15 VDC
Input/Output Connectors	
Ethernet Port (10/100)	RJ-45 Female
Serial Data Interfaces (One of four selectable)	Baud Rates 2400 to 115,200
1. RS-232 Port 1 (4-Wire) Tx,Tx-Gnd,Rx,Rx-Gnd	RJ-45 Female (Shared with 48VDC Port)
2. RS-232 Port 2 (With Handshaking Signals)	RJ-45 Female, Optional RJ-45 To DB9, 3-Wire Adaptor Available
3. RS-485 Port	RJ-45 (Shared With 4-20 mA Sensor Port)
4. RS-422 Port	RJ-45 (Shared With Ethernet Port)
4-20 mA I/O	RJ-45 Female (Shared With RS-485 Port)
Antenna Input/Output	TNC Female Connector
External DC Input Power	Mini-Combicon, 3 pin female
Protocols	
Serial Data Interface, Master PLC mode protocols supported by auto-digi-repeater function	Allen Bradley DF1, Opto22, Modbus RTU/ASCII, and Transparent protocols
Ethernet Interface protocols supported for remote access via ARP proxy on Master Gateway Unit	ICMP Echo (ping), Modbus/TCP (Aux Voltage, 4-20mA readings, RSSI, MCU Core Temperature), Remote Configuration
Ethernet Interface protocols (direct access only)	Telnet, IP Configuration, Firmware upgrades
Mechanical / Environmental	
Temperature Range	-30° to +60° C
Humidity	95% Non-condensing
Dimensions	1.9 in. H x 6.7 in. W x 6.2 in. L
Weight	1.25 lbs.
Product Warranty	1 Year
Options	
Outdoor Pole Mount Kit	AA195PM
48 VDC Power Supply	TBD
RJ-45 To DB9 Serial Adaptor	TBD
RJ-45 To Terminal Block Adaptor	TBD
Antennas/Surge Protectors/Cables, etc.	Contact factory for various options (market@esteem.com or 509-735-9092)

Antenna Specifications

Model No:	AA19C
Antenna Type:	Omni-Directional, $\frac{1}{2}$ Wave
Applications:	Mobile Mount.
Frequency:	450 to 470 MHz - AA19C 400 to 420 MHz - AA19F
Polarization:	Vertical
Impedance:	50 ohms
Gain:	2 db.
VSWR:	< 2 to 1
Front To Back Ratio:	n/a
Horizontal Beamwidth:	n/a
Vertical Beamwidth:	60 degrees
Antenna Material:	Rubber duck whip.
Mounting Hardware:	Magnetic base.
Antenna Connector:	TNC with 12 feet integral RG-58 cable.
Antenna Envelope:	16 in. length. Magnetic base 3.5 in. by 3 in by 1 in.
Weight:	1 lb. 5 oz.



Model AA19C

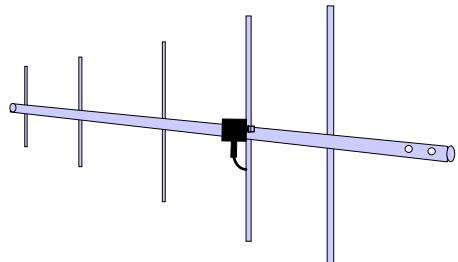
Model No:	AA20C.1
Antenna Type:	Omni-Directional, DC grounded, Collinear 5/8 wave over 1/2 wave.
Applications:	Fixed base or mobile mounting. L shaped mounting bracket may be removed for panel mounting. Ground plane radials may be removed depending on application.
Frequency:	450 to 470 MHz - AA20C.1
Polarization:	Vertical
Impedance:	50 ohms
Gain:	4.5 dB.
VSWR:	< 1.5
Front To Back Ratio:	n/a
Horizontal Beamwidth:	n/a
Vertical Beamwidth:	30 degrees
Antenna Material:	Stainless steel whip and ground plane radials. All other hardware anodized metal.
Mounting Hardware:	Stainless steel clamps for mounting to $\frac{3}{4}$ in. to 1/2 in. pipe with right angle mount or direct mount.
Antenna Connector:	N-Type Female
Antenna Envelope:	37 $\frac{1}{2}$ in. length by 16 in width with ground plane radials.
Weight:	2 lbs.



Model AA20C.1

Antenna Specifications

Model No:	AA202C & AA202F
Antenna Type:	Directional, DC grounded, 5 element yagi.
Applications:	Fixed base.
Frequency:	450 to 470 MHz - AA202C 400 to 420 MHz - AA202F
Polarization:	Vertical or Horizontal
Impedance:	50 ohms
Gain:	10 dB
VSWR:	< 1.5
Front To Back Ratio:	20 dB
Horizontal Beamwidth:	59 degrees
Vertical Beamwidth:	53 degrees
Antenna Material:	High strength aluminum with gold chromate finish.
Mounting Hardware:	Heavy duty U bolts for mounting up to 2 1/8 in. pipe with right angle mount or direct panel mount.
Antenna Connector:	N-Type Female
Maximum Power Input:	300 Watts
Antenna Envelope:	34.5 in. length by 13.25 in. width
Windload (RWV):	100 mph
Weight:	1.68 lbs.

**Model AA202C/F**

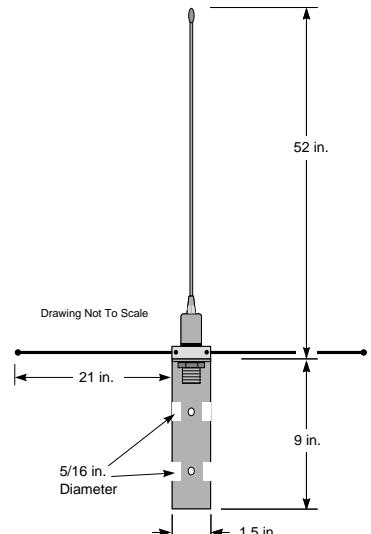
ESTeem 195M Specifications	
Transmitter/Receiver	
Frequency of Operation (Software Selectable)	150 to 174 Mhz (6.25Khz / 12.5 KHz Channel Spacing)
Frequency Stability, -30C to +60C	+/- 1.5ppm
RF Data Rate @ 6.25Khz channel spacing	4.8Kbps
RF Data Rate @ 12.5Khz channel spacing	9.6Kbps
Tx Output Power (Software Adjustable)	0.5 to 4 Watts
Tx Output Impedance	50 ohms
Rx Sensitivity	-110 dBm
Rx Adjacent Channel Rejection	> 55 dB
Modulation	4-Level GFSK
Forward Error Correction	TCM, Coding Rate 3/4
Data Error Detection	32-Bit Cyclic Redundancy Check
FCC ID	ENPESTEEM195M
Industry Canada Type Acceptance	2163 192 195M
LED Indicators	Power (48VDC, 12V-Aux), Status Multi-Color LED (Tx, Rx, Rx-Valid, Rx-Error), RS-232 Tx/Rx, RS-485 Tx/Rx, RS-422 Tx/Rx, Ethernet Activity / Link
Data Packet Information	
Radio Addressing	1-254 Total Units, Digi-repeating allows up to 3 repeaters between end-points
Data Packet Size	1-2000 Bytes
Serial Data Interface Buffer Size	8K bytes Tx / 8K bytes Rx
Data Retry	Software Adjustable
Power Requirements	
Receive / Without Ethernet Link	120 ma @ 12 VDC
Receive / With Ethernet Link	160 ma @ 12 VDC
Transmit @ 4 Watts RF Output	1540 ma @ 12 VDC
External 48 VDC Power Supply, EST P/N (tba)	30 Watts, RJ-45 Connector, Cat 5 Cable (300 Ft Maximum)
External DC Power Input	10.8 to 15 VDC
Input/Output Connectors	
Ethernet Port (10/100)	RJ-45 Female
Serial Data Interfaces (One of four selectable)	Baud Rates 2400 to 115,200
1. RS-232 Port 1 (4-Wire) Tx,Tx-Gnd,Rx,Rx-Gnd	RJ-45 Female (Shared with 48VDC Port)
2. RS-232 Port 2 (With Handshaking Signals)	RJ-45 Female, Optional RJ-45 To DB9, 3-Wire Adaptor Available
3. RS-485 Port	RJ-45 (Shared With 4-20 mA Sensor Port)
4. RS-422 Port	RJ-45 (Shared With Ethernet Port)
4-20 mA I/O	RJ-45 Female (Shared With RS-485 Port)
Antenna Input/Output	TNC Female Connector
External DC Input Power	Mini-Combicon, 3 pin female
Protocols	
Serial Data Interface, Master PLC mode protocols supported by auto-digi-repeater function	Allen Bradley DF1, Opto22, Modbus RTU/ASCII, and Transparent protocols
Ethernet Interface protocols supported for remote access via ARP proxy on Master Gateway Unit	ICMP Echo (ping), Modbus/TCP (Aux Voltage, 4-20mA readings, RSSI, MCU Core Temperature), Remote Configuration
Ethernet Interface protocols (direct access only)	Telnet, IP Configuration, Firmware upgrades
Mechanical / Environmental	
Temperature Range	-30° to +60° C
Humidity	95% Non-condensing
Dimensions	1.9 in. H x 6.7 in. W x 6.2 in. L
Weight	1.25 lbs.
Product Warranty	1 Year
Options	
Outdoor Pole Mount Kit	AA195PM
48 VDC Power Supply	TBD
RJ-45 To DB9 Serial Adaptor	TBD
RJ-45 To Terminal Block Adaptor	TBD
Antennas/Surge Protectors/Cables, etc.	Contact factory for various options (market@esteem.com or 509-735-9092)

Antenna Specifications

Model No:	AA19M
Antenna Type:	Omni-Directional, $\frac{1}{2}$ Wave over $\frac{1}{4}$ Wave
Applications:	Mobile Mount.
Frequency:	150-174 MHz
Polarization:	Vertical
Impedance:	50 ohms
Gain:	Unity
VSWR:	< 1.5 to 1
Front To Back Ratio:	n/a
Horizontal Beamwidth:	n/a
Vertical Beamwidth:	60 degrees
Antenna Material:	Rubber duck whip.
Mounting Hardware:	Magnetic base.
Antenna Connector:	TNC with 12 feet integral RG-58 cable.
Antenna Envelope:	11 in. length. Magnetic base 3.5 in. by 3 in by 1 in.
Weight:	1 lb. 5 oz.

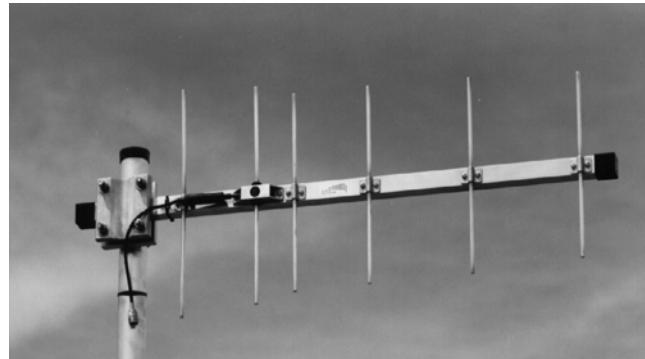
**Model AA19M**

Model No:	AA20M
Antenna Type:	Omni-Directional, DC grounded, Collinear 5/8 wave
Applications:	Fixed base or mobile mounting. L shaped mounting bracket may be removed for panel mounting. Ground plane radials may be removed depending on application.
Frequency:	150 to 175 MHz
Polarization:	Vertical
Impedance:	50 ohms
Gain:	3.0 dBD with ground plane radials
VSWR:	< 1.5
Front To Back Ratio:	n/a
Horizontal Beamwidth:	n/a
Vertical Beamwidth:	60 degrees
Antenna Material:	Stainless steel whip and ground plane radials. All other hardware anodized metal.
Mounting Hardware:	Stainless steel clamps for mounting to $\frac{3}{4}$ in. to 1.5 in. pipe with right angle mount or direct mount.
Antenna Connector:	UHF Female (SO-239)
Antenna Envelope:	61 in. length by 43.5 in. width with ground plane radials
Weight:	2 lbs.

**Model AA20M**

Antenna Specifications

Model No:	AA202M
Antenna Type:	Directional, 6 element yagi.
Applications:	Fixed base mounting.
Frequency:	150 to 174 MHz
Polarization:	Vertical or Horizontal
Impedance:	50 ohms
Gain:	8 dBD
VSWR:	< 1.2:1
Front To Back Ratio:	12-18 dB
Horizontal Beamwidth:	80 degrees
Vertical Beamwidth:	58 degrees
Antenna Material:	.250" – 6061-T6 Aluminum
Mounting Hardware:	Heavy duty U bolts for mounting up to 2 1/8 in. pipe with right angle mount or direct panel mount.
Antenna Connector:	N-Type Female
Maximum Power Input:	150 Watts
Antenna Envelope:	61 in. length by 41 in. width
Wind Surface Area (sqr. ft)	0.82
Windload (RWV):	100 mph
Weight:	5 lbs.

**Model AA202M**