



Application Note #5456

Antenna Installation and Calibration

November 11, 2005

Antenna Installation Procedure:

- 1) Ensure Antenna is of proper characteristics for RF network being installed. (e.g. In a 900MHz network the antenna being installed capable of covering the 902MHz to 928MHz bandwidth.)
- 2) Ensure cable is proper length and of adequate loss rating to preserve the integrity of the signal. (See FreeWave installation guide for further information.)
- 3) During installation, ensure all RF cable connections are secure without over tightening.

Omni Directional Antenna Installation:

- 1) Mount Omni antenna vertically on Mast or Tower. Follow all manufacturer installation guidelines and precautions.
- 2) Install ground plane radials as needed. (Must be used with Monopole antennas. Not needed with Dipole antennas.)
 - A. Ensure as much vertical separation as possible between all antennas. Free-Wave recommends 10' of vertical separation from other 900MHz or other high power antennas.
- 3) Connect the RF cable to the antenna and seal with shrink tubing or weatherproof tape.
 - A. FreeWave recommends running a ground wire along with the RF cable from the antenna to the lightning suppressor. See FreeWave drawing DAC1696BA for more information.
- 4) Secure the cable as needed to the mast or tower.
- 5) Install a lightning suppressor and ground appropriately following all manufacturer installation guidelines and precautions.
- 6) Connect the RF cable to the lightning suppressor and seal with shrink tubing or weatherproof tape.
- 7) Connect a second RF cable to the lightning suppressor and a pre-programmed radio. Install weatherproofing as needed.



Yagi Antenna Installation:

- 1) Mount the Yagi Antenna in a vertical orientation (length of the antenna parallel to the ground with the elements pointing to the ground and skyward).
 - A. Reference the Path Study for the site to set the position of the antenna. This is done with the help of a compass or GPS unit and the azimuth value as defined in the Path Study for each site.
 - B. If no Path Study has been done, make an educated guess as to the initial position of the antenna and follow the steps in the next section to calibrate.
- 2) Connect the RF cable to the antenna and seal with shrink tubing or weatherproof tape.
 - A. FreeWave recommends running a ground wire along with the RF cable from the antenna to the lightning suppressor. See FreeWave drawing DAC1696BA for more information.
- 3) Secure the RF cable as needed to the mast or tower.
- 4) Install a lightning suppressor and ground appropriately following all manufacturer installation guidelines and precautions.
- 5) Connect the RF cable to the lightning suppressor and seal with shrink tubing or weatherproof tape.
- 6) Connect a second RF cable to the lightning suppressor and a pre-programmed radio. Install weatherproofing as needed.



Testing and Calibration:

A new procedure has been created using the Point to Point diagnostic software (PTP100) to assist in calibrating Point to Multipoint Slave radios using Yagi antennas. Please see App. Note #5455 for more information.

- 1) Apply power to the radio. If other radios in the network are already installed look at the three LED's on the front of the radio to check for a link into the network.
 - A. A solid **GREEN** CD LED shows a link has been established.
 - B. A solid **RED** CTS LED shows a solid link to the Master (or Repeater) in a Point to Multipoint network.
 - C. See user manual for complete list of LED definitions.
- 2) Connect a diagnostic cable to the radio and start the program – EZConfig. (Version 2.3 or higher).
- 3) Select Tools Tab. Then select - Terminal Window.
- 4) Put the radio into Setup mode (all 3 LED's **GREEN**). The Main setup menu will be displayed. Select 4 - Show Radio Statistics.
- 5) Ensure the reported value of Antenna Reflected Power is close to 0. A higher value may indicate a poor connection or bad antenna. A value above 15 should be investigated.
- 6) The Signal and Noise values, as shown in "J" numbers, should have a margin of 26 or more points. Lower margins are representative of a weak link. (The margin is determined by subtracting the noise value from the signal value.)
- 7) A high noise value may be evident of ambient noise in the area. FreeWave offers a band-pass filter which will eliminate most out of band interference which could be causing a lower signal to noise margin than is acceptable. (Band-pass Filter, FreeWave part number: EBF900)
- 8) The Rate % value should be above 75% for a robust link.
- 9) If a site utilizing a Yagi antenna is exhibiting a low margin repositioning the antenna may be necessary. If a compass and Path study are not available to verify the antennas position:
 - A. Remove the radio from Setup mode. (Cycle power on the radio or hit Esc on the PC keyboard.)
 - B. Rotate the antenna slowly by hand while monitoring the LED's on the radio.
 - I. CD should remain solid **GREEN** while CTS should become more and more solid **RED** as the signal strength increases. (For a Point to Multipoint network.)
- 10) When the CTS LED has been optimized for maximum "on time", enter the Terminal Window in EZConfig and review the Radio Statistic values again.
- 11) If the link cannot be improved, the antenna will more than likely need to be repositioned. Height is everything.



Troubleshooting:

Adjusting the antenna to maximize signal strength and minimize noise will insure a more robust link and better communications between radios.

If the noise level cannot be decreased and is excessively high (above 70) a Band-pass filter may help to eliminate out of band noise.

If the signal level is low (below 40) there may be a line of site issue with the antenna. The antenna may need to be redirected or increased in height.

Alternatively, there may be a problem in the antenna/RF cable network. Readdress the antenna gain and RF cable loss to ensure the integrity of the signal is intact. Meaning, make sure the net gain of the antenna/RF cable assembly is no less than 0dBm and no more than 6dBm.