

February 2012

## Reducing Antenna VSWR

An antenna's Voltage Standing Wave Ratio (VSWR) is a measurement of how much of an RF signal is transmitted out of the antenna and how much is reflected back into the radio. High VSWR means a large percentage of energy is reflected back. This reduces range and can even harm the radio's electronic components. You can see the effect of VSWR on radio range by using Pacific Crest's PCC Range Estimator program, available for free download from [www.pacificcrest.com](http://www.pacificcrest.com).

A VSWR between 1.5 and 4 is considered normal. Range is not reduced significantly and not enough energy is reflected back into the radio to harm it. But if the VSWR is higher than 4, and if the radio is outputting more than 25 W, the potential for damage can be too high. For this reason, the ADL Vantage Pro includes an antenna detection feature that automatically reduces the radio's output power to 25W if VSWR is measured to be  $> 4$ . If the VSWR is measured to be  $> 6$ , the radio will reduce output power to 20W. And if the VSWR  $> 8$ , the radio will reduce output power to 2W. In each case, the user is warned to check the antenna. *If you know that the antenna you are using is of the correct frequency band, e.g., 450-470 MHz, you do not need the antenna detection feature and should turn it off.*

The ADL Vantage and ADL Sentry radios do not output enough power to be damaged even if there is no antenna attached. They do not measure VSWR for this reason.

High VSWR is typically caused by the following conditions:

- a. There is an antenna mismatch, i.e., the radio is transmitting at a frequency more than 10 MHz away from the central frequency of a 20 MHz-wide antenna or more than 20 MHz away from the central frequency of a 40 MHz-wide antenna, etc.
- b. The antenna is damaged or corroded
- c. The antenna cable is damaged or corroded
- d. There is water or debris in any of the following connections: radio to antenna; radio to cable; cable to antenna
- e. There is no antenna attached

All Pacific Crest antennas now come labeled as to their frequency band so you can better avoid antenna mismatches.

If you operate in areas with high levels of static electricity, you should use a lightning surge protector. Even if you do not see electricity near your antenna, it could still be conducting enough to damage both it and the radio. It bears repeating that operation during electrical storms or near power lines is extremely dangerous.

Each unity gain and 5 dB gain antenna that Pacific Crest sells comes with a rubber gasket that forms a watertight seal between the antenna and antenna cable. Water within the antenna-cable or antenna-radio connector will impair the connection between the antenna and the cable/radio. This will increase – perhaps significantly - the amount of energy reflected back into

the radio, i.e., the VSWR. If you lose your antenna gasket, they can be easily replaced at any hardware store or plumbing supply outlet.

The gasket between the antenna and the cable also acts to prevent the spring-loaded antenna element from being over-compressed and so unable to make a good contact with the NMO connector on the antenna cable. If you have been attaching/detaching your antenna from the antenna cable repeatedly without using the gasket, it is likely that cable-antenna connection is insufficient for full transmission of the radio's signal. This will greatly increase VSWR.

The gasket also helps prevent over-tightening the antenna onto the cable. When this happens the threaded nut on top of the antenna cable's NMO connector can separate from the connector and come away with the antenna should the user detach it. The brass nut should never be removed from the antenna cable because it houses a second o-ring that is the second line of defense against water ingress into the cable. Should the nut become separated from the connector, care must be taken (1) to keep the o-ring in the channel on the underside of the nut and (2) to tighten the nut onto the threaded brass post in the center of the NMO connector. It is this threaded post – not the brass nut - that connects the radio to the antenna. Please note that only authorized Trimble service centers should detach the top of the NMO connector from the bottom.

#### Tips for reducing antenna VSWR:

1. Do not transmit at a frequency not covered by your antenna
2. Check the antenna and antenna cable frequently for damage, dust or water ingress and corrosion.
3. Check that the gasket is still in place and that the spring-loaded contact inside the bottom of the antenna is not overly compressed. If the antenna uses a pogo-spring, check that it fully extends without sticking. If it uses a leaf spring, you may gently pull the spring toward the bottom of the antenna to ensure better contact between the spring and the center post of the NMO connector.
4. If the rubber antenna gasket comes off the antenna, gently stretch it and place it around the brass nut on the cable. Press the gasket tightly against the black metal top of the NMO connector before screwing down the antenna.
5. If the gasket is lost, it can be replaced at any hardware store. Until it is replaced be sure not to over-tighten the antenna onto the brass nut. "Finger tight" is sufficient.
6. Never use any tape on the brass nut. The antenna is grounded through the brass nut and a good contact is essential.