

How Do I?

An Occasional Series

100th Article

This Week: Antenna Topics: SWR

Special Note: While articles in the *How Do I?* series have been written by many authors, and over 130 *How Do I?* articles have been published so far, this is this author's 100th. Thank you for your support!

And thanks to our Publisher, Editor and Chief Cook and Bottle Washer for turning these scribblings into finished works. Andy-AF3I deserves a share of the credit for these!

SWR- What is it? Why does it matter?

Pickup any issue of *QST* and you will see alphabet soup. Today's flavor is **SWR**. Let's take a look at what is SWR, and why it may be the holy grail of amateur radio. Today's article is about the math and science of radio.

SWR -- Standing Wave Ratio is really a measure of the transmission line and not the antenna itself. It is simply the ratio of Forward Power to Reflected Power.

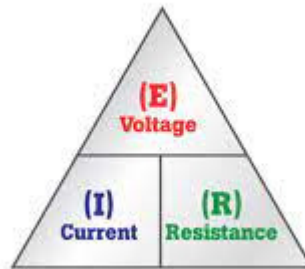
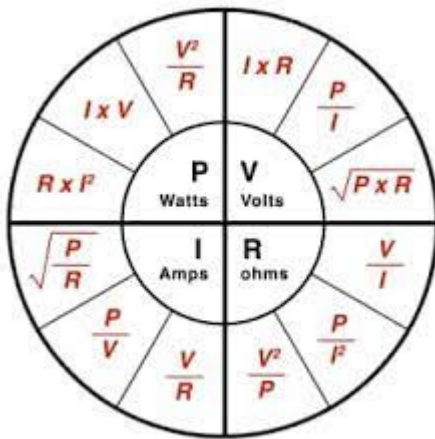
An ideal transmission line terminated in its characteristic impedance (Z_0) will deliver all of its power to the matched load. In other words, 100 watts of RF leaves the radio and 100 watts goes out from the antenna, or a 1:1 SWR. In the real world, the transmission line will have some of its own losses which we choose to ignore in this presentation.

That 1:1 SWR can be hard to accomplish. So if the Z_0 is anything else, part of the power will be reflected back from the antenna. This creates a situation where you may have 100 watts leaving the radio, but 95 watts leaving the antenna.

How do we measure SWR? Many modern transceivers have a built in SWR meter. In many transceivers, if the SWR is in excess of 2:1 or maybe 3:1, the transceiver will reduce power to protect itself. Many amateurs have a standalone SWR meter, which typically measures the forward and reflected power and displays the SWR. Some units simply measure the power and require the user to calculate the SWR. An antenna analyzer provides more measurements and generally more detail about the antenna and transmission line. A "tuner" can be used to make the radio see a lower SWR. There are other articles in this ***How Do I...*** series about coax cables, antenna tuners, SWR meters and antenna analyzers.

Achieving a low SWR is very frequency dependent. It is also not typically an issue at VHF and UHF frequencies where wavelengths are relatively short. But on HF it matters a lot. You can have an excellent SWR at the top portion of the General Class band on 75 meters (4.0 MHz), while at the low end of the band (3.5 MHz) SWR may be high.

The ratio of applied voltage to initial current is impedance. Remember Ohm's Law and the questions regarding it on the General License exam?

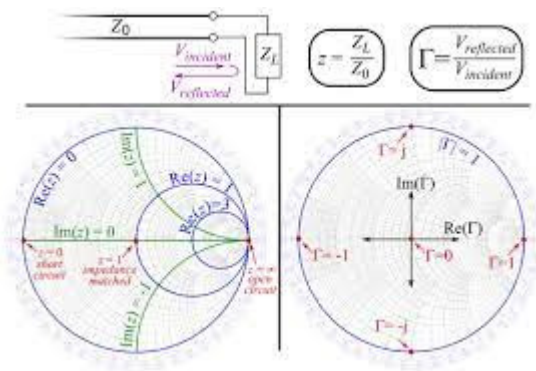


Amps X Volts = Watts
 Volts = Amps X Resistance

It's coming back now, right? Your radio almost certainly was designed to like a 50 Ohm or 50 Ω load.

If the transceiver puts out 100 watts, with a perfect (mythical) feed line, to a perfect theoretical antenna), 100 watts or 100% gets transmitted. If you have 100 watts going out from the radio, but you have 10% reflected, that leaves 90 watts out. If you have 25 watts reflected, that leaves 75 watts out. Think that is a lot of loss? I read an antenna review that calculated a commercially available antenna, in perfect working order, transmitted only 5% of the input power. Yep, 95% was reflected!

Calculating SWR is very time consuming if done by hand. There were charts, very similar to the log tables you may recall from your trigonometry text book. A Smith Chart can show a graphical solution



Computers, specifically a computer program called *TLW Transmission Line for Windows* packaged with the *ARRL Antenna Book*, reduces tedious calculations to entering a few parameter values. For most, a commercial SWR meter or antenna analyzer provides the necessary information very quickly.

SWR can be a quick measurement to ensure your antenna system is working and will not fold back so much power it damages the radio.

Catch 'ya on the air!

Links:

ARRL Antenna and Antenna Analyzer books:

<http://www.arrl.org/arrl-antenna-book>

<https://www.arrl.org/shop/Understanding-Your-Antenna-Analyzer>

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