

The Radio Hotel – SWR – Scary Watt Readings

.....Hey, it's Halloween. So, trick or treat!

by Rick Hiller – W5RH

One of the scary things within the world of RF and Ham Radio is SWR. Especially, high SWR. But why is SWR so important and why do we try to avoid high SWR. What operational detriment does it present to our gear and our signal?

As I and many others have written in the past, SWR is a measure of the quality of the impedance match of the transmission line (TL) to the antenna. The TL, coax usually, is a fixed impedance, so it is going to be the antenna that causes SWR variations, as its' feed impedance varies as we tune across the band for which the antenna is designed.

To measure SWR we insert a power meter or SWR meter in series with the TL. It compares the forward power to the reflected power and displays the SWR. In most cases, 2.5 or lower is desirable. But why? That is the \$ 1,000,000 question....well, for this column anyway.

Three things that we should be concerned about: 1) Higher SWR causing higher voltages generated at the radio end of the TL; 2) voltages generated all along the coax (causing possible di-electric breakdown); and 3) loss of signal power both going and coming. With the aid of the ARRL's TLW software by N6BV (*see the BVARC Beacon TRH July 2021*) I have generated some applicable numbers as a demonstration case.

RMS Voltage generated 100 watts out LMR-400
SWR= 1:1 1.5:1 2:1 3:1 5:1 10:1
Volts = 76 84 94 114 135 178

Loss Generated dB at all power levels LMR-400
SWR = 1:1 1.5:1 2:1 3:1 5:1 10:1
dB = -.66 -.7 -.8 -1.04 -1.5 -2.5

RMS Voltage generated 500 watts out LMR-400
SWR= 1:1 1.5:1 2:1 3:1 5:1 10:1
Volts = 158 187 211 250 301 376

Coax Maximum V Ratings and Loss
LMR-400 is 600V with 10:1 2.5 dB loss

i.e. RG-58 is 300V with 10:1 5 dB loss

RMS Voltage generated 1000 watts out LMR-400
SWR = 1:1 1.5:1 2:1 3:1 5:1 10:1
Volts = 223 264 298 352 426 532

Use the TLW software to set up your specific test case to determine what's happening on your antenna system. Note that higher quality levels of coax allow greater SWR voltage handling and lessen the effects of SWR caused signal loss. \$'s versus performance. The SWR voltages generated increase with the power out of the transmitter. Of course, we typically want full power, but it might be OK to use reduced power out at times, depending on the mode etc. Also, it might be OK to have some signal power loss of up to 2.5 dB (with LMR-400) or 5 dB (with RG-58) not even an S-unit. A caution -- Some older transceivers and solid state amps do not have an SWR monitoring circuit and power cut back built in, so it is up to the operator to monitor the SWR to avoid blowing the final PA's in the xmitter or amplifier.

Best of luck and enjoy All Hallows Eve....73, Rick W5RH