Transmission Lines and Standing Wave Ratio[1]

The standing wave ratio can be measured using directional watt meters. In that case the standing wave ratio or SWR is given by:

$$SWR = \frac{1+\sqrt{\frac{P_r}{P_f}}}{1-\sqrt{\frac{P_r}{P_f}}} \quad ,$$

where P_r is the reflected power and P_f is the forward power. The slug in a directional power meter must be rotated to make each one of the measurements. In a dual meter movement watt meter one neddle indicates the forward power and the other neddle the reflected power. Then the two needle cross at a point and the SWR can be estimated from the SWR scale, typically in red.

This would require a great deal of calculation on the element 3 examination. To simpilfy the calculation the ratio of impedances are used. It can be shown that this is equivalent to:

$$SWR = \left(\frac{Z_L}{Z_o}\right)^{\pm 1} \quad ,$$

where Z_L is the load impedance such as the antenna and Z_o is the coax impedance. The proper sign of plus or minus must be chosen to make the ratio greater than 1. It is easier when given impedance to use:

$$SWR = \frac{Z_{\text{Largest}}}{Z_{\text{Smallest}}} \quad ,$$

where Z_{Largest} is the larger impedance and Z_{Smallest} ia the smaller impedance. If the two are the same size use either one in either position. In the questions in the element 3 pool this last relationship will be used.

Note the SWR is stated a SWR:1 or SWR to 1.

Questions

G9A09 (A)
What standing wave ratio will result when connecting a 50 ohm feed line to a non-reactive load having 200 ohm impedance?

A. 4:1
B. 1:4
C. 2:1
D. 1:2

Using $SWR = Z_{\text{Largest}} / Z_{\text{Smallest}} = 200/50 = 4$ and we say the SWR is 4:1. Therefore A is correct.

1 2015-2019 Element 3 Question Pool, revised 11 February 2015

G9A11 (B)
What standing wave ratio will result when connecting a 50 ohm feed line to a non-reactive load having 50 ohm impedance?
A. 2:1
B. 1:1
C. 50:50
D. 0:0

Using $SWR = Z_{\text{Largest}} / Z_{\text{Smallest}} = 50/50 = 1$ and we say the SWR is 1:1. While C is technically correct, this is not in standard form where the SWR is SWR to 1. Therefore B is correct.

G9A12 (A)
What standing wave ratio will result when connecting a 50 ohm feed line to a non-reactive load having 25 ohm impedance?
A. 2:1
B. 2.5:1
C. 1.25:1
D. You cannot determine SWR from impedance values

Using $SWR = Z_{\text{Largest}} / Z_{\text{Smallest}} = 50/25 = 2$ and we say the SWR is 2:1. Therefore A is correct.

G9A13 (C)
What standing wave ratio will result when connecting a 50 ohm feed line to an antenna that has a purely resistive 300 ohm feed point impedance?
A. 1.5:1
B. 3:1
C. 6:1
D. You cannot determine SWR from impedance values

Using $SWR = Z_{\text{Largest}} / Z_{\text{Smallest}} = 300/50 = 6$ and we say the SWR is 6:1. Therefore C is correct.