

Problem 2.74 A $25\text{-}\Omega$ antenna is connected to a $75\text{-}\Omega$ lossless transmission line. Reflections back toward the generator can be eliminated by placing a shunt impedance Z at a distance l from the load (Fig. P2.74). Determine the values of Z and l .

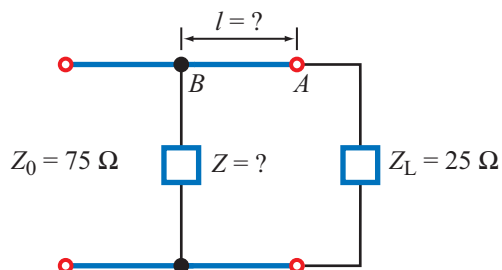
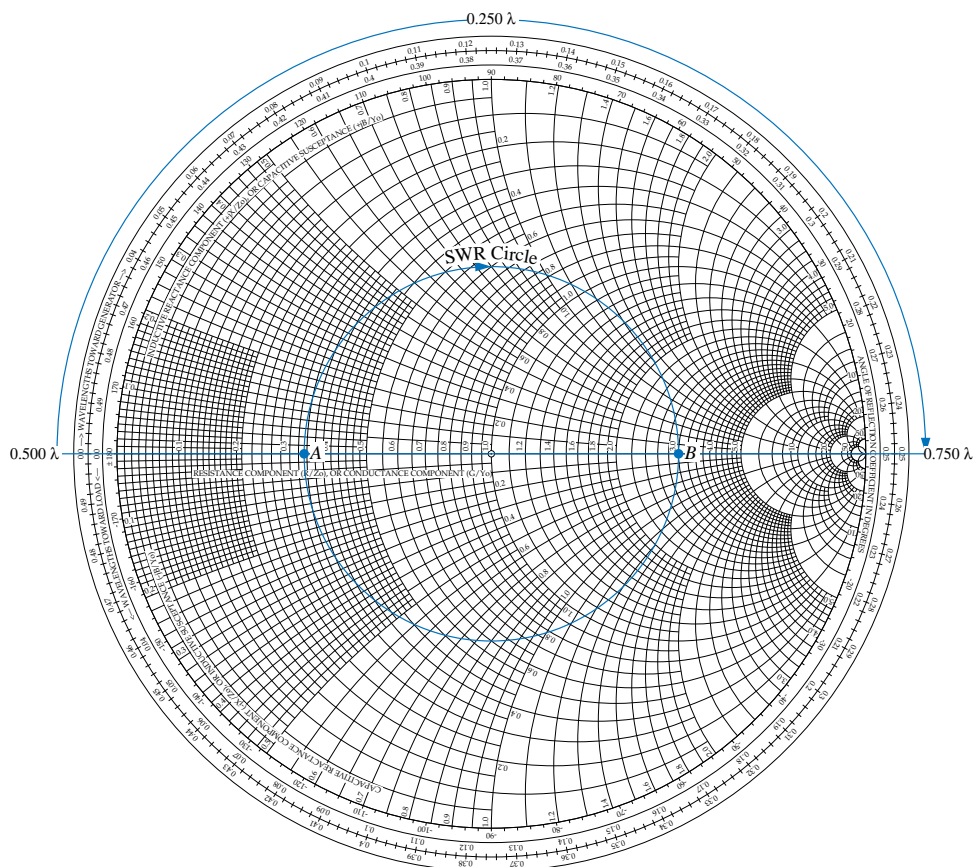


Figure P2.74: Circuit for Problem 2.74.

Solution:



The normalized load impedance is:

$$z_L = \frac{25}{75} = 0.33 \quad (\text{point A on Smith chart})$$

The Smith chart shows A and the SWR circle. The goal is to have an equivalent impedance of $75 \, \Omega$ to the left of B. That equivalent impedance is the parallel combination of Z_{in} at B (to the right of the shunt impedance Z) and the shunt element Z. Since we need for this to be purely real, it's best to choose l such that Z_{in} is purely real, thereby choosing Z to be simply a resistor. Adding two resistors in parallel generates a sum smaller in magnitude than either one of them. So we need for Z_{in} to be larger than Z_0 , not smaller. On the Smith chart, that point is B, at a distance $l = \lambda/4$ from the load. At that point:

$$z_{\text{in}} = 3,$$

which corresponds to

$$y_{\text{in}} = 0.33.$$

Hence, we need y , the normalized admittance corresponding to the shunt impedance Z, to have a value that satisfies:

$$y_{\text{in}} + y = 1$$

$$y = 1 - y_{\text{in}} = 1 - 0.33 = 0.66$$

$$z = \frac{1}{y} = \frac{1}{0.66} = 1.5$$

$$Z = 75 \times 1.5 = 112.5 \, \Omega.$$

In summary,

$$l = \frac{\lambda}{4},$$

$$Z = 112.5 \, \Omega.$$
