2.74 A 25-Ω antenna is connected to a 75-Ω 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.

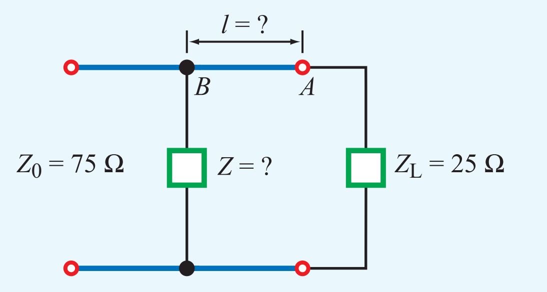
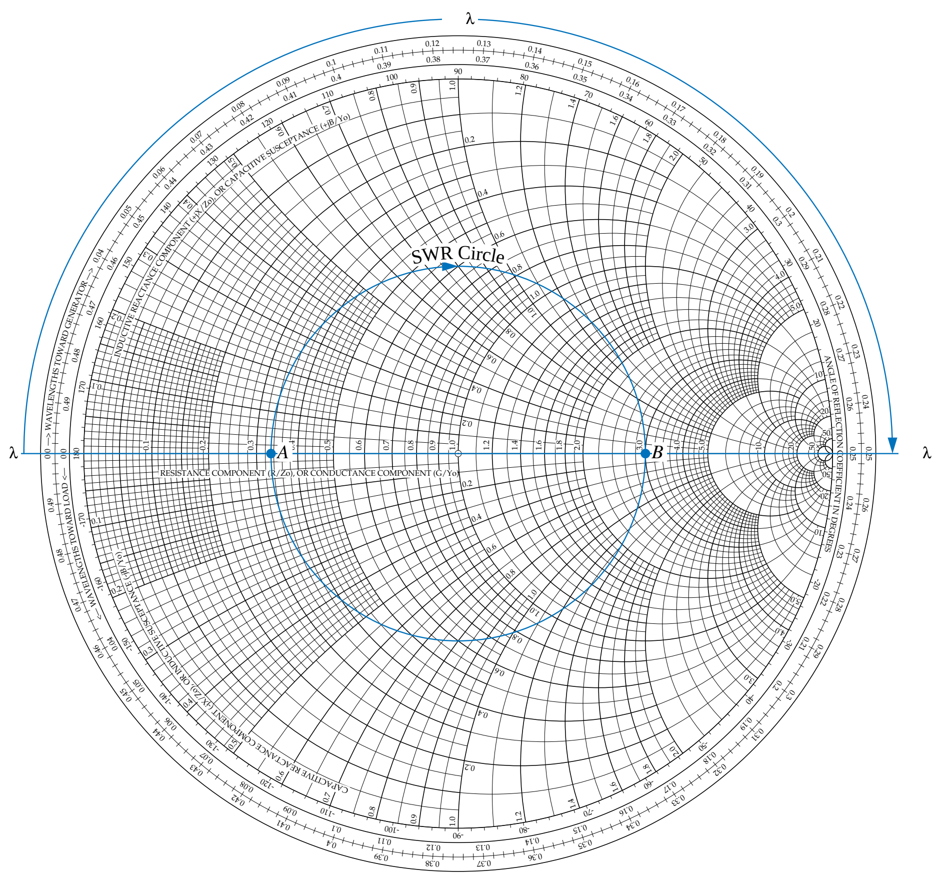


Figure P2.74 Circuit for Problem 2.74.

Solution:



The normalized load impedance is:

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

The Smith chart shows A and the SWR circle. The goal is to have an equivalent impedance of 75 Ω 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:

$$z_{in} = 3,$$

which corresponds to

$$y_{in} = 0.33.$$

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

$$\begin{aligned} y_{in} + y &= 1 \\ y &= 1 - y_{in} = 1 - 0.33 = 0.66 \\ z &= \frac{1}{y} = \frac{1}{0.66} = 1.5 \\ Z &= 75 \times 1.5 = 112.5\ \Omega. \end{aligned}$$

In summary,

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

$$Z = 112.5\ \Omega.$$