

Problem 2.63 A $50\text{-}\Omega$ lossless line 0.6λ long is terminated in a load with $Z_L = (50 + j25)\text{ }\Omega$. At 0.3λ from the load, a resistor with resistance $R = 30\text{ }\Omega$ is connected as shown in Fig. P2.63. Use the Smith chart to find Z_{in} .

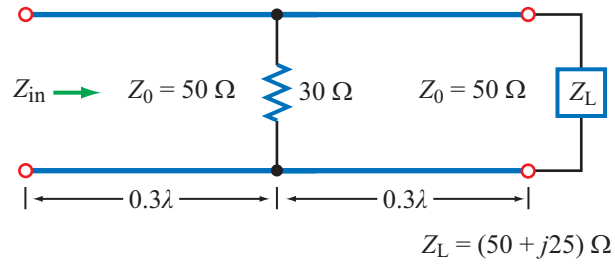


Figure P2.63: Circuit for Problem 2.63.

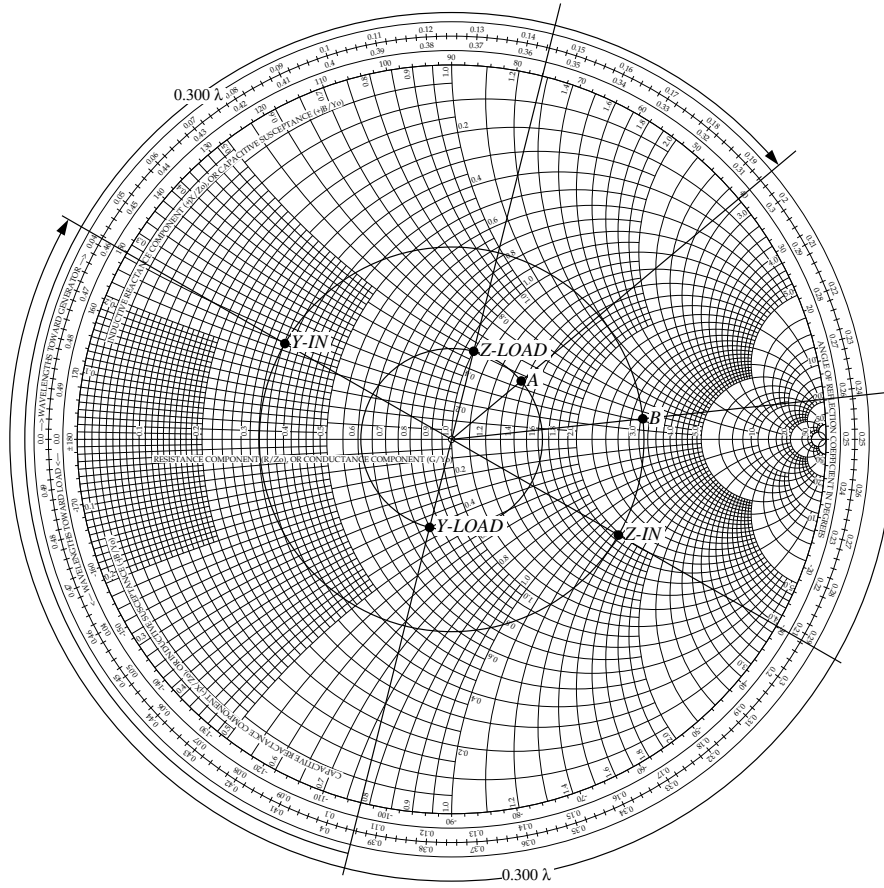


Figure P2.63: (b) Solution of Problem 2.63.

Solution: Refer to Fig. P2.63(b). Since the $30\text{-}\Omega$ resistor is in parallel with the input impedance at that point, it is advantageous to convert all quantities to admittances.

$$z_L = \frac{Z_L}{Z_0} = \frac{(50 + j25)\ \Omega}{50\ \Omega} = 1 + j0.5$$

and is located at point *Z-LOAD*. The corresponding normalized load admittance is at point *Y-LOAD*, which is at 0.394λ on the WTG scale. The input admittance of the load only at the shunt conductor is at $0.394\lambda + 0.300\lambda - 0.500\lambda = 0.194\lambda$ and is denoted by point *A*. It has a value of

$$y_{inA} = 1.37 + j0.45.$$

The shunt conductance has a normalized conductance

$$g = \frac{50 \, \Omega}{30 \, \Omega} = 1.67.$$

The normalized admittance of the shunt conductance in parallel with the input admittance of the load is the sum of their admittances:

$$y_{inB} = g + y_{inA} = 1.67 + 1.37 + j0.45 = 3.04 + j0.45$$

and is located at point B . On the WTG scale, point B is at 0.242λ . The input admittance of the entire circuit is at $0.242\lambda + 0.300\lambda - 0.500\lambda = 0.042\lambda$ and is denoted by point $Y-IN$. The corresponding normalized input impedance is at $Z-IN$ and has a value of

$$z_{in} = 1.9 - j1.4.$$

Thus,

$$Z_{in} = z_{in}Z_0 = (1.9 - j1.4) \times 50 \, \Omega = (95 - j70) \, \Omega.$$
