2.50 Use the Smith chart to determine the input impedance Z_{in} of the two-line configuration shown in Fig. P2.50.

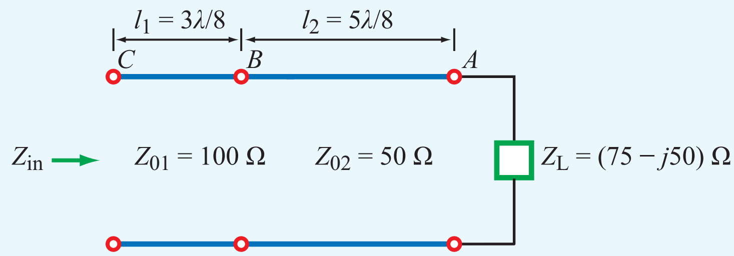
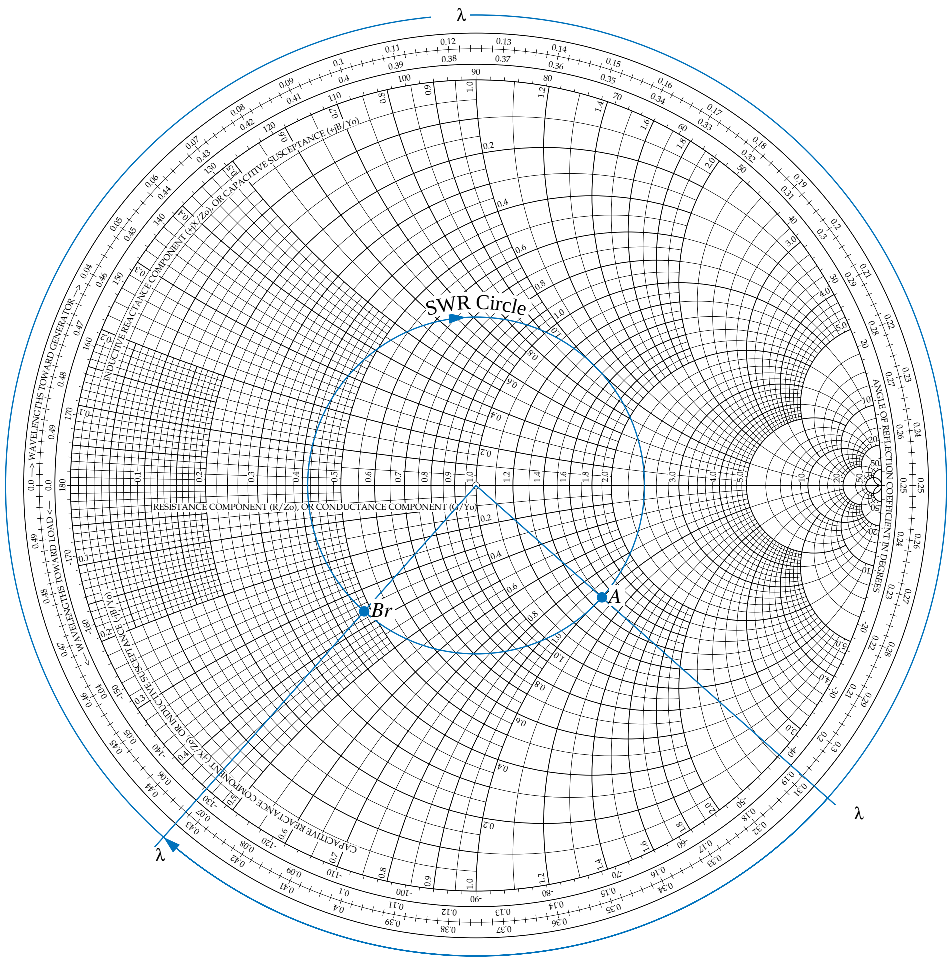


Figure P2.50 Circuit for Problem 2.50.

Solution:



Smith Chart 1

Starting at point A, namely at the load, we normalize Z_L with respect to Z_{02}:

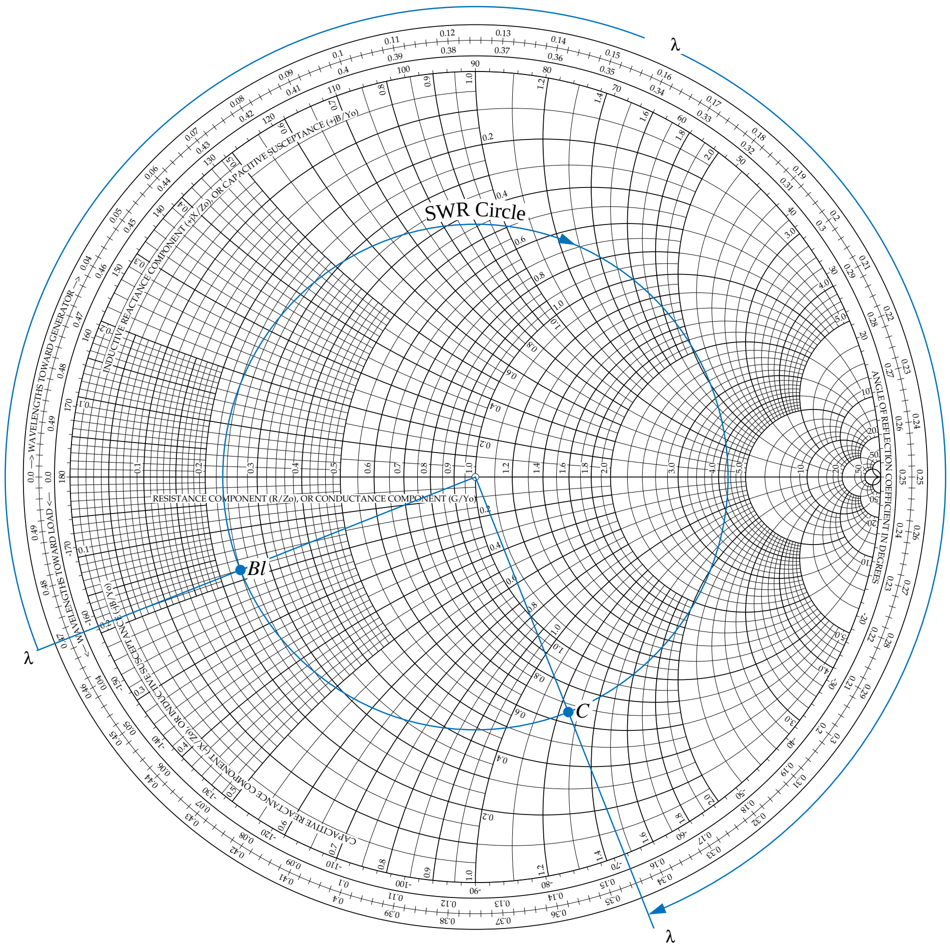
$$z_L = \frac{Z_L}{Z_{02}} = \frac{75 - j50}{50} = 1.5 - j1. \qquad \text{(point } A \text{ on Smith chart 1)}$$

From point A on the Smith chart, we move on the SWR circle a distance of $5\lambda/8$ to point B_r, which is just to the right of point B (see figure). At B_r, the normalized input impedance of line 2 is:

$$z_{in2} = 0.48 - j0.36 \qquad \text{(point } B_r \text{ on Smith chart)}$$

Next, we unnormalize z_{in2}:

$$Z_{in2} = Z_{02} z_{in2} = 50 \times (0.48 - j0.36) = (24 - j18)\ \Omega.$$



Smith Chart 2

To move along line 1, we need to normalize with respect to Z_{01}. We shall call this z_{L1}:

$$z_{\mathrm{L1}} = \frac{Z_{\mathrm{in2}}}{Z_{01}} = \frac{24 - j18}{100} = 0.24 - j0.18 \qquad \text{(point } B_\ell \text{ on Smith chart 2)}$$

After drawing the SWR circle through point B_ℓ, we move $3\lambda/8$ towards the generator, ending up at point C on Smith chart 2. The normalized input impedance of line 1 is:

$$z_{\mathrm{in}} = 0.66 - j1.25$$

which upon unnormalizing becomes:

$$Z_{\mathrm{in}} = (66 - j125)\ \Omega.$$