At 600 MHz, match an antenna ($Z_A = 20 - j\,50\ \Omega$) to a feeding transmission line ($Z_0 = 50\ \Omega$ & $u = 2.4\times10^8$ m/s) using a discrete <u>capacitor</u> connected in series as close to the antenna as possible. Draw a fully labeled sketch of final design.

- The wavelength is $\lambda = c/f = 2.4\times10^8/600\times10^6 = 0.4$ m = 40 cm.

Steps

1) Calculate the normalized impedance $z_A = Z_A / Z_0 = (20 - j\,50)/50 \;\Rightarrow\; \mathbf{z_A = 0.4 - j\,1\ \Omega/\Omega}$ and plot on **Smith chart** (see Figure 2).

2) Draw circle, centered on Smith chart, through z_A point. This circle of constant $|\Gamma|$ includes the locus of all possible z_{in} (and y_{in}) along the transmission line with this load.

3) The two match points are $z_{m,i} = 1 \pm j1.85\ \Omega/\Omega$. To use a discrete series capacitor for matching, **select $z_{m,1} = 1 + j1.85\ \Omega/\Omega$** as it has an inductive reactance. Note, the match point impedance is $Z_{m,1} = z_{m,1}\, Z_0 = (1 + j1.85)\,50 = 50 + j92.5\ \Omega$.

4) Find the distance d_1 from z_A to $z_{m,1}$ using scales on Smith chart, $d_1 = (0.131 + 0.184)\,\lambda$ $\Rightarrow$ **$d_1 = 0.315\lambda$** or $d_1 = 0.315\,(40\text{ cm})$ $\Rightarrow$ **$d_1 = 12.6$ cm**.

5) At d_1, add a discrete capacitor in series with reactance $Z_{cap} = -j/\omega C = -j\,92.5\ \Omega$. Solving yields $C = 1/[(2\pi\,600\times10^6)\,92.5] = 2.86766\times10^{-7}$ F $\Rightarrow$ **$C = 2.87$ pF**.

6) As shown on Figure 1, everywhere toward the source from the location of C will be matched, i.e., $Z_{in} = 50\ \Omega$.

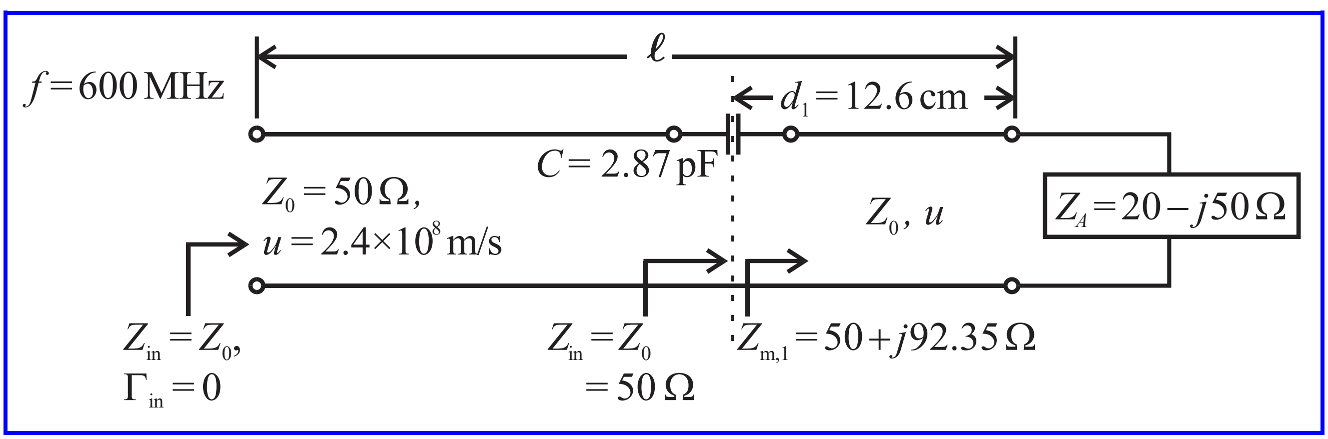

Figure 1 Matching antenna using discrete <u>series</u> capacitor.

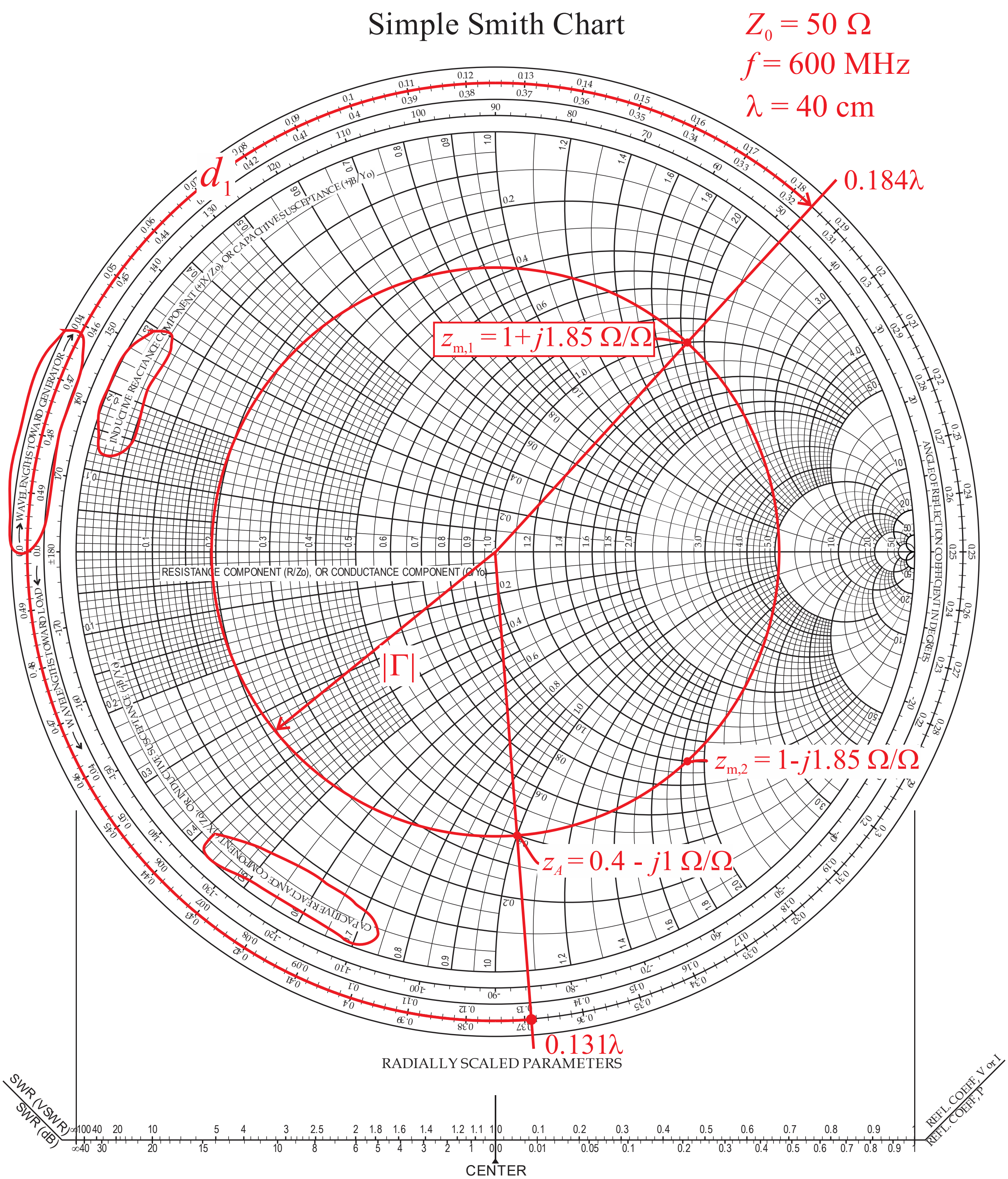

Figure 2 Smith chart for matching an antenna using discrete <u>series</u> capacitor.