

An antenna has input impedance $Z_A = 37.5 - j75 \Omega$ at 100 MHz. Match it to a feeding transmission line ($Z_0 = 75 \Omega$ & $u = 2.25 \times 10^8$ m/s) using a discrete inductor connected in parallel as close to the antenna as possible. Draw a fully labeled sketch of the final design.

➤ The wavelength is $\lambda = c/f = 2.25 \times 10^8 / 100 \times 10^6 = 2.25$ m.

Steps

- 1) Calculate normalized impedance $z_A = Z_A/Z_0 = (37.5 - j75)/75 \Rightarrow \underline{z_A = 0.5 - j1 \Omega/\Omega}$ 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) Go $\lambda/4$ (180°) around the circle of constant $|\Gamma|$ from z_A point to the normalized admittance point $\underline{y_A = 0.4 + j0.8 \text{ S/S}}$ (or just calculate $y_A = 1/z_A$ and plot).
- 4) Note, the two match points are $y_{m,i} = 1 \pm jb = 1 \pm j1.58 \text{ S/S}$. In order to use a discrete inductor for matching, **select $\underline{y_{m,1} = 1 + j1.58 \text{ S/S}}$** as it has a capacitive susceptance. Note, $Y_{m,1} = y_{m,1}/Z_0 = (1 + jb)/Z_0 = (1 + j1.58)/75 = 0.01333 + j0.02107 \text{ S}$.
- 5) Find distance d_1 from y_A to $y_{m,1}$ using scales on Smith chart, $d_1 = 0.178\lambda - 0.1148\lambda \Rightarrow \underline{d_1 = 0.0632\lambda}$, or, in meters, $d_1 = 0.0632(2.25) \Rightarrow \underline{d_1 = 0.1422 \text{ m} = 14.22 \text{ cm}}$.
- 6) At the match point $y_{m,1}$, a distance d_1 from y_A , add a discrete inductor in parallel with susceptance $Y_{ind} = -jb/Z_0 = -j0.02107 \text{ S} = -j/\omega L$. Solving the equation for L yields, $L = 1/[2\pi 100 \times 10^6 (0.02107)] = 7.554 \times 10^{-8} \text{ H} \Rightarrow \underline{L = 75.54 \text{ nH}}$.
- 7) As shown on Figure 1, everywhere toward the source from the location of L will be matched, i.e., $Y_{in} = 1/75 = 0.01333 \text{ S}$ or $Z_{in} = 75 \Omega$.

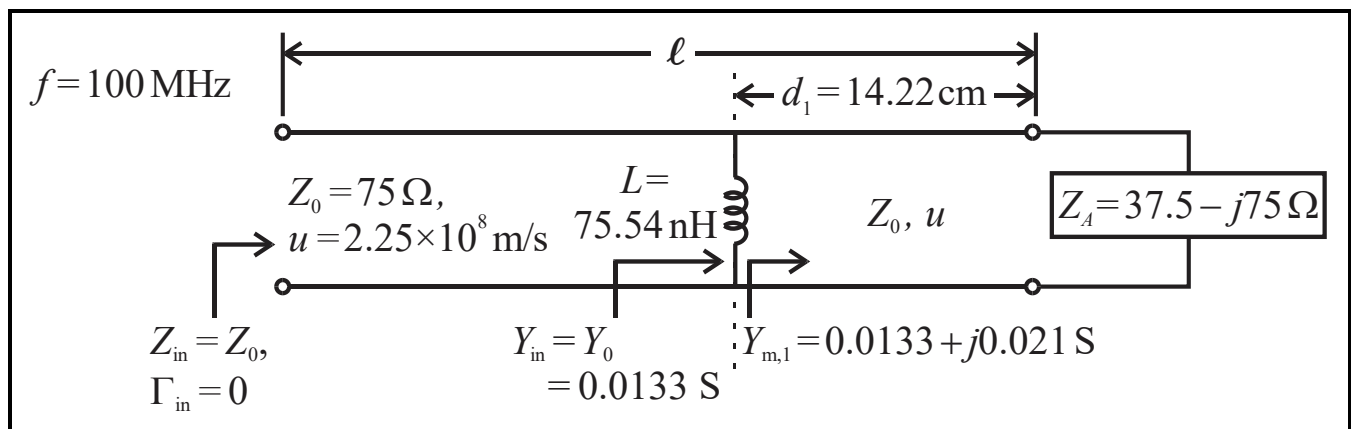


Figure 1 Matching antenna using discrete parallel inductor.

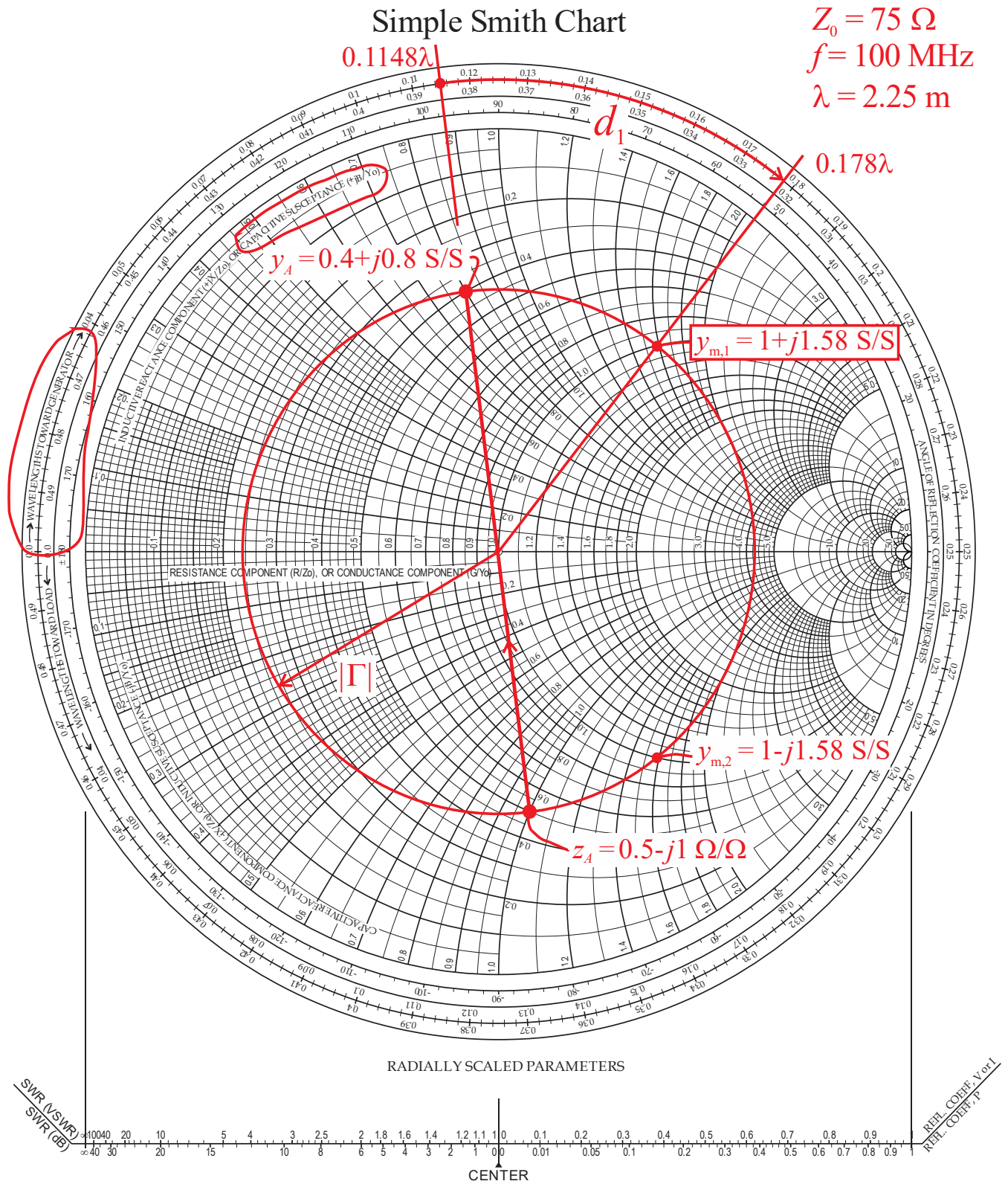


Figure 2 Smith chart for matching antenna using discrete parallel inductor.