

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 stub of the same transmission line with a short-circuit (SC) termination. Place the stub as close to the antenna as possible and make the stub as short 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) The match points are $y_{m,i} = 1 \pm j1.58 \text{ S/S}$. The one closest to y_A is $\underline{y_{m,1} = 1 + j1.58 \text{ S/S}}$.
- 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 location of $y_{m,1}$, add a shunt stub with an short-circuit termination with normalized susceptance $y_{\text{stub}} = -j1.58 \text{ S/S}$, i.e., start at short-circuit point ($y_{\text{SC}} = \infty$) and move length l_1 in “WAVELENGTHS TOWARD GENERATOR” direction to the $-j1.58 \text{ S/S}$ point on outer edge of Smith chart. Here, $d_1 = 0.3398\lambda - 0.25\lambda \Rightarrow \underline{l_1 = 0.0898\lambda}$ or $l_1 = 0.0898(2.25 \text{ m}) \Rightarrow \underline{l_1 = 0.20205 \text{ m} = 20.205 \text{ cm}}$.
- 7) As shown on Figure 1, everywhere toward the source from the location of the shunt SC stub will be matched, i.e., $Z_{in} = 75 \Omega$.

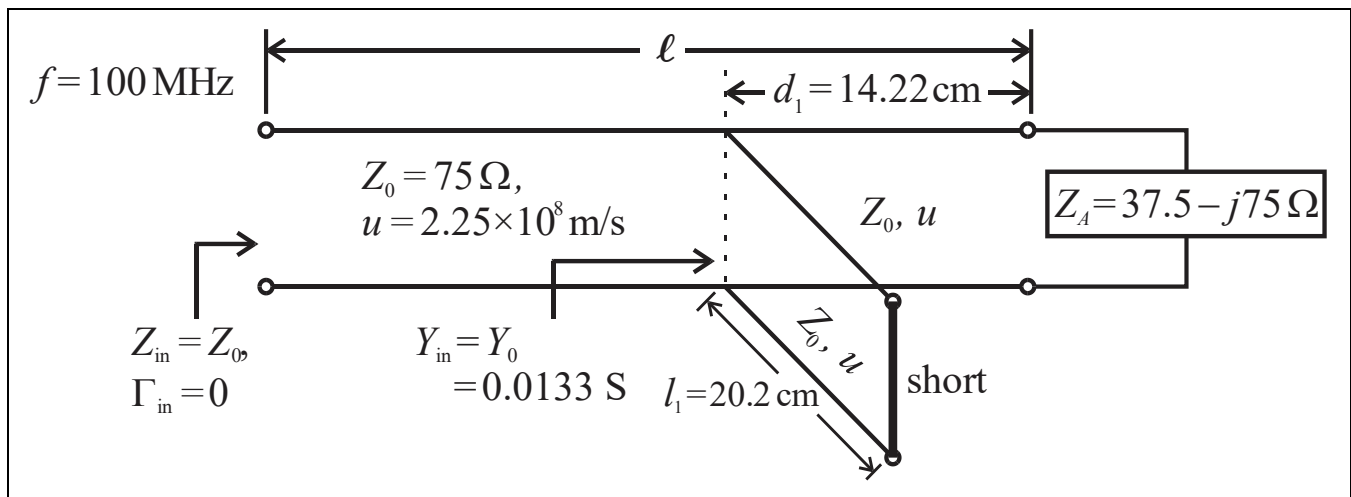


Figure 1 Matching antenna using a shunt stub with short-circuit termination.

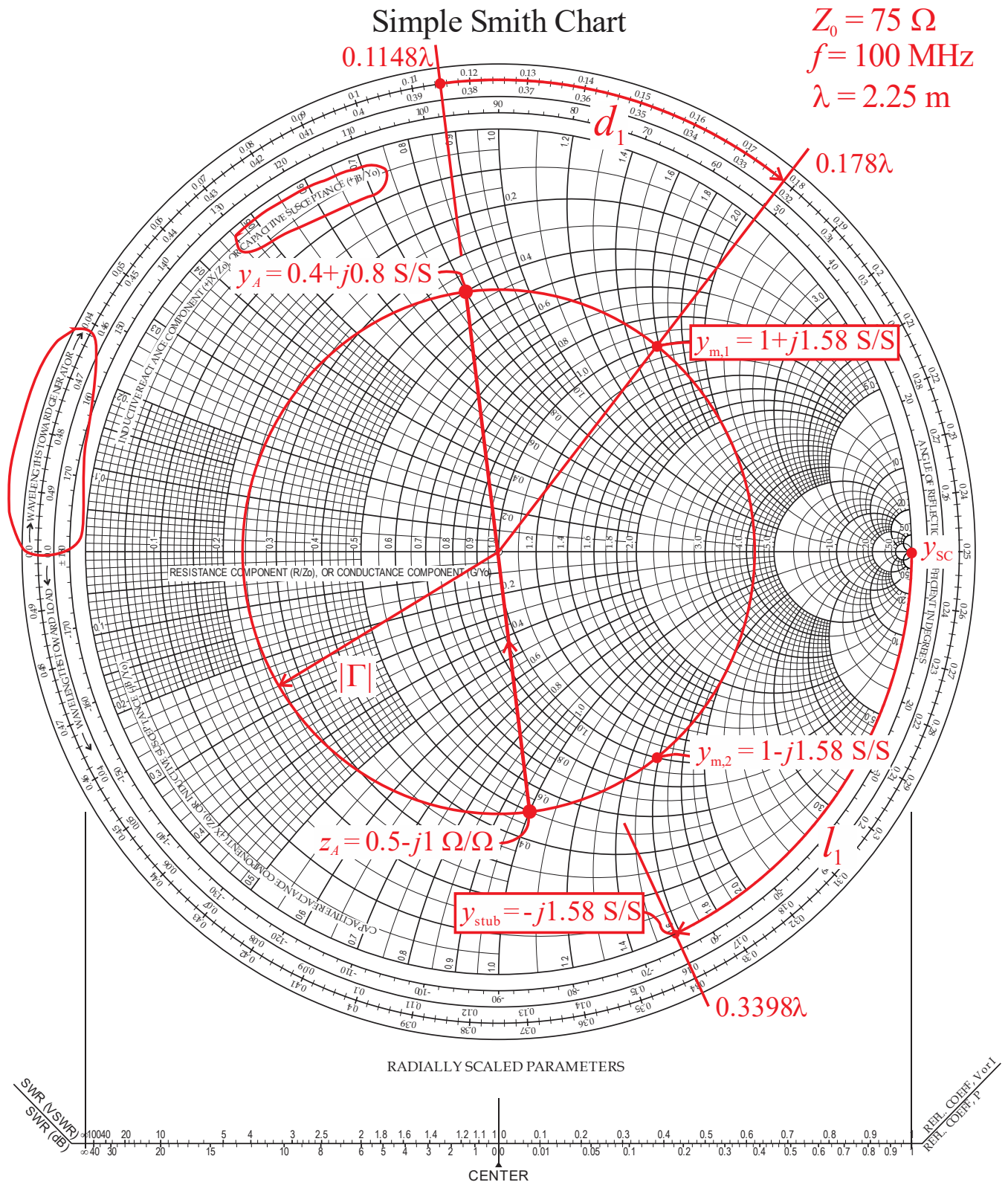


Figure 2 Smith chart for matching antenna using a shunt stub with short-circuit termination.