

At 102 MHz, match an antenna ($Z_A = 300 - j450 \Omega$) to a feeding transmission line ($Z_0 = 300 \Omega$ & $u = 2.1 \times 10^8$ m/s) using a stub of the same transmission line with an open-circuit 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 final design.

➤ The wavelength is $\lambda = c/f = 2.1 \times 10^8 / 102 \times 10^6 = 2.05882353$ m.

Steps

- 1) Calculate normalized impedance $z_A = Z_A/Z_0 = (300 - j450)/300 \Rightarrow \underline{z_A = 1 - j1.5 \Omega/\Omega}$ 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 $\underline{y_A = 0.308 + j0.462 \text{ S/S}}$ point and plot.
- 4) Note, the two match points are $y_{m,i} = 1 \pm j1.5 \text{ S/S}$. Select $\underline{y_{m,1} = 1 + j1.5 \text{ S/S}}$ as it is closest to y_A .
- 5) Find the distance d_1 from y_A to $y_{m,1}$ using scales on Smith chart, $d_1 = 0.176\lambda - 0.074\lambda \Rightarrow \underline{d_1 = 0.102\lambda}$ or, in meters, $d_1 = 0.102(2.05882353) \Rightarrow \underline{d_1 = 0.21 \text{ m} = 21 \text{ cm}}$.
- 6) At d_1 , add a shunt open circuit stub with normalized susceptance $y_{\text{stub}} = -j1.5 \text{ S/S}$, i.e., start at the open circuit point ($y_{\text{OC}} = 0$) move length ℓ_1 in the “WAVELENGTHS TOWARD GENERATOR” direction to the $-j1.5 \text{ S/S}$ point on outer edge of the Smith chart. Here, $\underline{\ell_1 = 0.3436\lambda}$ or $\ell_1 = 0.3436(205.882353 \text{ cm}) \Rightarrow \underline{\ell_1 = 70.74 \text{ cm}}$.
- 7) As shown on Figure 1, everywhere toward the source from the location of L will be matched, i.e., $Z_{in} = 50 \Omega$.

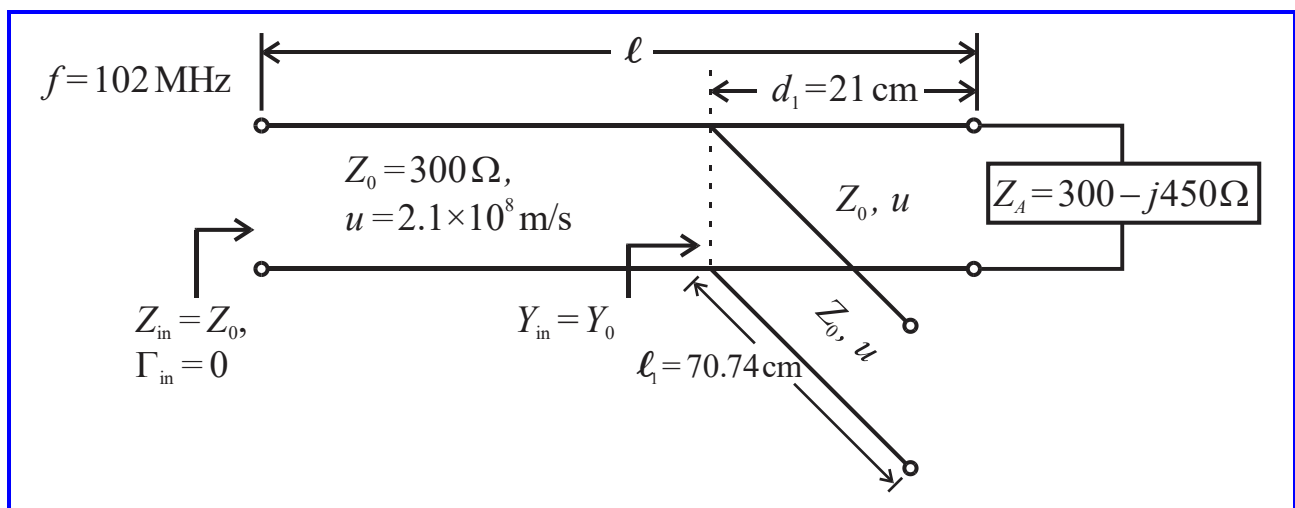


Figure 1 Matching antenna using shunt open circuit stub.

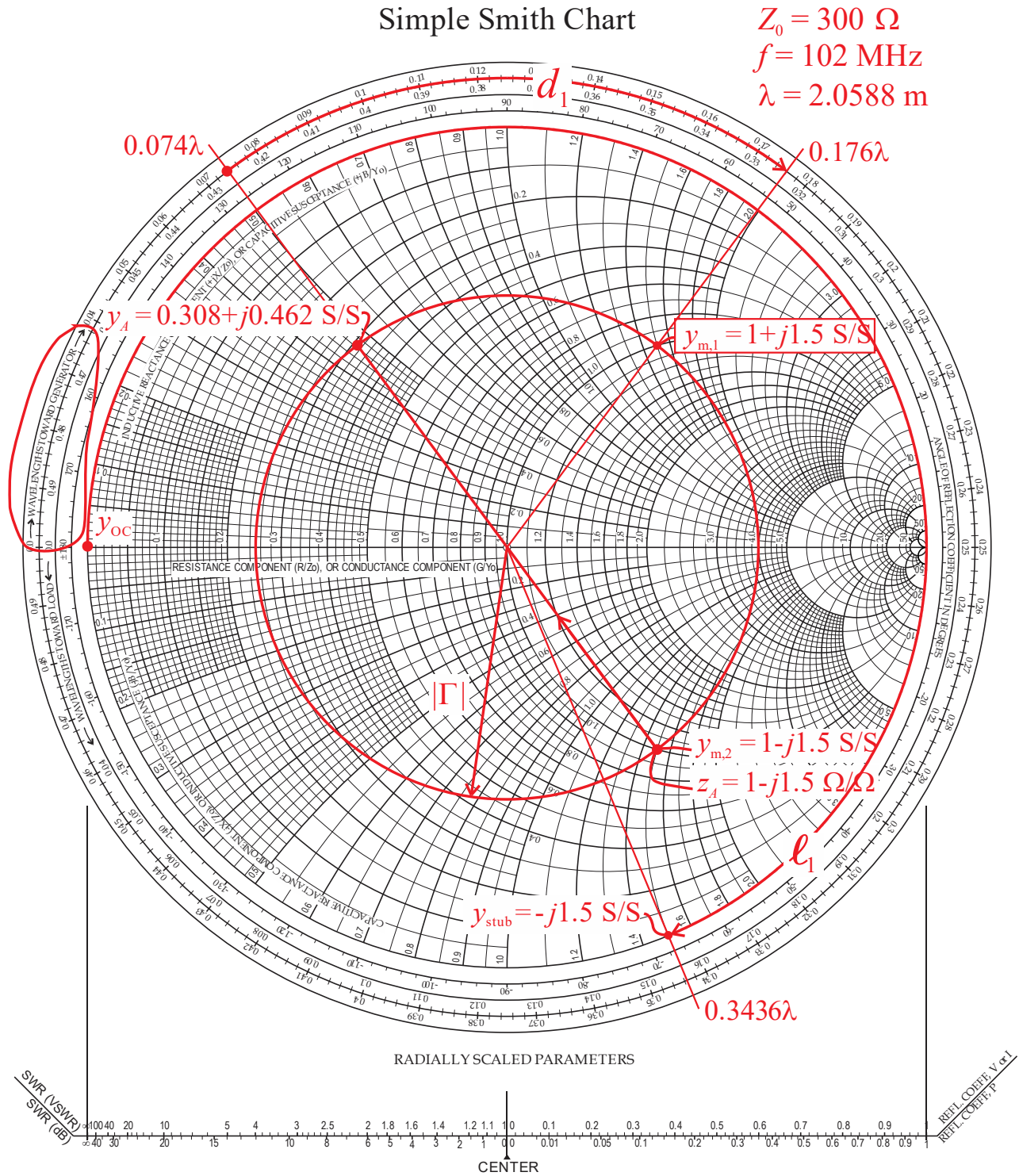


Figure 2 Smith chart for matching antenna using shunt open circuit stub.