

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 discrete inductor connected in parallel as close to the antenna 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 $\underline{y_A = 0.308 + j0.462}$ **S/S** point and plot.
- 4) Note, the two match points are $y_{m,i} = 1 \pm j1.5$ S/S. To use a discrete inductor for matching, **select $y_{m,1} = 1 + j1.5$ S/S** as it has a capacitive susceptance. Note, $Y_{m,1} = y_{m,1}/Z_0 = (1 + j1.5)/300 = 0.00333 + j0.005$ S.
- 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 discrete inductor in parallel with susceptance $Y_{ind} = -j/\omega L = -j0.005$ S. Solving yields $L = 1/[(2\pi \cdot 102 \times 10^6) \cdot 0.005] = 3.120685 \times 10^{-7}$ H $\Rightarrow \underline{L = 312.0685 \text{ nH}}$.
- 7) As shown on Figure 1, everywhere toward the source from the location of L will be matched, i.e., $Z_{in} = 300 \Omega$.

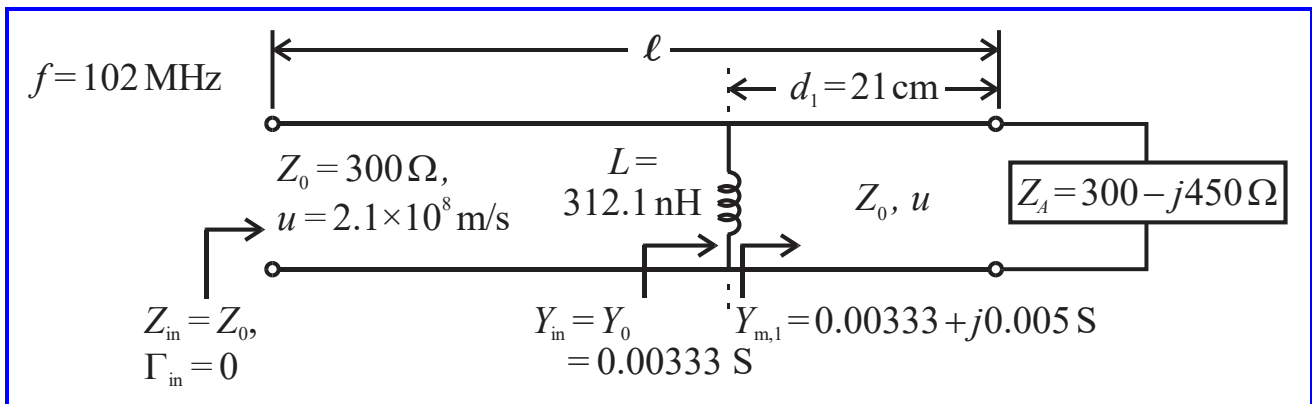


Figure 1 Matching antenna using discrete parallel inductor.

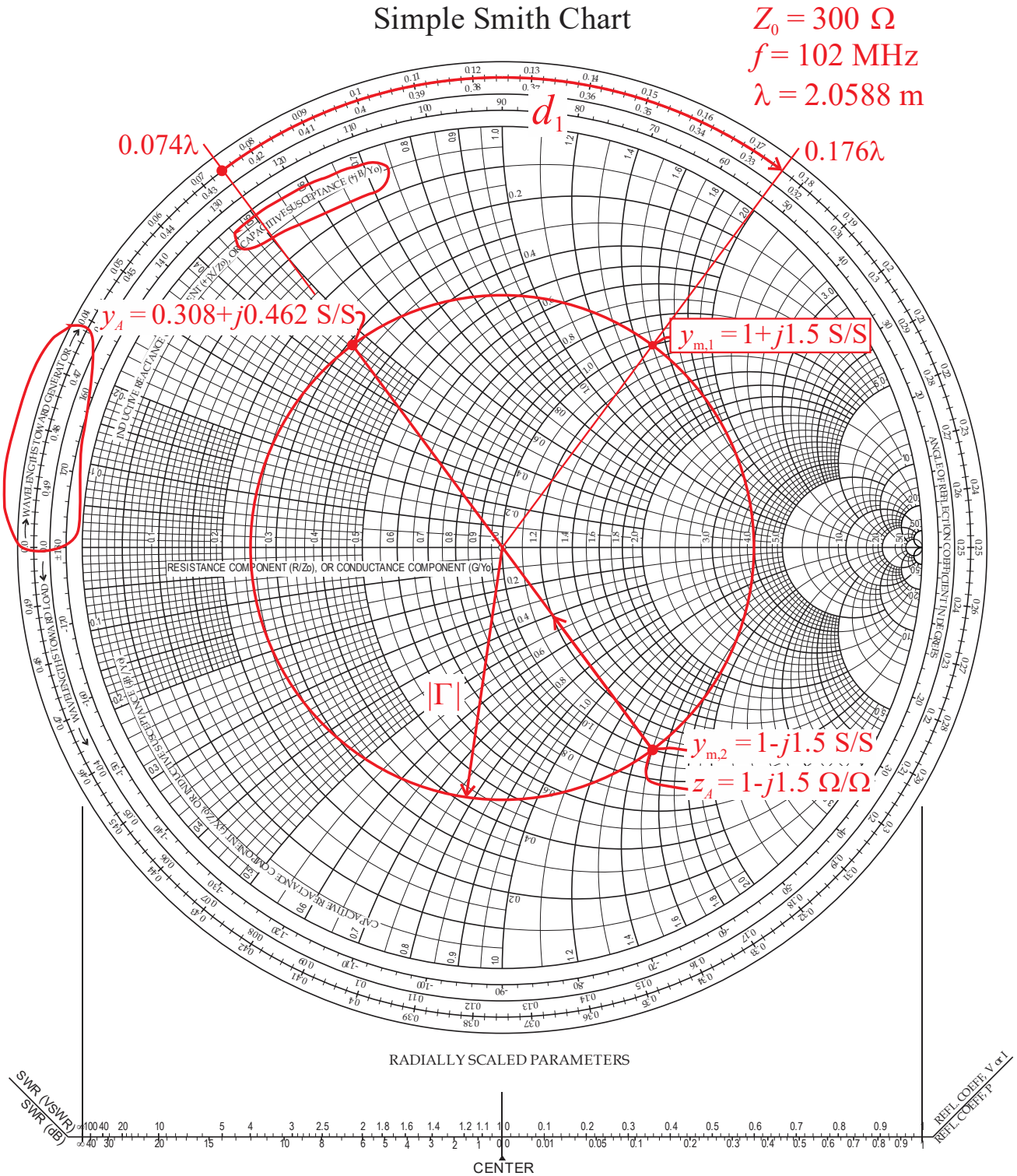


Figure 2 Smith chart for matching antenna using discrete parallel inductor.