An antenna has input impedance Z_A = 80 + j 45 Ω at 125 MHz. Match it to a feeding transmission line (Z_0 = 50 Ω & u = 2.5 × 10^8 m/s) using a quarterwave transformer (QWT) placed as close to the antenna as possible. Assume the wavelength λ' of the QWT is 90% of λ for the feeding transmission line. Draw a fully labeled sketch of the final design.

- The wavelength is $\lambda = u / f = 2.5 \times 10^8 / 125 \times 10^6 \Rightarrow$ <u>λ = 2 m = 200 cm</u>.
- Given, the QWT wavelength is λ' = 0.9 λ = 0.9(2) ⇒ <u>λ' = 1.8 m = 180 cm</u>.

Steps

1) Calculate the normalized impedance for the antenna $z_A = Z_A / Z_0 = (80 + j\,45) / 50 \Rightarrow$ **<u>z_A = 1.6 + j 0.9 Ω/Ω</u>** and plot on **Smith chart** (see Figure 2).

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

3) The two match points where the circle of constant |Γ| intersects the real axis are $r_{m,1} = r_{max} = 2.3$ [or $R_{max} = 2.3(50) = 115$ Ω] and $r_{m,2} = r_{min} = 0.436$. Select the $r_{m,1} = r_{max} = 2.3$ match point as it is closest to z_A.

4) Find the distance d_1 from z_A to $r_{m,1} = r_{max}$ using scales on Smith chart, $d_1 = 0.25\lambda - 0.1983\lambda$ ⇒ **<u>$d_1 = 0.0517\lambda$</u>** or $d_1 = 0.0517(200) \Rightarrow$ **<u>d_1 = 10.34 cm</u>**.

5) Starting at d_1 from z_A, insert the QWT. It will have a characteristic impedance $Z'_{0,min} = \sqrt{Z_0 R_{max}} = \sqrt{50(115)} \Rightarrow$ **<u>Z_0' = 75.83 Ω</u>** and length λ'/4 = 180/4 ⇒ **<u>λ'/4 = 45 cm</u>**.

6) As shown on Figure 1, everywhere toward the source from the QWT sees an input impedance of $Z_{in} = Z_0 = 50$ Ω.

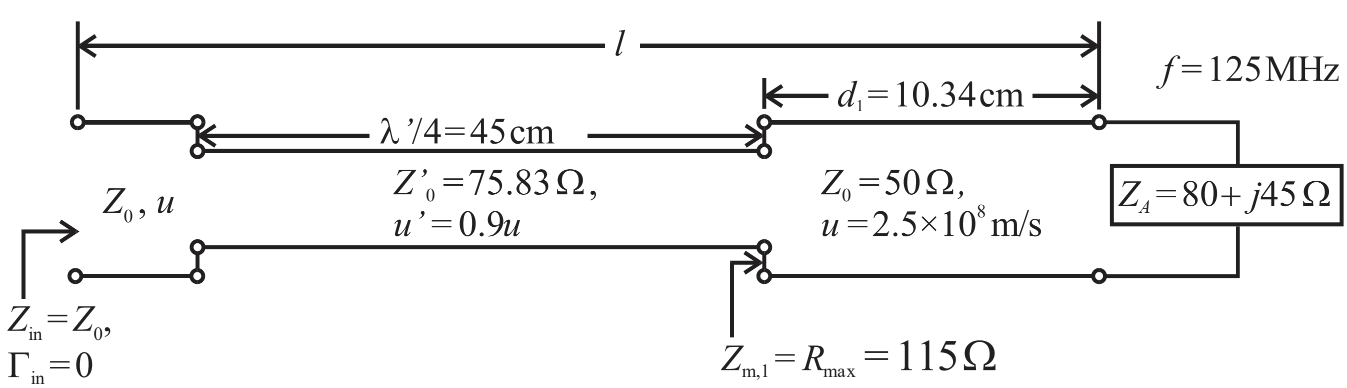

Figure 1 Matching an antenna using a QWT.

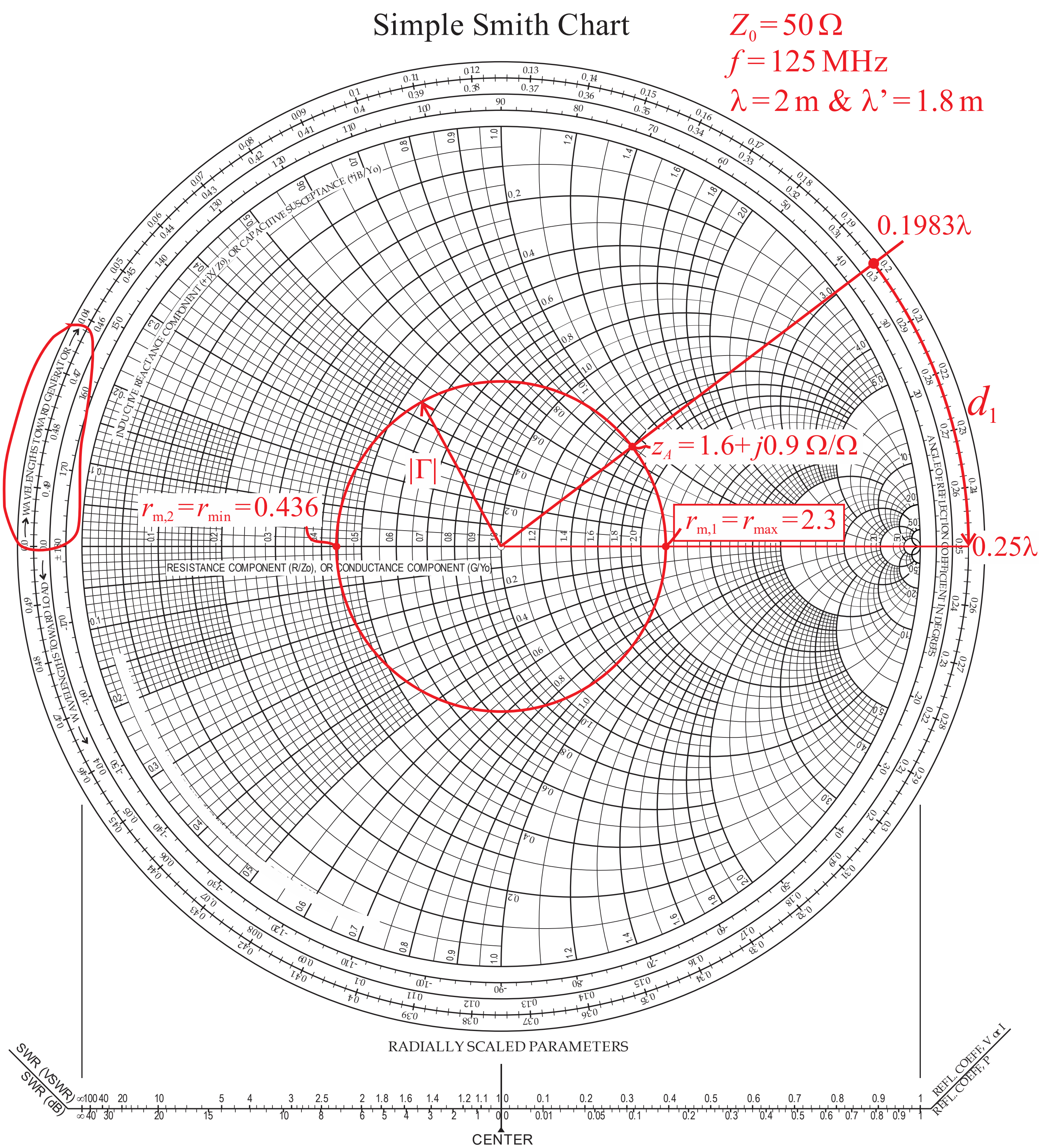

Figure 2 Smith chart for matching an antenna using a QWT.