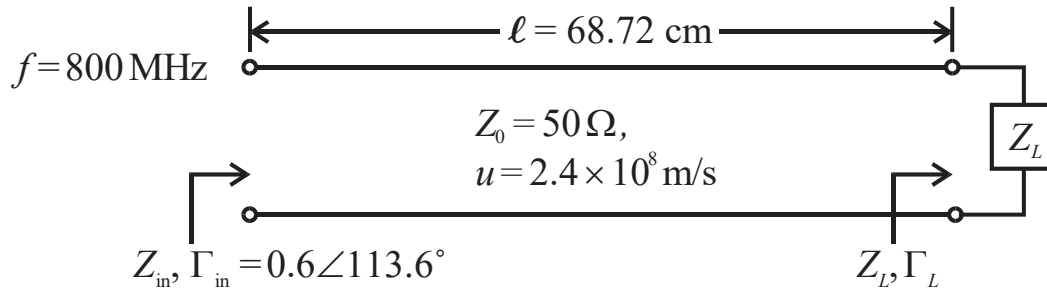


A lossless transmission line ($Z_0 = 50 \Omega$, $u = 2.4 \times 10^8$ m/s), operating at 800 MHz, has an input reflection coefficient of $0.6 \angle 113.6^\circ$. If the transmission line is 68.72 cm long, use a Smith chart to find: a) input impedance, b) SWR, c) load reflection coefficient Γ_L , d) load impedance Z_L , and e) load admittance Y_L .



a)

- Plot $\Gamma_{in} = 0.6 \angle 113.6^\circ$ point on Smith chart by: 1) drawing radial line from center of Smith chart through $\angle \Gamma_{in} = 113.6^\circ$ on “ANGLE OF REFLECTION COEFFICIENT IN DEGREES” scale (on perimeter), 2) set compass to $|\Gamma_{in}| = 0.6$ on the “REFL. COEFF. V or I” scale below Smith chart on right side, 3) draw circle, centered on Smith chart, and 4) note z_{in} is at intersection of circle & radial line.
- At intersection, use normalized resistance circles on Smith chart to read $r = 0.35$.
- At intersection, use normalized reactance arcs on Smith chart to read $x = 0.6$.
- Put together to get $z_{in} = 0.35 + j0.6 \Omega/\Omega$.
- Un-normalize to get input impedance $Z_{in} = (0.35 + j0.6) 50 \Rightarrow \boxed{Z_{in} = 17.5 + j30 \Omega}$.

b) Use compass to mark SWR (VSWR) scale below Smith chart on left side. Read standing wave ratio to be $\boxed{SWR = 4}$.

c) Calculate wavelength, $\lambda = u/f = 2.4 \times 10^8 / 800 \times 10^6 = 0.3$ m = 30 cm. Next, calculate TL length in wavelengths $\ell / \lambda = 68.72 / 30 = 2.2907$ and remove integer multiples of 0.5 to get $\ell / \lambda = 0.2907$.

- Need to move 0.2907 in the “WAVELENGTHS TOWARD LOAD” direction (CCW) on the circle of $|\Gamma| = 0.6$ to get to Γ_L / z_L point.
- On “WAVELENGTHS TOWARD GENERATOR” scale read that $\angle \Gamma_{in}$ corresponds to 0.0921. That means we need to go to $0.2907 - 0.0921 = 0.1986$ on the “WAVELENGTHS TOWARD LOAD” scale and draw radial line from center of Smith chart. Mark Γ_L / z_L point at intersection of this radial line and circle of $|\Gamma| = 0.6$.
- Use the “ANGLE OF REFLECTION COEFFICIENT IN DEGREES” scale to read $\angle \Gamma_L = -37^\circ$.
- Put magnitude & angle of load reflection coefficient together $\Rightarrow \boxed{\Gamma_L = 0.6 \angle -37^\circ}$.

d) At Γ_L / z_L point:

- Use normalized resistance circles on Smith chart to read $r_L = 1.6$.
- Use normalized reactance circles on Smith chart to read $x_L = -1.8$.
- Put together to get $z_L = 1.6 - j1.8 \Omega/\Omega$.
- Un-normalize z_L to get $Z_L = (z_L) Z_0 = (1.6 - j1.8) 50 \Rightarrow \boxed{Z_L = 80 - j90 \Omega}$.

e)

- Extend radial line from z_L point through center of Smith chart to circle of $|\Gamma| = 0.6$ on opposite side. Mark intersection on opposite side as y_L .
- Use normalized conductance circles on Smith chart to read $g_L = 0.28$.
- Use normalized susceptance arcs on Smith chart to read $b_L = 0.31$.
- Put together to get normalized load admittance $y_L = 0.28 + j0.31 \text{ S/S}$.
- Calculate load admittance as $Y_L = y_L / Z_0 = (0.28 + j0.31) / 50 \Rightarrow \boxed{Y_L = 5.6 + j6.2 \text{ mS}}$.

