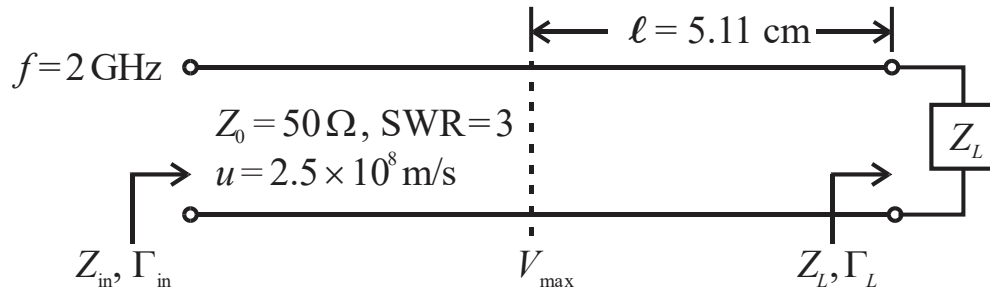


A lossless transmission line ($Z_0 = 50 \Omega$, $u = 2.5 \times 10^8$ m/s) operates at 2 GHz and is terminated with an unknown load. The SWR is measured to be 3. The nearest voltage maxima is measured to be 5.11 cm from the load. Find $R_{\max}$, Γ_L and Z_L using a Smith chart.



- Set compass to $\text{SWR} = 3$ using SWR (VSWR) scale below Smith chart on left side and draw circle centered on Smith chart.
- Use compass to mark the “REFL. COEFF. V or I” scale below Smith chart on right side. Read $|\Gamma| = 0.5$.
- Mark location of $r_{\max} = S = 3$. This is also the location of $V_{\max}$.
- Un-normalize $R_{\max} = Z_0 r_{\max} = 50(3) \Rightarrow \boxed{R_{\max} = 150 \Omega}$.
- Calculate wavelength, $\lambda = u/f = 2.5 \times 10^8 / 2 \times 10^9 = 0.125$ m = 12.5 cm. Next, calculate distance from $V_{\max}$ to load in wavelengths $\ell_{\max} / \lambda = 5.11 / 12.5 = 0.4088$.
- From $r_{\max}$, move $0.4088 = 0.25 + 0.1588$ in the “WAVELENGTHS TOWARD LOAD” direction (CCW) on the circle of $\text{SWR} = 3$ to get to the Γ_L / z_L point and draw radial line from center of Smith chart to perimeter.
- Use the “ANGLE OF REFLECTION COEFFICIENT IN DEGREES” scale to read the load reflection coefficient angle as $\angle \Gamma_L = -65.2^\circ$.
- Put magnitude & angle of load reflection coefficient together $\Rightarrow \boxed{\Gamma_L = 0.5 \angle -65.2^\circ}$.
- At Γ_L / z_L point, use normalized resistance circles on Smith chart to read $r_L = 0.9 \Omega/\Omega$.
- At Γ_L / z_L point, use normalized reactance circles on Smith chart to read $x_L = -1.1 \Omega/\Omega$.
- Put together normalized resistance & reactance together to get $z_L = 0.9 - j1.1 \Omega/\Omega$.
- Un-normalize z_L to get $Z_L = (z_L) Z_0 = (0.9 - j1.1) 50 \Rightarrow \boxed{Z_L = 45 - j55 \Omega}$.

Simple Smith Chart

$Z_0 = 50 \Omega$
 $u = 2.5 \times 10^8 \text{ m/s}$
 $f = 2 \text{ GHz}$

