Use a 1 m length of the coaxial transmission line from 1) to create a TL circuit with $V_g = 16\angle 0°$ V, $Z_g = 45 - j10\ \Omega$, and $Z_L = 100 - j50\ \Omega$ operating at 3.6 GHz. Find: a) the load reflection coefficient, b) input reflection coefficient, c) V_0^+, d) the general phasor voltage & current equations.

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A coaxial transmission line, operating at 3.6 GHz, has the distributed parameters $R = 3.8\ \Omega$/m, $L = 248$ nH/m, $G = 6.4$ mS/m, and $C = 112$ pF/m. Calculate the a) propagation constant, b) attenuation constant (both Np/m and dB/m), c) phase constant, d) characteristic impedance (both polar & rectangular forms), e) wavelength, and f) phase velocity (m/s and fraction of c).

From earlier problem-

$\gamma = 0.19096 + j\,119.2113$ 1/m, $Z_0 = 47.0561 + j\,0.435\ \Omega = 47.0561\angle 0.05297°\ \Omega$,

$\lambda = 0.052706$ m $= 5.2706$ cm, and $v_p = 1.89743 \times 10^8$ m/s $= 0.6329c$

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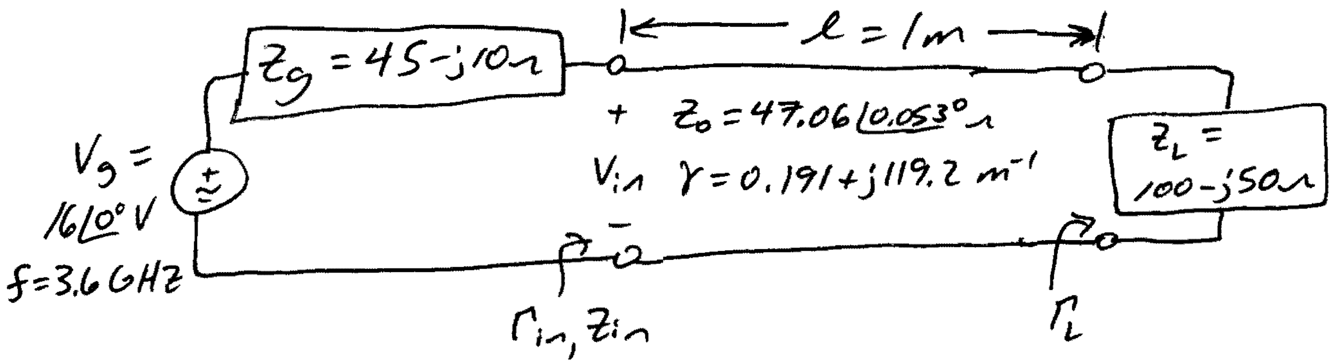


a) (2.35) $\Gamma_L = \dfrac{Z_L - Z_0}{Z_L + Z_0} = \dfrac{(100-j50)-(47.056+j0.435)}{(100-j50)+(47.056+j0.435)}$

$$\Gamma = \Gamma_L = 0.4691\angle -24.6237°$$

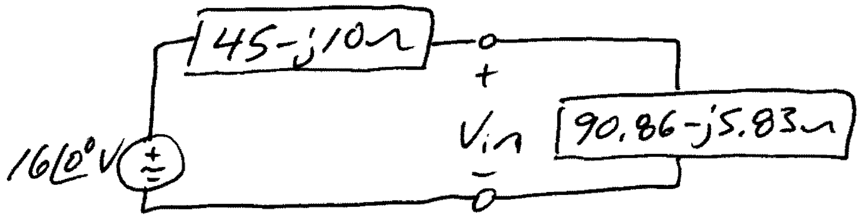
b) (2.90) $\Gamma_{in} = \Gamma(\ell) = \Gamma e^{-2\gamma\ell} = 0.469\angle -24.6°\ e^{-2(0.191+j119.2)1}$

$$\Gamma_{in} = 0.3202\angle -5.2318°$$

c) (notes) $Z_{in} = Z_0 \dfrac{1+\Gamma_{in}}{1-\Gamma_{in}} = (47.056+j0.435)\dfrac{1+0.3202\angle -5.23°}{1-0.3202\angle -5.23°}$

$$Z_{in} = 90.86 - j5.83\ \Omega$$

c) cont. Equiv. circuit



$$V_{in} = 16\angle 0^\circ \frac{90.86 - j5.83}{(45-j10)+(90.86-j5.83)} = 10.6504\angle 2.9753^\circ \text{ V}$$

Per (2.89a) $V(z) = V_0^+\left(e^{-\gamma z} + \Gamma e^{\gamma z}\right)$. At the input $z=-1\text{m}$ & $V(z=-1\text{m}) = V_{in}$, we find

$$V_0^+ = \frac{V_{in}}{e^{\gamma(1)} + \Gamma_L e^{\gamma(-1)}} = \frac{10.6504\angle 2.9753^\circ}{e^{0.191+j119.2} + (0.469\angle -24.6^\circ)e^{-0.191-j119.2}}$$

$$\underline{\underline{V_0^+ = 6.6702\angle 13.9394^\circ \text{ V}}}$$

d) Per (2.89a),

$$\boxed{V(z) = (6.67\angle 13.94^\circ)\left[e^{-(0.191+j119.2)z} + (0.469\angle -24.6^\circ)e^{(0.191+j119.2)z}\right] \text{V} \quad -1\text{m} \le z \le 0}$$

Per (2.89b), $I(z) = \frac{V_0^+}{Z_0}\left(e^{-\gamma z} - \Gamma e^{\gamma z}\right)$

$$I(z) = \frac{6.67\angle 13.94^\circ}{47.06\angle 0.053^\circ}\left(e^{-(0.191+j119.2)z} - (0.469\angle -24.6^\circ)e^{(0.191+j119.2)z}\right)$$

$$\boxed{I(z) = (0.14175\angle 13.886^\circ)\left[e^{-(0.191+j119.2)z} - (0.469\angle -24.6^\circ)e^{(0.191+j119.2)z}\right] \text{A} \quad -1\text{m} \le z \le 0}$$