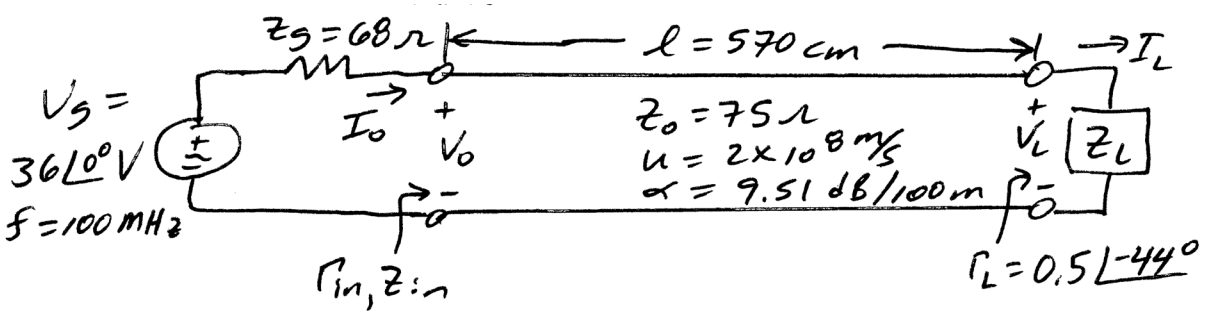
An RG-6 coaxial transmission line ($Z_0 = 75\ \Omega$, $u = 2 \times 10^8$ m/s, $\alpha = 9.51$ dB/100 m) of length 570 cm is terminated with a load. Using a vector network analyzer (VNA), a load reflection coefficient of $\Gamma_L = 0.5\angle{-44°}$ is measured. The transmission line is connected to a generator with $V_g = 36\angle 0°$ V and $Z_g = 68\ \Omega$ operating at 100 MHz. Draw the TL circuit. Then, determine (a) the attenuation (Np/m), phase (rad/m), & propagation constants, (b) SWR & load impedance, (c) input reflection coefficient & impedance, (d) phasor input current & voltage, (e) phasor forward voltage wave amplitude, and (f) phasor load current & voltage.




a) $\alpha = \frac{9.51\ dB}{100\ m}\left(\frac{1\ Np}{20\log e\ dB}\right) \Rightarrow \alpha = 0.0109488\ \frac{Np}{m}$

(11.14) $\beta = \frac{\omega}{u} = \frac{2\pi(100\times10^6)}{2\times10^8} \Rightarrow \beta = 3.14159\ rad/m$

(11.11) $\gamma = \alpha + j\beta \Rightarrow \gamma = 0.010949 + j3.14159\ 1/m$

b) (11.38a) $SWR = \frac{1+|\Gamma_L|}{1-|\Gamma_L|} = \frac{1+0.5}{1-0.5} \Rightarrow SWR = 3$

$Z_L = Z_0\frac{1+\Gamma_L}{1-\Gamma_L} = 75\frac{1+0.5\angle{-44°}}{1-0.5\angle{-44°}} \Rightarrow Z_L = 106 - j98.178\ \Omega$

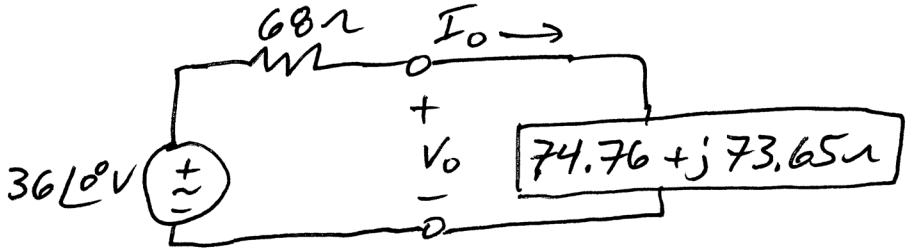
c) (11.37) $\Gamma_{in} = \Gamma_L e^{-2\gamma\ell} = 0.5\angle{-44°}\, e^{-2(0.01095+j3.1416)5.7}$

$\Gamma_{in} = 0.44133\angle 64°$

$Z_{in} = Z_0\frac{1+\Gamma_{in}}{1-\Gamma_{in}} = 75\frac{1+0.44133\angle 64°}{1-0.44133\angle 64°}$

$Z_{in} = 74.7576 + j73.6528\ \Omega$

d) Use equivalent circuit




$$I_0 = \frac{36\angle 0°}{68 + (74.76 + j\,73.65)} \Rightarrow \underline{I_0 = 0.2241\angle -27.291°\ A}$$

$$V_0 = (0.2241\angle -27.29°)(74.76 + j\,73.65) \Rightarrow \underline{V_0 = 23.519\angle 17.283°\ V}$$

e) (11.27a) $V_0^+ = \frac{1}{2}[V_0 + I_0 Z_0]$

$$V_0^+ = \frac{1}{2}[23.519\angle 17.283° + (0.2241\angle -27.291°)\,75]$$

$$\underline{V_0^+ = 18.7005\angle -1.102°\ V}$$

f) Notes $V_L = V_0^+ e^{-\delta \ell}(1 + \Gamma_L)$

$$V_L = (18.7005\angle -1.102°)\, e^{-(0.01095 + j\,3.14159)5.7}\,(1 + 0.5\angle -44°)$$

$$\underline{V_L = 24.6553\angle 38.568°\ V}$$

$$I_L = V_L / Z_L = \frac{24.655\angle 38.57°}{106 - j\,98.178}$$

$$\underline{I_L = 0.17065\angle 81.374°\ A}$$