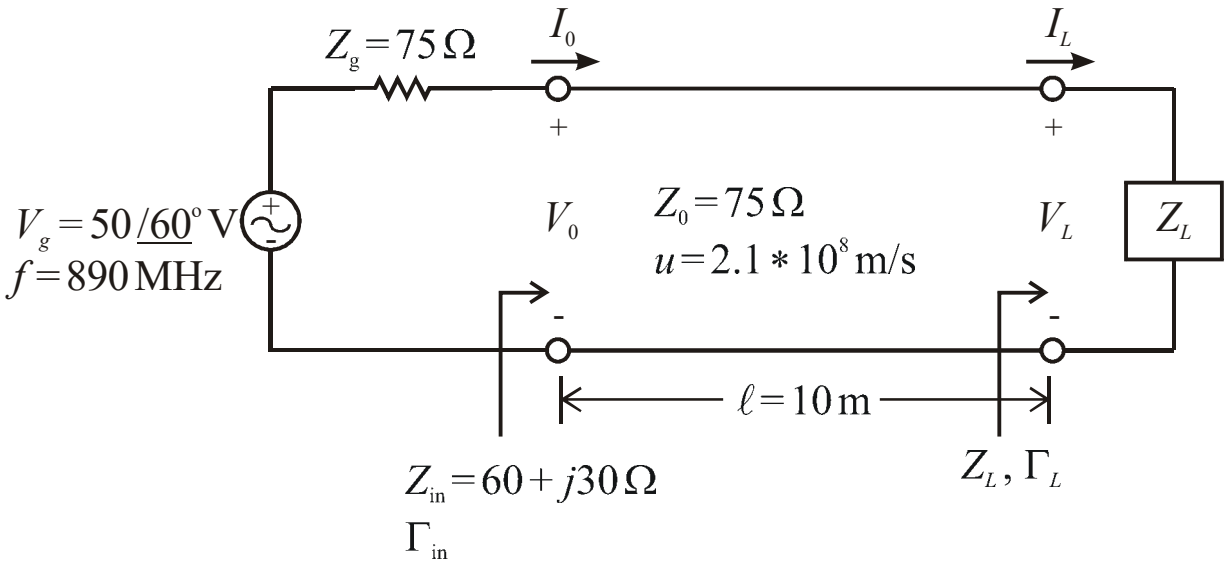
EE 381 Lossless Transmission Line example



For the lossless transmission line circuit shown, calculate quantities of interest, especially at the input and load ends of the transmission line. Note, we are given the input impedance Z_{in} rather than load information.

Given:

$Vg := 50 \cdot e^{j \cdot 60 \cdot \frac{\pi}{180}}$ V $f := 890 \cdot 10^6$ Hz $Zg := 75$ Ω

$Zin := 60 + j \cdot 30$ Ω $Z0 := 75$ Ω $L := 10$ m $u := 2.1 \cdot 10^8$ m/s

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$\Gamma in := \frac{Zin - Z0}{Zin + Z0}$ $|\Gamma in| = 0.2425$ $\arg(\Gamma in) \cdot \frac{180}{\pi} = 104.036$ deg

$\beta := \frac{2 \cdot \pi \cdot f}{u}$ $\beta = 26.629$ rad/m $\lambda := \frac{u}{f}$ $\lambda = 0.23596$ m

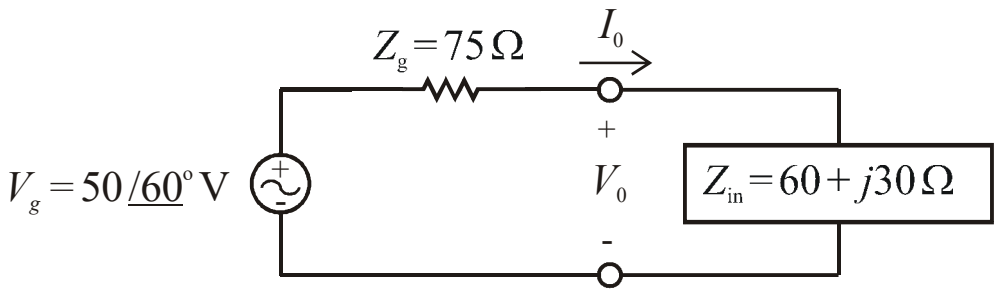
$\beta L := \beta \cdot L$ $\beta L = 266.287$ rad $\beta L \cdot \frac{180}{\pi} = 15257$ deg $\frac{\beta L}{2 \cdot \pi} = 42.381\ \lambda$

$\Gamma L := \Gamma in \cdot e^{j \cdot 2 \cdot \beta \cdot L}$ $|\Gamma L| = 0.2425$ $\arg(\Gamma L) \cdot \frac{180}{\pi} = 18.322$ deg

$ZL := Z0 \cdot \frac{1 + \Gamma L}{1 - \Gamma L}$ $ZL = 117.973 + 19.113i$ Ω

EE 381 Lossless Transmission Line example cont.

Draw equivalent circuit at input of the lossless transmission line.



$$V0 := Vg \cdot \frac{Zin}{Zg + Zin} \qquad |V0| = 24.2536 \text{ V} \qquad \arg(V0) \cdot \frac{180}{\pi} = 74.036 \text{ deg}$$

$$I0 := \frac{Vg}{Zg + Zin} \qquad |I0| = 0.36155 \text{ A} \qquad \arg(I0) \cdot \frac{180}{\pi} = 47.471 \text{ deg}$$

Calculate V_0^+ as well as phasor load voltage and current using reflection coefficient form of the phasor voltage and current equations.

$$V0plus := \frac{V0}{1 + \Gamma in} \qquad |V0plus| = 25 \text{ V} \qquad \arg(V0plus) \cdot \frac{180}{\pi} = 60 \text{ deg}$$

$$VL := V0plus \cdot e^{-j \cdot \beta \cdot L} \cdot (1 + \Gamma L) \qquad IL := \frac{V0plus}{Z0} \cdot e^{-j \cdot \beta \cdot L} \cdot (1 - \Gamma L)$$

$$|VL| = 30.815 \text{ V} \qquad \arg(VL) \cdot \frac{180}{\pi} = -73.6 \text{ deg}$$

$$|IL| = 0.25784 \text{ A} \qquad \arg(IL) \cdot \frac{180}{\pi} = -82.8 \text{ deg}$$