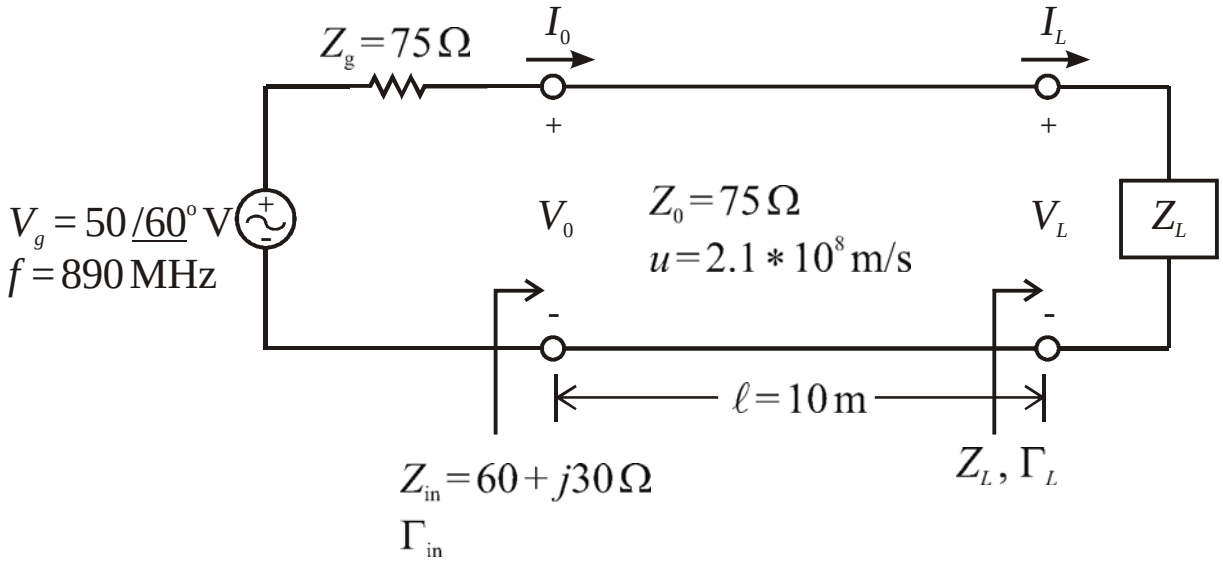
EE381 Lossless Transmission Line example 2



For the lossless transmission line circuit shown, calculate quantities of interest, especially at the input and load ends of the transmission line.

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 $L := 10.0$ m $u := 2.1 \cdot 10^8$ m/s

---

$\Gamma 0 := \frac{Zin - Z0}{Zin + Z0}$ $|\Gamma 0| = 0.2425$ $\arg(\Gamma 0) \cdot \frac{180}{\pi} = 104.036$ deg

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

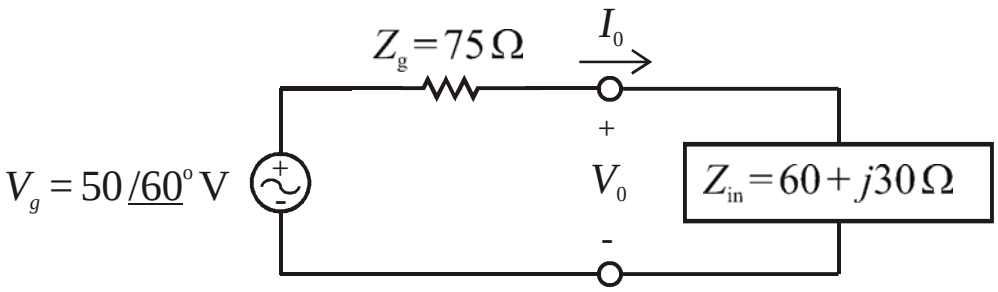
$\beta L := \beta \cdot L$ $\beta L = 266.287$ rad $\beta L \cdot \frac{180}{\pi} = 15257$ deg $\frac{\beta L}{2 \cdot \pi} = 42.381$ λ

$\Gamma L := \Gamma 0 \cdot e^{j \cdot 2 \cdot \beta \cdot L}$ $|\Gamma L| = 0.2425$ $\arg(\Gamma L) \cdot \frac{180}{\pi} = 18.322$ deg

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

EE381 Lossless Transmission Line example 2 cont.

Draw equivalent circuit at input of the lossless transmission line.



$$V0 := Vg \cdot \frac{Zin}{Zg + Zin} \qquad |V0| = 24.25356 \text{ V} \qquad \arg(V0) \cdot \frac{180}{\pi} = 74.036 \text{ deg}$$

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

$$Vplus := \frac{V0}{1 + \Gamma 0} \qquad |Vplus| = 25 \text{ V} \qquad \arg(Vplus) \cdot \frac{180}{\pi} = 60 \text{ deg}$$

$$VL := Vplus \cdot e^{-j \cdot \beta \cdot L} \cdot (1 + \Gamma L) \qquad |VL| = 30.81501 \qquad \arg(VL) \cdot \frac{180}{\pi} = -73.597 \text{ deg}$$

$$IL := \frac{Vplus}{Z0} \cdot e^{-j \cdot \beta \cdot L} \cdot (1 - \Gamma L) \qquad |IL| = 0.25784 \qquad \arg(IL) \cdot \frac{180}{\pi} = -82.799 \text{ deg}$$

EE381 Lossless Transmission Line example 2 cont.

Let's plot |V(z)| and |I(z)| for values of *z* near the load *z* = L = 10 m.

$n := 0 .. 2000 \qquad z_n := \frac{n}{2000} \cdot L \qquad \Gamma z_n := \Gamma L \cdot e^{-j \cdot 2 \cdot \beta \cdot (L - z_n)}$

$Vs_n := Vplus \cdot e^{-j \cdot \beta \cdot z_n} \cdot (1 + \Gamma z_n) \qquad Is_n := \frac{Vplus}{Z0} \cdot e^{-j \cdot \beta \cdot z_n} \cdot (1 - \Gamma z_n)$