

## ECE 3113

### Transmission Line Modeling

#### Objective

In this project you are asked to perform some basic Transmission Line (TL) computations in ADS. The simulations are done in the time-domain and involve a coax cable from the TLines-Ideal palette in ADS. Figure 1 depicts the arrangement.

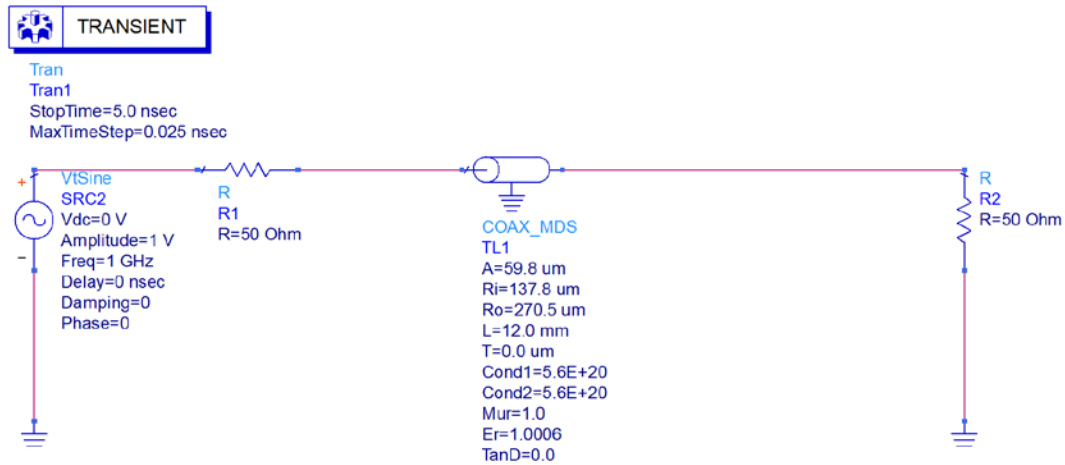


Figure 1. A coax cable connected to a source and terminated by a resistor.

As you can see, COAX\_MDS represents the coax cable with inner radius  $A$  of the inside conductor and inside radius of the outer conductor  $R_i$ . The length is 12 mm, copper thickness  $T$  is 0, and conductivities of the conductors are set to infinity (here  $5.6 \times 10^{20}$  S/m). Further,  $\mu_r=1$ ,  $\epsilon_r=1.0006$ , and the loss tangent is zero.

#### Solution:

1. Based on the given data, compute inductance and capacitance per unit length of this coax cable and determine the characteristic impedance. What is the wavelength for  $f = 1$  GHz?

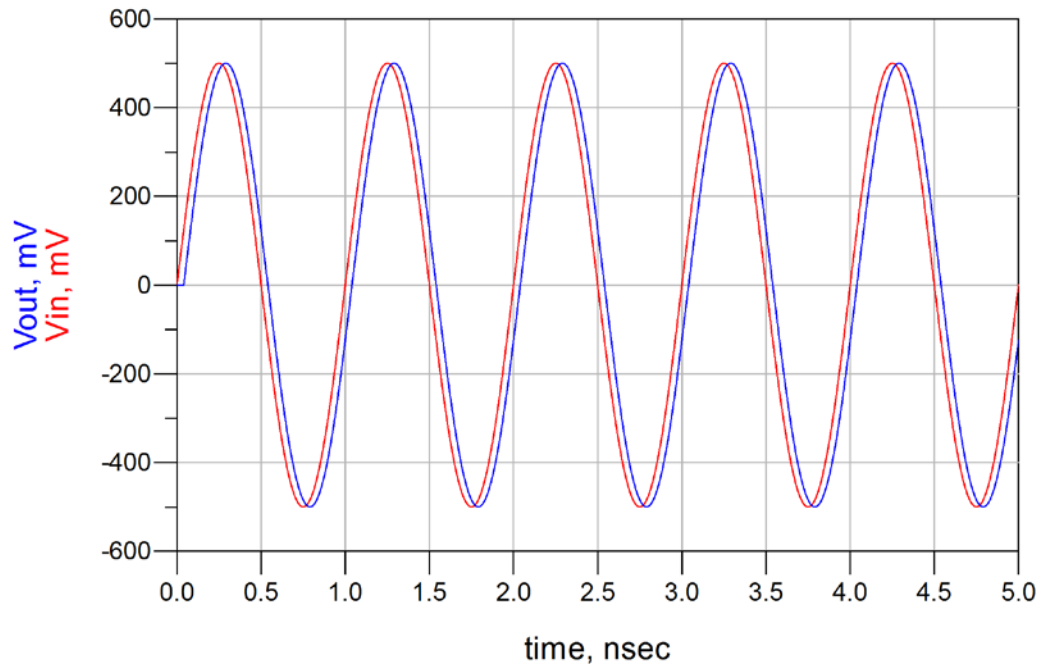
$$C' = \frac{2\pi\epsilon_0\epsilon_r}{\ln\left(\frac{R_i}{A}\right)} = 66.65 \text{ pF/m}$$

$$L' = \frac{\mu_0}{2\pi} \ln\left(\frac{R_i}{A}\right) = 166.96 \text{ nH/m}$$

$$Z_0 = \sqrt{L'/C'} = 50\Omega$$

$$\lambda = \frac{u_p}{f} = 30cm$$

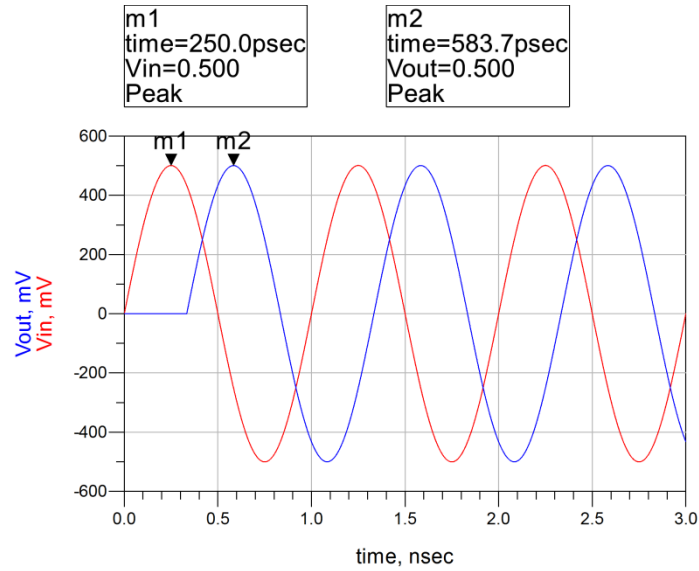
2. Plot the voltages at the beginning and end of the cable.



You should note the slight phase shift, and the fact that the voltage is stepped down as a result of the voltage divider R1/R2. Since source and load are matched, the TL only provides a

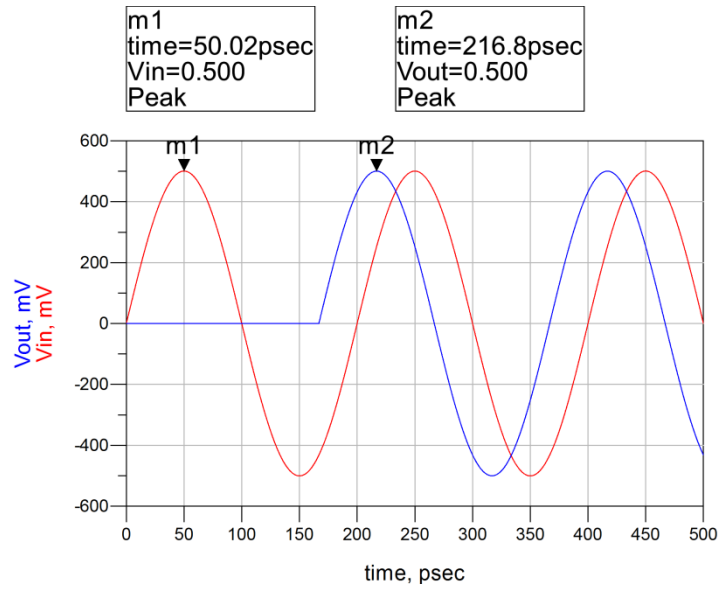
3. To achieve a delay of 340ps based on a 1GHz source frequency, how long does the cable approximately have to be?

100mm:



4. You now increase the frequency to 5GHz and you are required to implement a delay of 167ns. How long does the coax cable have to now?

50mm:



5. For case 4) what happens if the load resistance is increased from  $50\Omega$  to  $100\Omega$ ?

