EXERCISE SECTION 13: TRANSMISSION LINES

13.1. Transmission line basics

A transmission line of length L connects a load to a sinusoidal voltage source with an oscillation frequency f. Assuming that the velocity of wave propagation on the line is c.

For which of the following situations is it reasonable to ignore the presence of the transmission line in the solution of the circuit (and why? Figure 13.1.1 might help you.).

a) $L=20$ cm, $f=20$ kHz

b) $L=50$ km, $f=60$ Hz

c) $L=20$ cm, $f=600$ MHz

d) $L=1$ mm, $f=100$ GHz

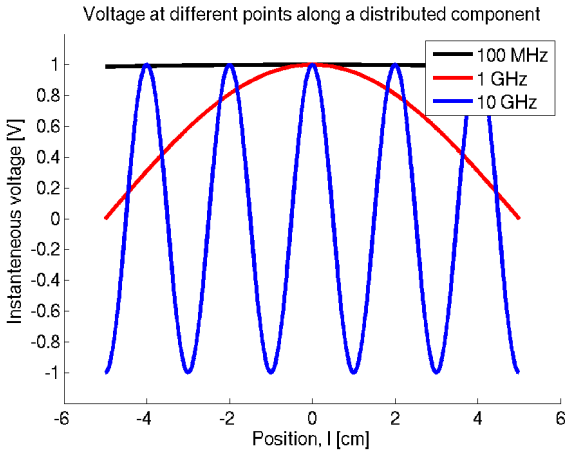

Figure 13.1.1: Example of a (normalized) wave through a physical distance.

13.2. Reflections

Assume a transmission line with characteristic impedance of

$Z_0=50$ Ω and source resistance of $R_S=1$ Ω.

The load resistance is $R_L=1000$ Ω and the input voltage describes a step function from 0 to 5 Volts at $t=0$.

The speed-of-propagation is u =20 cm/ns. The transmission line is 20 cm long.

a) What are the reflection coefficients at both ends?

b) Find the voltage across the load resistor as a function of time.

c) What is the final voltage at the load resistor.

✗ This exercise also exists in the andaLectureTest lab library.

13.3. Matched loads

Assume a transmission line with characteristic impedance of

$Z_0=50$ Ω, and source resistance of $R_S=25$ Ω.

The load resistance is $R_L=50$ Ω and the input voltage describes a step function from 0 to 5 Volts at $t=0$.

The speed-of-propagation is u =20 cm/ns. The transmission line is 20 cm long.

a) What are the reflection coefficients at both ends?

b) Find the voltage across the load resistor as a function of time.

c) What is the final voltage at the load resistor.

✗ This exercise also exists in the andaLectureTest lab library.

13.4. DC Termination

Assume you have a transmission line with a characteristic impedance of

$Z_0=50$ Ω, and source resistance of $R_S=67$ Ω

The termination load consists of two resistors, one from supply to the end point and one to ground from the end point. Call them R_1 and R_2, respectively. The input describes a step from 0 to 3.3 Volts at $t=0$.

a) Dimension R_1 and R_2 to provide matched load and a DC voltage of 0.75 V.

b) Calculate the current through the driver for the high and low states.

c) With the "traditional" termination (only resistor R_2), what would be the current through the driver for high and low states?

d) Which configuration, b or c, consumes most power?