

EECS 117A Demonstration 1 Pulse Propagation and Dispersion

NAME _____

Introduction. In this experiment you will observe reflection and transmission of incident pulses as they propagate down a coaxial transmission line. Please review Secs. 2.1 through 2.5 (skip 2.5.2) of Inan & Inan.

You will observe the effects of matched and mismatched termination impedances on the amplitude and sign of the reflected pulses. By measuring the time between the arrival of the incident and reflected pulses, you will calculate the length of the line. By varying the pulse width you will observe the superposition of the incident and reflected pulses.

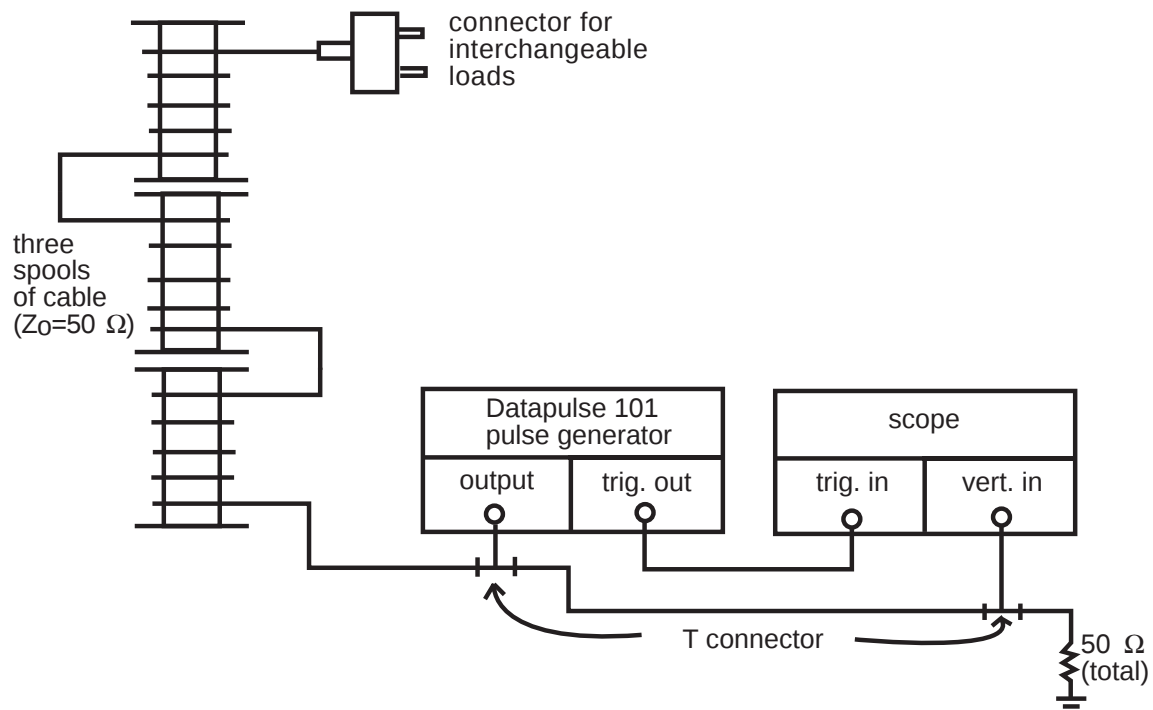
Control Settings:

Scope

Vert. 1.0 V/div
Horz. 1.0 $\mu\text{s}/\text{div}$

Pulse Generator

Frequency 10 kHz
Delay 10 μs
Width 1 μs
Amplitude 2 V



Procedure:

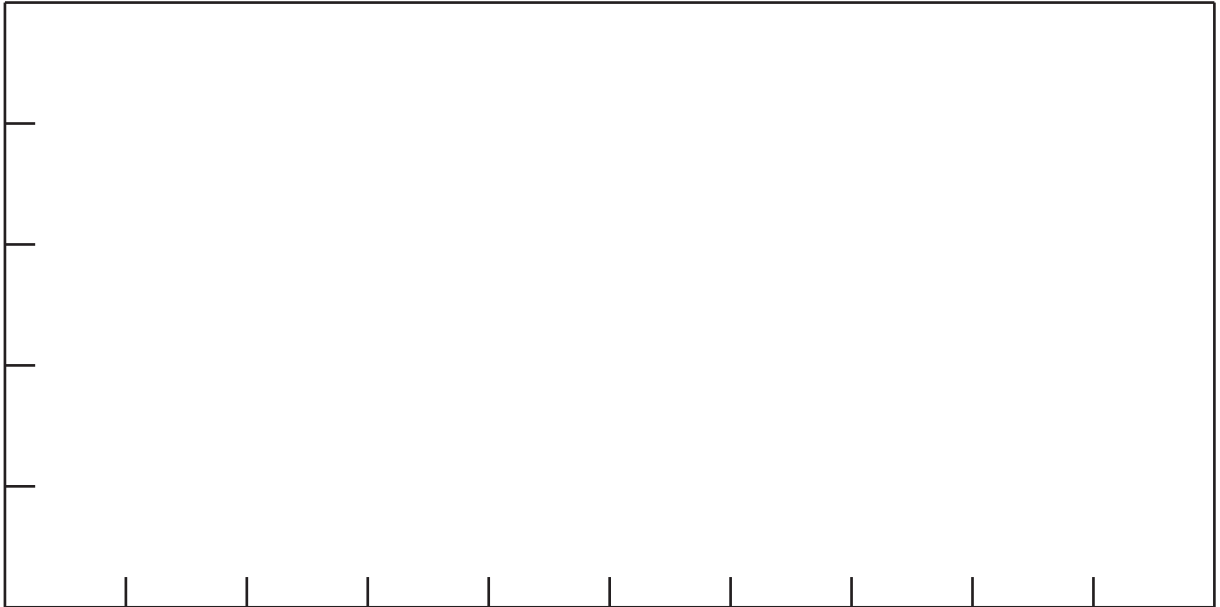
1. Carefully measure the time delay between the incident and reflected pulses and use this information to calculate the length of the line. Note that $\epsilon \approx 2\epsilon_0$ and $\mu = \mu_0$ for the insulating material between inner and outer conductors. Thus the velocity v_p of the pulses is less than the velocity of light ($c = 3 \times 10^8$ m/sec).

Approximate length of line: _____ m.

Is your measured length reasonable? _____ .

2. Using the control settings as a guide, display the incident and reflected pulses on the scope. Terminate the line with the various terminations provided. Below note the type of termination used and carefully draw the incident and reflected (if any) pulses. In the space below this, briefly relate your observations to what you have learned in lecture.

Termination: Short

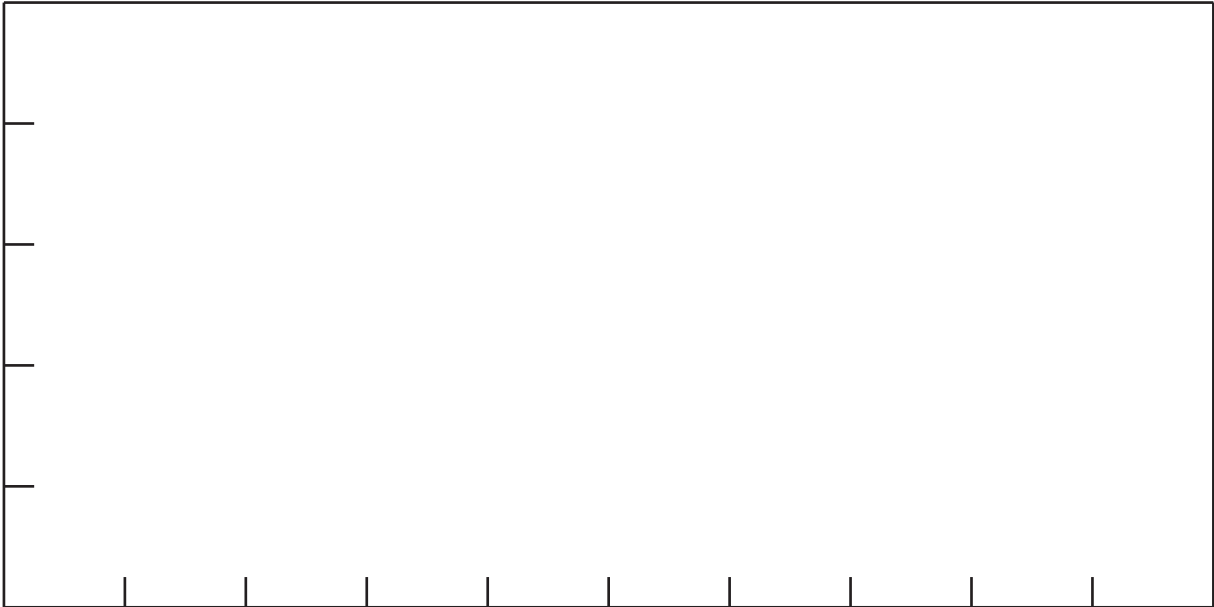


The reflection coefficient is -1 for this case. Why is the amplitude of the reflected pulse smaller than the amplitude of the applied pulse? _____

What is the measured roundtrip attenuation $\eta = V_{refl}(\text{meas})/V_{appl}(\text{meas})$?

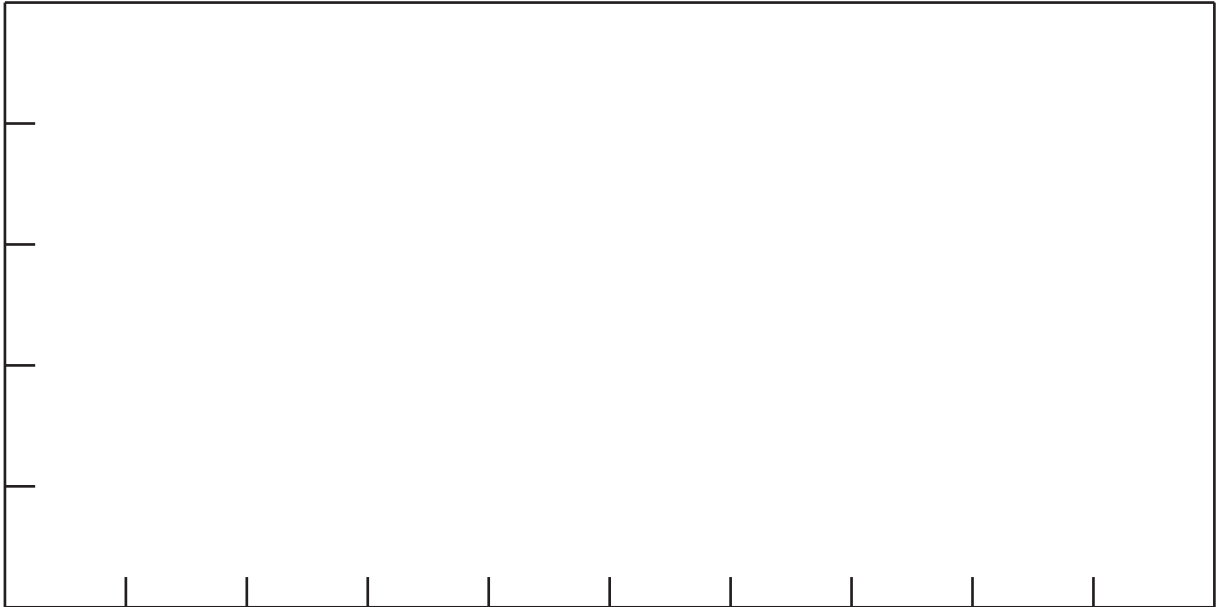
$\eta =$ _____ .

Termination: $50\ \Omega$



Comments: _____

Termination: $10\ \Omega$



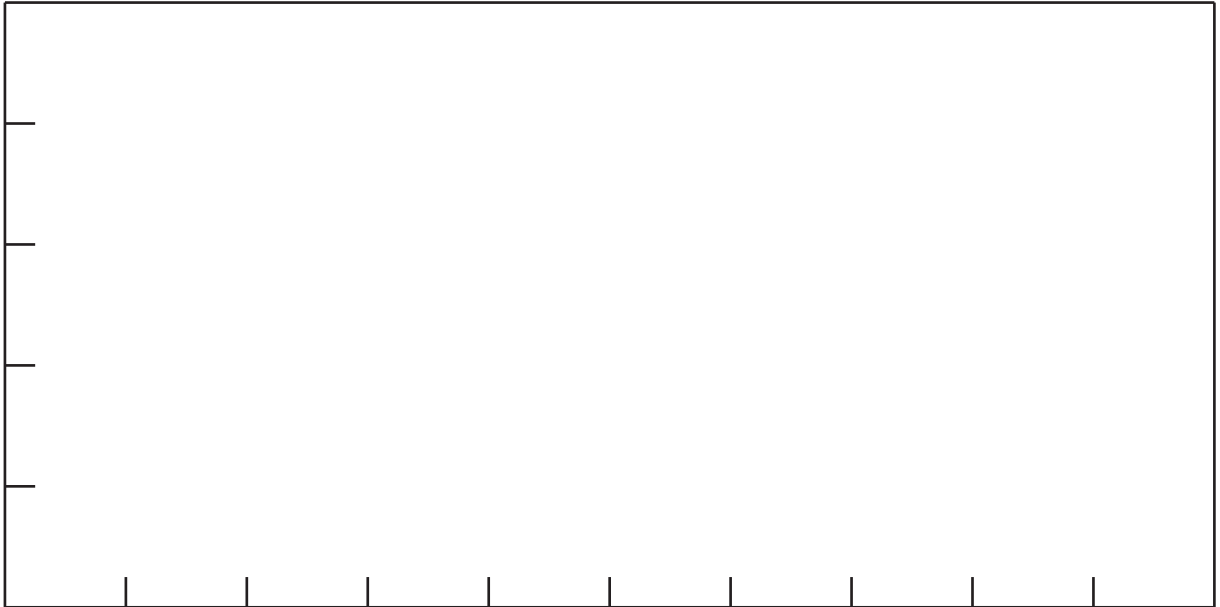
Measured reflection coefficient: $\rho(\text{meas}) = \underline{\hspace{2cm}}$.

Theoretical reflection coefficient for lossless line: $\rho(\text{theor}) = \underline{\hspace{2cm}}$.

$\eta\rho(\text{theor}) = \underline{\hspace{2cm}}$.

Comments: _____

Termination: 100 Ω



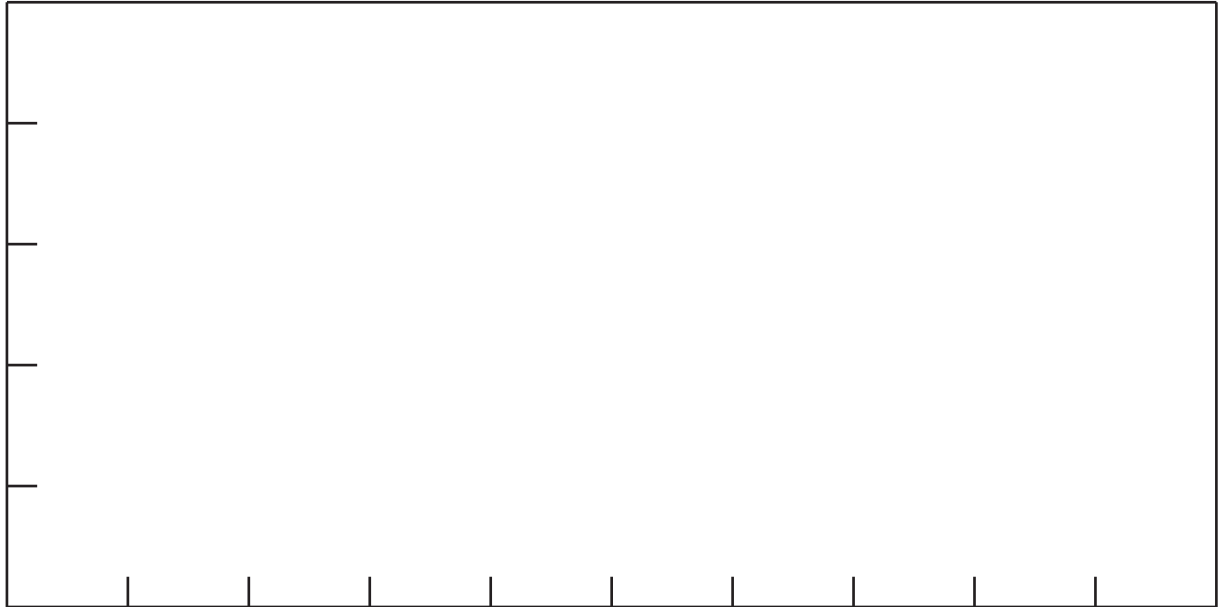
Measured reflection coefficient: $\rho(\text{meas}) = \underline{\hspace{2cm}}$.

Theoretical reflection coefficient for lossless line: $\rho(\text{theor}) = \underline{\hspace{2cm}}$.

$\eta\rho(\text{theor}) = \underline{\hspace{2cm}}$.

Comments: _____

Termination: Open With an open termination on the line vary the width of the incident pulse and observe the effect of this change on the waveform displayed on the scope. Draw the waveform below and explain briefly what has happened.



3. Let a transmission line having characteristic impedance Z_0 [Ω], attenuation constant α [m^{-1}] and length l [m] be terminated in a load resistor R_L [Ω].

Let V_{inc} [V] be the amplitude (magnitude) of the incident pulse at the generator, and V_{refl} [V] be the amplitude (magnitude) of the reflected pulse at the generator. The reflection coefficient at the load is $\rho_L = (R_L - Z_0)/(R_L + Z_0)$. Therefore, the measured reflection coefficient magnitude at the generator is:

$$\eta = \frac{V_{refl}}{V_{inc}} = |\rho_L| e^{-2\alpha l}.$$

From your measurements of η for an open circuited load, use the above equation to calculate the attenuation constant α : _____ m^{-1} .