Transmission and Attenuation

First Laboratory Report for CENG 3331

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Abstract

The goal of this lab was to view how distance and frequency affected attenuation on a transmission line. The major results that we gathered from this lab were that as distance and frequency were increased, both caused a corresponding increase in attenuation. This was concluded because both resulted in a drop in voltage.

Write-Up

Introduction

Attenuation is the loss of energy as a signal travels through a transmission medium. This happens because as the signal travels, it faces resistance in the medium and has to overcome it, which results in a drop in voltage. To visualize this relationship, we used MultiSim to construct our circuit.

Task 1: Build the simulated transmission system

We began our experiment by constructing the transmission line using 4 components: a digital clock, a digital ground, a lossy transmission line, and an oscilloscope in MultiSim. This circuit sends signals from the digital clock and digital ground to the lossy transmission line and finally to the oscilloscope which will give us readings to how the voltage changes due to different variables being modified. The circuit can be seen in the appendices section under Figure 1.

Task 2: Investigate attenuation as a function of frequency

For task 2, we continued the experiment by modifying the frequency variable in the digital clock and observed the changes in the oscilloscope. Our first frequency tested was 10k Hz and it resulted in an output peak voltage of 9.996 V, a smallest output voltage of 5.015 V, and a peak-to-peak voltage of 4.981 V. Our second frequency tested was 100k Hz and it resulted in an output peak voltage of 9.982 V, a smallest output voltage of 5.048 V, and a peak-to-peak voltage of 4.934 V. Our last frequency tested was 1000k Hz and it resulted in an output peak voltage of 8.797 V, a smallest output voltage of 6.712 V, and a peak-to-peak voltage of 2.085 V. The timing diagrams of these 3 tests can be found in the appendices section of this report under Figures 2, 3, and 4 while the table of these values can be seen below:

Frequency (Digital Clock)	Output Peak Voltage	Smallest Output Voltage	Peak to Peak Voltage
10k Hz	9.996 V	5.015 V	4.981 V
100k Hz	9.982 V	5.048 V	4.934 V
1000k Hz	8.797 V	6.712 V	2.085 V

As you can see by the table above, as we increased frequency of the circuit, peak-to-peak voltage decreased which means that attenuation increased. This is concluded because the lower voltage correlates to the signal losing less energy as frequency was increased.

Task 3: Investigate attenuation as a function of distance

In this final task, we concluded the experiment by first changing frequency back to 100k Hz and then modifying the distance variable in the lossy transmission line component and observed the changes in the oscilloscope. Our first distance tested was 1 meter and it resulted in an output peak voltage of 9.982 V, a smallest output voltage of 5.048 V, and a peak-to-peak voltage of 4.934 V. Our second distance tested was 10 meters and it resulted in an output peak voltage of 10 V, a smallest output voltage of 9.976 V, and a peak-to-peak voltage of 24.412 mV. Our final distance tested was 100 meters and it resulted in an output peak voltage of 10 V, a smallest output voltage of 10 V, and a peak-to-peak voltage of 1.776 fV. The timing diagrams of these 3 tests can be found in the appendices section of this report under Figures 5, 6, and 7 while the table of these values can be seen below:

Distance (meters)	Output Peak Voltage	Smallest Output Voltage	Peak to Peak Voltage
1 meter	9.982 V	5.048 V	4.934 V
10 meters	10 V	9.976 V	24.412 mV
100 meters	10 V	10 V	1.776 fV

As you can see by the table above, as we increased distance of the circuit, peak-to-peak voltage decreased which means that attenuation increased. This is concluded because the lower voltage correlates to the signal losing less energy as distance was increased.

Conclusion

In conclusion, this experiment proved that distance and frequency are proportional to attenuation and are inversely proportional to voltage. In Task 2, we observed that as frequency was increased, voltage decreased which correlated to a higher attenuation. In Task 3, we observed that as distance was increase, voltage decreased which also correlated to a higher attenuation.

Appendix

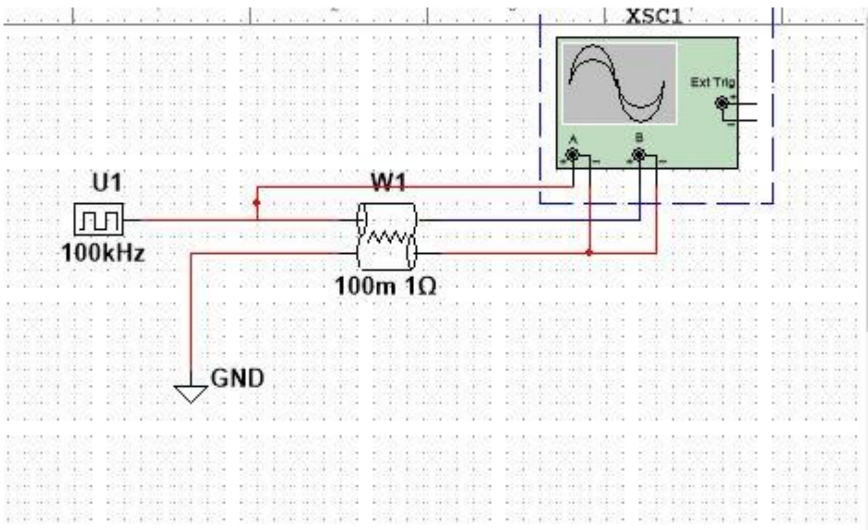

Fig. 1. Circuit Diagram

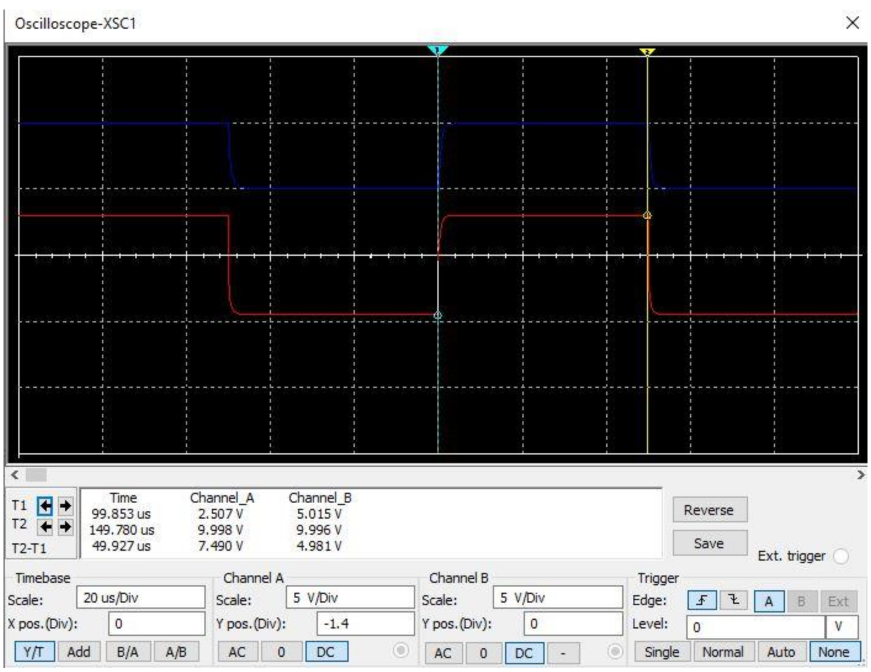

Fig. 2. Timing diagram of Task 2.1(10k Hz test)

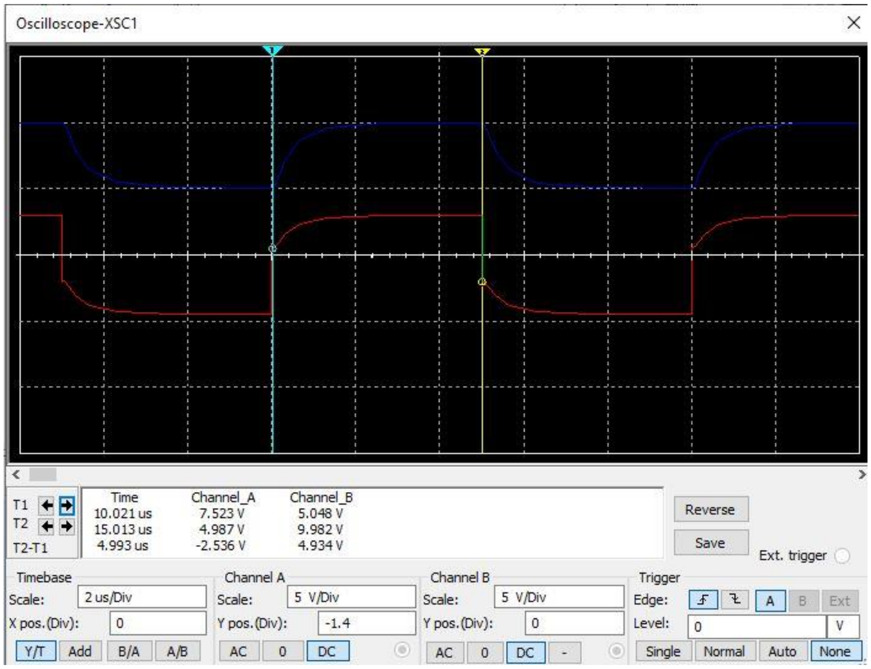

Fig. 3. Timing diagram of Task 2.2(100k Hz test)

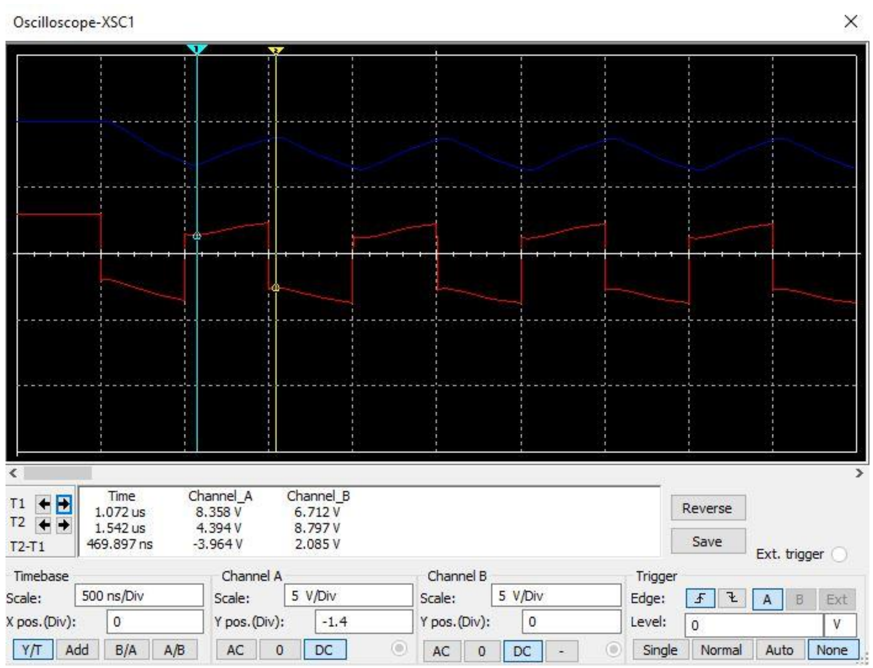

Fig. 4. Timing diagram of Task 2.3(1000k Hz test)

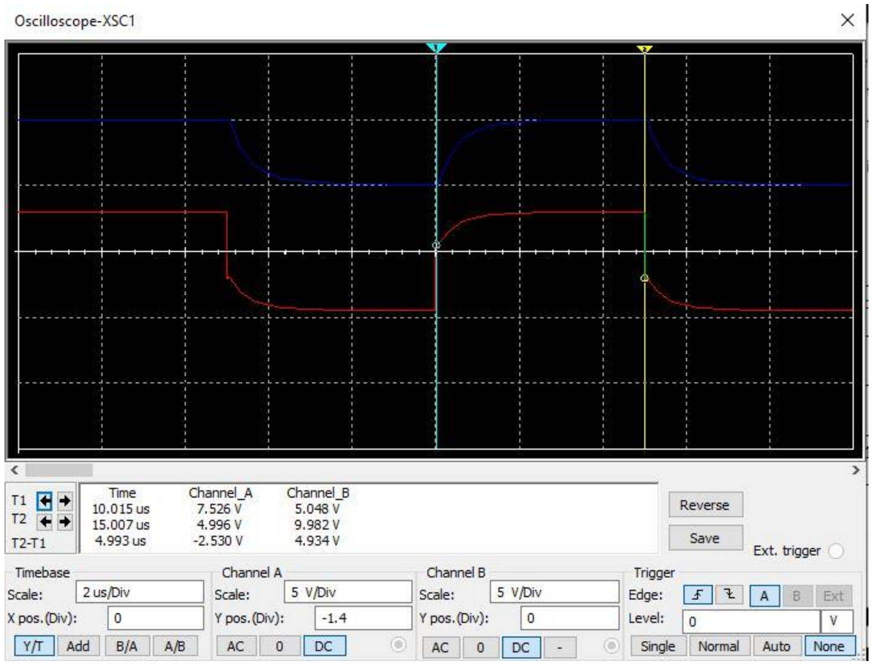

Fig. 5. Timing diagram of Task 3.1(1 meter test)

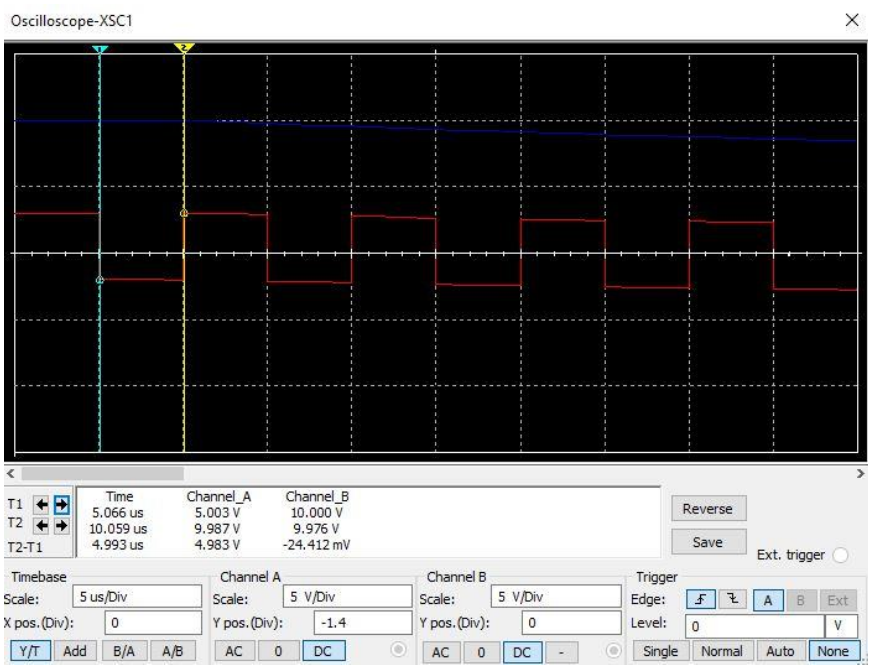

Fig. 6. Timing diagram of Task 3.2(10 meter test)

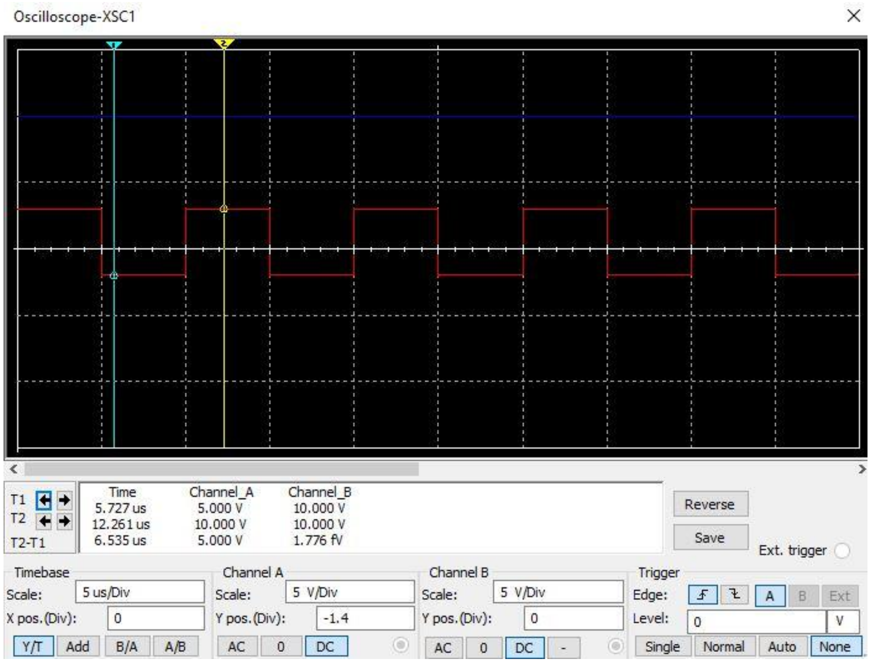

Fig. 7. Timing diagram of Task 3.3(100 meter test)