ECE320: Fields and Waves

Lab 1 Report: Waves on Transmission Lines

Alp Tarım, Pranshu Malik

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1 Introduction

This laboratory focused on investigating the characteristics of transmission lines, studying voltage and current propagation along them, as well as its depedance on the nature of load impedance.

2 Determining the Characteristic Impedance, Z_0

We varied the load on the switch box until we saw little or no traces of reflected waves. This was at $Z_L = 50\Omega$ which is also equal to the charactertic impedance since we know that the reflections nullify when $Z_L = Z_0$. The corresponding waveforms captured at the generator input (channel 1, top) and the transmission line input (channel 2, bottom) are shown in Figure 1.

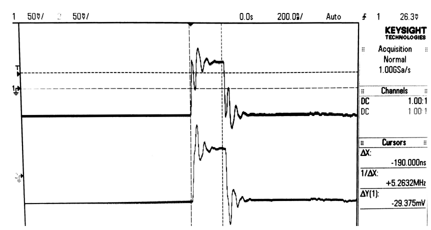

Figure 1: Transmission line terminated with load equal to Z_0

3 Determining Z_0 using $\frac{\tilde{V}^+(z=0)}{\tilde{I}^+(z=0)}$

Find something below:

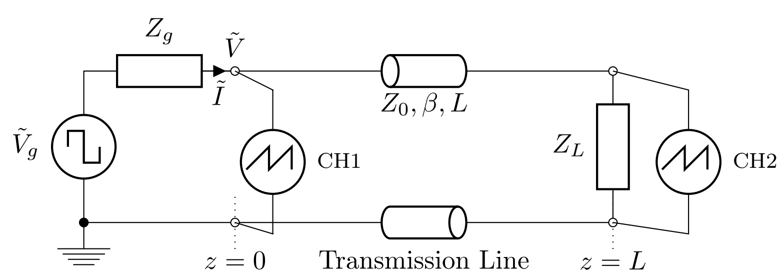

Figure 2: Circuit setup

As seen in the picture the voltage at v_g is 154mV and v_1 is equal to 51mV. Assuming the resistance in between is 100Ω $i_l = \frac{0.154-0.051}{100} = 1.03 * 10^{-}3$A. Which means $Z_0 = \frac{v_1}{i_l} = \frac{0.051}{1.03*10^{-}3} = 49.51\Omega$ 50Ω

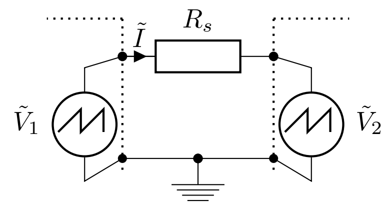

Figure 3: Laborartory setup for studying characteristcs of tranmission lines

Thus, we can see something there.

4 Observation of Travelling Waves

We know that the phase velocity of an electromagentic wave in space with magnetic permeability, μ, and electric permittivitty, ϵ is given by:

$$v_p = \frac{1}{\sqrt{\mu\epsilon}}$$

5 Observation of Travelling Waves

Testig data: voltage division.

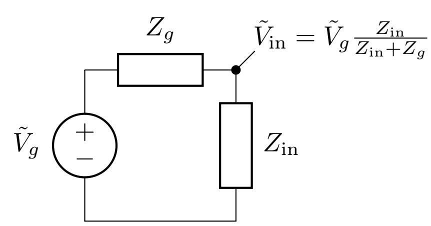

Figure 4: Circuit setup

We know that the impedance changes.

$$Z_{\text{in}} = Z_0 \frac{1+\Gamma_d}{1-\Gamma_d} = Z_0 \frac{Z_0 + jZ_L \tan\beta L}{Z_L + jZ_0 \tan\beta L}$$

6 Conclusion

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7 Notes

All pictures taken during the lab were post-processed in a batch using a custom script that bit-wise inverted the pixels and the thresholded to produce a binarized image. No adjustments or modifications were made to the readings, for which the oscilloscope's measurements are also shown alongside the waveforms. All work can be found at `github.com/pranshumalik14/ece320-labs`.