EE 382/382L Applied Electromagnetics (Spring 2018)
Laboratory Project Time-Domain Transmission Line Measurements

Background

In this lab, you will be using your knowledge of the behavior of time-domain transmission lines to investigate a lossy coaxial transmission line of unknown length with a BNC-m coaxial connector on one end and an unknown load (either an open or a short) on the other end. You may work in groups of up to three individuals.

Resources (available in EP 127, check with instructor if items not found)

- Agilent 33120A 15 MHz Function/Arbitrary Waveform Generators (AWG). You may assume that the AWG Thevenin equivalent impedance is $Z_g = 50\ \Omega$.
- Agilent 33250A 80 MHz Function/Arbitrary Waveform Generators ($Z_g = 50\ \Omega$)
- Tektronix TDS2012 Two Channel Digital Storage Oscilloscopes 100 MHz (1GS/s)
- Tenma Digital Multimeters
- miscellaneous BNC adaptors/connectors (e.g., tees) and short (~1 m) coaxial test cables
- Two labeled "mystery" coaxial cables A & B.

Preliminary (in logbook)

Design a time-domain experiment to **measure** the characteristic impedance, length, approximate attenuation constant, and load for a "mystery" coaxial cable. In your logbook, write out, in a clear linear fashion, a test procedure. At each step, clearly describe how, what, and why each quantity/quantities is/are being measured. Show block diagrams/figures detailing all test set-ups. Then, describe the subsequent calculations (including any necessary equations) to determine the characteristic impedance, length, approximate attenuation constant, and load for a "mystery" coaxial cable.

Hints: 1) You are allowed to examine the cable for any markings.

2) For a time-domain pulse propagating on a lossy transmission line, the magnitude of the first reflected pulse is $|V_{\text{refl}}| = |V_{\text{init}}||\Gamma_L|\ e^{-2\alpha l}$

3) The phase velocity of the cable must be known "a priori".

4) Don't trust keypad settings of AWGs, measure open circuit output voltage waveforms.

Experiment (in logbook)

Go to EP 127 with lab group (open lab). Select a "mystery" coaxial cable. Be sure to write down cable identifier/label (i.e., "mystery" label) as well as cable brand/model. Implement your experiment. Make comments at each step detailing what you are doing/measuring at each step. Whenever possible, **include** oscilloscope screen shot showing measurements.

Analysis and Conclusions (in logbook)

1) Using the data gathered in step 1), determine the characteristic impedance, length, approximate attenuation constant, and load for your "mystery" coaxial cable. Put results in a table (include cable label and manufacturer model number).
2) Discuss and summarize your results. What conclusions can be drawn from this lab? In retrospect, what changes needed to be made or were made to your experiment?

Technical Report (separate document, not in logbook)

- Use your logbook, text, and course notes as reference resources to compose a technical report on the procedure and results of this laboratory project.
- The technical report is a separate document consisting of: 1) Cover Page, 2) Introduction, 3) Experimental Procedure, 4) Experimental Results, 5) Analysis, 6) Summary & Conclusions, 7) References, and 8) Appendices (optional). A Table of Contents, List of Figures, and/or List of Tables are not necessary. The report shall be entirely electronically produced (i.e., use MS-Word or equivalent).
- The Cover Page should include: EE 382/382L Applied Electromagnetics (Spring 2018), Laboratory Project Time-Domain Transmission Line Measurements, *your name(s)*, and *date*. Center and format in a legible and professional manner.
- Where possible, tabulate results and use plots/figures. All tables and figures should be captioned (i.e., numbered and named).
- Put the calculations, results, tables, and/or plots/figures in the body of the report. Appendices are **NOT** to be used as a "dumping ground" for these items; no one likes to spend time flipping between the body of a report and searching through appendices. However, long mathematical derivations and computer code/m-files may be attached as Appendices **if individually referenced in the text** of the report.
- Unless otherwise specified, follow format guidelines contained in course syllabus with regard to fonts etc.
- Correct spelling and proper grammar are part of being professional and will be considered in grading.

Logbook and report due Wednesday, April 25, 2018 at class.