Fields and Waves I

ECSE-2100 **Fall**

1999

Preparation Assignment for Project 2

Due at the start of class.

Reading Assignment

See the handouts for each lesson for the reading assignment.

12 November Lessons 4.5 and 4.6

a. Write out the general expression for the characteristic impedance of a general lossy line. Under what conditions does this expression reduce to that of a lossless line?

b. What is the VSWR when a transmission line is properly matched?

15 and 17 November

Open Shop for Project 2

Fields and Waves I

ECSE-2100 **Fall**

1999

Project 1 (*Due: 19 November)*

Cable TV Station Blocker

For this project, students can work in groups of two to four. No reports will be accepted from single students.

Grading

Introduction (4 pts)	_____
Initial Design (8 pts)	_____
Analysis (8 pts)	_____
Basic Performance (4 pts)	_____
Implementation (7 pts)	_____
Final Design (8 pts)	_____
Performance (7 pts)	_____
Personal Responsibility (2 pts)	_____
Creativity (0-5 pts extra credit)	_____
Appendix (2 pts)	_____
Total (50 pts)	_____

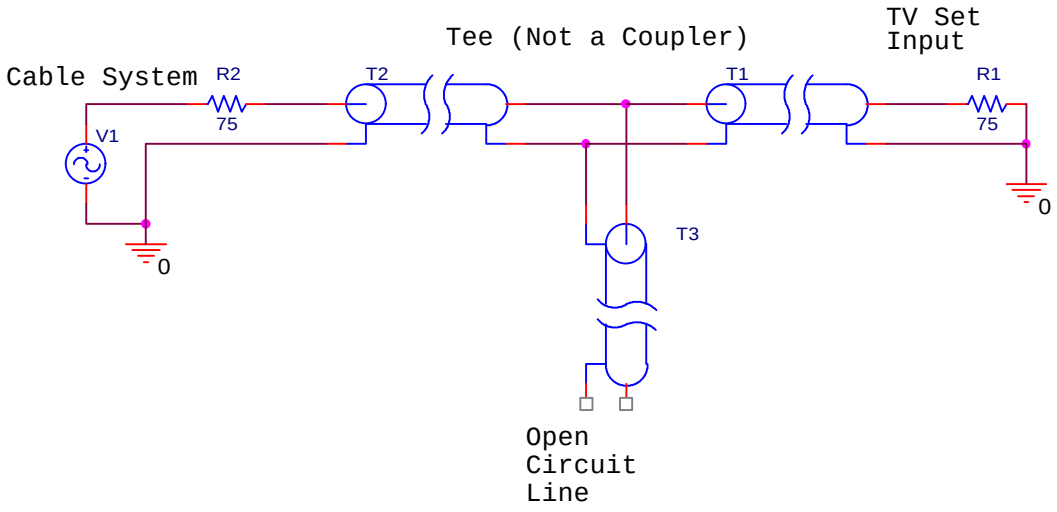
Please note: the critical tasks for this project are underlined and in red (on the web page.) Also, please be sure that you include this entire write up in your report.

Group Members:

1. _____
2. _____
3. _____
4. _____

1999

Cable TV Blocker



Introduction (4 pts): Introduce and describe the goals of the project.

The purpose of this project is to build a simple device that blocks the signal from a particular cable TV channel while leaving the other channels with sufficient signal to be viewable. No active or lumped circuit elements will be used for this purpose. Rather, this will be accomplished by adding a stub-type tuner to the cable that brings the signal to the TV. List at least three educational goals for this project. That is, list at least three topics you might encounter in practical electromagnetics that play a significant role in this project. Be specific, indicating where in the textbook or other course reference materials these topics are discussed.

Initial Design (8 pts): Describe your initial project design, how it works, how you came up with this particular design, and discuss potential problems. This last item is very important.

The basic principle of this signal blocker is relatively simple. The CATV cable (T2 in the figure above) is interrupted with a Tee coupler to which is connected a short piece of cable (T3 above) with nothing connected to it (open circuited line). The input impedance of this extra piece of cable adds in parallel to the input impedance of the cable that runs from the Tee to the TV set (T1 above). Assuming that the cable is properly matched to the TV, the input impedance of this cable will be equal to the characteristic impedance of the cable. In this case, the impedance of the cable and the TV is 75 ohms. Since the input impedance Z_{in} is a function of the electrical length of the cable (through the terms like tanbd where d is the length), the Z_{in} of the open-circuited cable will change with frequency. If the length of this cable is properly selected, the signal from one CATV channel will be reflected from the Tee while the signals from other channels will not be reflected. A crude explanation of how this can work can be made by looking just at two frequencies where Z_{in} is either very small or very large.

Describe the basic design. Draw a picture if your artistic skills are up to it. When you have a description of your design, show it or email it to a TA or to Prof. Connor. It is very important that you understand the basic principles before you proceed with the rest of the project. Also, be sure that you identify at least two potential problems. Remember that you will probably be basing your design on an ideal lossless model of transmission lines. Anything that deviates from such an ideal can cause a problem.

Analysis (8 pts): Discuss why your initial design should work and support your discussion with calculations, graphs, simulations, reference materials and/or common sense reasoning.

Write out the equations that describe how this channel blocker works. Select a length for the open-circuited cable. Determine the voltage and power transfer function for the complete system. Use Maple or Matlab to solve the equations for the entire range of frequencies of the CATV channels received in the Albany-Schenectady-Troy area.

Information on the Standard Cable-TV Frequencies can be found at
http://www.info2000.net/~aloomis/catv.html

Basic Performance (4 pts): To test out your designs, you must identify one channel that will be blocked by your first choice of cable length.

CATV Channel _____ Length _____ Witnessed _____

Implementation (7 pts) -- Discuss what problems were encountered during the implementation of your project and how you solved them. Include advice you would offer to someone who wished to avoid these problems in the future.

Describe your problems and be as helpful to others as possible.

Final Design (8 pts) – Select a particular channel to be blocked and one that is not to be blocked. This channel must be different than the one you used above. Show that the new design works with experimental data from your hardware and simulations or paper-and-pencil analysis. Include schematics. To demonstrate your design you must either build a CATV channel blocker (which will be tested by a member of the course staff) or use your model on an equivalent experiment that can be done in the studio. Since the function generator is limited to 15MHz, use a range of frequencies that is equivalent to the CATV frequencies you analyzed. That is, the maximum and minimum frequencies should be in the same ratio as the CATV frequencies. The latter choice is simpler to do since you do not need to build anything. To build the former, you will have to provide your own Tee, which can be made from a coupler by removing the lumped circuit elements and by wiring together the three connectors.

CATV Channel _____ Length _____ Witnessed _____
(This is for the design, not the test of the hardware.)

Performance (7 pts) – Build and test your design or do an equivalent experiment in the studio.

CATV Channel _____ Length _____ Witnessed _____
This is for the test of a CATV channel blocker.

For the equivalent test in the studio, describe the method you used to take the data and discuss the features of the data you have obtained. For example, explain the voltage levels observed. Be sure that you explain why the measurements you have made demonstrate that your model is sufficient to build an actual channel blocker. Have your experimental data signed by a TA or instructor.

Personal Responsibilities (2 pts) -- A short paragraph should be written describing what each group member did to develop and implement the final design.

Creativity (0-5 pts) – Any exceptionally creative approaches to implementation, analysis and/or design will be rewarded with up to 5 additional points.

*Please note that this category is reserved for **exceptionally creative** work.*

Appendix (2 pts): Include any background materials you used in the preparation of your design.