Project 1 (*Due: October 9)*

(Turn in at the beginning of lecture)

RF Notch Filter

Trap for Unwanted Frequencies

For this project, students can work in groups of two to four. Hand in one report for each group. Be sure to re-read the Pre-Project write-up, especially the ***Suggestions*** section.

Grading

1. Pre-Project (20 pts) _____

2. Design Plan (5 pts) _____

3. Frequency Response for Design (10 pts) _____

4. Performance of Design (8 pts) _____

5. Discussion (5 pts) _____

6. Task Breakdown (2 pts) _____

Total (50 pts) _____

Group Members:

1. _____

2. _____

3. _____

4. _____

Overall Goals:

You must design two systems. Preferably, one should block a TV channel below 150MHz and one should block a channel above 300MHz. However, you can choose any two channels as long as they are not too close in frequency. Your lossy transmission line model must be correct at the frequency of interest for both cases. For the Matlab analysis option, your model should hold at all reasonable frequencies. For the PSpice option, there is no way to easily incorporate a frequency dependent resistance per unit length *r*. Thus, you should do a complete frequency scan (covering the entire range of channel frequencies) for each of the two cases, using the appropriate value for *r*. This will help you to identify the range of validity of your two models.

Once the analysis has been done, you must build a channel blocker for the two TV channels (two F-type Tee connectors will be provided for each group and some cable and connectors). You must test your final designs (for the two channels) and record the results (e.g. channels blocked and channels unaffected). Then, you must demonstrate its efficacy to a TA using the cable feed in the studio to the TV display and the spectrum analyzer.

Specific Tasks:

1. Provide all information on the parameters of the cables you are using and justify the accuracy of your numbers. Be sure that you include cable losses at the frequencies you wish to block. Fully document the sources of your information. (3 pts)

2. Qualitatively analyze the filter schemes (show your work). For example, show your hand calculations for the length of the open stub you plan to construct and predict the frequencies it will block. Check these frequencies against the list of CATV stations on campus to identify which signals will be affected. (This is what you were asked to do during the pre-project day, but you may want to update your work here.) (5 pts)
    a. Blocking a lower frequency cable TV station (your choice) while leaving as many other channels as possible unaffected.
    b. Blocking a higher frequency cable TV station (your choice) while leaving as many other channels as possible unaffected.

3. Using one of the three analysis options (Matlab, Smith Charts, PSpice) do your full analysis for lossy lines, incorporating the data from item 1 above. *You must clearly annotate your plots so it is completely clear what information they contain.* Compare the frequency response from your analysis to the performance of a commercially available channel eliminator by incorporating both sets of information on the same plot. (7 pts)

4. Build and test the TV channel blocker which must be turned in with your report and tested in class jointly with one of the course instructors. Testing should include connecting your blocker to the spectrum analyzer and recording changes in the observed spectrum. A simple way to do this is to photograph the display of the spectrum analyzer. However, a simple sketch is also fine. You should also connect your blocker to the cable line that feeds the VCR and observe changes in the display projected on the screens at the front of the room. Describe the changes you see.
    a. **Low Frequency Design** (4 pts)
    b. **High Frequency Design** (4 pts)

5. Discuss your results. What worked as expected? What did not? How close are the predictions of your model to the actual experimental results you obtained? How does the performance of your blocker compare with a commercially available channel eliminator? (5 pts)

6. Task Breakdown: You must formally divide the work up in this project and assign each task to a member of your group. (2 pts)

Extra Credit

(Up to 5 pts) From readily available online sources, identify interesting devices and/or systems that incorporate significant application of transmission line concepts in their design.