

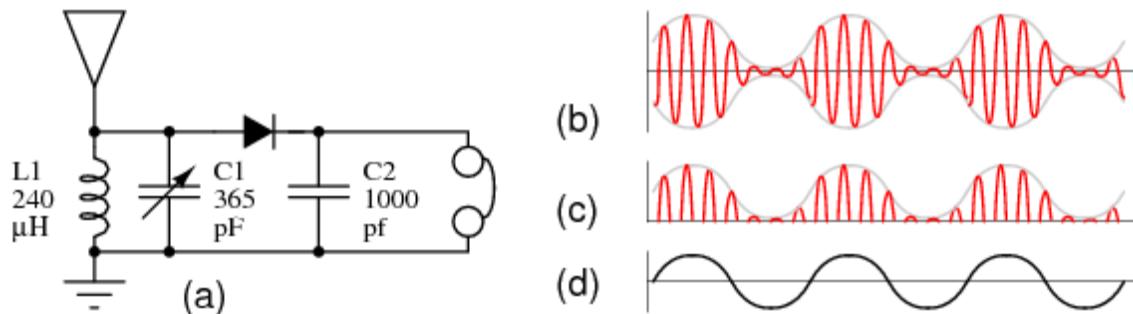
THE UNIVERSITY OF BRITISH COLUMBIA
Department of Electrical and Computer Engineering

ELEC 391 – Electrical Engineering Design Studio II

Lab Assignment 5 – Sensitivity and Selectivity

1 Objectives

This lab consists of free-form experiments that explore the issues associated with measuring and improving the sensitivity of a low power receiver, the selectivity of the resonant circuit used to tune the receiver and techniques for measuring distortion of the demodulated signal. These experiments will be performed *on the bench* using signal sources to generate modulated signals an oscilloscope or spectrum analyzer as appropriate to characterize the output.



(a) Low power radio. (b) Modulated RF at antenna. (c) Rectified RF at diode output without C2 filter capacitor. (d) Demodulated audio to headphones.

As discussed during the in-class workshop, you and your group will:

- Assess the selectivity of the resonant circuit used to tune the low power radio, identify possible issues that may be impairing performance, suggest ways to overcome these limitations, implement the most promising schemes and assess them,
- Assess the sensitivity of the envelope detector used to demodulate the audio signal, identify possible issues that may be impairing performance, suggest ways to overcome these limitations, implement the most promising schemes and assess them,
- Assess the distortion introduced by the envelope detector used to demodulate the audio signal, identify possible issues that may be impairing performance, suggest ways to overcome these limitations, implement the most promising schemes and assess them.

2 Lab Preparation

Before the lab session, please work *as a group* to summarize the possible impairments and design solutions concerning the selectivity, sensitivity, and distortion introduced by the circuit, possible measurement setups used to assess performance and formats for presenting and interpreting the results.

3 Lab Schedule

1. *Before your assigned lab period:* Review the lab assignment and begin the prelab assignment in Section 2 as a group! Although the assignment will not be formally marked, it will be checked for completeness and correctness and will be considered when your mark for this lab assignment is assigned.
Meet with your lab partners to discuss the lab assignment and to assign responsibilities during the lab session.
2. *During the scheduled lab period:* Submit your individual prelab assignment and work with your lab partners to complete the freeform experiments.
3. *During the few days after your assigned lab period:* Meet with your lab partners to plot and/or reduce your data, to draw conclusions, and to the group lab report.
4. *Tue, 31 July 2018:* Submit your group lab report for marking.

4 Test and Measurement Equipment

The following equipment and accessories will be available for use in this lab session. Where applicable, please record the serial numbers of each item.

1. Automatic RCL Meter (Fluke Model PM6303A)
2. RF Signal Generator (Agilent, model 8648B, 9 kHz – 2 GHz)
3. Function/Arbitrary Waveform Generator (Rigol, model DG1022, 2 Channel, 20 MHz, 100 MSa/s)
4. Spectrum analyzer (Rigol, model DS 815A), 9 kHz-1.5 GHz
5. Dual-channel oscilloscope (Tektronix, model TDS 2012C, 100 MHz)

You will not necessarily need to use all of this equipment.

Note that there are only two Automatic RCL meters that must be shared between the six groups. They are located on the table next to the technical support room, MCLD 312.

In order to protect the input of the spectrum analyzer, please make absolutely certain that the signal at the output of the signal generators does not exceed 5 V.

5 Components

The following components will be supplied to you:

1. 365 pF variable capacitor
2. Ferrite rod – (Amidon R61-050-400) (half-length)
3. Ferrite core – (Amidon FT-114-61)
4. Ferrite core (Amidon FT-50-61)
5. Magnet wire of selected gauges
6. Assorted capacitors
7. Assorted inductors
8. Assorted diodes

As in Lab Assignment 4, you will have access to 3D printing services in order to produce a coil form that will pass the ferrite rod and around which you can wrap wire. Hopefully you will be able to make use of the coil form(s) that you printed in Lab 4.

6 Experiment

As in Lab Assignment 4, you and your group must devise the design and measurement procedures mostly by yourself. Here is a general outline:

1. Assess the selectivity of the resonant circuit used to tune the low power radio, identify possible issues that may be impairing performance, suggest ways to overcome these limitations, implement the most promising schemes and assess them,
2. Assess the sensitivity of the envelope detector used to demodulate the audio signal, identify possible issues that may be impairing performance, suggest ways to overcome these limitations, implement the most promising schemes and assess them,
3. Assess the distortion introduced by the envelope detector used to demodulate the audio signal, identify possible issues that may be impairing performance, suggest ways to overcome these limitations, implement the most promising schemes and assess them.

Most of the relevant issues including impairments, possible methods for overcoming them, the need to predict the likely level of improvement, methods for presenting the response of the circuit in a way that is easily interpreted and understood, etc., were discussed in class.

This work will form an important basis for your work on the major project. We suggest that you sketch your plan and review it with the TA before pursuing each stage. Please give early thought to the best approach for documenting your work in an organized way and delivering a complete report.