ELEC 240
Lab 2 - Signal Sources and Sinks

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1 Objective

In this lab, we explored how to detect and change signals through the use of electroacoustic transducers. In the first section, we observed the various properties of a signal such as its frequency and amplitude through a speaker and calculated how measuring this signal with the speaker affects the circuit. In the second section, we now produced signals through various methods like our vocal cords and the lab PC and viewed these signal properties on the oscilloscope. Finally, in section three, we independently viewed the signal properties of a photodiode and a light-emitting diode, then combined the two to view how a light-emitting diode can send signals to a photoresistor to achieve optoelectronic communication.

2 Materials

- Virtual Bench (Software, Oscilloscope, Function Generator, DC Power Supply)
- BNC Male to Clips cord
- Oscilloscope Probe
- Speaker
- Breadboard
- Microphone
- 2 10 cm length wires (with 6 mm stripped on each end)
- Lab PC with associated sound files and sound card cable
- Photodiode
- Red LED
- BNC Banana Adapter
- Digital Multimeter
- 220 Ohm Resistor

3 Test Description

3.1 Electroacoustic Transducers I

We began by creating a 1kHz sine wave, connecting this signal to a speaker, and listening to the signal in audio form. We then varied the parameters of the input signal to listen to the effects on the output signal. Then using these measurements, we found the Thevenin voltage, and used this value to attempt to find the maximum power transfer.

3.2 Electroacoustic Transducers II

This time, we varied the input of the oscilloscope by attaching it to a microphone. After making various sounds into the microphone and visualizing the signals, we attempted to qualitatively analyze the signals created by vowels sounds created by humans as well as a virtual piano. After this, we attempted to analyze various given audio signals through the use of a speaker and the oscilloscope attached to the sound card cable of the computer playing the sounds.

3.3 Optoelectrical Signal Sources and Sinks

We created a simple circuit connecting a photodiode to the oscilloscope and observed the AC and DC signals created by this circuit before and after covering the diode with a hand. After this a LED was connected to the DC power supply. and qualitative observations were recorded while varying the amplitude and frequency of the incoming voltage. Then the optical source and sink were combined, and the measurement across the photodiode was read as it received signals from blinking LED.

3.4 Pre-Lab Calculations and Schematics

No pre-lab calculations were needed, but

Note (To be deleted): Include the homework pre-calculations and schematics that serve as the initial setup for the test. Briefly explain the importance of each item you include. You may want to number your equations/figures so you can refer to them in later sections. Including photos of handwritten work is okay.

4 Results and Discussion

4.1 Experiment 2.1: Electrostatic Transducers I

4.1.1 Part A

- After connecting the 1kHz sine wave to the speaker, we heard a constant-pitch sound from the speaker.
- Measuring the voltage signal with an oscilliscope yielded a peak-to-peak measurement of 164.6 mV. This is because the speaker acts as a resistor, causing a proportional drop in voltage amplitude of the input signal.
- We then varied the parameters of the input signal. Increasing the frequency increases the pitch of the tone. Increasing the amplitude of the tone increases the volume of the tone. By changing the sinusoid to a square wave, the sound becomes a flatter, more piercing tone.

4.1.2 Part B: Thevenin Equivalent and Maximum Power Transfer

4.2 Experiment 2.2: Electrostatic Transducers II

4.2.1 Part A: Microphone

- We connected the connected the microphone to the oscilloscope by first connecting the microphone to the J1-4 port on the breadboard, then connecting the J1-4 to the J1-1 port, then connecting the oscilloscope to that J1-1 port. We then whistled into the microphone. We adjusted the trigger to 5 mV above the origin. By doing so, we were able to essentially "freeze" the sinusoid so that we could better view its properties.
- We then sang the 5 vowel sounds into the microphone. We found that the vowel A was the most sinusoid-like. Attached below is the sound of an "A" in comparison to the sound of "O".

1. We then played a perfect "A" tone off a smartphone speaker into the microphone. The resulting signal was a near-perfect sine wave.

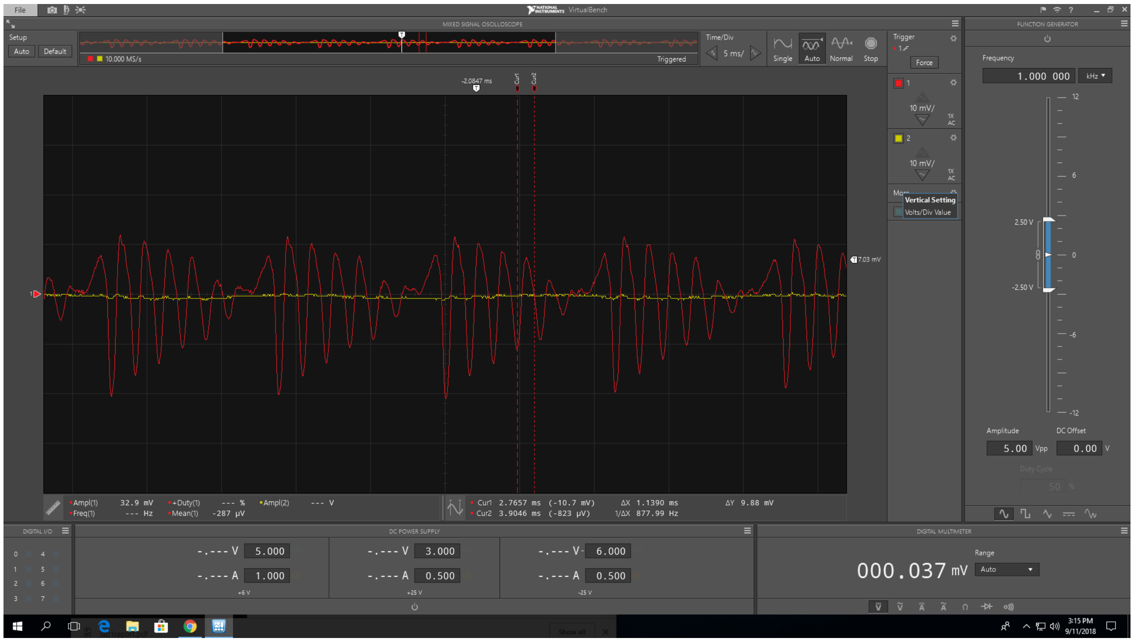

Figure 2: Sine Wave of Vocally Produced "O" Sound for comparison

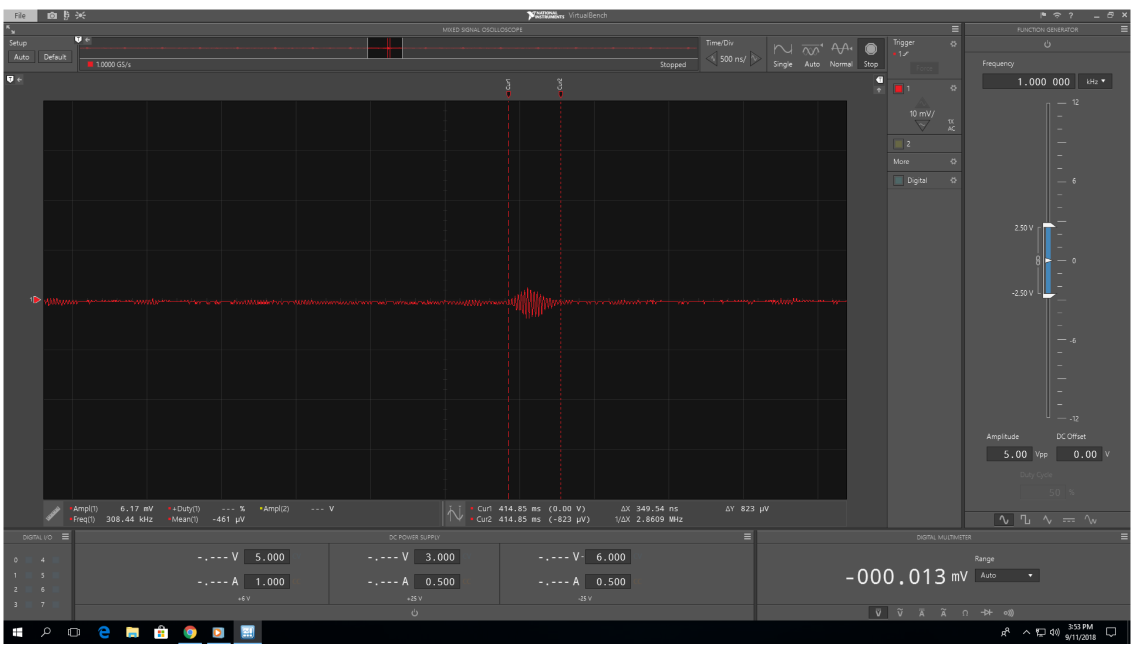

Figure 1: Sine Wave of Vocally Produced Vowel "A" Sound

5 References

Your text here

Note (To be deleted): List any datasheets, websites, lab procedure, etc. used during the lab.

6 Conclusion

Your text here

Note (To be deleted): While the "Results and Discussion" section focused on the test results individually, the "Conclusion" discusses the results in the context of the entire experiment. Usually, the objectives given in the "Introduction" are reviewed to determine whether the experiment succeeded. If the objectives were not met, you should analyze why the results were not as predicted.

7 Errors

Your text here

Note (To be deleted): Briefly list sources of error and discuss how to eliminate or deal with them