Final Project PreLab
Laser Microphone
Real World Measurement

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April 11, 2013

1 Introduction

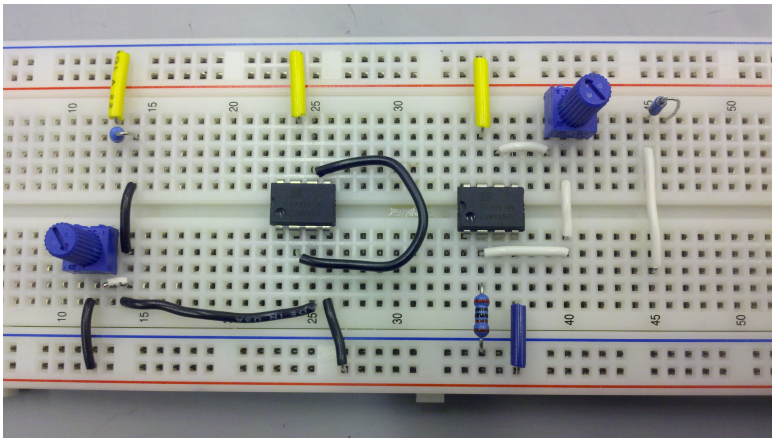

Figure 1: A shot of our transmitter circuit

For our self-designed lab, the goal was to test the functionality of the receiver circuit. This was an important first step, because it verified that our project is feasible. For just this lab, our transmitter circuit consisted of a laser that we first modulated with the function generator and later by songs through an 3.5mm auxiliary audio connector. We tested two methods of receiving. In the first method we simply connected our photodiode directly to an amplifier and to the speaker. For additional testing, we added our planned bandpass filter between the photodiode and the amplifier.
In this lab, one can find the schematics for our circuit, theoretical and experimental bode plots, as well as data collected during the three different tests of our circuits.

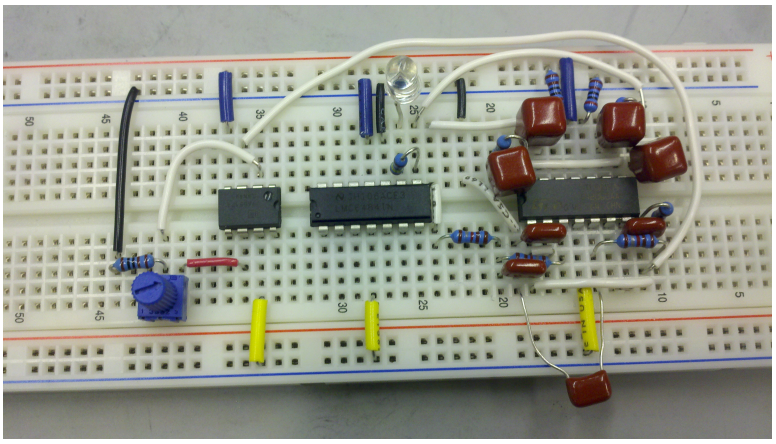

Figure 2: A shot of our receiver circuit

2 Circuit Diagram

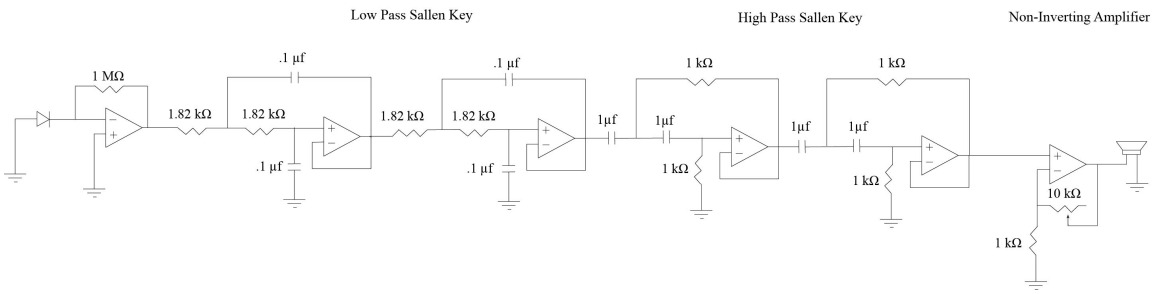

Figure 3: A diagram of our Receiver Circuit

Figure 3 shows the band-pass filter we designed for our receiver circuit. We doubled up the high pass and low pass filters to have much steeper cut off frequencies. This filter is designed to only allow frequencies within the speaking range of men and women to pass through to the speaker.

3 Bode Plot

Figure 4 shows a great correlation between our theory and our experimental data. The graph shows that we were successful in narrowing down our detected frequencies to only those within a humans speaking range.

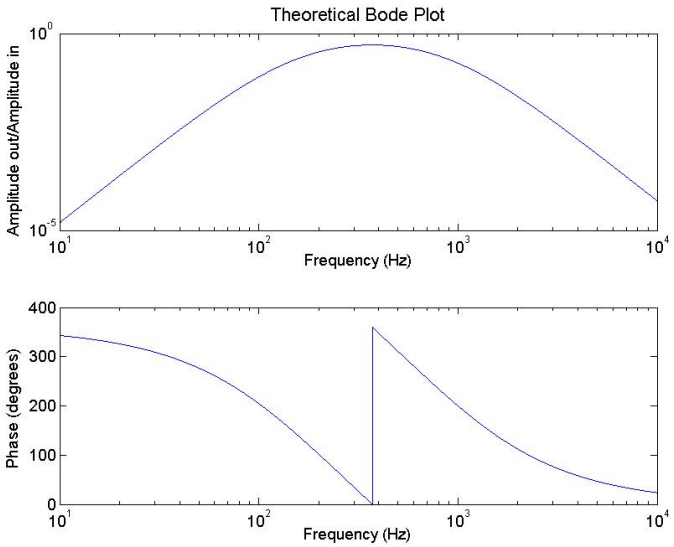

Figure 4: Bode Plot of the Band-Pass Filter

4 Test Descriptions

Function Generator Test:
The laser turns on when it is provided with a voltage difference in excess of 3V. So theoretically, an oscillating voltage would cause the laser to pulse. When this pulsing laser was shined at our photodiode we were able to transfer the frequency to our speaker. We were successful in transferring the signal from the function generator through the laser and to the speaker. Figure 5 below shows the generated function and what our receiver circuit detected.

Music Test (No Filter):
We wanted to understand how our laser transmitter degraded more complex audio waveforms. We played music from a laptop and amplified it to span the correct voltage range to power the laser. Although the sound quality was significantly reduced, we were able to recognize melodies and some lyrics of various songs. Figure 6 shows the corresponding data collected during this test.

Music Test (With Filter Chain):
For our final test, we wanted to hear the effects of our bandpass filter. Because our filter was designed for speaking range, it did cut out some of the highest and lowest frequencies in the music. Still the speaker output was audibly recognizable and overall cleaner. The data from this test is shown in Figure 7

5 Collected Data

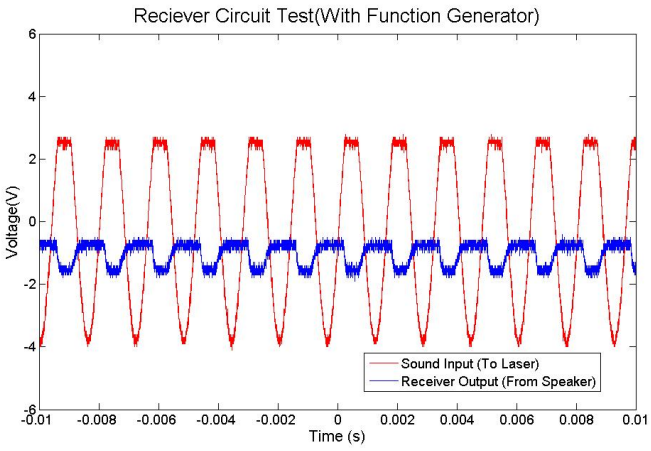

Figure 5: Comparison of Laser Input and Receiver Output during Function Generator Test

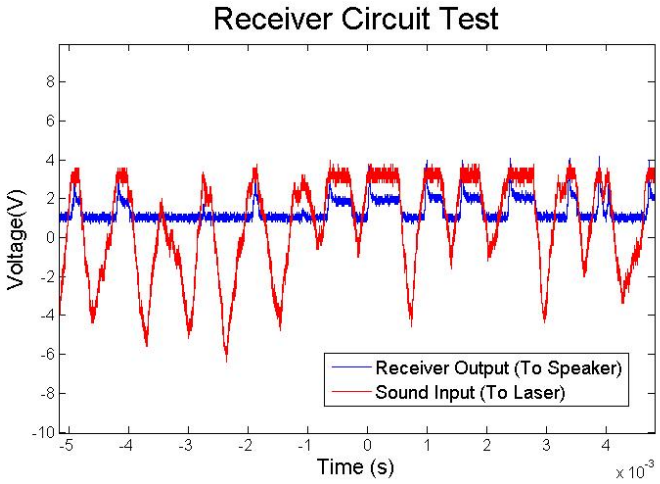

Figure 6: Comparison of Laser Input and Receiver Output during Unfiltered Music Test

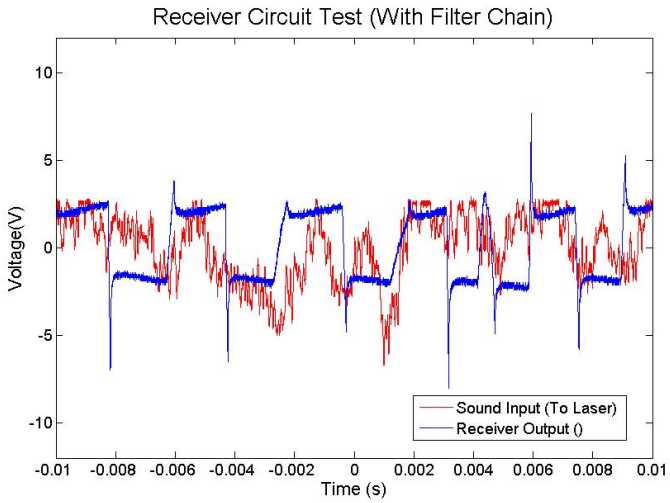

Figure 7: Comparison of Laser Input and Receiver Output during Filtered Music Test

6 Video of Experiments

To really get a feel for our project it is helpful to see and hear the circuits at work. To do so, please check out the 'Week 2 Test' video in Team ESL's folder on the public drive.