Pulse Oximeter

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1 Introduction

The objective of this lab was to create a working pulse oximeter. This is a device that is commonly found in hospital which uses light to measure the pulse of a patient and the oxygen content of their blood.

In this lab, I used a photo-diode to read in the signal. Next I used a high pass filter to attenuate frequencies lower than 1 Hz, a low pass filter to attenuate frequencies higher than 10 Hz. I also used two amplifier to amplify the signal.

2 Choosing Resistor and Amplifier Values

In this lab I had to choose appropriate values for our filter and amplifiers. First I had to convert our natural frequency(f) to an appropriate RC value using:

$$RC = \frac{1}{2\pi f}$$

For the high pass filter, I wanted a cutoff frequency of $\approx 1Hz$ The RC constant was found to be 0.158. As seen in Figure 1, we chose a $158k\Omega$ resistor and a $1\mu F$ capacitor as there were no other design limitations.

For the low pass filter, I wanted a cutoff frequency of $\approx 10Hz$ The RC constant was found to be 1.58. As seen in Figure 1, we chose a $15.8k\Omega$ resistor and a $1\mu F$ capacitor. We chose these values taking into consideration the amplifier that was before this. Considering that we wanted a larger portion of the current to flow through the filter and not the amplifier, I chose a lower resistor value in the filter and a much high resistor value in the amplifier.

In both amplifier we chose the first resistor to be $1M\Omega$ and the second resistor to be $100k\Omega$ to achieve a gain of ≈ 11. These values were chosen because of the current flow issue mentioned earlier.

Finally, a last few remarks of the circuit in general. Each of the amplifier is connected to and the high pass filter $2.5V$ to shift our frame of reference. The low pass filter is connected ground as for lower frequencies the current just passes through and for high frequencies the capacitor acts like a wire and the current passes through the capacitor.

3 Figures

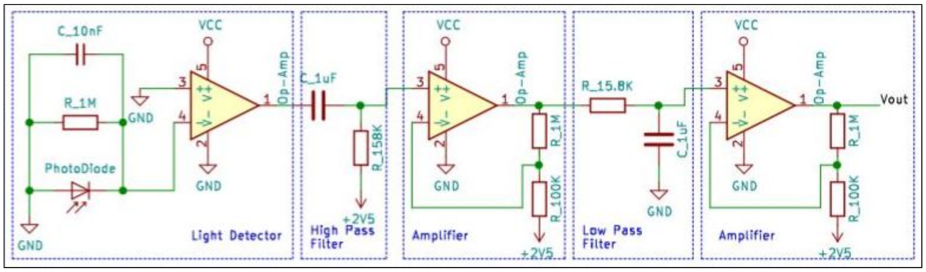

Figure 1: Circuit Schematic
This figure shows the final circuit schematic for the pulse oximeter. The important values to note are the $158k\Omega$ resistor and a $1\mu F$ capacitor in the high pass filter and the $15.8k\Omega$ resistor and a $1\mu F$ capacitor in the low pass filter. Additionally each amplifier has a gain of ≈ 11 achieved using $1M\Omega$ and $100k\Omega$ resistors.

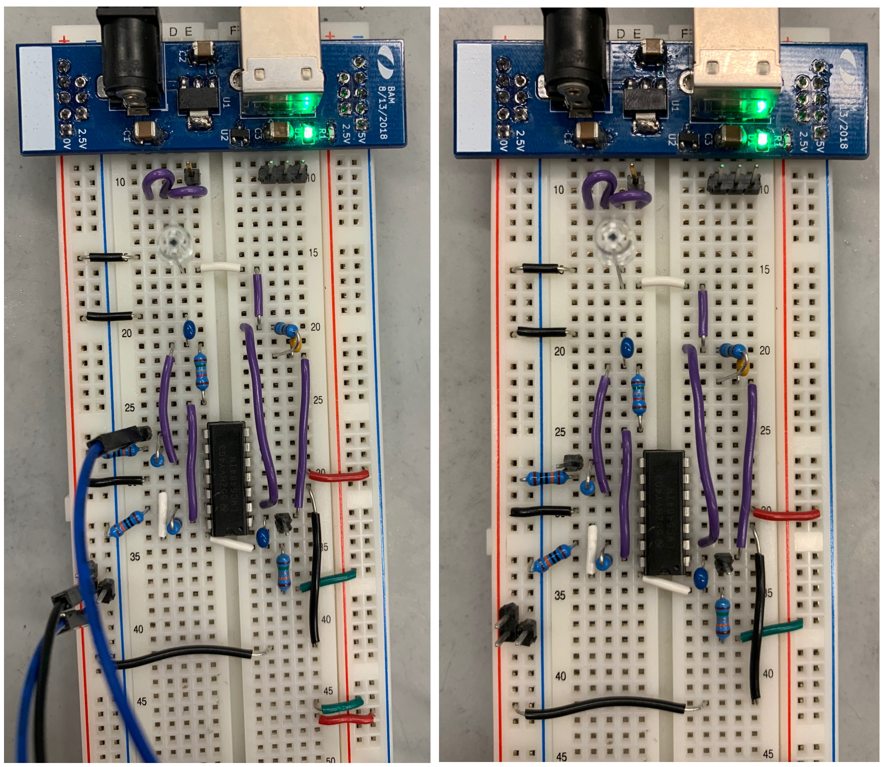

Figure 2: Clean Circuit with and without Analog Discovery Wires

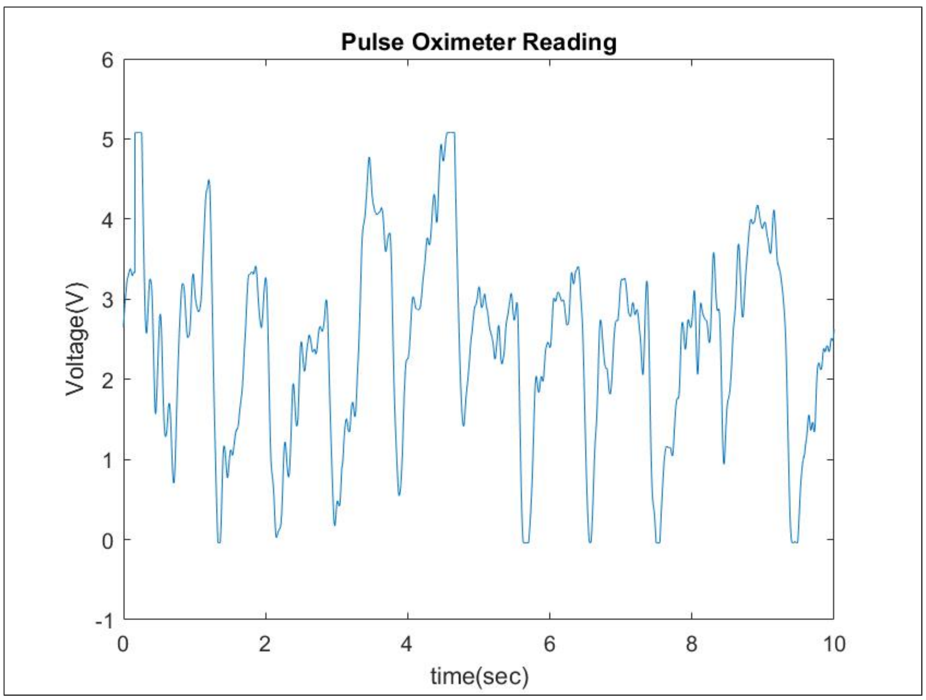

Figure 3: Circuit Schematic
This figure shows the final reading of the after passing through the circuit. It is interesting to note that the amplification of this circuit actually hits the maximum output of the final Op-amp and as such there is clipping seen in this figure.