# Chapter 5 Lab Writeup

Zach Thompson, Simon Hannes, Kyle Peterson

March 2, 2017

## Overview

The purpose of this lab was to examine different types of filters and how they react to changing frequencies. Three different filters were given to classify.

## Process

To determine the filter type of each circuit we are taking two measurements on the osciloscope at each of the 10 frequencies in the table. The voltage is measured across the capacitor, inductor, and resistor for the respective mystery filters one, two, and three. The time shift is also recorded to be able to use with calculating the phase shift. The corner frequencies can be found using the data collected and the equation $V_{out} = (7.07)V_{in}$ . For the third filter two corner frequencies are found. The data is graphed on a logarithmic scaled graph.

## Results

The corner frequency is found when the output voltage is equal to 5.656V.

Figure 1: Band Pass Filter

| VIN (V) | Freq (Hz) | VOUT(V) | Period (sec) | Time Shift | Phase Shift (degree) |
|---|---|---|---|---|---|
| 8 | 10 | 0 | 0.1 | 25000 | 90 |
| 8 | 30 | 0.14 | 0.033333333 | 9000 | 97.2 |
| 8 | 100 | .49 | 0.01 | 2480 | 89.28 |
| 8 | 300 | 1.4 | 0.003333333 | 760 | 82.08 |
| 8 | 1000 | 5.28 | 0.001 | 116 | 41.76 |
| 8 | 3000 | 4.56 | 0.000333333 | 46 | 49.68 |
| 8 | 10000 | 1.28 | 0.0001 | 23 | 82.8 |
| 8 | 30000 | 0.4 | 3.33333E-05 | 8.6 | 92.88 |
| 8 | 100000 | 0.074 | 0.00001 | 2.4 | 86.4 |
| 8 | 300000 | 0.5 | 3.33333E-06 | 0.92 | 99.36 |

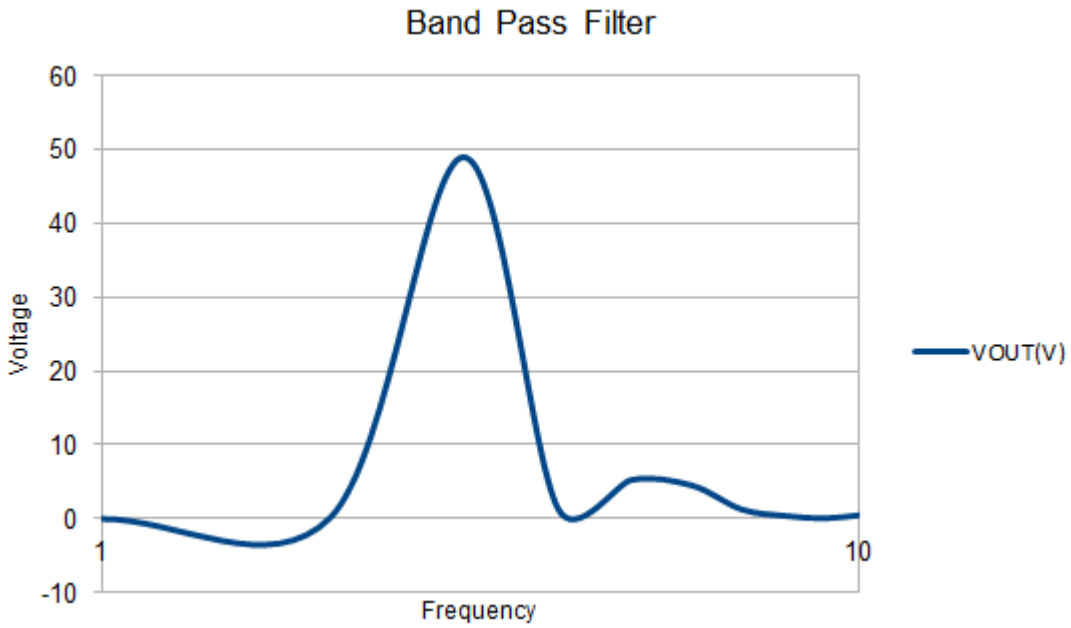


Figure 2: High Pass Filter

| VIN (V) | Freq (Hz) | VOUT(V) | Period (sec) | Time Shift | Phase Shift (degree) |
|---|---|---|---|---|---|
| 8 | 10 | 0 | 0.1 | 25000 | 90 |
| 8 | 30 | 0.14 | 0.033333333 | 9000 | 97.2 |
| 8 | 100 | 49 | 0.01 | 2480 | 89.28 |
| 8 | 300 | 1.4 | 0.003333333 | 760 | 82.08 |
| 8 | 1000 | 5.28 | 0.001 | 116 | 41.76 |
| 8 | 3000 | 4.56 | 0.000333333 | 46 | 49.68 |
| 8 | 10000 | 1.28 | 0.0001 | 23 | 82.8 |
| 8 | 30000 | 0.4 | 3.33333E-05 | 8.6 | 92.88 |
| 8 | 100000 | 0.074 | 0.00001 | 2.4 | 86.4 |
| 8 | 300000 | 0.5 | 3.33333E-06 | 0.92 | 99.36 |

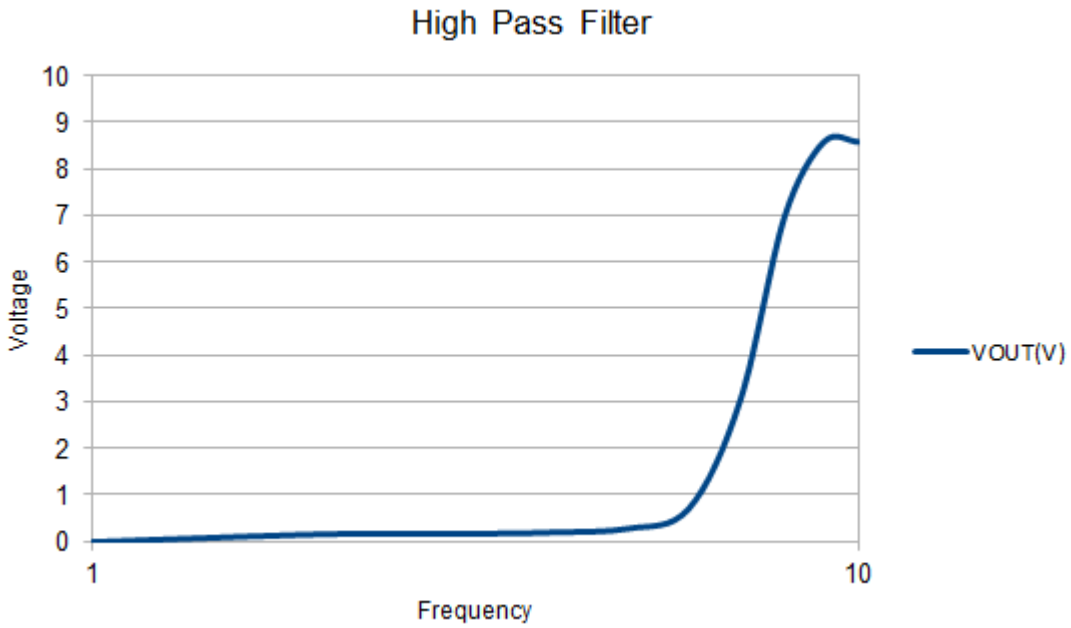
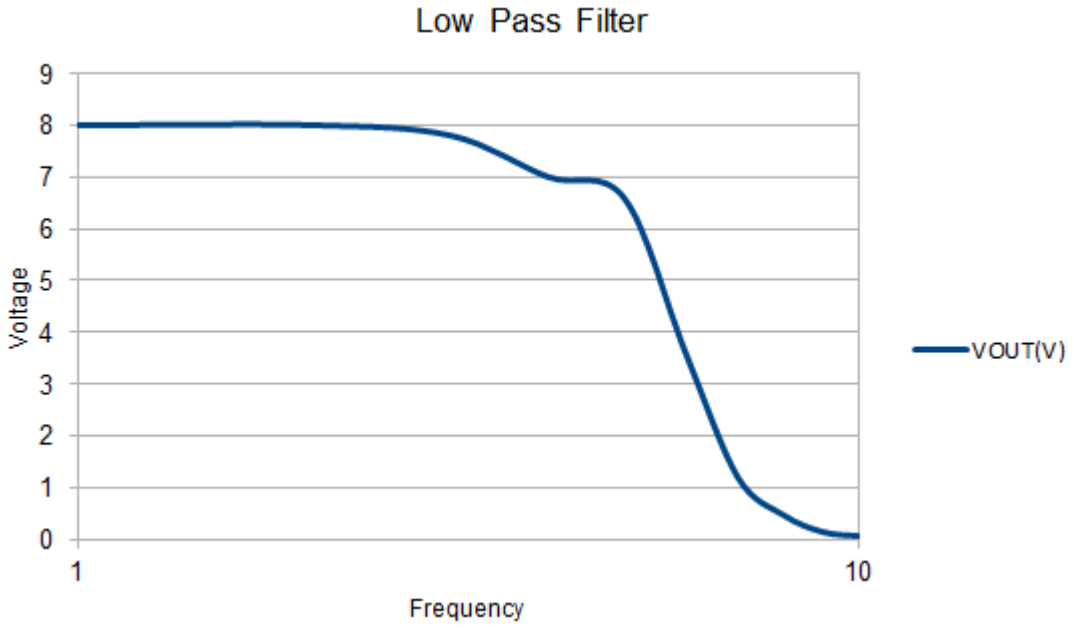


Figure 3: Low Pass Filter

| VIN (V) | Freq (Hz) | VOUT(V) | Period (sec) | Time Shift (micro s) | Phase Shift (degree) |
|---|---|---|---|---|---|
| 8 | 10 | 8 | 0.1 | 0 | 0 |
| 8 | 30 | 8 | 0.033333333 | 0 | 0 |
| 8 | 100 | 7.8 | 0.01 | 0 | 0 |
| 8 | 300 | 7 | 0.003333333 | 120 | 12.96 |
| 8 | 1000 | 6.6 | 0.001 | 88 | 31.68 |
| 8 | 3000 | 3.6 | 0.000333333 | 64 | 69.12 |
| 8 | 10000 | 1.2 | 0.0001 | 24 | 86.4 |
| 8 | 30000 | 0.48 | 3.33333E-05 | 8 | 86.4 |
| 8 | 100000 | 0.15 | 0.00001 | 2.2 | 79.2 |
| 8 | 300000 | 0.074 | 3.33333E-06 | 0.48 | 51.84 |



## Conclusion

The first filter is a low pass filter. We can determine this from just the first value of $10Hz$ which has a $V_{\{}out\} = V_{\{}in\}$ with a phase shift of zero. Then as the frequency increases $V_{\{}out\}$ decreases. That voltage to frequency response is what would be expected from a low pass filter.

The second filter is a high pass filter. Unlike the first filter it starts with a $V_{\{}out\} = 0$ at a low frequency then increases until $V_{\{}out\} = V_{\{}in\}$ at a high frequency. We can conclude that the result is as would be expeced from a high pass filter.

The third and final filter is a band pass filter. A Band pass has low voltage outputs at bioth low and high frequencies with a notable peak around the center. Our data actually has two peaks, one being much smaller than the other. This is most likely caused by some sort of wrap around in relation to the phase response of the circuit. We can then conclude that the filter is a band pass because the voltages at the low and high frequencies was zero.

## Study Questions