Chapter 5 Lab Writeup

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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

Our Voltage in is a constant 8V for all three filters. This Means that the corner frequency is found where the output is equal to $(7.07) * 8 = 5.656$. In filter one, this corresponds to a frequency 2000 Hz with voltages dropping sharply as the frequency is increased. In filter two, this corresponds to a frequency of 20,000 Hz with voltages increasing sharply as frequency continues to climb. In filter three, two corner frequencies can be found at 700 Hz and 1000 Hz, with greatly dimished voltages recorded below 700 Hz and above 1000 Hz. The corner frequency is found when the output voltage is equal to 5.656V.
Low Pass Filter: $F_{3db} = 1.7kHz, PhaseShift = 48.96°$
High Pass Filter: $F_{3db} = 23kHz, PhaseShift = 66.24°$
Band Pass Filter: $F_{3db} = 1.1kHz, PhaseShift = 39.6°$ and $F_{3db} = 1.5kHz, PhaseShift = 54°$

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

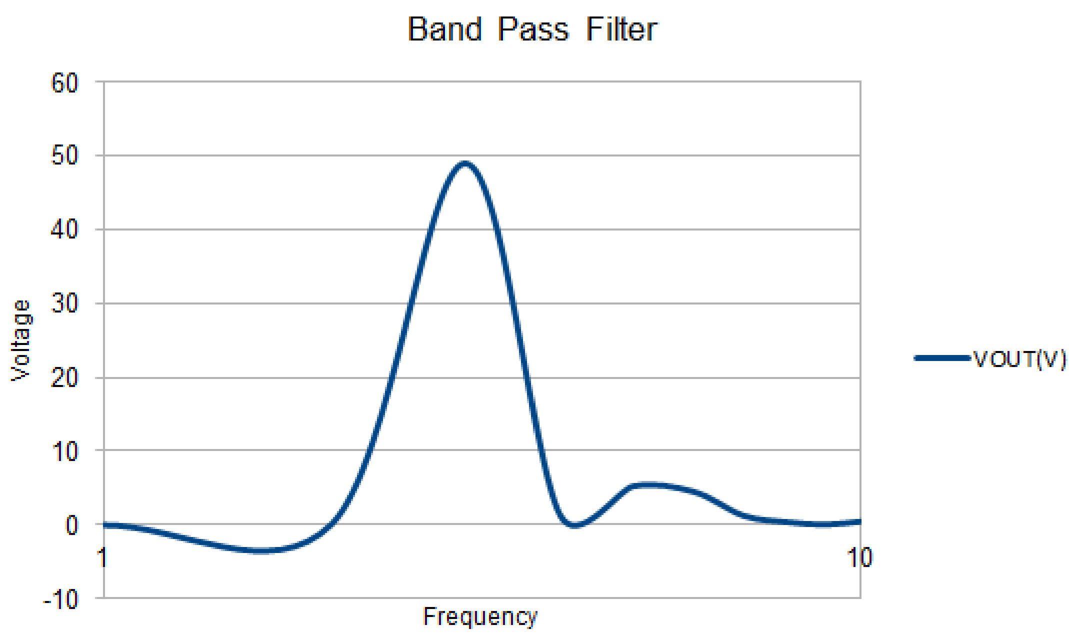


Figure 2: High Pass Filter

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

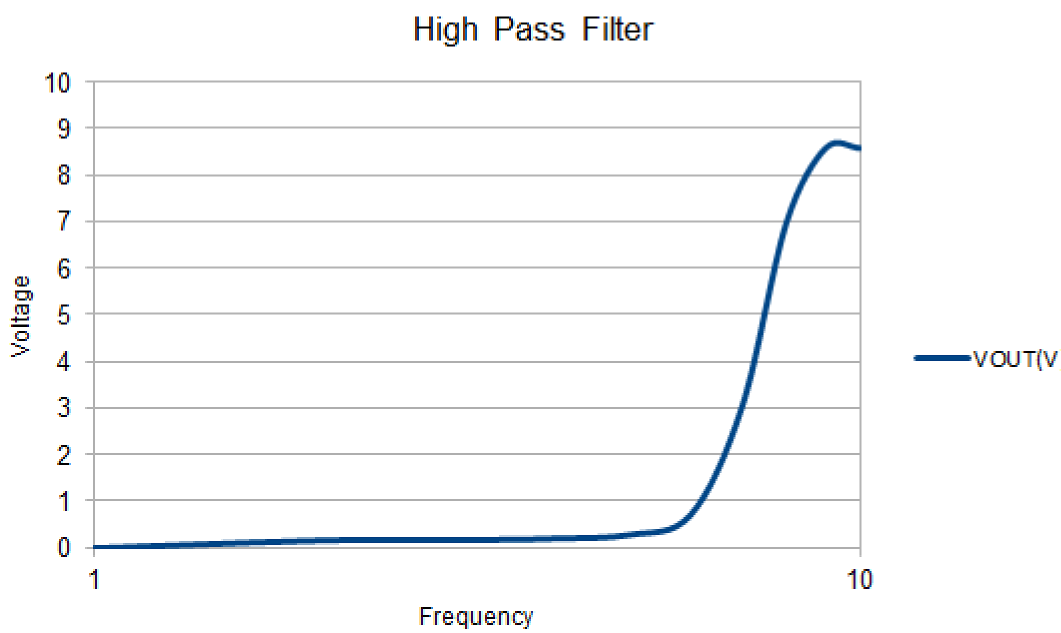
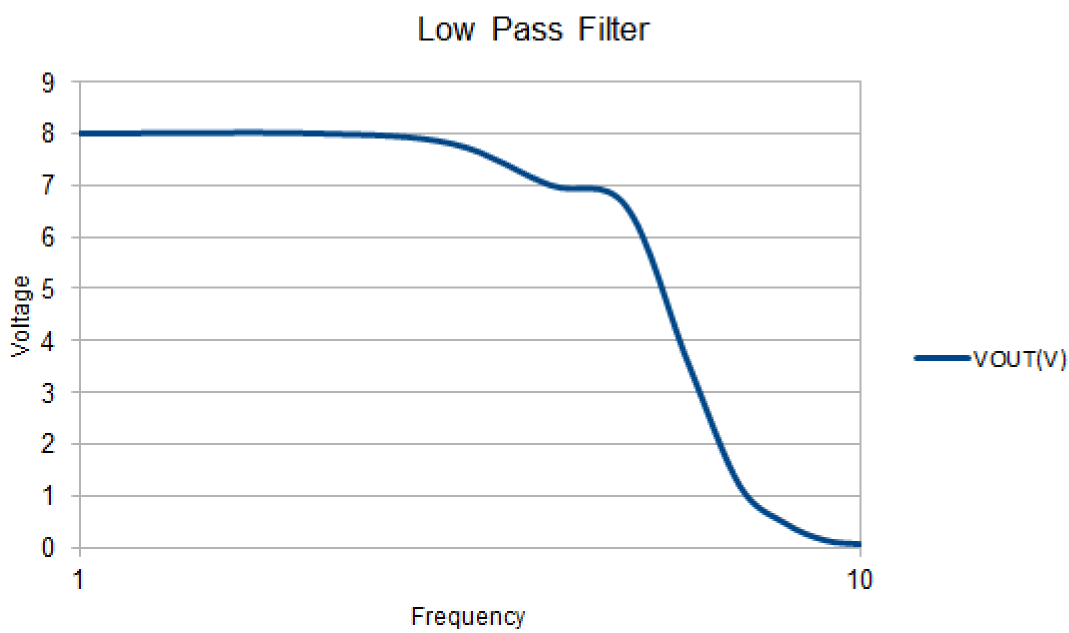


Figure 3: Low Pass Filter

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

To determine the values of the components used, we will employ a similar strategy as that of lab 4. Our $V_\{out\}$ value and the phase shift comprise the phasor of the voltage across the capacitor or inductor. We can take the total voltage supplied and subtract the voltage across the capacitor/inductor to get the voltage drop across the resistor. We divide this value by the known resistor value to get the current across the circuit. Our component value, then, is the voltage across the component divided by the current through the circuit, all over the frequency at which the data was collected.