

EE230: Lab 7

Active Filters

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1 Overview of the experiment

1.1 Aim of the experiment

1. Plotting the filter response of Sallen Key Active Low-Pass Filter and comparing the theoretical results for cutoff frequency and roll-off with the ideal case.
2. Plotting the filter response of Sallen Key Active High-Pass Filter and comparing the theoretical results for cutoff frequency and roll-off with the ideal case.
3. Plotting the filter response of Multiple Feedback Active Band-Pass Filter and comparing the theoretical results for cutoff frequency and roll-off with the ideal case.

1.2 Methods

The circuit diagrams for all the 3 parts were provided in the lab handout, using which I built the circuits on a breadboards and measured the required values.

2 Design & Working

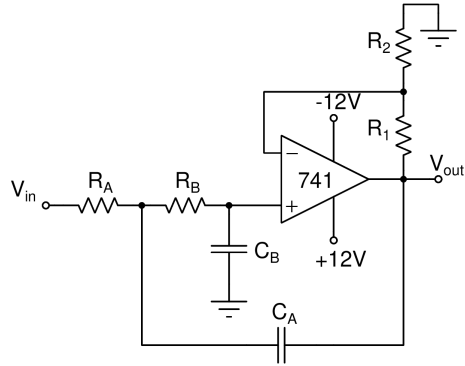


Fig. Sallen Key (2 pole) Active Low-Pass Filter

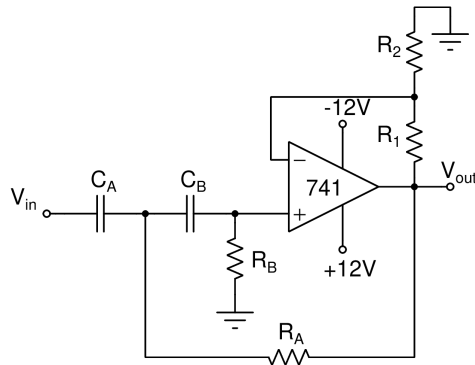


Fig. Sallen Key (2 pole) Active High-Pass Filter

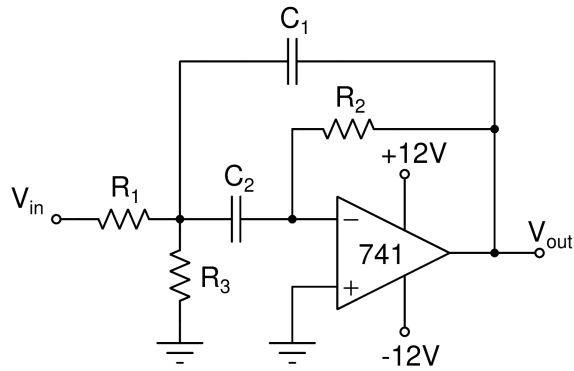


Fig. Multiple Feedback Active Band-Pass Filter

3 Experimental results

3.1 Sallen Key Active Low-Pass Filter

$$f_c = \frac{1}{2\pi RC} \quad (1)$$

The theoretical cutoff frequency is **338Hz** and the roll-off is **-40dB/decade** beyond the cutoff frequency

Frequency (Hz)	$V_{out}(V)$	Gain (dB)
20	1.62	4.19
50	1.62	4.19
70	1.6	4.08
100	1.56	3.86
200	1.44	3.17
250	1.34	2.54
300	1.24	1.87
350	1.14	1.14
400	1.02	0.17
450	0.94	-0.54
500	0.84	-1.51
600	0.68	-3.35
700	0.56	-5.04
800	0.48	-6.38
900	0.38	-8.4
1000	0.34	-9.37
2000	0.12	-18.42

Given below is the comparison between observed and theoretical values for cut-off frequency and roll-off:

Characteristic	Observation	Theoretical
Cut-off Frequency	338Hz	350Hz
Roll-off	-40dB/decade	-32dB/decade

3.2 Sallen Key Active High-Pass Filter

$$f_c = \frac{1}{2\pi RC} \quad (2)$$

The theoretical cutoff frequency is **338Hz** and the roll-off is **-40dB/decade** beyond the cutoff frequency

Frequency (Hz)	$V_{out}(V)$	Gain (dB)
2000	1.62	4.19
1000	1.54	3.75
900	1.48	3.4
800	1.44	3.17
700	1.4	2.92
650	1.32	2.54
600	1.28	2.41
550	1.16	1.29
500	1.08	0.67
450	1.02	0.17
400	0.85	-1.41
300	0.58	-4.73
200	0.3	-10.46
100	0.1	-20
70	0.07	-23.09
50	0.05	-26.02
20	0.04	-27.96

Given below is the comparison between observed and theoretical values for cut-off frequency and roll-off:

Characteristic	Observation	Theoretical
Cut-off Frequency	338Hz	550Hz
Roll-off	-40dB/decade	-31dB/decade

3.3 Multiple feedback Active Band-Pass Filter

$$f_c = \frac{1}{2\pi C} \sqrt{\frac{R_1 + R_3}{R_1 R_2 R_3}} \quad (3)$$

$$BW = \frac{f_c}{\pi f_c C R_2} \quad (4)$$

The theoretical cutoff frequency is **736Hz** and the bandwidth is **177Hz**.

Frequency (Hz)	$V_{out}(V)$	Gain (dB)
20	0.02	-33.98
50	0.04	-27.96
70	0.05	-26.02
100	0.07	-23.1
200	0.13	-17.72
300	0.22	-13.15
400	0.35	-9.12
500	0.64	-3.88
550	0.83	-1.62
560	0.91	-0.82
570	0.98	0.18
580	1.01	0.09
590	1.1	0.83
600	1.13	1.06
610	1.17	1.37
620	1.2	1.58
630	1.22	1.73
640	1.23	1.8
650	1.22	1.73
660	1.19	1.51
670	1.14	1.14
680	1.12	0.98
690	1.09	0.75
700	1.04	0.34
710	1.01	0.83
720	0.98	0.18
730	0.94	-0.54
740	0.9	-0.92
750	0.83	-1.62
800	0.68	-3.35
900	0.5	-6.02
1000	0.38	-8.4
2000	0.14	-17.08

Given below is the comparison between observed and theoretical values for cut-off frequency and roll-off:

Characteristic	Observation	Theoretical
Center Frequency	736Hz	640Hz
Lower Frequency	647Hz	550Hz
Upper Frequency	825Hz	750Hz
Bandwidth	177Hz	200Hz