Experiment 42

Sunday, April 9, 2023 11:33 AM

Lillian Tucker

Objectives:

1. To build and demonstrate an active low-pass filter (LPF).
2. Plot the frequency response of an active LPF.
3. Measure the BW of the LPF with square-wave testing.

Pre-Lab:

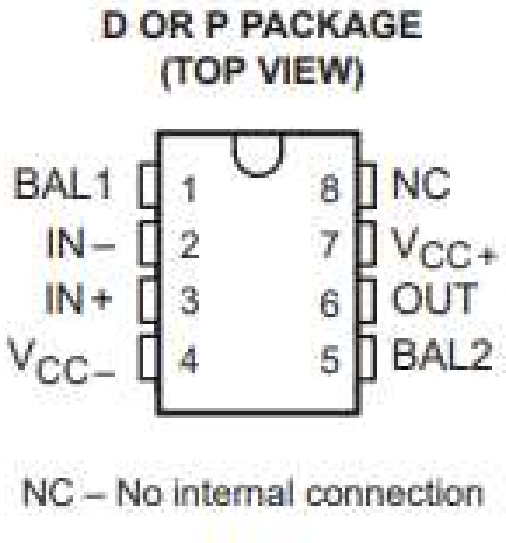

Figure 1 (LF411 Op Amp diagram)

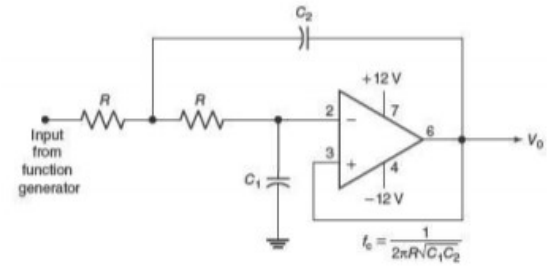

Figure 2 (Circuit Schematic of Active Low-pass Filter)

$$f_c = \frac{1}{2\pi R\sqrt{C_1 C_2}}$$

Figure 3 (formula for corner frequency)

Procedure:

Steps 1-5:

Table 1 (Ideal and Non-Ideal Corner Frequencies	Corner frequency (calculated) [Hz]	Corner Frequency (measured) [Hz]
Ideal	1591.55	1585
Non-Ideal (5% tolerance)	1718.81	195

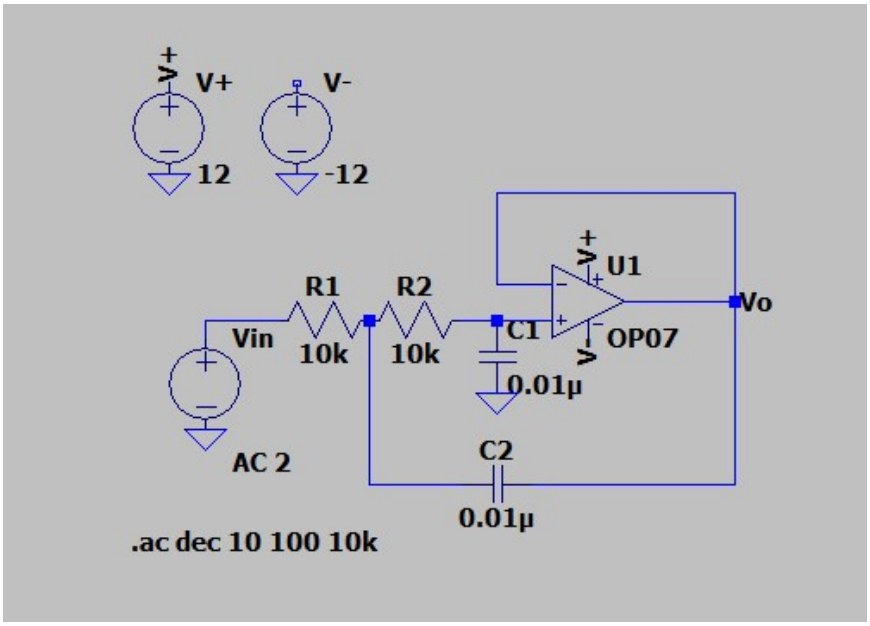

Figure 4 (LTSpice Circuit Schematic of Low-pass Filter with ideal values)

- Corner Frequency: 1.585 kHz, -56 dB

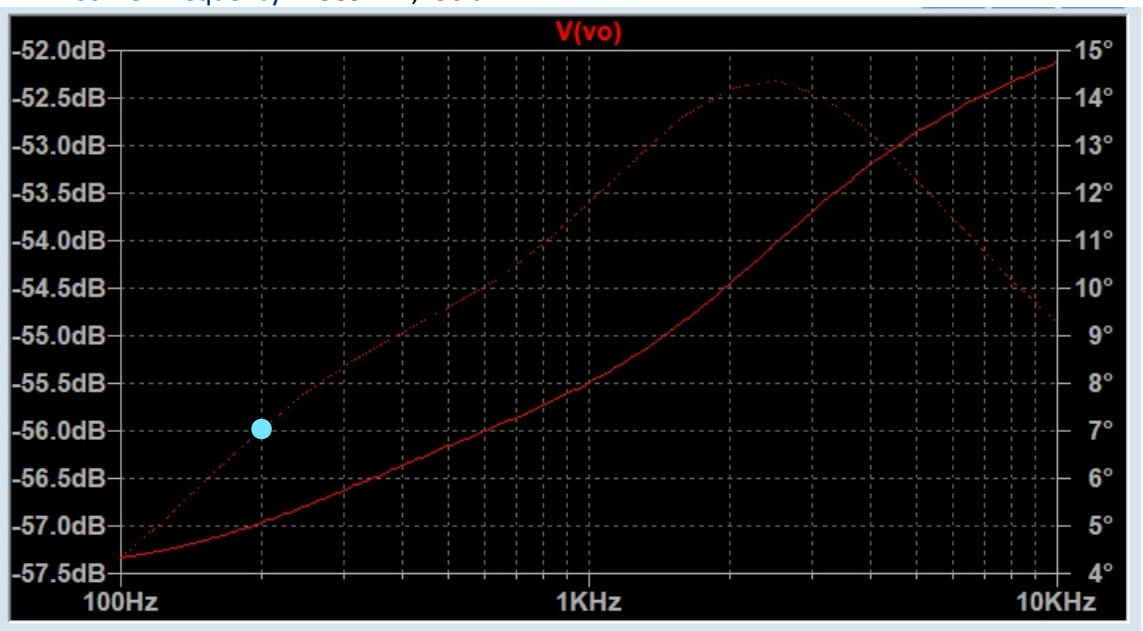

Figure 5 (LTSpice frequency analysis from 100 Hz to 10 kHz for Low-pass Filter with ideal values)

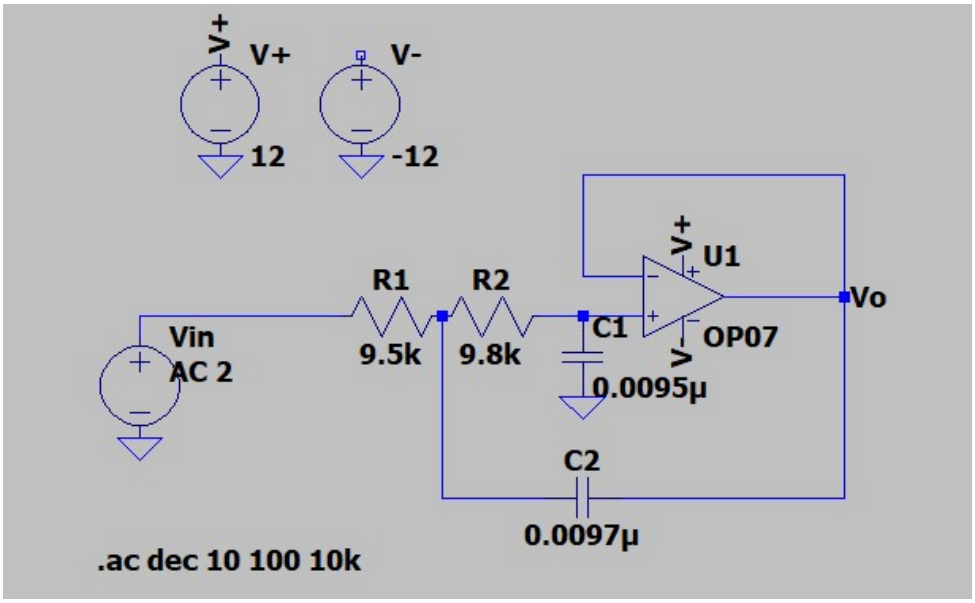

Figure 6 (LTSpice Circuit Schematic of Low-pass Filter with non-ideal values)

Corner Frequency: 195 Hz, -56 dB

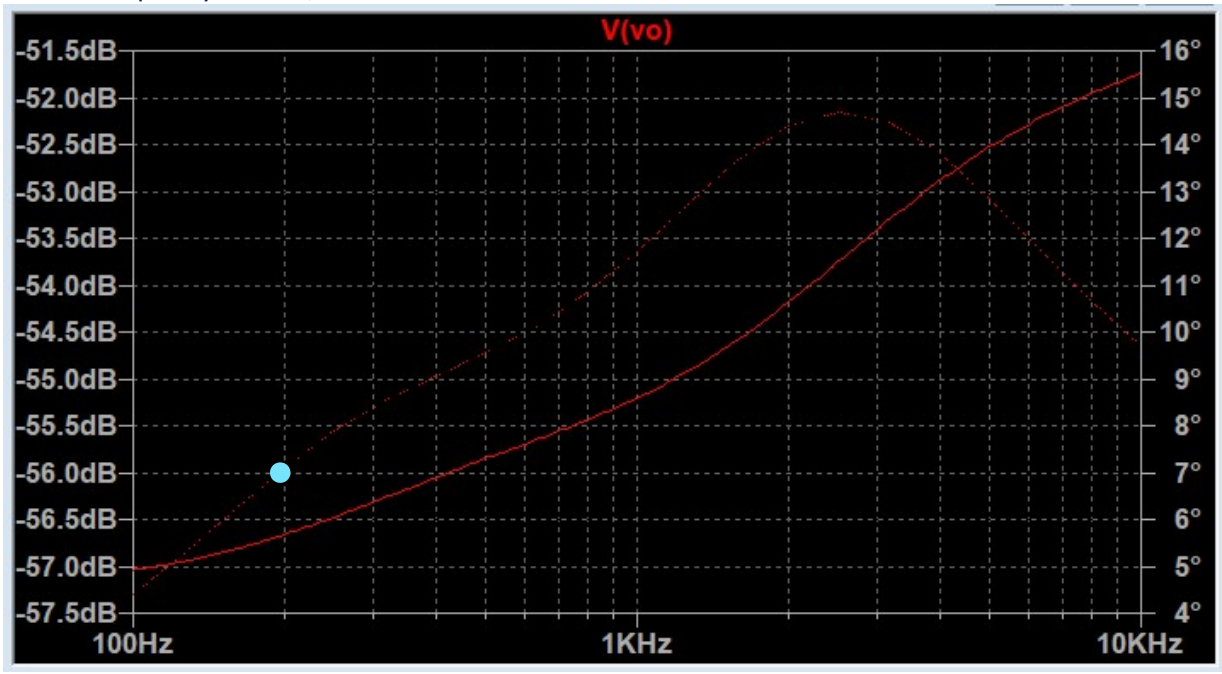

Figure 7 (LTSpice frequency analysis from 100 Hz to 10 kHz for Low-pass Filter with non-ideal values)

Step 6:

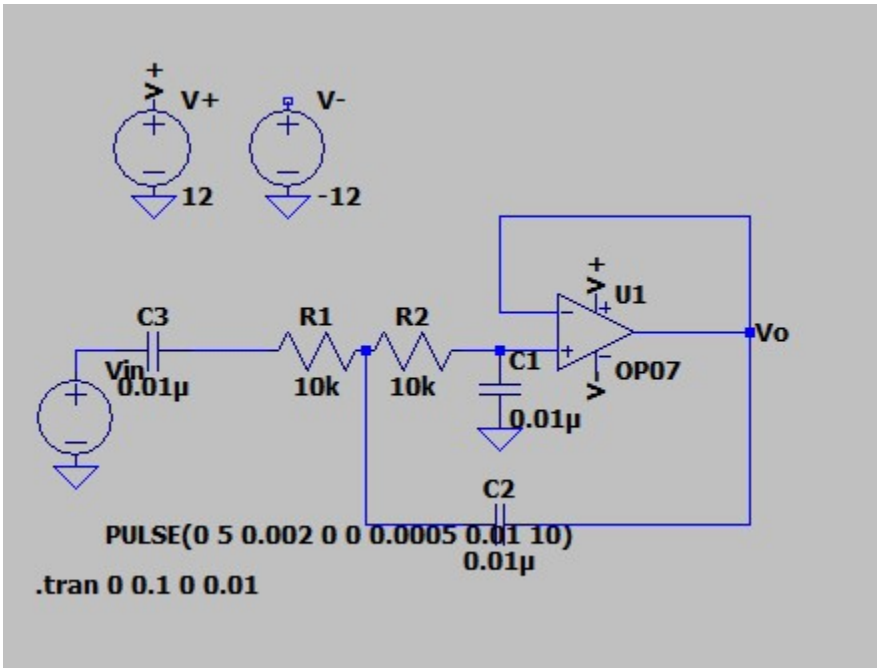

Figure 8 (LTSpice Circuit Schematic of Low-pass Filter with ideal values with additional capacitor)

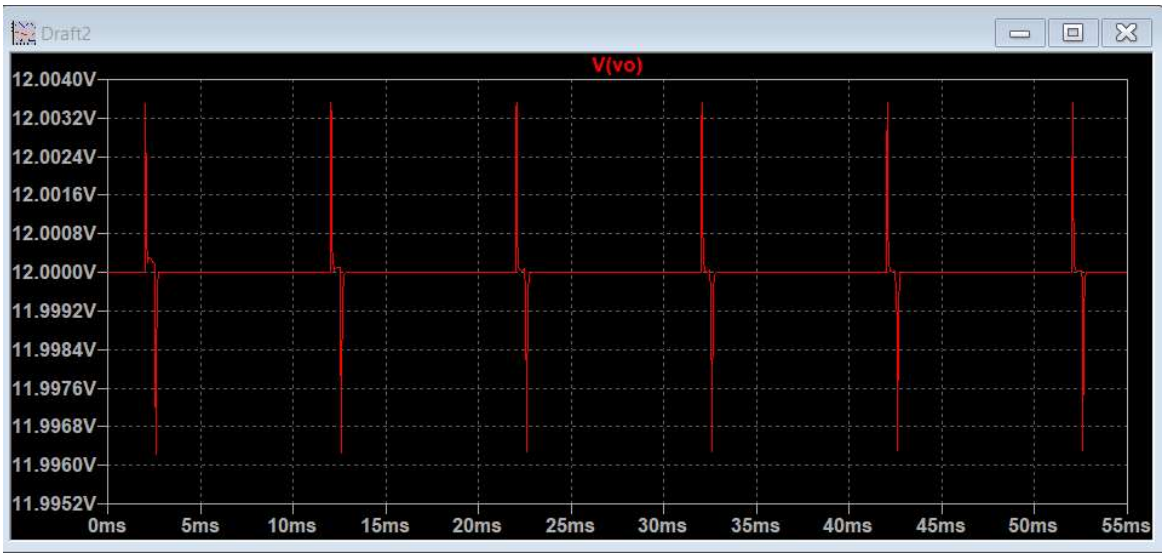

Figure 9 (LTSpice square wave 5 Vpp with ideal component values with additional capacitor)

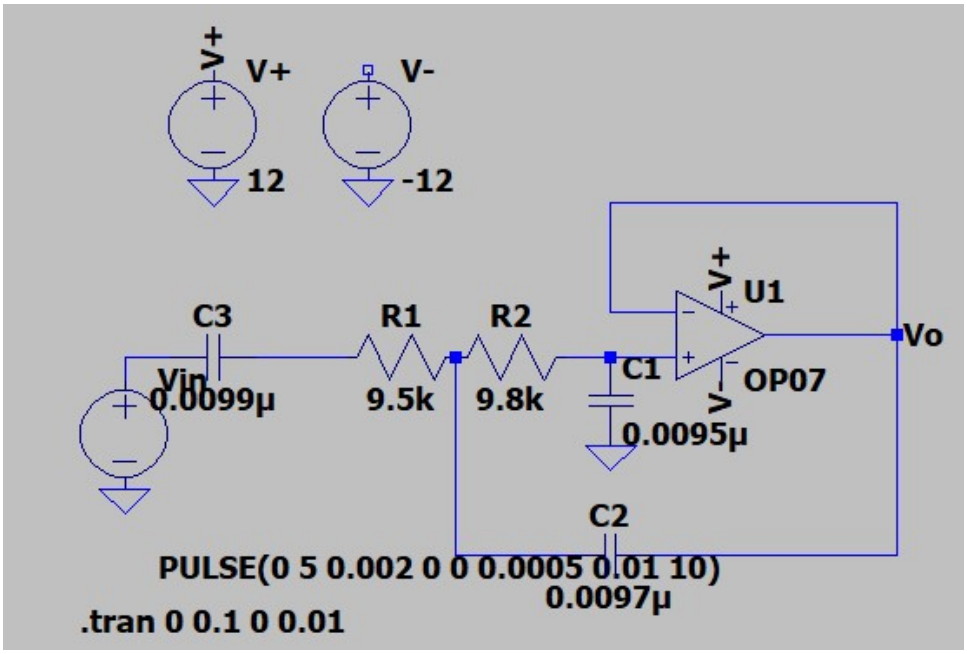

Figure 10 (LTSpice Circuit Schematic of Low-pass Filter with non-ideal values with additional capacitor)

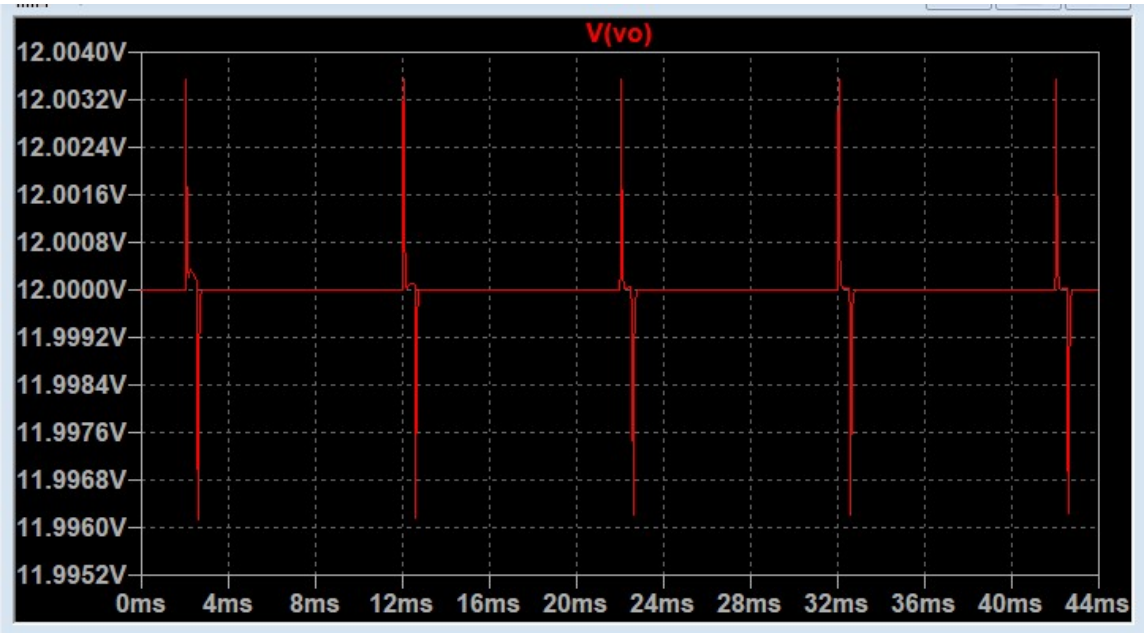

Figure 11 (LTSpice square wave 5 Vpp with non-ideal component values with additional capacitor)

Step 7-8:

Table 2 (Rise Time and Corner Frequency from Rise Time	Rise Time (tt) [ms]	Corner Frequency from tt [Hz]
Ideal	0.05	7000
Non-Ideal (5% tolerance)	0.05	7000

Step 9:

Questions:

1. Besides the values of R and C in an active filter, what determines the upper-frequency limit of this filter?
   - The input voltage determines the upper frequency limit.

2. What would be the rolloff rate of a filter made up of two cascaded stages of the circuit in Fig. 42-1?
   - The rolloff rate of two cascaded filters would be double the rolloff rate of a single stage of the circuit in Figure 42-1.

3. What is the voltage gain of the circuit in Fig. 42-1?
   - 0.0025 V/V