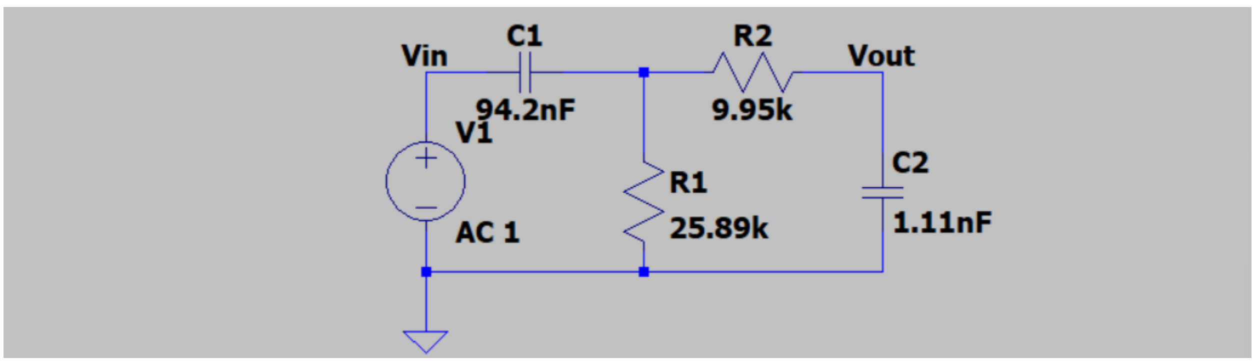
Project 3

Nutthawat Panyangnoi(G08285564)

Mateen Ahsan(014952418)

Jingkai Yao (G08288506

DESIGN



This is the conclusive design schematic for the Project 3. We went through trial and error trying to find out how to make this system work and finally landed on this design that utilizes the low pass filter and high pass. Our designed was originated from the lab7. To ascertain the values of the resistor and capacitor, we leveraged the frequency cutoff formula $fc = \frac{1}{2\pi RC}$. Notably, the decision was made to compute the high-pass filter parameters first, followed by the low-pass filter. The detailed calculations are provided below. For the high-pass filter, the calculated values were C=100 nF R=26 kΩ. Subsequent experimental measurements yielded values closely approximating the theoretical calculations, with C=94.2 nF and R=25.89kΩ.

Concurrently, for the low-pass filter, our calculated values were C=1 nF and R=1kΩ. Experimental measurements resulted in values of C=1.11 nF and R=9.95 kΩ. In an effort to align our design with real-world performance, we judiciously opted to integrate the measured values into our schematic, thereby ensuring convergence between anticipated and actual outcomes.

Calculation Derived

In the design of a high-pass filter circuit, we initially determined a preferred capacitor value and calculated the corresponding resistor value using the frequency cutoff formula $fc = \frac{1}{2\pi RC}$. For the lower frequency cutoff of 62 Hz, the equation was solved for the resistor (R), yielding an approximate value of 26 kΩ. Subsequently, for the higher frequency cutoff of 15 kHz, we selected a resistor value and solved for the capacitor (C), resulting in a theoretical value of 1 nF.

Apply frequency cutoff formula $fc = \frac{1}{2\pi RC}$

We first determined Capacitor value that we like and we solve for R.

Given left frequency = 62 hz, and right frequency = 15 Khz

$$fc = \frac{1}{2\pi RC} \; -> 62 = \frac{1}{2(3.14)R(100*10^{-9})} = solve\ for\ R,\ R\ is\ approximately\ 26k$$

Next, we solve for right frequency, we pick Resistor value that we like and solve for capacitor

$$15000 = \frac{1}{2(3.14)(1000)C} = solve\ for\ C,\ C\ is\ 0.00000001 * 10^{8} = 1nF$$

Upon measuring the real-world values of the capacitors and resistors, it was observed that they deviated slightly from the calculated theoretical values. In response to this variance, a decision was made to adjust the resistor value to align with the actual physical capacity value obtained from the measured components. This iterative process ensures that the filter circuit achieves the desired frequency response characteristics in consideration of real-world component tolerances and variations.

TEST PLAN & RESULTS

After the obtain the calculated value we enter capacitor values and resistor values to our schematic on LTspice to simulate the values. We tested multiple time to make sure that they value from simulator is close enough to what we need which are left frequency 62 Hz and Right frequency is 15 KHz. During design session we running into make issue which caused us to spent more time to change the design. Another issue that we ran into was our test results were shaky due to the real measured value of Capacitors and Resistor were slightly off from our designed. We have to use resistance box to adjusting resistor accordingly to capacitor value that we measured.

<u>Result from experiment test</u>

Expectation = $-\ 3db\ =\ 20log|\frac{Vout}{Vin}|\ =-\ 3db\ =\ 20log(0.7)$

Result =$-\ 3db\ =\ 20log|\frac{Vout}{Vin}|\ =-\ 3db\ =\ 20log(0.3)$

Although , we failed to achieve gain of 0.7 $\rightarrow -\ 3db\ =\ 20log(0.7)$

What we obtain is only 0.3 from our value.

We obtain the right frequence gain = $|\frac{144mv}{458mv}|\ =\ 0.314$ gain.

We obtain the left frequence gain = $|\frac{168mv}{458mv}|\ =\ 0.3.$ gain

CONCLUSION/LESSON LEARNED

This project ended up working and we learned a lot while doing it. Asking questions is critical because one mistake can set you back hours, and when there is a deadline steadily approaching, that is dangerous. We spent too much time and almost ran out of time in the end. Time management and a written plan were necessary. While building the circuit, we also ran into wiring trouble. If we had written out a diagram of the physical circuit, we could have eliminated that issue. Unfortunately, we were unable to finish the demo to present to the professor. Although we did construct the circuit. We ran out of time and couldn't get three test values from the oscilloscope.

Data:

Result =$-\ 3db\ =\ 20log|\frac{Vout}{Vin}|\ =-\ 3db\ =\ 20log(0.3)$ Gain

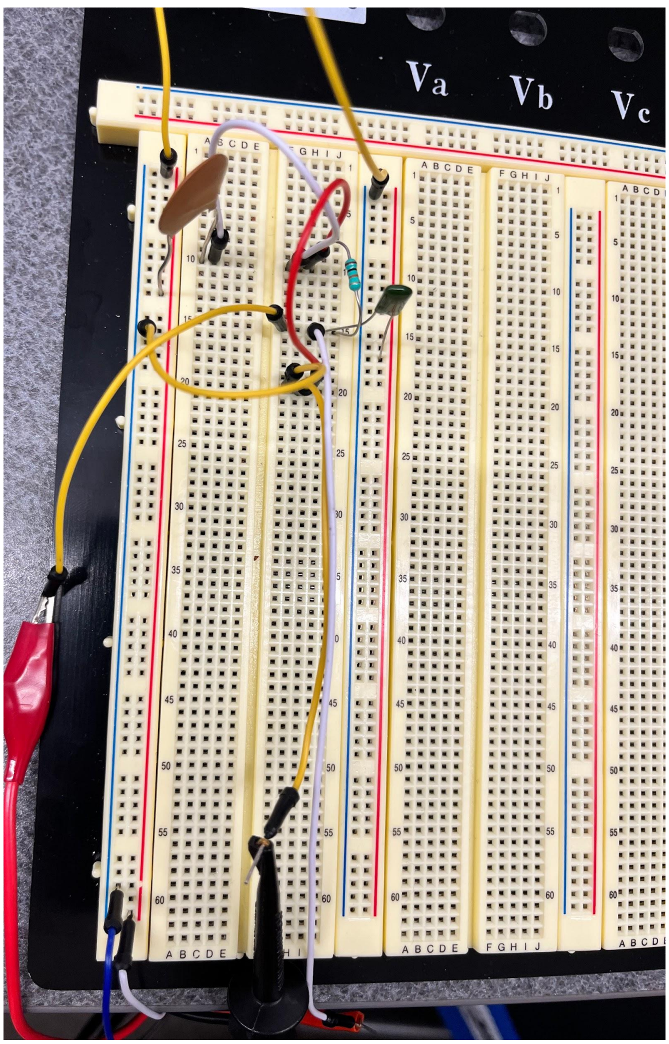
Although , we failed to achieve gain of 0.7 $\rightarrow -\ 3db\ =\ 20log(0.7)$

What we obtain is only 0.3 from our value.

We obtain the right frequence gain = $|\frac{144mv}{458mv}|\ =\ 0.314$ gain.

We obtain the left frequence gain = $|\frac{168mv}{458mv}|\ =\ 0.3.$ gain


RIGOL
T'D
H 20.0us
500MSa/s
120k pts
D 0.00000000ps
T 0.00V
Vertical
Vmax
Vmin
Vpp
Vtop
Vbase
Vamp
AX: = -51.20us
AY: = 64.00mV
BX: = 17.20us
BY: = -80.00mV
BX-AX: = 68.40us
BY-AY: = -144.0mV
1/|dX|: = 14.62kHz
Cursor
Mode
Manual
Select
Source
CH2
CursorA
64.00mV
CursorB
-80.00mV
CursorAB
Period=66.40us
Freq=15.1kHz
Freq=15.1kHz
1 = 200mV
2 = 200mV
3 = 50.0 V
4 = 50.0 V
LA
All Inputs 1MΩ//13p


Va
Vb
Vc