CPE 316: Electrical Circuits and Electronic Design Laboratory.

Lab 02

Inverting and Noninverting OP-Amp Circuits.

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Date of Experiment: 08/29/22.

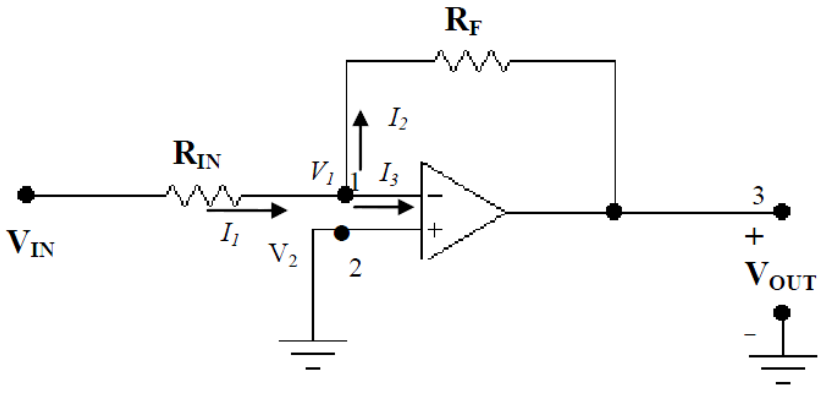
INTRODUCTION:

This laboratory session was about op-amps. Op-amps are short for operational amplifiers, and they are high-gain electronic components used in a lot of electronic equipment. The goal for this lab was to design and test non-inverting and inverting op-amps. The first step was to create Multisim AC/DC designs of op-amps and then recreate the same configurations for AC in the laboratory.

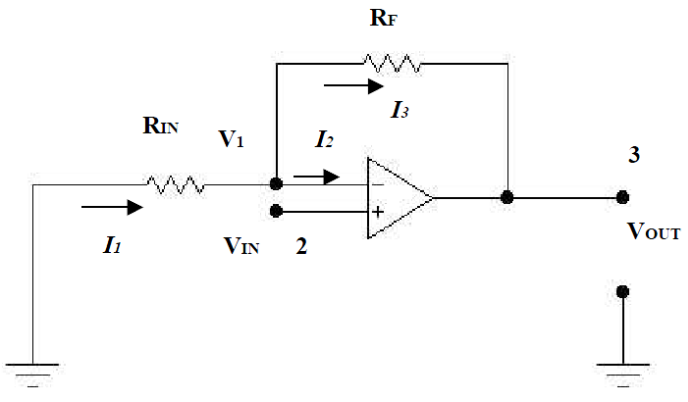
PART A:

The first task in the lab was to digitally design the non-inverting and inverting op-amps. And then determine the gain. We also needed to plot the input and output waveforms using the inbuilt digital oscilloscope.

For the appropriate configurations, the designs were to match the following diagrams:



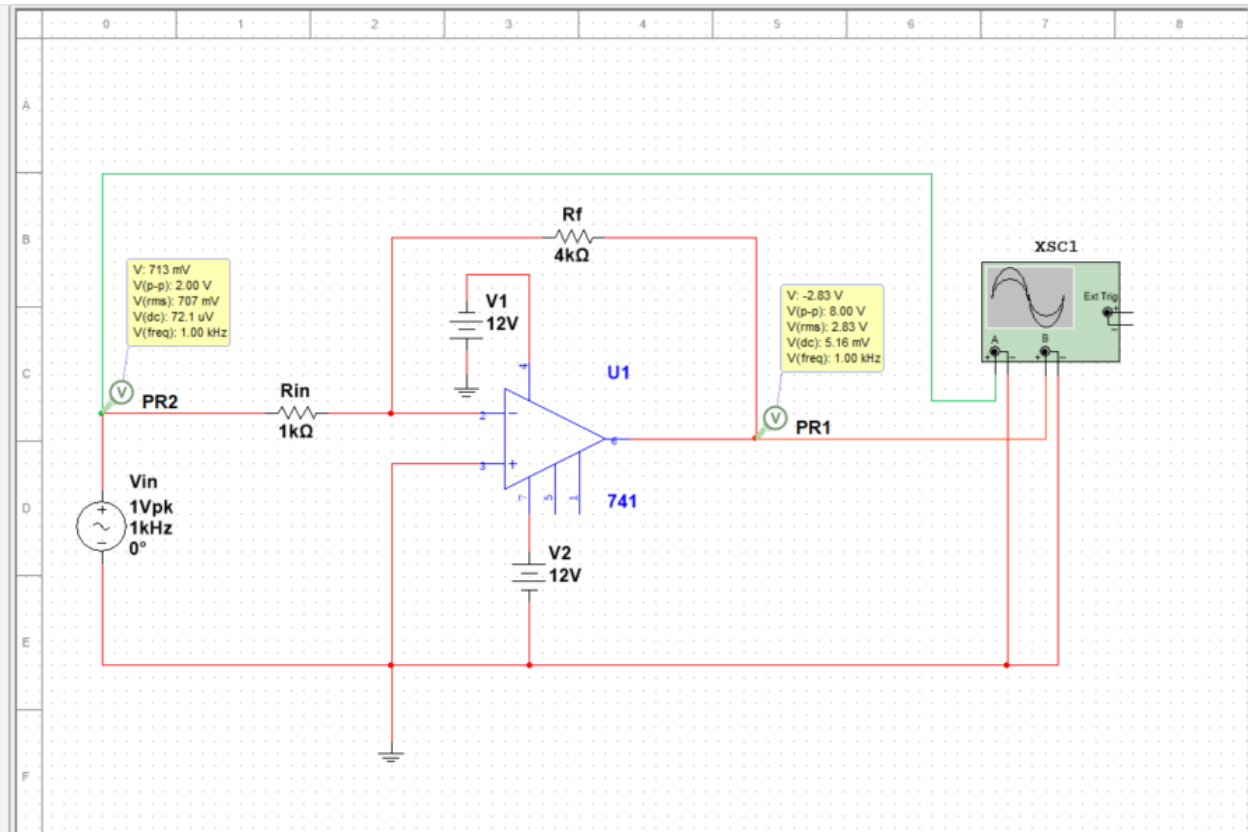
inverting op-amp configuration



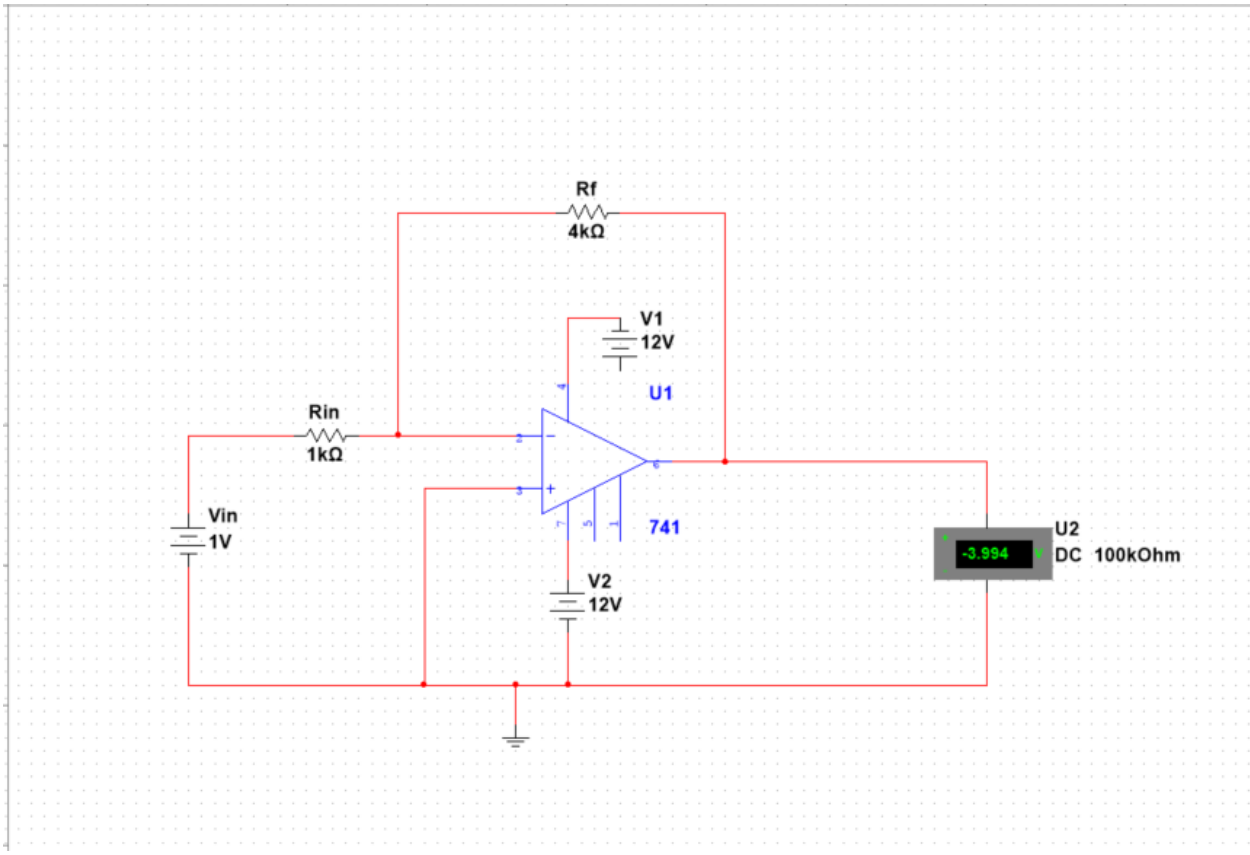
non-inverting op-amp configuration.

We set the input voltage, Vin as 1Volt and the input resistance, Rin as 1K.

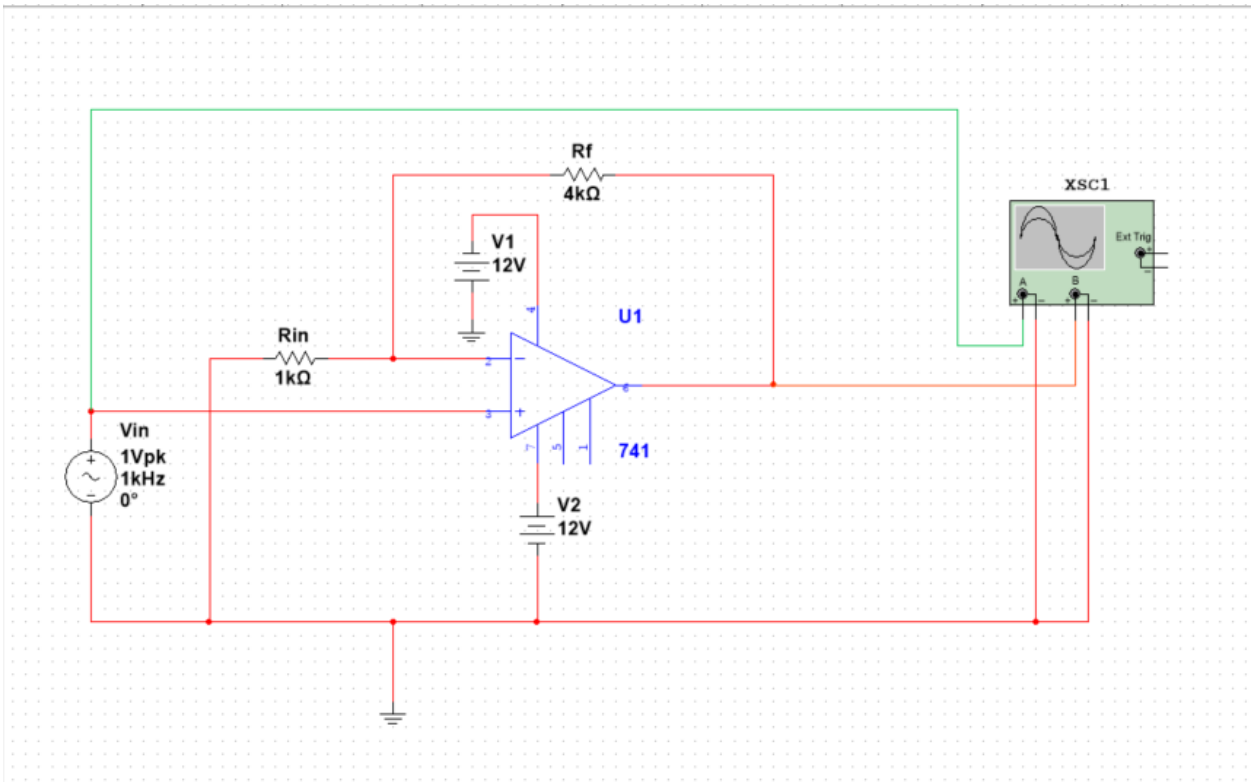
AC inverting op-amp design:



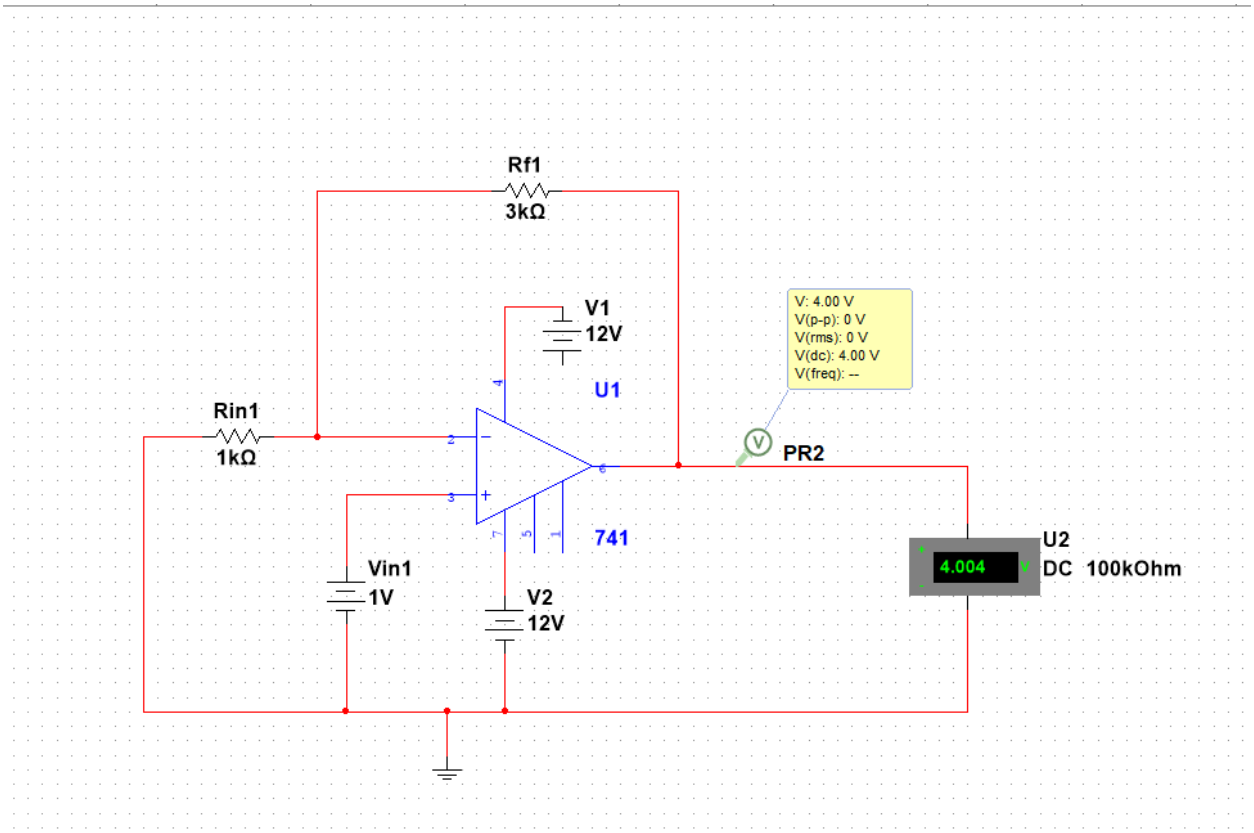
DC inverting op-amp design:



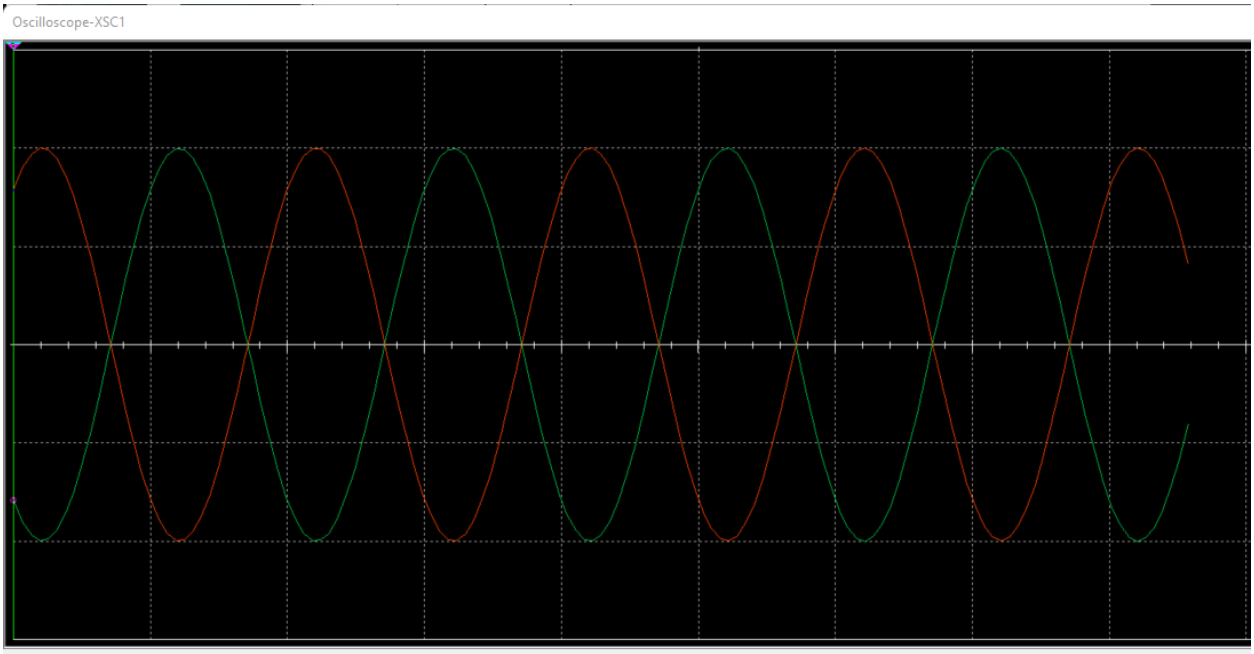
AC non-inverting design:

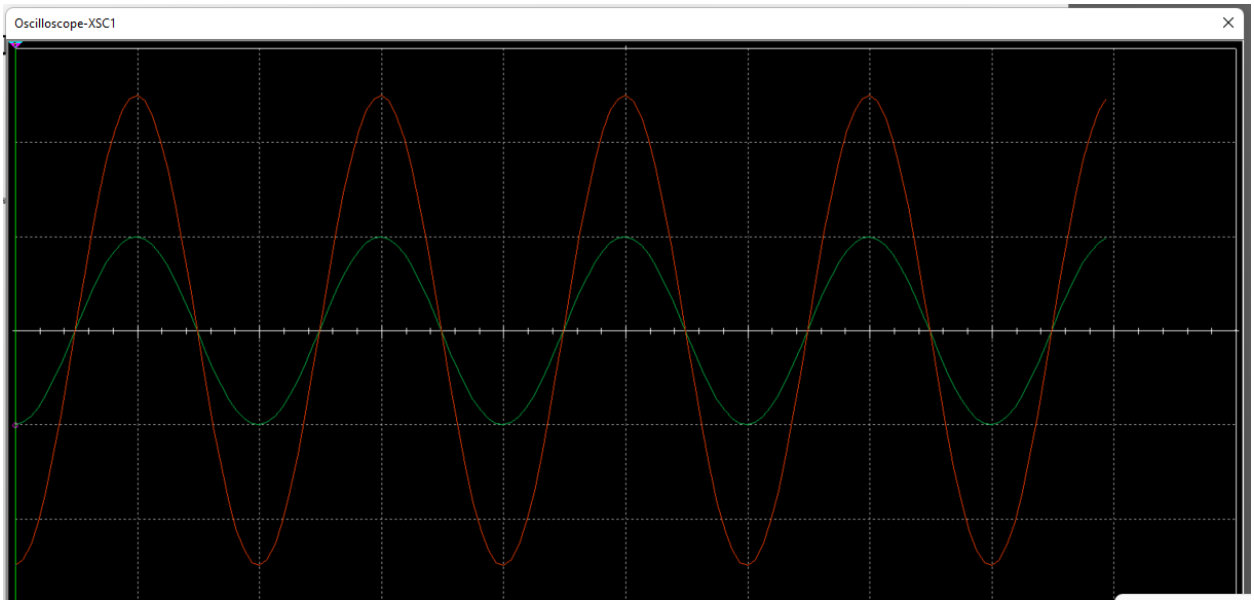


DC non-inverting design:



We checked the inverting and noninverting input and output waveforms using the oscilloscopes attached to the AC configurations as seen below:

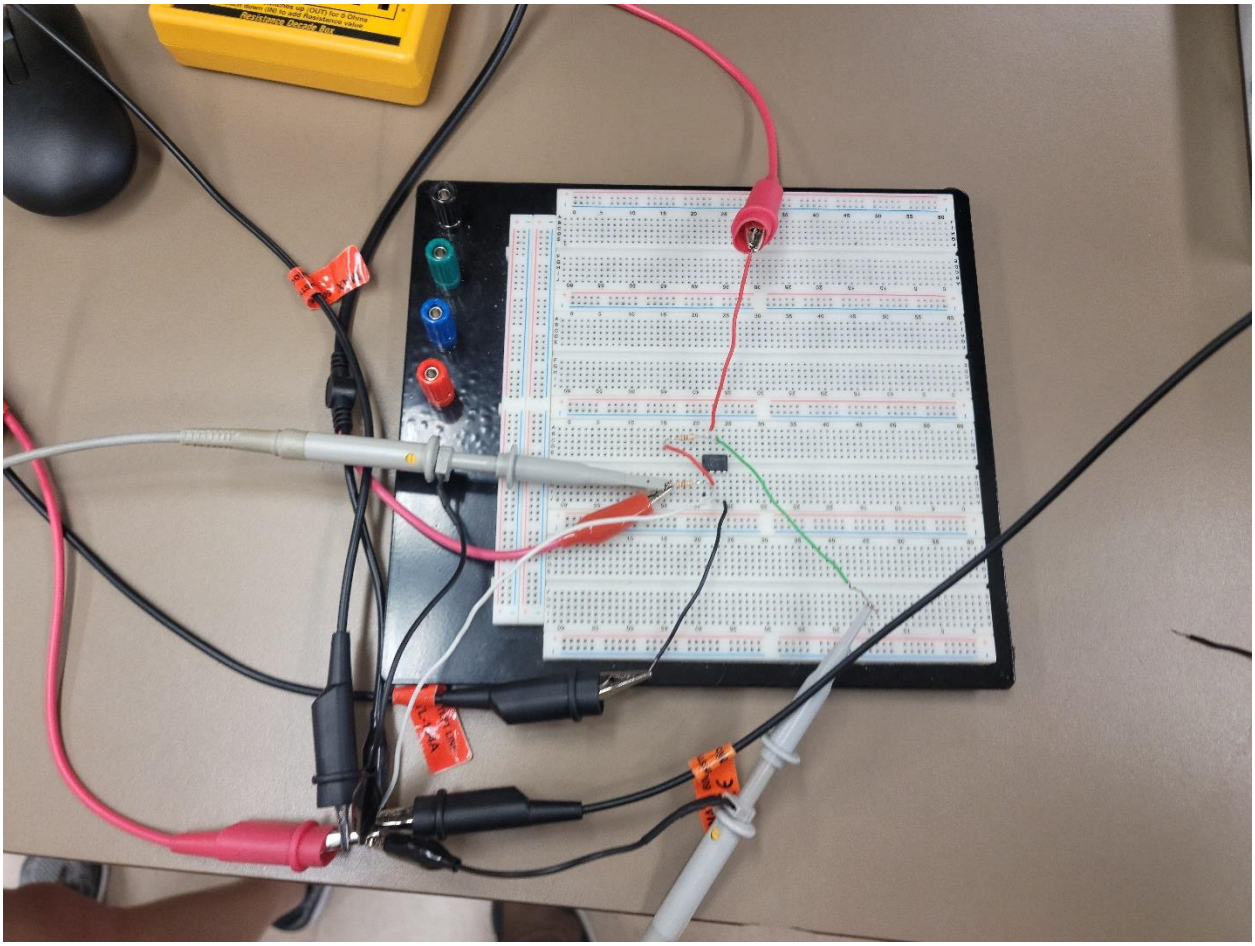


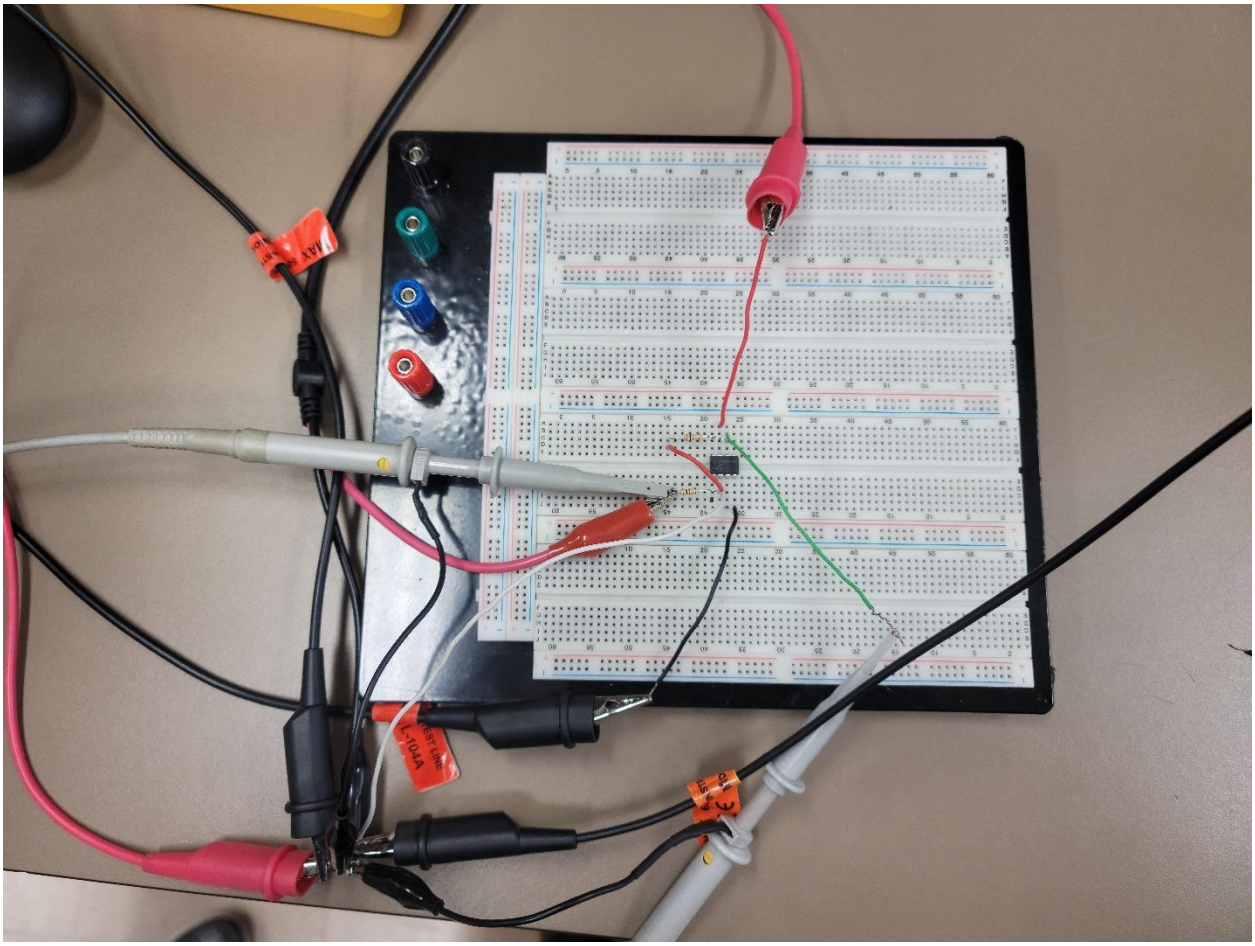


The DC configurations were digitally connected to a voltmeter to get output voltage values.

PART B:

Part B of this lab was to recreate the circuits in the diagrams above at the laboratory. We only designed the AC configurations for the laboratory part and then used Oscilloscopes and function generators to study the input and output waveforms. The lab setup was as below:

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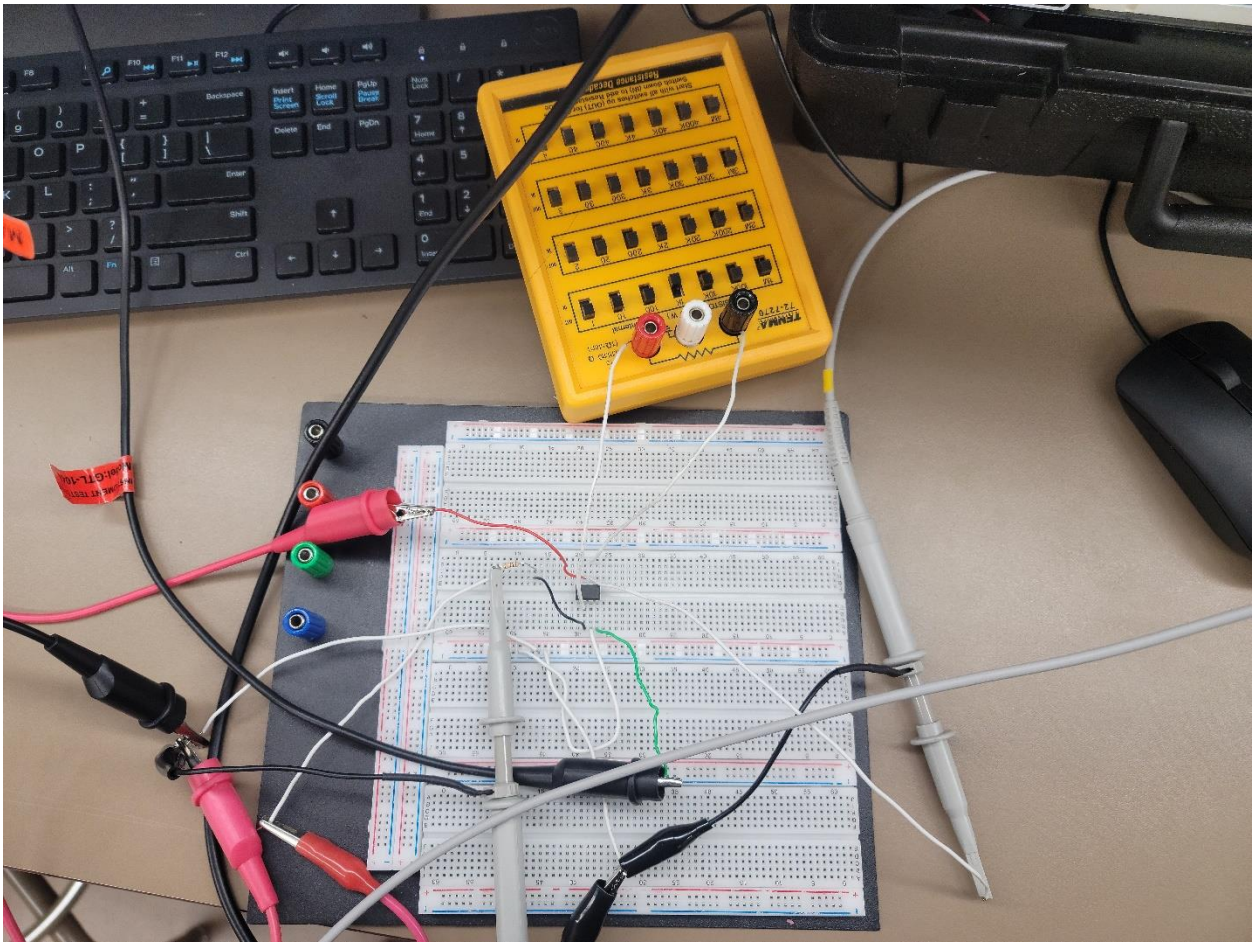
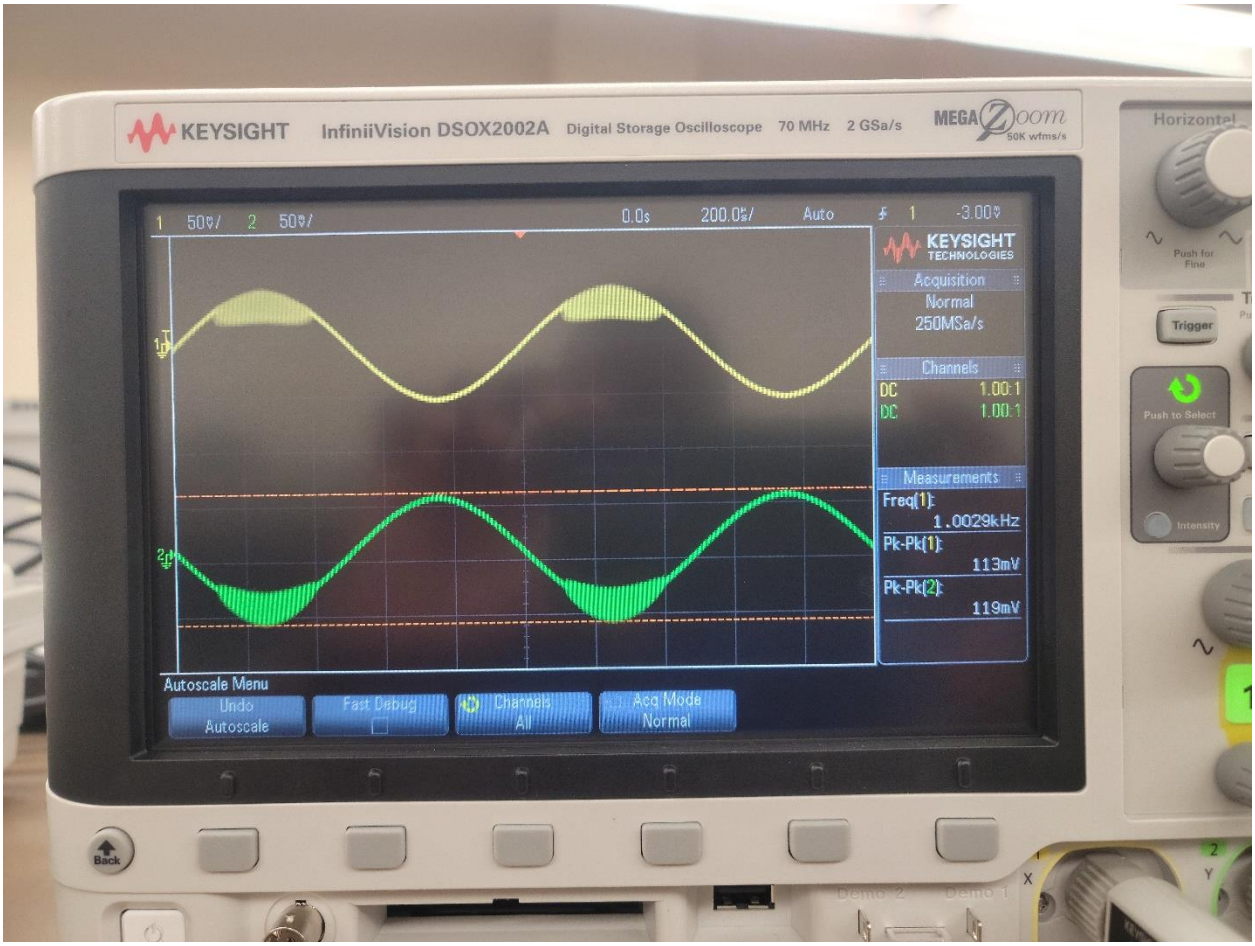
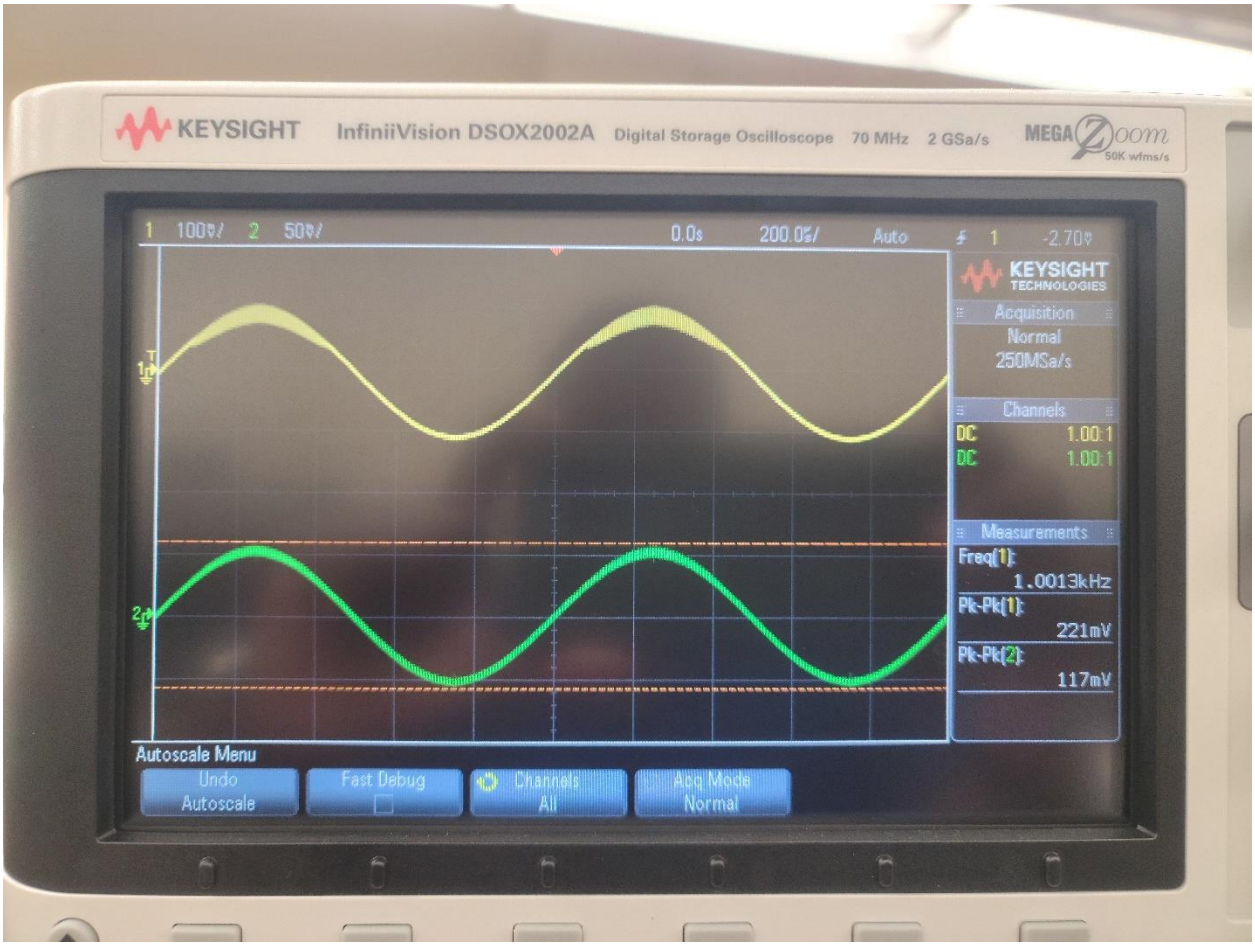


The input and output sine waves generated from the Oscilloscope are as below:

Inverting waveform:



Noninverting Waveform:



The tables below show the values achieved by theoretical, simulated and lab results.

DC source:
Vin = 1V, Rin = 1K

Table 2.1 (Inverting Amplifier)

	Theoretical Results		Multisim Results		Lab Results	
R_F (K)	V_{OUT} (V)	Gain	V_{OUT} (V)	Gain	V_{OUT} (V)	Gain
0.5	-0.5	-0.5	-0.498	-0.498	N/A	N/A
1	-1	-1	-0.998	-0.998	N/A	N/A
2	-2	-2	-1.997	-2	N/A	N/A
3	-3	-3	-2.996	-3	N/A	N/A
4	-4	-4	-3.994	-3.99	N/A	N/A

Table 2.2 (Non-Inverting Amplifier)

	Theoretical Results		Multisim Results		Lab Results	
R_F (K)	V_{OUT} (V)	Gain	V_{OUT} (V)	Gain	V_{OUT} (V)	Gain
0.5	1.5	1.5	1.502	1.5	N/A	N/A
1	2	2	2.002	2	N/A	N/A
2	3	3	3.003	3	N/A	N/A
3	4	4	4.004	4	N/A	N/A
4	5	5	5.005	5	N/A	N/A

AC source:
Vin = 2Vpp, Rin = 1K

Table 2.3 (Inverting Amplifier)

	Theoretical Results		Multisim Results		Lab Results	
R_F (K)	**V_{OUT} (V)**	**Gain**	**V_{OUT} (V)**	**Gain**	**V_{OUT} (V)**	**Gain**
0.5	-1	-0.5	0.997	0.5	0.998	0.499
1	-2	-1	2	1	1.995	1.00
2	-4	-2	3.98	1.99	3.996	1.998
3	-6	-3	5.99	2.99	5.994	2.99
4	-8	-4	7.99	3.99	7.997	3.99

Table 2.4 (Non-Inverting Amplifier)

	Theoretical Results		Multisim Results		Lab Results	
R_F (K)	**V_{OUT} (V)**	**Gain**	**V_{OUT} (V)**	**Gain**	**V_{OUT} (V)**	**Gain**
0.5	3	1.5	3	1.5	2.997	1.497
1	4	2	3.98	1.99	3.999	1.998
2	6	3	5.98	3	6.0	2.999
3	8	4	7.99	4	8.04	4.02
4	10	5	9.99	5	9.994	4.997

We can see that there is not much difference in the values, considering the small margin of error. The DC lab portion of the experiment was not part of this laboratory assignment.