Name: Maxwell Rizzo Date: 1/22/23

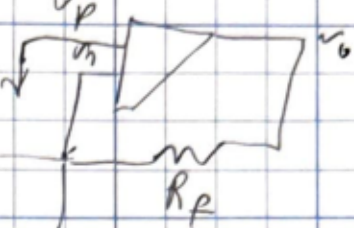
Experiment: 382 OP-AmPS

Pre-Lab:

Q1: Yes, Batteries, and Amplifiers with OP-Amps can Both have voltages without a current.

When input voltages are the same, output at 0volts 0 current.

Also, finite differences along contour



Q2: Yes, current through conducting wire has little to-no voltage drop.

Q3.) Typically 30 to 50 mA. not a lot.

Q4. Feedback into one of the input terminals

Q5 $V_p = V_n$, the two input terminals have equivalent voltage

Q6 An voltage amplifier, limits at a peak ± 15 Volts.

If the ΔV between terminals is too large, reach the op-amp voltage peak.

= comparator.

7.) $V_0 = A_0(V_p - V_n)$ - difference in voltage times gain A_0.

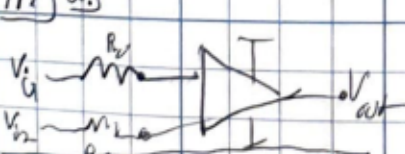
8.) It can be, as long as the difference in voltage between the two is small.

9.)

Both inverting & non-inverting summers attenuate the input voltage

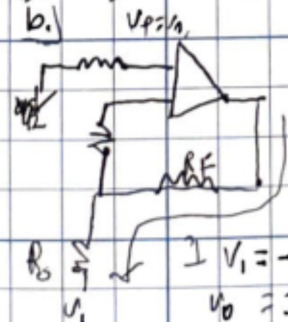
10.) Linearity. $T x' = T(x_1) + T(x_2) = T(x_1 + x_2)$ $x' = x_1 + x_2$

11.) a.)



$$\boxed{V_{out} = A_0(V_2 - V_1)}$$

b.)



I $V_1 = -IR_s$ $-IR_F$

$V_0 = IR_F$

$$\boxed{\frac{V_0}{R_F} = \frac{-V_1}{R_S} \qquad \frac{V_0}{V_1} = \frac{-R_F}{R_S}} = \frac{-R_2}{R_1}$$

Important: Place card under blue copy.

Name: Maxwell Rizzo   Date:

Experiment: OP - AMPS

1] Comparator

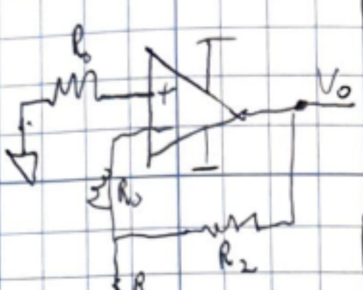
V_1	V_2	V_0(th)	Measured V_1	V_2	V_0
5.00	4				
4.20	11				
4.05					
3.95					
3.85					
3.80					
3.00					

Negatives V_{1,V_2}

Expect

$V_0 = A_0(\cancel{V_2 - V_1})$
$= A_0(V_1 - V_2)$

2] Inv. Amp

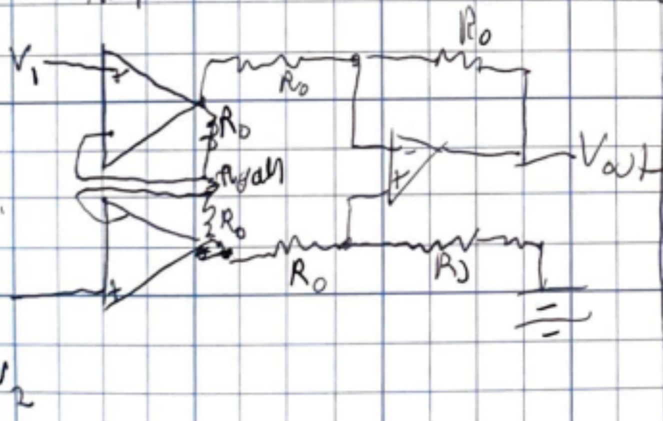


$V_i = -I R_1$
$V_0 = I R_2$

V_{in}	V_0(Th.)	Measured V_{in}	V_{out}
2.00V			
1.50V			
.7			
.5			
.1			
-.1			
-.5			
-.7			
-1.5			
-2.0			

$\frac{V_0}{R_2} = -\frac{V_1}{R_1}$, $\frac{V_0}{V_1} = -\frac{R_2}{R_1}$

3] Instrumental Amp



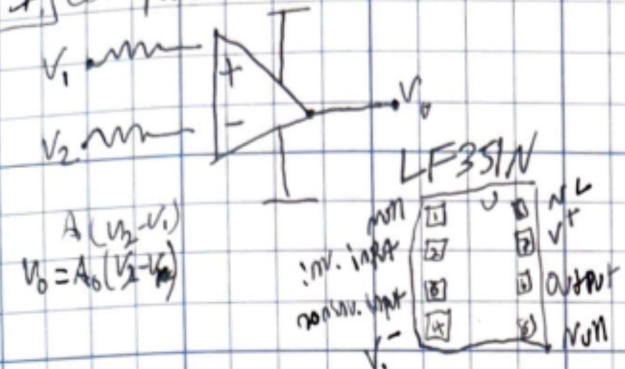
target ΔV_{in}	expected ΔV_0	Measured V_1	V_2	ΔV_{in}	ΔV_0
100mV					
50mV					
20					
10					
1					
-1					

QB] 1 switches, - Make plots
2 Does
3 work

Name: Max Rizzo Date: 1/23/23

Experiment: OP-Amps

1 | Comparator



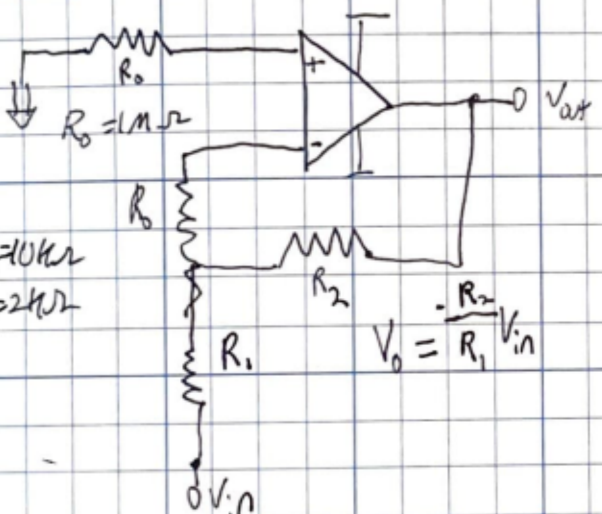
$A(V_2 - V_1)$

$V_0 = A_0(V_2 - V_1)$

			Measured		
V_1(Th.)	V_2(Th.)	V_0(Th.)	V_1	V_2	V_0
5.00	4.00	~~-7.63~~	5.00	4.004	-7.63
4.20	"		4.20	"	-7.57
4.05			4.05		-7.50
3.95			3.95		8.51
3.85			3.85		8.50
3.80			3.80		8.50
3.00	"		2.99		8.49
-5.00	-4.00		-5.00	-4.00	8.50
-4.20	"		-4.20	"	8.50
-4.05			-4.06		8.50
-3.95			-3.95		-7.51
-3.85			-3.85		-7.56
-3.80	"		-3.80		-7.57
-3.00			-3.00		-7.63

1 Data collection went well, Data symmetric.
Looks like Op-Amp max is 8.5 V.
V_0 Flips sign when $V_2 \geq V_1$, equal voltages.
Next day will do 2 & 3

2 | Inverting Amplifier



$R_2 = 10k\Omega$

$R_1 = 2k\Omega$

$$V_0 = \frac{-R_2}{R_1} V_{in}$$

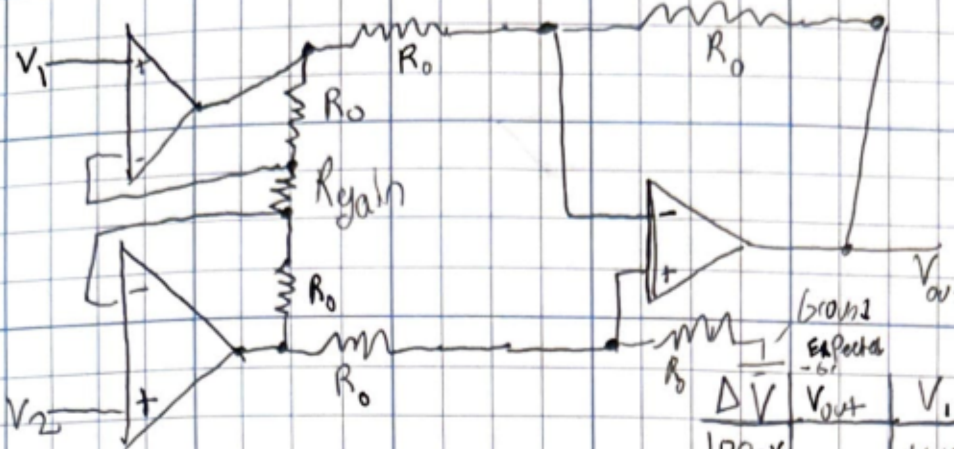
Theory		Measured	
V_{in}(Th.)	V_{out}(Th.)	V_{in}	V_{out}
2.00		1.970	-7.37
1.50		1.532	-7.29
0.7		.739	-3.62
0.5		.514	-2.51
0.1		.1035	-0.50
-0.1		-.1022	0.49
-0.5		-.508	2.48
-0.7		-.693	3.34
-1.50		-1.502	7.35
-2.00		-2.001	8.11

JR7 1/23/23

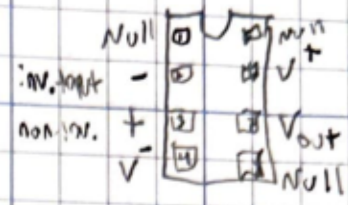
Name: OPAMPS Date: 1/30/23 36

Experiment: OPAMP

Instrumental Amplifier Circuit



More LF351N



$R_0 = 1\,M\Omega$

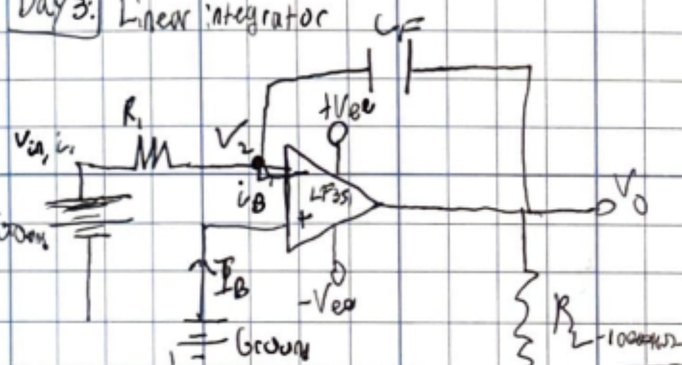
$R_g = 20\,k\Omega$

$$\text{gain } A = \frac{V_{out}}{\Delta V} = \left(1 + \frac{2R_0}{R_{gain}}\right)$$

will

ΔV	V_{out} (Expected)	V_1	V_2	$V_2 - V_1$ (ΔV)	V_{out}
100mV		4.172	4.272		8.50
50		4.224	4.272		8.50
20		4.240	4.272		6.14
10		4.265	4.272		5.42
1		4.276	4.272		3.46
-1		4.282	4.272		3.00
-15		4.240	4.272		0.9
-20		4.240	4.272		0.43
-50		4.327	4.272		-3.41
-100mV		4.375	4.272		-7.57

Day 3: Linear integrator



$$V_0 = -\frac{1}{R_1 C_F}\int_0^t V_{in}\,dt$$

~~$R_1 = R_2 = 10\,k\Omega$, $C_F = 47\,nF$~~ 100pF

$R_1 = R_2 = 10\,k\Omega$, $C_F = 100\,pF$

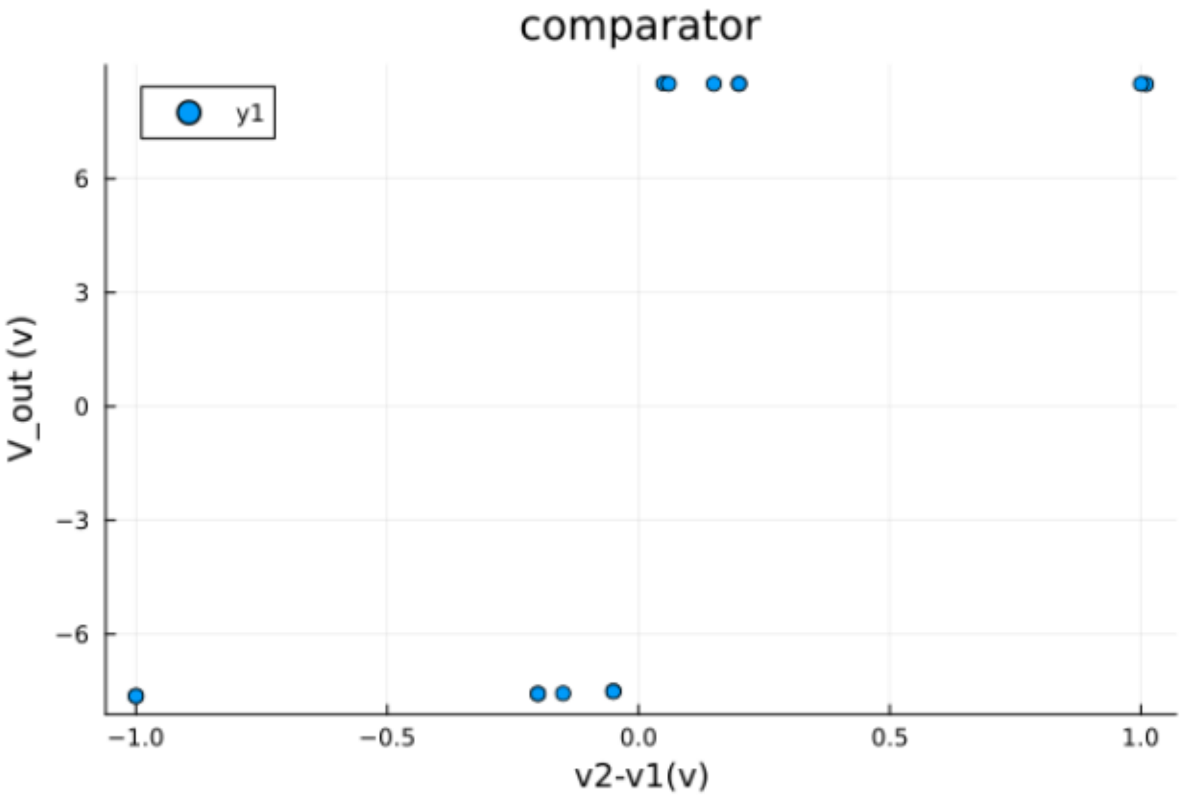
will

Input	Output 14.4/2
~~Ground~~ Square 15 kHz, 90mV	Triangle, ~~240mV~~ amp, Same Freq
Square 21 kHz, 130mV	Triangle, 14.4/2 V, Same Freq
Sine 21 kHz, 130mV	Cosine, 11.4/2, Same Freq
Sine 71 kHz, 130mV	cosine, 4.60/2, Same Freq
Sine 41 kHz, 130mV	cosine, 6.60/2, Same Freq
Triangle 41 kHz, 130mV	Sine, 5.20/2, Same Freq

Overall, good Results. Plots and images of circuits will be attached to the PDF. No Plot for integrator, Just paired behavior to integral output. Frequency matches, shape matches integral.

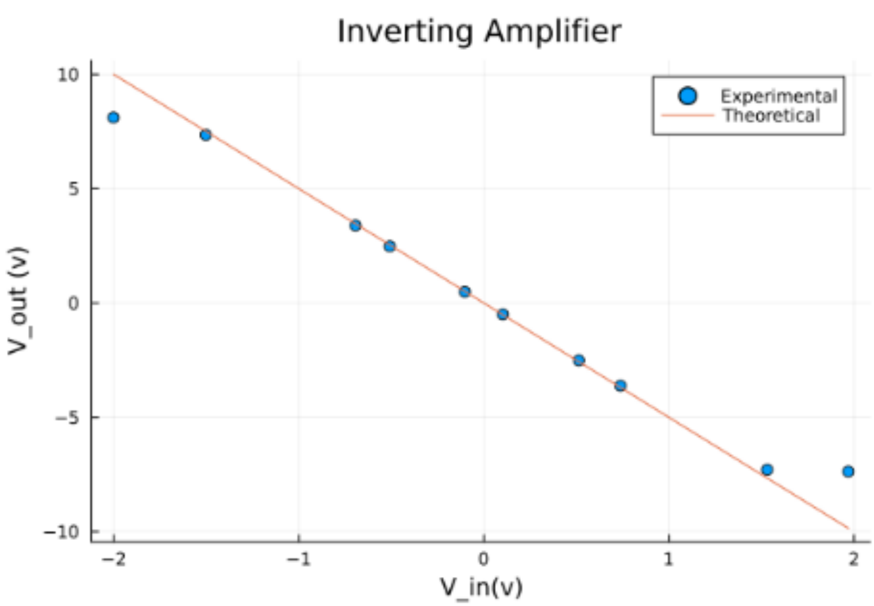
Phys382 Lab Notes - Op Amp - Maxwell Rizzo

1. Comparator

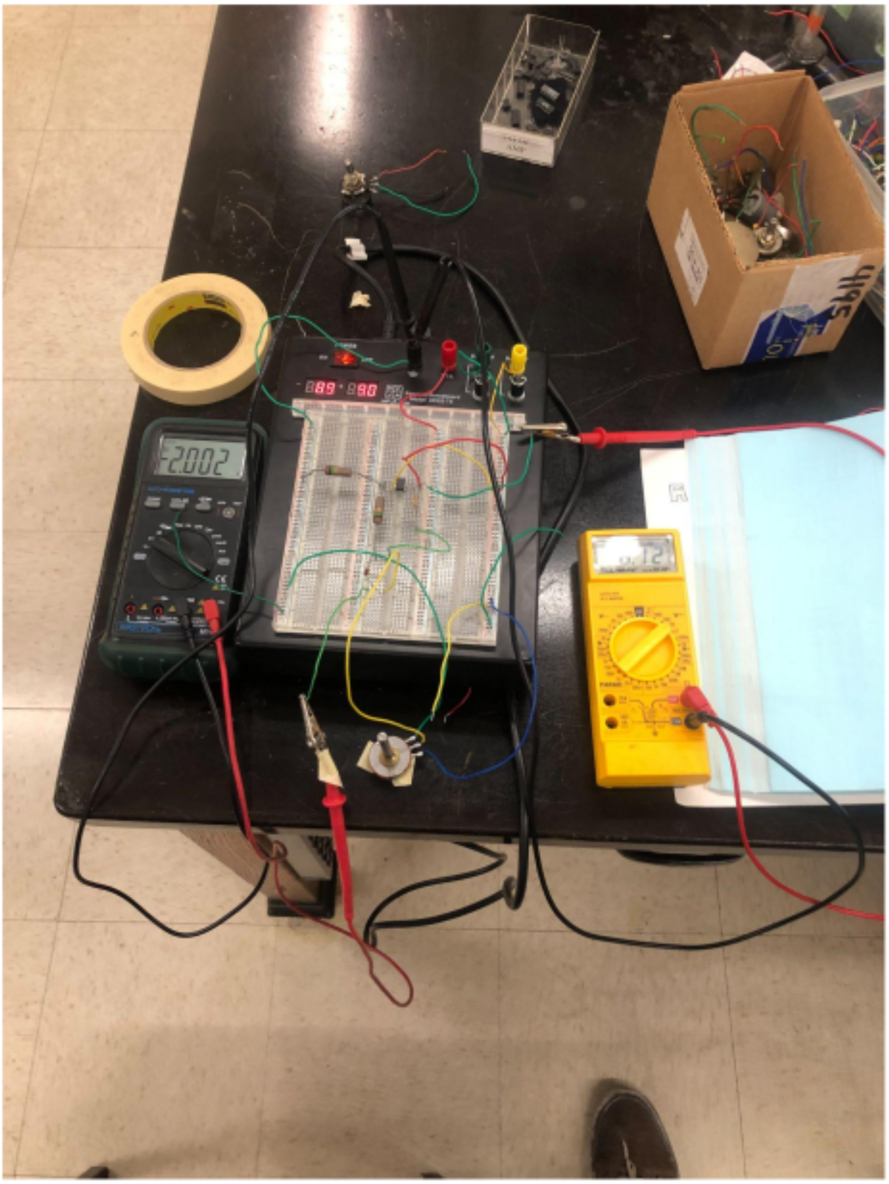


Op-Amp rails out instantly, step function. Expected result.

2. Inverting Amp

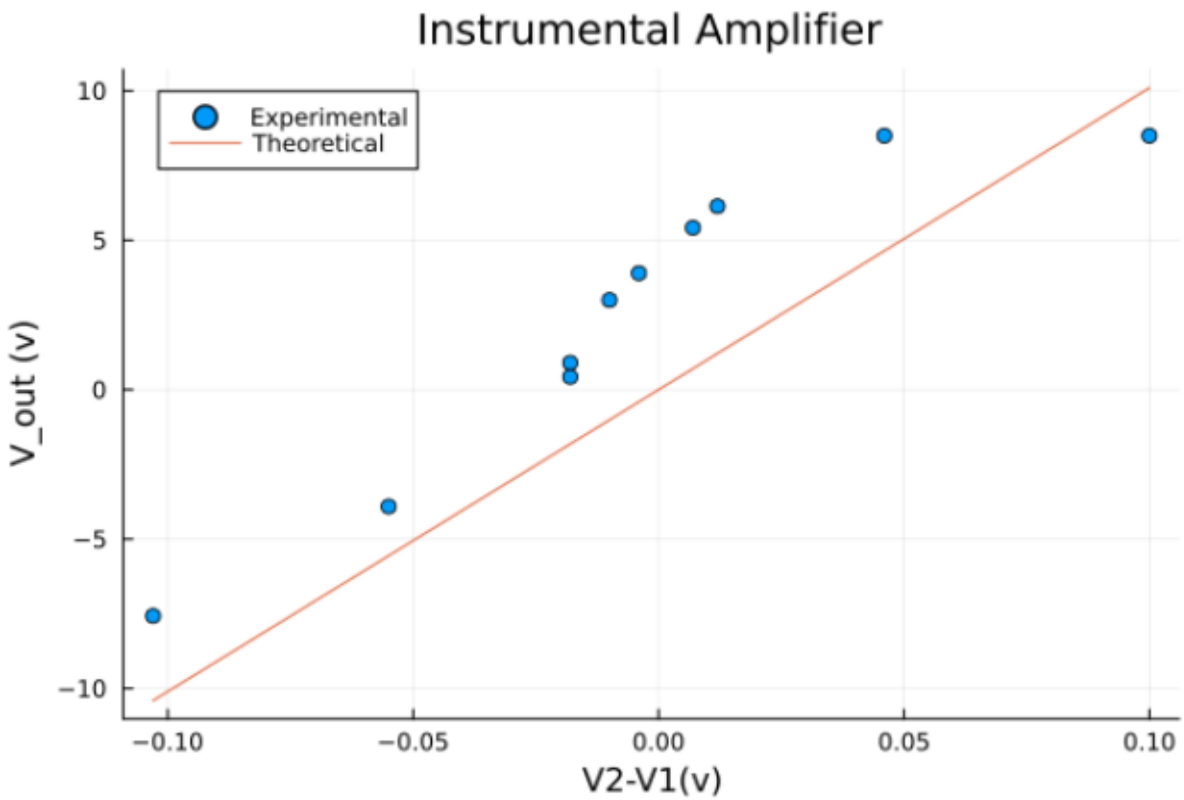


Data matches the theoretical model very closely, good data.



Inverting Amplifier Circuit setup

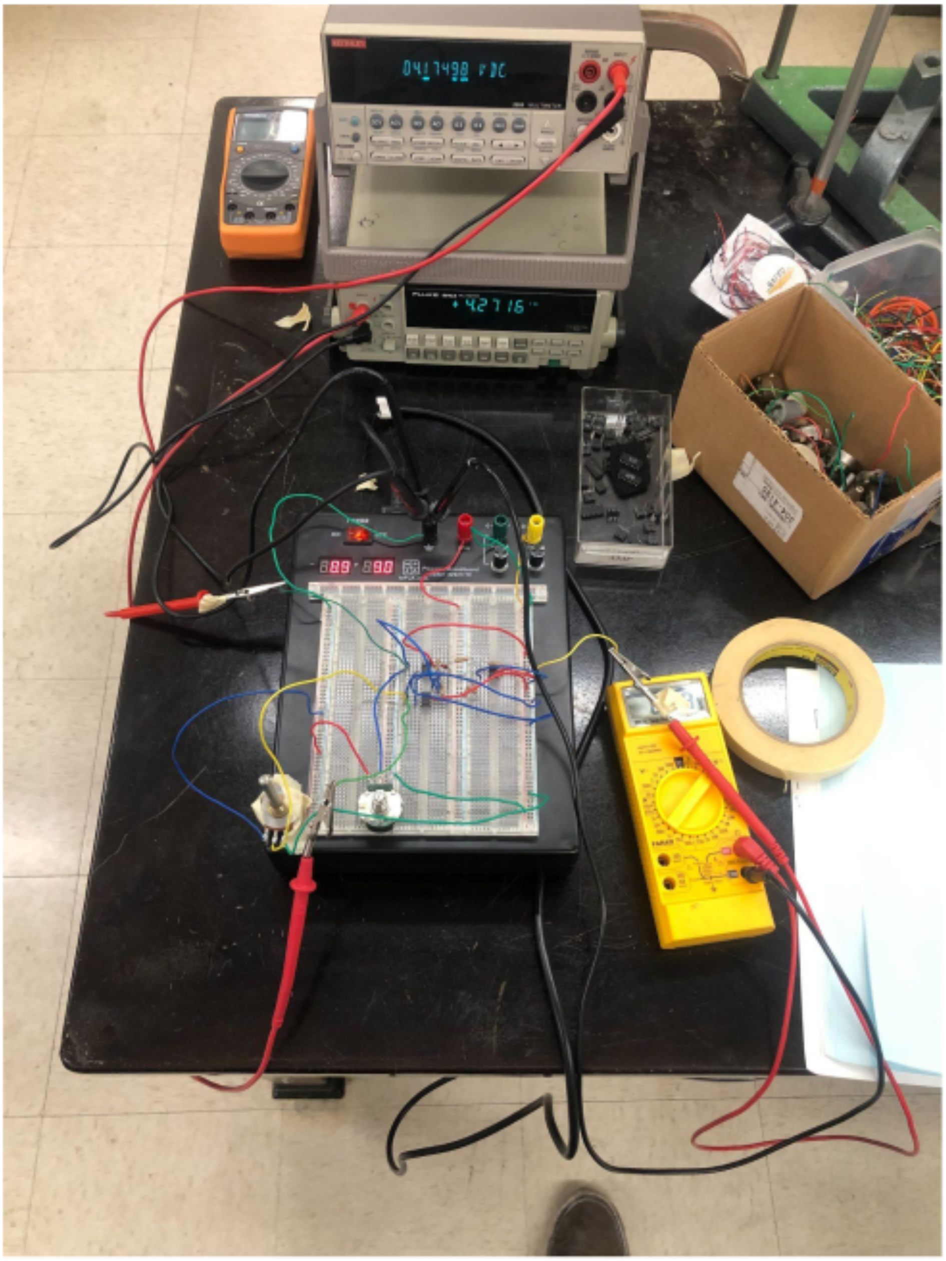
3. Instrumental Amplifier



Experimental data matches theoretical model closely again, good data. Apparatus photo on next page.

4. Linear Integrator

No plot made, qualitative behavior and response recorded and detailed in lab notebook.



Apparatus for Instrumental amplifier