Lab 2 pre-lab

- part of the pre-lab is to do all calculations of the ~~la~~ lab. Tables of each section will be made now, then measured data will be filled in.

The purpose of this lab is to understand Operational Amplifier (OP-Amp) datasheets and to construct ~~four~~ four types of Op-amp circuits

1) A Buffer
2) a Comparator
3) An Inverting Op-Amp
4) a summing Op-amp

Parameter	Specified Value			units
	min	Typical	Max	
Input offset voltage, V_{os}		5	10	mV
Input bias current, I_{BIAS}		50	200	pA
Input offset current, I_{os}		25	100	pA
CMRR	70	~~90~~ 100		dB
Slew rate	8	13		V/µs

Tools

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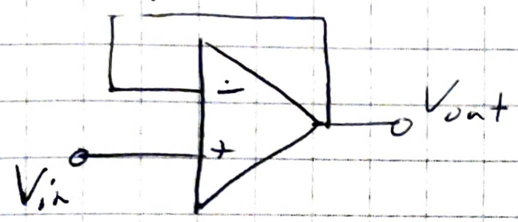
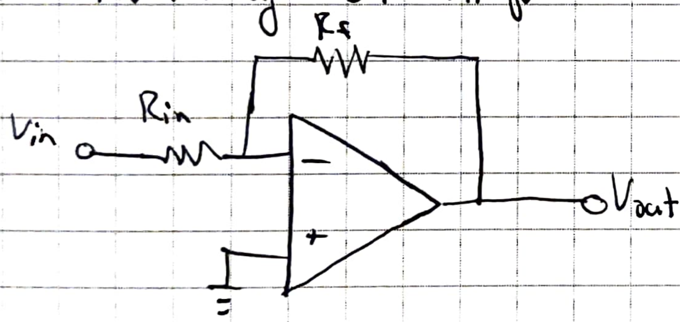
1) ~~Y~~Buffer



Vin (volts)	Vout ~~Vout~~ Calculated	Measured
+2.0	+2.0	
-2.0	-2.0	
5	5	
+7.0	+7.0	

$V_{out} = V_{in}$

2) Inverting OP-Amp



$V_{out} = -\frac{V_{in}}{R_{in}} \cdot R_f$

Vin (volts)	Vout Calculated	Measured
+0.2	~~[illegible]~~ -1	
-0.3	1.5	
0	0	
+0.32	-1.6	
+0.3	~~-2.4~~ -.72	
-0.25	~~3.6~~ 0.6	
-0.2	~~8~~ 0.48	
+0.4	~~-3.84~~ ~~-.88~~	
	-0.96	

$R_{in} = 2K\Omega$

$R_f = 10K\Omega$

$V_{out} = -V_{in}\left(\frac{10K\Omega}{2K\Omega}\right)$

$R_{in} = \cancel{2K\Omega}\ 10K$

$R_f = 24K\Omega$

$V_{out} = -V_{in}\left(\frac{24K\Omega}{\cancel{2K\Omega}\ 10K\Omega}\right)$

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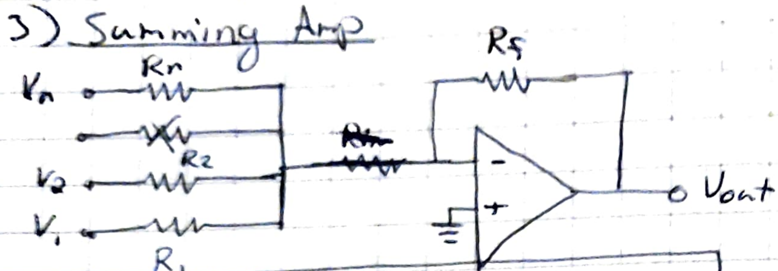
3) Summing Amp



$V_o = I_{Rf} \cdot R_f$

$R_1, R_2, R_n = 20\,K\Omega$

$I_{Rf} = \Sigma I_n$

~~Rm~~

$R_f = 20K\Omega$

calc	Input Voltages V_1	V_2	V_3	Vout Calculated	Vout Measured
1	+1	+1	+1	3V	
2	-1	-1	+1	-1V	
3	-1	-1	+2	0 ~~-1.8V~~	
4	+3	-3	-3	-3V ~~3V0~~	
5	-2	+1	-2	-3V	

1) $I_{R_1} = \frac{1}{20K} =$ ~~.05mA~~ $.05\,mA$

$I_{R_2} = \frac{1}{20K} = 0.05\,mA$

$I_{R_3} = \frac{1}{20K} = 0.05\,mA$

$I_{RF} = 0.15\,mA$

$V_o = (0.15\,mA)(20\,K\Omega) = \underline{3V}$

2) $I_{R_1} = \frac{-1}{20K} = -0.05\,mA$

$I_{R_2} = \frac{-1}{20K} = -0.05\,mA$

$I_{R_3} = \frac{+1}{20K} = 0.05\,mA$

$I_{RF} = -0.05\,mA$

$V_o = (-0.05\,mA)(20\,K\Omega) = \underline{-1V}$

3) $I_{R_1} = -\frac{1}{20K} = -0.05\,mA$

$I_{R_2} = \frac{-1}{20K} = -0.05\,mA$

$I_{R_3} = \frac{2}{20K} = 0.1\,mA$

$I_{RF} = \cancel{-0.09\,mA}\ 0$

$V_o = (-0.09\,mA)(20\,K\Omega) = \cancel{-1.8V}\ 0$

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4] $I_{R_1} = \frac{3}{20K} = \cancel{0.15\,mA}$ $.15\,mA$

$I_{R_2} = \frac{+3}{20K} = \cancel{0.15\,mA}$ $-.15\,mA$

$I_{R_3} = \frac{-3}{20K} = \cancel{-0.15\,mA}$ $-.15\,mA$

$\cancel{I_{RF} = 0.016}$

$I_{RF} = -0.15\,mA$

$V_o = (-0.15\,mA)(20\,k\Omega) = \underline{-3V}$

5] $I_{R_1} = \frac{-2}{20K} = -0.1\,mA$

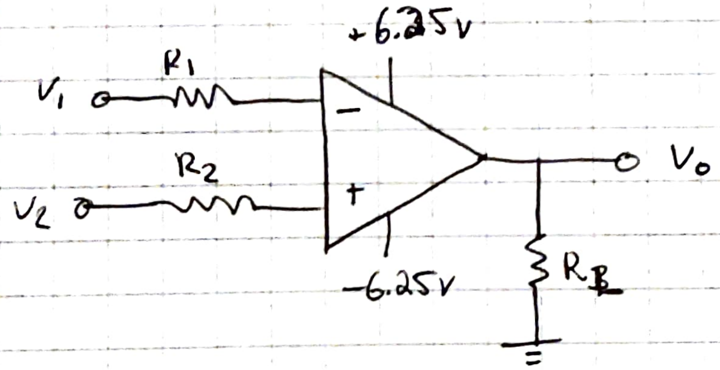
$I_{R_2} = \frac{1}{20K} = 0.05\,mA$

$I_{R_3} = \frac{-2}{20K} = -0.1\,mA$

$I_{RF} = \cancel{0.03\,mA}$ $-0.15\,mA$

$V_o = (\cancel{0.03\,mA})(20\,k\Omega) = \underline{-3V}$
$-0.15\,mA$

4) Comparator



$R_1 = R_2 = 10\,k\Omega$
$R_L = 10\,k\Omega$

Input		Output	
V_1 (−)	V_2 (+)	Calculated	measured
+4	+1	−5V	
+2	+3	5V	
+1	0	−5V	
+4	+4	0	
0	+1	5V	
+3	+2	−5V	

- If (−) > (+) ; $V_o = -5V$
- If (−) < (+) ; $V_o = 5V$
- If both the same, $V_o = 0V$

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