	Simulation		Hand Analysis	
	Stage 1	Stage 2	Stage 1	Stage 2
I_C	93.34μA	47.21μA	94μA	47μA
I_B	888.6nA	502nA	900nA	500nA
I_E	94.23μA	47.72μA	95μA	48μA
V_C	12.67V	12.64V	12.7V	12.6V
V_B	2.485V	2.492V	2.5V	2.5V
V_E	1.885V	1.909V	2V	2V
Gain	10μV/V	14μV/V	10μV/V	14μV/V

Full circuit Gain = 85

Rin:

$$I_{in} = \frac{2.485197250 - 2.484309802}{1k}$$

$$= 888.23nA$$

$$R_{in} = \frac{2.484309802}{888.23nA}$$

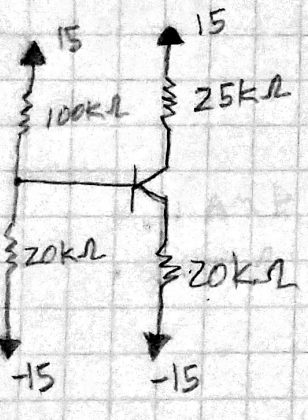
$$= 2.796 M\Omega$$

Rout:

$$= \frac{12.6396 - 87.4\mu V}{87.4\mu V} \cdot 50k$$

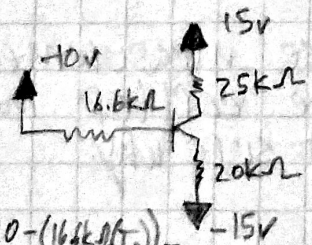
$$= 7.23^{10}\Omega$$

Stage 1



$$V_{Th} = \frac{(15_V(20k\Omega)) - (15_V(100k\Omega))}{100k + 20k} = -10V$$

$$R_{Th} = \frac{100k \cdot 20k}{100k + 20k} = 16.6k\Omega$$



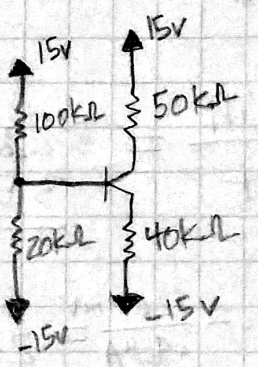
$$V_{B_1} = -10 - (16.6k\Omega(I_B)) = 2.5V$$

$$V_{E_1} = 2V$$

$$V_{C_1} = 15 - I_C(25k\Omega) = 12.7V$$

$$V_E = -15V$$

Stage 2



$$V_{Th} = \frac{15(20k) - 15(100k\Omega)}{100k\Omega + 20k\Omega}$$

$$= -10V$$

$$R_{Th} = 16.6k\Omega$$

$$-10 - I_B(16.6k) - 0.7 - I_E(40k) + 15 = 0$$

$V_{E_2} = 2V$ $I_{E_2} = 148\mu A$

$V_{B_2} = 2.5V$ $I_{B_2} = 500nA$

$V_{C_2} = 12.6V$ $I_{C_2} = 47\mu A$

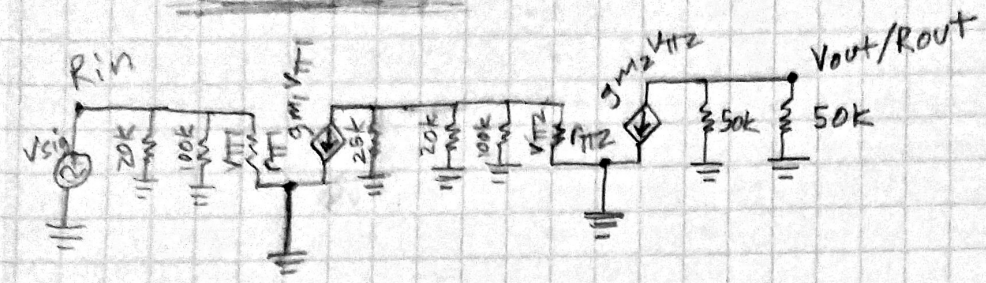
$$-10 - I_B(16.6k\Omega) + 15 = .7 - I_E(20k\Omega) = 0$$

$$I_{E_1}\left(\frac{16.6k\Omega}{101} - 20k\Omega\right) = -4.3 \equiv 295\mu A$$

$$I_{B_1} = \frac{I_E}{101} = 900nA$$

$$I_{C_1} = 94\mu A$$

Full circuit



$$V_{out} = \frac{(g_{m2}V_{\pi 2})(50k)}{50k+50k}(50k)$$

$$R_{out} = 50k \parallel 50k = 25k\Omega$$

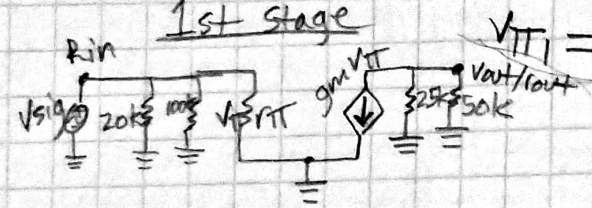
$$R_{in} = (20k \parallel 100k) \parallel r_{\pi 1} = \frac{16.6k(r_{\pi 1})}{16.6k + r_{\pi 1}}$$

★ Dont know how to find exact values without any given variables.

$$V_{\pi 2} = \frac{(g_{m1}V_{\pi 1})(100k \parallel r_{\pi 2})}{25k \parallel 20k + 100k \parallel r_{\pi 2}}$$

$$V_{\pi 2} = \frac{(g_{m1}V_{\pi 1})\frac{(100k)(r_{\pi 2})}{100k+r_{\pi 2}}}{11.11k + \frac{(100k)(r_{\pi 2})}{100k+r_{\pi 2}}}$$

1st Stage



$$V_{\pi 1} = V_{sig}$$

$$V_{out} = \frac{(g_m V_\pi)(25k)}{75k}(50k)$$

$$V_\pi = V_{sig}$$

$$\frac{V_{out}}{V_{sig}} = \frac{(g_m)(25k)}{75k}(50k)$$

$$\frac{V_{out}}{V_{sig}} = \left(g_{m2}\left(\left((g_{m1})\frac{(100k)(r_{\pi 2})}{100k+r_{\pi 2}}\right) \parallel 11.11k + \frac{(100k)(r_{\pi 2})}{100k+r_{\pi 2}}\right)50k\right)\frac{}{100k}$$

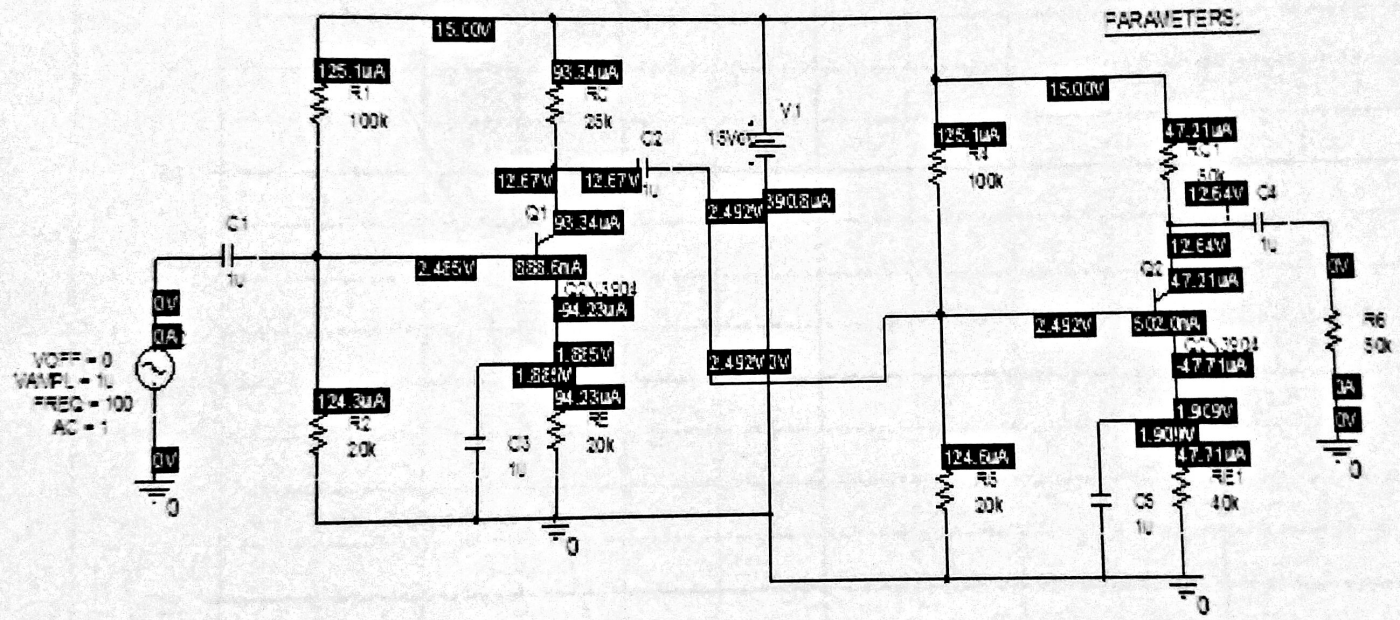
2nd Stage

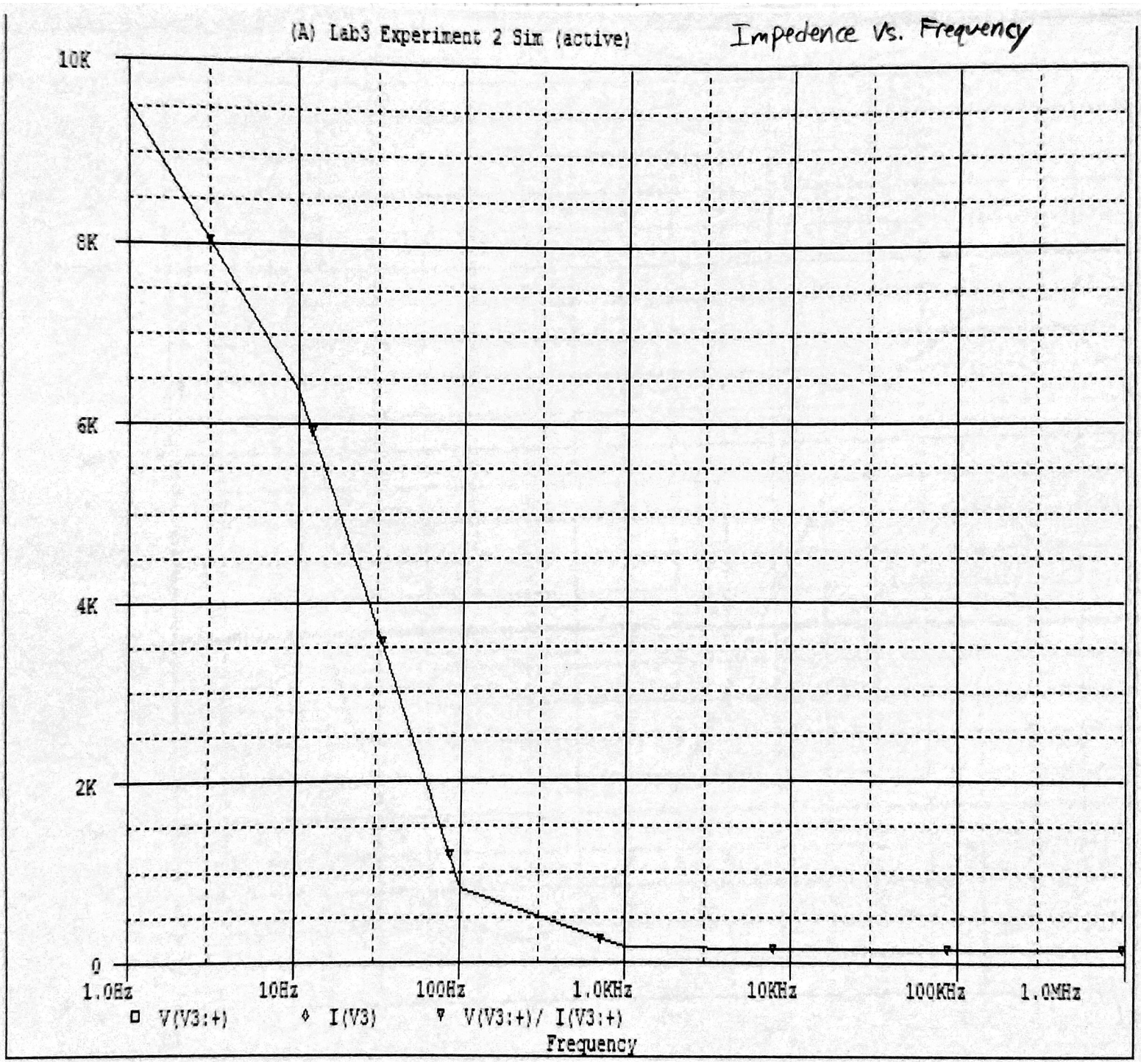
$$V_\pi = V_{sig}$$

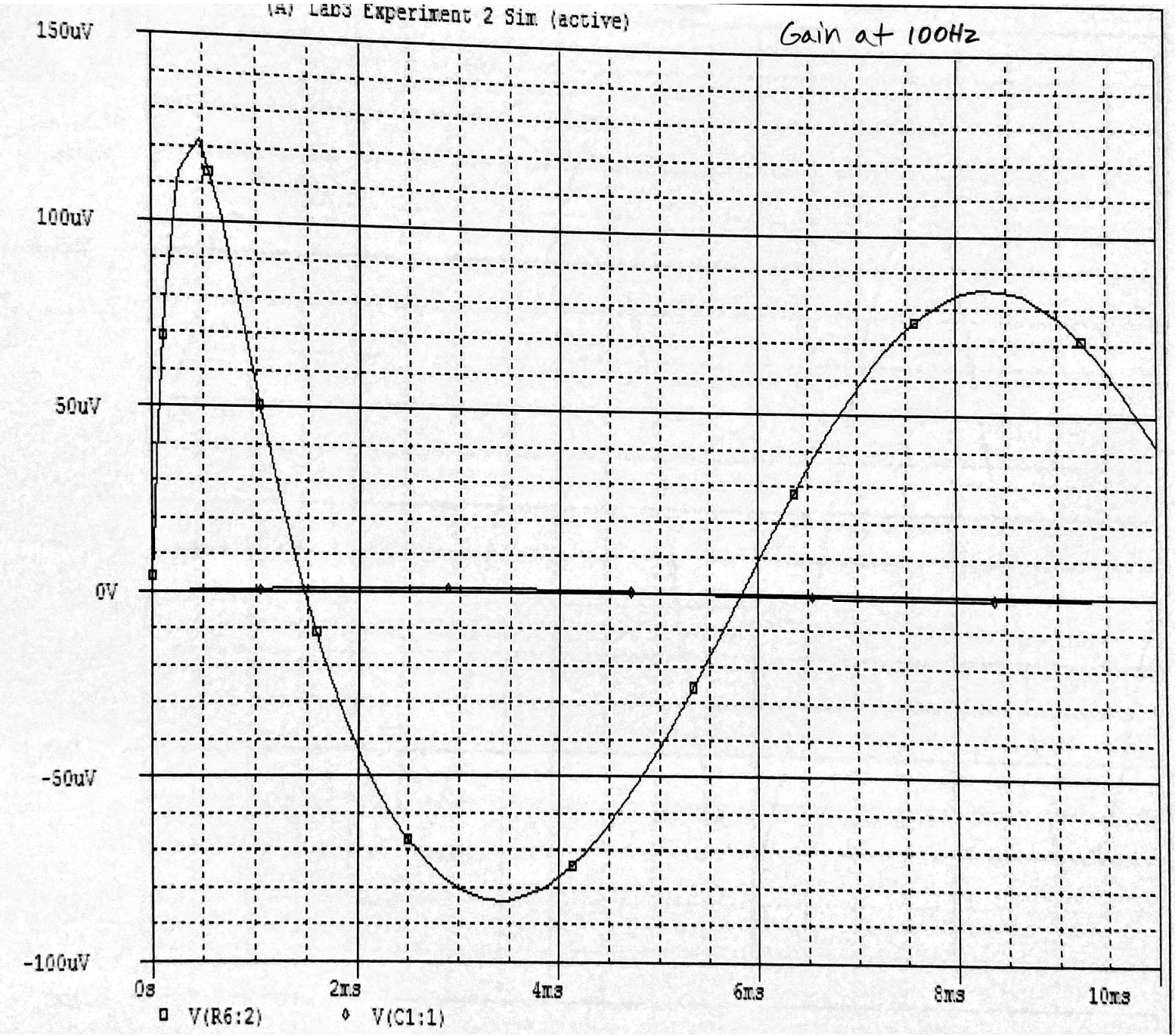
$$V_{out} = \frac{(g_m V_\pi)\,50k}{100k}50k$$

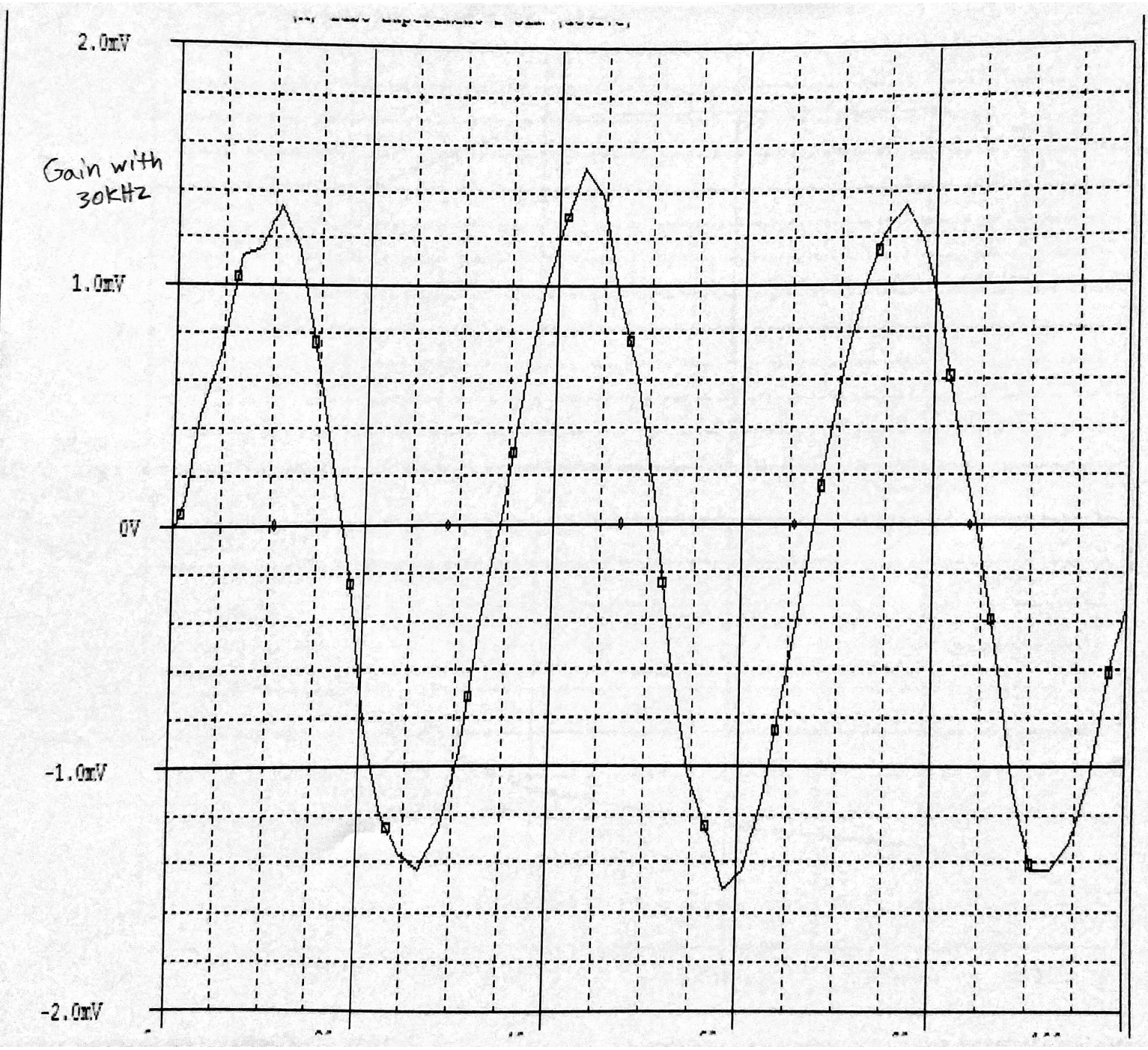
$$\frac{V_{out}}{V_{sig}} = \frac{(g_m)\,50k}{100k}50k$$

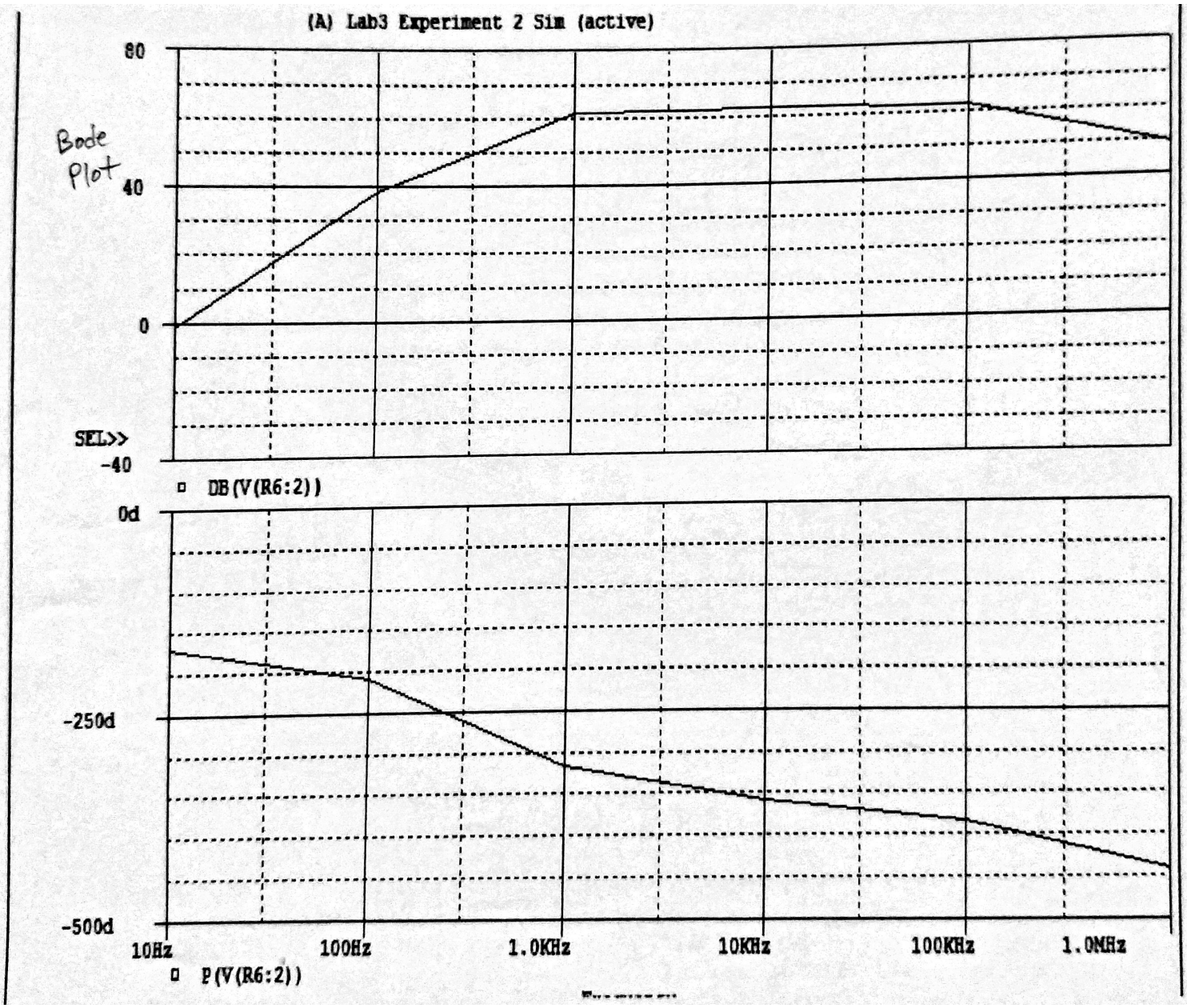
Verification of DC voltages and currents for active mode.




(A) Lab3 Experiment 2 Sim (active)
Impedence Vs. Frequency
10K
8K
6K
4K
2K
0
1.0Hz
10Hz
100Hz
1.0KHz
10KHz
100KHz
1.0MHz
V(V3:+)
I(V3)
V(V3:+)/ I(V3:+)
Frequency


(A) Labs Experiment 2 Sim (active)
Gain at 100Hz
150uV
100uV
50uV
0V
-50uV
-100uV
0s
2ms
4ms
6ms
8ms
10ms
V(R6:2)
V(C1:1)


2.0mV
Gain with
30KHz
1.0mV
0V
-1.0mV
-2.0mV


(A) Lab3 Experiment 2 Sim (active)
80
Bode Plot
40
0
SEL>>
-40
DB(V(R6:2))
0d
-250d
-500d
10Hz
100Hz
1.0KHz
10KHz
100KHz
1.0MHz
P(V(R6:2))

Parts needed:

3x 20kΩ
0.1μF
1μF
25kΩ
100kΩ
2x 50kΩ
40kΩ

Measurements

	BJT 1			BJT 2		
	E	B	C	E	B	C
Voltage						
Current						

Measurements:

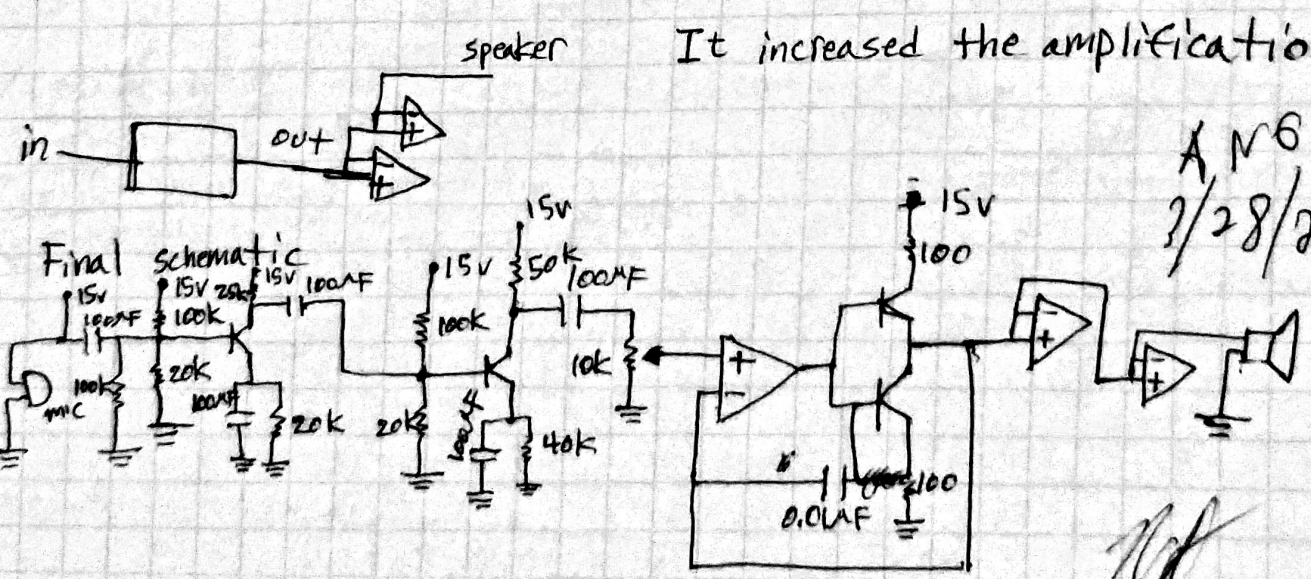
	Stage 1	Stage 2
I_C	100μA	50μA
I_B	1μA	.5μA
I_E	100μA	50μA
V_C	1.82V	11V
V_B	12.83V	14.55V
V_E	13.46V	15V
Gain	~~20~~ 30	20

For better sound, I increased capacitor values from 1μF to 100μF for all capacitors.

Im not entirely sure if I did measurements correct but between 100-30k frequency I was getting an audible sound.

I added an op-amp at the end before out put to speaker:

It increased the amplification.



AM6
3/28/2016