# EEEN203 Lab 6

## Experimental Procedure

Expected Gain

$$G = 1 + \frac{R_2}{R_1}, \qquad R_1 = 0.9956\ k\Omega, R_2 = 9.995\ k\Omega$$

$$G = 1 + \frac{9.995}{0.9956} = 11.0392 \approx 11$$

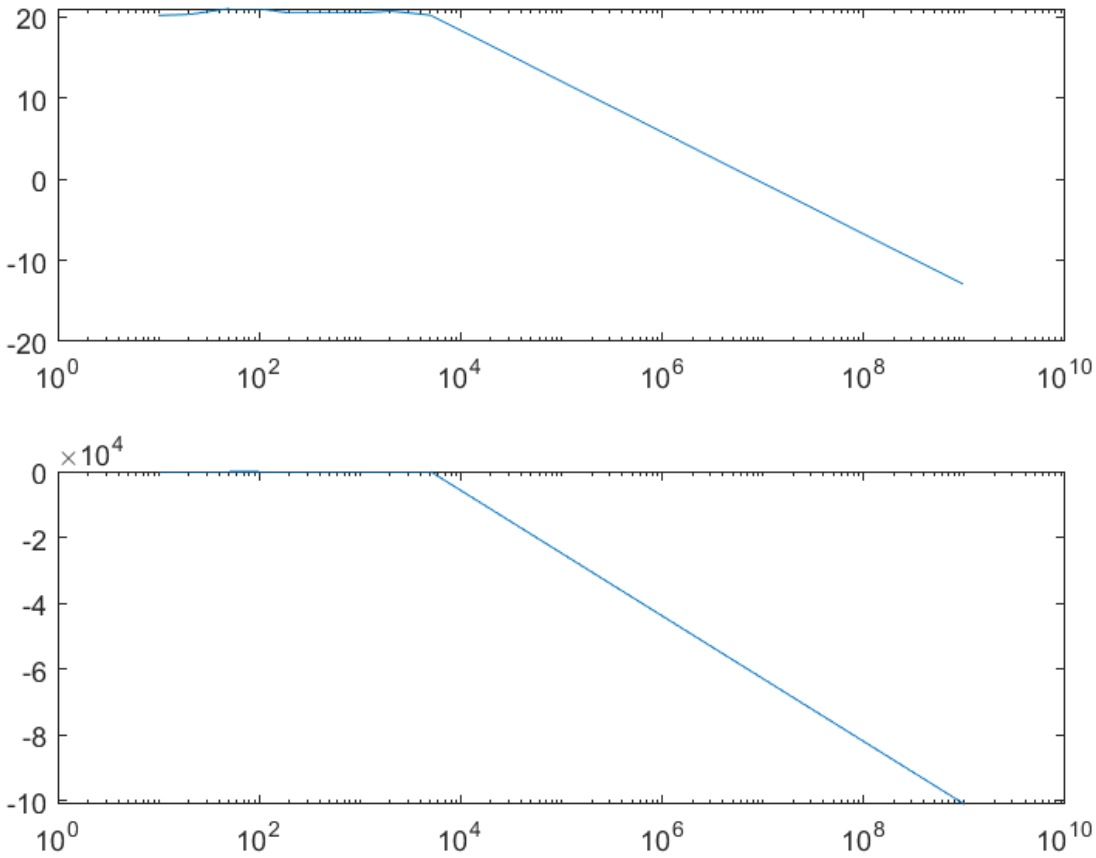
Measured voltage source

$$V^+_{measured} = 12.000$$
$$V^-_{measured} = -12.004$$

Oscilloscope measurements for $R_2 = 10\ k\Omega$

| In Amp | f | $\lvert V_i \rvert$ | $\lvert V_o \rvert$ | Gain | Gain | Period, T | $t_{delay}$ | Phase delay |
|---|---|---|---|---|---|---|---|---|
| mV | [Hz] | [V] | [V] | | [dB] | [s] | [s] | [degrees] |
| 250 | 10 | 0.168 | 1.72 | 10.23809 | 20.2044 | 0.1 | $-267\mu s$ | -3.62 |
| 300 | 20 | 0.216 | 2.24 | 10.3703 | 20.3159 | 0.5 | $-200\mu s$ | -1.44 |
| 500 | 50 | 0.256 | 2.88 | 11.25 | 21.0231 | 0.2 | $-40\mu s$ | -1.08 |
| 500 | 100 | 0.256 | 2.88 | 11.25 | 21.0231 | 0.01 | $20\mu s$ | 0.720 |
| 500 | 200 | 0.272 | 2.88 | 10.5882 | 20.4965 | 0.05 | $-35\mu s$ | -1.44 |
| 500 | 500 | 0.272 | 2.88 | 10.5882 | 20.4965 | 0.02 | $-15\mu s$ | -2.70 |
| 500 | 1 k | 0.272 | 2.88 | 10.5882 | 20.4965 | 0.001 | $-3.50\mu s$ | -1.26 |
| 500 | 2 k | 0.272 | 2.96 | 10.5882 | 20.4965 | 0.005 | $-2.52\mu s$ | -1.83 |
| 500 | 5 k | 0.288 | 2.96 | 10.2233 | 20.2380 | 0.002 | $-2.20\mu s$ | -3.94 |
| | 100k | | | | | | | |
| | 200k | | | | | | | |
| | 500k | | | | | | | |
| 1100 | 1 M | 0.6 | 0.134 | 0.2233 | -13.0209 | 0.000001 | $-281ns$ | -100 |

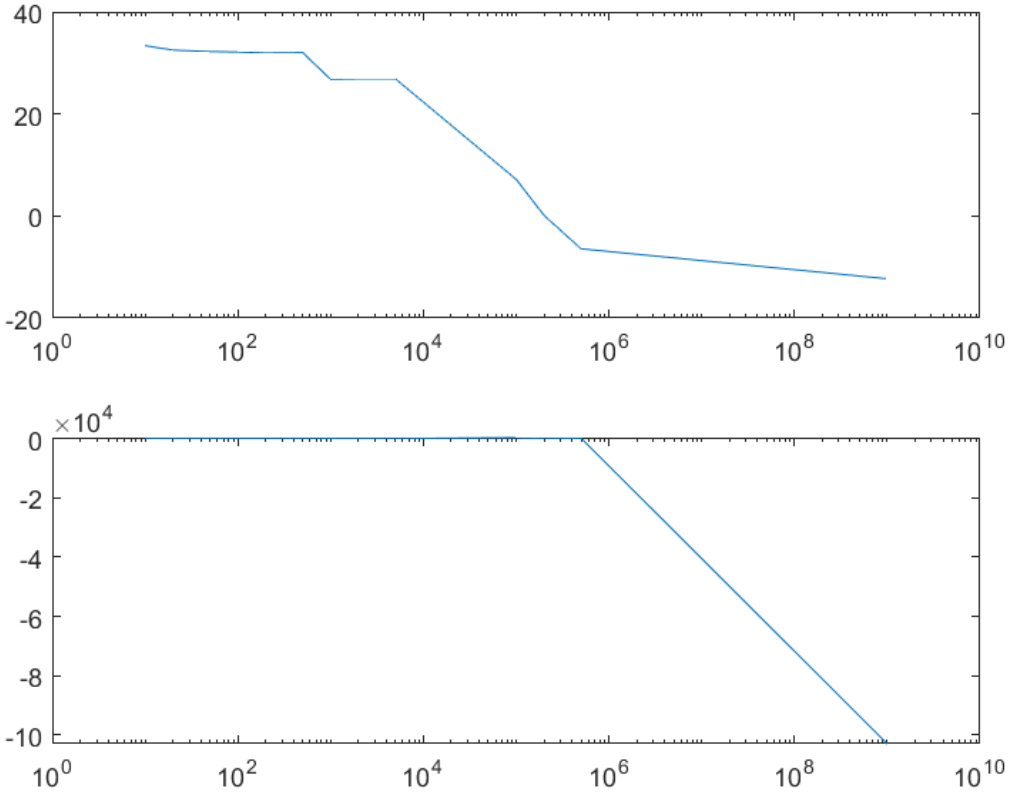
Frequency Response Graph for $R_2 = 10\ k\Omega$




Oscilloscope measurements for $R2 = 100\ k\Omega$

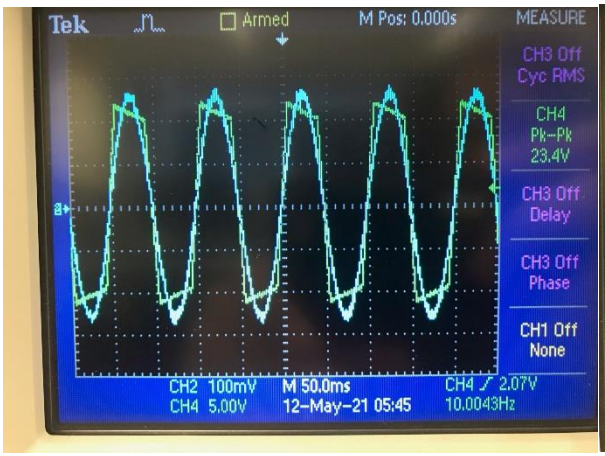
| In Amp | f | $\|V_i\|$ | $\|V_o\|$ | Gain | Gain | Period, T | $t_{delay}$ | Phase delay |
|---|---|---|---|---|---|---|---|---|
| mV | [Hz] | [V] | [V] | | [dB] | [s] | [s] | [degrees] |
| 500 | 10 | 0.272 | 12.7 | 46.6912 | 33.3847 | 0.1 | $-700\mu s$ | -2.52 |
| 500 | 20 | 0.27 | 11.4 | 42.2222 | 32.5108 | 0.05 | $-50\mu s$ | -0.36 |
| 500 | 50 | 0.274 | 11.2 | 40.8759 | 32.2293 | 0.02 | $-104\mu s$ | -1.86 |
| 500 | 100 | 0.272 | 11 | 40.4412 | 32.1365 | 0.01 | $-26.7\mu s$ | -0.960 |
| 500 | 200 | 0.278 | 11 | 40.4412 | 31.9470 | 0.005 | $-40\mu s$ | -2.88 |
| 500 | 500 | 0.276 | 11 | 39.5683 | 32.0097 | 0.002 | $-49.2\mu s$ | -8.86 |
| 1000 | 1 k | 0.503 | 11 | 21.8683 | 26.7965 | $999\mu s$ | $-26.7\mu s$ | -9.61 |
| 1000 | 2 k | 0.503 | 11.1 | 22.06759 | 26.8751 | $500.4\mu s$ | $-23.7\mu s$ | -17 |
| 1000 | 5 k | 0.503 | 11.1 | 22.06759 | 26.8751 | $200.4\mu s$ | $-22.9\mu s$ | -41.0 |
| 1000 | 100k | 0.503 | 1.15 | 2.2863 | 7.1826 | $10.04\mu s$ | $-7.62\mu s$ | -86.9 |
| 1000 | 200k | 0.503 | 0.509 | 1.0119 | 0.1030 | $5.00\mu s$ | $-1.17\mu s$ | -84.2 |
| 1000 | 500k | 0.503 | 0.240 | 0.4771 | -6.4271 | $1.984ns$ | $-512ns$ | -92.9 |
| 1000 | 1 M | 0.505 | 0.122 | 0.2415 | -12.3386 | $1.003\mu s$? | $-286ns$? | -103? |

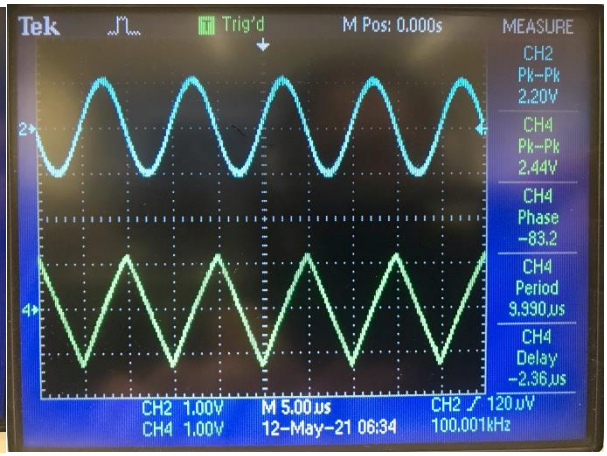
Frequency response graphs for $R_2 = 100\ k\Omega$

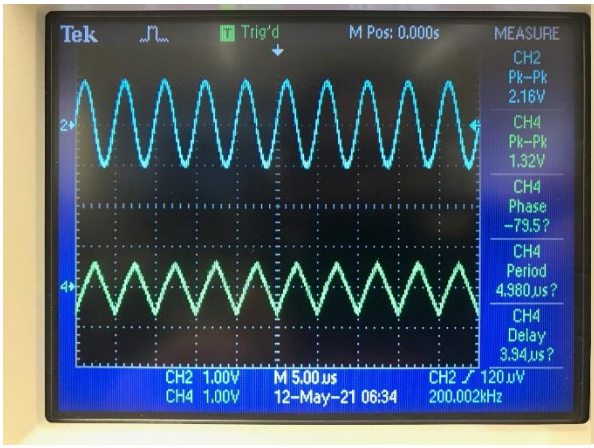


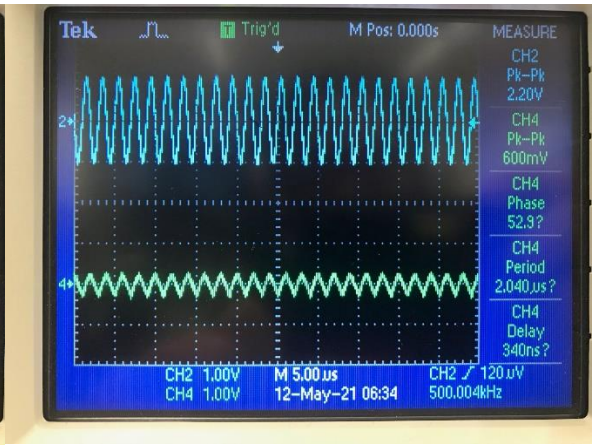

Misc: photos of the output of the Op amp:

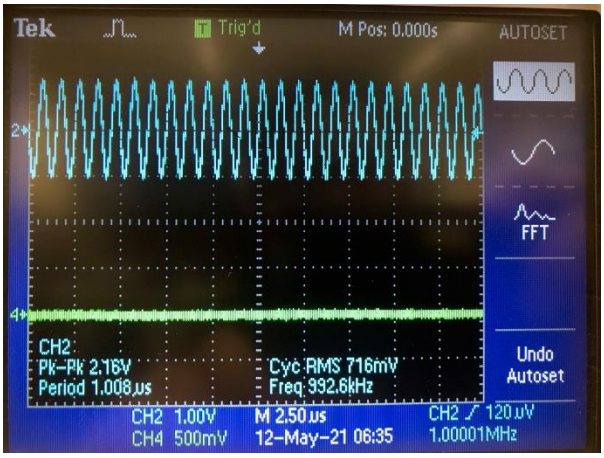
- Getting cut of at the top as the gain exceeds the maximum voltage from the inputs
- Becoming sharper due to the slew rate being exceeded
- Gain reducing as the frequency goes past cutoff




Tek
Trig'd
M Pos: 0.000s
MEASURE
CH2
Pk-Pk
2.16V
CH4
Pk-Pk
1.32V
CH4
Phase
-79.5?
CH4
Period
4.980µs?
CH4
Delay
3.94µs?
CH2 1.00V
CH4 1.00V
M 5.00µs
12-May-21 06:34
CH2 ∕ 120µV
200.002kHz


Tek
Trig'd
M Pos: 0.000s
MEASURE
CH2
Pk-Pk
2.20V
CH4
Pk-Pk
600mV
CH4
Phase
52.9?
CH4
Period
2.040µs?
CH4
Delay
340ns?
CH2 1.00V
CH4 1.00V
M 5.00µs
12-May-21 06:34
CH2 ∕ 120µV
500.004kHz


Tek
Trig'd
M Pos: 0.000s
AUTOSET
FFT
CH2
Pk-Pk 2.16V
Period 1.008µs
Cyc RMS 716mV
Freq 992.6kHz
Undo
Autoset
CH2 1.00V
CH4 500mV
M 2.50µs
12-May-21 06:35
CH2 ∕ 120µV
1.00001MHz