ECEN 325 - 512

Operational Amplifiers - Part 1

Date: 9/24/2023

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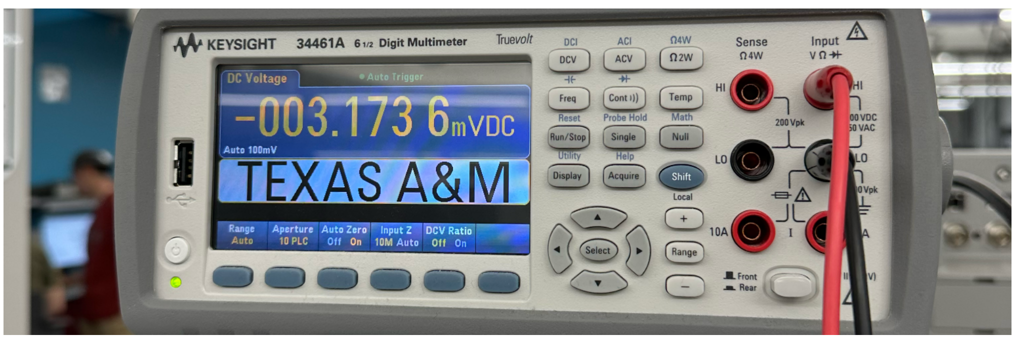
Measurements

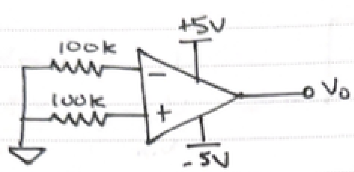
Input Offset Current Measurement

Resistor #1:

Resistor #2:



INPUT OFFSET CURRENT MEASUREMENT



VOLTAGE THRU

R1 = −3.166mV

R2 = −3.2307mV

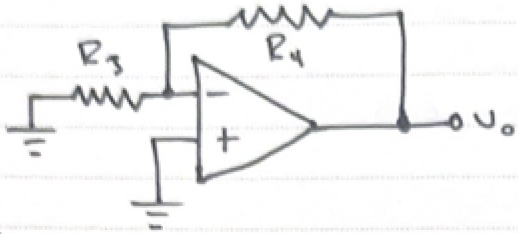
$$i_1 = \frac{-3.166\,\text{mV}}{100\text{k}\Omega} = -0.03166\,\mu A$$

$$i_2 = \frac{-3.173\,\text{mV}}{100\text{k}\Omega} = -0.03173\,\mu A$$

$$I_{os} = I_B^+ - I_B^- \Rightarrow 0.08\,nA$$

DC Offset Current Measurement

DC Offset Voltage Measurement



$V_o = 5.11mV$

$\frac{V_{out}}{V_{in}} = -\frac{47k\Omega}{10k\Omega}$

$\rightarrow -4.7dB$

①

$A_{dB} = 20 \log_{10}(A)$

$\rightarrow A = 10^{\left(\frac{-4.7}{20}\right)} \rightarrow A = 0.316$

$V_{os} = \frac{5.11mV}{0.316} \approx \underline{16.17mV}$

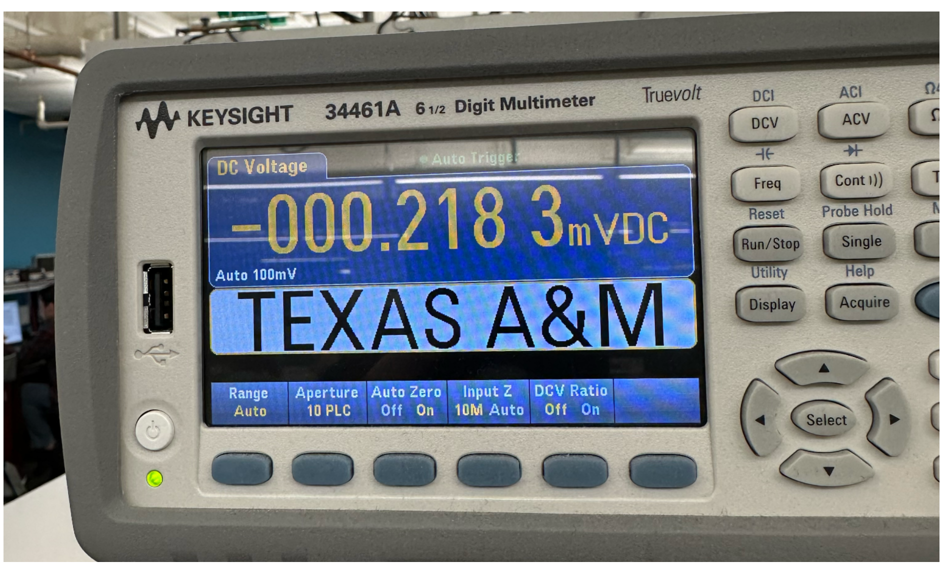
Adding Potentiometer

$V_{OUT} = 0.061mV$

In Potentiometer:

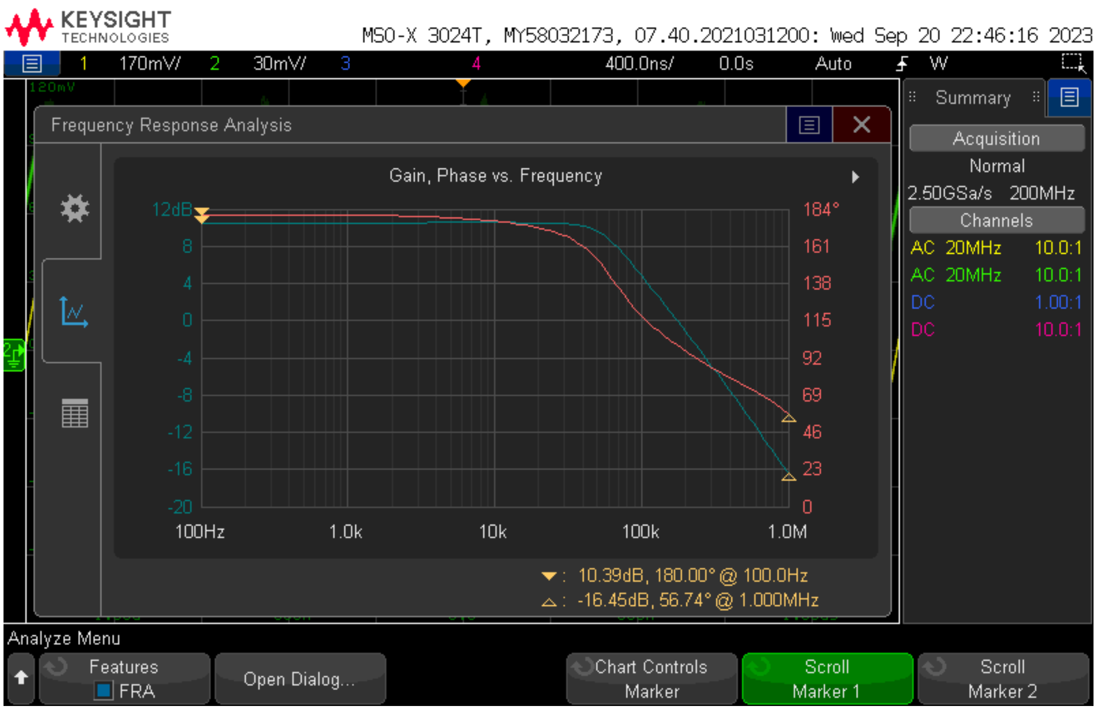
$R_1 = 91.5k\Omega$

$R_2 = 5.9k\Omega$

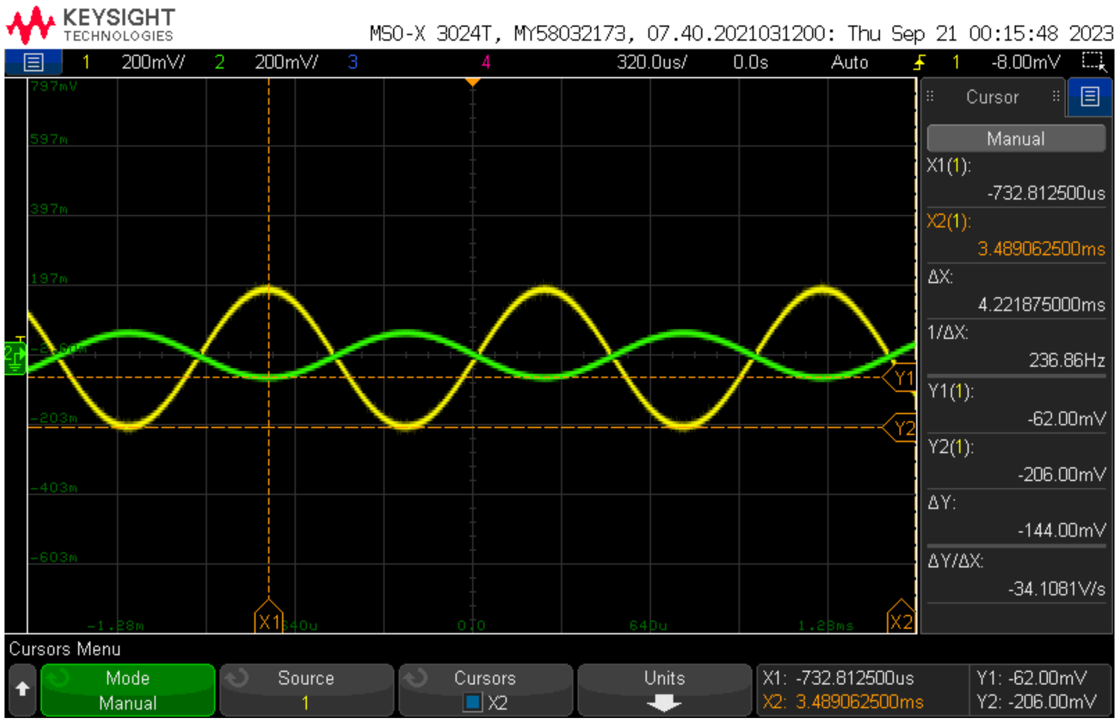


Inverting Configuration

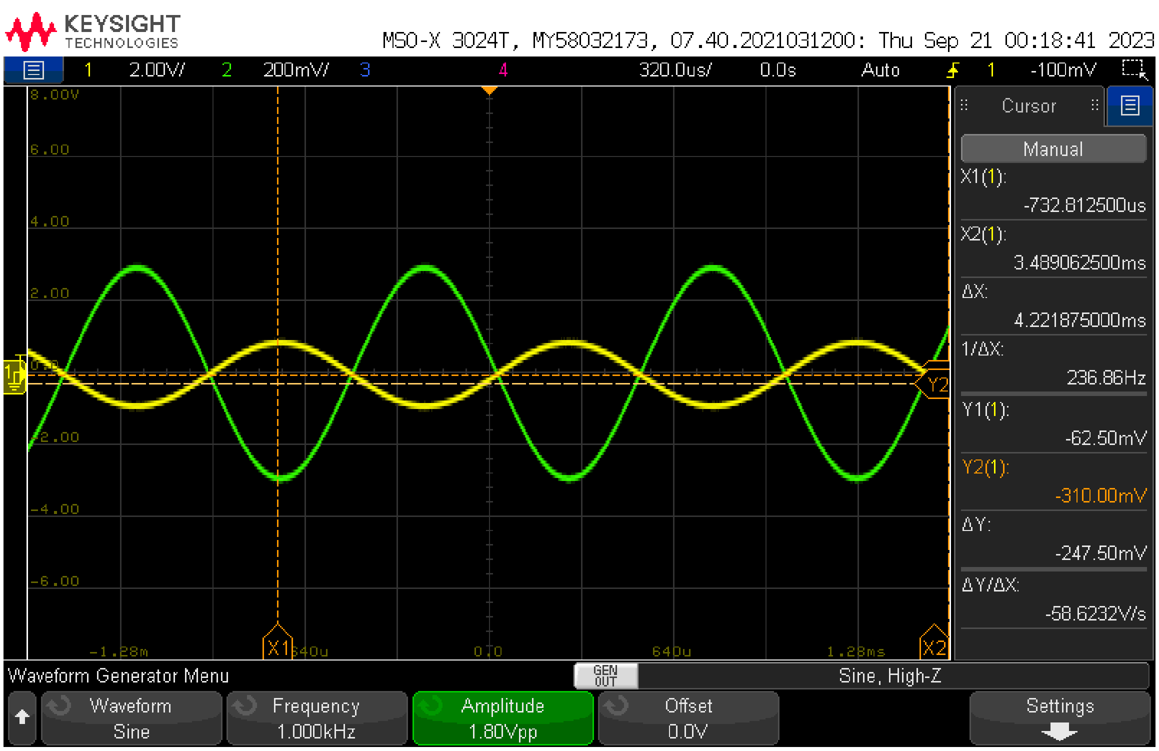
1) Bode plot with gain measured at 1kHz.

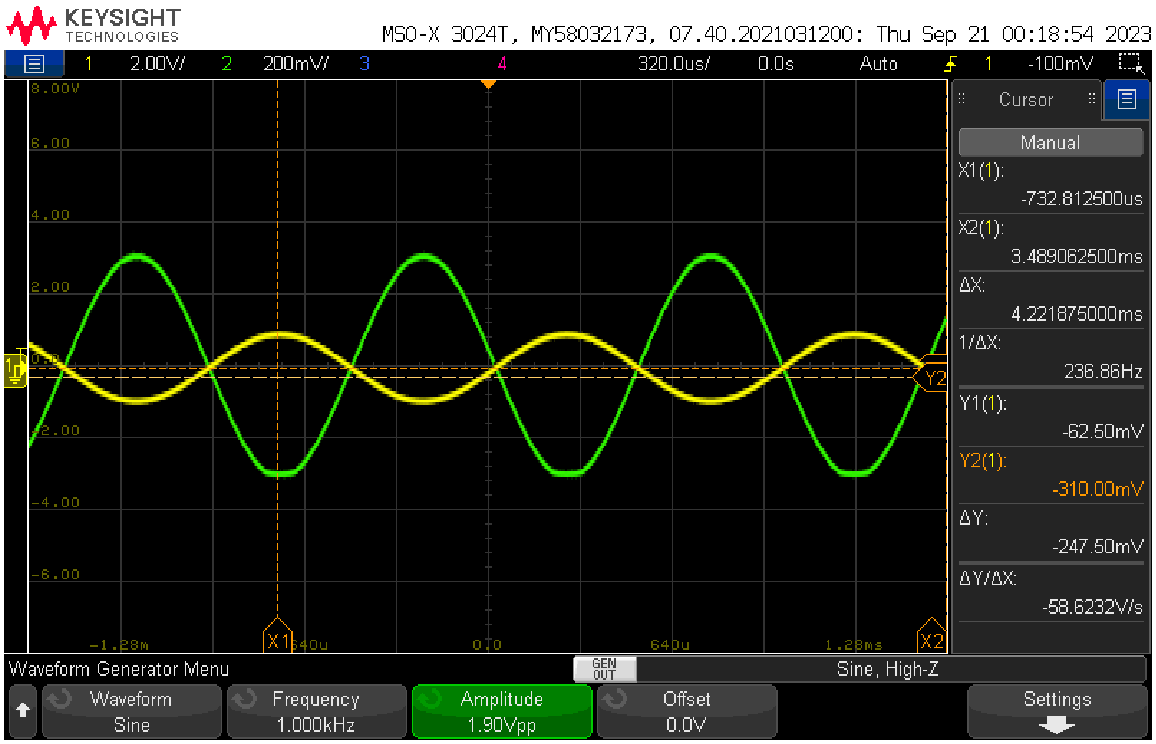


2) Input $V_i(t) = 0.2 sin(2\pi 1000t)$ time domain waveform

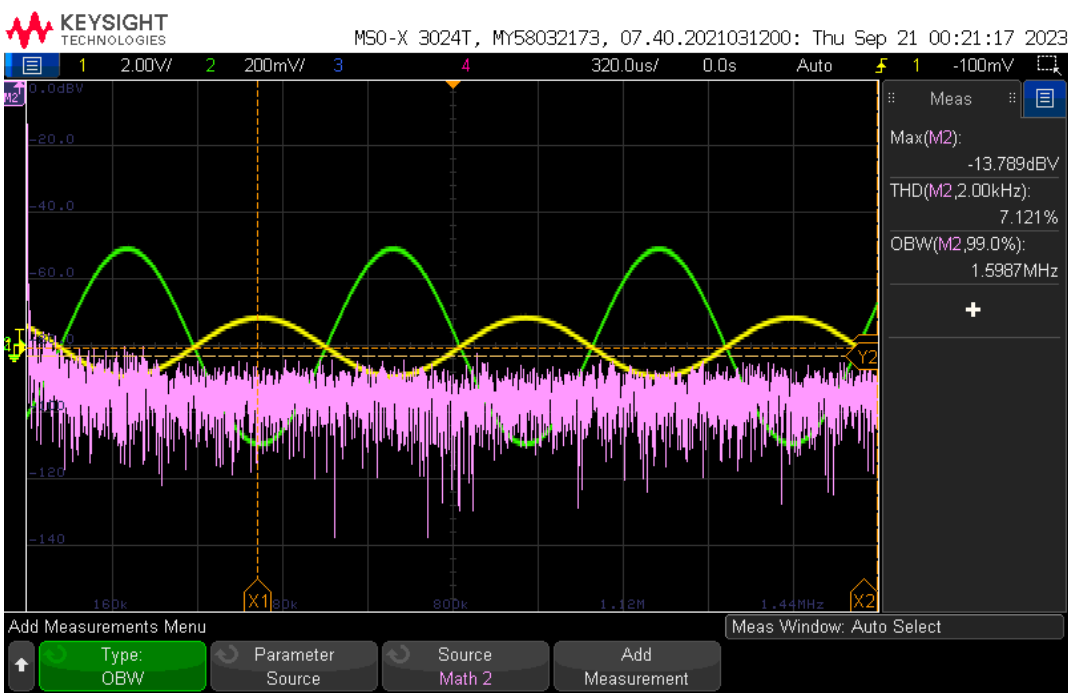


3) $V_{i,max}$ before and after clipping occurs



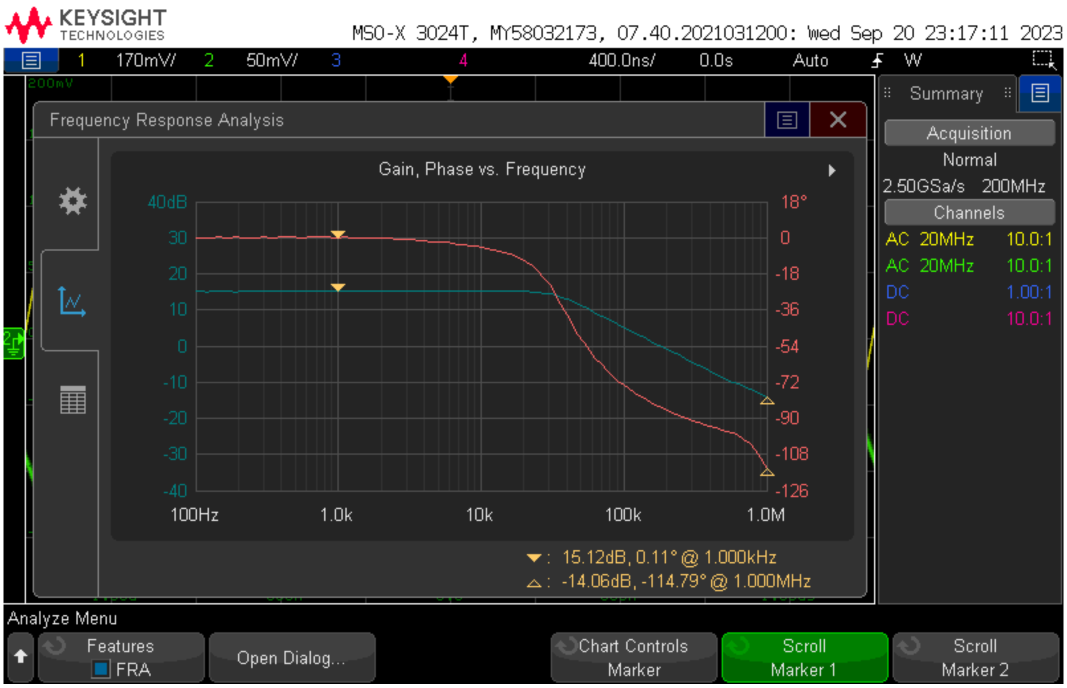


4) Total Harmonic Distortion (THD) at $V_i(t) = 1.8sin(2\pi1000t)$

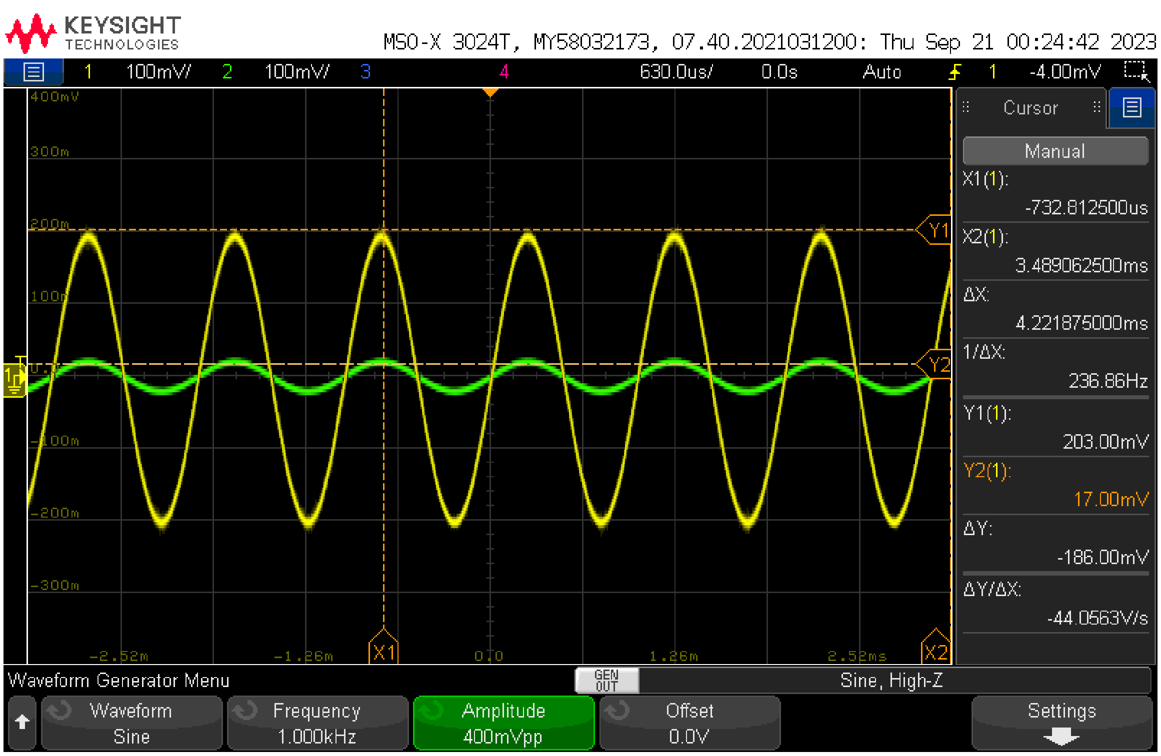


Non-inverting Configuration

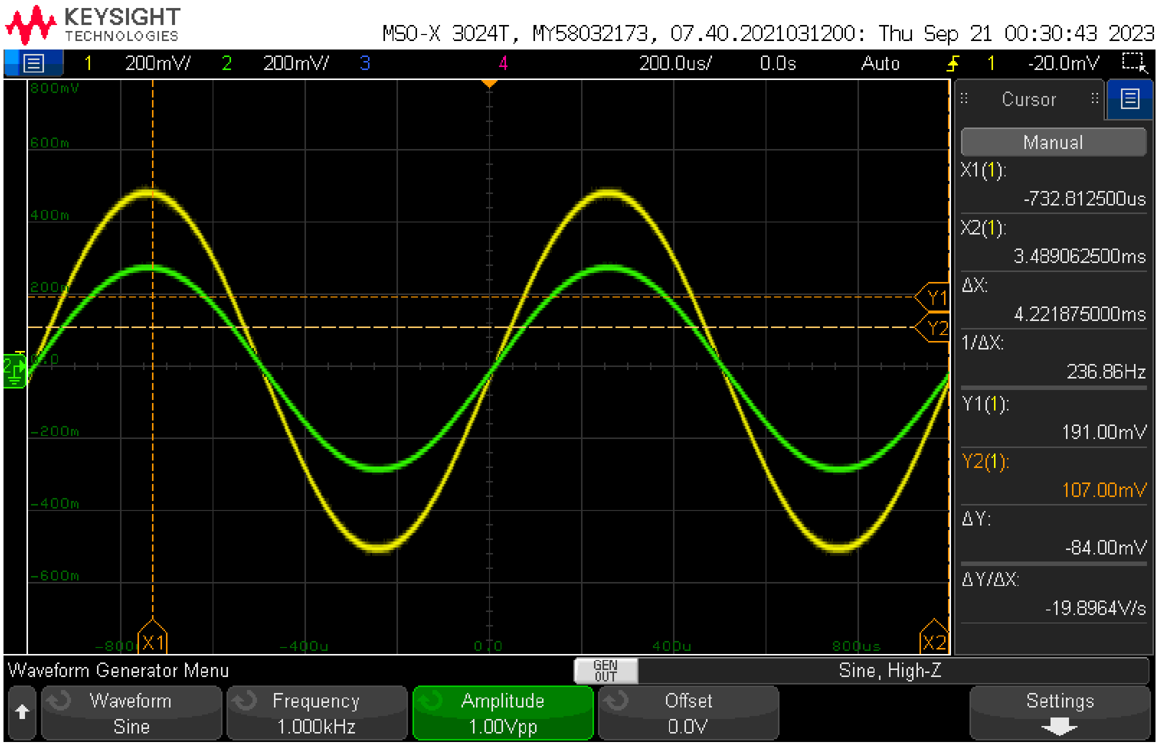
5) Bode plot with gain measured at 1kHz.

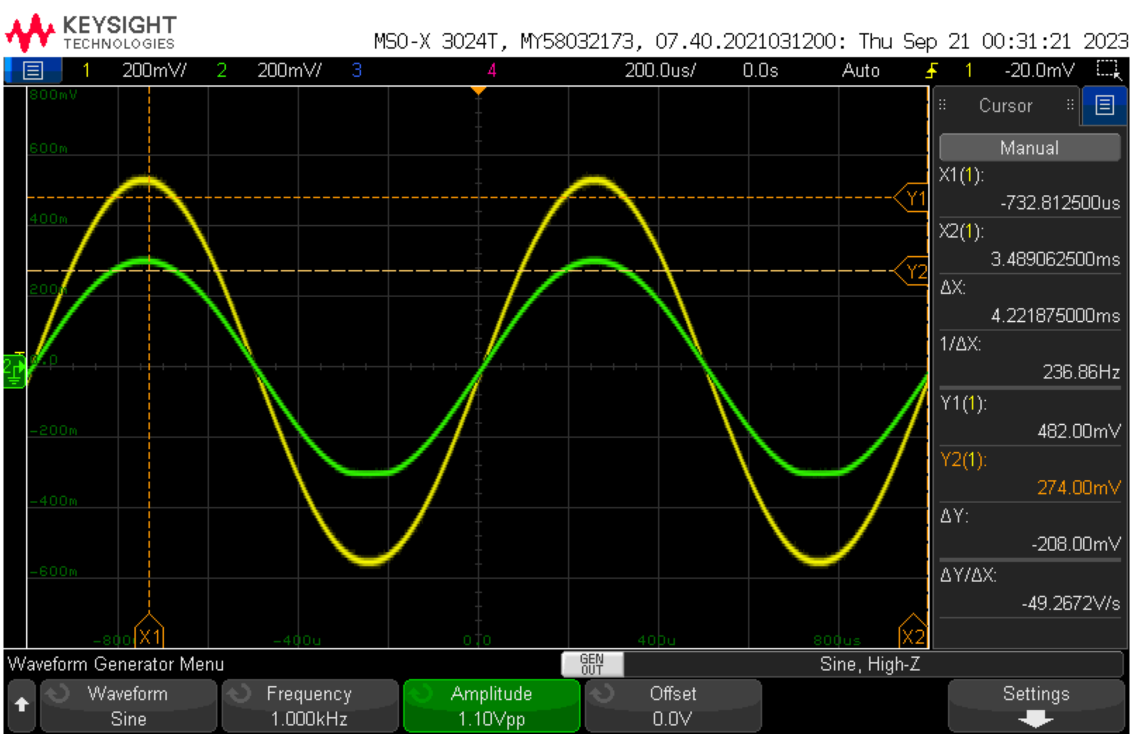


6) Input $V_i(t) = 0.2sin(2\pi 1000t)$ time domain waveform

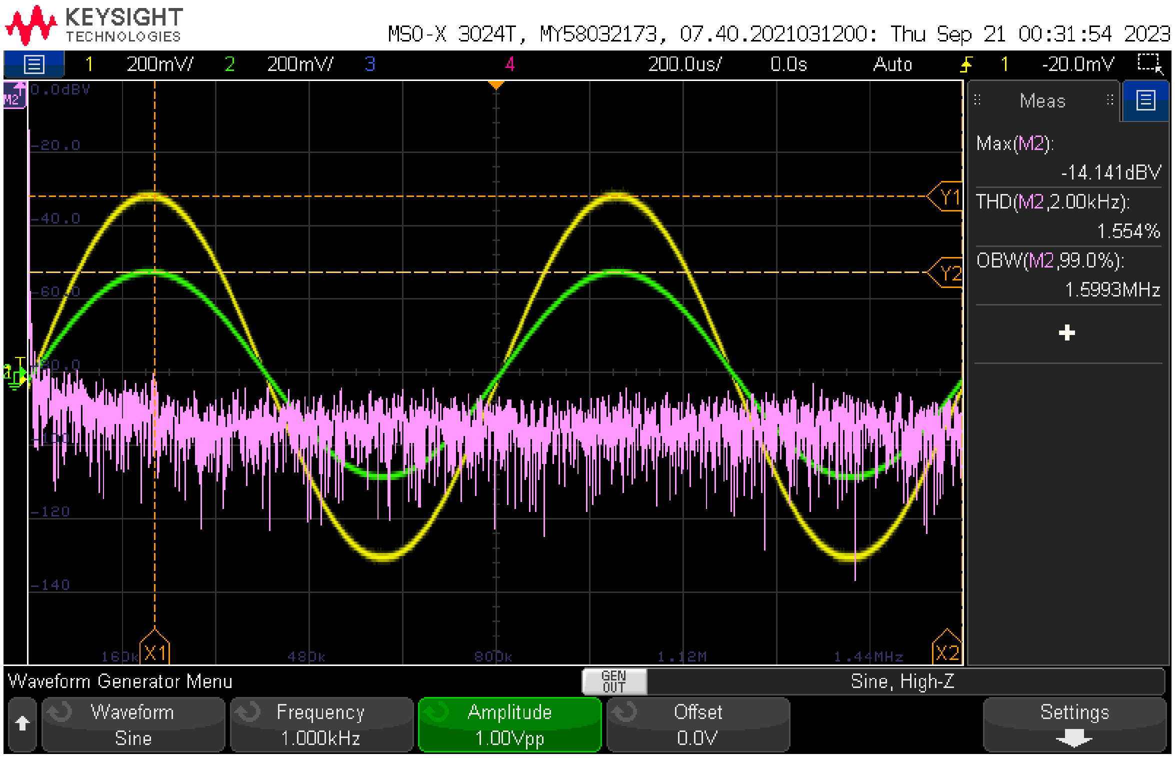


7) $V_{i,max}$ before at 1.0Vpp, after at 1.1Vpp





8) Total Harmonic Distortion (THD) at $V_i(t) = 1.0 sin(2\pi 1000t)$



Data Table:

The provided data table is a good way to organize and present our range of calculated, simulated, and measured values. It is divided into two distinct sections: Inverting and Non-inverting Op Amps, which correspond to different stages and aspects of the experiment or analysis. This format simplifies the detection of inconsistencies, allows for easy comparison of results across different methods or frequency domains, and ensures transparency and data integrity. By structuring data in this manner, we can efficiently manage and reference our findings, enhancing the clarity and reliability of our work.

	Simulated	Measured
Inverting Gain @ 1 kHz	9.54 dB	10.39 dB
Inverting Output Voltage	591.99 mV	197 mV
Inverting Input Voltage	-200.00 mV	-62 mV
Inverting Voltage Gain	791.99 mV	259 mV
Inverting Max Input Amplitude	1.80 V	1.80 V
Inverting THD	36.1%	7.21%

Non-inverting Gain @ 1 kHz	12.04 dB	15.12 dB
Non-inverting Output Voltage	1.20 V	203 mV
Non-inverting Input Voltage	199.57 mV	17 mV
Non-inverting Voltage Gain	1.00 V	186 mV
Non-inverting Max Input Amplitude	1 V	1 V
Non-inverting THD	100%	1.55%
Input Offset Current	2 nA	0.8 nA
DC Offset Voltage	1 mV	16.17 mV

Results:

In our recent lab experiment, an inadvertent application of a 200mV amplitude instead of the intended 400mV, compounded by the fact that the simulation software we relied on during the prelab was not working correctly, taught us important lessons: the significance of adaptability in the face of unforeseen challenges, the critical importance of precision in measurements, the non-linear nature of scientific progress where setbacks can yield valuable insights, the need for continuous improvement in procedures and communication, and the resilience required to overcome obstacles. While the experiment did not unfold as planned, these lessons will undoubtedly contribute to our growth as engineers and improve the outcomes of our future endeavors.