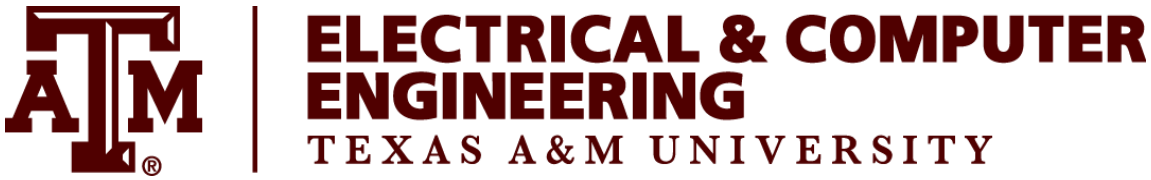


Pre-Lab 5: Operational Amplifiers
Part 3

Kylan Lewis

UIN: 719001131

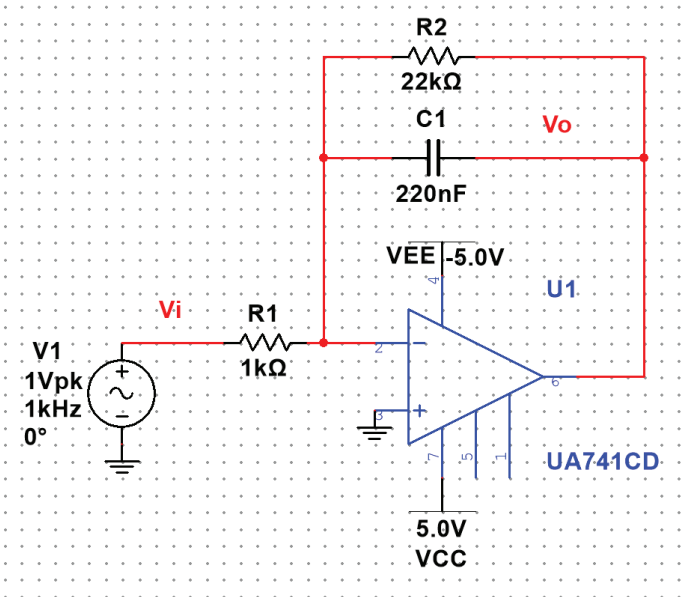
ECEN 325 -501

TA: Jian Shao

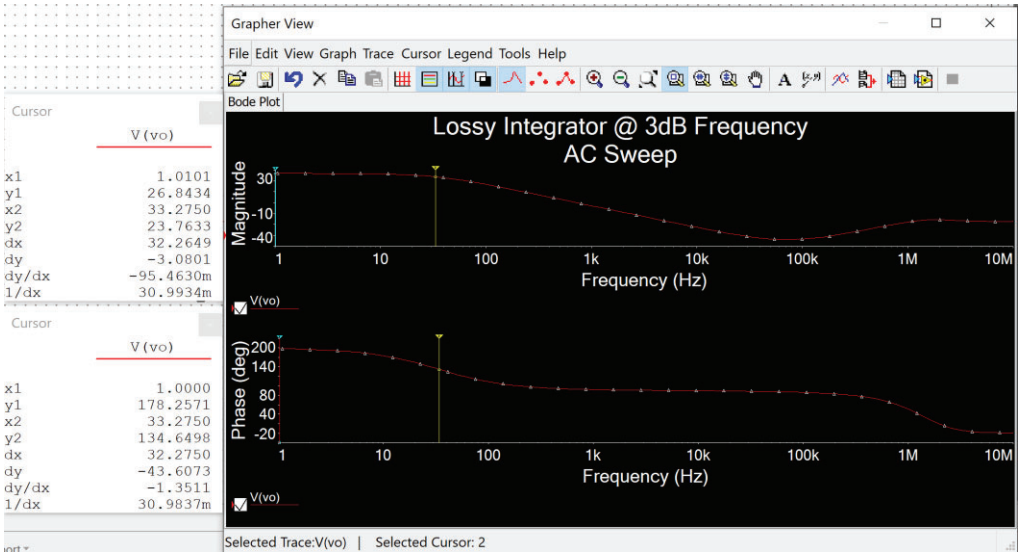
Date: 9/16/2020

Simulations

Lossy Integrator:

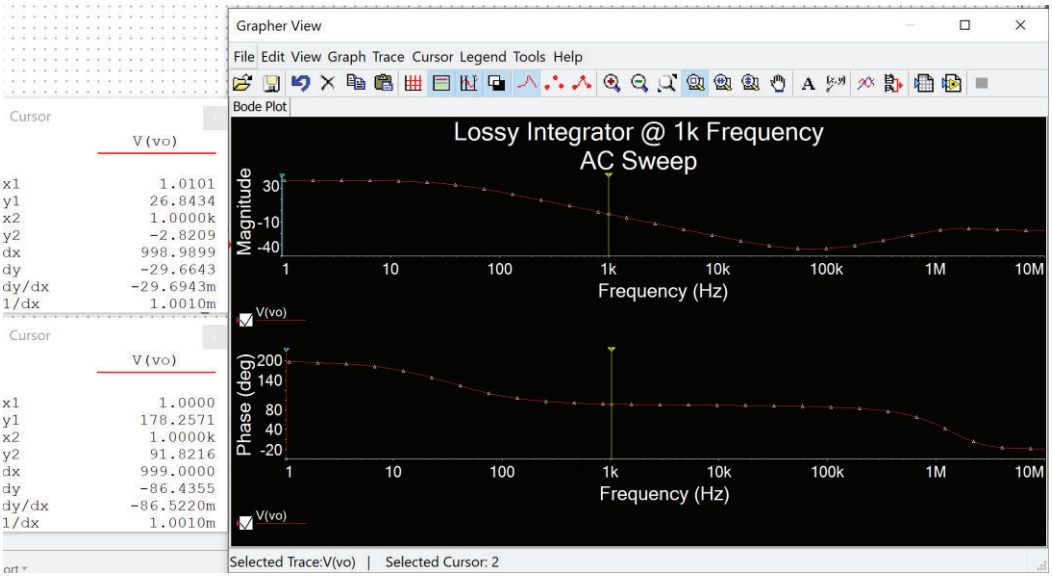


Bode Plot ▼



Low Frequency Gain = 23.76dB

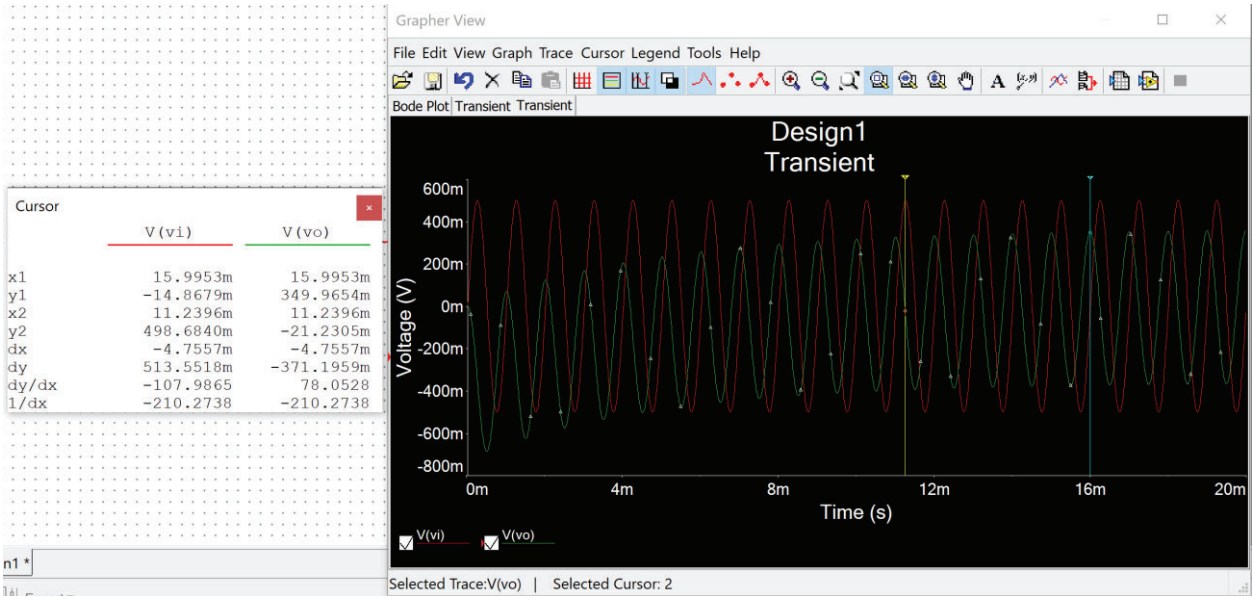
3dB-Frequency = 33.27Hz



Magnitude = -2.8209dB @ 1k Frequency

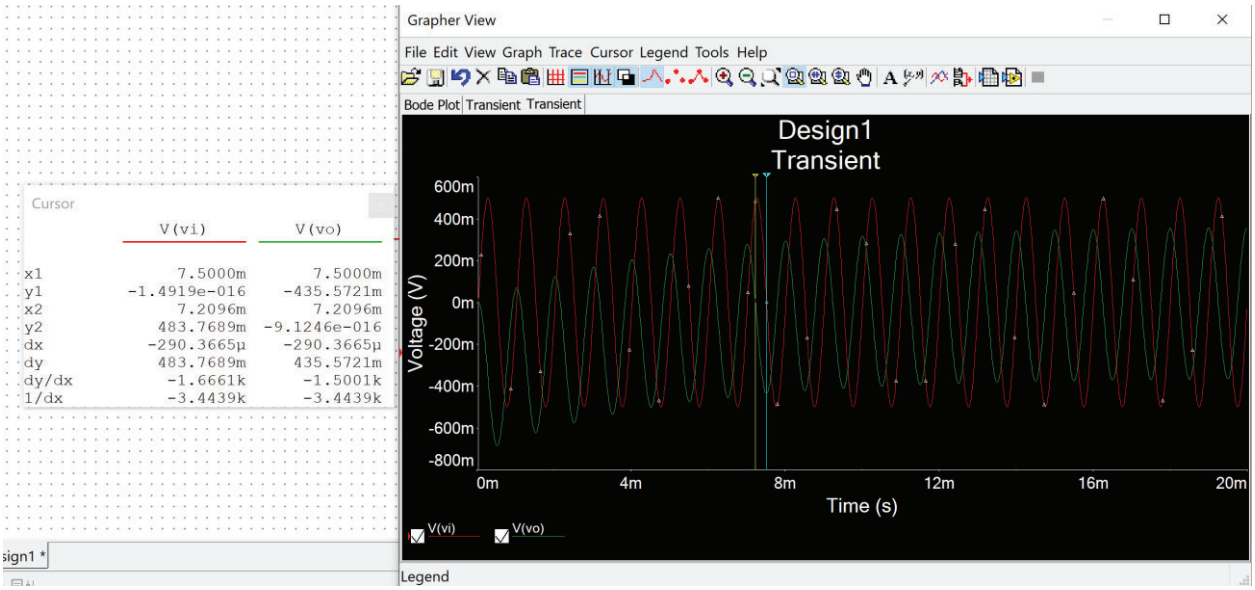
Phase = 91.8216 ° @ 1k Frequency

Time-Domain Waveform (with 1kHz 500mV sine wave) ▼



Magnitude of Vin = 0.498 V

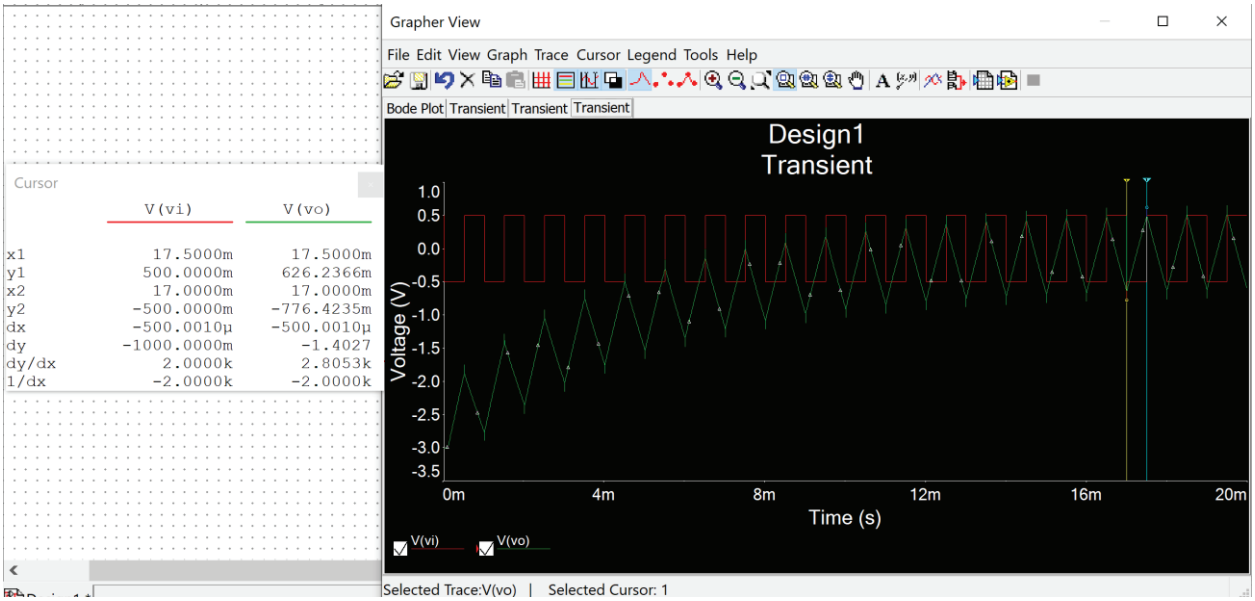
Magnitude of Vout = 0.350 V



Time different = dx = 290.4 us

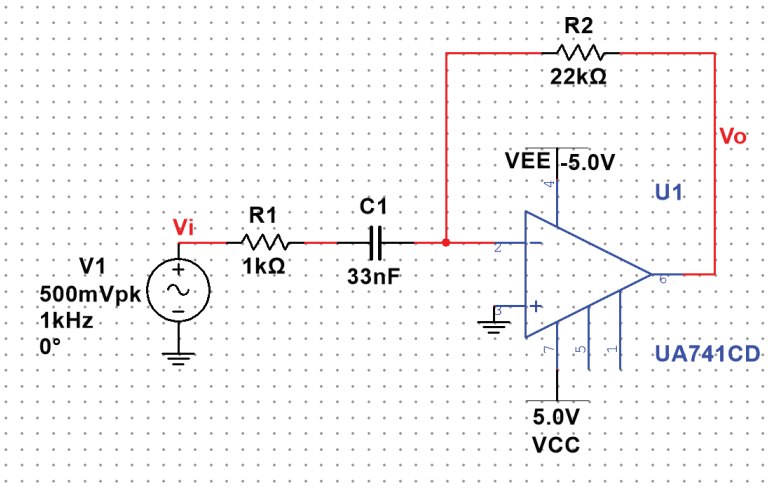
Phase different = $290.4*10^{-6}*1k*360 = 104.54°$

Time-Domain Waveform (with 1kHz 500mV square wave) ▼

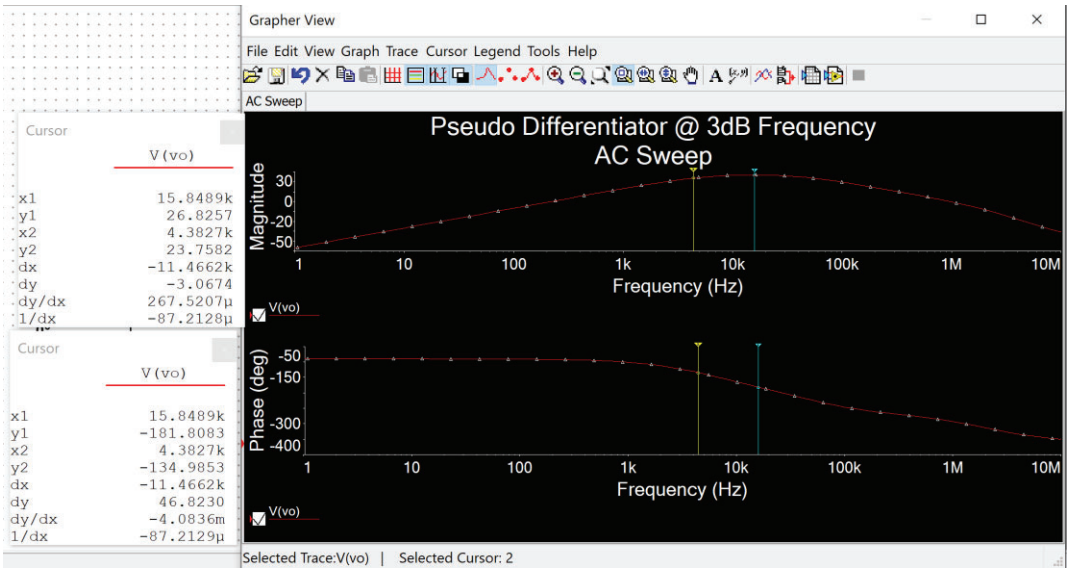


Peak-to-peak voltage = 0.626+0.776 = 1.402 V

Pseudo Differentiator:

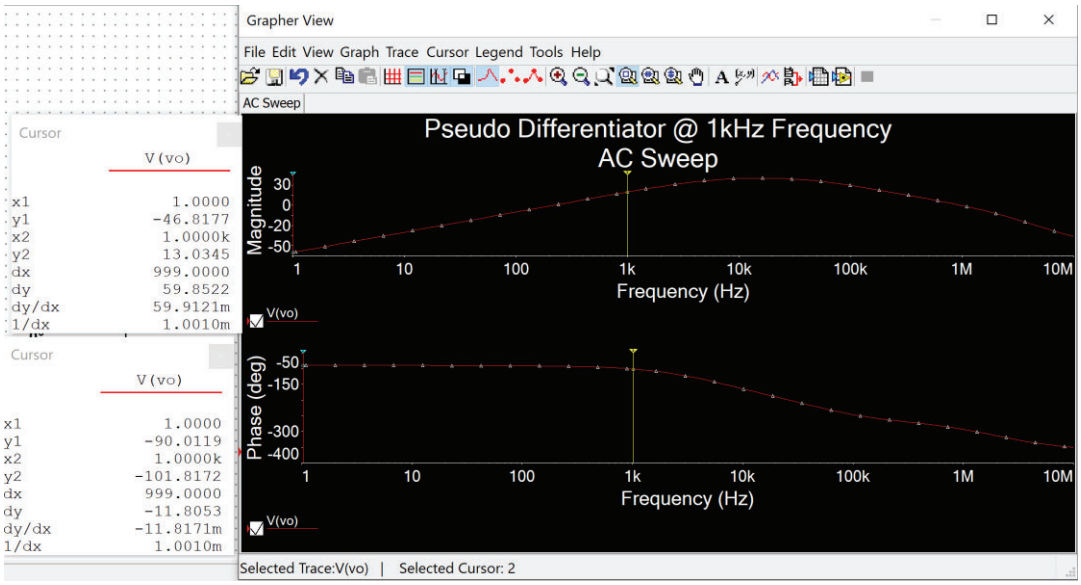


Bode Plot ▼



Low Frequency Gain = 23.76 dB

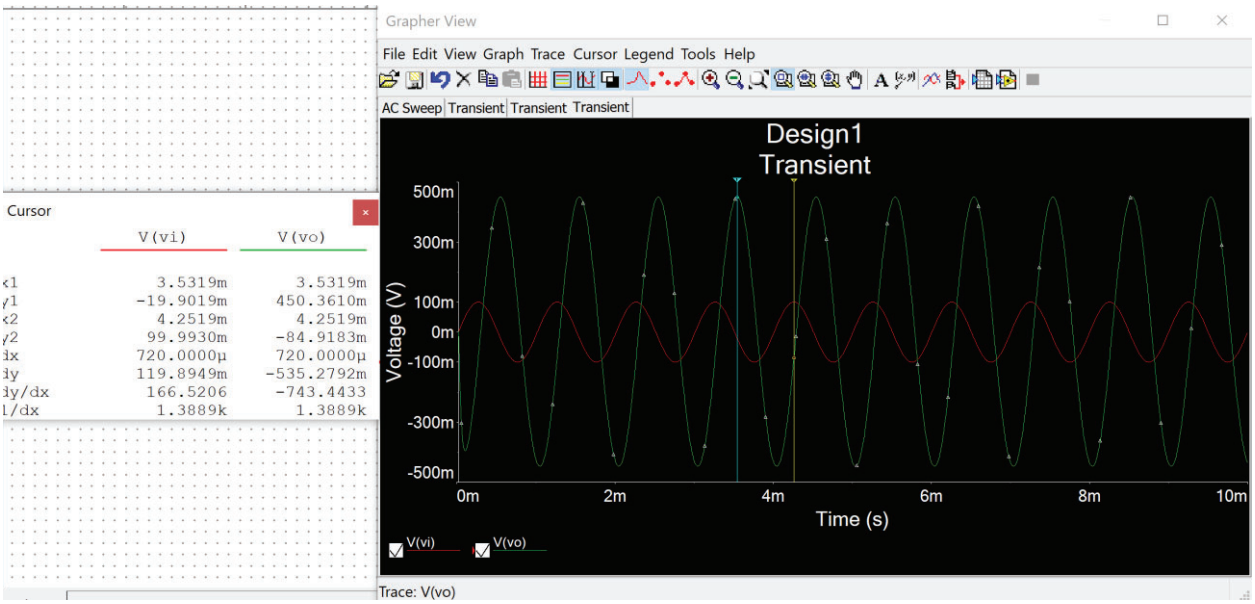
3dB-Frequency = 4.38 kHz



Magnitude = 13.03 dB @ 1k Frequency

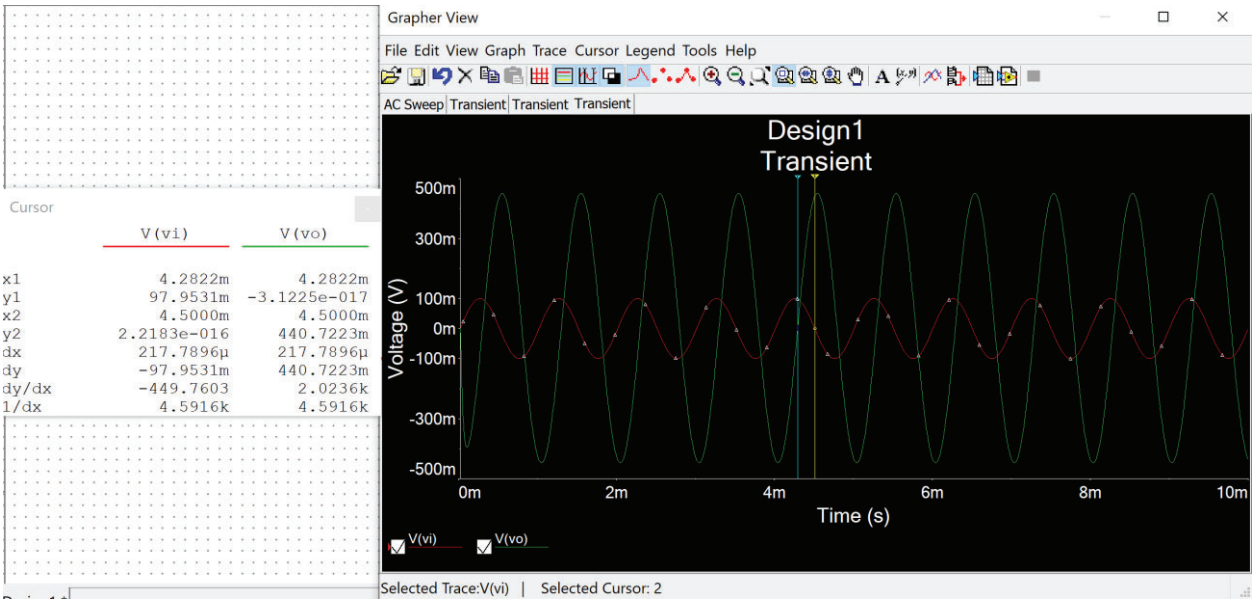
Phase = -101.82° @ 1k Frequency

Time-Domain Waveform (with 1kHz 100mV sine wave) ▼



Magnitude of Vin = 0.100 V

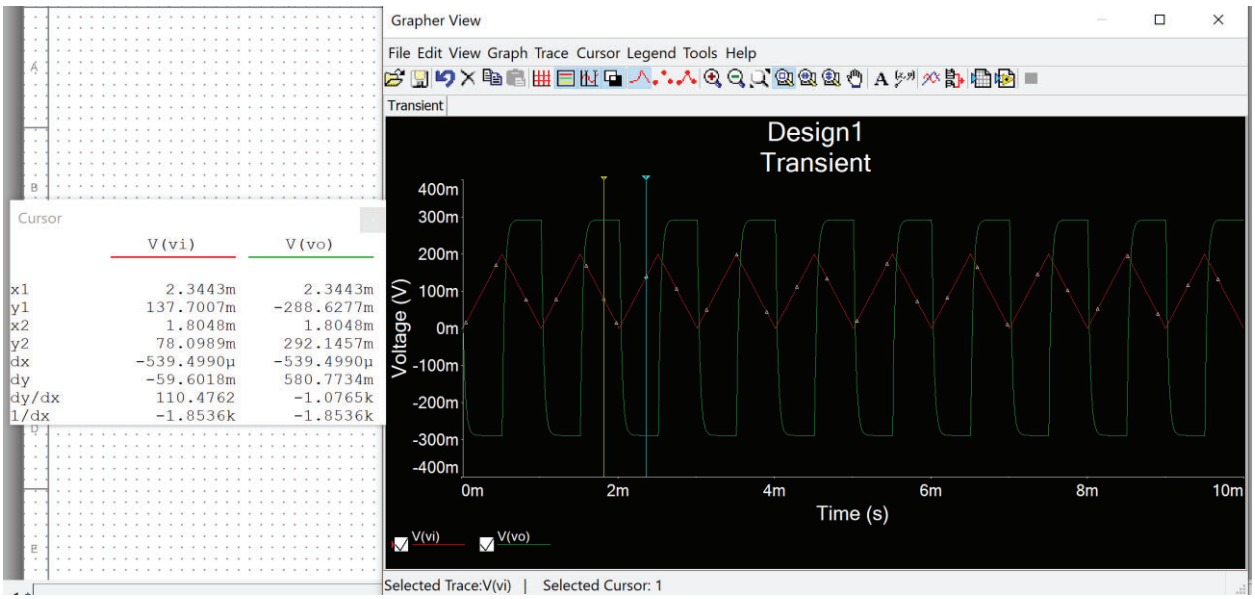
Magnitude of Vout = 0.450 V



Time different = dx = 217.8 us

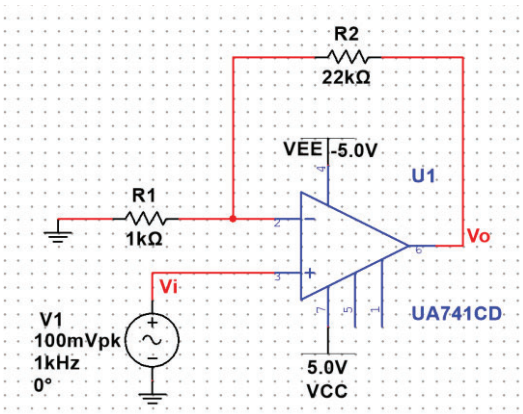
Phase different = $217.8*10^{-6}*1k*360 = 78.408°$

Time-Domain Waveform (with 1kHz 100mV triangular wave) ▼

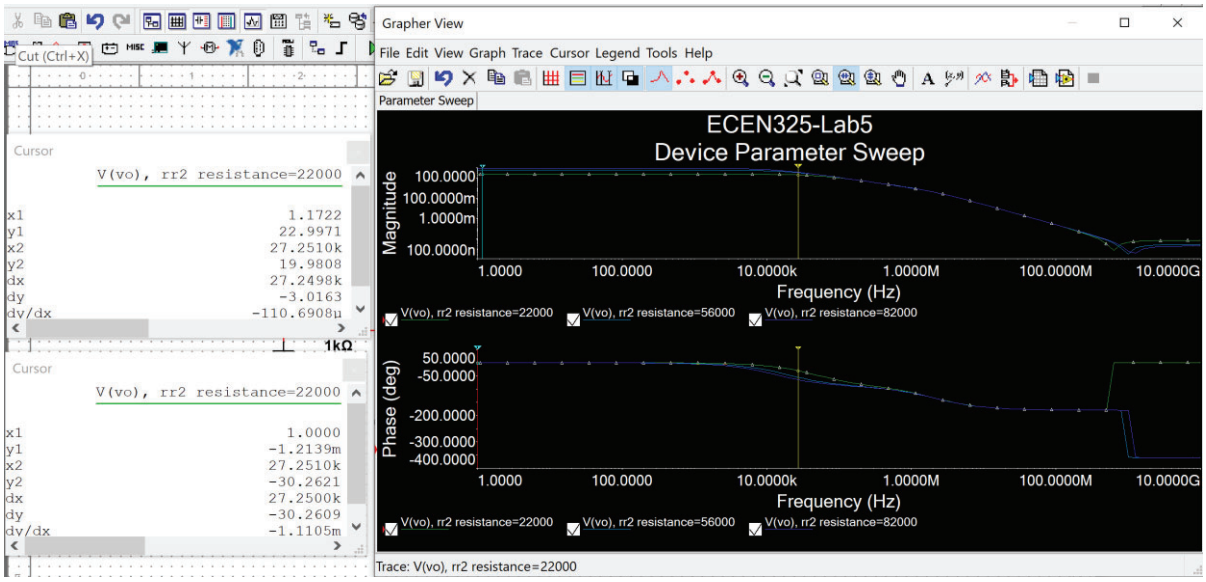


Peak-to-peak voltage = 0.289+0.292 = 0.581V

Finite GBW Limitations:



Bode Plot ▼

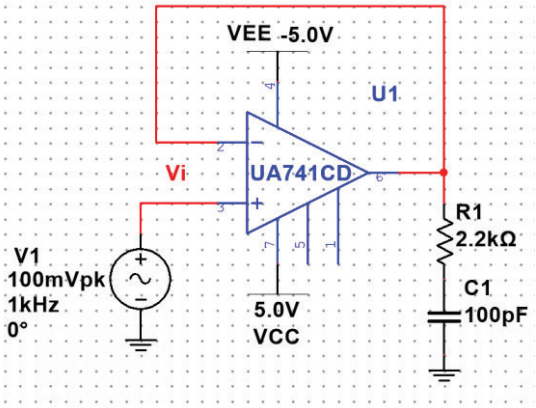


3dB Frequency for 22k Resistor = 27.2510kHz

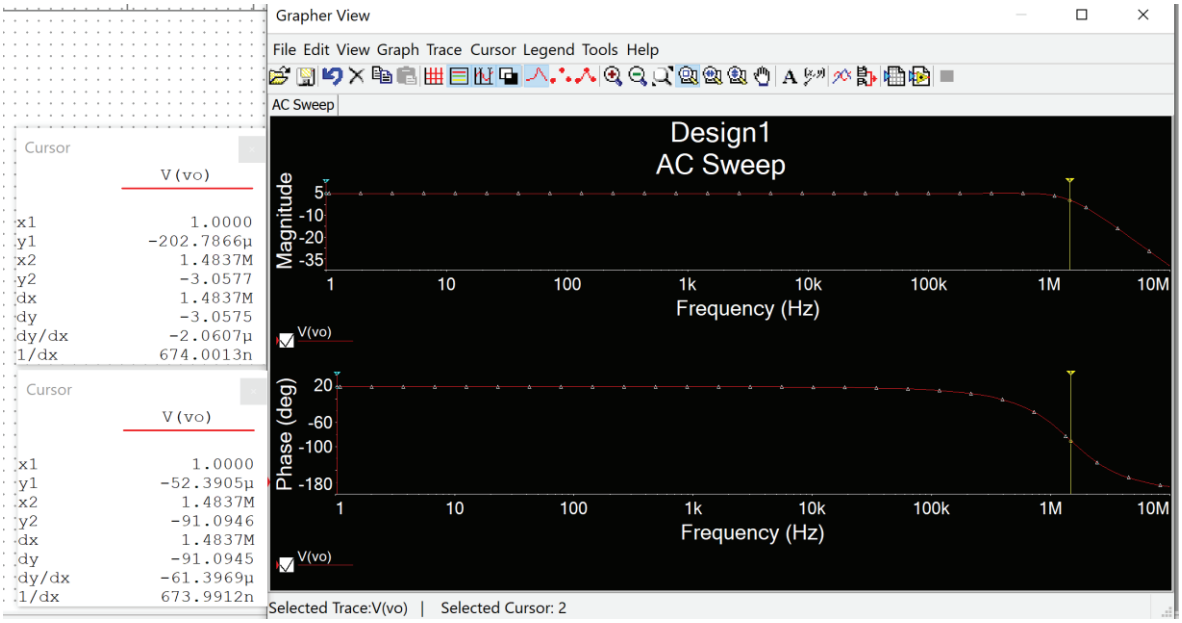
3dB Frequency for 56k Resistor = 6.5103kHz

3dB Frequency for 82k Resistor = 3.6225kHz

Slew Rate Limitations:

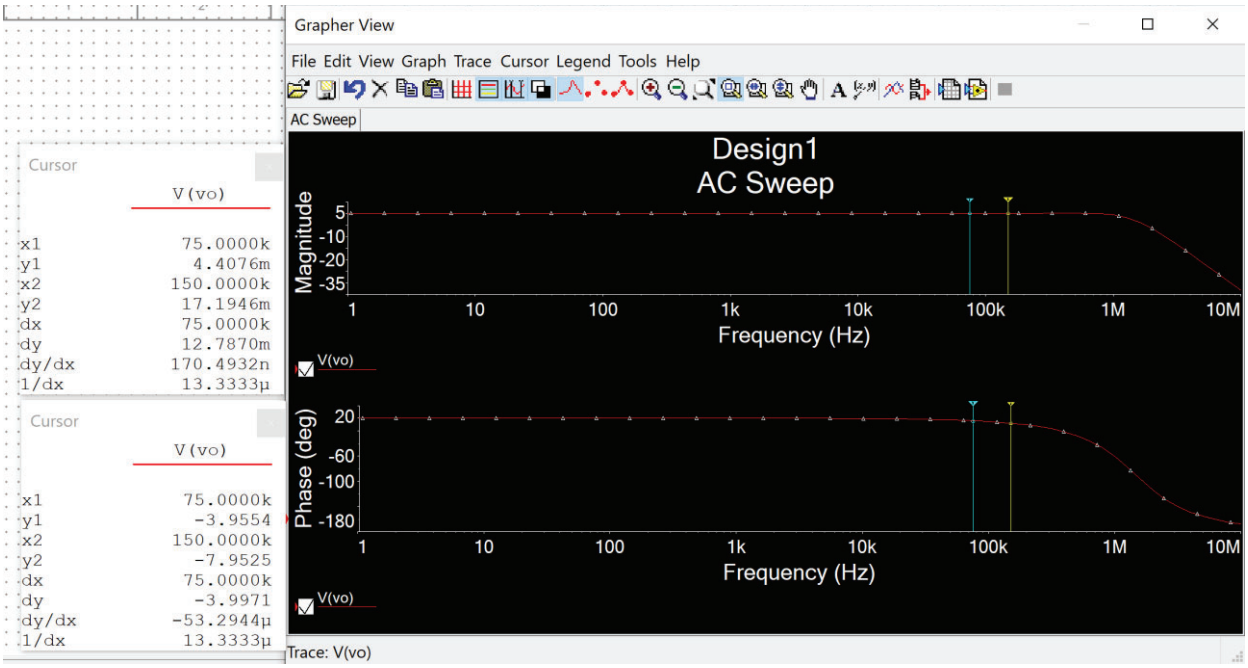


Bode Plot ▼



Low Frequency Gain = -3.06 dB

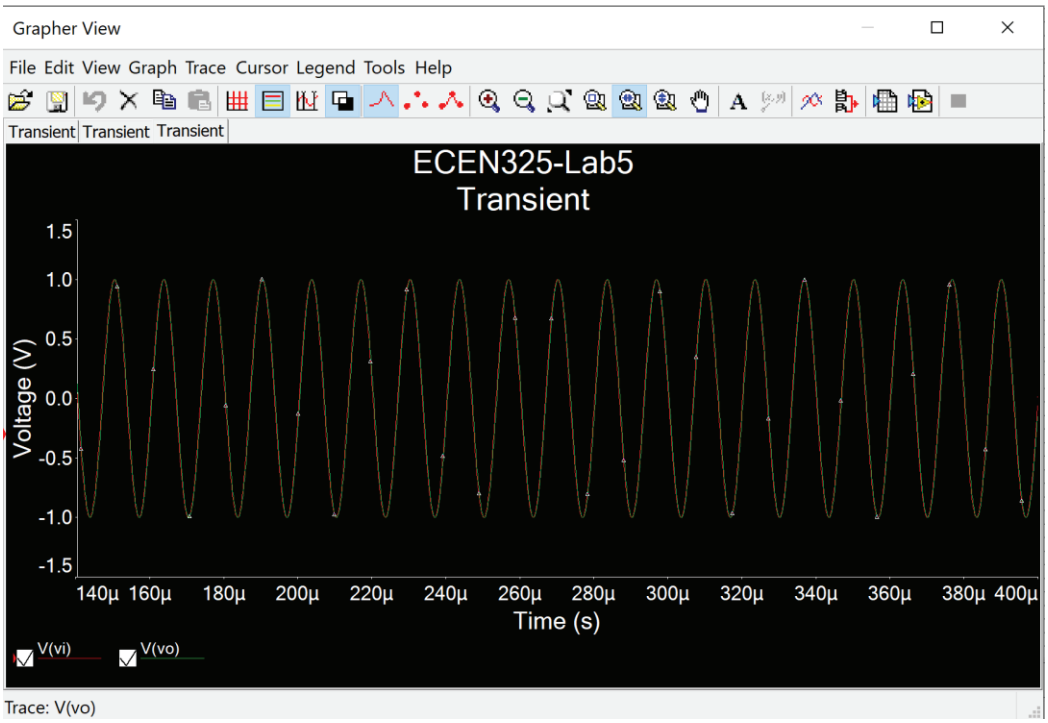
3dB-Frequency = 1.48M Hz



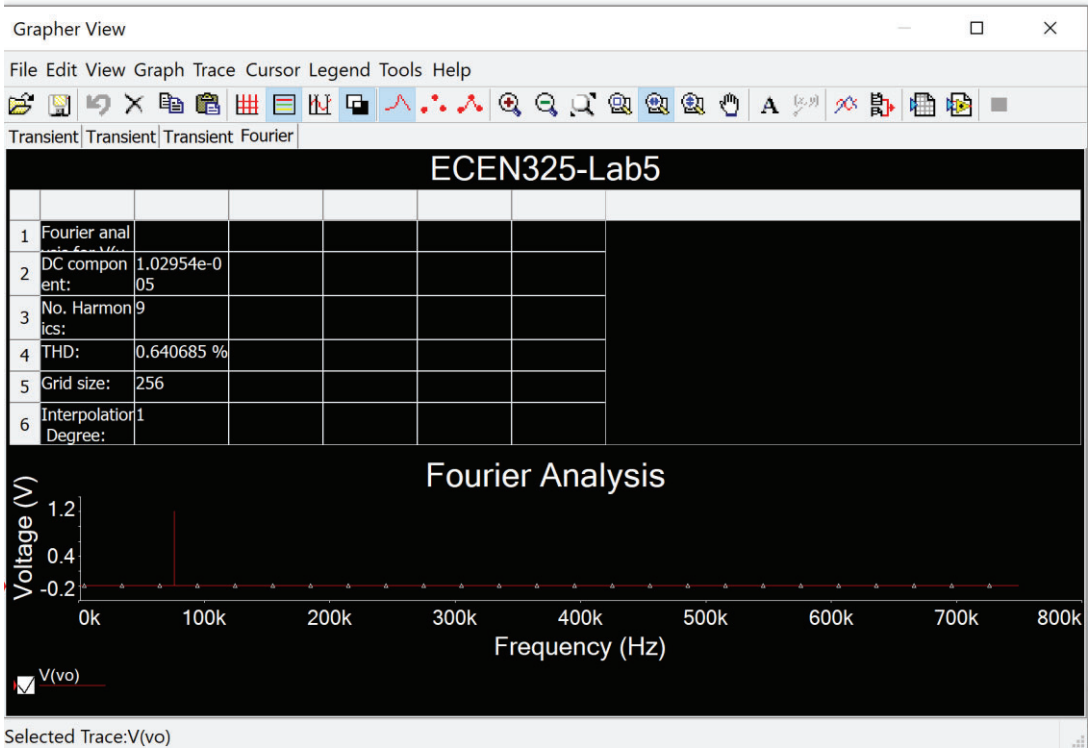
Magnitude @ 75kHz = $4.4076*10^{-3}$ dB

Magnitude @ 150kHz = $17.1946*10^{-3}$ dB

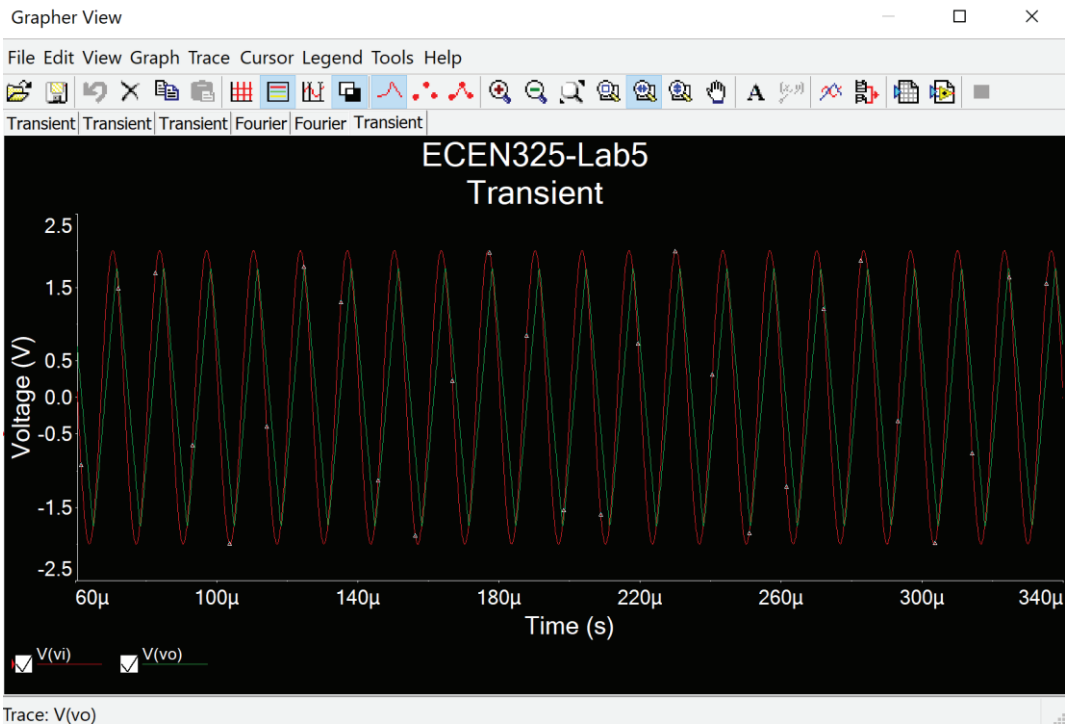
Time-Domain Waveform (with 75kHz 1V sine wave) ▼



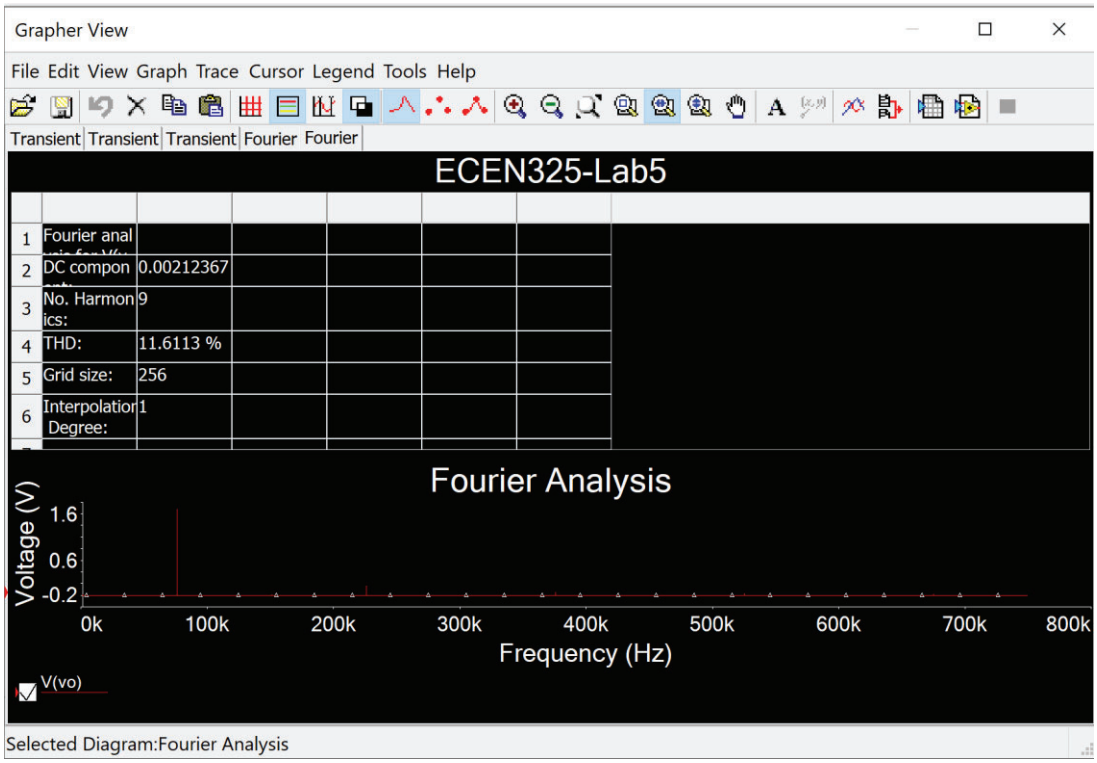
Total Harmonic Distortion (with 75kHz 1V sine wave) ▼



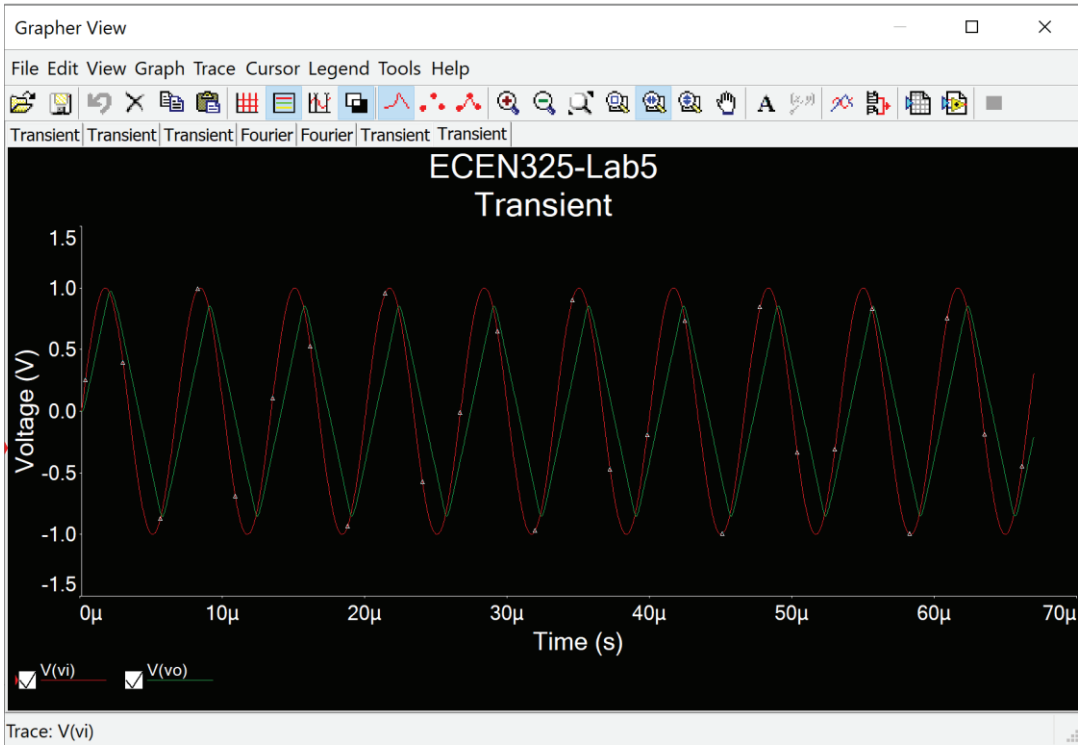
Time-Domain Waveform (with 75kHz 2V sine wave) ▼



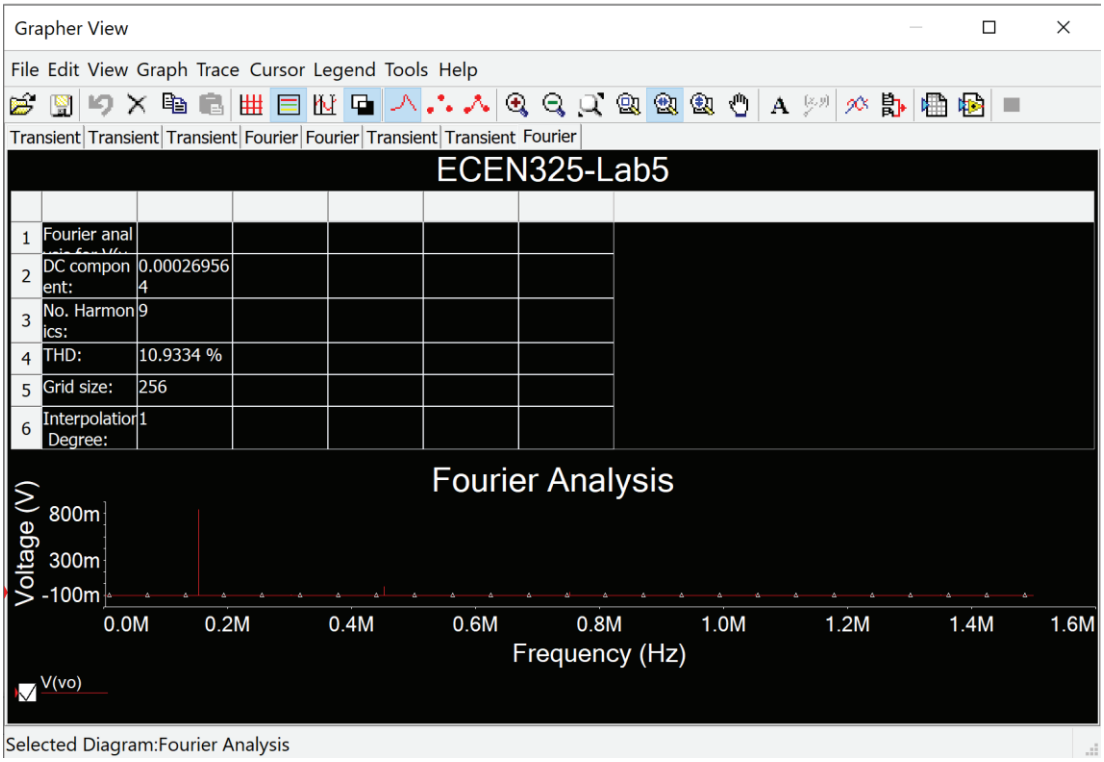
Total Harmonic Distortion (with 75kHz 2V sine wave) ▼



Time-Domain Waveform (with 150kHz 1V sine wave) ▼



Total Harmonic Distortion (with 150kHz 1V sine wave) ▼



Answer to the TA Questions:

Why did the entire output waveform shift up when the student removed the resistor in parallel with the capacitor?

Anytime that you have resistivity to a signal path in a circuit, you are limiting the amount of current flowing through that signal path. By removing the resistor (R2) the capacitor has only one way to discharge and thus there was a positive DC shift in the graph. .

Also by looking at the transfer function of a lossy integrator circuit

$$V_{out} = \frac{\frac{R_2}{R_1}}{1 + sR_2C} V_i$$

Keeping everything else constant and by removing R2 we can immediately see that the output voltage will be larger.