EE330 Lab 8

Section 5, 8:00 am

Discrete Semiconductor Amplifiers

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Part 1: Voltage Controlled Amplifier

EE 330 Lab 8

1)

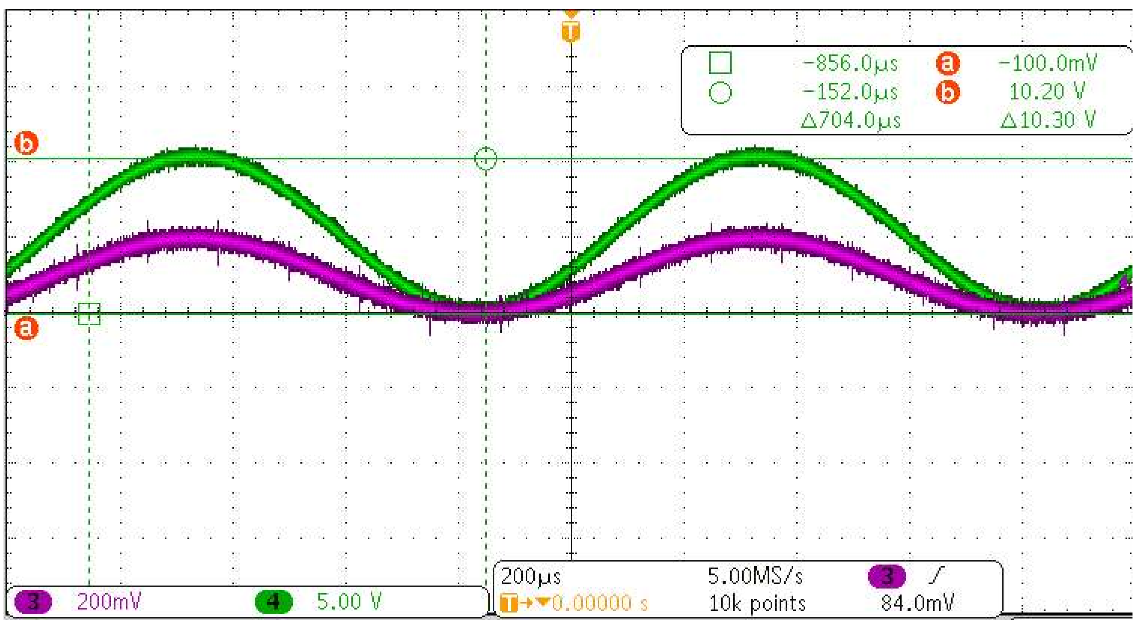
$R_{FET} = \left[\frac{uC_{ox}\cdot W}{L}(V_{GS}-V_T)\right]^{-1}$ => Using Long Channel : $\frac{W}{L} = \frac{60}{3}$

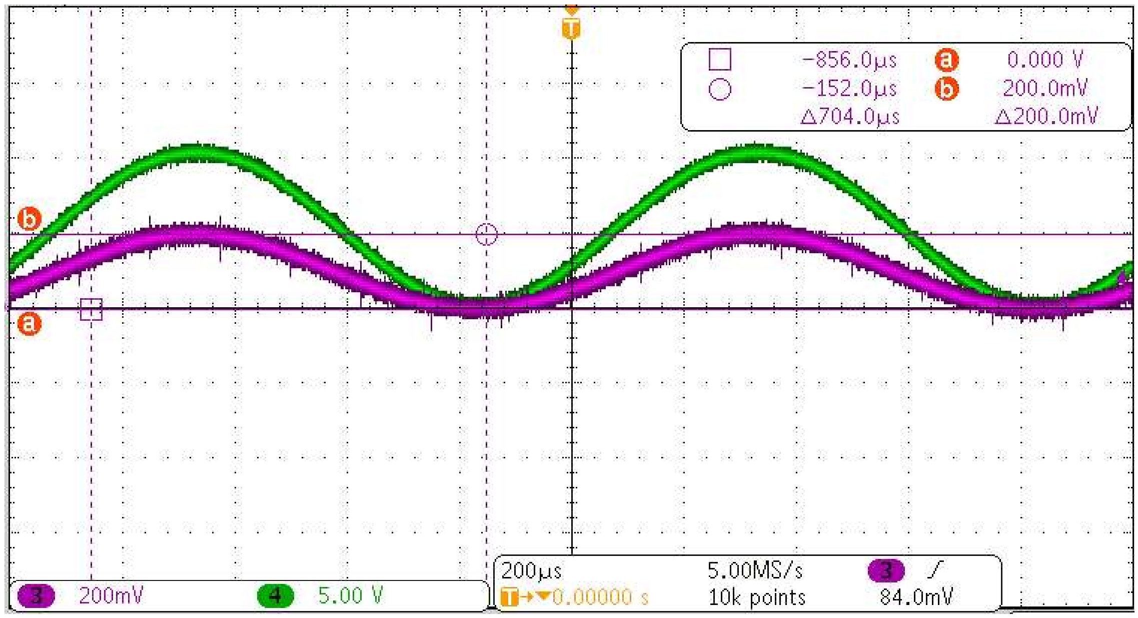
$R_{FET} = \left[\frac{(150\cdot 10^{-6})\cdot 60}{3}(2.5-.5)\right]^{-1} = 166.\bar{6}\ \Omega$

Gain $= R/R_{FET} = 50$ => $50 \cdot 166.\bar{6} = R = 8333.\bar{3}\ \Omega$

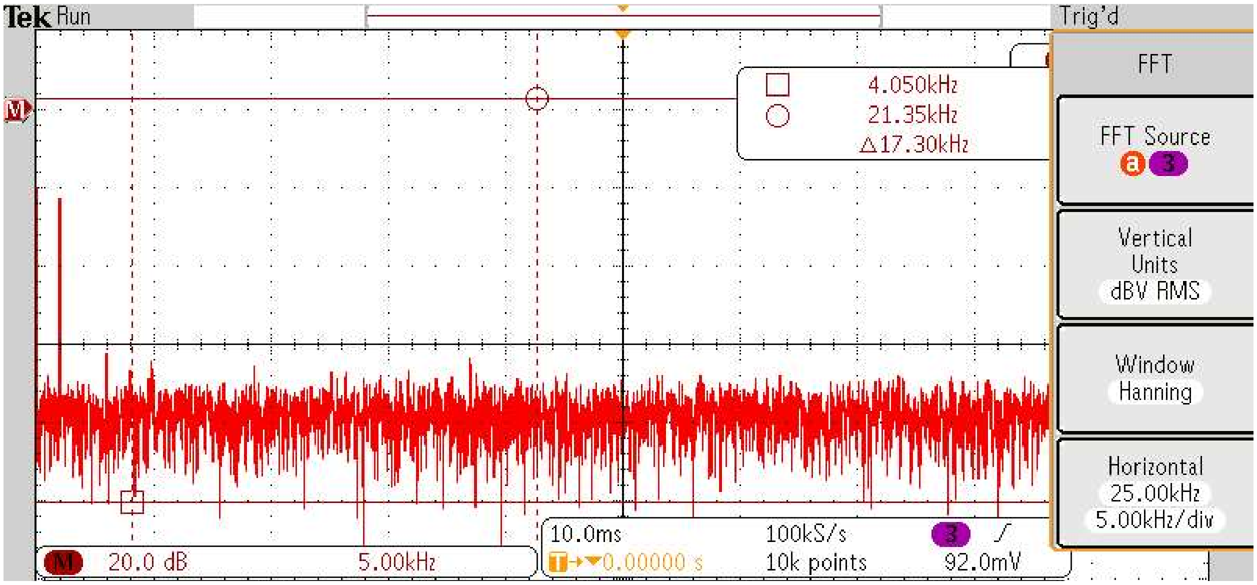
$8333.3\Omega \cdot \left[(150\cdot 10^{-6})20(V_{conr} - .5)\right]$ = Gain $= 25V_{conr} - 12.5$

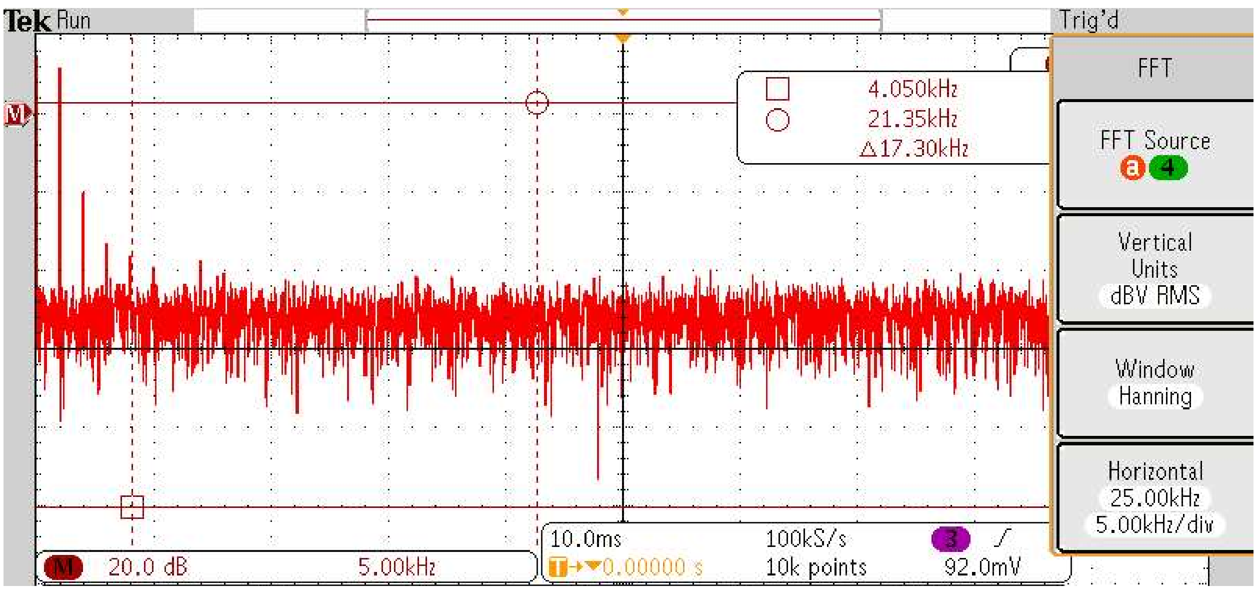
For Gain = 2, $V_{conr} = .58V$





As shown by the readings above, the input (3) at 200mV is amplified by the circuit with a gain of ~50 to 10.3V (4).
The fourier transforms of these readings are shown below

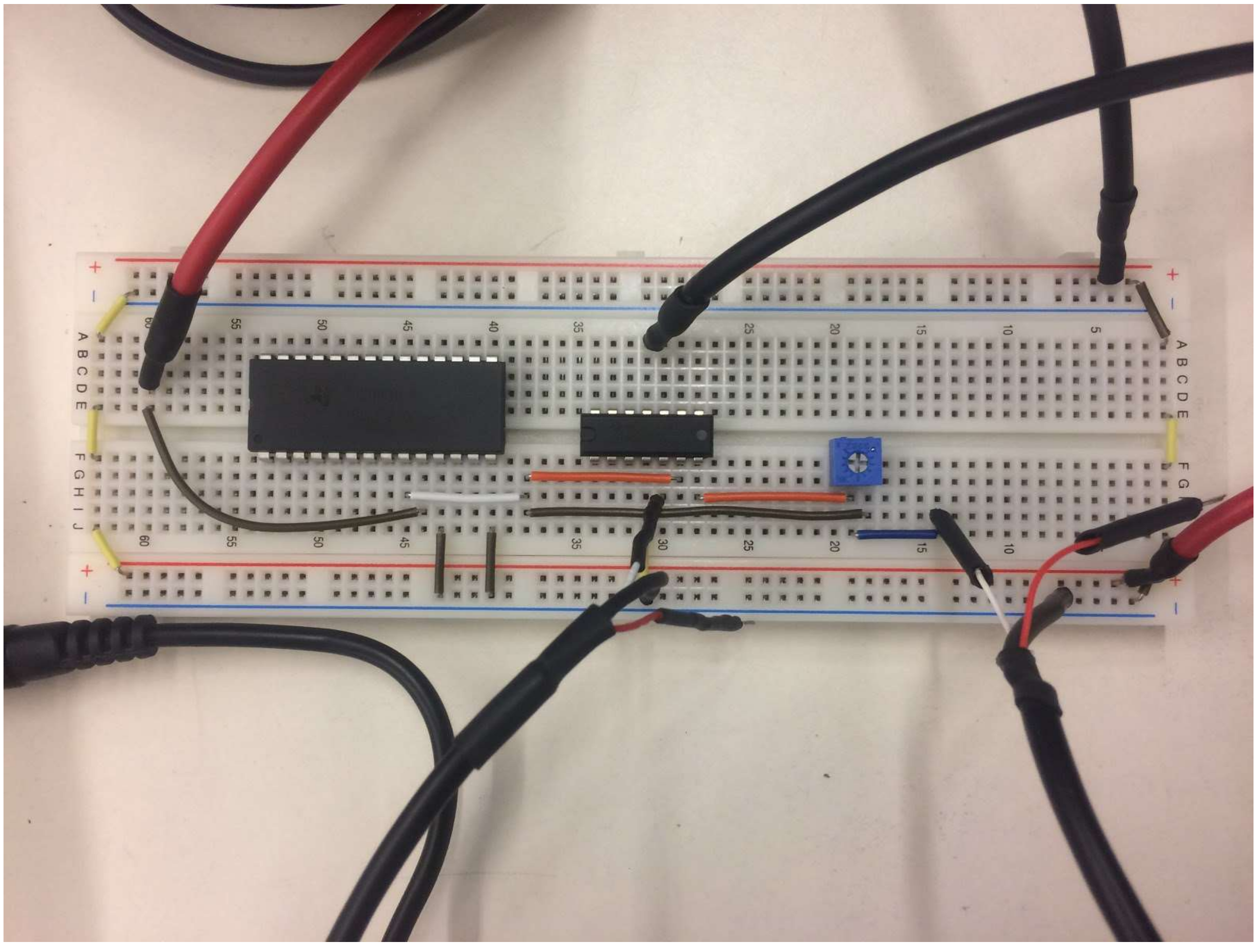




The FFTs of each signal are different because of the amount of distortion each signal experiences. The input signal (3) is pure, and so has only one large spike at the operation frequency, while the output signal (4) is partially distorted and as such has other large spikes at different frequencies.

Vcont must be changed to 0.58V for a gain of 2

Part 2: Fast Fourier Transform and Distortion



Using this circuit, where the wires from top to bottom, left to right are:
Vcont, -15V (Vcc), 0V (Gnd)
Audio-In, Audio-Out, +15V (Vdd)
Vdd is connected to the op-amp by a yellow wire slightly hidden behind Audio-In.

With high gain, the music sounded clear, with only a small amount of distortion if you really listened to it.
With low gain however, that distortion was much more noticeable, easily apparent whether or not something was playing.

Part 3: A Nonlinear Application

These circuits are both half-wave signal rectifiers, with the transistor acting as a diode when the input voltage drops below 0V. Therefore, for each circuit:

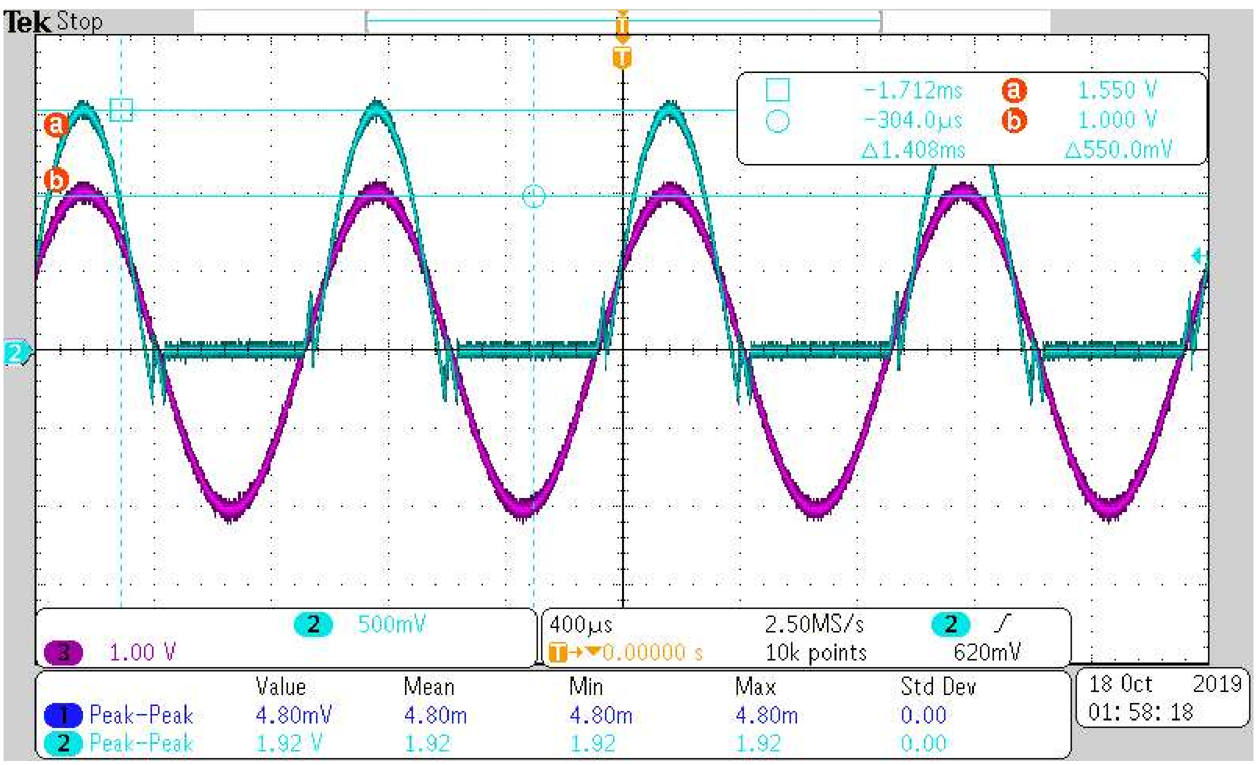
Vin <   0V ⇒ Vo = 0V

Vin >= 0V ⇒ Vo = Vin

The circuit will behave the same with a sinusoidal voltage, with values less than 0 unable to propagate through the circuit.

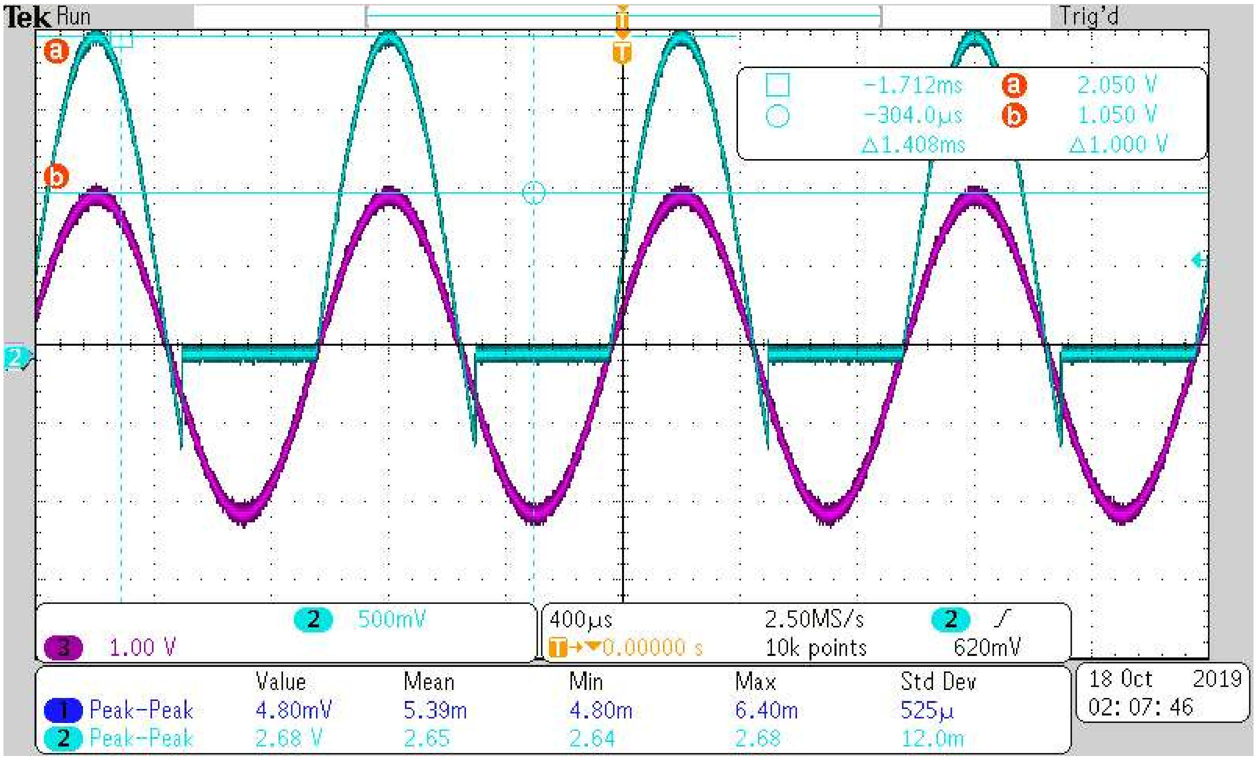
I used a 10k resistor for these circuits.

Circuit using MOSFET:



As seen above, the circuit provides a small amount of amplification to the input signal, but more notably acts as a half wave rectifier, cutting out the negative half of the input signal.

<u>Circuit using diode:</u>



This circuit provides a slight amount more amplication than its mirror using the MOSFET, but still acts as a signal rectifier. This circuit also appears to distort the output signal less than the other.