Electric Circuits & Electronics Design Lab

EE 316-01

Final: (Lab12) Amplification with MOSFETs

By: Jaiden Gann

Lab Section 316-01

Lab Date: 7/27/22

Lab Due: 7/29/22

Introduction:

For the final lab, I did the amplification with MOSFETs. There will be three sections: theoretical that gives some background on MOSFETS, experimental, and results and conclusion. The data gathered in lab along with pictures of the circuits will be provided in the Appendix.

Theoretical Analysis:

To start, we look at how a MOSFET is constructed, works, behaves depending on the state or mode it is in. The MOSFET is a three terminal unipolar semiconductor that is a voltage-controlled field effect transistor. The main gate is isolated from the current carrying channel and no current flows into the gate. They operate in two modes: depletion which requires the gate source voltage to switch off and enhancement which requires a gate source voltage to switch the device on. Figures 1 and 2 gives the characteristic curves for an n-channel MOSFET and p-channel MOSFET in depletion (a) and enhancement mode (b).

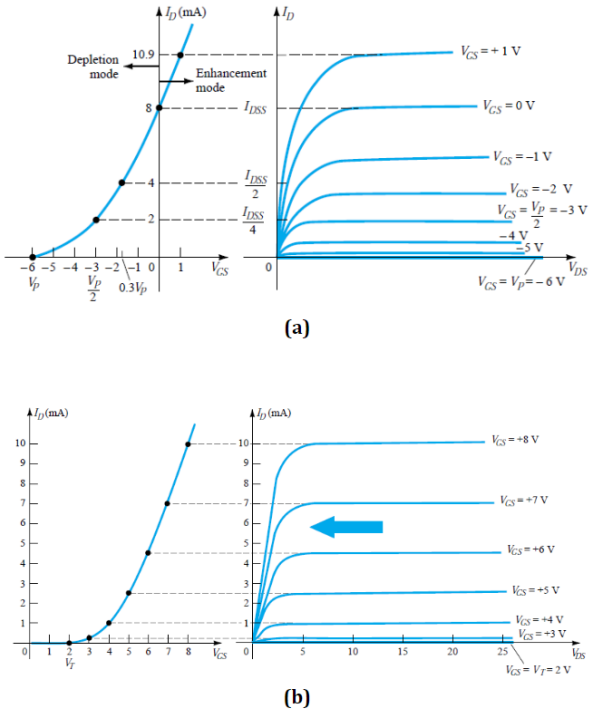


Figure 1. Characteristics of N-Channel MOSFET

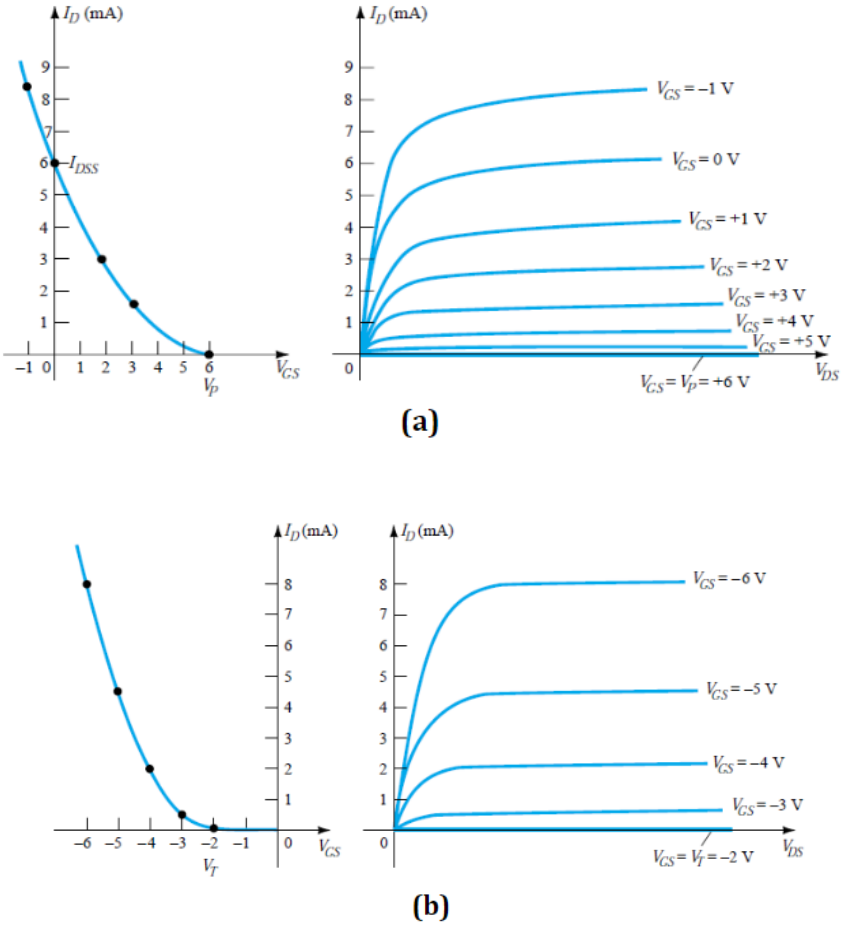


Figure 2. Characteristics of P-Channel MOSFET

Experimental:

For this part of the lab, we created the circuit in Figure 3 on a physical board and observed the output given a certain frequency. The gain versus frequency was plotted so we could observe the bandwidth of the MOSFET. The lowest frequency that would give a result was 30 Hz. The bandwidth is shown by the green line. Table 1 is the data collected and Figure 4 is the plot of gain versus frequency.

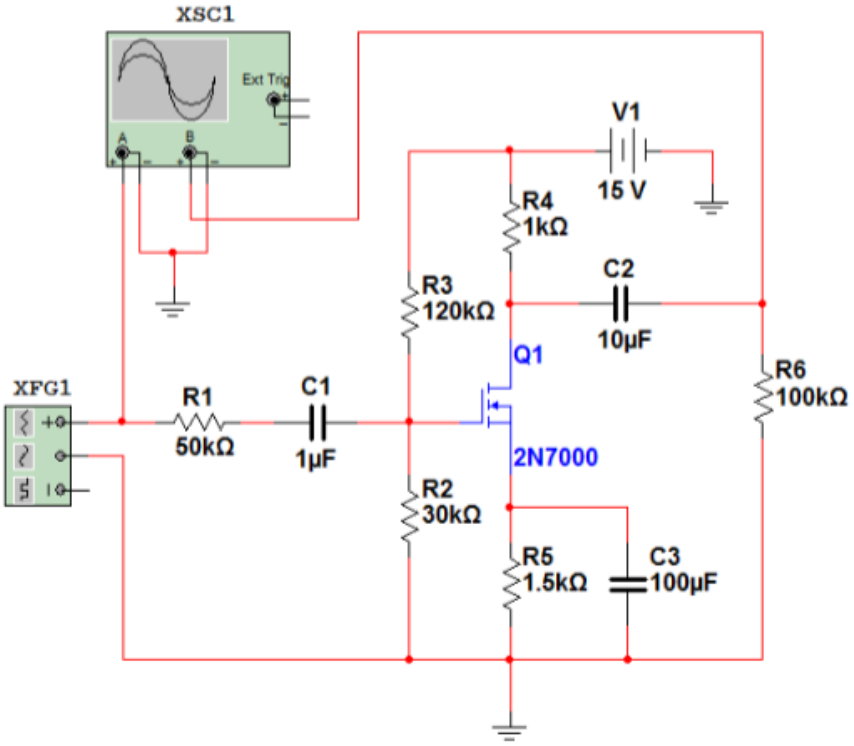


Figure 3. Amplification circuit with MOSFET

Table 1. Amplification observations

F(HZ)	V_{OUT} (mV)	Gain(db)
20	580	7.921441451
30	800	10.71468132
60	920	11.92863813
100	1.01 v	12.73930906
200	1.05 v	13.07666756
500	1.05 v	12.92881906
1000	1.05 v	12.92881906
2000	1.05 v	12.92881906
5000	1.03 v	12.76177757
10000	980	12.32955459
15000	940	11.96759015
20000	880	11.39468652
50000	580	7.62821902
75000	420	4.824644956
100000	340	2.989237489
150000	240	-0.03611602
200000	200	-1.61974094
500000	100	-7.64034085

750000	80	-9.57854111
1000000	60	-12.0773158
1500000	60	-12.0773158

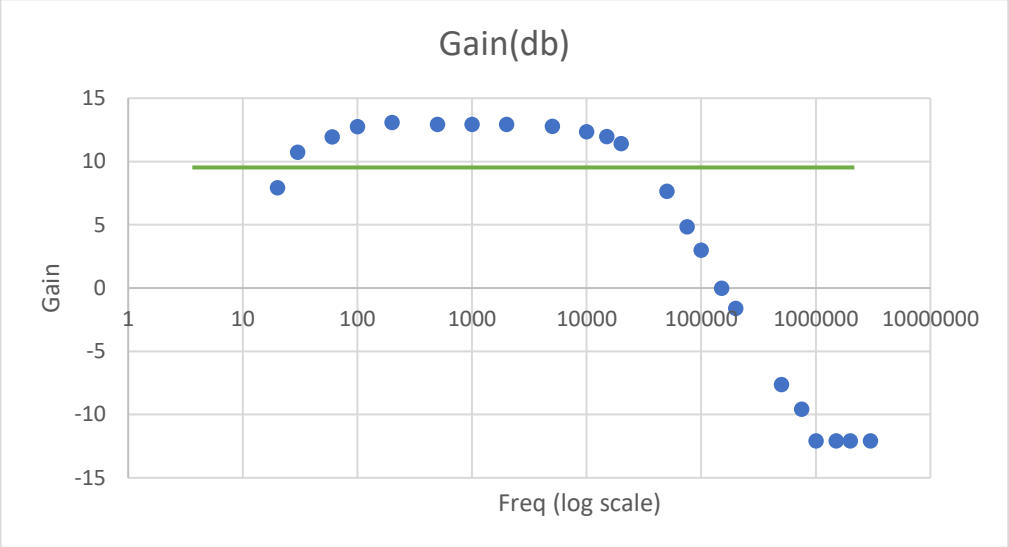


Figure 4. Gain vs Frequency

Results and Discussion:

The bandwidth is anywhere the gain is greater than 9. Compared to the previous results gathered for Lab 12 and in the simulation portion of that lab, the plot follows the same trend we say. Its also around the same gain as the simulation results. There are more points on the right side of the plot because the MOSFET starts out already being really close to the bandwidth which makes more points on the other side be lower.

Once again the oscilloscope was doing weird things. The auto scale would always default the output to around 400 mV after 1M Hz. The output gathered also seemed to be very high, however, this is not the first time the oscilloscope has given an output that is higher than it should be but still followed the correct trend.

Figure 5 is an example of the output waveform at 300 Hz and Figure 6 is the waveform at 3M Hz before pressing auto scale and Figure 7 is after pressing auto scale.

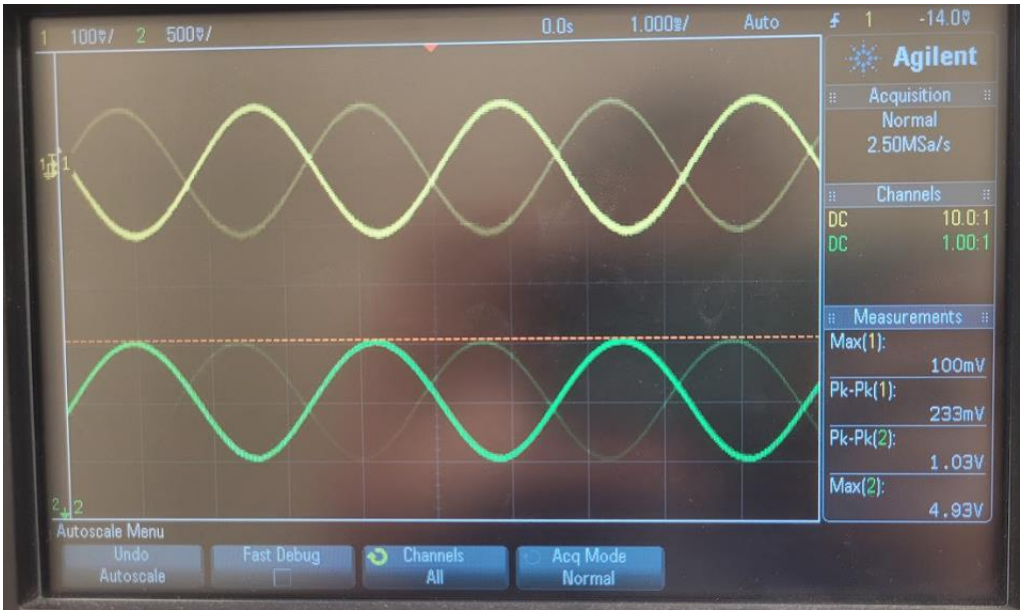


Figure 5. Waveform at 300 Hz

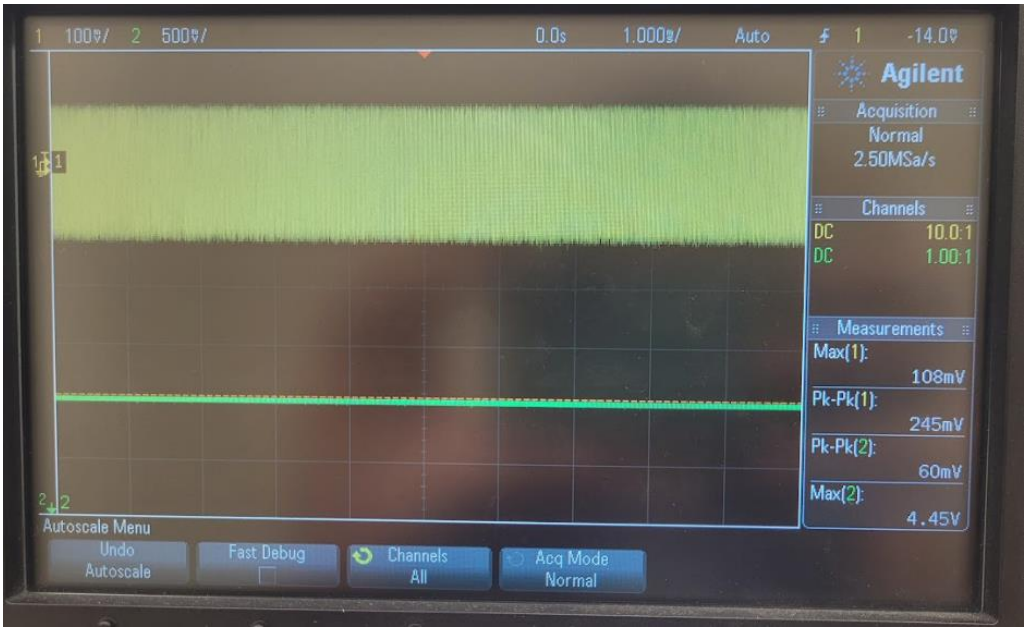


Figure 6. 3M Hz No Auto Scale

Figure 7. 3M Hz Auto Scale

Conclusion

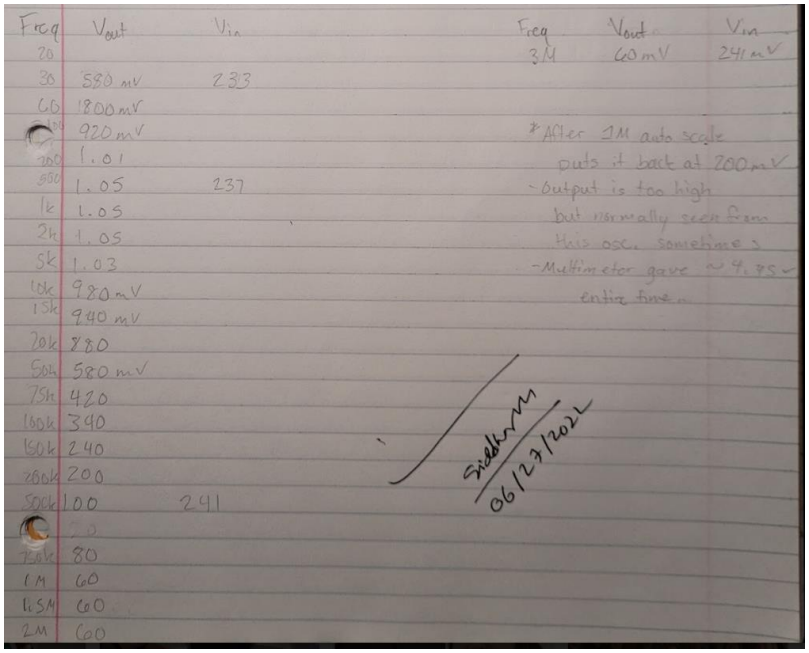
Overall, the results of lab matched pretty well with the simulation done earlier as far as the plot. The data itself in comparison to the simulation was higher but the highest gain was only 1 more than what was observed in simulation. In comparison to the last time the experimental part was done, the data itself is very different from the previous data collected but the plot is similar.

Appendix 1:

N/A

Appendix 2:

Signed lab results



Pictures of Circuits

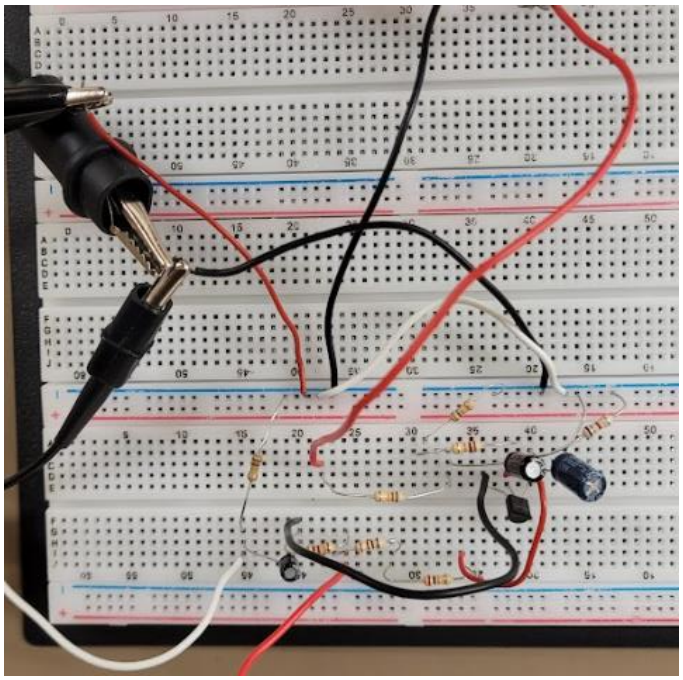


Figure 1. Characteristic Circuit (ref Figure 3)