

ECE 311, ELECTRONIC CIRCUITS



**LAB 6: MOSFET part 2**

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## 1 Problem or objective

We investigated the characteristics of two common MOSFET amplifiers in this lab: a common source amplifier and a source follower amplifier.

## 2 The abstract of this labratory

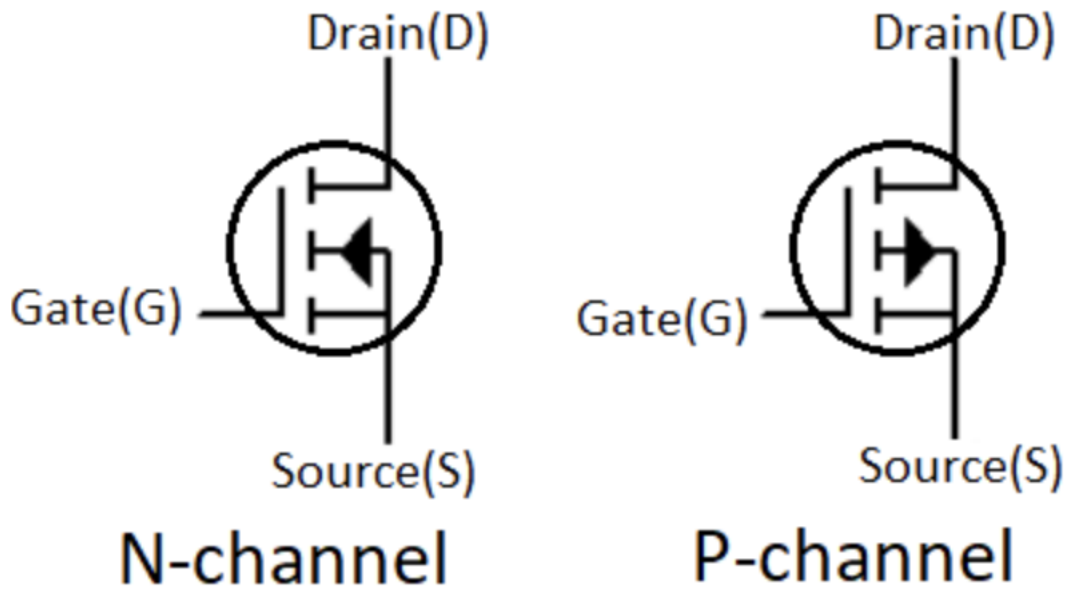
We began by simulating two separate circuits in LT-spice: a common source amplifier and a source follower amplifier. The simulations compared the effects of grounding the source to grounding the drain. We build these two circuits in the lab to compare the results in order to validate the simulation results.

## 3 intro about mosfet

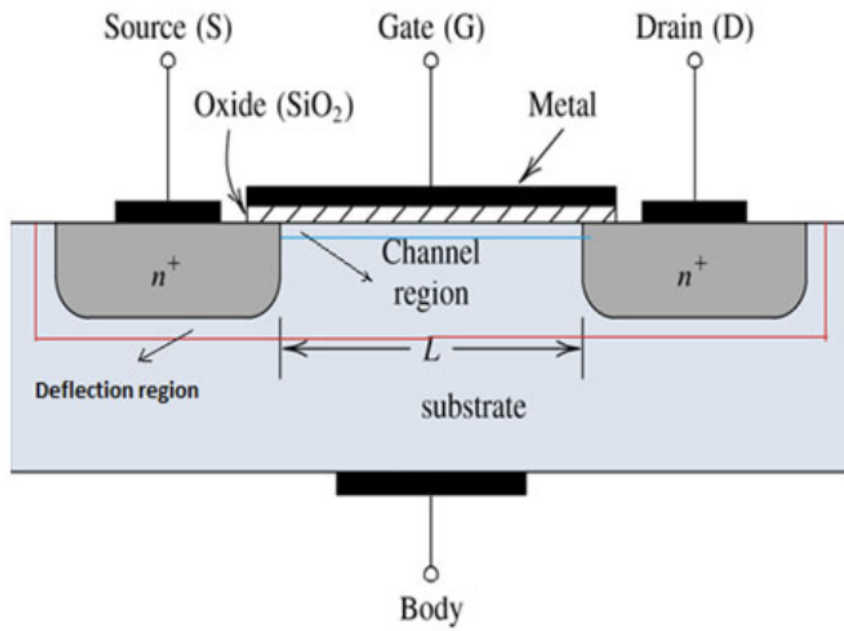
MOSFETs are a subtype of transistor. MOSFET is an abbreviation for metal-oxide-semiconductor field effect transistor. It allows and stops current flow without the use of a mechanical device. MOSFETS are more power efficient than bipolar junction transistors and are commonly used in their place.

A MOSFET has three terminals: the gate, the drain, and the source. MOSFETS are classified as either N-channel or P-channel. The direction of the arrow on the source terminal indicates the type. The MOSFET on the left in the figure below is an N-channel because the arrow points to the gate terminal. Because the arrow is pointing away from the gate terminal, the one on the right is a P-channel.

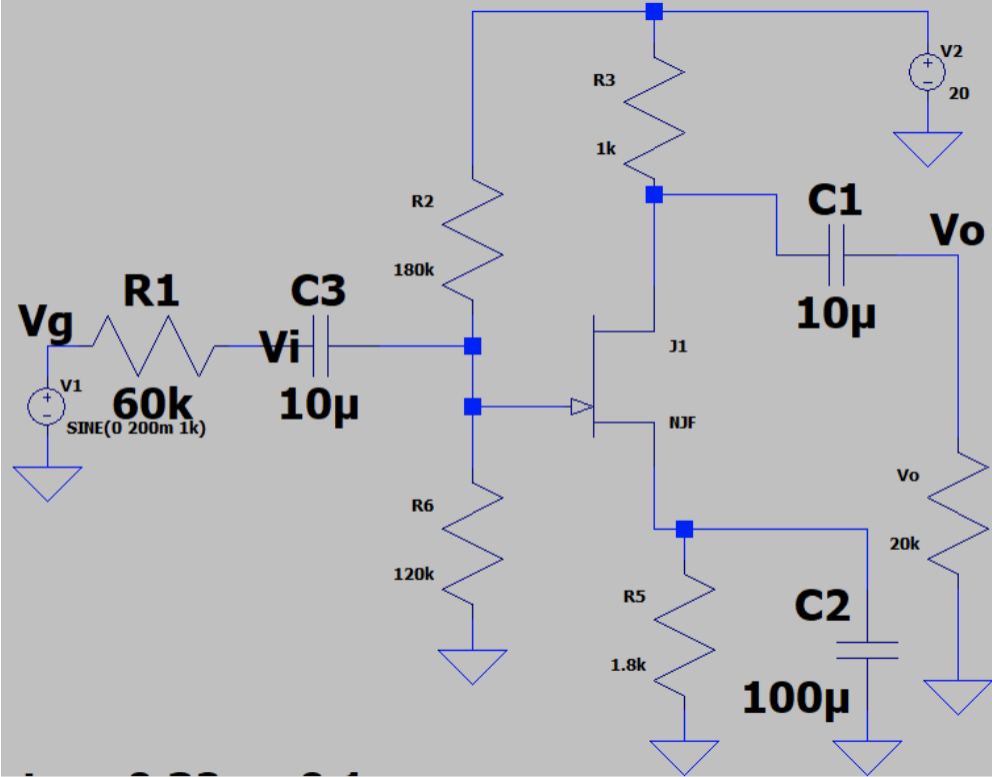
A MOSFET's internal structure is similar to that of two diodes and a capacitor. The cross hair region below the gate terminal in the diagram below is SiO<sub>2</sub> insulator. The metal regions are the solid black areas. The regions of N, P, and metals combine to form an E-field.



There is a depletion zone, just like in a bipolar junction transistor. Doping is the process of impurities being added to a semiconductor. We can use this process to create an N-channel by increasing the number of free electrons, or we can use it to create a P-channel by decreasing the number of free electrons. If we want the magnetic field to travel from the top of the MOSFET to the bottom, we should connect the positive side of the input to the gate terminal. Another power source is connected from the source to the drain. When electrons from this path are grabbed, it creates a channel by using the electric field to grab the electrons from this path. This is the design of a MOSFET.

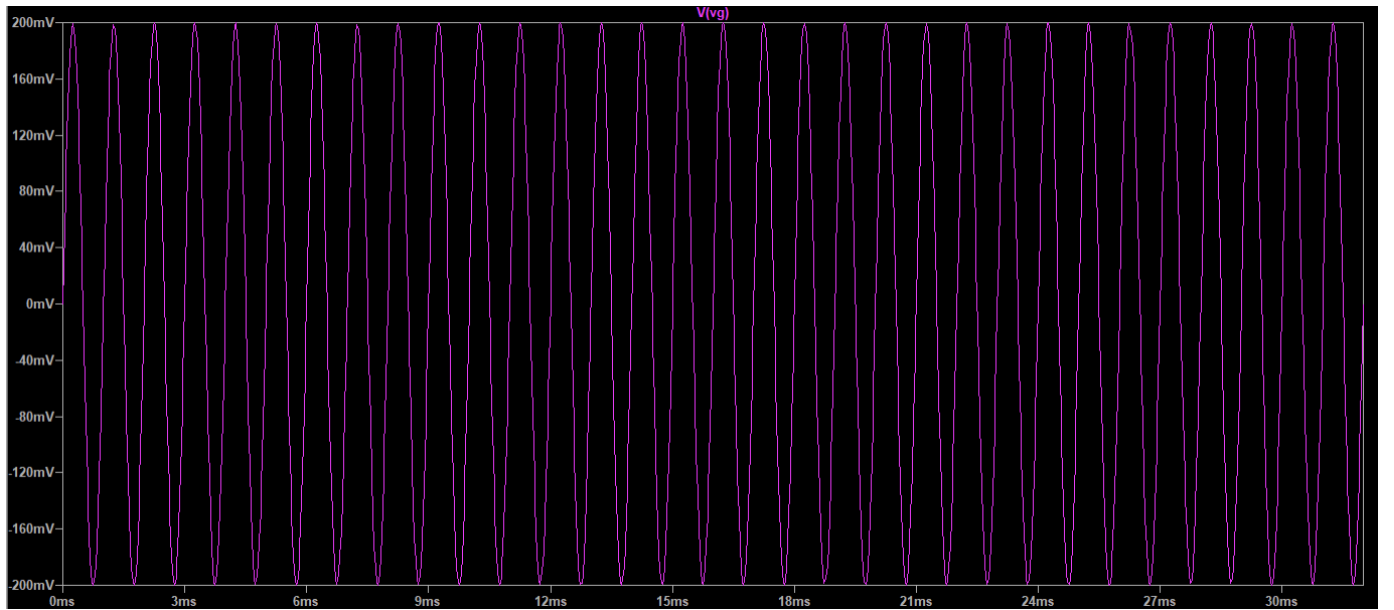
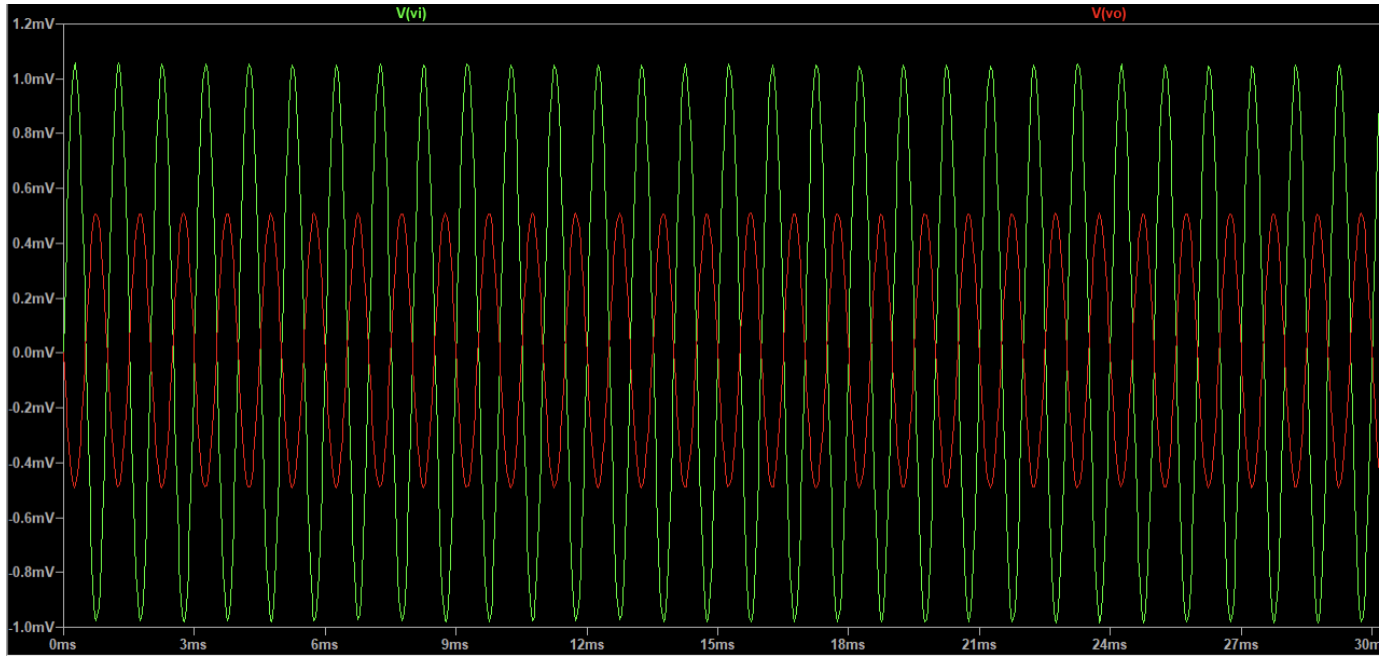


# 4 simulation

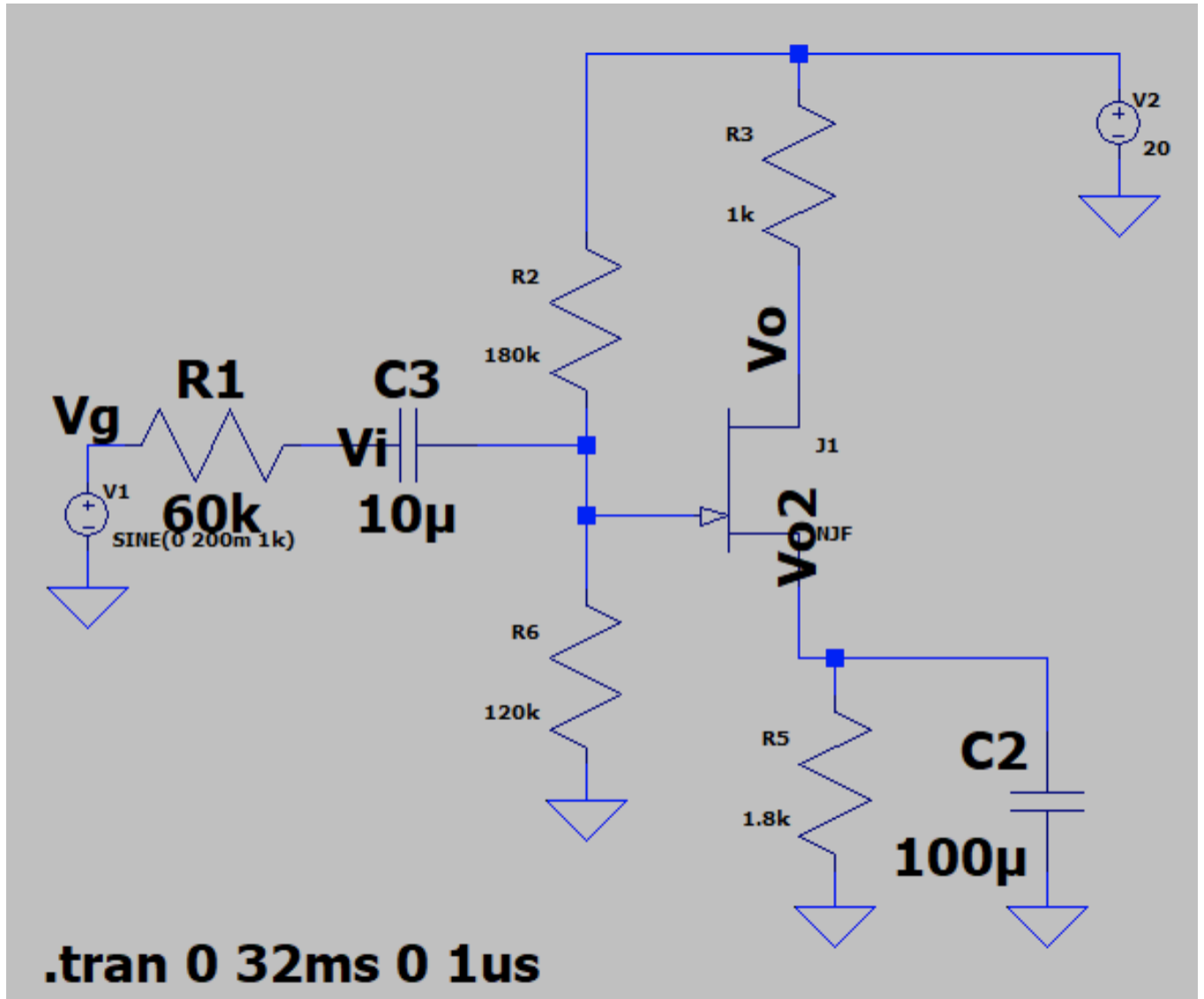


The above graph is The MOSFET common-source (CS) amplifier , which is analogous to the BJT common-emitter amplifier. Its popularity stems from its high gain and the fact that by cascading several of them, larger signal amplification can be achieved.

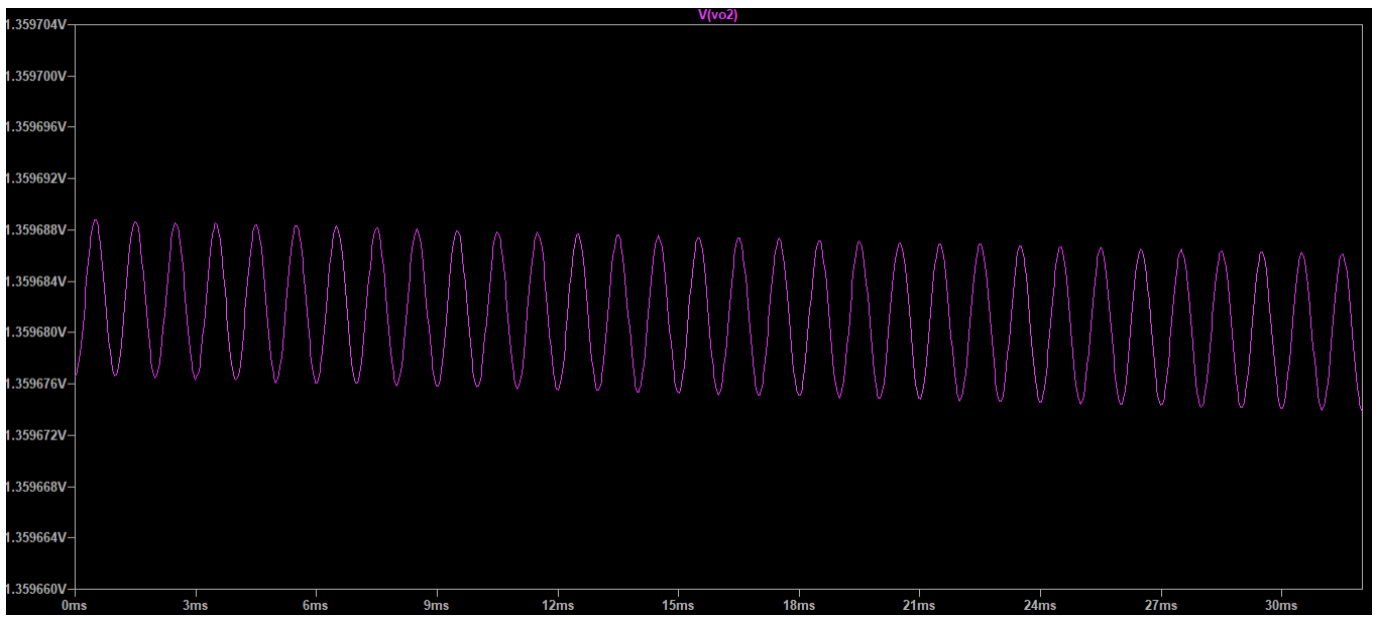
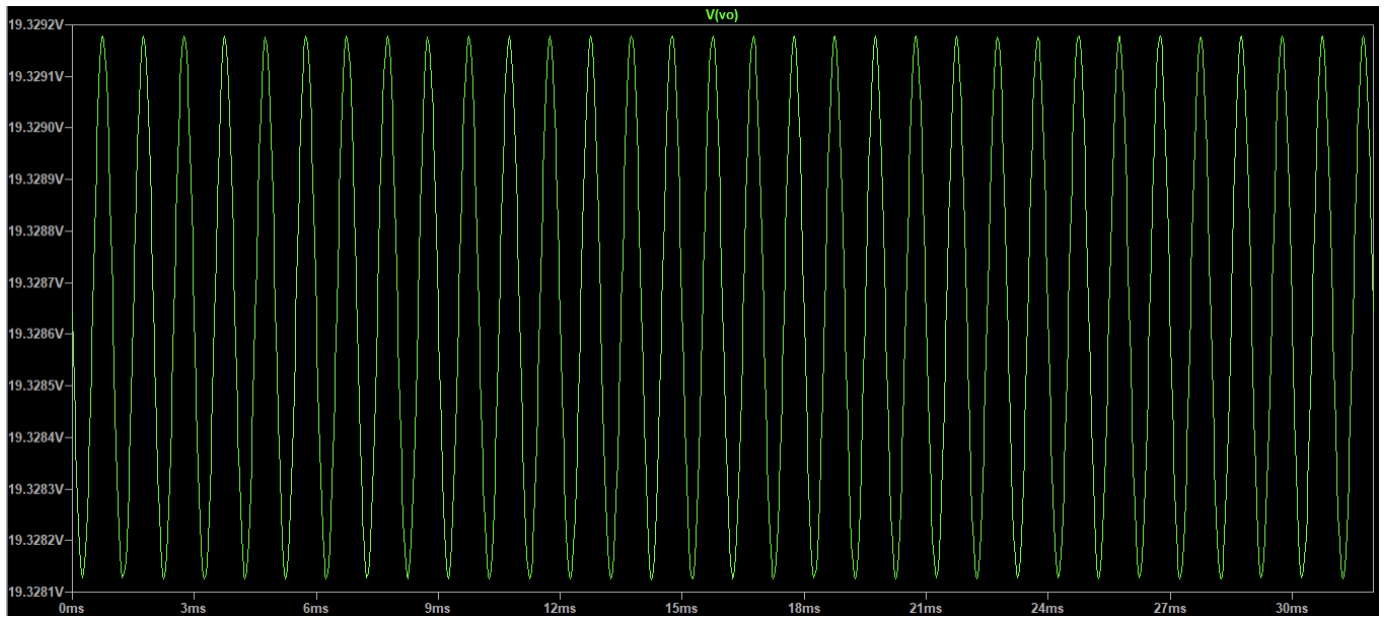
The large amplification achieved due to the mosfet’s characteristics can be seen below. which is why the top schematic consisted of the (CS) amplifier.

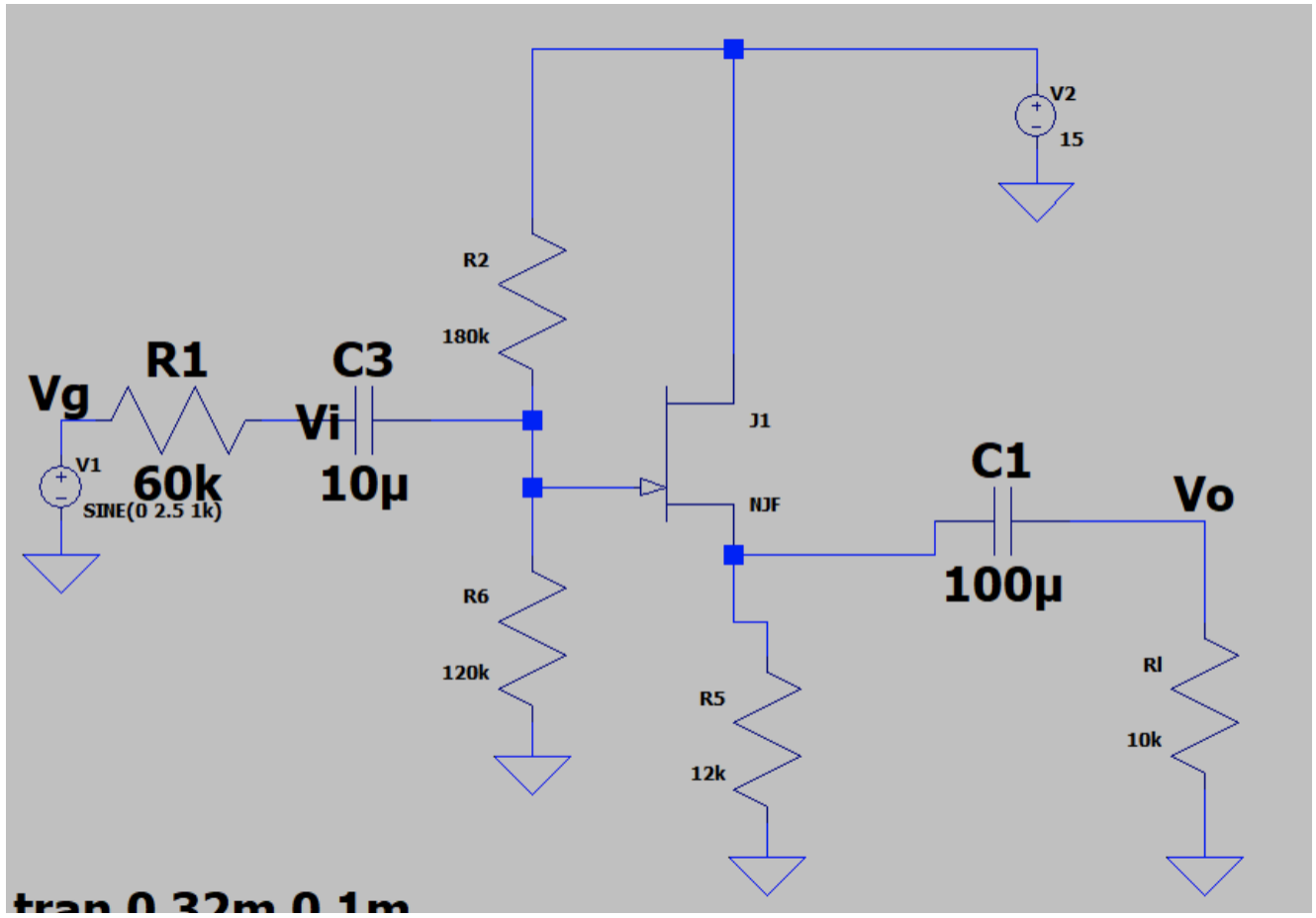


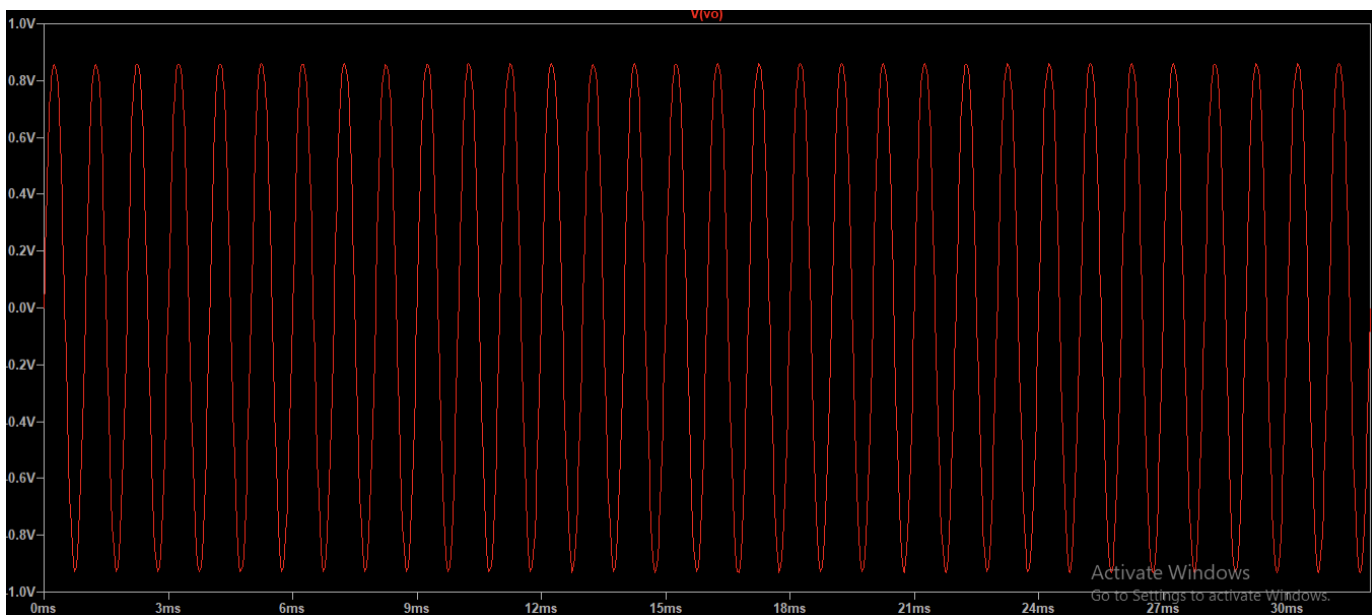
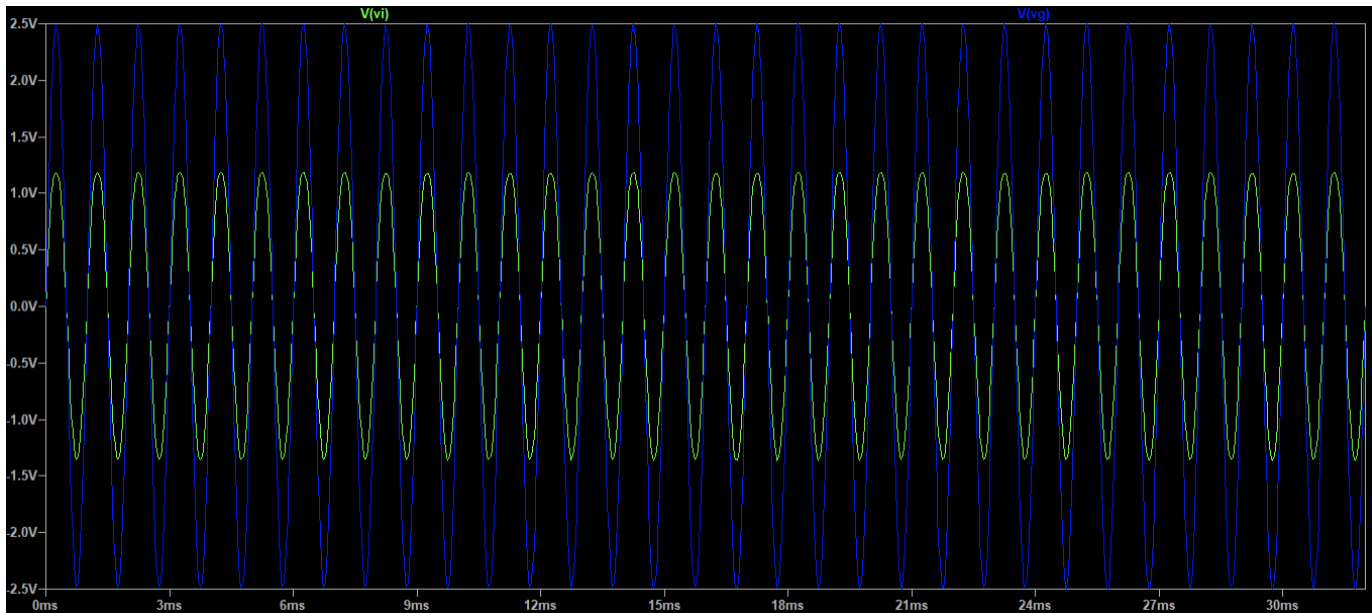
the above graph was of  $v_g$ .

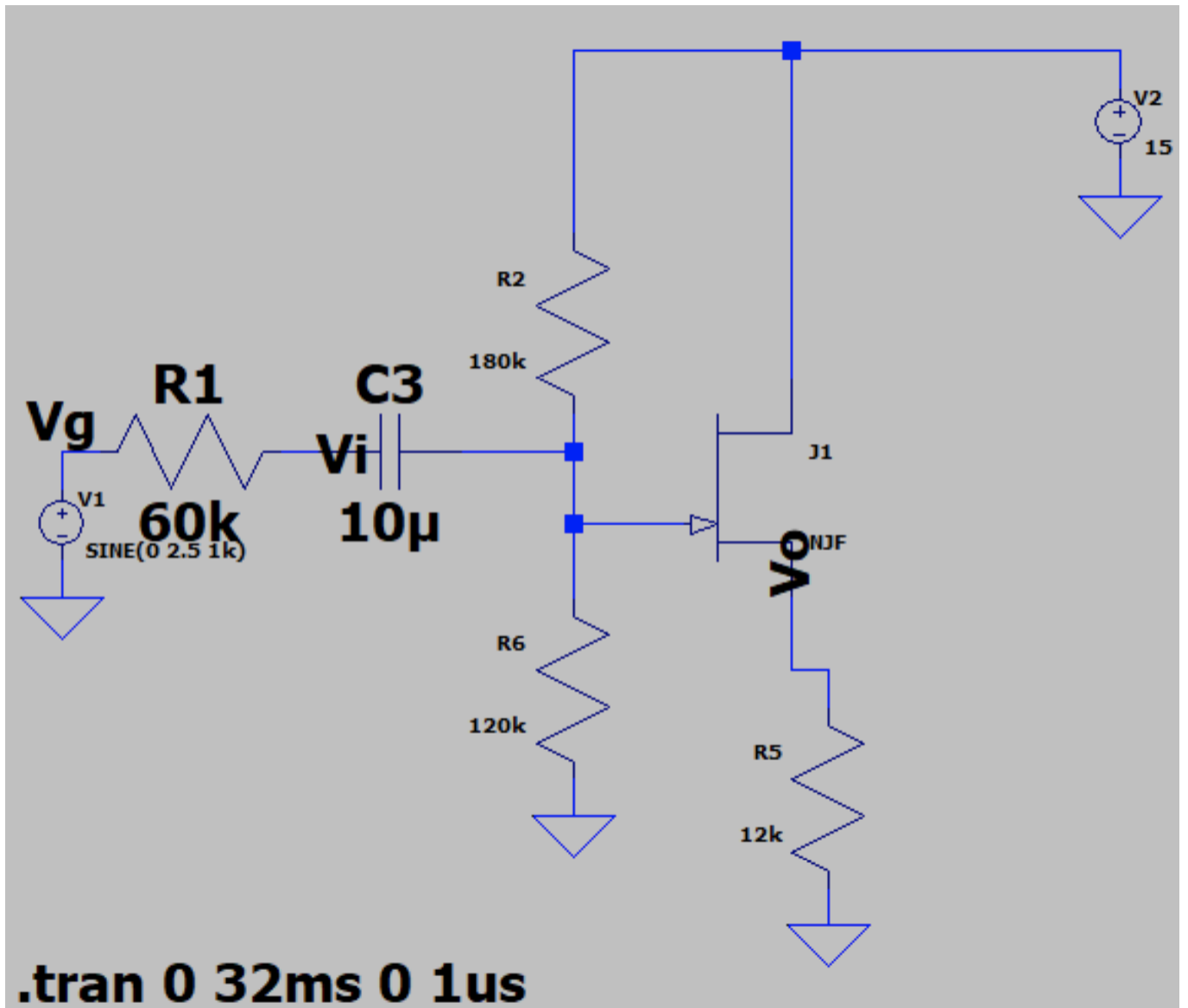


this the common source schematic diagram

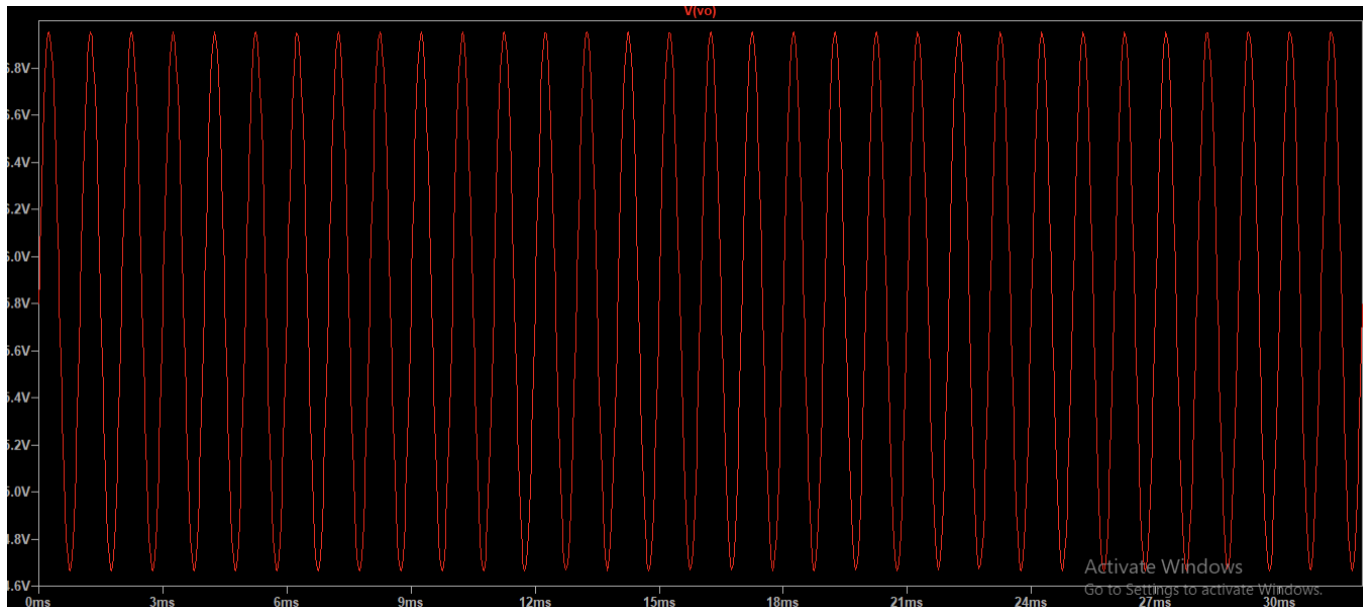








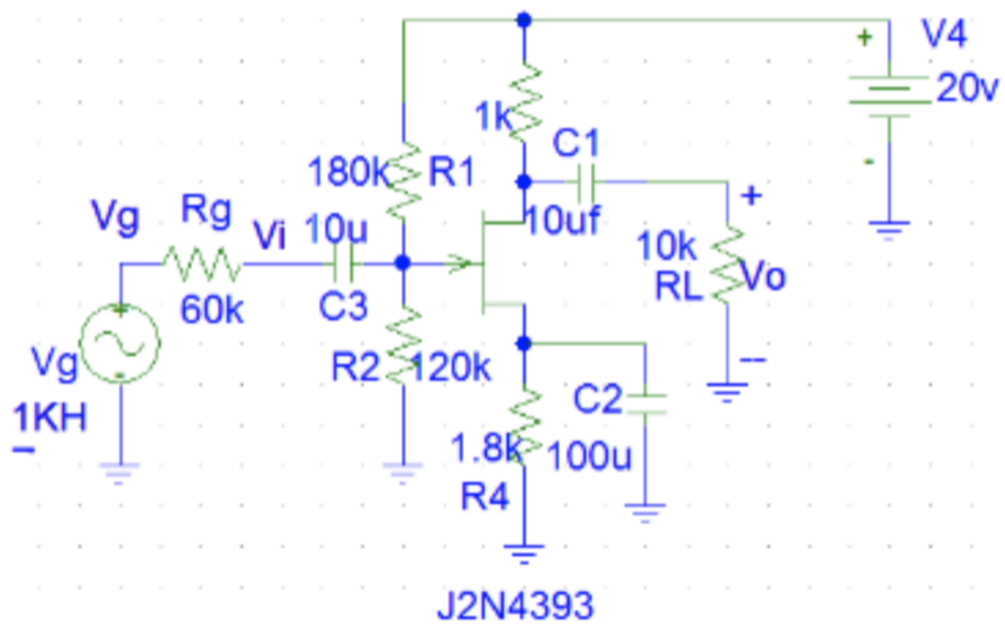
this shows an amplifier of the source follower.



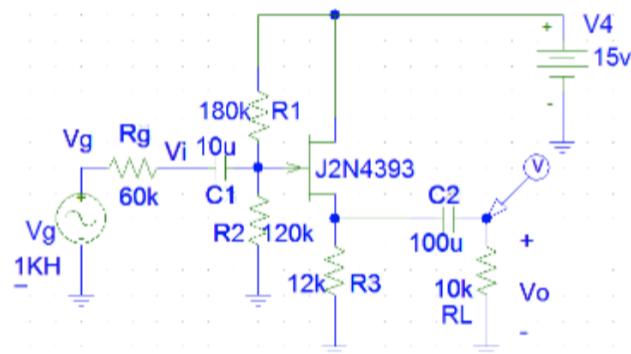
3	part 1			
4				
5	Li	$(v_g - V_i)/r_g$	$(200\text{m} - 1\text{m})/60\text{k}$	3.32
6	Io	$V_o/R_i$	$.5\text{m}/20\text{k}$	.025u
7	Ri	$V_i/I_i$	$1\text{m}/.025\text{u}$	40k
8	Ro	$V_o/I_o$	$.5\text{m}/.025\text{u}$	20k
9	Avo	$V_o/V_i$	$.5\text{m}/1\text{m}$	0.5
10	Av	$V_o/V_i$	$.5\text{m}/1\text{m}$	0.5
11	Ai	$I_o/I_i$	0.007537	
12	Ap	$A_v * A_i$	$.5 * 0.00753$	0.003796

3	part 1			
4				
5	$L_i$	$(v_g - V_i)/r_g$	$(200m - 1m)/60k$	3.32
6	$l_o$	$V_o/R_i$	$.5m/20k$	.025u
7	$R_i$	$V_i/l_i$	$1m/.025u$	40k
8	$R_o$	$V_o/l_o$	$.5m/.025u$	20k
9	$A_{vo}$	$V_o/V_i$	$.5m/1m$	0.5
10	$A_v$	$V_o/V_i$	$.5m/1m$	0.5
11	$A_i$	$l_o/l_i$	0.007537	
12	$A_p$	$A_v * A_i$	$.5 * 0.00753$	0.003796

## 5 experiment



2	Vg Peak	400mv	
3	Vi Peak	350mv	
4	Vo w/o RL	100mv	
5	Vo w/ RL	4.652mv	
6			
7			
8			
9	parameter	equaiton	calculation result
10	li	$(Vg-Vi)/Rg$	5uA
11	lo	$Vo/RI$	.4625mA
12	Ri	$Vi/li$	70kohms
13	Ro	$Vo/lo$	10kohms
14	Avo	$Vo/vi$	13.21v/v
15	Av	$vo/vi$	13.21v/v
16	Ai		1 1.0v/v
17	Ap	$vo/vi$	13.21v/v



20	Vg Peak	400mv	
21	Vi Peak	5.225(v)	
22	Vo w/o RL	5.275(v)	
23	Vo w/ RL	4.000(v)	
24			
25	parameter	equaiton	calculation result
26	li	$(Vg-Vi)/Rg$	-0.483
27	lo	$Vo/RI$	.400mA
28	Ri	$Vi/li$	10.28kohms
29	Ro	$Vo/lo$	10kohms
30	Avo	$Vo/vi$	.766v/v
31	Av	$vo/vi$	.766v/v
32	Ai	1	1.0v/v
33	Ap	$vo/vi$	.766v/v

## 6 discussion of results

Because the  $A_p$  is less than one, the data appears to be incorrect. When the RL is removed, the  $V_o$  is much larger than either the  $V_i$  or  $V_g$ , which appears to be consistent with what would be expected. These simulation results contradict the hardware results, which appear to have more accurate data based on figure 17 due to  $A_p$  being greater than one and  $V_i$  not dropping as much as the simulation data.

Despite having a lower  $V_o$  than  $V_i$ , the data appears to be correct because the  $A_p$  is greater than one. When the RL is removed, the  $V_o$  increases significantly. The hardware results, as in Part 1, differ from the simulated data. However, the data this time leads me to believe that the simulation was more correct because the  $A_p$  was greater than one only for the simulation and the hardware data had a  $V_i$  peak greater than  $V_g$ .

## 7 concoulsion

We investigated the characteristics of two common MOSFET amplifiers in this lab: a common source amplifier and a source follower amplifier. To simulate these two circuits, we used LT-spice and. The results of the simulations and hardware experiments demonstrated the effects of grounding the source versus the drain.