

ELEC-313
Lab 7: MOSFET Amplifier Circuits

November 12, 2013

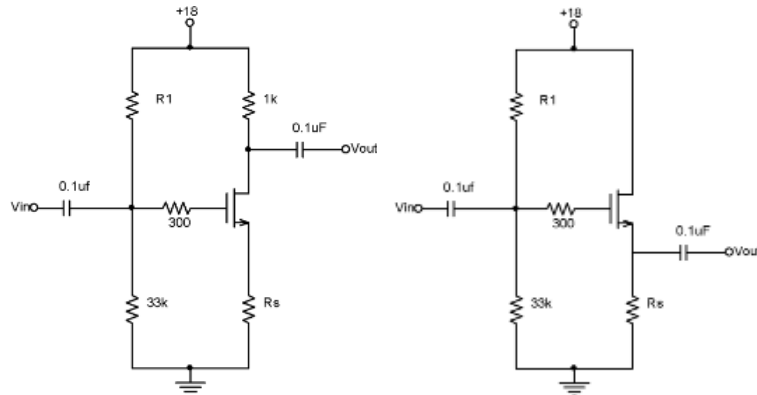
Date Performed: November 06, 2013
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1 Objective

2 Equipment

Transistor: 2N7000 Power supply: HP E3631A
Function generator: HP 33120 Multimeter: HP 34401A
Oscilloscope: Agilent 54622D Capacitors: $0.1\ \mu\text{F}$
Resistors: $100\ \Omega$, $300\ \Omega$, $470\ \Omega$, $1\ \text{k}\Omega$ (x2) $33\ \text{k}\Omega$, $100\ \text{k}\Omega$ (x2)

3 Schematics



(a) Common-source amplifier (b) Source-follower amplifier

Figure 1: Circuits used in this lab. $R_1 = 100\ \text{k}\Omega$, $R_s = 470\ \Omega$

4 Procedure

The following procedures were identified to observe the basic operation of MOSFET amplifier circuits.

4.1 Common-Source Amplifier

1. Build the circuit of figure 1. Use the closest resistor values available for R_1 and R_s .
2. Measure and record the dc voltages at all terminals of the MOSFET. Compute the drain current.
3. Set the function generator for a 200mV PP , 20-kHz sine wave with 0V DC offset. Connect it to V IN .

4. Connect a 100kohm load resistor from V OUT to ground. This will be considered a no-load scenario.
5. Connect CHANNEL 1 of the oscilloscope to V IN and CHANNEL 2 to V OUT . Set the scope to trigger off of CHANNEL 1 . This setting is accessed using the EDGE button on the oscilloscope.
6. Adjust the function generator to an amplitude of 200mV pp as measured on CHANNEL 1 of the oscilloscope.
7. Measure the peak-to-peak output voltage on CHANNEL 2 of the oscilloscope.
8. Repeat step 6 for input voltages (as measured on CHANNEL 1 of the oscilloscope) of 300, 400, 500, 600, 700, 800, 900, and 1000mV pp .
9. Replace the 100kohm from V OUT to ground with a 1kohm load resistor.
10. Reset the function generator to an amplitude of 200mV pp as measured on CHANNEL 1 of the oscilloscope.
11. Measure the peak-to-peak output voltage on CHANNEL 2 of the oscilloscope.

4.2 Source-Follower Amplifier

1. Construct the circuit of figure 2 by removing the 1kohm drain resistor and moving the output capacitor to the source of the MOSFET.
2. Measure and record the dc voltages at all terminals of the MOSFET. Compute the drain current.
3. Connect a 100kohm load resistor from V OUT to ground. This will be considered a no-load scenario.
4. Adjust the function generator to an amplitude of 200mV pp as measured on CHANNEL 1 of the oscilloscope.5) Measure the peak-to-peak output voltage on CHANNEL 2 of the oscilloscope.
5. Repeat step 4 for input voltages (as measured on CHANNEL 1 of the oscilloscope) of 300, 400, 500, 600, 700, 800, 900, and 1000mV pp .
6. Reset the function generator to an amplitude of 200mV pp as measured on CHANNEL 1 of the oscilloscope.
7. Replace the 100kohm resistor from V OUT to ground with a 1kohm resistor and measure the peak-to-peak output voltage on CHANNEL 2 of the oscilloscope.
8. Now replace the 1kohm load resistor with a 100ohm load resistor and measure the peak-to-peak output voltage on CHANNEL 2 of the oscilloscope.

5 Results

5.1 Common-Source Amplifier

V_G	V_D	V_S	I_D
4.391 V	13.498 V	2.11 V	4.52 mA

Table 1: Transistor characteristics

V_{in} (mV)	V_{out} (V)
200	0.382
300	0.566
400	0.760
500	0.939
600	1.140
700	1.340
800	1.530
900	1.721
1000	1.90

Table 2: Common-source amplifier

5.2 Source-Follower Amplifier

V_G	V_D	V_S	I_D
4.391 V	18.003 V	2.12 V	4.579 mA

Table 3: Transistor characteristics

6 Conclusion

7 Equations

$$V_{o,L} = V_{o,NL} \frac{R_L}{R_o + R_L} \quad (1)$$

$$V_G = \frac{V_{DD} \cdot 33 \text{ k}\Omega}{100 \text{ k}\Omega + 33 \text{ k}\Omega} \quad (2)$$

$$V_S = V_G \cdot \sqrt{\frac{I_D}{K_N}} - V_{TN} \quad (3)$$

$$V_D = V_{DD} - I_D \cdot 1 \text{ k}\Omega \quad (4)$$

V_{in} (mV)	V_{out} (mV)
200	182
300	268
400	360
500	451
600	541
700	634
800	725
900	813
1000	906

Table 4: Source-follower amplifier

	V_G (V)	V_D (V)	V_S (V)	I_D (mA)
Measured	4.391	13.498	2.11	4.52
Theoretical	4.466	14.000	2.4214	4.00
% Difference	1.712%	3.719%	14.800%	11.500%

Table 5: % Difference

$$\%_{diff} = \frac{|measured - theoretical|}{theoretical} \times 100\% \quad (5)$$