ELEC 313 Lab 7
MOSFET Amplifier Circuits

REFERENCE: Appropriate chapters of ELEC 306 text.

OBJECTIVE: The objective of this experiment is to observe the basic operation of MOSFET amplifier circuits.

EQUIPMENT: MOSFET 2N7000
Resistors: 100Ω, 300Ω, 470Ω, 2×1kΩ, 33kΩ, 2×100kΩ
Capacitors: 2×0.1μF
Power Supply (Vdc), Function Generator, Multi Meter(s), Oscilloscope,

PRIOR PREPARATION (Pre-Lab):

In the circuit shown in figure 1, with V_{DD} =18 V, determine the values of R_1 and R_s that make the voltage at the MOSFET gate 4V and the drain current 4mA. The transistor is a 2N7000. Use a gate threshold voltage of 2V and let $\frac{1}{2}k_n'\left(\frac{W}{L}\right) = 75\frac{mA}{V^2}$.

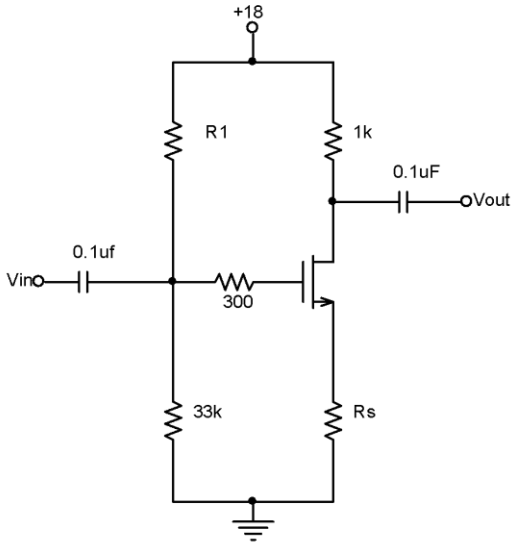

Figure 1: Common Source Circuit.

EXPERIMENT

Common Source Amplifier

1) Build the circuit of figure 1. Use the closest resistor values available for R1 and Rs.
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 100kΩ 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 100kΩ from V_{OUT} to ground with a 1kΩ 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.

Source Follower Amplifier

1) Construct the circuit of figure 2 by removing the 1kΩ drain resistor and moving the output capacitor to the source of the MOSFET.

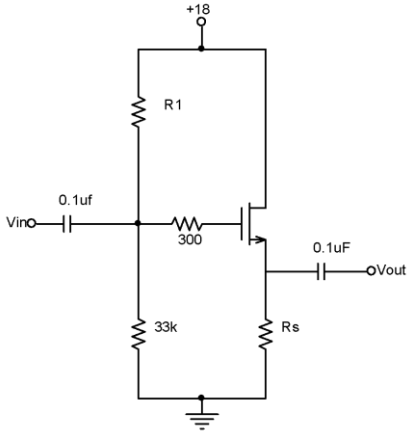

Figure 2: Source Follower Circuit.

2) Measure and record the dc voltages at all terminals of the MOSFET. Compute the drain current.
3) Connect a 100kΩ 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.
6) 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}.
7) Reset the function generator to an amplitude of 200mV_{pp} as measured on CHANNEL 1 of the oscilloscope.
8) Replace the 100kΩ resistor from V_{OUT} to ground with a 1kΩ resistor and measure the peak-to-peak output voltage on CHANNEL 2 of the oscilloscope.
9) Now replace the 1kΩ load resistor with a 100Ω load resistor and measure the peak-to-peak output voltage on CHANNEL 2 of the oscilloscope.

Data Analysis

Common Source Amplifier

- Determine the theoretical DC voltages with the actual resistor values used in lab and the FET specifications from the prelab. Compare these to the measured DC voltages.

- Compute the no-load ac voltage gain of the amplifier at each input level by comparing the input and output V_{pp} measurements. Make a plot of gain vs. input voltage.

- Based on the no-load and loaded output voltages calculate the output resistance of the circuit.

Source Follower Amplifier

- Compute the no-load ac voltage gain of the amplifier at each input level by comparing the input and output Vpp measurements. Make a plot of gain vs. input voltage.

- Based on the no-load and loaded output voltages calculate the output resistance of the circuit.

LAB REPORT

Your report should be completed in the format requested by the instructor. The lab report should include conclusions about the gains and output resistances of each type of amplifier and should discuss when each amplifier would be useful.