EE 3310L/5310L · Electronic Devices and Circuits Laboratory

Lab 7: Common-Source N-Channel MOSFET Voltage Amplifier

Purpose

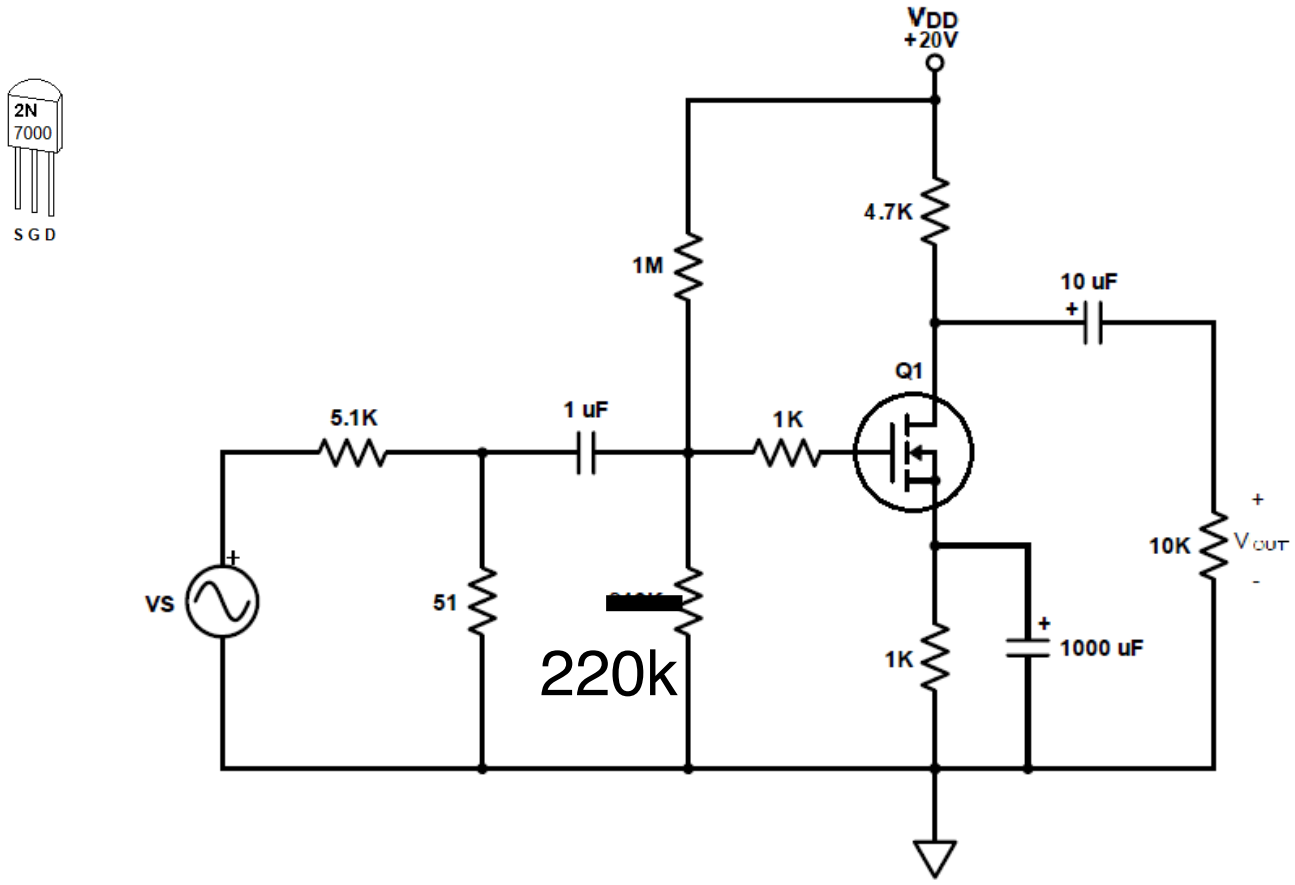
The purpose of this lab is to construct and test a common-source voltage amplifier using a 2N7000 N-channel enhancement-type MOSFET. **Important: due to the insulated gate that distinguishes a MOSFET from a JFET, these are static-sensitive devices! Handling of MOSFETs should only be done in a proper ESD-safe environment with dissipative work surface and wrist strap. Use caution and try not to touch the gate terminal!**

We will analyze the DC operating point, amplifier gain, and frequency response.

Procedure

DC Circuit

Build the following circuit. Measure and record all transistor DC voltages before applying an AC signal. For reference, you should measure approximately 1.8 V at the source of the MOSFET for a quiescent drain current of 1.8 mA. If necessary, adjust the resistor values in the bias network to achieve this operating point. Note the 1-kΩ resistor in series with the MOSFET gate; this is a widely-used technique called a *gate stopper* resistor and should be placed as close to the gate as possible in order to prevent parasitic oscillation.



3) Connect channel 1 of the oscilloscope to the function generator and channel 2 to the output of the amplifier (V_{OUT}).

4) Set the signal generator to 1 $V_{P\text{-}P}$, 1 kHz sine and verify this amplitude on the oscilloscope. Display both channels simultaneously; **the output waveform should be an inverted sine wave**.

5) **Measure and record the peak-to-peak output voltage shown on the oscilloscope. Use it to calculate the 1-kHz gain of the amplifier by $A_V = (V_{OUT}/V_S)$. Also compute A_V(dB).** Don't forget to divide V_S by 100, as this is the effective signal amplitude at the input of the amplifier due to the 40-dB input pad!

6) Increase the frequency of the signal generator until the output has decreased 3 dB (i.e., the peak-to-peak voltage times 0.707). **Record the frequency; this is the upper cutoff frequency, f_H.**

7) Now decrease the frequency of the signal generator (below 1 kHz) until the output drops by 3 dB. **Record the frequency; this is the lower cutoff frequency, f_L.**

8) Return the signal generator to 1 kHz. **Increase the amplitude until the output waveform is visibly clipped; record the maximum peak-to-peak output voltage at clipping.**

Postlab

1) **Analytically determine all DC and AC parameters using equations we derived in class for the common-source configuration.** Show all work!

2) Simulate the circuit using Multisim; determine the DC values, midband gain, and high- and low-frequency cutoffs.

3) Compare simulated, experimental, and analytical values.

4) How does the performance of the common-source amplifier compare to the common-emitter amplifier you tested in Lab 5, given that they have similar operating points?