

Lab 12

MOSFET variable gain amplifier and amplitude modulation

Pre-Lab

1. Decide which NMOS transistor to use for the experiment.
2. Sketch the experimental setup in each section of the lab.

In this lab you will use the NMOS as a variable gain resistor to amplitude modulate a carrier with a signal. Using a rectifier and low-pass filter you will then demodulate the original signal from the carrier.

Measuring the channel resistance

1. Pick a NMOS transistor on the MOSFET IC and bias it between -5 and $+5$ V, with the drain connected to V_{DD} through a large resistor. Connect the gate to a variable supply voltage.
2. For several values of the gate voltage measure the drain current and v_{DS} for small values of v_{DS} (adjusting R_D as necessary).
3. From the previous compute and plot the channel resistance as a function of gate voltage.

Building the variable gain amplifier

In this section you will build a variable gain amplifier using an op-amp, in which the gain is controlled by the voltage on the NMOS gate.

4. Now connect the NMOS to be the ground resistor of a non-inverting amplifier. Pick a value for v_{GS} and a value for the feedback resistor from your previous experiments, to get a gain of 10 to 100.
5. Apply a small-amplitude sinusoidal carrier of moderately high frequency to the non-inverting input of the amplifier. How high can you go in frequency before you lose gain?
6. Apply to the gate an offset plus a small-amplitude sinusoidal signal to modulate the gain of the input signal. Choose frequency and amplitude and verify that the amplitude of the carrier signal on the non-inverting input is modulated.

Demodulation

In this section you will attempt to recover the low-frequency sinusoidal signal. You may need to adjust gains and offsets to get this to work properly.

7. Rectify the output of a non-inverting amplifier with a diode.
8. Low-pass filter it with an appropriate time-constant. Compare the input signal to the output signal on the oscilloscope.