ECE 2274 MOSFET Voltmeter

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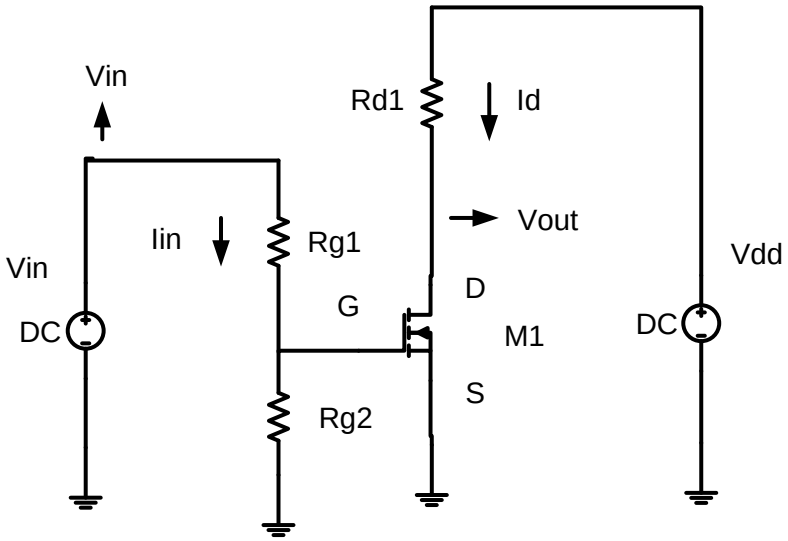
Pre-Lab for MOSFET Voltmeter. **Include CRN on prelab**.

Voltmeter design:

Build a MOSFET (2N7000) voltmeter in LTspice must include LTspice schematic. The MOSFETs in the voltmeter act as switches. To turn on the MOSFET. For design assume Vg = 2.1Vdc when it begins to switch on. Design the Rd value, such that the maximum drain current when the MOSFET in on is 8mA for Vdd = 10Vdc Vds_{SAT} = 100mV. Design the input voltage divider resistors values such that **Vout** turns on at approximately at Vin = 6Vdc, Vin = 10Vdc, and Vin = 14Vdc. Choose input resistors (Rg1, Rg2) values that are in the **10kΩ to 150kΩ range**.

To find the voltage divider resistors Rg1, Rg2, to you must create three input voltage circuits thresholds when Vin= 6V, Vin=10V, and Vin=14V. The calculation steps will be identical to the first voltmeter, but the input voltage (Vin) will be the only difference. Design the voltage divider (Rg1, Rg2) so that the gate voltage is 2.1Vdc with the desired Vin voltage.



Show all work Fill in table below from your circuit simulation must include LTspice schematic.

All currents are derived for a voltage across a known resistor.

Set Rg1, and Rg2 for Vin = 6Vdc threshold circuit.

Vin Voltage when MOSFET starts to conduct	
V_G Voltage of gate when MOSFET starts to conduct	
Id steady state on current	
Vin Voltage when MOSFET current Id reaches steady state	
V_G Voltage of gate when MOSFET current Id reaches steady state	
Vds sat Voltage when MOSFET current Id reaches steady state	
Rg1 Value used	
Rg2 Value used	
Rd1 Drain current limit resistor Value	

Set Rg1, and Rg2 for Vin = 10Vdc threshold circuit.

Vin Voltage when MOSFET starts to conduct	
V_G Voltage of gate when MOSFET starts to conduct	
Id steady state on current	
Vin Voltage when MOSFET current Id reaches steady state	
V_G Voltage of gate when MOSFET current Id reaches steady state	

Vds sat Voltage when MOSFET current Id reaches steady state	
Rg1 Value used	
Rg2 Value used	
Rd Drain current limit resistor Value	

Set Rg1, and Rg2 for Vin = 14Vdc threshold circuit.

Vin Voltage when MOSFET starts to conduct	
V_G Voltage of gate when MOSFET starts to conduct	
Id steady state on current	
Vin Voltage when MOSFET current Id reaches steady state	
V_G Voltage of gate when MOSFET current Id reaches steady state	
Vds sat Voltage when MOSFET current Id reaches steady state	
Rg1 Value used	
Rg2 Value used	
Rd Drain current limit resistor Value	

Run a DC Sweep simulation on Vin from 0V to 20V in increments of 100mV. Plot Vds for each voltmeter circuit Print out your plot. Remember that a MOSFET is considered to be "on" after V_{DS} voltage is approximately 0.2 volts. From the LTspice plot Vds of when the MOSFET is fully on. What input voltage did each on the MOSFETs reach steady state?

Required Attachments: (3 plots) (6V, 10V, 14V) Vdd = 10Vdc,

DC Sweep, varying Vin plotting Vds, plotting Id, and plotting Vg for each input voltage divider plots. Three traces per plot (Vds, Id, Vg) must include LTspice schematic, and label all plots.

Lab Exercise MOSFET Voltmeter

1. MOSFET voltmeter circuit

a. Redesign the MOSFET voltmeter circuit such that the maximum drain current when the MOSFET is on is 10mA. For the design assume Vg = 2.1Vdc when it begins to switch on and Vdd = 12Vdc Vds_{SAT} = 100mV. Design the input voltage divider resistors values such that **Vout** turns on at approximately at Vin = 12Vdc. Choose input resistors (Rg1, Rg2) values that are in the **10kΩ to 150kΩ range**. **Fill out table by running a .op simulation**. Include the schematic and show all work.

b. Using the same resistor values from above, only change the Vin voltage to 3V and run the .op simulation again. Answer the questions on the datasheet.

2. DC sweep

Run a DC Sweep simulation on Vin from 0V to 20V in increments of 100mV. Plot Vds, Vg and Id for the voltmeter circuit designed above. Print out your plot. Answer the questions on the datasheet.

DATA SHEET

Name: _____ CRN: _____

Date: _____

1. a. Set Rg1, and Rg2 for **Vin = 12 Vdc** threshold circuit. Record measurements from .op simulation.

Vin Voltage when MOSFET starts to conduct	
V_G Voltage of gate	
Id steady state on current	
Vin Voltage when MOSFET current Id reaches steady state	
V_G Voltage of gate when MOSFET current Id reaches steady state	
Vds sat Voltage when MOSFET current Id reaches steady state	
Rg1 Value used	
Rg2 Value used	
Rd1 Drain current limit resistor Value	
IRg1 current	
IRg2 current	

b. For Vin = 3V

Fill out the table below

Id current	
Vout	
Vg gate voltage of the MOSFET	
IRg1	

Using the results from the table above what happens if the input is 3V.

2. DC sweep of the circuit with plots of Vds, Vg and drain current Id.

a. What is the value of the steady state current Id?

b. How can you change the value of Vout?

c. How will the results change if you build the circuit and compare your simulation values with experimental values?

Required Attachments:

1. Schematic from problem 1

2. DC Sweep plot