

## EXPERIMENT 4: MOSFET CHARACTERISTICS

### *Objectives*

The objective of this experiment is to obtain DC characteristics of a MOSFET and to learn the operation of a MOSFET practically.

### *Components Required:*

DC Voltage Source

Oscilloscope

Multimeter

**Transistor:** BS108 transistor

**Resistors:** 1k $\Omega$

### *Preliminary Work:*

1. Find and examine the datasheet of the BS108 transistor on the Internet. Write the critical information for the experiment. Which leg of the MOSFET corresponds to which of G, D, S. Using the datasheet, find this information and add it to your report.
2. Explain how we perform a robustness test of a MOSFET using a multimeter.
3. Research how to extract and use the MOSFET's input and output characteristics. Give brief information about this in the report.
4. Can a MOSFET be used as a switch? Explain how it can be used as a switch.
5. What is the meaning of 'threshold voltage ( $V_{th}$ )' for the MOSFETs?
6. Setup the circuit given in Figure 1 in OrCAD. You can refer to Figure 2 to understand how to add the MOSFET in the circuit. Plot input characteristic of the transistor (VGS-ID). You can select the analysis type as 'DC Sweep' and options as 'Primary Sweep' with 'Secondary Sweep'. Primary Sweep input voltage (VGS) from 0 to 10V in steps of 0.1V. Secondary Sweep input voltage (VDS) from 0 to 2V in steps of 0.5V. Specify critical points on the plot and **comment about your simulation result.**
7. Setup the circuit given in Figure 1 in OrCAD. You can refer to Figure 2 to understand how to add the MOSFET in the circuit. Plot output characteristic of the transistor (VDS-ID). You can select the analysis type as 'DC Sweep' and options as 'Primary Sweep' with 'Secondary Sweep'. Primary Sweep input voltage (VDS) from 0 to 10V in steps of 0.1V. Secondary Sweep input voltage (VGS) from 0 to 2V in steps of 0.5V. Specify critical points on the plot and **comment about your simulation result.**
8. Perform simulations of all of the circuits in the experimental work using TinkerCAD.

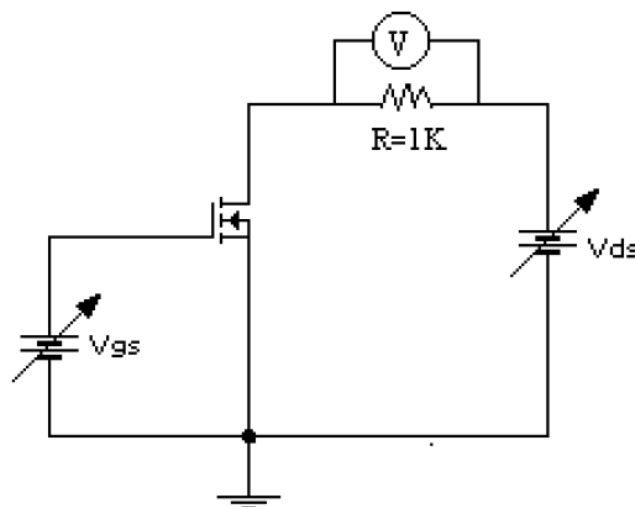
- Add Table 1 and Table 2 to your report.
- The link below may help you to simulate the circuit:

<https://www.youtube.com/watch?v=4wv3CUQE3Q0>

### *Experimental:*

Set up the circuit given in Figure 1.

1. Set the VDS source to 2V.
  - Then, determine the threshold voltage of VGS ( $V_{th}$ ). Use an oscilloscope for this purpose.
  - Connect the oscilloscope probes between the drain terminal and ground.
  - Add Vmax to the oscilloscope screen. Remove other parameters from the oscilloscope screen.
  - Increase the VGS value from zero to 2 (Look at Table 1 for step size).
  - Fill in Table 1 for the Vmax values you obtained.
  - Determine  $V_{th}$  using the measured VD voltages (see Table 1).
2. Set the VGS source to 0.5V.
  - Connect the oscilloscope probes' resistor terminals.
  - Add Vmax to the oscilloscope screen. Remove other parameters from the oscilloscope screen.
  - Increase the VDS value from zero to 10 (Look at Table 2 for step size).
  - Fill Table 2 helping with Vmax values you obtained. (Attention: You should write current values instead of voltage values)
  - Repeat the same steps for VGS=1V and VGS=1.5V and fill Table 2.
  - Draw the output characteristic of the MOSFET using the obtained values from VGS=1V.



*Figure 1*

$V_{GS}$	$V_D$
$0\text{ V}$	
$0.1\text{ V}$	
$0.2\text{ V}$	
$0.3\text{ V}$	
$0.5\text{ V}$	
$0.7\text{ V}$	
$0.8\text{ V}$	
$1\text{ V}$	

Table 1

$V_{th} =$

Comments about  $V_{th}$ :

$V_{DS}$	$V_{GS}=0.3\text{ V}$ $I_{ds}$	$V_{GS}=0.7\text{ V}$ $I_{ds}$	$V_{GS}=1\text{ V}$ $I_{ds}$
$0\text{ V}$			
$0.1\text{ V}$			
$0.2\text{ V}$			
$0.3\text{ V}$			
$0.5\text{ V}$			
$0.7\text{ V}$			
$1\text{ V}$			
$2\text{ V}$			
$4\text{ V}$			
$6\text{ V}$			
$8\text{ V}$			
$10\text{ V}$			

Table 2

Comments about output characteristic of the MOSFET:

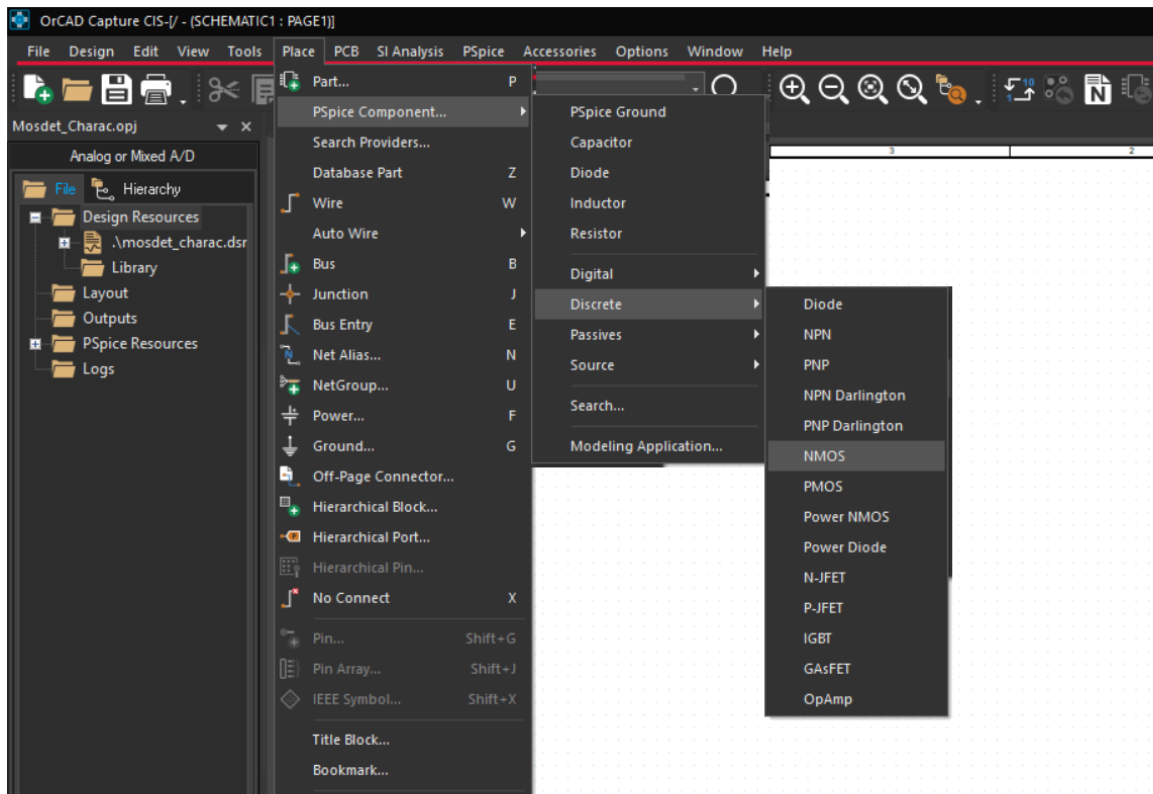


Figure 2