NUI MAYNOOTH
Ollscoil na hÉireann Má Nuad

National University of Ireland, Maynooth
Department of Electronic Engineering

EE204FZ

Title: Characteristics of the FET Transistor
Number: 1

EQUIPMENT

2 voltage sources, voltmeters, ammeter, a laboratory lead kit

OBJECTIVE

The purpose of this experiment is to understand the function of the MOSFET. In this experiment we take a MOSFET and sketch the device's input current characteristic for different drain-source voltages and gate-source voltages. The intention is to develop an understanding of the different operating regions for a FET transistor.

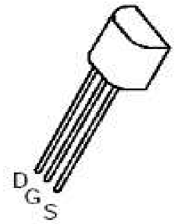
PROCEDURE

Part 1

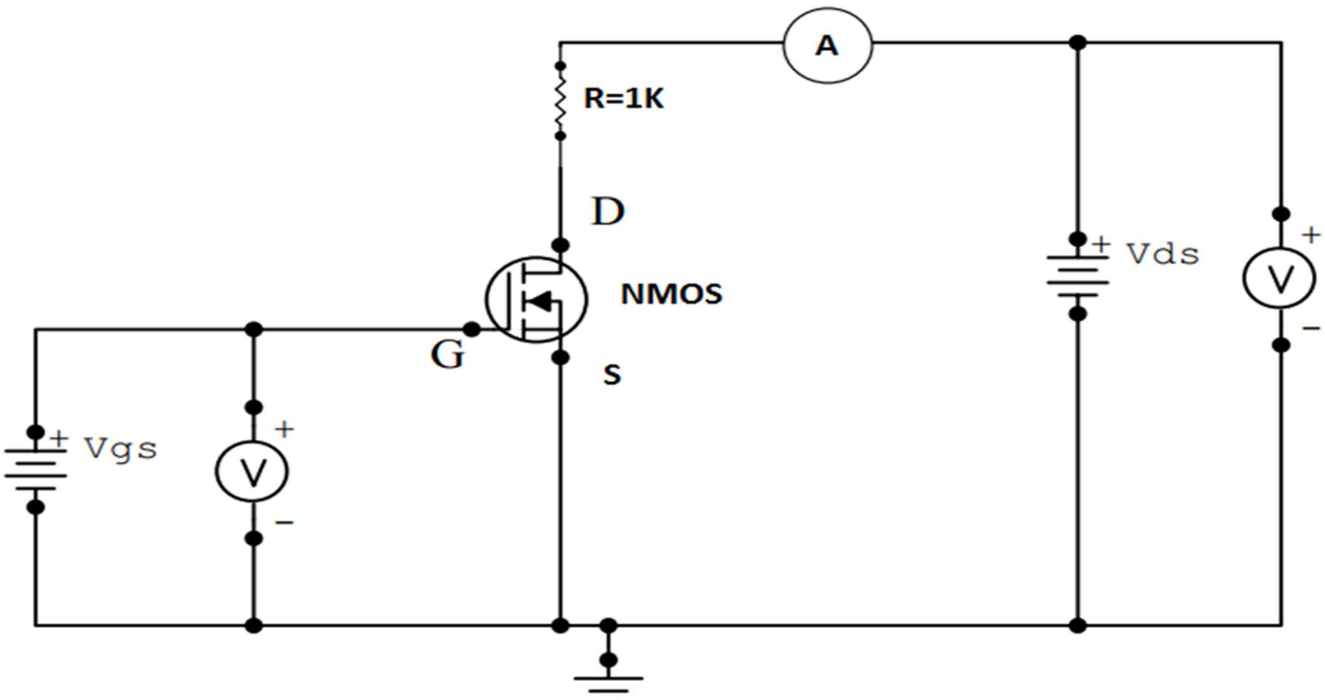
This experiment requires a, 1 K resistor and two voltage sources, two voltmeters and an ammeter.

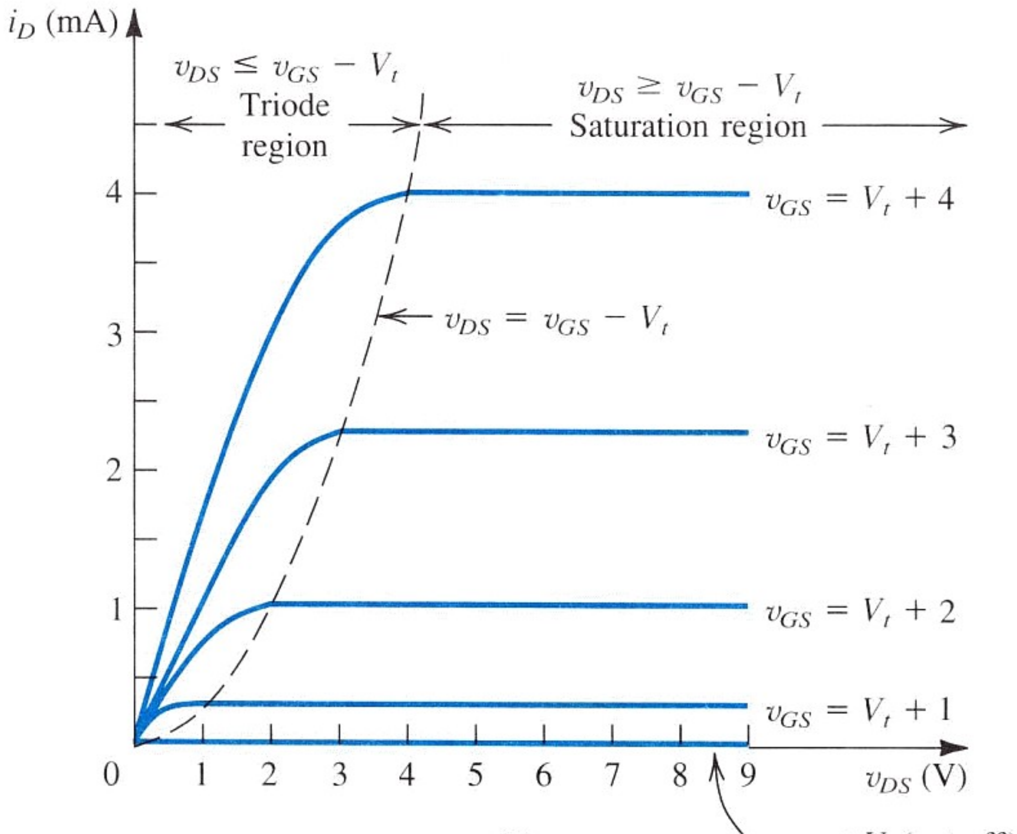
Before connecting any power supply to the circuit, check using either the oscilloscope or the voltmeter the value of the supply you are connecting. It is too late to fix the voltage after connection if it is too high as the transistor may have been damaged by then. Ensure that the ammeter used is the mA and not the μA. Do not use the electronic meter. Ensure that the scale is at 1000, the currents in this experiment will be very high.

In the following circuit, the current will be controlled by the characteristic equation of the MOSFET. There should be no current into the gate of the MOSFET. You can place an ammeter here to check.



Case and pins of ZVN2106 and ZVP2106





(b)

The transistor should have a threshold voltage around 2 volts but it can vary for different transistors. The intention of the first part of the lab exercise is to construct the *V-I* graph that is shown above.

To do this, set V_{DS} (the drain source voltage) to 1 V and then vary V_{GS} (the gate-source voltage) until current flows. Identify the gate-source voltage at which current begins to flow. Changing the current scale will allow you to get finer resolution. Note the current will increase rapidly, do not decrease the current scale below 100 mA and be prepared to increase the scale if the meter needle is forced all the way over. The voltage that you identify will be the point at which inversion occurs and a small increase on this will generate strong inversion and then strong currents. Increase the drain-source voltage until you get to 5 volts, you can take 1 volt steps once you have crossed the threshold voltage. At all points record the V_{DS} voltage and the drain current.

Repeat the current measurements for the following values of V_{GS} of 0, 0.5, 1.0, 1.5, 2, 3, and 5 volts. Your results will look something like the following table.

	V_{DS} = 0 V	1 V	2 V	3 V	4 V	5 V
V_{GS} = 0 V	I_D = 0					
V_{GS} = 0.5 V						
V_{GS} = 1.0 V						
V_{GS} = 1.5 V						

V_{GS} = 2.0 V						
V_{GS} = 3.0 V						
V_{GS} = 5.0 V						

I. In your report, please add a graph of your results and discuss it's similarity and differences with the ideal chart from the previous page.

II. Now calculate the resistance (V_{DS}/I_D) and graph this in your report for different values of V_{DS} and V_{GS}. This is similar to the last graph except now R is on the y axis and not I_D.

III. What is V_T for your particular FET?

NOTE: Real systems are never as smooth or as simple as the ideal charts, so draw what you measured. It should be broadly similar at the extremes, but the middle transition region may be different.

Part 2

Using the same circuit, for V_{GS}=3.0 (or whatever gives you a good curve), measure the current I_D that flows for values of V_{DS} steps of 0.1 volts. Instead of taking a LOT of measurements, take measurements for values of V_{DS} in the ranges 0 to 1 volts and V_{DS} from 3 volts to 4 volts. Feel free to do it for wider ranges.

One measure of resistance is given by the ratio of the increase in current over an increase in voltage. Work out the resistance given by ratio of the increase in current (ΔI_D) for each 0.1 volt increase in voltage dropped (ΔV_{DS}). Chart these results.

On the same chart, plot the resistance calculated from the total voltage (V_{DS}) dropped divided by the total current (I_D) flowing. (hopefully will look similar to the graph from PART1 for the same value of V_{GS}).

REQUIRED RESULTS IN REPORT

To be uploaded via Moodle before the next laboratory.

Please transcribe the results of the questions in the order of experiment.

Your report should have the following structure:

- A brief introduction showing you know what the lab is about (3 - 4 lines MAX)
- For each section you need the following:
  - A drawing of the circuits used;
  - Your results;
  - Comments and opinions on results or methods used.

- Conclude your report with a summary section which may include any additional conclusions you may have.

Late reports can still be submitted on Moodle but will incur penalties of 10% per day (or part of a day, weekends are counted the same as weekdays).

Marks will be deducted for poorly presented, poorly written reports.
Marks will only be awarded for sections completed.