AKDENIZ UNIVERSITY
Faculty of Engineering
Electrical and Electronics Engineering

Akdeniz Üniversitesi, Mühendislik Fakültesi,
Elektrik-Elektronik Mühendisliği, TR-07058, Konyaaltı/Antalya

eem@akdeniz.edu.tr

EEM 303 Electronic II Laboratory 2

E-VMOSFET Characteristics I

	Student Name	Student ID	Group Number
1.			
2.			
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Objective:

To understand input characteristics of E-VMOSFETs

Equipment will be available at the laboratory:

DC power supply, Oscilloscope, Electronic Training Set(Y-0016), Patch wires,

Equipment will be ensured by students:

Digital Multi-Meter

Preliminary Work:

Read the laboratory sheets. There might be a test or classical exams in the beginning of each laboratory hour. Questions will be asked mostly from *Supplementary Information* and *Procedure* sections.

A brief summary of MOSFET operating regions should be documented into A4 paper and given to instructor(s) at beginning of laboratory hour.

Supplementary Information:

The metal-oxide-semiconductor field-effect transistor (MOSFET, MOS-FET, or MOS FET) is a type of field-effect transistor (FET), most commonly fabricated by the controlled oxidation of silicon. It has an insulated gate; whose voltage determines the conductivity of the device. This ability to change conductivity with the amount of applied voltage can be used for amplifying or switching electronic signals. A metal-insulator-semiconductor field-effect transistor or MISFET is a term almost synonymous with MOSFET. Another synonym is IGFET for insulated-gate field-effect transistor.

The IGFET or MOSFET is a voltage-controlled field effect transistor that differs from a JFET in that it has a “Metal Oxide” Gate electrode which is electrically insulated from the main semiconductor n-channel or p-channel by a very thin layer of insulating material usually silicon dioxide, commonly known as glass.

This ultra-thin insulated metal gate electrode can be thought of as one plate of a capacitor. The isolation of the controlling Gate makes the input resistance of the MOSFET extremely high way up in the Mega-ohms (MΩ) region thereby making it almost infinite.

As the Gate terminal is electrically isolated from the main current carrying channel between the drain and source, *"NO current flows into the gate"* and just like the JFET, the MOSFET also acts like a voltage-controlled resistor where the current flowing through the main channel between the Drain and Source is proportional to the input voltage. Also, like the JFET, the MOSFETs very high input resistance can easily accumulate large amounts of static charge resulting in the MOSFET becoming easily damaged unless carefully handled or protected.

Like in the previous JFET experiment, MOSFETs are three terminal devices with a Gate, Drain and Source and both P-channel (PMOS) and N-channel (NMOS) MOSFETs are available. The MOSFETs are available in two basic forms:

- *Depletion Type:* the transistor requires the Gate-Source voltage, (VGS) to switch the device "OFF". The depletion mode MOSFET is equivalent to a "Normally Closed" switch.
- *Enhancement Type:* the transistor requires a Gate-Source voltage, (VGS) to switch the device "ON". The enhancement mode MOSFET is equivalent to a "Normally Open" switch.

The symbols and basic construction for both configurations of MOSFETs are shown below.

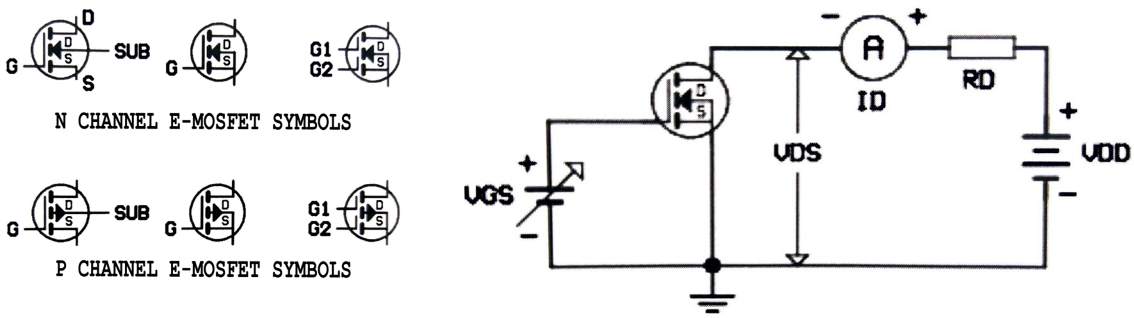

Figure 1: The symbols and basic characteristic circuit of E-VMOSFETs

Some MOSFETs are used as drive amplifiers, especially in high power controls. Hence, this type of transistors is called Power MOSFETs which have wider channel structure. The structure is vertical and not planar. Using a vertical structure, it is possible for the transistor to sustain both high blocking voltage and high current. This type of Power MOSFETs is called Vertical MOSFETs, also shortly V-MOSFETs.

Procedure:

1. Turn on Y-0016 module and adjust the *Adjustable DC Power Supply* to 20V.
2. Turn off the Y-0016 module and insert the Y-0016-012 module into training set.
3. Connect the patch wires to the module as it is shown in Figure 2.
4. Turn the power on for Y-0016 Training Set.

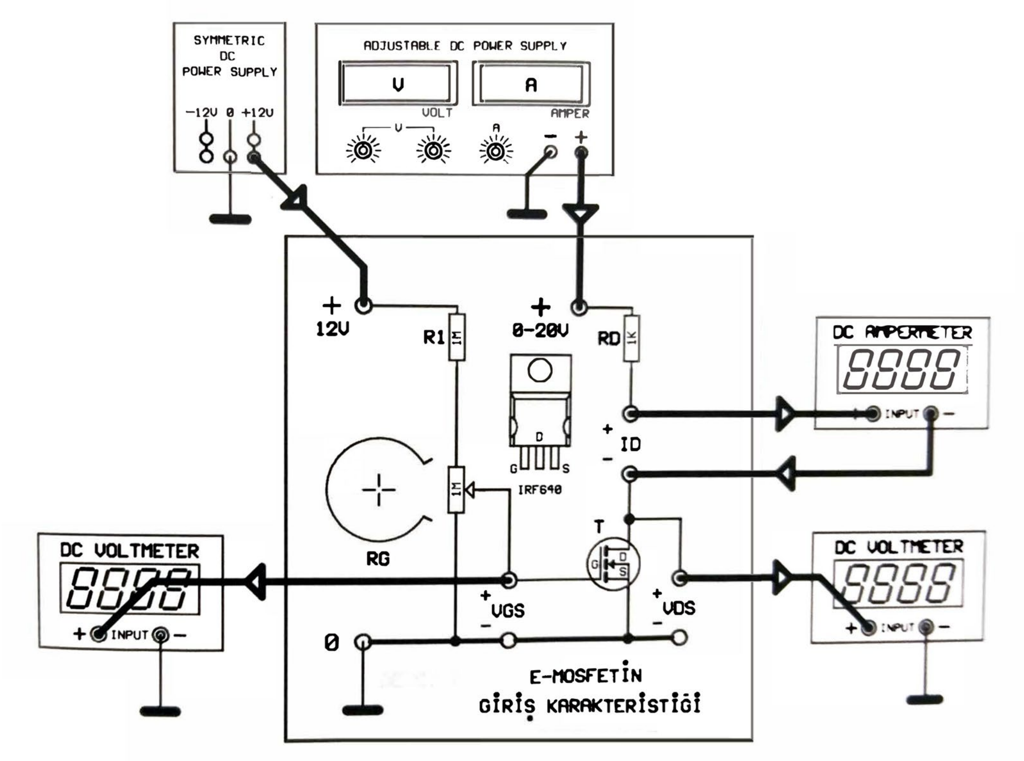

Figure 2: Connection scheme of E-VMOSFET input characteristic circuit.

Input Characteristics of E-VMOSFETs

5. Adjust the V_{GS} voltages in order to the values in Figure 3 by using the RG potentiometer,
6. Record I_D values respectively to the table in the Figure 3,
7. Determine the V_{GS} voltages that changes the operating states,
8. Measure the V_{DS} voltages at determine V_{GS} voltage and record the values in Figure 3.
9. Turn the power off for Y-0016 Training Set.
10. Sketch the V_{GS} and the I_D curve into Figure 5.
11. Repeat the same procedure for V_{DD} voltage at constant 10V.
12. Record I_D values respectively to the table in the Figure 4.

Results:

Input Characteristics of E-VMOSFET, V_{DD} at 20V

$V_{DD} = 20V$ (Constant)			
V_{GS} (Volt)	I_D(mA)	V_{GS} (Volt)	I_D(mA)
0.0		3.1	
1.0		3.2	
2.0		3.3	
2.2		3.4	
2.4		3.5	
2.6		3.6	
2.8		3.8	
3.0		4.0	

$V_{GS(active)}$ =	$V_{GS(saturation)}$ =
$V_{DS(active)}$ =	$V_{DS(saturation)}$ =

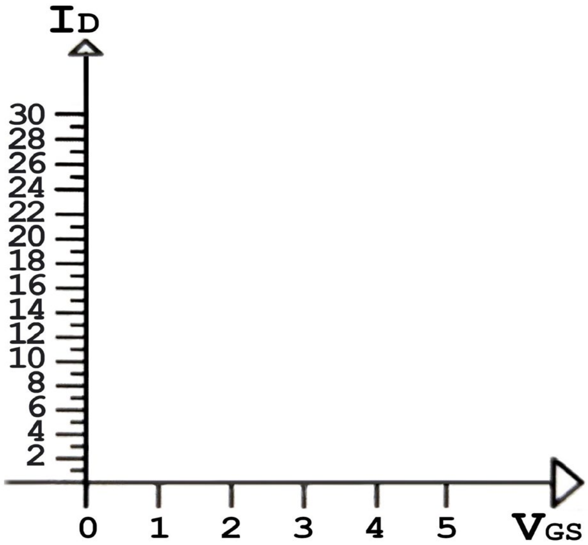

Figure 3: Input characteristic curve according to V_{GS} and I_D at $V_{DD} = 20\ V$

Input Characteristics of E-VMOSFET, V_{DD} at 10V

$V_{DD} = 10V$ (Constant)			
V_{GS} (Volt)	I_D(mA)	V_{GS} (Volt)	I_D(mA)
0.0		3.1	
1.0		3.2	
2.0		3.3	
2.2		3.4	
2.4		3.5	
2.6		3.6	
2.8		3.8	
3.0		4.0	

$V_{GS(active)}$ =	$V_{GS(saturation)}$ =
$V_{DS(active)}$ =	$V_{DS(saturation)}$ =

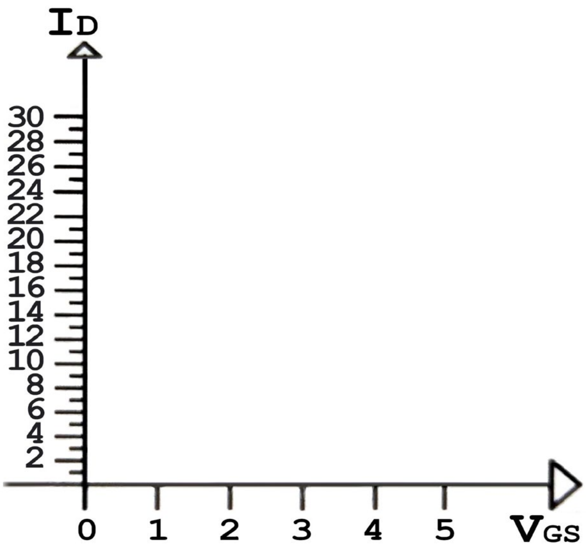

Figure 4: Input characteristic curve according to V_{GS} and I_D at $V_{DD} = 10\ V$

Conclusion: