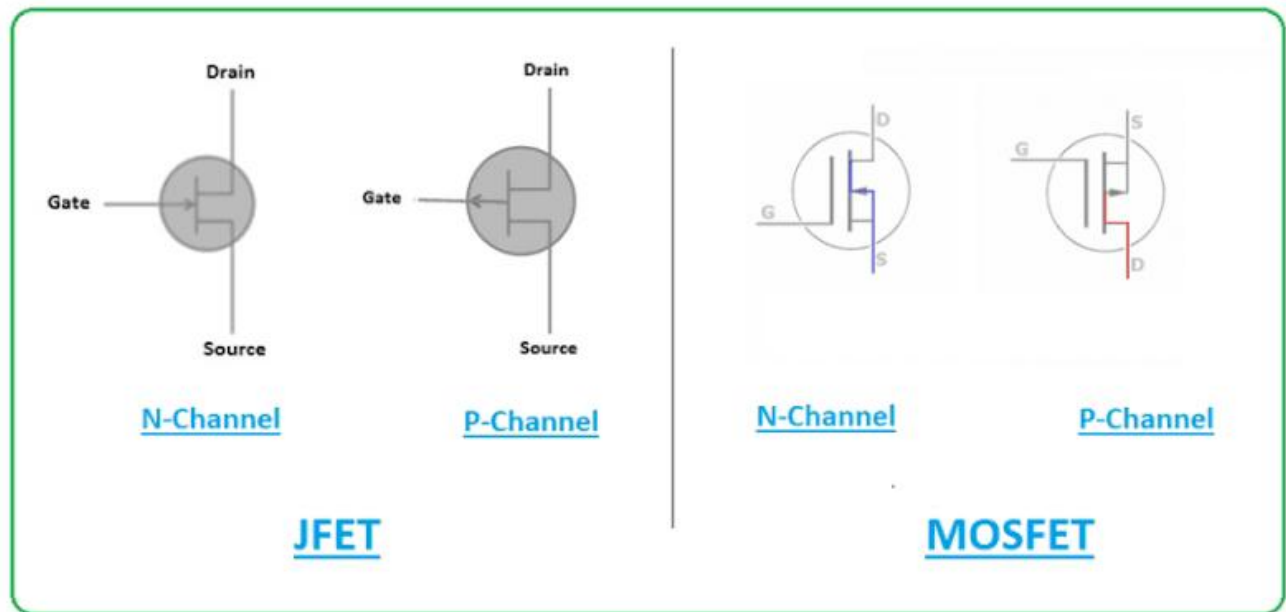


FET (Field-effect transistor)



The field effect transistor, FET is a key electronic component using within many areas of the electronics industry.

The FET used in many circuits constructed from discrete electronic components in areas from RF technology to power control and electronic switching to general amplification.

However the major use for the field effect transistor, FET is within integrated circuits. In this application FET circuits consume much lower levels of power than ICs using bipolar transistor technology. This enables the very large scale integrated circuits to operate. If bipolar technology was used the power consumption would be orders of magnitude greater and the power generated far too large to dissipate from the integrated circuit.

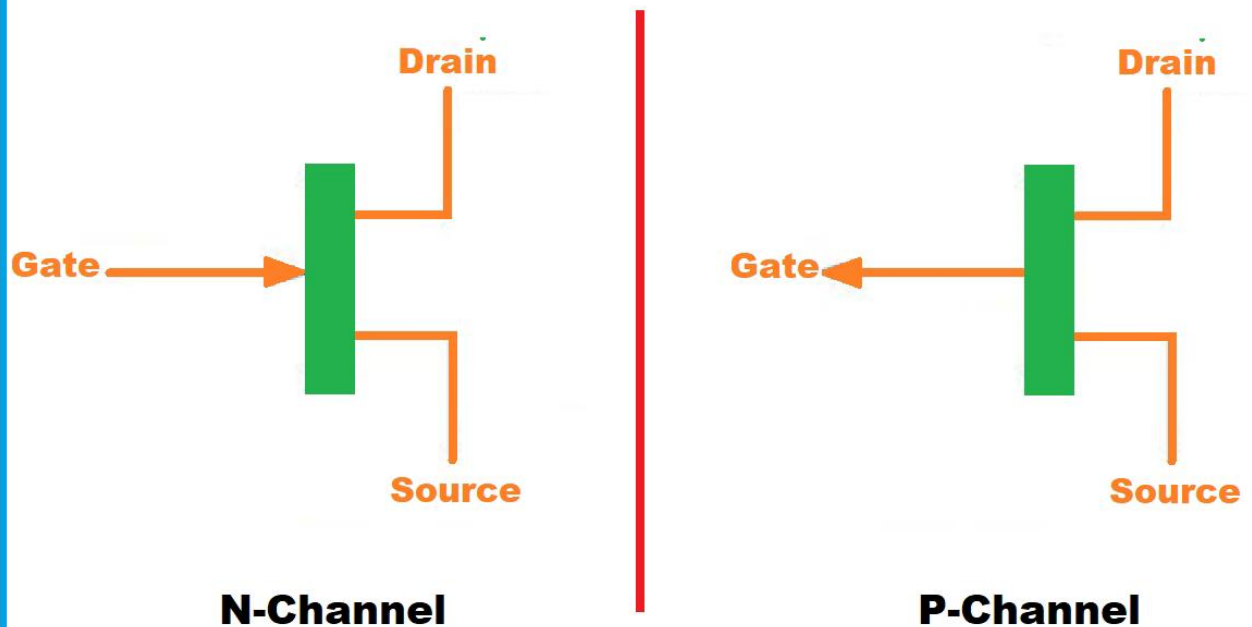
Apart from being used in integrated circuits, discrete versions of these semiconductor devices are available both as leaded electronic components and also as surface mount devices.



Symbol of Field Effect transistor (FET)

- The following figure shows the symbol of a field effect transistor.
- Three terminals can be seen in the figure namely gate, source, and drain represented by D, G, and S.

Symbol of Field Effect transistor

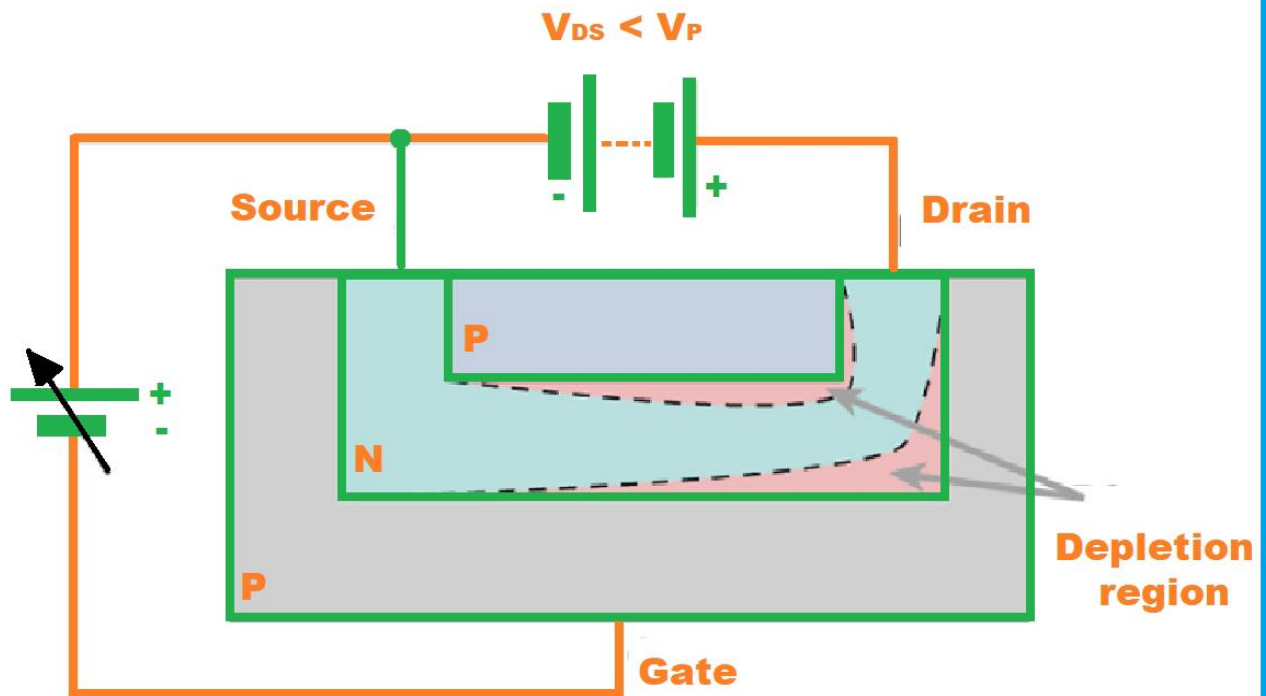


- The direction of the arrowhead reflects the direction of the electric field.
- The symbol is slightly different for two different types of field-effect transistors FETs, they can either be N channel FET or P channel FET, you will learn the symbols of different FETs in their respective sections of this article.

Working of FET

- As you have a brief idea about the main components of a Field Effect Transistor and their function, we are going to discuss the working of FET.
- The current always flows from the source S towards the Drain D.
- A voltage is applied across the Gate and Source terminal which creates a conductive channel between the source S and Gate G.
- The electrons or holes flow from the source S to Drain D in the form of a stream through the channel.
- There are several other things involved in the working and function of a field effect transistor according to their types, which we are about to discuss in respective sections. So, stay tuned!
- Here arises a simple question which is often left unasked and answered too, why the field effect transistors FETs are called voltage-controlled devices?
- The FETs are called voltage-controlled devices because the current in the drain represented as I_D depends on the voltage across the gate G, unlike the bipolar junction transistor which is a current-controlled device.
- The gate voltage is very important for the conduction of current towards the Drain.
- There are two phenomena that influence it one is depletion of the channel and the other is the enhanced state of the channel. Let us discuss them one by one.
- Depletion of channel: Consider an N channel FET, it has the majority of electrons as charge carriers, by making the gate more negative we would repel the electrons from the gate and these electrons would saturate the channel increasing its resistance. This makes the gate region thinner because of the minimal traffic of electrons, but the conduction channel is said to be depleted due to increased resistance.

Working of FET



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- Again consider the n channel FET, now think yourself, what would happen when you will make the gate G of the FET is more positive? The traffic of electrons would rush towards the gate! It would make the gate region thicker due to greater traffic but on the parallel lines, the conduction channel would be enhanced due to less resistance.

Types of Field Effect

Transistor

We can divide the field effect transistor into the following types based on their structure;

- o Junction Field-effect transistor JFET
- o Metal oxide Field Effect Transistor MOSFET

Junction Field-effect transistor

(JFET)

JFET or Junction Field Effect Transistor is one of the simplest types of field-effect transistor. Contrary to the Bipolar Junction Transistor, JFETs are voltage-controlled devices. In JFET, the current flow is due to the majority of charge carriers.

Metal oxide Field Effect

Transistor (MOSFET)

Metal Oxide Silicon Field Effect Transistors commonly known as MOSFETs are electronic devices used to switch or amplify voltages in circuits. It is a voltage controlled device and is constructed by three terminals. The terminals of MOSFET are named as follows:

- o Source
- o Gate
- o Drain
- o Body

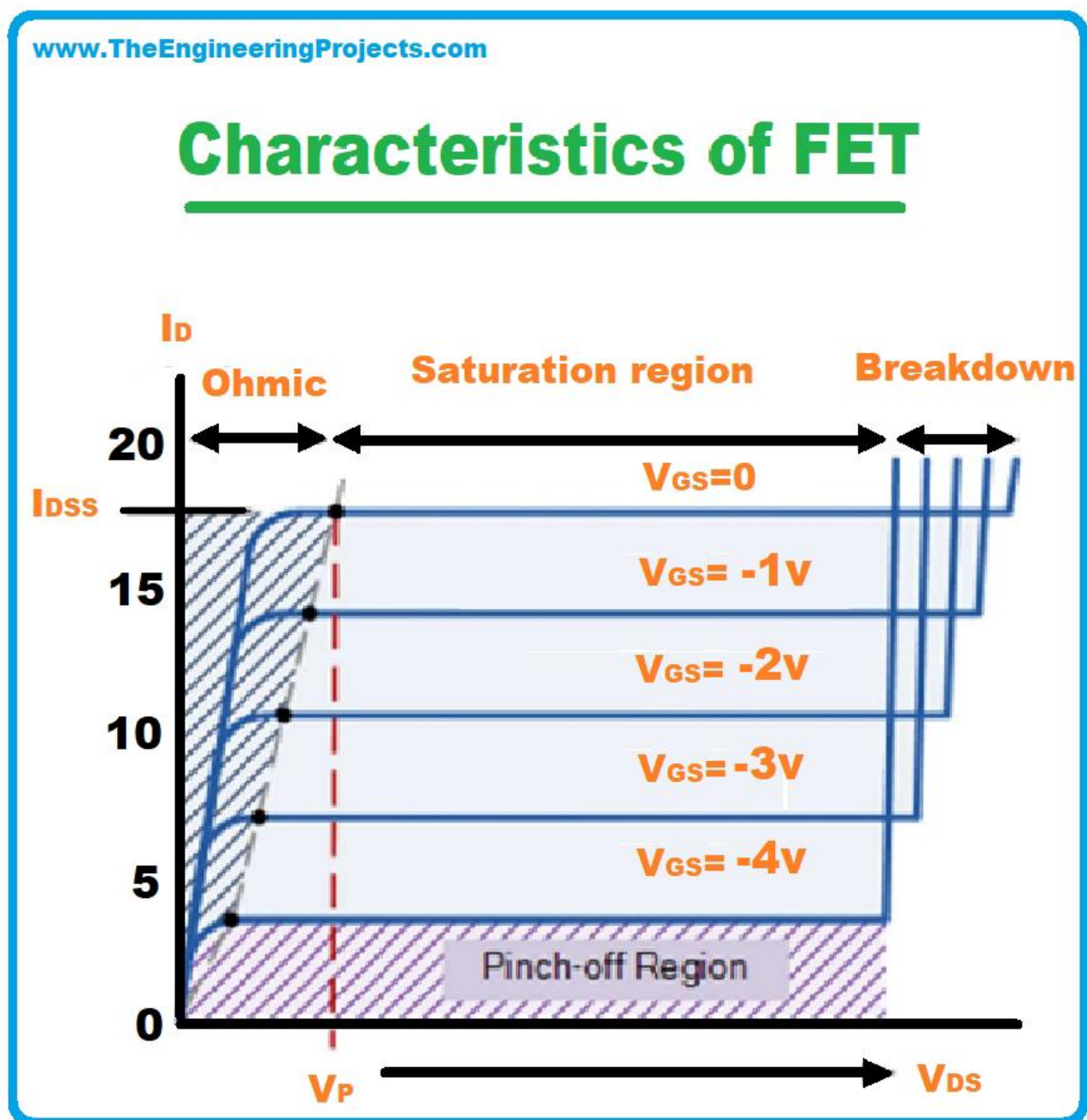
I-V Characteristics of Field Effect Transistor

- The Current Voltage, I-V characteristics of the Field Effect Transistor is plotted between the applied voltage V_{DS} and Drain Current I_D .
- The graph for studying the characteristic curve of a field effect transistor_ FET is plotted between the varying values of Drain Current represented by I_D along the y-axis, with the varying values of V_{DS} along the x- axis.

The graph shows the following regions;

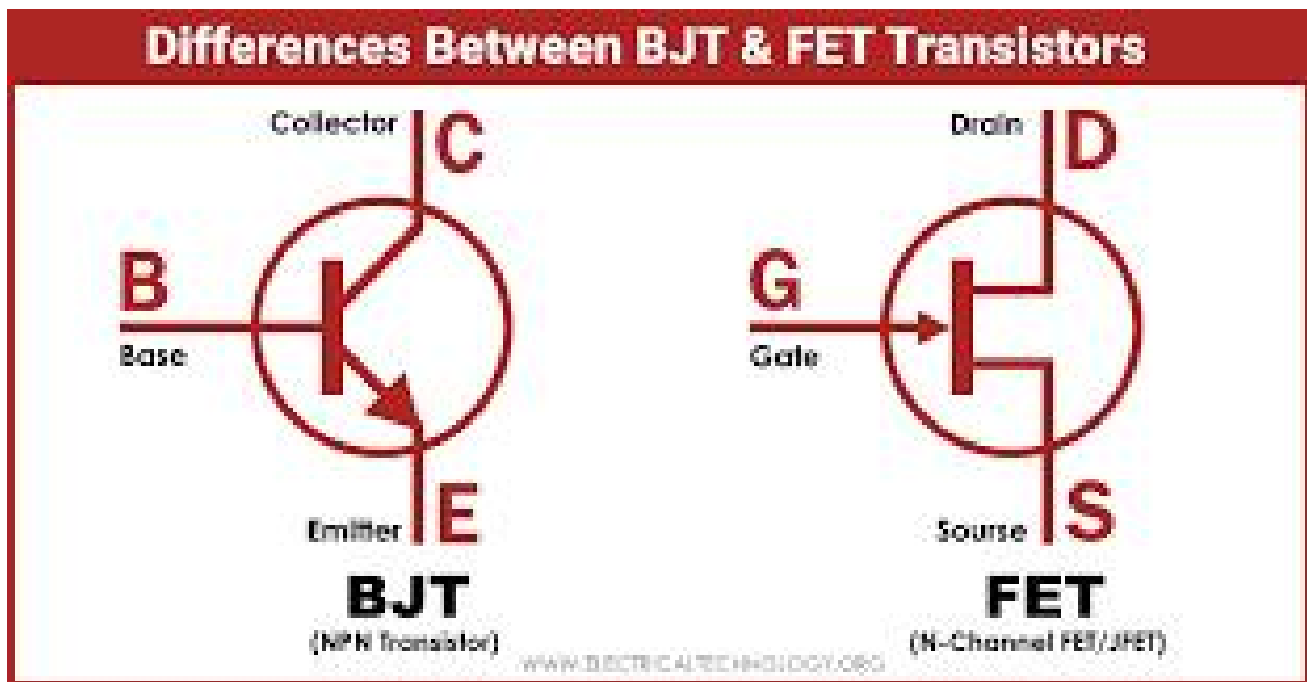
- o Ohmic Region
- o Cut off region
- o Saturation or Active Region
- o Breakdown region

Refer to the graph for better understanding.



BJT Vs FET

- BJT is a bit noisy than FET.
- BJT has a higher output impedance than FET.
- BJT is current controlled meanwhile FET is voltage controlled device.
- BJT has a lower input impedance than FET.



Applications of the FET

- Field Effect Transistors have revolutionized the electronic world, there is an endless list of uses of field effect transistors, we are going to discuss a few important ones in this section.
- Field Effect Transistors FETs are frequently used in Integrated Circuits because of their smaller size and compactness.
- FETs are used in operational amplifiers as VRs, Voltage Variable Resistors.
- They are also used in tone controls for mixer operations on TV and on FM as well.
- Field Effect Transistors are also used in logic gates.
- Field Effect Transistors are widely used in the production of digital switches as well.

PLAGIARISM REPORT

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Q1 What are the comparisons and differences between a BJT and a FET?

Answer: The main difference of BJT (Bipolar Junction Transistor) and FET (Field Effect Transistor) is BJT is a current controlled device, while FET is a voltage controlled device (Control by the change in voltage at the gate terminal). The current in BJT is produced due to the movements of both electrons and holes (current flow is due to both majority and minority carriers). In FET, the current is produced due to either electrons or holes (current flow due to majority charge carriers only). The main advantage of BJT and FET is that in electrical and electronics circuits, both devices can be used as switches and amplifiers. As compared to BJT, FETs are faster switching devices. In BJT, the Current-Voltage (I-V) characteristics are linear, but in FET, it is non-linear. For radiation, FET is good, while BJT is sensitive. The noise effect is more in BJT as compared to FET.

Q2: What are the typical applications of a JFET?

Answer: Buffer, RF amplifier, cascade amplifier, variable resistor in op amps, mixer circuit, memory cell.