# Field Effect Transistor

**Subject: BEC (22225)**
**Class: FYCO**
**Group No: 2**
**Roll No: 411-420**

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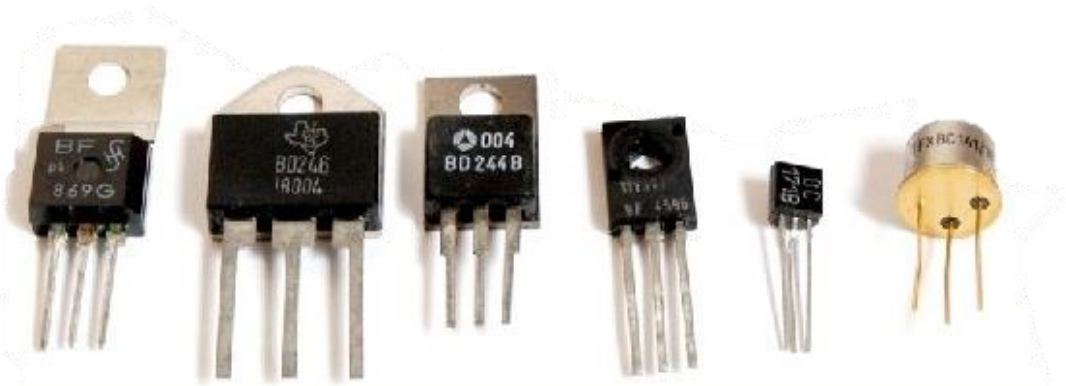
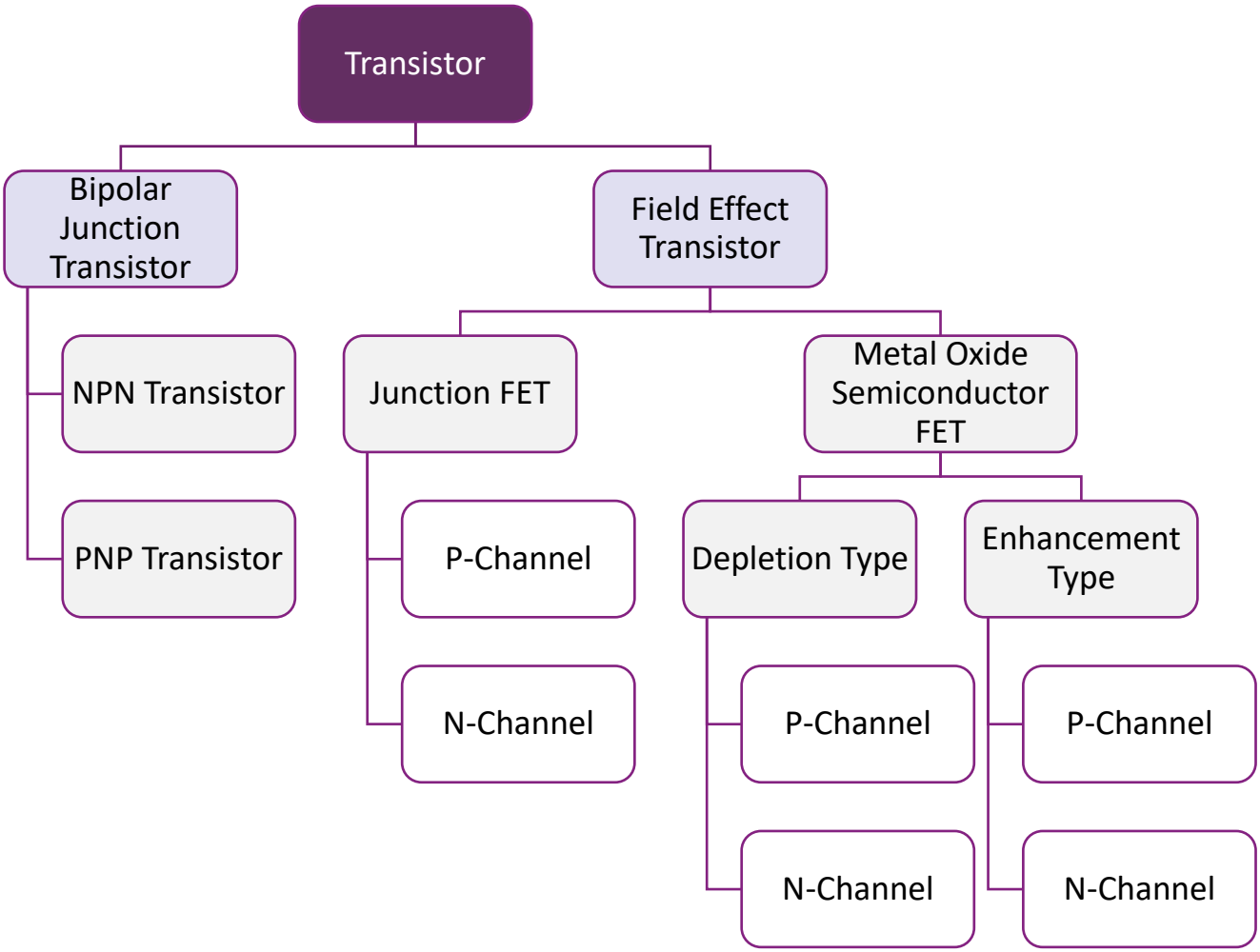
# Introduction

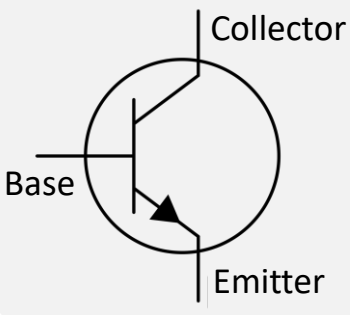
Transistor is a semiconductor device used to amplify or switch electronic signals and electrical power. Transistors are one of the basic building blocks of modern electronics. It is composed of semiconductor material usually with at least three terminals for connection to an external circuit. A voltage or current applied to one pair of the transistor's terminals controls the current through another pair of terminals. Because the controlled (output) power can be higher than the controlling (input) power, a transistor can amplify a signal. Today, some transistors are packaged individually, but many more are found embedded in integrated circuits. The most widely used type of transistor is the metal–oxide–semiconductor field-effect transistor (MOSFET)

Most transistors are made from very pure silicon, and some from germanium, but certain other semiconductor materials are sometimes used. A transistor may have only one kind of charge carrier, in a field-effect transistor, or may have two kinds of charge carriers in bipolar junction transistor devices. Compared with the vacuum tube, transistors are generally smaller and require less power to operate. Certain vacuum tubes have advantages over transistors at very high operating frequencies or high operating voltages. Many types of transistors are made to standardized specifications by multiple manufacturers.

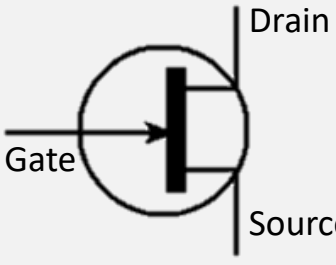


# Types of Transistor



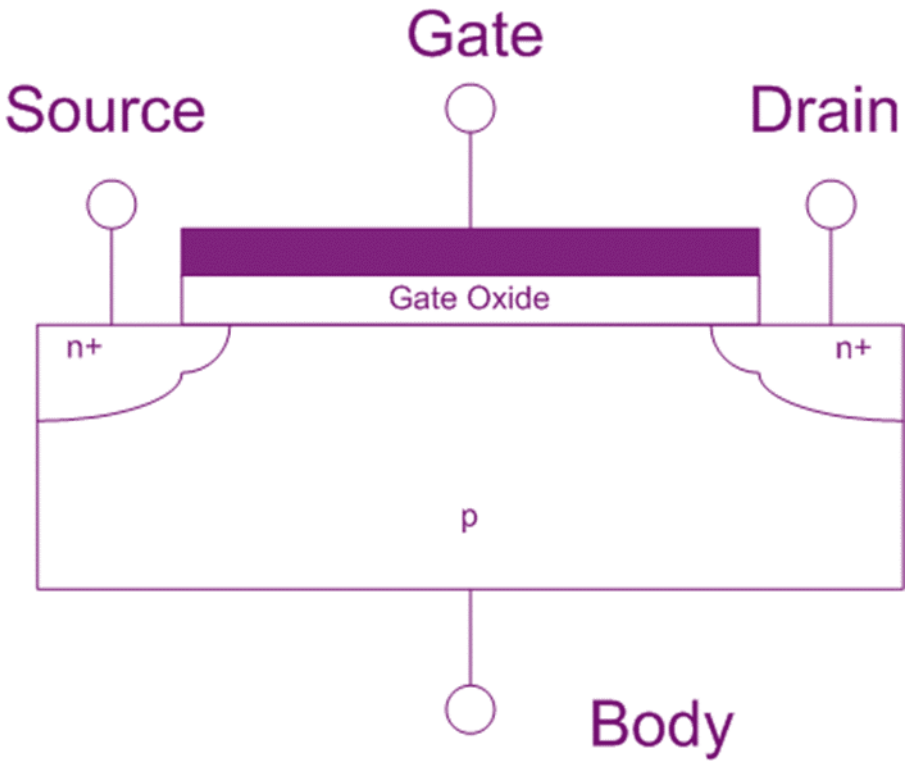




**BJT Transistor**




**FET Transistor**

# Basics of FET



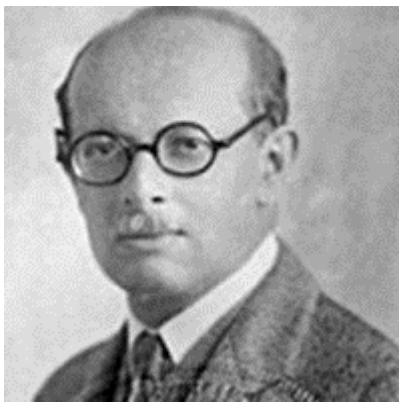

FETs are devices with three terminals: source, gate, and drain. FETs control the flow of current by the application of a voltage to the gate, which in turn alters the conductivity between the drain and source. FETs are also known as unipolar transistors since they involve single-carrier-type operation.

That is, FETs use either electrons or holes as charge carries in their operation, but not both. Many different types of field effect transistors exist. Field effect transistors generally display very high input impedance at low frequencies. The most widely used field-effect transistor is the MOSFET (metal-oxide-semiconductor field-effect transistor).

# History

The concept of a field-effect transistor (FET) was first patented by Austro-Hungarian physicist Julius Edgar Lilienfeld in 1925 and by Oskar Heil in 1934. The transistor effect was later observed and explained by John Bardeen and Walter Houser Brattain while working under William Shockley at Bell Labs in 1947. In the course of trying to understand the mysterious reasons behind their failure to build a working FET, it led to Bardeen and Brattain instead inventing the point-contact transistor in 1947, which was followed by Shockley's bipolar junction transistor in 1948.

The first FET device to be successfully built was the junction field-effect transistor (JFET) which was patented by Heinrich Welker in 1945. The static induction transistor (SIT), a type of JFET with a short channel, was invented by Japanese engineers Jun-jchi Nishizawa and Y. Watanabe in 1950. Following Shockley's theoretical treatment on the JFET in 1952, a working practical JFET was built by George F. Dacey and Ian M. Ross in 1953.



Julius Edgar Lilienfeld proposed the concept of a field-effect transistor in 1925

Heinrich Welker built the first successful FET – Junction field-effect transistor in 1945

# Disadvantages

A field-effect transistor has a relatively low gain–bandwidth product compared to a BJT. The MOSFET is very susceptible to overload voltages, thus requiring special handling during installation. The fragile insulating layer of the MOSFET between the gate and channel makes it vulnerable to electrostatic discharge or changes to threshold voltage during handling. This is not usually a problem after the device has been installed in a properly designed circuit.

FETs often have a very low "on" resistance and have a high "off" resistance. However, the intermediate resistances are significant, and so FETs can dissipate large amounts of power while switching. Thus efficiency can put a premium on switching quickly, but this can cause transients that can excite stray inductances and generate significant voltages that can couple to the gate and cause unintentional switching. FET circuits can therefore require very careful layout and can involve trades between switching speed and power dissipation. There is also a trade-off between voltage rating and "on" resistance, so high-voltage FETs have a relatively high "on" resistance and hence conduction losses.

**Disadvantages of Field Effect Transistor**

- FETs have a poor frequency response due to its high input capacitance
- FETs have a very poor linearity, and generally they are less linear than Bipolar Juntion Transistor
- FETs can be damaged due to the static electricity

# Applications

The field-effect transistor (FET) is a type of transistor that uses an electric field to control the flow of current. FETs control the flow of current by the application of a voltage to the gate, which in turn alters the conductivity between the drain and source. Applications of FET include:

## APPLICATIONS OF FIELD EFFECT TRANSISTOR

- Field effects transistors (FETs) are used in mixer circuits to control low inter modulation distortions.
- FETs are used in low frequency amplifiers due to its small coupling capacitors.
- Being a voltage controlled device it is used in operational amplifier as voltage variable resistors.
- It is commonly used as input amplifiers in devices due to their high input Impedance.
- It is also used in radio frequency amplifiers for FM devices.
- It is used for mixer operation of FM and TV receiver.
- It is used in Large Scale Integration (LSI) and computer memories because of its small size.