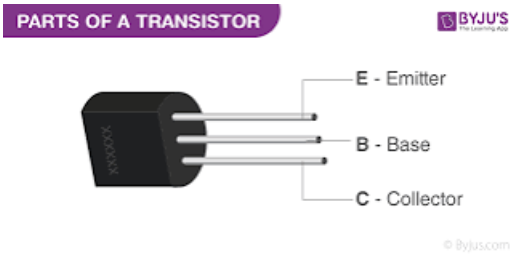
NAME:AL-AMIN HARUNAH ONUH

MATRIC NUMBER: VUG/SEN/23/9908

Transistors are the basic building blocks in modern electronics; they act as a switch in many or in amplifying an electric signal in a circuit, performing an essential part of the conduction means of electric currents within different electronic devices.



The two major types of transistors are the bipolar junction transistors (BJTs) and the field effect transistors (FETs). For simplicity, I shall adhere to discussions regarding the BJTs in the following discussions.

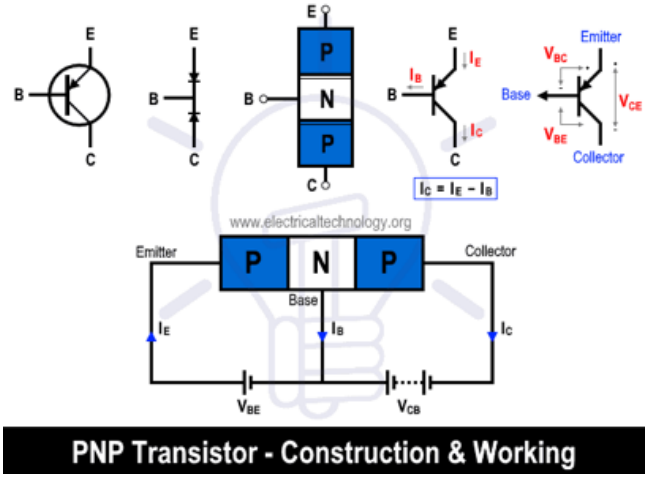
BJT is a three-layered semiconductor device in which two layers are the emitter and the collector, and the third layer is the base. In an NPN transistor, the emitter is the N-type material, and the P-type material is the base, whereas in an NPN, the collector is again N-type.

Type of BJT

This three-layer device formed by back to back connection has specific names. It can be weather **PNP** or **NPN**. Both connections are disused here briefly.

PNP Construction

In PNP bipolar transistor, the N-type semiconductor is sandwiched between two P-type semiconductors. PNP transistors can be formed by connecting cathodes of two diodes. The cathodes of the diodes are connected together at a common point known as **base**. While the anodes of the diodes that are on the opposite sides are known as the **collector** and the **emitter**.



PNP Transistor - Construction & Working

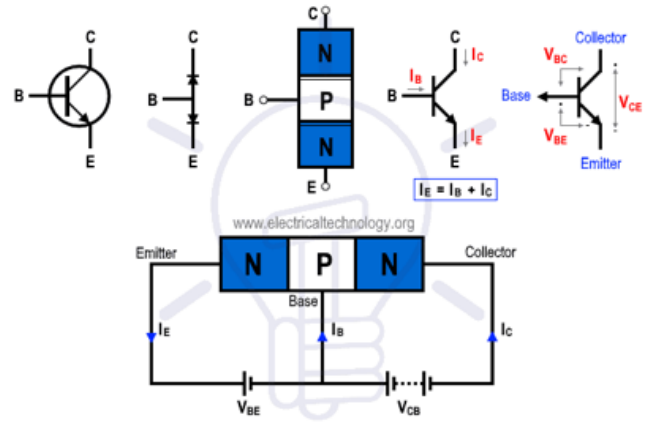
The emitter-base junction is forward bias while collector-base junction is reverse bias. So, in PNP type current flows from emitter to collector. The emitter, in this case, is at high potential to both collector and base.

- ***Related Post:*** ***What is PNP Transistor? Construction, Working & Applications***

NPN Construction

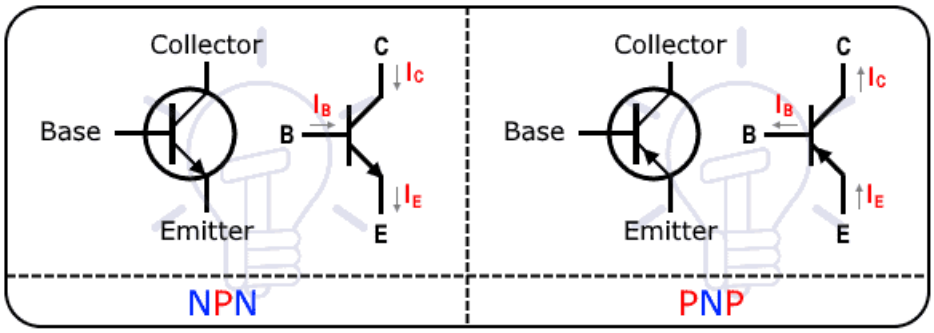
NPN type is exactly opposite to PNP type. In NPN bipolar transistor, the P-type semiconductor is sandwiched between two N-type semiconductors. When the anodes of two diodes are connected together it forms an NPN transistor. The current will flow from

the collector to emitter because the collector terminal is more positive than emitter in NPN connection.



NPN Transistor - Construction & Working

The difference between PNP and NPN symbol is the arrow mark at the emitter which shows the direction of flow of current. The current will either flow from emitter to collector or from collector to emitter. The arrow mark in PNP transistor is inward, which shows the flow of current from emitter to collector. In case of NPN collector, the arrow mark is outward, which shows the flow of current from collector to emitter.



Working of BJT

The word "transistor" is the combination of two words, "Trans" (Transform) and "istor" (Varistor). So, it means the transistor can transform its resistance. The resistance varies in such way that it can either act as an insulator or conductor by applying small signal voltage. This changing ability makes it able to perform both as an "**Amplifier**" or a "**Switch**". It can be used either as a switch or an amplifier at a single time. Therefore, BJT can operate in three different regions to perform the said operation.

Active Region:

In **Active region**, one of the junctions is in a forward bias while the other is in reverse bias. Here, the base current $\mathbf{I_b}$ can be used to control the amount of collector current $\mathbf{I_c}$. Therefore, the active region is used for amplification purposes where the BJT acts as an amplifier with a gain **β** using the equation;

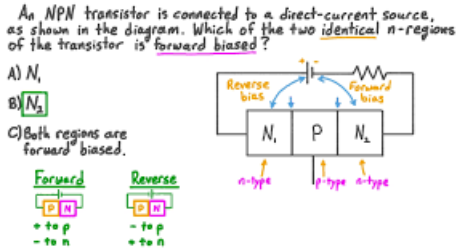
$$\mathbf{i_c = \beta \times I_b}$$

It is also known as **linear region**. This region is in between the **cutoff region** and the **saturation region**. The normal operation of BJT occurs in this region.

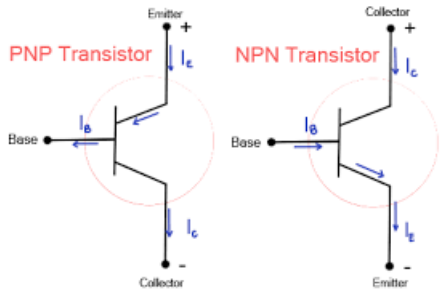
A transistor controls the number of charge carriers (be it either electrons or holes) through the three layers. There is a relatively small current between the base and emitter that regulates a much larger current flowing between the collector and emitter terminals.

Here is how the current will flow in the NPN transistor.

Forward Biasing: If a voltage of positive polarity is applied to the base concerning the emitter (forward bias), it injects holes in the base region. These holes diffuse toward the collector through the thin base region

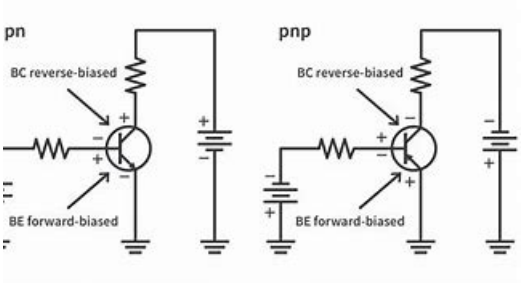


Base Region: The base region is fragile; therefore, a minimal number of carriers recombine with electrons in this region. Most of the airlines diffuse across the base toward the collector.



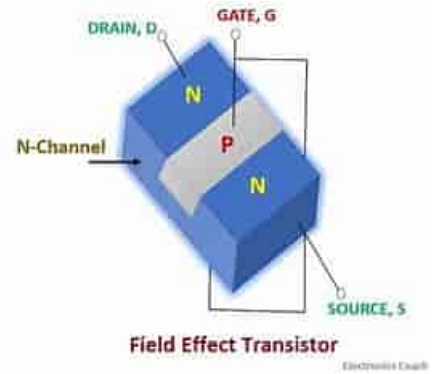
Collector region: Highly doped, it is relatively much broader compared to the base to collect most of the carriers. The collector-base junction is reverse-biased to enable easy travel of the electrons injected from the emitter into the collector. Emitter Region: It is heavily doped and gives off most of the charge carriers. Electrons are injected from the emitter to the base region by the forward bias of the base-emitter junction. Emitter Current: The current flowing in from the emitter and out to the collector is called the emitter current, IE. Most of the electrons minus the small base current will flow to the collector terminal, originating the collector current, IC.

3.Reverse Biasing



This is, in a real sense, reverse-biased when connected to the voltage source: the positive terminal of the voltage source is connected to the collector, and the negative terminal is connected to the base. That is, the majority of carriers, holes in the base region, will not be allowed to flow to the collector because of this reverse bias. So, the current in the collector is mainly due to the flow of minority carriers, that is, the electrons in the P-type base region, which diffuse across the base-collector junction.

A) Field-Effect Transistor(FET)



A FET has three terminals: source, gate, and drain. It works by allowing current from a source to pass to a drain but controlling the same current flow, which becomes effective due to the varied voltage applied on the gate terminal.

How Current Flows in an FET:

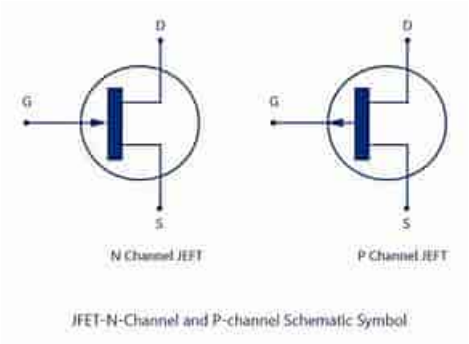
1. Voltage Control

The FET regulates the conduction of the current passing through an electric field caused by the applied voltage on the gate terminal. The gate, therefore, can create an electric field across the channel between the source and the drain, changing the conductivity of the channel.

Types of FET

Essentially, two general types of FETs exist: the junction FET (JFET) and the metal-oxide-semiconductor FET (MOSFET). In a JFET, the gate-channel junction is reverse-biased; in a MOSFET, the gate is insulated from the channel by a skinny layer of oxide.

Channel Control: A change in the applied gate terminal voltage will change the width and conductivity of the channel between the source and drain so that conduction is controlled.



A simplified structure of an NPN BJT is shown below: