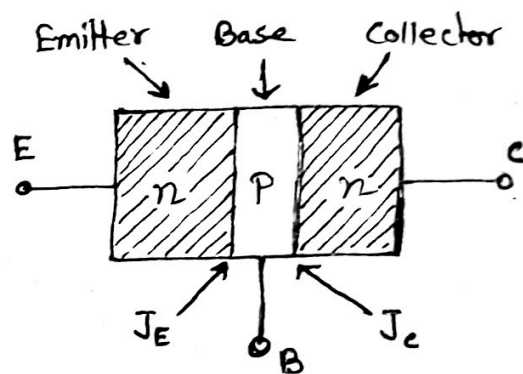
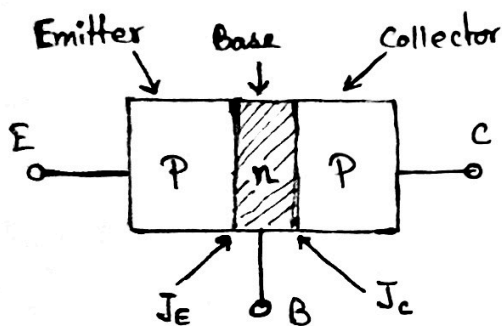


~~Semiconductor Devices~~

The Junction Transistor:

A junction transistor is made up of semiconductors such as germanium (Ge) or silicon (Si) in which a p-type thin layer is sandwiched between two n-type layers. The transistor so formed is called n-p-n transistor. Alternatively when a transistor has an n-type layer in between two p-type layers, the transistor so formed is called p-n-p transistor.



The emitter-base junction is usually referred to as emitter-junction (J_E) and the collector-base junction is known as collector-junction (J_C).

Since both the majority and the minority carriers are involved in the junction transistor, this type of transistor is called bipolar junction transistor (BJT).

In the normal transistor operation, emitter-base junction is forward-biased and the collector-base junction is reverse-biased.

Transistor Manufacturing Techniques:

Transistors are generally fabricated with the help of the four basic techniques. They are as follows,

i) Grown Technique:

In this method, an n-p-n transistor is constructed by drawing a single crystal from a ~~metal~~ melt of Silicon (Si) or Germanium (Ge) having n-type impurities. During the drawing operation, the conductivity type is changed by adding p-type impurities to form the base region of the transistor. Finally n-type impurities are added again.

In similar fashion, a p-n-p transistor can be grown.

ii) Alloy or Fused Technique:

In this method, to construct a p-n-p transistor a thin wafer of an n-type material is taken to serve as the base of the transistor. Two small dots of ~~indium~~ indium (In) are placed on the opposite sides of the wafer. This system is heated for a short time to a high temperature above the melting point of indium but below the wafer material. Indium dissolves and penetrates a little in the wafer, producing a p-type material on the either side of the n-type base. Thus a p-n-p transistor is formed.

iii) Diffusion Technique :

In this technique, a wafer of n-type silicon is heated in a furnace containing p-type impurities in a gaseous form. The impurities diffuse into the surface of the wafer producing a p-type region which is the base of the transistor.

The system is now covered by a mask with apertures and heated again with gaseous n-type impurities, which diffuse through the apertures producing an n-type layer over the p-layer. In this way an n-p-n transistor is formed.

iv) Epitaxial Technique :

The word 'epitaxy' is coined from the greek word 'epi' meaning 'on' and 'taxy' meaning 'arrangement'. Therefore epitaxy ~~and~~ refers to the process of growing a thin crystalline layer on a crystalline substrate.

In this process, very thin p-type and n-type layers of a semiconductor can be grown on a heavily doped material of the same semiconductor. Thus the layer produced can be the emitter, base and collector.

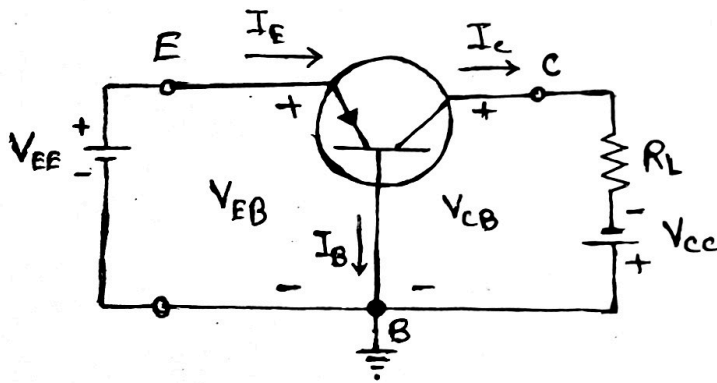
Modes of transistor operation:

A transistor can be operated in any of the following three modes depending on the common terminal between the input and output.

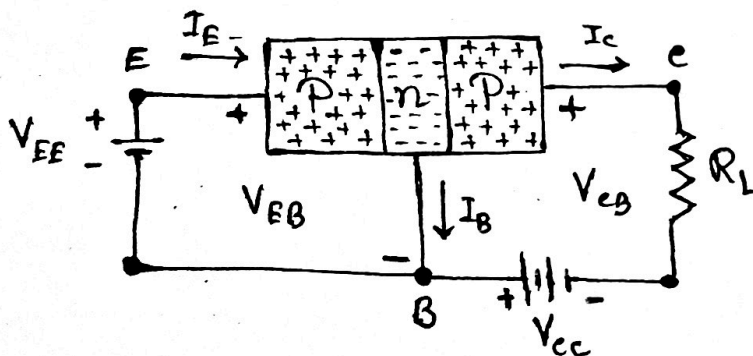
i) Common-Base (CB) Mode:

This configuration is also known as the grounded-base configuration. In this configuration the base terminal of the transistor is commoned between the input and the output circuit.

The common-base (CB) configuration of a P-n-p transistor is shown below,



Logic diagram of a P-n-p transistor in CB configuration



Block diagram of a P-n-p transistor in CB configuration