CONFIGURATIONS

Transistor configuration :

1. CB Configuration
2. CE Configuration
3. CC configuration

Common base configuration :

Current amplification factor is defined as ratio of change in output current to change in input current.

$$\alpha = \frac{\Delta I_C}{\Delta I_C} \qquad (A.C.currents)$$

$$\alpha = \frac{I_C}{I_E} \qquad (D.C.currents)$$

α varies from 0.9 to 0.995

I_C : Total collector current consists of part of emitter current which reaches collector region.

$$I_C = \alpha I_E$$

Reverse saturation current due to minority charge carriers due to CB junction is reverse biased. This leakage current is very much less than αI_E .

$$I_C = \alpha I_E + I_{leakage}$$

When the emitter circuit is open circuted $(I_E = 0)$ I_{CBO} which is leakage current due to minority charge carriers which is reverse biased.

I_{CBC} is collector to base current due to emitter is open circuited.

$$\therefore I_C = \alpha I_E + I_{CBC}$$

common base input characteristics

In the active region the input diode is forward biased, therefore, input characteristic is simply the forward biased characteristic of the emitter to base diode for various collector voltages. fig. 3. Below cut in voltage (0.7 or 0.3) the emitter current is very small. The curve with the collector open represents the forward biased emitter diode. Because of the early effect the emitter current increases for same V_{EB}. (The diode becomes better diode).

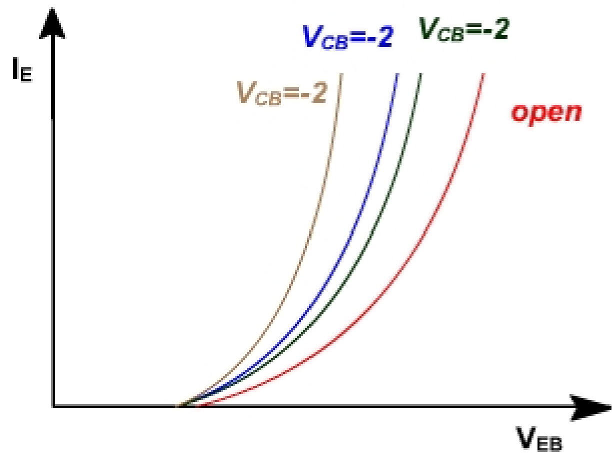

Fig. 3

When the collector is shorted to the base, the emitter current increases for a given V_{EB} since the collector now removes minority carriers from the base, and hence base can attract more holes from the emitter. This mean that the curve V_{CB}= 0, is shifted from the character when V_{CB} = open.

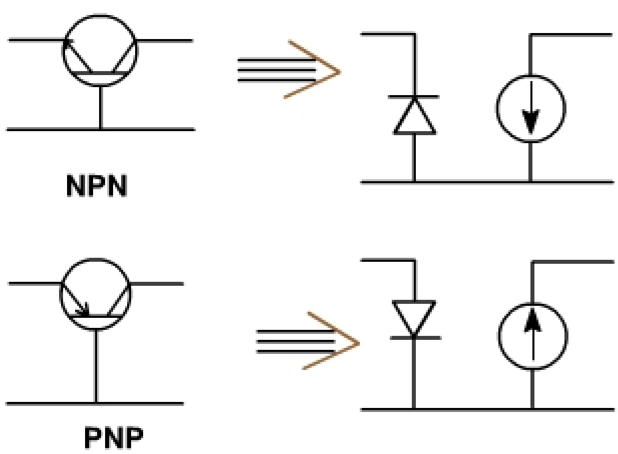

Fig.4

In an ideal transistor, a_{dc}= 1. This means all emitter electrons entering the base region go on to the collector. Therefore, collector current equals emitter current. For transistor action, emitter diode acts like a forward bias diode and collector diode acts like a current source. The equivalent circuits of npn and pnp transistors are shown in fig. 4. The current source arrow points for conventional current. The current source is controlled by emitter current.

Early effect or Base-width modulation :

When V_{CB} increases depletion region at CB junction increases. So effective base width decreases. Change in effective base width due to V_{CB} is known as base width modulation.

Consequences of base-width modulation :

i. There would be less recombination's as charge particles of base region reaches emitter vastly.

ii. There by I_E and I_C are increases.

Note : For extremely larger values of V_{CB}, effective base width may be zero causing breakdown in transistor. This phenomenon is called punch through

Output characteristics :

It is the curve drawn between output voltage and output current at constant input current.

It is curve between collector to base voltage V_{CB} and collector current I_C at constant emitter current I_E

Cut off region : EB, CB are reverse biased.

Active region : EB is forward biased and CB is reverse biased.

Saturation region: EB, CB both are forward biased.

Cut of region :

Both junctions are reverse biased. But small current flows through transistor due to reverse saturation current but this current is not sufficient to drive the transistor through application. So transistor should not be operated in cut-off region.

Though the V_{CB} is a negative voltage but it is represented on +ve x-axis. So that we can visualise the diagram the region below $I_E = 0$ is called cut-off region.

saturation region:

Both V_{EB} junction and V_{CB} junction are forward biased in saturation region.

The region to the left of $V_{CB} = 0$ (+ve V_{CB} voltage) and above $I_E = 0$ called saturation region.

For a small variation of V_{CB} there is a very large change in I_C. Then there is no proper control over the current. Here I_C does not depend in I_E and the transistor is not operated in the saturation region.

Generally transistors are operated in active region for amplifier application.

Here EB junction is forward biased

CB junction is reverse biased

Active region corresponds to $I_E > 0$

Even if $I_E > 0$ there is a small current which flows that is equal to I_{C_0} and this is represented by a horizontal straight line.

But there is a slight increase in I_C with V_{CB} i.e., due to early effect and then it becomes constant. Here I_C is α times I_E which is almost equal to I_E.