

Transistor Circuit Configurations

Basically, there are three types of circuit connections (called configurations) for operating a transistor.

1. common-base (CB),
2. common-emitter (CE).
3. common-collector (CC).

The term 'common' is used to denote the electrode that is common to the input and output circuits. Because, the common electrode is generally grounded, these modes of operation are frequently referred to as grounded-base, grounded-emitter and grounded-collector configurations as shown in Figure for a PNP transistor.

Since a transistor is a 3-terminal (and not a 4-terminal) device, one of its terminals has to be common to the input and output circuits.

CB Configuration

In this configuration, emitter current I_E is the input current and collector current I_C is the output current. The input signal is applied between the emitter and base whereas, output is taken out from the collector and base as shown in Fig. (a).

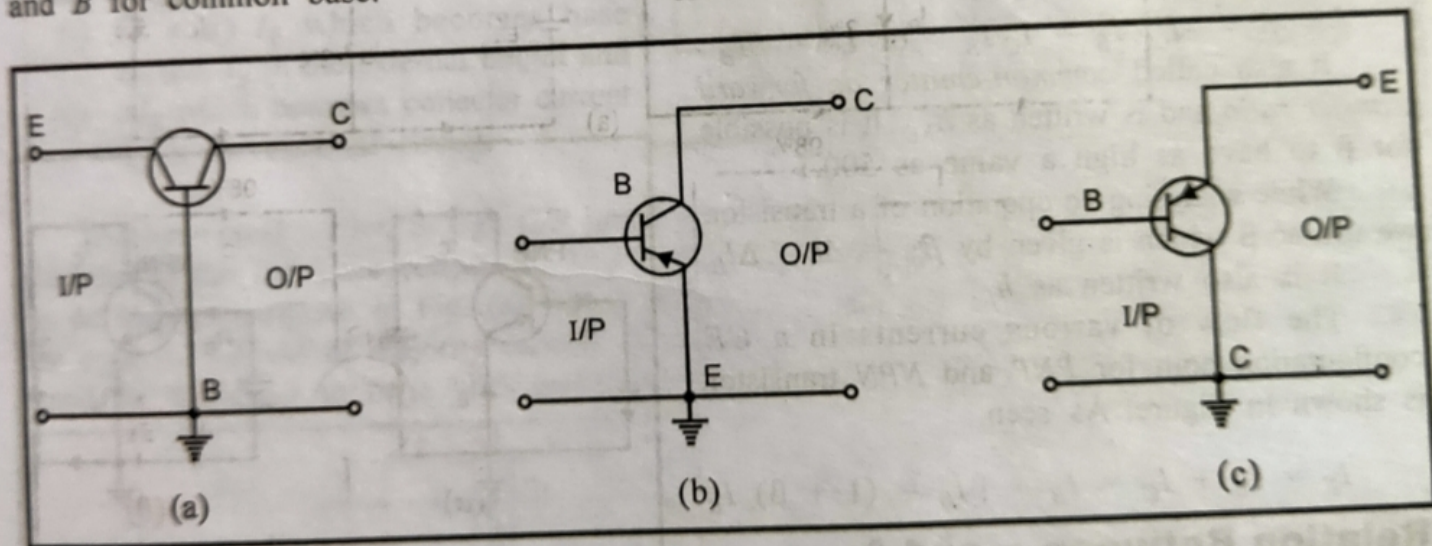
The ratio of the collector current to the emitter current is called dc alpha (α_{dc}) of a transistor.

$$\alpha_{dc} = \frac{-I_C}{I_E}$$

The negative sign is due to the fact that current I_E flows into the transistor whereas, I_C flows out at it. Hence, I_E is taken as positive and I_C as negative.

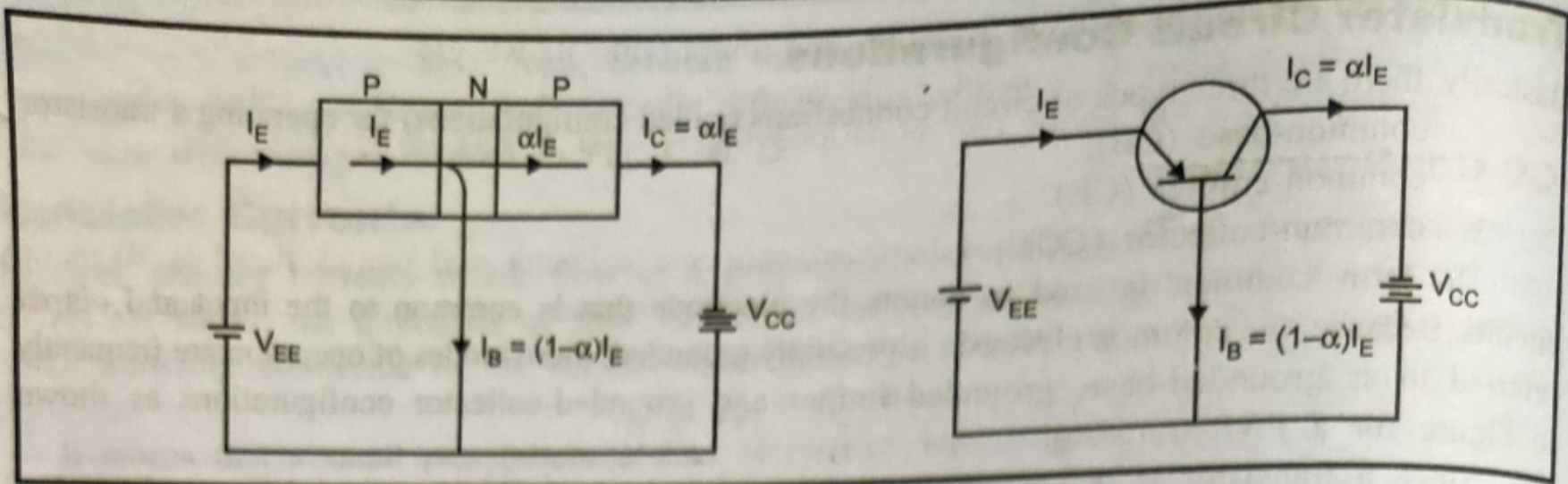
$$I_C = -\alpha_{dc} I_E$$

It is also called forward current transfer ratio ($-\alpha_{FB}$). In α_{FB} , subscript F stands for forward and B for common base.



The α of a transistor is a measure of the quality of a transistor; higher the value of α , better the transistor in the sense that collector current more closely equals the emitter current. Its value ranges from 0.95 to 0.999. Obviously, it applies only to CB configuration of a transistor. As seen from above and Figure.

$$I_C = \alpha I_E. \text{ Now, } I_B = I_E - \alpha I_E = (1 - \alpha) I_E$$



Incidentally, there is also an ac α for a transistor. It refers to the ratio of change in collector current to the *change* in emitter current.

$$\therefore \alpha_{ac} = \frac{-\Delta I_C}{\Delta I_E}$$

It is also, known as short-circuit gain of a transistor and is written as $-h_{fb}$. It may be noted that upper case subscript 'FB' indicates dc value whereas, lower case subscript '*fb*' indicates ac value. For all practical purposes, $\alpha_{dc} = \alpha_{ac} = \alpha$.