CE Transistor Characteristics

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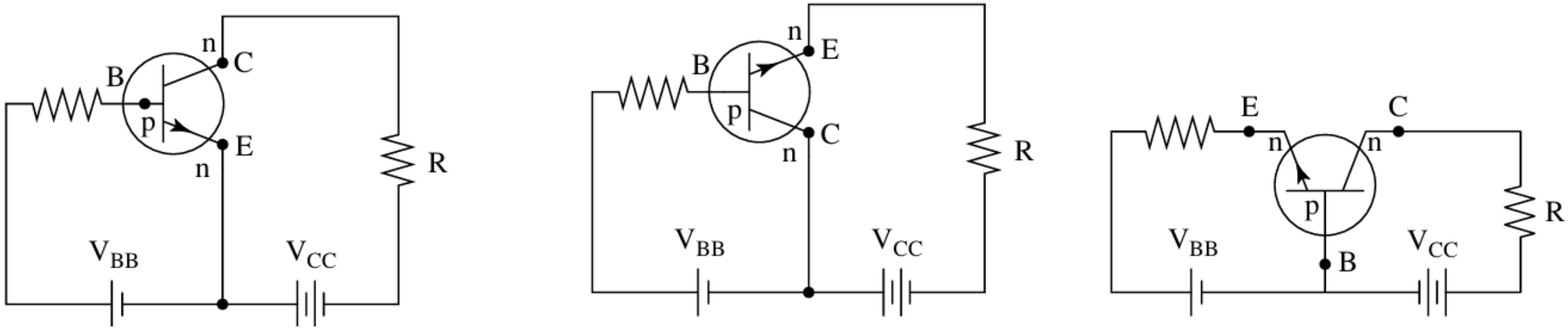
CONFIGURATIONS OF TRANSISTORS:



Common-emitter, common-collector, and common-base configurations of NPN transistors

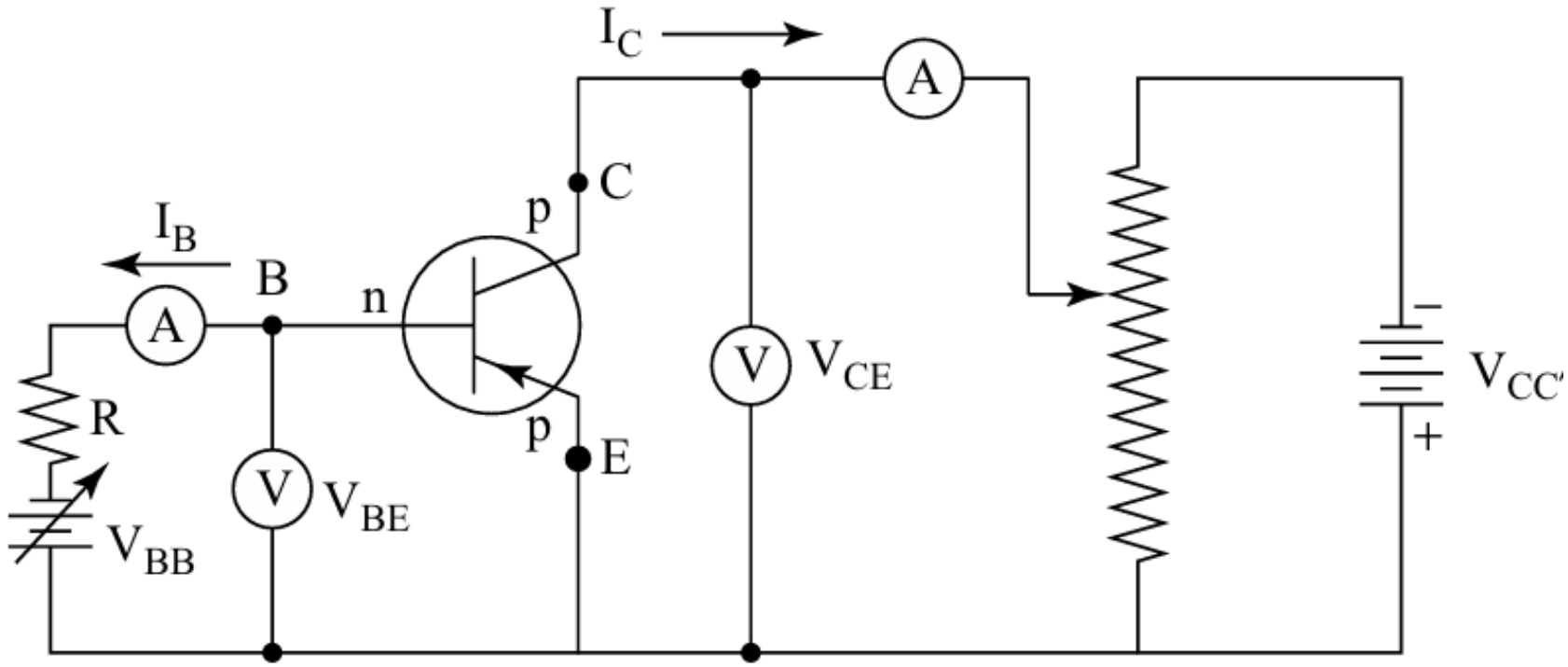
For the connection of input and output, one of the transistor terminals is made common.

There are three types of configurations, namely (i) common-emitter configuration; (ii) common-collector configuration; (iii) common-base configuration.

The common emitter configuration is the most widely used because of its very high voltage and power gain.

Therefore, we will discuss the common emitter configuration only.

COMMON EMITTER TRANSISTOR CHARACTERISTICS:



Circuit diagram for determining the common-emitter characteristics of PNP type transistor

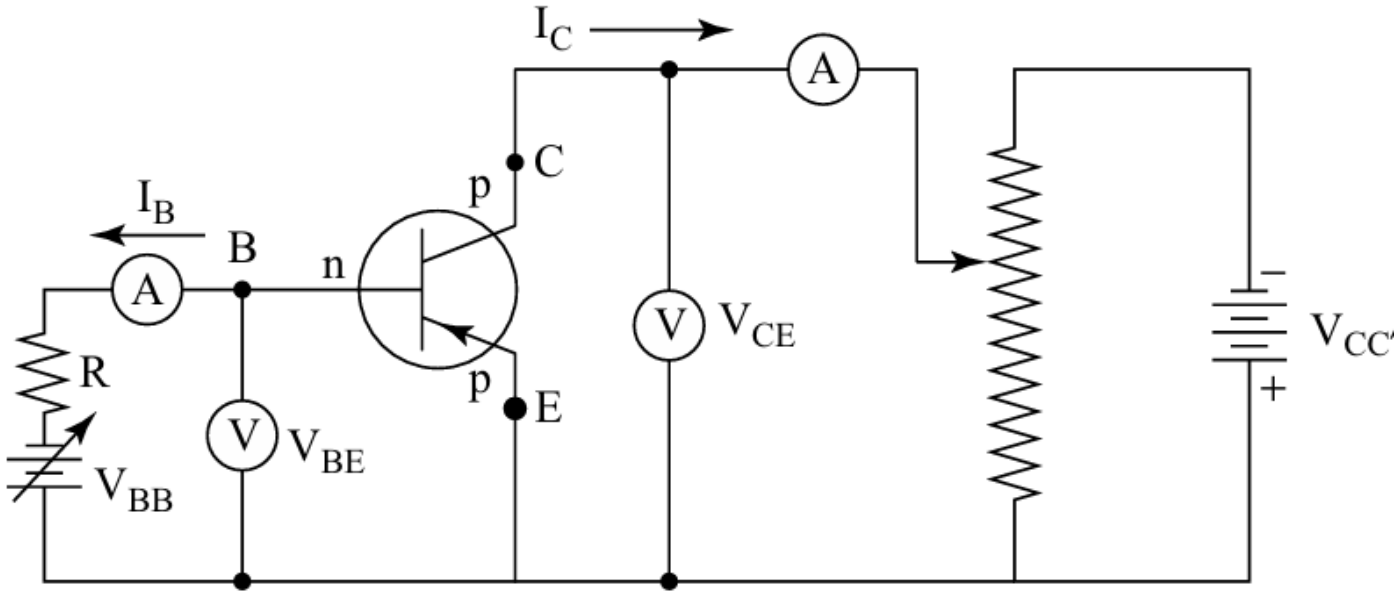
The input voltage is applied between the base and the emitter terminals.

The output is taken from the collector and the emitter terminals.

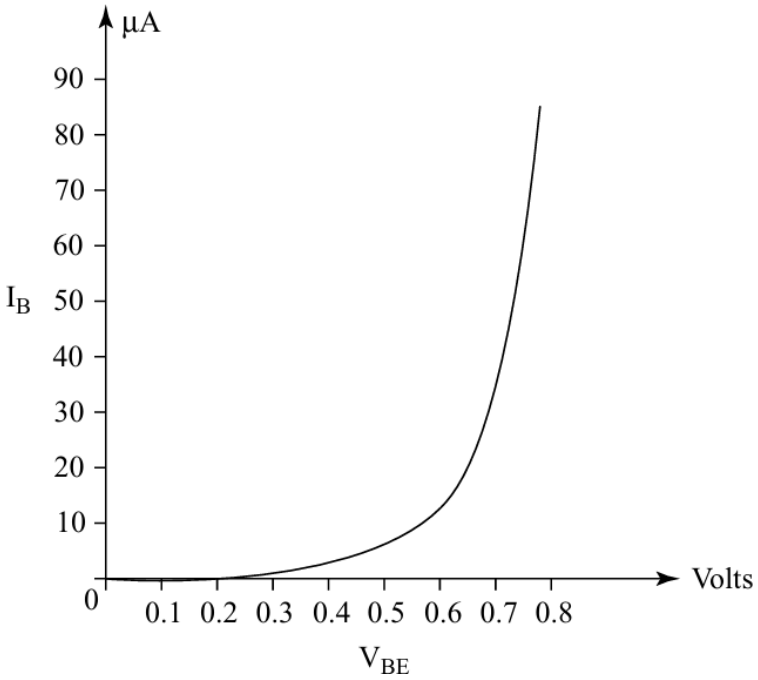
The emitter terminal is common to both input and output.

Thus, this connection is called the common-emitter configuration.

COMMON EMITTER TRANSISTOR CHARACTERISTICS:



Circuit diagram



Input Characteristics

The input characteristic is drawn between V_{BE} and I_B.

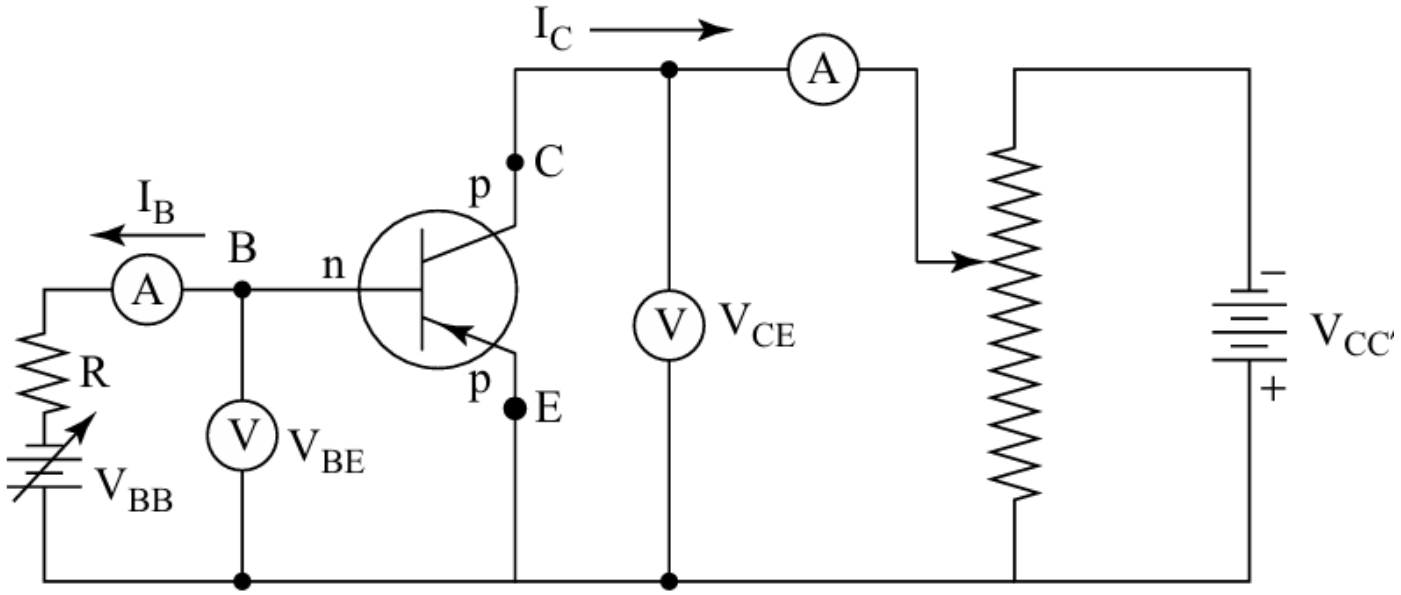
To draw the input characteristic, the voltage between the collector and the emitter, i.e., V_{CE} is kept constant.

By changing V_{BE}, current I_B is recorded and the characteristics can be plotted.

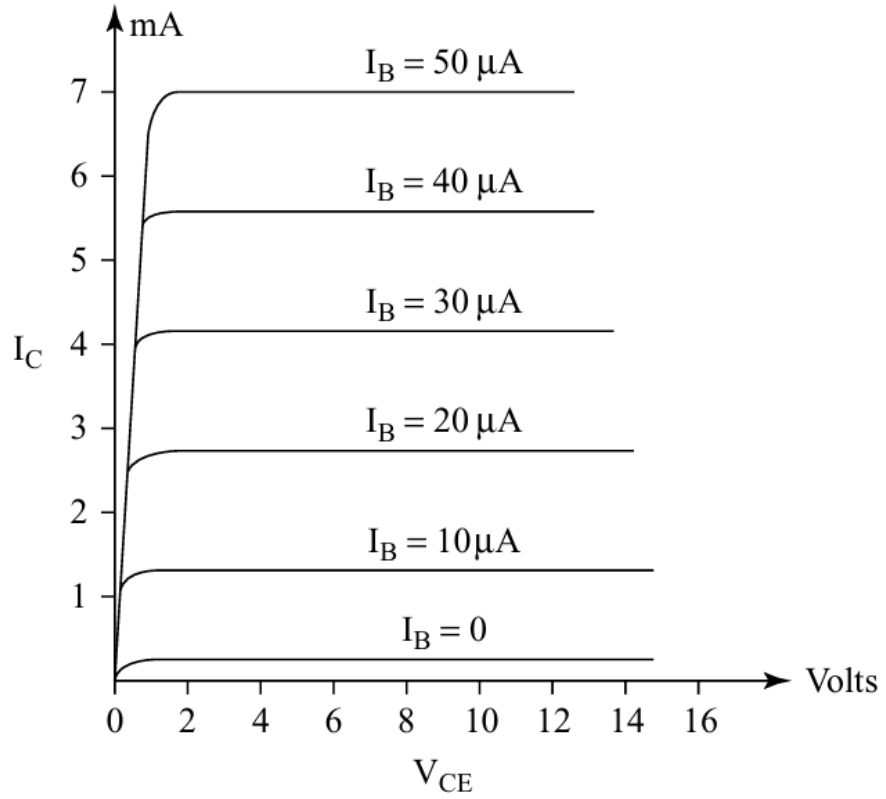
The input characteristics is similar to the characteristic of a forward-biased p–n junction.

The value of I_B is very small, is of the order of several microamperes only.

COMMON EMITTER TRANSISTOR CHARACTERISTICS:



Circuit diagram



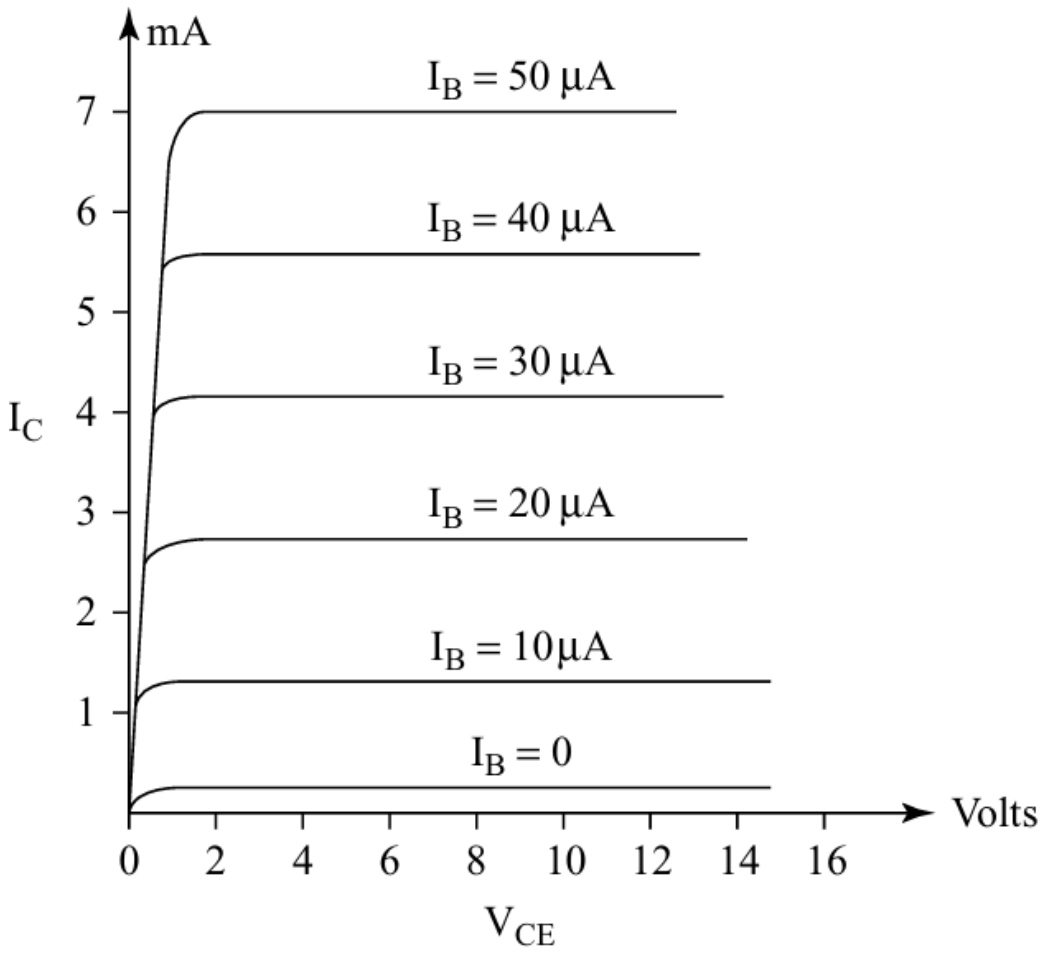
Output Characteristics

The output characteristics are drawn between I_C and V_{CE} keeping I_B constant.

For each value of I_B , V_{CE} is adjusted in steps and the values of I_C are recorded.

The values of I_C are plotted against V_{CE} for each value of I_B to obtain the output characteristics.

COMMON EMITTER TRANSISTOR CHARACTERISTICS:



Output Characteristics

From the output characteristics, it can be seen that for a small change in base current (in μA) there is a large change in collector current and emitter current (in mA).

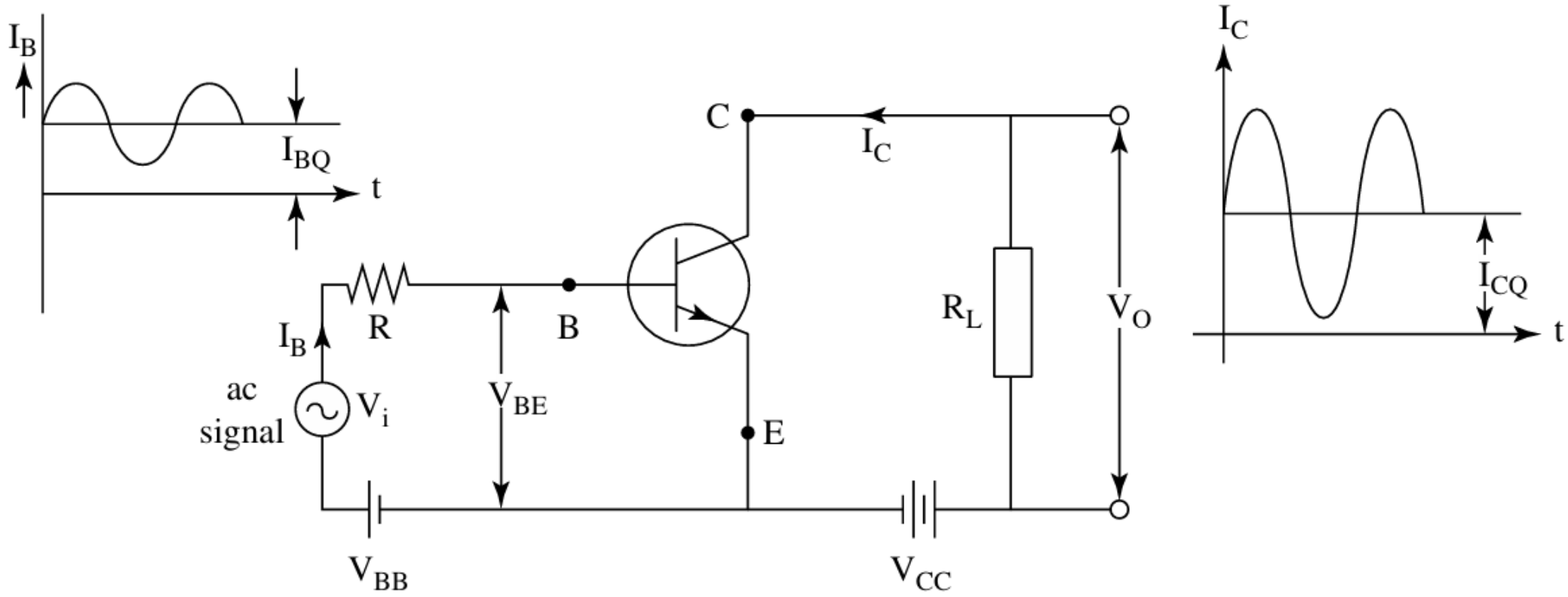
The current gain from the base to the collector can be stated as:

$$\beta_{dc} = \frac{\Delta I_C}{\Delta I_B}$$

Thus, the transistor can be used as a current amplification device.

The voltage gain, A_V of the transistor is defined as the ratio of output voltage to input voltage.

TRANSISTOR AS AN AMPLIFIER:



Simple transistor amplifier circuit using NPN transistor connected in the common emitter configuration

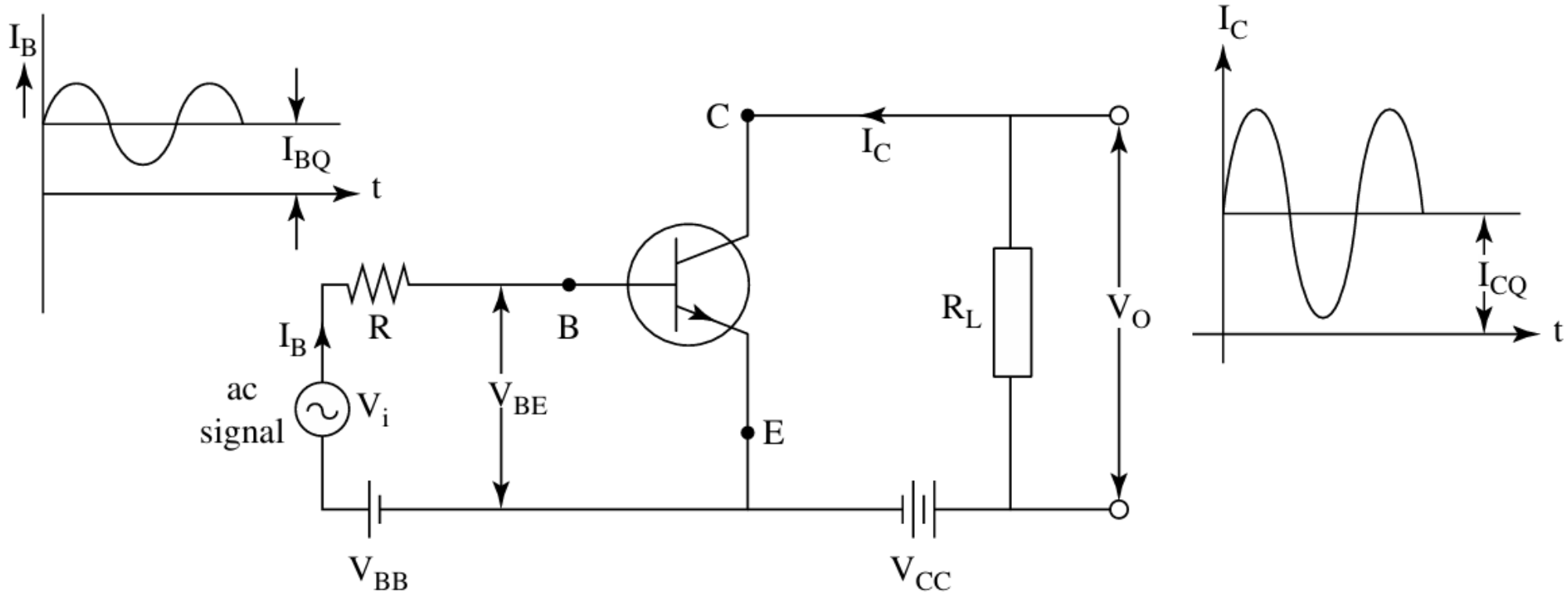
The ac signal which is to be amplified is connected to the base circuit.

The output is taken across a resistance, R_L in the collector circuit.

The voltage, V_{BE} is the summation of dc voltage V_{BB} and the ac input signal, V_i .

The dc voltage, V_{BB} is the bias voltage.

TRANSISTOR AS AN AMPLIFIER:



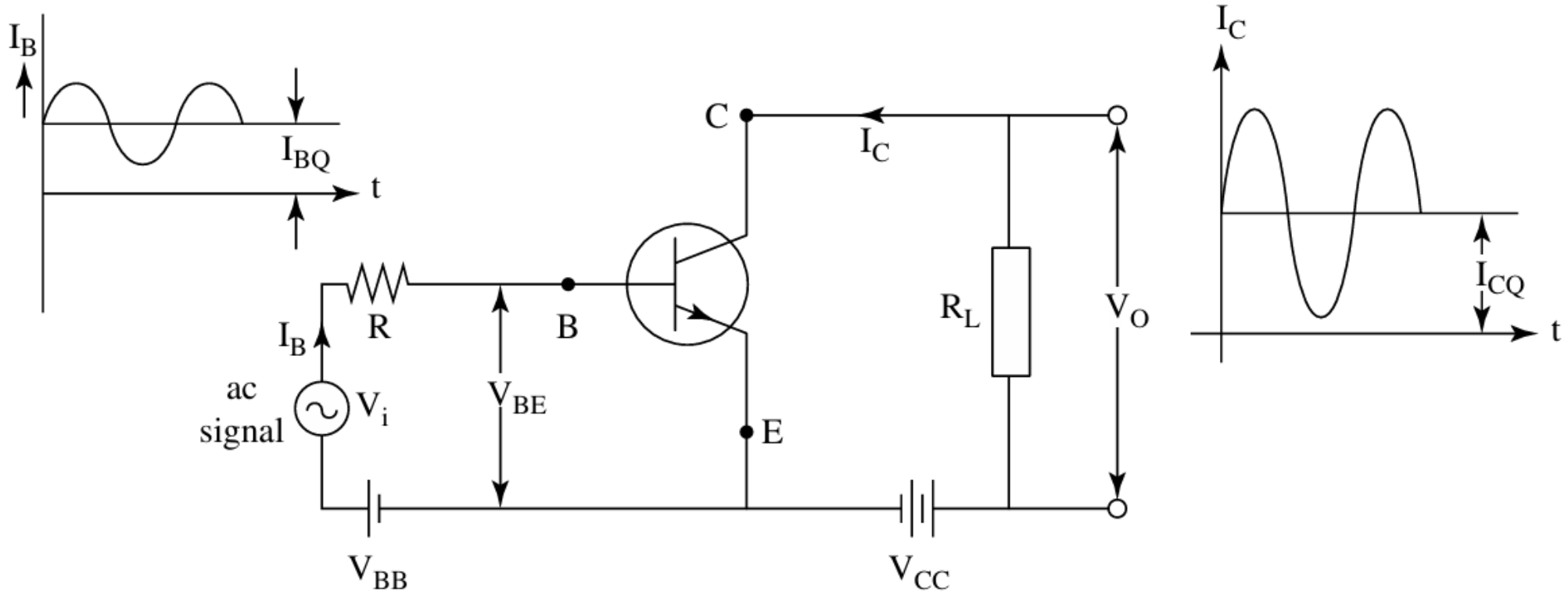
Simple transistor amplifier circuit using NPN transistor connected in the common emitter configuration

The magnitude of V_{BB} is such that the base will always remain positively biased in both half cycles of the input voltage.

The base current I_B is the sum of the dc base current I_{BQ} and the ac current.

Because of the variation in the base current there will be a large variation in the collector current, which will flow through the load resistance R_L.

TRANSISTOR AS AN AMPLIFIER:



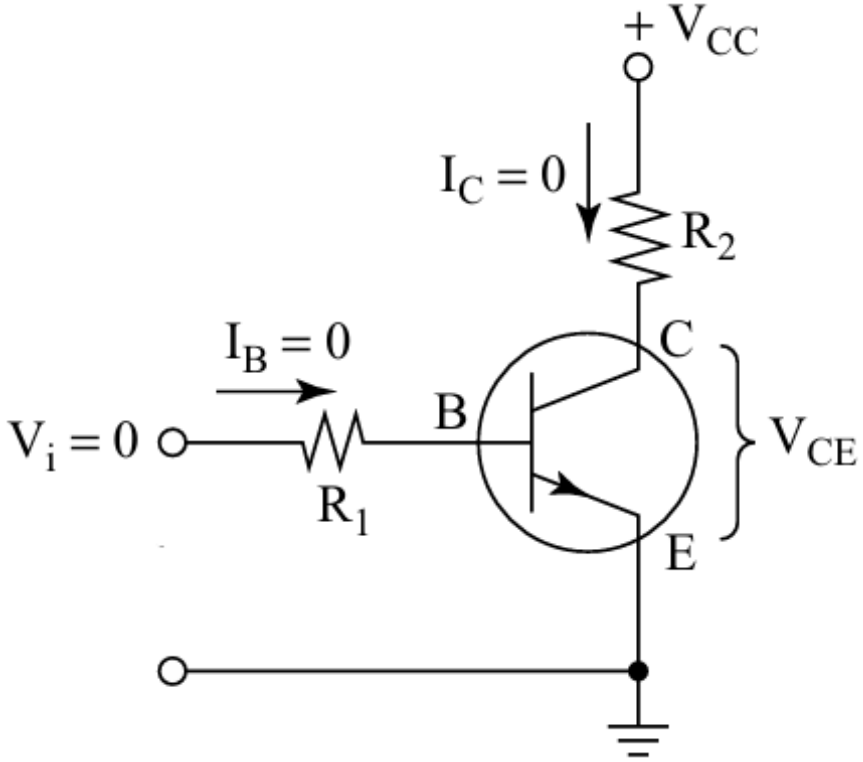
Simple transistor amplifier circuit using NPN transistor connected in the common emitter configuration

The amplified collector ac current is superimposed on the dc current, I_{CQ}.

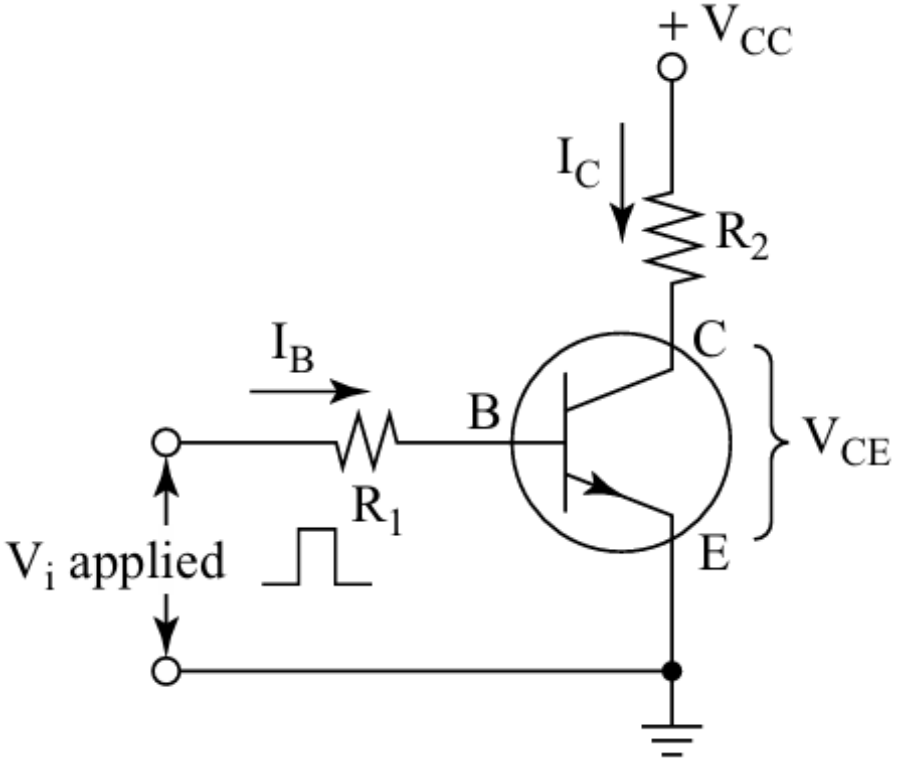
I_{CQ} is the collector current which will flow if the ac input signal is not applied.

Due to the large collector current, an amplified output voltage will be available across the load.

TRANSISTOR AS A SWITCH:



Off state of a BJT



ON state of a BJT

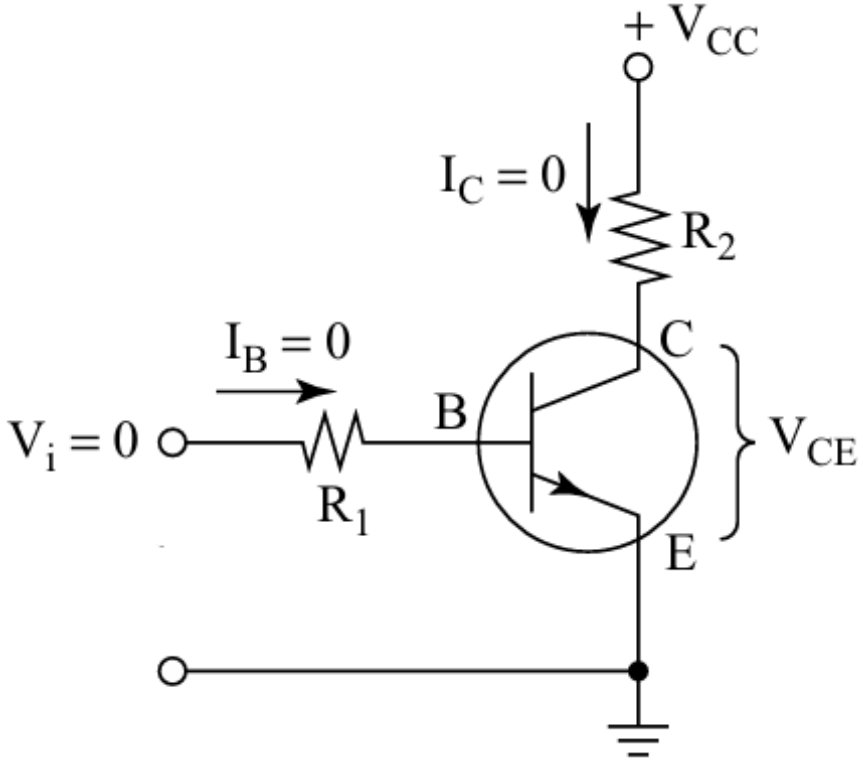
A BJT can be also used as a switch.

There are two states for a switch.

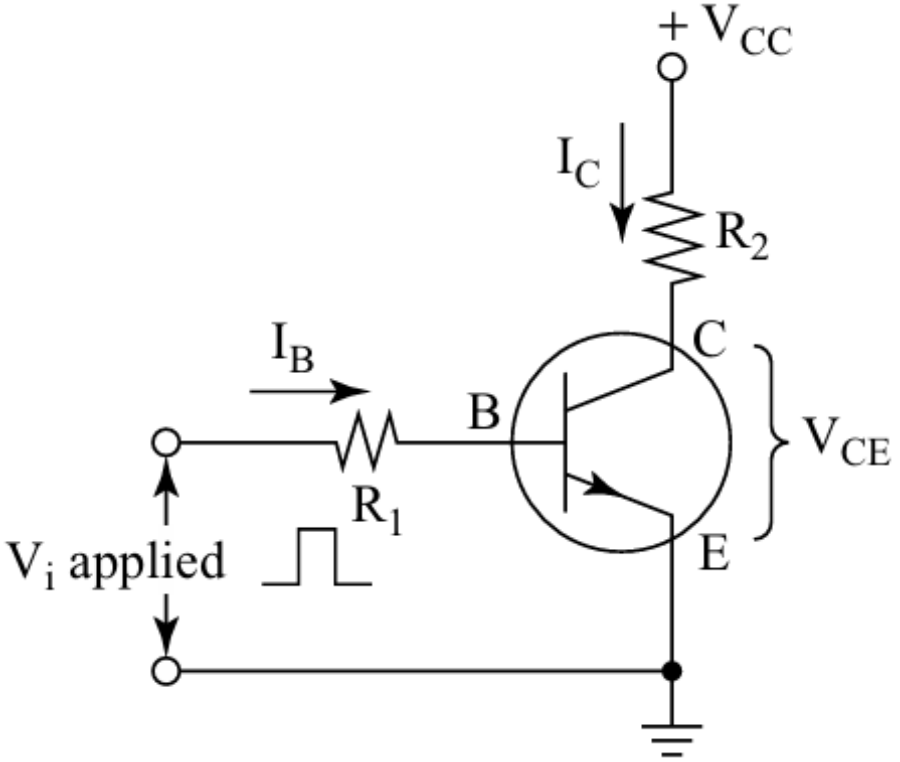
The switch is closed, i.e., it offers minimum resistance and current flows through it.

Or the switch is open, i.e., there is no current flow (cut off).

TRANSISTOR AS A SWITCH:



Off state of a BJT



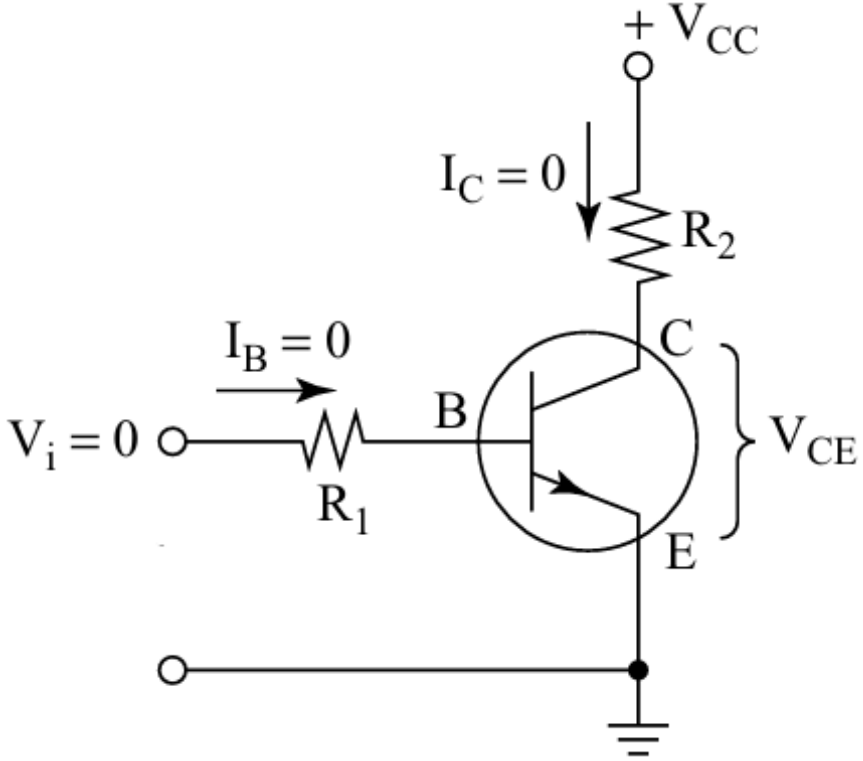
ON state of a BJT

The base voltage level is either at zero level or at an appropriate positive level.

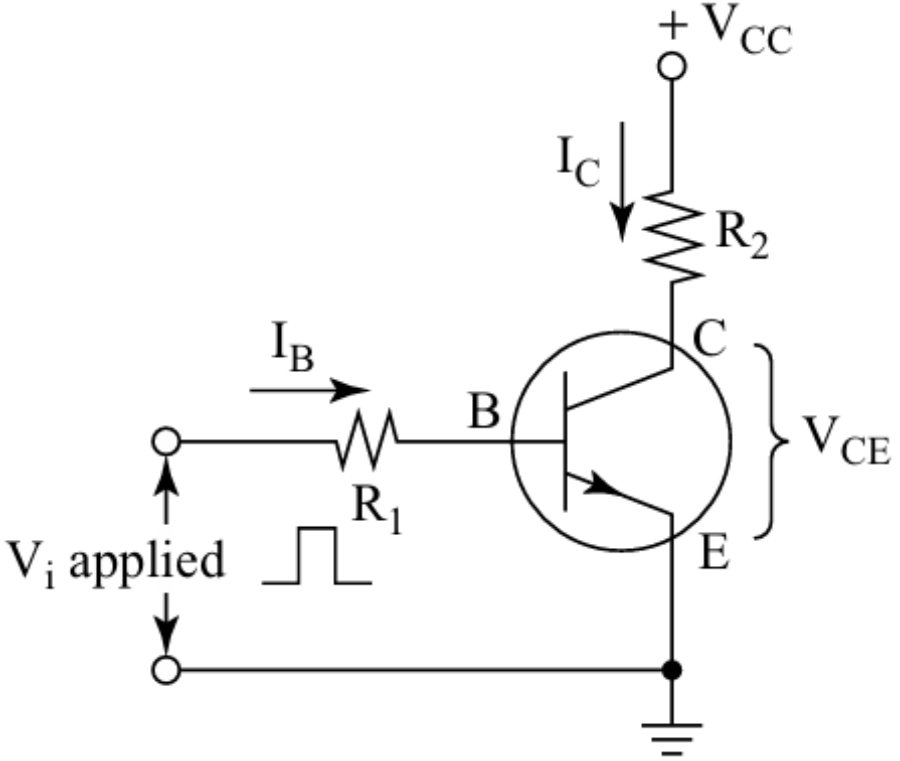
When the input voltage, V_i is at zero level, the base current is zero and there is no collector current, i.e., $I_C = 0$.

The transistor is cut off and works like an open switch.

TRANSISTOR AS A SWITCH:



Off state of a BJT



ON state of a BJT

If V_i is at positive level, and the base current I_B is made high enough, the transistor operates in the saturation region.

Under saturated condition, large collector current I_C flows and the transistor operates as a closed switch.

Thank You