2.5 COMMON COLLECTOR CONFIGURATION

In this configuration, the base terminal of the transistor serves as the input, the emitter terminal is the output and the collector terminal is common for both input and output. Hence, it is named as common collector configuration. The input is applied between the base and collector while the output is taken from the emitter and collector.

In common collector configuration, the collector terminal is grounded so the common collector configuration is also known as grounded collector configuration.

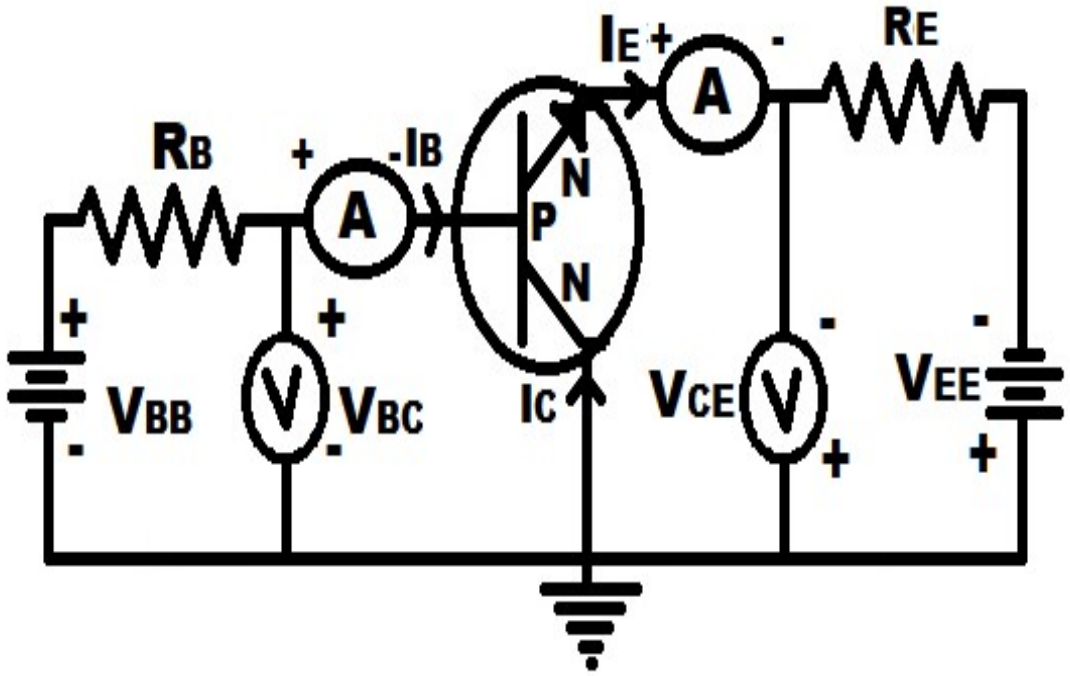

Fig:2.5.1 Common Collector Configuration of NPN Transistor

Sometimes common collector configuration is also referred to as emitter follower, voltage follower, common collector amplifier, CC amplifier, or CC configuration. This configuration is mostly used as a voltage buffer.

The input supply voltage between base and collector is denoted by VBC while the output voltage between emitter and collector is denoted by VEC.

In this configuration, input current or base current is denoted by IB and output current or emitter current is denoted by IE. The common collector amplifier has high input impedance and low output impedance. It has low voltage gain and high current gain.

The power gain of the common collector amplifier is medium. To fully describe the behavior of a transistor with CC configuration, need two set of characteristics input characteristics and output characteristics.

Input characteristics

The input characteristics describe the relationship between input current or base current (IB) and input voltage or base-collector voltage (VBC).

The input current or base current (IB) is taken along y-axis (vertical line) and the input voltage or base-collector voltage (VBC) is taken along x-axis (horizontal line).

To determine the input characteristics, the output voltage VEC is kept constant at 3V and the input voltage VBC is increased from zero volts to different voltage levels. For each level of input voltage VBC, the corresponding input current IB is noted. A curve is then drawn between input current IB and input voltage VBC at constant output voltage VEC (3V).

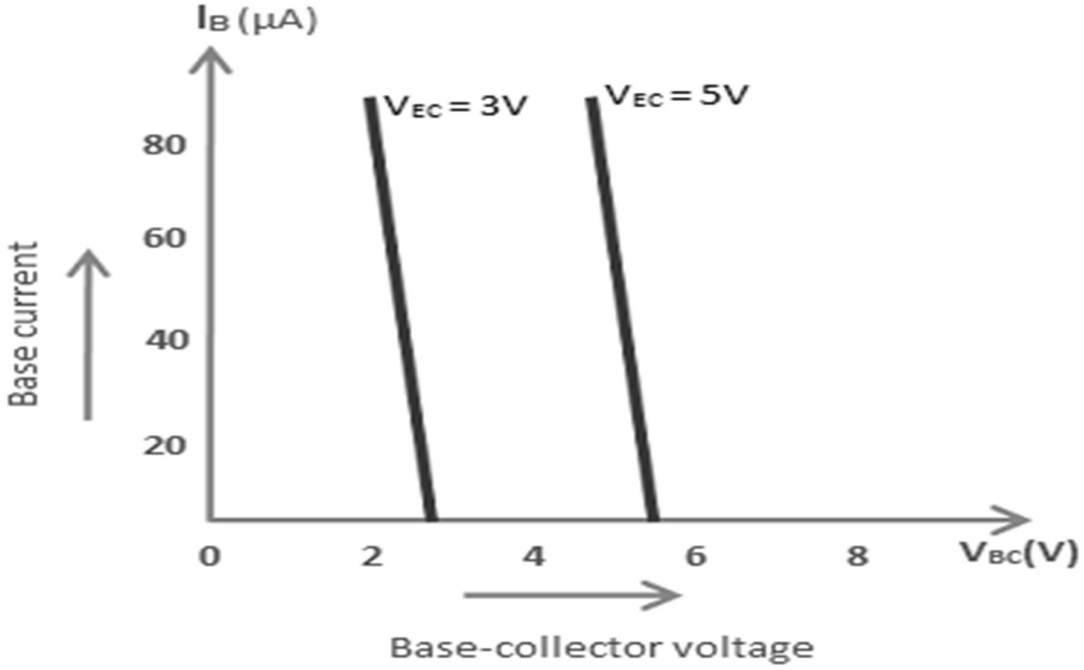

Fig:2.5.2 Input characteristics of Common Collector Configuration

Next, the output voltage VEC is increased from 3V to different voltage level, say for example 5V and then kept constant at 5V. While increasing the output voltage VEC, the input voltage VBC is kept constant at zero volts.

After kept the output voltage VEC constant at 5V, the input voltage VBC is increased from zero volts to different voltage levels. For each level of input voltage VBC, the corresponding input current IB is noted. A curve is then drawn between input current IB and input voltage VBC at constant output voltage VEC (5V).

This process is repeated for higher fixed values of output voltage (VEC).

Output characteristics

The output characteristics describe the relationship between output current or emitter current (IE) and output voltage or emitter-collector voltage (VEC).

The output current or emitter current (IE) is taken along y-axis (vertical line) and the output voltage or emitter-collector voltage (VEC) is taken along x-axis (horizontal line).

To determine the output characteristics, the input current IB is kept constant at zero micro amperes and the output voltage VEC is increased from zero volts to different voltage levels. For each level of output voltage VEC, the corresponding output current IE is noted. A curve is then drawn between output current IE and output voltage VEC at constant input current IB (0 μA).

Next, the input current (IB) is increased from 0 μA to 20 μA and then kept constant at 20 μA. While increasing the input current (IB), the output voltage (VEC) is kept constant at 0 volts.

After kept the input current (IB) constant at 20 μA, the output voltage (VEC) is increased from zero volts to different voltage levels. For each level of output voltage (VEC), the corresponding output current (IE) is recorded. A curve is then drawn between output current IE and output voltage VEC at constant input current IB (20μA). This region is known as the active region of a transistor.

This process is repeated for higher fixed values of input current IB (I.e. 40 μA, 60 μA, 80 μA and so on).

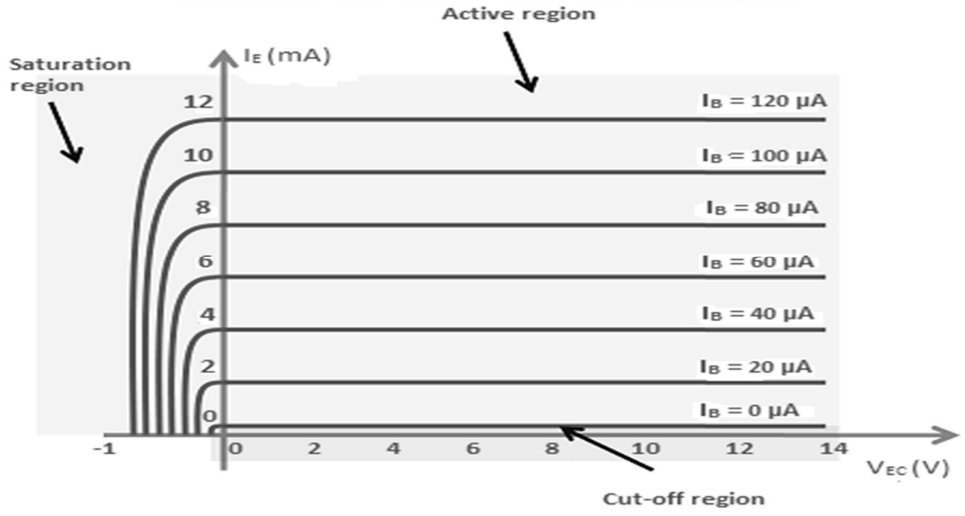

Fig:2.5.3 Output characteristics of Common Collector Configuration

In common collector configuration, if the input current or base current is zero then the output current or emitter current is also zero. As a result, no current flows through the transistor. So the transistor will be in the cutoff region. If the base current is slightly increased, then the output current or emitter current also increases. So the transistor falls into the active region. If the base current is heavily increased, then the current flowing through the transistor also heavily increases. As a result, the transistor falls into the saturation region.

Transistor parameters

Dynamic input resistance (ri)

Dynamic input resistance is defined as the ratio of change in input voltage or base voltage (VBC) to the corresponding change in input current or base current (IB), with the output voltage or emitter voltage (VEC) kept at constant.

$$r_i = \frac{\Delta V_{BC}}{\Delta I_B}, \qquad V_{EC} = \text{constant}$$

The input resistance of common collector amplifier is high.

Dynamic output resistance (ro)

Dynamic output resistance is defined as the ratio of change in output voltage or emitter voltage (VEC) to the corresponding change in output current or emitter current (IE), with the input current or base current (IB) kept at constant. The output resistance of common collector amplifier is low.

$$r_o = \frac{\Delta V_{EC}}{\Delta I_E}, \qquad I_B = \text{constant}$$

Current amplification factor (γ)

The current amplification factor is defined as the ratio of change in output current or emitter current IE to the change in input current or base current IB. It is expressed by γ.

$$\gamma = \frac{\Delta I_E}{\Delta I_B}$$

The current gain of a common collector amplifier is high.