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.



Common collector configuration

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 V_{BC} while the output voltage between emitter and collector is denoted by V_{EC} .

In this configuration, input current or base current is denoted by I_B and output current or emitter current is denoted by I_E . 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, we need two set of characteristics - input characteristics and output characteristics.

Input characteristics

The input characteristics describe the relationship between input current or base current (I_B) and input voltage or base-collector voltage (V_{BC}).

First, draw a vertical line and a horizontal line. The vertical line represents y-axis and horizontal line represents x-ax

The input current or base current (I_B) is taken along y-axis (vertical line) and the input voltage or base-collector voltage (V_{BC}) is taken along x-axis (horizontal line).

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



Next, the output voltage V_{EC} is increased from 3V to different voltage level, say for example 5V and then kept constant at 5V. While increasing the output voltage V_{EC} , the

input voltage V_{BC} is kept constant at zero volts.

After we kept the output voltage V_{EC} constant at 5V, the input voltage V_{BC} is increased from zero volts to different voltage levels. For each level of input voltage V_{BC} , the corresponding input current I_B is noted. A curve is then drawn between input current I_B and input voltage V_{BC} at constant output voltage V_{EC} (5V).

This process is repeated for higher fixed values of output voltage (V_{EC}).

Output characteristics

The output characteristics describe the relationship between output current or emitter current (I_E) and output voltage or emitter-collector voltage (V_{EC}).

First, draw a vertical line and a horizontal line. The vertical line represents y-axis and horizontal line represents x-axis.

The output current or emitter current (I_E) is taken along y-axis (vertical line) and the output voltage or emitter-collector voltage (V_{EC}) is taken along x-axis (horizontal line).

To determine the output characteristics, the input current I_B is kept constant at zero micro amperes and the output voltage V_{EC} is increased from zero volts to different voltage levels. For each level of output voltage V_{EC} , the corresponding output current I_E is noted. A curve is then drawn between output current I_E and output voltage V_{EC} at constant input current I_B (0 μ A).



Output characteristics

Next, the input current (I_B) is increased from 0 μ A to 20 μ A and then kept constant at 20 μ A. While increasing the input current (I_B), the output voltage (V_{EC}) is kept constant at 0 volts.

After we kept the input current (I_B) constant at 20 μ A, the output voltage (V_{EC}) is increased from zero volts to different voltage levels. For each level of output voltage (V_{EC}), the corresponding output current (I_E) is recorded. A curve is then drawn between output current I_E and output voltage V_{EC} at constant input current I_B (20 μ A). This region is known as the active region of a transistor.

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

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 (r_i)

Dynamic input resistance is defined as the ratio of change in input voltage or base voltage (V_{BC}) to the corresponding change in input current or base current (I_B), with the output voltage or emitter voltage (V_{EC}) kept at constant.

 $\mathbf{r}_{i} = \frac{\Delta V_{BC}}{\Delta I_{B}}, \qquad V_{EC} = \text{constant}$

The input resistance of common collector amplifier is high.

Dynamic output resistance (r_o)

Dynamic output resistance is defined as the ratio of change in output voltage or emitter voltage (V_{EC}) to the corresponding change in output current or emitter current (I_E), with the input current or base current (I_B) kept at constant. The output resistance of common collector amplifier is low.

$$\mathbf{r}_{o} = \frac{\Delta \mathbf{V}_{EC}}{\Delta \mathbf{I}_{E}} , \quad \mathbf{I}_{B} = \textbf{constant}$$

Current amplification factor (γ)

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

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

The current gain of a common collector amplifier is high.