Bipolar Junction Transistor (BJT) Configuration

Course: CSE 131; Basic Electronics Engineering

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CSE 45th

Overview

- Types of transistor configurations.
- Common Base configuration.
- Common Emitter configuration.
- Common Collector configuration.
- Best one.
- Alpha , Beta and Gamma.
- Advantage & Disadvantage of common Emitter configuration.

BJT Configuration

(i)Common Base

(ii)Common Emitter

(iii)Common Collector

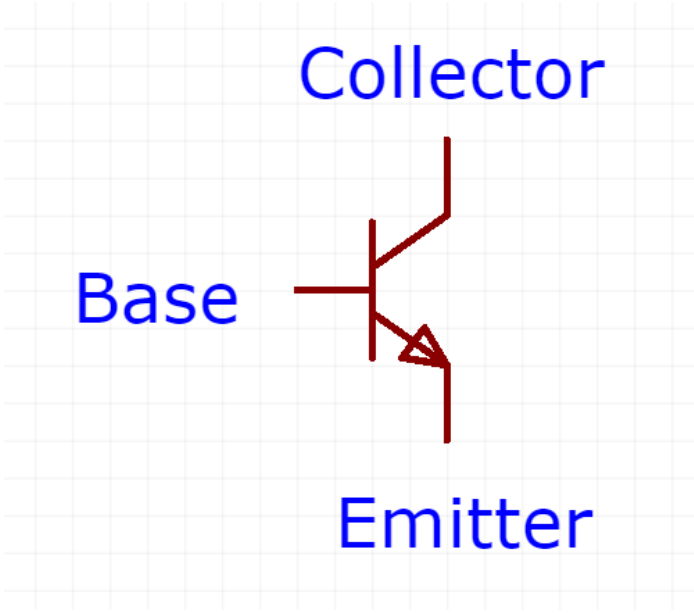


Figure: Bipolar Junction Transistor

Common Base Configuration:

- This transistor configuration provides a low input impedence while offering a high output impedance.

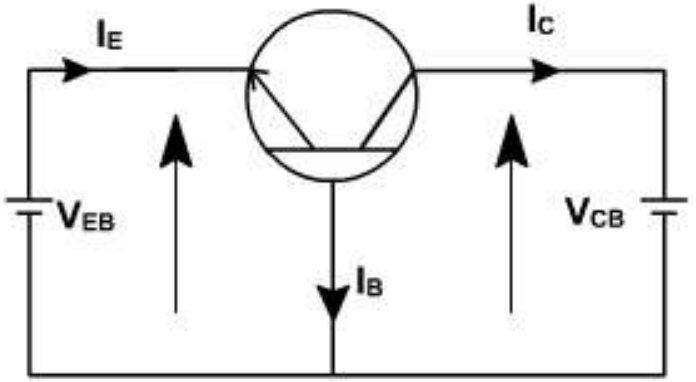


Figure: Common Base Configuration

Common Emitter Configuration:

- This transistor configuration is probably the most widely used.
- The circuit provides a medium input and output

impedance levels. Both current and voltage gain can be described as

medium, but the output is the inverse of the input, i.e. 180° phase

change. This provides a good over performance and as such it is

often thought of as the most widel configuration.

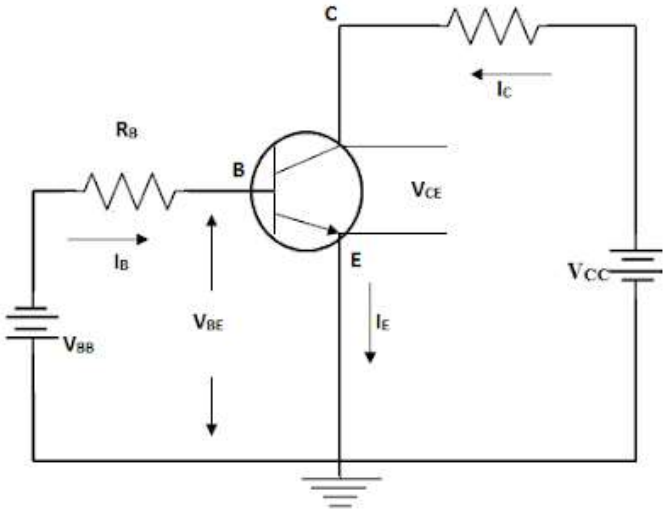


Figure: Common Emitter Configuration

Common Collector Configuration

Common collector: This transistor configuration is also known as the emitter follower because the emitter voltage follows that of the base. Offering a high input impedance and a low output impedance it is widely used as a buffer. The voltage gain is unity, although current gain is high. The input and output signals are in phase.In view of these characteristics, the emitter follower configuration is used as a buffer circuit providing a high input impedance to prevent loading of the previous stage, and a low output impedance to drive following stages.

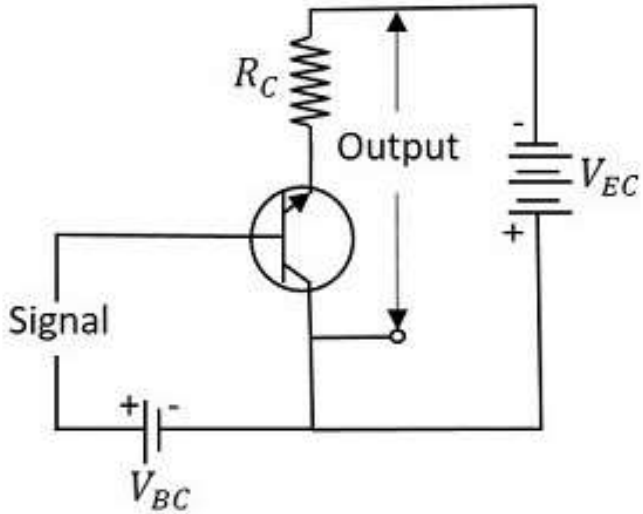


Figure: Common Collector Configuration

Differences or comparisons between the transistor configuration

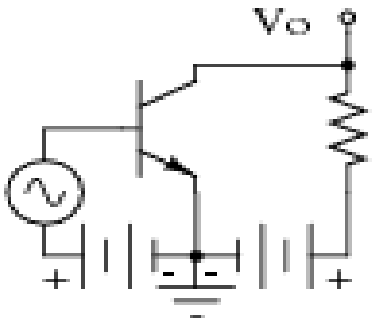
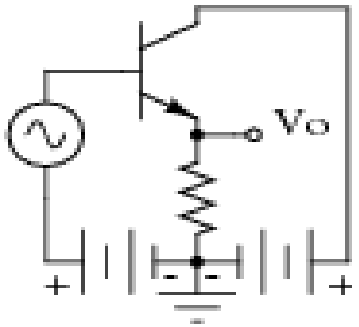
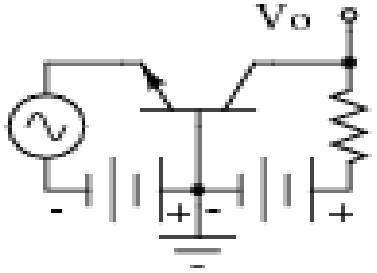
Basic circuit	Common emitter	Common collector	Common base
			
Voltage gain	high	less than unity	high, same as CE
Current gain	high	high	less than unity
Power gain	high	moderate	moderate
Phase inversion	yes	no	no
Input impedance	moderate ≃ 1 k	highest ≃ 300 k	low ≃ 50 Ω
Output impedance	moderate ≃ 50 k	low ≃ 300 Ω	highest ≃ 1 Meg

Figure: BJT Configuration summary table

Alpha(α),Beta(β) & Gamma(γ)

ALPHA (α): It is a large signal current gain in common bas configuration. It is the ratio of collector current (output current) to the emitter current (input current).

$$\alpha = \frac{Collector\ current}{Emitter\ current}$$

$$\alpha = \frac{I_C}{I_E}$$

Beta (β): It is a current gain factor in the common emitter configuration. It is the ration of collector current (output current) to base current (output current).

$$beta = \frac{I_C}{I_B}$$

Alpha(α),Beta(β) & Gamma(γ)

Gamma (γ): It is a current gain in common collector configuration and It is the ration of emitter current (output current) to base current (input current).

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

It is also called emitter efficiency that how much current is injected from the emitter to base after recombination of minority charge carriers in base. It's value is high compared to α,β.

Relation between α,β and γ in a transistor

α,β and γ are the current gain factors in three CB, CE and CC configurations respectively.

Relation between α, β and γ :

$$\alpha = \frac{\beta}{\beta + 1}$$

$$\beta = \frac{\alpha}{1 - \alpha}$$

$$\gamma = \beta + 1$$

I_{CB0} and I_{CE0} in a transistor and the relation between I_{CB0} and I_{CE0}

- I_{CB0} is the collector to base reverse saturation current.

$$I_{CE0} = (\beta + 1) I_{CB0}$$

- I_{CE0} is the collector to emitter reverse saturation current.

Advantage of common emitter configuration

1)It is used in Audio Amplifiers.
2)It is used in Microphones, Radio, and Music Players.
3)It is used in Frequency generation circuit to increase the strength of input signal.
4)It is used to increase the speed of Fans, Motors, and Timer circuits.

Disadvantage of common emitter configuration

1)It has a tendency to become noisy with age especially in moist climate.

2)The voltage gain reduces at low as well as high frequencies.

3)It provides poor impedance matching and hence it cannot be used as a final stage of an amplifier.

Thank You