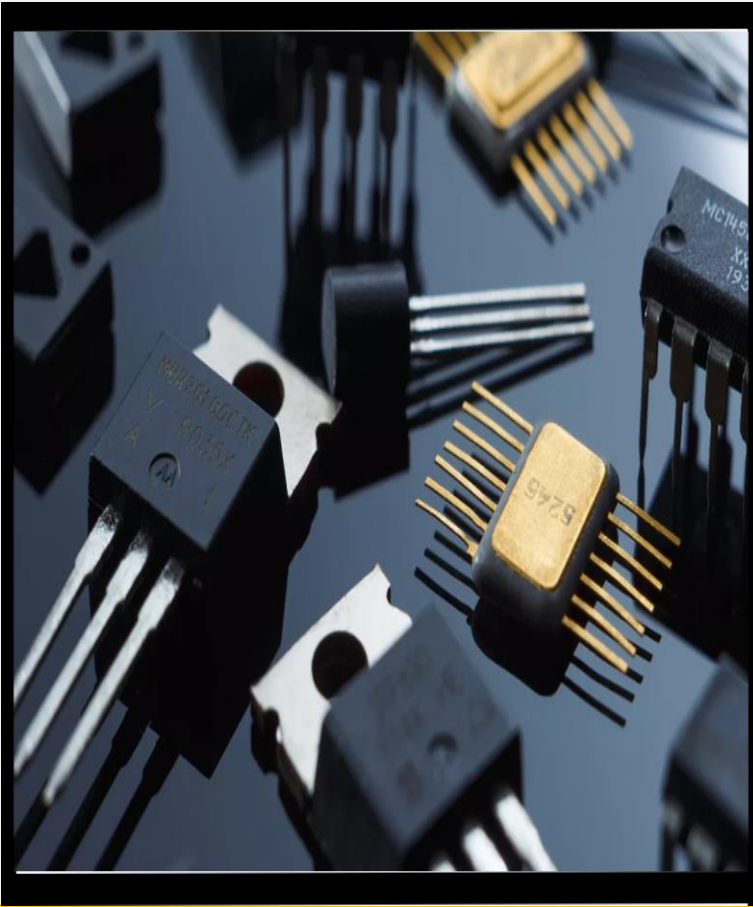


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Understanding Transistor Operation

L1 Computer Engineering
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1. Introduction



Introduce transistor

A **transistor** is a semiconductor device used to **amplify** or **switch** electronic signals and electrical power. It is one of the fundamental building blocks of modern electronic circuits.

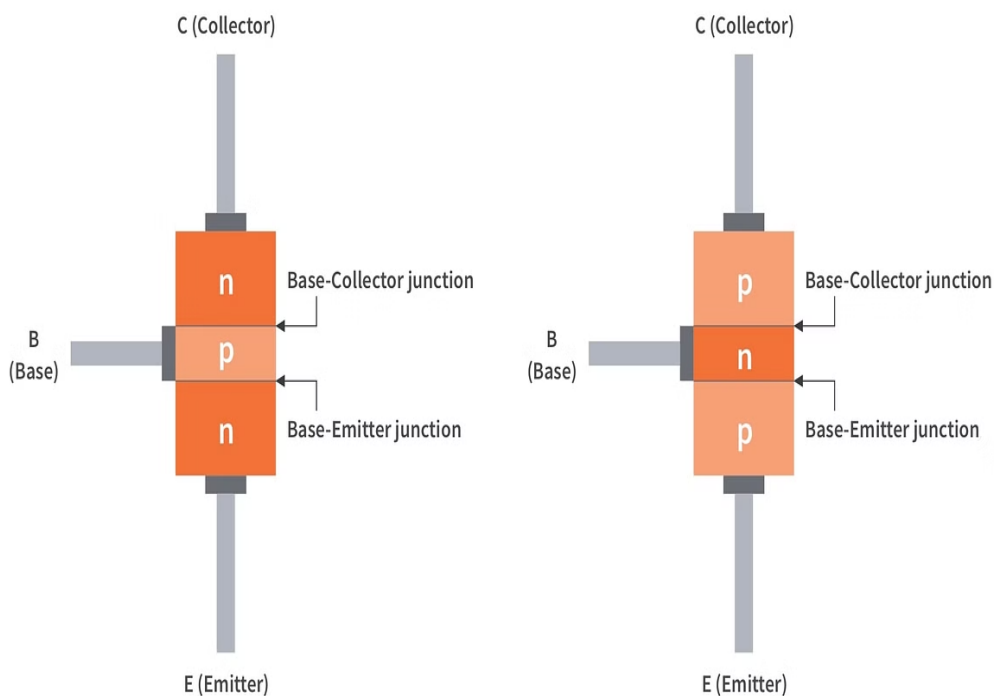
are typically made from semiconductor materials, like **silicon**, that have been "doped" with impurities to control their electrical properties.

Type of transistor: Bipolar Junction Transistor-BJT, Fiel Effect Transistor-FET





2. Bipolar Junction Transistor BJT



Emitter

The emitter injects charge carriers (either electrons or holes) into the base region.

Base

The base region controls the flow of charge carriers between emitter and collector.

Collector

The collector collects the charge carriers and allows them to flow through the device, amplifying or switching the signal.

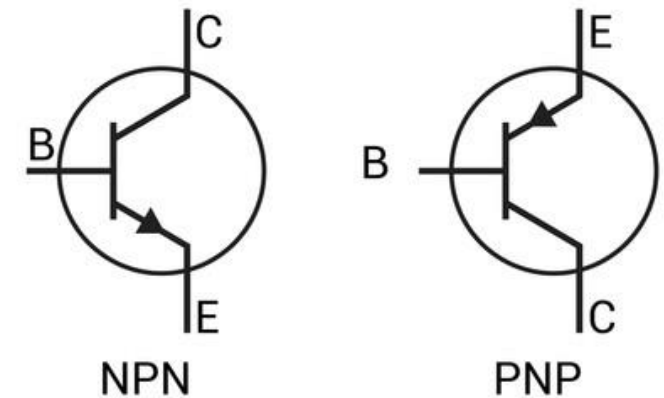


PNP Structure

PNP transistors operate by controlling current flow from the emitter to the collector through the base, with the base connected to the lower voltage side.

NPN Structure

NPN transistors function by allowing current to flow from the collector to the emitter when the base is connected to a higher voltage.



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- The primary distinction between PNP and NPN transistors lies in the direction of current flow and the required biasing voltages for operation.
- Both of these two main types have three terminals (Emitter E, Base B, and Collector C)



3. Transistor Configurations Explained



A transistor can be connected in three different ways depending on which terminal is used as the common point for both the input and output.

- **1. Common Emitter (CE)**

- The **emitter** is common to both input and output.
- It gives **high voltage and current gain** → so it can **amplify signals strongly**.
- The **output signal is inverted** (opposite direction to the input).
- 💡 **Used for:** Amplifiers and switches.

- **2. Common Base (CB)**

- The **base** is common to input and output.
- It has **low input resistance** and **high voltage gain**, but **small current gain**.
- The **output signal is in phase** (same direction as input).
- 💡 **Used for:** High-frequency circuits, like radio amplifiers.

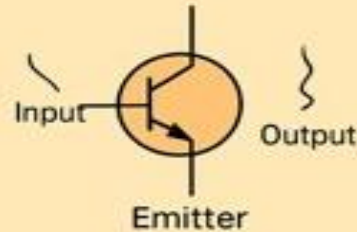
- **3. Common Collector (CC)**

- (also called **Emitter Follower**)
- The **collector** is common to input and output.
- It has **high input resistance** and **low output resistance**.
- The **voltage gain is about 1**, but **current gain is high**.
- The **output follows the input** (no inversion).
- 💡 **Used for:** Buffers and impedance matching.



TRANSISTOR CONFIGURATIONS EXPLAINED

A transistor can be connected in three different ways depending on which terminal is used as the common point for both the input and output. These are called transistor configurations.

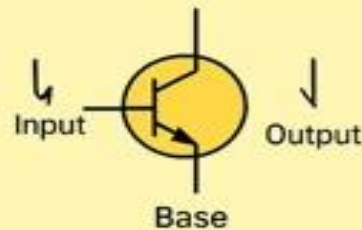


Common Emitter (CE)

- Emitter is common
- High voltage and current gain



Used for: Amplifiers and switches

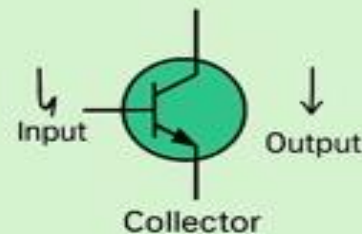


Common Base (CB)

- Base is common
- High voltage gain, small current gain



Used for: High-frequency circuits



Common Collector (CC)

- Collector is common
- High input resistance, low output resistance



Used for: Buffers and impedance matching



Summary Table

Configuration	Common Terminal	Voltage Gain	Current Gain	Phase	Main Use
Common Emitter	Emitter	High	High	Inverted	Amplifier
Common Base	Base	High	Low	Same	High-frequency amp
Common Collector	Collector	≈ 1	High	Same	Buffer



4. Understanding Transistor Effects



Saturation Effect

In saturation, the transistor allows maximum current flow between the collector and emitter, acting like a closed switch.

Cut-off Effect

In cut-off, the transistor restricts current flow, behaving like an open switch, which is essential for signal switching applications.

Active Region

The active region is where the transistor operates as an amplifier, with controlled current flow and minimal power loss.

Breakdown Effects

Breakdown effects occur when the transistor exceeds its maximum voltage or current limits, potentially leading to damage

Thank **you!**

