Tesca Technologies Pvt. Ltd.

Transistor

History

In 1906, the eccentric American inventor Lee De Forest developed a triode in a vacuum tube.

The transistor was successfully demonstrated on Hill, New Jersey.

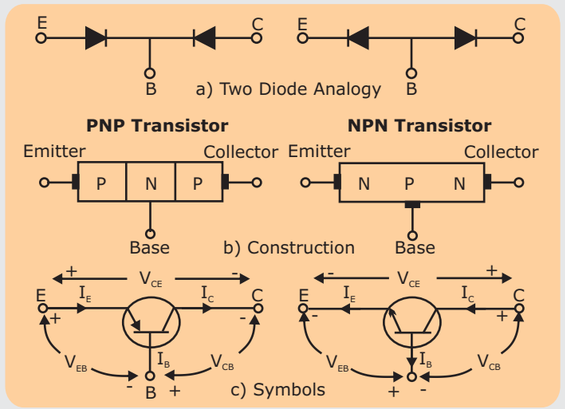
The three individuals credited with the invention of the transistor were William Shockley, John Bardeen and Walter Brattian.

The term transistor was derived from the words TRANSFER and Resistor.

Operation of the transistor - the transfer of an input signal current from a low-resistance circuit to a high-resistance circuit.

Transistor is used fro amplification of input signals.

Construction of Transistor by using Diode: Two Diodes Connected Back to Back



The three elements of the two-junction transistor are:

(a) The EMITTER, which gives off or emits current carriers
(b) The BASE, which controls the flow of current carriers
(c) The COLLECTOR, which collects the current carriers.

Classification:
Transistors are classified as either NPN or PNP according to the arrangement of their N and P materials.

An PNP transistor is formed by introducing a thin region of P-types material between two regions of N-type material.

One PN junction is between the emitter and the base; the other PN junction is between the collector and the base.

Area Wise: Collector has more area, Base has thin & Emitter has moderate area
Doping Status: Emitter: heavily doped, Base: lightly doped, Collector: moderately doped

Bipolar Transistor Configurations:
As the Bipolar Transistor is a three terminal device, there are basically three possible ways to connect it within an electronic circuit with one terminal being common to both the input and output.

Common Base Configuration - has Voltage Gain but no Current Gain
Common Emitter Configuration - has both Current and Voltage Gain
Common Collector Configuration - has Current Gain but no Voltage Gain.

Regions of Transistor
Bipolar transistors have the ability to operate within three different regions:
Active Region - the transistor operates as an amplifier and $I_c = \beta, I_c$
Saturation - the transistor is "fully-ON" operating as a switch and $I_c = I$ (saturation)
Cut -off - the transistor is "fully-OFF" operating as a switch and $I_c = 0$

Common Base Configuration

In Common Base or ground base configuration, the BASE connection is common to both the input signal AND the output signal with the input signal being applied between the base and the emitter terminals.

The corresponding output signal is taken between the base and the collector terminals with the base terminal grounded. The input current flowing into the emitter is quite large as it's the sum of both the base current and collector current respectively.

The collector current output is less than the emitter current input resulting in a current gain for this type of circuit of "1" (unity) or less, the common base configuration "attenuates" the input signal.

Common Emitter Configuration

In Common Emitter or grounded emitter configuration, the EMITTER connection is common to both the input signal and the output signal with the input signal applied between base and emitter terminals.

The corresponding output signal is taken between the emitter and the collector terminals with the base terminal grounded.

The current flowing out the transistor as the emitter current is given as IC = IC + Ia

The collector current is higher than the base current input resulting in a current gain for this type of circuit is greater than 1.

The common emitter configuration "amplifiers" the input signal.

Common Collector Configuration

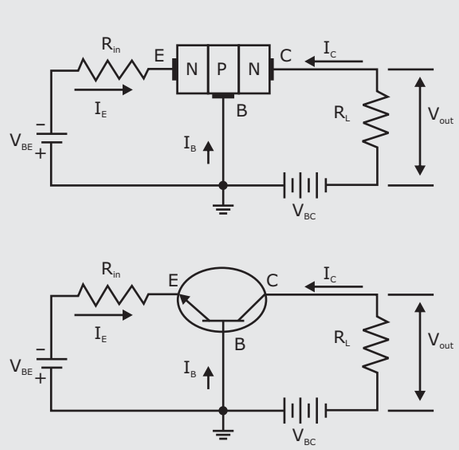
In the Common Collector or grounded collector configuration, the COLLECTOR is now common through the supply. The input signal is connected directly to the base.

While the input is taken form the emitter load. This type of configuration is commonly known as a Voltage Follower or Emitter Follower circuit.

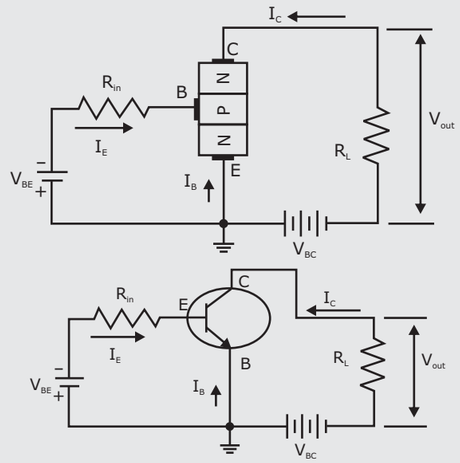
The emitter follower configuration is very useful for impedance matching applications because of the very high input impedance.

In the common collector configuration the load resistance is situated in series with the emitter so its current is equal to that of the emitter current.

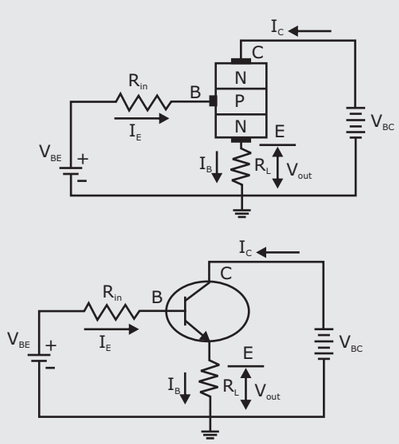
Common Base Transistor Circuit



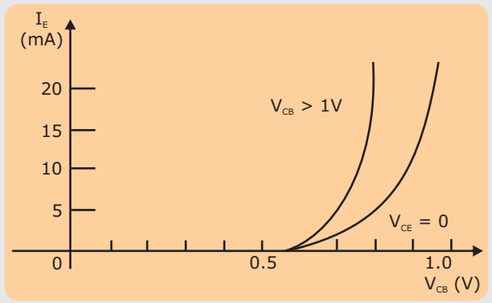
Common Emitter Transistor Circuit



Common Collector Transistor Circuit



Input Characteristics



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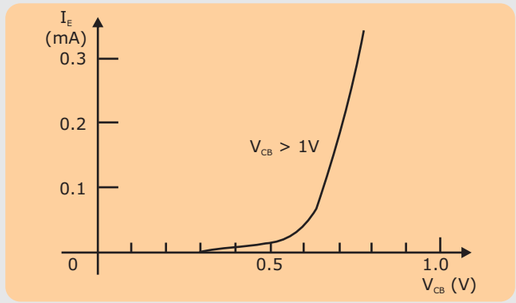
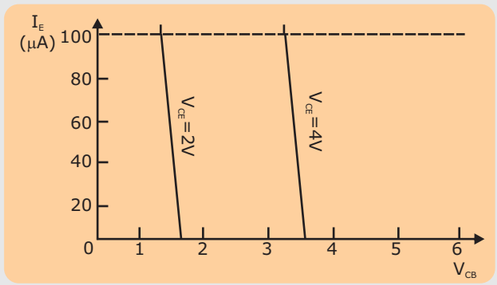
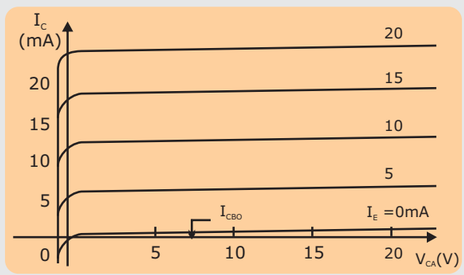


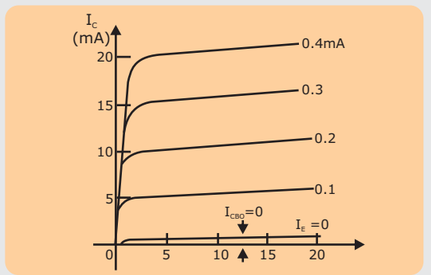
Input Characteristics



Output Characteristics



Output Characteristics



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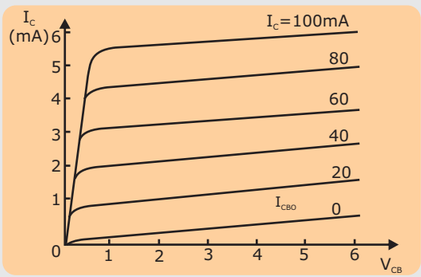

36153
Transistor Characteristics

36174
Study of UNI junction Transistor

36206
Transistor Series & Shunt Voltage

36308
Transistor as a Switch

36310
Feedback Amplifier (4 Types Using Transistors)

36311
Feedback Amplifier (4 Types Using FET & Transistors)

36330
Transistor Amplifier Demonstrator

36341
Transistor Designer Trainer

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