Transistor can act as a switch or gate for electronic signals.

It ensures the circuit is ON if the current is flowing and switched off if it is not flowing.

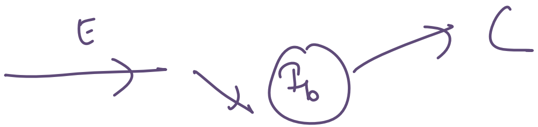
Transistor are used in typical switching circuit that comprises all the modern telecommunication devices.

Transistor play an imp. role in amplifying electronic signals. For example: radio applications such as FM receiver where the received electrical signal may be weak due to disturbance. amplification is required to provide audible output.

Bipolar Junction Transistor (BJT)

- Most common type of transistor. These can be either PNP / NPN.
- BJT can amplify electrical signal or switch the current ON or OFF.

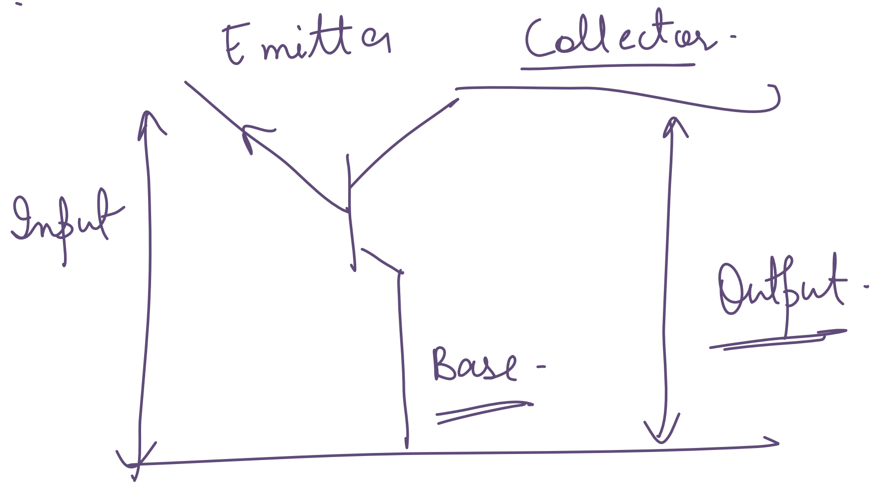
- BJT [Base emitter junction] is forward bias with a very small emitter resistance while base-collector region is reverse biased with larger resistance.



- Collector current is slightly less than the emitter current.
- Base controls the current flow from the emitter to the ~~cur~~ collector.

Common Base Configuration:

the base terminal of the transistor is common between input and output terminal.



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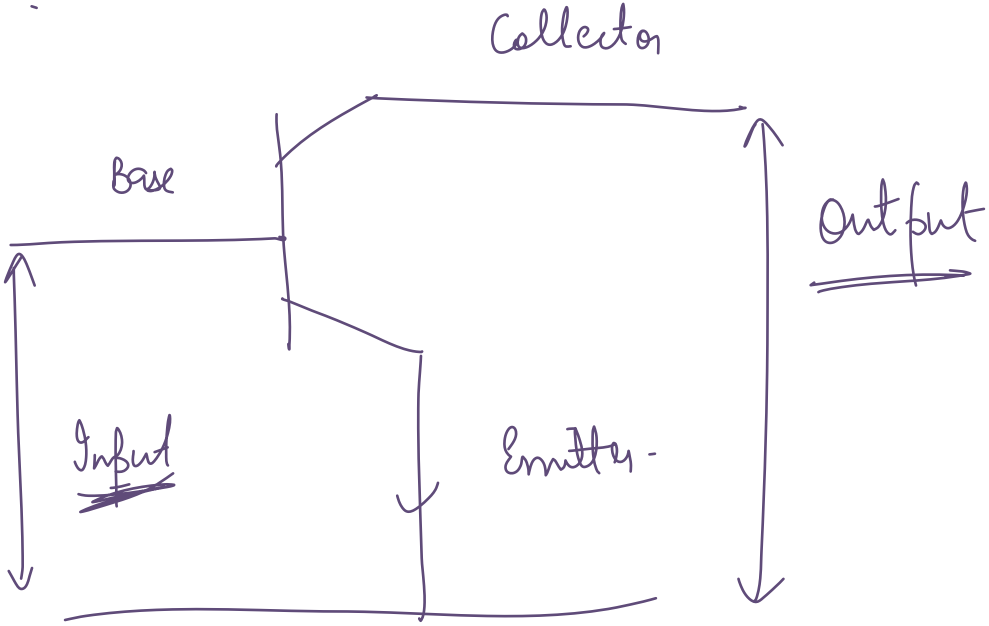
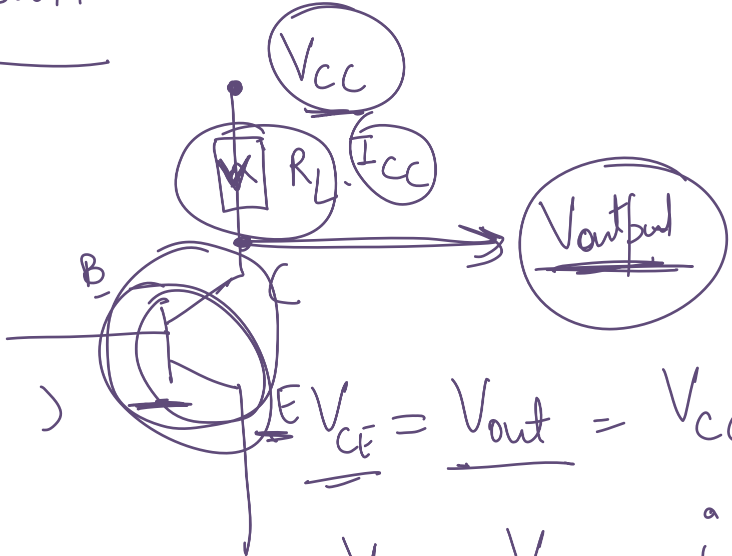
Common Emitter :

The emitter terminal is common between the input and output terminal.



Transistor as a Switch:



$V_i \simeq 0\,V.$

$V_{BE} > 0.7\,V.$

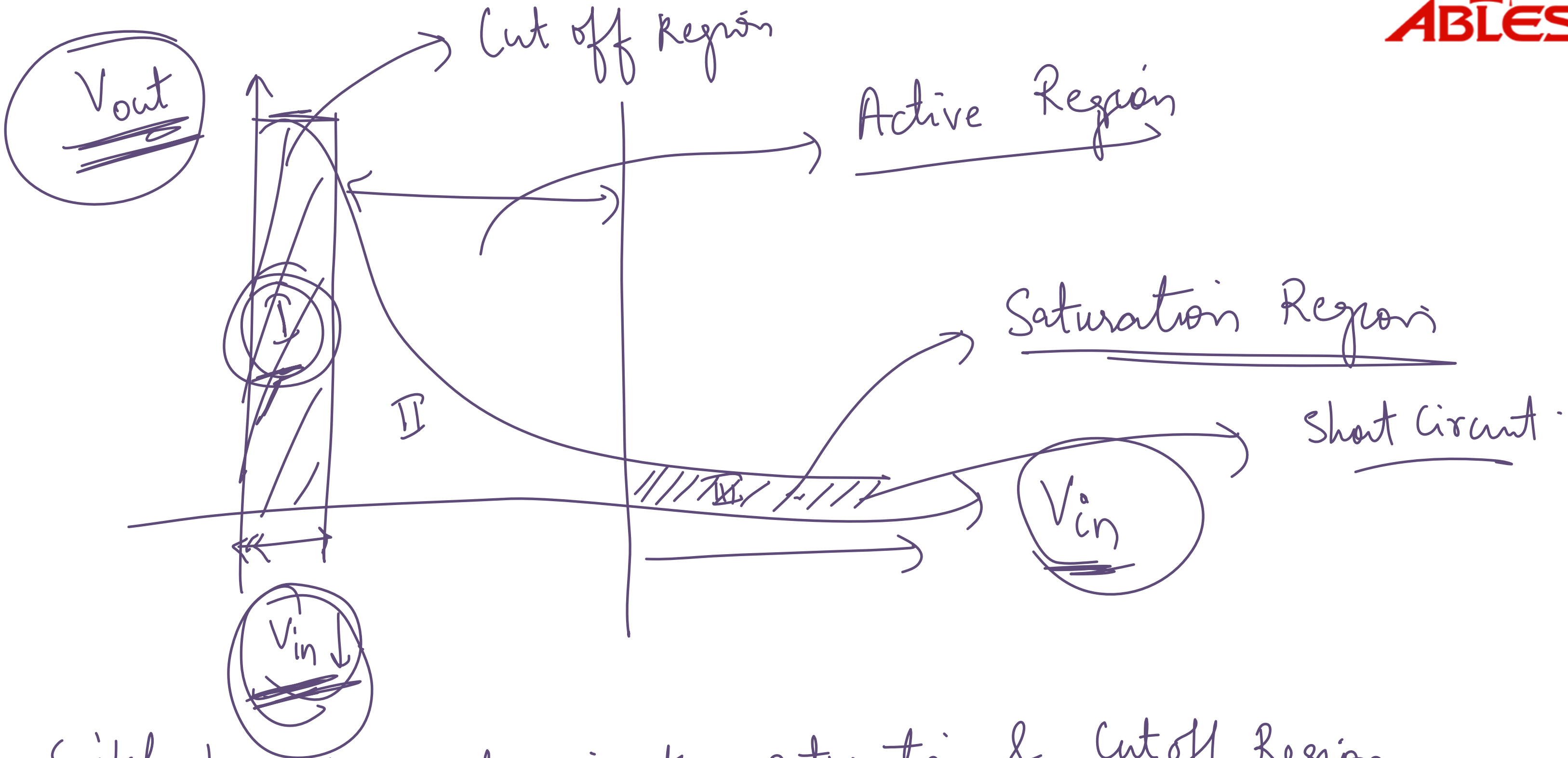
$V_{CE} = V_{out} = V_{CC} - I_C R_L$

$V_0 = V_{CC} - i_C R_C.$

$i_B \times R_i + V_{BE}$

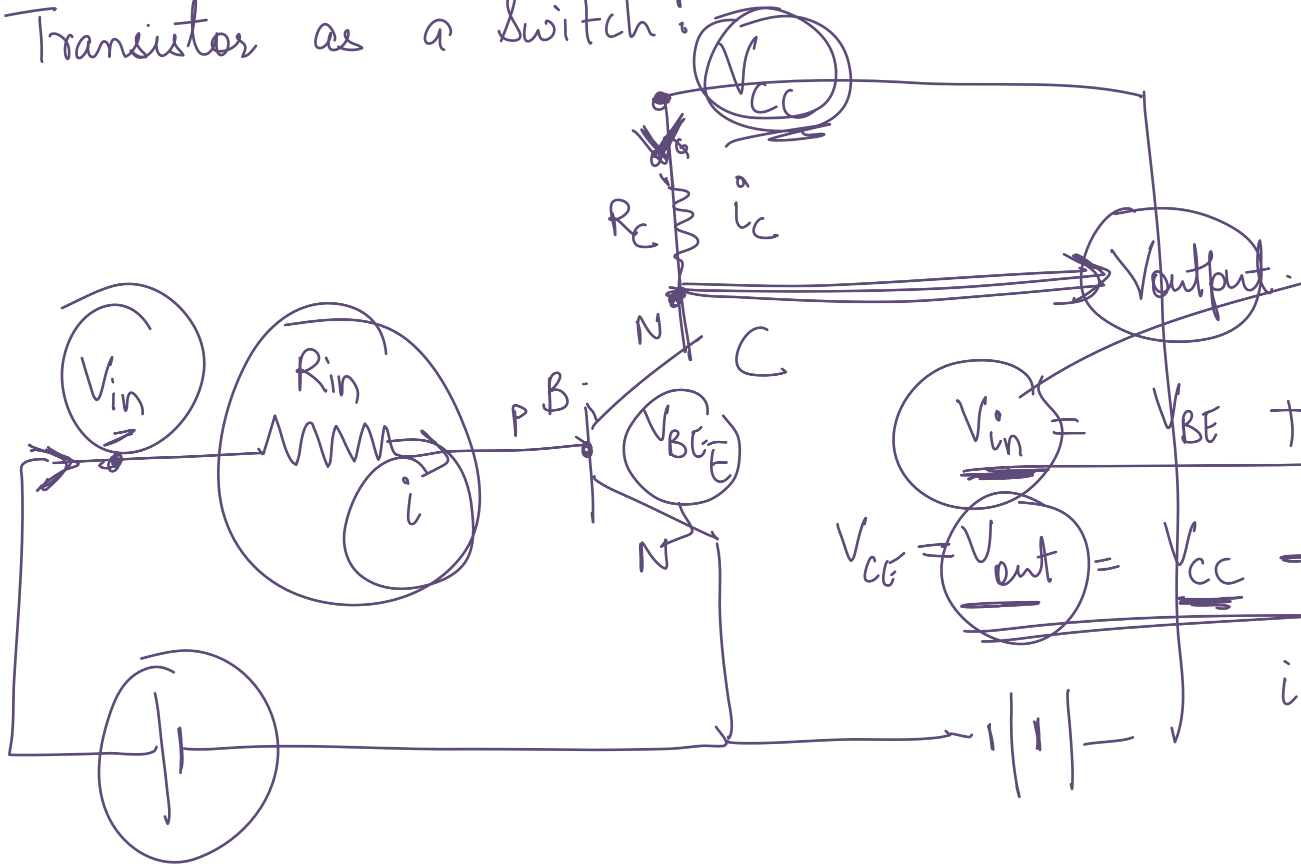
$V_i < 0.6V. \longrightarrow$ Cut off Region.

$I_C = 0.$, $V_0 = V_{CC}$



In Switch, transistor works in the saturation & Cut off Region.

Transistor as a Switch:



$V_{in} > V_{BE} \rightarrow 0.7\,eV.$

$$V_{in} = V_{BE} + i_b R_{in}.$$

$$V_{CE} = V_{out} = V_{CC} - i_C R_C.$$

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Case I : (Cut off Region)

$V_i < 0.7 V$.

$V_{BE} = 0.7 V$

$I_C = 0$, $V_{out} = V_{CC}$.

Case II : → Active Region

$V_i \uparrow > 0.7V$, As $i_b \uparrow$, $i_C \uparrow$, $V_o \downarrow$.

Case III :

As $V_i \uparrow$, $I_c \uparrow$

$$V_{out} = V_{CC} - i_c R_C .$$

$\Rightarrow$ $V_0 \approx 0 .$ $\longrightarrow$ Saturation Region

It is $\longrightarrow$ 0 . + 0 .

When V_i is low, Transistor is forward biased, V_o is high.

If V_i is sufficiently high, it would saturate the transistor. $(V_o \simeq 0)$.

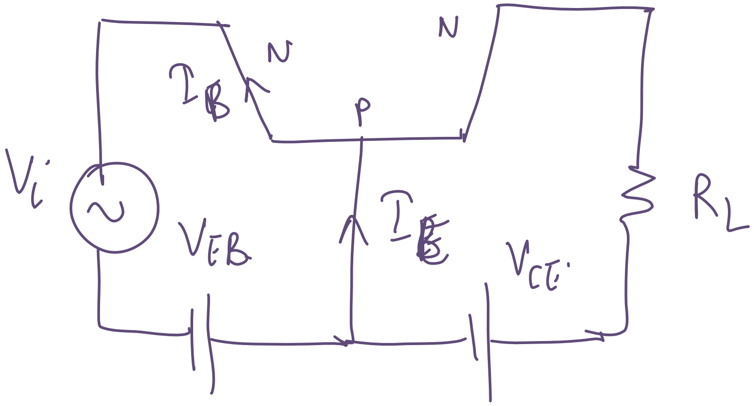
It is switched off when the transistor is not conducting

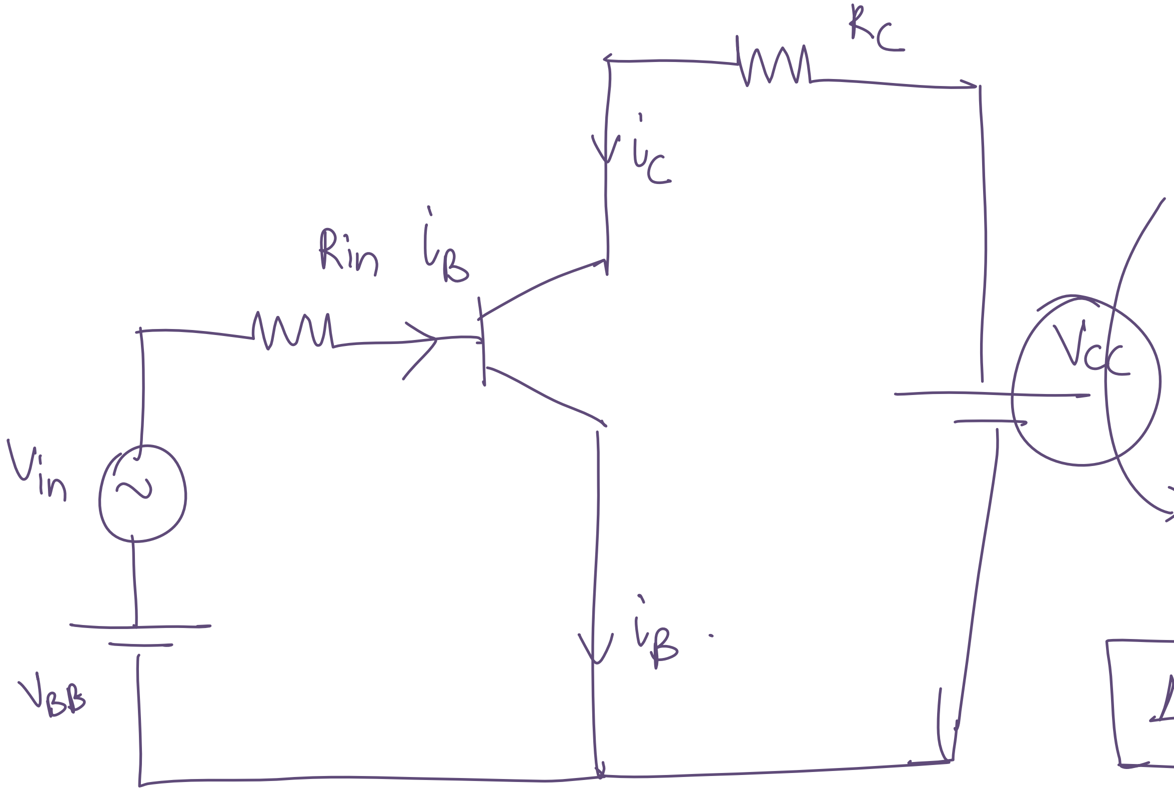
So, a low & high value values are met below & above the point of voltage

Transistor as an amplifier :

Transistor works as an amplifier in the active region.

A transistor can take a very small weak signal through base junction and release the amplified signal.





$$V_o = V_{cc} - i_c R_c$$

$$V_i = I_B R_B + V_{BE}$$

$$\Delta V_o = \Delta V_{cc} - \Delta i_c R_c$$

0

$$\Delta V_o = \Delta i_c R_c$$

Output Voltage = − Input Current × R.

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The gain in terms of voltage when the change in input & output current is called voltage gain.

$$V_i = I_B R_B + V_{BE}$$

$$\Delta V_i = \Delta I_B R_B + \Delta V_{BE}$$ ($\Delta V_{BE} \to 0$)

$$\boxed{\Delta V_i = \Delta I_B R_B}$$

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

$$\text{Amplification} = \frac{\Delta V_o}{\Delta V_i}$$

$$= \frac{\Delta I_C R_C}{\Delta I_B R_B}$$

Change in collector collector as base current is change

=

$$\beta = \frac{\Delta I_C}{\Delta I_B} > 1.$$

↑

Current Amplification Factor.

$$\text{Power gain} = V_{gain} \cdot i_{gain}$$

$$V_{gain} = \beta \times \frac{R_{out}}{R_i}$$