logic families basic

Logic families

Logic family explains, how to implement a logic device using active device

→ Logic families classification is based on the active device used

→ propagation delay is related to internal capacitance effects

→ * In MOSFET, internal capacitance is in the range of pf
* In BJT, internal capacitance is in the range of nf, and Pf
* As capacitance is increased, charging and discharging time increases and hence propagation delay is more in FET

→ BJT logic family having less propagation delay with more power consumption compared to unipolar (FET) logic family.

→ power consumption is higher in BJT

Bipolar logic family

- Saturated logic family
  - BJT operating b/w cutoff & saturation regions
- Non Saturated logic family
  - BJT operating b/w cutoff & active region

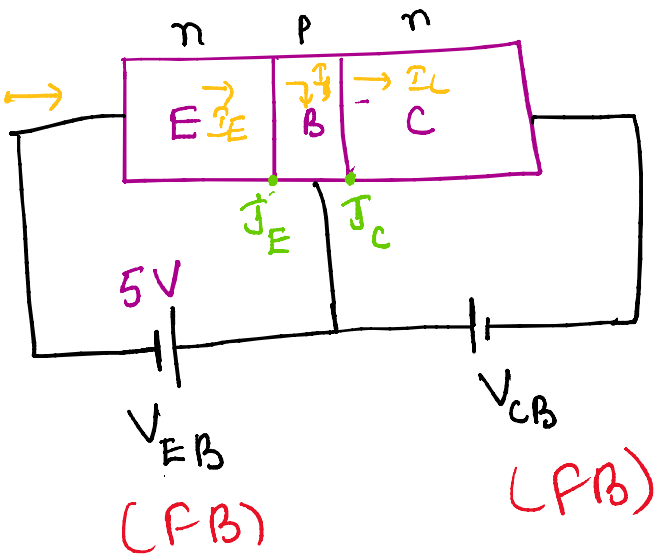
Modes of operation of transistor

1. Active mode → (BE → FB) (BC → RB) → Amplifier
2. Saturation mode → (BE → FB) (BC → FB) → ON switch
3. cut off mode → (BE → RB) (BC → RB) → off switch

BJT logic families (Saturated logic) uses Saturation & cut off mode.

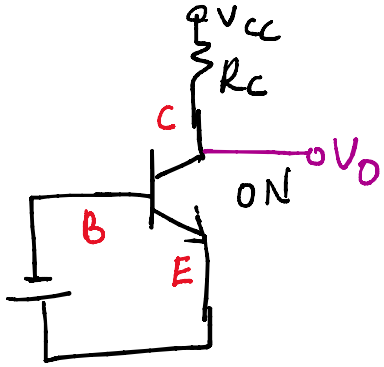
Non-Saturated logic families uses active & cutoff mode.

n p n (Transistor)



Saturation mode

ON switch

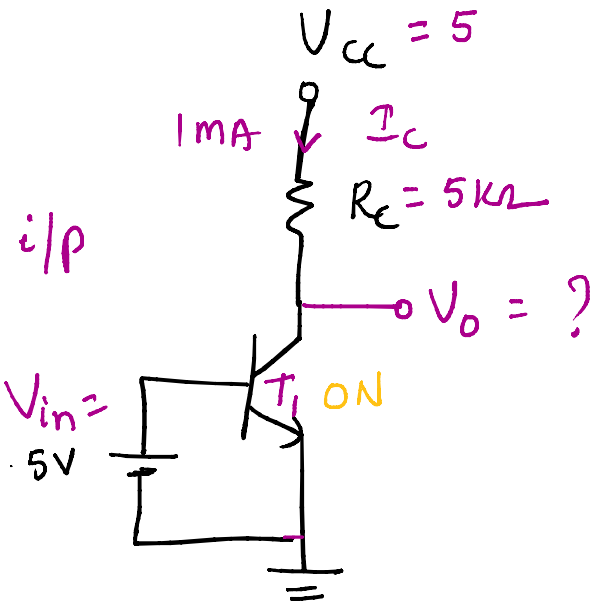


NPN transistor as ON switch apply 5V to the base of the transistor

NPN → off switch, $V_B = 0V$

If 5V as i/p

T_1 ON



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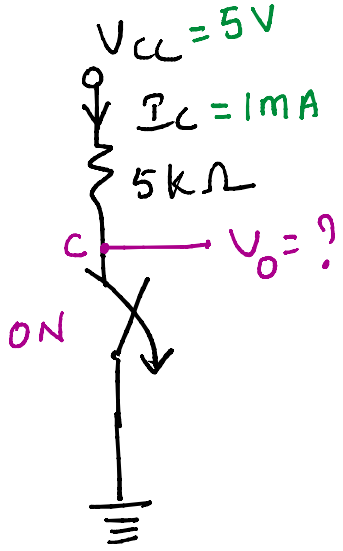


$V_{cc} = I_c R_c + V_o$

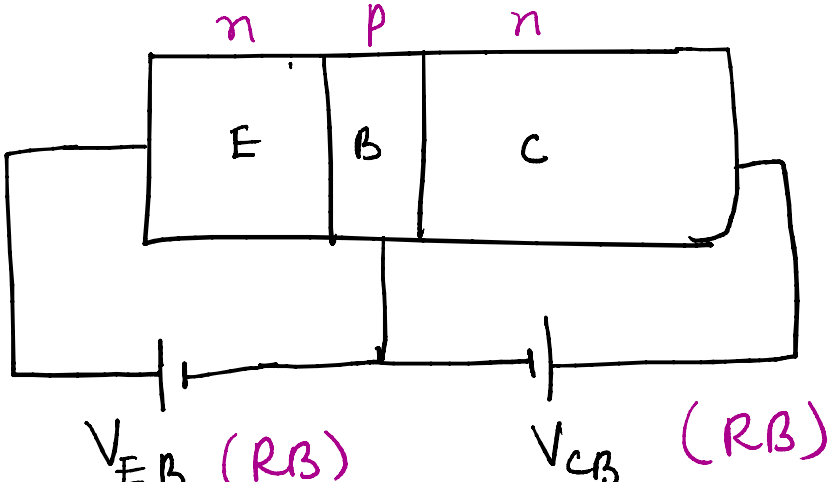
$V_o = V_{cc} - I_c R_c$

$= 5 - 1 \times 10^{-3} \times 5 \times 10^{3}$

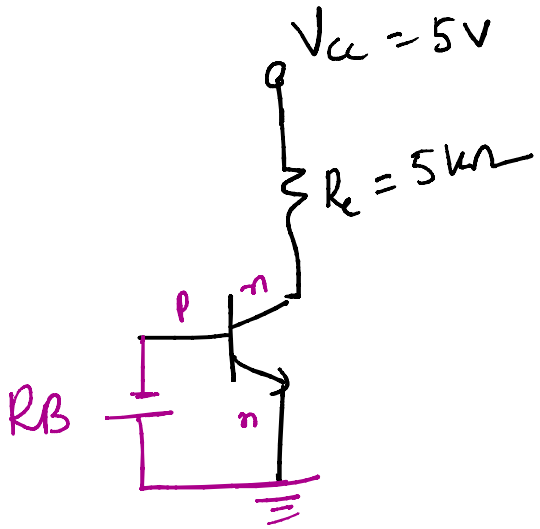
$= 0\ V$

Here $V_{in} = 5V$ then $V_o = 0$

Cut off mode (off switch)

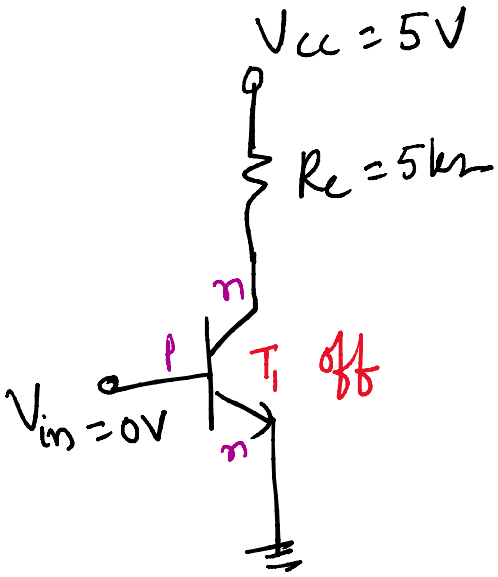


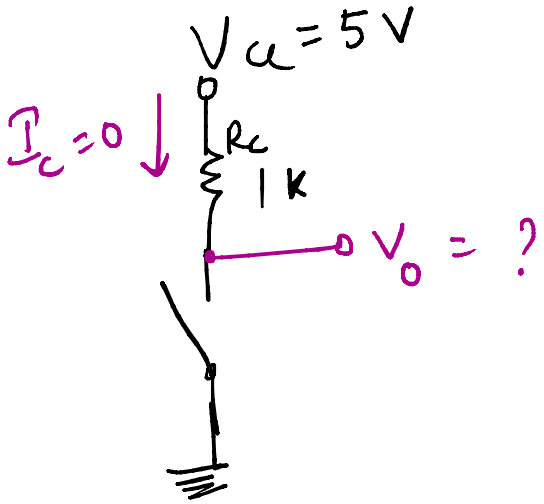
V_{EB} (RB)



$\simeq$

V_{CB} (RB)





$$V_{cc} = I_c R_c + V_o$$

$$V_o = V_{cc} - \underbrace{I_c R_c}_{0}$$

$$= 5 - 0$$

$$V_o = 5\,V$$

If $V_{in} = 0 \Rightarrow$ then $V_o = 5V$

Truth Table (NOT)

V_{in}	V_0
5	0
0	5V

5V ≅ logic '1'

0V ≅ logic '0'

V_{in}	V_0
1	0
0	1

NOT symbol