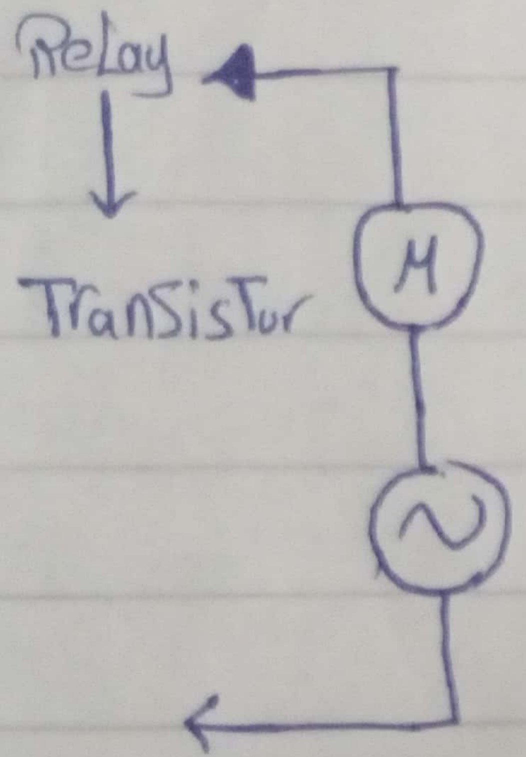
- using Transistor To Control high voltage devices



Example

→ Transistor used To control relay consuming 25mA, and $V_{in} = 5V$

$R_B = ?$, $\beta = 100$,

$I_C = \beta \times I_B \cancel{= 25\times100 = 2500\times10^{-3} = 0.25\times10^{-3}\times100 = 0.25mA}$

$I_B = \frac{25}{100} = 0.25mA \rightarrow 5\times0.25 = 1.25$

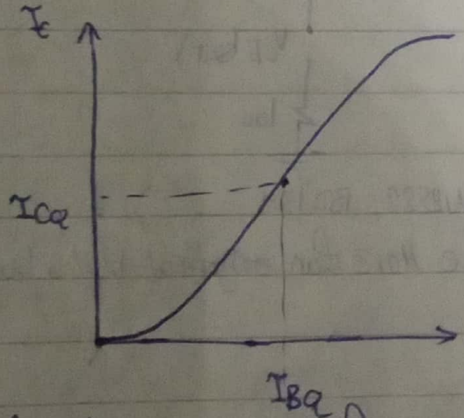
$R_B = \frac{V_{in} - V_{BE}}{I_B} = \frac{5-0.7}{1.25} = 3.44K\Omega$

(1.25mA) → As when Transistor act as Switch so I_B must be greater than its value by 5 or 10 Times.

* A diode must be used To protect the transistor.

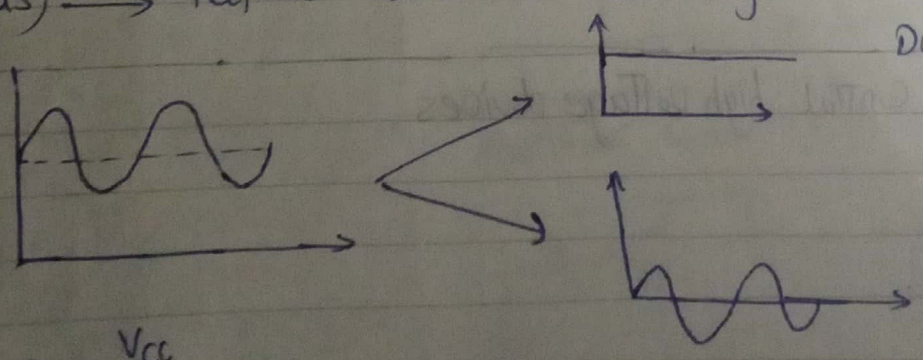
Transistor as ~~multiplier~~ (مكبر صوتي) Amplifier

* works in active region.



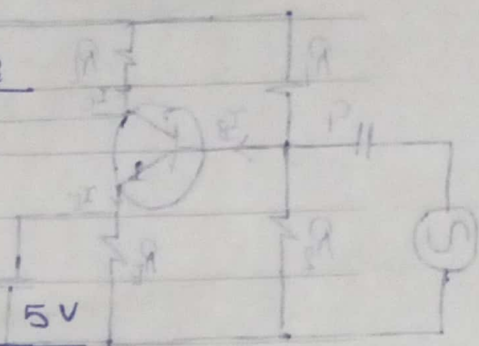
(Q-Point) is Point in which Transistor work.

* (Bias) → Keep the wave in the active region



* $V_{CEQ} = \frac{V_{CC}}{2}$

sTePs To design Transistor as ~~Multiplier~~ مكبر صوت



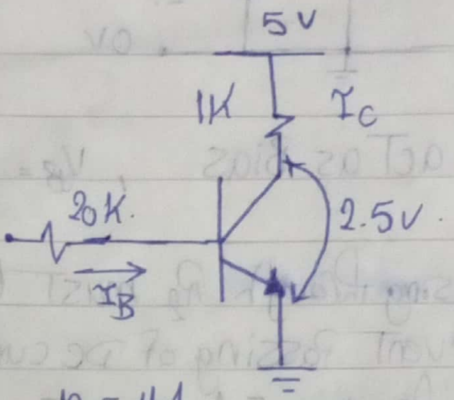
→ V_{CE} نحدد ال $\quad V_{CEQ} = \frac{V_{CC}}{2}$

→ I_{CQ} نحدد ال $\quad I_{CQ} = \frac{V_{CC} - V_{CEQ}}{R}$

→ I_{BQ} نحدد ال $\quad I_{BQ} = \frac{I_{CQ}}{\beta}$

→ Bias نحدد قيمة ال

Example.



$V_{CEQ} = \frac{5}{2} = 2.5V$

$I_{CQ} = \frac{5-2.5}{1000} = 2.5mA$

$\beta = 200 \longrightarrow I_{BQ} = \frac{I_{CQ}}{\beta} = 12.5\mu A$

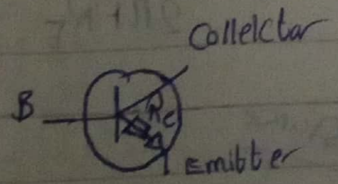
$V_{BQ} = 20 \times I_B + 0.7$

$= 0.9\ V$

كيف تحسب مقدار ال (Gain)؟

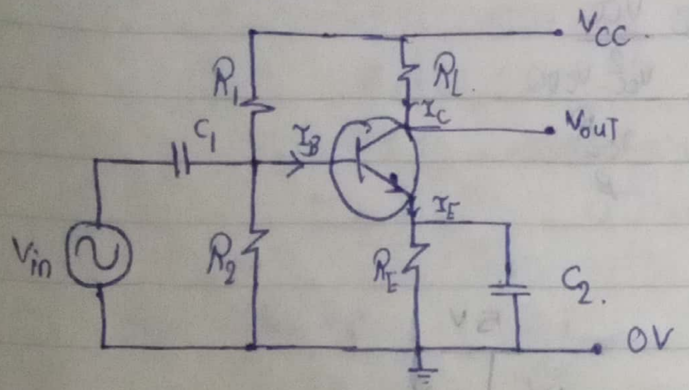
Voltage gain $= \frac{\text{output}}{\text{input}} = \frac{V_{out}}{V_{in}}$

Note



$R_e = \frac{25}{I_E}$, $\text{Gain} = \frac{R_L}{R_E}$

Example: مكبر عوره



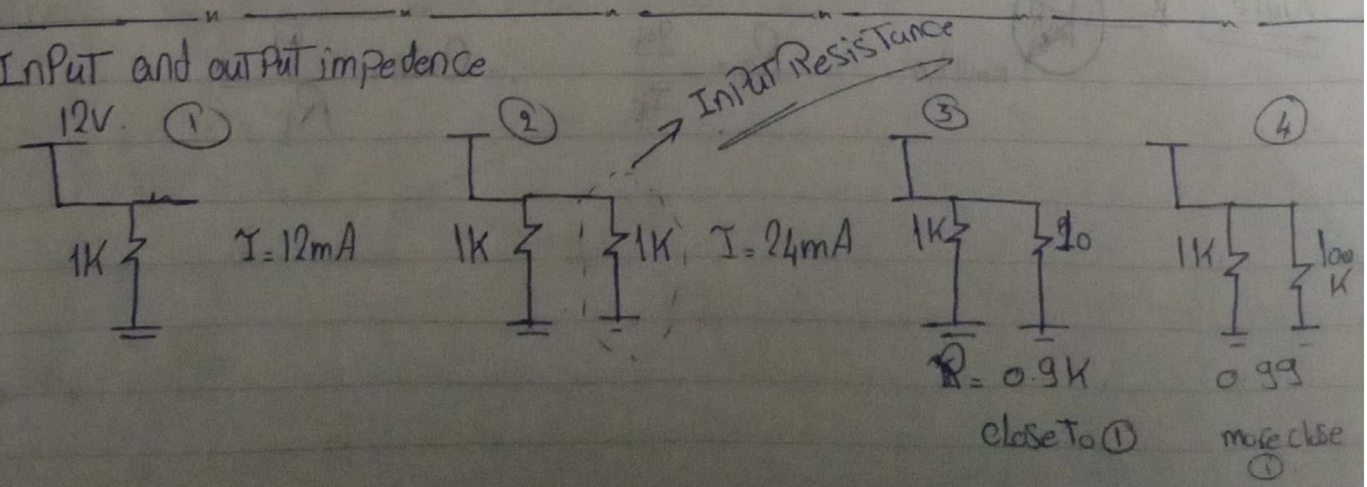
* $(R_1, R_2) \longrightarrow$ act as Bias , $V_B = \dfrac{V_{CC} R_2}{R_1 + R_2}$

* Current Passing through R_2 must be 10 Times value of I_B
* (C_1) To Prevent Passing of DC current From V_{CC} and allow the Passing ~~through~~ of AC current.

$$C_1 > \frac{1}{1000 \pi F}$$

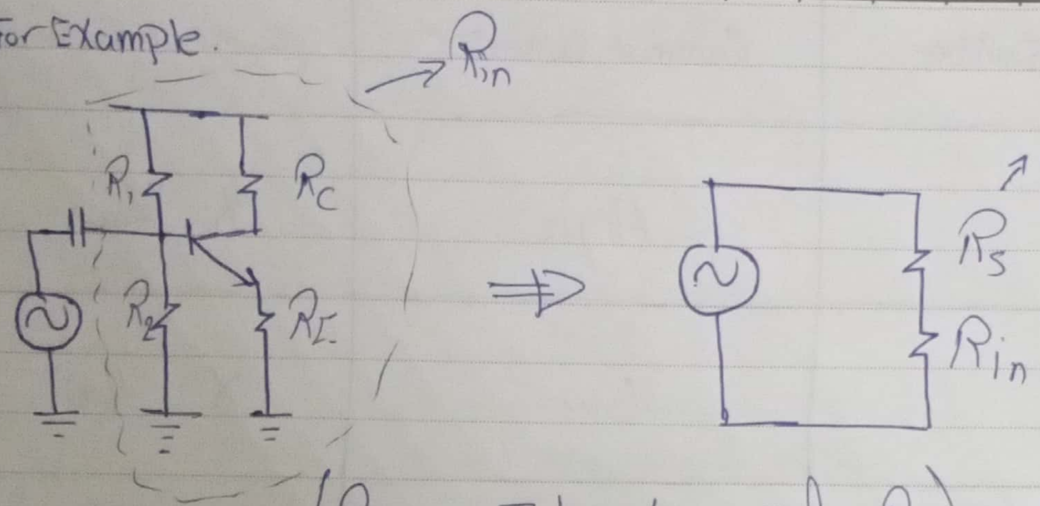
* R_E is used To Protect the Transistor From high current and high Temperature.
* one of disadvantage of (R_E) that it reduce the value of (Multiply) of the signal. , $R_E = 10\%$ of V_{CC} , $V_E = V_{Bias} - 0.7$
* $(C_2) \longrightarrow$ Avoids the Previous disadvantage , $C_2 > \dfrac{10}{2\pi F R_E}$

InPut and outPut impedence



/ /

For Example.

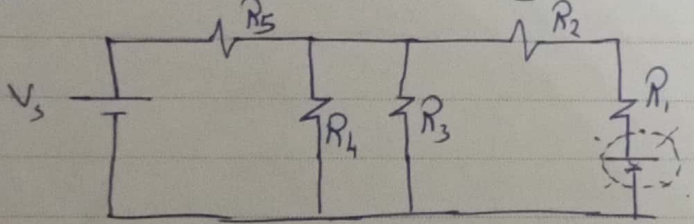


↗ Internal resistance of Source.

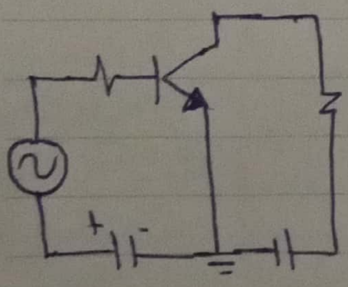
(R_{in} must be Larger than R_S) ~~[illegible]~~

Note

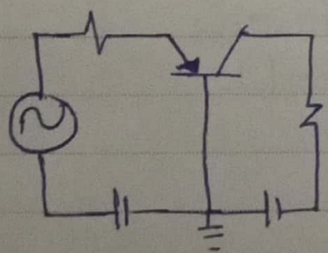
- يتم إلغاء مصادر الجهد فى الأثر لمراد معرفة مقاومتها



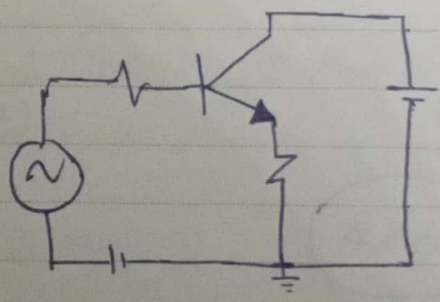
Amplifier Connections (Common emitter, Common Collector, Common base)



Common emitter
→ OutPut (opposite inpute, Phase Shift = 180°).
→ Amplitude is Amplified



Common base
- ~~without Shifting~~
- ~~Same Amplitude~~
- ~~input Resistance very high~~
- No Shifting.
- Amplitude is Amplified
- Not Commonly used.



Common Collector.
- without Shifting
- Same Amplitude
- input Resistance very high

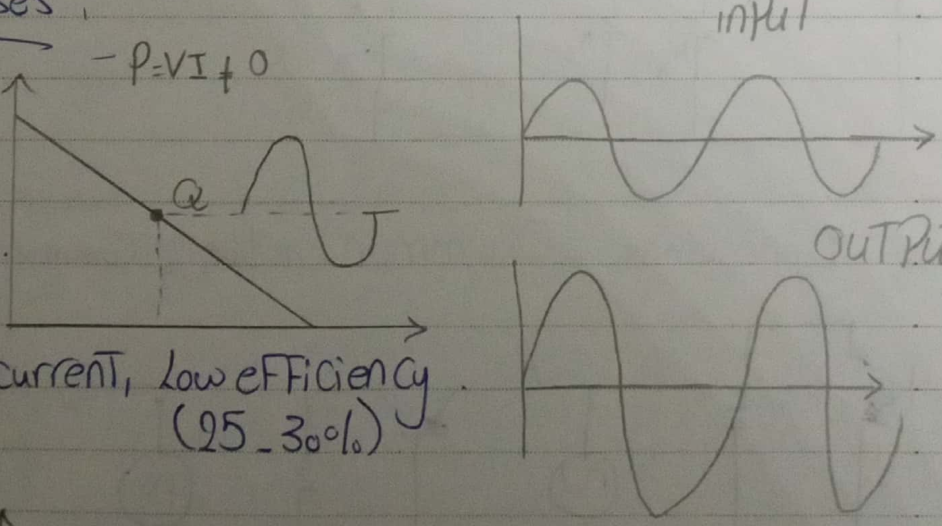
	Common Emitter	Common Collector	Common base
input internal Impedance		High	X Low
output impedence		Low	X High
Amplifier	✓	Same	✓ (Not Used)

* ~~We can design by using Application Transi~~

* Amplifier classes :

class A

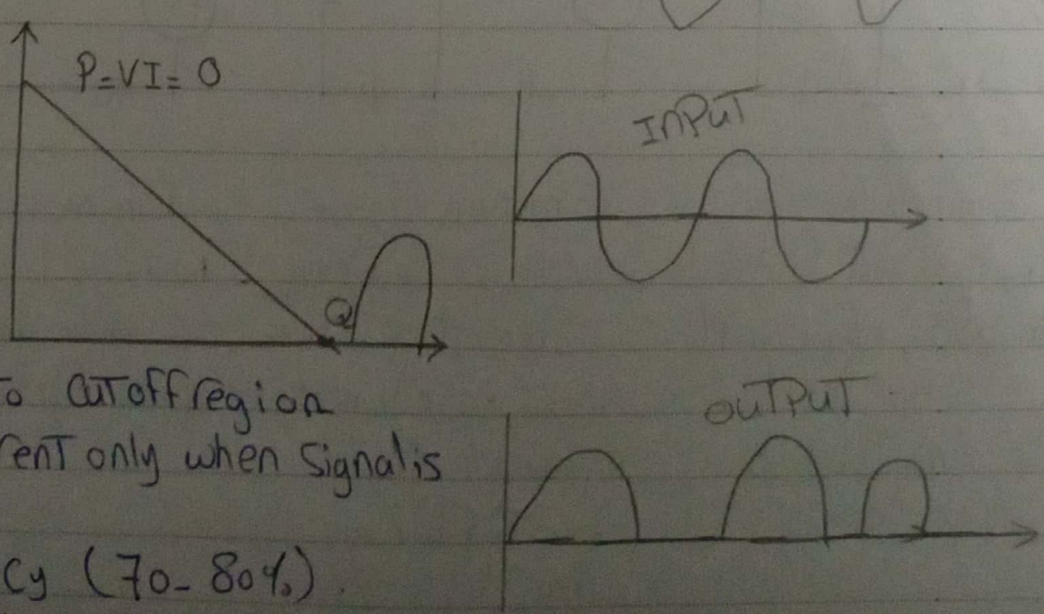
- $P = VI \neq 0$



- Q-Point at middle.
- Consumes DC current, low efficiency (25 - 30%)

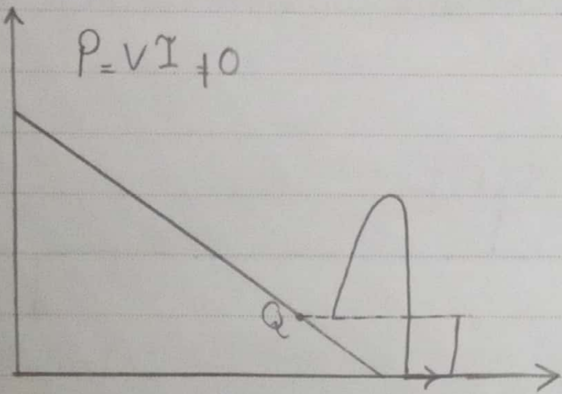
class B

$P = VI = 0$



- Q-Point near To cutoff region
- Consumes current only when signal is availiable
- High efficiency (70 - 80%)

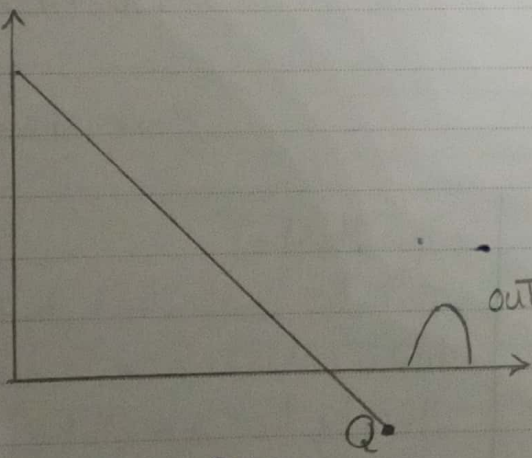
Class AB



- Q-Point between CutOff region and middle.
- efficiency is High. (Better than A, Less than B)

Class C

Not used as Amplifier.



→ Q Point is out CutOff region.
→ efficiency is very high, (Higher than 80)

Transistor

- Field effect Transistor (FET)
  - J-FET
    - N
    - P
  - MOSFET
- Bipolar Junction Transistor
  - NPN
  - PNP

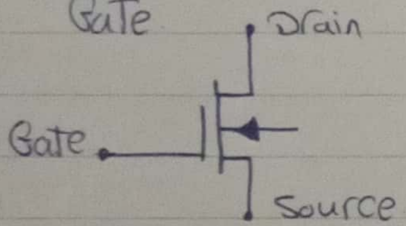
/ /

in Case of (MosFET) → doesn't Consume current To control, So the input resistance is very high

MosFET

Depletion (N, P)

- Transistor is (on) without any ~~Potential on the~~ voltage on Gate



(Normally opened)

Enhancement (N, P)

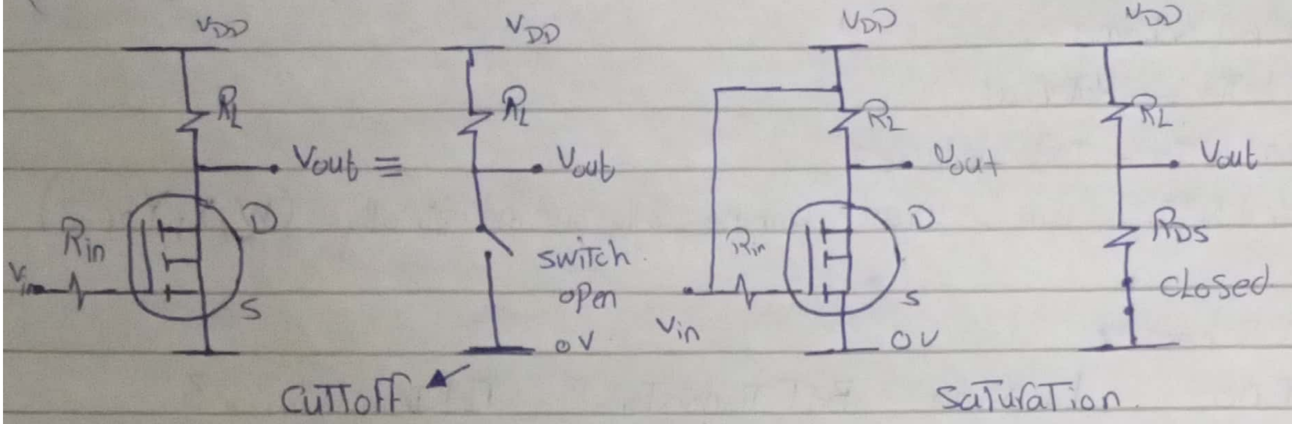
opposite To Depletion

(Normally closed)

- More used

→ BJT	→ MosFET
- Can be controlled by the current on base	- Can be controlled by ~~voltage~~ Potential difference on the gate
- input resistance very small	- input resistance is very high
- ability to ~~Control cur~~ Amplify current is Low	- Ability to Amplify current is high
~~cts~~ - Percentage To be damaged is very small	- Percentage of damage is very high
	- Works on high frequencies

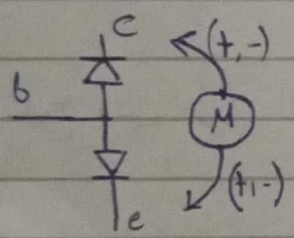
(MOSFET) as a Switch



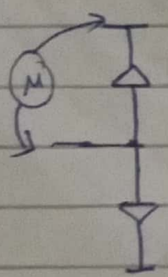
→ We should choose (MOSFET) with small R_{DS} to minimize power disipation.

How to examine Transistor (BJT)?

①



ـإذا اعطى قراءه لاخيره فهو تالف

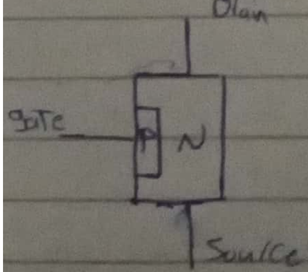


Forward - يجب أن نتحصل على قراءه مقاومه بين (500.1K)

Reverse - " أن نحصل على مقاومه عاليه

② By using digital Multimeter, (Diode) Function, we should get a value between 0.3_0.8 V

How To examine Transistor MOSFET?



1) By using digital Multimeter on (Diode Function or Resistance
2) Connect or let the Gate To Touch Source
3) (-ve) Connect To Source
4) (+ve) Connect To drain → OL open circuit
5) then Put the (+ve) Probe on the Gate
6) Finally Touch gate and Source, the value will be very high

Transistor Coding

① Pro-electron scheme

→ First letter = Material

→ Second letter = Type and uses

→ third letter = Can be used Commercially and industrially (W, X, Y or Z)

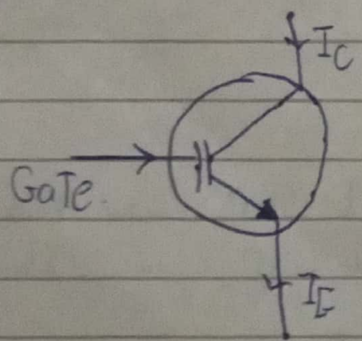
② JEDEC Scheme.

→ First no: 1 = Diode , BJT Transistor = 2 , FET Transistor = 3.

→ Second letter N

→ third letter (رقم تسلسلي)

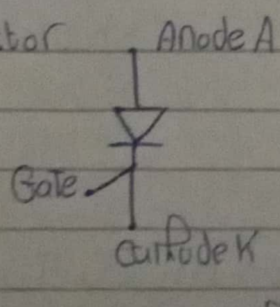
(IGBT) Transistor → BJT / FET   يجمع بين مزايا ال FET, BJT



- Doesn't Consumes current.
- Can be Controlled by Potential d.
- High ability to withstand current.
- the most expensive.

Applications → inverters, (3phase محرك), Power Supply.

thyristor



(its Function like the Diode but it differs, that
* it must be given a pulse on its gate To Pass current From Anode to Cathode.

→ we can Control the ~~gate~~ thyristor through gate

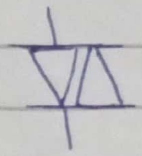
→ if we give the gate any voltage, the thyristor will be on and act as a diode

→ If we remove the voltage on Gate the thyristor remains on without any change

→ we can change it To (OFF) if the voltage on Anode become (-ve) or removing the source, or by making short circuit between Anode and Cathode

→ if the current passing through thyristor reaches "minimum holding current"
* thyristor will be off

Diac: Element which is similar To diode



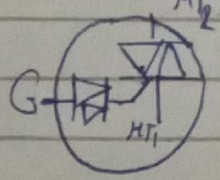
* IT needs more VolTage To Pass the current. has no (anode and cathode)
  (Breakdown voltage) V_{BR}
* How To Examine diac.
  By using DMM to the Poles of Diac and change the Poles ~~on~~ to take the readings in both Cases and they must be equal

---

Traic: iTis Similar To the thyrestor but it can Pass current in both directions
APPlicaTions $\longrightarrow$ used to conTrol loads working on AC Currents

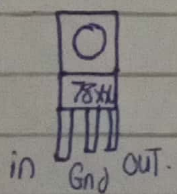
Disadvantage of Traic

$\longrightarrow$ ~~Signal~~ +ve Signal on the gate to open may be not equal to the (-ve)
So, to Solve this Problem we use a diac to avoid this problem
Also there is another elemenT called (Quadrac) which ConsisTs of a(diac and a Traic) Together

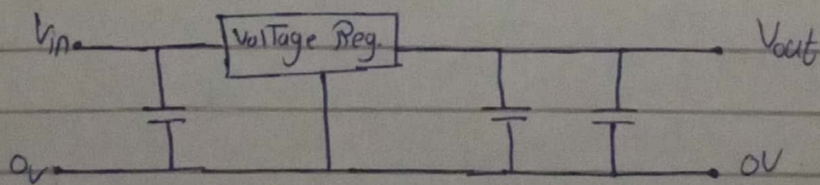


$\rightarrow$ How To examine Triac?
PuT PosiTive Probe on the GaTe and MT1 and the negaTive Probe on MT2, so the ResisTance will be very Small value.

VolTage Regulator



(xx) $\longrightarrow$ idenTify the inpuT and ouTPuT VolTage



(VolTage Regulators), decreases iTs Temperature aT Certain PoinT To protect itself from ~~damaging~~ damaging