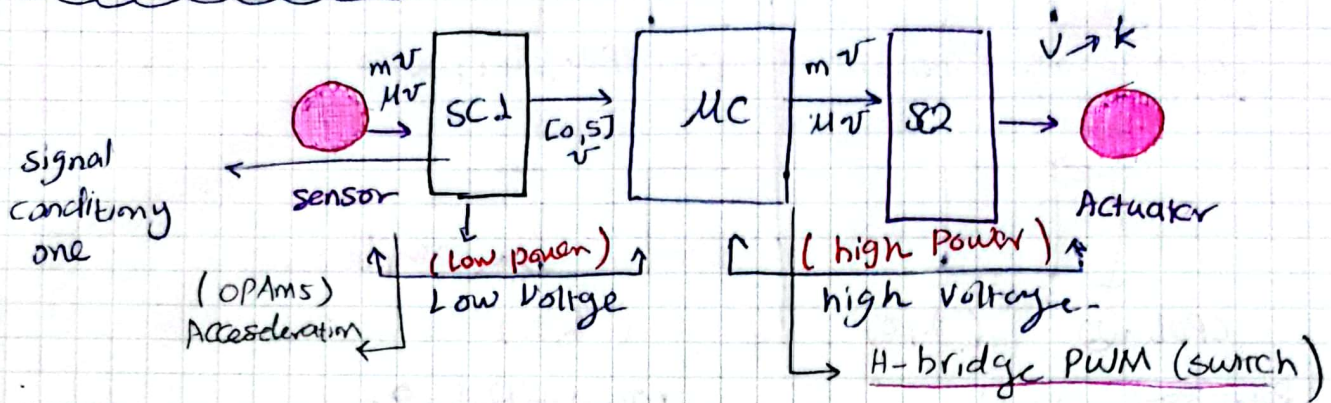
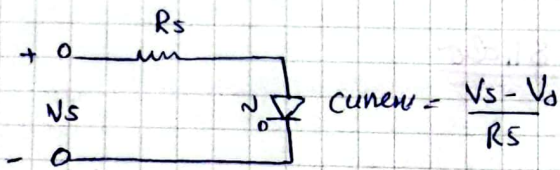


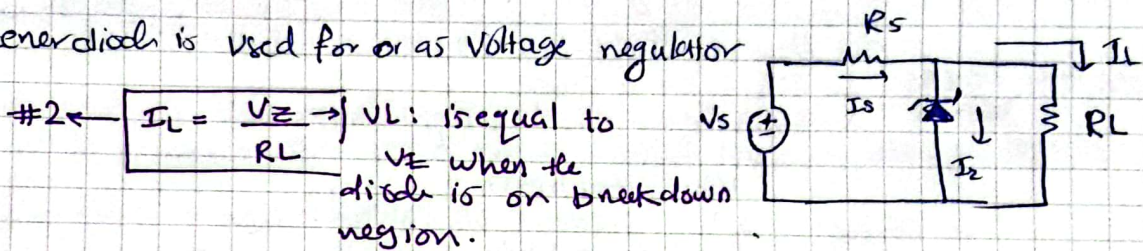
\* Interfacing Circuits :- Transistors Amplifiers 2-



\* if you want to be very good PN-Junction [understand PN-Physical]



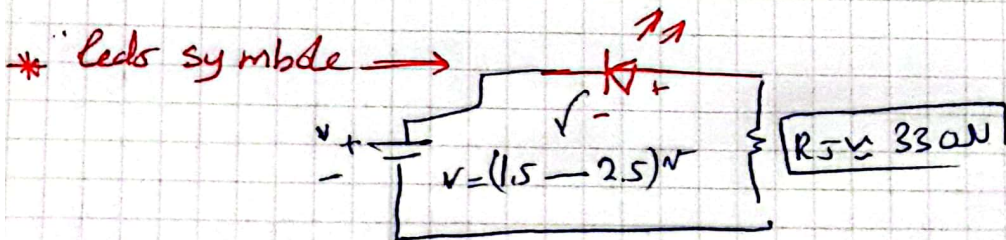
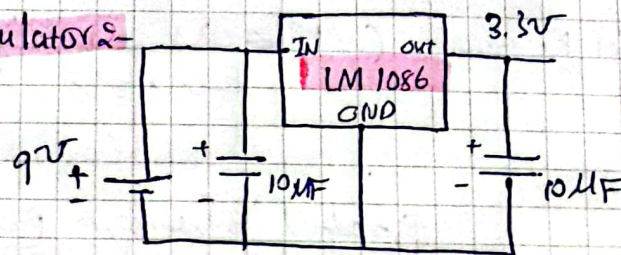
→ Zener diode is used for or as voltage regulator



$I_L = I_S - I_Z$  → #1 →  $I_S = \frac{V_S - V_Z}{R_S}$  → #2

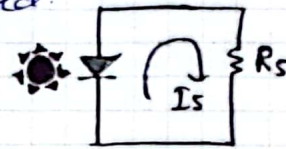
Power in Zener  $P_{Z, max} = I_{Z, max} \cdot V_Z$

\* Another Voltage Regulator :-



\* **Photo Diode** is worked as a Reversed Biased.

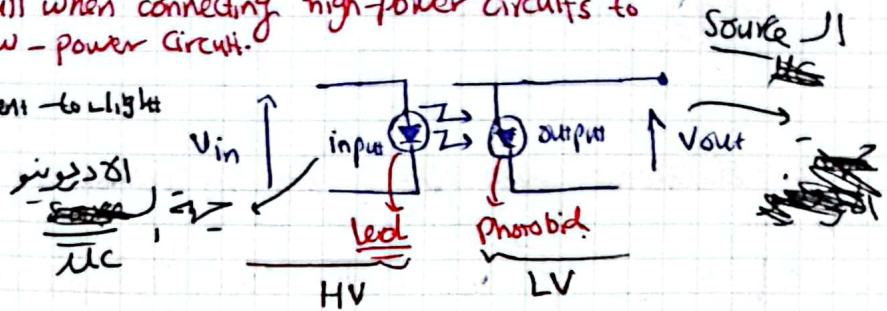
→ sing work in Region (4) :-



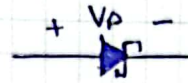
\* **OTOCouplers** consist of diode and photo diode,

→ Aim: ① Usefull when connecting high-power circuits to Low-power circuit.

② Current to Light

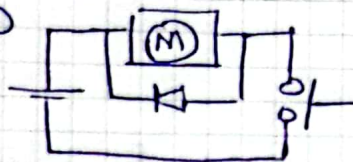


\* **Shottky Diodes** :-



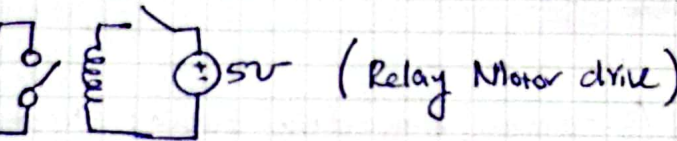
① What is cool about it, works on high frequencies > 1 MHz

\* **switches** ①



(Push button Motor) (we don't care about this)

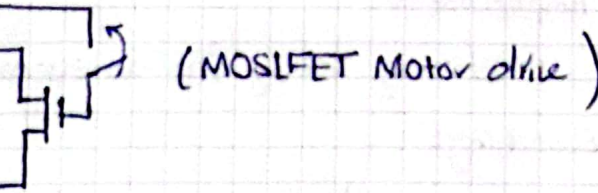
②



(Relay Motor drive)

most important Two

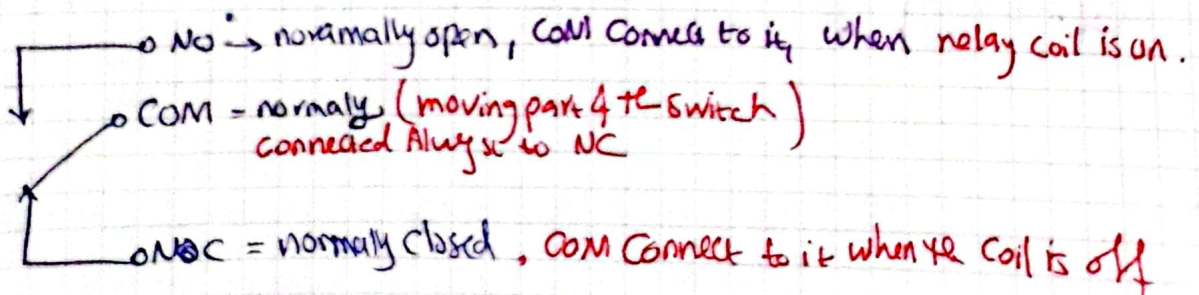
③



(MOSFET Motor drive)

① Relay Motor drive - is an electrically operated switch.

② The magnetic field attracts a lever & change the switch contacts.



Adv

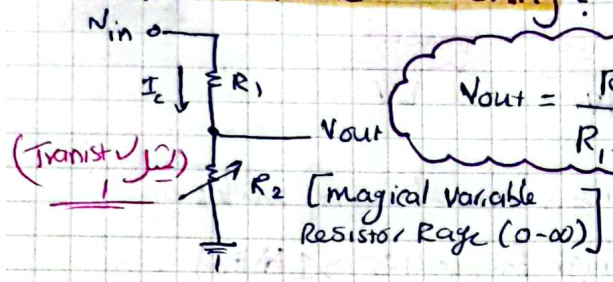
1. Inexpensive
2. Large selection
3. handle high current and voltage
4. Resistant to electrical surges

disadv.

1. Bulky (ضخمة)
2. prone to 'striking' or mechanical fatigue
3. Show (5 to 15msec) switching time
4. Limited cycle rate.

ابه سكاكر ميكانيكية  
↓

\* Electronic Switching? yes by Transistors.



$$V_{out} = \frac{R_2}{R_1 + R_2} (V_{in})$$

when  $R_2 = 0$ , open } This is like  
 $R_2 = \infty$ ,  $V_{out} = V_{in}$  } The switch

$$V_{out} = V_{in} - I_c R_c$$

بتحكم فيها من  $R_2$  ، فلما اتحكم في  $R_2$  ، يتحكم في  $I_c$  ويتحكم في  $V_{out}$   
 فلو انا  $R_2$  اذا تتحكمنا فيها ايتار بغير BJT  
 انا اذا تتحكمنا فيها من voltage بغير MOSFET

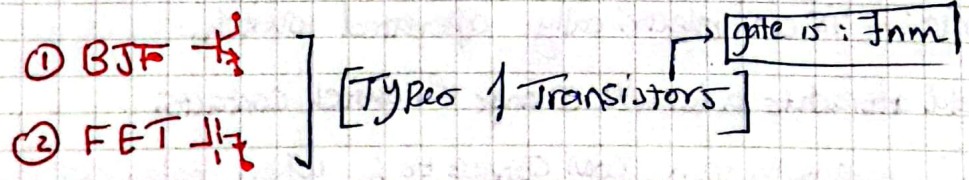
\* Transistors - (3-terminal) semiconductor devices capable of performing two fundamental operations

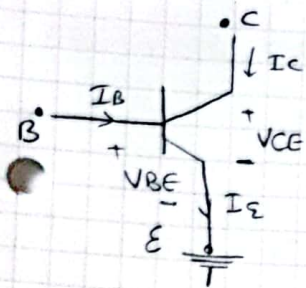
1. Amplification

transferring energy from an external source.

2. Switching

control large current between or voltage.





$$I_E = I_C + I_B$$

$$V_{BE} > 0.7$$

(1) Active Region

$$I_C = \beta I_B$$

(2) Cutoff

$$I_E = (1 + \beta) I_B$$

$$\beta = \frac{\alpha}{1 - \alpha}$$

(3) Saturation

$$\beta = \frac{I_B}{I_C} \quad \alpha = \frac{I_E}{I_C}$$

$$P = I_C V_{CE}$$

heat plate  
transistor

① In cutoff mode  $\Rightarrow V_{BE} < 0.7$  (transistor will be open circuit)

② In saturation mode

$$V_{BE} = 0.7 \text{ \& } I_B > \frac{I_{C(max)}}{\beta}$$

$$V_{CE} = V_{sat} \approx 0.2V$$

$\Rightarrow$  to make the BJT as a switch, we should toggle between the cut-off and the saturation regions.

Low Point (A):  $[I_B = 0, V_{in} < 0.6]$  (Low)

$$I_C \approx I_E \approx 0 \Rightarrow V_{out} = V_{CC}$$

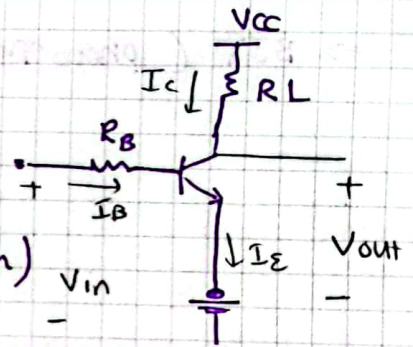
$\rightarrow$  switch open

High Point (B):  $I_B > I_{B(sat)}, V_{in} > 0.7$  (high)

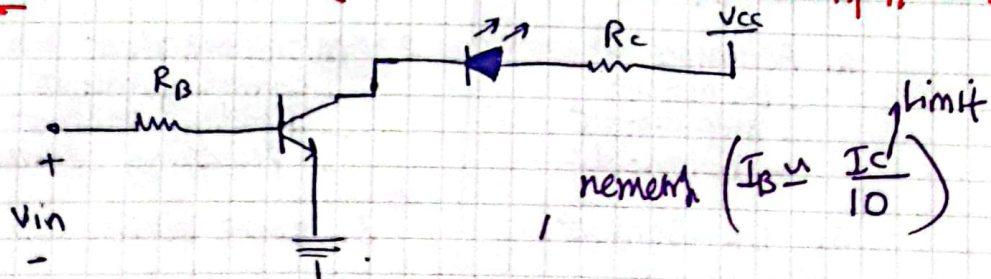
$$V_{out} \approx V_{CE(sat)} \approx 0.2V$$

$\rightarrow$  switch closed

$$I_B = \frac{V_{in} - V_{BE(sat)}}{R_B} \approx I_C = \frac{V_{CC} - V_{CE(sat)}}{R_L}$$

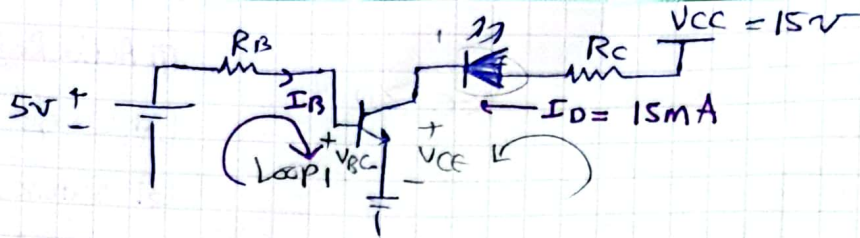


\* Important: LED Driver (BJT as a switch to Turn on/off an LED)



if  $V_{in} = 5$  &  $V_{CC} = 15$ , choose the value of  $R_B$  &  $R_C$  so

that the led current is 15mA, assume led drops 1.8V when lit



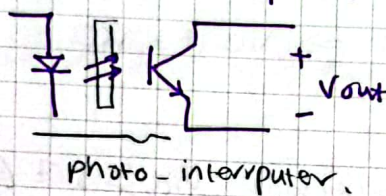
①  $I_B \approx \frac{I_C(\text{given})}{\beta} = \frac{1.5\text{mA}}{10} \Rightarrow 1.5\text{mA}$

From Loop(1)  $\Rightarrow -5 + R_B(I_B) + V_{BE} = 0$

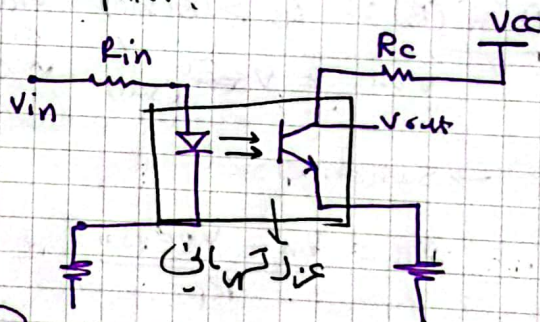
$R_B = \frac{5 - 0.7}{1.5\text{mA}} = \boxed{2.87\text{ k}\Omega}$

② The value of  $R_C \Rightarrow = \frac{V_{CC} - V_{CE}}{I_{LED}} = \frac{15 - 1.8}{1.5\text{mA}} = 0.88\text{ k}\Omega$

$\Rightarrow$  BJT (photo Transistor)  $\Rightarrow$  ① optical switch



② LED + photo transistor

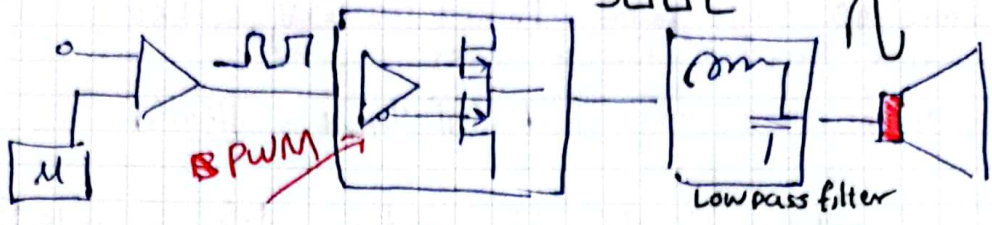


Power Amplification

high power	NIC	Low power
1. 100mA, 5V		2. ~10mA, 3.3 OR 5V
2. Actuators - DC Motors - Step motors - Solenoids		2. Microcontrollers - Controlling motors - Reading sensors - Processing controllers.
3. IR - Sensors.		3. some sensors
4. Big LEDs		4. Small LEDs

high power  $\leftarrow$  Transistor  $\leftarrow$  Low power

لدينا  
اشارات  
فكرة  
ال  
H  
Bridge



① works in saturation mode. [switch (on), (off)]

② motor: acts like low pass filter.

To generate PWM :-  
1. using Arduino  
2. 555 timer

\* Motor Drivers (Amplifier)

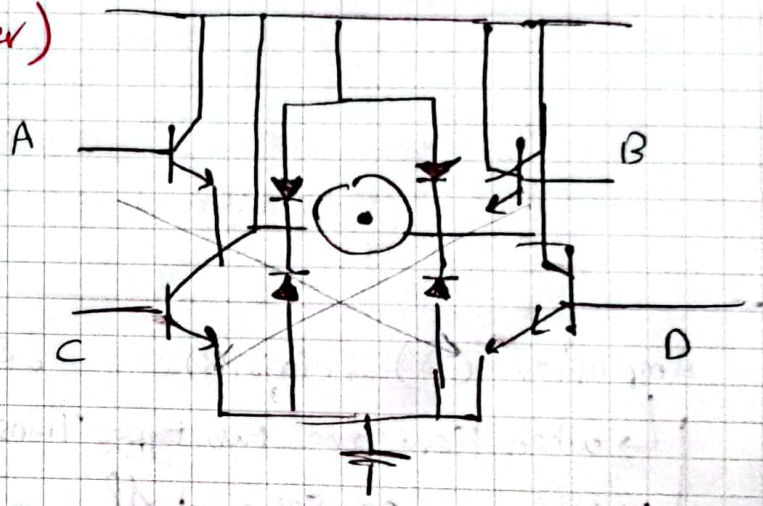
This H-bridge

if  $A = D = H$

$C = B = L$

does it work?

A is open  
D is open



① The voltage will work & the direction is from  $A \rightarrow D$  (forward)

② when C & D are on, the direction is back ward (A & D are off)

⇒ other than that break