Chapter-3

Electrical Quantities

What is the comparision between the voltage and current?

Voltage	Current
→ Voltage is the difference in electrical potential b/w the two points. (Also called as electromotive force)	It is the rate of flow of electric charge or we can say the amount of charge flow in a circuit at a particular point.
→ The S.I unit is volt.	→ The S.I unit is Ampere.
→ Voltage is the cause of the current.	→ current is the effect of the voltage. i.e current cannot flow without voltage.
→ V = workdone / charge	→ I = Charge / Time
→ In a series connection voltage changes that is it gets distributed over all the component.	→ In a series connection the current remain the same throughout all the component.
→ In a parallel connection the voltage remain same across all the component.	In a parallel connection current changes i.e it get distributed over all the component.

Resistance :-

According to the ohms law, there is a relation b/w the current flowing through a conductor and the potential difference across it. It can also be called, to oppose the flow of current is called as resistance.

$V = IR$, V = potential difference
R = Resistance
I = current

The factor affecting the Resistance :-

$R = \frac{\rho l}{A}$ l - length
ρ - Resistivity
A - Area of the cross-sectional Area.

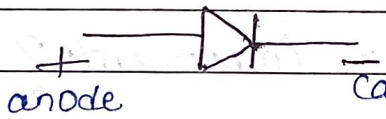
Q. What are Active Components?

The active components are the semi-conductor devices consisting of semi-conductor materials. Typical electronic devices such are Diodes, and Transistors, for performing the active operation such as rectifying, amplifying converting supplied current.

The Active components supply electric power to the circuit or power gain in the circuit.
(Semiconductor are the substances which have both the properties of conductor as well as Insulator. eg. Silicon, Germanium)

* Diode:-

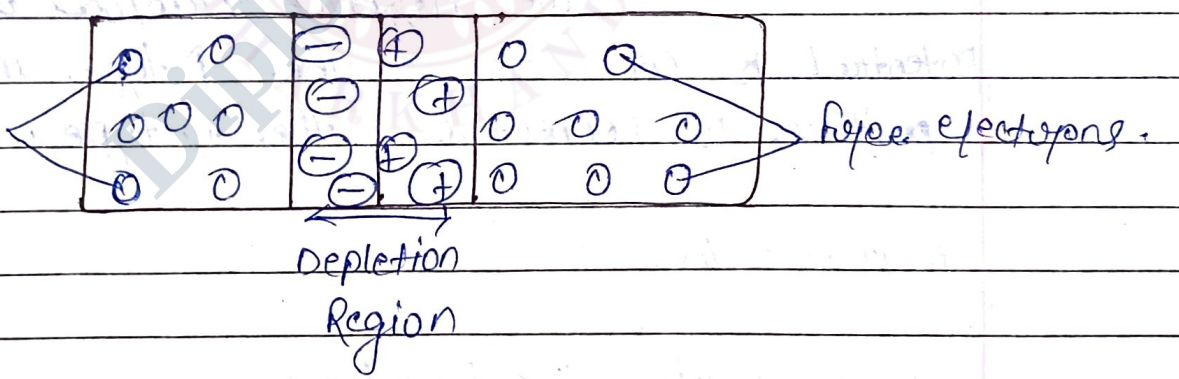
Diode are used to protect the service by limiting the voltage and also transform AC to DC. Semiconductor such as germanium and silicon are used to make most of the diode. Even though they transmit the current into single direction. The way with which they transmit refers



What is P-N junction?

A P-N junction is an interface or a boundary b/w two semiconductor material types, namely the P-type and the N-type, inside a semiconductor.

In a semiconductor, the P-N junction is created by the method of doping. The P-side or the positive side of the semiconductor has an excess of holes, and the n-side or the negative side has an excess of electrons.
The process of doping is explained in further detail in the next section.



Biasing Conditions for the P-N junction Diode

There are two operating regions in the P-N Junction diode:
P-type
N-type

There are three biasing conditions for the P-N junction diode, and this is based on the voltage applied:

Zero bias: No external voltage is applied to the P-N junction diode.

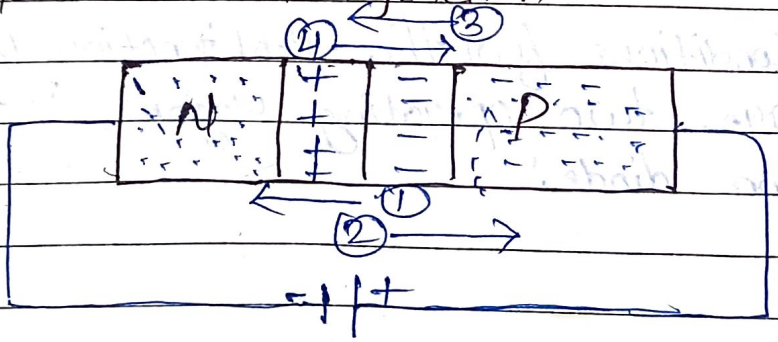
Forward bias: The positive terminal of the voltage potential is connected to the P-type while the negative terminal is connected to the n-type.

Reverse bias:

The negative terminal of the voltage potential is connected to the P-type and the positive is connected to the n-type.

Forward Bias

Forward Bias P-n junction:

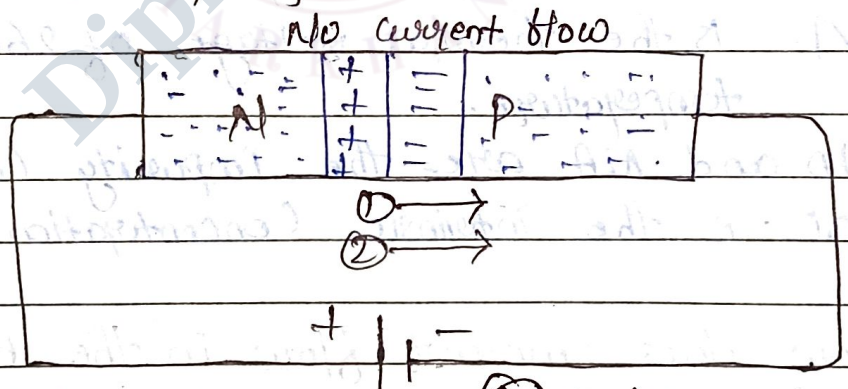


1. Battery induced electric field.
2. Built-in electric field.
3. Conventional current
4. Electron current

When the P-type is connected to the battery positive terminal and the n-type to the negative terminal then the P-N junction is said to be forward biased. When the P-N junction is forward biased, the built-in electric field add up, the resultant electric field has a magnitude lesser than the built in electric field.
This result in a less resistive and thinner depletion region.
The Depletion region resistance becomes negligible when the applied voltage is large.

Reverse Bias.

Reverse Bias P-n junction.



① Battery induced electric field. ② Built-in electric field.

When the P-type is connected to the battery's negative terminal and the n-type is connected to the positive side, the P-N junction is in Reverse Biased.

The depletion region becomes more resistive and thicker if the applied voltage become larger.

P-N junction formula:

The formula used in the P-N junction depends upon the built-in potential difference created by the electric field. is given as:
where,

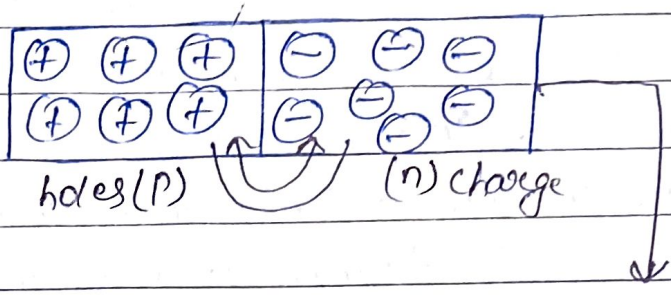
$$E_0 = V_T \ln \frac{N_D \cdot N_A}{n_i \ln 2}$$

E_0 is the zero bias junction voltage.
V_T is the thermal voltage of 26mV at room temperature.
N_D and N_A are the impurity concentrations.
n_i is the intrinsic concentration.

How does current flow in the PN junction diode?
The flow of electrons from the n-side towards the p-side of the junction takes place when there is an increase in the voltage.

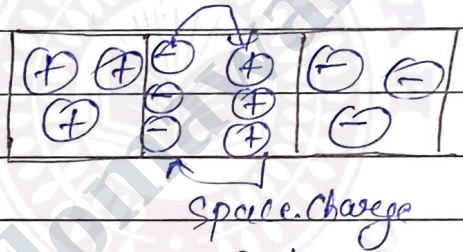
Similarly, the flow of holes from the P-side towards the n-side of the junction takes place along with the increase in the voltage.
This results in the concentration gradient b/w both sides of the terminals. Due to the concentration gradient formation, charge carriers will flow from higher concentration regions to lower concentration regions.
The movement of charge carriers inside the P-N junction is the reason behind the current flow in the circuit.

P-N junction Diode



e⁻ near the junction jump from N to P Semiconductor & vice versa.

Due to e⁻ movement a space charge Region get created between them.



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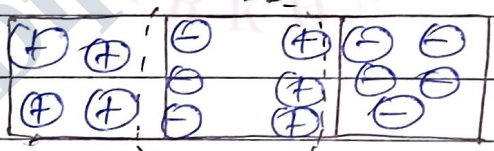
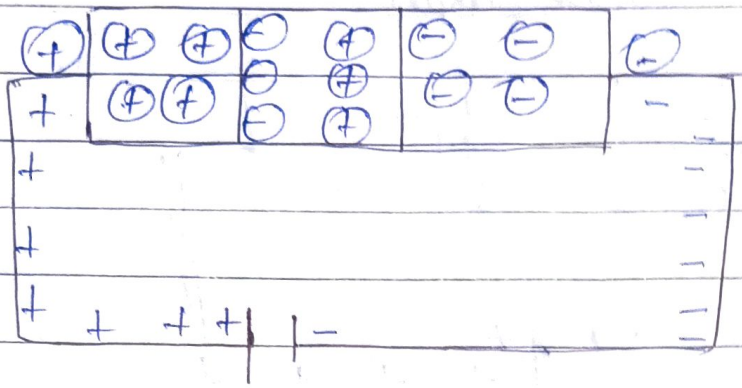


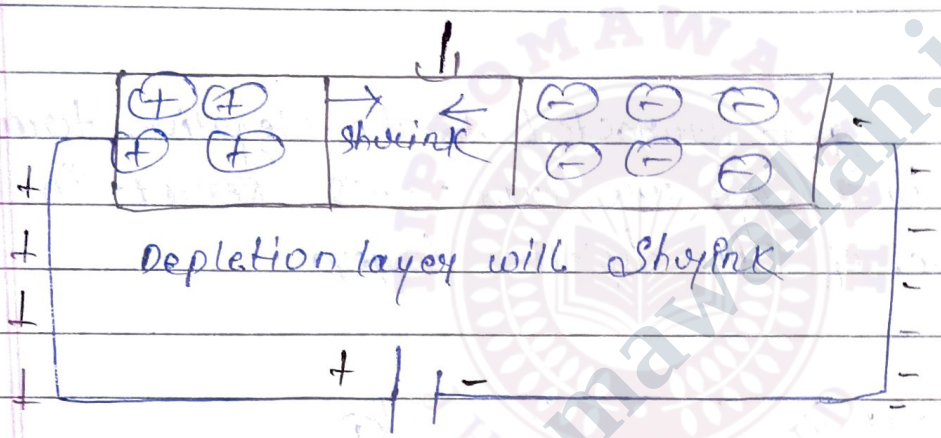
↳ Electric field created due to the movement of the e⁻s

Doping :

pure Semiconductor + Impurity added → Semiconductor used

- Trivalent Boron B^{3+} → Hole
- Pentavalent Phosphorus P^{5+}



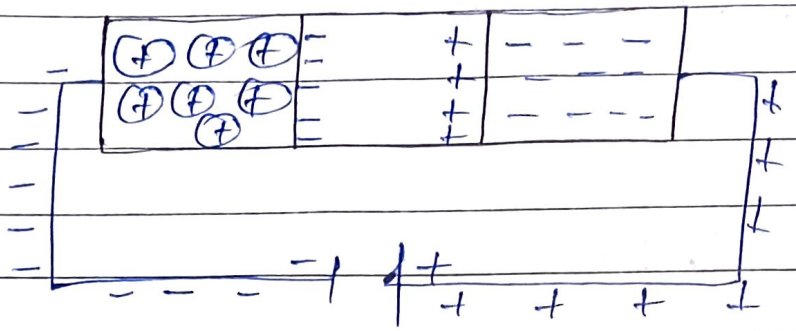


Due to repulsion the depletion Region will narrow down.

But if the voltage in the forward bias is above the specified Range, the e's in the N Region drifts through the junction and migrates to the P Region & vice versa.

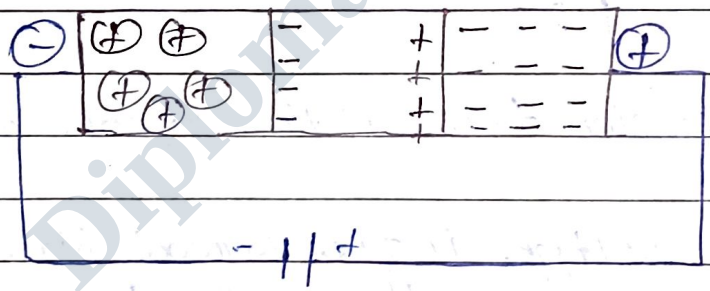
Now the current flows across the circuit called as Drift current.

Reverse Bias

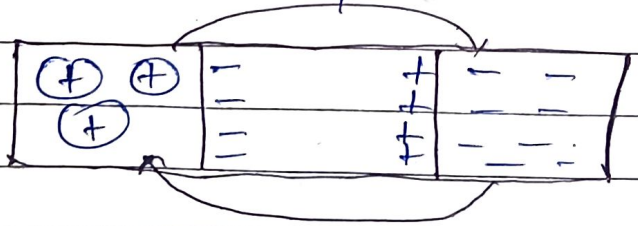


Holes get attracted to the Negative terminal of the battery and vice versa. This Result in increase of the depletion layer.

⇒



Now the PN junction acts as an insulator will not allow any current to flow in the circuit, if the Battery voltage is above a particular limit (Reverse Bias Breakdown voltage) thus,



e's and the holes breakdown through the PN junction and cross resulting in the current to flow through the circuit. This breakdown called as Avalanche breakdown.

In this process the current flowing through the P-N Junction is very high an ultimately the P-N Junction get damage due to overheating or overuse caused by the access flow of current.

Usage of P-N junction
→ Solar cell
→ Light emitting diode (forward bias)

✗ passive component :-

Q what is the difference between active components and passive components?

Active

Active	passive
* It requires a external power supply to operate in the circuit.	It does not require external power supply.
* It produces the energy in the form of current or voltage.	It store the energy in the form of current or voltage.
* Active components can power gain in the electrical circuit.	It cannot provide power gain
* It control the flow of current.	It cannot control the flow of current.
Ex- Semiconductor, diodes, Transistors, Resistor	Ex- Resistor, inductor, Capacitor & Transformer.

* Types of the passive component
  i) ~~Register~~ Resistor
  ii) Capacitor
  iii) Transformer

* ~~Register~~ :-
  Resistor :-

They are basically used to control the flow of current. They are used to limit the current, divide the voltage (a type of opposition) to current.

$V = IR$

* Capacitor :-

Capacitor are used to store and release the electrical energy. They are basically use for filtering, Storage and sometimes also used in ~~amply~~ Amplifying in the electronic circuit.

i) It is used to pass AC and block DC.

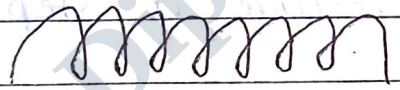
ii) It oppose the flow of Direct current.

* Inductor :-

It store and release the magnetic energy. They are used for energy storage, filtering, minimizing the AC in the ~~circuit~~ circuit.

Inductors also work on electromagnetic induction.

All the inductor are coiled structure.



* Transformer :-

It is the component used to transfer the electrical power from one circuit to another circuit with the help of magnetic core.

i) Transformer has two winding on a core. The winding in which the input power is given (primary winding).

ii) The winding which deliver the power to the load (Secondary winding).

iii) Transformer ~~Step~~ Step up ~~down~~, Step down, Voltage.

power and energy remain the same on the primary and secondary side. As energy is not amplify.

* They are passive component as they only use to vary the voltage level and keep the power constant.

* AC to DC Convetar

AC to DC Convetar are electronic circuit that convert AC to DC current. These Convetars are used in electronic devices that require DC power supply such as Computer, TV, Mobile. The AC to DC Convetar are product friendly, allowing the electronic devices to operate effectively.

* AC to DC Convetar include a step-down transformer

Why Transformer is a passive? (power constant होता है)

→ mainly it does not generate our amplify the new power voltage. it only transfer the electrical energy from1 circuit to another circuit without changing the overall power level. (means it simply alters voltage levels while maintaining the same amount of energy on the both side of Transformer)

Key points

1) No more new power gain

2) Relies on the existing energy.

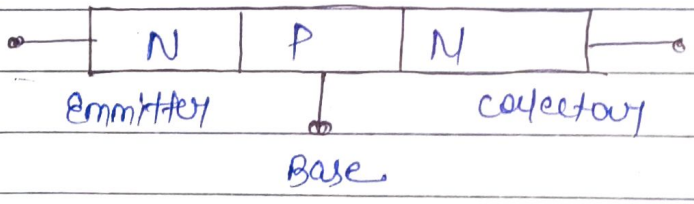
3) The power (primary side) = The power (Secondary side)

BJT

* It is a Bi-polar junction Transistor. A Semiconductor device used to amplify or switch the electrical signal or power. BJT is also type of Transistor that uses electrons and holes as charge carriers.

* It is a three terminal semiconductor device that uses the two new P-N junction which are able to amplify the signals. (It is a current controlled device.

* It is a semiconductor device that is constructed with a three doped semiconductor regions i.e base, collector and emmitter separated by two P-N junctions. It is uses in mobile phone, TV, radio, industries.



Emmitter - Emits the -s
collector - collect the electrons.

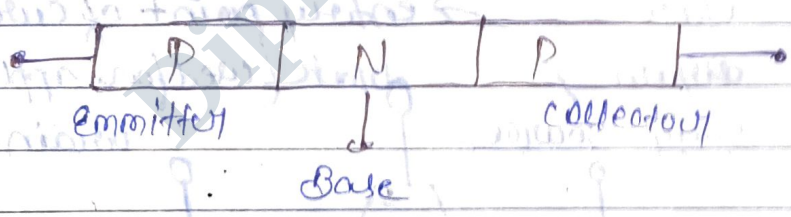
Types of BJT

There are two types of BJT:

i) PNP

ii) NPN

i) PNP:- In PNP BJT, the 'N' type semiconductor is placed b/w the two 'P' type semiconductor. The two P type semiconductor act as a emitter and collector while the 'N' type semiconductor acts as a base. The current enters into the transistor through the emmitter such that the emitter base junction is foward Bias and the collector base junction is reverse Bias.



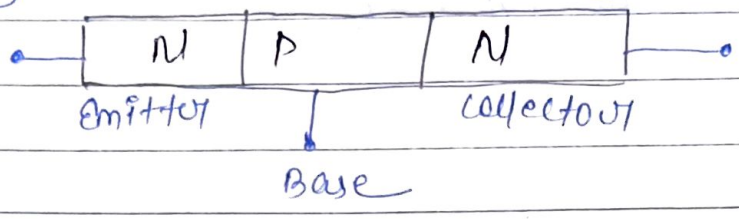
ii) NPN:-

P type semiconductor is placed b/w the two N type semiconductors. The two 'n' type Semiconductor acts as a emmiter and collector while the 'P' type semiconductor act as a base. Current Entering into the emmitter, base and collector has a Sign convection of positive, while

Voltage Turn ON

N-channel mosfet (Electron flow dominate)
P-channel mosfet (Hole flow dominate)

leaving the circuit as a negative.



* MOSFET :- It stands for metal oxide silicon field effect transistor.

It is used to amplify the voltage in the circuit. It is a voltage controlled device. It is also a three terminal device which contains:-

i) Source or Terminals
ii) Gate
iii) Drain
iv) Body

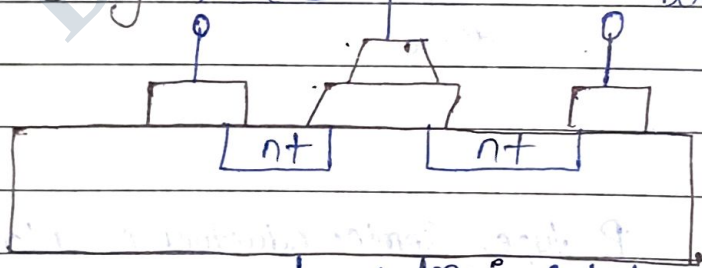
It is used mainly for switching and amplification.

It is the entry point of current.

Gate (used for apply the voltage)

It is the exit point of output current

Drain



Body (main substrate that internally connect with source).

Appli
* SMPS
* Microprocessors
* Amplifiers
* motor control

The body of the MOSFET is made up of 'P' type semiconductor, the two types of base are highly doped with the 'n' type of impurity which is given as 'n+' in diagram.

Working → The MOSFET operates by controlling the voltage at the gate terminal, in which current flow b/w source and drain.
→ When voltage is not applied gate is off;
→ When a voltage is applied to the gate, it create electric field that form conductive channel b/w source and drain.

(Base is divided as source and drain).

When voltage is applied to the gate, the electrical field is generated that changes the with of the channel where the electrons flow, The wider the channel, the better the conductivity.

* Sensor :-

Sensor is a device that is used to detect the some amount of input from the physical environment. The input can be light, heat, motion, pressure, humidity etc. The output is generally a signal that is converted into the human language in a digital form. Sensor play a important role in IOT.

The types of sensor are:-

i) Temperature sensor
ii) pressure sensor
iii) proximity sensor
iv) level sensor
v) Motion sensor
vi) Humidity sensor
vii) Light sensor
viii) sound sensor
ix) Infrared sensor
x) Ultrasonic sensor.

* Transducer:-

It is electronic device that convert energy from one form to another form.

Some of the common examples of Transducer are: loudspeaker, microphone, Thermometers and LED.

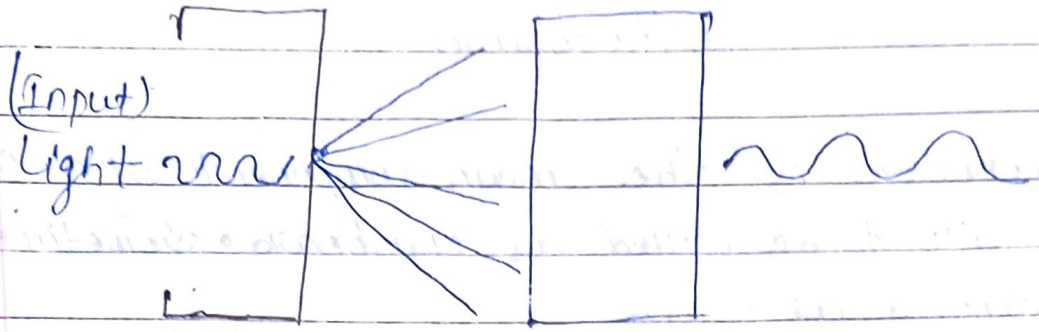
* pulse with modulation:-

It is a technique that generate the analog signal from the digital devices such as microcontrollers. The signal which is produced has a multiple pulses, which is in the form of square wave. It reduces the electric power delevered by the electrical signals by converting the signal into many parts.

(pulse = A sharp change in voltage, current or any other quantity.)

* optocoupler:-

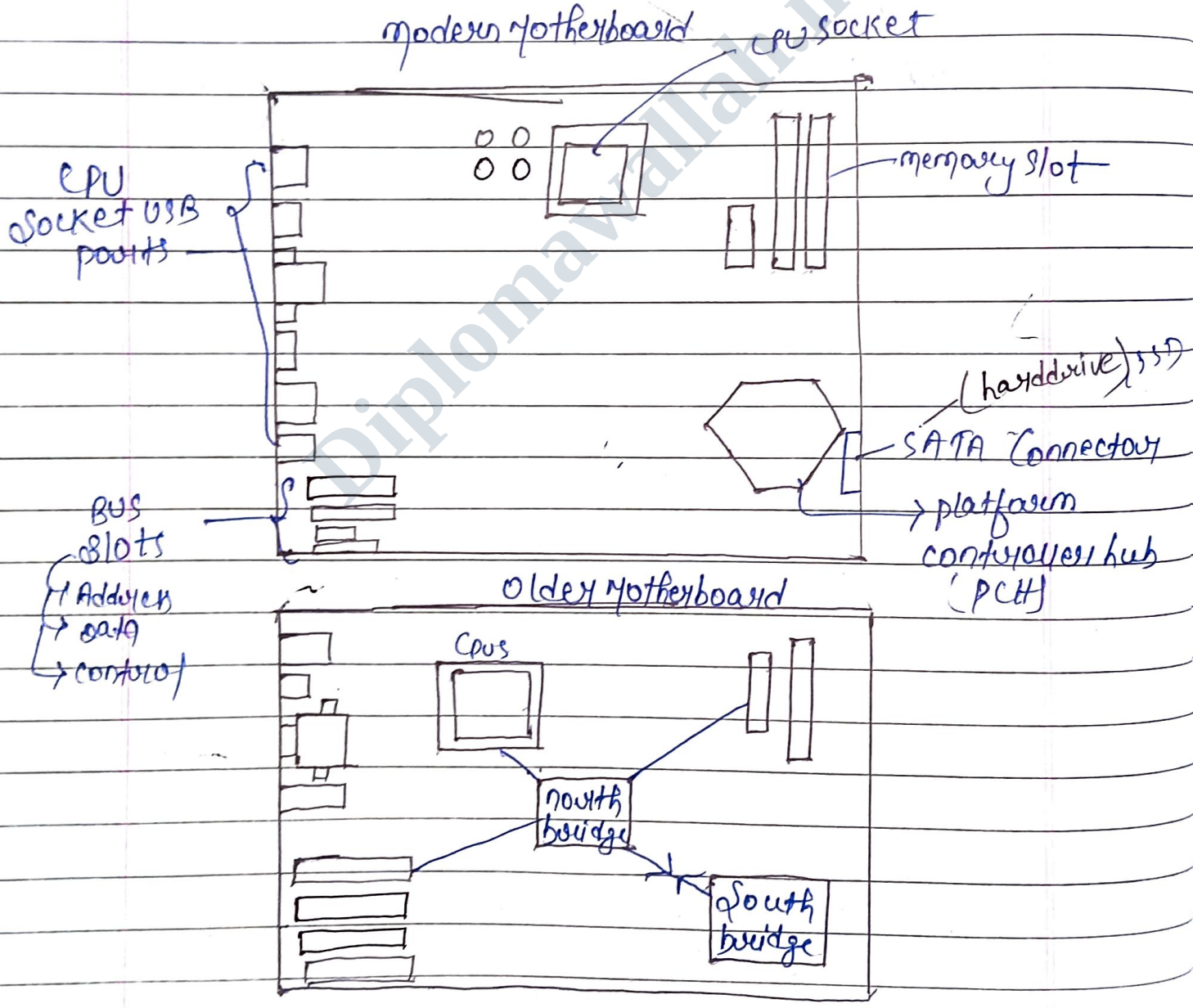
It is also called as up to Isolater. It is a semiconductor device that allow the electrical signal to be transmitted between the two isolated circuit.



* ~~Motherboard~~ :
~~Mother~~

Motherboard

* Motherboard is the main component of a computer. It is also to be called as Mainboard. Sometimes also denoted as Mobo.
* It is a large circuit that fix into the computer in which all the important components get connected to it.



In the modern motherboard we get extra many components:-

1) PCH
2) CPU Socket
3) ~~The~~ PCH Replaced → South Bridge
   CPU Socket replaced by North Bridge

* The motherboard which is a main circuit contains a CPU Socket (The CPU Socket is where the Central processing unit is placed). There are the memory slots in which the primary memory modules known as RAM are inserted, there is also a 'bus slots' in motherboard or expansion slot in which all contain the data, address, control bus.
* All these are used to install various Component to add some capibilities to the Computer like. VideoCard, SoundCard, Network Card. There is a SATA Connector where you would attach Storage devices such as Harddrive or SSD. There is also 'M.2 Slot' which is used to attach the drive memory memories.

* The PCH is a ~~cheap~~ chip set architecture which replace the South bridge in older motherboard

The CPU Socket replace the North Bridge in the older motherboard.

Older motherboard:-

Based upon the older motherboard we get two interfaces:-

i) North Bridge:- This Bridge is located in the upper side of the motherboard.

ii) South Bridge:- Similarly the South Bridge located in the lower part of the motherboard.

* While passing the information from South to North a wire get connected, which show incapibilities of the older motherboard, it takes time to pass the message from south to North or vice versa.

* In older motherboard we use VGA but in modern motherboard we use HDMI port.

* Function of Motherboard :-

→ Connect the Components :- It is used to connect the all the important components of the computer system such as printer, Keyboard, such o mouse, harddisk etc.

→ provide power :- The Motherboards gives the power based upon each component.

→ Communication :- The Modern motherboard ~~form~~ help all the components to communicate with each other without any problem.

→ Store BIOS Settings :-

BIOS (basic input output System) are stored in the battery (memory battery, clock battery).

→ provide interface :- whenever a user wants to connect the external divices like Keyboard, mouse the hardware and Software interfaces work upon it.

CMOS Battery
Cmos

* Fourm factour :—

fourm factour is a purocess in which size., shape, weight, physical arrangement of a computing devices fourm factour is usually used to describe the design of a device in such a way thyough it can fit it.

Example:- A Computer Keyboard has a fourm factour- The size get dewrease and fitted into the laptop.

* Component of Motherboard

(I) powery Connectours :- It is used to give the powery to each and euery component, unit to perform the duty.

(II) CPU Socket:-

Also called as bypain of the Computer.

(III) RAM Slot :- The Internal Memoury (DCIM), Local disc (laptop).

(IV) Battery:- CMOS Battery (Uyeneyally this kind of battery power the CMOS chips, which Shoure the system time and data BIOS setting

(v) Expansion Slot:-

Install many kinds of cards like Graphics card, Sound card, Network card, Video card to improve the Input output.

(vi) Chip Set:-

The flow of data from one place to another place generally done by chip, register.

(vii) BIOS

* CPU Socket:-

The CPU Socket is also called as CPU slot, it is used to connect the microprocessor, allowing for the CPU to be installed or replace more easily on the motherboard.

The common types of socket are:-

(i) PGA:

pin Grid Array

(ii) LGA:

Land Grid Array

(iii) BGA:

Ball Grid Array

CPU socket

* BGA completely removed (mobile phone)
  ↳ It cannot be replaced easily.

* LGA
  ↳ Can be replaced.

(I) PGA:-

It is the oldest technology used by 'intel' now a days only used in 'AMD chips'. This type of socet is difficult as the connectar pins places on the processor rather than the motherboard.

(II) LGA:

It is the easiest to install or replace, placing the connectar pins directly on the motherboard. It is time efficient, generally used by the engineers.

(III) BGA:-

Basically this type of socket are used in mobile phones or laptop. They are directly used on the motherboard without any sign of removal (In case if you remove it cost highey to the user)

↓

* Among all CPU socket this is the least expensive

* Microarchitecture of intel

Intel micro architecture is the internal architecture of its processor it is a specific implementation of intel architecture that's turned four specific optimization like :- power on core speed.

Examples of Intel Microarchitecture :-

i) Intel core :- i) A multicore processor, release in 2006 by the intel and the name of the architecture which was replaced by the 'intel micro architecture' was 'yonah microarchitecture.'

~~ii) As~~

ii) As compare with yonah intel microarchitecture used in desktop, server, mobiles etc.

iii) Vector processing has been improve, time efficient, low price.

* you can use 'cpuid' command to find out the micro architecture of intel CPU.