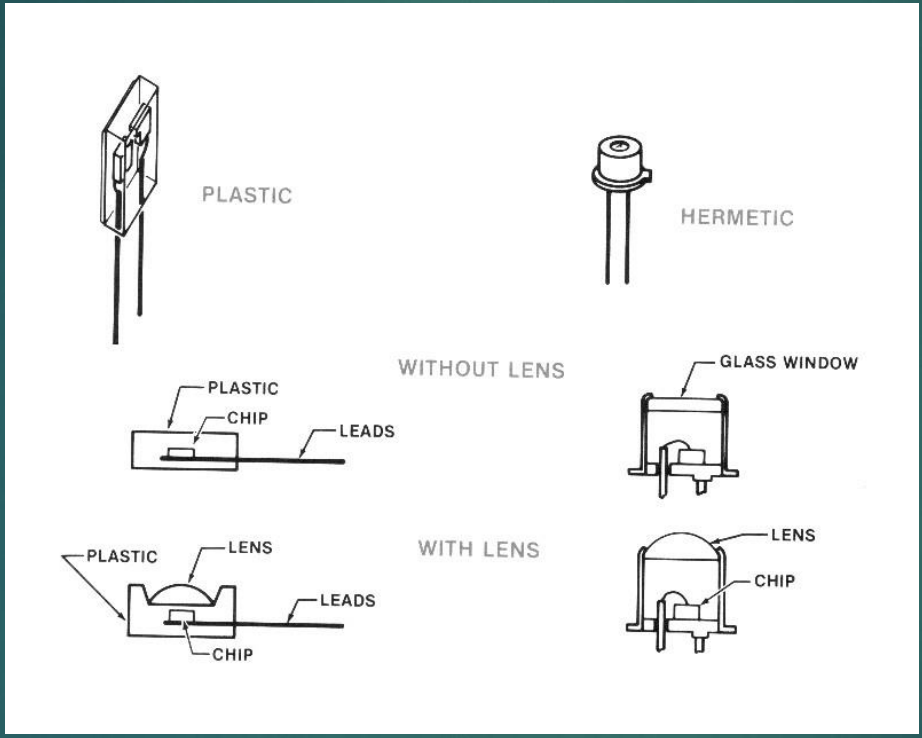
Phototransistor

- Introduction
- Package and Scheme
- Operation
- Advantages
- Example and applications

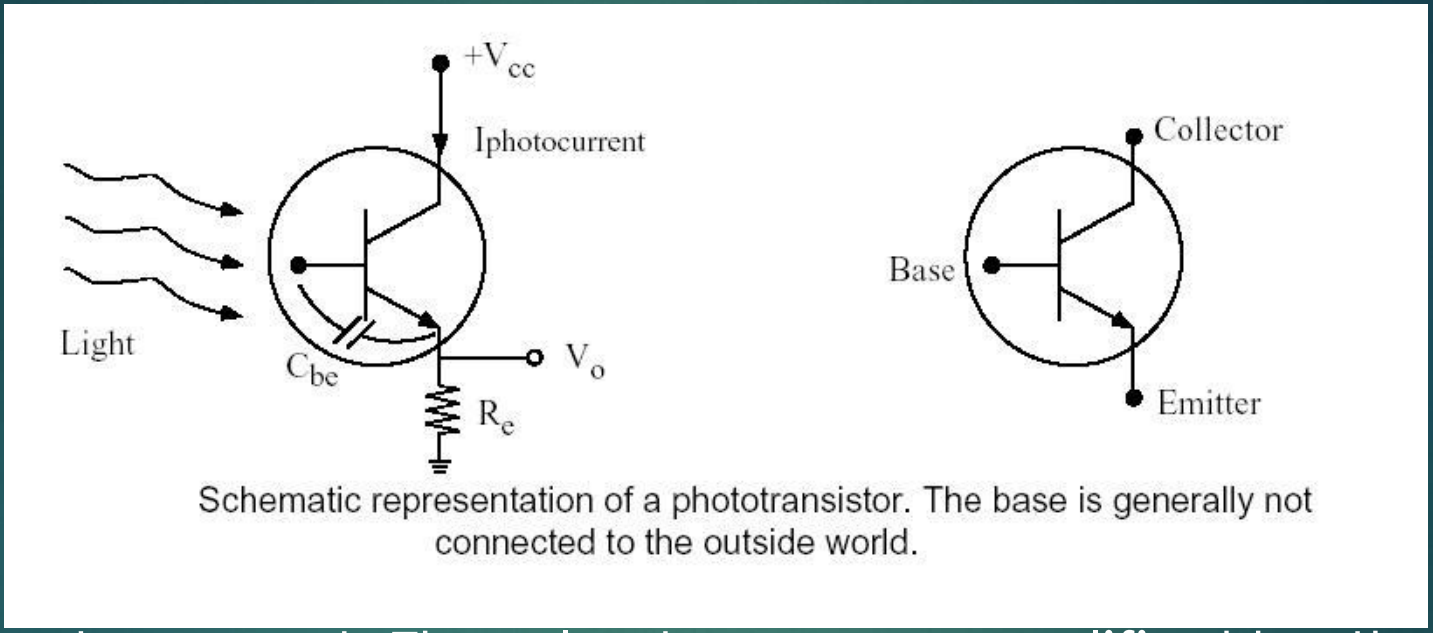
Phototransistor Introduction

- A transistor which is sensitive to the input light intensity
- Operation similar to traditional transistors; Have collector, emitter, and base
- Phototransistor base is a light-sensitive collector-base junction
- Dark Current: Small collector can emit leakage current when transistor is switched off.

Phototransistor Packages



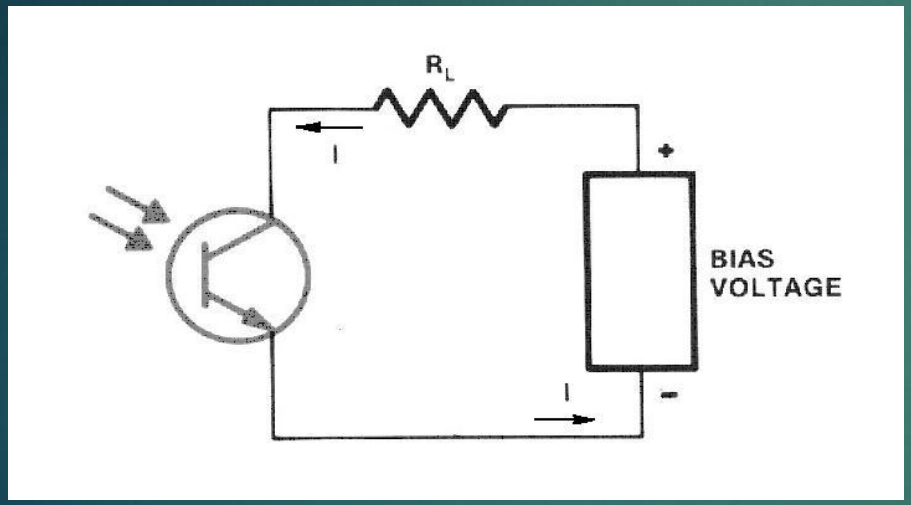
Phototransistor Scheme



Schematic representation of a phototransistor. The base is generally not connected to the outside world.

- Photocurrent: The electrons are amplified by the transistor and appear as a current in the collector/emitter circuit.
- The base is internally left open and is at the focus of a plastic lens.

Phototransistor Operation



- The phototransistor must be properly biased
- A light sensitive collector base p-n junction controls current flow between the emitter and collector
- As light intensity increases, resistance decreases, creating more emitter-base current
- The small base current controls the larger emitter-collector current
- Collector current depends on the light intensity and the DC current gain of the phototransistor

Why Use Phototransistors?

- More sensitive than photodiodes of comparably sized area
- Available with gains form 100 to over 1500
- Moderately fast response times
- Available in a wide range of packages
- Usable with almost any visible or near infrared light source such as IREDs, lasers, sunlight, and etc
- Same general electrical characteristics as familiar signal transistors

Phototransistor Applications

- Computer/Business Equipment
  - Write protect control – floppy driver
  - Margin controls – printers
- Industrial
  - LED light source – light pens
  - Security systems
- Consumer
  - Coin counters
  - Lottery card readers

Optoisolator

- Introduction
- Scheme and Package
- Optocoupler Interrupter Example
- Advantages and applications

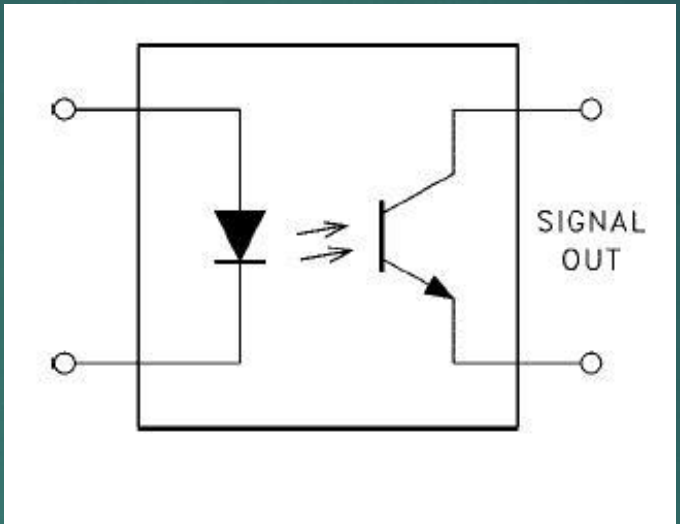
Optoisolator Introduction

- A device that uses a short optical transmission path to accomplish electrical isolation between elements of a circuit.

Note 1: The optical path may be air or a dielectric waveguide;

Note 2: The transmitting and receiving elements may be contained within a single compact module.

Optoisolator Scheme



- The light emitted form the LED is detected by a photodetector which sits across from the LED inside the chip, and output a current.
- Since the input signal is passed from the LED to the photodetector, and cannot be passed form the photodetector to the LED, the input device is optically isolated from the circuit connected to the output side.

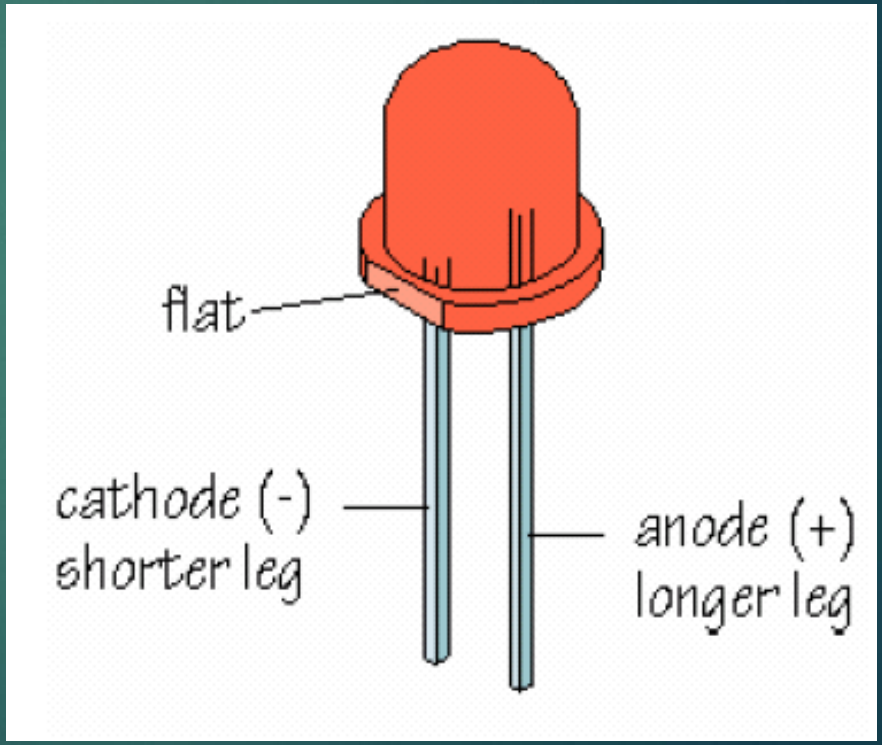
Optoisolator Advantages & Applications

- Advantages
  - Output signals have no effect on input
  - High reliability and high efficiency
  - Noise isolation
  - Small size
- Applications
  - Optical switch
  - Signal transmission devices
  - Used to control motors, solenoids, etc.

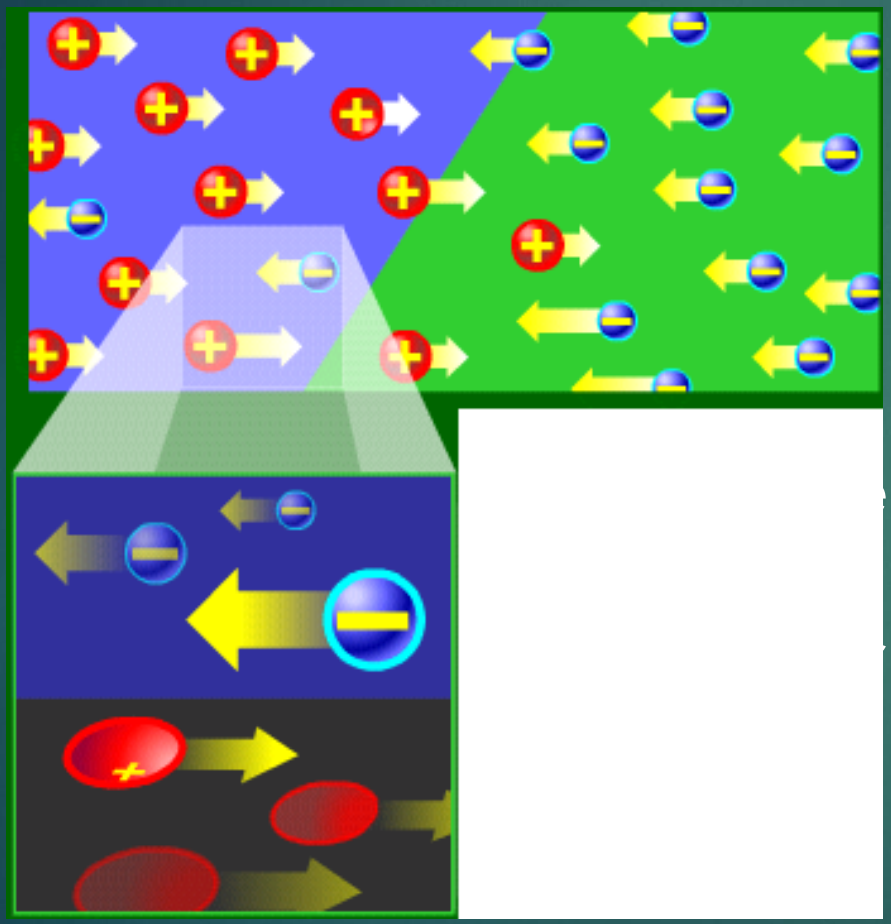
Light Emitting Diode: LED

What is an LED?

- Light-emitting diode
- Semiconductor
- Has polarity



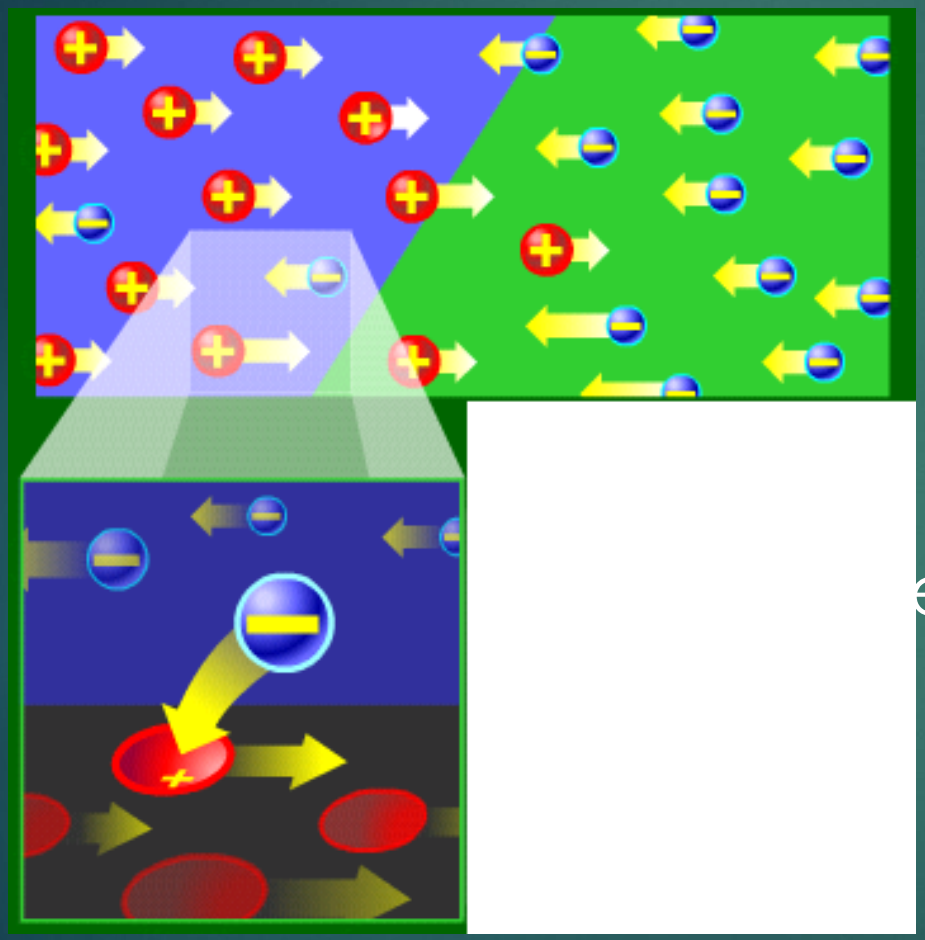
LED: How It Works



- When current flows across a diode

electrons move one
positive holes move
way

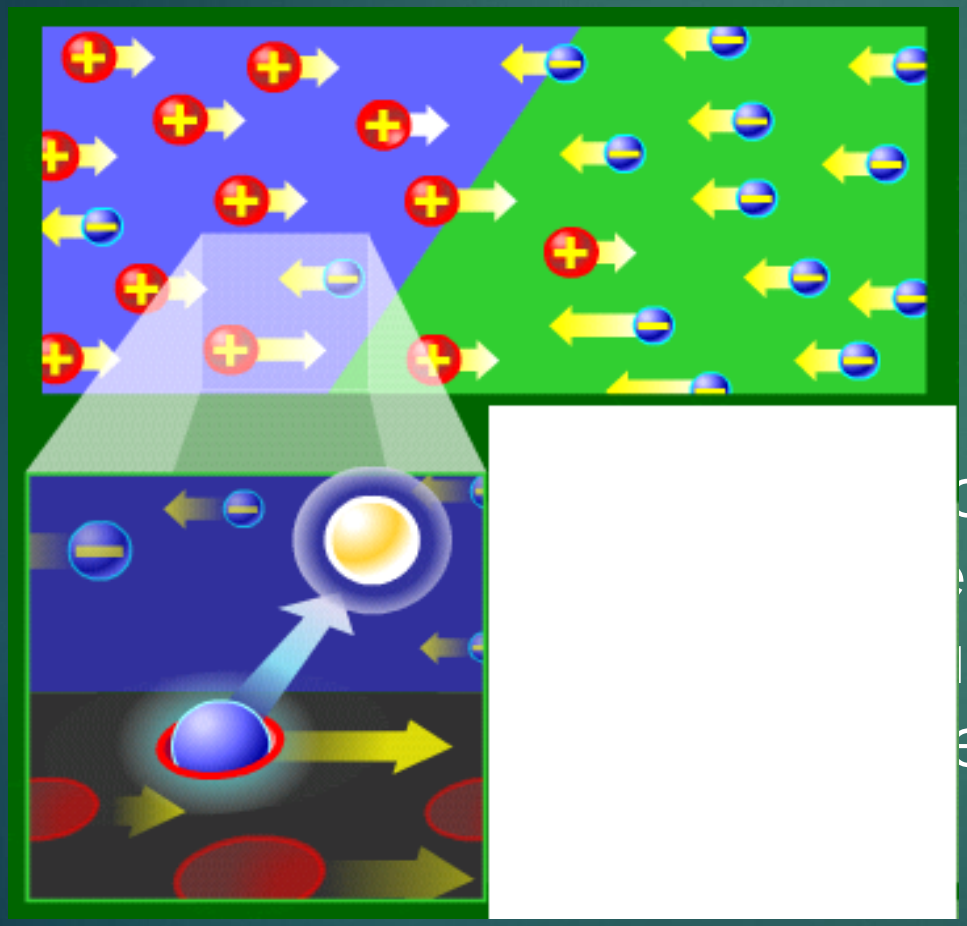
LED: How It Works



- The wholes exist at a lower energy level than the free electrons

when a free electrons
es energy

LED: How It Works



- This energy is emitted in a form of a photon, which causes light

of the light is
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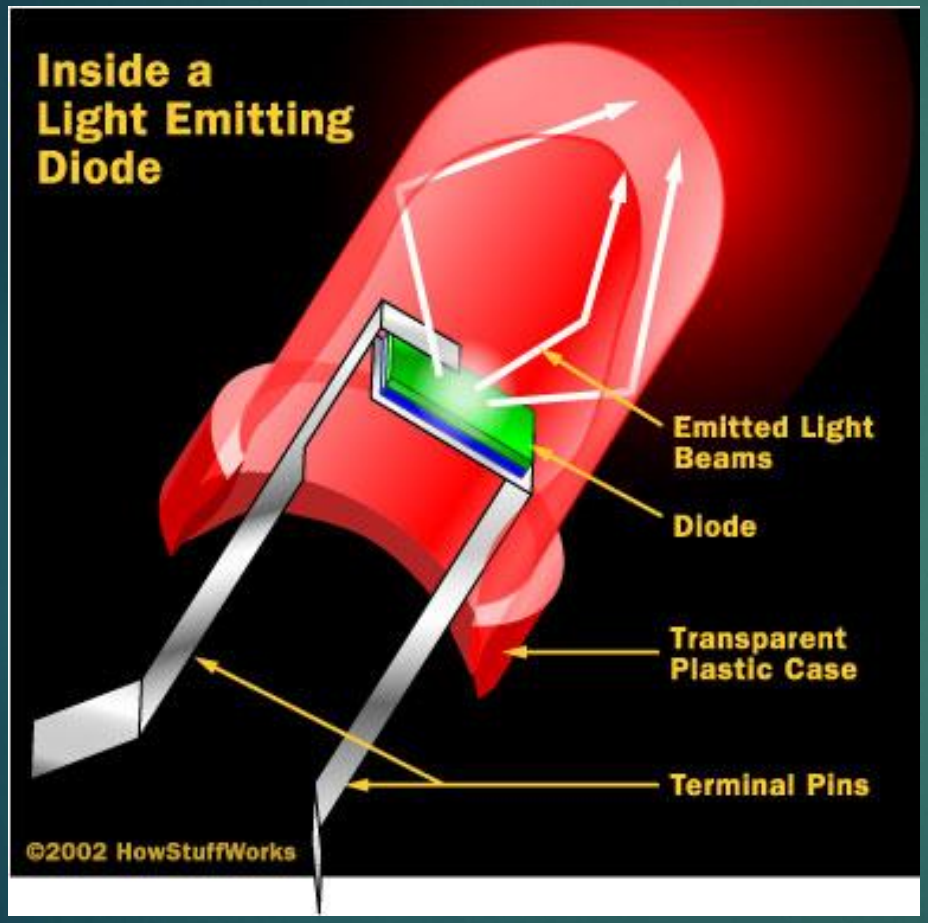
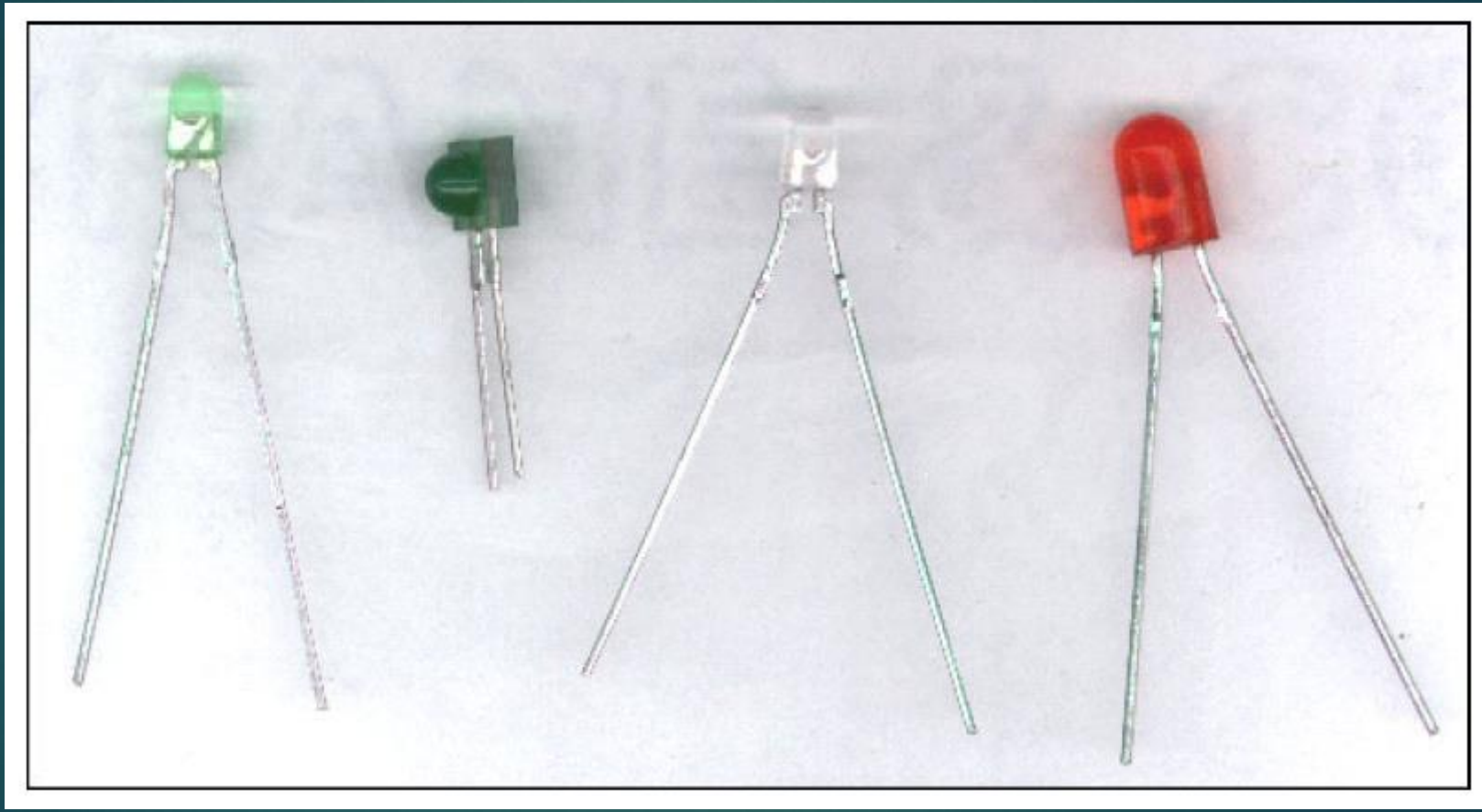
nd hence energy
e photon

Inside a Light Emitting Diode



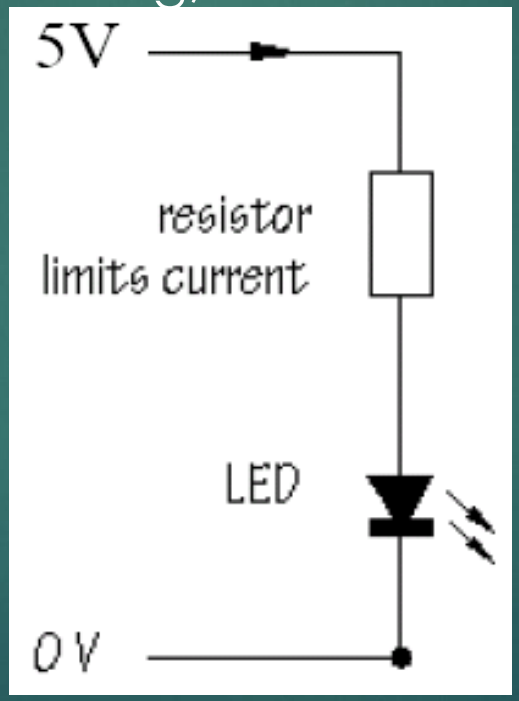
1. Transparent Plastic Case
2. Terminal Pins
3. Diode

Kinds of LEDs

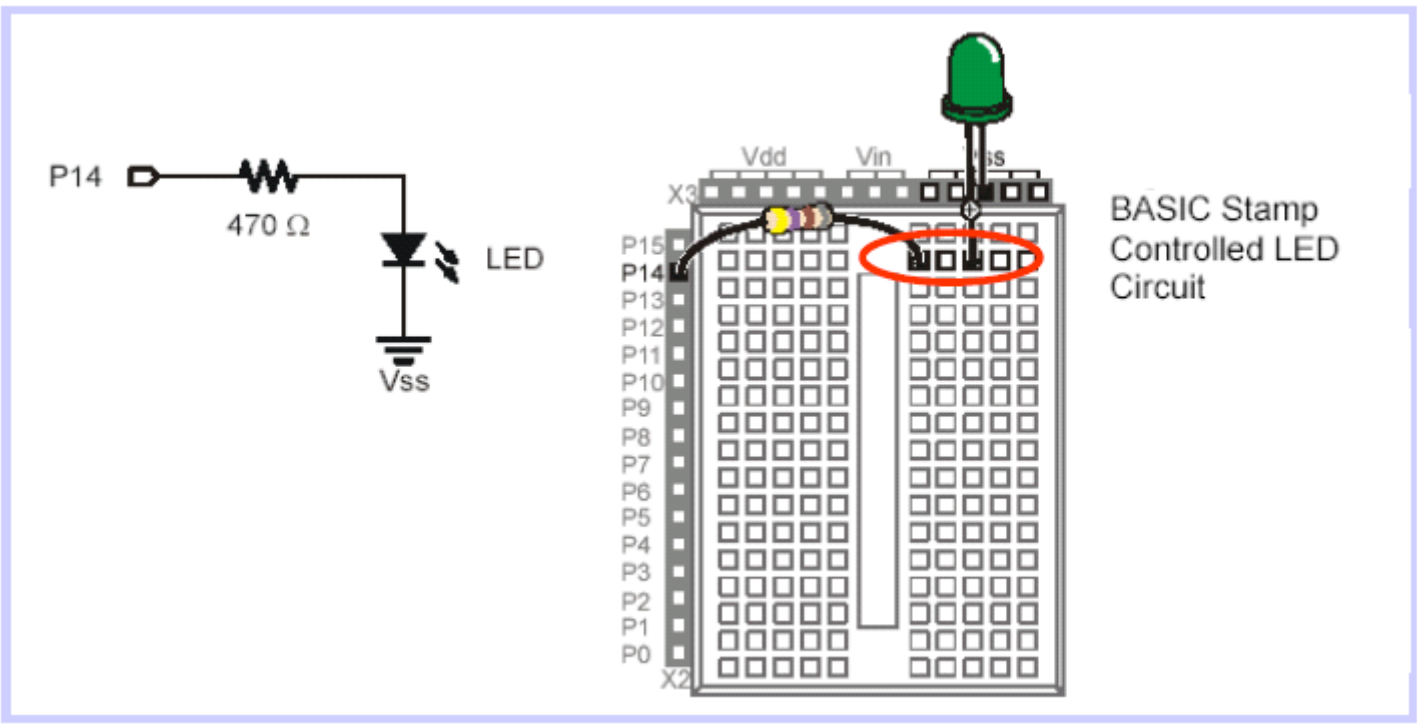


How to Connect a LED:

- Requires 1.5~2.5V and 10 mA
- To prevent overloading, use resistor 470 Ω



How to Connect a LED:



ANTENNA

ANTENNA

- An antenna is an electrical device which converts electric energy into radio waves, and vice versa. It is usually used with a radio transmitter or radio receiver.

- An antenna is a device for sending or receiving electromagnetic waves.

TRANSMITTER ANTENNA

A device that converts sound, light, or electrical signals into radio, microwave, or other electrical signals .

RECIVER ANTENNA

An antenna used to convert electromagnetic waves in to electrical energy.

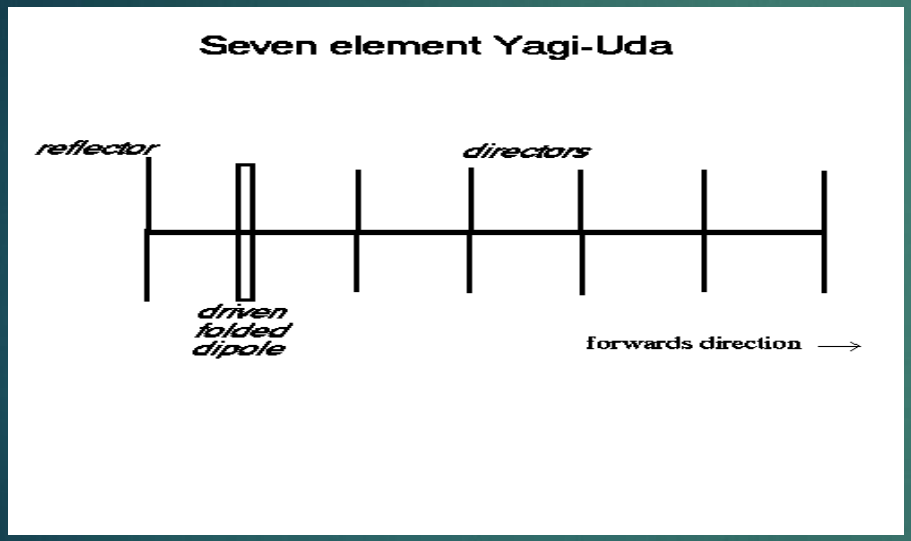
TYPES OF ANTENNA

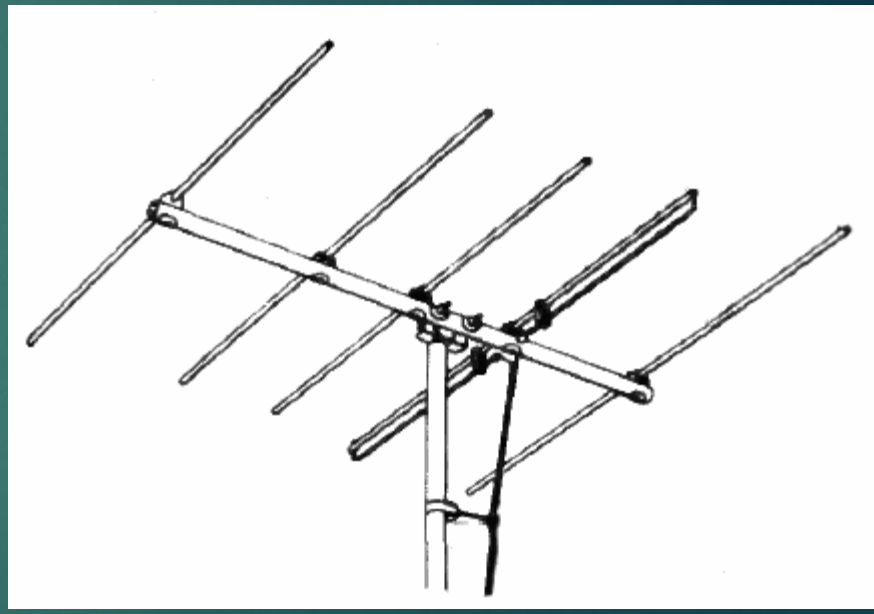
- YAGI – UDA ANTENNA
- LOG – PERIODIC ANTENNA
- HELIX ANTENNA
- PARABOLIC ANTENNA
- LOOP ANTENNA

YAGI – UDA ANTENNA

- Yagi-Uda antenna consist of reflector, director and driven element.
- It is unidirectional antenna.
- Frequency range – 300MHz-3GHz

Seven element Yagi – Uda





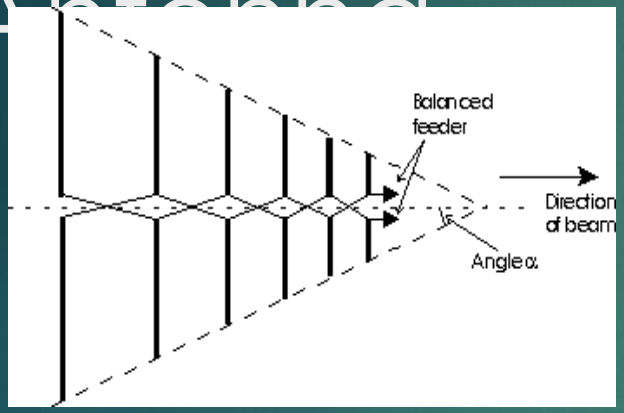
Yagi – Uda advantage

- High gain and good front to back ratio.
- It has narrow bandwidth.
- It is fixed frequency device.
- Grater directivity due to director and reflector.

Log - periodic antenna

- A unidirectional antenna in which the length and spacing of the elements increase logarithmically from one end to the other.
- It is frequency-independent antenna.
- Frequency range – VHF and UHF band.

Log – Periodic Antenna



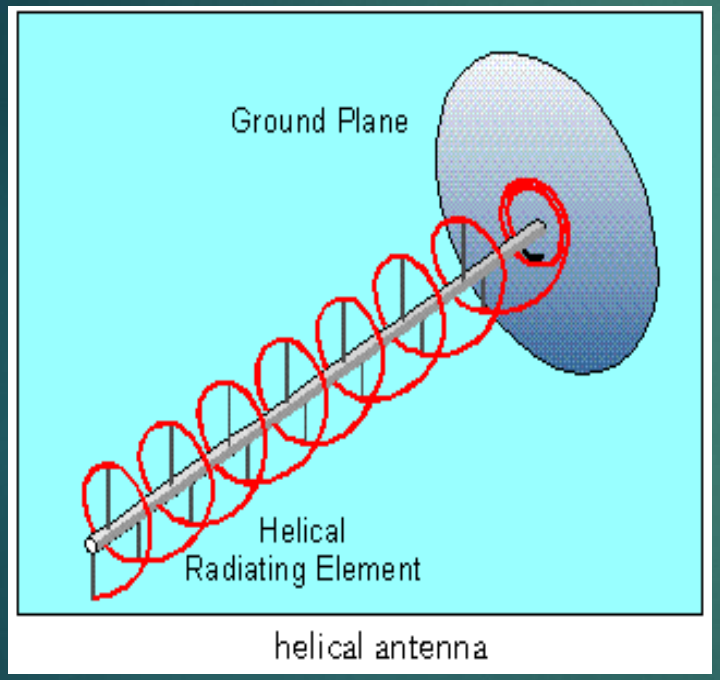
Advantages

- It is broadband antenna.
- It is unidirectional antenna.
- It is frequency independent antenna.

HELIX ANTENNA

- A conducting wire in the form of screw thread fed by power source.
- The feed line is connected between the bottom of the helix and the ground plane.
- Helix antenna is Omni directional.
- Frequency range – VHF and UHF band.

Helix Antenna



helical antenna

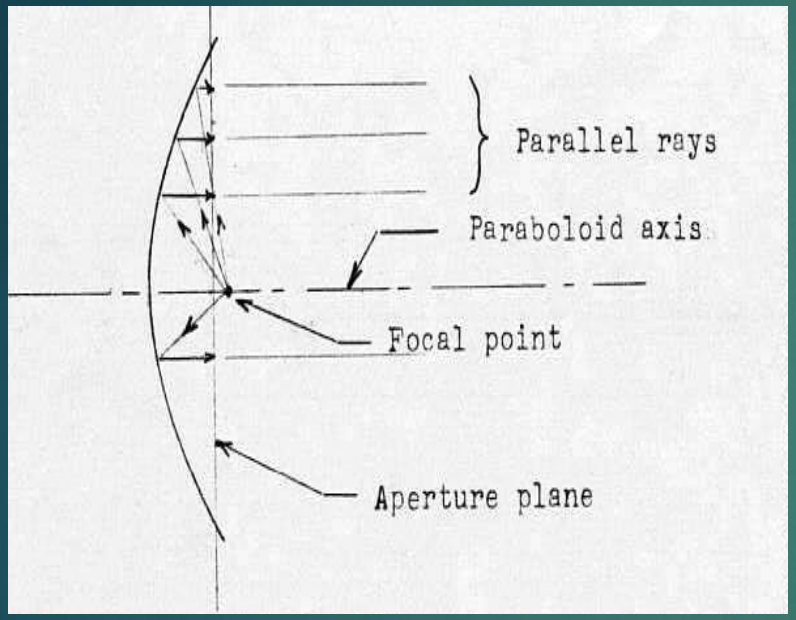
Application

- Satellite communication.
- Space communication & space probes.
- For telemetry applications.

PARABOLIC REFLECTOR ANTENNA

- This is used to convert spherical wave into plane wave
- The feed antenna is called primary antenna and reflector is secondary antenna.
- Frequency range - 3GHz-30GHz

Parabolic Reflector



Application

- Radar communication.
- Satellite communication.

LOOP ANTENNA

- A directional-type antenna consisting of one or more complete turns of a conductor.
- It determine the direction of arrival of radio signals.
- Frequency range – 500-1600KHz.

Loop Antenna

Application

- Direction finding of signal propagation.
- Radio(AM/FM)reception.
- Long distance point to point communication.

LCD

Introduction

- A Liquid Crystal Display (LCD) is a thin , flat panel display device used for electronically displaying information such as text ,images and moving picture.
- LCD is used in Computer monitors, Televisions , Instrument panels, Gaming devices etc.
- Polarization of lights is used here to display objects.

Why LCD ?

- **Smaller size** —LCDs occupy approximately 60 percent less space than CRT displays an important feature when office space is limited.
- **Lower power consumption—**LCDs typically consume about half the power and emit much less heat than CRT displays.
- **Lighter weight** —LCDs weigh approximately 70 percent less than CRT displays of comparable size.
- **No electromagnetic fields** —LCDs do not emit electromagnetic fields and are not susceptible to them. Thus, they are suitable for use in areas where CRTs cannot be used.
- **Longer life** —LCDs have a longer useful life than CRTs.

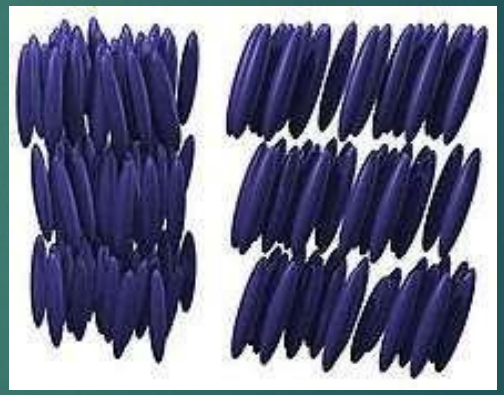
Liquid crystals

- Liquid crystals are liquid chemicals in a state that has properties between those conventional liquid and solid crystals. That is a liquid crystal may flow like a liquid, but its molecules may be oriented in a crystal like way.
- Liquid crystals molecules can be aligned precisely when subjected to electric fields, as like as in the way metal shavings line up in the field of a magnet. When properly aligned, the liquid crystals allow light to pass through.

Liquid crystals

- Two liquid crystal materials which are important in display technology are nematic and smectic.

Nematic phase



smectic phase

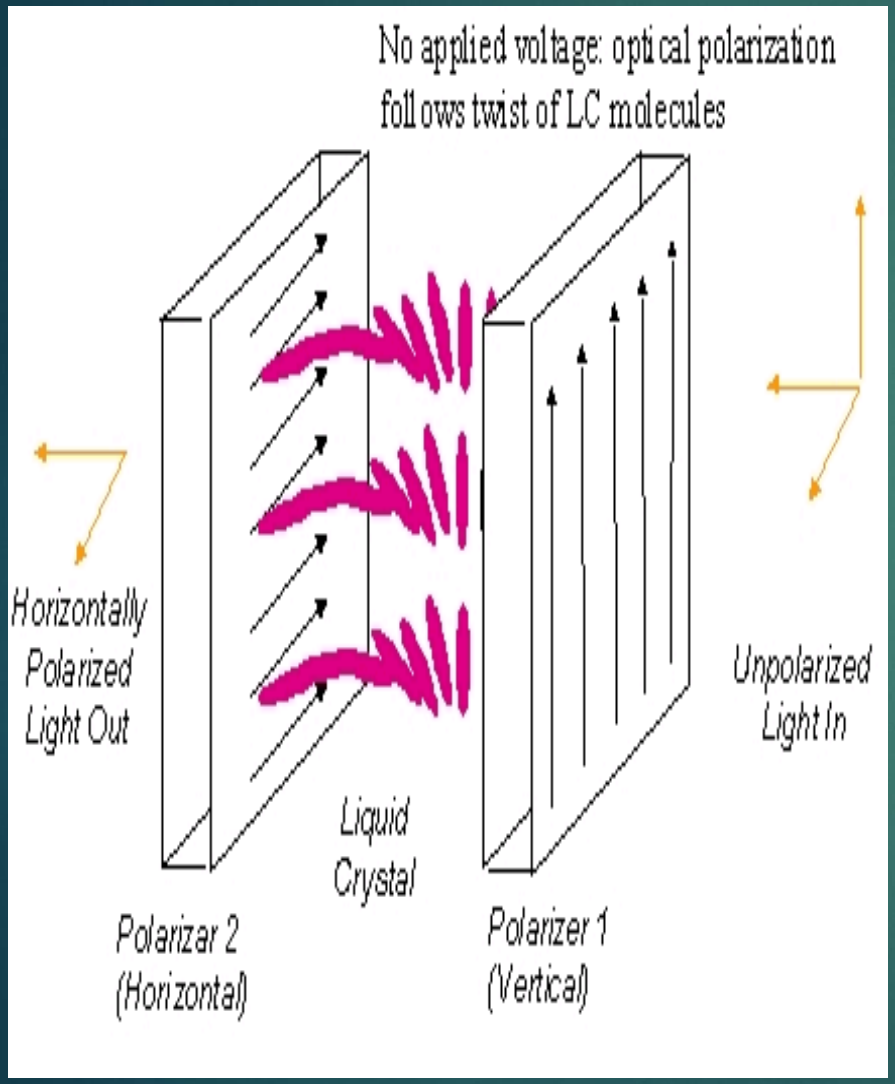
Liquid crystals

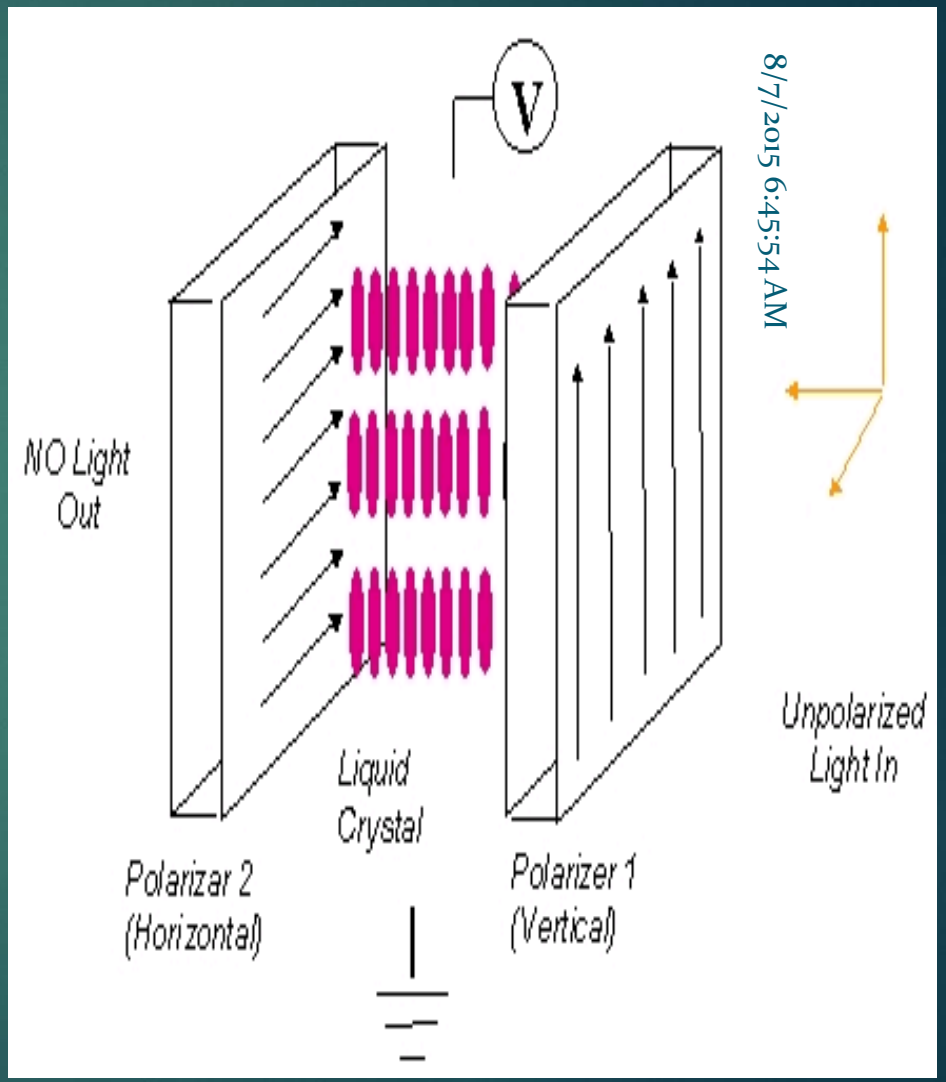
- The most popular liquid crystal structure is the nematic liquid crystal(NLC). When they are in a nematic phase, liquid crystals are a bit like a liquid: their molecules can move around and shuffle past one another, but they all point in broadly the same direction.
- The liquid is normally transparent, but if it is subjected to a strong electric field, ions move through it and disrupt the well ordered crystal structure, causing the liquid to polarise and hence turn opaque. The removal of the applied field allows the crystals structure to reform and the material regains its transparency.

How LCDs work

- Liquid crystals can adopt a twisted up structure and when we apply electricity to them, they straighten out again. This is the key how LCD displays turn pixels on and off.
- The polarization property of light is used in LCD screen to switch its colored pixels on or off. At the back of the screen, there is a bright light that shines out towards the viewer. In front of this, there are the millions of pixels, each one made up of smaller areas called sub-pixels, that are colored Red, Green, or Blue.

LCD working





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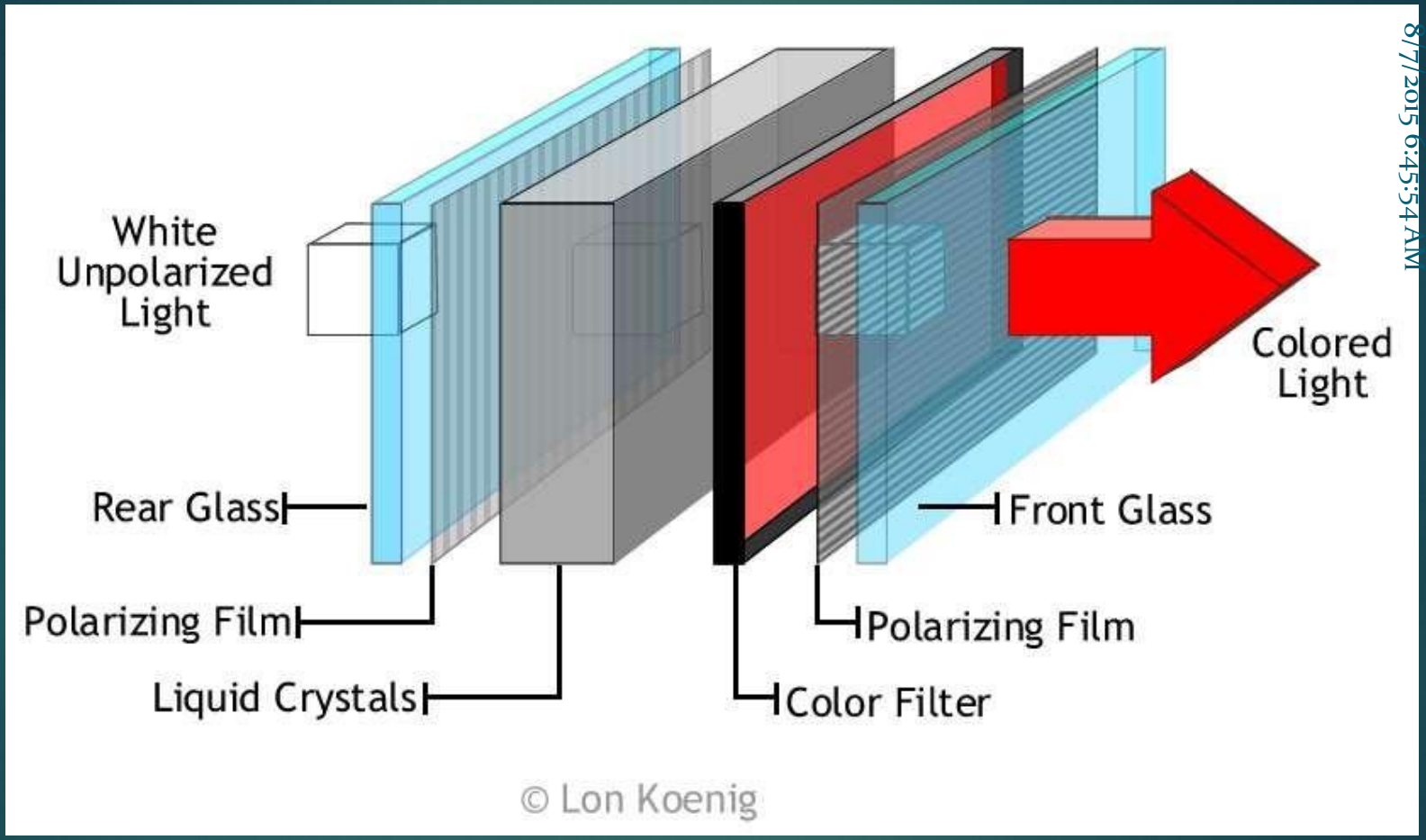
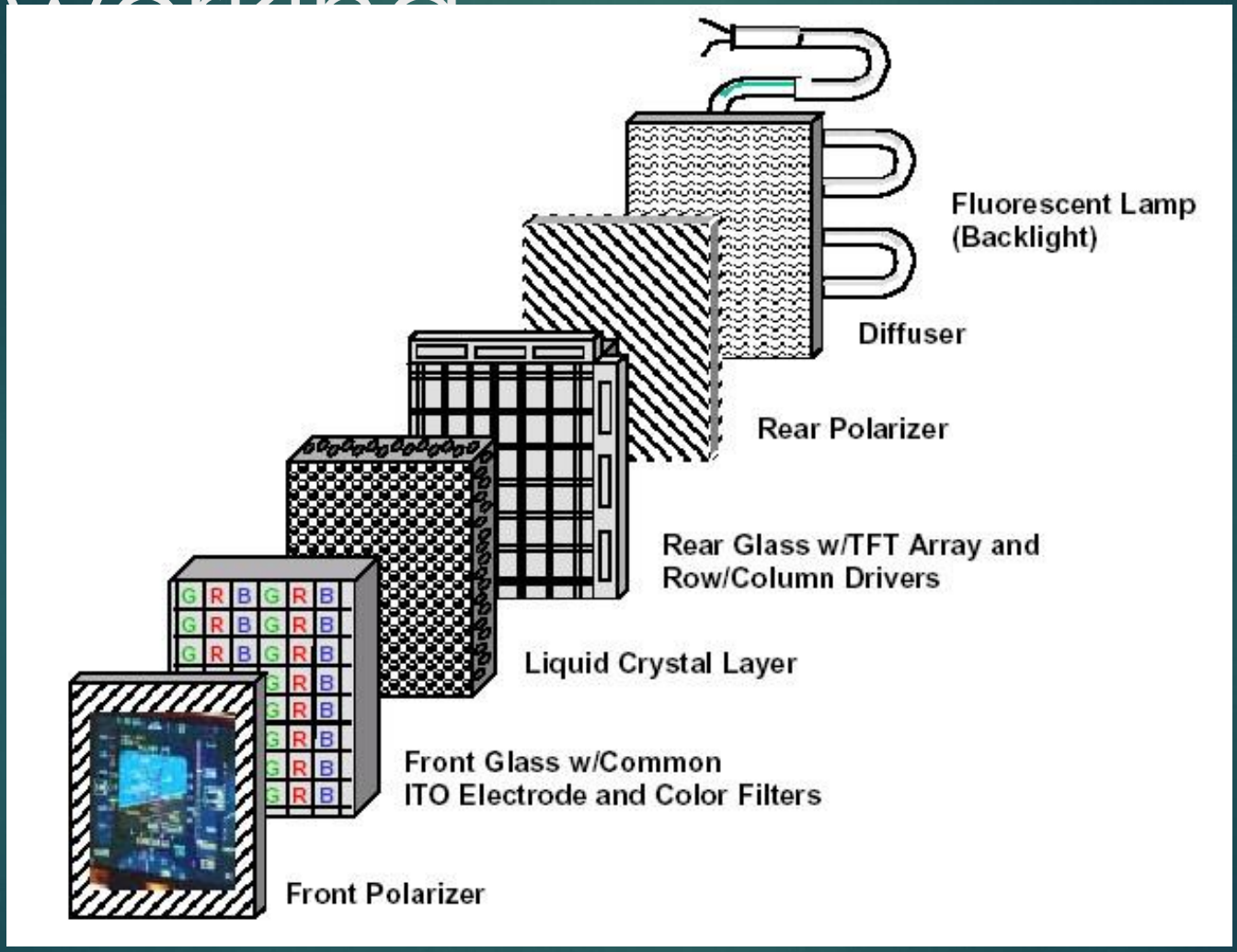
LCD working

- Each pixel has a polarizing glass filter behind it and another in front of it at 90 degrees. Normally the pixels looks dark.
- In between the two polarizing filters there is a tiny twisted, nematic liquid crystal that can be switched on or off electronically.
- When it is switched on, it rotates the light passing through it through 90 degrees, effectively not allowing light to flow through the two polarizing filters and making the pixel look dark.
- Each pixel is controlled by a separate transistor that can switch it on or off many times each second.

LCD working



LCD working

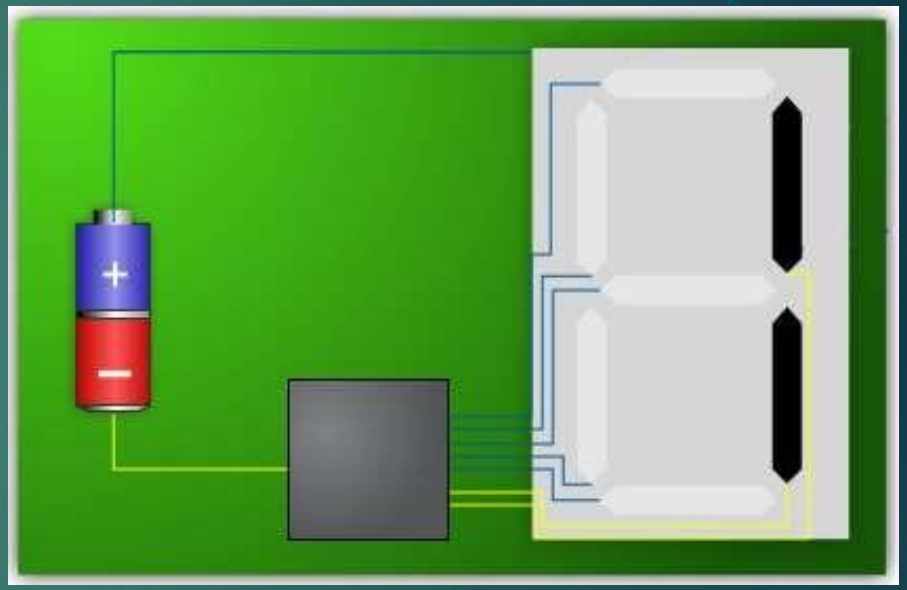


Types of LCD

- Direct Address Display
- Passive Matrix Display
- Active Matrix Display

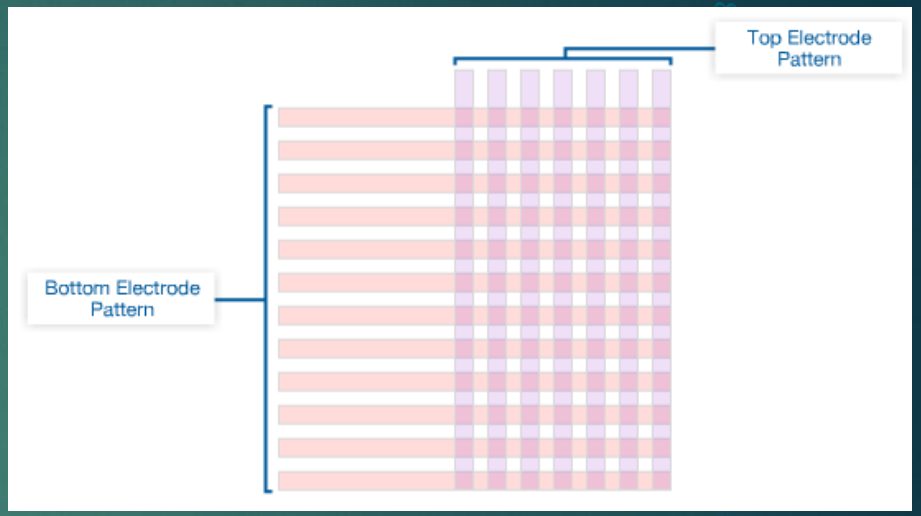
Direct Address Display

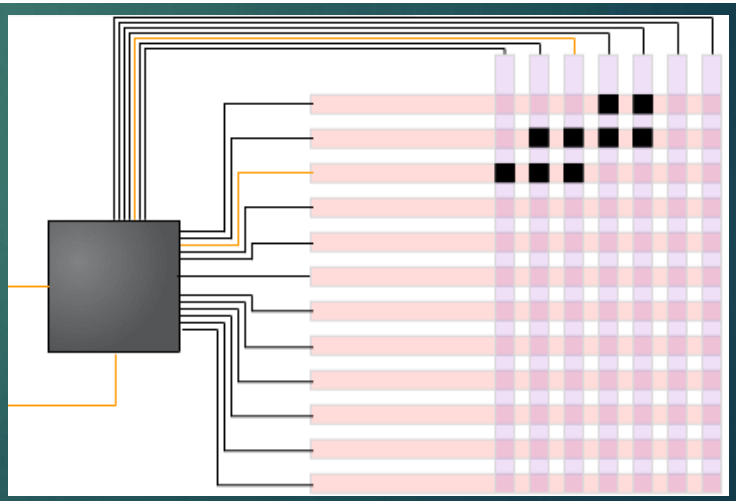
- When the display include limited variable components such as
  - Watches
  - Calculators
- Simple electronics is used to control the components



Passive Matrix Display

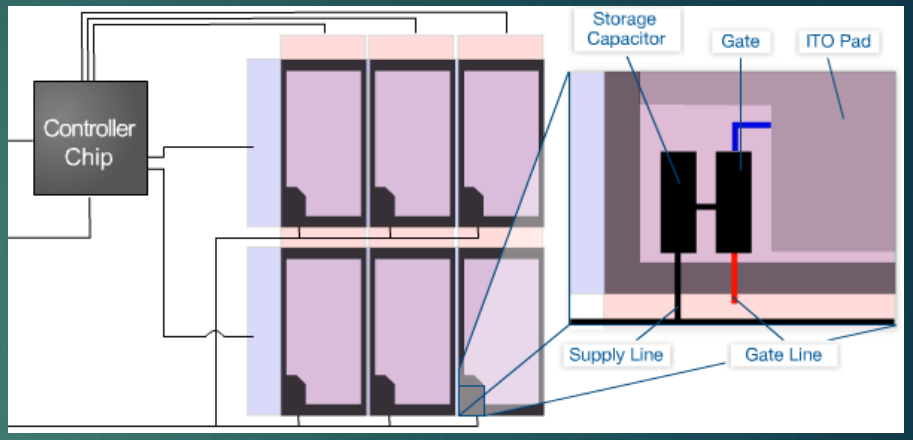
- Passive matrix display has
  - Rows of electrodes on one piece of glass.
  - Columns of electrodes on the opposing piece of glass.
  - Complex electrical waveform control the voltage differential at the intersection of the electrodes.
- The intersection of the columns and rows are the pixels





Active Matrix Display

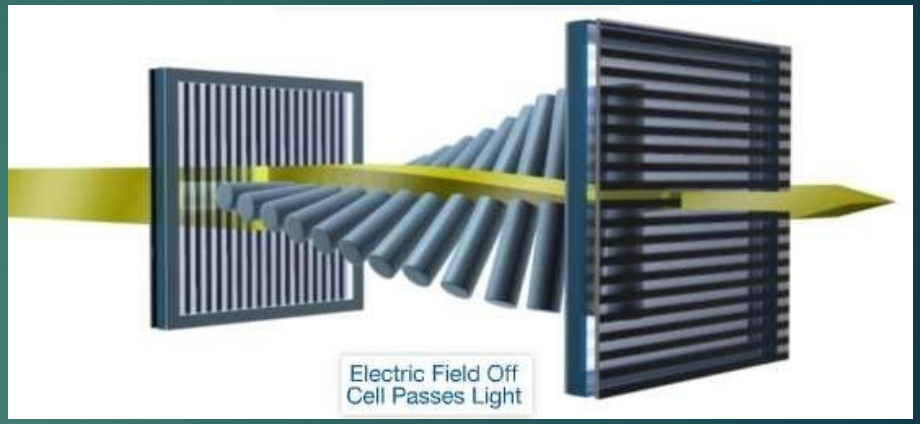
- Allow very high resolution
- Each sub-pixel is individually controlled by an isolated thin-film transistor (TFT).
- It allows the electrical signal for each sub-pixel to avoid influencing adjacent elements.
- The TFT is patterned into the glass layer



A display with 1024x768 resolution
Include 1024x768x3
= 2,359,296 sub-pixels

Twisted Nematic (TN) Display

- Is the most common LCD Display.
- The two alignments layer for the liquid crystal material are orthogonal.
- The light entering the polarize panel rotates by the twist in the liquid crystal and allowing it to pass through the second polarize



MAGNETIC TAPE

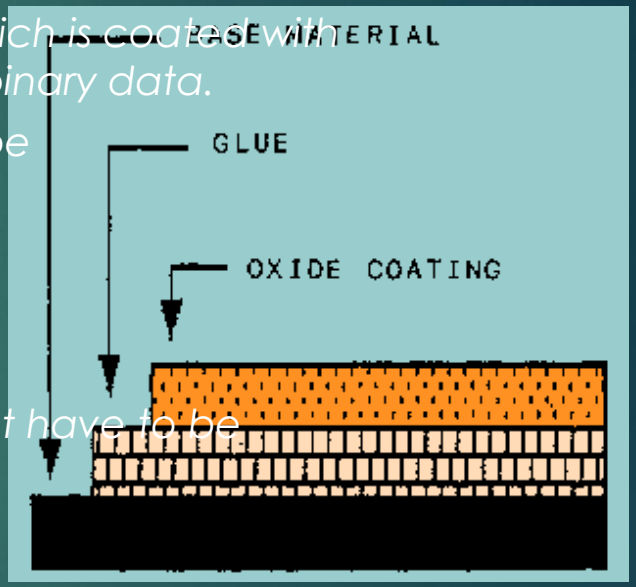
Here are some images of Magnetic tape:

Magnetic tape:

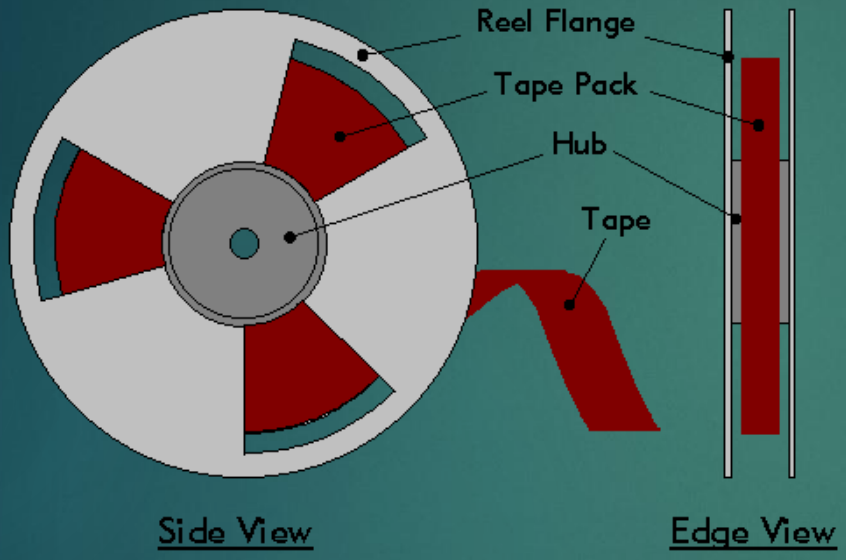
- *Consists of a thin ribbon of plastic, one side of which is coated with a material that can be magnetized to record a binary data.*
- *A* **sequential** *storage media Usually cartridge type*
- *Serves as a primary means of*
- *= backup*

  = a method of transferring data between system

  = a cost effective way to store data that does not have to be accessed immediately



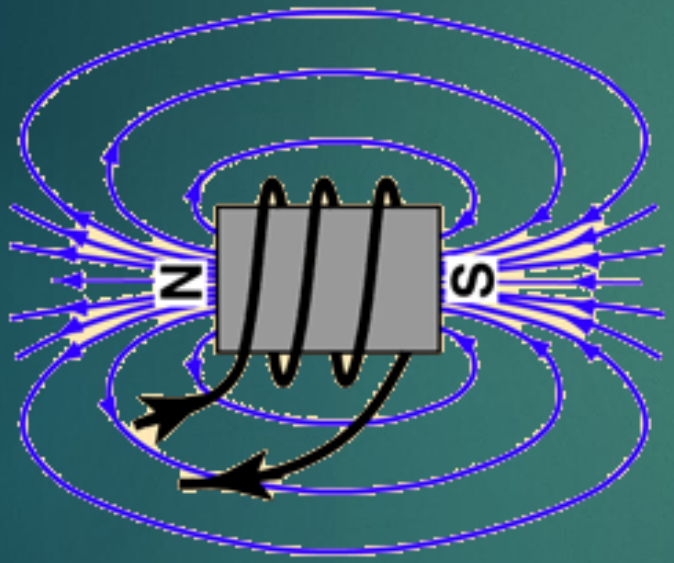
Construction:



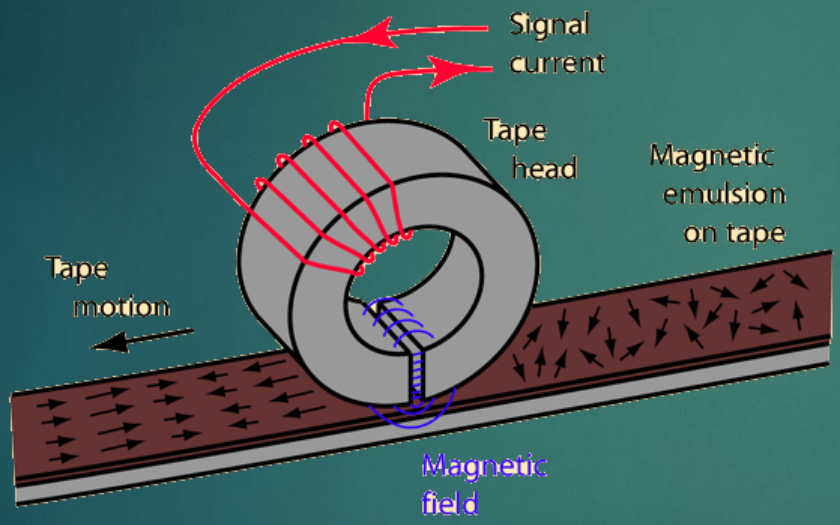
- *It consists of a circular disc type structure around which the* **Reel** *is wrapped.*

- **LENGTH AND WIDTH OF MAGNETIC TAPE**: THE MAGNETIC TAPE IS COMMONLY 732M LONG BY *LENGTH AND 22MM BY WIDTH.*
- **Magnetic materials**: *The one side of the tape is coated with magnetic material. The magnetized dot represents 1 and demagnetized dot represents 0.*
- **Channels or tracks**: *The tape is divided width-wise in rows. These rows are called tracks or channels.*
- **Frames**: *The vertical divisions of a tape along with length are called frames.*
- **Storing capacity**: *The storing capacity of the magnetic tape is 500MB, 2GB, 10GB and more*
- **Records and blocks**: *The group of data stored and arranged in tape is called records. A group of records is called block*
- **IGB(Inter Block Gap)**: *The gap between two consiquiting block is called IGB.*

Working of Magnetic Tape:



- *An electric current in a coil of wire produces a magnetic field similar to that of a bar magnet, and that field is much stronger if the coil has a ferromagnetic (iron-like) core.*



- *Tape heads are made from rings of ferromagnetic material with a gap where the tape contacts it so the magnetic field can fringe out to magnetize the emulsion on the tape. A coil of wire around the ring carries the current to produce a magnetic field proportional to the signal to be recorded. If an already magnetized tape is passed beneath the head, it can induce a voltage in the coil. Thus the same head can be used for recording and playback*

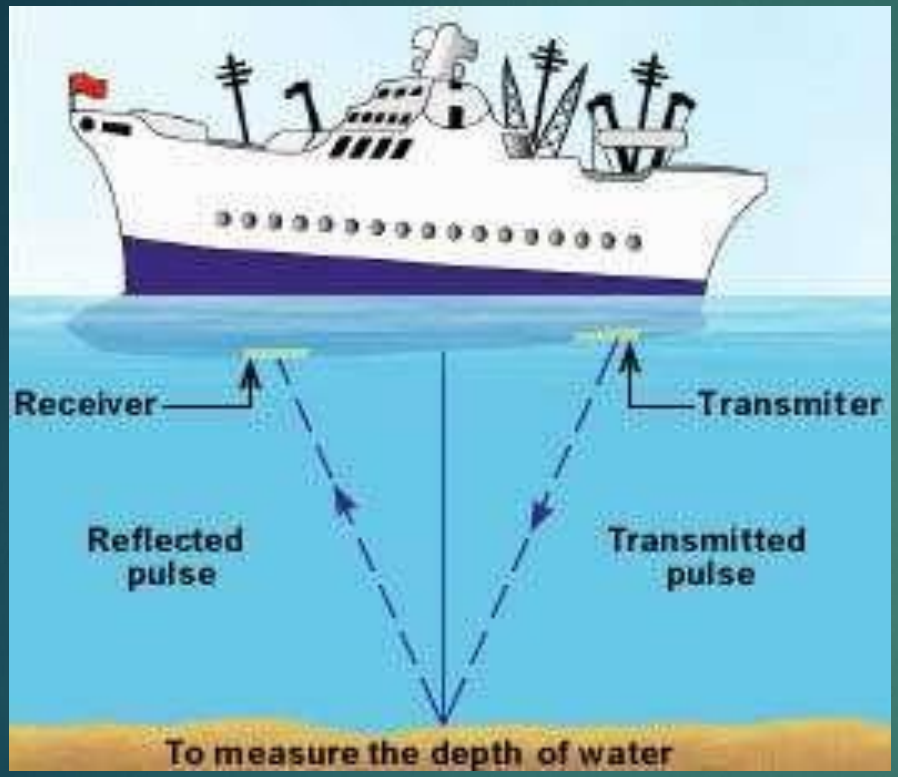
Advantages and Disadvantages:

- *Advantages:*
- *High data storage at cheap rate. Suitable for batch processing.*
- *No complicated software is required for file handling.*
- *Disadvantages:*
- *Slow data transfer rate.*
- *Data are arranged in sequential order, so specific data cannot be retrieved randomly.*
- *Larger in size than floppy so not so easy in handling.*

SONAR

Sonar

- Sonar is a device that is used to detect underwater objects using sound waves.
- In this system a sound pulse is generated and sent underwater through a transmitter.
- sound waves are reflected by the underwater object which are received at receiver.
- The time taken by sound wave to come back is recorded.
- And by knowing the speed of sound wave in water the distance can be easily calculated by formula.
- Distance = speed x time


Receiver
Transmiter
Reflected pulse
Transmitted pulse
To measure the depth of water

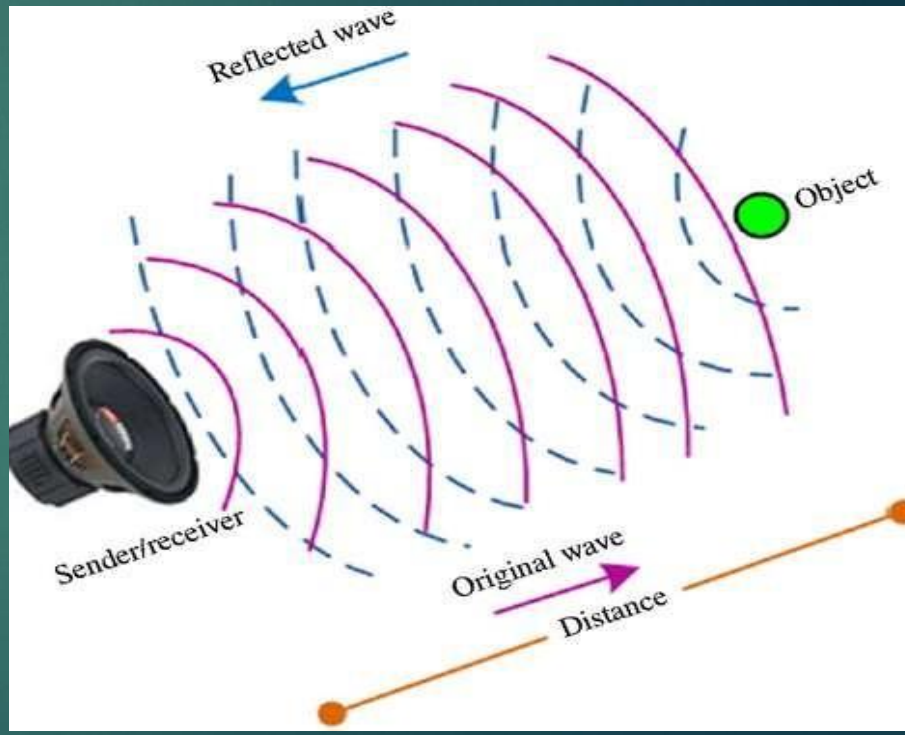
Type of sonar

sonar is of two types:

- Active sonar
- Passive sonar

Active sonar

- Active sonar uses sound transmitter and receiver . And there are 3 modes of operation :
- Monostatic mode
- Bistatic mode
- Multistatic mode

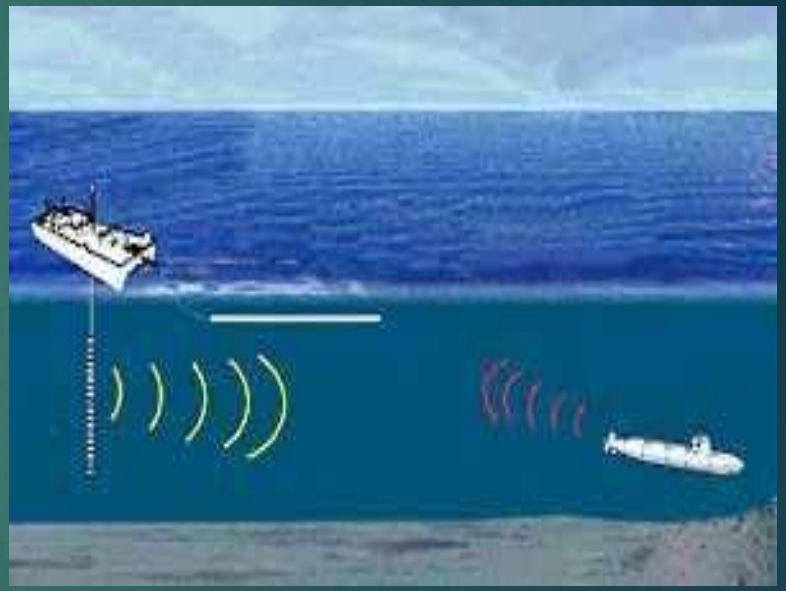


- Monostatic mode : when the transmitter and receiver are at the same place.
- Bistatic mode : when the transmitter and receiver are separated by some distance.
- Multistatic mode : When more transmitters (or more receivers) are used, again spatially separated.

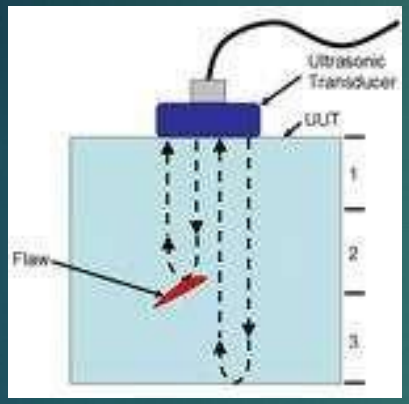
- Most sonars are used monostatically with the same array often being used for transmission and reception.
- Active sonar creates a pulse of sound, often called a "ping", and then listens for reflections (echo) of the pulse.
- This pulse of sound is generally created electronically using a sonar projector consisting of a signal generator, power amplifier and electro-acoustic transducer/array.
- To measure the distance to an object, the time from transmission of a pulse to reception is measured and converted into a range by knowing the speed of sound.
- To measure the bearing, several hydrophones are used, and the set measures the relative arrival time to each.

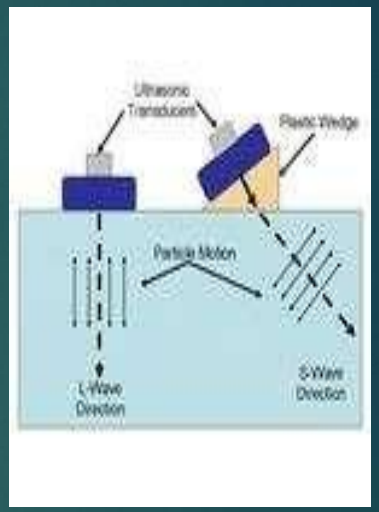
Passive sonar

- Passive sonar listens without transmitting.
- Passive sonar has a wide variety of techniques for identifying the source of a detected sound.
- Passive sonar system have large sonic database but sonar operator classify signals by use of computer and use these databases to identify classes of ships and action.



ULTRASONIC TRANSDUCER





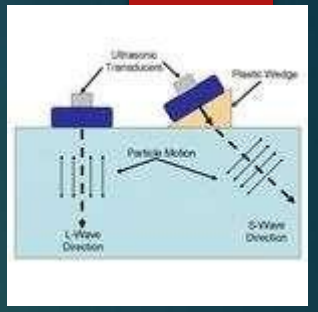
ULTRASONIC TRANSDUCERS

The devices that use ultrasonic waves for the measurement of certain parameters are called as the ultrasonic transducers.

What are Ultrasonic Waves?

- The ultrasonic waves frequency lies above 20 Khz, which is above the band of frequency that human beings can hear. The speed of transmission of ultrasonic waves depends on the media through which they are passing. In most of the cases where ultrasonic waves are used in the instruments, the waves have to travel through the air.

Working



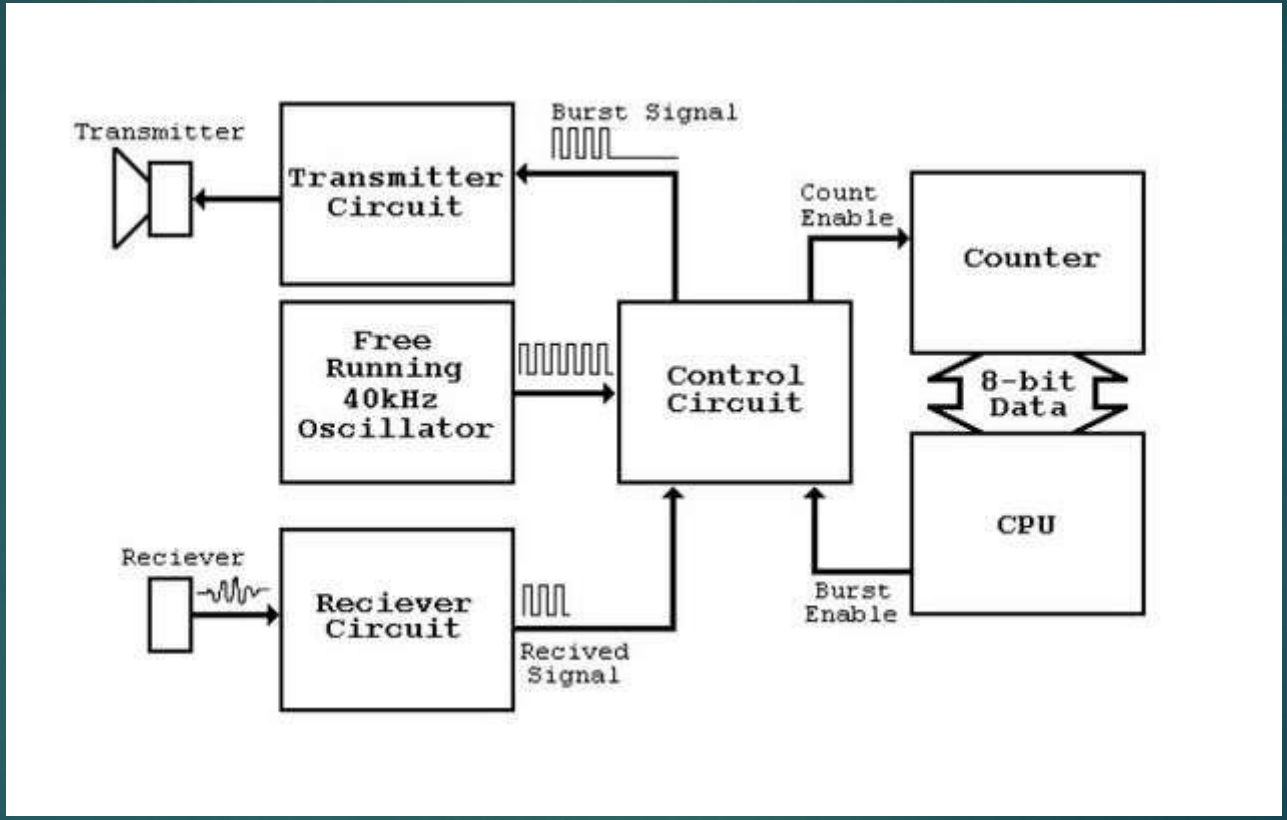
- The measurement devices using the ultrasonic waves comprise of the two major parts. One part of the device transmits the ultrasonic waves and the other part of the devices receives the ultrasonic waves.
- The devices transmitting and the receiving the ultrasonic waves may be located at the two opposite ends. In some cases the transmitting and the receiving devices are located at the same end and on the same side.

- No matter what the arrangement of the transmitting and the receiving device is, there is a timer that measures the time difference between the sending of the ultrasonic waves and receipt of the ultrasonic waves.
- This time is calibrated against the parameter to be measured. Thus the speed of the ultrasonic waves is an important property based on which the transducers using the these waves work.

- IN SOME ULTRASONIC TRANSDUCERS, INSTEAD OF THE SPEED, THE CHANGE IN THE PHASE OR FREQUENCY OF THE TRANSMITTING AND THE RECEIVING ULTRASONIC WAVES IS USED AS THE BASIS FOR THE MEASUREMENT OF THE PARAMETER.

- THE PIEZOELECTRIC CRYSTAL IS ONE OF THE MOST COMMONLY USED ELEMENTS IN THE ULTRASONIC TRANSDUCERS. IT CAN BE USED AS THE BOTH, TRANSMITTING AS WELL AS THE RECEIVING DEVICE, IN
- The voltage passed through these devices generates the ultrasonic waves.

General functional block diagram



USE

The ultrasonic transducers are used commonly for the measurement of

- flow rates of the fluids
- the level of the liquid
- displacement of the object etc.

Thank You!!!