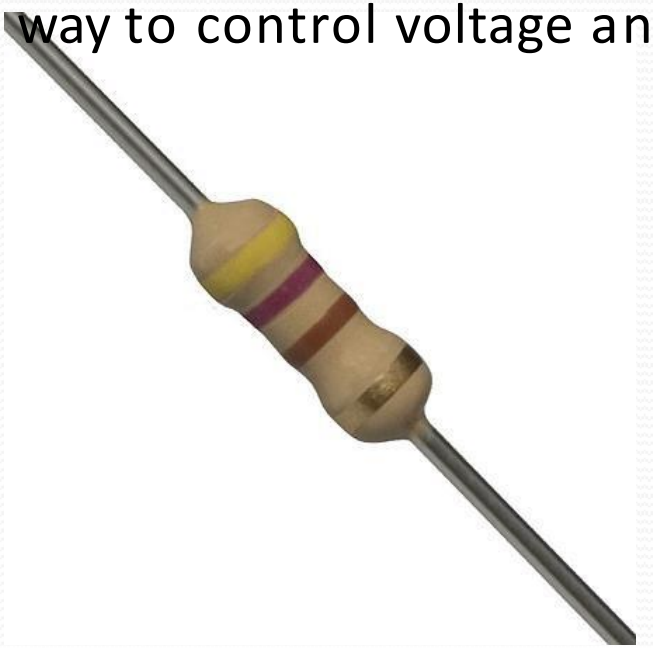
# Basics on Electronics Engineering (ECI 101)

## Basic Electronic Components
## &
## Measuring Instruments

# Resistors

- A resistor impedes the flow of electricity through a circuit.
  - Resistors have a set value.
  - It is a passive component.
  - Since voltage, current and resistance are related through Ohm's law, resistors are a good way to control voltage and

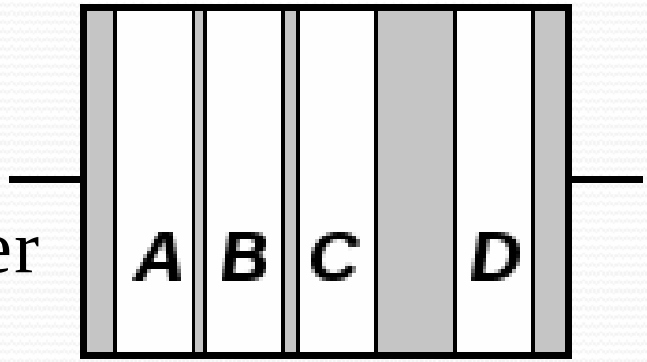
# Resistor color codes

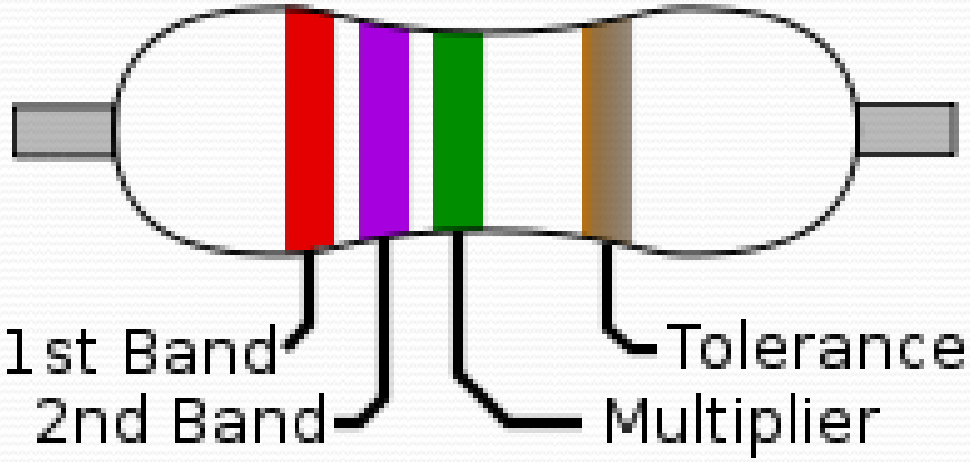
1st band = 1st number

2nd band = 2nd number

3rd band = # of zeros / multiplier

4th band = tolerance



# Color code

B B R O Y of G B has a V G W

0 1 2 3 4 5 6 7 8 9

❖Tolerance: Gold = within 5%

**Black: 0**

**Brown: 1**

**Red: 2**

**Orange: 3**

**Yellow: 4**

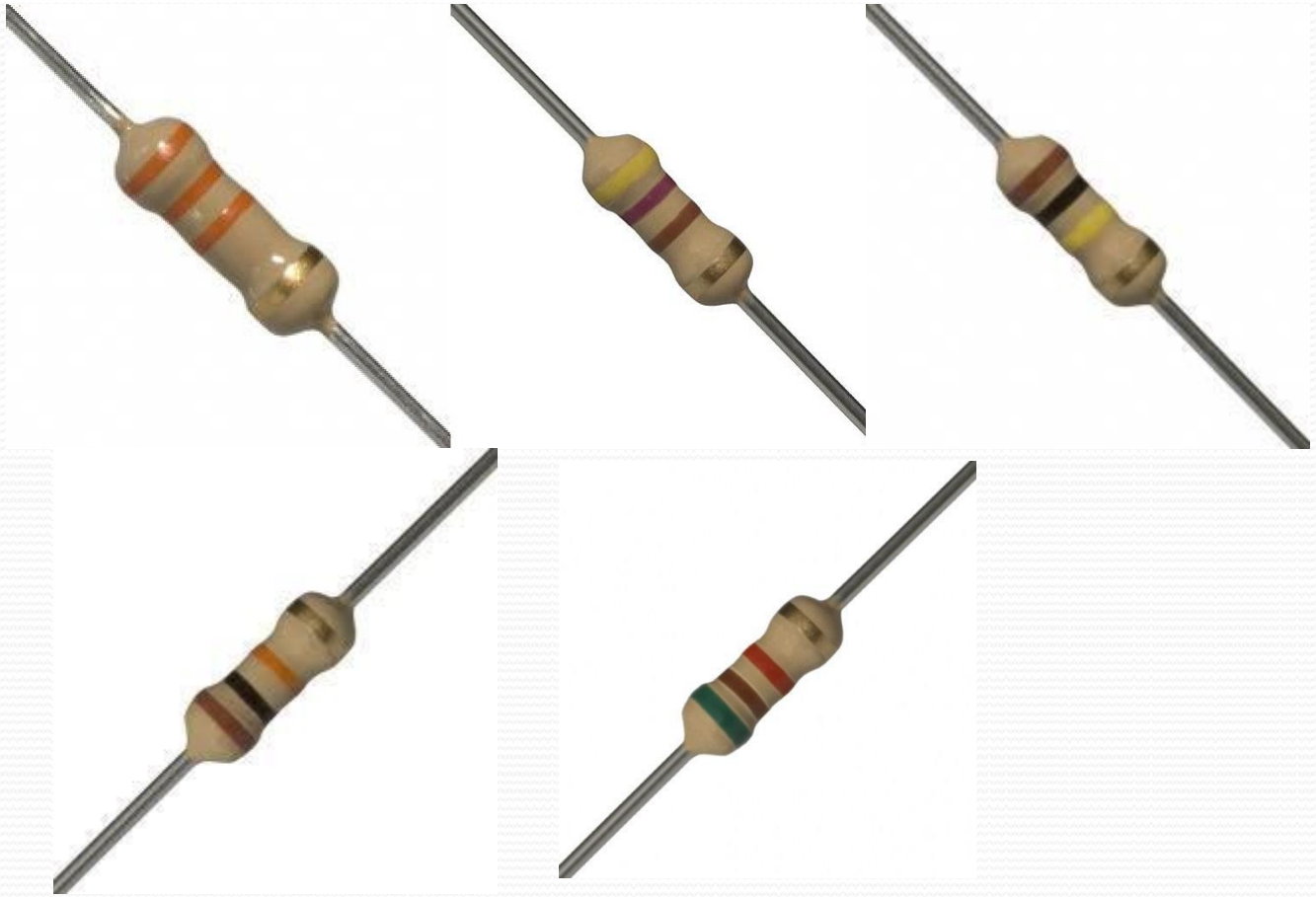
**Green: 5**

**Blue: 6**

**Violet: 7**

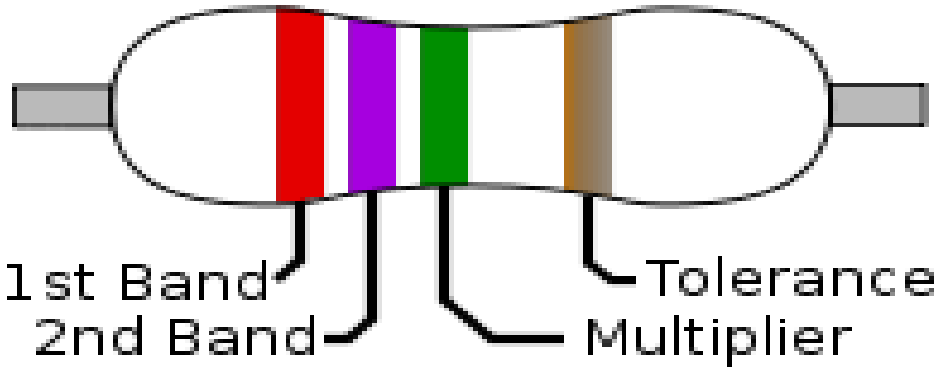
**Gray: 8**

**White: 9**



| Colour | Digit | Multiplier | Tolerance |
|---|---|---|---|
| Black | 0 | 1 | |
| Brown | 1 | 10 | ± 1% |
| Red | 2 | 100 | ± 2% |
| Orange | 3 | 1,000 | |
| Yellow | 4 | 10,000 | |
| Green | 5 | 100,000 | ± 0.5% |
| Blue | 6 | 1,000,000 | ± 0.25% |
| Violet | 7 | 10,000,000 | ± 0.1% |
| Grey | 8 | | ± 0.05% |
| White | 9 | | |
| Gold | | 0.1 | ± 5% |
| Silver | | 0.01 | ± 10% |
| None | | | ± 20% |

# Color Code Example




- $(27 \times 10^7\ ohm) \pm (5\%\ \text{of}\ (27 \times 10^7\ ))$

Tolerance factor

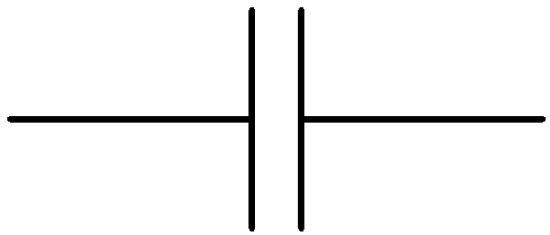
# Capacitors

Capacitor stores electrical energy in the form of electrial charge.

- Capacitance is measured in Farads. The small capacitors usually used in electronics are often measured in microfarads

Value: 103: 10 kilo pF=0.01 µF

| Value in µF | Value in pF | Capacitor Marking |
|---|---|---|
| 0.000001 µF | 1pF | |
| 0.00001 µF | 10pF | |
| 0.0001 µF | 100pF | 101 |
| 0.001 µF | 1000pF | 102 |
| 0.01 µF | 10000pF | 103 |
| 0.1µF | 100000pF | 104 |

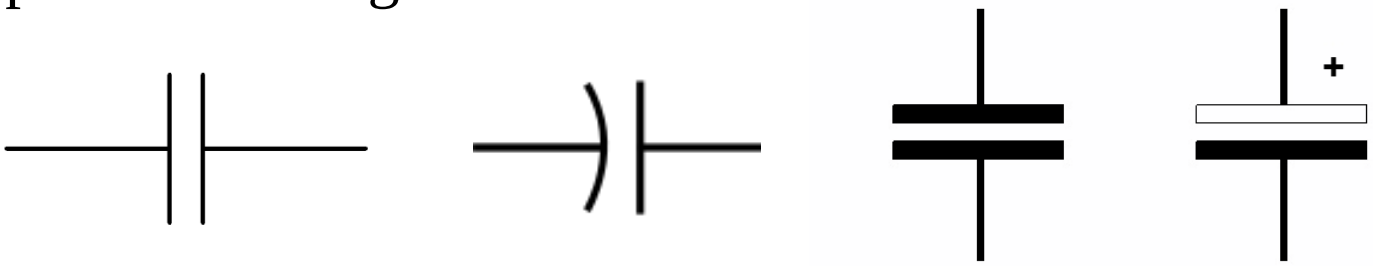



Symbol

# Polarity of capacitors

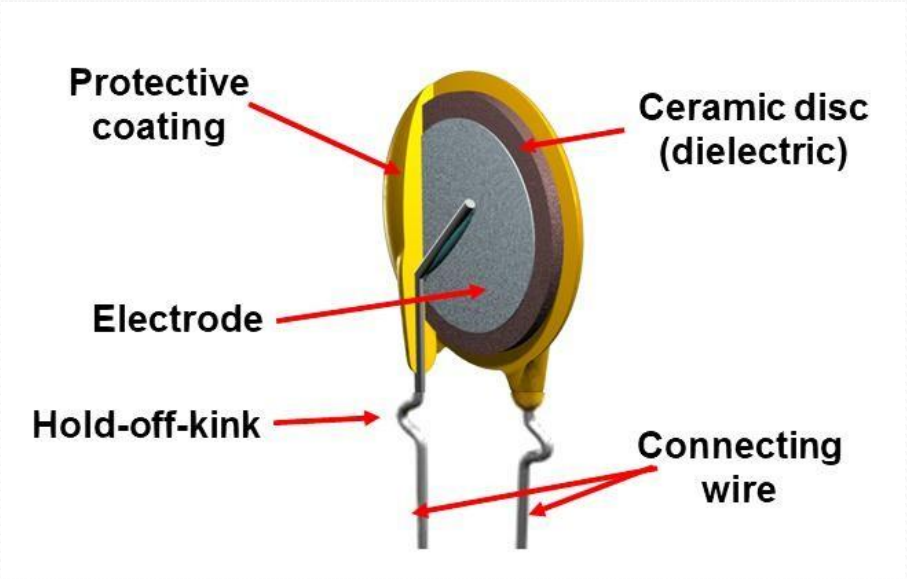
Some capacitors are polarized. Note the different length terminals on one of the capacitors.


- The shorter terminal goes on the negative side.
- The stripe is on the negative terminal side of the capacitor.
- The board is marked for positive or negative.



# Applications of capacitors

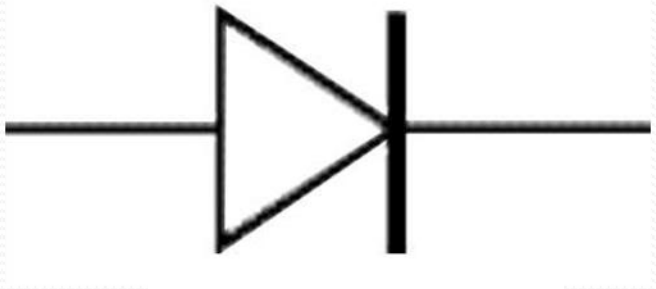
- Capacitors can smooth out a signal – eliminate the ripples or spikes in DC voltage.
  - The capacitor can absorb the peaks and fill in the valleys of a rippled signal.



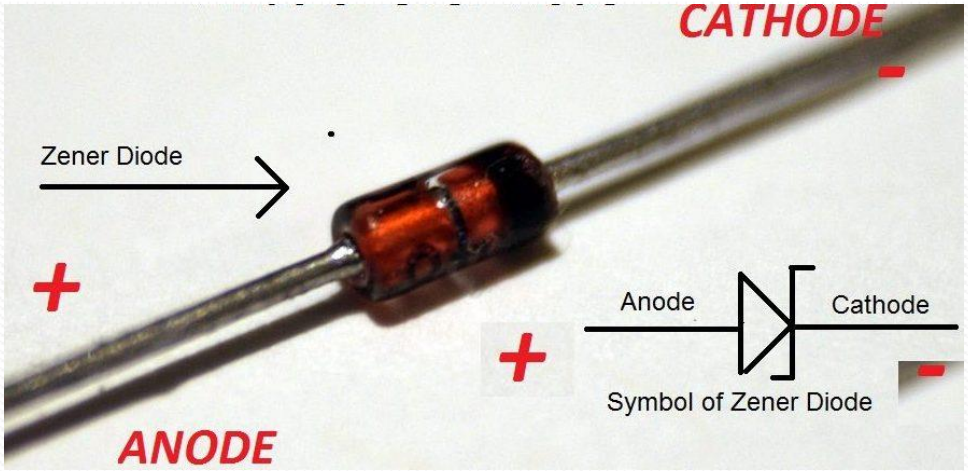
# Diode

- A diode is a one way valve (or gate) for electricity. It is a component with an asymmetrical transfer characteristic. A diode has low (ideally zero) resistance in one direction, and high (ideally infinite) resistance in the other direction.

Rectifier diode



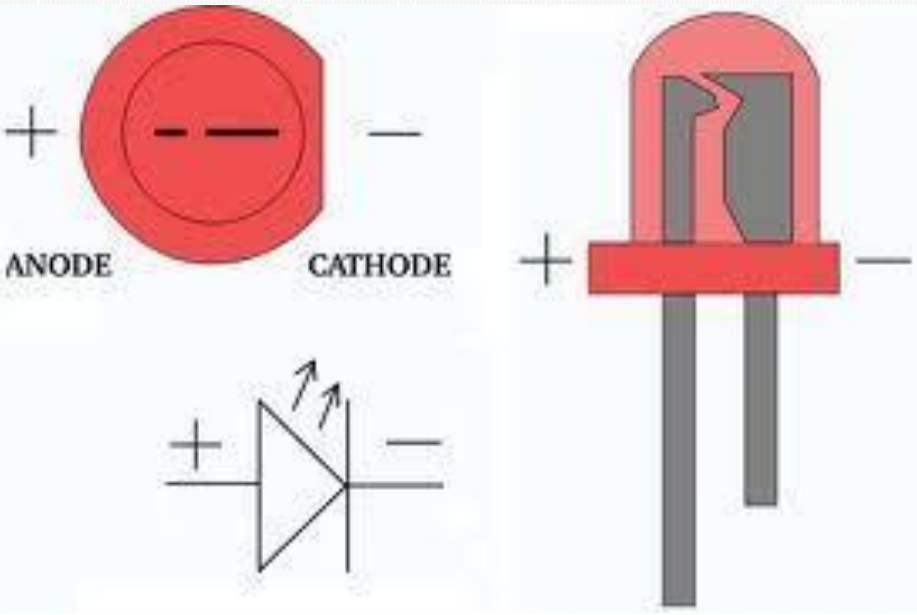
Zener diode




Diodes will protect your electronics.

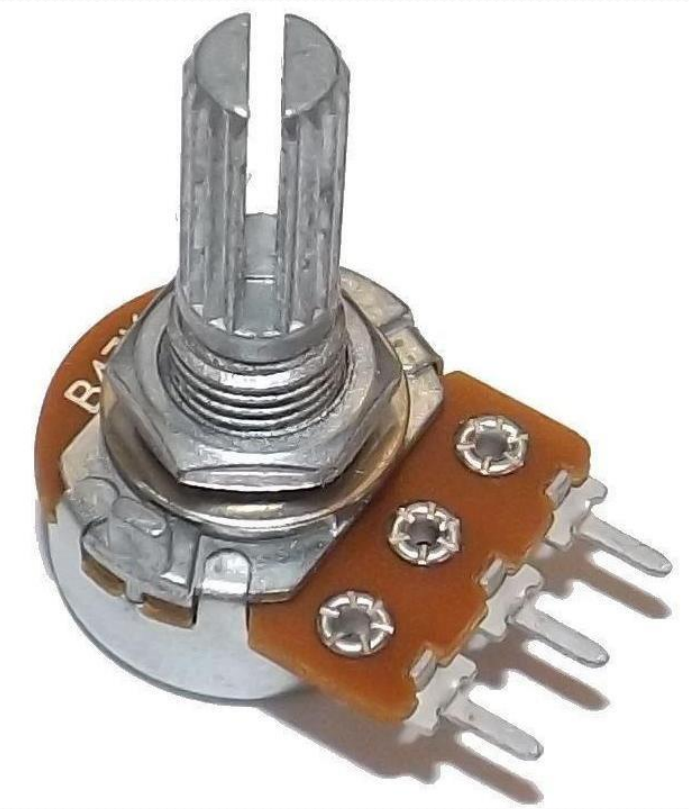
# Light emitting diode(LED)

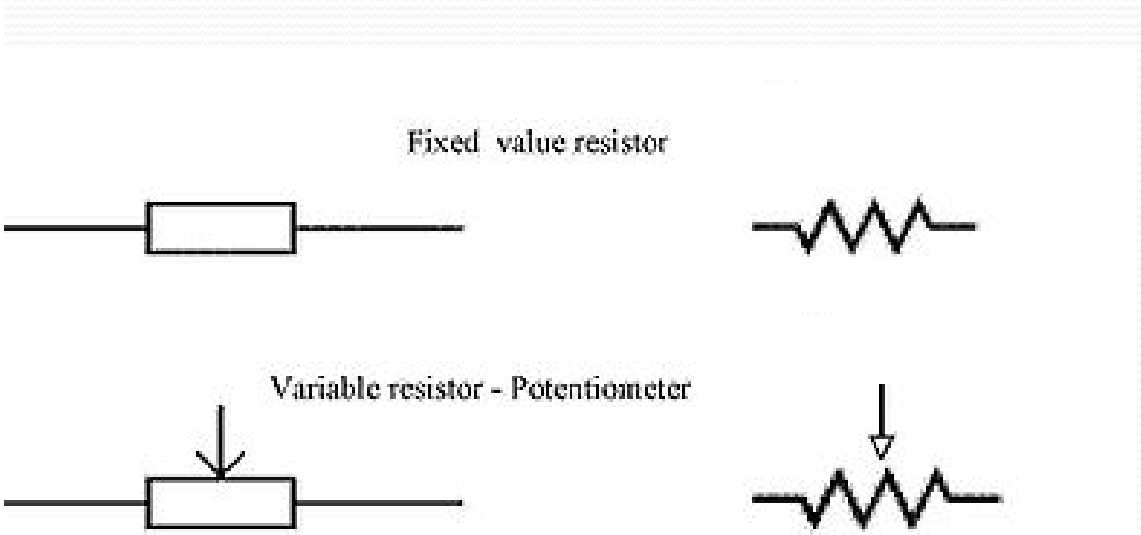
- A light emitting diode (LED) is a semiconductor light source. When electricity is passing through the diode, it emits light.




# Variable resistor / Potentiometer

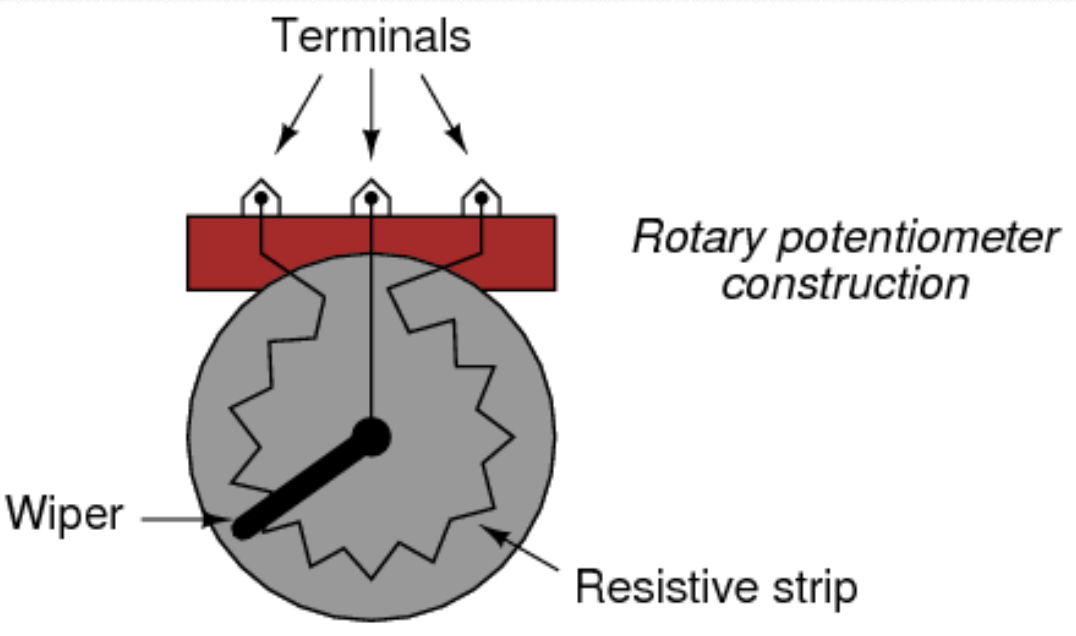
- A potentiometer is a variable resistor. As you manually turn a dial, the resistance changes.



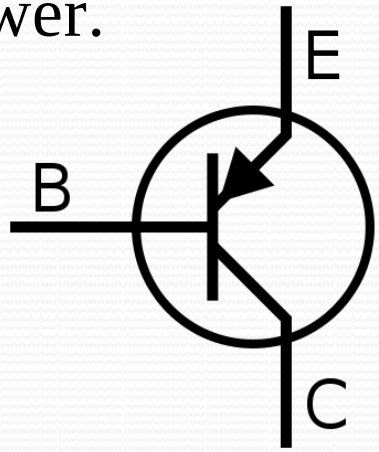


# How a variable resistor works

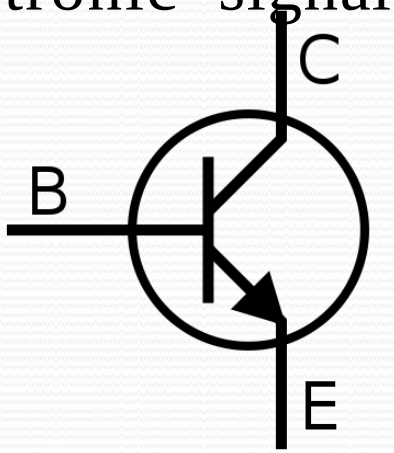
- As the dial/wiper turns, electricity must go through more or less of the resistive strip.
  - So as you turn the dial/wiper, you get a change in voltage



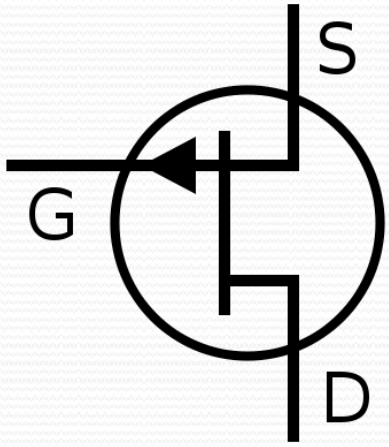
**Transistors:** Transistor is a semiconductor device used to amplify and switch electronic signals and electrical power.



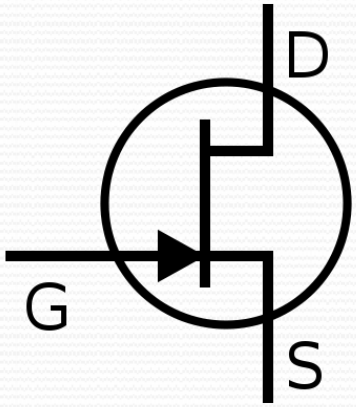

**BJT PNP**




**BJT NPN**

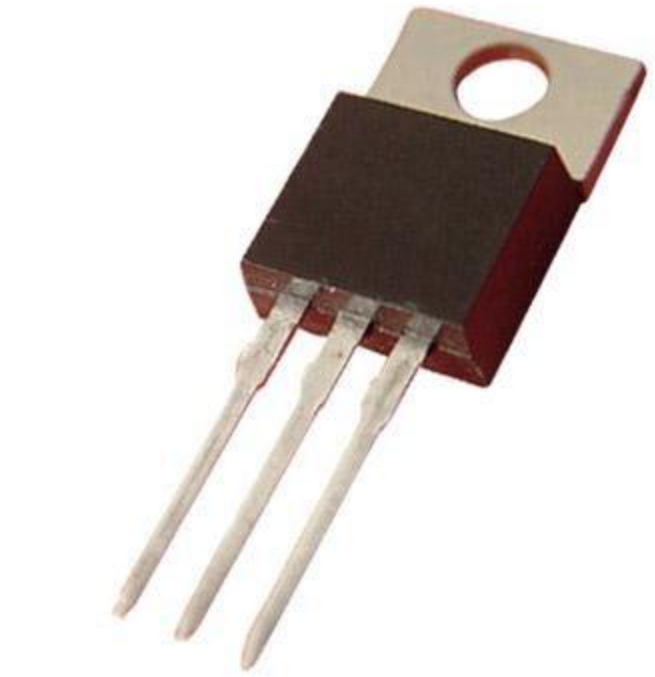



**P-channel FET**




**N-channel FET**

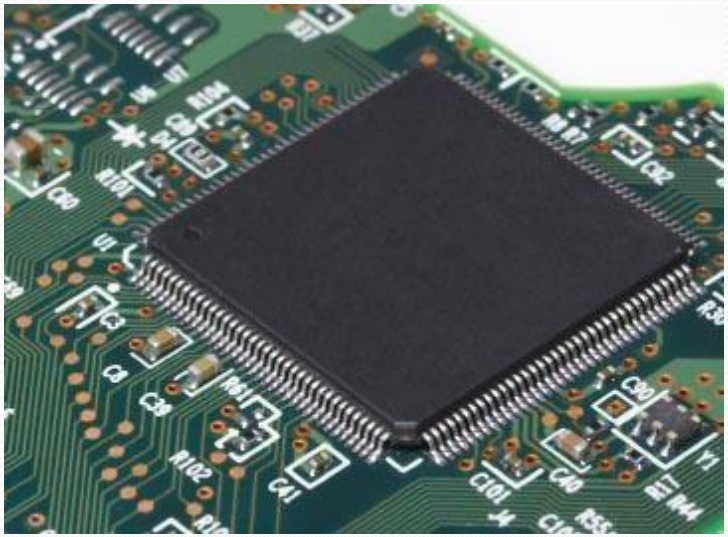
# Transistors

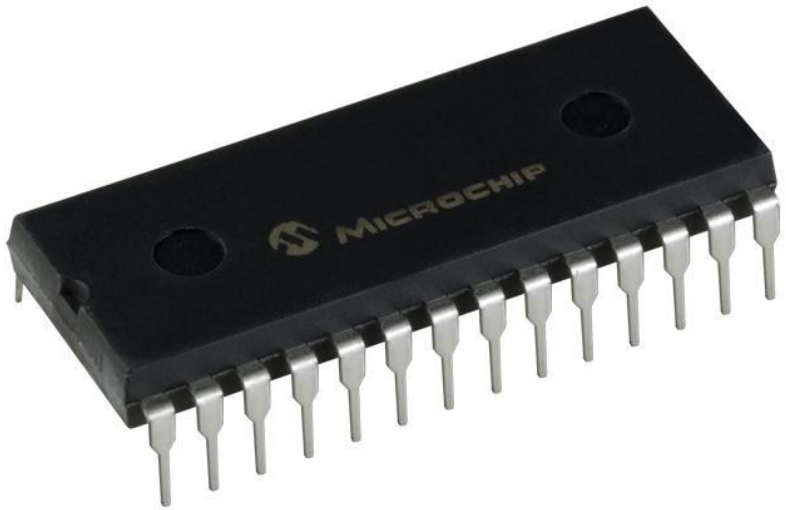



- Metal body is acting as collector for the BJT in the middle
  - To dissipate heat – power transistor
  - Main current flow and hence heat is produced in collector

# Integrated Circuit (IC)

- An integrated circuit (IC) is a set of transistors that is the controller or 'brain' of an electronic circuit.
  - An input is received, an output is sent out.

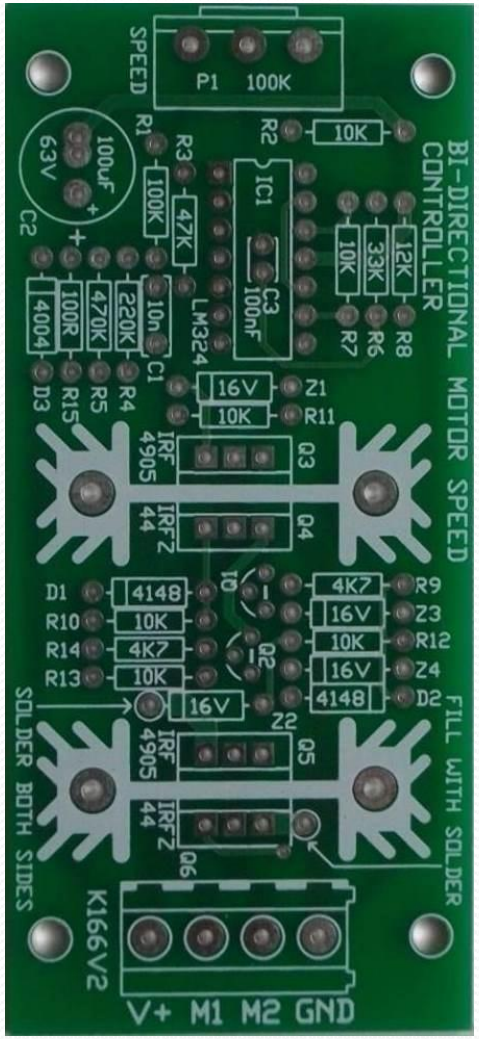





Modern microprocessor ICs can have billions of transistors per square inch!

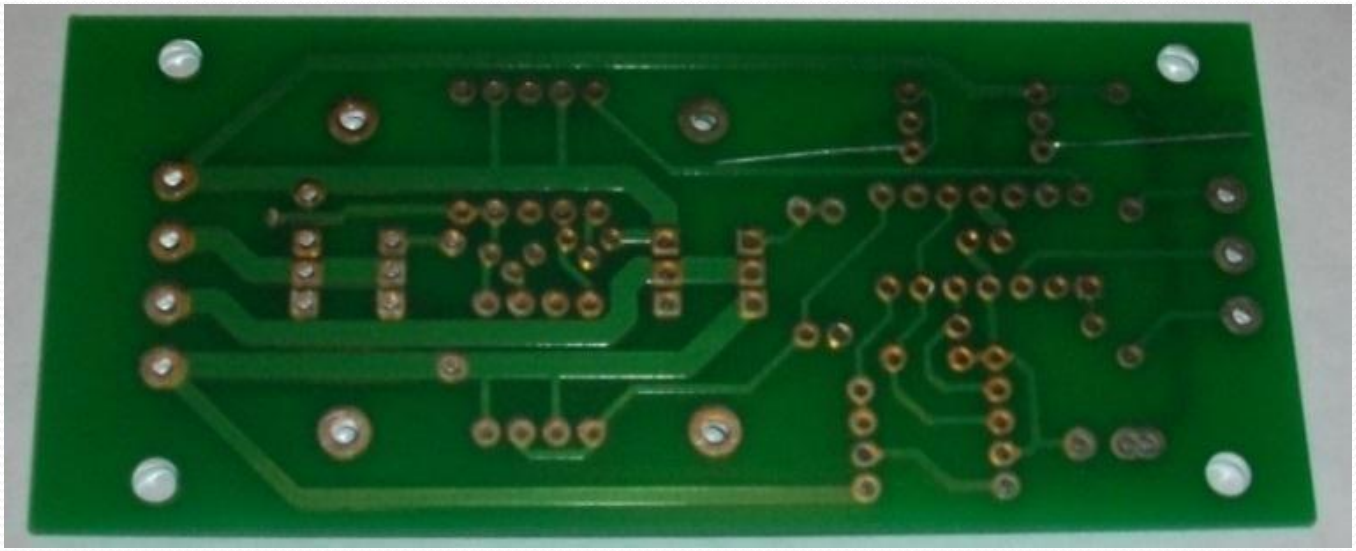
# Printed Circuit Board (PCB)

- Components are attached to a printed circuit board.
- The '**front**' side of the board will have printed component information, such as resistor, diode type and polarity, etc.
- Holes go all the way through the board from one side to the other. Through-hole soldering is needed to connect components to the board.



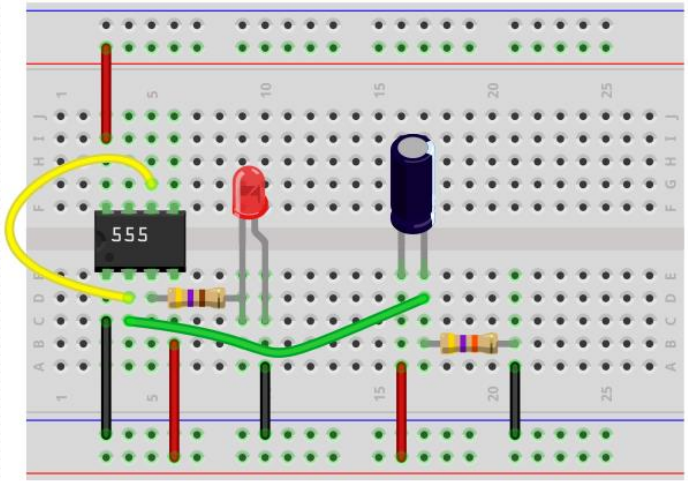
# Back of Circuit Board

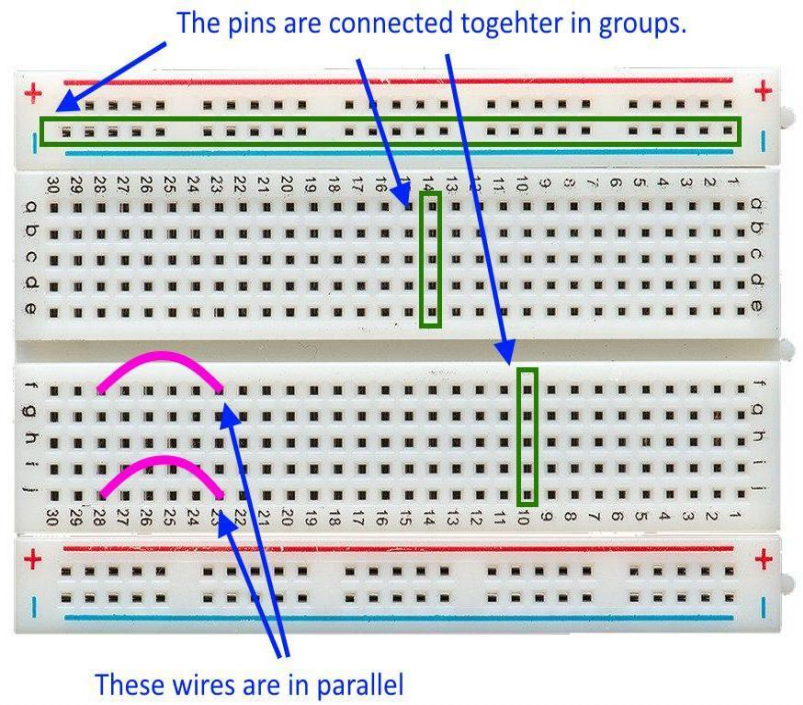
- The '**back**' side of the board has lines indicating connections between components. The lines on the back are similar to wires.
- Thicker lines denote more current (electrons) moving through.



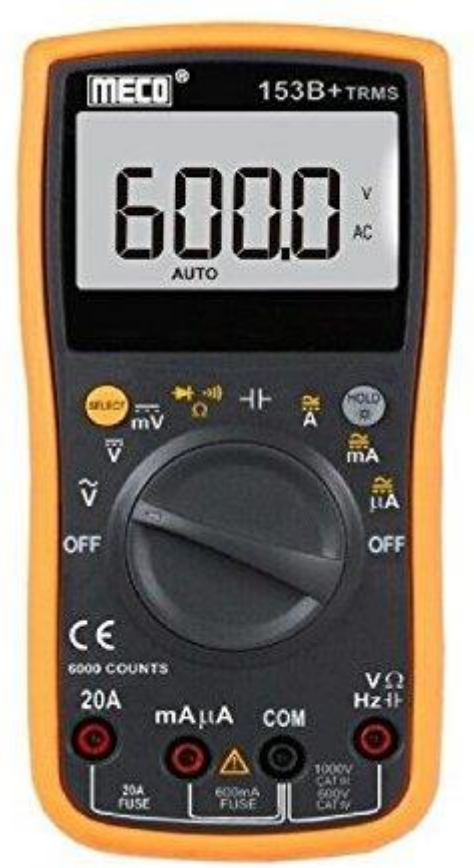
# BreadBoard

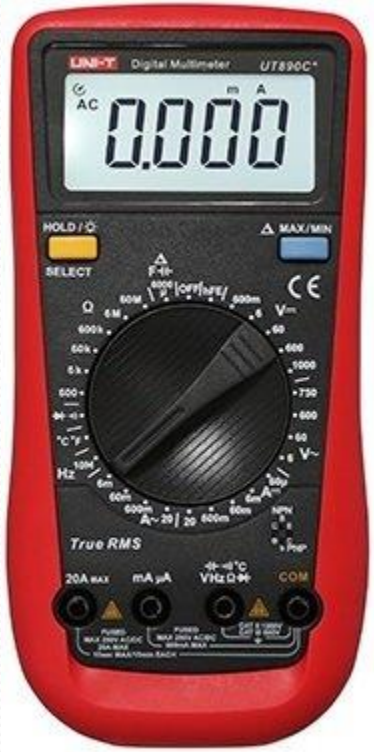
- To make circuit for testing purpose
- Some horizontally and some vertically shorted lines are there.



# Digital Multimeter



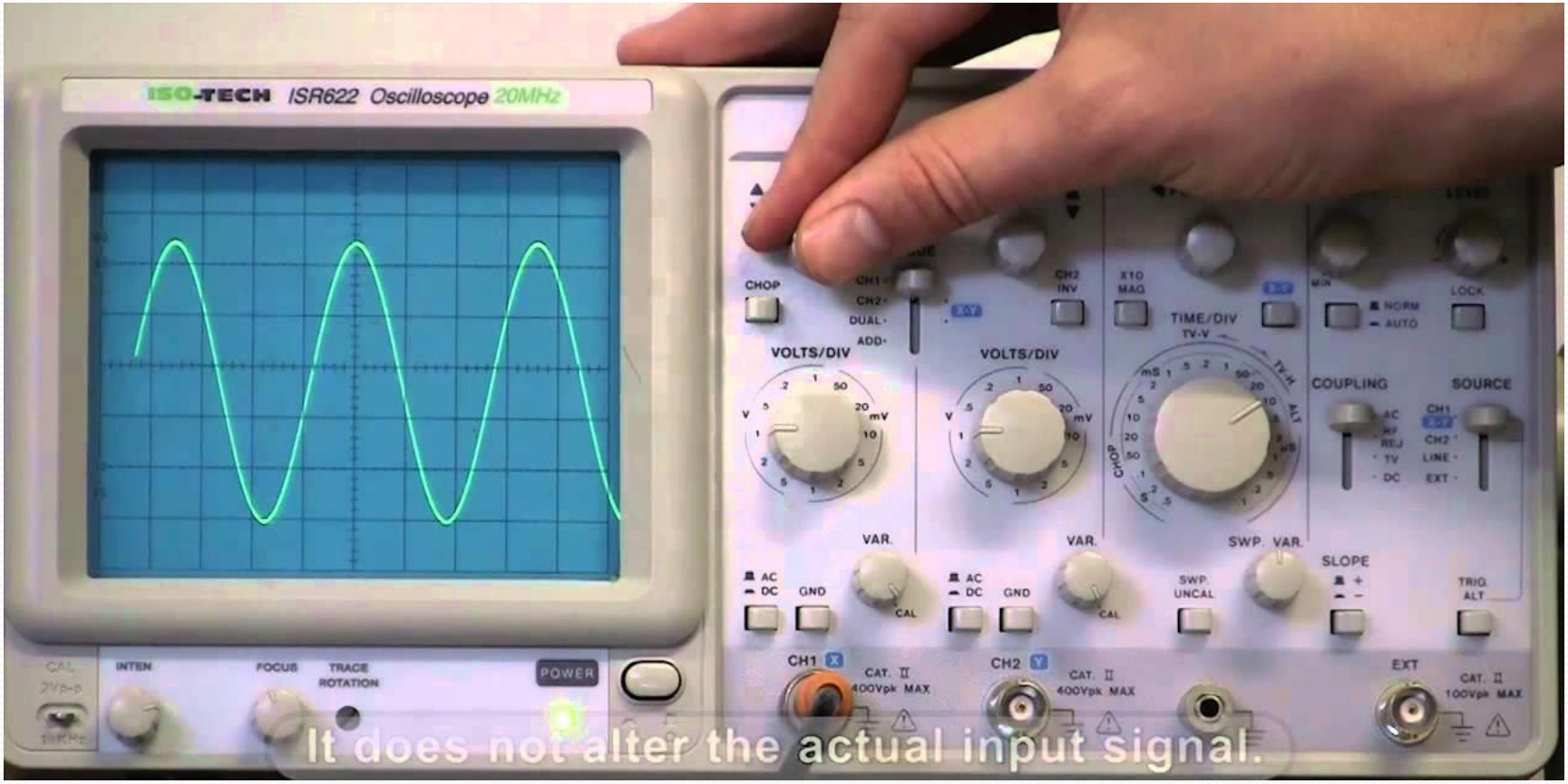

# D C Power Supply

❖ Generation of DC supply voltage, like ±5V, ± 10V, ± 30 V etc.


# Function Generator

❖Generates function like sine wave, triangular wave, square wave, pulse etc.

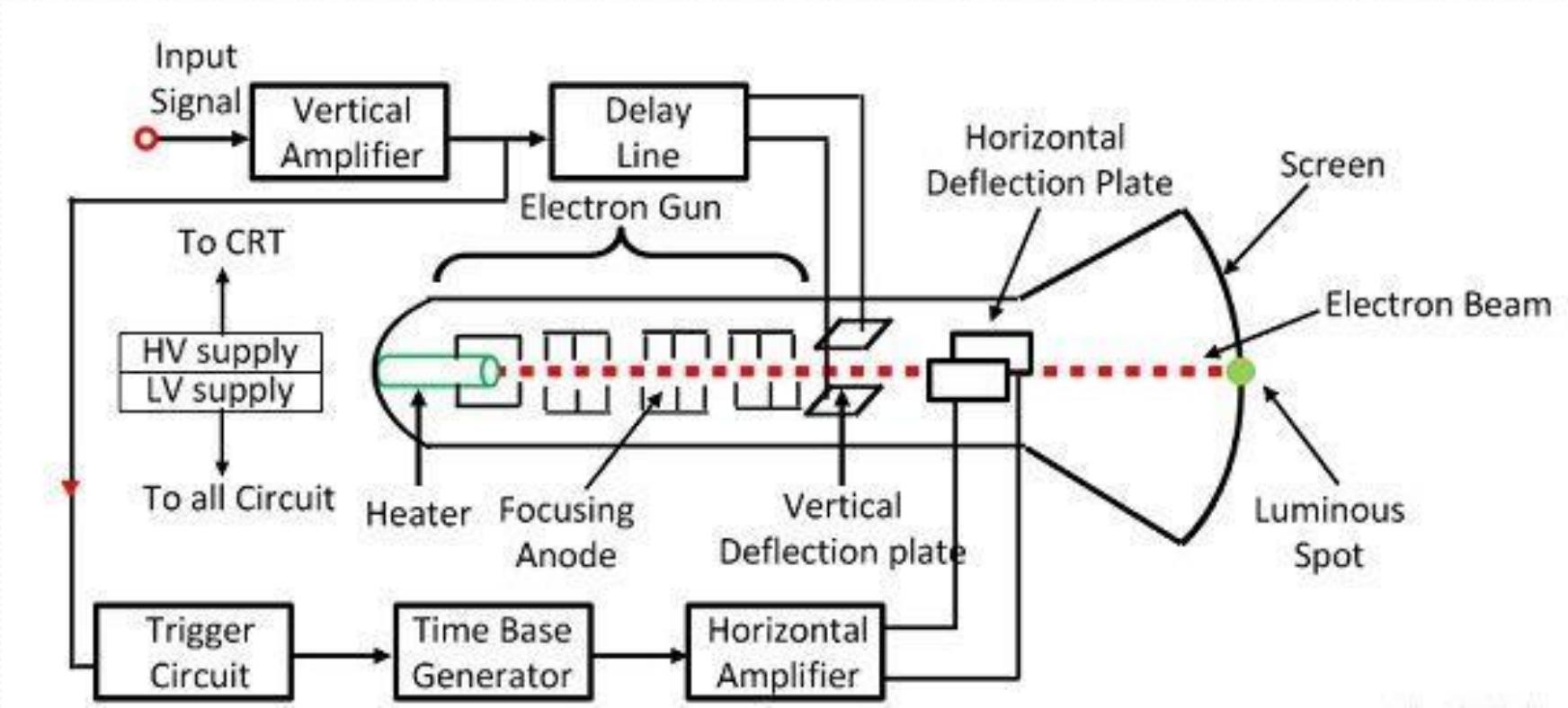
# Cathode Ray Oscilloscope (CRO)




- Time domain display of signals
- Measurement of voltage, current and frequency, phase of a signal

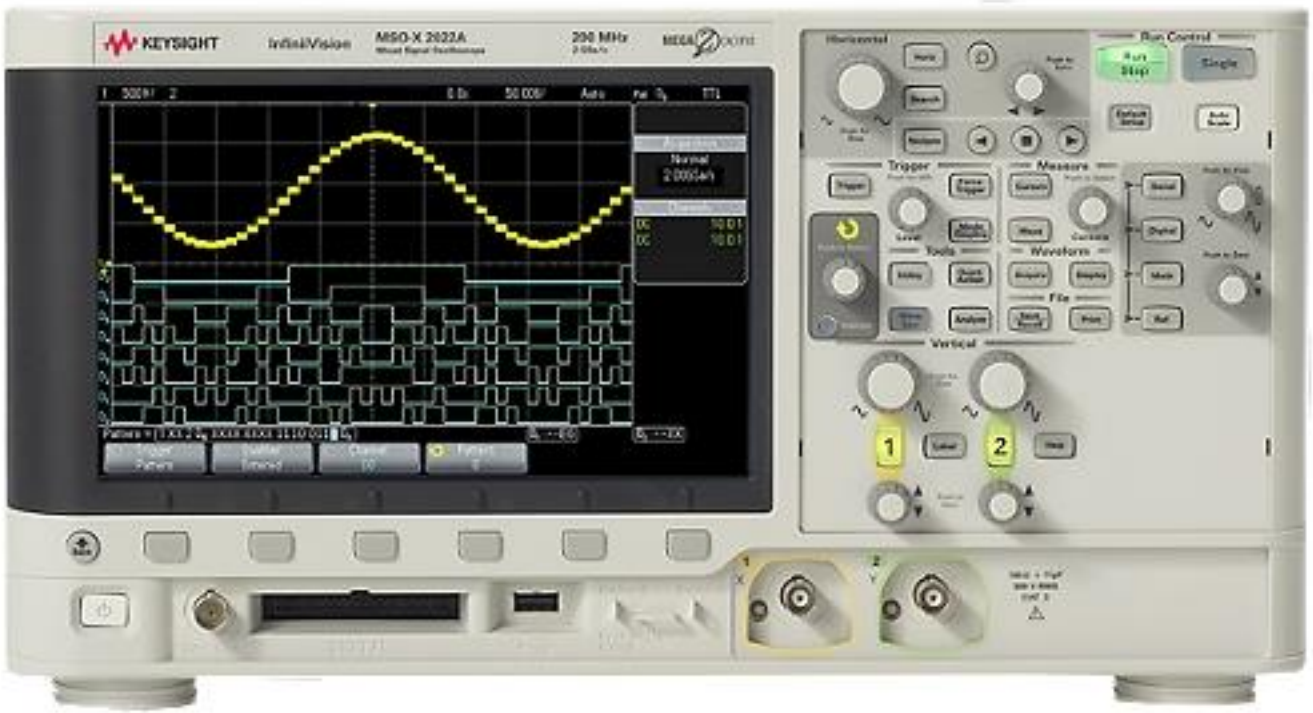
**How ??**

# Cathode Ray Oscilloscope (CRO)



# Digital Storage Oscilloscope (CRO)

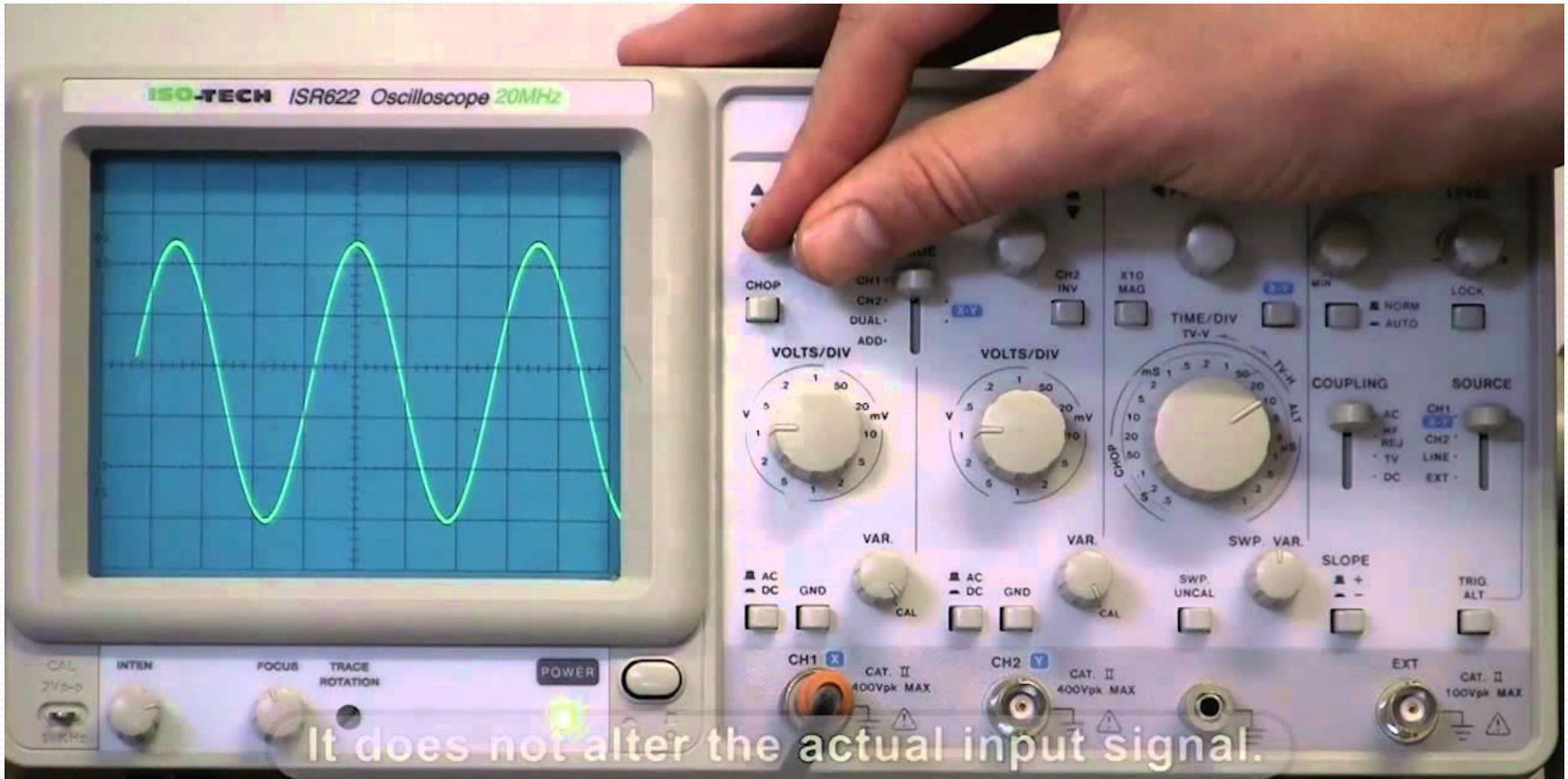
- To display and measure signals, both analog and digital
  - ✓Measurement of voltage, frequency, phase, time period etc.
- Data Storage for live tracking



# How to Measure??

Voltage, Frequency, Phase of a signal using Oscilloscope

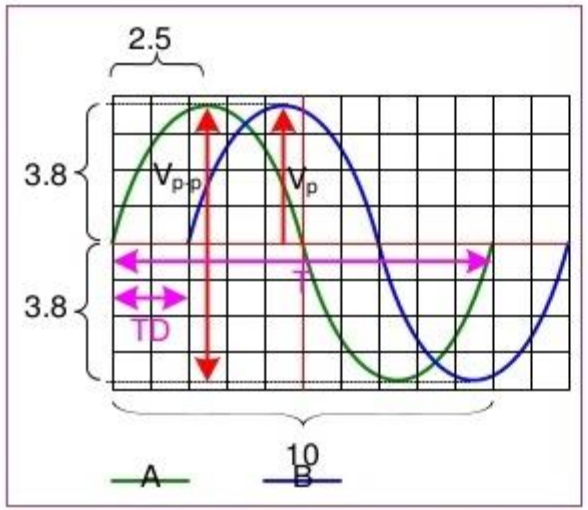
- Volt/div, time/div ??
- For current: Voltage across a known resistance
- Phase: Lissajous figures



# How to Measure??

Voltage, Frequency, Phase of a signal using Oscilloscope

- Volt/div, time/div ??
- For current: Voltage across a known resistance
- Phase: Lissajous figures (two signals in two deflecting plates)




a) Voltage Peak-to-Peak

$V_{p-p}$ = (V/Div) x No. of vert. div.

= 100 mV/div x (3.8 x 2)

= 0.76 V

b) Voltage Peak

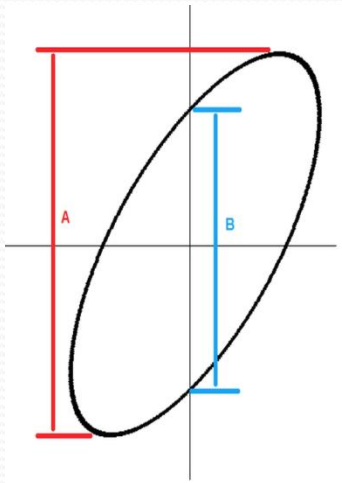
$V_p$ = (V/Div) x No. of vert. div.

= 100 mV/div x (3.8)

= 0.38 V

(Volt/Div : 100mV/Div, Time/Div : 0.5ms/Div)

# Phase of a signal using Oscilloscope ???




$$\sin \Phi = \frac{B}{A}$$

$\Phi$ = Phase Angle