BASIC ELECTRONIC COMPONENTS

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★ **Electronic components** are the elements of an electronic circuit. They work together to create wonderful modern electrical systems.

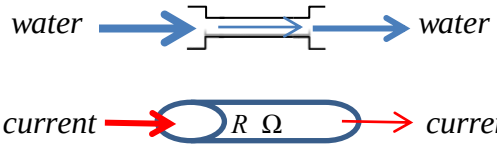
Active (Diode,Transistor, battery) **Passive** (**R, L, C, Transformers**)

Active → possess gain, i.e. can amplify or energize the given signal

Passive → do not possess gain, i.e. cannot amplify or energize the signal; but can only attenuate the signal

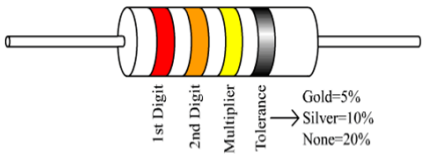
★ **Resistor** is a component that resists the flow of current. Resistance is measured in unit of Ohm (Ω).

★ Similar to water flow reduction in a narrow path from a wider path ,



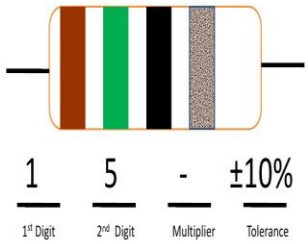
resistor restricts or limits or controls the amount of current flowing through it to a desired value.

★ The **value of the resistance** can be identified from the colour bands on its surface.



Calculating the Tolerance: Previous Example

- (0) Black
- (1) Brown
- (2) Red
- (3) Orange
- (4) Yellow
- (5) Green
- (6) Blue
- (7) Violet
- (8) Grey
- (9) White



15 X 10%= 1.5 Ω

The tolerance range for this resistor is 13.5 – 16.5 Ω

Tolerance Band: Brown = ±1%, Red = ±2%, Gold = ±5%, Silver = ± 10 %

Color	Digit	Multiplier	Tolerance (%)
Black	0	10^0 (1)	
Brown	1	10^1	1
Red	2	10^2	2
Orange	3	10^3	
Yellow	4	10^4	
Green	5	10^5	0.5
Blue	6	10^6	0.25
Violet	7	10^7	0.1
Grey	8	10^8	
White	9	10^9	
Gold		10^{-1}	5
Silver		10^{-2}	10
(none)			20

Some Forms of Resistors

Name	Symbol	Image
Resistor		
Power Resistor (Used to dissipate high power)		
LDR (Light Dependent Resistor)		
Variable Resistor		

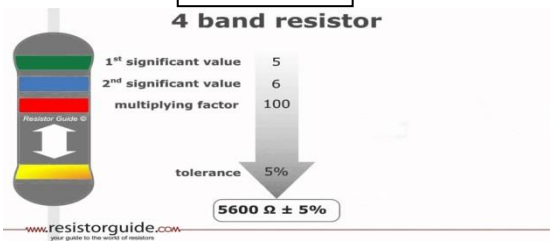
The resistor colour coding can be remembered easily by sentence:

"**B B ROY** of **G**reat **B**ritain has a **V**ery **G**ood **W**ife".

0 1 2 3 4 5 6 7 8 9

1/ Resistance = Conductance. Unit: mho or Siemen

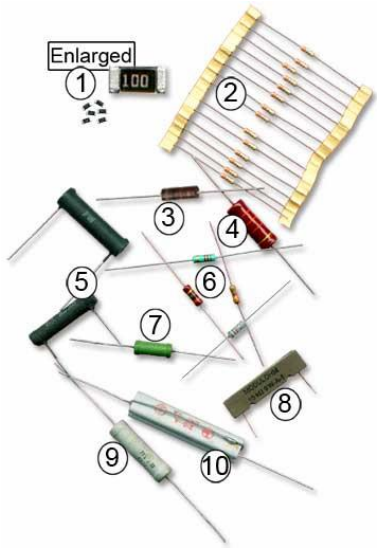
Example



Types of Resistors

- Fixed Resistors
- Variable Resistors

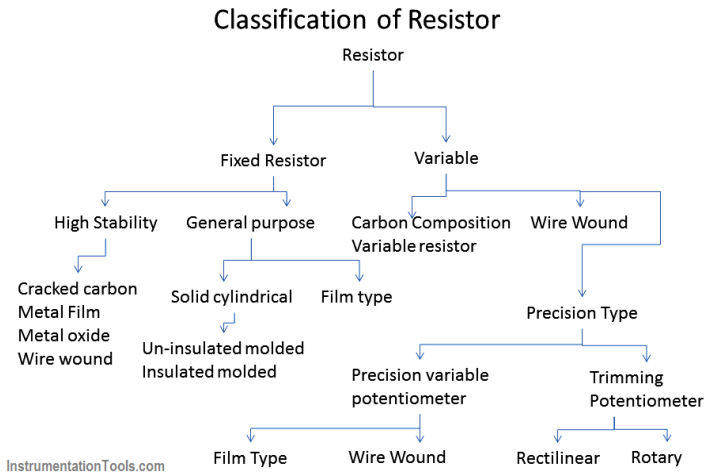
(Based on uses, materials, construction technology, etc.)

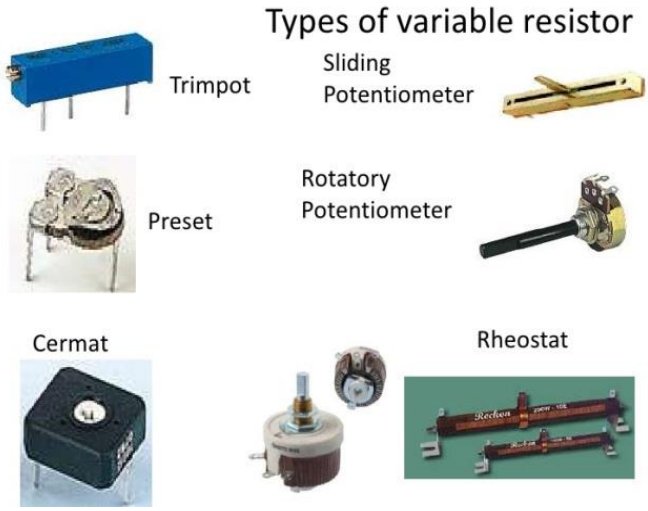


Fixed Resistors

1. Surface Mount Technology
2. Carbon Film Resistor
3. Carbon Composition Resistor
4. 1-W Resistor
5. Wire-Wound Resistor (WWR)
6. Metal Film Resistor
7. 5-W Wire-Wound Resistor
8. PCB Mounting WWR
9. High-Power Metal Film Resistor
10. Fusible Wire-Wound Resistor

Variable Resistors





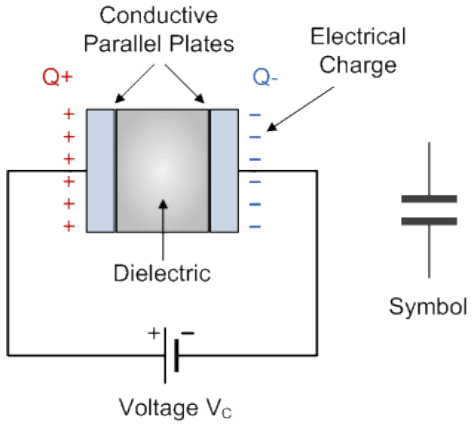
When a number of 'n' resistors are connected in series, the effective resistance is $R = R_1 + R_2 + \ldots + R_n$.

When they are connected in parallel, the effective resistance is $\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \ldots + \frac{1}{R_n}$.

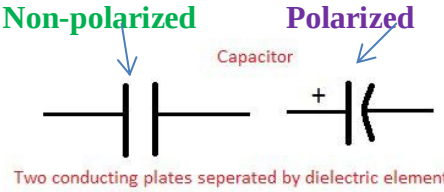
Capacitor is a device that stores electrical energy in an electric field. It is a passive electronic component with two terminals. It is also called as **Condensor** or **Condensator.**

- Most capacitors contain at least two electrical conductors often in the form of metallic plates or surfaces separated by a dielectric medium.
- The conductor may be a foil, thin film, sintered bead of metal, or an electrolyte.
- Dielectric Materials commonly used are glass, ceramic, plastic film, paper, mica, air, and oxide layers.

- Capacitors are simple passive devices that can **store electrical charge** on their plates when connected to a voltage source, Q = C x V Coulombs.
- **When used in a direct current or DC circuit**, a capacitor charges up to its supply voltage but ***blocks*** the flow of current through it because the dielectric of a capacitor is non-conductive and basically an insulator.
- **When it is connected to an alternating current or AC circuit**, the flow of the current appears to pass straight through the capacitor with little or ***no resistance***.



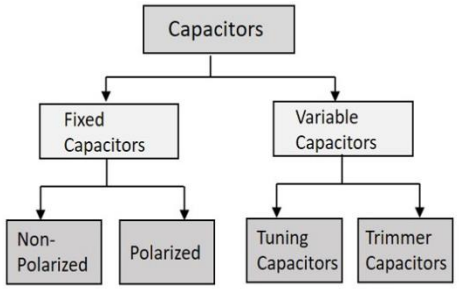
- The generalised equation for the capacitance of a parallel plate capacitor is given as: C = ε (A / d)
  where
  ε represents the permittivity of the dielectric material
  A is the cross-sectional area of the parallel plates
  d is the distance between the parallel plates.
- The effect of capacitor is called the **capacitance** and is measured in **Farad**. The inverse of capacitance is called the **elastance** and its unit is **daraf**.

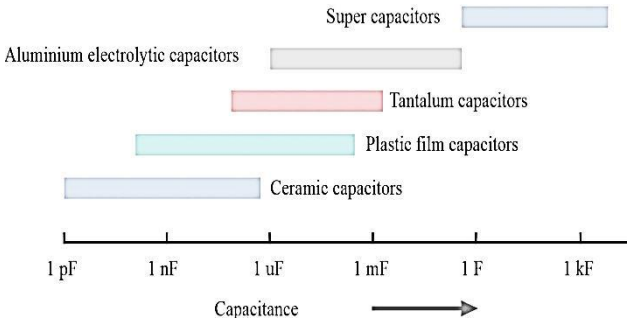


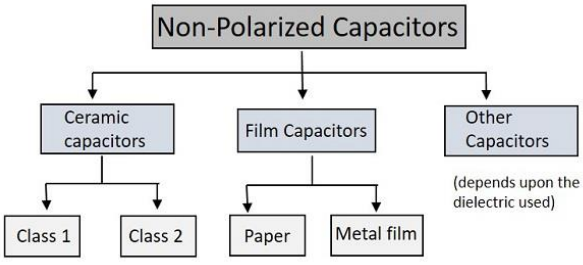
When 'n' number of capacitors are connected in series, the effective capacitance is $\frac{1}{C}=\frac{1}{C_1}+\frac{1}{C_2}+\ldots+\frac{1}{C_n}$

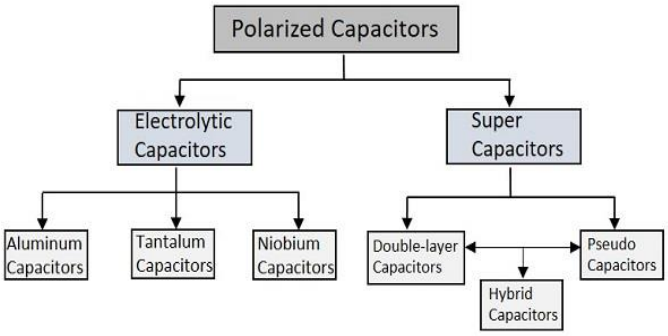
When they are connected in parallel, the effective capacitance is $C= C_1+ C_2+ \ldots + C_n$.

Types of Capacitors



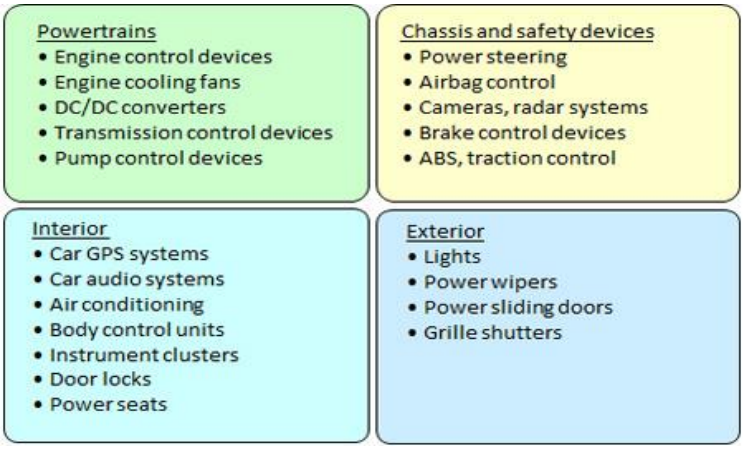






Applications of Capacitors

- Power Supply Smoothing
- Audio Frequency Coupling
- RF Coupling Capacitor Applications
- RF Decoupling Applications
- Tuned Circuits



Inductor (also called a **coil**, **choke**, or **reactor)** is a passive two-terminal electrical component that stores energy in a magnetic field when electric current flows through it. An inductor typically consists of an insulated wire wound into a coil around a core.It works on Faraday's law of Electromagnetic induction.

- An electric current flowing through a conductor generates a magnetic field surrounding it.
- The magnetic flux linkage generated by a given current depends on the geometric shape of the circuit. Their ratio defines the inductance L.
- Many inductors have a magnetic core made of iron or ferrite inside the coil, which serves to increase the magnetic field and thus the inductance.
- Inductor is characterized by its **inductance**, which is the ratio of the voltage to the rate of change of current. The unit of inductance is the **Henry** (H), equivalent to weber/ampere.

- They are used to block AC while allowing DC to pass. They are also used in electronic filters to separate signals of different frequencies, and in combination with capacitors to make tuned circuits, used to tune radio and TV receivers.
- Two (or more) inductors in proximity that have coupled magnetic flux (mutual inductance) form a **transformer,** which is a fundamental component of every electric utility power grid.

Inductor types based on core

- ★ Air Core Inductor
- ★ Iron Core Inductor
- ★ Ferrite Core Inductor
- ★ Iron Powder Inductor
- ★ Laminated Core Inductor
- ★ Bobbin based inductor
- ★ Toroidal Inductor
- ★ Multi-layer Ceramic Inductors
- ★ Film Inductor
- ★ Variable Inductor
- ★ Coupled Inductors

Core Core wounded with wire Inductors having different types of core

* When a number of inductors are connected in **series,** the total **self inductance** is given by $L_{Total} = L_1 + L_2 + \ldots + L_n$ When inductors are connected in **parallel,** $\frac{1}{L} = \frac{1}{L_1} + \frac{1}{L_2} + \ldots + \frac{1}{L_n}$

* **Mutual Inductance** M is the interaction of one coil's magnetic field on another coil, as it induces a voltage in the adjacent coil.

* Mutually connected series inductors can be classed as either "Aiding" or "Opposing" the total inductance. If the magnetic flux produced by the current flows through the coils in the same direction, then the coils are said to be **Cumulatively Coupled**. If the current flows through the coils in opposite directions then the coils are said to be **Differentially Coupled.**

* $L_{Total} = L_1 + L_2 + 2M$ (Aiding) $L_{Total} = L_1 + L_2 - 2M$ (Opposing)

* If two mutually coupled coils are connected in parallel,

$$L = \frac{L_1 L_2 - M^2}{L_1 + L_2 - 2M}$$ (Aiding) &

$$L = \frac{L_1 L_2 - M^2}{L_1 + L_2 + 2M}$$ (Opposing)

Few Applications:

- ★ Used extensively in analog circuits and signal processing. For example, removes ripple in power supplies.
- ★ Small inductance of the ferrite rod installed around a cable to prevent radio frequency interference.
- ★ Used as the energy storage device in many switched-mode power supplies to produce DC current.
- ★ A tuned circuit (L and C) acts as a resonator in radio transmitters and receivers, as narrow bandpass filters to select a single frequency from a composite signal, and in electronic oscillators to generate sinusoidal signals.
- ★ Two (or more) inductors are used in the construction of a transformer (basic in electric utility power grid).

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