

A capacitor is a two-terminal electrical device(we observe in laptop,fan) that can store and release energy in the form of an electric charge (amount of electrons that pass from one body to another by different methods like conduction, Friction (Triboelectric Effect) etc...,which has 2 charges +,-)

Advantages: cost effective,it has wide ranges of sizes ,Rapid Charge and Discharge Cycles,long life span

Disadvantages: Environmental Impact(contains hazardous materials), safety is less (accidental short circuits can leads to electric shock)

Applications:Signal processing(used to represent information in analog and digital form),Filtering(used to filter out the noise)

How does a capacitor work?

A capacitor consists of two conducting plates which are separated by the insulating material. These conducting plates are electrically neutral which means the amount of positive and negative charges

are equal. When the voltage is supplied. electrons on the one plate will get attracted towards the positive terminal of the battery and through the negative terminal of the battery electrons are pushed towards the second plate. Because of the dielectric material in between the two plates, electrons are not able to cross the dielectric barrier.

So, over the period of time one plate develops positive charge (Shortage of electrons) and the other plate develops the negative charge. (Excess of electrons) And in this way, the charge is stored on the two plates.

Because of these charges, the potential difference(it is the difference in the amount of energy that charge carriers have between two points in a circuit.) is generated between the two plates and in turn, an electric field is developed between the two plates. So, in this way, the energy is stored across the capacitor in the form of electrostatic field(attractive and repulsive force between particles are caused due to their electric charges) (because of the charges at two plates)

Feature	Polarized Capacitors	Non polarized Capacitors
Polarity	Has positive and negative terminals; must be connected correctly	No polarity; can be connected in any direction
Flexibility	less	more

Flexible devices: Flexible devices are electronic devices that can bend, stretch ,twist, fold them or change shape without breaking it.

Advantages: 1.Portability(light weight so that it can easily move around)

2.duration is high

3.Conformability is more

Disadvantage: 1.Performance is very limited

2.Complex Manufacturing

3.cost will be more

Thin films: A thin film is a layer of material ranging from fractions of a nm to several micrometers(μm) in the thickness.

Adv:improves the reflection, absorption process

Disadv: efficiency is low,more cost

Dielectric: A dielectric is an insulating material or a very poor conductor of electric current. When electric field is applied, dielectrics does not conduct electricity because they lack of free electrons.

Instead, electric polarization occurs: positive charges within the dielectric are slightly displaced in the direction of the electric field, while negative charges are displaced in the opposite direction. This polarization reduces the overall electric field within the dielectric.

Unitless and dimensionless

Ratio of substance(with dielectric) and free space permittivity(without dielectric)

dipole moment is the product of the magnitude of the charge and the distance between the centers of the positive and negative charges.

$$P = qd$$

Ferroelectricity : It is a dielectric material which exhibits the electric polarization even in the absence of electric field

Advantage: 1.High Dielectric Constant
2.Non-Volatile Memory (Ferroelectric materials retain their polarization state without the need for a continuous power supply) which has some characteristics are low power and providing fast response

Disadvantage: 1.temperature dependent
2.Hysteresis Losses

Domain: groups of magnetic moments naturally align in the same direction.