

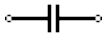
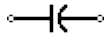
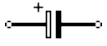
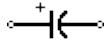
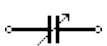
## Capacitor

Working principle of capacitors

Capacitor is an electronic component that stores electric charge. The capacitor is made of 2 close conductors (usually plates) that are separated by a dielectric material. The plates accumulate electric charge when connected to power source. One plate accumulates positive charge and the other plate accumulates negative charge.

The capacitance is the amount of electric charge that is stored in the capacitor at voltage of 1 Volt.

The capacitance is measured in units of Farad (F).

|                            |   |   |
|----------------------------|---|---|
| <b>Capacitor</b>           |  |  |
| <b>Polarized capacitor</b> |  |  |
| <b>Variable capacitor</b>  |  |   |

## Capacitance

The capacitance (C) of the capacitor is equal to the electric charge (Q) divided by the voltage (V):

$$C = \frac{Q}{V}$$

C is the capacitance in farad (F)

Q is the electric charge in coulombs (C), that is stored on the capacitor

V is the voltage between the capacitor's plates in volts (V)

## Types of Capacitor

### Electrolytic Capacitors

Electrolytic Capacitors are generally used when very large capacitance values are required. Here instead of using a very thin metallic film layer for one of the electrodes, a semi-liquid electrolyte solution in the form of a jelly or paste is used which serves as the second electrode (usually the cathode).

The majority of electrolytic types of capacitors are Polarised, that is the DC voltage applied to the capacitor terminals must be of the correct polarity, i.e. positive to the positive terminal and negative to the negative terminal as an incorrect polarisation will break down the insulating oxide layer and permanent damage may result.

### Polyester capacitor

The polyester capacitor is referred to by other names apart from polyester. The trade name for the material used as the dielectric is Mylar, and they may also be referred to as PET capacitors because the synthetic polyester material used goes by this abbreviation.

### Tantalum capacitors

Tantalum capacitors are a subtype of electrolytic capacitors. They are made of tantalum metal which acts as an anode, covered by a layer of oxide which acts as the dielectric, surrounded by a conductive cathode. The use

of tantalum allows for a very thin dielectric layer. This results in a higher capacitance value per volume, superior frequency characteristics compared to many other types of capacitors and excellent stability over time.

### Mica capacitors

mica capacitors are capacitors which use mica as the dielectric. There are two types of mica capacitors: clamped mica capacitors and silver mica capacitors. They are made by sandwiching mica sheets coated with metal on both sides.

### Surface mounted

Surface mounted or SMD or SMT surface mount capacitors are used in high volume manufacture - quantities used are numbered in the billions. They are small, leadless and can be placed onto modern printed circuit boards using pick and place machines used in modern manufacturing.

There are many different types of SMD capacitor ranging from ceramic types, through tantalum varieties to electrolytics and more. Of these, the ceramic SMD capacitors are the most widely used.

### Colour coding of Capacitors

#### Capacitor Colour Code Table

| Band Colour | Digit A | Digit B | Multiplier D | Tolerance (T) > 10pf | Tolerance (T) < 10pf | Temperature Coefficient (TC) |
|-------------|---------|---------|--------------|----------------------|----------------------|------------------------------|
| Black       | 0       | 0       | x1           | ± 20%                | ± 2.0pF              |                              |
| Brown       | 1       | 1       | x10          | ± 1%                 | ± 0.1pF              | -33×10 <sup>-6</sup>         |
| Red         | 2       | 2       | x100         | ± 2%                 | ± 0.25pF             | -75×10 <sup>-6</sup>         |
| Orange      | 3       | 3       | x1,000       | ± 3%                 |                      | -150×10 <sup>-6</sup>        |
| Yellow      | 4       | 4       | x10,000      | ± 4%                 |                      | -220×10 <sup>-6</sup>        |
| Green       | 5       | 5       | x100,000     | ± 5%                 | ± 0.5pF              | -330×10 <sup>-6</sup>        |
| Blue        | 6       | 6       | x1,000,000   |                      |                      | -470×10 <sup>-6</sup>        |
| Violet      | 7       | 7       |              |                      |                      | -750×10 <sup>-6</sup>        |
| Grey        | 8       | 8       | x0.01        | +80%,-20%            |                      |                              |
| White       | 9       | 9       | x0.1         | ± 10%                | ± 1.0pF              |                              |
| Gold        |         |         | x0.1         | ± 5%                 |                      |                              |
| Silver      |         |         | x0.01        | ± 10%                |                      |                              |

## Capacitor Voltage Colour Code Table

| Band Colour | Voltage Rating (V) |        |        |        |        |
|-------------|--------------------|--------|--------|--------|--------|
|             | Type J             | Type K | Type L | Type M | Type N |
| Black       | 4                  | 100    |        | 10     | 10     |
| Brown       | 6                  | 200    | 100    | 1.6    |        |
| Red         | 10                 | 300    | 250    | 4      | 35     |
| Orange      | 15                 | 400    |        | 40     |        |
| Yellow      | 20                 | 500    | 400    | 6.3    | 6      |
| Green       | 25                 | 600    |        | 16     | 15     |
| Blue        | 35                 | 700    | 630    |        | 20     |
| Violet      | 50                 | 800    |        |        |        |
| Grey        |                    | 900    |        | 25     | 25     |
| White       | 3                  | 1000   |        | 2.5    | 3      |
| Gold        |                    | 2000   |        |        |        |
| Silver      |                    |        |        |        |        |

### Capacitor Voltage Reference

Type J – Dipped Tantalum Capacitors.

Type K – Mica Capacitors.

Type L – Polyester/Polystyrene Capacitors.

Type M – Electrolytic 4 Band Capacitors.

Type N – Electrolytic 3 Band Capacitors.