Capacitors – A Reactive Component

Capacitors store energy in an electric field between two conductive plates separated by an insulator, acting like a temporary battery.

The value of capacitors is measured in Farads (F). However, the normal values used are more often represented in microfarads (μf), nanofarads (nF) & picofarads (pF).

1 μF (microfarad) = 1,000 nF (nanofarad) = 1,000,000 pF (picofarad)

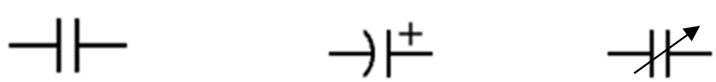
There are capacitor value converters on the Internet to provide the conversion of specific values between μF, nF, and pF.

Along with capacitance, capacitors are also rated in their working voltage, ESR, temperature coefficient and tolerance. For the purposes of this class, we will only concern ourselves with capacitor's values in μF, nF or pF and the capacitor's voltage rating, which is the maximum voltage which may be applied to the capacitor's two terminals.

Capacitors are manufactured from various materials and designs based upon the type of capacitor and its application. The types of capacitors we will use in class are film and aluminum electrolytic.

Some capacitors are sensitive to the polarity of the voltage applied. Unless the capacitor is non-polarized, connect the positive terminal of the capacitor to the positive voltage and the negative terminal to the ground or less positive voltage.

There are three different common symbols for capacitors:



Non-Polarized (NP) Polarized Variable

Parallel and Series Connected Capacitors

Capacitors, like resistors, may be connected in parallel or series to provide a specific capacitance value, but the calculations are opposite that of resistors.

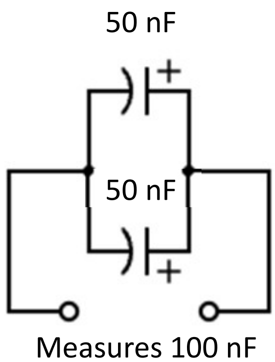
Parallel Capacitor Formula – Increases Capacitance

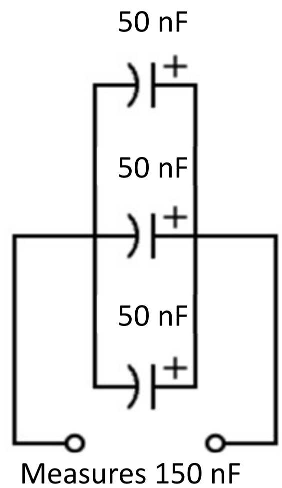
$C_{Total} = C1 + C2 + C3 \ldots$ Applies to capacitors of the same or different values

The working voltage of parallel capacitors is the lowest working voltage of any single capacitor.

Capacitors – A Reactive Component

When parallelling polarized capacitors, all positive (+) terminals are connected together and all negative (–) terminals are connected together.





<u>Series Capacitor Formula – Decreases Capacitance</u>

$\frac{1}{\text{C Total}} = \frac{1}{\text{C1}} + \frac{1}{\text{C2}} + \frac{1}{\text{C3}}$ (Applies to capacitors of the same or different values)

For two capacitors: $C_{Total} = \frac{\text{C1 x C2}}{\text{C1} + \text{C2}}$

For a series of the same value capacitors use:

C_{Total} = Calculate the average (C of any capacitor ÷ Number of capacitors)

The working voltage of a series of the same value capacitors is equal to the working voltage of a single capacitor times the number of capacitors. Example:

Capacitor 100 VDC working value x 3 capacitors = 300 VDC working voltage.

It is not easy to compute the <u>voltage</u> applied to capacitors of varying values connected in series, and this is beyond the scope of our class.