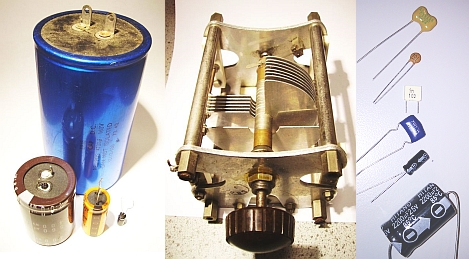
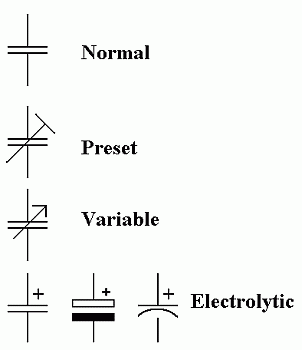
# DC RC Timing Page 27

Two parallel plates insulated from each other. Many capacitors have this structure rolled up into a tube to save space.



* It takes time to fill the tank / charge the capacitor
* The tank/capacitor fills fast at first and the fill rate slows down, the fuller it gets
* The tank/capacitor empties fast at first and the emptying rate slows down, the emptier it gets
* Eventually the battery/reservoir would be drained
* The water level/capacitor charge can not change suddenly
* If there were more pressure/voltage, the tank/capacitor would fill faster
* The tank fills until the water levels are equal. The capacitor charges until the voltages are equal.

### Capacitor Properties

The main characteristics or properties of capacitors are ...

* Capacitance is measured in Farads or more often pico, nano or microfarads.
* One Farad is an enormous capacitance and rarely found in real life.
* Capacitors store energy in the form of a stored electric charge.
* Charge is measured in Coulombs.
* Energy is measured in Joules.
  + Q = CV where
  + Q is the charge,
  + C is the capacitance and
  + V is the potential difference across the capacitor
  + If you double the voltage, the stored charge will double.
* E = CV2 / 2 where
  + E is the energy stored,
  + C is the capacitance and
  + V is the potential difference across the capacitor
  + If you double the voltage, the energy stored increases by 22 (four times)
* capacitors block direct current (DC)
* capacitors pass alternating current (AC)
* The breakdown voltage (in Volts). The voltage across the capacitor should never exceed this.
* The upper useful frequency properties.
* The DC leakage current (a particular problem with electrolytic capacitors).

### Uses of Capacitors

* Timing
  + R C timing circuits use a resistor and a capacitor for timing purposes.
  + The capacitor charges through the resistor.
  + A bigger resistor will make the capacitor take longer to charge.
  + Also a bigger capacitor will take longer to charge.
* Coupling
  + Also known as a DC blocking capacitor.
  + Couple an AC signal from one subsystem to the next.
  + Prevent DC potentials from being coupled from one subsystem to the next.
* Decoupling
  + Remove unwanted AC signals from the circuit.
  + The capacitor is connected to ground and any AC signals are passed straight to ground.
* Smoothing
  + DC power supplies produce lumpy DC.
  + The smoothing capacitor stores enough charge to smooth out the lumps.
  + Smoothing capacitors are often very big.
* Filtering
  + This is an A2 topic but many AS projects need to take this into consideration.
  + Since capacitors pass high frequencies and block low ones and DC, they can be used to filter low or high frequencies.
  + Capacitors can be wired up to couple (pass) or decouple (block) higher frequencies.
* Tuning
  + When combined with an inductor, a tuned circuit is formed.
  + This is used in radio tuning to select the wanted signal and reject others.

### Electrolytic Capacitors

Electrolytic capacitors use thin rolled up foil plates separated by a liquid or gel electrolyte. The insulation between the plates relies on a chemical reaction. If the capacitor is connected up the wrong way round, this chemistry fails and the capacitor works as a conductor instead. It gets hot and can explode!

* Electrolytic capacitors have a very large capacitance for their size
* The breakdown voltage is low. 12 to 160 volt ratings are common
* They have a significant DC leakage current, sufficient to upset some timing circuits
* They are not manufactured with good tolerance / accuracy and this can be up to 50% out
* Their capacitance is not stable and can change with time
* They are not suitable for high frequency radio applications because the coiled up foil roll acts as an inductor blocking high frequency performance
* They work well at audio and ultrasonic frequencies.

**Their uses include ...**

* DC power supply smoothing - This is a particular example of decoupling.
* Audio signal coupling - Block DC and pass AC.
* Audio signal decoupling - Remove unwanted AC signals.
* Timing in 555 or other timer circuits - RC resistor capacitor circuit

**They can not be used ...**

* In AC circuits where the polarity across the capacitor reverses
* In logic gate astable circuits because the polarity across the capacitor reverses