



Electromagnetics:
Electromagnetic Field Theory

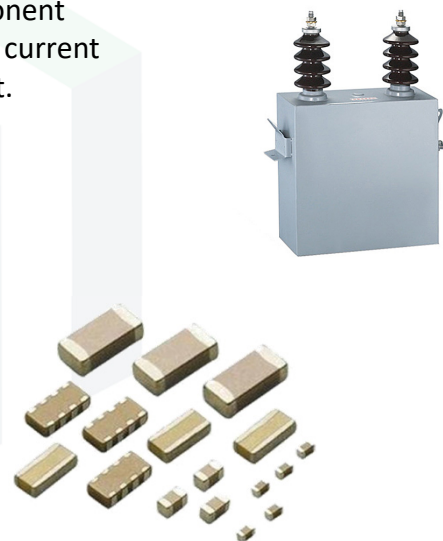
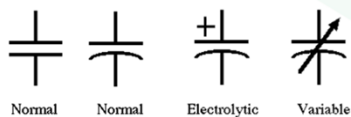
Analyzing Capacitors



1

What is a Capacitor?

A capacitor is a passive two-terminal electrical component that can store and release electric energy. It supplies current so as to keep the voltage across its terminals constant.



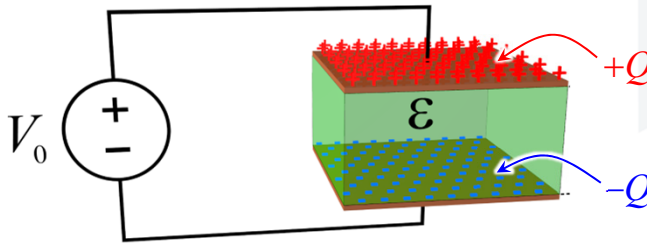
2

Capacitance, C

Capacitance is defined as the magnitude of the charge on one of the plates to the potential difference between the two plates.

The signs of charge and applied voltage are not needed when calculating capacitance.

$$C = \frac{|Q|}{|V_0|}$$



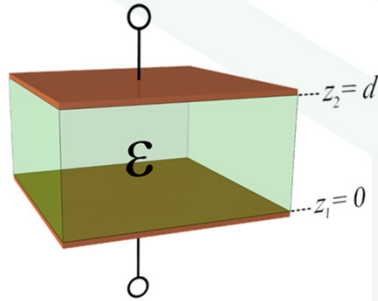
Recipe for Analyzing Capacitors

1. Choose a convenient coordinate system.
2. Let the plates carry charges $+Q$ and $-Q$.
3. Calculate \vec{D} using Gauss' law.
4. Calculate \vec{E} using $\vec{E} = \vec{D}/\epsilon$.
5. Calculate V_0 using $V_0 = -\int_L \vec{E} \cdot d\vec{\ell}$.
6. Calculate C using $C = |Q|/|V_0|$.

Note: The final equation for C should not contain Q or V_0 . Use this as a self-check.

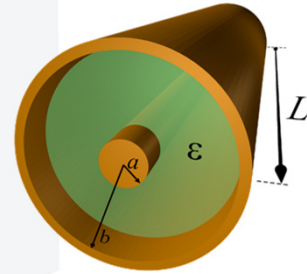
Some Simple Capacitors

Parallel Plate Capacitor



$$C = \frac{\epsilon S}{d}$$

Coaxial Line



$$C = \frac{2\pi\epsilon L}{\ln(b/a)}$$