Capacitors
Continued

Session 2e of “Basic Electricity”
A Fairfield University E-Course
Powered by LearnLinc

Basic Electricity

Two Sections

- Electron Flow and Resistance
  - 5 on-line sessions
  - Lab
- Inductance and Capacitance
  - 5 on-line sessions
  - Lab

Mastery Test, Part 1

Basic Electricity (Continued)

- Text: "Electricity One-Seven," Harry Mileaf, Prentice-Hall, 1996, ISBN 0-13-889585-6 (Covers several Modules and more)
- References:
  - "Digital Mini Test: Principles of Electricity Lessons One and Two," SNET Home Study Coordinator, (203) 771-5400
  - Electronics Tutorial (Thanks to Alex Pounds)
  - Electronics Tutorial (Thanks to Mark Sokos)
  - Basic Math Tutorial (Thanks to George Mason University)
  - Vector Math Tutorial (Thanks to California Polytec at atom.physics.calpoly.edu)

Section 2:
AC, Inductors and Capacitors

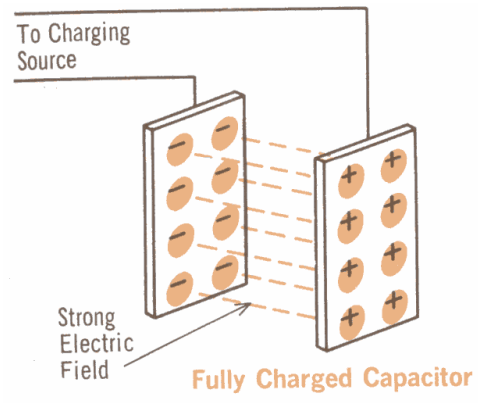
- 0BJECTIVES: This section introduces AC voltage / current and additional circuit components (inductors, transformers and capacitors).

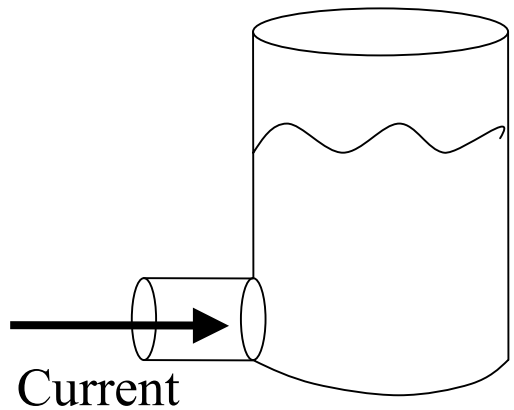
Section 2 Schedule:

Session 2a – 03/27	Alternating Current & Sine Waves	Text 3.1 – 3.41
Vector Math – 04/01	Sine Waves, Magnitude, Phase and Vectors	Text 4.1 – 4.24
Session 2b – 04/03 (Fri. Q&A session)	Inductors and Circuits	Text 3.42 – 3.73
Session 2c – 04/08	Transformers	Text 3.74 – 3.100
Session 2d – 04/10 (lab - 04/13, Sat.)	Capacitors	Text 3.101 – 3.135
Session 2e – 04/15	**More Capacitors**	**Text 3.135 – 3.148**
Session 2f – 04/22	Review (Discuss Quiz_2)	

Capacitor 1 Session Review

- Energy stored in an electric field
- C = Q / V (Farads)
- Time constant
  - $\tau = R * C$
  - 63.2% each τ
- Capacitors in parallel – add
- Capacitors in series – add as inverses
- AC & capacitors
  - Capacitive reactance - $Xc = 1 / (2 * \pi * f * C)$
  - $| I | = | V | / Xc$
  - Current "Leads" Voltage (ICE)

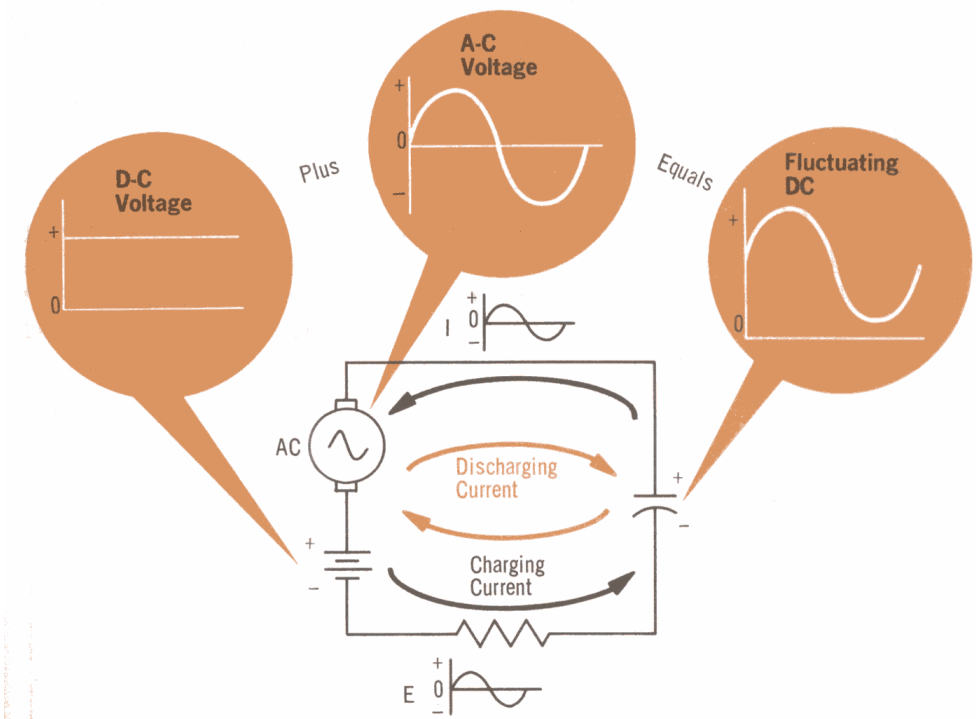




Voltage: pressure at bottom

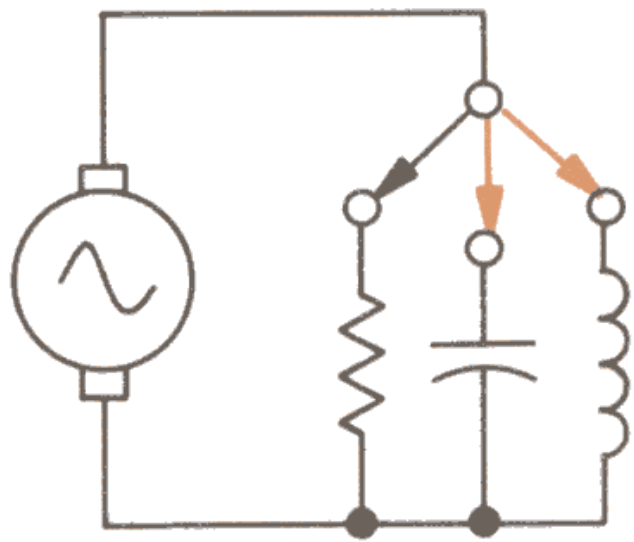
DC and AC
Superposition

- Superposition
  - DC is the average value of the Voltage or Current
  - AC is the fluctuation about the “mean”
- A series capacitor
  - Blocks DC current
  - Only AC voltage across the series resistor



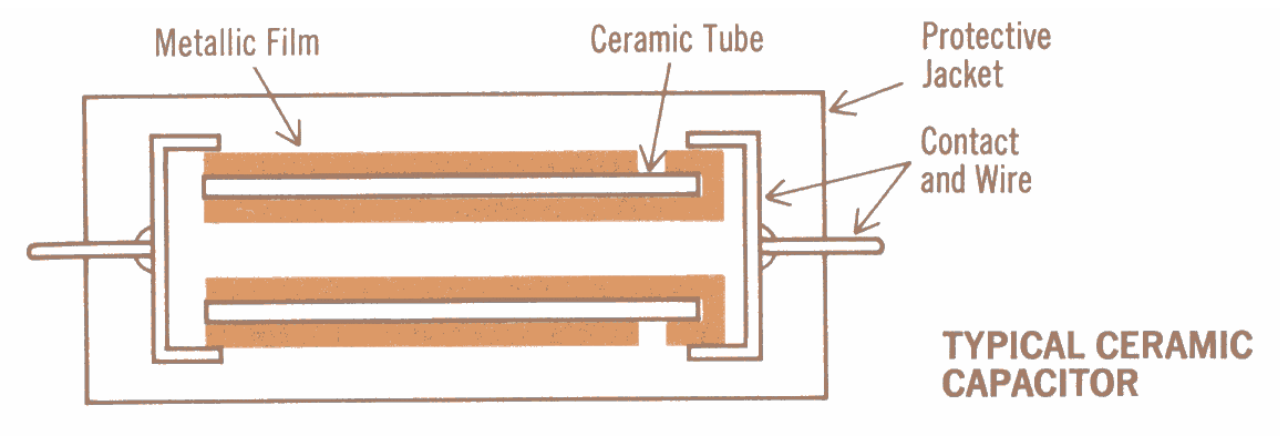
Power Factor

- Power Factor
  - AC power circuits
  - PF = cos(θ) :
    θ is the phase difference between the voltage and current supplied by the power source
- True Power
  - Resistive circuit: P = V*I
  - Reactive circuit: P = V*I*cos(θ)



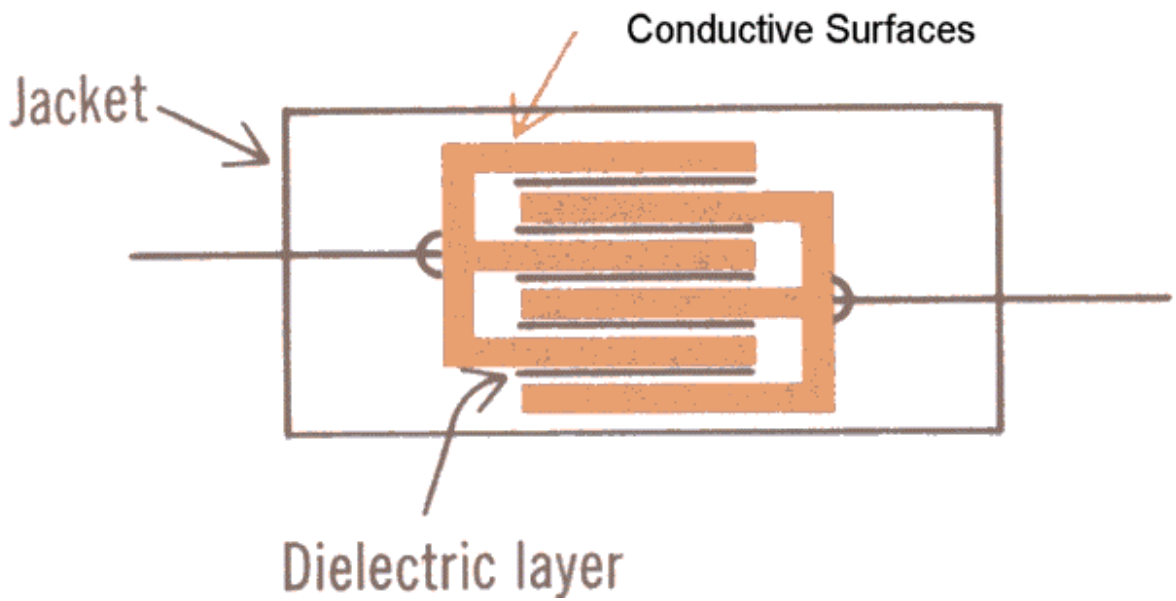
Ceramic Capacitor

- Metallic film deposited on a ceramic tube forms the capacitor "plates"
- Ceramic "disk" capacitors most common
  - Metal deposited on sides of a ceramic disk insulator.



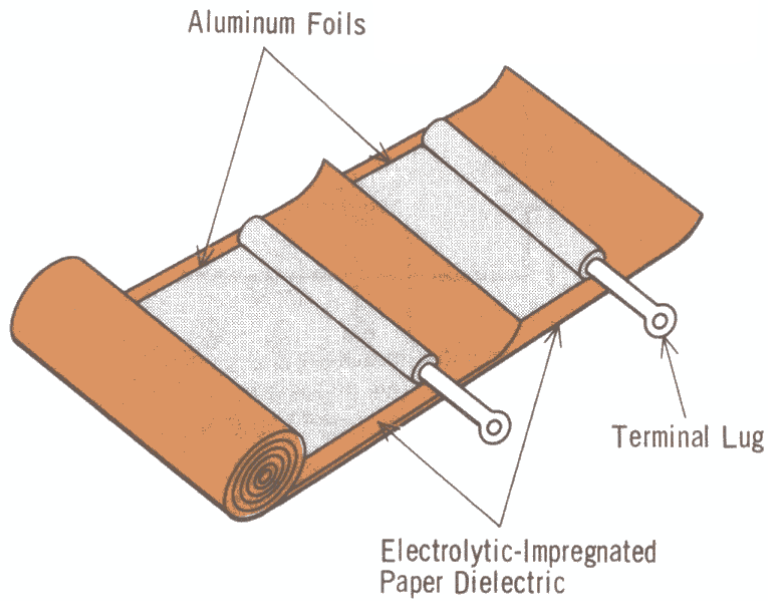
Mica Capacitor

- Layers of metal foil (often silver) separated by mica insulators.
- High breakdown voltage, low loss, but expensive



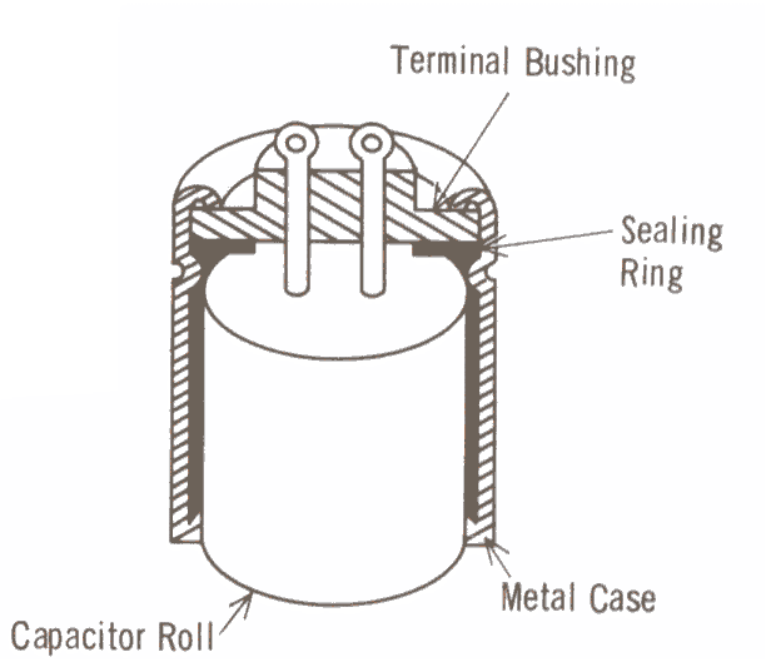
Electrolytic Capacitor

- Polarized Dielectric material
  - One aluminum “plate” is oxidized
  - Dielectric no longer a good insulator if the voltage is reversed
- High capacitor values (e.g. 4700µF) are possible
- Can fail violently
  - Breakdown voltage exceeded
  - Polarity reversed



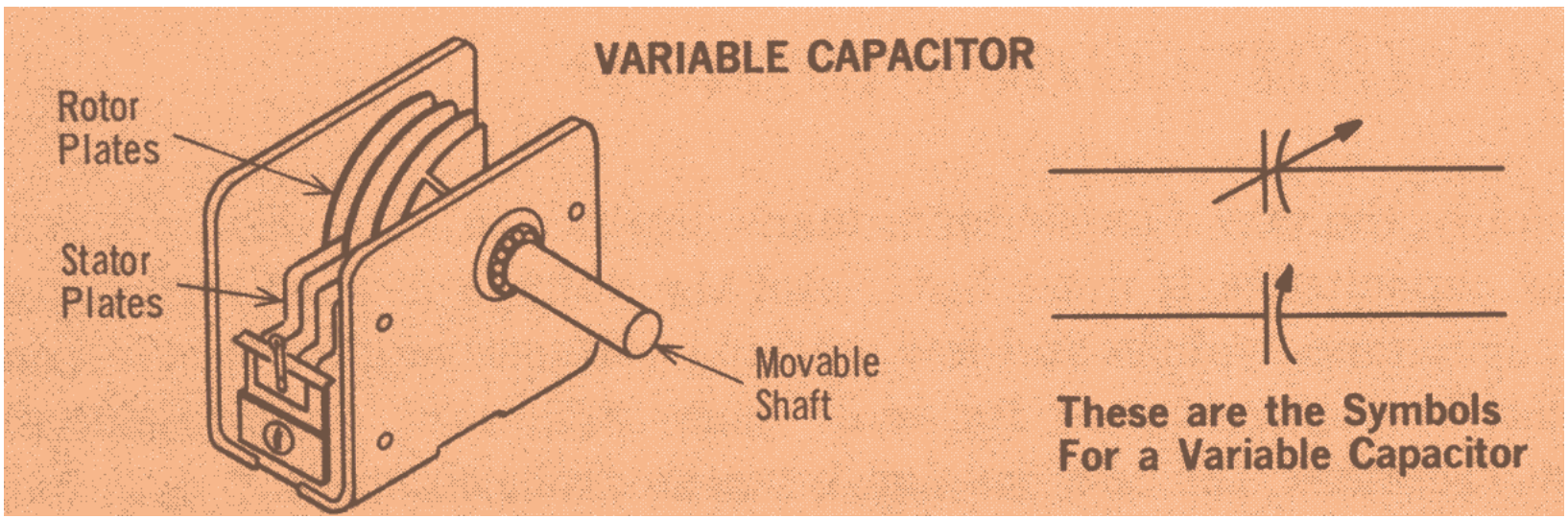
Electrolytic Capacitor
continued

- Sealed in a metal case
- Positive terminal indicated
  - Longer lead
  - Lead at marked end of case
- Used for power supply "Filters"
- Often several separate capacitors are packaged in one case.
- Small size:
  use tantalum dielectric



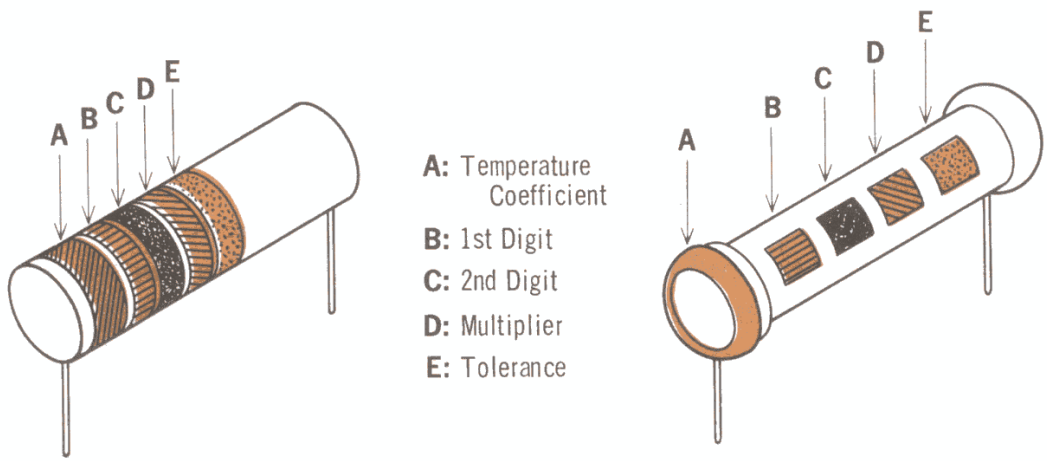
Adjustable Capacitors

- Parallel plate capacitor shown
  - "Tuning" capacitor in radios
  - "Resonance: cancel inductor reactance at one frequency
- "Trimmer" capacitors:
  - Vary distance between plates



Capacitor Color Codes

- Not Standardized
- Similar to the resistor codes



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Quiz 2 (no Wed. session)		
Session 2f – 04/22	**Review (Discuss Quiz 2)**	