# Electrical and Electronic Drawing

## Electronic Components – Part 2

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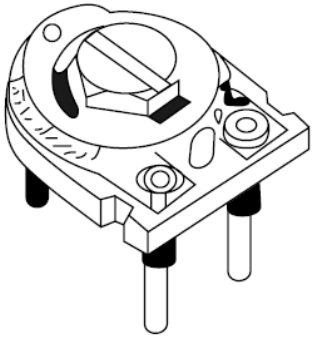
# Variable Resistors or Potentiometers

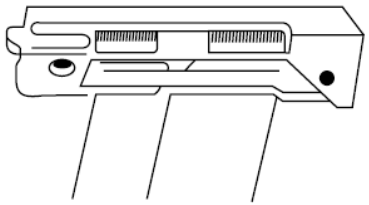
- "Pots" consist of a track of some type of resistance material with which a movable wiper makes contact
- 3 Categories: (a) Carbon (b) Cermet (c) Wire wound

Skeleton trimmer (carbon)

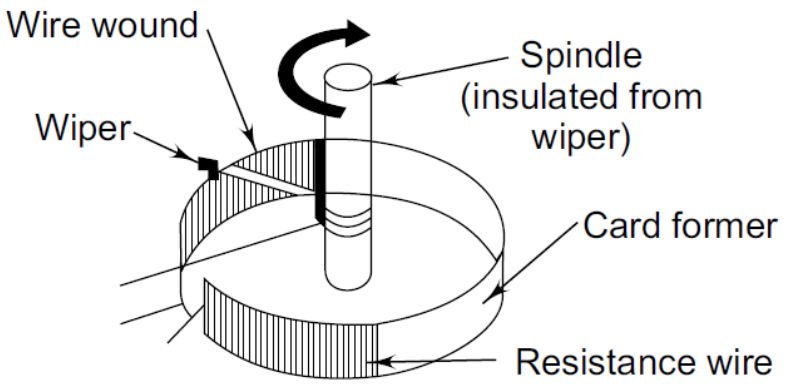


(a)

Cermet multi-turn pot



(b)



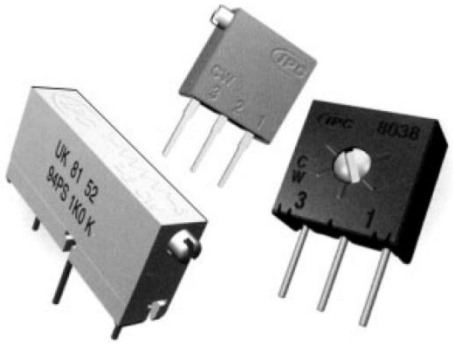

(c)

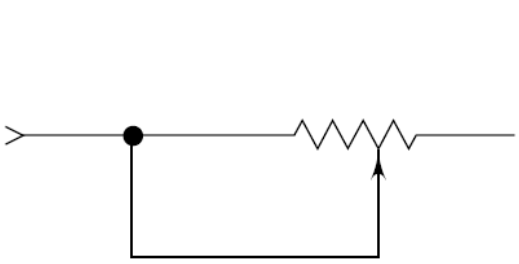
# Variable Resistors or Potentiometers

- Pots can be categorized into the following types depending upon the number of resistors and control arrangement used:
  - *Single Potentiometers*: *Pot control with one resistor*
  - *Tandem Potentiometers*: Two identical resistor units controlled by one spindle
  - *Twin Potentiometers*: Two resistor units controlled by two independent concentric spindles
  - *Multi-turn Potentiometers*: Potentiometer with knob or gear wheel for resistance adjustment; they may have up to 40 rotations of spindle
  - *Potpack*: Rectangular pots, either single or multi-turn

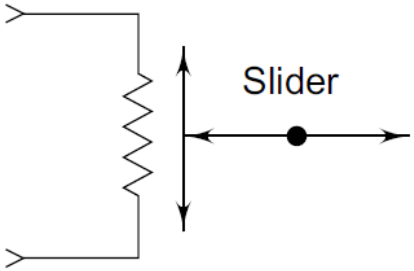
# Variable Resistors or Potentiometers

- Variable resistor can be used either as a rheostat or potentiometer



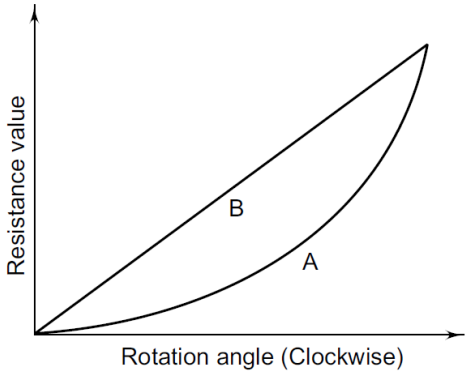


Rheostat




Potentiometer

- Construction resistance laws:
  - Linear
  - Logarithmic
  - Sine-Cosine



# Light-dependent Resistors (LDRs)

- Made of cadmium sulphide and contain very few free electrons
  - When kept in complete darkness and therefore, exhibit very high resistance.
  - When in light, electrons are liberated and the material becomes more conducting.
- Typical dark resistance of LDRs is 1-10 MOhms.
- Typical light resistance is 75 -300 ohms.
- LDRs take some finite time to change its state and this time is called the recovery time.
  - Typical recovery rate is 200 kOhms/sec.

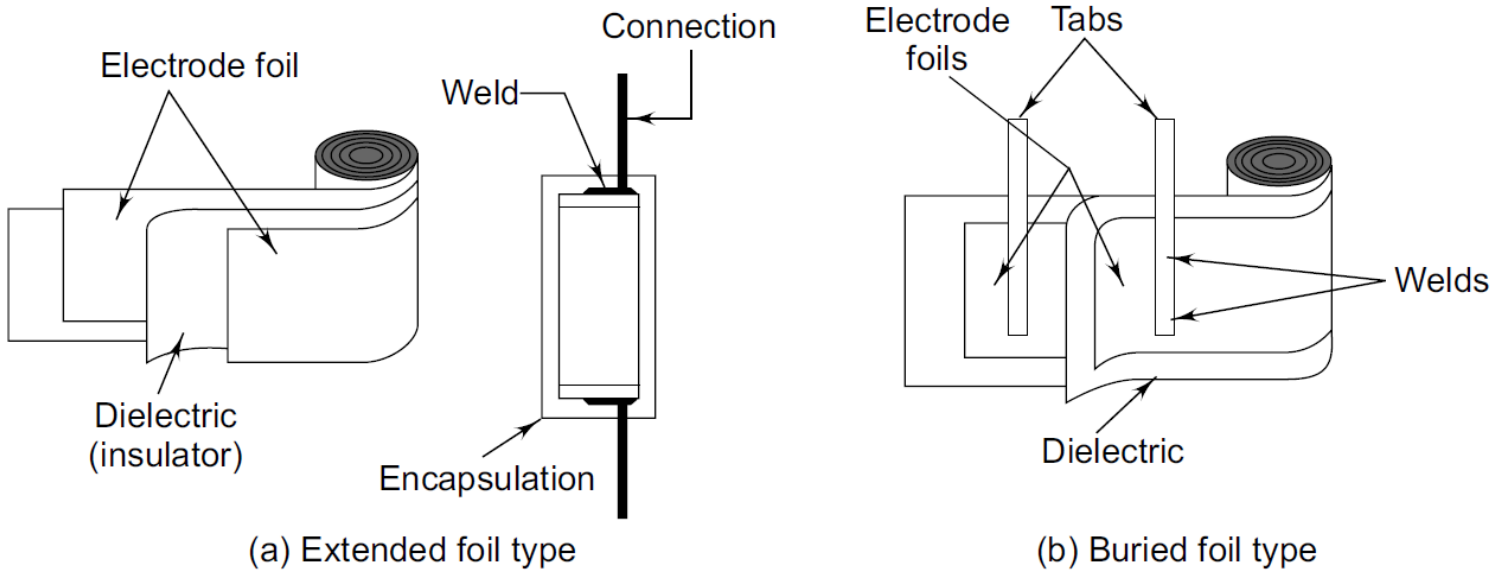
# Thermistors

- Resistors with high temperature co-efficient of resistance
- Two types:
  - Positive temperature coefficient (PTC)
  - Negative temperature coefficient (NTC) (most popular)
- Available in a wide variety of shapes and forms suitable for use in different applications.
- Inherently nonlinear resistance–temperature curve
  - Can be linearized by proper circuit

# Capacitors (Condensers)

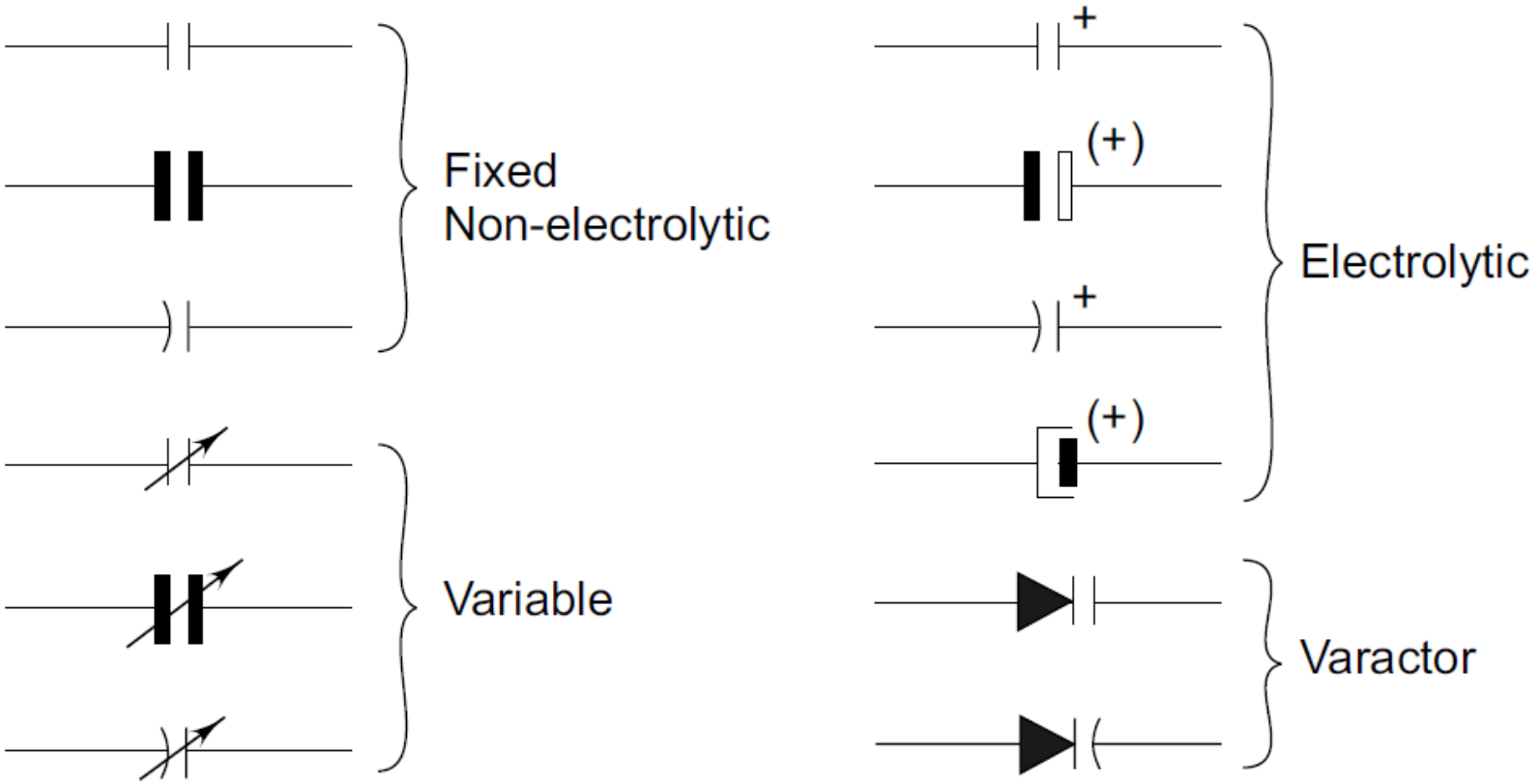
- Passive component that can be used to store electrical charge – measured in Farads (F)
- Consists of two facing conductive plates called electrodes, which are separated by a dielectric or insulator

$$Q = CV$$



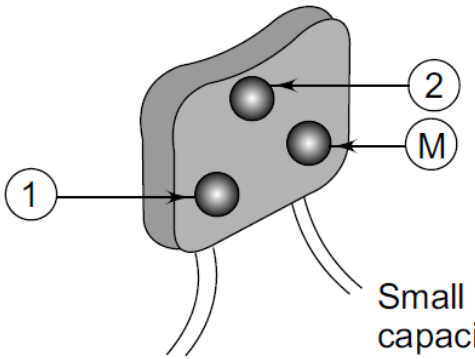
# Capacitors (Condensers)

- Graphical symbols

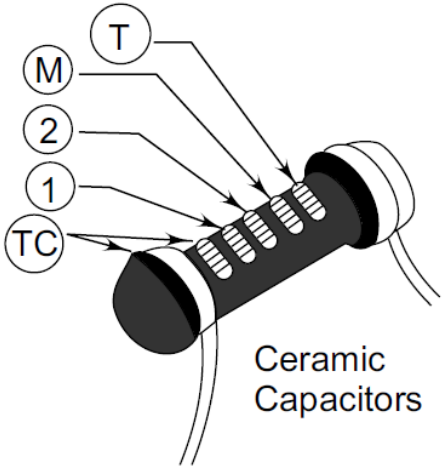


# Capacitors (Condensers)

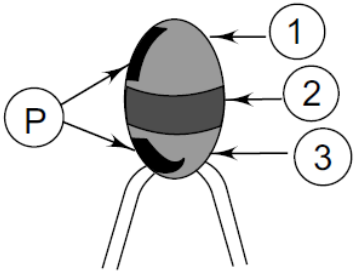
- Color code




Small disk capacitors




Ceramic Capacitors




Dipped tantalum electrolytics

Colour code

(1) (2) and (3) 1st, 2nd and 3rd significant figs.

(M) Multiplier (T) Tolerance

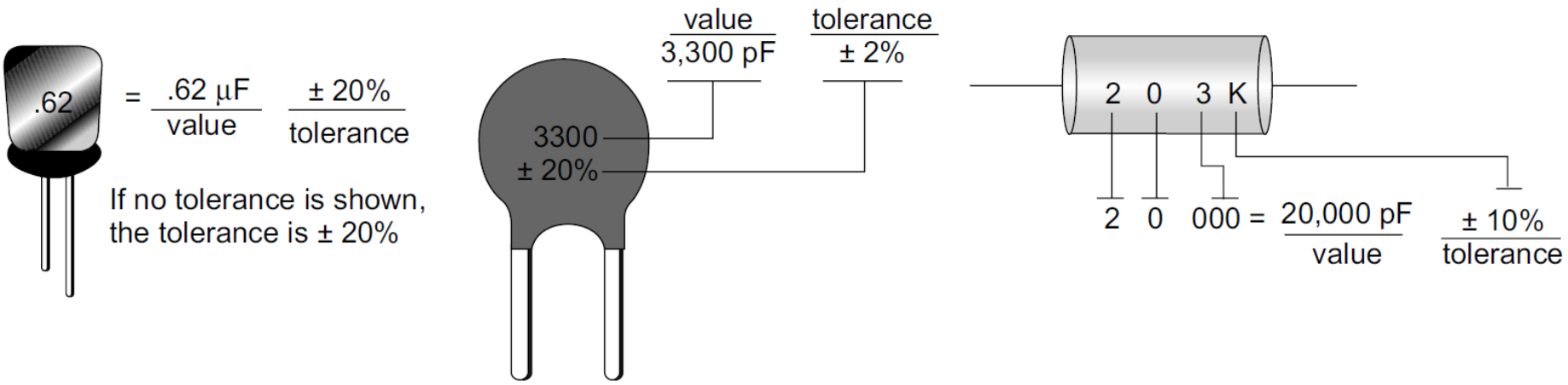
(TC) Temperature coefficient

(T) and/or (TC) Colour code may not be present on some capacitors

(P) Positive (+) polarity and voltage ratings

# Capacitors (Condensers)

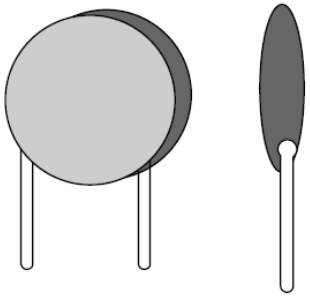
- Code for numbered capacitors



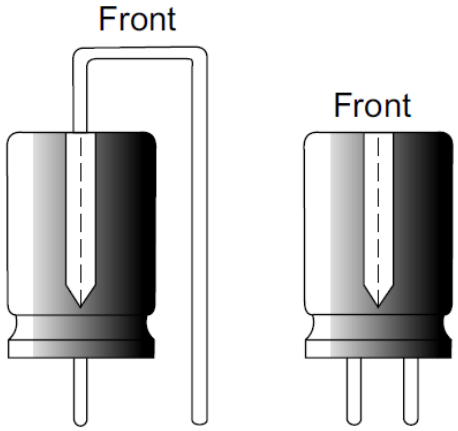

F = ±1%, G = ±2%, J = ±5%, K = ±10%, M = ±20% and Z = +80 to –20%

# Capacitors (Condensers)

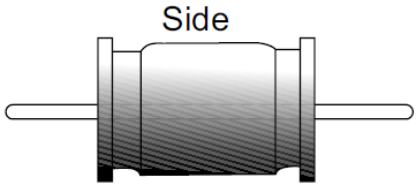
- Types



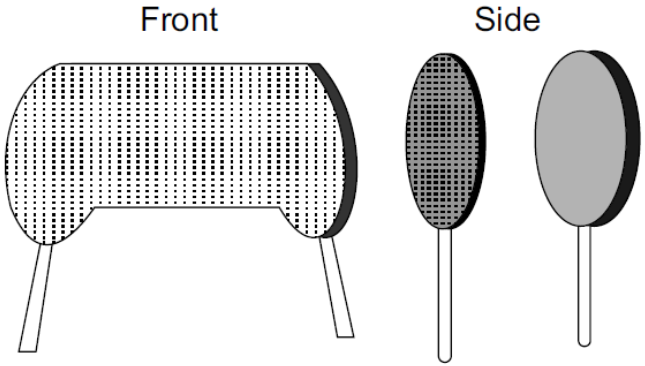

Ceramic disk



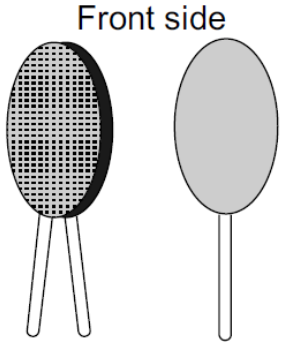

Electrolytic-negative lead is marked on the case




Polystyrene-clear covering metallic case




Metallized film

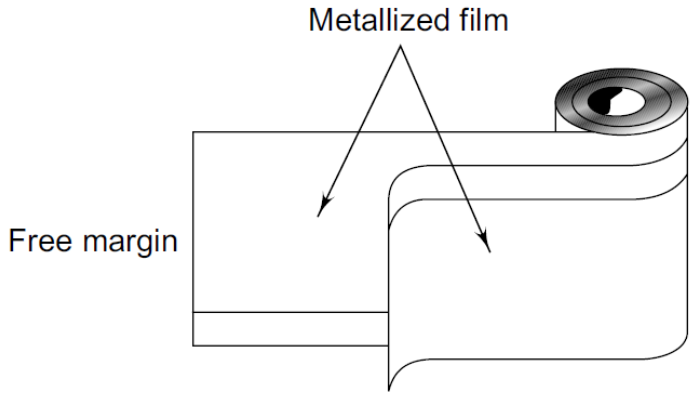



Tantalum

# Capacitors (Condensers)

- Paper capacitors

| | | |
|---|---|---|
| Typical range | : | 10 nF to 10 µF |
| Typical dc voltage | : | 500 V(max.) |
| Tolerance | : | ± 10% |




- Mica capacitors

| | | |
|---|---|---|
| Typical range | : | 5 pF to 10 nF |
| Typical dc voltage | : | 50 to 500 V |
| Tolerance | : | ± 0.5% |

- Ceramic capacitors

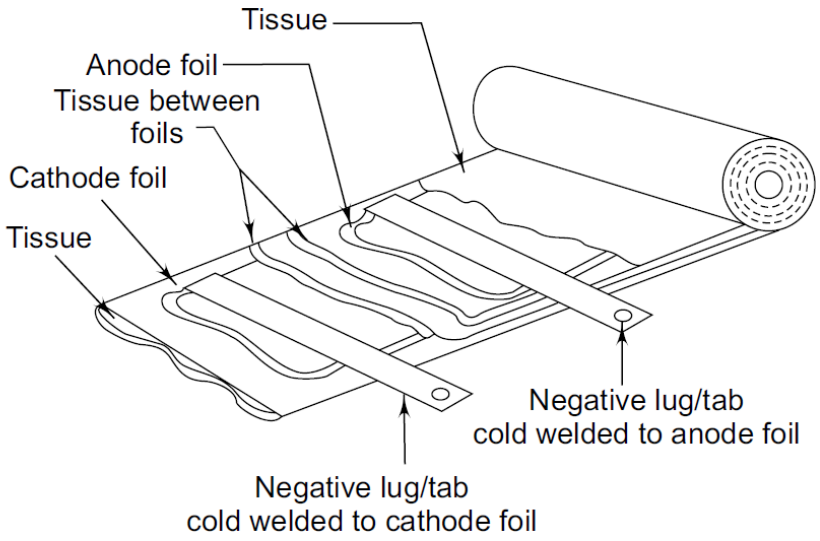
| | | |
|---|---|---|
| Typical range | : | (a) Low loss (steatite)<br>5 pF to 10 nF<br>(b) Barium titanate<br>5 pF to 1 µF<br>(c) Monolithic<br>1 nF to 47 µF |

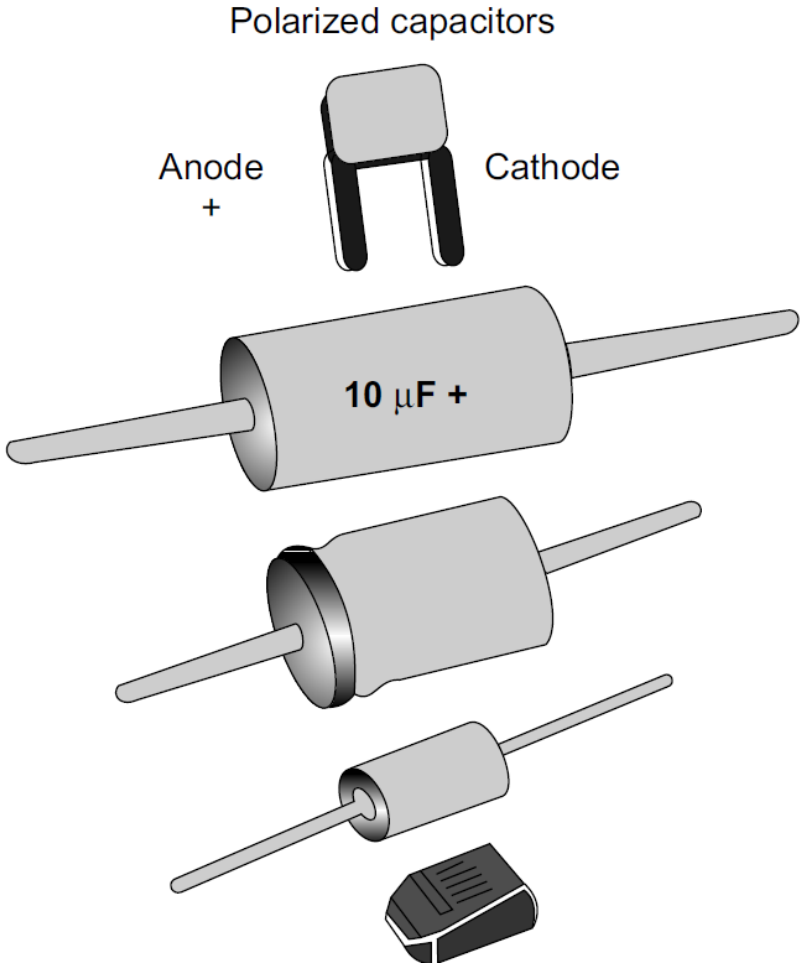
| | | |
|---|---|---|
| Typical voltage range | : | For a and b<br>60 V to 10 kV<br>For c: 60 V to 400 V |
| Tolerance | : | ± 10% to ± 20% |

- Plastic capacitors

# Capacitors (Condensers)

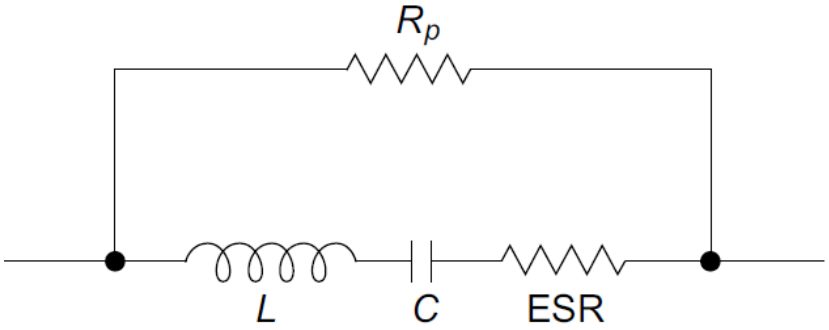
- Electrolytic capacitors
  - Aluminum
  - Tantalum



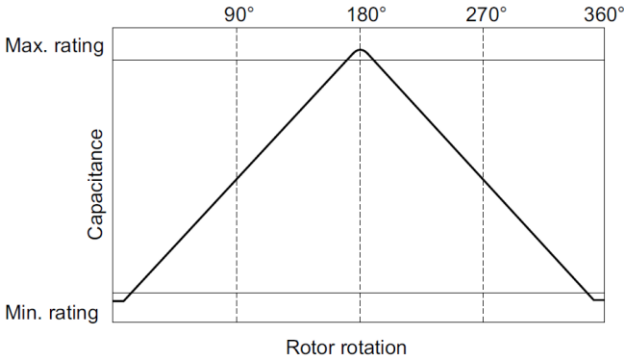
# Capacitors (Condensers)

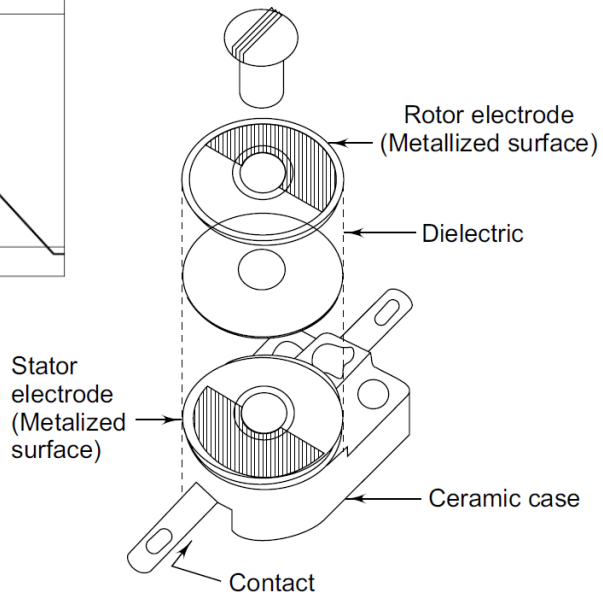
- Capacitance
- Tolerance
- Working Voltage (= ½ *breakdown voltage)*
- Temperature Coefficient
- DC Leakage
- Parasitic Effects
  - dissipation factor ($DF$)=1/$Q$

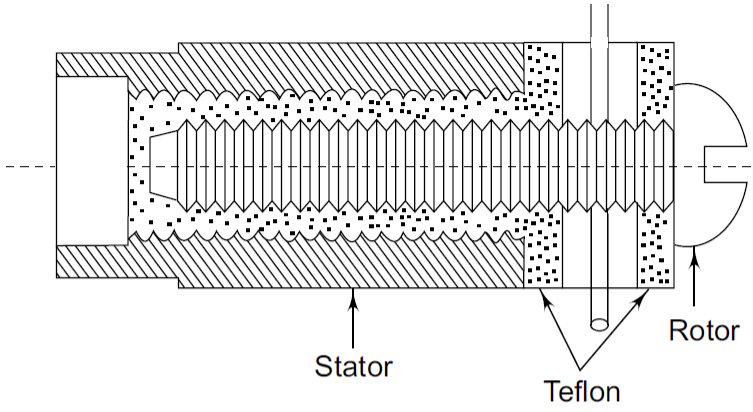


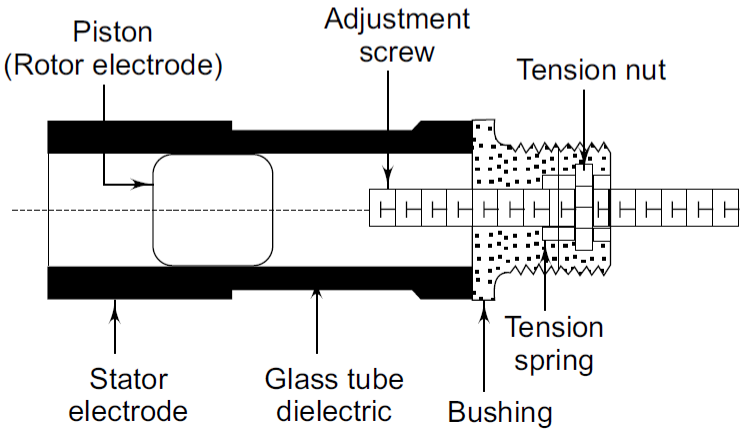
# Variable Capacitors

- Variable capacitor has a stator and a rotor to change area
  - Button type
  - Tubular type



# Assignments

- Visit Digikey Corp. web site (www.digikey.com) and select sample components for different types/packages discussed in this lecture. Report the specifications (including catalog page number and picture) of each and include your comments about the cost of different types.