

ELTN 115

Lecture 2.1

Electronic Components introduction and Passive devices

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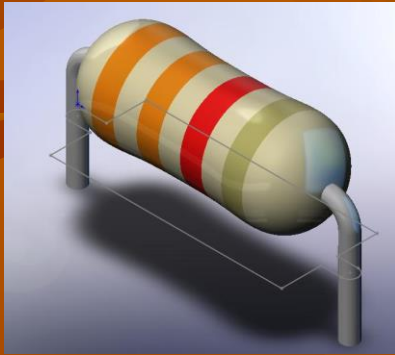
Electronic Components can be broken down into three main groups:

- Passive
- Active
- Electro-Mechanical

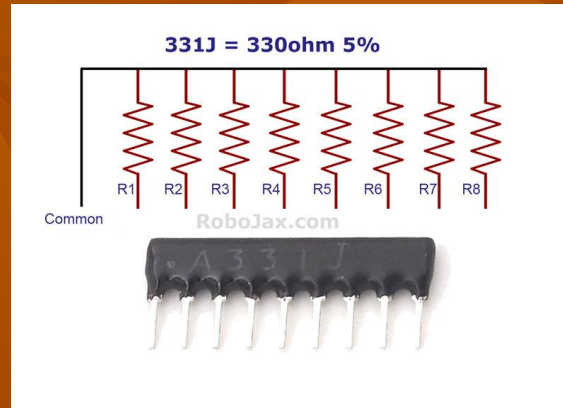
Passive components

- “Passive Devices” – how defined?
 - Cannot provide “gain” or amplification / switching in a circuit
- “Discrete” (individual) components
- Typically 2 leaded devices (2 wires / pins)
- Three general types – Resistors, Capacitors, Inductors

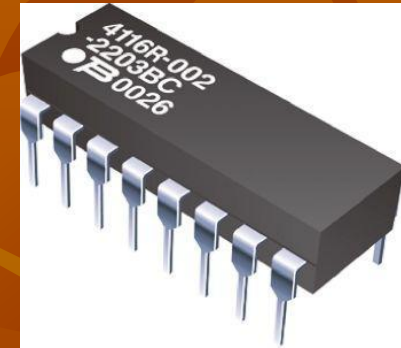
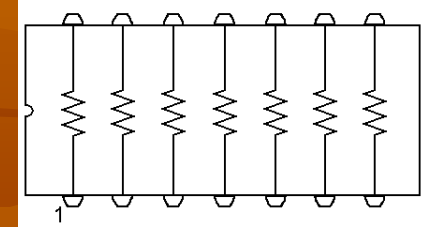
Resistors – common packages



Through Hole
Package



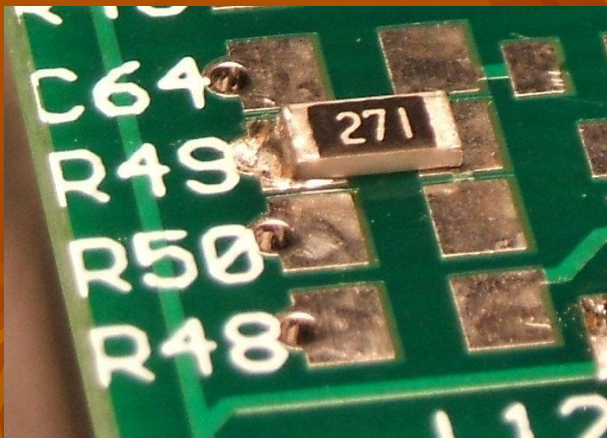
SIP – Single in-line Package



DIP – Dual in-line
Package

SMT Resistors

- Most current components are packaged as *Surface Mount Devices* (SMD), which are part of Surface Mount Technology (SMT).
- SMT resistors don't use a color code to identify values:



Most Common

223	223 = 22×10^3 = 22,000 Ohm = 22K Ohm	8202	8202 = 820×10^2 Ohm = 82,000 Ohm = 82 KOhm
Three-Digit Resistor		Four-Digit Resistor	
4R7	4R7 = 4.7 Ohm	0R22	0R22 = 0.22 Ohm
Resistor With Radix Point		Resistor With Radix Point	
0	0 = 0 Ohm	000	000 = 0 Ohm

For the resistor shown above, the first two numbers are the “value” and the third number is the multiplier, or # of zeros. So, the value would be 270 Ohms.

Resistors – cont'd



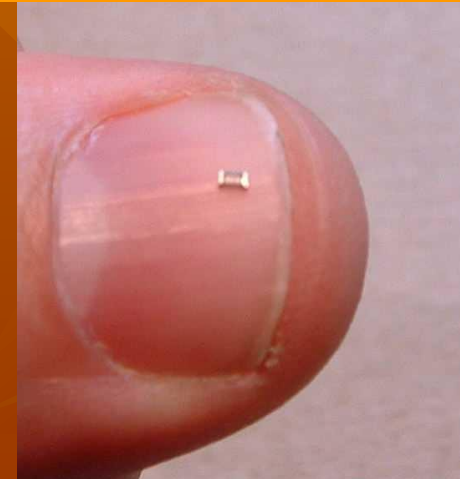
Three common sizes:

0603, 0805, 1206

Example: 0805

08 = .08" length 05 = .05" width

Case Size	Component Length	Component Width
0603	0.063	0.030
0805	0.080	0.050
1206*	0.126	0.063
2010	0.200	0.100
2512	0.250	0.125



Power Resistors

- Note – high wattage resistors are “wire-wound” using strips of metal or wire as the primary resistive material, not carbon. Wattages range from 10 – 100W
- These are not very common in PCB design due to their size!



Passives #2 - Capacitors

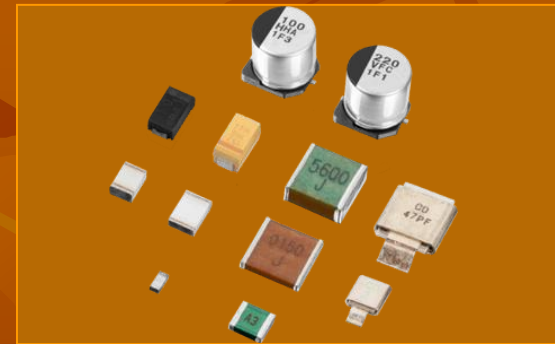
- Capacitors come in a variety of packages:



Electrolytic



Polyester

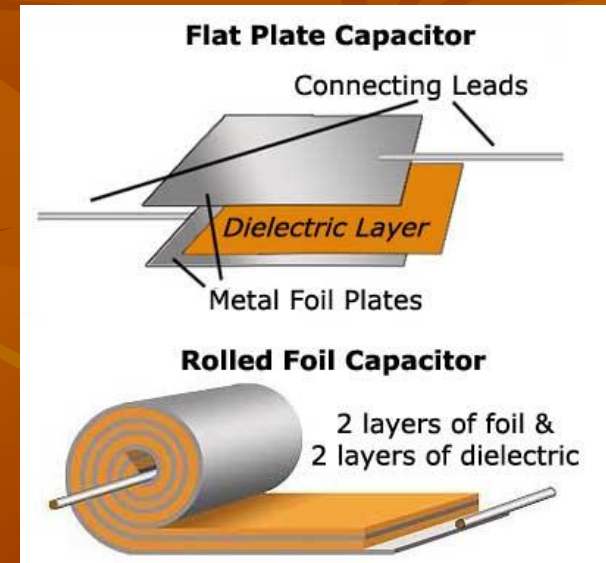
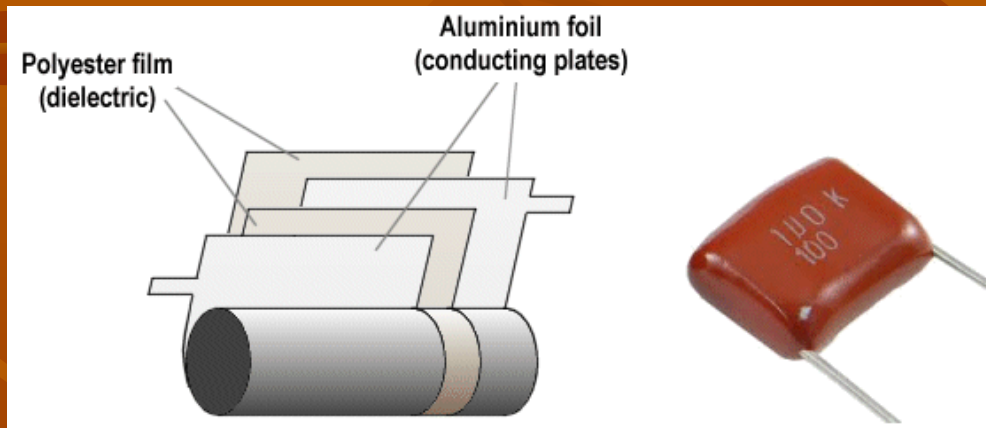


Surface Mount

Note – SMT Capacitors typically do NOT have numbers / values, except for polarized types (positive and negative leads)

Capacitors - Internal construction

What is a capacitor made of?



- Layers of conductors and Insulators
- Insulators are called *dielectric*
- The dielectric affects the sensitivity to temperature and other effects. There are LOTS of different types of dielectrics, often plastics are used.

Capacitor values

- Some small capacitor values are listed with numbers, not a color code: In this example, the number 104 is equal to 1×10^4 picofarads, which translates to $0.1\mu\text{F}$.



- Larger Electrolytic (polarized) capacitors have value printed on the case - This example shows $120\mu\text{F}$, 400V



Capacitor Tolerances

- Capacitor tolerances are based on the materials they are manufactured from.
- A single letter is used to define the tolerance band.
- Most common are in the +/-5% to 20% range

Code	Tolerance	Code	Tolerance
A	± 0.05 pF	K	± 10 %
B	± 0.1 pF	L	± 15 %
C	± 0.25 pF	M	± 20 %
D	± 0.5 pF	N	± 30 %
E	± 0.5 %	P	-0 to 100 %
F	± 1 %	S	-20 to 50 %
G	± 2 %	W	-0 to 200 %
H	± 3 %	X	-20 to 40 %
J	± 5 %	Z	-20 to 80 %

<http://mechatrotutor.blogspot.com/>

“Decoding” a capacitor!

- What data is important for selecting a capacitor?



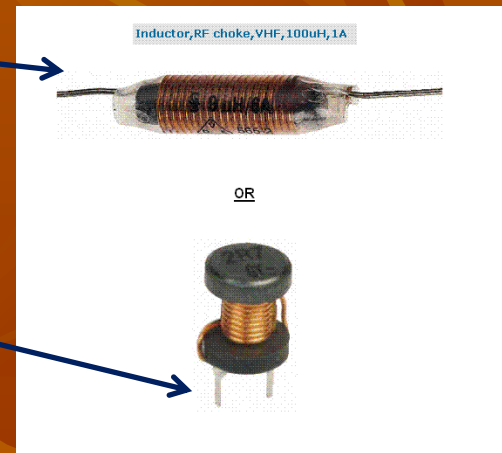
- Value
- Voltage
- Tolerance

Value: 120pF
Voltage: 8kV
Tolerance “K” = 10%

- So, based on what we’ve learned, what are these parameters for this capacitor?

Inductors

- Typically a coil of wire wound around a ferrite core.
- Packages are usually “radial” or “axial”
 - Axial – think “axle”
 - Radial – both leads (wires) on same end



Values

- Values are typically small – micro-Henries or milli-Henries. 1 Henry is VERY large!
- Current rating is critical – listed for both DC and AC current, depending on the application.