Resistors

{ ELTN 130
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– Engineer / Teacher / Student / Hobbyist

Resistors – the most common discrete component in electronics
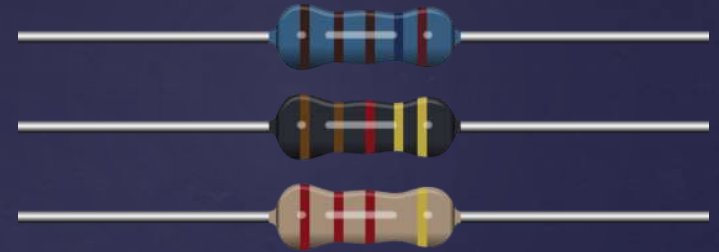
Schematic symbol: Standard way of drawing a resistor in a circuit diagram:

Several aspects of resistors we'll be looking at:

o Purpose / Use

o Resistor Identification

o Resistor construction

o Types of resistors

o Color Code

o Tolerance

o Standard Resistor Values

o Power Rating

o Variable Resistors

Basic Information:

- Purpose: limit the flow of current – also "drop" voltage
- Variety of shapes and sizes

Come in two classifications:
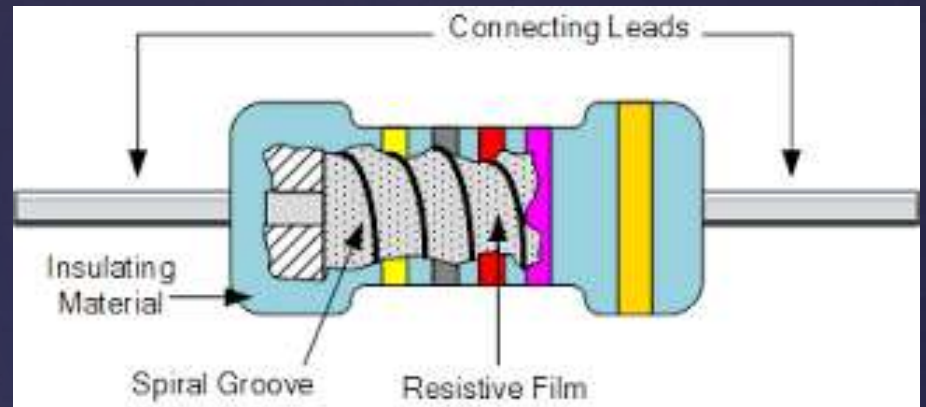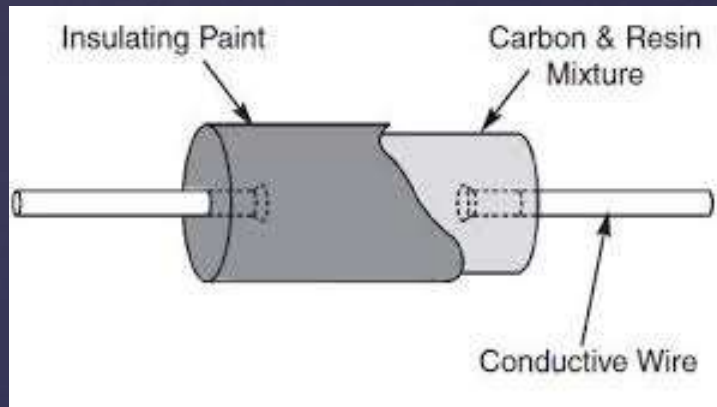   Fixed values / Variable
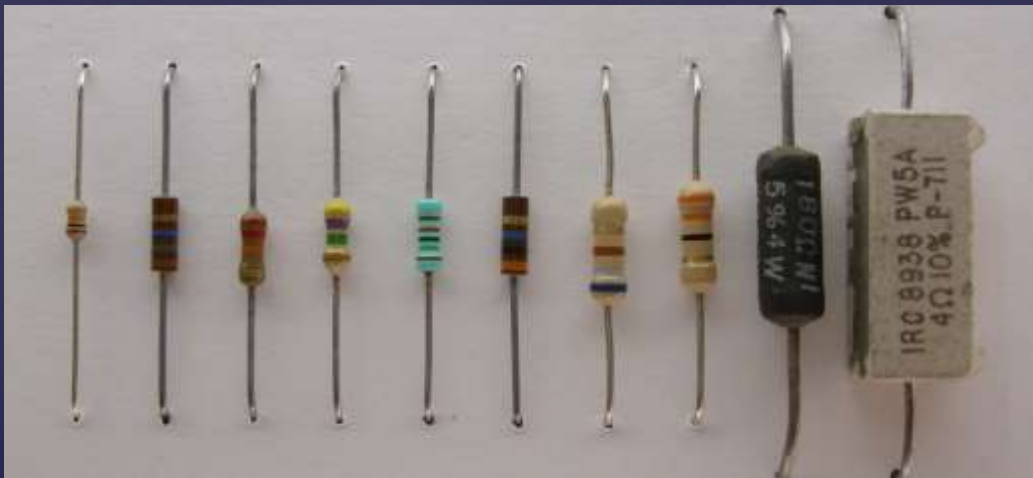
Fixed Value Resistors

Variable Resistors
(Potentiometers)

Fixed value – internal construction

• Resistors have two wires for connections to circuits.

• Since there is no "polarity" (positive or negative side) it doesn't matter how they are connected in a circuit.

• The value of the resistance is based on the ratio of conductive material to insulating material.

Common types of resistors…

Carbon film Resistor

– Most common

– Inexpensive

– Manufactured in standard values
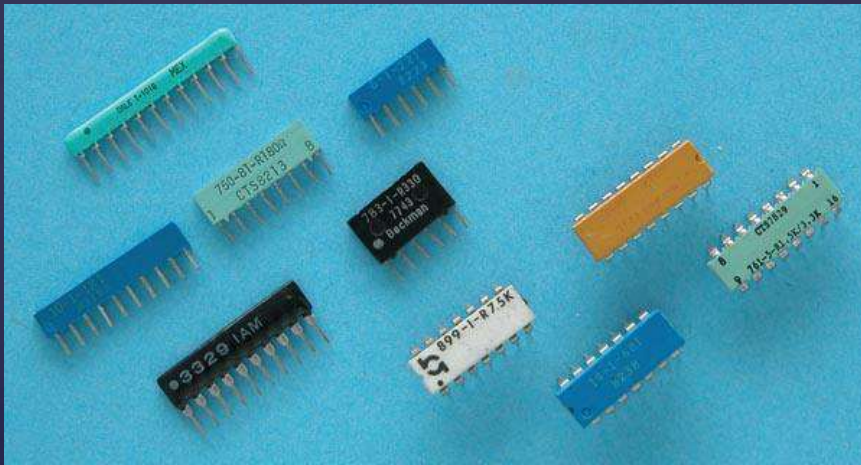
Power resistors (wire wound)

- Used in high-current circuits

Common types of resistors…

Resistor Networks / Surface Mount

- Networks – multiple resistors in one package
- Surface mount – most common for high volume manufacturing using robots (consumer electronics)

Resistor Networks

Surface Mount resistors

Ranges of resistor values

- Resistors have a wide range of values – from .01Ω to 10,000,000 Ω !!
- Engineers use **Engineering Notation** with letter abbreviations:

1,000 Ω = 1 x 10^3 , abbreviated **1K** Ω (K stands for Kilo)

1,000,000 Ω = 1 x 10^6 , abbreviated **1M** Ω (M stands for Meg)
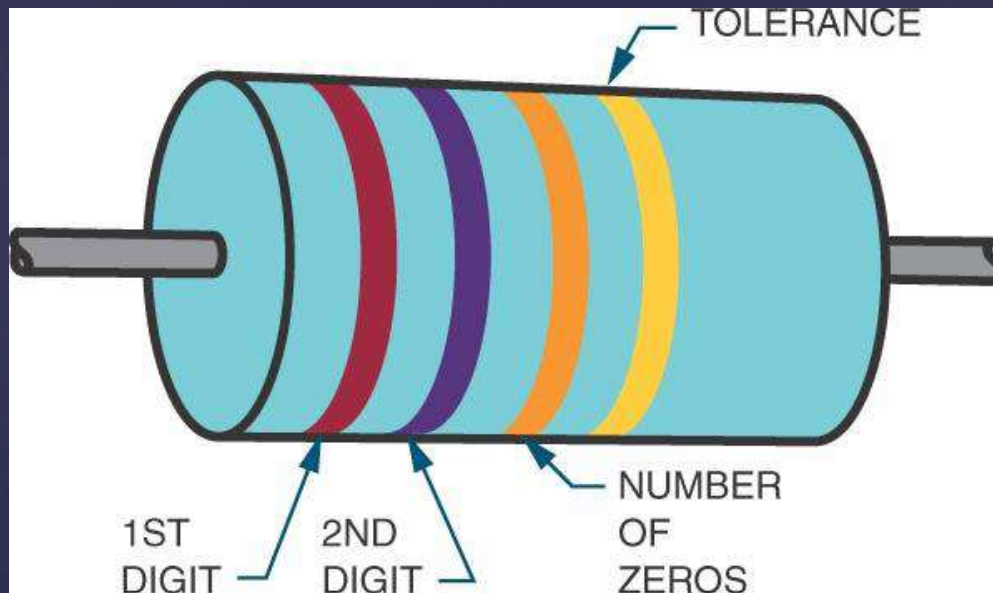
A 15,000 Ohm resistor is written as **15K** Ω

A 2,200,000 Ohm resistor is written as **2.2M** Ω

Standard Resistor Values

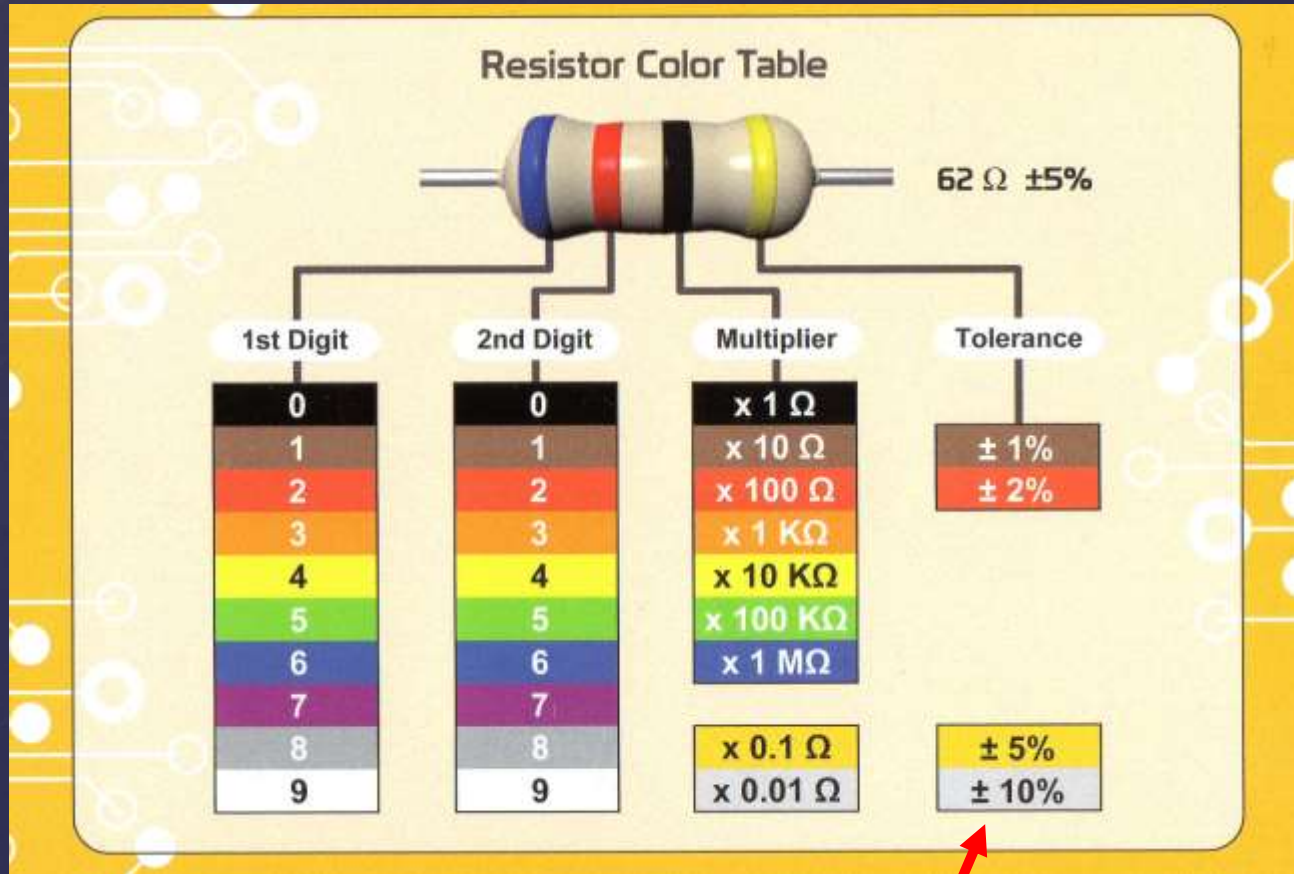- Resistor values have a "cardinal" (fixed sequence) order.

- For example: 1Ω, 1.5Ω, 2.2Ω, 3.3Ω, 4.3Ω, 4.7Ω, etc.
- These follow in powers of 10:   33 Ω, 330 Ω, 3.3K Ω, etc.

- For more information:
- https://www.youtube.com/watch?v=jSPNvJ0XYCQ
- https://youtu.be/jSPNvJ0XYCQ1

Color Code

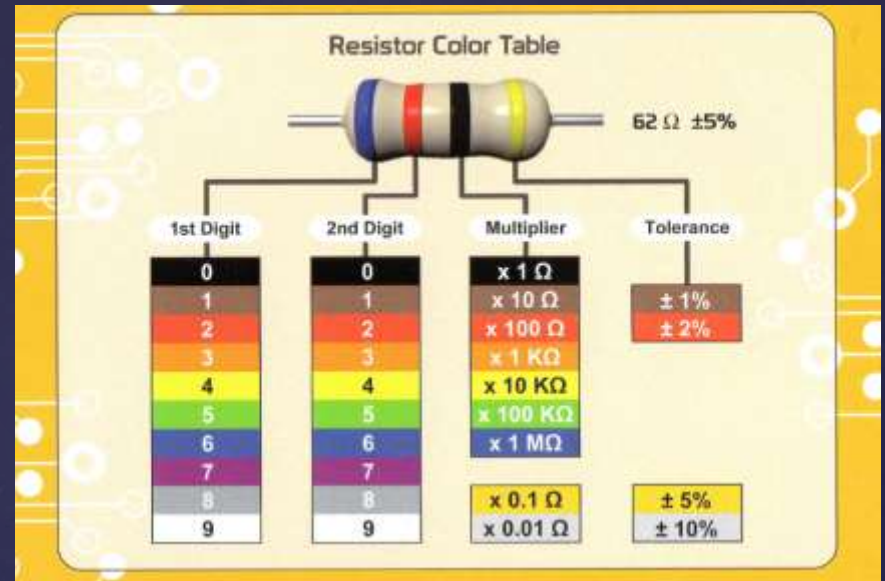Resistor values are identified using a banded color code system

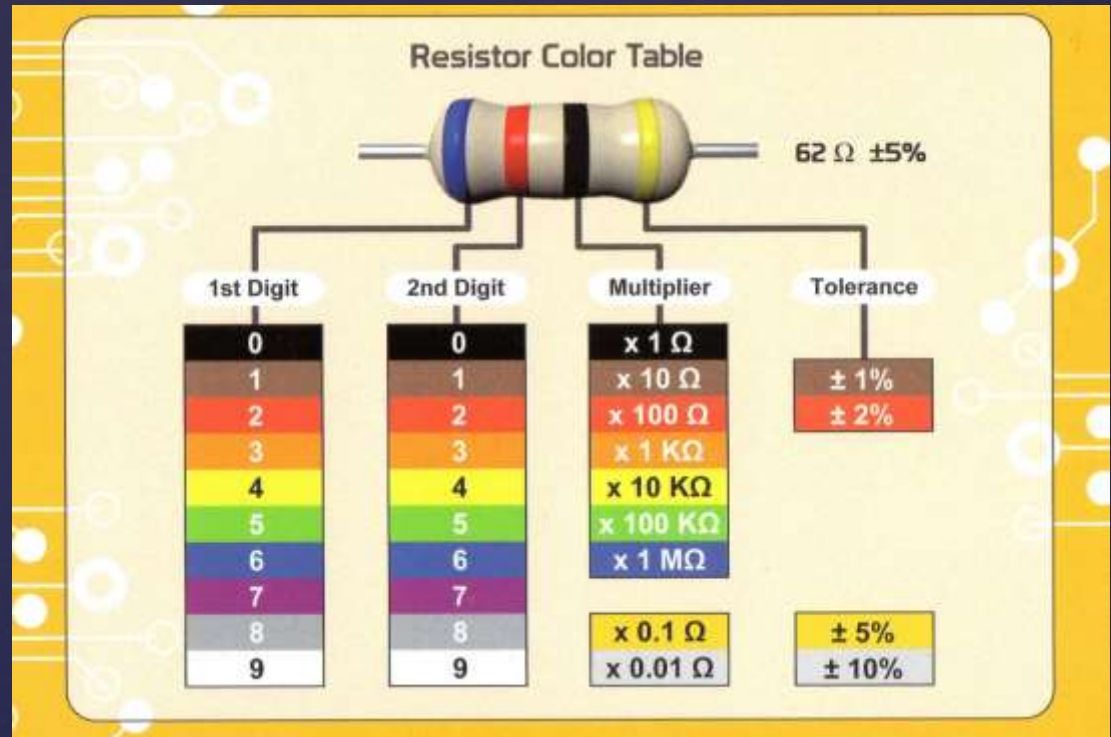# Color code cont'd

Note: +/-5% is GOLD
+/-10% is SILVER

Practice…color code to value

o Red Red Red Silver

o Yellow Violet Brown Gold

o Orange White Red Gold

o Brown Black Red Gold

o Brown Black Black Gold

o Green Blue Orange Gold

o Blue Green Green Gold

Resistor Color Table

Practice…the other way…

– 1K Ω 5%
– 270Ω 10%
– 33 Ω 5%
– 750K Ω 5%
– 2.2M Ω 5%
– 56K Ω 5%

Resistor Color Table

62 Ω ±5%

1st Digit	2nd Digit	Multiplier	Tolerance
0	0	x 1 Ω	
1	1	x 10 Ω	± 1%
2	2	x 100 Ω	± 2%
3	3	x 1 KΩ	
4	4	x 10 KΩ	
5	5	x 100 KΩ	
6	6	x 1 MΩ	
7	7		
8	8	x 0.1 Ω	± 5%
9	9	x 0.01 Ω	± 10%

Tolerance calculations

- Tolerance is determined by the 4th band
- Gold = 5% = most common tolerance
  - This really means +/-5%
- Example: 100 Ohm resistor…
  - 0.05 x 100 = 5 Ohms
  - Since it's +5% and -5% , add and subtract the tolerance from the value:
  - 100 Ω + 5 Ω = 105 Ω
  - 100 Ω – 5 Ω = 95 Ω
  - Lowest possible value = 95 Ω, largest value = 105 Ω

Value calculator webtool

http://resistor.cherryjourney.pt/

Power Rating

- The resistor's power rating is limited by the physical size and construction – power is related to heat dissipation and measured in **Watts**
- Most resistors we will use are ¼ Watt.

Variable Resistors

- Variable resistors are also called *potentiometers*. They allow a change in resistance based on rotary position.
- We will cover these in class in future labs.
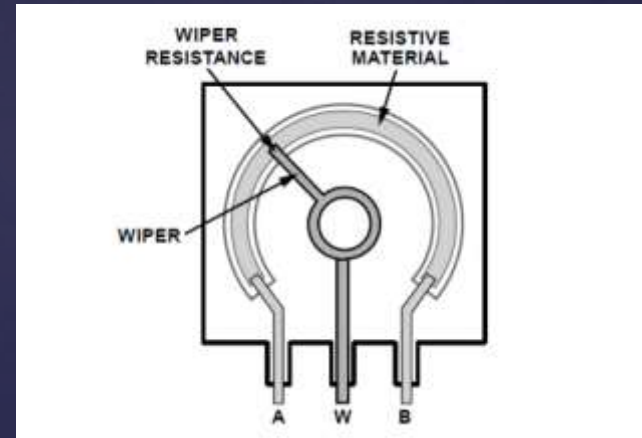
References

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- www.quora.com
- https://www.google.com/search?newwindow=1&biw=1344&bih=681&tbm=isch&sa=1&q=resistor+internal&oq=resistor+internal&gs_l=img.3..0i30j0i8i30l3.95444.96995.0.97742.10.9.0.0.0.0.410.836.2j2j4-1.5.0....0...1c.1.64.img..5.5.826...0j0i24.J2wv7W4cOnc#imgrc=Ez_J8ap5APRxQM%3A
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- https://www.google.com/search?newwindow=1&biw=1344&bih=681&tbm=isch&sa=1&q=resistors&oq=resistors&gs_l=img.3..0l10.2182.3546.0.3695.9.8.0.0.0.0.259.951.0j3j2.5.0....0...1c.1.64.img..4.5.943.G_a39QJsQfE#imgrc=fUfeZr1sp6O47M%3A
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- 8x8GHVyj9xRn4n5txAgwQ&ust=1463531044664192https://www.google.com/search?newwindow=1&biw=1344&bih=681&tbm=isch&sa=1&q=resistor+color+code&oq=resistor+color+code&gs_l=img.3..0l10.2678235.2682114.0.2682309.19.18.0.0.0.0.325.2675.0j6j4j2.12.0....0...1c.1.64.img..7.12.2658.BntmGgxoj4M#imgrc=_
- www.canstockphoto.com