



# **Component Identification: Analog**

## **Introduction to Resistors and Capacitors**

# Component Identification

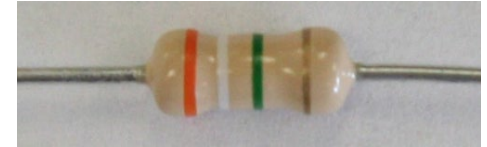
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This presentation will...

- Introduce common components used in electronics.
- Define a resistor and present various resistor types and package styles.
- Demonstrate how to read a resistor's nominal value and how to measure its actual value with a Digital Multi-Meter (DMM).
- Define a capacitor and present various capacitor types and package styles.
- Demonstrate how to read a capacitor's nominal value.



# Resistors

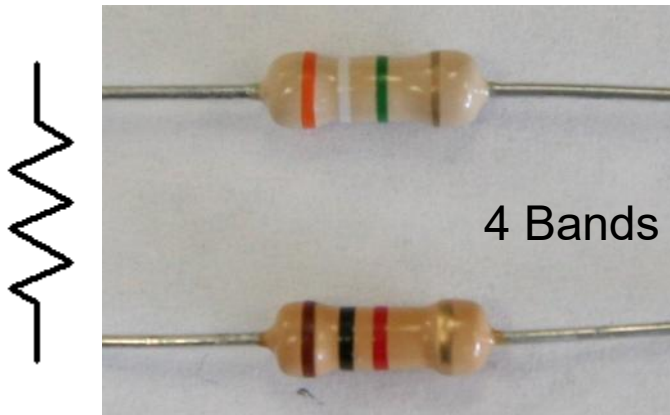


- A resistor is an electronic component that resists the flow of electrical current.
- A resistor is typically used to control the amount of current that is flowing in a circuit.
- Resistance is measured in units of ohms ( $\Omega$ ) and named after George Ohm, whose law (Ohm's Law) defines the fundamental relationship between voltage, current, and resistance.

# Resistors: Types and Package Styles

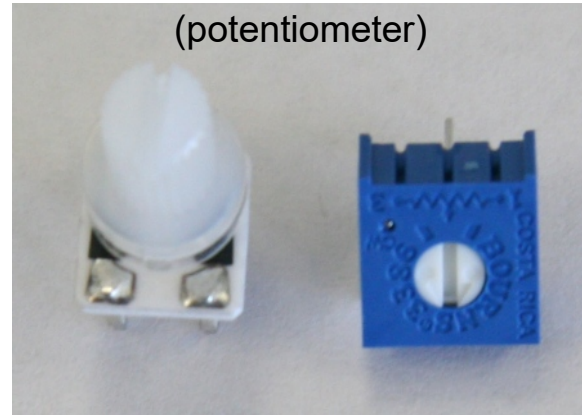
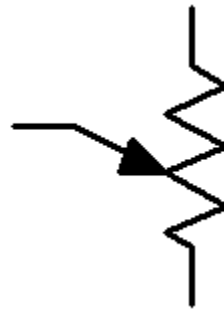
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Carbon Film Resistors

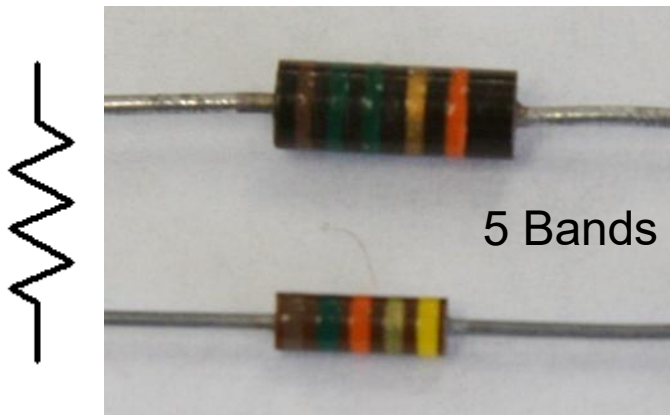


Variable Resistors

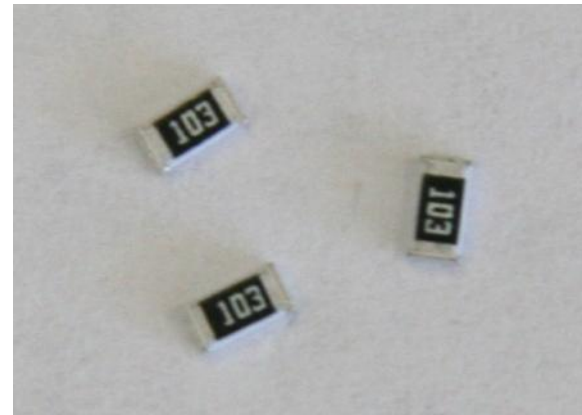
(potentiometer)



Carbon Film Resistors

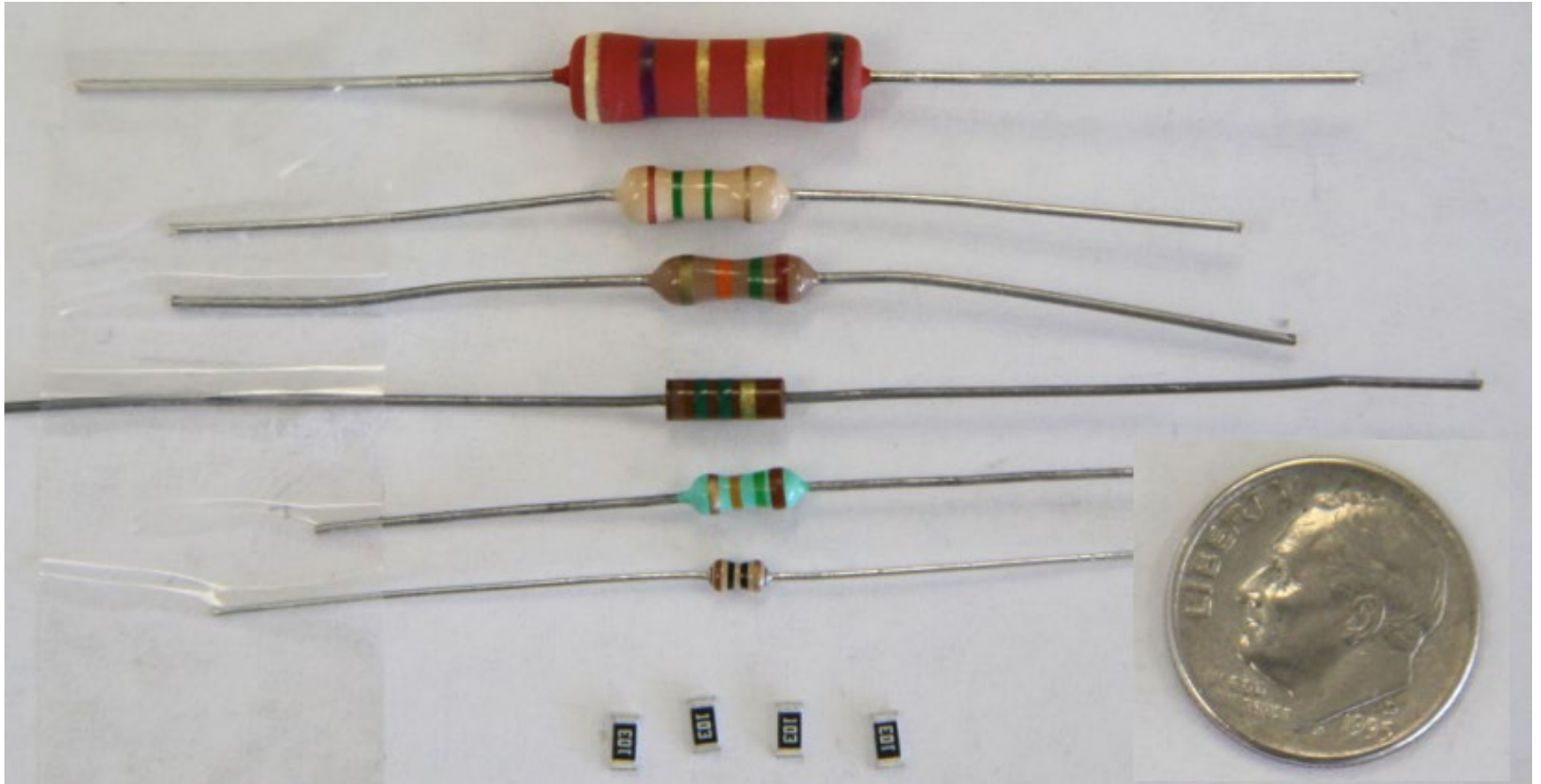


Surface Mount Resistors



# Resistors: Size Comparison

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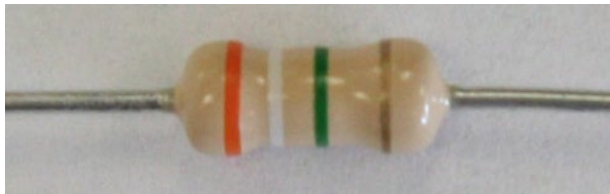


# Determining A Resistor's Value

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## Color Code

- Resistors are labeled with color bands that specify the resistor's nominal value.
- The nominal value is the resistor's face value.



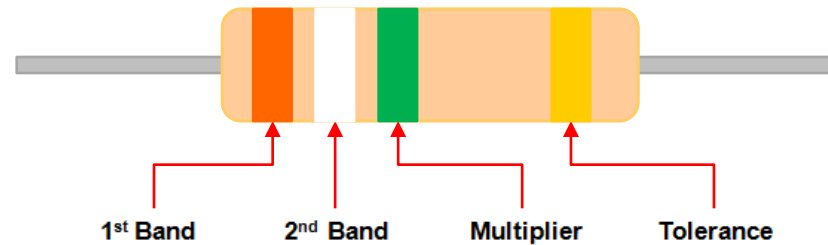
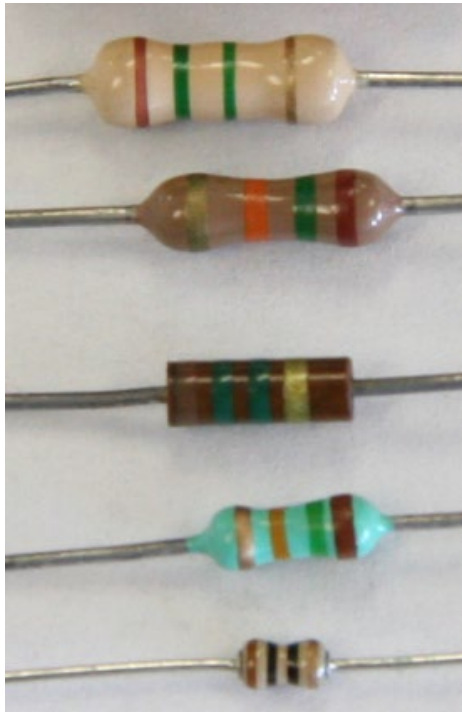
## Measured Value

- A Digital Multimeter DMM can be used to measure the resistor's actual resistance value.



# How To Read A Resistor's Value

## Resistor Color Code



NONE				20%
Silver			0.01	10%
Gold			0.1	5%
Black	0	0	1	
Brown	1	1	10	
Red	2	2	100	
Orange	3	3	1K	
Yellow	4	4	10K	
Green	5	5	100K	
Blue	6	6	1M	
Violet	7	7	10M	
Gray	8	8	100M	
White	9	9	1000M	

# Resistor Value: Example #1

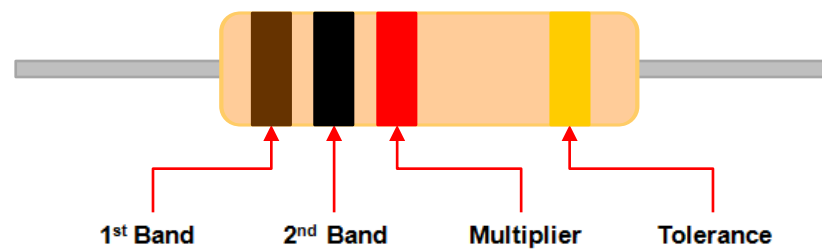
Example:

Determine the nominal value for the resistor shown.

1 0 X 100

1000  $\Omega$

1 k $\Omega$



NONE				20%
Silver			0.01	10%
Gold			0.1	5%
Black	0	0	1	
Brown	1	1	10	
Red	2	2	100	
Orange	3	3	1K	
Yellow	4	4	10K	
Green	5	5	100K	
Blue	6	6	1M	
Violet	7	7	10M	
Gray	8	8	100M	
White	9	9	1000M	



# Resistor Value: Example #2

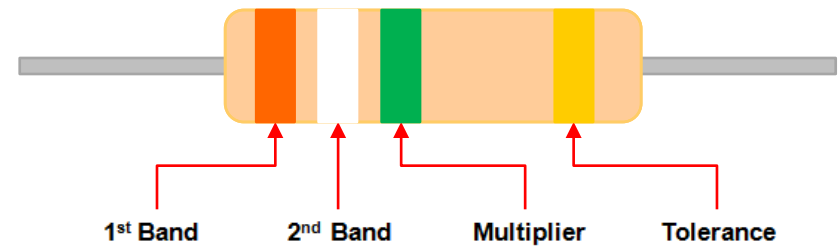
Example:

Determine the nominal value for the resistor shown.

3 9 X 100K

3900 k $\Omega$

3.9 M $\Omega$



NONE			20%
Silver		0.01	10%
Gold		0.1	5%
Black	0	0	1
Brown	1	1	10
Red	2	2	100
Orange	3	3	1K
Yellow	4	4	10K
Green	5	5	100K
Blue	6	6	1M
Violet	7	7	10M
Gray	8	8	100M
White	9	9	1000M

# Resistor Value: Example #3

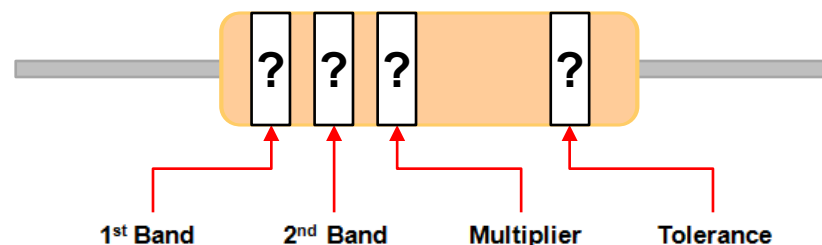
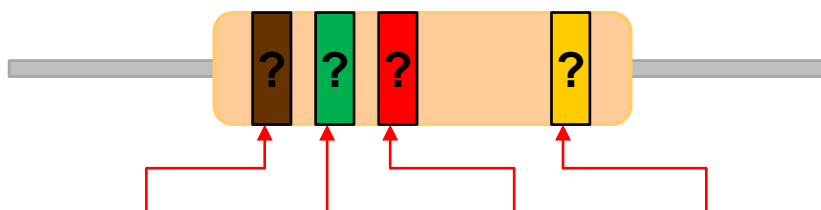
Example:

Determine the color bands for a  $1.5 \text{ K } \Omega \pm 5\%$  resistor.

Brown

Green

Red



NONE				20%
Silver			0.01	10%
Gold			0.1	5%
Black	0	0	1	
Brown	1	1	10	
Red	2	2	100	
Orange	3	3	1K	
Yellow	4	4	10K	
Green	5	5	100K	
Blue	6	6	1M	
Violet	7	7	10M	
Gray	8	8	100M	
White	9	9	1000M	

# Measured Value

Using a Digital Multi-Meter (DMM) to measure resistance.





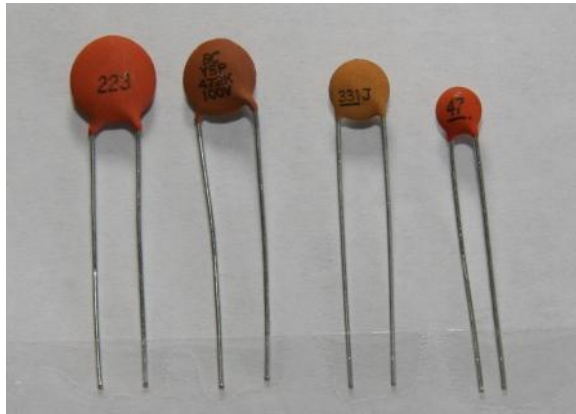
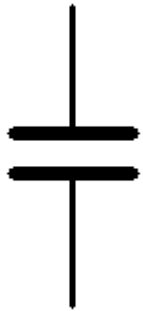
# Capacitors



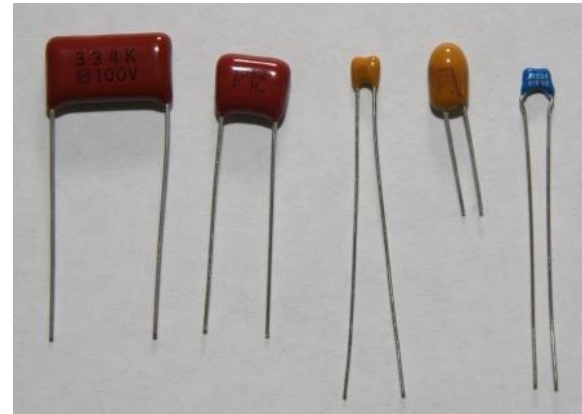
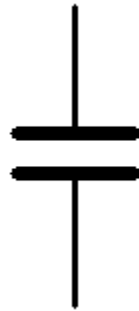
- A capacitor is an electronic component that can be used to store an electrical charge.
- Capacitors are often used in electronic circuits as temporary energy-storage devices.
- Capacitance is measured in units of farads (F) and named after Michael Faraday, a British chemist and physicist who contributed significantly to the study of electromagnetism.

# Capacitors: Types and Package Styles

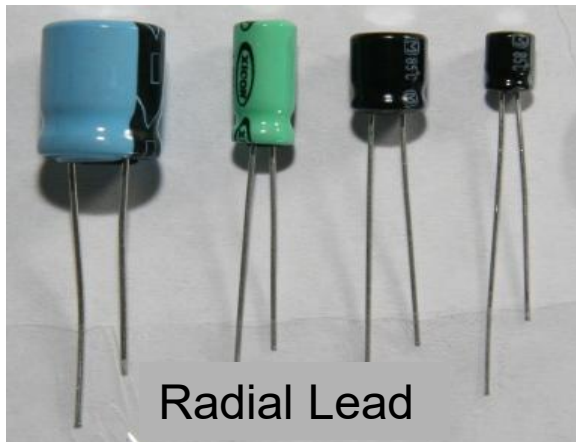
Ceramic Disc Capacitors



Mylar / Tantalum  
Monolithic Ceramic

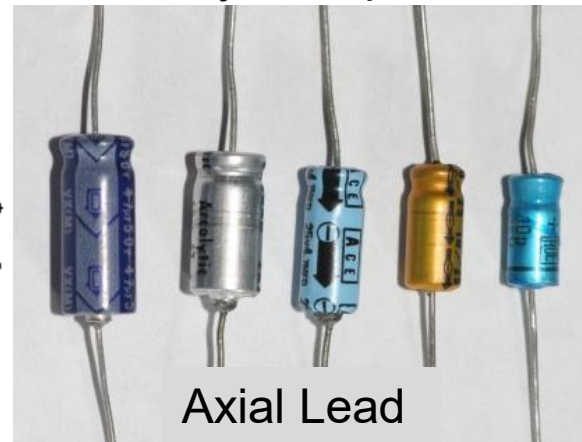


Electrolytic Capacitors



Radial Lead

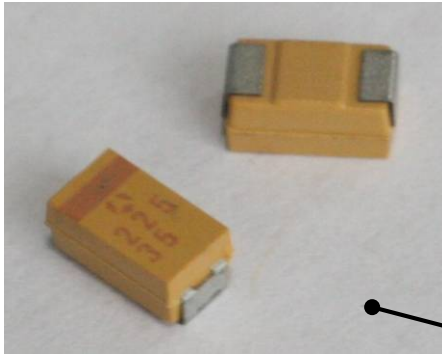
Electrolytic Capacitors



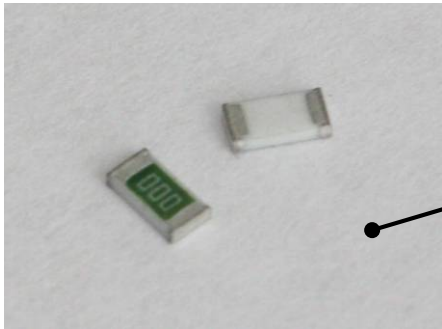
Axial Lead

# Capacitors: Types and Package Styles

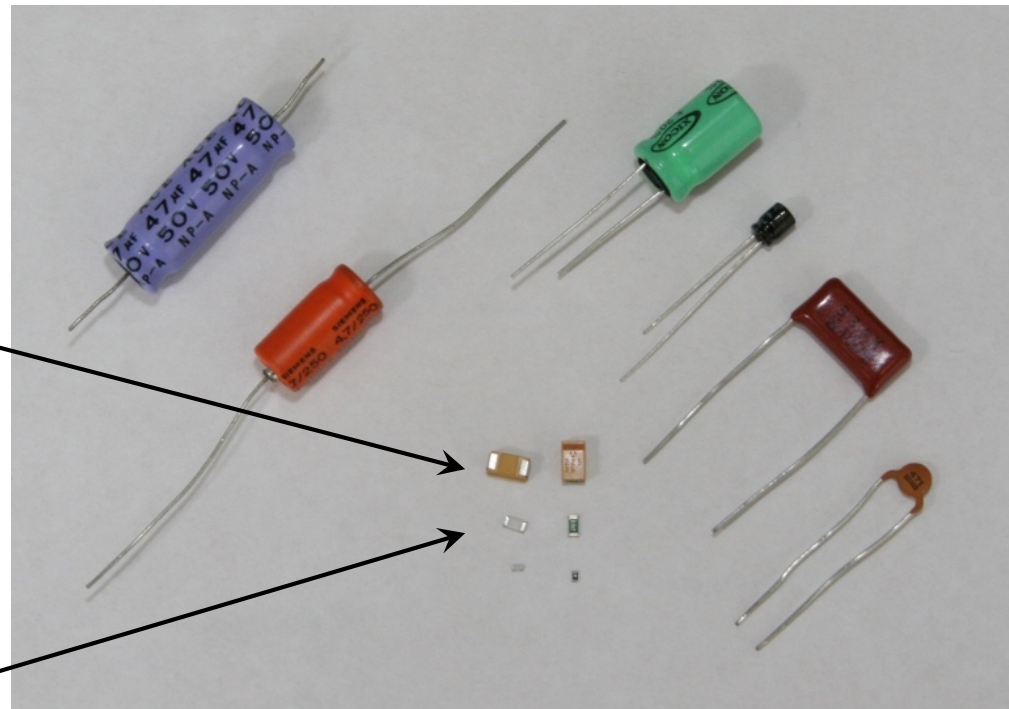
Surface Mount  
Tantalum Capacitors



Surface Mount  
Ceramic Capacitors



Size Comparison

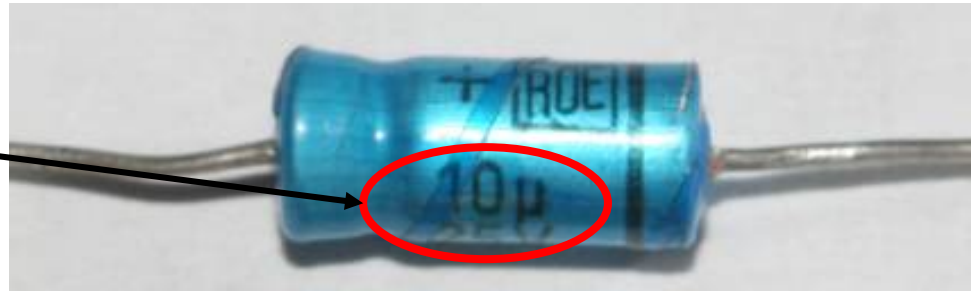


# How To Read A Capacitor's Value

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## Electrolytic Capacitors

**$10\ \mu\text{F} \pm 20\%$**



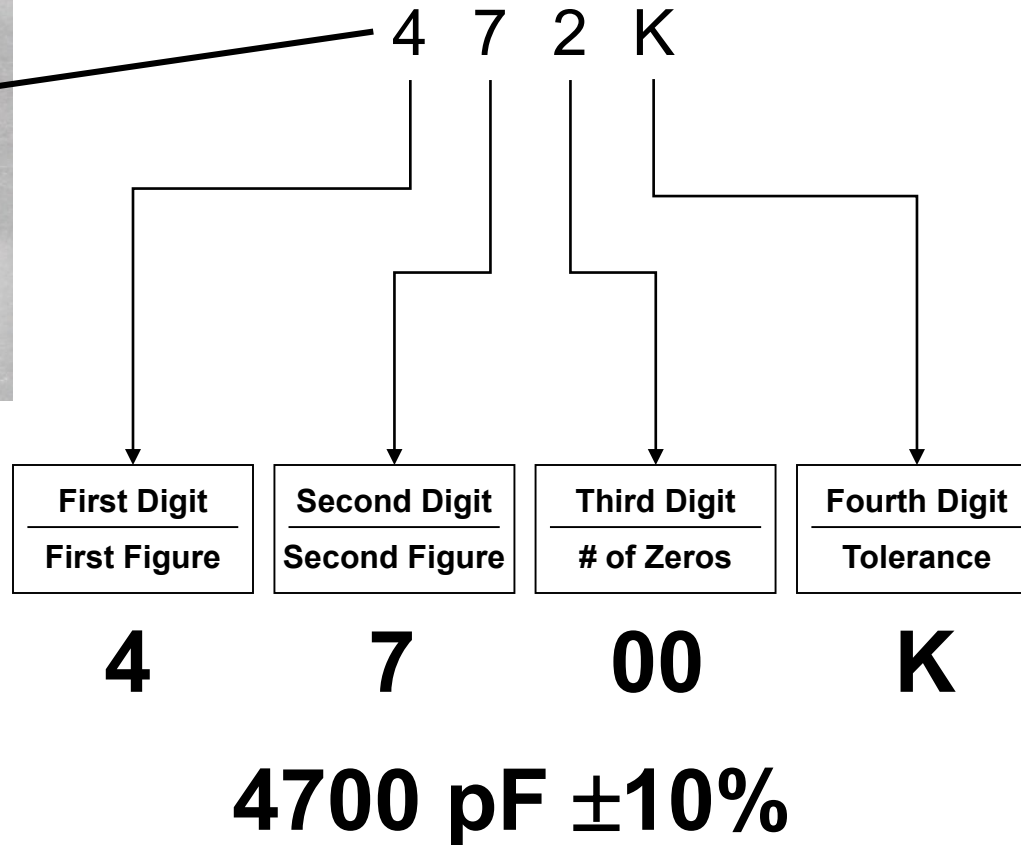
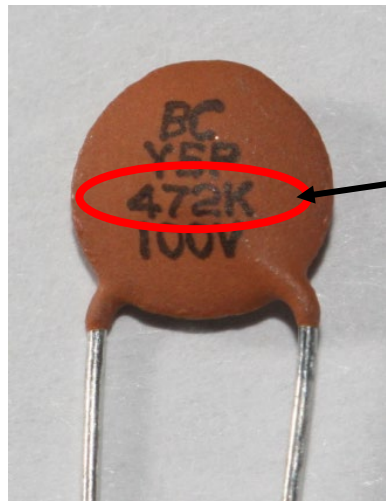
**$0.47\ \mu\text{F} \pm 20\%$**





# How To Read A Capacitor's Value

## Disc Capacitors



Code	Tolerance
A	±0.05%
B	±0.1%
C	±0.25%
D	±0.5%
F	±1%
G	±2%
J	±5%
K	±10%
M or NONE	±20%
N	±30%
Q	-10%, +30%
S	-20%, +50%
T	-10%, +50%
Z	-20%, +80%

Note: Units on Disc Capacitors are always in pico-farads



# Capacitor: Example #1

Example:

Determine the nominal value for the capacitor shown.



3 3 0  $\pm 5\%$

330 pF  $\pm 5\%$

Code	Tolerance
A	$\pm 0.05\%$
B	$\pm 0.1\%$
C	$\pm 0.25\%$
D	$\pm 0.5\%$
F	$\pm 1\%$
G	$\pm 2\%$
J	$\pm 5\%$
K	$\pm 10\%$
M or NONE	$\pm 20\%$
N	$\pm 30\%$
Q	-10%, +30%
S	-20%, +50%
T	-10%, +50%
Z	-20%, +80%

# Capacitor: Example #2

Example:

Determine the nominal value for the capacitor shown.



1 0 000  $\pm 10\%$

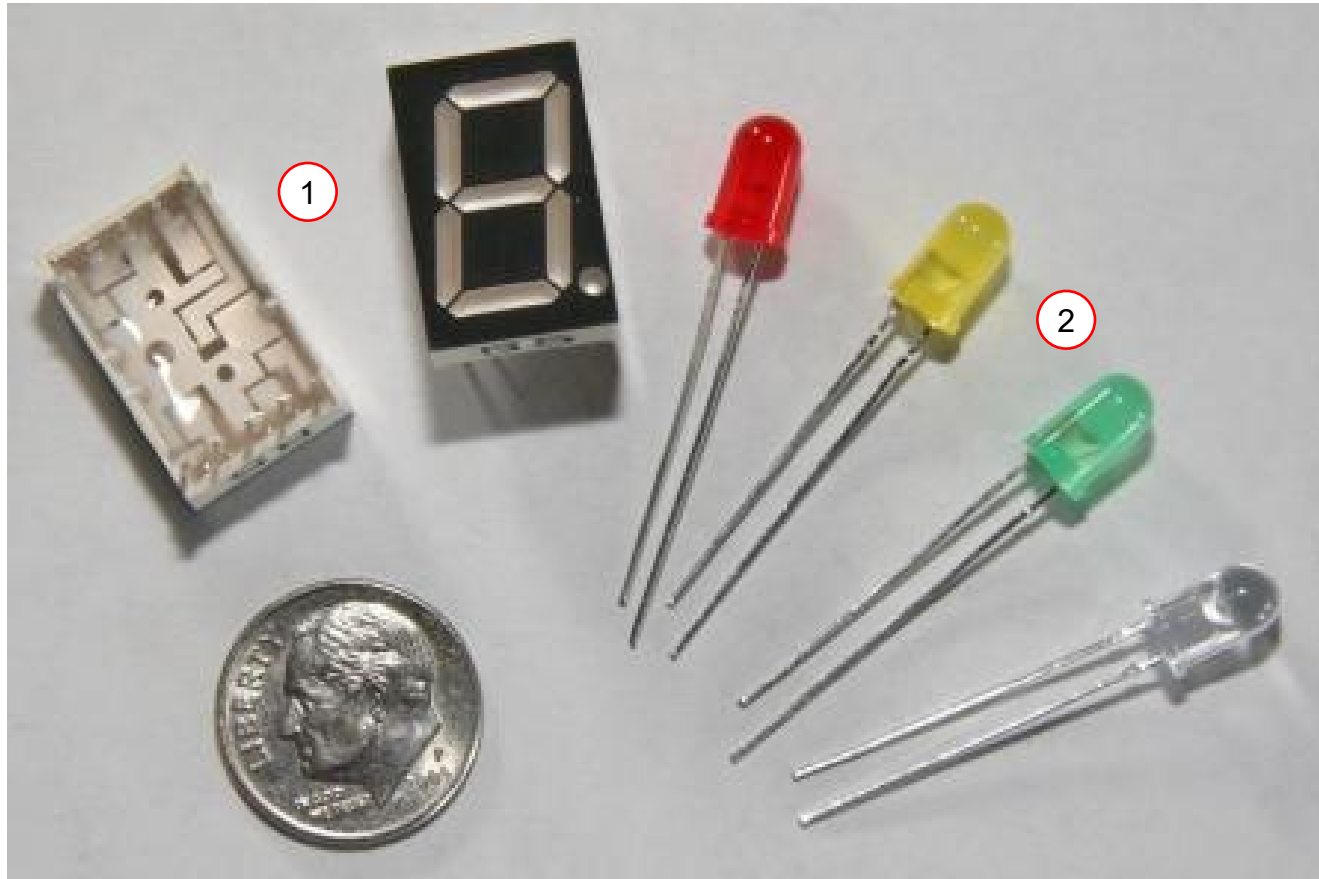
10000 pF  $\pm 10\%$

Code	Tolerance
A	$\pm 0.05\%$
B	$\pm 0.1\%$
C	$\pm 0.25\%$
D	$\pm 0.5\%$
F	$\pm 1\%$
G	$\pm 2\%$
J	$\pm 5\%$
K	$\pm 10\%$
M or NONE	$\pm 20\%$
N	$\pm 30\%$
Q	-10%, +30%
S	-20%, +50%
T	-10%, +50%
Z	-20%, +80%

# Common Electronic Components

## Displays

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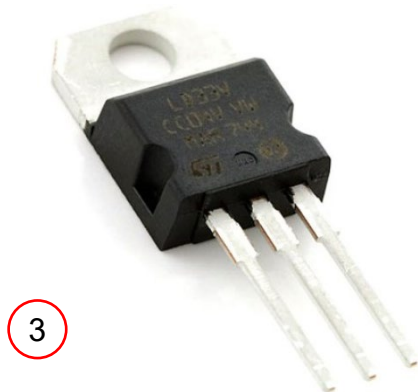
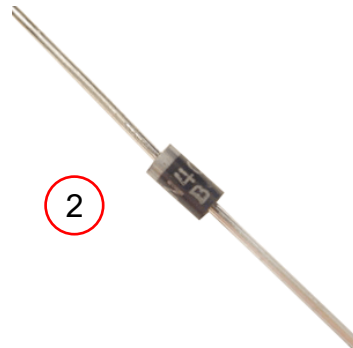
1) Seven Segment Display

2) Light Emitting Diodes (LED)

# Common Electronic Components

## Miscellaneous Components

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1) Fuses

2) Diodes

3) Voltage  
Regulator