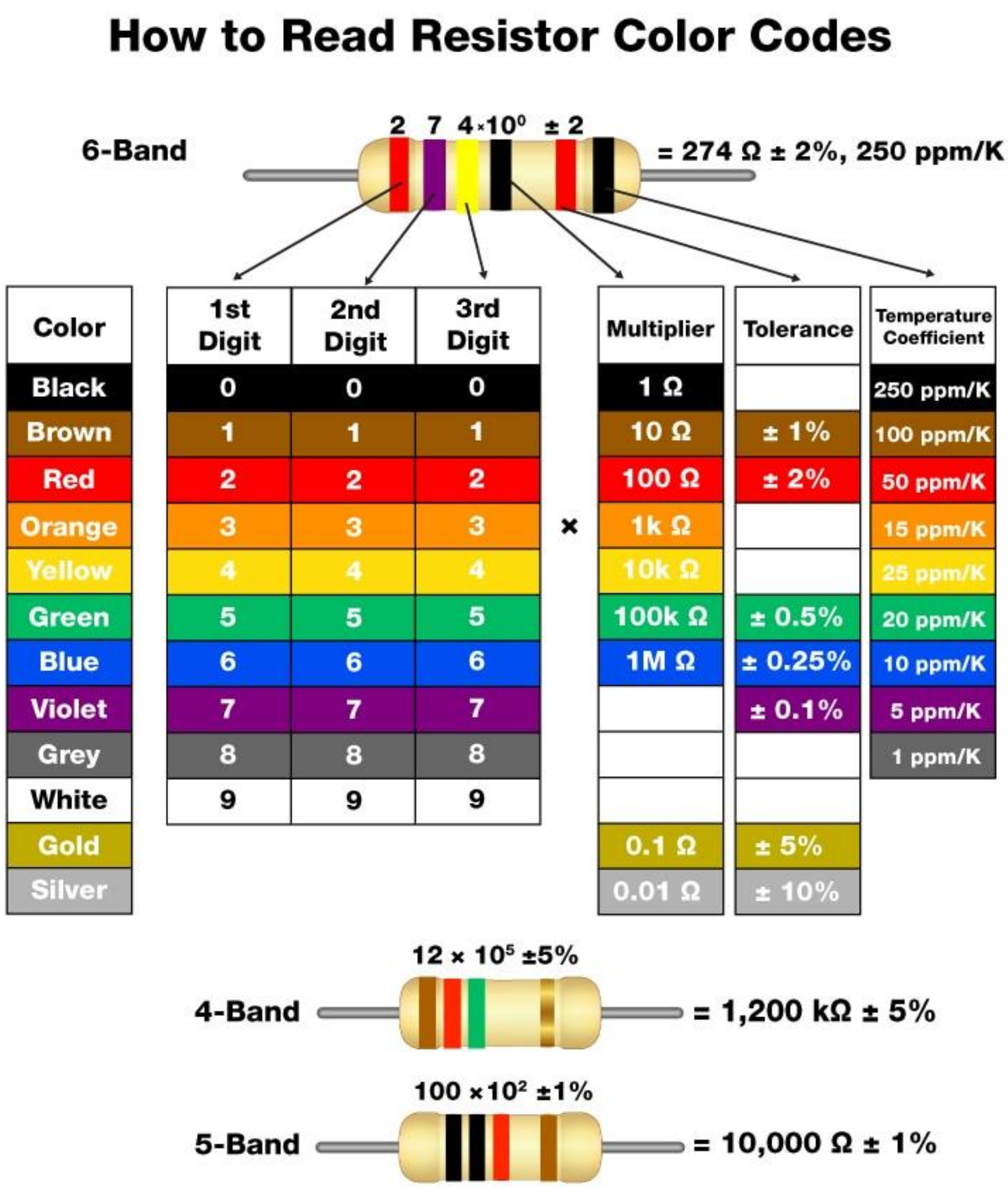
Resister color codes

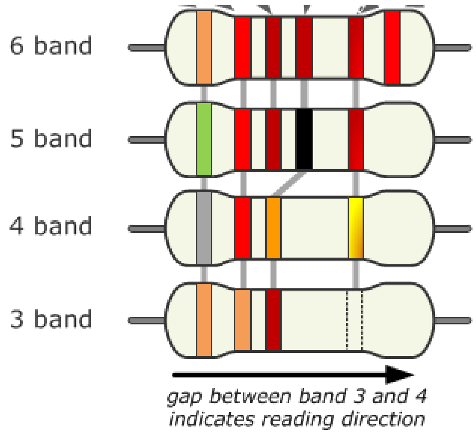
Resistor calculations

Mnemonic (A **mnemonic** is a memory aid that helps you remember information):

Remember: Better **B**e **R**ight **O**r **Y**our **G**reat **B**ig **V**enture **G**oes **W**est



Color	1st Digit	2nd Digit	3rd Digit	× Multiplier	Tolerance	Temperature Coefficient
Black	0	0	0	1 Ω		250 ppm/K
Brown	1	1	1	10 Ω	± 1%	100 ppm/K
Red	2	2	2	100 Ω	± 2%	50 ppm/K
Orange	3	3	3	1k Ω		15 ppm/K
Yellow	4	4	4	10k Ω		25 ppm/K
Green	5	5	5	100k Ω	± 0.5%	20 ppm/K
Blue	6	6	6	1M Ω	± 0.25%	10 ppm/K
Violet	7	7	7		± 0.1%	5 ppm/K
Grey	8	8	8			1 ppm/K
White	9	9	9			
Gold				0.1 Ω	± 5%	
Silver				0.01 Ω	± 10%	



Reading Resistor Color Codes

Step 1: Identify the Color Bands

A typical resistor has four, five, or six color bands. The most common type is the four-band resistor.

Step 2: Learn the Color Code Chart

Memorize the following color code chart. Each color corresponds to a number:

Significant Digits:

- Use a color code chart to translate the first two bands into numerical values.

Each color corresponds to a specific digit or multiplier:

Color	Digit	Multiplier	Tolerance	Temperature Coefficient
Black	0	1		
Brown	1	10	±1%	100 ppm/K
Red	2	100	±2%	50 ppm/K
Orange	3	1,000		15 ppm/K
Yellow	4	10,000		25 ppm/K
Green	5	100,000	±0.5%	
Blue	6	1,000,000	±0.25%	
Violet	7	10,000,000	±0.1%	
Gray	8	100,000,000	±0.05%	
White	9	1,000,000,000		
Gold		0.1	±5%	
Silver		0.01	±10%	
None			±20%	

The full form of ppm/K is **parts per million per kelvin**.

Color	Digit
Black	0
Brown	1
Red	2
Orange	3
Yellow	4
Green	5
Blue	6
Violet	7
Gray	8
White	9

Multiplier:

- The third band indicates the multiplier.

Color	Multiplier
Black	10^0
Brown	10^1
Red	10^2
Orange	10^3
Yellow	10^4
Green	10^5
Blue	10^6
Violet	10^7
Gray	10^8
White	10^9
Gold	10^{-1}
Silver	10^{-2}

- Black: $\times 1$
- Brown: $\times 10$
- Red: $\times 100$
- Orange: $\times 1,000$ (or 10^3)
- Yellow: $\times 10,000$ (or 10^4)
- Green: $\times 100,000$ (or 10^5)
- Blue: $\times 1,000,000$ (or 10^6)
- Violet: $\times 10,000,000$ (or 10^7)
- Gray: $\times 100,000,000$ (or 10^8)
- White: $\times 1,000,000,000$ (or 10^9)
- Gold: $\times 0.1$ (or 10^{-1})
- Silver: $\times 0.01$ (or 10^{-2})

Tolerance:

- The fourth band indicates the tolerance.

Color	Tolerance
Brown	±1%
Red	±2%
Green	±0.5%
Blue	±0.25%
Violet	±0.1%
Gray	±0.05%
Gold	±5%
Silver	±10%
No Band	±20%

Step 3: Determine the Value Using the Bands

1-Band Resistor

- **First Band**: Significant digit (This is not standard and typically not used as it provides very limited information).

2-Band Resistor

- **First Band**: First significant digit.
- **Second Band**: Second significant digit.

3-Band Resistor

- **First Band**: First significant digit.
- **Second Band**: Second significant digit.
- **Third Band**: Multiplier (number of zeros to add).

4. Four-Band Resistors:

- The first two bands represent the first two digits.
- The third band is the multiplier.
- The fourth band is the tolerance.

5. Five-Band Resistors:

- The first three bands represent the first three digits.
- The fourth band is the multiplier.
- The fifth band is the tolerance.

6. Six-Band Resistors:

- The first three bands represent the first three digits.
- The fourth band is the multiplier.
- The fifth band is the tolerance.
- The sixth band indicates the temperature coefficient.

Ohm's Law is a fundamental principle in electrical engineering and physics that describes the relationship between voltage, current, and resistance in an electrical circuit. It is usually stated as:

$$V = I \times R$$

where:

- V is the voltage across the circuit (in volts, V),
- I is the current flowing through the circuit (in amperes, A),
- R is the resistance of the circuit (in ohms, Ω).

Understanding Ohm's Law:

1. **Voltage (V):** This is the electrical potential difference between two points. It drives the current through the circuit.
2. **Current (I):** This is the flow of electric charge through the circuit. It is measured in amperes (A).
3. **Resistance (R):** This is the opposition to the flow of current in the circuit. It is measured in ohms (Ω).

Using Ohm's Law:

To solve for any one of the three variables, you rearrange the formula:

- To find Voltage (V):
  $$V = I \times R$$
- To find Current (I):
  $$I = \frac{V}{R}$$
- To find Resistance (R):
  $$R = \frac{V}{I}$$

Example Calculations:

1. If you know the voltage and resistance, and you want to find the current:

   Suppose $V = 12\ \mathrm{V}$ and $R = 4\ \Omega$.

   $I = \frac{V}{R} = \frac{12\ \mathrm{V}}{4\ \Omega} = 3\ \mathrm{A}$

2. If you know the current and resistance, and you want to find the voltage:

   Suppose $I = 2\ \mathrm{A}$ and $R = 10\ \Omega$.

   $V = I \times R = 2\ \mathrm{A} \times 10\ \Omega = 20\ \mathrm{V}$

3. If you know the voltage and current, and you want to find the resistance:

   Suppose $V = 9\ \mathrm{V}$ and $I = 3\ \mathrm{A}$.

   $R = \frac{V}{I} = \frac{9\ \mathrm{V}}{3\ \mathrm{A}} = 3\ \Omega$

Ohm's Law is a fundamental tool for analyzing electrical circuits and understanding how changes in voltage, current, or resistance affect each other.

1. Converting Kilo Ohms to Ohms

1. Identify the value in kilo ohms (kΩ).
   - Example: 4.7 kΩ
2. Multiply by 1,000 to convert to ohms (Ω).
   - Calculation: $4.7\,\mathrm{k}\Omega \times 1{,}000 = 4{,}700\,\Omega$

So, 4.7 kilo ohms is 4,700 ohms.

2. Converting Ohms to Kilo Ohms

1. Identify the value in ohms (Ω).
   - Example: 2,200 Ω
2. Divide by 1,000 to convert to kilo ohms (kΩ).
   - Calculation: $\frac{2{,}200\,\Omega}{1{,}000} = 2.2\,\mathrm{k}\Omega$

So, 2,200 ohms is 2.2 kilo ohms.

Conversion Between Amperes and Milliamperes:

1. From Amperes to Milliamperes:
   - To convert from amperes to milliamperes, multiply by 1,000.
   - Formula: $\mathrm{mA} = \mathrm{A} \times 1,000$

   Example:

   - $2\ \mathrm{A} = 2 \times 1,000 = 2,000\ \mathrm{mA}$
2. From Milliamperes to Amperes:
   - To convert from milliamperes to amperes, divide by 1,000.
   - Formula: $\mathrm{A} = \mathrm{mA} \div 1,000$

   Example:

   - $250\ \mathrm{mA} = 250 \div 1,000 = 0.250\ \mathrm{A}$

Practical Context:

- **Small Devices:**

  - Many small electronic devices, like LEDs and small sensors, operate on currents measured in milliamperes.
  - Example: An LED might require 20 mA to operate.
- **Larger Appliances:**
  - Larger electrical appliances, like toasters or microwaves, operate on currents measured in amperes.
  - Example: A microwave might use 10 A.

Visual Representation:

Imagine water flowing through pipes:

- **Amperes (A):** Represents a large pipe where a lot of water (electric charge) flows through per second.
- **Milliamperes (mA):** Represents a smaller pipe where a smaller amount of water (electric charge) flows through per second.

Summary

- **Amperes (A):** Unit of electric current, where 1 A = 1 coulomb/second.
- **Milliamperes (mA):** One-thousandth of an ampere, where 1 mA = 0.001 A.
- **Conversion:**
  - $1\ \mathrm{A} = 1,000\ \mathrm{mA}$
  - $1\ \mathrm{mA} = 0.001\ \mathrm{A}$
- **Use in Circuits:**
  - Milliamperes are used for small electronic devices.
  - Amperes are used for larger electrical appliances.

Understanding these units and their conversion helps in designing and analyzing electrical circuits effectively.

Tolerance:

- The fourth band indicates the tolerance.

Color	Tolerance
Brown	±1%
Red	±2%
Green	±0.5%
Blue	±0.25%
Violet	±0.1%
Gray	±0.05%
Gold	±5%
Silver	±10%
No Band	±20%

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Each color corresponds to a specific digit or multiplier:

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Gray	8	100,000,000	±0.05%	
White	9	1,000,000,000		
Gold		0.1	±5%	
Silver		0.01	±10%	
None			±20%	

Explanation:

- **ppm (parts per million)**: This is a unit of measurement that describes the concentration or the ratio of one part of a substance to one million parts of the total mixture or solution.
- **K (kelvin)**: This is the unit of absolute temperature in the International System of Units (SI).

Context in Resistors:

In the context of resistors, ppm/K indicates the temperature coefficient of resistance (TCR), which describes how much the resistance of the resistor changes with temperature. For example, a TCR of 50 ppm/K means that for every 1 kelvin (K) change in temperature, the resistance of the resistor changes by 50 parts per million of its value. This is crucial for precision app ppm/°C (parts per million per degree Centigrade)

Temperature Coefficient (Temp Coeff) Explained in a Simple and Easy Way

The temperature coefficient (Temp Coeff) of a resistor indicates how its resistance changes with temperature. Here's how to understand and use it with the given information:

1. Identify the Temperature Coefficient:

For the 6-band resistor, the temperature coefficient is given as **100 ppm/°C** (parts per million per degree Celsius).

2. Understand the Temperature Coefficient:

- **Temperature Coefficient (TC):** 100 ppm/°C means that for every degree Celsius change in temperature, the resistance will change by 100 parts per million.

3. Calculate the Change in Resistance:

To calculate how much the resistance will change with a temperature change, use the following formula:

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To calculate how much the resistance will change with a temperature change, use the following formula:

$$\Delta R = R \times \mathrm{TC} \times \Delta T$$

Where:

- ΔR = Change in resistance
- R = Nominal resistance value
- TC = Temperature coefficient (in ppm/°C)
- ΔT = Change in temperature (in °C)

- **ΔR**: Represents a change in resistance.
- **ΔT**: Represents a change in temperature.

The symbol "Δ" is called the **delta** symbol. In mathematics and science, it is commonly used to represent a **change** or **difference** in a particular quantity.

4. Example Calculation:

Let's calculate the change in resistance for a 10°C temperature change:

- Nominal Resistance (R): 6,800 ohms
- Temperature Coefficient (TC): 100 ppm/°C (which is 100×10^{-6} or 0.0001)
- Temperature Change (ΔT): 10°C

Plug these values into the formula:

Plug these values into the formula:

$$\Delta R = 6,800\,\text{ohms} \times 0.0001 \times 10$$

$$\Delta R = 6,800 \times 0.001$$

$$\Delta R = 6.8\,\text{ohms}$$

5. Result:

With a temperature change of 10°C, the resistance of the resistor will change by 6.8 ohms.

In summary, the temperature coefficient tells you how much the resistance of a resistor will vary with changes in temperature. For the given resistor, each degree Celsius change in temperature will cause a 100 ppm change in resistance.

To calculate the tolerance of a resistor, follow these steps:

To calculate the tolerance of a resistor, follow these steps:

1. **Identify the resistor value and tolerance:**
   - **Value:** 4,700 ohms (or 4.7 kΩ)
   - **Tolerance:** ±5%
2. **Calculate the tolerance range:**
   - **Tolerance Amount:** 5% of the resistor value.
3. Calculate the tolerance amount:

$$\text{Tolerance Amount} = \text{Resistor Value} \times \text{Tolerance Percentage}$$

$$\text{Tolerance Amount} = 4,700\,\text{ohms} \times 0.05$$

$$\text{Tolerance Amount} = 235\,\text{ohms}$$

4. Determine the range of possible resistor values:
   - Minimum Value:

$$\text{Minimum Value} = \text{Resistor Value} - \text{Tolerance Amount}$$

$$\text{Minimum Value} = 4,700\,\text{ohms} - 235\,\text{ohms}$$

$$\text{Minimum Value} = 4,465\,\text{ohms}$$

- **Maximum Value:**

$$\text{Maximum Value} = \text{Resistor Value} + \text{Tolerance Amount}$$

$$\text{Maximum Value} = 4,700\,\text{ohms} + 235\,\text{ohms}$$

$$\text{Maximum Value} = 4,935\,\text{ohms}$$

5. **Result:**

   The resistor with a value of 4,700 ohms and a tolerance of ±5% can actually be anywhere between 4,465 ohms and 4,935 ohms.