



Resistor Color-Coding



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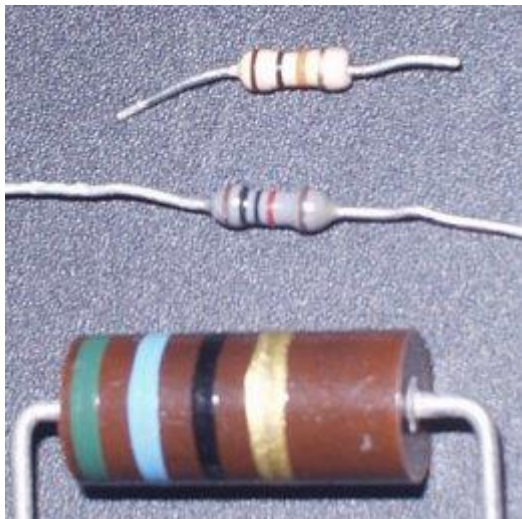
Introduction

This lesson explains how **to read the color code painted on the bands of the resistors**. This information is deliberately brief - but sufficient - because of the many electronic lessons that can be found on the Internet.

In most cases, the resistor is presented with **colored rings (bands)** around it. Each color corresponds to a digit.

The correspondence between the digits and the colors of the bands is named "the **resistor color code**": this code is used to determine the value of a resistor or indicate its values by using a color code. It is defined by the international standard "IEC 60062" entitled "Marking codes for resistors and capacitors".

Example of a resistor:



Source: Wikipedia.org.

Method to read

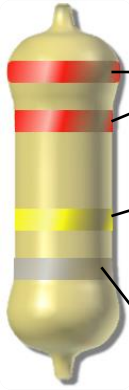
You must first turn the resistor the right way up. Usually, the resistor has a **gold** or **silver** band that must be placed on the **right**. In other cases, it is the **largest** band that must be placed on the **right** or the band placed **closest the extremity** you must put on the **left**.

There are **three types of resistors** depending on the number of bands: 4-band, 5-band and 6-band resistors. Each resistor type is described in the following paragraphs.

1. 4-band resistors

- The first two bands provide **significant figures**: the first gives the ten and the second the unit.
- The third gives the **multiplier**, in other words the power of 10 to be multiplied to significant digits (the number of zeros to add to the significant figures).
- The fourth determines the **tolerance** of the resistor that indicates the uncertainty on the effective value of the resistor given by the manufacturer. The selling price of the resistor is inversely proportional to its precision.

• Example:



Significant figures. The red color corresponds to the digit **2** (see the correspondence between color and digit in the summary table). The significant digits are **22**.

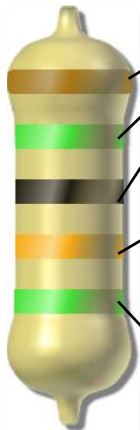
Multiplier. The yellow color corresponds to the digit **4**. The significant digits have to be multiplied by 10^4 (ie. add **4 zeros** after the 2 significant figures). The value of the resistor is **220 000 Ω** or **220 k Ω** .

Tolerance. The silver color corresponds to the tolerance **$\pm 10\%$** . It means that given the incertitude provided by the manufacturer, the effective value of the resistor varies from **198 k Ω** ($220\text{ k}\Omega - 220\text{ k}\Omega \times 10/100$) and **242 k Ω** ($220\text{ k}\Omega + 220\text{ k}\Omega \times 10/100$).

2. 5-band resistors

- The first three bands provide the **significant figures**: the first gives the hundred, the second the ten and the third the unit. The third band is only used when the tolerance of the resistor is less than 2%.
- The fourth gives the **multiplier**, in other words the power of 10 to be multiplied to significant digits (the number of zeros to add to the significant digits).
- The fifth is the **tolerance** of the resistor that indicates the incertitude on the effective value of the resistor given by the manufacturer. The selling price of the resistor is inversely proportional to its precision.

Example:



Significant figures. The brown color corresponds to the digit **1** (see the correspondence between color and digit in the summary table), the green color to **5** and the black color to **0**. The significant digits are **150**.

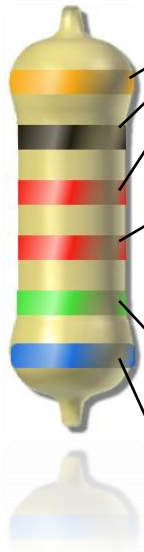
Multiplier. The orange color corresponds to the digit **3**. The significant digits have to be multiplied by 10^3 (ie. add **3 zeros** after the 3 significant figures). The value of the resistor is **150 000 Ω** or **150 k Ω** .

Tolerance. The green color corresponds to the tolerance **$\pm 0.5\%$** . It means that given the incertitude provided by the manufacturer, the effective value of the resistor varies from **149.25 k Ω** ($150\text{ k}\Omega - 150\text{ k}\Omega \times 0.5/100$) and **150.75 k Ω** ($150\text{ k}\Omega + 150\text{ k}\Omega \times 0.5/100$).

3. 6-band resistors

- The first five bands have the same meaning as the 5-band resistors (see above).
- The sixth band is a **temperature coefficient** that indicates the change in electrical conductivity with temperature.

Example:



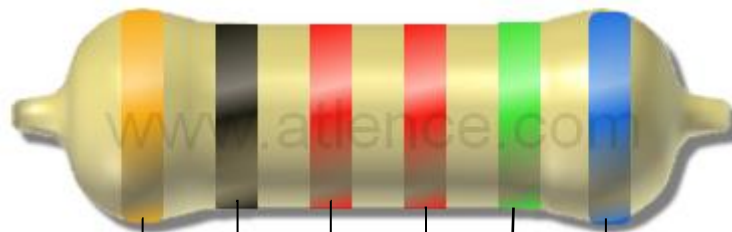
Significant figures. The orange color corresponds to the digit **3** (see the correspondence between color and digit in the summary table), the black color to **0** and the red one to **2**. The significant figures are **302**.

Multiplier. The red color corresponds to the digit **2**: the significant digits have to be multiplied by **10²** (ie. add **2 zeros** after the 3 significant figures). The value of the resistor is **30 200 Ω** or **30.2 kΩ**.

Tolerance. The green color corresponds to the tolerance **±0.5%**. It means that given the incertitude provided by the manufacturer, the effective value of the resistor varies from **30.049 kΩ** (30.2 kΩ - 30.2 kΩ x 0.5/100) and **30.351 kΩ** (30.2 kΩ + 30.2 kΩ x 0.5/100).

Temperature coefficient. The blue color corresponds to a temperature coefficient equal to **10 ppm/°C**.

Summary table



Significant figures	Multiplier	Tolerance	Temperature coefficient (ppm/°C)
0 Black	x10⁻² Silver	±20% None	200 Black
1 Brown	x10⁻¹ Gold	±10% Silver	100 Brown
2 Red	x10⁰ Black	±5% Gold	50 Red
3 Orange	x10¹ Brown	±1% Brown	15 Orange
4 Yellow	x10² Red	±2% Red	25 Yellow
5 Green	x10³ Orange	±0.5% Green	10 Blue
6 Blue	x10⁴ Yellow	±0.25% Blue	5 Violet
7 Violet	x10⁵ Green	±0.10% Violet	1 Grey
8 Grey	x10⁶ Blue	±0.05% Grey	
9 White	x10⁷ Violet		
	x10⁸ Grey		
	x10⁹ White		

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Note: The 3rd band (3rd significant digit) is only used when the tolerance of the resistor is **less than 2%**.

Test your skills

To practice and test your knowledge on the resistor color code, visit the Website <http://www.atlence.com> and download the software **Atlence Resistor Viewer**. It includes a **quiz on the resistor color code**.

Tips

A mnemonic to keep in mind the resistor color code is to remember one of the following two sentences:

Bad Beer Rots Our Young Guts But Vodka Goes Well

or

Black Bears Rarely Outrun Young Grizzlies But Victimize Gray Wolves

By taking the first letter of each word, you get the color:

<i>1st letter</i>	<i>Color</i>	<i>Position</i>
B	Black	0
B	Brown	1
R	Red	2
O	Orange	3
Y	Yellow	4
G	Green	5
B	Blue	6
V	Violet	7
G	Grey	8
W	White	9

The **position of the words** in the sentence (by starting the numbering at 0) indicates the digit that corresponds to the **color of the band**.

