Name: ___________________________

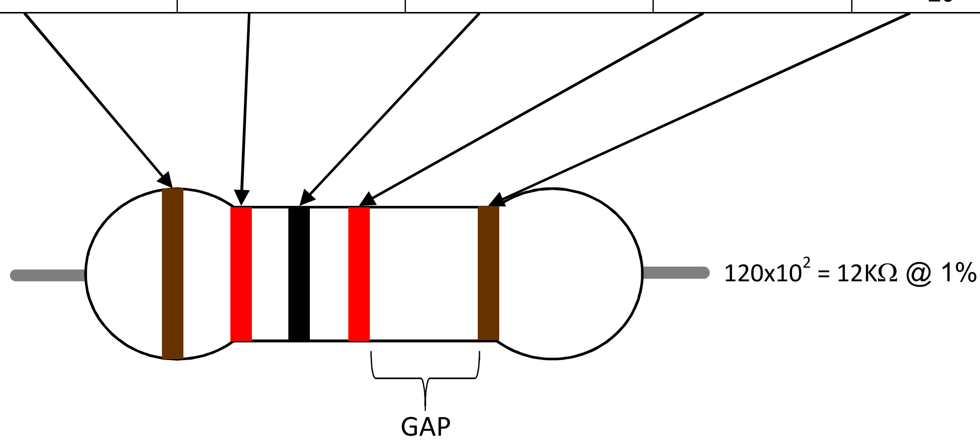
Resistor Value Worksheet

Discussion Overview

Through-hole resistors use a color coded scheme to represent the value of the resistor. This scheme uses different colors, shown in Table 1 below, to designate a different digit.

Table 1 - Resistor Color Coding Scheme

Color	Significant Digits			Multiplier	Tolerance (%)
Black	0	0	0	x 10^0 = x 1	
Brown	1	1	1	x 10^1 = x 10	1
Red	2	2	2	x 10^2 = x 100	2
Orange	3	3	3	x 10^3 = x 1K	
Yellow	4	4	4	x 10^4 = x 10K	
Green	5	5	5	x 10^5 = x 100K	0.5
Blue	6	6	6	x 10^6 = x 1M	0.25
Violet	7	7	7	x 10^7 = x 10M	0.1
Grey	8	8	8	x 10^8 = x 100M	0.05
White	9	9	9	x 10^9 = x 1G	
Gold			3rd digit significant only in a 5 band configuration	x 10^{-1} = x 0.1	5
Silver				x 10^{-2} = x 0.01	10
None					20



Depending on the tolerance value, a resistor might contain 4 or 5 bands. Resistors with tolerances larger than or equal to 5% contain only 4 color bands while resistors with tolerances smaller than 5% contain 5 color bands. Regardless of the number of bands, the last (right most) color band signifies the tolerance value; the color band second to last signifies the magnitude (exponent) or the multiplier; and the remaining bands signify the digits in the precision part of the value. Therefore, a 4 color band resistor has 2 significant digits in its precision part while a 5 color band resistor has 3 significant digits.

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The color bands are read from left to right where the tolerance band is the right most band with a gap between the tolerance band and the rest of the bands as shown in the diagram above.

In the example above, there are 5 color bands; therefore, the first 3 bands are significant digits, the fourth band is the exponent, and the right most band is the tolerance. The first (left most) band is brown = 1, the second band is red = 2 and the third band is black = 0. Therefore, the significant digits are 120. The fourth band is red = 2, and therefore, the exponent is 2. Combining the precision part and the exponent part gives us the value 120×10^2 or 12KΩ for the value of the resistor. The left most band is brown = 1 which indicates that the tolerance of this resistor is 1%.

Tolerance

The tolerance of a resistor indicates the amount by which the actual value of the resistor might vary from its "nominal" (printed) value. The tolerance is expressed in percent and is multiplied by the nominal value of the resistor to determine the maximum variation. For example, for the resistor above, the value of the resistor is 12KΩ, and its tolerance is 1%. Therefore, the actual value of the resistor can vary by as much as 12,000 x 1% = 120Ω. In other words, the actual value of the resistor can be as low as 12,000 – 120 = 11,880Ω or as high as 12,000 + 120 = 12,120Ω.

Procedure

1. Given the nominal values and tolerances in table below, determine and record the corresponding color code bands:

Value	Band 1	Band 2	Band 3	Band 4	Band 5
27 @ 10%					
125 @ 1%					
2.7K @ 5%					
822K @ 1%					
1.5M @ 10%					
59M @ 20%					

2. Given the color codes in the table below, determine and record the nominal value, tolerance and minimum and maximum acceptable values:

Colors	Nominal	Tolerance	Minimum	Maximum
Red-red-black-silver				
Blue-gray-black-gold				
Brown-green-gray-red-red				
Red-violet-red-silver				
Gray-red-yellow-none				
Green-black-green-silver				

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3. From the collection of your resistors, determine the minimum and maximum values based on the nominal value and tolerance. Record these values in the table below. Using a DMM, measure the actual value of the resistor and record it in the table below as well. Determine the percent deviation of the resistor based on the measured and nominal value and record it in the table. Circle the deviation if the resistor is out of tolerance. The equation for percent deviation is

$$\%Deviation = 100 \times \frac{|measured - nominal|}{nominal}$$

Resistor Color Bands	Nominal	Minimum	Maximum	Measured	Deviation

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