

Chapter 2: Color Codes

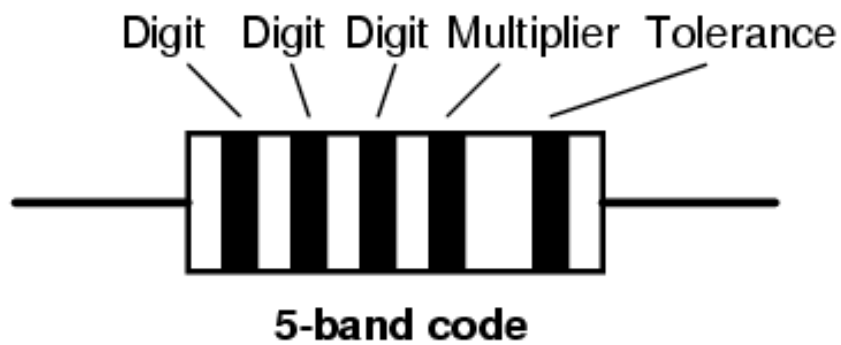
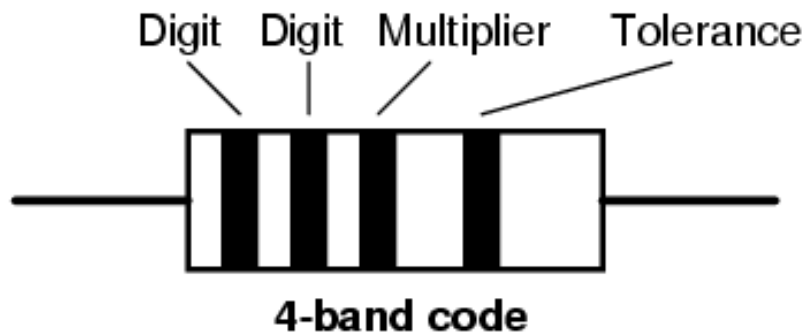
Resistor Color Codes

Components and wires are coded with colors to identify their value and function.

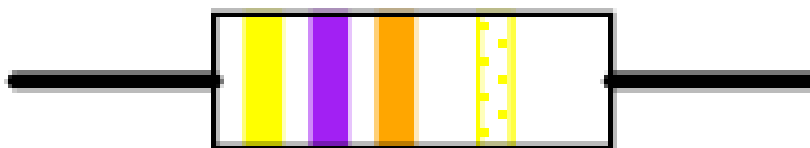
[] {#Resistor color codes}

Color	Digit	Multiplier	Tolerance (%)
Black	0	10^0 (1)	
Brown	1	10^1	1
Red	2	10^2	2
Orange	3	10^3	
Yellow	4	10^4	
Green	5	10^5	0.5
Blue	6	10^6	0.25
Violet	7	10^7	0.1
Grey	8	10^8	
White	9	10^9	
Gold		10^{-1}	5
Silver		10^{-2}	10
(none)			20

The colors brown, red, green, blue, and violet are used as tolerance codes on 5-band resistors only. All 5-band resistors use a colored tolerance band. The blank (20%) "band" is only used with the "4-band" code (3 colored bands + a blank "band").



Example #1



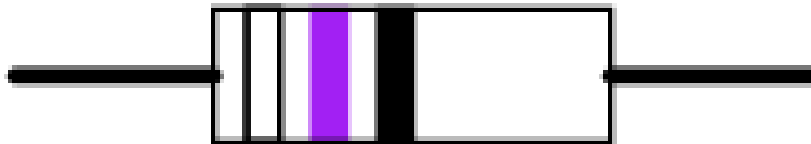
A resistor colored *Yellow-Violet-Orange-Gold* would be 47 k Ω with a tolerance of $\pm 5\%$.

Example #2



A resistor colored *Green-Red-Gold-Silver* would be $5.2\ \Omega$ with a tolerance of $\pm 10\%$.

Example #3



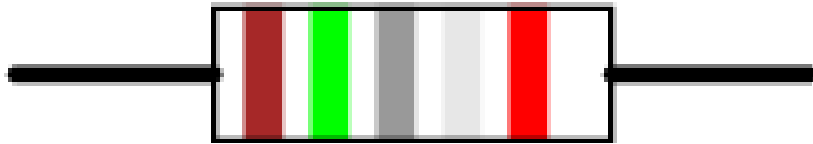
A resistor colored *White-Violet-Black* would be $97\ \Omega$ with a tolerance of $\pm 20\%$. When you see only three color bands on a resistor, you know that it is actually a 4-band code with a blank (20%) tolerance band.

Example #4



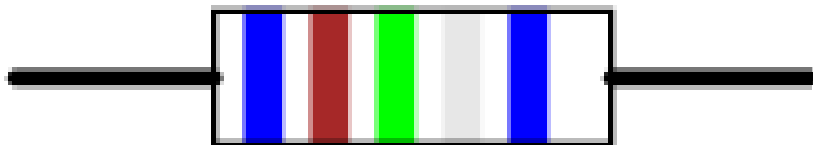
A resistor colored *Orange-Orange-Black-Brown-Violet* would be $3.3\ \text{k}\Omega$ with a tolerance of $\pm 0.1\%$.

Example #5



A resistor colored *Brown-Green-Grey-Silver-Red* would be 1.58Ω with a tolerance of $\pm 2\%$.

Example #6



A resistor colored *Blue-Brown-Green-Silver-Blue* would be 6.15Ω with a tolerance of $\pm 0.25\%$.

Wiring Color Codes

Wiring for AC and DC power distribution branch circuits are color coded for identification of individual wires. In some jurisdictions all wire colors are specified in legal documents. In other jurisdictions, only a few conductor colors are so codified. In that case, local custom dictates the “optional” wire colors.

IEC, AC: Most of Europe abides by IEC (International Electrotechnical Commission) wiring color codes for AC branch circuits. These are listed in Table [below](#). The older color codes in the table reflect the previous style which did not account for proper phase rotation. The protective ground wire (listed as green-yellow) is green with yellow stripe.

IEC (most of Europe) AC power circuit wiring color codes.

Function label Color, IEC Color, old IEC

Protective earth PE green-yellow green-yellow Neutral N blue blue Line, single phase L brown brown or black Line, 3-phase L1 brown brown or black Line, 3-phase L2 black brown or black Line, 3-phase L3 grey brown or black

UK, AC: The United Kingdom now follows the IEC AC wiring color codes. Table [below](#) lists these along with the obsolete domestic color codes. For adding new colored wiring to existing old colored wiring see Cook. ((Pck?))

UK AC power circuit wiring color codes.

Function label Color, IEC Old UK color

Protective earth PE green-yellow green-yellow Neutral N blue black Line, single phase L brown red Line, 3-phase L1 brown red Line, 3-phase L2 black yellow Line, 3-phase L3 grey blue

US, AC: The US National Electrical Code only mandates white (or grey) for the neutral power conductor and bare copper, green, or green with yellow stripe for the protective ground. In principle any other colors except these may be used for the power conductors. The colors adopted as local practice are shown in Table [below](#). Black, red, and blue are used for 208 VAC three-phase; brown, orange and yellow are used for 480 VAC. Conductors larger than #6 AWG are only available in black and are color taped at the ends.

US AC power circuit wiring color codes.

Function label Color, common Color, alternative

Protective ground PG bare, green, or green-yellow green Neutral N white grey Line, single phase L black or red (2nd hot) Line, 3-phase L1 black brown Line, 3-phase L2 red orange Line, 3-phase L3 blue yellow

Canada: Canadian wiring is governed by the CEC (Canadian Electric Code). See Table [below](#). The protective ground is green or green with yellow stripe. The neutral is white, the hot (live or active) single phase wires are black, and red in the case of a second active. Three-phase lines are red, black, and blue.

Canada AC power circuit wiring color codes.

Function label Color, common

Protective ground PG green or green-yellow Neutral N white Line, single phase L black or red (2nd hot) Line, 3-phase L1 red Line, 3-phase L2 black Line, 3-phase L3 blue

IEC, DC: DC power installations, for example, solar power and computer data centers, use color coding which follows the AC standards. The IEC color standard for DC power cables is listed in Table [below](#), adapted from Table 2, Cook. ((**Pck?**))

IEC DC power circuit wiring color codes.

Function label Color

Protective earth PE green-yellow 2-wire unearthed DC Power System Positive L+ brown Negative L- grey 2-wire earthed DC Power System Positive (of a negative earthed) circuit L+ brown Negative (of a negative earthed) circuit M blue Positive (of a positive earthed) circuit M blue Negative (of a positive earthed) circuit L- grey 3-wire earthed DC Power System Positive L+ brown Mid-wire M blue Negative L- grey

US DC power: The US National Electrical Code (for both AC and DC) mandates that the grounded neutral conductor of a power system be white or grey. The protective ground must be bare, green or green-yellow striped. Hot (active) wires may be any other colors except these. However, common practice (per local electrical inspectors) is for the first hot (live or active) wire to be black and the second hot to be red. The recommendations in Table [below](#) are by Wiles. ((**JWi?**)) He makes no recommendation for ungrounded power system colors. Usage of the ungrounded system is discouraged for safety. However, red (+) and black (-) follows the coloring of the grounded systems in the table.

US recommended DC power circuit wiring color codes.

Function label Color

Protective ground PG bare, green, or green-yellow 2-wire ungrounded DC Power System Positive L+ no recommendation (red) Negative L- no recommendation (black) 2-wire grounded DC Power System Positive (of a negative grounded) circuit L+ red Negative (of a negative grounded) circuit N white Positive (of a positive grounded) circuit N white Negative (of a positive grounded) circuit L- black 3-wire grounded DC Power System Positive L+ red Mid-wire (center tap) N white Negative L- black

Bibliography

1. [PCK]Paul Cook, "Harmonised colours and alphanumeric marking", IEE Wiring Matters, Spring 2004 at http://www.iee.org/Publish/WireRegs/IEE_Harmonized_colours.pdf
2. [JWi]John Wiles, "Photovoltaic Power Systems and the National Electrical Code: Suggested Practices", Southwest Technology Development Institute, New Mexico State University, March 2001 at <http://www.re.sandia.gov/en/ti/tu/Copy%20of%20NEC2000.pdf>

