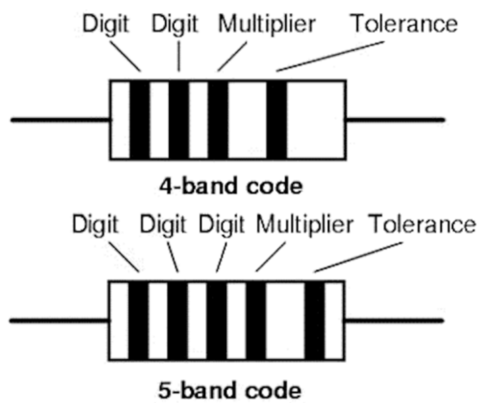
Resistor Color Codes

Resistor values are commonly represented by four or five colored bands:



Five bands are used for "precision" 1% tolerance resistors, all the rest using the four-band system.

The colors in the first three or four bands represent the numbers 0 through 9:

0 = black	5 = green
1 = brown	6 = blue
2 = red	7 = violet
3 = orange	8 = gray
4 = yellow	9 = white

The colors in the fourth or fifth bands are used to represent the tolerance:

20%	=	none
10%	=	silver
5%	=	gold
1%	=	brown

There are various cute mnemonics for remembering this sequence of colors. The one I learned in my all-male, benignly sexist Air Force classroom was …

"Bad Boys Rape Our Young Girls
But Violet Gives Willingly."

In today's more politically-correct military, they probably teach something like …

"Big Boys Race Our Young Girls
But Violet Generally Wins."

The cluster of colored bands is always closer to one end of the resistor, and is read in sequence beginning on that end.

For non-precision resistors, the first two bands represent the first two numbers in the resistance value, the third band representing the number of zeros following.

For example …

Red	Ylw	Org	Gold
2	4	000	5%

… or 24,000 (24K in other words).

For 1% resistors, the first three bands are read as numbers, with the fourth band representing the number of zeros ..

Red	Org	Red	Red
2	3	2	00

… or 23,200 (23.2K in other words).

In a special case, Gold or Silver appearing as the third band of a non-precision resistor, or the fourth band of a 1% resistor, means “x0.1” or “x0.01” respectively …

Red	Ylw	Gold	Gold
2	4	x.1	5%

… would therefore identify a 2.4Ω resistor, and …

Red	Org	Red	Silver
2	3	2	x.01

… would identify a 2.32Ω precision resistor.

Body-End-Dot

If you ever happen to encounter any antique electronics, you might find resistors color-coded using the *body-end-dot* system (also called *body-tip-spot* if you're English). This was a method used before machine banding, to paint color codes on components by hand.

The body of the resistor was painted one color, one end was painted in another color, and a dot of another color was painted in the middle. The colors represent the same numbers as the bands used today, and are read like this …

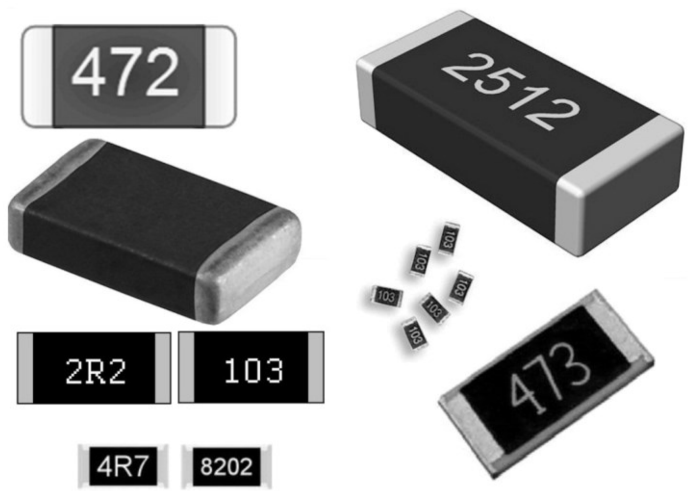
- body = first digit
- end = second digit
- dot = number of zeros following

There wasn't any code included for tolerance back then since the resistors were manufactured to merely fall within a 20% tolerance.

Laser Marking Systems

Today's fast laser surface marking systems now make it possible to mark resistors, and other electronic components, with actual alpha-numeric values.

An example is surface-mount, or "SMT" resistors. They're typically marked with either three or four numbers; the first two or three being significant digits, and the last one being a multiplier, representing the number of zeros following. The letter “R” is used to signify a decimal point.



In this image, the values shown are 4.7K, 25.1K, 2.2Ω, 10K, 47K, 4.7Ω, and 82K.

Common Resistor Decades

Resistors are commercially available in a limited number of standard resistance values. The *E24 Decade* has twenty-four incremental values, ranging from 1.0 to 9.1. As you can see, this is called a “decade” because those twenty-four numbers are increased in multiples of ×10 to provide a choice of 168 values, ranging from 1.0Ω to 9.1MΩ. For uses where precision is not important, you would be able to select a standard resistance value within ±10% of your preferred resistance.

E-24 Resistor Decade

1.0	1.8	3.3	5.6
1.1	2.0	3.6	6.2
1.2	2.2	3.9	6.8
1.3	2.4	4.3	7.5
1.5	2.7	4.7	8.2
1.6	3.0	5.1	9.1

Where precision is required, the *E-96 Decade* is available. This table, as the name suggests, includes ninety-six increments, offering 480 values from 10.0Ω to 976K, which are within about 1% of each other. These are "precision" resistors having a tolerance of ±1%.

E-96 Resistor Decade

100	147	215	316	464	681
102	150	221	324	475	698
105	154	226	332	487	715
107	158	232	340	499	732
110	162	237	348	511	750
113	165	243	357	523	768
115	169	249	365	536	787
118	174	255	374	549	806
121	178	261	383	562	825
124	182	267	392	576	845
127	187	274	402	590	866
130	191	280	412	604	887
133	196	287	422	619	909
137	200	294	432	634	931
140	205	301	442	649	953
143	210	309	453	665	976

Okay. Now we know all about resistors, we'll move on to some circuit design examples!
