

Resistors

Last updated 1/10/24

Resistors

- Basics

- R

$$V = IR$$

- Circuit Symbols



fixed resistor



potentiometer



variable resistor

- Tolerance

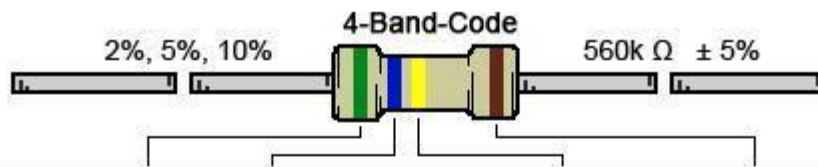
- .05% → 20%
- Most common: 5%, 10%
- Lower tolerance → more expensive

Common Values (5%)		
<u>value</u>		<u>range</u>
10	33	
11	36	
12	39	
13	43	10Ω
15	47	to
16	51	680KΩ
18	56	
20	62	
22	68	
24	75	
27	82	
30	91	

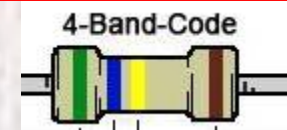
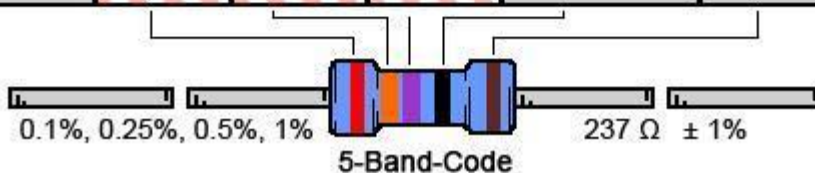
Resistors

- Leaded Resistor
 - Carbon Film, Metal Film, Metal Oxide

Count the number of bands on the resistor first



COLOR	1 ST BAND	2 ND BAND	3 RD BAND	MULTIPLIER	TOLERANCE
Black	0	0	0	1 Ω	
Brown	1	1	1	10 Ω	\pm 1% (F)
Red	2	2	2	100 Ω	\pm 2% (G)
Orange	3	3	3	1K Ω	
Yellow	4	4	4	10K Ω	
Green	5	5	5	100K Ω	\pm 0.5% (D)
Blue	6	6	6	1M Ω	\pm 0.25% (C)
Violet	7	7	7	10M Ω	\pm 0.10% (B)
Grey	8	8	8		\pm 0.05%
White	9	9	9		
Gold				0.1 Ω	\pm 5% (J)
Silver				0.01 Ω	\pm 10% (K)



Green 5
 Blue 6
 Yellow 4

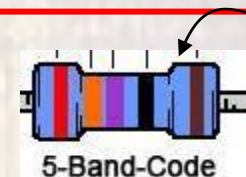
gap

$(5 \times 10 + 6) \times 10^4 = 560,000\Omega = 560K\Omega$

Gold \pm 5%

560K Ω \pm 5%

Note – we use Engineering Notation



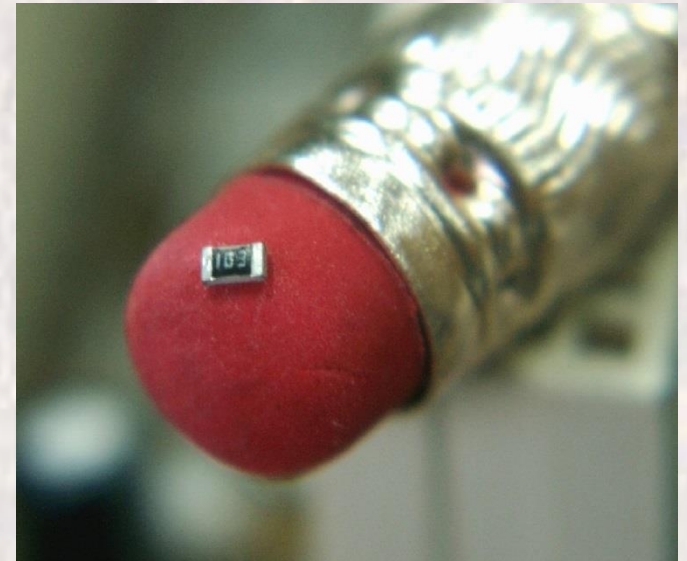
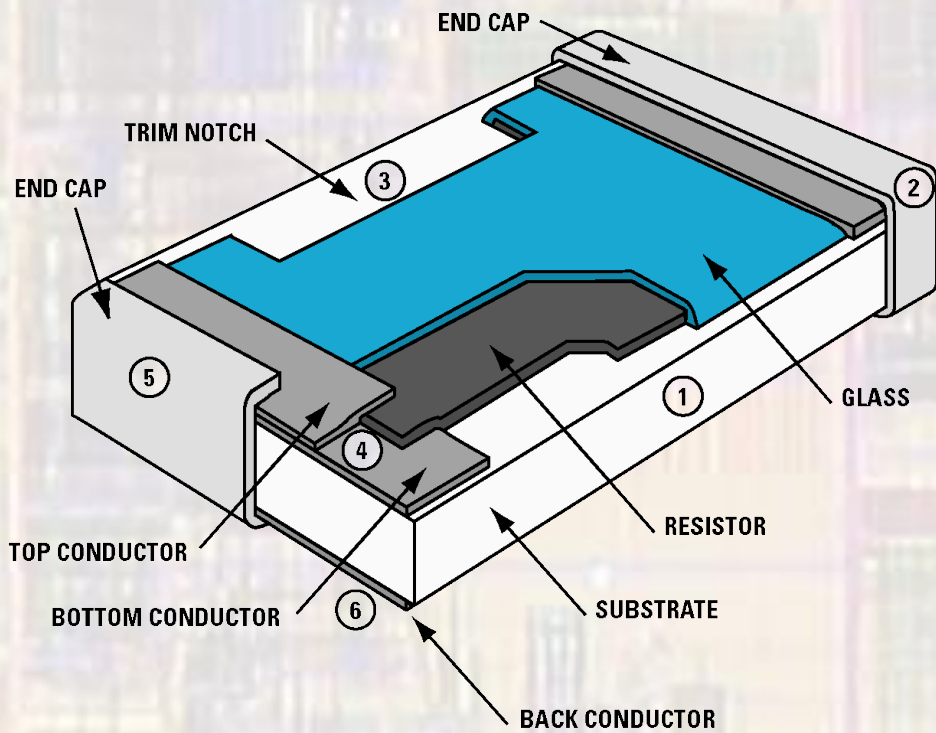
red – orange – violet – black – brown

$(2 \times 100 + 3 \times 10 + 7) \times 10^0 = 237\Omega \pm 1\%$

gap

Resistors

- Chip Resistor



ANATOMY OF A HIGH RELIABILITY THICK FILM CHIP RESISTOR

Resistors

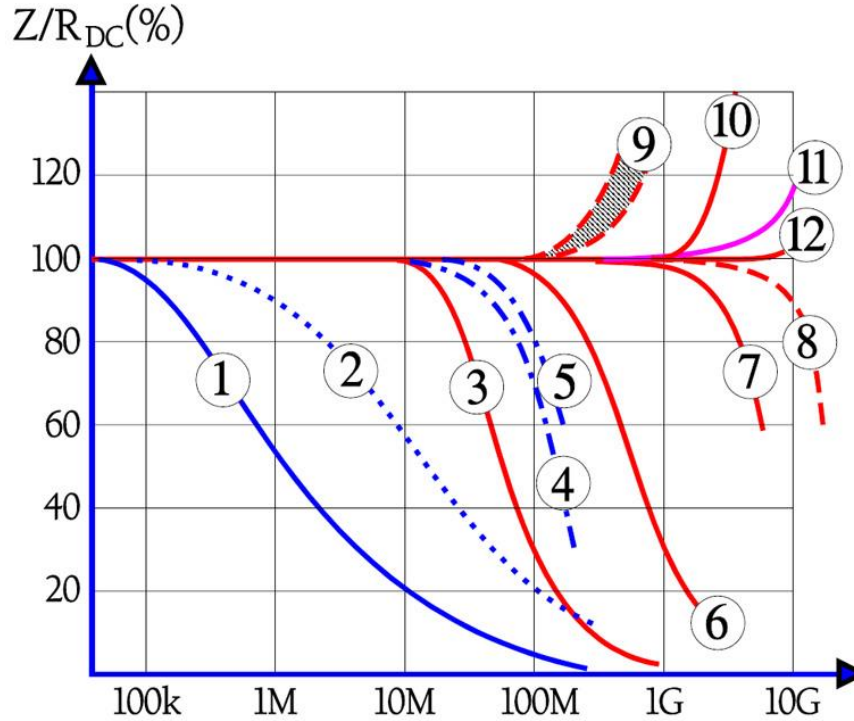
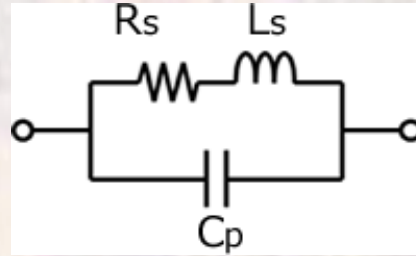
- Chip Resistor
 - Also called Surface Mount Resistor



- Sizes – mm
 - L W
 - 0201, 0402, 0603, 0805, 1206, 1812
- Markings
 - If an R exists – indicates the decimal point
 - R100 \rightarrow 0.100 Ω 1R2 \rightarrow 1.2 Ω
 - Otherwise – just like leaded resistors
 - 123 \rightarrow 12x10³ Ω 1234 \rightarrow 123x10⁴ Ω

Resistors

- Frequency Response
 - Model



1. Carbon composition, $\frac{1}{4}$ W, 1 MW.
2. Carbon composition, $\frac{1}{4}$ W, 100 kW.
3. Chip, thick film, EIA size 0603, 100 kW; $c \gg 0.05$ pF; $L \gg 0.4$ nH.
4. Metal glaze or metal film, DIN size 0207, 100 kW; $c \gg 0.4$ pF.
5. MELF, DIN size 0204, 10 kW.
6. Chip, thick film, EIA size 0603, 10 kW; $c \gg 0.05$ pF; $L \gg 0.4$ nH.;
7. Chip, metal foil, EIA size 1210, 10 kW.
8. MELF, DIN size 0102, high frequency design, 10 W; $c \gg 0.035$ pF; $L \gg 0.8$ nH.
9. MELF, DIN size 0204, 10 W.
10. Chip, thick film, EIA size 0603, 10 W; $c \gg 0.05$ pF; $L \gg 0.4$ nH.
11. Chip, thin film, EIA size 0603, 100 W; $c \gg 0.035$ pF; $L \gg 1.2$ nH.
12. Chip, thick film, EIA size 0603, 100 W; $c \gg 0.05$ pF; $L \gg 0.4$ nH

Src: DOEET.com