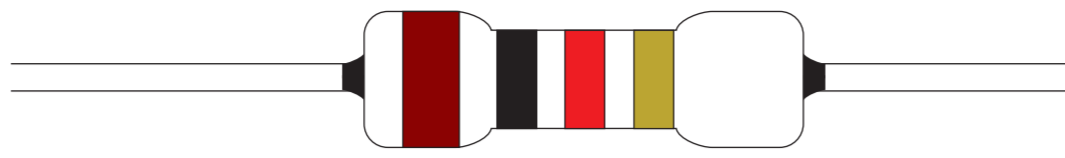


Resistors

Resistor Colour Codes – carbon film

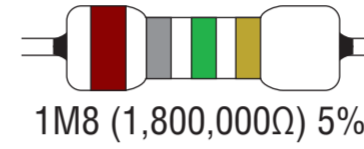


Gold	–	–	÷10	5% tolerance
Silver	–	–	÷100	10% tolerance
Black	0	0		
Brown	1	1	0	1% tolerance
Red	2	2	00	
Orange	3	3	000	
Yellow	4	4	0000	
Green	5	5	00000	
Blue	6	6	000000	
Violet	7	7	0000000	
Grey	8	8		
White	9	9		

Multiplication factors and symbols

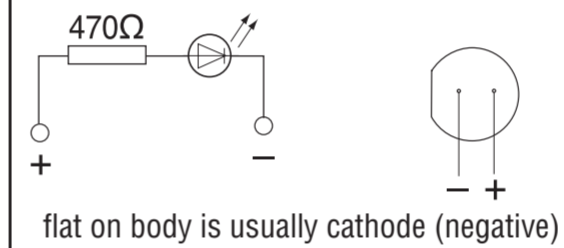
M	mega	1 000 000	(10 ⁶)
K	kilo	1 000	(10 ³)
m	milli	0.001	(10 ⁻³)
μ	micro	0.000 001	(10 ⁻⁶)

EXAMPLES



Resistor values for LEDs assuming approximately 20mA is required

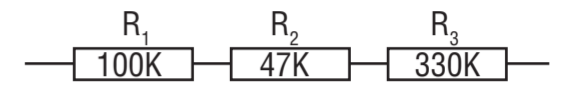
Voltage	Value
3V	120Ω
5V	220Ω
9V	470Ω
12V	560Ω



Resistors in series

$$R_{TOTAL} = R_1 + R_2 + R_3 \text{ etc...}$$

Example:



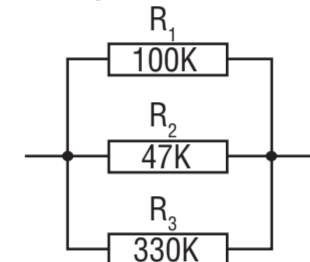
$$R_{TOTAL} = 100K + 47K + 330K$$

$$R_{TOTAL} = 447K\Omega$$

Resistors in parallel

$$\frac{1}{R_{TOTAL}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} \text{ etc...}$$

Example:



$$\frac{1}{R_{TOTAL}} = \frac{1}{100K} + \frac{1}{47K} + \frac{1}{330K}$$

so the total resistance is

$$\frac{1}{0.334} = 2.99K\Omega$$

Capacitors

Capacitance codes give a value in pF. The first two digits are significant digits and the third digit is number of zeros.

Capacitance (picofarad pF)	Capacitance (nanofarad nF)	Capacitance (microfarad μF)	Capacitance Code
10	0.01		100
15	0.015		150
47	0.047		470
82	0.082		820
100	0.1		101
330	0.33		331
470	0.47	0.00047	471
1000	1.0	0.001	102
1500	1.5	0.0015	152
2200	2.2	0.0022	222
4700	4.7	0.0047	472
6800	6.8	0.0068	682
10000	10	0.01	103
22000	22	0.022	223
47000	47	0.047	473
100000	100	0.1	104
220000	220	0.22	224
470000	470	0.47	474

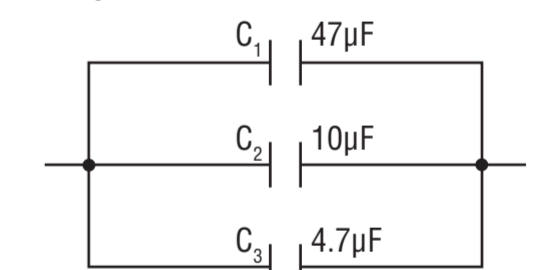
Examples:

103 is 10 with three zeros – 10,000pF or 10nF
471 is 47 with one zero – 470pF or 0.47nF

Capacitors in parallel

$$C_{TOTAL} = C_1 + C_2 + C_3 \text{ etc...}$$

Example:



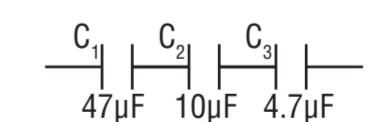
$$C_{TOTAL} = 47\mu F + 10\mu F + 4.7\mu F$$

$$C_{TOTAL} = 61.7\mu F$$

Capacitors in series

$$\frac{1}{C_{TOTAL}} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3} \text{ etc...}$$

Example:



$$\frac{1}{C_{TOTAL}} = \frac{1}{47\mu F} + \frac{1}{10\mu F} + \frac{1}{4.7\mu F}$$

so the total capacitance is

$$\frac{1}{0.334} = 2.99\mu F$$

