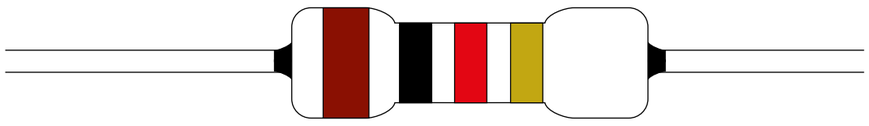
# Resistors

## RESISTOR COLOUR CODES – CARBON FILM

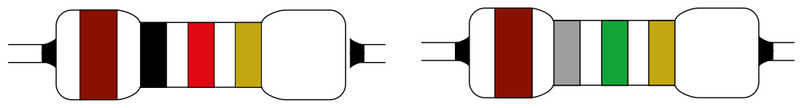


| | 1st Band | 2nd Band | 3rd Band Multiplier | 4th Band Tolerance |
|---|---|---|---|---|
| Gold | – | – | ÷10 | 5% tolerance |
| Silver | – | – | ÷100 | 10% tolerance |
| Black | 0 | 0 | | |
| Brown | 1 | 1 | 0 | 1% tolerance |
| Red | 2 | 2 | 00 | |
| Orange | 3 | 3 | 000 | |
| Yellow | 4 | 4 | 0000 | |
| 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 | ($10^{-6}$) |

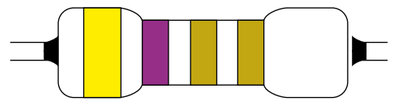
### EXAMPLES



1K (1,000Ω) 5%



1M8 (1,800,000Ω) 5%



4R7 (4.7Ω) 5%

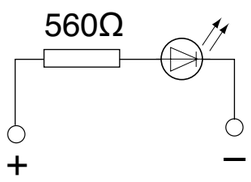
220K (220,000Ω) 5%

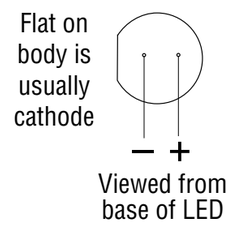
### Equation for selecting resistor value for LEDs

Supply voltage - forward voltage of LED
÷ forward current of LED in amps

**Example:**
RED LED at 2V and 20mA on a 12 Volt supply

12V-2V = 10V ÷ .02 Amps= 500 Ohms
(use next preffered value which is 560 Ohms).




### Resistors in series

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

**Example:**



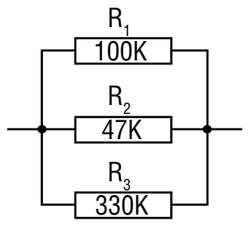

$R_{TOTAL} = 100K + 47K + 330K$

$R_{TOTAL} = 477K\Omega$

### Resistors in parallel

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

**Example:**




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

$R_{TOTAL} = 29.15K$

**Measuring resistance with a multimeter**

**SCAN HERE WATCH VIDEO**

# Capacitors

| 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 |

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

**Examples:**

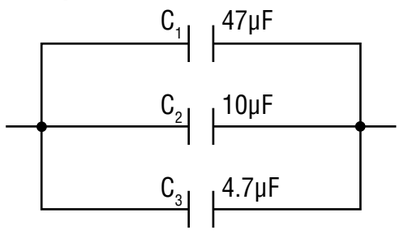
103 is 10 with three zeros – 10,000pF or 10nF

471 is 47 with one zero – 470pF or 0.47nF

### Capacitors in parallel

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

**Example:**



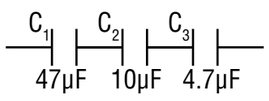

$C_{TOTAL} = 47\mu F + 10\mu F + 4.7\mu F$

$C_{TOTAL} = 61.7\mu F$

### 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 2.99µF