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Resistor Color Coding

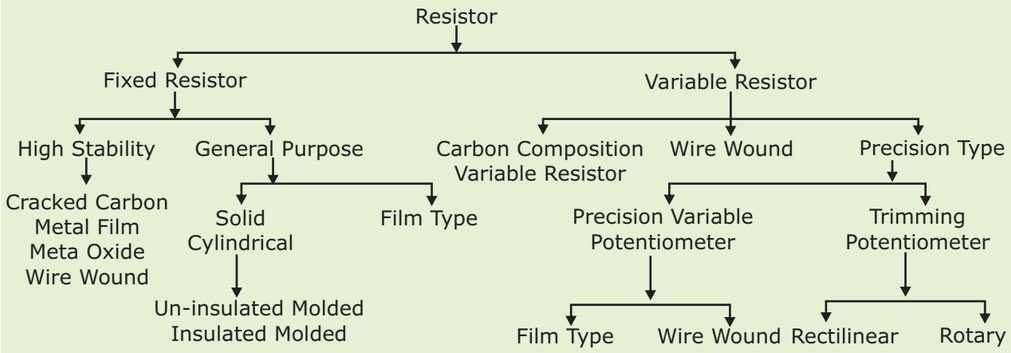
Resistor

A resistor is a passive component which introduces resistance. Resistance is defined as the property of the material which opposes the flow of current. Resistors have no polarity and they can be connected in the circuit in either direction.

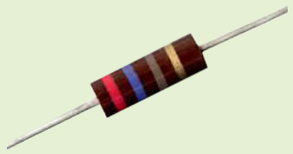
$$R=\rho \frac{L}{A}$$

Where, R = Resistance (Ω)
L = Length of conductor (m)
A = Area of cross-section of conductor (m^2)
ρ = Specific resistance or resistivity of material

Classification of Resistor



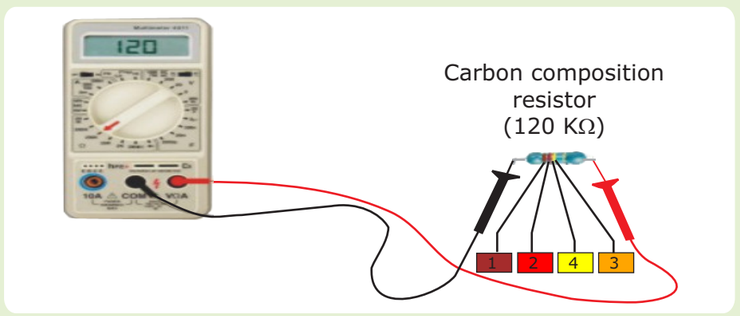
Carbon Resistors are the most common type of Composition Resistors. Carbon resistors are cheap general purpose resistor used in electrical and electronic circuits. Their resistive element is manufactured from a mixture of finely ground carbon dust or graphite (similar to pencil lead) and a non-conducting ceramic (caly) powder to bind it all together.



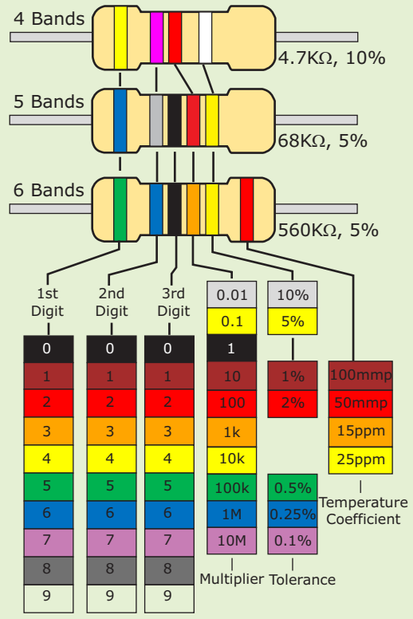
Film Resistor consist of Metal Film, Carbon Film and Metal Oxide Film resistor types, which are generally made by depositing pure metals, such as nickel, or an oxide film, such as tin-oxide, onto an insulating ceramic rod or substrate.

Wirewound Resistor is made by winding a thin metal alloy wire (Nichrome) onto an insulating ceramic former in the form of spiral helix.

Measurement of Resistance with Multimeter



Resistor Color Code Chart



Resistor Color Code Table

Colour	Digit	Multiplier	Tolerance
Black	0	1	
Brown	1	10	±1%
Red	2	100	±2%
Orange	3	1,000	
Yellow	4	10,000	
Green	5	100,000	±0.5%
Blue	6	1,000,000	±0.25%
Violet	7	10,000,000	±0.1%
Grey	8		
White	9		
Gold		0.1	±5%
Silver		0.01	±10%
None			±20%

Calculating Resistor Values
Digit Digit Multiplier = Colour Colour × 10^{Colour} in Ohm's (Ω's)
Example
Yellow Violet Red =
$47 \times 10^1 = 47000\Omega$ or 4.7KΩ

Tolerance
Resistor tolerances for film Resistors range from 1% to 10% while carbon resistors have tolerances upto 20%

Connecting Resistors Together

Resistor Connection

Series Parallel Series & Parallel
All resistors obey Ohm's Law and Krichoff's Circuit Laws

Total Resistance

$R_1 = R_1 + R_2 + R_3$

$R_1 = R_1 + R_2 + R_3$
$= 1k\Omega + 2k\Omega + 6k\Omega = 9k\Omega$

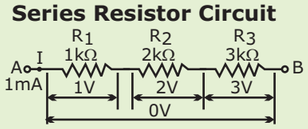
Series Resistor Equation

$R_{total} = R_1 + R_2 + R_3 \ldots\ldots\ldots R_n$ etc.

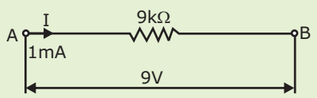
Total Voltage Caluclation

$V_{total} = V_{R1} + V_{R2} + V_{R3} \ldots\ldots + V_{rn}$

Series Resistor Circuit



Equivalent Resistance

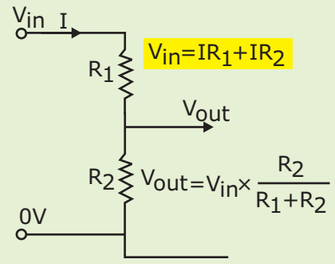


Series Resistor Voltage

Using Ohm's Law, the voltage across the individual resistors can be calculated as:
Voltage across $R_2 = IR_1 = 1mA \times 1k\Omega = 1V$
Voltage across $R_2 = IR_2 = 1mA \times 2k\Omega = 2V$
Voltage across $R_3 = IR_3 = 1mA \times 6k\Omega = 6V$
$V_{R1} = V_{R5} + V_{R2} + V_{R3} = 9V$

Potential Divider Circuit

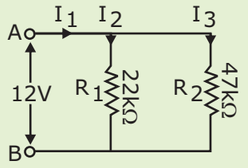
Ability to generate different voltages produces a circuit called as potential Divider Network.



Resistors in Parallel

Resistors are said to be connected together in "parallel" when both of their terminals are respectively connected toeach terminal of the other resistor or resistors.

Parallel Resistor Circuit



Parallel Resistor Equation

$$\frac{1}{R_{total}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} \ldots + \frac{1}{R_n} \text{etc.}$$

Equivalent Resistance

$$R_T = \frac{R_1 \times R_2}{R_1 + R_2}$$

Currents in a Parallel Resistor Circuit

$$R_T = \frac{22k\Omega \times 47k\Omega}{22k\Omega + 47k\Omega} = 14{,}985\Omega \text{ or } 14.9k\Omega$$

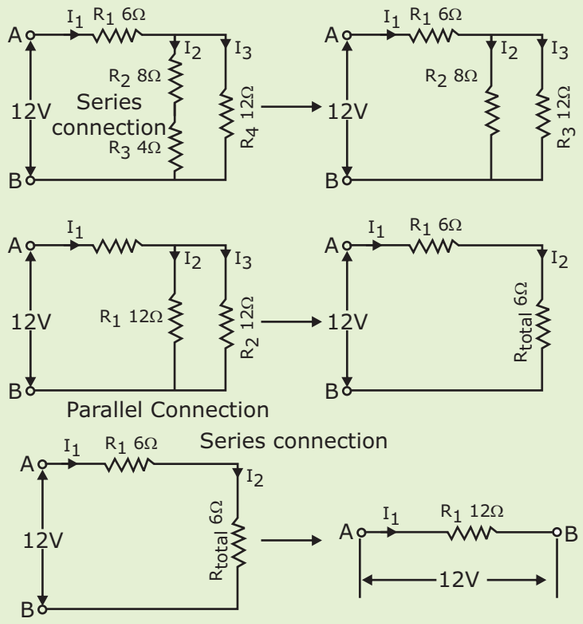
The total current flowing in the circuit is given as:

$I_T = I_{R1} + I_{R2}$

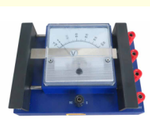
$I_T = I_1 + I_2 + I_3 \ldots\ldots + I_n$

Current flowing in $R_1 = V/R_1 = 12V + 22k\Omega = 0.545mA$
Current flowing in $R_2 = V/R_2 = 12V + 47k\Omega = 0.255mA$
$I_r = 0.545mA + 0.255mA = 0.8mA$ or $800\mu A$

Resistor Combinations




19001
Decade Resistance Box


20007
Multirange Ammeter & Voltmeter


21001
Rheostat Open Type


33515
Electricity Trainer


33516
Electricity Lab


36101
Linear I.C. Trainer


36185
Discrete Component Trainer


36325
Basic Electronic Trainer

IT-2013, Ramchandrapura Indl. Area, Sitapura Extension, Jaipur-302022, India. Ph: +91-9829132777; +91-9413330765; Email: info@tesca.in; Web: www.tesca.in