Resistors

Active components and Passive components – Resistors – Resistor Color code – Factors affecting Resistance – Types of Resistors – Fixed Resistors -Variable resistors - LDR – Resistors in Series and Parallel

Electronic Components

Introduction

Electronic circuits are made up of electronic components. The electronic components are classified into two types. They are Passive components and active components.

Active Components

The electronic components that deliver or produce energy in the form of a voltage or current are called active components. Active components are energy donors. It doesn't require an external source for the operation. It can control the flow of current. Active components are capable of providing the power gain. The behaviour of active components is Non linear.

Ex: Diode, Transistor, IC etc.,

Passive Components

The electronic components that utilize or store energy in the form of a voltage or current are called Passive components. Passive components are energy acceptors. It requires an external source for the operation. It can't control the flow of current. Passive components are not capable of providing the power gain. The behaviour of passive components is linear.

Ex: Resistor, capacitor, Inductor etc.,

Resistance value = 10K Ω ±20%

Resistor

A resistor is a passive component which reduces flow of current through it. The resistor has no polarity can be connected in the circuit in either direction.

Symbol

Unit

Ω

Factors affecting Resistance

Resistance of a resistor is given by

$$R=\rho L/A\ (\Omega)$$

Where L - Length of the conductor

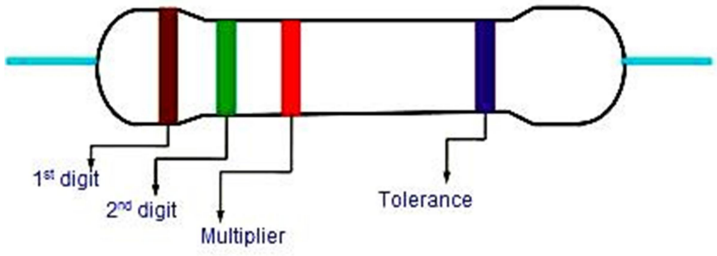
A - Area of cross section of conductor

ρ - Resistivity of the material

Resistor Colour Code

Colour coding method is used to find the resistance value. Carbon resistors are coded to identify the resistance value and tolerance. Resistance value find from Left to right.

Resistor Diagram:



Description:

The first two colour bands represent the digits. The third colour band is the Decimal Multiplier i.e. number of zeros. The fourth colour band represents the tolerance.

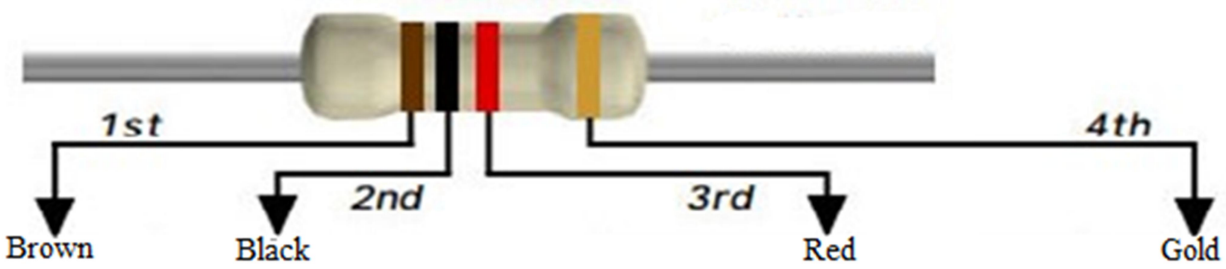
Colour code table:

Color	Digit	Digit	Multiplier
Black	0	0	10^0
Brown	1	1	10^1
Red	2	2	10^2
Orange	3	3	10^3
Yellow	4	4	10^4
Green	5	5	10^5
Blue	6	6	10^6
Violet	7	7	10^7
Grey	8	8	10^8
White	9	9	10^9

Four colour bands:

The four color bands represent the resistance value as per the colour code.

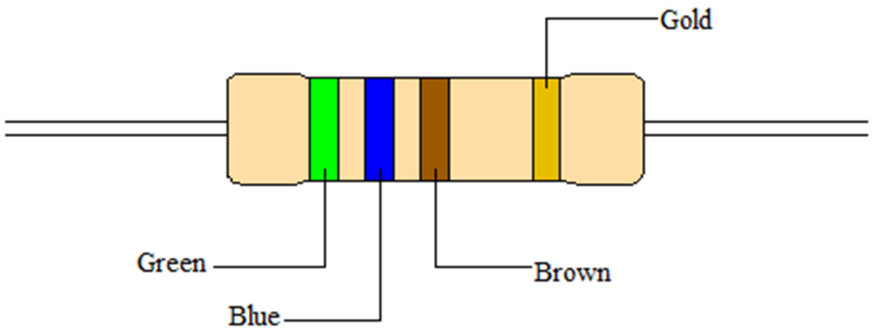
Example 1:



Brown	Black	Red	Gold
1	0	10^2	±5%

Resistance value = 1KΩ ± 5%

Example:2



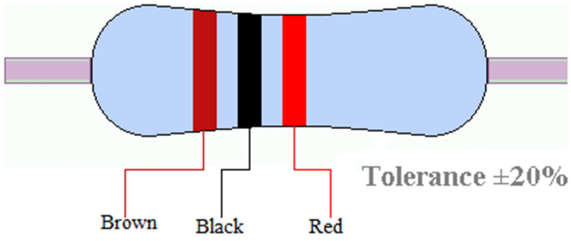
Green	Blue	Brown	Gold
5	6	0	± 5%

Resistance value = 560 Ω ± 5 %

Three Colour bands:

The three colur bande represent the resistance value as per the colour code system. The fourth colour band is missing. Therefore the tolerance is ±20%.

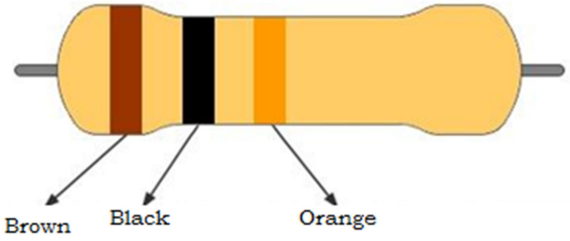
Example 1:



Brown	Black	Red	Tolerance
1	0	10^2	±20%

Resistance value = 1KΩ ±20%

Example 2:



Brown	Black	Orange	Tolerance
1	0	10^3	±20%

Resistance value = 10K Ω ±20%

Types of Resistors

- Fixed Resistors
- Variable Resistors

1. Fixed Resistors

Fixed Resistor is a resistor whose resistance value is fixed and cannot be changed.

Types of Fixed Resistors:

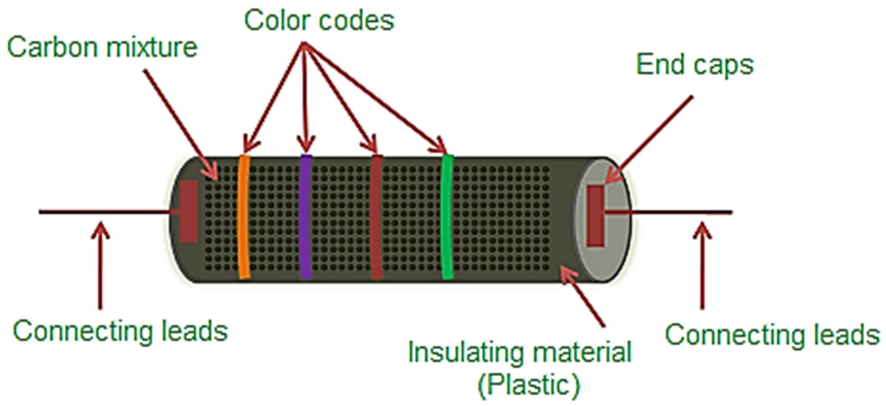
- Carbon composition Resistor
- Carbon Film Resistor
- Metal Film Resistor
- Wire Wound Resistor

1.1 Carbon Composition Resistor

Introduction:

The Carbon composition resistor is a fixed resistor whose resistance value is fixed and cannot be changed. It is also called as Carbon resistors. It uses carbon clay composition to reduce the flow of current.

Circuit Diagram:



Construction:

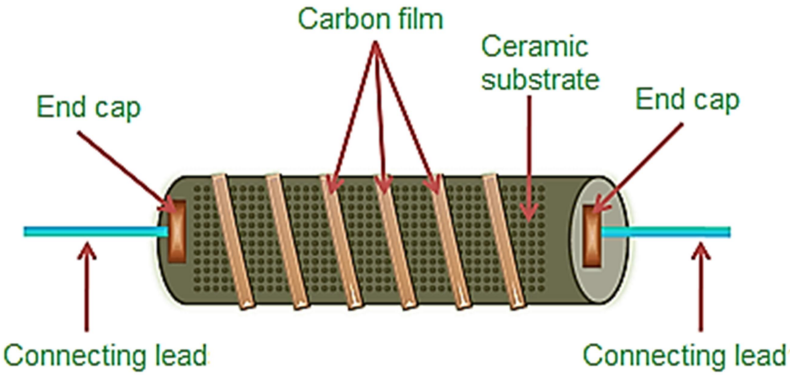
The Carbon composition resistor is made from the mixture of carbon powder and ceramic. The resistive element is of carbon clay composition. The resistor's value depends on the resistive element. The cylindrical resistive element is covered with plastic to provide electrical insulation and protection from moisture. Metallic end caps are fitted at both ends of the resistive material. The leads made of copper are joined at two ends of the resistive element. The carbon composition resistor's range is from few Ω to 100 MΩ. Its Power range is from 1/8, 1/4, 1/2, 1, 2 watts.

1.2 Carbon film Resistor

Introduction:

The Carbon film resistor is a type of fixed resistor whose resistance value is fixed and cannot be changed. It uses Carbon film to restrict the flow of current.

Circuit Diagram:



Construction:

The carbon film resistor is made by placing the Carbon film on a ceramic substrate. The Carbon film acts as the resistive material. The resistive element is covered with the ceramic. Metallic end caps are fitted at both ends of the resistive material. The leads made of copper are joined at two ends of metallic end caps.

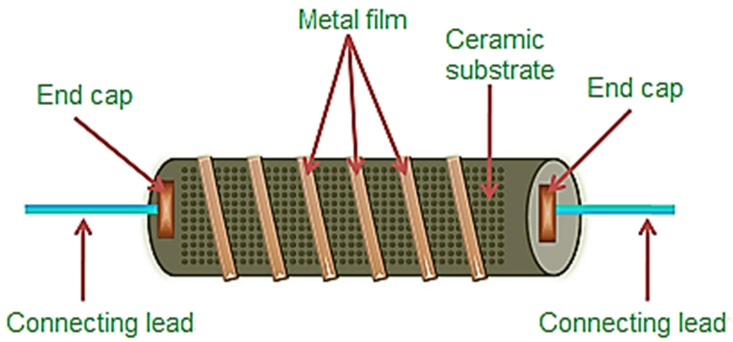
In carbon film resistor, the desired resistance value can be achieved by cutting the carbon in a helical manner. This is done by using the lasers. The cutting of carbon is stopped once the desired resistance value is obtained. The carbon film resistor's range is from few Ω to 100 KΩ. Its Power range is from 2 watts to few watts.

1.3 Metal film Resistor

Introduction:

The Metal film resistor is a type of fixed resistor whose resistance value is fixed and cannot be changed. It uses Metal film to restrict the flow of current. The Used Metal is Nickel Chromium (Nichrome).

Circuit Diagram:



Construction:

The Metal film resistor is made by placing the Metal film on a ceramic substrate. The Metal film acts as the resistive material. The resistive element is covered with the ceramic. Metallic end caps are fitted at both ends of the resistive material. The leads made of copper are joined at two ends of metallic end caps.

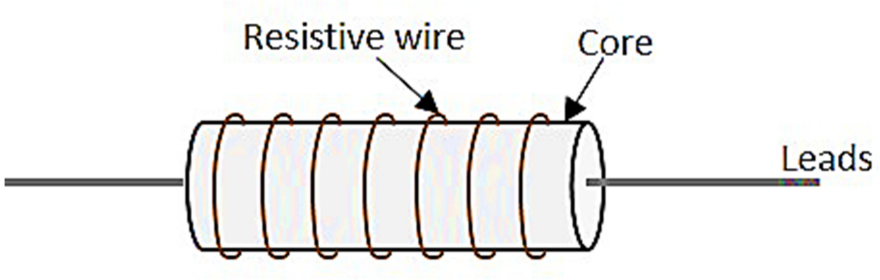
In Metal film resistor, the desired resistance value can be achieved by cutting the metal in a helical manner. This is done by using the lasers. The cutting of metal is stopped once the desired resistance value is obtained. The Metal film resistor's range is from few Ω to 100 KΩ. Its Power range is from 2 watts to few watts.

1.4 Wire wound Resistor

Introduction:

Wire wound resistor is a fixed resistor whose resistance value is fixed and cannot be changed. It uses metal wires to reduce the flow of electric current.

Circuit Diagram:



Construction:

Wire wound resistors are constructed from the metal wire wound on a ceramic core. The metal wire may be Nickel – Chromium (Nichrome). The metal wire is used as the resistive element. The length of the metal wire and its resistivity determine the resistance value. The metal wire must have good uniformity & high resistivity. The entire assembly is covered with a ceramic material. The Wire wound resistor's range is from 1Ω to 1MΩ. Its Power range is from 5 watts to 200 watts.

2. Variable Resistors

Variable Resistor is a resistor whose resistance value is variable. It is used to control the flow of electric current by manually increasing or decreasing the resistance

Symbol:

Types of Variable Resistors:

➨Rheostat ➨Potentiometer

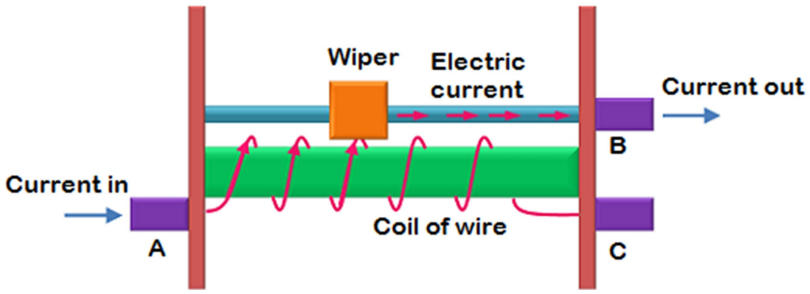
2.1 Rheostat

Introduction:

Rheostat is three terminal resistor in which the resistance is manually varied to Control the flow of electric current. It is derived from the Greek word "rheos" and "statis" which means a current controlling device.

Symbol:

Circuit Diagram:



Description:

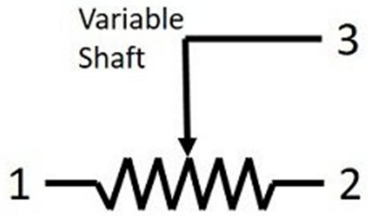
The Rheostat has three terminals among which two are fixed and one is variable. The two fixed terminals are connected to both ends of the resistive element. The resistive element is made of wire wound or carbon film. Rheostats are mostly wire wound. Hence, rheostats are also called as variable wire wound resistors. The resistive element is called as track and third terminal is connected to the wiper. The wiper that moves over the track varies the resistance of the rheostat. The resistance of the rheostat depends on the length of the resistive element through which electric current is flowing.

2.2 Potentiometer

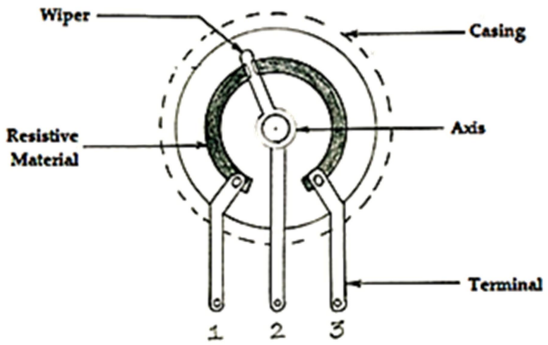
Introduction:

A potentiometer is a three terminal resistor in which the resistance is manually varied to Control the flow of electric current.

Symbol:



Circuit Diagram:



Description:

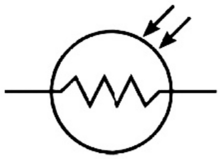
The potentiometer has three terminals among which two are fixed and one is variable. The two fixed terminals are connected to both ends of the resistive element. The resistive element is made up of

carbon. The resistive element is called as track and third terminal is connected to the wiper. A shaft is present over which the wiper is fabricated. The wiper that moves over the resistive element in rotary manner. The wiper is adjusted to get desired resistance value. All of the components is housed inside a casing, to prevent it from external physical damages.

LDR

A light dependent resistor is a light controlled variable resistor. Its resistance changes with the light intensity that falls on it. It is also called as Photo resistor or photocell or Photoconductors or Photoconductive cell.

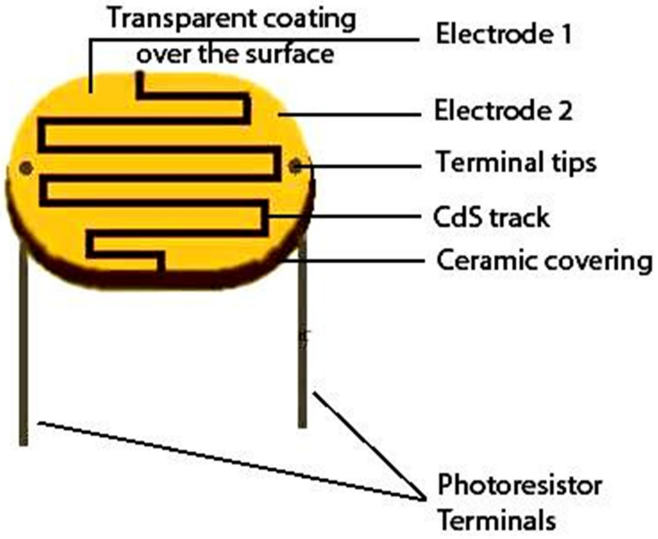
Symbol:



Principle: Photoconductivity

A LDR works on the principle of photoconductivity. Photo conductivity is an optical phenomenon in which the materials conductivity reduces when light is absorbed by the material. (i.e) The resistance of a LDR decreases with increasing incident light intensity.

Structure: Construction:

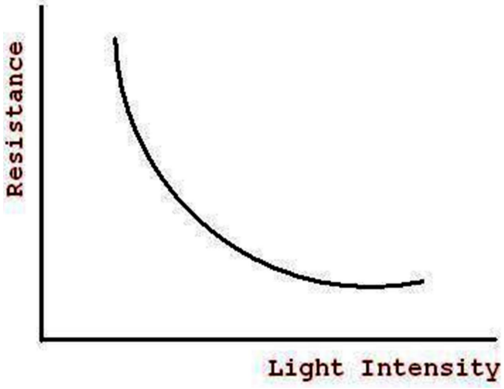


Light dependent resistors are made up of cadmium sulphide (cds). A light sensitive material is deposited on ceramic substrate. The material is deposited in zigzag pattern to obtain the desired resistance. This zigzag separates two metal coated areas acting as electrode. The assembly is enclosed in metal case with a glass window.

Working:

When light falls on the device, the electrons in the valence band are excited to the conduction band. This result current starts flowing and hence its resistance value is decreased. When a light dependent resistor is kept in dark, its resistance is very high and is called as **dark resistance**.

Characteristics:



Description:

If a constant voltage is applied to LDR and intensity of light is increased, the current starts increasing and hence the resistance value decreases.

Applications:

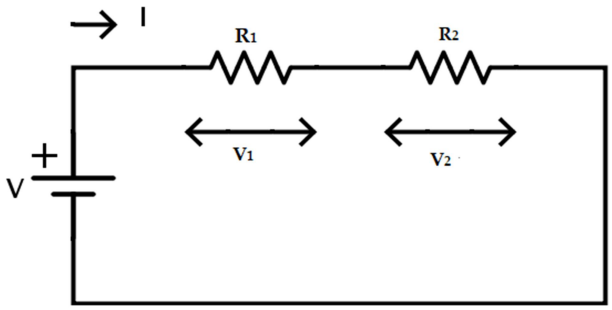
- Light sensor
- Audio compressor
- Automatic street light
- Fire alarm

Resistors in Series &Parallel

Resistors in Series

Consider the resistors R_1,R_2 connected in Series

Circuit diagram



Analysis

The current through each resistor is same while the voltage across each resistor is different.

Voltage across each resistor R_1,R_2 is V_1, V_2respectively.

According to Kirchhoff's Voltage Law $V = V_1+V_2$

According to Ohms law, $V=IR$, $V_1=IR_1$, $V_2=IR_2$

$IR=IR_1+IR_2$

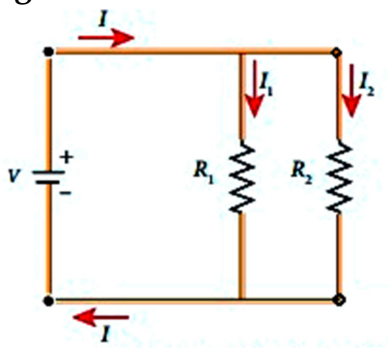
$IR=I (R_1+R_2)$

$$R=R_1+R_2$$

Resistors in Parallel

Consider the resistors R_1, R_2 connected in Parallel

Circuit diagram



Analysis

Voltage across the resistor is same while current through each resistor is different.

Current through the resistors R_1,R_2 is I_1,I_2respectively.

According to Kirchhoff's Current Law $I= I_1+I_2$

According to Ohms law, $I=V/R$, $I_1=V/R_1$, $I_2=V/R_2$

$V/R =V/R_1+V/R_2$

$V/R =V(1/R_1+1/R_2)$

$1/R =1/R_1+1/R_2$

$1 / R = (R_1+ R_2) / R_1R_2$

$$R= R_1R_2/(R_1+ R_2)$$