



BHAGAVATULA CHARITABLE TRUST

# **ELECTRONICS – An Introduction**

ఎలక్ట్రానిక్స్ - పరిచయము

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# Basic Introduction a book for beginners in Electronics

*This Chapter provides a basic introduction to a beginner in Electronics Learning and helps in understanding basic components.*

**E**lectronics play an important role in our modern life. To understand the new technologies and gadgets on how they work is one type of interest in Electronics field. To be able to design a new gadget and make it useful in daily life presents new vistas of interest.

I C O N   K E Y	
	Valuable information
	Test your knowledge
	Laboratory exercise
	Workbook review

**To understand the course structure** and follow the guidelines some icons are used in this book. Each icon indicates a different action and listed in the icon key table. E.g., if there is a pencil symbol () next to the paragraph, the action is to take a test and evaluate the gained knowledge.

## Introduction

Intention of this course is to teach the operation of basic electronic components. By co-relating their functions by comparing with mechanical function of water flow through pipes. The pipe networks are slower in their operation than their electronic counterparts, but a comparison however is helpful in understanding each of the fundamental electronic components.

This book is not intended to be a Textbook. It is a reference book and is intended to provide some knowledge for the Practical learning of Electronics.

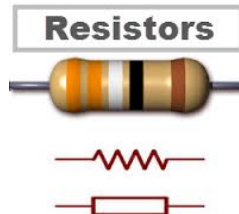
## Contents:

The following are the components covered in this book:

- a. **Resistor:** Resists current flow.
- b. **Capacitor:** Stores electrical charges
- c. **Inductor / Coil:** Induces electrical charges. Use magnetic fields
- d. **Semi-Conductors:** Electronic control devices
  - a. **Diode:** Conducts electricity in one direction only.
  - b. **LED:** Emits light based on electricity; Light Emitting Diode
  - c. **Transistor:** Amplifies signal, Works as electronic switch
  - d. **IC:** A mixed circuit of several devices; Integrated Circuit
- e. **Switch:** A mechanical device that controls flow of electricity
- f. **Relay:** A device that allows flow of electricity based in input signal / electric current
- g. **Transformer:** Transforms electrical energy using electromagnetic induction
- h. **Motor:** An electro-mechanical device that converts electrical energy to mechanical energy.
- i. **Breadboard:** A board used for making an experimental model of an electronic circuit.
- j. **Multi-meter:** A device used for measuring voltages, electric current and various other parameters of electronic components.
- k. **Power Supply:** Supplying power at different voltages to the electronic circuit

## Resistor

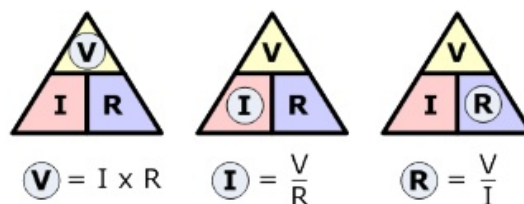
A resistor is a device that resists electrical current flow in a circuit. Following are the properties / characteristics of a resistor. It is a wire or coil wound around a ceramic cylinder. Its value is measured in Ohms.



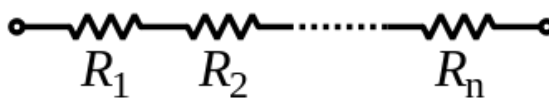
### General Characteristics

- a. The amount of flow of electric current is same in both directions and the resistor behaves the same, when connected either way.
- b. **OHM's Law:** The Voltage across the resistor is proportional to the flow of the electric current.  $V = i R$ , where  $V$  is the Voltage,  $i$  is the electric current flowing and  $R$  is the constant value of the resistance, measured in Ohms ( $\Omega$ ). This equation is known as Ohm's Law.

The current is directly proportional to the voltage and indirectly proportional to the resistance.

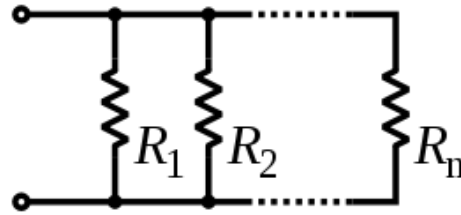


- c. When resistors are connected in series, the total effective resistance is the sum of all the resistances.



$$R = R_1 + R_2 + \dots + R_n$$

When the resistors are connected in parallel, the total effective resistance is the inverse sum of all the resistances.



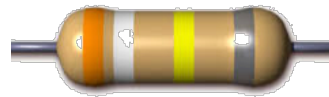
$$1/R = 1/R_1 + 1/R_2 + \dots + 1/R_n$$

d. The amount of Power (measured in Watts) consumed when electricity flows through the Resistor is directly proportional to the square of the electric current flowing through it.

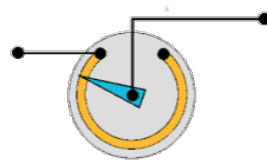
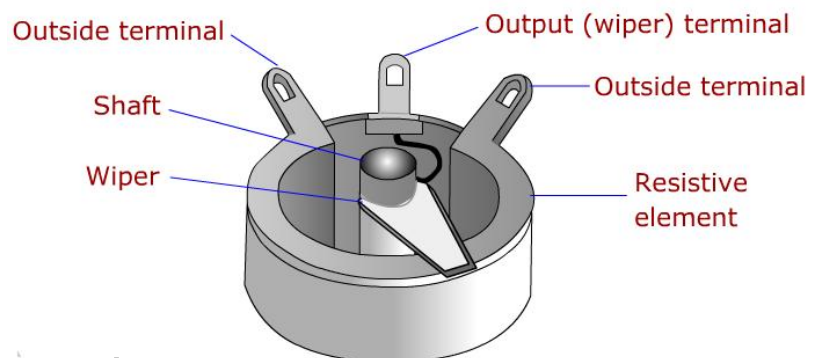
$$P = i^2 R \text{ Watts}$$

e. There are two basic types of resistors.

a. Fixed Resistor



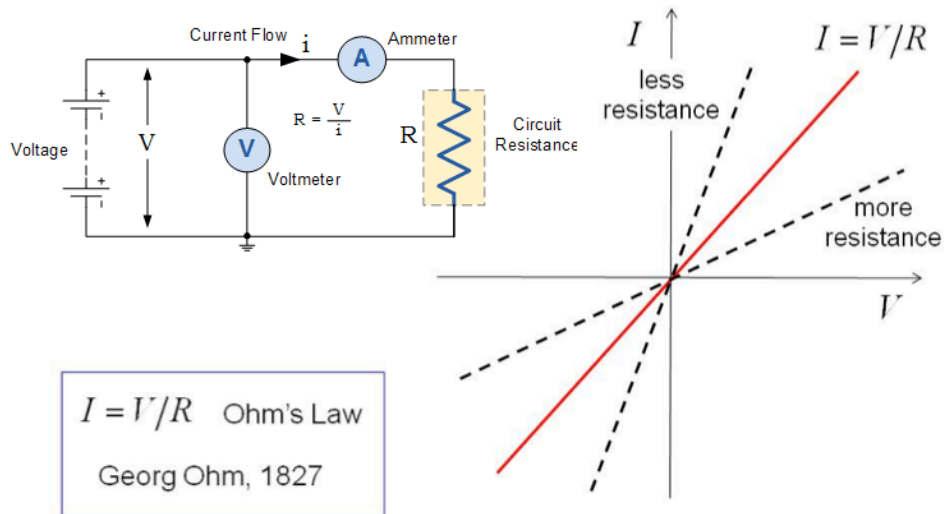
b. Variable Resistor



Circuit Diagram for Variable resistor ..... Symbol for Variable resistor

## Electrical Characteristics

When a voltage is applied across the resistor, an electric current flows through the resistor. As the Voltage increases, the electric current flow increases. If the voltage decreases, the electric current flow decreases. A resistor can get damaged if the voltage applied and the current flowing is more than the rated values.

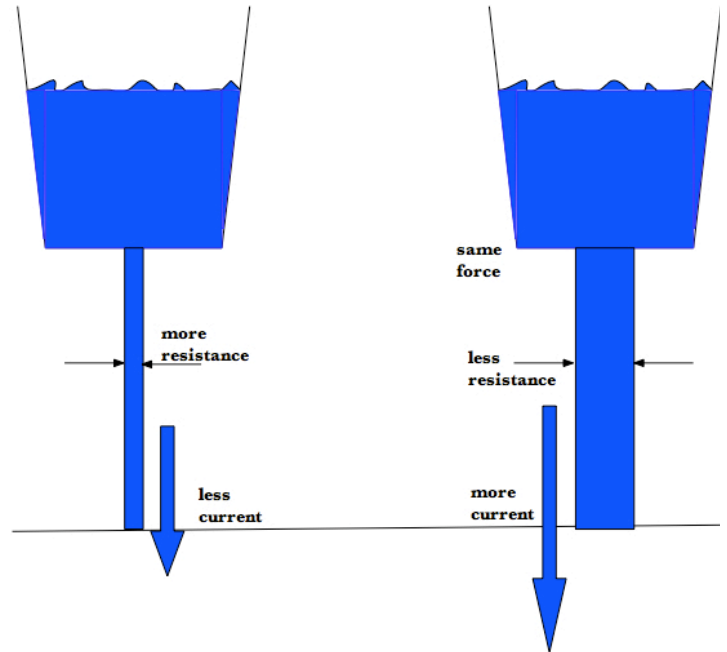




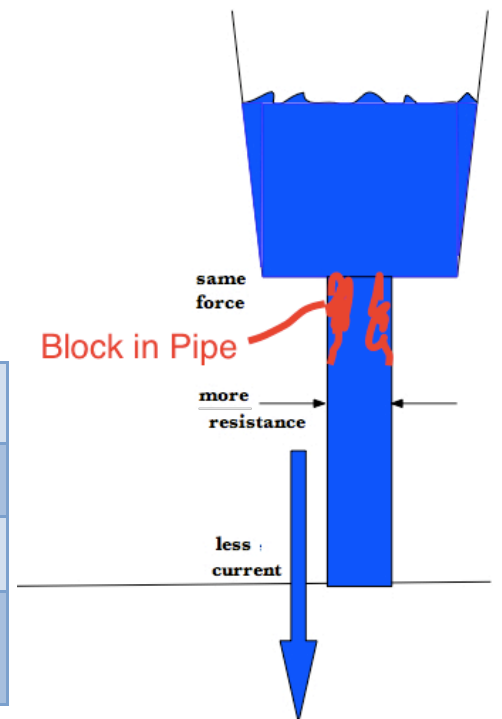
### Hydraulic Analogy

Imagine a water tank with a pipe at the bottom. If the pipe diameter is small, the water flowing through will face more friction or 'resistance' and hence the water 'current' flow is less.

If the pipe diameter is larger, the water flowing through will face less friction or 'resistance' and hence the water 'current' flow is more.



Consider another case. If the pipe diameter is larger, but has some particles blocking the flow in pipe, the amount of water 'current' flow is less and the pipe is effectively offering more friction or 'resistance'.

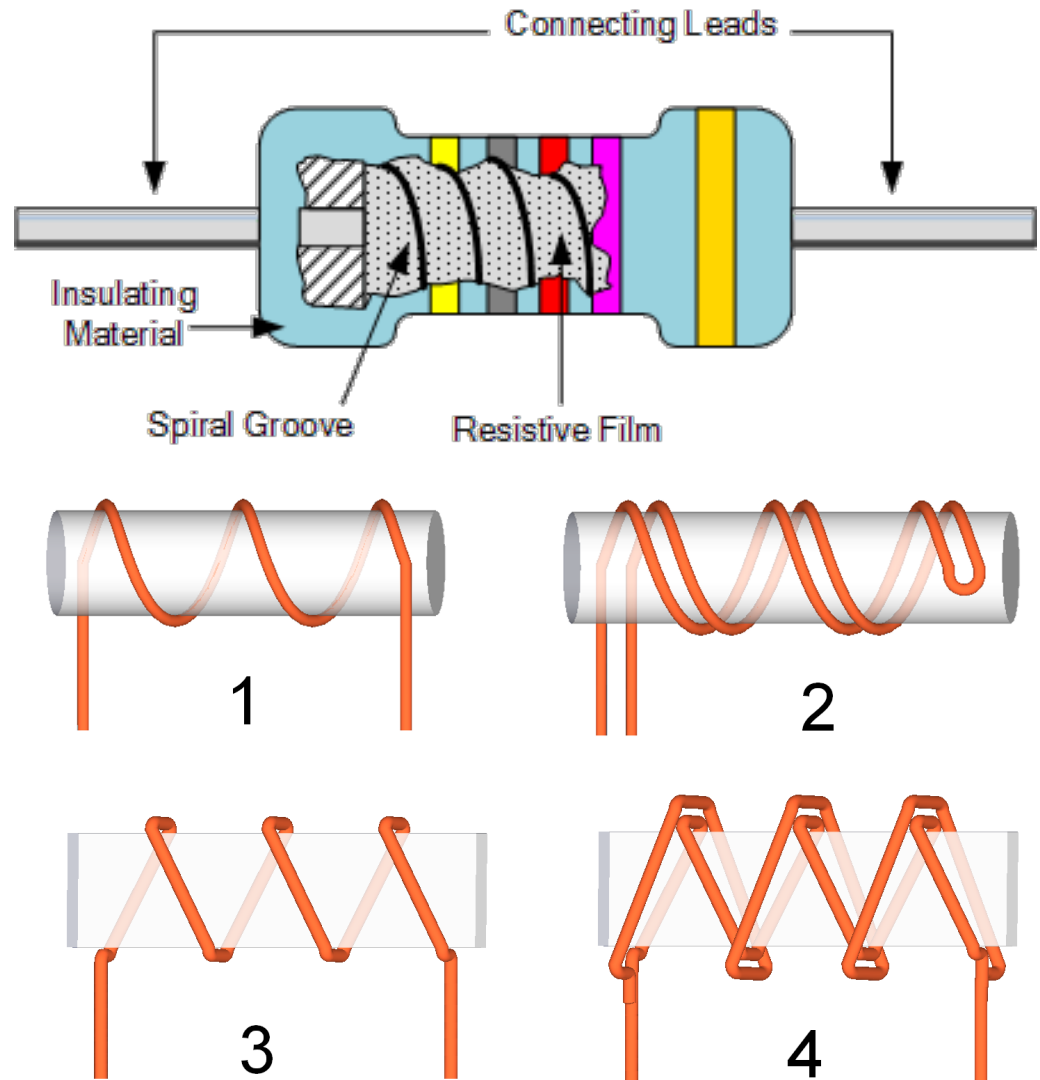


### Comparison

Hydraulic system	Electrical System
Water flow in pipe	Electric Current
Pipe diameter	Resistance
Height of Water in the bucket	Voltage

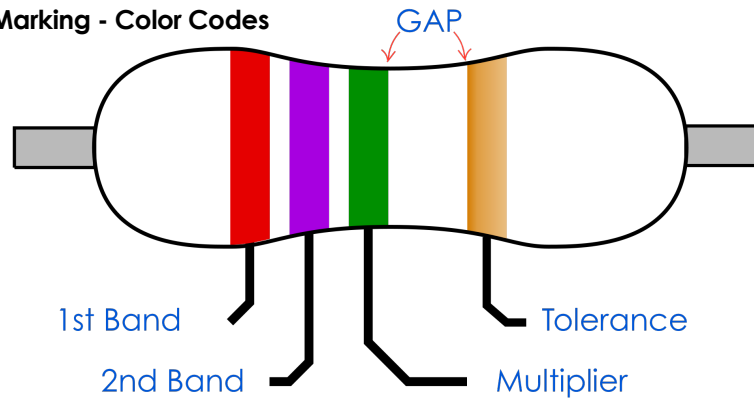
The electrical current is a flow of electrons and the resistance is the friction that opposes the flow of electric current flowing in the circuit.

### Resistor Construction



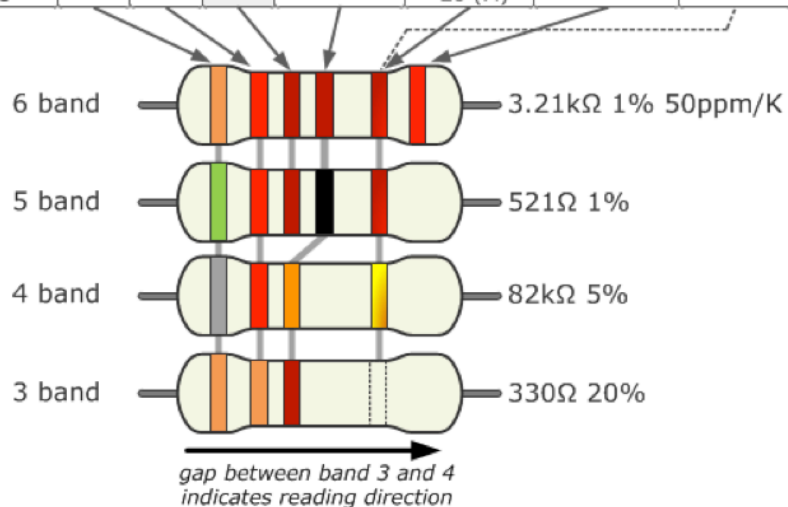
This is one type of construction of resistor. A wire or film with known resistance per meter is wound around a ceramic cylinder and the ends are connected to the metallic leads. The construction is shown above. A protective coating is applied over the resistor and colored bands are painted indicating the value of the resistance.

### Resistor Marking - Color Codes



The color codes could be 4 or 5 or 6 bands depending on type of resistor. The gap will indicate on which end is the Tolerance band. The picture below provides the value of each colored band.

Color	Significant figures			Multiply	Tolerance (%)	Temp. Coeff. (ppm/K)	Fail Rate (%)
black	0	0	0	x 1		250 (U)	
brown	1	1	1	x 10	1 (F)	100 (S)	1
red	2	2	2	x 100	2 (G)	50 (R)	0.1
orange	3	3	3	x 1K		15 (P)	0.01
yellow	4	4	4	x 10K		25 (Q)	0.001
green	5	5	5	x 100K	0.5 (D)	20 (Z)	
blue	6	6	6	x 1M	0.25 (C)	10 (Z)	
violet	7	7	7	x 10M	0.1 (B)	5 (M)	
grey	8	8	8	x 100M	0.05 (A)	1(K)	
white	9	9	9	x 1G			
gold			3th digit only for 5 and 6 bands	x 0.1	5 (J)		
silver				x 0.01	10 (K)		
none					20 (M)		



Black – 0, Brown – 1, Red – 2, Orange – 3, Yellow – 4, Green – 5, Blue – 6, Violet – 7, Grey – 8, White – 9