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A Review on Modern Trends in Electronic Component – Resistors

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Abstract

The real beginning in electronics was made in 1906, when Lee De Forest invented vacuum triode. Without this device, the amplifier which is the heart of all intricate and complex electronic gadgets would not have been possible. Until the end of World War II, the vacuum tubes dominated the fields of Electronics. Instrumentation plays very important in any industry and research organization. Electronics deals in the micro and milli range of voltage, current and power, but it is capable of controlling kilo and mega volts, amperes and watts. Therefore, it is not surprising to find the fundamentals of electronics as a core subjects in all branches of engineering nowadays.

1. Introduction

In 1948, the innovation of the transistor by the three Nobel laureates – john Barden, Walter Brattain and William Shockley at the Bell laboratory, completely revolutionized the electronics industry. Transistors opened the floodgate to the future developments in electronics. Within almost 10 years of its discovery, the process of miniaturization of electronic equipment had gained momentum.

The first integrated circuits (ICs) appeared in the market during the early sixties. Man’s desire to conquer space accelerated this growth even further. The electronic age had truly begun. Now, during the eighties, the tremendous growth rate is not only continuing but is accelerating in every year.

Due to the rapid developments in integrated circuits technology – starting from the small scale integration (SSI), then medium scale integration (MSI), large scale integration (LSI) and now with the most recent, very large scale integration (VLSI) technique – even the use of individual transistors is becoming unnecessary.

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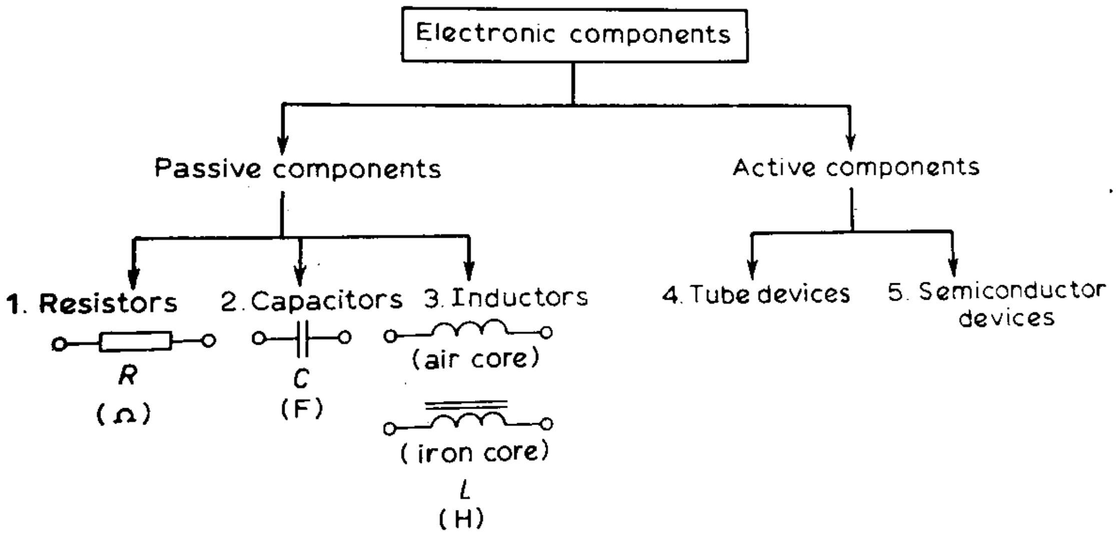
The vast changes that have taken place during the last 20 years can best be understood by nothing the reduction in size and price of modern digital computers.

2. Electronic Components

An electronic circuit may appear quite complicated and may be capable of performing fantastic functions. But, all electronic circuits, however complicated, contain a few basic components. Generally speaking, there are only five components – three passive and two active. An integrated circuit may contain thousands of transistors ,a few thousands of resistors ,etc. on a very small chip, The total number of components used in an electronic circuit may run into thousands – vet each component will be one of the above five types.

Table 2.1 Types of Electronic Components



3. Passive Components

Resistors, capacitors and inductors are called passive components. These components by themselves are not capable of amplifying or processing an electrical signal. However, these components are as important, in electronic circuits, as active components are. Without the aid of these components a transistor cannot be made to amplify signals.

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3. a. Resistors

The flow of charge through any material, encounters an opposing force similar in many respects to mechanical friction. This 'opposing force' is called the resistance of the material. It is measured in ohms. For which the symbol is omega it is a Greek letter. The circuit symbol for resistance is shown in table 2.1.

In some parts of an electronics circuit, resistance is deliberately introduced. The device or component to do this is called a resistor. Resistors are made in many forms. But all belong to either two groups - fixed or variable.

3. b. Fixed Resistors

The most common of the low voltage, fixed – type resistors is the modulated carbon composition resistors. The basic construction is shown in Figure 3.1. The resistive material is of carbon clay composition. The leads are made of tinned copper. Resistors of this type are readily available in values ranging from few ohms to about 22 Mega ohms, having a tolerance range of 5 to 20%. They are quite inexpensive. A resistor may cost only fifty paisa.

The relative sizes of all fixed resistors change with the wattage rating. The size increases for increased wattage rating in order to withstand the higher currents and dissipation losses. The relative sizes of moulded – carbon composition resistors for different wattage ratings are shown in Figure 3.2

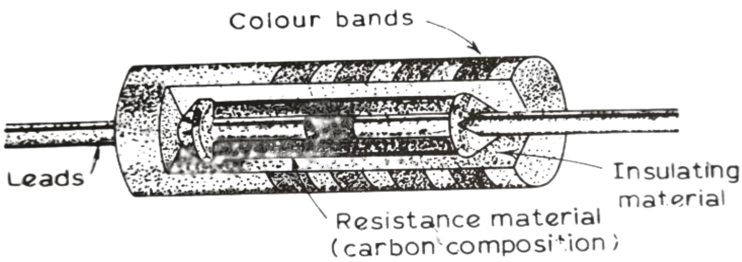

Figure 3.1 The basic construction of a fixed, moulded-carbon composition resistor

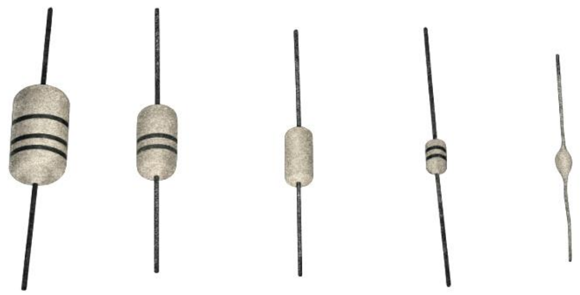

Figure 3.2 Moulded-carbon composition resistors of different wattage ratings

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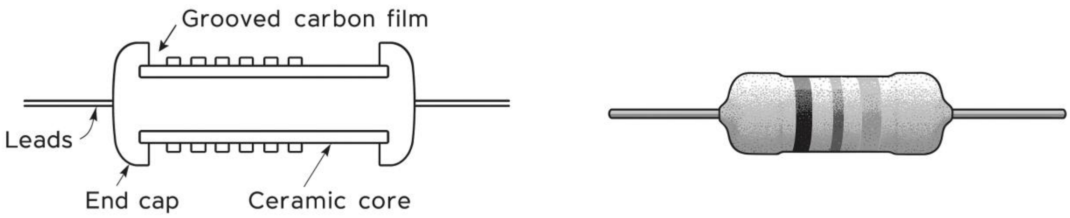
Another variety of carbon composition resistors is the metalized type. Its basic structure is shown in Figure 3.3. It is made by depositing a homogeneous film of pure carbon over a glass, ceramic or other insulating core. The carbon film can be deposited by pyrolysis of some hydrocarbon gas on the ceramic core. Only approximate values of resistance can be obtained by this method. Desired values are obtained by either trimming the layer thickness or by cutting helical grooves of suitable pitch along its length.



(a) (b)

Figure 3.3 Carbon-film resistor (a) Construction ;(b) A carbon –film resistor

During the Process, the value of resistors is monitored constantly. The cutting of groove is stopped as soon at the desired value of resistance is obtained. Contact caps are fitted on both ends. The lead wires, made of tinned copper, are then welded to these end caps. This type of film resistors sometimes called precision type, since it can be obtained with an accuracy +, - 1%.

A wire wound resistor uses a length of resistance wire, such as nichrome. This wire is wound onto a round, hollow porcelain core. The ends of the winding are attached to metal pieces inserted in the core. Tinned copper wire leads are attached to these metal pieces. The assembly is coated with enamel containing powdered glass. It is then heated to develop a coating known as vitreous enamel. This coating s very smooth and gives mechanical protection to the winding. It is also helps in conducting heat away from the unit quickly. In other wire-wound resistors, a ceramic material is used for the inner core and the outer coating see in figure 3.4. Commonly available wire wound resistors have resistance values from 1 ohm to 100 Kilo ohm, and wattage ratings up to about 200W.

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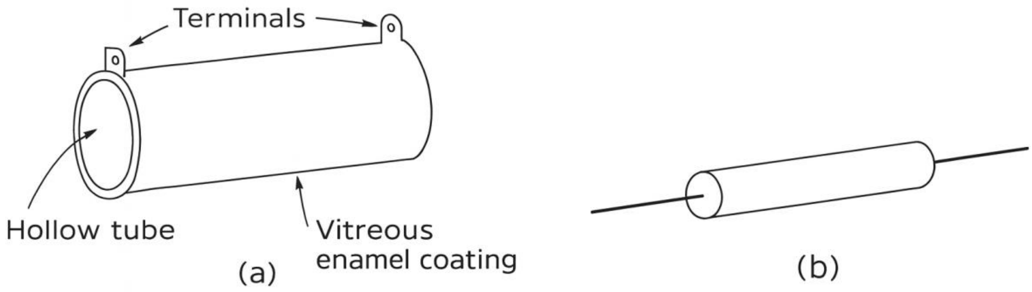

Figure 3.4 Wire wounded fixed resistors (a) Vitreous enamel type (b) Ceramic type

Colour coding and standard resistor values – some resistors are large enough in size to have their resistance printed on the body. However, there are some resistors that are too small in size to have numbers printed on them. Therefore, a system of colour coding is used to indicate their values. For the fixed, moulded composition resistor, four colour bands are printed on one end of the outer casing as shown in Figure 3.5a.

The numerical value associated with each colour is indicated in table 3.1. The colour bands are always read left to right from the end that has the bands closest to it, as shown in Figure 3.5a.

Table 3.1 Colour Coding

Colour	Digit	Multiplier	Tolerance
Black	0	$10^{\circ} = 1$	–
Brown	1	$10^2 = 10$	±1%
Red	2	10^2	±2%
Orange	3	10^3	–
Yellow	4	10^4	±0,5%
Green	5	10^5	±0,5%
Blue	6	10^6	±0,25%
Violet	7	10^7	±0,1 B%
Gray	8	10^8	±0,05%
White	9	10^9	±0,05%
Gold	–	$0.1 = 10^{-1}$	±5%
Silver	–	$0.01 = 10^{-2}$	±10%
No colour	–	–	±20%

The first and second bands represent the first and second significant digits, respectively, of the resistance value. The third band is for the number of zeros that follow the second digit. In case the third band is gold or silver, it represents a multiplying factor of 0.1 or 0.001. The fourth band represents the manufacturing tolerance. It is a measure of the precision with which the resistor was made. If fourth band is not present, the tolerance is assumed to +,- 20%.

The colour coding for wire wound resistors, and composition resistors with radial leads is shown in Figure 3.5b and c, respectively. Note that the first band in Figure 3.5b is of double the compared to the rest. The system of colour coding used for the moulded resistors with radial leads is called body-end-dot system. This numerical values associated with each colour is the same for all the three methods of colour coding.

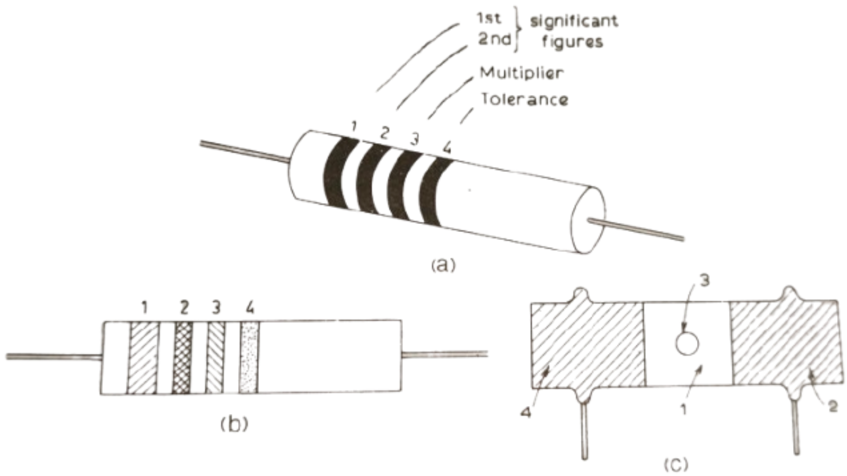

Figure 3.5 Colour coding: (a) Moulded composition resistor; (b) wire –wound resistor (c) Moulded composition resistor with radial leads (the system of colour coding is called body-end-dot system)

3. c. Variable resistors

In electronic circuits, sometimes it becomes necessary to adjust the values of currents and voltages. For Example, it is often desired to change the volume of sound, the brightness of a television picture, etc. such adjustments can be done by using variable resistors.

Although the variable resistors are usually called rheostats in other applications, the smaller variable resistors commonly used in electronic circuits are called potentiometers, the symbol for potentiometer is shown in Figure 3.6a. The arrow in the symbol is a contact carbon film element. The basic construction of a wire wound potentiometer is shown figure 3.6b. The resistance wire is wound over a dough shaped core of Bakelite or ceramic. There is a rotating shaft at the centre of the core. The shaft moves an arm and a contact point from end to end of the

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resistance element. There are three terminals coming out of a potentiometer. The outer two are the end points of the resistance element, and the middle leads to the rotating contact.

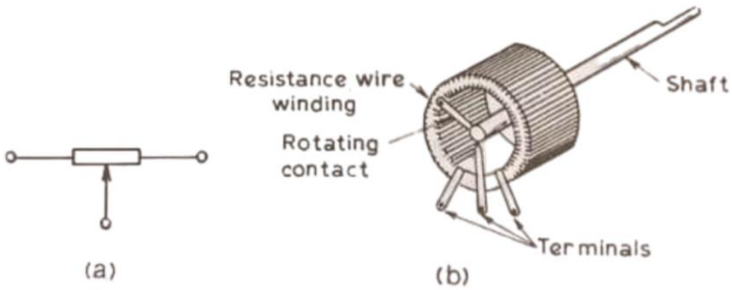

Figure 3.6 Potentiometer; (a) Symbol; (b) Basic construction of a wire-wound potentiometer.

A potentiometer can be either linear or non linear, Figure 3.7 shows the construction of both a linear and non linear potentiometer. In the linear type, the former is of uniform height and that is why the resistance varies linearly with the rotation of the contact. In a non linear potentiometer, the height of the former is not uniform.

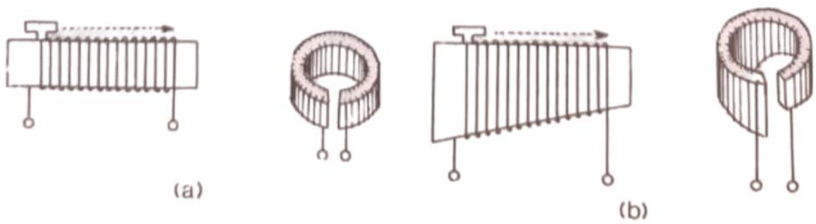

Figure 3.7 Wire-wound potentiometer; (a) Linear Type; (b) Non Liner Type

To make a potentiometer of this type, a tapered strip is taken and the resistance wire is wound over it, ensuring a uniform pitch. The strip is then bent into a round shape. The tapered strip gives a non linear variation of resistance with the rotation of the moving contact. The strip can be tapered suitably so as to obtain a desired variation in resistance per unit rotation of the moving contact. The 'pots' used as volume control in sound equipment are generally of the non linear type (logarithmic variation).

4. ACTIVE COMPONENTS

There are many active components used in electronic circuits. But all the active devices or components can be broadly classified into two categories: tube-type and semiconductors-type. Tube devices can again be of two types: vacuum tubes and gas tubes. These devices came prior to the semiconductors devices. Because of their advantages, the semiconductor devices are replacing the tube devices in almost all electronics applications.

5. CONCLUSION

Use of automatic control systems in industries in increasing day by day electronic circuits are used in industrial applications like control and thickness and quality , weight and moisture content of a material. Hence resistors play an important role in circuits.

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