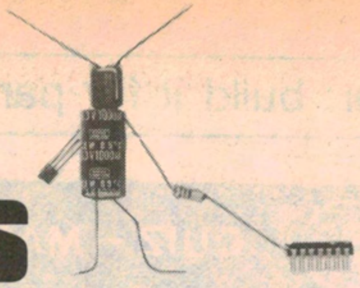
Know Your Components



Resistance and Resistors

Resistors are among the commonest, and often the cheapest, components used in electronic equipment. Without getting involved in obscure theory, here are a few basic facts about resistors, which might assist newcomers to the hobby.

As the term implies, the basic role of a resistor is to "resist" the flow of current through an electrical circuit; not to prevent current flow altogether, but to resist, or impede, or limit current flow to a degree required by the circuit design.

The degree to which a resistor may do this is signified by its "resistance". Fairly obviously, the higher the value of resistance, the greater will be the effect or limitation on current flow through the circuit concerned.

The basic unit of resistance is the "ohm", often represented by the Greek letter Omega (Ω). A certain resistor may therefore be said to have a value of so many ohms; eg, 1 ohm, 10 ohms, 100 ohms, etc.

Where the number of ohms involved rises to a thousand or more, resistance values can conveniently be expressed in "kilohms", or thousands of ohms, often abbreviated to the letter "k". Thus 4.7k means the same thing as 4700 ohms. European practice is to put the k in the place of the decimal point, leading to the expression "4k7", instead of 4700 ohms.

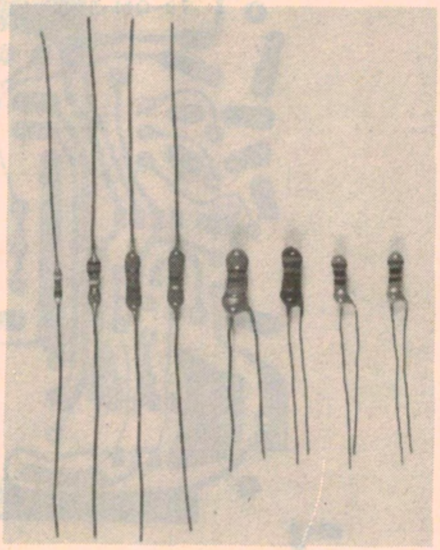
Similarly, for still larger values of resistance, the term "megohm" can be used to denote 1 million ohms. In abbreviated form 4,700,000 ohms might be written as 4.7M or 4M7.

With physically large resistors, the value may be printed directly on to their surface but, with small resistors, it is more common practice to indicate the value by means of colour bands conforming to an international colour code. Details of this code can be obtained from various electronics testbooks, including our own publication "Basic Electronics".

Resistors have a central body, which accommodates the resistance element, with a tinned copper lead at each end so that it can readily be soldered into a circuit. The body is normally encapsulated, or coated with lacquer or vitreous enamel to provide some degree of protection and insulation, and to limit the ingress of moisture.

In so-called "wire-wound" resistors, the current has to pass through a coil of resistance wire, wound on the central body between the two pigtails. The finer and longer the wire in the coil, and the higher the natural resistance of the particular metal or alloy involved, the higher will be the overall resistance of the component.

In practice, wire wound construction lends itself best to more bulky, heavy duty resistors in the lower range of values — say, from a few ohms to a few thousand ohms. For physically smaller, or higher value resistors, other methods of construction are normally preferred.



Resistors come in many sizes, types and styles. These are miniature carbon film types.

For example, in a conventional (and traditional) "carbon resistor, the body between the pigtails is a rod moulded from a mix of finely divided carbon particles and a non-conducting binder. The actual resistance is largely dependant on the ratio of carbon to insulator in the mix. Carbon resistors are cheap, and can be made to a wide variety of sizes and resistance values. However, they are difficult to mass produce to target figures and may change value due to heat, moisture and ageing. For this reason, they are not favoured nowadays.

In "carbon film" resistors, a carbon mix is deposited on the surface of a glass or ceramic rod. By then grinding a spiral in the deposit, to increase the effective length of the carbon path, the resistance can be adjusted to the required value. In general, carbon film resistors can be manufactured to within smaller tolerances and they will hold that value better than the moulded carbon types mentioned earlier.

"Metal film" or "metal oxide" resistors are similar in concept to the carbon film type but use a metallic rather than a carbon based material as the conductor. They are generally more accurate, more stable — and more expensive!

To rationalise production and application, resistors are normally manufactured to values which look odd at first glance. In fact, the so-called "preferred" range has been worked out mathematically to meet the anticipated needs of circuit designer, with the minimum number of different values.

Resistor values most commonly encountered in electronic circuitry are based on the series 1.0, 1.2, 1.5, 1.8, 2.2, 2.7, 3.3, 3.9, 4.7, 5.6, 6.8 and 8.2. Resistors are commonly sold marked in those numbers of ohms. in the next decade, the values run: 10, 12, 15, 18, 22, 27, 33, 39, 47, 68 and 82 ohms. So on through the decades to at least 10 megohms.

It is normal practice to design circuits around values from the abovementioned range. It is also usual to specify that the resistors shall have a maximum tolerance of 5% or 10% — ie, the actual resistance will not differ from the marked value by more than plus or minus 5% (or 10%, if specified). If the circuit design requires closer tolerances or inbetween values, these can usually be obtained at extra cost.

As well as being manufactured to specified tolerances, resistors also have a specified maximum power dissipation which is rated in watts or fractions of a watt, depending on their design and size. This rating should not be exceeded otherwise the life of the resistor will be seriously shortened.