
Resistors

pots and pans

Electronic circuits use lots of resistors. This isn't always obvious when you look at modern circuits which appear to consist of a group of 'silicon chips' or *Integrated Circuits* wired together. In fact, IC's (even digital ones) don't just contain transistors, they also contain a lot of hidden resistors. Although resistors come in various forms we can divide them up into just two basic types.

- 'Fixed' resistors
- Variable resistors (or 'potentiometers')

A fixed resistor is a component with two wires which obeys Ohm's Law — i.e. it's a bit of material which behaves as we described in the last section. Electronic engineers and manufacturers have adopted some standards for resistors. These are intended to keep the cost down and make it easier for you to buy them from whichever supplier you like without having to redesign the equipment you want to put them in.

The first standard concerns the resistor values you can buy. If you look through a catalogue of electronic components you'll see that the resistance values offered nearly always follow the same series:-

1.0 Ω , 1.2 Ω , 1.5 Ω , 1.8 Ω , 2.2 Ω , 2.7 Ω , 3.3 Ω , 3.9 Ω , 4.7 Ω , 5.6 Ω ,

6.8 Ω , 8.2 Ω , 10 Ω , 12 Ω , 15 Ω , 18 Ω , ... etc.

This is called the 'E12' series. The values are chosen to give twelve values in each decade (tenfold change in value). Most of the time, engineers who want a particular resistance value just pick the 'nearest' one from this list. You can buy other values. You can even have them specially made to whatever value you like. But the E12 series are much cheaper because so many of them are made. If you take the logs of the above series you'll find that they're roughly equally spaced. This ensures that the fractional error of choosing the closest value to the one you really wanted stays about the same for any size of resistor.

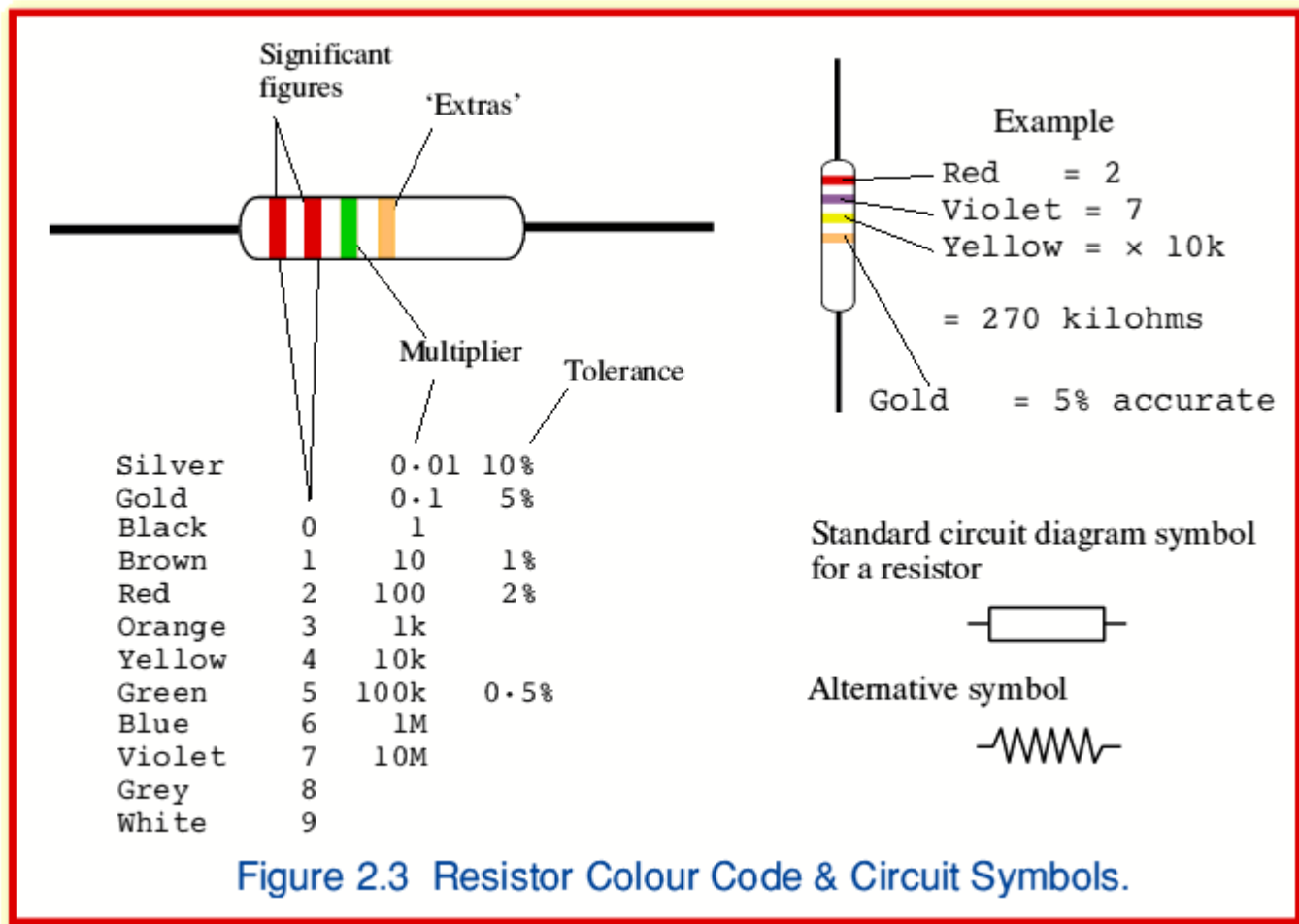
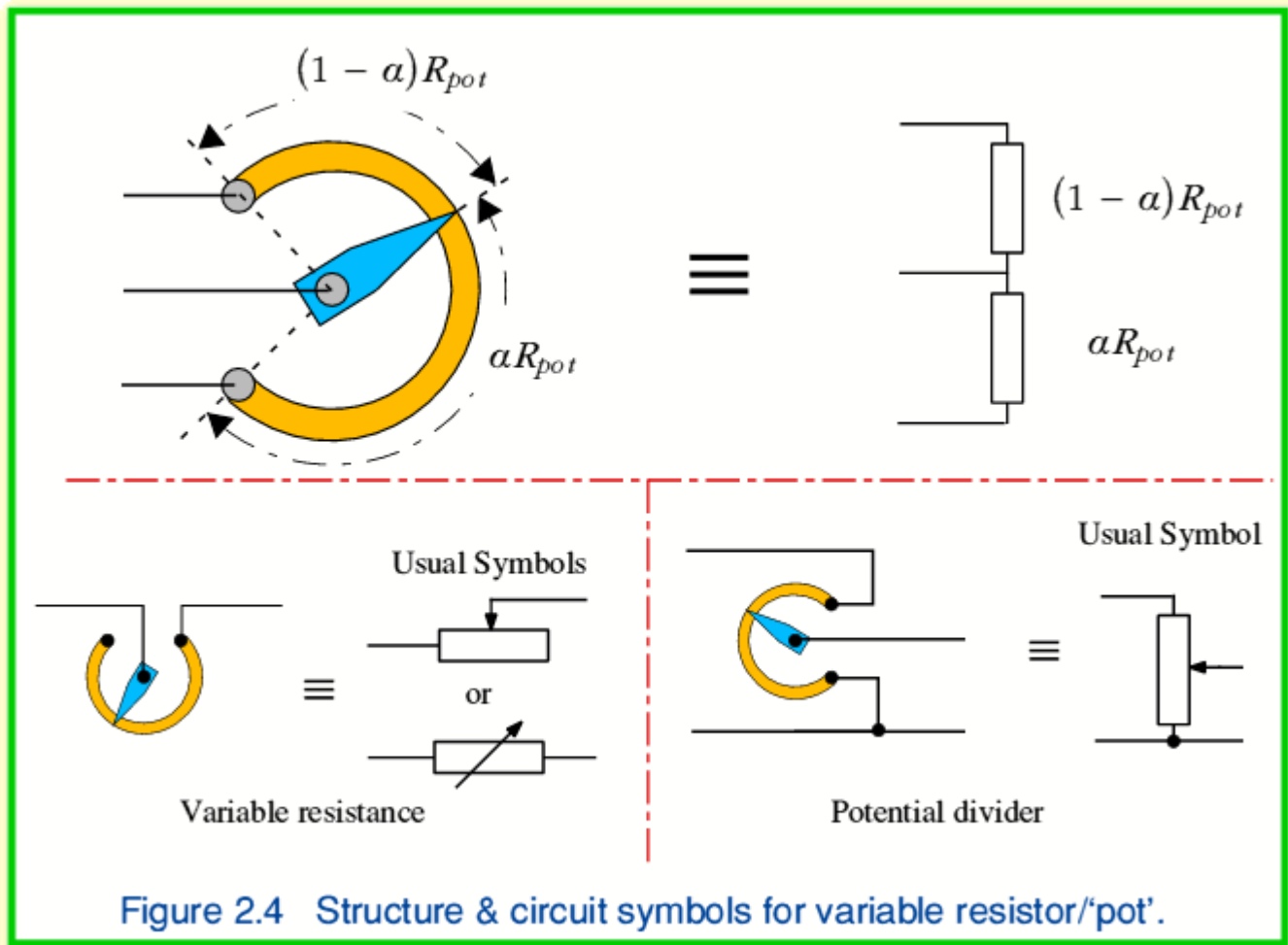


Figure 2.3 Resistor Colour Code & Circuit Symbols.

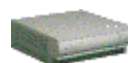
The second standard is the use of the *resistor colour code*. Modern resistors can be very small & there might be hundreds of them on a circuit board, pointing in all sorts of directions. Trying to find or read printed values in this situation would be something of a nightmare! To avoid this problem, resistors normally display their value as a series of coloured bands or rings. These use colours as indicated in figure 2.3. These are read starting with the band nearest an end. Most resistors have just four bands. The first two give the significant figures. The third gives a power of ten which you multiply the figures by to get the correct resistance. The fourth band (which isn't always there!) gives the *tolerance* or accuracy of the value. Some resistors have extra bands, but we won't worry about that in this course!

Variable resistors are usually a stubby cylindrical shape with a rod poking out one end and with three metal 'tags'. Figure 2.4 illustrates a typical example. Two of the tags are connected to a horseshoe-shaped resistor fitted inside the cylinder. Hence the resistance between these two tags has a fixed value. The third tag (usually the middle one) is connected to a metal 'finger' or 'wiper' which is pressed against the side of the curved resistor. When we twist the rod we can move this wiper along the resistor, shifting it away from one end and towards the other. As a result, the resistance between this tag and the ones at the ends goes up and down as we rotate the rod. In the diagram shown below, the horseshoe shape of resistive material is coloured orange, and the wiper is coloured blue.



As with fixed resistors, variable ones tend to come in standard end-to-end values in the same E12 series. In this case the most 'popular' ones have end-to-end resistances which are simply 1, 10, 100, 1000 (=1k), 10k, etc, Ohms. (25k Ω and 50k Ω pots also turn up a lot in Hi-Fi's as volume/balance potentiometers even tho' they aren't E12 values.)

Oh, if you are wondering where 'pots and pans' came from in the title of this page. Pots is an abbreviation of potentiometer. 'pan' is a term used to mean setting the stereo location of a sound by adjusting the relative volume levels it has from the speakers in a stereo system! Thus pots can be used to pan the sound of something.



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