GCSE Electronics: Component 1

Unit 3: Resistive components in circuits

Resistors

Resistors have many uses in circuits. Primarily they are used to control and limit current to protect other devices, like lamps and LEDs, from damage or as part of sensing circuits to convert changes in light or temperature.

Selecting a resistor:

Once you have calculated the ideal value of the resistor, there are a number of factors to consider when choosing a resistor.

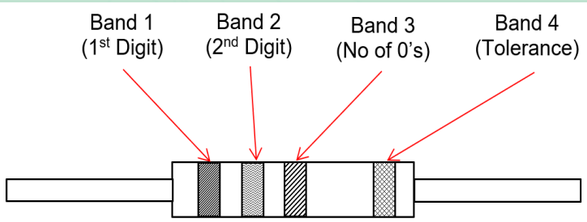
a. Preferred values – Only certain values of resistors are available. In the E24 series used in electronics, you need to select the nearest value from: 10, 11, 12, 13, 15, 16, 18, 20, 22, 24, 27, 30, 33, 36, 39, 43, 47, 51, 56, 62, 68, 75, 82, 91, together with multiples of ten of these values, up to about 10MΩ.

b. Tolerance – This gives an indication of how much above or below the stated value of the resistor might be. Different tolerances are available: carbon film ±5%, metal film ±1%, wirewound ±0.1%, etc.

c. Power rating – This gives the limit of how much power can be dissipated safely by the resistor. Carbon/metal film are usually low power (0.25W) to a maximum of 2W. Wirewound can be as high as 50W.

Resistor colour code

The value of carbon film resistors can be worked out from four coloured bands on its body:



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

Resistors in series

The total or effective resistance (R_S) of resistors in series is given by the general equation:

$$R_S = R_1 + R_2 + R_3 + \ldots$$

Resistors in parallel

The total or effective resistance (R_p) of resistors in parallel is given by the general equation:

$$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \ldots$$

For only **two resistors** in parallel, this can be simplified to:

$$R_p = \frac{R_1 \times R_2}{R_1 + R_2}$$

1. Always check your answer when using the formula to make sure that the effective resistance of two resistors in parallel is smaller than the individual resistor values.

2. When two equal resistors are connected in parallel, the effective resistance is ½ of their individual values.

3. If three resistors of the same value are connected in parallel, then the effective resistance is 1/3 (one third) of their individual values.

4. In general, if 'n' resistors of the same value are connected in parallel then the effective resistance is 1/n (one 'n^{th}') of their individual values.

Potentiometers

A potentiometer consists of a circular conducting track made of carbon or resistance wire, over which a sliding contact or wiper moves.

A potentiometer can be used:

i. as a variable resistor by using the sliding contact and one of the end contacts

ii. as a voltage divider by connecting the power supply across the two end connectors and using the slider and 0V connection to provide the variable voltage.

A preset is a smaller version of the potentiometer and are adjusted by a screwdriver. Once they are adjusted to the correct value, they are sealed and are not altered again.

Light dependent resistors

A LDR consists of a cadmium sulphide track set out on an insulator base. The resistance of the track depends upon the intensity of light which falls upon it. **The resistance of the LDR decreases as the light intensity increases.**

NTC thermistors

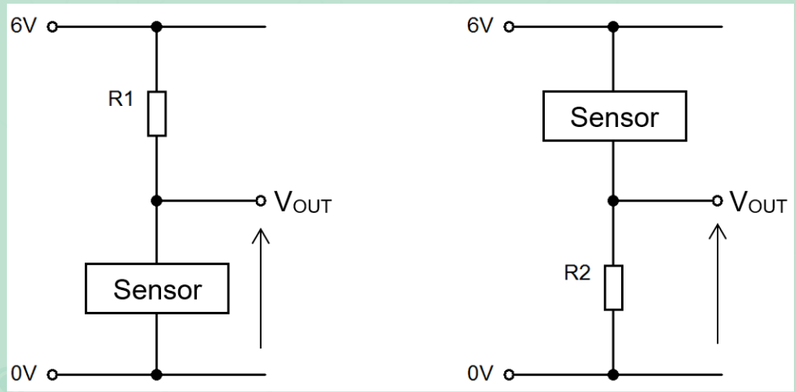
A thermistor is a two-lead resistive component that changes resistance as the temperature increases. **The resistance of the thermistor decreases as the temperature increases.**

Switches

There are a variety of switches available for use in electronic circuits. These are: press switches, toggle and slide switches, reed switches, microswitches and tilt switches.

Designing sensing circuits

There are two possible arrangements for an input sensor incorporated into a voltage divider circuit.



1. For a light sensing circuit, the sensor should be at the top.

2. For a darkness sensing circuit, the sensor should be at the bottom.

3. For a decrease in temperature sensing circuit, the sensor should be at the bottom.

4. For an increase in temperature sensing circuit, the sensor should be at the top.

Note: All of the above arrangements provide V_{OUT} which increases from low to high.

Outputs

There are a number of different output devices that can be used in electronic circuits. These are buzzer, siren, filament lamps, indicator lamps, light emitting diodes, motors and solenoids.

LEDs come in a wide range of colours, but they cannot handle very large currents/voltages, so they are connected in series with a protective resistor.