**LIGHT EMITTING DIODES (LEDS)**

Example:   LED    Circuit symbol:   LED circuit symbol

### Function

LEDs emit light when an electric current passes through them.

### Connecting and soldering

LED connectionsLEDs must be connected the correct way round, the diagram may be labeled **a** or **+** for anode and **k** or **-** for cathode (yes, it really is k, not c, for cathode!). The cathode is the short lead and there may be a slight flat on the body of round LEDs. If you can see inside the LED the cathode is the larger electrode (but this is not an official identification method).

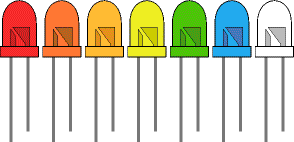
LEDs can be damaged by heat when soldering, but the risk is small unless you are very slow. No special precautions are needed for soldering most LEDs.

### Testing an LEDTesting an LED

Never connect an LED directly to a battery or power supply!   
It will be destroyed almost instantly because too much current will pass through and burn it out.

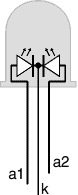
LEDs must have a resistor in series to limit the current to a safe value, for quick testing purposes a 1kohm resistor is suitable for most LEDs if your supply voltage is 12V or less. **Remember to connect the LED the correct way round!** .

### Colors of LEDs

LEDs are available in red, orange, amber, yellow, green, blue and white. Blue and white LEDs are much more expensive than the other colours.

The colour of an LED is determined by the semiconductor material, not by the colouring of the 'package' (the plastic body). LEDs of all colours are available in uncoloured packages which may be diffused (milky) or clear (often described as 'water clear'). The coloured packages are also available as diffused (the standard type) or transparent.

### Tri-colour LEDs

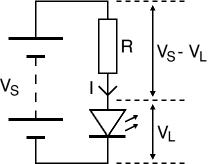
The most popular type of tri-colour LED has a red and a green LED combined in one package with three leads. They are called tri-colour because mixed red and green light appears to be yellow and this is produced when both the red and green LEDs are on.

The diagram shows the construction of a tri-colour LED. Note the different lengths of the three leads. The centre lead (k) is the common cathode for both LEDs, the outer leads (a1 and a2) are the anodes to the LEDs allowing each one to be lit separately, or both together to give the third colour.

### Bi-colour LEDs

A bi-colour LED has two LEDs wired in 'inverse parallel' (one forwards, one backwards) combined in one package with two leads. Only one of the LEDs can be lit at one time and they are less useful than the tri-colour LEDs described above.

### Calculating an LED resistor value

An LED must have a resistor connected in series to limit the current through the LED; otherwise it will burn out almost instantly.

The resistor value, R is given by:

|  |
| --- |
| **R = (VS - VL) / I** |

**VS** = supply voltage   
**VL** = LED voltage (usually 2V, but 4V for blue and white LEDs)   
**I** = LED current (e.g. 10mA = 0.01A, or 20mA = 0.02A)   
Make sure the LED current you choose is less than the maximum permitted and **convert the current to amps (A)** so the calculation will give the resistor value in ohms (ohm).   
To convert mA to A divide the current in mA by 1000 because 1mA = 0.001A.

If the calculated value is not available choose the nearest standard resistor value which is **greater**, so that the current will be a little less than you chose. In fact you may wish to choose a greater resistor value to reduce the current (to increase battery life for example) but this will make the LED less bright.

#### For example

If the supply voltage VS = 9V, and you have a red LED (VL = 2V), requiring a current I = 20mA = 0.020A,   
R = (9V - 2V) / 0.02A = 350ohm, so choose 390ohm (the nearest standard value which is greater).

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