



# SCOUT ELECTRONICS BADGE GLOSSARY

## Alternating current (AC)

Mains electricity is supplied as AC. AC switches its direction of flow at regular intervals – the supply to UK homes switches at 50 cycles/second (50Hz). For some devices, AC needs to be converted into direct current in order to be usable. This is called rectification. UK domestic AC is supplied at 230V.

## Capacitor

Capacitors are components that store charge. The higher the capacitance, the more charge they store. Capacitance is measured in Farads (F).

Capacitors need to charge before they will allow electricity to pass out of them and around a circuit. This makes them useful in timing circuits where they are combined with resistors to introduce a delay in the flow of current round the circuit. They are also used to smooth out varying DC currents.

There are two main types of capacitor:

- Non-electrolytic (also known as non-polarised or ceramic) capacitors – these have capacitance up to  $1\mu\text{F}$
- Electrolytic (or polarised) capacitors – these have higher capacitance than ceramic capacitors
- Electrolytic capacitors have a positive and negative terminal and must be connected into circuits the right way round. The negative terminal is marked by arrows painted on the capacitor body.

For small capacitors printing onto the capacitor is difficult so the value is given as a code where:

- 1st number is the 1st digit
- 2nd number is the 2nd digit
- 3rd number is the number of zeros to give capacitance in pico Farads ( $\text{pF}$  -  $1\text{pF} = 1$  trillionth of a Farad).

## Diodes

Diodes will let electricity flow through them in one direction only. They are used to protect electric circuits and as part of logic gates.

There are four commonly used types of diode:

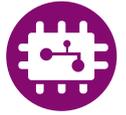
- Light Emitting Diodes (LEDs)
- Signal diodes – used in radio and television receivers and in logic gates
- Rectifier diodes – used to convert an AC current to DC, for example in a car's alternator.
- Zener diodes – designed to let current through the "wrong" way at a set voltage. They are used as voltage regulators.

Diodes must be connected the right way round. The negative terminal (cathode) is indicated by a line on the diode body.

In circuit diagrams, the arrow on the diode symbol should point in the direction of current flow.



Diode circuit symbol showing current flow from left to right.

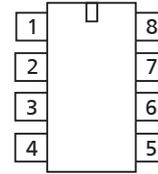


## Direct current (DC)

In DC, the current flows constantly in the same direction. Batteries provide a direct current.

## Integrated circuit (IC)

Integrated circuits are tiny, complex circuits etched onto a semiconductor chip. The chip is protected by a plastic case with pins connected to the circuit inside. The case has a small semi-circular notch at one end. With this notch at the top, the pins are numbered anticlockwise starting top left.



In circuit diagrams the pin numbers are rearranged to make the diagram easier to read.

Heat from soldering can easily damage these chips, so they are usually supplied with a DIL (dual in line) socket which the chip fits into. The DIL should be soldered without the chip, and then the chip can be pushed in place.

## LEDs

LEDs are available in red, orange, amber, yellow, green, blue and white. The colour is determined by the semiconductor used. Since LEDs are diodes, they will only work when wired in the correct direction.

The terminals can be identified in two ways:

- The wire for the negative terminal (cathode) is shorter than that for the positive terminal.
- There is also a small, flattened area on the LED casing on the cathode side.

LEDs need a current of around 20mA (0.02A). If the current is too high, they will burn out. You should check the forward voltage of any LEDs you use.

The resistance values needed for LEDs in circuits is calculated using the equation  $R = (V_S - V_L) / I$  (see Ohm's Law) where:

- R = resistance
- $V_S$  = supply voltage
- $V_L$  = LED voltage
- I = LED current (note this is in Amps, not milliamps - 20mA = 0.02A)



## Light dependent resistor (LDR)

Light dependent resistors are a type of resistor that is sensitive to light. Their resistance decreases as the amount of light falling on them increases.

## Motor

Electric motors work through the interaction between electricity and magnetism. The motor's rotor is an electromagnet – a tightly rolled coil of copper through which a current is passed. Surrounding the rotor are two magnets, one with the north pole facing the rotor and the other with the south pole facing the rotor. The repulsion between the poles of the electromagnet and the surrounding magnet makes the rotor spin by half a turn. At this point, the electromagnet flips poles so that it is once again repelled by the surrounding magnets and it flips again. This happens in a continuous cycle to make the motor rotate.

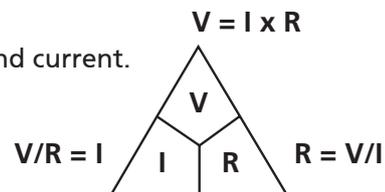
A vibration motor has an offset weight on the axle which makes the motor unbalanced so it wobbles around.

## Ohm's Law

Ohm's Law describes the relationship between voltage, resistance and current.

Ohm's Law:  $\text{resistance (R)} = \frac{\text{voltage (V)}}{\text{current in amps (I)}}$

(It is named after Georg Ohm, the German physicist who discovered the relationship).



Ohm's triangle can help when applying Ohm's Law

## Piezo Buzzer

Piezo buzzer contains a piezoelectric sensor – a sensor made of a material that produces a small electric current in response to mechanical stress. Piezoelectric sensors can detect changes in pressure, acceleration, strain or force.

## Potentiometer

A potentiometer is a type of resistor with a dial that allows the resistance to be varied. Potentiometers have lots of uses. For example they are used in volume controls and were once used to alter contrast and brightness in televisions.

## Resistor

Resistors restrict the flow of electricity round a circuit. They have many uses including preventing damage to components and as voltage dividers.

Resistor values are given in Ohms and represented by a series of bands on the side of the resistor. For a full explanation of resistor coding, see "Bring it Ohm!" in the Scout and Leaders' packs)

Resistors are available as a set of standard values.



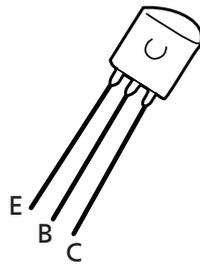
## Transistor

Transistors are one of the most important inventions of the 20th century. Without them we would not have modern electronics.

The main uses of transistors are:

- As a voltage sensitive switch that turns on and off parts of a circuit, for example in response to changes in a sensor.
- As signal amplifiers which take a signal from a low current device and use them to switch on a high current device.

Transistors have three terminals known as the collector (C), the emitter (E) and the base (B).



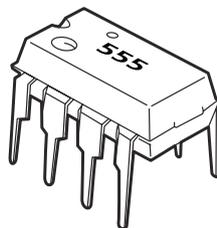
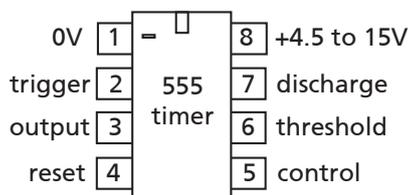
The base, which is the middle terminal of the three, controls the transistor, switching it on or off. When the electricity reaching the base hits a threshold value, a small amount of electricity flows from the base to the emitter. This switches turns the transistor from an insulator into a conductor and allows a current to flow through the circuit from the collector to the emitter.

## 555 Timer

The 555 timer is a particularly useful and common eight-pin integrated circuit. A typical 555 timer contains 25 transistors, two diodes and 15 resistors.

It has three main modes:

- A monostable output – the circuit switches on for a period and then switches off again.
- An astable output – the circuit switches on and off in a repeating cycle.
- A bistable output – a trigger turns the circuit on and it stays on until another trigger turns it off.



## Thermistor

A thermistor is a type of resistor that is sensitive to temperature. With most thermistors, resistance decreases with increasing temperature.

