

Electronics

Electrical conductors allow an electric current to flow through them - they have low resistance

- E.g. most metals

Electrical insulators do not allow an electric current to easily flow through them - they have a high resistance

- E.g. plastic, wood, rubber

Semiconductors are a hybrid between insulators and conductors. The resistance they have lie between that of insulators and conductors. Semiconductors allow for electrical current to be routed in one direction or another and can be used to switch a current on or off. Semiconductors are vital components in many electrical appliances.

- E.g. silicon

Electronic Components

Electronic components are devices that are arranged into a circuit to control the flow of an electric current around that circuit. There are 3 classifications of components:

- Inputs
- Processes
- Outputs

<u>Inputs</u>	<u>Processes</u>	<u>Outputs</u>
Variable Resistor	LEDs	LEDs
Switches	Integrated Circuits	Buzzers
Sensors	Relays	Motors
Fuses	Resistors	Speakers
Motors (when used as generator)	Solenoids	Light Bulbs

Resistors

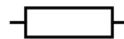
Resistors control the direction of a current, divide voltages, adjust signal levels and reduce current flow.

2 common resistor types:

- Fixed
- Variable

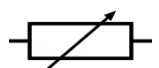
Fixed Resistor

Resistance is set and cannot be changed



Variable Resistor

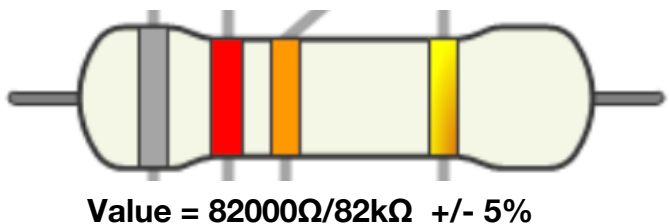
Can have its resistance set to any value between 0Ω and whatever value is stated on the packaging. Resistance is usually changed by twisting a dial on the resistor.



Reading Resistor Values

When reading the value of a fixed resistor it is indicated on the body of the resistor. Each coloured band corresponds to a set number. Reading from left to right so that the 3 bands closest together are on the left hand side.

1. The first band tells us the value of the first number
2. The second band tells us the value of the second number
3. The third band tells us the number of zeros on the end of the number
4. The fourth band tells us the accuracy of the resistance within the stated value i.e. the tolerance - **red means 2%, gold means 5%, silver means 10%, no band means within 20%**



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

Diodes

Diodes are polarised devices. This means that they only allow current to flow through them in one direction. They are semiconductors.

Polarisation

When a component is polarised it matters what direction they are inserted into a circuit. They have a positive leg (anode) at one end and a negative leg (cathode) at the other end. In order to conduct electricity the anode must be connected to the positive end of the battery and the cathode must be connected to the negative end. This configuration is called forward biased.

If the diode is connected the other way around it will not conduct electricity. This is called reverse bias.

LEDs (Light Emitting Diodes)

LEDs are diodes that emit light when supplied with a current. The long leg of the LED is the anode while the short leg next to the flat side of the LED is the cathode. LEDs require significantly less power than bulbs.

Sensors

- Thermistors - sense heat change
- LDRs (Light Dependent Resistors)/Photo-resistors - sense light change
 - Resistance high in the dark and low in the light
- Moisture Sensors - detect moisture or water levels
- Pressure Sensors - sense pressure
- IR sensors - can be used to detect proximity

Capacitors

Capacitors are essentially two pieces of metal separated by an insulator. Capacitors are used for storing electric charge. Capacitors are used in timing circuits.

Capacitance is a measure of how much charge the capacitor can hold. The unit of capacitance is the farad.

Types of capacitors:

- Fixed capacitor
- Electrolytic/Polarised capacitor
- Variable capacitor

Switches

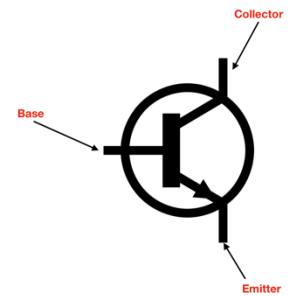
Switches allow for an electric circuit to be turned on and off. They are used in nearly all electrical appliances. Switches are binary devices meaning that they are either on or off.

Types of switches:

- PTM - Push-to-make (red)
- PTB - Push-to-break (black)
- DPDT - Double pole double throw
- DPST - Double pole single throw
- SPST - Single pole single throw
- SPDT - Single pole double throw
- Reed switch
- Tilt switch

Transistors

Transistors are very sensitive electronic switches. They have three legs: emitter, base & collector. They mainly function as a high speed, automatic switch in a circuit or as an amplifier of current.



Solenoids

Solenoids convert electric current into linear movement. Inside the solenoid is a small wire coil. As a current is passed through it it becomes magnetised and pulls a metal var into the centre of the coil. When the current is then switched off the spring pushes the bar back to its original position. Solenoids are often used to operate switches or to electronically lock doors.

Relays

A relay is an electronic switch which contains a solenoid which is used to safely turn on and off circuits that require very high electrical currents. Relays are used in the opening and closing of security gates, raising and lowering high window blinds etc.

Integrated Circuits (IC)

Integrated circuits combine many components into one body allowing them to carry out a variety of tasks. They are vital in nearly every electrical appliance. Most ICs have 8+ legs which allow them to slot into a larger circuit. To find out which number corresponds to which leg you start counting from the top left (indicated by a semi-circular notch) in an anticlockwise direction.

Series vs Parallel

The components of an electrical circuit can be connected in different configurations to accomplish different tasks.

Series

Resistors connected in series are connected one after another and the total resistance is calculated by simply adding up all the individual resistances.

Parallel

When connected in parallel each resistor is connected parallel to the other one from a central wire that splits to each resistor.

$$\text{Total Resistance in Parallel} = 1/R_{\text{total}} = 1/R_1 + 1/R_2...$$

Signals

Analogue Signals

Analogue signals can have any value within a certain range. The value of the signal continuously rises and falls.

- E.g. petrol gauge, household clock

Digital Signals

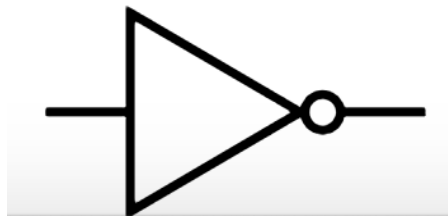
Digital signals can only have one or two possible values: on or off. On is referred to as 1 which off is referred to as 0.

- Most modern electronic appliances work in digital signalling.

Logic Gates

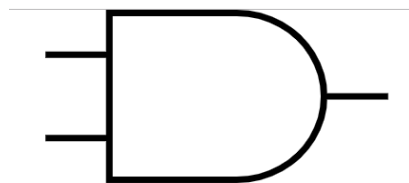
NOT Gate

Input	Output
1	0
0	1



AND Gate

Input X	Input Y	Output W
0	0	0
0	1	0
1	0	0
1	1	1



OR Gate

Input X	Input Y	Output W
0	0	0
0	1	1
1	0	1
1	1	1

