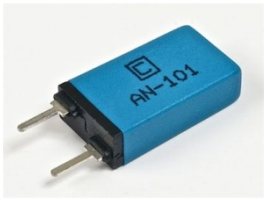
Electronic Components Jargon Buster

Your Model Railway Layout has a number of electronic components, and there may be times when you may have to add components to get something to work properly. Here we try to explain to you what the component is and how and why it works. **Please note this is by no means the full description and theory behind each component, just enough to allow you to understand why it does what it does.**

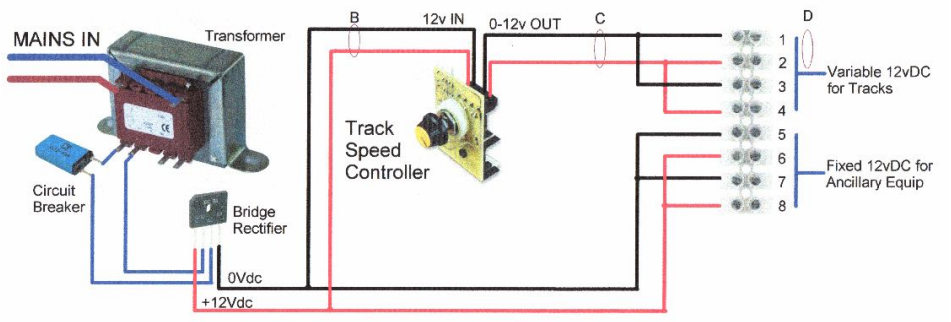
1) Circuit Breaker
2) Electrolytic Capacitor
3) Diodes - Zener Diode
4) LED
5) Resistor
6) Preset Resistor
7) EMF (Electro Motive Force)

1) Circuit Breaker

A circuit breaker is like a Fuse as it protects equipment when a short or overload is detected. In the case of a fuse it will blow when the current goes above that of the fuse rating, whereas a circuit breaker will open a contact (switching OFF power) and then will reset when the current is below its rating or the short has been fixed.



The circuit breaker in the following circuit is placed between the transformer and the bridge rectifier. The current rating of the circuit breaker is set at just below the rating of the transformer.



How does this happen. In a circuit breaker the switch is made of a bimetal strip (2 metals fused together). The 2 metals are selected because they bend at different rates when heated. As the current rises the bimetal strip heats up, when the current is above the switch ratinging the bimetal strip will have heated enough to bend it away from the other contact, this then opens the switch so no power can flow through it. As there is no power going through the switch the bimetal strip starts to cool down and bend back into shape , which will make contact with the other part of the switch, this then connects the power back to the circuit it is protecting.
Most modern equipment will have one of these in the circuit somewhere.
See our separate page on Circuit Breakers.

2) Electrolytic Capacitors.

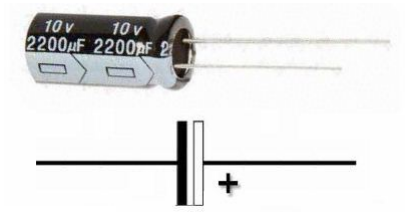
All electrolytic capacitors are polarized capacitors whose anode (+) is made of a particular metal on which an insulating oxide layer forms by anodization, acting as the dielectric of the electrolytic capacitor. A non-solid or solid electrolyte which covers the surface of the oxide layer in principle serves as the second electrode (cathode) (-) of the capacitor.

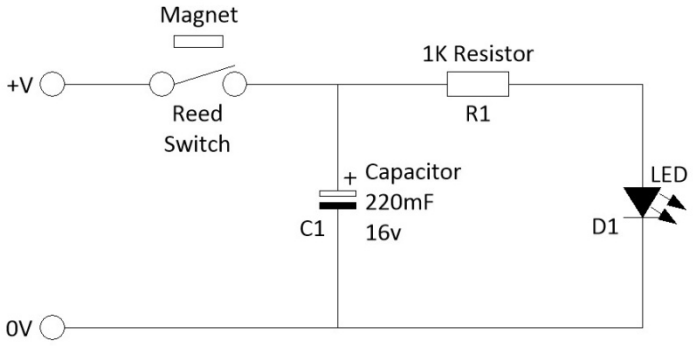
In other words a capacitor stores power and release power (a little like a battery) The amount it stores is dependent on the size, and the rate it dissipates is dependent on the subsequent load.

Electrolytic Capacitor are available in 'Axial' (A lead at each end) or 'Radial

(both leads at one end). The casing will show the Negative lead, which with radials will be shorter than the positive.

Electrolytic Capacitors are used in Power Supply units to smooth out the Output voltage. If there are any ripples in the voltage from the transformer the capacitor smoothes them out because it gives out stored power during a ripple. (This is a very simplistic description, there is more to a smooth power supply than just putting a capacitor across the output)
They are also used to keep LED's on for a short time once power is removed.





In the above circuit the capacitor is charged up when the Reed switch is closed, this also illuminated the LED. When the Reed switch opens the voltage stored in the capacitor will keep the LED illuminated until the capacitor is discharged.

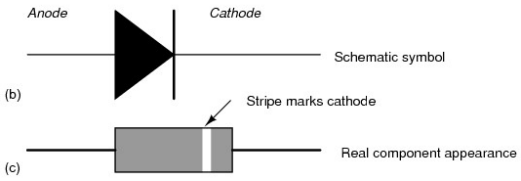
CDU (Capacitor Discharge Unit) use a number of large capacitors to store power, so it can give a large shot of power to activate the points.

(Care should be taken with used larger capacitors, they have been known to hold electrical power for a long time, and can give you quiet a shock)

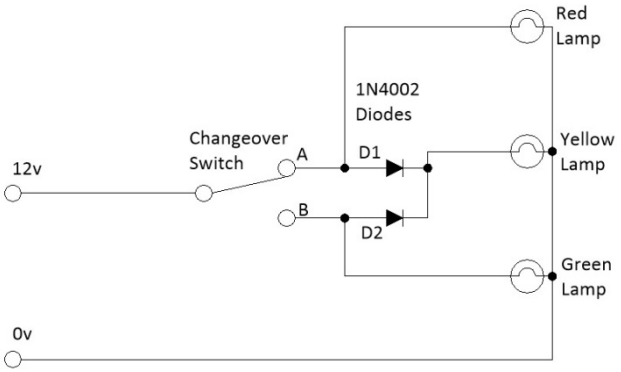
3) Diodes.

A **diode** is an electrical device allowing current to move through it in one direction with far greater ease than in the other. The most common kind of diode in modern circuit design is the semiconductor diode, although other diode technologies exist.
In other words it allows current to flow forward (from Anode to Cathode) but not backward.(Cathode to Anode)

This drawing is the Schematic Symbol and the Real life appearance. A diode always has a line (white or black depending on the background) to denote the Cathode.



Signal Diode:
As mentioned above the signal diode is very useful to block certain voltages from other voltages.
The best example of this is this simple circuit. With the switch in the position 'A' The Red & Yellow Lamps are ON & Green is OFF. In position 'B' the Yellow & Green are ON & the Red is OFF.
The reason for this is, in position 'A' diode D2 is blocking the voltage getting to the Green Lamp, and in Position 'B' the diode D1 is blocking the voltage getting to the Red Lamp.



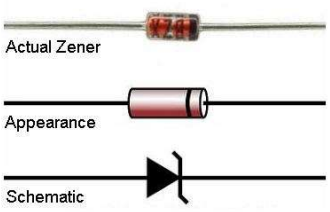
Diodes are also used to convert AC (Alternating Current) into DC (Direct Current)

Zener Diode:

A **Zener diode** allows current to flow from its anode to its cathode like a normal semiconductor diode, but it also permits current to flow in the reverse direction when its "Zener voltage" is reached. The Zener still conducts electricity in the

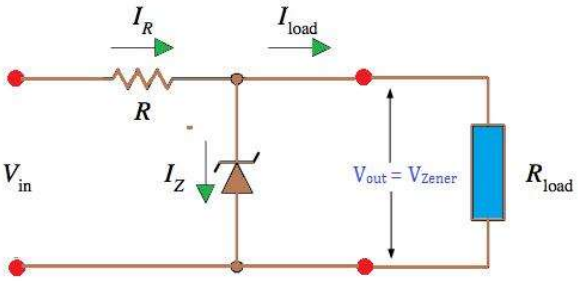
forward direction like any other diode, but also conducts in the reverse direction, if the voltage applied is reversed and larger than the Zener breakdown voltage.

In other words it allows voltage to pass the Diode up to the value of the Zener diode and no more.



This drawing shows the Actual, Appearance and Schematic of a Zener diode.
A Zener diode always has a line (white or black depending on the background) to denote the Cathode.

In this circuit the Zener diode is controlling the output voltage at Vout
If the Vin voltage is 12vDC and the Zener Vz is 9v then the output at Vout will be 9v.
The resistor would be 3.9 Ohms rated at 2.3watts will give an output of 9v at 500mAmps.



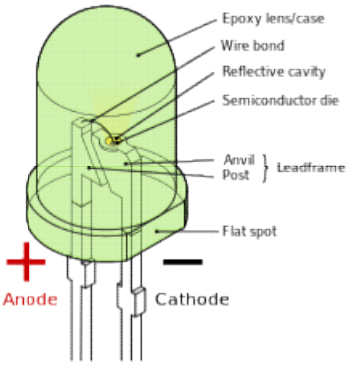
The Formula is Resistor Value(R) = (Vin - Vout) / I where I is the current required at the output.
http://www.brimal.co.uk/catalogsearch/result/?q=vr

4) Light Emitting Diode (LED)

A light-emitting diode (LED) is a two-lead semiconductor light source. It is a p–n junction diode, which emits light when activated. When a suitable voltage is applied to the leads, electrons are able to recombine with electron holes within the device, releasing energy in the form of photons.

In other words when current is passed through the LED from Anode to Cathode the LED will be illuminated, if the current/voltage is reversed nothing will happen.

An LED always has a flat on the body and a shorter lead to denote the Cathode.

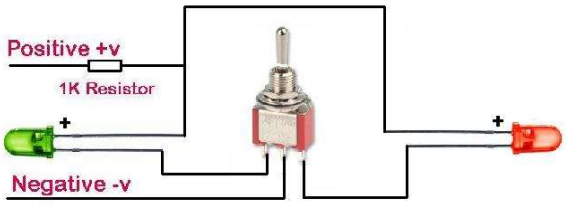


LED's only require a small voltage to make them work, so when using them on a 3 to 24 volt DC circuit you will require a 'dropping resistor' to bring the voltage down to the working voltage of the LED.

The Formula to use is Resistor (R) = (Voltage Supply - LED Voltage) / Led Current

http://www.calculatoredge.com/electronics/led%20resistor.htm

In this simple circuit the positive side of the LED's are common through a resistor to 12v voltage. The Negative side of the LED's are switched through the toggle switch.

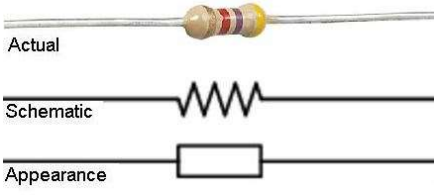


5) Resistors.

A resistor is a passive two-terminal electrical component that implements electrical resistance as a circuit element. Resistors may be used to reduce current flow, and, at the same time, may act to lower voltage levels within circuits. In electronic circuits, resistors are used to limit current flow, to adjust signal levels

In other words it reduces the amount of power coming out of it.

This drawing shows the Actual, Appearance and Schematic of a Resistor
A Resistor will have a series of coloured strips which tell you the value of the resistor, the tolerance of the resistor and sometimes the wattage.



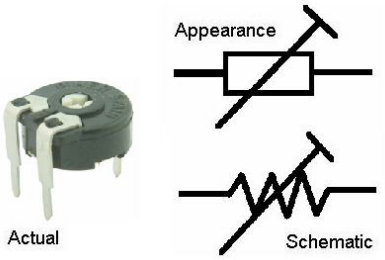
There are many different types and shapes of resistors but for the purpose you want a carbon film resistor is adequate. They are available in values from 1 Ohm to 10M Ohm, and different power rating (wattage)

See our separate page on Resistor.

6) Preset Resistor

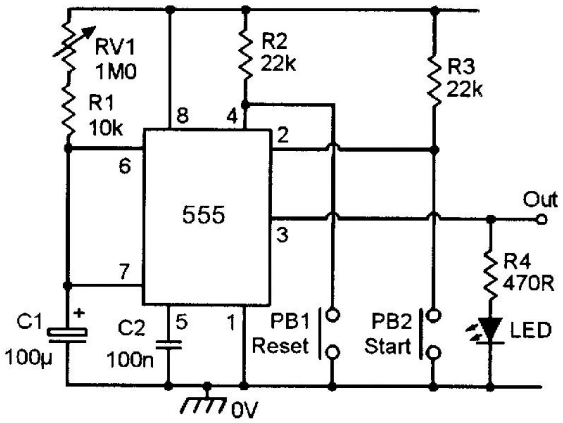
A preset is a three legged electronic component which can be made to offer varying resistance in a circuit. The resistance is varied by adjusting the rotary control on the preset resistor. The adjustment can be done by using a small screw driver or a similar tool. The resistance does not vary linearly but rather varies in exponential or logarithmic manner. Such variable resistors are commonly used to adjust the length a timer in ON.

The variable resistance is obtained across the single terminal at front and one of the two other terminals. The two legs at back offer fixed resistance which is divided by the front leg. So whenever only the back terminals are used, a preset acts as a fixed resistor. Presets are specified by their fixed value resistance.



In other words it reduces the amount of power coming out, which is variable, from non to full - a little like a water tap.

This drawing shows a practical variable-period (max 50s) manually-triggered 555 timer, the timing action is initiated by briefly closing START switch PB2, and the output state is visible via an LED. The output can be used to drive a relay or indicator lamp. The fixed-period output pulse can be varied by adjusting RV1



For further information on any of the above circuits please see other project sheets.

7) EMF (Electro Motive Force)

The collapsing magnetic field, when an inductive circuit is broken, causes a voltage transient or back EMF. This will eventually lead to complete welding of the switch. Coil operated relays or solenoid control valves possess considerable inductive values. The significant factor to guard against is the release of energy, temporarily stored in the coil, at the time the switch opens.

The switch can be of any type where to metals join together to make a circuit:- reed switch, toggle switch, leaf switch, push button switch, relay, etc.

The diode is excellent for removing the inductive voltage spike, as the back EMF is directed through the diode. Contact erosion is reduced to a minimum but, when placed across a relay coil, release time of the relay contacts will be increased by several milliseconds while the stored energy is being dissipated. The diode chosen must have a forward current rating equal to, or greater than, the steady state current of the circuit and the diode must be connected cathode to positive