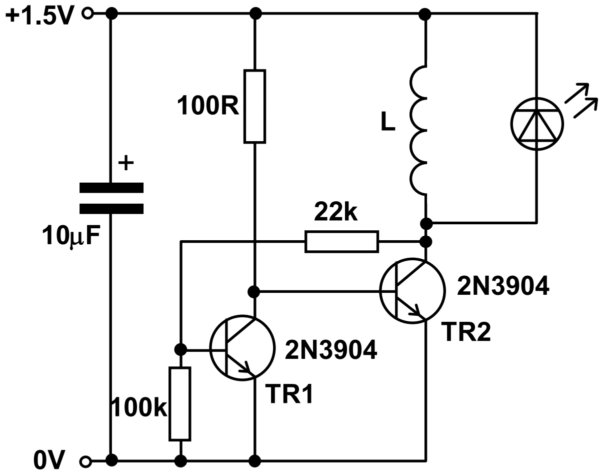
1.5V white LED circuit.

Specification

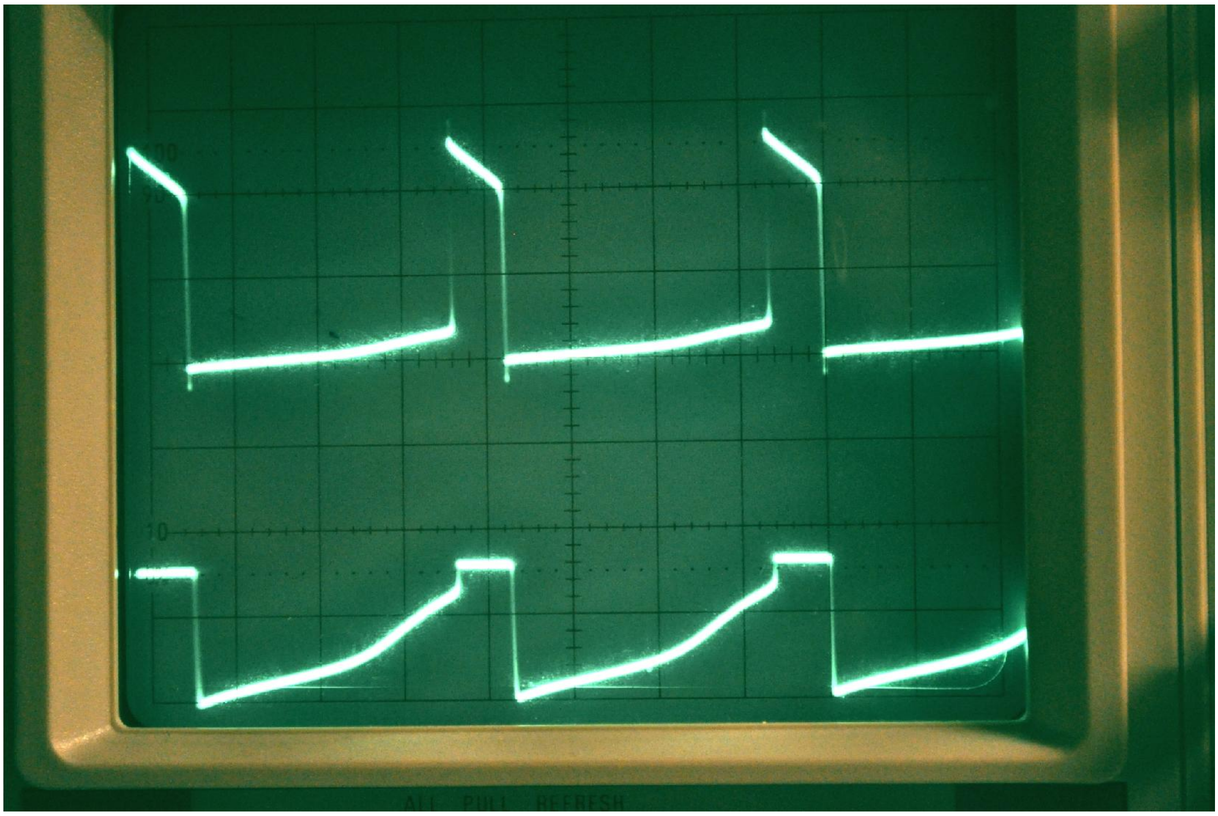
Powers a 3V or 9V white LED from a 1.5V supply.
Powers any colour LED as well as white .
Operates from 1 to 1.5V.
Operating current approximately 20mA from 1.5V.



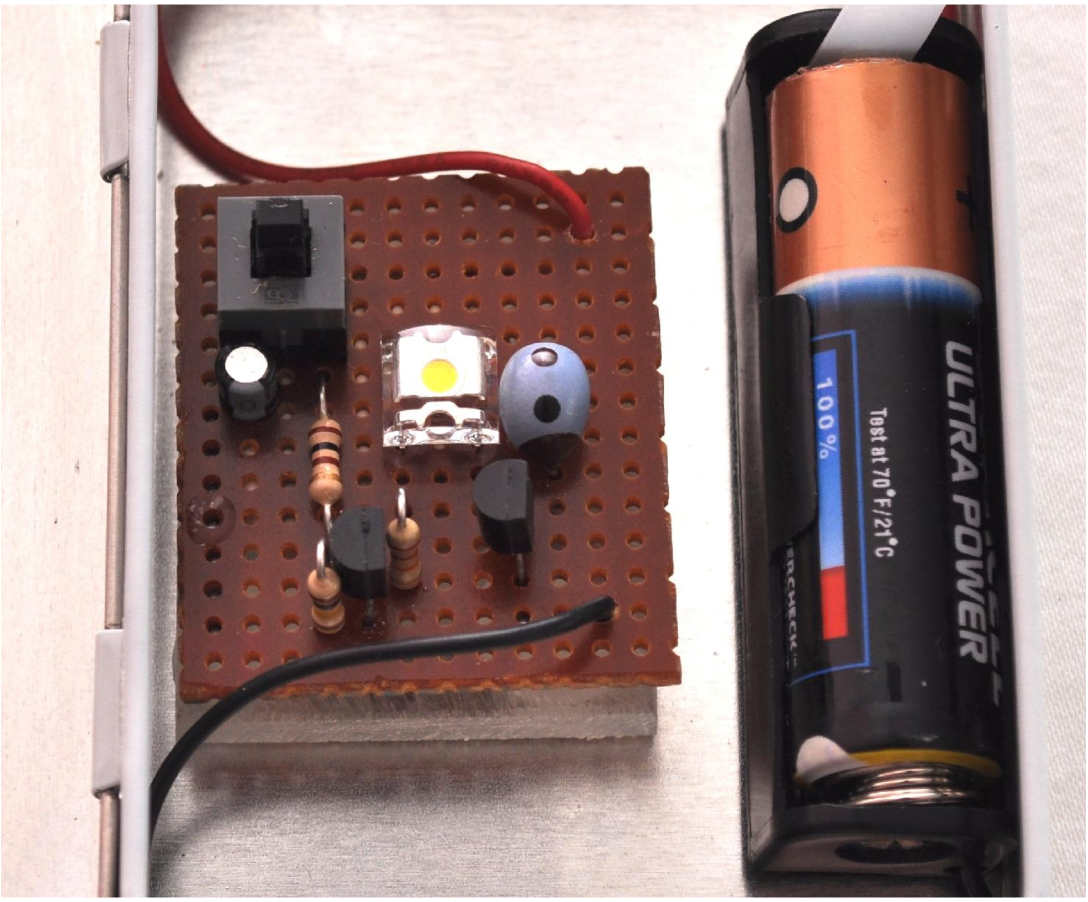
Inductor values are not critical.
Inductor values of around 1mH work well, with the circuit oscillating at around 15kHz.
The resistance of the inductor should be small - 1-2Ω.
The 22k resistor may need adjusting to provide stable operation with some inductors.

How it works.

When first switched on there is no current passing through the inductor, L, so TR1 will be switched off and TR2 will be switched on. Current now starts to pass through L, and increases until the voltage across TR2 starts to rise. This makes the voltage at the base of TR1 start to rise and the voltage at the collector of TR1 start to decrease, so starting to switch TR2 off.
As TR2 switches off, the inductor tries to maintain the current passing and so increases the voltage at the collector of TR2 and the voltage at the base of TR1. This switches on TR1 and switches off TR2. The voltage produced across L is sufficient to light the LED and the energy stored in the inductor is dissipated in the LED.
With no LED across the inductor, in excess of 30V is produced, and so LEDs can be connected in series if required.
The trace below shows the collector voltage of TR2 (upper, 2V/div) and the base voltage of TR1 (lower, 0.5V/div). In the upper trace, the voltage can be seen to rise as the energy is stored in the inductor, and then when switching occurs, the energy stored can be seen transferring to the LED (linear negative slope on the pulse).
In the lower trace,the base voltage can be seen to rise towards 0.6V, at which point, TR2 switches off and the large induced voltage from the inductor saturates TR1 until the stored energy is dissipated.

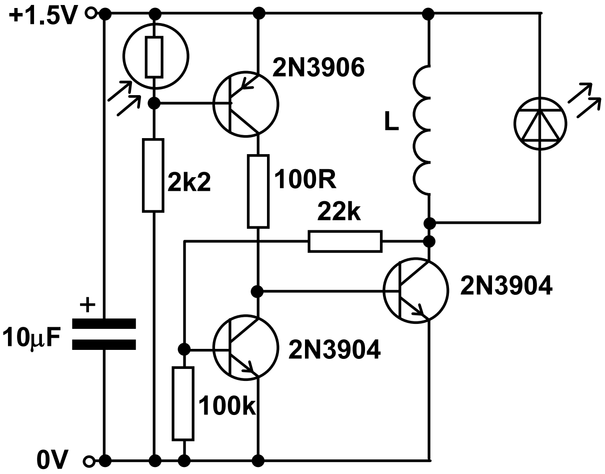


The photograph below shows the circuit with a 9V white LED module. The circuit is built into a small tin box and the switch operates the lamp when the box is opened. A small piece of plastic has been inserted at the top of the battery holder so that the photograph could be taken without the LED being lit.



Modifications

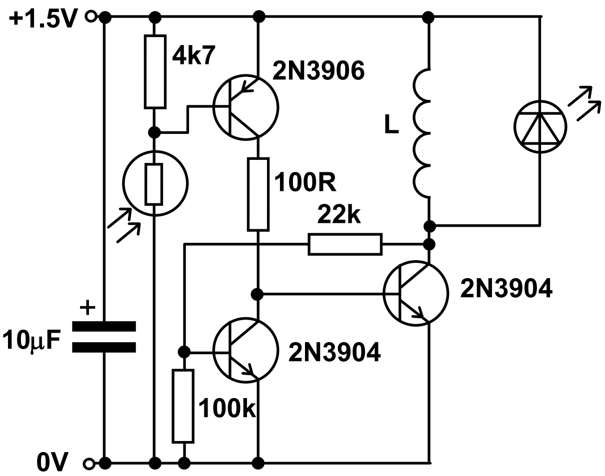
The circuit below has been adapted so that the LED only lights in the dark.



The LDR is an ORP12 type device and the 2k2 resistor can be adjusted to provide the required light level at which the LED will switch on.

If a rechargeable cell is used to power the circuit, then a photovoltaic panel could be connected, via a diode, to the cell so that it charges during the day and the LED switches on at night.

The circuit below has been modified so that it can act as an electronic candle.



The LDR should be placed so that light from the LED can fall onto the LDR when it is lit.

The LDR will need to be shielded from ambient light to ensure that it responds only to light from near the LED.

To operate, a match is struck and placed near to the LED/LDR. Light from the match will cause the LED to light, and from light feedback to the LDR, the LED will stay lit.

To turn off the LED, light must be prevented from going to the LDR and this can be achieved by placing your fingers over the LED, as if snuffing out a candle.

The value of the 4k7 resistor may need adjusting to obtain the correct operation.