Kitronik

ESSENTIAL INFORMATION

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LEARN ABOUT SIMPLE CIRCUITS WITH THIS

SQUEEZY TORCH KIT

Version 2.0

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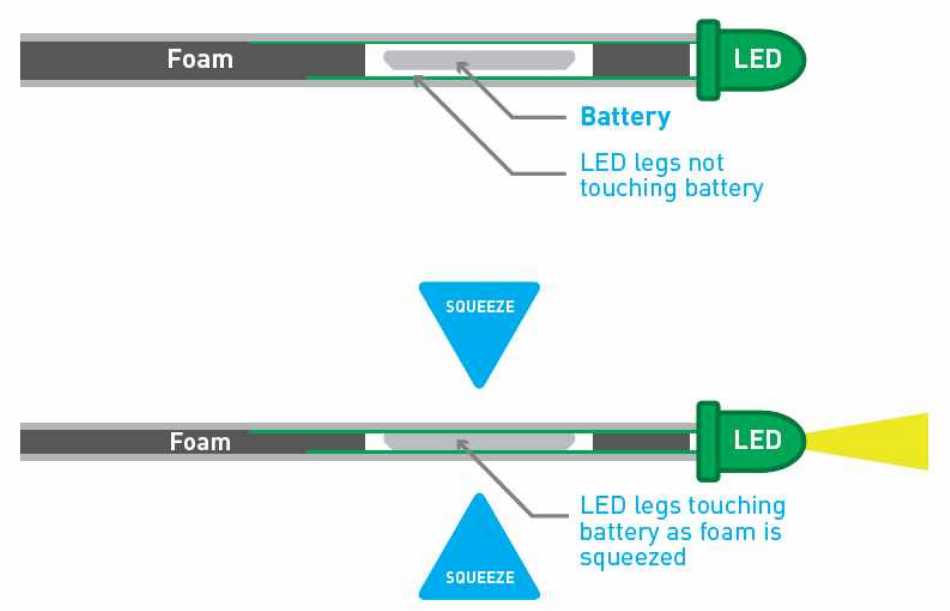
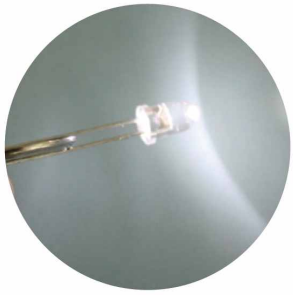
Squeezy Torch Essentials

www.kitronik.co.uk/2148

How the Squeezy Torch Works



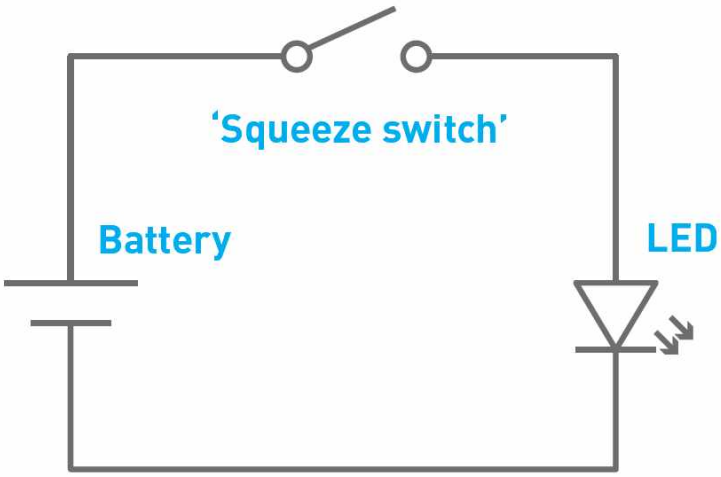
The torch works by powering a white LED from a coin cell battery. When the legs of the LED are touched against the terminals (faces) of the coin cell battery by squeezing the foam core, electricity flows from the battery through the LED, causing it to light up.



You can try this by placing the coin cell battery between the legs of the LED as shown in the picture to the right. It is important to connect the battery the correct way around otherwise it will not work. The longest leg of the LED should touch the side of the battery marked with the '+' sign.

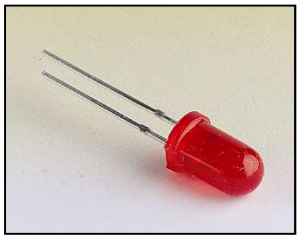
Circuit diagram

The diagram to the right shows the very simple torch circuit.



LEDs & Current Limit Resistors

Before we look at LEDs, we first need to start with diodes. Diodes are used to control the direction of flow of electricity. In one direction they allow the current to flow through the diode, in the other direction the current is blocked.



An LED is a special diode. LED stands for Light Emitting Diode. LEDs are like normal diodes, in that they only allow current to flow in one direction, however when the current is flowing the LED lights.

The symbol for an LED is the same as the diode but with the addition of two arrows to show that there is light coming from the diode. As the LED only allows current to flow in one direction, it's important that we can work out which way the electricity will flow. This is indicated by a flat edge on the LED.

For an LED to light properly, the amount of current that flows through it needs to be controlled. To do this we use a current limit resistor. If we didn't use a current limit resistor the LED would be very bright for a short amount of time, before being permanently destroyed.

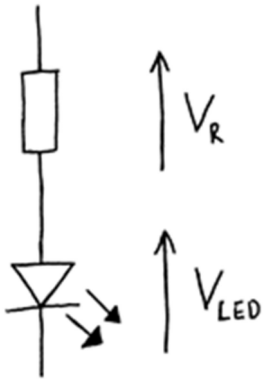
To work out the best resistor value we need to use Ohms Law. This connects the voltage across a device and the current flowing through it to its resistance.

Ohms Law tells us that the flow of current (I) in a circuit is given by the voltage (V) across the circuit divided by the resistance (R) of the circuit.

$$I = \frac{V}{R}$$

Like diodes, LEDs drop some voltage across them: typically 1.8 volts for a standard LED. However the high brightness LED used in the 'white light' version of the lamp drops 3.5 volts.

The USB lamp runs off the 5V supply provided by the USB connection so there must be a total of 5 volts dropped across the LED (V_{LED}) and the resistor (V_R). As the LED manufacturer's datasheet tells us that there is 3.5 volts dropped across the LED, there must be 1.5 volts dropped across the resistor. ($V_{LED} + V_R = 3.5 + 1.5 = 5V$).



LEDs normally need about 10mA to operate at a good brightness. Since we know that the voltage across the current limit resistor is 1.5 volts and we know that the current flowing through it is 0.01 Amps, the resistor can be calculated.

Using Ohms Law in a slightly rearranged format:

$$R = \frac{V}{I} = \frac{1.5}{0.01} = 150\Omega$$

Hence we need a 150Ω current limit resistor.

LEDs Continued

The Colour Changing LEDs used in the 'colour' version of the lamp has the current limit resistor built into the LED itself. Therefore no current limit resistor is required. Because of this, a 'zero Ω' resistor is used to connect the voltage supply of 5V directly to the Colour Changing LED.

Packages

LEDs are available in many shapes and sizes. The 5mm round LED is the most common. The colour of the plastic lens is often the same as the actual colour of light emitted – but not always with high brightness LEDs.

Advantages of using LEDs over bulbs

Some of the advantages of using an LED over a traditional bulb are:

Power efficiency	LEDs use less power to produce the same amount of light, which means that they are more efficient. This makes them ideal for battery power applications.
Long life	LEDs have a very long life when compared to normal light bulbs. They also fail by gradually dimming over time instead of a sharp burn out.
Low temperature	Due to the higher efficiency of LEDs, they can run much cooler than a bulb.
Hard to break	LEDs are much more resistant to mechanical shock, making them more difficult to break than a bulb.
Small	LEDs can be made very small. This allows them to be used in many applications, which would not be possible with a bulb.
Fast turn on	LEDs can light up faster than normal light bulbs, making them ideal for use in car break lights.

Disadvantages of using LEDs

Some of the disadvantages of using an LED over a traditional bulb are:

Cost	LEDs currently cost more for the same light output than traditional bulbs. However, this needs to be balanced against the lower running cost of LEDs due to their greater efficiency.
Drive circuit	To work in the desired manner, an LED must be supplied with the correct current. This could take the form of a series resistor or a regulated power supply.
Directional	LEDs normally produce a light that is focused in one direction, which is not ideal for some applications.

Typical LED applications

Some applications that use LEDs are:

- Bicycle lights
- Car lights (break and headlights)
- Traffic lights
- Indicator lights on consumer electronics
- Torches
- Backlights on flat screen TVs and displays
- Road signs
- Information displays
- Household lights
- Clocks

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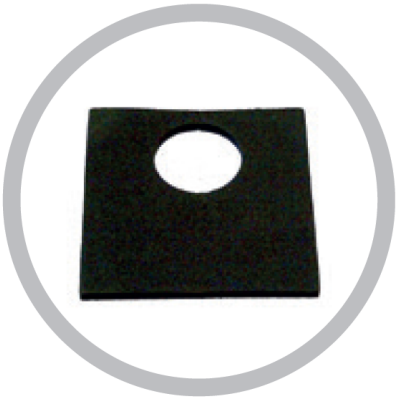
What's in the Kit?

1 x Ultra Bright White LED

1 x 3V Coin Cell Battery (CR2016)



1 x Neoprene foam core

2 x White PVC outer pieces

Equipment required

You will need the following items to build the torch:

- Double sided tape (ideally 50mm wide variety).
- Scissors.

Optional parts

- Paints, glue, glitter etc. to decorate the finished torch.

Battery life

The battery will last for approximately 4 hours while the torch is in use.

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Build Instructions

Build the torch by following these simple steps.

1 INSERT COIN CELL INTO FOAM

Insert the coin cell battery into the circular cut out in the neoprene foam core. The result should look like the picture shown.

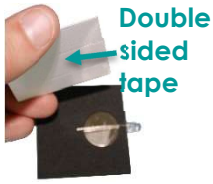
2 PUT THE LED INTO PLACE

Now place the legs of the LED either side of the battery and foam layer as shown in the picture to the right. The result should look like the picture below, right. It is important that the LED is connected to the battery the correct way around otherwise the torch will not work.

The longest leg of the LED should be placed on the side of the battery marked with the '+' sign. You can check this by gently holding the legs against the battery. If the LEDs lights then everything is the correct way around.

3 APPLY DOUBLE SIDED TAPE

The next step is to apply double sided tape to one side of each of the white PVC pieces.



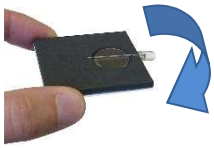
4 ATTACH THE FIRST PVC PIECE

Take one of the pieces of PVC, remove the cover of the double sided tape and lay it over the foam inner layer.

Be careful to ensure that it is aligned with the foam centre. When you are happy, stick it in place.

5 ATTACH THE SECOND PVC PIECE

Now turn the torch over and stick the other piece of PVC to the other side of the foam by repeating the actions in step 4.



6 TEST THE CIRCUIT

It's time to see if your torch works! Gently squeeze the two white sides of the torch together and the LED should come on.

Online Information

Two sets of information can be downloaded from the product page where the kit can also be reordered from. The 'Essential Information' contains all of the information that you need to get started with the kit and the 'Teaching Resources' contains more information on soldering, components used in the kit, educational schemes of work and so on and also includes the essentials. Download from:

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