Kitronik

Electro Fashion

Sewable LED kits



Teaching Notes

Issue 1.1

Product information: www.kitronik.co.uk/quicklinks/2702/

Introduction

About the project kit

This project kit has been carefully designed for use by textiles teachers in KS2 and KS3 design and technology. It is designed so that even teachers with no electronics experience can use it as basis around which to form a scheme of work. This booklet contains a wealth of material to aid the teacher.

PLEASE NOTE THAT THE ELECTRONICS ARE NOT WATER RESISTANT AND SHOULD NOT BE WASHED.

Using the booklet

This booklet is intended as an aid for teachers when planning and implementing your scheme of work. It contains information designed to form the basis around which lessons can be planned. The teacher can pick and choose to use the information as they see fit. Please feel free to print any pages of this booklet to use as student handouts in conjunction with Kitronik project kits.

Support and resources

You can also find additional resources at www.kitronik.co.uk There are component fact sheets, information on calculating resistor and capacitor values, puzzles and much more.

Kitronik provide a next day response technical assistance service via e-mail. If you have any questions regarding this kit or even suggestions for improvements please e-mail us at: support@kitronik.co.uk Alternatively phone us on 0845 8380781.

Using the conductive thread and how it Works



Conductive thread is ideal for introducing electronics into textiles projects. The thread looks and behaves like conventional sewing thread with the added bonus of being conductive, allowing the thread to be used with conventional electronics in the place of wires.

Electrical Characteristics

The thread has a low resistance but it is not a perfect conductor. The thread has a resistance of approximately 0.4 ohm / cm (40 ohm / m). This is quite sufficient for, say, powering LEDs over quite large distances. If very long lengths of thread are used to connect the LEDs, this may result in the LEDs being slightly dimmer. Resistance does not vary significantly from one length of thread to the next.

Physical Characteristics

The thread has a breaking strain of around 9.3 pounds (4.2 kilos). It comprises roughly 96 individual filaments, each coated with a micron-thick layer of natural silver. In construction, 16 of these filaments are wound together to form an initial twist; two of these twists are then twisted together, and finally three of these twists are combined to form the finished thread.

The thread is around 18 denier in thickness (a denier is a measurement of a threads weight or thickness). This means it is slightly heavier than a regular sewing thread, but not as heavy as an upholstery thread. It can be hand sewn, or it can be sewn on most sewing machines using either a regular needle or the next size up. The thread does not fray.

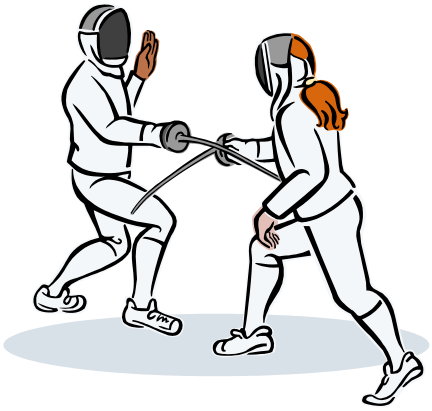
Examples applications of conductive thread

There are many applications in which conductive thread and fabrics can be used.

Electronics in textiles
Conductive thread is perfect for adding electronics into textiles (clothing, hats, bags etc.). This does not have to be just LEDs. The thread could be used to connect many different types of sensors or input devices, and also many types of output devices.

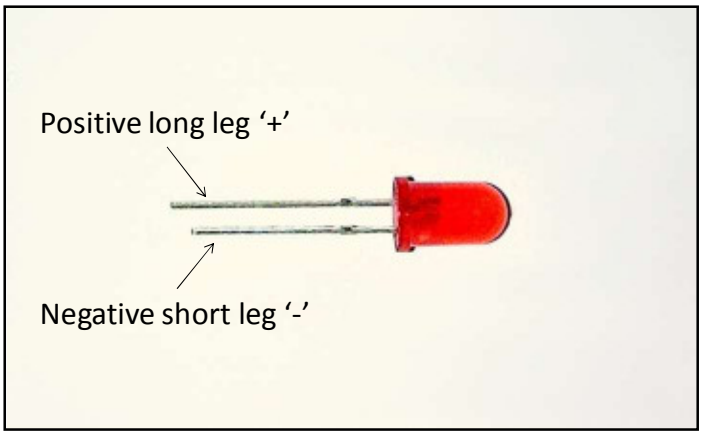
ESD (Elecro static discharge) prevention
Many electronics can be damaged by what is known as electro static discharge. This is likely to happen when the electronic components are handled. This is most likely to occur during the manufacturing process (when the parts are put onto the PCB). To prevent this manufacturers often require their employees to where conductive clothing. These garments allow any static build up to be conducted away in a safe manner, therefore protecting the sensitive electronic parts.

Fencing
Conductive materials have been used in fencing for a number of years. During a fencing match the competitors wear a conductive jacket that covers the 'scoring' area. An opponent scores points by striking the scoring area with their foil (sword). The contact between the metal foil and the conductive jacket can be detected by an electronic circuit and is used to register valid 'strikes'. The jackets used are very expensive and it is common for owners to repair worn jackets with patches of conductive material and thread.



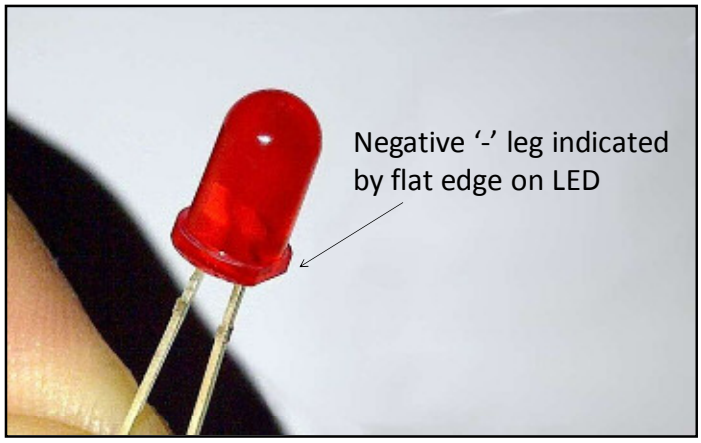
LEDs – identifying the positive leg

The LEDs that are used in the kit will only work if they are connected the correct way around. It is very easy to determine the positive leg (anode) and negative leg (cathode).



Leg length

The easiest way to identify the positive and negative leg is by the length of the legs (see diagram left). The long leg is the positive '+' and the short leg is the negative '-'.



Flat edge

The other way of identifying the negative '-' leg is by the flat edge on the LED (see diagram left). This can be very useful if you have formed your leg into eyelets.

Why don't I need a current limit resistor?

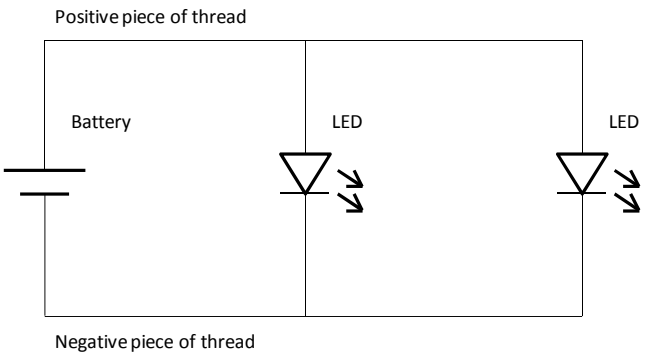
For an LED to light properly the amount of current that flows through it needs to be controlled. To do this a current limit resistor is normally used. A resistor is a device that opposes the flow of electrical current. The bigger the value of a resistor the more it opposes the current flow. The value of a resistor is given in Ω (ohms) and is often referred to as its 'resistance'.

Normally 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. It is not necessary to use a current limit resistor in the sewable LED kits for three reasons.

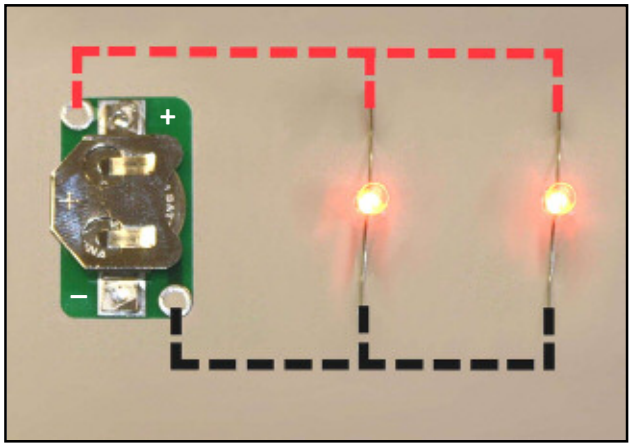
1. The types of LEDs used have the resistor built in to them.
2. The conductive thread has a slight resistance.
3. The coin cell has some internal resistance, which means the power it can deliver is limited.

Build Instructions

Circuit diagram

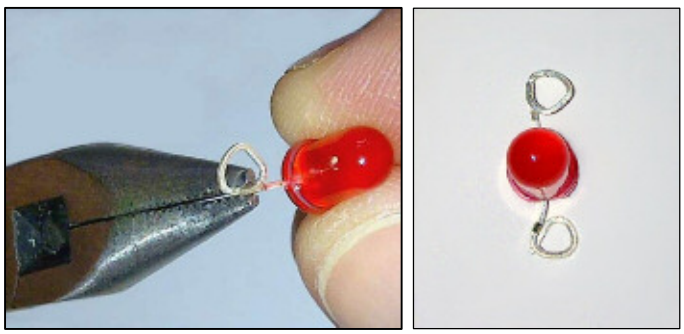


Stitched equivalent



The basic sewable LED circuit is very simple and created by placing the LEDs in parallel with the battery. This is shown in the circuit diagram above left.

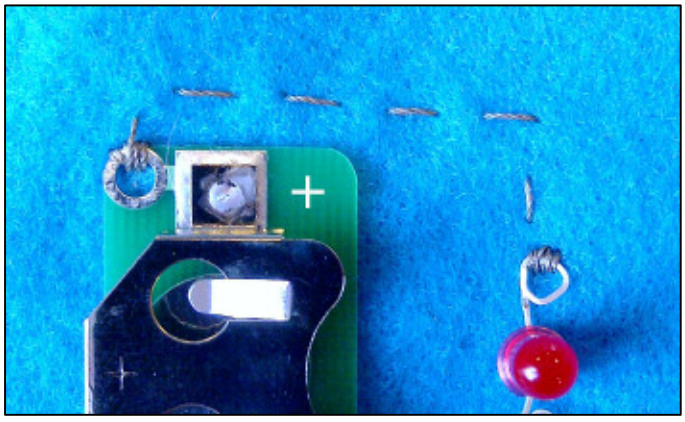
To recreate this circuit, two pieces of conductive thread are used. One is used to connect the positive connection on the battery holder, to the positive leg on each LED used. The second piece of thread is used to connect the negative connection on the battery holder, to the negative leg on each LED used. The positive and negative pieces of thread **must not touch** each other.



Forming the LED legs into 'eyelets'

To make the LEDs easier to stitch into position the legs can be formed into 'eyelets'. This can be achieved easily by forming the legs of the LED with a pair of long nose pliers.

The reason for creating the 'eyelets' is to ensure the thread can be securely attached the LED, without the possibility of it being easily dislodged.



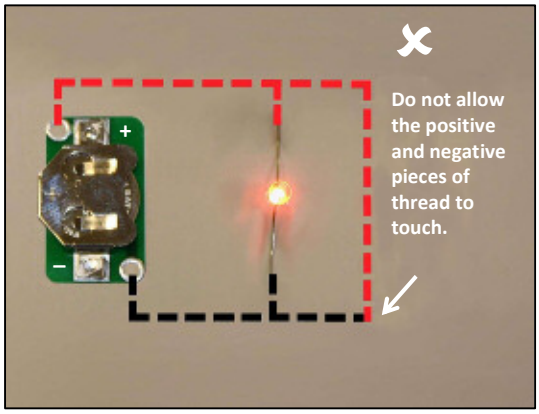
Stitched connections

It is important to created tight and secure connections at the point where the thread attaches to the battery holder and LEDs. The thread must be attached tightly to these items, so that a good electrical connection is established.

Each joint should be stitched through a number of times, each time it should be pulled tight, to ensure this is the case.

Fault finding

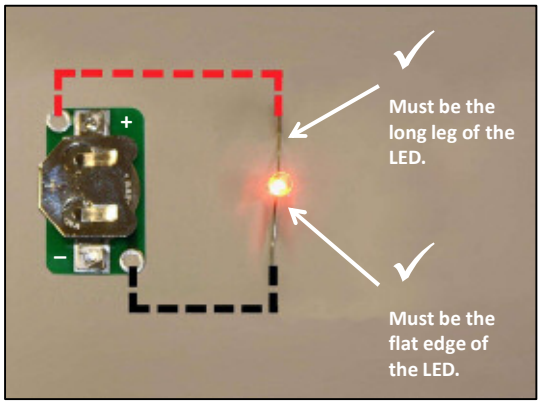
Below is a list of common faults that can stop your final circuit from working.



Thread touching / shorting

It is important to ensure that the positive and negative connecting pieces of conductive thread aren't touching each other. If they do the battery will be shorted which will prevent the LED from lighting up.

It is a good idea to fix or stitch the pieces into place so that no loose pieces can accidently touch.

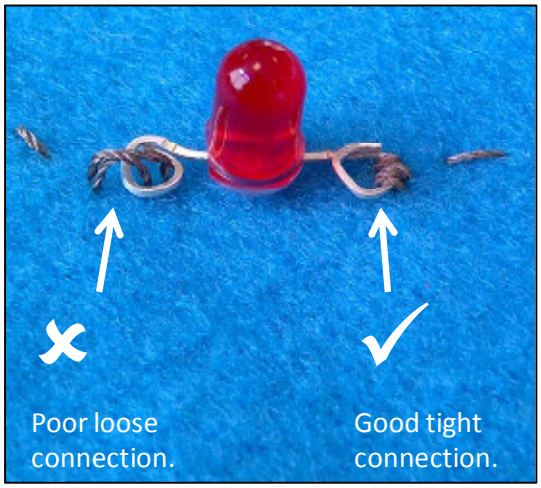


LEDs connected backwards

If the LED is connected backwards then it will not work.

Check the following:

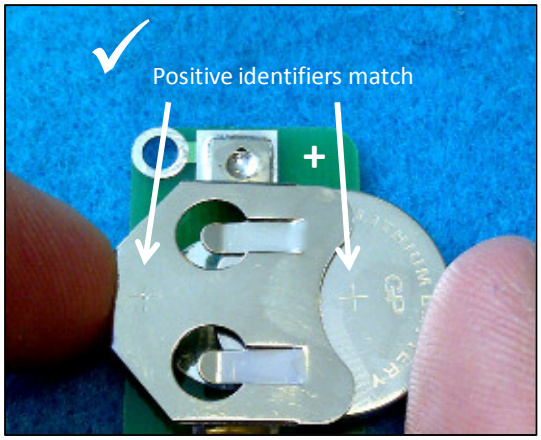
- The long leg of the LED connects to the positive piece of thread.
- The flat on the LED connects to the negative piece of thread.



Thread connections not tight enough

If the point at which the thread connects to a component is not tight enough, the circuit may not work at all, or it may work in an inconsistent manner.

The image left, shows an example of a good connection and a bad connection.



Battery insertion

If the battery is not inserted correctly, the power to the LEDs will be in reverse and they will not work.

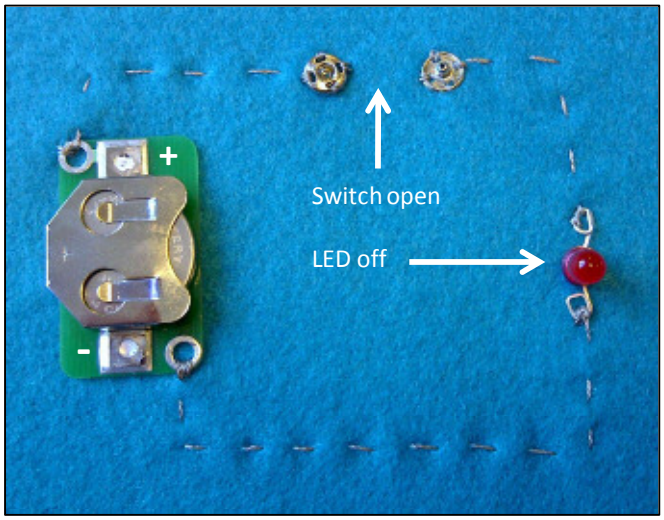
As shown in the picture to the left, both the top of the battery and the top of the coin cell retaining clip are marked with a '+' (positive) sign. The battery should be inserted so that they match.

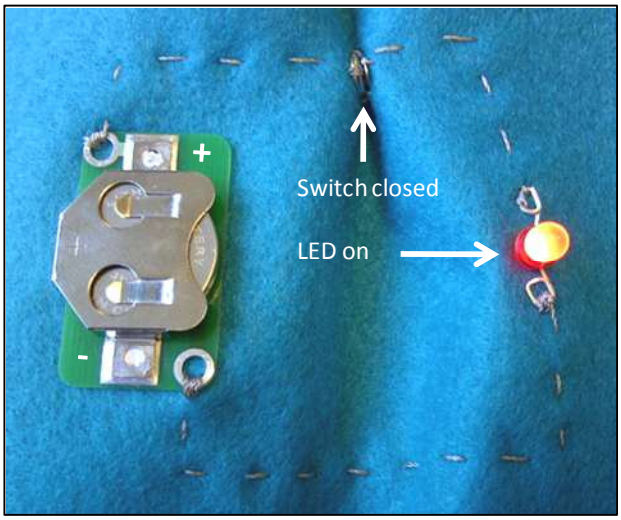
Adding a switch to the circuit

There will be many ingenious ways in which a switch can be added / create in a conductive thread circuit. Two of the most common methods are listed below.

Press stud switch

This is an easy way to add a textiles 'switch' into your circuit. Instead of the positive thread being sewn directly to the LED, a metal press stud is sewn in series as shown below. When the press stud is open the circuit is broken and no electricity can flow to the LED, which will therefore be off. When the press stud is closed the circuit is completed and he LED will be on.





How many LEDs can I use?

We have successfully run up to five colour changing or flashing LEDs from a single (new) coin cell. You may be able to run more, but it very much depends of the lengths of conductive thread and type of LEDs used.

Please note that when multiple colour changing or flashing LEDs are used, the LEDs will not cycle / flash in time with each other.

How long will the batteries last?

A typical LED uses about 20mA and the capacity of a lithium coin cell is 200mA. Therefore the table below will give a battery life estimate for between one and five LEDS.

Number of LEDs	Battery life
1	10 hours
2	5 hours
3	3.3 hours
4	2.5 hours
5	2 hours

What other LEDs can be used?

As the coin cell provides 3V any LED with a supply or forward voltage of between 3V and 5V will generally be OK.

LEDs that meet this requirement are, colour changing, flashing, 5V and most white and blue LEDs.

A PDF showing the specification of all of our LEDs can be seen at: www.kitronik.co.uk/pdf/leds.pdf

Examples / ideas

There are an unlimited number of projects that can be created by using conductive thread to power LEDs in textiles.

Below are two simple examples that we created in a short period of time. These are both purchased products and we used the thread to add LEDs to them. The projects could be made much longer if the products themselves were also made by the student.

Purse with illuminated LED flowers



Hat with illuminated LED flower



Reordering information

Description	*Stock code*
Flashing blue LED kit	2702
Flashing green LED kit	2703
Flashing red LED kit	2704
Flashing yellow kit	2705
Colour changing LED kit	2706
Sewable LED - 60 student bulk pack	2707

Sales
Phone: 0845 8380781
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Email: sales@kitronik.co.uk

Technical support
Email: support@kitronik.co.uk
Phone: 0845 8380781

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