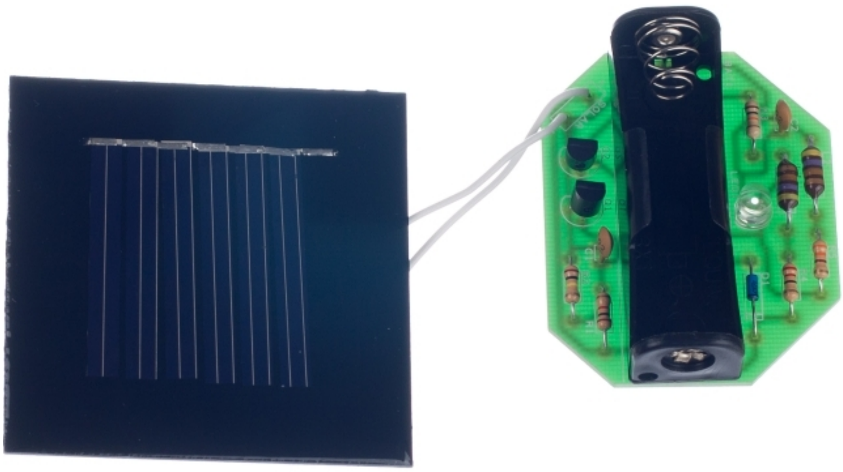
ESSENTIAL INFORMATION

BUILD INSTRUCTIONS
CHECKING YOUR PCB & FAULT-FINDING
MECHANICAL DETAILS
HOW THE KIT WORKS

HARNESS THE POWER OF THE SUN WITH THIS

SOLAR GARDEN LIGHT KIT



Version 2.0

Solar Garden Light Essentials

www.kitronik.co.uk/2134

Build Instructions

Before you start, take a look at the Printed Circuit Board (PCB). The components go in the side with the writing on and the solder goes on the side with the tracks and silver pads.

1 PLACE RESISTORS

Start with the three resistors:
The text on the PCB shows where R1, R2 etc go.
Ensure that you put the resistors in the right place.

PCB Ref	Value	Colour Bands
R1	1K	Brown, black, red
R2	100K	Brown, black, yellow
R3	10K	Brown, black, orange
R4	22Ω	Red, red, black
R5	330Ω	Orange, orange, brown

2 SOLDER THE DIODE

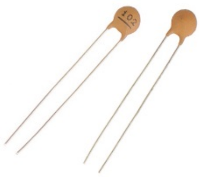
Solder the diode into the board where it is labelled D1. It is important that the diode is inserted the correct way around otherwise it will not work. If you look closely at the diode, you will see that it has a black band at one end. This should match the outline on the PCB.

3 SOLDER THE INDUCTORS

Solder the two inductors into the PCB where it is labelled L1 and L2. The inductors look like the resistor but are slightly larger. It doesn't matter which way around the inductors go into the PCB.

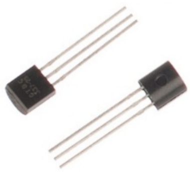
4 SOLDER THE CAPACITORS

Solder the two 1nF capacitors into the PCB where it is labelled C1 and C2. The capacitors can be identified by the text '102' which is written on them. It doesn't matter which way around they are put into the PCB.



5 SOLDER THE TRANSISTORS

Solder the two transistors into the PCB where it is labelled Q1 and Q2. The transistors have to be inserted the correct way around to work. Make sure that the outline of the component matches the outline on the PCB.



6 SOLDER THE LED

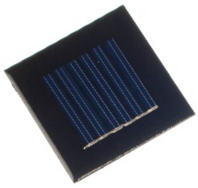
Solder the LED (Light Emitting Diode) into the PCB where it is labelled LED1. The LED has to be inserted the correct way around to work. Make sure that the outline of the component matches the outline on the PCB (the LED has one flat edge). Depending on your enclosure design, you may wish to mount the LED at a specific height above the PCB or on wire leads.

7 SOLDER THE BATTERY HOLDER

Solder the PCB mount battery holder into the PCB where it is labelled BAT1. The battery holder has to be inserted the correct way around to work. The markings on the PCB show where the 'spring' end of the battery holder goes.

8 CONNECT THE SOLAR CELL

Next connect the solar cell to the PCB. First, look at the back of the solar cell. There are markings to show which are the '+' terminals and which are the '-' terminals. Now look at the PCB and you will see that the terminals labelled 'solar' also have labels to indicate which is '+' and which is '-'. In the kit there is a bundle of wire. Use two lengths of this to connect each of the terminals on the PCB to the corresponding terminal on the solar cell. The solar cell has terminals that have already been tinned with solder and you will find these the easiest to solder to.



9 INSERT THE BATTERY

The last job is to insert the rechargeable battery (the battery holder indicates which way around the battery goes). Before you insert the battery please go through the 'Checking your solar light PCB' section on the right.

Checking Your Solar Light PCB

Carefully check the following before you insert the battery:

Check the bottom of the board to ensure that:

- All holes are filled with the lead of a component.
- All these leads are soldered.
- Pins next to each other are not soldered together.

Check the top of the board to ensure that:

- The flat edges on the LEDs and transistors match the outlines on the PCB.
- The band on the diode matches the corresponding outline on the PCB.
- The spring end of the battery holder is next the 'BAT1' text on the PCB.
- The positive connection on the solar cell is connected to the positive 'solar' terminal on the PCB and the negative connection on the solar cell is connected to the negative 'solar' terminal on the PCB.

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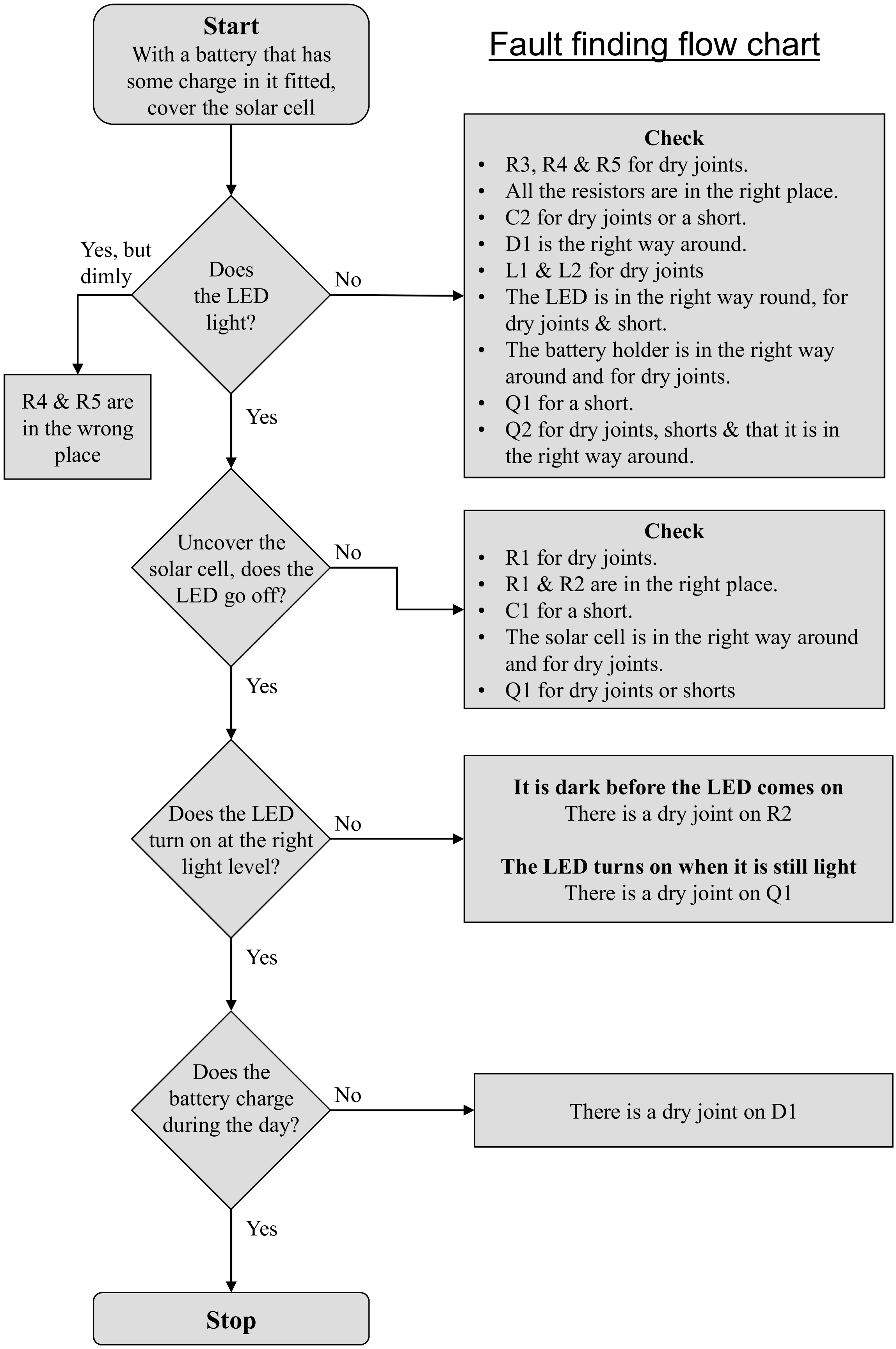
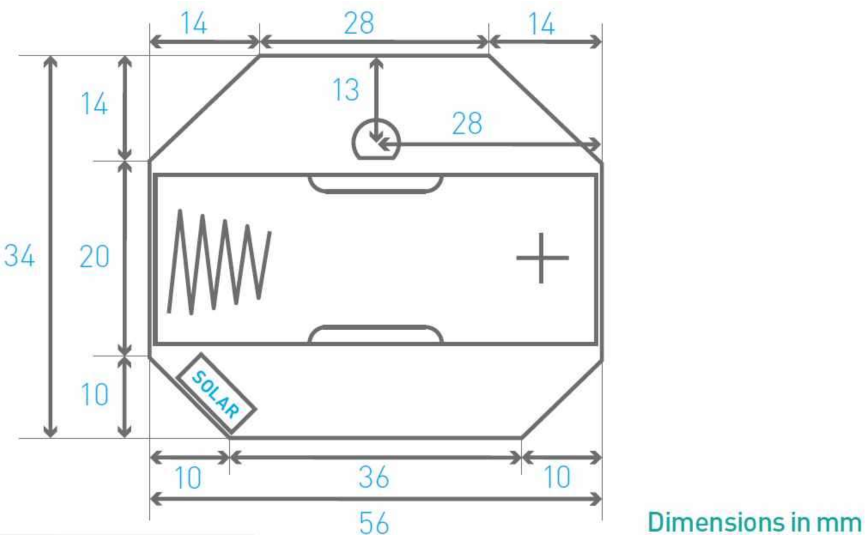
Fault finding flow chart

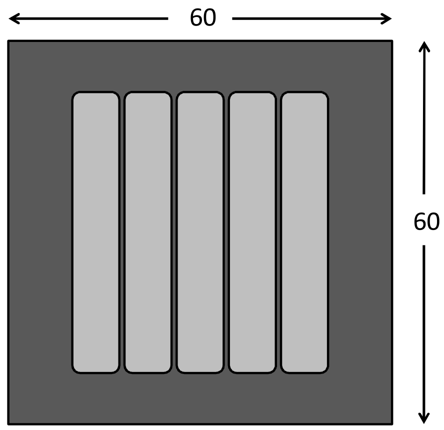


Designing the Enclosure

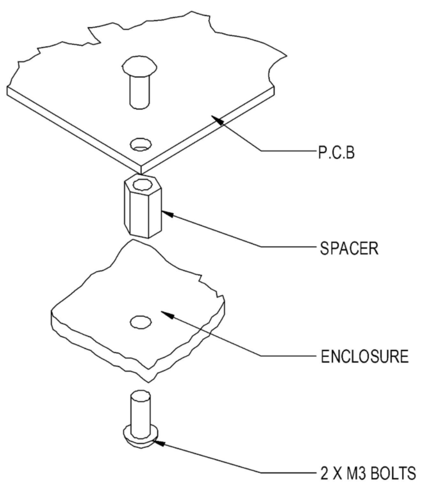
When you design the enclosure, you will need to consider:

- The size of the PCB (below left).
- The size of the solar cell (below right).
- Where the LED is mounted (shown in the top middle of the PCB).





All dimensions in mm.
The diameter of the LED is 5 mm and the total height of the unit approximately 15mm.
The LED can be mounted on flying leads if you want to position it away from the PCB.



Mounting the PCB to the enclosure

The drawing to the left shows how a hex spacer can be used with two bolts to fix the PCB to the enclosure.

Your PCB has four mounting holes designed to take M3 bolts.

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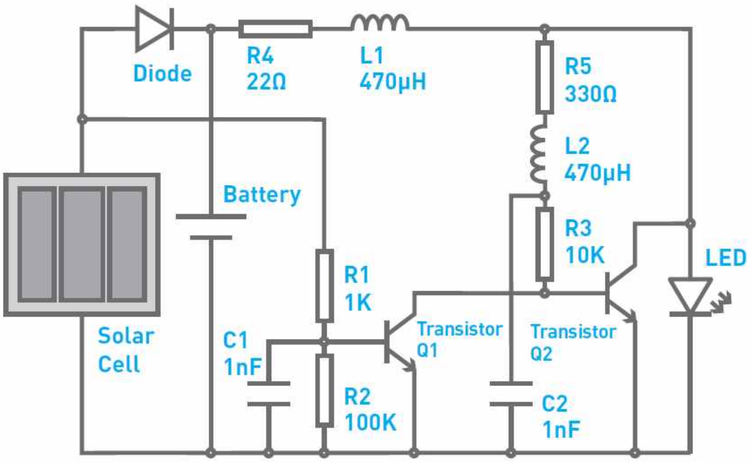
How the Solar Garden Light Works



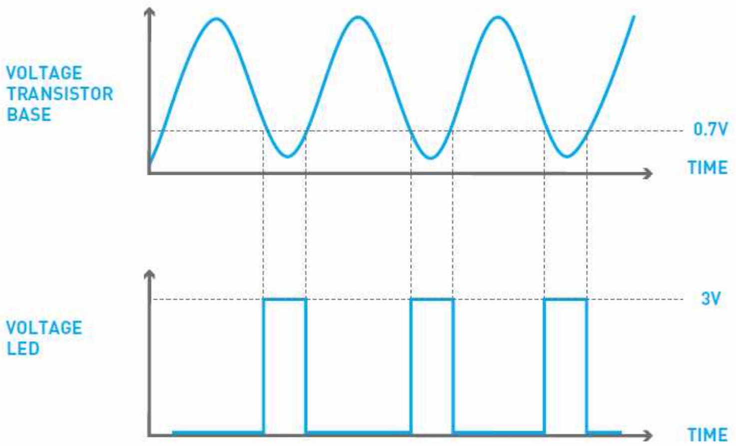
The garden light uses a solar cell to charge a rechargeable battery during the day. At night, when the light level has dropped, the circuit switches from charging the battery to discharging the battery through a high brightness LED.

The solar cell and the diode form the parts used to charge the battery. When sunlight shines on the solar cell, it produces enough power to charge the battery. The diode is used to stop the battery discharging back (as it only allows electricity to flow in one direction) into the solar cell if there is not enough sunlight falling upon (and therefore not enough voltage generated by) the solar cell.

Resistors (R1) and (R2) and transistor (Q1) form the part of the circuit that switches the LED on when the light level has fallen below the desired level.

When there is sunlight on the solar cell, the voltage it produces is enough to turn transistor (Q1) on (this keeps the LED turned off). As the amount of sunlight falls, the voltage it produces falls until there is not enough to keep transistor (Q1) turned on. The resistors (R1) and (R2) form a potential divider, which is used to feed only a proportion of the voltage produced by the solar cell through to the transistor. This allows the point where the LED comes on to be fine-tuned to the desired level.

Once activated, the remaining parts are used to power the LED. The LED requires around 3V to work but the battery can only supply about 1.2V. In order to generate 3V for the LED, the circuit has been designed so that the LED is not always on but when it is, 3V can be supplied.



This happens so fast that to the human eye, the LED looks like it is always on. The inductor (L2) and the capacitor (C2) form a resonant circuit that produces an alternating signal as shown in the picture above. When this alternating signal produces a voltage above 0.7V it turns on the transistor (Q2), which keeps the LED off. When this voltage drops below 0.7V, the transistor turns off and the LED comes on. When it is on the inductor (L1), which has been storing an amount of electricity, discharges into the LED at the same time as the battery which produces the extra voltage needed to give the 3V for the LED.

The resistors (R4) and (R5) have been selected to reduce the amount of power the LED drive circuit uses. This helps to extend the battery life so that the light can last about ten hours from a good days charging in the summer. When there is less daylight in winter, this time will be reduced.

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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This kit is designed and manufactured in the UK by Kitronik

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