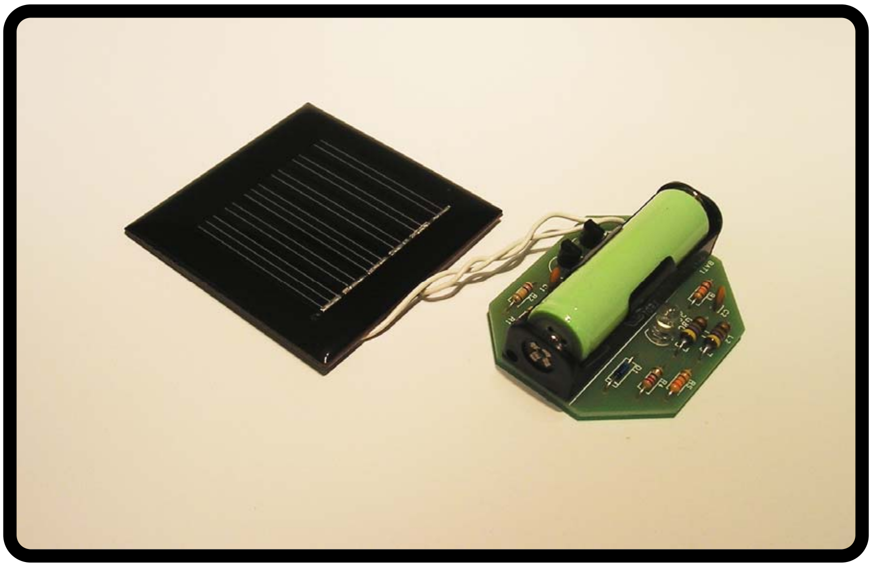
Kitronik

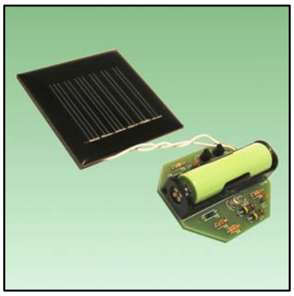
Solar Garden Light Kit



Build Instructions

Issue 1.0

Build Instructions



The finished solar garden light is shown left. Before you put any components in the board or pick up the soldering iron, just 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. You will find it easiest to start with the small components and work up to the taller larger ones. If you've not soldered before get your soldering checked after you have done the first few joints.

Step 1

Start with the resistors (shown right). There are five different value resistors that can be identified by the colour of the bands on the resistors. The text on the PCB shows where the resistors should go. It doesn't matter which way around the resistors go into the PCB. When you are happy that you have all the resistors in the correct place you can solder them into place.

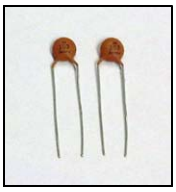
R1 = 1K ohm resistor (brown, black and red coloured bands)
R2 = 100K ohm resistor (brown, black and yellow coloured bands)
R3 = 10K ohm resistor (brown, black and orange coloured bands)
R4 = 22 ohm resistor (red, red and black coloured bands)
R5 = 330 ohm resistor (orange, orange and brown coloured bands)

Step 2

Solder the diode (shown left) into the board where it is labeled 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.

Step 3

Solder the two inductors (shown right) into the PCB where it is labeled 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.

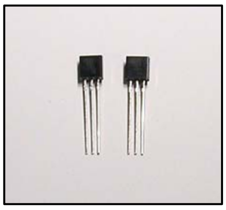


Step 4

Solder the two 1nF capacitors (shown left) into the PCB where it is labeled 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.

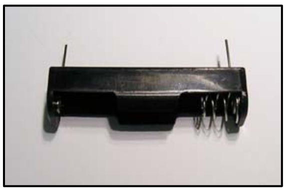
Step 5

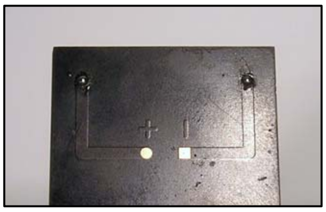
Solder the two transistors (shown right) into the PCB where it is labeled Q1 and Q2. The transistors have to be inserted the correct way around to work. Make sure the outline of the component matches the outline on the PCB.



Step 6
Solder the LED (Light Emitting Diode) into the PCB where it is labeled LED1. The LED has to be inserted the correct way around to work. Make sure 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.

Step 7
Solder the PCB mount battery holder into the PCB where it is labeled 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.





Step 8
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 labeled '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.

Step 9
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 Circuit' section below.

Checking Your Circuit

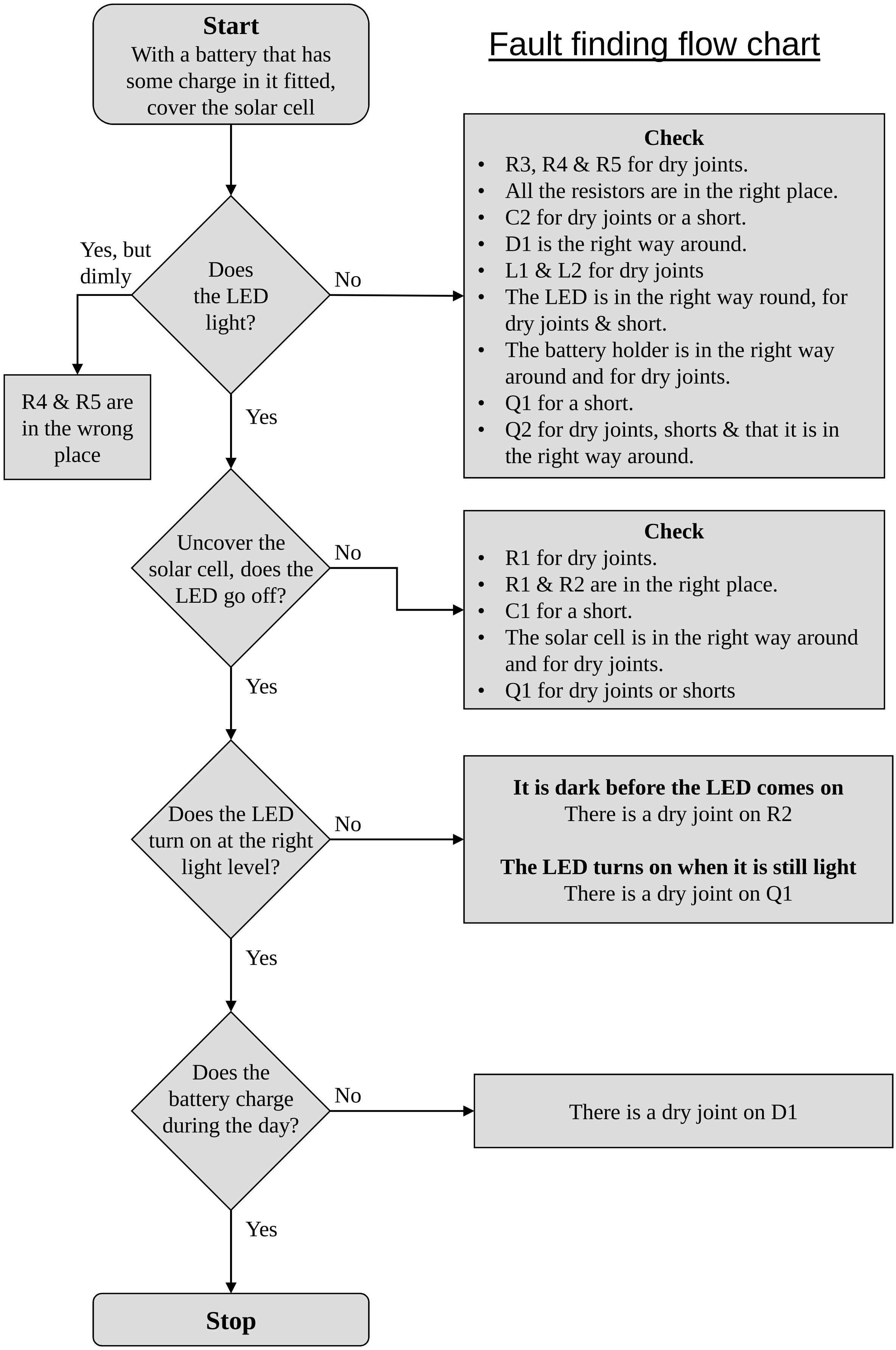
Check the bottom of the board to ensure that:

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

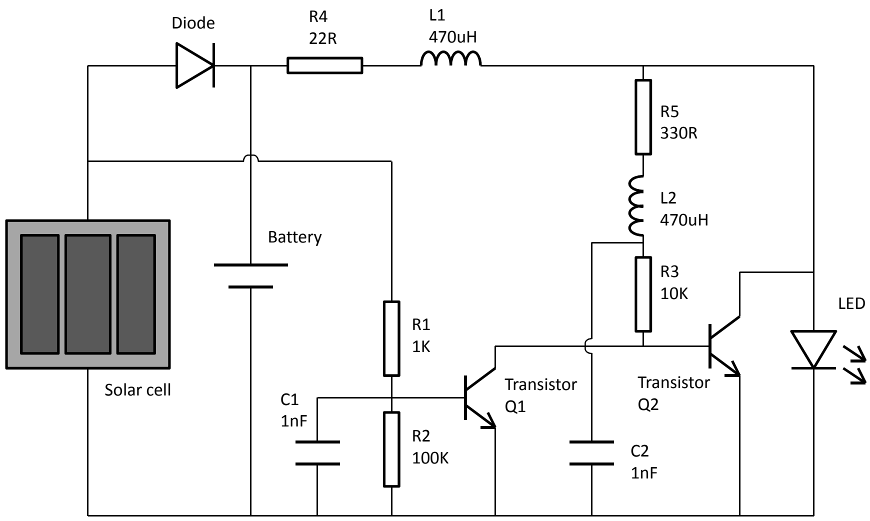
Check the top of the board to ensure that:

- 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.

Fault finding flow chart



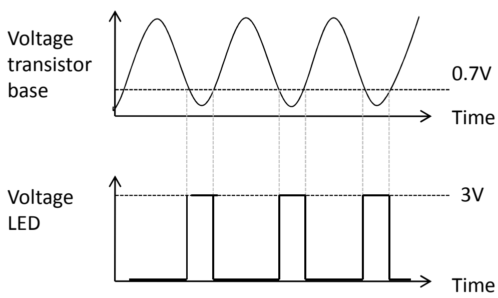
How the Solar Garden Light Works



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. To generate the 3V for the LED the circuit is designed so that the LED is not always on but when it is on it can be supplied with the required 3V it needs. This happens so fast that to the human eye, the LED looks like it is always on. The inductor (L2) and capacitor (C2) form a resonant circuit that produces an alternating signal as shown in the top picture to the right. 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 and 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.