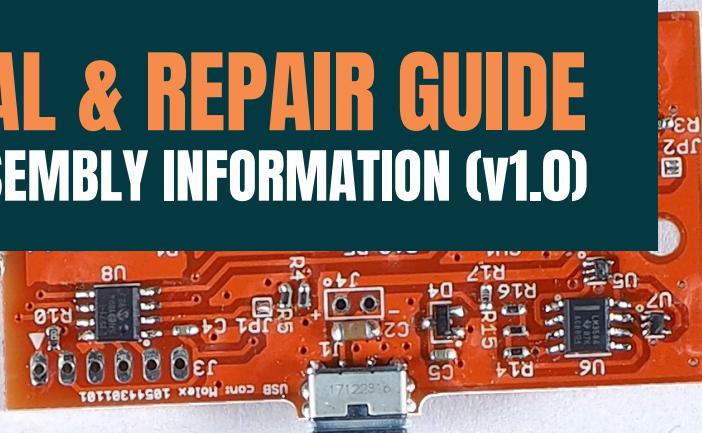


**SOLAR WHAT ?!**

# **USER MANUAL & REPAIR GUIDE**

## **INCL. SAFETY & ASSEMBLY INFORMATION (v1.0)**



THE UNIVERSITY  
of EDINBURGH



## ABOUT

People have the right to repair products that they buy and to decide who fixes them. People have the right to information, tools and spare parts that make repair possible. Designing products for repair addresses global challenges of electronic waste and creates livelihood opportunities.

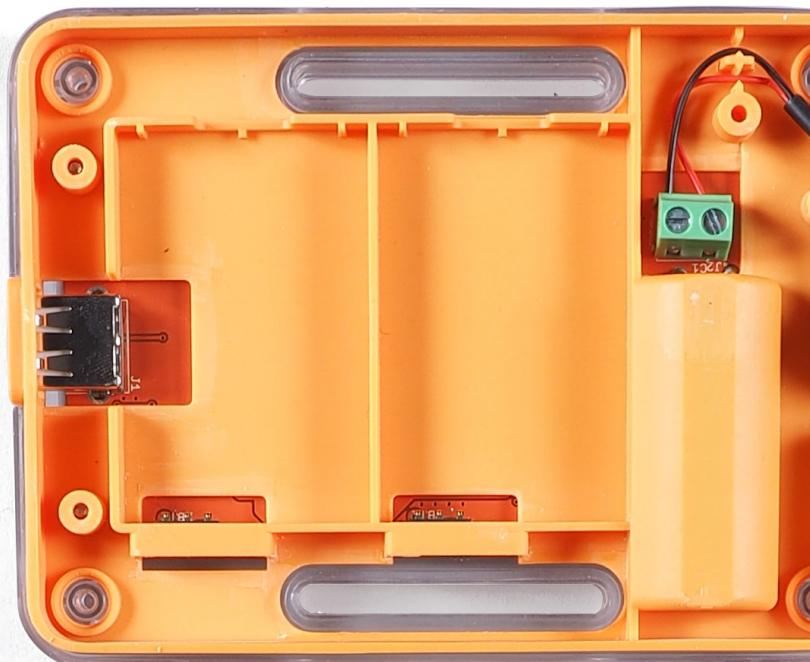
Detailed information about repair is almost never provided with off grid solar lighting products. If the solar economy is to become sustainable, this needs to change.

Solar What?! has been designed to be opened, hacked, repaired, and upgraded. This user manual provides information about how to replace and repair key components.

Solar What?! is the outcome of ongoing research at the University of Edinburgh. The product design process has taken place over three continents, with input from solar technicians, end users and energy access practitioners.

## CONTENTS

Legal and Safety Information	3
<b>Solar What?! Light</b>	<b>5</b>
Using the Product	6
Components	7
Maintenance and Repair	8
<b>Solar What?! Power</b>	<b>12</b>
Using the Product	13
Components	14
Maintenance and Repair	15



## LEGAL & SAFETY INFORMATION

### LEGAL

Solar What?! is licensed under Creative Commons Share Alike 4.0 International (available at: <https://creativecommons.org/licenses/by/4.0/legalcode.txt>) and as such uses the Disclaimer of Warranties and Limitation of Liability found in Section 5 of this license.

---

### SAFETY

We have made our products as easy to assemble, disassemble, repair, and use as possible: limited technical ability is required for basic maintenance. Solar What?! does, however, expect users attempting any repair to read the safety information below and have relevant technical expertise where required. Please note, this information is not exhaustive and all activities are carried out at the user's own risk.

#### Battery Safety:

- **WARNING!**: Improperly replaced batteries may present a risk of leak or explosion and personal injury. Mistreated rechargeable batteries may present a risk of fire or chemical burn. Do not open, mutilate, or expose to conducting materials, moisture, liquid or heat above 54°C. Do not short circuit the battery by directly connecting the terminals.
- We encourage users to replace worn out BL5C batteries with other BL5C batteries. Use of other batteries and power sources has been designed for, but should only be attempted by users with appropriate electrical knowledge and at their own risk.
- Only use Lithium Ion batteries with devices that specify their use. Only charge Lithium Ion batteries with devices intended for that purpose and not with devices intended to recharge Nickel Cadmium or Nickel Metal Hydride batteries.
- Keep Lithium Ion batteries out of reach of children.
- For further information, refer to the manufacturer of the battery used.

#### Battery Use, Maintenance and Disposal:

- The recommended BL5C battery is best charged at 21°C. Charging below 10°C, or above 35°C, is not recommended and Solar What?! products will not charge at temperatures below 0°C or above 50°C.
- It is normal for batteries to become warm during charging or use.
- If a battery is not working, check to see if the metal terminals are clean. If they are dirty, wipe them with a soft dry cloth.
- All rechargeable batteries experience a deterioration in performance over time. If a battery has reached the point where it is no longer providing charge for a convenient amount of time you should consider replacing it. See the relevant sections of this manual for guidance.
- For further information on using, charging or storing batteries, refer to the manufacturer of the battery used.
- Batteries should be appropriately disposed of by handing them into a battery collection point, where available. Used batteries should not be buried, burned or otherwise damaged in ways stated above.



## Wiring and Soldering Safety:

- Solar What?! products have been designed with only one wired connection: connecting an external solar panel with the Solar What?! Power. Instructions relating to this can be found in the relevant section of this manual. Care should be taken when cutting and stripping wires. The Solar What?! Power has reverse polarity protection so incorrectly wiring the product will not damage to the circuitry.
- Components on the printed circuit boards which are most likely to experience deterioration from extended use (switches, ports and electrolytic capacitors) have been placed so they are relatively straightforward to remove and replace with a soldering iron. The components are relatively standard and information regarding their replacement can be found in the relevant section of this manual. Repairs with a soldering iron should only be undertaken by people with the technical ability to use a soldering iron and appropriate knowledge of electronic repair.

## Handling Printed Circuit Boards (PCBs)

PCBs are mounted with sensitive electrical components. These can easily be damaged. Follow the advice below to limit the risk to the PCB:

- Before handling a PCB touch a piece of metal for two seconds to discharge any residual static electricity you may have built up.
- Remove any plastic from your work area as this can build up static and discharge it to the PCB.
- Wear anti static gloves, if available, and always hold the PCB by the edges. Avoid touching any components with your hands unless necessary. Ungloved hands can transfer oils and dirt to the PCB which can damage it.
- Avoid putting pressure on the components.

## Disassembly and Long Term Durability

Solar What?! products actively encourage users to replace batteries and engage in the basic repairs outlined in this document. More complex repairs are also possible, for those with the technical ability, through the files available in the GitHub repositories. These can be found at [www.github.com/solarwhat](http://www.github.com/solarwhat).

It is important to note, however, that Solar What?! products should only be disassembled when necessary. Frequent disassembly and assembly may expose components to water and dirt and damage the electronics.

Throughout this document you will see this symbol . It indicates caution is required and particular attention should be paid to the above safety warnings.

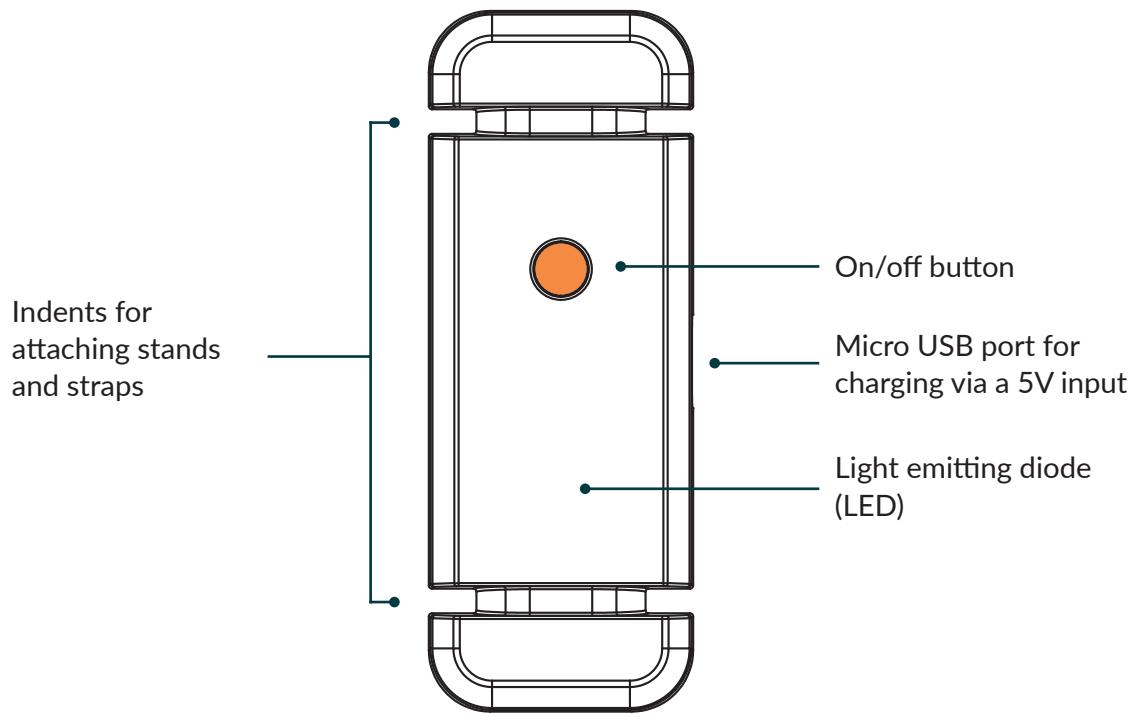


# SOLAR WHAT ?! LIGHT (SW1001)



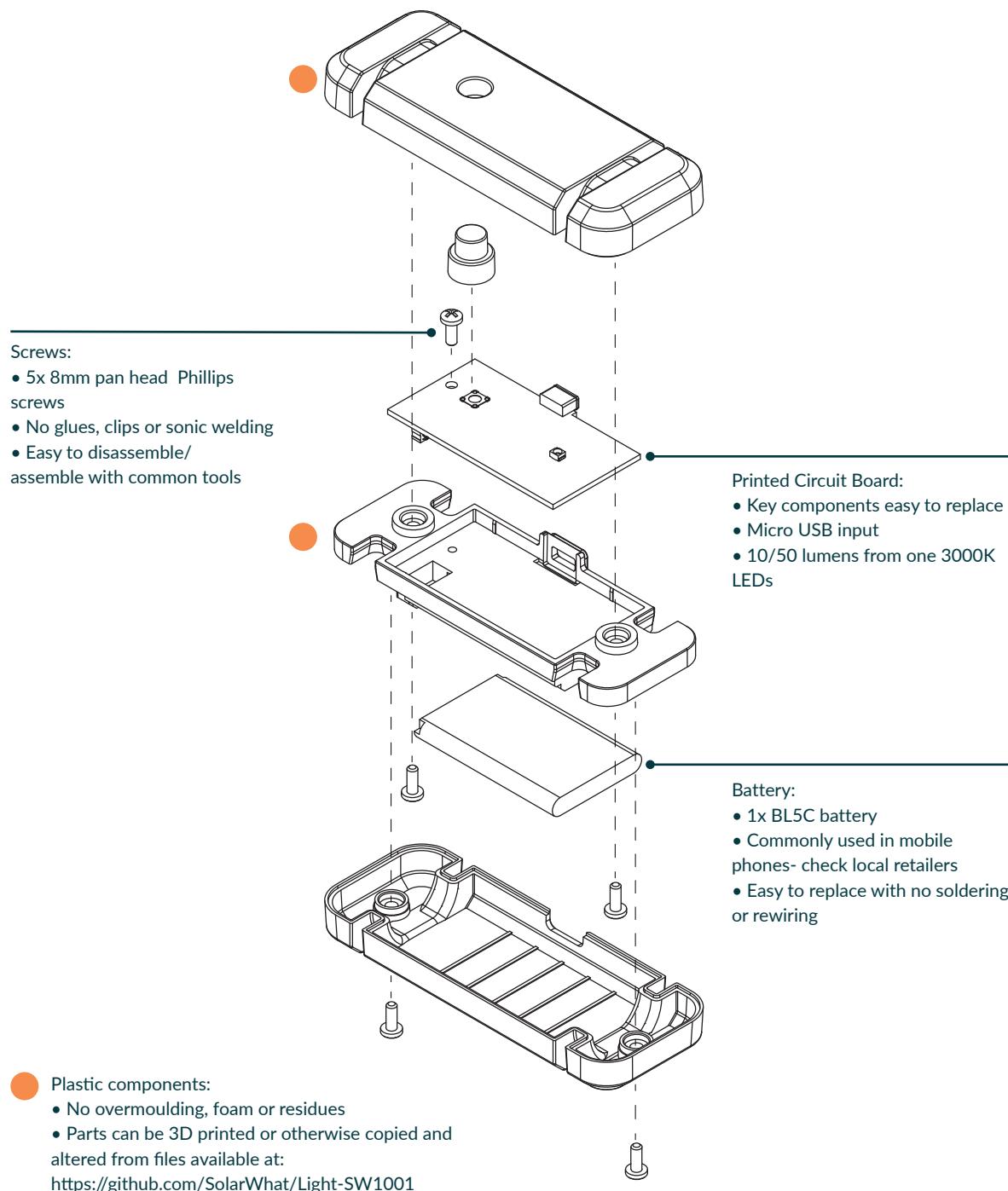
THE UNIVERSITY  
of EDINBURGH

## SOLAR WHAT ?! LIGHT (SW1001) USING THE PRODUCT



# SOLAR WHAT ?! LIGHT (SW1001) COMPONENTS

Solar What?! Light has been designed to maximise the ease of assembly, disassembly and repair. It is simple to separate components out into electrical and plastic parts, repair or replace those which may be faulty, or just change a battery. This section outlines one way to repair this product, but we encourage experimentation and 'hacking' if you know what you are doing and are aware of the risks.



# SOLAR WHAT?! LIGHT (SW100) MAINTENANCE AND REPAIR

This product has been designed to allow easy access to important components when they need replacing or repairing. Nothing lasts forever, but there is no need to throw away a whole product when some simple steps can help to fix a problem.

## 1. INITIAL PERIOD OF USE

A new Solar What?! Light should last for 2-3 years before requiring any sort of basic maintenance or repair. Depending on how frequently it is used, and how it is looked after, this period could vary in length.

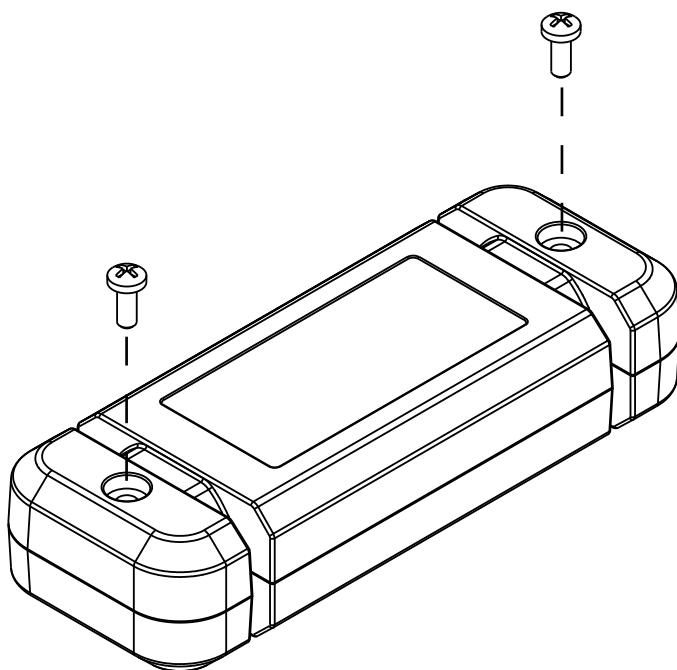
## 2. REPLACING THE BATTERY

*Tools needed:*

1x Philips screwdriver (preferably PH1)

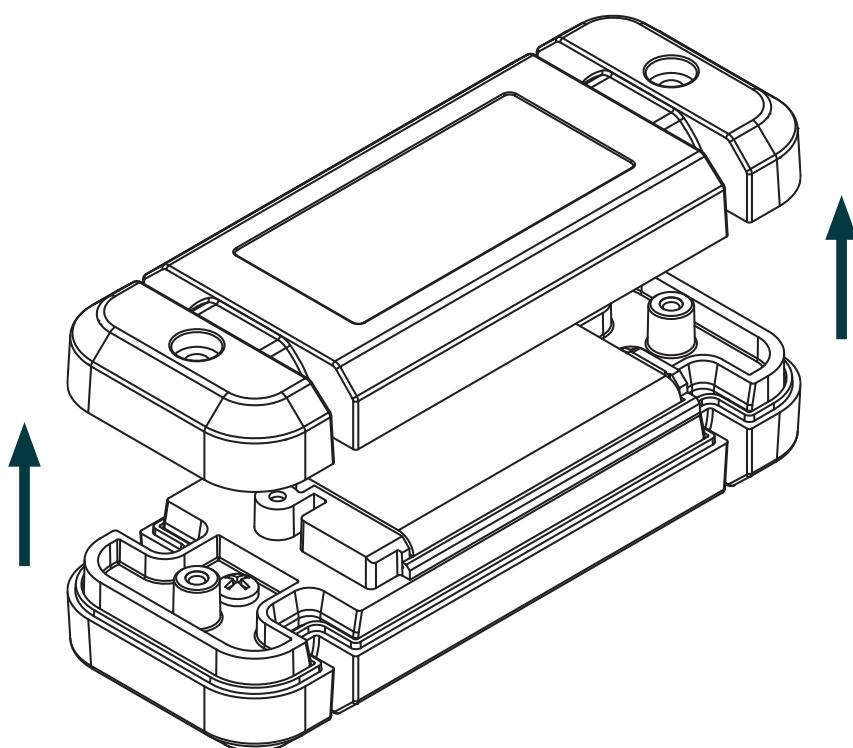
Alternatively, a small flat-head or Pozi-drive screwdriver

1

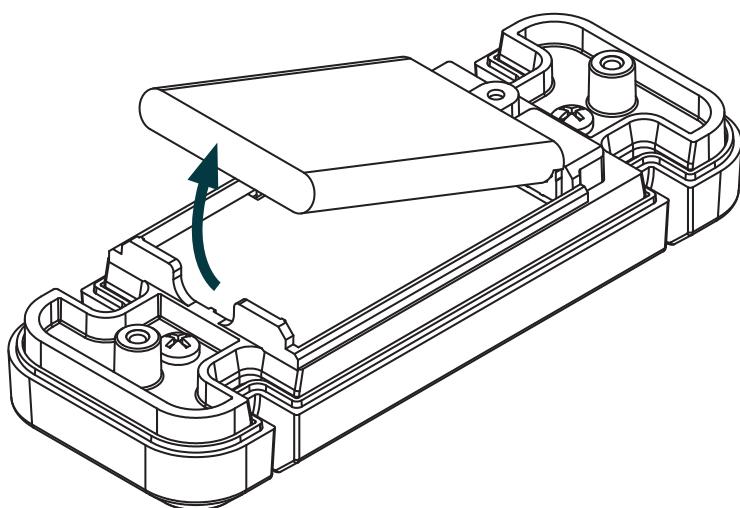


THE UNIVERSITY  
of EDINBURGH

2



3



Replace the battery with a new or newer BL5C, and reverse the steps to reassemble the product. Ensure the battery terminals are lined up with the connector pins on the underside of the PCB.



Make sure you treat the battery with care and follow the guidance given in the Legal and Safety section of this document, on pages 3 and 4.



THE UNIVERSITY  
of EDINBURGH

### 3. REPLACING PCB COMPONENTS

The longer the SW Light is used, the more wear and tear will be experienced by key components on its printed circuit board (PCB). The micro USB connector and the switch are most likely to suffer from repeated use. Instructions for their replacement are detailed below:

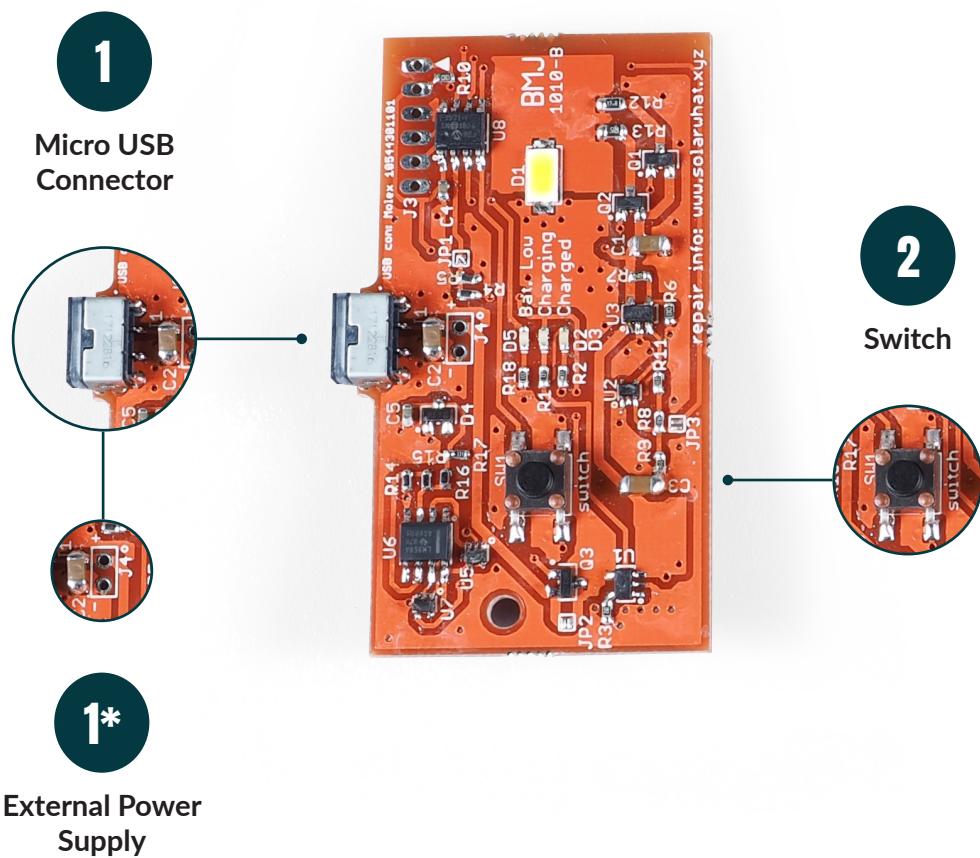
*Tools needed:*

1x Soldering iron

1x Solder wick or solder pump (optional)

The micro USB and switch both have accessible leads and a minimum pitch of 0.65mm. Most commonly available soldering irons will be able to unsolder/resolder these components.

 Take care when using a soldering iron. Follow the guidance given in the Legal and Safety section of this document, on pages 3 and 4.



## 1. Micro USB Connector

A through-hole-technology component. As the PCB is double sided, solder will need to be removed from the leads on both sides of the PCB before it can be removed.

The manufacturer's part number (10544301-1101) is written on the PCB, next to the component. If a direct replacement is not available then most right angle, through-hole-technology, micro USB connectors should be compatible.

This component has a built-in seal for increased ingress protection against water and dust. If this component is not used then the product may be more at risk from damage from water and dust. Refer to the Gerber files on GitHub (<https://github.com/SolarWhat/Light-SW1001>) to assess specific requirements.

### 1\*. External Power Supply

The PCB has two through-holes located behind the micro USB port. If a suitable component is not available to replace the micro USB connector, an external 5V power supply can be soldered in place here. This will charge the battery or power the board directly should a battery be missing or flat.

Look either side of the holes for indicators of polarity.

-  It is important that any power supply connected in this way should be able to be turned off when battery charging is complete or when light is no longer required.

## 2. Switch

This component is a surface mounted, single pole, single throw switch. All four leads will need to be unsoldered before removal.

The manufacturer's part number is FSM4JSMA. However, many other similar SPST surface mounted switches will also work. Refer to the Gerber files on GitHub (<https://github.com/SolarWhat/Light-SW1001>) to assess specific requirements.

-  It is important to note that any repair option which does not use the same components as the originals may compromise the durability and longevity of the product.

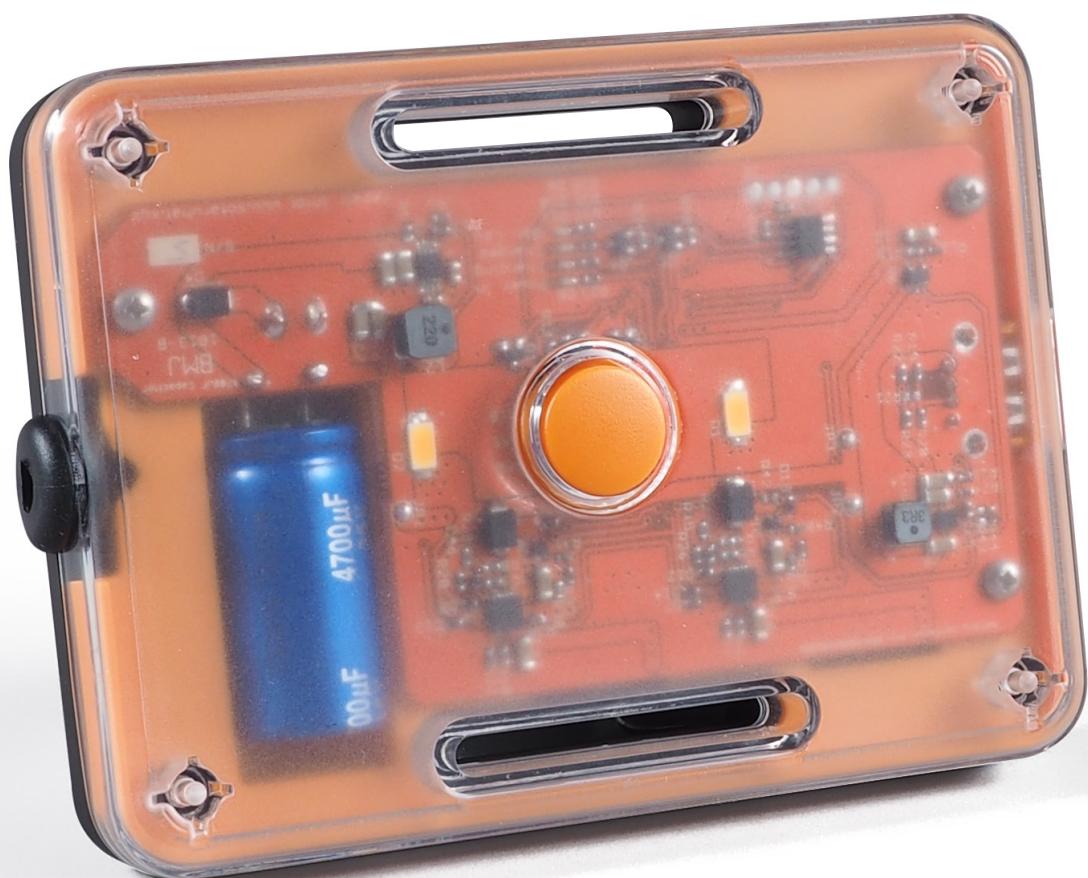
To aid with more complex repairs please download the Bill of Materials, Gerber files and firmware for the board at <https://github.com/SolarWhat/Light-SW1001>.

STL files for the enclosure can also be downloaded here should you wish to reproduce a plastic component or modify the design.



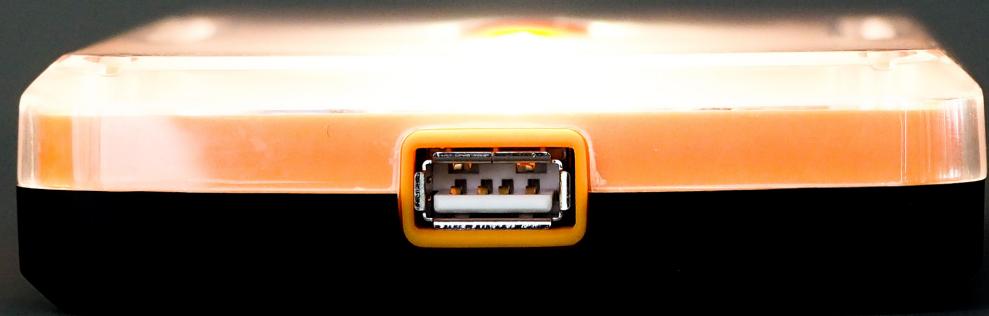
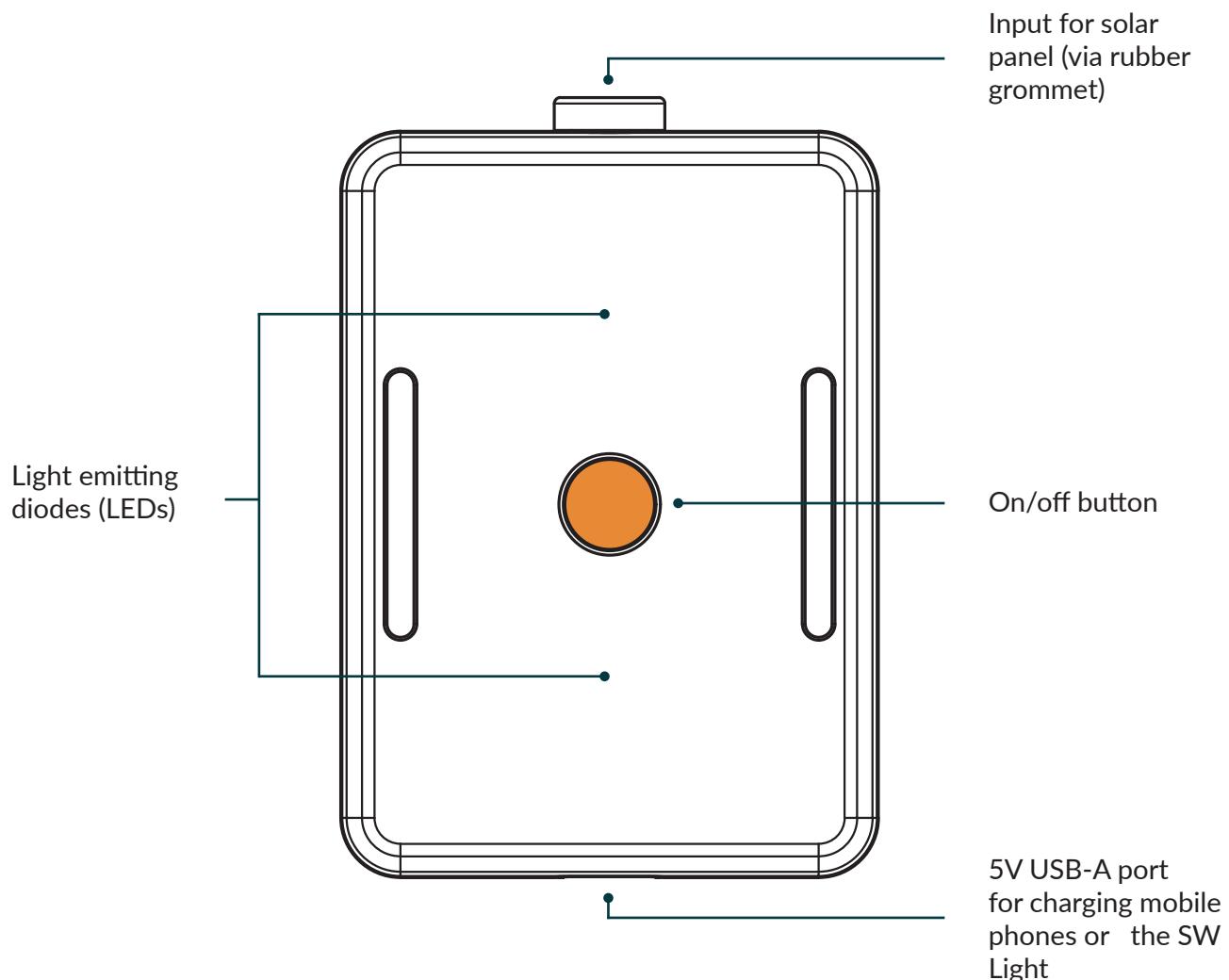
# SOLAR WHAT ?!

## POWER (SW2001)



THE UNIVERSITY  
of EDINBURGH

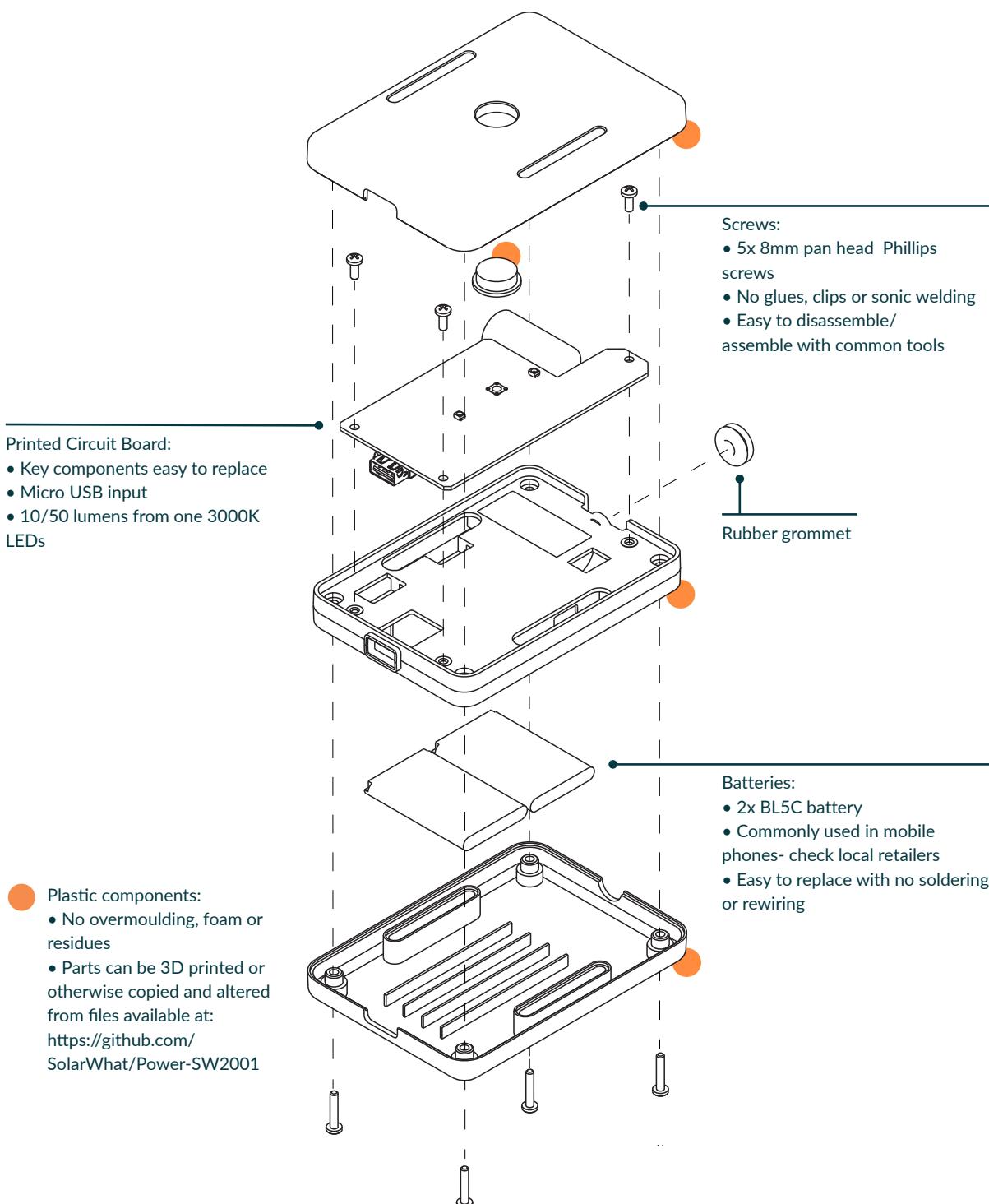
## SOLAR WHAT?! POWER (SW2001) USING THE PRODUCT



# SOLAR WHAT?! POWER (SW2001)

## THE COMPONENTS

Solar What?! Power has been designed to maximise the ease of assembly, disassembly and repair. It is simple to separate components out into electrical and plastic parts, repair or replace those which may be faulty, or just change a battery. This section outlines one way to repair this product, but we encourage experimentation and ‘hacking’ if you know what you are doing and are aware of the risks.



# SOLAR WHAT?! POWER (SW2001) MAINTENANCE AND REPAIR

This product has been designed to allow easy access to important components when they need replacing or repairing. Nothing lasts forever, but there is no need to throwaway a whole product when some simple steps can help to fix a problem.

## 1. INITIAL PERIOD OF USE

A new Solar What?! Power should last for 2-3 years before requiring any sort of basic maintenance or repair. Depending in how frequently it is used, and how it is looked after, this period could vary in length.

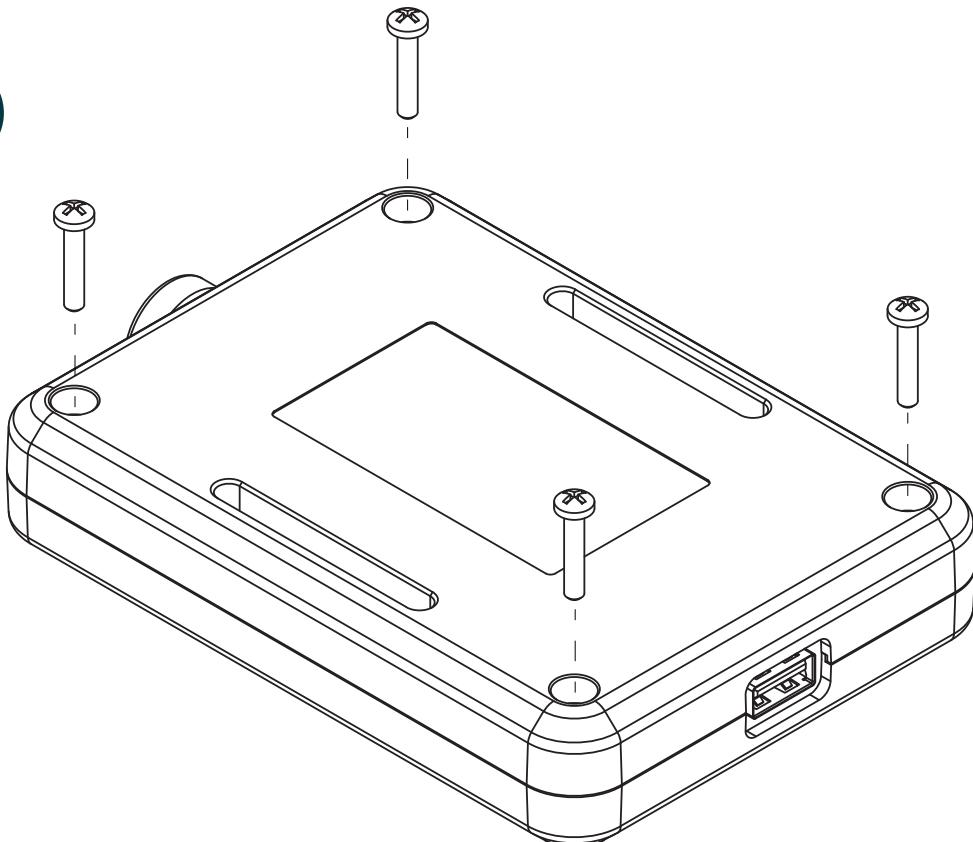
## 2. REPLACING THE BATTERY

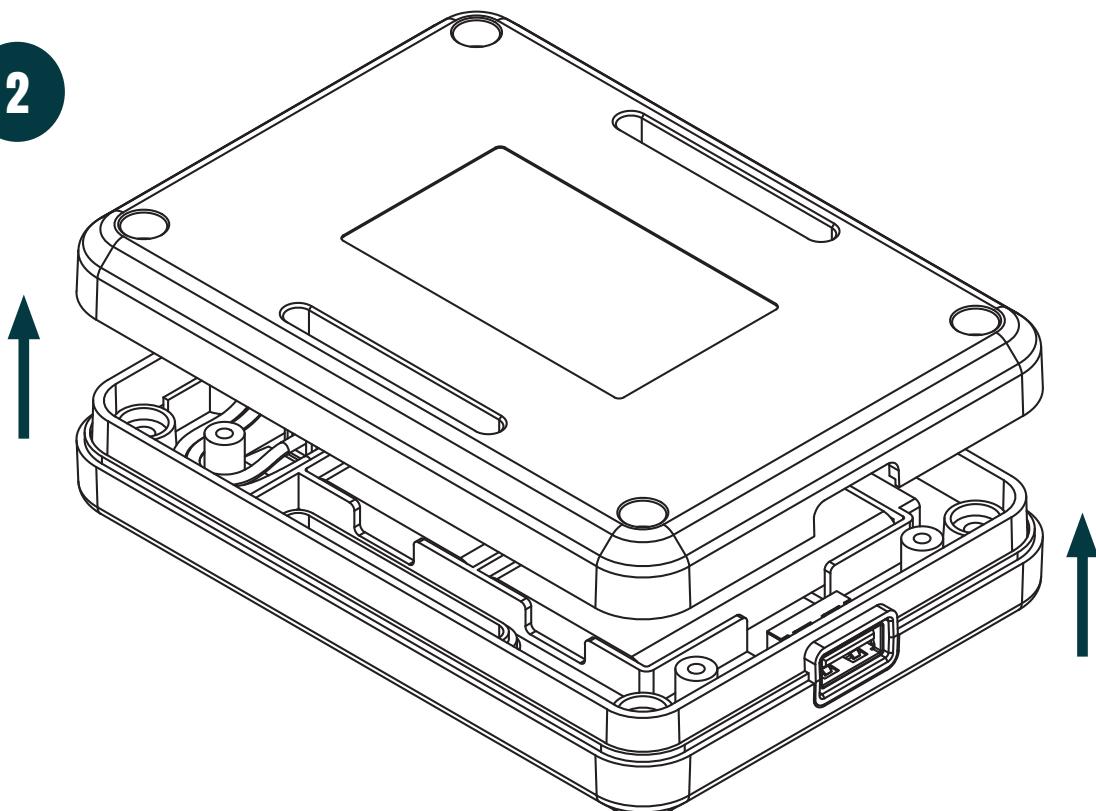
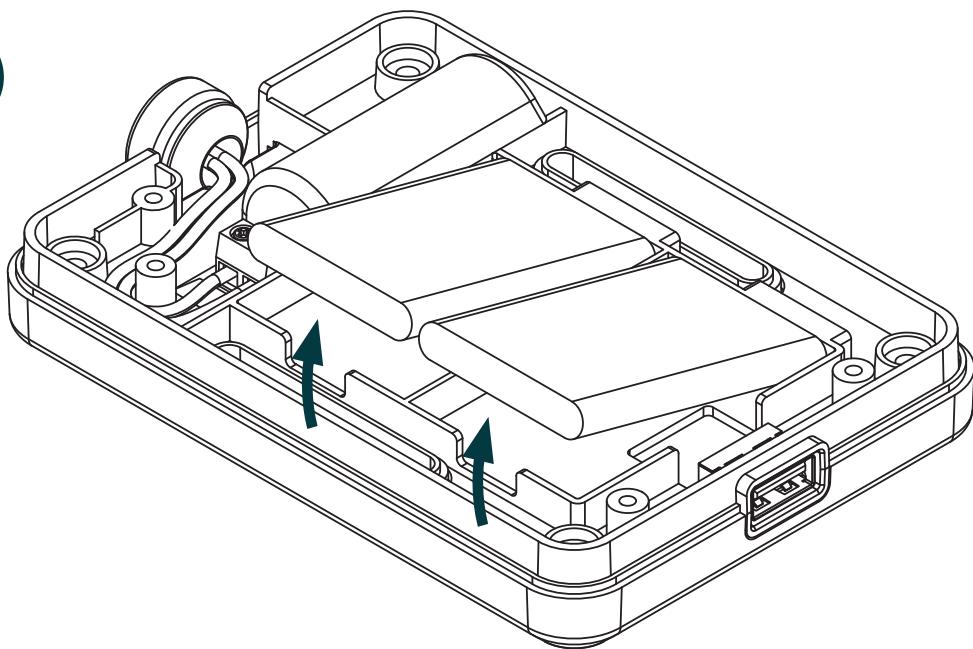
*Tools needed:*

1x Philips screwdriver (preferably PH1)

Alternatively, a small flat-head or Pozi-drive screwdriver

1



**2****3**

Replace the batteries with a new or newer BL5C, and reverse the steps to reassemble the product. Ensure the battery terminals are lined up with the connector pins on the underside of the PCB.



Make sure you treat the battery with care and follow the guidance given in the Legal and Safety section of this document, on pages 3 and 4.



THE UNIVERSITY  
of EDINBURGH

### 3. REPLACING THE SOLAR PANEL

Solar What?! Power is capable of being powered by a range of solar panels between 5V and 24V. It is straight forward to replace a broken panel or add a larger one. Good quality solar panels have lifetimes in excess of 20 years so it is important to use and reuse them so they can generate as much power as possible over their lifespan.

*Tools needed:*

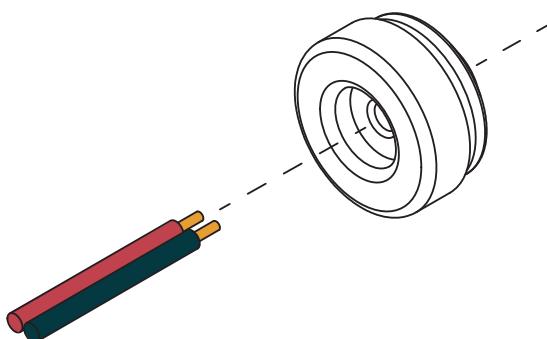
1x Flat head screwdriver (3mm or smaller)

1x Wire stripper or a sharp knife

1x Solar photovoltaic panel (between 5V and 24V with a peak voltage of no more than 30V)

\*It is important to note there will be energy loss when using higher voltage panels. This product does not support maximum power point tracking.

1



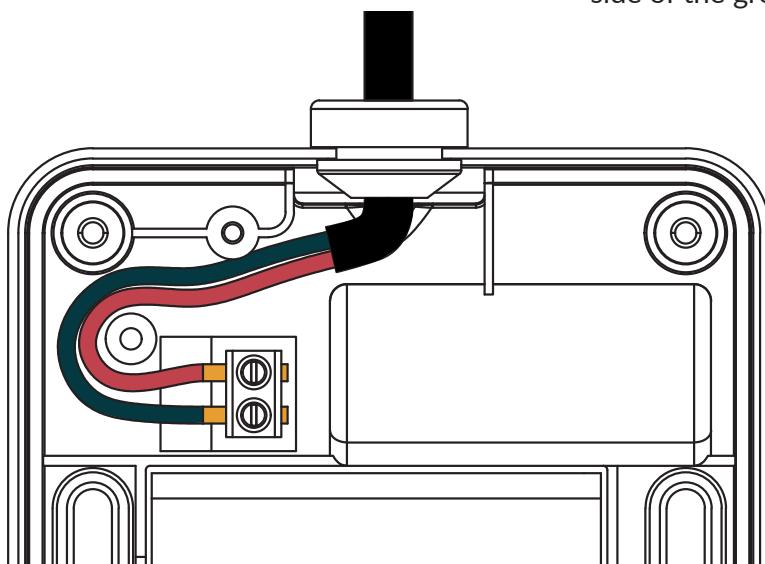
a) If present, cut off the DC jack from the solar panel cable.

b) Remove 45-50mm of the outer cable exposing the live and neutral wires.

c) Strip the ends of the live and neutral wires back to their cores, exposing between 2mm and 3mm of copper.

d) Pass the stripped wires through the grommet as shown. The outer sheath should be present on either side of the grommet.

2



a) Unscrew the terminals and push in the corresponding ends of the stripped wires. Either refer to markings on the board or the diagram above or ensure the correct polarity.

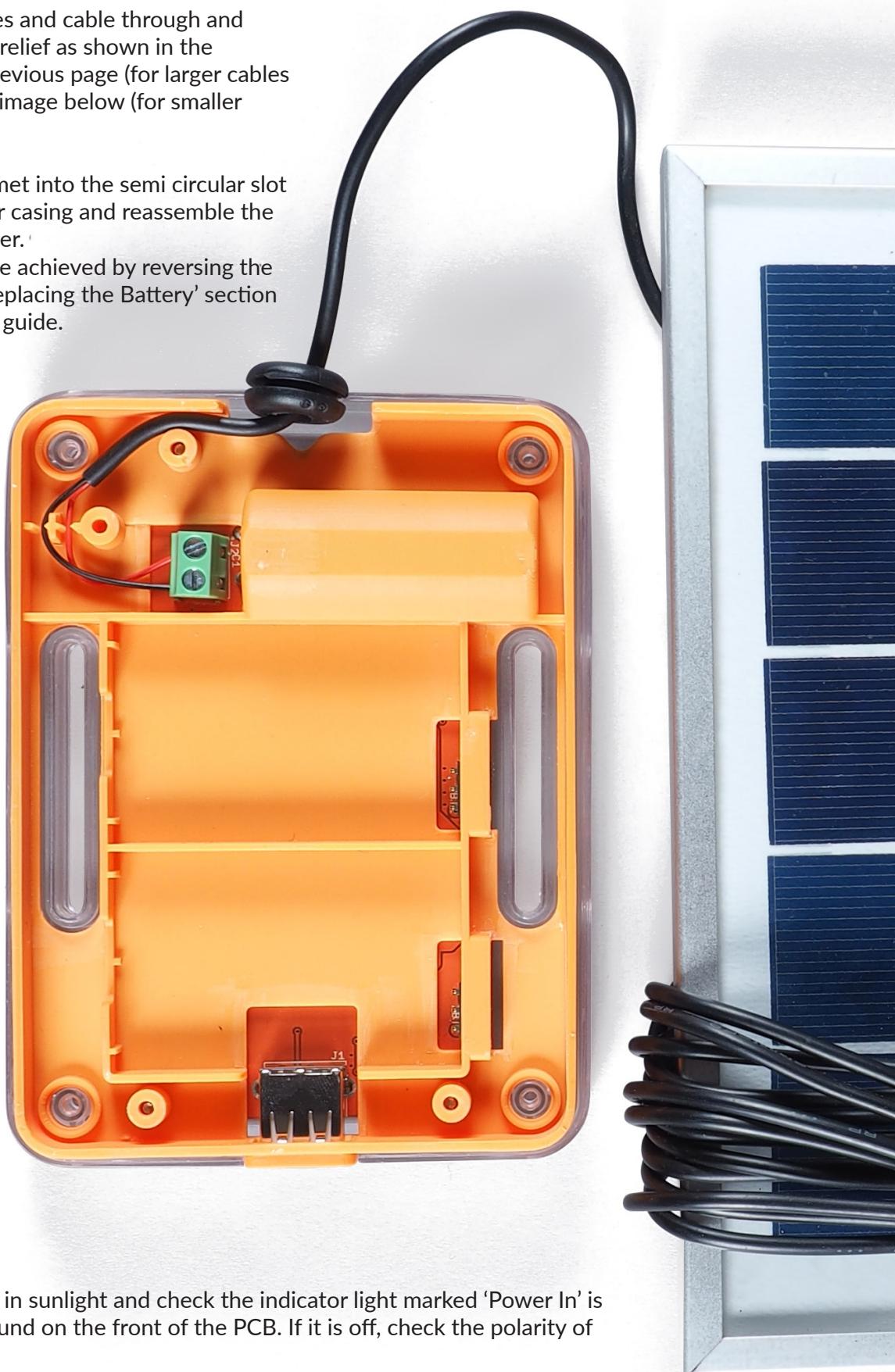


THE UNIVERSITY  
of EDINBURGH

b) Thread the wires and cable through and around the strain relief as shown in the diagram on the previous page (for larger cables diameters) or the image below (for smaller cable diameters).

c) Push the grommet into the semi circular slot on the clear upper casing and reassemble the Solar What?! Power.

Reassembly can be achieved by reversing the steps from the 'Replacing the Battery' section of this part of the guide.



d) Place the panel in sunlight and check the indicator light marked 'Power In' is on. This can be found on the front of the PCB. If it is off, check the polarity of the wiring.



The PCB has reverse polarity protection. It is important, however, that the panel used is not capable of exceeding 30V else the PCB will be damaged.



### 3. REPLACING PCB COMPONENTS

The longer the SW Power is used, the more wear and tear will be experienced by key components on its printed circuit board (PCB). The USB connector, the switch and the electrolytic capacitor are most likely to suffer from repeated use. Instructions for their replacement are detailed below:

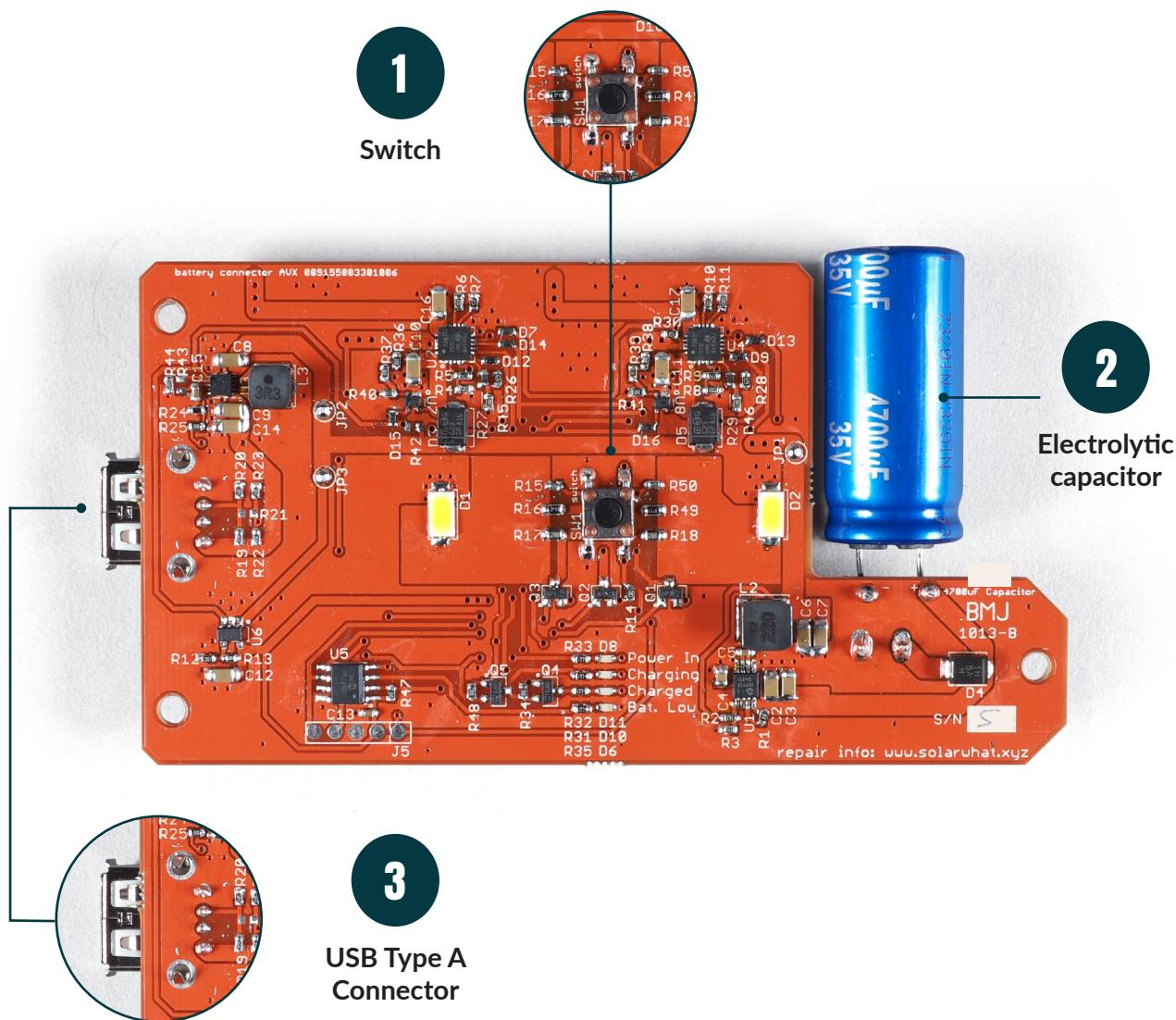
*Tools needed:*

1x Soldering iron

1x Solder wick or solder pump (optional)

 Take care when using a soldering iron. Follow the guidance given in the Legal and Safety section of this document, on pages 3 and 4.

The components addressed below all have accessible leads and a minimum pitch of 0.65mm. Most commonly available soldering irons will be able to unsolder/resolder these components.



## 1. Switch

This component is a surface mounted, single pole, single throw switch. All four leads will need to be unsoldered before removal. The manufacturer's part number is FSM4JSMA. However, many other similar SPST surface mounted switches will also work. Refer to the Gerber files on GitHub (<https://github.com/SolarWhat/Light-SW2001>) to assess specific requirements.

## 2. Electrolytic Capacitor

A through-hole-technology component. Solder has been applied on both sides of the PCB to add strength to the connection. This will all need removing before the electrolytic capacitor can be removed. Solder should be reapplied to both sides when the component is replaced.

Polarity information is provided on the PCB.

The manufacturer's part number is ECA1VAM472X. If a direct replacement is not available then another 4700 $\mu$ F electrolytic capacitor, of a similar size, should be compatible. Refer to the Gerber files on GitHub (<https://github.com/SolarWhat/Light-SW2001>) to assess specific requirements.

## 3. USB Type A Connector

A through-hole-technology component. Solder will need to be removed from the leads on the opposite side of the PCB to the component before it can be removed.

The manufacturer's part number is MC32593. If a direct replacement is not available then most right angle, through-hole-technology, USB Type A, connectors should be compatible. Refer to the Gerber files on GitHub (<https://github.com/SolarWhat/Light-SW2001>) to assess specific requirements.



It is important to note that any repair option which does not use the same components as the originals may compromise the durability and longevity of the product.

To aid with more complex repairs please download the Bill of Materials, Gerber files and firmware for the board at <https://github.com/SolarWhat/Power-SW2001>.

STL files for the enclosure can also be downloaded here should you wish to reproduce a plastic component or modify the design.





THE UNIVERSITY  
of EDINBURGH

[www.solarwhat.xyz](http://www.solarwhat.xyz)