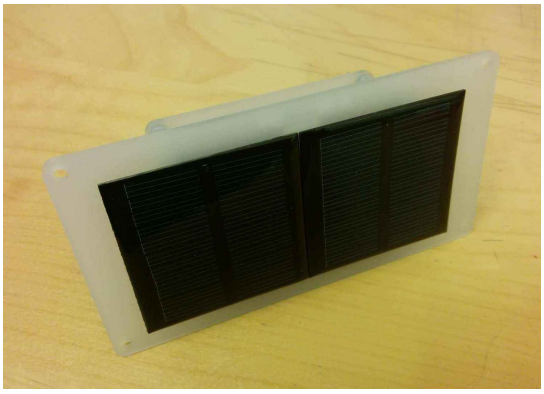
THE CURIOUS ELECTRIC CO.

Solar Charger Kit

Instructions

Date:	15/09/17	Version:	1.0	By:	Matt Little



This is a DIY solar LiIon charger unit.

It is designed to run small electronics projects (such as data-loggers and environmental monitoring units) in places where there is no supply of electricity. I designed it originally to run a small weather station which monitored and wirelessly sent back data to a base station.

It uses the Texas Instruments BQ24210.

This is a 800mA single-input, single cell Lithium Ion battery charger IC. The datasheet is available here:http://www.ti.com/lit/ds/slusa76b/slusa76b.pdf

This IC is pre-soldered, as it is a very small SMD. All the other parts are through-hole and can be soldered by hand.

The kit uses 2 x 1W 5V solar PV cells (connected in parallel).

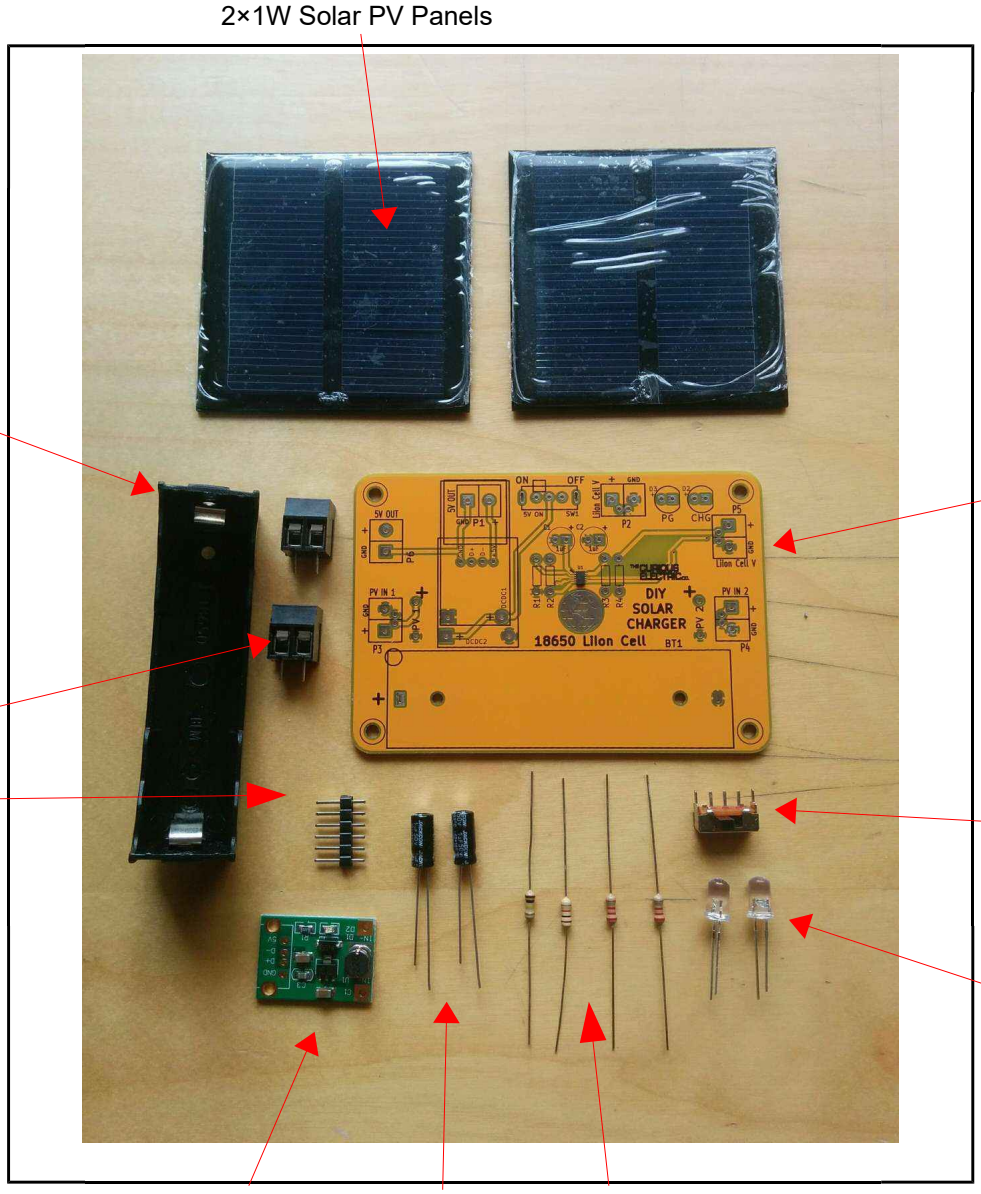
This IC is used to recharge a single 18650 LiIon cell, which are widely available in a range of capacities.

The output can be used directly, as the voltage of the LiIon cell (around 3.7-4.4V DC). This can be used on micro-controller projects, such as data-loggers and weather stations which might need a local source of reliable, off-grid power.

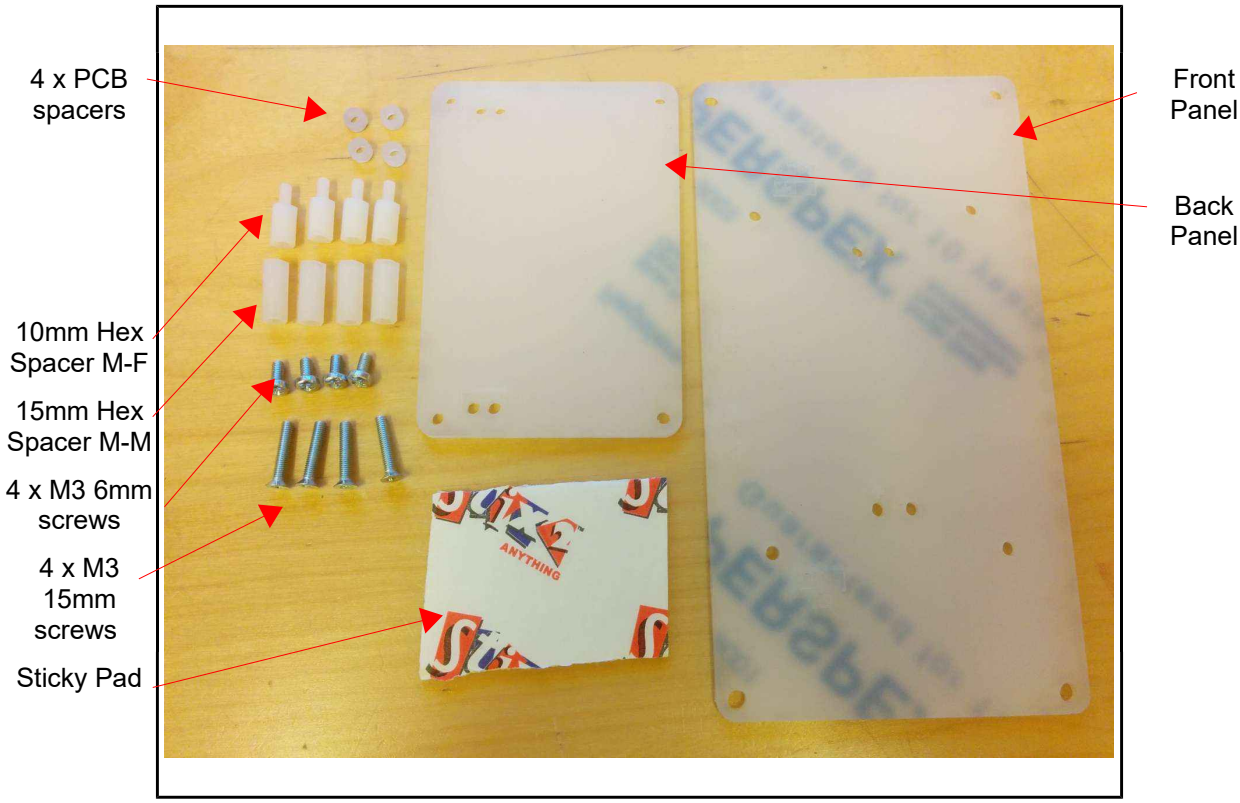
There is also a DC/DC converter unit to provide a 5V output. The 5V output is switched. The 5V output can be used to power USB devices or your microcontroller projects.

This is a reasonably simple kit which requires some soldering.
It should take 1-2 hours to build.
Not suitable for under 12 years old.

Parts included:



Enclosure Parts:



PCB Parts List:

Ref	Item	Quantity	Ref	Item	Quantity
BT1	18650 Cell Holder	1	R1	1k resistor	1
Battery	18650 Cell	*Not included	R2	100k Resistor	1
C1, C2	1uF Capacitor	2	R3, R4	2k2 Resistor	2
D2, D3	LED	2	PV1, PV2	1W 5V PV module	2
DCDC	DC-DC boost converter	1	SW1	Switch	1
P1, P2, P3, P4, P5, P6	2 way Screw Terminal	6	U1	BQ24210	1
PCB1	Circuit Board	1		Single-core cable	piece

**Note: We do NOT supply the 18650 size Lithium Ion cell. This is due to shipping restrictions. These cells are easily available locally. We suggest getting a good-quality cell with a decent capacity (in the region of 5000-6000mAh). This is the cell used for testing, manufactured by UltraFire.*

Hardware Parts List:

Ref	Item	Quantity	Ref	Item	Quantity
	Front Plate	1		M3 15mm countersunk screws	4
	Back Plate	1		M3 8mm pan-head screws	4
	10mm Hex Spacer	4		M3 3mm spacers	4
	15mm Hex Spacer	4		Sticky Pads	2

Tools required:

Soldering Iron

Solder

Side cutters

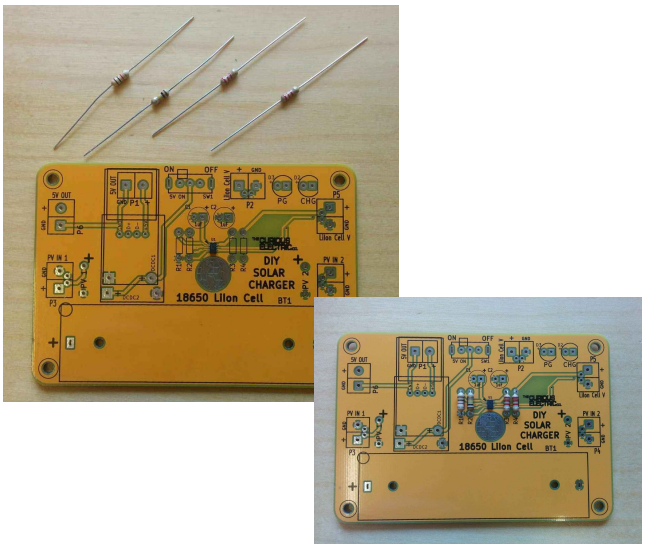
Scissors (not shown)

Long-nosed Pliers

Posi-drive Screwdriver

Instructions:

Step: 1	Solder resistors



Ref	Value	Colour
R1	1k	Brown – Black – Red - Gold
R2	100k	Brown – Black – Yellow - Gold
R3,R4	2k2	Red – Red – Red - Gold

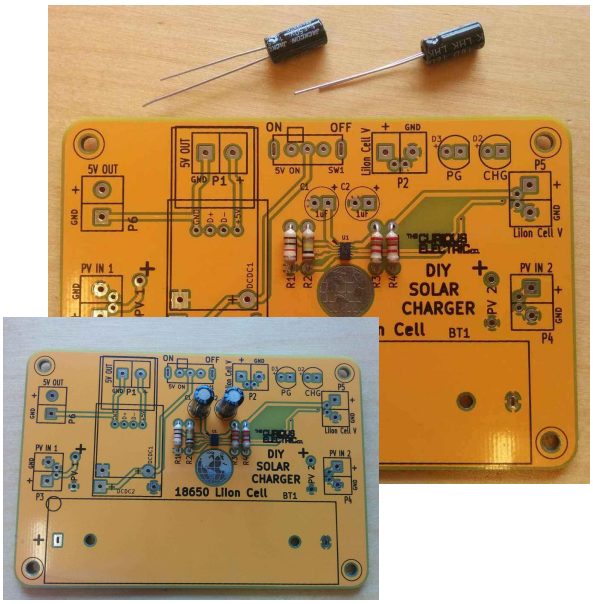
Insert and solder the resistors.
Polarity does not matter for resistors.
Ensure they are soldered flat close to the PCB.

Use a multimeter or colour code chart to ensure correct resistor values.

Step: 2	Solder capacitors

Ensure correct orientation of these components.
The negative lead is marked with a white strip. The positive lead is slightly longer than the negative. Align the positive lead with the + sign and the negative lead with the white PCB marking.

Ref	Value	Marking
C1, C2	1uF	1uF 50V

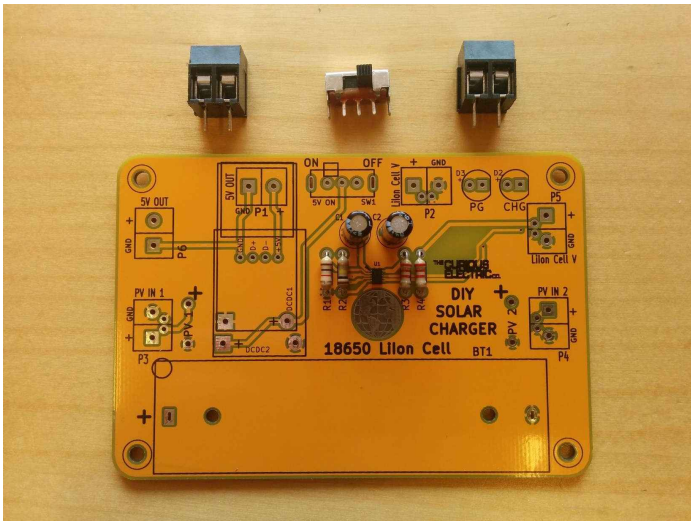


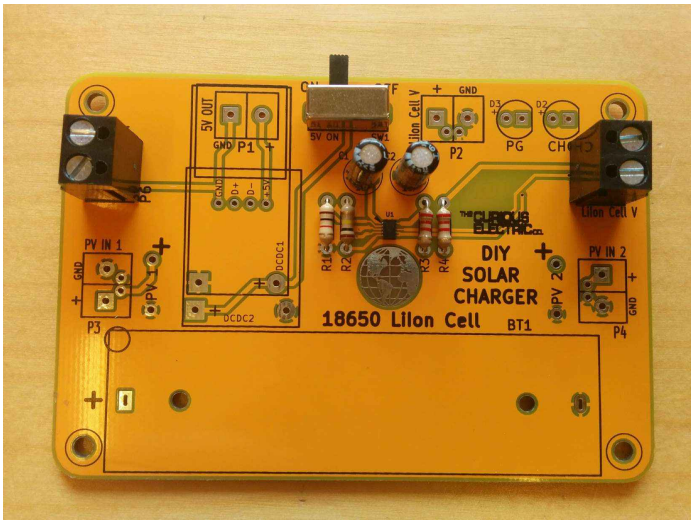
Step: 3	Solder switch and screw terminals

Solder the switch into the position SW1.

The two screw terminals can be soldered on in various positions, depending upon the use you need.

There are 5 positions you can add the screw terminals:





It is suggested that you install them in positions:

P5 – LiIon Cell Voltage output (3.7-4.2V DC)
P6 – 5V DC Output (regulated and switched)

Other options:

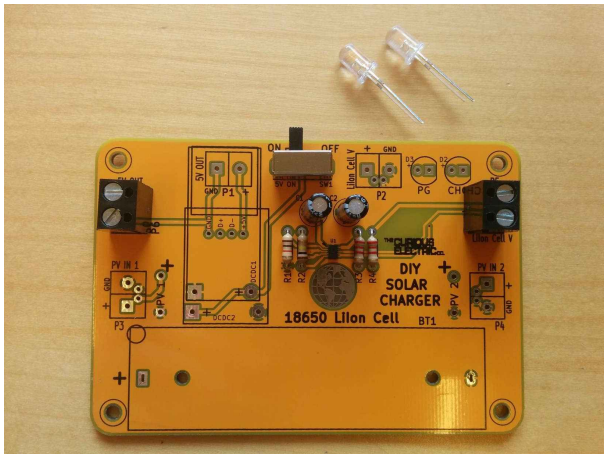
P2 – LiIon Cell Voltage, but in a different position. (3.7-4.2V DC)

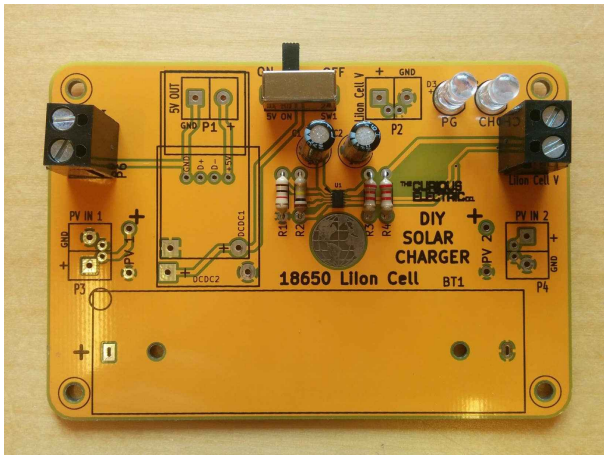
P3 and P4 can be used if you would like to use external solar PV modules. The maximum PV input should be 2W and up to 10V DC.

Step: 4	Solder LEDs

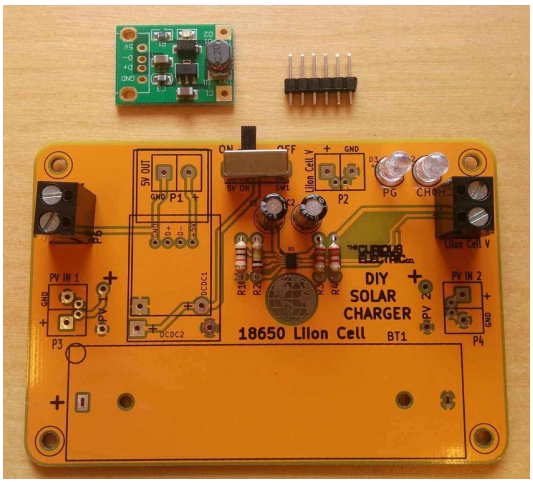
Solder the two LEDs into D1 and D2.
This is a polarised component, so must be soldered in the correct way around.

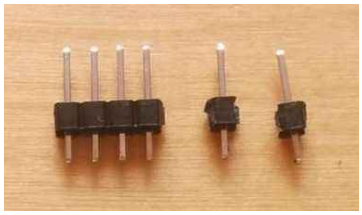
The long lead is positive, so place that into the hole marked +. The negative side is slightly flat.





Step: 5	Solder DC-DC converter (version 1)





If you don't need a 5V supply, then you do not need to add this component – just use the Li Cell output.

Version 1 does NOT have a USB output. You use the 5V via the screw terminals.

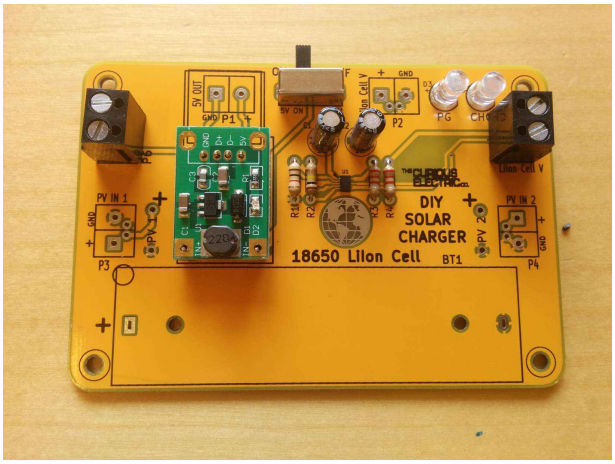
Cut the 6 way header into a 4 way piece and 2×1pins, as shown.

The 4 way header is soldered on the PCB in the 4 holes in a line.

The 1 way pins are soldered to the lower two holes marked "DCDC2", as shown.

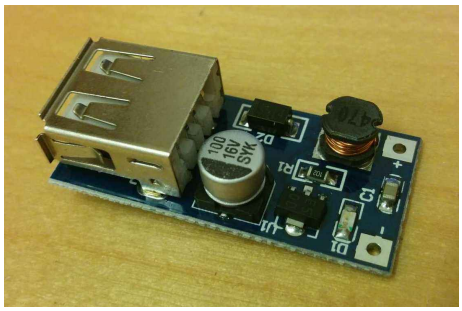
Double check this by aligning the DC-DC converter over the pins.

Solder the pins to the PCB.



Then fit the DC-DC converter and solder this from the top of the board.

Step: 5	Solder DC-DC converter (version 2)



Version 2 is for a USB output socket.

Cut two pins from the 6 way header. These are soldered onto the PCB in the slightly higher up, marked “DCDC1”.

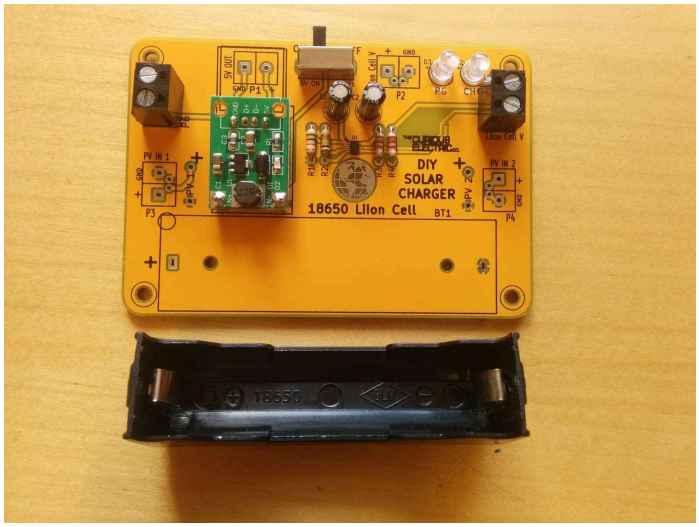
Use a small square of the double sided sticky pad to hold the PCB in place.

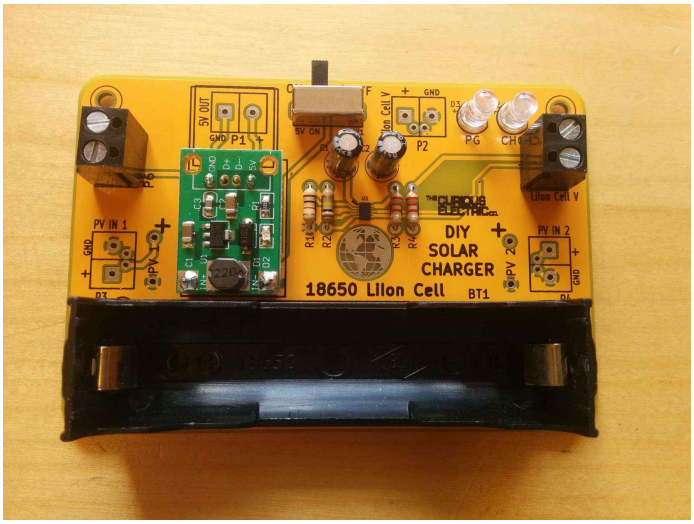
Solder the DC DC converter from the top.

This version will NOT use the 5V output screw terminals – you get the power from the USB socket.

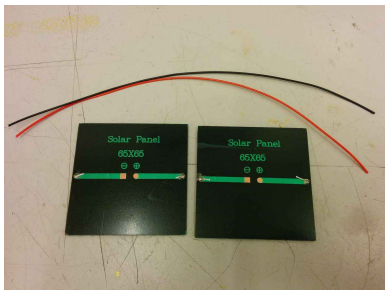
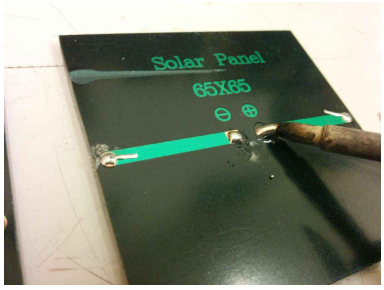
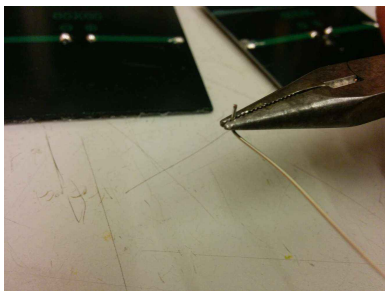
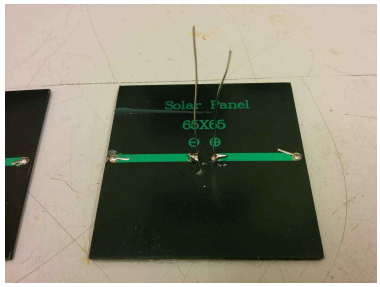
Step: 6	Solder Li Ion cell holder

Double check that the + marking on the battery holder aligns with the + marked on the PCB.

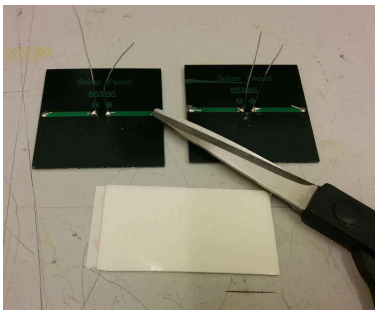


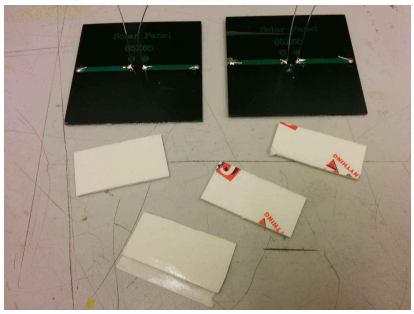
Step: 7	PCB is finished!
	The IC is a surface mount device and almost impossible to solder by hand, hence we have already soldered this component for you.

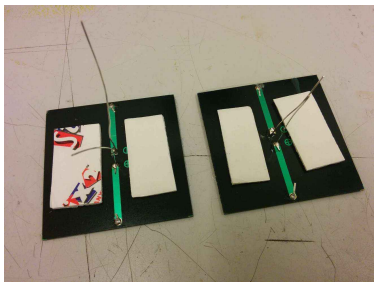
Enclosure Instructions:

Step: 8	Cut and solder solar panel connections
Strip the insulation off the wire. Add a blob of solder to the two inner PV module connections. Cut the wire into 4 equal pieces. Bend about 5mm of the ends of wire to make ‘feet’. Solder these cables to the + and – connections on the solar PV modules. Ensure these stick up vertically.	   

Step: 9	Cut sticky pads to hold solar panels







Cut the large sticky pad into 4 strips.

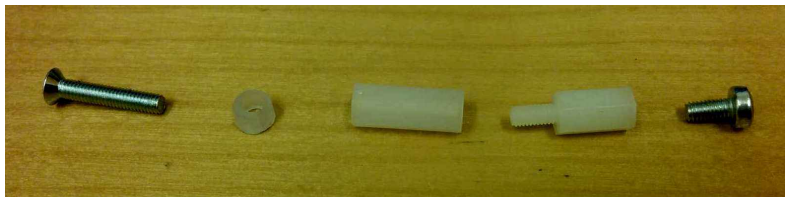
Peel off one side and stick to each side of the solar panel, as shown.

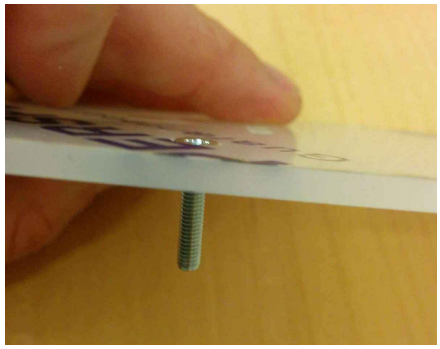
Step: 10	Add PCB to front enclosure

Before we finish the solar panels, we need to add the PCB to the front panel.

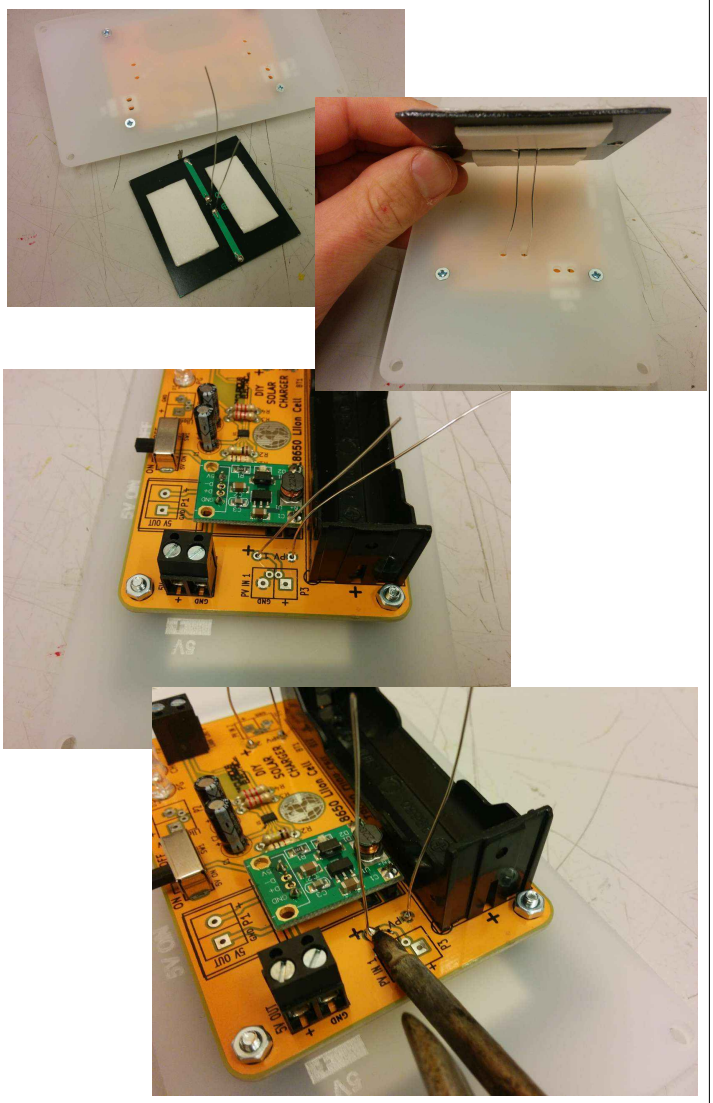
First remove the backing cover on all the laser-cut plastic pieces.

The PCB is held in place





Step: 11	Fit solar panels and solder to PCB



The fitting of the solar panels is a bit fiddly.

We want the wires you soldered to the panels to go through he plastic front piece and through the PCB holes.

Ensure the correct orientation – you want the solar panel + to g through and align with the +ve on the PCB.

Take the covering off the sticky pads before you push the wires through.

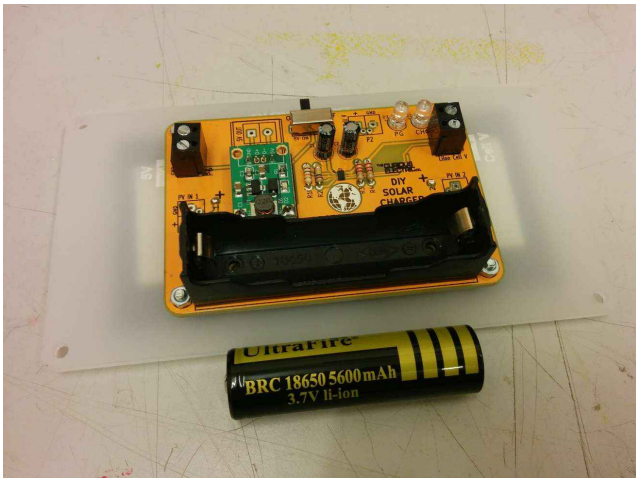
Push the wires through and ensure the panel is square to the plastic front piece.
The push hard to stick down the panel.

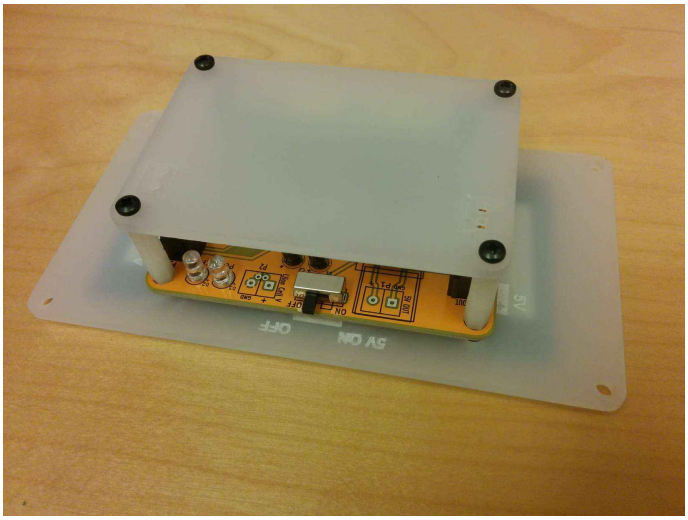
Do this for both panels – they should be aligned next to each other.

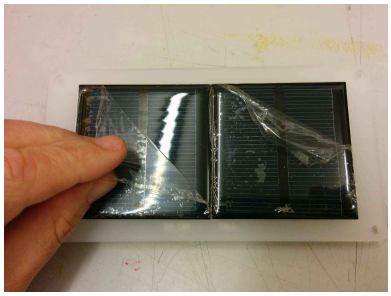
Flip the unit over and solder the solar PV panels from the top of the PCB.

Step: 12	Add Li-Ion Cell

Double check the orientation of the Li Ion cell – the +ve of the cell should align with the + ve on the holder and on the PCB.



Step: 13	Add cover plate
	Use the 4 x M3 6mm screws to hold the back panel in place. These screw into the plastic hex spacers.

Step: 16	Build is finished!
 	Remove the protective plastic covering from the solar panels. The unit can either be stood on its side or hung from the various holes on the front cover. Have a nice cup of tea. 

Testing

Initially the unit may not switch on to give a 5V output - this is because the battery may be totally discharged.
To start put the switch in the OFF position.
Place the unit in the sun for a while. The red LEDs D1 and D2 should light after a while. This may take 5-10mins in weak sunlight.

PG LED shows that there is enough sunlight to power the IC.
CHG LED shows that the Li Ion cell is charging.

The unit will take around 14 hours of strong sunlight to fully charge the battery. This would be around 4 days in the summer and around 14 days (!) in winter to fully charge the

battery from empty.

You can either use the power direct from the Li Ion cell, in which case this will be a variable voltage between around 3.7V to 4.2V, or you can use the switched supply with is 5V regulated output.

If you are using the 5V output then please ensure you switch off the unit when you have finished using it, as the DC-DC converter LED will drain the battery.

This unit is designed as a building block for your projects. It has many uses - from powering data-logging systems to emergency recharging of mobile devices.

Note: *The weather and available sunlight is variable, so there are no definite rules about recharging times.*
If outside on an average UK summers day the batteries will be fully charged in around 3-4 days.
If outside on an average UK winters day then the batteries will be fully charged in 10-15 days.
If used behind a window, the glass will affect the available sunlight and increase the recharge times by a factor of around 50%.

Contact details:

This kit has been designed and produced by:

The Curious Electric Company
hello@curiouselectric.co.uk
www.curiouselectric.co.uk
Hopkinson, 21 Station Street, Nottingham, NG2 3AJ

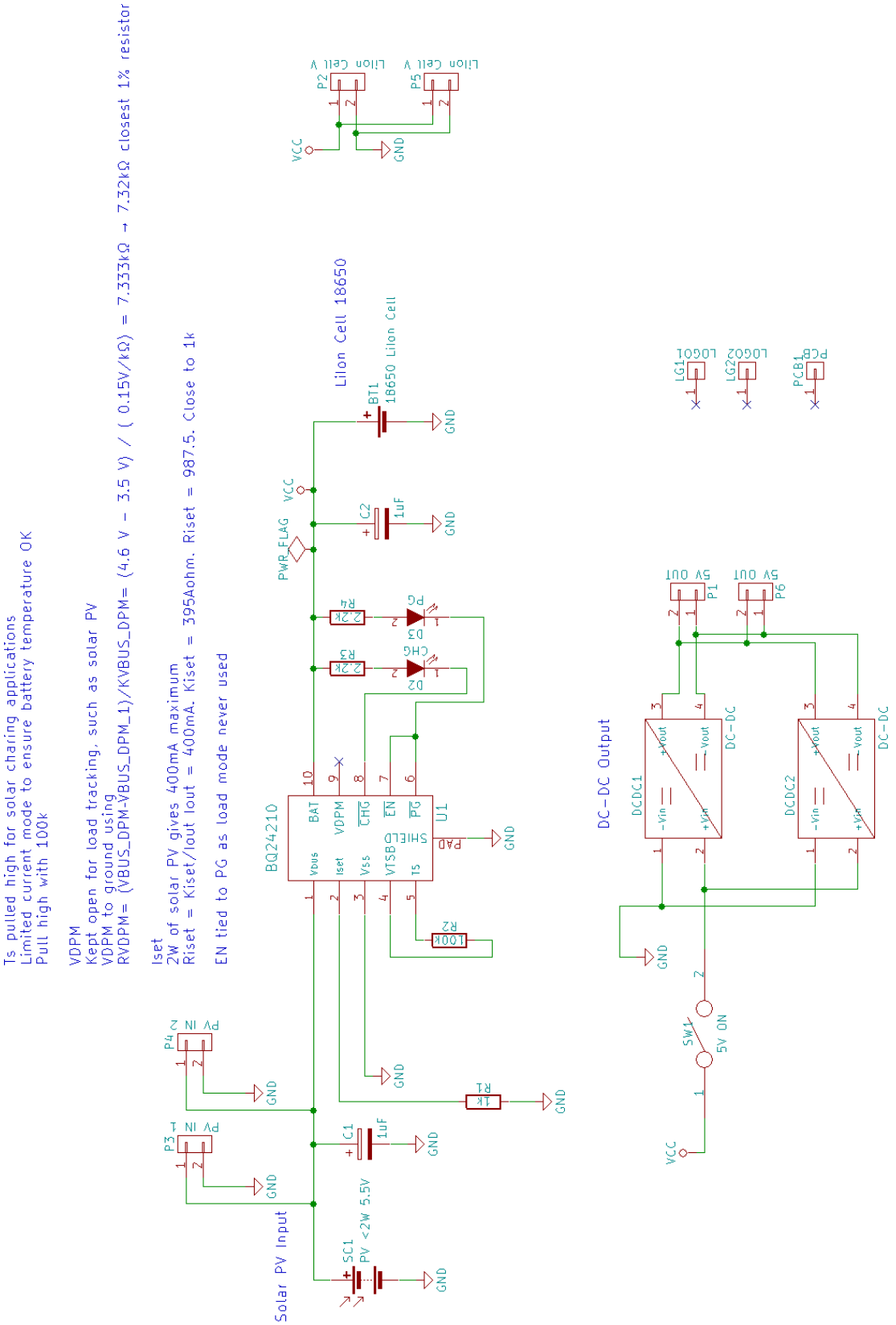
We would like you to be happy with this kit. If you are not happy for any reason then please contact us and we will help to sort it out.

Please email **hello@curiouselectric.co.uk** with any questions or comments.
Please tweet us at **@curiouselectric**

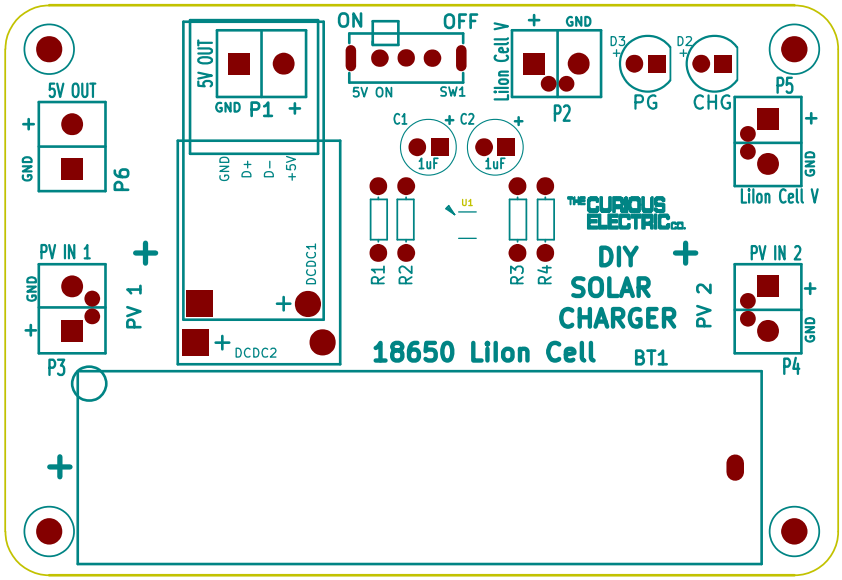
If any parts are missing from your kit then please email **hello@curiouselectric.co.uk** with details, including where the kit was purchased.

More technical information can be found via **www.curiouselectric.co.uk**

Circuit Schematic:



PCB:


5V OUT
GND
P6
PV IN 1
GND
PV 1
P3
5V OUT
GND P1
GND
D+
D-
+5V
DCDC1
DCDC2
ON
OFF
5V ON
SW1
Lilon Cell V
+
GND
P2
C1
1uF
C2
1uF
R1
R2
R3
R4
U1
D3
PG
D2
CHG
P5
Lilon Cell V
GND
THE CURIOUS ELECTRIC CO.
DIY
SOLAR
CHARGER
18650 Lilon Cell
BT1
PV IN 2
PV 2
GND
P4

Resistor Colour Codes: