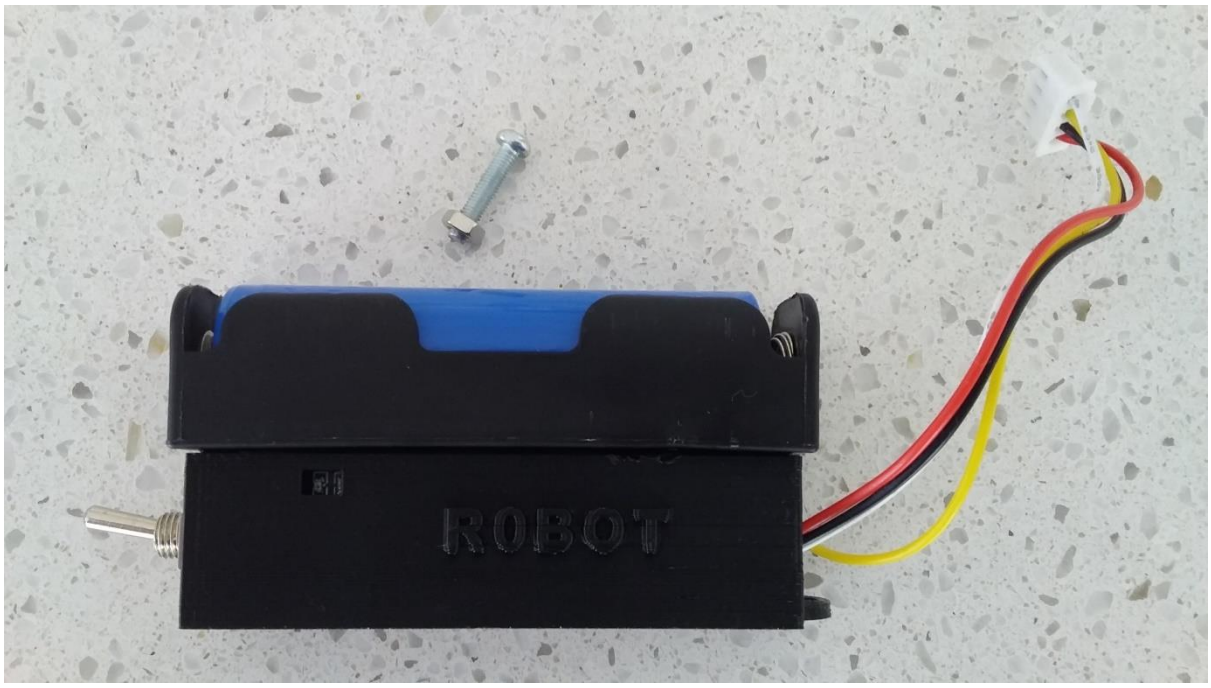
Li-Ion-Battery Pack

This document describes the steps required to make the 18650 Li Ion battery pack.



Warning: Build this power pack at your own risk. The author assumes no liability for fire or other damage resulting from the construction and use of this power pack.

In addition to the parts listed here you need a good quality 18650 Li Ion battery.

Li Ion Battery Pack Circuit

The Li Ion battery pack provides two separate power supplies: Vin for the Arduino and other electronics and servo, and Vmotor for the drive motors.

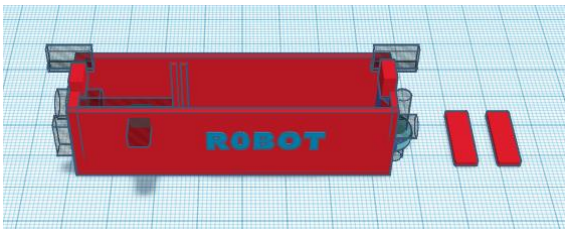
The battery pack consists of a battery protection circuit, a charging module (TP4056), a DC-DC step up converter (MT3608) and a filter circuit (inductor and capacitor).

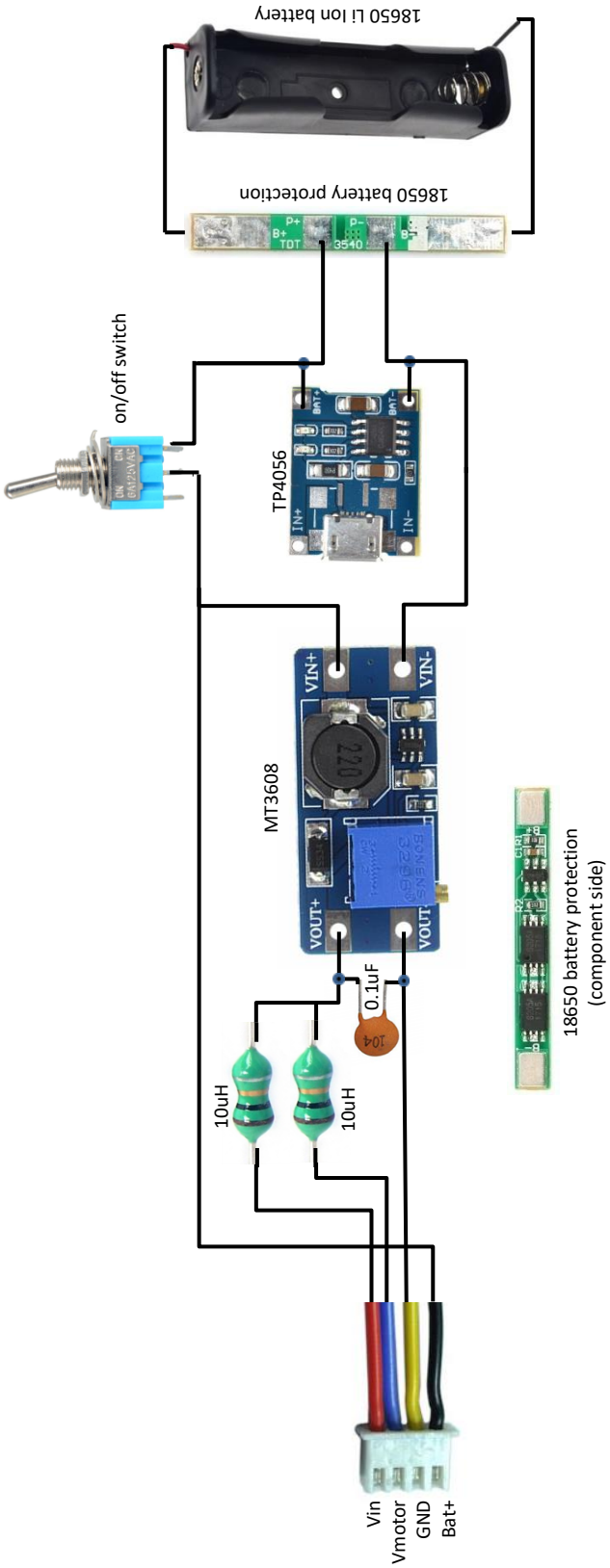
The protection circuit protects the Li Ion battery from overvoltage during charging, under voltage during discharge and limits the max current from the battery to 4 Amps.

The MT3608 ten turn potentiometer is adjusted for a VOUT+ of 7.2 Volts.

Note, there is a 0.1uF ceramic capacitor soldered between VOUT+ and VOUT- and there is a 10uH inductor in series with VOUT+ and connected to Vin and Vmotor outputs. The inductor is to reduce noise from the Vmotor supply interfering with Vin to the Arduino.

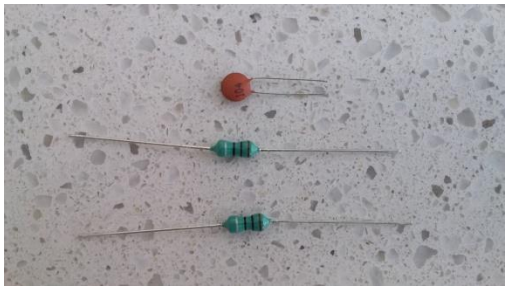
The battery pack container is available on TinkerCAD (search in “3D designs” for “balrobot” in the TinkerCAD gallery).

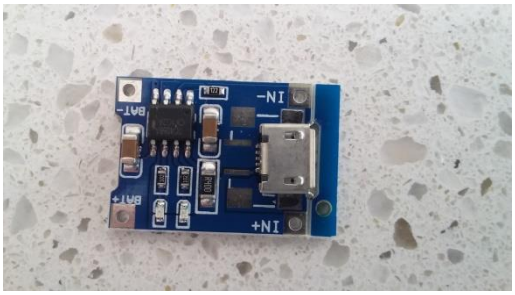




Parts Required for Power Pack

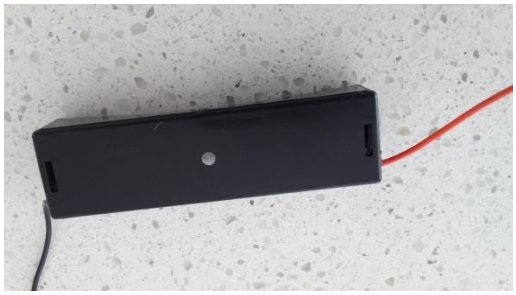
Note: the links to suppliers are provided to give more information about the part or is a supplier I have used in the past – however I do not endorse or otherwise recommend the supplier - the parts are widely available from many suppliers.

	3D printed container (PLA filament) and rectangular fixing piece - the pieces are available in TinkerCAD : https://www.tinkercad.com/ search in “3D designs” for “balrobot” in the tinkerCAD gallery.
	1 x 0.1uF ceramic capacitor 2 x 10uH inductors https://www.aliexpress.com/item/0401-50pcs-lot-DIP-1-2W-Color-loop-inductance-10uh/32805165131.html?spm=a2g0s.9042311.0.0.27424c4d9M4nto
	On/Off SPDT toggle switch https://www.aliexpress.com/item/10pcs-Lot-Mini-Toggle-Switches-MTS-102-3-Pin-SPDT-ON-ON-AC-125V-6A-New/32808175225.html?spm=a2g0s.9042311.0.0.27424c4dAtoQf3

	TP4056 Li Ion battery charging module https://www.aliexpress.com/item/Free-Shipping-10pcs-lot-TP4056-1A-charging-board-charger-module-lithium-battery-DIY-Mini-USB-Port/1687423359.html?spm=a2g0s.9042311.0.0.594b4c4dNkfG61
	MT3608 step-up power module https://www.aliexpress.com/item/10pcs-lot-MT3608-2A-Max-DC-DC-Step-Up-Power-Module-Booster-Power-Module-For-Arduino/32366162385.html?spm=a2g0s.9042311.0.0.27424c4dHnr6wM
	Li Ion Battery 4 Amp protection module https://www.aliexpress.com/item/10-pcs-1S-3-7V-4A-li-ion-BMS-PCM-18650-Battery-Protection-Board-PCB-for/32825371822.html?spm=a2g0s.9042311.0.0.594b4c4dNkfG61

Wide slot battery holer

Narrow slot battery holder



18650 Li Ion battery holder - order one with the wires connected and mounting slots in the rear of the holder, e.g.

https://www.aliexpress.com/item/5pcs-lot-New-Power-Bank-18650-Battery-Holder-Plastic-Battery-Holder-Storage-Box-Case-for-1x/32813026986.html?spm=a2g0s.9042311.0.0.594b4c4dNkfG61

Note, there are several different styles of 18650 battery holders available. They have different size slots at the rear of the holder and the wires exiting on different sides etc.

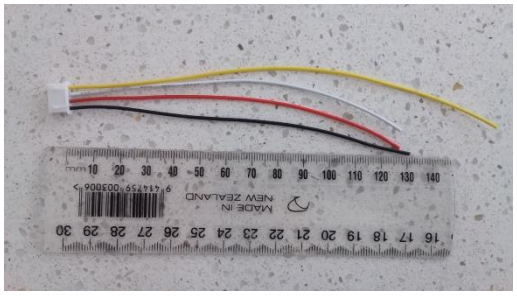
Even if the supplier shows a particular style in their photo it is possible you will get a different style.

I have two versions of the container, one for a wide slot in the rear of the battery holder, and one for a narrow slot in the rear of the battery holder.

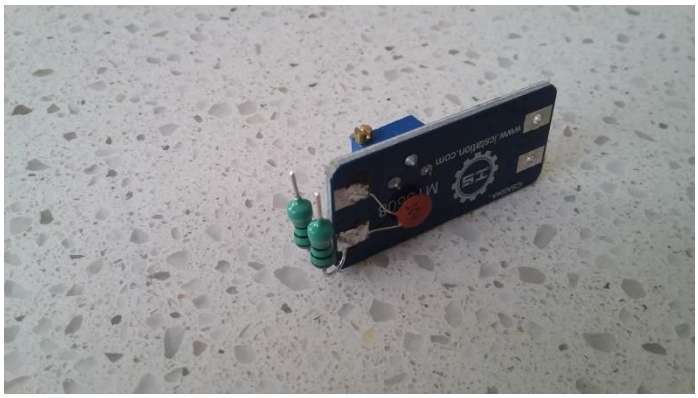
Note the narrow slot battery holder also has the red wire existing on the other side of the holder, and so you need to drill of hold on the other side and more the wire through this hole (see photo).

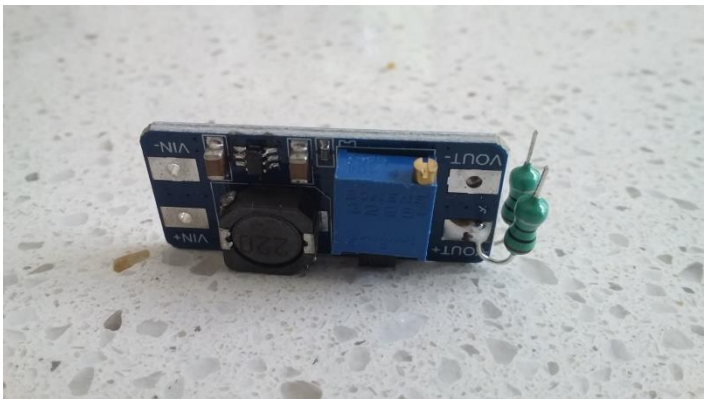
When you search for “balrobot” in tinkerCAD you will see the wide and narrow slot battery pack container.

Since you have the tinkerCAD design you can always modify the container design if the battery holder you have is different from the ones shown here.

	3 x lengths of hook-up wire - lengths and wire stripped at the locations shown in the photo.
	4Pin JST XH 2.54mm plug and connecting wire cut to the length shown in the photo. https://www.aliexpress.com/item/100pcs-lot-26AWG-JST-XH2-54-2-3-4-5-6-7-8-9-10-Pin/32874612769.html?spm=a2g0s.9042311.0.0.27424c4dWooXsZ
	2 x lengths of 2.5mm diameter heat shrink tubing - length cut as shown in the photo.

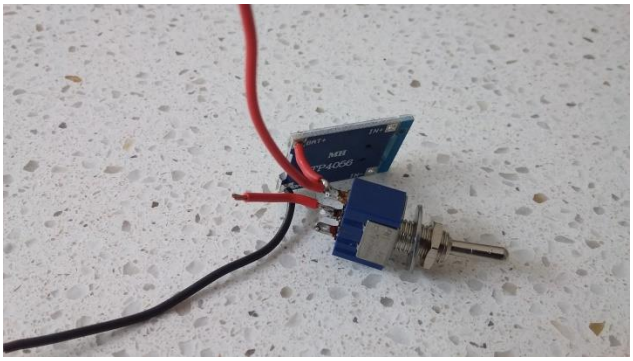
Make Steps

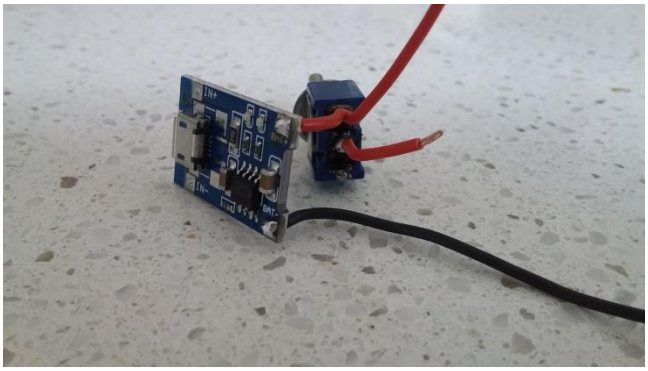


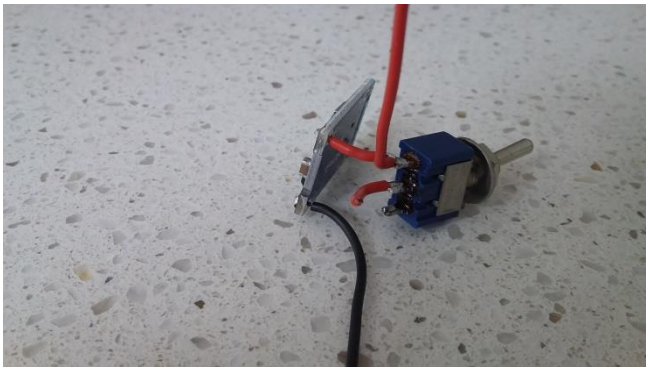


Step (1)

Solder the 0.1uF ceramic capacitor and 2 x 10uH inductors onto the VOUT+ and VOUT- terminals of the MT3608 step-up module as shown in the photos – it may be help to also refer to the circuit diagram.



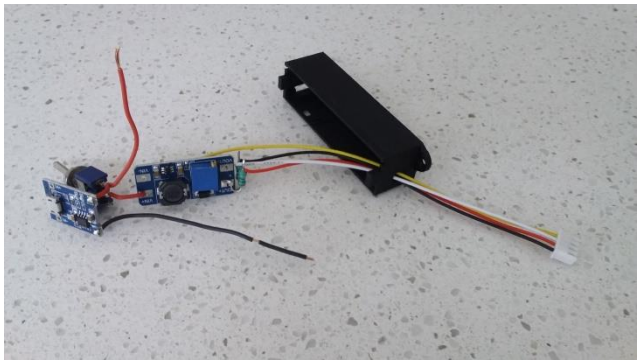


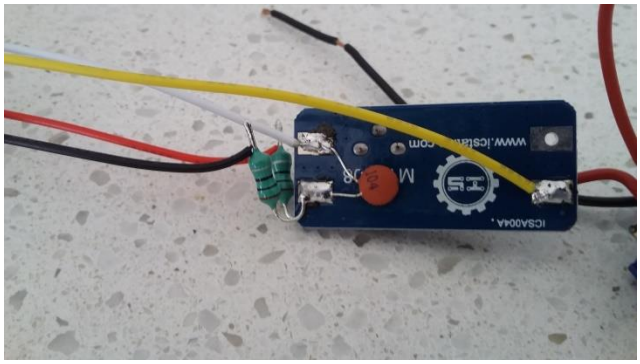


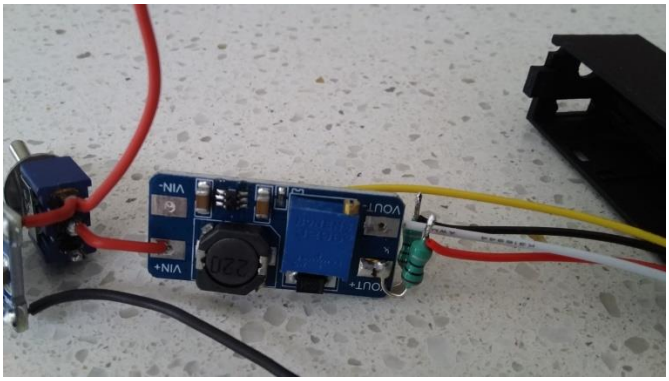
Step (2)

Cut and strip the 3 lengths of hook-up as listed in the parts section.

Solder the lengths of hook-up to the TP4056 charging module and toggle switch as shown in the photos.







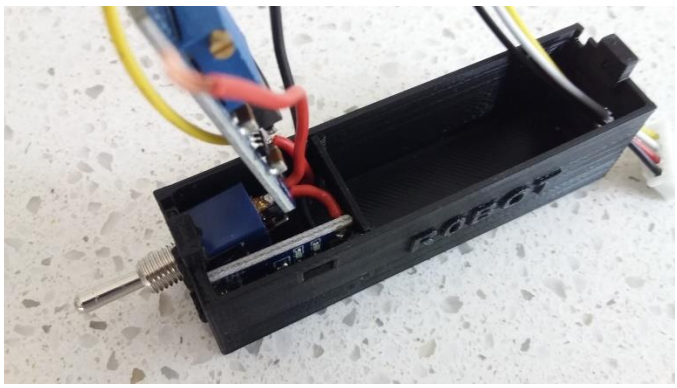
Step (3)

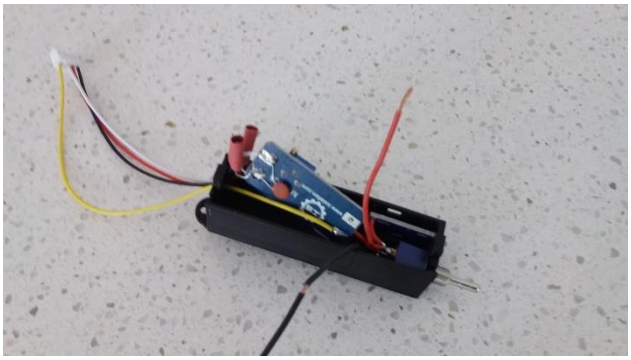
Solder the JST XH plug and leads to the MT3608 module you prepared earlier.

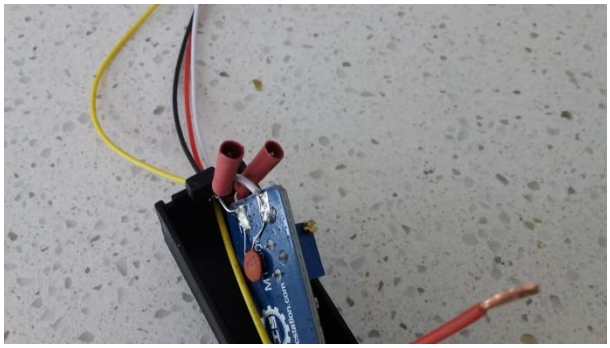
Make sure you insert the XH plug leads through the battery container hole first.

Be careful with the colours on the JST XH plug. Different suppliers use different colour wires and some reverse the colours. So, carefully look at the circuit diagram and make sure you solder the wires to the correct places.

Solder the hook-up wire from the toggle switch to the VIN terminal on the MT3608 module.







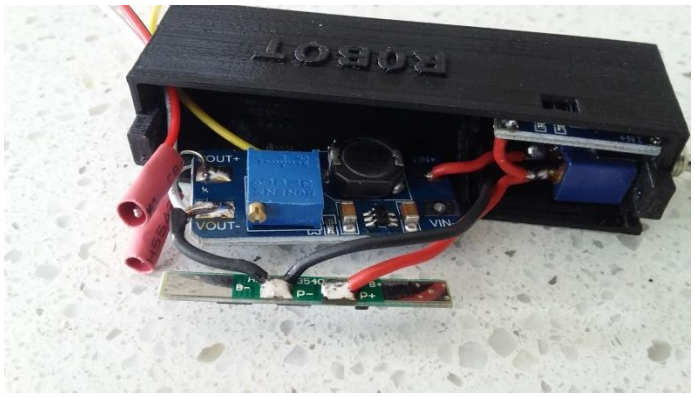
Step (4)

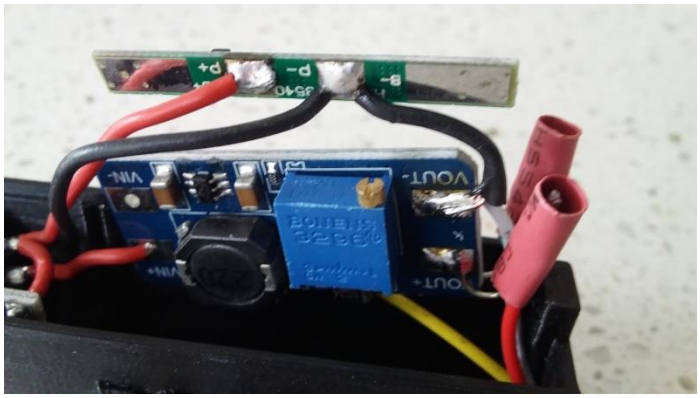
Insert the TP4056 and switch into the battery container as shown.

Slide the rectangle fixing piece into the slots on the sides of the container and push to the bottom of the container. This holds the TP4056 in place.

Once the rectangular fixing piece is in place push the MT3608 into the container so it is approx half sticking out, as shown.

Slide the two heat shrink sleeves over the bare connections to the inductors.

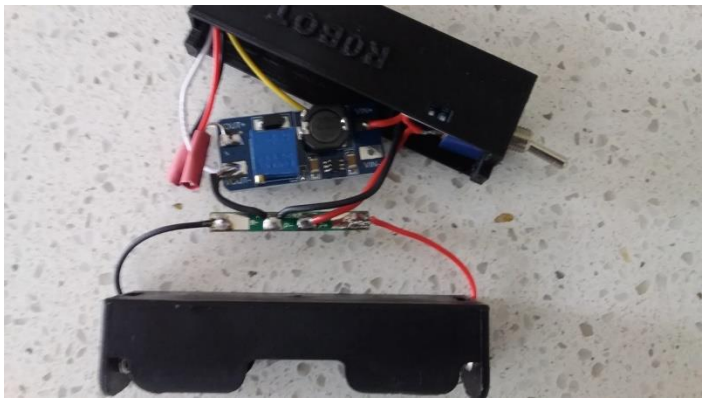


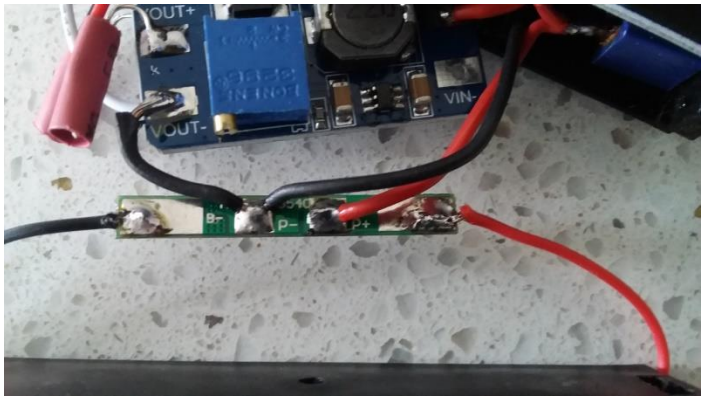


Step (5)

Solder the protection circuit to the 2 lengths of hook-up wire that is not connected yet.

Note that the end of the black hook-up connects to the VOUT- terminal of the MT3608

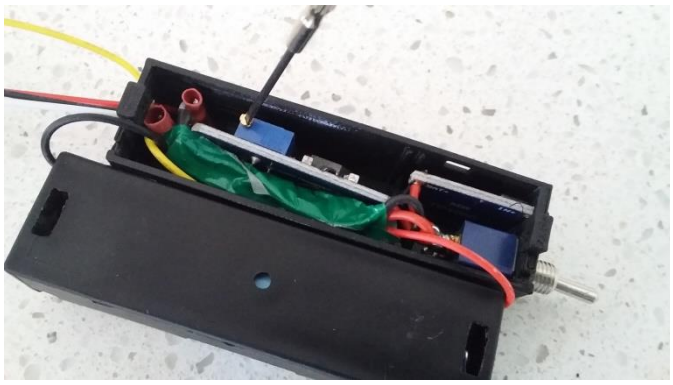


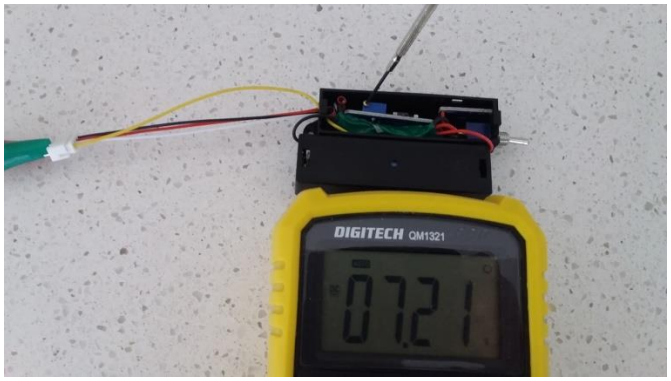


Step (6)

Solder the 18650 battery holder to the protection module terminals.

Wrap the entire protection module in electrical insulation tape and push the protection module and MT3608 fully into the battery pack container.





Step (7)

Insert a 18650 Li Ion battery into the holder, switch on the toggle switch. Check there is nothing getting hot or smoking – switch off immediately if thereis an check you wiring - Li Ion battery packs need to be handled with care.

Put a voltmeter between ground and either Vin or Vmotor.

Adjust the 10 turn pot to a voltage of 7.2 Volts.

Once the voltage has been adjusted correctly, push the battery pack container and battery holder together.

Screw on the holding nut and washer for the toggle switch (note you need to bend up the tag on the washer).

It is important to handle Li Ion power pack with care, including:

- Charge the battery before the LED on the robot shield turns RED.
- Do not remove the battery from its holder because this may damage the battery.
- Do not physically damage the battery.
- Do not expose to water (e.g. do not use the robot outside when wet)
- Do not expose the battery to heat. If the battery is hot, turn off the robot and take it outside.
- Do not use the Li Ion battery if it has not been charged for more than 6 months.
- Charge the battery pack while you remain in the same room.