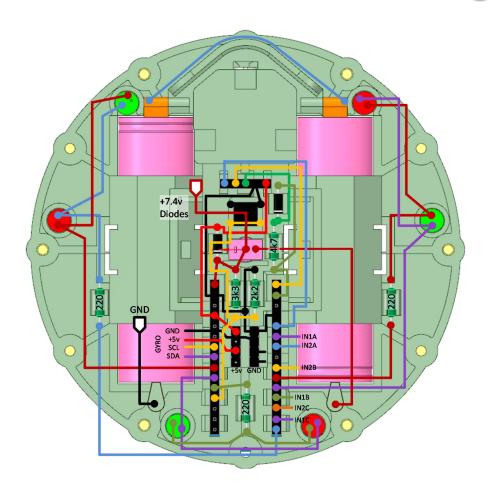
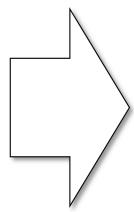
Ball Balancing Robot

Circuits









Released: 23/06/2019

TechKnowTone

Hand Tools:

Fine Nosed Pliers
Side Cutters
M3 Tap
M4 Tap
2.5 mm Drill
3.0 mm Drill
3.5mm Drill
6.0 mm Drill
Needle Files
M3 Box Spanner
Screwdriver
Craft Knife

Note: Not all items are shown here.





Hand Tools:

Temperature controlled iron
Heat shrink sleeving gun
Hot melt glue gun
Solder flux
Resin cored solder
6mm adhesive copper tape
Screw drivers
Wire wrapping tool
Wire wrapping wire 30 AWG











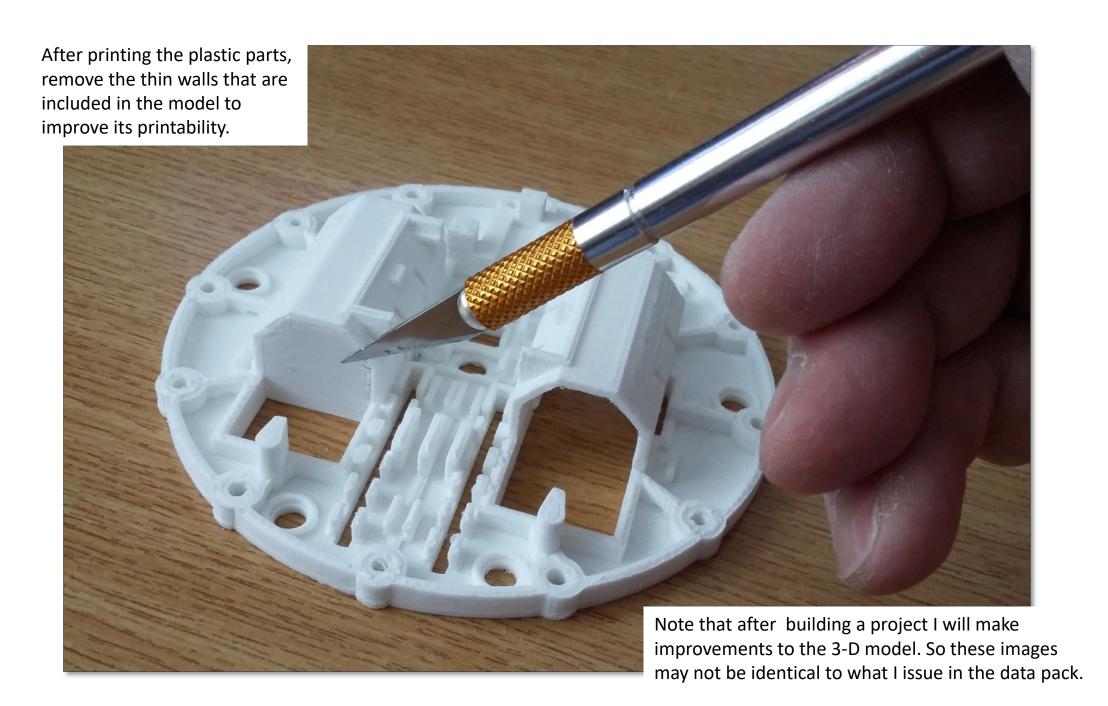




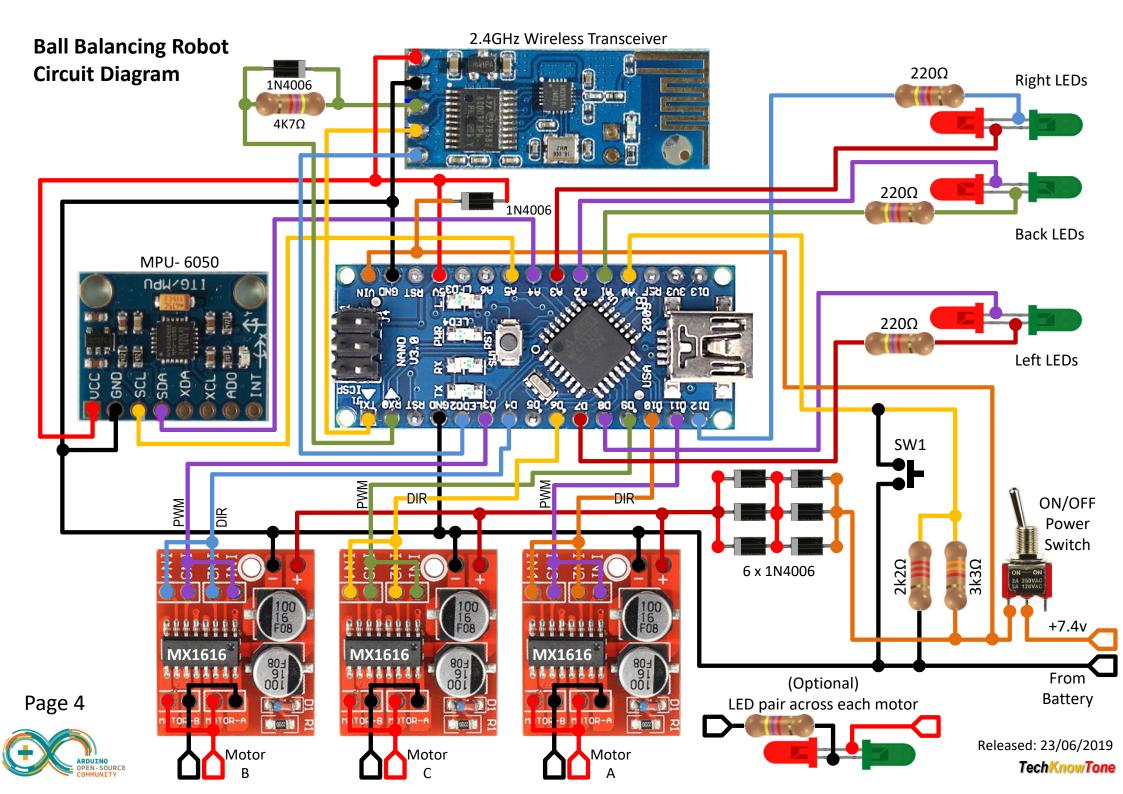


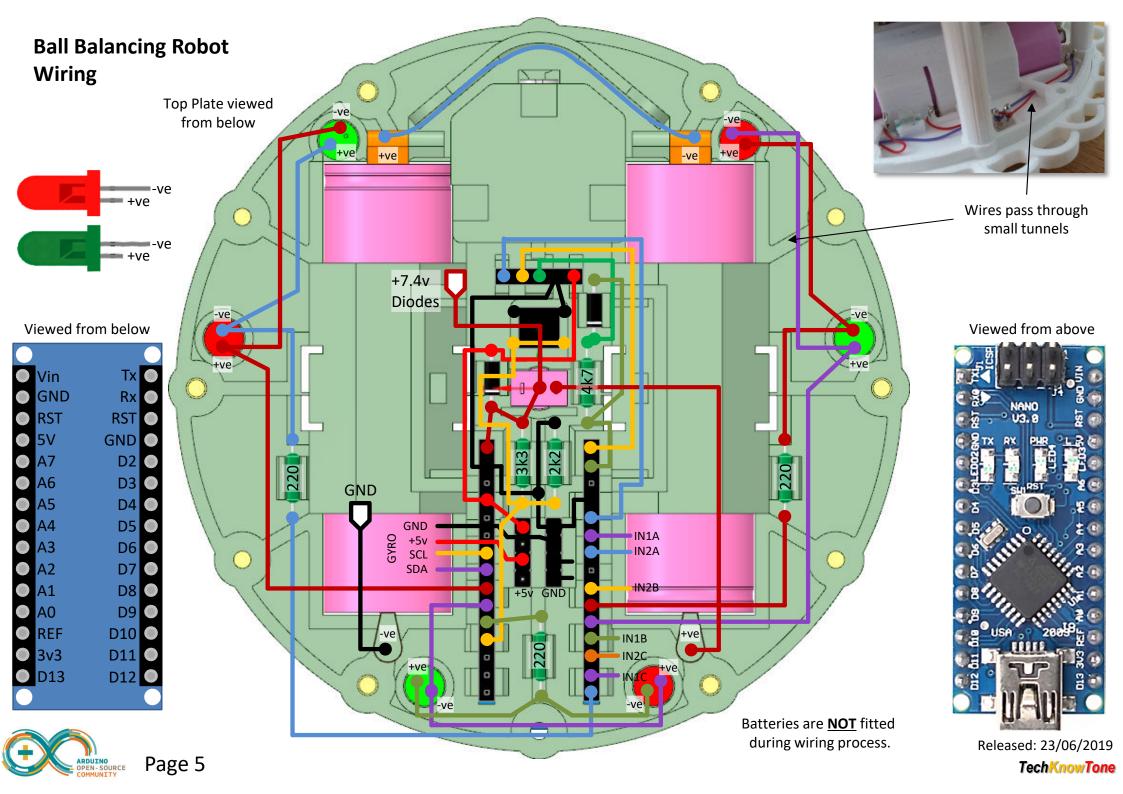


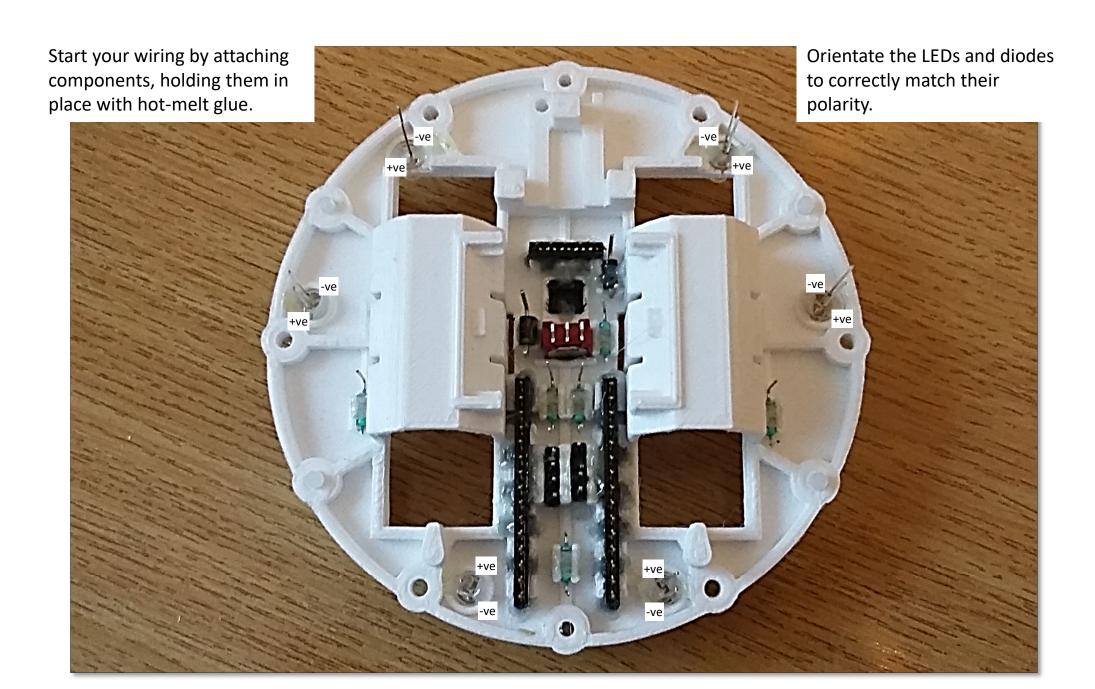




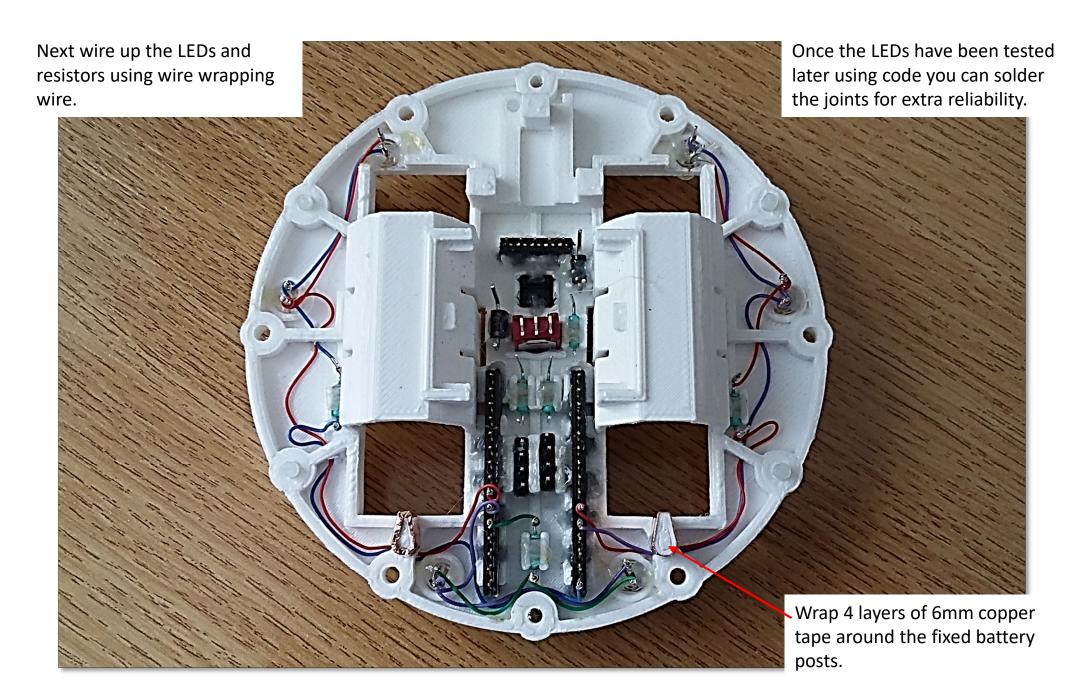




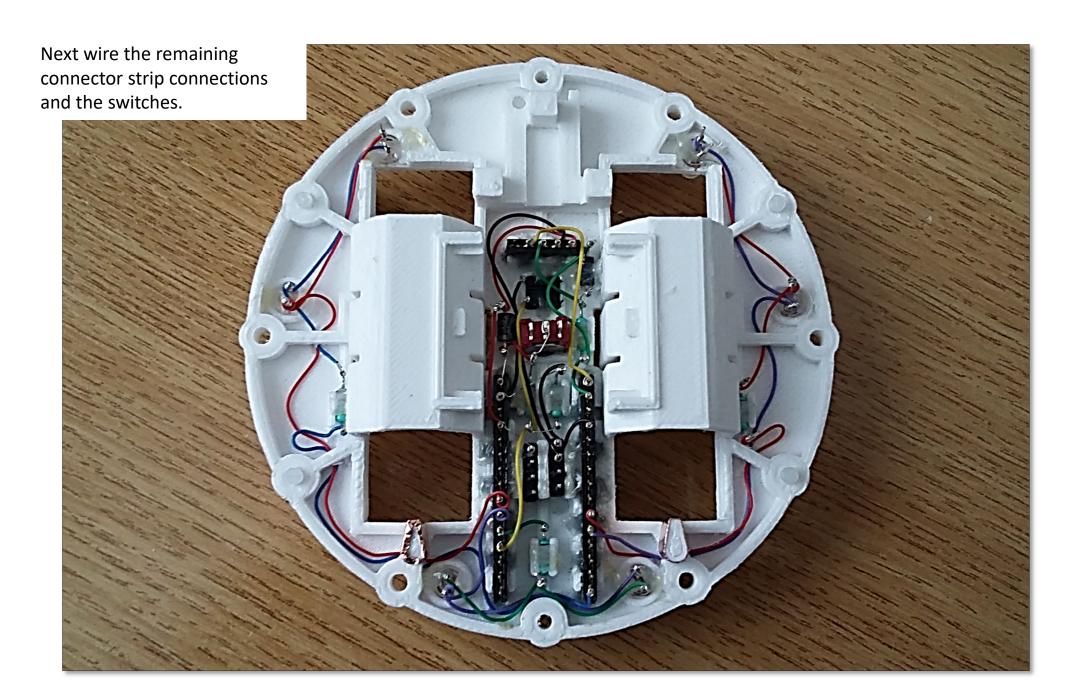




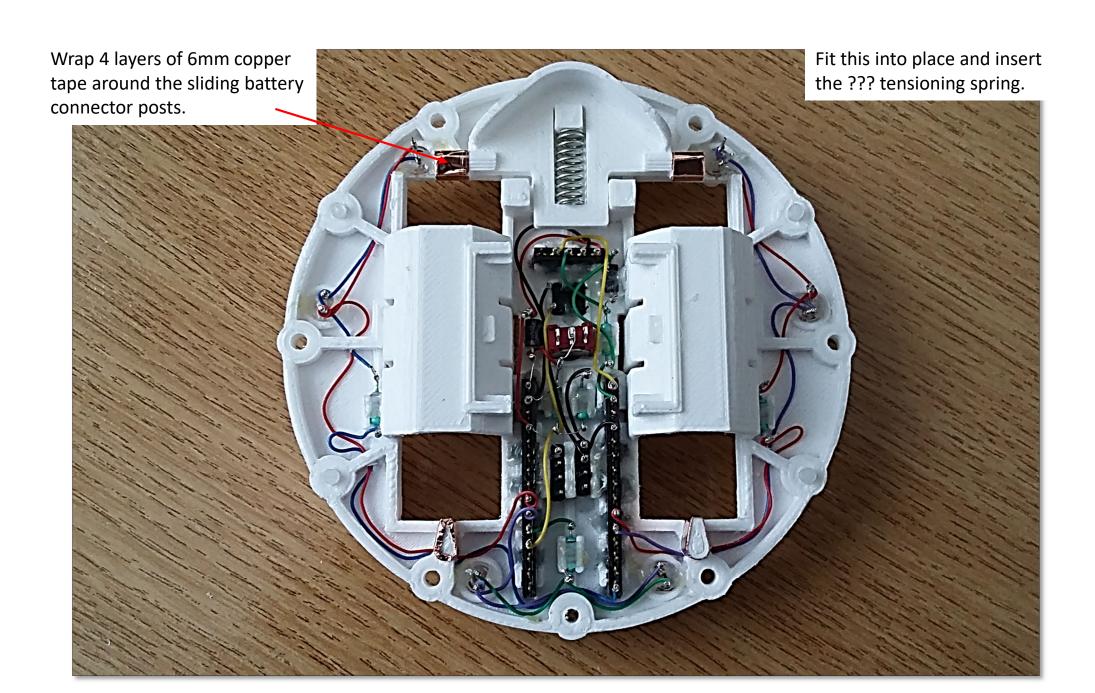




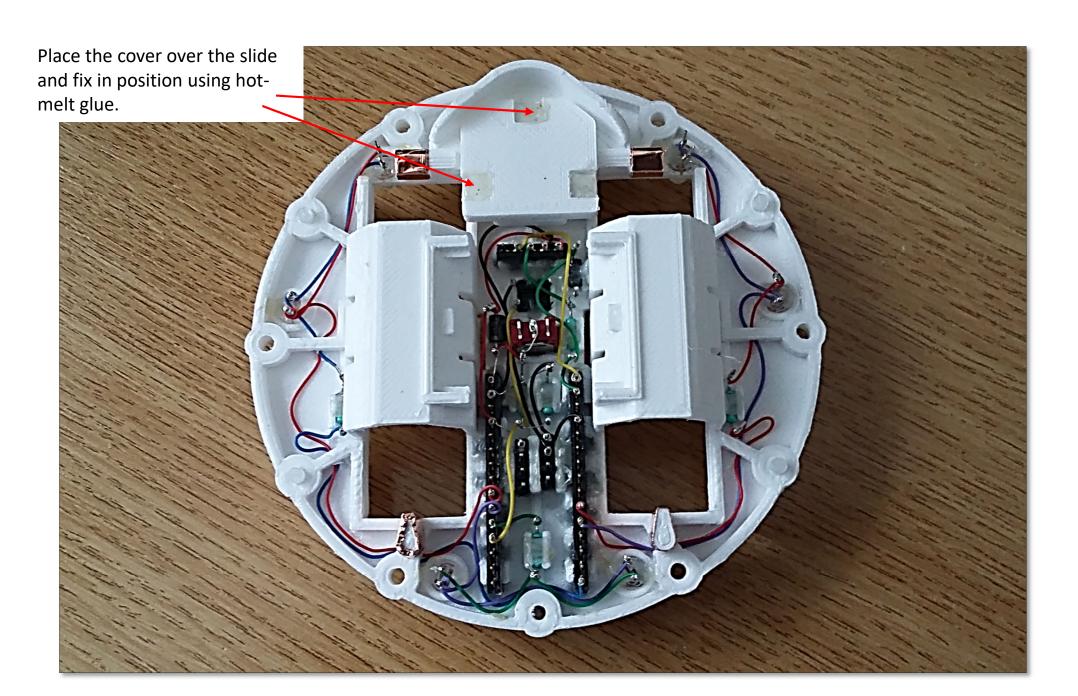




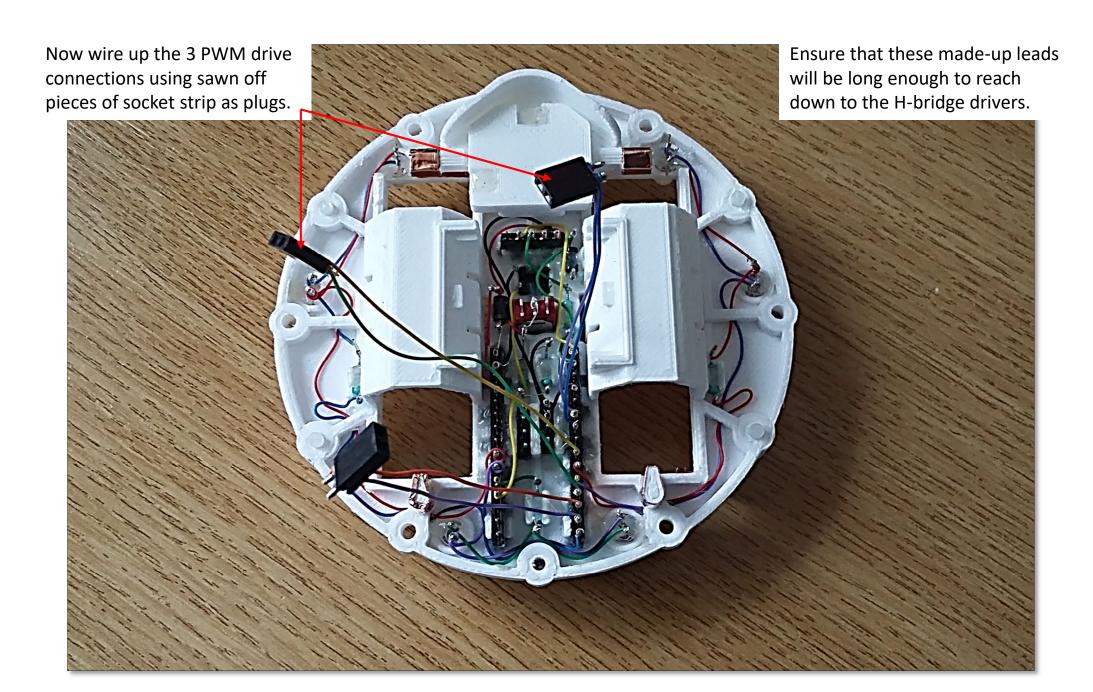




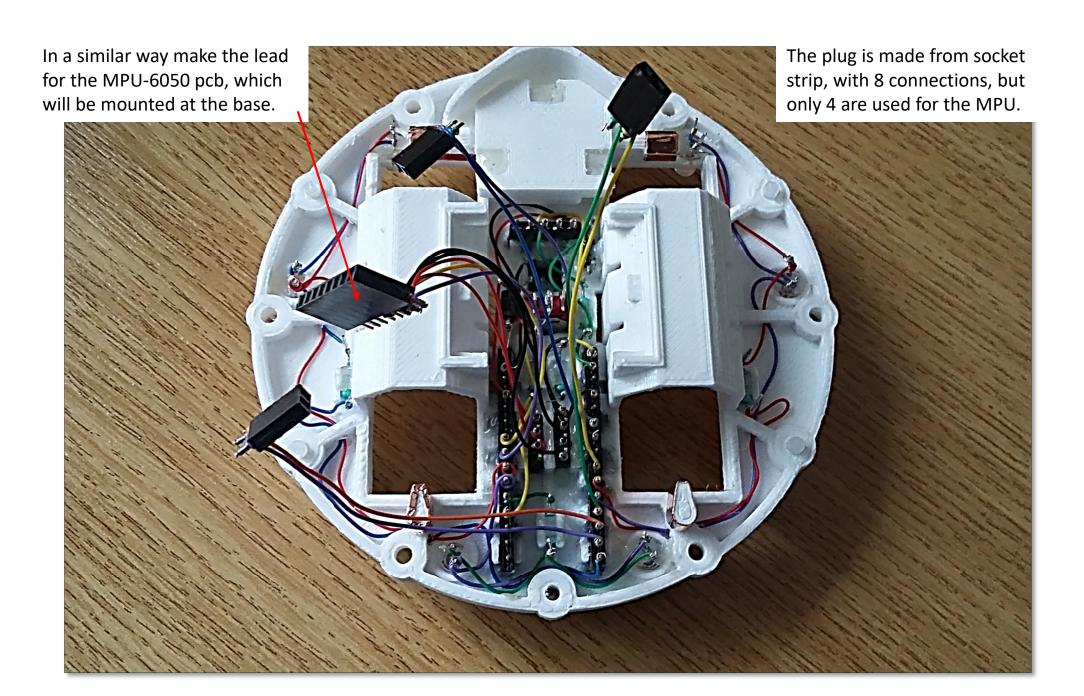




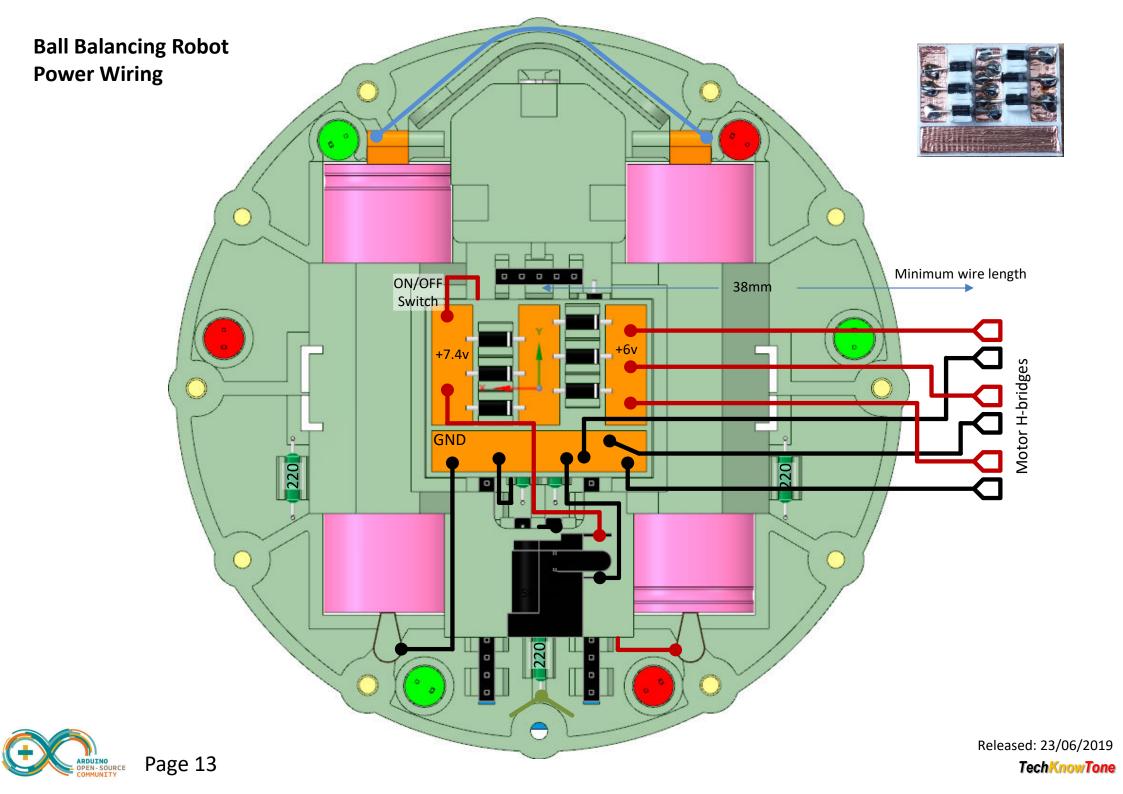




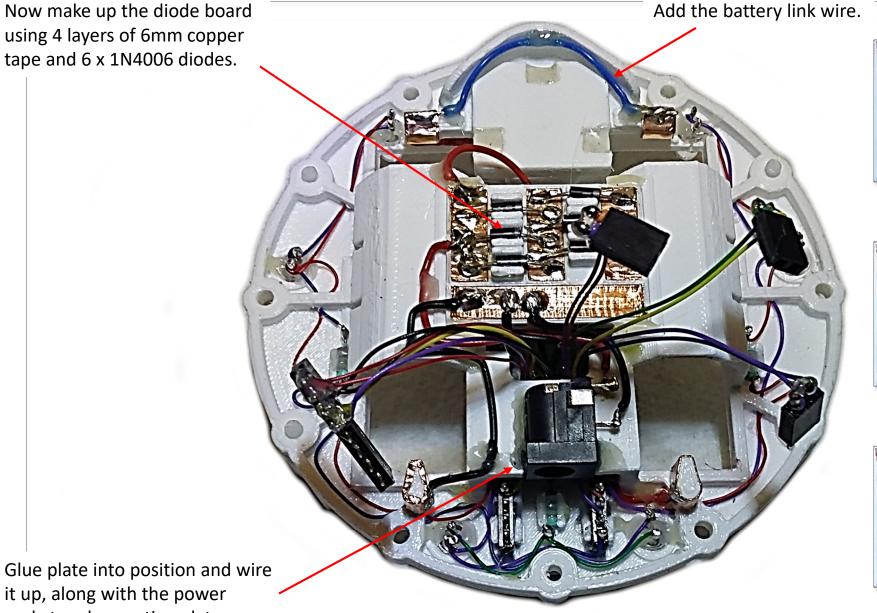








Now make up the diode board using 4 layers of 6mm copper tape and 6 x 1N4006 diodes.





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it up, along with the power socket and mounting plate. Finally make up the 3 power leads, again using socket strip for the 2 pin plugs.

These are soldered directly onto the diode board and grouped together using heat shrink sleeving.

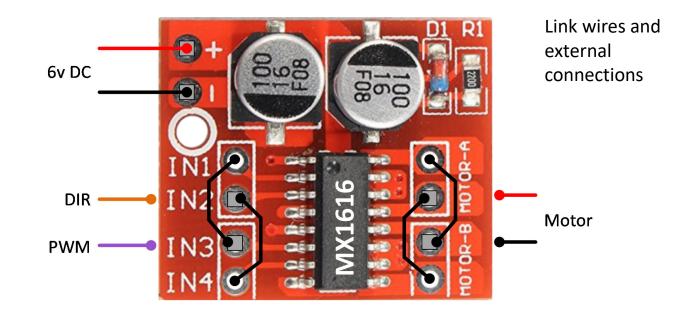
Ensure that the leads are long enough to reach the power input pins on the driver pcbs.

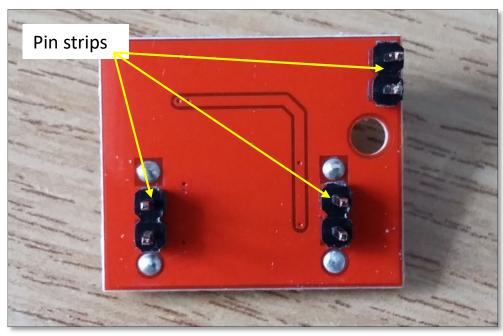


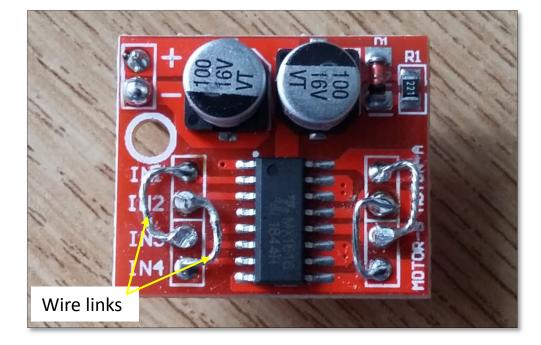
The 3 H-bridge driver boards need to be pre-wired as follows using formed link wires and pin strips.

Each driver board contains two circuits, which we combine to drive a motor. The circuits need to be combined in a very specific way.

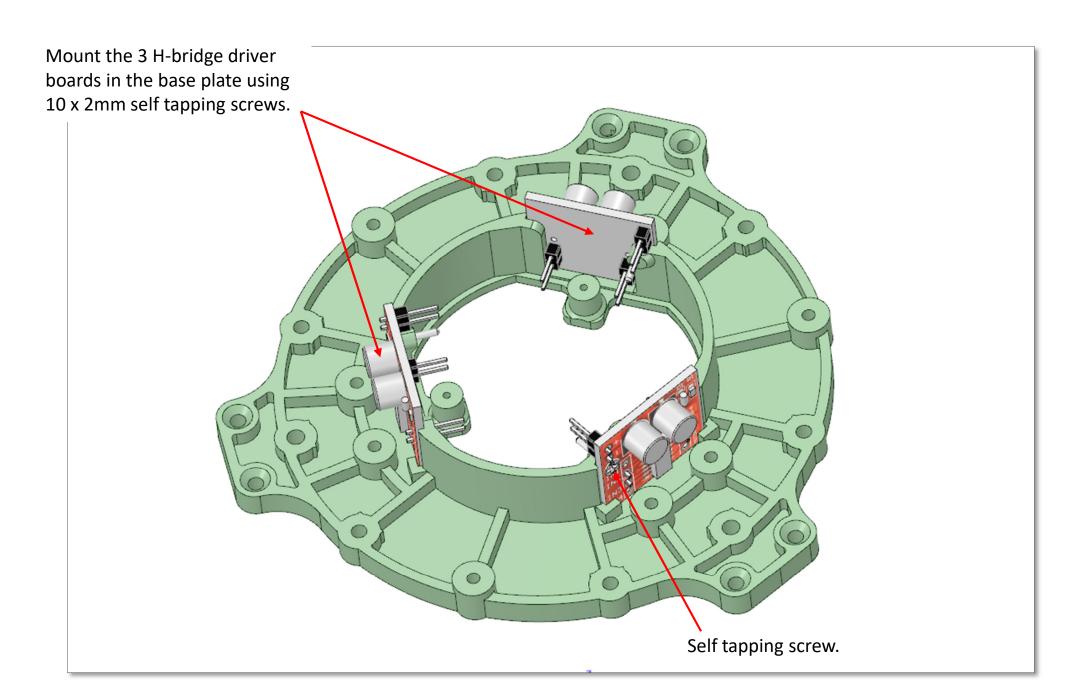
Pin strips are applied to the reverse side of the board before forming and attaching the wire links.





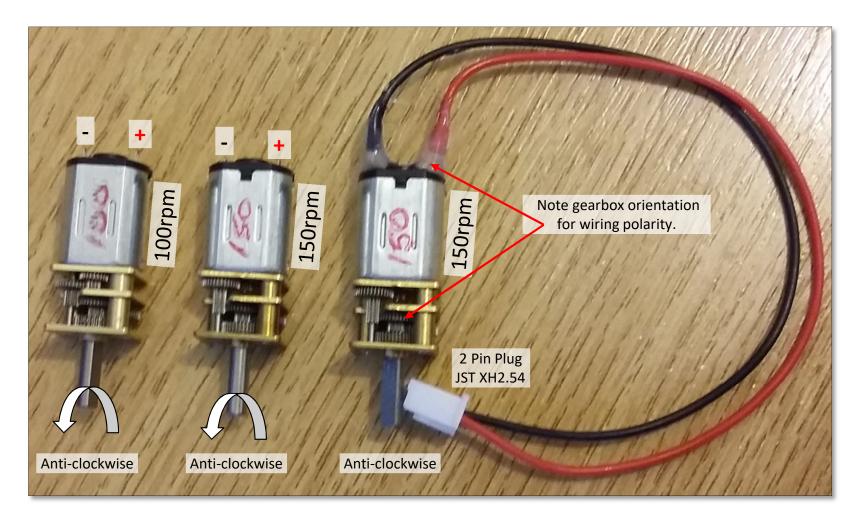






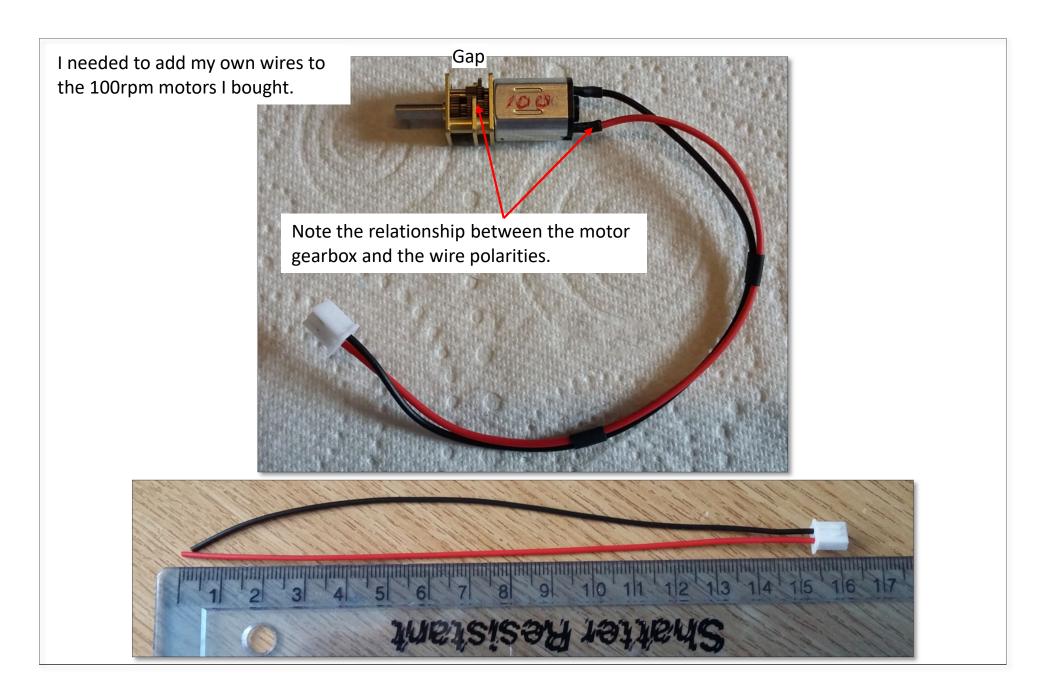


Motor Wiring

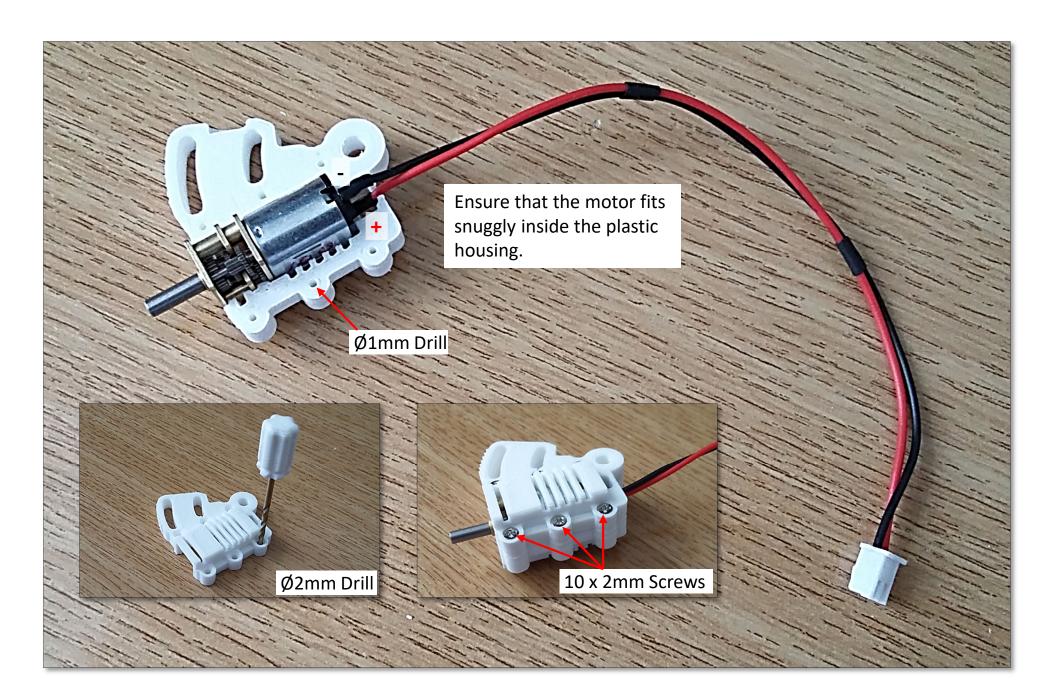


Note: All three motors need to have matching rpm values (obviously!). I started with 150rpm but later switched to 100rpm for increased torque at the expense of slower speed. If your motors are not pre-wired, then you need to wire them up in this way. If not pre-wired you can source the motors and cable separately.

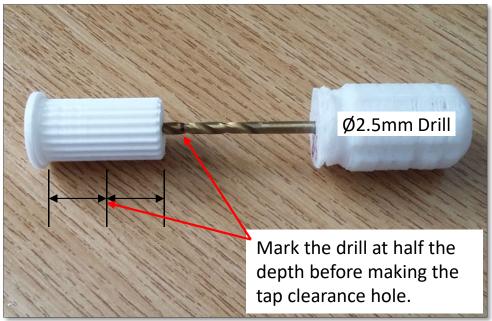




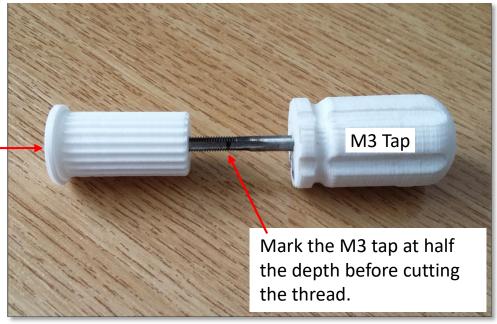








Ensure that you do not damage the half-round hole which mates with the motors drive shaft.





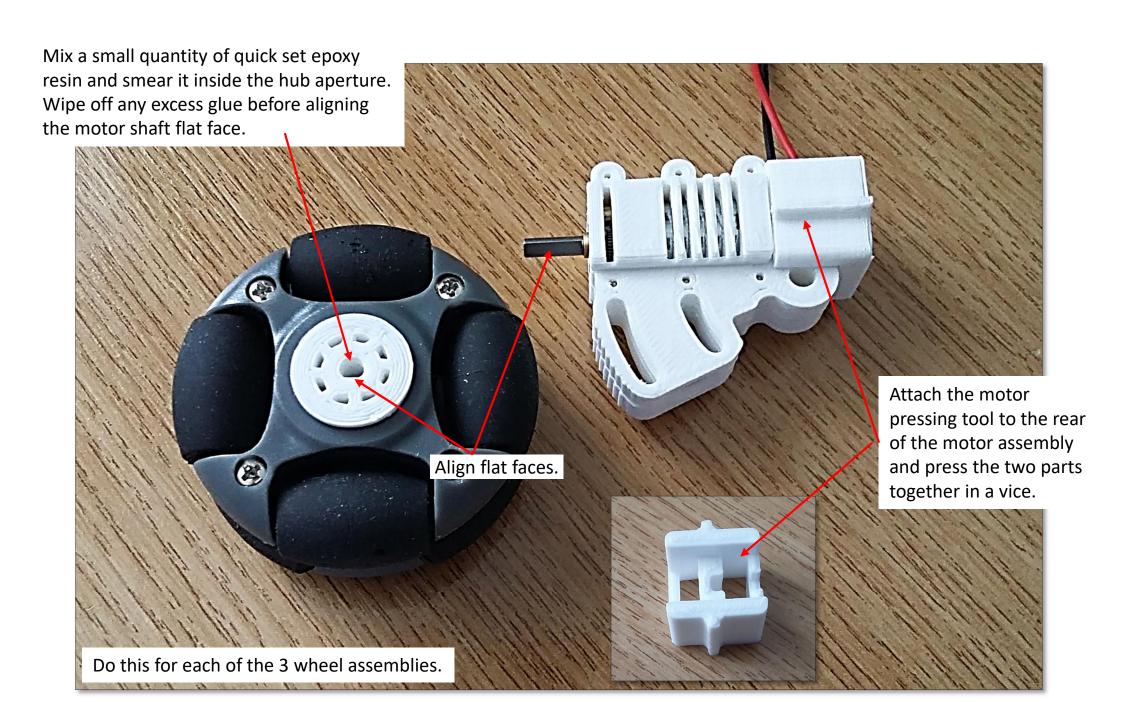


Place the hub inside the Omni-wheel. It should only go half way in by hand.

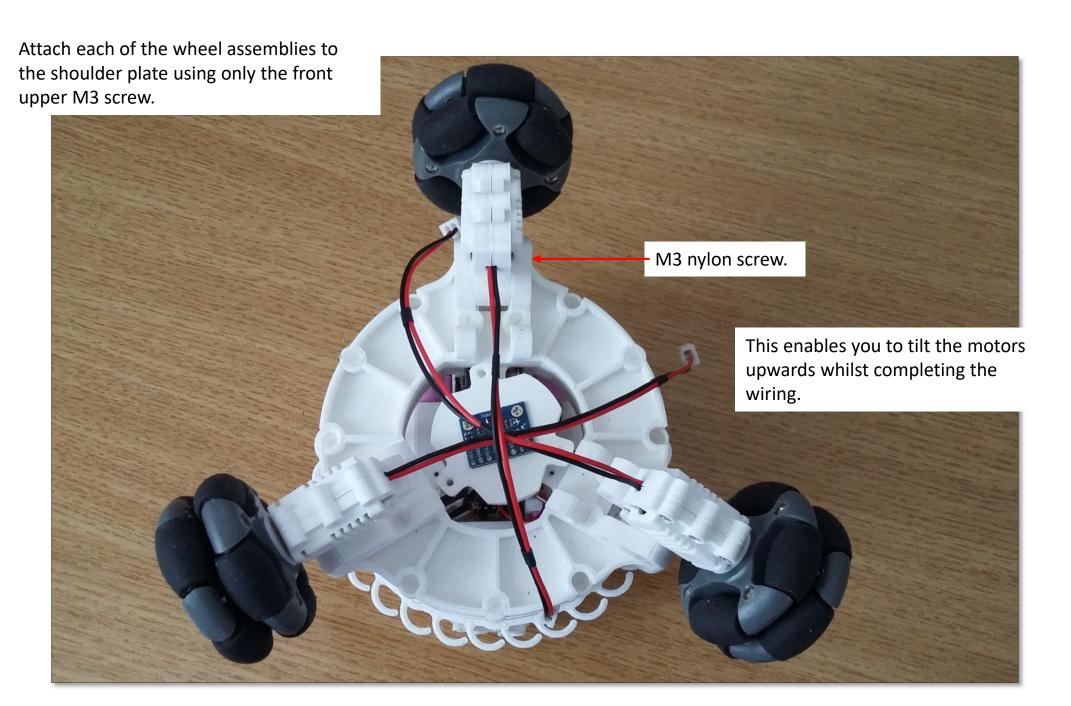
Place the assembly in a vice or use a G-clamp to press the hub all the way into the wheel.



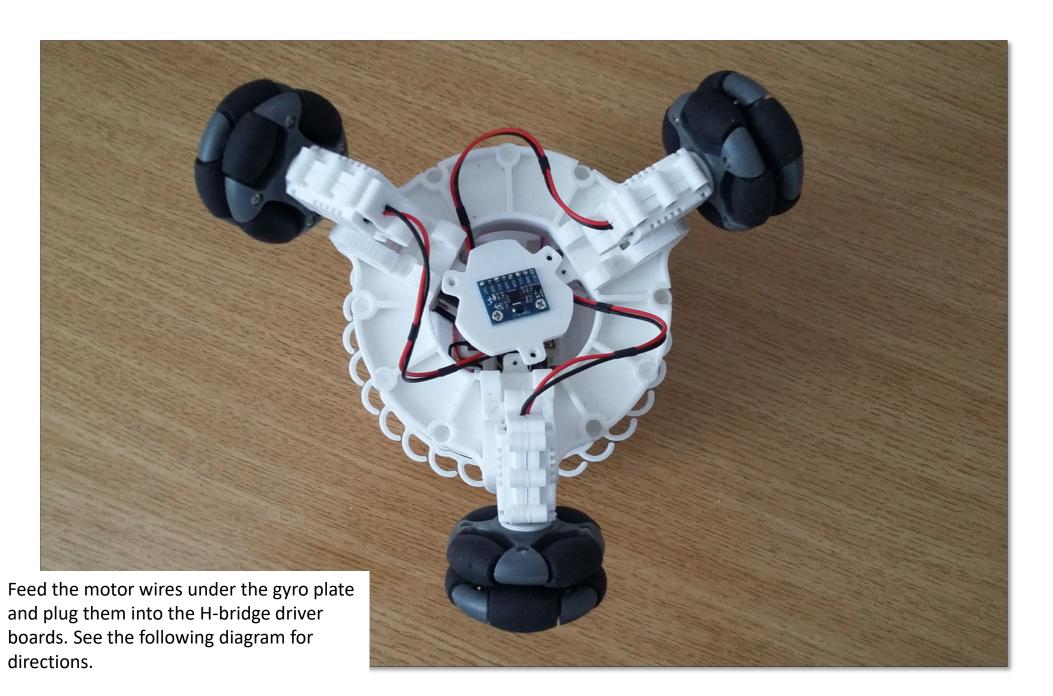




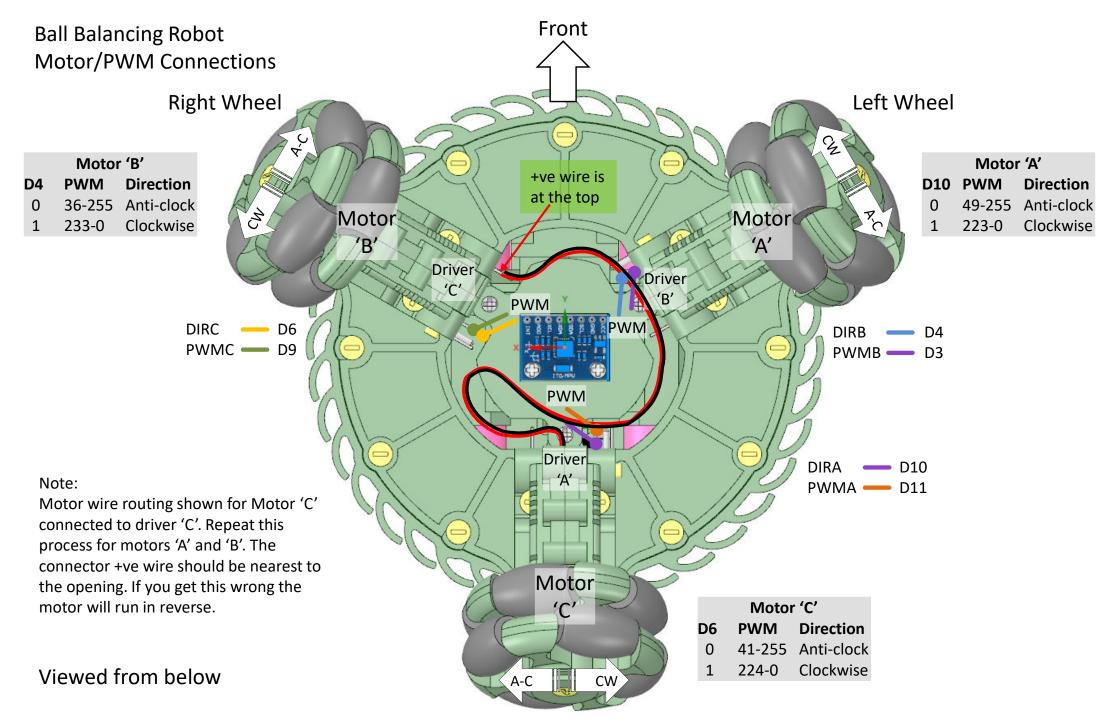






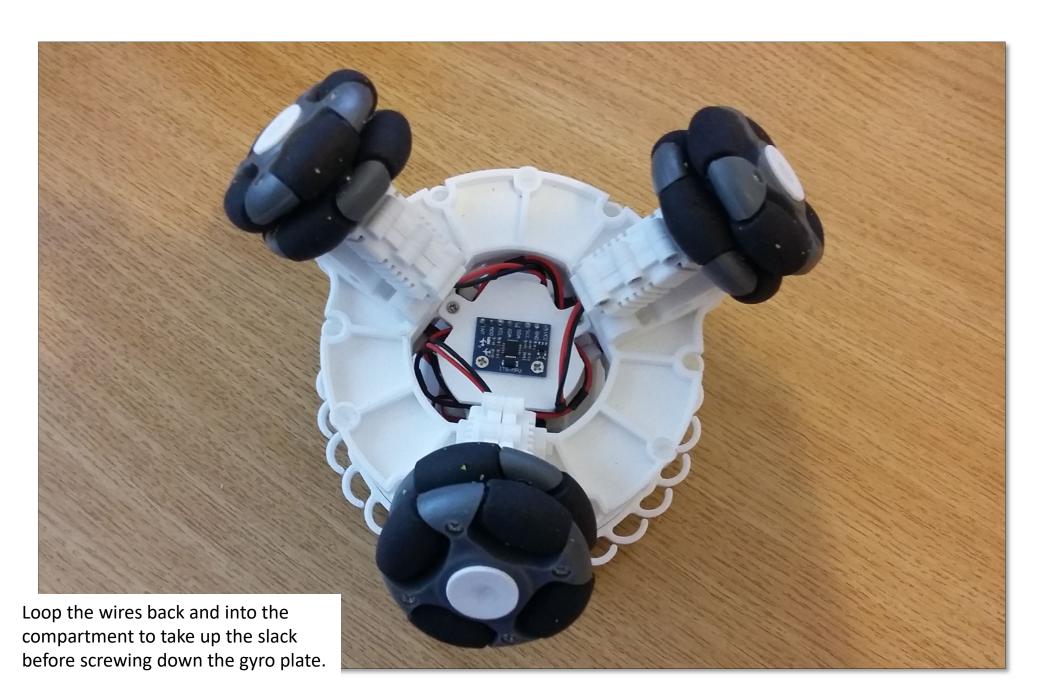






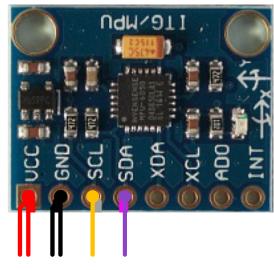


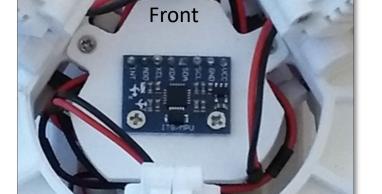
Rear Wheel





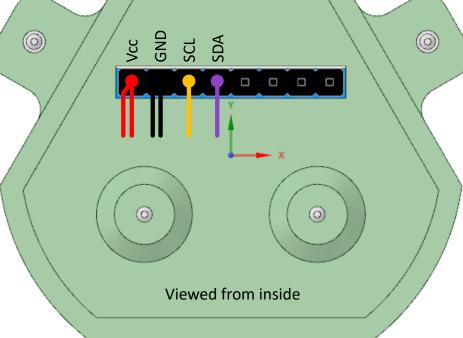
Viewed from below





Front





(





Data Sheet

DC MOTOR	MODE	IN1	IN2	IN3	IN4
MOTOR-A	Forward	1/PWM	0		
	Reversion	0	1/PWM		
	Standby	0	0		
	Brake	1	1		
MOTOR-B	Forward			1/PWM	0
	Reversion			0	1/PWM
	Standby			0	0
	Brake			1	1

"Note:

1. "1 "represents a high level;" 0 "represents a low level;" PWM "on behalf of pulse width modulated wave, adjusts the duty cycle to change speed.

2. IN1, IN2 control MOTOR-A; IN3, IN4 control MOTOR-B; two are completely independent.

3. INx anti input common conduction function, pin floating is equivalent to low input.

Built-in low on-resistance MOS switch.

Dual 1.5A o/p with peak current of 2.5A

Built-in thermal protection, automatic recovery

Dual H-bridge motor driver, can drive two DC motors, or a 4-wire two-phase stepper motors.

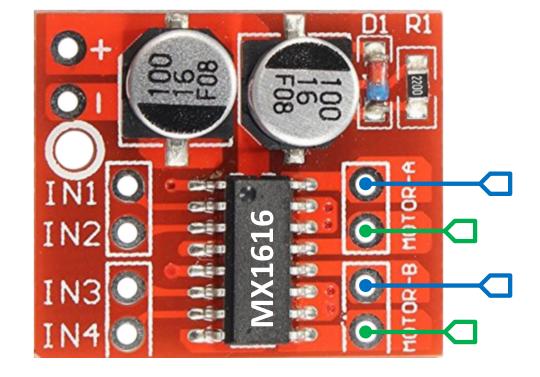
The module supply voltage: 2V-10V

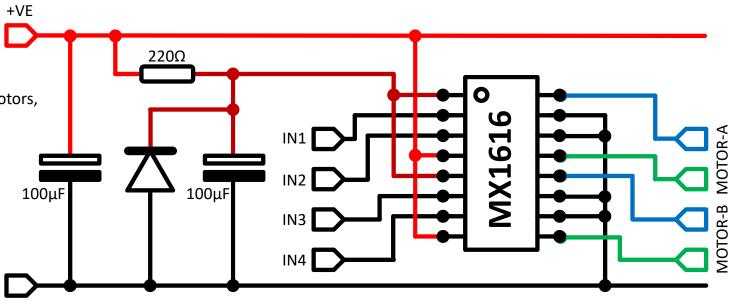
Signal input voltage: 1.8-7V Single Operating Current: 1.5A

Peak current up to: 2.5A Size: 24.5 x 21.0 mm

Mount hole: 3.0 mm dia

Connecter holes: 1.0 mm dia, 2.5 mm centres

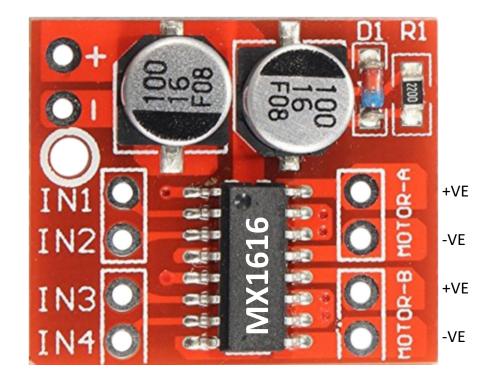






Data Sheet

		PWM	DIR	PWM	DIR
DC MOTOR	MODE	IN1	IN2	IN3	IN4
MOTOR - A	Forward	PWM – 1	0		
	Reverse	0	PWM – 1		
	Forward	1	PWM - 0		
	Reverse	PWM – 0	1		
	Standby	0	0		
	Brake	1	1		
MOTOR - B	Forward			PWM - 1	0
	Reverse			0	PWM – 1
	Forward			1	1 – PWM
	Reverse			1 - PWM	1
	Standby			0	0
	Brake			1	1



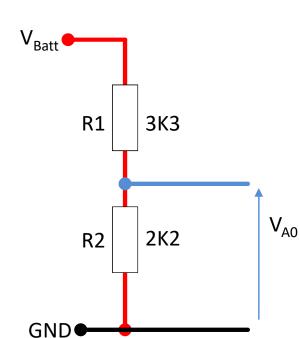
Note:

- 1. Table indicates that 'Forward' and 'Reverse' can be achieved with only one PWM signal, with the direction being set by the other pin. However to control speed in reverse the PWM value is effectively inverted. See lines 1 and 4 in the truth table for single PWM and DIRection control.
- 2. If only one channel is required then inputs can be tied together, IN1+IN3 and IN2+IN4, then H-bridge common 'MOTOR' outputs can also be tied together, -VE & -VE and +VE & +VE.
- 3. Input pull-down resistors measured in the region of $11k\Omega$, so an Arduino digital pin can easily drive two or more INx pins.





Battery Monitor (Protection)



$$V_{A0} = \frac{V_{Batt} \times R2}{R1 + R2}$$

$$V_{A0} = \frac{V_{Batt} \times 2K2}{5K5}$$

$$V_{FSD} = 12.5v @ V_{A0} = 5$$

Two cells in series gives a nominal 7.4v constant discharge voltage. To prevent damage, stop using once the following conditions are reached:

$$3.60 + 3.00 = 6.60v$$
 (one battery fades early)

$$3.30 + 3.30 = 6.60v$$
 (both batteries fade together)

Hence
$$V_{AOD} = 540 @ V_{Batt} = 6.60v$$

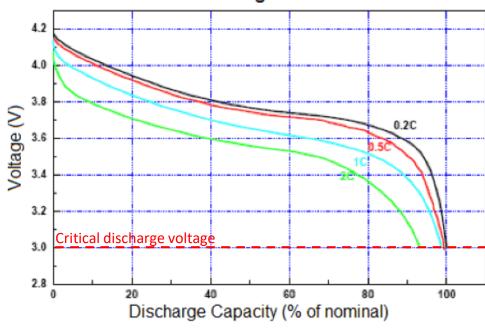
The code will shut down when the value drops to 540.

$$V_{AOD} = \frac{V_{AO} \times 1023}{5}$$

voltage read by 10-bit ADC

$$V_{AOD} = \frac{V_{Batt} \times 0.4 \times 1023}{5}$$

18650 Lithium Battery Discharge Profile



Discharge: 3.0V cutoff at room temperature.