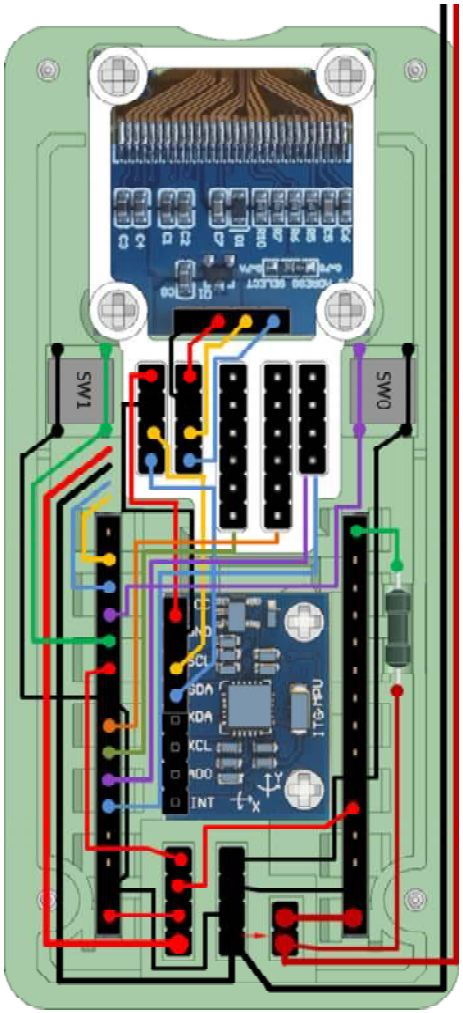
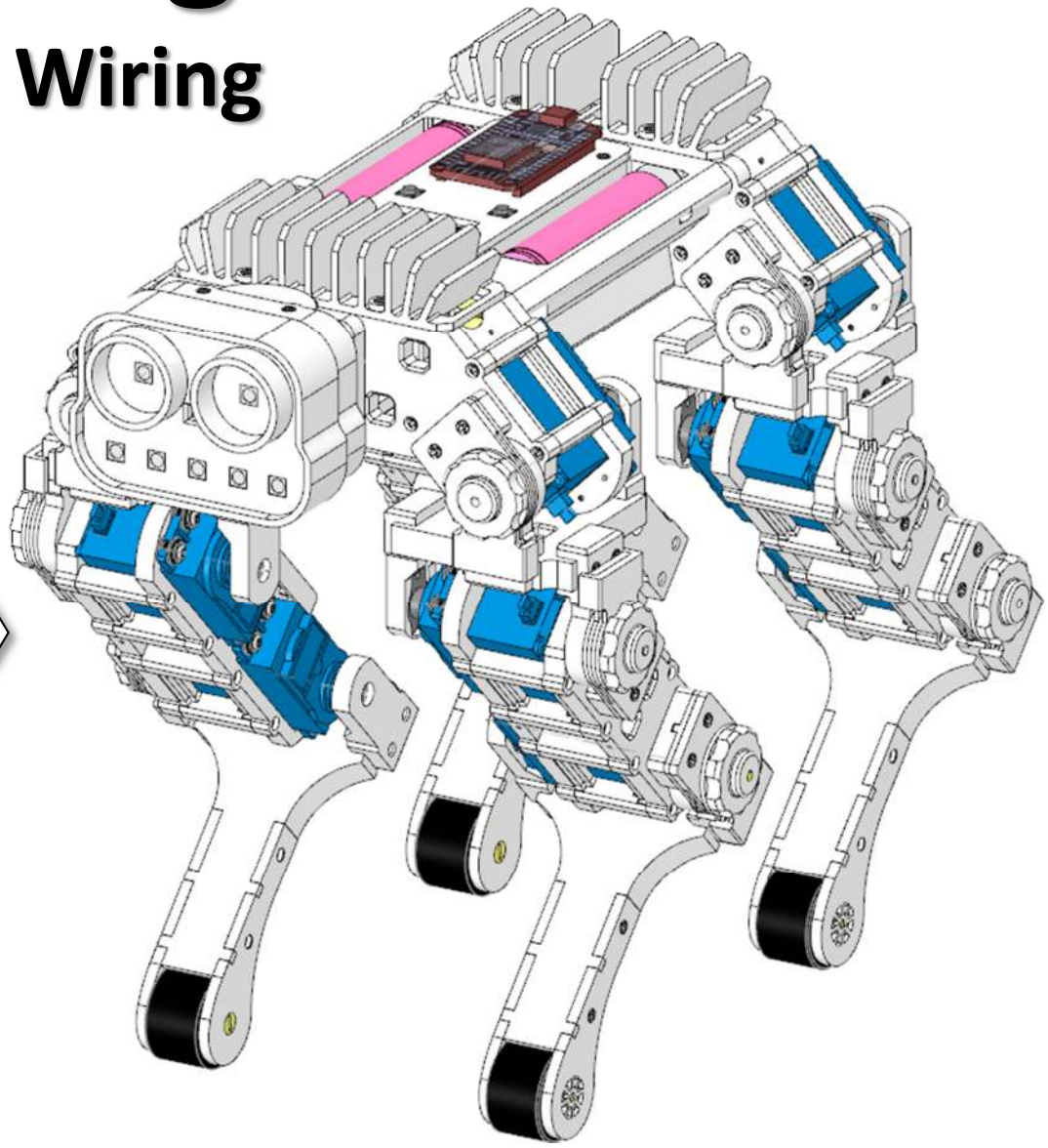
# RoboDog

## Circuits & Wiring



# Hand Tools:

Recommended:

- Fine Nosed Pliers
- Side Cutters
- M3 Tap
- M4 Tap
- 1.5 mm Drill
- 2.0 mm Drill
- 2.5 mm Drill
- 3.0 mm Drill
- Needle Files
- Screwdriver
- Craft Knife

Note: Not all items are shown here.



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# Tools & Materials:

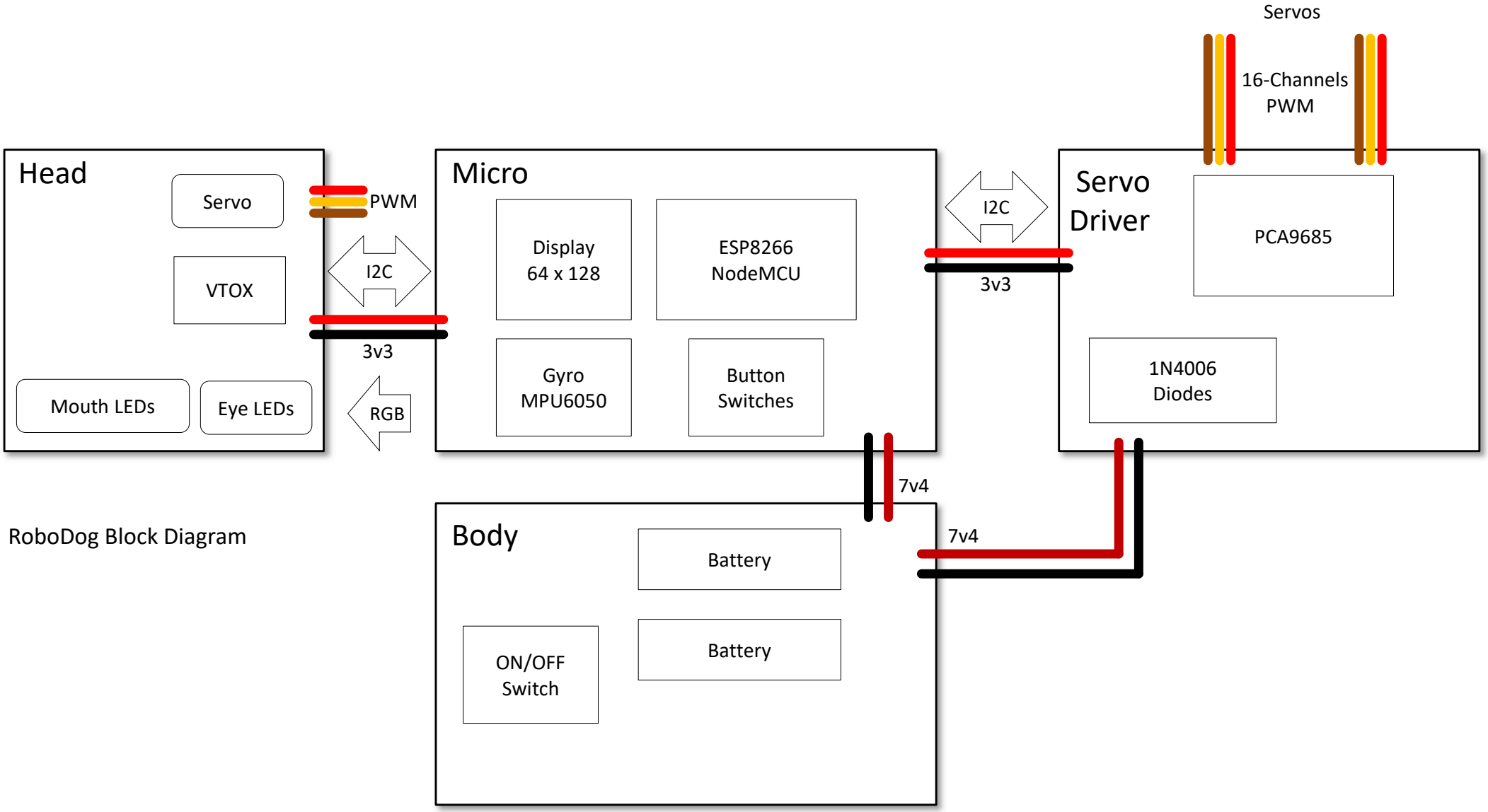
Temperature controlled iron
Solder flux
Resin cored solder
Hot melt glue gun
2-part epoxy resin glue
6mm adhesive copper tape
Screw drivers
Wire wrapping tool
Wire wrapping wire 30 AWG







# RoboDog Block Diagram




RoboDog Block Diagram



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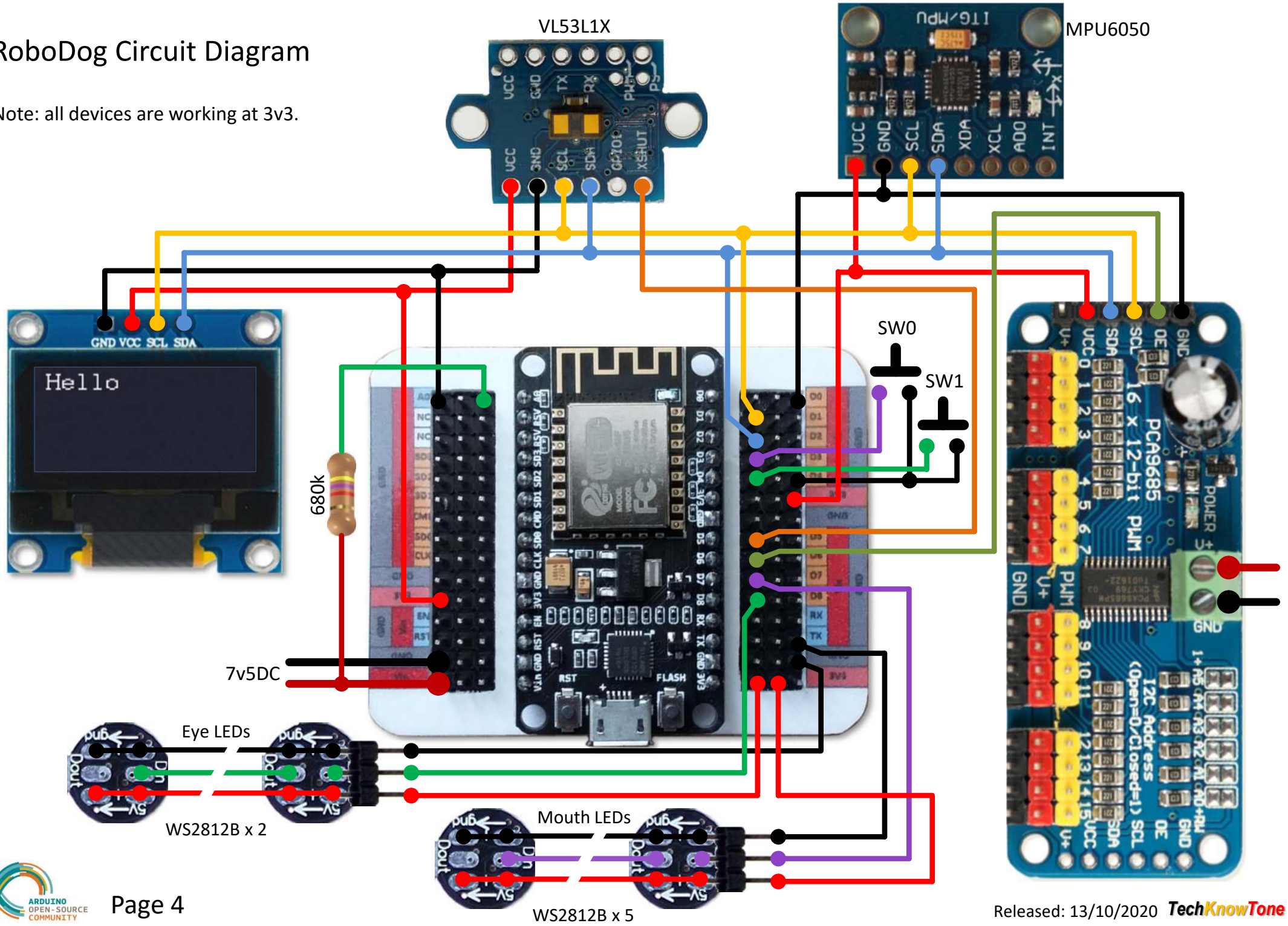
# RoboDog Circuit Diagram

Note: all devices are working at 3v3.



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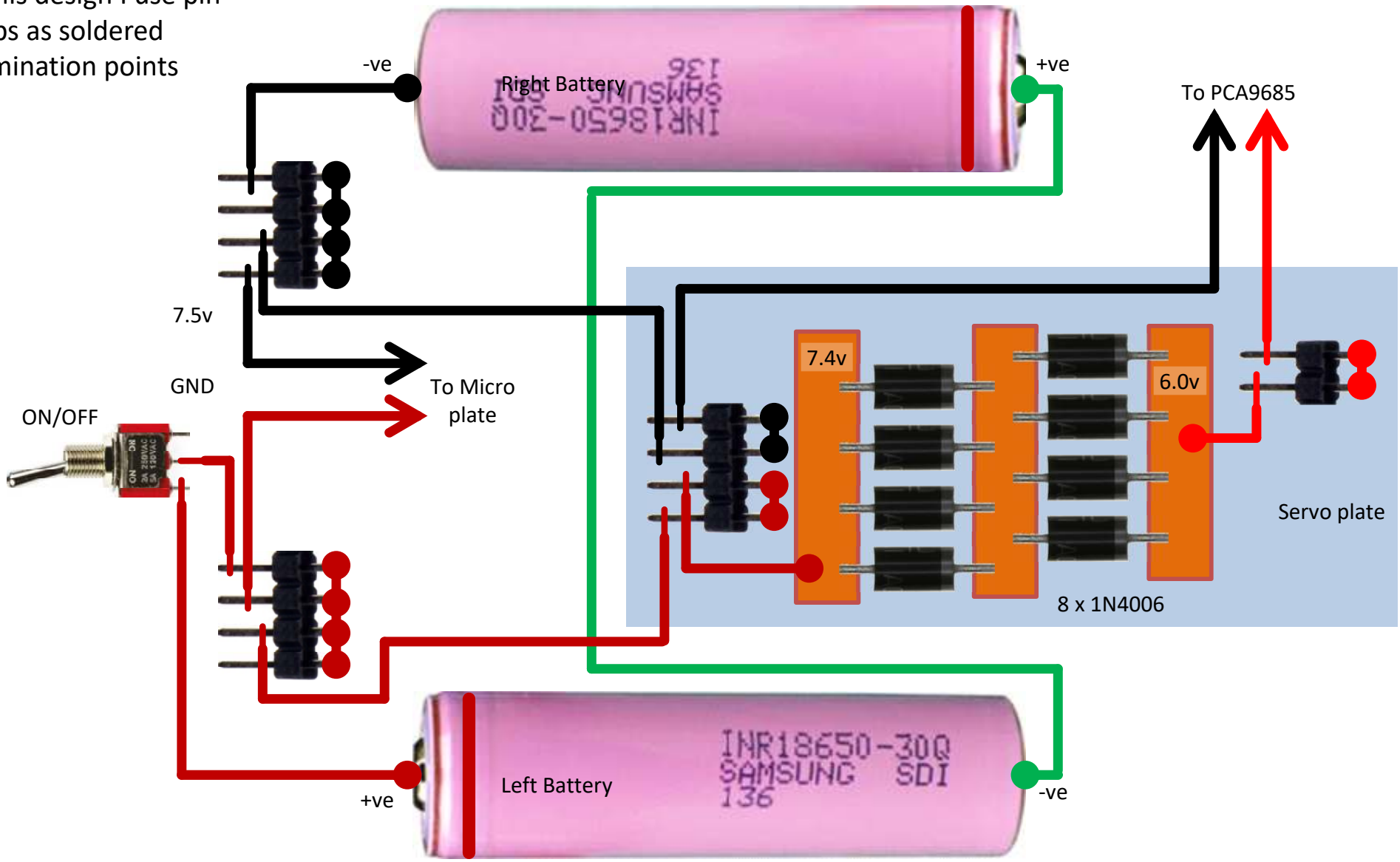
# RoboDog Body Power Wiring

In this design I use pin strips as soldered termination points



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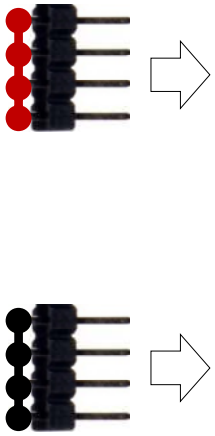
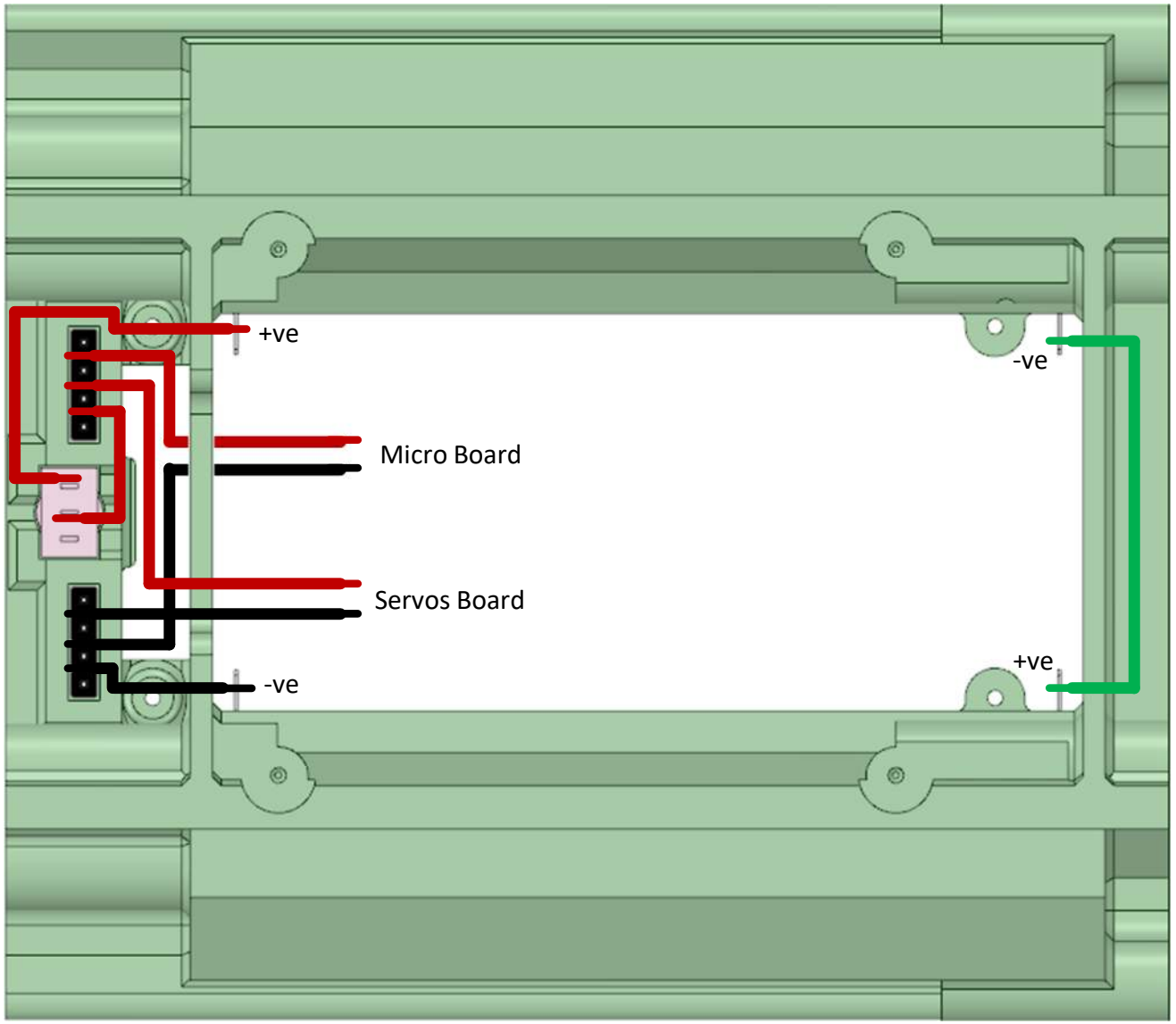
# Body Wiring

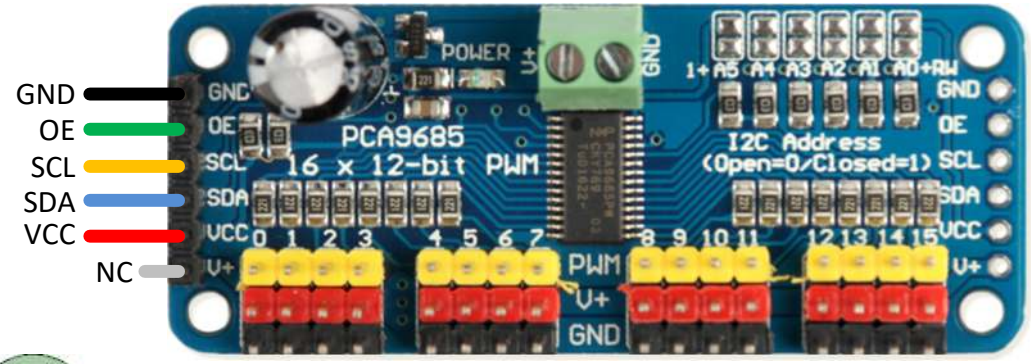
Pins are wired together before being glued into their respective holders in the plastic body.






A round needle file can be used to open up the eyelets in the battery connectors, if the wire used is too large.

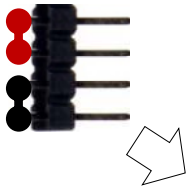
# Servo Board Wiring

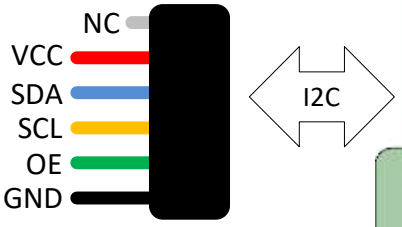


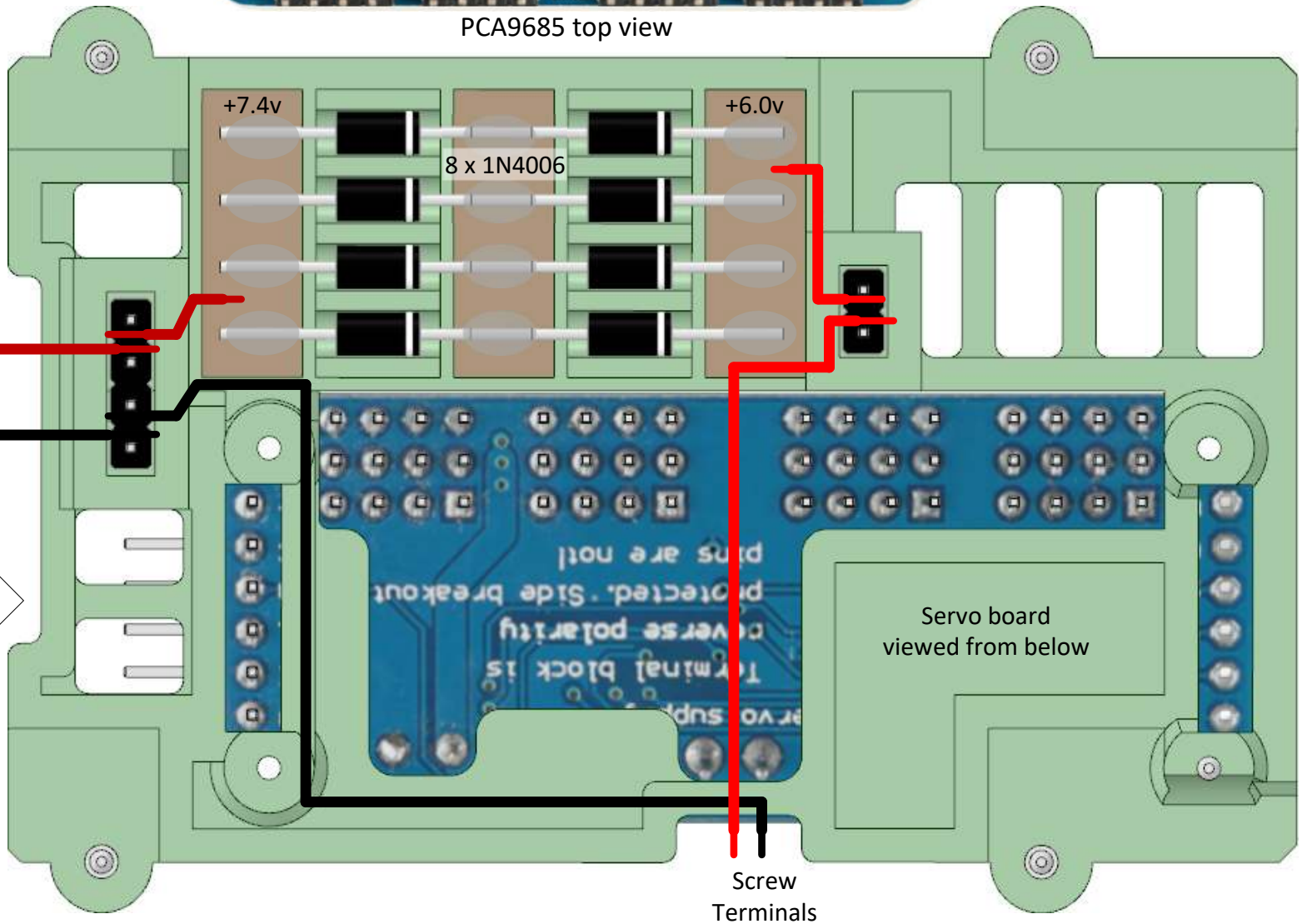

PCA9685 top view

The use of multiple 1N4006 diodes provides a much sharper forward characteristic and lower voltage drop.

Solder pin pairs before gluing into position.





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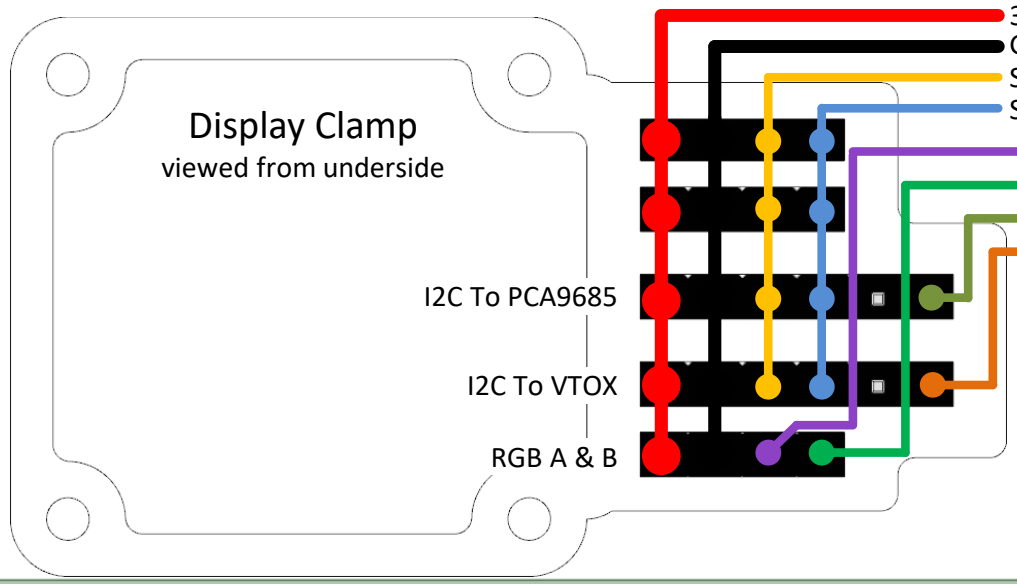
# Micro Board Wiring

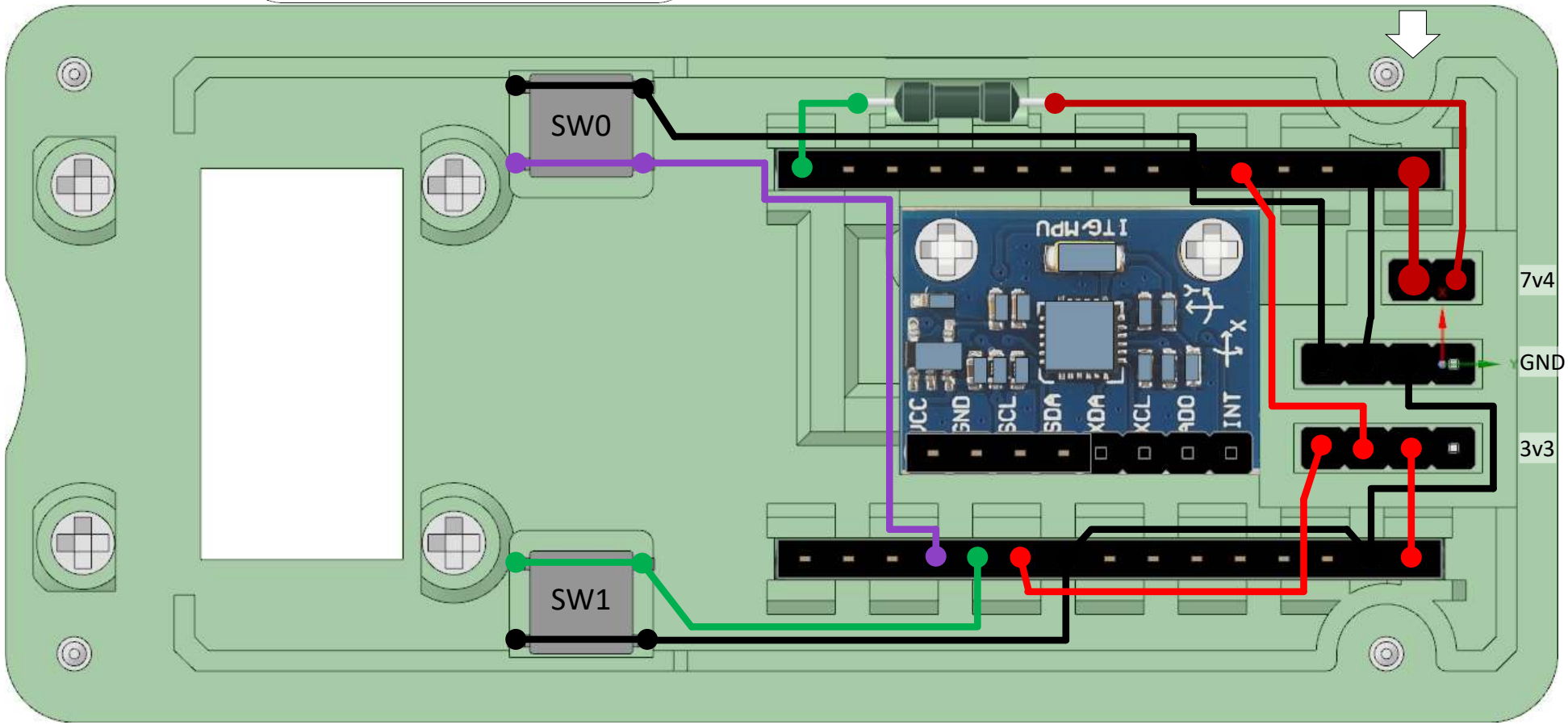
## Initial steps

The display clamp is initially wired as a sub-assembly, before being turned over and mounted; then wired into the main board as shown on the next slide.




Make wires long enough to make off the connections once inverted and mounted on the back of the display.

Wire and solder pins together before gluing into the top plate.



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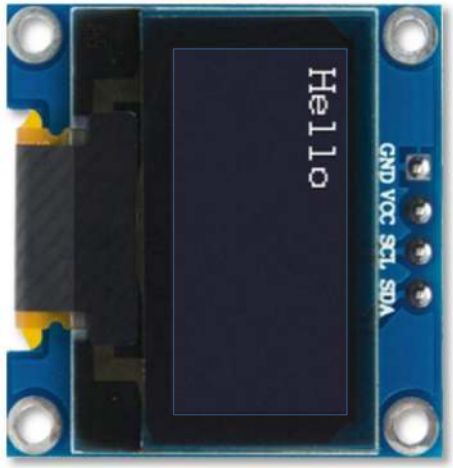
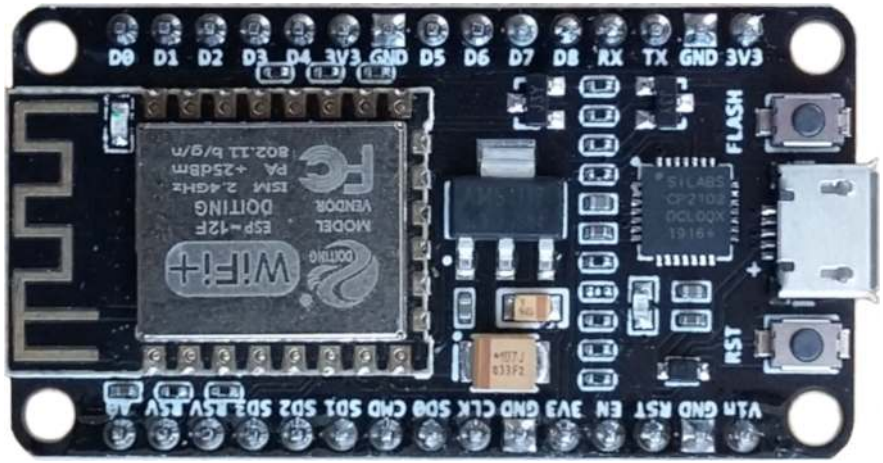
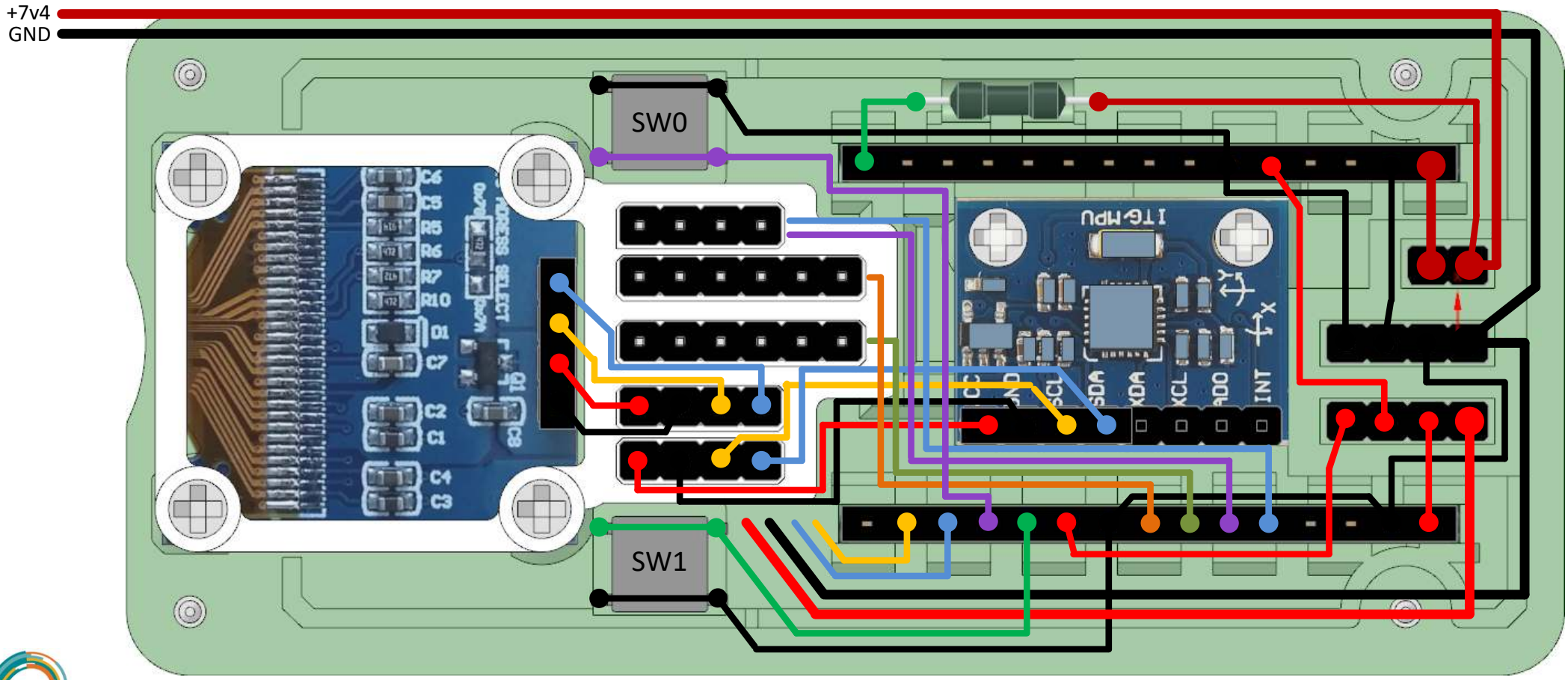
# Micro Board Wiring

Final steps



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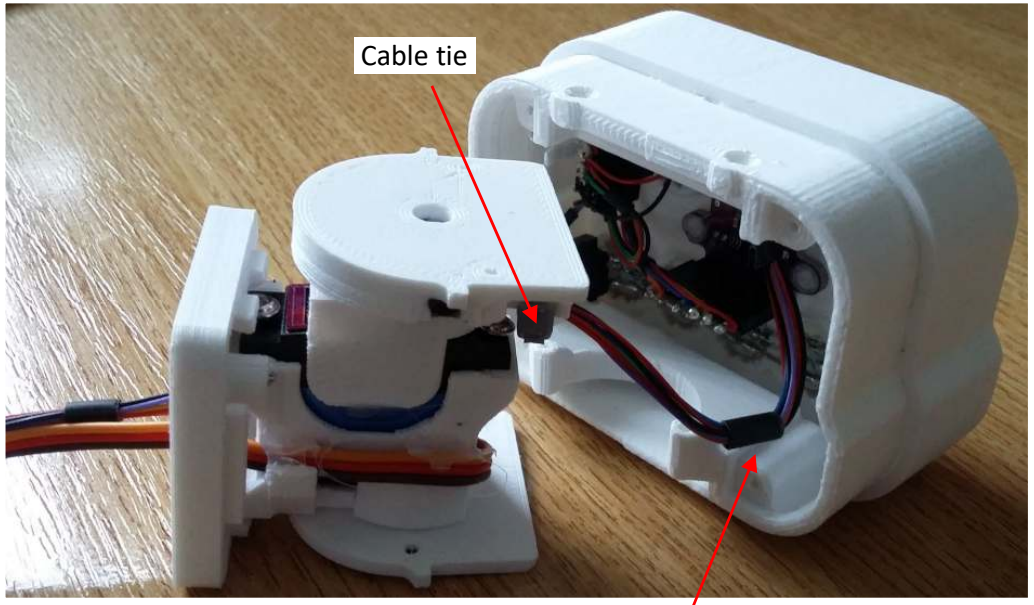
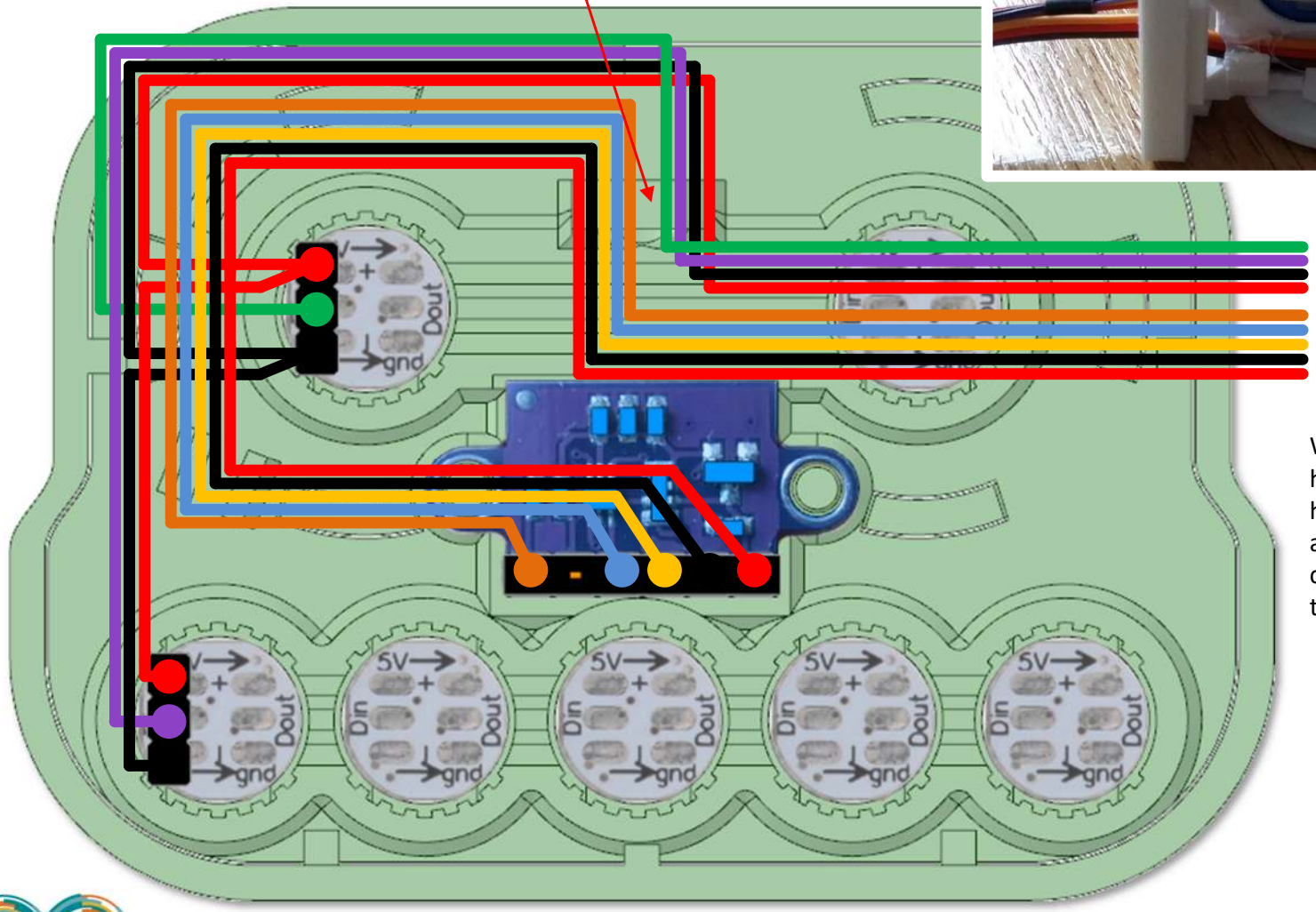
# RoboDog Face Wiring

Group the wires together with heat shrink sleeving and thread them through the moulded eyelet. This is done before the face plate is glued into the outer rim.




RGB A & B

I2C

Wires are looped within the right hand head cavity area to allow for head movement side to side, then attached to the servo via a loose cable tie, before passing through the neck and into the body area.

Cable tie



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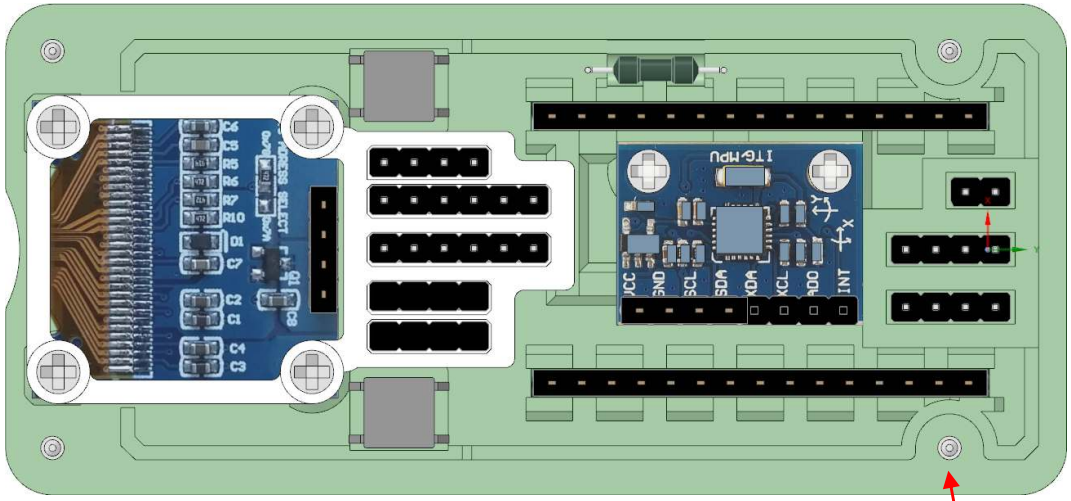
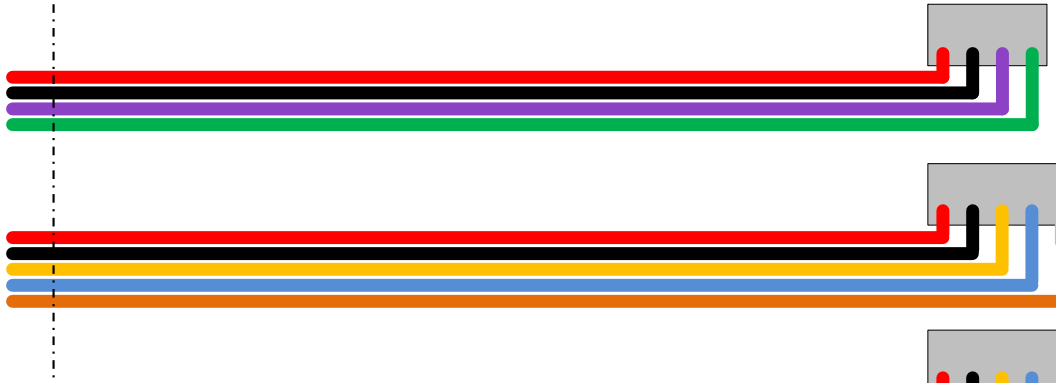
# RoboDog Harness Wiring

Micro board shown without its associated wiring.




Build these harness from the head first. Allowing sufficient length to loop within the head then pass by the servo, through the neck and into the upper body area.

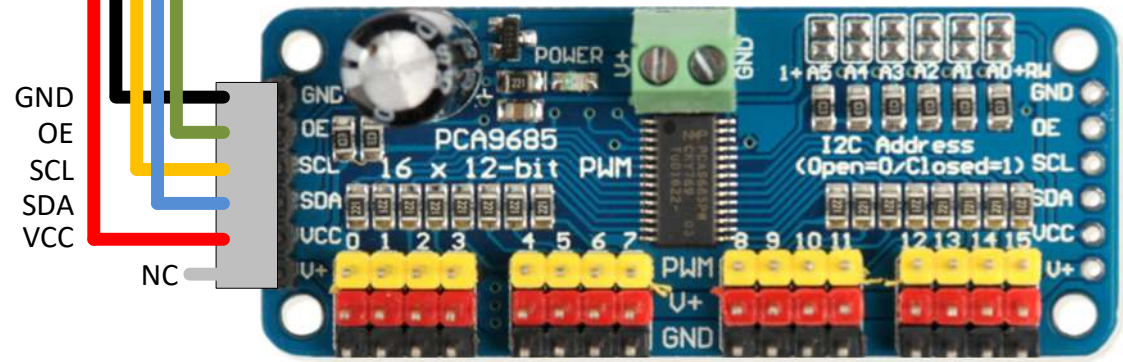


RGB A &B

VTOX XSHUT

PCA9685 EN

Support the micro board on brackets. Wire onto the associated headers, allowing a small amount of float in length to ease plugging and unplugging the connectors.




PCA9685 top view



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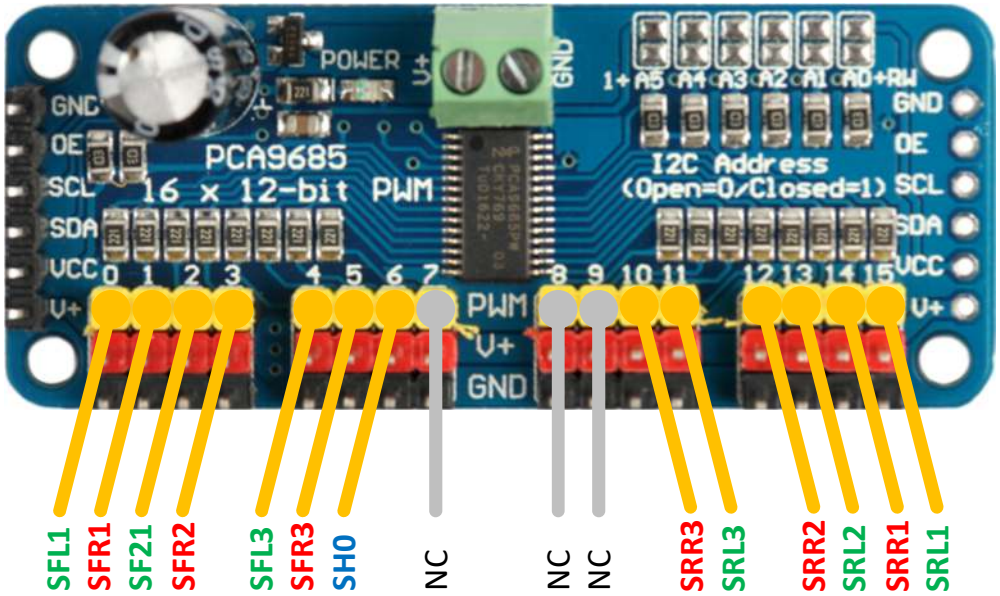
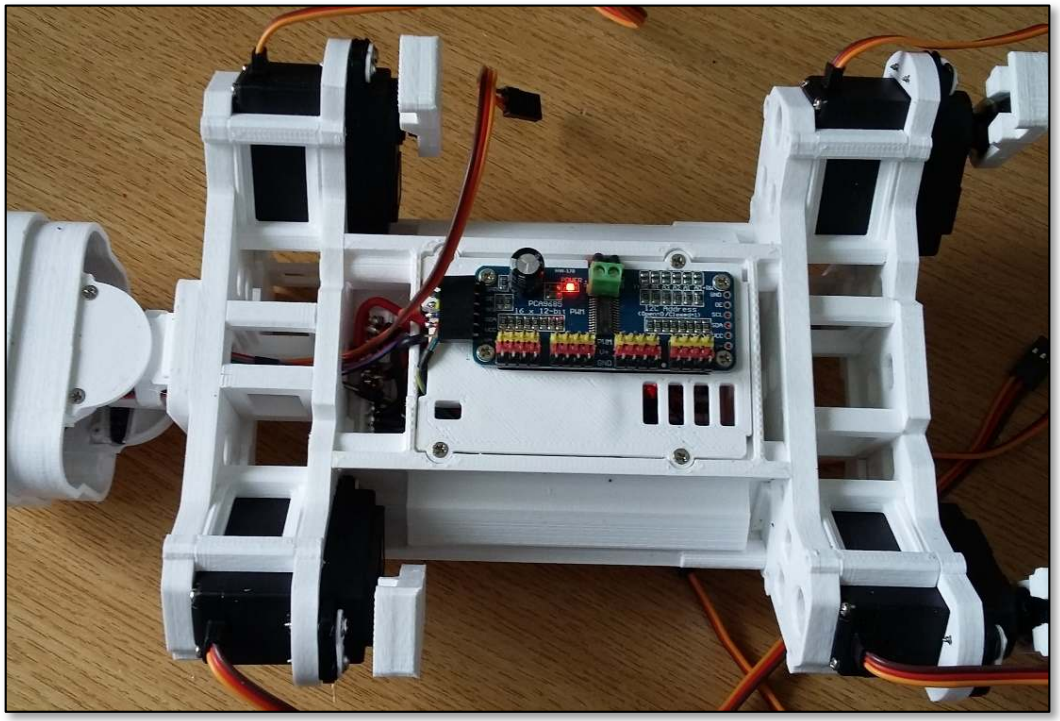
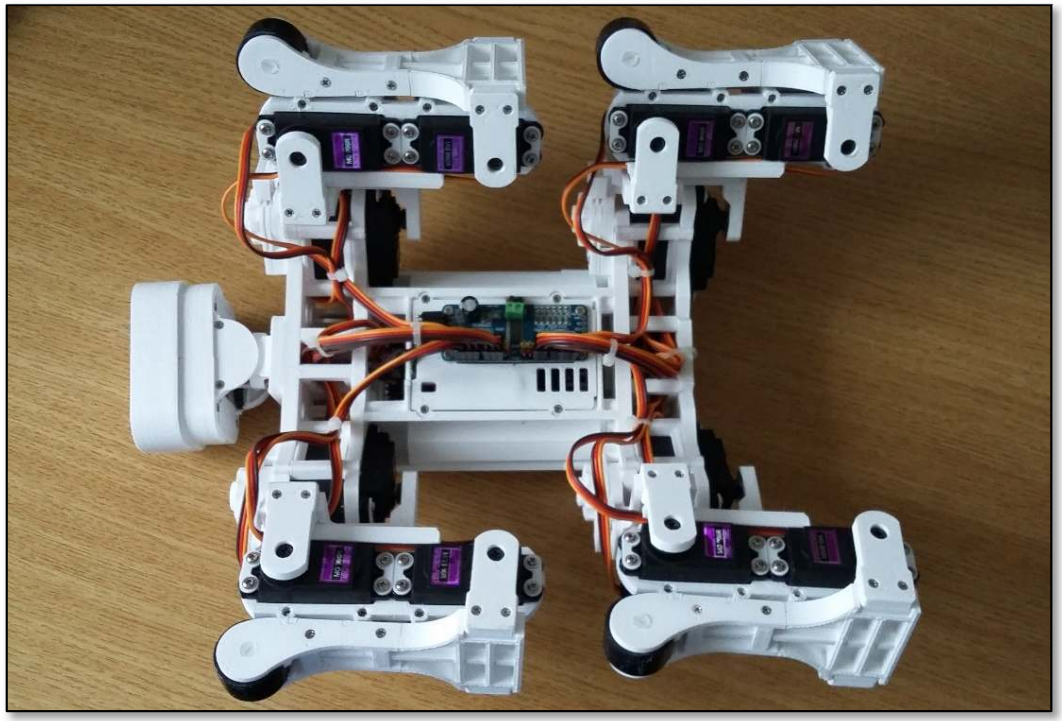
# Servo Wiring





**Wiring order:**

1. Start with the PCA board mounted on the cover plate.
2. Place the robot upside down on a flat surface as shown.
3. Route the wire from servo SFL1 to channel 0, then SFR1 to channel 1.
4. Continue with SFL2, SFR2, etc up to SFR3, then the head servo SH0.
5. Now start from the other side with SRL1 to channel 15.
6. Continue with SRR1 to channel 14, SRL2 to 13, etc.
7. Hide the excess cables in the shoulder compartments.
8. Use the cable guide covers for SFR1, SFL1, SRR1, SRL1.
9. Group cables and apply cable ties.
10. Ensure that legs can move freely, whilst not stretching the leads.

**Servo - Channel Mapping**

| | | | |
|---|---|---|---|
| SH0 | 6 | NC | 8 |
| SFL1 | 0 | NC | 9 |
| SFR1 | 1 | SRL3 | 11 |
| SFL2 | 2 | SRR3 | 10 |
| SFR2 | 3 | SRL2 | 13 |
| SFL3 | 4 | SRR2 | 12 |
| SFR3 | 5 | SRL1 | 15 |
| NC | 7 | SRR1 | 14 |

## Battery Voltage Health Monitoring

See 18650 discharge curve obtained from the internet. In this analysis both batteries are identical and connected in series,
Assume fully charged batteries max voltage is $V_{BM}$ = 8.4v max
I measured my rechargeable PP3 at 8.65v when connected and ON.
Set battery warning point at $V_B$ = 7.00v
Set battery critical point at $V_{BC}$ = 6.60v

NodeMCU is powered from batteries connected to $V_{in}$.
It has internal resistor network of 220k + 100k, so 3.2v at A0 pin gives 1.0v at VADC == 1023 on 10-bit converter (1024 max).
If we use a 680k resistor feeding A0 we get 10.0v == 1023
Using a Multimeter I determined the conversion factor to be 103.66

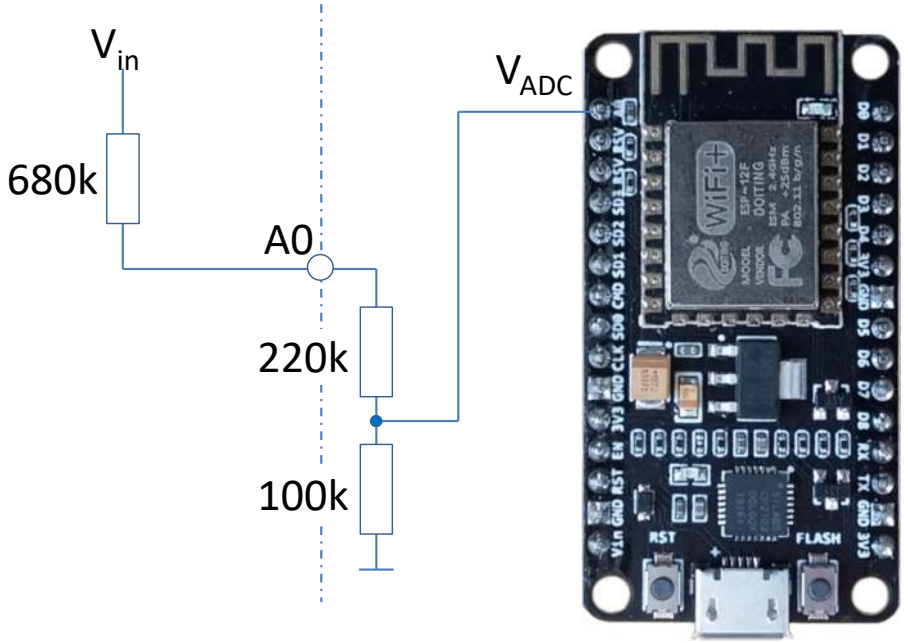
WARNING: $V_B$ = 7.0v, gives A0 = 726 on ADC ($V_B$*103.7)

CRITICAL: $V_{BC}$ = 6.6v, gives A0 = 683 on ADC ($V_{BC}$*103.7)

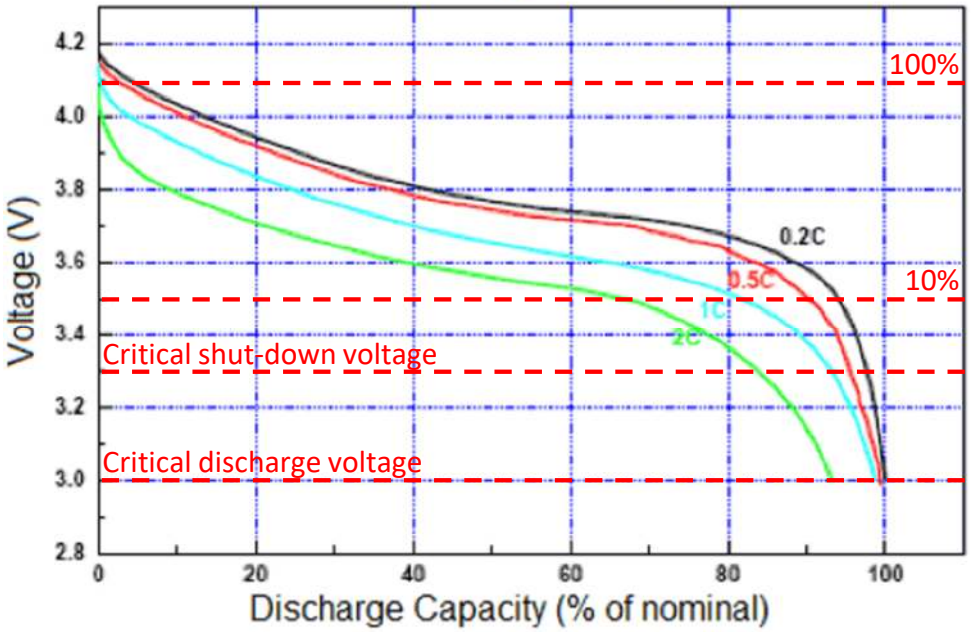
The code will sample the battery voltage on power-up to ensure it is sufficient, then at every 40ms interval, calculating an average (1/20) to remove noise.

Given the relatively light current drawn I have assumed a linear discharge curve ranging from 8.2v (100%) to 6.6v (0%) capacity. The rate of discharge is monitored and used to actively predict the life of the battery in use.

Note: If connected to USB port with internal battery switched OFF the ADC will read a value 5 volts (A0 = 519) or less. So if the micro starts with such a low reading it knows that it is on USB power.




18650 Lithium Battery
Discharge Profile




Discharge: 3.0V cutoff at room temperature.