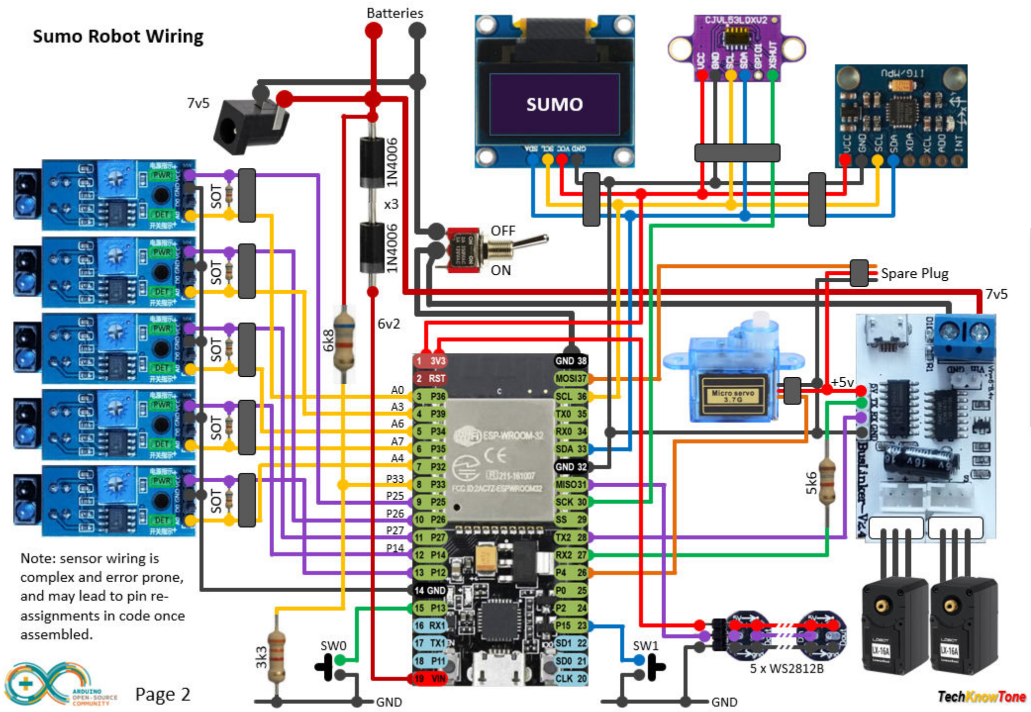
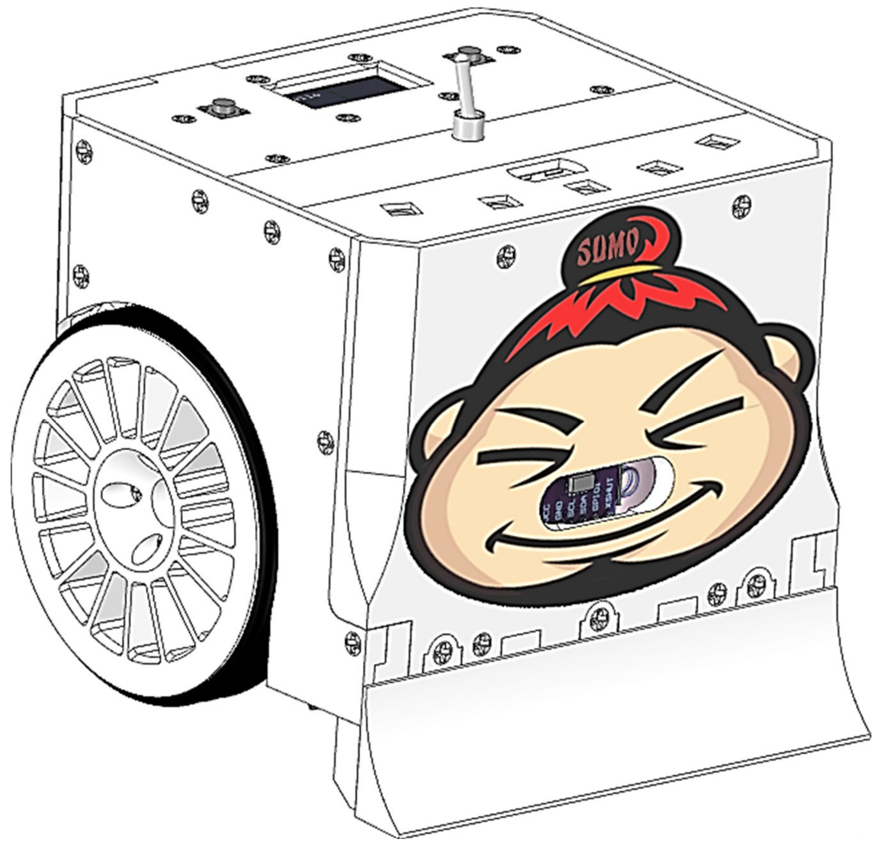
SUMO Robot^{mini}

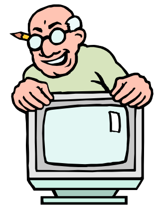
Circuits & Wiring





Issue: 1.1 Released: 08/12/2025 TechKnowTone

CAUTION



Lithium batteries can be <u>extremely</u> dangerous, if not handled and cared for properly. This design does not include any form of current limiting circuit, like a fuse. So, care <u>must</u> be taken to ensure that the wiring guidelines are followed accurately, that checks are made for short-circuits, and that battery polarities are marked, and they are inserted the correct way round. Failure to do so, could result in an explosive fire.

Charging Practices: Always remove batteries from your project to charge them. Use a charger, designed for the battery used, and from a trusted supplier. Choose a flat, non-flammable surface to charge on, away from flammable materials. Never leave unattended when charging. Don't charge overnight. Monitor charging to ensure charge characteristics are as expected. Only pair batteries with similar characteristics. Do not overcharge, or leave charging for prolonged periods. This increases the risk of damage and fire.

Battery care & maintenance: Stop using a battery if it is swollen, damaged, dented or leaking. Never charge a damaged battery. Never allow a Lithium battery to discharge below 3.2 volts, as cell damage will occur. Avoid extreme temperatures. Do not charge or store batteries in very hot or cold environments. Don't cover batteries whilst charging, as this can trap heat, causing overheating.

In case of fire: Get out and stay out. If a fire starts, leave immediately, and call the fire brigade. For low voltage Lithium batteries, water is a safe extinguisher.

Built-in Monitoring: Most of my project designs include code, and circuitry, to monitor battery voltage, whilst in use. This code then seeks to alert the operator, when the battery has reached a critical low voltage, before shutting down power consuming circuitry; including the micro. Time should therefore be spent on calibrating this feature, as a precaution, for good battery management and maintenance.

Carefully dispose of batteries that damaged, or discharged below their critical voltage.

Hand Tools:

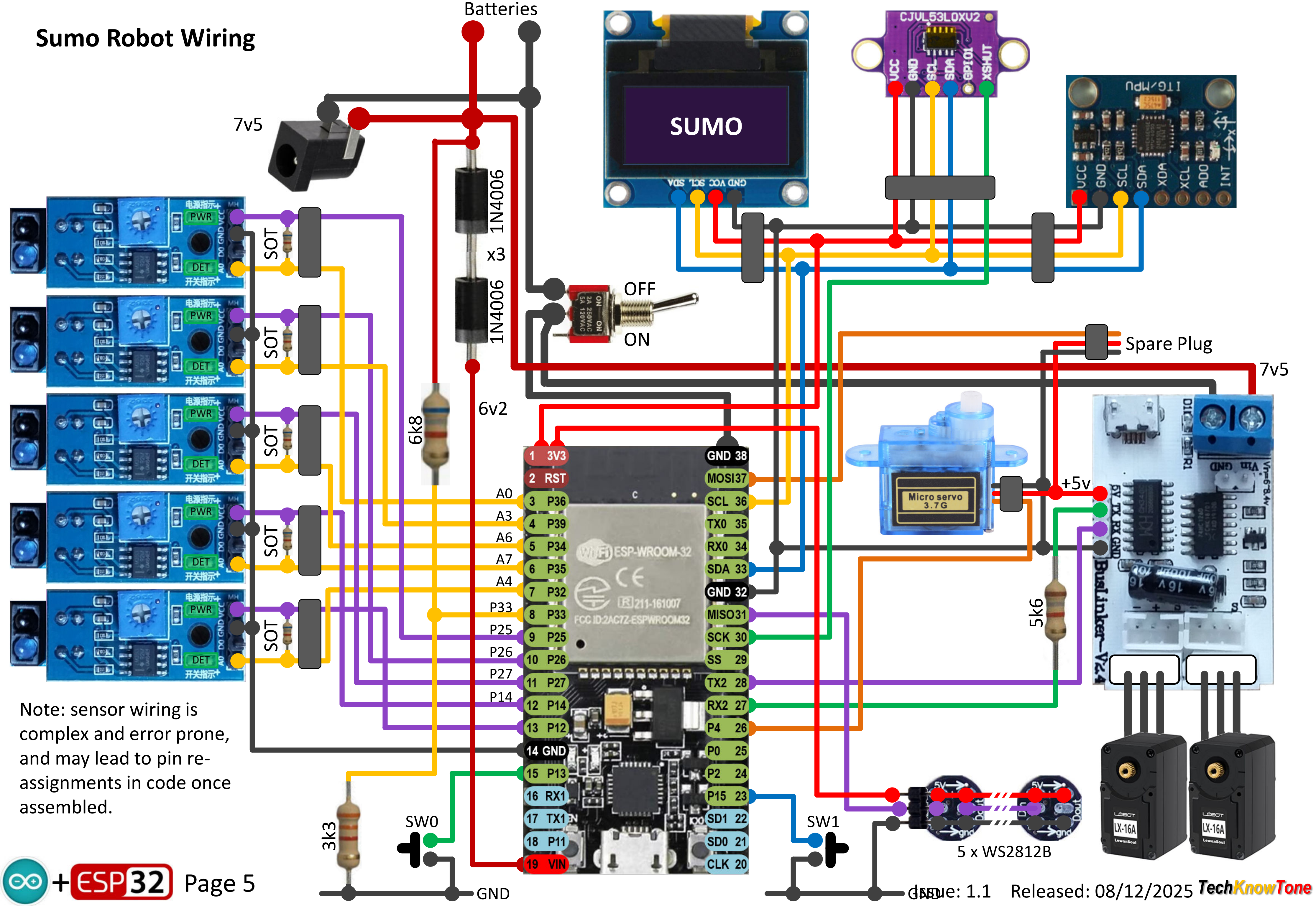
Recommended:
- Fine Nosed Pliers
- Side Cutters
- M3 Tap
- M4 Tap
- 1.5 mm Drill
- 2.0 mm Drill
- 2.5 mm Drill
- 3.0 mm Drill
- Needle Files
- Screwdriver
- Craft Knife

Note: Not all items are shown here.

Tools & Materials:

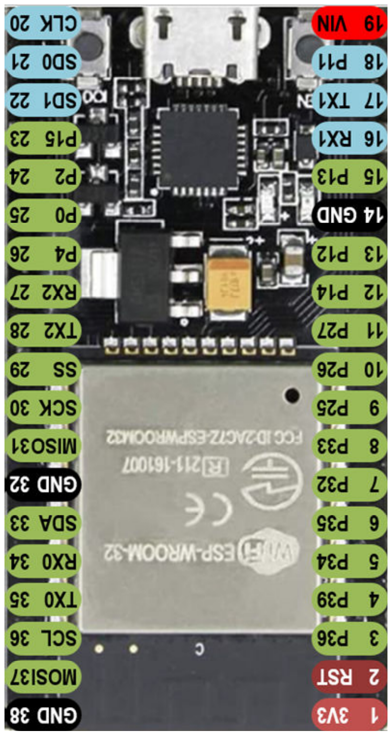
Temperature controlled iron
Solder flux
Resin cored solder
Hot melt glue gun {optional)
2-part epoxy resin glue
Screw drivers
Tweezers
Wire wrapping tool
Wire wrapping wire 30 AWG
24 AWG stranded wire (red, black & yellow)
Multimeter

Sumo Robot Wiring

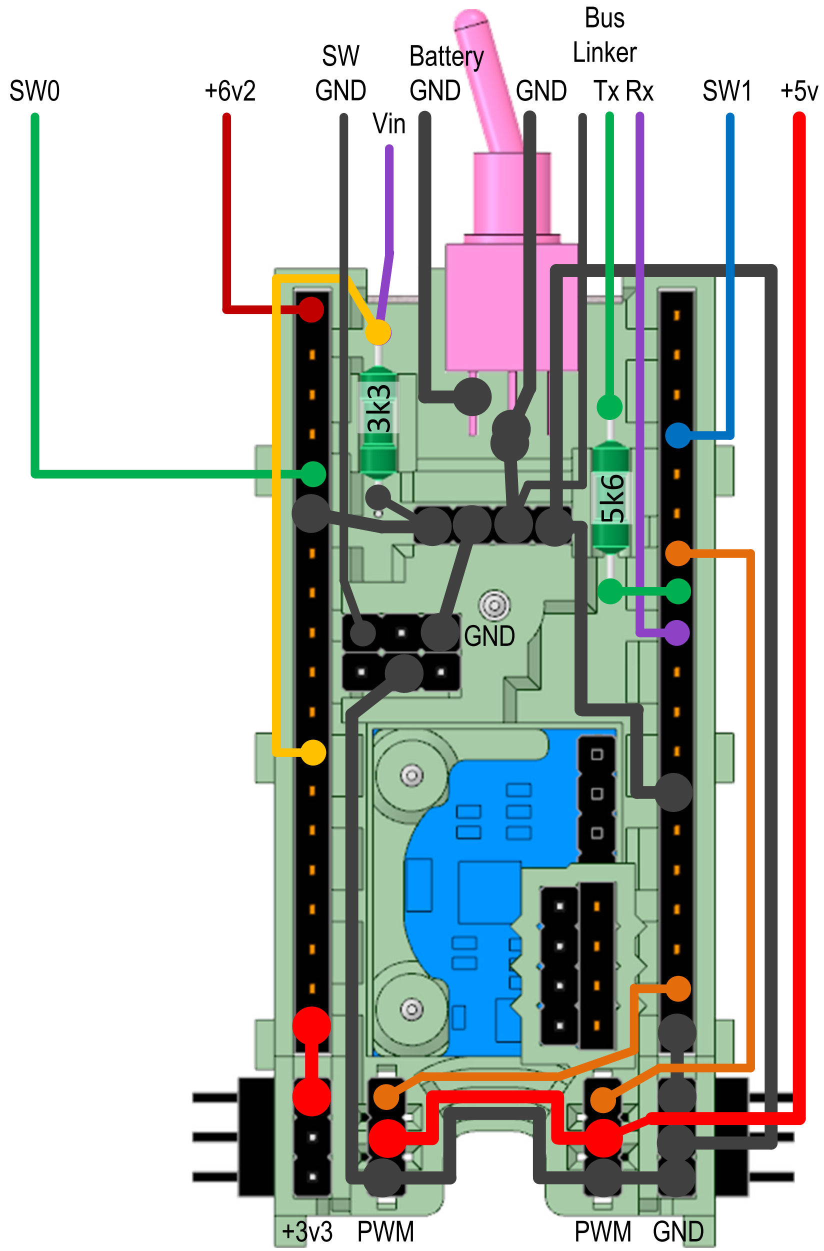


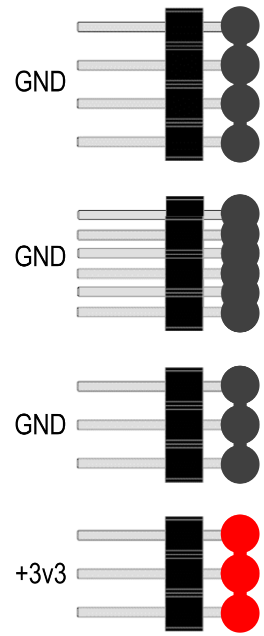
Note: sensor wiring is complex and error prone, and may lead to pin re-assignments in code once assembled.

Micro Plate Wiring – step 1



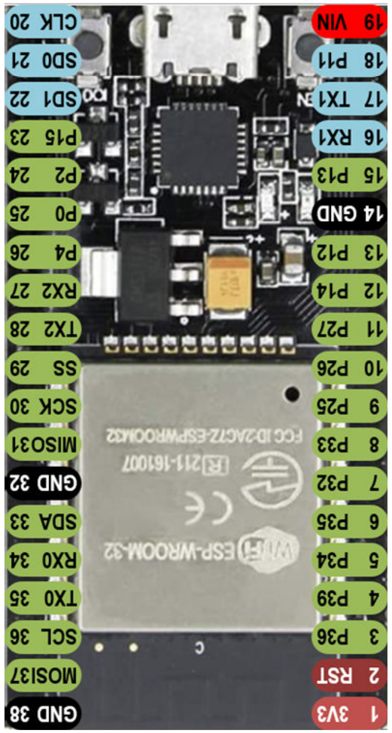
Viewed from top side
Reverse connections
when wiring!



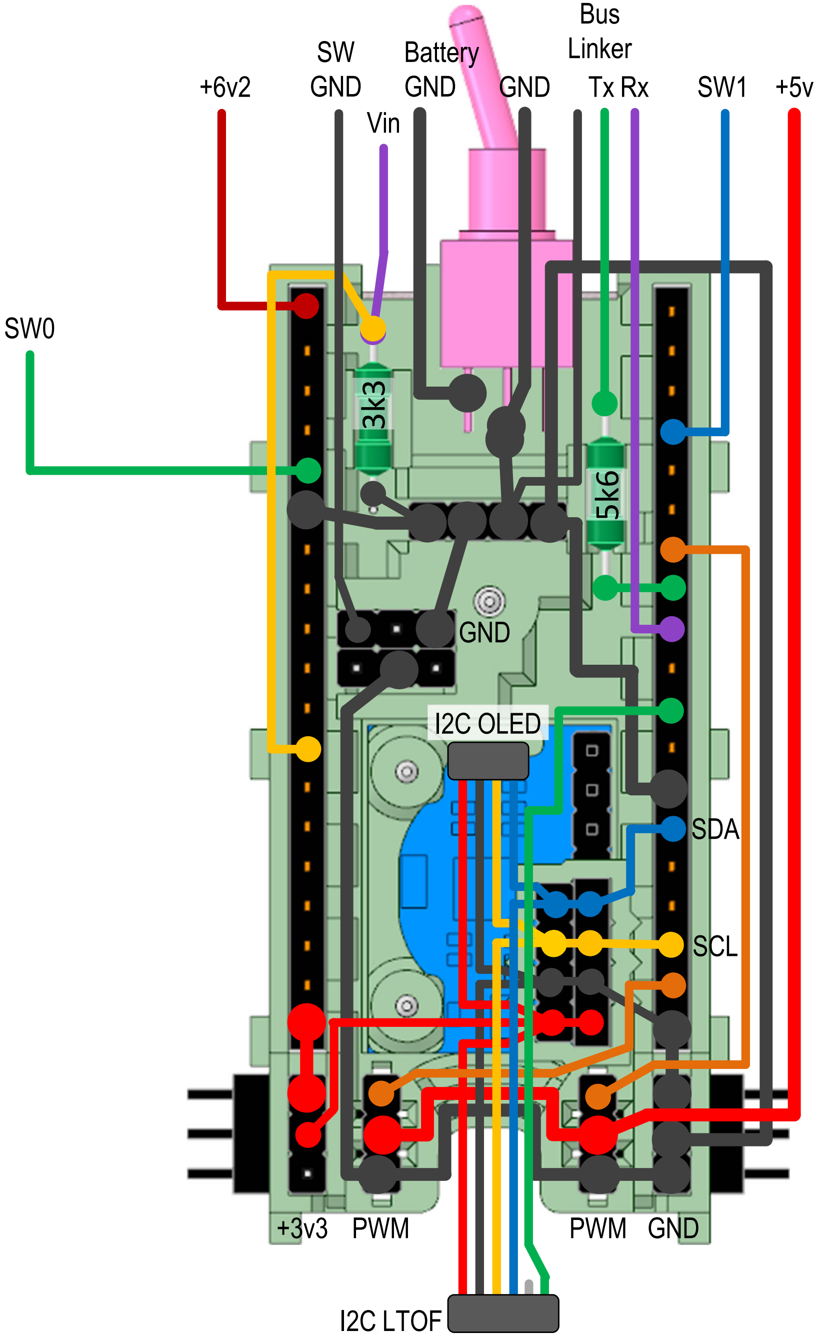


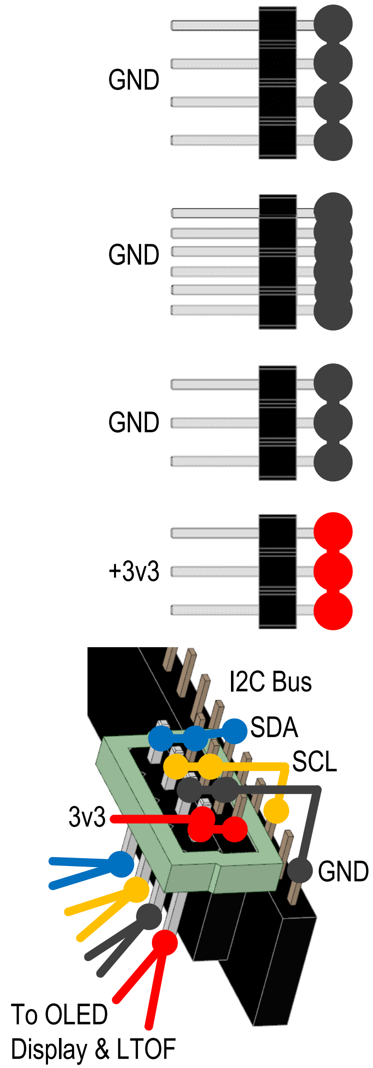
Issue: 1.1 Released: 08/12/2025 TechKnowTone

Micro Plate Wiring – step 2

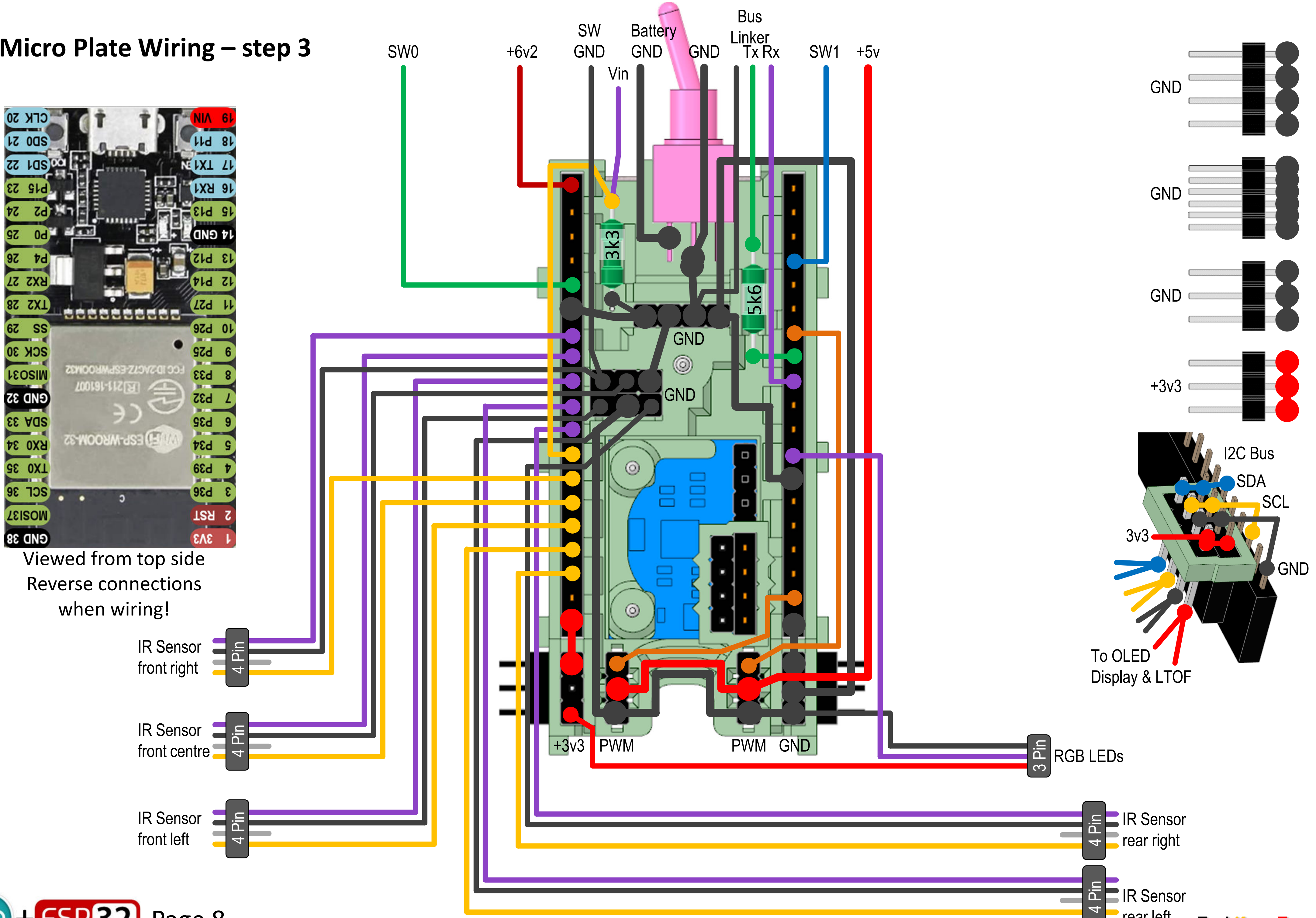


Viewed from top side
Reverse connections
when wiring!

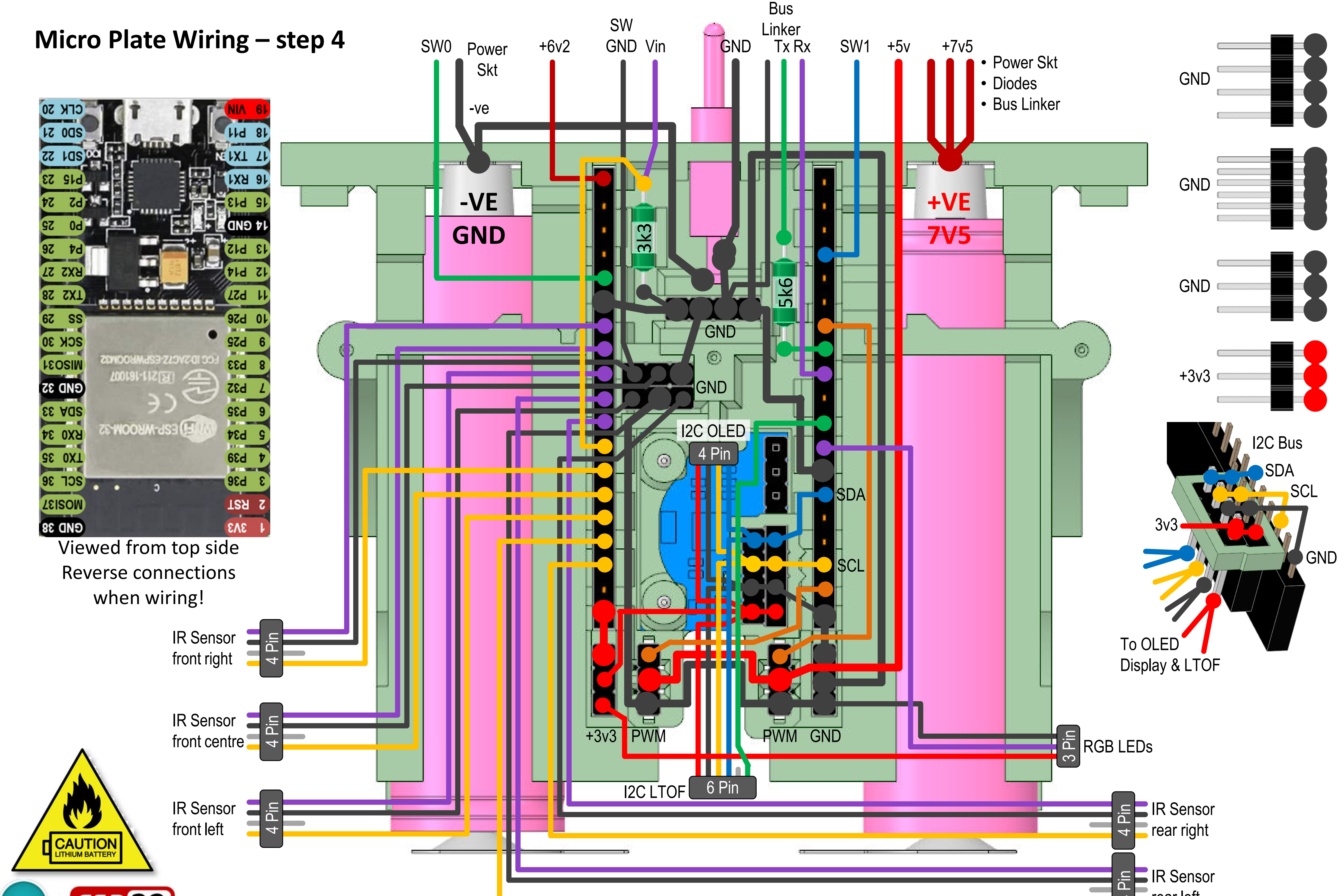




Micro Plate Wiring – step 3

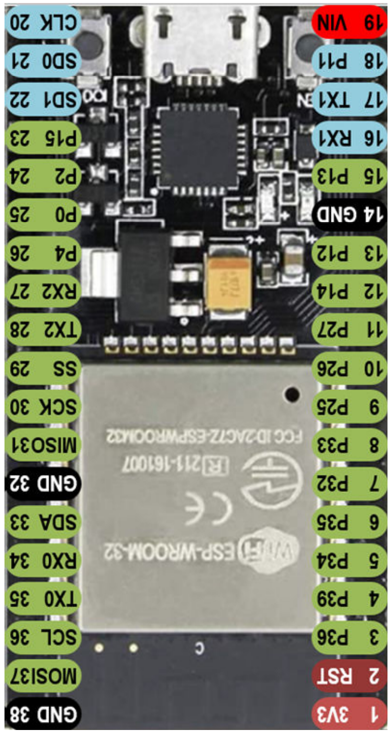


Micro Plate Wiring – step 4

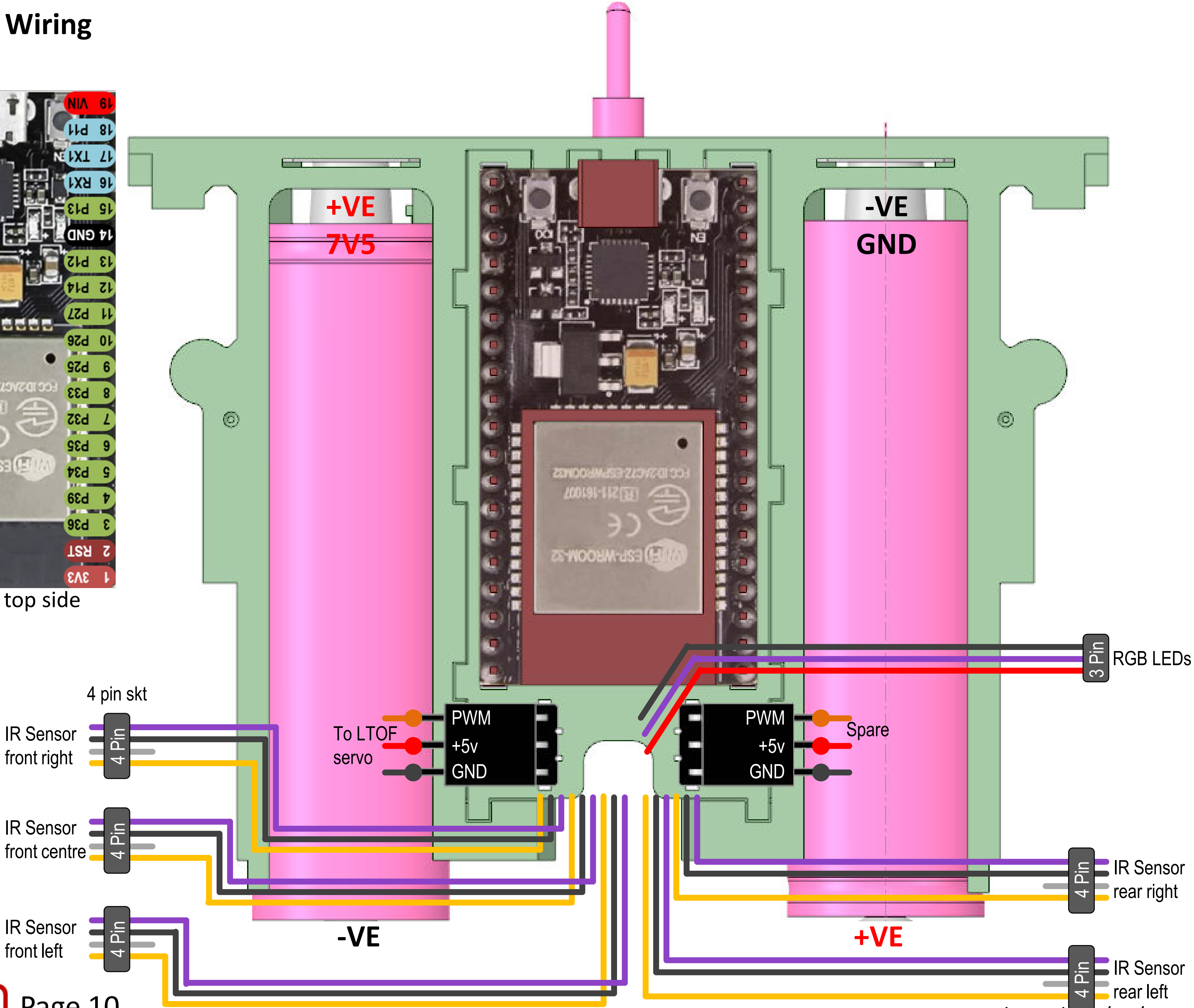


Issue: 1.1 Released: 08/12/2025 TechKnowTone

Micro Plate Wiring

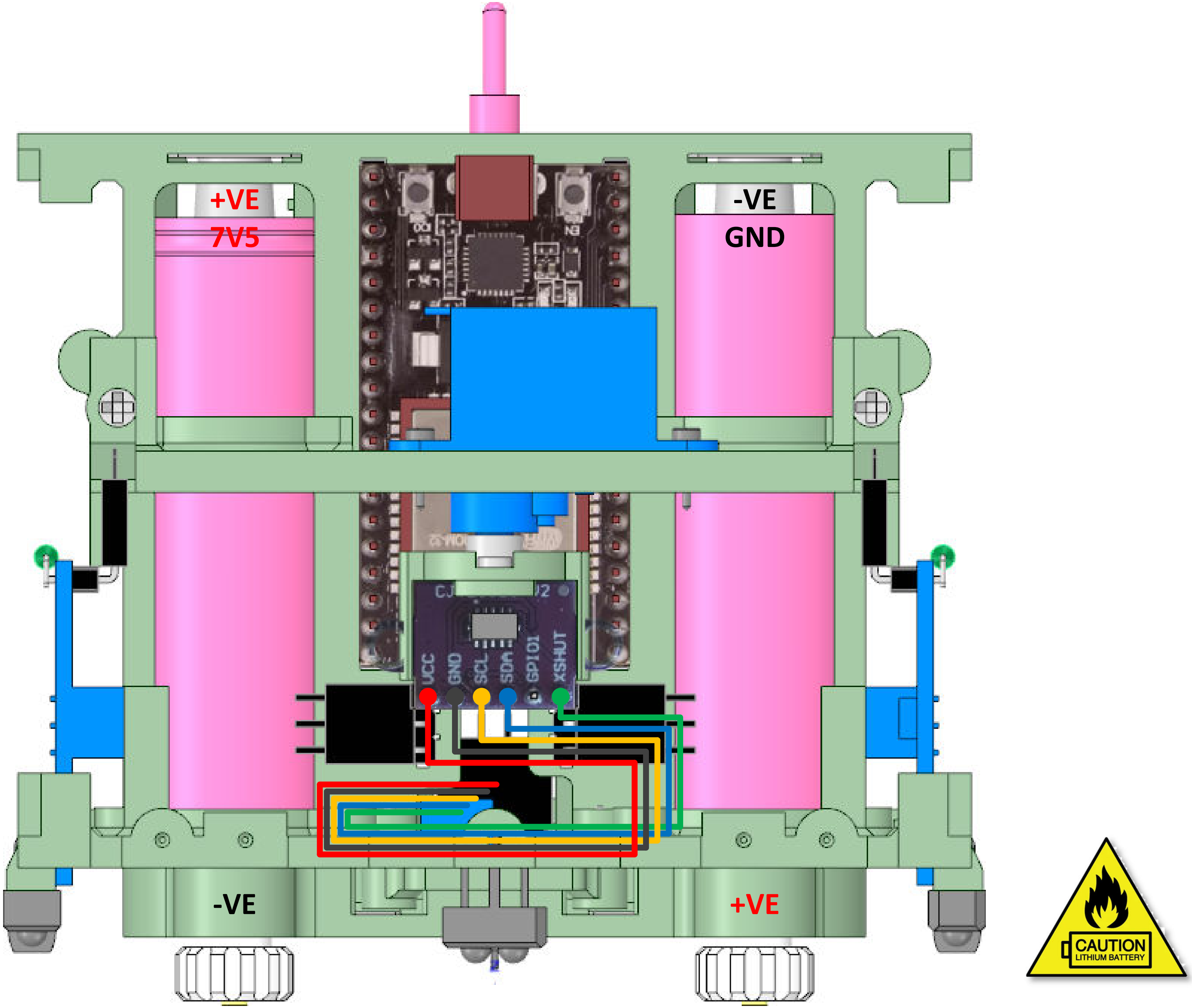


Viewed from top side



Issue: 1.1 Released: 08/12/2025 TechKnowTone

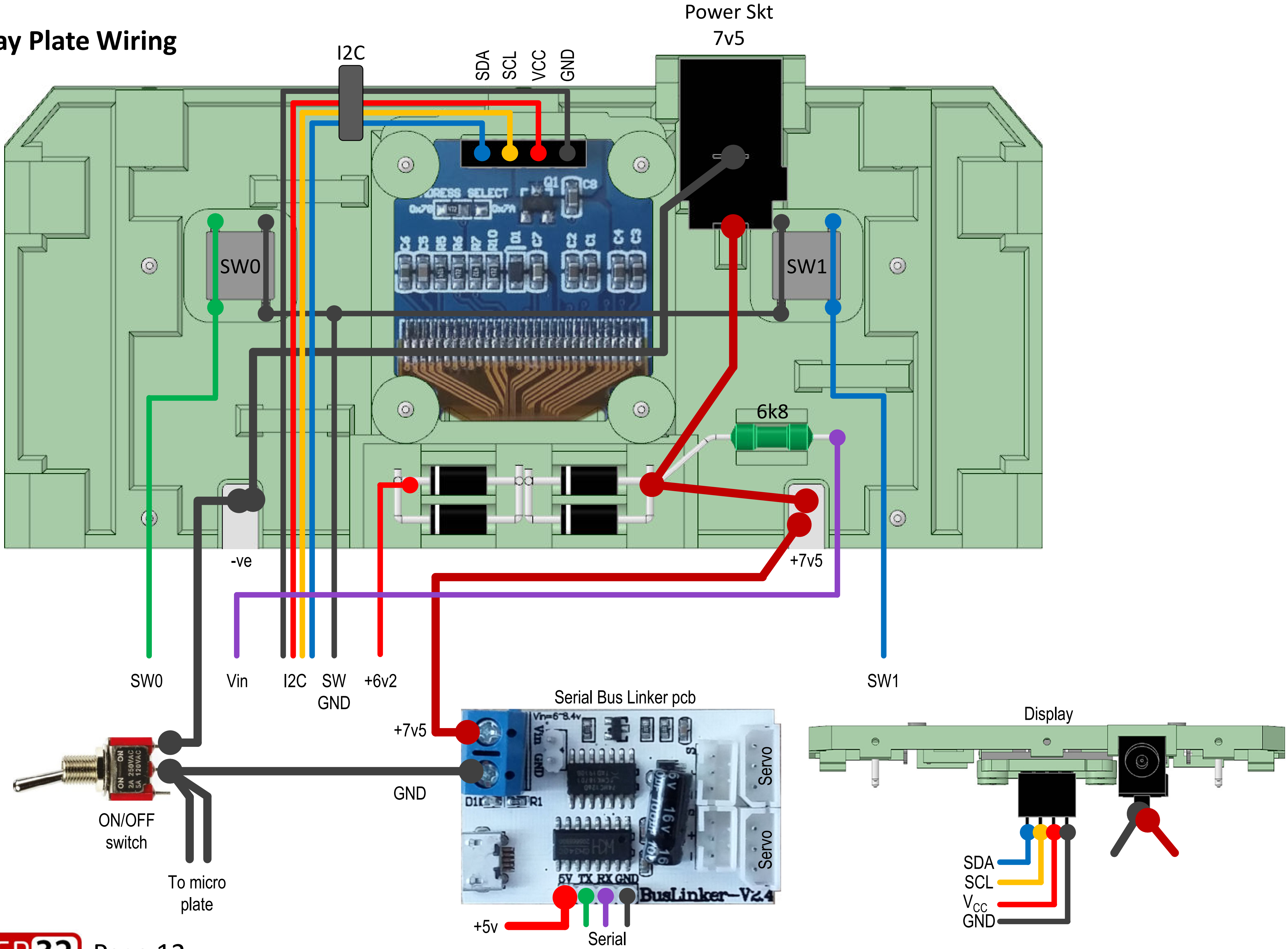
LTOF Sensor Wiring



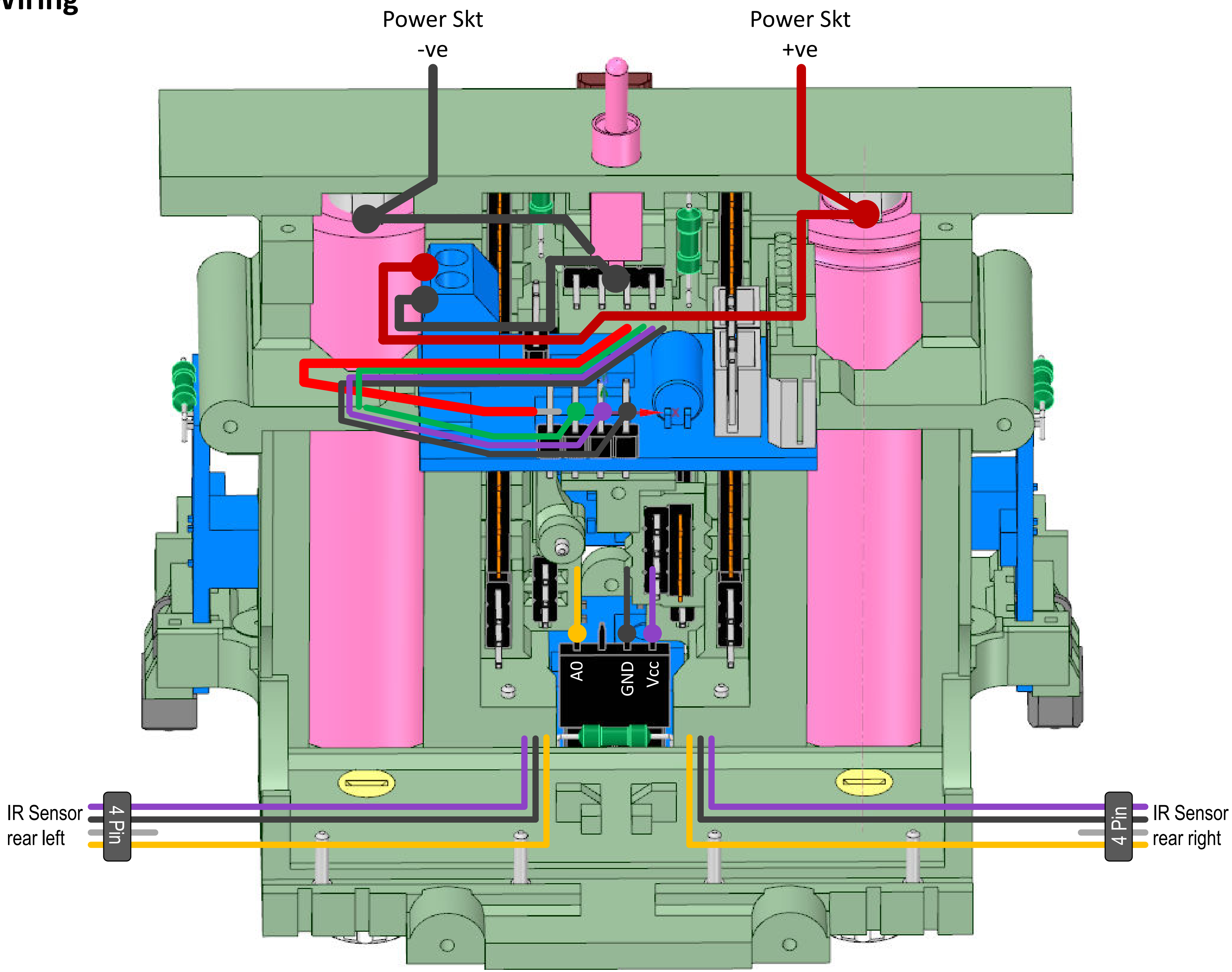
Wiring is looped round to allow the sensor to freely rotate.
Once tested successfully then solder and apply glue to add support to the wiring.

Issue: 1.1 Released: 08/12/2025 TechKnowTone

Display Plate Wiring



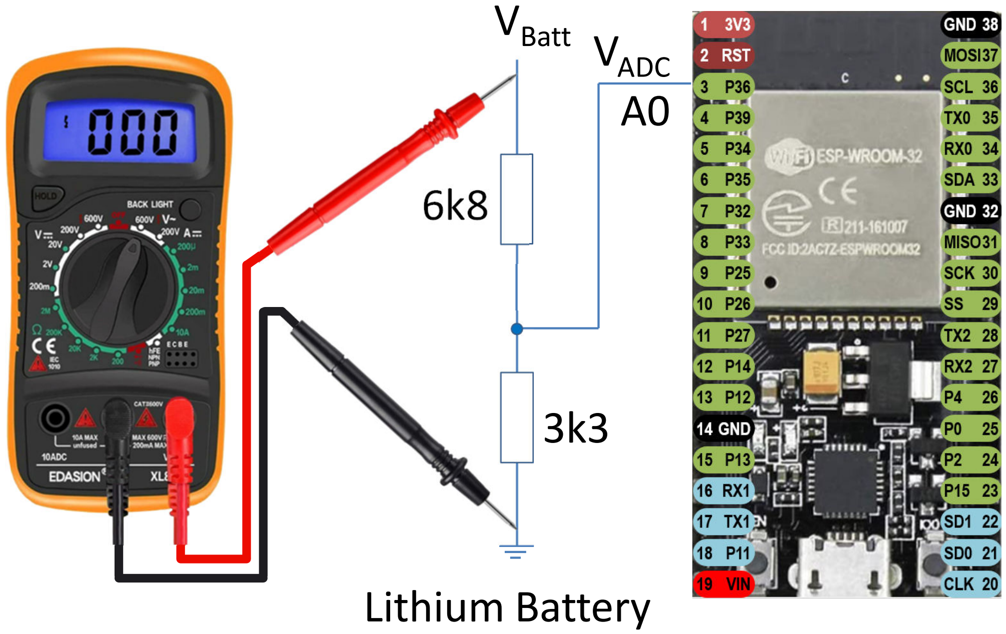
Base Total Wiring



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} >= 8.2v 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

ESP32 is powered from batteries connected to V_{in}.
3.3v at VADC == 4095 on 12-bit converter (4095 max).
If we use a 6k8 resistor feeding A0 and a 3k3 resistor to GND, we get a conversion factor of 10.1v == 4095 or 2.47mV/bit or 404.85
Using a Multimeter I determined the conversion factor needed to be reduced to 372.0 to display voltage correctly.



MAX: V_M = 8.2v, gives A14 = 3048 on ADC (V_M*404.85 * 0.918)

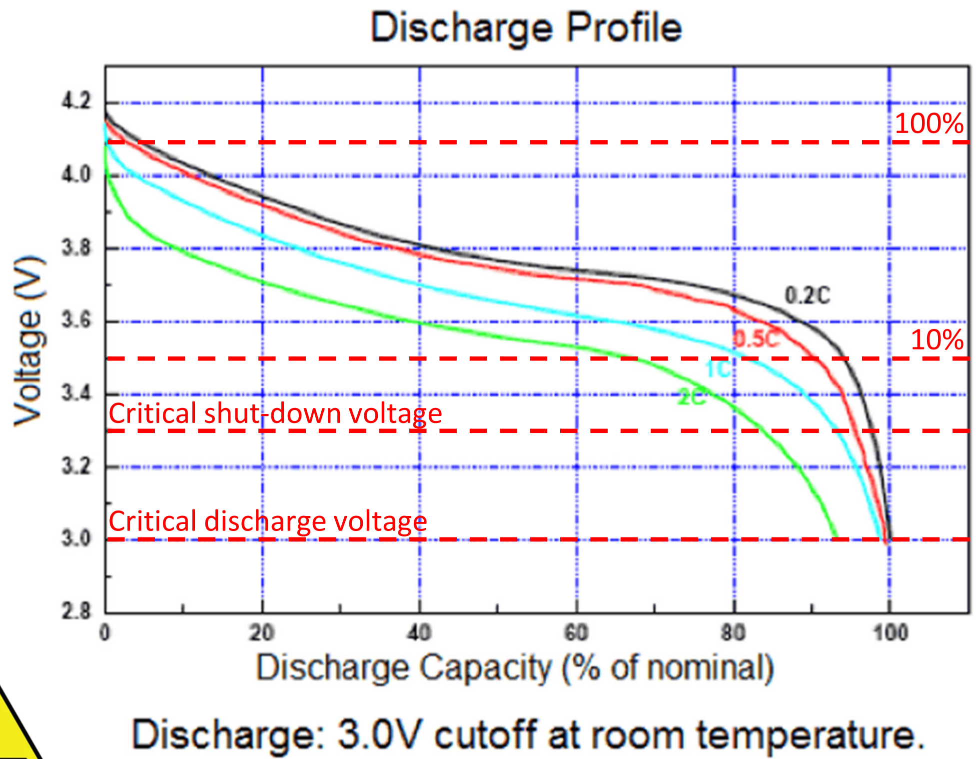
WARNING: V_B = 7.0v, gives A14 = 2602on ADC (V_B* 404.85 * 0.918)

CRITICAL: V_{BC} = 6.6v, gives A14 = 2453 on ADC (V_{BC}* 404.85 * 0.918)

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.

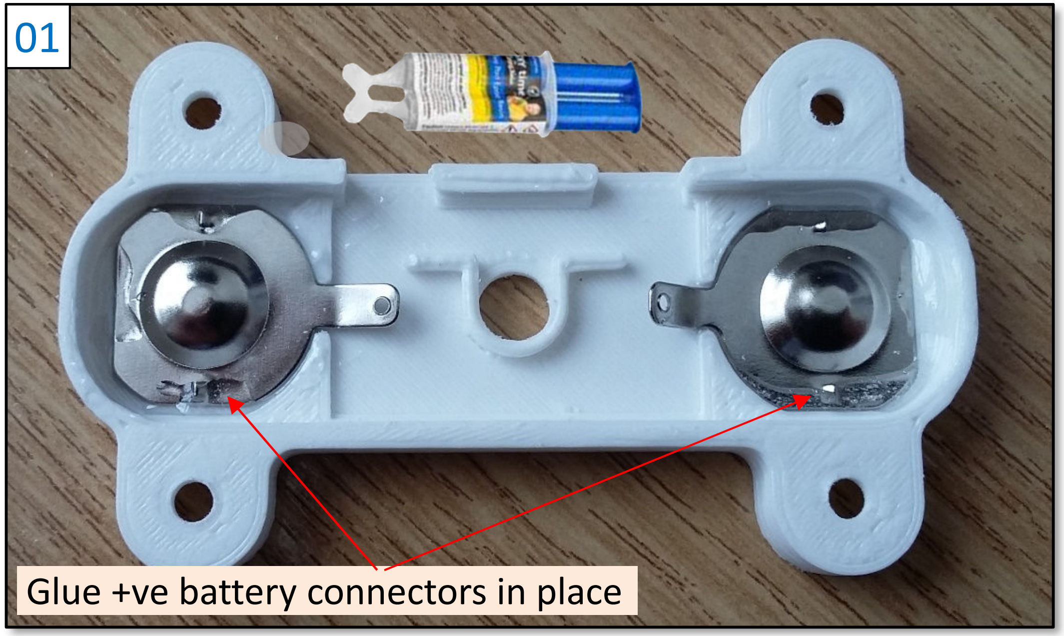
Given the relatively light current drawn I have assumed a linear discharge curve ranging from 8.2v (100%) to 6.6v (0%) capacity. The rate of discharge is monitored and used to actively predict the life of the battery in use.

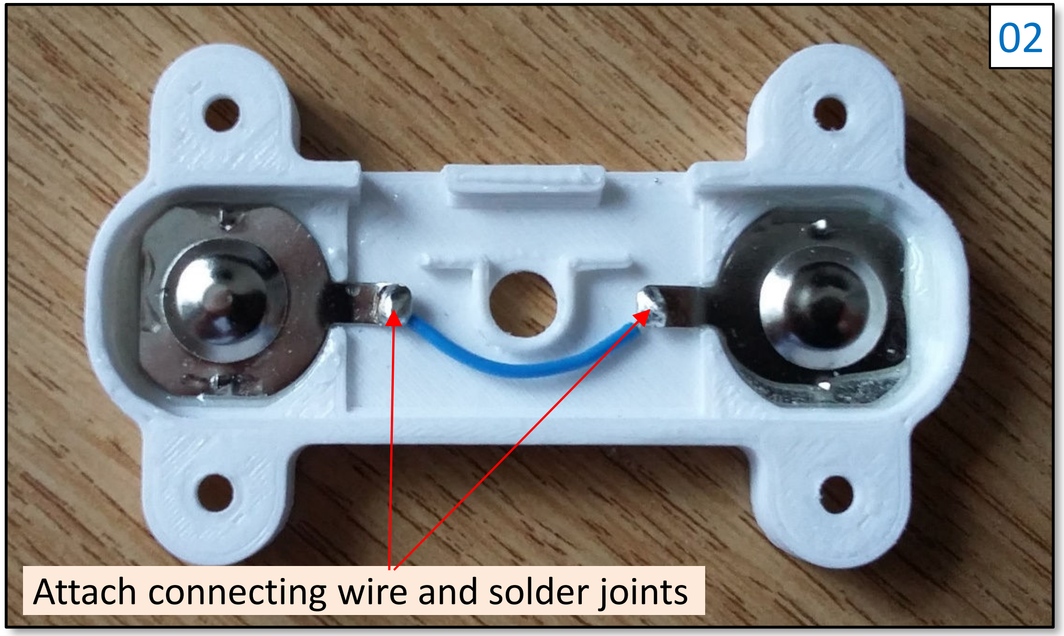
Note: If connected to USB port with internal battery switched OFF the ADC will read a value 5 volts (A14 = 1858) or less. So if the micro starts with such a low reading it knows that it is on USB power.

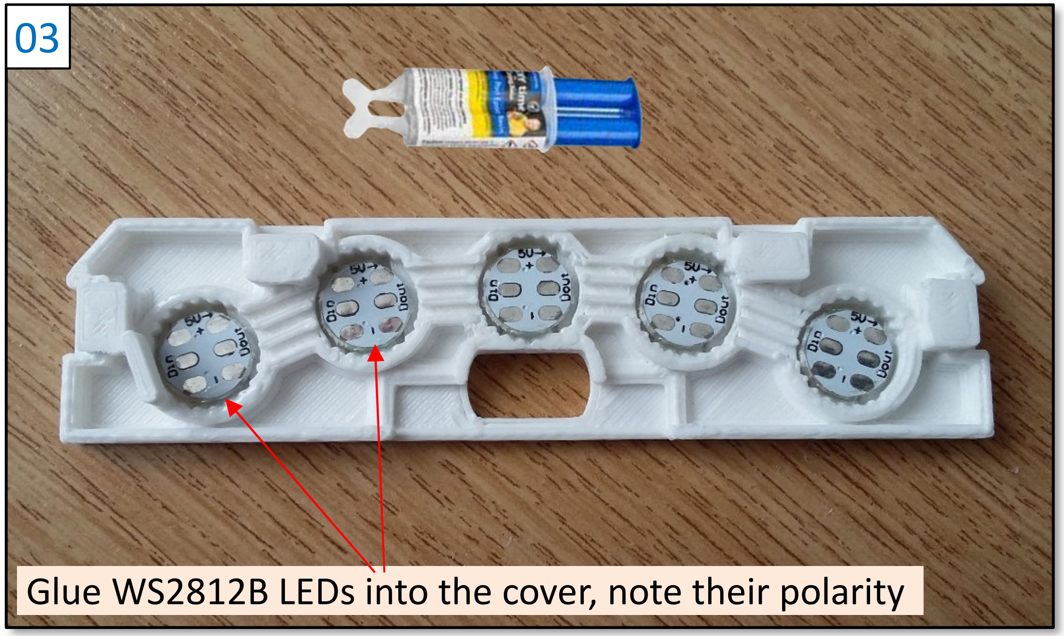


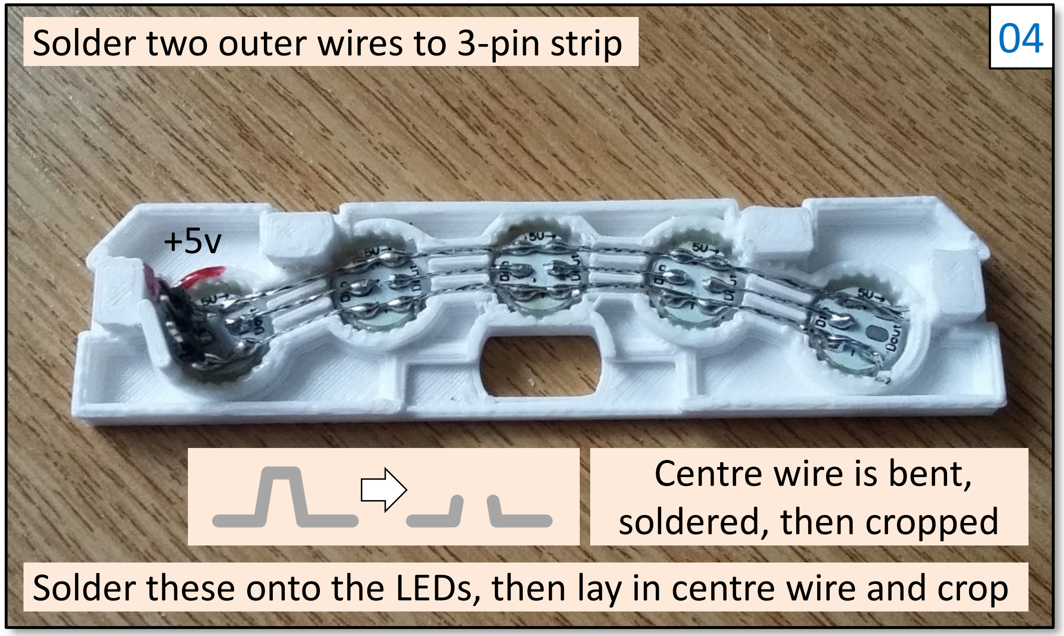
Issue: 1.1 Released: 08/12/2025 TechKnowTone

Wiring Sequence

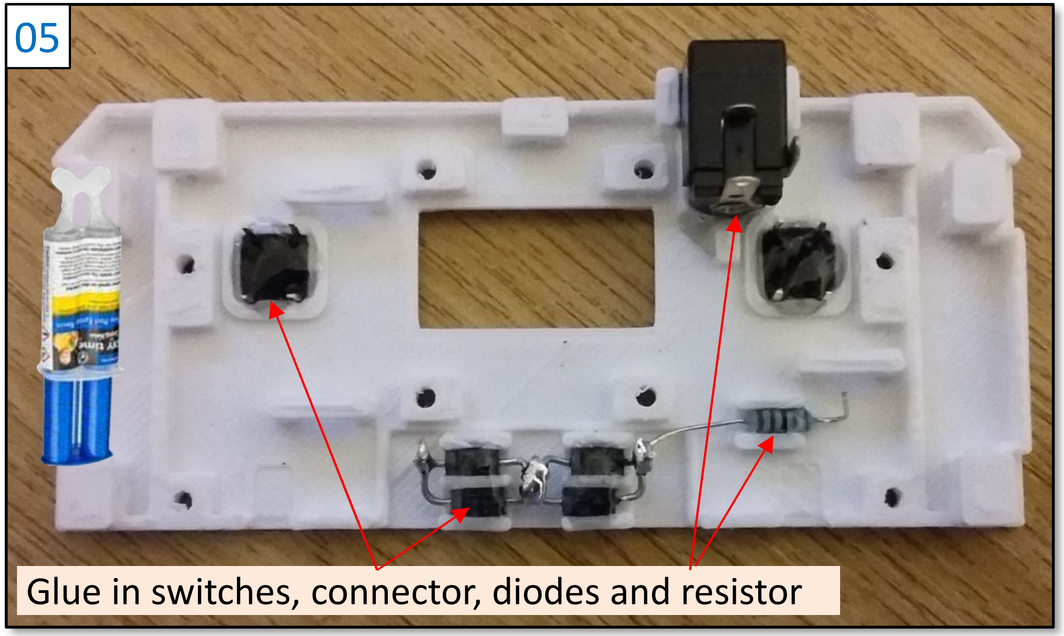


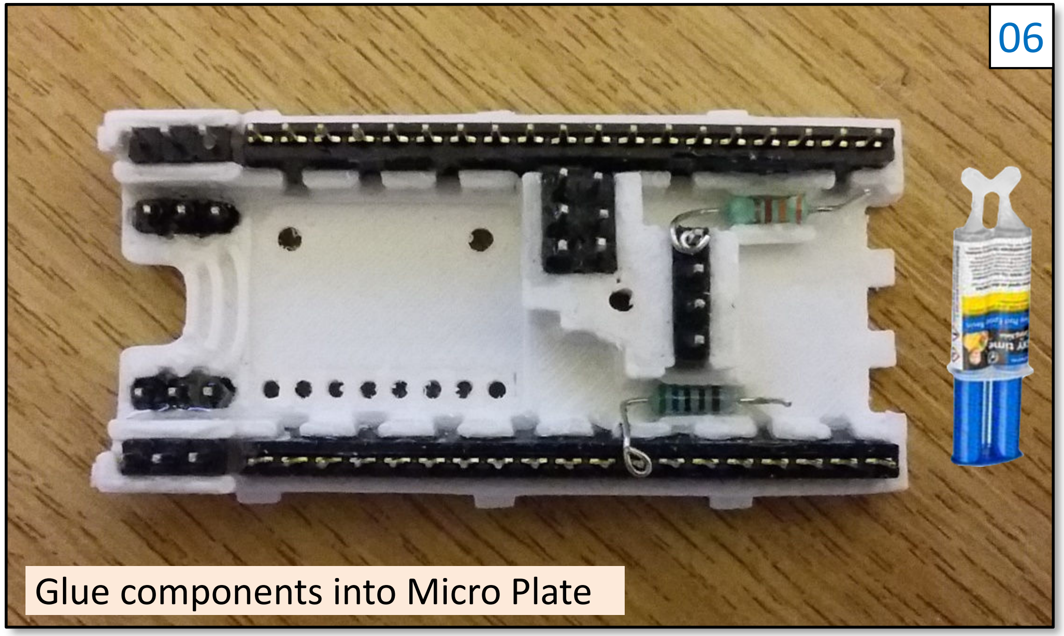


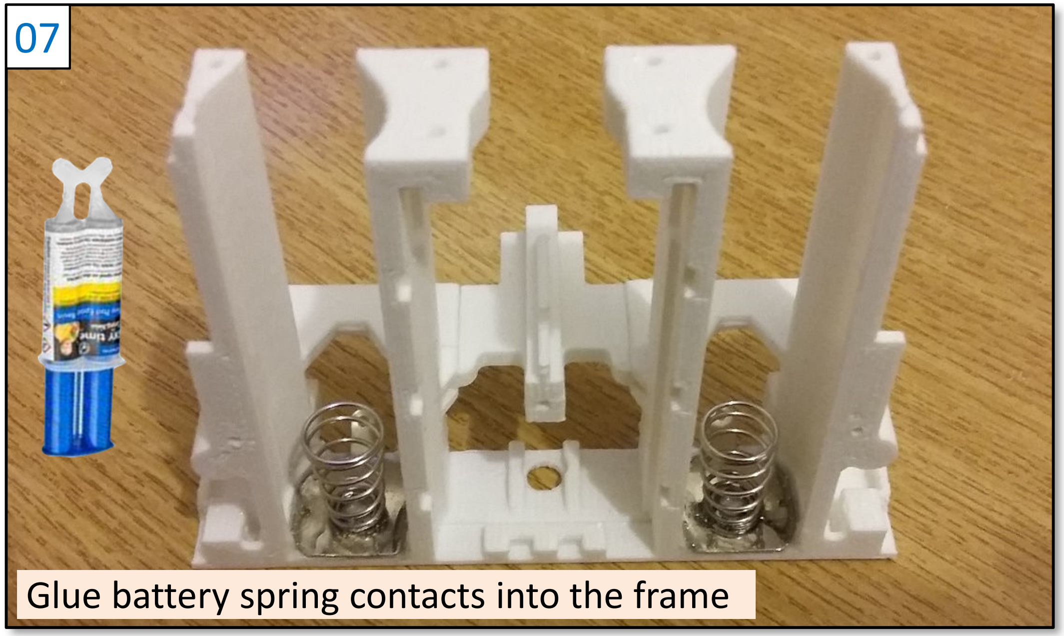


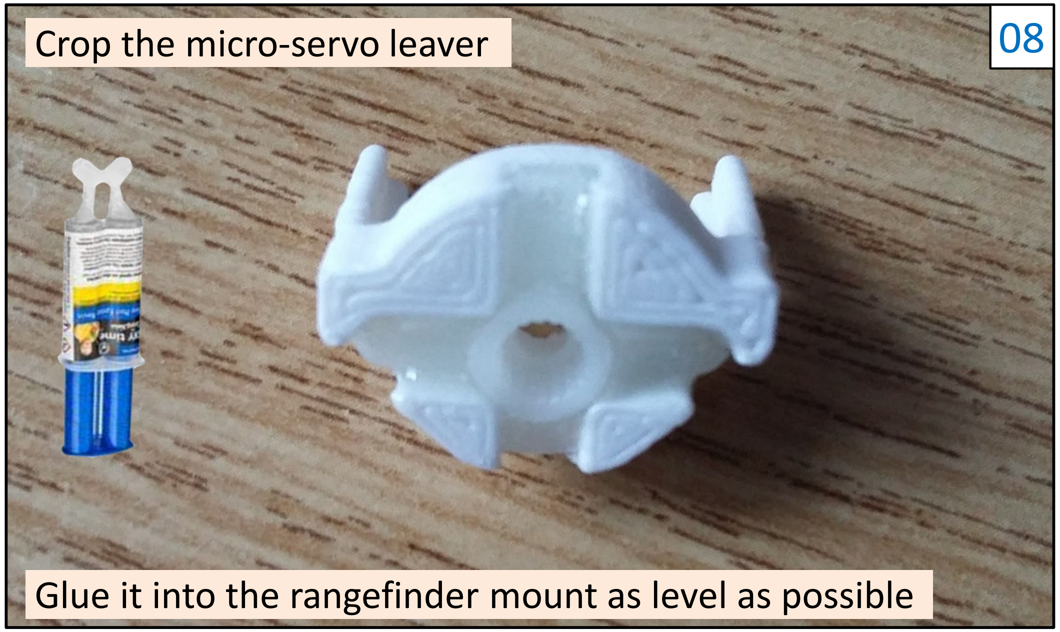


Wiring Sequence



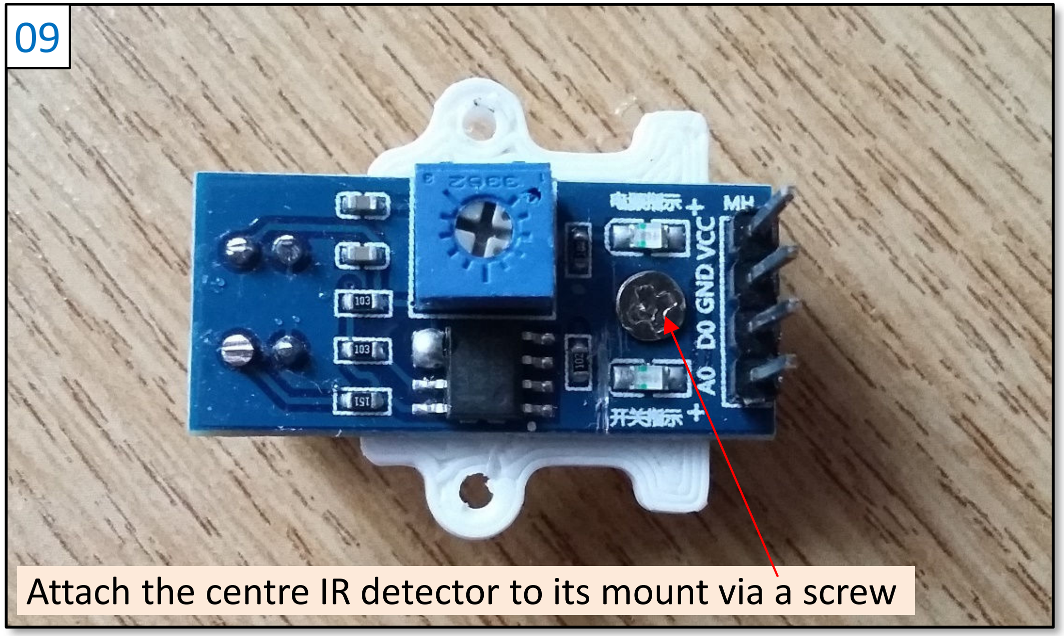






Wiring Sequence

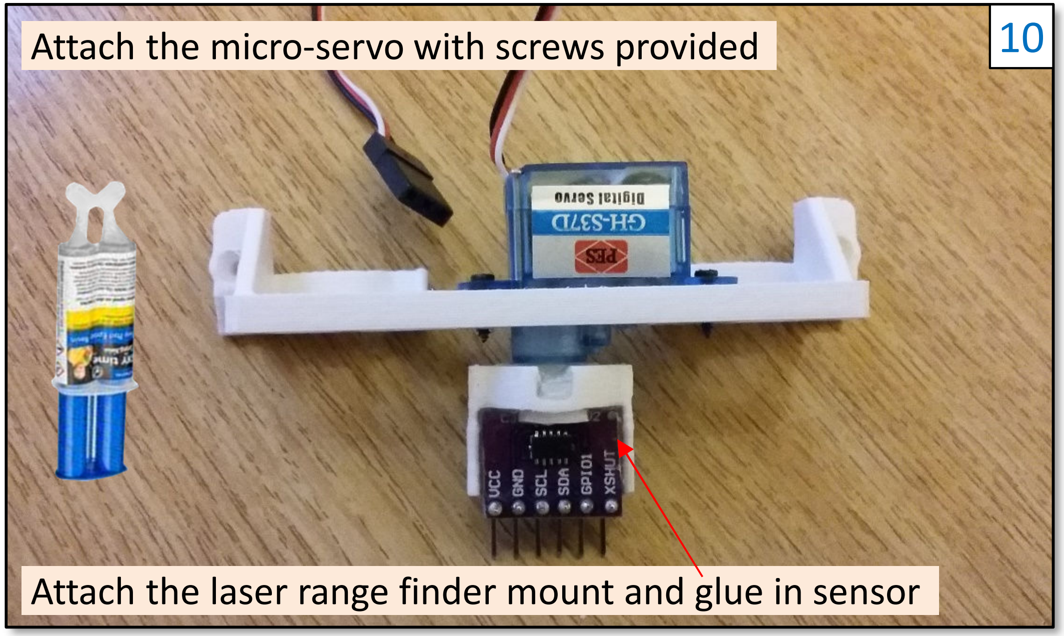
09



Attach the centre IR detector to its mount via a screw

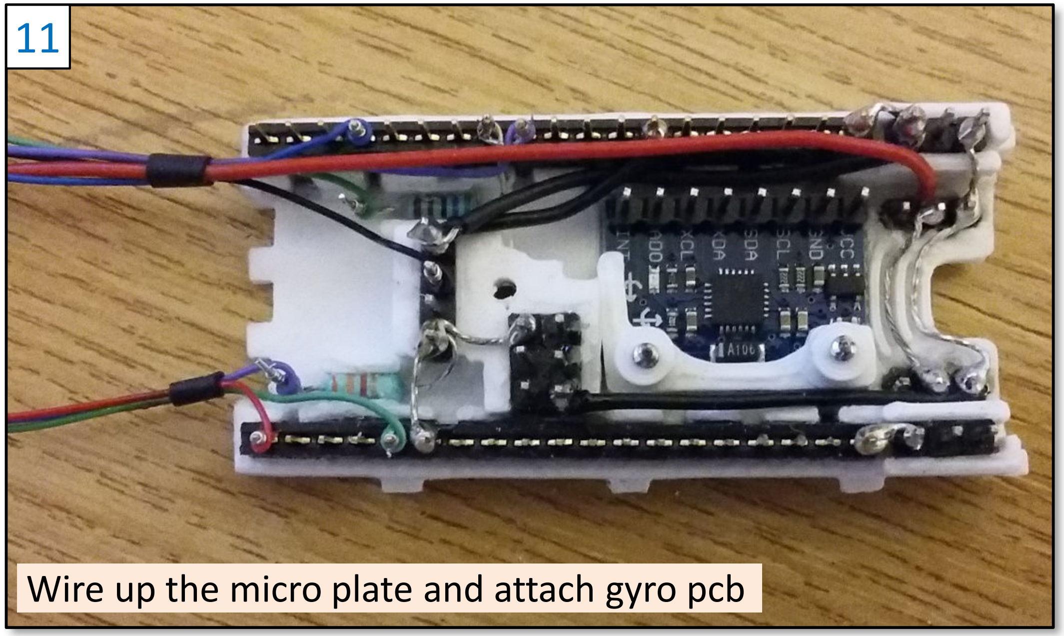
10

Attach the micro-servo with screws provided



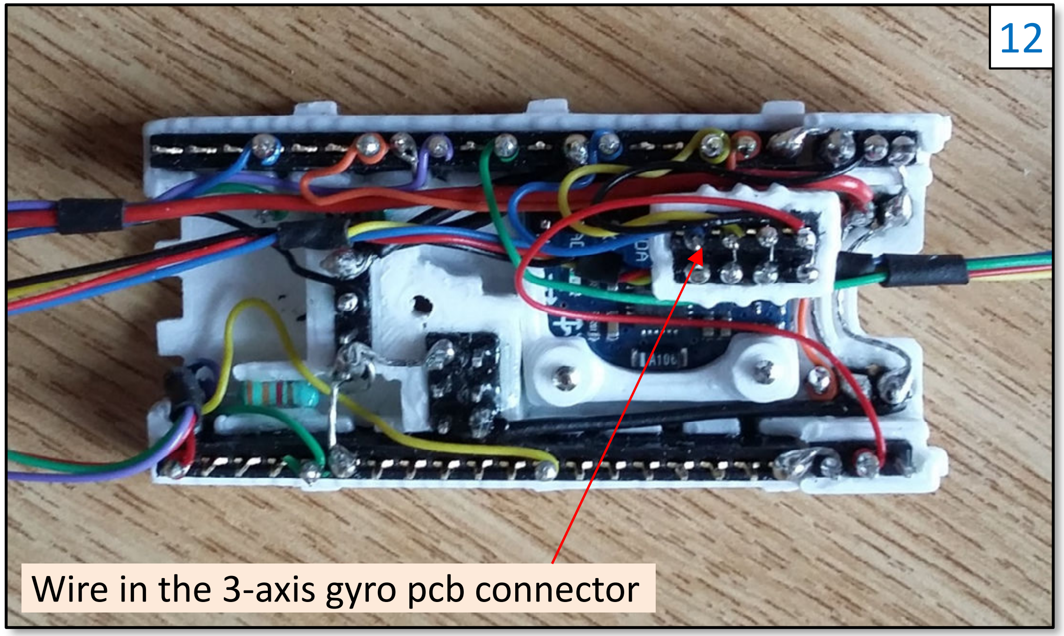
Attach the laser range finder mount and glue in sensor

11



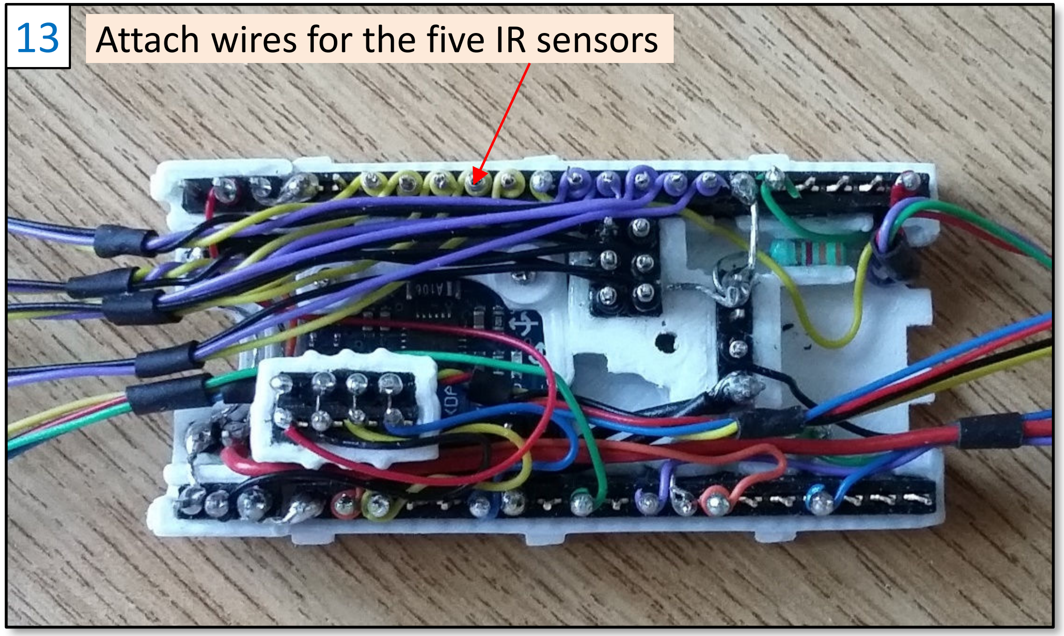
Wire up the micro plate and attach gyro pcb

12

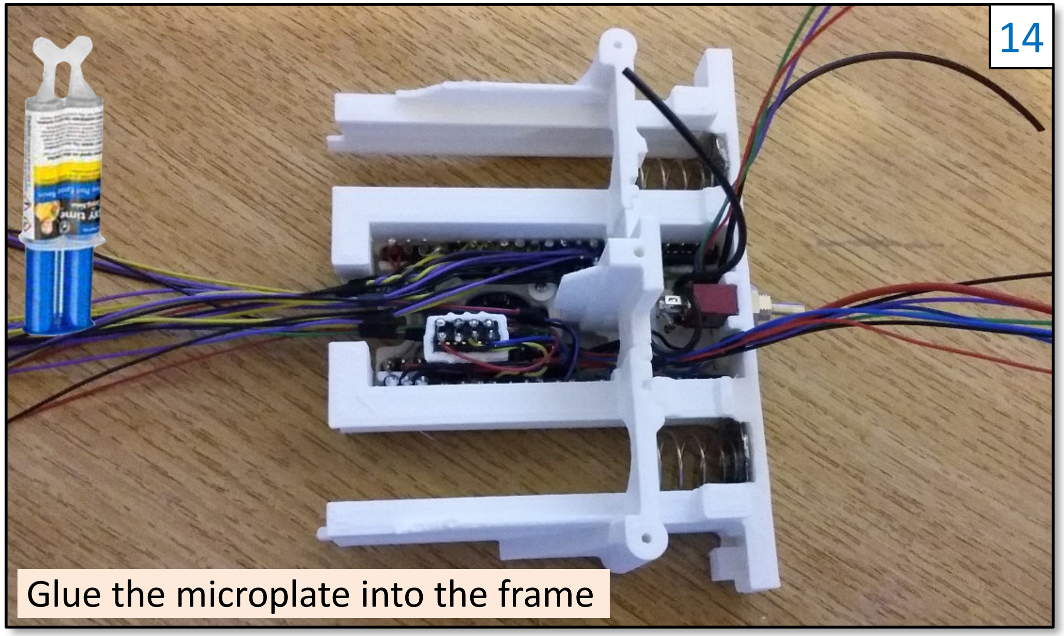


Wire in the 3-axis gyro pcb connector

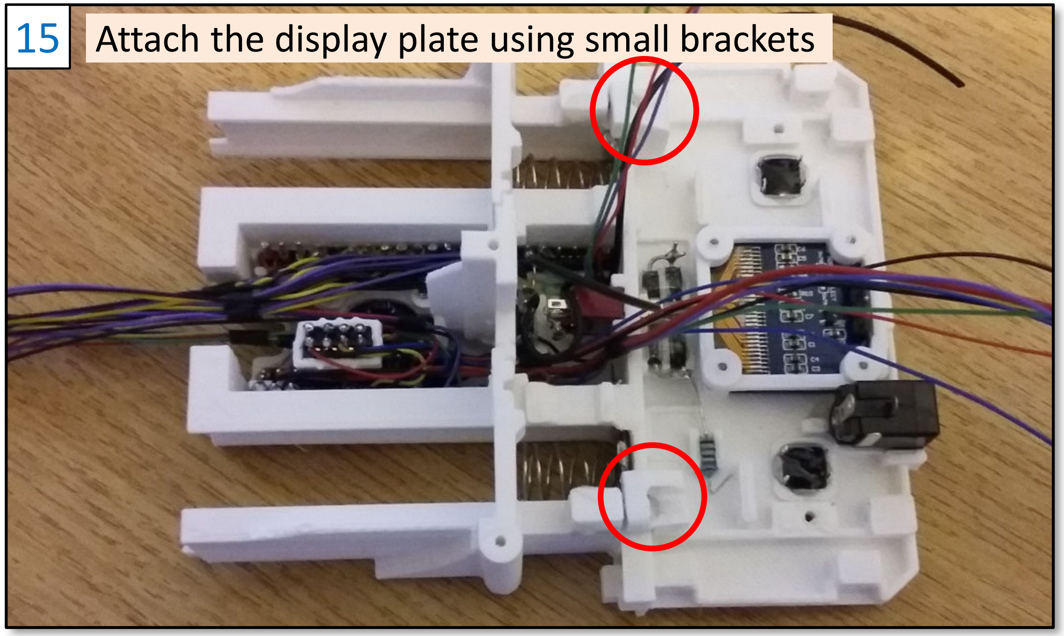
Wiring Sequence



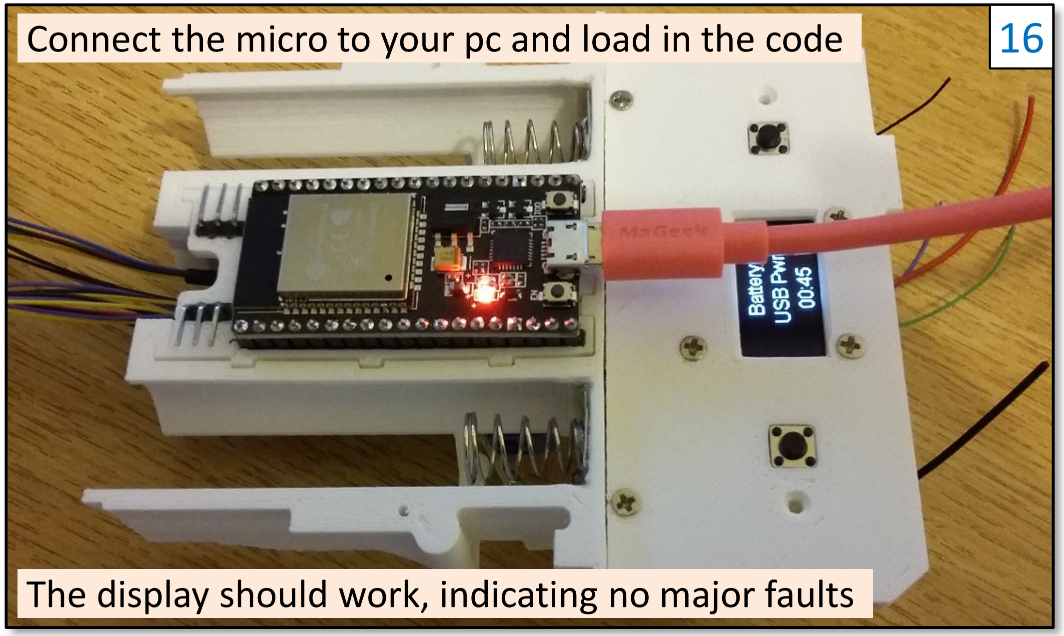
13 Attach wires for the five IR sensors



14 Glue the microplate into the frame



15 Attach the display plate using small brackets



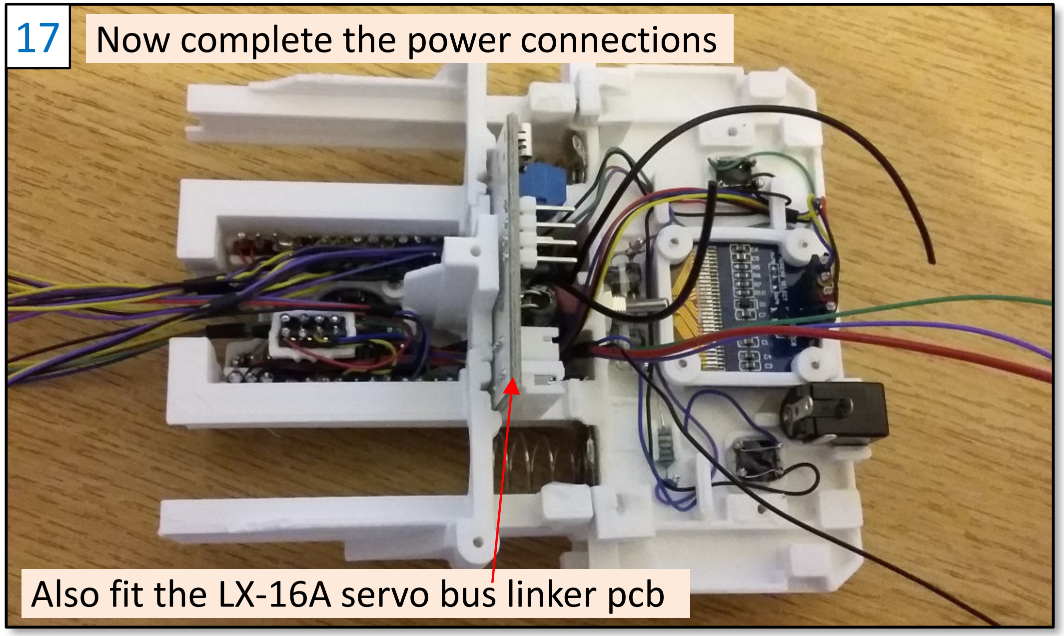
16 Connect the micro to your pc and load in the code

The display should work, indicating no major faults

Wiring Sequence

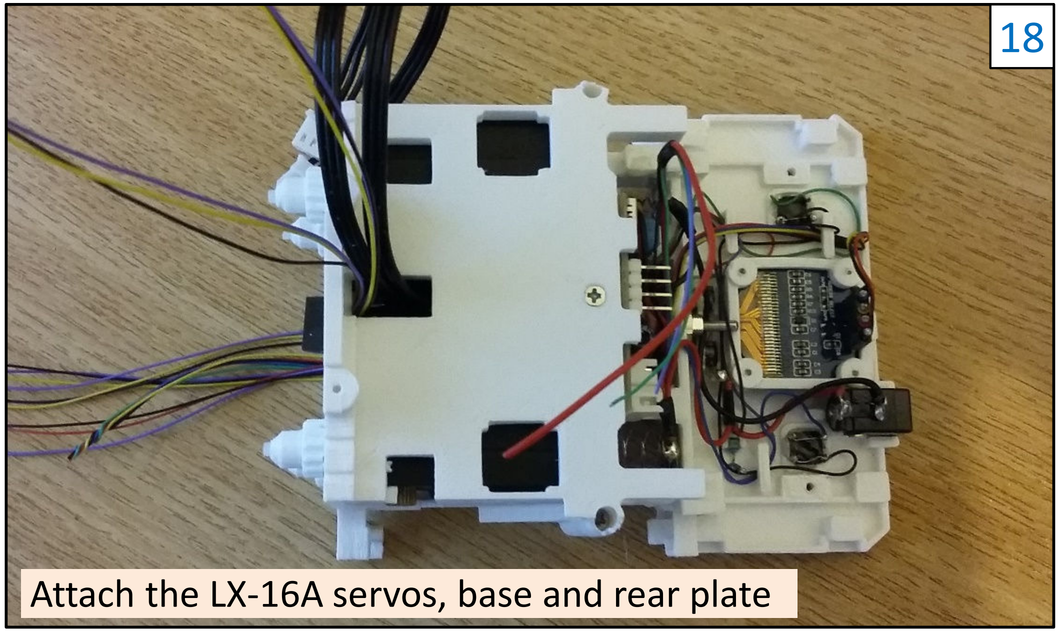
17

Now complete the power connections



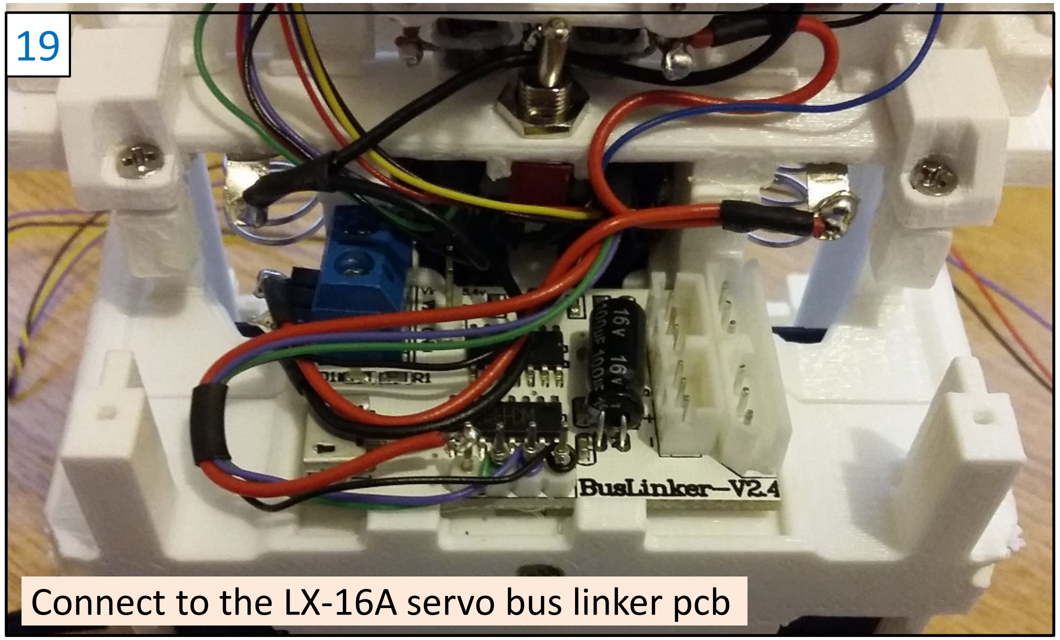
Also fit the LX-16A servo bus linker pcb

18



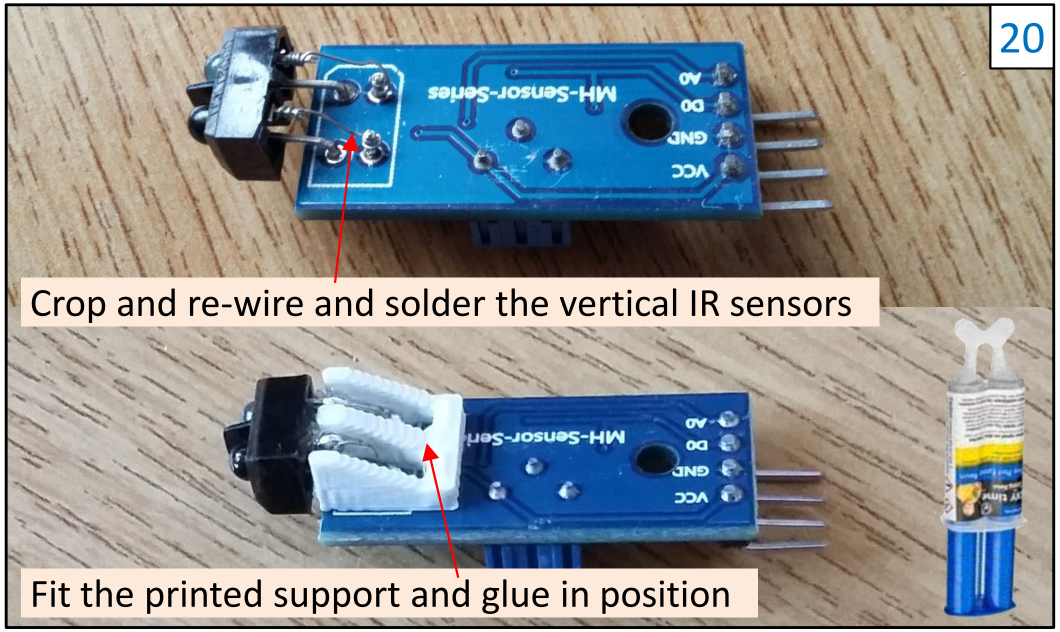
Attach the LX-16A servos, base and rear plate

19



Connect to the LX-16A servo bus linker pcb

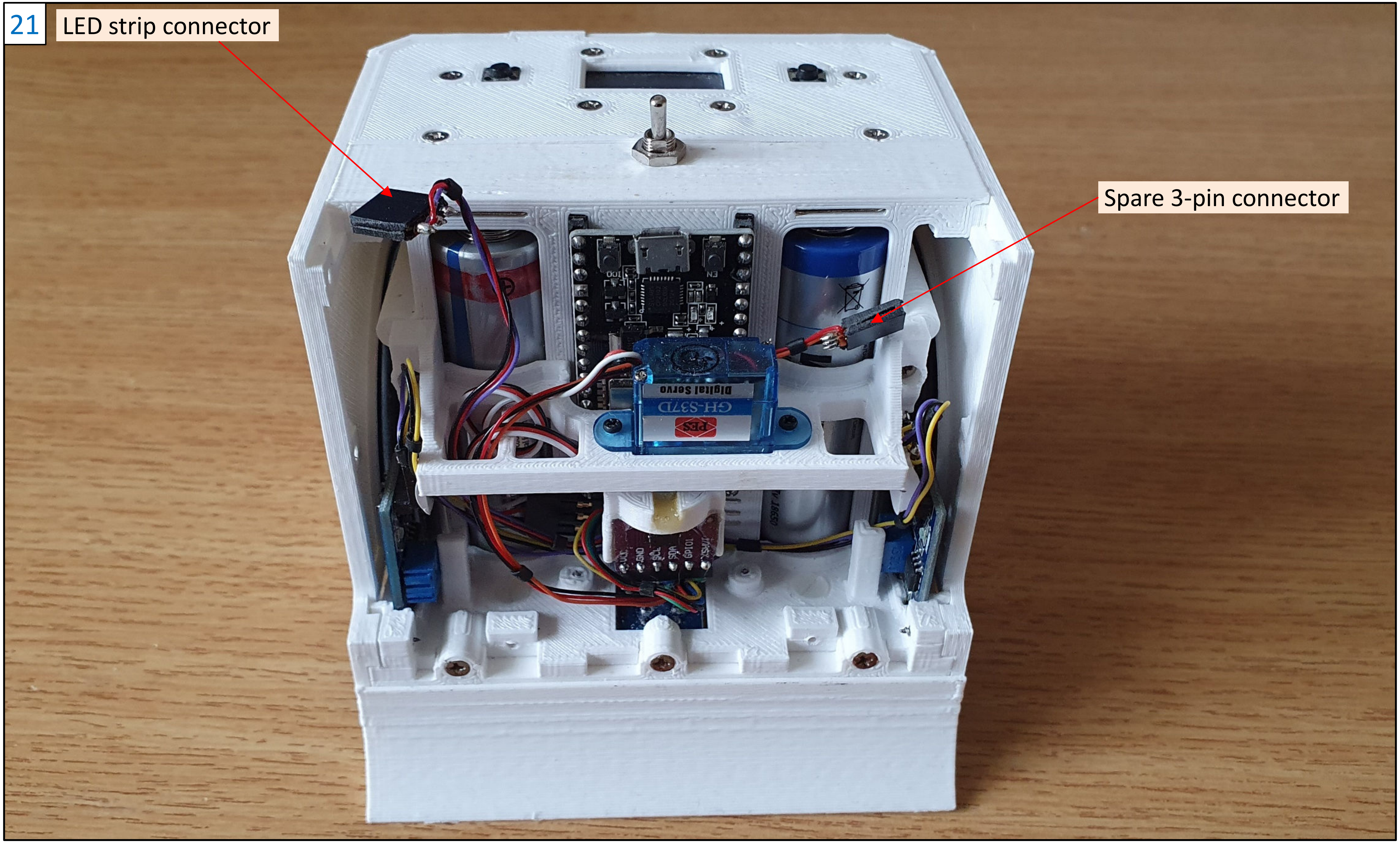
20



Crop and re-wire and solder the vertical IR sensors

Fit the printed support and glue in position

Wiring Sequence



Base Total Wiring

Attach side plates, front and rear plates, and wheels.

When changing the code in the ESP32 micro you will need to use stand-off brackets under the LED plate. This is so that you have access to the boot switch, when flashing the device.

The aperture for the laser range finder was subsequently enlarged to provide maximum side to side visibility. Auto-calibration of the window side angles is included in the code.

A copper wedge plate was tried initially but subsequently found to be too heavy for the 500g overall limit.