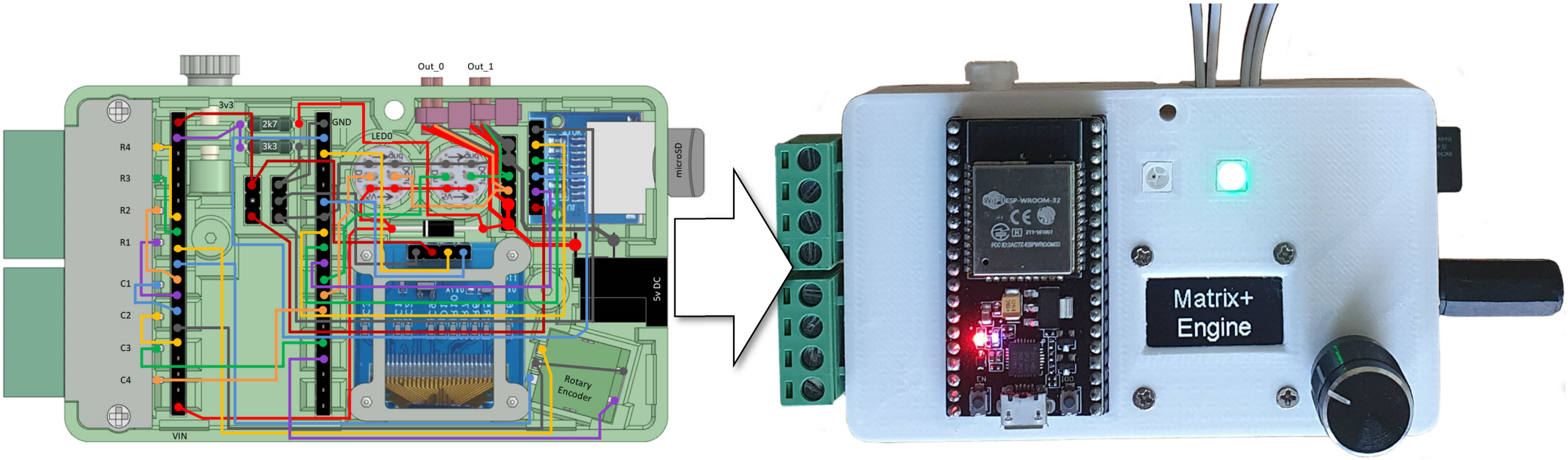
Matrix+ Controller

Circuits & Wiring



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Hand Tools:

Recommended:

- Fine Nosed Pliers
- Side Cutters
- 1.5 mm Drill
- 2.0 mm Drill
- 3.0 mm Drill
- Needle Files
- Screwdrivers
- Craft Knife

Note: Not all items are shown here.

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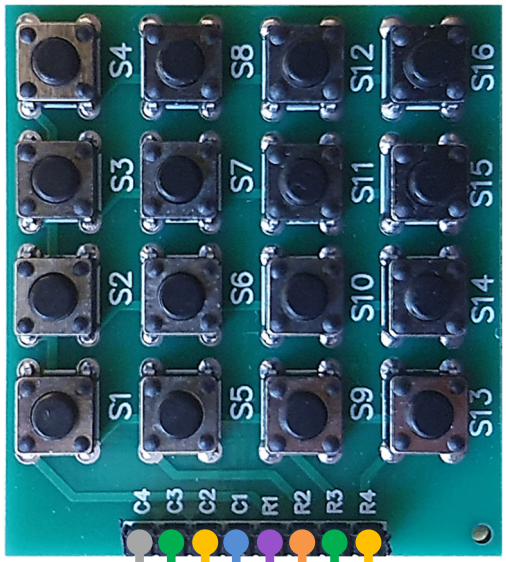
Tools & Materials:

Temperature controlled iron
2-part epoxy resin glue
Solder flux
Resin cored solder
Screw drivers
Wire wrapping tool
Wire wrapping wire 30 AWG
24 AWG stranded wire (red & black)

Matrix+ Micro Controller Wiring

Note that the 64x128 OLED display and rotary encoder are optional items, only needed if you want to have a menu system in your project.

The switch matrix uses TDM to read 16 switches with only 8 GPIO pins.



4 x 4 Switch Matrix

The assigned pins ,of the ESP32, can also be used as 8 touch sensitive inputs, as indicated by the blue dots on the micros pads.

You will need to modify the .ino code to do this, replacing the matrix scanner code, with one that reads the touch sensors, and flags a change about a given threshold value.

5v DC

Matrix Controller

SDA SCL VCC GND

microSD

3V3 CS MOSI CLK MISO GND

I2C Bus

SPI Bus

+3v3

2k7

3k3

1N4006

+4v4

+5v

Pwr1

DC Power only

+5v

Pwr0

A0
A1
A2
A3

R4 R3 R2 R1
C1 C2 C3 C4
T0 T1 T2 T3 T4 T5 T6 T7

1 3V3
2 RST
3 P36
4 P39
5 P34
6 P35
7 P32
8 P33
9 P25
10 P26
11 P27
12 P14
13 P12
14 GND
15 P13
16 RX1
17 TX1
18 P11
19 VIN

GND 38
P23 MOSI 37
P22 SCL 36
P01 TX0 35
P03 RX0 34
P21 SDA 33
GND 32
P19 MISO 31
P18 SCK 30
P05 SS 29
P17 TX2 28
P16 RX2 27
P4 26
P0 25
P2 24
P15 23
SD1 22
SD0 21
CLK 20

ESP-WROOM

LED1

WS2812B

LED0

WS2812B

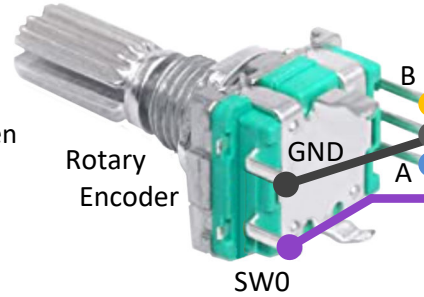
$D_{OUT}1$

DC Power + Data

$D_{OUT}0$

GND

The assigned pins, to the rotary encoder, have been reassigned in this design, when compared with its predecessor.



Rotary Encoder

The single LEDs act as level- shifters, to drive the rest of the LED matrix, as the 3v3 logic HIGH output of the ESP32 is insufficient to drive the WS2812B LEDs directly, when they are powered from a 5v supply. Note that the GPIO pin assignments also differ from its predecessor.

These touchpad pins can not be used for touch on this ESP32 module.

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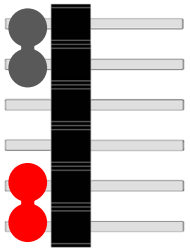
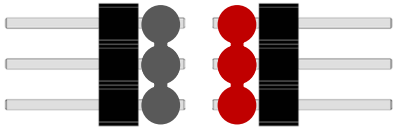
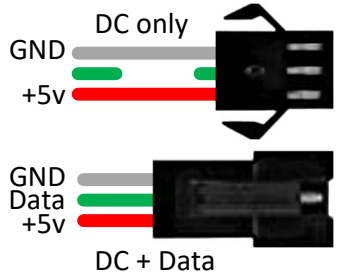
Micro Plate - Total Wiring

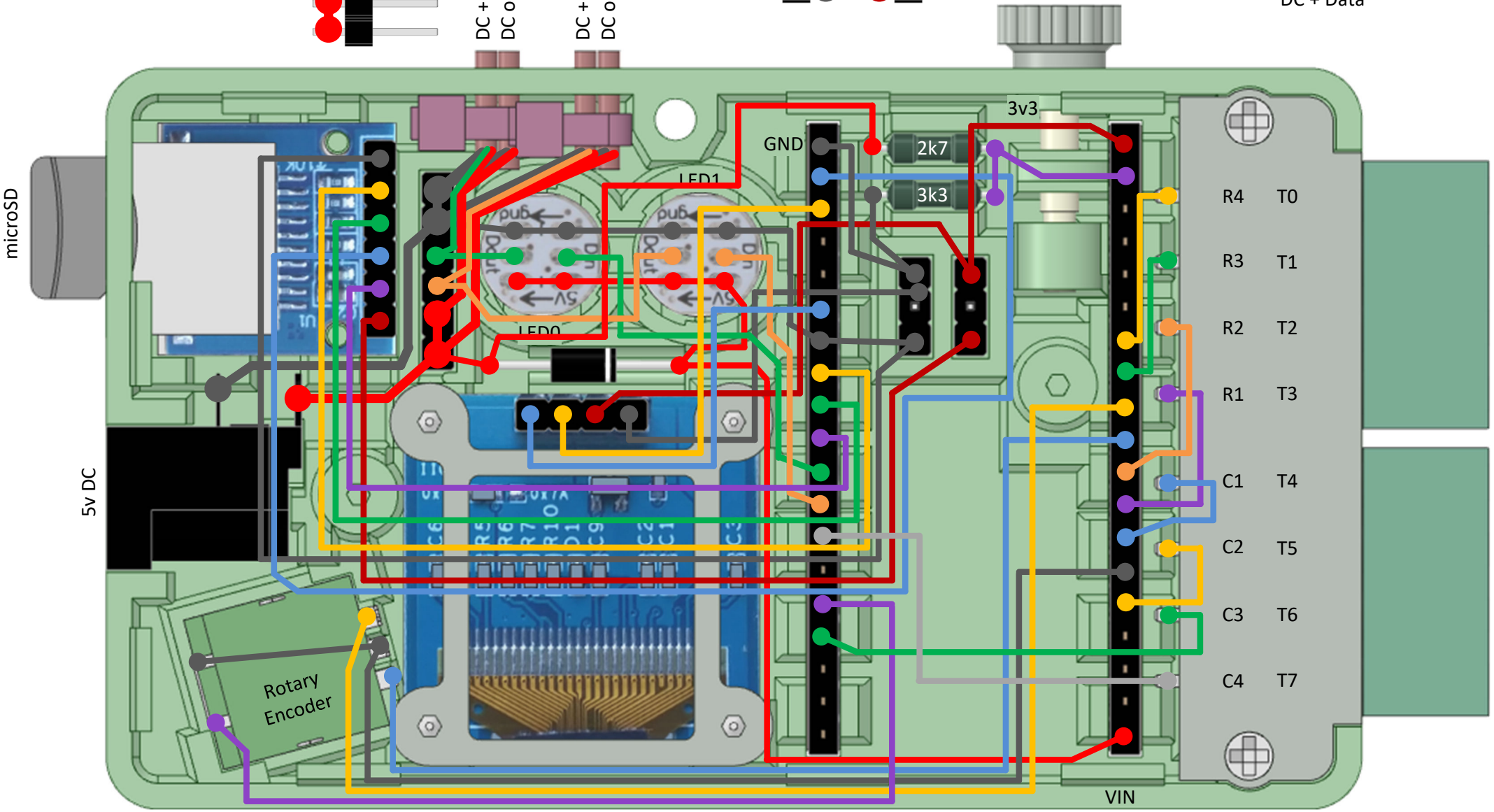
Complete the wiring by following the steps on the next pages.

Note: pin strips have some pins wired together and soldered, before gluing them into micro plate.



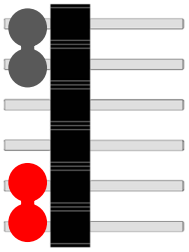






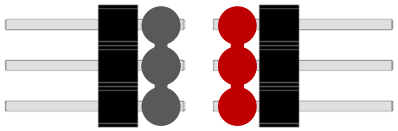
Micro Plate - Step 1

Start by wiring in the power connections and those feeding data signals to/from the RGB LEDs.

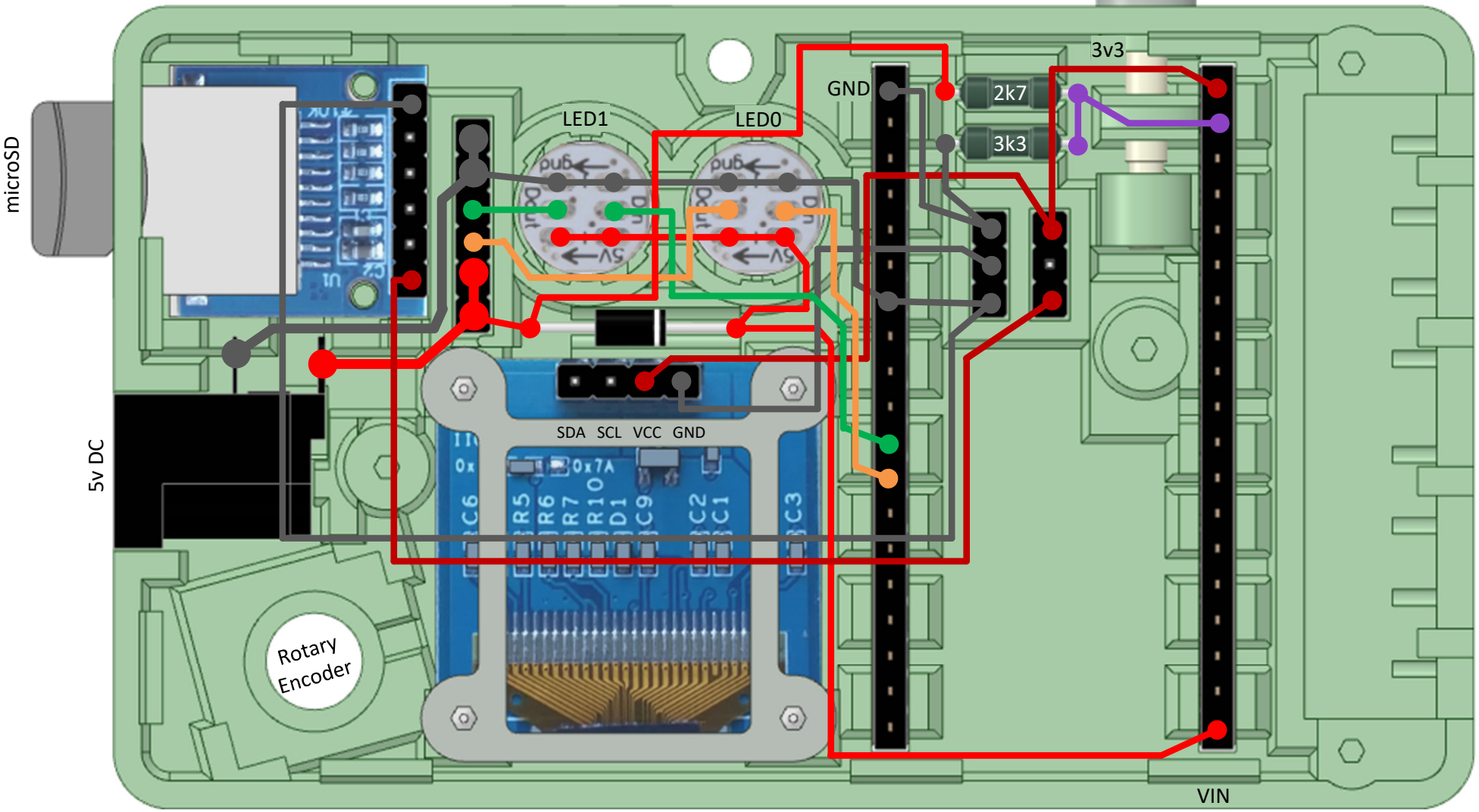


6 pin strip

Note: pin strips have <u>some</u> pins wired together before gluing into micro plate.



2 x 3 pin strips



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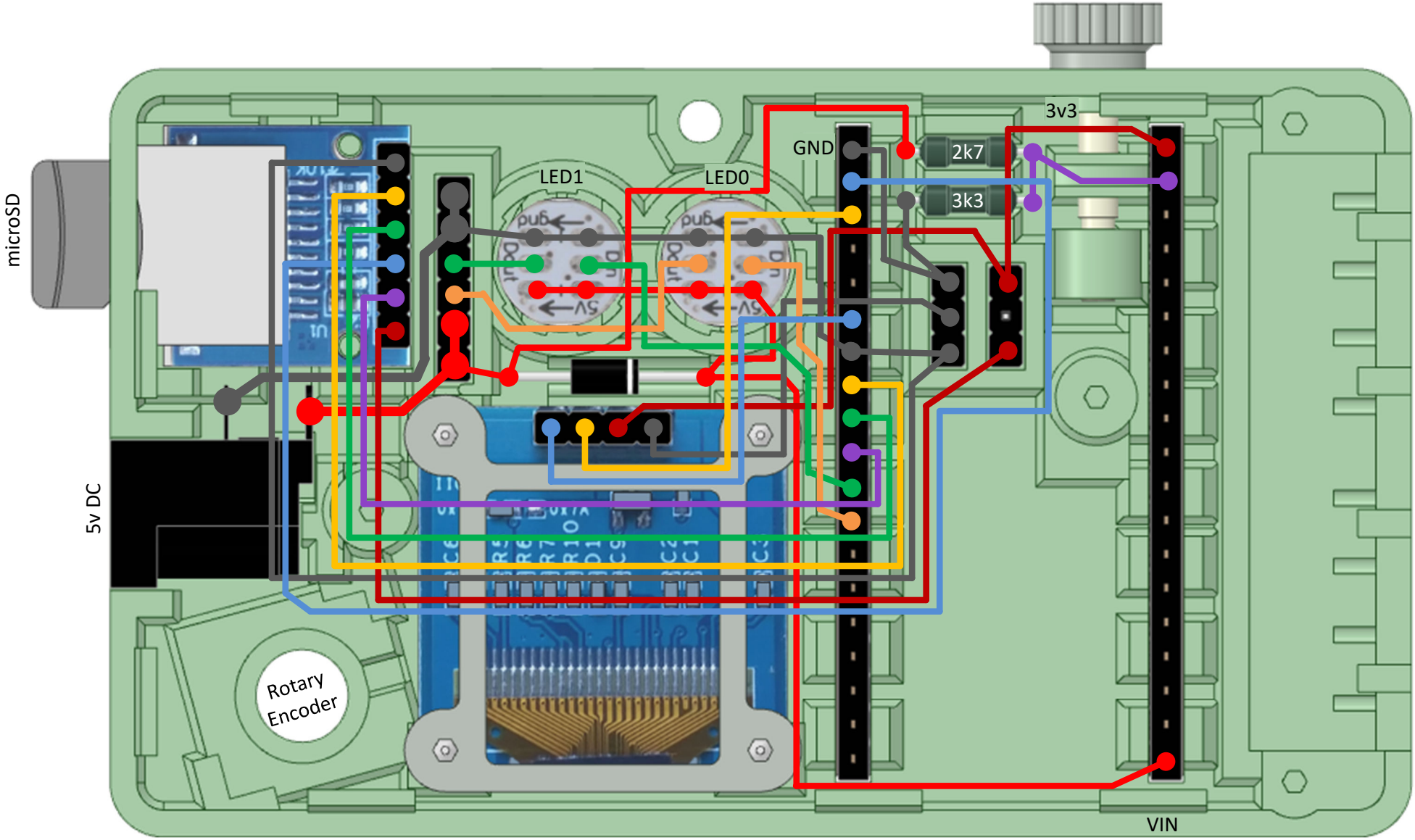
Micro Plate - Step 2

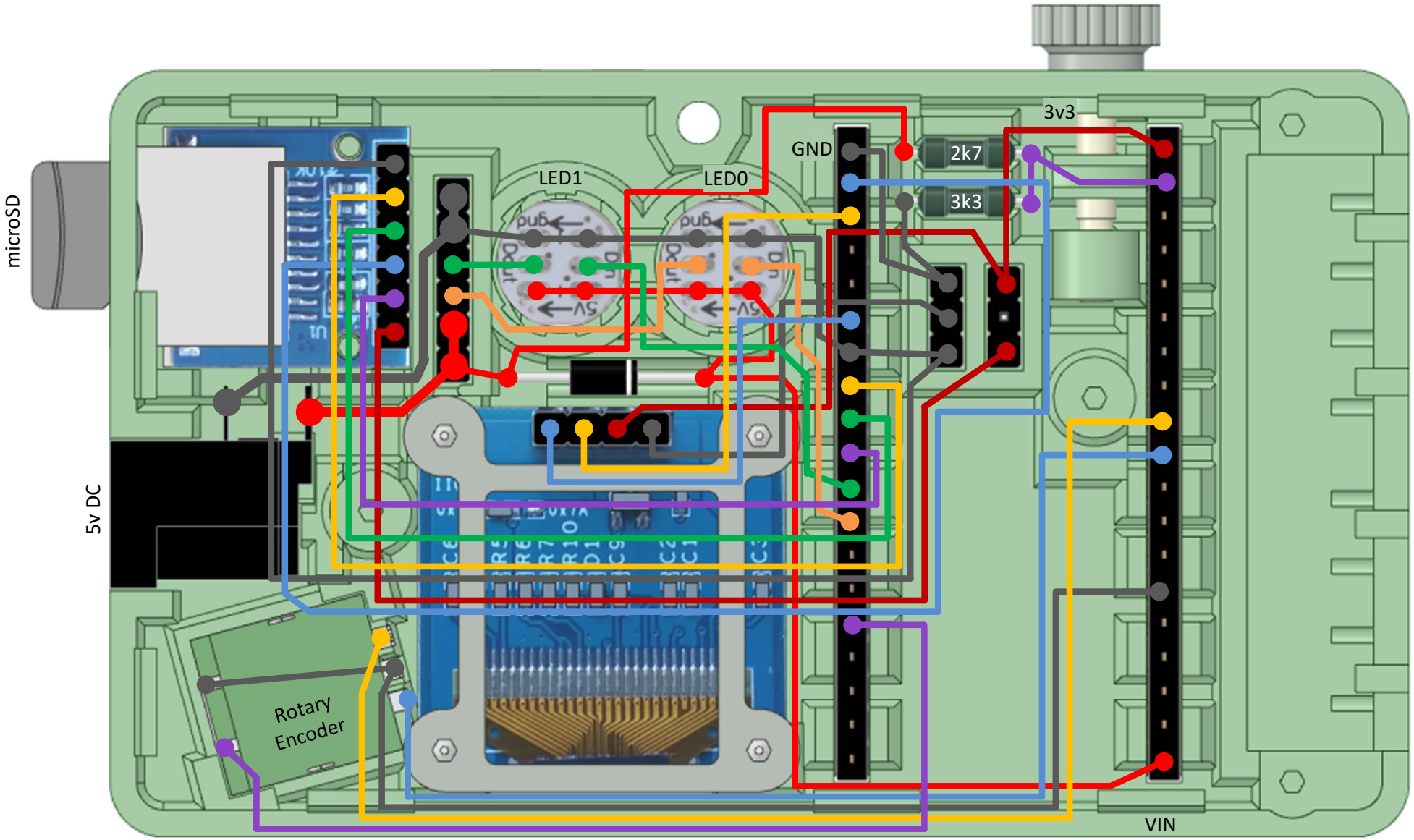
Then wire in the micro SD card reader, and the LCD display.

Note that some displays have the GND and VCC connections reverse. And displays can vary in size, so ensure yours is correct before starting.



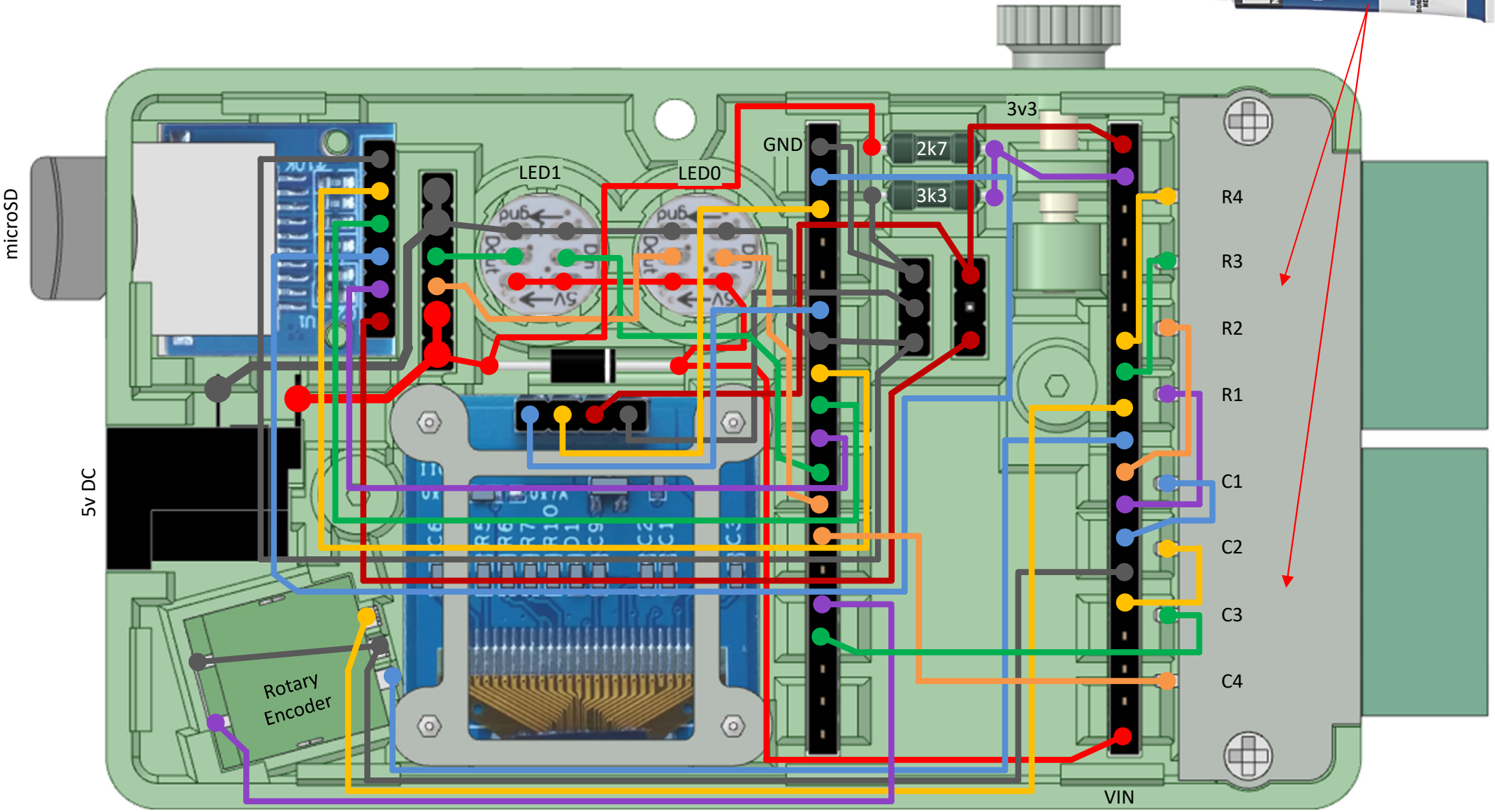
Micro Plate - Step 3

Then install and wire in the rotary encoder



Micro Plate - Step 4

Then wire in the two 4-way terminal blocks. The design is such that, once you are happy with the wiring, the clamp strap retaining the connectors is glued to the connectors as an additional constraint.



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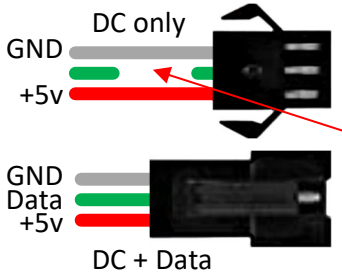
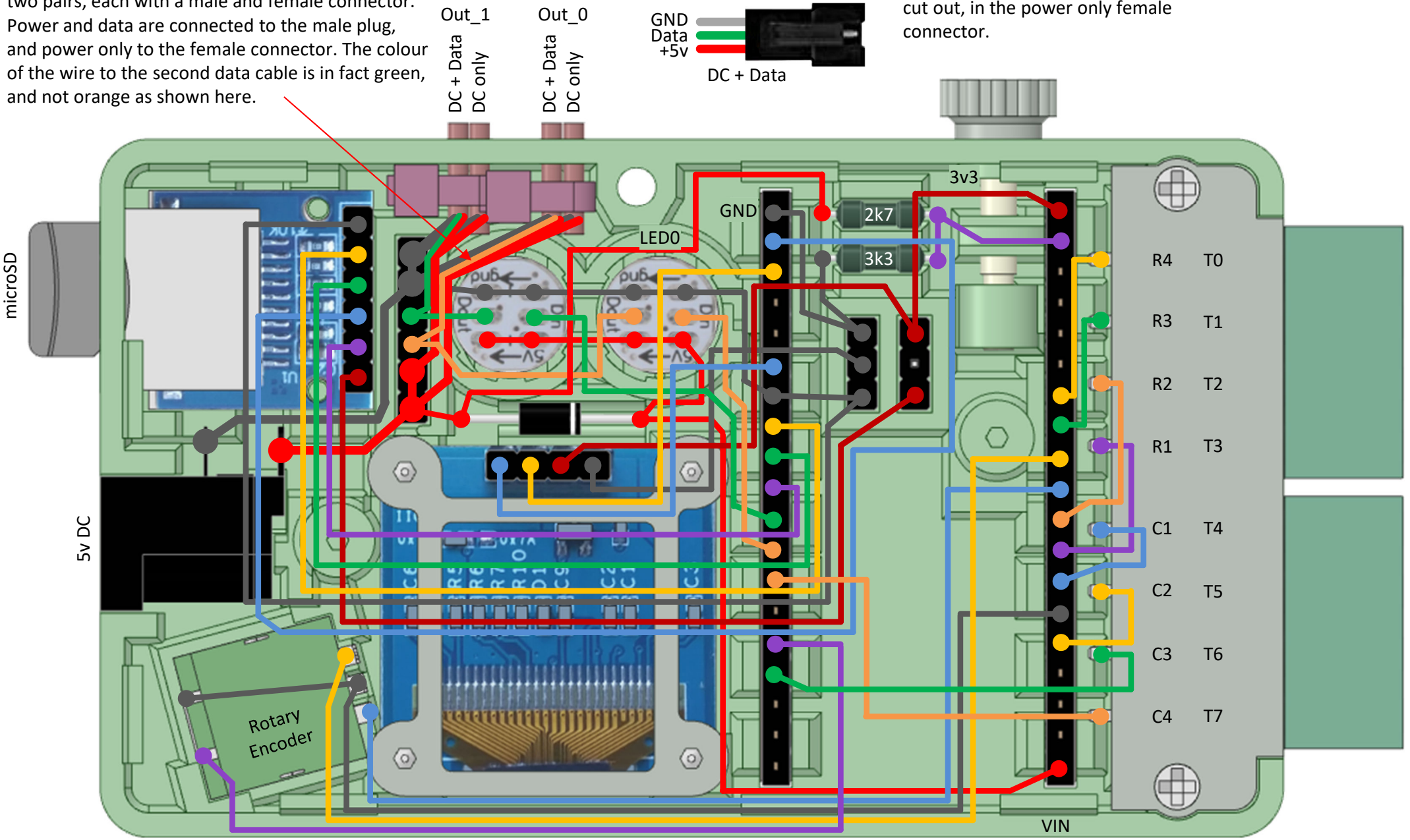
Micro Plate - Step 5

Finally wire in the BTF wiring connectors. There are two pairs, each with a male and female connector. Power and data are connected to the male plug, and power only to the female connector. The colour of the wire to the second data cable is in fact green, and not orange as shown here.



Note that a part of the data wire is cut out, in the power only female connector.



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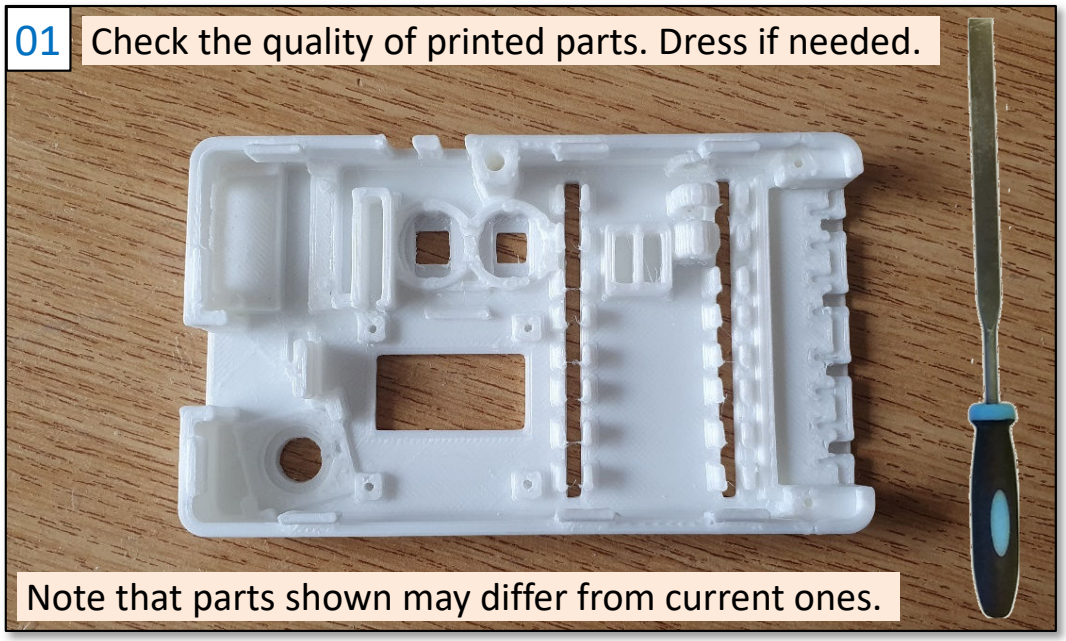
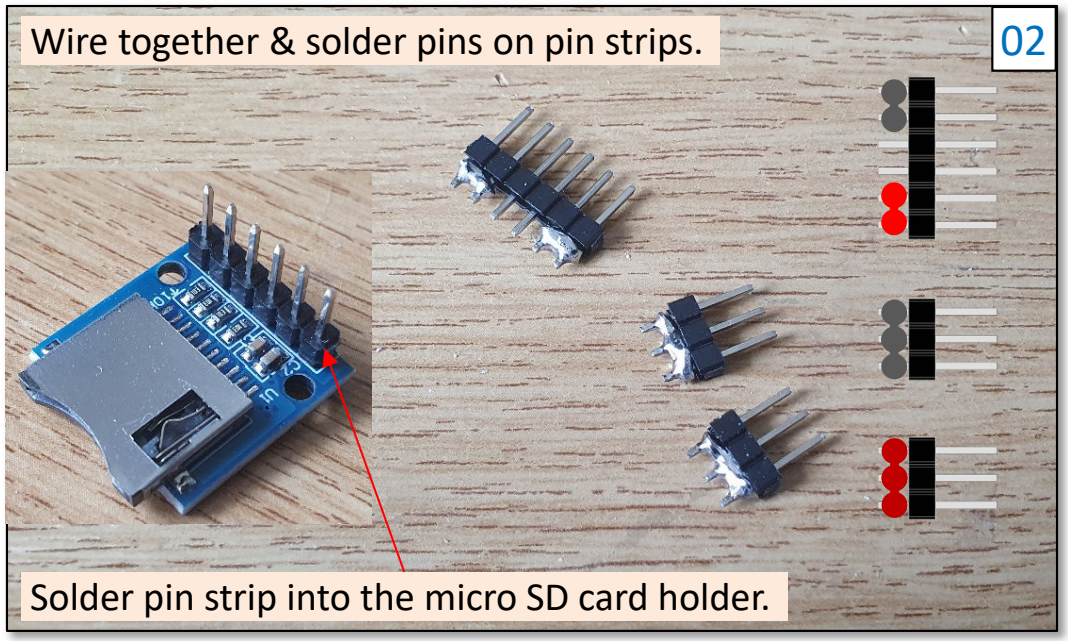
Build Sequence

01 Check the quality of printed parts. Dress if needed.



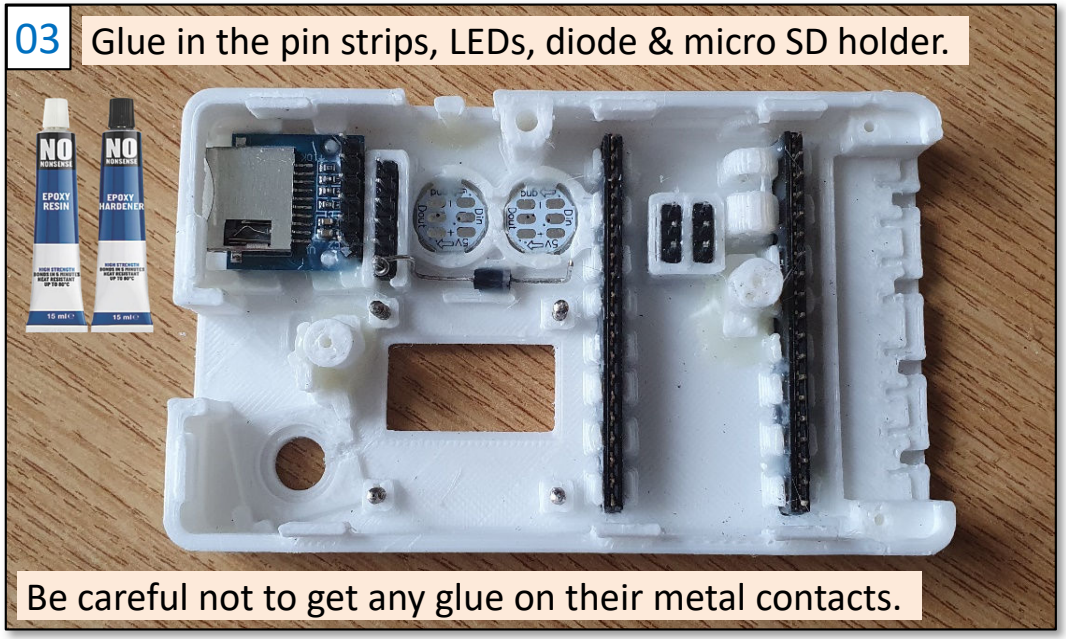
Note that parts shown may differ from current ones.

Wire together & solder pins on pin strips. 02



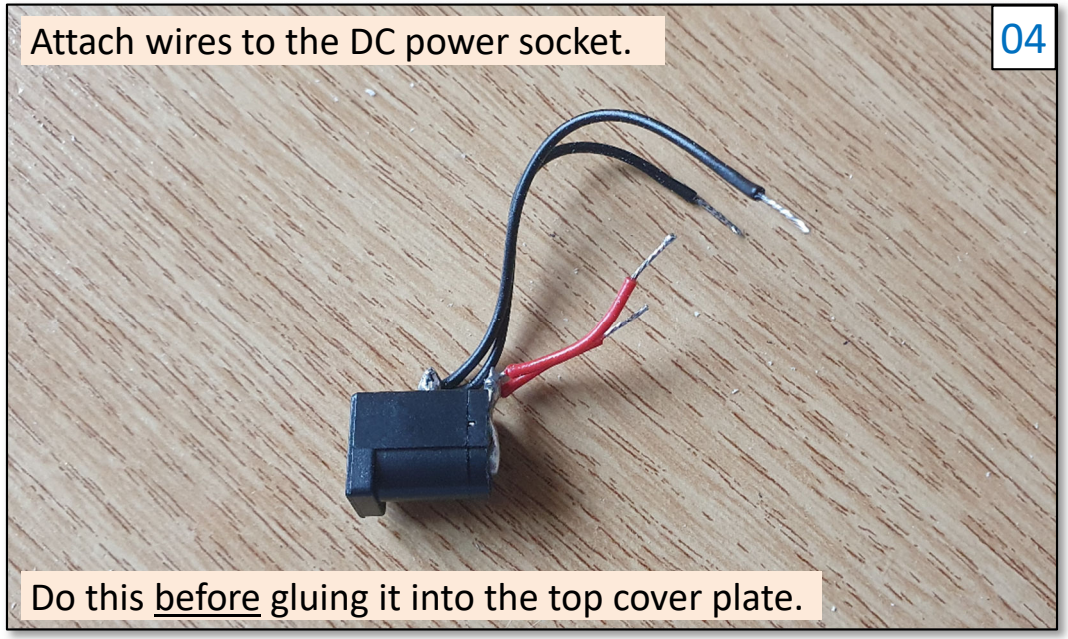
Solder pin strip into the micro SD card holder.

03 Glue in the pin strips, LEDs, diode & micro SD holder.



Be careful not to get any glue on their metal contacts.

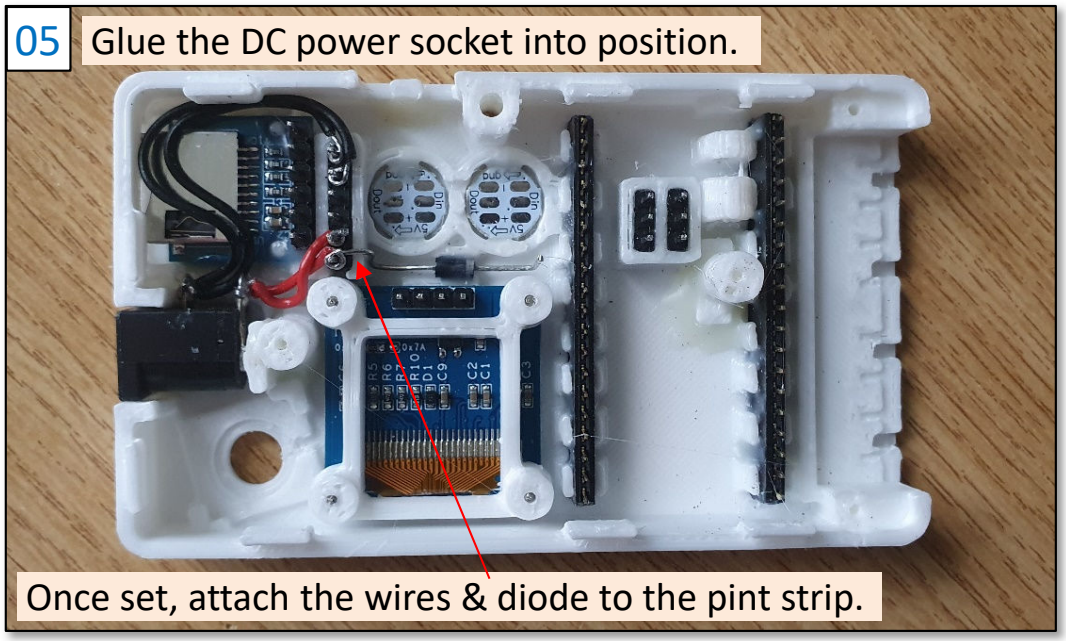
Attach wires to the DC power socket. 04



Do this before gluing it into the top cover plate.

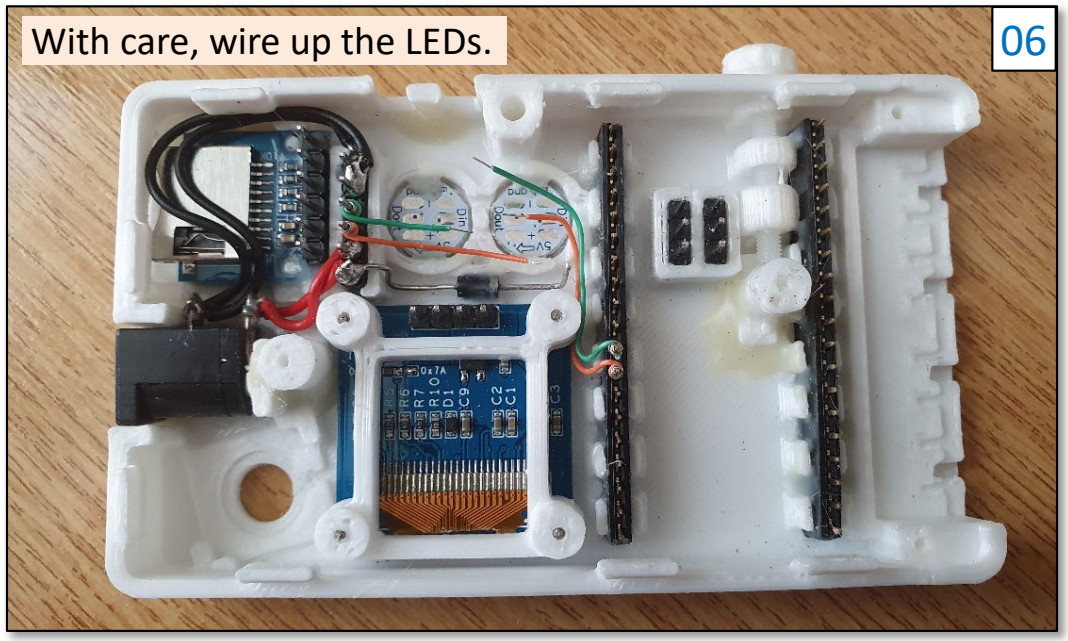
Wiring Sequence

05 Glue the DC power socket into position.

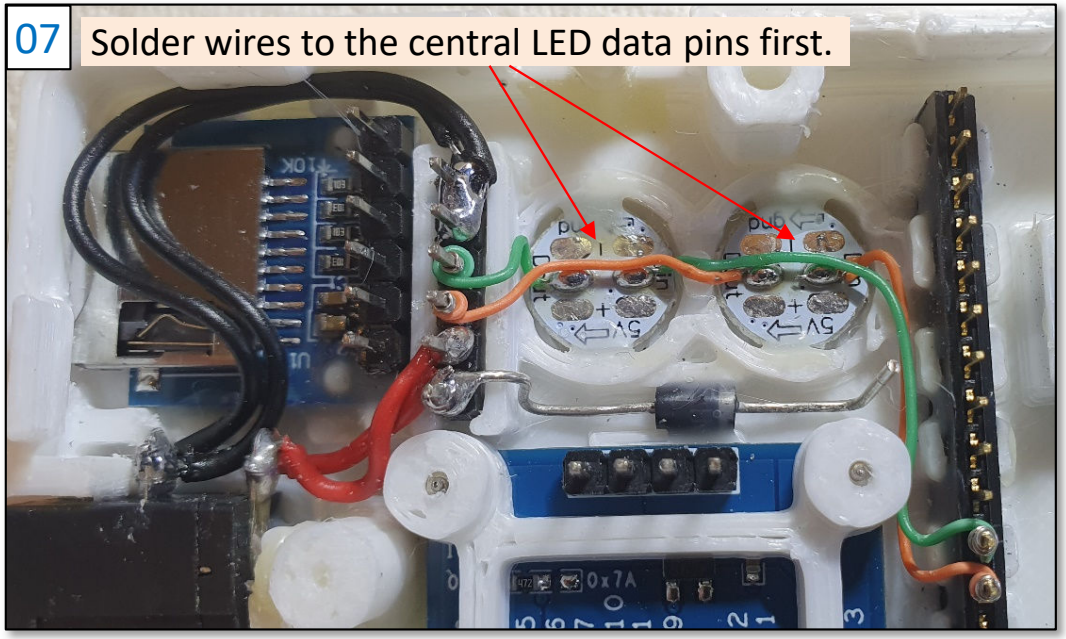


Once set, attach the wires & diode to the pint strip.

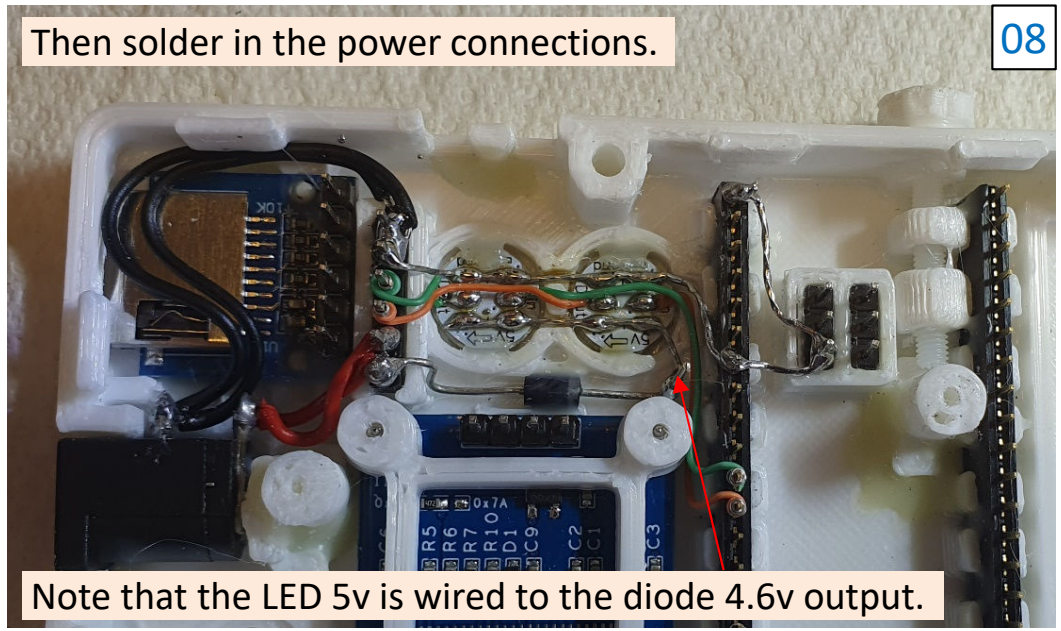
With care, wire up the LEDs. 06



07 Solder wires to the central LED data pins first.



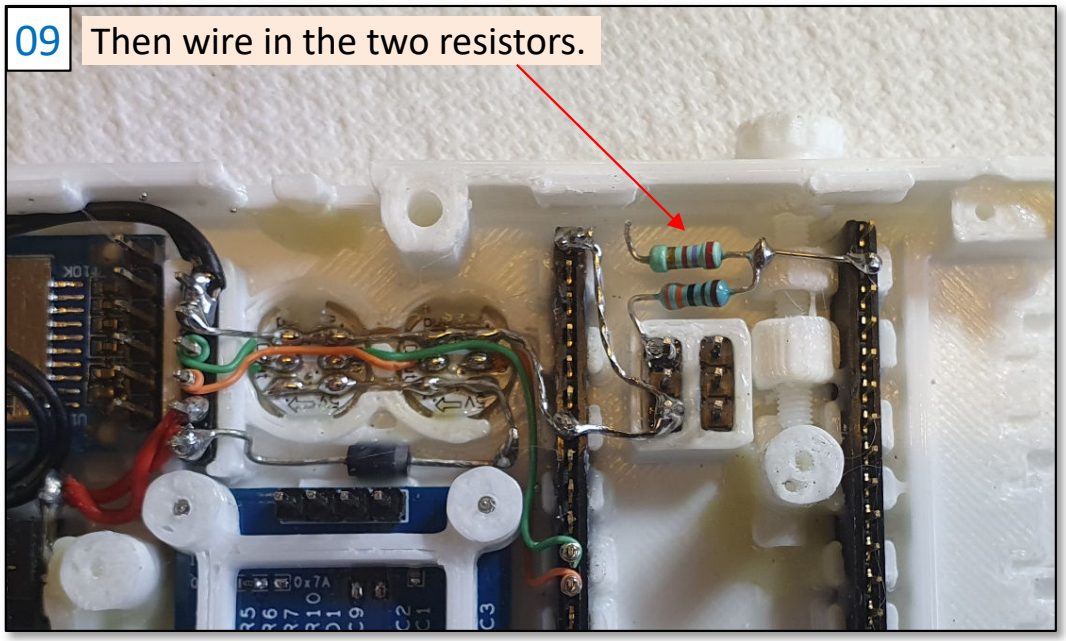
Then solder in the power connections. 08



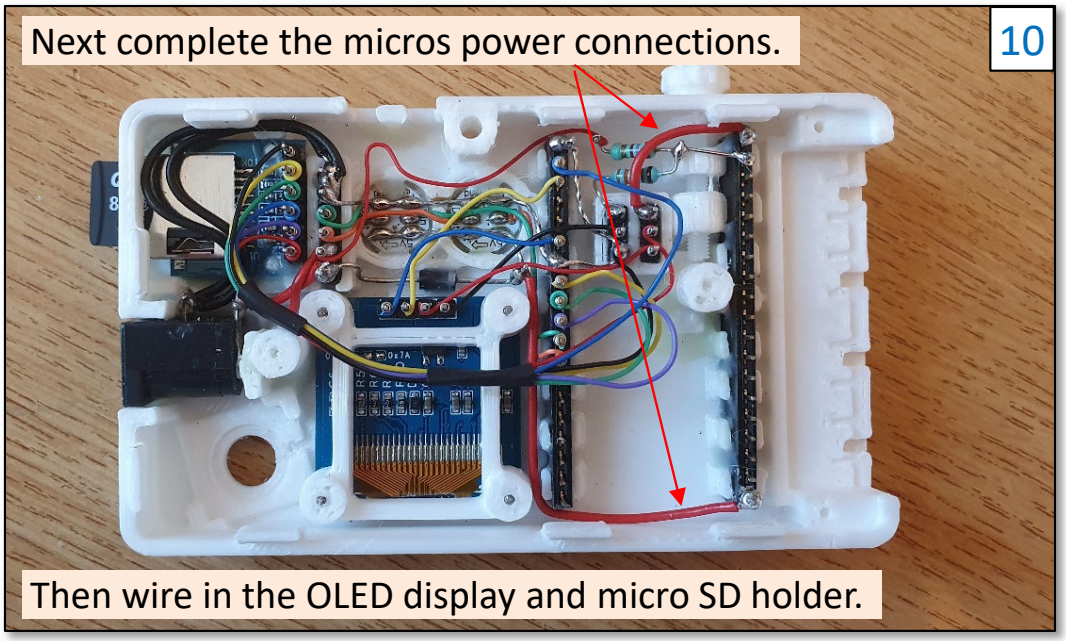
Note that the LED 5v is wired to the diode 4.6v output.

Wiring Sequence

09 Then wire in the two resistors.

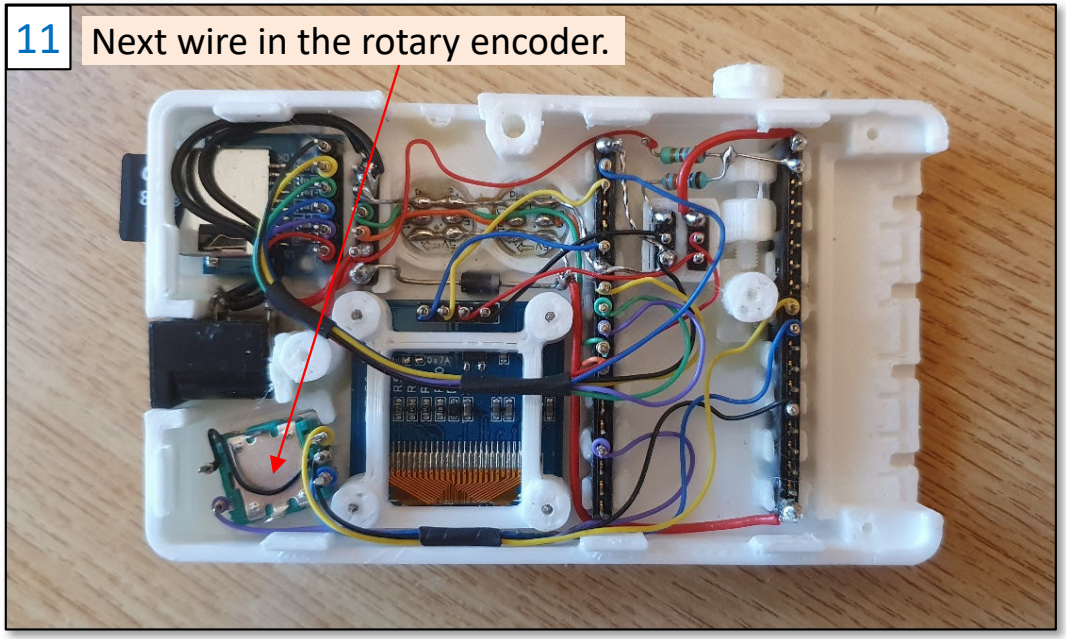


Next complete the micros power connections. 10

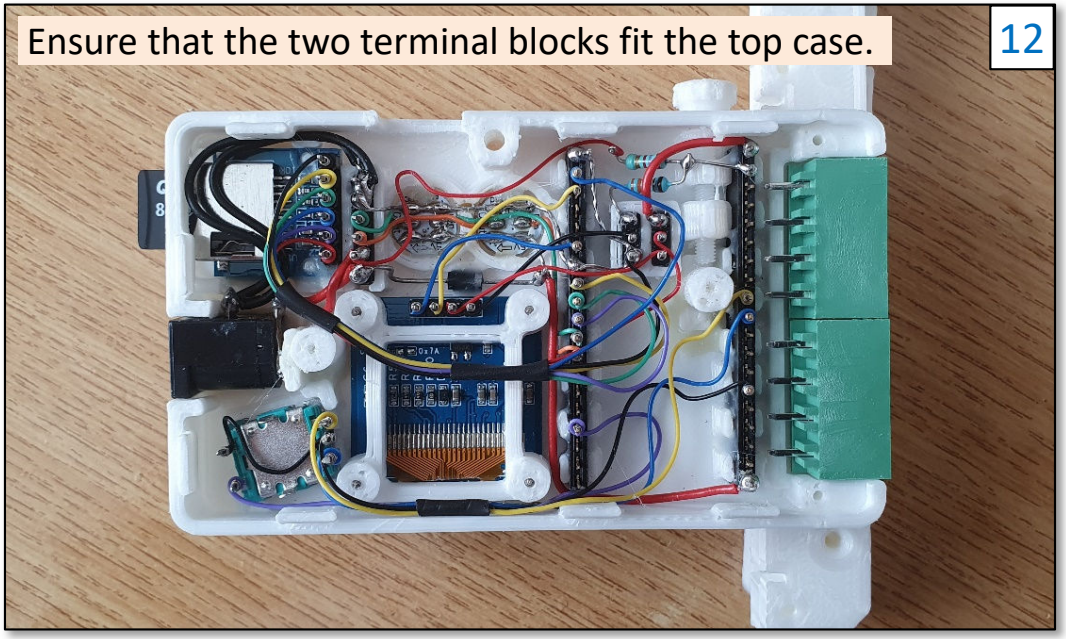


Then wire in the OLED display and micro SD holder.

11 Next wire in the rotary encoder.

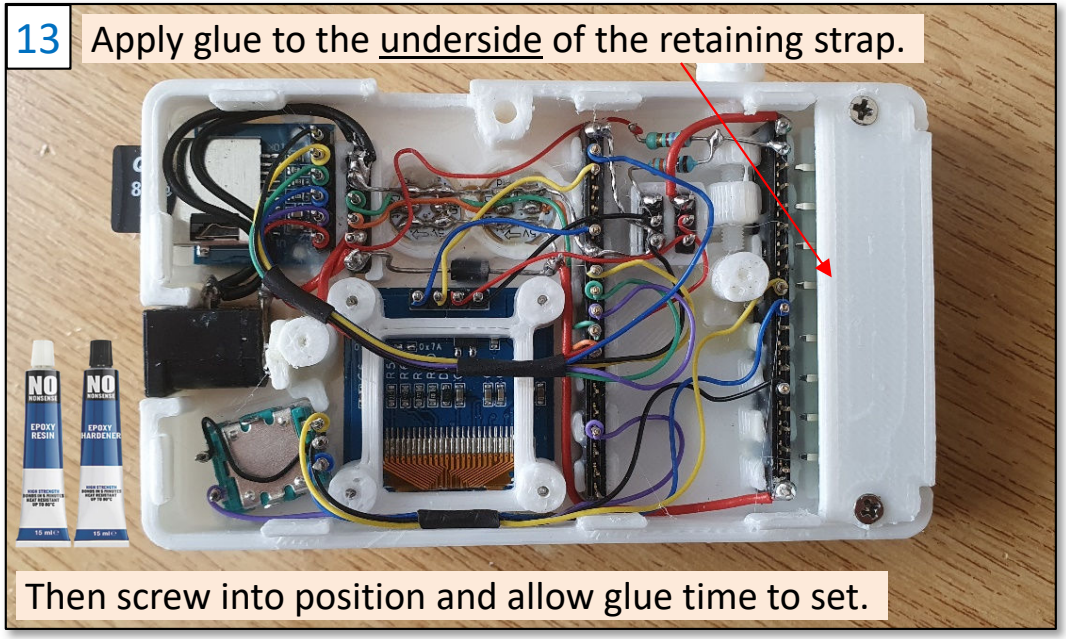


Ensure that the two terminal blocks fit the top case. 12



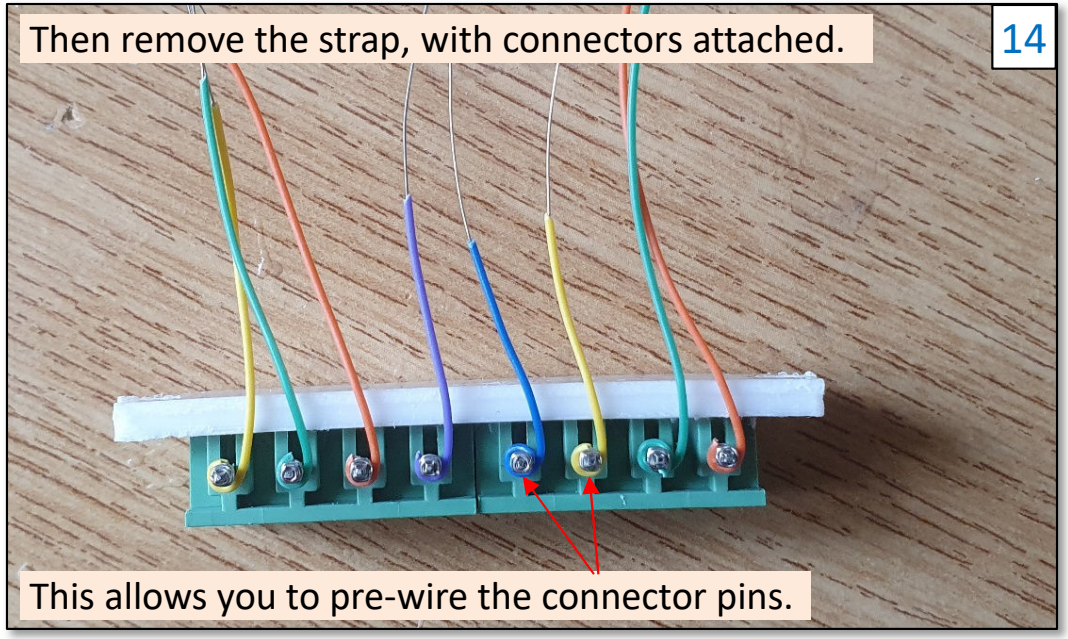
Wiring Sequence

13 Apply glue to the underside of the retaining strap.



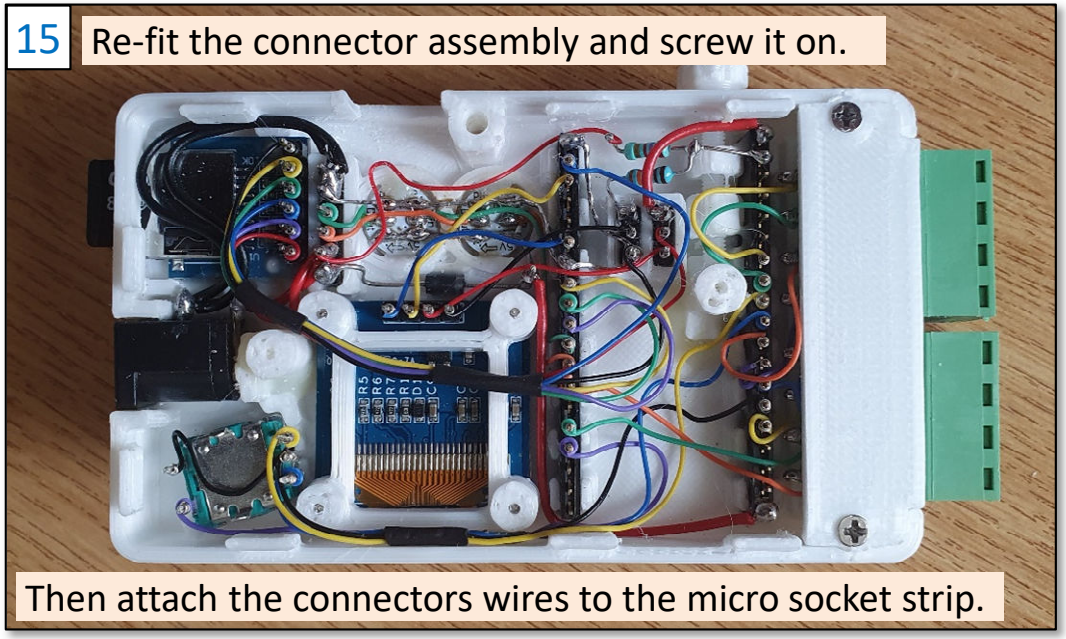
Then screw into position and allow glue time to set.

Then remove the strap, with connectors attached. 14



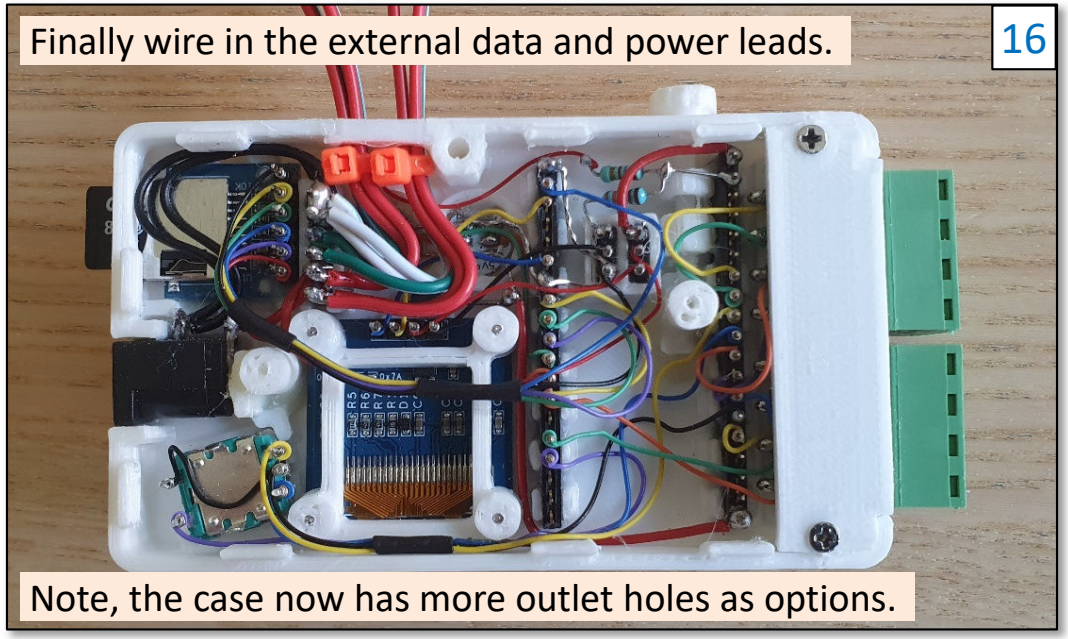
This allows you to pre-wire the connector pins.

15 Re-fit the connector assembly and screw it on.



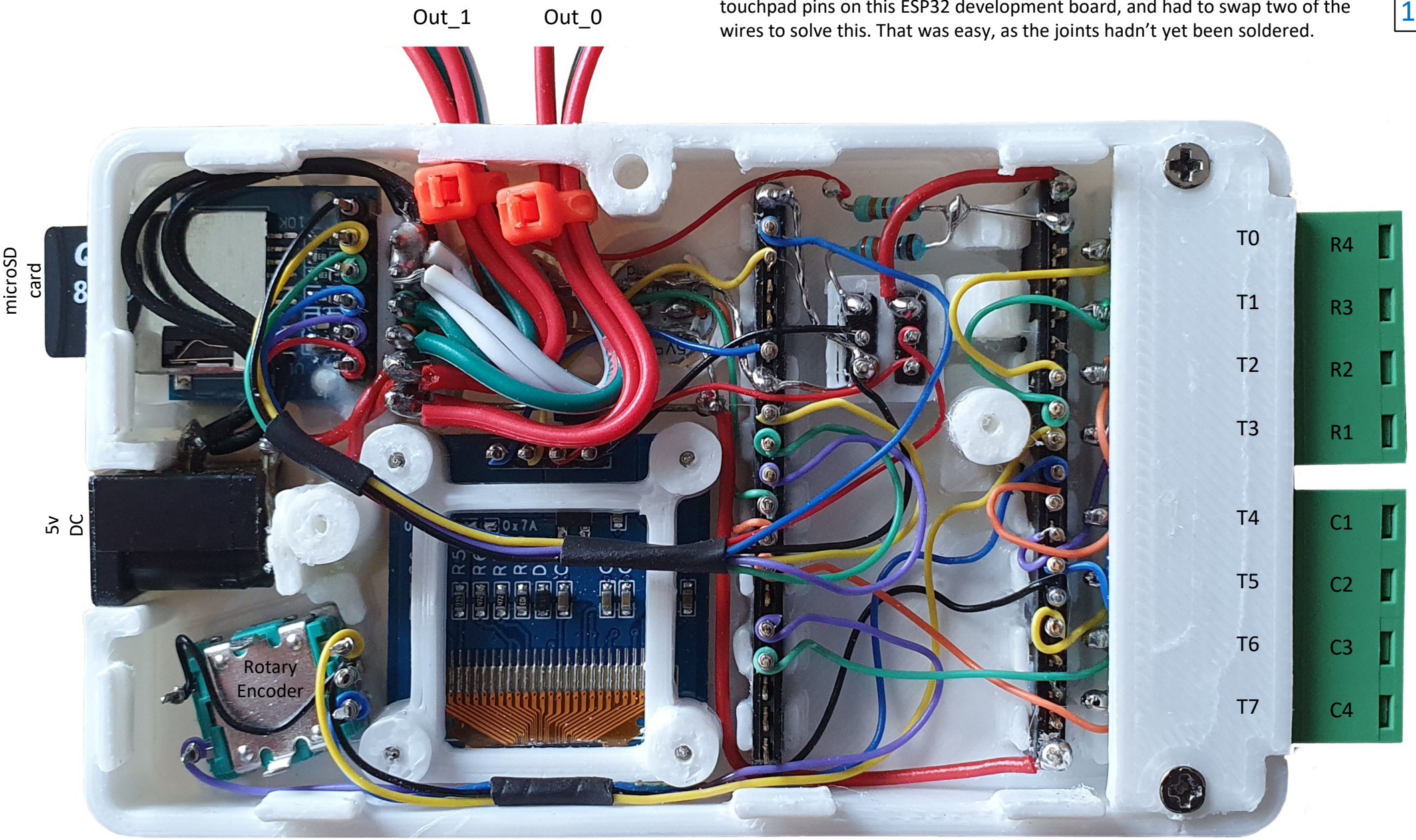
Then attach the connectors wires to the micro socket strip.

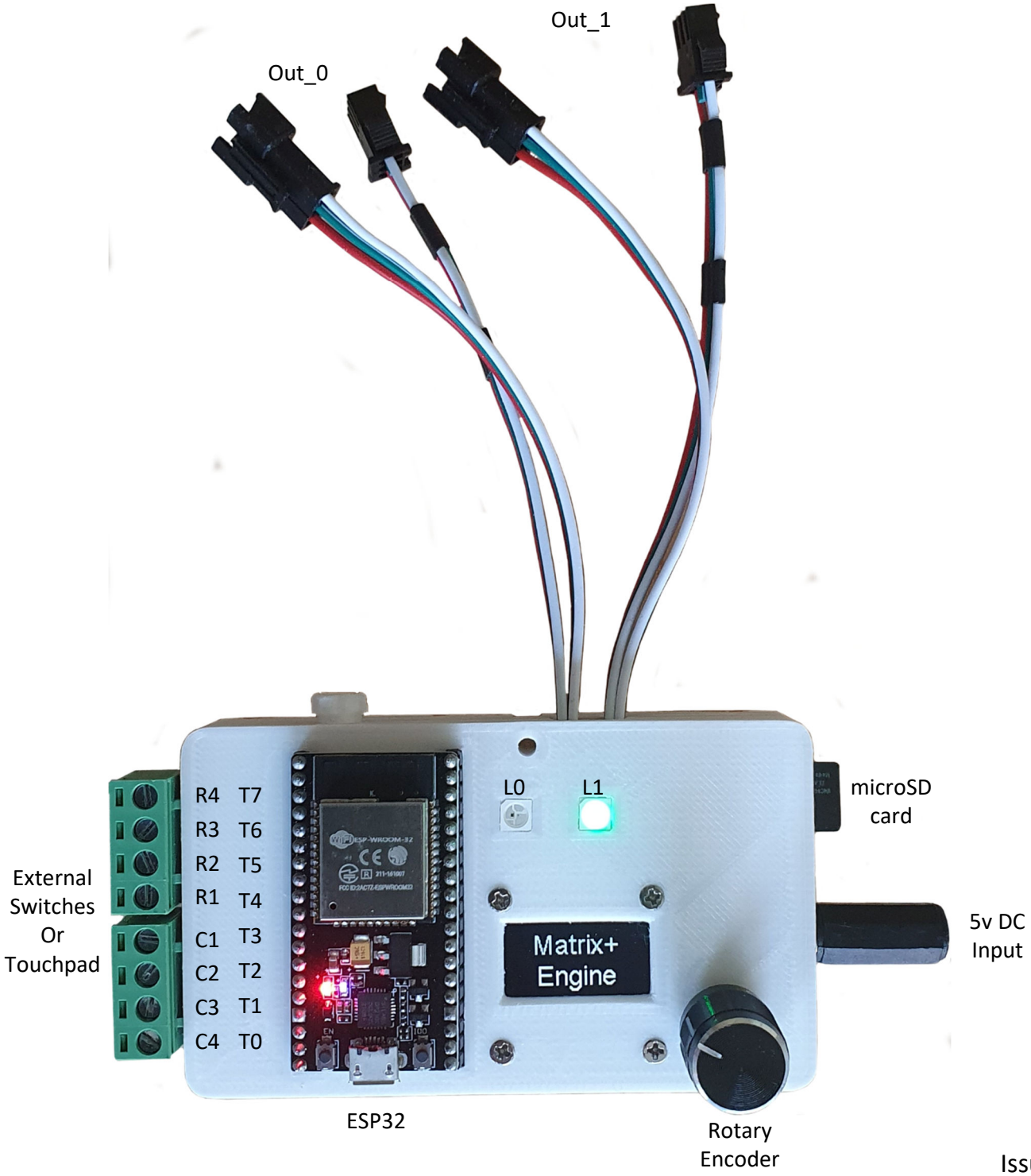
Finally wire in the external data and power leads. 16



Note, the case now has more outlet holes as options.

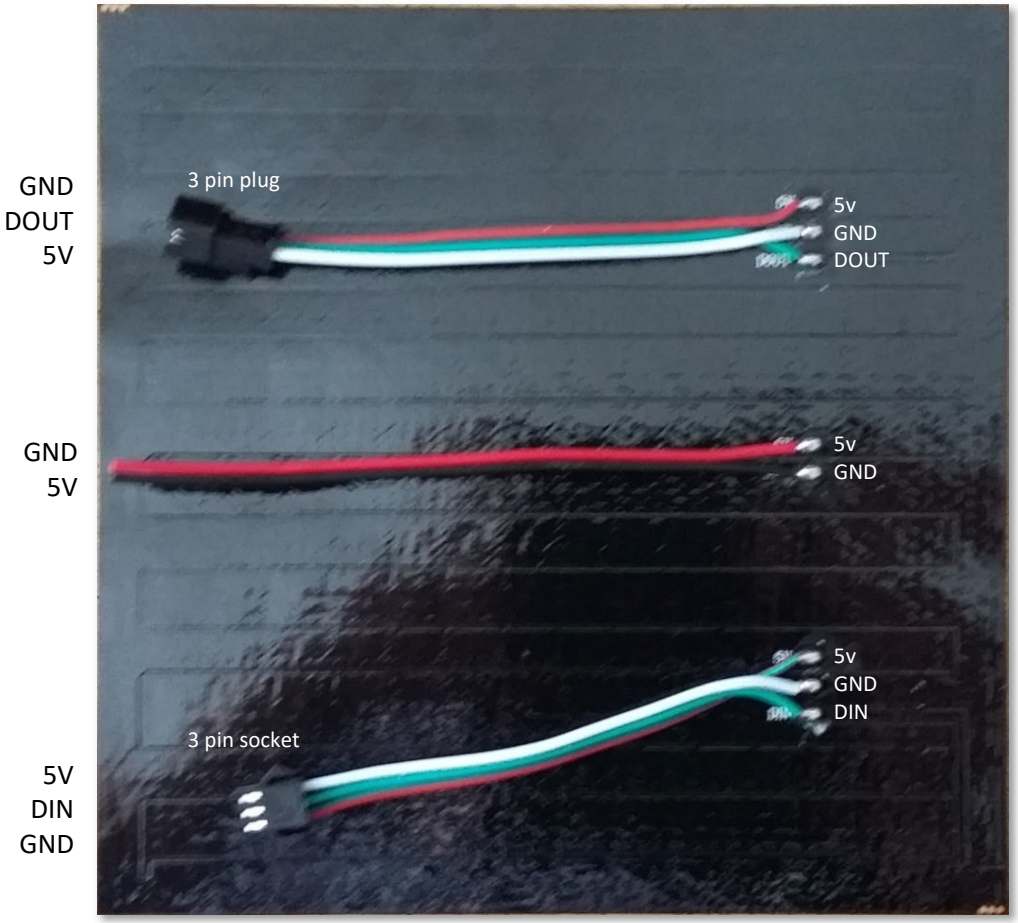
To get the most from wire wrapping, it is best to test your system before finally soldering the joints. For example, I discovered a problem with using certain touchpad pins on this ESP32 development board, and had to swap two of the wires to solve this. That was easy, as the joints hadn't yet been soldered.




Out_0
Out_1
R4 T7
R3 T6
R2 T5
R1 T4
C1 T3
C2 T2
C3 T1
C4 T0
External Switches Or Touchpad
L0
L1
microSD card
Matrix+ Engine
5v DC Input
ESP32
Rotary Encoder

16 x 16 Panel Wiring & Mapping

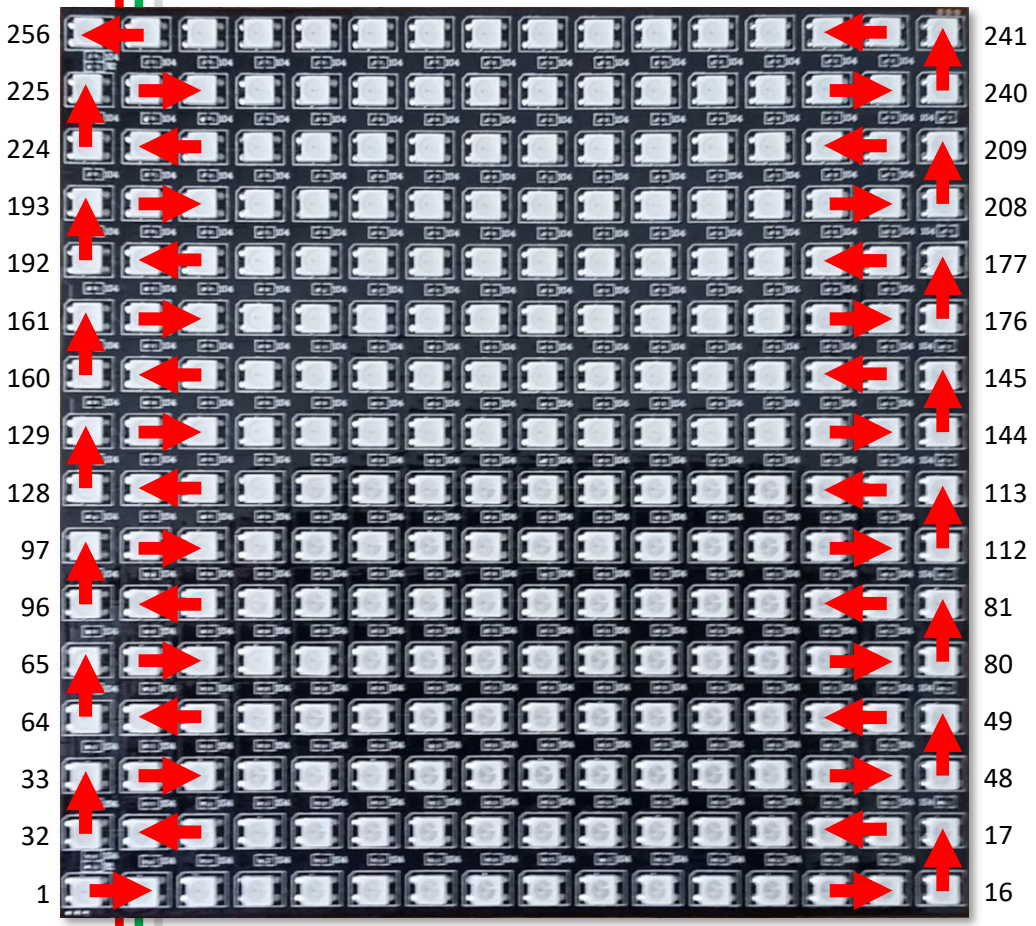
Note that the pcb tracks within the panel effectively snakes the daisy chain of LEDs from one side to the other, as shown here on the right.



Viewed from the rear

Data Out

16x16 WS2812B Panel 15.9x15.9cm



Viewed from the front

Data In

Be careful not to bend the wires too much next to their solder joints, as they can be very brittle and break. It is best to glue them down as shown later in this document.

The LED numbering assumes that the panel is fed from a single level shifter LED, which takes up LED position 0.

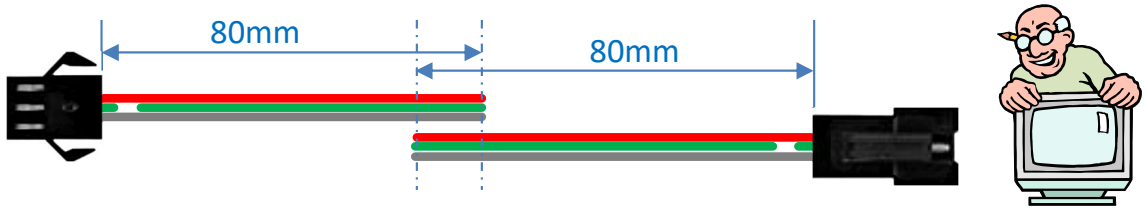
Gluing Sequence

Note: DO NOT apply glue to the areas marked with an **X**, as this will impede the fitting of the mounting brackets.

1. Apply quick set 2-part epoxy glue to the areas indicated by the arrows [1], ensuring that the LED matrix is accurately aligned with the frame. Positioning is critical.
2. Apply pressure to the frame whilst the glue stiffens for at least 10 minutes, then leave for a further 20 minutes to firm up.
3. Using the four bracket plates and clamps, along the top and bottom edges, then apply the glue to the areas indicated by the arrows [2].
4. Allow at least 30 minutes for the glue to firm up.
5. Release the clamps and apply them to the left and right hand edges, and apply glue to the areas indicated by the arrows [3].
6. As the clamps are applied we can also apply glue to the areas indicated by the arrows [4].
7. Allow at least 30 minutes for the glue to firm up.
8. Release the clamps and finally apply glue to the areas indicated by the arrows [5].
9. Allow at least 30 minutes for the glue to firm up, 24 hrs to set.

Note that the design of this mounting frame has changed but the same principles apply.

16 x 16 LED Inter-panel Wiring

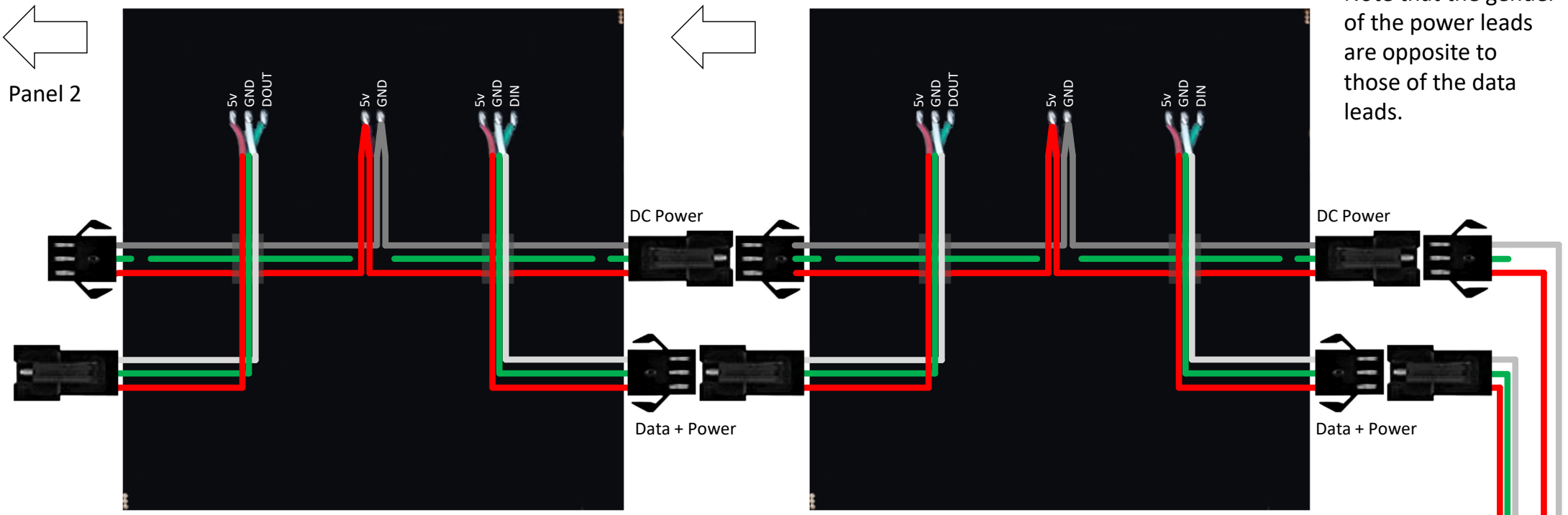


Note that the gender of the power leads are opposite to those of the data leads.

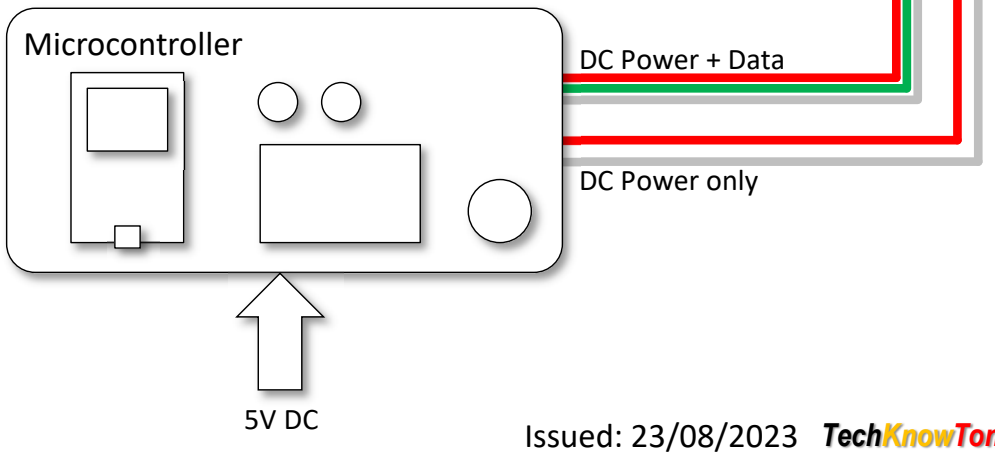
Panel 1

Panel 0

Panel 2



Cut the power leads to the lengths show, measured from the end of the wires to the base of the connectors. Also cut out a section of the green data wire, as shown, as it is not needed in the power leads.



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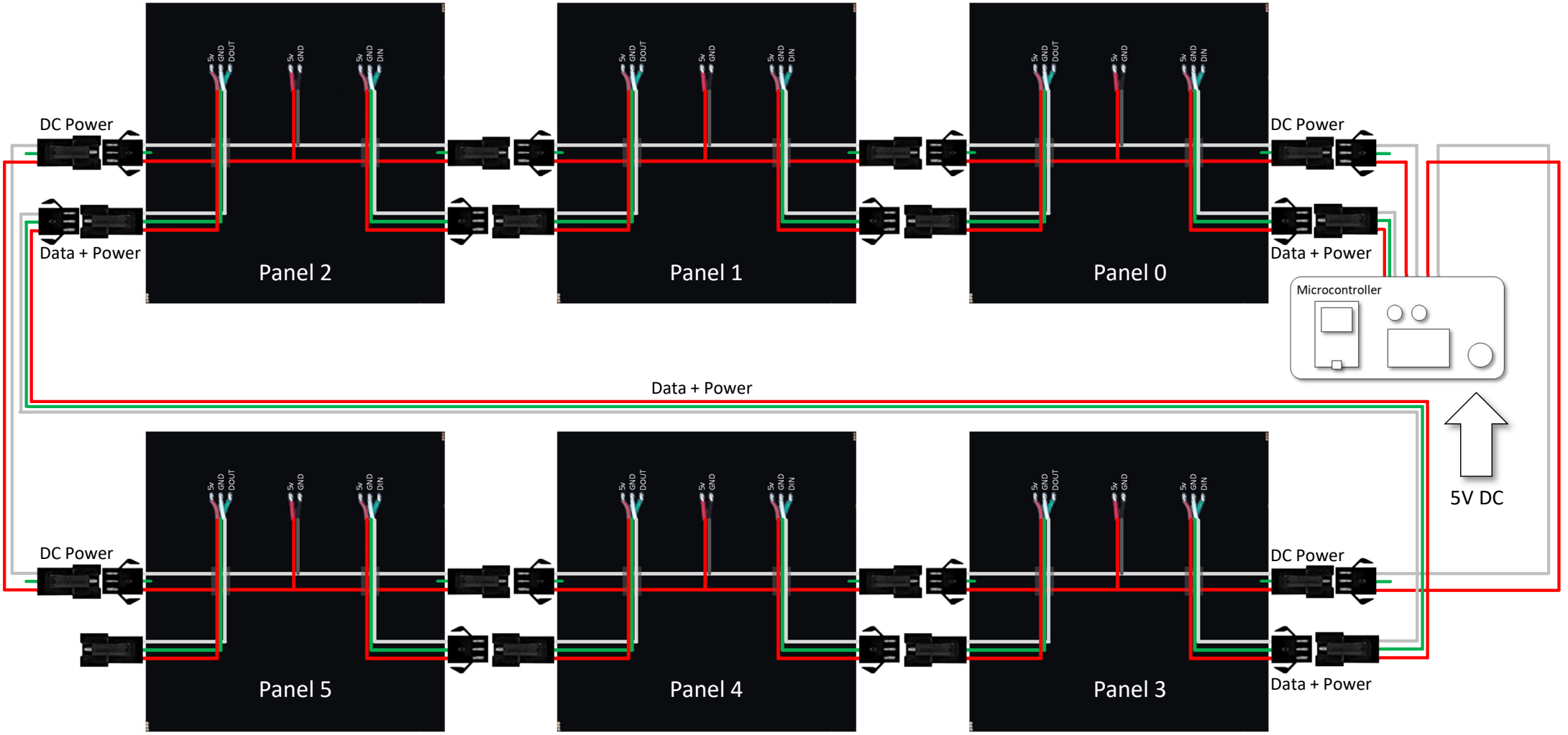
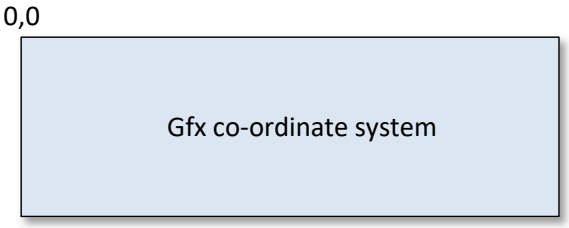
Inter-panel Wiring – 6 panels in series (2h x 3w)

The Matrix+ controller can drive panel arrays up to 3 x 8 (W x H). In this example we see two rows of 3 panels connected in series to one data port of the controller. The power grid is configured as a ring with the two power outputs of the controller being connected to the ends of the two rows to complete the ring, such that any one panel receives power from two directions.

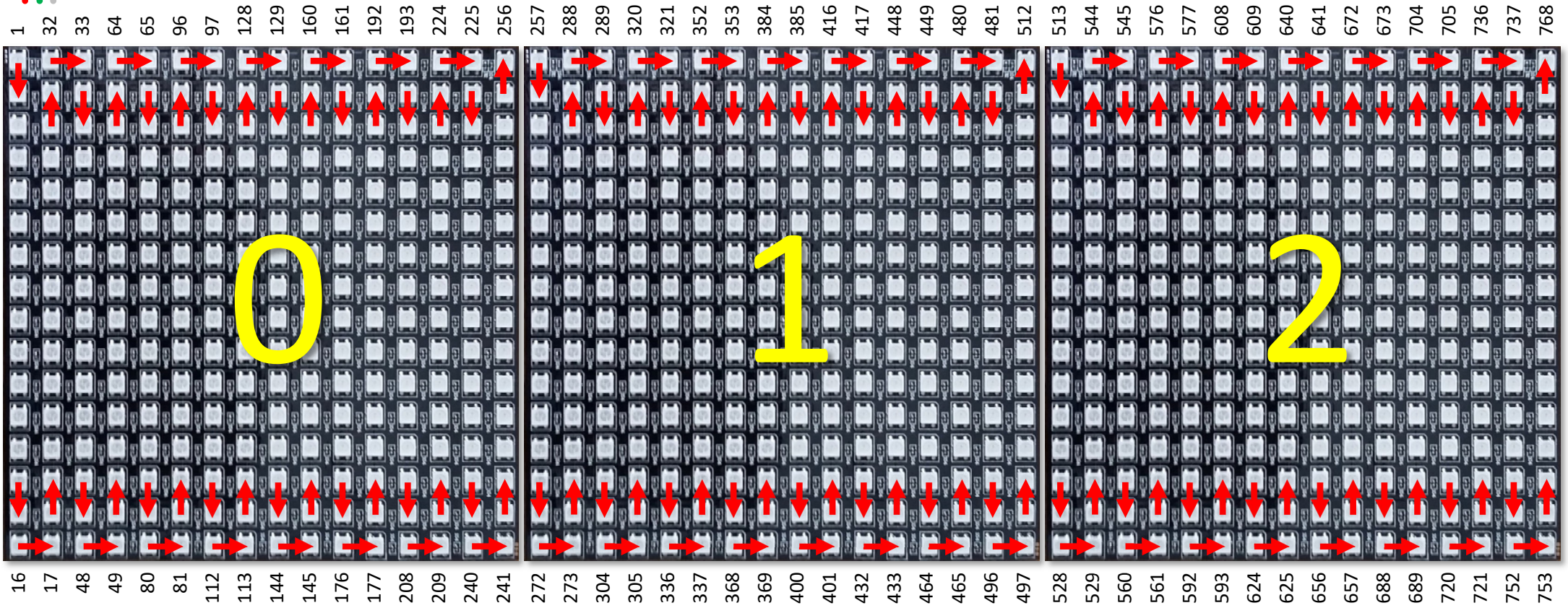


To achieve a higher frame rate you could disconnect the data link from Panel 2, and connect Panel 3 to the 2nd controller data output. Then configure the controller to work in 2H rather than 1P single panel mode.

LED Mapping For 3 Panels



16x16 WS2812B Panels 15.9x15.9cm



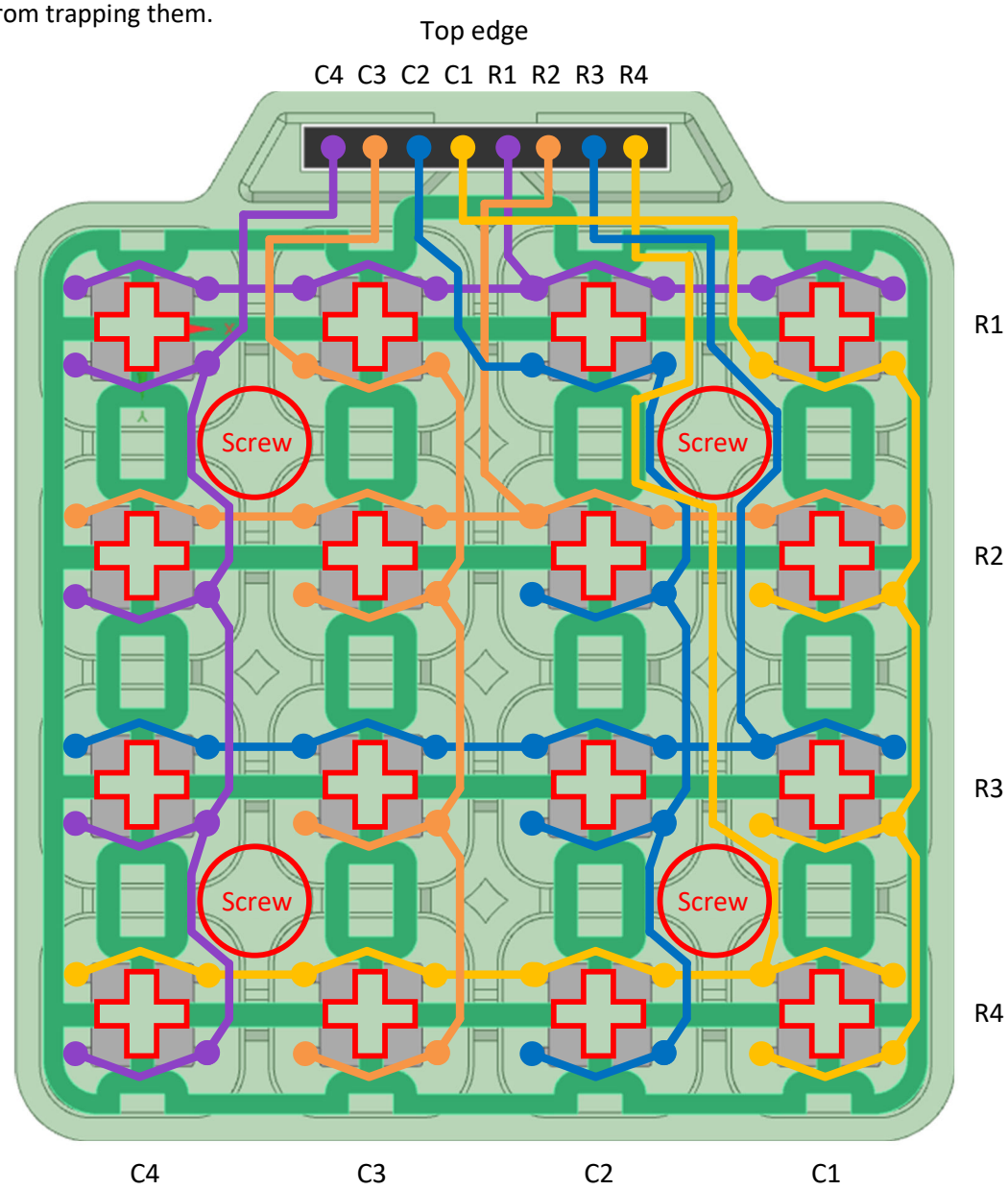
The LED numbering assumes that the panel is fed from the left D_{IN} via a single level shifter LED, which takes up LED position 0, hence the panel LED number starts at 1.

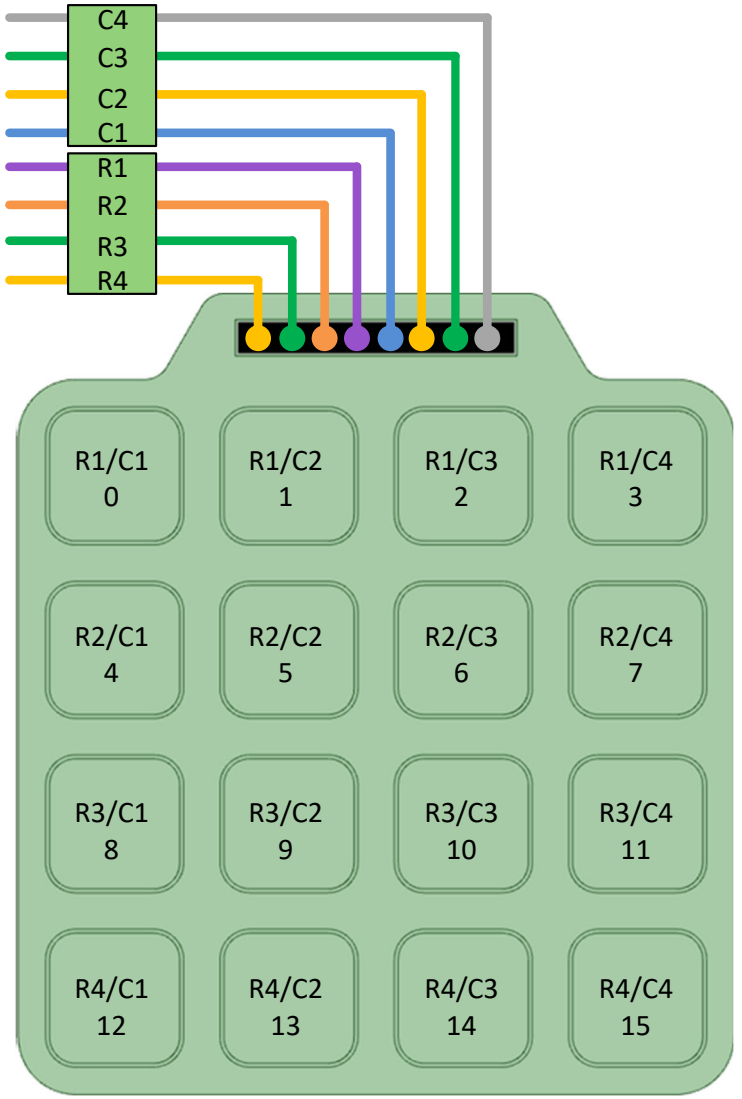
X,Y co-ordinate system assumes Panel 0, top left, is 0,0 (X,Y)

Note that in larger panel configurations, it is important for the controller code to know how many horizontal panels there are, in order to determine the X,Y co-ordinates of an LED correctly.

4x4 Keypad internal wiring

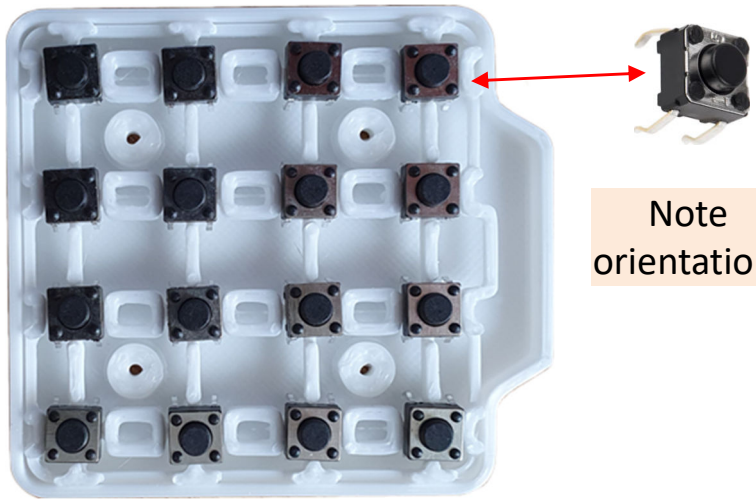
The wiring is completed using coloured lengths of wire wrap wire. Notice how the wiring is routed around the case screw pillars (shown in red), and formed at the switches to avoid the bases cross headed supports (shown in red) from trapping them.





Build Sequence

01 Place the 5mm button switches into the frame



Note orientation

Use the Base Plate as a support, to raise their pins

Put a blob of epoxy glue along one edge of each switch. 02

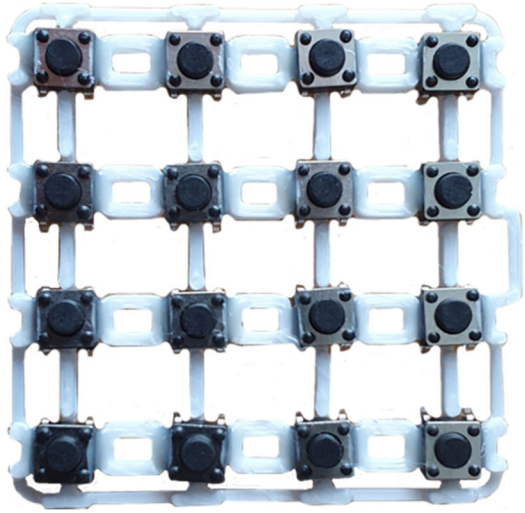
5 minute set time

Then place a weighted plate on top to hold them flat

03 Once the glue has set, do the same on the other edge.

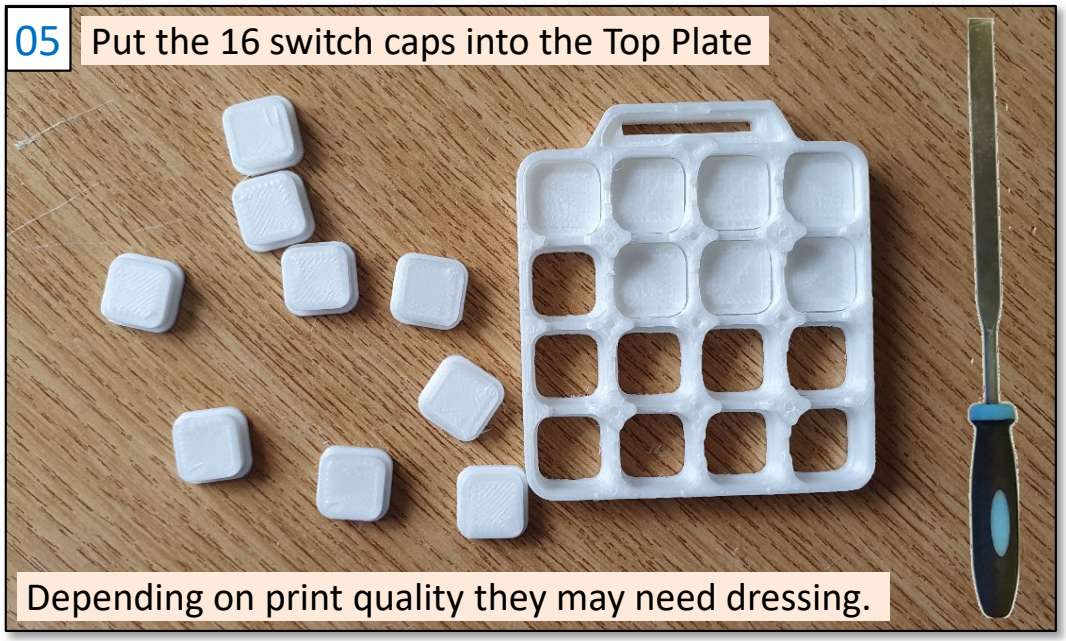
Rotate the job to make this easier.

Once the glues is set the frame should then look like this. 04



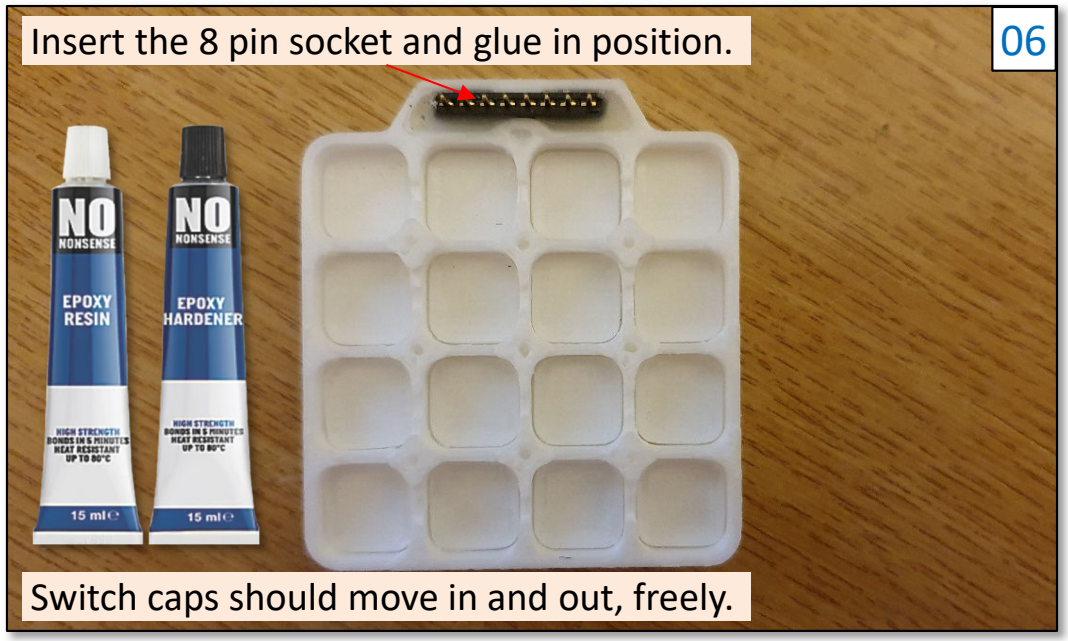
Wiring Sequence

05 Put the 16 switch caps into the Top Plate



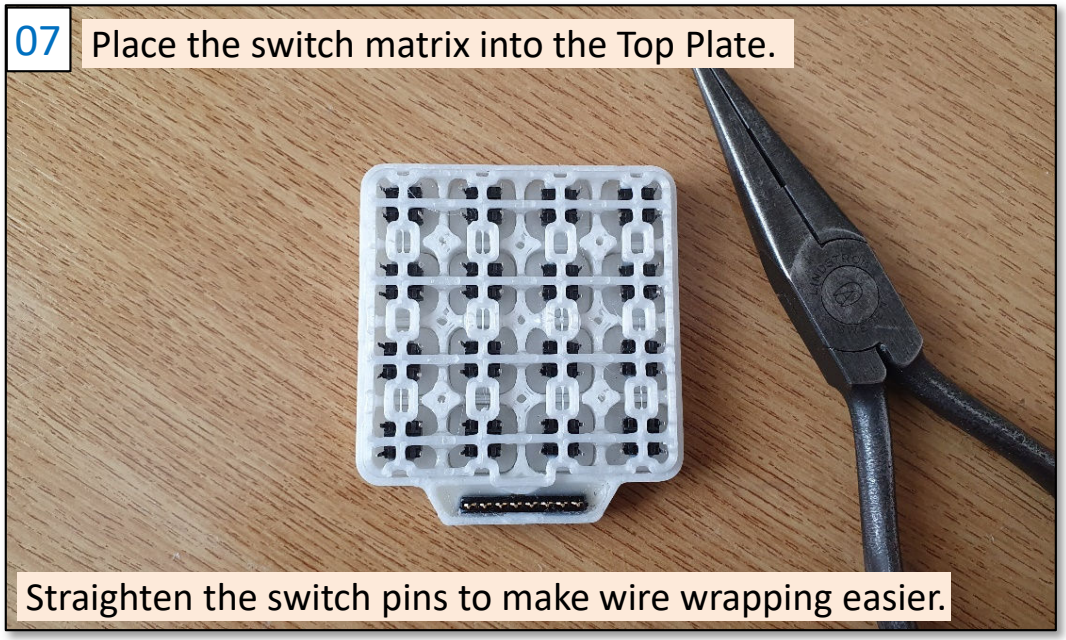
Depending on print quality they may need dressing.

Insert the 8 pin socket and glue in position. 06



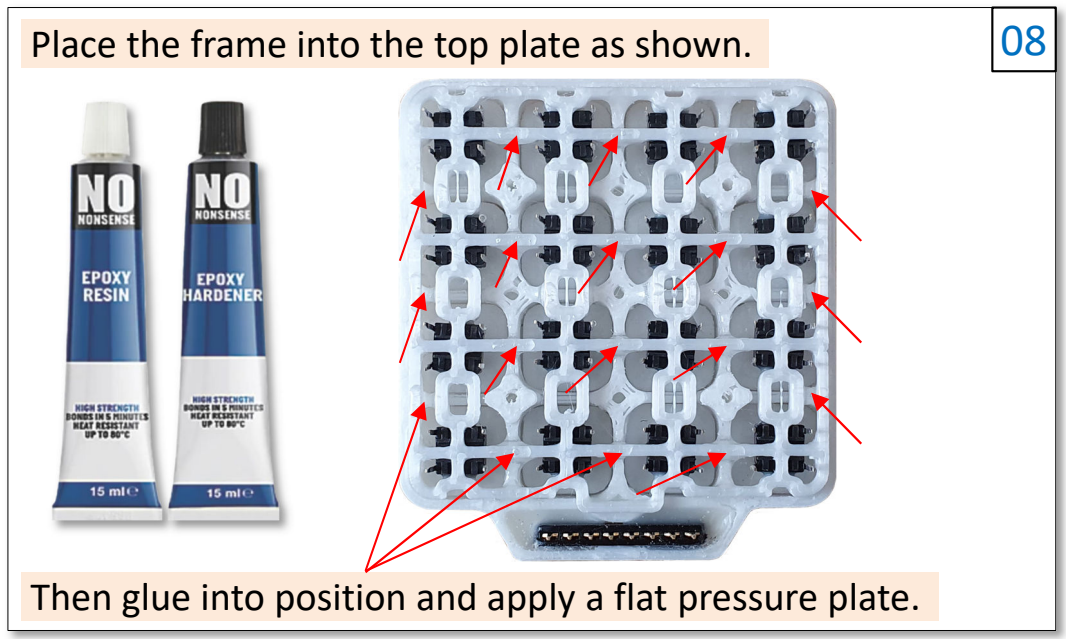
Switch caps should move in and out, freely.

07 Place the switch matrix into the Top Plate.



Straighten the switch pins to make wire wrapping easier.

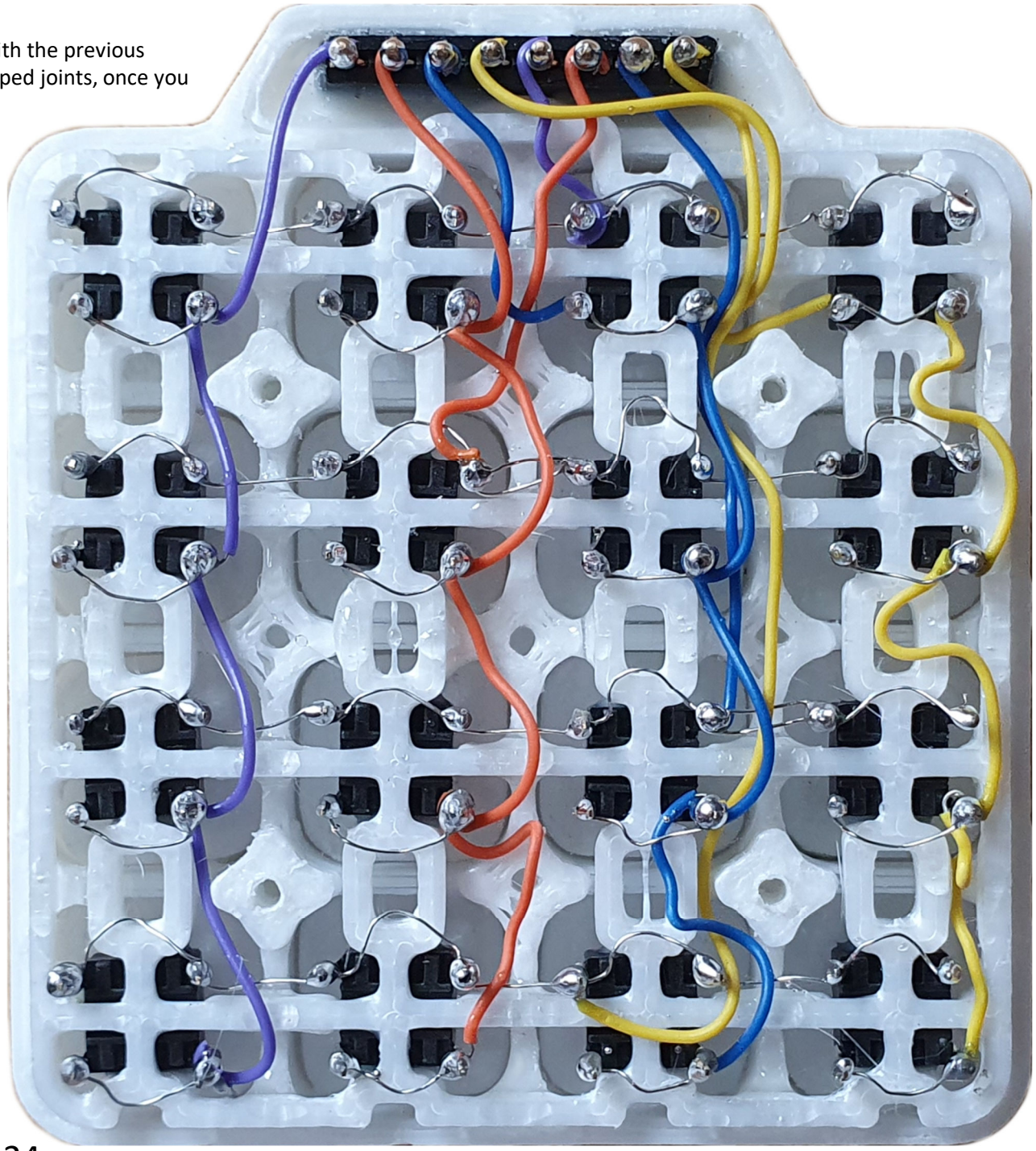
Place the frame into the top plate as shown. 08



Then glue into position and apply a flat pressure plate.

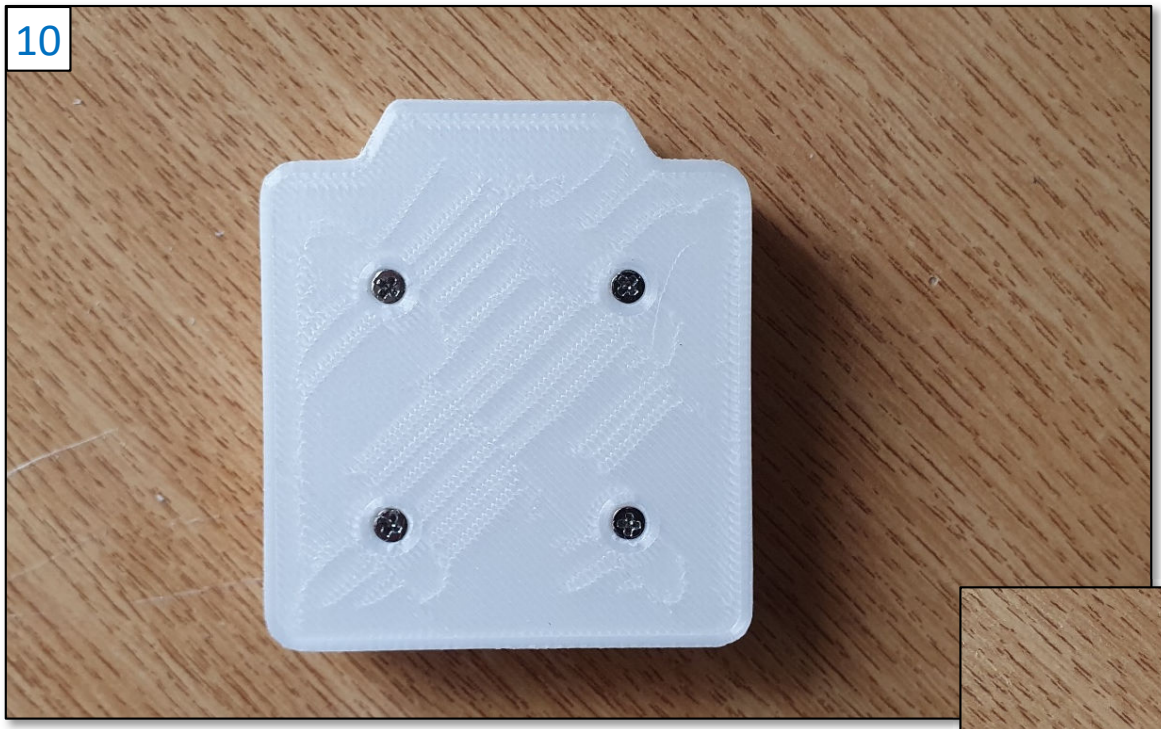
4x4 Keypad Wiring

Wire up the switches in line with the previous diagram. Solder the wire wrapped joints, once you have tested the unit first.



Build complete

10

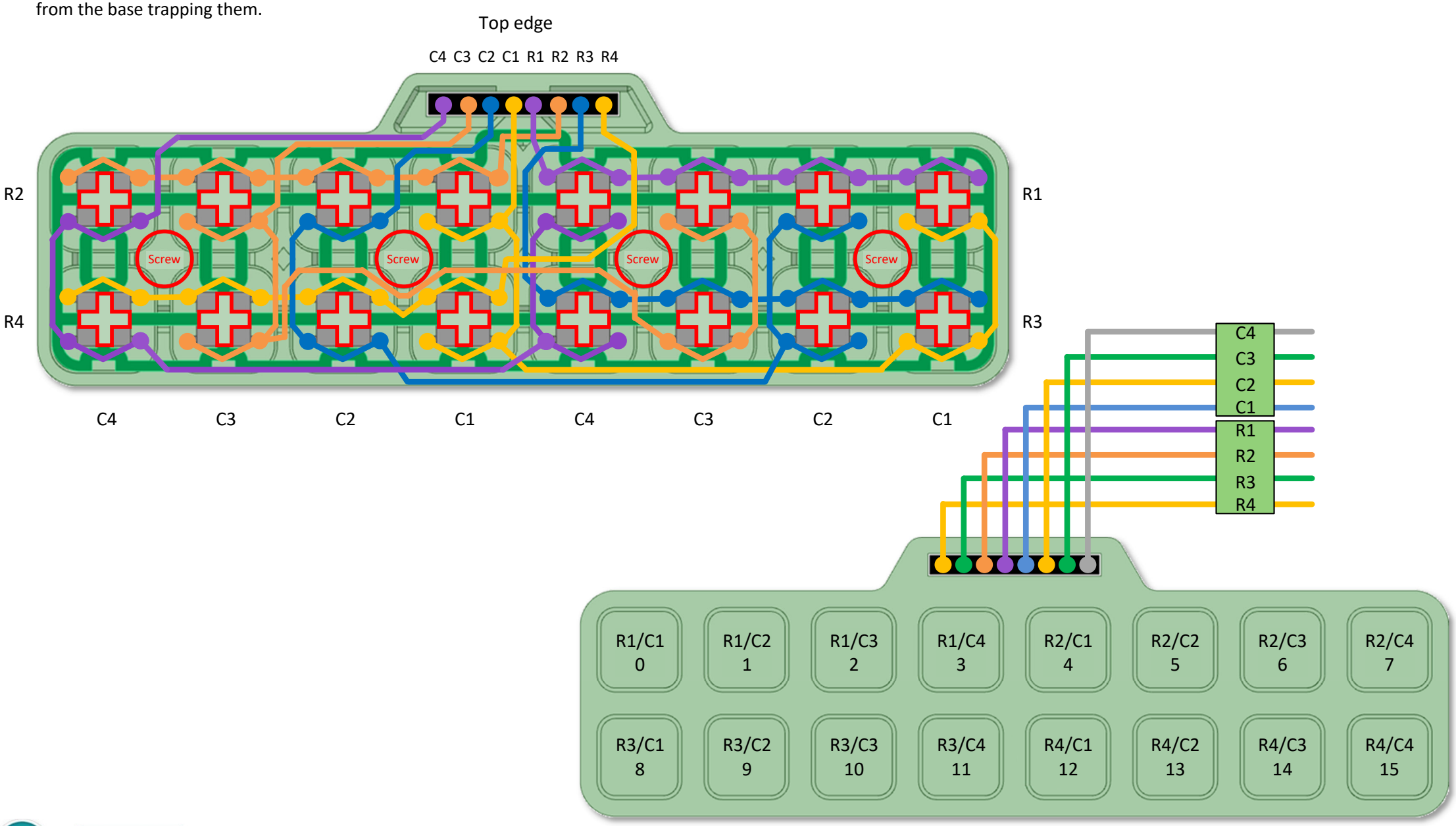


Insert the four 2x10mm self-tapping screws into the base plate, attach it to the top plate assembly, and tighten, and you're done!

11

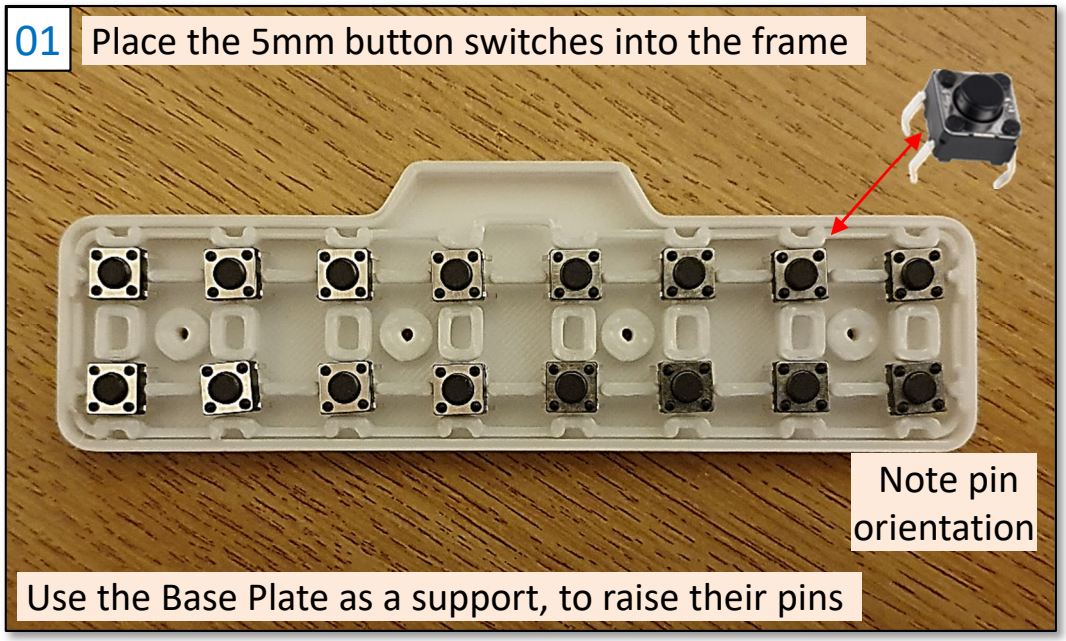
8x2 Keypad internal wiring

The wiring is completed using coloured lengths of wire wrap wire. Notice how the wiring is routed around the case screw pillars (shown in red), and formed at the switches to avoid the cross headed supports (shown in red) from the base trapping them.



Build Sequence

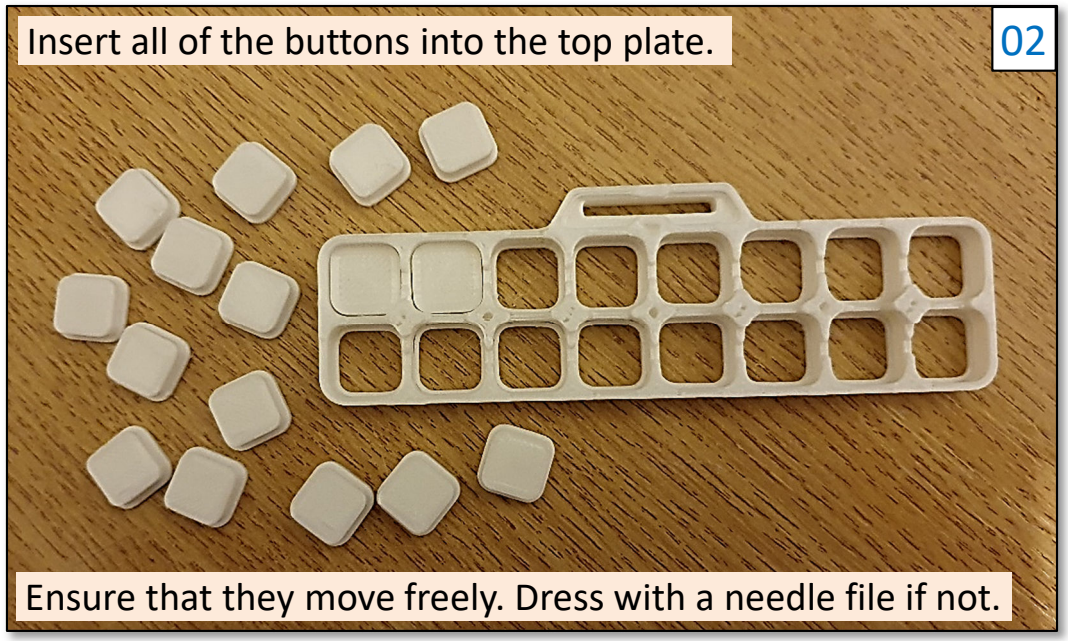
01 Place the 5mm button switches into the frame



Note pin orientation

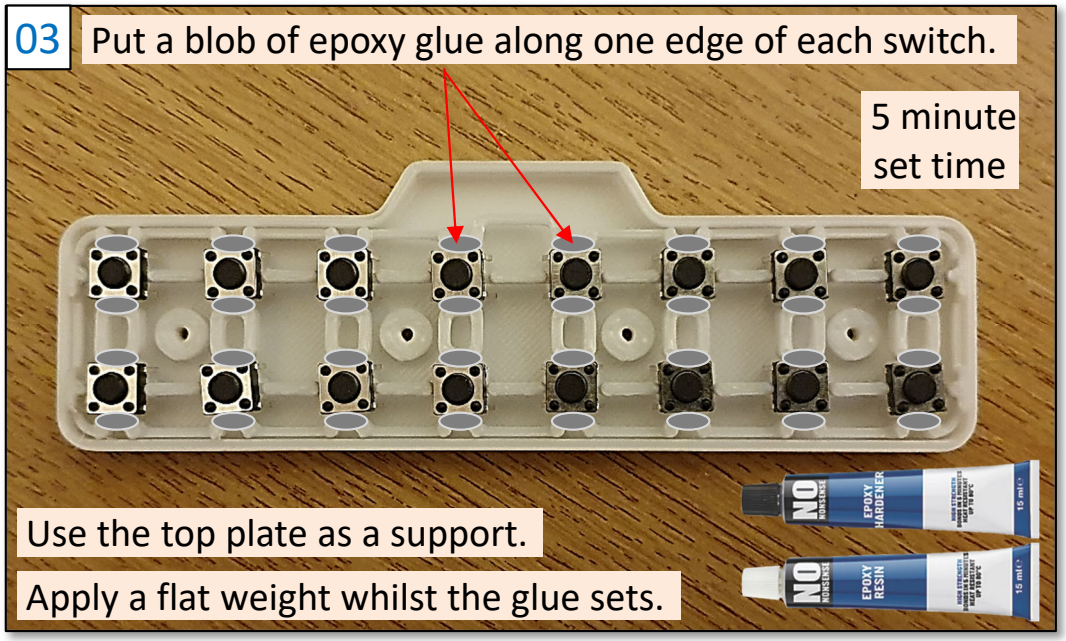
Use the Base Plate as a support, to raise their pins

Insert all of the buttons into the top plate. 02



Ensure that they move freely. Dress with a needle file if not.

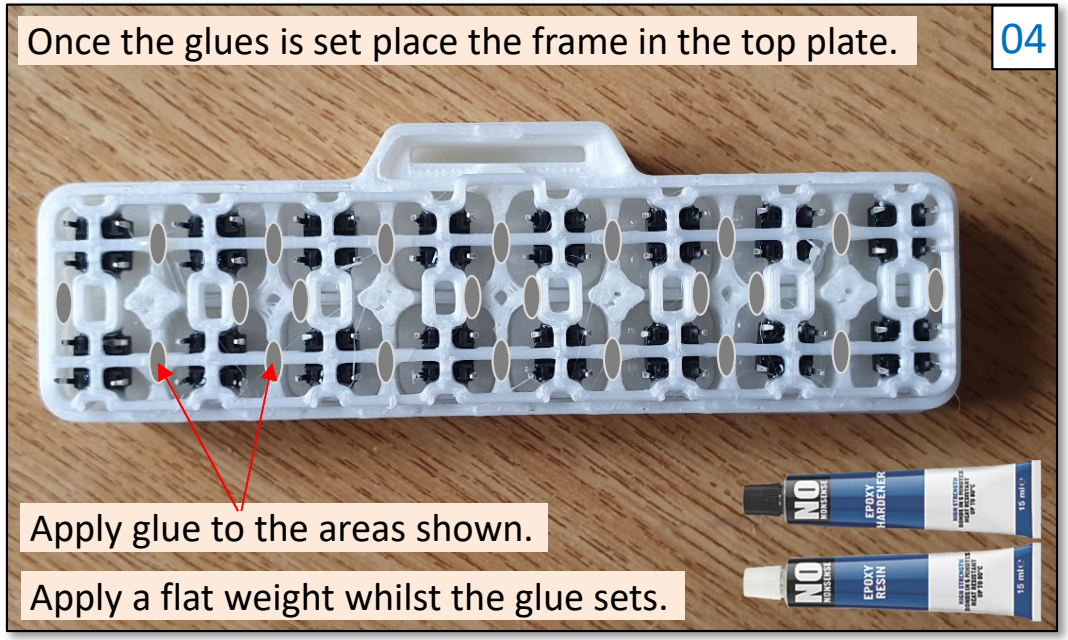
03 Put a blob of epoxy glue along one edge of each switch.



Use the top plate as a support.

Apply a flat weight whilst the glue sets.

Once the glues is set place the frame in the top plate. 04



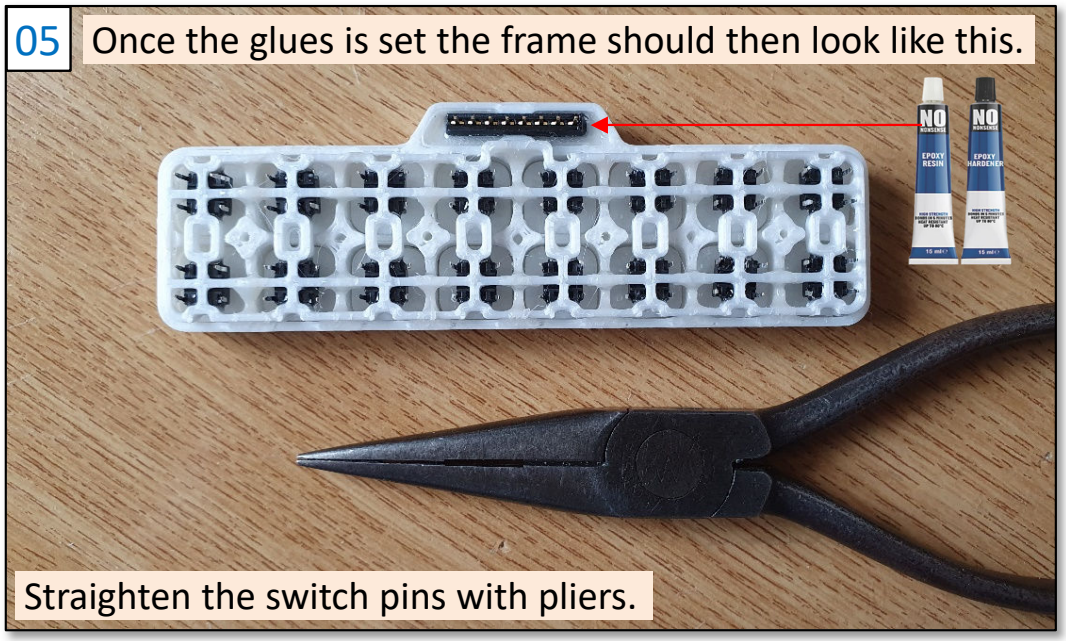
Apply glue to the areas shown.

Apply a flat weight whilst the glue sets.

Issued: 23/08/2023

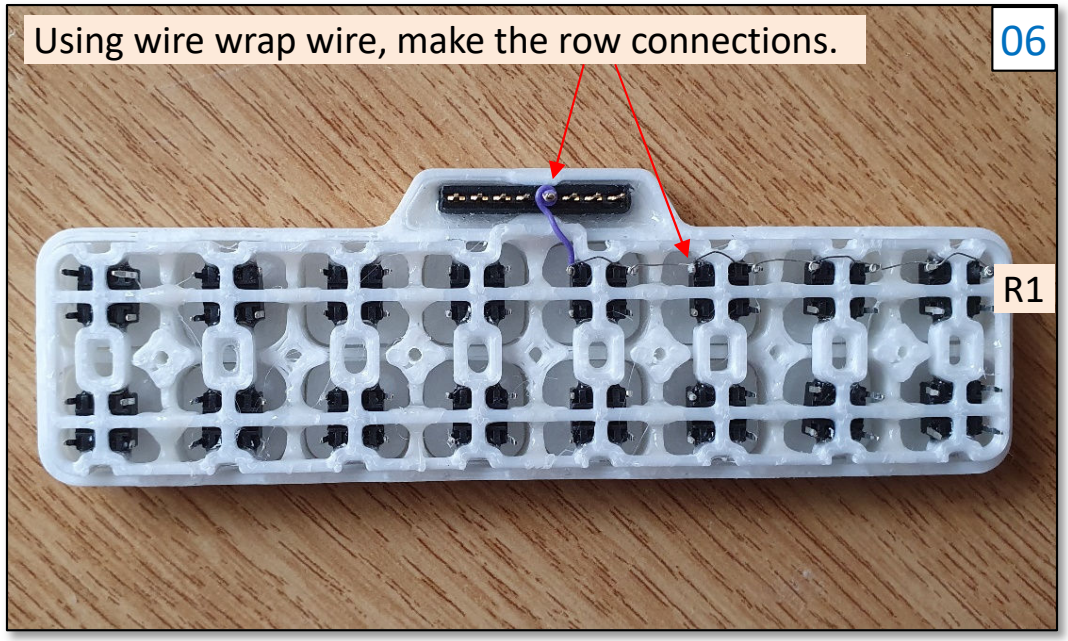
Wiring Sequence

05 Once the glues is set the frame should then look like this.

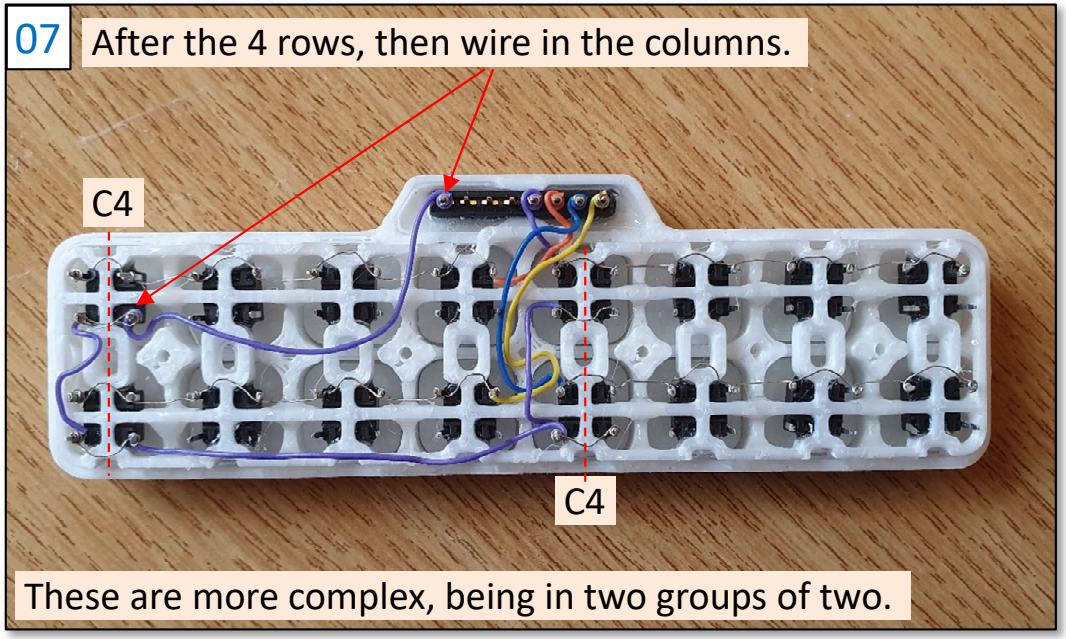


Straighten the switch pins with pliers.

Using wire wrap wire, make the row connections. 06

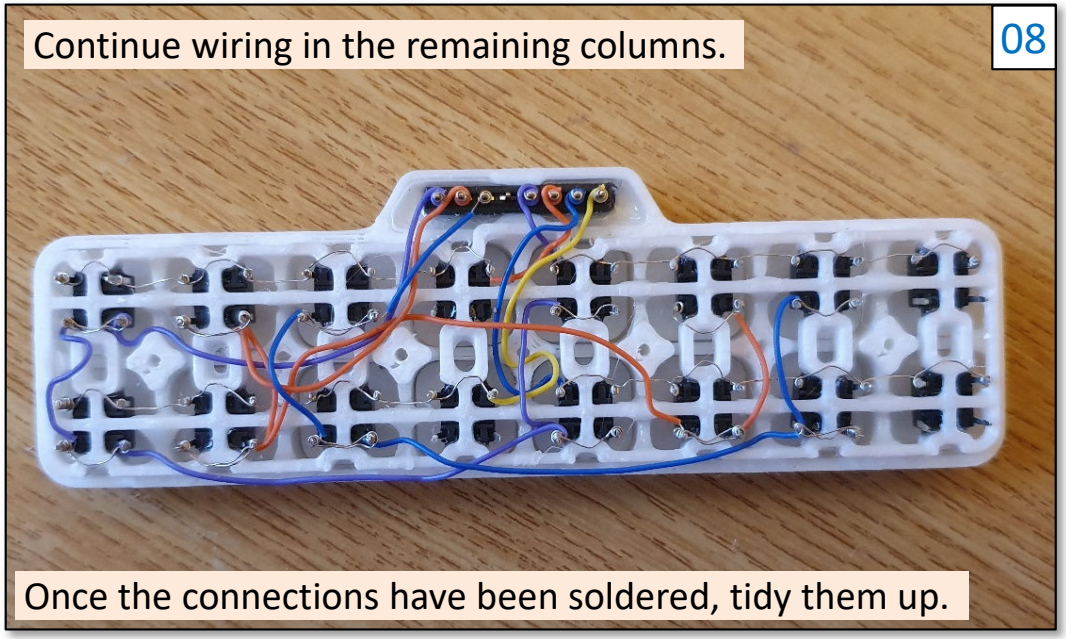


07 After the 4 rows, then wire in the columns.



These are more complex, being in two groups of two.

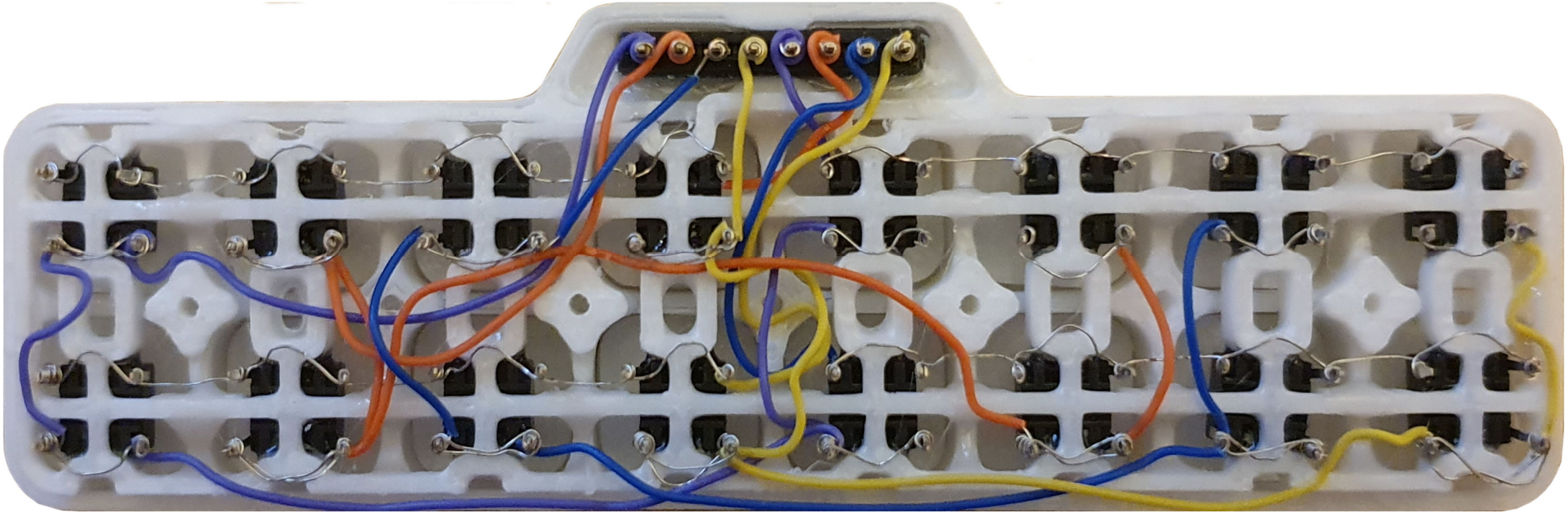
Continue wiring in the remaining columns. 08



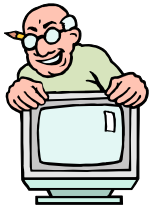
Once the connections have been soldered, tidy them up.

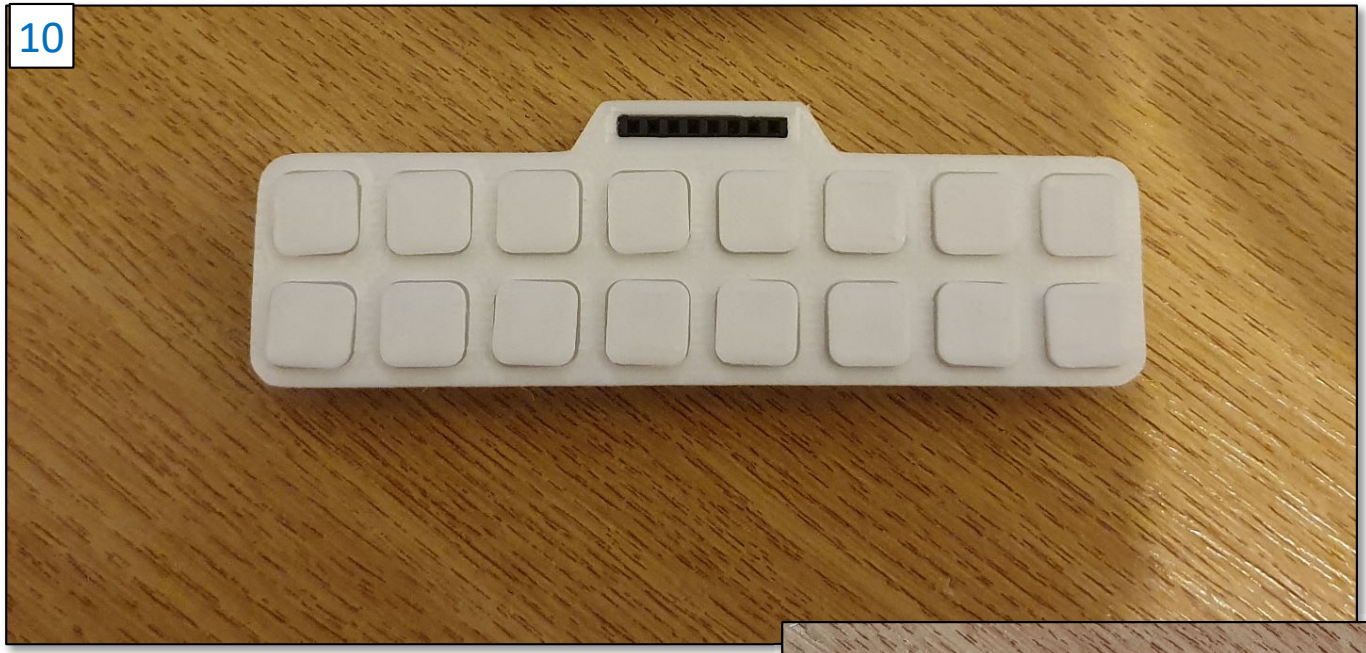
8x2 Keypad Wiring

Wire up the switches in line with the previous diagram. Solder the wire wrapped joints, once you have tested the unit first.



Build complete

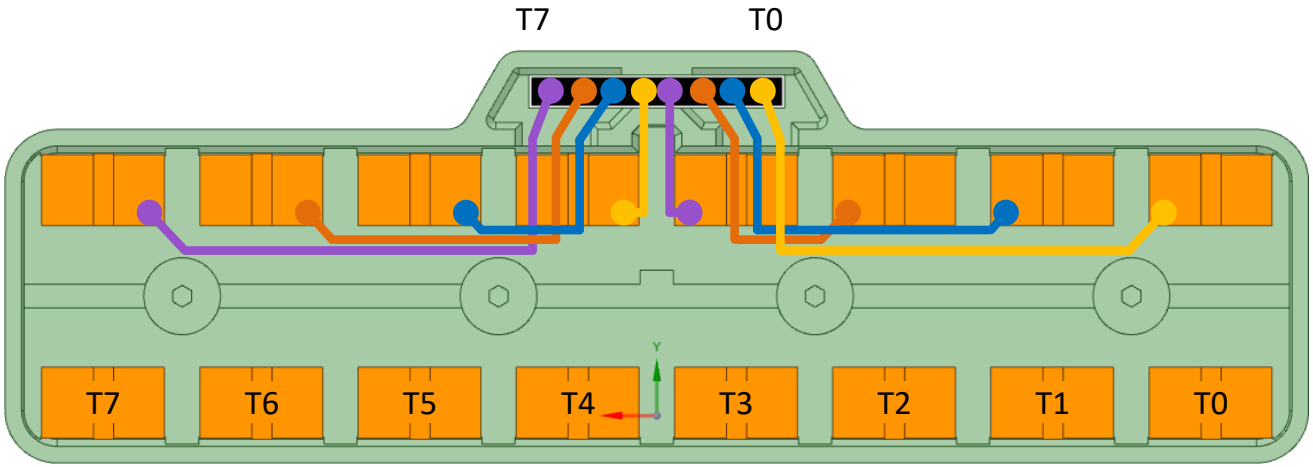


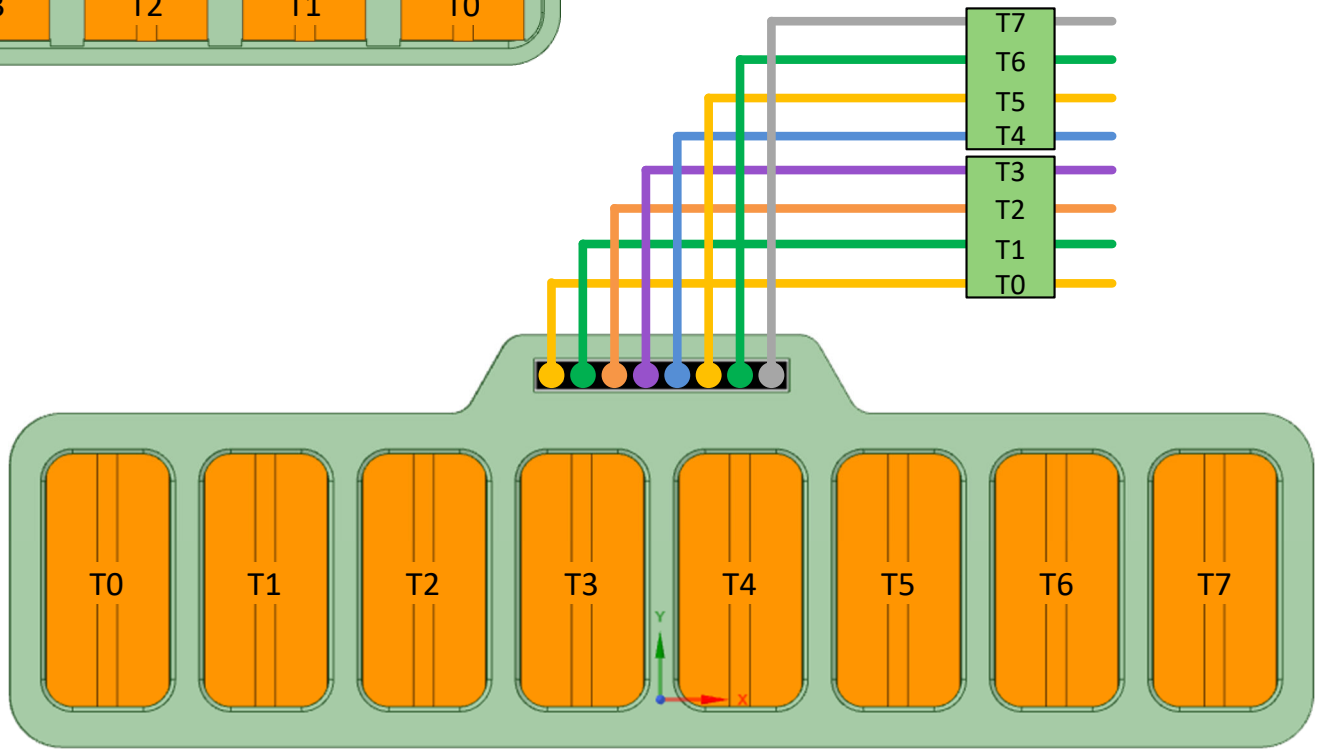


Insert the four 2x10mm self-tapping screws into the base plate, attach it to the top plate assembly, and tighten, and you're done!

Touchpad Internal Wiring

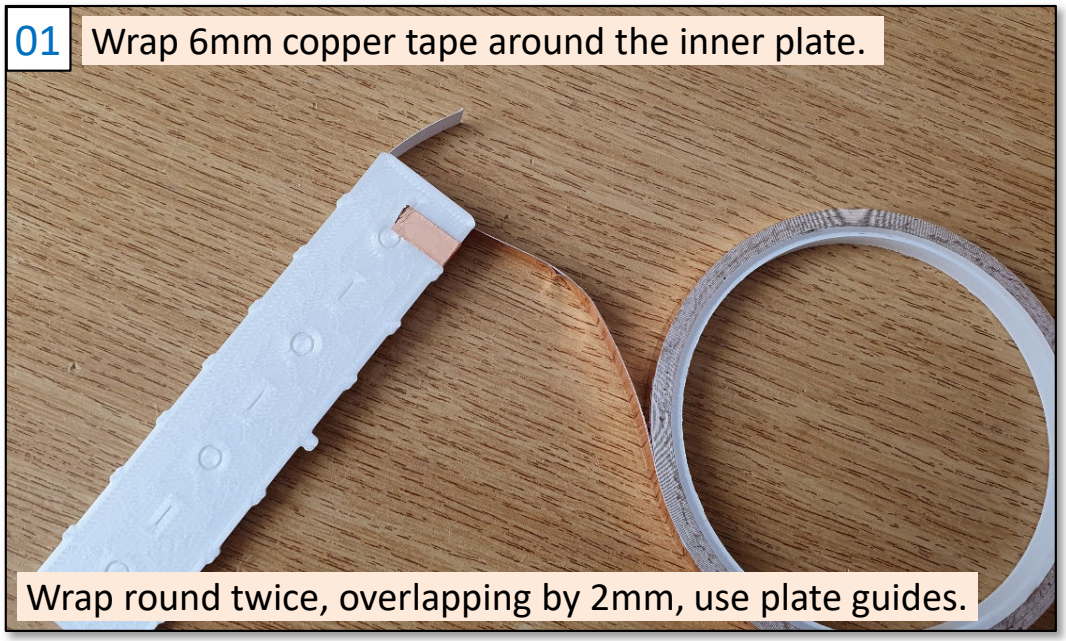
The internal wiring is completed using coloured lengths of wire wrap wire.
Each wire is soldered to the corner of one of the copper tape touchpads.
Taking care not to apply too much heat, that would melt the plastic





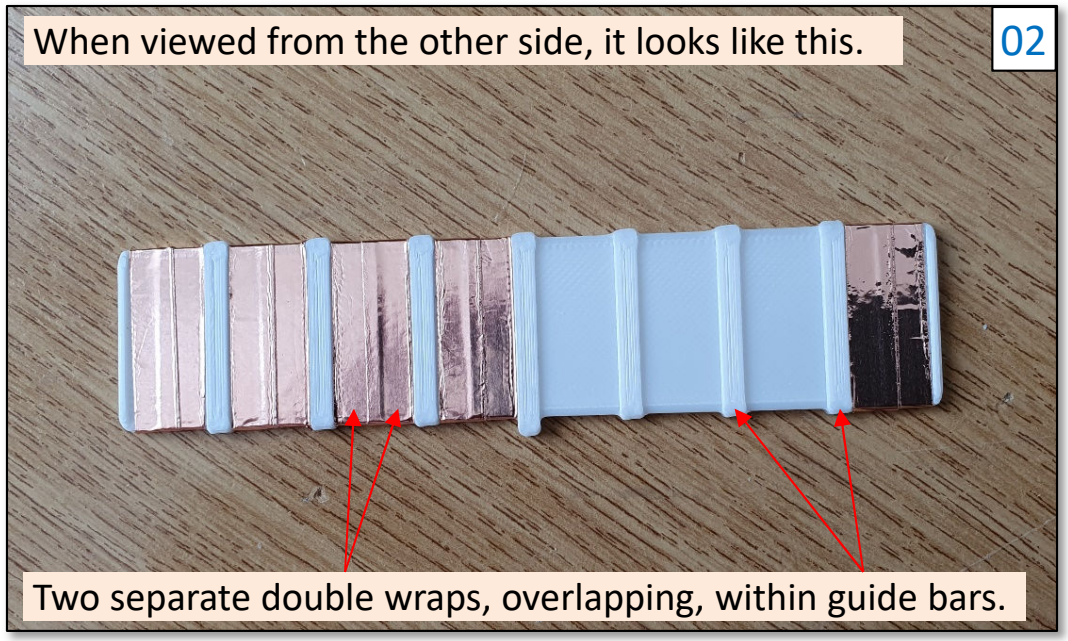
Touchpad Build Sequence

01 Wrap 6mm copper tape around the inner plate.



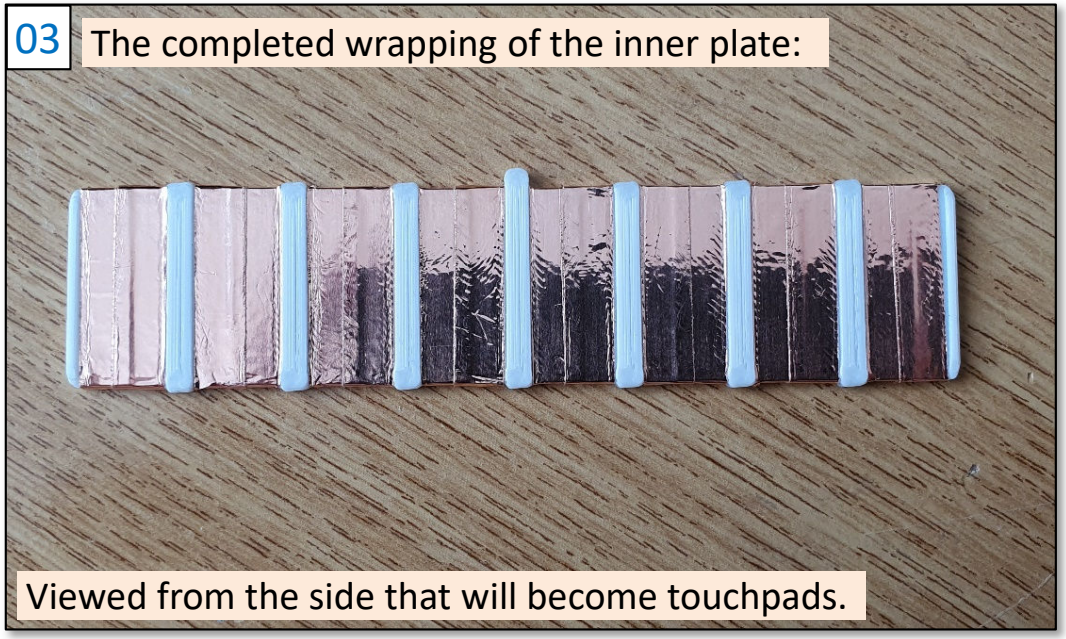
Wrap round twice, overlapping by 2mm, use plate guides.

When viewed from the other side, it looks like this. 02



Two separate double wraps, overlapping, within guide bars.

03 The completed wrapping of the inner plate:



Viewed from the side that will become touchpads.

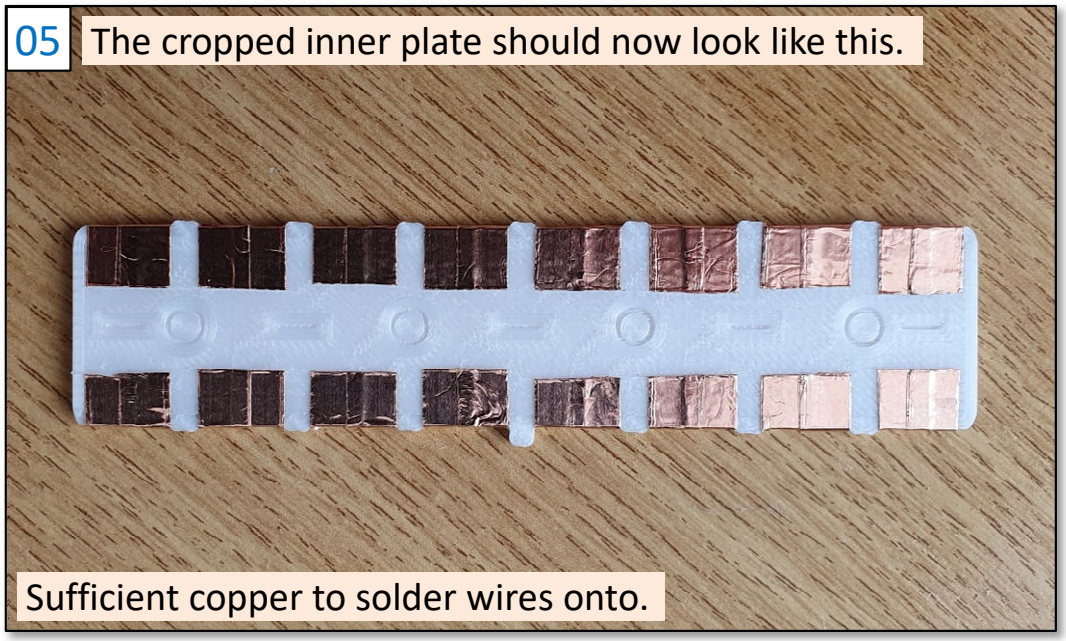
Use a craft knife to remove tape from the underside. 04

This leaves an exposed area for gluing later.

Circles

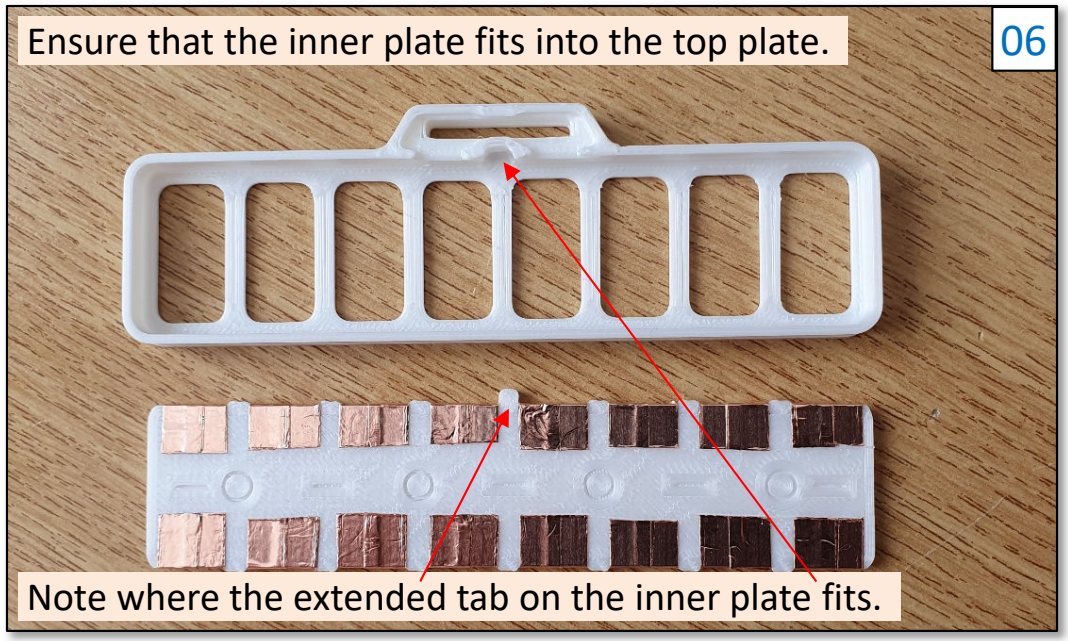
Touchpad Build Sequence

05 The cropped inner plate should now look like this.



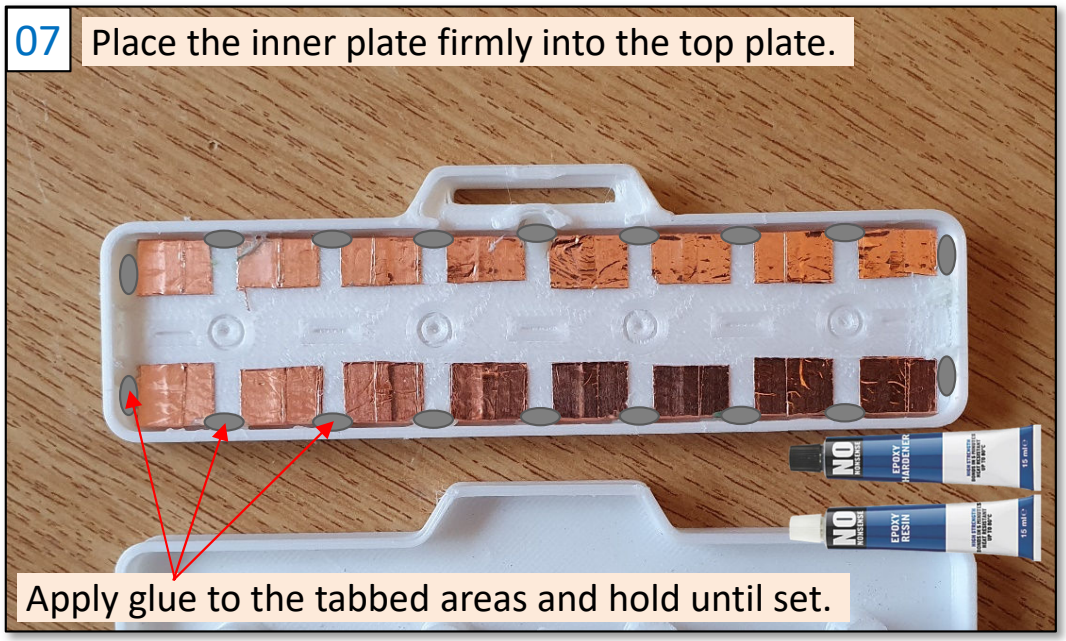
Sufficient copper to solder wires onto.

06 Ensure that the inner plate fits into the top plate.



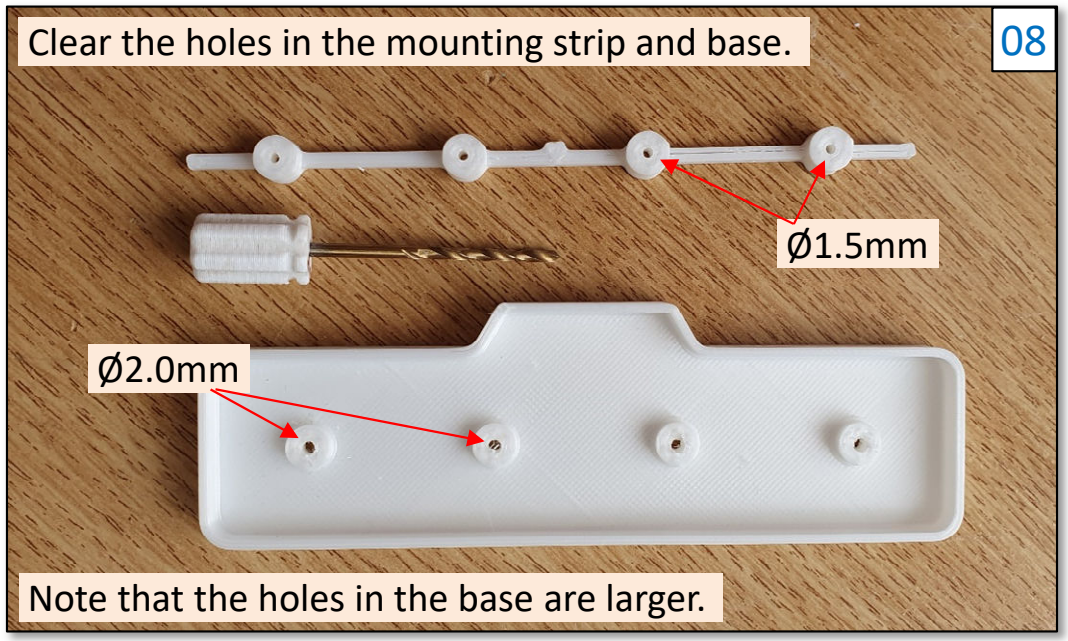
Note where the extended tab on the inner plate fits.

07 Place the inner plate firmly into the top plate.



Apply glue to the tabbed areas and hold until set.

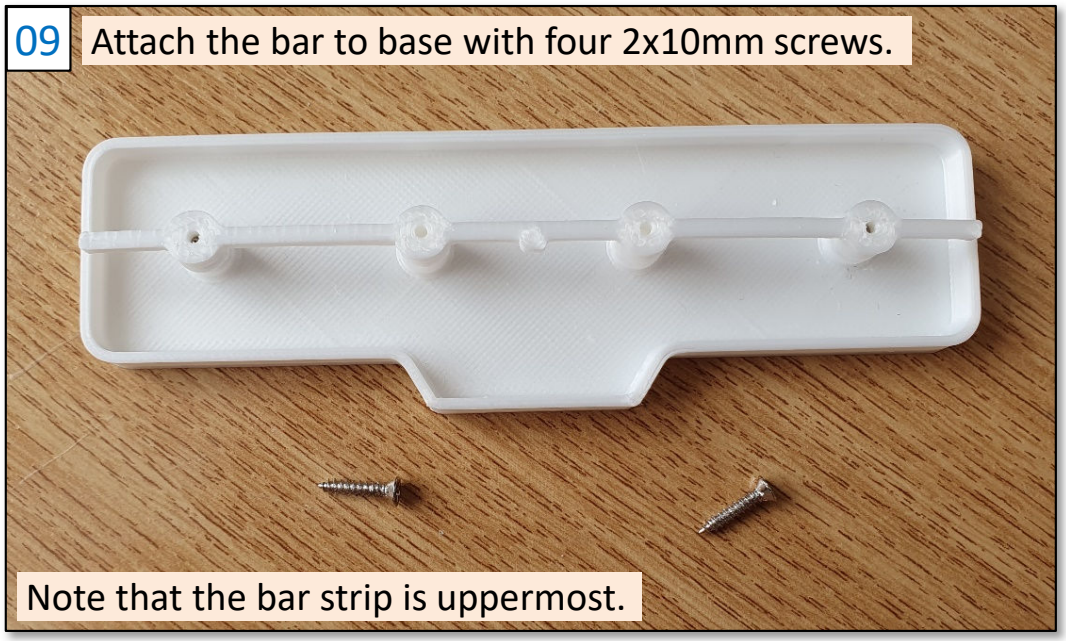
08 Clear the holes in the mounting strip and base.



Note that the holes in the base are larger.

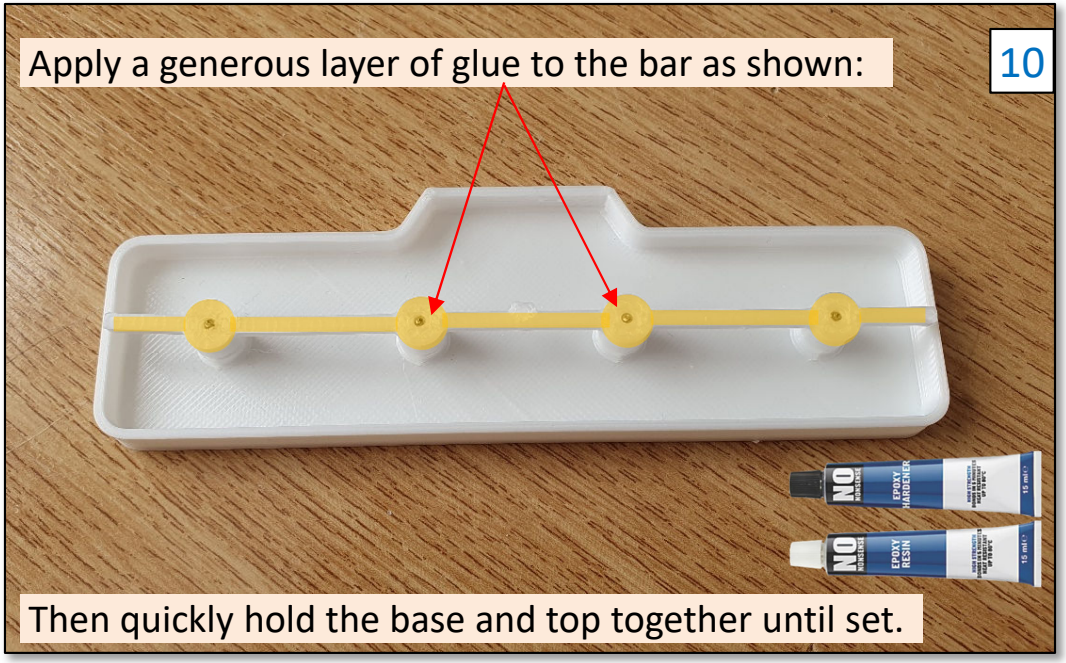
Touchpad Build Sequence

09 Attach the bar to base with four 2x10mm screws.



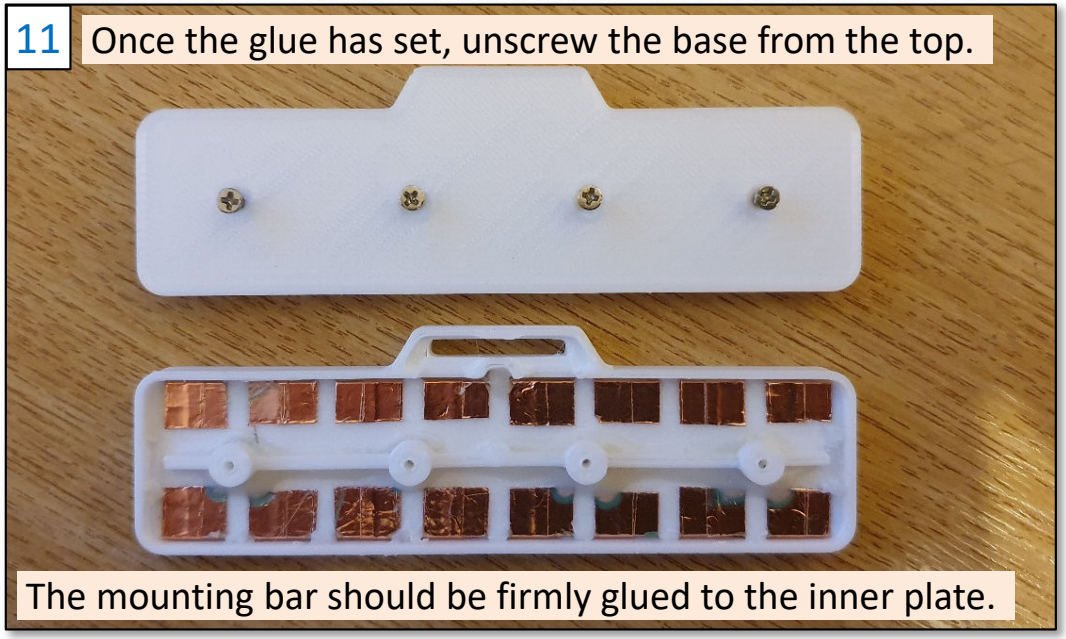
Note that the bar strip is uppermost.

10 Apply a generous layer of glue to the bar as shown:



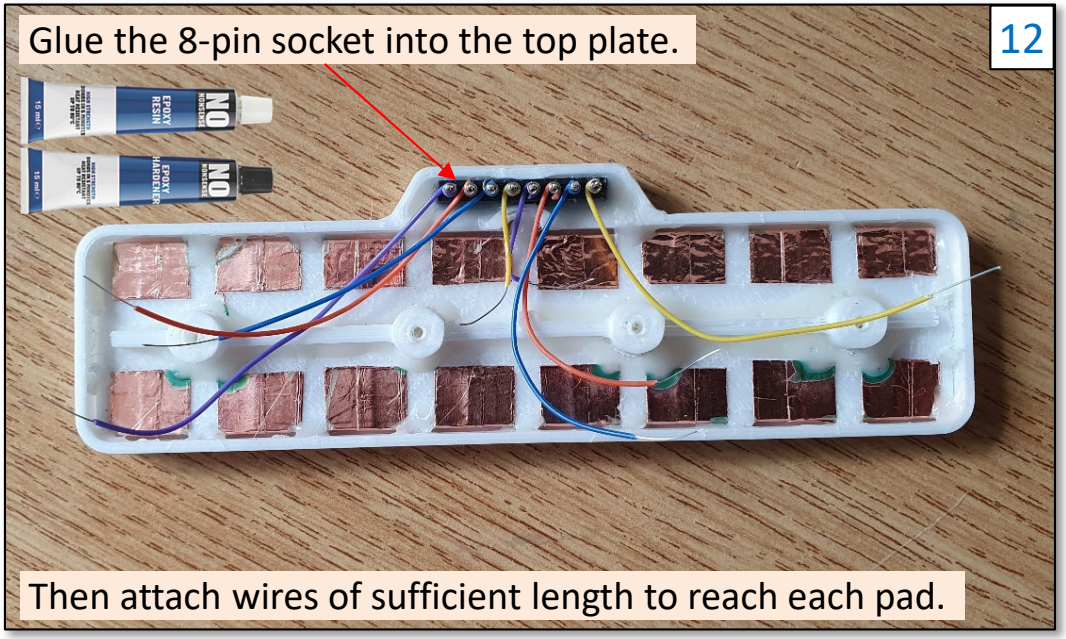
Then quickly hold the base and top together until set.

11 Once the glue has set, unscrew the base from the top.



The mounting bar should be firmly glued to the inner plate.

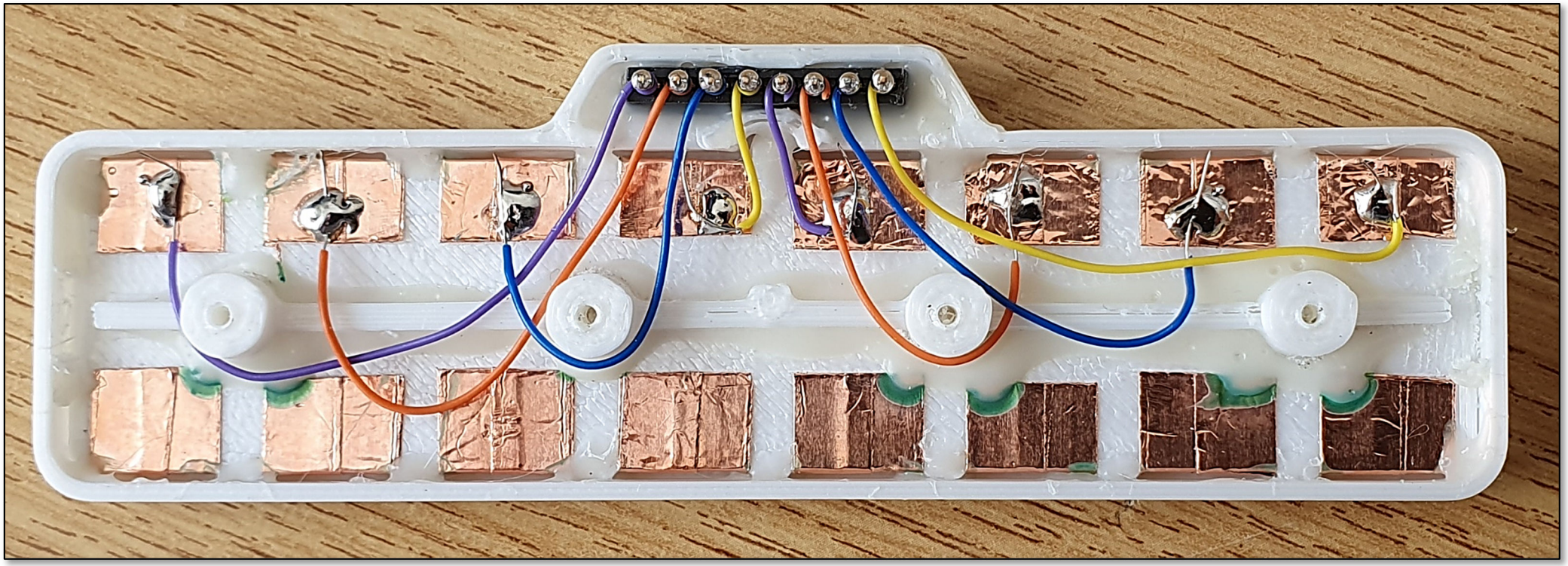
12 Glue the 8-pin socket into the top plate.



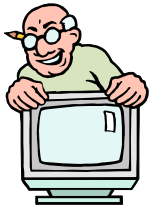
Then attach wires of sufficient length to reach each pad.

Touchpad Wiring

Wire up the touchpads in line with the previous diagram. Solder the wire wrapped joints, and the wires onto the respective copper pads. Be careful not to apply too much heat from the soldering iron, as this will lift the copper take and could distort the touch surfaces on the other side.



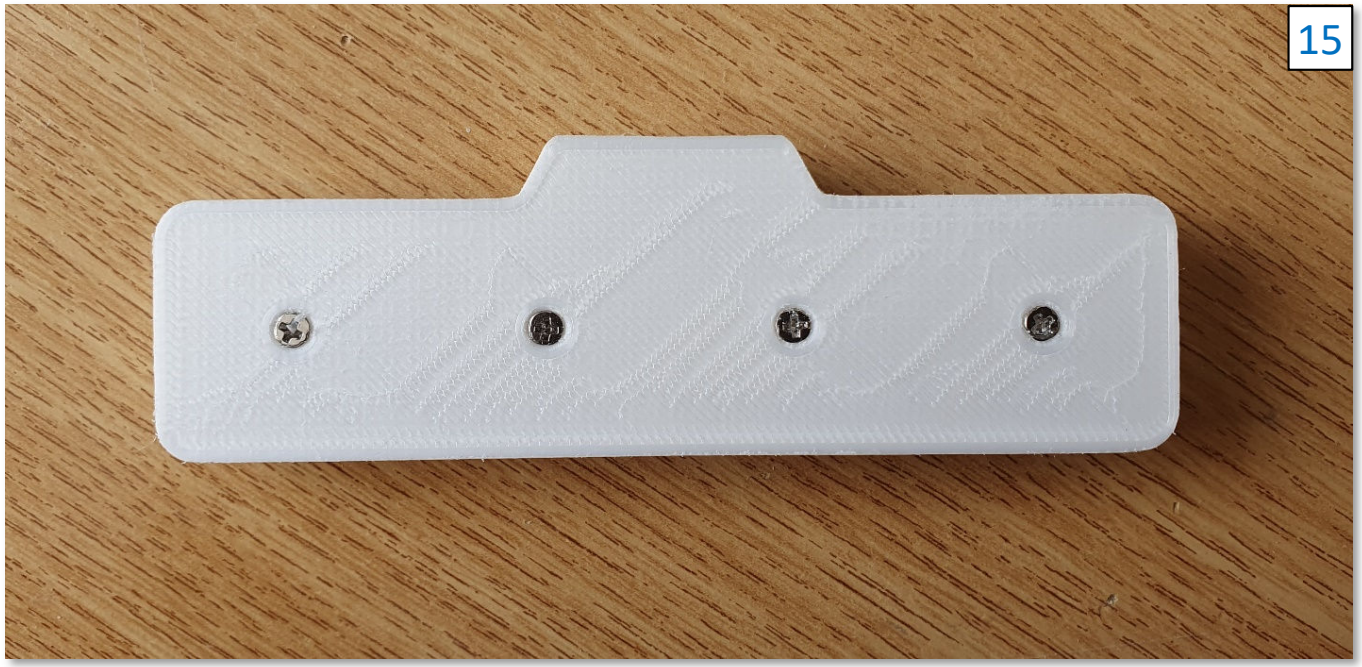
Build complete



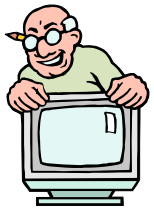
14

Insert the four 2x10mm self-tapping screws into the base plate, attach it to the top plate assembly, and tighten, and you're done!

15

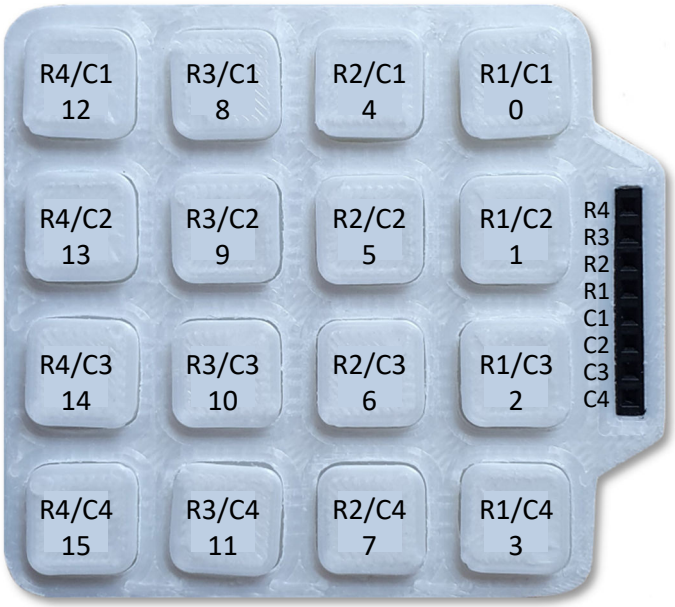


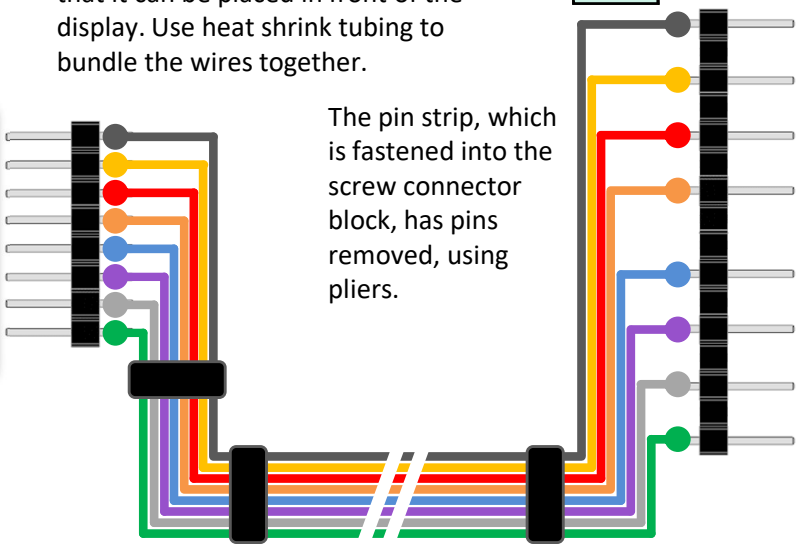
Switch harness wiring

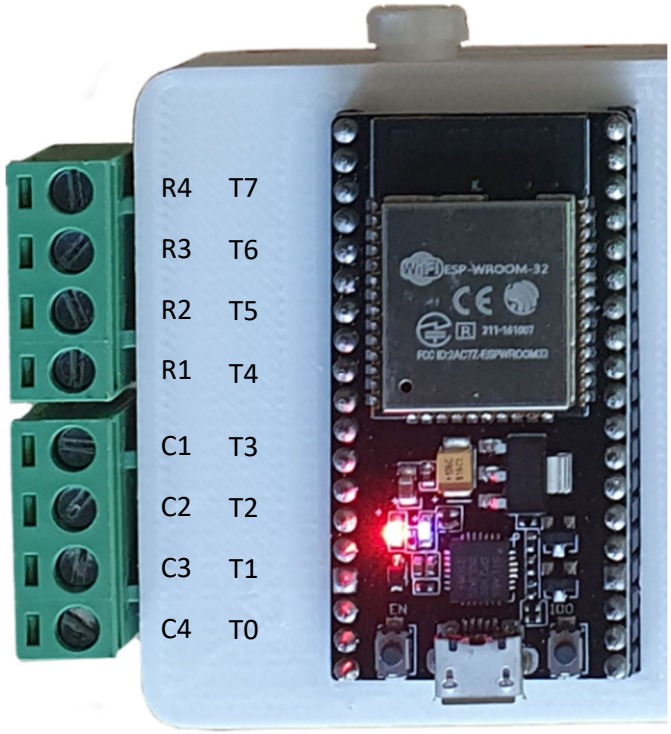


A harness can be made, to connect the button box to the MATRIX+ controller. Use different coloured wires, and make it of sufficient length (60cm), so that it can be placed in front of the display. Use heat shrink tubing to bundle the wires together.

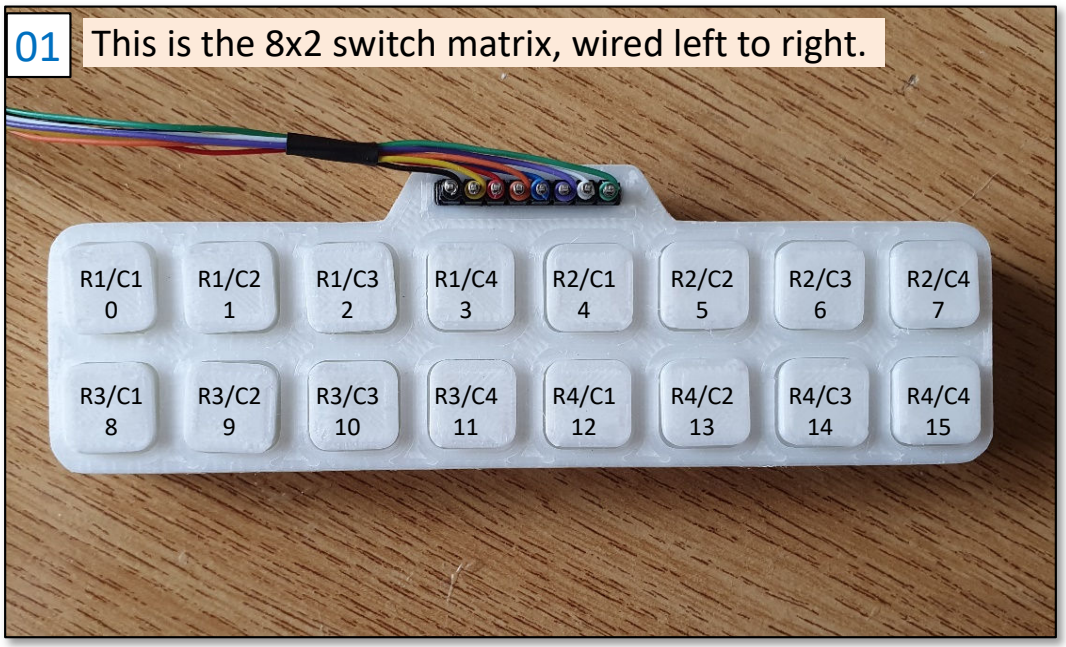
The pin strip, which is fastened into the screw connector block, has pins removed, using pliers.



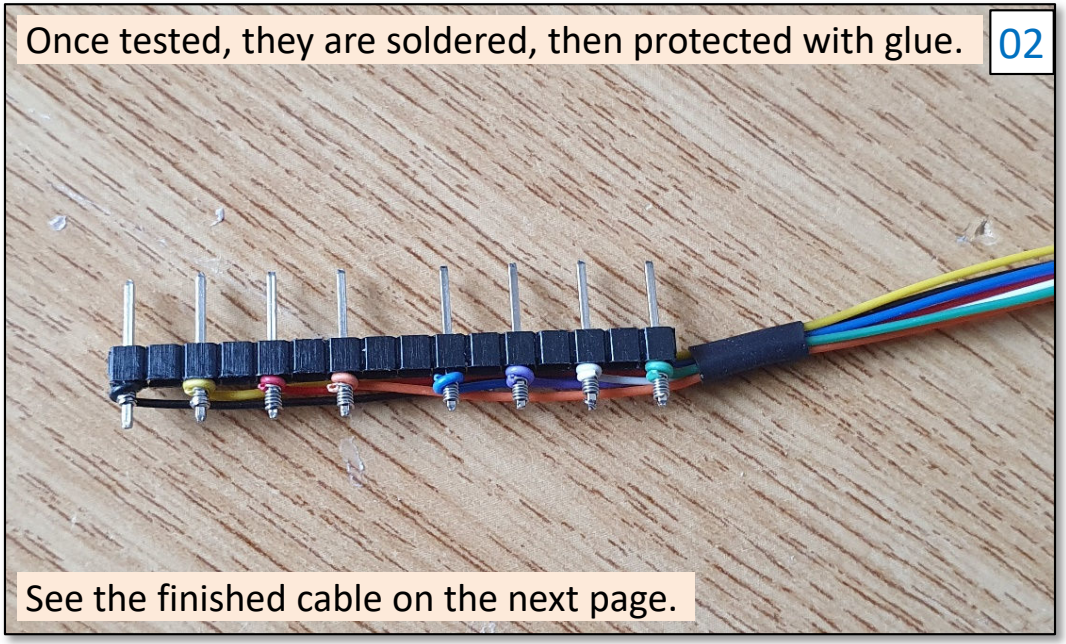




01 This is the 8x2 switch matrix, wired left to right.



Once tested, they are soldered, then protected with glue. 02



See the finished cable on the next page.

Switch harness

I then printed some end caps to hold the pint strips and filled them with glue.