# Arduino Nano 4x 18650 Smart Charger / Discharger



by bwatt1

This is my Arduino Nano 4x 18650 Smart Charger / Discharger Open Source Project.

This unit is powered by 12V 5A. It can be powered by a computer power supply.

**Links**

Battery Portal: https://portal.vortexit.co.nz/

Parts List: http://www.vortexit.co.nz/parts-list-nano-4x/

Schematic: https://easyeda.com/brettwatty/arduino-nano-4x-ch...

PCB Gerber Files: https://www.pcbway.com/project/shareproject/Brett...

Source Code: https://github.com/brettwatty/arduino-nano-4x-cha...

Facebook Group: https://www.facebook.com/groups/DIYbatterycharger...

Forum: https://secondlifestorage.com/t-Brett-s-Arduino-8...

Checkout my database stats page of all currently processed batteries: http://www.vortexit.co.nz/batteries-recycled/

Donate: http://www.vortexit.co.nz/donate/

**The History**

I wanted to make a smart Arduino powered charger, discharger battery tester that could have a barcode scanner that scanned barcodes on batteries and input all the data into an Online Database Portal. This would allow me to correctly sort and analyze trends in all my reclaimed lithium batteries.

Version 1: I originally started out using a single sided PCB milled out with my CNC. This unit only had one cell and could charge ,discharge and test milli ohms.

Version 2.2: I moved onto using smaller PCB's that were etched then I had two cell modules on a Arduino UNO.

Version 3.2: I used the same smaller PCB's but I used an Arduino Mega and mounted it all on a Acrylic stand. I had originally planned to have 16 modules but ended up only using 8 cell modules as I would of needed to use analog signal multiplexers and the wiring was already very messy.

Arduino Mega 8x Charger / Discharger 1.1: I designed a PCB in easy EDA for an Arduino Mega 8x Charger / Discharger. This has a 20x4 LCD, Rotary Encoder, SD Card reader (never used), Ethernet, USB Host for a barcode scanning direct into the Arduino.

Arduino Mega 8x Charger / Discharger 1.2+: Later I made some small changes and added a ESP8266 Adaptor for WIFI communication.

Arduino Nano 4x 18650 Smart Charger / Discharger 1.0: I started designing a 4x version to make it much cheaper and easier to build. This version does not have a barcode scanner but it communicated with the Vortex IT Battery Portal to send and receive data via the internet.

Arduino Nano 4x 18650 Smart Charger / Discharger 1.1: This has some small amendments from Version 1.0 as it had some small bugs in the design and this version was released to the public.


https://youtu.be/kqh-6cJdm3M

https://youtu.be/fOgDwKMc5Ok

https://youtu.be/yiqRIWckhIc

https://youtu.be/1tfvKwLLAqg

https://youtu.be/ZZXsa100KX0

https://youtu.be/kqWTXIesRHg

https://youtu.be/YPh8iscYf-0

https://youtu.be/xmNw5mv-Zwg

https://youtu.be/r1ETSpIHiqk

https://youtu.be/nmQ_sGsKhms

https://youtu.be/eAdStmLM8A0

## Step 1: Get the Components

**PCB Gerber Files**

PCB Gerber Files:
https://www.pcbway.com/project/shareproject/Brett_s_Arduino_4x_ASCD_18650_Smart_Charger_Discharger_1_11.html

**Main Components**

- Arduino Nano 3.0 ATmega328P x1 AliExpresseBay
- ESP8266 Arduino Adaptor x1 AliExpresseBay
- ESP8266 ESP-01 x1 AliExpresseBay
- LCD 1602 16x2 Serial x1 AliExpresseBay
- Battery Holder 4 x 18650 x1 AliExpresseBay
- TP5100 Module x4 AliExpresseBay
- CD74HC4067 Module x1 AliExpresseBay
- 74HC595N DIP16 x1 AliExpresseBay
- DIP16 Socket x1 AliExpresseBay
- Temp Sensor DS18B20 x5 AliExpresseBay
- Tactile Switch 6MM x1 AliExpresseBay
- Connector KF301-2P 5.08mm x4 AliExpresseBay
- DC Jack 5.5 x 2.1mm x1 AliExpresseBay
- Resistor Carbon Film 3.3ohm 5W x4 AliExpresseBay
- Conical Rubber Feet 14x8mm x8 AliExpresseBay
- Insulating Washers 3x7x0.8mm x16 AliExpresseBay
- M3 x 12mm Flat Head Stainless Steel 304 Hex Socket Screw x20 AliExpresseBay
- M3 304 Stainless Steel 304 Hex Nuts x4 AliExpresseBay
- M3 Standoff 18mm Brass F-F x4 AliExpresseBay
- M3 Standoff 35mm brass F-F x4 AliExpresseBay
- Header Female 2.54mm 1x4 x1 AliExpresseBay
- Headers Male 2.54mm 1x40 Pin x1 AliExpresseBay
- Header Female Right Angle 2.54mm 1x4 x1 AliExpresseBay
- USB to ESP8266 ESP-01 Programmer x1 AliExpresseBay
- 5V Active Buzzer x1 AliExpresseBay
- 12V 5A PSU x1 AliExpresseBay

**THT (Through Hole) Component Option**

- 10k - 1/4w Resistor THT x7 AliExpresseBay
- 4.7k - 1/4w Resistor THT x1 AliExpresseBay
- 1k - 1/4w Resistor THT x8 AliExpresseBay
- P-Channel MOSFET FQP27P06 TO-220 x4 AliExpresseBay
- N-Channel MOSFET IRLZ44N TO-220 x8 AliExpresseBay
- NPN Transistor BC547 TO-92 x4 AliExpresseBay
- Diode IN4007 x2 AliExpresseBay

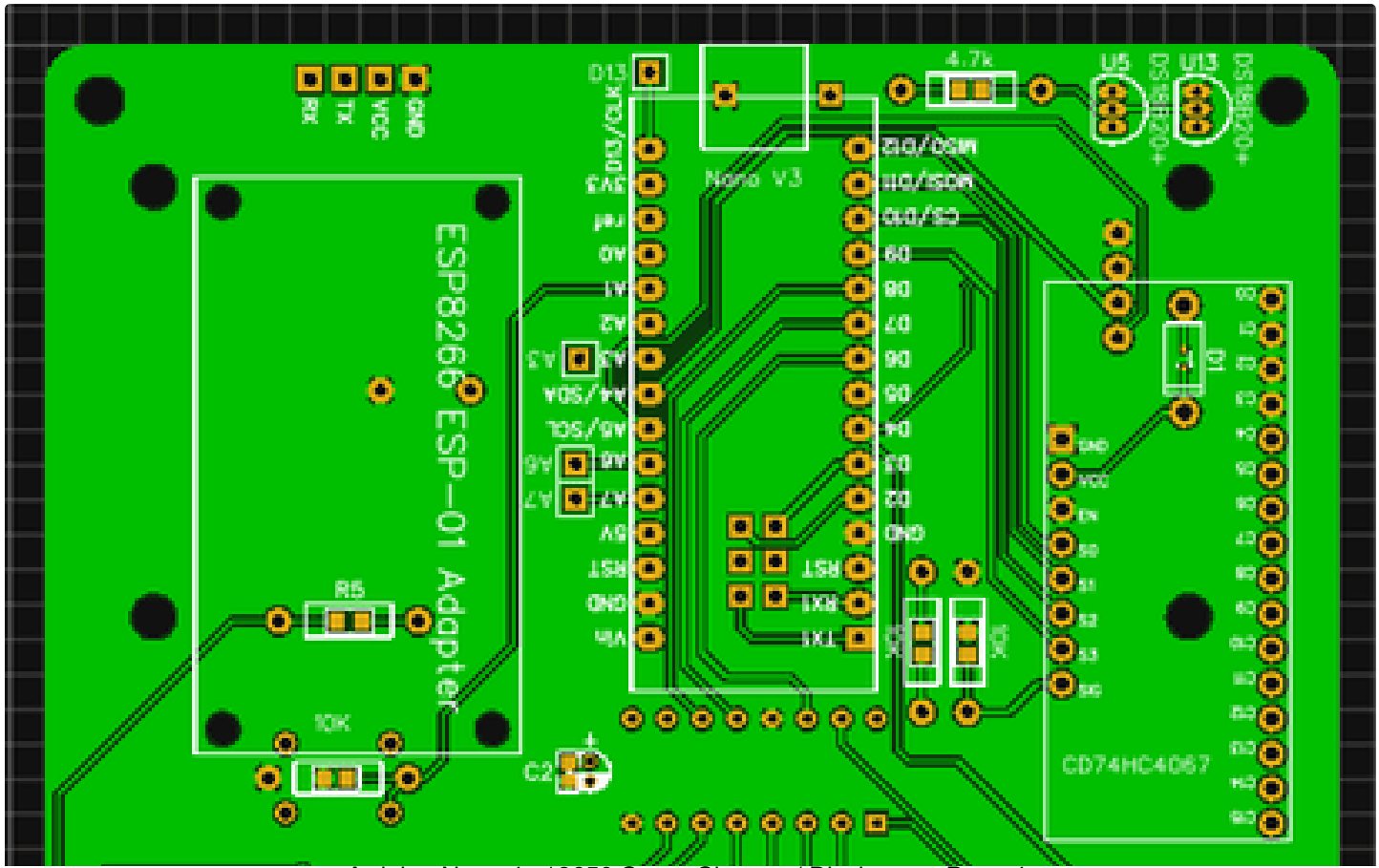
**SMD (Surface Mount) Component Option**

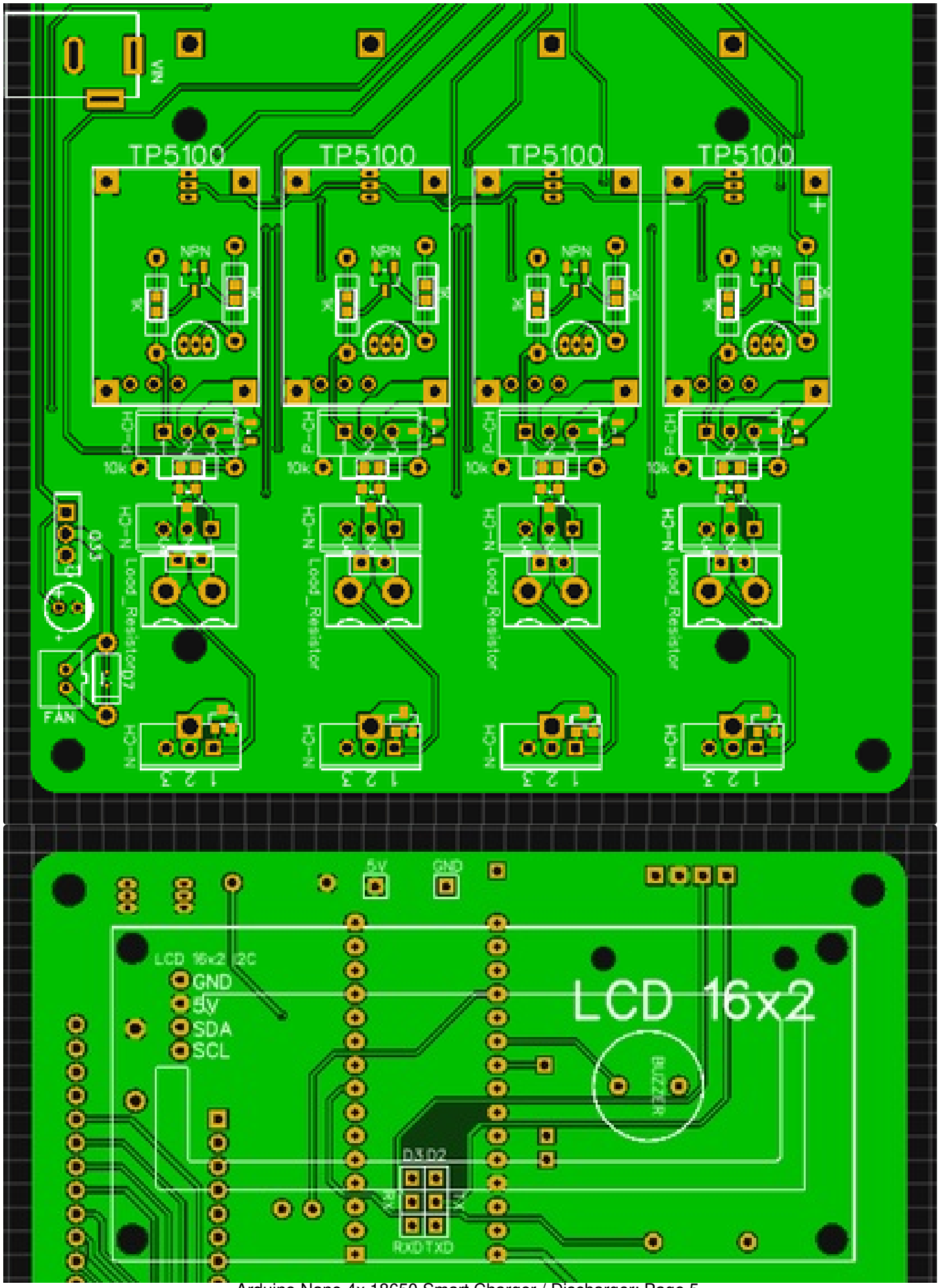
- 10k - 1/8w Resistor SMD 0603 x7 AliExpresseBay
- 4.7k - 1/8w Resistor SMD 0603 x1 AliExpresseBay
- 1k - 1/8w Resistor SMD 0603 x8 AliExpresseBay
- N-Channel Mosfet IRLML2502TRPBF x8 AliExpresseBay
- P Channel MOSFET AO3407 SOT-23 x4 AliExpresseBay
- NPN Transistor SOT23 BC847 x4 AliExpresseBay
- Diode 1N4148 0603 x2 AliExpresseBay

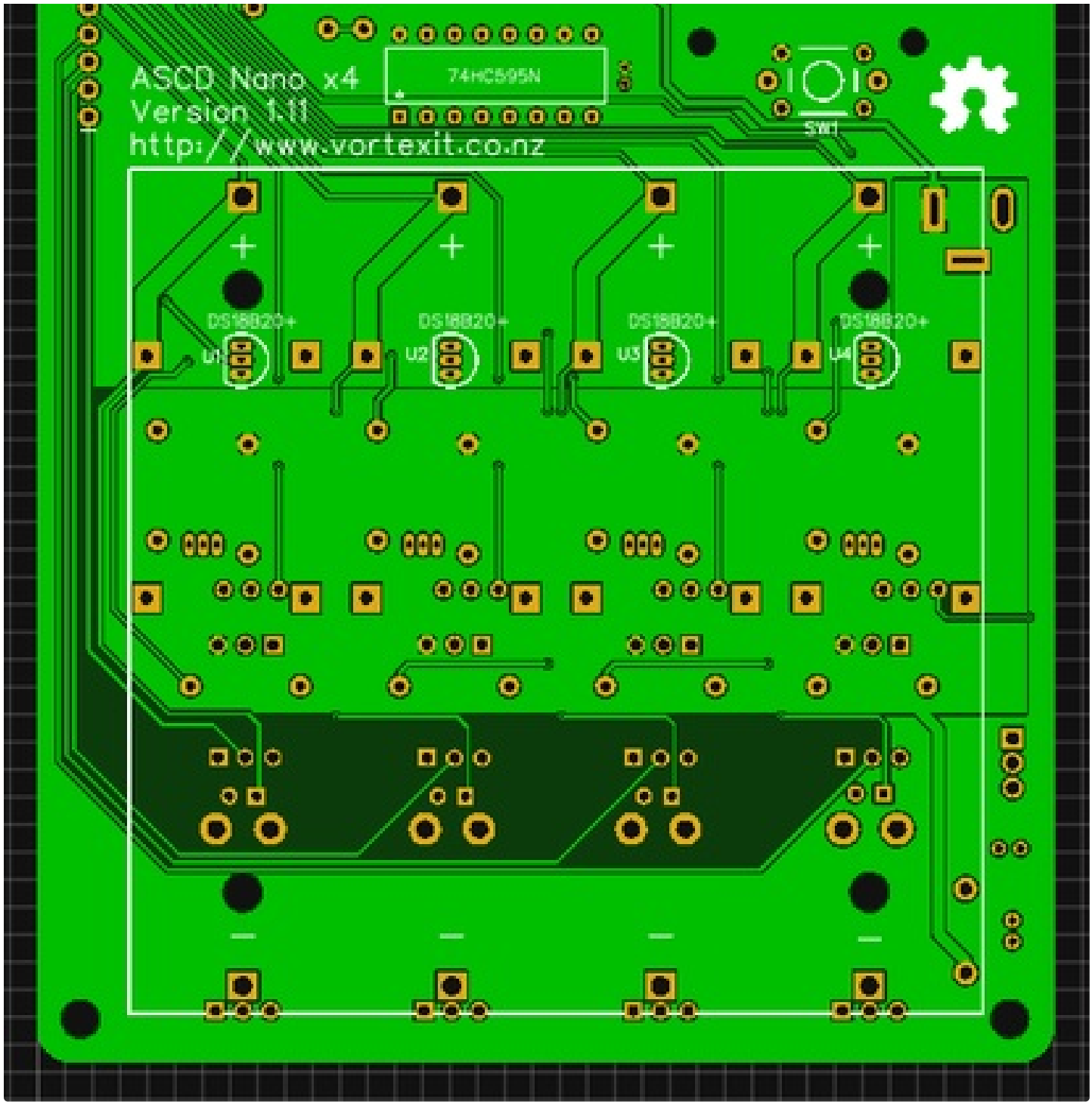
**Tools**

- Solder Wire 60/40 0.7mm AliExpresseBay
- Diagonal Pliers AliExpresseBay
- Youyue 8586 SMD Soldering Rework Station AliExpresseBay
- UNI-T UT39A Digital Multimeter AliExpresseBay
- Wire Strippers AliExpresseBay
- Barcode Scanner AliExpresseBay
- Barcode Printer AliExpresseBay
- Barcode Labels 30mm x 20mm x700 AliExpresseBay
- MECHANIC Solder Paste AliExpresseBay
- Anti-Static Tweezers AliExpresseBay
- Third Hand Soldering Stand AliExpresseBay
- AMTECH NC-559-ASM No-Clean Solder Flux AliExpresseBay
- Solder Wick AliExpresseBay
- Precision Magnetic Screwdriver Set AliExpresseBay

For an updated list go to my website: http://www.vortexit.co.nz/parts-list-nano-4x/

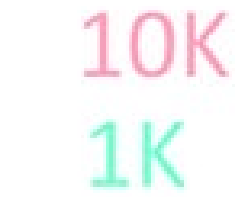


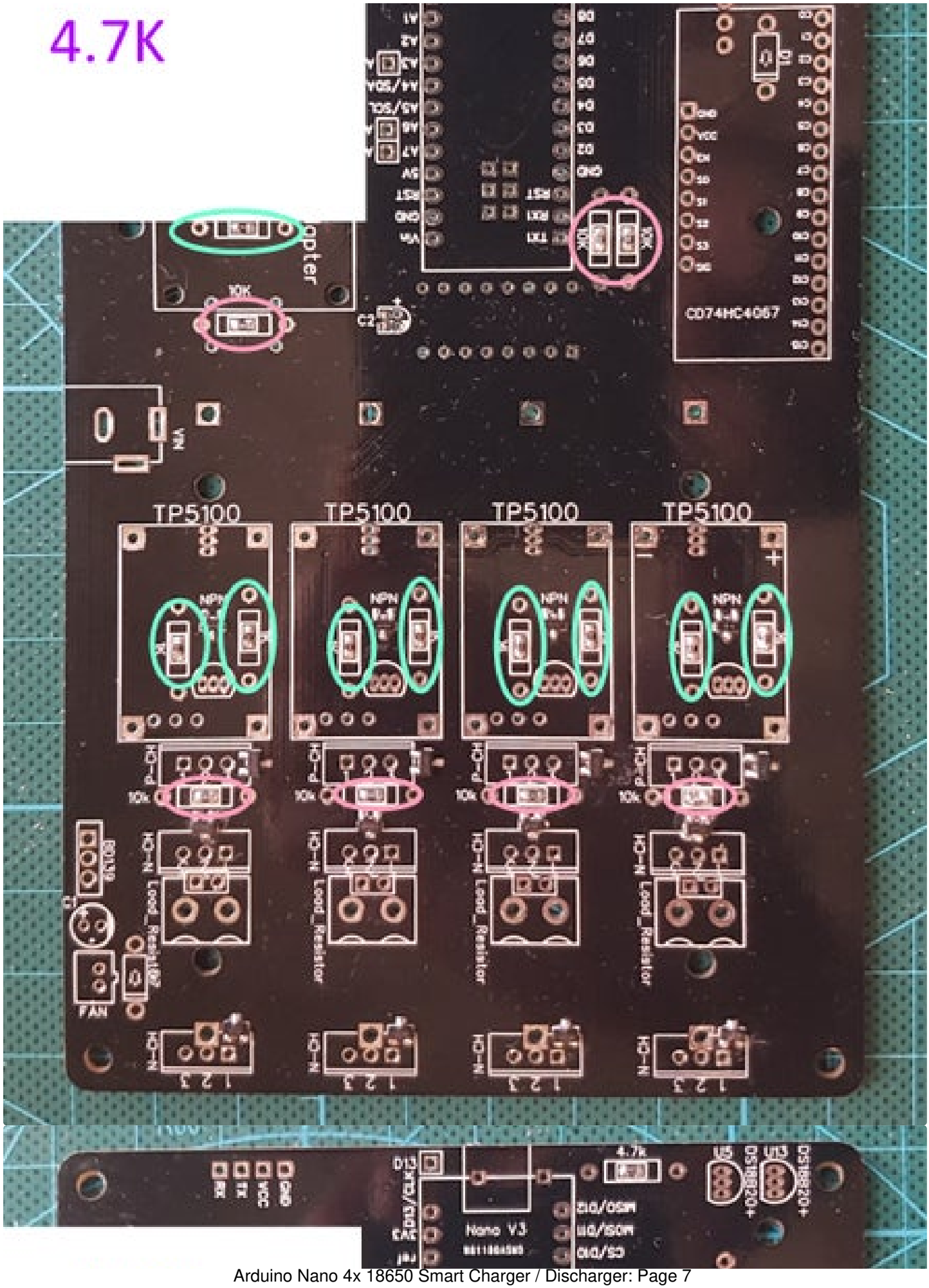

VIN
TP5100
TP5100
TP5100
TP5100
NPN
NPN
NPN
NPN
P-CH
P-CH
P-CH
P-CH
10k
10k
10k
10k
N-CH
N-CH
N-CH
N-CH
Load_Resistor
Load_Resistor
Load_Resistor
Load_Resistor
D5
D4
FAN
1 2 3
1 2 3
1 2 3
1 2 3
5V
GND
LCD 16x2 I2C
GND
5V
SDA
SCL
LCD 16x2
BUZZER
D3 D2
RXD TXD

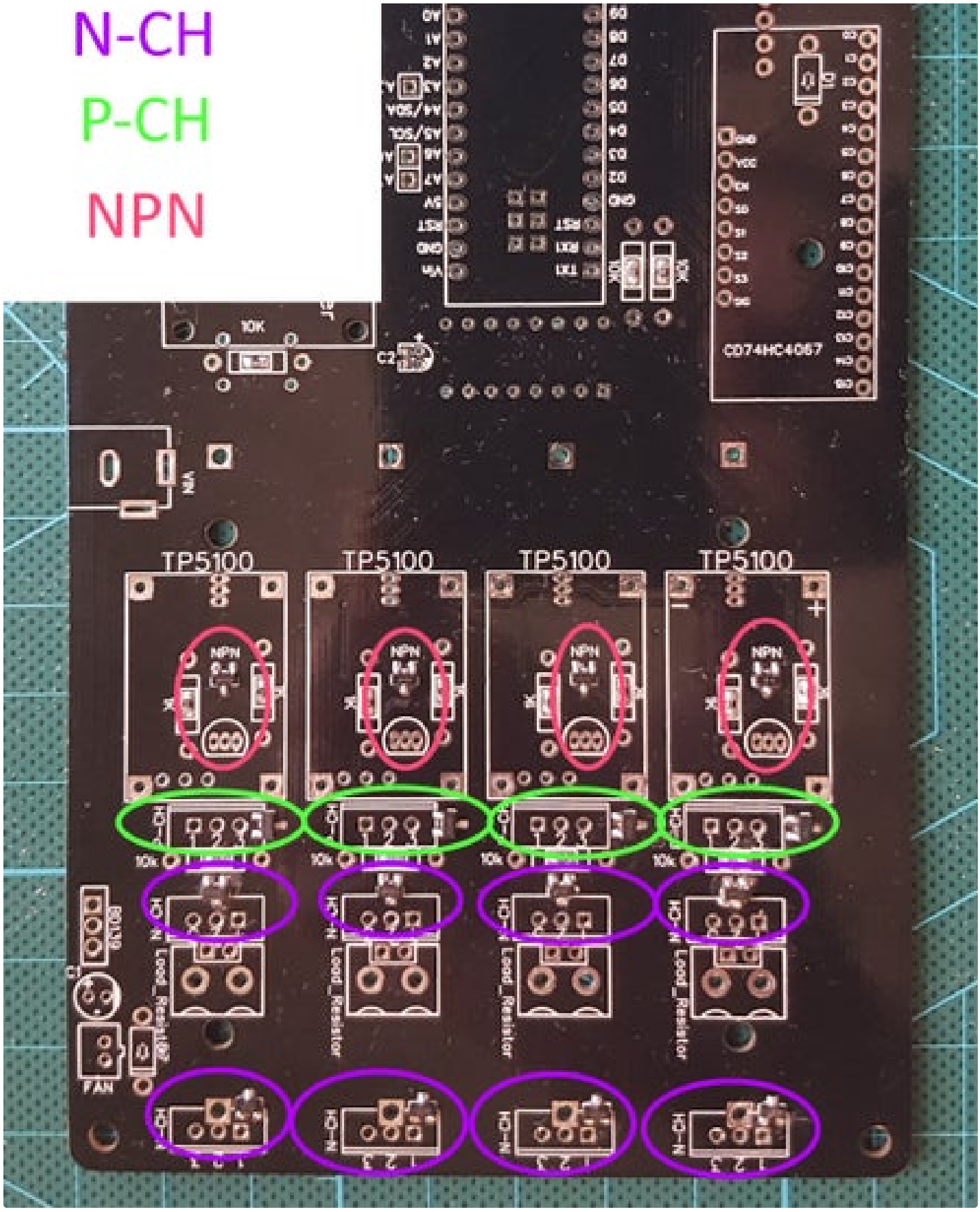



## Step 2: Solder Resistors, Transistors and MOSFETs

Either SMD or THT solder (not both) the 1K, 4.7K, 10K, P-Channel, N-Channel and NPN components



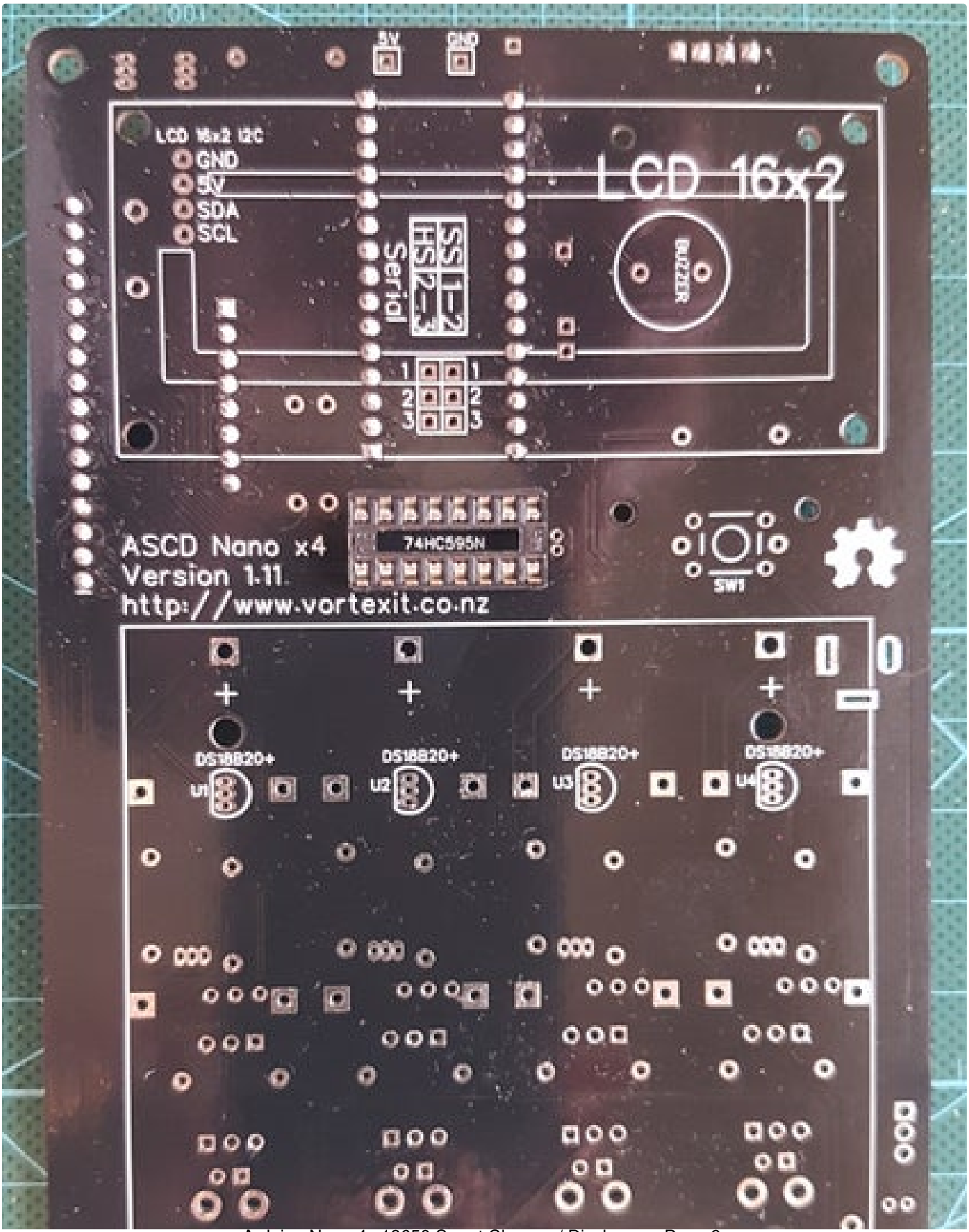


4.7K
TP5100
TP5100
TP5100
TP5100
CD74HC4067
Nano V3
FAN

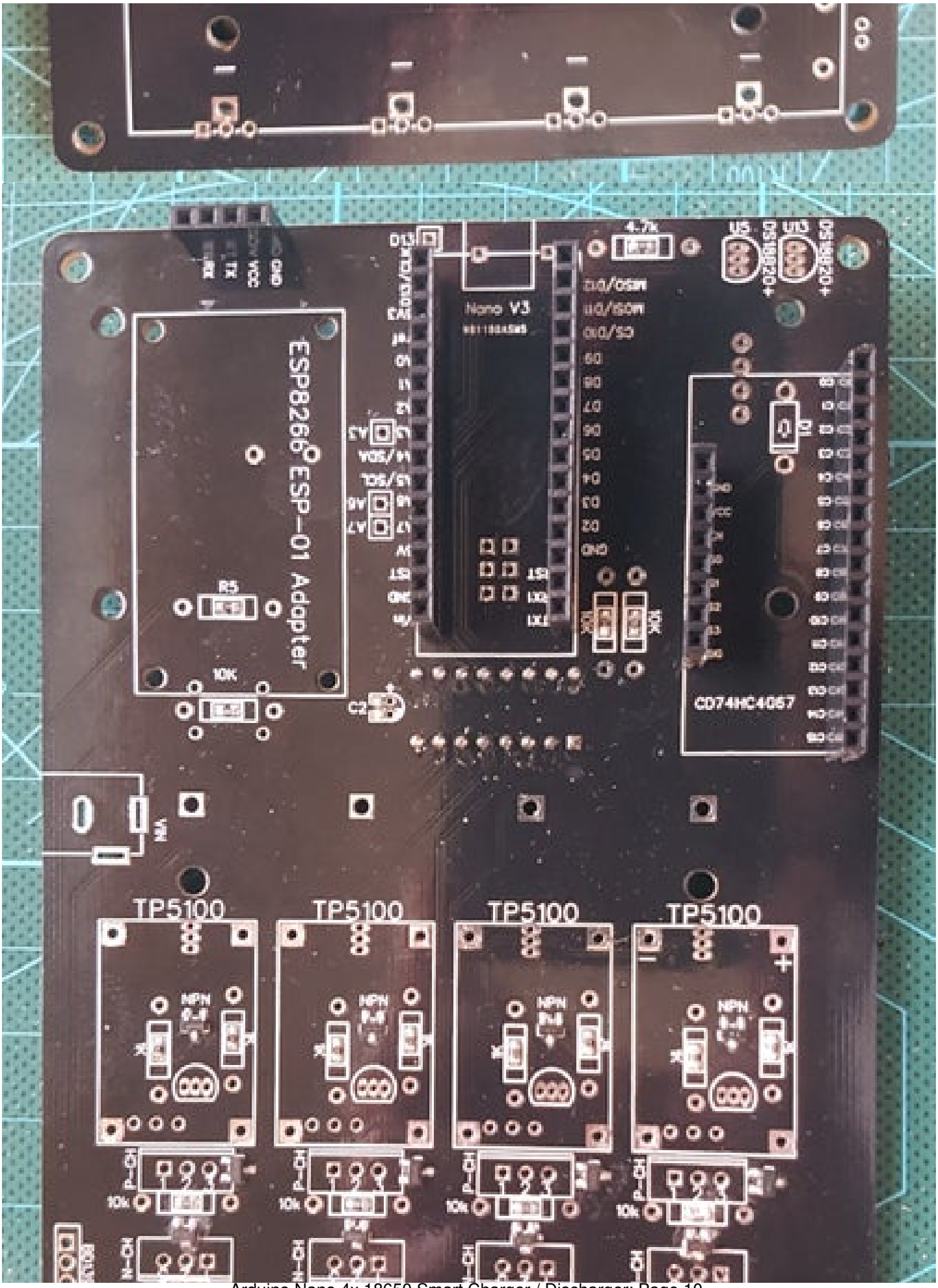


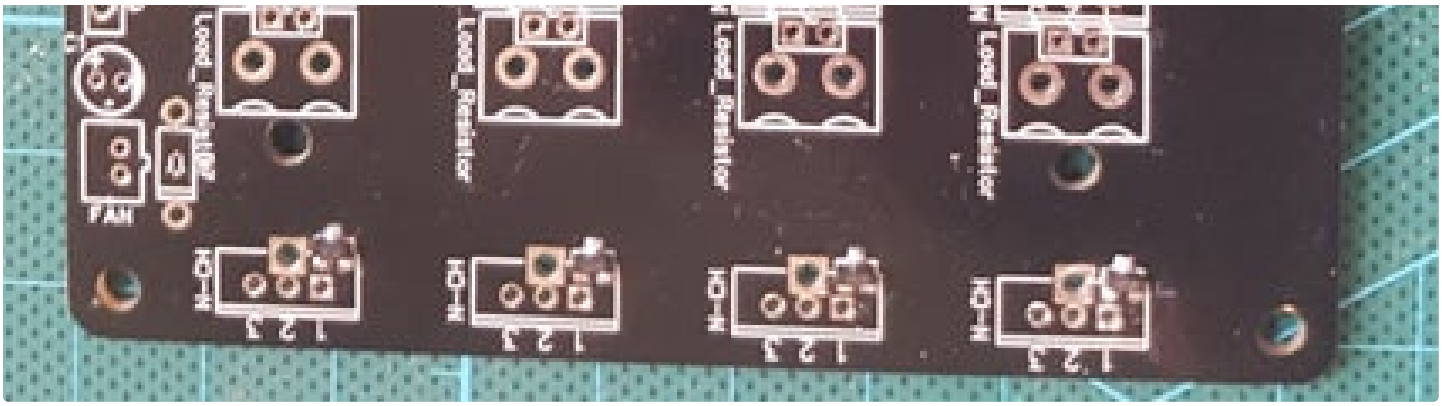

**Step 3: Solder in the Headers and DIP Socket**

Solder the Nano's two 15 pin female headers, 16x CD74HC4067 Multiplexers 8 pin and 16 pin female headers, ESP8266 adaptors 4 pin female, LCD 4 pin female and the 74HC595N Shift registers 16 pin DIP IC socket.

*Note: solder all components on the silk screen side.*



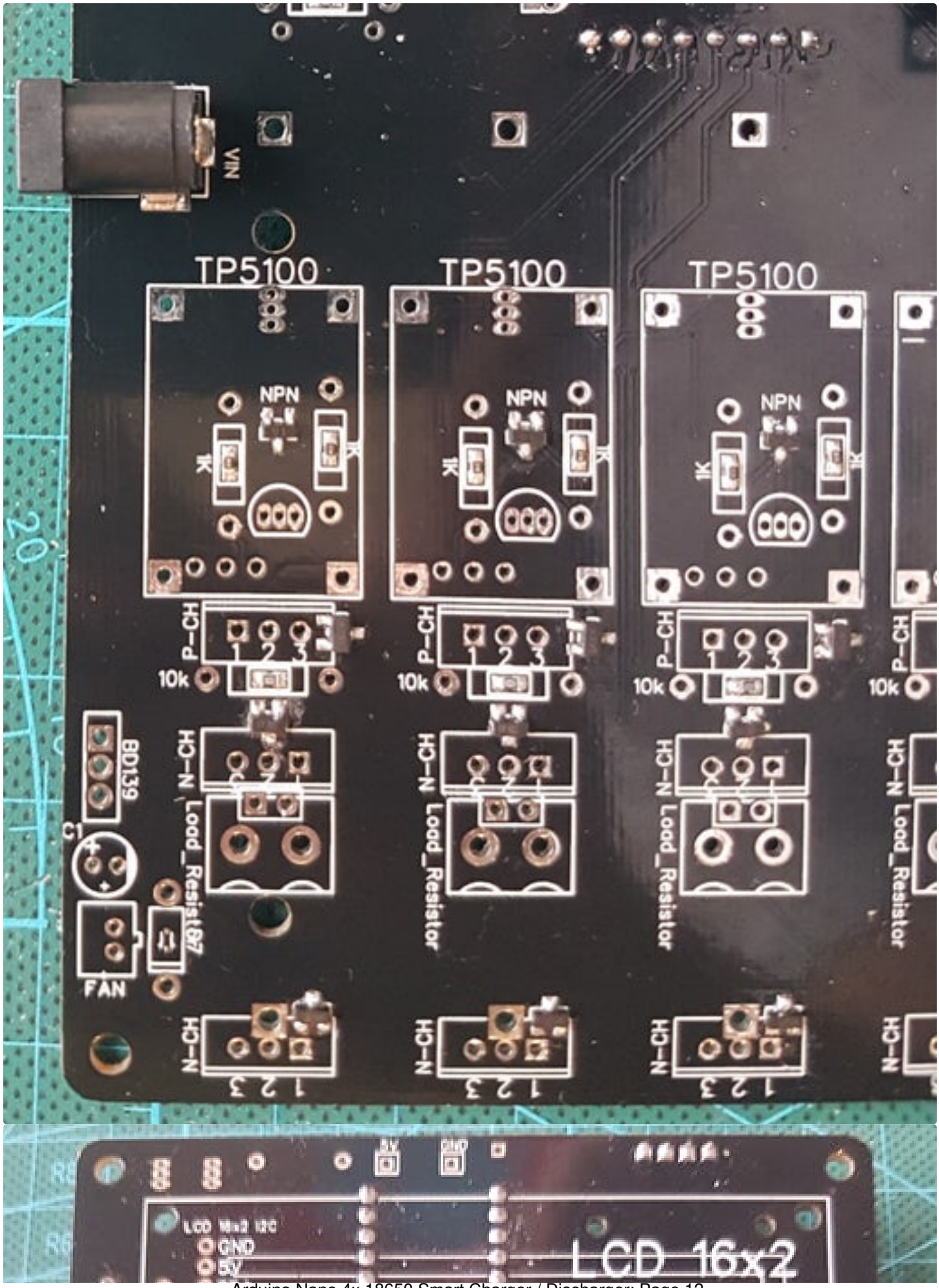

ESP8266 ESP-01 Adapter
Nano V3
CD74HC4067
TP5100
TP5100
TP5100
TP5100
NPN
10K

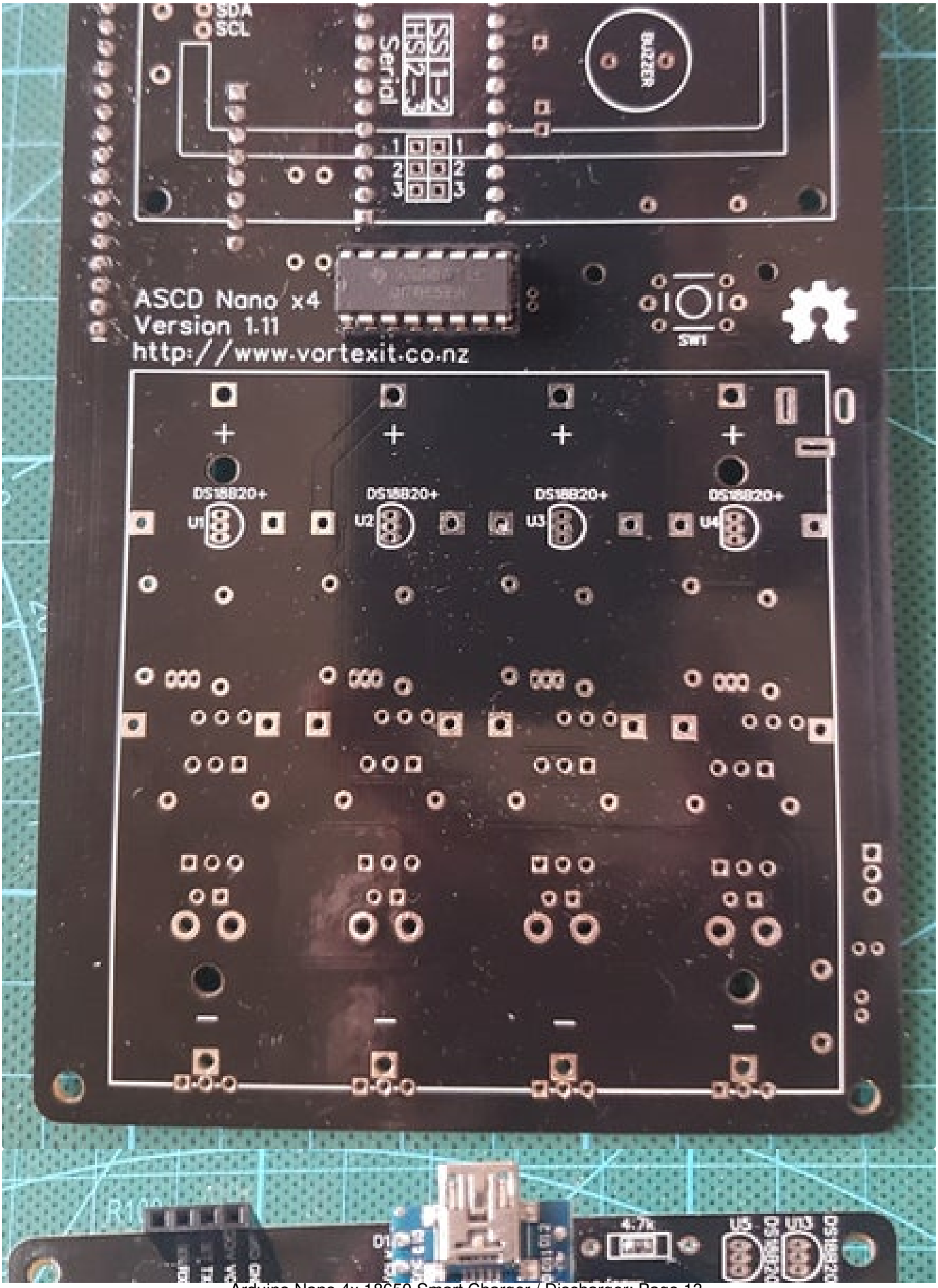


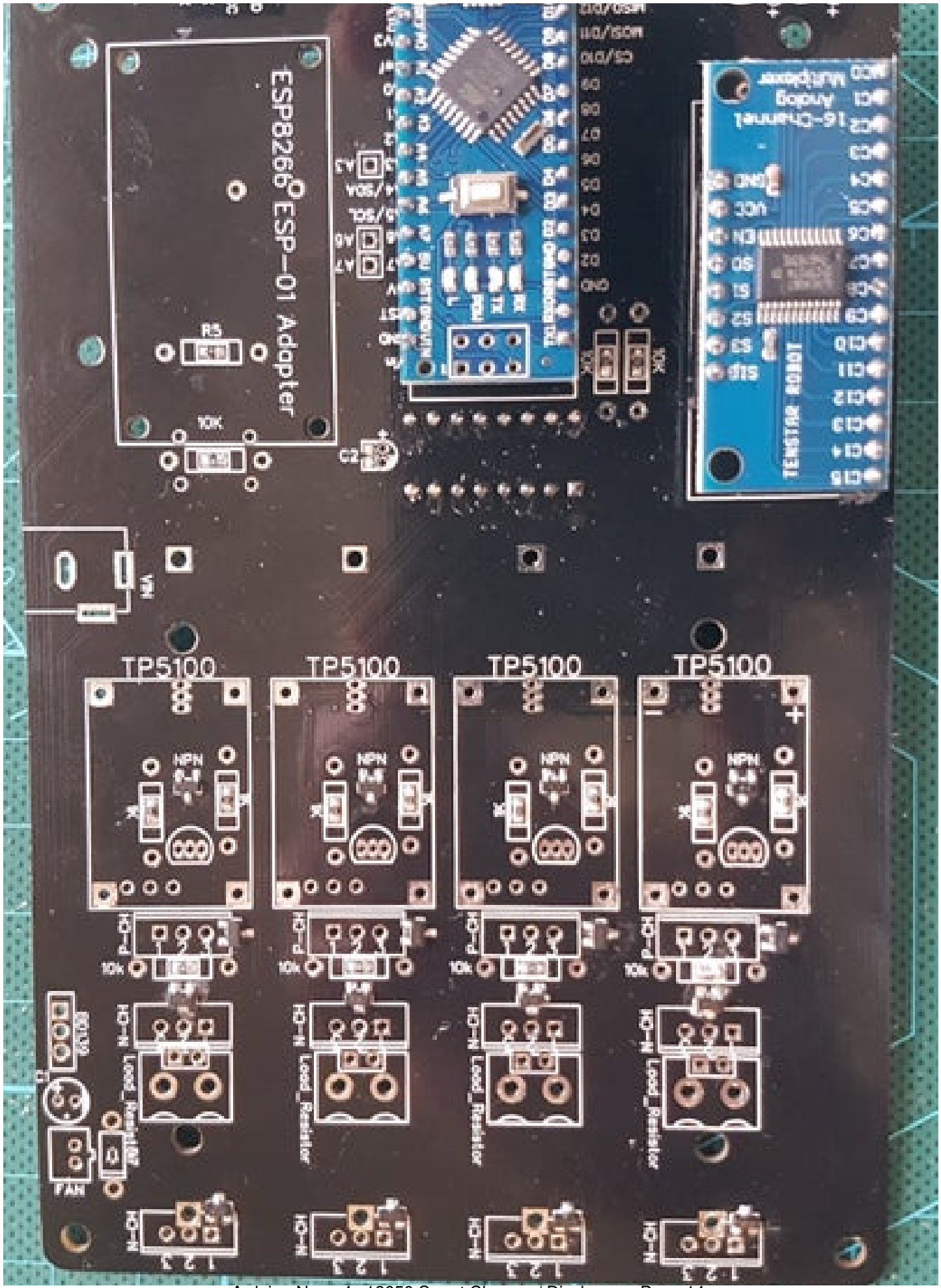

## Step 4: Solder Basic Components

Solder and install the 5.5mm DC Jack, Arduino Nano 328p, CD74HC4067 multiplexer and 74HC595N shift register.

When soldering the Arduino Nano and the Multiplexer I recommend first placing the male header pins in the female header pins then solder the component in place.


VIN
TP5100
TP5100
TP5100
NPN
NPN
NPN
1K
1K
1K
P-CH
10k
10k
10k
1 2 3
HC-N
Load_Resistor
BD139
C1
FAN
5V
GND
LCD 16x2
LCD 16x2 I2C
GND
5V


SDA
SCL
Serial
BUZZER
ASCD Nano x4
Version 1.11
http://www.vortexit.co.nz
SW1
DS18B20+
U1
U2
U3
U4
4.7k


ESP8266 ESP-01 Adapter
R5
10K
C2
16-Channel Analog Multiplexer
TP5100
TP5100
TP5100
TP5100
NPN
10k
Load_Resistor
FAN

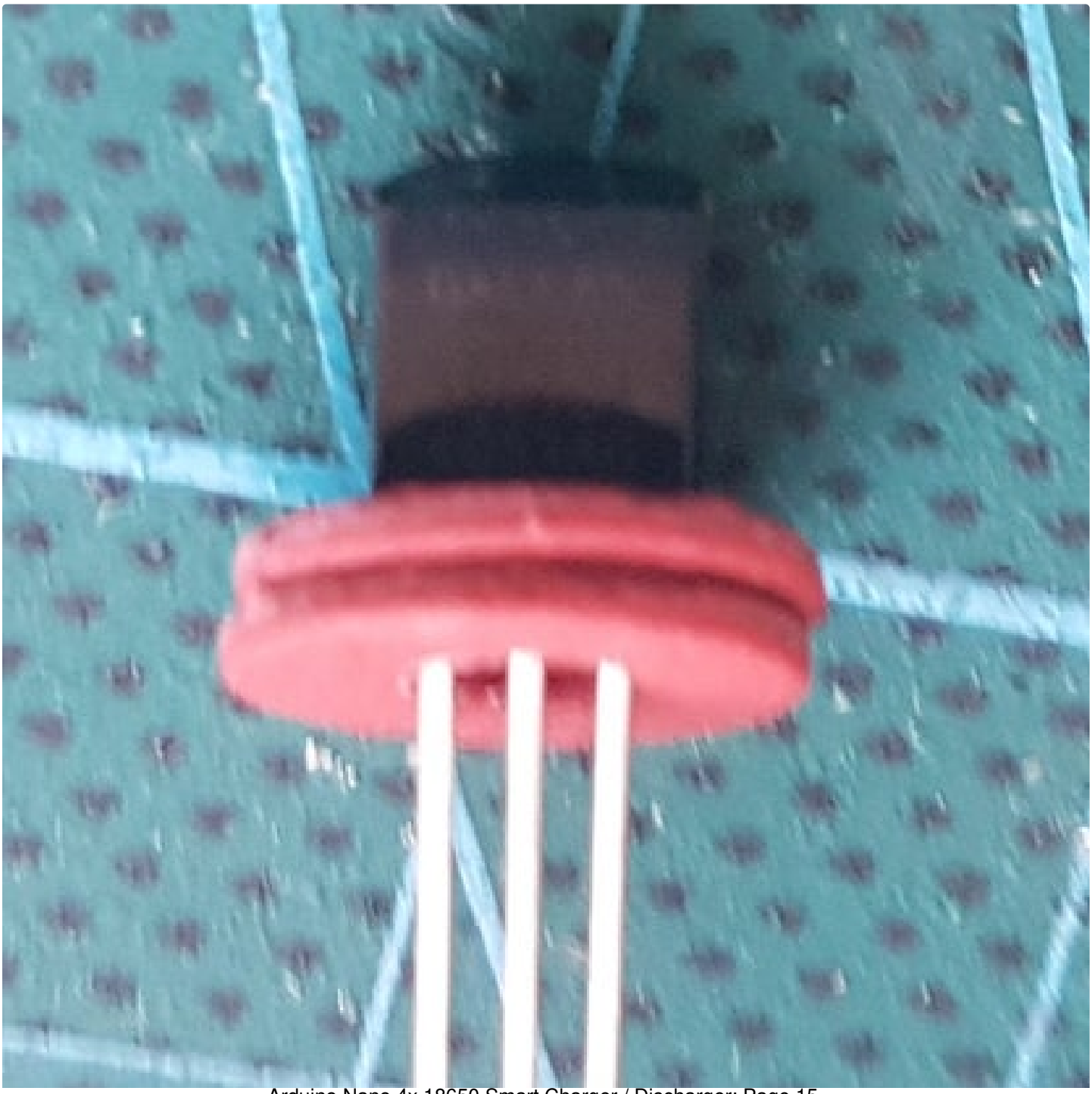
## Step 5: Solder the Dallas DS18B20 Temperature

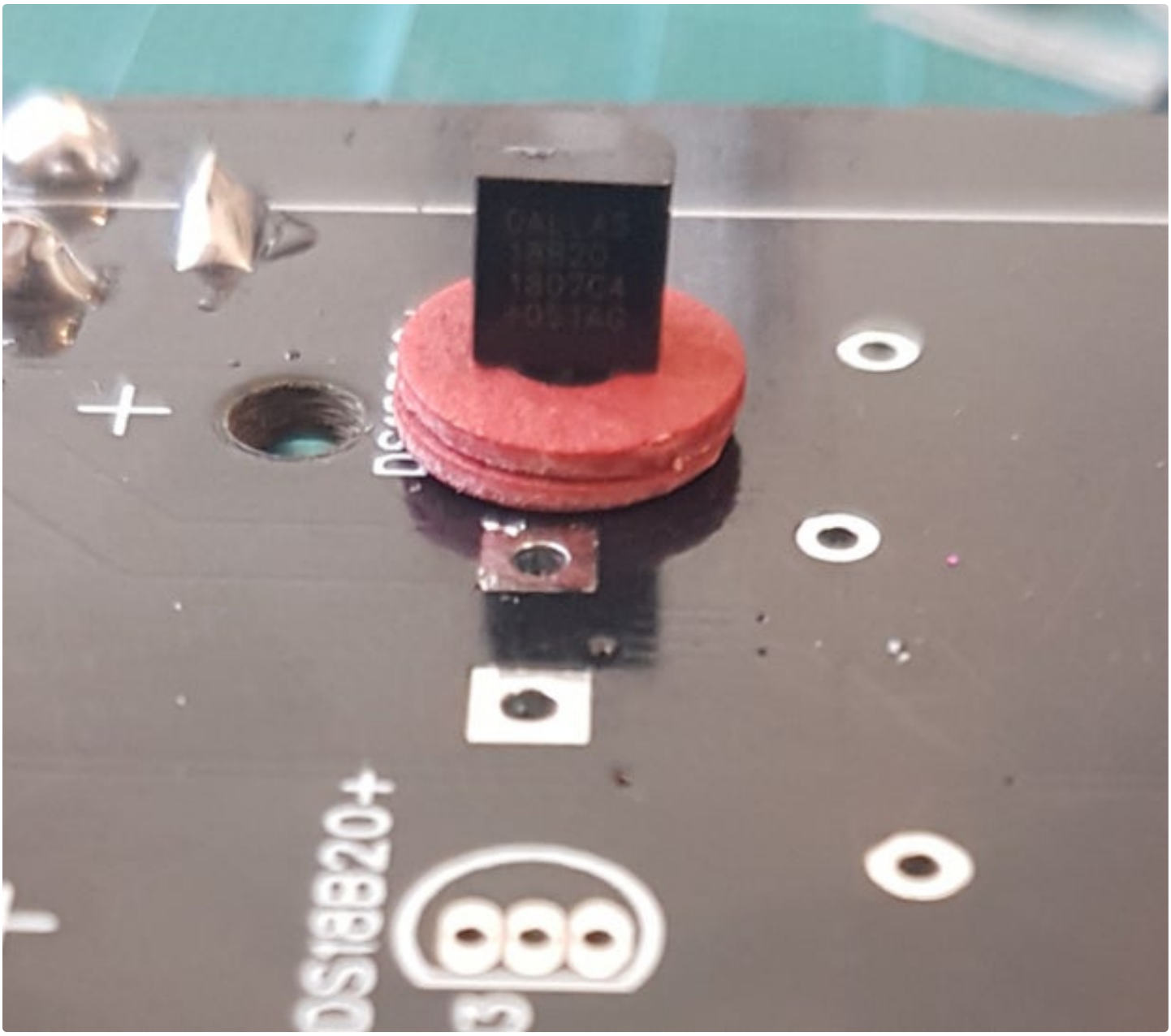
First place two 3mm x 7mm x 0.8mm Insulating Washers on each Dallas Sensor (This is used to create a space off the PCB so you don't measure the PCB temperature)

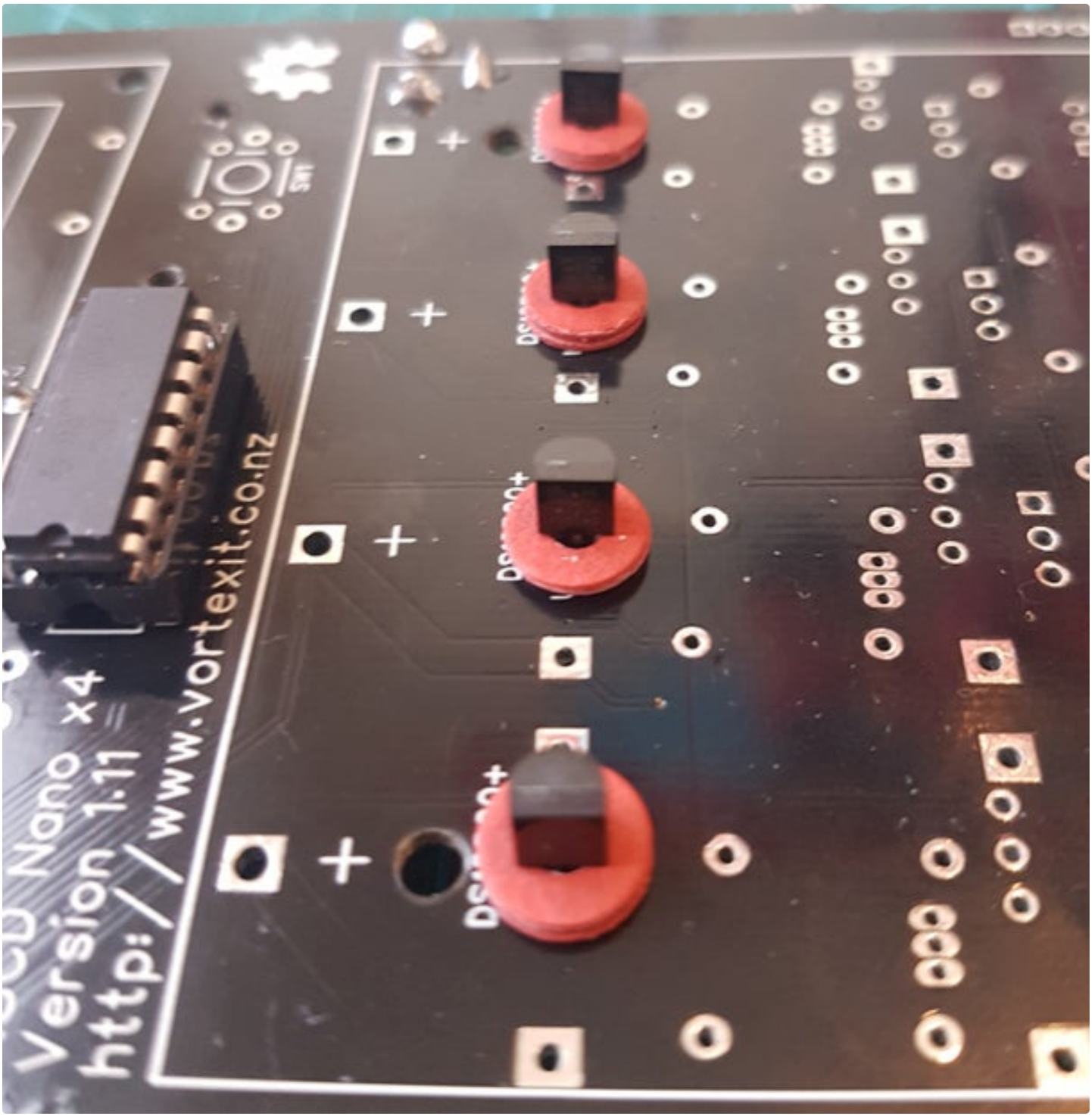
Solder the 4x Dallas Sensors on the top layer for each cell module plus the ambient sensor on the bottom layer.

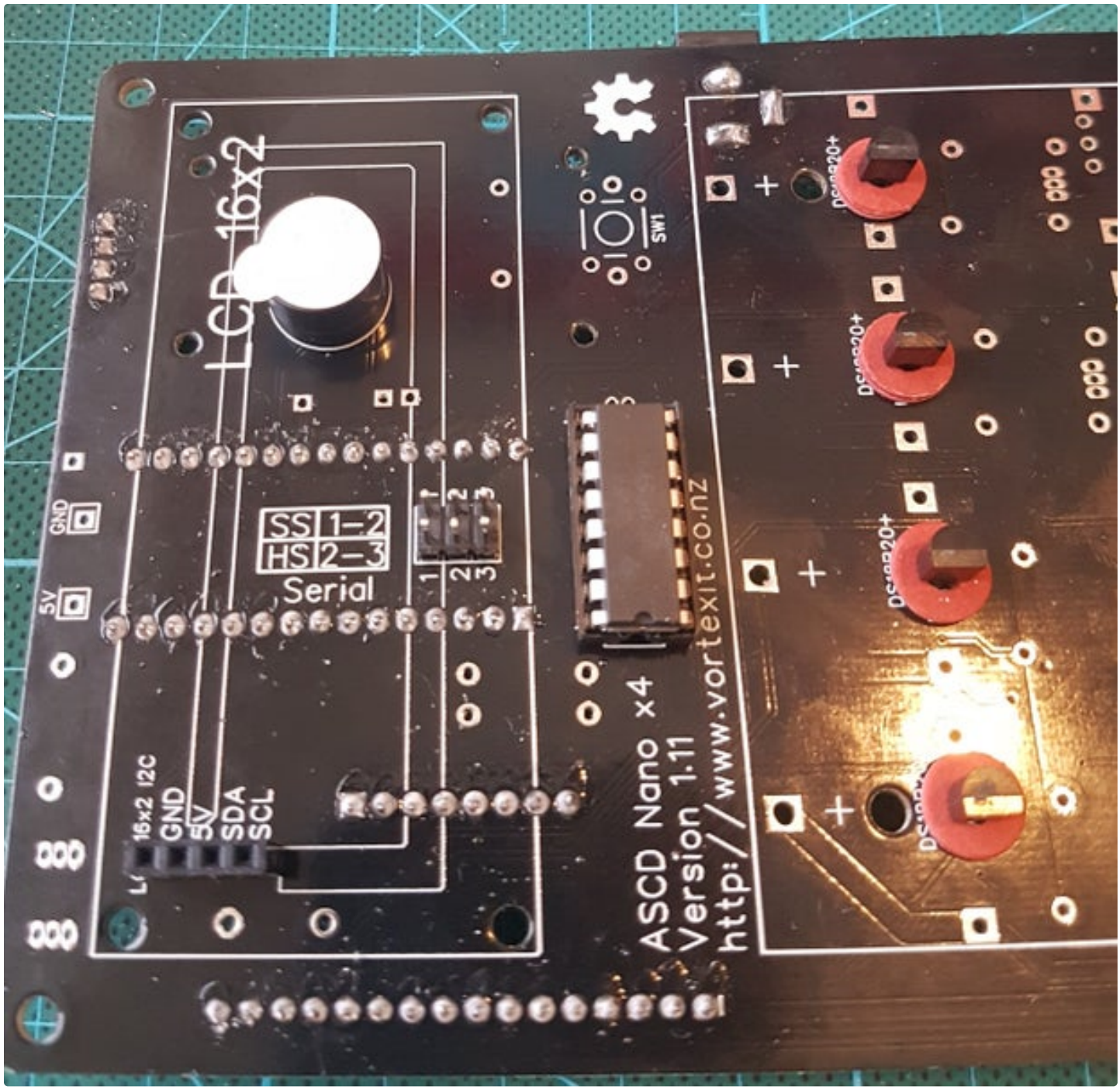
Be careful not to bridge the solder joints on the TO-92 solder pads. Once soldered measure in diode mode on your multi-meter between each leg on any Dallas Sensor (they are all connected in parallel)

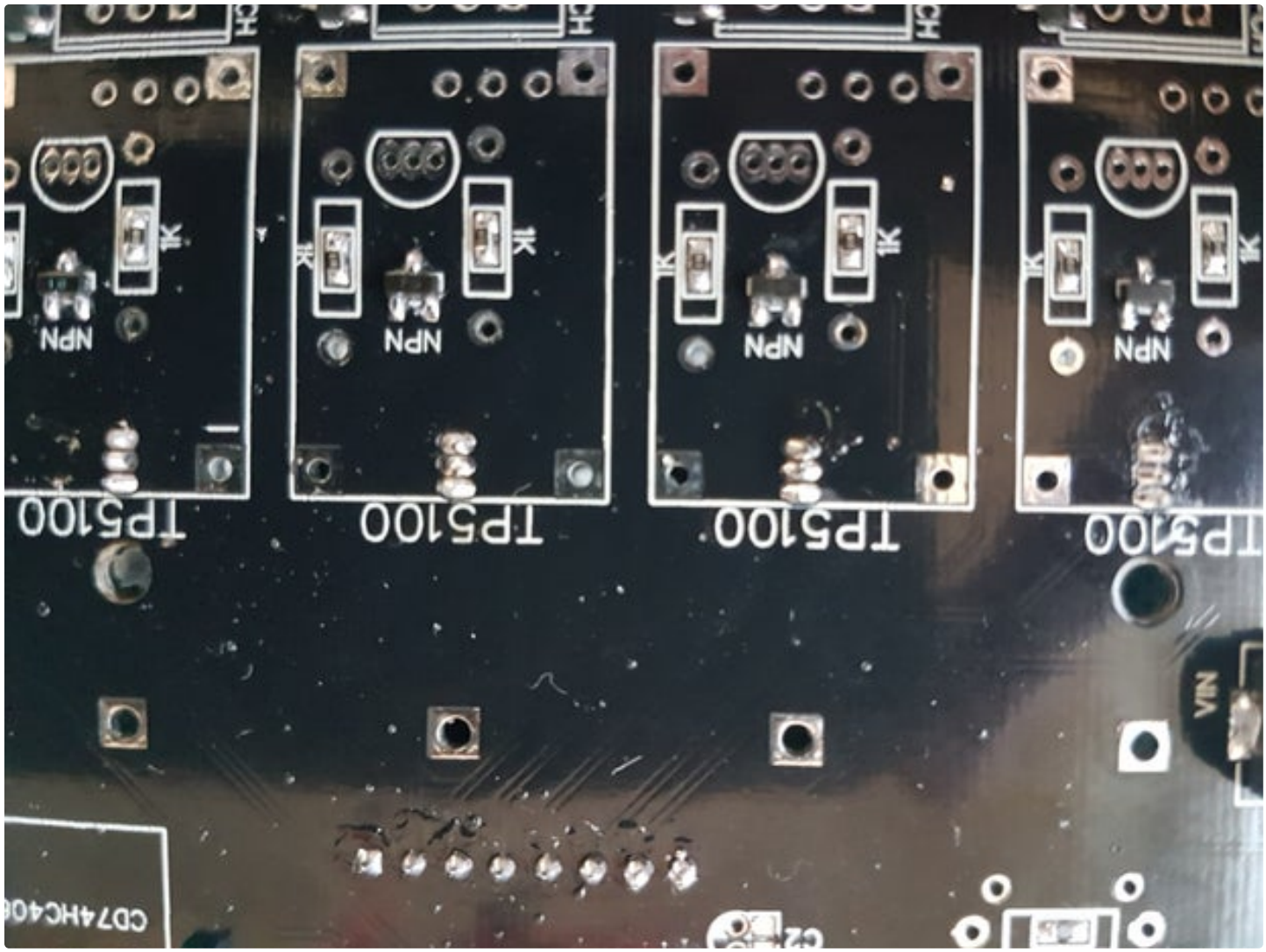
Solder the 5V Active Buzzer on the top layer where the + (positive) pin is facing the Arduino Nano

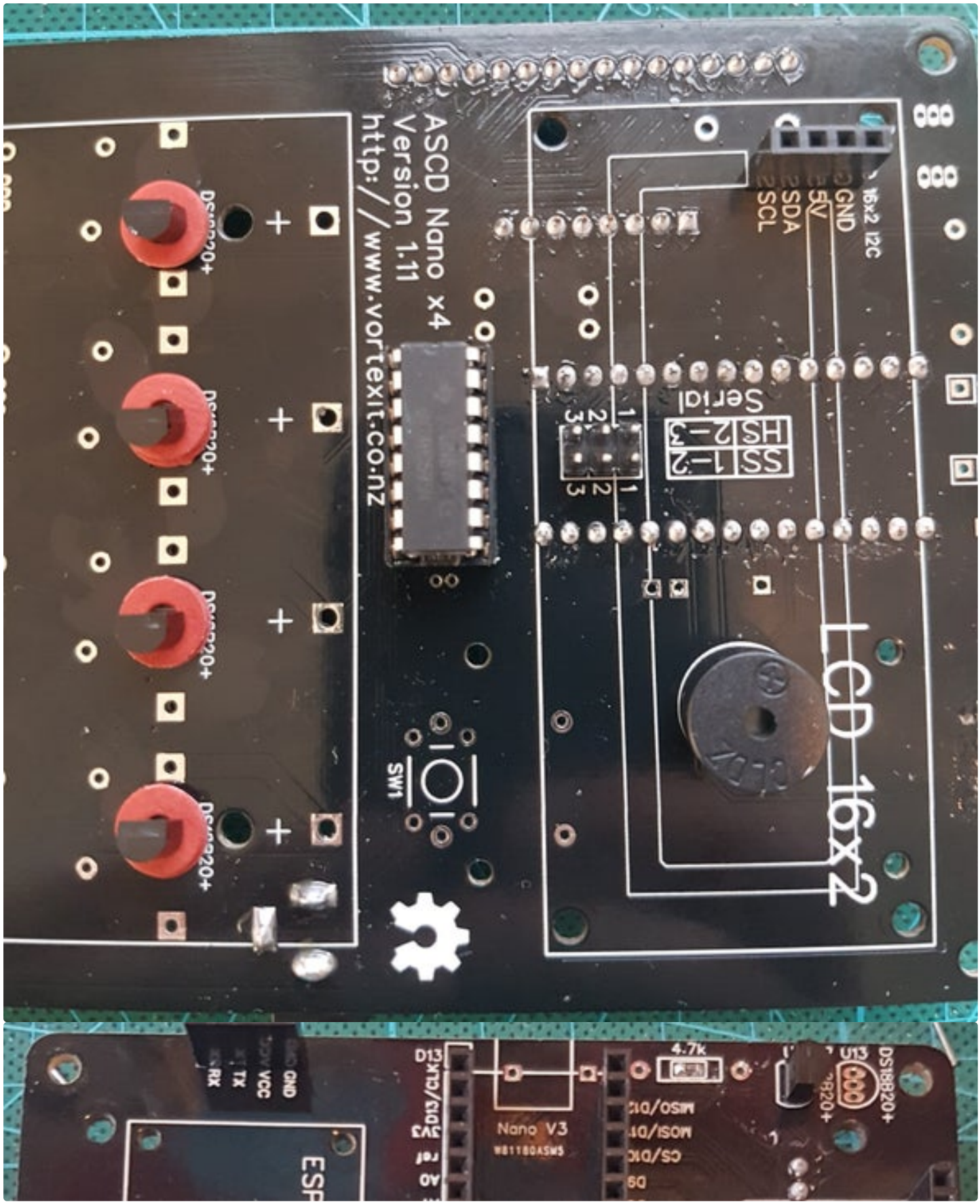



DS18B20+


Version 1.11
http://www.vortexit.co.nz


LCD 16x2
SW1
SS 1-2
HS 2-3
Serial
1 2 3
GND
5V
16x2 I2C
GND
5V
SDA
SCL
ASCD Nano x4
Version 1.11
http://www.vortexit.co.nz

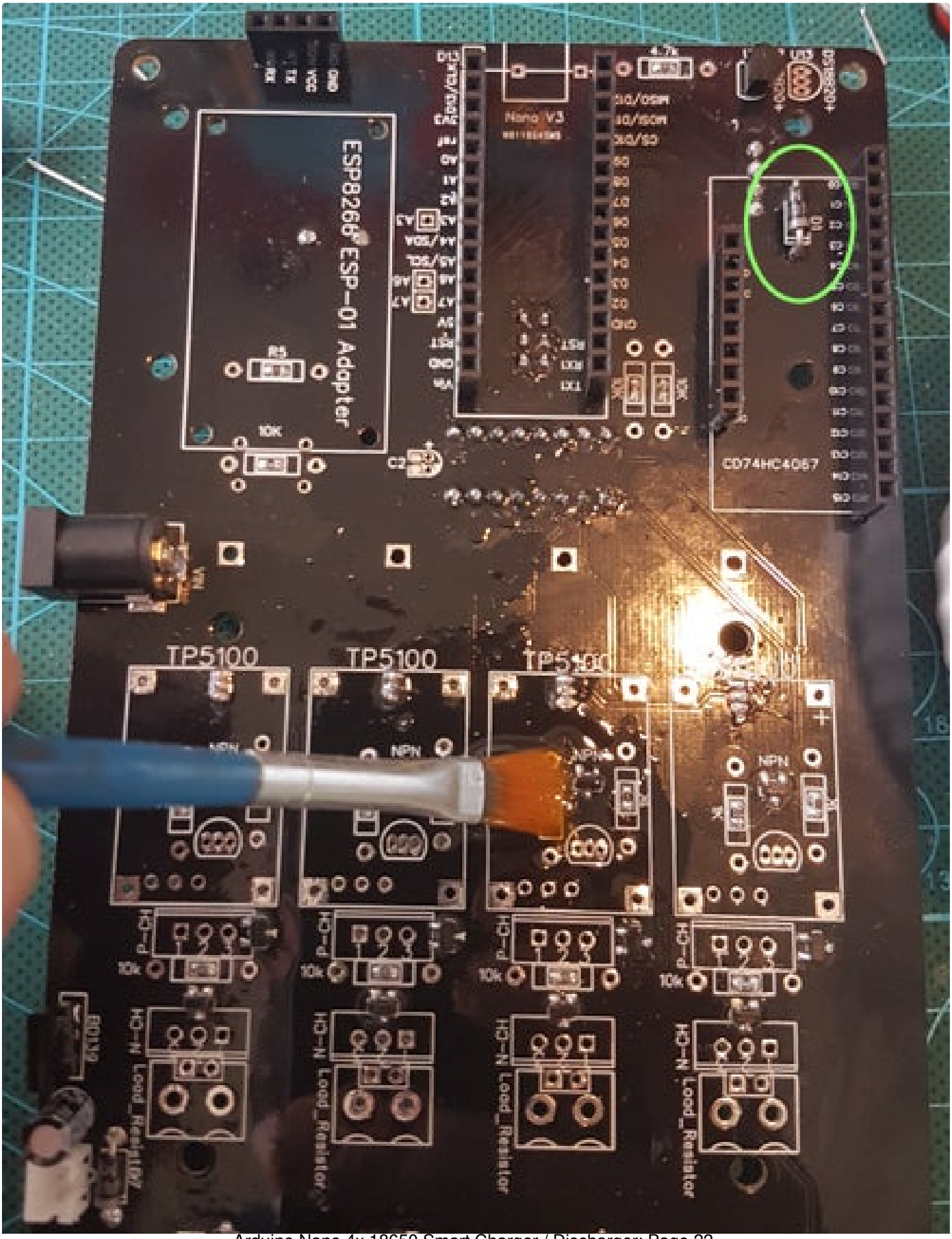

NPN
NPN
NPN
NPN
TP5100
TP5100
TP5100
TP5100
VIN




## Step 6: Solder in the Diode

Solder in the Diode under the CD74HC4067 multiplexer

It is good practice to clean the flux with isopropyl alcohol.



## Step 7: Test and Adjust the LCD Screen Contrast / Serial Jumpers

**LCD Contrast**

Connect the LCD Serial 4 pin female to a 4 pin Male -> Female Dupont Jumper wires. Make sure you connect you connect exactly:

GND -> GND

VCC -> 5V

SDA -> SDA

SCL -> SCL

Load the Arduino Sketch from github: ASCD_Nano_Test_LCD_Screen

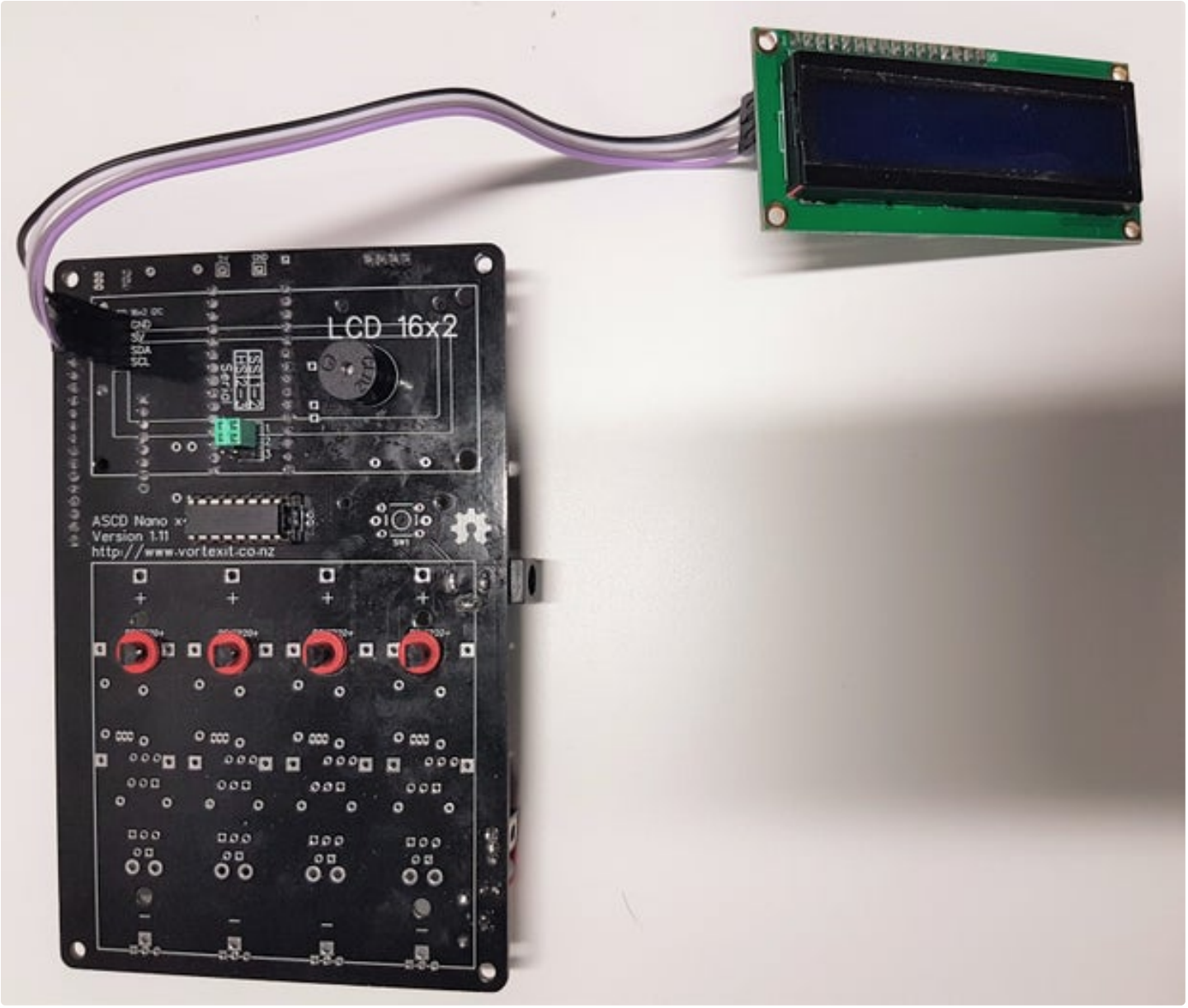
Unplug the USB cord and use a 12V power cord in the 5.5 mm DC Jack (+ positive center / - negative outer)

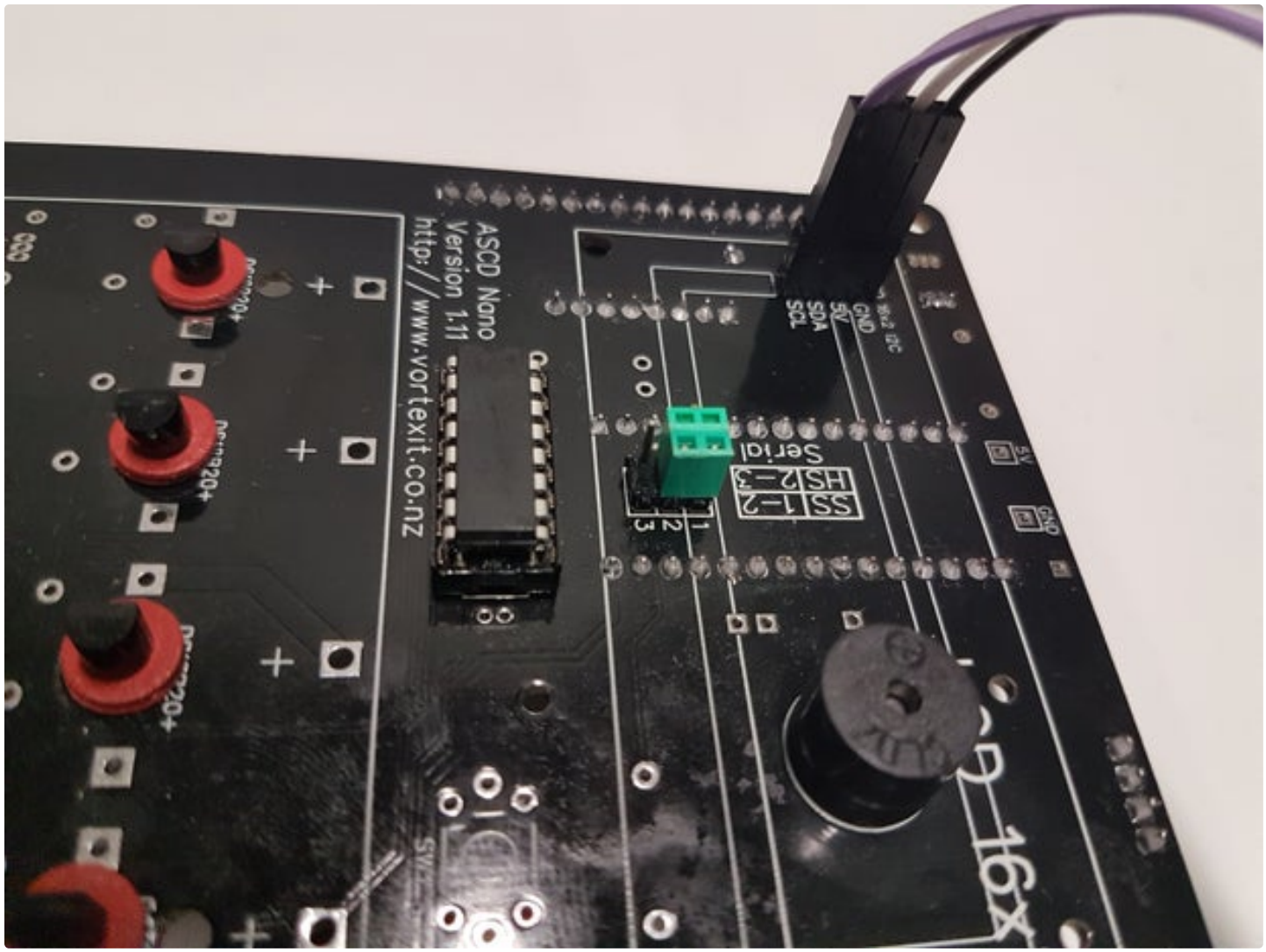
Adjust the potentiometer on serial adaptor at back of the LCD Screen CC or CW until you see the text displayed.

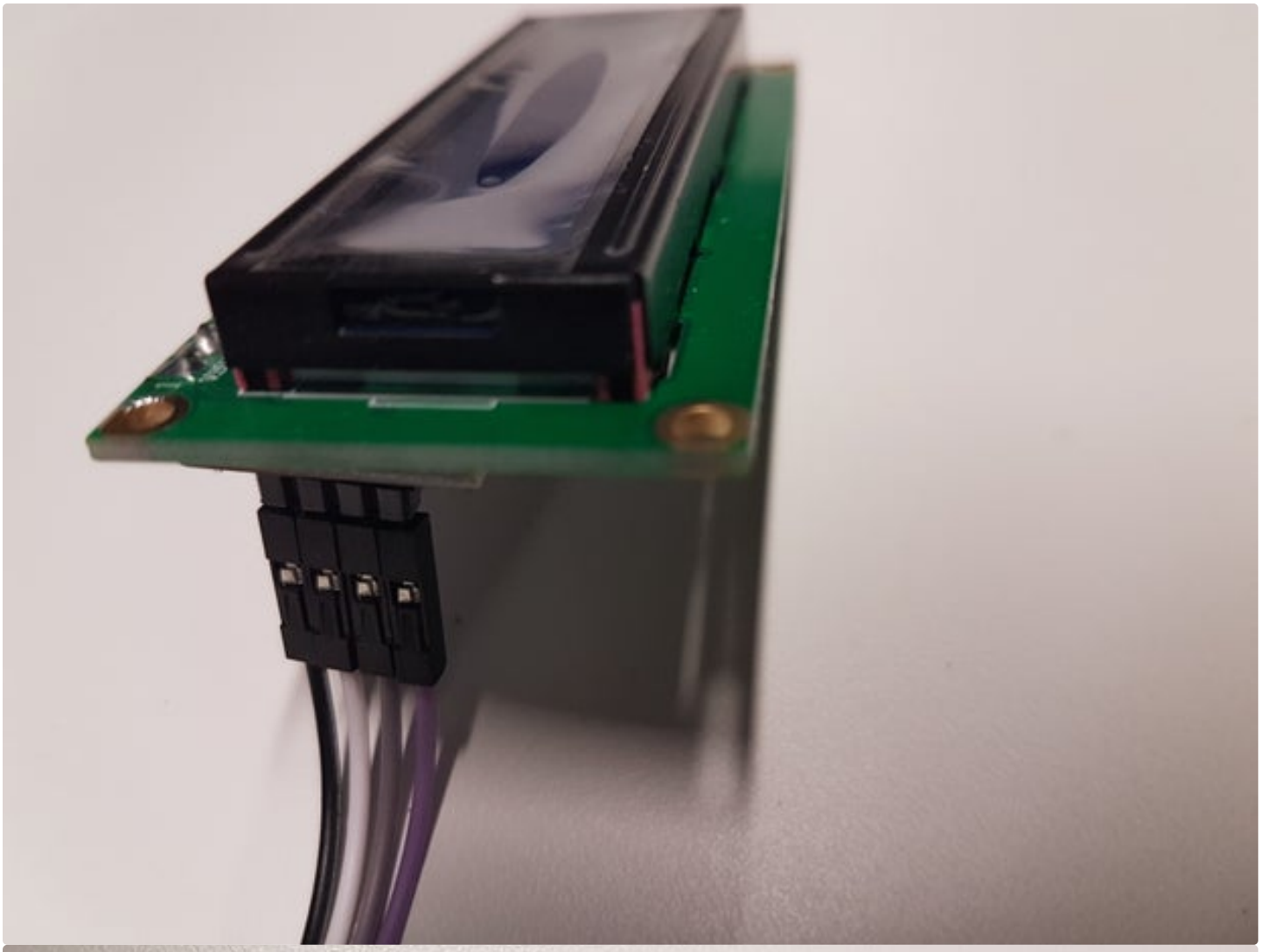
Once you are happy with the contrast remove the Dupont Jumper wires.

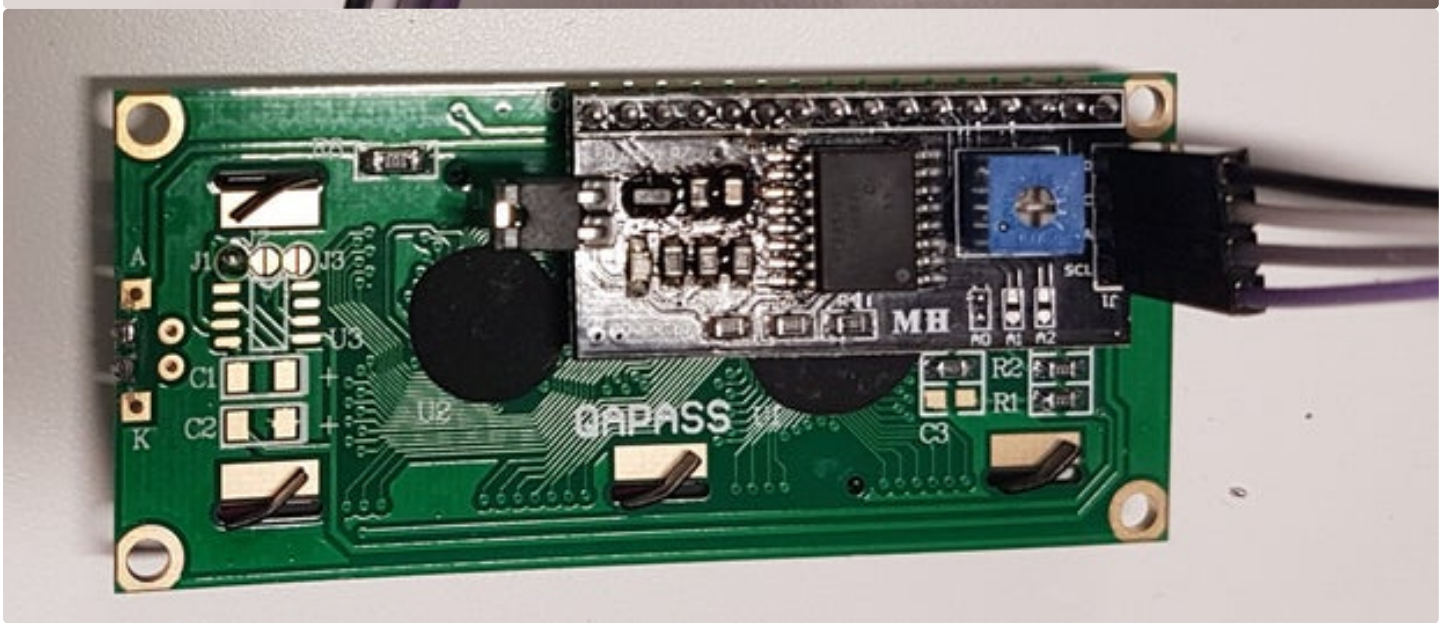
**Serial Jumpers**

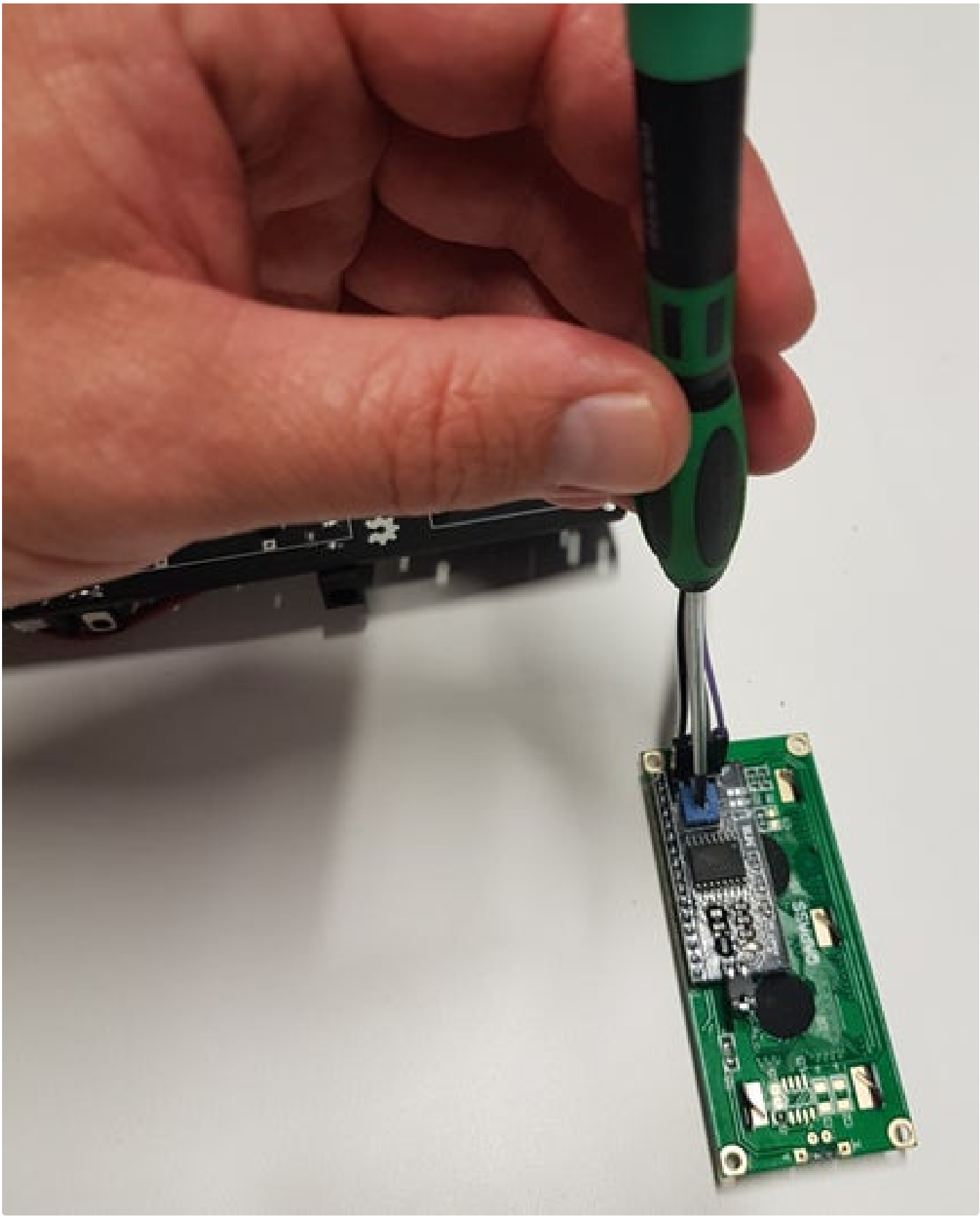
Connect 2x 2.54 mm jumpers on pins 1-2 for software serial communication with the ESP8266

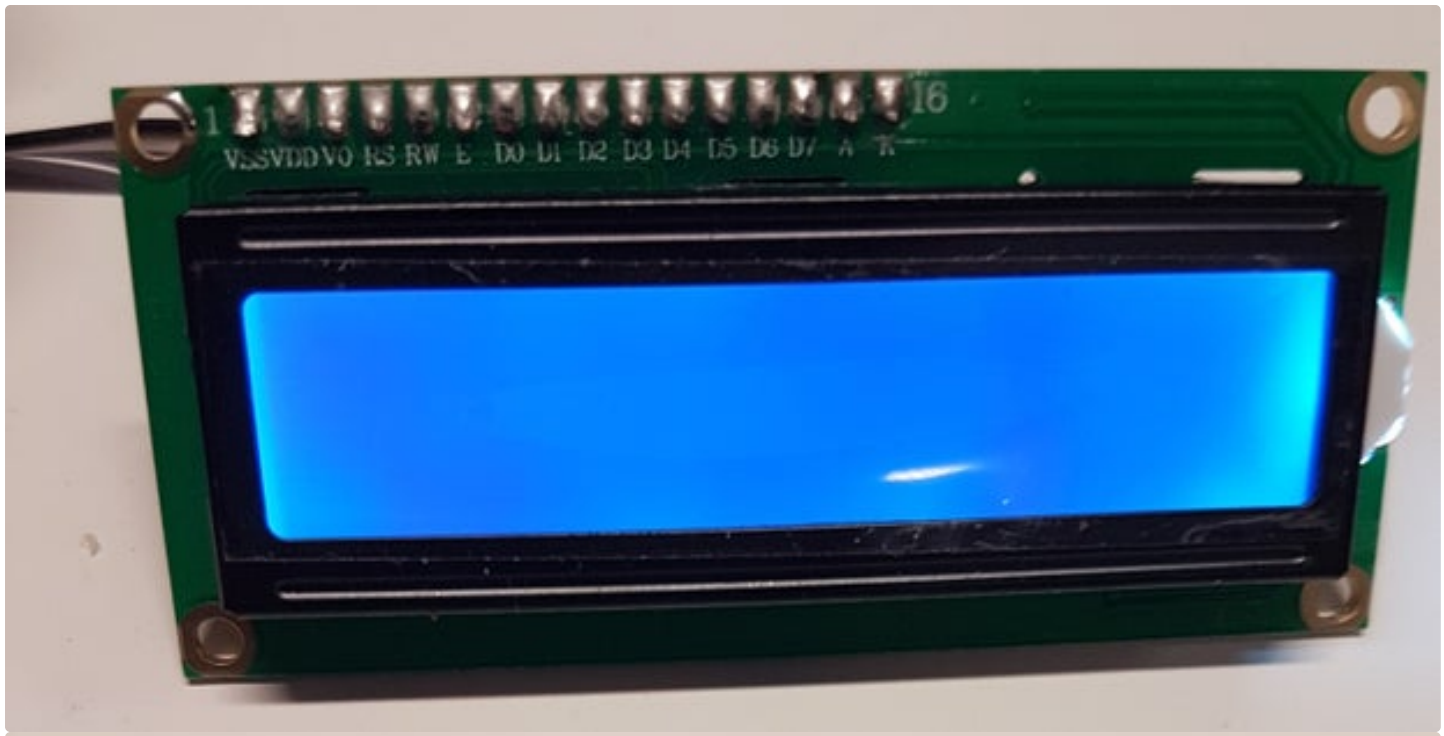

LCD 16x2
ASCD Nano x4
Version 1.11
http://www.vortexit.co.nz


ASCD Nano
Version 1.11
http://www.vortexit.co.nz
GND
5V
SDA
SCL
Serial
SS 1-2
HS 2-3
1
2
3



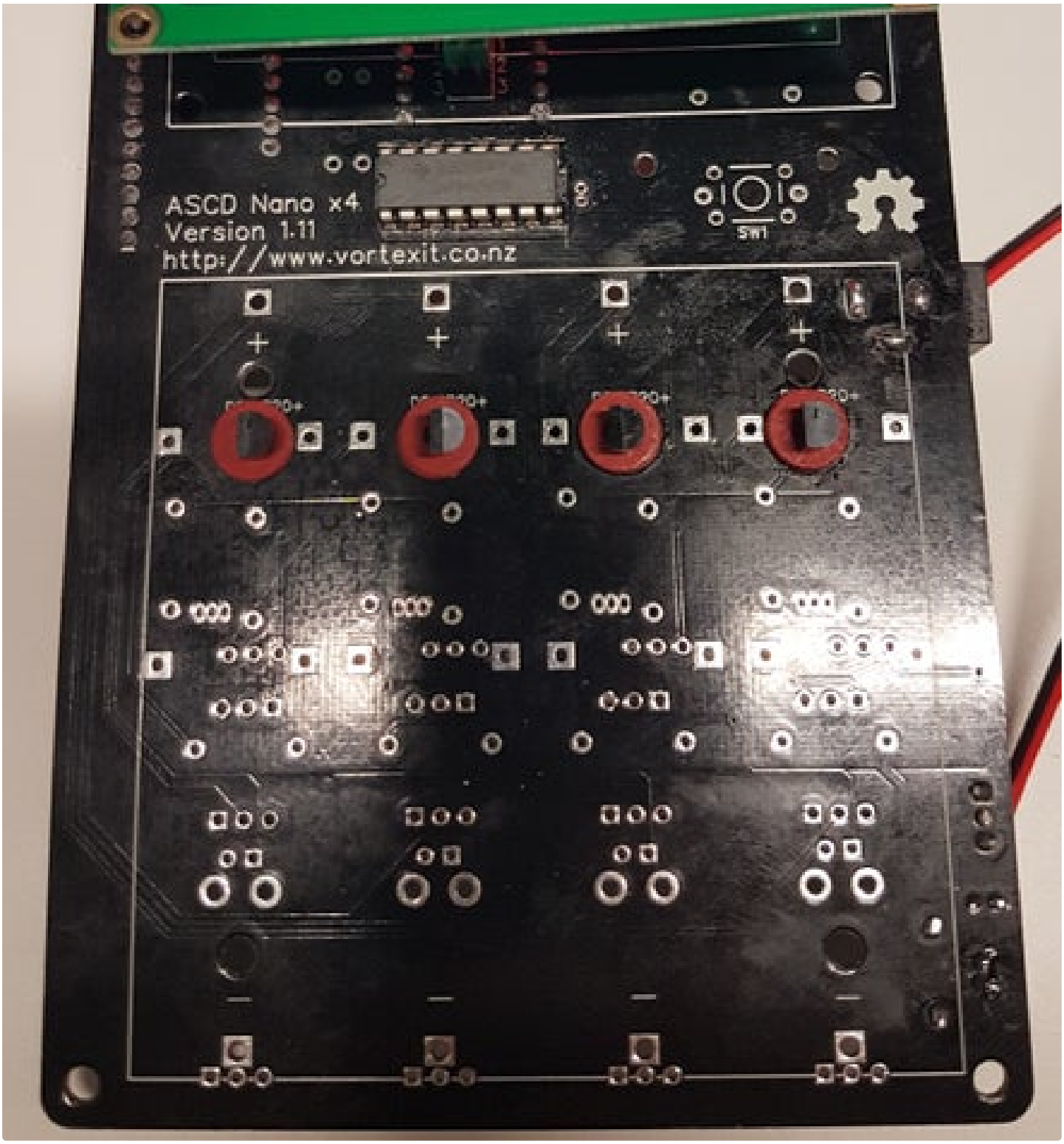

A
J1
J3
U3
C1
C2
K
U2
MH
SCL
R2
R1
C3




1
16
VSSVDDVO RS RW E D0 D1 D2 D3 D4 D5 D6 D7 A K


1
16
VSSVDDVO RS RW E D0 D1 D2 D3 D4 D5 D6 D7 A K
Testing LCD 16x2
0123456789ABCDEF


Testing LCD 16x2
0123456789ABCDEF




## Step 8: PWM Fan

**Components**

Solder the following components:

JST 2.0 PH 2pin connector (*Note: the silk screen is backwards on the PCB version 1.11)*

100uF 16V Electrolytic Capacitor

BD139 NPN Transistor

Diode

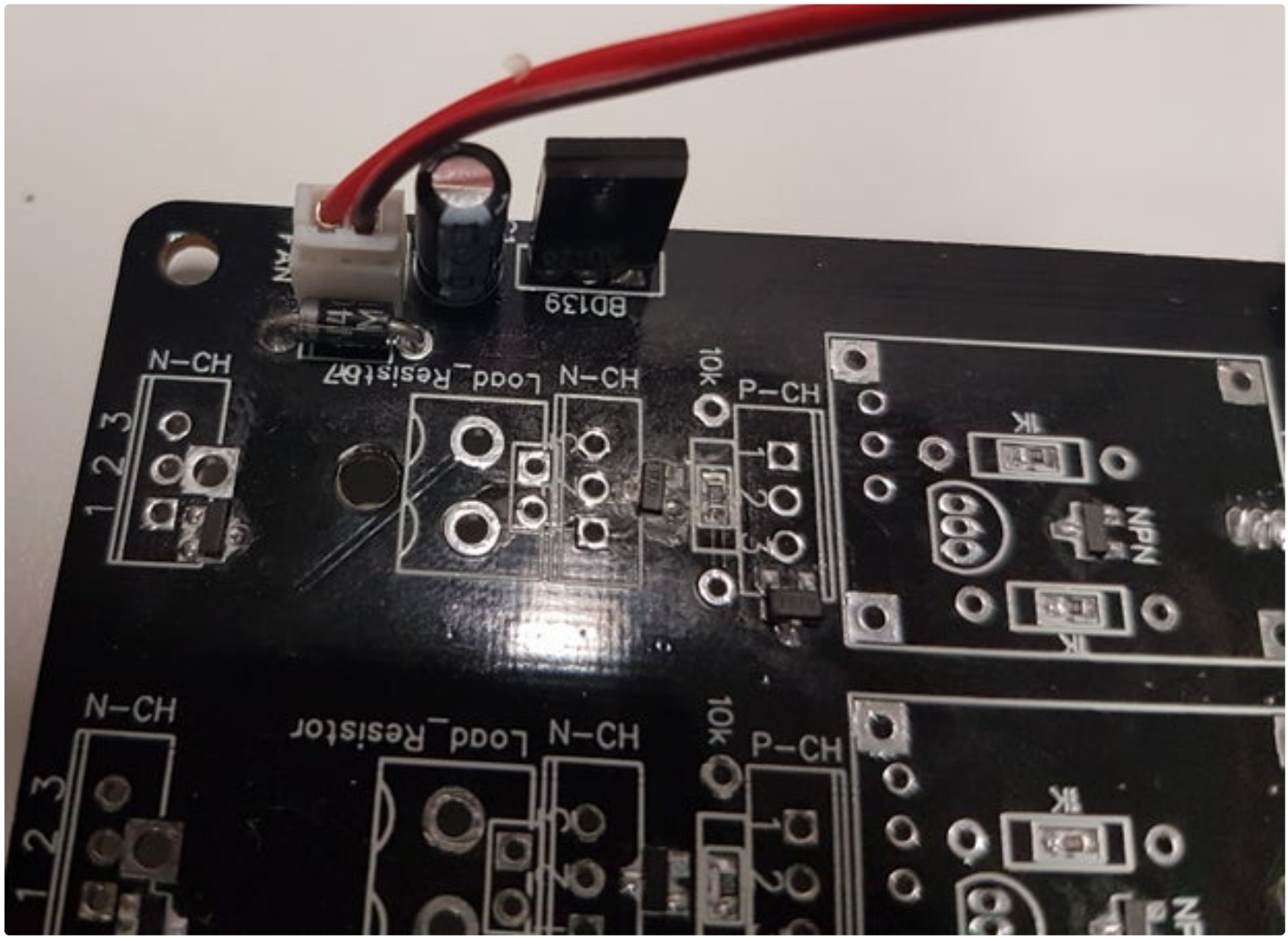
**Test**

Load the Arduino Sketch from github: ASCD_Nano_Test_Fan

Unplug the USB cord and use a 12V power cord in the 5.5 mm DC Jack (+ positive center / - negative outer)

Plug in the 30mm Fan

The Fan should speed up then stop




## Step 9: Testing the MOSFETs

**Testing N-Channel Resistor Discharge MOSFETs**

Load the Arduino Sketch from github: ASCD_Nano_Test_Charge_Discharge_Mosfets

Unplug the USB cord and use a 12V power cord in the 5.5 mm DC Jack (+ positive center / - negative outer)

With the PCB facing the bottom layer set your multi-meter to diode / continuity mode.

Place the negative probe on a GND source and the positive probe on the 1st modules load resistors connectors right side (as shown in the images).

Your multi-meter should beep for 1 second then no beep for 1 second.

Repeat this for each module.

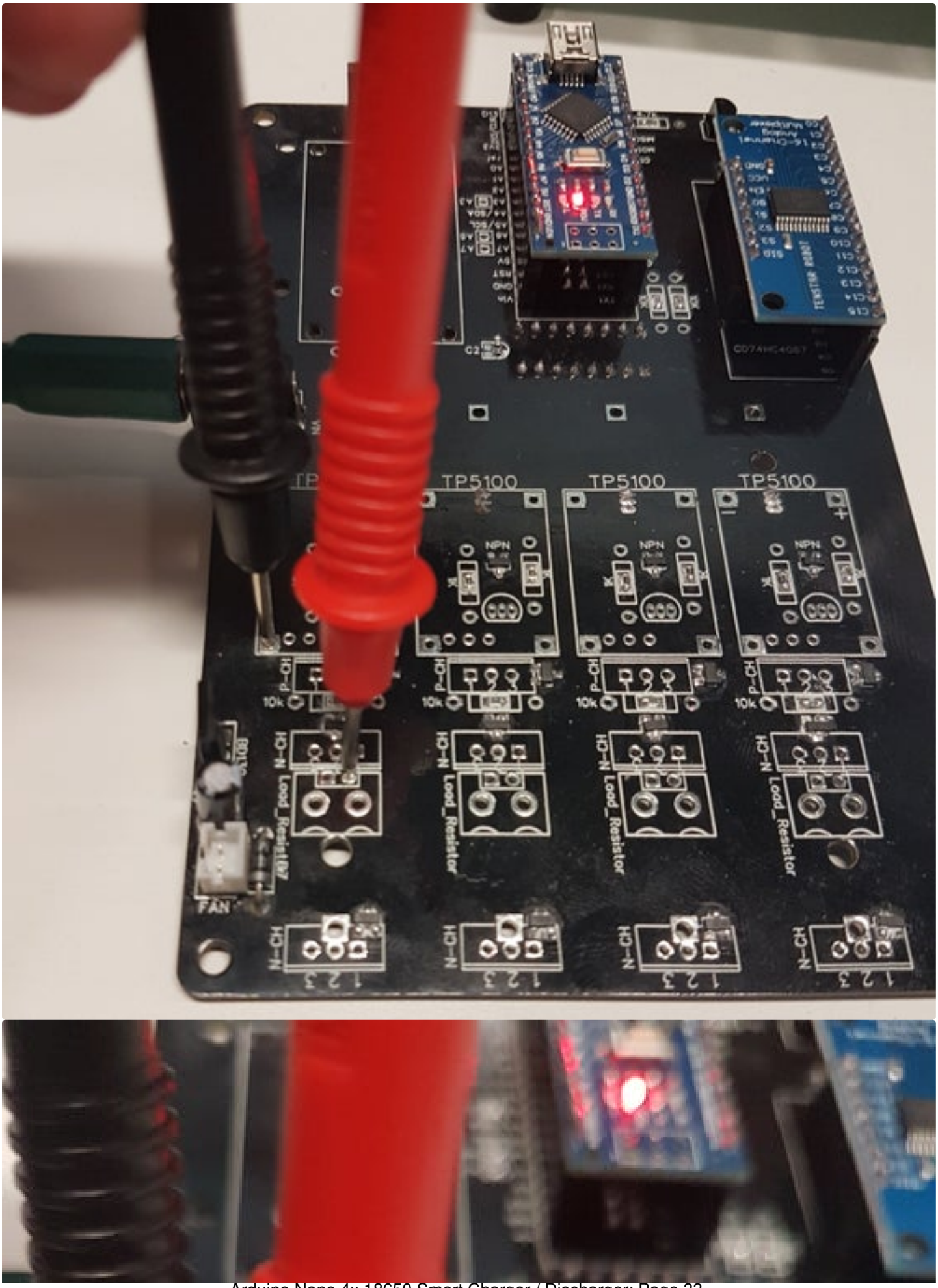
#### Testing P-Channel TP5100 Charge MOSFETs

Load the Arduino Sketch from github: ASCD_Nano_Test_Charge_Discharge_Mosfets (Same as above you can use this sketch for both tests)

Unplug the USB cord and use a 12V power cord in the 5.5 mm DC Jack (+ positive center / - negative outer)

With the PCB facing the bottom layer set your multi-meter to DC voltage mode (usually 20V range).

Place the negative probe on a GND source and the positive probe on the 1st modules TP5100 right side + positive connector (as shown in the images).
Your multi-meter should show 12V for 1 second then a low voltage for 1 second. Repeat this for each module.


TP5100
TP5100
TP5100
NPN
NPN
NPN
P-CH
P-CH
P-CH
10k
10k
10k
N-CH
N-CH
N-CH
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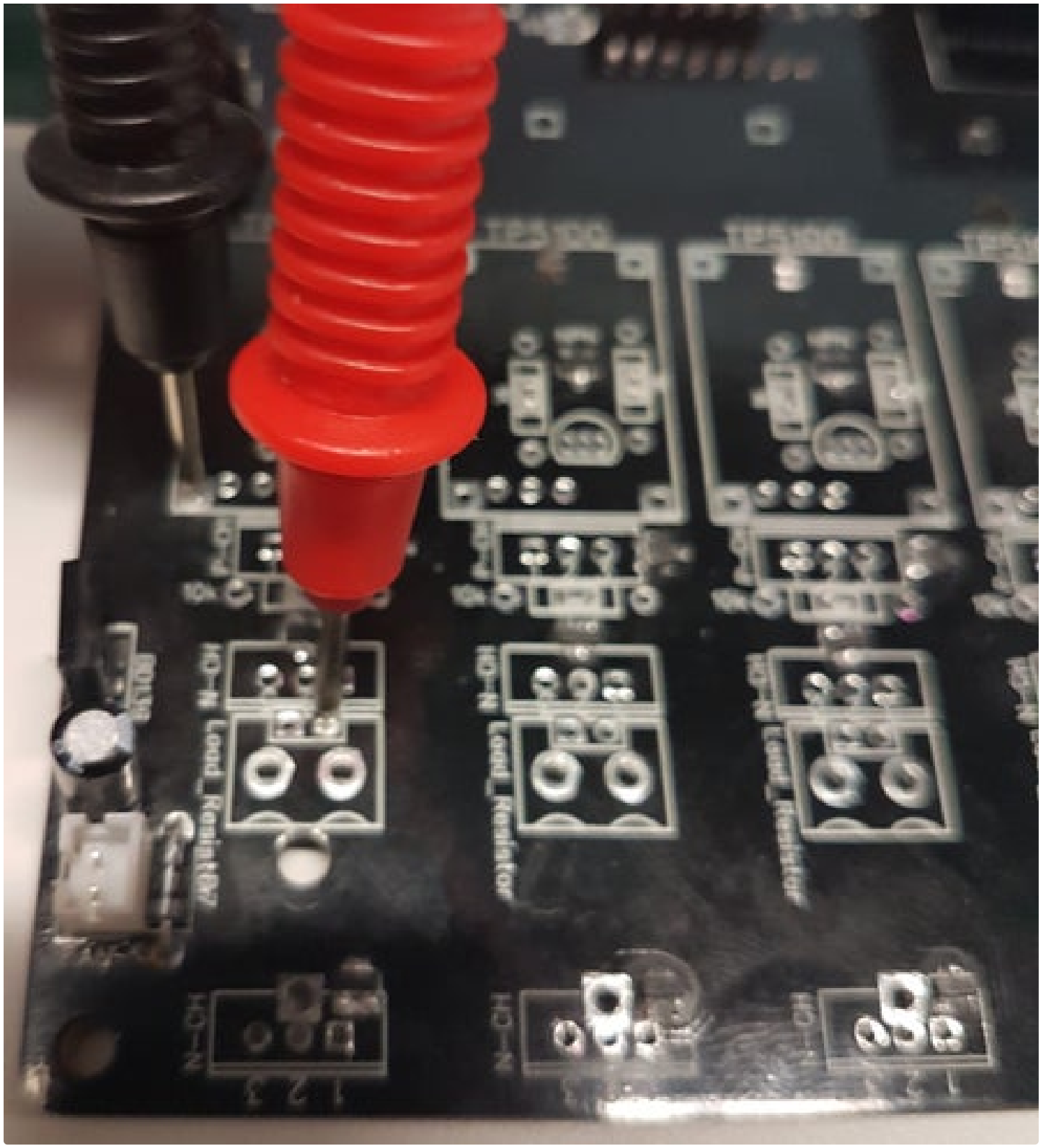
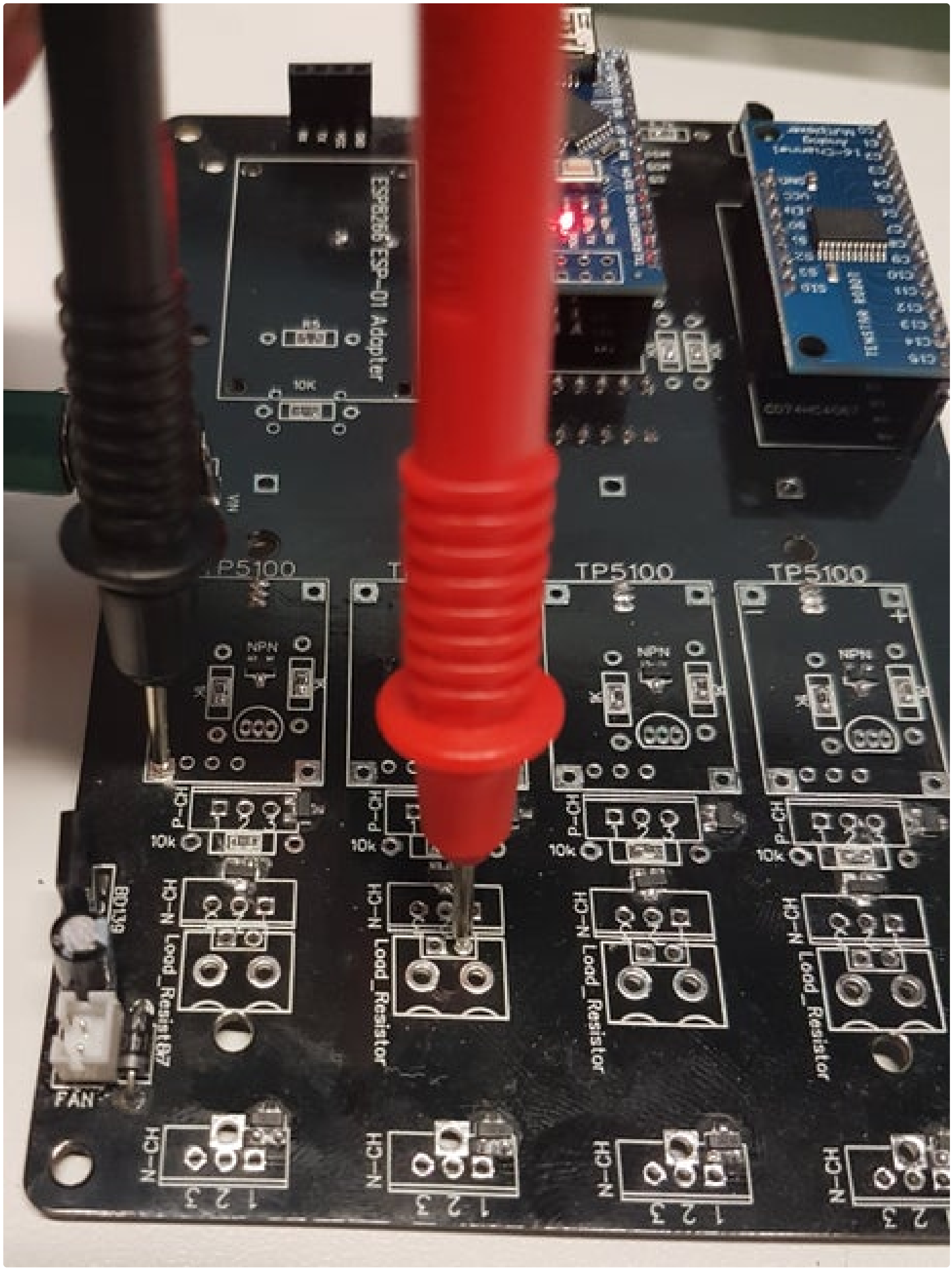
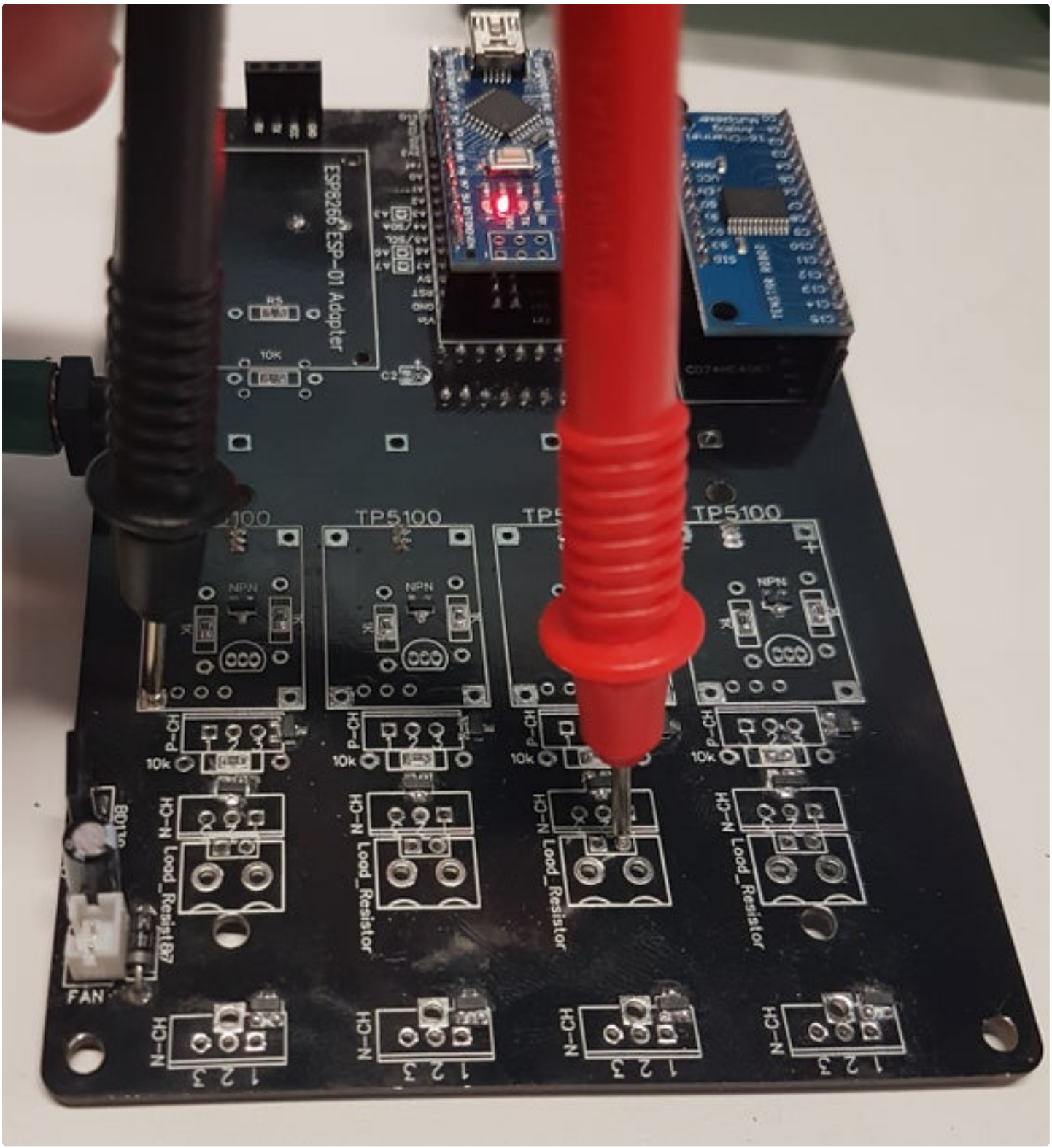
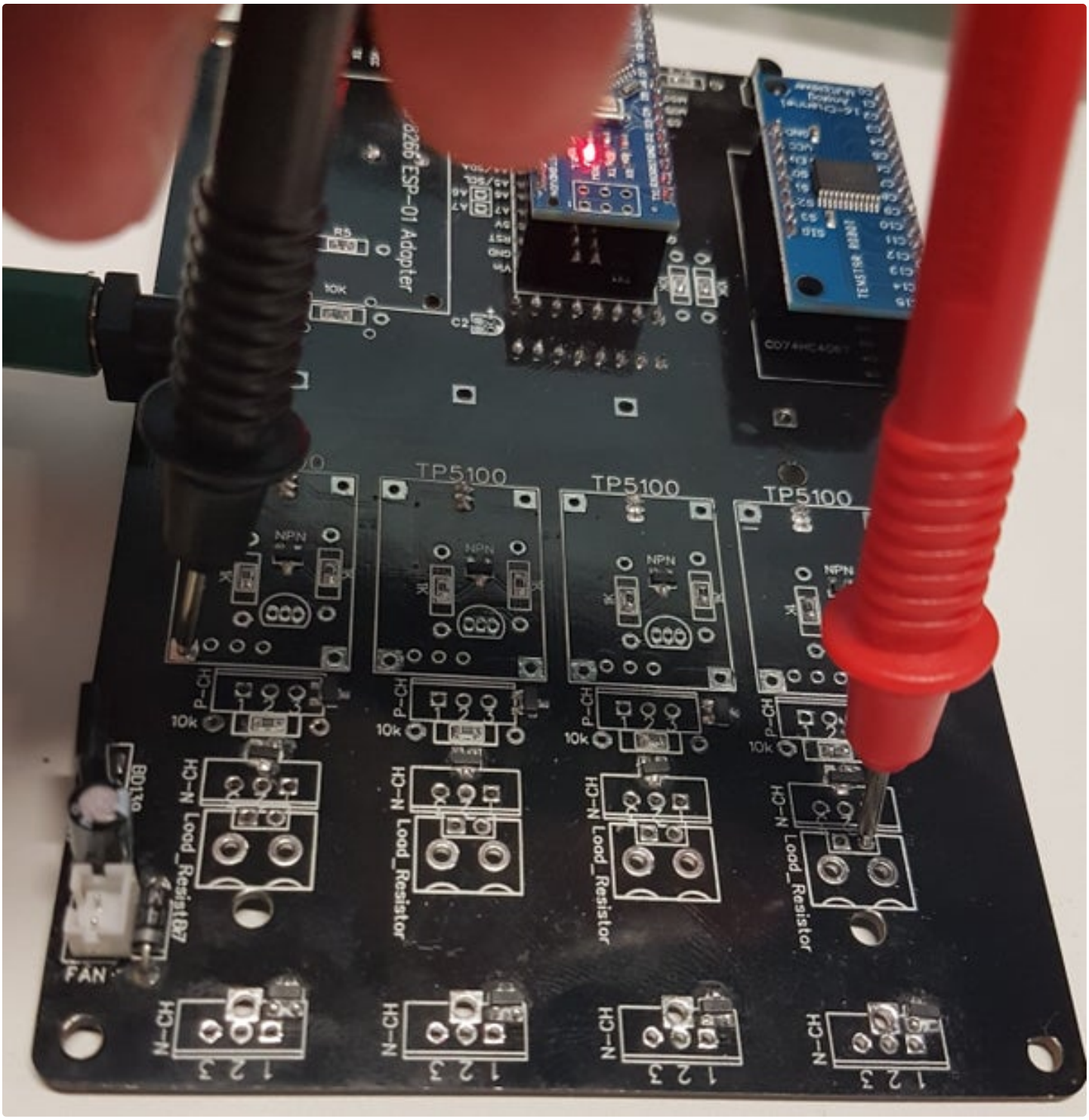
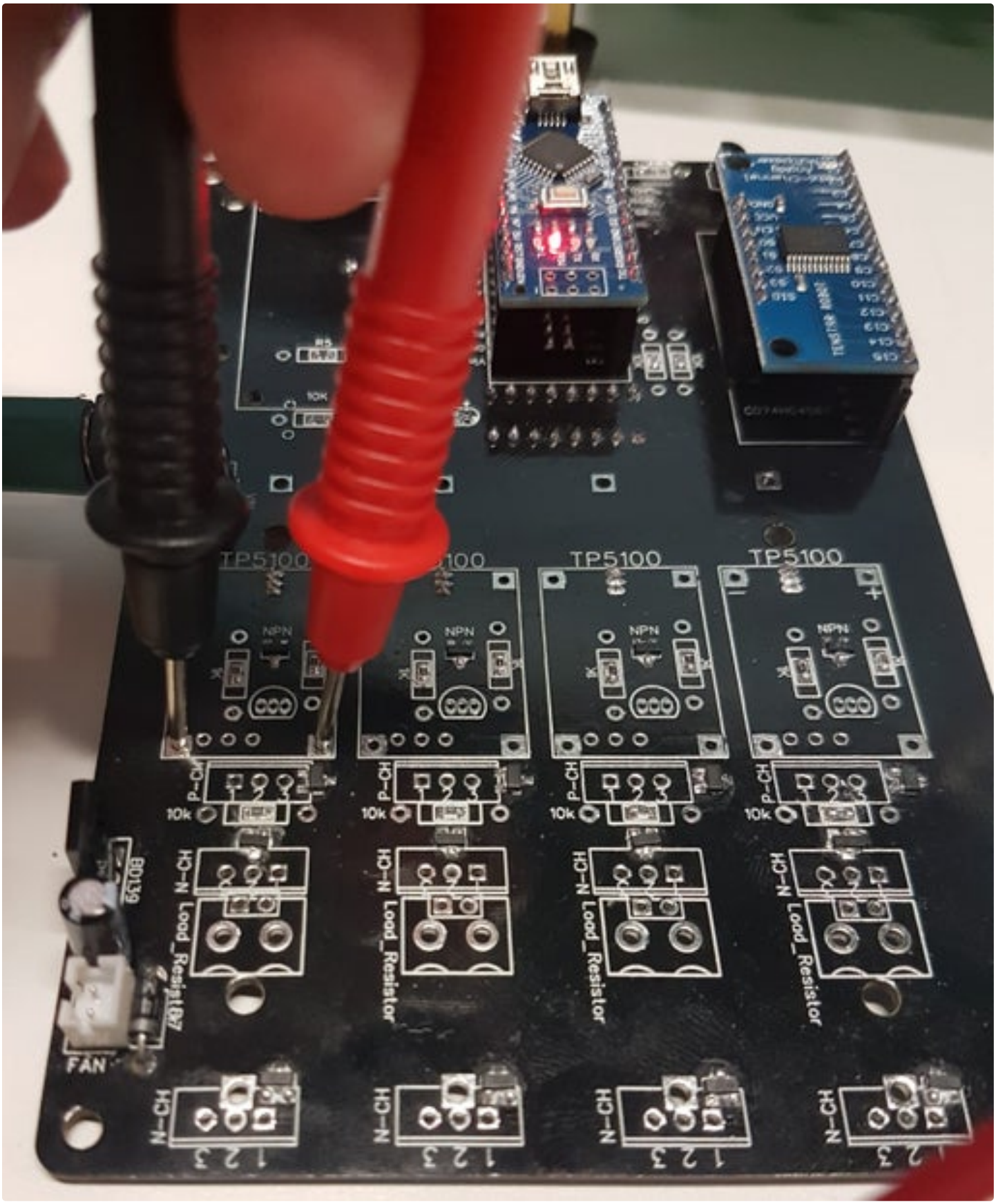
Load_Resistor
Load_Resistor
Load_Resistor
Load_Resistor
FAN
1 2 3
1 2 3
1 2 3
1 2 3




ESP8266 ESP-01 Adapter
10K
TP5100
TP5100
TP5100
NPN
P-CH
10k
H-CH
Load_Resistor
FAN
1 2 3

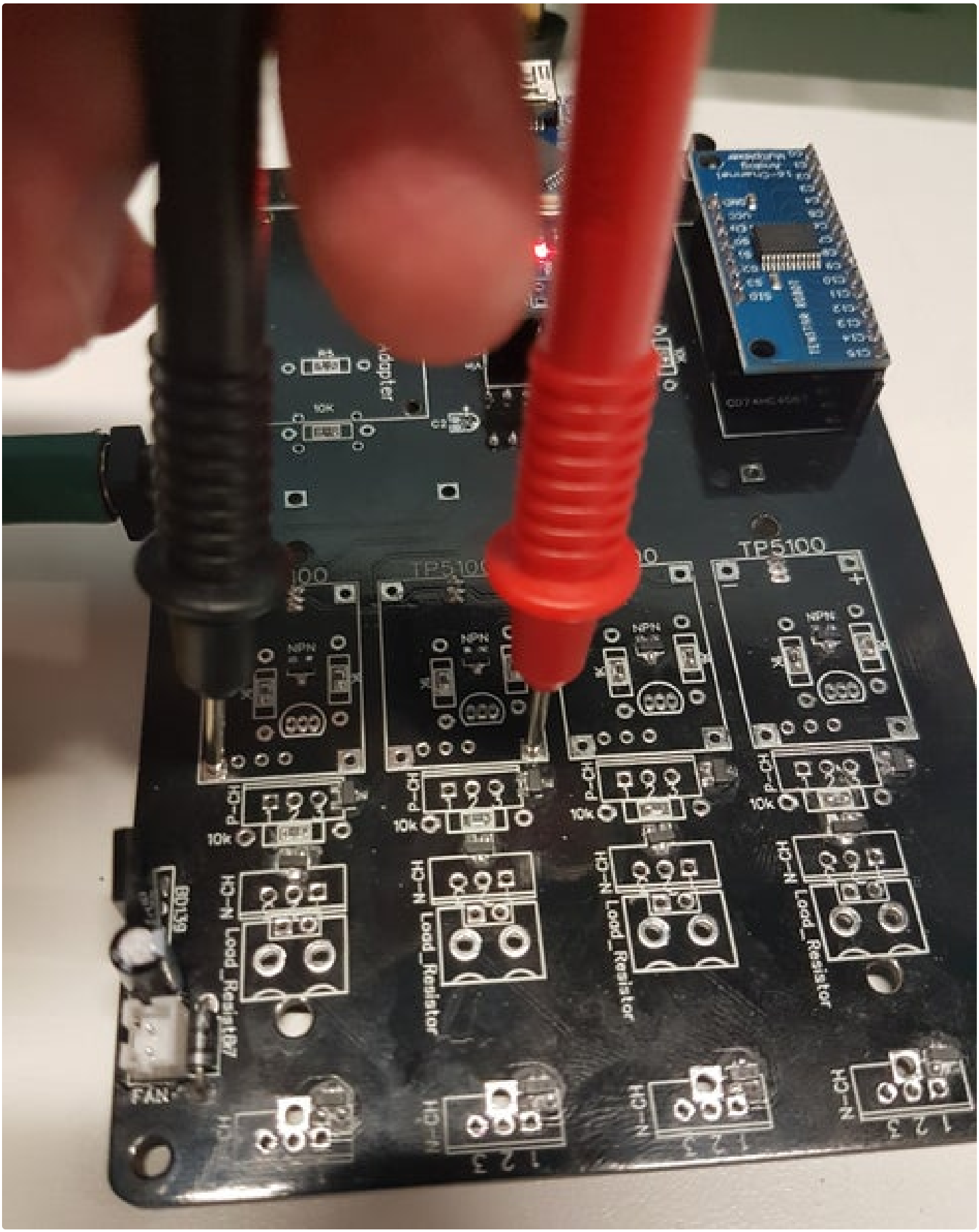

ESP8266 ESP-01 Adapter
TP5100
TP5100
TP5100
NPN
NPN
NPN
10k
10k
10k
10k
HC-N Load_Resistor
HC-N Load_Resistor
HC-N Load_Resistor
HC-N Load_Resistor
FAN
N-CH
HC-N
HC-N
HC-N

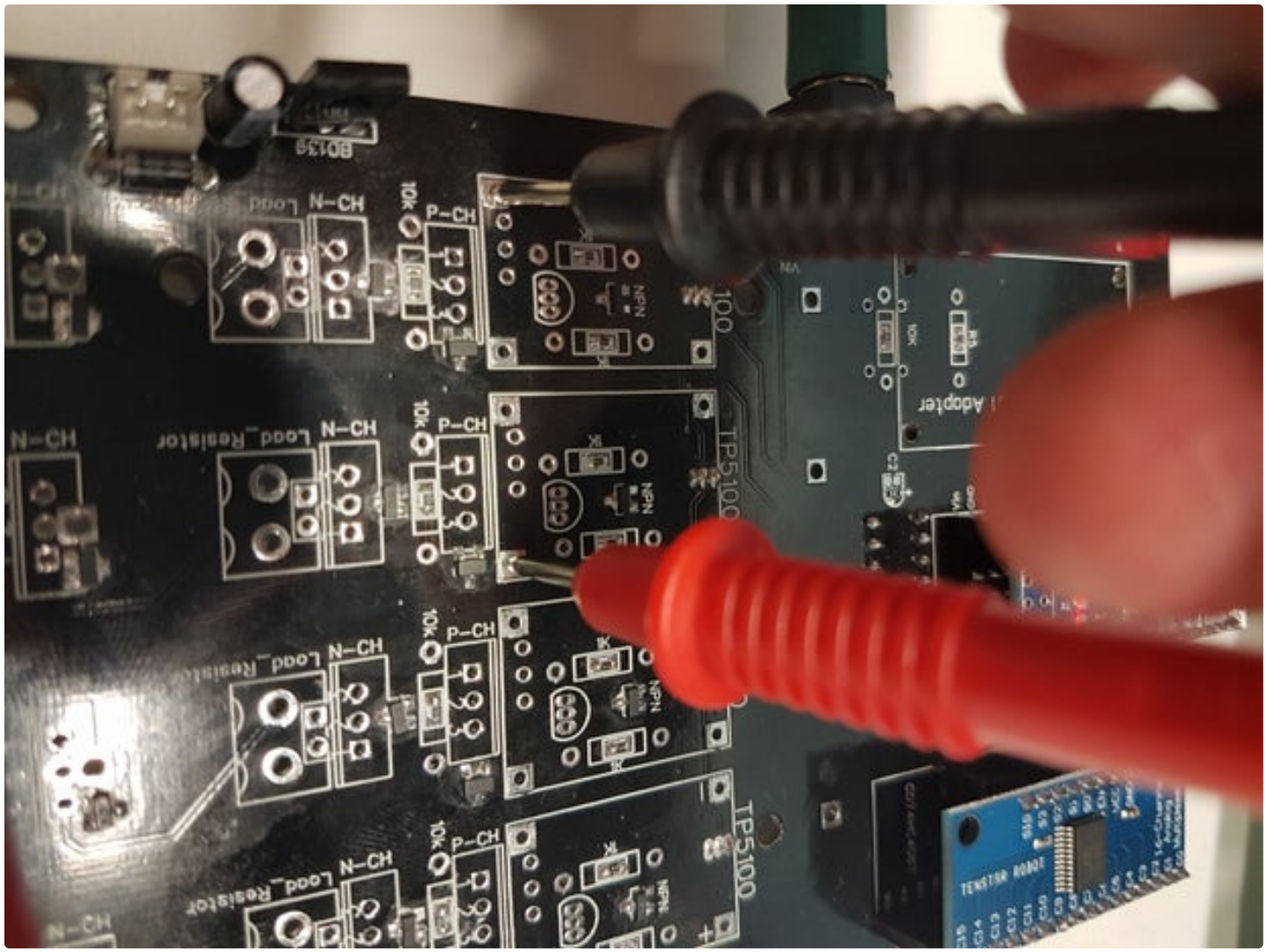

8266 ESP-01 Adapter
TP5100
TP5100
TP5100
NPN
10k
HC-N Load_Resistor
FAN
BD130

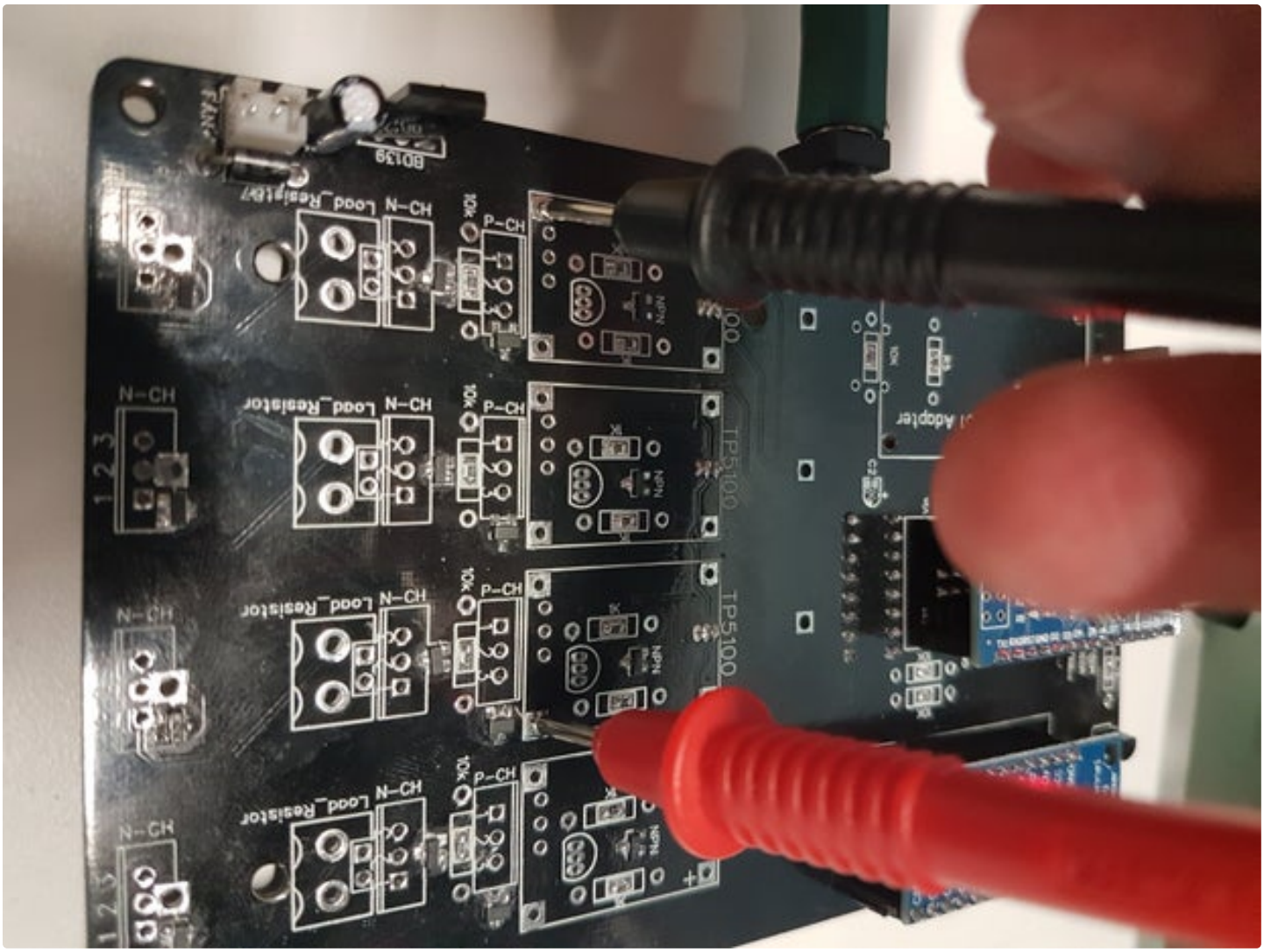

TP5100
TP5100
TP5100
NPN
NPN
NPN
P-CH
P-CH
P-CH
10k
10k
10k
BD136
FAN
N-CH
N-CH
N-CH
N-CH
Load_Resistor
Load_Resistor
Load_Resistor
Load_Resistor
1 2 3
1 2 3
1 2 3
2 3

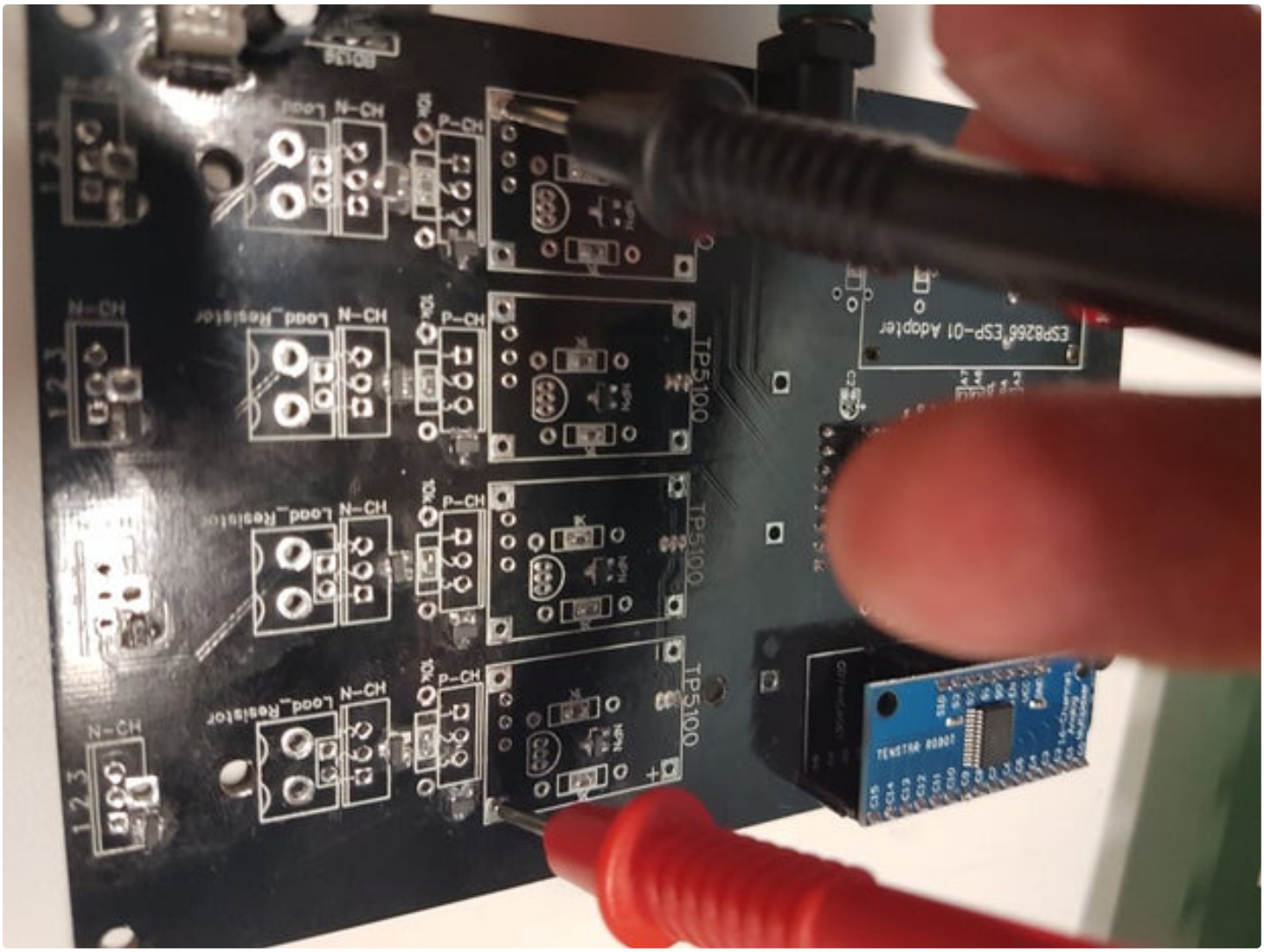

DIGITECH
QM1523
12.30
HOLD
E B C E
NPN
PNP
POWER
V
500
200
N287
AUTO
200µ
2m
20m


DIGITECH
QM1523
HOLD
E B C E
NPN
PNP
POWER
V
500
200
N287
200µ
2m
20


TP5100
TP5100
TP5100
NPN
P-CH
10k
H-N Load_Resistor
FAN


N-CH
P-CH
10k
Load_Resistor
TP5100
TP5100
Adapter


N-CH
Load_Resistor
P-CH
10k
TP5100
Adapter




## Step 10: Get the Dallas DS18B20 Temperature Sensor Serials

Load the Arduino Sketch from github: ASCD_Nano_Get_DS18B20_Serials

Leave in the USB cable. Do not connect the Fan or 12V Power.

Open the Serial monitor in Arduino IDE at 115200 baud rate.

It should detect / locate 5x devices.

Heat up the 1st DS18B20 Temperature Sensor with the upper tip of your soldering iron for a short period of time.

*Note: Module number are from left to right with the PCB facing upright on the top layer*

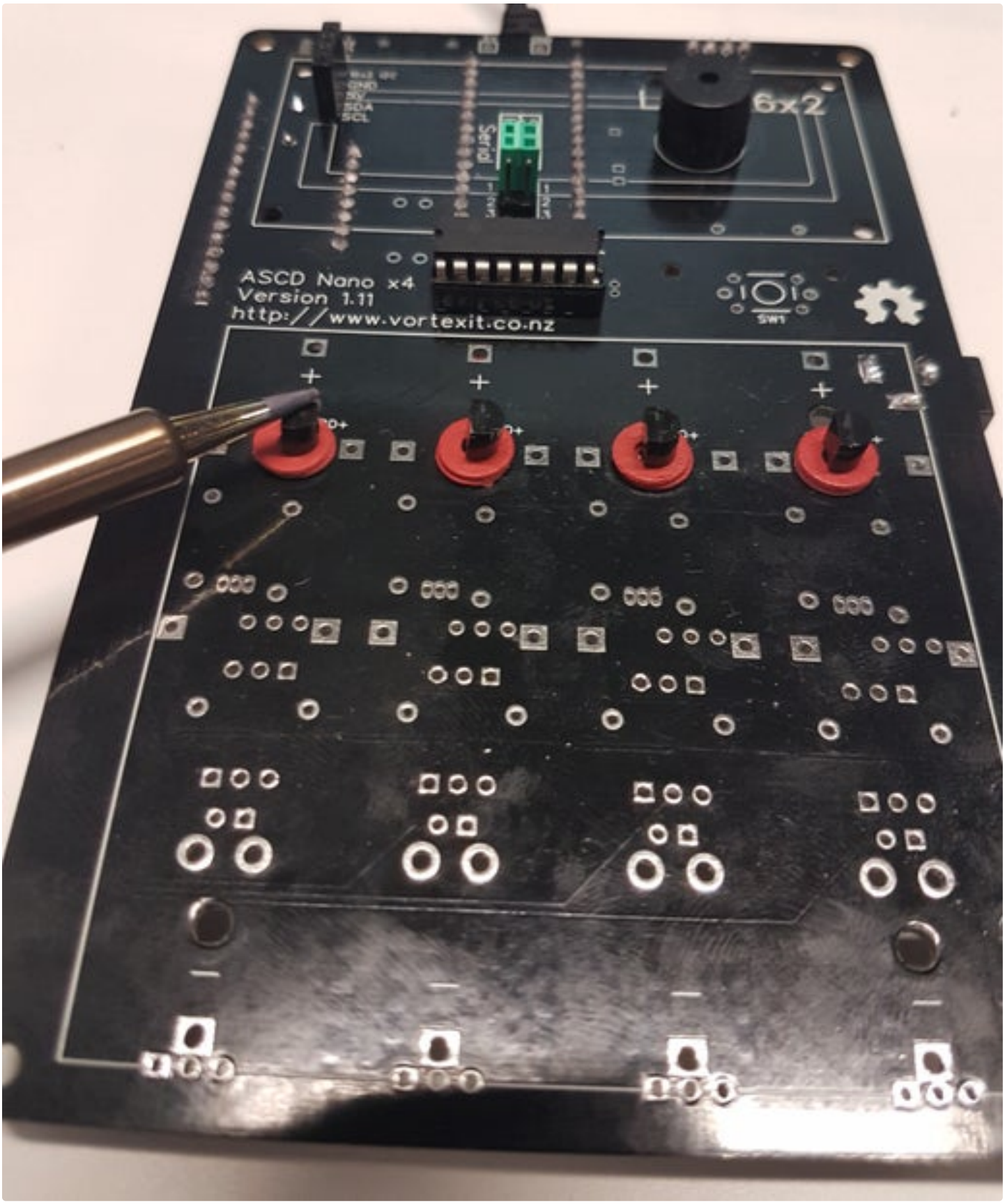
It should print "Detected Battery: 1" then "Heat Up Battery Sensor: 2"

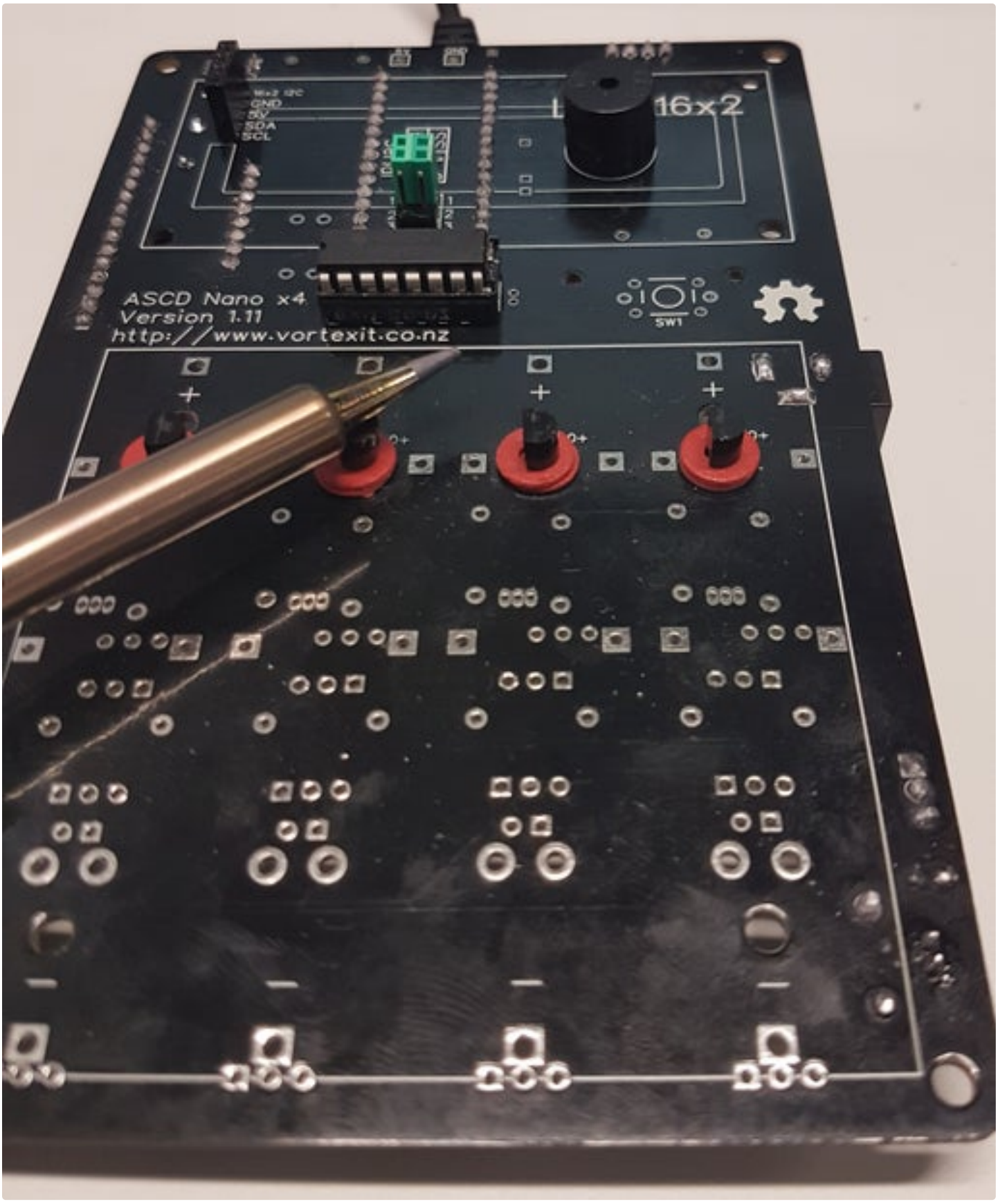
This will sequentially go through each 4 x modules until it says "Detected Ambient Sensor Completed"

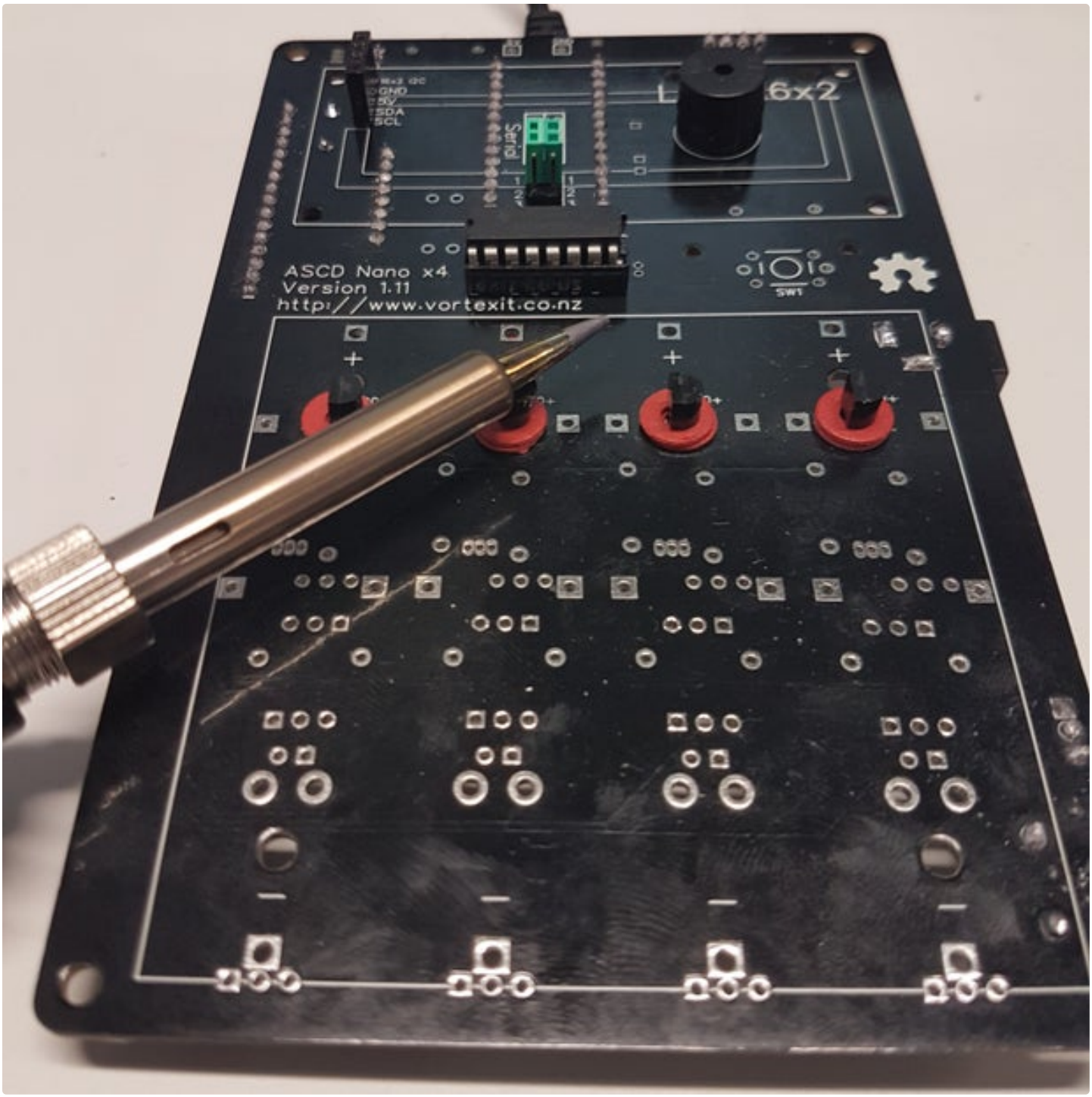
It will display the Hexadecimal Serial numbers of all the DS18B20 Temperature Sensors at the bottom.

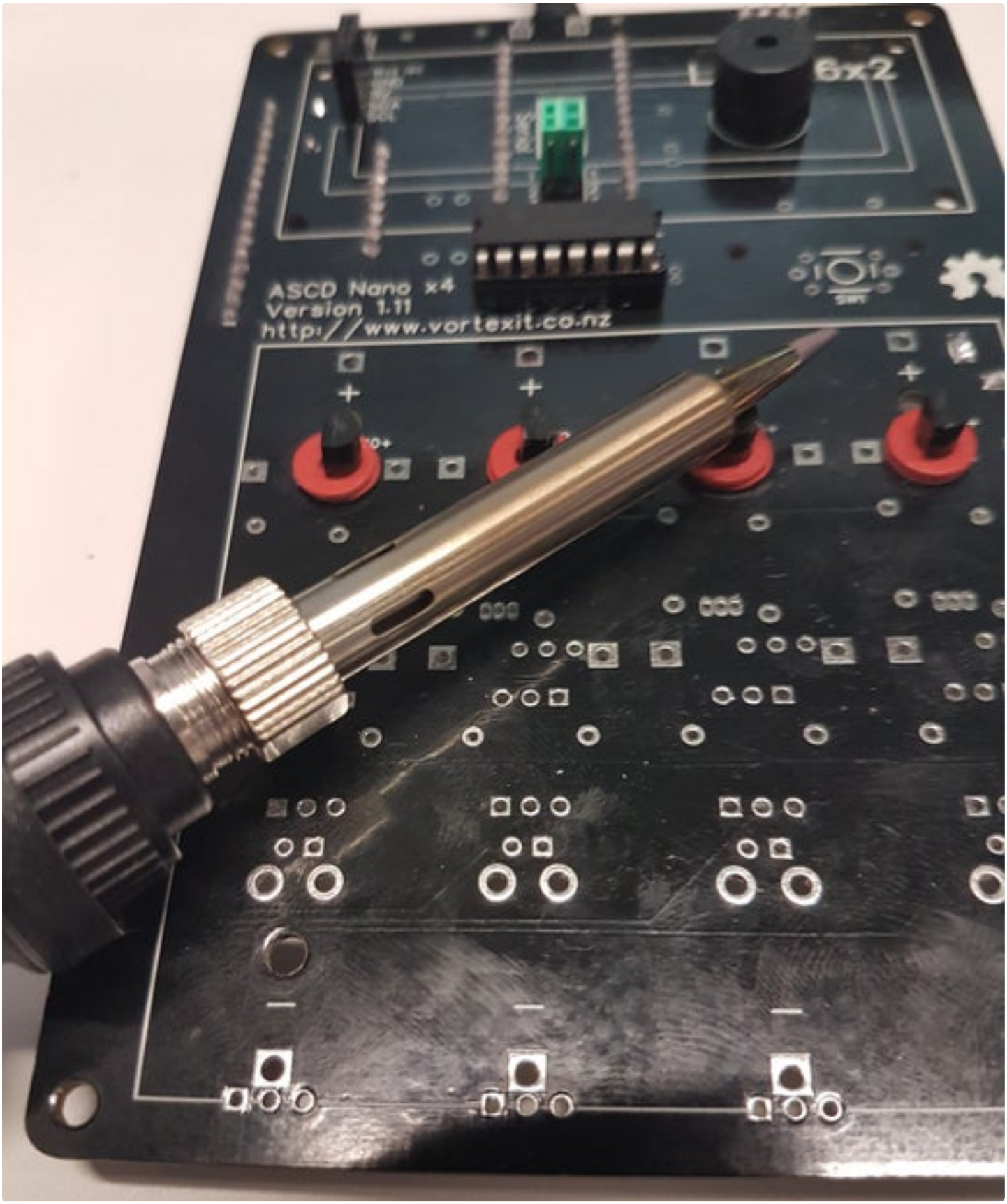
Copy the 5x Serial numbers and then paste them into "Temp_Sensor_Serials.h" within the " ASCD_Nano_1-0-0" sketch. Make sure you emit the last comma (shown in the image)

*Note: If you get 99 degrees Celsius temperature reading it means that there is an error reading that sensor. Either the serial is wrong or the device is faulty.*


ASCD Nano x4
Version 1.11
http://www.vortexit.co.nz
6x2
SW1


16x2
GND
5V
SDA
SCL
ASCD Nano x4
Version 1.11
http://www.vortexit.co.nz
SW1


ASCD Nano x4
Version 1.11
http://www.vortexit.co.nz
SW1


6x2
ASCD Nano x4
Version 1.11
http://www.vortexit.co.nz


6x2
ASCD Nano x4
Version 1.11
http://www.vortexit.co.nz

COM9

```
Dallas Temperature Detection
Locating devices...Found 5 devices.
Device 0 Address: {0x28, 0x90, 0x09, 0x79, 0x97, 0x02, 0x03, 0x46},

Device 1 Address: {0x28, 0xC8, 0x9C, 0x79, 0x97, 0x05, 0x03, 0xC2},

Device 2 Address: {0x28, 0x55, 0xE9, 0x79, 0x97, 0x05, 0x03, 0x86},

Device 3 Address: {0x28, 0x4B, 0x6C, 0x79, 0x97, 0x04, 0x03, 0x13},

Device 4 Address: {0x28, 0xCF, 0x2B, 0x79, 0x97, 0x05, 0x03, 0x59},

------------------------------------Heat Up Battery Sensor: 1------------------------------------
Sensor 0 Temp: 24.00
Sensor 1 Temp: 24.00
Sensor 2 Temp: 24.00
Sensor 3 Temp: 24.00
Sensor 4 Temp: 24.56
------------------------------------Heat Up Battery Sensor: 1------------------------------------
Sensor 0 Temp: 24.50
Sensor 1 Temp: 24.00
Sensor 2 Temp: 24.00
Sensor 3 Temp: 24.00
Sensor 4 Temp: 24.50
------------------------------------Heat Up Battery Sensor: 1------------------------------------
Sensor 0 Temp: 24.50
Sensor 1 Temp: 24.00
Sensor 2 Temp: 24.00
Sensor 3 Temp: 24.00
Sensor 4 Temp: 24.50
------------------------------------Heat Up Battery Sensor: 1------------------------------------
Sensor 0 Temp: 24.50
Sensor 1 Temp: 24.00
Sensor 2 Temp: 24.00
Sensor 3 Temp: 24.50
Sensor 4 Temp: 24.50
------------------------------------Heat Up Battery Sensor: 1------------------------------------
Sensor 0 Temp: 24.50
Sensor 1 Temp: 24.00
Sensor 2 Temp: 24.00
Sensor 3 Temp: 24.00
Sensor 4 Temp: 24.50
```

COM9

```
Sensor 0 Temp: 24.50
Sensor 1 Temp: 24.00
Sensor 2 Temp: 24.00
Sensor 3 Temp: 24.50
Sensor 4 Temp: 24.50
------------------------------------Heat Up Battery Sensor: 1------------------------------------
Sensor 0 Temp: 24.50
```

```
Sensor 2 Temp: 24.50
Sensor 3 Temp: 24.50
Sensor 4 Temp: 24.50
-------------------------------------Heat Up Battery Sensor: 1-------------------------------------
Sensor 0 Temp: 24.50
Sensor 1 Temp: 24.00
Sensor 2 Temp: 24.50
Sensor 3 Temp: 24.50
Sensor 4 Temp: 24.50
-------------------------------------Heat Up Battery Sensor: 1-------------------------------------
Sensor 0 Temp: 24.50
Sensor 1 Temp: 24.00
Sensor 2 Temp: 25.00
Sensor 3 Temp: 24.50
Sensor 4 Temp: 24.50
-------------------------------------Heat Up Battery Sensor: 1-------------------------------------
Sensor 0 Temp: 24.50
Sensor 1 Temp: 24.00
Sensor 2 Temp: 27.00
Detected Battery: 1
Sensor 3 Temp: 24.50
Sensor 4 Temp: 24.50
-------------------------------------Heat Up Battery Sensor: 2-------------------------------------
Sensor 0 Temp: 24.50
Sensor 1 Temp: 24.00
Sensor 3 Temp: 24.50
Sensor 4 Temp: 24.50
-------------------------------------Heat Up Battery Sensor: 2-------------------------------------
Sensor 0 Temp: 24.50
Sensor 1 Temp: 24.00
Sensor 3 Temp: 24.50
Sensor 4 Temp: 24.50
-------------------------------------Heat Up Battery Sensor: 2-------------------------------------
Sensor 0 Temp: 24.50
Sensor 1 Temp: 24.00
Sensor 3 Temp: 24.50
Sensor 4 Temp: 24.50
-------------------------------------Heat Up Battery Sensor: 2-------------------------------------
Sensor 0 Temp: 30.50
Detected Battery: 2
Sensor 1 Temp: 24.00
Sensor 3 Temp: 24.50
Sensor 4 Temp: 24.50
-------------------------------------Heat Up Battery Sensor: 3-------------------------------------
Sensor 1 Temp: 24.00
Sensor 3 Temp: 24.50
Sensor 4 Temp: 24.50
```

COM9

```
Sensor 4 Temp: 24.50
-------------------------------------Heat Up Battery Sensor: 2-------------------------------------
Sensor 0 Temp: 24.50
Sensor 1 Temp: 24.00
Sensor 3 Temp: 24.50
```

```
Sensor 4 Temp: 24.50
-------------------------------------Heat Up Battery Sensor: 2-------------------------------------
Sensor 0 Temp: 24.50
Sensor 1 Temp: 24.00
Sensor 3 Temp: 24.50
Sensor 4 Temp: 24.50
-------------------------------------Heat Up Battery Sensor: 2-------------------------------------
Sensor 0 Temp: 24.50
Sensor 1 Temp: 24.00
Sensor 3 Temp: 24.50
Sensor 4 Temp: 24.50
-------------------------------------Heat Up Battery Sensor: 2-------------------------------------
Sensor 0 Temp: 30.50
Detected Battery: 2
Sensor 1 Temp: 24.00
Sensor 3 Temp: 24.50
Sensor 4 Temp: 24.50
-------------------------------------Heat Up Battery Sensor: 3-------------------------------------
Sensor 1 Temp: 24.00
Sensor 3 Temp: 24.50
Sensor 4 Temp: 24.50
-------------------------------------Heat Up Battery Sensor: 3-------------------------------------
Sensor 1 Temp: 24.00
Sensor 3 Temp: 24.50
Sensor 4 Temp: 25.00
-------------------------------------Heat Up Battery Sensor: 3-------------------------------------
Sensor 1 Temp: 24.00
Sensor 3 Temp: 24.50
Sensor 4 Temp: 25.00
-------------------------------------Heat Up Battery Sensor: 3-------------------------------------
Sensor 1 Temp: 24.00
Sensor 3 Temp: 24.50
Sensor 4 Temp: 25.00
-------------------------------------Heat Up Battery Sensor: 3-------------------------------------
Sensor 1 Temp: 24.00
Sensor 3 Temp: 25.00
Sensor 4 Temp: 36.50
Detected Battery: 3
-------------------------------------Heat Up Battery Sensor: 4-------------------------------------
Sensor 1 Temp: 24.00
Sensor 3 Temp: 25.00
-------------------------------------Heat Up Battery Sensor: 4-------------------------------------
Sensor 1 Temp: 24.00
Sensor 3 Temp: 25.00
-------------------------------------Heat Up Battery Sensor: 4-------------------------------------
Sensor 1 Temp: 24.00
Sensor 3 Temp: 25.00
-------------------------------------Heat Up Battery Sensor: 4-------------------------------------
Sensor 1 Temp: 24.00
Sensor 3 Temp: 24.50
```

COM9

```
Sensor 4 Temp: 25.00
-------------------------------------Heat Up Battery Sensor: 3-------------------------------------
Sensor 1 Temp: 24.00
Sensor 3 Temp: 24.50
Sensor 4 Temp: 25.00
-------------------------------------Heat Up Battery Sensor: 3-------------------------------------
Sensor 1 Temp: 24.00
Sensor 3 Temp: 24.50
Sensor 4 Temp: 25.00
-------------------------------------Heat Up Battery Sensor: 3-------------------------------------
Sensor 1 Temp: 24.00
Sensor 3 Temp: 25.00
Sensor 4 Temp: 36.50
Detected Battery: 3
-------------------------------------Heat Up Battery Sensor: 4-------------------------------------
Sensor 1 Temp: 24.00
Sensor 3 Temp: 25.00
-------------------------------------Heat Up Battery Sensor: 4-------------------------------------
Sensor 1 Temp: 24.00
Sensor 3 Temp: 25.00
-------------------------------------Heat Up Battery Sensor: 4-------------------------------------
Sensor 1 Temp: 24.00
Sensor 3 Temp: 25.00
-------------------------------------Heat Up Battery Sensor: 4-------------------------------------
Sensor 1 Temp: 24.00
Sensor 3 Temp: 24.50
-------------------------------------Heat Up Battery Sensor: 4-------------------------------------
Sensor 1 Temp: 24.00
Sensor 3 Temp: 25.00
-------------------------------------Heat Up Battery Sensor: 4-------------------------------------
Sensor 1 Temp: 24.00
Sensor 3 Temp: 25.00
-------------------------------------Heat Up Battery Sensor: 4-------------------------------------
Sensor 1 Temp: 24.00
Sensor 3 Temp: 39.50
Detected Battery: 4
-------------------------------------Heat Up Battery Sensor: 5-------------------------------------




-------------------------------------Detected Ambient Sensor Completed-------------------------------------



-----------------------------------
Copy and Paste these Addresses into the Arduino Charger / Discharger Sketch
-----------------------------------
{0x28, 0x55, 0xE9, 0x79, 0x97, 0x05, 0x03, 0x86},
{0x28, 0x90, 0x09, 0x79, 0x97, 0x02, 0x03, 0x46},
{0x28, 0xCF, 0x2B, 0x79, 0x97, 0x05, 0x03, 0x59},
{0x28, 0x4B, 0x6C, 0x79, 0x97, 0x04, 0x03, 0x13},
{0x28, 0xC9, 0x9C, 0x79, 0x97, 0x05, 0x03, 0xC2},
-----------------------------------
```

```
-----------------------------------Detected Ambient Sensor Completed-----------------------------------




-----------------------------------
Copy and Paste these Addresses into the Arduino Charger / Discharger Sketch
-----------------------------------
{0x28, 0x55, 0xE9, 0x79, 0x97, 0x05, 0x03, 0x86},
{0x28, 0x90, 0x09, 0x79, 0x97, 0x02, 0x03, 0x46},
{0x28, 0xCF, 0x2B, 0x79, 0x97, 0x05, 0x03, 0x59},
{0x28, 0x4B, 0x6C, 0x79, 0x97, 0x04, 0x03, 0x13},
{0x28, 0xC8, 0x9C, 0x79, 0x97, 0x05, 0x03, 0xC2},
-----------------------------------
```

ASCD_Nano_1-0-0 - Temp_Sensor_Serials.h | Arduino 1.8.7

File Edit Sketch Tools Help

ASCD_Nano_1-0-0 | Temp_Sensor_Serials.h

```
1  // ASDC Nano 4x Arduino Charger / Discharger
2  // -----------------------------------------------------------------------------
3  // Created by Brett Watt on 19/03/2019
4  // Copyright 2018 - Under creative commons license 3.0:
5  //
6  // This software is furnished "as is", without technical support, and with no
7  // warranty, express or implied, as to its usefulness for any purpose.
8  //
9  // @brief
10 // ASDC Nano 4x Arduino Charger / Discharger
11 // Dallas Temperature Sensor Serial header file
12 // Version 1.0.0
13 //
14 // @author Email: info@vortexit.co.nz
15 //       Web: www.vortexit.co.nz
16
17 // You need to run the Dallas get temp sensors sketch (ASCD_Nano_Get_DS18B20_Serials.ino) to
18 DeviceAddress tempSensorSerial[5] =
19 {
20     {0x28, 0x81, 0xCB, 0x79, 0x97, 0x05, 0x03, 0xE5},
21     {0x28, 0xAA, 0xF5, 0x6F, 0x1D, 0x13, 0x02, 0xAC},
22     {0x28, 0xAA, 0x37, 0x78, 0x1D, 0x13, 0x02, 0xB3},
23     {0x28, 0xAA, 0xB7, 0x71, 0x1D, 0x13, 0x02, 0xEB},
24     {0x28, 0xAA, 0x2D, 0x6F, 0x1D, 0x13, 0x02, 0xCC}
25 };
```

## Step 11: Install and Test the TP5100 Charging Modules

**Install**

With a knife or some diagonal pliers cut 20x single Male 2.54 mm headers.

Place 5x Male headers per TP5100 module on the bottom layer on the PCB. I recommend putting the long side down through the hole.

Place a TP5100 module on each module and solder it in place. Use some tweezers to manipulate the Male headers if they won't align.

On the top layer of the PCB solder the connectors as flush with the PCB as you can. (You will need to fit the plastic Battery holder on top so the less stick out the better)

*Note: Make sure you connect the Charge Pin on the TP5100. It is the closest pin next to the VCC in GND above the P-Channel MOSFET*

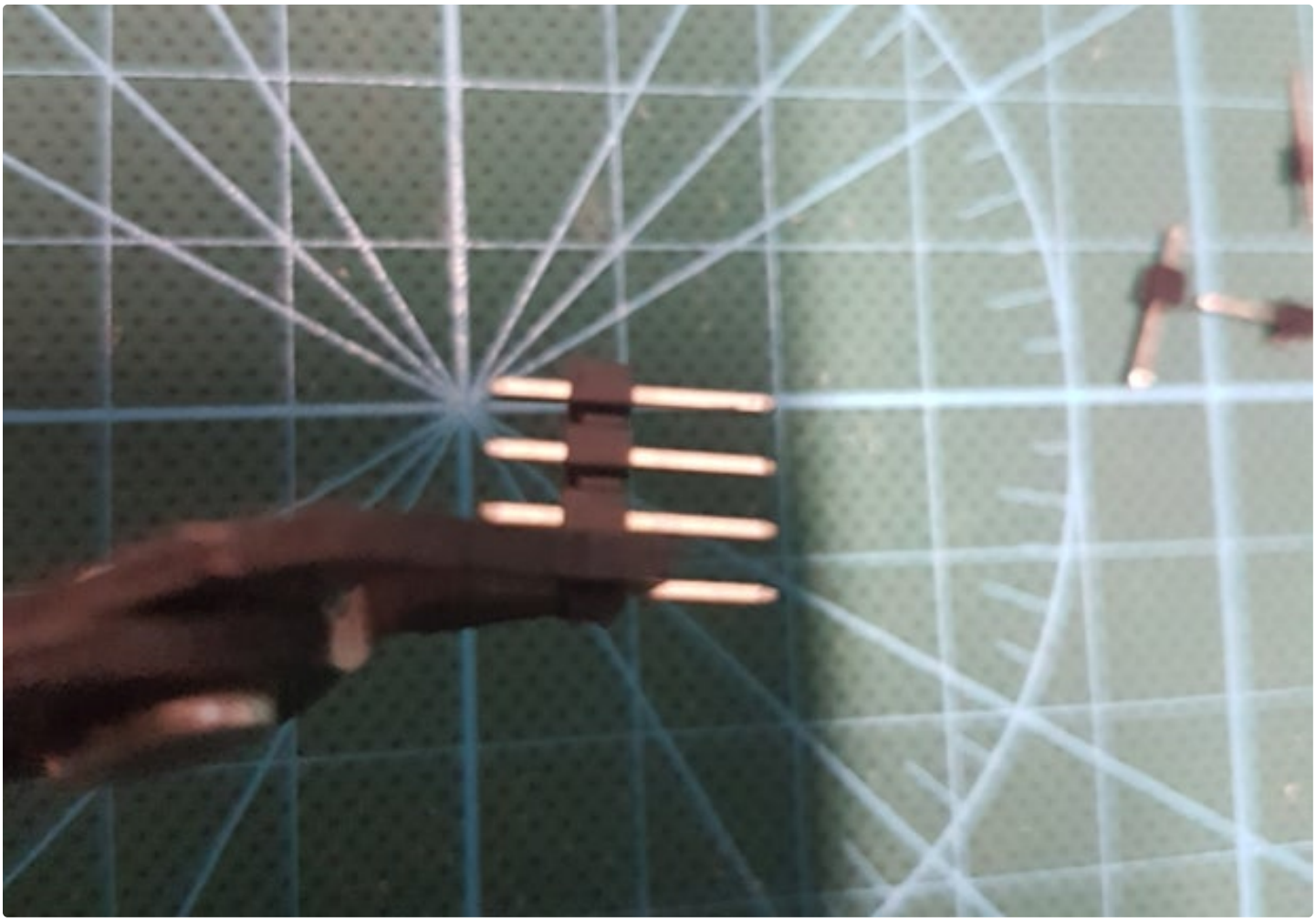
**Test**

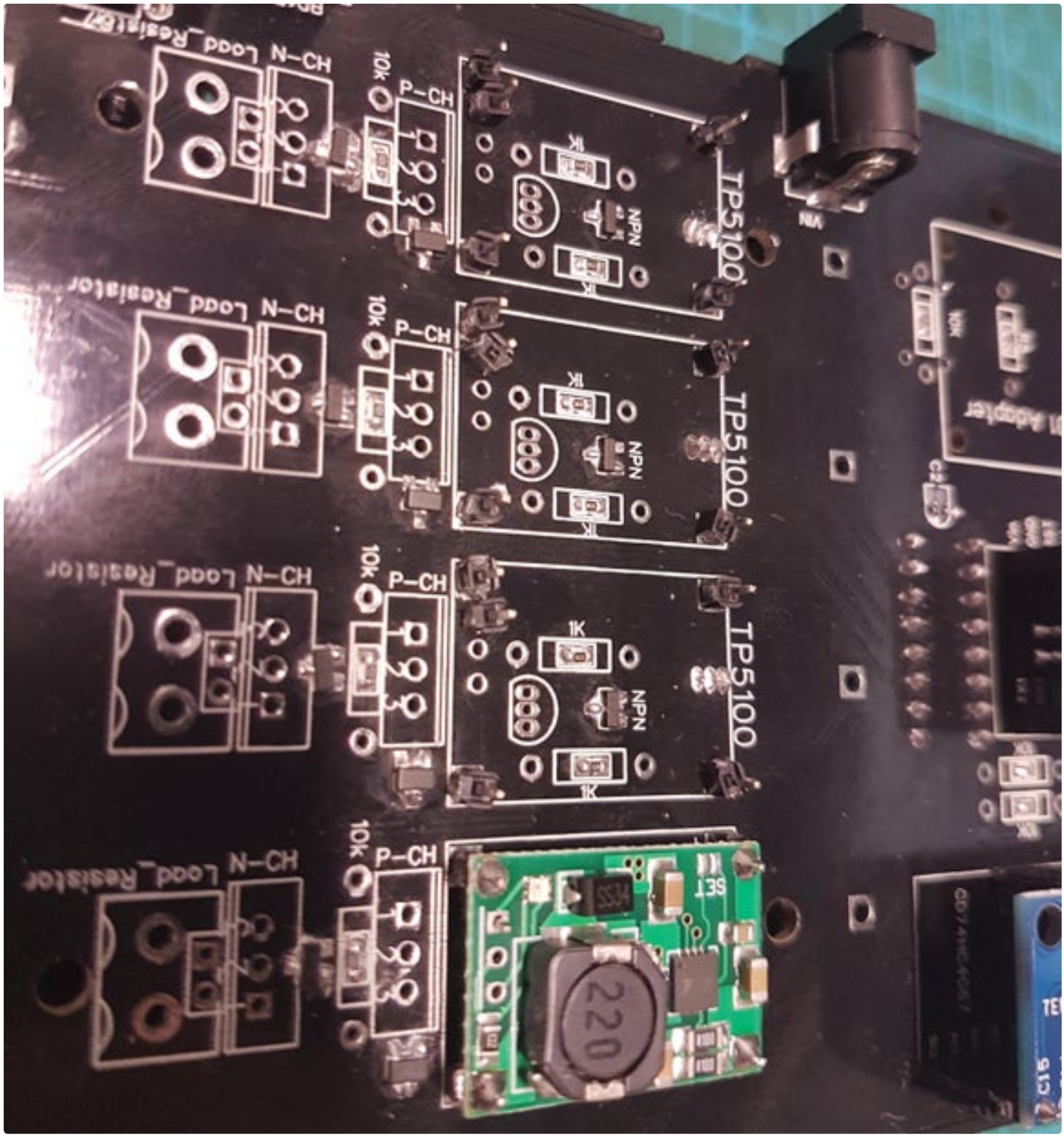
Load the Arduino Sketch from github: ASCD_Nano_Test_Charge_Discharge_Mosfets (Same as above you can use this sketch for both tests)

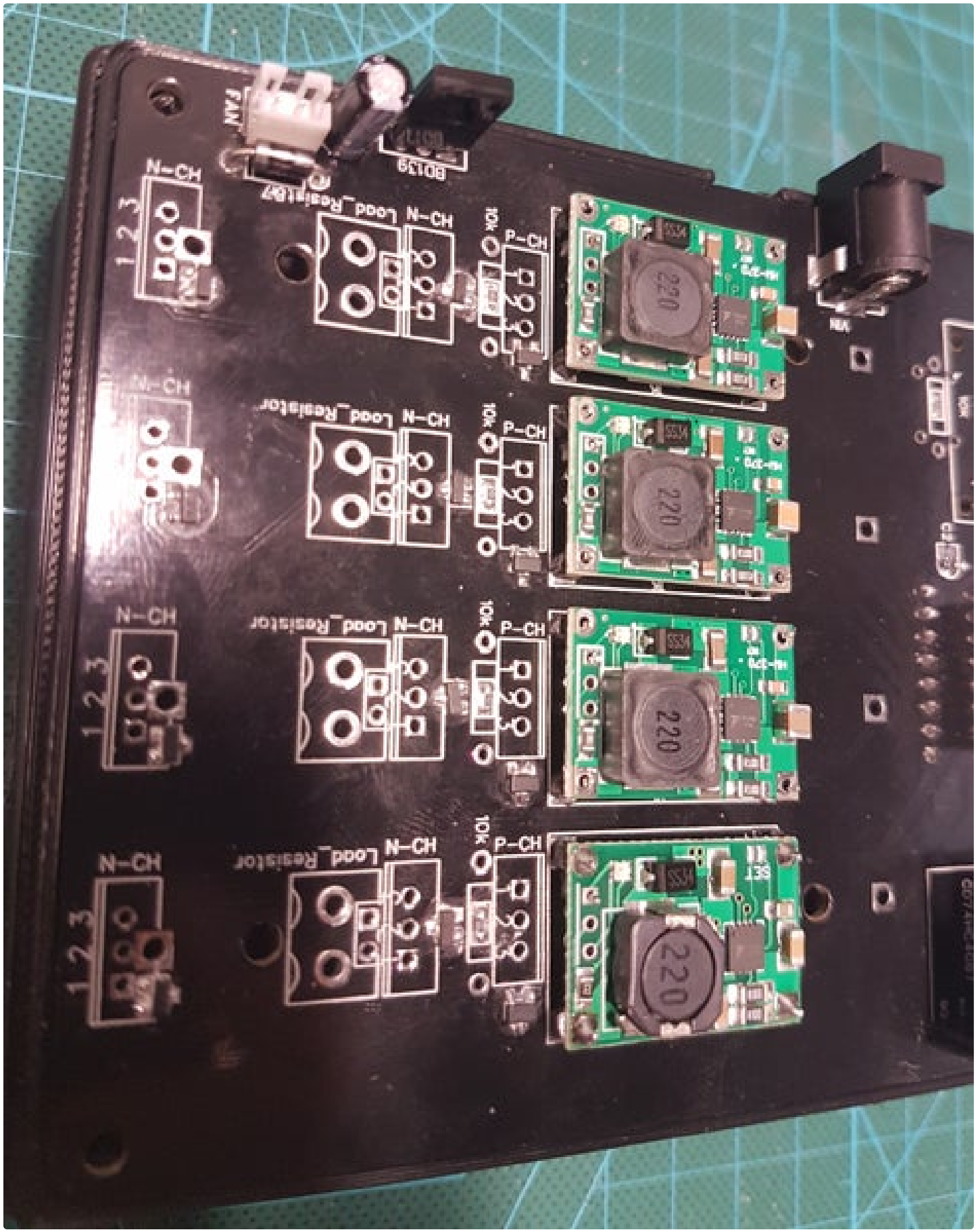
Unplug the USB cord and use a 12V power cord in the 5.5 mm DC Jack (+ positive center / - negative outer)

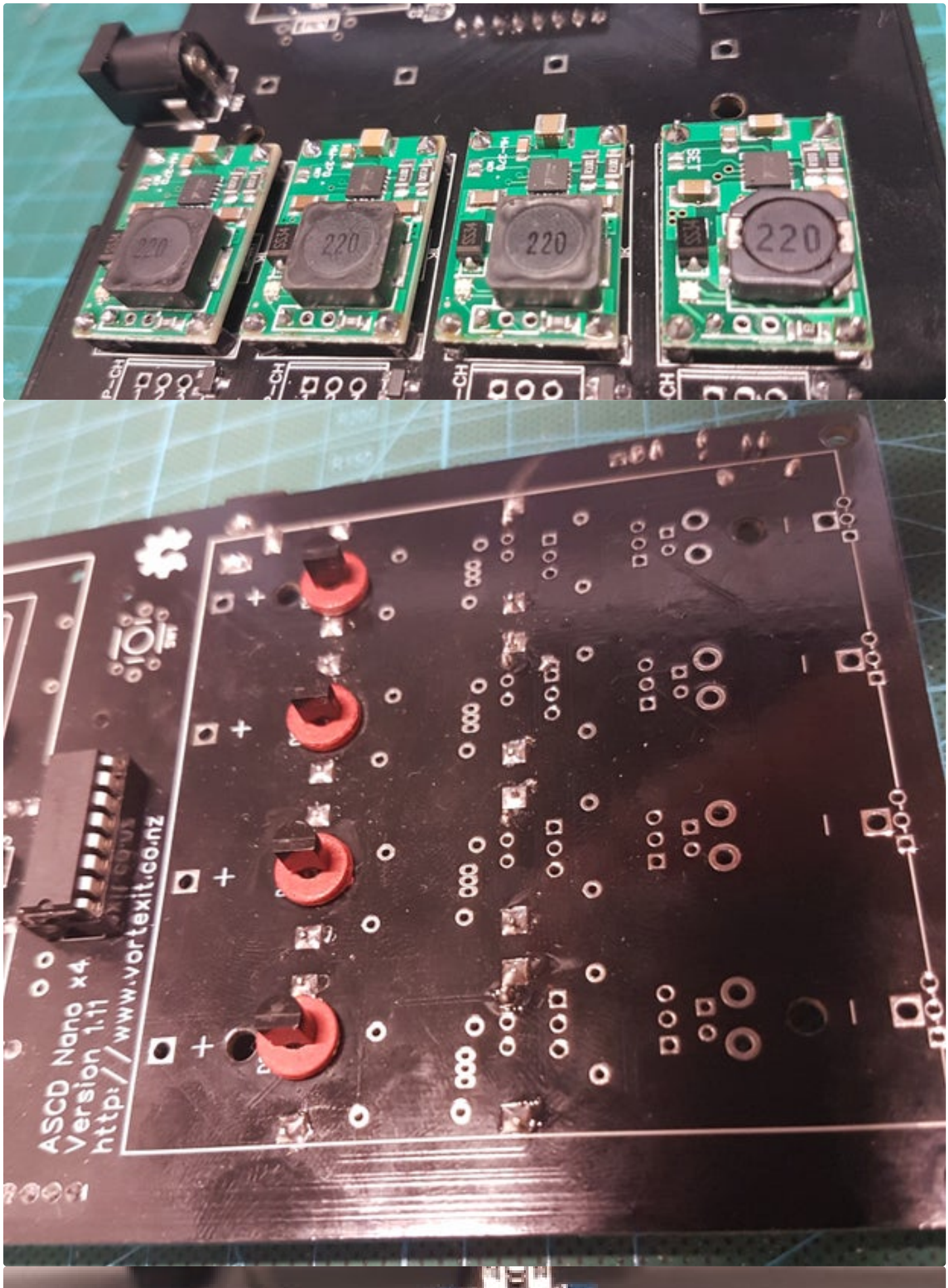
All the TP5100 modules should turn on for 1 second the turn off for 1 second.

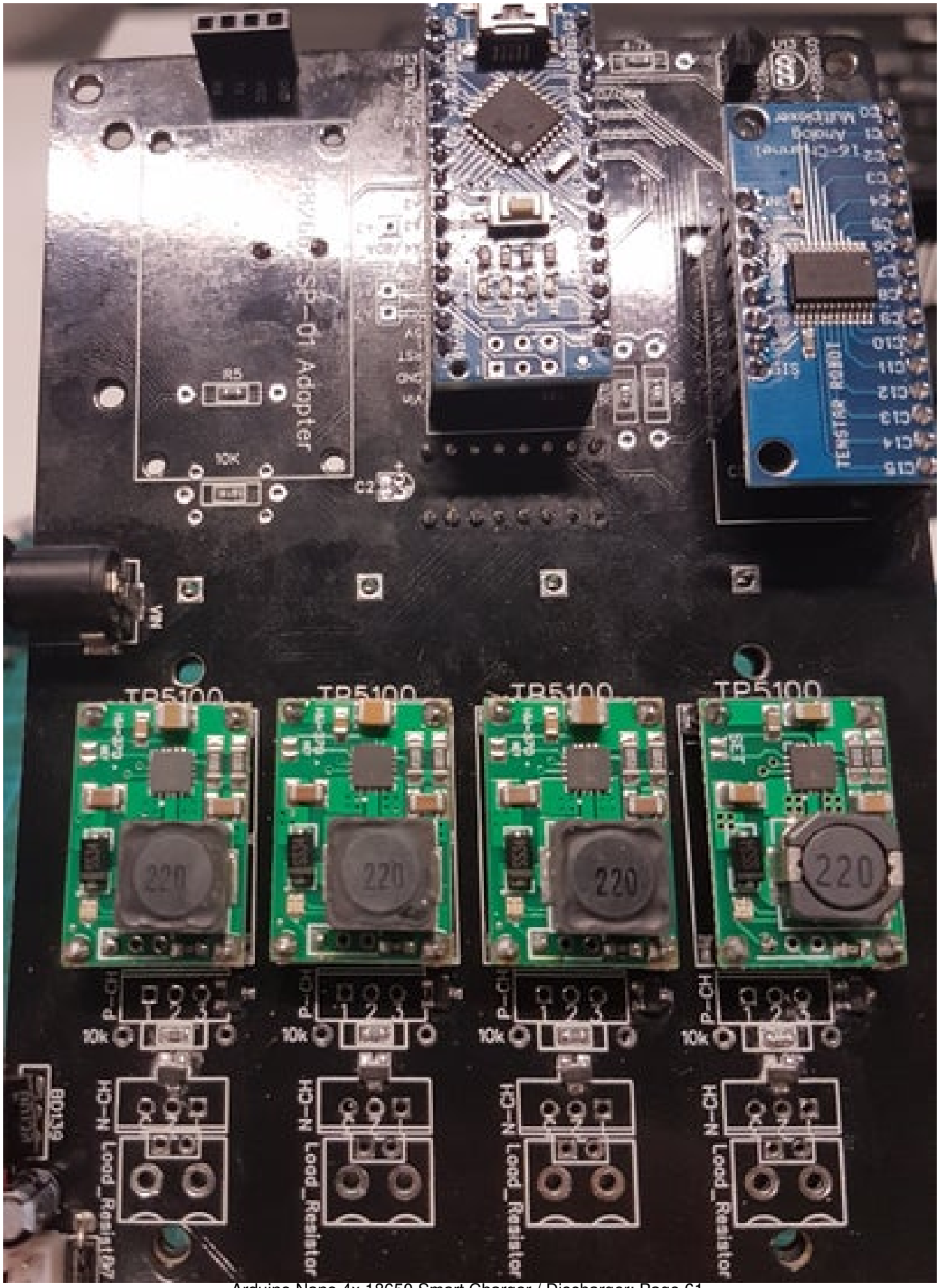

MAX.040"(1mm) DIA COPPER WIRE
NO SAFETY GLASSES
MODEL 170
SHEARS

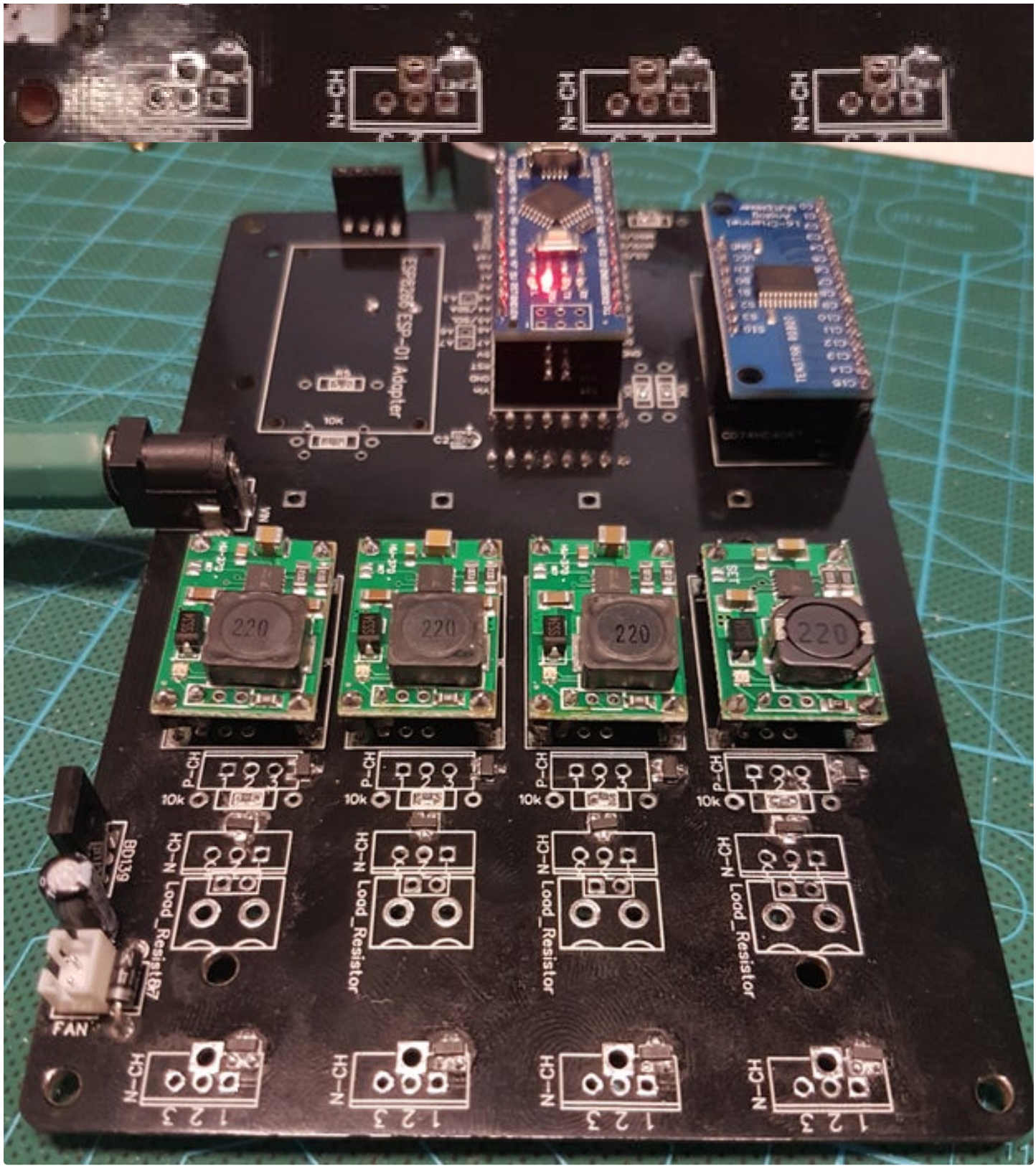


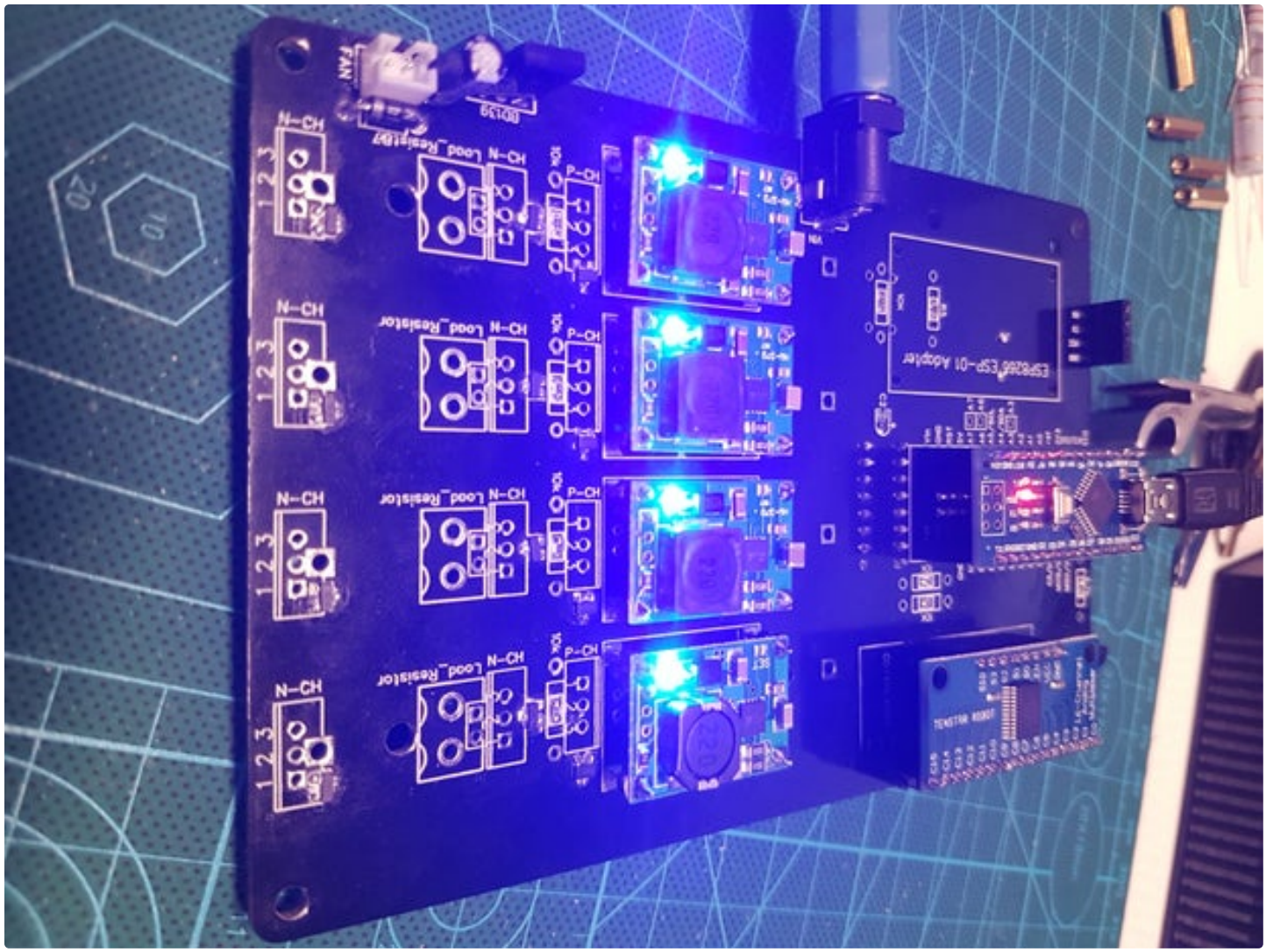

N-CH
P-CH
10k
1K
NPN
TP5100
220


FAN
BD139
N-CH
Load_Resistor
P-CH
220


220
220
220
220
ASCD Nano x4
Version 1.11
http://www.vortexit.co.nz


TP5100
TP5100
TP5100
TP5100
220
220
220
220
10k
10k
10k
10k
HI-N
HI-N
HI-N
HI-N
Load_Resistor
Load_Resistor
Load_Resistor
Load_Resistor
10K
R5
C2
TESTER ROBOT


Espressif ESP-01 Adapter
220
P-CH
10k
CH-N
Load_Resistor
FAN
1 2 3




## Step 12: Drill DS18B20 Temperature Sensor Clearance Holes

**Tools required**

- 0.7mm Drill bit or Scribe
- 3mm Drill bit (optional)
- 6.5mm - 7mm Drill bit

**Drill**

Get a spare blank PCB and a 4x 18650 Battery Holder

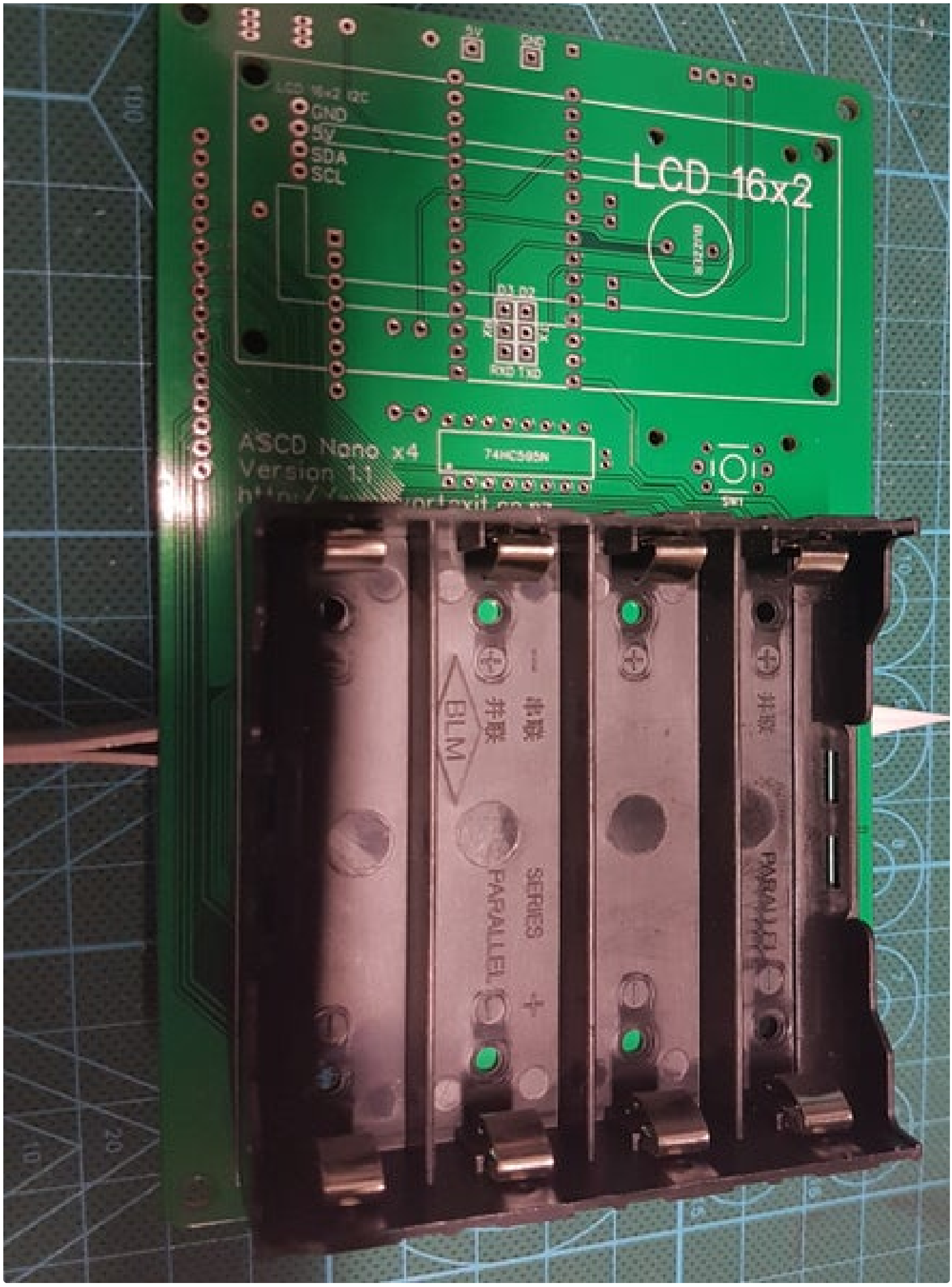
Mount the 4x 18650 Battery Holder with the + marking facing the top of the board

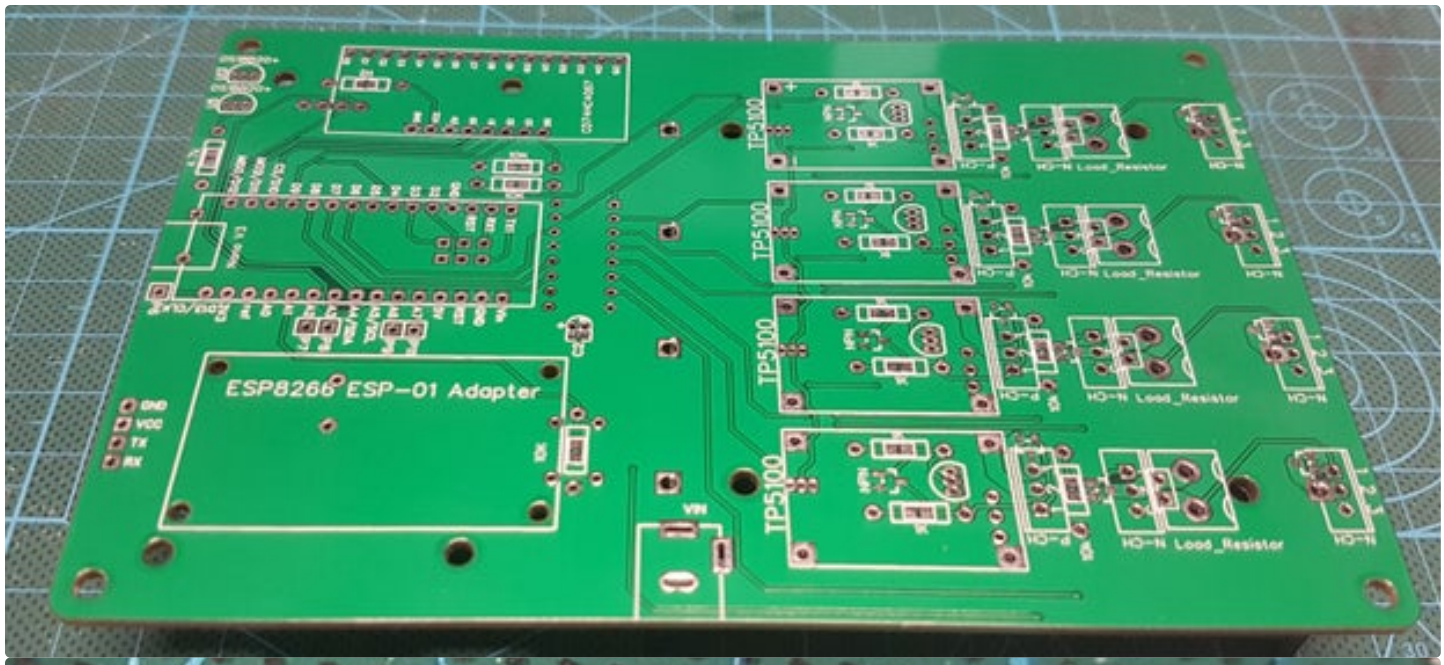
Mark the hole positions with a 0.7mm Drill bit or a Scribe via the center pin on each of the TO-92 DS18B20 Temperature Sensors

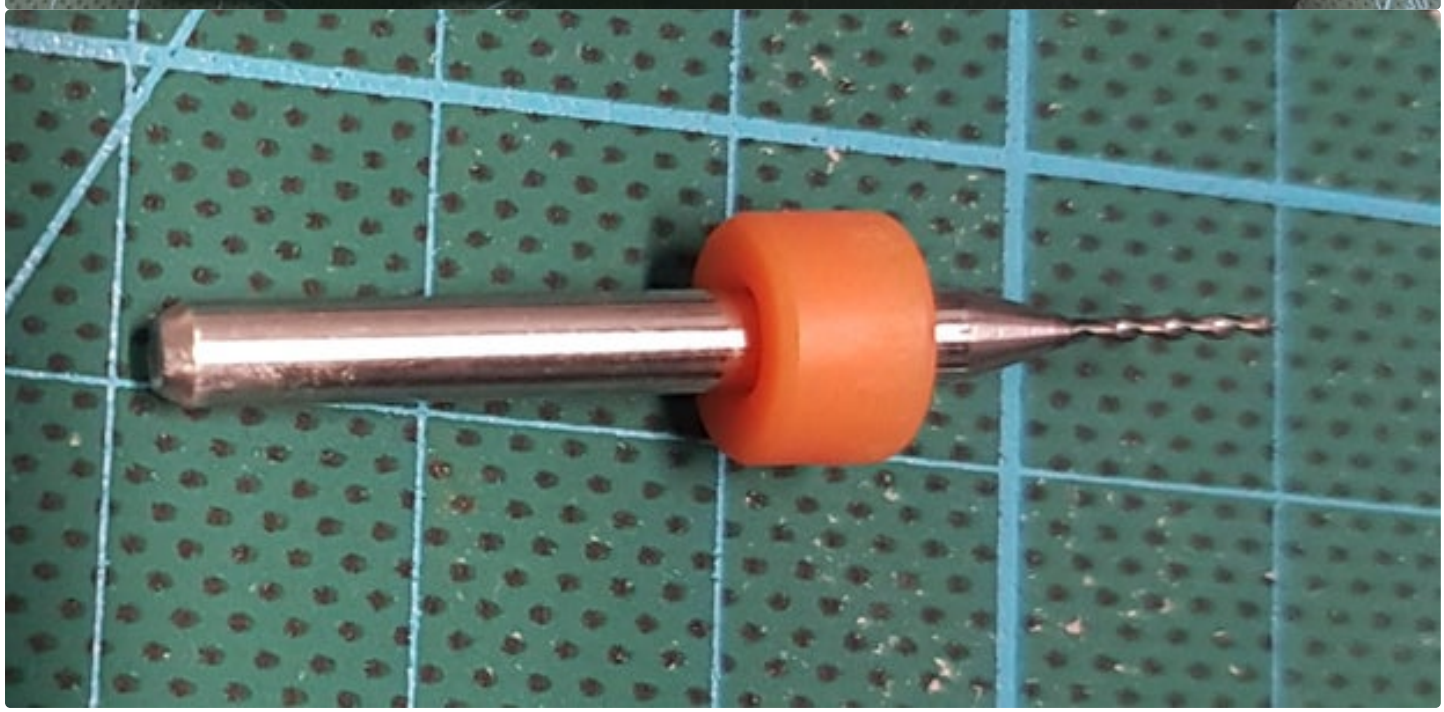
Remove the 4x 18650 Battery Holder and drill a 6.5mm - 7mm hole. I recommend using a smaller drill bit first.

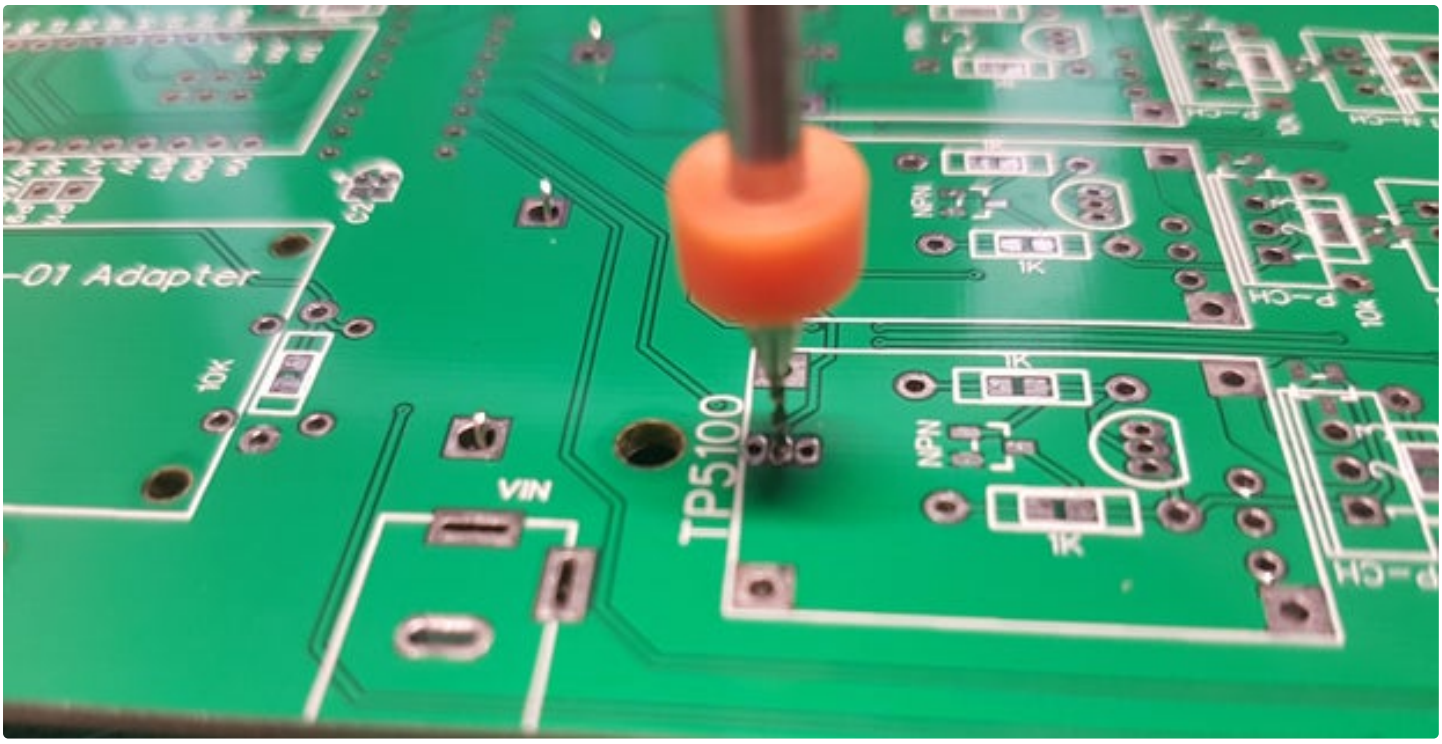
Test fit the 4x 18650 Battery Holder and see if the DS18B20 Temperature Sensor have sufficient clearance.

Note: Do not solder the 4x 18650 Battery Holder until all other components have been soldered.

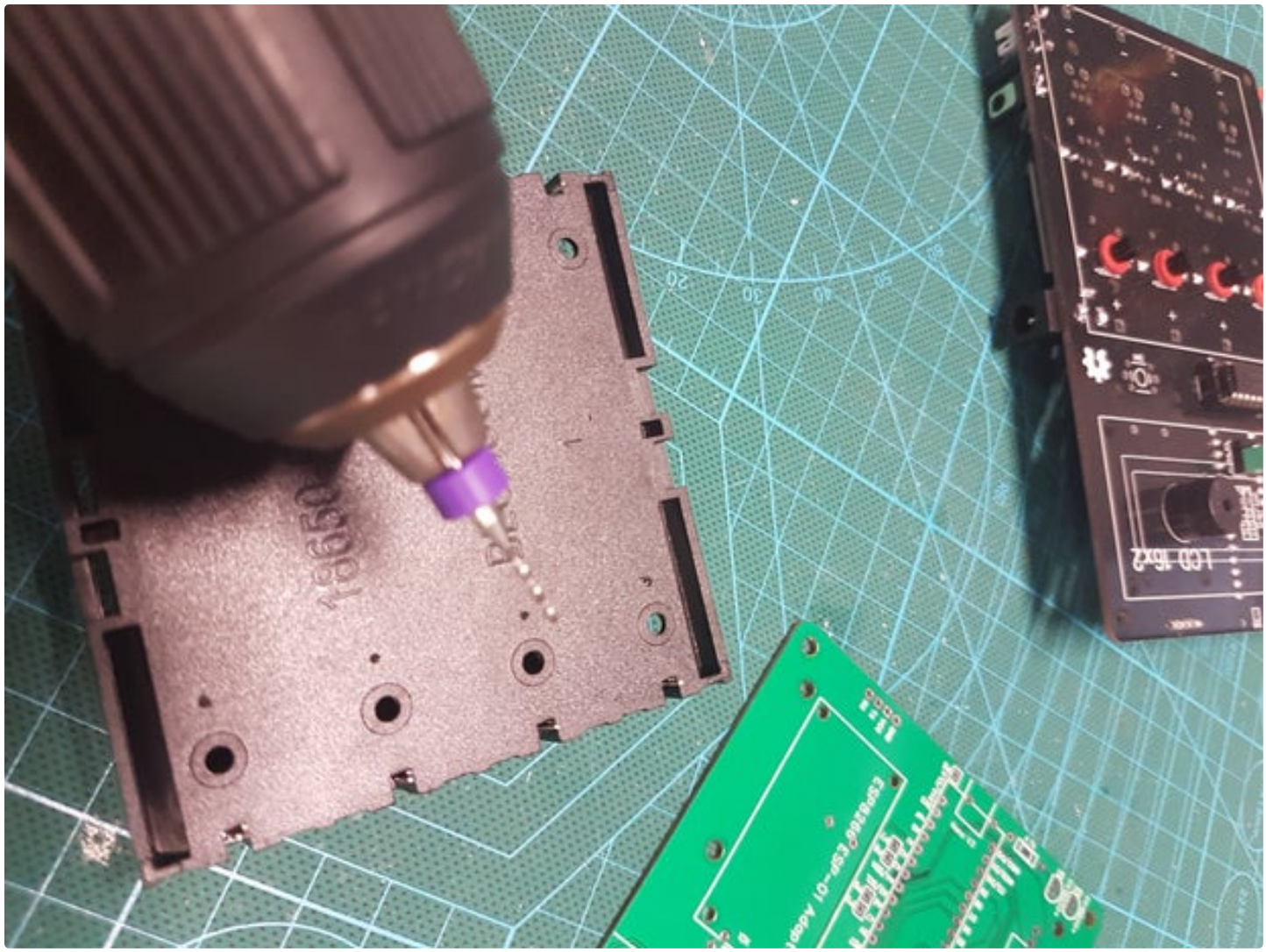

LCD 16x2 I2C
GND
5V
SDA
SCL
LCD 16x2
ASCD Nano x4
Version 1.1
74HC595N
BLM
SERIES
PARALLEL
PARALLEL

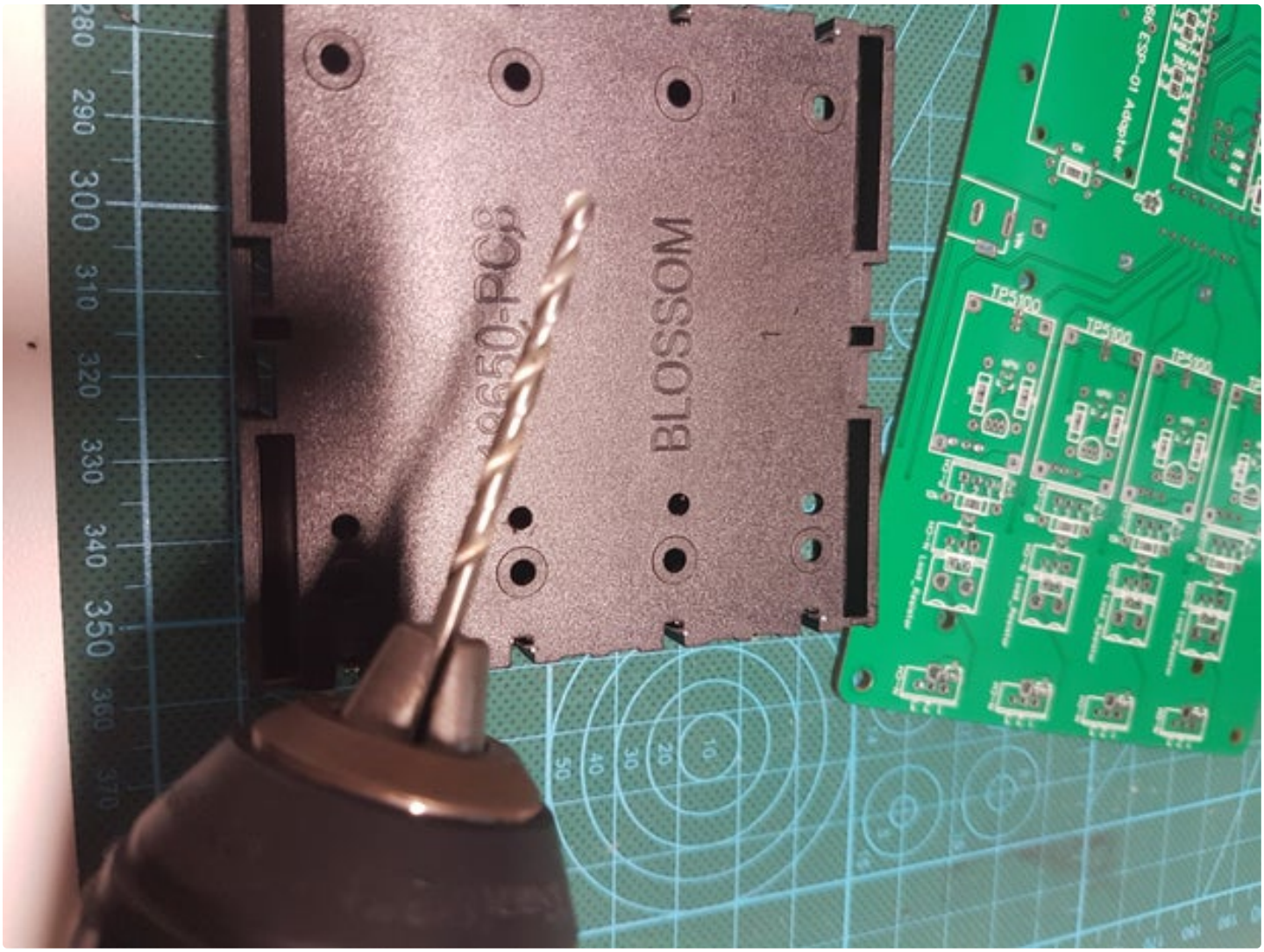

ESP8266 ESP-01 Adapter
GND
VCC
TX
RX
TP5100
TP5100
TP5100
TP5100
VIN
HD-N Load_Resistor
HD-N Load_Resistor
HD-N Load_Resistor
HD-N Load_Resistor

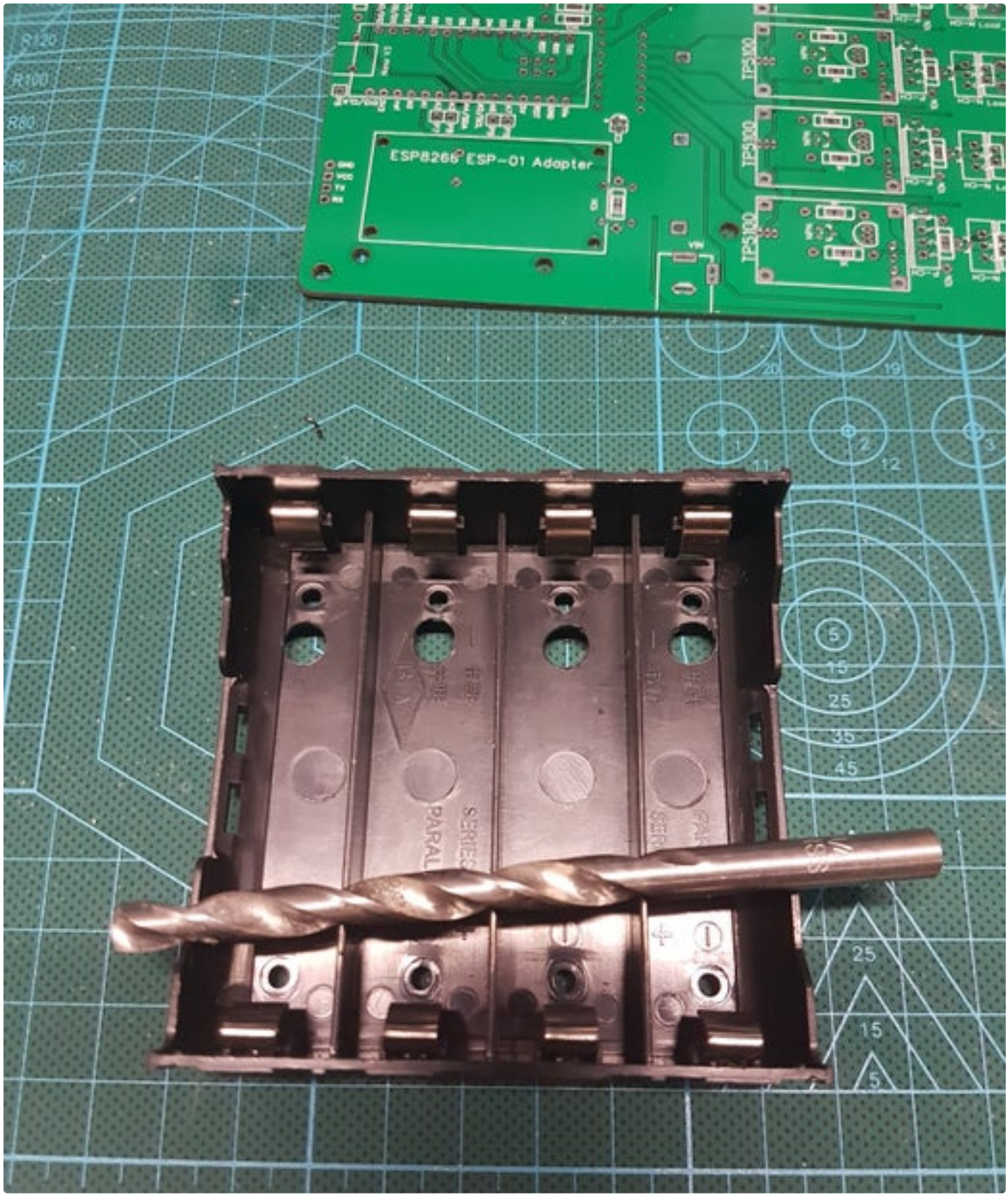


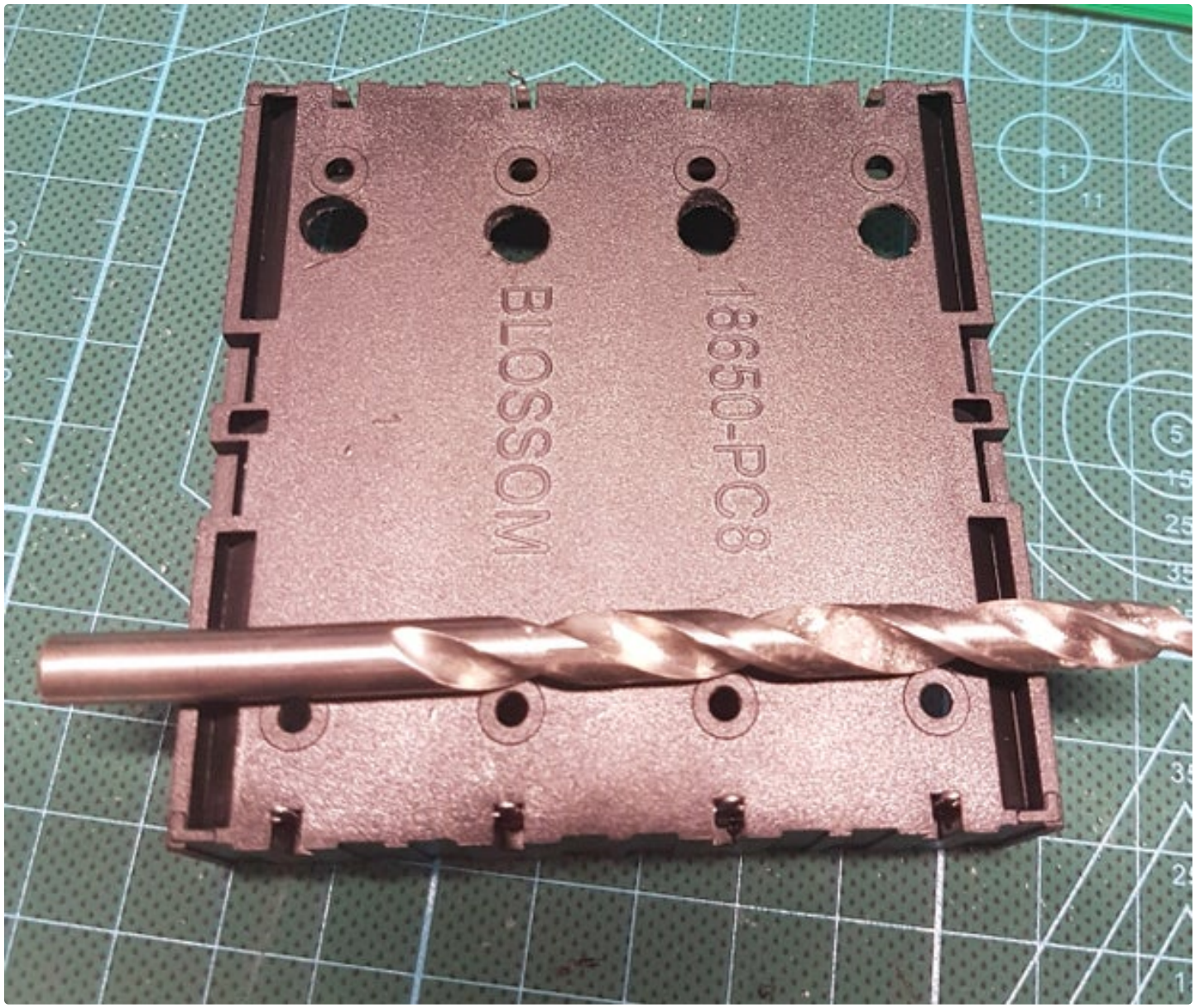

-01 Adapter
10k
VIN
TP5100
NPN
1K
NPN
1K


BLOSSOM
18650-PCB




BLOSSOM


ESP8266 ESP-01 Adapter
TP5100
TP5100
TP5100
SERIES
PARAL


BLOSSOM
18650-PC8


## Step 13: Mount the Discharge Resistors

**Mount and Solder Headers**

First mount the headers. You can either use the 5.08mm Screw Terminal or JST 2.54mm Male Header.

*Note: I use some blu tack to hold the header / terminal in place while soldering.*

Solder them in.

#### Measure Ohms of Resistors (Optional)

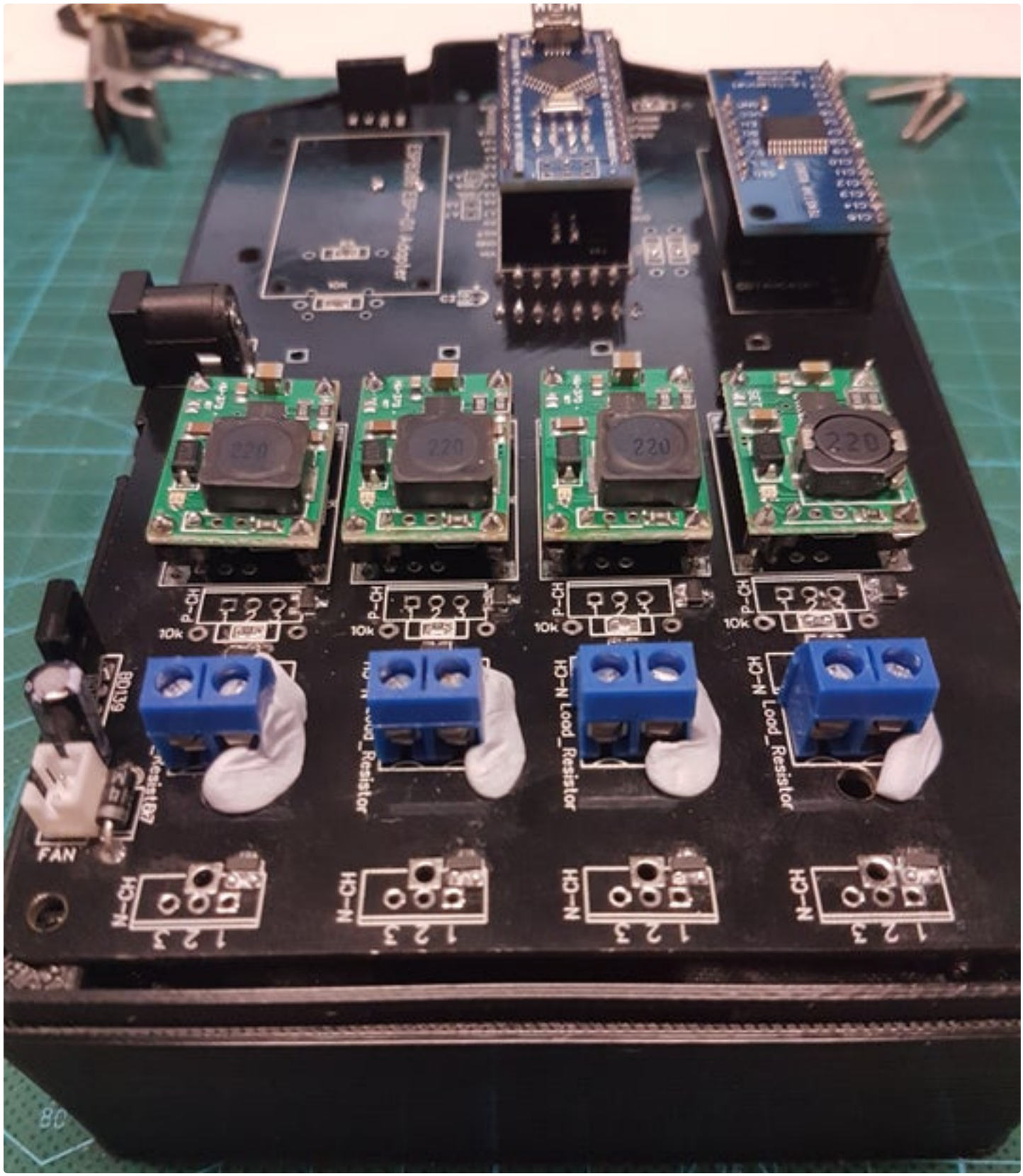
Measure, number and log the resistance of each resistor.

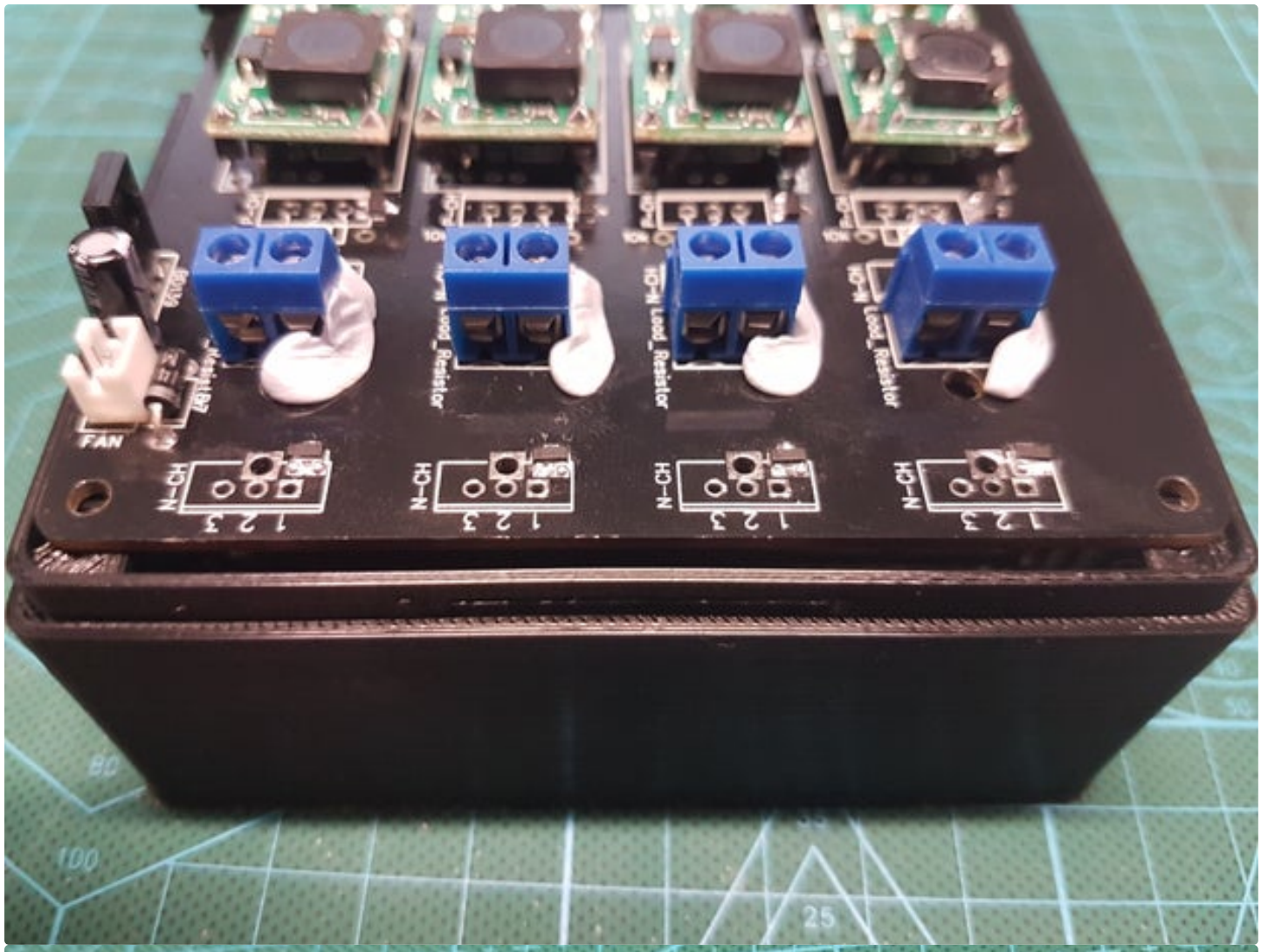
I use my LCR-T4 Tester for this. You could use a quality multi-meter (this is not 100% accurate but is a good base measurement)

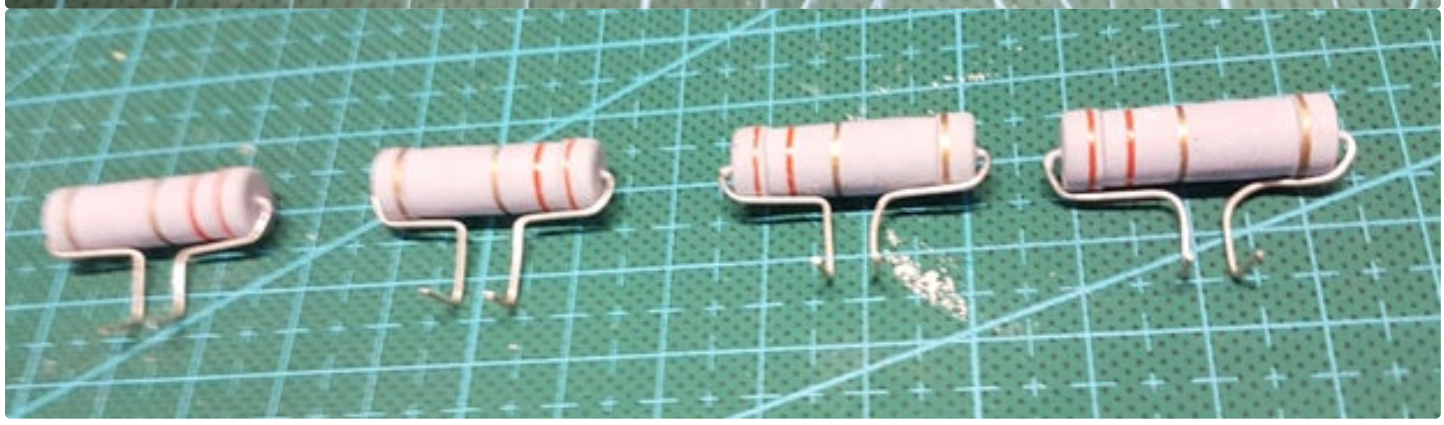
Edit the Arduino Sketch from github: ASCD_Nano_1-0-0 add in the amended resistor values.

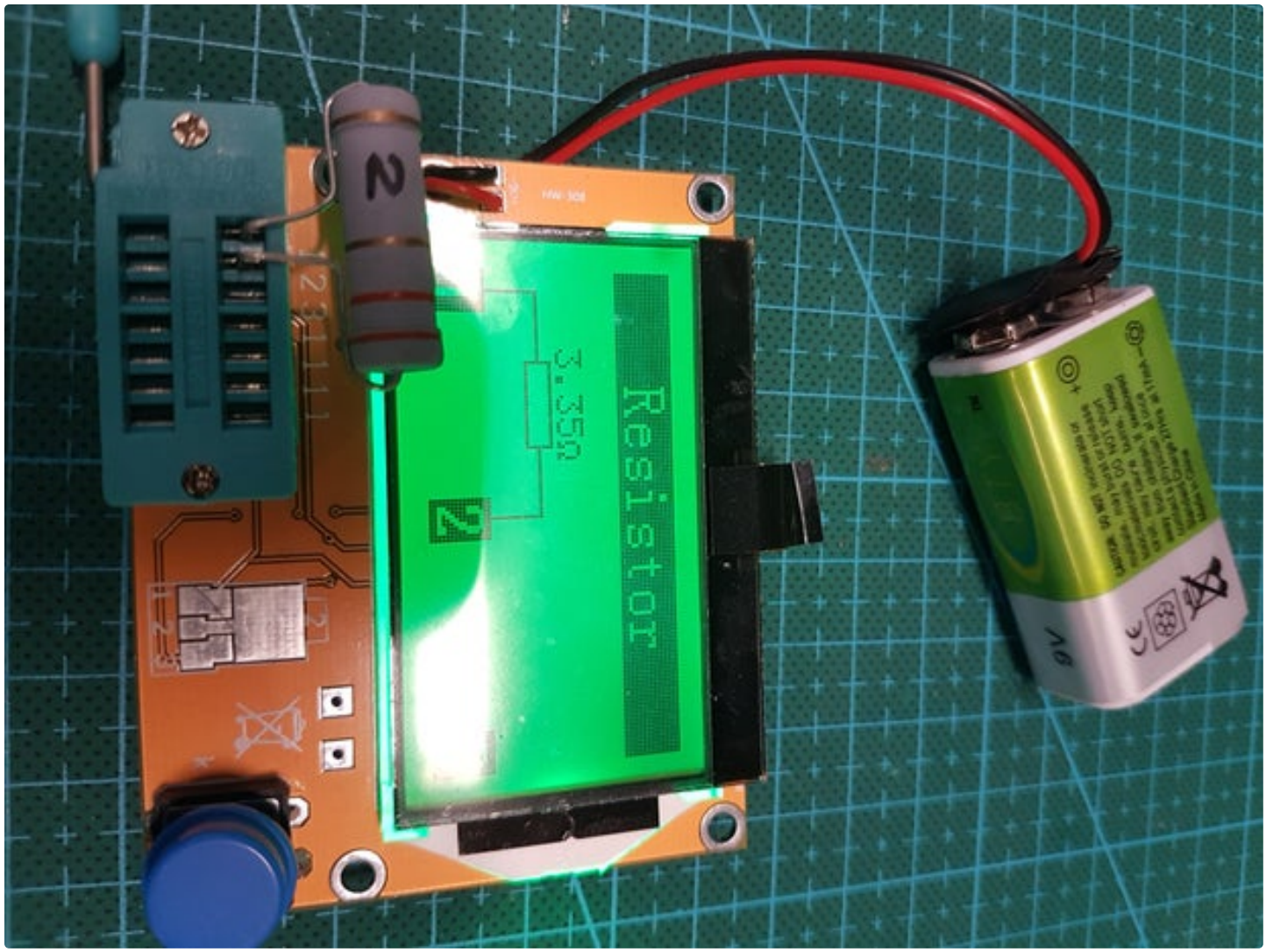
#### Mount the Resistors

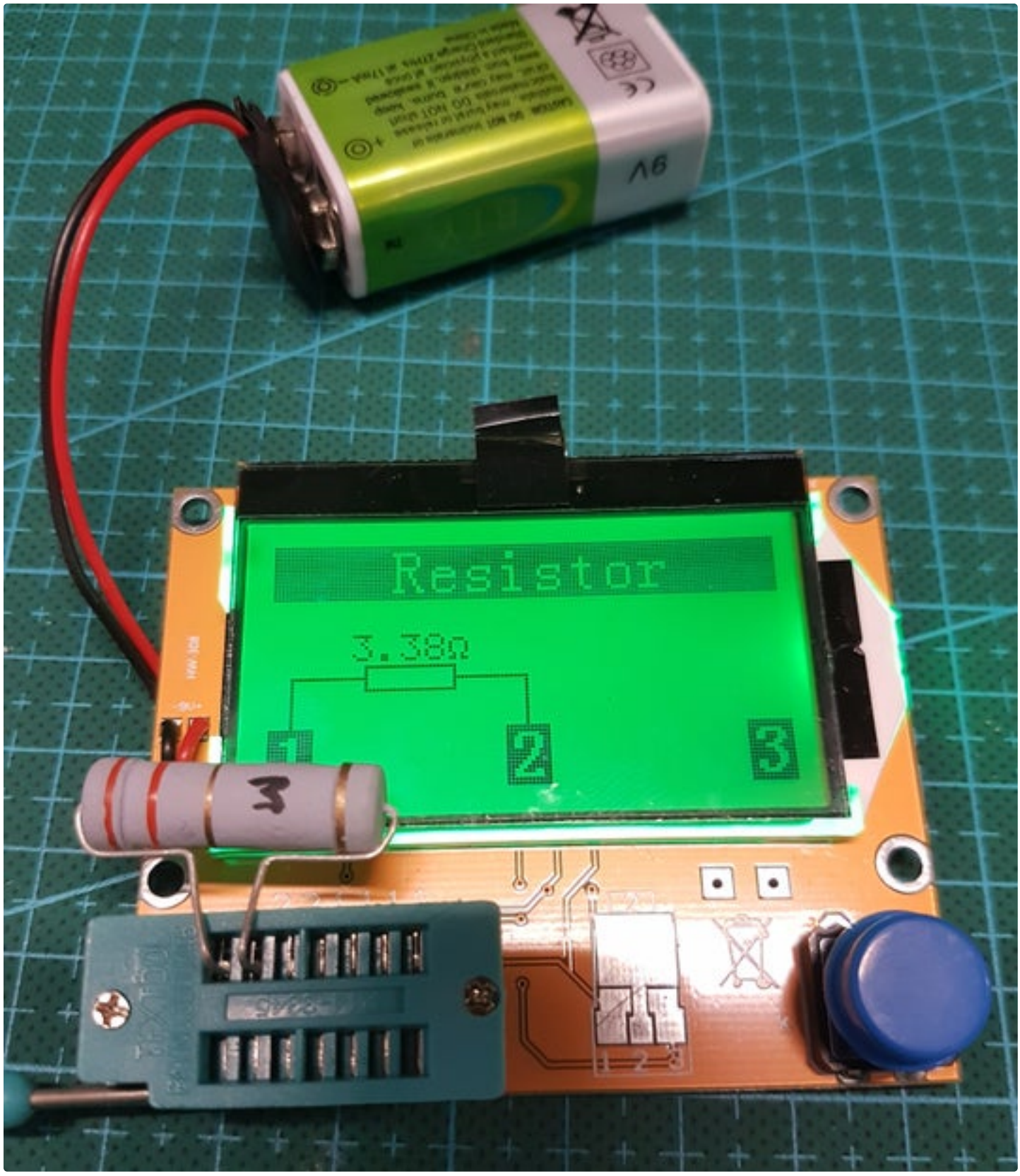
In this example I am using the 5.08mm Screw Terminals and I am staggering each wire wound resistor. Later I will add steps for aluminium clad resistors on a heat-sink.

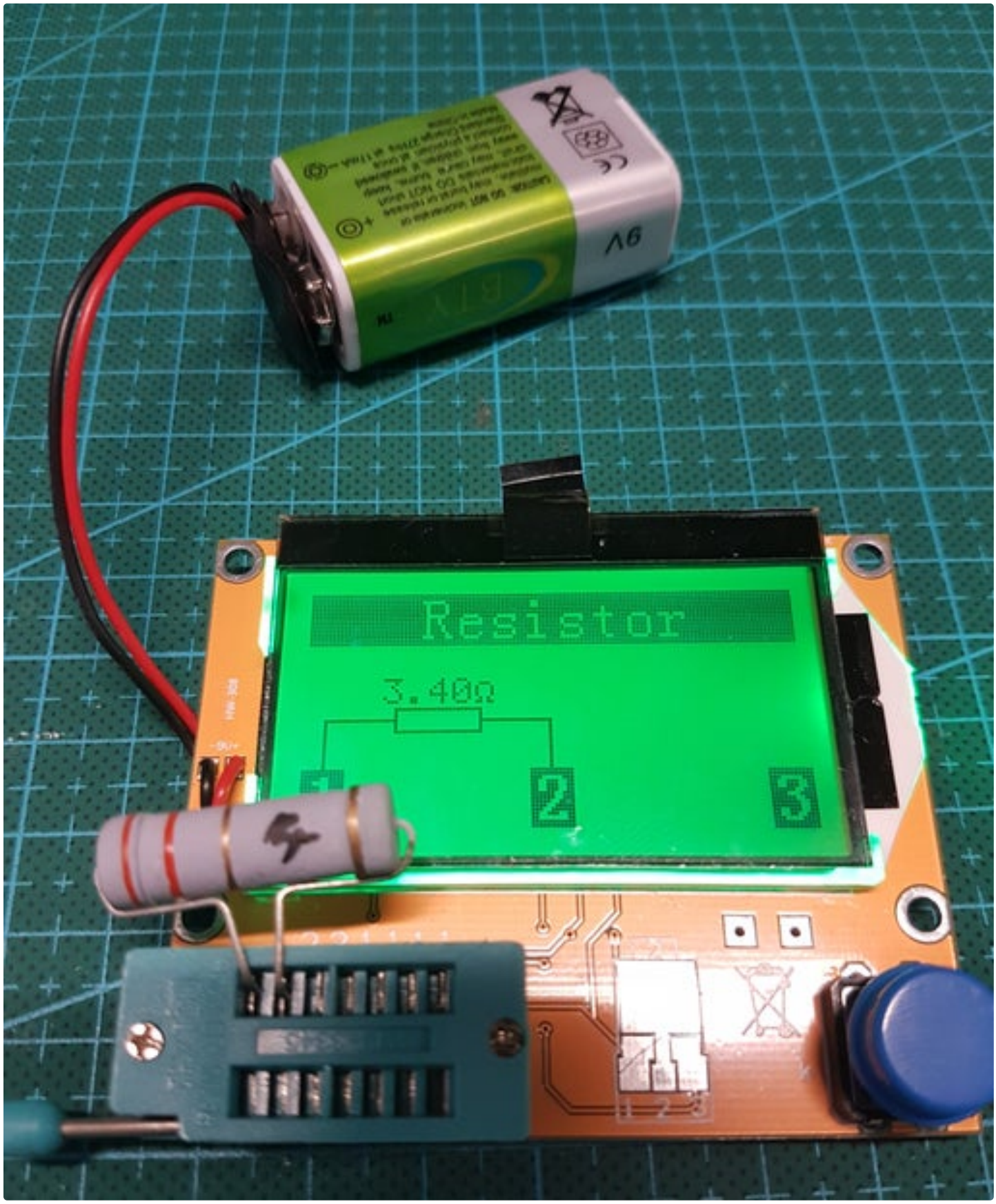

220
220
220
220
10k
10k
10k
10k
FAN
BD139
Resistor
Load_Resistor
Load_Resistor
Load_Resistor
HCH-N
HCH-N
HCH-N
HCH-N
1 2 3
1 2 3
1 2 3
1 2 3

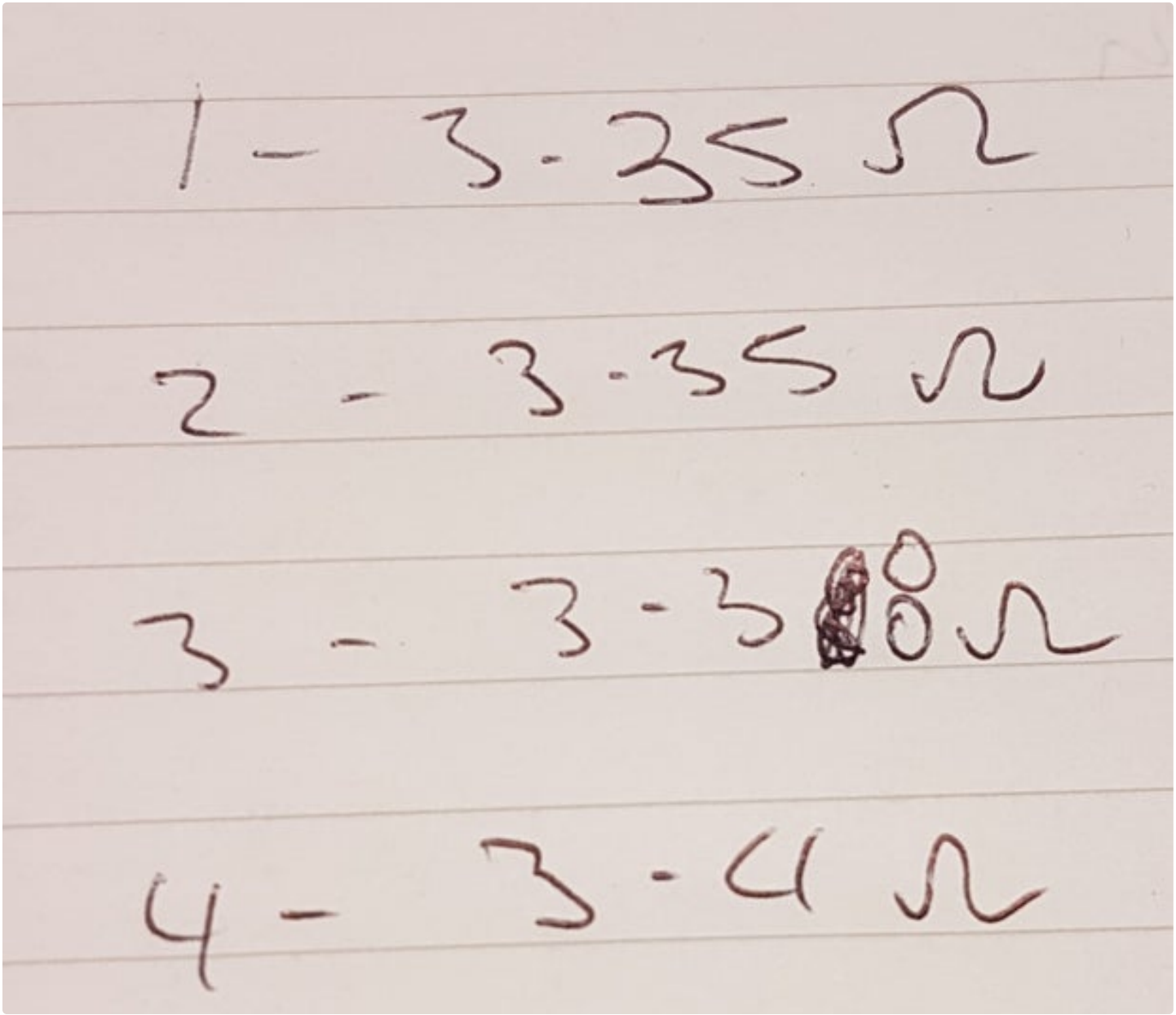

FAN
CH-1 Load_Resistor
CH-2 Load_Resistor
CH-3 Load_Resistor
CH-4 Load_Resistor
CH-1
CH-2
CH-3
CH-4

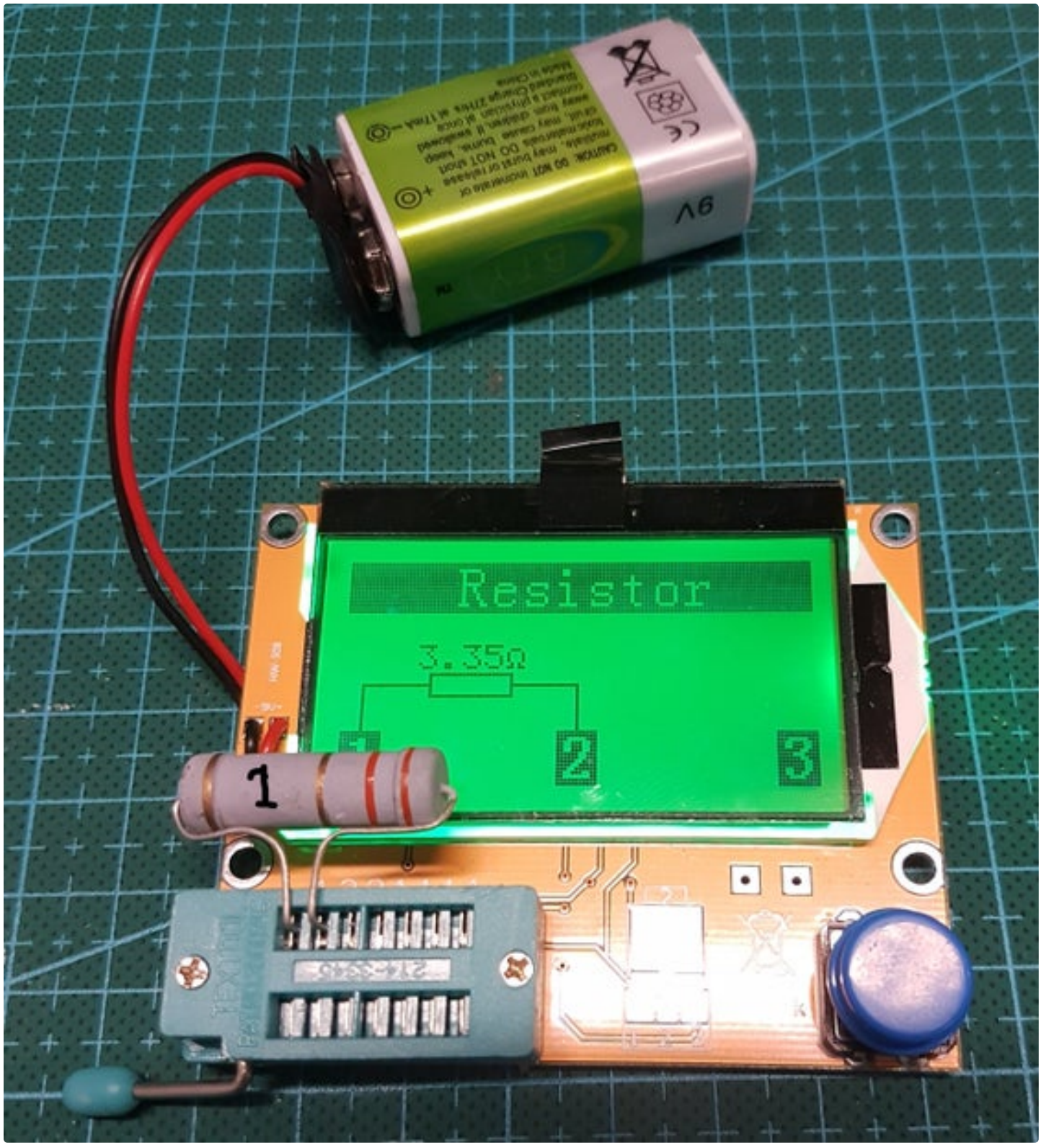


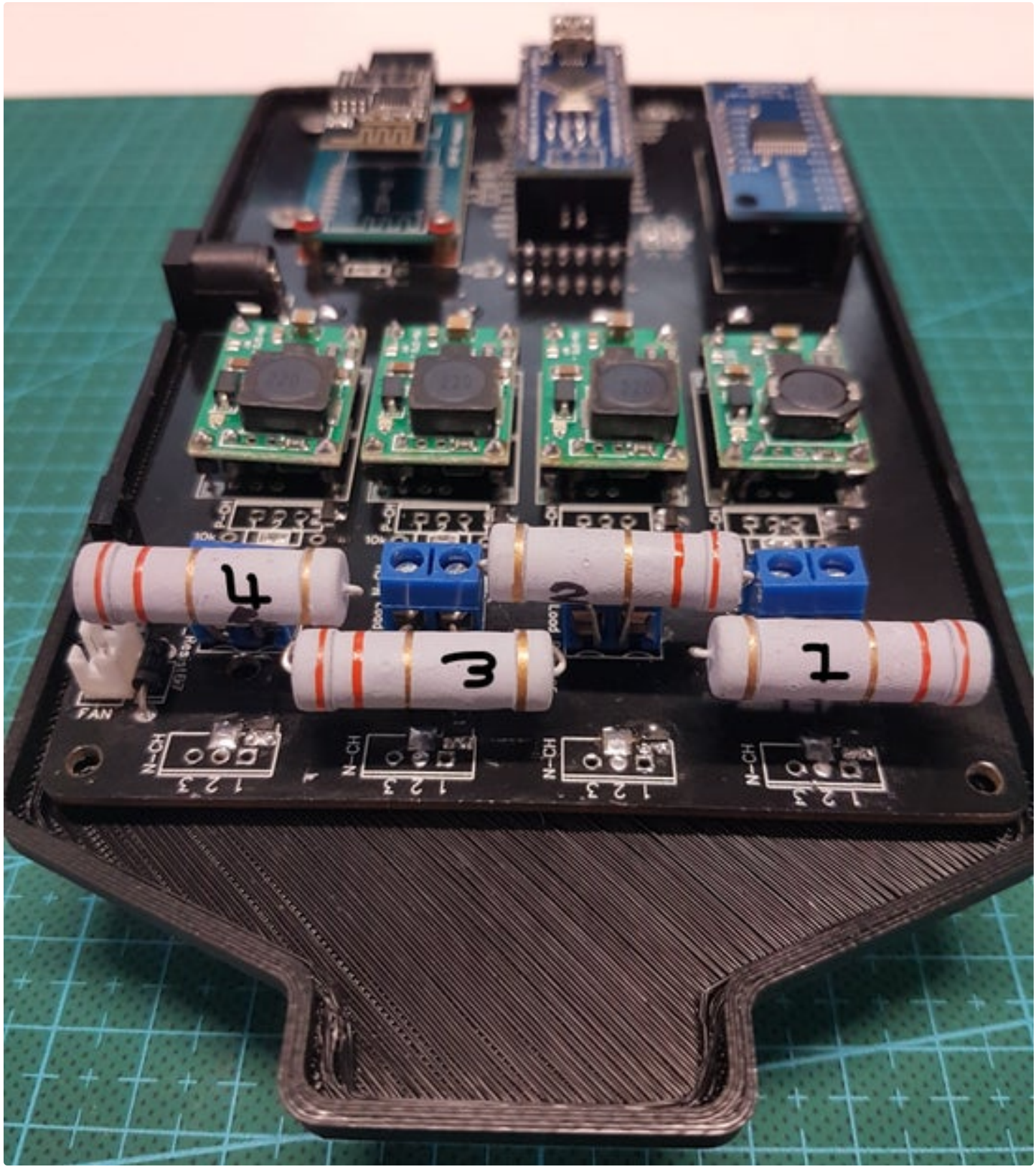

Resistor
3.35


9V
Resistor
3.38Ω
1
2
3


9V
Resistor
3.40Ω
1
2
3


1 - 3.35 Ω
2 - 3.35 Ω
3 - 3.3[illegible] Ω
4 - 3.4 Ω


9V
Resistor
3.35Ω
1
2
3
1


4
3
1
FAN
1 2 3
1 2 3
1 2 3
1 2 3

ASCD_Nano_1-0-0 | Arduino 1.8.7

File Edit Sketch Tools Help

ASCD_Nano_1-0-0 §

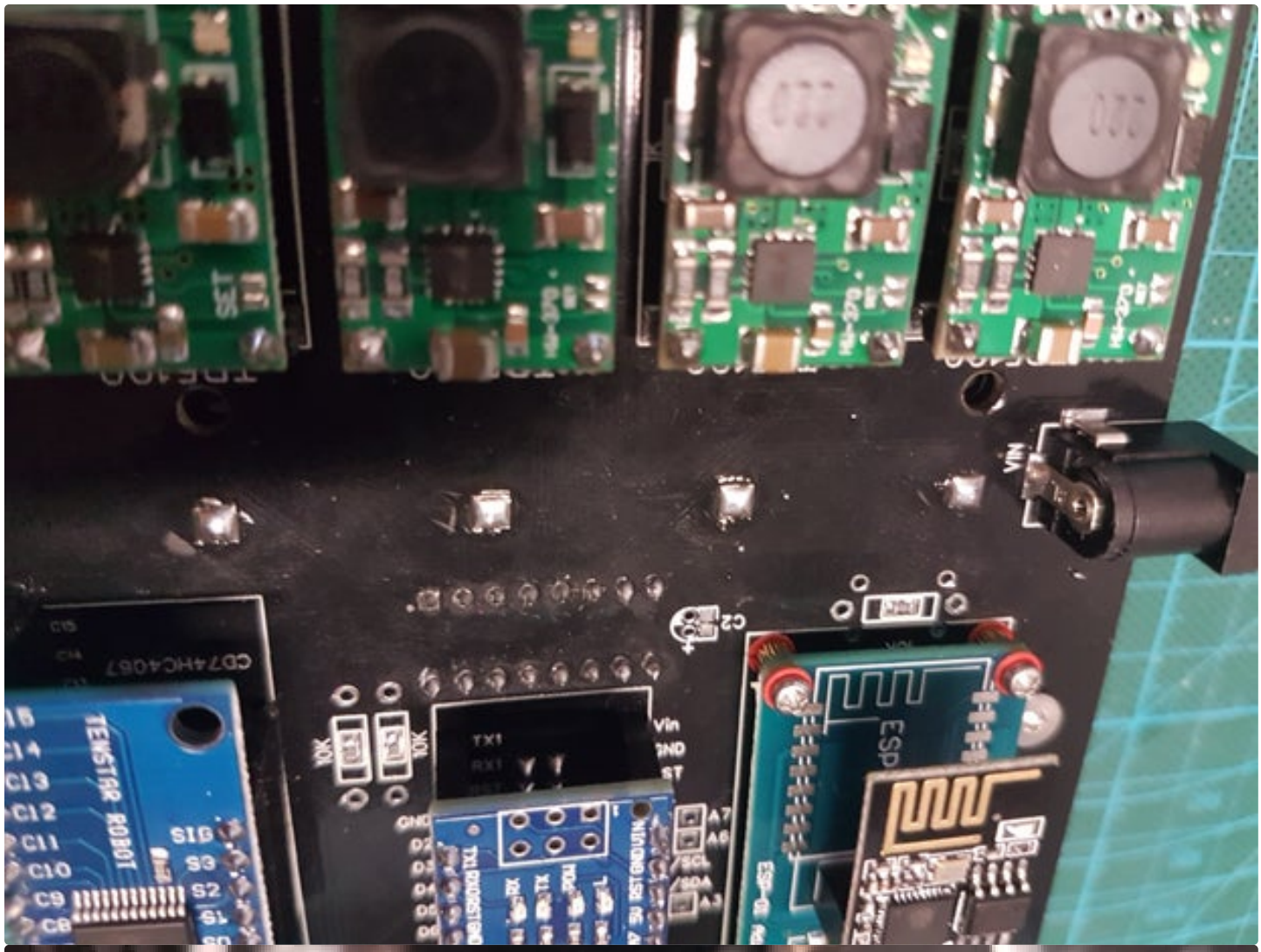
```
  int intMilliSecondsCount;
  unsigned long longMilliSecondsPreviousCount;
  unsigned long longMilliSecondsPrevious;
  unsigned long longMilliSecondsPassed;
  float dischargeMilliamps;
  float dischargeVoltage;
  float dischargeAmps;
  bool dischargeCompleted;
  int dischargeMinutes;
  bool pendingDischargeRecord;
} Modules;

Modules module[4] =
  {
    {{1, 1, 0, 1}, {1, 1, 1, 1}, {0, 1, 0, 1}, 0, 1},
    {{1, 0, 0, 1}, {0, 1, 1, 1}, {0, 0, 0, 1}, 2, 3},
    {{1, 1, 1, 0}, {1, 0, 1, 1}, {0, 1, 1, 0}, 4, 5},
    {{1, 0, 1, 0}, {0, 0, 1, 1}, {0, 0, 1, 0}, 6, 7}};

typedef struct
{
  const float shuntResistor[4] = {3.33, 3.35, 3.38, 3.4};
  const float referenceVoltage = 5.01;       // 5V Output of Arduino
  const float defaultBatteryCutOffVoltage = 2.8; // Voltage that the discharge stops
  const byte restTimeMinutes = 1;          // The time in Minutes to rest the battery after charge. 0-59 are valid
  const int lowMilliamps = 1000;           //  This is the value of Milli Amps that is considered low and does not get recharged because it is considered faulty
  const int highMilliOhms = 500;           //  This is the value of Milli Ohms that is considered high and the battery is considered faulty
  const int offsetMilliOhms = 0;           // Offset calibration for MilliOhms
  const byte chargingTimeout = 8;          // The timeout in Hours for charging
  const byte tempThreshold = 7;          // Warning Threshold in degrees above initial Temperature
  const byte tempMaxThreshold = 20;        //Maximum Threshold in degrees above initial Temperature - Considered Faulty
  const float batteryVolatgeLeak = 0.50;       // On the initial screen "BATTERY CHECK" observe the highest voltage of each module and set this value slightly higher
  const byte moduleCount = 4;            // Number of Modules
  const byte screenTime = 4;             // Time in Seconds (Cycles) per Active Screen
  const int dischargeReadInterval = 5000;      // Time intervals between Discharge readings. Adjust for mAh +/-
} CustomSettings;
```

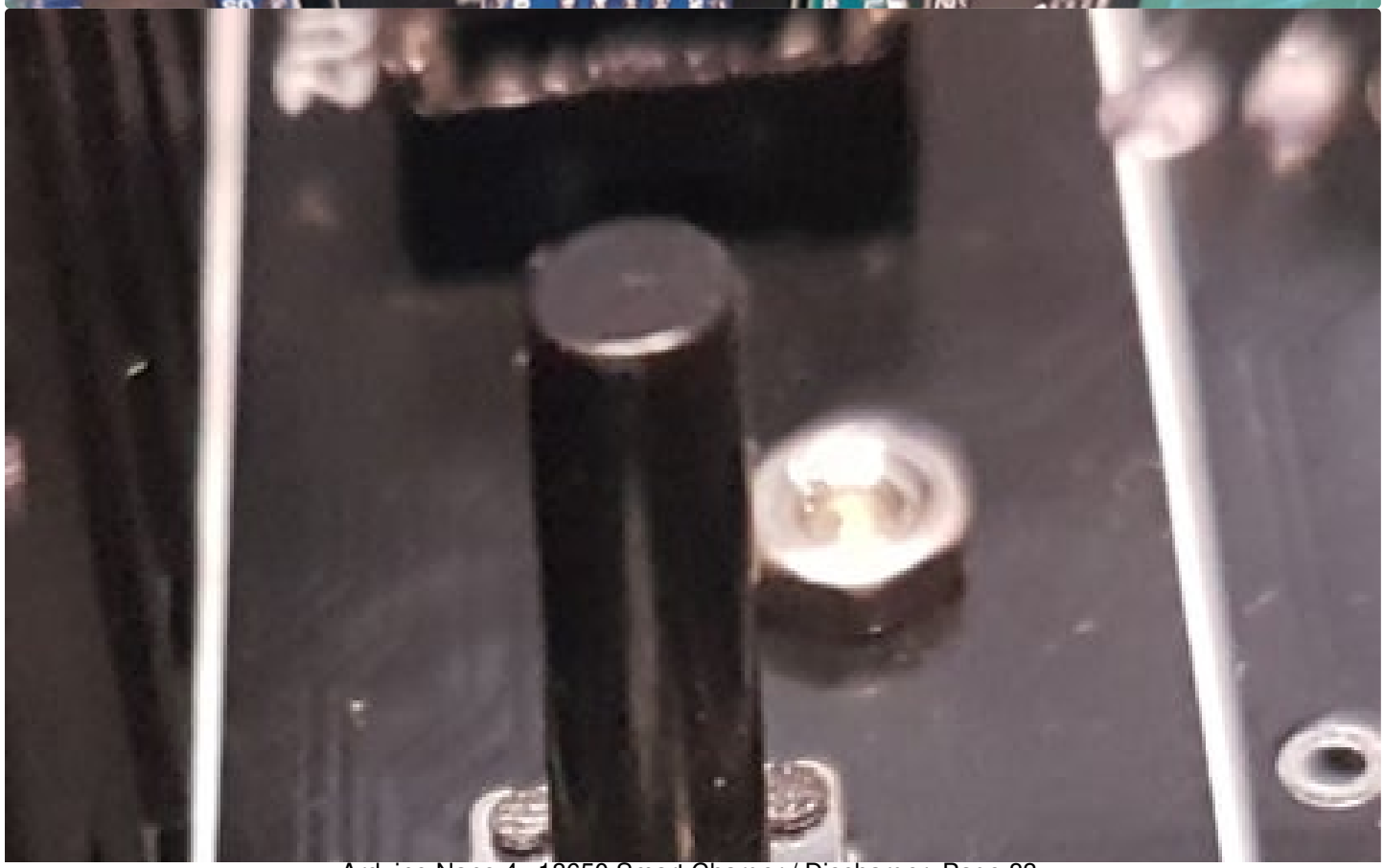
## Step 14: Solder the Final Components

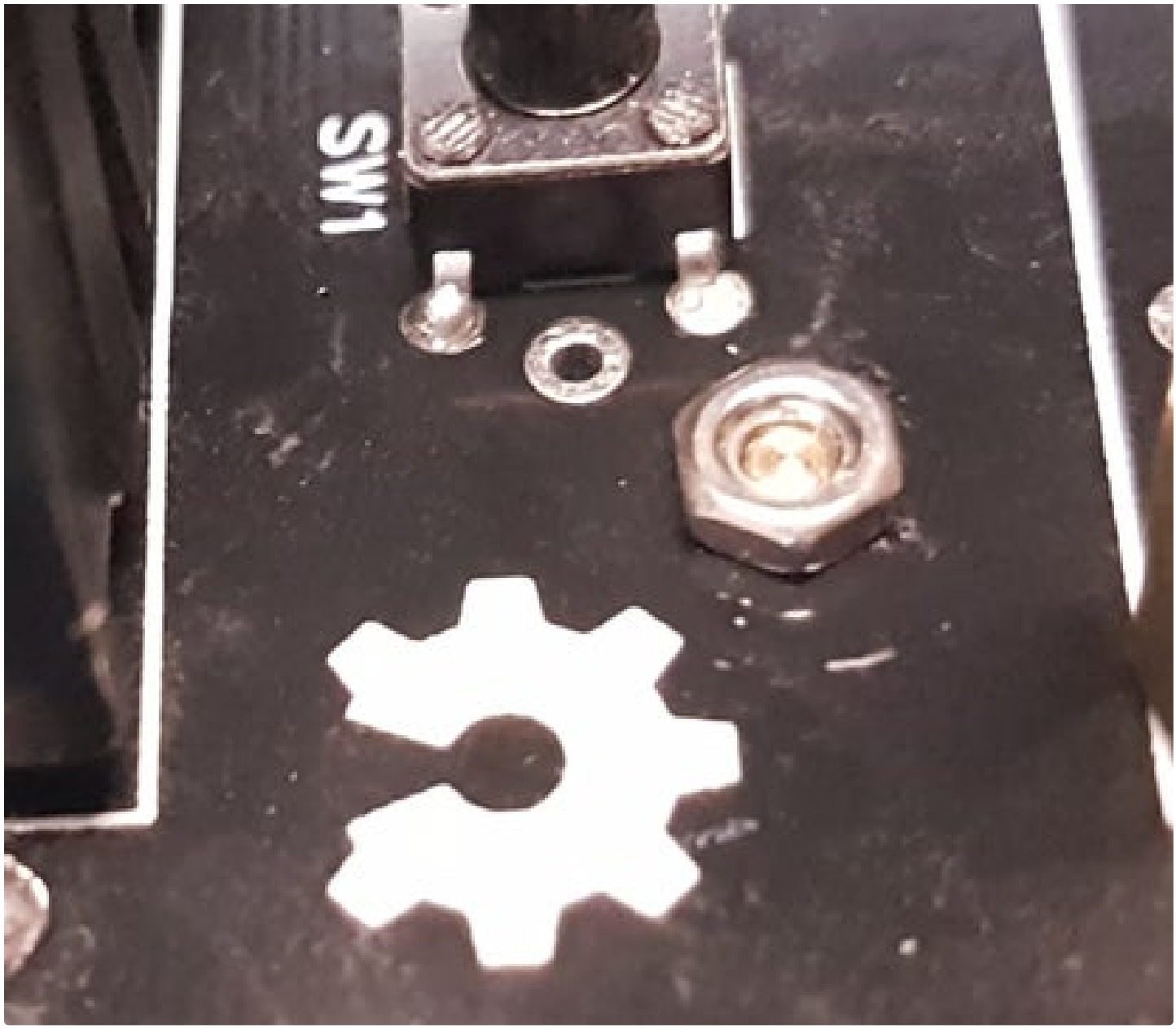
Solder in the 4x 18650 Battery Holder.

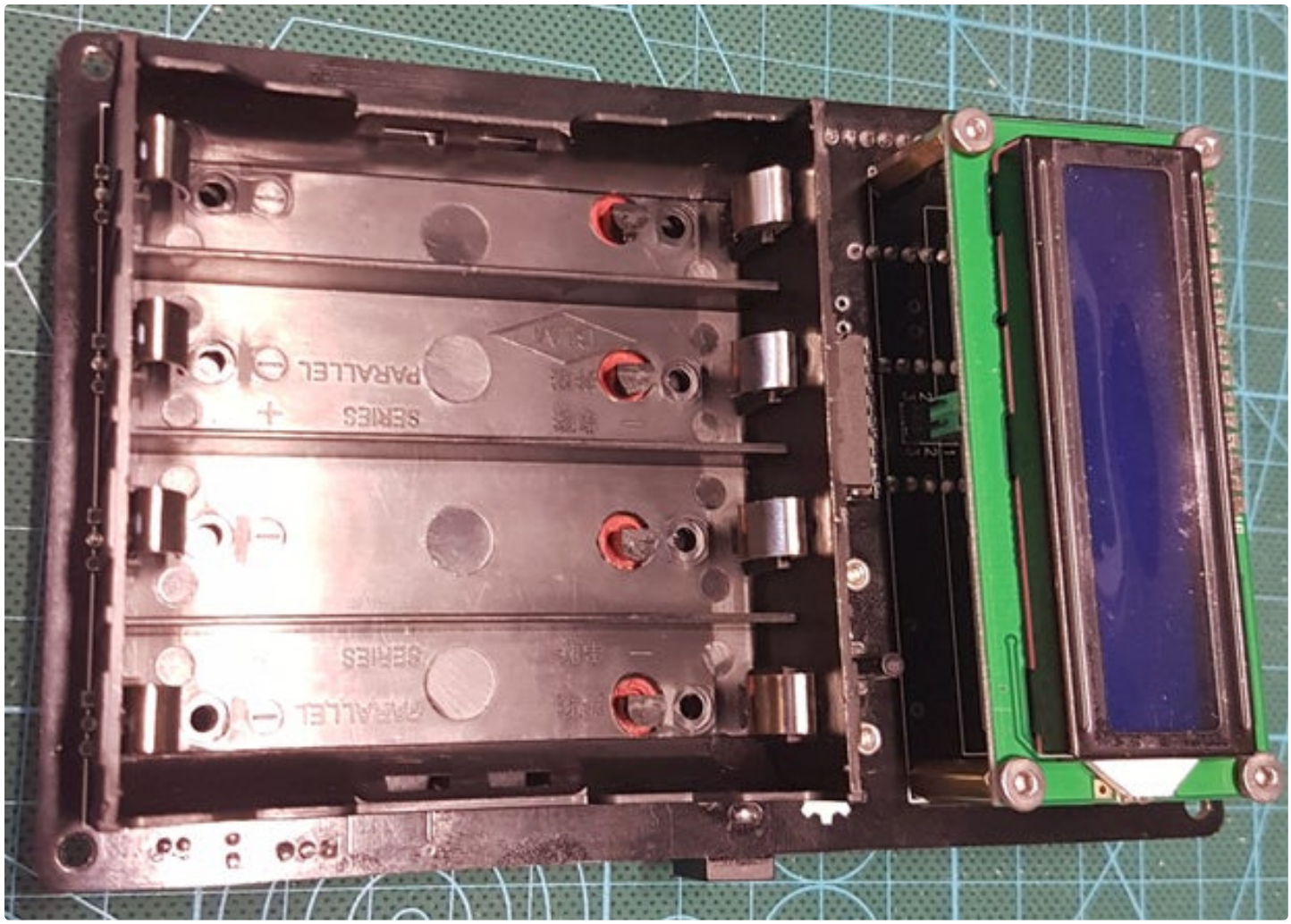
*Note: You may need to trim some contacts down with some flush / diagonal pliers.*

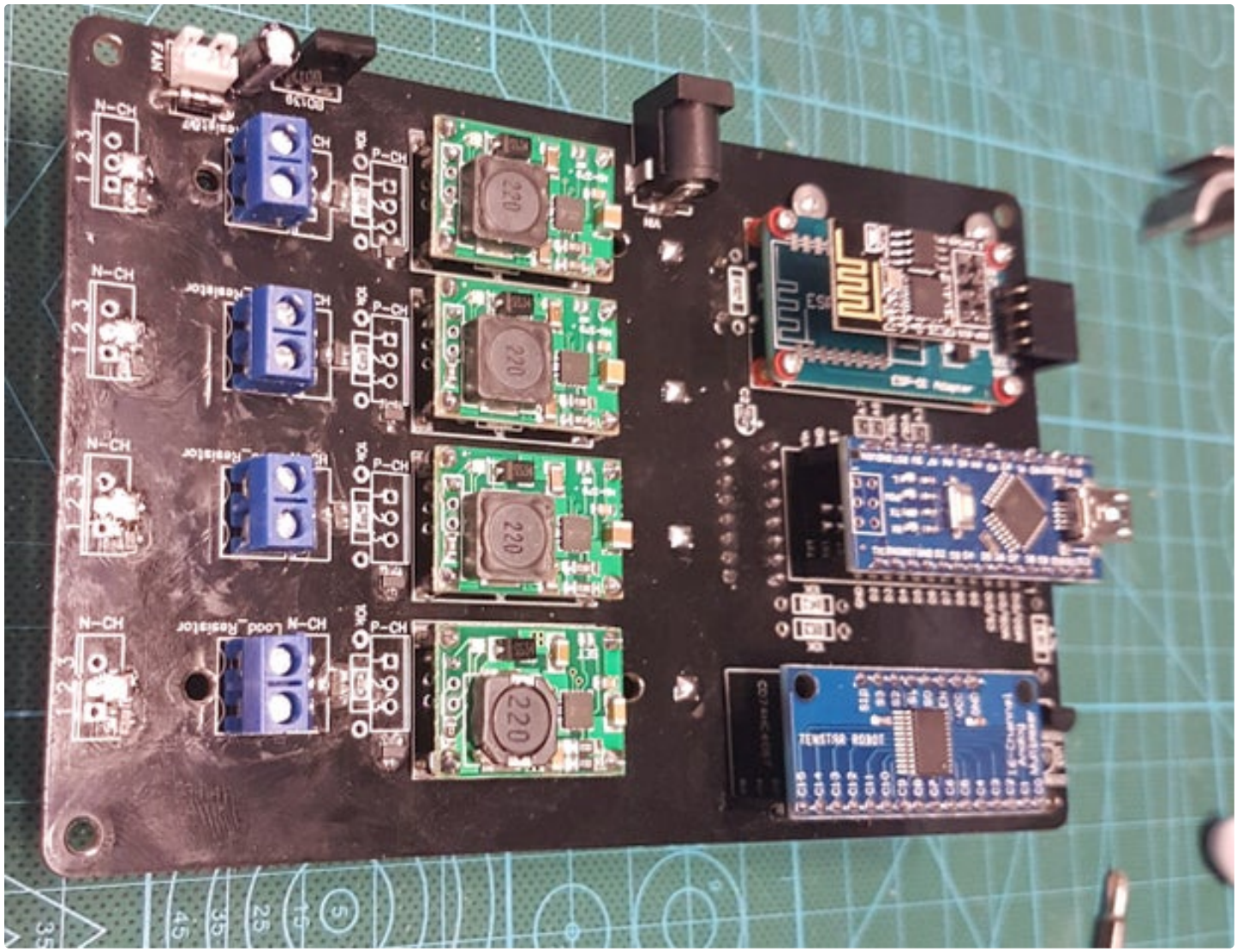
*Solder the 6mm push button.*


TEMSTAR ROBOT
TX1
RX1
Vin
GND
10K
10K
ESP




SW1


PARALLEL
SERIES
SERIES
PARALLEL




## Step 15: Mount All the Hardware

**ESP01 Adapter**

4x Use M2.5 stand-offs M-F or F-F

8x M2.5 Screws or 4x M2.5 screws and 4x M2.5 nuts depending if you use M-F or F-F stand-offs

Use a right angle 4pin 2.54mm connector to connect the Female to Male connectors.

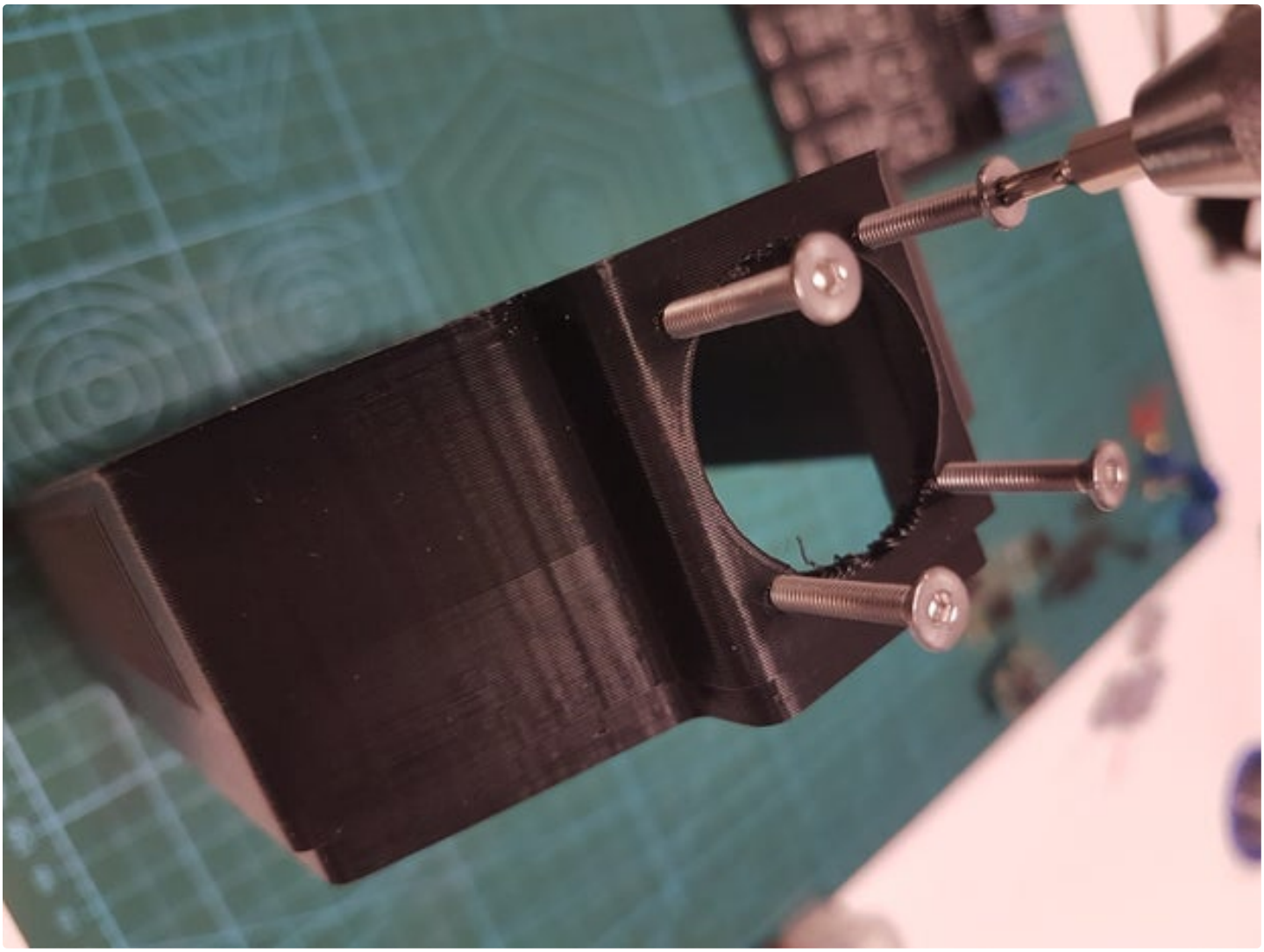
*Note: you may need to tin the connector to get a good connection if it is loose.*

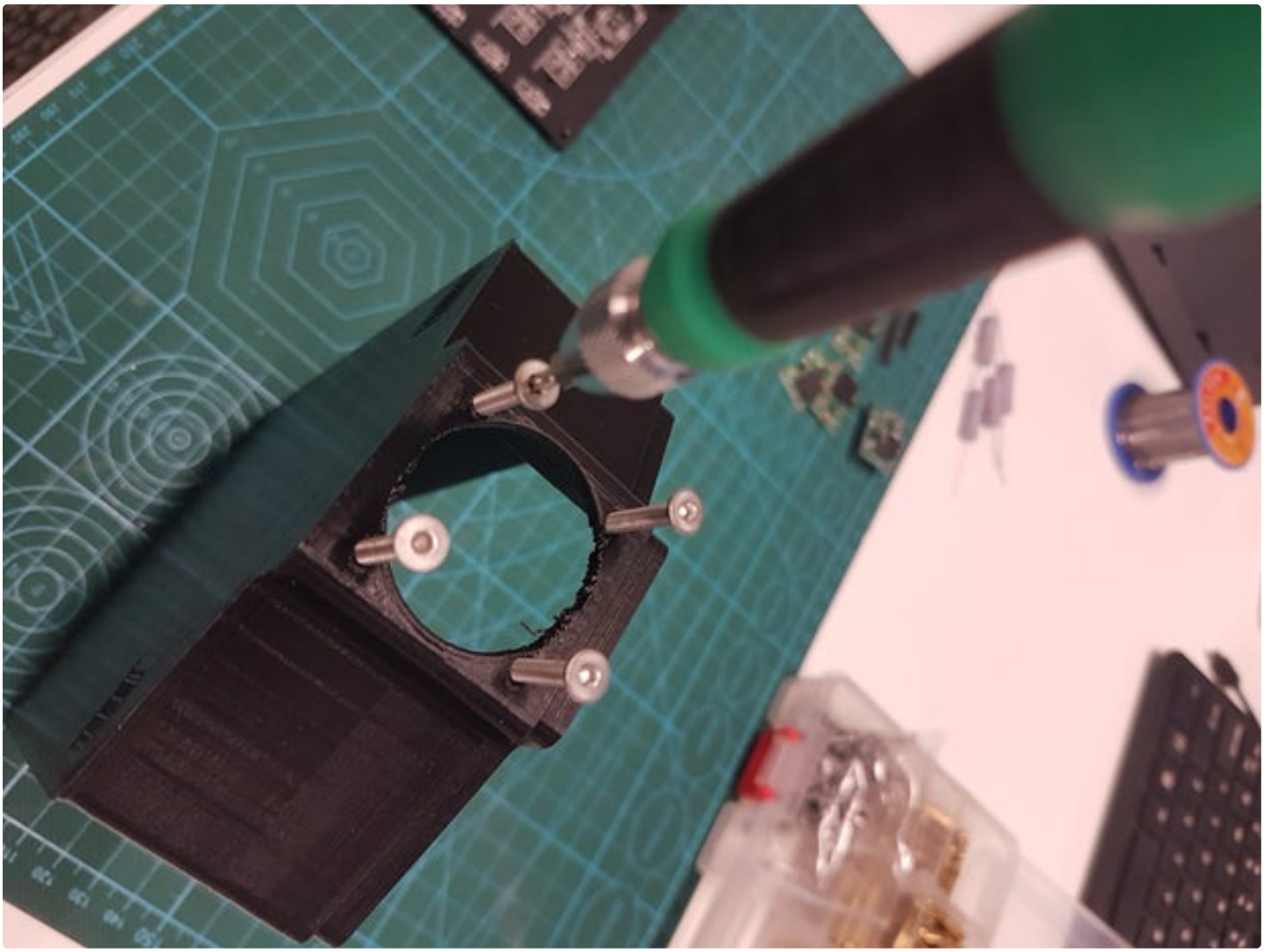
**LCD**

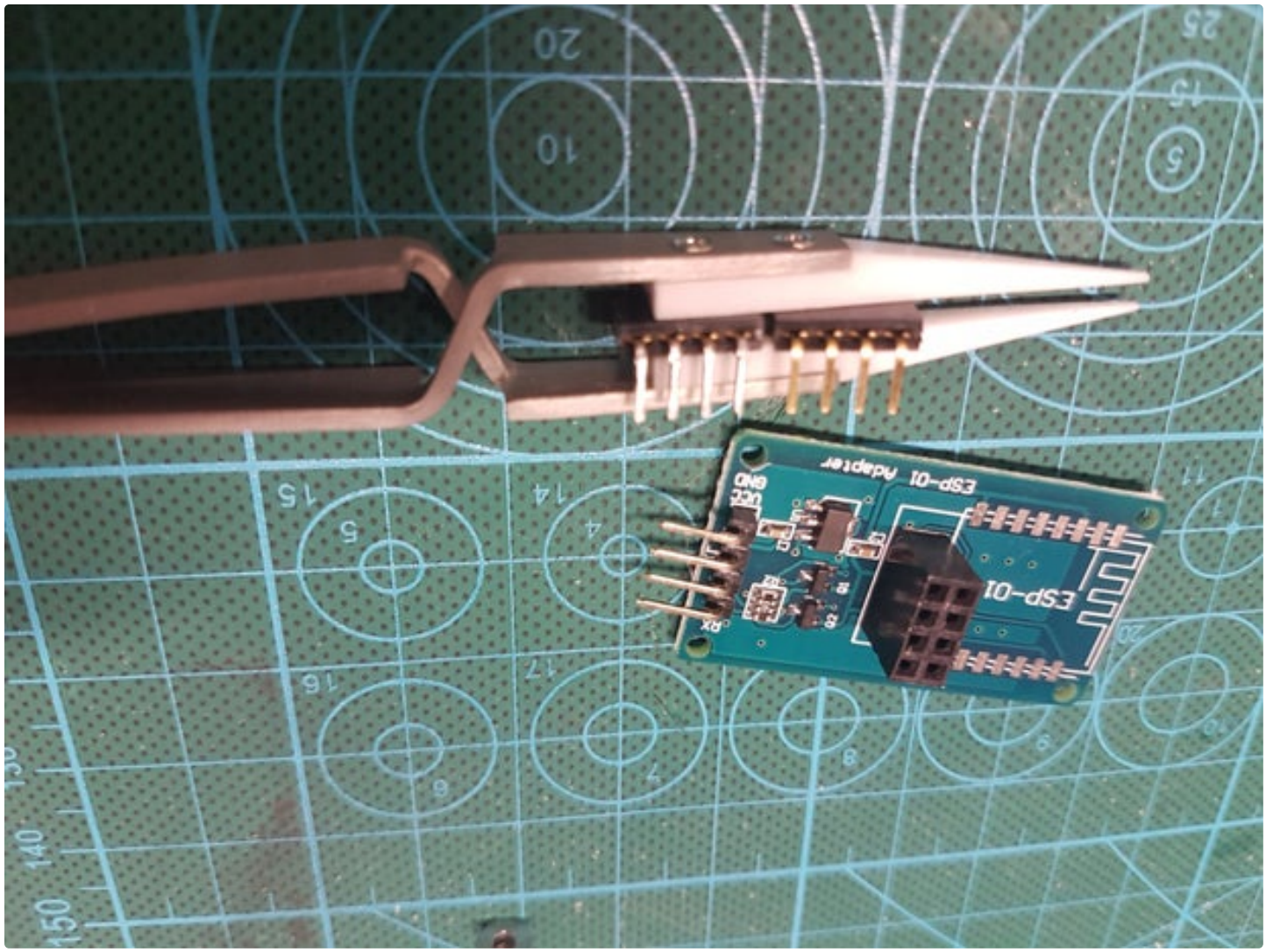
4x M3 Standoff 18mm Brass F-F and 8x M3 x 12mm Screws for the LCD

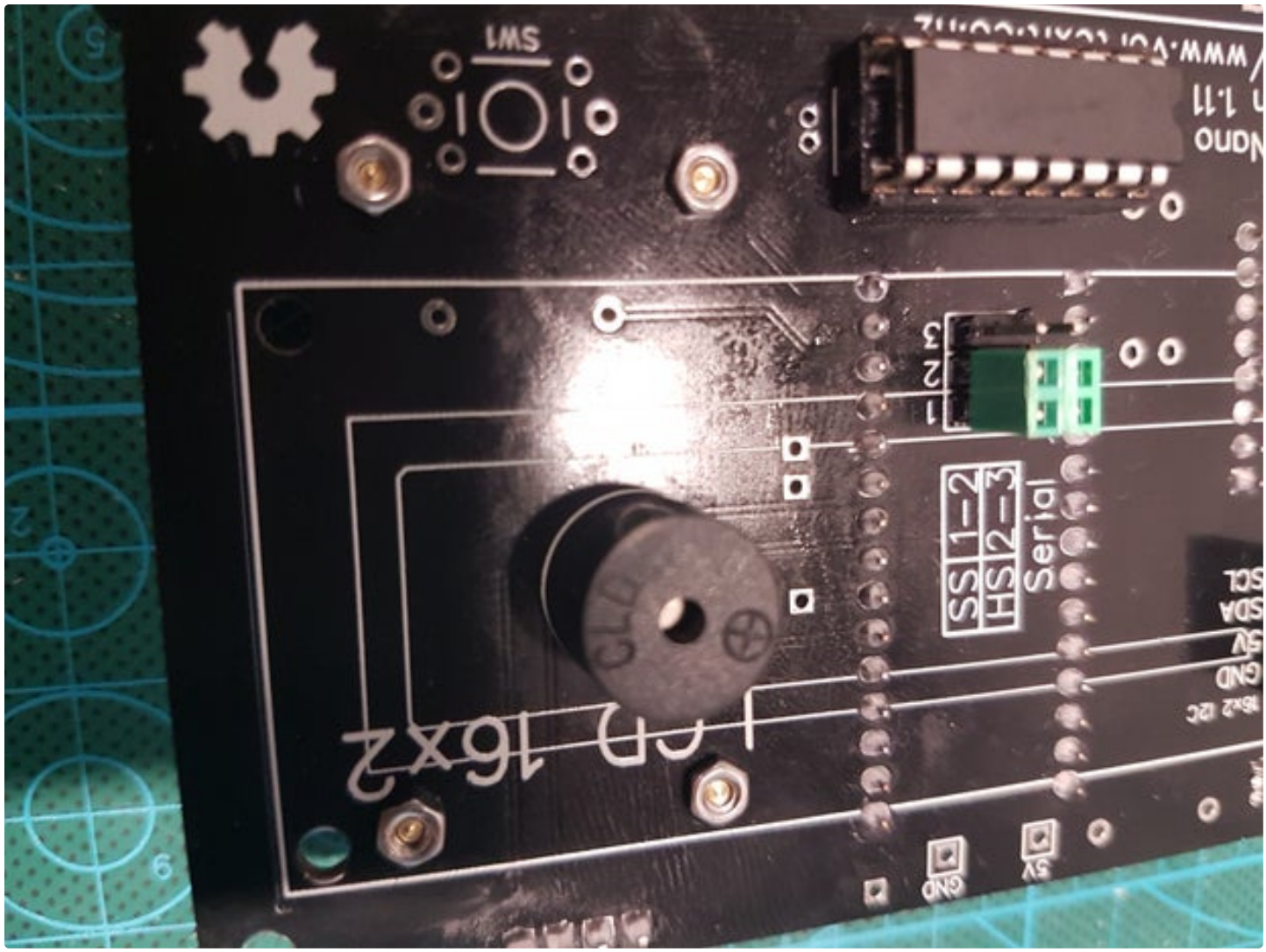
**Fan**

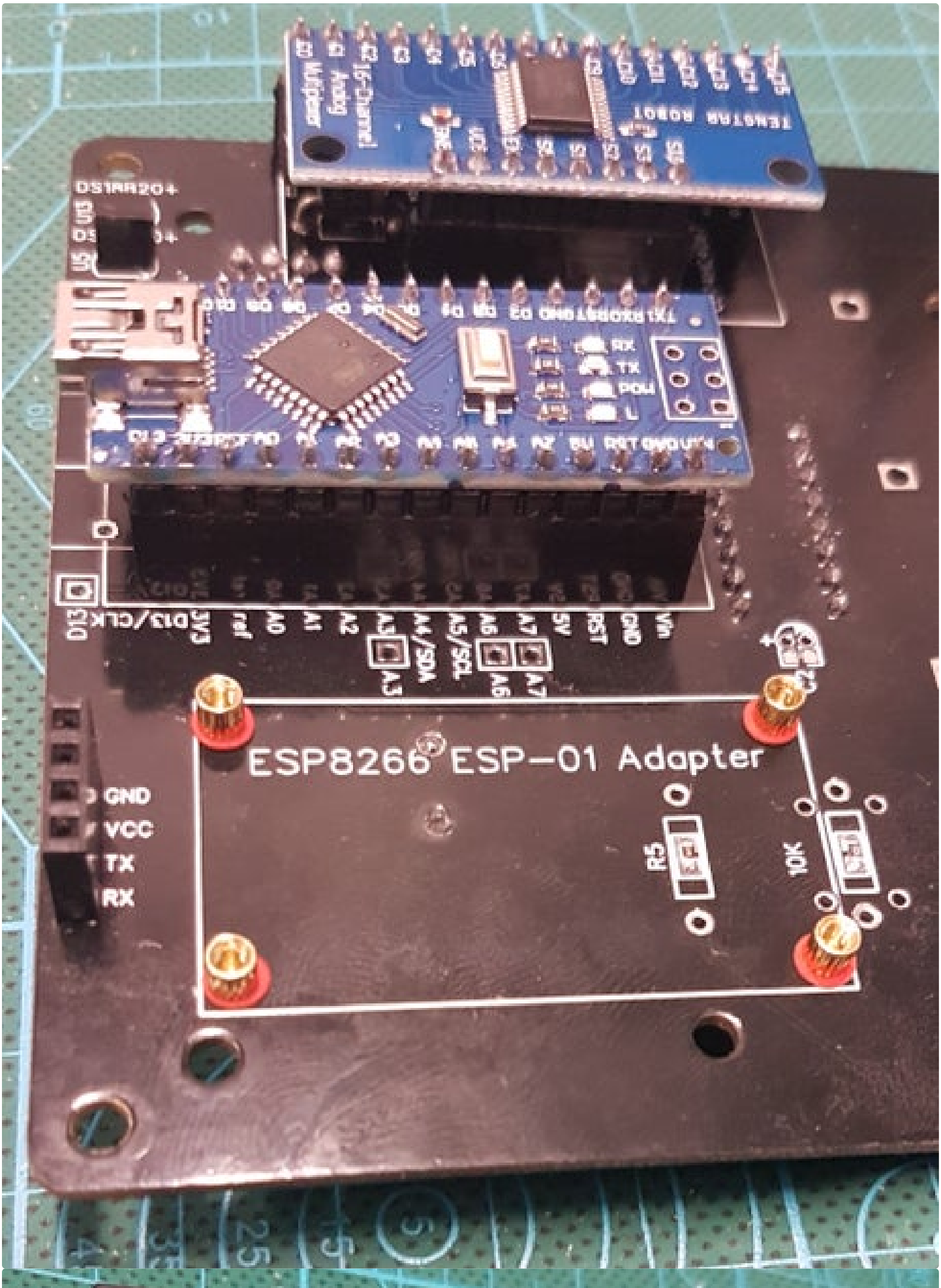
3D Printed case only: Thread some M3 x 18mm screws the Fan screw holes add the Fan.

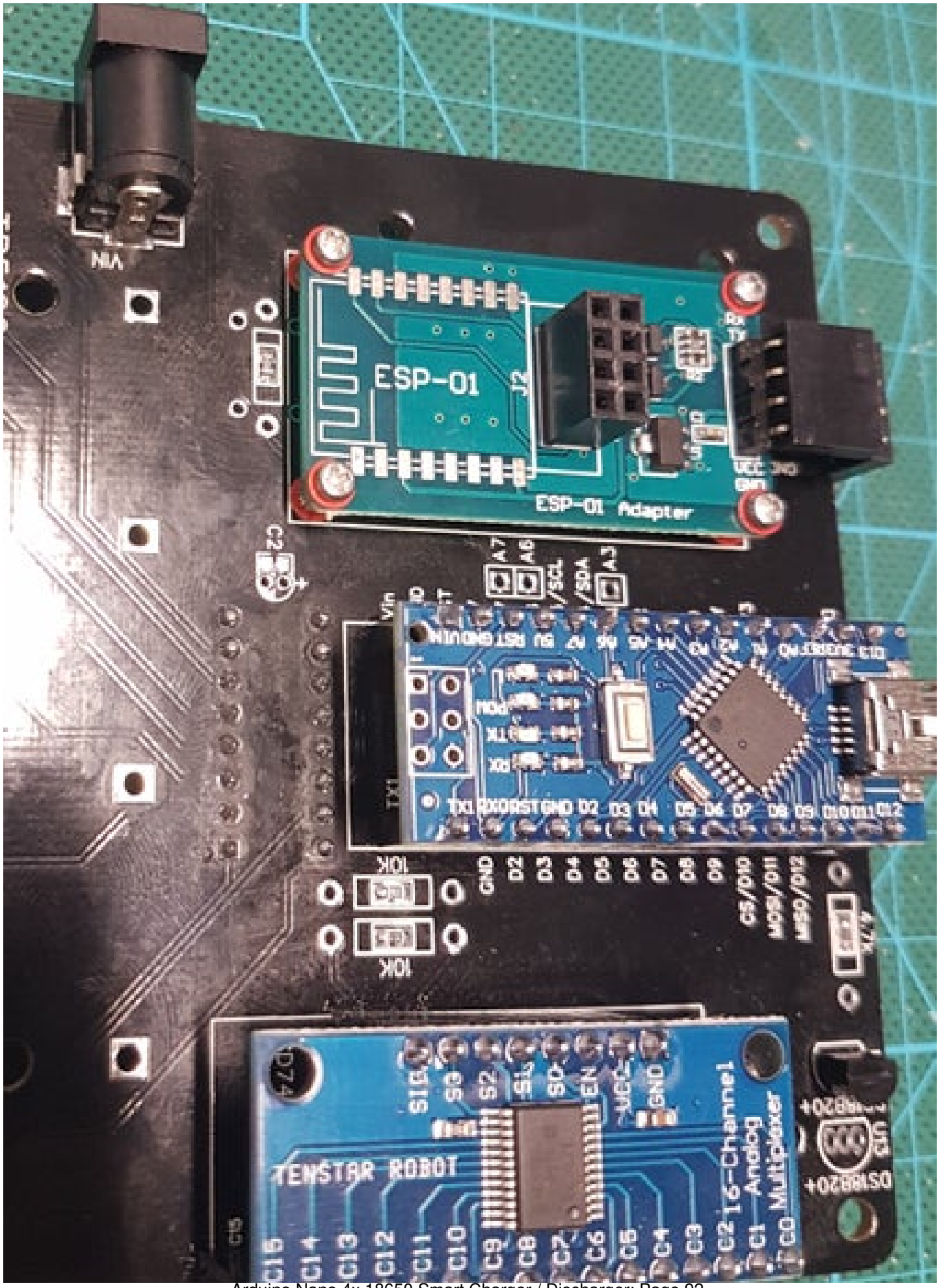


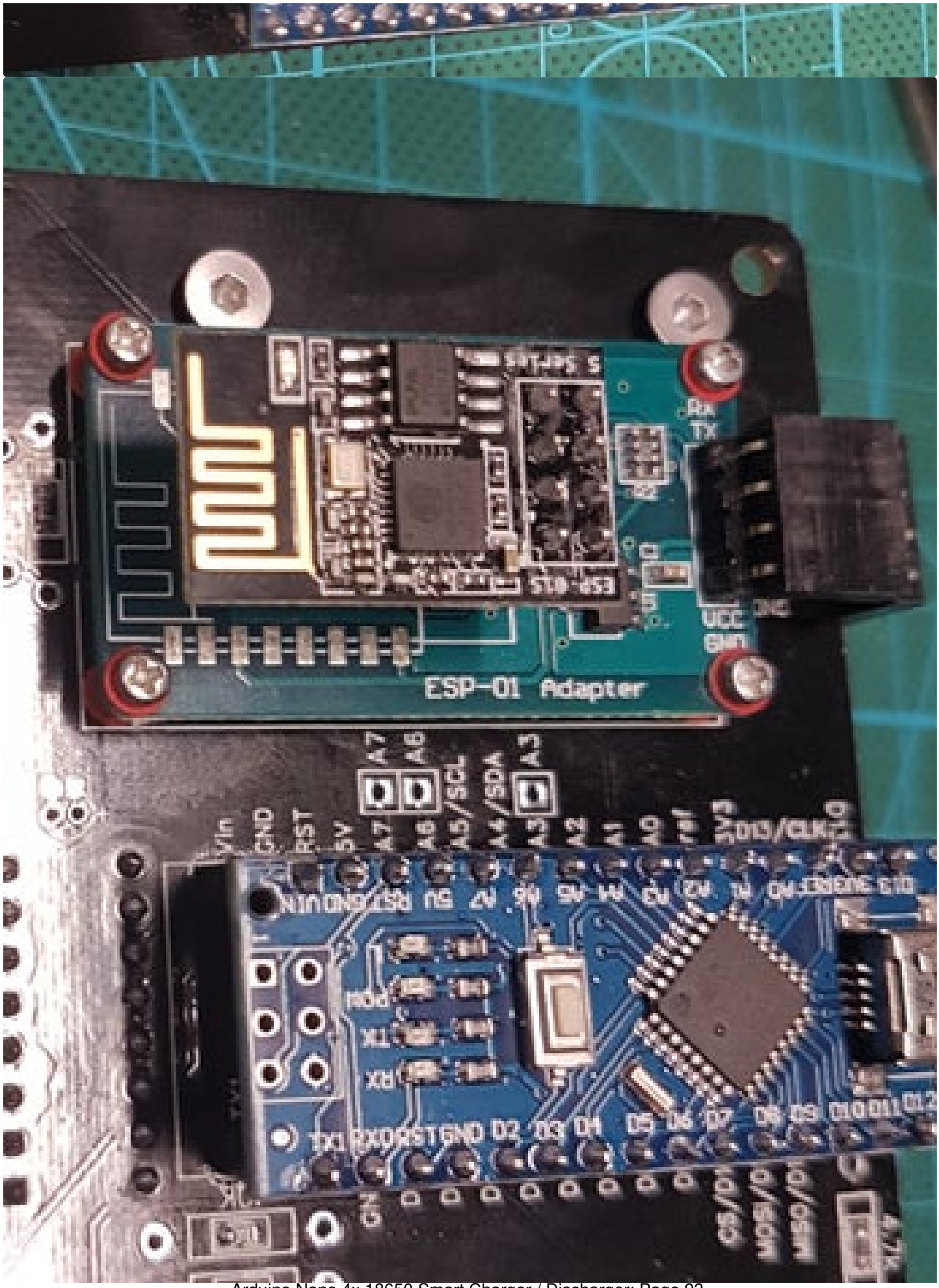


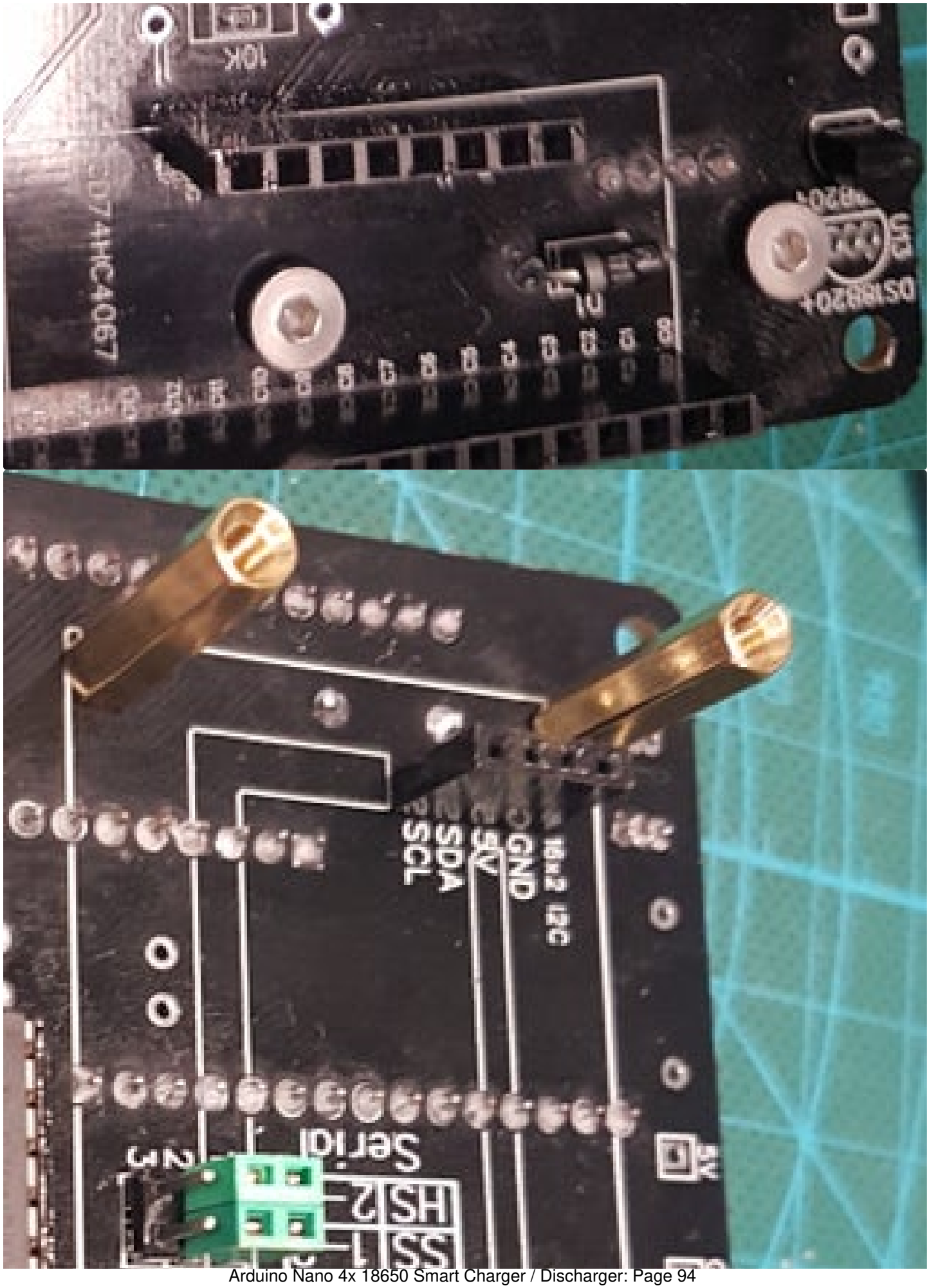

ESP-01 Adapter
GND
VCC
RX
ESP-01

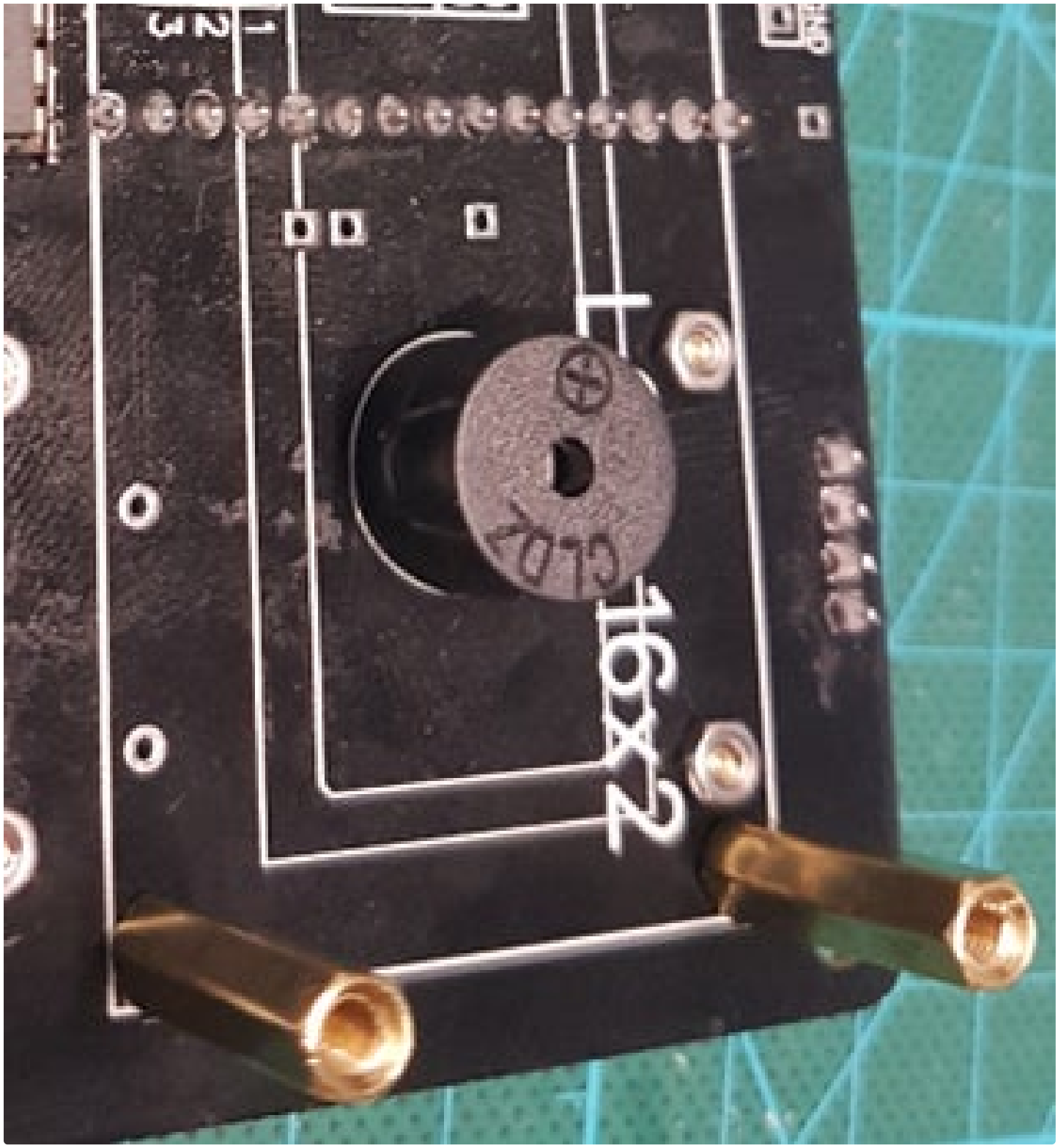

SW1
3
2
1
SS 1–2
HS 2–3
Serial
SCL
SDA
5V
GND
16x2 I2C
GND
5V

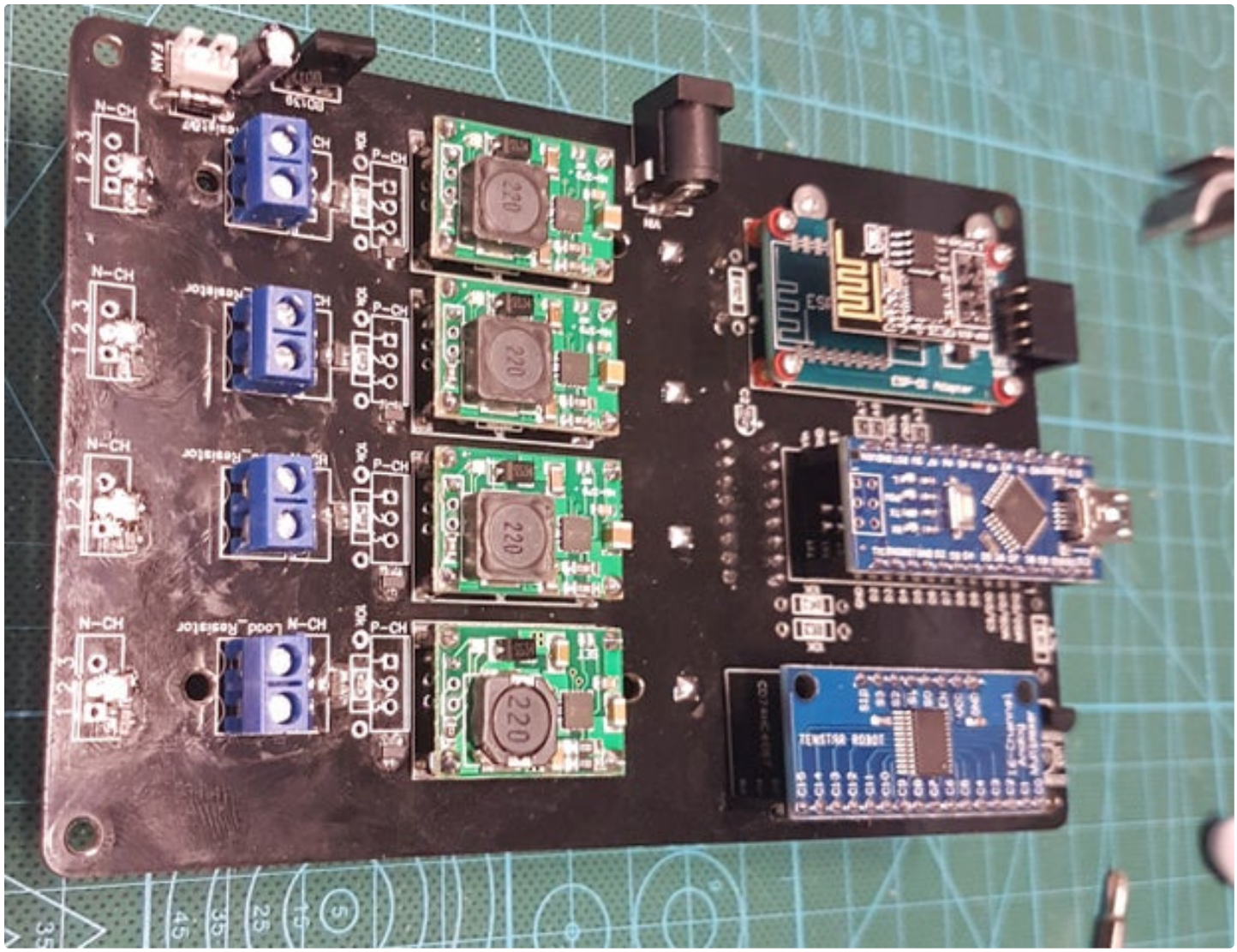

ESP8266 ESP-01 Adapter
GND
VCC
TX
RX
10K

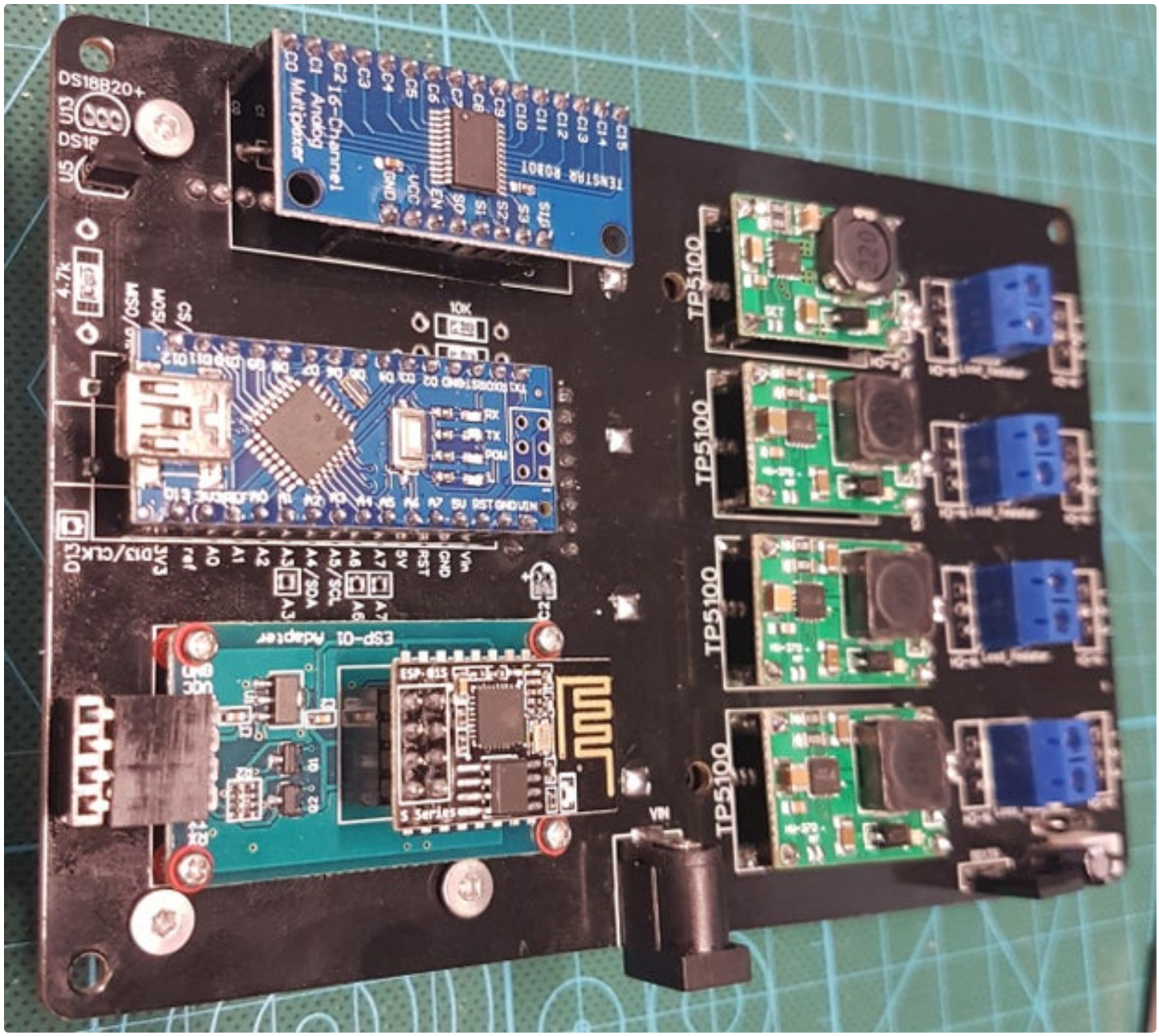

ESP-01
ESP-01 Adapter
TENSTAR ROBOT
16-Channel Analog Multiplexer
10K
10K

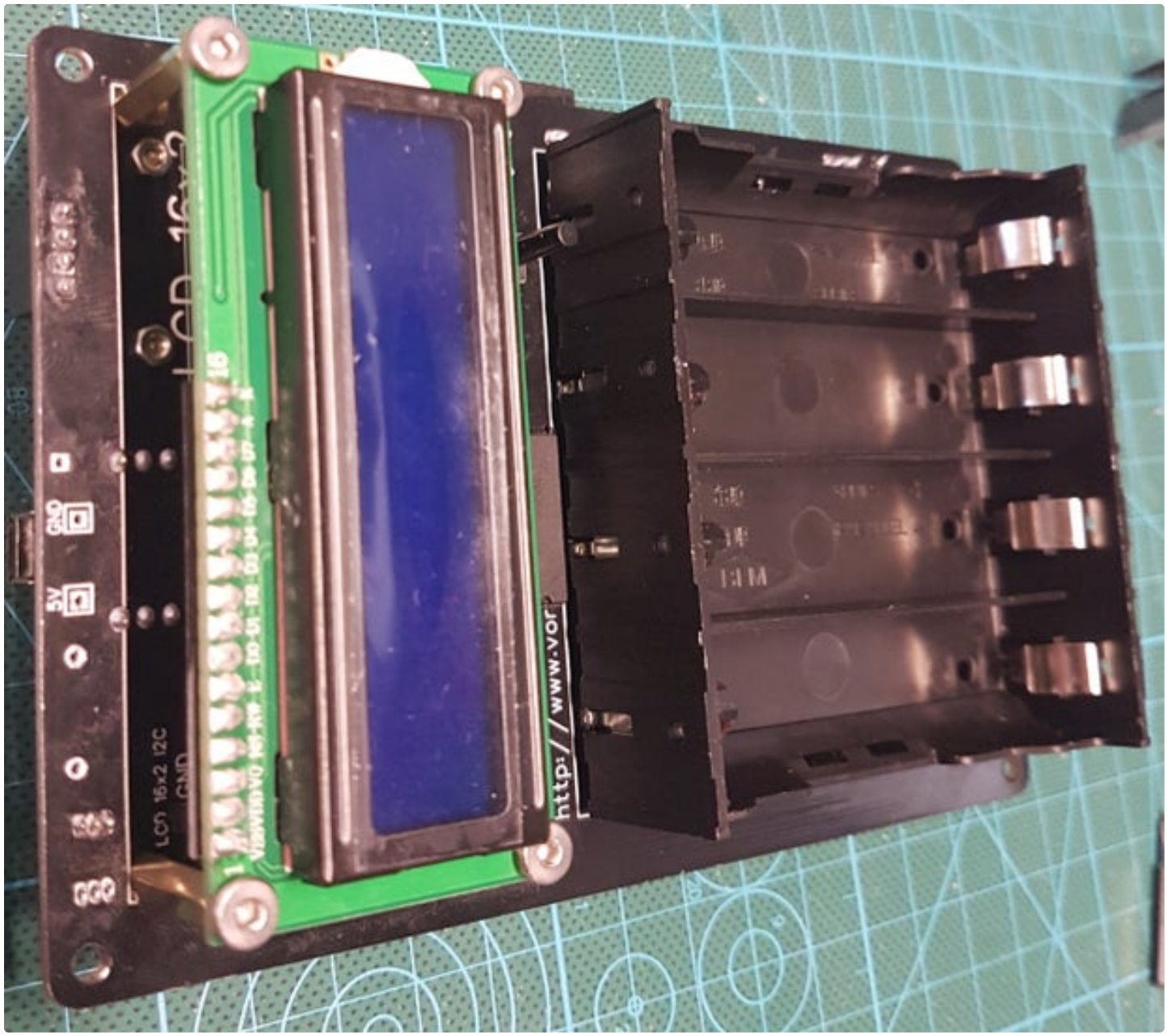

ESP-01 Adapter
Rx
Tx
Vin
GND
RST
5V
A7
A6
A5
A4/SDA
A3
A2
SCL/A5
SDA/A4
TX
RX
RST
GND
D2
D3
D4
D5
D6
D7
D8
D9
D10
D11
D12

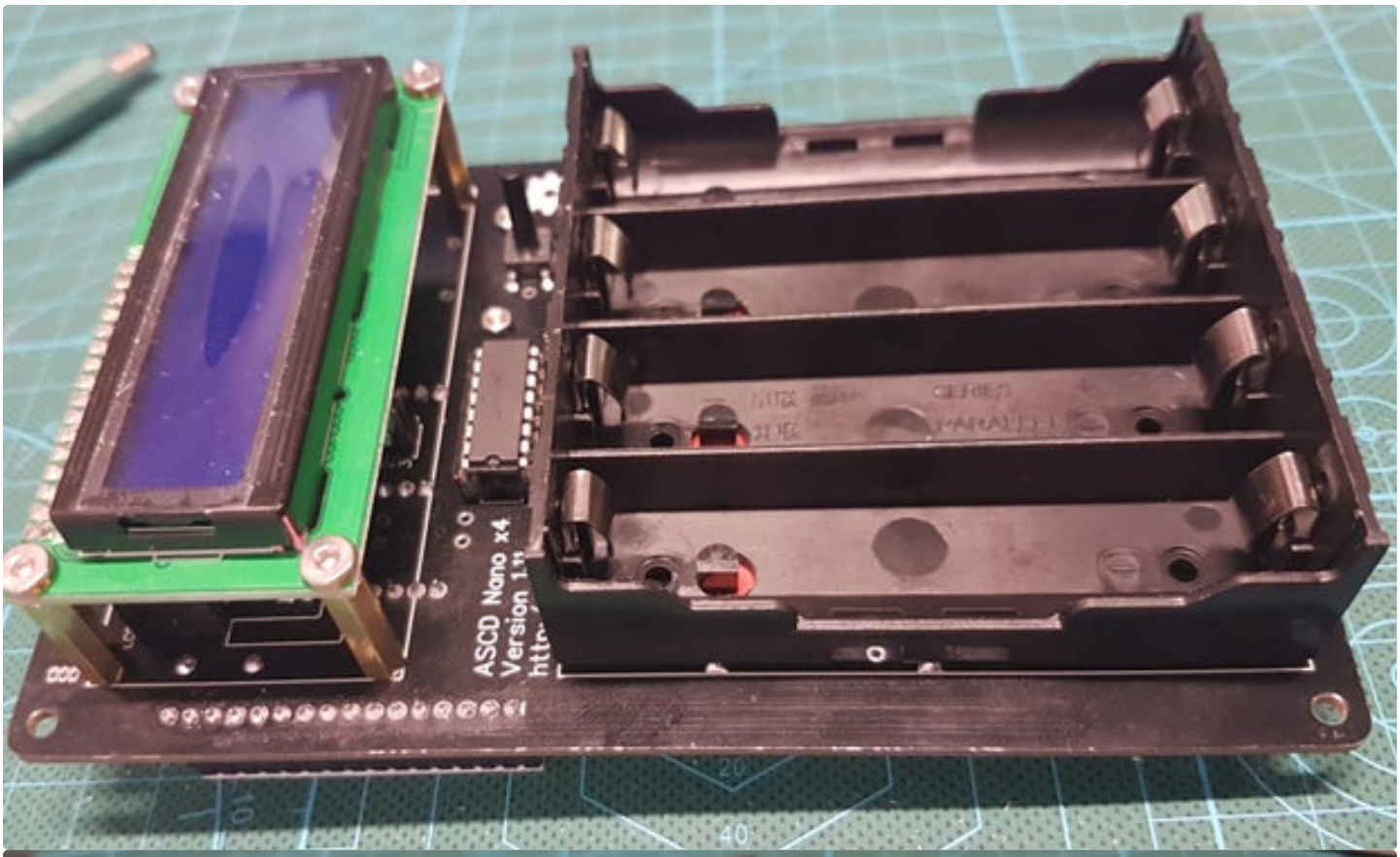

10K
74HC4067
SCL
SDA
GND
I2C
Serial
GND

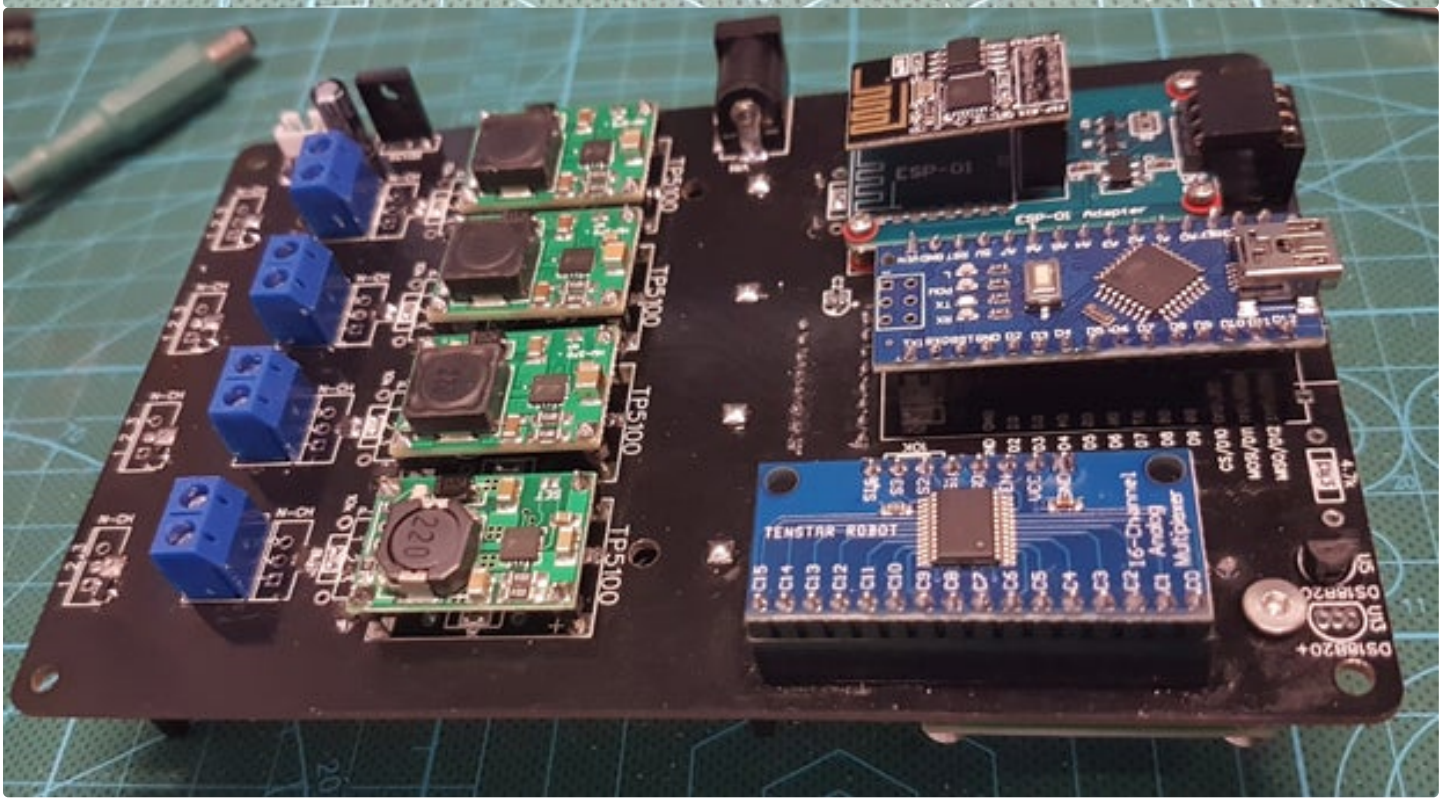

16x2

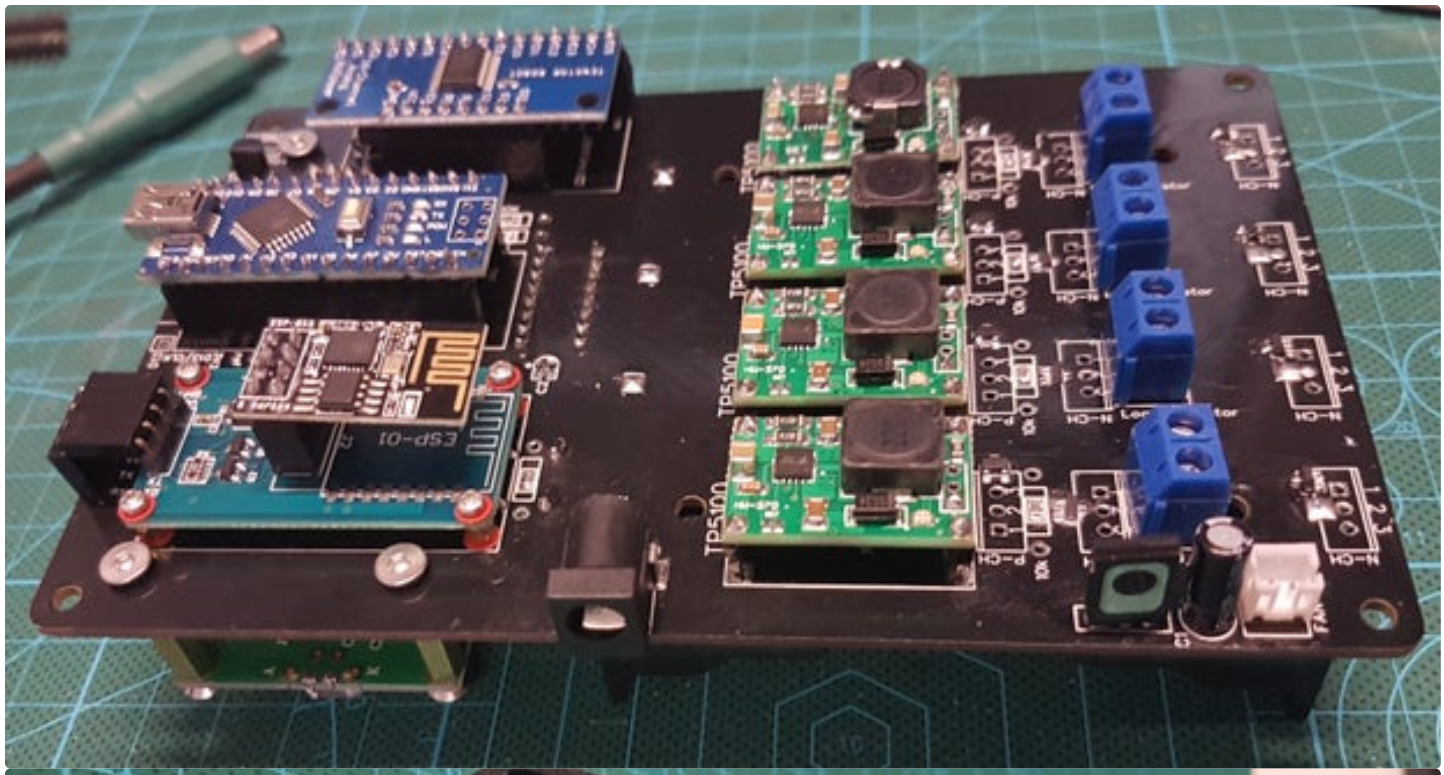

FAN
N-CH
P-CH
220
Load_Resistor
ZENSTHA ROBOT

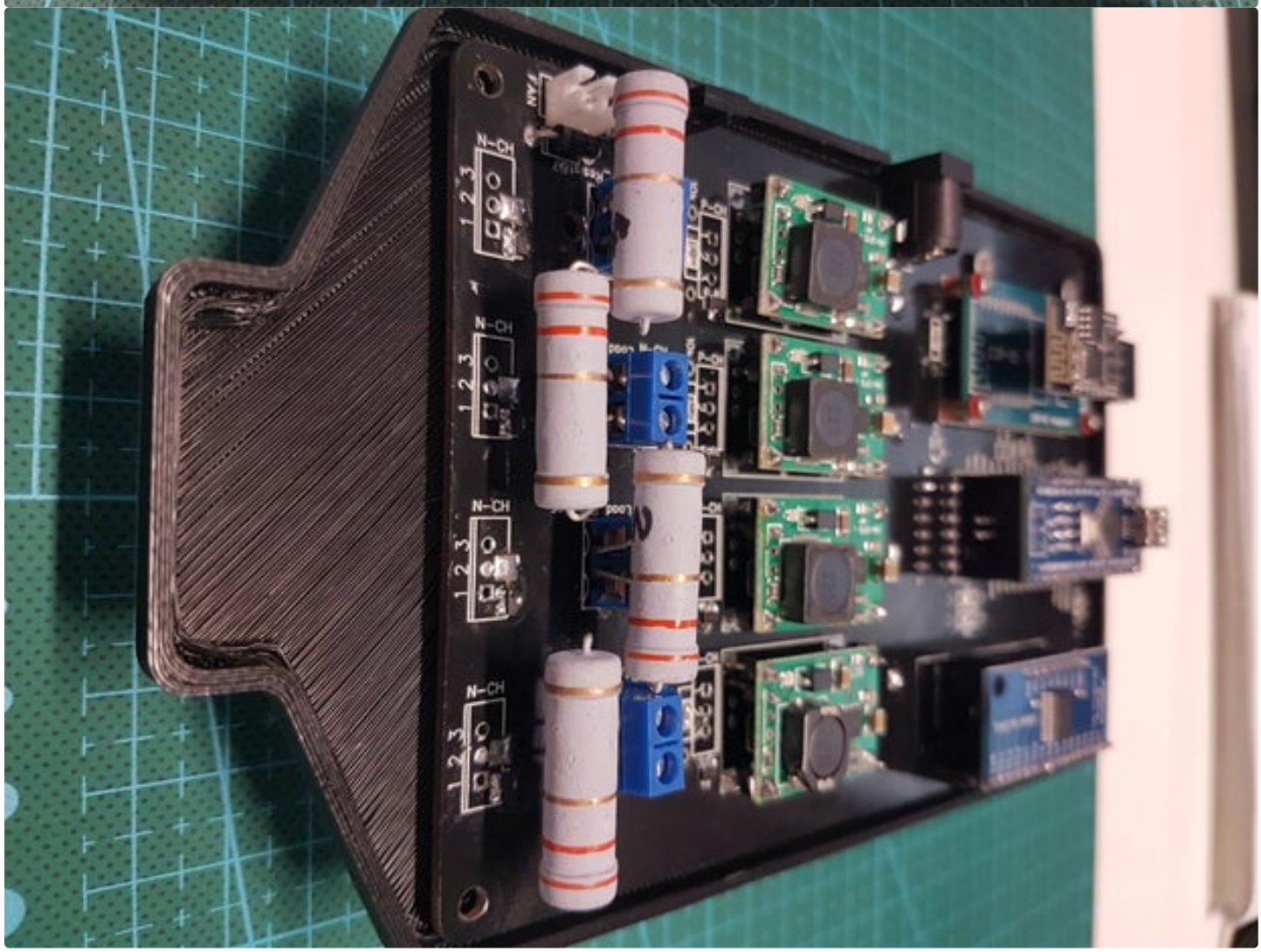

DS18B20+
U13
DS1P
U5
4.7k
16-Channel Analog Multiplexer
TENSTAR ROBOT
10K
TP5100
TP5100
TP5100
TP5100
ESP-01 Adapter
VIN


LCD 16x2
GND
5V
LCD 16x2 I2C
GND
http://www.vor


ASCD Nano x4


ESP-01
ESP-01 Adapter
TENSTAR ROBOT
16-Channel Analog Multiplexer
IP5100
IP5100
IP5100
220


ESP-01
TP5100
TP5100
TP5100


N-CH
N-CH
N-CH
N-CH
1 2 3

## Step 16: Upload the Arduino Nano Sketch

Before uploading the sketch check the 5V Voltage output from the Arduino's Voltage Regulator. There are two probe points about the LCD screen.

Edit the Arduino Sketch from github: ASCD_Nano_1-0-0 Change this line in the Arduino Sketch to your voltage reading

```
const float referenceVoltage = 5.01;     // 5V Output of Arduino
```

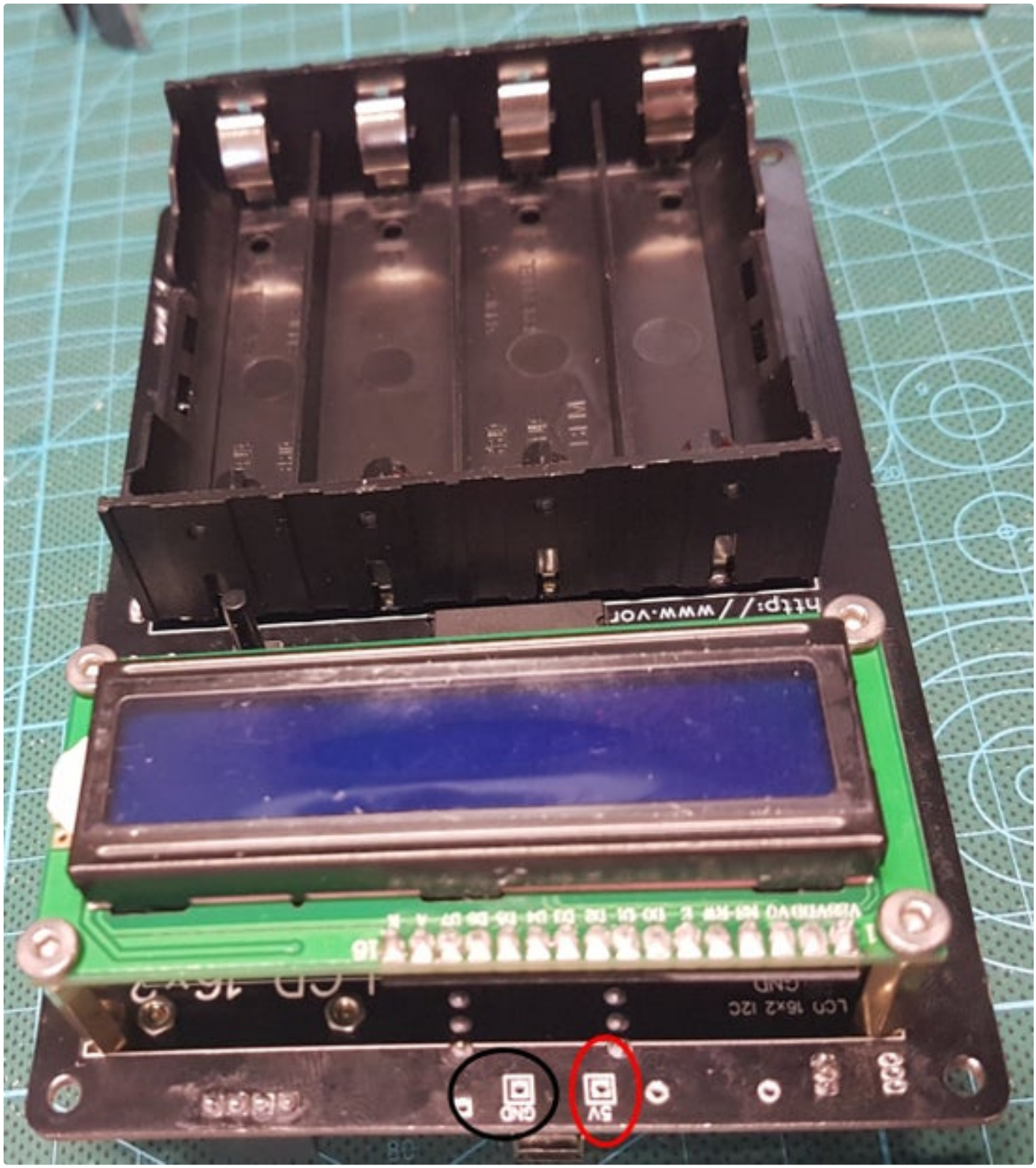
You can also change some other custom setting for your testing needs

```
const float shuntResistor[4] = {3.3, 3.3, 3.3, 3.3};
const float referenceVoltage = 5.01;     // 5V Output of Arduino
const float defaultBatteryCutOffVoltage = 2.8;    // Voltage that the discharge stops
const byte restTimeMinutes = 1;      // The time in Minutes to rest the battery after charge. 0-59 are valid
const int lowMilliamps = 1000;      // This is the value of Milli Amps that is considered low and does not get recharged because it is considered faulty
const int highMilliOhms = 500;      // This is the value of Milli Ohms that is considered high and the battery is considered faulty
const int offsetMilliOhms = 0;      // Offset calibration for Milli Ohms
const byte chargingTimeout = 8;      // The timeout in Hours for charging
const byte tempThreshold = 7;      // Warning Threshold in degrees above initial Temperature
const byte tempMaxThreshold = 20;     // Maximum Threshold in degrees above initial Temperature - Considered Faulty
const float batteryVolatgeLeak = 0.50;     // On the initial screen "BATTERY CHECK" observe the highest voltage of each module and set this value slightly higher
const byte moduleCount = 4;      // Number of Modules
const byte screenTime = 4;      // Time in Seconds (Cycles) per Active Screen
const int dischargeReadInterval = 5000;     // Time intervals between Discharge readings. Adjust for mAh +/
```

Connect up the Arduino Nano to your computer and load the ASCD_Nano_1-0-0 sketch

You may need to use ATmega328P (Old boot loader) as the processor in Arduino IDE

Select the correct COM port and upload the sketch




## Step 17: Upload the ESP8266 Sketch

If you have not already registered your Vortex It - Battery Portal Account go to the next step.

You need to install the ESP8266 Arduino Addon in your Arduino IDE use this guide:
https://learn.sparkfun.com/tutorials/esp8266-thing...

Change the following in the ESP8266_Wifi_Client_1-0-0 Arduino Sketch

```
const char ssid[] = ""; -> to your WIFI routers
```

```
SSID const char password[] = ""; -> to your WIFI routers Password
```

```
const char userHash[] = ""; -> to your UserHash (Get this from "Charger / Discharger Menu -> View" in the Vortex It Battery Portal)
```

```
const byte CDUnitID = ; -> to your CDUnitID (Get this from "Charger / Discharger Menu -> View -> Select your Charger / Discharger" in the Vortex It Battery Portal)
```

Use USB to ESP8266 ESP-01 Programmer to upload sketch ESP8266_Wifi_Client_01.ino to the ESP8266 with the switch on PROG

## Step 18: Setup Your Vortex It - Battery Portal Account

Go to https://portal.vortexit.co.nz

If you have not already register for an account.

Login with your credentials

On the menu click "Charger / Discharger" -> "New"

Select from the drop down list "Arduino 4x C/D"

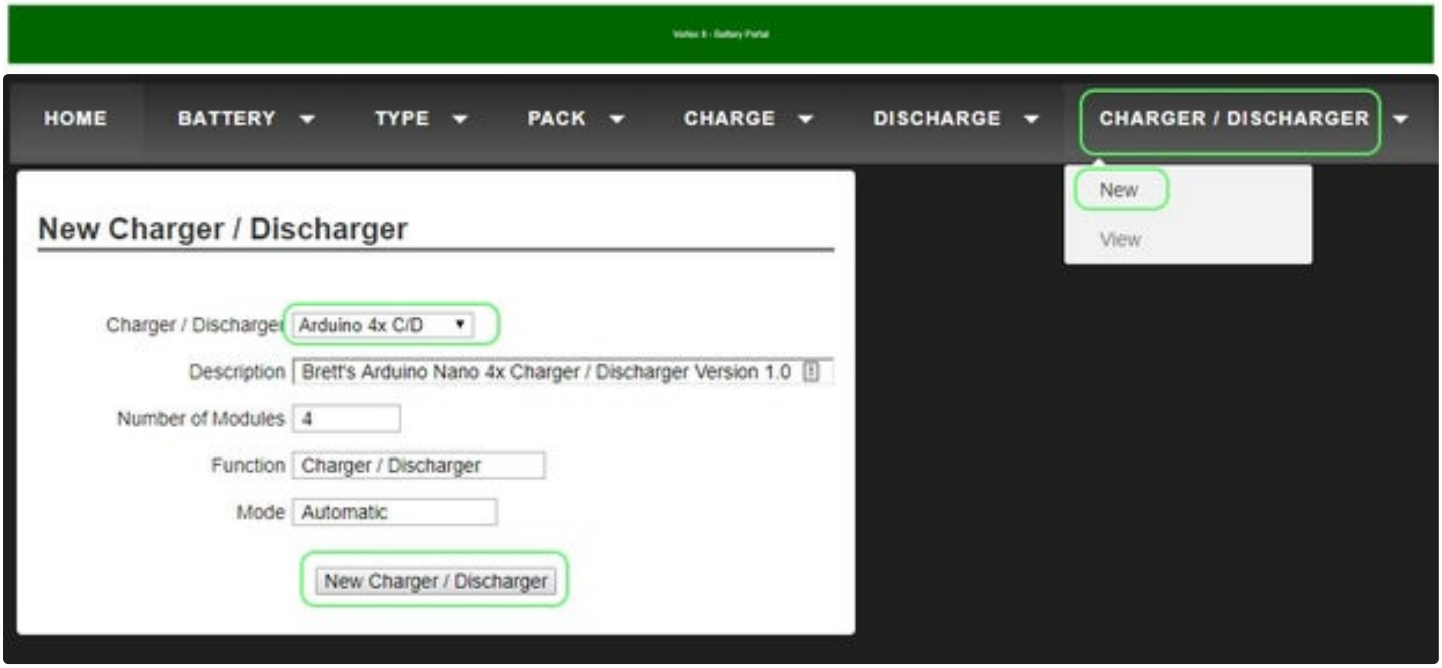
Click "New Charger / Discharger"

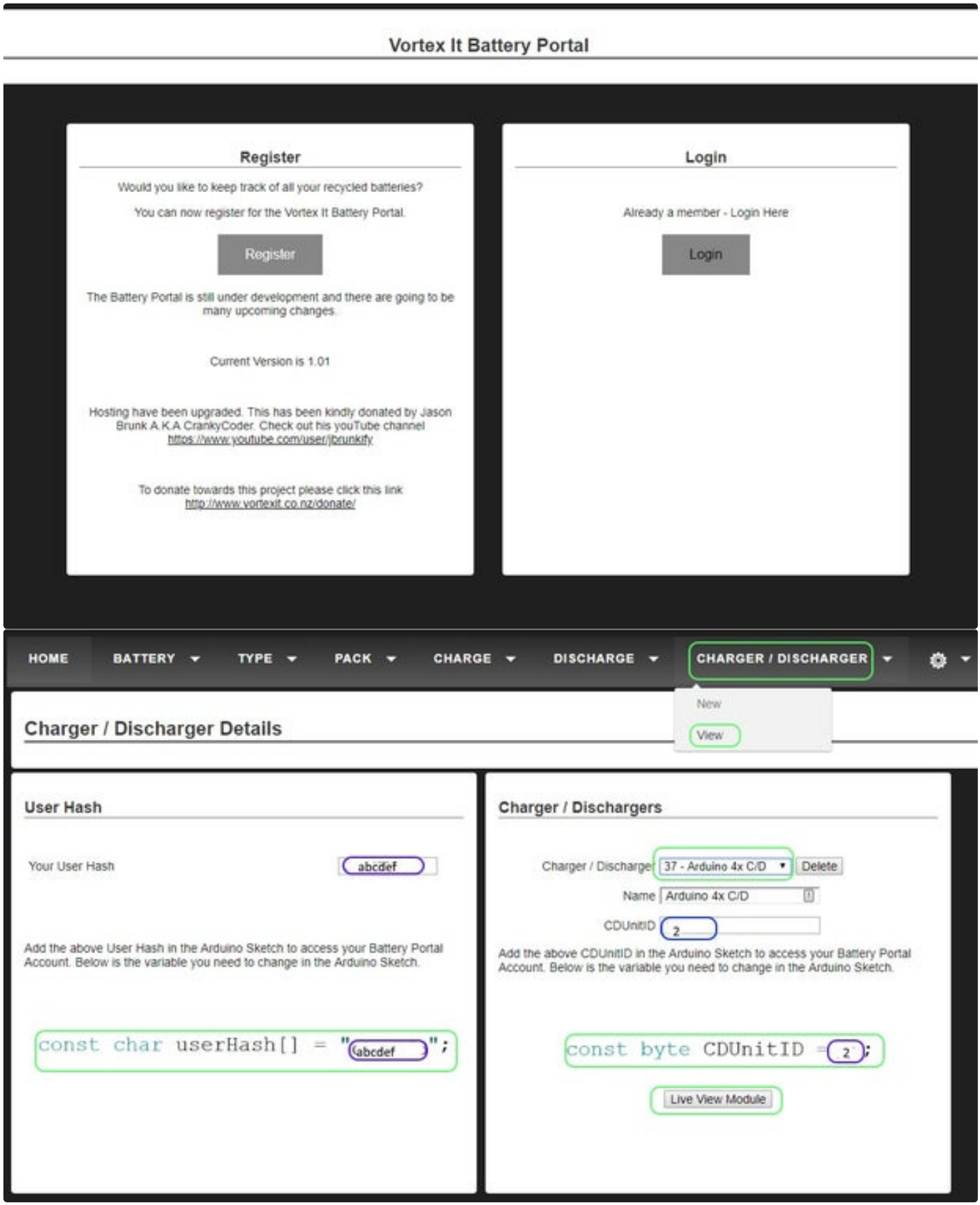
On the menu click "Charger / Discharger" -> "View"

Select from the drop down list "xx - Arduino 4x C/D" (where xx is the CDUnitID)

Make not of your "UserHash" and "CDUnitID"

Click "Live View Module" to view you Charger / Discharger online




## Step 19: Optional - Make a 3D Printed Enclosure

If you have a 3D printer you can print an enclosure that I have designed. Feel free to make your on style of enclosure and share it:

**Fusion 360**

https://gallery.autodesk.com/fusion360/projects/asdc-nano-4x-arduino-charger--discharger-enclosure

**Thingiverse STL**

https://www.thingiverse.com/thing:3502094


## Step 20: Start Testing Cells

Insert some batteries into the Cell Modules and go to the "Live View Module" page scan in your barcodes and you are off.

Check out the Facebook group for updates, information, help and discussions.
https://www.facebook.com/groups/DIYbatterychargerdischargertesters/


3-SCAN BARCODE
3.40V
ASCP Nano x4

Why did you not used only the ESP8266 (that is already an "arduino") but use it only as accessory to the Arduino Nano? It's not clear to me, please could you explain? Thanks!

Did the DS18B20 Temperature Sensor test and it only works with the 3.80 Version from https://github.com/milesburton/Arduino-Temperature...
The actual one is not working any more