

# MK2(S) External Driver Board v2.4

## Installation Manual

Thanks for supporting this project! I'll try to guide you as best as I can, but I will not go to the simple details as how to place the nuts on their place and put together a box, I assume you're good enough to do this.

Here's two important things to know before proceeding with this mod:

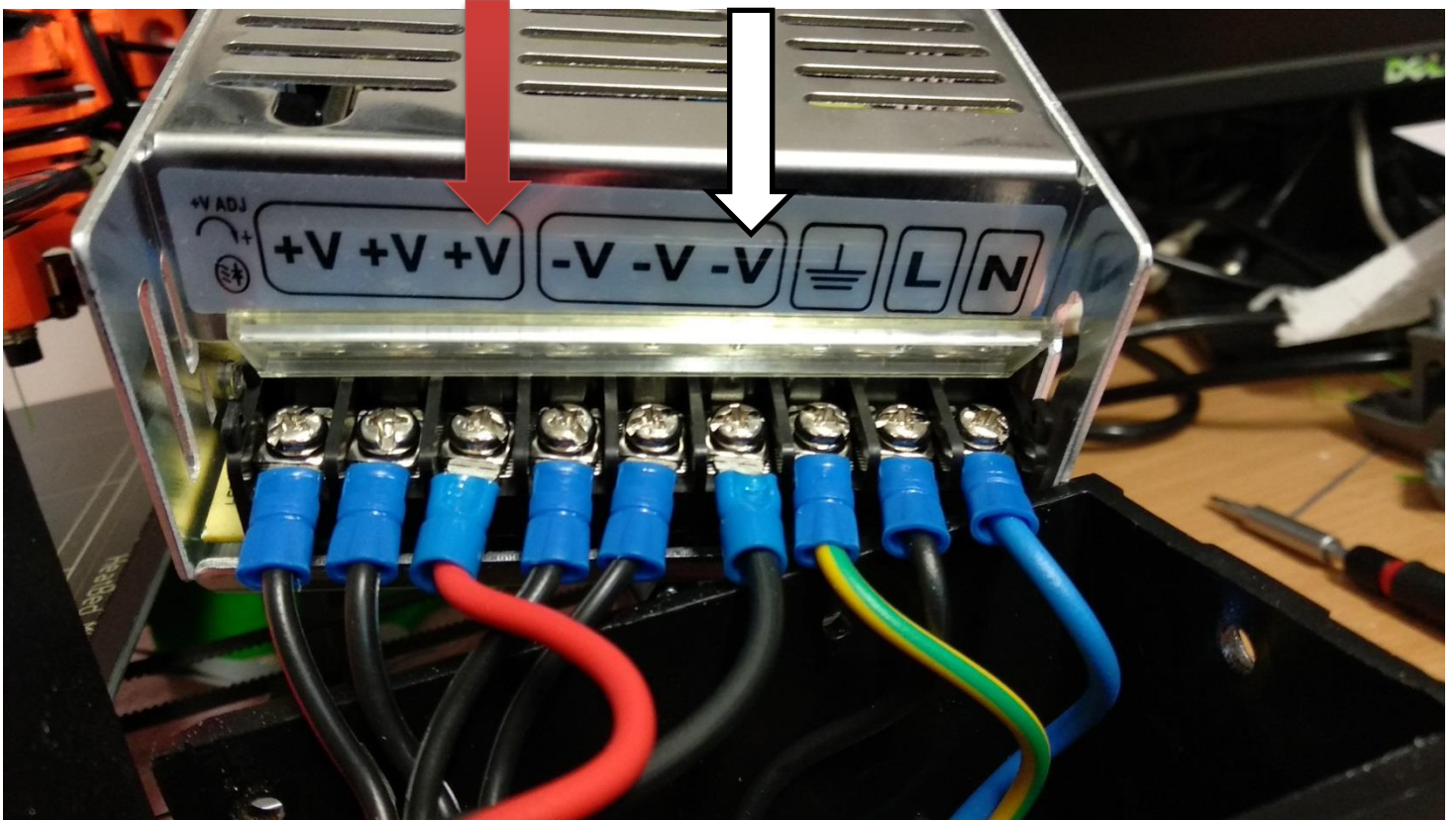
1. By soldering on the back of your mini-rambo you're practically voiding your prusa warranty!
2. I take no responsibility if you mess this modification up and/or damage your printer. You need to have basic soldering skills. Do at your own risk, or get someone more experienced to do it for you!

Let's start:

First you need to supply power to the board. You disassemble the original PSU plastic cover and take it out just a little up so you can connect the power leads to it:



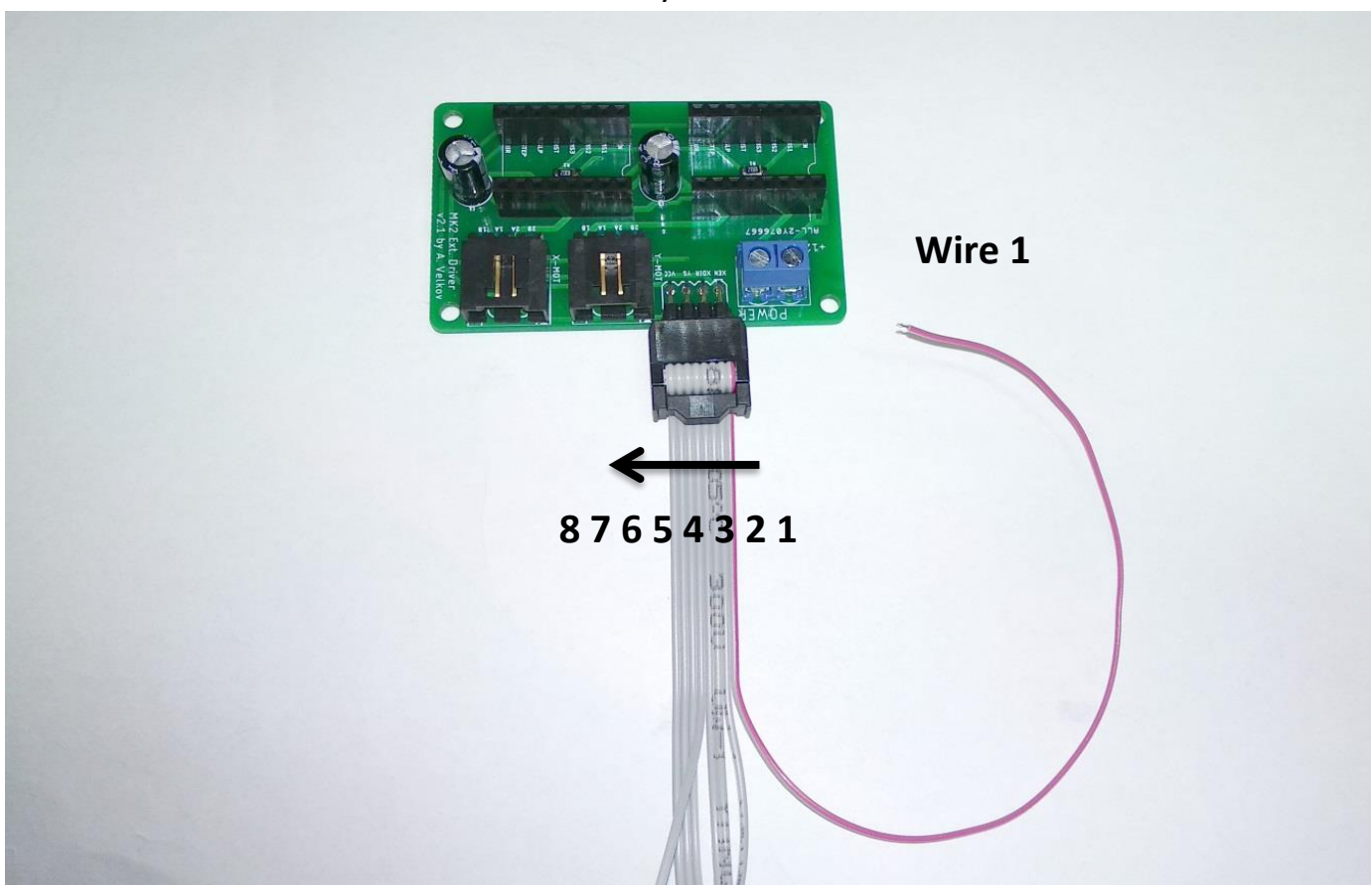
There's a hole on the bottom left of the PSU plastic cover where all cables enter, put the new cable through there and connect to the PSU as shown (red is +V and black is -V):



Assemble back the PSU and route the wires with the original power wires to the mini-Rambo box.

Next is soldering the data wires to the mini-Rambo board.

The data cable has 8 wires and they are counted like this:



Wires description:

The wire on the side of the blue power connector is always wire number 1 (**cable color could be red or grey**)

1. X-EN - has to be soldered to XEN pad on the mini Rambo
2. X-STEP – has to be soldered to XSTEP pad on the mini Rambo
3. X-DIR – has to be soldered to XDIR pad on the mini Rambo
4. Y-EN – has to be soldered to YEN pad on the mini Rambo
5. Y-STEP - has to be soldered to YSTEP pad on the mini Rambo
6. Y-DIR - has to be soldered to YDIR pad on the mini Rambo
7. VCC - has to be soldered to +5V pad on the mini Rambo
8. GND - has to be soldered to GND pad on the mini Rambo

Unfortunately you will have to solder all 8 wires to the back of the mini-rambo.

Carefully peel off all 8 wires of the data cable almost to the end of the cable. Length should be enough to reach the solder points on the mini-rambo. Tin all wire ends and cut the excess wire so that you end up with very short tinned end.

In order to solder the wires you'll have to unplug all cables and take the mini-rambo out of the box. Solder all wires on the back as shown below. (open the high res picture from the folder for clearer view)



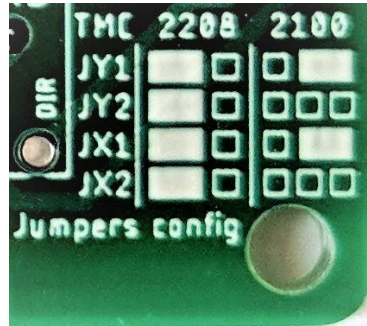


Next you'll have to solder the jumpers on the bottom of the ext. board according to the drivers/modes you want to use.

I suggest you use the TMC2208 or TMC2209 as they have a number of advantages over TMC2100. You can read more here:

<https://vmod.wordpress.com/2018/06/04/ext-driver-board-with-tmc2208/>

There's a quick cheat table on the right side of the ext. board on which jumpers to solder:



Here's the combinations for the TMC drivers:

TMC2208 / TMC2209 (solder all jumpers on the left side for **StealthChop2 mode**):



TMC2100 (solder JY1 and JX1 on the right side for SpreadCycle or **leave all unsoldered** for **StealthChop** which is the **recommended** mode):

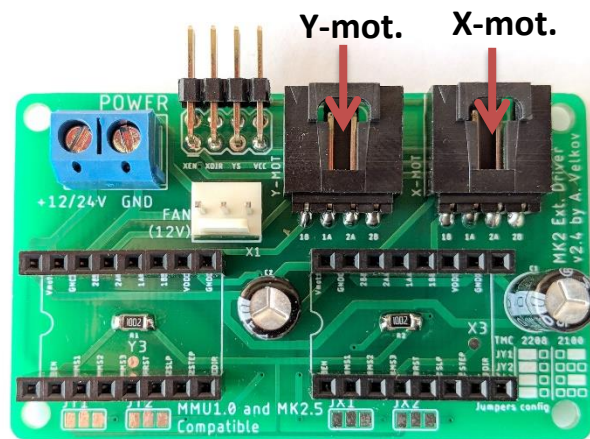


**Be careful not to short the other side of the jumpers when soldering! You WILL DAMAGE your mini-Rambo if you short both sides of any jumper!!**

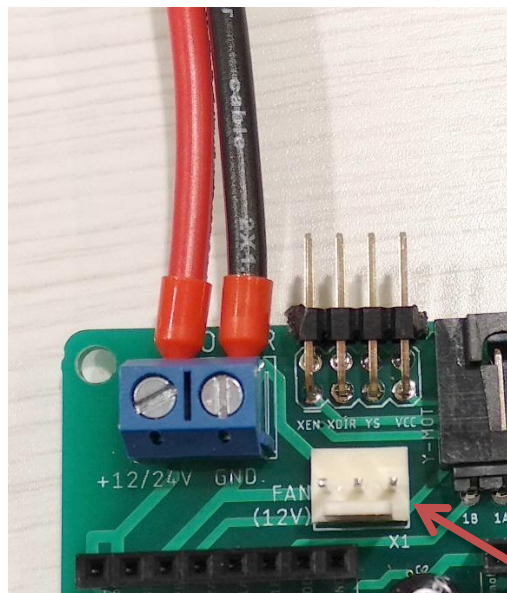


You can now assemble the mini-rambo back in the original box with all cables plugged back (except for X and Y motor cables). Replace the bottom two screws with longer ones, remove the nuts from the original box and place them on the Ext. driver board box. (I assume you have printed it, <https://www.thingiverse.com/thing:2777899>) Assemble the external driver board in the new box and secure the box to the original box with the two longer screws. (**note: If you're installing a voltmeter place it first before the external board, otherwise it won't be possible later**) You should now have all data wires soldered, mini-rambo back in place with all cables plugged and the new box secured on the outside.

You can now plug motor cables for X and Y motors in the external driver board:

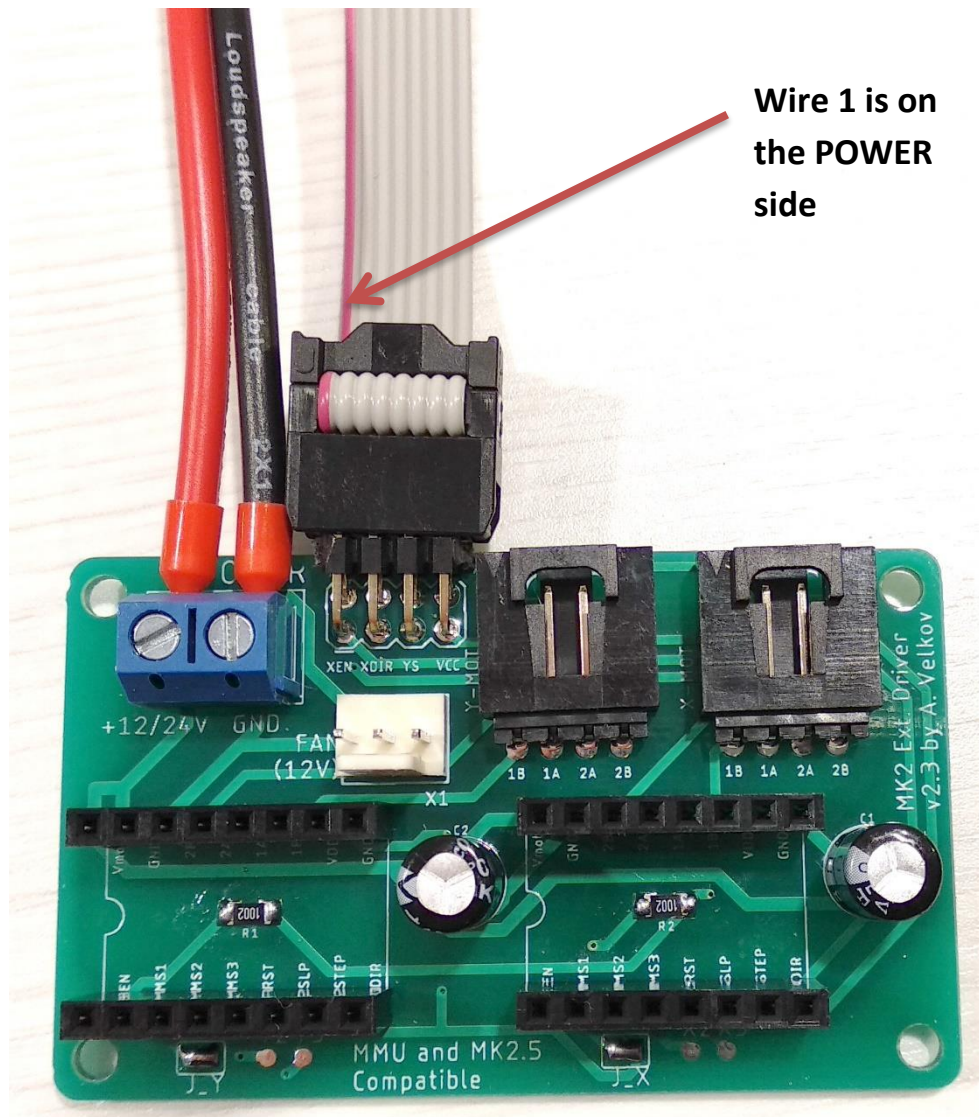


Next screw the power cables to the POWER socket, red is +12V, black is GND:



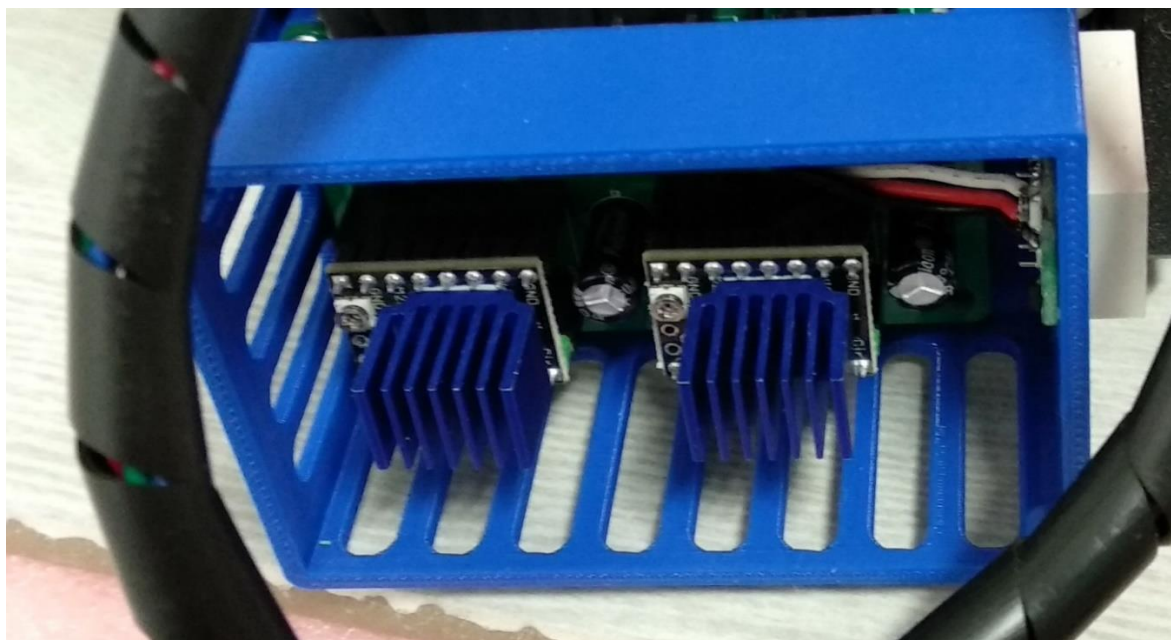
You can plug the optional 40x40 Noctua fan in the FAN socket on the board.

Next connect the Data connector to the external driver board so that wire number 1 is on the POWER side:



\*Note – picture is from v2.3 but it's the same wiring for v2.4

Now that you have all the wiring done you can plug the drivers to their places oriented with the pot trimmer/pot hole on the left side (TMC2208 have the pot on the bottom, so look for the hole to the pot). Example of TMC2100s plugged:

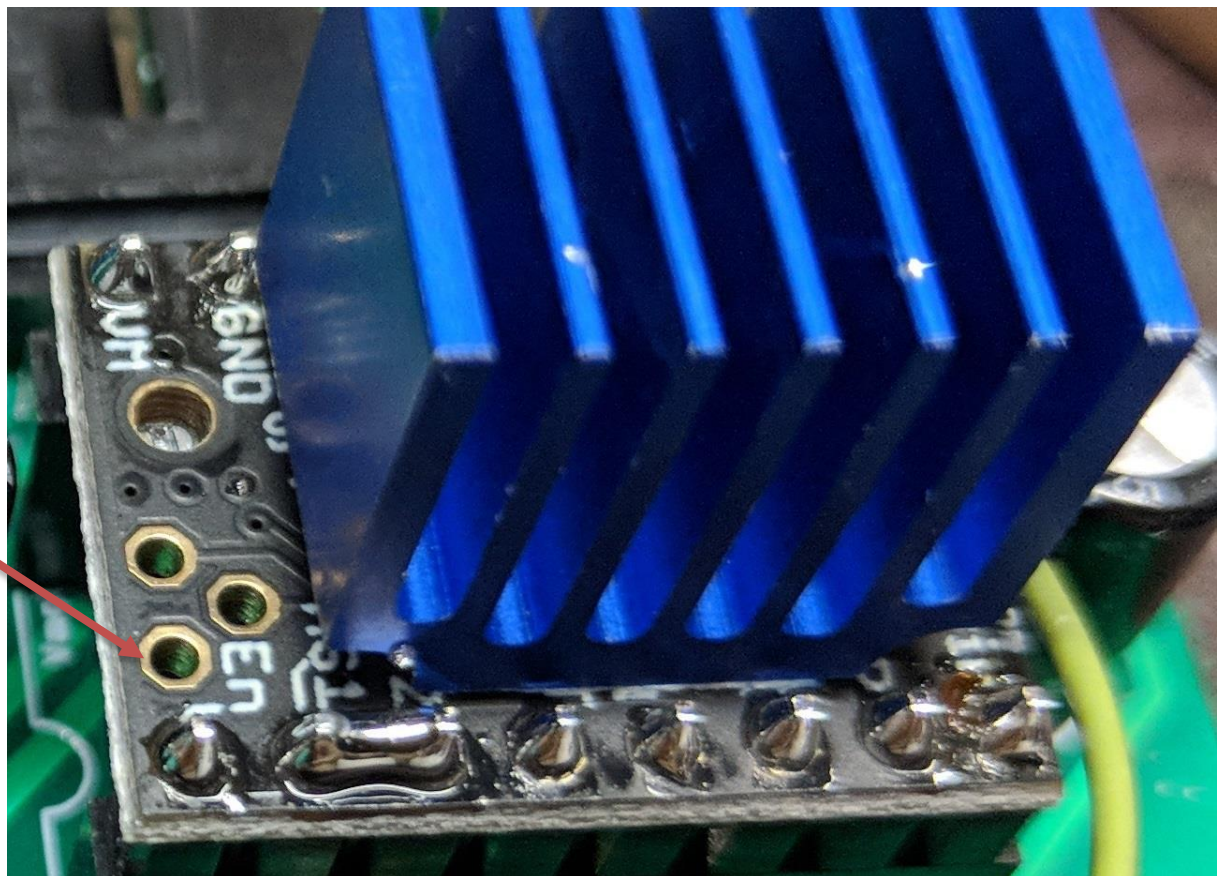




Check all wiring again before turning the printer on. Place bigger heatsinks if available on the drivers.

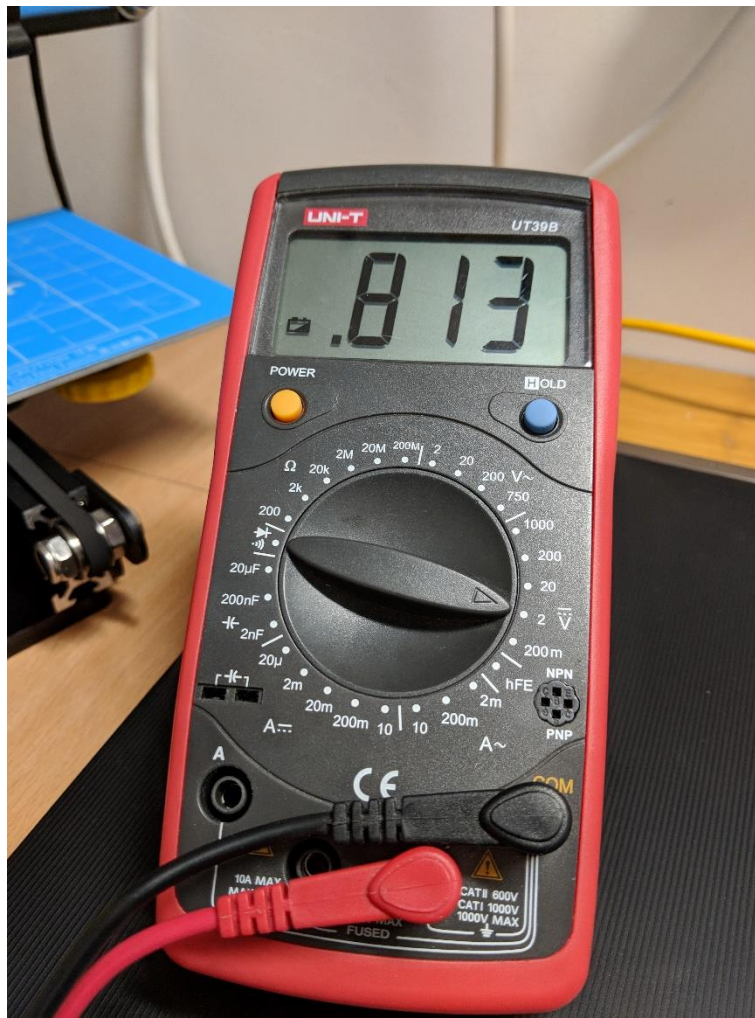
After powering on don't rush to print, follow this first:

1. Check X and Y motors movement directions (Settings -> Move axis). Move them from the menu one by one. Are directions correct?
2. Check if "Disable steppers" is working fine.
3. Now you have to set Vref on the drivers, but it depends on what bearings you have on your Prusa. If you have LM8UU original bearings set Vref to 0.81V. If you use IGUS I recommend to set Vref to 1V or replace them back with the original metal ones, because IGUS will cause more friction and may cause layer shifting...
4. Set the Vref voltages on both drivers to 0.81 V with multimeter, here's how:
  - Put the multimeter to small DC voltage range (2 – 5 volts, etc.)
  - Place the **Black lead to GND** on the **POWER** socket.
  - Place the Red lead to the **pot center** (TMC2100) or at the **Vref** pin (TMC2208 / TMC2209)



- **Be careful not to touch anything else with the Red multimeter lead!**
- Rotate the pot with **plastic** screwdriver slowly clockwise so that voltage gets to 0.81 V:





- Stepper motors will get hot during print, but this seems to be normal for the TMC drivers. Using plastic screwdriver will ensure you're not going to short anything. I've already burned one driver with metal screwdriver...

5. Do XYZ calibration, and first layer calibration.

(<http://www.youtube.com/watch?v=JqH41K2vq0g&t=9m50s>)

X and Y stepper movement should be normal and quieter than before.

Before making the first print assemble the box cover with the optional Noctua fan. Cooling the drivers will be your second assurance for normal operation and no layer shifting.

Finally – enjoy your new silent printer! Happy printing!

## Basic troubleshooting:

### **1. Strange noise during mesh bed levelling or high speeds:**

Read this: <https://vmod.wordpress.com/2018/07/09/tmcs-and-rubbing-sound-during-mesh-bed-levelling/>

### **2. If X or Y motors are not moving you have a couple of reasons why:**

- Check connection of wire 2 for X and wire 5 for Y.
- Check connection of wire 1 for X and wire 4 for Y.
- There's no power to the external board, check the voltage on the power socket with multimeter (Red lead to 12V and Black to GND).
- There's no 5V power to the stepper drivers, check wires 7 and 8. check the voltage between them with multimeter, should read 5V)
- Vref is too low. Set Vref according to the manual above.
- The stepper driver is faulty. I've seen this with some Chinese clones. Turn the printer off and swap the two TMCs. If now the other axis is not moving then you have either wiring problem or driver is faulty.

### **3. "Disable steppers" is not working:**

- Check connection of wire 1 for X and wire 4 for Y

### **4. Motor is moving only in one direction despite what you command from the LCD:**

- Check connection of wire 3 for X and wire 6 for Y

### **5. XYZ calibration fails:**

- Increase Vref with 0.05V on both stepper drivers. Repeat if it appears again.

### **6. Layer shift in X or Y axis:**

- Check for hard movement on both directions.
- Increase Vref with 0.05V on the affected axis stepper driver. Repeat if it appears again.