

# External Driver Board v2.1 with MK2.5

## 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.

Ok, so you bought the old version of the ext. driver board (v2.1), but you want to install it with **MK2.5 upgrade or any other current or future upgrade**. This manual starts from the beginning but if you have it already installed you can skip some of the steps. Here's two important things to know before proceeding with this mod:

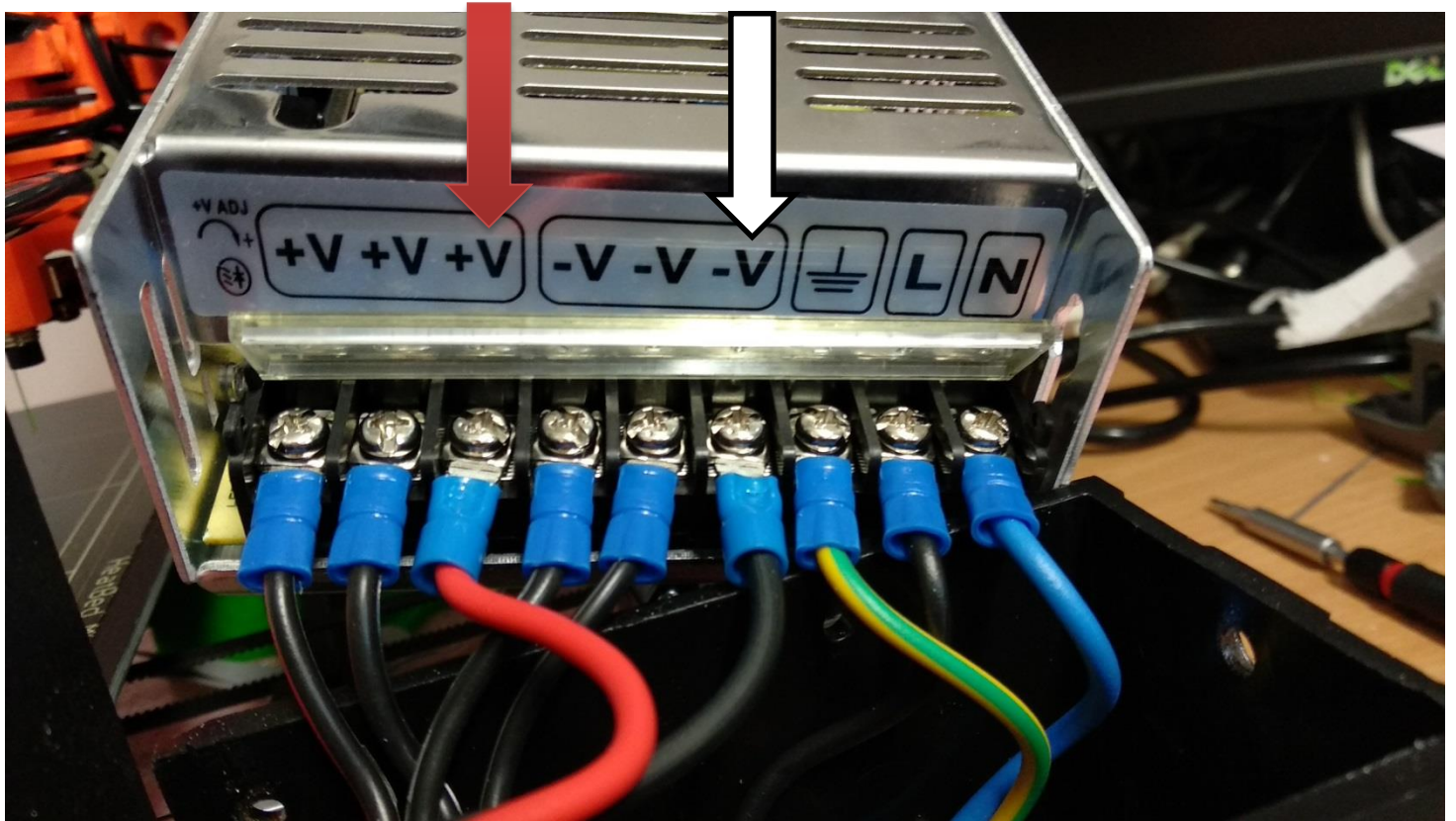
1. **By soldering on the back of your mini-rambo and changing motor connector pins you're practically voiding your prusa warranty!**
2. **I take no responsibility if you mess this modification up and/or damage your printer. You need to have basic soldering skills. Do at your own risk, or get someone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

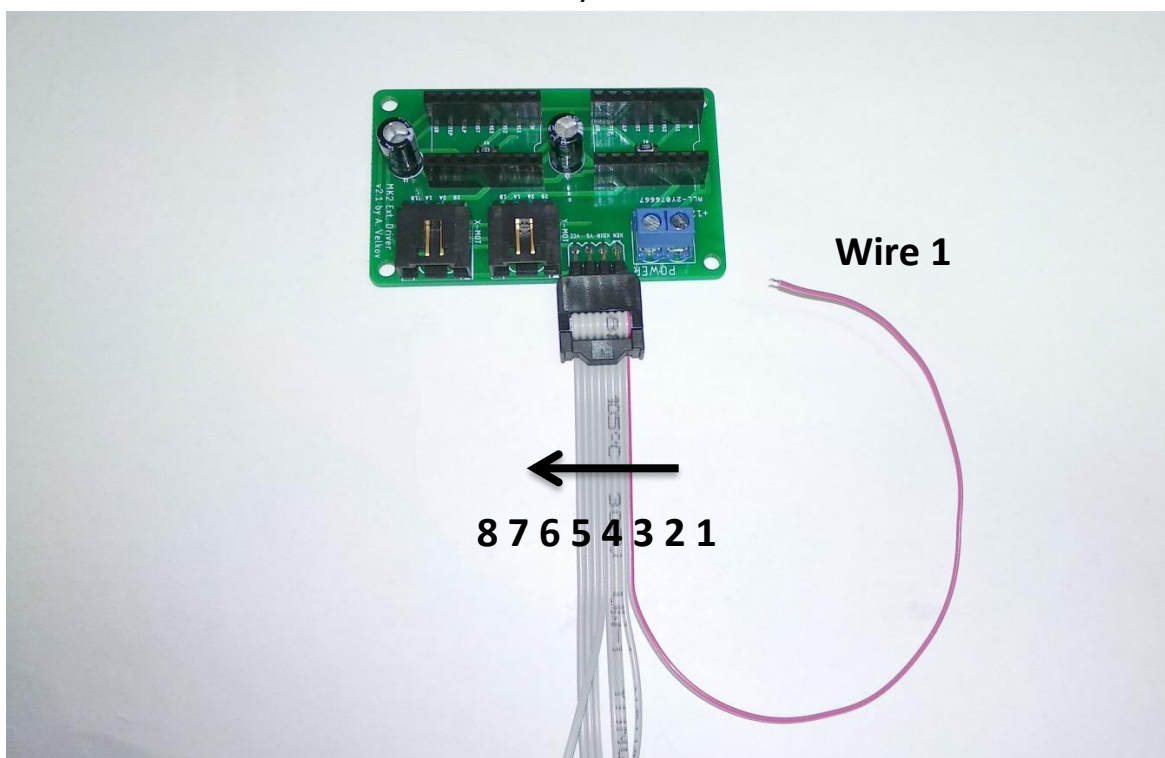


There's a hole on the bottom left of the PSU plastic cover where all cables enter, put the new cable through there and connect to the PSU as shown (red is +V and black is -V):



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 single 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.

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)





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.

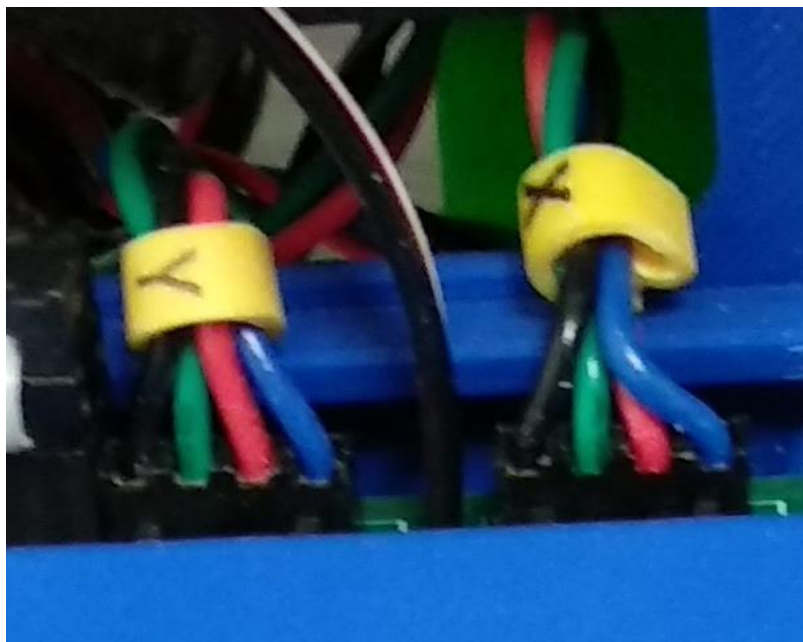
Now there's one more thing you need to do. The new stepper drivers (TMC2100) have their motor direction naturally reversed with regards to the old drivers on the mini-rambo. So there's two ways to fix this:

1. Use the original motor connector wiring and recompile the original prusa firmware with **INVERT\_X\_DIR** and **INVERT\_Y\_DIR** both set to **"true"** (located in Configuration.h)
2. Physically reverse the pins on the X and Y motor connectors and use the original untouched prusa firmware.

So for the first option, if you got this far you should already know how to compile and flash your own custom firmware. If not, let me know so I can send you the current re-compiled firmware for MK2.5 .

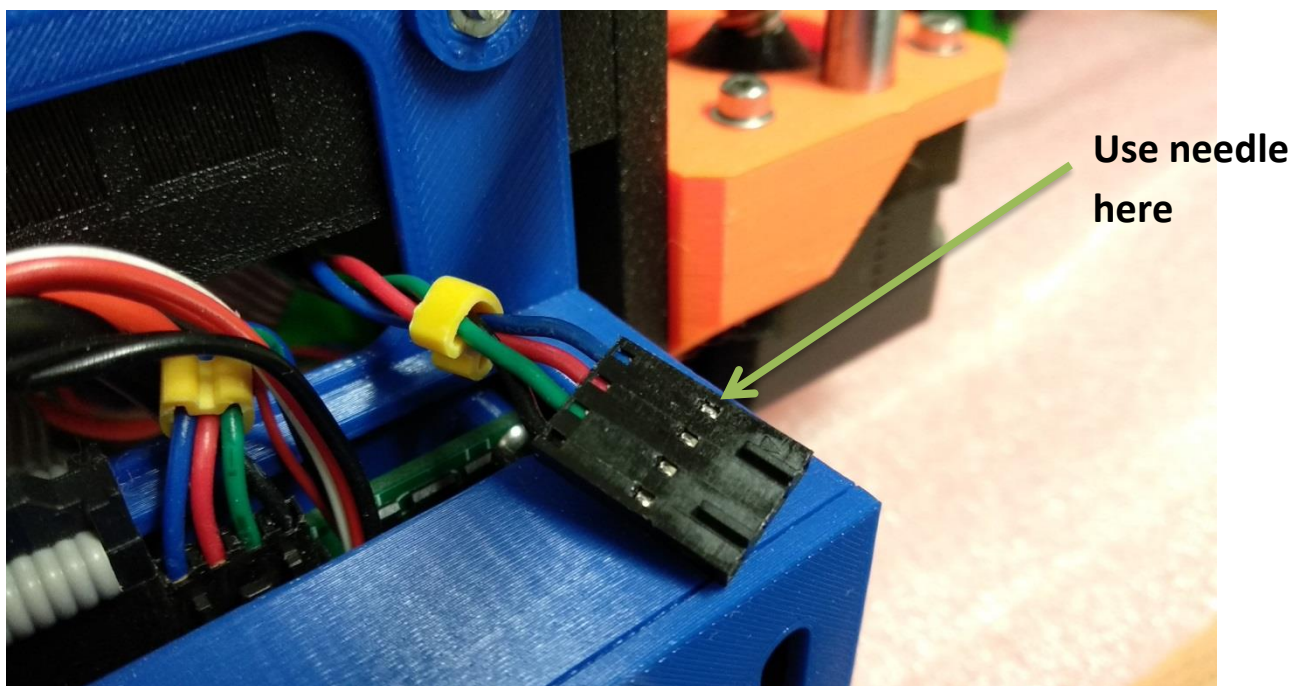
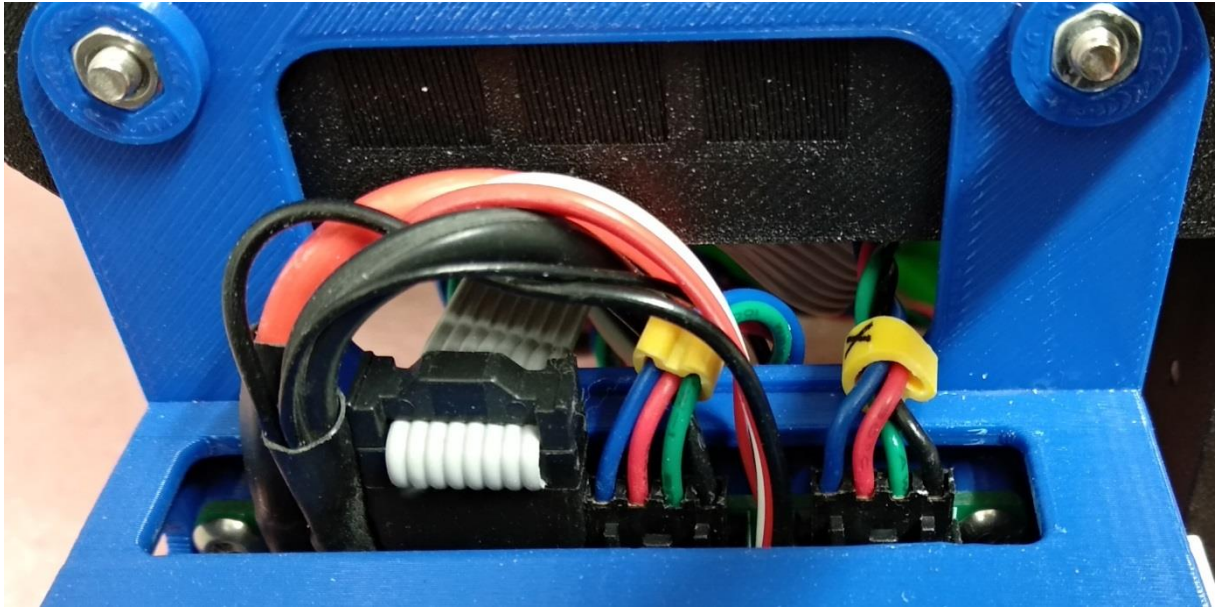
We'll continue with the second option.

So, we need to invert (switch) all wires on the X and Y motor connectors. Since connectors cannot be plugged in the opposite way you'll have to use a small needle to pull all pins from the connectors and plug them back in reverse order:  
Original wiring: Left to right – **Black, Green, Red, Blue**



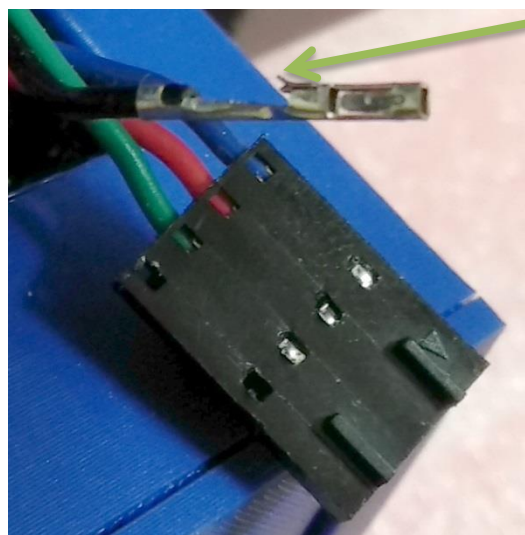


New wiring: Left to right – **Blue**, **Red**, **Green**, **Black**

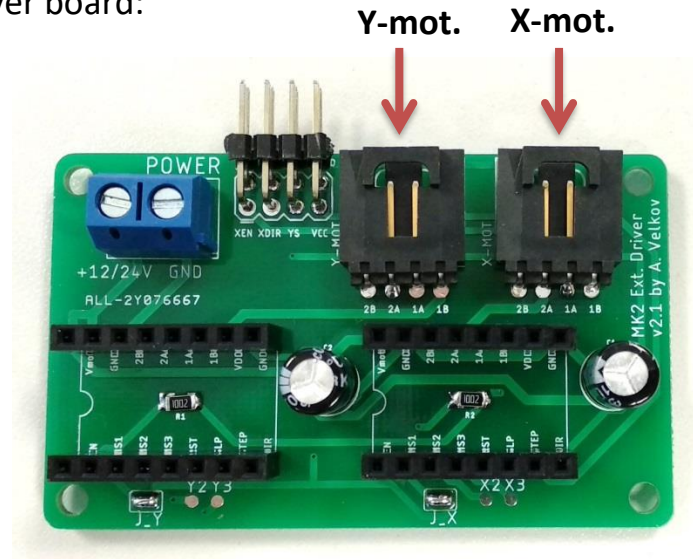


There's a small metal part that's preventing the pin to come out, you'll have to push it down with the needle. When assembling back you'll have to pull it back up in order for the connector to be pluggable again:

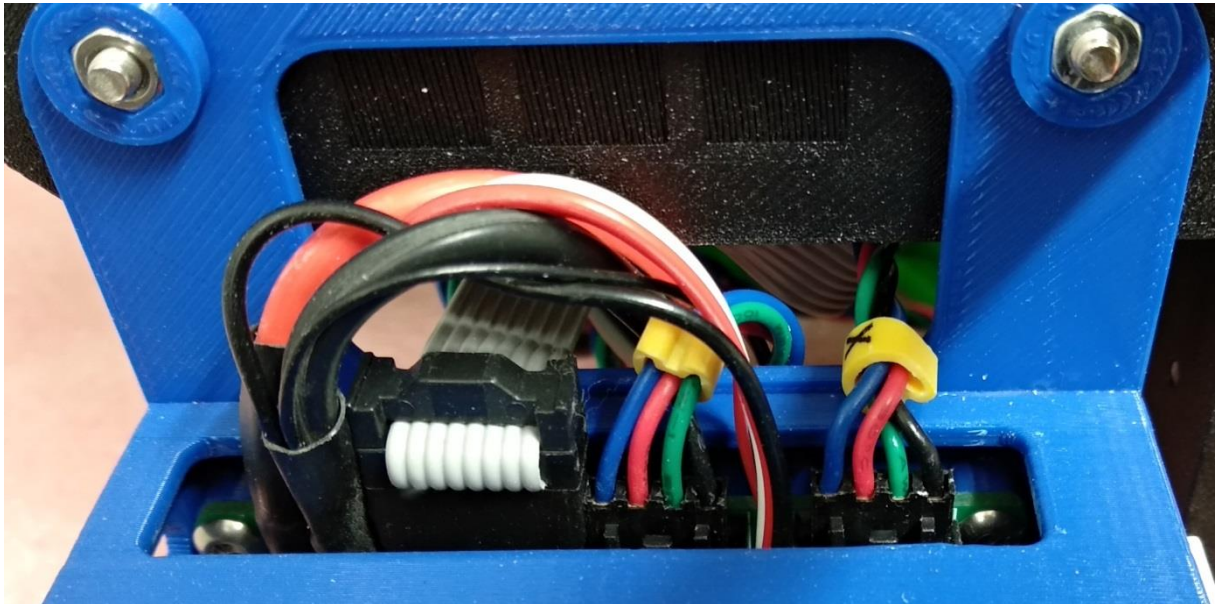
**Attention!**



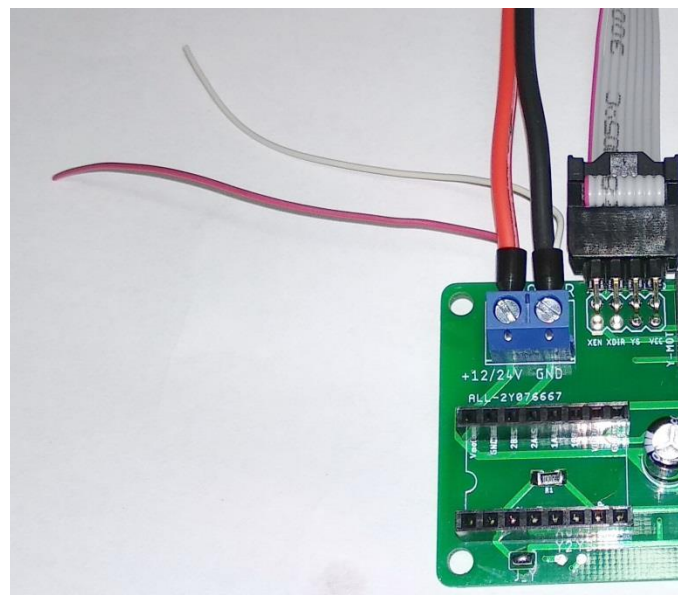
When you're done reversing the two motor connectors you can plug them in the external driver board:



Wire colors should look like this:

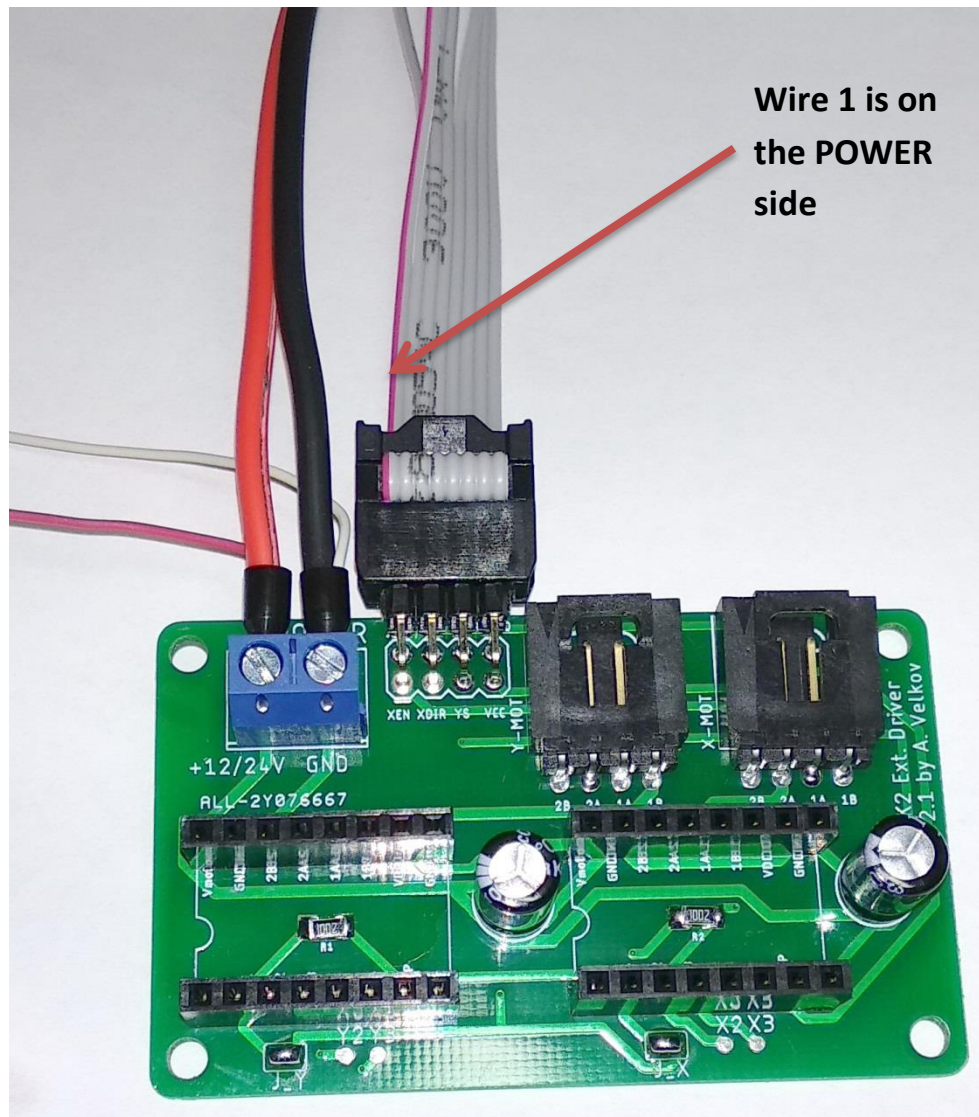


Next screw the power cables to the POWER socket, red is +12V, black is GND:



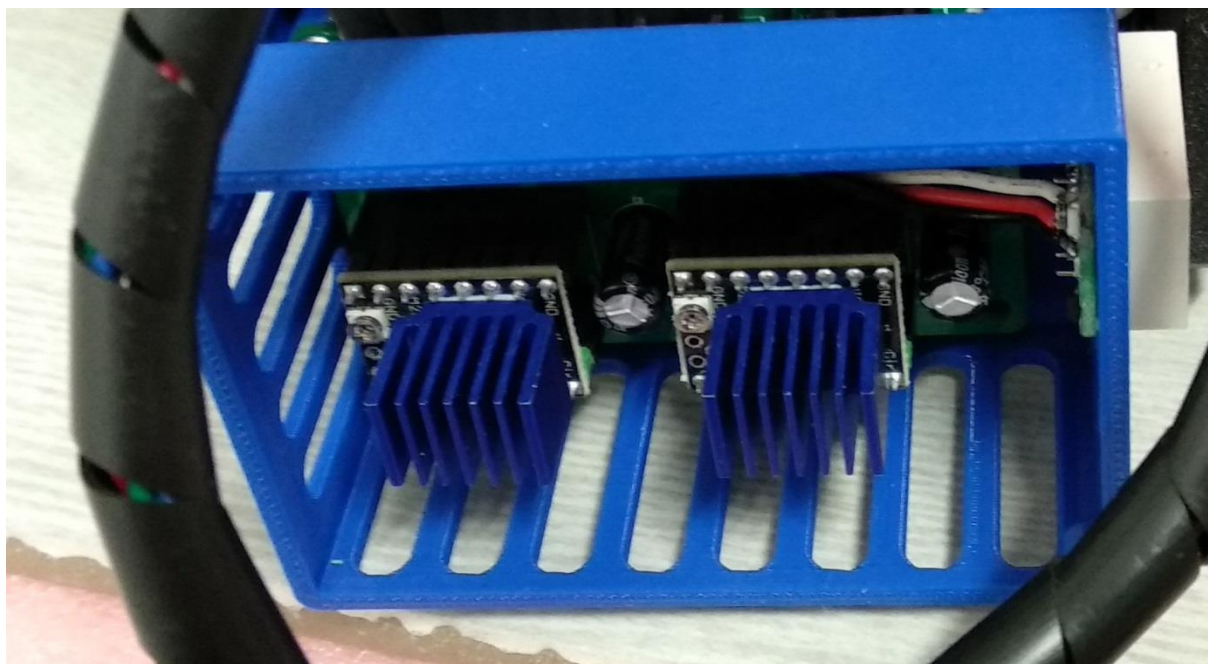


Lastly connect the Data connector to the external driver board so that wire number 1 is on the POWER side:





Now that you have all the wiring done you can plug the TMC2100 drivers to their places oriented with the pot trimmer on the left side:



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:**

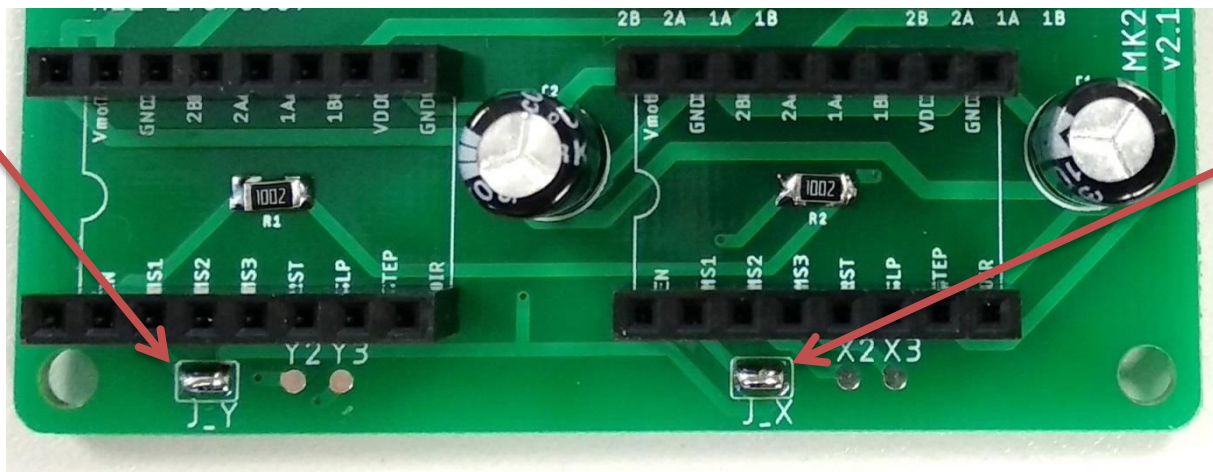
1. Check X and Y motors movement directions (Settings -> Move axis). Move them from the menu one by one. Are directions correct?
2. Check if "Disable steppers" is working fine.
3. Now you have to set Vref on the drivers, but it depends on what bearings you have on your Prusa. If you have LM8UU original 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 or at the Vref pin if your driver has the pot on the bottom side.
  - 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 TCM2100 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.

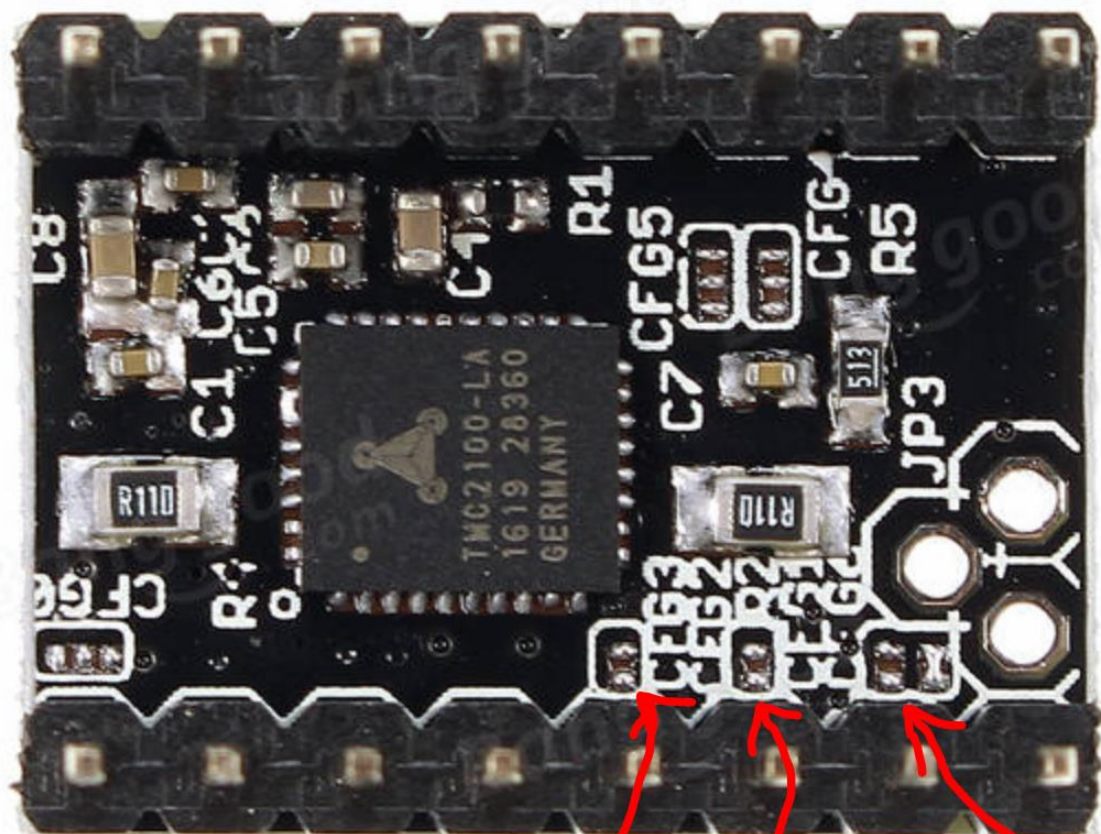
Note that if you purchased original Watterott drivers they are configured by default for 1/16<sup>th</sup> SpreadCycle mode via the two jumpers on my board. You will probably hear whining or hissing in this mode.

To get the 1/16<sup>th</sup> StealthChop (silent) mode you have to desolder the X and Y jumpers here:



This is only for the original Watterott drivers.

If you purchased chinese clone drivers (MKS etc., black PCB) you'll be already running in 1/16<sup>th</sup> StealthChop mode as those have their CGF pins floating and they are not affected by the jumpers on my board.



CFG 3

CFG 2

CFG 1



You can read more about this here:

<https://vmod.wordpress.com/2018/05/02/important-news-about-the-tmc2100-drivers/>

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 MK2.5 printer! Happy printing!

Basic troubleshooting:

1. 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 TMC2100s. If now the other axis is not moving then you have either wiring problem or driver is faulty.
2. "Disable steppers" is not working:
  - Check connection of wire 1 for X and wire 4 for Y
3. 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
4. XYZ calibration fails:
  - Increase Vref with 0.5V on both stepper drivers. Repeat if it appears again.
5. Layer shift in X or Y axis:
  - Check for hard movement on both directions.
  - Increase Vref with 0.5V on the affected axis stepper driver. Repeat if it appears again.