

MK2(S) External Driver Board

Installation Manual

Detailed features and description can be found on the blog page here:

<https://vmod.wordpress.com/prusa-mk2s-ext-driver-board/>

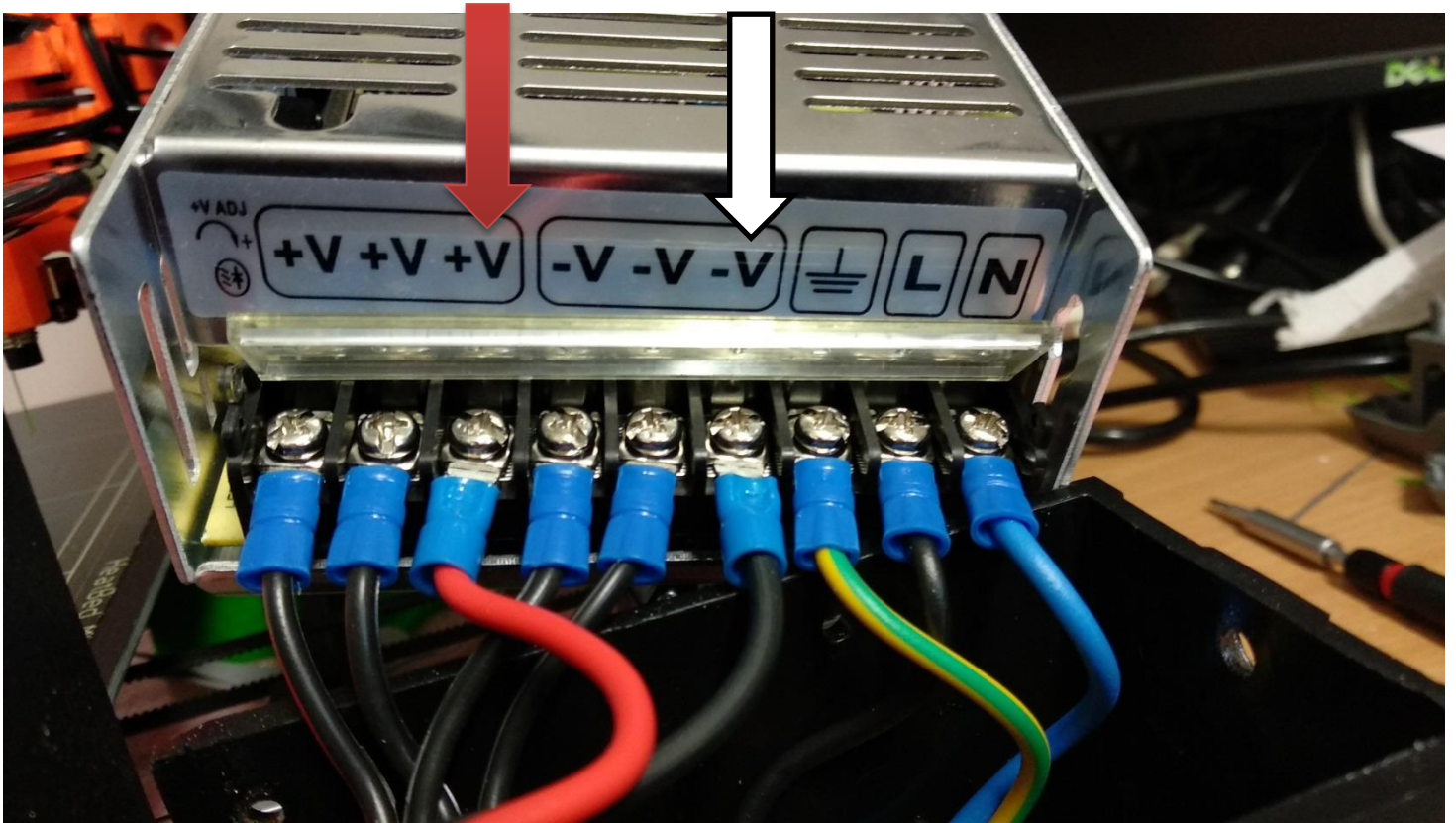
Thanks for supporting this project! I'll try to guide you as best as I can, but I will not go to the simple details as how to place the nuts on their place and put together a box, I assume you're good enough to do this.

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:

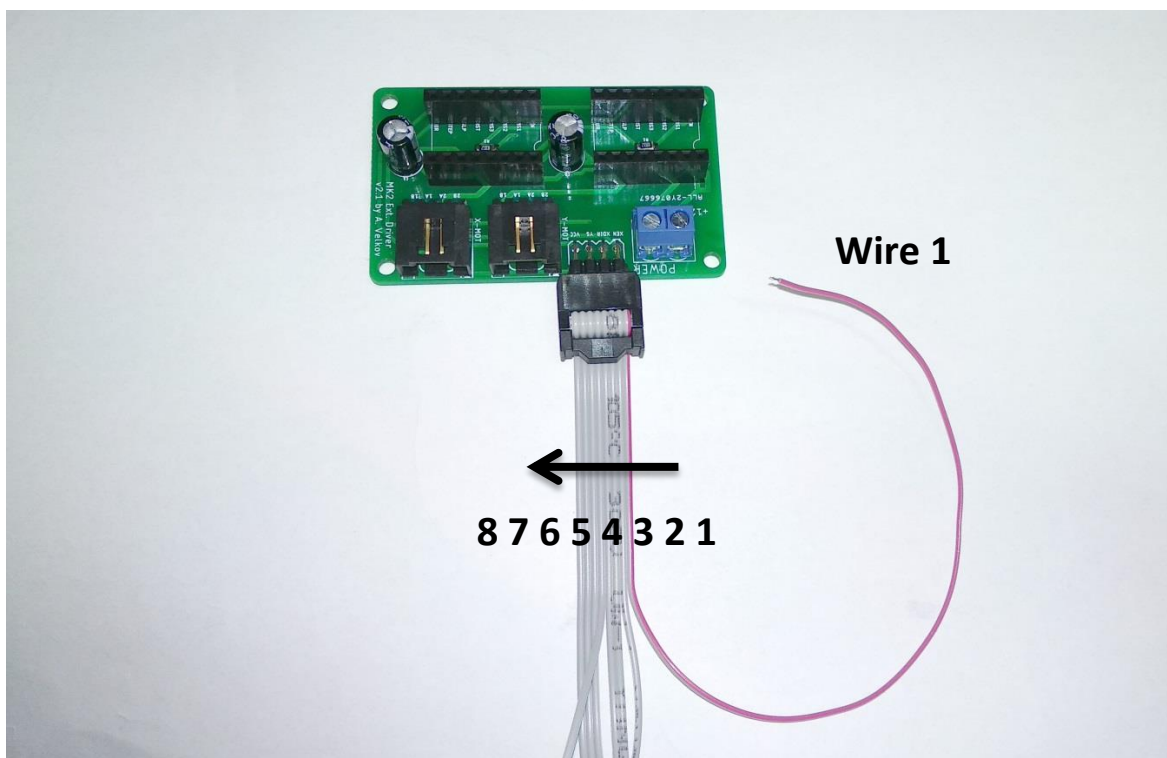


There's a hole on the bottom left of the PSU plastic cover where all cables enter, put the new cable through there and connect to the PSU as shown (red is +V and black is -V):



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

Next is plugging the data wires to the mini-Rambo board. The data cable has 8 wires and they are counted like this:

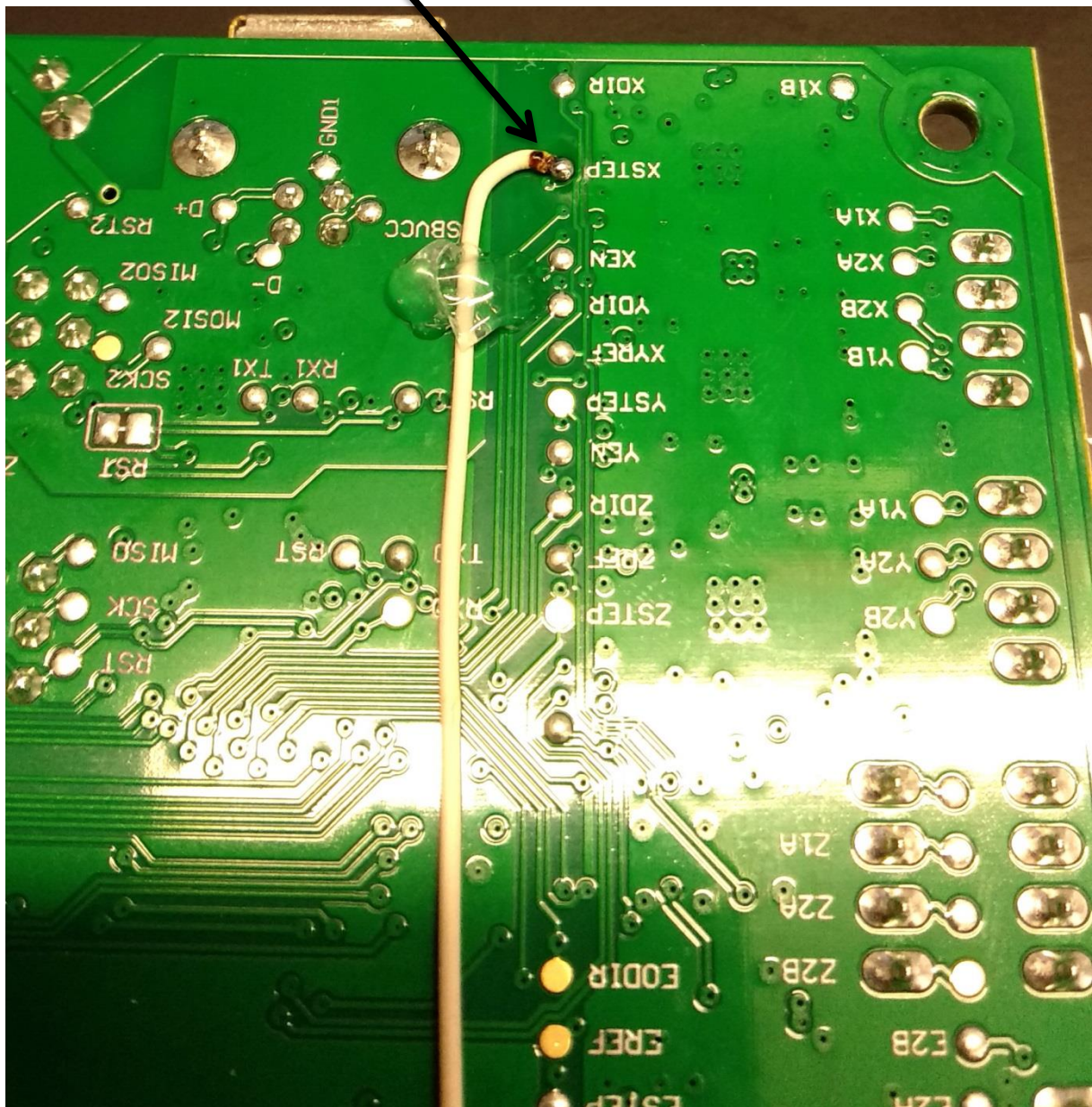


Wire description:

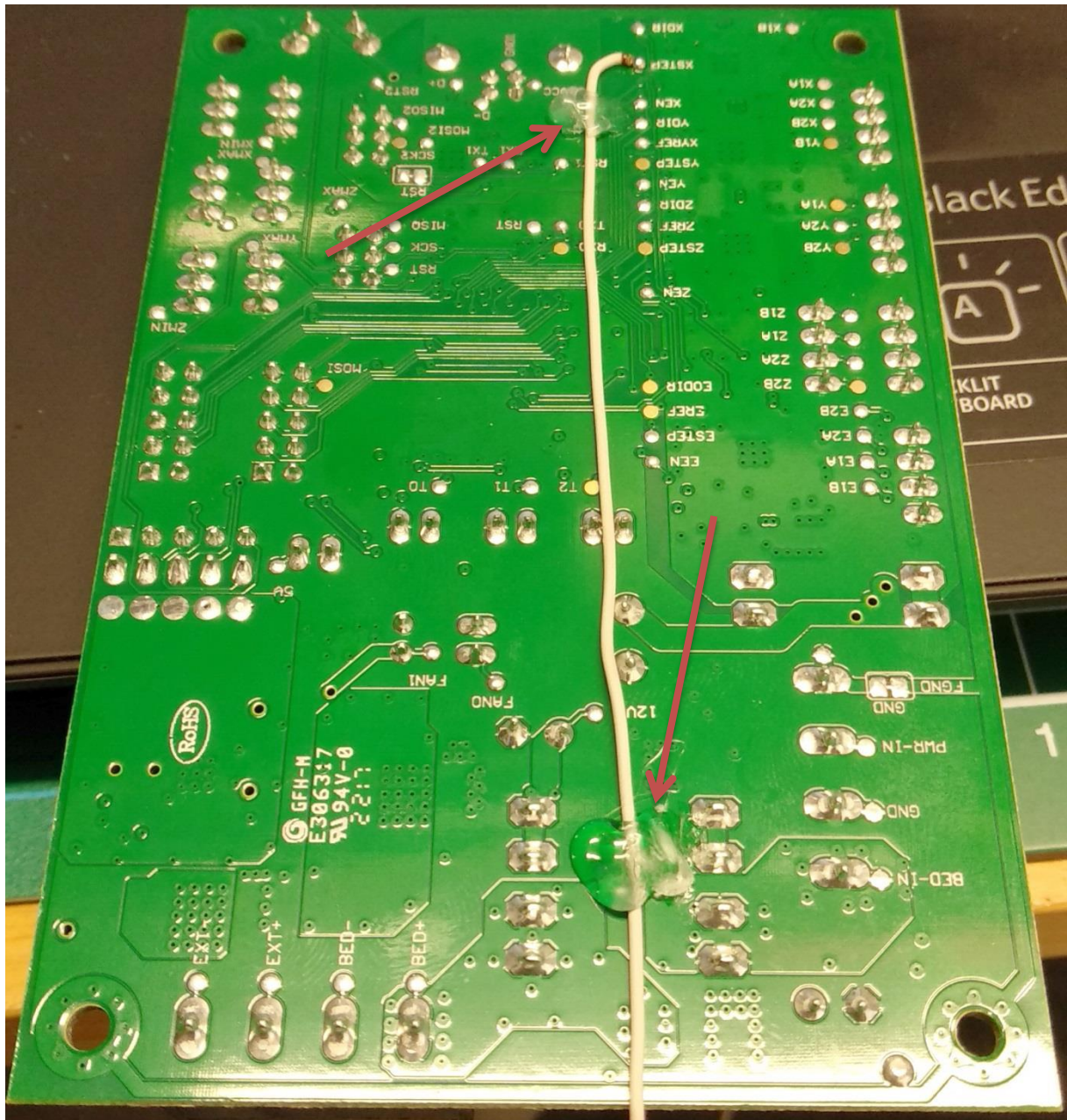
The single wire without connector is always wire number 1. (cable color could be red or grey)

1. X-En - has to be soldered to XSTEP pad on the mini Rambo (explained later)
2. X-Step – goes to Z-Max socket
3. X-Dir – goes to pin 6 on the P3 socket
4. Y-En – goes to pin 8 on the P3 socket
5. Y-Step - goes to Y-Max socket
6. Y-Dir - goes to X-Max socket
7. VCC - goes to X-Max socket
8. GND - goes to X-Max socket

In order to solder wire number 1 to the mini Rambo you'll have to unplug all cables and take the board out of the box. Solder the wire to the XSTEP test pad as shown below:

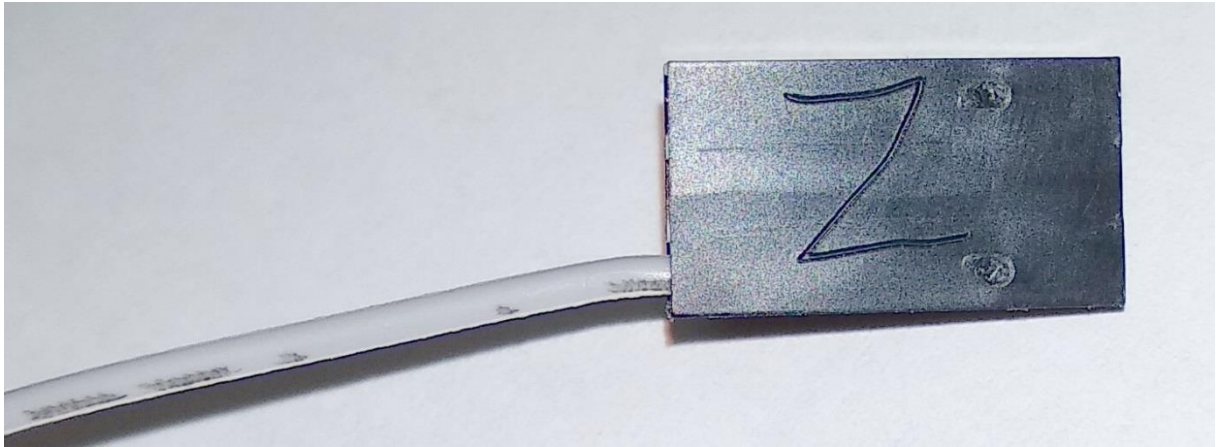


Route the wire down and secure it with some hot silicone. This will prevent cutting the wire from vibrations etc:

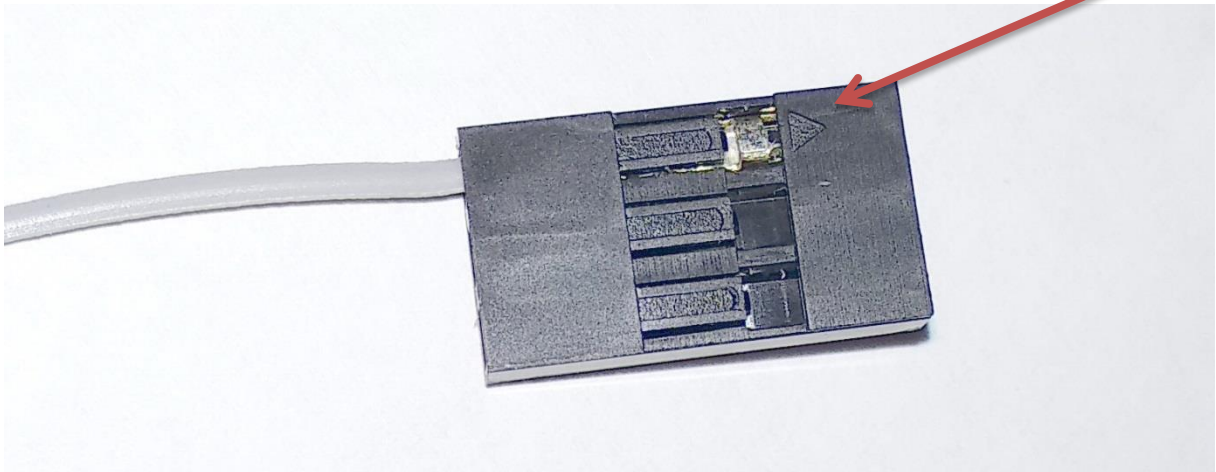


You can now assemble the mini-rambo back in the original box with all cables plugged back (except for X and Y motor cables). Replace the bottom two screws with longer ones, remove the nuts from the original box and place them on the Ext. driver board box. (I assume you have printed it, <https://www.thingiverse.com/thing:2777899>) 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 wire number 1 soldered, mini-rambo back in place with all cables plugged and the new box secured on the outside with no cables plugged to the external driver board. We'll plug them later.

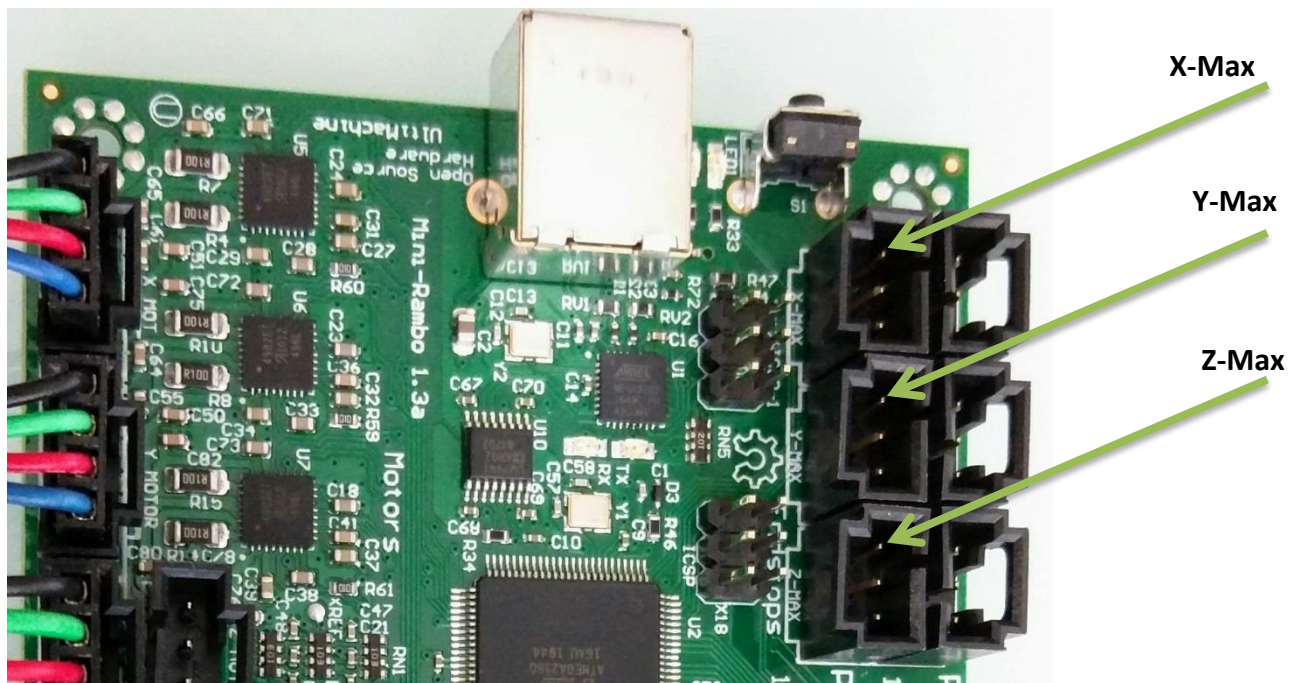
Let's continue with the rest of the data wires. I've written a letter on every 3 pin connector like this:



This means this connector goes to the Z-Max endstop socket on the mini-rambo. Same goes for the X and Y connectors. There's one more thing you must follow – every connector has an arrow on the other side:

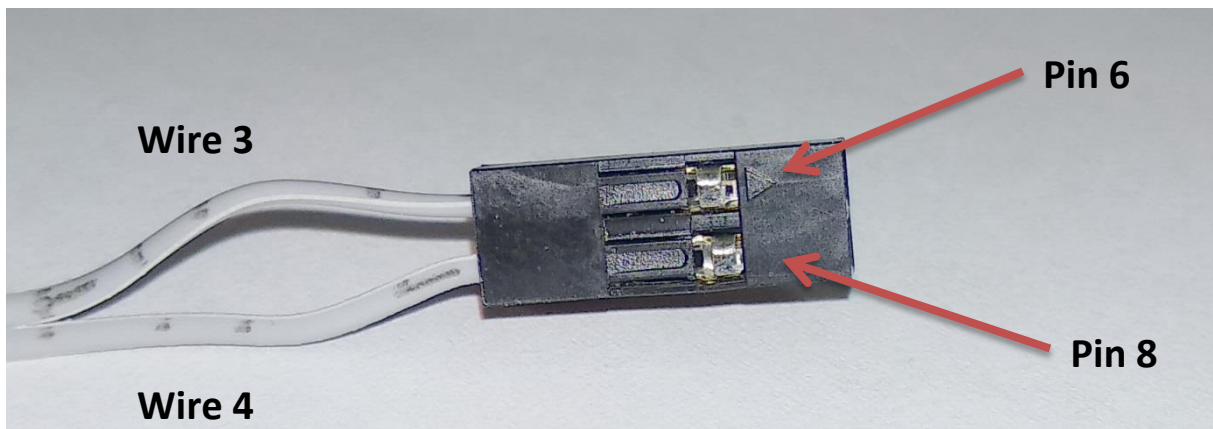


This is the sign on how to plug the connector in the socket. The arrow must be on the upper side when plugging to the X,Y and Z max sockets, like this:

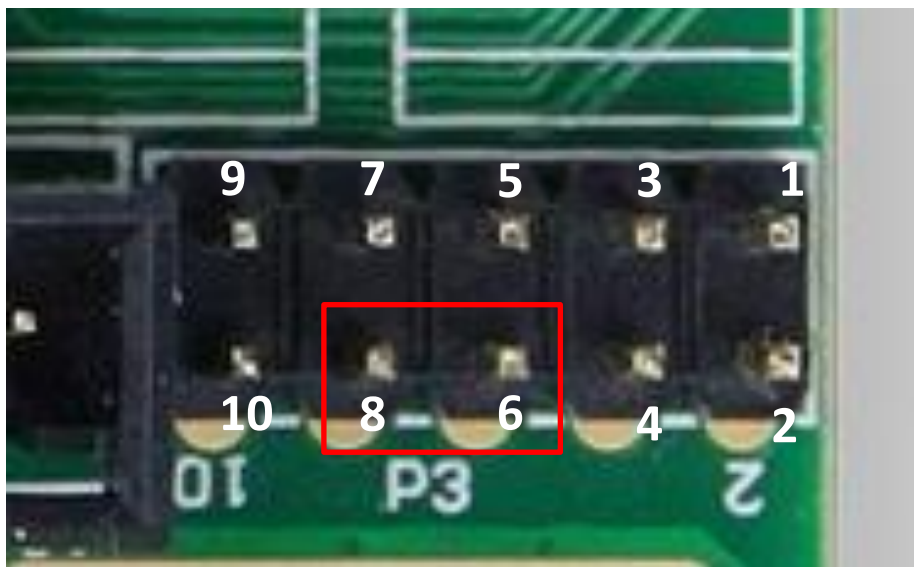


Take caution to plug them in the correct orientation. Plug the X, Y and Z connectors to their respectful sockets (X-Max, Y-Max, Z-Max) on the mini-Rambo.

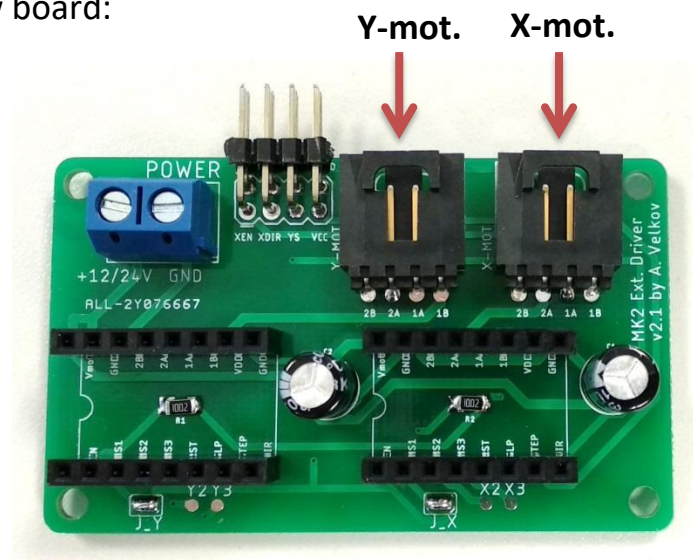
Now there's only one 2 pin connector left:



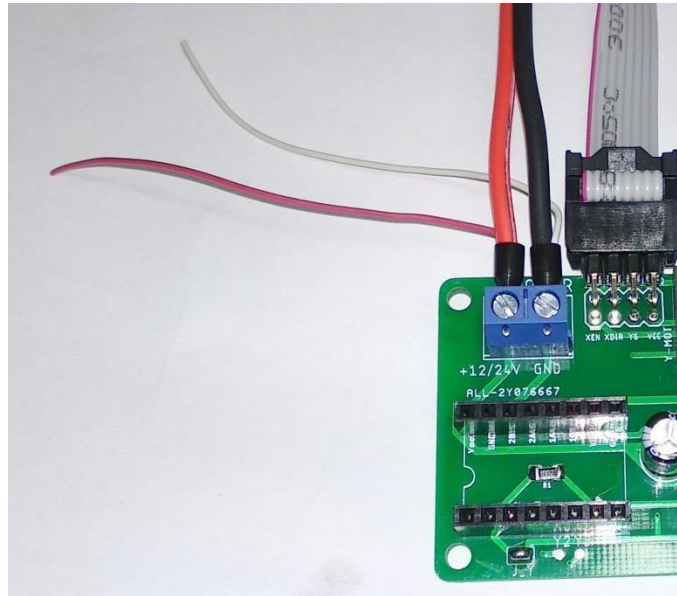
You connect it to pins 6 and 8 on the P3 socket (located below the LCD sockets):



Next unplug the X and Y motor wires from the mini Rambo, route and plug them in the new board:

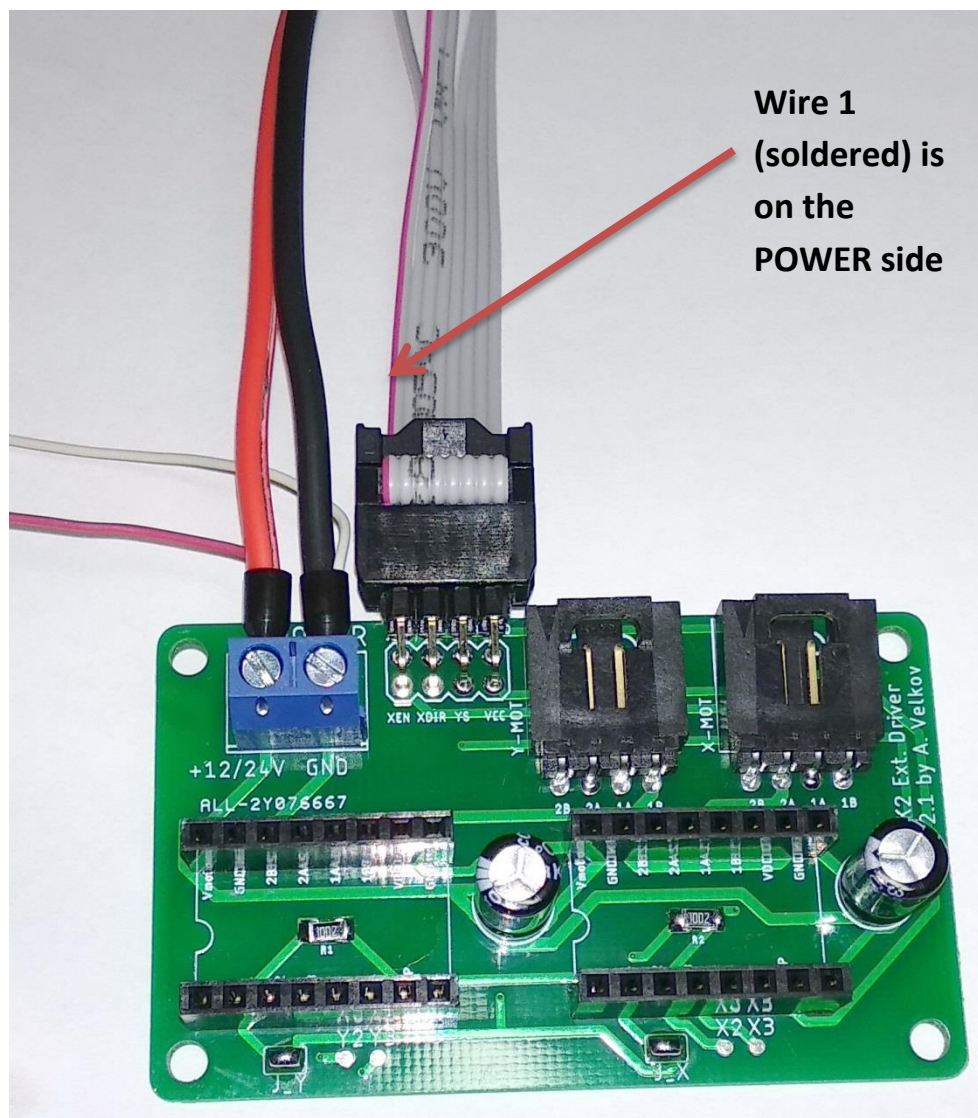


Next screw the power cables to the POWER socket, red is +12V, black is GND:

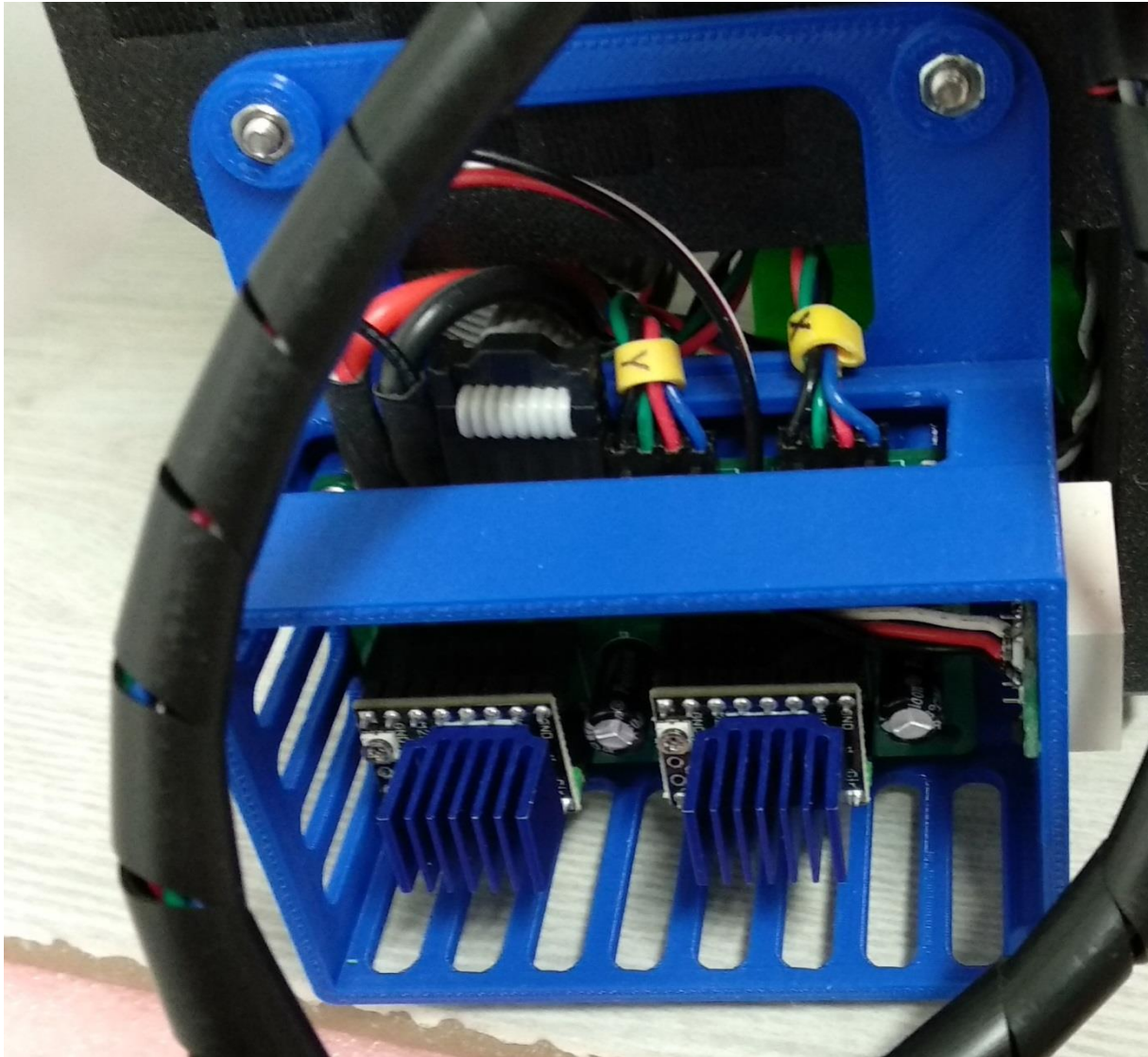


The two extra wires are for the optional 40x40 Noctua fan and voltmeter. Connect them if needed or **insulate** them if not needed.

Lastly connect the Data connector to the external driver board so that wire number 1 (the soldered wire) 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:



Everything should look like on the picture above. Check all wiring again before turning on the printer. Place bigger heatsinks if available on the drivers.

Now we're ready to flash the modified firmware to the mini-Rambo. Download the ZIP file with the firmware from here (currently v3.1.0):

https://drive.google.com/file/d/1ZUJ4TQwXW29yG_LHIU8oj9F0EPkxLeVB/view?usp=sharing

Inside you'll find the original firmware for MMU and the standard printer and the modified ones for the external driver board. Turn on the printer and upload the desired firmware (in our case: 1_75mm_MK2-RAMBo13a-E3Dv6full_Ext_Driver_Board.hex) with the original Prusa Firmware Updater tool. You can follow the Prusa guide here (from Step 4):

<http://help.prusa3d.com/l/en/article/r5ByKgVm69-firmware-upgrade-and-flashing>

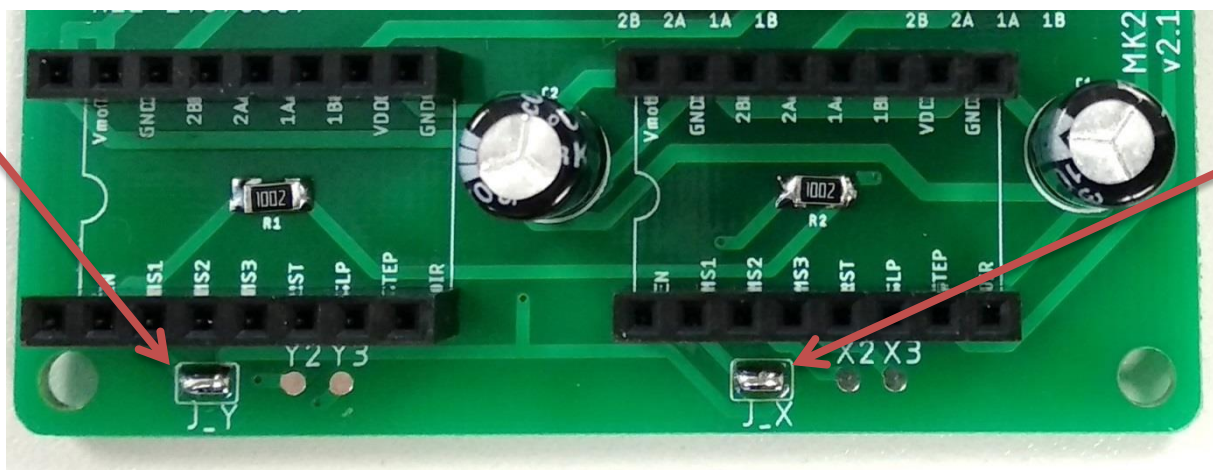
After successful update don't rush to print, follow this first:

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. Set the Vref voltages on both drivers to 1V 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 so that voltage is 1V. I run mine at this voltage. 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...
4. 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. The two drivers are configured by default for 1/16th SpreadCycle mode, which is the recommended one.

If you want to experiment you can turn on the 1/16th StealthChop mode by desoldering the X and Y jumpers here:



This will make it even quieter but will reduce the motor current and you might experience layer shifting. I don't recommend this mode.

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(S) printer! Happy printing!

Basic troubleshooting:

1. If X or Y motors are not moving you have a couple of reasons why:
 - You have placed a connector the wrong way at the mini-rambo. Remember that the arrow on the connector should be on the upper side of the socket. Check again.
 - 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).
 - 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