



PRUSA I3 ELECTRONICS AND SOFTWARE GUIDE

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1 Introduction

Welcome to part 2 of your DIYElectronics Prusa i3 kit assembly guide! In this section we will discuss how to connect your electronics, setup your software and test your printer. Please follow this guide carefully, especially with the electronics since they are delicate! Never work on your electronics with the power on or the USB plugged in and avoid shorting the electronics with anything metallic as this is the fast track to disappointment.

1.1 Helpful Symbols



Warning! Please read the following text carefully!



Information: Useful tip, note or advice to help you along.

2 Electronics and Wiring

This chapter deals with the installation and setup of your 3D printer electronics.



Warning: Be careful when assembling the electronics, they are delicate!

- Make sure you note wiring and connector orientations correctly and make sure you have no short circuits.
- If you live in a low humidity area with large amounts of static electricity (E.G. Johannesburg) we suggest you use an anti-static mat for this part of the assembly.



Note: Your RAMPS board is assembled with motor drivers installed and the correct firmware loaded. The assembled boards have been fully tested to ensure you have a printer up and running with minimal fuss.

2.1 Electronics Wiring Reference Diagram

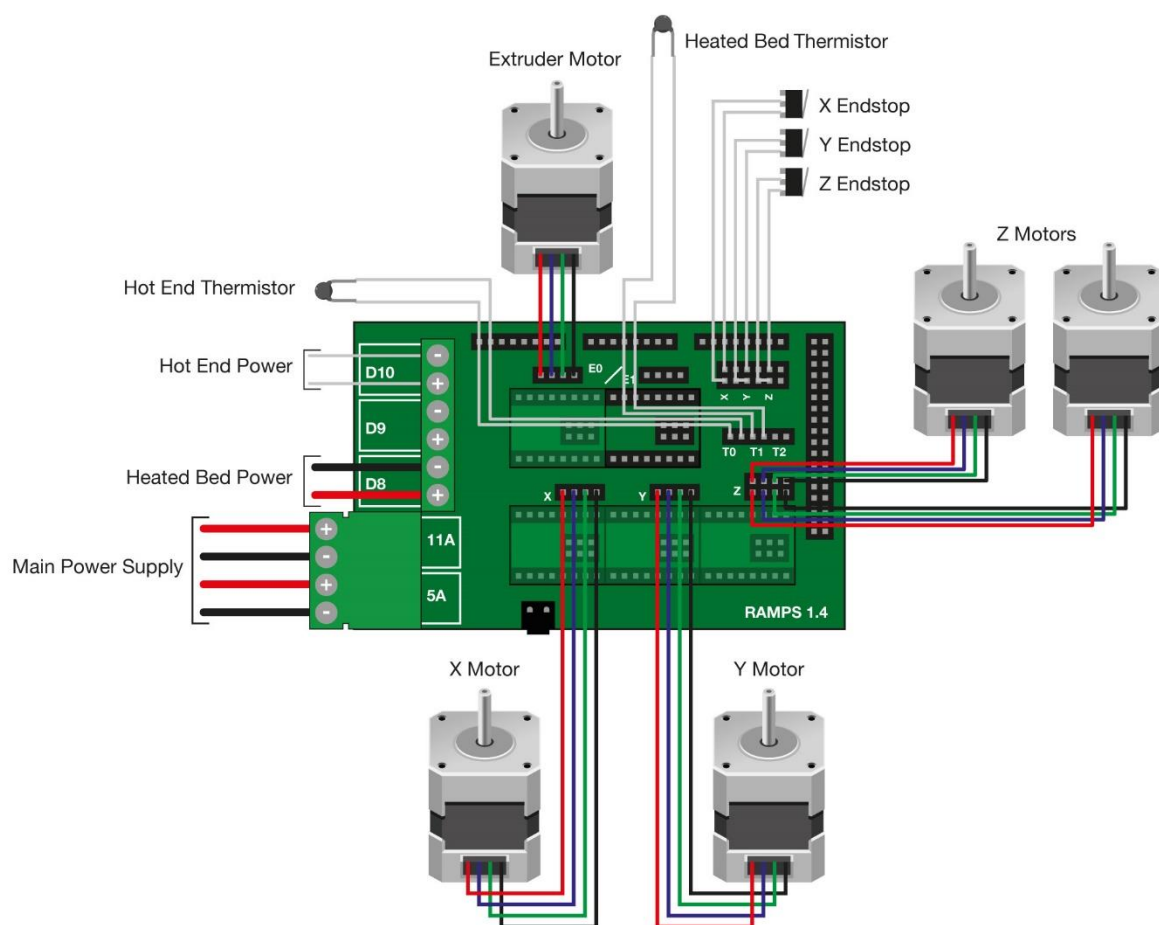


Figure 1 - Electronics Wiring Reference

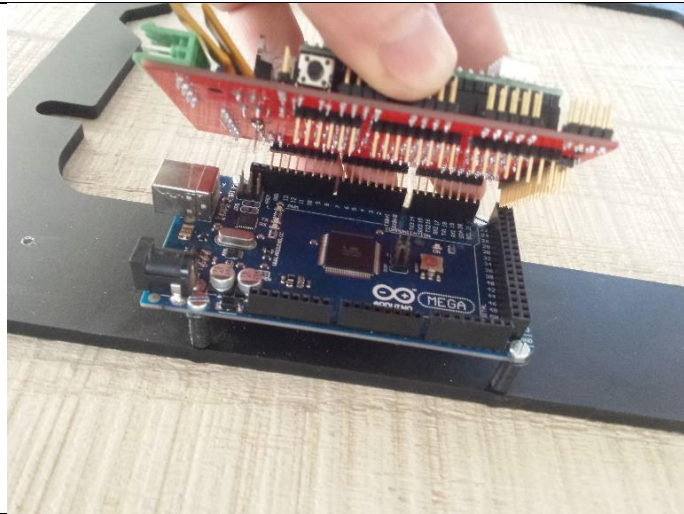
2.2 RAMPS Assembly:



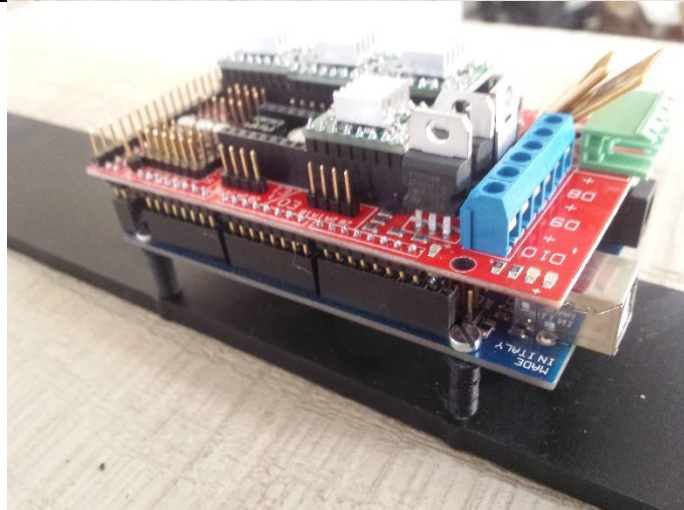
Note: After the mechanical assembly of the printer in the previous chapter, the Arduino Mega and Power Supply should be installed on the printer frame.

2.2.1 Installing the RAMPS Shield

Carefully connect the Ramps board to the Arduino board. If any of the pins are bent, gently bend them back into place with a screwdriver or needle nose pliers. Line up the pins and press down.

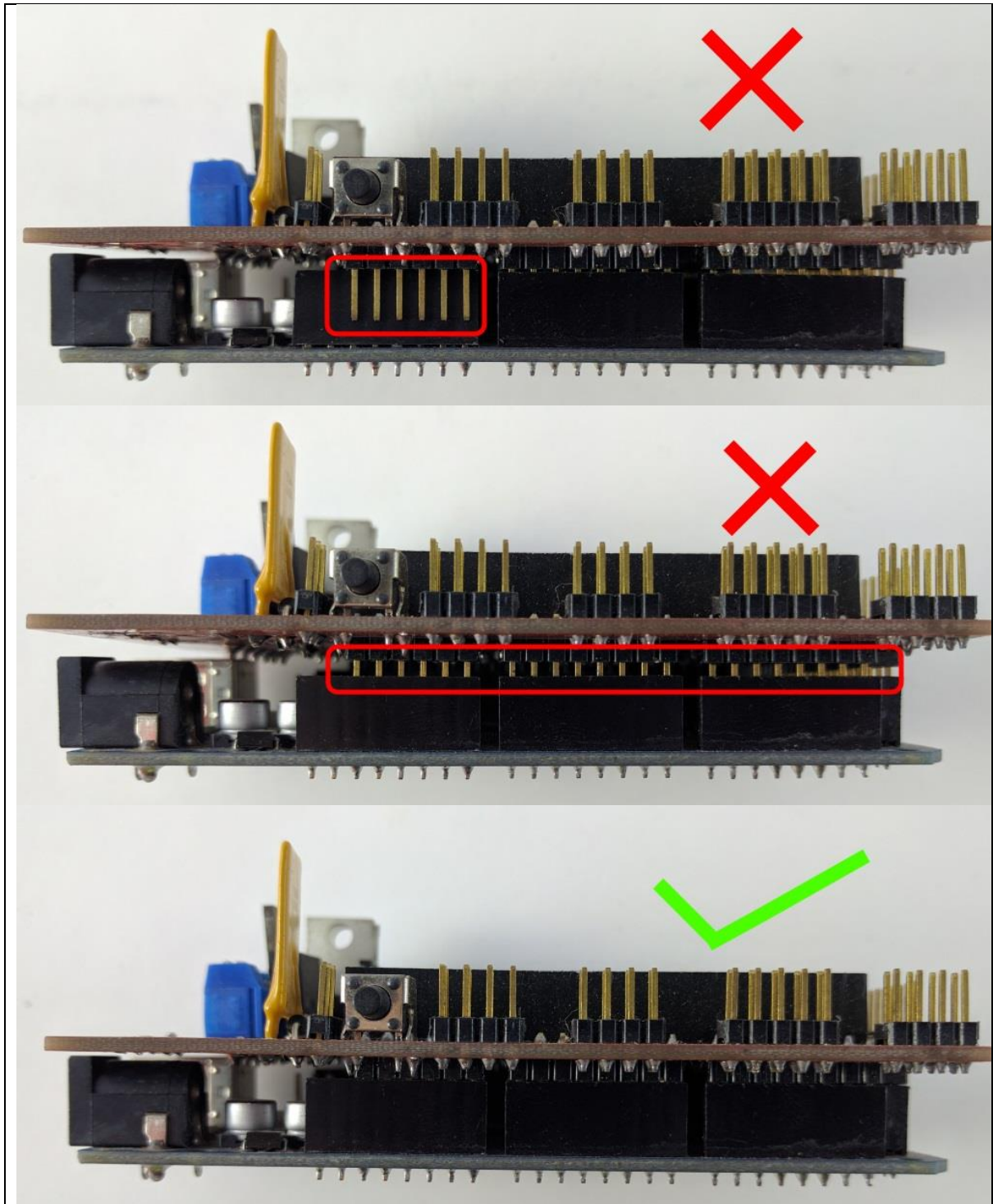


Once you are happy that all of the pins are in place, press down on all edges of the Ramps board to ensure good connections are made.



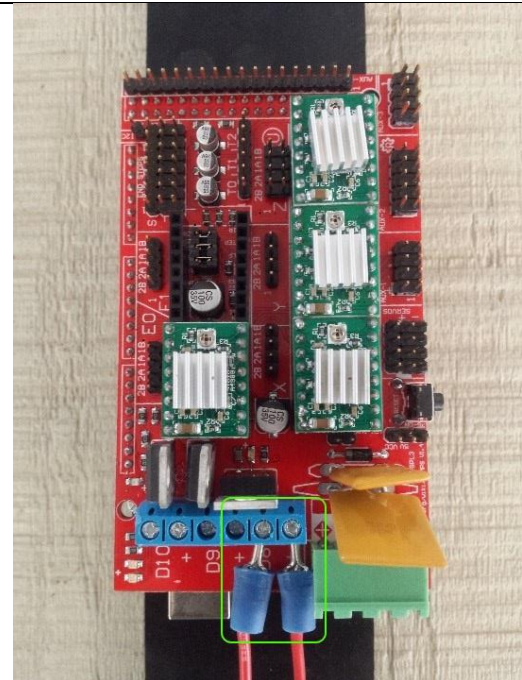
This is what your Ramps and Arduino assembly should look like when pressed together properly. Check all sides are properly connected.



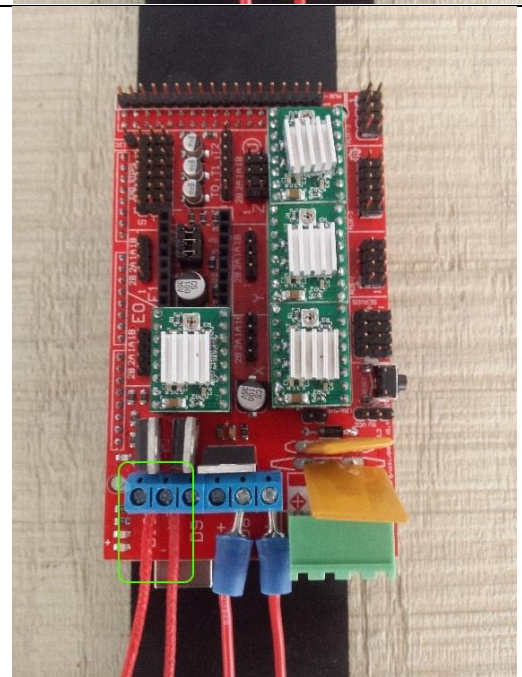


2.2.2 Connecting Heaters

Connect the heated bed wires to the **D8** port and make sure they are **secure**. The heated bed has no polarity; the order of the wires does not matter.



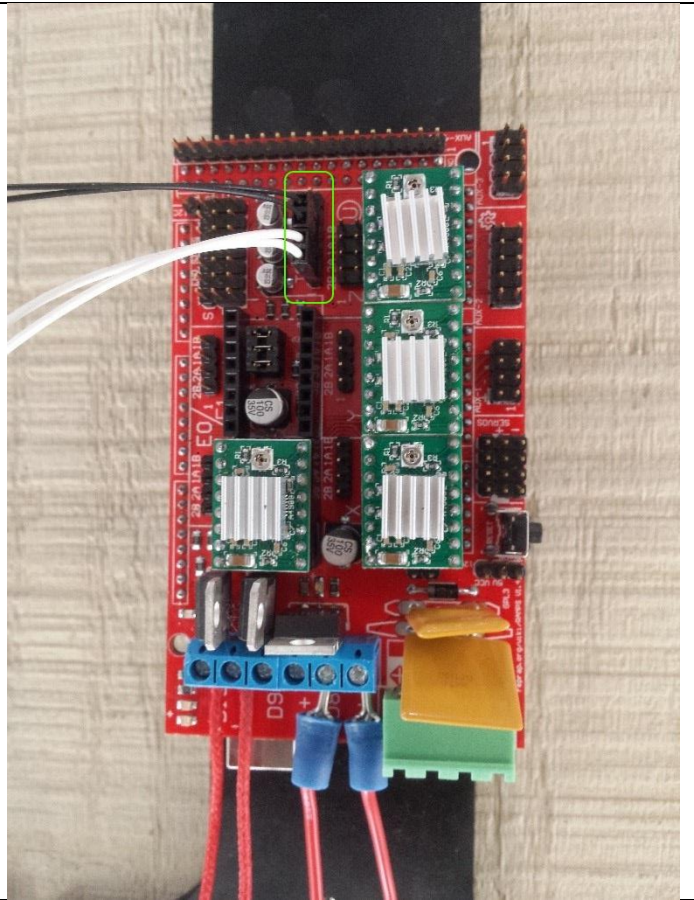
Insert the HotEnd heater cables into terminal **D10**. Tighten and ensure a good connection. Once again the heater has no polarity.



2.2.3 Connecting Thermistors

Place the two pin connector for the Hotend thermistor into the **T0** position on the RAMPS board as shown.


Do the same for the Heat Bed thermistor into **T1** position

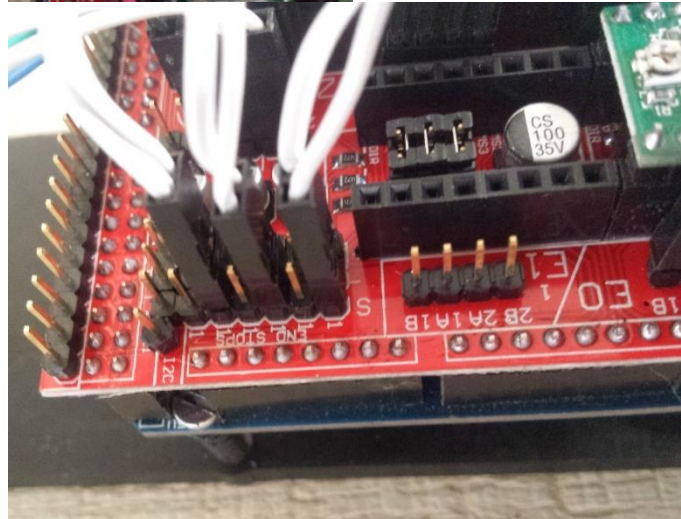
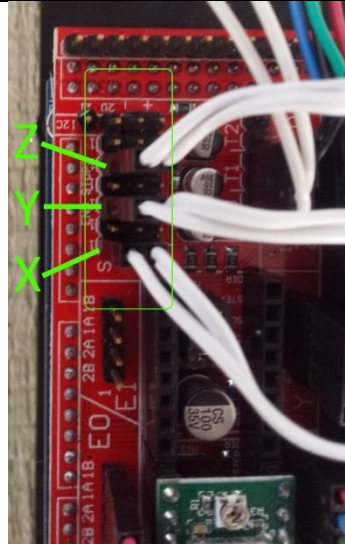


2.2.4 Connecting the Endstops

i **NOTE:** If you have purchased the auto-level sensor upgrade, please skip to the next section for endstop wiring with the auto-level board.

Connect the endstop connectors to the RAMPS board.
Use the two **LEFT MOST** pins
(Just like the images).

 If you connect using the right most pins, you risk damaging the board.



2.2.5 (Optional) Connecting the Auto-Level Sensor Endstop Module

i NOTE: This section only applies to you if you have the auto-level upgrade.

The inductive auto-level upgrade probe will come pre-wired with a small circuit board module.

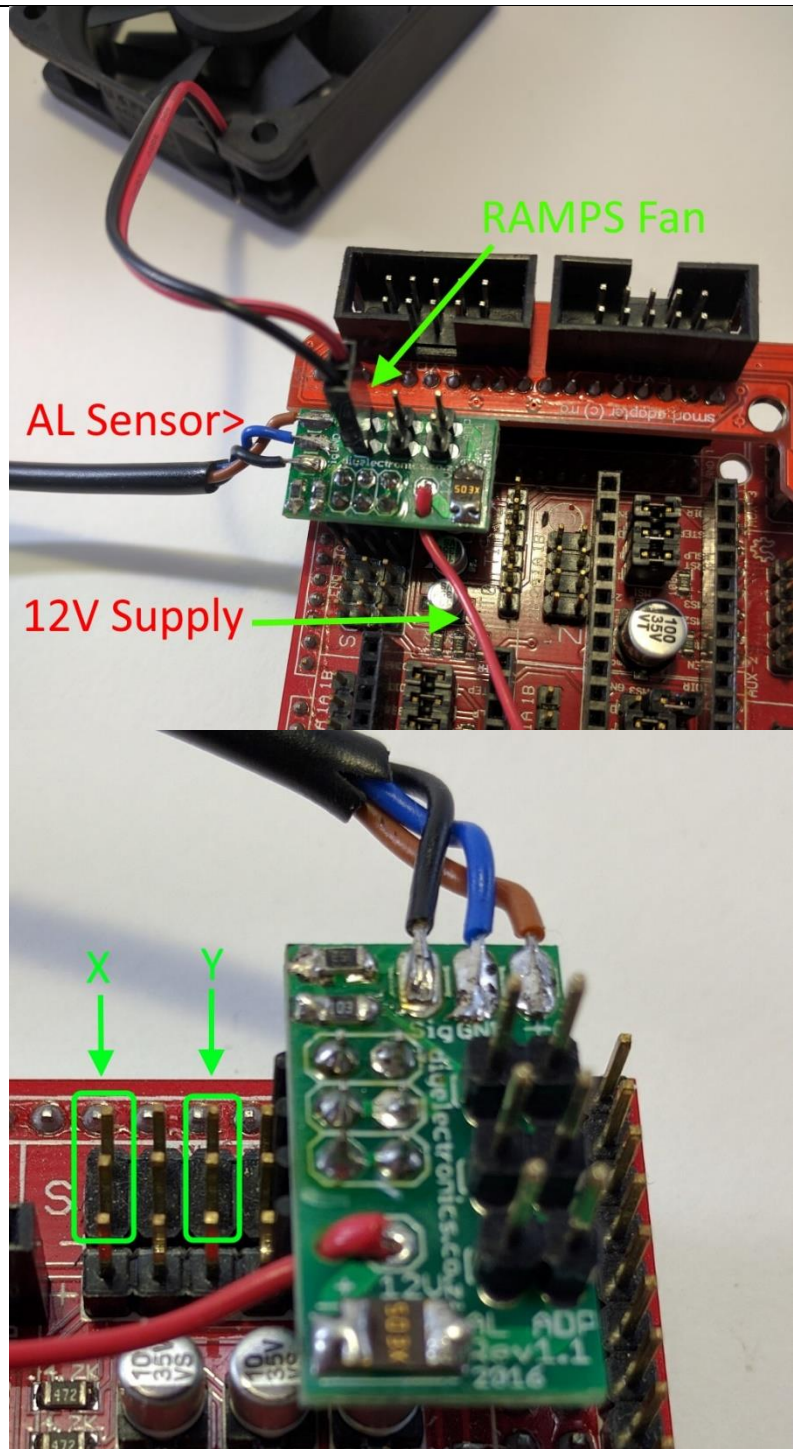
Connect the auto-level adaptor module to the RAMPS board as shown.

Make sure you connect it to the 5th and 6th row of pins from the bottom of the endstop connectors.

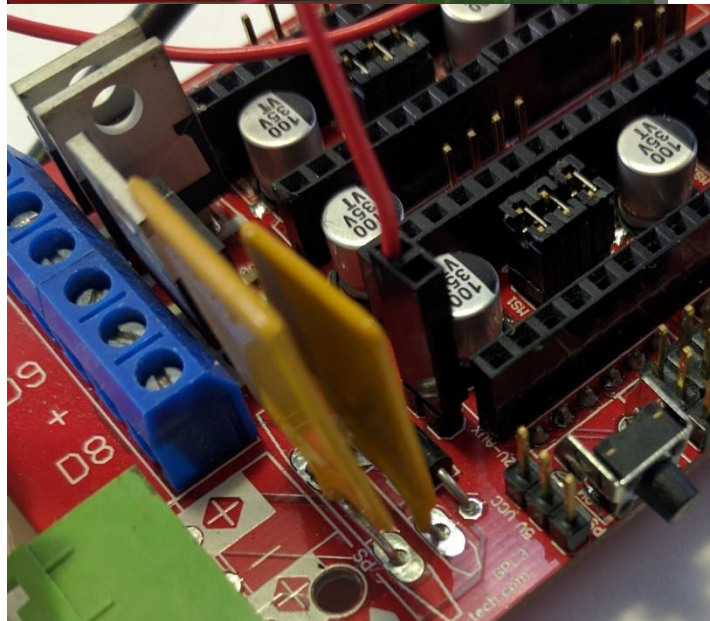
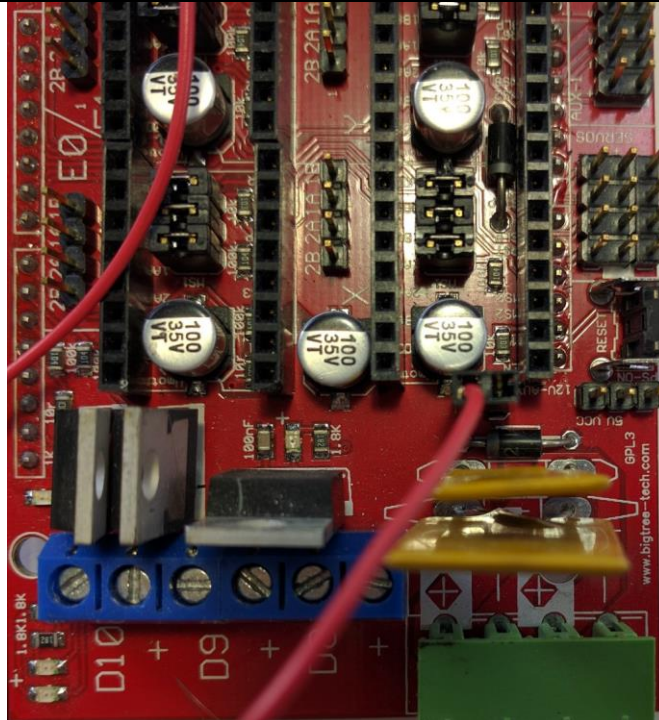
As shown in the second image, the bottom four rows are still exposed for the X and Y endstops.

Connect the X and Y endstops to the locations as shown in the second image.

Remember to connect the RAMPS fan to one of the three 12V headers. Orientate the fan connector so the positive (red) wire is at the top.



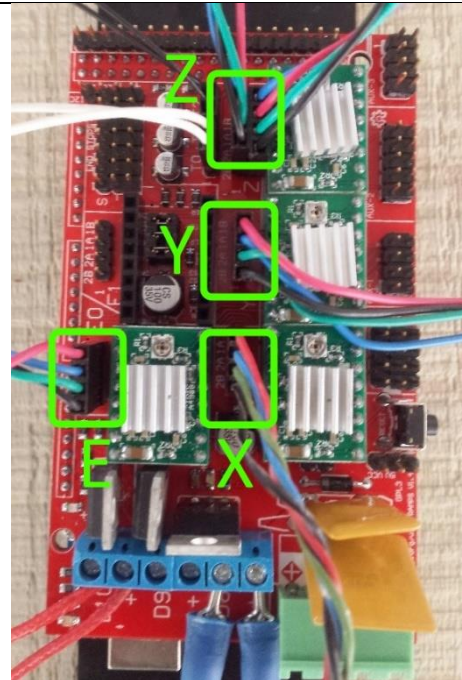
Connect the 12V lead from the auto-level module to the 12V Aux connector on the RAMPS board.



2.2.6 Connecting Motors

Place the four pin stepper motor connectors into the Ramps board as shown.

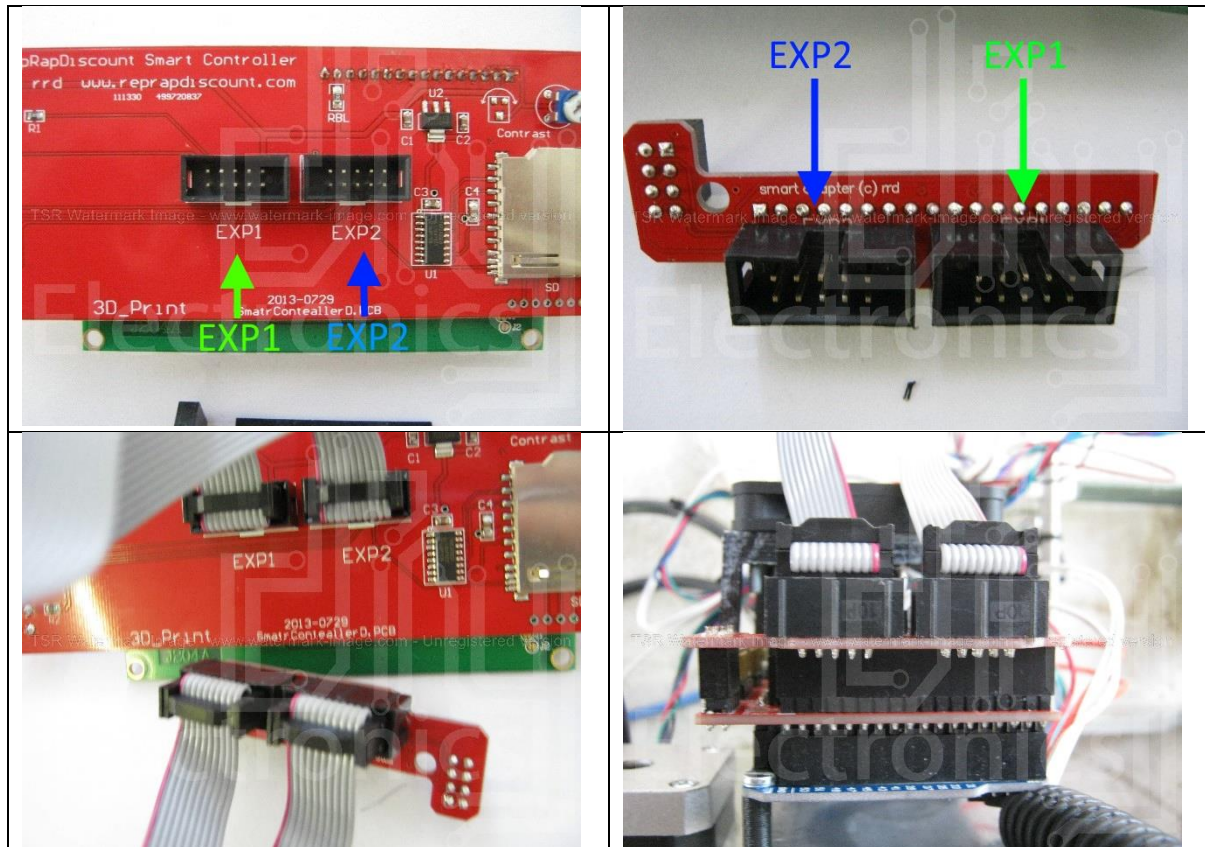
i **Note:** Try to orientate with the black wire side at the bottom of the connector. Handy tip: When you get the printer running and **IF** one of the stepper motors operates in the incorrect direction, **all** you need to do is flip the stepper motors connector 180 degrees. IE. the side with the RED wire at the bottom. See troubleshooting for more info.



2.2.1 Connecting the LCD (Optional)

If you have the LCD panel upgrade use the following instructions to install it:

i NOTE: Ensure that you connect EXP1 port on the LCD to the EXP1 port on the adaptor and the EXP2 port to the EXP2 port. These ports are shown in the images below.



The procedure is the same for the Graphical LCD module. Please note however that you will need to use the graphical LCD enabled firmware. If you purchased the graphical LCD as part of your kit, this should be loaded for you from the factory.

2.2.2 Connecting the RAMPS Fan

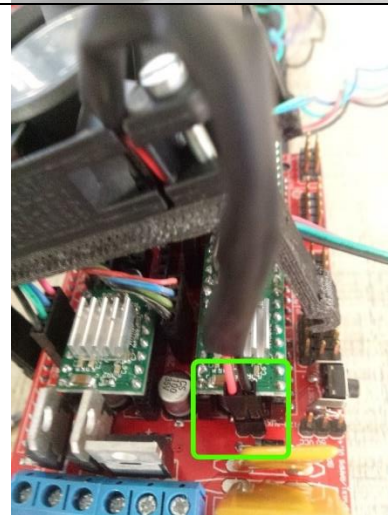
Connect the supplied fan 60mm fan to the printed RAMPS fan brackets. Use 4x M3x20 screws + nuts.



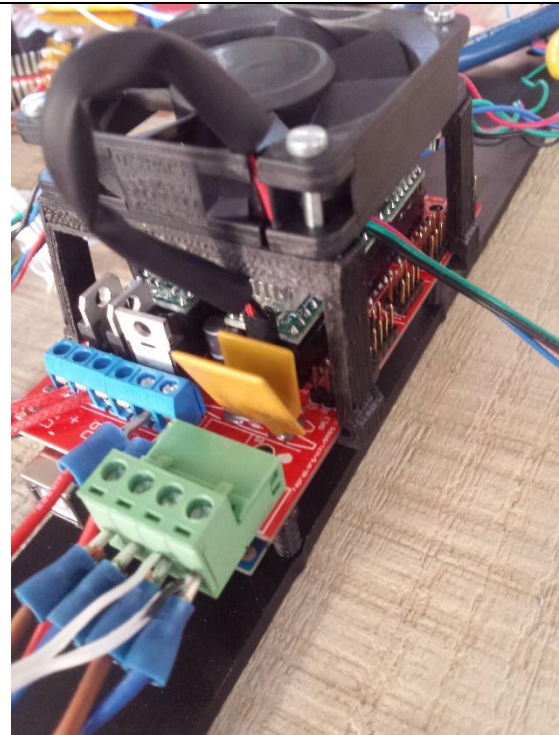
Insert the two pin Ramps fan connector to the 12V pins on the ramps board as shown. Make sure that the black (ground) pin is on the right.



Alternatively; If you have the Auto-Level upgrade kit you must use the 12V supply pins on the top of the adaptor module. (see section 2.2.5)

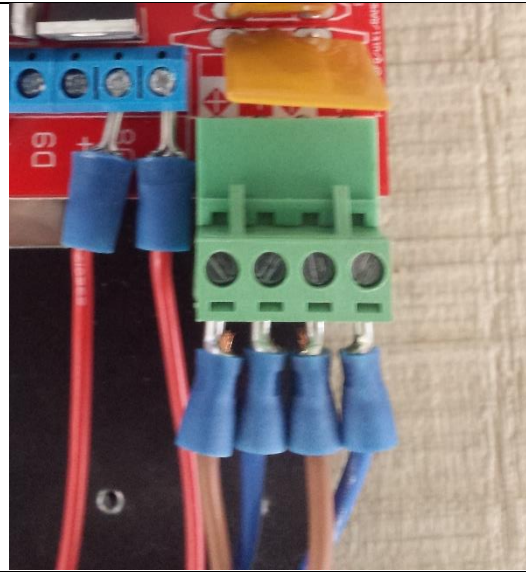


Finally clip the fan mount onto the edges of the RAMPS board. Be careful not to disturb any of the wiring or components.



2.2.3 Connecting the Power Supply

Plug the Green 12V power connector from your Power Supply into the RAMPS.
Make sure it is seated **Firmly**. Also make sure none of the power cables are loose.



2.2.4 Connect the Hot-End Fan

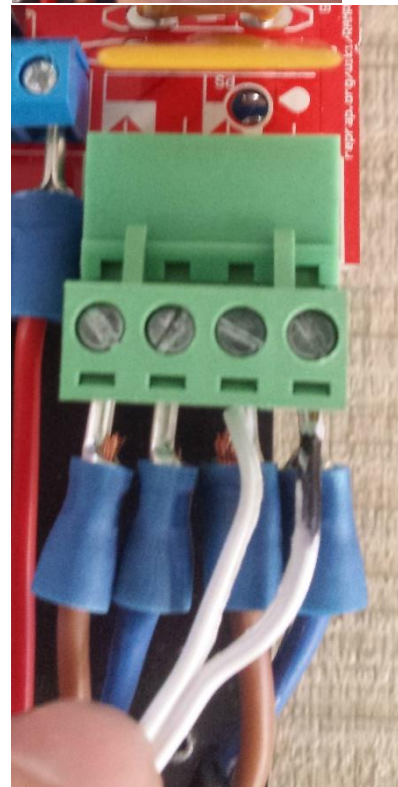


NOTE: We are currently working on a much better method of connecting the fans, we realise this is not ideal! Please contact us if you have any issues, we would be happy to assist you.

Now you need to connect the Hot-End fan to the 12V power supply connector. Unscrew the terminal screws, remove the two right hand side power wires (brown and blue).

Next insert the hotend fan wires. Make sure that wire with the black mark or black wire (ground) is on the right most connector position, so that the polarities match.

Insert the Brown (12V) and Blue (Ground) power leads back into the terminals along with the hotend fan. Tighten and make sure the connections are **secure**.



You have now wired up your electronics! Please check the wiring diagram in section 2.1 at least twice and confirm your connections before turning on for the first time!

The next sections will cover what to do before turning on for the first time.

2.2.1 Printer Firmware for RAMPS Marlin



NOTE: The firmware (software on the printer electronics) is pre-loaded onto the Arduino at our factory when we assemble your printer or kit, there is no need to change the firmware!

We will have loaded the correct firmware for your configuration.

If you have an issue with the firmware, you can follow the guide at the following link to flash one of our pre-compiled Marlin files to your printer:

http://www.diyelectronics.co.za/firmware/RAMPS_XLoader_Guide_rev1.pdf

3 Software Setup:

3.1 Install Repetier-Host

Install the Repetier-Host printer control software¹.

Download link: <https://www.repetier.com/download-now/>



This is the desktop side software to control your printer. RH would have also included Slic3r, a package used to slice your 3D models into G-Code ready for printing (via RH 😊)

How to manually control your printer:

<https://www.repetier.com/documentation/repetier-host/rhmanual-control/>

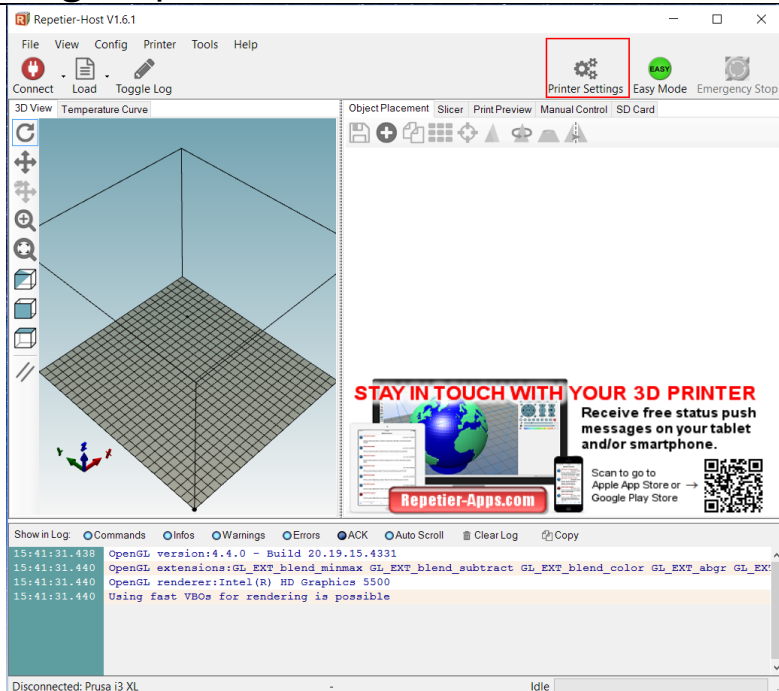
More documentation on Repetier-Host:

<https://www.repetier.com/documentation/repetier-host/>

¹ An alternative control software we recommend is Cura, should you have problems with Repetier-Host. Google is your friend here.

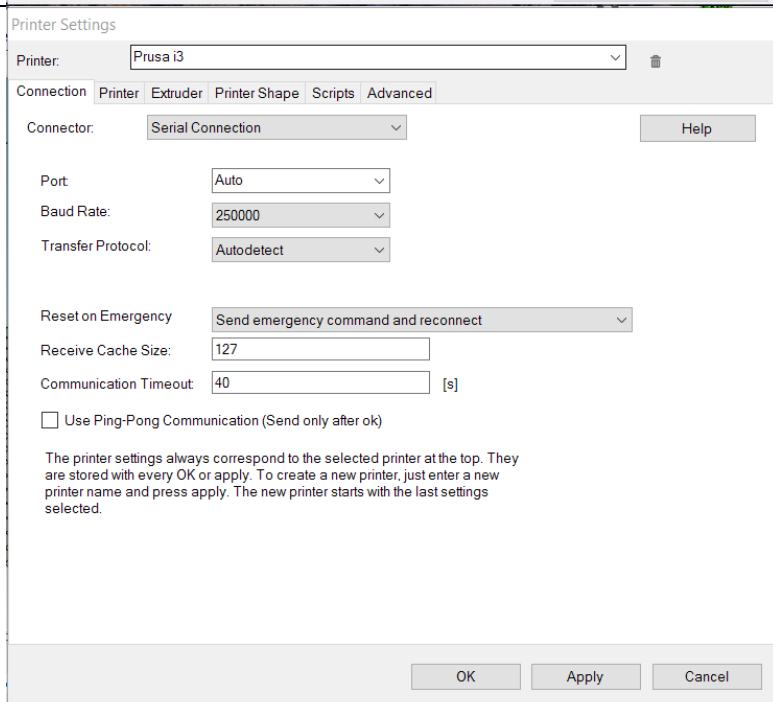
3.1.1 Configuring Repetier-Host:

With Repetier-Host installed, Open the program and Click the **Printer Settings** icon or select it from menu **Config > Printer Settings**.



In the top text box give your new printer a friendly name ☺

- **Port:** Auto, or select the port your printer is on.
- **Baud Rate:** 250 000



Click the **Printer Tab**, default settings are acceptable although you might want to change some settings to your personal preferences.

Printer Settings

Printer: Prusa i3

Connection Printer **Extruder** Printer Shape Scripts Advanced

Travel Feed Rate: 4800 [mm/min]

Z-Axis Feed Rate: 100 [mm/min]

Manual Extrusion Speed: 2 20 [mm/s]

Manual Retraction Speed: 30 [mm/s]

Default Extruder Temperature: 200 °C

Default Heated Bed Temperature: 55 °C

☒ Check Extruder & Bed Temperature

☐ Remove temperature requests from Log

Check every 3 seconds.

Park Position: X: 0 Y: 0 Z min: 0 [mm]

☒ Send ETA to printer display ☐ Go to Park Position after Job/Kill

☒ Disable Extruder after Job/Kill ☒ Disable Heated Bed after Job/Kill

☒ Disable Motors after Job/Kill ☒ Printer has SD card

Add to comp. Printing Time 8 [%]

Invert Direction in Controls for ☐ X-Axis ☐ Y-Axis ☐ Z-Axis ☐ Flip X and Y

OK Apply Cancel

Click **Extruder** tab, nothing serious to change here, however your nozzle diameter needs to be set to 0.4mm as this is the standard size on our printers. This is just for the filament visualization and not important for slicing.

Printer Settings

Printer: Prusa i3

Connection Printer **Extruder** Printer Shape Scripts Advanced

Number of Extruder: 1

Max. Extruder Temperature: 280

Max. Bed Temperature: 120

Max. Volume per second 12 [mm³/s]

☐ Printer has a Mixing Extruder (one nozzle for all colors)

Extruder 1

Name:

Diameter: 0.4 [mm] Temperature Offset: 0 [°C]

Color:

Offset X: 0 Offset Y: 0 [mm]

OK Apply Cancel

Click **Printer Shape**, set the bed size here.
Print Area:

- **Standard kit:**
200 x 200mm
- **Plus & Premium kit:**
250 x 270mm
-

Printer Settings

Printer: Prusa i3

Connection Printer Extruder Printer Shape Scripts Advanced

Printer Type: Classic Printer

Home X: Min Home Y: Min Home Z: Min

X Min: 0 X Max: 250 Bed Left: 0

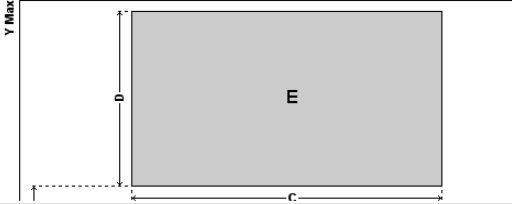
Y Min: 0 Y Max: 270 Bed Front: 0

Print Area Width: 240 mm

Print Area Depth: 260 mm

Print Area Height: 200 mm

The min and max values define the possible range of extruder coordinates. These coordinates can be negative and outside the print bed. Bed left/front define the coordinates where the printbed itself starts. By changing the min/max values you can even move the origin in the center of the print bed, if supported by firmware.



OK Apply Cancel

Finally click apply and then click **Connect** as indicated in the following screen. Your printer should now be connected!

Repetier-Host V1.6.1

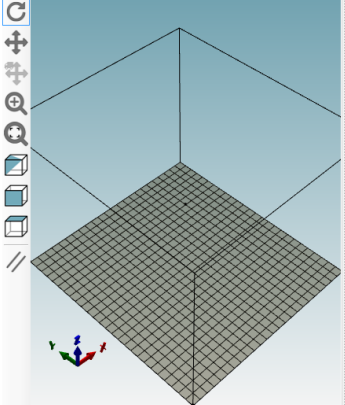
File View Config Printer Tools Help

Connect Load Toggle Log

Printer Settings Easy Mode Emergency Stop

Object Placement Slicer Print Preview Manual Control SD Card

3D View Temperature Curve



STAY IN TOUCH WITH YOUR 3D PRINTER

Receive free status push messages on your tablet and/or smartphone.

Scan to go to Apple App Store or Google Play Store

Repetier-Apps.com

Show Log: Commands Infos Warnings Errors ACK Auto Scroll Clear Log Copy

```

15:41:31.438 OpenGL version:4.4.0 - Build 20.19.15.4331
15:41:31.440 OpenGL extensions:GL_EXT_blend_minmax GL_EXT_blend_subtract GL_EXT_blend_color GL_EXT_abgr GL_EX
15:41:31.440 OpenGL renderer:Intel(R) HD Graphics 5500
15:41:31.440 Using fast VBOs for rendering is possible
  
```

Disconnected: Prusa i3 XL Idle

3.1.2 A Note on CAD Software and Part Files:

As for 3D modelling software to actually create your own models, there are many choices out there and many different ways to model. We usually use Solidworks or Autodesk Inventor which are expensive commercial CAD packages. For free CAD packages, we recommend Autodesk 123Design, Google Sketchup or OpenSCAD is also good if you are into programming.

This link has a few guides if you'd like to check the different packages out:

<http://hackaday.com/2014/02/19/3d-printing-making-a-thing-with-solidworks/>

<http://thingiverse.com/> Has plenty of awesome prints if you are not interested in designing anything yourself!

4 Printer Setup & Testing

4.1 Understanding the Power Supply

The Arduino/RAMPS on your printer can be powered by two sources:

- **USB Cable:** Only powers the Arduino however cannot run the printer.
- **DC Power Supply:** Powers the entire printer and allows the printer to print.

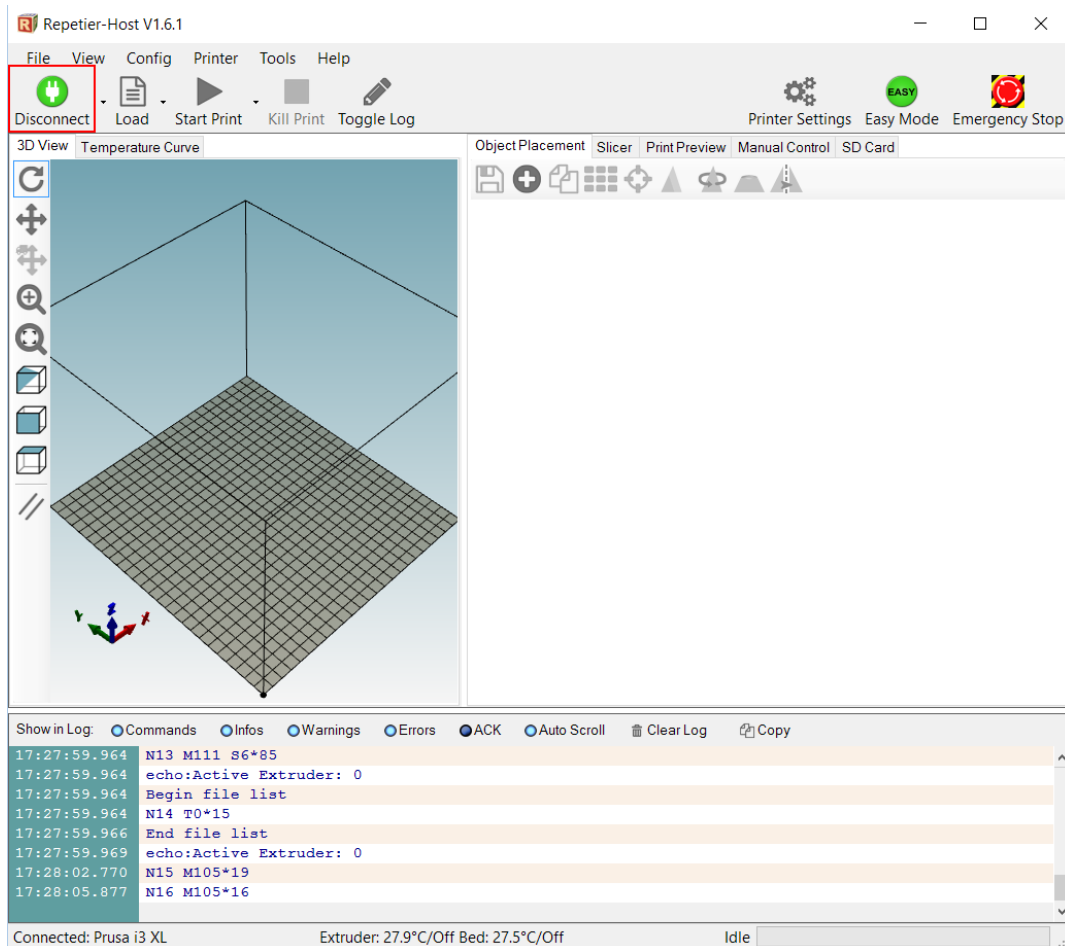
You can program and communicate with the electronics with only the USB cable connected but you cannot print without the power supply turned on.

4.1.1 Check Wiring and Turn on Power Supply

- Double ***check your wiring*** to make sure no errors or shorts are present.
- Turn on the power supply.
- Any sign of trouble, burning smell etc. Turn off immediately and contact us.
- If all is well, turn off power supply and move to the next step.

4.1.2 Connect the Printer to the PC

- With the power supply **off**, connect the USB cable to the printer and the PC.
- Turn on the power supply.
- Connect to the printer in Repetier-Host. The connect button should turn green after a few seconds indicating the printer is connected! If not, see troubleshooting section.



4.2 Printer Testing

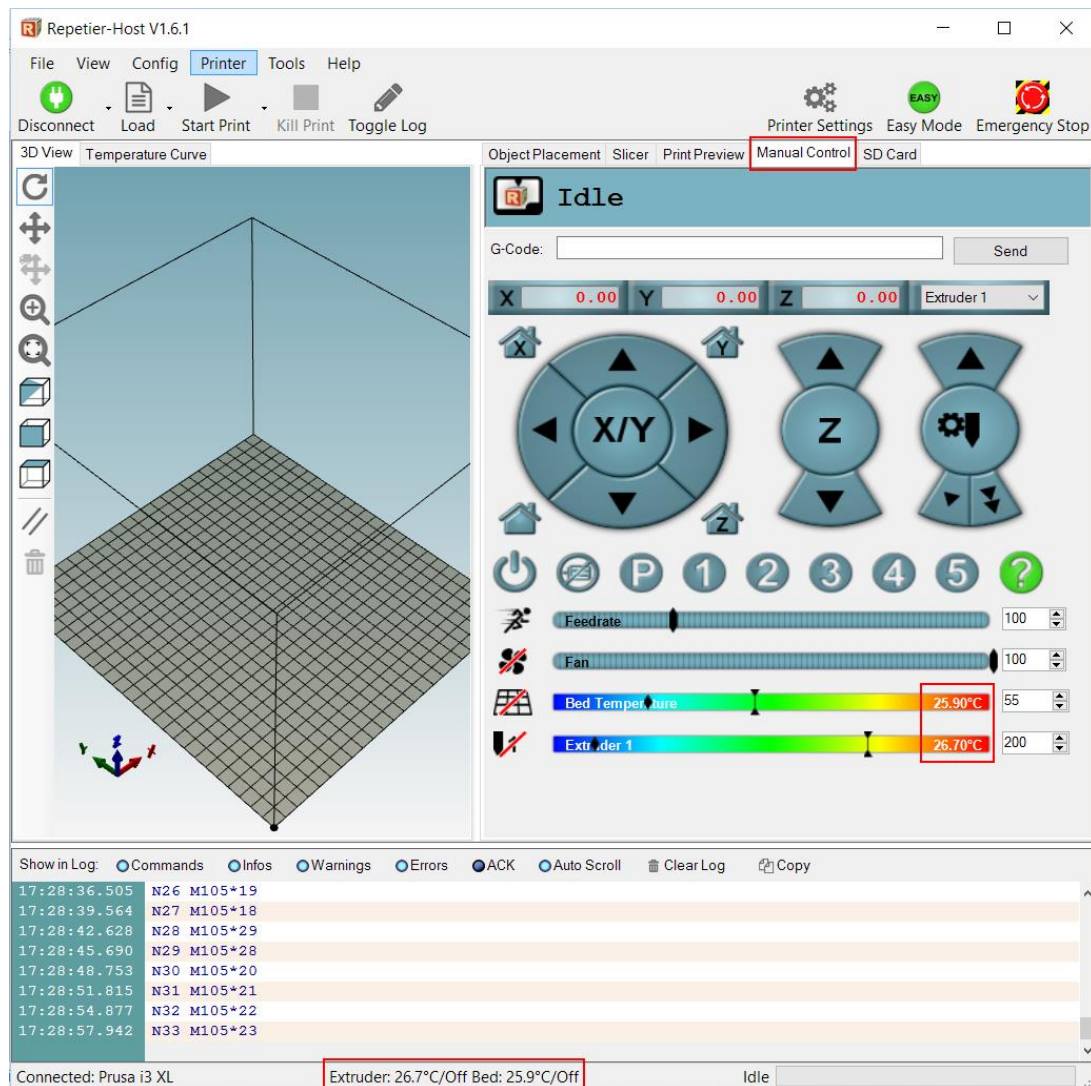
With your printer now turning on and connecting to the software host we are ready to start testing and calibrating all the components! Please follow each test carefully and make sure each test is successful before moving on to the next test.

4.2.1 Test 1 Thermistors:

Click on the **Manual Control** tab in Repetier-Host and note the temperatures of the extruder and heated bed.



Note: The printer will not function at all if the thermistors are not working properly therefore it is important that this test is run correctly.



Both values should be similar to the current room temperature. If there are any problems refer to the following table:

- **Zero Temp (0°C):** Thermistor likely unplugged or wrong position, check wiring. Repetier / RAMPS will give a *MINTEMP* error.
- **Very High Temp:** Possible short in thermistor wiring or to heater block / bed. Check wiring. Possible damaged thermistor.
- **Negative Temp:** Incompatible thermistor and firmware tables loaded, contact us.

4.2.2 Test 2 Heating:

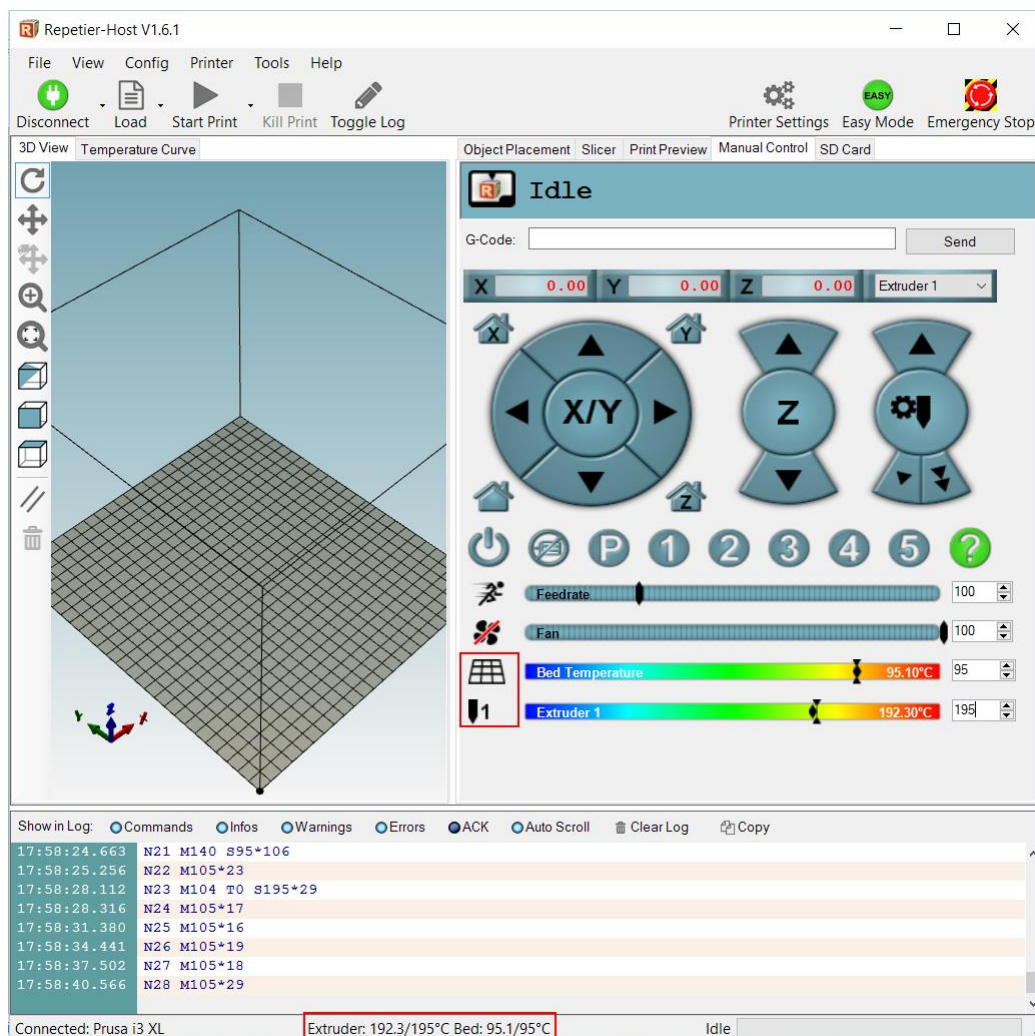
Click the **Bed** and **Extruder** buttons highlighted below, this should start heating up the components. Start out at 50°C for both components and increase the temperatures 10°C at a time until all is confirmed working.

Use the following guide for temperatures:

- **PLA:** Hotend: 180°C – 200°C Bed: 40°C – 50°C
- **ABS:** Hotend: 200°C – 255°C Bed: 70°C – 100°C



Note: Beware of hot components! Any sign of trouble, burning smell etc. TURN OFF.

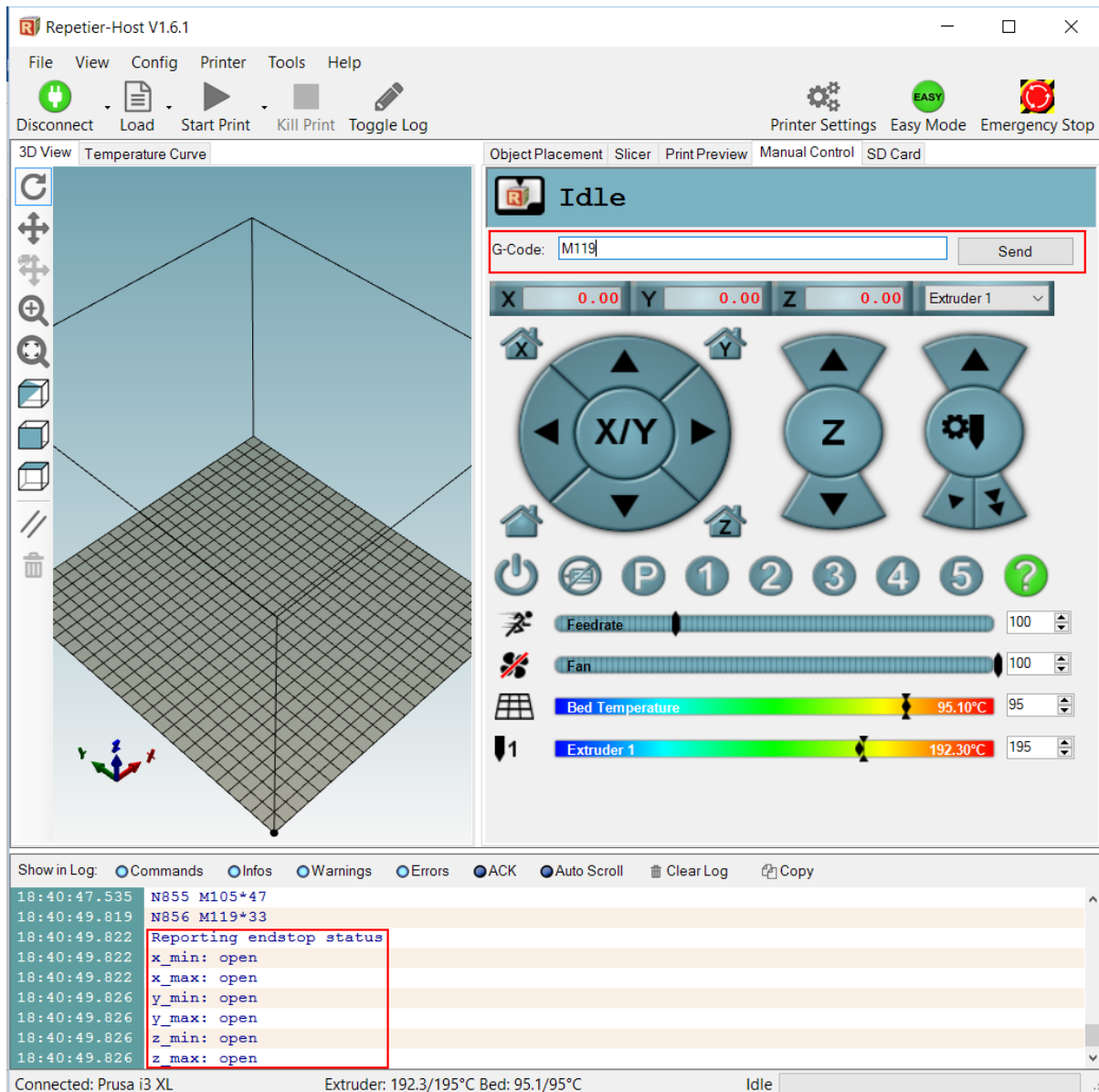


If either of the components does not heat up, refer to the troubleshooting guide. Also ensure that the Bed and Extruder are not switched around, i.e. bed should respond to bed temperature changes.

You can leave the components heated for the following tests.

4.2.3 Test 3 End Stops:

To test the endstops, first make sure none of the X, Y or Z axis endstops are pressed. In the Repetier-Host G-Code command line run the **M119** command as shown below. Note the result in the text log.



Reporting endstop status

x_min: open

x_max: open

y_min: open

y_max: open

z_min: open

z_max: open

All of the endstops should read 'open', if not make sure none are pressed and check wiring.

Next hold each endstop one at a time and run **M119** again, the corresponding min endstop should read '*TRIGGERED*'.

- **Pressing X Endstop:** x_min: TRIGGERED
- **Pressing Y Endstop:** y_min: TRIGGERED
- **Pressing Z Endstop:** z_min: TRIGGERED



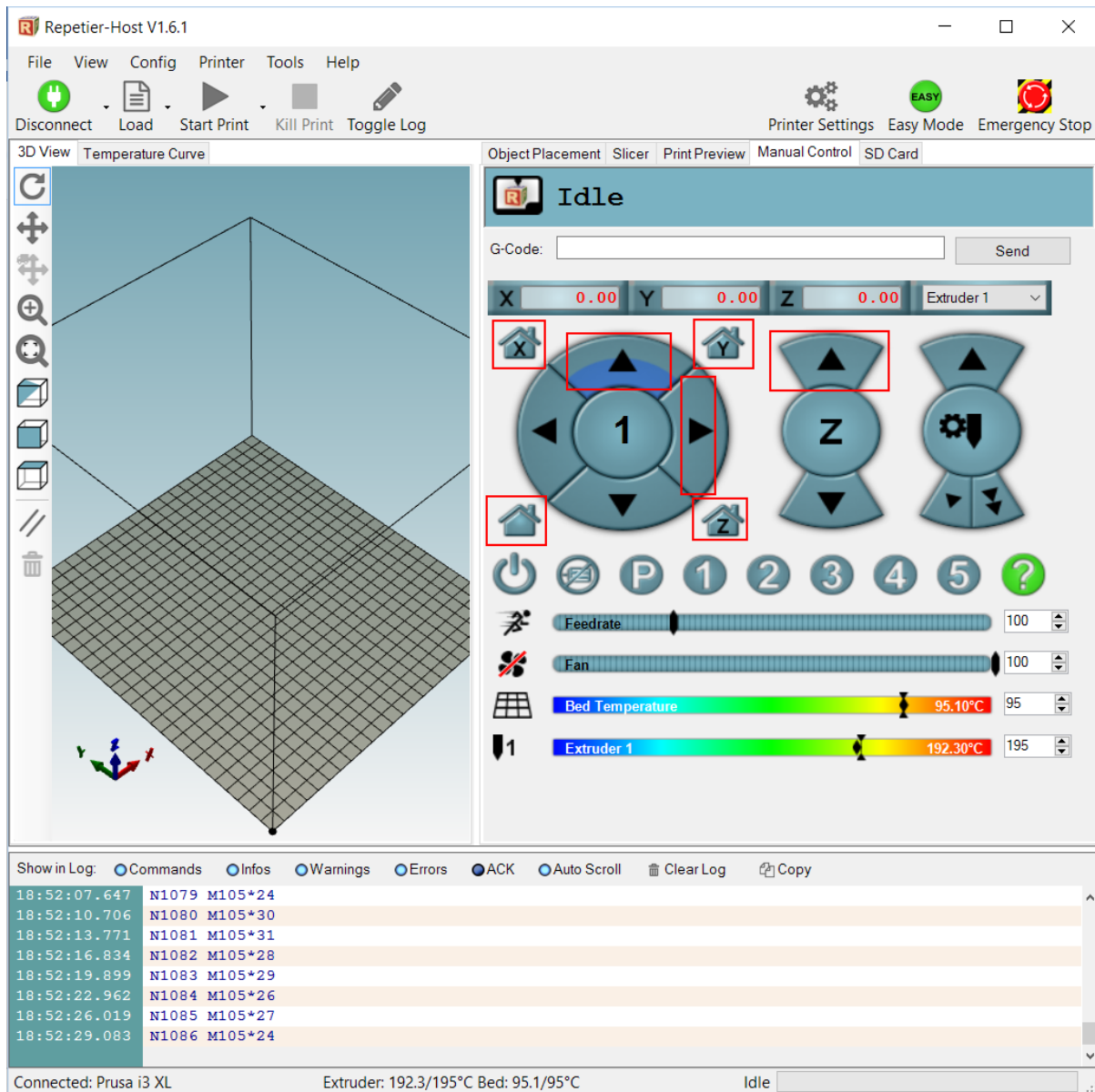
NOTE: If you have an autolevel upgrade, then you will need to hold a steel object such as a screwdriver under the inductive sensor to trigger the Z endstop.

All of the **max** endstops should always read '*open*', if any of them read '*TRIGGERED*' then it is likely you have an endstop plugged into the wrong location.

If any of the endstops do not work as described, then please check wiring and connectors.

4.2.4 Test 4 Motors:

In the **Manual Control** tab, use the motor control buttons to move the X, Y and Z axis. Start small by moving **Positive 1mm** on each axis. The corresponding axis should move a short distance **away from the endstop**.



- **Axis Moves Toward Endstop:** See troubleshooting on how to reverse an axis. This is done by flipping the motor plug.
- **Wrong Axis Moves:** e.g. clicked +1 on X axis and Y axis moved, check motor plugs are in correct location on RAMPS board.
- **Axis Does Not Move:** See troubleshooting guide on checking an axis that does not work.



NOTE: When the printer has just been started/reset, the axis will only move in the positive direction until homed.

Next try homing each axis by clicking each home button, i.e. the X in house button.



. The corresponding axis should then move toward the endstop and then stop.

- **Axis Does Not Stop When Hitting Endstop:** Check the endstop setup is working as per previous section.



Finally try the 'home all' button . Each axis should home in turn.

4.2.5 Test 5 Extrusion:

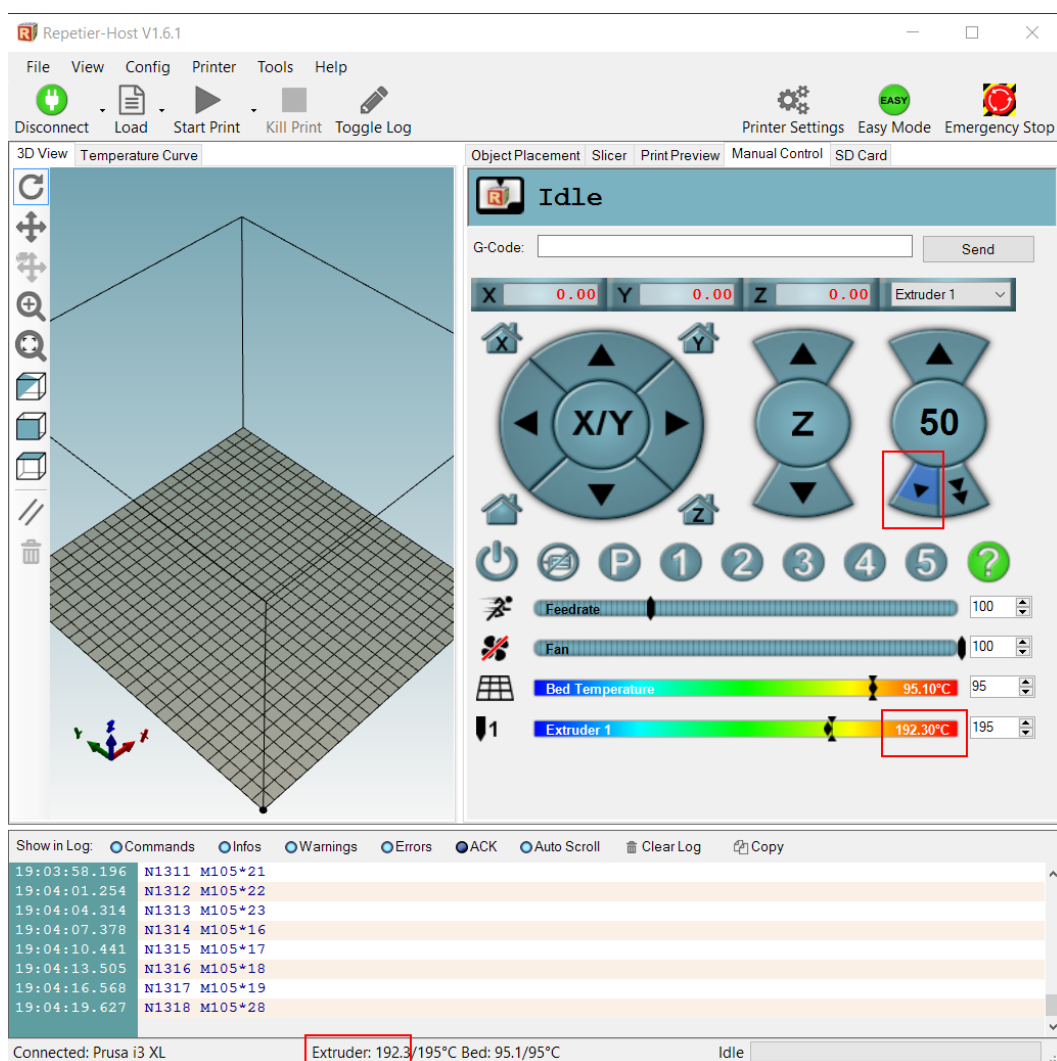
To test that the extruder motor is working correctly, first **heat the extruder to 200°C**.



NOTE: The extruder will not turn unless the hotend is hotter than 180°C. This is a safety feature and prevents jamming of the drive gear.

Click the 'extrude 50mm' button in Repetier-Host. The extruder should now turn. Make sure the large gear is turning clockwise, i.e. the hobbled bolt is turning the correct direction to drive filament into the extruder.

- **The Extruder is Turning the Wrong Direction:** See troubleshooting guide to reverse the axis direction. This is done by flipping the motor plug.





NOTE: If you are using an all metal hotend for the first time, heat the hotend to 240°C and tighten the nozzle with a No.8 spanner before extruding any filament to prevent leaks. **Not too tight or you will damage the fragile heat break!**

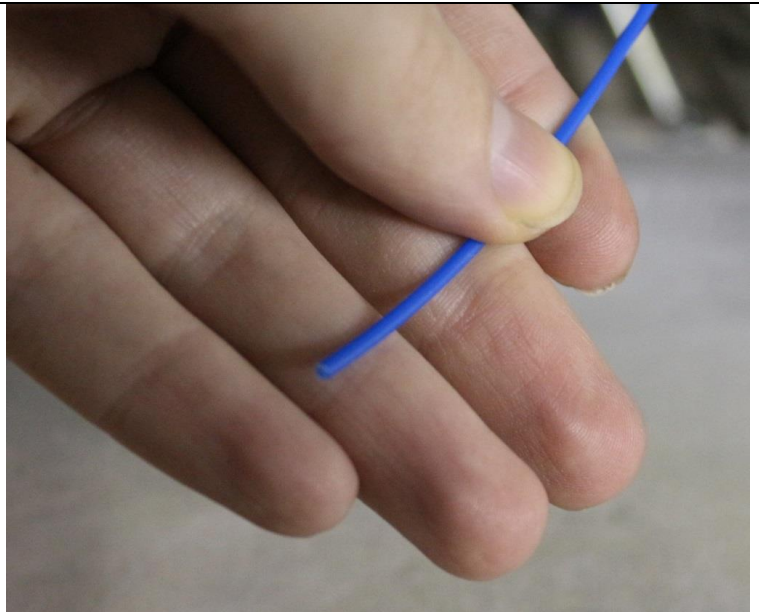
4.2.6 Test 6 Load and Extrude Filament:

To feed in new filament, follow the steps below:

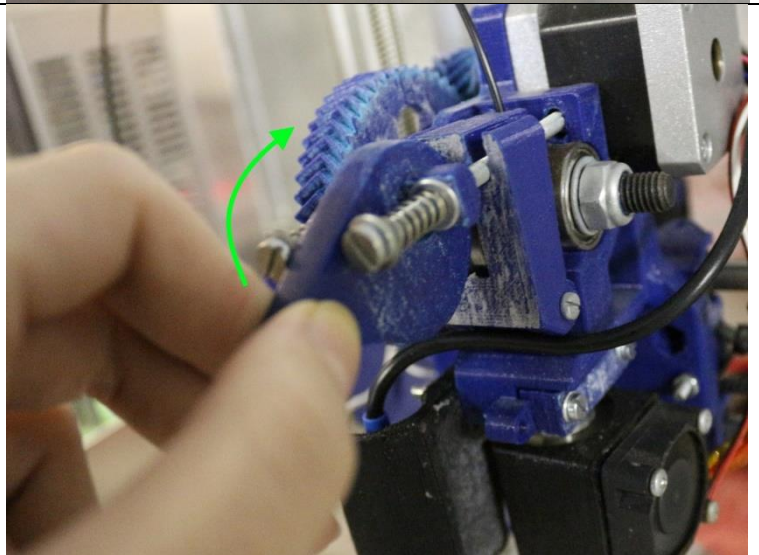
- Heat the hotend to the correct temperature range for your plastic.
- Turn the motors off by clicking the 'motors off' button in Repetier-Host.



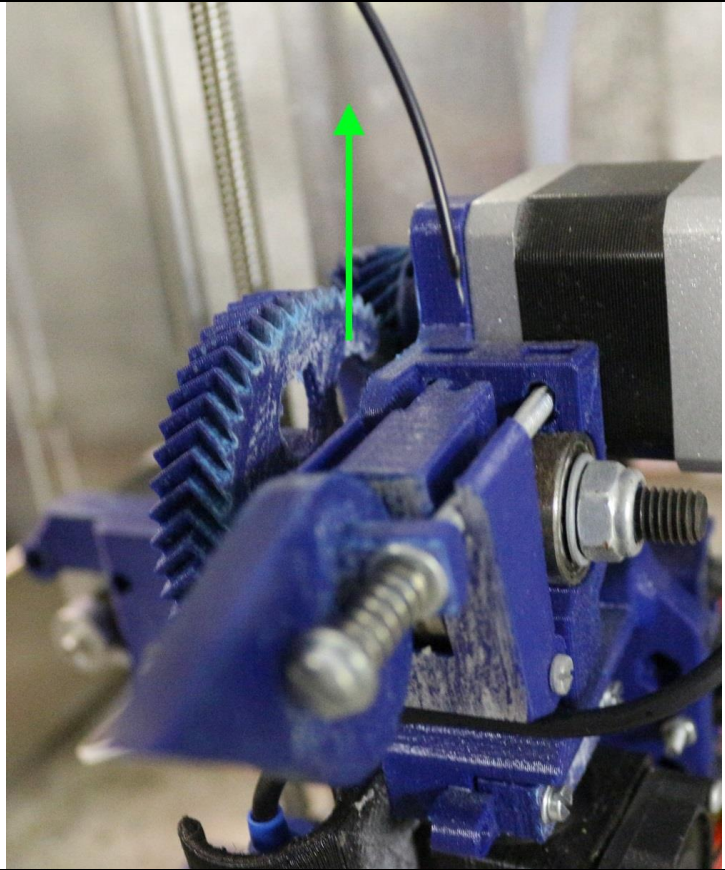
- Take the beginning of your chosen filament and cut off the end to create a straight starting point.



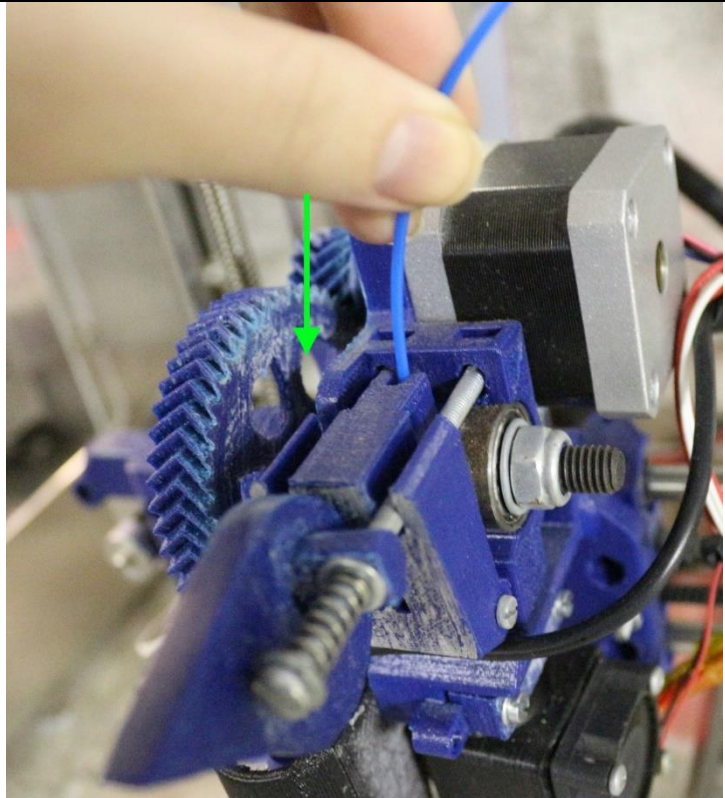
- If you are changing filament begin by turning the gear in the direction shown to retract the filament from the hot nozzle.
- Open the filament idler cam gear.



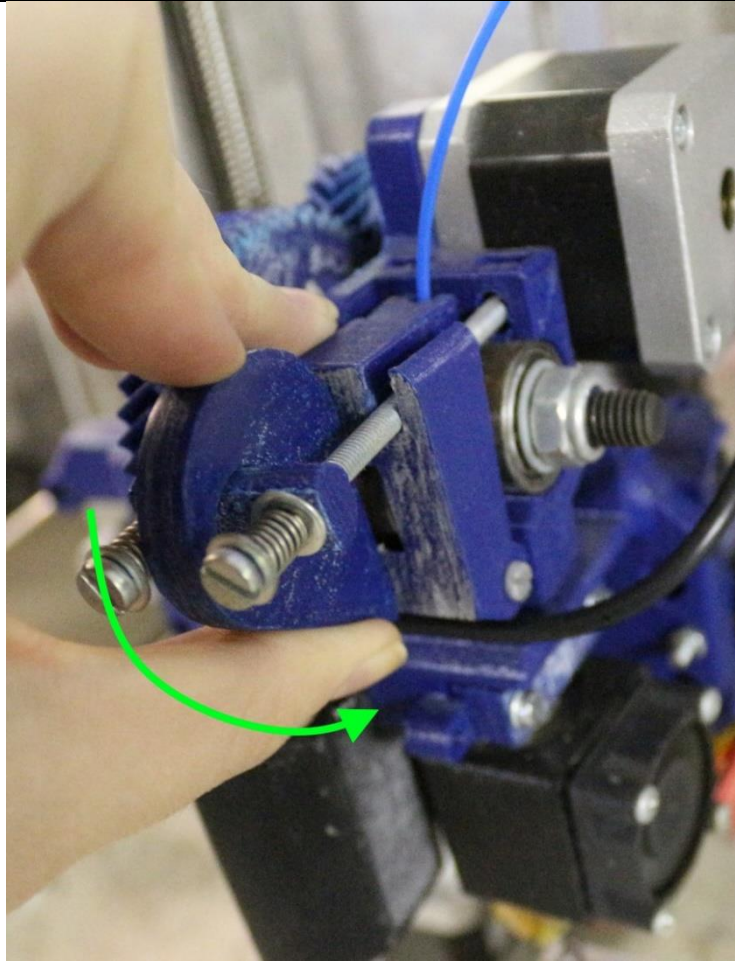
- Remove old filament (if present) by pulling upwards.



- Feed the new filament end into the extruder body until it starts to extrude from the nozzle.
- If you did not completely open the idler then you may need to turn the extruder gear to do this.

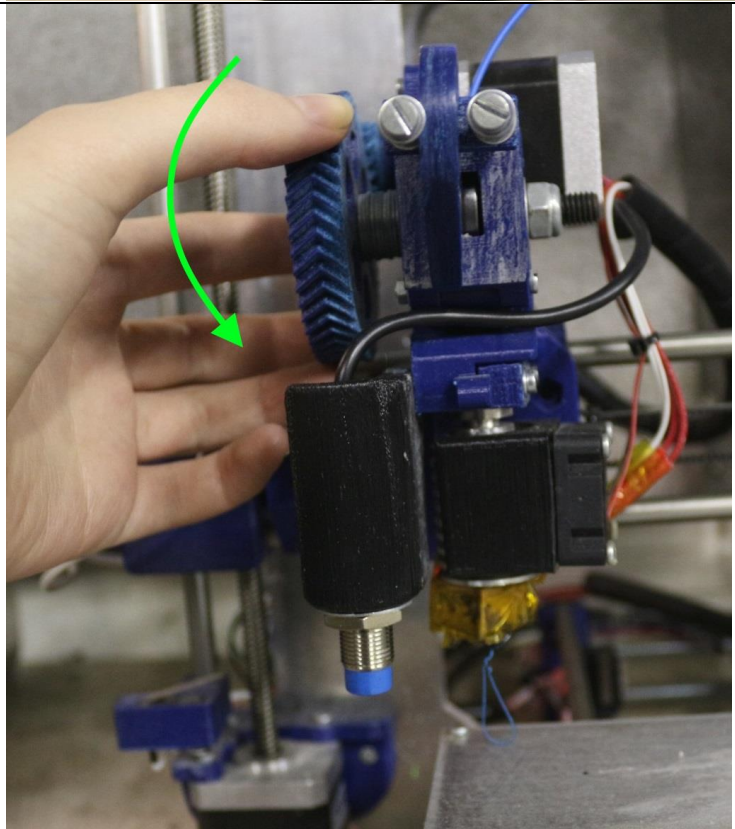


- Close the idler cam gear to clamp the plastic into the hobbed bolt.
- Tighten the spring screws until the springs are approximately half way compressed.



- Manually turn the extruder gear until the filament is extruded from the nozzle. If it does not make sure that the hobbed bolt is not jammed with stripped plastic. If it is open the idler and carefully clean the plastic from the hobbed bolt teeth until it is clean.

You have now successfully loaded new filament.



Return to the **Manual Control** and extrude 50mm of filament, if all is well your printer should be ready for calibration and printing!



NOTE: Our preloaded firmware should be good enough to start printing with if you like. We recommend you refer to the calibration section either now or the near future to ensure that the hobbed bolt calibration is correct as each hobbed bolt varies slightly.

5 FAQ

Maintenance:

The following link should be adequate in helping you with maintenance of your 3D printer.

<http://www.nextdayreprint.co.uk/maintenance-of-your-reprint-prusa-mendel-3d-printer/>

Important points are to keep the **linear bearings and shafts oiled with a light lubricating oil** and remember to **check the belt tensions regularly**.

6 Troubleshooting:

- ***T: My stepper motors are shaking/juddering/jump around/ move in the wrong direction occasionally.***

A: This is usually caused by a loose wire or connector, or from the connector being placed incorrectly (only on 3pins and not all 4 pins on the RAMPs board) Another cause is the motor current being set too low or too high. Try turning the adjustment potentiometer on the stepper motor driver 1/8th of a turn clockwise to increase the current to the motor slightly (or anti-clockwise to reduce the current), some experimentation is needed here.