Welcome to the Assembly Guide for the Rostock MAX v2.0 3D printer.
Version 1.67, August 27th, 2014

Repetier-Host Edition

Questions or corrections should be emailed to geneb@deltasoft.com

Disclaimer text provided by LulzBot

READ ME FIRST!

READ THIS MANUAL COMPLETELY BEFORE ASSEMBLING AND POWERING UP YOUR PRINTER!

Hazards and Warnings

The SeeMeCNC Rostock MAX 3D printer has motorized and heated parts. When the printer is in operation always be aware of possible hazards.

Electric Shock Hazard

Never open the electronics bay of the printer while the printer is powered on. Before removing the access door, always power down the printer and unplug the AC line cord.

Burn Hazard

Never touch the extruder nozzle or heater block without first turning off the hot end and allowing it to completely cool down. The hot end can take up to twenty minutes to completely cool. Also, never touch recently extruded plastic. The plastic can stick to your skin and cause burns.
Also before of the heated bed which can reach high temperatures capable of causing burns.

Fire Hazard

Never place flammable materials or liquids on or near the printer when powered on or in operation. Liquid acetone and vapors are extremely flammable.

Pinch Hazard

When the printer is in operation, take care to never put your fingers in the moving parts, including the belts, pulleys or gears. Also, tie back long hair or clothing that can get caught in the moving parts of the printer.

Static Charge

Make sure to ground yourself before touching the printer, especially the electronics. Electrostatic charges can damage electronic components. To ground yourself, touch a grounded source.

Age Warning

For users under the age of 18, adult supervision is recommended. Beware of choking hazards around small children.

Table of Contents

0 – Introduction and Acknowledgments

I’d like to welcome you to the Rostock MAX v2 assembly guide!

Even if you've built an original Rostock MAX v1 3D printer, you'll want to read this manual carefully. There are no common Melamine parts from the v1 design. The construction has been greatly streamlined and should prove to be a shorter build. The design changes made will ensure that you've got a long lasting, easy to calibrate, delta configuration 3D printer.

Please read this entire guide before you begin assembly of your new Rostock MAX v2! It will help you avoid any unpleasant surprises and will ensure that you’ve got everything you need BEFORE you need it! Understand that the photographs in this assembly guide do NOT tell the whole story of each step! Make sure you read and understand the accompanying text for each step!

A quick note on the RAMBo, the controller for your Rostock MAX. The RAMBo is static sensitive, so please don't take it out of the static bag it ships in until you're ready to use it.

The box containing the RAMBo and its wiring should also contain a printed, black & white sheet that looks like this:

http://www.reprap.org/wiki/File:Rambo-conn-all.jpg

Please refer to this sheet when you reach Chapter 18. This is a valuable guide to wiring the RAMBo up to your Rostock MAX. Note that the connector polarity is clearly marked on the board for the “MOSFET Outputs”.

Acknowledgments

I'd like to thank LulzBot for the use of their images in the Troubleshooting Section and safety disclaimer as well as the gentleman that runs http://minow.blogspot.com.au/ for his excellent guide on calibrating delta configuration 3D printers.

I'd also like to thank the whole gang over at the SeeMeCNC forums for providing excellent feedback. This would be a much lesser creation without their contributions and insights.

1 – Required and Optional Tools And Materials

Before you begin assembly of your Rostock MAX v2, please make sure you've got everything on the following list of tools and additional materials.

- P1 & P2 sized Phillips screwdrivers
- Standard flat head screwdriver
- 3/32" Allen (hex) wrench. A ball-end, T-handle version is a good choice for this and the other sizes of Allen wrenches used
- 5/32" Allen (hex) wrench.
- 7/64" Allen (hex) wrench.
- Needle nose pliers
- Forceps – these will come in handy when routing the belts and reaching for small, hard to reach parts. They can be purchased from Amazon for as little as $3.50 for a set of two.

- Wire strippers
- Wire cutters
- 5/16" open-ended wrench (Used primarily on the nuts that hold the Cheapskates together)
- 2 7/16" open end wrenches. (used to adjust Cheapskate Bearings)
- 11/16" open-ended wrench (used for hot-end mount)
- PermaTex Ultra Copper High Temp RTV

- A small razor knife like an X-Acto knife. This will be handy for cleaning the flashing off the injection molded parts.
- 1/2” wide roll of Kapton tape
- Uninsulated crimp on connectors, sized for 22-18ga wire.

  Radio Shack P/N 640-3036 is an excellent choice.
- A digital caliper. These can be purchased from Harbor Freight tools for around $10.

- A small squeeze clamp that can open at least 2”
- Crimping tool (Jameco P/N 159266 is a good choice)

- Battery powered screwdriver. If you ever needed an excuse to buy one of these, THIS IS IT.
- Pencil.
- 40W Soldering Iron.
- Blue thread locking compound (Loctite or Permatex Threadlocker Blue)
- A small file.
- Elmer's Glue Stick – must be marked “Disappearing Purple”.

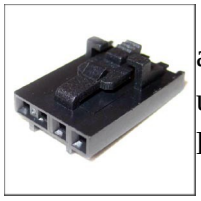
The following is a list of optional things that can make your life easier in the long run.

- Electrician's tape.
- Waxed lacing cord. You can use this in place of wire ties in pretty much any application. You can find it here: http://www.skygeek.com/wht-string.html. While expensive, you'll never really need to buy a wire tie again and it'll likely last you the rest of your life. :)
- .100” (2.54mm) Latching Polarized Male Housing (1x4) and matching crimp pins. This is used to add a connector to the end of the EZStruder extension cable and makes life a lot easier. You can purchase 2 of these connectors and their associated crimp pins from Hansen Hobbies (http://www.hansenhobbies.com/products/connectors/pt1inlpconnectors/pt1in_lp_1x4/) very inexpensively. The link for the pins is shown in the description for the male housing.

If you want to be able to change your hot end easily, I would highly recommend getting quick-disconnect connectors for the hot end as well as the PEEK and layer fans.

For the hot end, I'd recommend these four connectors:

This is a four pin, latching polarized male connector housing. This should be used on the hot-end heating resistor wires and thermistor wires. I'll illustrate the correct installation in the chapter that covers those steps.



This is a four pin, latching polarized female connector housing. This should be attached to the wires coming from the power supply. The female connector is used here in order to prevent accidental shorting of the power and thermistor leads. Some of these are included in the RAMBo box.

This is a female JST connector. These are very nice connectors for both the PEEK and layer fans. These would be fitted to the power leads of the fans.

This is a male JST connector. Just as with the male hot end connector, these would be attached to the power wires coming up from the RAMBo.

The use of these connectors is entirely optional! This is how *I* like to rig my printers and it's entirely okay to not do this. The pre-assembled printers from SeeMeCNC don't include these connectors, so don't feel obligated to use them. Now that being said, having a quick-disconnect hot end is just *cool.* :)

The JST connectors can be purchased from Hansen Hobbies as well – just make sure you order the right pins! Read the description pages carefully.

The JST connectors can be found here:
http://www.hansenhobbies.com/products/connectors/miscconnectors/

The Latching Polarized connectors can be found here:

http://www.hansenhobbies.com/products/connectors/pt1inconnectors/

If you don't already have a crimping tool, the one shown above will do the job, but the best choice would be a ratcheting crimp tool like this one from Pololu: http://www.pololu.com/product/1928

That's the tool that I use on my projects. It's reasonably priced at $34.95.

There was a great discussion on the SeeMeCNC forums recently on how to properly use this kind of crimping tool. I recommend you check it out if you haven't used this kind of tool before.

http://forum.seemecnc.com/viewtopic.php?f=36&t=4342

As an additional resource, Hansen Hobbies has produced an excellent wire crimping tutorial here: http://www.hansenhobbies.com/products/connectors/Connectors.pdf

2 – Visual Bill of Materials

Your Rostock MAX v2 kit should contain four laser cut Melamine sheets, a large box containing hardware, injection molded parts, the RAMBo controller and the required wiring. The box will also contain a 450W ATX style power supply.

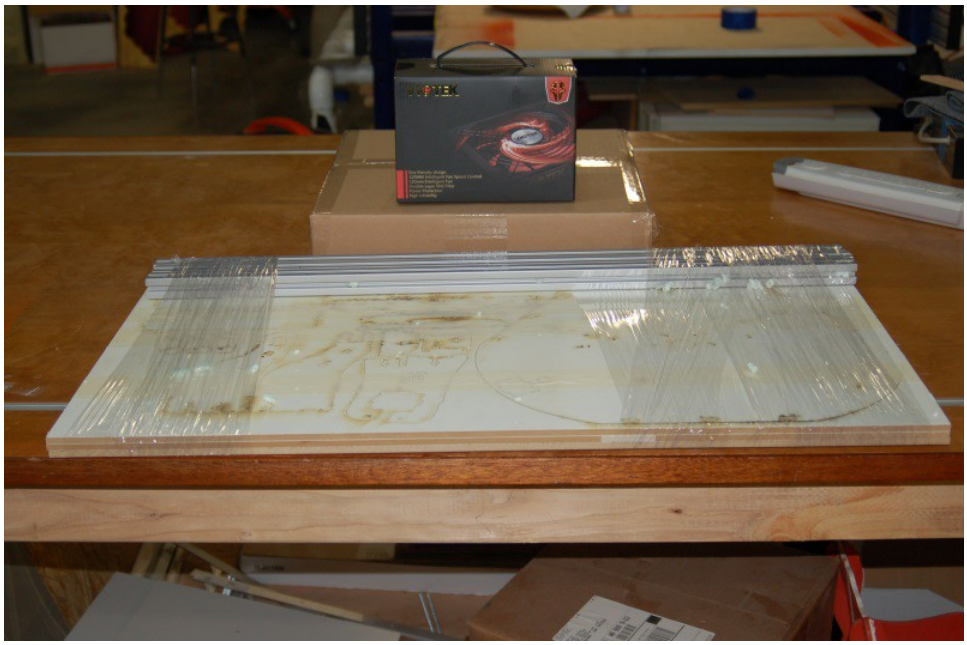


Fig. 1-1: Shipping box contents.

The Melamine parts are held in place with masking tape in order to protect them during shipping. The parts are also covered with a special cutting mask that prevents the laser cutting operation from depositing cutting residue on the Melamine surface. You'll need to remove all of this material before beginning construction.

Included in the three laser cut sheets is an additional smaller sheet that contains a component that's part of the printer's upper section, as seen in Fig. 1-2.

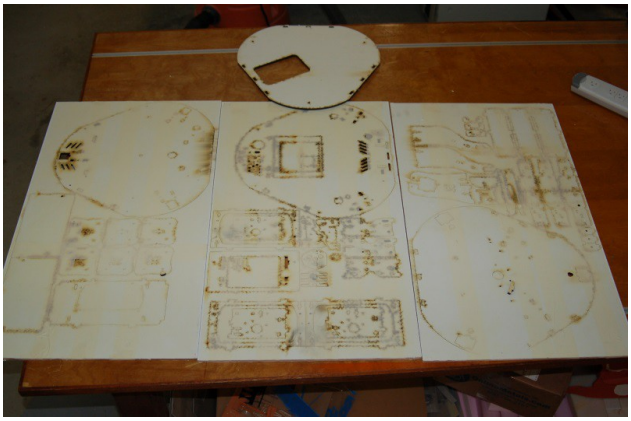


Fig. 1-2: Laser cut parts.

Take special care when removing the laser cut parts from the sheets. Sometimes the laser doesn't quite cut all the way through. If you find a part like this, you'll want to gently score the back side of the sheet along the faint cut line and then press the part out from the front of the sheet. The front and back of the sheet is easily identifiable – the front of the sheet will have very dark laser cut lines with “flash” deposits to either side of the laser cut line. The back of the sheet will have much fainter marks.

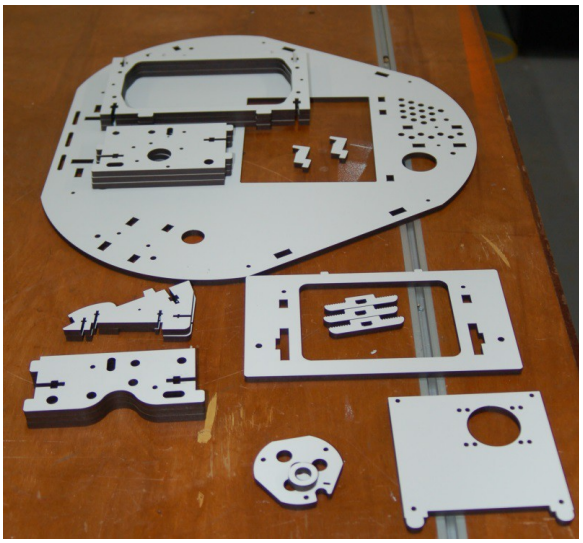


Fig. 1-3: Sheet #1 parts.

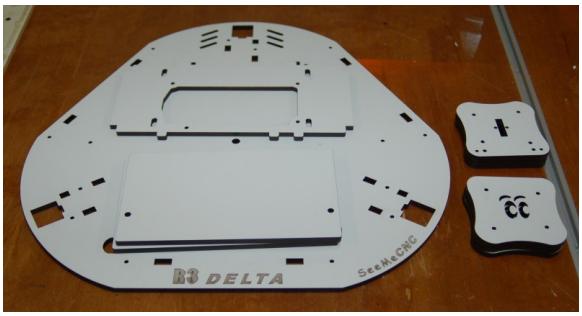


Fig. 1-4: Sheet #2 parts.

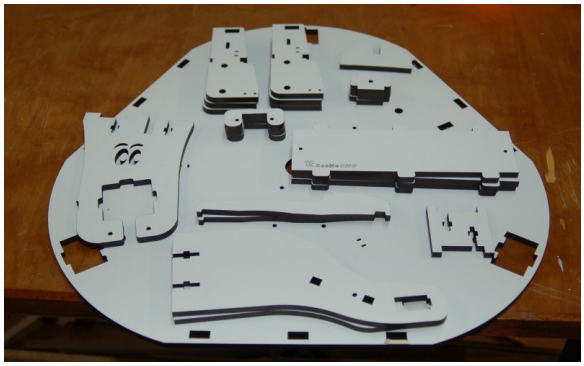


Fig. 1-5: Sheet #3 parts.

The cardboard box contains all the non-melamine components required to build the Rostock MAX v2. Many are in individual baggies, some are in heat-sealed bag "packs". As you go through the following Bill of Materials, please count and check off each item. This is important as you don't want to be short a vital part during the build. It's better to find out before hand than being forced to stop the assembly process due to a missing part. If you are missing any parts, please contact support@seemecnc.com with the subject line of "Missing Parts!". *Note that the quantities shown in the photographs may not necessarily match the quantity listed to the right. When it doubt, follow the quantities listed in the text!*

For those that aren't sure how to identify the various screw types, Bolt Depot has made available some *excellent* references. I would recommend Fastener Basics (http://www.boltdepot.com/fastener-information/Printable-Tools/Fastener-Basics.pdf) and their Fastener Type Chart (http://www.boltdepot.com/fastener-information/Type-Chart.aspx).

Hardware Package #1

Rubber foot pack. Contains 6 each of the following components:

(___) #10-32, 5/8" Nylon Pan Head Screws

(___) #10-32 Nylon Finish Nuts

(___) Injection molded legs (black)

(___) Soft rubber feet

(___) 9 each, #10-32, 3/4" Knurled Nylon Thumb Screws.

These are for the right & left base covers as well as the LCD panel.

(___) 4 each, #6-32, 1/2" Slotted Pan Head Screws (Nylon).

These are used to mount the 450W ATX power supply

(___) 31 each, #6-32, 1" Phillips Pan Head Screws. Used for general assembly.

(___) 6 each, #6-32, 5/8” Socket Head Cap Screws. Used for mounting the U-Joint plates to the Cheapskate plates.

(___) 12 each, #6-32, 1-3/4” Phillips Pan Head Stainless Steel screws. Used for 608 idlers in the motor mounts as well as the hot end standoffs.

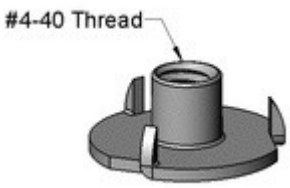
(___) 63 each, #6-32 Stainless Steel Nylon Lock Nut – covers all #6-32 screws.

(___) 14 each, #6-32, 2” Phillips Pan Head Stainless Steel screws. Used for Cheapskate plates and EZStruder mount.

(___) 15 each, #6-32, 1/2” 18-8 Stainless Steel Flathead screw. Used inside of base and top side plates, to retain acrylic panels and the three end-stop triggering screws installed in the Cheapskate U-Joint mounts.

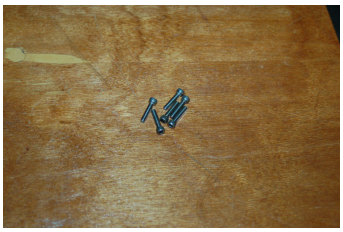
(___) 25 each, #¼-20, 1/2” Stainless Steel Button Head Cap Screws. Used for T-Slot mounting.

(___) 25 each, #¼-20 nut plates. Used for T-Slot mounting.

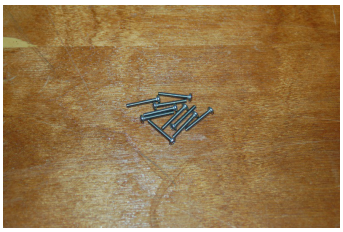


(___) 10 each, #4-40 T-Nuts. Used for belt clamps and RAMBo mounting.

(___) 4 each, #4-40, 3/4” Phillips Flat Head Machine screws. Used for mounting the RAMBo Controller.



(___) 6 each, #4-40, 1/2” Stainless Steel Socket Head Cap screws. Used for the belt clamps.



(___) 14 each, #2-56, 5/8” Pan Head Phillips Machine screws. Used for LCD mounting and end-stop switch mounting.

(___) 14 each, 2-56 Finish Nuts. Used for LCD mounting and end-stop switch mounting.

(___) 14 each, #4, 3/8” Phillips Pan Head Sheet Metal screws. Used for LCD sides and tower alignment guides.

(___) 12 each, M3x.5, 10mm Pan Head Machine screws. Used for mounting the stepper motors.

(___) 18 each, #6 Stainless Steel Flat washers. Used on the 608 bearings that go in the top & bottom t-slot rails.

(___) 6 each, #4 Stainless Steel Flat washers. Used with the belt clamp screws.

(___) 21 each, 608ZZ Ball Bearings. Used in the Cheapskates and belt idlers.

(___) 1 each, #10-32, 5/8” Socket Head Cap Screw. Used as a tap for the #10-32 Nylon thumb screws.

Hardware Pack #2

(___) 18 each, 608 Cheapskate Idler Bearing Spacer. Used for belt idlers.

(___) 12 each, 608 Cheapskate Carriage Bearing Spacers (black).

(___) 12 each, 608 Cheapskate Eccentric Bearing Spacers (gray).

Your kit may include Acetal u-joints instead of the machined aluminum version. In that case you will NOT have the aluminum ones listed below.

(___) 12 each, Universal Joints (Injection Molded Acetal)

(___) 12 each, Universal Joints (machined aluminum).

(___) 6 each, 3-1/8” Steel Universal Joint axle shafts.

(___) 3 each, 1” long machined aluminum hot end platform spacers.

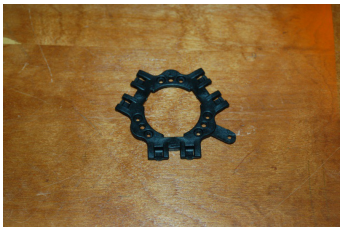
Hardware Pack #3

(___) 10 each, Plastic Bearing Rollers. 4 are used for mounting the RAMBo and six are used for the belt clamps.

(___) 12 each, Wire ties. Used for wire management or Barbie Handcuffs.Your call.

(___) 1 each, GT2 2mm pitch belt pulley pack. Includes six grub screws and hex wrench.

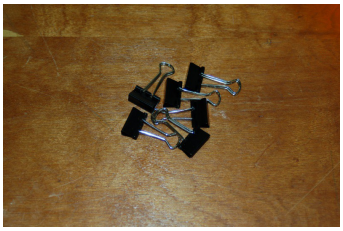
(___) 3 each, Carriage base for U-Joints. Outer tabs have been removed to allow for spring clips.



(___) 1 each, Effector Platform (spring clip style).

(___) 6 each, U-Joint Spring Clips.

(___) 1 each, 15 Tooth Gear. Used for manually operating extruder motor.



(___) 6 each, Binder Clips. Used to hold the Borosilicate glass build plate to the Onyx heated bed.

Rostock MAX v2 Electronics and Hardware Pack #4

(___) 1 each, RAMBo Electronic Control Board with screw terminals and end stop wires.

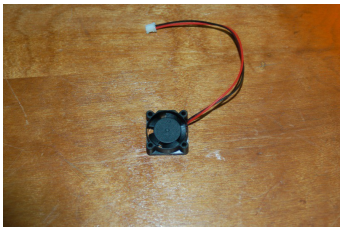
(___) 1 each, USB Cable.

(___) 1 each, Onyx Heated Bed Kit.

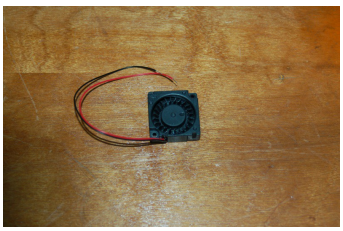
(___) 1 each, LCD Smart Controller with SD card, LCD to RAMBo Adapter Kit and 1 Soft Touch 5mm knob.

(___) 4 each, NEMA 17 Stepper Motors (4800cgm holding torque). Used for three motion axes and extruder drive.

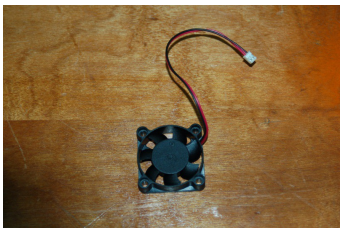
(___) 1 each, Rocker switch, including spade lug crimp terminals.



(___) 1 each, 25x25x10mm 12VDC fan. Used to cool the PEEK section on the hot end.



(___) 1 each, 30x30x10mm 12VDC fan. Used for part cooling.



(___) 1 each, 40x40x10mm 12VDC fan. RAMBo cooling fan.

(___) 10 feet, 18ga, 4 conductor wire. Used for the hot end power and thermistor.

(___) 10 feet, 22ga, 4 conductor wire. Used to extend wiring for extruder motor.

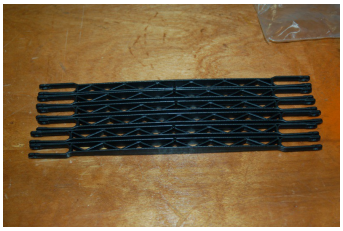
(___) 15 feet, 26ga, Black & Red wire. Used for hot end PEEK and part fans.

(___) 4 feet, 3/8” diameter Expandable Mesh Wire Loom (black). Used to cover wiring & bowden tube from the top to the hot end platform.

Includes 3” of 5/16” heat shrink tubing.

(___) 3 each, 76” GT2 Timing Belts.

(___) 24 each, Bearing Sleeves. Used to cover 608ZZ bearings.



(___) 6 each, Rostock MAX Delta Arms.

(___) 1 each, EZStruder Cold End Kit. Includes stepper motor mounting hardware.

(___) 1 each, Hot End Kit. Includes hot end, heating resistors, thermistor, PTFE sleeve for thermistor, PTC fittings and PTFE bowden tube.

Smoked Acrylic Parts Pack

(___) 1 each, Smoked Acrylic parts pack. Includes, LCD face, LCD sides (left & right), base and top covers.

Miscellaneous Parts

(___) 1 each, 300mm x 3mm Borosilicate Glass Build Plate. Used with Onyx Heated Bed. (Yes, there's a big glass disc inside that foam sleeve!)

(___) 1 each, 450W ATX Power Supply.

(___) 3 each, T-Slot rails, 32” long.

(___) 3 full and one partial laser cut sheet of Melamine parts.

3 – Prepping the Hot End and Power Supply

Preparing the Hot End

The hot end for your Rostock MAX v2 3D printer uses Permatex Ultra Copper RTV to hold both the heating resistors and the temperature sensor (the thermistor) in place. Because it takes a few hours for the RTV to set completely (I recommend letting it cure over night), it's a good idea to get that started now. You'll also want to find something ahead of time that you can use to hold the hot end nozzle up that won't be disturbed while the RTV cures.

For this step, you'll need the parts out of the hot end pack. This includes the hot end itself, the two heating resistors and the tiny pack with the thermistor and it's PTFE tubing.

You'll start by coating each heating resistor with RTV as shown in Fig. 3-2.

You'll want to try to keep the resistor leads free of RTV, but don't skimp on the RTV application.

Fig. 3-1: RTV & heating resistor.

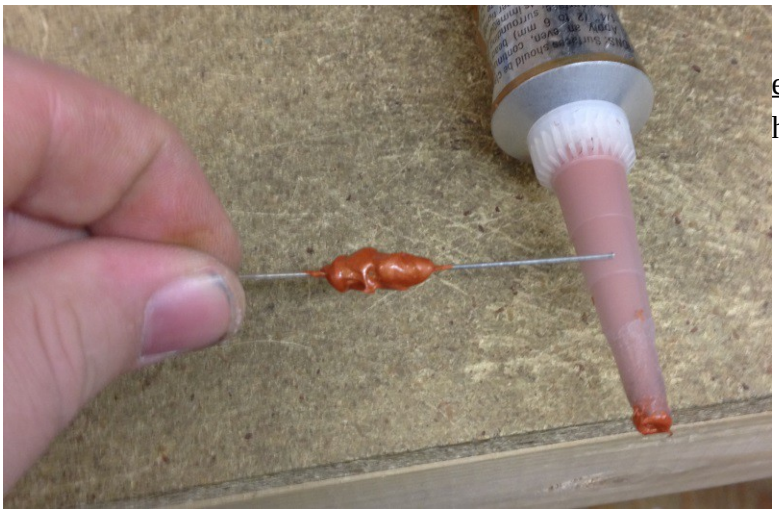


Fig. 3-2: Coating the heating resistor with RTV.

This stuff is goopy and sticks to everything! Keep a paper towel or ten handy.

Carefully insert both heating resistors into the pockets in the hot end as shown in Fig. 3-3.

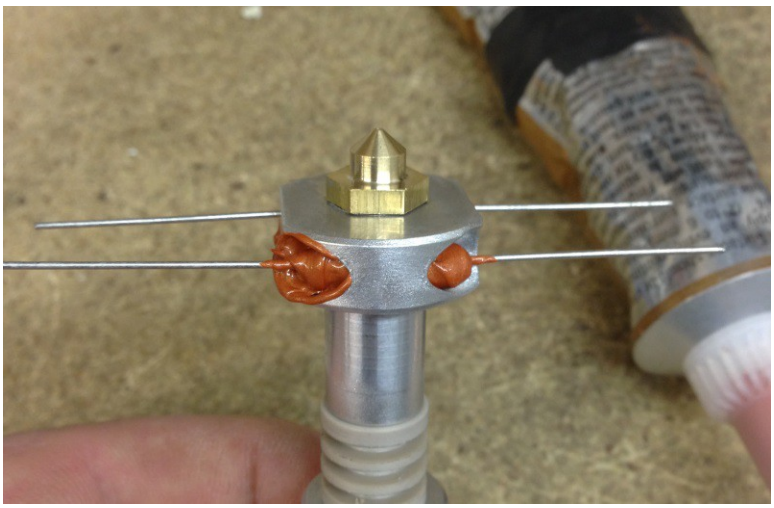


Fig. 3-3: Resistors installed in the hot end.

You'll need to add a little more RTV to both ends of the resistor in order to fully fill the cavity that the resistors sit in.

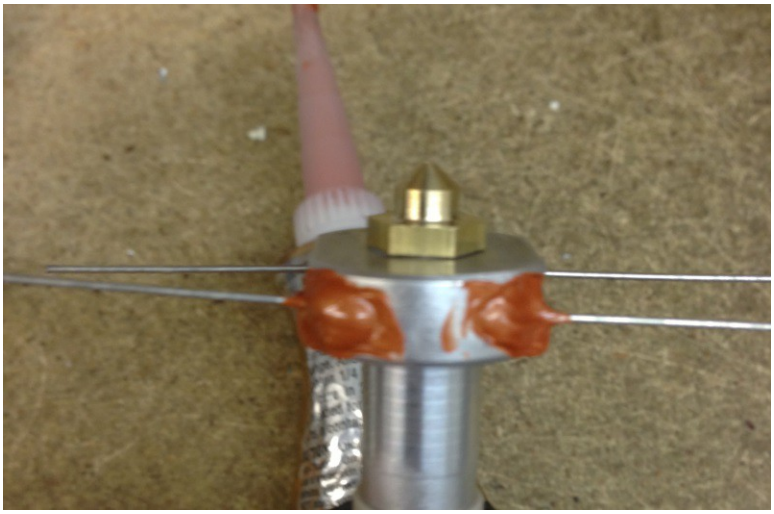


Fig. 3-4: Resistor cavities filled with RTV.

Don't be surprised if your application of RTV is not nearly as neat as shown above. These hot end assembly photos were shot by Andy Oprisko, a SeeMeCNC employee. He's literally built hundreds of hot ends and is very, very good at it.

Set the hot end aside, with the nozzle pointing up. We're going to prep the thermistor for installation next.

Take the short length of PTFE tubing from the thermistor package and cut it in half. Remove the thermistor from the paper protector (aka The Post-It! Of Shielding) and slide the a PTFE tube on to each of the thermistor leads as shown below.

Fig. 3-5: Thermistor with PTFE sleeves installed.

Using a pair of needle nosed pliers, bend a 90 degree angle in the thermistor and PTFE tubing as shown below. Take special care to not damage the thermistor head! It's made of glass and is very delicate.

Fig. 3-6: Bending the thermistor.

Take the nozzle off the Permatex Ultra Copper RTV tube and dip the end of the thermistor into the RTV as shown below.

Fig. 3-7: Coating the thermistor with RTV.

The thermistor should now be installed in the thermistor port on the flatted side of the hot end as shown. Set it aside in a safe place to allow the RTV to cure.

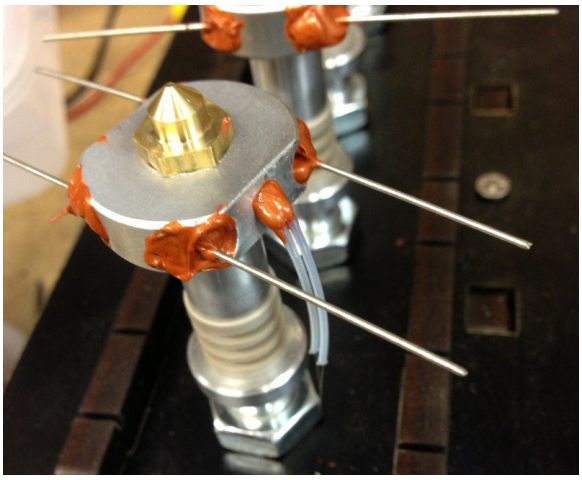


Fig. 3-8: Thermistor installed.

Preparing the Power Supply

Your Rostock MAX v2 uses a standard, 450 Watt ATX computer power supply to provide power to the RAMBo controller, the Onyx heated bed and the hot-end. All of these components require 12V DC. The 12V wires on an ATX power supply are yellow. You'll need four of these for the heated bed power, and one each for the hot-end and motors.

Start by locating six long yellow and black wires in the power supply. You want the most reach possible. 13" will be adequate. Clip the yellow & black wires you've chosen from the connectors they're attached to. You'll then want to locate one black wire and the green wire on the large ATX connector and cut those free as well. The green wire will turn on the power supply when it's connected to the black wire.

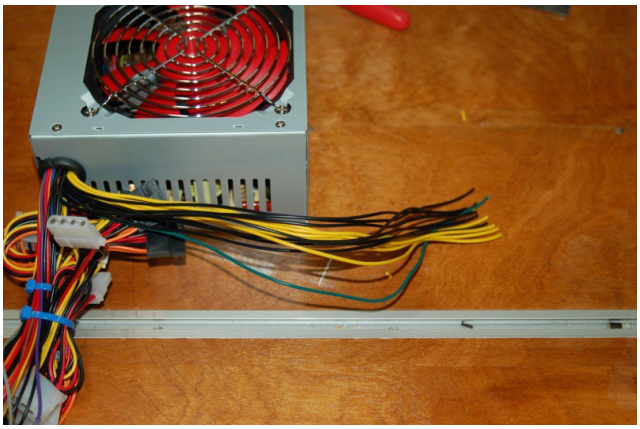


Fig. 3-9: Prepping the power wires.

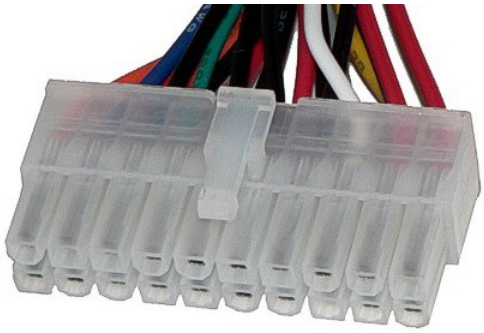


Fig. 3-9A: Typical ATX connector.

Once you've got the needed wires cut free from their connectors, you'll want to get the two crimp-on spade lug connectors out of the power switch package.

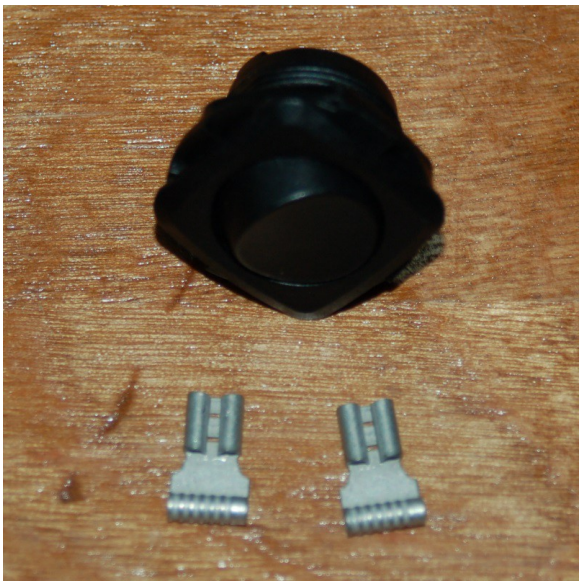


Fig. 3-10: Power switch and crimp-on spade lugs.

Strip off about 3/8” of insulation from the black & green wires that you cut from the big ATX connector and crimp the spade lug connector to each as shown in Fig. 3-10.

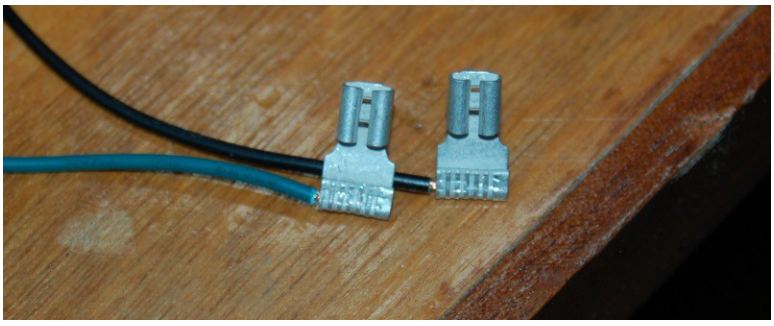


Fig. 3-11: Power switch connectors installed.

Now take the four long black wires from the bundle and strip about 3/4” of insulation from each. Tightly twist them together as shown below. Do the same for the four long yellow wires.

Fig. 3-13: Twisted Wires!

The remaining two yellow and two black wires only need about 3/8” of insulation stripped from them. Next, you'll need to get the RAMBo power connector and install the wires into it. The connector is found in the little bag marked “RAMBo v1.2 Kit” (the version number may be different) inside the white RAMBo controller box.

Install the four bundled black and yellow wires into the far left of the connector as shown in Fig. 4-13 on the next page and then insert the remaining power wires into the connector as shown. Please pay careful attention to the order of installation! If you reverse the yellow and black locations, you'll destroy the RAMBo when you turn on the power.

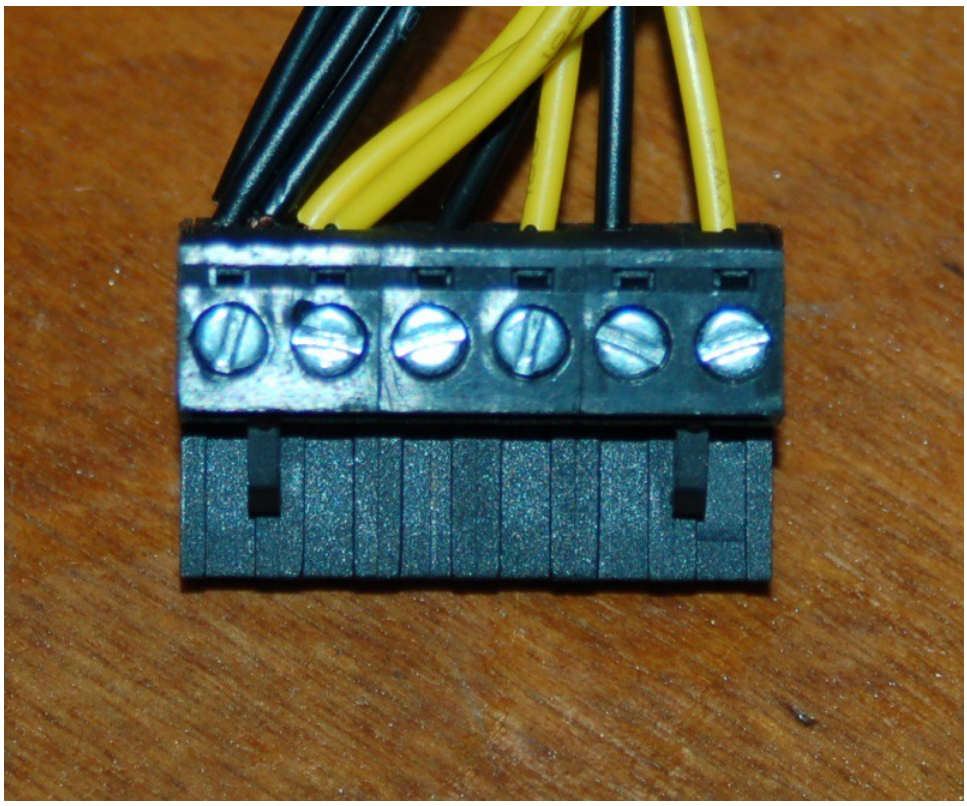


Fig. 3-13: Wires installed in the RAMBo power connector.

I made Fig. 3-13 pretty big so you can see exactly how it is supposed to be wired up.

Once you have the connector installed, grab a couple of the wire ties (or lacing cord!) and bind up the black & yellow wires that go to the connector. It's not strictly required, but it makes for a neat appearance. You can do the same with the black and green wires that will eventually be connected to the power switch. (If you're gonna brag about your baby, she's gotta look *nice!)*

4 – Building the Base

In order to build the base, you'll need the following parts:

1. (___) Base Plate Bottom, Base Plate Top (Not Shown)
2. (___) Vertical Supports (3)
3. (___) RAMBo Mounting Legs (2)
4. (___) Foot Assemblies (6)
5. (___) #6-32 Nylon Lock Nuts (12)
6. (___) #6-32 1/2” Stainless Steel Flat Head Screws (6)
7. (___) #6-32 1” Stainless Steel Pan Head Screws (6) (Not shown.)
8. (___) #6-32 1/2” Nylon pan head screws (4) (Not shown.)
9. (___) Power Supply and Onyx Heated Bed Pack (Not shown.)

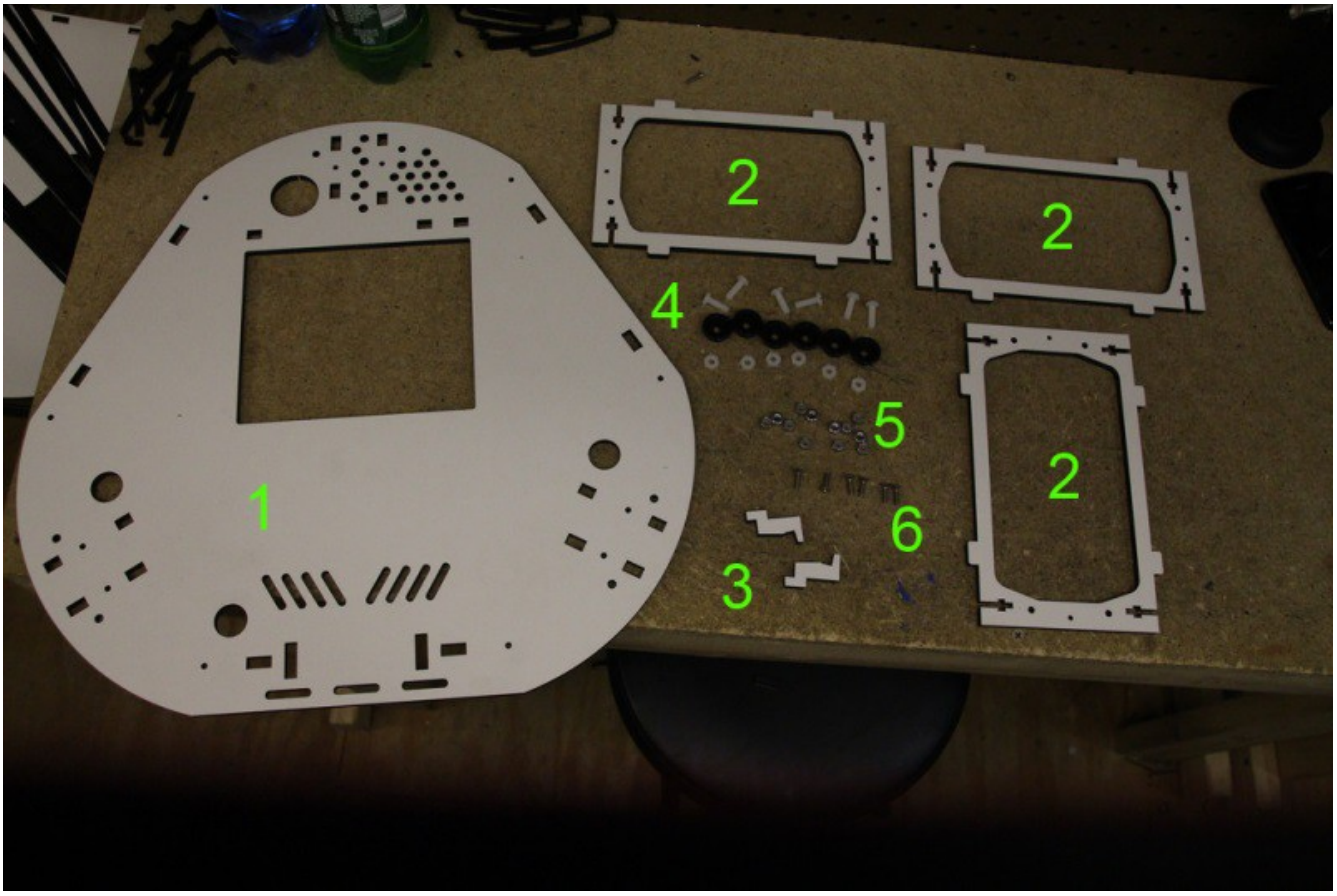


Fig. 4-1: Required base parts.

In addition to the parts listed above, you'll also need the power supply mounting plate, shown below.

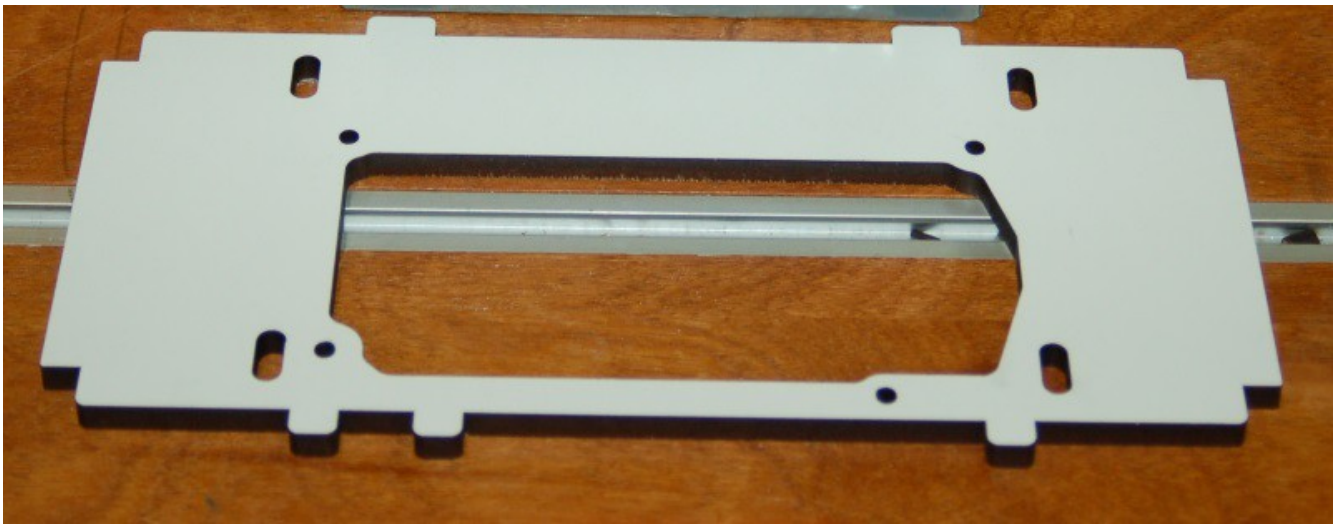


Fig. 4-2: Power Supply Mounting Plate.

Installing The Feet

Set the base plate upside down on your build table and install the six feet as shown below. You won't be installing the rubber “shoes” until the end of the build. The shoes are high-friction parts and it will hamper your ability to spin the machine around on your table while building it.

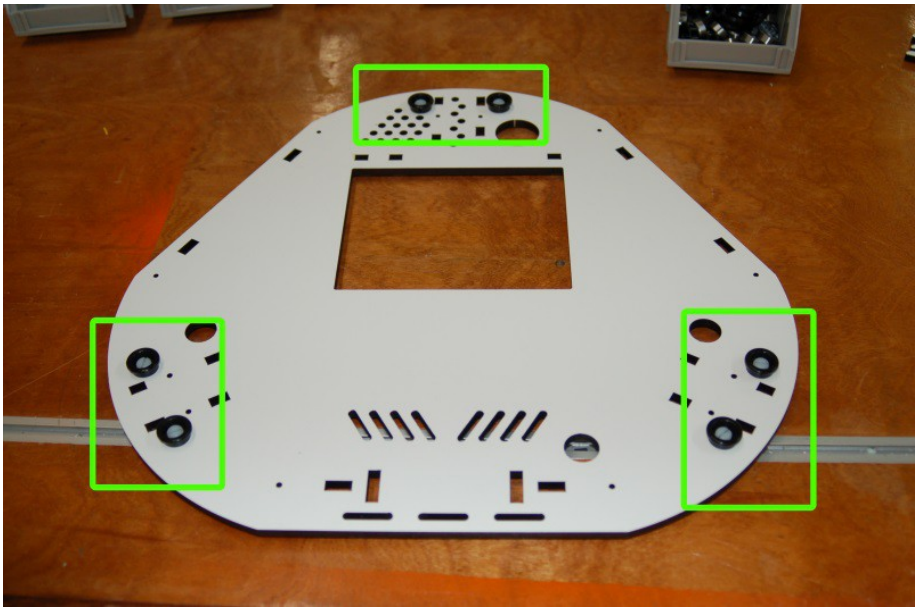


Fig. 4-3: Installing the foot assemblies.

Make sure you've got the base plate oriented exactly as shown, with the angled vent holes closest to you and the two medium sized holes to your right.

Preparing the Vertical Supports

The vertical supports need to have four #6-32 Nylon lock nuts and two #6-32, 1/2” Stainless Steel flat head screws installed in each one.

The simplest way to install the lock nuts is to use a pair of needle nosed pliers and grip the nut as shown in Fig. 4-4.

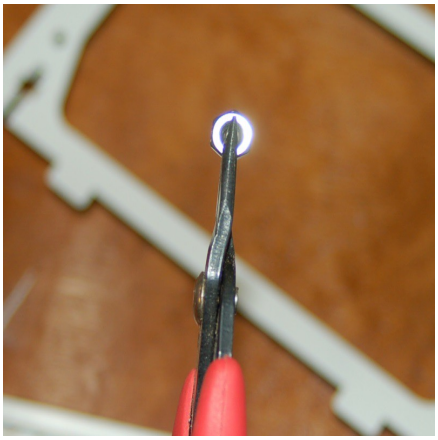


Fig. 4-4:Gripping a nut. (Quit snickering!)

Install each nut in the nut pockets laser cut in the vertical supports as shown below.

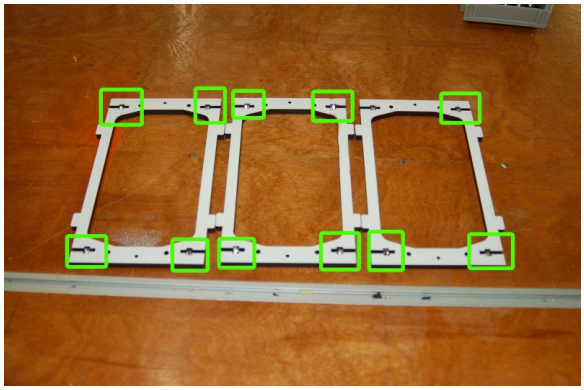


Fig. 4-5: Nut installation points.

The lock nuts need to be oriented such that their flat face is facing the channel leading to the edge of the part as shown in Fig. 4-6.

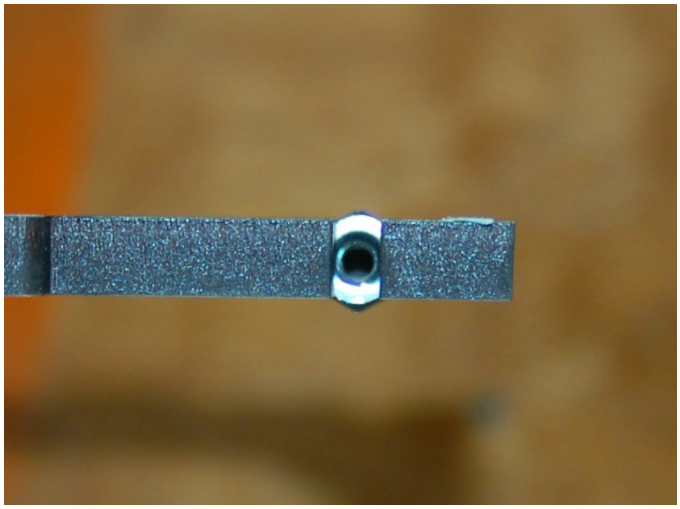
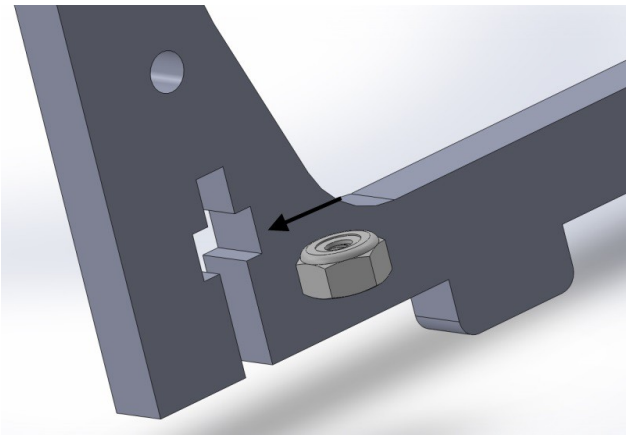


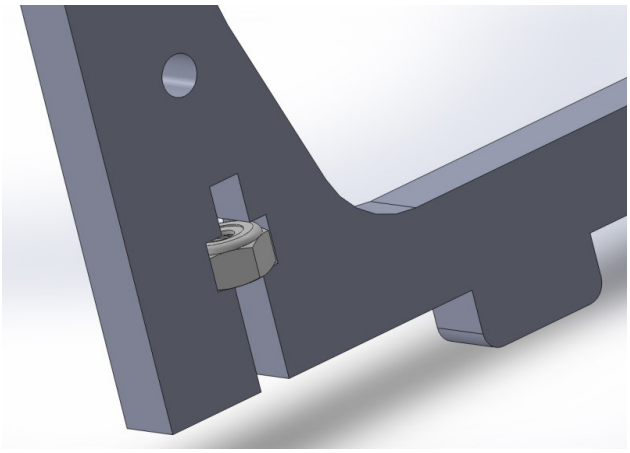
Fig. 4-6: Nut orientation.

The pockets the nuts fit into are tight, but the nuts will fit. If you're having trouble getting the nut to fit, try inserting it from the other side of the part. The laser kerf results in a slight cut angle that makes one side of a cut area a tiny bit wider than the other. This will help get the nuts inserted. If they're too lose, you can use a small tab of Scotch tape to hold them in until you've put screws in the problem nuts.

The two following illustrations should help clarify how the nylon lock nuts fit into the nut pockets. This method is used throughout the build.



Ill. 4-1: Placing the nylon lock nut.



Ill. 4-2: Lock nut installed.

Next, you need to install two #6-32, 1/2" Stainless Steel flat head screws into each vertical support as shown in Fig. 4-7.

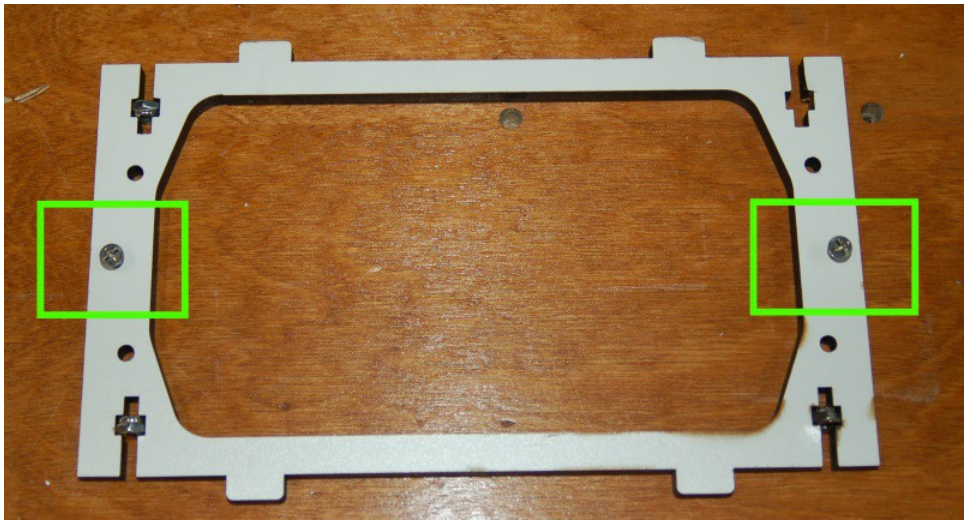


Fig. 4-7: Flat head screw locations.

This is the point where having an electric screwdriver comes in VERY handy. The simplest way to install the flat head screws is to lay the vertical support flat on the table and drive the screws in like in Fig. 4-8. You only want to drive the screw until the tip of the screw is even with the opposite face of the vertical support as shown in Fig. 4-9.

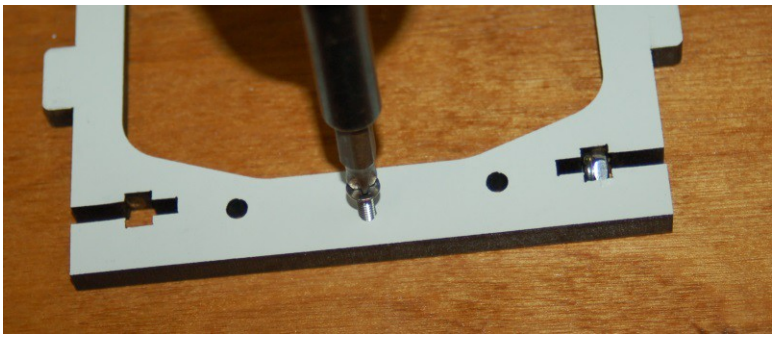


Fig. 4-8: Installing the screw.

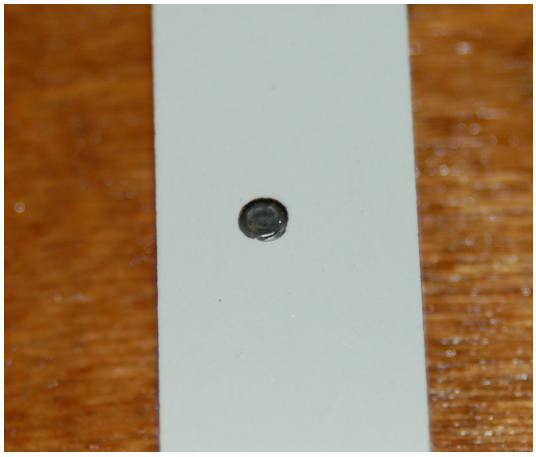


Fig. 4-9: Correct screw depth.

Installing the Vertical Supports and Power Supply

Before the two back vertical supports can be installed, we need to install the power supply on the power supply mounting plate with the four #6-32, 1/2” Nylon pan head screws.

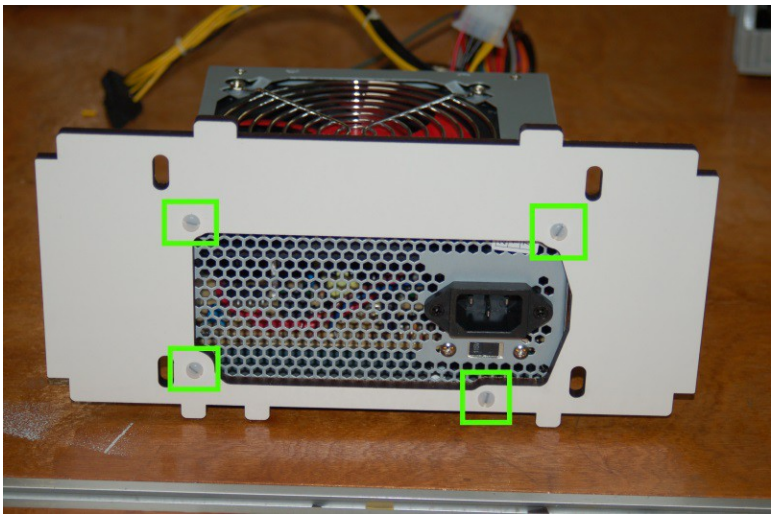


Fig. 4-10: Power supply attached to its mount.

Pay careful attention to the orientation of the mount. As you can see in Fig. 4-10 above, the mount has the two closely spaced tabs on the lower left of the mount. The green squares indicate the locations of the four Nylon screws.

The power supply base is held in place with the vertical supports that are installed to either side of it. You'll install all three parts at the same time – the fit tolerance is loose enough that they just drop in. Make sure that when you're installing the vertical supports that the 1/2” screws you installed are facing ***inward***. These screws are used to capture the acrylic covers that are installed later.

Fig. 4-11: Power supply mount and vertical supports.

The 1/2” screws are not shown in Fig. 4-11 but should be present!

Figs. 4-12 and 4-13 are provided to give you a bit of additional detail as to how the mount rests on the vertical supports. ***The 1/2" screws are not shown in Figs. 4-12 & 4-13 but should be present!***

Fig. 4-12: Detail of power supply bracket, right side.

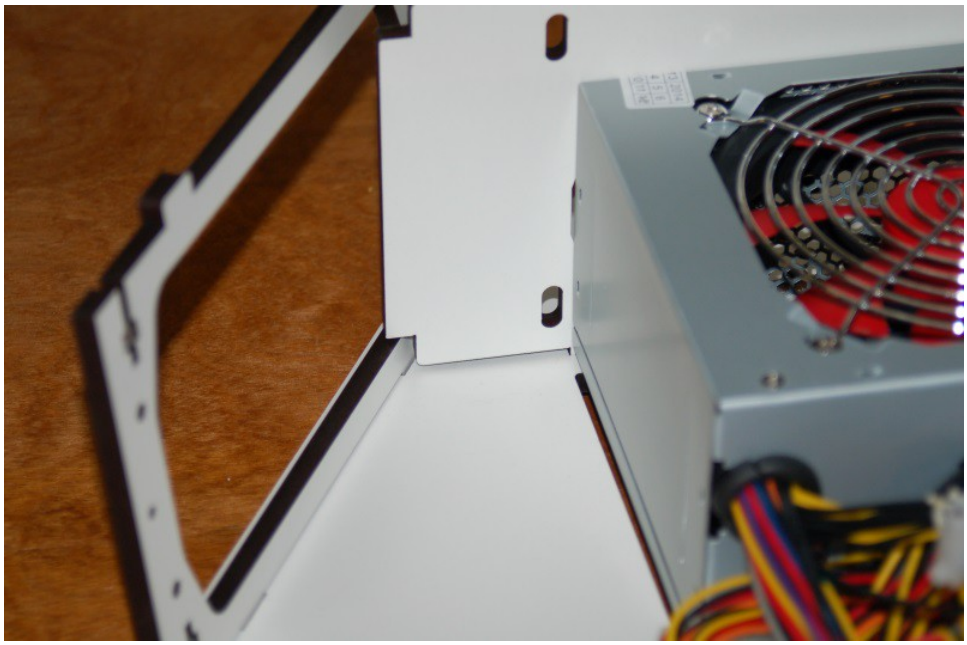


Fig. 4-13: Detail of power supply bracket, left side.

Get four #6-32, 1” Stainless Steel pan head screws and attach them to the two vertical supports you just installed. See the image below for an example.

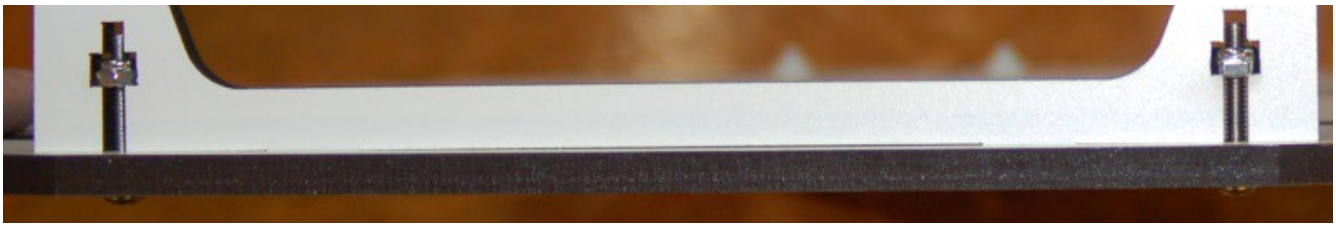


Fig. 4-14: Screws installed in vertical support

Make sure you leave the screws a bit loose – you'll need a bit of “slop” to help you align the tabs when you install the top plate on the base.

Before you can install the last of the three vertical supports, you'll need to install the two RAMBo support panel legs to the front of the base.

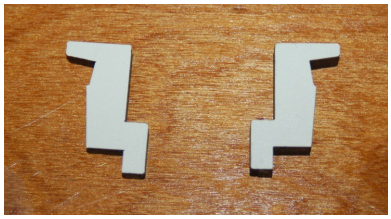


Fig. 4-15: Support Legs.

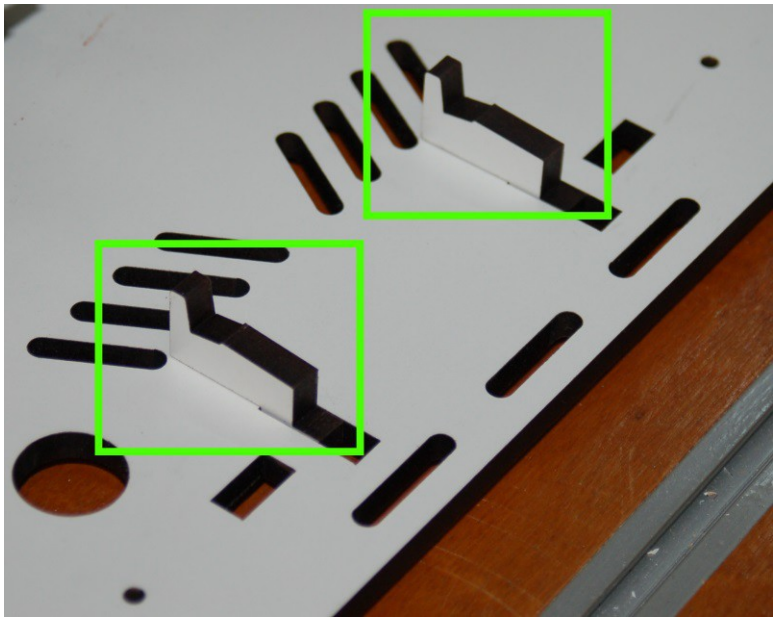


Fig. 4-16: Support legs installed.

The support legs just rest in place – they're held firmly when the support plate is installed over the top of them.

Use two #6-32, 1” Stainless Steel pan head screws to attach the front vertical support over the two RAMBo legs as shown below. Like the two back supports, leave this a bit loose in order to assist with fitting the top.

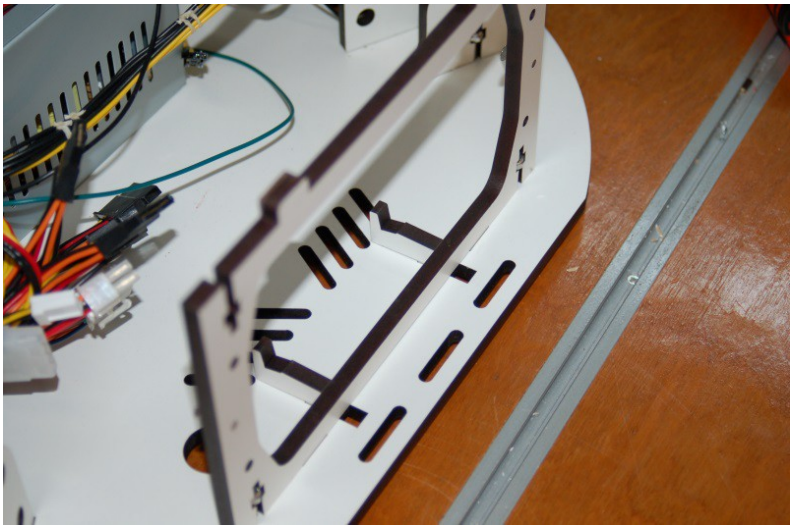


Fig. 4-17: Front vertical support and RAMBo legs installed.

Installing the Drive Gears on the Stepper Motors

For this step you'll need three of the four stepper motors, the drive gear wheel pack and some blue thread locking compound.

Fig. 4-18: Setting up the first stepper.

When you attach the drive gears to the stepper motor, you should start off by putting a bit of thread locker on the first grub screw and install it as shown in Fig. 4-19.

The green arrow points to the “flat” in the stepper motor shaft. You want your first grub screw to press against that flat spot. This will ensure that the drive gear doesn't rotate on the shaft over time. When you slide the drive gear over the shaft, make sure that the outside face of the gear is even with the face of the stepper motor's output shaft. Place a small amount of thread locker and install the second grub screw. Repeat this task for the other two stepper motors.

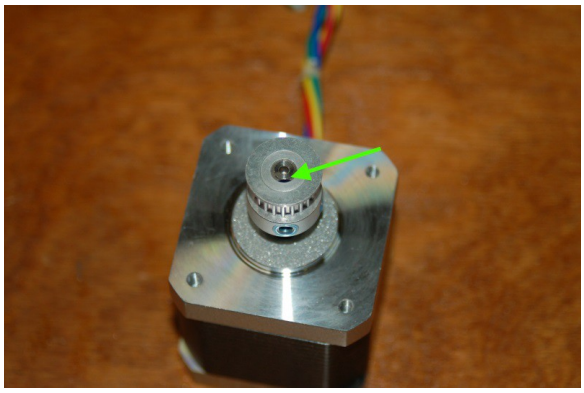


Fig. 4-19: Installing the first grub screw.

Fig. 4-20 shows the correct orientation and alignment of the drive gear. The green line indicates that the gear face and shaft face should be even.

I highly recommend taking the time to put a slight twist in the stepper motor wires and bind them up with some wire ties or lacing cord.

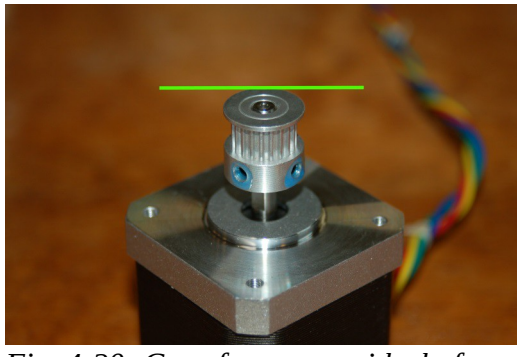


Fig. 4-20: Gear face even with shaft.

Assembling the Tower Supports

For this step, you'll need the following materials:

1. (___) Stepper Motor Support Plates (3)
2. (___) Tower Support Plates (3)
3. (___) Cheapskate Idler Bearing Spacers (12)
4. (___) 608ZZ Roller Bearings (6)
5. (___) ¼-20 1/2” Button Head Cap Screws (12)
6. (___) ¼-20 T-Slot nut plates (12)
7. (___) #6-32 Nylon Lock Nuts (12)
8. (___) #6-32 1” Stainless Steel Pan Head Screws (6)
9. (___) M3 10mm Stainless Steel Pan Head Screws (12)
10. (___) #6-32 1-3/4” Stainless Steel Pan Head Screws (6)
11. (___) Stepper Motors (3)
12. (___) #4, 3/8” Stainless Steel Pan Head Sheet Metal Screws (3)
13. (___) #6-32 Stainless Steel Flat Washers (6)

First up, you'll need to put together the six belt support bearings by sandwiching each 608ZZ bearing between a pair of the black idler bearing spacers.

Fig. 4-22: Idler bearing parts.

Fig. 4-23: Assembled idler bearing.

Set those aside and grab a stepper motor and a stepper motor support plate. Align the stepper motor as shown in Fig. 4-24 and install it using four of the M3 10mm screws. Apply a little bit of thread locker to each one before installing.

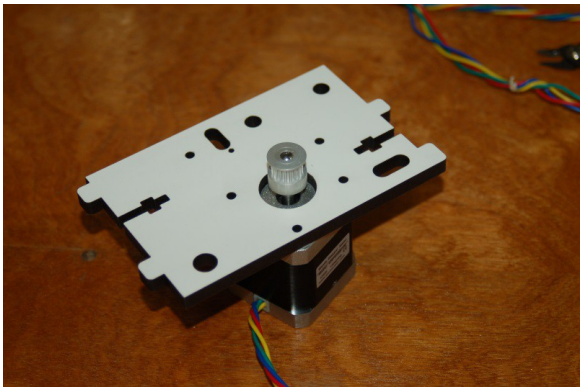


Fig. 4-24: Correct mounting plate alignment.

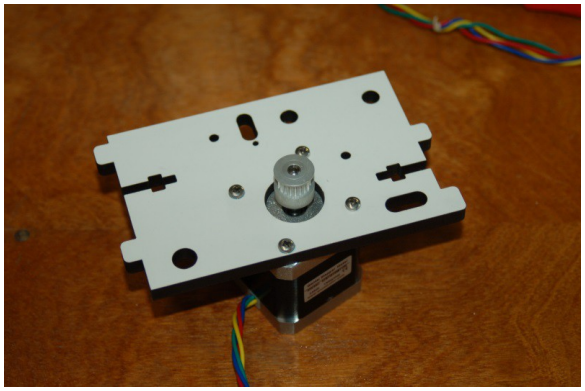


Fig. 4-25: Stepper motor screws installed.

Now you need to install a #4, 3/8” sheet metal screw where indicated in Fig. 4-26.

This screw is used as a stop in order to set the correct T-Slot tower depth.

Assemble ***TWO*** stepper motor support plates like you have here. The third is mirrored and will not install properly any other way.

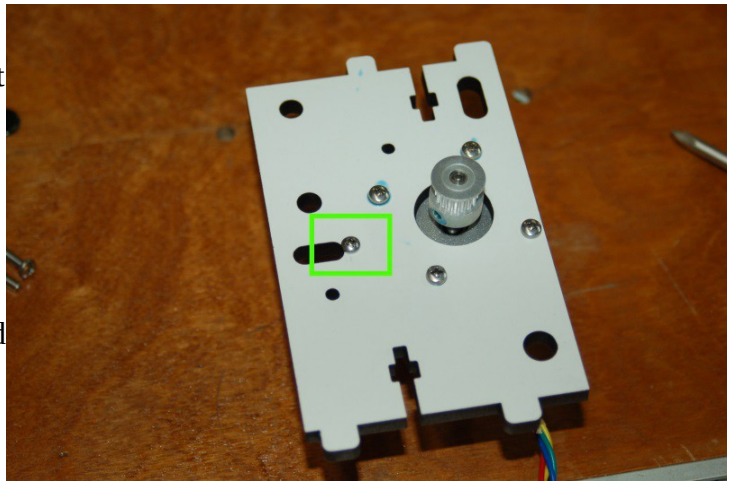


Fig. 4-26: T-Slot stop screw.

Make sure you build the third stepper motor support shown exactly as shown in Fig. 4-27.

When you're finished, you should have three stepper motor support assemblies that look exactly like the three shown in Fig. 4-28.

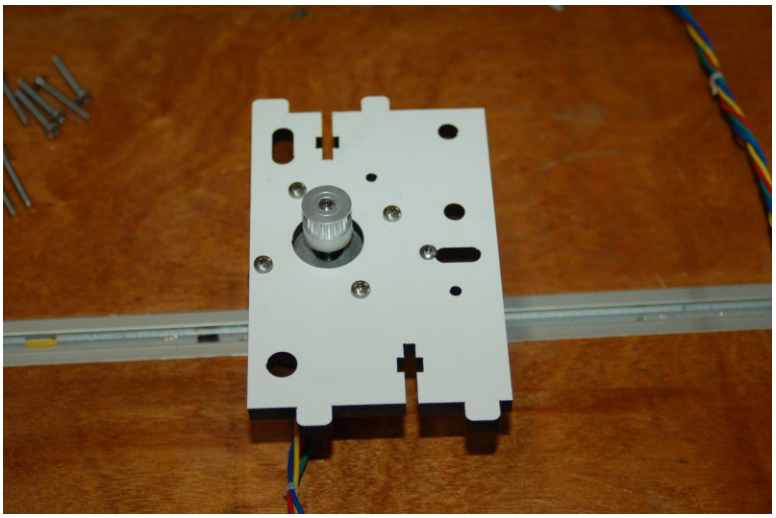


Fig. 4-27: Mirrored stepper motor plate.

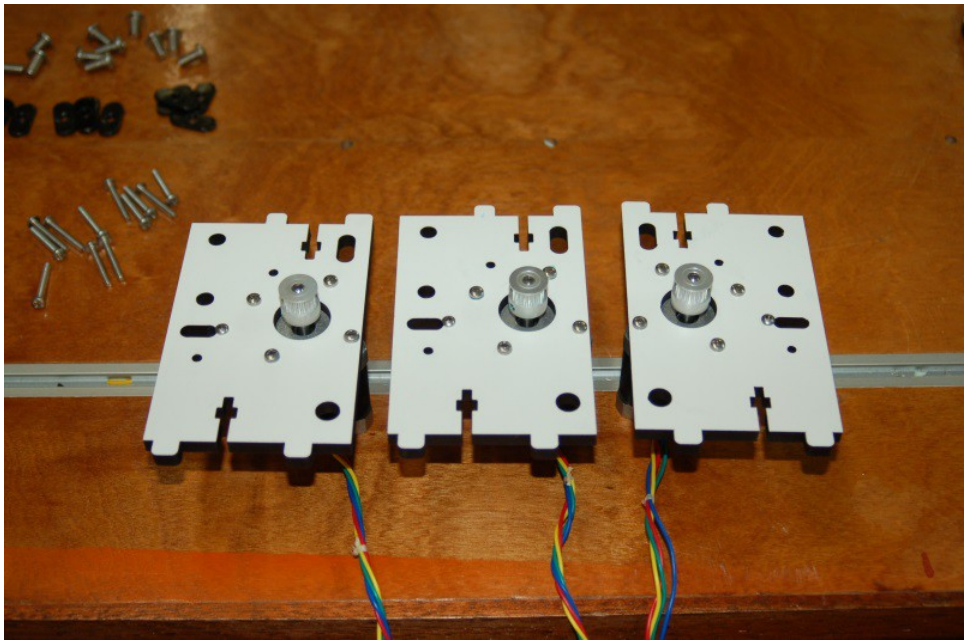


Fig. 4-28: Correctly assembled stepper mount plates.

Now install the 12 #6-32 Nylon lock nuts in the locations shown in Fig. 4-29. Make sure the flat faces of the nuts are facing “out” towards the edge of the part, just like you did for the three vertical supports.

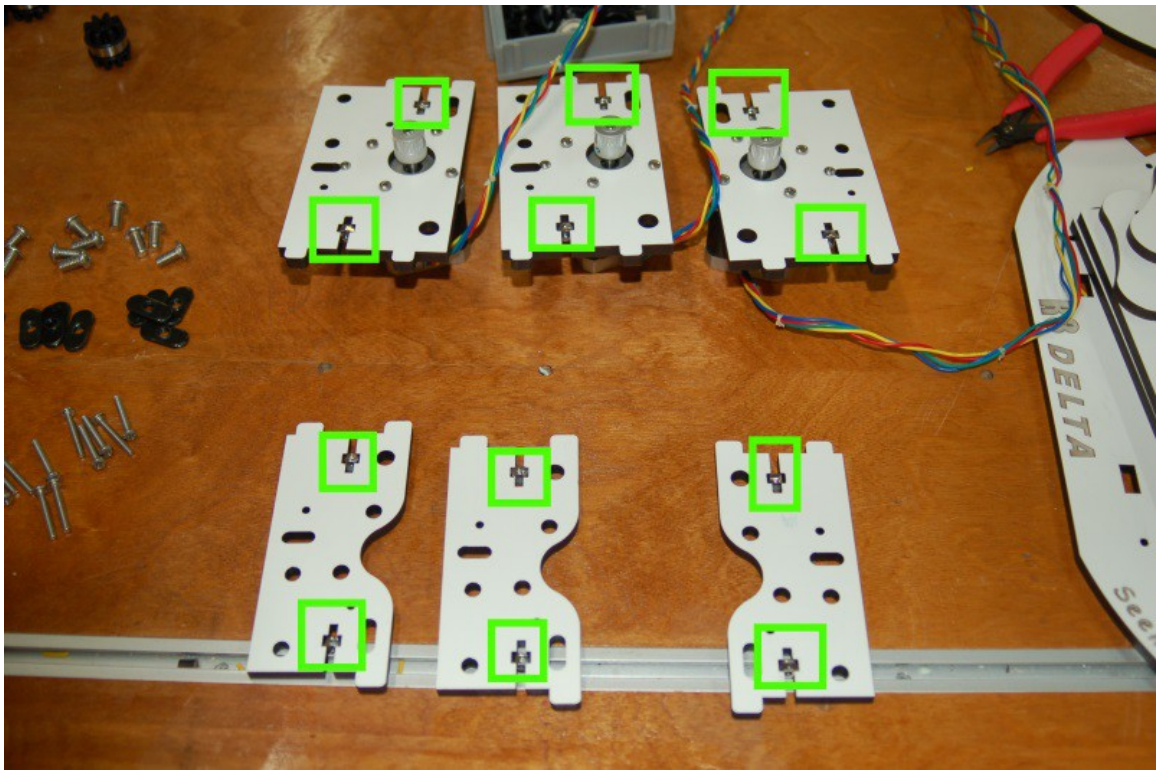


Fig. 4-29: Installation of the Nylon lock nuts.

Each tower support holds the idler bearing assemblies that you put together. In order to install them, you'll need to add a #6-32 washer to two of the #6-32, 1-3/4” Stainless Steel flat head screws and insert them into the back of each stepper motor mounting plate as shown below:

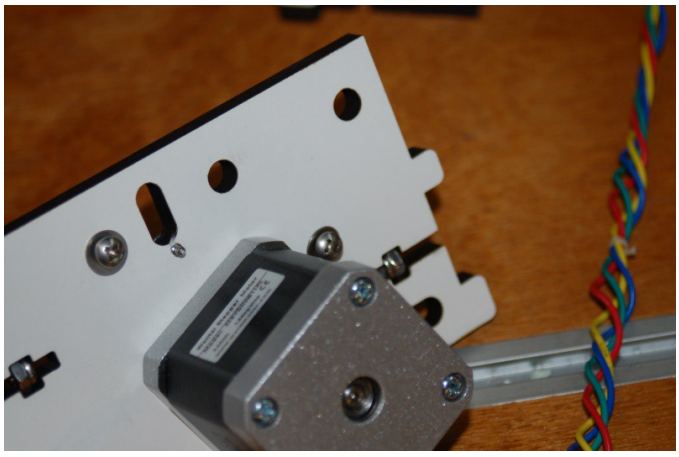


Fig. 4-30: Idler bearing screws installed.

Install two of the idler bearing assemblies on the two screws you just inserted and add the tower support plate on top. Add two #6-32 flat washers and two #6-32 Nylon lock nuts and tighten them down only enough to start engaging the Nylon. The looseness will help install it in the bottom plate and assist in fitting the top plate.

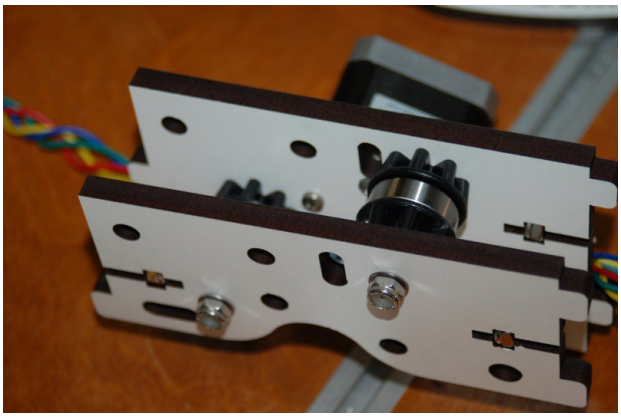


Fig. 4-31: Assembled Tower Support.

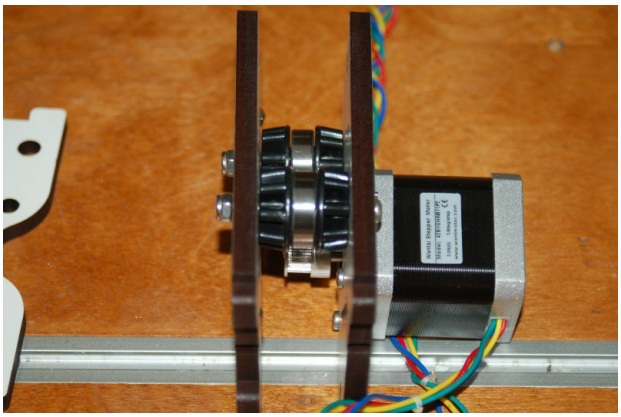


Fig. 4-32: Assembled Tower Support.

Now you need to install four of the ¼-20 cap head screws and four T-Slot nut plates into each tower support assembly. Only thread the T-Slot nut plates enough to feel the end of the screw catch all the threads in the plate – the space is needed to make the tower installation easier.

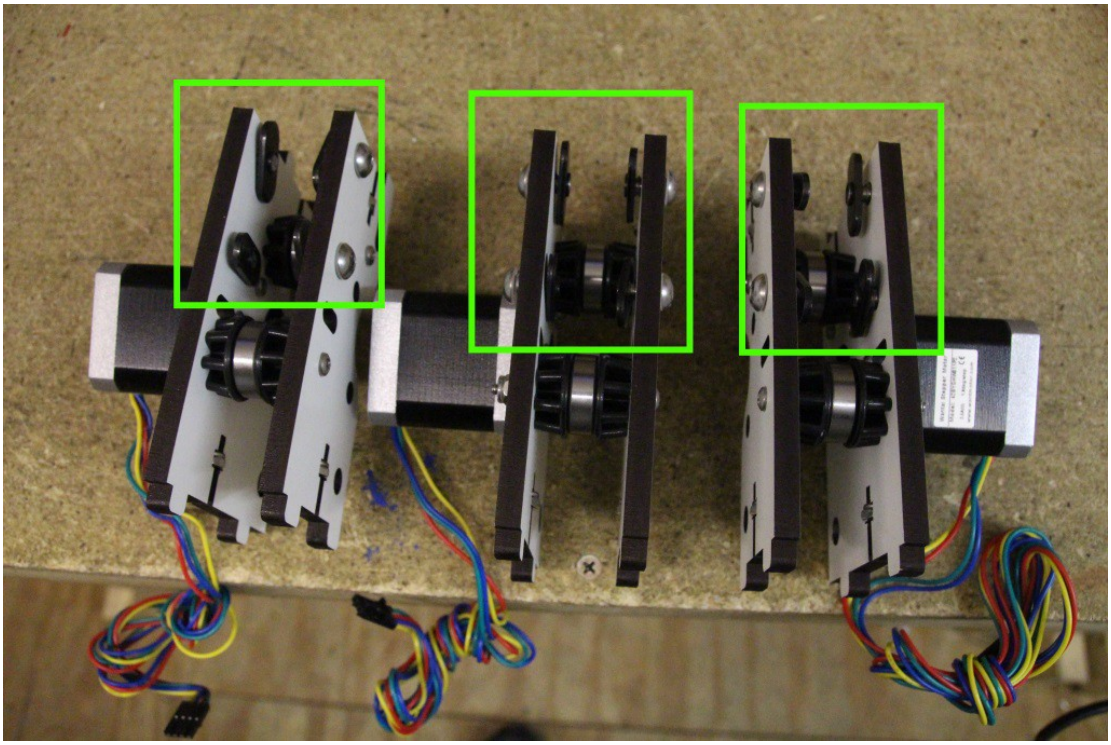


Fig. 4-35: Tower mounting hardware installed.

Finish assembling the other two tower supports. Install the three tower supports as shown in Figs. 4-34 and 4-35. The X (on the left) and Y (on the right) axis tower supports are opposites of one another as you can see in Fig. 4-34. Use six of the #6-32, 1" Stainless Steel pan head screws to attach the tower supports to the base. Leave them a bit loose as you did with the other base plate mounted parts. You should label each stepper motor wire with the name of the axis you're installing it on. This will make it easier to identify when it comes time to plug them into the RAMBo controller.

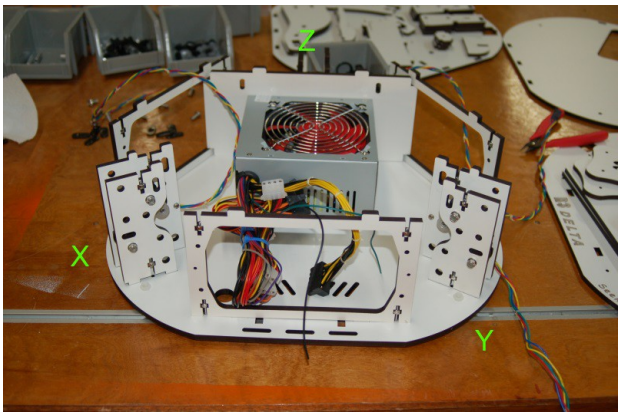


Fig. 4-34: X and Y tower supports installed.

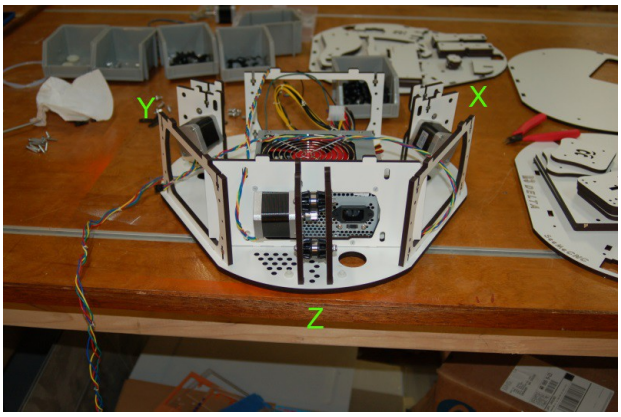


Fig. 4-35: Z axis tower support installed.

Now route the Z axis stepper motor wires through the hole in the power supply mounting plate as shown in Fig. 4-36.

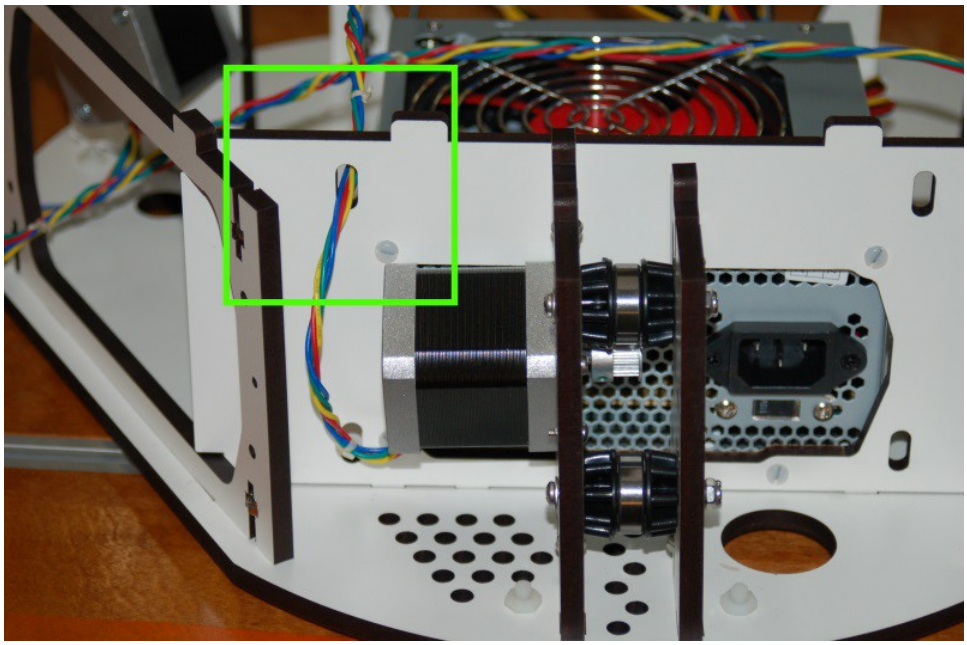


Fig. 4-36: Routing the stepper wiring.

Installing the Top Plate

The next step requires that you open up the Onyx Heated Bed package and remove the included #4-40 T-Nuts. These will be installed on the underside of the top plate as indicated by the green squares in Fig. 4-37. You'll also need 12 #6-32 1” Stainless Steel pan head screws in order to affix the top plate to the base.

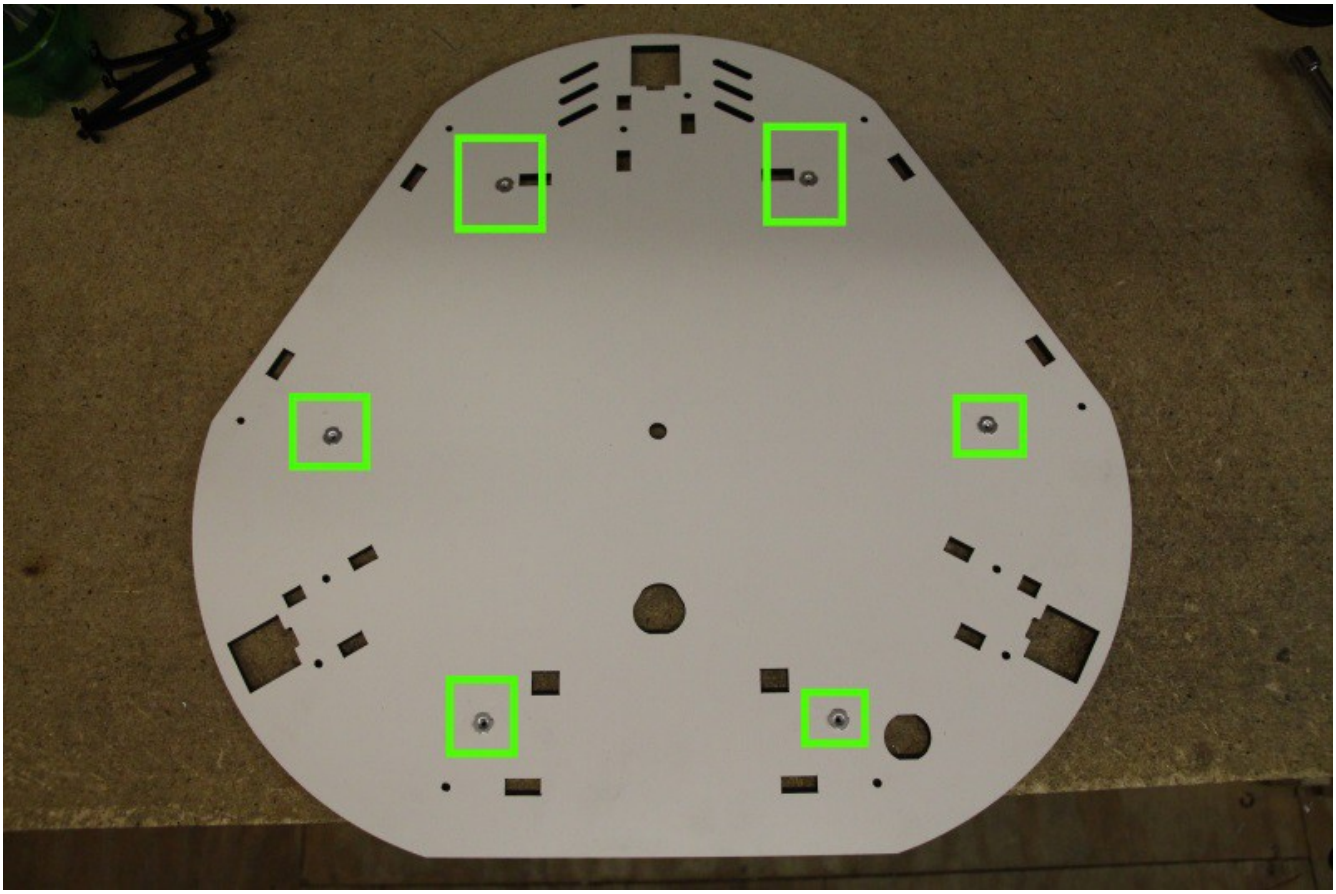


Fig. 4-37: T-Nut locations.

Please ensure that you've oriented the top plate as shown above so you'll be installing the T-Nuts on the underside of the top plate. The T-Nuts can be installed by lightly tapping them in with the back of a screwdriver, or by “drawing” them in using one of the #4-40 flat head screws that are included in the Onyx package. Make sure you use a small washer under the flat head screw if you do this, otherwise you could damage the holes in the top plate.

You may want to cover the T-Nuts with Scotch tape in order to make sure that they don't accidentally get driven out of the holes when you begin installing the Onyx Heated Bed.

If you have a Rev6 Onyx heated bed, the mounting holes will be rotated 30 degrees from the position shown above.

In order to install the top plate on the base you've assembled, you'll need to carefully begin to align the tabs in the three vertical supports and the three tower supports with the notches in the top plate. As you work one section down on to the tabs, install a #6-32 1” screw at a near hole to keep that section from popping out while you're working your way around the top. It takes a little patience to get done, but it's *vastly* easier than installing the original Rostock MAX top plate.

Fig. 4-38: Top Plate Installed.

Once you've gotten the top fully seated, fully tighten all of the #6-32 1” screws. Tighten the three vertical supports both top and bottom and then tighten down the three tower supports.

You don't want to over-tighten them however. If you do, you'll collapse the laser cut nut pockets.

5A – Installing the Rev2 Onyx Heated Bed

If your Onyx heated bed is labeled 'Rev3', please skip to Section 5B. If the Onyx is labeled 'Rev5' or 'Rev6', please skip to section 5C."

For this task you'll need the remaining parts in the Onyx Heated Bed package:

1. (___) Thermistor Pack. Includes a red LED, PTFE insulation tubing, a thermistor and a small resistor.
2. (___) Onyx Heated Bed
3. (___) "Snowflake" Mounting Plate (Not Shown)
4. (___) Nylon Spacers (6) (Not Shown)
5. (___) #4-40, 3/4" Stainless Steel Flat Head Screws (6) (Not Shown)

Fig. 5A-1: Onyx heated bed parts.

Installing the Thermistor, LED and Power Wires

Before you begin wiring up the Onyx, please take a few minutes to cover up the copper “vias” on the top surface of the Onyx. This is done to prevent accidental short circuits should you decide to use a metal “heat spreader” plate in the future.

Even if you never expect to use such an accessory (not sold by SeeMeCNC!), you still need to cover the center hole where the thermistor is installed from the bottom. This will prevent the RTV used in the process from raising above the top surface of the Onyx.

Fig. 5A-2: Via locations that need to be covered.

Once you've got the Kapton applied, open up the small package that contains the thermistor and the PTFE tubing. Cut two 1/4” tubes from the PTFE tubing and slide them on to the thermistor leads. You'll then bend the thermistor the same way you did when prepping the hot end.

See Fig. 5A-3 for an example of what you need to do.

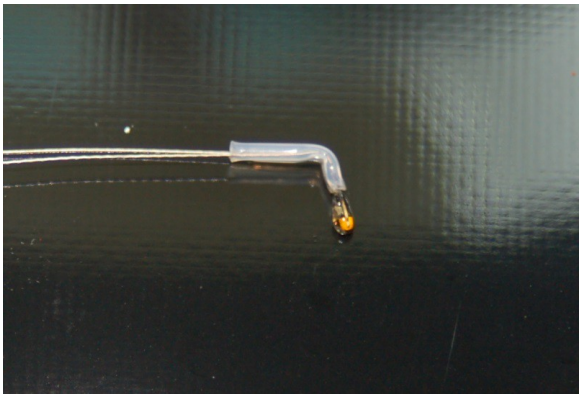


Fig. 5A-3: Thermistor properly bent.

As you did with the hot end thermistor, dip the end of the heated bed thermistor into some RTV and insert it in the center hole in the Onyx as shown below. Make sure you've got your thermistor oriented the way I show it.

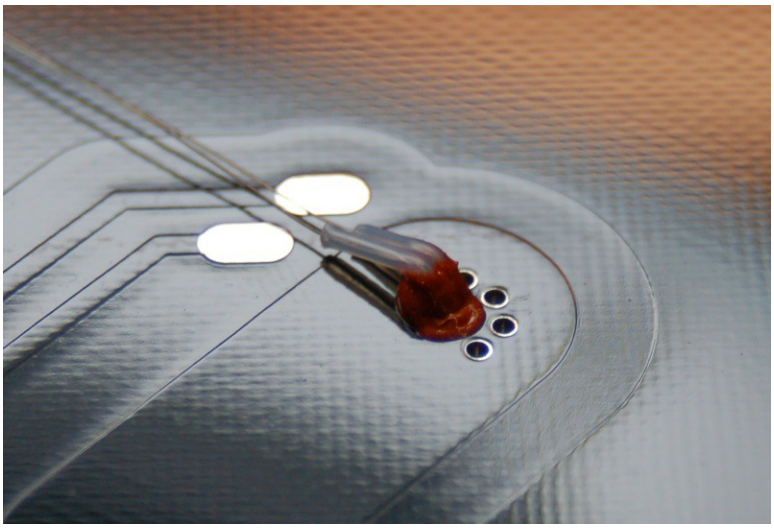


Fig. 5A-4: Thermistor inserted in the Onyx heated bed.

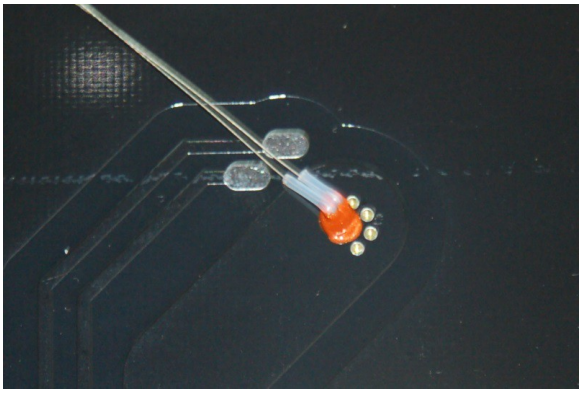


Fig. 5A-5: Same thing, different view.

Once you've got the thermistor in the Onyx, I want you to spread the thermistor leads apart such that each one crosses the center of a solder pad and then tape the thermistor in place using a short strip of Kapton tape. This will keep the thermistor in place while you're soldering the leads to the pads.

Next, solder down the leads to the solder pads. Make sure you don't create a solder bridge between the two pads. Use only enough solder to do the job. When you're done, clip off the excess leads.

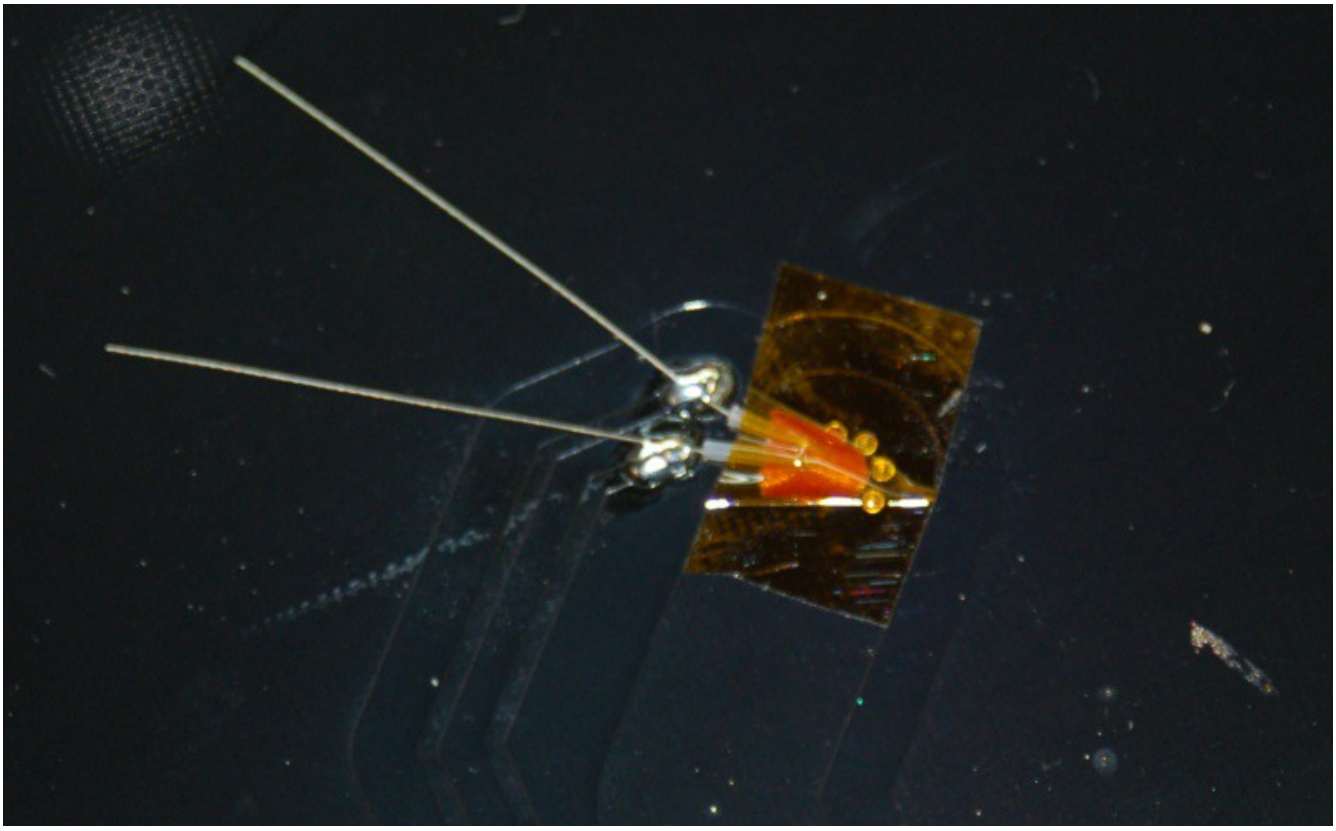


Fig. 5A-6: Thermistor taped in place and soldered.

With the Onyx still upside down, I want you to install the resistor as shown in Fig. 5A-7. The resistor is soldered from the side of the Onyx facing you, not the opposite side as you'd normally do when soldering in parts. After you finish soldering it in, clip the leads flush to the opposite side of the Onyx and using a small file, ***carefully*** file away the remaining tips of the resistor leads that stand proud of the surface. The 300mm Borosilicate build plate covers this area and you don't want to scratch it or cause it to lift up.

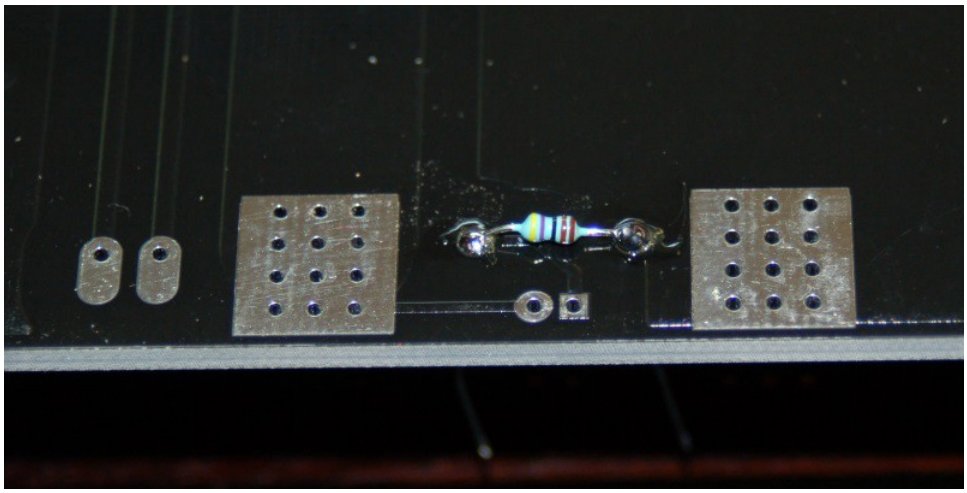


Fig. 5A-7: Resistor soldered to the bottom of the Onyx.

Once you've got the clipped leads cleaned up, install the red power LED as shown:

The LED is oriented with its Cathode (- side) facing to the right as indicated by the arrow. If you install it backwards it won't come on when the power is applied to the Onyx. The LED is bent “down” in order to be viewed easily from the top of the Onyx. (Remember, in this photo the Onyx is upside down.) As you did with the resistor, clip the excess leads and carefully file away any remaining part that sticks above the surface of the “top” face of the Onyx.

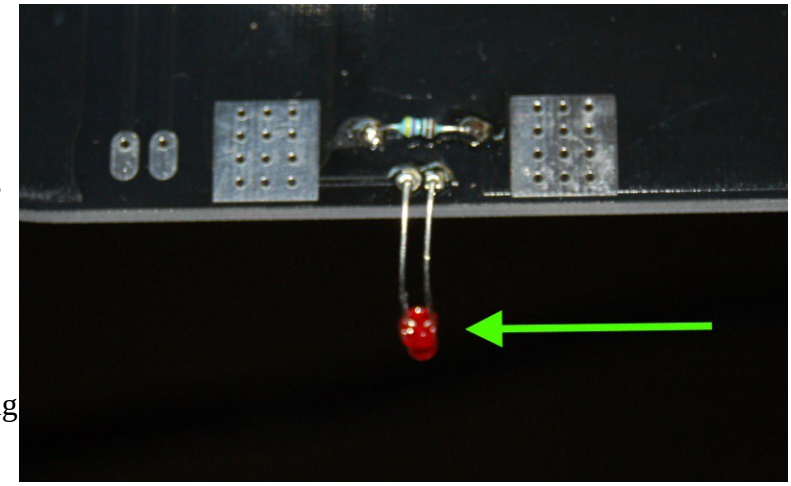


Fig. 5A-8: LED installed.

Cut 21” off the 18ga, four conductor cable included with your kit and remove the black & red wires from it. These are the power wires that need to be soldered to the power pads on the bottom of the Onyx.

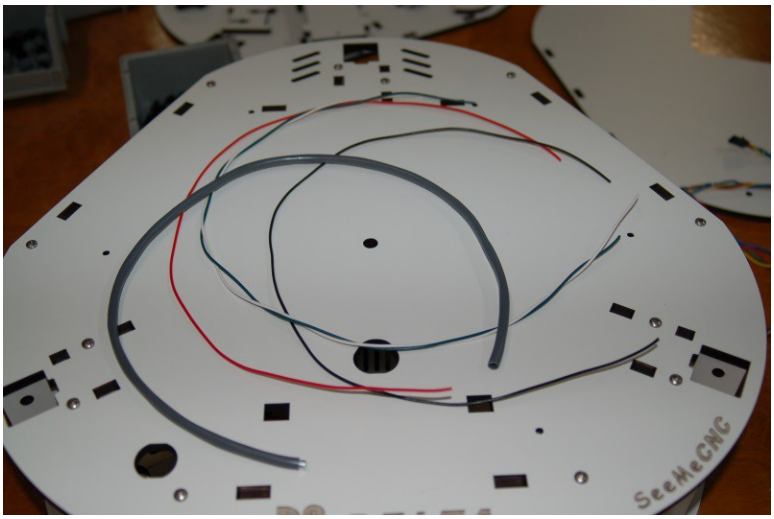


Fig. 5A-9: Wire stripped out of the 4 conductor. cable.

Flatten the end of the black wire and lay it on the pad as shown below. Solder in place.

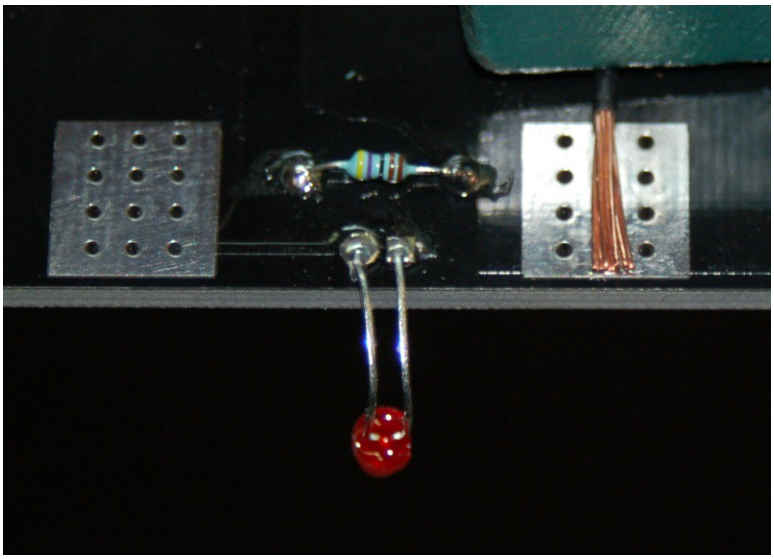


Fig. 5A-10: Ground lead ready to be soldered down.

Repeat the process with the red wire as shown in Fig. 5A-11.

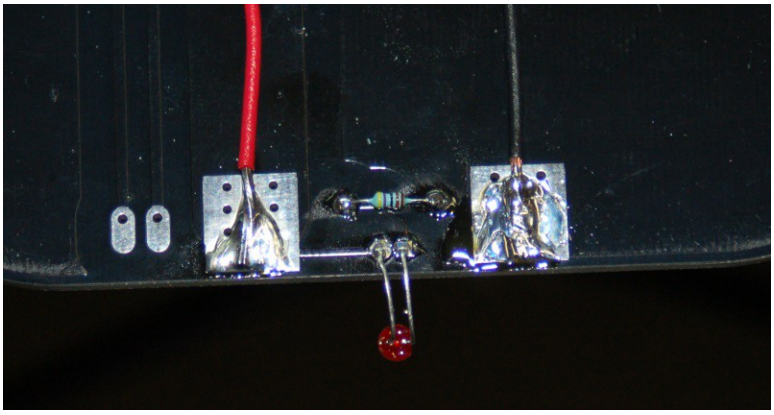


Fig. 5A-11: Power wires soldered down.

Now you need to attach the thermistor signal leads. You'll find them in the box that the RAMBo came in. It's a long, two wire (both white) cable with a connector fitted to one end.

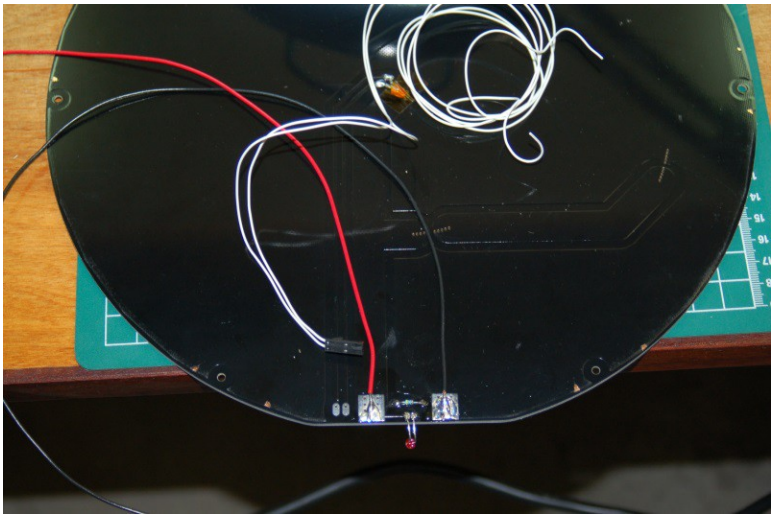


Fig. 5A-12: Thermistor signal wires.

Strip about 1/8” of the insulation of the bare ends of the thermistor wires and solder them on top of the solder pads that are located to the red wire. One wire per pad and take care to avoid solder bridges. When you're finished, cover the thermistor signal wire pads and the two power wire pads with Kapton tape to guard against a short circuit.

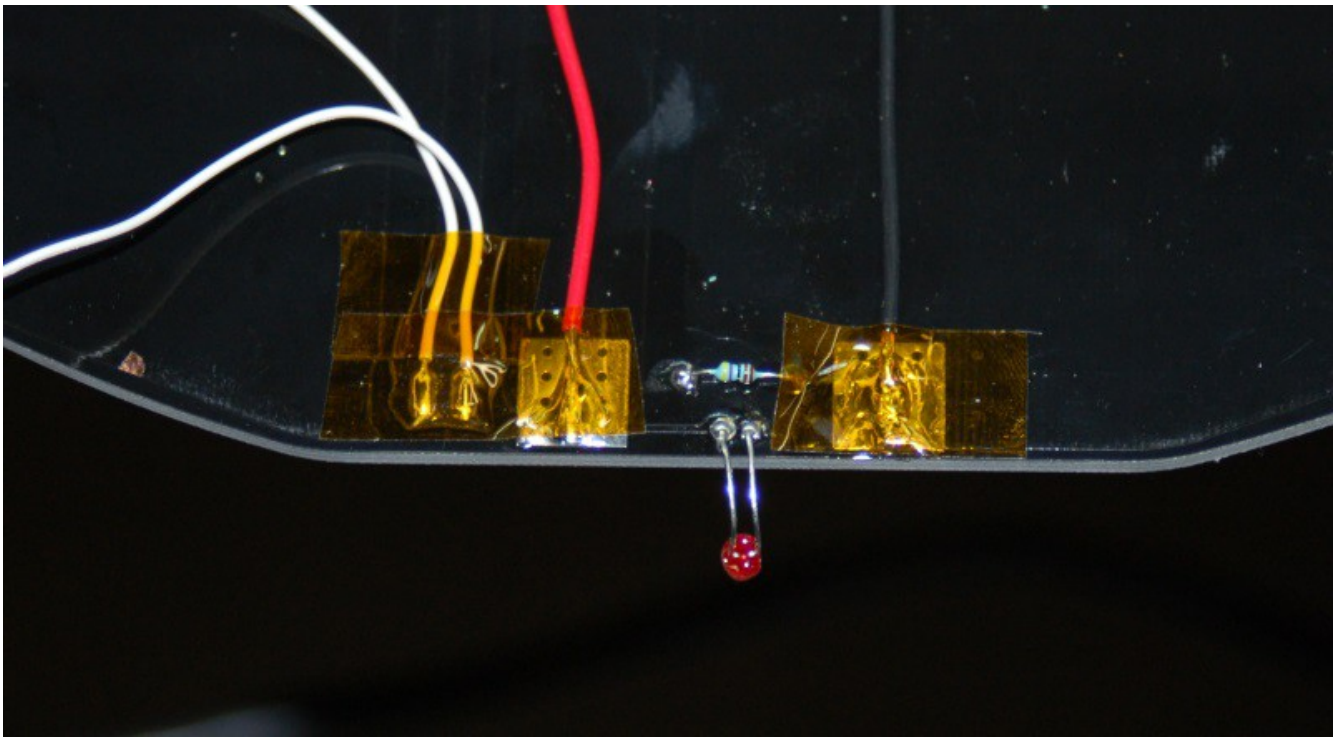


Fig. 5A-13:Thermistor wires installed and covered with Kapton tape.

Mounting the Onyx Heated Bed to the Base

In order to mount the Onyx on the base, you'll need to route the power and thermistor signal wires through the center of the base as shown below.

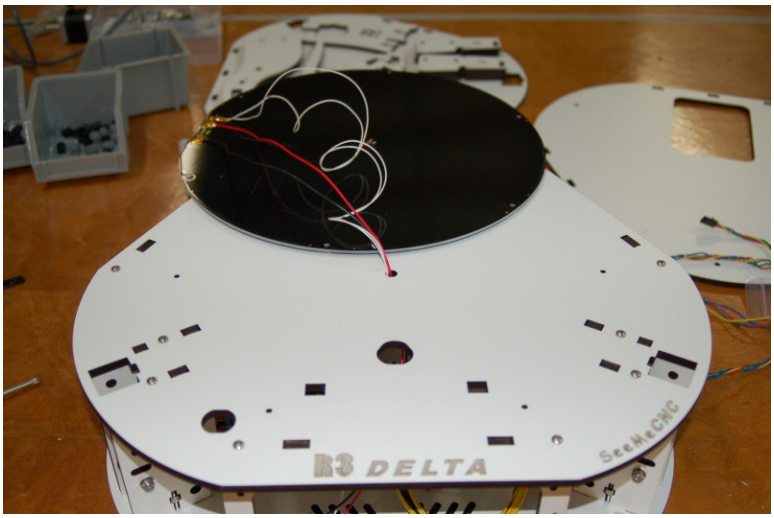


Fig. 5A-14:Routing the Onyx wiring.

Pull the wiring forward through the opening in the front facing vertical support in order to get them out of your way. Next, you'll need to lay down the Onyx support plate – it's the snowflake-shaped Melamine part that came in the Onyx Heated Bed package.

Lay the mounting plate on the bed and then lay the Onyx heated bed on top of it.

Fig. 5A-15: Orienting the Onyx on the mounting plate.

Now it's time to attach the Onyx and its mounting plate to the base – grab the round nylon spacers and the six #4-40 flat head screws that were included with the Onyx. Adjust the position of the printer so that the Z axis is farthest away from you.

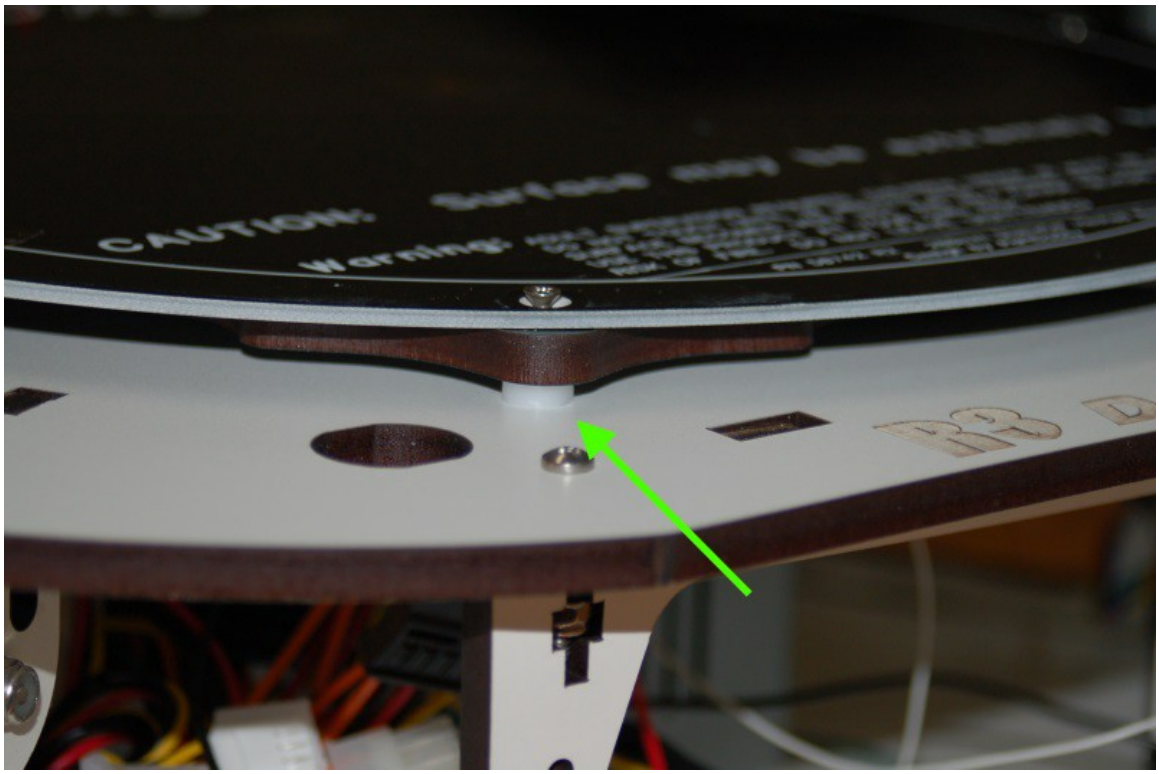


Fig. 5A-16:Attaching the Onyx & mounting plate.

Orient the Onyx heated bed such that the LED is farthest away from you and near the Z axis. You can refer to Fig. 5A-17 on the following page for clarification if needed.

Make sure that the Onyx and its mounting plate holes are roughly aligned with the mounting holes in the top of the base. Slide a nylon spacer under the mounting plate so that it aligns with both the Onyx and mounting plate holes. Insert a #4-40 flat head screw and tighten it only a turn or two. You want to leave the screws loose until you've got all six installed.

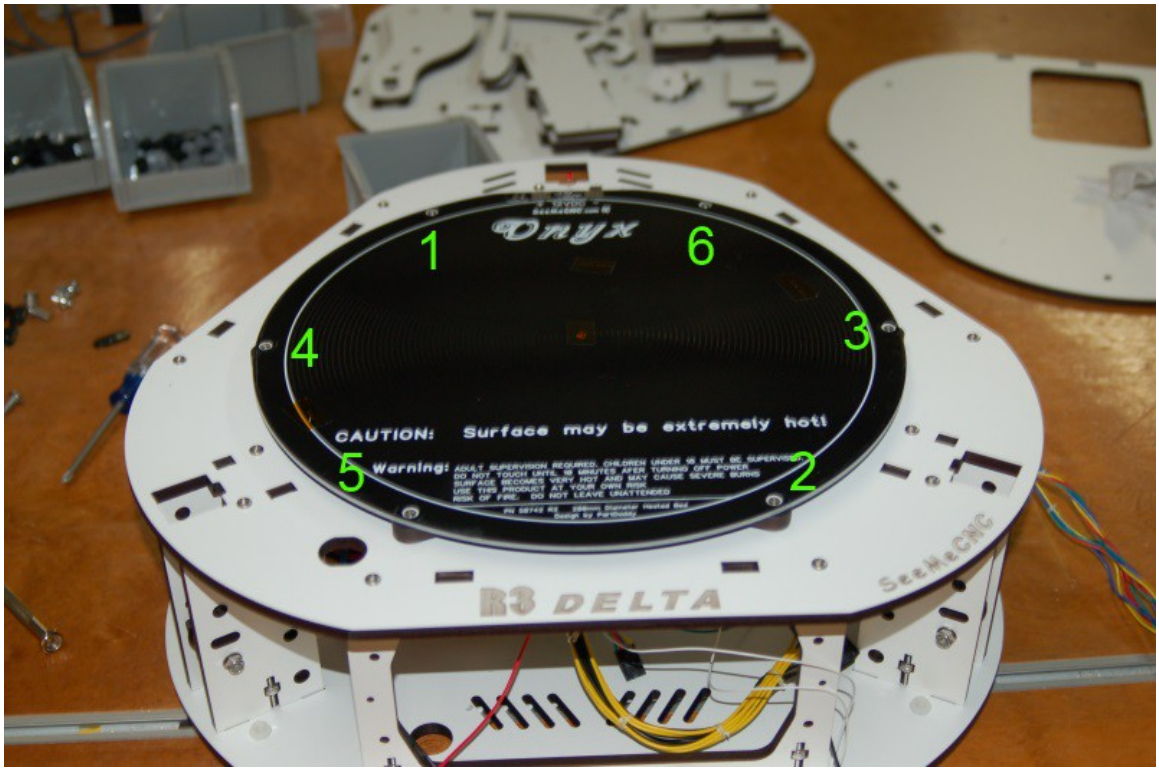


Fig. 5A-17:Screw tightening order.

When you've got all six screws loosely installed, carefully take up any extra slack in the Onyx wiring by carefully pulling any extra through the center hole in the base. Tighten the six screws using the order shown in Fig. 5A-17 above. This will help ensure that the Onyx remains as flat as possible when it heats. As you tighten each screw, make sure you only turn it a bit more than finger tight – if you apply too much force, the screw head will damage the Onyx.

5B – Installing the Rev3 Onyx Heated Bed

For this task you'll need the remaining parts in the Onyx Heated Bed package:

1. (___) Thermistor Pack. Includes a red LED, PTFE insulation tubing, a thermistor and a small resistor.
2. (___) Onyx Heated Bed
3. (___) “Snowflake” Mounting Plate (Not Shown)
4. (___) Nylon Spacers (6) (Not Shown)
5. (___) #4-40, 3/4” Stainless Steel Flat Head Screws (6) (Not Shown)

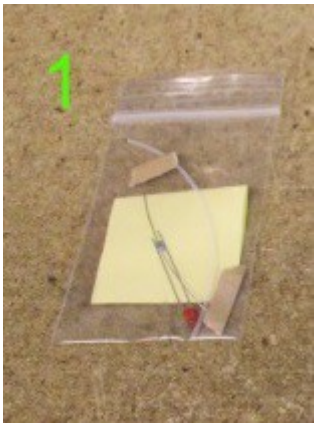


Fig. 5B-1A: Thermistor Pack.

Fig. 5B-1B: Onyx Headed Bed, Rev3.

Installing the Thermistor, LED and Power Wires

Before you begin wiring up the Onyx, please place a short length of Kapton tape over the thermistor hole in the center of the heated bed. This will protect the top of the thermistor as well as prevent RTV from leaking on the top of the board.

Fig. 5B-2: Center hole covered.

Once you've got the Kapton applied, open up the small package that contains the thermistor and the PTFE tubing. Cut two 1/4” tubes from the PTFE tubing and slide them on to the thermistor leads. You'll then bend the thermistor the same way you did when prepping the hot end.

See Fig. 5B-3 for an example of what you need to do.

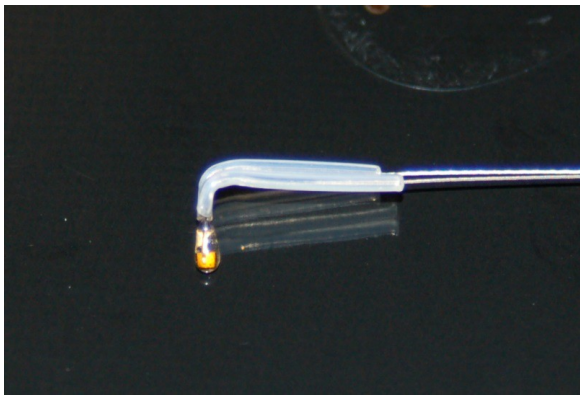


Fig. 5B-3: Thermistor bent prior to insertion.

As you did with the hot end thermistor, dip the end of the heated bed thermistor into some RTV and insert it in the center hole in the Onyx as shown below. Make sure you've got your thermistor oriented the way I show it.

Fig. 5B-4: Dipped in RTV!

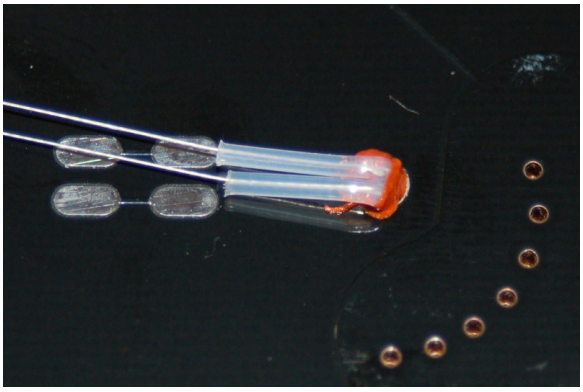


Fig. 5B-5: Set in the center hole.

Cover the end of the thermistor with Kapton tape as shown in Fig. 5B-6. This will both protect the thermistor and help you position the wires for the next step – soldering them in!

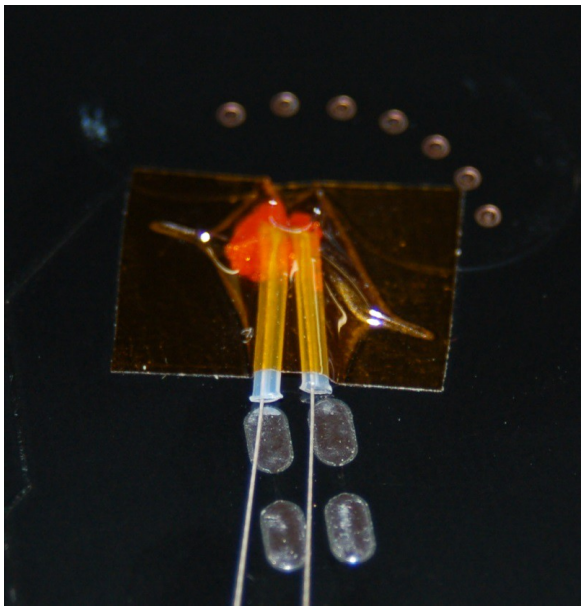


Fig. 5B-6: Thermistor covered.

Next, solder down the leads to the solder pads. Make sure you don't create a solder bridge between the two pads. Use only enough solder to do the job. When you're done, clip off the excess leads.

Note that we're using the pair of pads closest to the thermistor. The farther pair is where we'll install the thermistor connector wires.

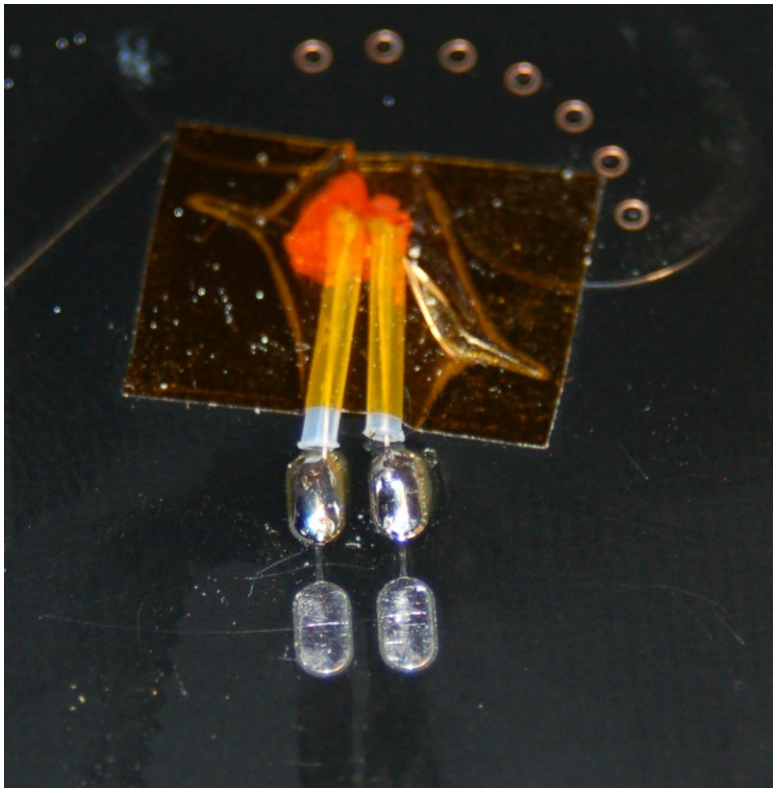


Fig. 5B-7: Soldering the thermistor leads.

We're going to install the power LED next – the LED has a polarity to it, so we need to make sure that the LED is installed the correct way.

The flat side of the LED is the “cathode” or negative (-) side. You want to insert the diode in the hole with the cathode lined up with the square pad as shown below.

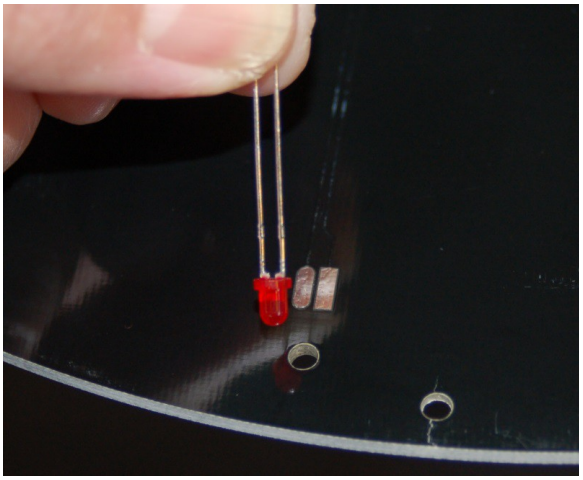


Fig. 5B-8: LED orientation.

Fig. 5B-9: LED orientation detail.

Bend the leads over so they are laying flat against the two solder pads as shown below.

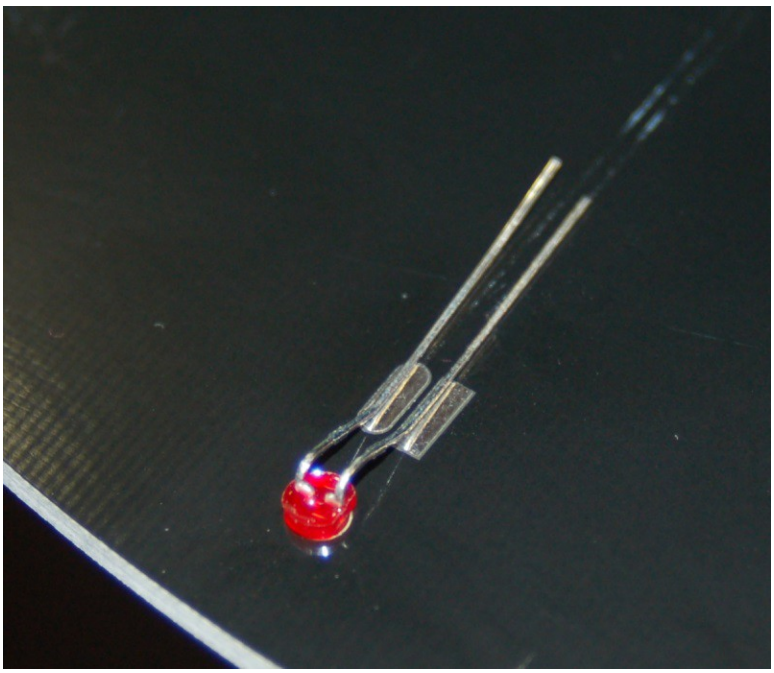


Fig. 5B-10: Bend the LED leads.

Solder the two LED leads down and trim the leads flush.

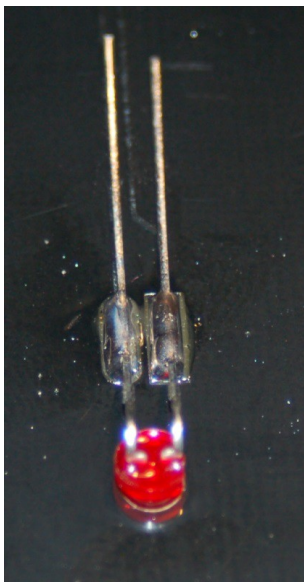


Fig. 5B-11: Soldered.

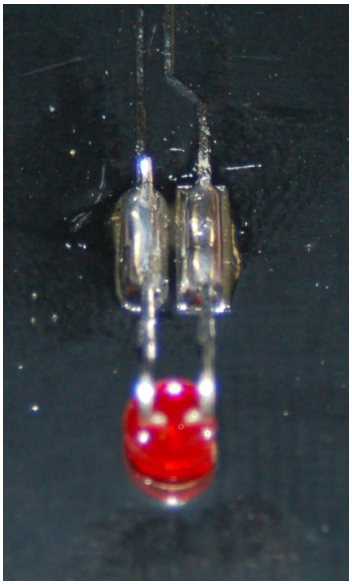


Fig. 5B-12: Trimmed!

After you've trimmed the leads on the LED, press the LED back through the hole so the tip of the LED is flush or slightly below the top surface of the Onyx. This will ensure that the LED won't be pressing up against the Borosilicate glass plate when it's installed.

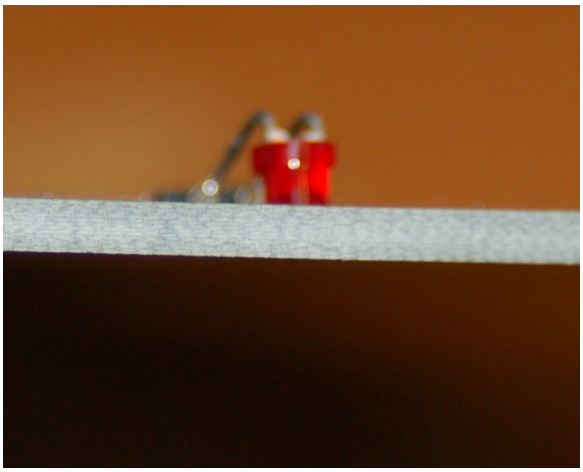


Fig. 5B-13: Correct LED depth.

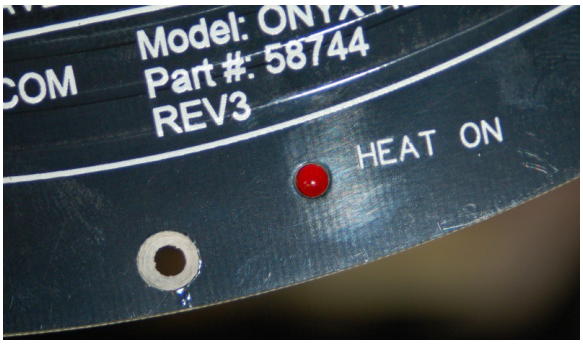


Fig. 5B-14: LED as viewed from the top.

The next step is to install the resistor that the LED needs to operate. Bend the leads on the resistor and position it over the solder pads as shown below.

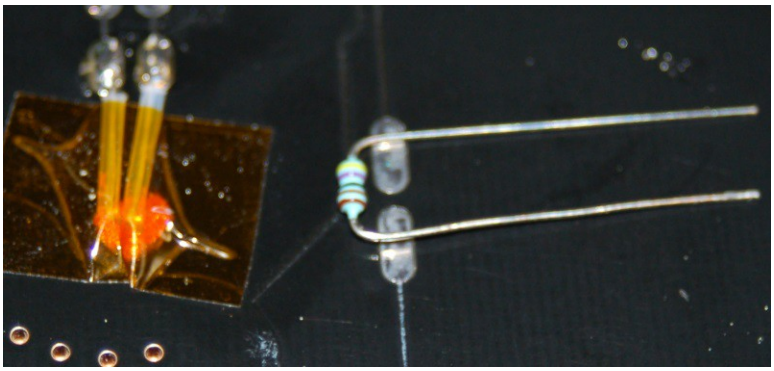


Fig. 5B-15: Resistor installation position.

Solder the resistor into place and trim off the excess lead.

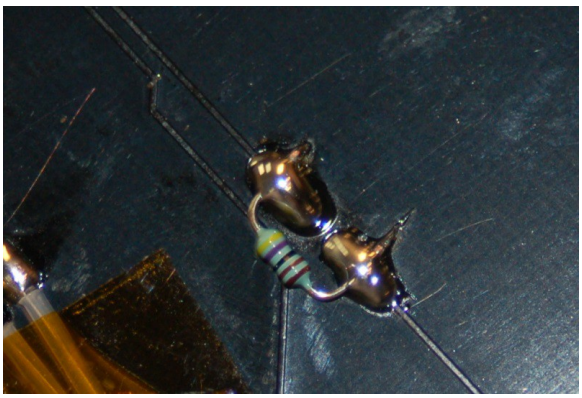


Fig. 5B-16: Resistor soldered into place.

Cut 17” off the 18ga, four conductor cable included with your kit and remove the black & red wires from it. These are the power wires that need to be soldered to the power pads on the bottom of the Onyx.

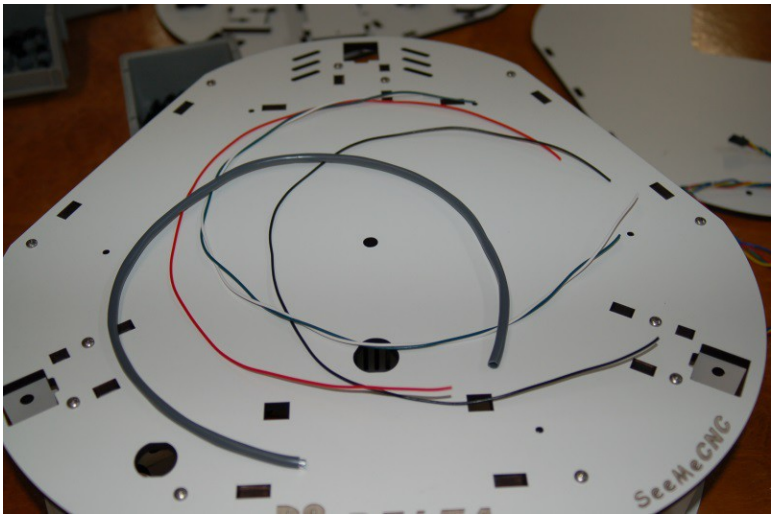


Fig. 5B-17: Wire stripped out of the 4 conductor. cable.

Flatten the ends of the black & red wires and solder them in place as shown. Please pay special attention to what pads the black & red wires are attached to! If you install them backwards, the LED will not light up when power is being fed to the heated bed!

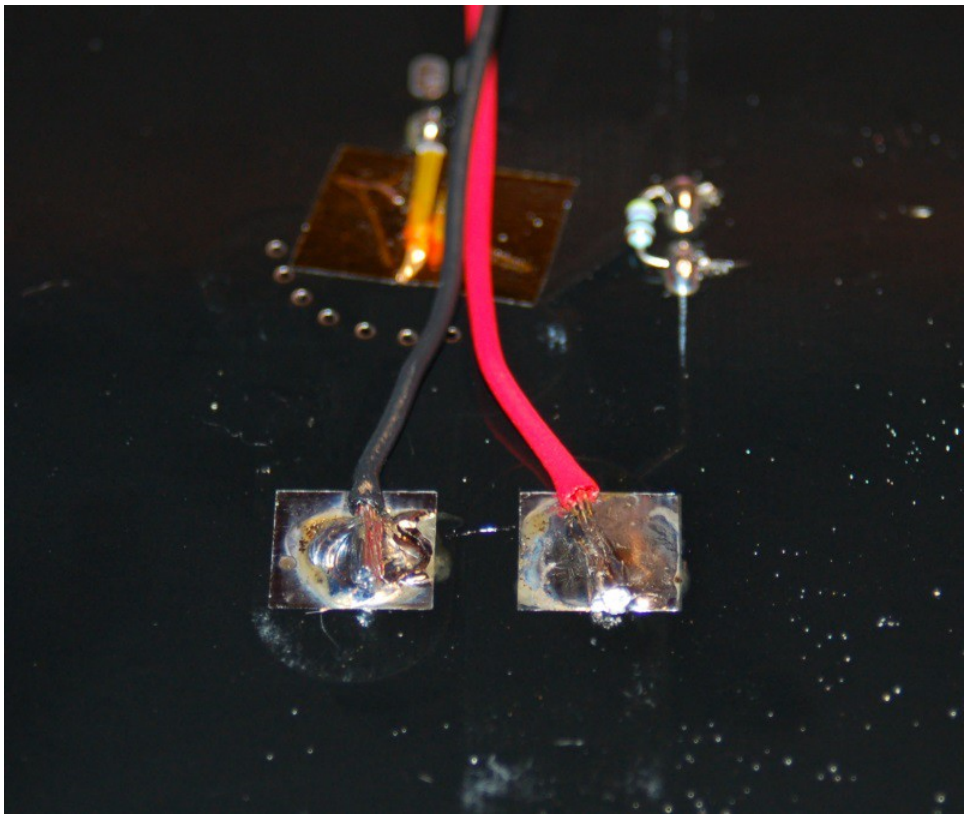


Fig. 5B-18: Power wires soldered into place.

In order to protect the wires from accidental shorts, place a few strips of Kapton tape over the solder pads & wire as shown. The tape will also add a little bit of strain-relief.

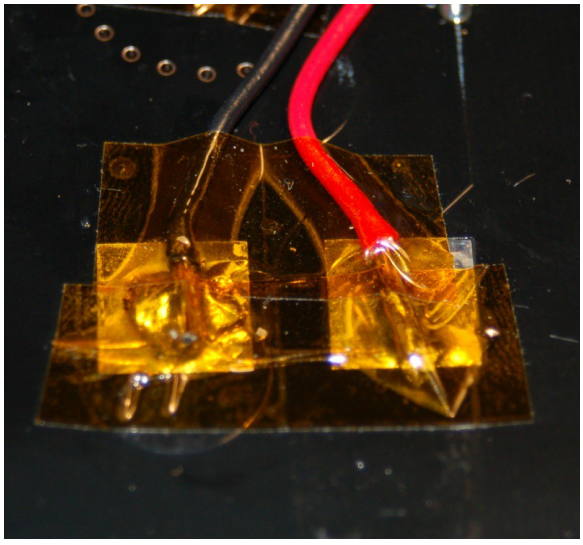


Fig. 5B-19: Kapton tape applied.

Now you need to attach the thermistor signal leads. You'll find them in the box that the RAMBo came in. It's a long, two wire (both white) cable with a connector fitted to one end.

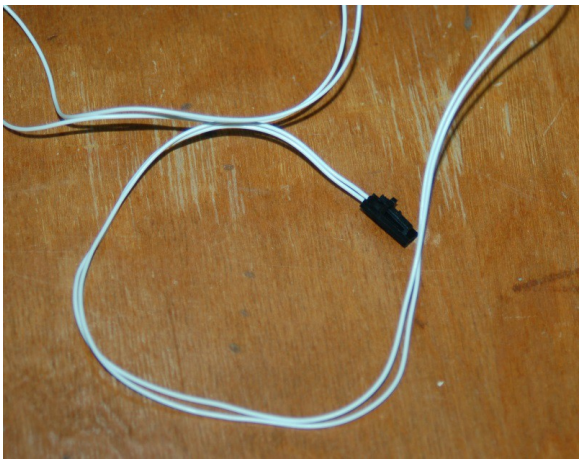


Fig. 5B-20: Thermistor signal wires.

Strip about 1/8” of the insulation of the bare ends of the thermistor wires and solder them on top of the solder pads that are in with the two solder pads you soldered the thermistor to. One wire per pad and take care to avoid solder bridges. When you're finished, cover the thermistor signal wire pads and the two power wire pads with Kapton tape to guard against a short circuit.

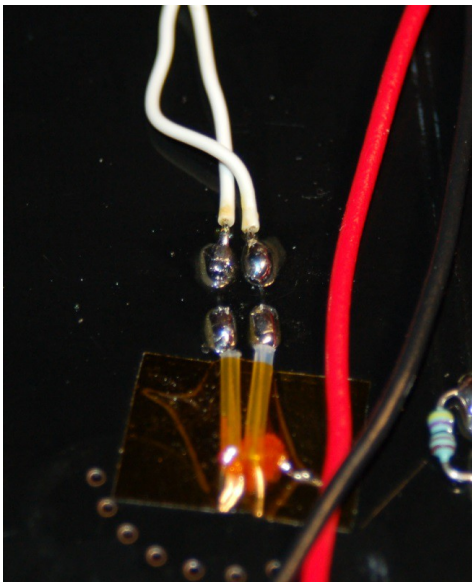


Fig. 5B-21: Thermistor wires soldered in place.

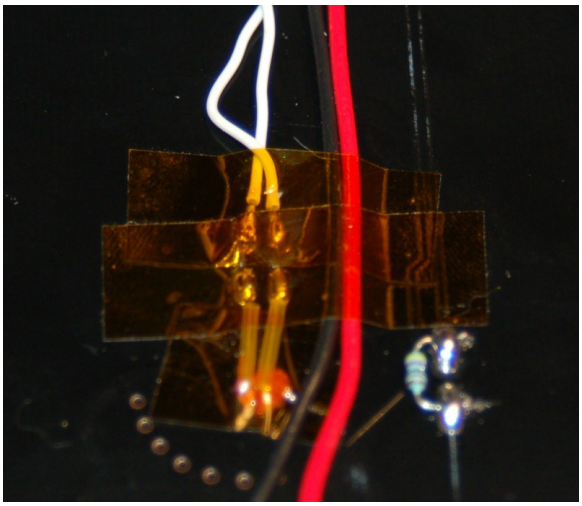


Fig. 5B-22: ...and covered in Kapton tape.

Mounting the Onyx Heated Bed to the Base

In order to mount the Onyx on the base, you'll need to route the power and thermistor signal wires through the center of the “snowflake” mounting plate and the base as shown below.

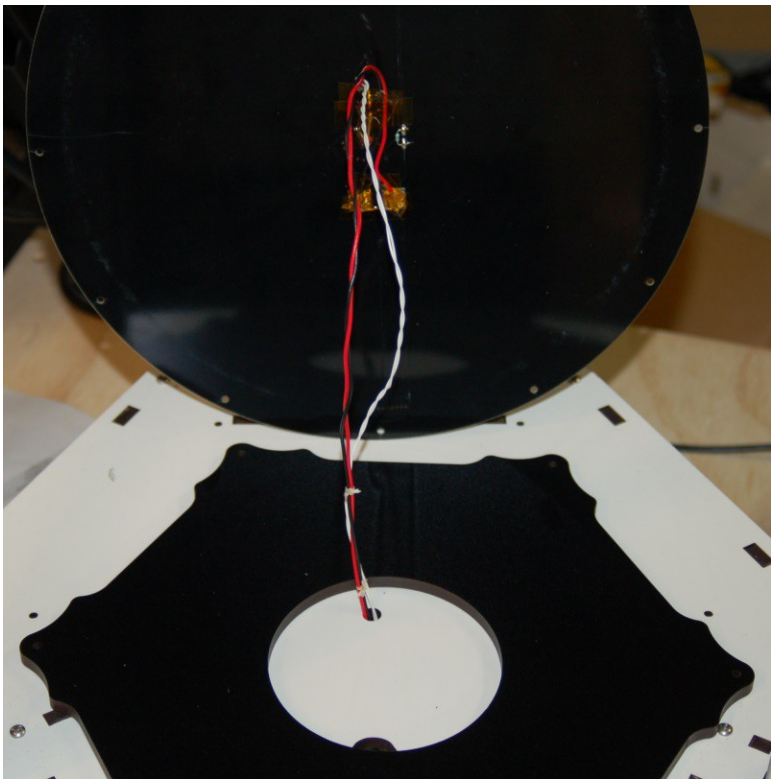


Fig. 5B-23: Routing the heated bed wiring.

Pull the wiring forward through the opening in the front facing vertical support in order to get them out of your way.

Rotate the mounting plate so it's oriented the way it is in Fig. 5B-23 above and then lay the Onyx heated bed on top of it. You'll want to make sure that the Onyx is rotated such that the power LED is directly opposite the Z tower, “facing” towards the front of the machine.

Now it's time to attach the Onyx and its mounting plate to the base – grab the round nylon spacers and the six #4-40 flat head screws that were included with the Onyx.

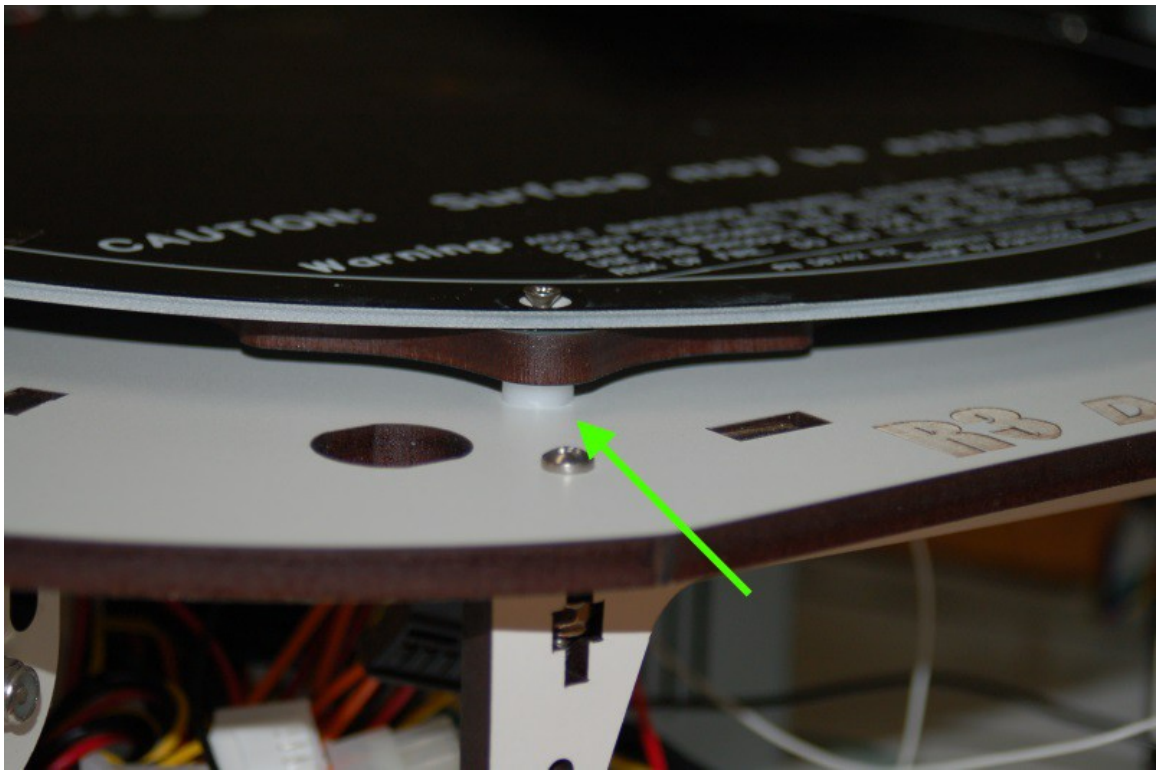


Fig. 5B-24:Attaching the Onyx & mounting plate.

Orient the Onyx heated bed such that the LED is farthest away from you and near the Z axis. You can refer to Fig. 5B-25 on the following page for clarification if needed.

Make sure that the Onyx and its mounting plate holes are roughly aligned with the mounting holes in the top of the base. Slide a nylon spacer under the mounting plate so that it aligns with both the Onyx and mounting plate holes. Insert a #4-40 flat head screw and tighten it only a turn or two. You want to leave the screws loose until you've got all six installed.

Fig. 5B-25: Screw tightening pattern

When you've got all six screws loosely installed, carefully take up any extra slack in the Onyx wiring by carefully pulling any extra through the center hole in the base. Tighten the six screws using the order shown in Fig. 5B-25 above. This will help ensure that the Onyx remains as flat as possible when it heats. As you tighten each screw, make sure you only turn it a bit more than finger tight – if you apply too much force, the screw head will damage the Onyx.

You may notice that the machine in Fig. 5B-25 shows completed steps that you haven't performed yet. This is because the Rev3 Onyx heated bed became available long after the machine in this manual was assembled. I decided against disassembling the entire machine just so I could avoid giving you a sneak-peek of what it looks like when finished. :)

5C – Installing the Rev5/6 Onyx Heated Bed

For this task you'll need the remaining parts in the Onyx Heated Bed package:

1. (___) Thermistor Pack. Includes two red LEDs, PTFE insulation tubing, a thermistor and two resistors.
2. (___) Onyx Heated Bed
3. (___) “Snowflake” Mounting Plate (Not Shown)
4. (___) Nylon Spacers (6) (Not Shown)
5. (___) #4-40, 3/4” Stainless Steel Flat Head Screws (6) (Not Shown)

Fig. 5C-1: Thermistor Pack

Fig. 5C-2: Onyx Heated Bed.

The Rev5 Onyx heated bed is very similar to the Rev3, but adds an offset thermistor location, a better heater design and a hot-end power indicator LED.

You can easily check to see which revision Onyx you have by checking the part # block on the bottom edge of the Onyx.

Fig 5C-3: Onyx Heated Bed, Rev5

The Rev6 bed is the same as the Rev5, but the offset thermistor hole is not present.

Installing the Thermistor, Power LEDs and Power Wires

Before you begin wiring up the Onyx, please place a short length of Kapton tape over the thermistor hole in the center of the heated bed. This will protect the top of the thermistor as well as prevent RTV from leaking on the top of the board. You'll notice that the thermistor hole is offset from the center – this gives a more accurate bed temperature reading. If your kit includes a Rev6 Onyx, then the thermistor will be installed in the center, just like the Rev3 and prior.

Fig. 5C-4: Covering the thermistor hole.

Once you've got the Kapton applied, open up the small package that contains the thermistor and the PTFE tubing. Cut two 1-1/4” tubes from the PTFE tubing and slide them on to the thermistor leads. You'll then bend the thermistor the same way you did when prepping the hot end.

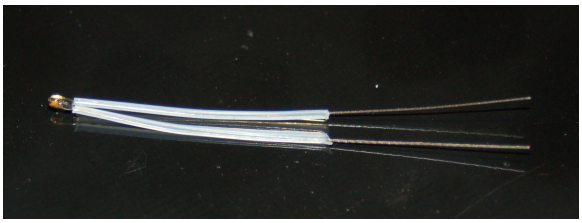


Fig 5C-4: Tubing over the thermistor leads.

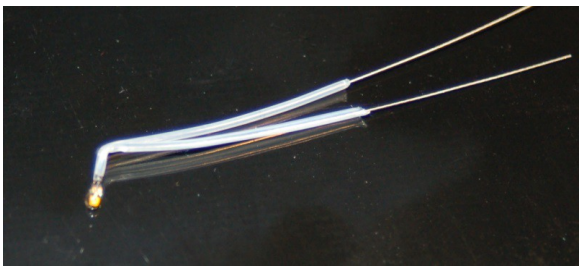


Fig 5C-5: Thermistor and tubing bent.

As you did with the hot end thermistor, dip the end of the heated bed thermistor into some RTV and insert it in the offset hole in the Onyx as shown below. Make sure you've got your thermistor oriented as shown.

Fig 5C-6: Thermistor dipped in RTV.

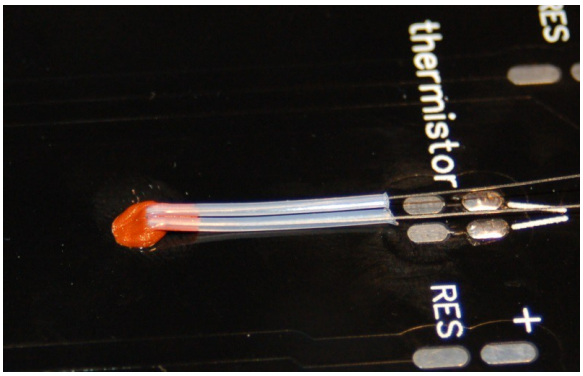


Fig. 5C-7: Thermistor installed.

Cover the end of the thermistor with Kapton tape as shown below. This will both protect the thermistor and help you position the leads for the next step – soldering them in!

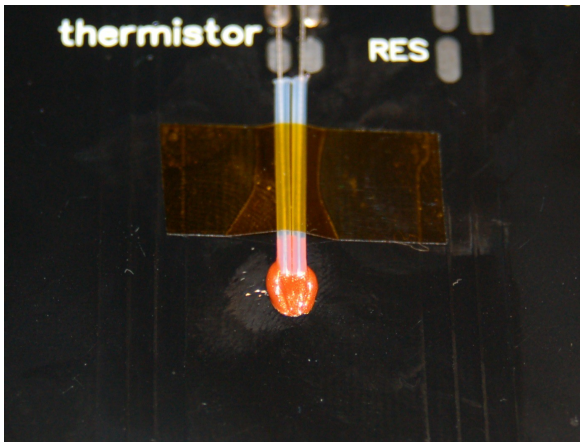


Fig. 5C-8: Taping the thermistor in place.

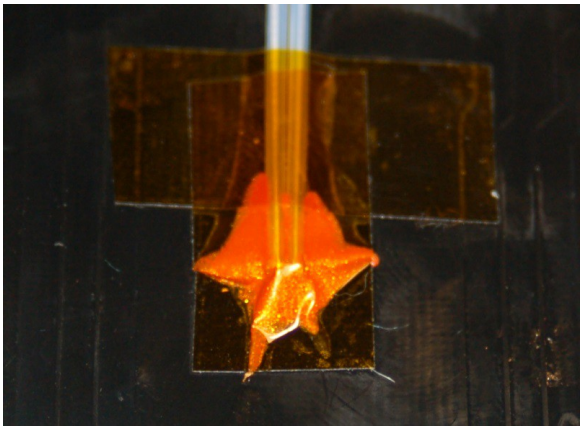


Fig. 5C-9: Taping the thermistor in place.

Next, solder down the leads to the solder pads. Make sure you don't create a solder bridge between the two pads. Use only enough solder to do the job. When you're done, clip off the excess leads.

Note that we're using the pair of pads closest to the thermistor. The farther pair is where we'll install the thermistor signal wires.

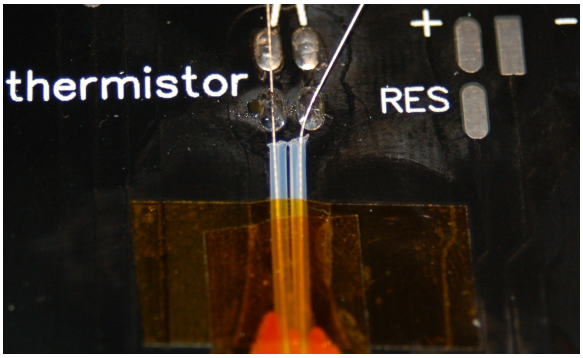


Fig5C-10: Soldered down...

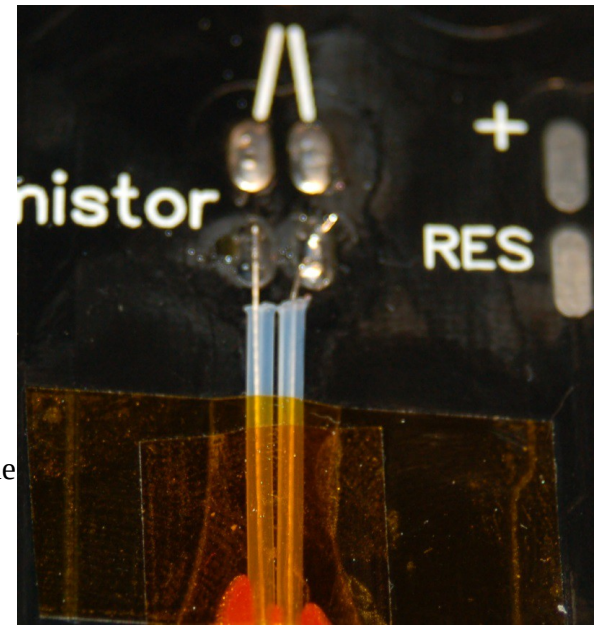


Fig. 5C-11: ...and clipped.

We're going to install the power LEDs next – the LEDs has polarity to themn, so we need to make sure that each LED is installed correctly, otherwise they won't light up.

The flat side of the LED is the “cathode” or negative (-) side. You want to insert the diode in the holes with the cathode lined up with the square pad as shown below.

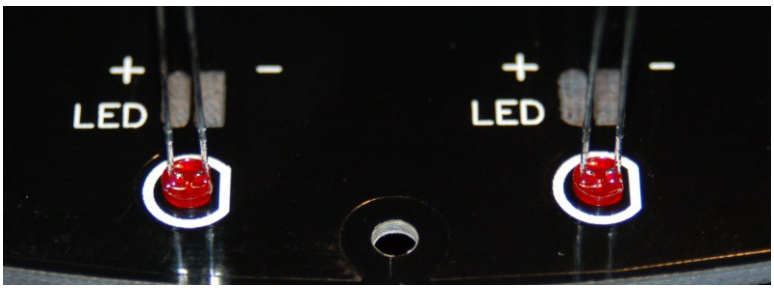


Fig. 5C-12: Power LED orientation.

Bend the leads over so they are laying flat against the two solder pads as shown below and then solder them into place.

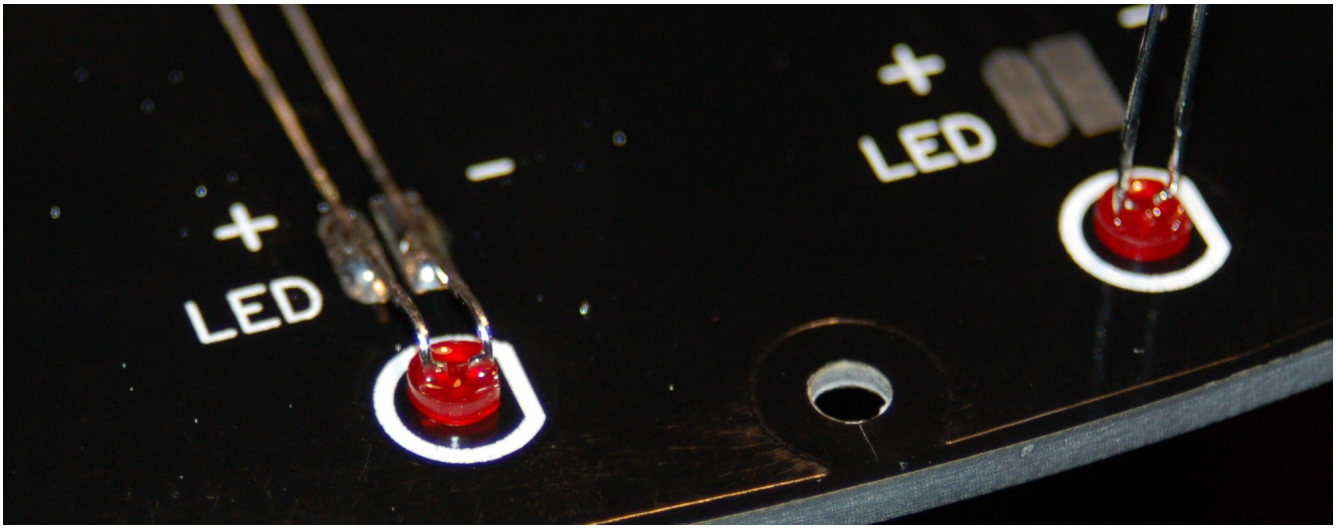


Fig. 5C-13: First one..

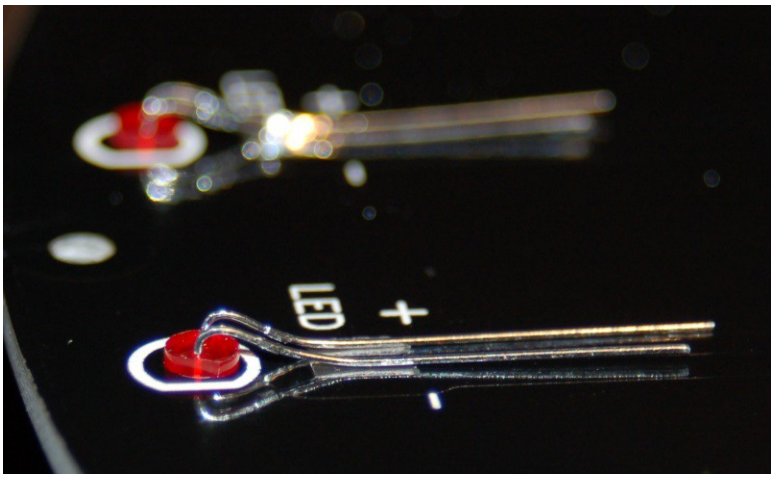


Fig. 5C-14: ..and getting ready for the other!

When you're done soldering the leads, trim them as shown below.

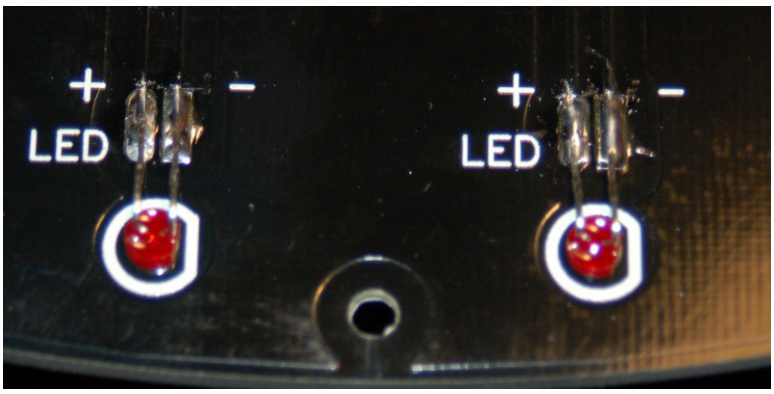


Fig. 5C-15: Both LEDs installed & trimmed.

After you've trimmed the leads on the LEDs, press the LEDs back through the hole so the tip of each LED is flush or slightly below the top surface of the Onyx. This will ensure that the LED won't be pressing up against the Borosilicate glass plate when it's installed.

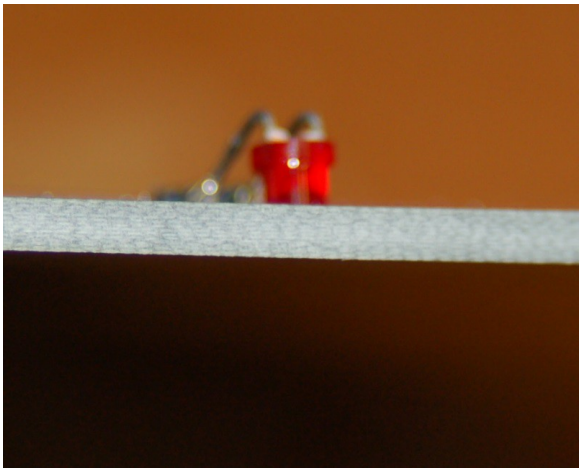


Fig. 5C-16: Correct LED depth.

The next step is to install the resistors that the hot end and Onyx power LEDs need to operate.

Install the resistor for the heated bed LED first. Bend the leads on the resistor and position it over the solder pads and solder into place as shown below. Trim the leads when you're done.

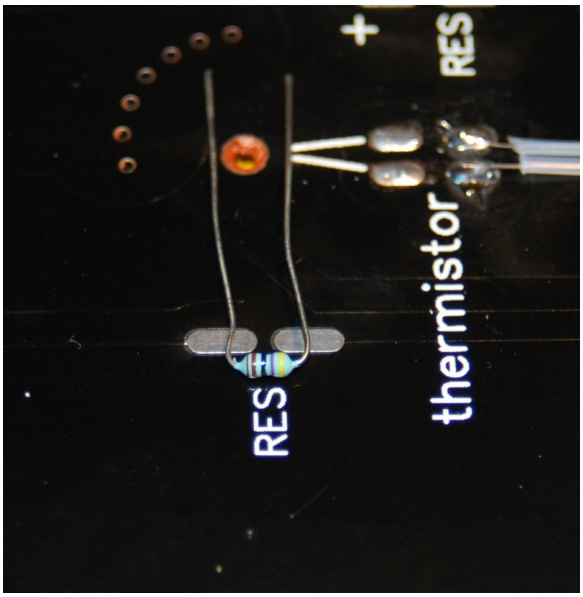


Fig. 5C-17: Placing the resistor.

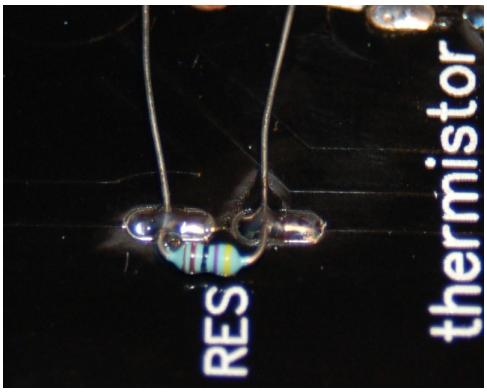


Fig. 5C-18: Soldered into place.

Now install the resistor for the hot end LED and trim.

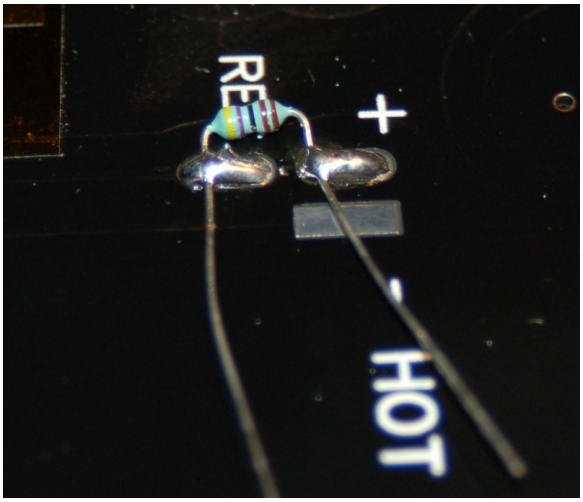


Fig. 5C-19: Hot end LED installed...

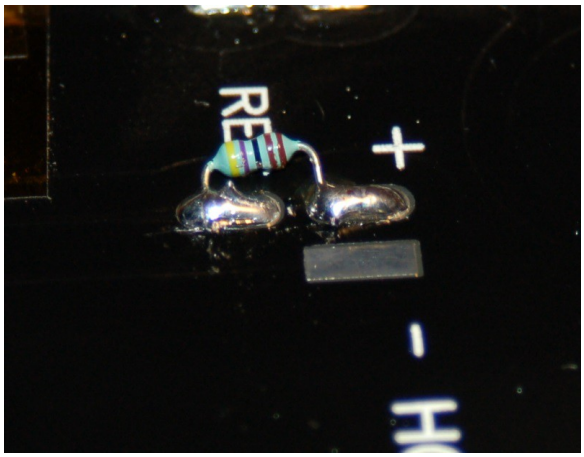


Fig. 5C-20: ..and trimmed!

Cut 17” off the 18ga, four conductor cable included with your kit and remove the black, red, white and green wires from it. These are the power wires that need to be soldered to the power pads on the bottom of the Onyx. The red & black wires will provide power to the Onyx heated bed and the white and green wires will be used to provide power to the “Hot End” power LED you just installed.

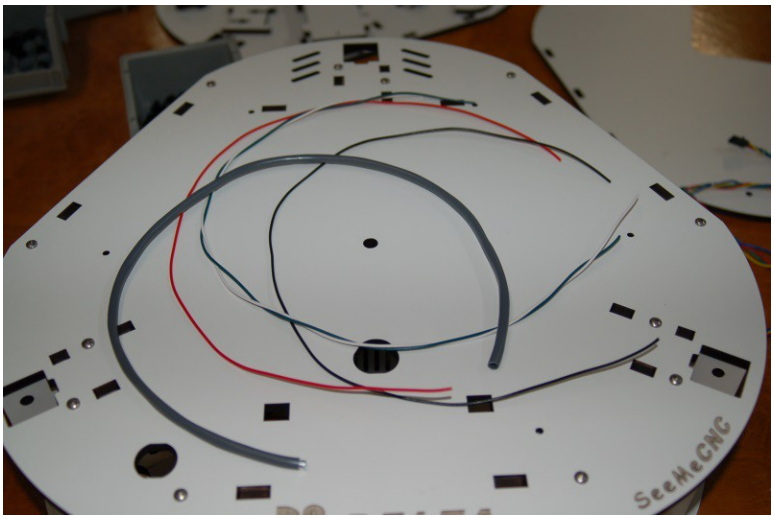


Fig. 5C-21: Wire stripped out of the 4 conductor. cable.

Flatten the ends of the black & red wires and solder them in place as shown. Please pay special attention to what pads the black & red wires are attached to! If you install them backwards, the LED will not light up when power is being fed to the heated bed!

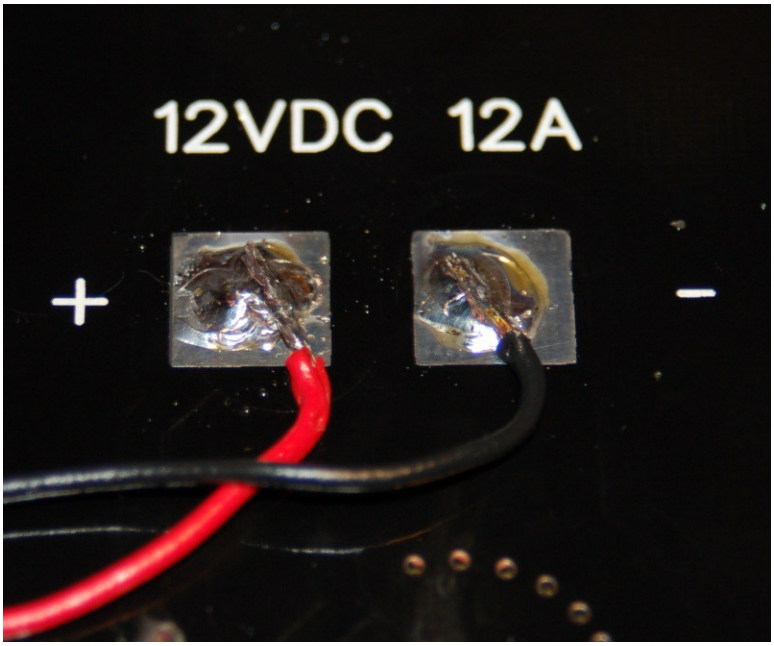


Fig. 5C-22: Power leads installed.

Now you need to attach the thermistor signal leads. You'll find them in the box that the RAMBo came in. It's a long, two wire (both white) cable with a connector fitted to one end.

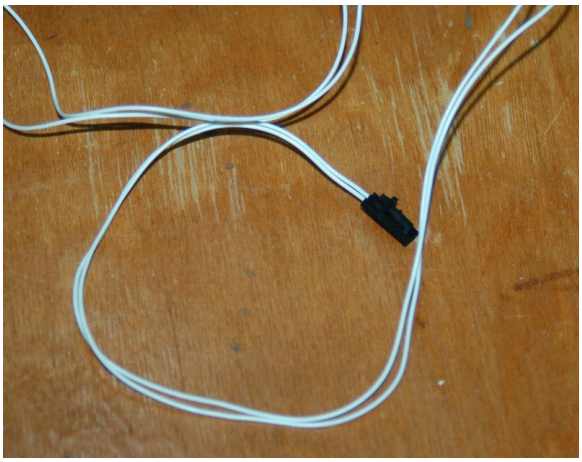


Fig. 5C-23: Thermistor signal wires.

Strip about 1/8” of the insulation of the bare ends of the thermistor wires and solder them on top of the solder pads that are aligned with the two solder pads you soldered the thermistor to. One wire per pad and take care to avoid solder bridges.

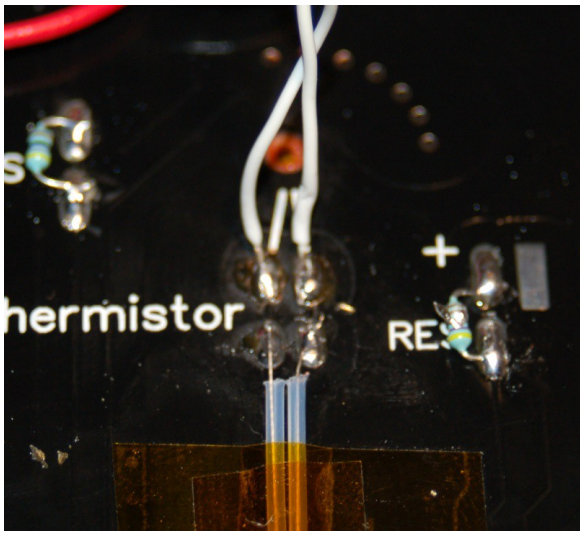


Fig. 5C-24: Thermistor signal wires installed.

Strip about 1/8” from the white & green wires. These are used as the power wires for the hot end LED and are installed as shown below. Make sure you've got the green wire attached to the “+” pad and the white wire attached to the “-” pad.

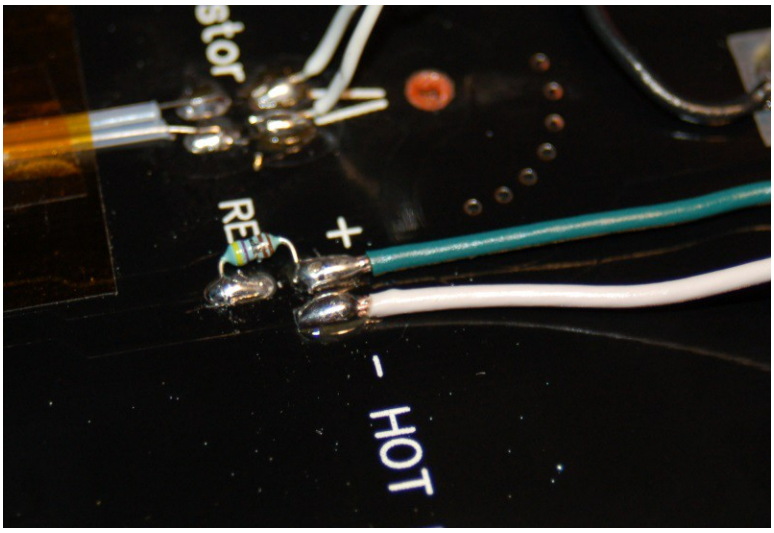


Fig. 5C-25: Hot end power indicator wires installed.

In order to protect the wires from accidental shorts, place a few strips of Kapton tape over the solder pads & wire as shown below. The tape will also add a little bit of strain-relief.

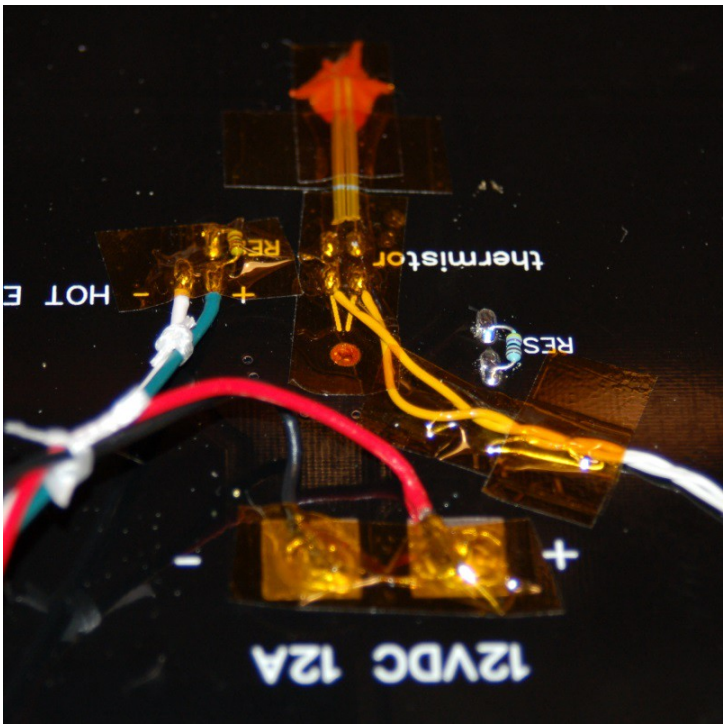
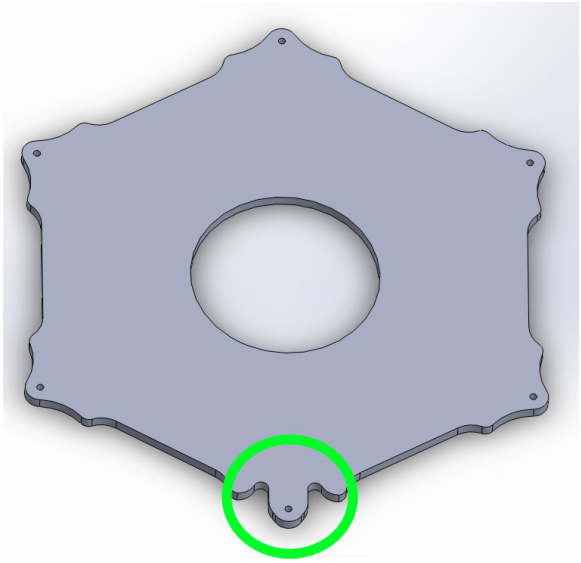


Fig. 5C-26: Kapton tape covering solder joints.

Mounting the Onyx Heated Bed to the Base

If you have a Rev6 Onyx heated bed, the support platform will look like this:



The bed support should be oriented such that the feature outlined in green above, should be pointed towards the front of the machine.

In order to mount the Onyx on the base, you'll need to route the power and thermistor signal wires through the center of the “snowflake” mounting plate and the base as shown below. I recommend binding the power wires together with waxed lacing cord. This helps manage the wiring and make it easier to deal with. Use Kapton tape if you don't have any lacing cord as even small plastic wire ties won't fit through the center hole.

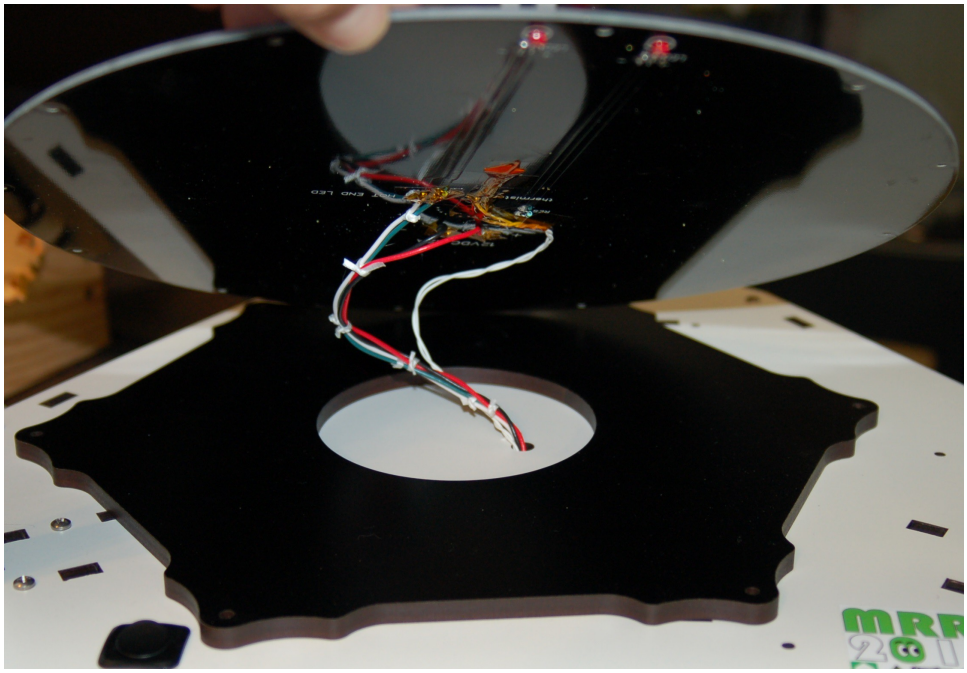


Fig. 5C-27: Wiring routed into the base.

Pull the wiring forward through the opening in the front facing vertical support in order to get them out of your way.

Rotate the mounting plate so it's oriented the way it is in Fig. 5C-27 above and then lay the Onyx heated bed on top of it. You'll want to make sure that the Onyx is oriented such that the power LEDs are directly opposite the Z tower, “facing” towards the front of the machine.

Now it's time to attach the Onyx and its mounting plate to the base – grab the round nylon spacers and the six #4-40 flat head screws that were included with the Onyx.

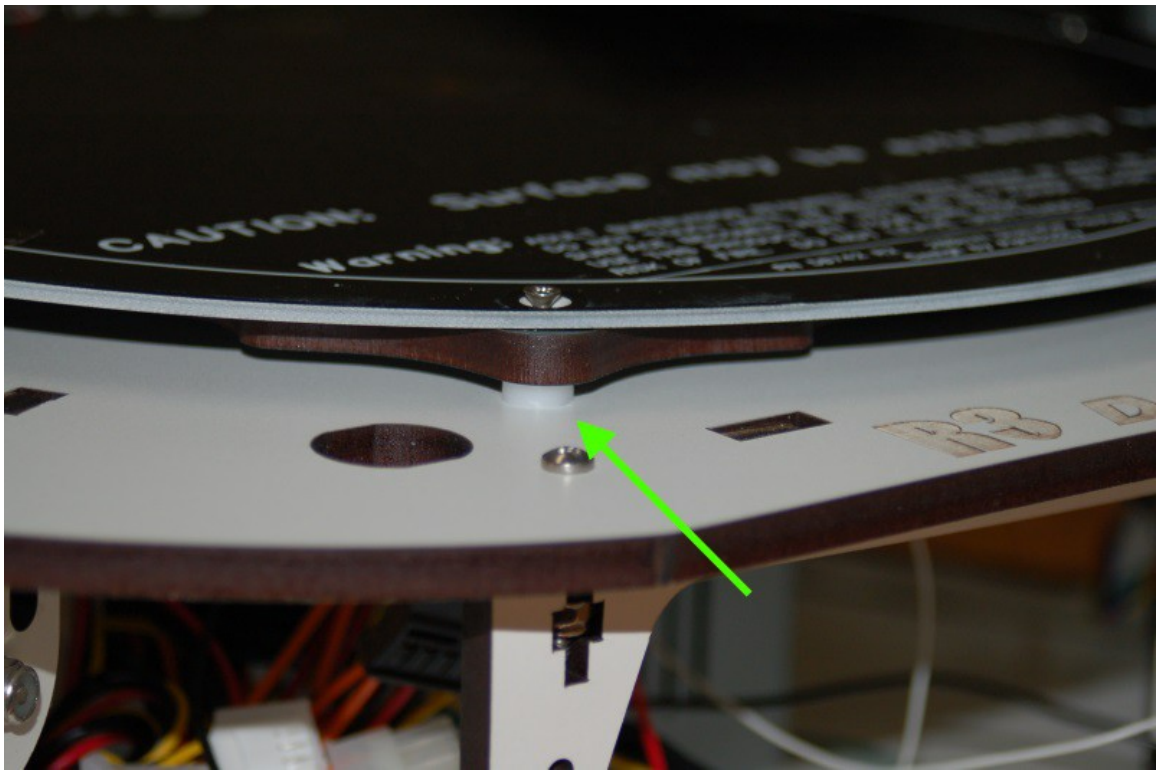


Fig. 5C-28:Attaching the Onyx & mounting plate.

Orient the Onyx heated bed such that the LED is farthest away from you and near the Z axis. You can refer to Fig. 5C-29 on the following page for clarification if needed.

Make sure that the Onyx and its mounting plate holes are roughly aligned with the mounting holes in the top of the base. Slide a nylon spacer under the mounting plate so that it aligns with both the Onyx and mounting plate holes. Insert a #4-40 flat head screw and tighten it only a turn or two. You want to leave the screws loose until you've got all six installed.

Fig. 5C-29: Screw tightening order.

When you've got all six screws loosely installed, carefully take up any extra slack in the Onyx wiring by carefully pulling any extra through the center hole in the base. Tighten the six screws using the order shown in Fig. 5C-29 above. This will help ensure that the Onyx remains as flat as possible when it heats. As you tighten each screw, make sure you only turn it a bit more than finger tight – if you apply too much force, the screw head will damage the Onyx. The Rev6 Onyx uses the other set of holes, so adjust the tightening order accordingly.

You may notice that the machine in Fig. 5C-29 shows completed steps that you haven't performed yet. This is because the Rev5 Onyx heated bed became available long after the machine in this manual was assembled. I decided against disassembling the entire machine just so I could avoid giving you a sneak-peek of what it looks like when finished. :)

6 – Installing the Towers & Tower Wiring

For this task you'll need the following items:

1. (___) Aluminum Tower Extrusions (3)
2. (___) 18ga, four conductor cable
3. (___) 22ga, four conductor cable
4. (___) End Stop Wires (3)
5. (___) 26ga black & red wire

Threading the Towers

In the Rostock MAX v2, you'll be routing the hot end, extruder stepper and end-stop wiring through the center of the three towers. If you're upgrading a Rostock MAX v1 and using the original towers, please make sure to gently file off any sharp edges on either end of each tower.

In order to do this, you're going to have to strip the outer jacket from both four conductor cables. This is very easy to do, but there IS a bit of a trick to it. :)

Inside each cable is a very thin, very strong Nylon string. You're going to use this string to split the gray outer jacket of the cable along its full length.

Start by carefully removing about 6” worth of the outer jacket by using an X-Acto knife to score the jacket all the way around. When you've got it scored, pull the end away from the rest of the cable and the jacket should come off at the score line.

You'll be left with four colored wires, a bare wire, a very thin foil wrap and that magic little Nylon string. Wrap the string around your fingers to get a good grip on it and holding the exposed wires in one hand, pull the Nylon string away from you, along the length of the cable. Continue doing this until it's split the whole gray outer jacket. The only part we're interested in is the four colored wires.

The Z axis tower will get the 18ga hot end wires, the X axis tower will get the end-stop wires and the Y axis tower will get the 22ga wires for the extruder as well as two pair of 26ga wires for the PEEK fan and the layer fan.

The 18ga wire is the largest in diameter, followed by the 22ga wire and the 26ga wire is the thinnest.

The 18ga, four conductor cable is the first one we're going to use. When you're done stripping it, you should have something like this:

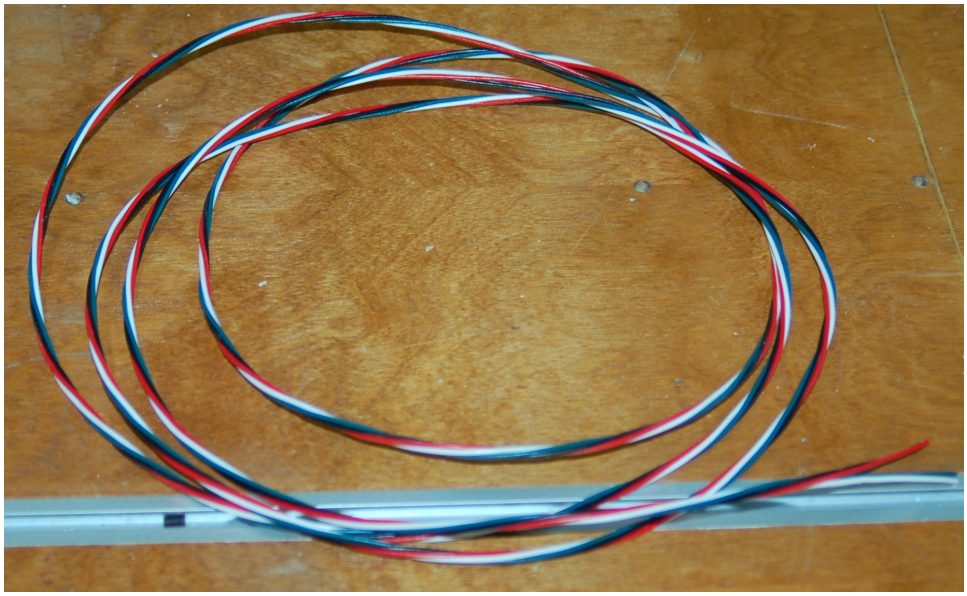


Fig. 6-1: 18ga, four conductor hot end cabling.

Take one of the aluminum extrusions and thread this wire right through the small hole in the center of the channel. Turning the wire counter-clockwise will help this process along.

When you're done, it should look like the image shown below.

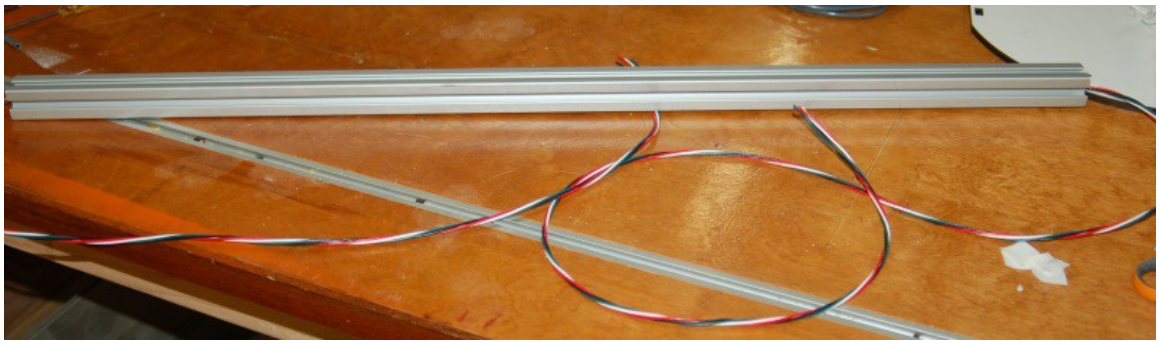


Fig. 6-2: 18ga wires in the Z axis tower.

Now grab the 22ga, four conductor cable and strip the jacket off of it if you haven't already.

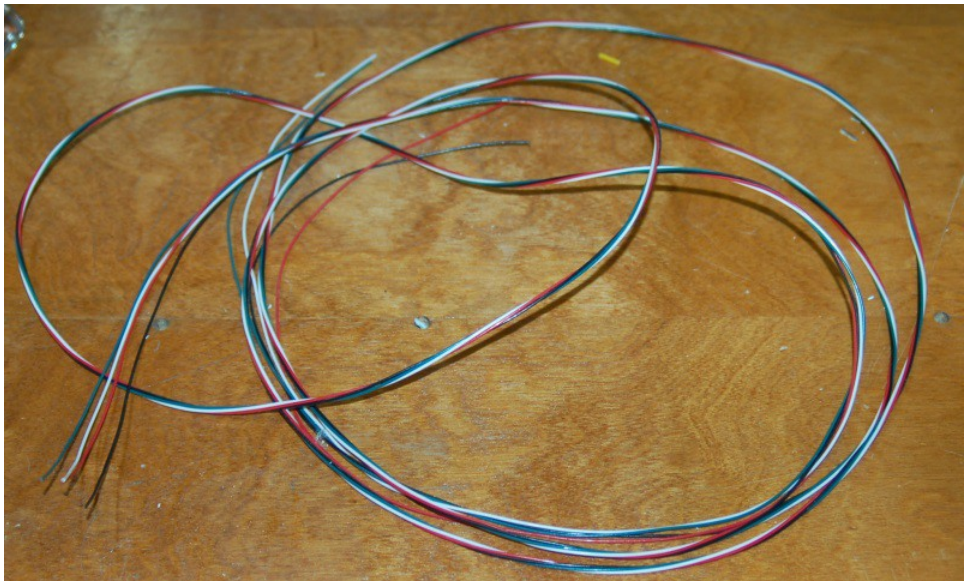


Fig. 6-3: 22ga wire with the jacket removed.

Next, grab the little bag that the 26ga wires are in. You'll want to unspool all of it and cut it in half so that you've got two equal lengths of black wire and two of red wire.

After you've cut the black & red wires in half, pair one black & one red together and tie a knot at the end. This will help you identify the pair later.

Fig. 6-4: 26ga wire for fans.

You'll need to pair up a black and red wire and then spindle the end as shown:

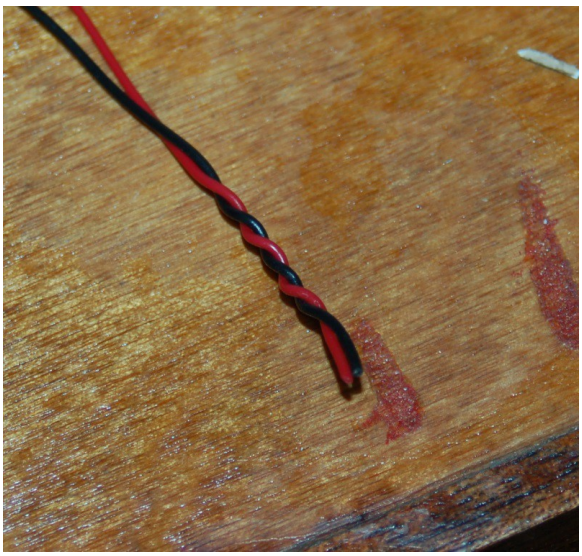


Fig. 6-5: Twisted fan wires.

Do this for the other black & red pair and then spindle them together with the 22ga wire. This whole bundle will go down the center of the next aluminum tower extrusion. The twisted wires will help make sure that all eight wires make it without any problems.

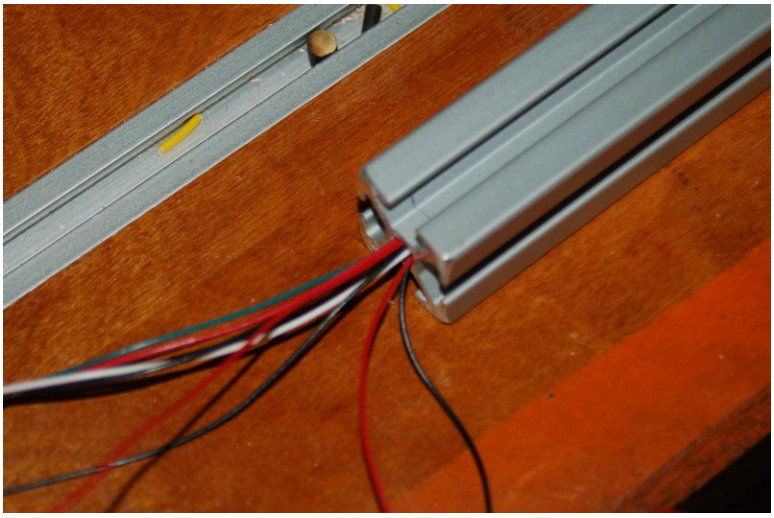


Fig. 6-6: Threading the Extruder & Fan wires.

When you've pulled the bundle through the tower, identify the black & red pair that you tied the knot in and tie a knot at this end as well.

Now you'll need to grab the end-stop wire bundle from the box the RAMBo was shipped in.

When you unspool the wires, you should end up with three pairs of wires, one black and one white. They'll have a female crimp-on connector on one end and a shielded, crimp-on spade lug connector on the other.

Fig. 6-7: End stop wires.

Take the first pair and using a Sharpie or other fine tip, permanent marker, write an “X” on the flat face of the two spade lug connectors.

Carefully spindle the ends of the wire with the female crimp connectors as shown in Fig. 6-8.

When you're done, thread the wire through the center of the next aluminum extrusion and label the pair with an “X” using Scotch tape or other label.

Fig. 6-8: Spindled wire ends.

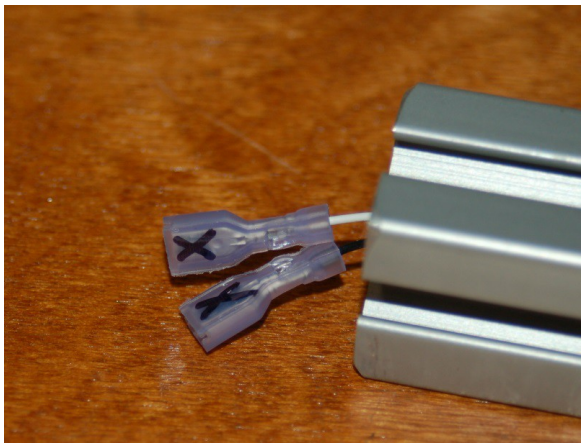


Fig. 6-9: Labeled end-stop wires.

Repeat the process for the next remaining pairs of wires – label them “Y” and “Z”. You'll need to know which one is which and it's a lot easier to do it now than to figure it out once everything is all assembled.

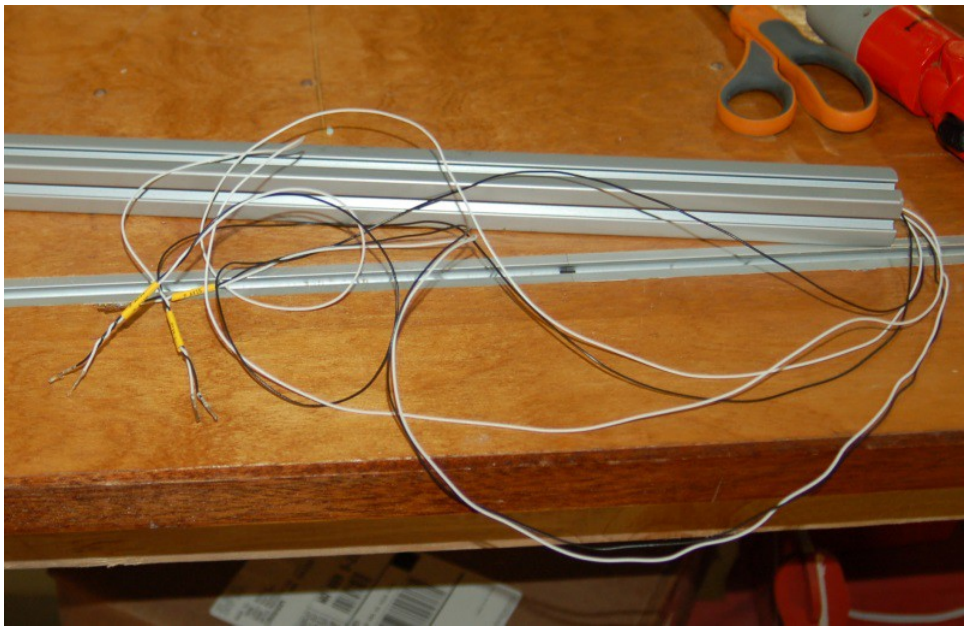


Fig. 6-10: End-stop wires pulled and labeled.

Setting the Towers

Now it's time to set each tower in its respective tower support assembly.

We're going to start with the Z axis – remember, it's the one right behind the power supply.

In order to set the Z axis tower (the one with the 18ga wires!), you'll need to turn the T-Slot nut plates such that they're oriented vertically as shown below.

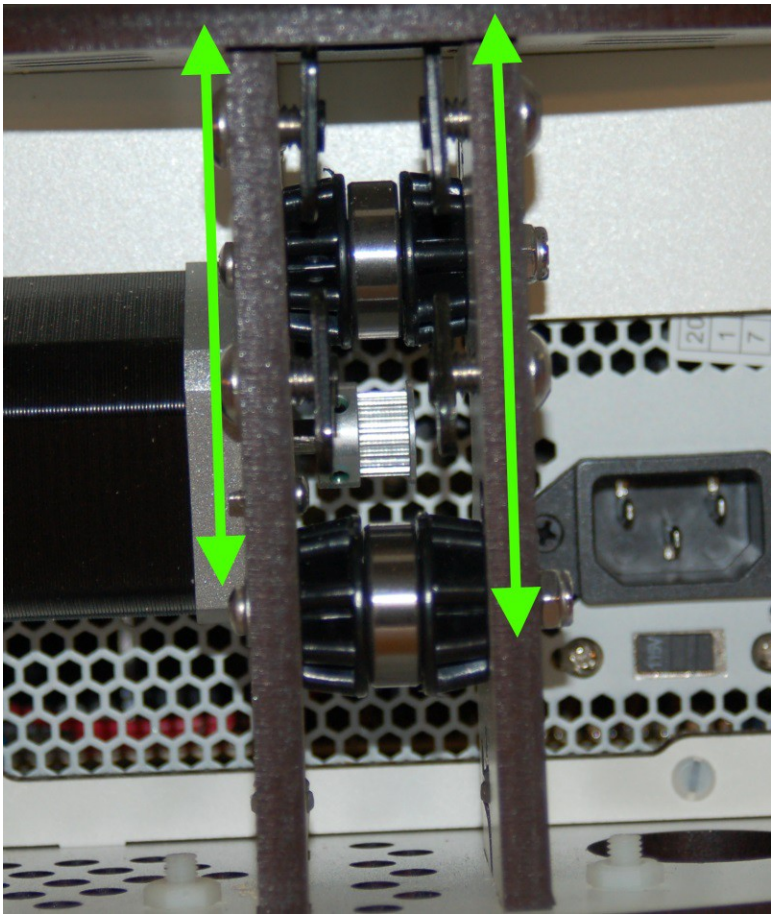


Fig. 6-11: T-Slot nut plate orientation.

Don't tilt your head, the picture is leaning a little bit. :)

Next, you're going to thread the wires coming out of the Z axis tower through the “post” hole in the top of the base that's right over the T-Slot nut plates.

Now carefully set the end of the tower in the post hole and slide it in. It's a VERY tight fit but do not wiggle it! You want to drive the tower straight down. If you wiggle it front to back too much, you can break the area where it's thin at the corners of the hole.

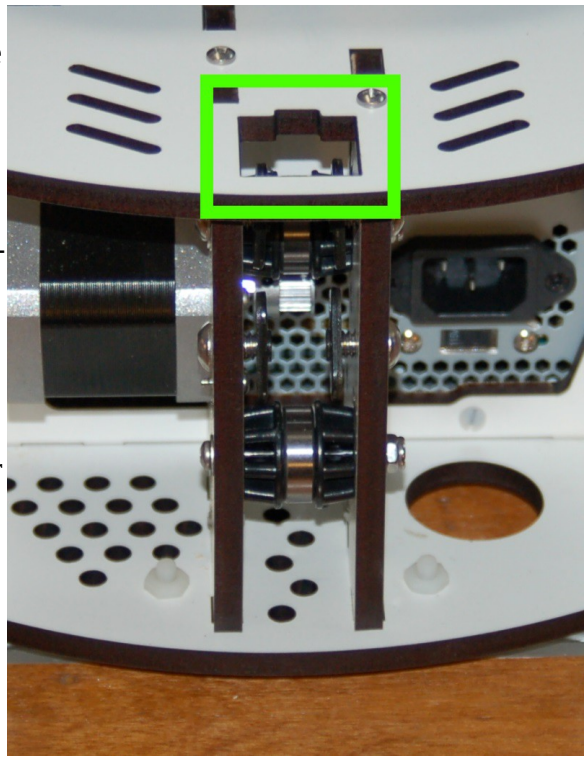


Fig. 6-12: Z-Axis post hole.

As you drive the tower down, make sure that the T-Slot nut plates are sliding into the t-slots on both sides of the tower. You'll want to drive it down until it comes into contact with the #4 leveling screw that you installed in the tower assembly. After the tower is set, use a 5/32 Allen (hex) wrench to tightened the ¼-20 cap screws only finger tight. You'll tighten them up after the top as been mounted.

Now that the tower is set, route the wires out the wire guide slot as shown in Fig. 6-13.

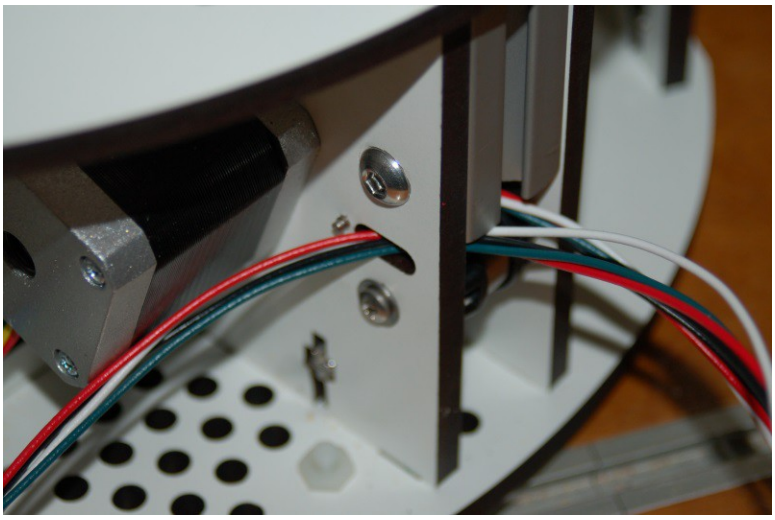


Fig. 6-13: Wire guide slot.

Now repeat the tower setting operation for the X axis.

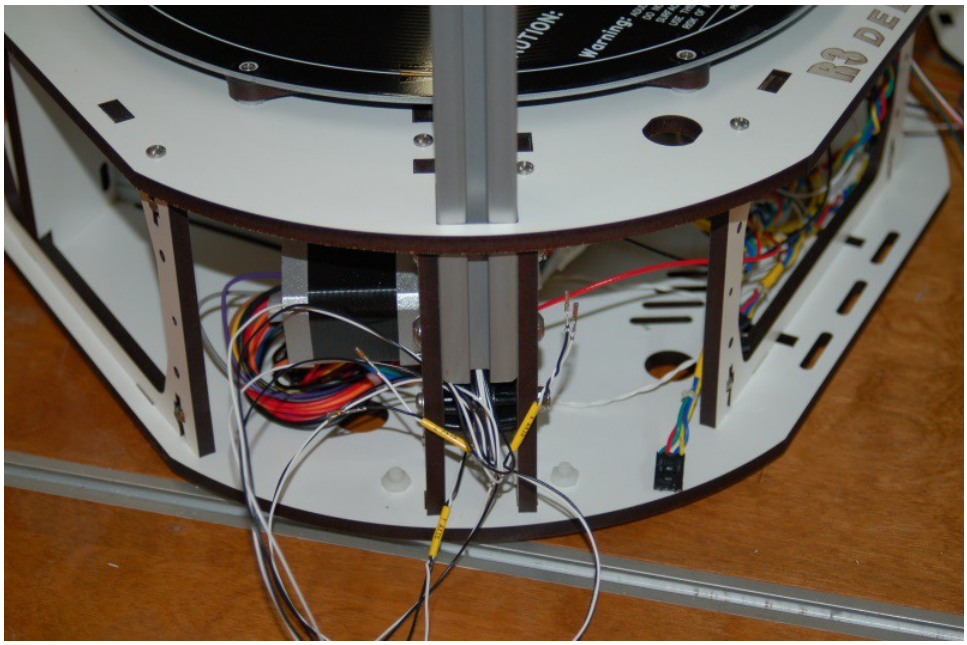


Fig. 6-14: X axis tower set and wire routed.

And again for the Y axis tower.

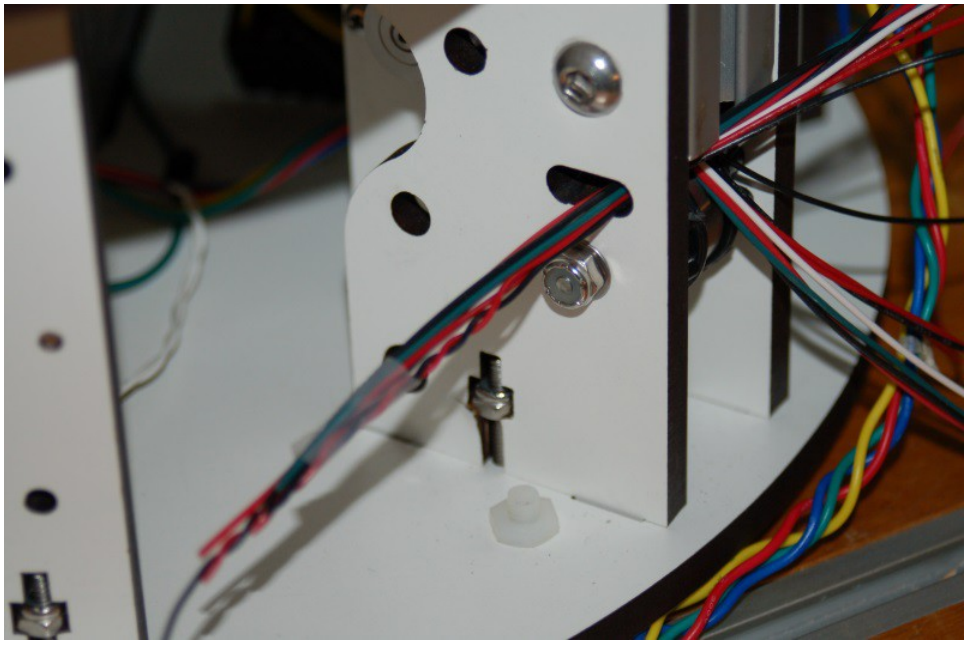


Fig. 6-15: Y axis tower set and wire routed.

7 – Assembling the Top Section

In order to assemble the top section of the Rostock MAX v2, you're going to need the following components:

1. (___) Top Section Base Plate
2. (___) Tower Spacers (3)
3. (___) #4, 3/8” Pan Head Sheet Metal Screws (3)
4. (___) Upper Tower Mounts (6)
5. (___) ¼-20, 1/2” Stainless Steel Button Head Cap Screws (12) (Not Shown.)
6. (___) T-Slot Nut Plates (12) (Not Shown.)

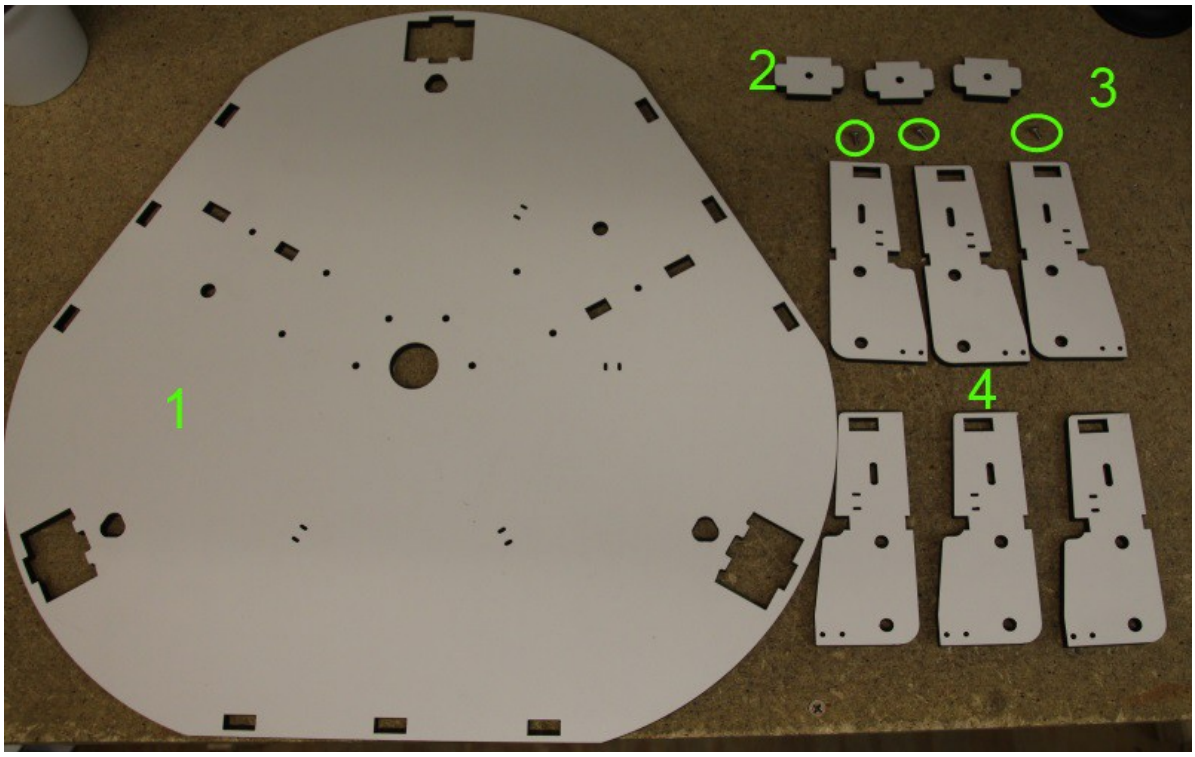


Fig. 7-1: Top Section Components.

Prepping the Upper Tower Mounts

Before you can install the upper tower mounts, three tower depth stop screws need to be installed as shown below.

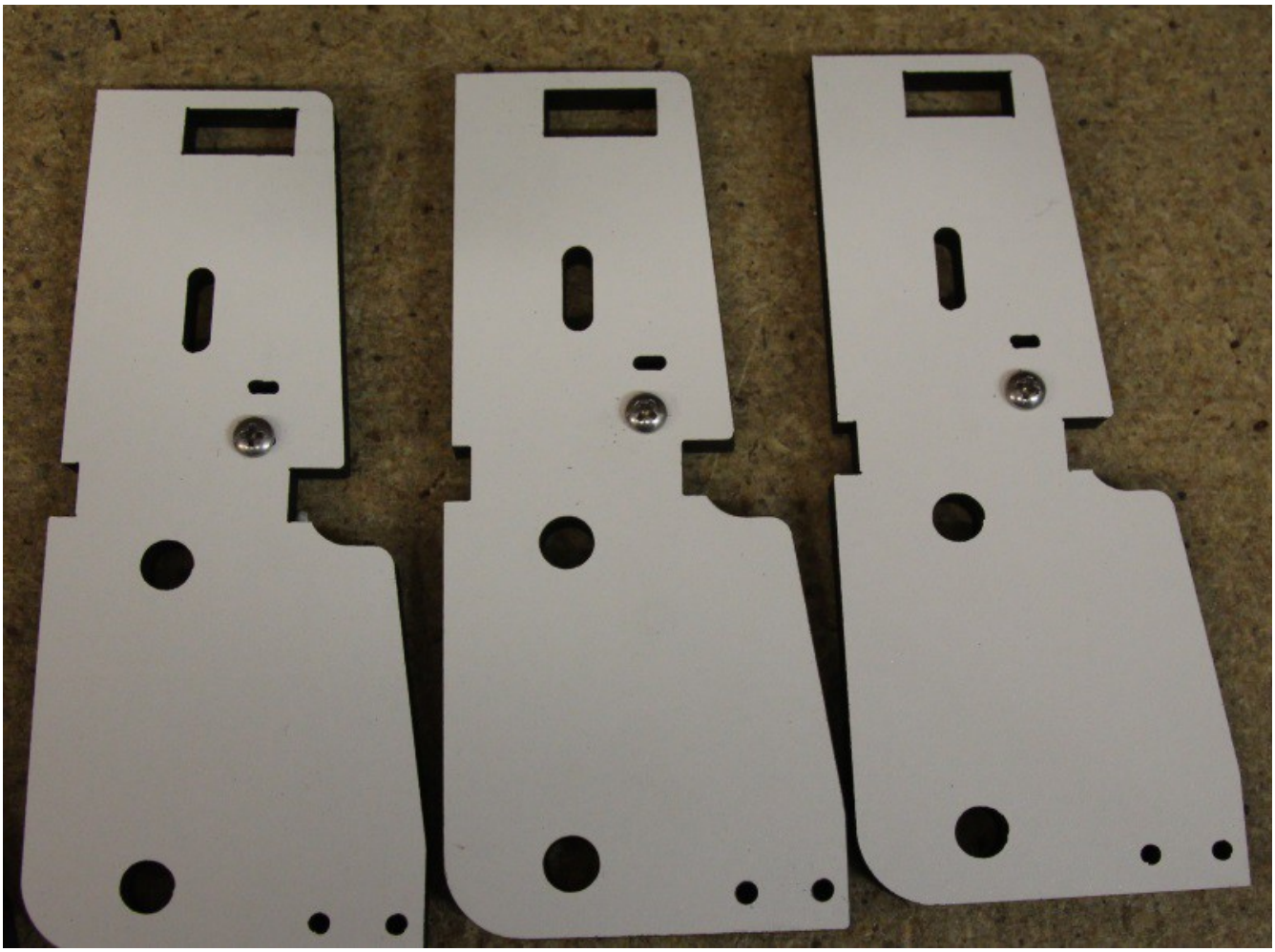
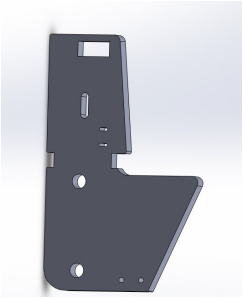


Fig. 7-2: Upper tower mounts (preliminary).

These screws perform the same function as the ones previously installed in the lower tower mounts. This helps guarantee that the top section will be at the correct height on all three towers.

Note that your kit will ship with a part that looks very much like the one to the right. This was a very recent design change and is not reflected in the manual. It is ***strictly*** a cosmetic change.



Installing the Upper Tower Mounts

The upper tower mounts don't fit in the tower sockets without being a bit clever in the installation process.

Take two upper tower mounts (make sure the one on your left has a tower depth stop screw installed!) and set them into the tower socket as shown in Fig. 7-3.

Now you want to adjust the mount on the right side so it's at the same angle as the one shown in Fig. 7-4 below.

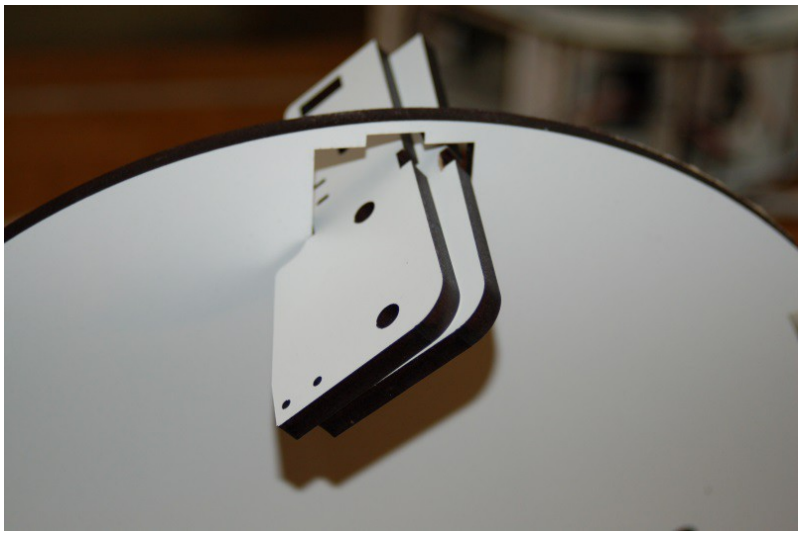


Fig. 7-3: Inserting the upper tower supports in the top plate.

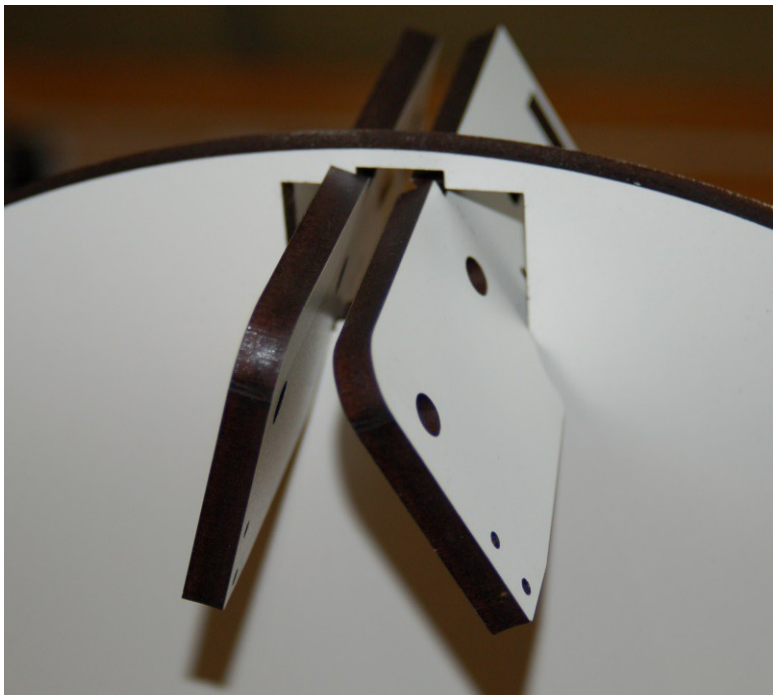


Fig. 7-4: Fitting the tower supports

Now carefully spread them apart so that they're flush with the sides of the tower pocket.

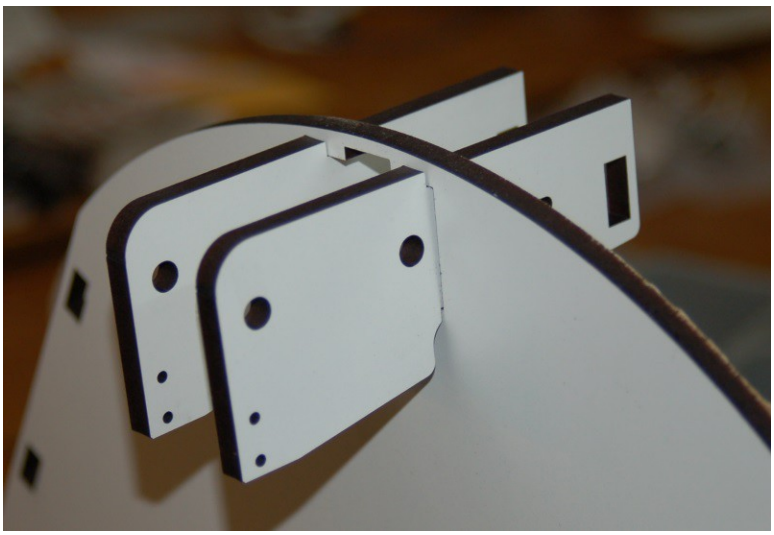
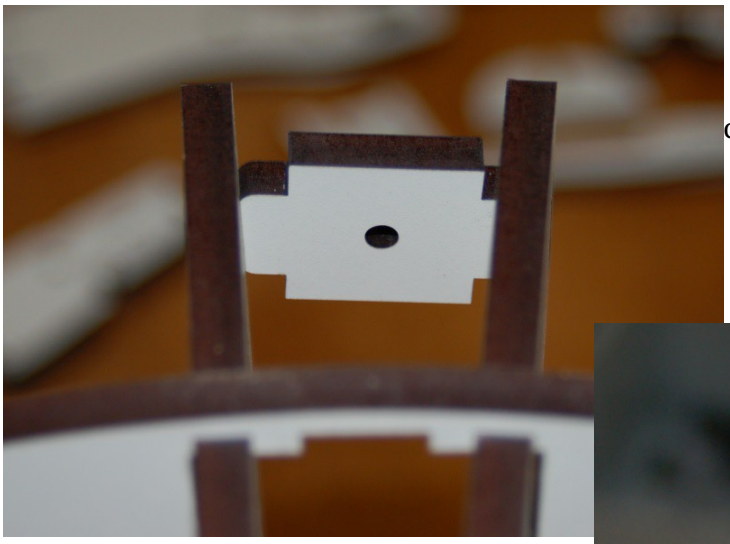
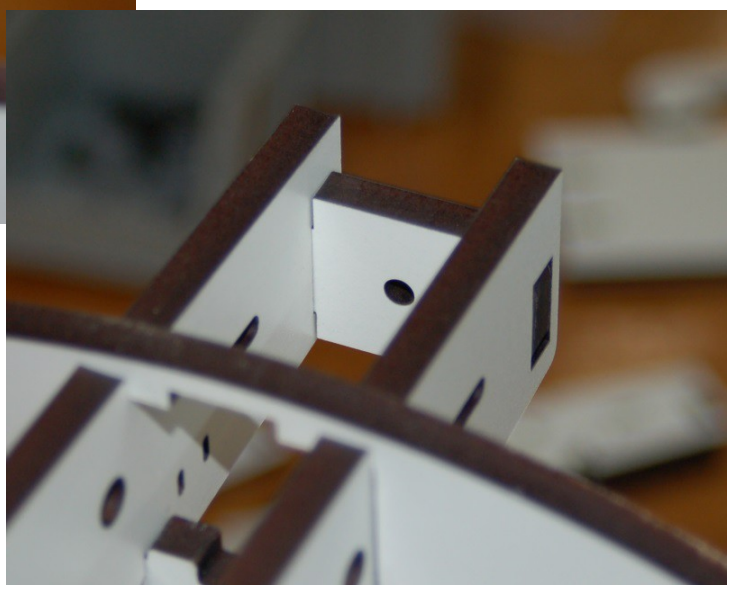


Fig. 7-5: Tower supports fully seated.

Now you want to insert one of the tower mount spreader blocks as shown below.



The fit is very tight, but it WILL fit. Just be careful to not break the tower support plates.



Repeat the process for all three upper tower supports.

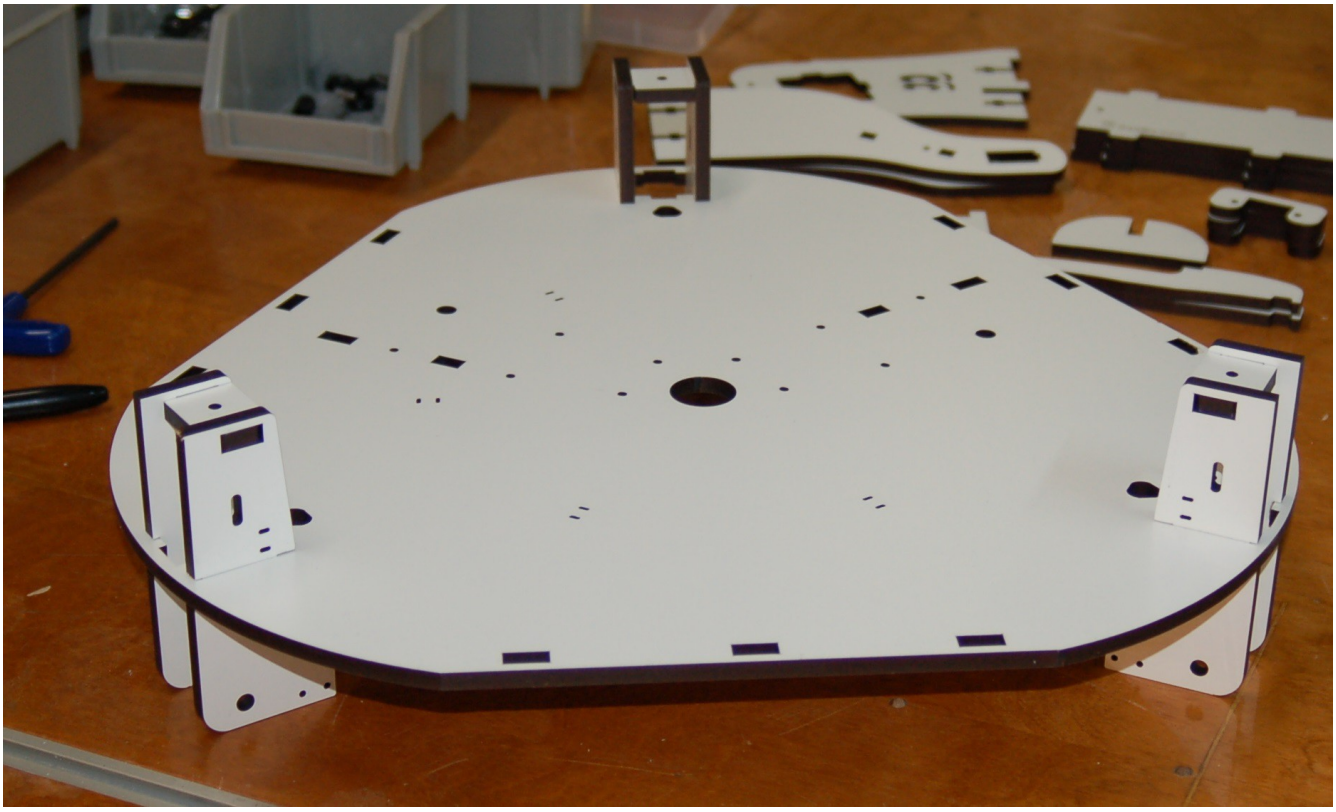


Fig. 7-8: All three upper tower supports installed.

Installing the End Stop Switches

For this step, you'll need the following parts:

1. (___) End Stop Switches (3)
2. (___) #2-56, 5/8” Pan Head Phillips Machine Screw (6)
3. (___) #2-56 Finish Nuts (6)

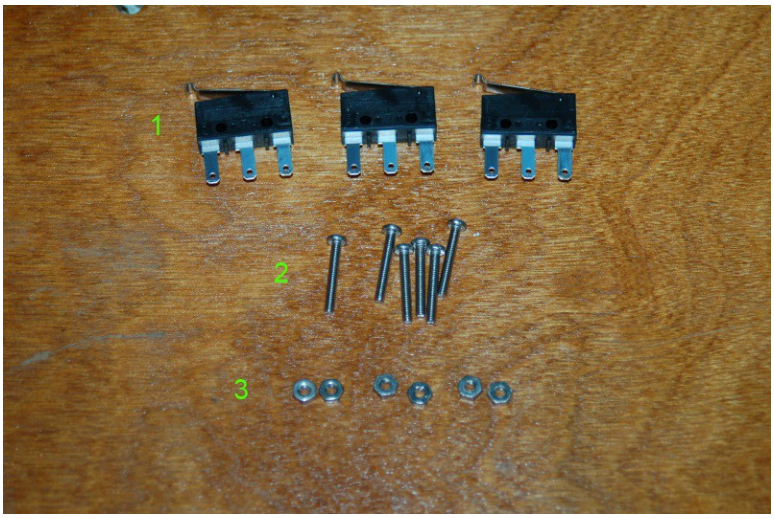


Fig. 7-9: End Stop Parts.

Using two #2-56 x 5/8” pan head screws and two #2-56 finish nuts, install the end-stop switches on to the upper tower support as shown. Make sure you don't over tighten the screws, or you'll crack the switch body. (Ignore the bent leads in Fig. 7-11.)

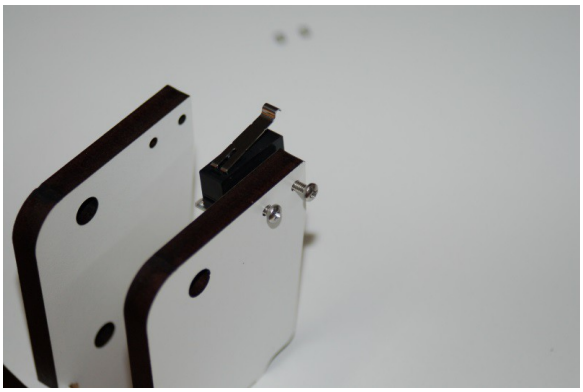


Fig. 7-10: Installing the end-stop switch.

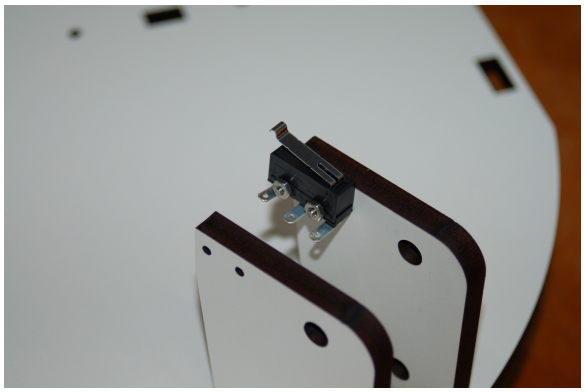


Fig. 7-11: Installing the end-stop switch.

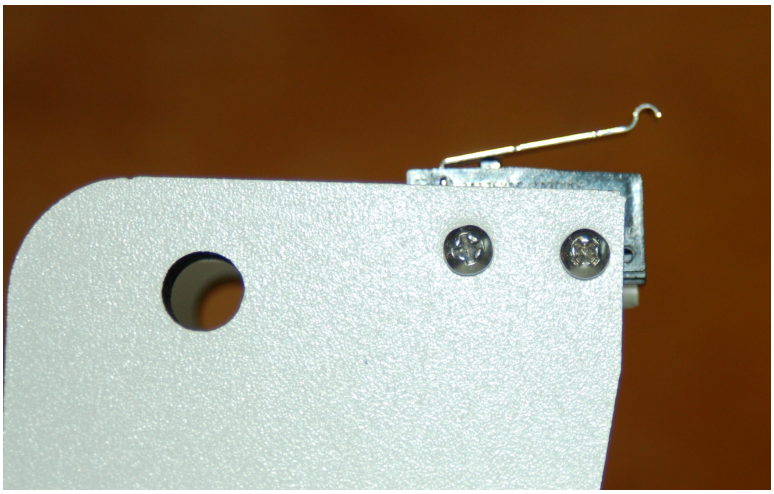


Fig. 7-12: End-stop switch installed.

When you're finished, the underside of the top plate should look like Fig. 7-13 below.

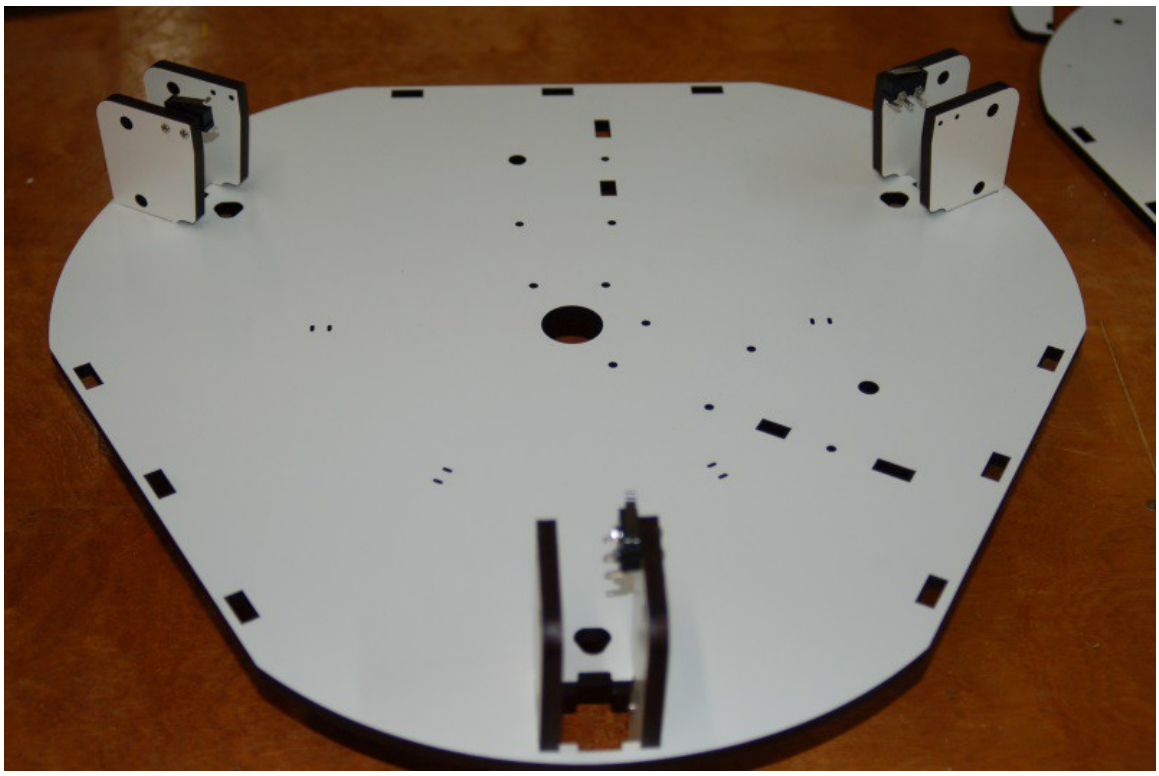


Fig. 7-13: Three end-stop switches installed.

Installing the Upper Tower Mounting Hardware

For this step, you'll need the following parts:

1. (___) ¼-20, 1/2” Button Head Cap Screws (12)
2. (___) T-Slot Nut Plates (12)

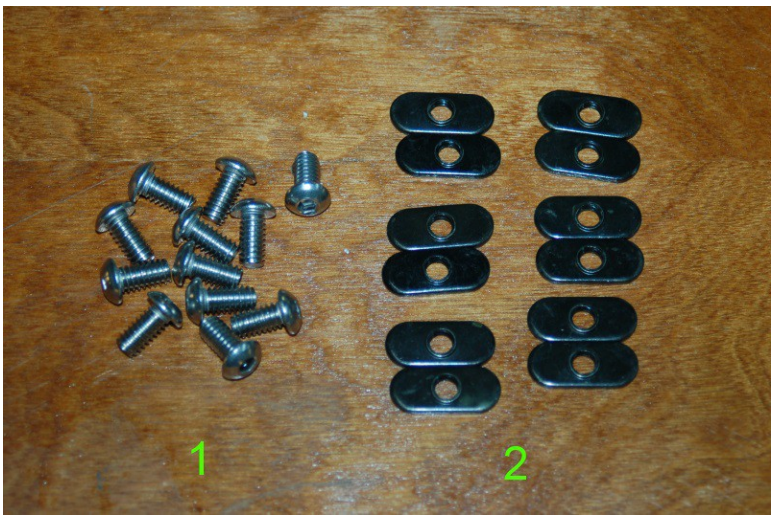


Fig. 7-16: Upper tower mounting hardware.

Install four ¼-20 button head screws and four T-Slot nut plates into each upper tower support as shown in Fig. 7-17.

Thread the nut plates only a couple of turns – they need to be as loose as the lower ones were in order to properly fit the towers.

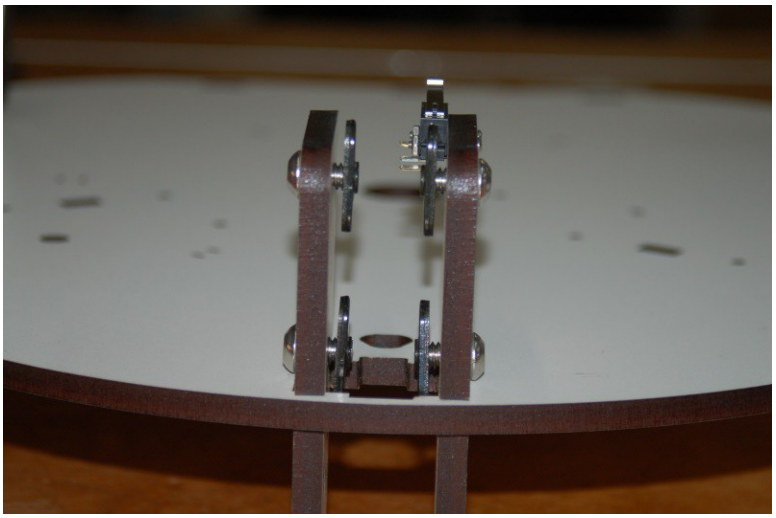


Fig. 7-17: Mounting hardware installed.

8 – Assembling and Installing the Cheapskate Carriages

Assembling the Cheapskate Rollers

For this step, you'll need the following components:

1. (___) Bearing Sleeves (24)
2. (___) 608ZZ Bearings (12)

Fig. 8-1: Bearing Sleeves.

Fig. 8-2: 608ZZ Bearings.

The Cheapskate rollers are made from two bearing sleeves and a single 608ZZ bearing. You'll need to apply sleeves to all 12 bearings used in this step.

Start by laying a sleeve on the table, wide “face” up. Press a 608ZZ bearing into it as shown in Fig. 8-4.

Set the second sleeve on top of the 608ZZ bearing and press down with the palm of your hand until it's fully seated. You may want to use a paper towel or cloth pad to protect your hand – the edges of the sleeve can be sharp.

Repeat this process for the 11 remaining 608ZZ bearings.

Fig. 8-4: Bearing seated in a sleeve half.

Fig. 8-4: Finished Cheapskate rollers.

Assembling the U-Joint Carriers

For this step, you'll need the following components:

1. (___) U-Joint Carriage Base (3)
2. (___) #6-32, 5/8” Socket Head Cap Screws (6)
3. (___) #6-32 Nylon Lock Nuts (6)
4. (___) Cheapskate Carriage Inside Plate (3) (Not shown.)
5. (___) #6-32, 1/2” Stainless Steel Flat Head Screws

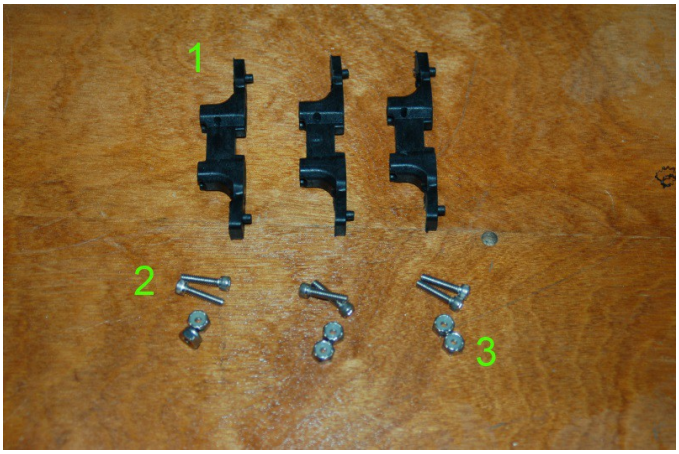


Fig. 8-5: U-Joint Carrier Hardware.

Quick point on the Melamine Cheapskate parts – they're designed to only go together one way and it's easy to accidentally flip one or both of them. The easiest way to figure out how they go is to put the inside and outside carriage plates together with the “eyes” upright and “looking” to the right. The four bearing holes should match those in the outside carriage plate.

The u-joint carrier bases get installed on the inside carriage plate by pressing their alignment pins into the holes indicated by the arrows in Fig. 8-6.

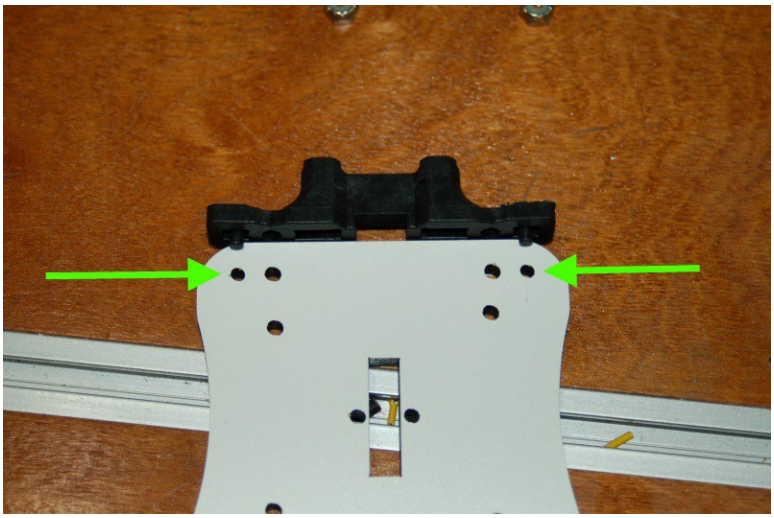


Fig. 8-6:Aligning the u-joint carriage base.

Note that these u-joint carriers are an interim design and are simply the original v1 parts that have had the end posts ground off. You may find that the grinding has removed enough material that the alignment pin is no longer able to remain in place. If you find that happening, just remove that alignment pin and hold it in place until you can get the socket head cap screws installed.

From the front side of the u-joint carrier, insert two #6-32, 5/8” socket head cap screws through the holes indicated. Install two #6-32 Nylon lock nuts on the back and tighten them down using a 7/64” hex wrench and a 5/16” wrench.

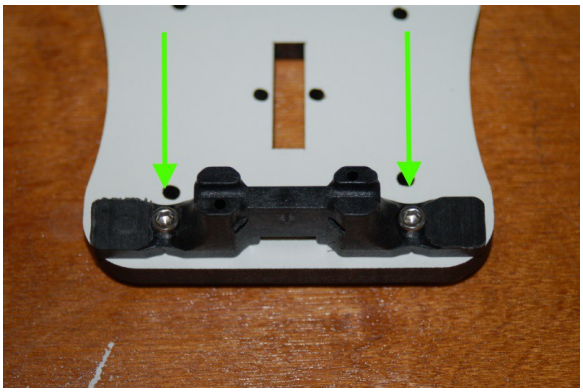


Fig. 8-7: Screw locations.

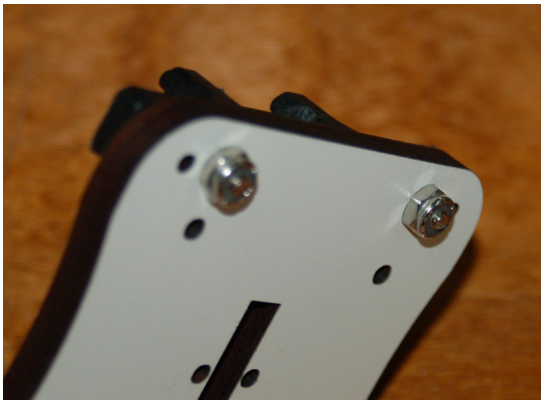


Fig. 8-8: Nylon lock nuts installed.

Next, you'll need to install a #6-32, 1/2” Stainless Steel flat head screw. This screw is what triggers the end-stops when the printer is commanded to its “home” position.

Install the screw *exactly* as shown in Fig. 8-9. Use the rightmost hole in the u-joint carrier – this hole lines up with where you installed the end-stop switch. When you install the screw, try to leave the bottom of the head even with the top of the inside carriage plate as indicated by the green line in the photo. This will give you a consistent start point when it comes time to calibrate the printer when your build is completed.

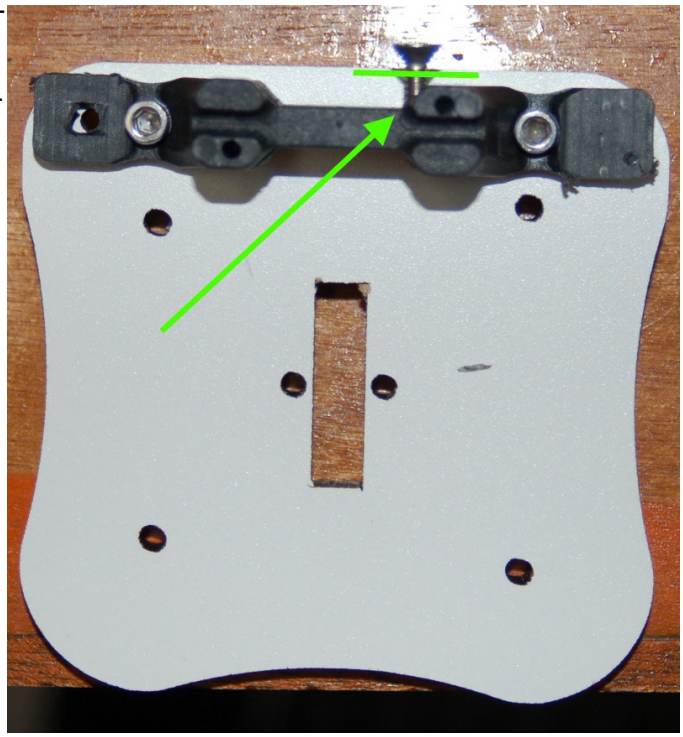


Fig. 8-9:Setting the end-stop triggering screw.

Fig. 8-9A: Screw alignment.

Fig. 8-9A should give you a good idea as to how the bottom of the screw head aligns with the line defined by the top of the Cheapskate inner carriage plate.

Repeat these assembly steps for the other two u-joint carriers.

Installing the U-Joints

For this task, you'll need the following components:

1. (___) U-Joint Spring Clip (3)
2. (___) #4, 3/8” Pan Head Sheet Metal Screw (6)
3. (___) 3-1/8” U-Joint Axle (3)
4. (___) Machined Aluminum (or Acetal) U-Joints (6)

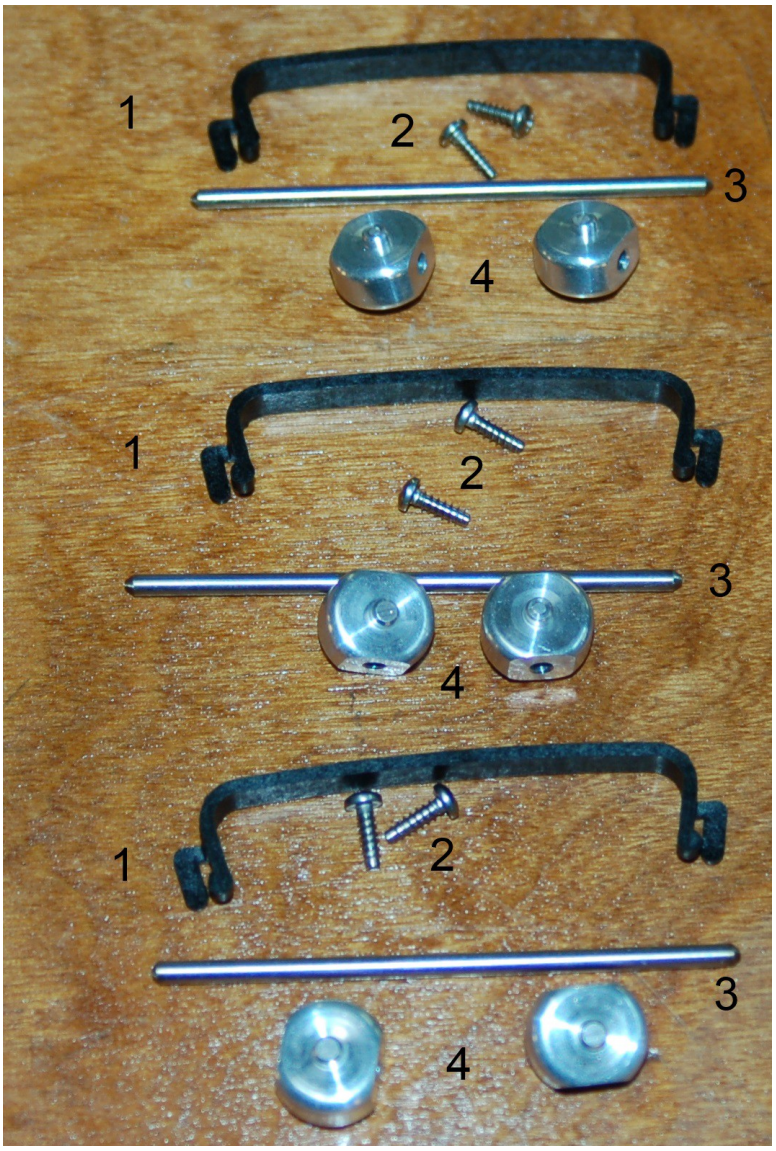


Fig. 8-10:U-Joint Components.

Fig. 8-10A: Injection Molded U-Joints

Carefully inspect the u-joint axles. Ensure that they're perfectly straight and are free of any scarring. If the axle is bent or badly scarred, contact support@seemecnc.com for a replacement. Test each u-joint by spinning it on the axle. They should all spin freely. If they don't check for burrs on the u-joint and de-burr as needed.

Using two #4, 3/8” screws, install the 3-1/8” u-joint axle as shown below.

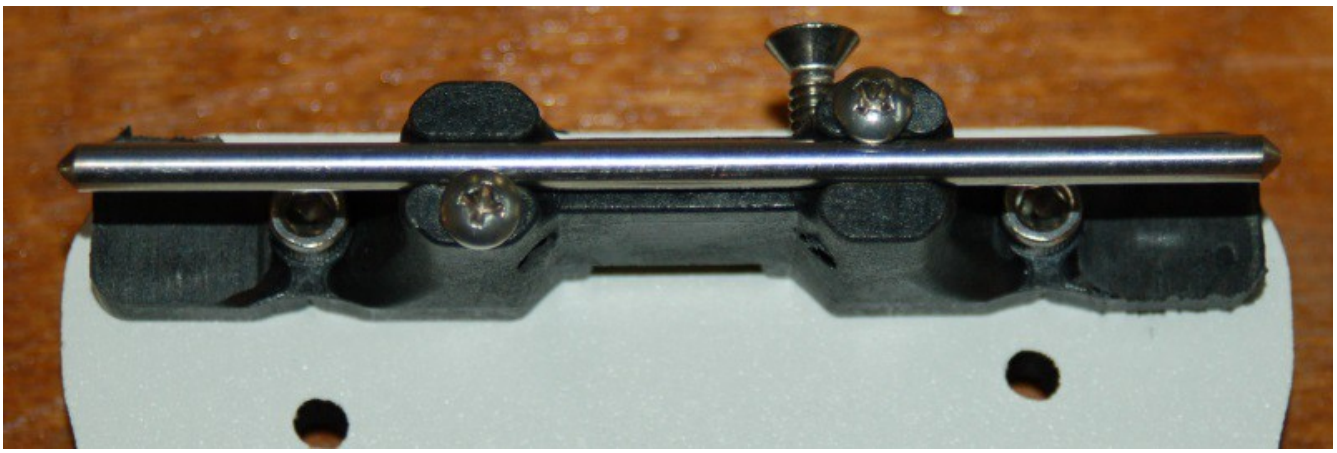


Fig. 8-11:Installing the u-joint axle.

Make sure that you've got the axle centered on the u-joint carrier. Note that the positions of the #4 screws in your build may be flipped from the image shown above. This is perfectly okay as long as the end-stop triggering screw is in the correct location.

Make sure that the axle is fully seated in the channel provided in the u-joint carrier. The #4 screws will be flush with the face of the u-joint carrier when the axle is properly seated.

Slide two u-joints on to the u-joint axle as shown below. If your kit shipped with the injection molded u-joints, make sure you slide the u-joint on to the axle with the ejector pin marks facing out. This will prevent any plastic scale from scraping against the u-joint carriage.

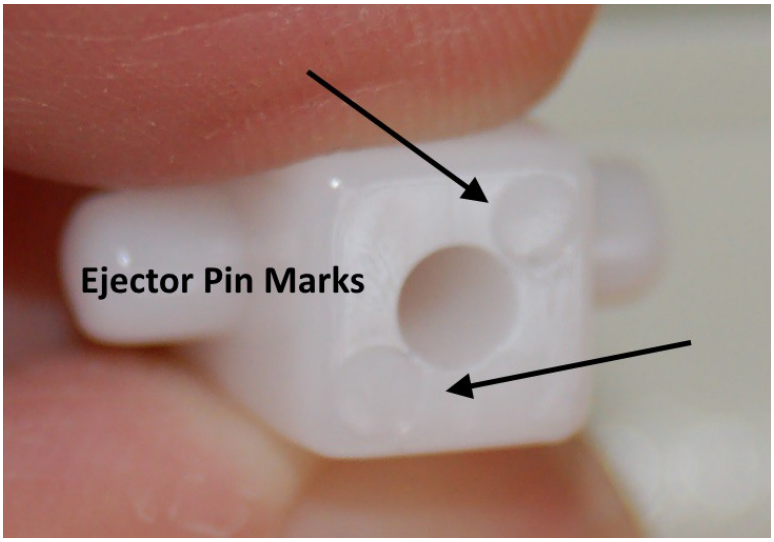


Fig. 8-12:U-Joints installed.

Now you can install the spring clip that retains the u-joints.

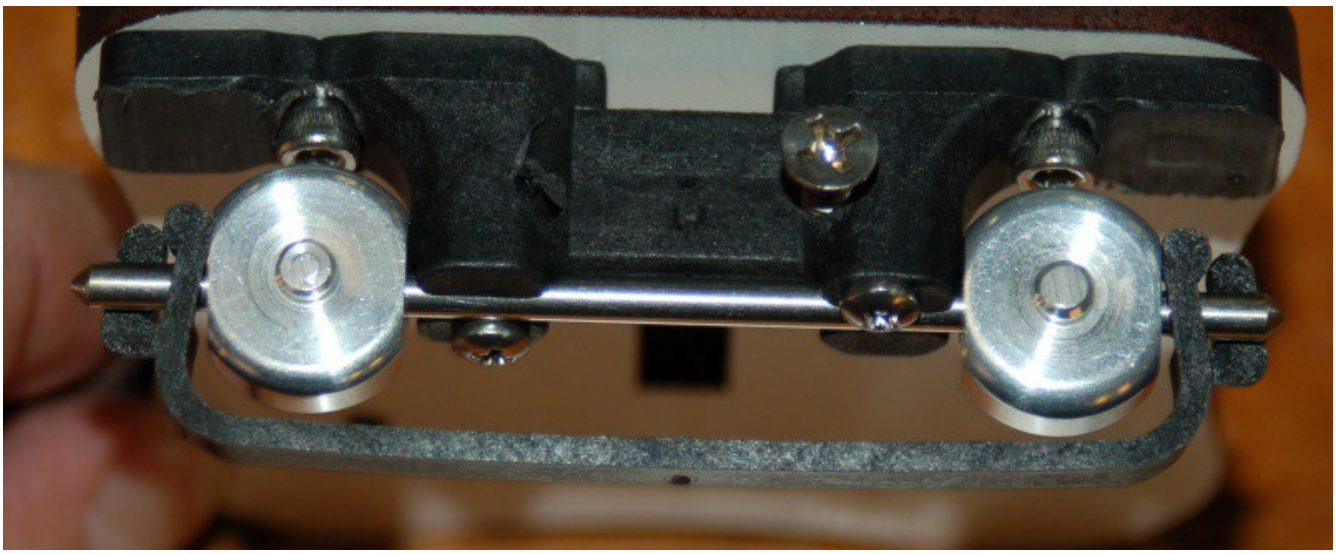


Fig. 8-13:U-Joint spring clip installed.

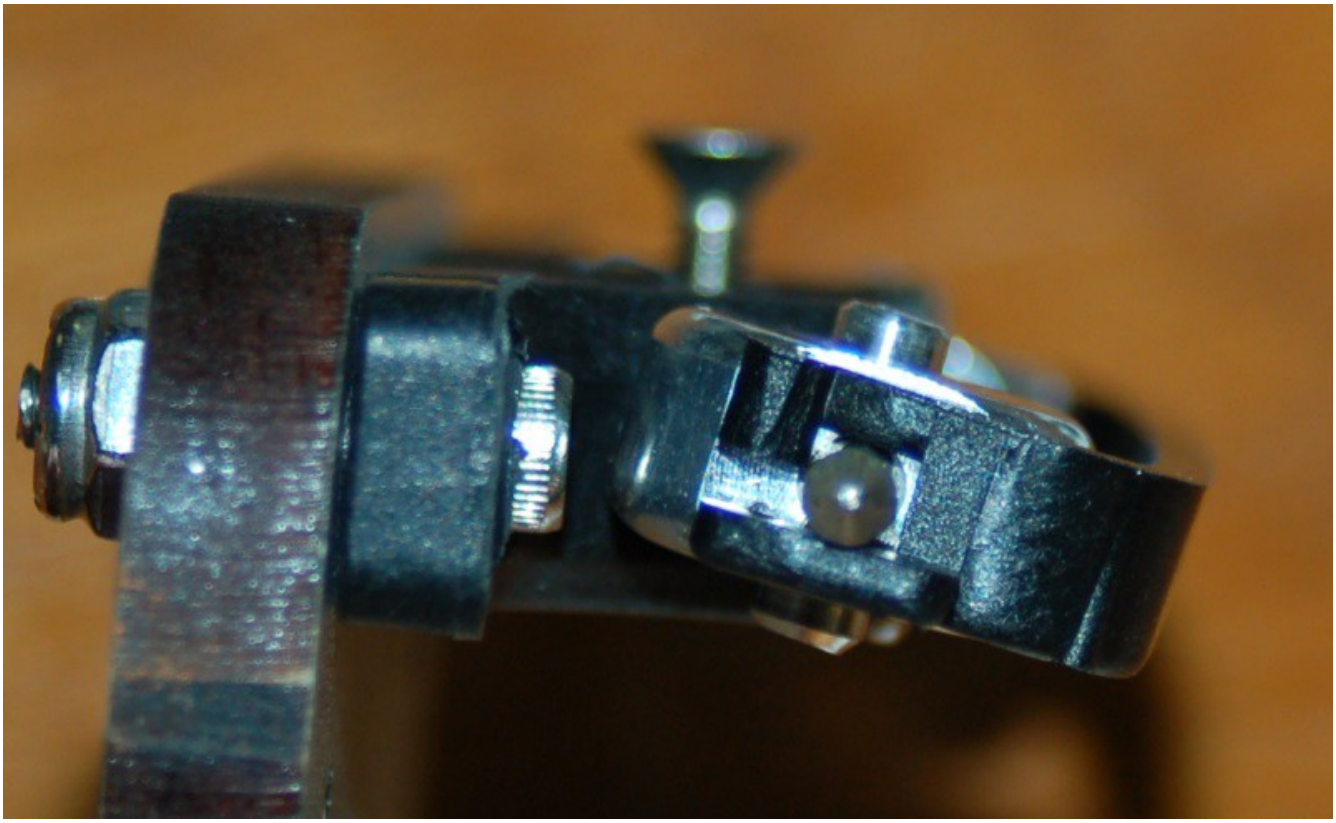


Fig. 8-14:U-Joint spring clip installed.

Repeat this task for all three u-joint carriers.

Installing the Belt Clip T-Nuts

For this step you'll need the following components:

1. (___) #4-40 T-Nuts (6)

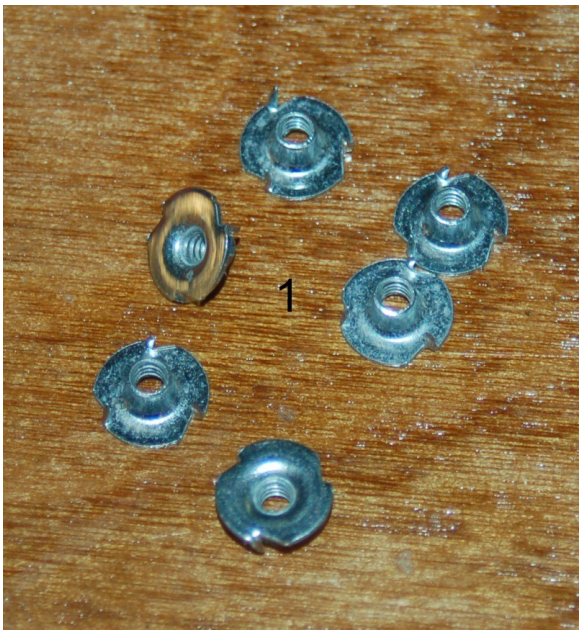


Fig. 8-15: Belt Clip T-Nuts.

Install two #4-40 T-Nuts in the back of all three Cheapskate inner carriage plates as shown.

Make sure the barbs on the t-nuts are fully seated in to the Melamine. If they're a bit loose, you can cover them with a small bit of Scotch tape to hold them in place until the belts are installed.

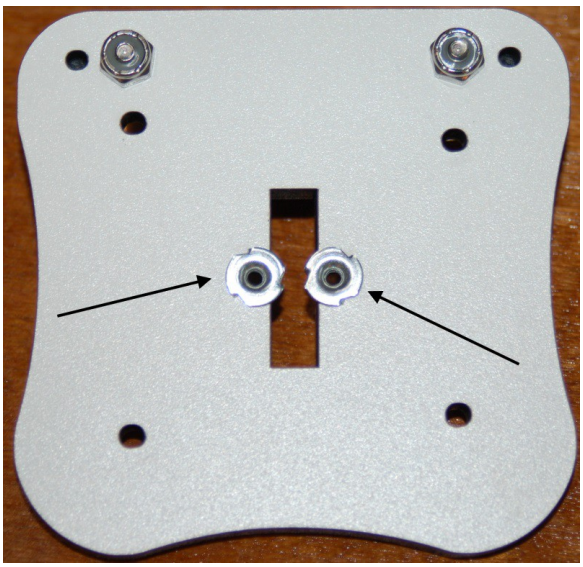


Fig. 8-16:Belt clip t-nuts installed.

Assembling and Installing the Cheapskate Carriages

For this step, you'll need the following components:

1. (___) #6-32, 2” Stainless Steel Pan Head Screws (12)
2. (___) #6-32 Nylon Lock Nuts (12)
3. (___) Cheapskate Bearing Black Plastic Spacer (12)
4. (___) Cheapskate Bearing Gray Plastic Eccentric Spacer (12)
5. (___) Cheapskate Outside Plate (3) (Not Shown.)
6. (___) Cheapskate Inside Plate (3) (Not Shown.)
7. (___) Cheapskate Roller (12) (Not Shown.)

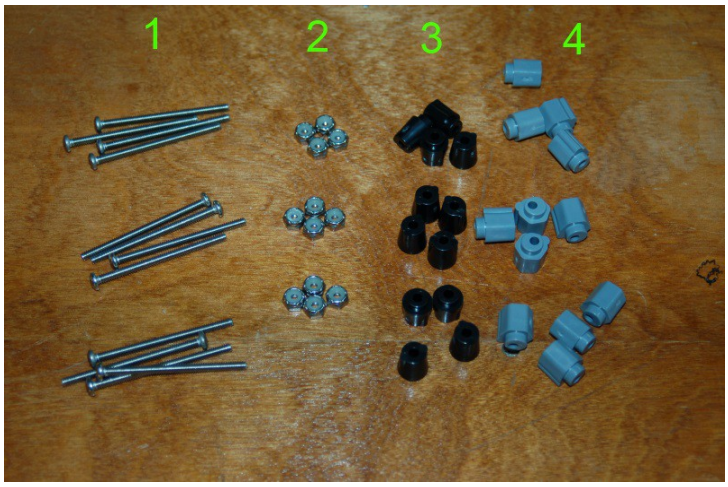


Fig. 8-17: Cheapskate hardware.

Start off by installing the black & gray spacers to each one of the 12 Cheapskate rollers you built previously.

Fig. 8-18:Standard spacers & roller.

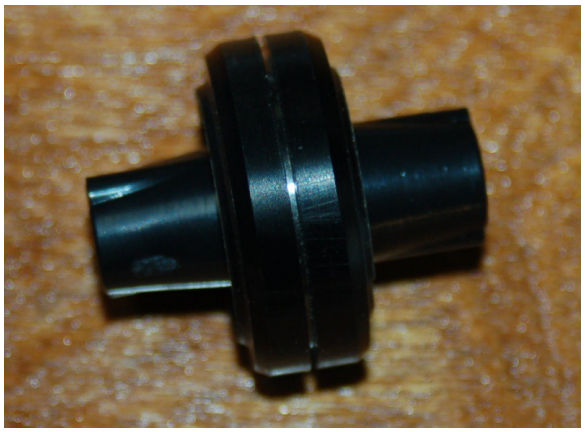


Fig. 8-19:Assembled std. roller.

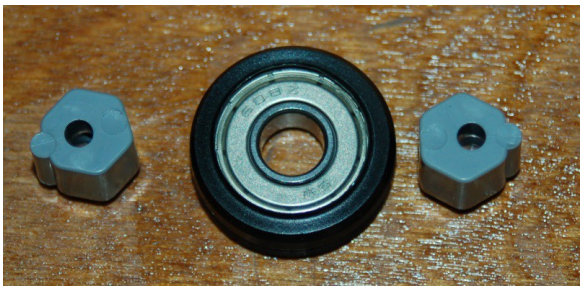


Fig. 8-20:Eccentric spacers & roller.

When you assemble the eccentric rollers, make sure that you've got the eccentric spacers aligned with one another as shown in Fig. 8-21.

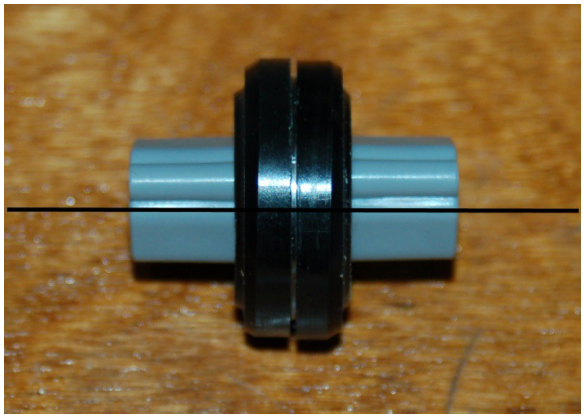


Fig. 8-21:Assembled Eccentric roller.

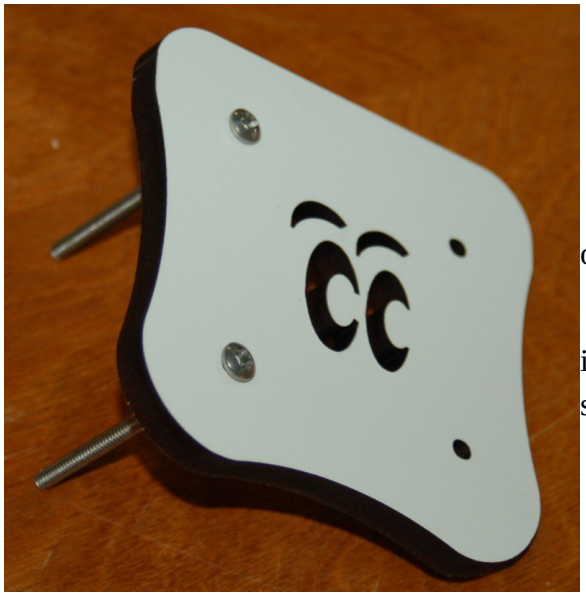


Fig. 8-22:Installing the 2" screws.

Install four #6-32, 2” flat head screws into the Cheapskate outer plate. Fig. 8-22 shows two of the four installed.

Lay the Cheapskate outer plate flat on your work table and install the roller bearing assemblies you just finished as shown in Fig. 8-23.

Now it's time to install the Cheapskate carriages on to the aluminum towers.

Place the Cheapskate outer carriage you just assembled on the tower and then slide the Cheapskate inner carriage on to the four 2” screws as shown below.

Fig. 8-23:Cheapskate rollers installed.

Note that I've oriented the tiny bulge on the eccentric spacers such that they “point” straight up.

This position puts the roller very close to the tower and will reduce the time needed to set the correct tension on the Cheapskate carriage.

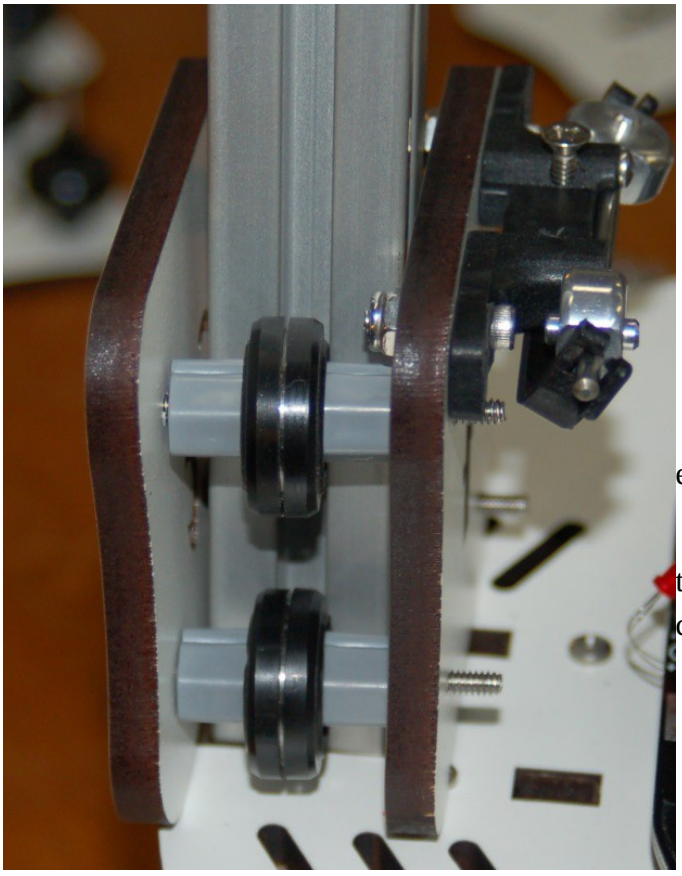


Fig. 8-24:Cheapskate on the tower.

Make sure that when you install the Cheapskate, it's oriented with the flat surface to the top and the “eyes” are oriented right-side up. See the first page of this guide if you're not sure. The “Blinky” eyes are part of the SeeMeCNC logo.

Install the four #6-32 Nylon lock nuts on to the 2” screws and tighten them down.

Fig. 8-25:Installing the #6-32 nuts.

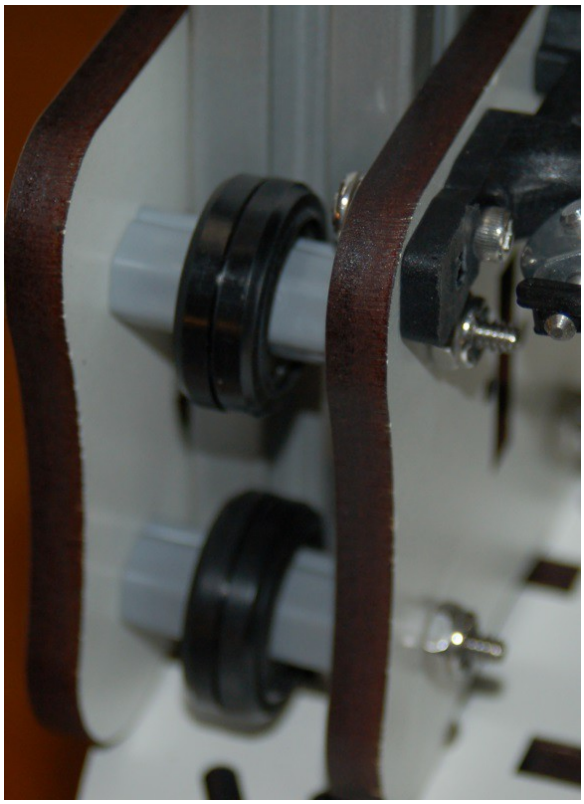


Fig. 8-26:Don't forget to tighten them!

Repeat these steps for the two remaining Cheapskate carriages.

Fig. 8-27:Cheapskate carriages installed!

Adjusting the Cheapskate Carriages

Once you've gotten all three carriages installed, you'll need to adjust the eccentric spacers in order to tighten the grip of the roller bearings on the aluminum tower.

You'll need two 7/16” wrenches in order to make sure that you're adjusting both eccentric spacers at the same time.

You want to tighten the upper and lower rollers such that it grips the tower with no horizontal or vertical rotation – it must roll straight up and down.

I've created a short YouTube video that shows the degree of tightness that you're after with your adjustments.

http://youtu.be/9dUL8VKzc34

Fig. 8-28: Adjusting the eccentric spacers.

Adjust all three Cheapskate carriages so that they're all at as close to the same “grip” as you can get it. A good way to estimate that is to make sure that the little bulges on the eccentric spacers match across all three Cheapskates. Get one set as good as you can and then make the position of the others match. If it doesn't get you dead-on, it won't take much adjustment after that point.

9 – Installing the Top Plate and Idler Bearings

For this task, you'll need the following components:

1. (___) #6-32, 1-3/4” Stainless Steel Pan Head Screw (3)
2. (___) #6-32 Nylon Lock Nut (3)
3. (___) 608ZZ Roller Bear (3)
4. (___) Black Plastic Bearing Spacer (6)
5. (___) Assembled Top Plate (Not Shown.)

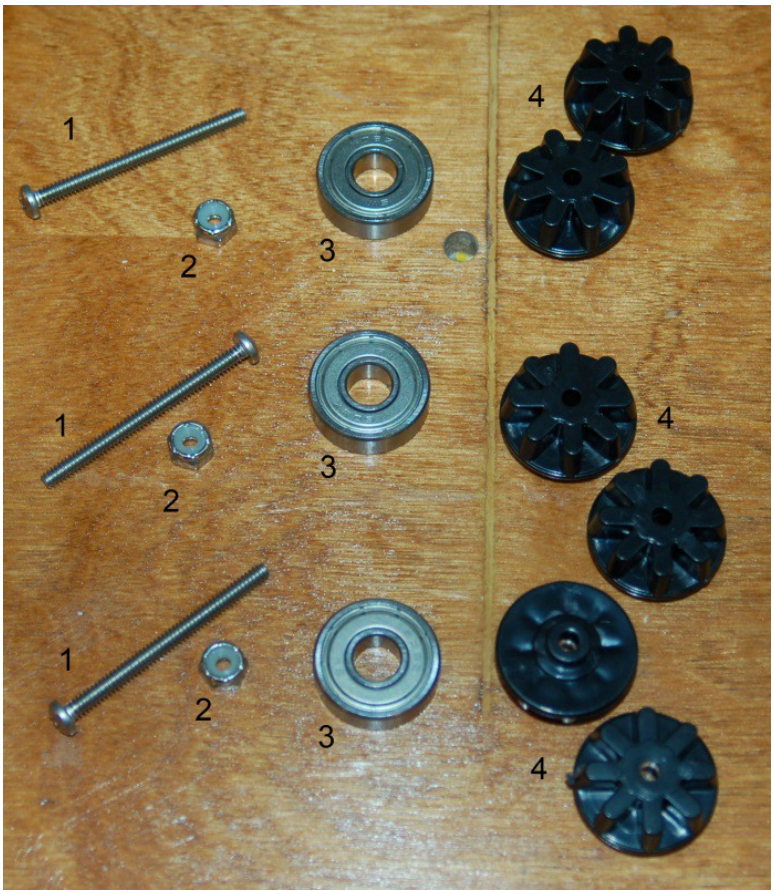


Fig. 9-1:Idler bearing hardware.

While completing this section you'll notice a discrepancy between the photos and the text with regard to the idler bearing installation. Originally, I installed the idler bearings into the top plate before mounting it to the towers. Doing that first increases the difficulty in getting the wiring threaded through the openings in the top plate, so I'm going to have you mount the top plate and THEN install the idler bearings. My apologies for any confusion this creates!

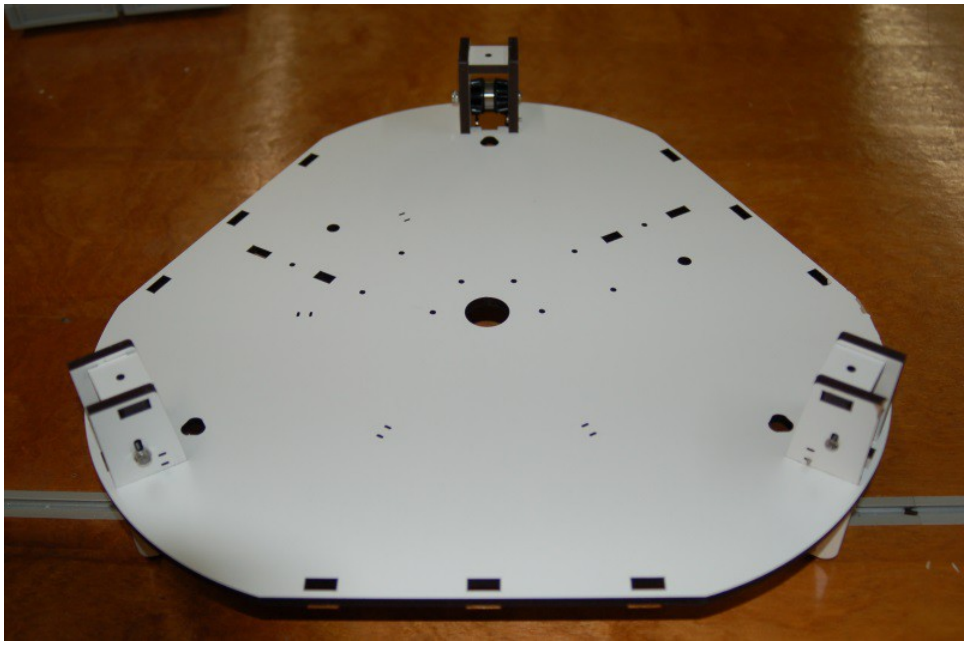
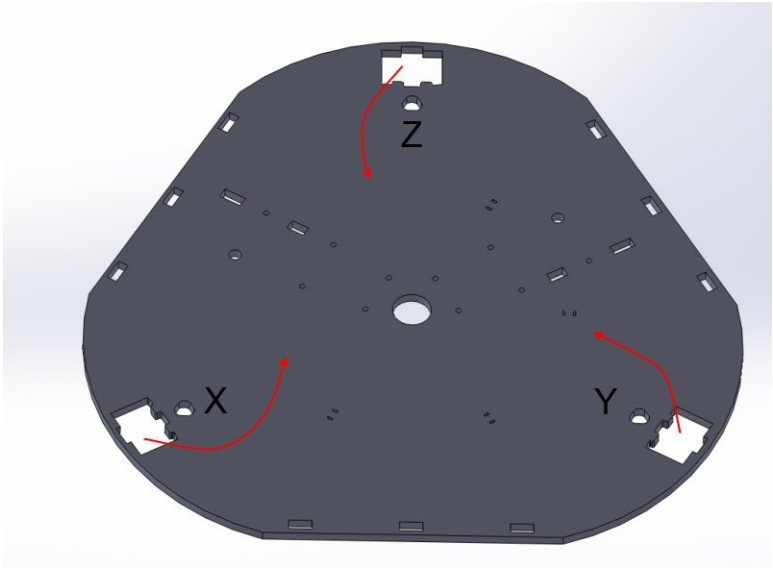


Fig. 9-2:Top Plate ready for installation.

Installing the top plate is pretty easy, it just takes patience. You'll want to orient the top so that the Z tower is farthest away and the X and Y towers are closest to you. See Ill. 9-1.

Carefully thread the wiring in each tower through the tower mounts and toward the center of the top plate as indicated by the red arrows in Ill. 9-1.



Carefully align the upper tower mounts with each tower, ensuring that the T-Slot nut plates are able to slide down the notches in the sides of the towers as shown below.

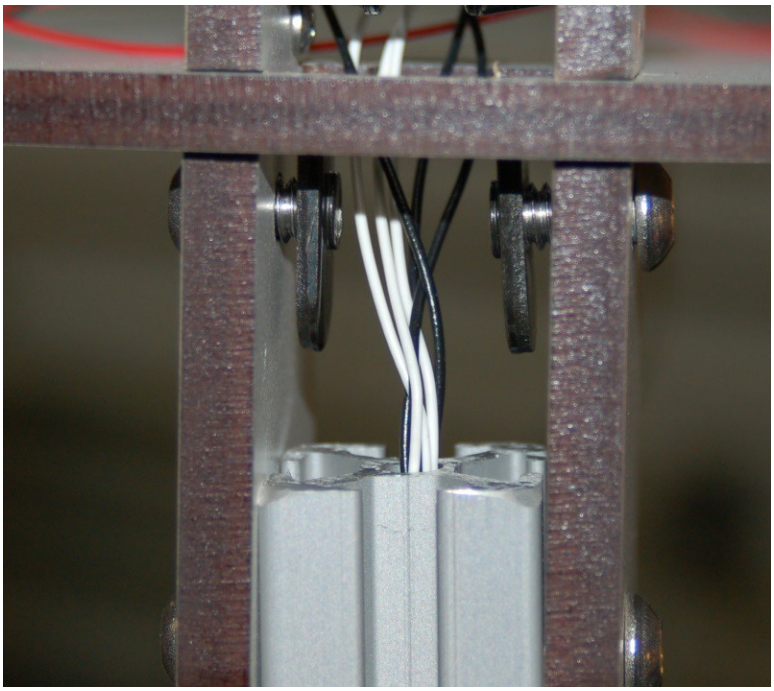


Fig. 9-3:Setting the top plate.

You want to keep the top plate level as any tilt will make it difficult for you to get all three upper tower mounts on the towers properly. The top plate should fit over the towers until the top of each tower comes into solid contact with the depth limiting screws that you installed when you assembled the upper tower mounts into the top plate.

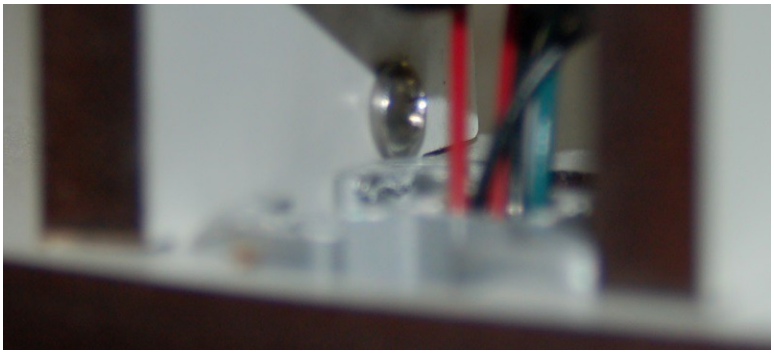


Fig. 9-4:Tower in contact with depth limiting screw.

Tighten each of the tower's button head cap screws only finger tight. We'll come back and tighten them the rest of the way once the top assembly is completed.

Assemble an idler bearing out of two black plastic bearings spacers and a 608ZZ roller bearing. Install it into the upper tower mounting as shown below. Use a #6-32 1-3/4” pan head screw and a #6-32 Nylon lock nut to hold it in place. Don't tighten it – we'll do that after the belts are installed.

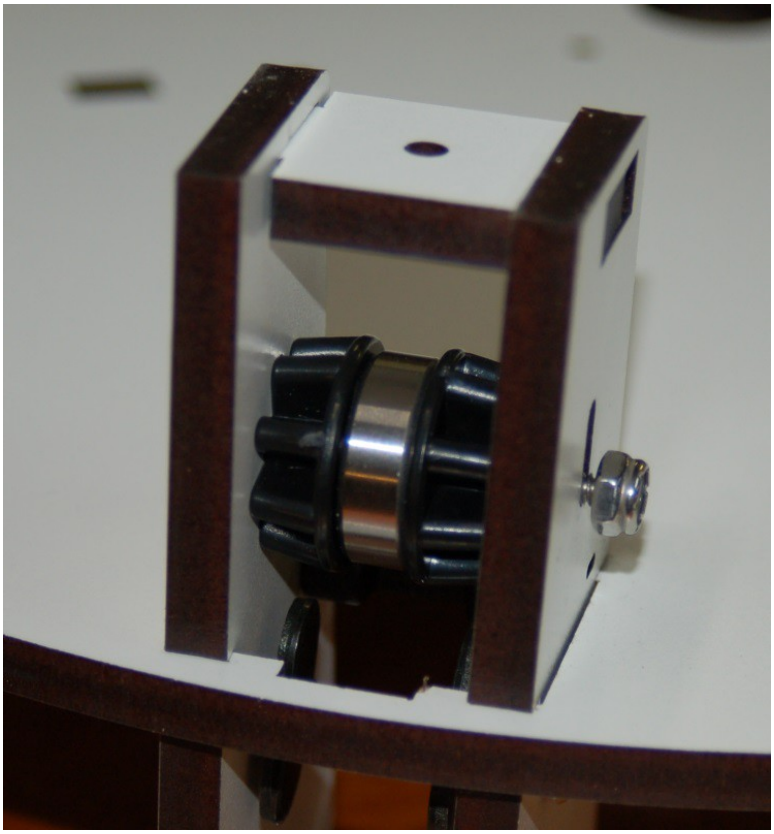


Fig. 9-5:Idler Bearing installed.

Repeat this step for the other two idler bearings.

10 – Wiring the End Stop Switches

For this task, you'll be routing the end-stop wires to the end-stop switches and connecting them up. You'll want to lay the machine flat with the Z axis pointing “up” for this step.

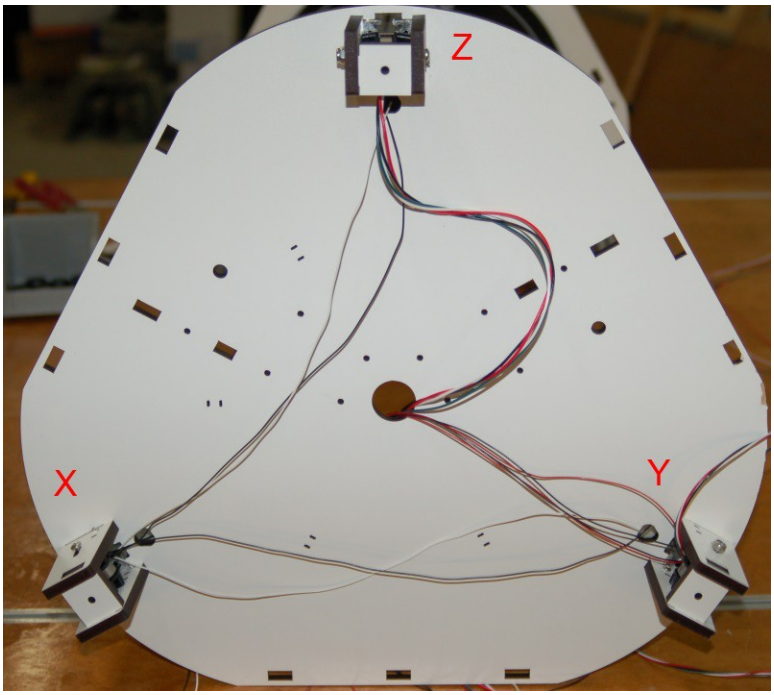
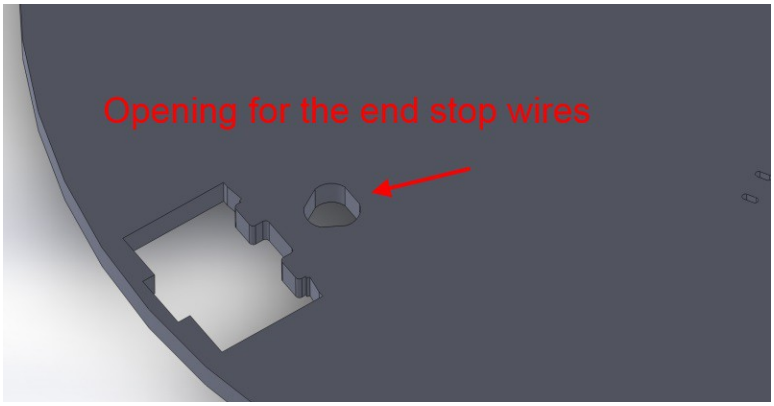


Fig. 10-1:Work orientation.

Next to each tower mounting point, there's a triangular shaped hole that the end-stop wires should pass through in order to reach the end-stop switches. To make this task easier, simply spindle each pair of end-stop wires as shown and then route each pair to the appropriate hole for each axis.

Fig. 10-2:End-stop wires.



Ill. 10-1:End-stop wire routing hole.

Start off with the Z axis end-stop. Thread the Z axis end-stop wires through the opening and attach the spade connectors to the lugs on the switch. You want to connect to the outer two lugs and ignore the center one. It's a tight fit, so please be careful not to damage the switch. A small pair of needle nosed pliers would big a big help here.

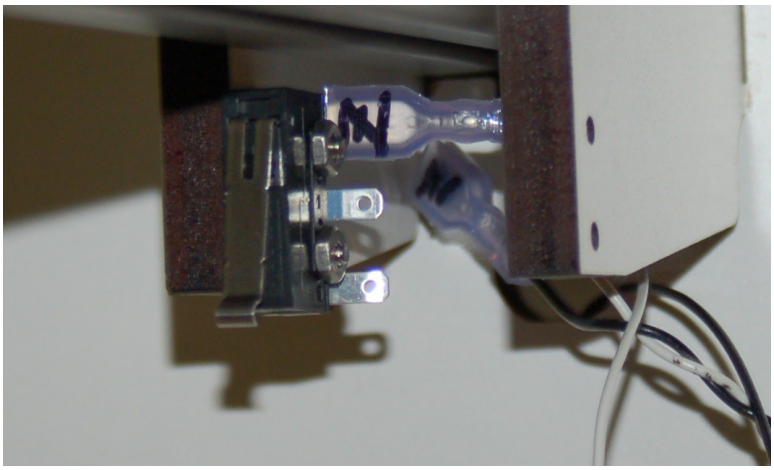
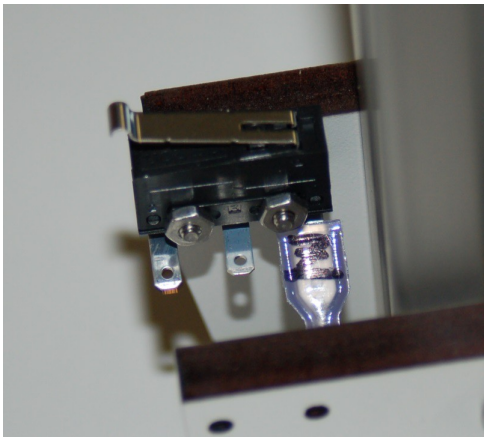
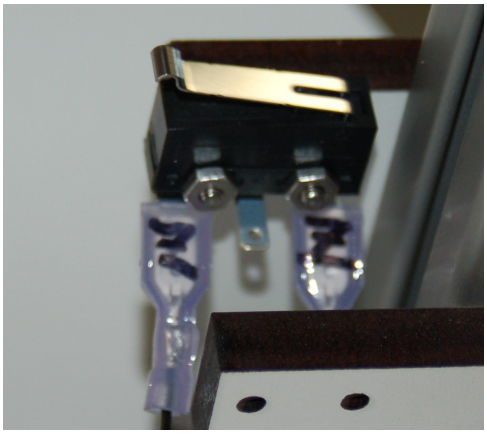


Fig. 10-3:Attaching Z axis end-stop wires.





Now go ahead and wire up the X and Y axis end-stop switches.

Wire Routing

Once all three end-stop switches are wired, carefully pull the slack out of the end-stop wires by ***carefully*** pulling them through from the bottom of the X axis tower.

Next, you want to pull the four 18ga wires from the Z tower and the four 26ga wires from the Y tower through the center hole in the top plate. Carefully feed 30” of wire as measured from the top plate. This will give you plenty of length to work with when it comes time to wire up the hot end.

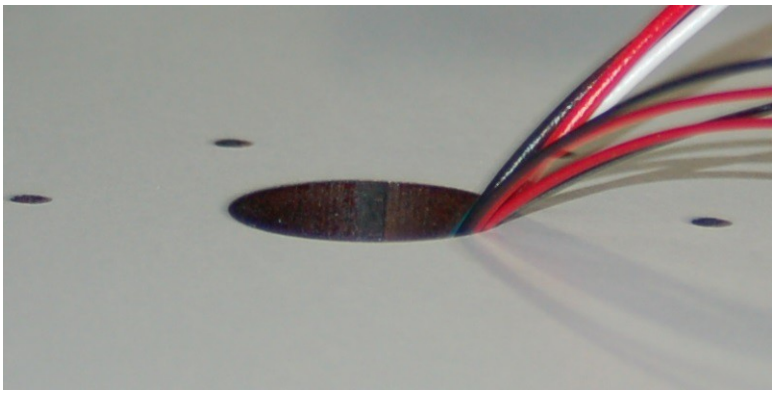


Fig. 10-6:Down the center hole!

Now route the four 22ga extruder motor wires from the Y axis tower till they touch the center hole. That will give you about 8” of wire from where the wires exit the top of the Y tower to the center of the top plate.

Moving to the bottom of each tower, route the wire through the side openings as shown.

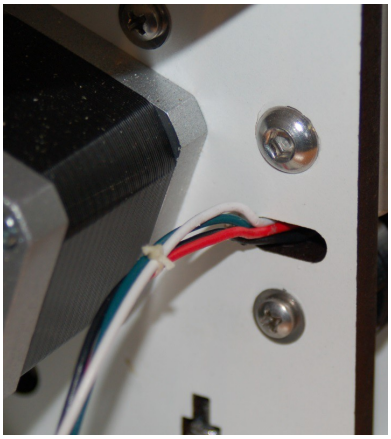


Fig. 10-7:Z Axis.

Fig. 10-8:Y Axis.

Fig. 10-9:X Axis.

Once that's complete, you'll need to tie down the wires using wire ties at the “tie” locations on the right side of each upper mounting bracket.

Before you tie the wires down, you'll want to make sure that the wire exits the center of the tower and comes directly to the inside face of the upper tower support, into a 90 degree bend and then towards its destination. This needs to be done in order to make sure the drive belt will not rub on the wires.

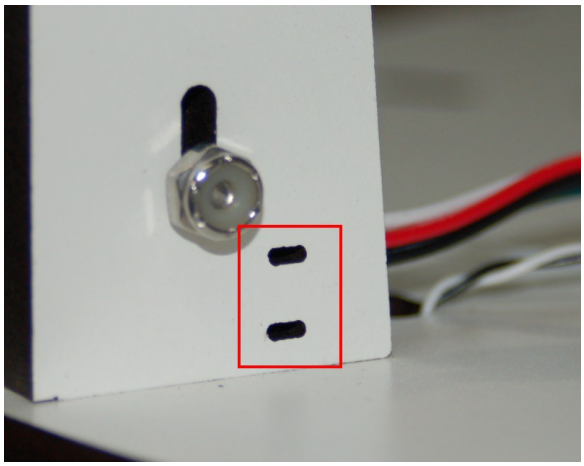


Fig. 10-10:Wire tie-down point.

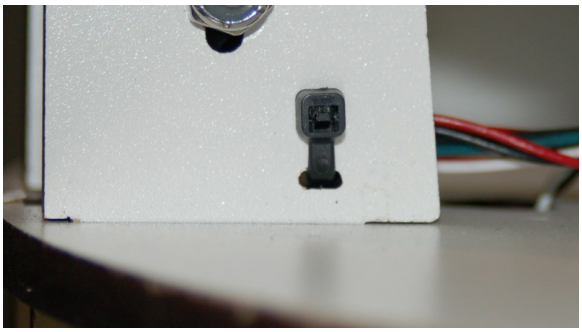


Fig. 10-11:Tie-down point, outside face.

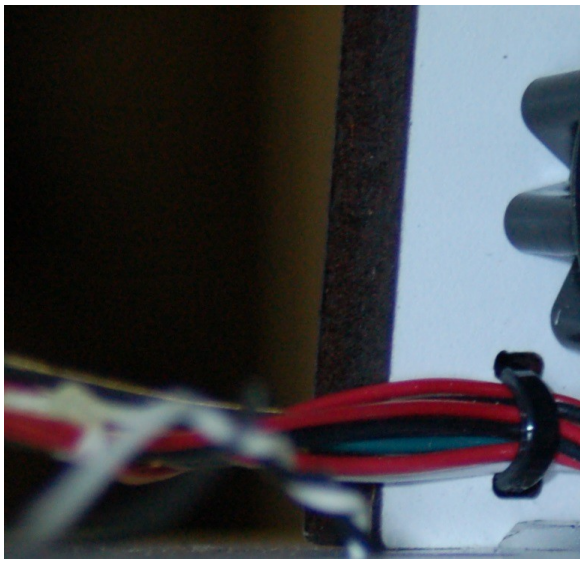


Fig. 10-12:Tie-down point, inside face.

Now you can tie down the end-stop wiring on the top plate.

Tie down the end-stop wires in the areas marked by the red boxes. Do not use the tie point marked by the red “X”. This tie point will be used later, but requires special wire routing that I'll cover later.

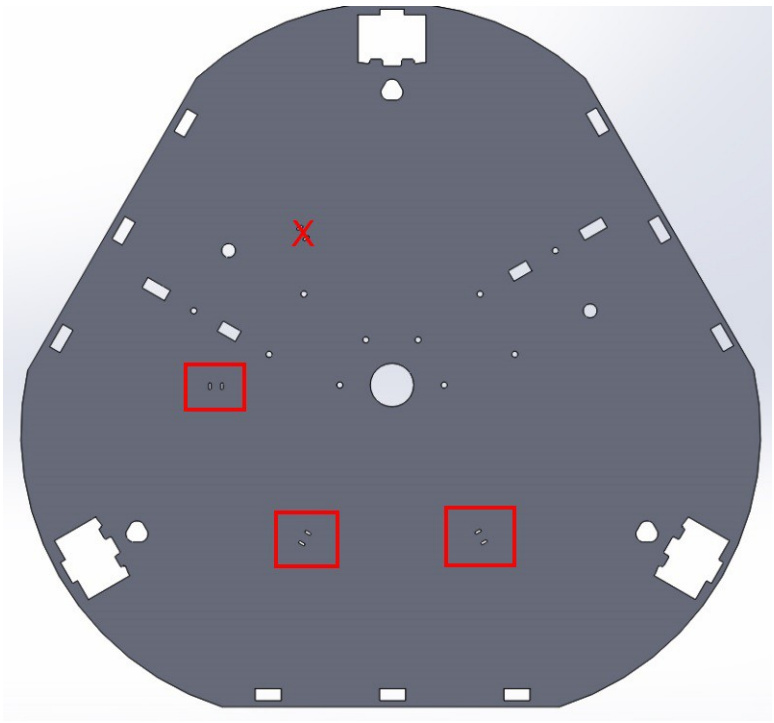


Fig. 10-13:Tie-down locations.

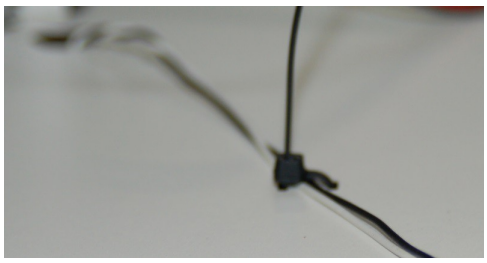


Fig. 10-14:Tied down.

Fig. 10-15:Ready for belts!

11 – Installing the Drive Belts

For this step, you're going to need the following components:

1. (___) GT2 Drive Belts (3)
2. (___) #4 Flat Washers (6)
3. (___) #4-40, 1/2” Socket Head Cap Screws (6)
4. (___) Laser Cut Belt Clamps (3)
5. (___) Plastic Bearing Rollers (6)

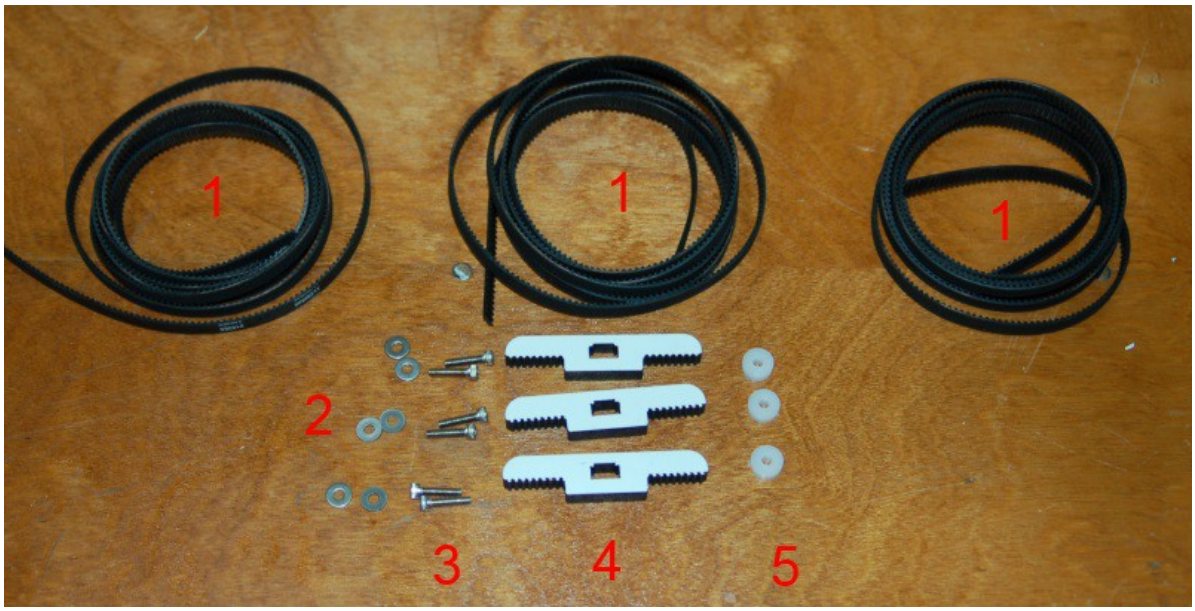


Fig. 11-1:Belt Clamp Components.

Installing the drive belts on the Rostock MAX v2 is a *lot* easier than it was on the Rostock MAX v1 kit. As you can see from the parts list required, the same job is done with fewer parts making for a much simpler installation.

Belt Routing

Take one of the GT2 drive belts and thread it into the notch at the base of the Z tower as shown in Fig. 11-2. Make sure that the belt teeth face ***in*** towards the tower.

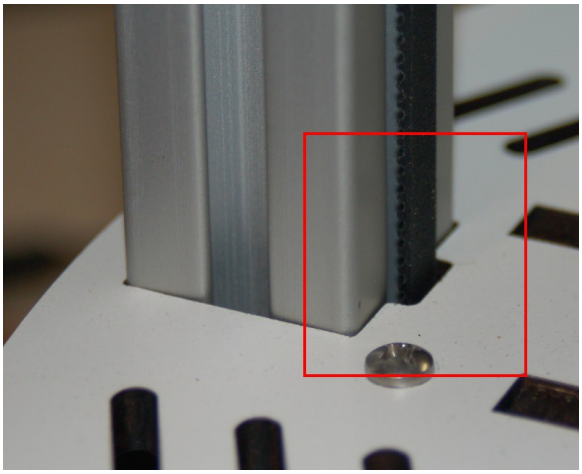


Fig. 11-2:Starting point for the belt route.

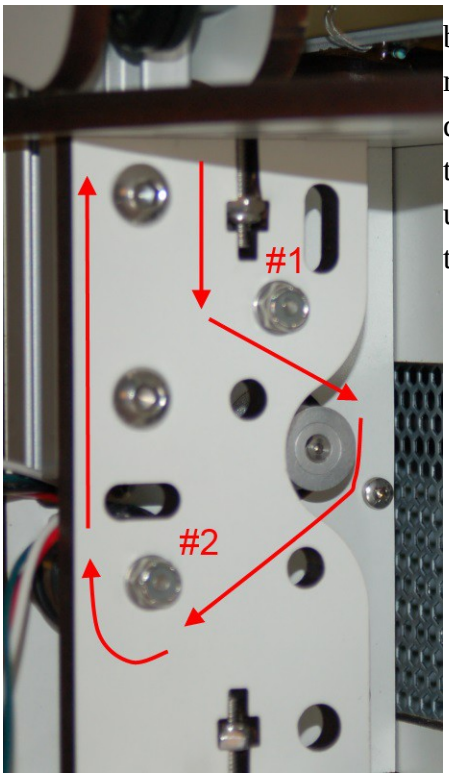


Fig. 11-3:Lower belt path.

Route the belt so that it passes to the outside of the #1 idler bearing, around the GT2 drive gear attached to the stepper motor and round the outside of the #2 idler bearing. At no point should the drive belt come into contact with the wiring – it should pass around the #2 idler cleanly. Route the belt up the tower and around the upper idler as shown in Fig. 11-4. Make sure that the belt passes through the notch as shown by the green rectangle,

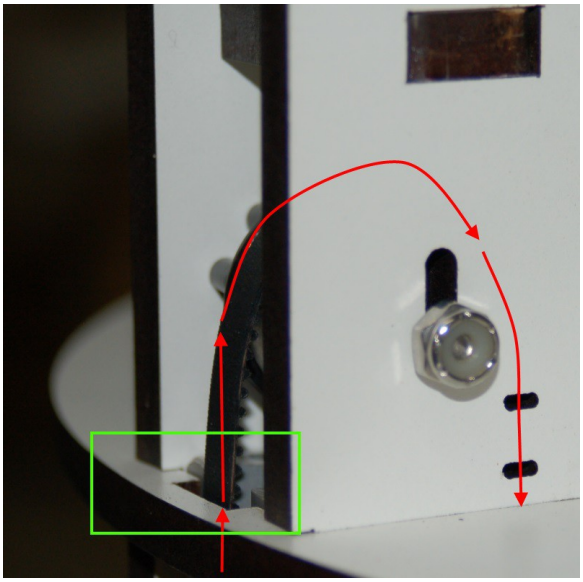


Fig. 11-4:Upper belt path.

As the belt passes over the upper idler, make sure it passes through the notch shown outlined in green.

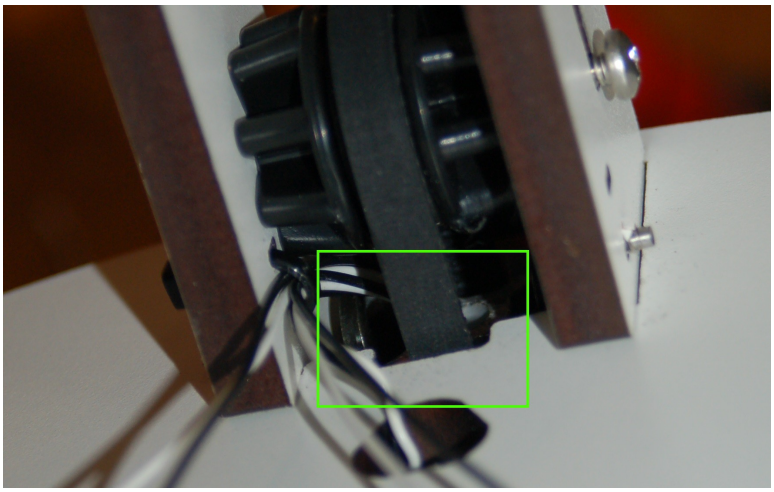


Fig. 11-5:Belt going back down to the Cheapskate.

Installing the Belt Clamps

The simplest way to do this is to clip the Cheapskate in place with a clothespin or other clamp and then pull the upper end of the belt through the belt feed slot in the Cheapskate. Use a small pair of needle nosed pliers to grab the belt end and pull it through the slot.

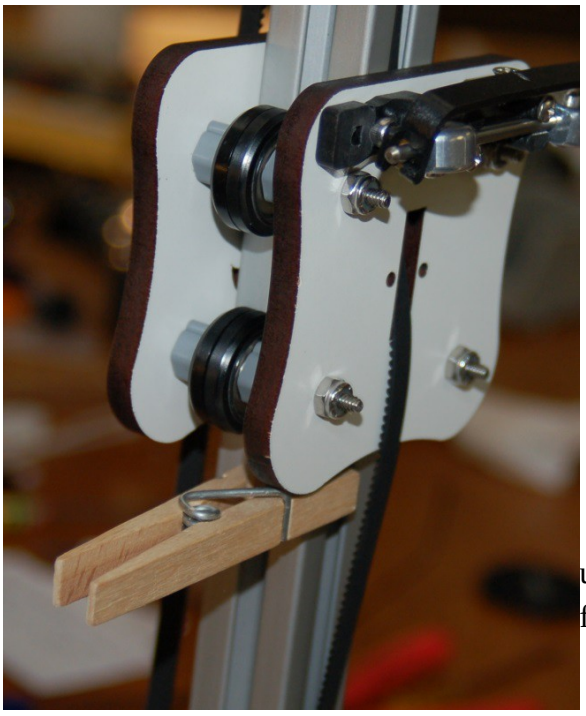


Fig. 11-6:Pulling the upper belt end.

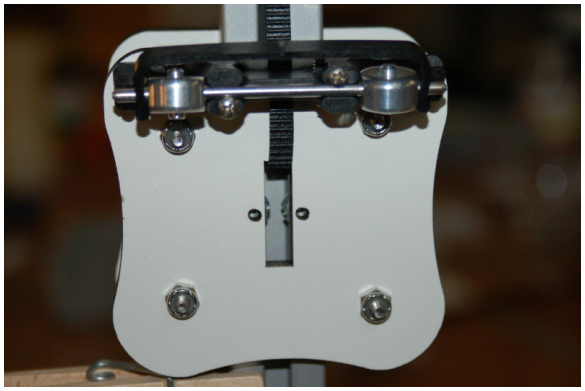


Fig. 11-7:Belt tucked under the u-joint carriage.

Route the end of the belt through the gap under the u-joint carriage as shown above. Tape it in place to keep it from moving while you're threading the lower belt end.

Now lay the machine down on your work table such that the Z axis is near you. This makes the next steps a lot easier!

Thread the lower belt end through the bottom of the Cheapskate as shown.

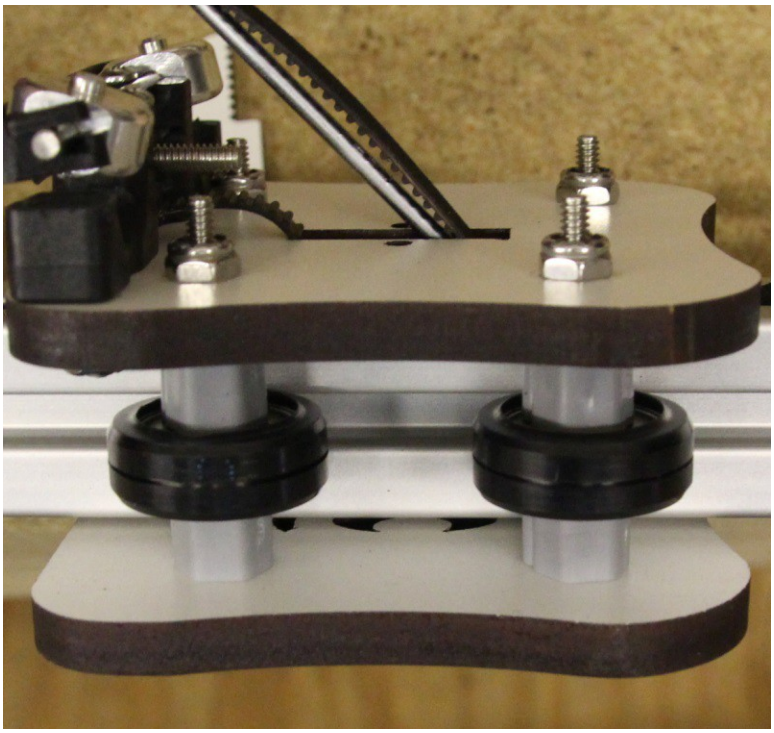


Fig. 11-8:Bottom end threaded into the Cheapskate.

Now pull the lower end of the belt a bit so that it eats up any available slack and starts to draw the upper belt end out of the Cheapskate. You want about 1” of belt above the left or “top” edge of the Cheapskate. Take a laser cut belt clamp and install it into the notch, capturing only the “top” end of the belt. Holding that end of the clamp in place, pull the bottom end of the belt tight and then press the belt clip in place. You want to pull the belt tight enough that little if any tension adjustment will be required at the top idler pulley. If you're not feeling especially dexterous today, tape the ends of the belt clamp in place tightly enough for it to keep a hold on the belt ends. (I have an invisible cat that's very handy, so you won't see me using tape. I just ask her nice, and she holds down whatever I need held down.)

(Don't see any cat paws do you? Told ya, invisible cat.)

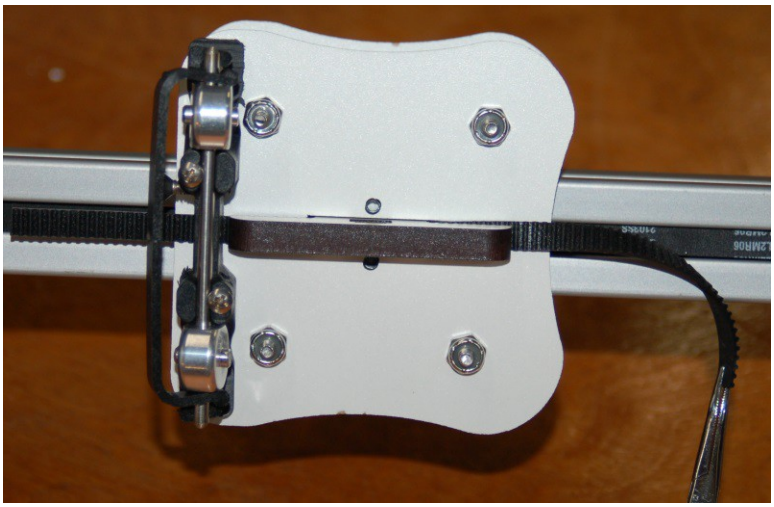


Fig. 11-9:Ready to install clamp fasteners.

Take a plastic roller bearing and a #4 flat washer and set them into place in the exposed notch on the belt clamp.

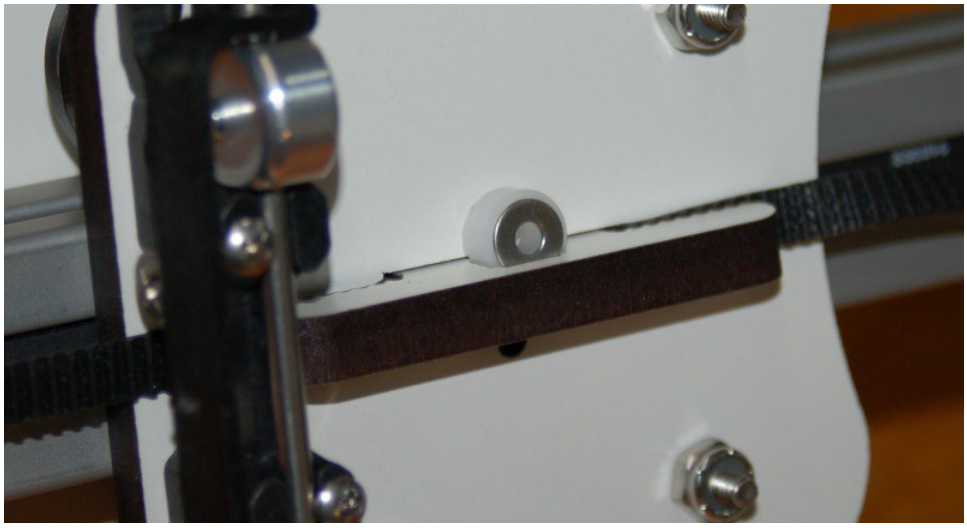


Fig. 11-10:Ready for a screw!

Here's a detail to watch out for when you're installing the belts. Notice in Fig. 11-11 below, the belt teeth on the left are resting on the outside surface of the belt clamp. The belt teeth on the right are correctly engaging the teeth on the clamp. Make sure that the teeth engage on both sides before you tighten down the belt clamp.

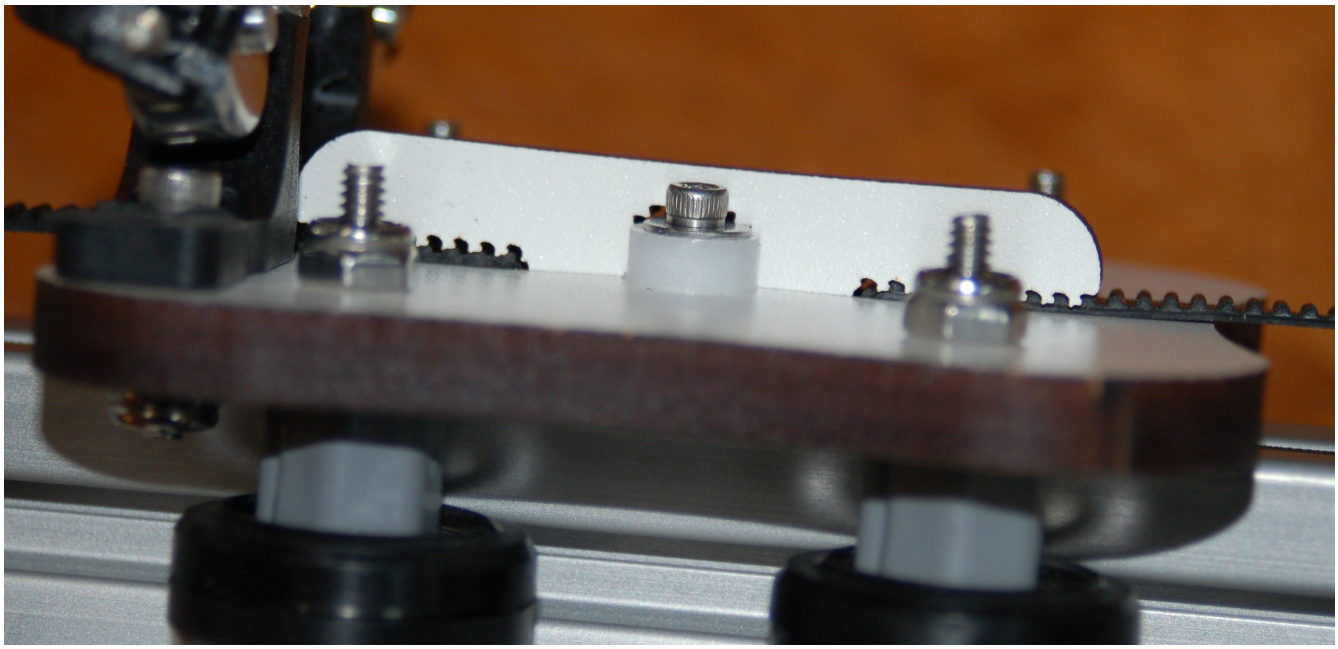


Fig. 11-11: Unaligned belt teeth.

Using a 3/32” hex wrench, install the #4-40, 1/2” socket head cap screw as shown below.

Fig. 11-12:Nearly done with the first belt clamp!

Now carefully roll the printer such that the other side of the belt clamp is face-up and install the other plastic spacer, #4 washer and #6-32 screw.

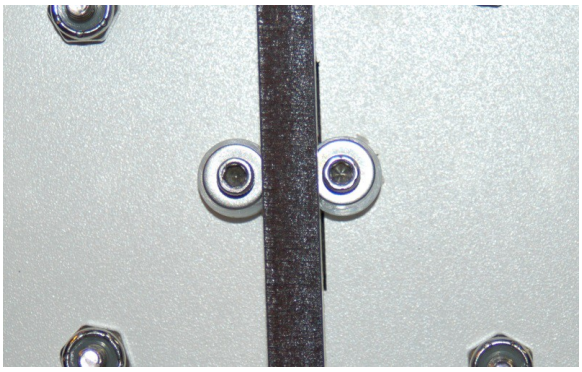


Fig. 11-13:Belt clamp installed!

Repeat this task for the X and Y axes. Make sure that while you're working with the belts that the lower belt doesn't slip off the GT2 drive gear! You're better off catching and correcting it now than having to take things apart to fix it later!

Fig. 11-14:Belt following correct path around GT2 gear.

When you're done installing all three belts, trim the “bottom” belt end to about 1” outside the clamp. This will give you enough to grab of you chose to tweak the belt tension at that point instead of on the top idlers.

Adjusting the Belt Tension

The mounting for the top idler pulleys is designed to allow you to increase the tension on the belts if necessary. In order to adjust the idler pulleys you're either going to need a helper or you'll need to lower the Rostock MAX v2 enough that you can hold a screwdriver in your mouth while you use your hands to tighten the idler. It sounds nuts, but it works pretty well.

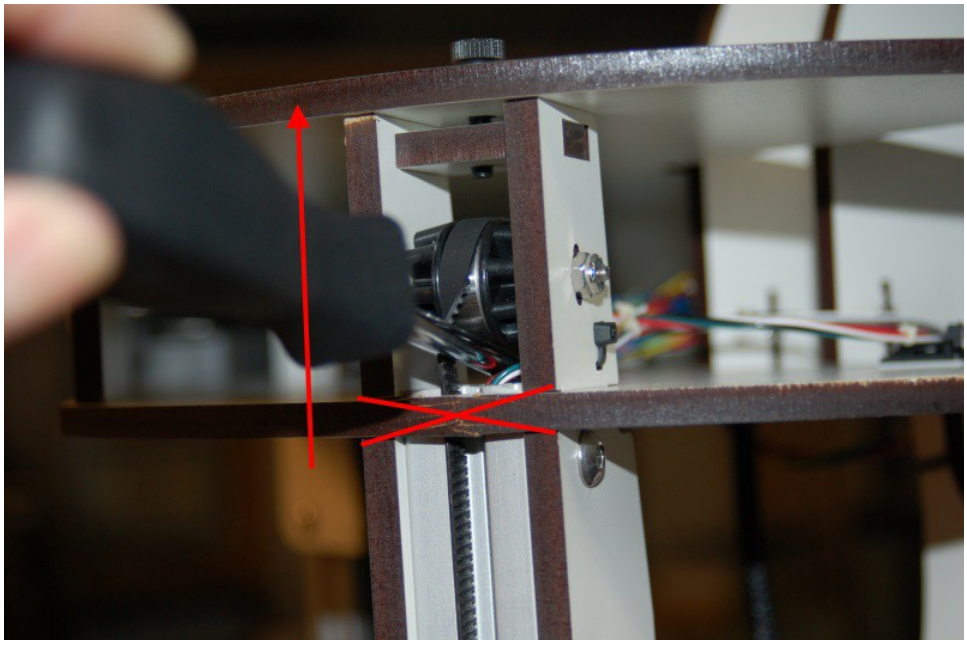


Fig. 11-15: Adjusting the belt tension.

Slide a screwdriver under the idler pulley from the right side and move the handle of the screwdriver slightly to the left. This will ensure two things – you won't be pressing against the wires that exit to the right and your screwdriver will be lifting up along the center-line of the bearing as shown above. Do NOT push down on the screwdriver – the Melamine cannot take the stress and will break as shown behind the red "X" above! When adjusting the tension, it's best if you move it a short distance and tighten it each time. Do NOT over tighten the screws or you'll damage the Melamine by pulling the screw or nut head through the material.

In order to set the correct tension, you're going to have to use your Mk. I Calibrated Hand as shown in Fig. 11-16.

Put your hand into the position shown on the right and using your right index finger, press on the meaty part of your palm as indicated by the arrow. That is roughly the same amount of "give" you want to feel when you're pressing on the belt. Press on the belt in a spot about 5" up from the heated bed, on the heated bed side of the tower.

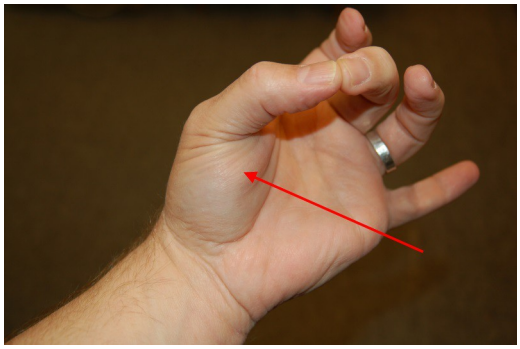


Fig. 11-16: Mk. I Calibrated Hand.

12 – Assembling the EZStruder and Filament Holder

For this step you'll need the following components:

1. (___) EZStruder Mounting Bracket (1)
2. (___) EZStruder Mounting Bracket Stabilizer (1)
3. (___) EZStruder Mounting Spacers (3)
4. (___) Filament Holder Spacer (1)
5. (___) Filament Holder, Inside (1)
6. (___) Filament Holder, Outside (2)
7. (___) NEMA 17 Stepper Motor (1)
8. (___) EZStruder Hardware Pack (1)
9. (___) #6-32 Nylon Lock Nuts (4) (Not Shown.)
10. (___) #6-32, 1” Pan Head Screws (2) (Not Shown.)
11. (___) #6-32, 2” Pan Head Screws (2) (Not Shown.)

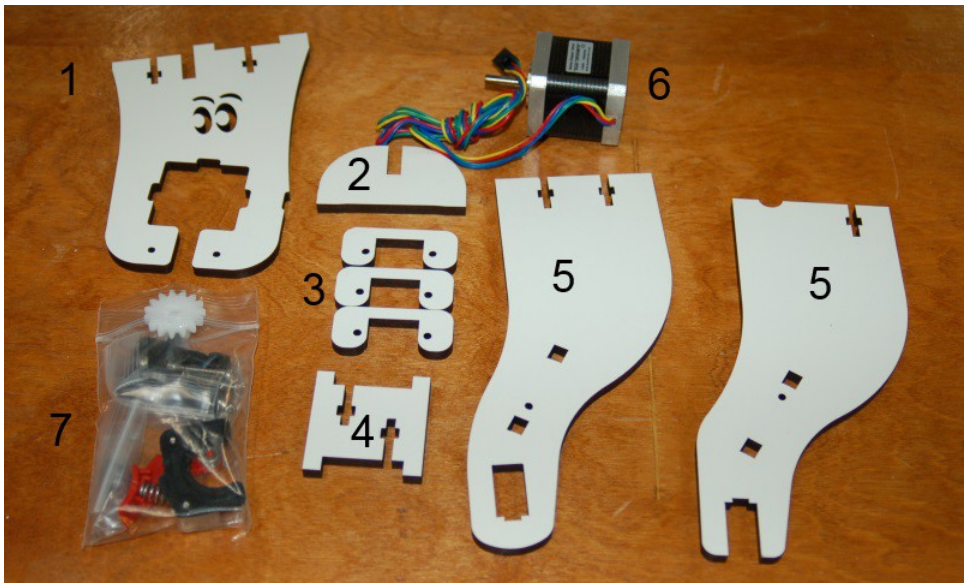


Fig. 12-1:EZStruder & Filament Holder Components.

Preparing the EZStruder

The EZStruder ships un-assembled, so let's take care of that first.

The EZStruder hardware pack consists of the following parts:

1. (___) Filament Tensioner
2. (___) Filament Guide Block and Bowden Tube Mount
3. (___) 1 Short metric screw
4. (___) 1 Long metric screw
5. (___) Hobbed gear, grub screw and a hex wrench.

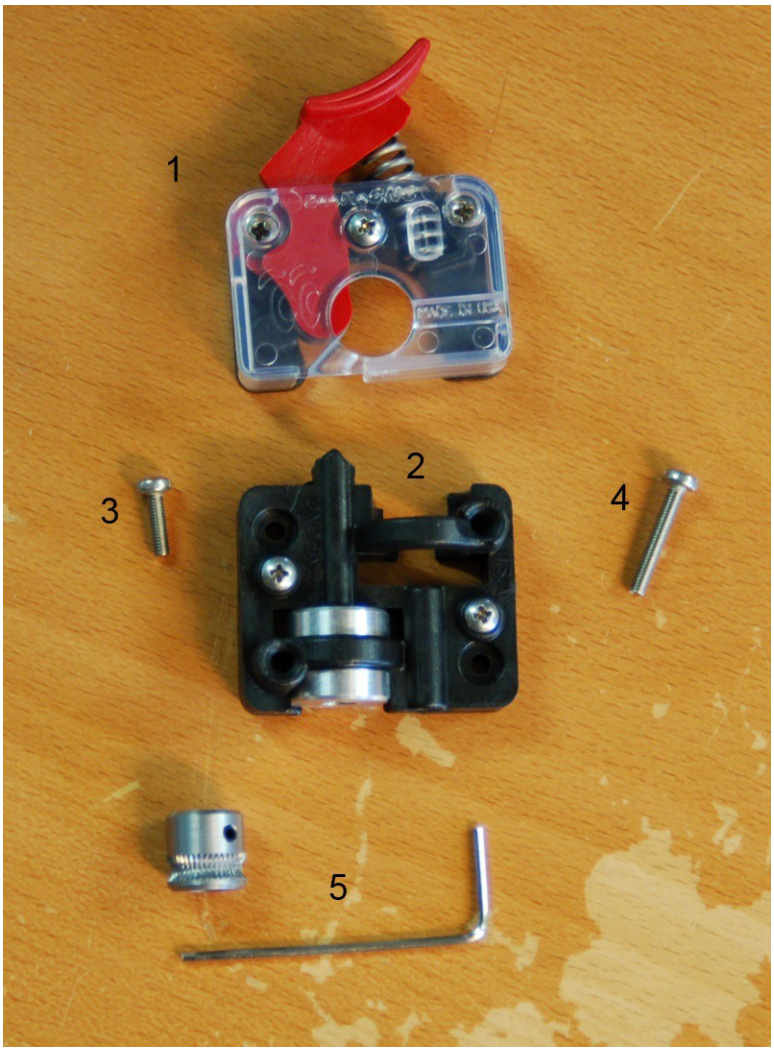


Fig. 12-2:EZStruder Hardware Pack.

The parts kit will also include a push-to-fit connector and that looks like the example in Fig. 12-3 below.

Fig. 12-3: PTF Conn.

In order to correctly align the hobbed gear on the output shaft of the stepper motor, we need to install the Filament Tensioner first. The tensioner has two screws that are “captured” and will be used to install it on to the stepper motor face as below. Make sure you keep the wires exiting the motor facing up as shown.

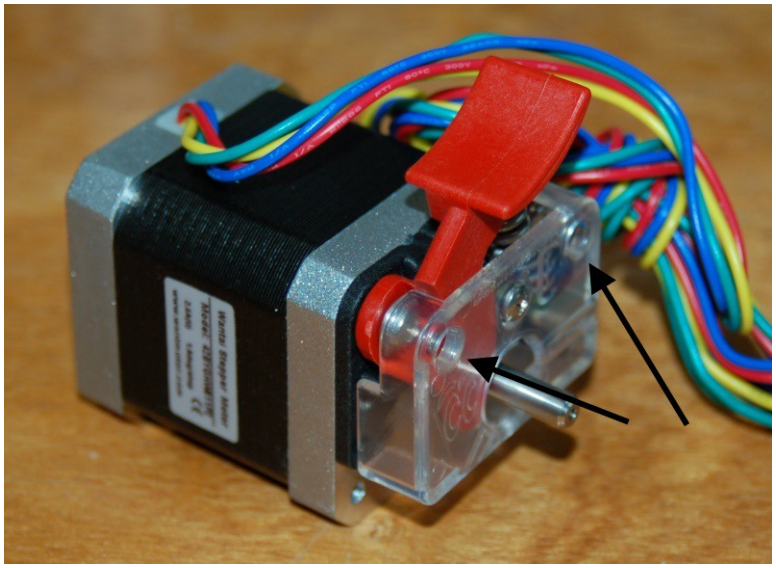


Fig. 12-4:Filament Tensioner installed.

The two black arrows in the figure above point to the two screw holes that have capture screws in them.

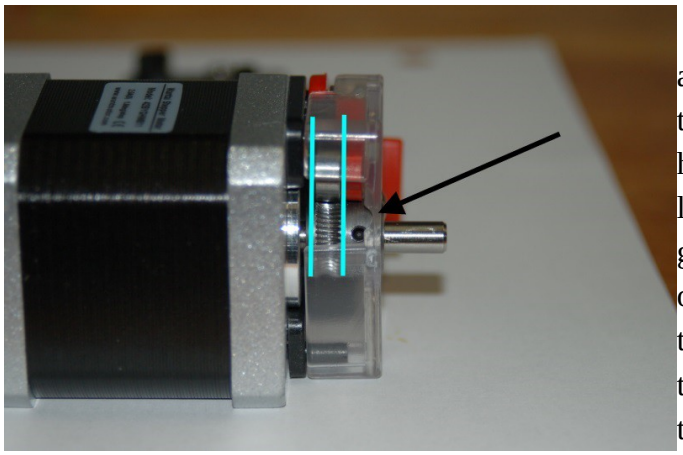


Fig. 12-5:Installing the hobbed gear.

Rotate the stepper shaft until the flat face along the shaft faces the small notch indicated by the arrow. Remove the grub screw from the hobbed bolt (if necessary) and put a dab of thread locker on it before putting it back into the hobbed gear. Slide the hobbed gear on to the stepper shaft, oriented as you see to the left. Make sure that you turn the gear so you can reach the grub screw through the channel pointed to by the arrow. Align the edges of the gear so they match the alignment marks (cyan lines) in the photo above. Tighten down the grub screw, making sure that it's coming into contact with the flat face of the stepper shaft.

Using the two metric screws included in the hardware pack, install the filament guide block on the face of the stepper motor as shown below.

Install the shorter of the two screws into the position marked #1 and the other, longer screw into the position marked #2.

Install the PFT connector (#3) finger tight.

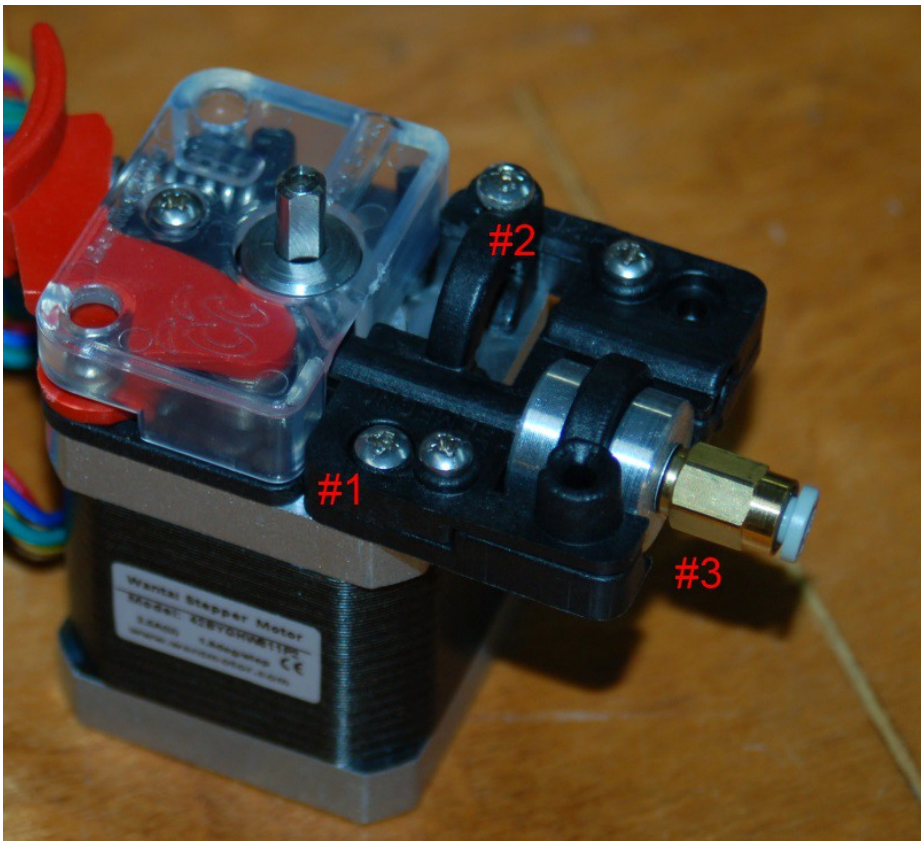


Fig. 12-6:Filament guide block installed.

Mounting the EZStruder

For this step, you'll need the following components:

1. (___) Assembled EZStruder (1)
2. (___) EZStruder Mounting Bracket (1)
3. (___) EZStruder Mounting Spacers (3)
4. (___) #6-32, 2” Pan Head Screws (2)
5. (___) #6-32 Nylon Lock Nuts (2)

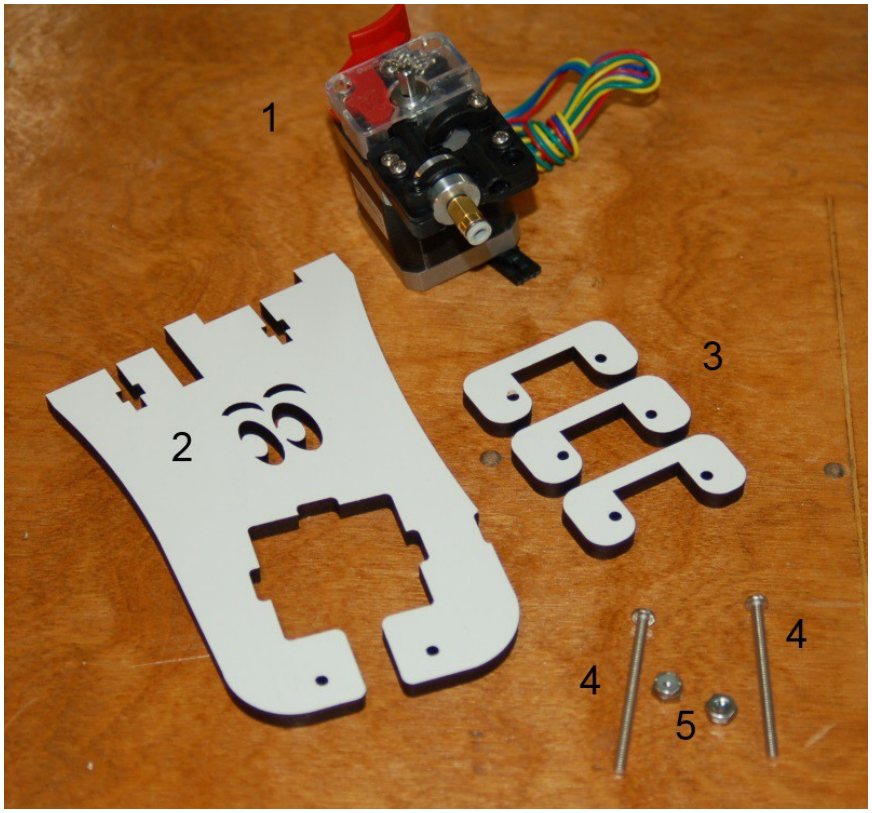


Fig. 12-7:EZStruder Mounting Parts

This assembly is extremely simple. Stack the three mounting spacers as shown below and using both of the #6-32 screws and Nylon lock nuts, install the EZStruder on to the mounting bracket. Please note that the screw holes in filament guide are VERY tight. You'll likely be cutting threads into the plastic as you install them. A power screwdriver is a huge help with this.

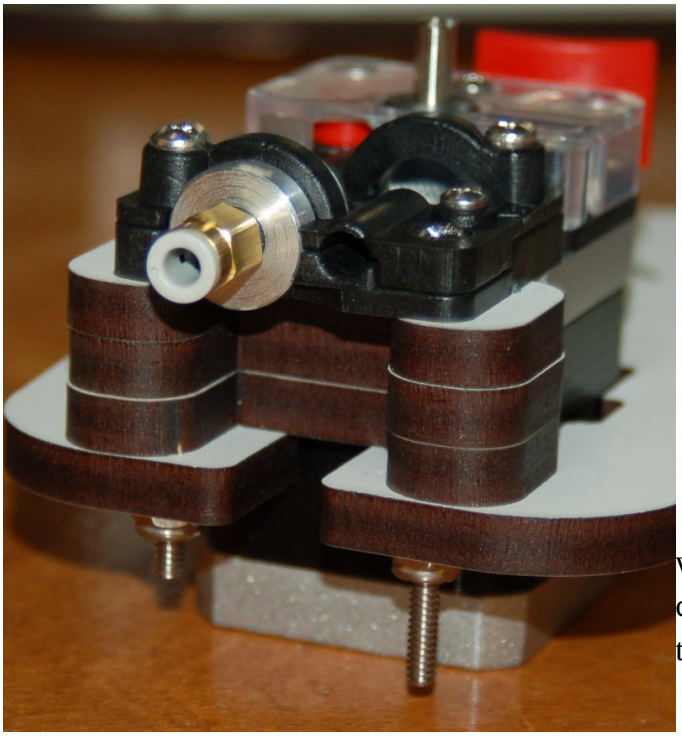


Fig. 12-8:EZStruder Mounted.

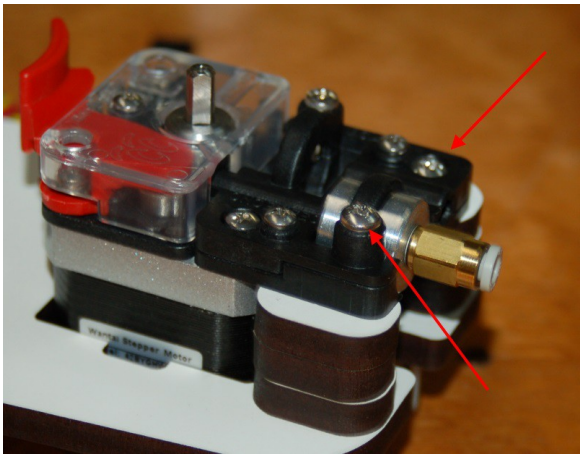


Fig. 12-9: Mounting screw locations.

Finally, locate the big white plastic gear – it was likely packed along with the other EZStruder components. Press the gear about half-way down the stepper motor shaft as shown below.

This gear will allow you to manually feed filament into the hot end when necessary.

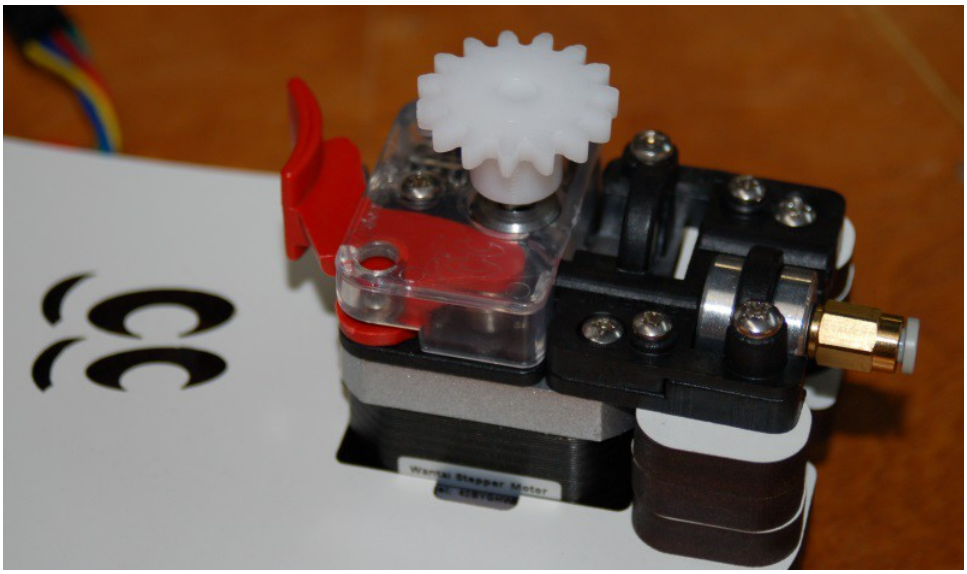


Fig. 12-10:Manual knob installed.

Installing the EZStruder Mount and Filament Holder

For this step, you'll need the recently assembled EZStruder mount, the mount stabilizer, two #6-32, 1” pan head screws and two #6-32 Nylon lock nuts.

Slide the mount stabilizer on to the stabilizer slot on the EZStruder mount as shown, then install two #6-32 Nylon lock nuts into the nut pockets.

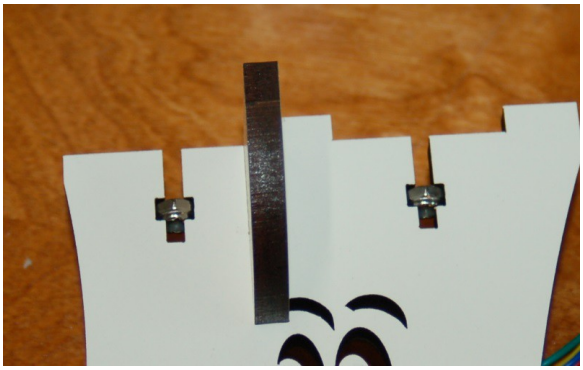


Fig. 12-11:Lock nuts....

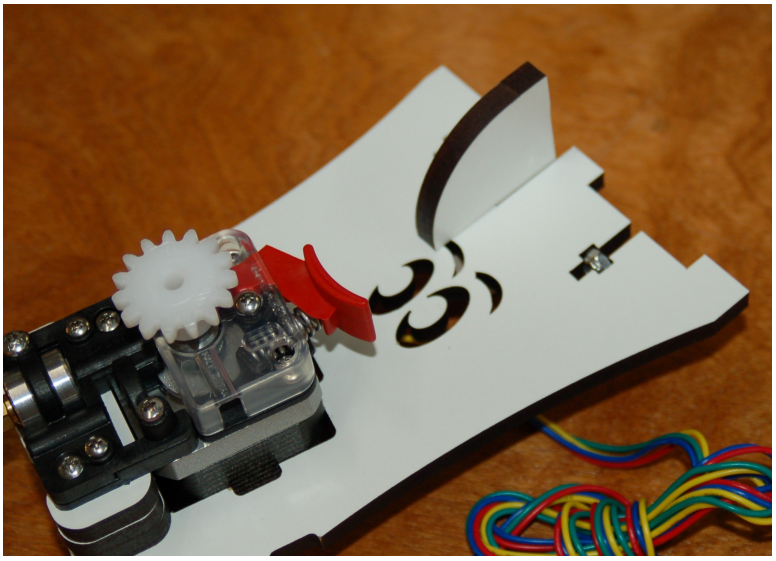
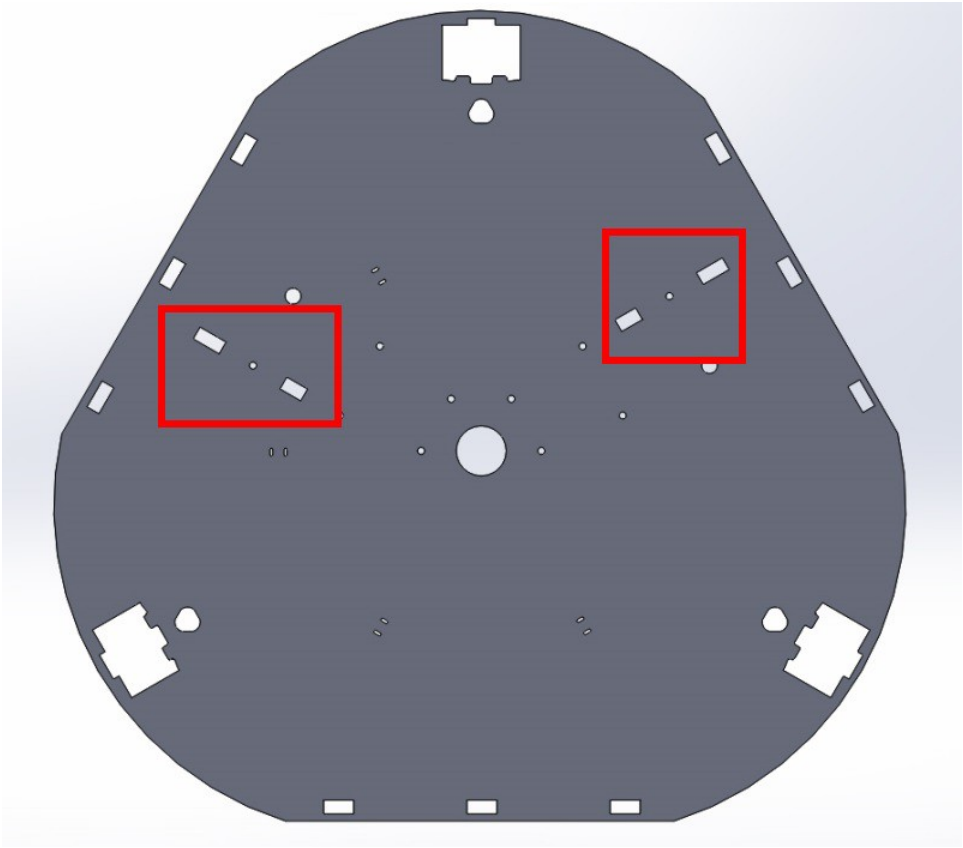


Fig. 12-12:...and mount stabilizer installed!

You've got two choices where you can mount the EZStruder to the top plate, both are shown in Ill. 12-1.



Ill. 12-1:EZStruder mounting points.

You can install your EZStruder mount in either of the positions marked in red. The currently shipping top finish plate for the Rostock MAX v2 will only accommodate a single extruder, but it will allow it to be installed in either position. The location is entirely your choice. No matter where you put it, make sure that it's oriented with the curve going towards the center of the machine and the extruder should be facing the filament guide hole in the top plate as demonstrated in Fig. 12-13. The arrow in the upper right corner is pointing to the filament guide hole. Install the mount to the top plate using two #6-32 1” screws.

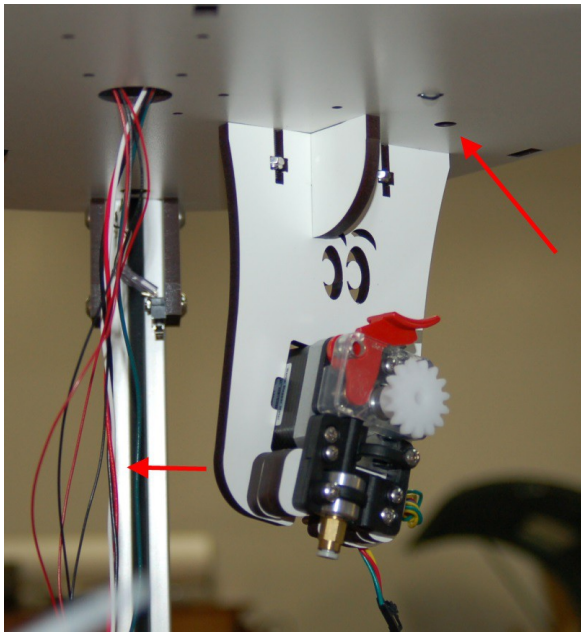


Fig. 12-13:EZStruder mount installed.

Wiring the EZStruder's Stepper Motor

After you've neatened up the stepper motor wires (ahem), tie the wires to the side of the EZStruder mount using a wire tie and route the wires up through the center hole in the top plate.

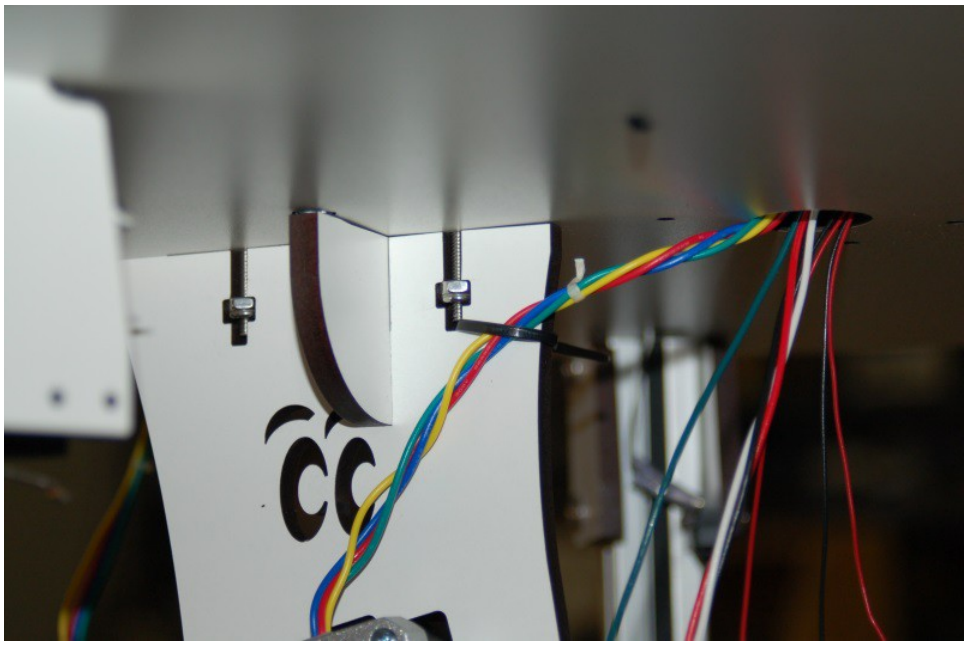


Fig. 12-14:Routing the extruder wires.

At this point you have a decision to make on whether or not you want to install a latching polarized connector to the stepper motor wires in the tower or not. If you do want to go that route, please jump ahead to Appendix A: Quick Disconnects in your Rostock MAX v2.

Cut the connector off of the EZStruder stepper motor and strip 1/2” of insulation off each stepper motor wire and each one of the 22ga wires that you routed up the Y tower.

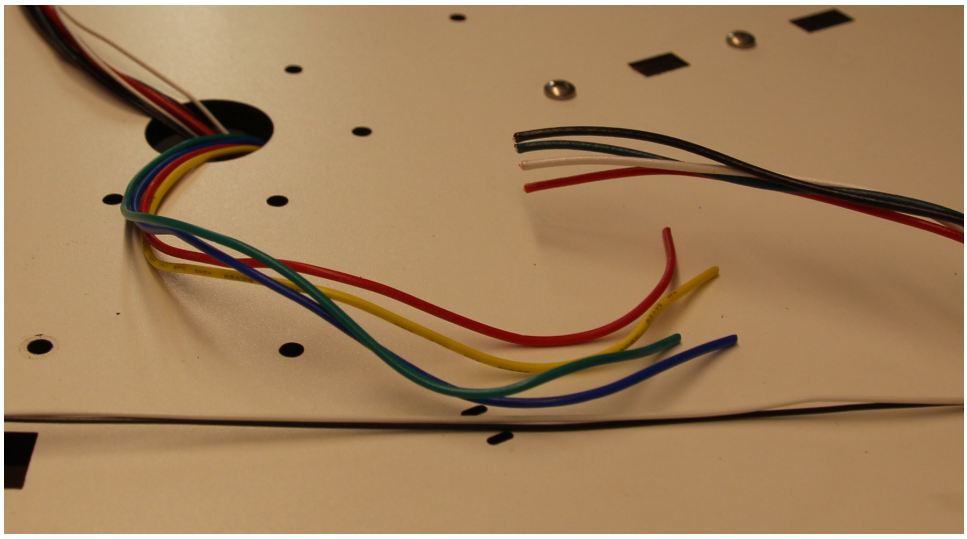


Fig. 12-15:Wires ready for splicing.

If you've never spliced wire before, I'd recommend using a simple splice called a Western Union Splice. You can see how it's done below in Ill. 12-2.

Below is an example of what the splice looks like.

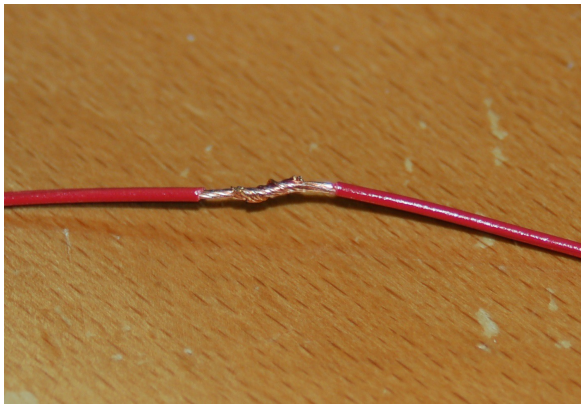
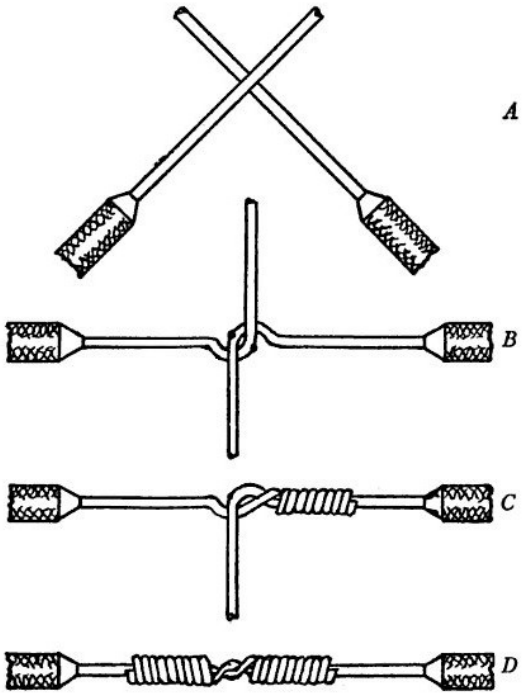


Fig. 12-16:Splice example.

I would recommend that if you use this splice, you solder the joint before covering it with Electrician's tape.



Ill. 12-2:A Western Union Splice.

When splicing the wires together, please follow the chart below. This is important in order to get the pin assignments correct when you add the connector to the other end of the extension cable. (The connector & pins are supplied as part of the RAMBo parts kit.)

If you're color-blind, please get some assistance with this step. Getting the wires backwards will make you crazy. :)

Pin	Stepper Color	Extension Color
1	Green	Green
2	Red	Red
3	Blue	Black
4	Yellow	White

Table 12-1:Wiring Color Chart.

When you're done with the splicing, use a few short lengths of Kapton tape to hold the wire along the path shown by the red arrow in Fig. 12-17.

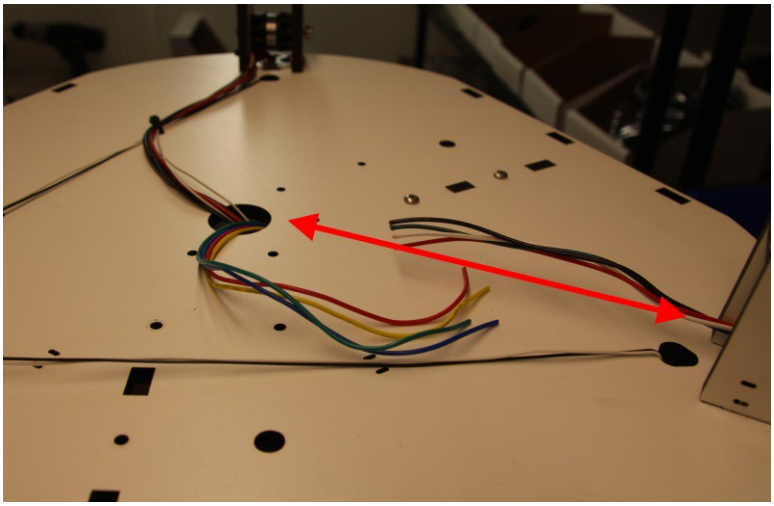


Fig. 12-17:Stepper motor wire path.

This is done in order to keep the motor wires way from the two small end-stop wires. If they're run in close parallel with one another, they can pick up current from the stepper motor and cause false end-stop triggers to be reported. If that happens, the printer does very, very odd things.

13 – Wiring & Assembling the Hot End, Bowden Tube

Preparing the Hot End Wiring

For this task, you'll need the short length of heat shrink tubing and the 3/8” Black, Expandable Mesh Loom.

Fig. 13-1:Expandable Mesh Loom and Heat Shrink Tubing.

Before we begin the task of installing the wire loom, I want to you take a second and tie down the hot end wires. This is an earlier step that was delayed until this point.

In order to avoid electrical interference of the X axis end-stop, you need to tie down the hot end wires coming out of the Z axis tower such that they cross the end stop wires exactly as shown in Fig. 13-2. By crossing over the end-stop wires perpendicularly, interference can be avoided.

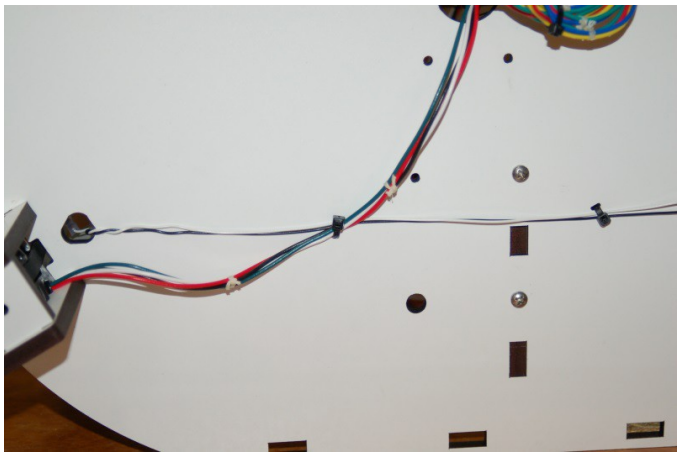
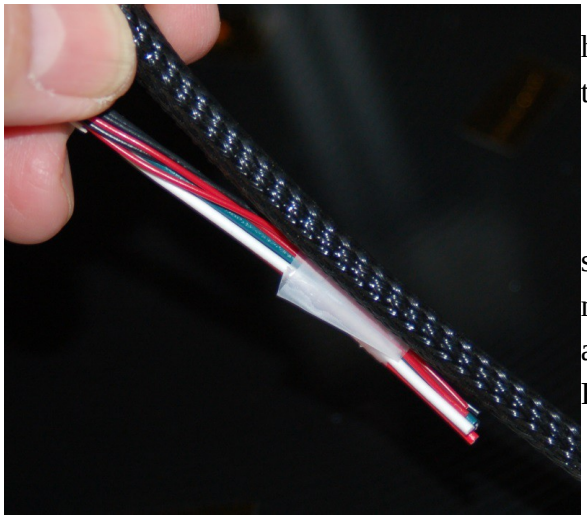


Fig. 13-2:Hot end wires crossing the end stop wires.

Cut a length of mesh loom that will cover the hot end wires from the top plate to a point about 2.5” short of the end of the wires. Tape the hot end wires together and slide the mesh loom section you just cut over them.



Make sure that when you slide the loom over the hot end wires that it reaches up to the center hole in the top, plus a little bit more.

Fig. 13-3:Wires and mesh loom.

Now, I want you to cut a 7/8” length of the heat shrink tubing and slide it over the bare-wire end of the mesh loom. Adjust it such that half is covering the mesh and half is covering the wire as indicated by the line in Fig. 13-4.

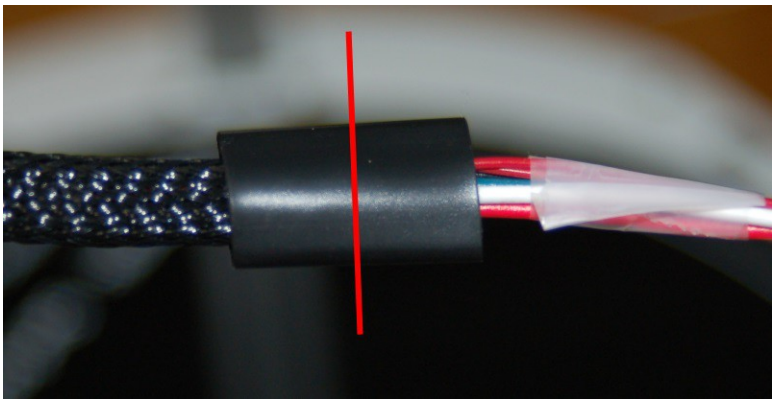


Fig. 13-4:Correct heat shrink location.

Using a hair dryer or heat gun, heat the tubing until it conforms to the loom & wires as shown in Fig. 13-5. Keep the heat source moving around the tubing as it shrinks to get an even shrink all the way around.

Cut another 7/8” length of heat shrink tubing and apply it to the other end of the mesh loom.

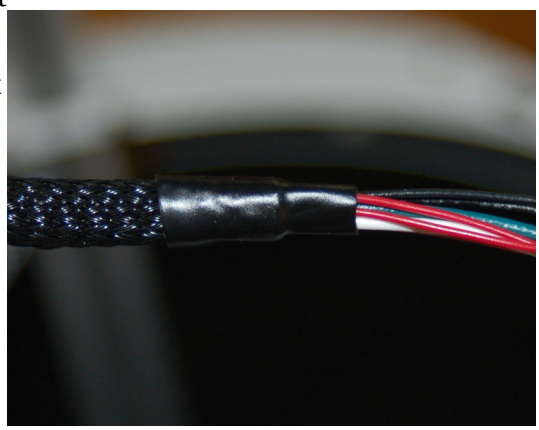


Fig. 13-5:Properly applied heat shrink.

If you're going to use quick-disconnect connectors for your hot end wiring, please see Appendix A for details on how to do this. When you've got your hot end wired up according to that guide, you can resume your build at Section 14.

Now it's time to prepare the hot end for wiring. By this time, the RTV in your hot end should be fully cured (make sure you've let it cure for at least 24 hours) and it should look like this:

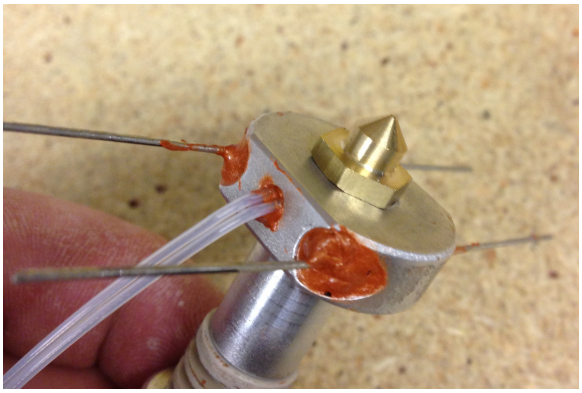


Fig. 13-6:Completed Hot End.

Using a pair of needle nosed pliers, bend the resistor leads as shown in the following photos.

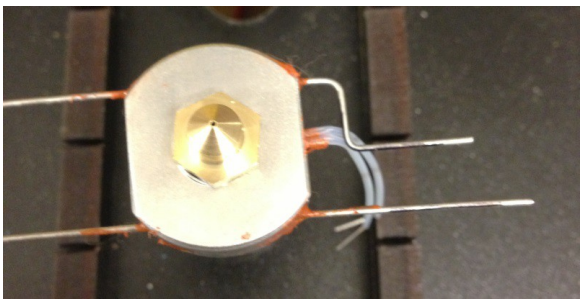


Fig. 13-7: Step #1.

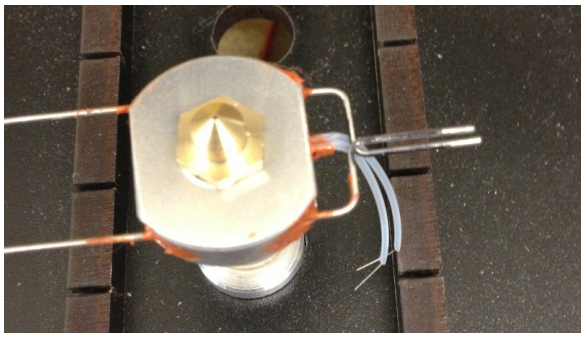


Fig. 13-8: Step #2.

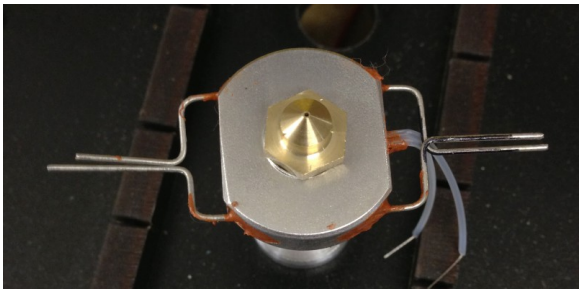


Fig. 13-9: Step #3.

Trim the bent leads such that they only occupy half the crimp connector. Install two 22-18ga uninsulated barrel crimp connectors as shown in Fig. 13-10.

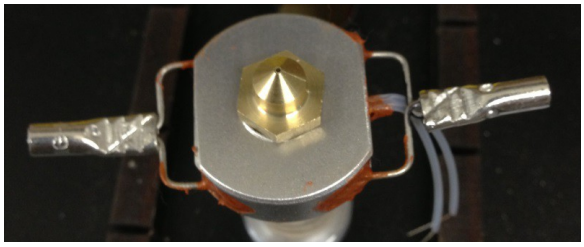


Fig. 13-10: Step #4.

Strip off 3/8” of insulation from the 18ga black & red wires coming from the hot end loom and crimp them into the connectors as shown.

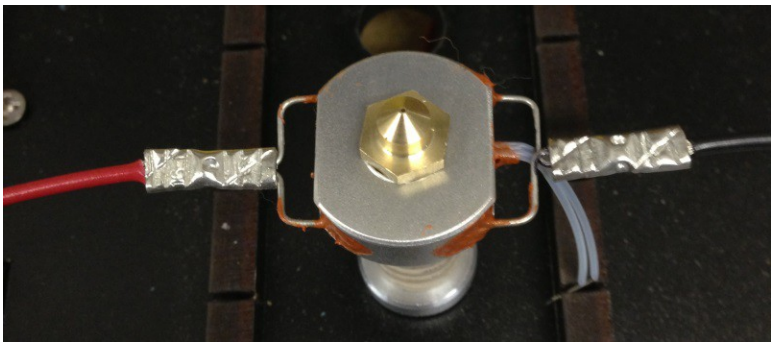


Fig. 13-11:Power wires connected.

At this point, I want you to cover the crimp connectors with a bit of Kapton tape – this will help prevent accidental shorts. The photos of the crimp connectors from this point forward have omitted the Kapton tape for clarity.

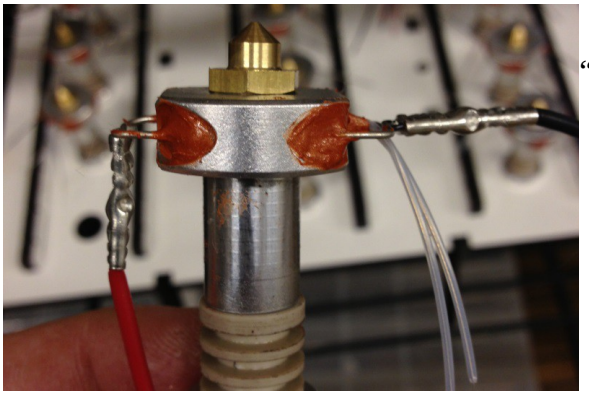


Fig. 13-12:Positive lead bent "up".

Bend the resistor legs connected to the red wire “up” as shown in Fig. 13-12.

Carefully solder the white wire to one thermistor lead and the green wire to the other. You may notice that the thermistor wires shown are different than the ones you're working with. This is okay and was a change made after the photographs were originally taken.

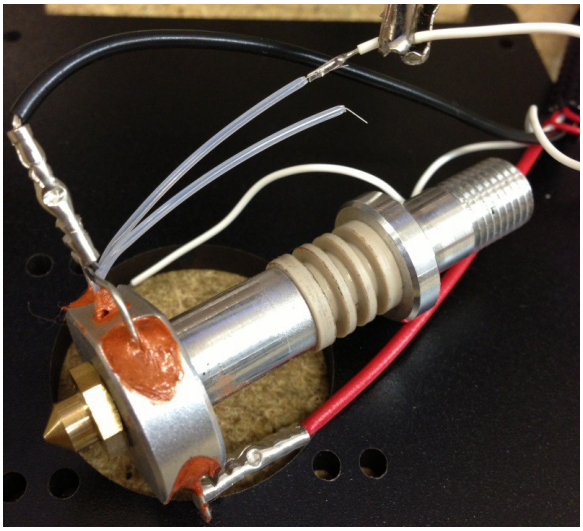


Fig. 13-13:Attaching thermistor leads.

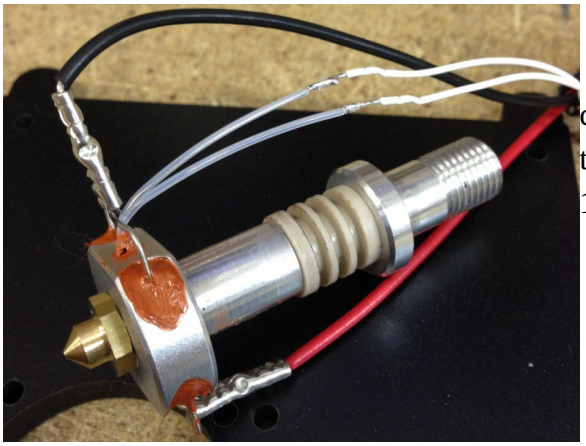


Fig. 13-14:Both thermistor leads connected.

Once you've got both thermistor leads connected, cover each connection with Kapton tape (individually) and then bind them together with Kapton as shown in Fig. 13-15.

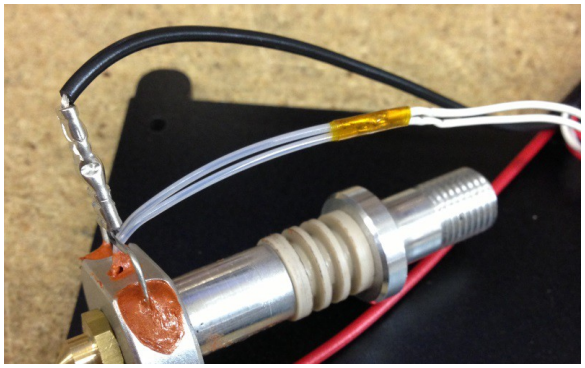


Fig. 13-15:Kapton covered leads.

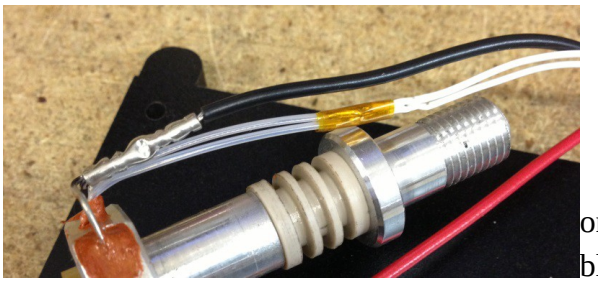


Fig. 13-16:Thermistor lead routing.

Bend the black wire “up” as you did with the red one and carefully line up the thermistor wires next to the black lead as shown to the left.

Bind the thermistor leads to the black wire with Kapton tape as shown in Fig. 13-17. This is an important step as it acts as a strain-relief to help prevent the thermistor from pulling out of the hot end. If the thermistor is pulled out during a print, the hot end will overheat and destroy the PEEK (the tan section) barrel.

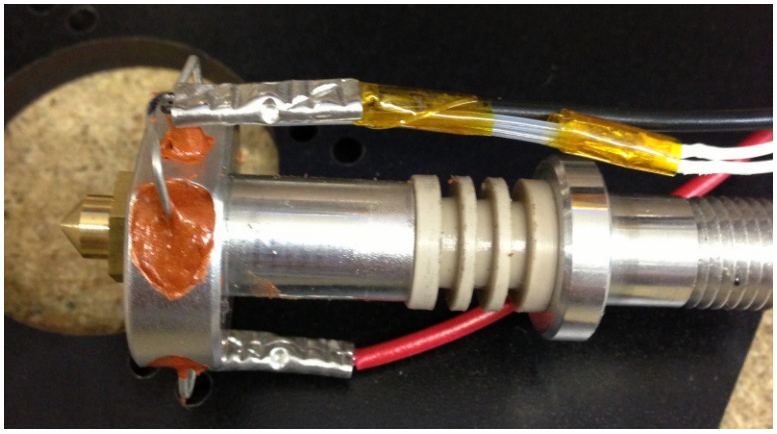


Fig. 13-17:Completed thermistor wiring.

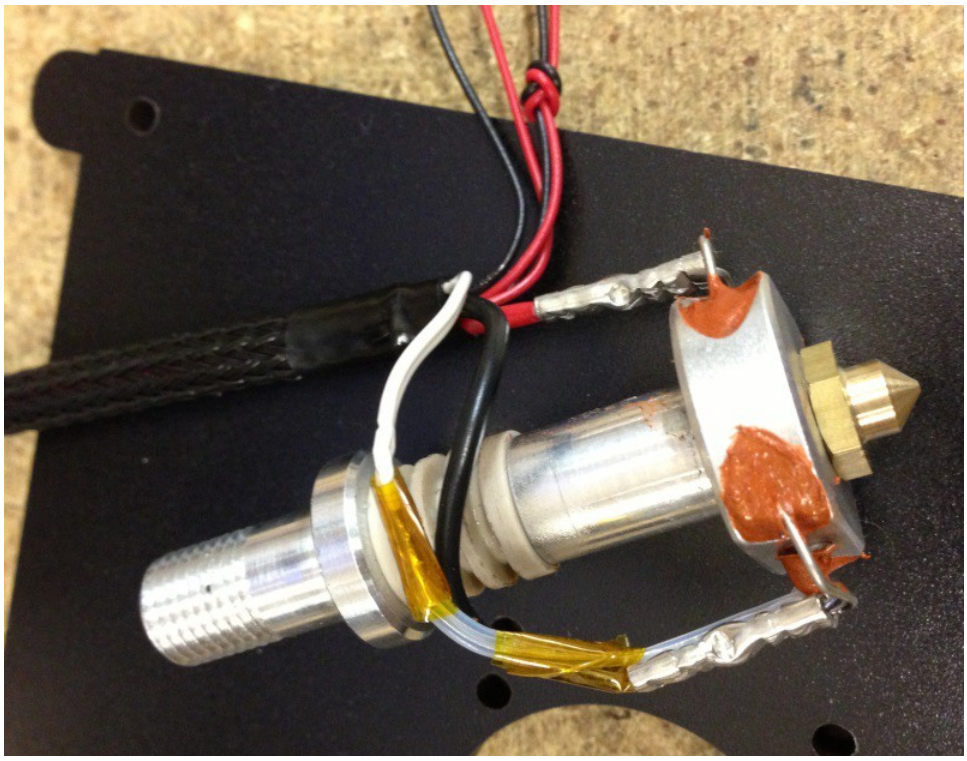


Fig. 13-18:Hot end wiring completed.

Attaching the Hot End to the Hot End Mounting Plate

You'll need the following components to complete this task:

1. (___) Hot End Mounting Nut (1) (Removed from hot end.)
2. (___) Hot End Mounting Plate (1)
3. (___) Hot End Mouting Plate Spacer (2)
4. (___) PTF Connector (1) (Removed from hot end.)
5. (___) Wired Hot End (1)
6. (___) Wire Tie (1) (Not Shown.)

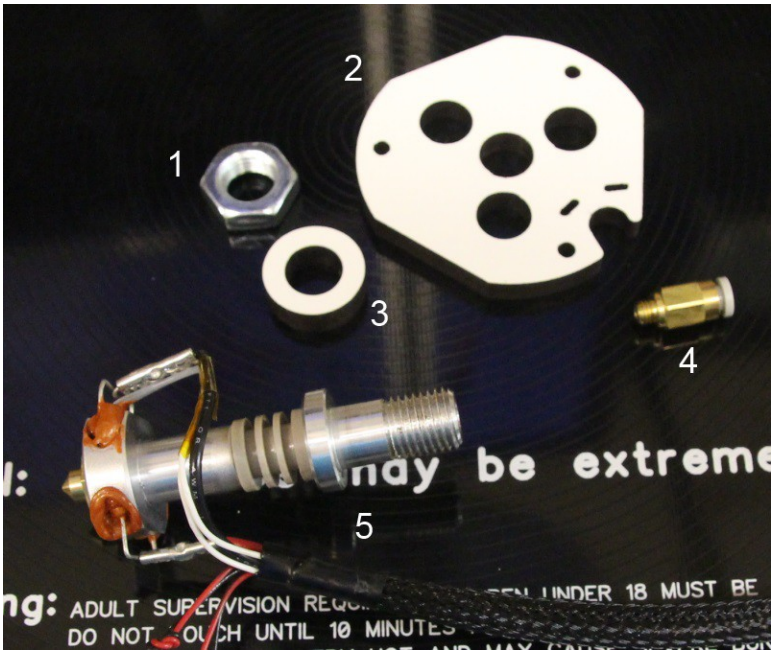


Fig. 13-19:Hot End Mounting Components.

Attaching the hot end to the mounting plate is very simple. Slide the hot end through the center hole in the mounting plate and then slide the mounting plate spacer over the hot end. Replace the nut (tighten) and the PTF connector (tighten) and you're done. ***Do NOT grip the PEEK section with pliers! You'll mar or damage the PEEK section.***

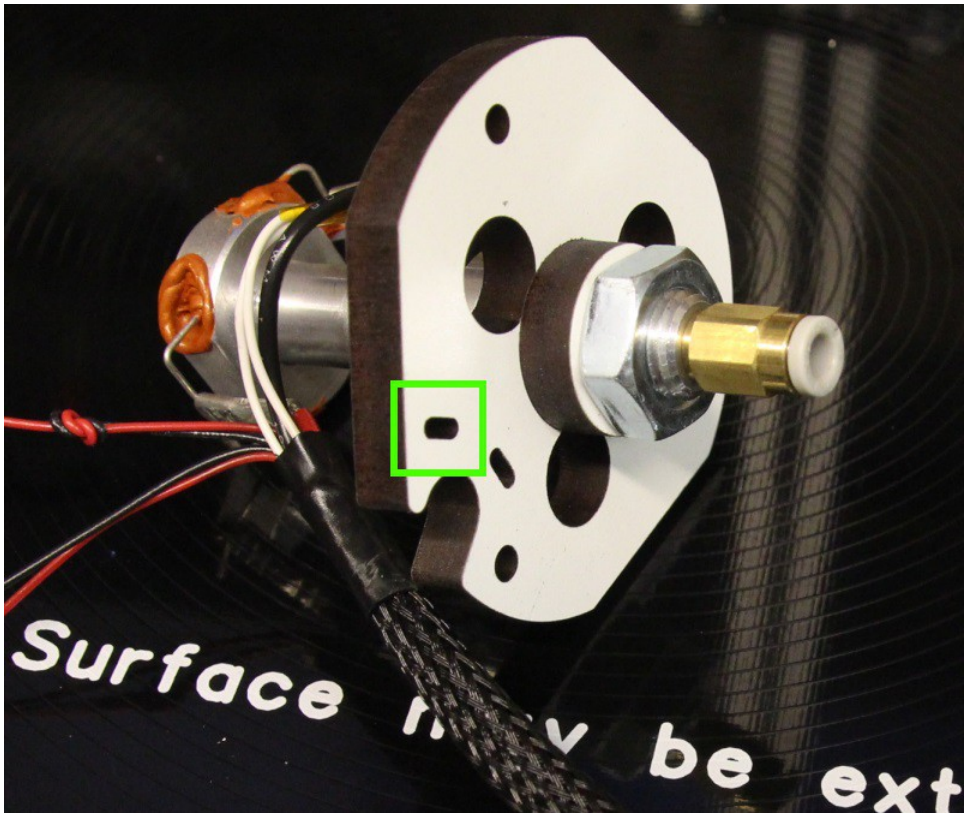


Fig. 13-20:Hot end mounted.

The last step is to install a wire tie through the slot highlighted in green, above. This will ensure that the wiring doesn't pull free from the hot end during normal operation.

See the photo to the right for details on how the wire tie is installed.

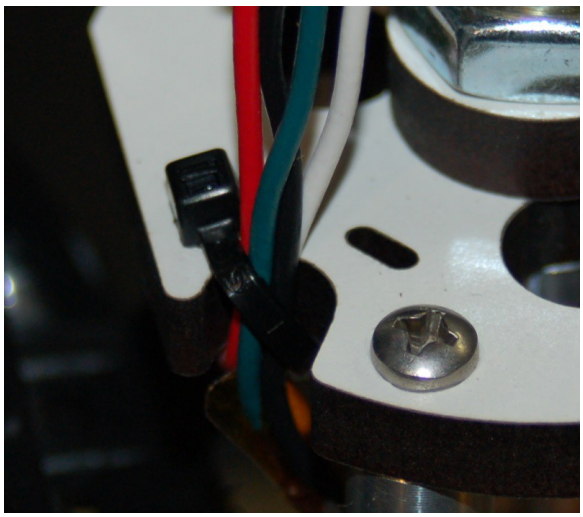


Fig. 13-21:Wire tie detail.

Installing the Bowden Tube

For this task you'll need the long PTFE Bowden tube that was included in the Hot End Pack.

The mesh in the hot end wiring loom will open up when you compress it. Grip the mesh about 2” above the heat shrink tubing and press down with the hot end on the table. This will open up the mesh enough so that you can insert the Bowden tube. Insert the tube 1” from the upper edge of the heat shrink tubing as shown below.

Fig. 13-22:Inserting the bowden tube.

Thread the Bowden tube up the loom to a point about 2-1/2” short of the PTF connector on the extruder.

Open up the loom at that point and allow the Bowden tube to exit. Pull the tube through and insert it into the PTF connection until it's fully seated.

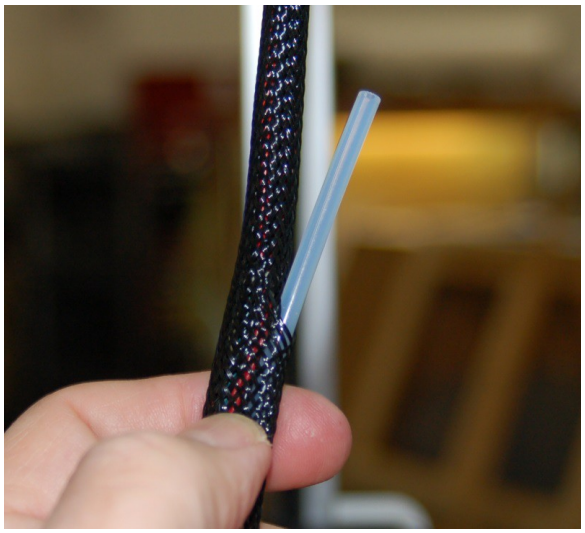


Fig. 13-23:Bowden tube exit

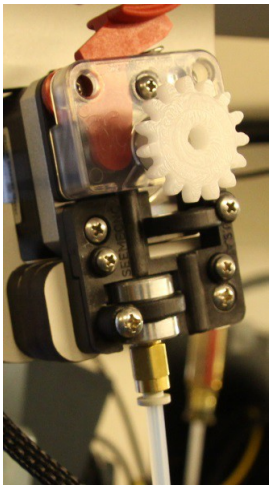


Fig. 13-24:Extruder PTF Connection.

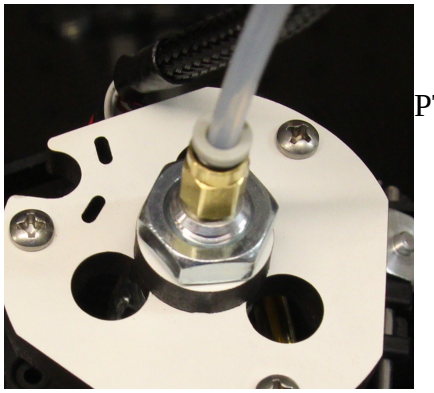


Fig. 13-25:Hot End PTF Connection.

Insert the other end of the Bowden into the PTF connector on the hot end.

14 – Installing the Effector and Delta Arms

Assembling the Effector Platform

For this task, you'll need the following components:

1. (___) Effector Platform (1)
2. (___) Spring Clip (3)
3. (___) U-Joint (Machined Aluminum or Injection Molded) (6)
4. (___) 3-1/8” U-Joint Axle (3)

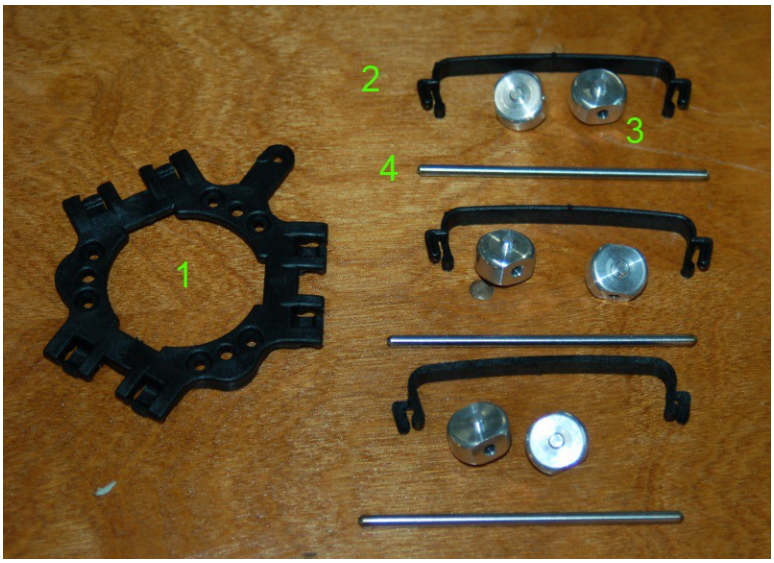


Fig. 14-1:Effector components.

The effector platform is very easy to assemble, especially in comparison to the original, v1 platform!

If you have a more recent kit, your effector platform will look like the one shown in Fig. 14-1A. The new design adds two additional fan mounting ears.

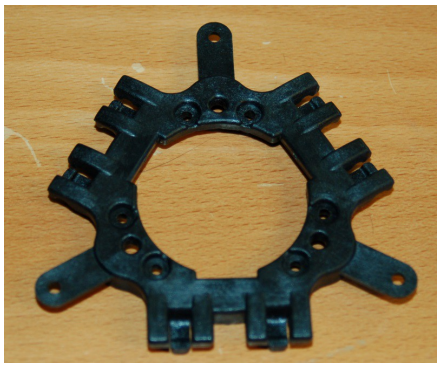


Fig. 14-1A: Updated Effector Platform.

First, check the condition of all three u-joints as you did when assembling the u-joint carriers on the Cheapskates.

Slide the three u-joint axles into the effector platform as shown below. Make sure that each u-joint is evenly spaced on each side of the effector platform.

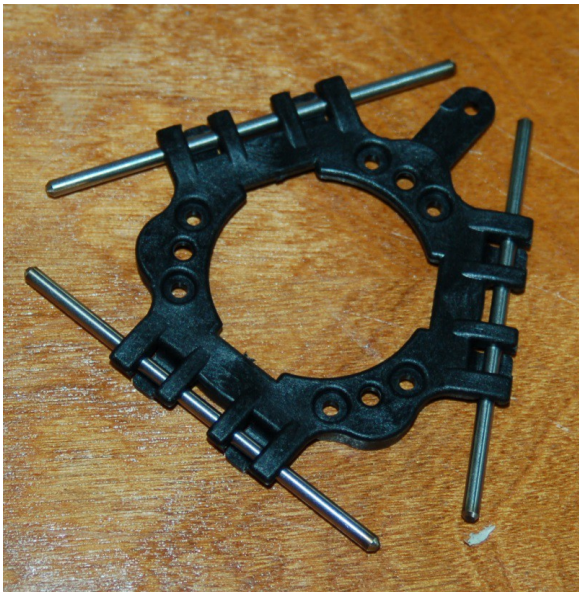


Fig. 14-2:U-Joint axles installed.

Now slip a u-joint on to either end of the axle and install the spring clip – it fits the same way as on the Cheapskate mounted u-joints. If your kit has the injection molded u-joints, you again want to make sure that the ejector pin marks on the u-joint are facing outward to prevent any extra plastic from rubbing on the effector platform.

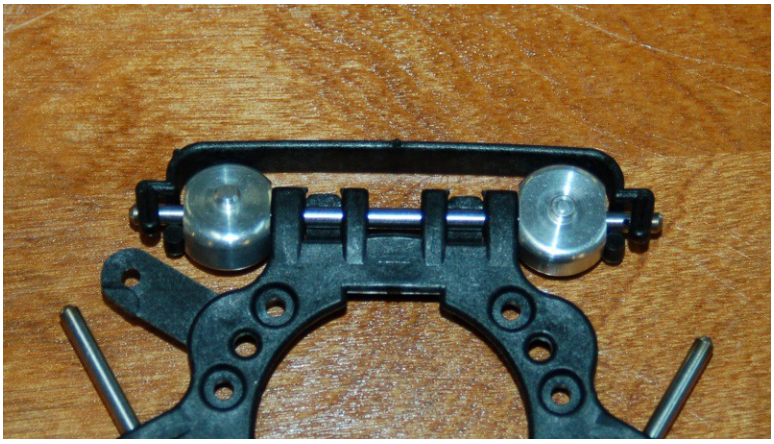


Fig. 14-3:U-Joints and spring clip installed.

Repeat the process for the other two u-joint positions.

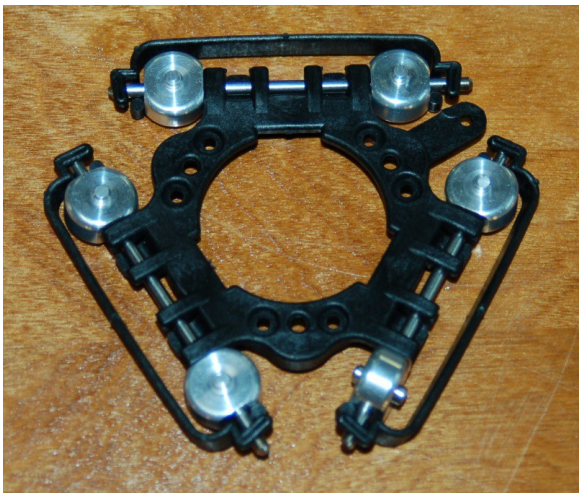


Fig. 14-4:Assembled Effector Platform.

Installing the Delta Arms

For this task, you'll need the six delta arms included in the kit.

Fig. 14-5:Delta Arms.

Before installing the delta arms, clean the mold flashing from the inner and outer faces of the arm tips that will come in contact with the u-joints. You can do this easily with an X-Acto knife.

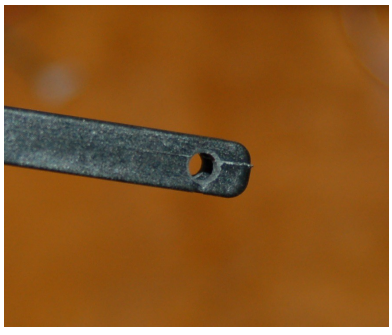


Fig. 14-6:Cleaned arm tips.

Fig. 14-7:Side view.

We'll start on attaching the delta arms at the Cheapskate mounted u-joints. The end of the arm grips the u-joint like a spring and can be opened with one finger as you slide it over the u-joint. Make sure that the posts on the u-joints seat fully in the arm end and that the spring clip is oriented as shown in Fig. 14-8.

Fig. 14-8:Installing an arm.

Repeat the process for the five remaining arms.

Attaching the arms to the effector platform is just as simple and straightforward as it was connecting the other end! Make sure you orient the effector platform with the smooth face up! (The writing will be on the bottom.)

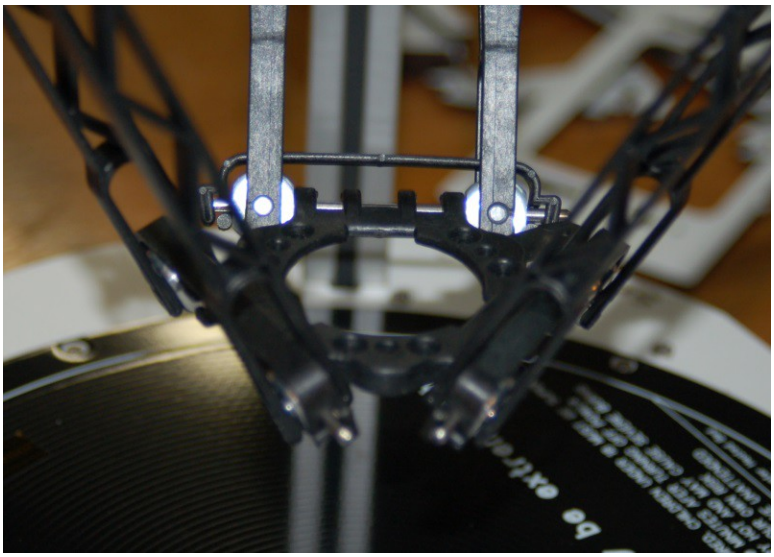


Fig. 14-9:Arms attached to the effector platform.

15 – Installing the Hot End

For this task you'll need the following components:

1. (___) #6-32 Nylon Lock Nuts (3)
2. (___) 1” Aluminum Spacers (3)
3. (___) #6-32, 1-3/4” Stainless Steel Pan Head Screws (3)

Fig. 15-1:Hot End Mounting Hardware.

You should also have a soft cloth that you can cover the Onyx heated bed with. That way if you accidentally drop a tool during the installation, you won't damage or scratch the bed.

In order to make installation simple, you're going to “invert” the delta arms. Do this by raising all three Cheapskates to the top of their travel and one at time, lower them until they come into contact with the base plate as shown in Fig. 15-2.

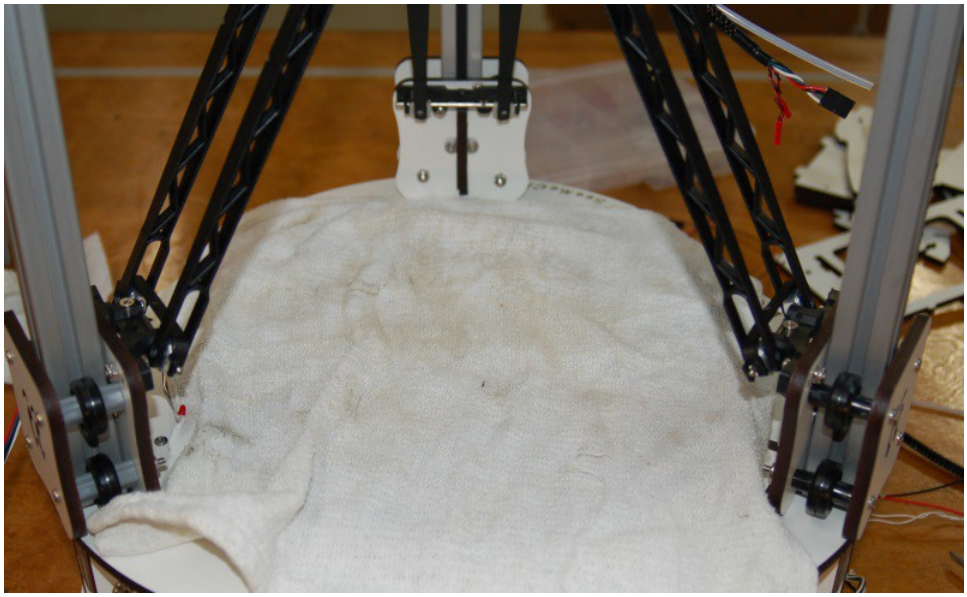


Fig. 15-2:Arms inverted and Onyx covered.

Now insert a #6-32, 1-3/4” pan head screw through one of the three mounting holes in the hot end and slide a 1” aluminum spacer over the screw. Then insert the screw into the effector platform as shown below. Thread on a #6-32 Nylon lock nut and repeat the process for the other two mounting holes.

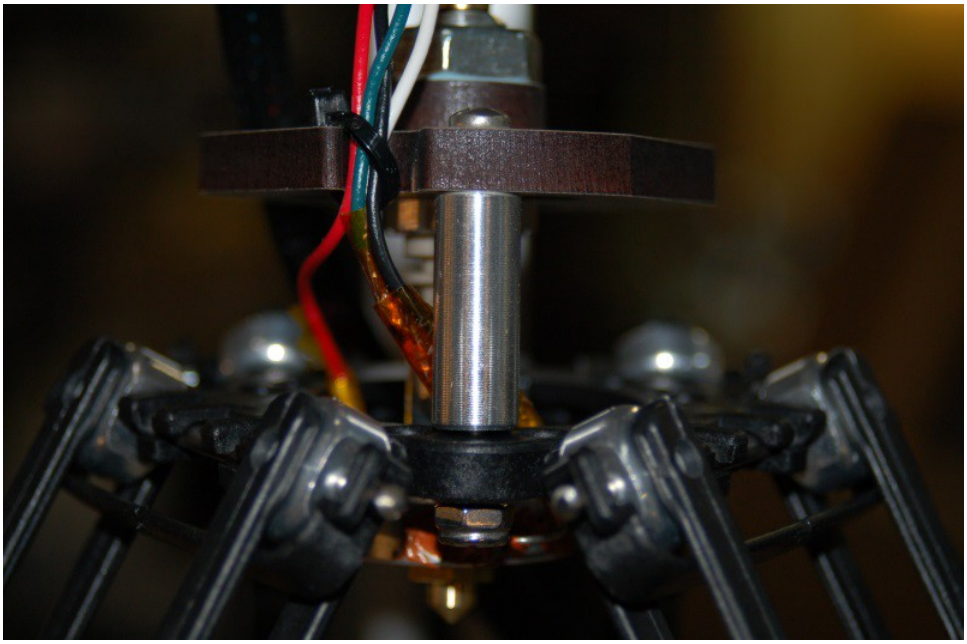


Fig. 15-3:First spacer installed.

After you've got all three started, use a Phillips screwdriver and a 5/16” wrench to tighten the three mounting screws down. When you're done, you should have something similar to Fig. 15-4.

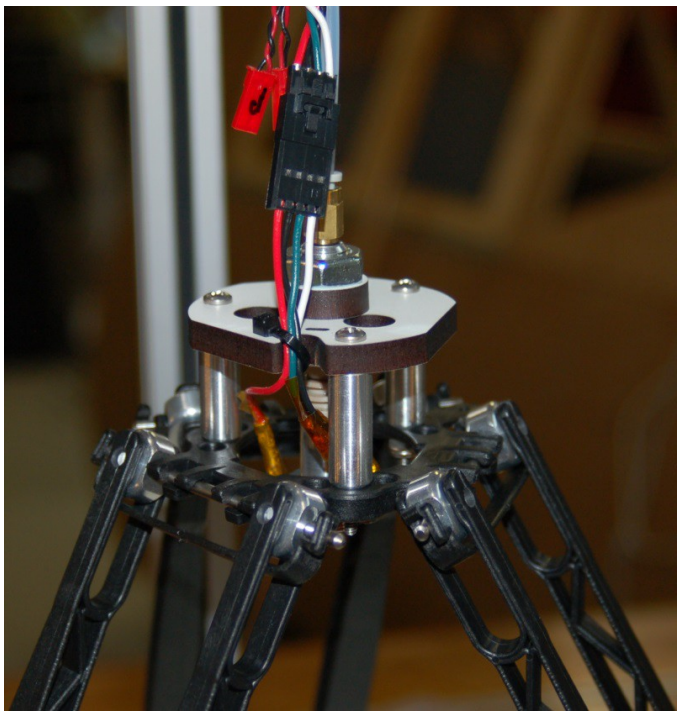


Fig. 15-4:Hot end mounted!

Now all you need to do is carefully raise each Cheapskate back up to the “operating” position.

This assembly step brings up a good suggestion for keeping your Rostock MAX v2 in good shape during transportation. If you invert the arms before you transport the machine, you'll not run the risk of the hot end getting knocked into the build plate. The inverted position also helps prevent the hot end moving around.

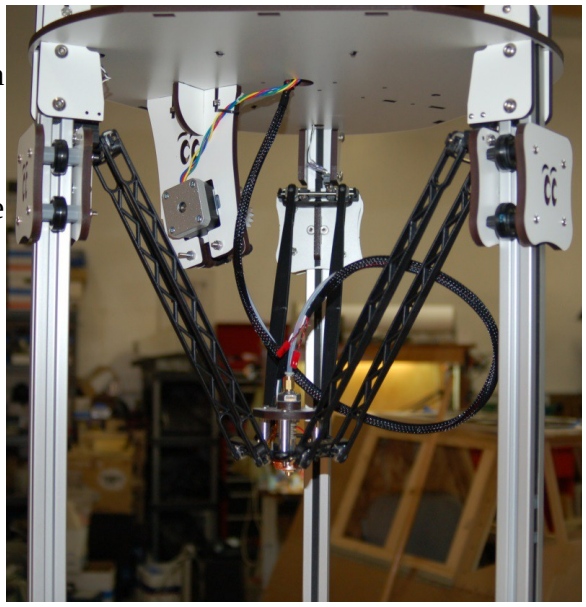


Fig. 15-5:All done!

16 – Finishing the Top End

For this step, you'll need the following components:

1. (___) Outer Spool Holder Mount (1)
2. (___) #6-32 Nylon Lock Nuts (5)
3. (___) #6-32, 1” Stainless Steel Pan Head Screws (5)
4. (___) Spool Mount Spacer Plate (1)
5. (___) Outer Spool Holder Mount
6. (___) Spool Arms (2)

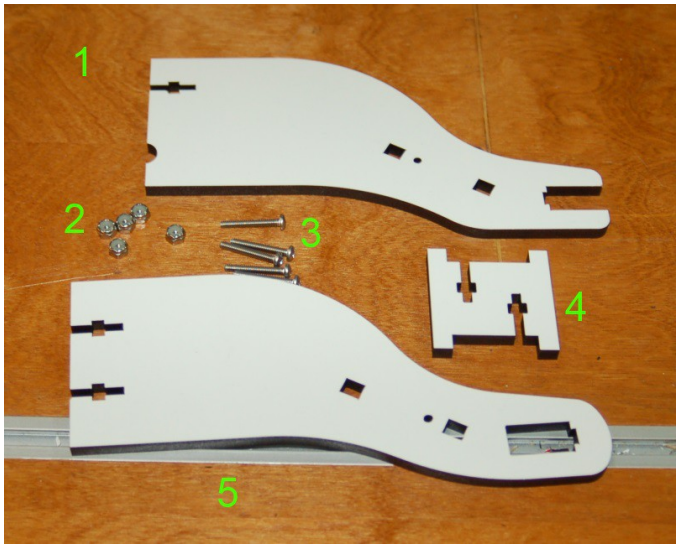


Fig. 16-1:Spool Mount Holder

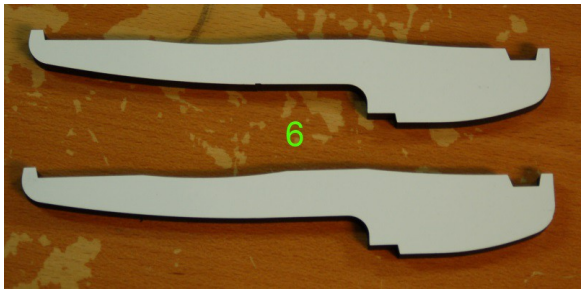


Fig. 16-2:Spool Arms

Installing the Spool Holder Mount

First, insert two of the #6-32 Nylon lock nuts into the spacer plate as shown in Fig. 16-3.

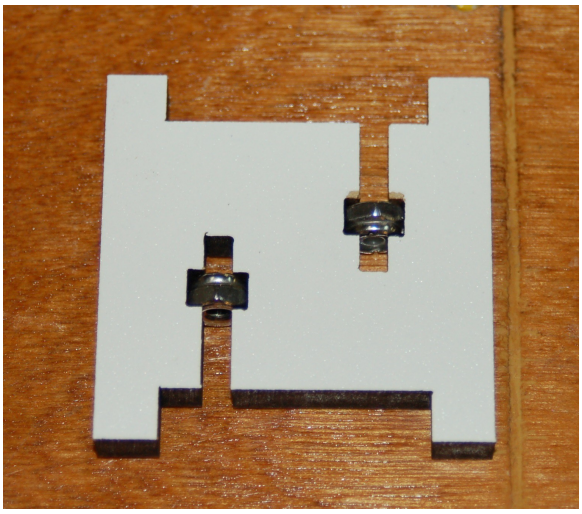


Fig. 16-3:Spacer plate nuts.

Insert the spacer plate into the outer spool mount and lock it in place with a #6-32, 1” pan head screw. Next, place the inner spool mount on the spacer plate and install a #6-32, 1” pan head screw.

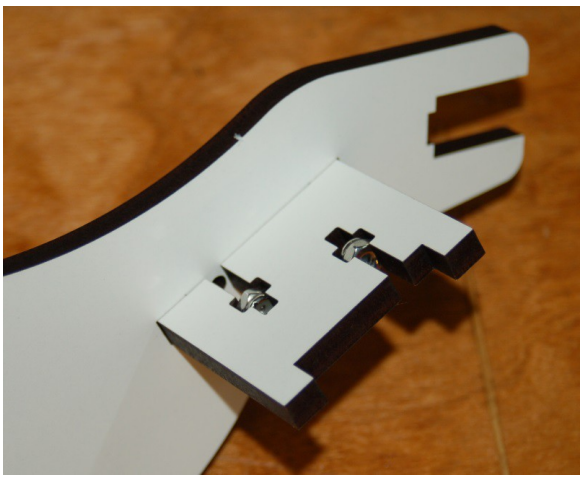


Fig. 16-4:Installing the spacer plate.

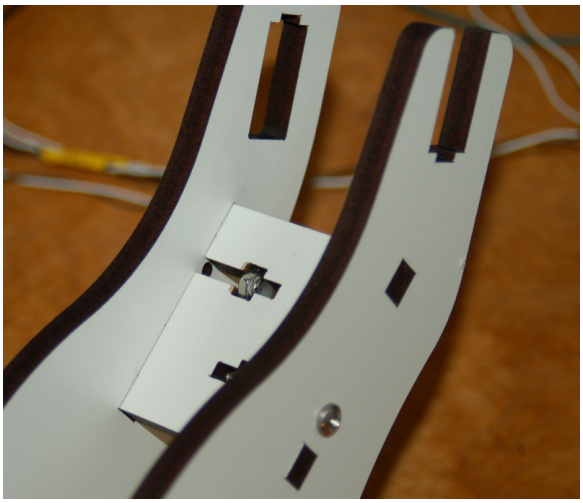


Fig. 16-5:Outer mount added.

Below is what the completed assembly looks like.

Fig. 16-6:Completed Spool Holder Mount.

Flip the mount over and insert three #6-32 Nylon lock nuts into the nut capture pockets.

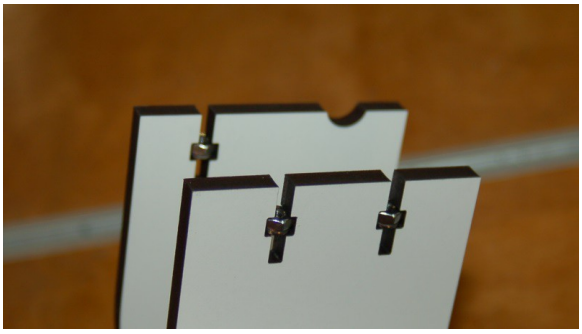


Fig. 16-7:Nuts installed.

The spool mount is going to fit into the top plate notches that are next to the position in which you mounted the extruder. As you probably figured out, the spool mount is held in place with three #6-32, 1” pan head screws. Here's a shot of the underside of the top plate, right next to the extruder mount. It'll give you an idea of where the spool holder will be positioned.

Fig. 16-8:Underside of the spool mount location.

This step caught me flat footed without a photo of what it looks like from the top BEFORE the top cover has been installed. Squint and pretend you don't see the cover in place below.

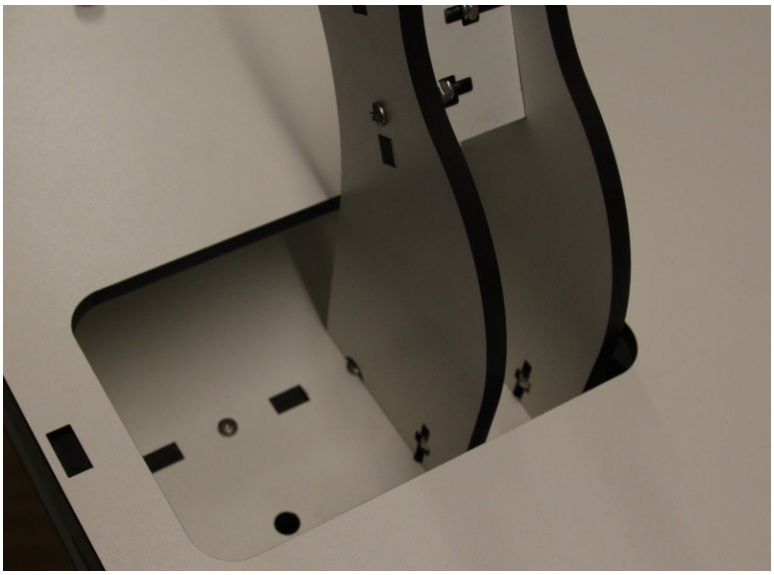
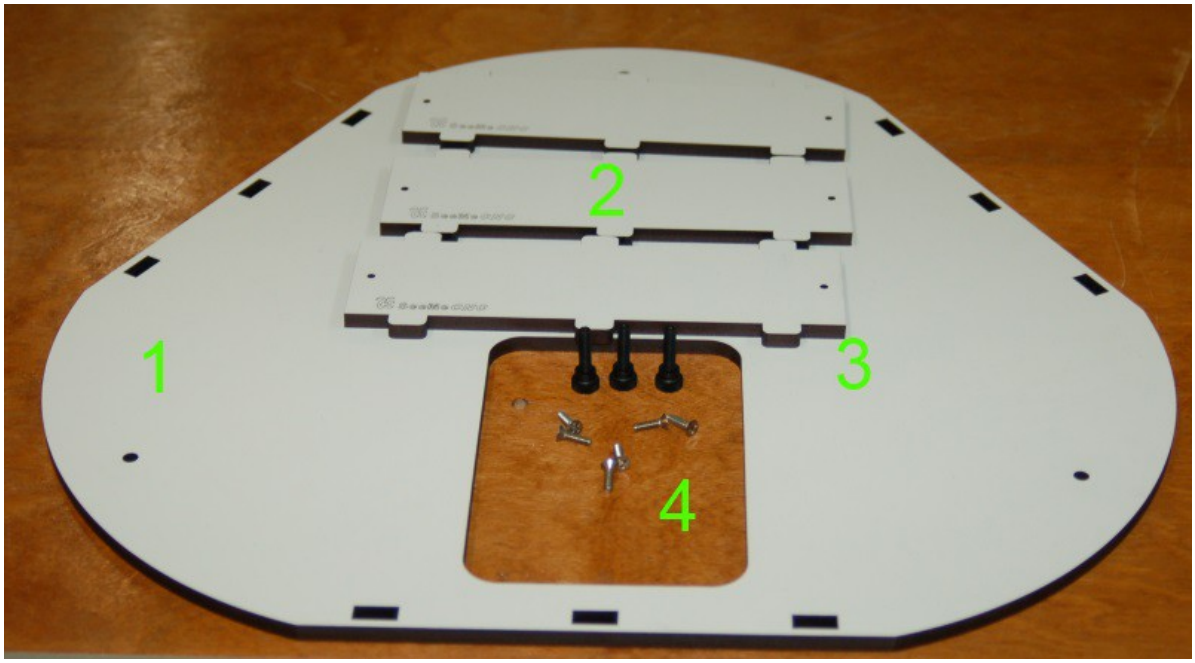


Fig. 16-9:Spool mount, top view.

Installing the Top Plate

For this task, you're going to need the following components:

1. (___) Top Plate (1)
2. (___) Top Plate Sides (3)
3. (___) #10-32 Black Nylon Thumb Screws (3)
4. (___) #6-32, 1/2” Stainless Steel Flat Head Screws (6)



The first thing you'll need to do is locate the #10-32, 5/8” socket head cap screw. You're going to use this to cut threads into the mounting holes that will be used to hold the top cover in place.

Now by all means – if you've got a real, #10-32 tap – use it!

Fig. 16-11:Stop laughing.

As you'll recall, you installed a little Melamine spacer in the upper tower mounts. The hole in the center is where you need to apply the tap. I would advise you lay the machine down to make this operation simpler, unless of course you happen to be in excess of seven feet tall or really like ladders.

You can do this slowly and carefully by using a 5/32” hex tool, or you can be a complete nut and do what John Oly does and use a drill.

If you DO decide to use a drill, you'd better make REALLY sure you can control the speed because if you just hammer that thing at full speed, you're going to make a great bloody mess out of those poor spacers.

Fig. 16-12:Duck!

Either way, you're going to drive the screw into the hole just as you would a normal wood screw. Keep it straight and take your time. You really do *not* want to screw this up. (no pressure, right?)

I'd love to show you an awesome photo of this whole process, but I cheated and used a tap, then forgot to take a picture. I can however, show you a photo of what the location looks like. Well from the underside...after it's done.. **sigh**

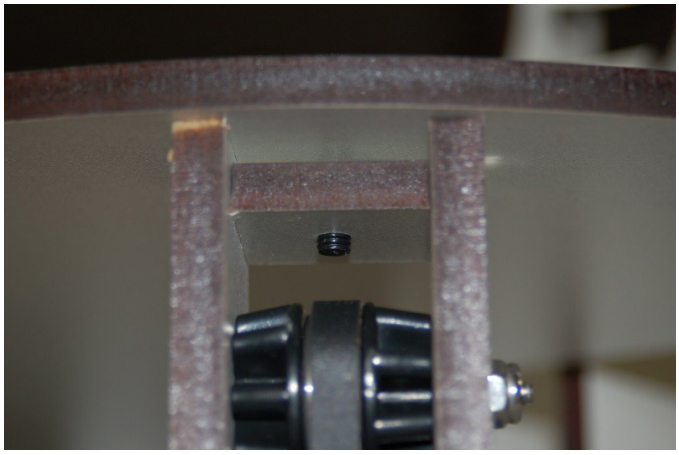


Fig. 16-13:Screw hole location.

I've embarassed myself enough for the moment – go ahead and tap all three holes and let's move along...

The top cover supports have holes in each end, just like the base supports did. The holes are for #6-32, 1/2” flat head screws that are for holding the acrylic covers in place. Make sure you install them as shown, with the logo text facing down.

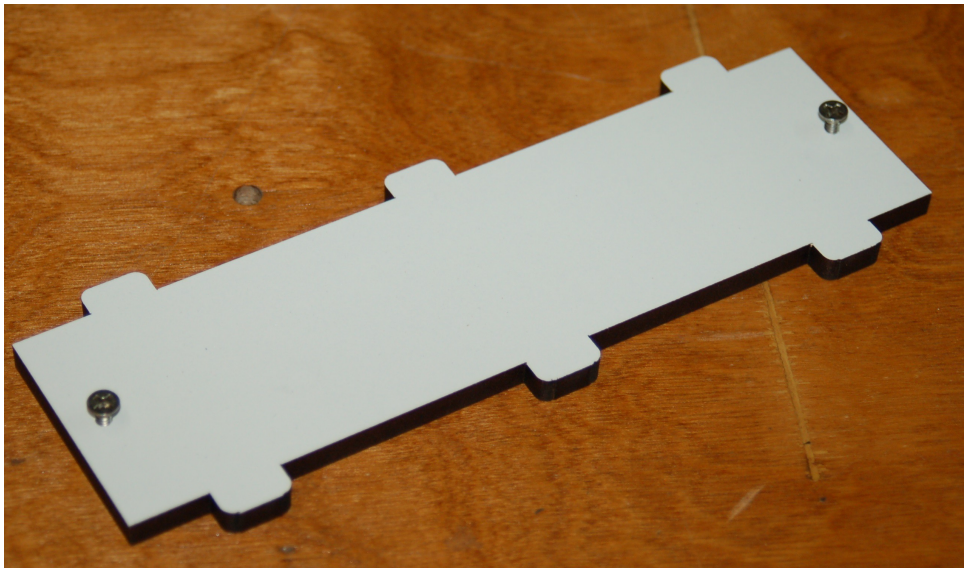


Fig. 16-14:Top cover support.

There's three locations along the flat edges of the top plate where these are installed. In my build, the tabs were ***very*** tight. If yours are the same tolerance I strongly suggest that you get your hands on a 12” long Irwin Squeeze Clamp. This will help you set the tabs without doing any damage to the supports.

Fig. 16-15:First top cover support in place.

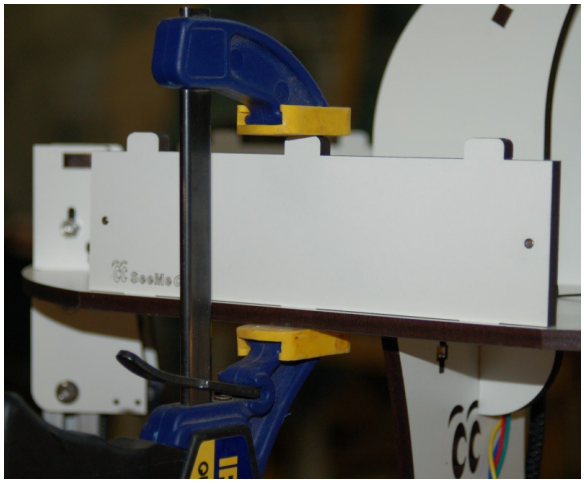


Fig. 16-16:"Helping" the fit.

Install all three top cover supports as shown.

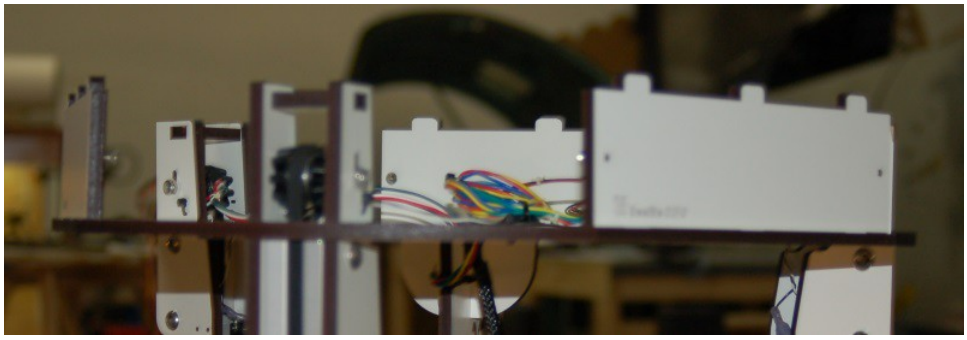


Fig. 16-17:Top cover supports installed.

Now you can set the top cover in place. As with the top cover support plates, the tabs can be a tight fit, so please be careful. Orient the top cover such that it fits around the spool holder mount as shown below. Install the three #10-32 black Nylon thumbscrews and you're just about done!

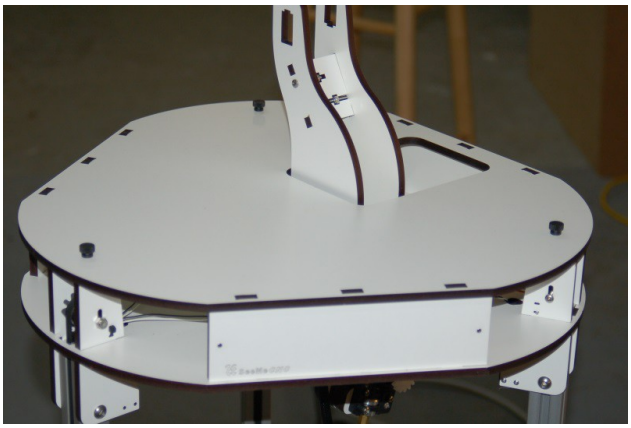


Fig. 16-18:Top cover in place.

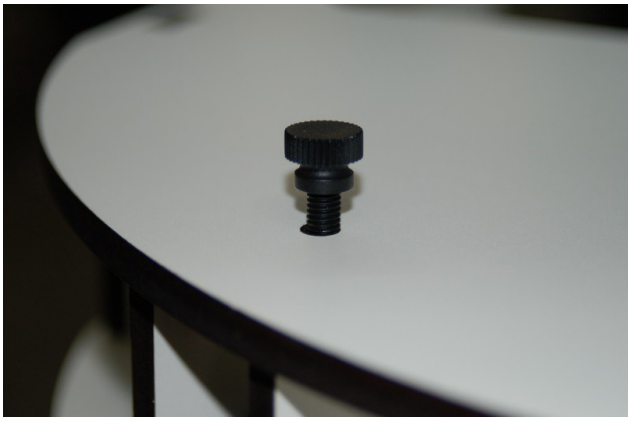


Fig. 16-18A: Thumbscrew detail.

The last step you're going to do is to tighten down all the screws that hold the towers in place. Start at the bottom and treat it like you're working with four “rows” of screws. Tighten the bottom two on each tower and then move up to the next two and tighten those. Move up to the top and tighten the lower pair on each tower first and then the last row.

Congrats! There's one last step to take before the mechanical build of your Rostock MAX v2 3D printer is completed!

That's right, you need to install the spool holder IN the mount! Now pay close attention, this is ***brutally*** complex.

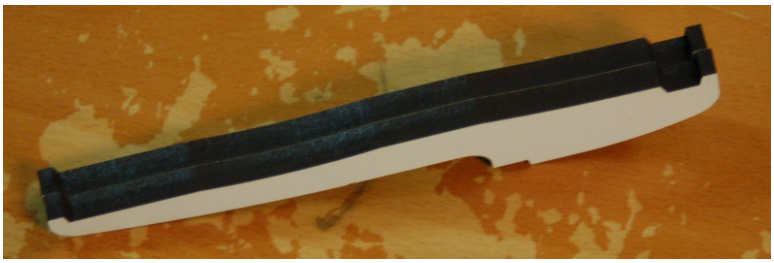


Fig. 16-19:Arms together now!

First, put your arms together. No, not YOUR arms, ^^^^ those arms. Jeeze.

Now oh so carefully, slide the arms (no, your arms won't fit) into the spool holder as shown.

Fig. 16-20:Not your arms.

TA DA!

Fig. 16-21:Yer done.

Okay, so I lied. You're not done yet. You're *almost* done.

17 – Assembling & Installing the LCD Panel Mount

For this task, you'll need the following components:

1. (___) Front Panel (1)
2. (___) LCD Mounting Brackets (2)
3. (___) #2-56, 5/8” Pan Head Screws (8)
4. (___) #6-32 Nylon Lock Nuts (2)
5. (___) #2-56 Finish Nuts (8)
6. (___) #6-32, 1” Pan Head Screws (2)
7. (___) LCD Panel (1) (Not Shown.)

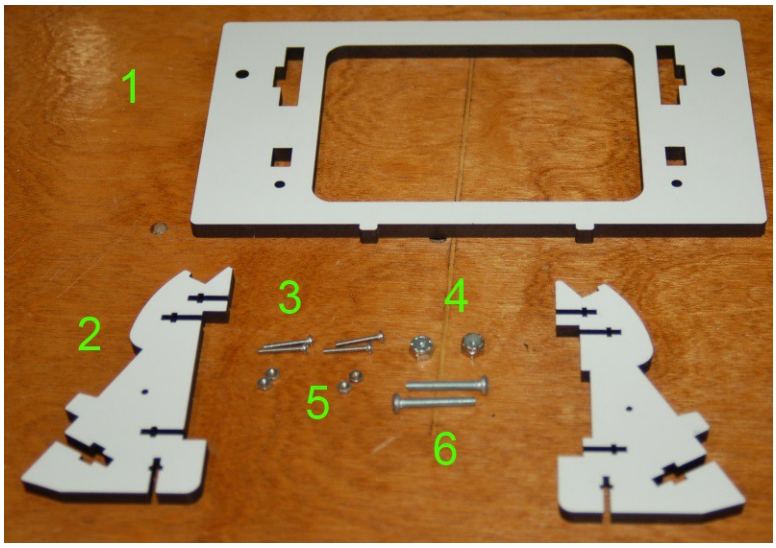


Fig. 17-1:LCD Panel Mount Parts.

Note that the photo above doesn't show all the #2-56 screws & nuts that are required for this assembly step. You may notice throughout this process that some of the #2-56 hardware is missing in the photos – this was due to an accidental part shortage when I was doing the initial photography. Please follow the text and make sure all the #2-56 hardware is used as directed.

Assembling the Front Panel

First up, go ahead and install the #6-32 Nylon lock nuts and the #2-56 finish nuts in the nut pockets on the two LCD mounting brackets.

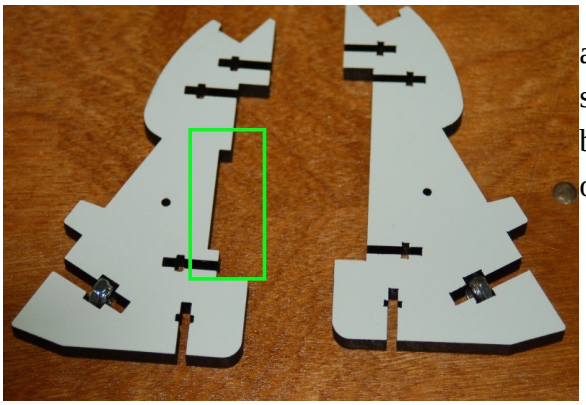


Fig. 17-2:Getting the nuts installed.

After you've gotten all the nuts installed, go ahead and insert the mounting brackets into the front panel as shown below. Note that there IS a left/right difference between the two brackets. You want the left bracket oriented as shown in Fig. 17-3.

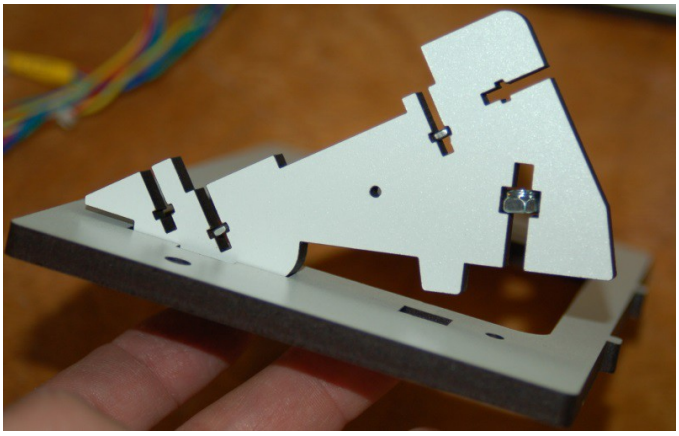


Fig. 17-3:LCD bracket alignment & fit.

The notch at the bottom of the bracket is there to accommodate the SD card socket in the LCD panel.

Lock the LCD mounting brackets in place with two #6-32, 1” pan head screws.

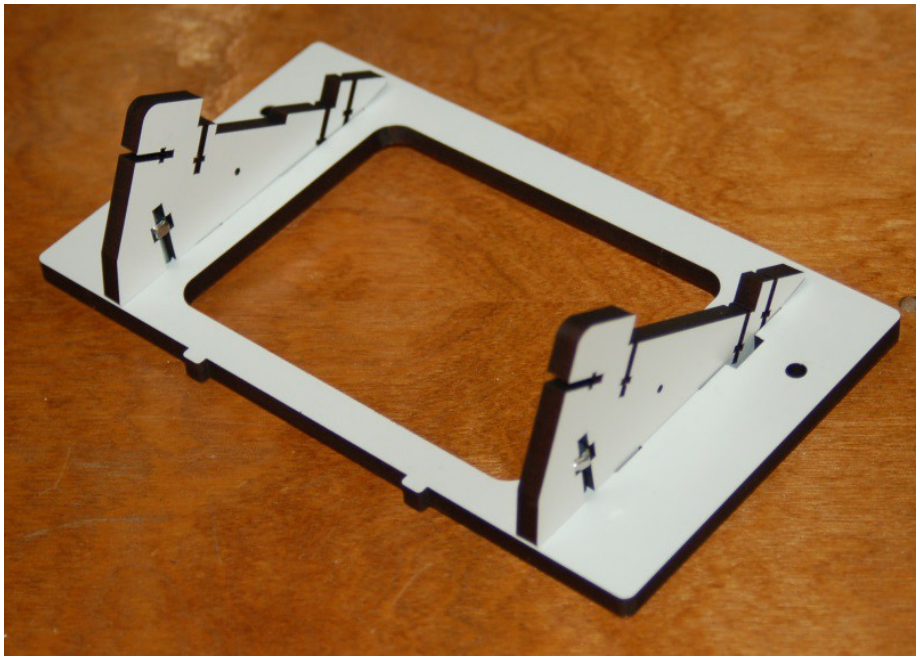


Fig. 17-4:LCD mounting brackets installed.

Now unpack the LCD panel from the bubble wrap and set it into the mounts as shown. Affix with four #2-56 pan head screws.

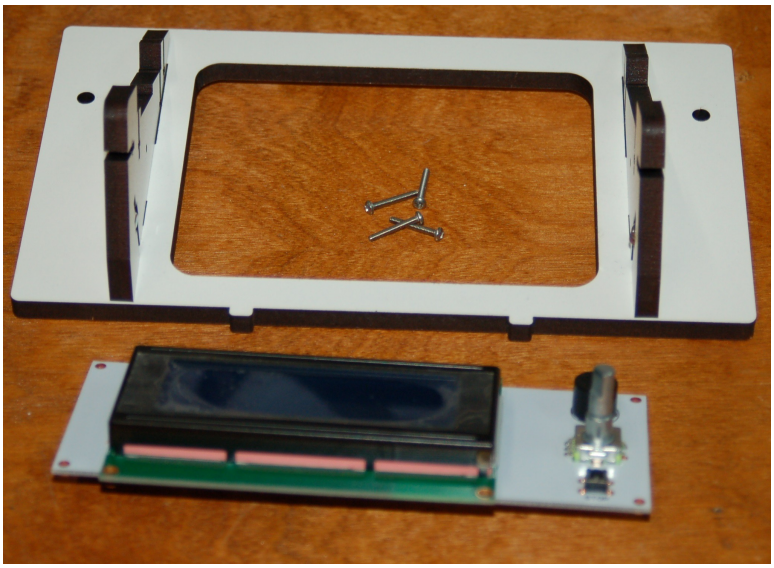


Fig. 17-5:LCD and front panel.

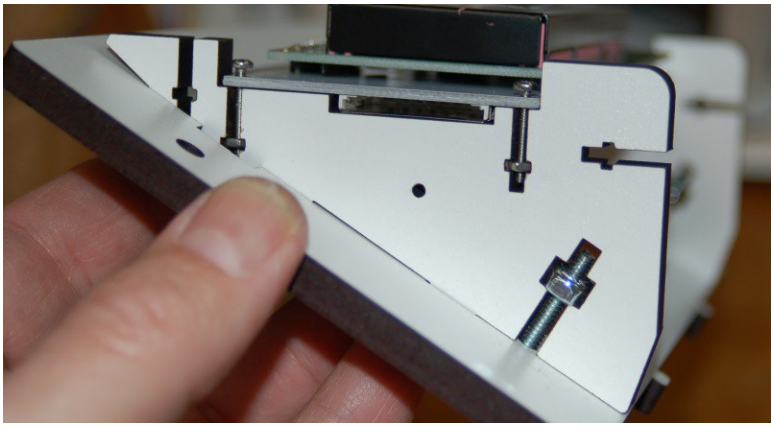


Fig. 17-6:LCD attached.

Installing the LCD Trim Panels

For this step, you'll need the following components:

1. (___) Acrylic Trim Panel, Left (1)
2. (___) #4, 3/8” Pan Head Sheet Metal Screws (2)
3. (___) Acrylic Trim Panel, Right (1)
4. (___) LCD Trim Panel (1)
5. (___) LCD Knob (1) (Not Shown.)

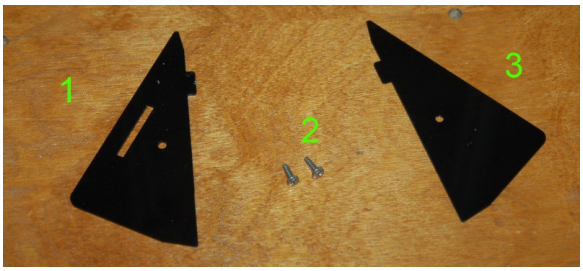


Fig. 17-7:Side trim panel parts.

Fig. 17-7A: LCD trim panel.

Set the left trim panel in place as shown and fasten with a #4 pan head screw.

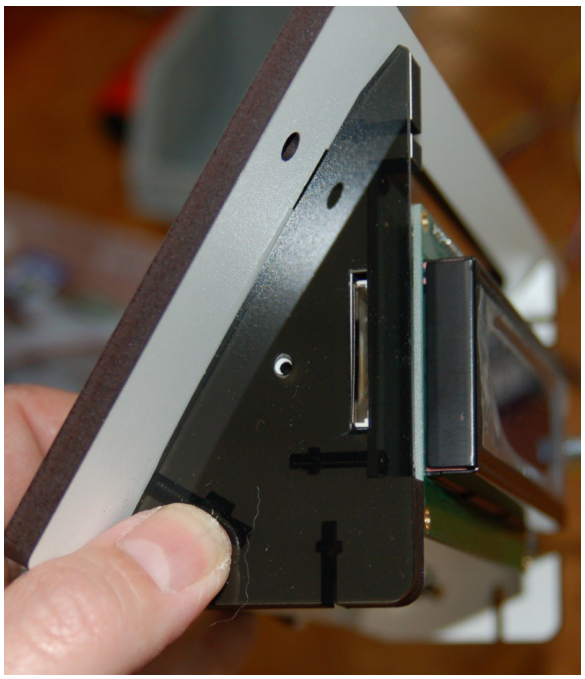


Fig. 17-8:Left trim panel in place..


Fig. 17-9:..and fastened down.

Repeat this task for the right side trim panel.

Now set the LCD trim panel in place as shown below and affix it with two #2-56 pan head screws in the spots indicated.

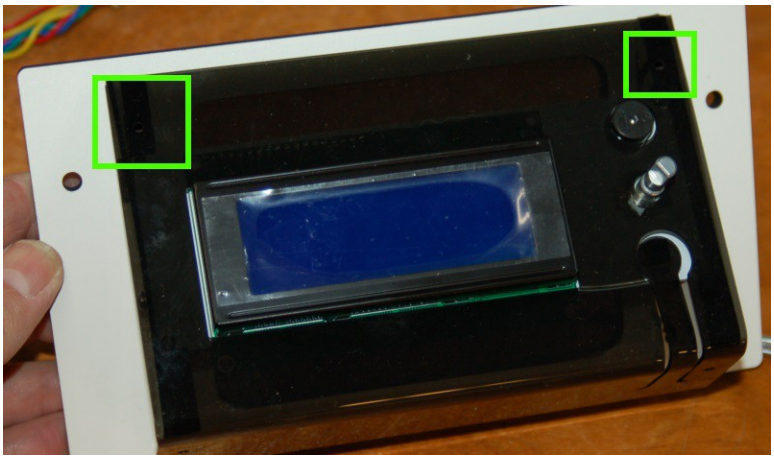


Fig. 17-10:Attaching the LCD trim panel.

Now press on the knob (should be in the plastic box the LCD came in) and you're done!

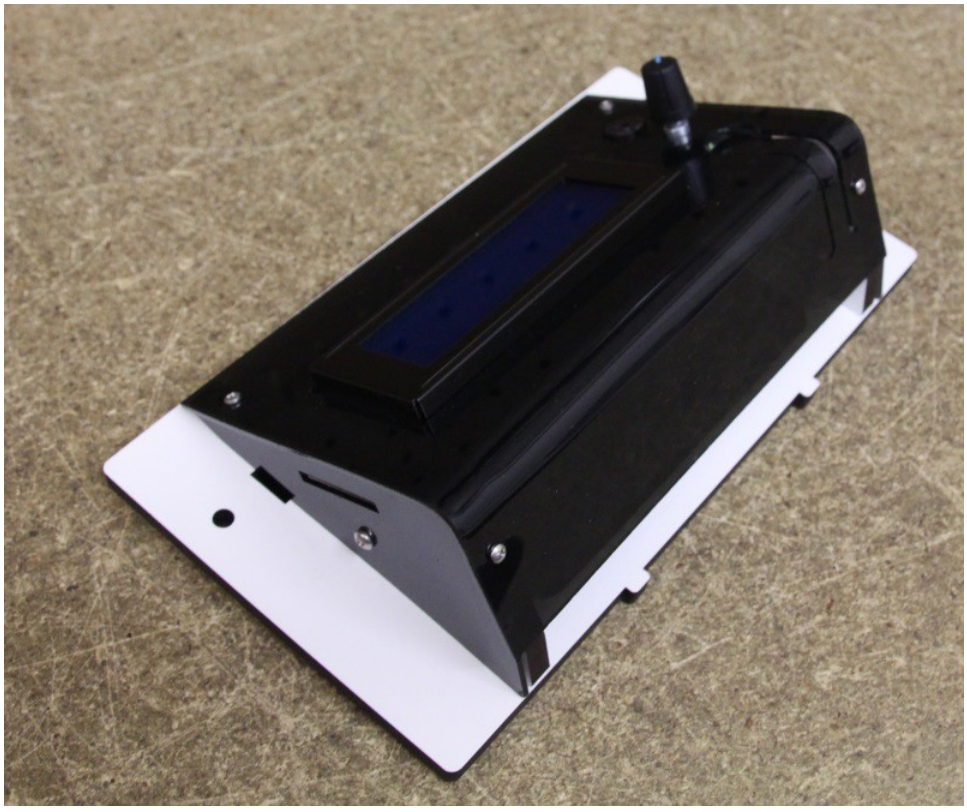


Fig. 17-11:Completed front panel.

Now flip the LCD panel face down and mark the two connectors as shown.

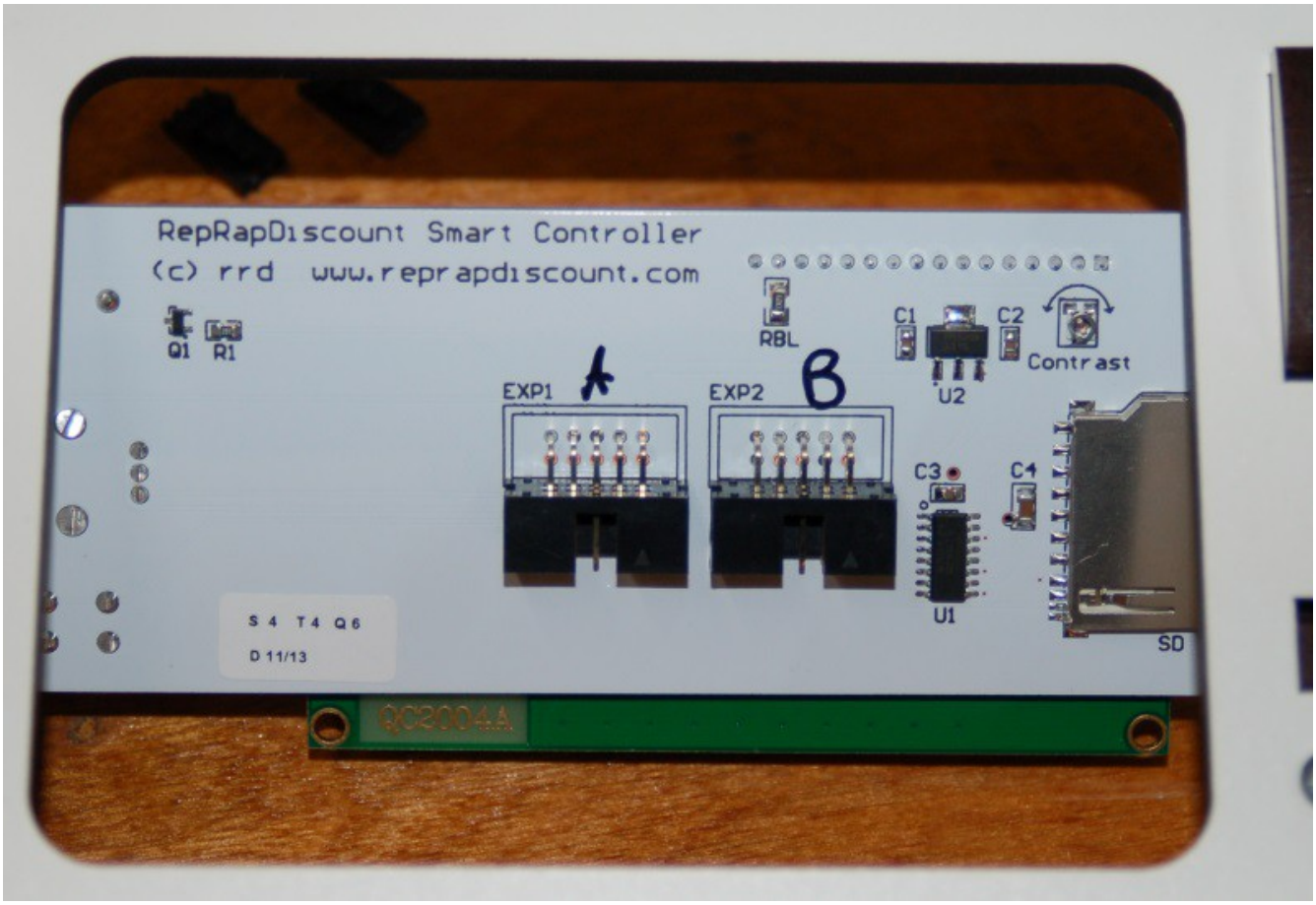


Fig. 17-12:Marking the interface connectors.

18 – Installing & Connecting the RAMBo Controller

For this step, you're going to need the following materials:

1. (___) RAMBo Mounting Panel (1)
2. (___) 40mm Fan (1)
3. (___) #4-40 T-Nuts (4)
4. (___) Short Wire Ties (2)

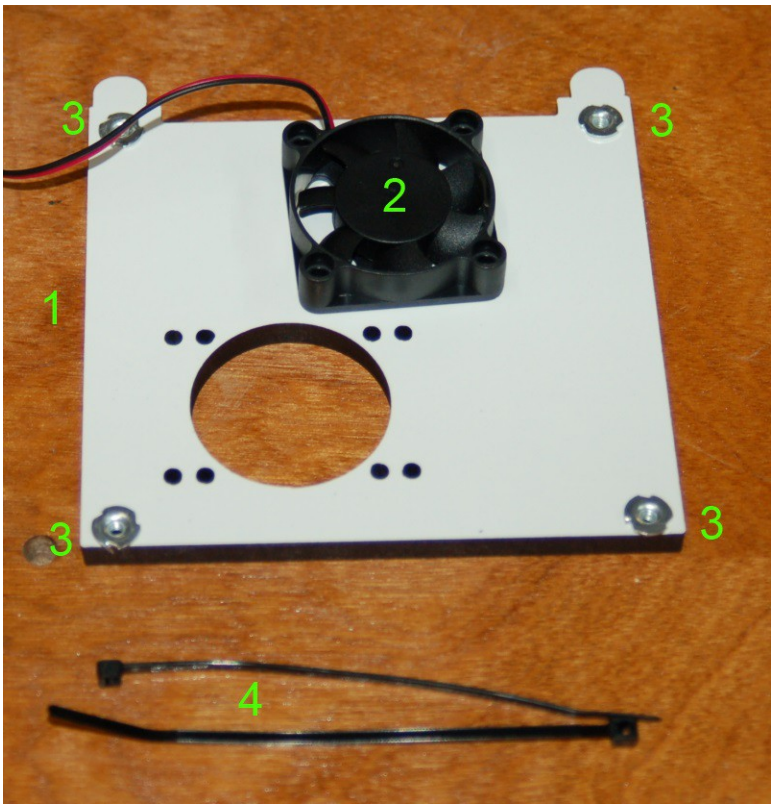


Fig. 18-1:RAMBo Mount Components.

The first thing you'll want to do is install the #4-40 t-nuts as shown above.

Make sure that you've got the RAMBo mount oriented as shown – you want to make sure that you're installing the t-nuts on the *back* of the mounting plate.

Installing the RAMBo Cooling Fan

Using two short wire ties, mount the 40mm cooling fan as shown.

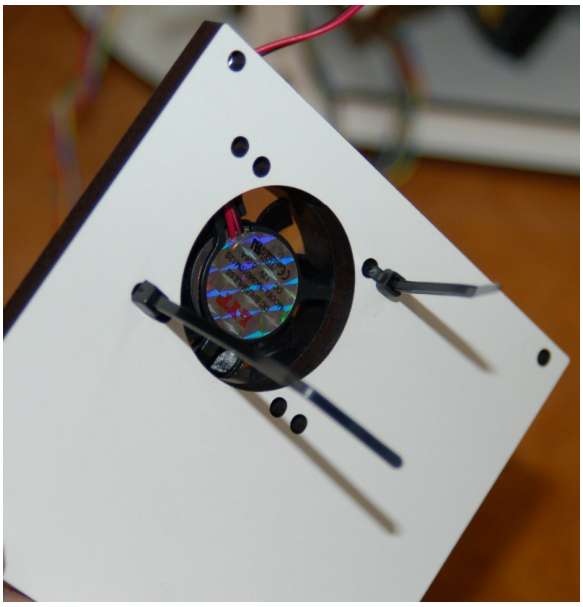


Fig. 18-2:Mounting the cooling fan.

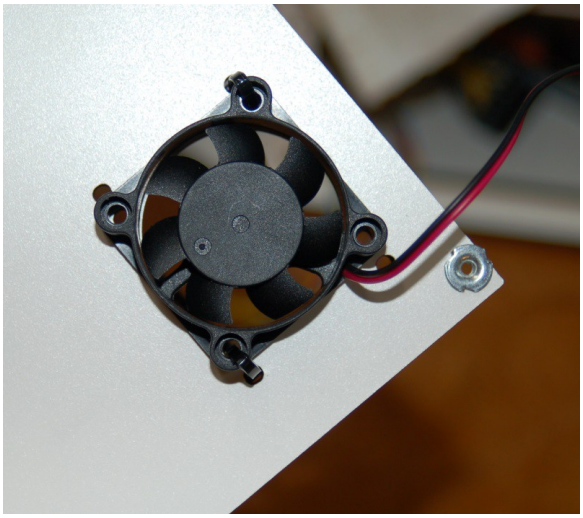


Fig. 18-3:Back view.

Make sure you've got the fan oriented as shown in order for it to draw air from the correct side.

Trim the wire tie “tails” flush with the wire tie head.

Mounting the RAMBo Controller

For this task, you'll need the following components:

1. (___) RAMBo Mounting Plate (1)
2. (___) RAMBo Controller (1)
3. (___) Plastic Bearing Rollers (4)
4. (___) #4-40, 3/4” Stainless Steel Flat Head Screws (4)

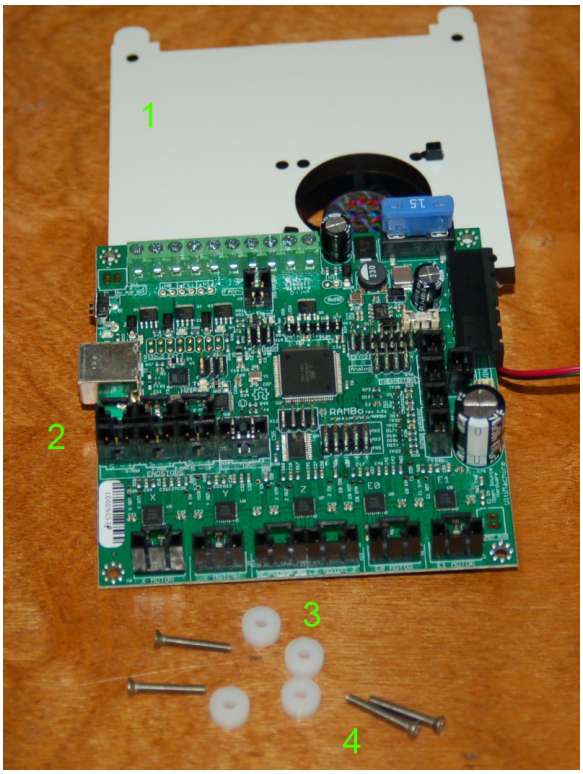


Fig. 18-4:RAMBo Mounting Components

Mounting the RAMBo is very straightforward. Simply set the RAMBo on top of the mount and slide a plastic roller between the RAMBo and the mounting plate as shown in Fig. 18-5. Insert a #4-40 flat head screw in the hole and that's all there is to it!

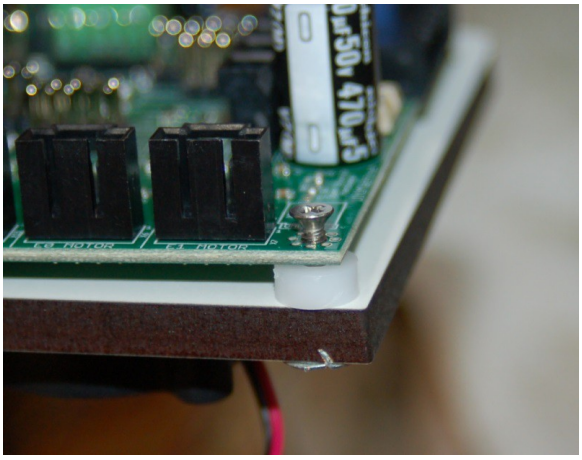


Fig. 18-5:Mounting the RAMBo.

Soldering the Cooling Fan

Cut the 2 pin connector off of the 40mm cooling fan and then strip 1/8” of insulation from the wires. ***Carefully*** solder the wires in place as shown in Fig. 18-6.

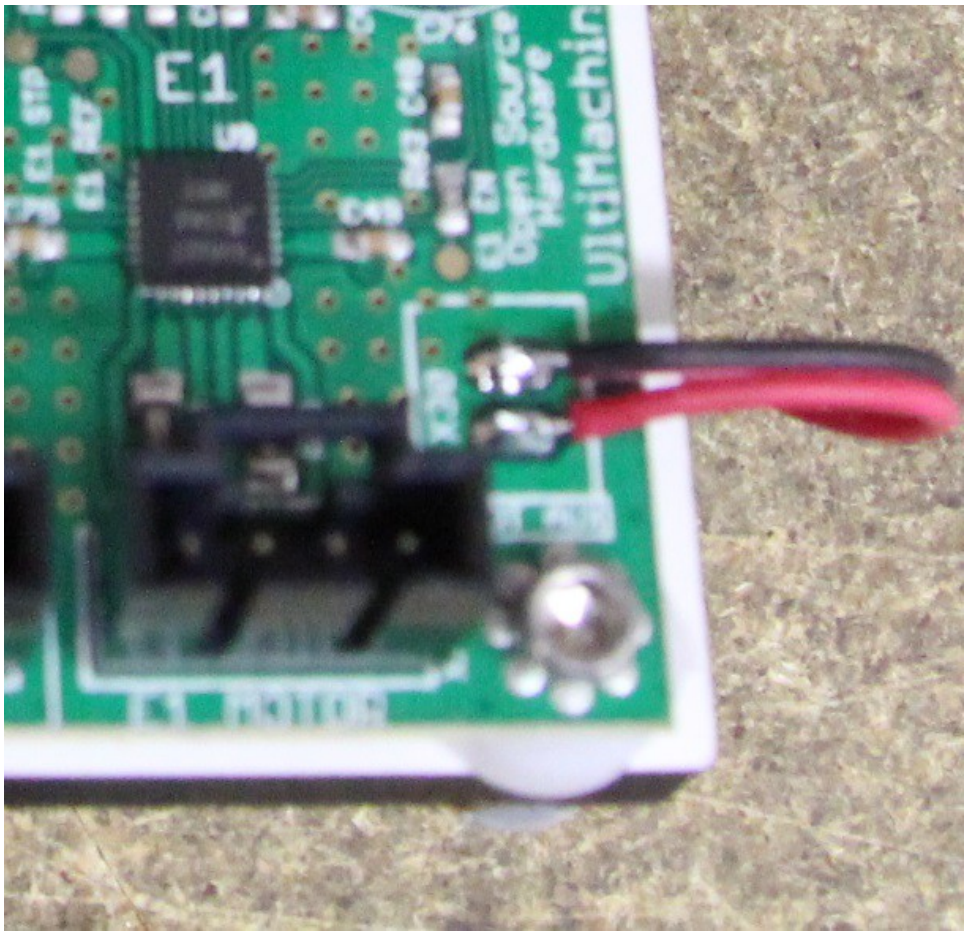


Fig. 18-6:Cooling fan wires soldered down.

Make sure you solder the wires to the top of the solder pads and match the wire polarity shown above.

Assembling the RAMBo LCD Interface Adapter

I've created a short video that does an excellent job of illustrating how this small board is soldered together. You can view the video here: http://www.youtube.com/watch?v=fzdWk5BtttA.

When you've finished the assembly, mark the connectors on the adapter as shown below and set the board aside for the moment.

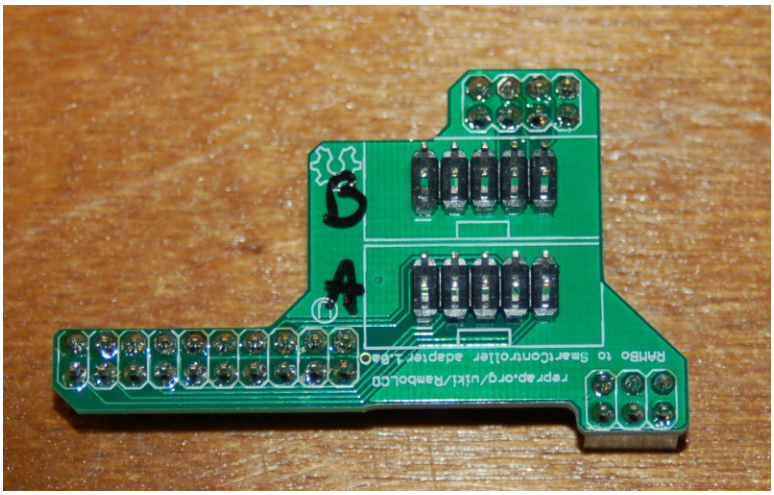


Fig. 18-7:Assembled & Marked LCD Adapter.

Assembling the End Stop Connectors

Inside the RAMBo parts baggie (marked “RAMBo v1.2 Kit” or similar), you'll find a number of different connectors. For this task you'll need three of the 3 pin locking polarized connectors.

Route the three end-stop wire pairs through the opening in the front of the base and attach a connector to each pair as shown:

Insert the white wire into the #1 position (as indicated by the little arrow at the end of the connector) and insert the black wire into the #2 position. The #3 position is ***NOT USED***.

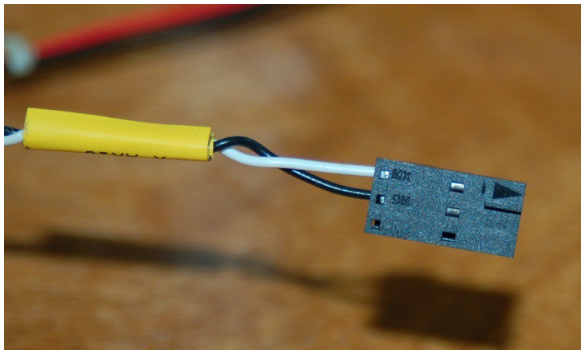


Fig. 18-8:End-Stop Connector.

You'll want to bundle up the end-stop wires similarly to how I've done on the right. The X axis end-stop wire should be looped up a little to take up the extra slack it has.

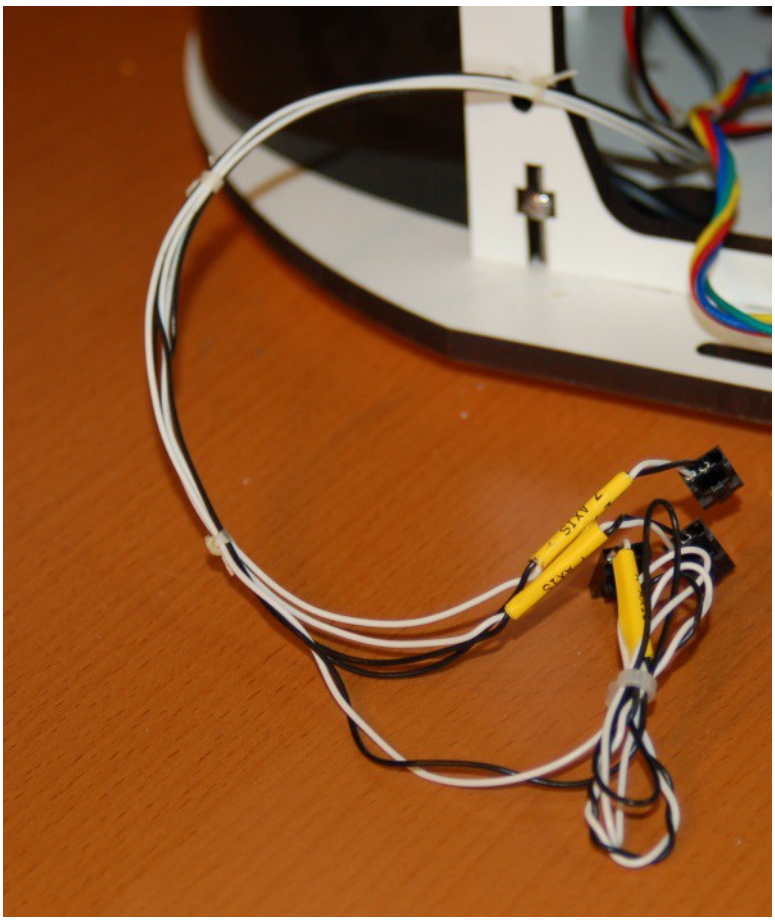


Fig. 18-9:End-Stop wires bundled, with connectors attached.

Installing the Hot End Thermistor Connector

Get a pair of crimp pins and a female, two pin locking polarized connector out of the RAMBo parts baggie. We're going to attach this to the 18ga white and green wires that go to the hot end thermistor.

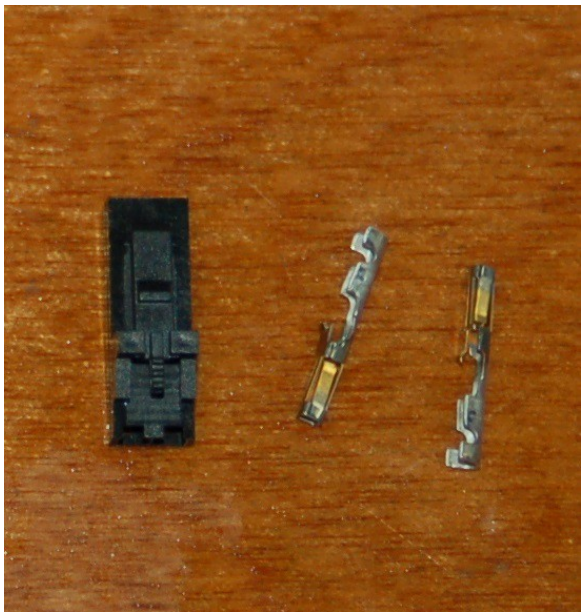


Fig. 18-10:2 pin female connector and crimp pins.

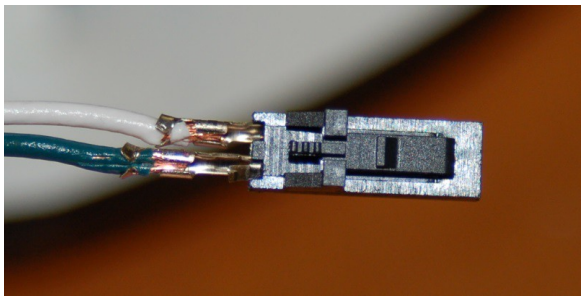


Fig. 18-11:Pins crimped & started in the connector.

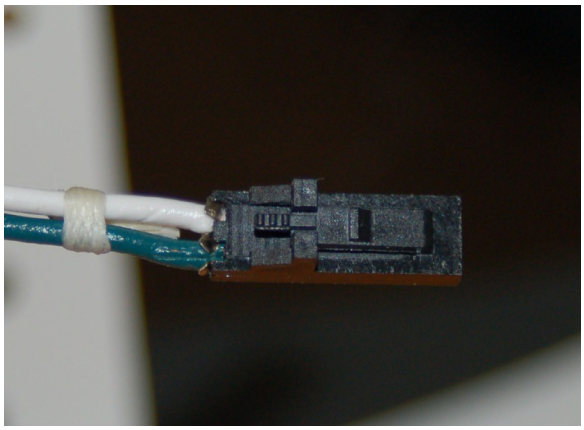


Fig. 18-12:Connector installed.

Wiring the RAMBo Controller – Terminal Block

Note that all wiring should be brought through the center opening in the front vertical support!

First up, let's get the hot end resistors connected to the RAMBo. Bring the wires forward so they exit the front opening of the printer and trim them so there is 6” of wire extending past the outside edge of the machine. You'll be trimming the other “bare” wires to this length as well, but not yet.

Strip 1/4” off the black & red 18ga wires that come from the hot end. Insert them into the **Heat 0** connector as shown below. Note that the black wire goes into the side with the “-” above it, and the red wire goes into the side with the “+” above it. Tighten the screws for these two points on the terminal block.

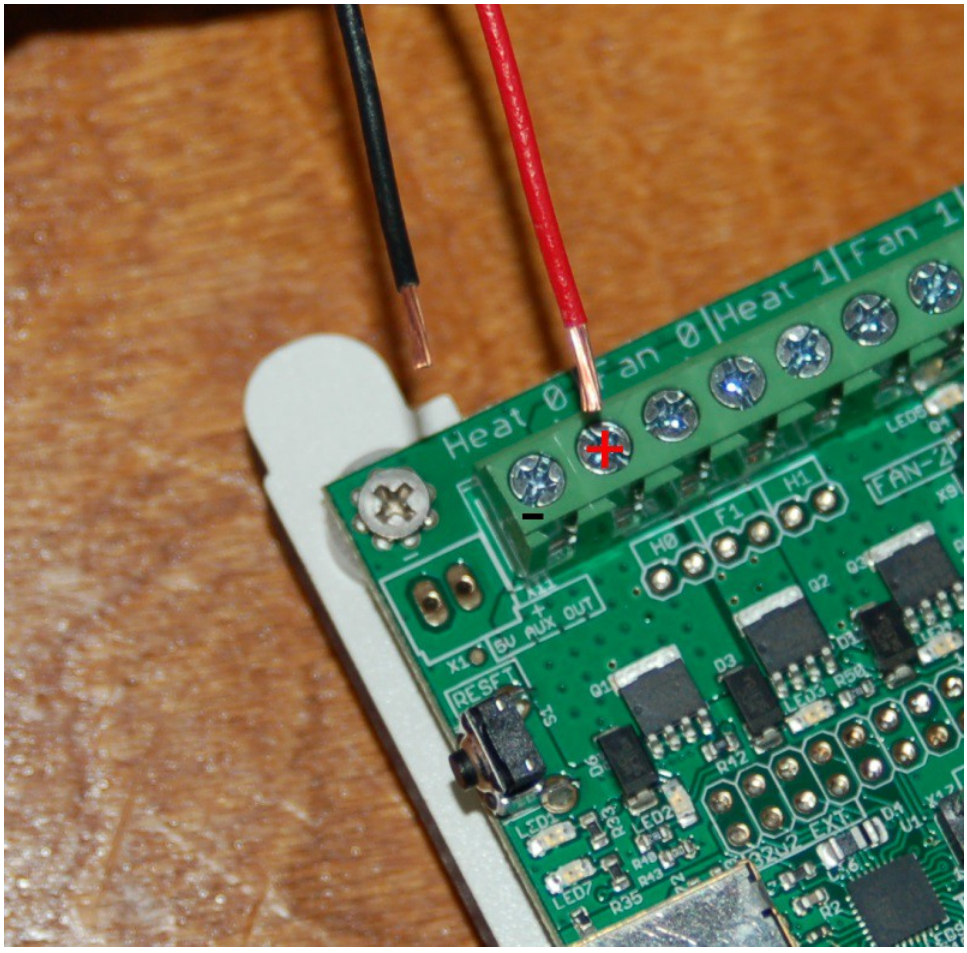


Fig. 18-13:Hot End Power Wiring.

Because the wires tend to block the labels above the terminal block I'm going to show you a clear photo of the terminal block and then describe how to wire each section.

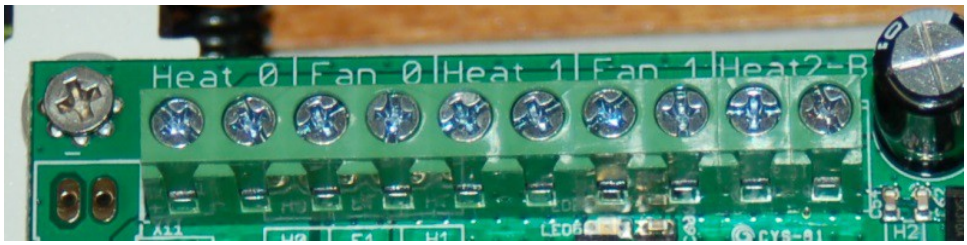


Fig 18-14:The RAMBo Terminal Block

Since we've already done the **Heat 0** position, we'll do **Fan 0** next.

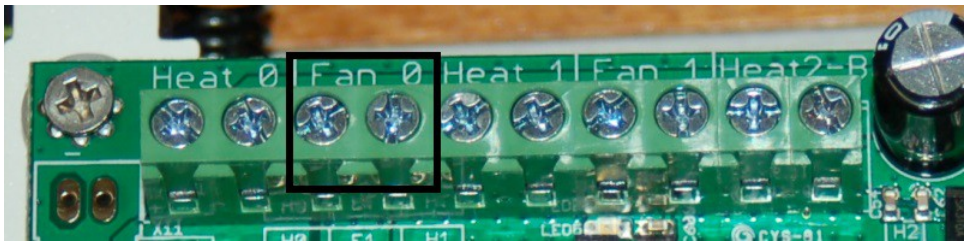


Fig. 18-15:FAN 0 location.

The **Fan 0** connector is used to control the Layer Fan. When wiring the hot end, the Layer fan is the 26ga pair of wires that does ***not*** have the knot in it. Bring the wire pair foreward as with the hot end power wires and trim them so there is 6" of wire out past the front of the machine. Strip 1/4" of insulation from the two wires and insert them into the **Fan 0** connector and tighten down the screws for those two positions. Make sure you observe the wire polarity – remember, "-" is black, "+" is red.

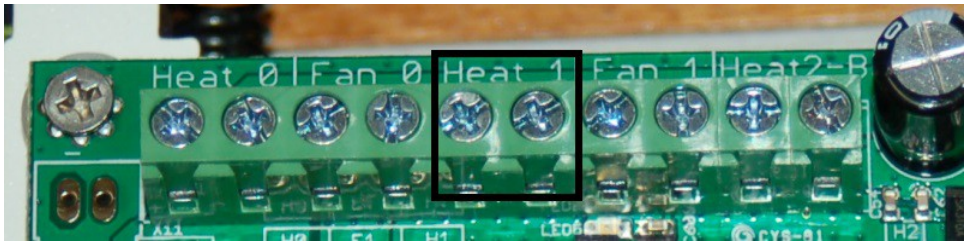


Fig. 18-16:HEAT 1 location.

The **Heat 1** connector is where the PEEK fan is wired in. The pair you want is the 26ga wires you tied the knot into. Like before, bring out 6" of wire, trim, strip and insert into the **Heat 1** terminals.

The PEEK fan will be automatically activated when the hot end reaches 50 degrees Celcius.

Finally, we've got the connector for the Onyx heated bed.

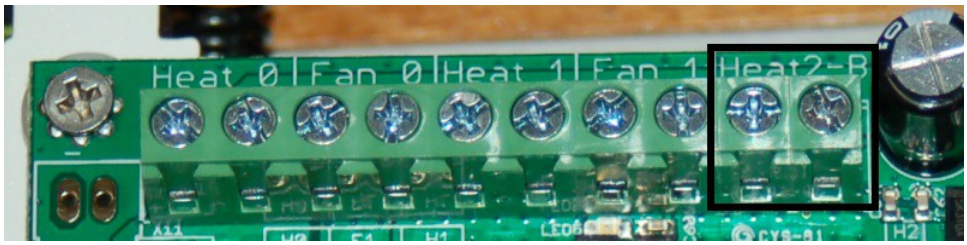


Fig. 18-17:Heat2Bed location.

Bring the 18ga Onyx heated bed wires to the front of the machine and trim the same as the others. Strip 1/4” off the ends and insert into the terminal block position marked **Heat2Bed**.

When completed, your terminal block should look exactly like that shown below.

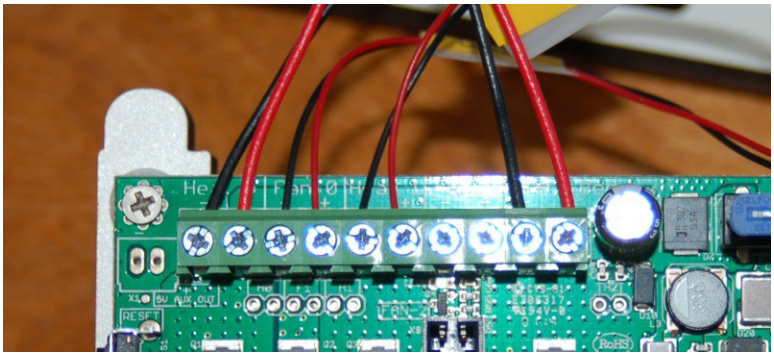


Fig. 18-18:Finished terminal block wiring.

If you've got a Rev5 Onyx heated bed with the hot end power LED, you'll need to insert the white & green wires from the bed into the **Heat 0** position on the terminal block as shown:

Just make sure you do a neater job of it than I did. :)

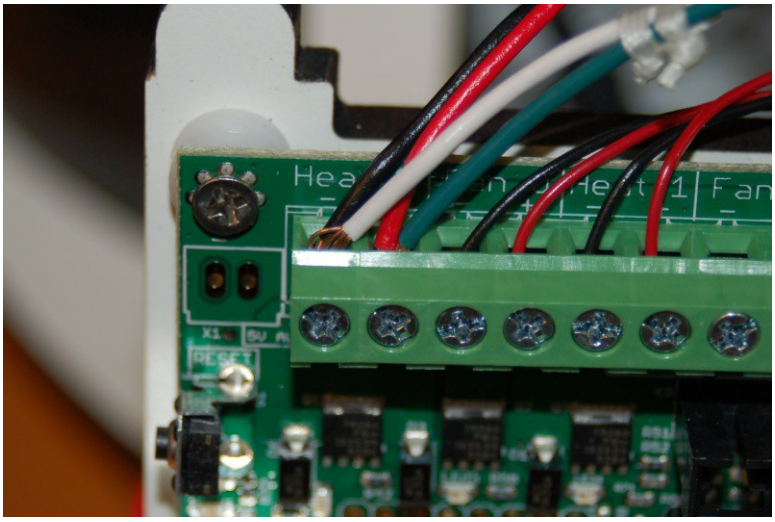


Fig. 18-18A: Hot end power LED connection.

Wiring the RAMBo Controller – Plug-In Connectors

Now we're going to plug in the end-stop connectors, the stepper motors, the thermistors and finally the main power connector. I'll keep the photos big so detail is easy to see.

First, let's install the end-stop wires.

Insert each of the three end-stop connectors into the sockets shown below, outlined in green. Each position is clearly labeled, so make sure you get the right end-stop into the right socket.

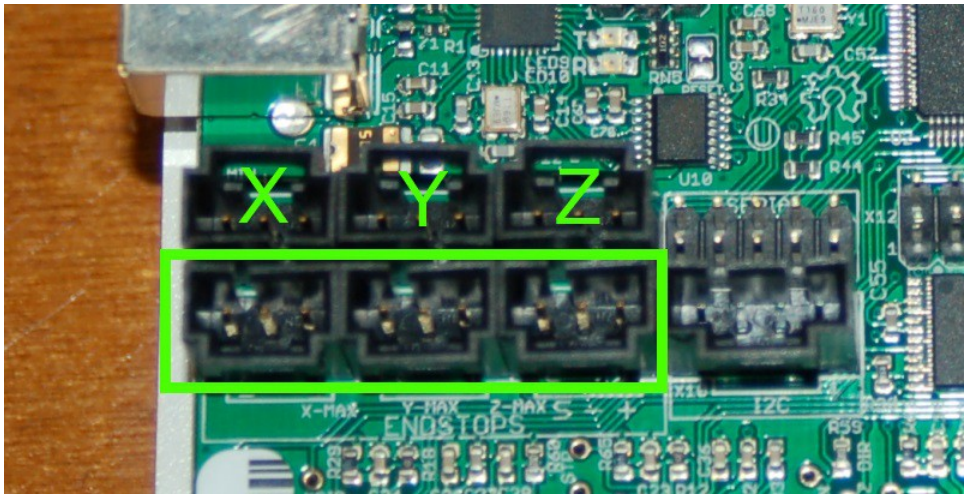
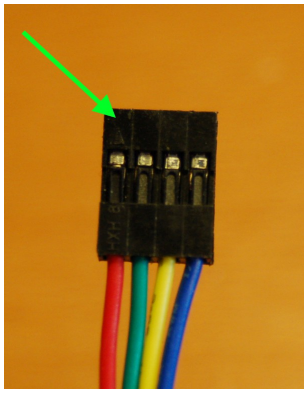


Fig. 18-19:End-stop sockets.

Included in the RAMBo parts baggie are a number of female, four pin locking polarized connectors and crimp pins. You'll need to grab one connector shell and four pins – you need to install the connector at the end of the extruder extension wires that you brought down through the Y axis tower.

Some Rostock MAX v2 kits will be shipped with stepper motors that come from a secondary source. These motors have a different connector on them and don't have the locking lever that the primary source motors have.

The connector fits the same as the other, just make sure that the pin marked by the green arrow is aligned with the right-most pin. Make sure the little pin releases shown are facing down and you'll get it right.



These motors are made by Kysan and you'll need to make a small firmware tweak to make them work at their best. We'll cover that later.

After crimping the pins on to the wiring, please make sure you follow the wire order in Fig. 18-20 *exactly*, otherwise your extruder drive may not operate properly.

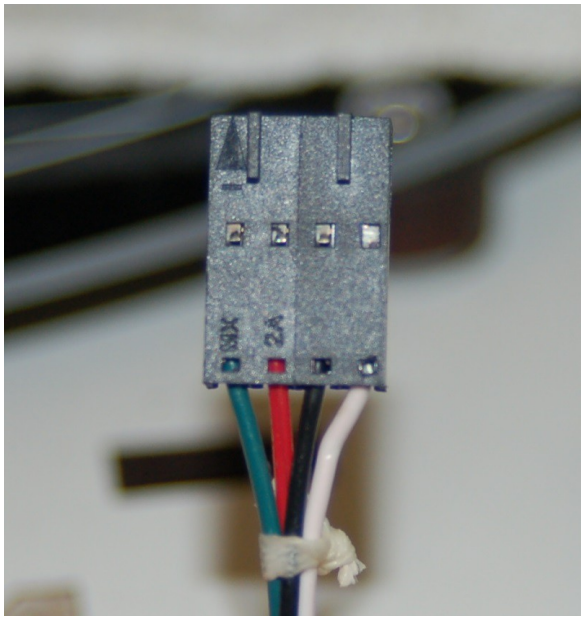


Fig. 18-20:Extruder extension connector installed.

Now bring out the stepper motor wires and connect them into the motor plugs along the bottom edge of the RAMBo controller. Each axis is labeled – make sure you match them up! The position marked "E" below is where the extruder extension goes that you just added a connector to.

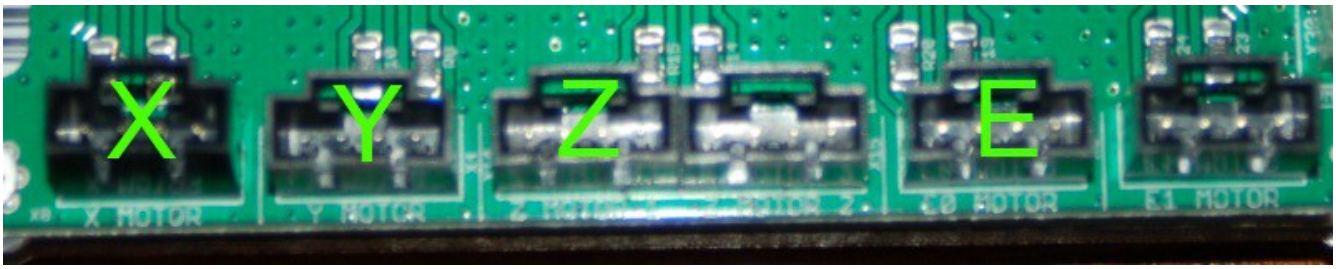


Fig. 18-21:Stepper motor connections.

The thermistor connections are next!

Plug the two pin thermistor wire coming from the hot end into the position marked “T0”.

Plug the two pin thermistor wire coming from the Onyx heated bed into the position marked “T2”.

Now you need to install the big power connector in to the socket on the upper right edge of the RAMBo board:

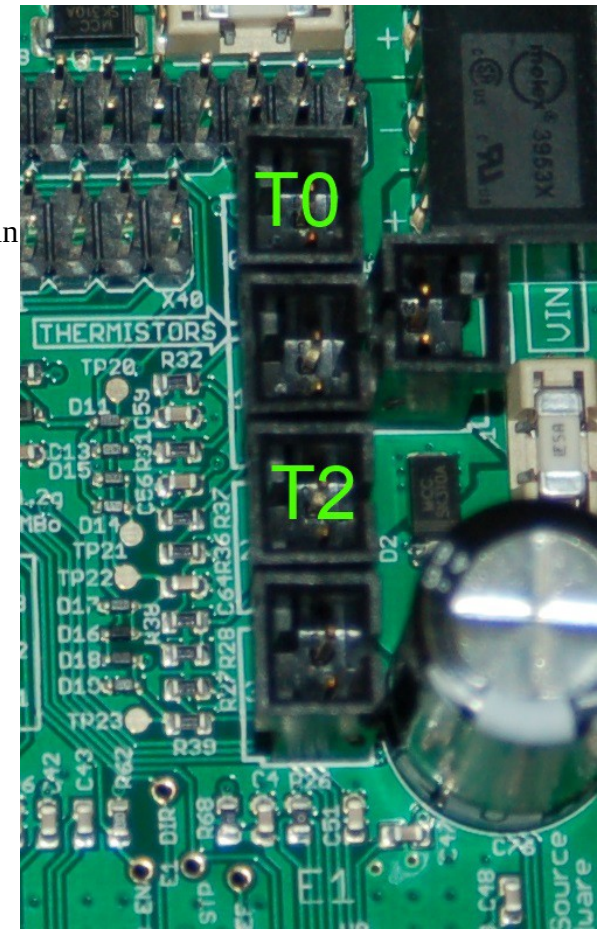


Fig. 18-22:Thermistor sockets.

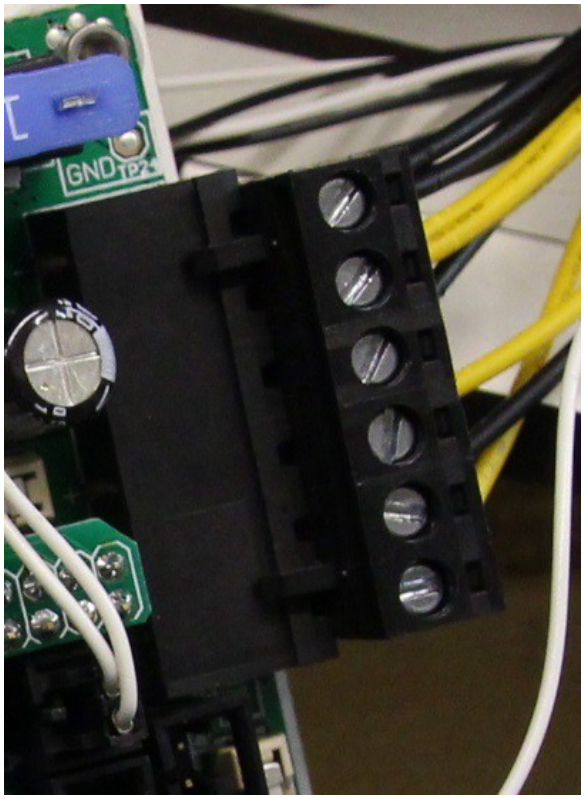


Fig. 18-23:Power connector installed.

Now the RAMBo board can be installed into the base of the printer.

The RAMBo mounting plate has two curved tabs that fit into slots located on the top plate of the base. When installed correctly, the tabs will fit into those notches and the base of the RAMBo mount will rest on the two support legs that you installed back in Chapter 4.

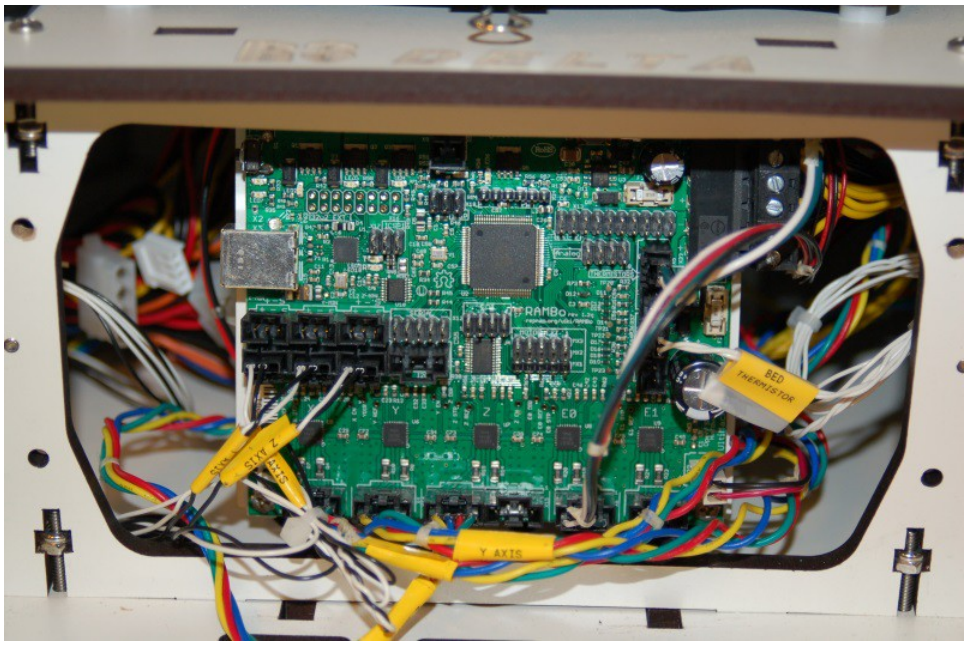


Fig. 18-24: RAMBo installed.

In Fig. 18-25, the green arrow indicates where the notches are that the tabs fit in, as well as the angle that the installed mount rests at.

The mount does provide enough clearance for the wires in the terminal block to pass between the RAMBo mount and the inside face of the top plate.

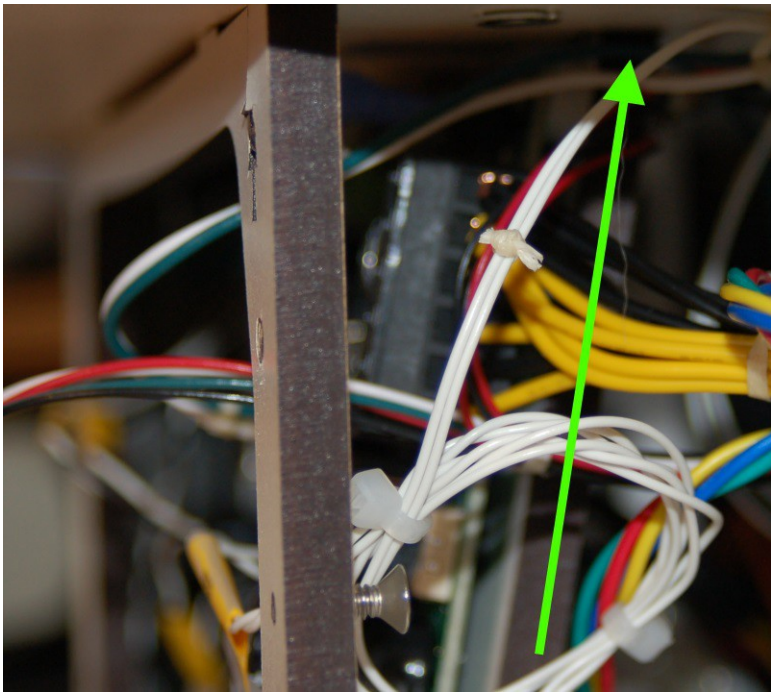


Fig. 18-25:Installation angle.

In the plastic box the LCD panel came in, you'll find two gray, flat ribbon cables. These cables connect the LCD to the RAMBo controller via the LCD interface board.

Label each end of one ribbon cable with the letter “A”. Label the ends of the other ribbon cable with a “B”.

Install the ribbon cables on the LCD interface board as shown below.

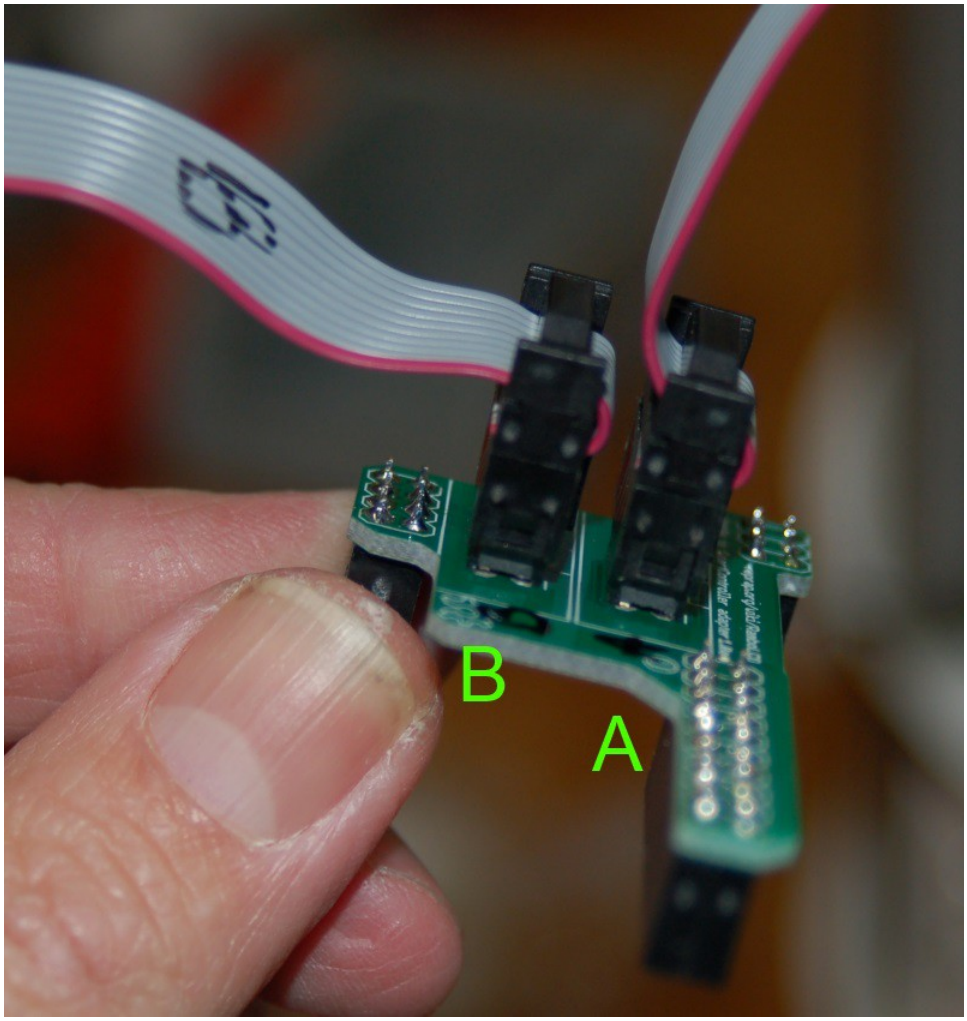


Fig. 18-26:LCD interface board.

Install the LCD interface board on to the RAMBo controller as shown. Wiring has been omitted for clarity.

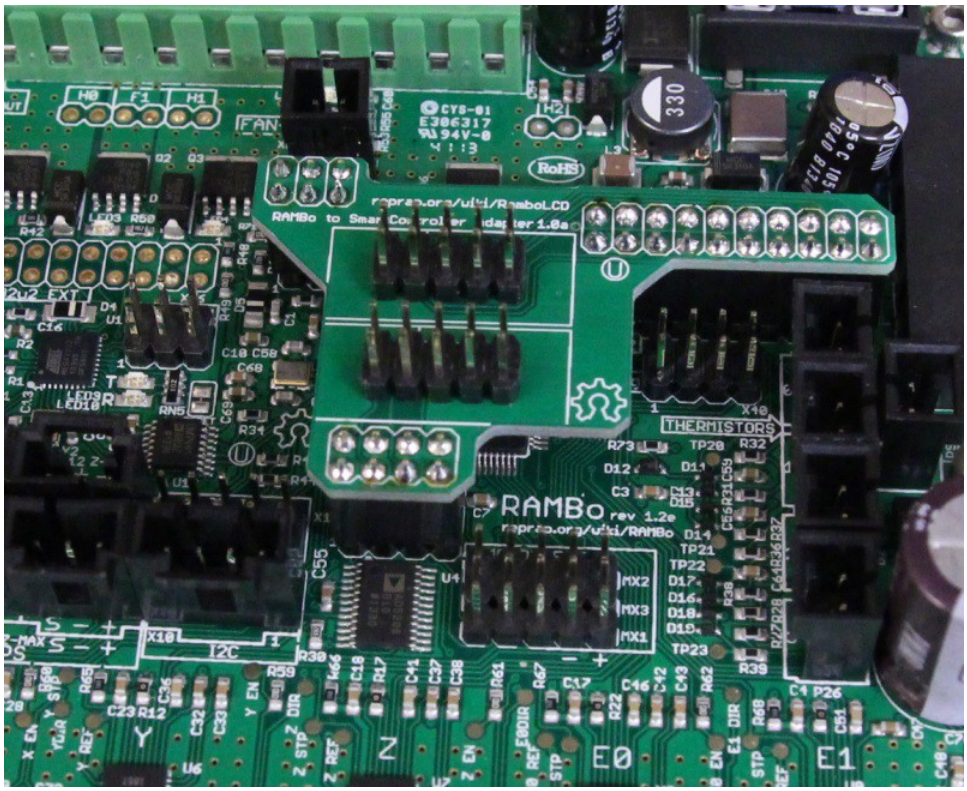


Fig. 18-27:LCD interface adapter installed.

Make sure that the interface adapter board is properly seated on the RAMBo board – it is possible to set the board down offset one row to the left or right and the LCD will not function.

The last step in this section will be to install the power switch.

Fig. 18-28:The Power Switch.

Remove the plastic nut from the power switch and route the black & green wires from the power supply through the nut and then up through the hole in the top plate as shown. Attach the spade connectors to the switch as shown in Fig. 18-30.

Fig. 18-29:Power switch mounting nut.

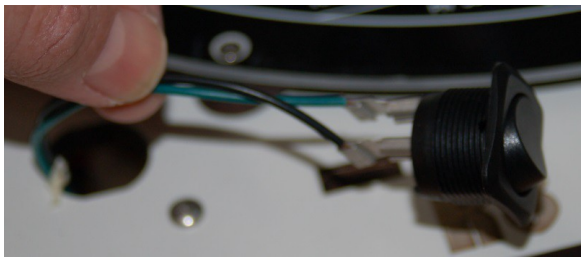


Fig. 18-30:Power switch connected.

Make sure you keep the power switch in the “off” position – as in Fig. 18-30.

Insert the power switch in the hole and thread the nut on to the lower switch body from below.

Fig. 18-31:Power switch installed.

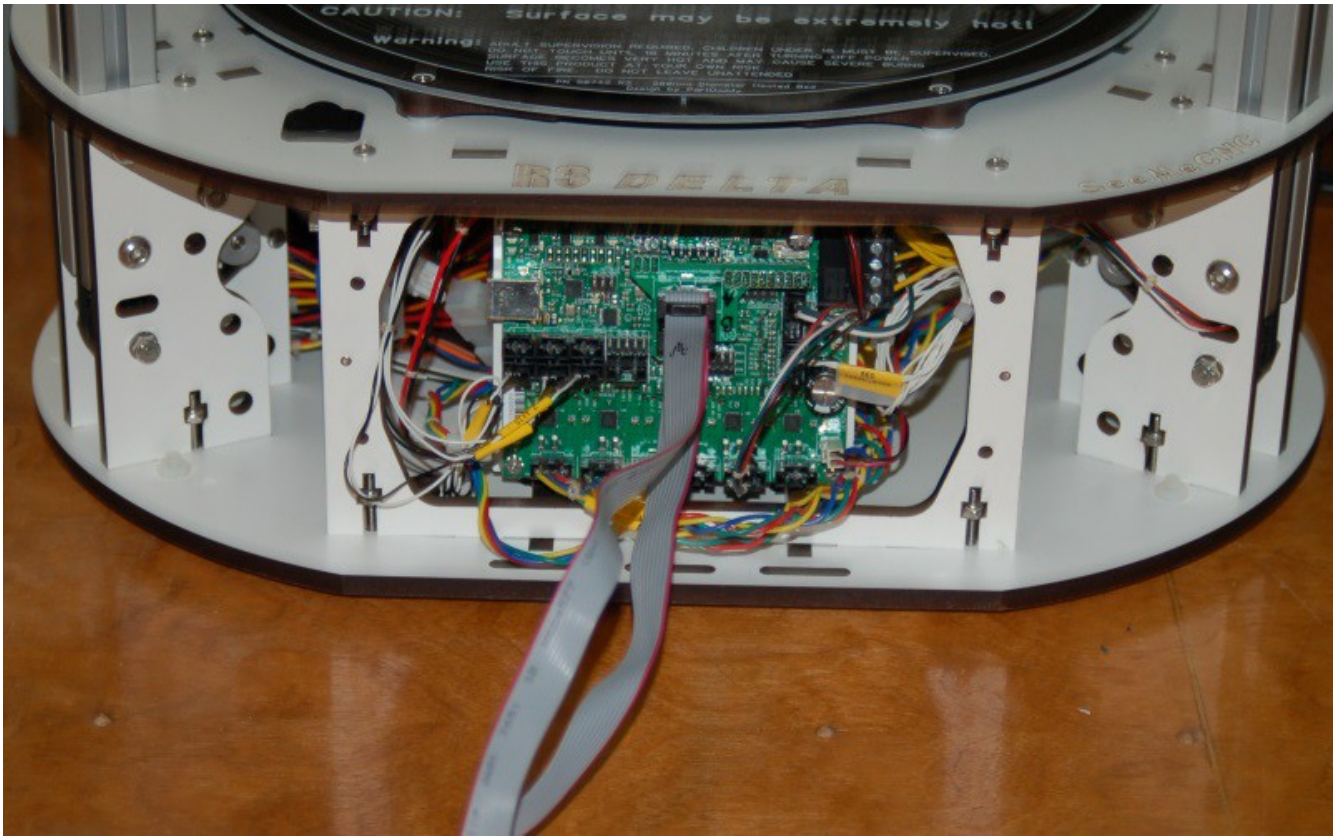


Fig. 18-31:RAMBo & Wiring complete!

19 – Final Assembly Tasks

Attaching the Base Covers & LCD Panel

For this task, you'll need the following components:

1. (___) #10-32, 3/4” Black Nylon Thumb Screws (6)
2. (___) Base Side Covers (2)
3. (___) LCD Front Panel (1) (Not Shown.)

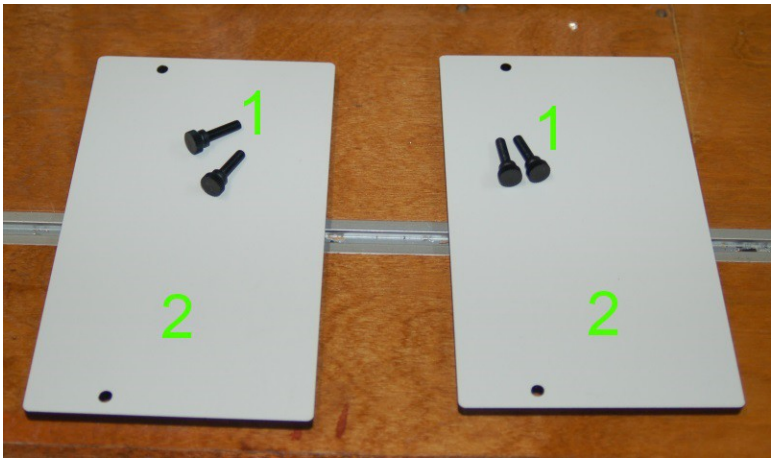


Fig. 19-1:Side Cover components.

In order to mount the side covers and the LCD panel you're going to have to tap the mounting holes on each vertical support. Yes, you get to go through the same adventure tapping these holes that you went through for the top cover mounting holes!

You'll need to tap the top two holes in each vertical support (highlighted in green).

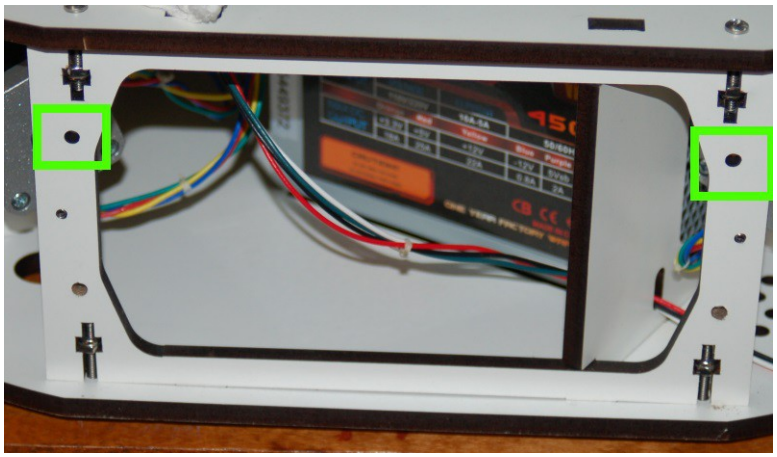


Fig. 19-2:Hole locations.

After you've got all six holes tapped, attach the two side panels as shown, using two #10-32, 3/4” thumbscrews for each panel.

Fig. 19-4:Side Panel installed.

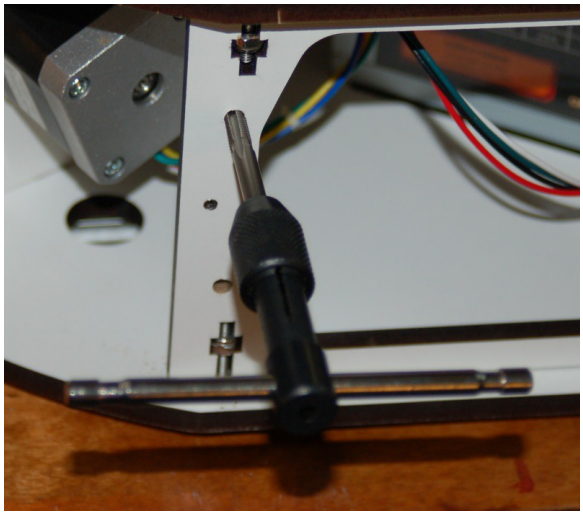


Fig. 19-3:Gene cheats.

Now grab the LCD panel and the last two thumbscrews.

Fig. 19-5:LCD Panel

Install the two gray ribbon cables from the RAMBo into the LCD controller as shown in Fig. 19-6. Make sure you match the “A” and “B” labels.

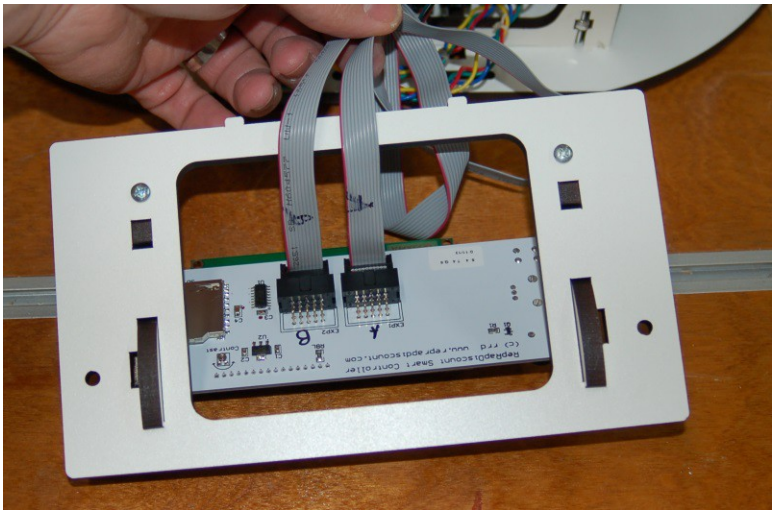


Fig. 19-6:Data cables for the LCD panel.

Fig. 19-7:LCD panel installed.

Attaching the Power and USB Cables

Attach the power cable to the power supply by routing the cable up through the hole int the bottom of the base as shown.

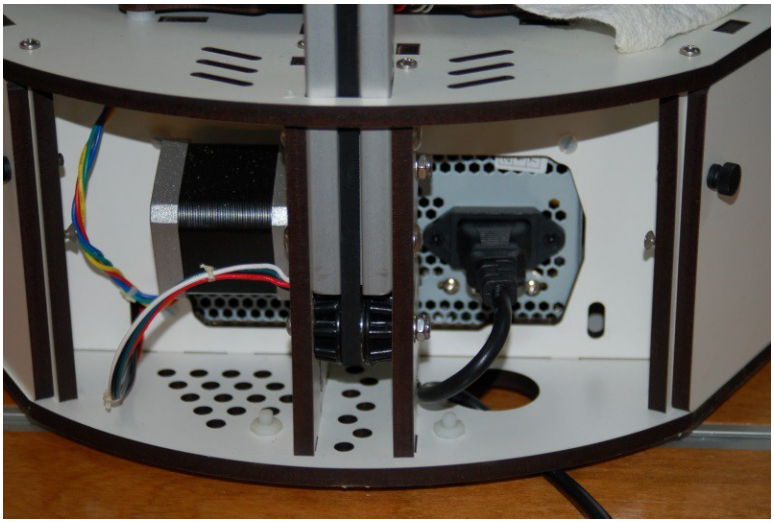


Fig. 19-8:Power cord installed.

When you install the power cord, make sure that the line voltage switch is set appropriately for your local power standard. If you're in the USA or a USA-compatible country, you can leave the voltage switch set the default, “115V”. If you're in Europe or in a country that uses 240V for line voltage, you'll need to slide the switch so it reads “240V”.

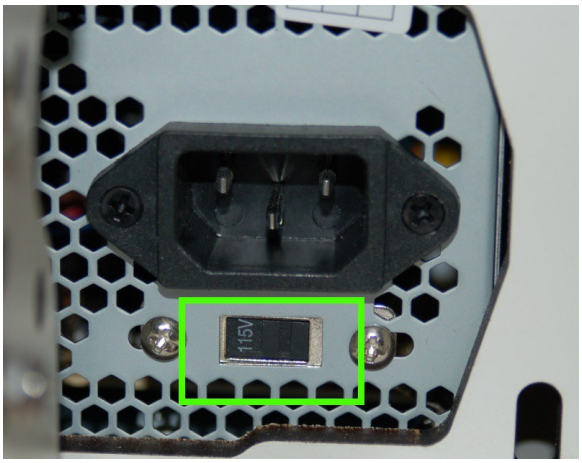


Fig. 19-9:Source voltage switch.

Route the USB cable up through the hole in the front of the machine and install it into the RAMBo as shown:

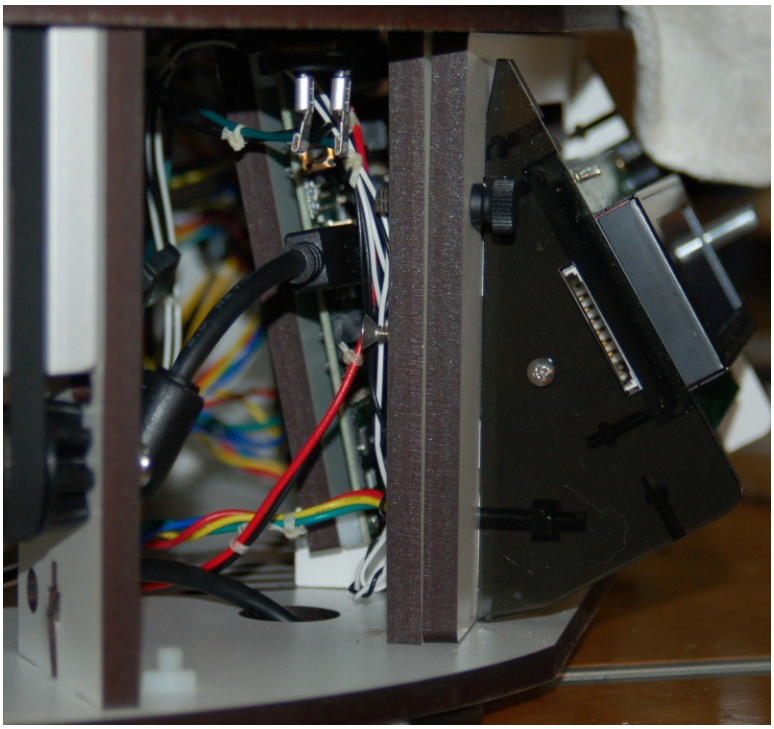


Fig. 19-10:USB cable installed.

Installing the Acrylic Cover Panels

The Rostock MAX v2 uses laser cut acrylic panels to cover the open spaces on the machine base and on the top assembly. The bottom uses two different sized panels. The one that covers the back of the Z axis is marked with a laser engraved “B” in the bottom corner.

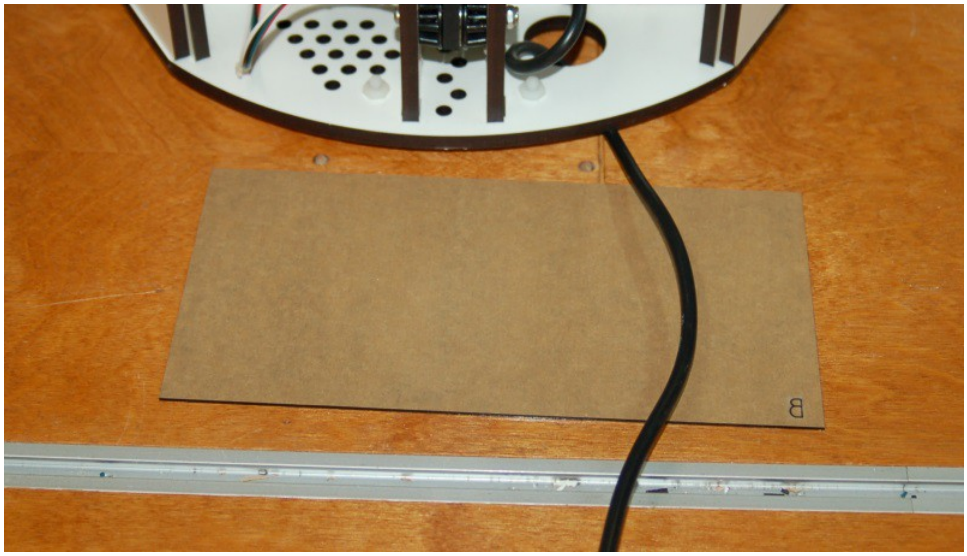


Fig. 19-11:Rear acrylic cover.

Peel the protective paper off the acrylic and install the panel by sliding just behind the left side until the acrylic stops on the 1/2” flat head screw that's installed on the vertical support.

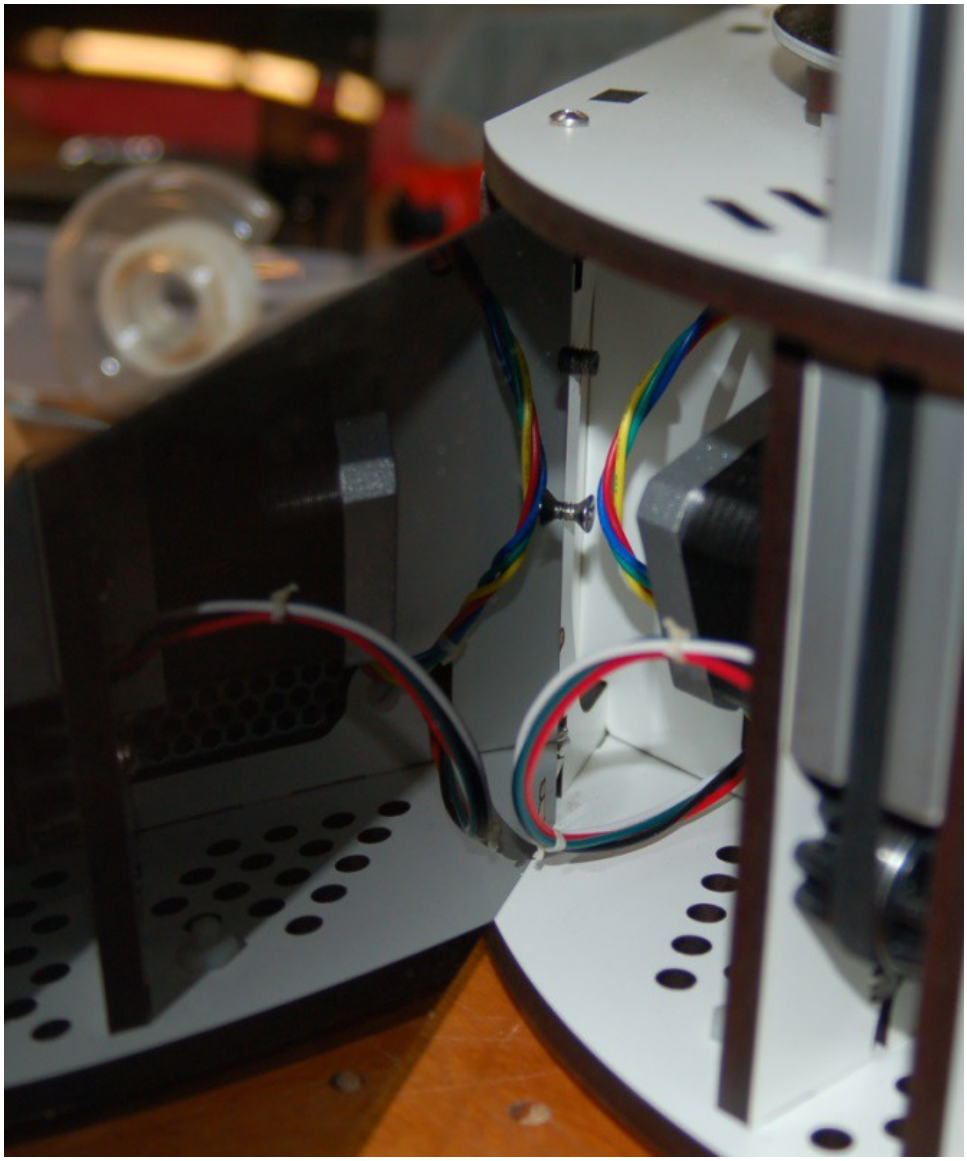


Fig. 19-12:Inserting the back acrylic cover.

Carefully bend the acrylic over the Z axis tower and insert it just behind the vertical support on the right. You want to set the panel such that the edge of the acrylic comes into contact with the stop screw that's highlighted in green. Please be careful – if the acrylic is bent too much, it can break.

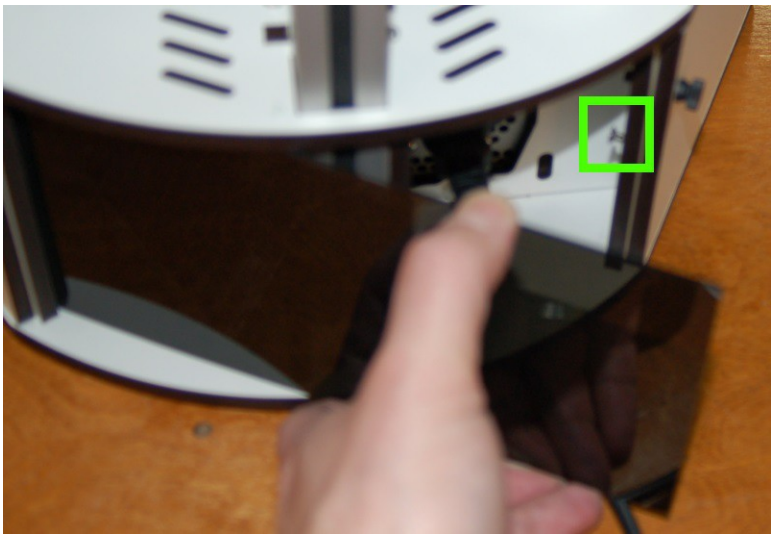


Fig. 19-13:Setting the back panel

Fig. 19-14:Panel installed.

The other two open spaces are filled by the two remaining large acrylic panels that are marked “R/L”.

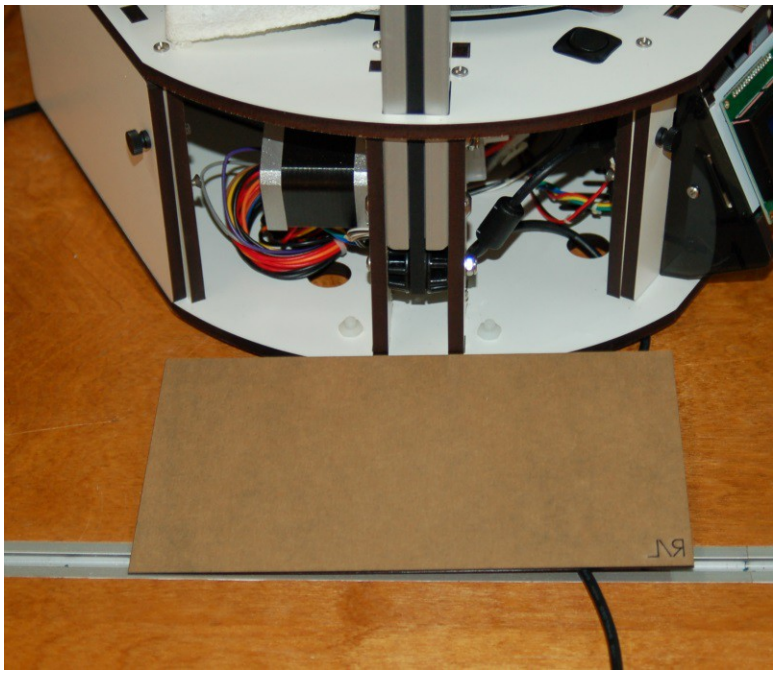


Fig. 19-15:Right & Left panels

Just like you did with the back panel, peel the protective film off and install the panels – make sure the engraved lettering is facing in.

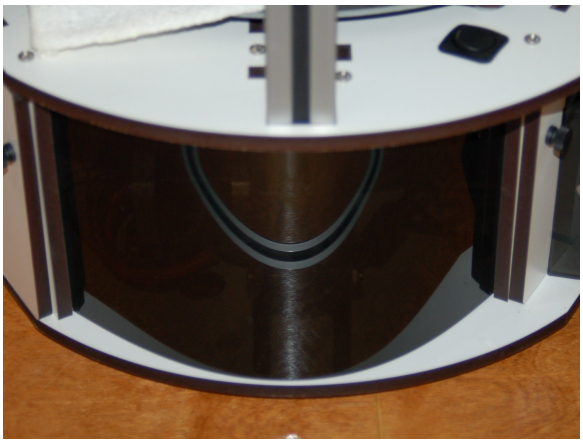


Fig. 19-16:Left cover in place.

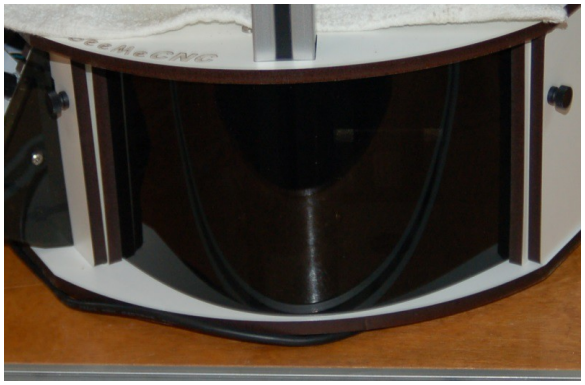


Fig. 19-17:Right cover in place.

Take the three small acrylic covers, peel their protective tape off and install around the top assembly just as you did the lower covers. All three should be the same size.

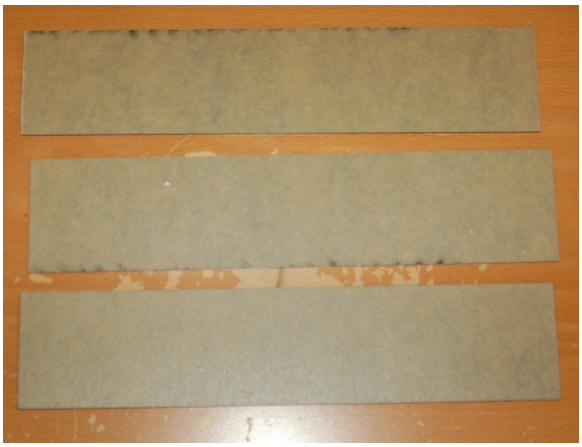


Fig. 19-18:Acrylic top covers.

Fig. 19-19:Covers in place.

The last thing to do is install the rubber “shoes” on the bottom of your printer.

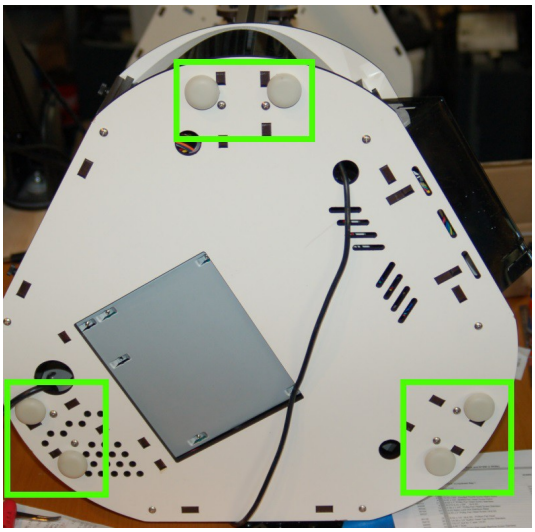


Fig. 19-20: We haz feets!

Now you can install the Borosilicate glass built plate on the Onyx heated bed. You'll need the glass plate and the included binder clips.

Center the glass plate on the Onyx and attach the binder clips as shown in Fig. 19-21.

One last thing (there's *always* something else, isn't there?) you should do is a final check of all your wiring in the Rostock MAX v2. Make sure no bare wire is touching any other bare wire, etc. Finally, plug the sucker in and hit the power switch. If everything works as expected, you should here the RAMBo cooling fan (if you listen closely) and the LCD display will display two rows of blocks and no readable text. This means that the RAMBo is active and waiting for a program upload. I'll cover the firmware upload next!

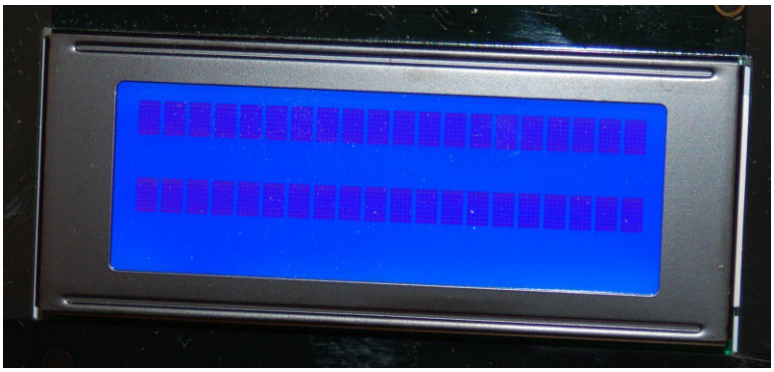


Fig. 19-20:Thousand yard stare, RAMBo style.

Congratulations, you've just successfully assembled the Rostock MAX v2 3D printer!

Kick back, relax and have your beverage of choice. You've earned it!

20 – Driver and Software Installation

The Rostock MAX v2 does not include the firmware required to operate it. This was a conscious decision by SeeMeCNC to encourage builders to become more proficient in the operation of their new 3D printer.

Downloading the tools necessary to build and upload Repetier-Firmware is simple and easy. However, before you get to that point, you're going to need to install a driver in order to communicate with the RAMBo controller. If you're using MacOS or Linux, you can skip the driver installation instructions.

Installing the RAMBo Driver

Download the USB Driver zip file from this location:

http://download.seemecnc.com/Software/RAMBo_USBdriver.zip

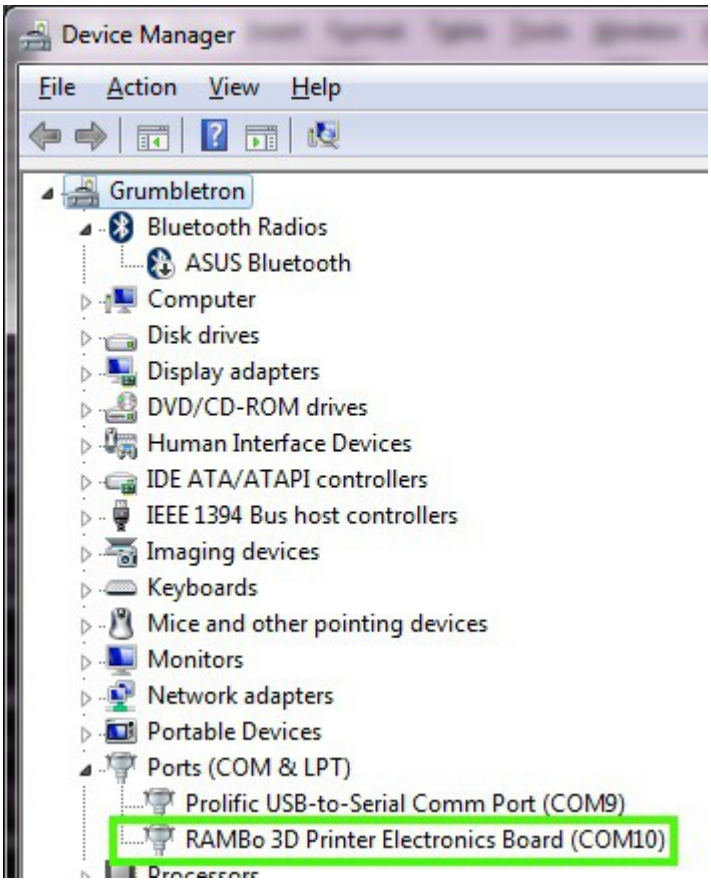
The driver will work with all versions of Windows – XP to v8.1.

If you haven't done so already, connect the Rostock MAX to your computer using the included USB cable and turn the Rostock MAX on using the power switch you installed previously.

Unzip the file to a temp directory or other place that you know the location of. For Windows users (and likely XP, Windows 8 and Vista users as well), plug in the RAMBo and let Windows “fail” to find the correct driver for the board. Open up the device manager by right-clicking on “Computer” or “My Computer” and select “Properties” followed by “Device Manager”. Scroll down to the “Unknown Devices” entry and right-click on the RAMBo entry. Choose “Update Driver” and then “Browse my computer for driver software” (or something similar to this). Choose “Let me pick from a list of device drivers on my computer”, then click the button for “Have Disk”. Browse to where you unzipped the file you downloaded and then click “OK”. It may complain (depending on OS) that the driver isn’t signed – allow it to install it anyway. That’s all there is to it. The RAMBo will now appear on your computer as a standard serial port. On my computer it appeared as COM10 – it will most likely be different on yours.

The easiest way to find out what port your RAMBo is listening on is to open up the Device Manager and look for the RAMBo entry. In order to discover this bit of information, you'll need to open up Device Manager (right click on My Computer, click “Properties” and then click “Device Manager”). You'll get a window that looks something like this:

The entry we're looking for is highlighted in green. Your “COM” entry will more than likely be different from mine. Write this entry down as you'll need it very soon.



Device Manager

Installing the Arduino IDE

In order to compile and upload the firmware to the RAMBo controller, you're going to need the Arduino IDE. This is an open source software development environment targeted at the Arduino family of ATMega-based microcontroller project boards. At its heart, the RAMBo controller is just an Arduino Mega 2560 with a *lot* of goodies attached to it.

You can download the Windows, MacOS and Linux version of the Arduino IDE from here:

http://arduino.cc/download

The version of the IDE used as of this writing is 1.0.5.

Install the Arduino IDE using the downloaded installer.

Now you need to download the firmware from SeeMeCNC's github repository.

https://github.com/seemecnc/Repetier-091-ROSTOCKMAX/archive/master.zip

Unpack the “master.zip” file that you downloaded into a directory where you can keep track of it. You may need to reference it in the future.

Start the Arduino IDE – you should be presented with a screen that looks like this:

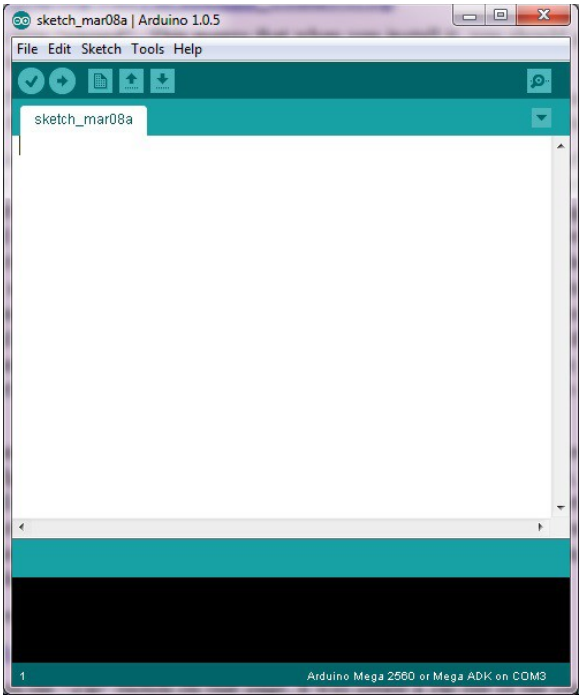


Fig. 20-1: The Arduino IDE.

Configuring the Arduino IDE

Before we can use the IDE to upload the firmware to the RAMBo controller, we need to tell the Arudino IDE what kind of board we have and what communications port it needs to use in order to perform the upload task.

Click on the “Tools” menu item and then click on “Board” and then “Arduino Mega 2560 or Mega ADK”.

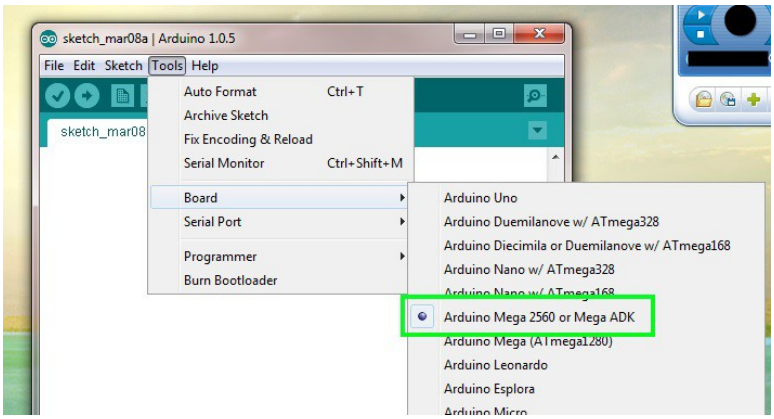


Fig. 20-2: Choosing the board type.

Next, you'll need to tell the Arduino IDE what port to talk to the RAMBo on. To do this, click on “Tools”, “Serial Port” and then choose the COM port that your RAMBo appears as on your computer.

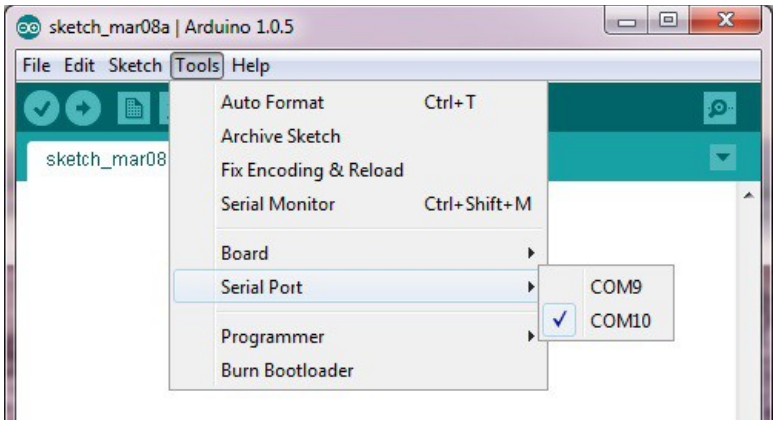


Fig. 20-3: Choosing the Serial Port.

Test Upload

Ok, now that you've got the Arduino IDE configured, we're going to do a quick task that'll do two things. First, it will validate that you've got the Arduino IDE configured properly and that you're able to connect and upload a program to the RAMBo controller. Remember – the RAMBo controller is just an Arduino Mega 2560 with a bunch of goodies piled on top!

Second, the program I'm going to have you run will clear the EEPROM on the RAMBo controller to make sure you start with a clean slate. The EEPROM is an Electrically Erasable Programmable Read Only Memory and it's where Repetier-Firmware will store settings. When you can store configuration information in the EEPROM, it means that you don't have to re-upload the firmware every time you make a change.

Click on “File”, “Examples”, “EEPROM”, and finally “eeprom_clear” as highlighted in green in Fig. 20-4.

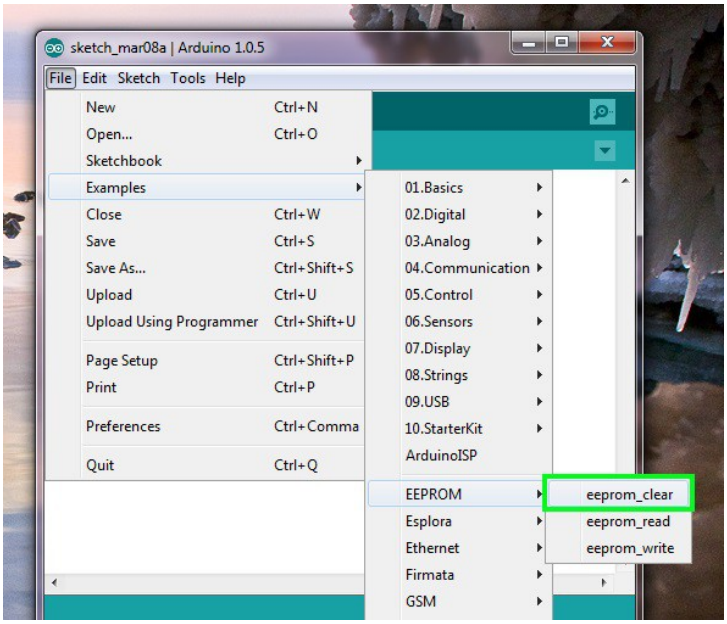


Fig. 20-4:Loading the eeprom_clear program.

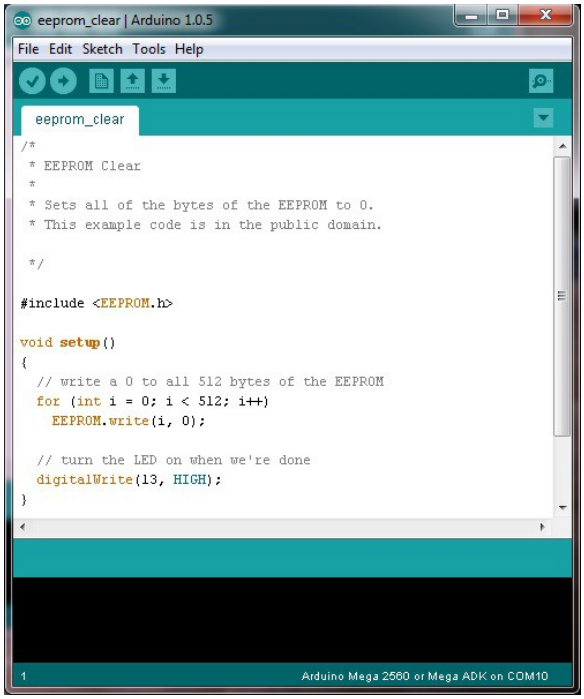


Fig. 20-5: eeprom_clear loaded and ready to go.

The only thing you need to do now is click the “Upload” icon in the Arduino IDE. The upload icon is represented by this symbol: 

Turn your Rostock MAX v2 on if you haven't already and then click the Upload icon.

When the upload is finished, you should see results similar to that in Fig. 20-6. The “Done uploading” is the status you want. There is no other external evidence that the eeprom_clear program has done its job, but it has!

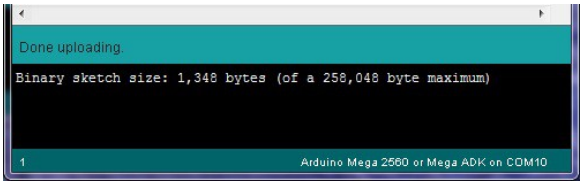


Fig. 20-6:Success!

Uploading Repetier-Firmware

Now it's time to load Repetier-Firmware into the Arduino IDE and upload it to the RAMBo controller!

Click “File”, “Open” and browse to where you unpacked the master.zip file you downloaded from the SeeMeCNC github repository. Select the file “Repeteir.ino” and click the Open button.

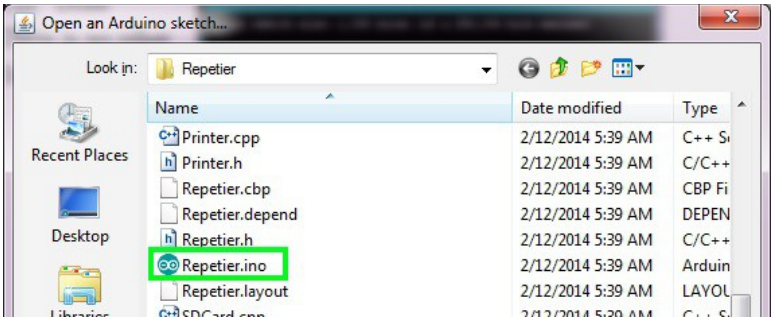


Fig. 20-7:Opening Repetier.ino

Once it's loaded up, the Arduino IDE is going to look something like this:

Go ahead and click on the Upload icon to send Repetier-Firmware to the RAMBo!

Depending on the speed of your computer, this could take up to a few minutes to accomplish. Be patient and wait for the “Done uploading.” status to appear just like it did when you uploaded the “eeprom_clear” program.

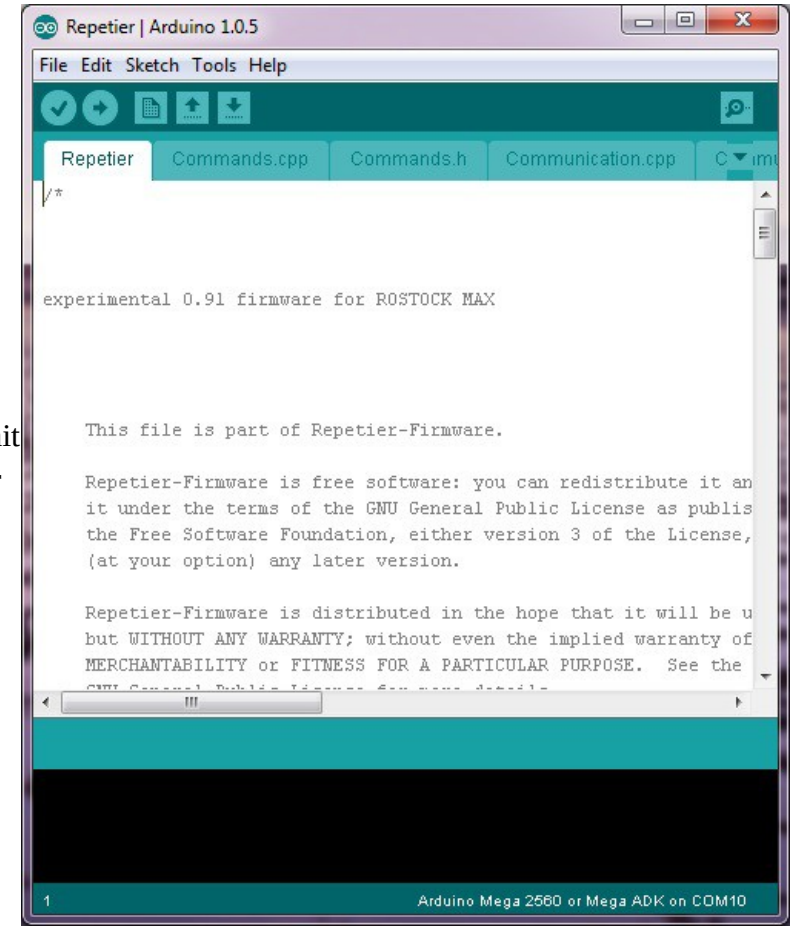


Fig. 20-8: Repetier-Firmware in the IDE.

When the upload has finished the RAMBo will restart and you should see the following display on the LCD:

*Fig. 20-9: It's **ALIVE**!*

Congrats again! You've got a living, breathing (hey, work with me here!) 3D printer that you've *built yourself.*

If for some weird, inexplicable reason you do NOT see that display (or something very, very similar!), carefully retrace your steps. Start back at the beginning with the eeprom_clear test and go from there. If you still don't get a working display please contact support@seemecnc.com right away!

If your kit was shipped with the Kysan stepper motors (we covered that earlier, remember?), you're going to need to make a small tweak to the firmware in order to adjust the current drive that they need.

Click on the tab in the Arduino IDE marked “Configuration.h”. At line #701, you should see this text: #define MOTOR_CURRENT {175,175,175,200,0}.

Change that line to this: #define MOTOR_CURRENT {155,155,155,165,0}

Save your changes and upload the updated firmware to the RAMBo, just like you did in the prior step.

The LCD and Front Panel Controls

Let's go over what information the LCD displays and what the front panel controls do.

Fig. 20-10:Default LCD display.

1. Nozzle Temperature. This is the temperature at the nozzle as measured by the thermistor that you installed when you put the hot end together. It reads in degrees Celcius – you'll find quickly that just about everything to do with 3D printing is done in Metric units of measure. FYI, 18.4C is 65.12F.
2. Target Nozzle Temperature. When you're printing a part, this field will show you what temperature you've set the hot end to.
3. Bed Temperature. This is the temperature of the Onyx heated bed as measured by the thermistor that you installed in the center of the bed. Just like the nozzle, it reads in Celcius.
4. Target Bed Temperature. This displays the temperature that you've set the Onyx to heat to.
5. Speed Rate. This is the speed multiplier field. Normally it will read 100%, but if you've changed the speed control from Repetier-Host, this number will display what that setting is. We'll get into this in more detail later.
6. Flow Rate. This shows the current flow rate of the extruder. This is also a field that is controlled from Repetier-Host.
7. Status Line. This is a multi-purpose display field that will change depending on what the printer is currently doing.

The front panel:

Fig. 20-11:The Front Panel.

1. The LCD Display. (but you knew that, right?)
2. Beeper. That's it does. Beeps. (and beeps, and beeps and beeps...)
3. Input Controller. Turning the knob clockwise & counter clockwise is how you navigate through the LCD menus. Pressing the button straight in acts similarly to a mouse click – it selects the current menu item.
4. Emergency Reset Button. When you hit that button, a number of things are going to happen. First, the RAMBo is going to turn off both the heat bed and the nozzle heaters. Next, it's going to send all three Cheapskates to their “home” positions at the top of the Rostock MAX v2 and then the RAMBo controller will reboot itself. If the printer is really going nuts on you, this is the fastest way to make it behave.

The last thing I'm going to cover in this section is the “activity” display that the LCD can show you. Turn the knob either direction and you'll get a display that looks something like this:

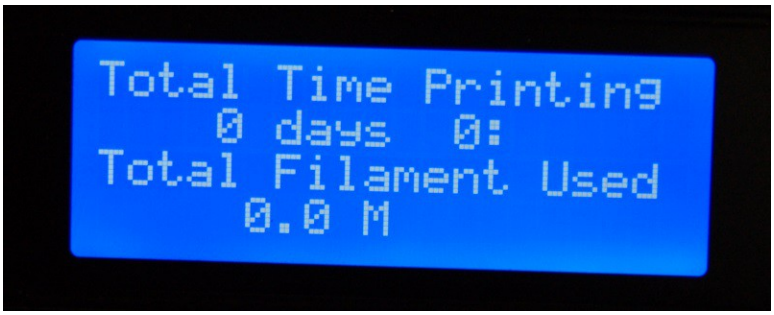


Fig. 20-12:Activity display.

This will tell you at a glance how much time your Rostock MAX v2 has spent printing and how much filament it's used in the process. The time display breaks down into days, hours and minutes. The filament display shows filament used in fractional meters.

Now let's get this thing calibrated and printing!

21 – Installing Repetier-Host and Calibrating the Printer

This is the fun part! The Rostock MAX v2 3D printer is very easy to calibrate, but it can take some time and a number of iterations to get it as good as you can. You'll want to take your time here because the better you calibrate the printer, the better it will perform.

Downloading, Installing, and Configuring Repetier-Host

The “host” software of choice for the Rostock MAX is called Repetier-Host.

Repetier-Host is a full featured and multi-platform host interface for 3D printers. There are other host interfaces out there such as Octoprint and Pronterface, but this guide will only cover Repetier-Host.

Repetier-Host can be downloaded from http://repetier.com. Click on the “Download” link.

The Repetier-Host installer for Windows also includes the latest stable release of Slic3r, which is the tool we'll be using to “slice” 3D models into a form that the Rostock MAX can print.

After the download completes, run Repetier-Host and click on “Config” and then “Printer Settings”.

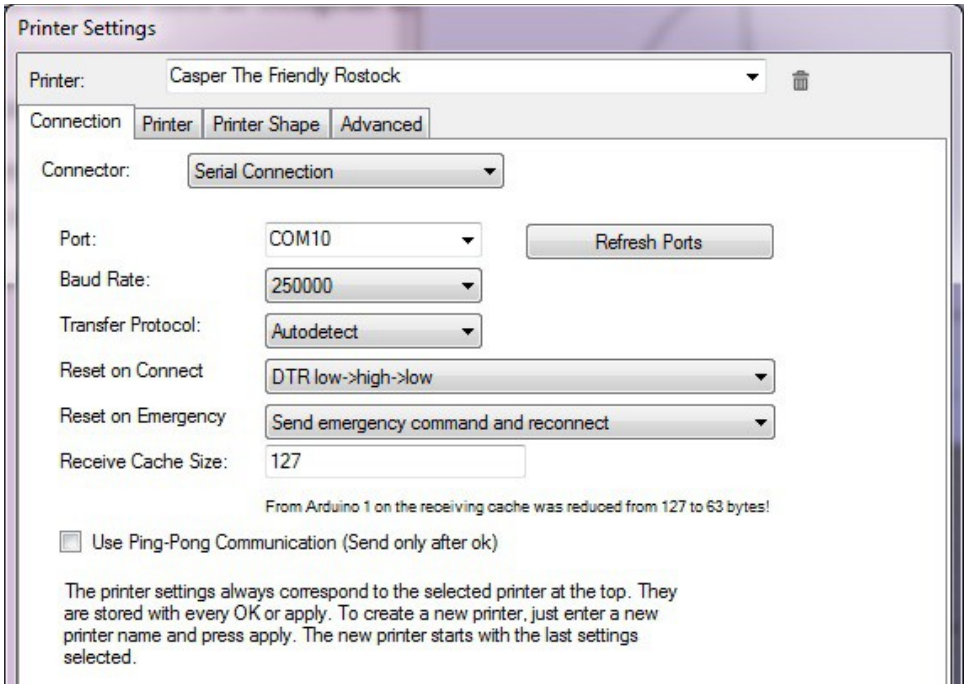


Fig. 21-1: Printer Configuration - Connection.

The first thing you should do is click in the “Printer:” box at the very top and type in a name for your Rostock MAX v2 3D printer. I've named mine “Casper The Friendly Rostock”. (quit laughing)

Click the drop-down next to the “Port:” label and choose the COM port that you used to upload the firmware to the RAMBo with – they're the same. Make sure the rest of the settings on the Connection tab are exactly as shown for your set up.

Now click on the “Printer” tab.

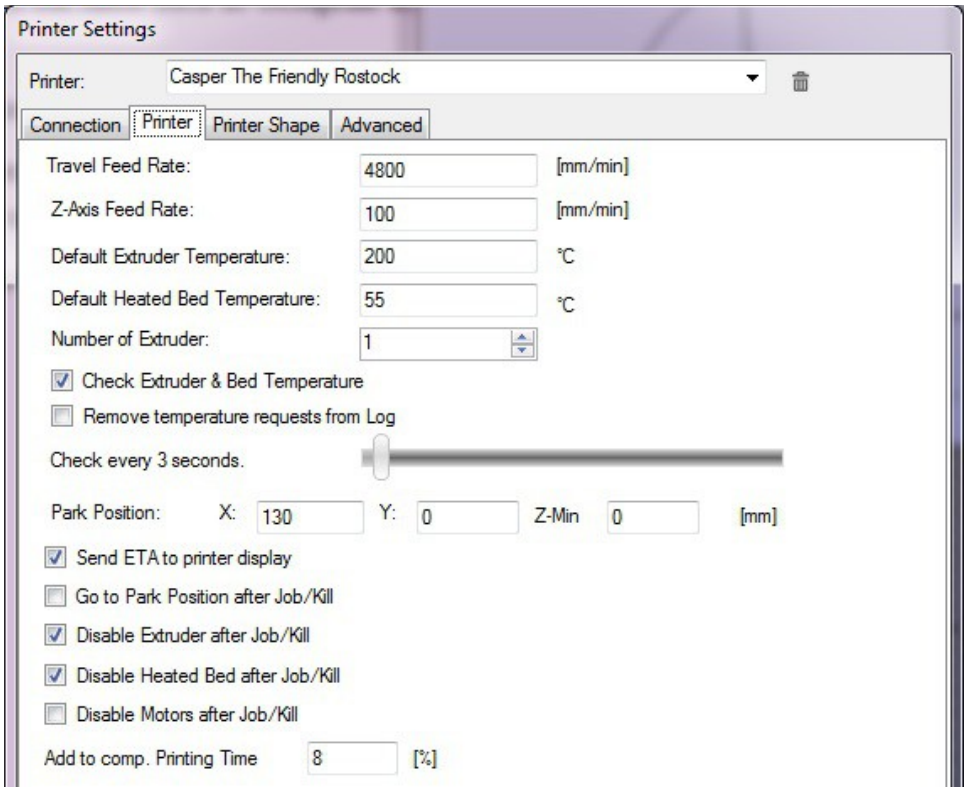


Fig. 21-2: Printer Settings - Printer.

Go over each setting shown above and make your Printer tab setting match those shown. When you're done, click the “Printer Shape” tab.

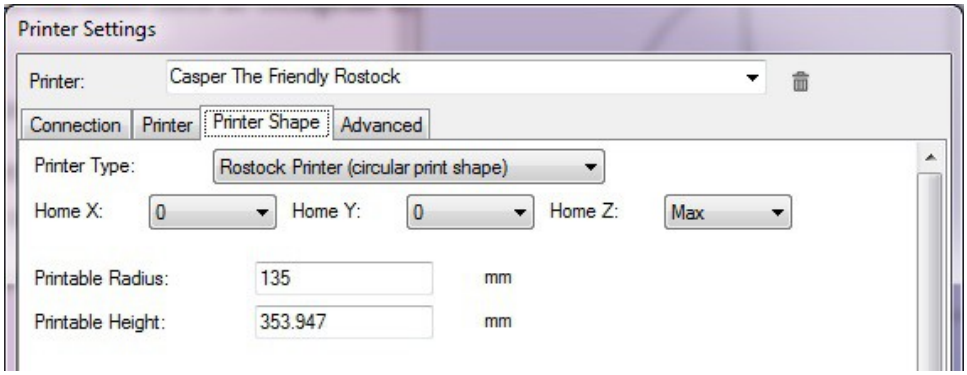


Fig. 21-3: Printer Settings - Printer Shape

Just like you did for the Printer tab, make sure your Printer Shape settings match the above example. You'll be changing the Printable Height field to precisely match your printer's height shortly.

Click the “OK” button to save your changes.

Click on the “Connect” icon to start Repetier-Host talking with your printer. If your connection is successful, you'll see a display similar to the example below appear in the Repetier-Host log window.

```
start
Free RAM:1143
X:0.00 Y:0.00 Z:0.00 E:0.00
FIRMWARE_NAME:Repetier_0.91 FIRMWARE_URL:https://github.com/seemecnc/Repetier-091-ROSTOCKMAX PROTOCOL_VERSION:1.0 MACHINE_TYPE:ROSTOCK
Printed filament:0.00m Printing time:0 days 0 hours 0 min
```

Fig. 21-4: Successful connection.

Initial Function Tests

Now we need to perform a test of the end-stop switches to make sure that they're functioning correctly.

Click on the “Manual Control” tab that's located in the right half of the Repetier-Host display window:

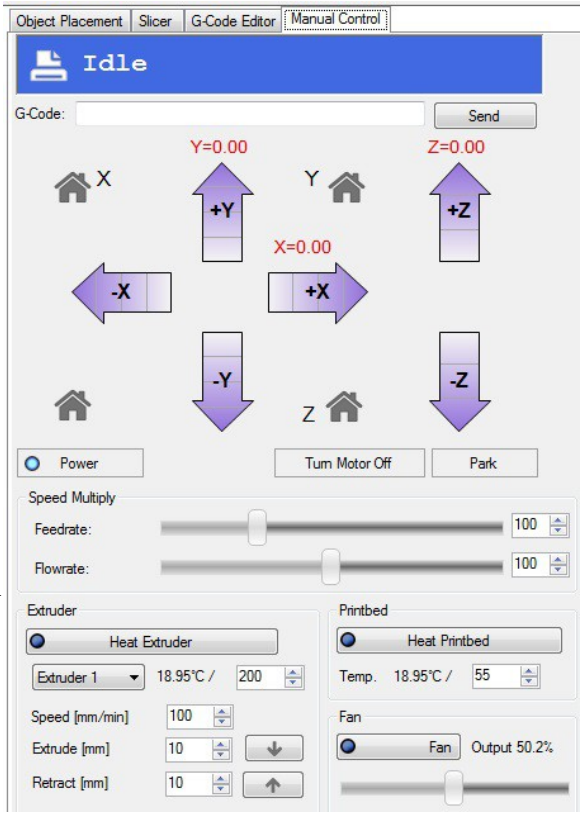


Fig. 21-5: The Manual Control Tab.

This is the Manual Control Panel and is the interface you'll use most often while working with the Rostock MAX v2. From here you can home the machine, move it around the work area, heat the hot end or heated bed, turn on fans, etc.

The next tests you're going to run make frequent use of the “G-Code:” input area on the Manual Control Panel. This is how you send commands directly to the RAMBo. Any time you see me write “Send the …. command”, I'm referring to you typing out the command exactly as written in the G-Code input box and press the ENTER key to send the command to the RAMBo.

The first test that you need to perform is on the end stop (or “limit”) switches that you installed at the top of each tower.

In order to test them, click your mouse in the “G-Code:” box and type: **M119** and then press **ENTER.** Make sure that the end stop adjustment screws are not in contact with the switches. If they are, move the platform down by hand a little bit to get them to disengage the switches.

In the log window, you should see the following text appear:

x_max:L y_max:L z_max:L

This indicates that all three end-stop switches have not been pressed. If you see anything different, please check your wiring! Now I want you to hold down the switch lever for the X axis and re-run the M119 command. You should see the **x_max** value change to “H”. Do this for the Y and Z axes. This will ensure the end stop switches are functioning – this is very important for the next step!

The next test we're going to perform involves making sure that the stepper motors on the towers are wired correctly. Every once and a while we'll see a stepper motor with the connector wired correctly, but the internal wiring is *backwards*. Maybe the elves that build stepper motors were having a bad cookie day or something. Let's find out if you won a bad cookie motor!

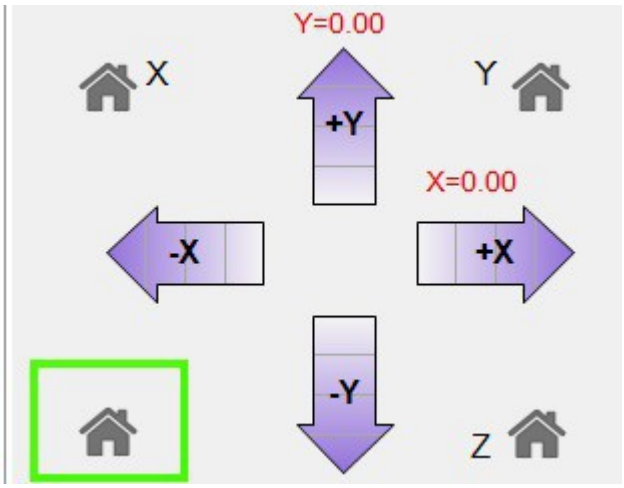


Fig. 21-6: The Home All button.

Place one hand on the power switch and then on the Manual Control tab, click the Home All icon. It's shown above in green. This will tell the Rostock MAX v2 to send the Cheapskates to their "home" position. What *should* happen is that all three Cheapskates should head for the top of the machine. What *might* happen is one more Cheapskates will head *down.* This is A Bad Thing.

If any of the Cheapskates head down, turn off the printer right away! We're going to need to tweak the firmware in order to fix this problem. Make sure you note which axis (or god forbid, AXES) enjoy the cookie motor. We'll need to know that in order to make our firmware fix.

If you need to apply this fix, click the "Disconnect" icon in Repetier-Host and then open up Repetier-Firmware in the Arduino IDE. Click on the tab marked "Configuration.h". You may need to increase the width of the IDE window in order to see that tab.

Scroll down until you find a small section marked "// Inverting axis direction".

```
// Inverting axis direction
#define INVERT_X_DIR true
#define INVERT_Y_DIR true
#define INVERT_Z_DIR true
```

Fig. 21-7: Inverting axis direction.

Once you've located this area, I want you to change the entry that corresponds to your misbehaving motor from **true** to **false**. If you have more than one, change those as well. For example, if your Y axis Cheapskate headed for the floor when you hit the reset button, you'll change **INVERT_Y_DIR** to **false**. Once you've made your changes, click “File”, “Save” and then hit the Upload icon to send your updated firmware to the RAMBo controller.

Once the upload finishes, click the Connect icon in Repetier-Host to reconnect to the printer.

The next test involves moving the axes around to make sure they're free and clear and there's no “bad” noises going on.

Click the Home All icon – the axes should travel all the way up and “bounce” off the limit switches.

Send “**G0 Z200 F3500”**. This will move the effector platform down a few centimeters. The idea is to get them off the end stops so we can move things around a bit.

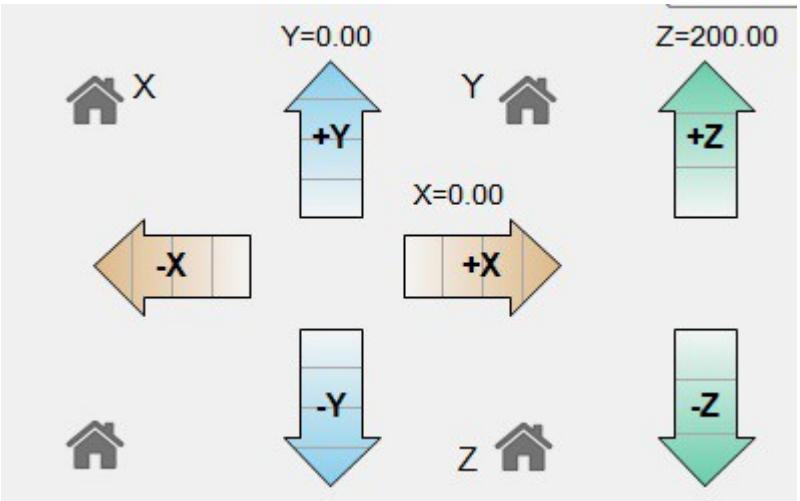


Fig. 21-8:Axis Motion Controls.

Fig. 21-8 shows the manual controls you have for moving the machine around. Each movement arrow is broken up into four sections. Each section represents a unit of motion. Hover your mouse over one of the arrows and the center will display the amount of motion it will cause when clicked.

For example, if you place your mouse cursor over the third “segment” from the left on the +X arrow, you'll see the following:

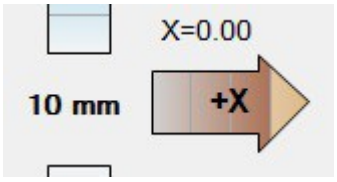


Fig. 21-9: Travel amount indication.

Experiment with how the machine moves by clicking around the various arrows. Be careful not to drive the hot end outside the boundaries. While learning how the motion controls work, please keep the Z height (the distance from the tip of the hot end to the build surface) a few inches above the build platform. We haven't set the Rostock MAX's true Z height yet and you don't want to smash the hot end into the bed by accident.

The last test involves checking the basic function of both the hot end heating resistors and the heated bed. For this test, you're only going to turn them on long enough to verify that they're indeed heating up as they should.

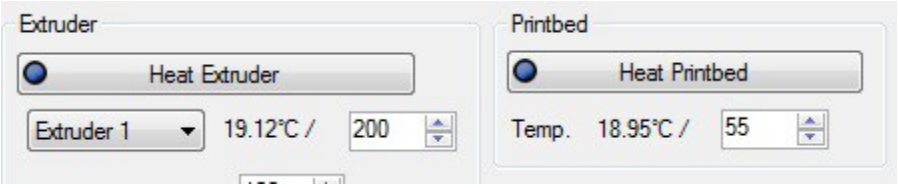


Fig. 21-10: Extruder and Heated Bed controls.

Make sure the target temperature field (“200” above) is set to 200 and then click on the “Heat Extruder” button. Once you see the target temperature (“19.12” above) begin to climb, wait 3 seconds and the click the Heat Extruder button to turn it off. Perform the same test with the print bed by clicking on the “Heat Printbed” button. You'll notice that after you turn the heaters off that the temperature will continue to climb for a short time. This is normal behavior. It' just like a burner on a stove. When you turn it on for a short time and turn it off again, it'll still continue to heat for a short time until the surrounding air can cool it down.

The reason you don't want them to reach the target temperature is because the PID loops need to be calibrated before they can be used for printing. (See: http://en.wikipedia.org/wiki/PID_controller for more information on the system the Repetier firmware uses to control the hot end and heated bed temperatures.)

Printer Calibration

Okay, now that you've spent the last 5 minutes (Who am I kidding? You've been poking at it for at least an hour, giggling like a little kid. Your dignity is the first casualty of having your own 3D printer. Don't worry, you're in good company.) moving the hot end around and seeing how it works, now it's time to get it calibrated so you can begin printing your army of squirrels and Yoda heads.

In order for the mechanical calibration to be accurate, we need to do the steps with the Rostock MAX at operating temperature. This means that both the hot end and heated bed must be at the temperature they'd normally be at while printing.

It's very important that the temperature controlling algorithm in the RAMBo (the PID loop) be as accurate as possible. To do this, we need to run what is called the “PID Auto tune” routine. This is a firmware function that you run in order to determine the best values for the P(roportional), I(ntegral) and D(erivative) values used by the PID loop.

First, let's start the auto tune routine for the hot end:

Send the command “**M303 S200”**. This begins the auto tune process and when it starts, it begins to add data to the log window at the bottom of the Repetier-Host display. The target temperature for this process is 200C (that's what the “**S200**” is for).

It will begin with the entry, “PID Autotune start”. You'll notice that the temperature in the hot end will begin to climb. A few minutes later, you'll start to see more information appear in the log window. IMPORTANT: Your hot end may smoke a *tiny* amount when reaching temperature. If it smokes a *LOT*, power off the printer immediately and check your wiring and make sure no damage has been done! Correct any wiring errors you find, repair any damage done and start this task again.

While it's working, click on the “Temperature Curve” tab in the main Repetier-Host window:

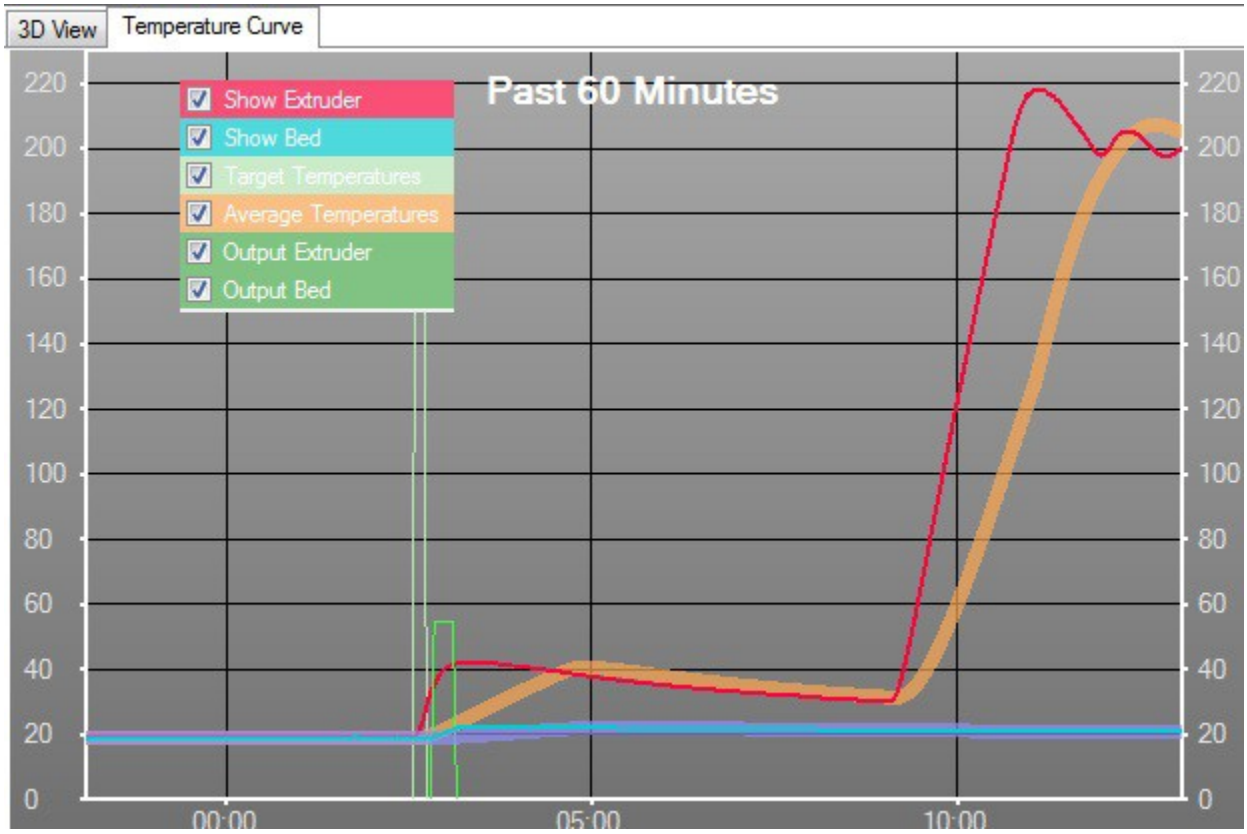


Fig. 21-11: Hot end temperature graph during PID auto-tune process.

Fig. 21-11 shows how well the controller manages temperature over time. The display we're interested in right now are the red and brown lines. The thin red line represents the actual hot end temperature and the brown line shows an average of the recorded temperature. After a short time, the display will look something like this:

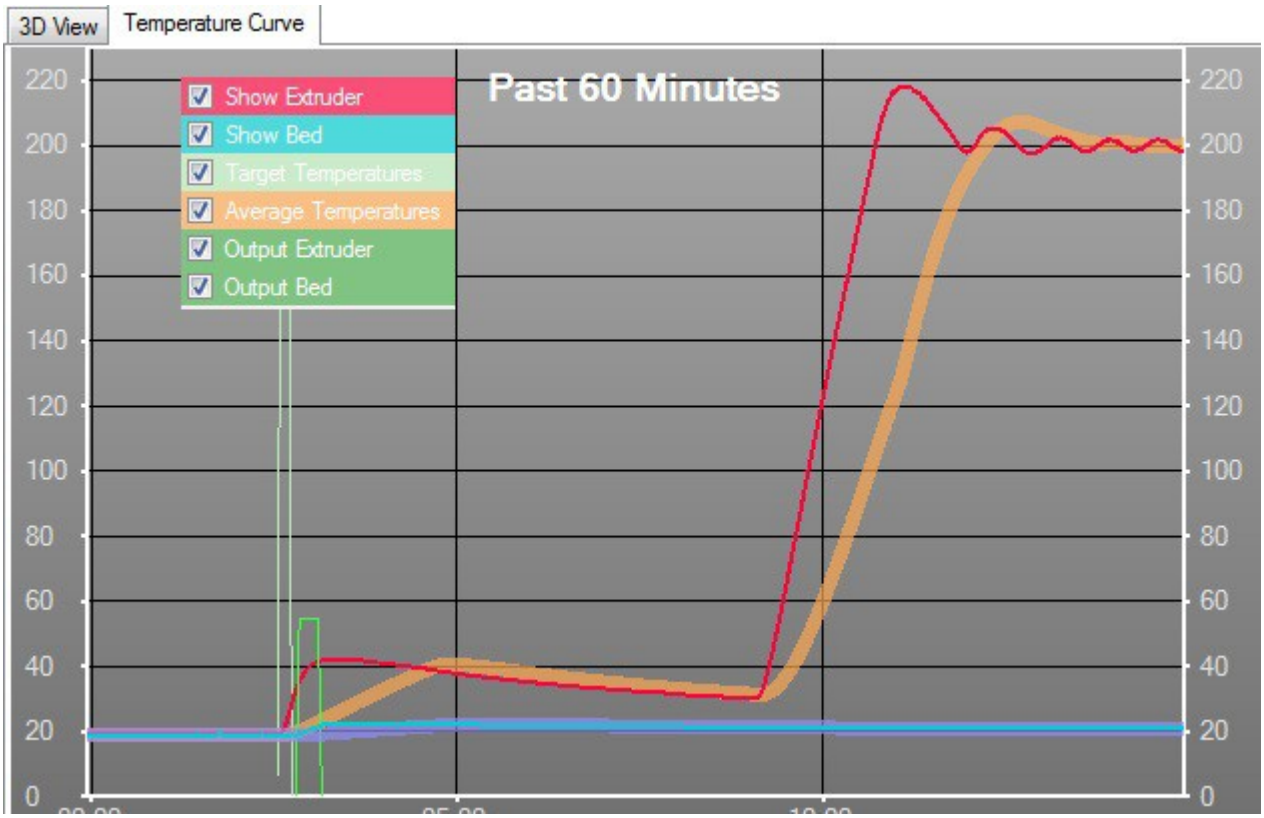


Fig. 21-11: Reaching and holding a target temperature.

You can see the PID auto tune function is “learning” how to better manage the temperature in the hot end. As time goes on, the actual temperature begins to hold to the center of the average target temperature.

In a few minutes, the routine will complete, and you'll get output similar to the below example:

```
18:09:03.735 : Info:PID Autotune start
18:12:41.024 : bias: 68 d: 68 min: 198.03 max: 205.37
18:13:27.277 : bias: 67 d: 67 min: 197.58 max: 202.59
18:14:06.978 : bias: 65 d: 65 min: 198.18 max: 202.22
18:14:06.978 : Ku: 20.48 Tu: 39.70
18:14:06.978 : Classic PID
18:14:06.978 : Kp: 12.29
18:14:06.978 : Ki: 0.62
18:14:06.978 : Kd: 60.99
18:14:46.629 : bias: 62 d: 62 min: 198.18 max: 202.04
18:14:46.629 : Ku: 20.48 Tu: 39.65
18:14:46.629 : Classic PID
18:14:46.629 : Kp: 12.29
18:14:46.629 : Ki: 0.62
18:14:46.629 : Kd: 60.89
18:15:26.247 : bias: 62 d: 62 min: 198.18 max: 201.67
18:15:26.247 : Ku: 22.65 Tu: 39.62
18:15:26.247 : Classic PID
18:15:26.247 : Kp: 13.59
18:15:26.247 : Ki: 0.69
18:15:26.247 : Kd: 67.31
18:15:26.251 : Info:PID Autotune finished ! Place the Kp, Ki and Kd constants in the Configuration.h or EEPROM
```

The values that you're interested in are the “Kp”, “Ki” and “Kd” values. There are three blocks of these values, each under the heading “Classic PID”. Create an average of all the values (add up all the Kp values, divide by three. Do the same with the Ki and Kd values) and we'll get them added to the proper spot in the EEPROM table.

In order to store your new set of PID values, we need to open up the EEPROM table in Repetier-Host. Click on “Config” and then “Firmware EEPROM Configuration”. This will bring up the EEPROM table editor.

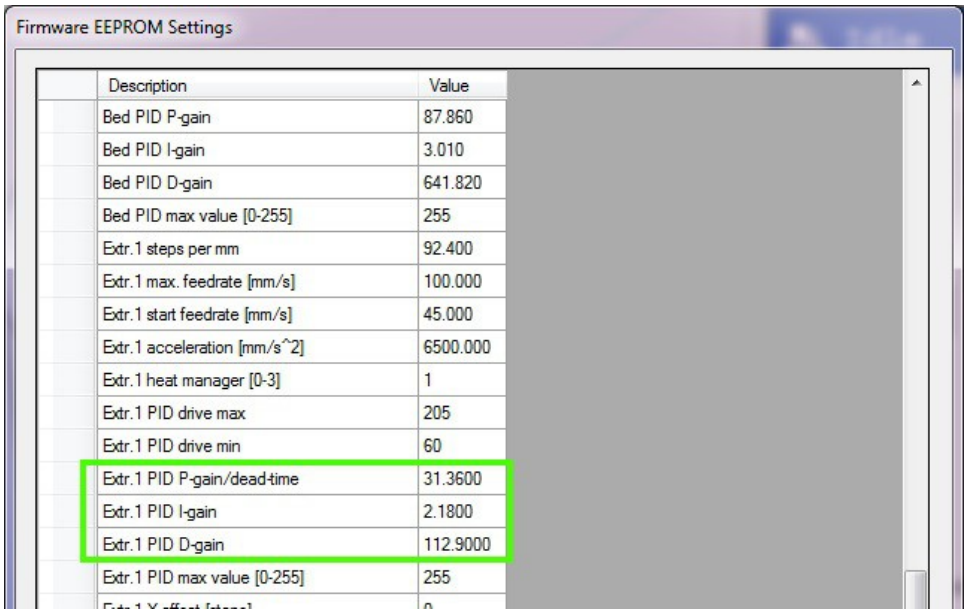


Fig. 21-12: EEPROM Table Editor.

Scroll down until you see the fields highlighted in green as above in Fig. 18-3. Change the P-gain field to the value you calculated for the average of Kp. Do the same for the I-Gain (Ki) and D-Gain (Kd) values and then click OK.

A properly tuned PID look will result in a temperature display that looks similar to the example below.

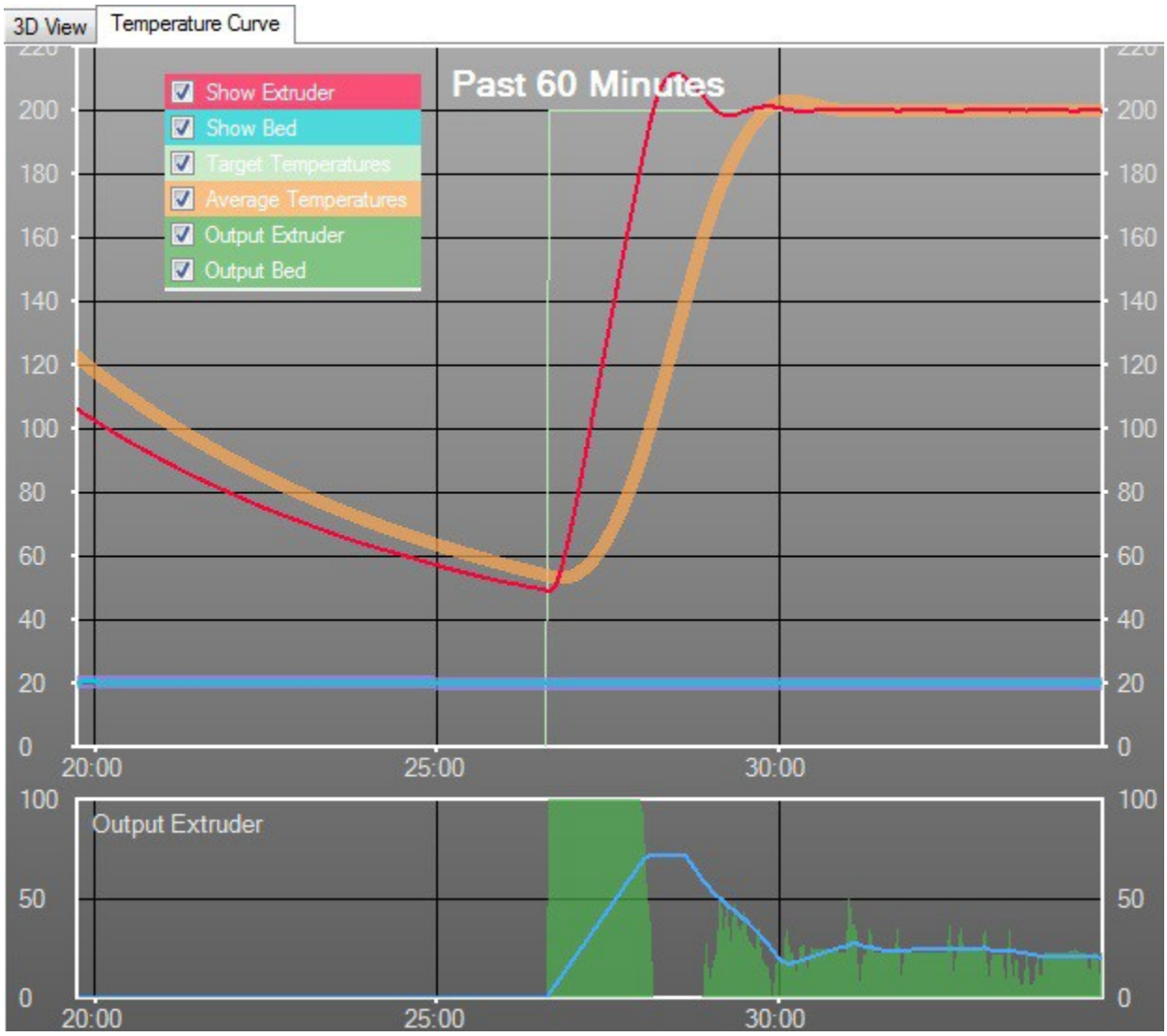


Fig. 22-13: Example of accurate temperature management.

The thin green line is the actual set point for the hot end (200C). You can see over time how the actual temperature (thin red line) eventually merges with the center-line of the average temperature line (brown line). This is a good representation of a well tune PID loop.

The graph at the bottom (“Output Extruder”) measures how much power in percent that is being fed to the hot end resistors. You can see how it applies 100% until it overshoots the target temperature. It then falls to zero and then slowly ramps back up as the target temperature is maintained.

Okay, now it's time to perform the same task, but this time we're going to tune the PID loop for the heated bed.

Send the command "**M303 P1 S60"**. This will start the auto tune process for the heated bed with a 60C target temperature. One thing you should note is the power LED on the Onyx heated bed should illuminate while the bed has power. It's a nice indication of a hot bed, so pay attention to it!

The graph for the heated bed auto-tune process will look something like that shown below.

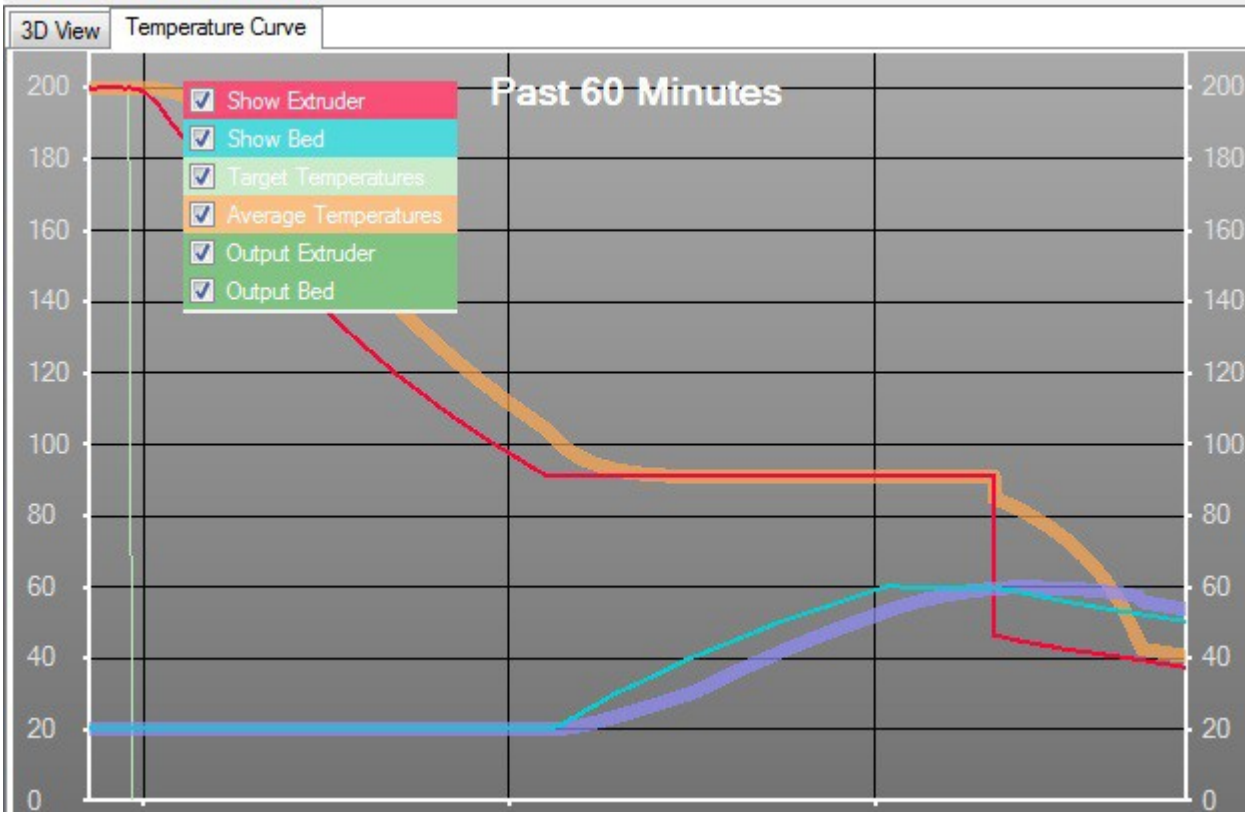


Fig. 22-14: PID auto-tune for the heated bed.

When the auto tune process finishes, you'll have a similar list of figures as what you got for the hot end PID loop auto tune process. Obtain the average values for Kp, Ki and Kd as before. Go into the EEPROM table editor and look for the fields shown below:

Bed PID P-gain	87.860
Bed PID I-gain	3.010
Bed PID D-gain	641.820

Fig. 22-15: Bed PID values.

Just like you did for the hot end PID values, enter the ones you got from the heated bed here. Save your changes and we're ready to go on to the next step!

Setting the Z Height

Bring your hot end and heated bed up to operating temperature. Set the hot end temp to 190C and the heated bed to 55C. We want the hot end and bed to expand to “normal” so we can get a fairly accurate measurement here.

Once the hot end and bed have reached their target temperatures, push the knob in on the LCD controller. This will take you to the LCD menu. Turn the shaft counter-clockwise until you reach the “Advanced Settings” entry and then click the button to select that option.

Fig. 22-16:Advanced Settings.

Rotate the shaft counter-clockwise until you reach the “Calibrate Z Height” option and click the button.

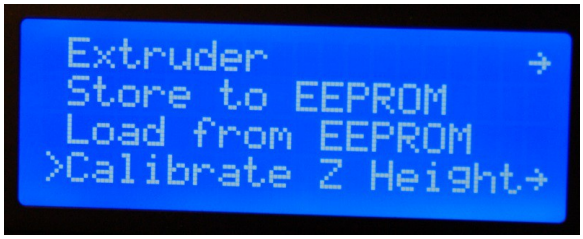


Fig. 22-17:Calibrate Z Height.

Rotate the knob counter-clockwise again and choose the “Home Towers” menu option and click. This will send the Rostock MAX to the home position. This is the same as sending **G28** to the printer or clicking the “Home All” icon in Repetier-Host. After the homing process finishes, select the “Z-Position” option and click.

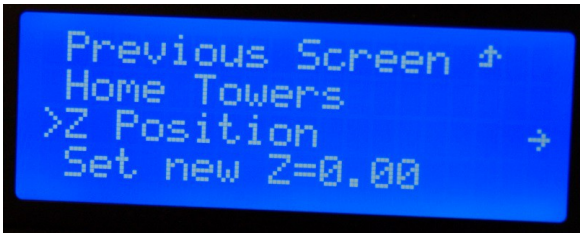


Fig. 22-18:Z Position.

When you click on the Z-Position option, you'll see a display similar to that shown below.

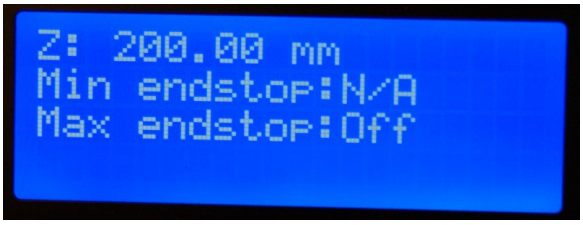


Fig. 22-19: Adjusting the Z height.

You control the height of the effector platform by turning the shaft on the LCD panel. Turning it counter-clockwise will lower the nozzle, and turning it clockwise will raise it.

If you turn the shaft quickly, you'll get large changes and if you turn it slowly, one step at a time, the change will only be 0.01mm per click. ***Please be careful not to accidentally burn yourself on the heated bed or the nozzle!***

Turn the shaft counter-clockwise until you're about 1/2” from the bed surface. Place a sheet of paper on the bed, under the nozzle. Lower the nozzle slowly until moving the paper around causes it to drag a little bit on the nozzle tip. You want it close enough that you can push the paper under the nozzle, such that it *almost* prevents you from pushing the paper under the nozzle.

When you've reached that point, press the knob to return to the LCD menu and then and select the “Set new Z=0.00” option. This will set the correct Z-Height for your Rostock MAX v2. Now that you know what the correct max Z height is, you'll need to update Repetier-Host with that information. Click on the EEPROM table by clicking on Config and then “Firmware EEPROM Configuration” in Repetier-Host.

You'll see a parameter in the table called “Z max length [mm]”. This is the actual maximum Z height that we just discovered using the LCD interface. Write that number down and dismiss the EEPROM table dialog box by clicking the “Cancel” button.

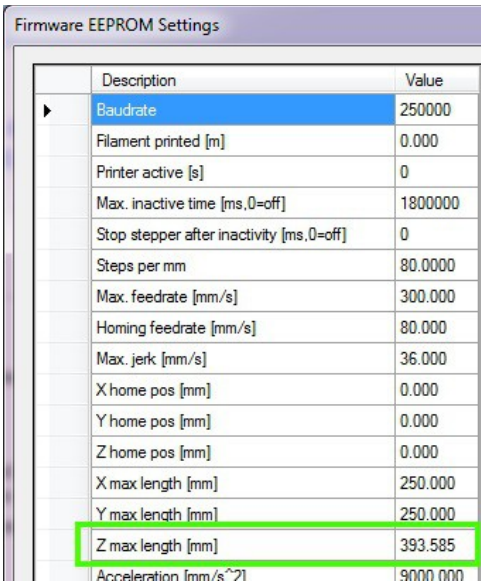


Fig. 22-20: Z max length.

In order to tell Repetier-Host what your printer Z height is, you'll need to disconnect from the Rostock MAX v2 to enable the “Printer Settings” option. Click the Disconnect icon and then open the Printer Settings dialog via the Config menu.

Click on the Printer Shape tab and make your change to the Printable Height field – populate it with the figure you noted from the EEPROM table's “Z max length [mm]” field.

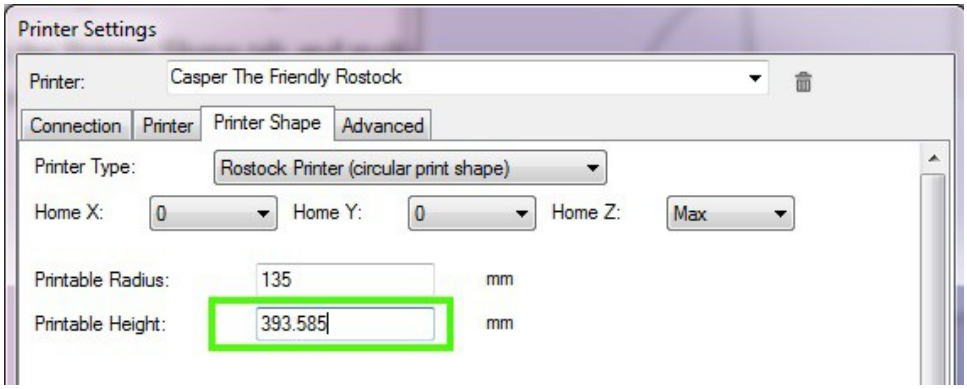


Fig. 22-21:Setting the Printable Height in Repetier-Host.

Once you're done, click the “Apply” and then “Ok” buttons to save your changes. Click the Connect icon to connect back up to the Rostock MAX v2.

Adjusting The End-Stops

Now we need to calibrate the end stops. This ensures that the effector platform your Rostock MAX v2 achieves an accurate nozzle height and parallel travel across the entire bed surface.

To make this process easier, we're going to set up three “scripts” within Repetier-Host.

To edit these scripts, you'll need to click on the **G-Code Editor** tab and then select “Script 1” from the drop down indicated by the arrow in Fig. 22-22, below.

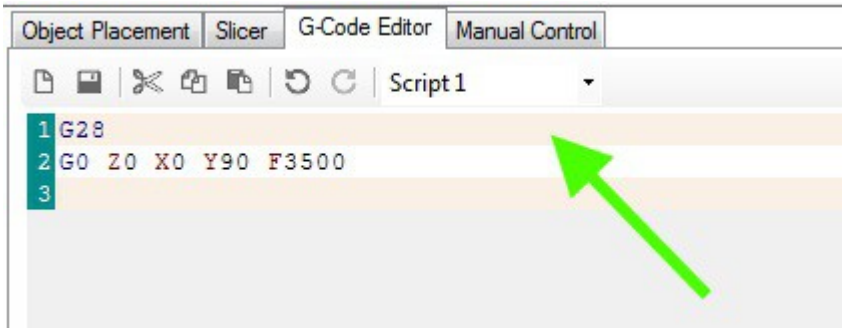


Fig. 22-22: Creating scripts.

Enter the g-code just as you see it on the previous page. After you've entered the two lines, click the Save icon and choose the next script, “Script 2” from the drop down. Enter “**G28**” on line #1 and “**G0 Z0 X77.94 Y-45 F3500**” on line #2. Save this script and pick “Script 3” from the drop down. As before, enter “**G28**” on line #1, and on line #2, enter “**G0 Z0 X-77.94 Y-45 F3500**”, then save it.

Last, enter the following code for Script 4.

G28

G0 Z0 F3500

And save it.

In order to make sure that each axis is higher than the three points listed above, I want you to position the machine using these commands:

G28

G0 Z5 X0 Y90 F3500

Click the “Home All” icon on the manual control panel and then stick a sheet of paper under the nozzle, just like you did when setting the Z height. Approach the zero point 1mm at a time by clicking on the down arrow for the Z axis. If you pinch the sheet of paper really hard before you hit the zero height point, use a #2 Philips screwdriver to turn the end stop adjustment screw two full turns to the right. Perform the same check on the other axes by issuing **G28** followed by **G0 Z5 X77.94 Y-45 F3500** and **G0 Z5 X-77.94 Y-45 F3500**. You're not after accuracy at this point, you just want to get the nozzle from pressing into the build plate.

Once you're confident you can go to the heated bed without striking it, you can begin to precisely adjust the end stop screws.

Click the “Printer” menu option at the top of the Repetier-Host window and select “Send Script 1”. This will send the g-code you entered previously to the Rostock MAX. Make sure you've got your sheet of paper under where the hot end will “land”. Script #1 covers the Z tower, #2 covers the Y tower and #3 covers the X tower. Having these in script form makes the repeating task of setting the end stops much easier. The shortcut key sequences for these are Ctrl-Alt-1, Ctrl-Alt-2, and Ctrl-Alt-3.

You adjust the height of each axis by turning the end stop adjustment screw to the right to *raise* the platform and to the left to *lower* the platform. Each time you make an adjustment, re-issue the Send Script 1 command. Repeat this process until you're getting the same amount of “grab” on the paper as you did when setting the initial Z height. When you're satisfied, move on to the #2 and #3 scripts.

Lay your sheet of notebook paper on the center of the build platform and execute Script 4. (Ctrl-Alt-4)

The nozzle tip is going to end up in one of three positions. It's going to be above your paper by a visible amount, it's going to pin the paper firmly to the bed, or if you're incredibly lucky, it will be "gripping" the paper the same amount as the tower base calibration steps. If it IS, I *strongly* recommend you go buy a lottery ticket. Your luck is *just that good*.

If you're merely mortal like the rest of us poor suckers, you're going to have to make an additional adjustment. Delta configuration printers like the Rostock MAX v2 have a very interesting geometry that will result in the hot end traveling in a non-flat path if it's not perfectly calibrated. This tiny error will express itself as a "virtual" convexity or concavity in what it thinks the bed shape is. If your hot end is pinning the paper to the build surface, the error is expressing itself as a concavity – the firmware thinks that it is moving flat, but the path of the hot end is actually concave and that's why it pins the paper to the build surface – the center is actually lower than it should be. The reverse is also true – if the hot end is not touching the paper at all, it thinks that the bed is dome shaped (convex).

The concave/convex shape of the bed is controlled by the EEPROM table entry labeled "Horizontal radius [mm]".

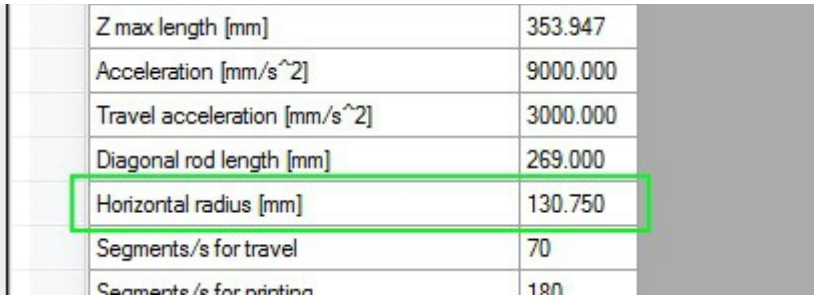


Fig. 22-23: Horizontal Radius Setting.

What you're going to do is bump that figure by 0.5 until the nozzle is touching the paper just the same as it was when you calibrated at the base of each tower.

In order to lower the nozzle, you'll need to *increase* the Horizontal Radius value.

In order to raise the nozzle, you'll need to *decrease* the Horizontal Radius value.

Each time you change the Horizontal Radius, you must re-calibrate the base of each tower as you did in the previous steps using Scripts 1 through 4. It may take a number of iterations to get the center nozzle height nailed down, but it IS worth the hassle. Your first layer quality and plastic adhesion require that the nozzle track across the entire bed as perfectly flat as it can.

Here's a flowchart that will hopefully clarify the process.

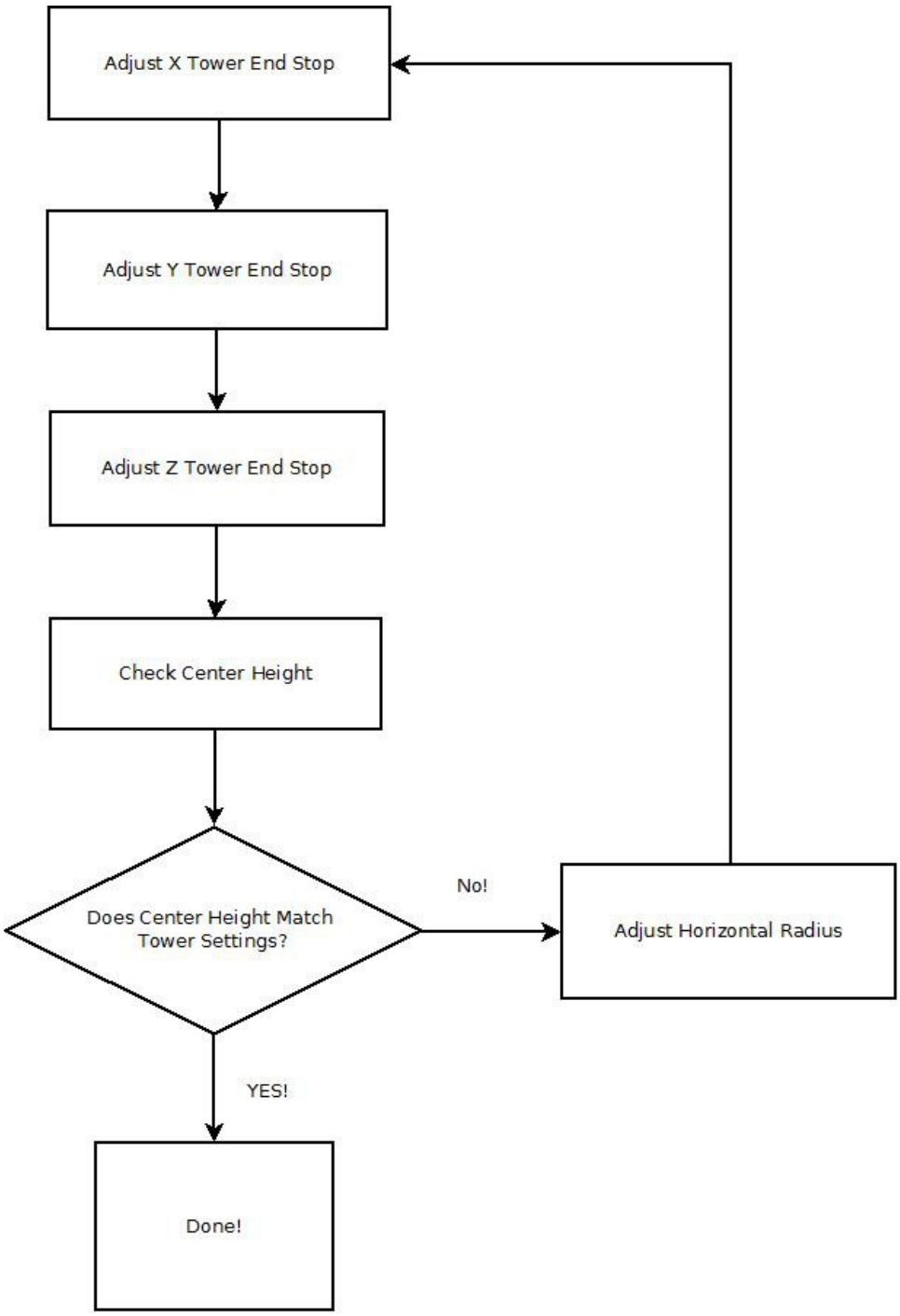


Fig. 22-24: Calibrating the Effector Platform.

The last task you'll need to perform before you can load plastic in to the machine is to correctly set the steps per mm (“E-Steps”) for the extruder. Open up the EEPROM configuration editor and look for the label highlighted below:

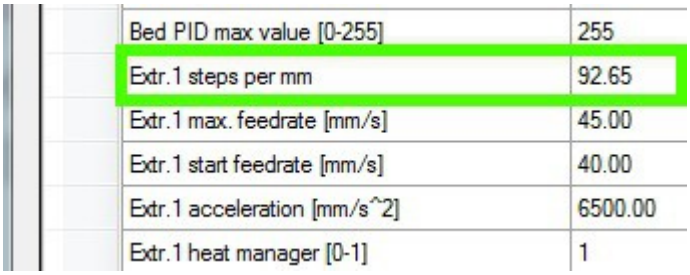


Fig. 22-25: Setting the E-steps per mm.

The value should be set to 92.65. If you're using the older Steve's Extruder, this value should be set to 584.

This value dictates the number of steps that the stepper motor must rotate in order to feed 1mm worth of filament to the hot end. The figures supplied will get your e-steps very close to ideal, but extra fine tuning can't hurt. I *highly* recommend that you check out the “E Steps Fine Tuning” section of Triffid_Hunter's excellent calibration guide. It can be found here:

http://reprap.org/wiki/Triffid_Hunter%27s_Calibration_Guide

The other portions of his calibration guide doesn't really apply to the Rostock MAX v2, so it's not necessary to read unless you're simply curious.

22 – Tonkabot's Missing Chapter

I some how managed to skip a chapter number while writing this manual.

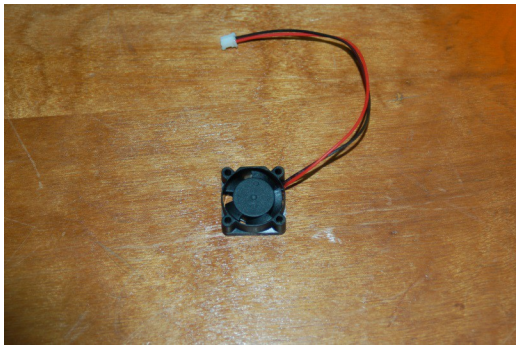
There's nothing quite like the metaphorical equivalent of walking in a circle with your foot in a bucket while yelling, “HURRR! CHAPTERZ!”.

Instead of renumbering chapters 23 onward, including the included figures (and figure filenames!) I decided to write a bit of filler and dedicate it to Tonkabot. He's the SeeMeCNC support forum user that spotted that chapter 22 seemed to have gone the way of the 13th floor in buildings. (I didn't forget it, I decided “22” was unlucky and skipped it! Yeah, that's it!)

At any rate, Tonkabot gets a pile of Internet Points for spotting a *glaring* omission that roughly 100+ builders hadn't spotted. Yet. :)

23 – First Print: PEEK Fan Shroud

For your first (and second!) prints, you're going to need to have ABS filament handy. This is because the PEEK and Layer fan shrouds can be exposed to temperatures that would turn PLA shrouds into a gooey mess. You're also going to need the 25x25x10mm PEEK fan itself.



You're just about ready to perform your first print! Before you can do that, you'll need to verify that the stepper motor on the extruder is turning in the right direction.

Verifying Extruder Stepper Operation

Start Repetier-Host, turn your printer on and connect Repetier-Host to it. We need to bring the hot end up to temperature for the direction test on the extruder.

The reason for this is that Repetier-Host will not allow extruder commands with a cold hot end.

Click the “Heat Extruder” button and set the temperature for 215C. Once the hot end is at temperature, I want you to click the Extrude button.

The button highlighted in green in Fig. 23-1 is the “forward” extrude button. Once you've hit your target temperature, watch the knob on the extruder and click that button. You should see the knob slowly turn counter-clockwise. If it's turning clockwise, you'll have to make a change in the firmware. It's a very simple change and you shouldn't have any problem at all doing it.

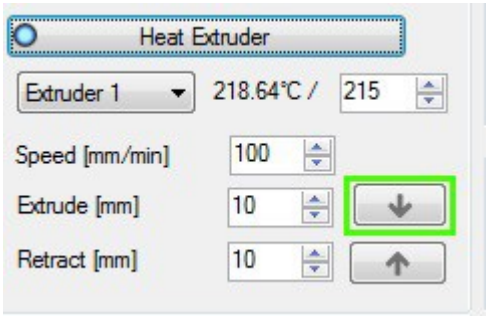


Fig. 23-1: Testing the extruder stepper.

If you've got backwards-running stepper motor, you'll need to open the Arduino IDE and make a single change in Configuration.h. Look for the following line:

#define EXT0_INVERSE true

You'll find it on or close to line #195 in the file. Whatever the value is set to, invert it. If it's true, change it to “false”. If it's false, change it to “true”. Save your changes and then upload the firmware to the RAMBo. *Make sure you've got Repetier-Host disconnected or the Arduino IDE won't be able to talk to the board.*

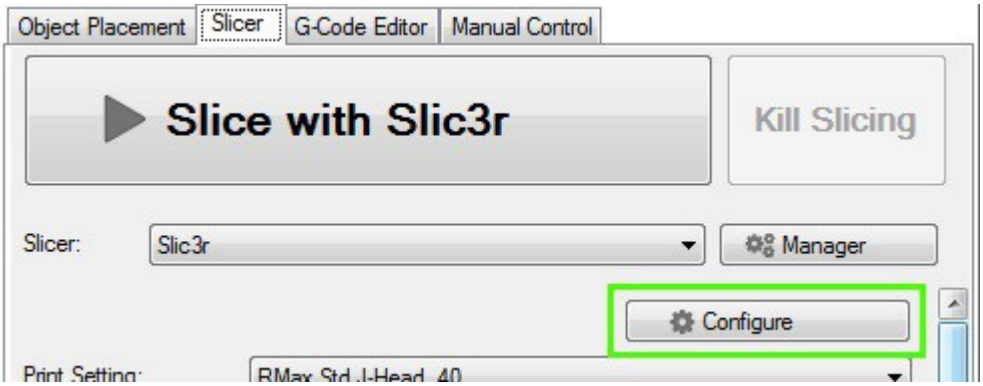
Configuring Slic3r

In order to convert the model of the PEEK fan shroud into something that can be printed, the model must first be “sliced”. You'll be using the slicing utility included with Repeiter-Host called “Slic3r”. To give you a head start on configuring Slic3r, SeeMeCNC has developed a set of default Slic3r configurations for ABS, PLA and T-Glase (pronounced “Tee Glass”). Head over to http://www.seemecnc.com/pages/downloads and scroll down towards the bottom. You're looking for a section headed, “Slic3r Pre-configured Settings for SeeMeCNC Rostock MAXs and Orion Deltas”.

Download all three files – we're only going to use the ABS Profile for right now though.

Unpack the ABS Profile into a spot you can find easily. Next we'll load this configuration into Slic3r.

If you needed to make a firmware change, re-connect Repetier-Host and click on the “Slicer” tab. Click the Configure button in order to get into the configuration tool for Slic3r.



When the configuration tool starts, click on “File” then “Load Config”. Browse to where you unpacked the ABS Profile and load it. We'll need to make one small change to the Printer Settings tab.

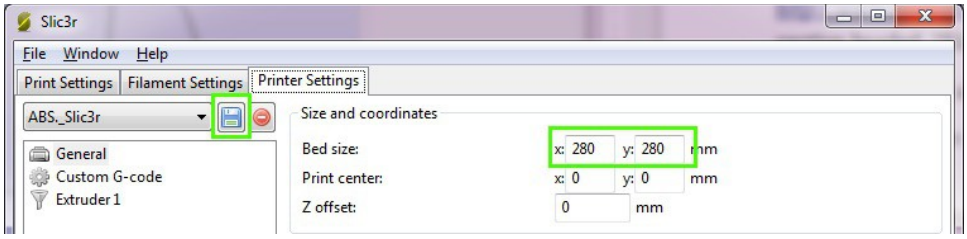


Fig. 23-3: Adjusting the bed size.

You'll need to change the Bed Size to 280 for both the X and Y fields. When you're done, click the little disk icon to save your changes.

Next, click on the Filament Settings tab. We're going to tweak the stated figure for the filament diameter.

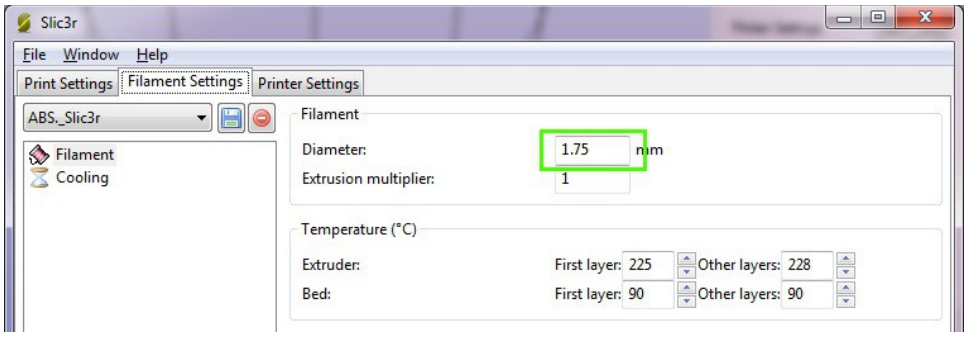


Fig. 23-4: Adjusting the filament diameter.

I want you to cut off about 2 meters of filament from the spool you're going to use to print the fan shroud. Using your digital caliper, take 5 measurements along the length and record each one. When you're done, calculate the average filament diameter and put that figure into the Diameter size field as shown above. It may be less than 1.75mm, but shouldn't be any more than 1.8mm. If you have any measurements of 1.8mm or greater on your filament, it may bind in the hot end.

Click the save button when you're done.

The last thing you need to do here is click on the Print Settings tab and then simply click the save icon. This just ensures that the settings you've imported “take”.

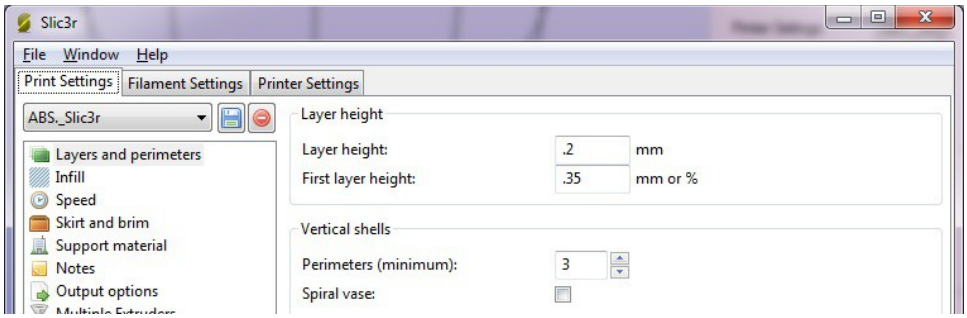


Fig. 23-5: Saving the print settings.

Now it's time to go get the file you're going to print!

Go here: http://repables.com/r/140/ and click the “Download” link. When the download is finished, unpack the file.

In order to slice the PEEK fan shroud, you'll need to load it into Repetier-Host first. Click the "Load" icon, browse to the location where you saved the STL file from the Repables link and select the file.

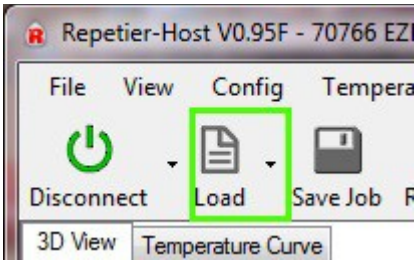


Fig. 23-6: Loading a file.

Once you've done that, you should see the model "drop" on to the print platform as shown below in Fig. 23-7.

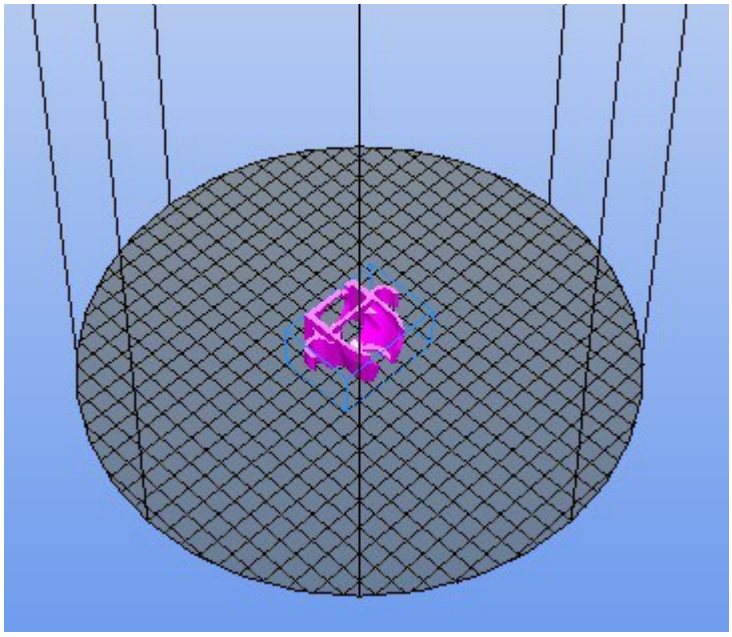


Fig. 23-7: PEEK fan shroud loaded.

The next step is to slice the model! Click on the Slicer tab and set the Print Setting, Printer Settings, and Extruder 1 dropdown boxes so they match the example below.

Once you've got all three set, just click the "Slice with Slic3r" button in order to slice up the PEEK fan shroud for printing.

The slicing process can take a few seconds to a few minutes, depending on the speed & capability of your computer.

When the slicing process completes, your PEEK fan shroud is ready to print!

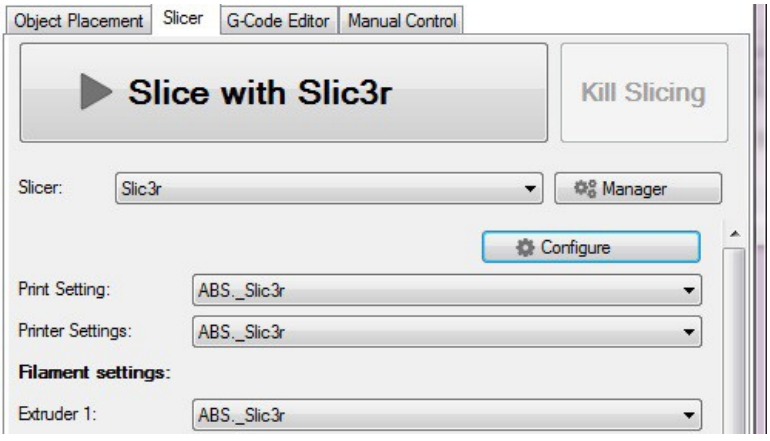


Fig. 23-8: Slic3r settings...

There's just one tiny little thing I need to cover. You guessed it, we need to load filament first!

Loading Filament

It's extremely simple to load filament into the EZStruder. Just place your index finger on the top of the extruder and your thumb on the tension lever (marked by the arrow below). Press the tension lever down and feed the filament by hand along the path marked by the green arrow. There is a small opening behind the tension lever that the filament will enter into the extruder through.

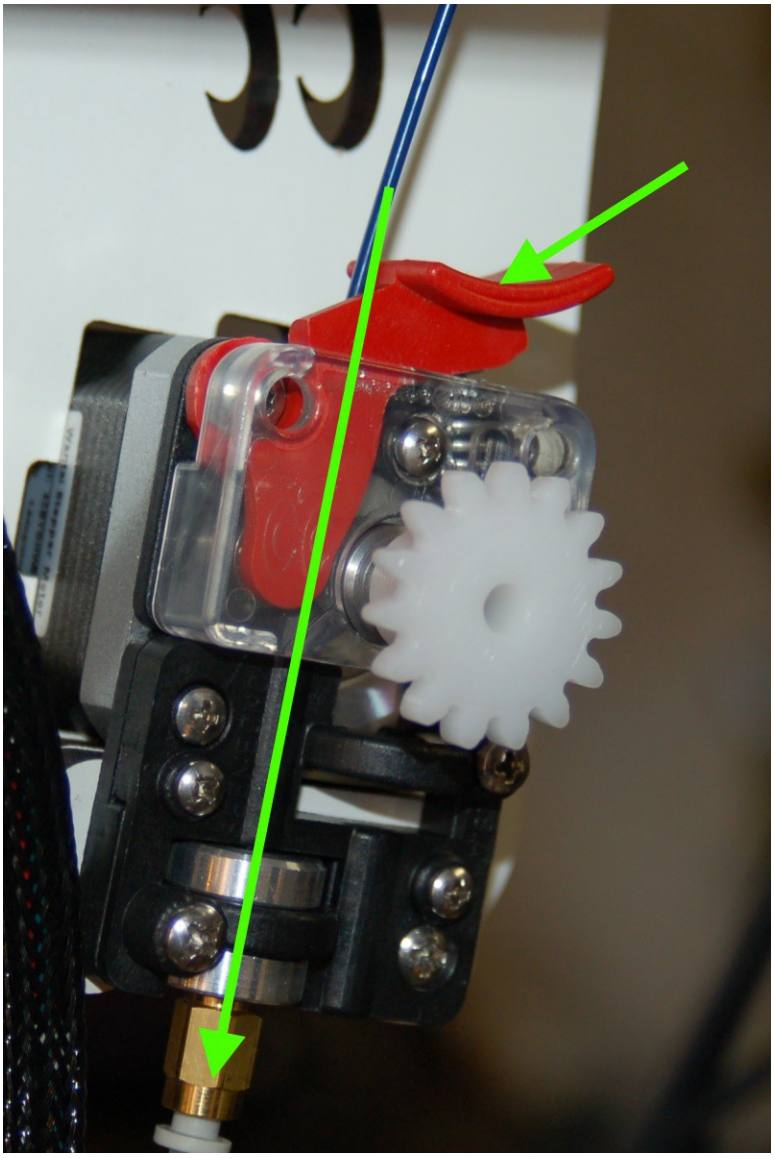


Fig. 23-9: Loading filament.

Continue to manually feed the filament until it passes through the other push-fit connector on the hot end.

Now you'll need to heat the hot end in order to prime it with filament. Once the hot end reaches the target temperature, I want you to start using the manual Extrusion button to feed filament into the hot end.

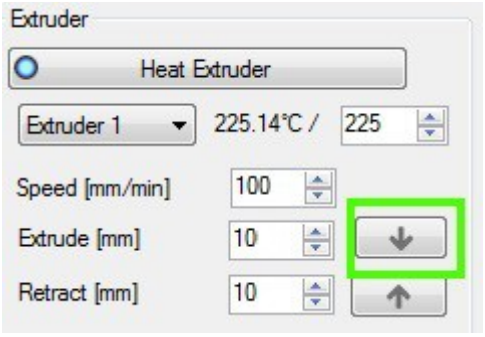


Fig. 23-10: Priming the hot end.

In the figure to the right, you'll see the control panel for the extruder. In order to safely feed the hot end, make sure that your settings match those in Fig. 23-10. The arrows on the panel control the feed – they indicate the actual filament direction. Click the down arrow to feed the first 10mm of filament into the hot end. You may have to click the down arrow a number of times to get filament coming out of the hot end, but you'll want to wait for the extruder to stop moving before you click it again.

Once it does begin to feed, go ahead and click the down arrow a few more times just to get the extruder all nice and primed.

I recommend that you extrude 20-30mm of filament each time you start up the printer for the day. This ensures that the hot end is primed and you have no jamming issues.

Preparing the Heated Bed

ABS won't stick to bare glass. In order to get the ABS to stick, you're going to need to apply two thin layers of glue to the bed. Remember back in the “need to have” list, I listed the Elmer's “Disappearing Purple” glue stick? This is where you're going to use it.

You'll want to apply two perpendicular layers of glue on to the heated bed. Follow the simple pattern in Fig. 23-11. The green lines represent the first layer and the red lines represent the second. The idea is to lay down a thin, even layer with no spaces between each “lane” of glue. Let the base layer completely dry before applying the second layer. Let THAT layer dry before starting a print.

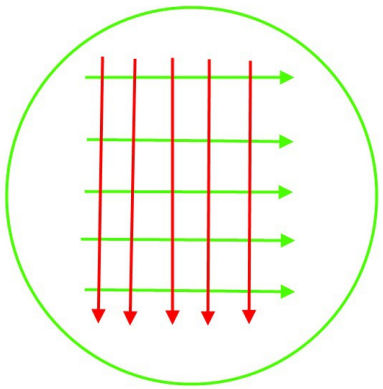


Fig. 23-11: Glue application.

Printing the PEEK Fan Shroud

Now that you've gotten everything loaded and prepped, starting the print is as simple as clicking on the “Run Job” button.

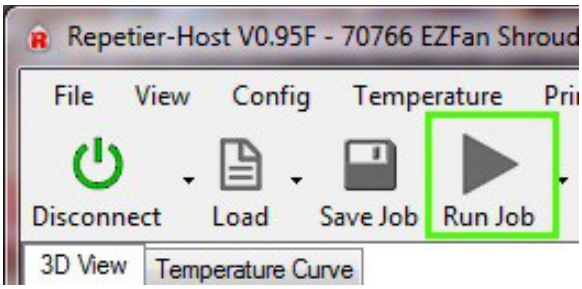


Fig. 23-11: Run Casper, Run!

You'll notice right off that when you click the run icon, the printer will home itself and then begin heating the hot end and the heated bed. The hot end will reach its target temperature first because it's pretty small. The Onyx heated bed can take 10 minutes or so to reach the 90C target.

Right before the printer begins to print, the RAMBo controller will “chirp” the LCD speaker and you'll see a text warning on the LCD controller to keep your hands away. There will be a short delay after this and the print job will begin!

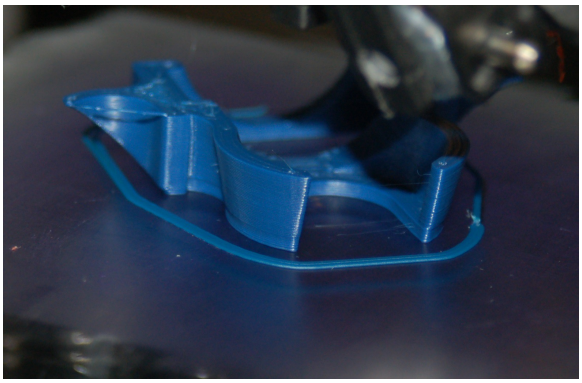


Fig. 23-13: Printing the PEEK fan shroud.

The print will take roughly an hour and a half to complete. When the job finishes, the controller will chirp and the machine will home itself.

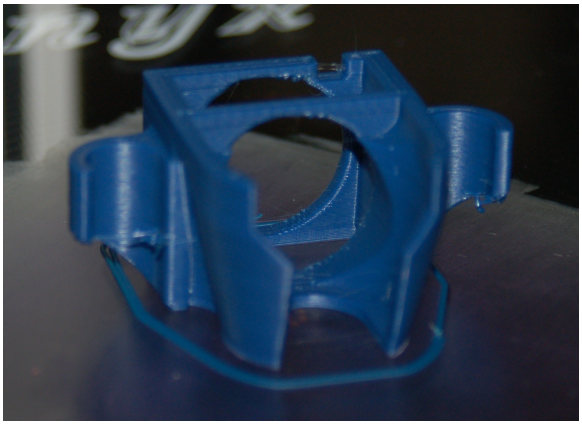


Fig. 23-14: Completed PEEK fan shroud.

Installing the PEEK Fan Shroud

Before you can install the PEEK fan shroud, you're going to have to wait for the hot end to cool to room temperature. You don't want to burn yourself while installing the shroud.

While you're waiting for the hot end to cool down, go ahead and install the 25x25x10mm fan into the shroud as shown:

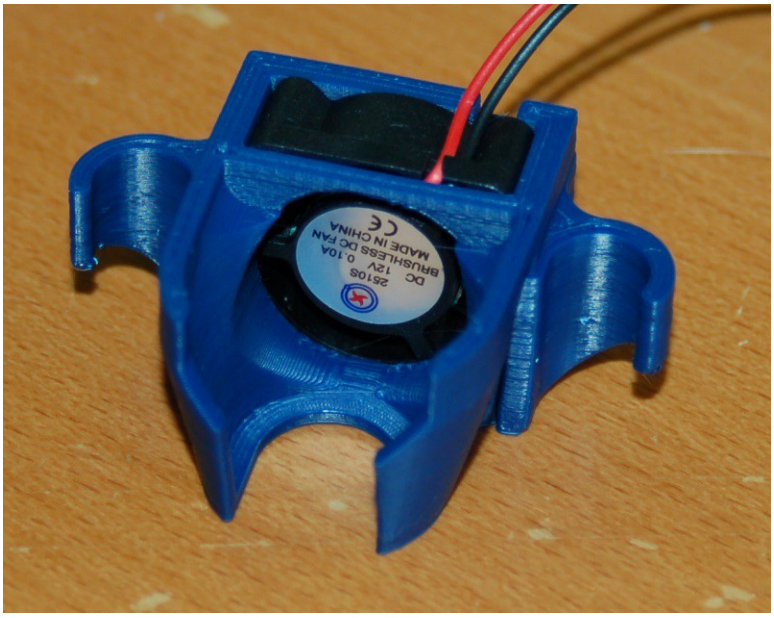


Fig. 23-15: Fan installed in shroud.

Make sure you've got the fan oriented exactly as shown. You want the label of the fan facing the space where the hot end will be. The power wires for the fan should rest in the notch provided.

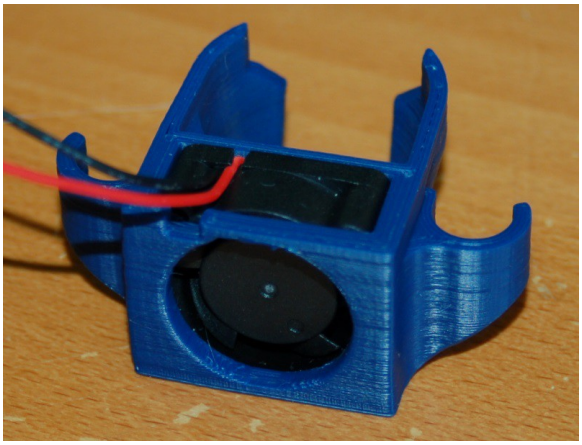


Fig. 23-16: 'Front" view.

Make sure that the fan is fully seated. It will need to fit between the hot end mount and the effector platform.

Pop off the delta arms from one side and loosen the two hot end mounting screws as indicated in Fig. 23-17. The “arms” on the fan shroud will fit flush against the 1” spacers while the “body” of the shroud will surround the hot end PEEK section. Make sure that the hot end is turned such that the body of the shroud can pass ***between*** the PEEK section and the power & thermistor wires. You do NOT want those wires pinched against the hot end!

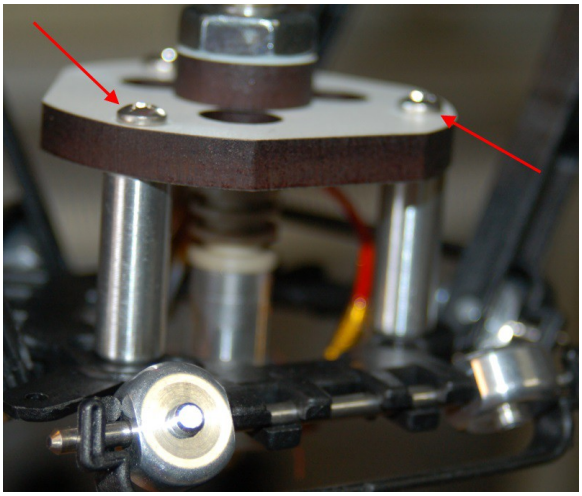


Fig. 23-17: Loosen mounting screws.

Insert the PEEK fan shroud in the space between the hot end mount and effector platform as shown:

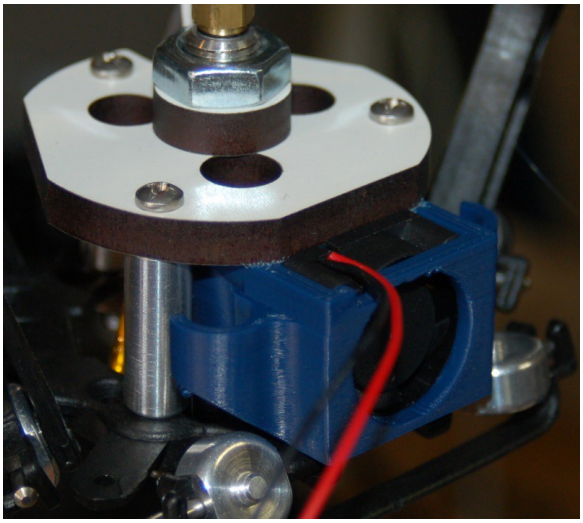


Fig. 23-18: PEEK fan installation.

Make sure that you've got the arms on the fan shroud fully seated as shown in Figs. 23-19 and 23-20.

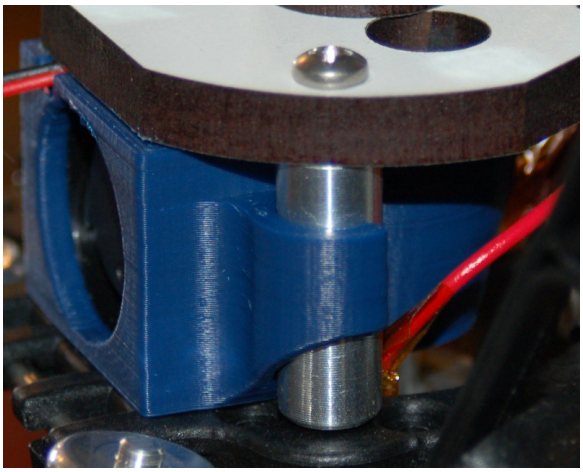


Fig. 23-20: Shroud fully seated, right side.

Lift up the hot end mounting plate a bit and press the PEEK shroud into it's fully installed position.

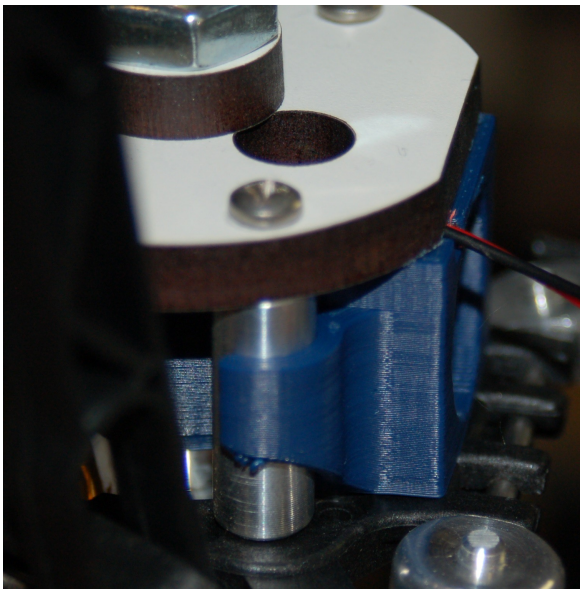


Fig. 23-19: Shroud fully seated, left side.

Note how the power wire passes to the outside of the fan shroud body. Also make sure that the power wires for the fan are not pinched between the hot end mount and the fan shroud. They should be resting in the notch.

Wire the fan into the PEEK fan wires by either using JST connectors like I've done, or just splice them together and cover the splice with a fold of Kapton tape.

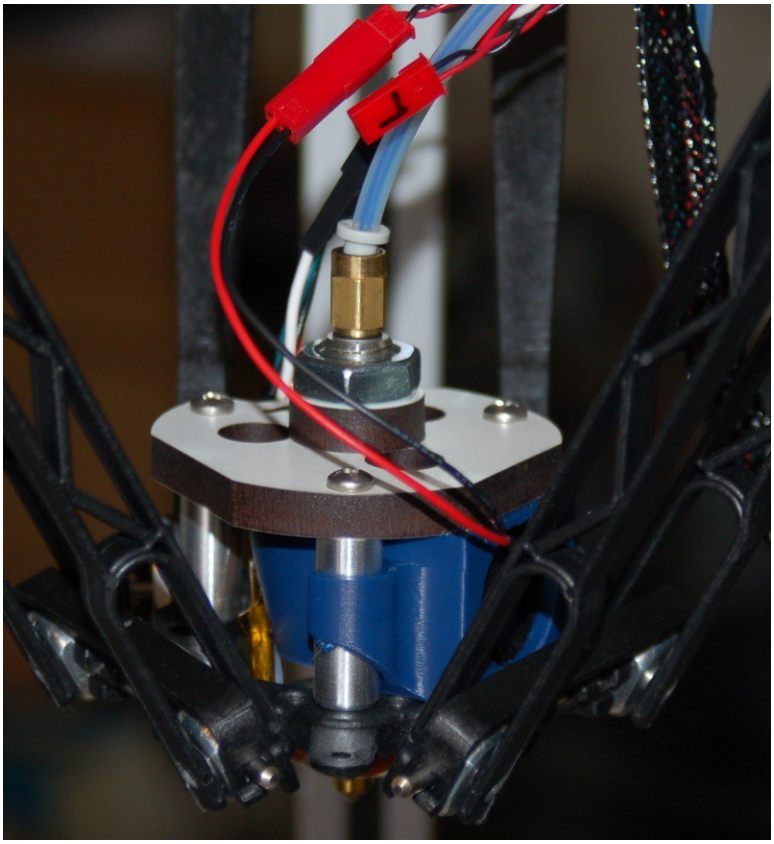


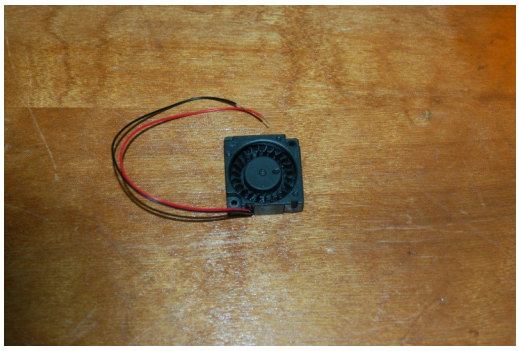
Fig. 23-21: Done!

The PEEK fan shroud is “virtually” linked to the hot end power. You should be able to see the fan running as soon as you hit the Heat Extruder button in Repetier-Host. Do that now to make sure the fan operates. When you run a print job, the PEEK fan will continue to run even after power has been removed from the hot end. It will continue to run until the hot end temperature falls below 50C.

After you've got the PEEK fan installed, please re-run the auto-tune PID routine for the hot-end. The running PEEK fan will have changed the heating profile and the PID variables need to be updated in order to account for this change.

24 – Second Print: Layer Fan Shroud

If you plan on printing in PLA or other materials that can benefit from a cooling fan (NOT ABS!), you'll want to print the layer fan shroud. The layer fan model can be downloaded from Repables, http://repables.com/r/212/. It's specifically designed to mount on the newly redesigned effector platform and the included 30mm squirrel cage fan.



Download, extract and load the layer fan model into Repetier-Host, just as you did for the PEEK fan. The printing parameters are the same, so just slice and go!

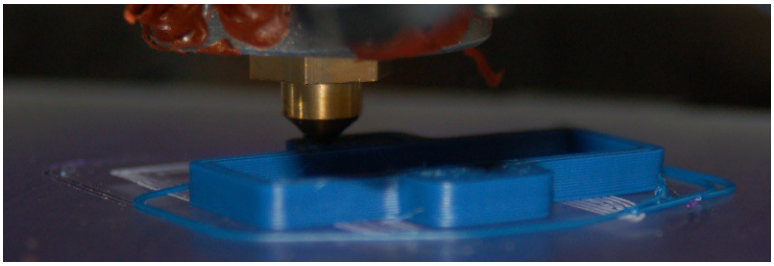


Fig. 24-1: Just a few minutes into the print...

One thing you've got to watch out for when printing with ABS is heat dissipation during the print. When you're printing small details too quickly, the ABS doesn't have enough time for the previous layer to cool. This can cause curling at the print site and other issues.

When you're printing the layer fan shroud, you'll want to slow the print down to about 30% using the Speed Slider in Repetier-Host.

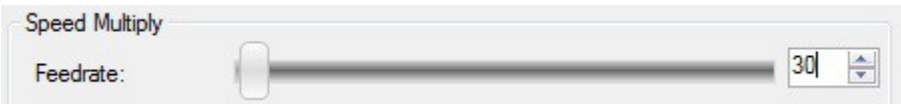


Fig. 24-2: Speed dialed back to 30%.

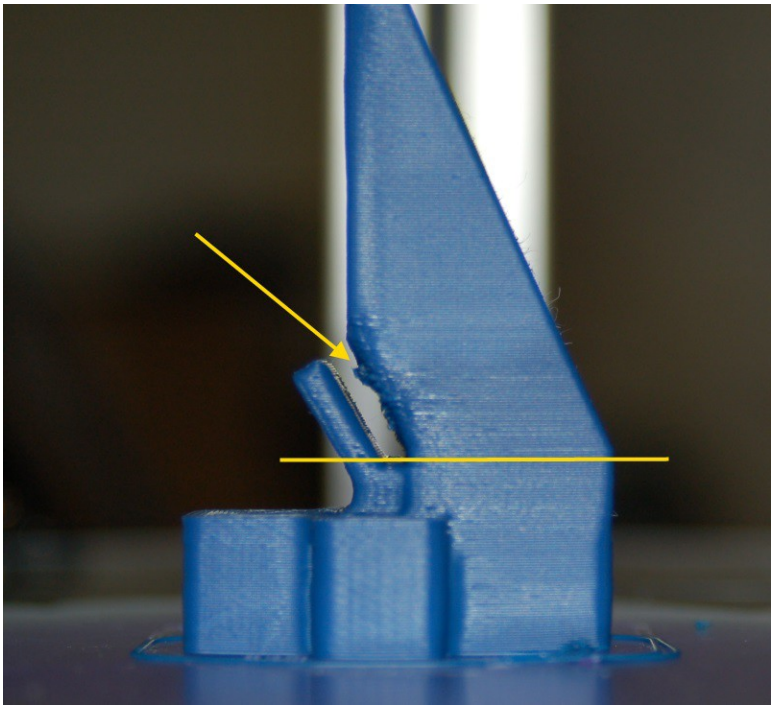


Fig. 24-3: Problem areas...

If you look at the photo above, you can see some print “artifacts” that were caused by printing too quickly and not allowing the ABS to cool. I would recommend that when the print job reaches the point where the horizontal yellow line is that you back off the speed to 30% and leave it for the rest of the print job. See if you can spot where I dialed the speed back on this print.

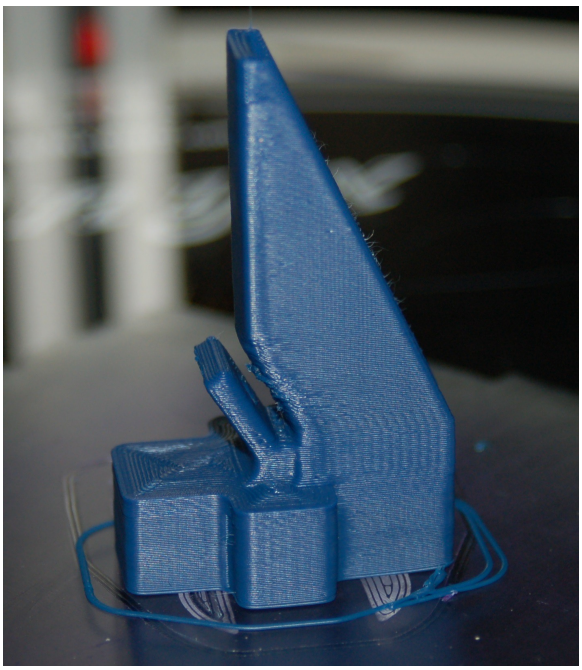


Fig. 24-4: Finished layer fan!

Now that you've gotten the fan shroud printed, go ahead and test fit it on the fan mounting tab on the extruder platform.

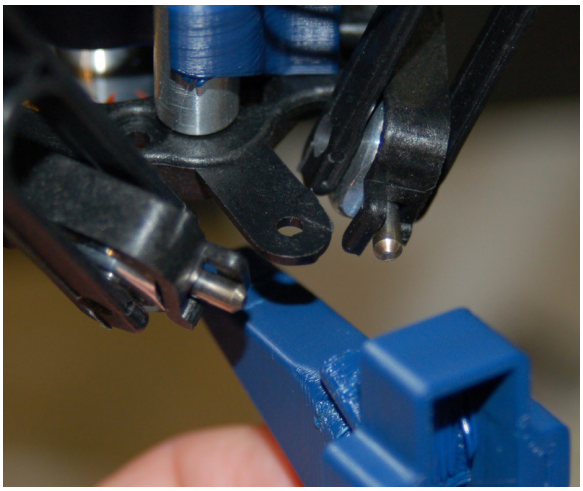


Fig. 24-5: Test fitting.

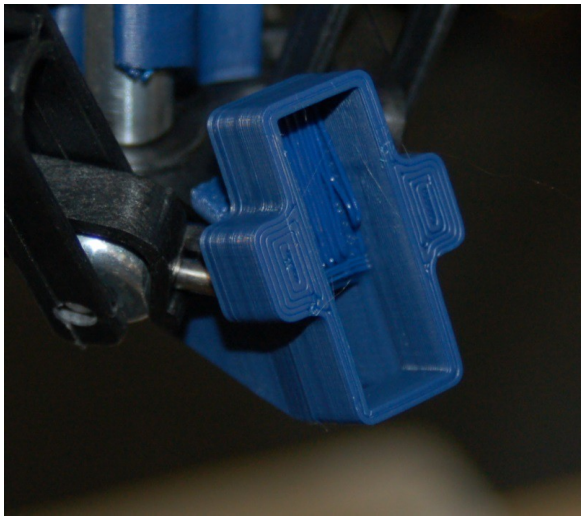


Fig. 24-6: Fitted in place.

You may need to do a little trimming on the layer fan shroud in order to get it to fit properly on the effector platform's mounting tab. The shroud needs to fit well enough that the holes in the fan shroud mounting tab aligns with the hole in the tab on the effector platform.

Now install the 30mm squirrel cage fan into the fan mount as shown below.

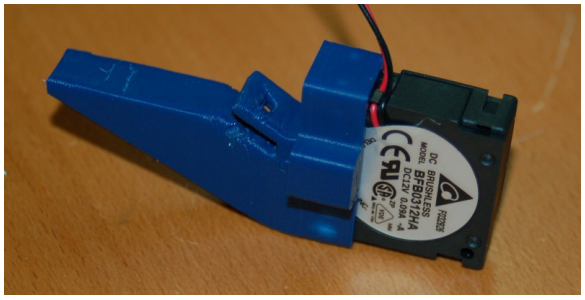


Fig. 24-7: Fan seated, left side.

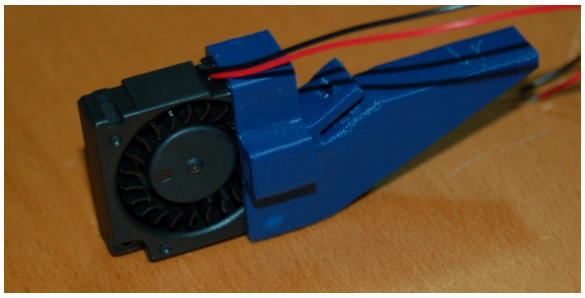


Fig. 24-8: Fan seated, right side.

Make sure the fan is fully seated into the mount.

Now you can either attach a JST connector like I did on mine, or just splice the wires to the layer fan wires and cover the splice with a fold of Kapton tape.

Before you attach the fan & mount, you should test it first to make sure the wiring is correct and that the squirrel cage moves freely.

Start up Repetier-Host and power up your Rostock MAX v2 and connect to it. Right below the Print Bed controls on the right side of the Manual Control tab, you'll see a fan control:

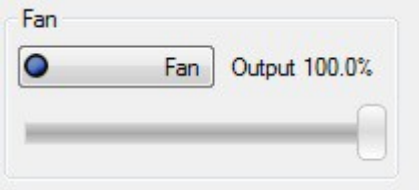


Fig. 24-9: Fan control.

Move the slider to the right so the Output field reads 100% and then click the Fan button. The layer fan should come on. If it doesn't, check your wiring and make sure the squirrel cage is not binding against the fan shroud. Once you've got the fan working, use a #4, 3/8” screw to install it.

With the installation of the layer fan, your Rostock MAX v2 is *totally* complete!

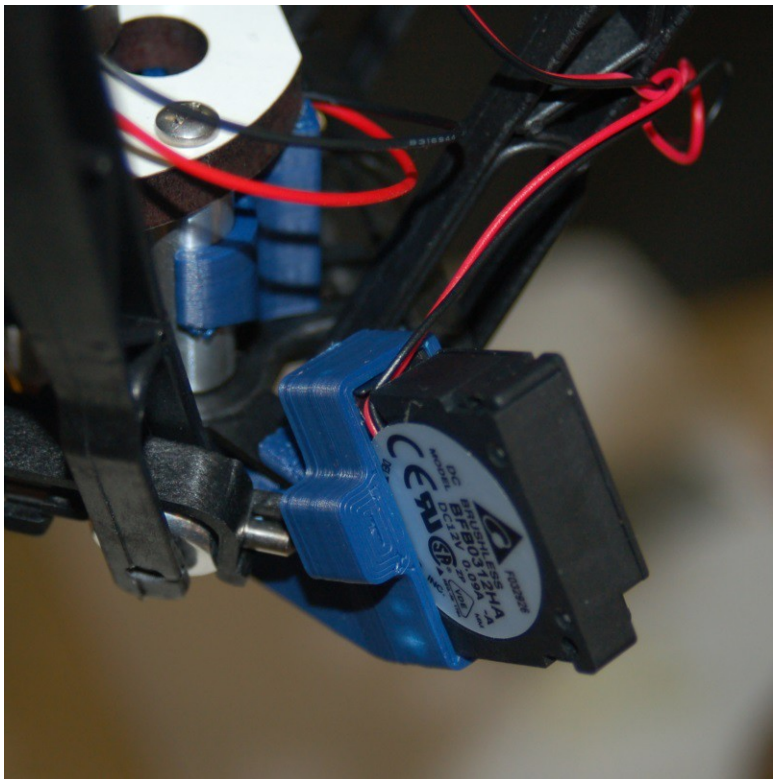


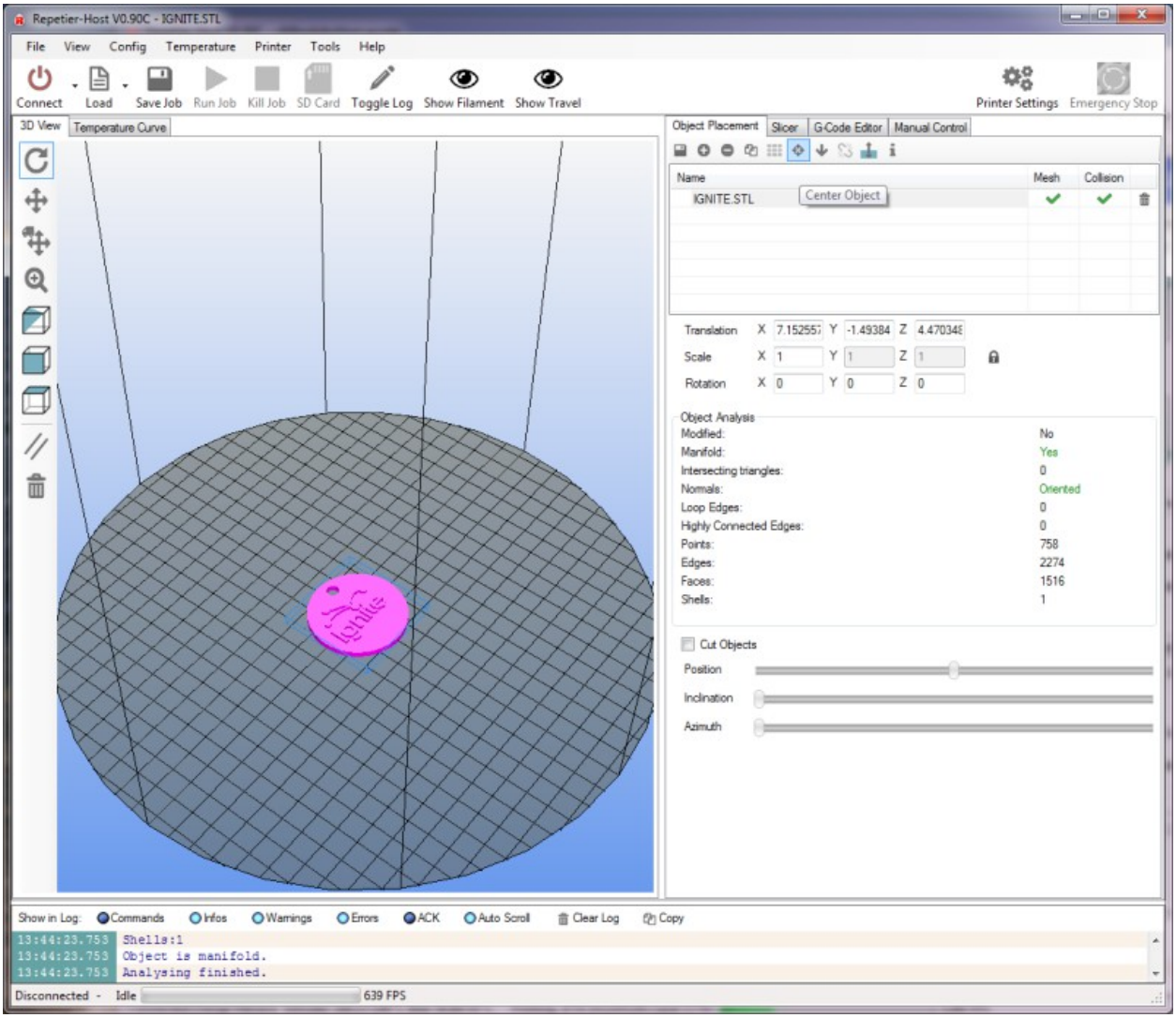
Fig. 24-10: Layer fan installed!

25 – Repetier-Host

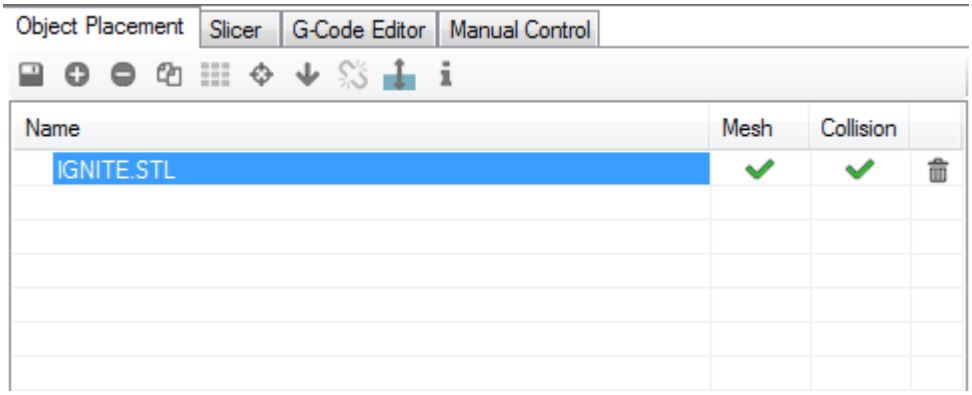
Repetier-Host is a pretty advanced piece of software and it can make your life a lot easier when it comes to printing your projects on your Rostock MAX.

I'm going to walk you through most of the more interesting things that Repetier-Host can do. For the printing examples, I'm going to use the Ignite Michiana Keychain that is available on the Repables website (http://www.repables.com/r/146/). Download and unpack the model.

I would like to first cover the Object Placement tab and show you the various functions that it can perform. Go ahead and load the IGNITE.STL file that you downloaded and we'll begin.



The Object Placement tab allows you to do a number of things with one or more loaded objects. Moving right across from left to right, the functions are:



Export

This allows you to save all the currently loaded (or only the selected ones) parts as a single STL or OBJ file.

Add Object

Clicking this allows you to add another object to the build platform. This can be handy when you've got a few different parts to print and you'd like to print them all during the same print job instead of one at a time. Go ahead and click the Add Object button and pick a new model to load – the Orion Key Fob would be fine for this. You'll notice that when it's loaded, the Ignite object is moved a bit to make room for the new part.

This would is a good time to show you what the Mesh and Collision columns do. Right-click on the Ignite object. Notice that the Ignite object turns purple and the Orion Key Fob turns yellow. The purple color highlights the object you're currently working with. Note that the Object Analysis section of the Object Placement tab is now filled with information related to that selected object. This section will be hidden if you've got more than one object selected.

Hold down your right mouse button and drag around – you can use this technique to manually position parts. Notice that when you move the part so it “overlaps” with another, that both turn a light blue color. This indicates that the models are colliding. The Collision columns will indicate colliding models with a red “X” Now while you CAN slice and print objects that are colliding, don't expect great results unless you've got a specific goal in mind.

Remove Object

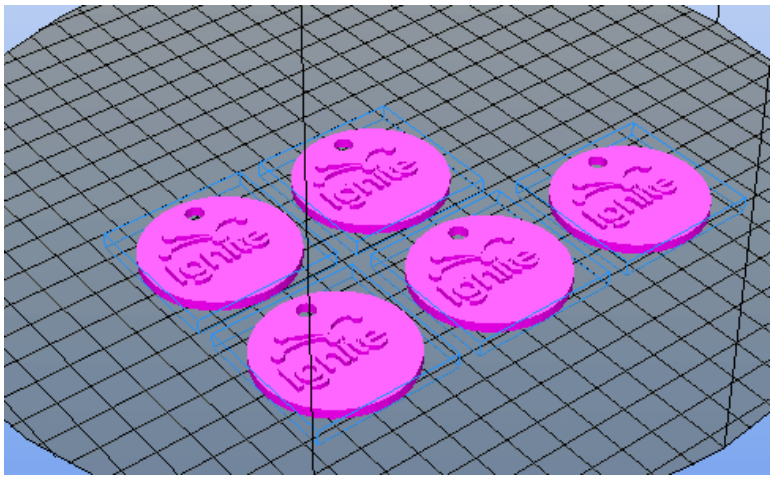
This is basically the opposite of Add Object. It will remove whichever object is currently selected.

Copy Objects

This is a neat little feature. Say you'd like to print four of the Ignite key chain tags. Select the Orion Key Fob and click the Remove Object button. Select the Ignite object and then click the Copy Objects button. Set the number of copies to four and make sure the “Auto Position after Adding Objects” box is checked. Click Copy.

You should now have five of the Ignite objects on your build surface.

You ended up with five because you made four copies of the one object. If your goal was only four objects total, you'd tell the copier you wanted three copies.



The copy feature is very handy when you have to make a lot of the same thing.

Autoposition

The Autoposition function will allow you to optimally arrange a number of objects with a single mouse click. Go ahead and move your five Ignite objects around manually and then hit the Autoposition icon to see how it re-arranges all the objects.

Center Object

This is handy if you've got a single object and you've accidentally moved it from its default position. Clicking the Center Object icon will automatically move the object to the center of the print volume.

The Drop Object and Split Object buttons are currently undocumented, and experimenting with them hasn't lead me to any new understanding of how they work.

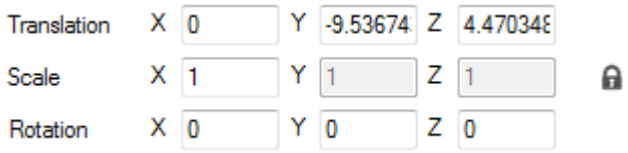
Fix Normals

This function will attempt to correct issues with your model file where there is a surface that should be facing outward, but is actually facing inward. This falls under an advanced modeling topic and won't be covered further here.

Object Information

This will give you some basic details about the currently selected object.

The next section of the Object Placement tab has to do with how objects are sized and oriented in the build volume.



The Translation row controls the object placement on the bed. This is normally something you'll never need to manipulate by hand as you can move the object around with the mouse, or by clicking the Autoposition icon.

The Scale row will allow you to change the size of the object. By default the Scale is locked to the X axis as denoted by the little padlock icon at the far right. Experiment with the scaling by changing the X column number. Think of it as a percentage. At 0.5, the object will be scaled in all axes by half. .75 would be ¾, etc. If you click the padlock, this will “unlock” the scaling for the Y and Z axes so you can change those independently from the X axis. Go ahead and unlock the scale and change them and see how it affects the model. You can easily go back to where you started by setting each axis back to 1 or by simply clicking the padlock icon again.

The Rotation row allows you to change the orientation of the object in the build volume and each field is in degrees. This comes in handy when you've loaded an object that isn't oriented in a way that will allow you to print it. To give you an idea of how this would work, click in the X field and enter “90”. This will flip the Ignite key fob 90 degrees to the build surface. If the Ignite model loaded in this position, you could enter “-90” and it would lay flat on the bed, making it easier to print.

The last section on the Object Placement tab is “Cut Objects”. When you check the Cut Objects box, it will allow you to slice or cut the object in various ways by using the three sliders as shown above. This is strictly a visual inspection tool and doesn't apply to the data fed to Slic3r. Select the Cut Objects box and play around with the sliders to see what they do to the object on the built surface.

The Slicer tab is the basic interface to the primary slicing utility that Repetier-Host uses, Slic3r.

Slic3r is one of the more popular slicing tools for 3D printing. It's open source and community supported.

The Slicer tab also provides access to Skeinforge, another free and open source slicing utility. Due to its complexity I won't be covering it here. If you like, you can learn more about it here: http://reprap.org/wiki/Skeinforge.

Slic3r allows you to manage multiple profiles for print settings, the printer itself and different types of filament. The Slic3r interface above allows easy access to any of those three preset categories. As time goes on, you'll collect a number of different configurations for the different models you print and the filaments used to print them. All of those setting can be accessed via the Configure button, located right below the “Kill Slicing” button. The details of the Configuration program for Slic3r is covered in the previously linked Slic3r manual and won't be covered here.

The last thing to note about the Slicer tab is the “Setup” button. This will allow you to tell Repetier-Host to go to a specific place for configuration files and the Slic3r executable. This can be used in the event that you wish to use a version of Slic3r that is different than the version supplied with Repetier-Host. This can come in handy when newer versions are released and you'd like to upgrade without waiting for a new product installer for Repetier-Host.

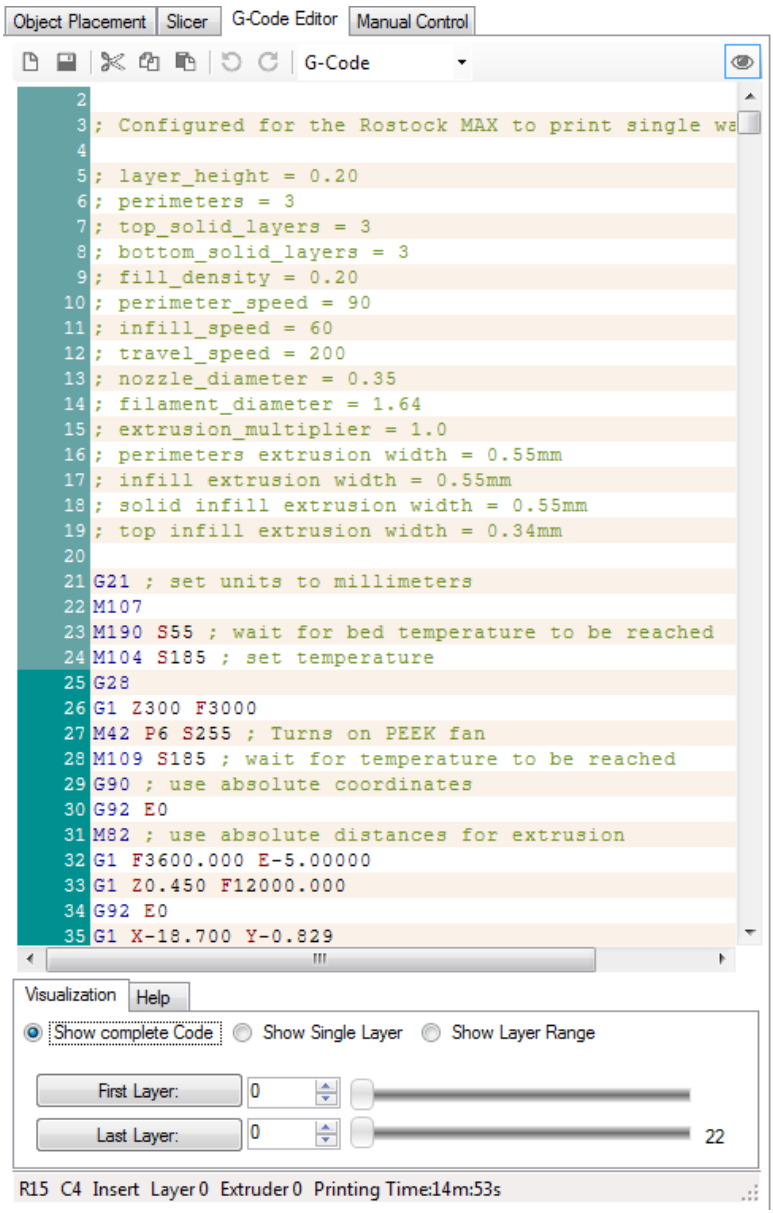
The last tab I'm going to cover is the G-Code Editor tab.

When you slice a model, the output of the slicer will be automatically loaded here.

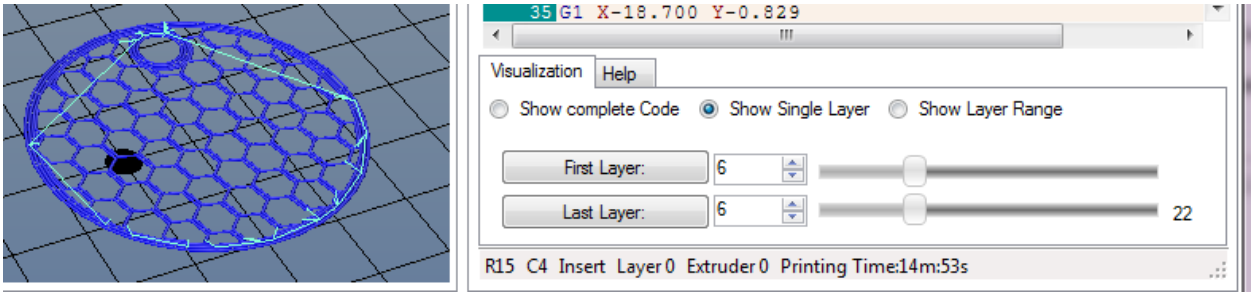
The G-Code Editor is basically just a fancy text editor. It allows you to view the G-Code that the slicer generates for the object(s) you sliced as well as allows you to view the tool path of each layer individually, or all the layers at once.

The G-Code Editor tab has two modes to it. “Visualization” and “Help”. In Visualization mode, you can use one of the three radio buttons to view the whole output, a single layer or a range of layers.

If you want to view a single layer, click the “Show Single Layer” selector and then move the First Layer slider around. You can also use the up/down arrows in the First Layer input box to more precisely go to a specific layer.

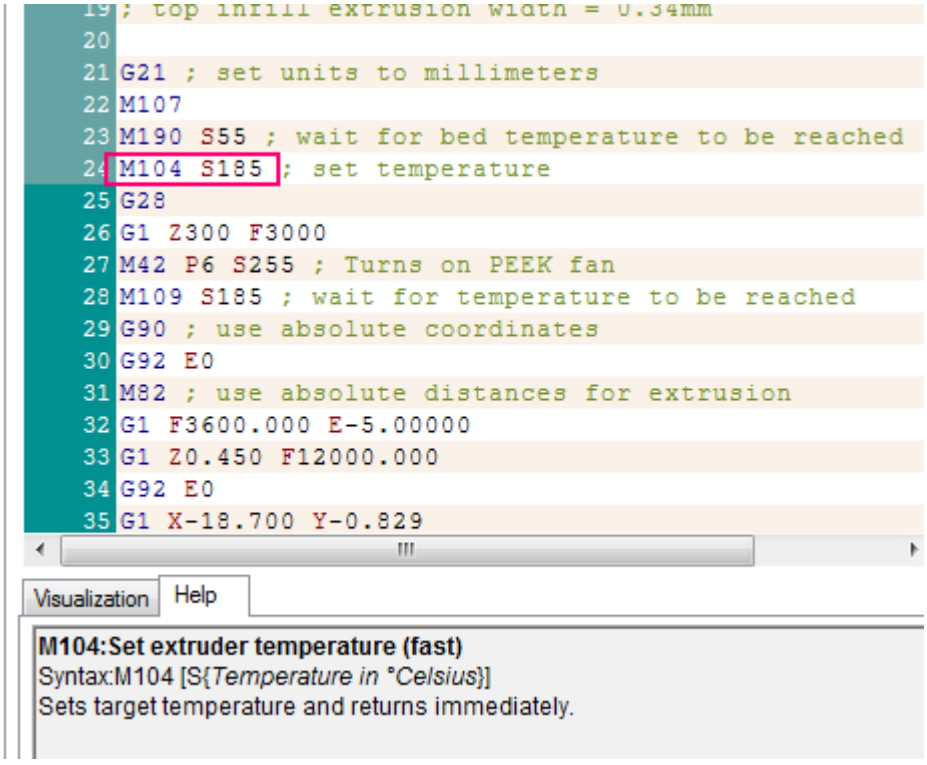


You can see an example of this below – it's currently showing layer 6 of the Ignite key fob that I've been using as my example part.



The Help mode (accessed by clicking the “Help” tab next to “Visualization”) is a very handy feature when you'd like to see what all that noise in the G-Code Editor is actually doing.

When you click on a G or M code that Repetier-Host knows about, it'll pull a description out of its database and display the information in the Help window as shown above.



If Repetier-Host doesn't know what a G or M code is, it won't display anything in the Help window at all.

I've covered a number of the basics with Repetier-Host and you should have a pretty good handle on how to use it with your own printed parts. There's one last thing that I'd like to cover and that is the **Temperature Curve** tab.

This shows some interesting data with regard to both your extruder and heated bed temperatures.

The image below shows a typical “cold” Rostock MAX.

There's four “tracks” worth of data shown on the graph.

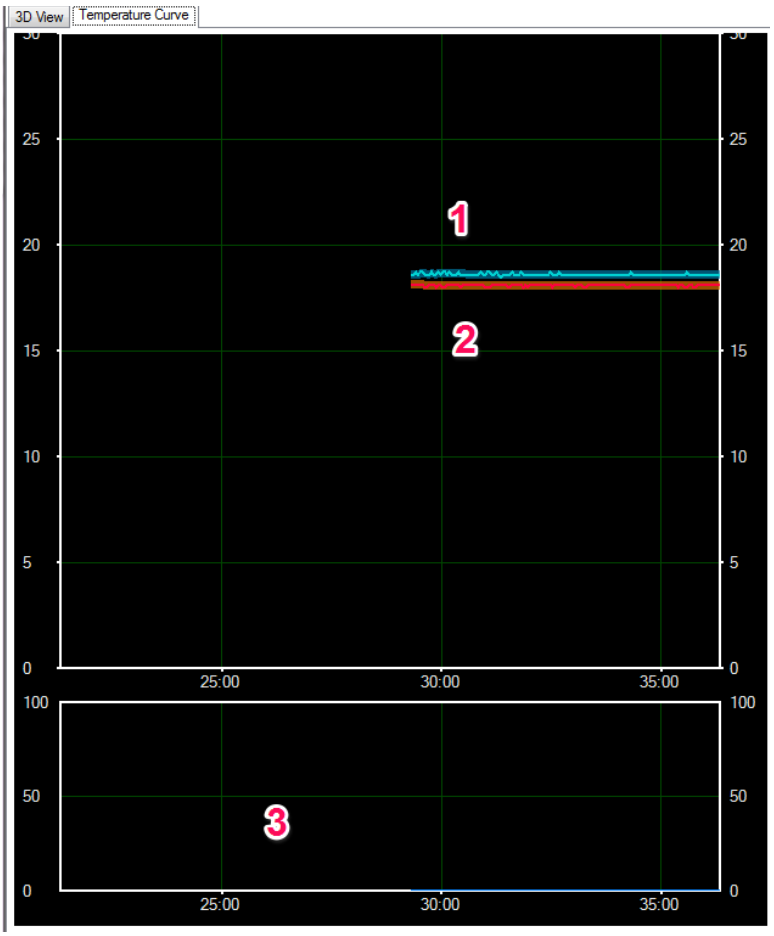
Graph #1 shows the bed temperature (the thinner cyan line) and the bed temperature average (thicker, dark blue line)

Graph #2 shows the hot end temperature (the thinner red line) and the hot end average temperature (thicker, brown line).

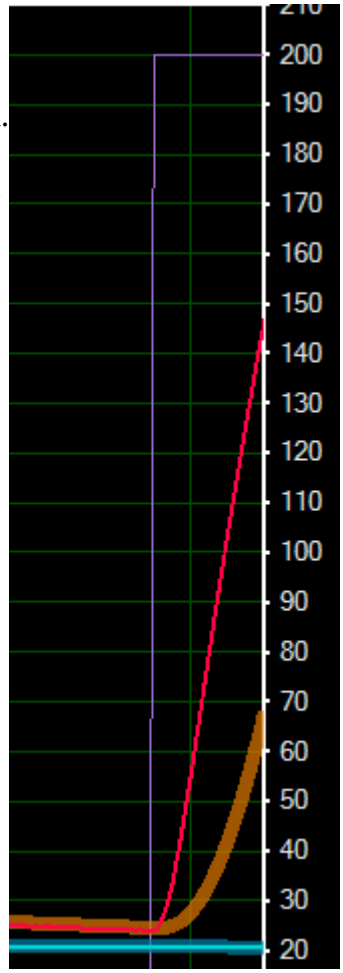
The graph scale is in time along the bottom (5 minute graduation) and the temperature scale is vertical and uses a 5 degree graduation.

The lower graph (#3) is the “power” graph and that shows how much power is being sent to the hot end.

Go ahead and click the Heat Extruder button on the Manual Control tab and watch what the temperature curve does.



The first thing that will happen is that the scale will jump considerably as it now needs to show your target temperature.

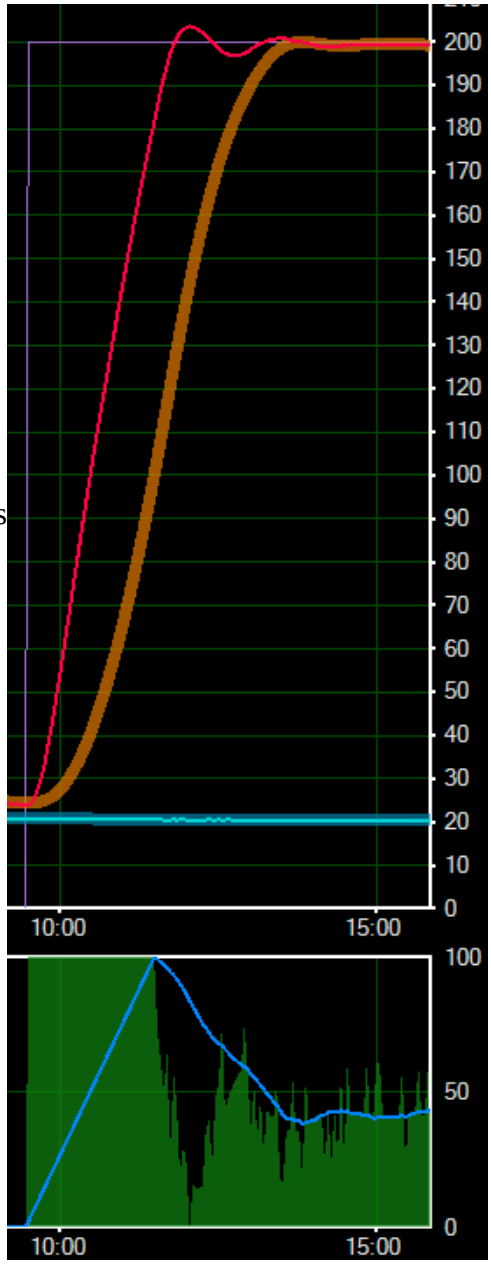


In the figure to the right, you'll see that a new graph line has appeared. The purple line is your target temperature. That is what the system is currently trying to reach. As time goes on, it may exceed that target by a few degrees and then back off on the power in order to get back down to it.

You'll see that the average temperature lags behind the actual by a short period of time. This is okay.

The image to the right shows what the Temperature Curve will show once the hot end has reached the target point. Notice how the power graph on the bottom corresponds to the actual temperature line shown in the top.

As time goes on, the actual temperature line will exist as a little “squggle” that will remain inside the border of the thicker average temperature graph. This is an indication of a properly tuned hot end controlling algorithm.



Appendix A: Quick Disconnects in Your Rostock MAX v2

If you're reading this appendix, chances are pretty good that you want to use the quick disconnect connectors that I mentioned at the beginning of this assembly guide. Let's get to it, shall we? If you've never installed crimp pins before, I can't recommend this excellent tutorial over at Hansen Hobbies enough. http://www.hansenhobbies.com/products/connectors/Connectors.pdf

The tutorial covers connectors that are mostly R/C oriented, but the lessons still apply to the connectors we'll be using here.

Wiring the EZStruder Extension Cable

For this step, you'll need a four pin male latching polarized connector and four male crimp pins.

Strip about 3/16” of insulation from each of the four 22ga stepper motor extension wires coming from the Y axis tower. Crimp each pin as shown in Fig. A-1.

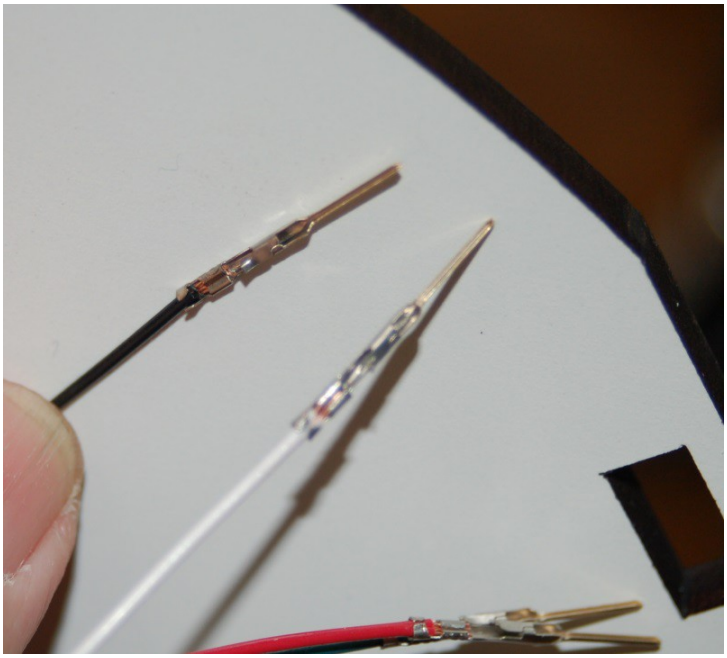


Fig. A-1:Male crimp pins installed.

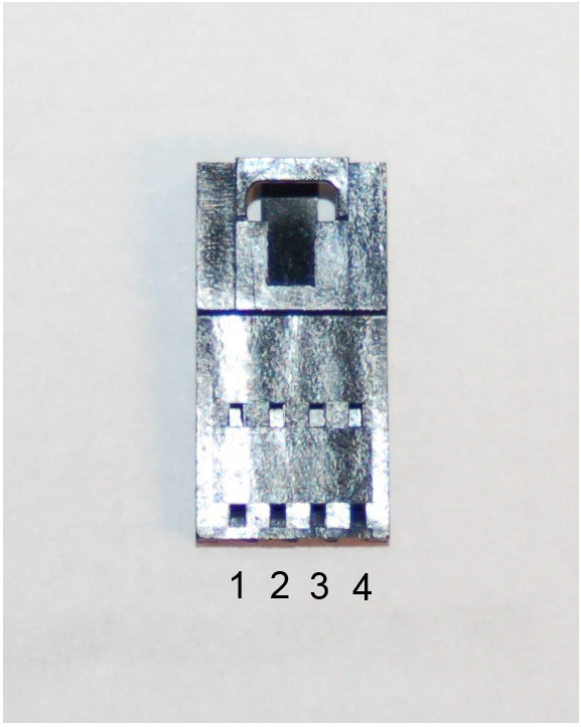


Fig. A-2:Male LP Connector.

Pin	Color
1	Green
2	Red
3	Black
4	White

Table A-1:Extension Wire Pin out.

Insert the crimped wires into the male LP connector using the order shown in Table A-1.

Now loop the stepper motor wires and extension wires as shown and then join the connectors.

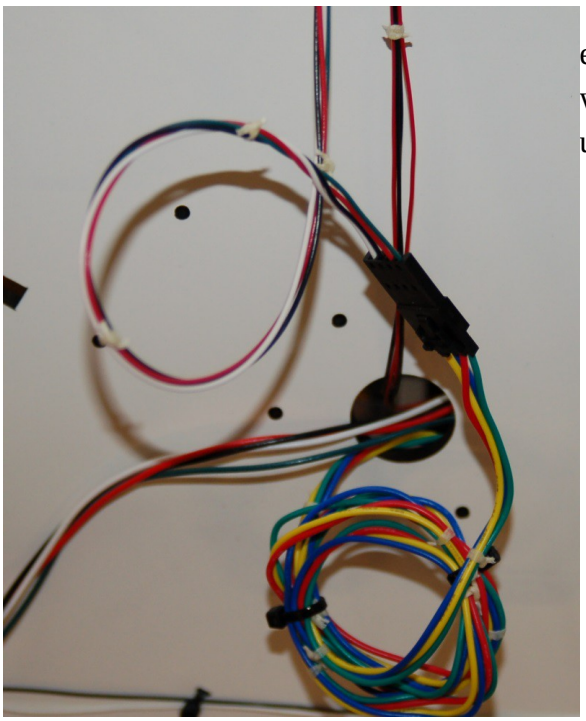


Fig. A-3:Looped & Connected!

I'm a bit of a wiring geek, so I tend to go to extremes when I'm cleaning things up. You can tape your wires down in the positions shown using Kapton tape. I use a stick-on wire tie pad. :)

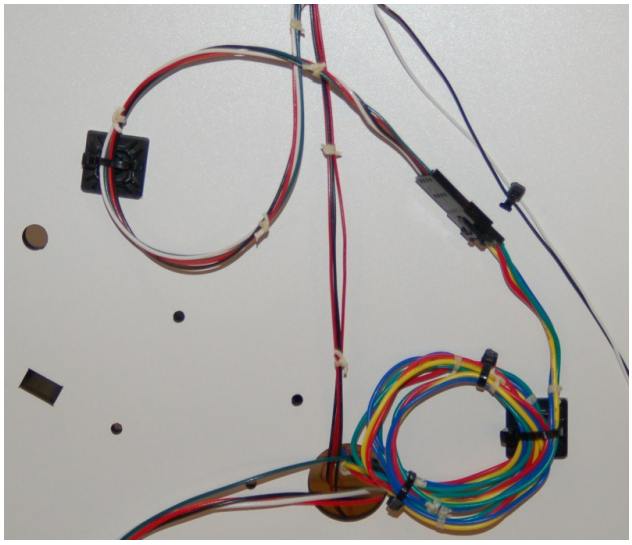


Fig. A-4:Extruder wiring done!

Wiring the Fans, Hot End, and Thermistor Connectors

First, we're going to mount the JST connectors to the PEEK and Layer fan leads (the two pair of 26ga wires).

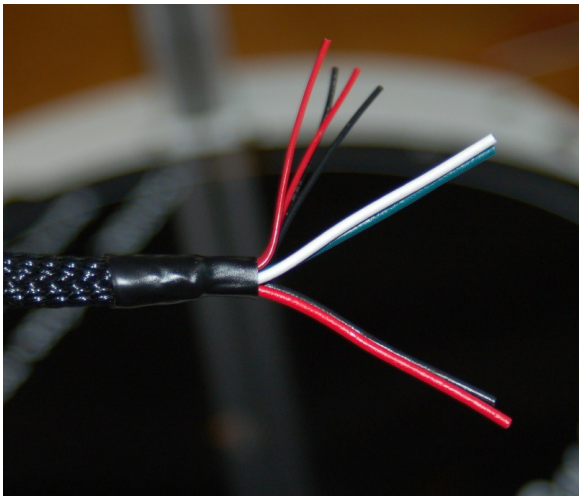


Fig. A-5: Hot end wires (knot not shown.)

The pair of wires that you tied a knot in are going to be the PEEK fan wires. Strip about 3/16” from the ends of the wires and crimp on a female crimp pin to each wire. Fold the PEEK fan wires back and add female crimp pins to the other pair. Take two female JST connector shells and mark them as shown below.

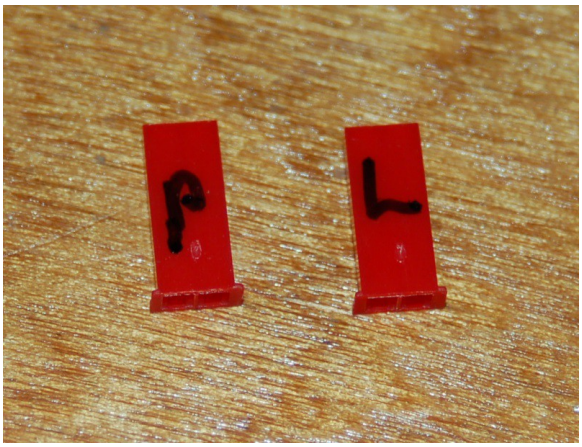


Fig. A-6:Marked fan connectors.

This will help identify the PEEK (“P”) and Layer (“L”) layer fans. The JST connectors have pin numbers molded into the lower face of each connector. Insert the black (-) wire into the pin #1 position and insert the red (+) into the pin #2 position.

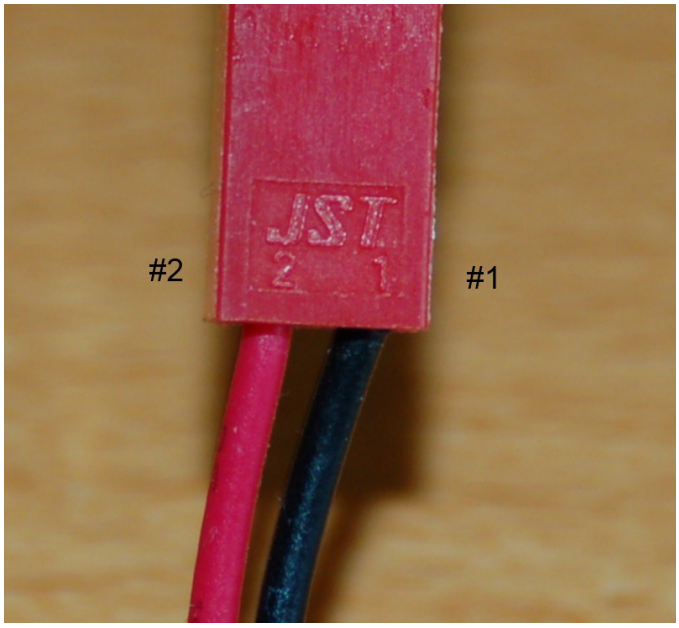


Fig. A-7:JST connector pin identification.

Now you need to strip off about 3/16” of insulation from the four 18ga wires coming out of the hot end loom. Crimp on a female crimp pin to each one and insert them into the four pin, locking polarized connector. Follow the wiring chart below.

Pin	Color
1	Red
2	Black
3	Green
4	White

Table: A-2:Connector Pin out.

The pin #1 location is indicated on the connector face by the white arrow in Fig. A-8.

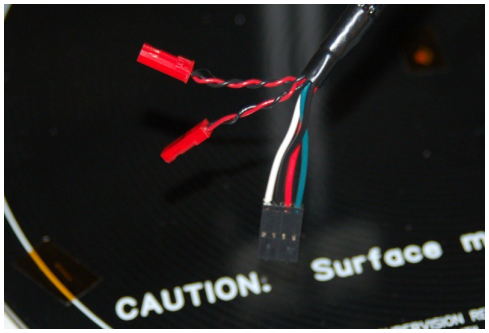


Fig. A-9:Finished hot end wiring.

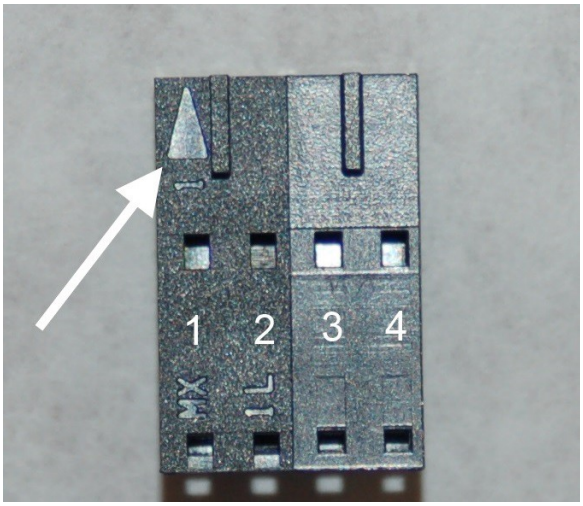


Fig. A-8:Connector pin identification.

Installing Connectors on the Thermistor and Heating Resistors

The first thing we'll need to do is get some wire to use for this task. There should be a lot of extra 18ga wire – pull all four wires forward (along with the two 26ga wire pairs) through the front of the machine if you haven't done so already. Cut 3-1/2” off the 18ga wire set so you'll have four wires (red, black, green and white) 3-1/2” long. Set those aside for the moment.

Now it's time to prepare the hot end for wiring. By this time, the RTV in your hot end should be fully cured (make sure you've let it cure for at least 24 hours) and it should look like this:

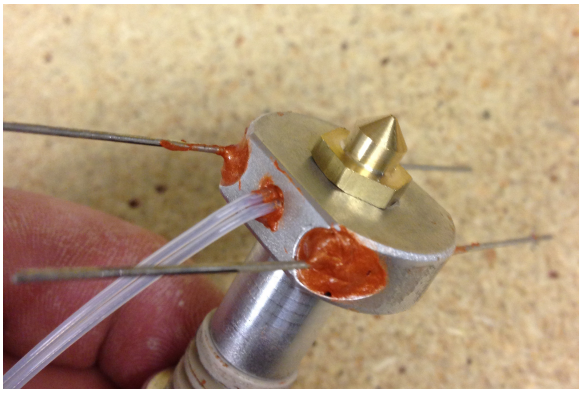


Fig. A-10:Completed Hot End.

Using a pair of needle nosed pliers, bend the resistor leads as shown in the following photos.

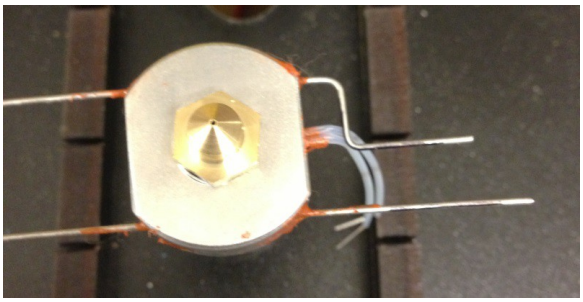


Fig. A-11: Step #1.

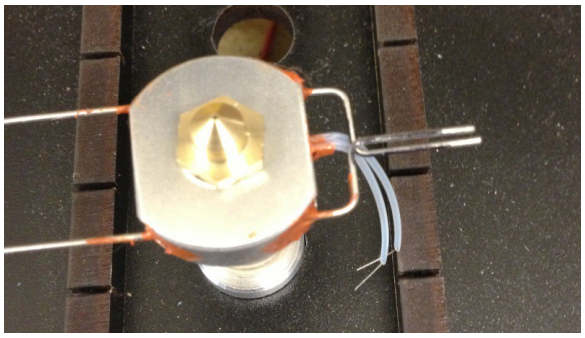


Fig. A-12: Step #2.

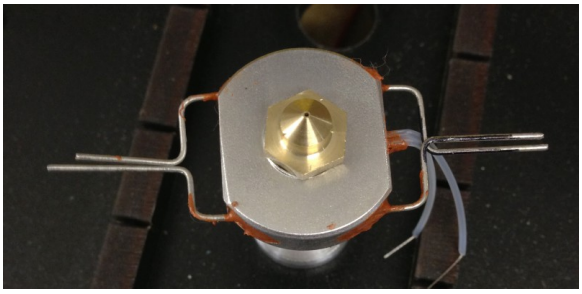


Fig. A-13: Step #3.

Trim the bent leads such that they only occupy half the crimp connector. Install two 22-18ga uninsulated barrel crimp connectors as shown in Fig. A-14.

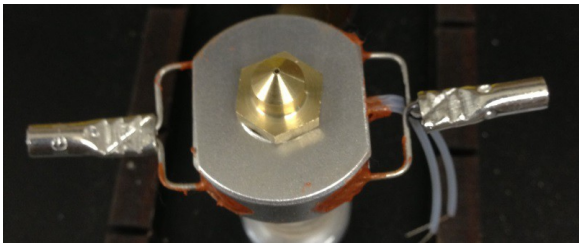
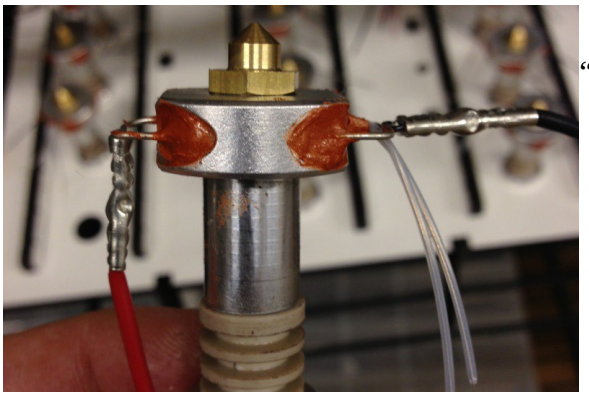


Fig. A-14: Step #4.

Strip off 3/8” of insulation from the 3-1/2” long 18ga black & red wires you collected earlier and crimp them into the connectors as shown.

Fig. A-15:Power wires connected.

At this point, I want you to cover the crimp connectors with a bit of Kapton tape – this will help prevent accidental shorts. The photos of the crimp connectors from this point forward have omitted the Kapton tape for clarity.



Bend the resistor legs connected to the red wire “up” as shown in Fig. A-16.

Fig. A-16:Positive lead bent "up".

Carefully solder the white wire to one thermistor lead and the green wire to the other. You may notice that the thermistor wires shown are different than the ones you're working with. This is okay and was a change made after the photographs were originally taken.

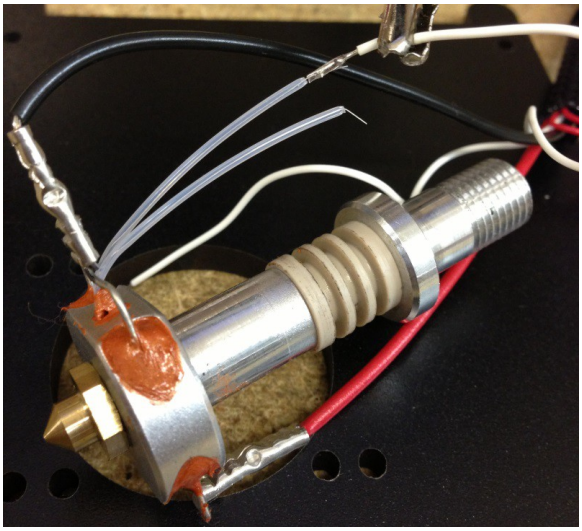


Fig. A-17:Attaching thermistor leads.

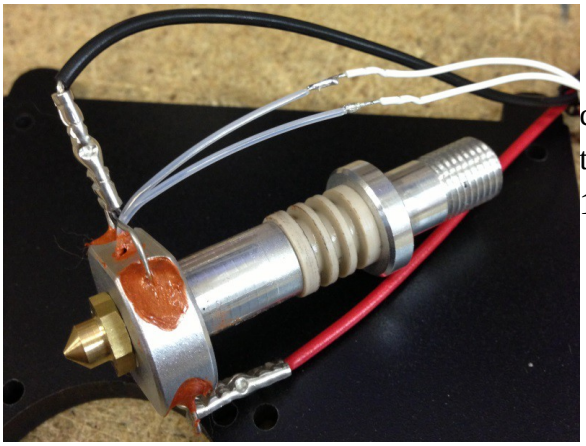


Fig. A-18:Both thermistor leads connected.

Once you've got both thermistor leads connected, cover each connection with Kapton tape (individually) and then bind them together with Kapton as shown in Fig. A-19.

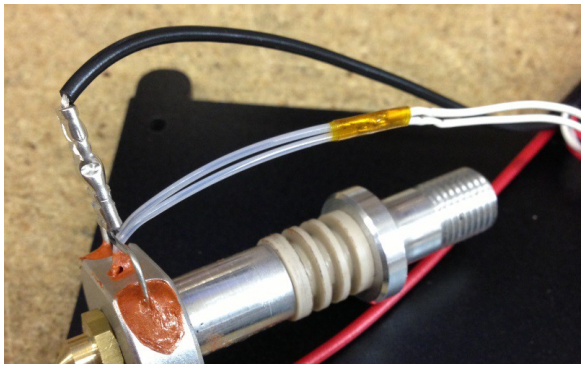


Fig. A-19:Kapton covered leads.

Fig. A-20:Thermistor lead routing.

Bend the black wire “up” as you did with the red one and carefully line up the thermistor wires next to the black lead as shown to the left Bind the thermistor leads to the black wire with Kapton tape as shown in Fig. A-21. This is an important step as it acts as a strain-relief to help prevent the thermistor from pulling out of the hot end. If the thermistor is pulled out during a print, the hot end will overheat and destroy the PEEK (the tan section) barrel.

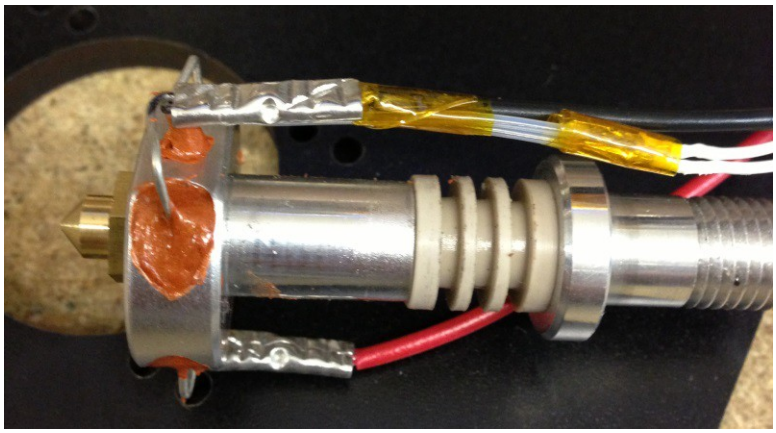


Fig. A-22:Completed thermistor wiring.

Trim a bit from the four wires in order to ensure they're all the same length. Strip 3/16” of insulation from the four wires coming from the hot end and crimp on four male crimp pins.

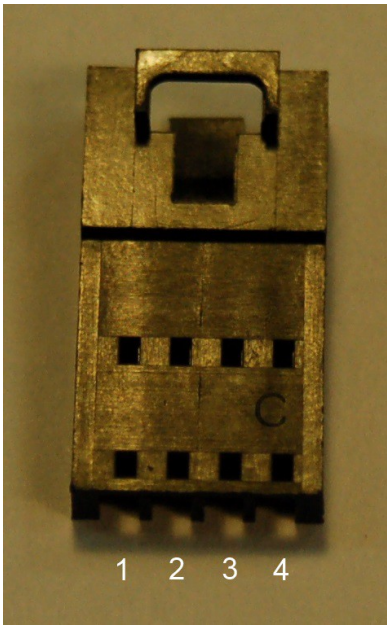


Fig. A-23:Pin Locations.

Pin	Color
1	Red
2	Black
3	Green
4	White

Table A-3:Hot End Pin out.

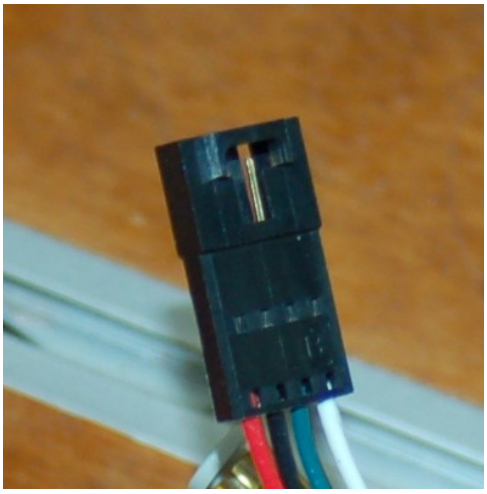


Fig. A-24:Finished Connector.

Attaching the Hot End to the Hot End Mounting Plate

For this step, you'll need the hot end mounting plate and the hot end mounting plate spacer.

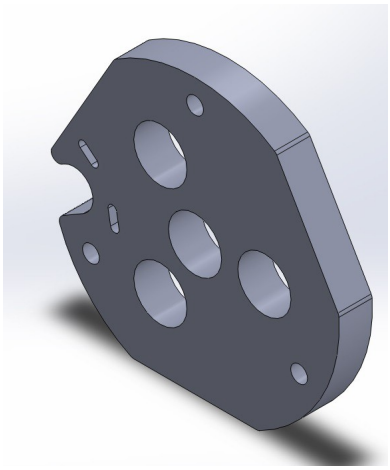


Fig. A-25:Hot End Mounting Plate.

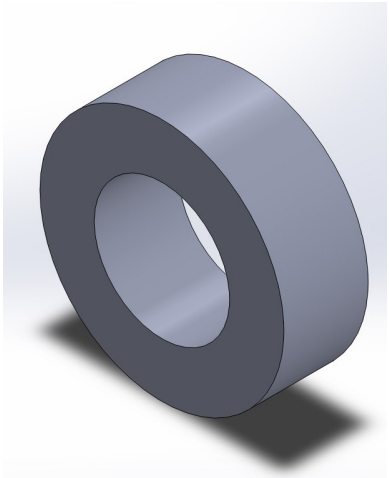


Fig. A-26:Hot End Mounting Plate Spacer.

Remove the PTF connector and the large nut from the top of the hot end and insert the hot end through the center hole in the mounting plate. Slide the mounting plate spacer over the top of the hot end and replace the nut (tighten with pliers (don't grip the PEEK section with pliers! You'll mar or damage the PEEK section) – don't allow the hot end to rotate as you tighten it) and replace the PTF connector – finger tight. Ensure that the mounting plate is oriented as shown in Fig. A-27.

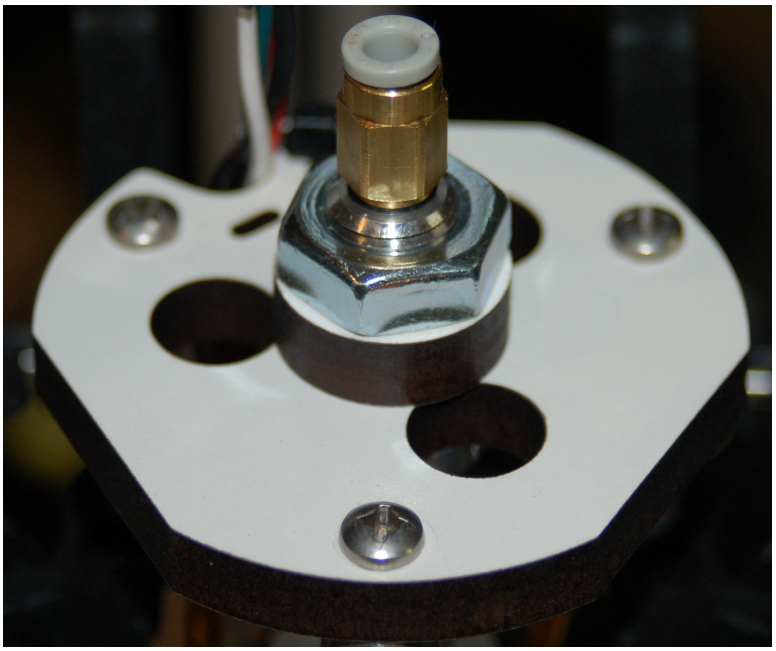


Fig. A-27: Hot end mounted to the hot end mounting plate.

To ensure that the normal operation of the printer doesn't damage the hot end wiring, I want you to use a wire tie to bind the power & thermistor wires to the hot end mounting plate as shown below.

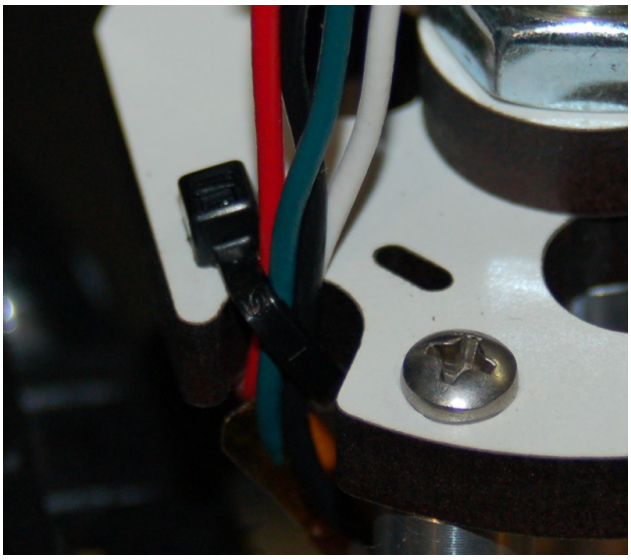


Fig. A-28:Wiring tied to the mounting plate.

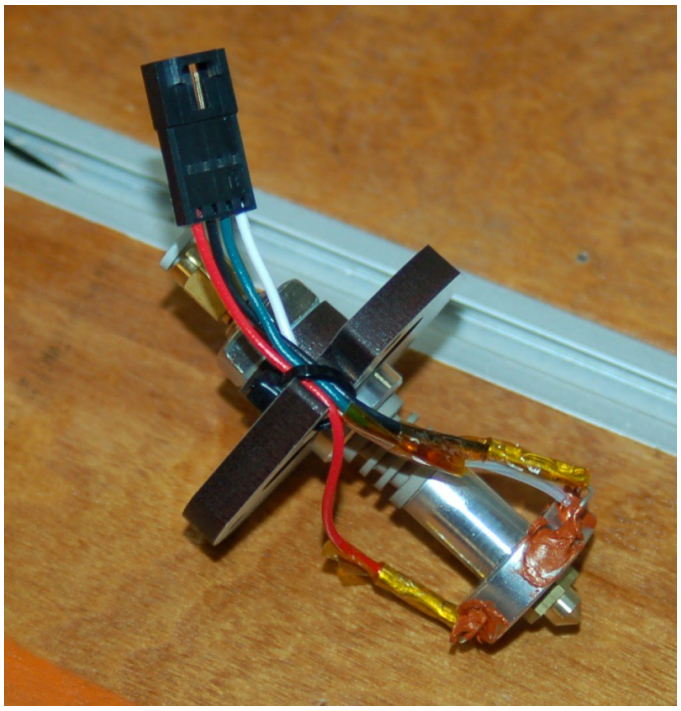


Fig. A-30:Finished hot end assembly.

Installing the Bowden Tube

For this task you'll need the long PTFE Bowden tube that was included in the Hot End Pack.

The mesh in the hot end wiring loom will open up when you compress it. Grip the mesh about 2” above the heat shrink tubing and press down with the hot end on the table. This will open up the mesh enough so that you can insert the Bowden tube. Insert the tube 1” from the upper edge of the heat shrink tubing as shown below.

Fig. A-31:Inserting the bowden tube.

Thread the Bowden tube up the loom to a point about 2-1/2” short of the PTF connector on the extruder.

Open up the loom at that point and allow the Bowden tube to exit. Pull the tube through and insert it into the PTF connection until it's fully seated.

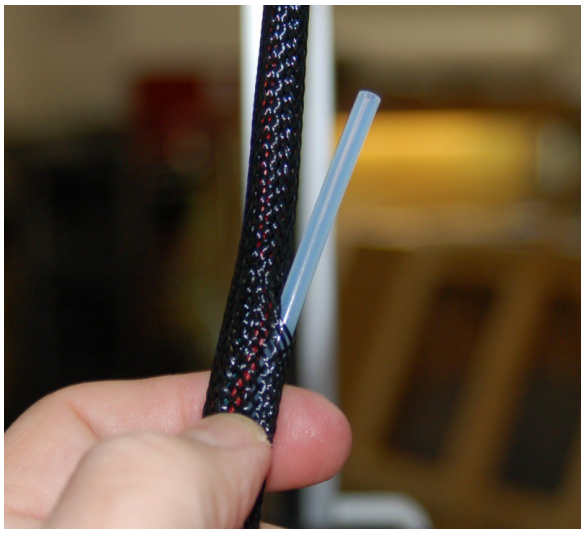


Fig. A-32:Bowden tube exit

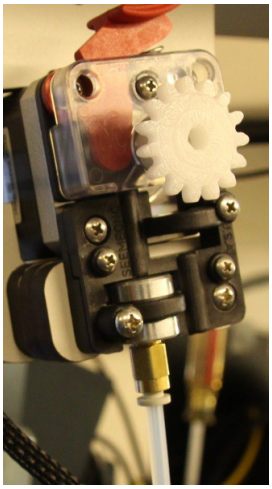


Fig. A-33:Extruder PTF Connection.

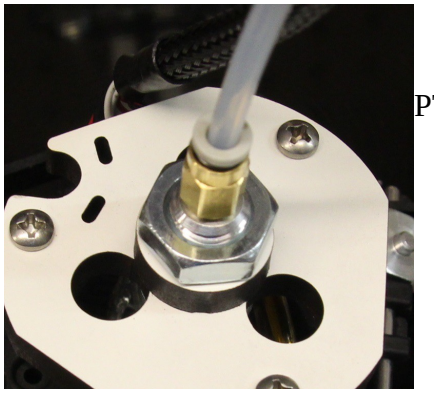


Fig. A-34:Hot End PTF Connection.

Insert the other end of the Bowden into the PTF connector on the hot end.

Appendix B: Maintenance and Troubleshooting

Like any machine, your Rostock MAX 3D printer needs preventative maintenance to continue to function as good as the day you built it. Vibration and heating/cooling cycles can take their toll and you want to stay ahead of any issues before they begin to adversely affect your prints.

1. Check the condition of your drive belts to insure they're not getting worn out or rubbing on any of the Rostock MAX v2 structure. Check to make sure that a print too close to the bed hasn't caused the drive gear to chew up the belt in one spot. This would be a good item to add to your start-up checklist.
2. Check all bolted connections to ensure that vibration hasn't begun to loosen them. This should be part of your start-up checklist.
3. Check the Cheapskate bearings to ensure that they still have a good hold on the rails. If you leave your Rostock MAX v2 idle for an extended period of time could cause "flat" spots to form on the Acetal bearing covers. You'll know this has happened if you begin to hear "ticks" as the flat spot comes into contact with the rail. The good news is that the flat spot isn't permanent as the Acetal will relax a bit with continued use and the flat spot will disappear.
4. Make sure that the fan in the power supply remains dust-free. Vacuum it out periodically to prevent the buildup of too much dust. Dust traps heat and isn't any good for power supplies.
5. Keep the RAMBo free of dust. Clean it periodically with either canned air or a dry paintbrush. Do ***NOT*** use a vacuum cleaner on it! The tip of a vacuum cleaner accumulates static electricity and will kill the RAMBo dead as a post.
6. Keep the heated bed free of scratches and debris. If your bed gets too scratched up to be usable, you can either order a new one from SeeMeCNC or go to your local glass shop and order a 300mm diameter disc of glass, 1/8" to 3mm thick. Compare the thickness of the glass and your original build surface. If the glass isn't the same, you may need to re-adjust your Z axis height.

The problem with troubleshooting is sometimes trouble shoots back. :)

Your Rostock MAX v2 3D printer is a pretty complex piece of machinery even though it looks pretty simple. As with any complex device sometimes things can go wrong in really weird ways. This won't be a comprehensive troubleshooting guide, but will touch on a few of the problems I've run into with my printer. As others offer tips, they'll be added to this section.

Print Layer Issues

When you first start a print, you should get a very even and consistent layer height. By properly adjusting the machine, you should get this automatically if you've got all three towers adjusted exactly the same. Unfortunately, that's really difficult to do. The larger the object you print, the more obvious first layer thickness inconsistencies will be, especially when using loops.

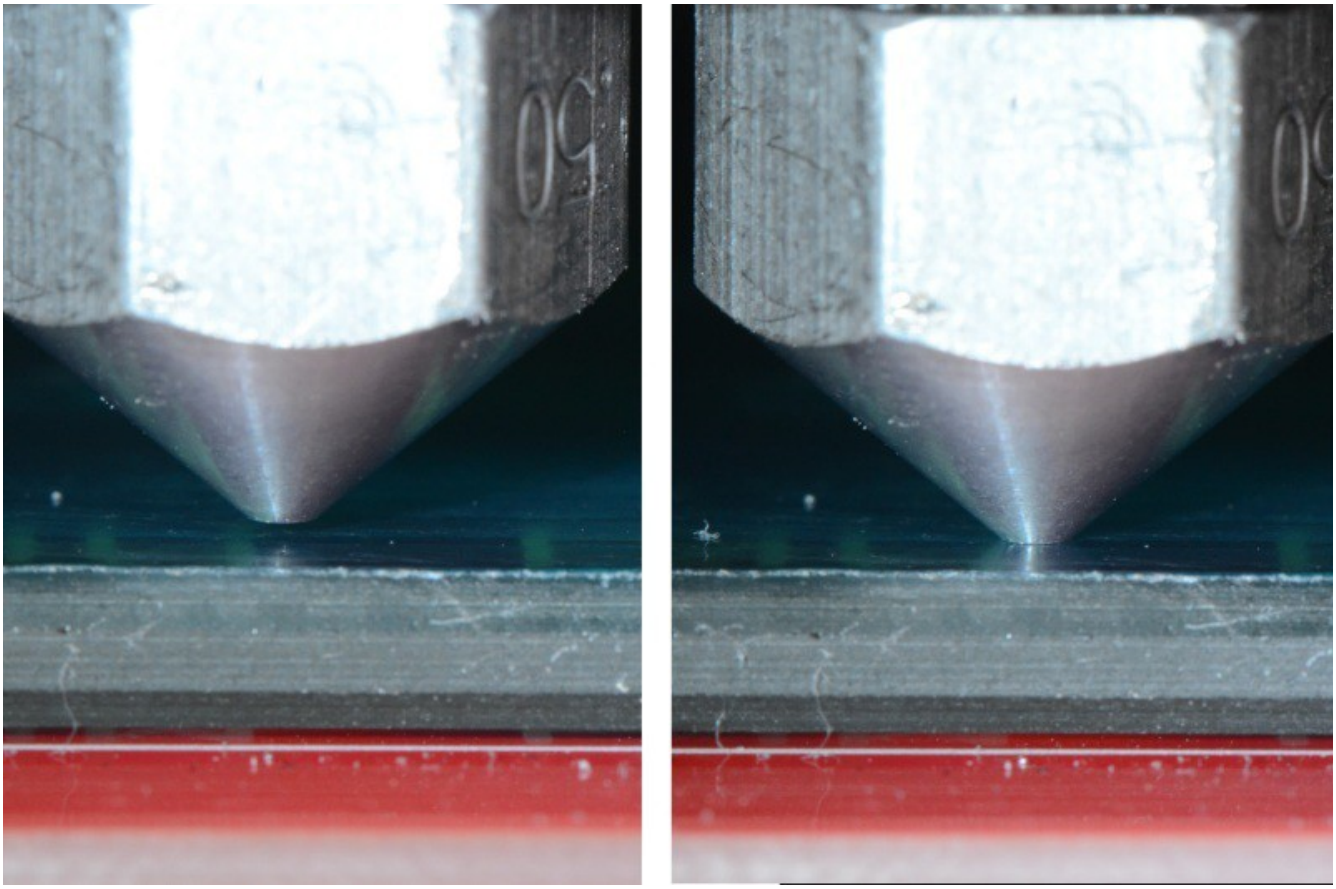


Fig. B-1: Nozzle height examples. (Image Courtesy of LulzBot)

Above is an example of correct and incorrect nozzle height. The nozzle on the right is right at the surface of the print bed. This means that there's no room for the plastic to go – the bed is effectively plugging the nozzle and will eventually cause the extruder to start skipping, or it'll grind a notch in the filament as it tries to feed it.

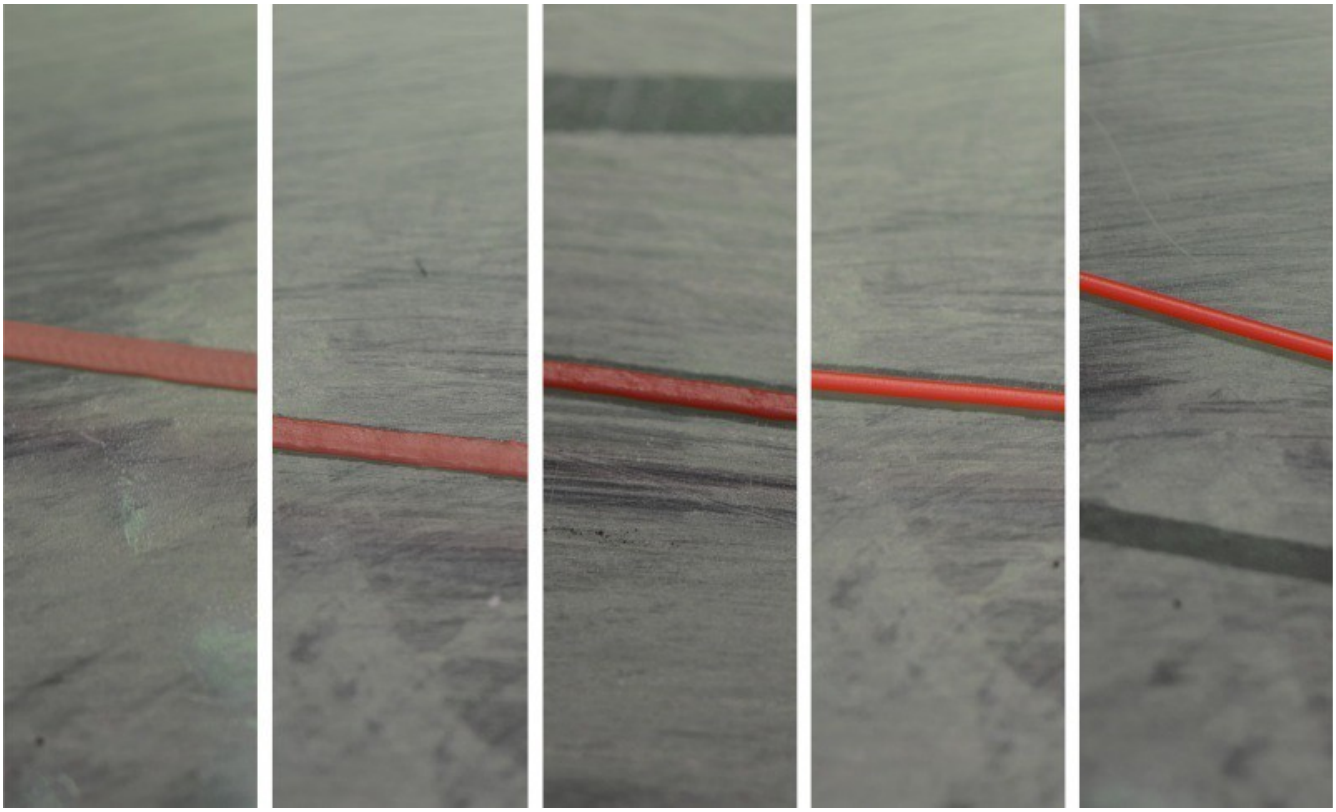


Fig. B-2: First print layer examples. (Image Courtesy of LulzBot)

In the figure above, you'll see five different print examples. On the far left you see the result of the nozzle being too close to the print bed, while at the far right you see the result of the nozzle being too far away. The result you're looking for is shown in the center. That's what a good first layer should look like. If you set the Z height such that you can just begin to feel a sheet of note paper begin to drag between the nozzle and machine bed, you're pretty close to the ideal Z height when at zero.

Machine Won't Move!

You've sent **G28** and the machine still won't move using the jog arrows. Take a look at the log output. You may be seeing an error go by that looks like this:

Extruder switched off. MINTEMP triggered!

What is most likely happening is that you haven't yet plugged the hot-end thermistor in. The firmware is preventing the machine from moving because of this – it's a safety measure of sorts. A cold thermistor will read ambient room temperature, but a failed one may not – it could read zero or some very high number. The firmware is will prevent the Rostock MAX from operating if the thermistor readings are below 3 degrees Celsius for the hot end and heated bed, or if the hot end temp is above 275 or the heated bed is above 140. (These are defaults and shouldn't be messed with unless you know ***exactly*** what you're doing)

Belt Damage or The Delta Arm Blues!

So you're printing along and you start to notice things like this:

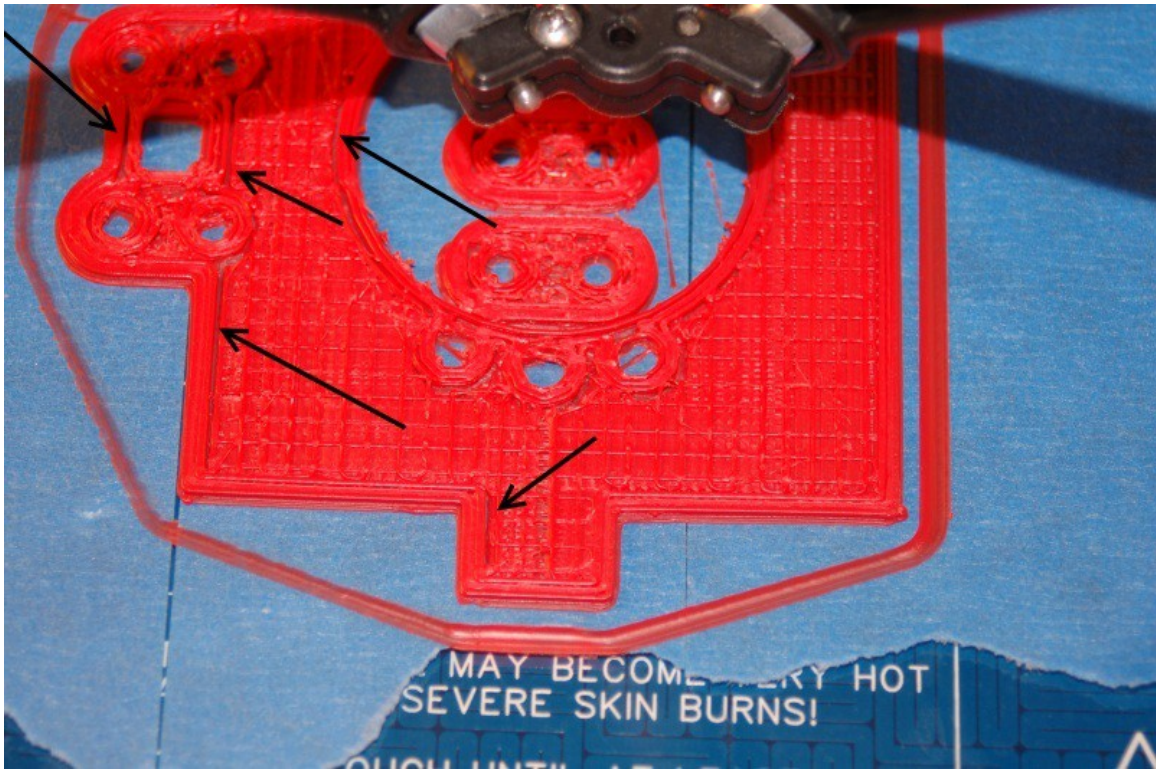


Fig. B-3: Infill not meeting the perimeter.

The arrows are pointing to a gap between the infill and the perimeter of the part. This was caused by a number of factors, eventually resulting in a sharp drive gear devouring all the teeth from a short section of the drive belt. Vigilant belt inspection and more care in setting the Z height would have helped to prevent this from happening.

A sign to watch for is the accumulation of tiny black “crumbs” in the area where the drive pulley is located. Pull the acrylic covers occasionally to check for this.

Another issue that will cause the problems shown above is known as “The Delta Arm Blues”. What happens is that one or more of the delta arm joints have a little bit of extra friction to them. When the delta platform changes direction, this tiny amount of drag will cause a positioning error resulting in the infill not completely meeting the perimeter. If you're seeing this kind of issue and your belts are in good shape, it's time to test each u-joint for fit. If you've got a tight u-joint even after applying a TINY amount of lithium grease or dry lubricant to it, you may have an axel problem. Contact SeeMeCNC support for further direction.