Welcome to the Assembly Guide for the Rostock MAX v2.0 3D printer.
Version 4.47, September 28th, 2016

Fourth Edition

Copyright 2016 by Gene Buckle

Licensed as Creative Commons Attribution-ShareAlike 3.0

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

Read Me First!

This document is your instruction manual for your new SeeMeCNC® 3D printer machine. Before using your new 3D printer, thoroughly read and understand this manual for safe and effective operation of the machine.

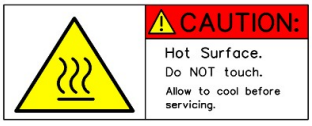
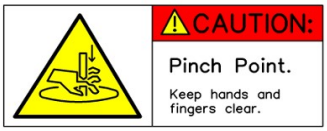
Warning	
Personal property damage, serious injury or death can result from not following instructions or warning in the manual or misuse of the machine.	
Automatic machine can start unexpectedly. Pay close attention and keep clear while power is connected to the machine	
Adult supervision required. Children under 18 years of age require supervision.	
	The machine power supply is connected to AC voltage and can be hazardous. Disconnect power before servicing this machine.
	The hot end of the machine can reach very high temperatures of 700F and can cause serious burns. The heated print surfaces (heated bed) can also reach temperatures high enough to cause severe burns. Allow both to cool for 20 minutes after turning off power.
	Use caution near moving parts of the machine. Keep body and loose articles clear.
	Risk of Fire. Do not leave machine unattended.
Use genuine parts manufactured or designated by SeeMeCNC.	
Poisonous gas, smoke, or fumes could be emitted by some materials you could use with the machine. In such case, you should install ventilation.	
	Choking Hazard. This machine contains small parts and can produce small parts which can be a choking hazard to children.
Keep a copy of this manual near the machine, easily accessible to all operators.	
Use of this machine is at your own risk.	
Visit http://www.seemecnc.com to contact us if you have any questions.	

Table of Contents

0 – Introduction and Acknowledgments

I'd like to welcome you to the 4th Edition of 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 v2. 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 v2. Note that the connector polarity is clearly marked on the board for the "MOSFET Outputs".

The Five Stages of Masking Tape...have been removed!

In a change from previous editions of the Rostock MAX v2 assembly guide, I'm going to spare you the time consuming task of removing *all* the parts from the laser cut sheets at one time. For the 4th Edition, you'll only "pull & peel" the parts as you need them. In order to help you locate the required parts, each task section will show the part, what sheet it comes on, and how many of them you need. This will also help avoid lost parts or parts that get thrown out accidentally.

Acknowledgments

I'd like to thank 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.

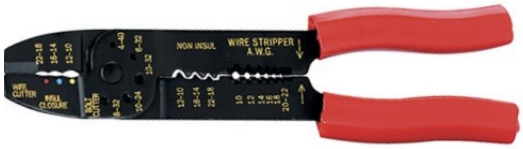
1 – Required Tools And Materials

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.

Tools

- P1 & P2 sized Phillips screwdrivers
- Standard flat head screwdriver
- A small 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
- Slip joint 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 (flush cut type)
- Wire crimping tool, similar to the one below. Used for crimping power supply wiring.



- 5/16” open-ended wrench.
- 11/16” open-ended wrench (used for hot-end mount)
- A digital caliper. These can be purchased from Harbor Freight tools for around $10.

- A small squeeze clamp that can open at least 6”
- Battery powered screwdriver. If you ever needed an excuse to buy one of these, THIS IS IT.
- Pencil.
- 40W Soldering Iron.
- Solder. (Example: https://www.sparkfun.com/products/9161)
- Blue thread locking compound (Loctite or Permatex Threadlocker Blue)
- A small file.
- 12” framing square.
- A small razor knife like an X-Acto knife. This will be handy for cleaning the flashing off the injection molded parts.

Additional Materials

- Toothpicks
- Isopropyl Alcohol
- 1 Roll of ABS filament. Needed to print the fan shrouds at the end of the build.
- PermaTex Ultra Copper High Temp RTV

- 1/2” wide roll of Kapton tape ($7-$10 at Amazon, search for “Kapton 1/2”.
- 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.

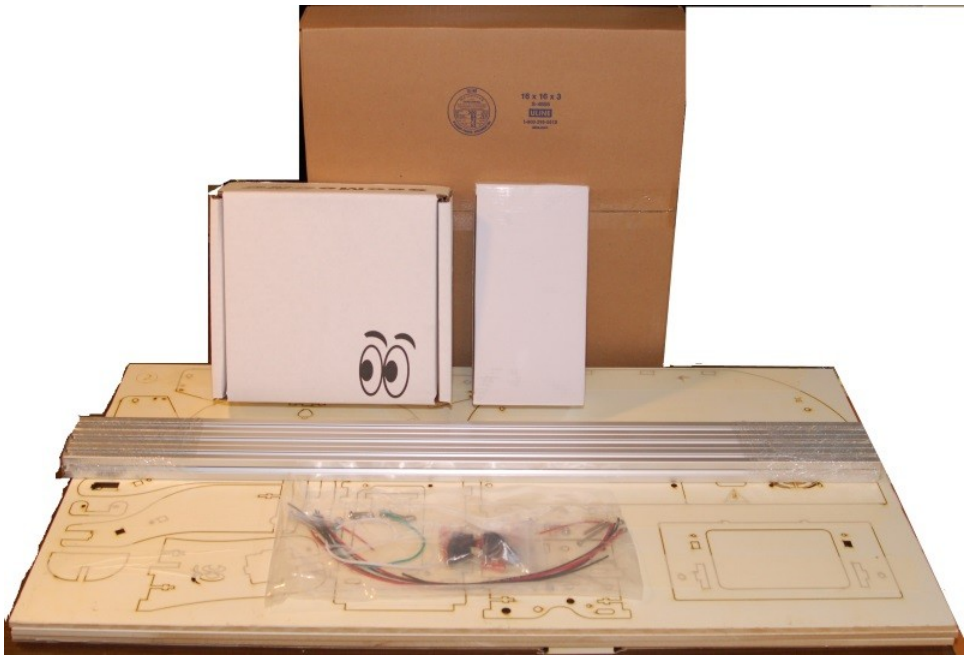
- Electrician's tape.
- Standard sized nylon wire ties.
- Waxed lacing cord. You can use this in place of wire ties in pretty much any application. You can find it here: http://www.skygeek.com/wht-string.html. While expensive, you'll never really need to buy a wire tie again and it'll likely last you the rest of your life. :)

I'd also recommend a little plastic box with part compartments in it. They're really cheap at craft stores and are perfect for building a kit like this – you can store all the various fasteners and have them ready to go as you need them. Here's the one I use for my various projects:

2 – Visual Bill of Materials

The Rostock MAX v2 kit shipping box should contain the following items:

- Four Melamine laser cut part sheets. (3 full, 1 partial) [84301]
- 1 Smoked Acrylic Parts Package [84302]
- 1 310mm x 3mm Borosilicate Glass Build Plate [26602]
- 3 T-Slot Rail, 1” (25mm) square x 32” (812mm) long aluminum [68310]
- 1 Power Supply 12VDC, 30A Model LIHUA-360W [26733]
- 1 Rostock MAX v2 Electronics and Hardware Pack, Rev3.



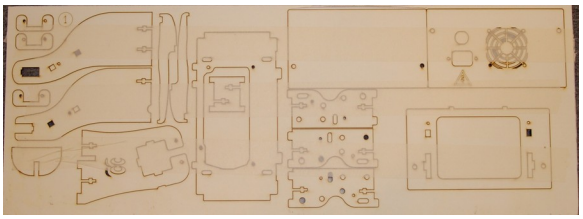
Shipping box contents.

If you're planning on painting your Rostock MAX v2, especially the part edges, you would be well served to carefully trace the outline of each part with a razor knife in order to cut the supporting masking tape. This way you can retain the protective mask on the parts in order to make painting the edges easier. Otherwise you'll have to re-apply a mask to avoid getting paint on the Melamine surfaces of the parts.

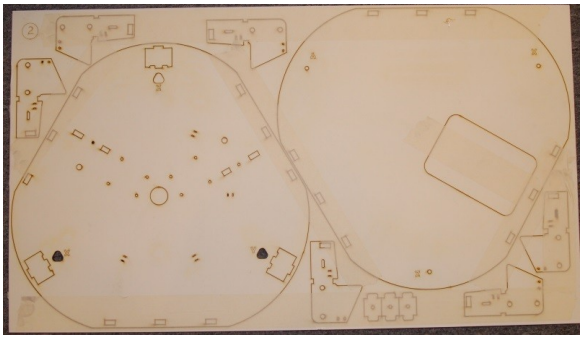
The Melamine parts are covered with a special cutting mask that prevents the laser cutting operation from depositing cutting byproducts on the Melamine surface.

Leave this protective covering on the parts until you need them. This will save you the laborious task of stripping all the masking tape off before the build. Note that if you want to paint your Rostock MAX v2, you'll probably want to go ahead and strip the masking off of the parts now. If you do so, please keep the parts grouped by sheet. When I specify parts for a task, I'll let you know what sheet you can find them. If you don't keep them grouped together by sheet number after you paint them, you'll spend more time looking for the parts I call out for a particular step.

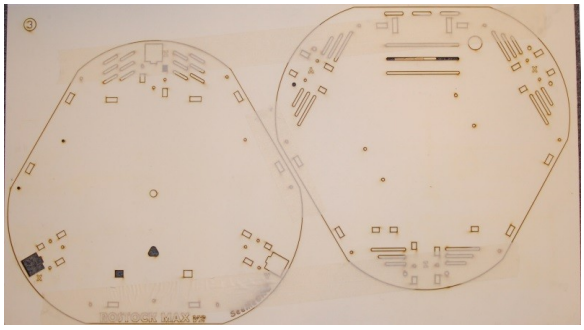
Take special care when removing the laser cut parts from the sheets. Sometimes the laser doesn't quite cut all the way through. If you find a part like this, you'll want to gently score the back side of the sheet along the faint cut line and then press the part out from the front of the sheet. The front 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.



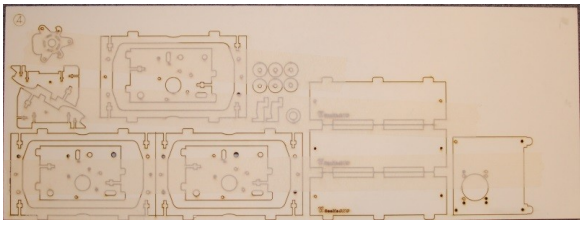
Part Sheet #1



Part Sheet #2



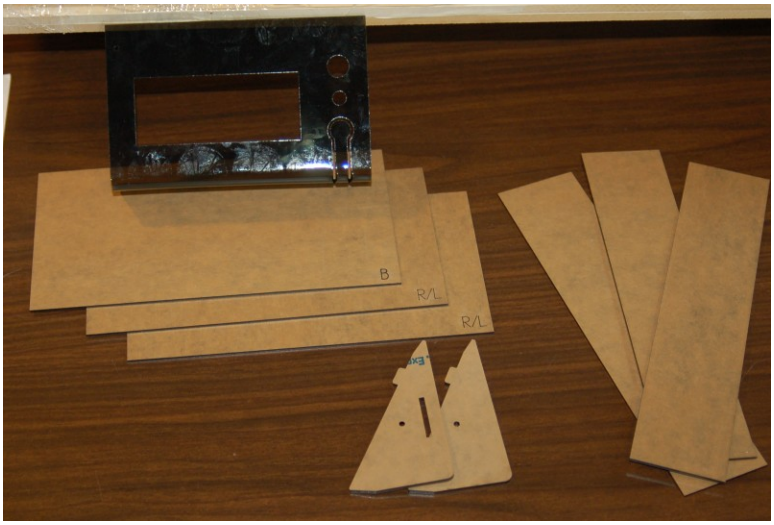
Part Sheet #3



Part Sheet #4

Note, the part sheets shown above will differ slightly from those that you have in your kit.

The white cardboard box will contain the laser cut Acrylic parts that are used in the build.



Acrylic parts.

The Acrylic parts have a paper protective covering on them. Please leave that in place until you're ready to install them.

The large cardboard box contains the hardware & electronic 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!”.

Hardware & Electronic Components

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).

Let's go ahead and do an inventory of the parts to ensure that you're not missing anything! Please check off each item as you locate it. Where possible, I'll include the SeeMeCNC part number enclosed in square brackets. Quantities are surrounded by parentheses.

Rostock MAX v2 Hardware Pack #1, Rev3 [84381]

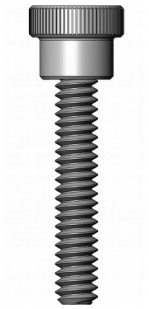
Rubber foot pack. Contains the following components:

[___] (6) #10-32, 5/8" Nylon Pan Head Screws [29998]

[___] (6) #10-32 Nylon Finish Nuts [30170]

[___] (6) Injection molded feet (black) [17505]

[___] (6) Soft rubber "shoes" [44010]



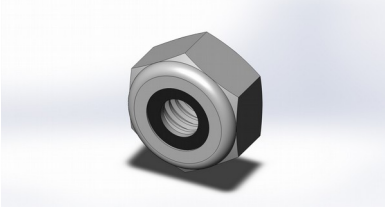
[___] (9) #10-32, 3/4" Knurled Black Nylon Thumb Screws. [30172]

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

[___] (31) #6-32, 1" Phillips Pan Head Screws. Used for general assembly. [30033]

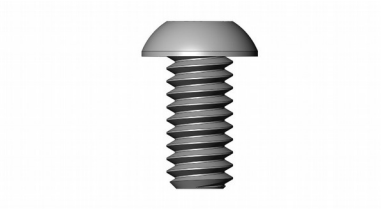
[___] (9) #6-32, 1-3/4" Phillips Pan Head Stainless Steel screws. Used for R4 idlers in the motor mounts as well as the hot end standoffs.

[30034]

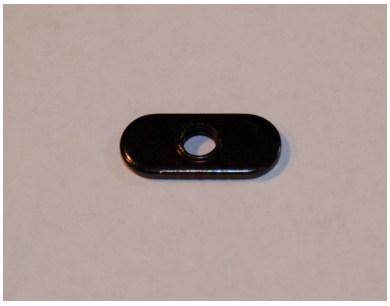


[___] (42) #6-32 Stainless Steel Nylon Lock Nut – covers all #6-32 screws. [30164]

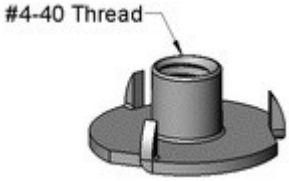
[___] (12) #6-32, 1/2” 18-8 Stainless Steel Flathead screw. Used inside of base and top side plates, to retain acrylic panels and the three end-stop triggering screws installed in the Cheapskate U-Joint mounts. [30135]



[___] (25) #¼-20, 1/2” Stainless Steel Button Head Cap Screws. Used for tower mounting. [30419]



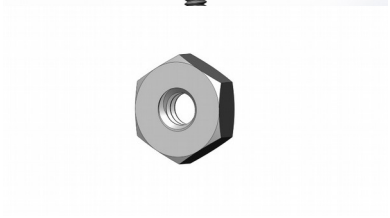
[___] (25) #¼-20 nut plates. Used for T-Slot mounting. [32005]



[___] (4) #4-40 T-Nuts. Used for RAMBo mounting. [30222]

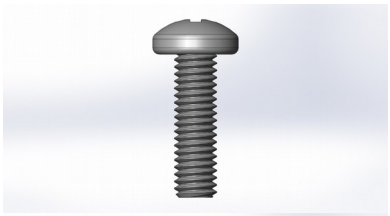
[___] (4) #4-40, 3/4” Phillips Flat Head Machine screws. Used for mounting the RAMBo Controller. [30236]

[___] (14) #2-56, 5/8” Pan Head Phillips Machine screws. Used for LCD mounting and end-stop switch mounting. [30650] (Combined Package)

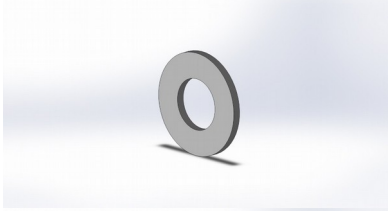


[___] (14) 2-56 Finish Nuts. Used for LCD mounting and end-stop switch mounting. [30642] (Combined Package)

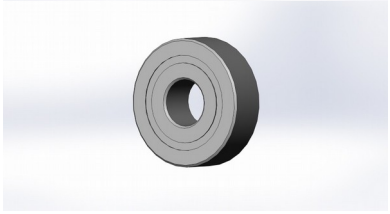
[___] (8) #4, 3/8” Phillips Pan Head Sheet Metal screws. Used for LCD sides and tower alignment stops. [30250]



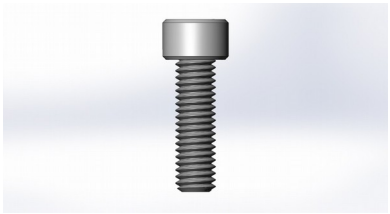
[___] (12) M3x.5, 10mm Pan Head Machine screws. Used for mounting the stepper motors. [30318]



[___] (18) #6 Stainless Steel Flat washers. Used on the 608 bearings that go in the top & bottom T-Slot rails. [30450]



[___] (9) R4 (Small) Ball Bearings. Used in the belt idlers. [35008]

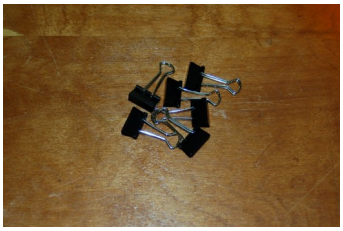


[___] (1) #10-32, 5/8” Socket Head Cap Screw. Used as a tap for the #10-32 Nylon thumb screws. [29999]

Rostock MAX v2 Hardware Pack #2, Rev 3 [84380]

[___] (12) Small Wire Ties. Used for wire management or Barbie Handcuffs. Your call.

[___] (1) GT2 2mm pitch belt pulley pack. Includes six grub screws and hex wrench. [39835]



[___] (6) Binder Clips. Used to hold the Borosilicate glass build plate to the Onyx heated bed. [58761]

[___] (5) Plastic Bearing Rollers. Used for RAMBo mounting. [71505]

Qty shown in the photo is higher than qty shipped.

[___] (1) 15 Tooth Gear. Used for manually operating extruder motor.

[71566] ***This part is replaced by the part shown below and may not be included in your kit.***

[___] (1) Stepper Motor 5mm Shaft Handwheel. Used for manually operating the extruder motor. [70710]

[___] (9) Pulley Bearing Cover for R4 Bearings. [39756]

[___] (18) R4 Bearing Standoffs [39757]

Rostock MAX v2 Electronics and Hardware Pack #3, Rev 3 [84376]

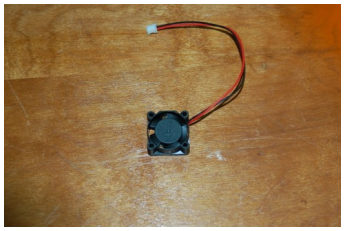
[___] (1) RAMBo Electronic Control Board with screw terminals and end stop wires. [26710]

[___] (1) USB Cable. [26708]

[___] (1) Onyx Heated Bed Sub-Assembly Pack [58770]

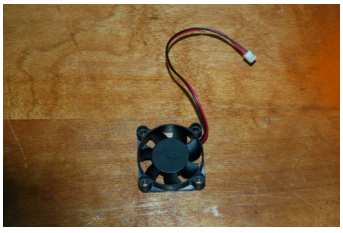
[___] (1) LCD Smart Controller with SD card, LCD to RAMBo Adapter Kit and 1 Soft Touch 5mm knob. [26720]

[___] (4) NEMA 17 Stepper Motors (4800gcm holding torque). Used for three motion axes and extruder drive. [26501]



[___] (1) 25x25x10mm 12VDC fan. Used to cool the PEEK section on the hot end. [26309]

This fan is installed after you print the PEEK fan shroud, as covered in the User Guide.



[___] (1) 40x40x10mm 12VDC fan. RAMBo cooling fan. [26177]

[___] 10 feet, 22ga, 4 conductor wire. Used to extend wiring for extruder motor. [26722]

[___] 15 feet, 26ga, Black & Red wire. Used for hot end PEEK and part fans. [26728, 26726] (Supplied as 30ft)

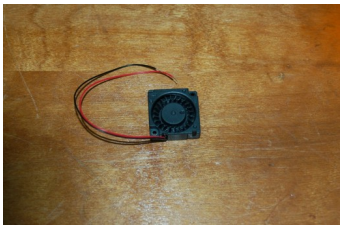
[___] 4 feet, 3/8” diameter Expandable Mesh Wire Loom (black). Used to cover wiring & bowden tube from the top to the hot end platform.

Includes 3” of 5/16” heat shrink tubing. [26727, 26729]

[___] (3) 76” GT2 Timing Belts. [39910]

[___] (1) EZStruder Cold End Kit. Includes stepper motor mounting hardware. [70780]

[___] (1) Hot End Kit. Includes hot end, heating resistors, thermistor, PTFE sleeve for thermistor, PTC fittings and PTFE bowden tube. [68394]



[___] (1) 30x30x10mm 12VDC fan. Used for part cooling. [26171]

T***his fan is installed after you print the layer cooling fan shroud, as covered in the User Guide.***

[___] 8 feet, 18ga Red wire & 8 feet, 18ga Black wire. [26724, 26723]

[___] 15 feet, 26ga White wire. [26730]

Rostock MAX v2 Hardware Pack #4, Rev 3 [84375]

[___] (2) 18awg, 2” Red [84310] Jumper for RAMBo terminal block.

[___] (2) 18awg, 2” Black [84311] Jumper for RAMBo terminal block.

[___] (1) 12awg, 14” Red [84312] PSU to RAMBo

[___] (1) 12awg, 14” Black [84313] PSU to RAMBo

[___] (1) 18awg, 8” Green [84314] IEC Connector to PSU

[___] (1) 18awg, 8” White [84315] IEC Connector to PSU

[___] (1) 18awg, 8” Black [84316] IEC Connector to PSU

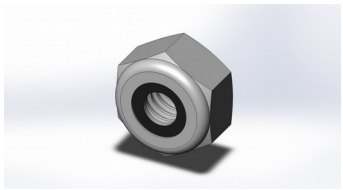
[___] (1) 18awg, 3” Black [84317] Rocker switch to PSU

[___] (1) AC Connector Screw Mount IEC Plug Style [26180]

[___] (1) AC Power Cord with IEC termination. [26737]

[___] (2) #6-32 x 1” Pan Head Screws [30033] for IEC connector

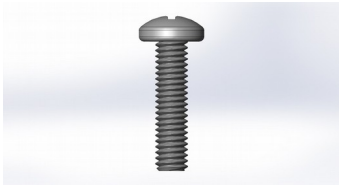
[___] (4) #6-32 x 1.75” Pan Head Screws [30034] for 60mm fan



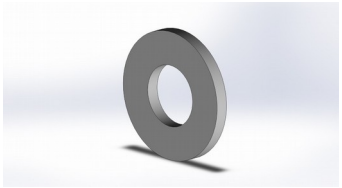
[___] (6) #6-32 Nylon Lock Nut [30164] Used with #6 hardware.

[___] (1) UL Warning Label for AC Power [45801]

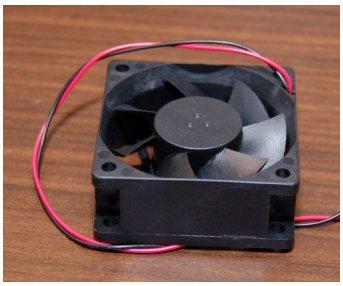
[___] (1) Rocker Switch, Black Round [26175]



[___] (4) M4 x 16mm Pan Head Screw. Used for power supply mounting. [30102]



[___] (4) M4 Flat Washer [30103]



[___] (1) 60mm x 60mm x 25mm fan [26310]

[___] (5) Spade Terminal Red Insulated for 18-22awg [26174]

[___] (5) Ring Terminal Red Insulated for #8 Stud and 18awg [26179]

[___] (2) Ring Terminal Yellow for #8 stud and 12awg [26178]

Smoked Acrylic Parts Pack

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

Miscellaneous Parts

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

[___] (3) T-Slot rail, 32” long. [68310]

Carriage Parts Pack [70849]

[___] (15) #4 Pan Head Phillips x 1/2” Sheet metal screws [30249]

[___] (3) Outer Carriage Half [70851]

[___] (3) Inner Carriage Half [70852]

[___] (6) #4 Flat Washers [30449]

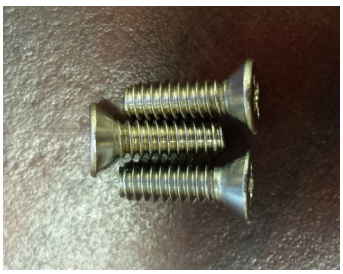
[___] (6) Belt Clips for Injection Molded Carriages [70859]

[___] (12) R4ZZ 1/4”ID x 5/8”OD x 0.196W Ball Bearings [35008]

[___] (24) R4 Bearing Sleeves (Color may vary) [87941]

[___] (3) Inner Spring Arms for Injection Molded Carriage [70854]

[___] (3) Outer Spring Arms for Injection Molded Carriage [70853]



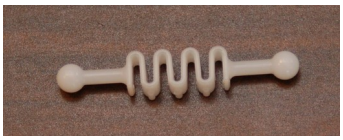
[___] (3) 4-40 x 3/8” Flat Head Machine Screws [30237]

IM Arm / Platform Sub-Assembly [70861]

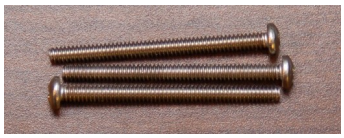
[___] (6) 290.8mm Ball Joint Arm for IM Carriage/Platform [70856]

[___] (6) Ball Joints for IM Carriage/Platform [70855]

[___] (3) Hot end Platform Spacer (Machined Aluminum) [68334]



[___] (6) Tension Spring for IM Ball Joint Arms [70860



[___] (3) #6-32 x 1.75” Phillips Pan Head Screw (Stainless) [30034]

[___] (3) #6-32 Nylon Lock Nut (Stainless) [30164]

[___] (6) #4 x 3/8” Pan Head Phillips Screw (Stainless) [30250]

[___] (6) #4 Flat Washer (Stainless) [30449]

[___] (1) Ball Joint Platform [70857]

[___] (1) Hot End Adapter, for the Ball Joint Platform [70862]

This component is included on Sheet #4.

3 – Preparing the Hot End and Power Supply

3.1 – Preparing the Hot End

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

Hot End Pack

You'll also need the Permatex Copper RTV sealant as well as a few toothpicks.

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 24 hours for the RTV to set fully, it's a good idea to get that started now. The hot end will have to remain upright during the period that the RTV is curing. The simplest way to do this is to use the large white box the Acrylic parts are shipped in. Take the parts out of the box and using a pair of scissors, cut a “+” hole in the top by shoving the scissor blade straight in. Put the Acrylic parts back in the box and set it aside – we'll use it soon!

Before we start on this, I'd like tighten the nozzle that's installed in the hot end. Grip the hot end by the heater block as shown below and gently tighten the nozzle with a 3/8” wrench.

Take care not to grip the sides of the heater block too tightly – you don't want to damage it.

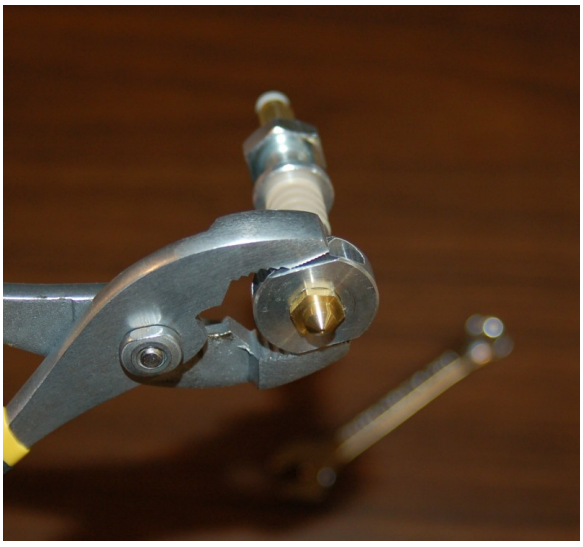


Fig. 3.1-1: Tightening the nozzle.

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.

Fig. 3.1-2: RTV & heating resistor.

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

You'll want to try to keep the resistor leads free of RTV, but don't skimp on the RTV application. You can always clean off excess RTV after it's cured.

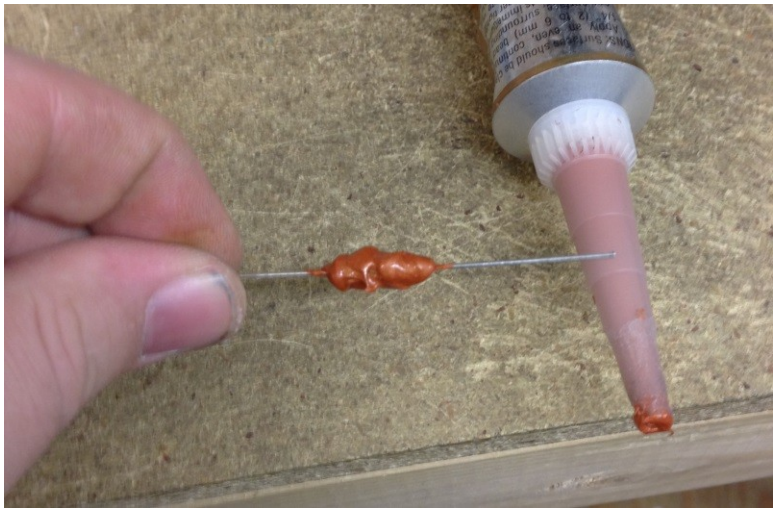


Fig. 3.1-3: Coating the heating resistor with RTV.

This stuff is goopy and sticks to everything! Avoid having to use the cat so keep a paper towel or ten handy.

Carefully insert both heating resistors into the pockets in the hot end as shown in Fig. 3-4.

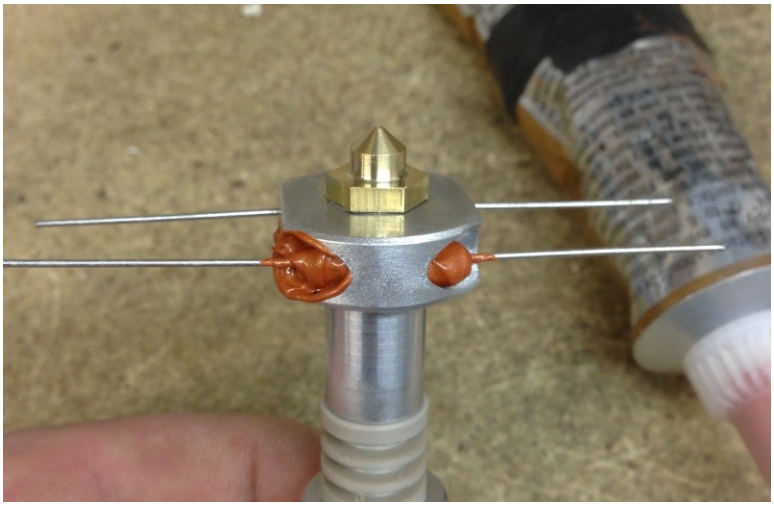


Fig. 3.1-4: Resistors installed in the hot end.

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. Use a toothpick to help pack the RTV in. You don't want any air pockets in there. Air pockets can shorten the life of the resistors because air exposure will allow the resistor to over-heat in a single area.

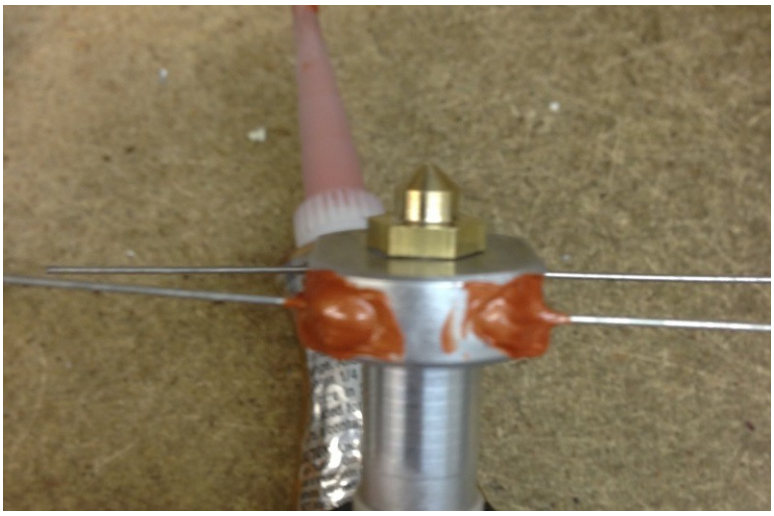


Fig. 3.1-5: Resistor cavities filled with RTV.

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 1mm diameter PTFE tubing from the thermistor package and cut it in half. Trim each half so it's about 1-1/4” long. 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. 3.1-6: 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 on the right. Take special care to not damage the thermistor head! It's made of glass and is very delicate.

Fig. 3.1-7: 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. 3.1-8: 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.

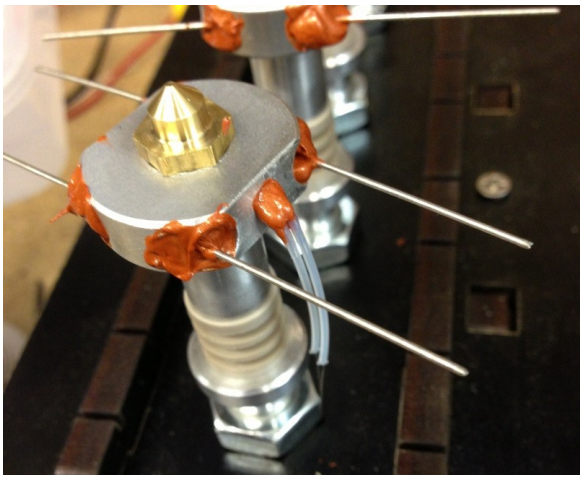


Fig. 3.1-9: Thermistor installed.

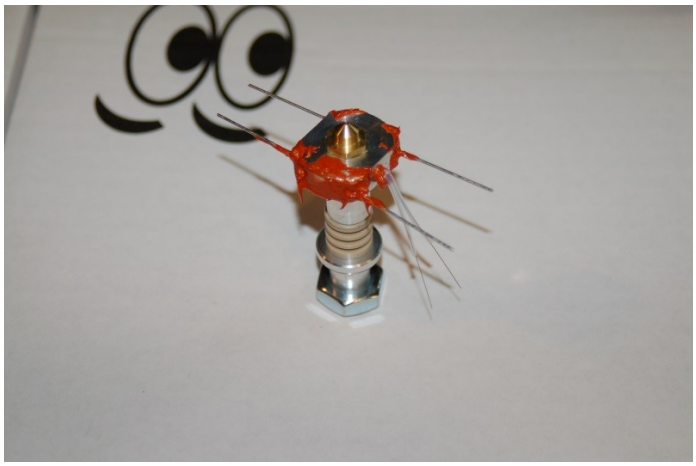
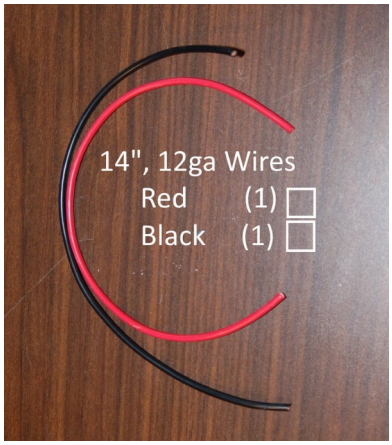
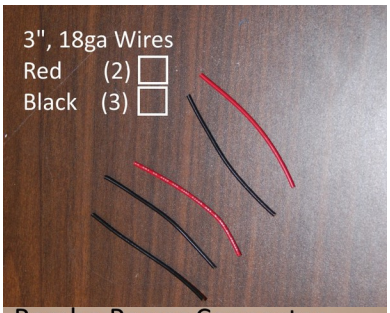


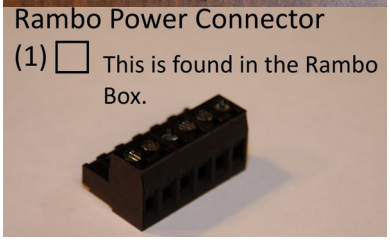
Fig. 3.1-10: Hot end plugged into the cardboard box for curing.

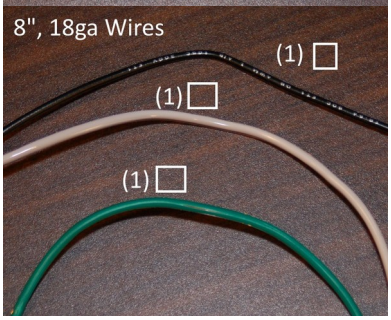
3.2 – Preparing the Power Supply

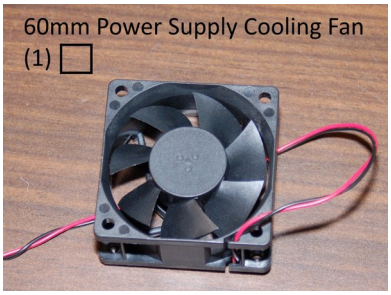
For this task, you'll need these components:











Your Rostock MAX v2 uses a 12 volt, 29 amp industrial power supply to provide power to the RAMBo controller, the Onyx heated bed and the hot-end. The power supply won't be installed until a later step, but there's some prep work that you can do now.

The very first thing you need to do is verify that the power supply is configured for the voltage source in your country. In the USA/Canada, it's 115v. In Europe and other countries, it's likely 230v. If you don't know, ask.

First, we're going to start by wiring up the RAMBo power connector. Grab the two 3”, 18ga red wires and insert them into the screw terminals in the RAMBo power connector as shown. You'll need a small flat tip screwdriver in order to tighten down the terminals. Do NOT “tin” the ends of the wire with solder. Over time, this will cause the compression terminal connection to fail.

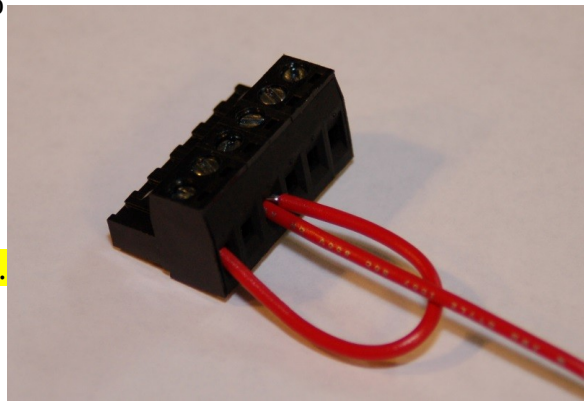


Fig. 3.2-1: First red wires.

Please take special care to keep the connector oriented as I show on the right. The red & black wires must go in the positions shown. If they're not, the RAMBo or the power supply could become quite annoyed with you and stomp off in a cloud of noxious smoke.

If you can see more than 1/16” of bare wire after the wire is fully seated into the terminal block, remove it and trim a tiny amount off and re-install the wire. Repeat until the wire length is correct. (It should come pretty close already.)

Next, take two 3”, 18ga black wires and insert those into the RAMBo power connector as shown.

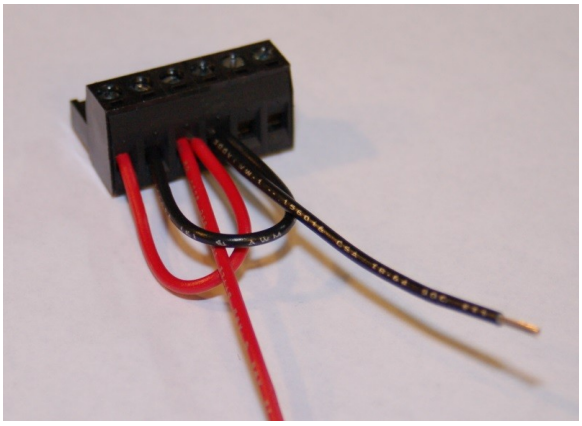


Fig. 3.2-2: Black wires inserted.

Now take one of the red and one of the black 12ga wires and insert them into the terminal block. Insert the smaller 18ga wire first and THEN the 12ga wire. Just like with the smaller wire, if you can see more than 1/16” of bare wire sticking out of the connector, trim it until it seats fully with little or no exposure of the bare wire.

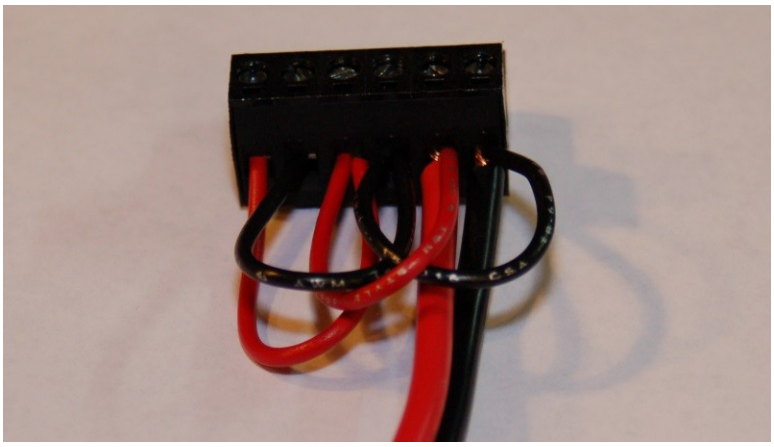


Fig. 3.2-3: RAMBo power connector completed.

3.3 – Put a Ring (terminal) On It...

...and a few female spade terminals too!

It's time to finish the RAMBo connector wiring by attaching two 12-10 AWG ring terminals to the 12ga wires coming out of the compression terminal block. When crimping a connector like this, you'll want to make sure that the tip of the wire is visible at the end of the crimp-barrel as shown below.

Each connector only needs a single crimp – there's no reason to hammer it with the crimping tool. As you can see in the background of Fig. 3.3-1, there's only a single crimp in the 12-10 ring terminal.

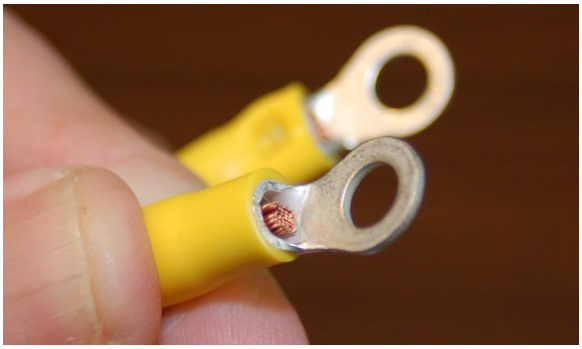


Fig. 3.3-1: Proper wire position.

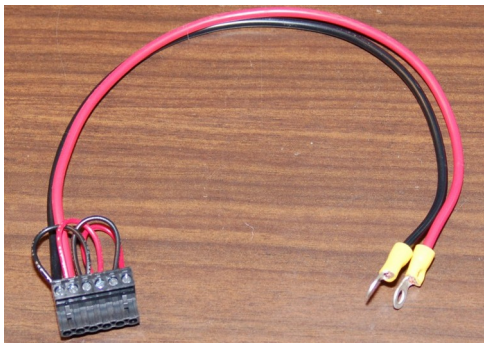


Fig. 3.3-2: RAMBo power connector completed.

Once you've done those, I want you to attach one 22-16awg ring terminal and one 22-16 female spade terminal to each of the 8”, 18ga wires. (Black, White, and Green).

Finally, attach two 22-16awg female spade terminals to each end of the last 3”, 18ga black wire.

The last task for this section is to attach two 22-16awg ring terminals to the 60mm fan as shown in Fig. 3.3-3.

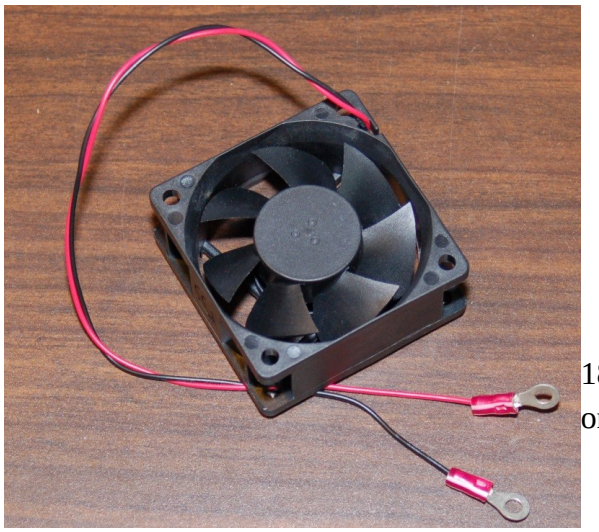


Fig. 3.3-4: Fan crimps.

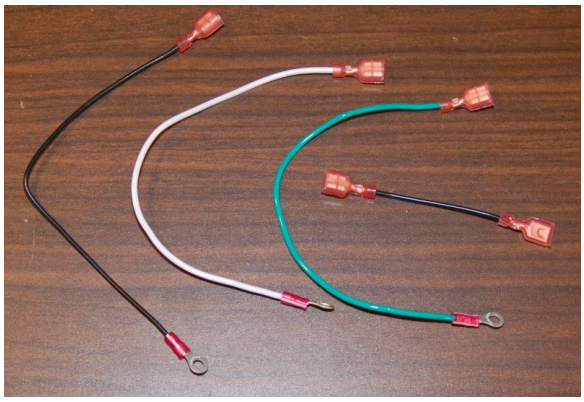


Fig. 3.3-3: Crimp connectors installed.

Set aside the 60mm fan and the one 3”, 18ga wire you put the female spade connectors on. We'll get to those in a later step.

3.4 – Attaching The Wiring To The Power Supply

The first thing I want you to do is remove the screws from the terminals marked “V+”, “V-”, “⏚”, N, and “L”.

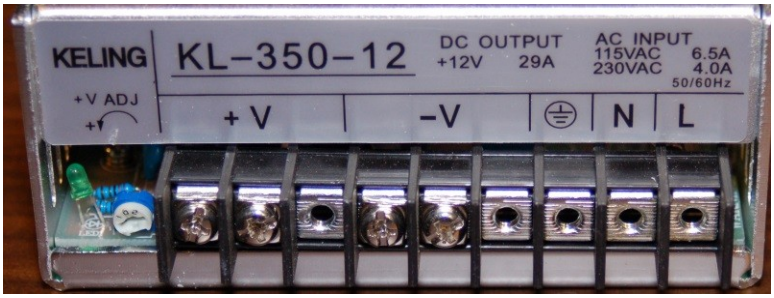


Fig. 3.4-1: Screws removed.

Install the ring terminal end of the black wire to the terminal marked “L”, the white wire on the terminal marked “N” and the green wire on the terminal marked “⏚”.

Grab the RAMBo power connector you just finished wiring up and attach the black 12ga wire to the terminal section marked “V-” and the red 12ga wire to the terminal section marked “V+”.

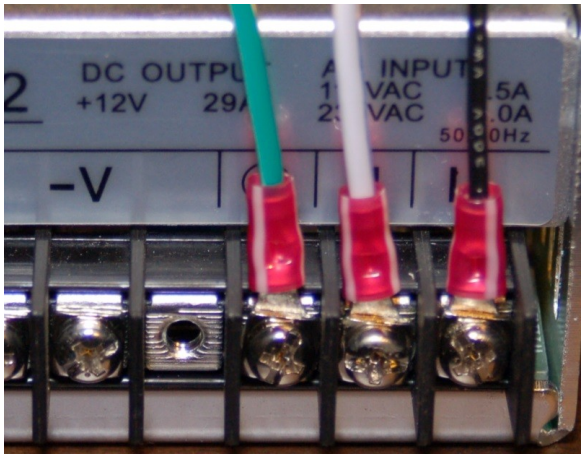


Fig. 3.4-2: A/C wires installed.

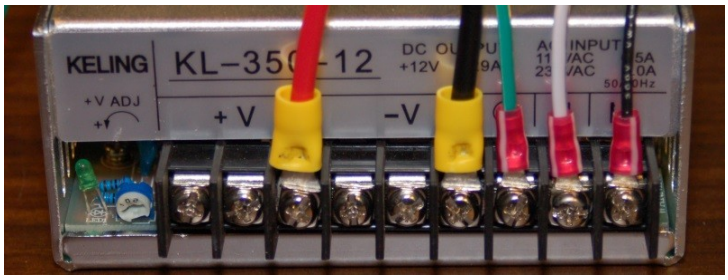


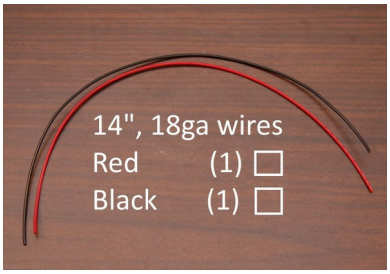
Fig. 3.4-3: Completed power supply wiring.

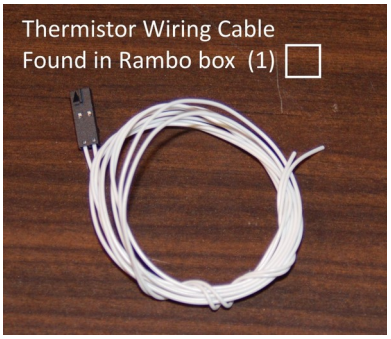
This completes the work you need to do on the power supply. Set it aside and we'll get it installed in the base very soon.

Checkpoint Video #1

4 – Preparing the Onyx Heated Bed

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





Just like the power supply, we're going to do some prep work on the Onyx Heated Bed in advance of actually needing it in the build. If your kit doesn't include 14” of pre-cut 18ga wires, you can cut 14” of wire from the long lengths of black & red 18ga wire that's included.

4.1 – Installing The Thermistor

The first thing we're going to do is cover the thermistor hole that's in the center of the Onyx. Cut yourself about 3/4” of Kapton tape and fold the end over to give yourself a “pull tab”. Then cover the center hole with it as shown.

You're covering the center hole in order to prevent any RTV from escaping the hole.

In the parts pack for the Onyx, you'll find a small baggie containing a thermistor and some thin PTFE sleeving, essentially identical to the thermistor and PTFE that you installed in the hot end preparation task.

Fig. 4.1-1: Covering the thermistor hole.

Cut off two 3/8” long lengths of PTFE and slip one over each leg of the thermistor. Just like you did with the hot end, carefully bend the end of the thermistor at a 90 degree angle.

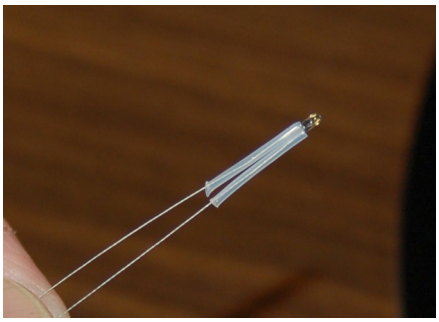


Fig. 4.1-2: PTFE insulators installed.

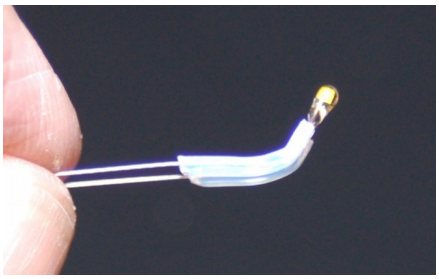


Fig. 4.1-3: Thermistor ready.

Dip the end of the thermistor in to RTV, just like you did for the hot end. Insert the RTV coated thermistor into the hole in the center of the Onyx as shown in Fig. 4.1-4.

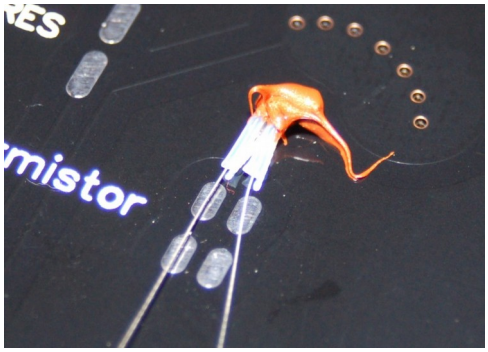


Fig. 4.1-4: Thermistor in place.

Next, you'll cover the thermistor with a few strips of Kapton tape in order to keep it in place.

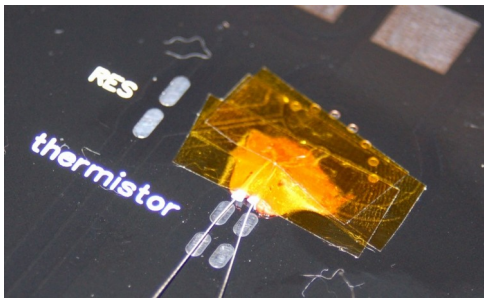


Fig. 4.1-5: Taped in place.

Now go ahead and solder the two thermistor leads to the two closest pads and then trim the leads.

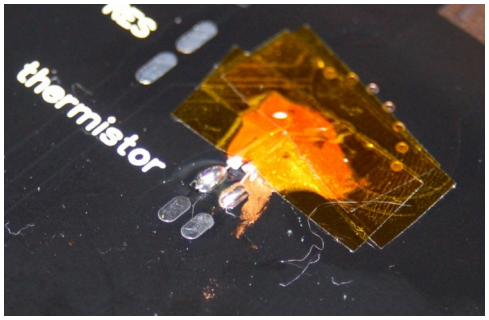


Fig. 4.1-6: Soldered & trimmed.

4.2 – Installing the Resistor and Power LED

Now get the small resistor and LED out of the Onyx parts pack. Bend the resistor leads and set it on the two solder pads marked “RES” as shown below.

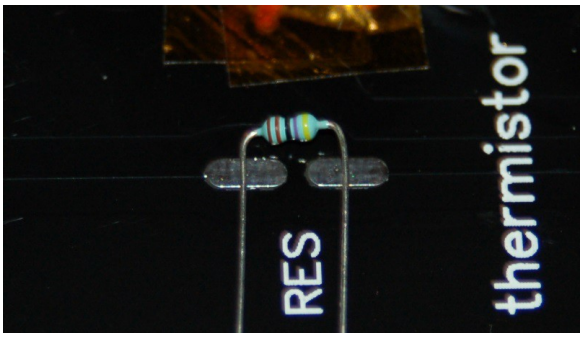


Fig. 4.2-1: Ready for solder!

Once you've got the resistor soldered into place, trim off the excess leads just like you did for the thermistor.

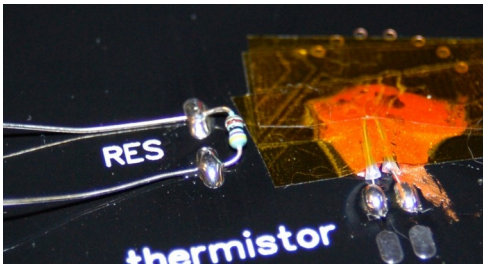


Fig. 4.2-2: Resistor installed.

We're going to install the power LED next. The LED has polarity to it, so we need to make sure that it's installed correctly, otherwise it won't light up.

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 rectangular solder pad as shown below. You'll notice that the part outline also has a flatted area that matches the one on the LED.

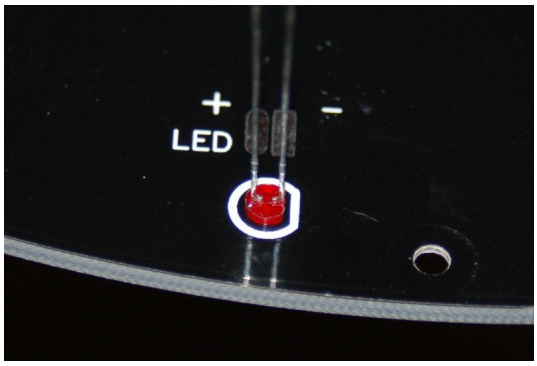


Fig. 4.2-3: LED orientation.

Bend the leads over so they are laying flat against the two solder pads as shown in Fig. 4.2-4 and then solder them into place. If you hold the rim of the LED in place with your thumbnail while you bend the leads over, you'll end up with a nice “ramp” in the leads.

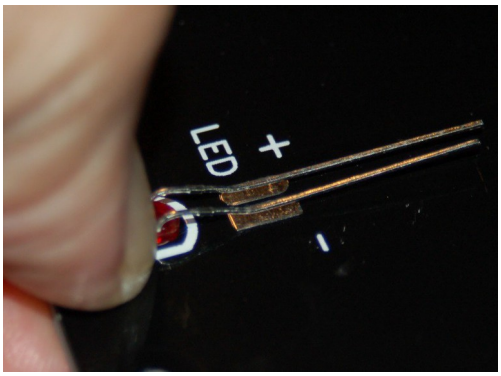


Fig. 4.2-4: LED ready to solder into place.

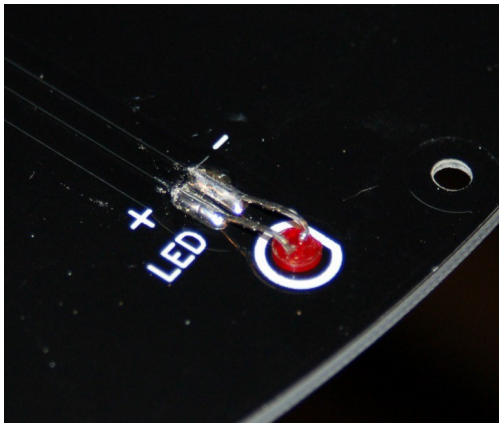


Fig. 4.2-5: Soldered and trimmed!

Once you're done installing the LED, you'll notice that it sticks up past the top surface of the Onyx. The LED needs to be pushed in so that it's flush or slightly below the top surface of the Onyx as shown below.

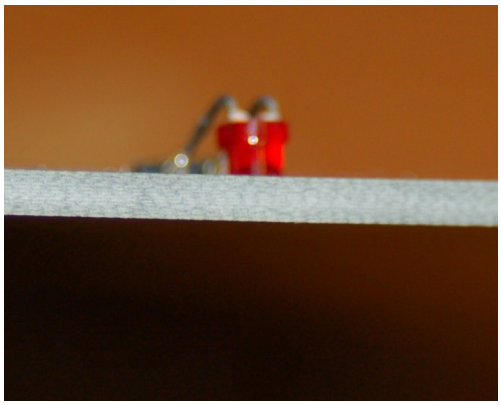


Fig. 4.2-6: LED depth.

4.3 – Attaching the Thermistor and Power Wiring.

The last two things you need to do is attach the thermistor signal wires and the 18ga power wires that feed the Onyx itself.

Let's start off with the thermistor signal wires. Strip off about 3/16” of insulation off of the leads and solder into place using the two pads near the thermistor as shown in the figures below.

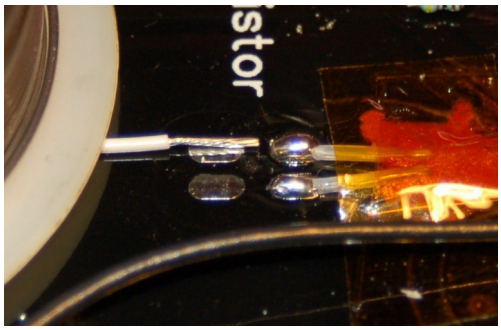


Fig. 4.3-1: Ready to solder!

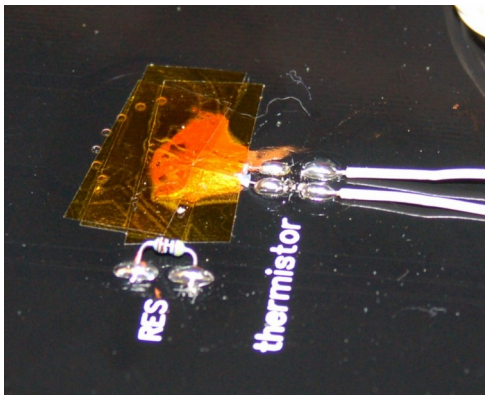


Fig. 4.3-2: Signal leads in place.

Soldering the power wires to the Onyx heated bed requires that you increase the temperature of your soldering iron to around 800F if it's adjustable. This is needed because the pad size can draw the heat away nearly as fast as the iron can provide it. Tin both square pads on the Onyx. You want an even coat of solder on the square pads. Having the solder on the pad and the wire makes the task much easier.

Next, trim about 1/2” of insulation off one end of the two 18ga power wires and about 1/4” off the other end. On the 1/2” end, I want you to flatten the wire out in something of a fan shape. Tin the wire end. Solder the red wire to the pad marked “+” as shown below. Solder the black wire to the “-” pad.

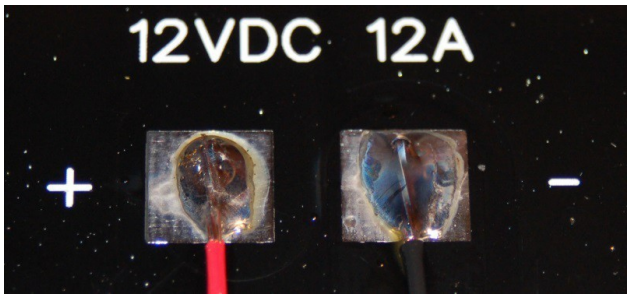


Fig. 4.3-3: Power wires soldered in place.

Finally, you'll need to cover all the exposed solder pads with Kapton tape. This will help ensure that no accidental short-circuits occur.

Put the assembled Onyx back in the package to protect it – we'll return to it later.

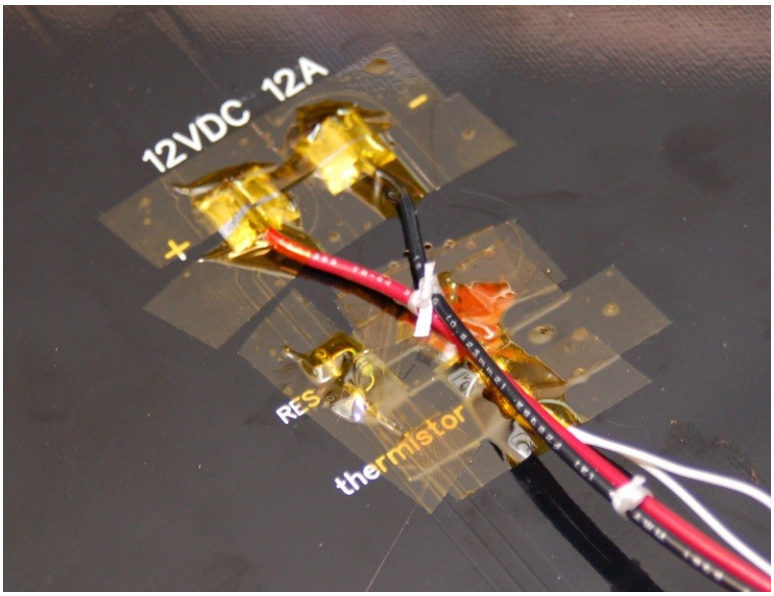


Fig. 4.3-6: Pads covered in Kapton.

Checkpoint Video #2

5 – Preparing the Drive Motors

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

Three Stepper Motors

Drive Gears

Thread locker

The stepper motors that are shipped with your Rostock MAX v2 kit are equipped with a “flatted' shaft. This means that a portion of the drive shaft has been ground flat. This ensures that a properly tightened drive gear won't be able to rotate on the shaft when properly tightened.

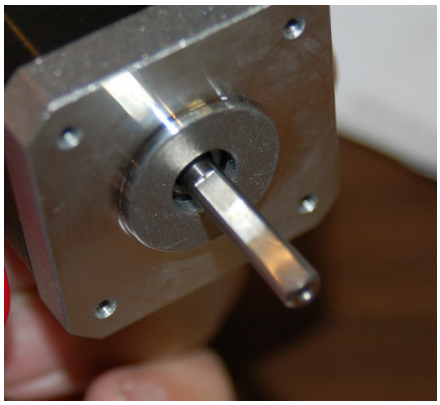


Fig. 5.1-1: Flatted shaft.

Thread both of the grub screws into a drive gear and then slide it on to the stepper shaft as shown. Make sure that a grub screw is aligned with the flatted portion of the shaft. You *also* want to make sure that the end of the stepper shaft is flush with the outside face of the drive gear – again, as shown below.

Fig. 5.1-2: Gear and grub screw aligned.

Fig. 5.1-3: Drive gear installed.

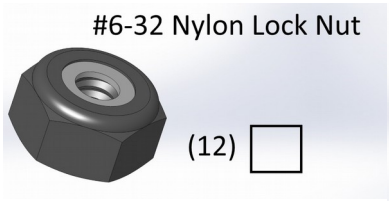
Get your thread locker out and dribble a *tiny* bit on the threads. Tighten the grub screws with the included Allen wrench.

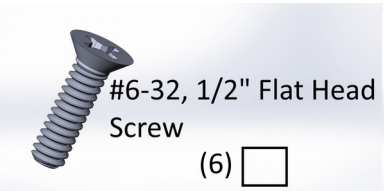
Complete the gear installation on the other two motors. Set aside when done.

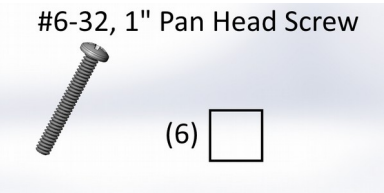
Checkpoint Video #3

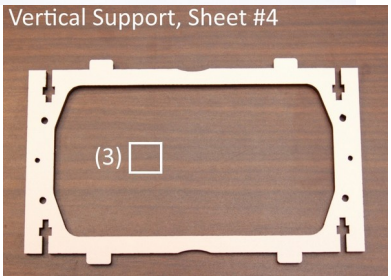
6 – Assembling the Base

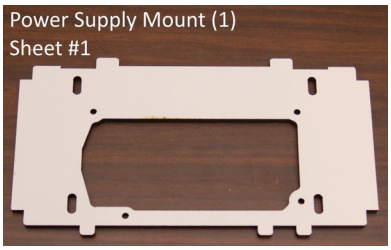
For the following task, you'll need the following parts:

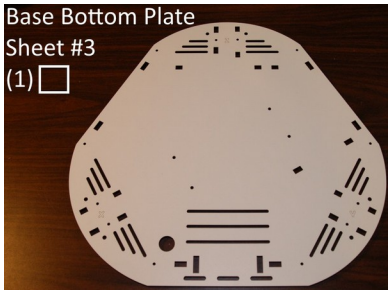












Foot Pack

6.1 – Installing The Feet

The feet on the Rostock MAX v2 are made from a hard plastic “foot” that is held in place by a nylon screw & bolt and is covered with a soft rubber “shoe”.

The feet are installed on the bottom of the Base Bottom Plate. The top surface has axis labels at each “corner” as shown.

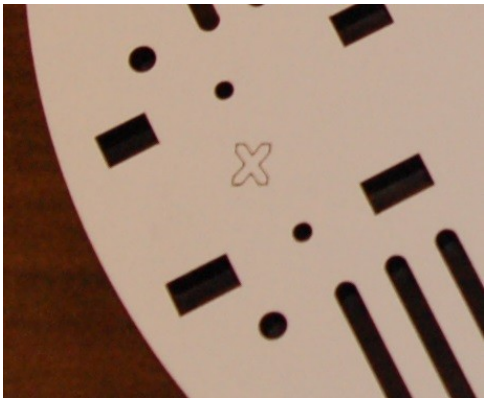


Fig. 6.1-1: The X axis label.

The nylon screws need to be inserted into the foot base as shown below.

Fig. 6.1-2: Screw orientation.

Install two feet at each location as indicated by the green rectangles.

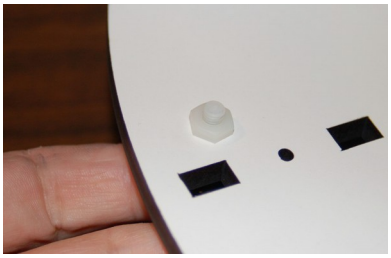


Fig. 6.1-3: Nut installed.

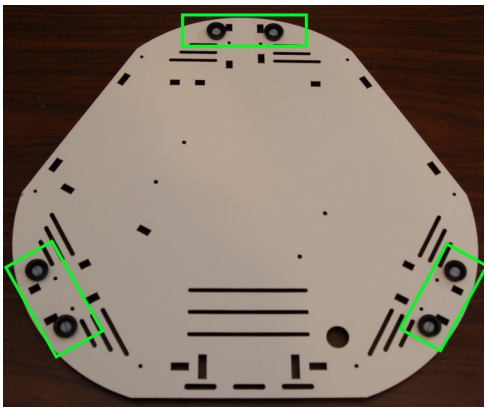


Fig. 6.1-5: Feet installed.

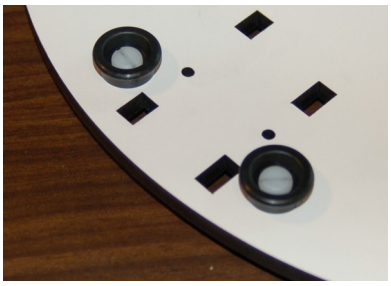


Fig. 6.1-4: Two feet installed.

Don't install the soft rubber “shoe” parts yet. They'll make it difficult to move the machine during the build!

6.2 – Installing the Cover Retention Screws & Threading the Panel Holes

The 1/2” screws are used to retain the Acrylic side panels that we'll be installing toward the end of the build. Let's get those installed first.

Fig. 6.2-1: Retaining screw installed.

Each of the three vertical supports should have one 1/2” flat head screw installed in each end as shown on the left. You don't want to install the screw all the way – just drive it enough so that the bottom face of the screw is flush with the opposite face of the vertical support as shown below.

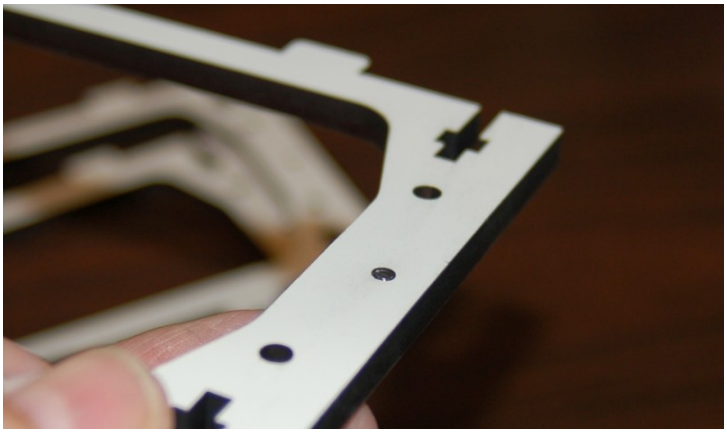


Fig. 6.2-2: Correct screw depth.

Fig. 6.2-3: Vertical support with panel retaining screws installed.

Now I need you to locate the #10-32, 5/8” Socket Head Cap Screw. We're going to use this to cut threads into the vertical support plates. These threaded holes will be used later with nylon thumbscrews to hold cover plates in place. You'll need a 5/32” Allen wrench to drive the screw in.

Fig. 6.2-4: Redneck Tapping Tool.

There are two holes on each end of the vertical supports that can take the retaining screws we're cutting threads for. The holes you need to use are the “top” ones.

Write “top” on each vertical support plate in the location shown in the figure below and then carefully drive the #10-32 socket head cap screw through the holes closest to the “top”.

Drive the screw though completely and then remove. it. Repeat this for the other two vertical support plates.

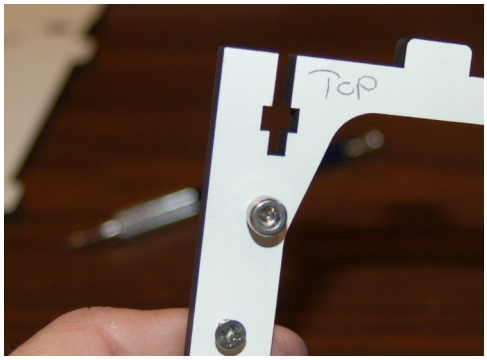


Fig. 6.2-5: Orientation marking.

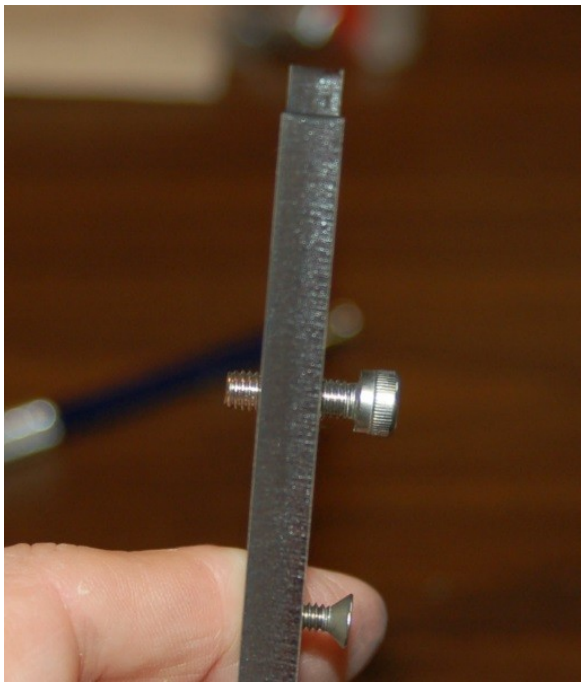
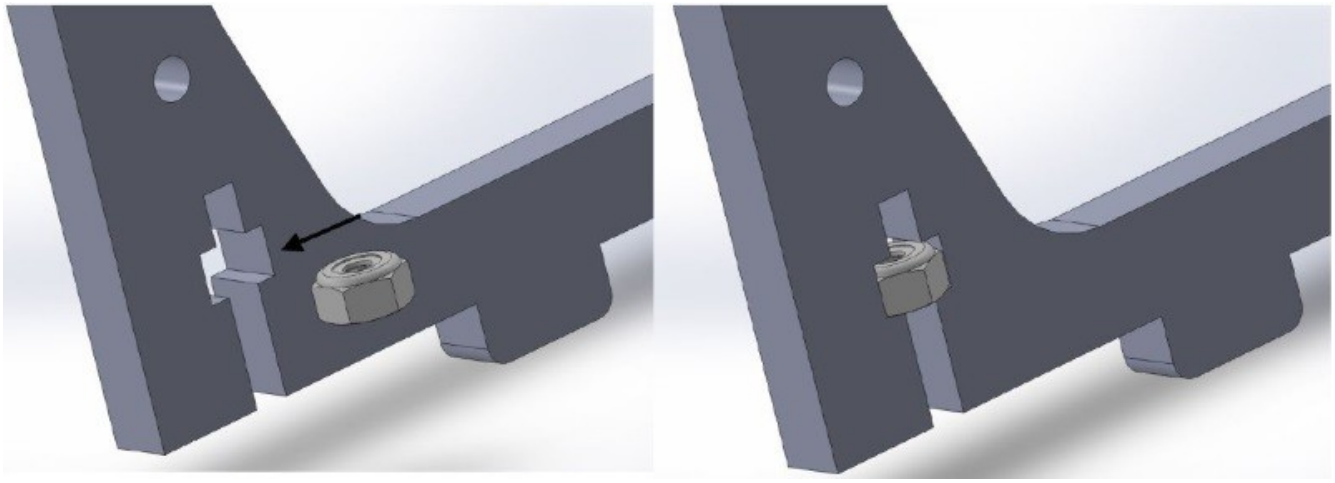


Fig. 6.2-6: "Tap" driven through completely.

6.3 – Installing the Vertical Support Retaining Nuts

The primary method of assembling the Rostock MAX v2 relies on capturing #6-32 nylon lock nuts in laser cut pockets. When a screw is threaded through a part and into that captured nut, it creates a very simple, strong joint. The nuts are installed in the laser cut pockets as shown below. Note how the bottom face of the nut is facing the outer edge of the part.



Inserting a nut into a laser cut pocket.

As you can see, the nut is oriented such that the flat sides of the nut fit into the laser cut pocket. The laser cut pockets are designed to be a very snug fit. However, sometimes the pockets may feel a bit too tight. If this is the case, try inserting the nut in from the other face. It may be easier due to the slight bevel the cut has in it due to the laser focus. You may also run into a situation where the nut pocket doesn't hold the nut tightly enough to keep it from falling out. In that case, you should use a small bit of tape to hold the nut in place until there's a screw driven into it.

The simplest way to install the lock nuts is to use a pair of needle nosed pliers and grip the nut as shown on the right.

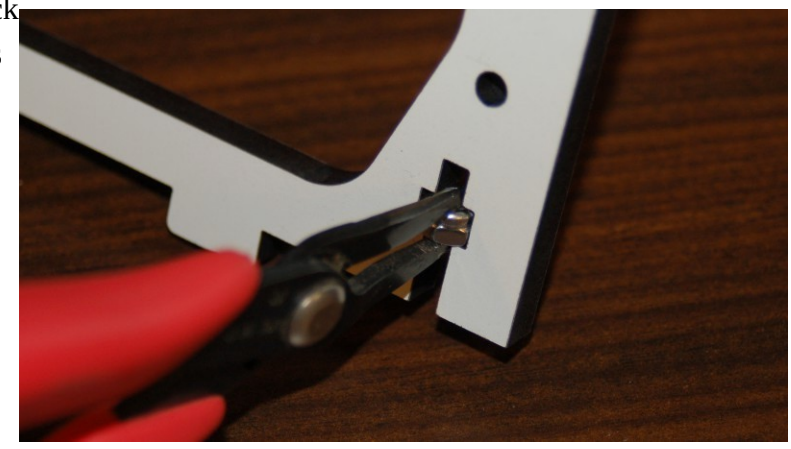


Fig. 6.3-1: Inserting a nut into a laser cut pocket.

When you're done with one of the vertical supports, you should have four nuts installed as shown below.

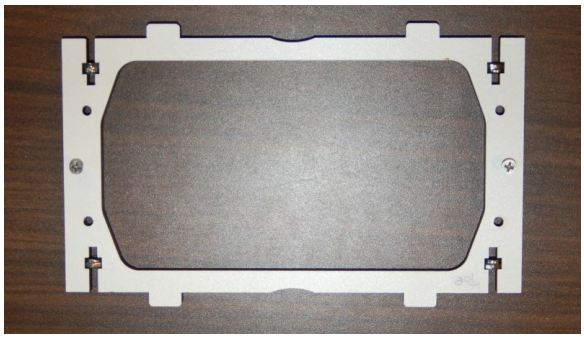


Fig. 6.3-2: Completed Vertical Support.

Install the eight remaining nuts into the other two Vertical Supports.

Fig. 6.3-3: All done!

6.4 – Installing the Vertical Supports and Power Supply Mount

By now I suspect you're wondering what's going on. “There's no WAY that power supply is going to fit on that mount!” You're entirely correct. The power supply NOT installed on the power supply mount any longer. The mount was designed to be used with the same ATX power supply that's (likely) in your computer. The Rostock MAX v1 and many v2s used the ATX power supply and now SeeMeCNC has gone to a much more compact and reliable power supply. The power supply mount has been left in as a structural component.

The power supply support 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***. (*“Inward” in this case means the screw heads are pointed at the interior of the frame.)* These screws are used to capture the acrylic covers that are installed later.

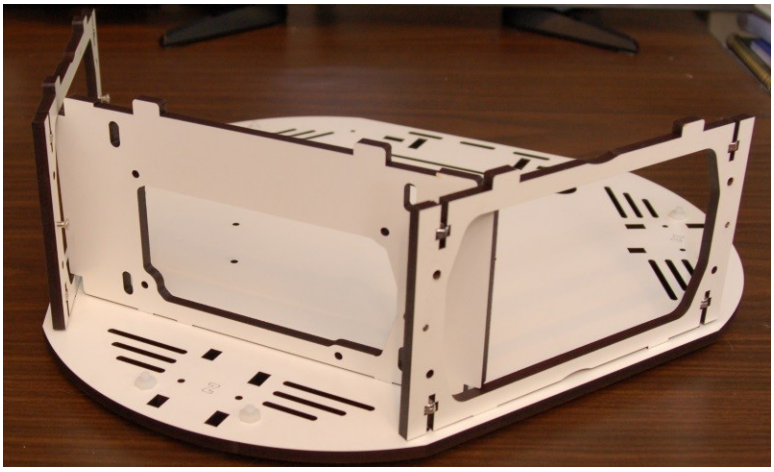


Fig. 6.4-1: Power supply mount and sides in position.

Now install a #6-32, 1” long pan head screw into each of the four lower nuts. This attaches the vertical supports to the bottom. Leave them just a little bit loose for now. Leaving them a bit loose will make installing the top a lot easier when we reach that point.

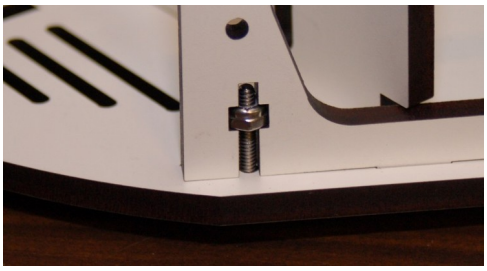


Fig. 6.4-2: Example of an installed screw.

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.

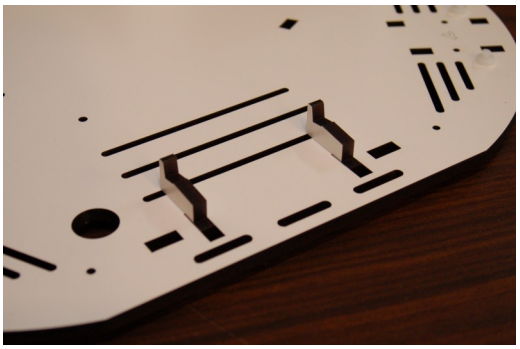


Fig. 6.4-3: Support legs positioned.

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.

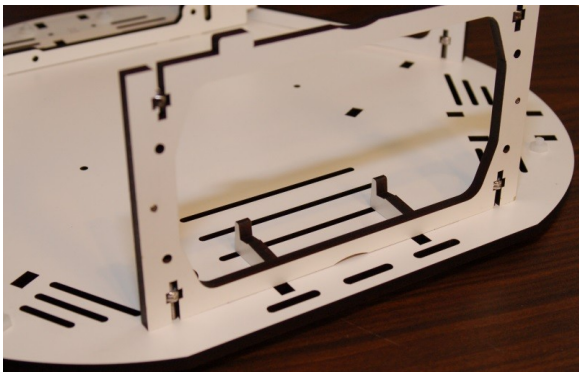
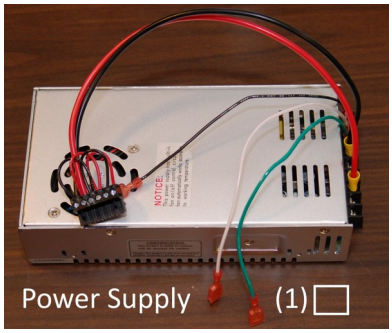


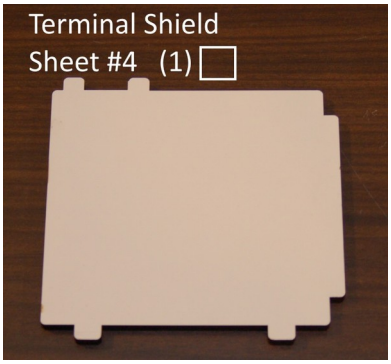
Fig. 6.4-4: Front vertical support installed.

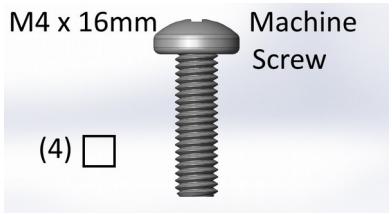
Checkpoint Video #4

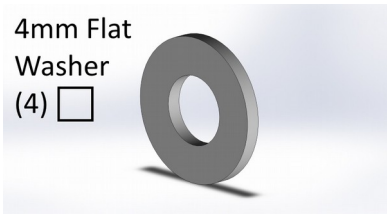
6.5 – Installing the Power Supply

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









Before the power supply can be installed, you'll need to install the Terminal Shield. This component helps prevent probing fingers from coming into contact with any of the terminals on the power supply. The part is a friction fit, no fasteners are used. It'll be locked into place once the top of the base is fitted.

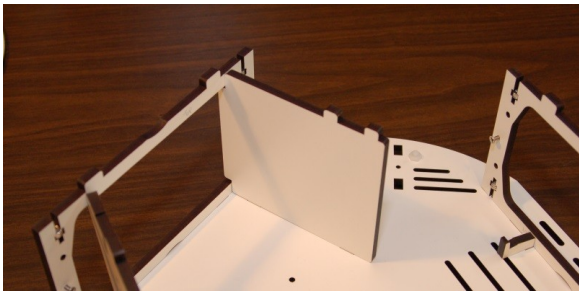


Fig. 6.5-1: Terminal Shield installed.

The power supply rests upon four laser cut melamine spacers. In order to install all four at the same time, you'll need to get creative. I used some clear tape in order to hold each spacer. The spacers are centered over the threaded holes in the power supply. The screw can easily punch through the tape, so don't worry about covering the center hole.

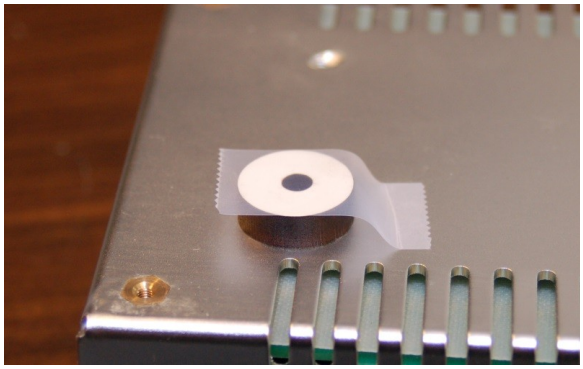


Fig. 6.5-2: Spacer held in place.

Attach the power supply to the base with four M4x16mm screws and the M4 washers. Make sure that you've got the terminal end of the power supply facing the opening in the vertical support. The screws may appear to be too short, but they *will* reach!

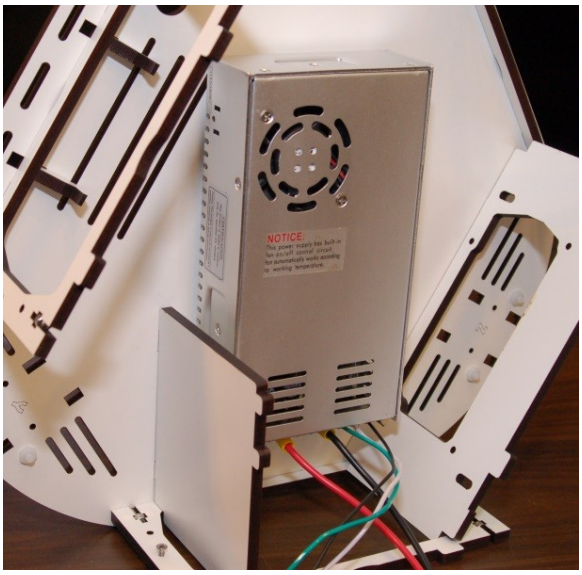


Fig. 6.5-3: Power supply mounted.

6.6 – Connecting the Power Supply and Fitting the Side Panel

The first step is to affix the safety decal to the front of the Power Supply Side Panel in the location shown below.

Fig. 6.6-1: Safety Third!

Install the IEC power connector using two 1”, #6-32 pan head screws and two #6-32 nylon lock nuts.

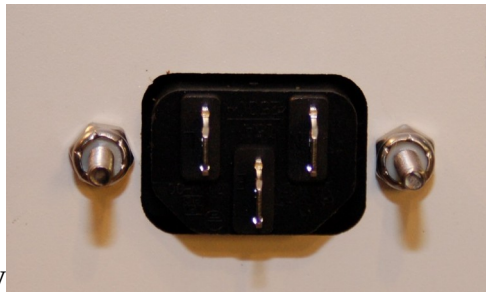


Fig. 6.6-2: Rear of IEC plug.

Next up is the power switch. Note that you need to pay attention to the orientation of the switch terminals when you install it. This ensures that “up” is the “on” position. The spade terminals should be closest to the IEC power connector.

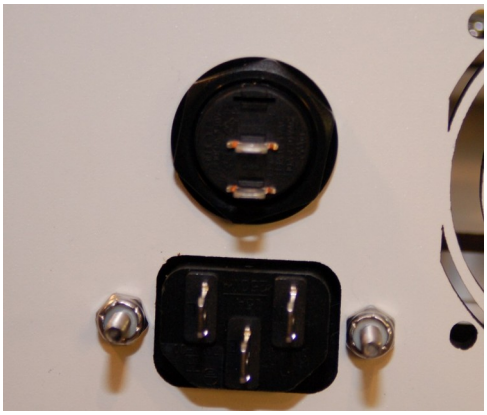


Fig. 6.6-3: Power switch installed.

Install the jumper wire exactly as shown in Fig. 6.6-4. This switches the “Load” or hot wire to the power supply.

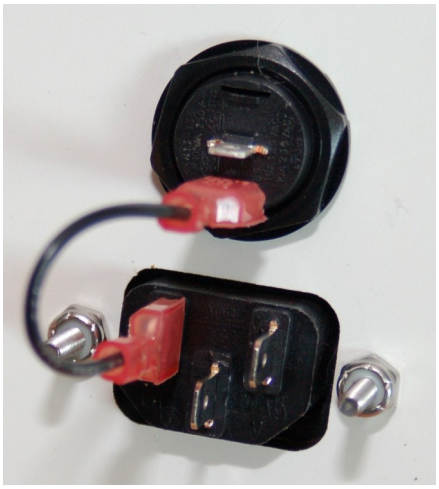


Fig. 6.6-4: Jumper wire installed.

Now install the 60mm fan on the back face of the power supply cover. The fan has a mark that indicates the airflow direction. Make sure you've got it pointed “out” as shown in below.

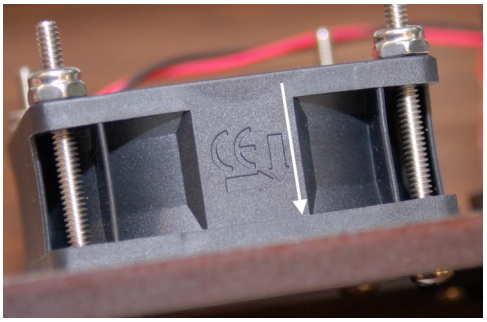


Fig. 6.6-5: Fan output direction.

Once the fan is installed, attach the ring terminals on the fan to the terminal block as shown below. Make sure that the black wire goes to the “V-” section and the red wire goes to the “V+” section.

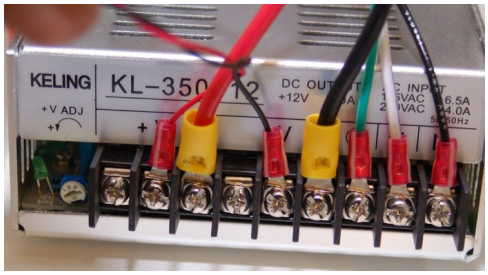


Fig. 6.6-6: Fan wired in!

Now you need to attach the green wire from the power supply to the center connector on the IEC connector and the white wire from the power supply to the right connector.

Connect the black wire from the power supply to the center connector on the power switch.

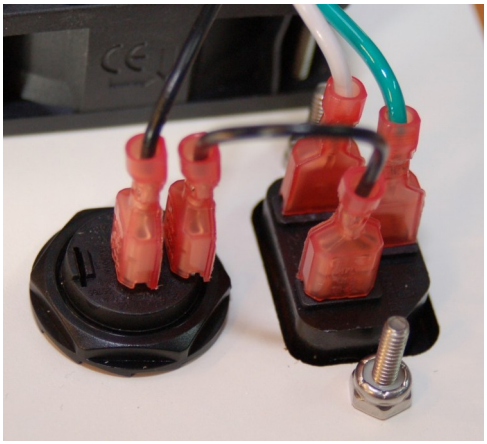


Fig. 6.6-7: IEC plug & switch wired.

Using two black nylon thumbscrews, attach the power supply cover to the vertical support.

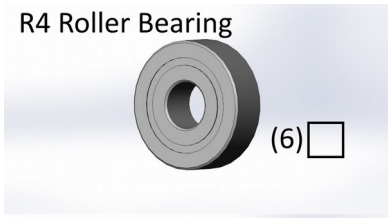
Fig. 6.6-8: Power supply install complete.

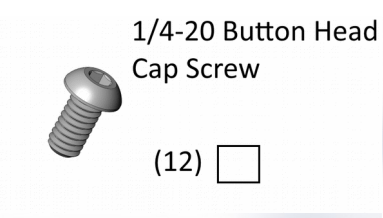
This would be a good time to test the power supply. Plug in the AC cord and turn on the power switch. The large cooling fan should start running. If it doesn't, turn the power switch off, unplug the power cord and double-check your wiring.

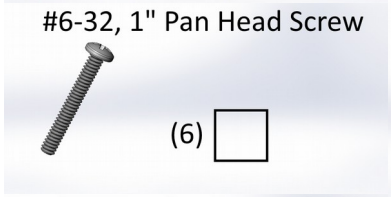
Checkpoint Video #5

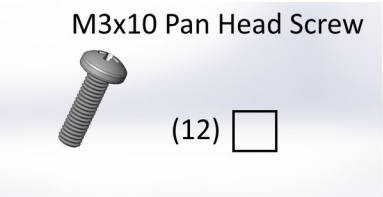
6.7 – Assembling the Tower Supports

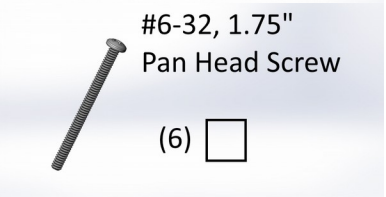
For this task, you'll need the following components:

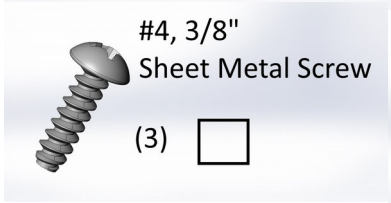


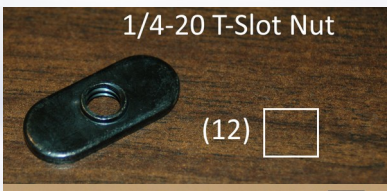


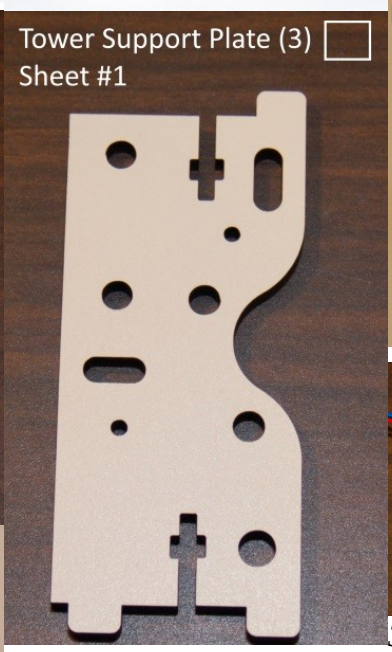












3 Steppers with Drive Gears

First up, you'll need to insert an R4 bearing into each of the 6 idler bearing sleeves. Note that there is a lip on the inside of the sleeve. The R4 bearing must be pressed all the way in until it rests against that lip. This ensures that the bearing is properly centered inside the sleeve.

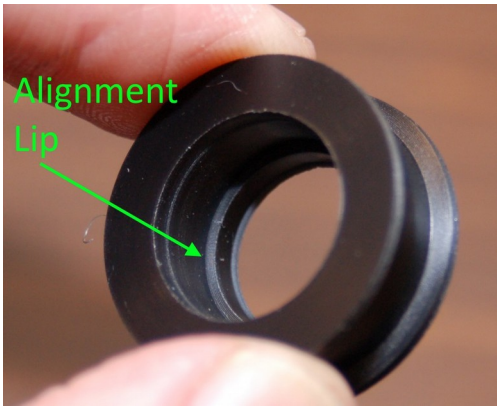


Fig. 6.7-1: Idler bearing sleeve.

The R4 bearing is a *very* tight fit in the sleeve. I would recommend that you use the back end of a screwdriver to press the bearing into place. Do not apply pressure to the center ring of the bearing if you can avoid it!

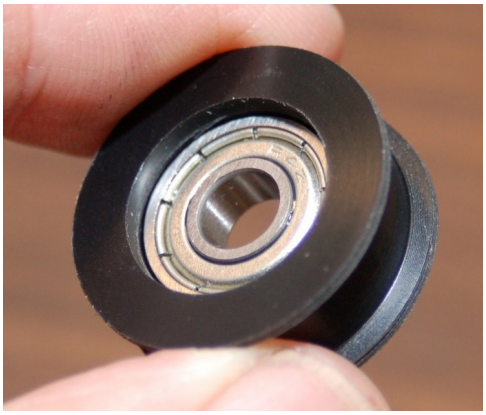


Fig. 6.7-2: R4 bearing installed.

Before we can assemble the tower supports, you'll need to do a little prep work on the Stepper Motor Mounts. Each mount will get two #6-32 nuts and one #4, 3/8" pan head machine screw.

Lay out the mounts exactly as shown in the figure below.

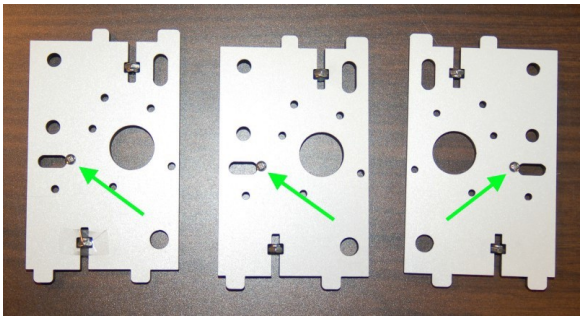


Fig. 6.7-3: Stepper Mount orientation.

The green arrows show the position where you'll install each #4, 3/8" pan head screw. These screws are used as an alignment stop. When it comes time to set the towers in place, you'll slide the tower down until the bottom strikes the head of the screw. This will guarantee that you've got all three towers at the same height.

Sometimes the screw pockets are a tiny bit over-sized. When this happens, you can use a short bit of tape to hold the #6-32 nut in place. You can see I've had to do this on one spot in Fig. 6.7-3. The tape will hold the nut long enough to get a screw into it.

Note that the two mounts on the right are mirrors of one another. This was done on purpose. The X and Y axis mounts are facing one another and if you don't mirror one of the mounts, you'll have two that fit fine and one that won't fit at all. :)

Now it's time to get the stepper motors attached to their mounts. Set the Stepper Motor Mount on top of a stepper motor and align the stepper motor as shown in Fig. 6.7-4 and install it using four of the M3 x10mm screws. Apply a little bit of thread locker to each one before installing.

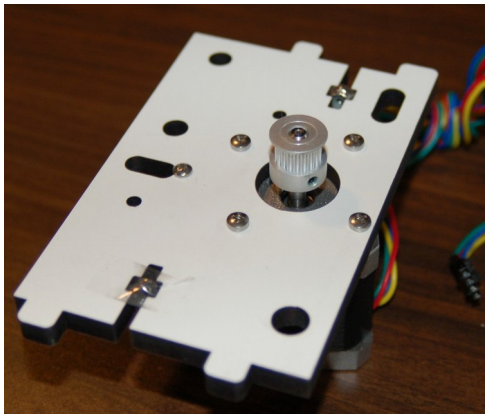


Fig. 6.7-4: First motor in place.

Assemble the next stepper motor mount the same as you did the first one, but assemble the third one mirrored. When you're done, the three mounts should look like the figure below.

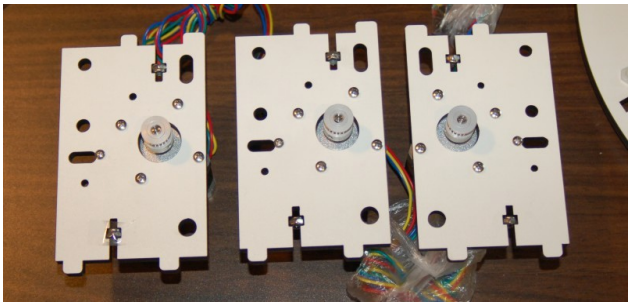


Fig. 6.7-5: Motors installed!

Now install two #6-32 nylon lock nuts into the three tower supports as shown below.

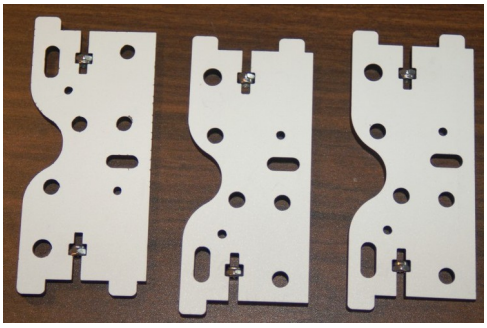


Fig. 6.7-6: Tower supports done.

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 pan head screws and insert them into the back of each stepper motor mounting plate as shown below:

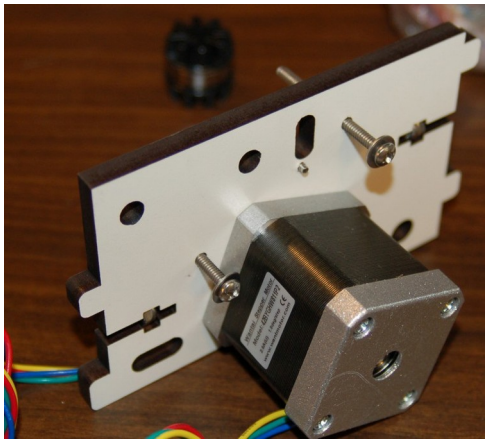


Fig. 6.7-7: Idler bearing support screws.

Install one idler bearing spacer on the two idler bearing support screws.

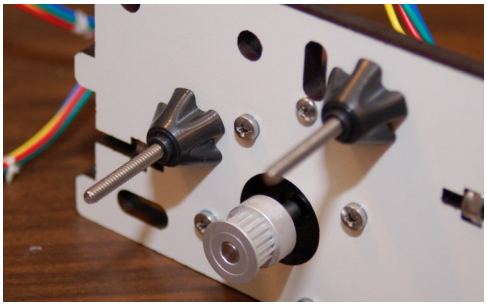


Fig. 6.7-8: Idler bearing spacers.

Now slide an idler bearing on to the spacers, followed by two more spacers.

Fig. 6.7-9: Idler bearings installed.

Now you can complete the assembly by fitting a tower support to the two screws. Install a #6-32 nylon lock nut to each screw – don't tighten it too much. Finger tight is fine. You want a bit of "wobble" in the assembly to assist in getting the top of the base installed.

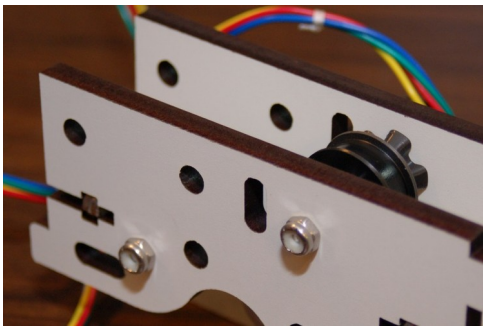


Fig. 6.7-10: Screws on.

Repeat this assembly process for the other two motors.

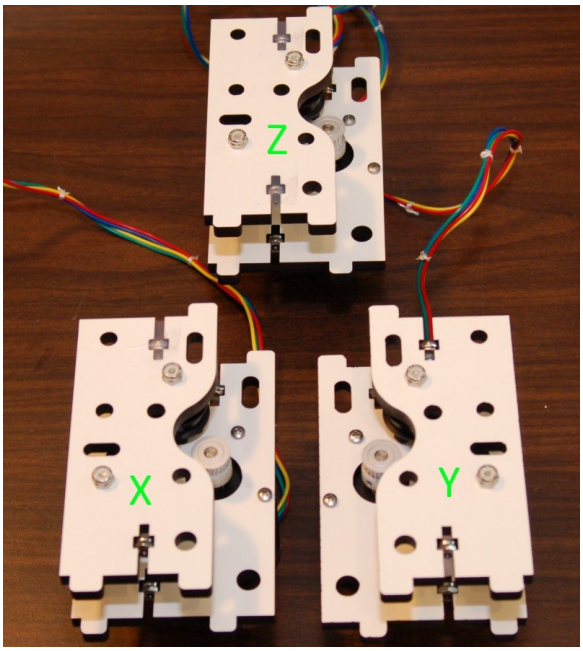


Fig. 6.7-11: Completed assemblies!

When you're done, you should have one motor assembly for each axis, as shown on the left. The green labels indicate where each motor assembly is installed.

Checkpoint Video #6

6.8 – Installing the Tower Supports

Now let's get the three tower support & motor assemblies attached to the base of the machine.

Drop the X and Y axes in as shown below. Install two #6-32, 1” pan head screws into each one, just a bit more than finger tight. We want a bit of wobble to help with the installation of the top. Note that the axis of each tower support location is laser engraved into the material. They're labeled “X”, “Y”, and “Z” respectively.

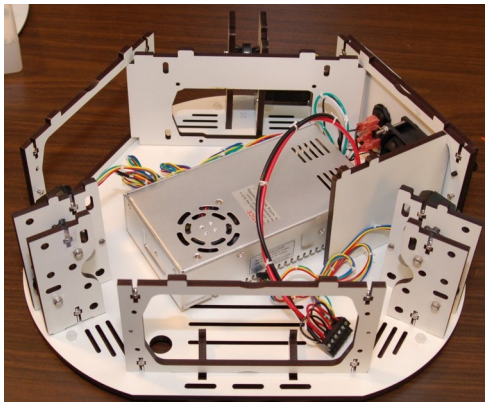


Fig. 6.8-1: X & Y Tower supports installed.

The Z axis tower & motor support installs the same way as the other two. The wires for the Z axis stepper motor should be routed through the lower hole in the power supply bracket as shown below. The connector is a tight squeeze, but it WILL fit.

Fig. 6.8-2: Z Axis motor wire route.

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 in order to properly fit inside the slot in the tower.

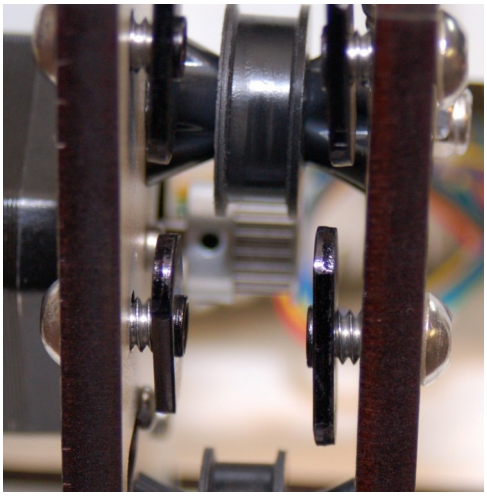


Fig. 6.8-3: T-Slot nut plates installed.

Checkpoint Video #7

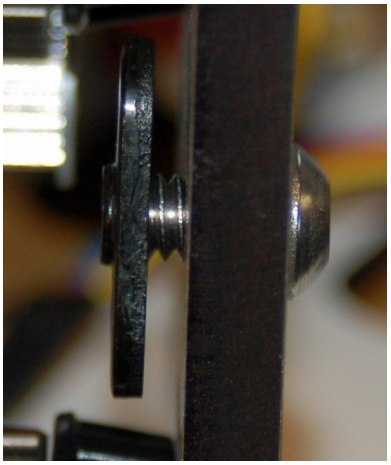
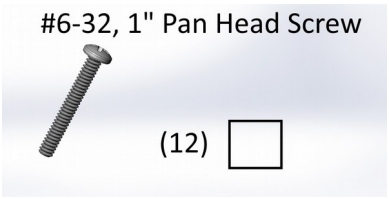
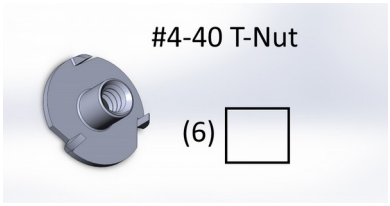


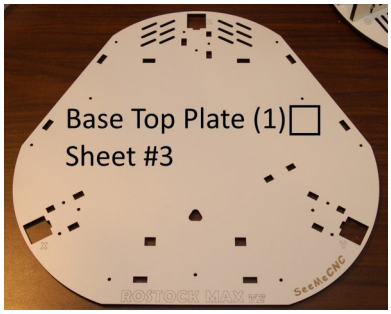
Fig. 6.8-4: Depth example.

6.9 – Installing the Base Top Plate

The next task requires the following components:







The six t-nuts specified above should come from the Onyx Heated Bed package and not from the t-nuts included in the hardware pack.

Fig. 6.9-1: Onyx hardware pack.

The next step requires that you open up the Onyx Heated Bed package and remove the included #4-40 T-Nuts.

When installing the t-nuts, I find it easier to “draw” them in instead of just pounding away at them to set them into place. Take a #4 flat head screw and a white spacer from the Onyx parts pack and use those to draw the t-nuts into the hole. Lay the top plate down with the lettering facing the table surface and insert a t-nut into each of the locations marked in green in Fig. 6.9-3.

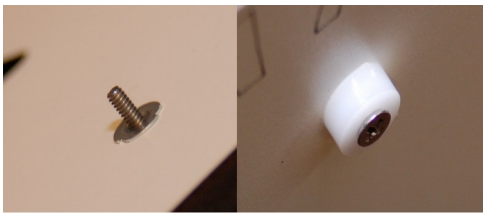


Fig. 6.9-2: Drawing the t-nut in.

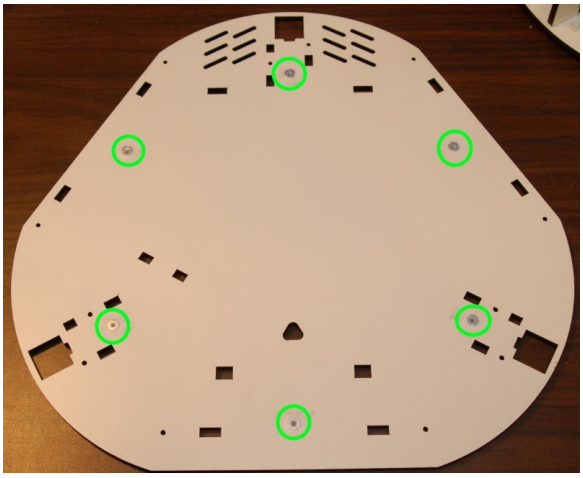


Fig. 6.9-3: T-nut locations.

When you're done, put a small bit of clear tape over each t-nut. This will help ensure that they won't fall out before the Onyx has been installed.

If your base top plate contains a hole in the exact center, please cover the hole with tape on both sides. This will prevent the power supply's cooling fan from blowing air on the center of the heated bed.

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 and if you find yourself getting frustrated with it, walk away for a bit. The last thing you want to do is get annoyed and help it along with a little percussive maintenance. ;)

Once you've gotten the top fully seated, fully tighten all of the #6-32 1” screws. Tighten the three vertical supports from the top and then tighten down the three tower supports. Flip the base upside down and repeat on the bottom screws. Also tighten the screws holding the two idler bearings in each tower base.

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

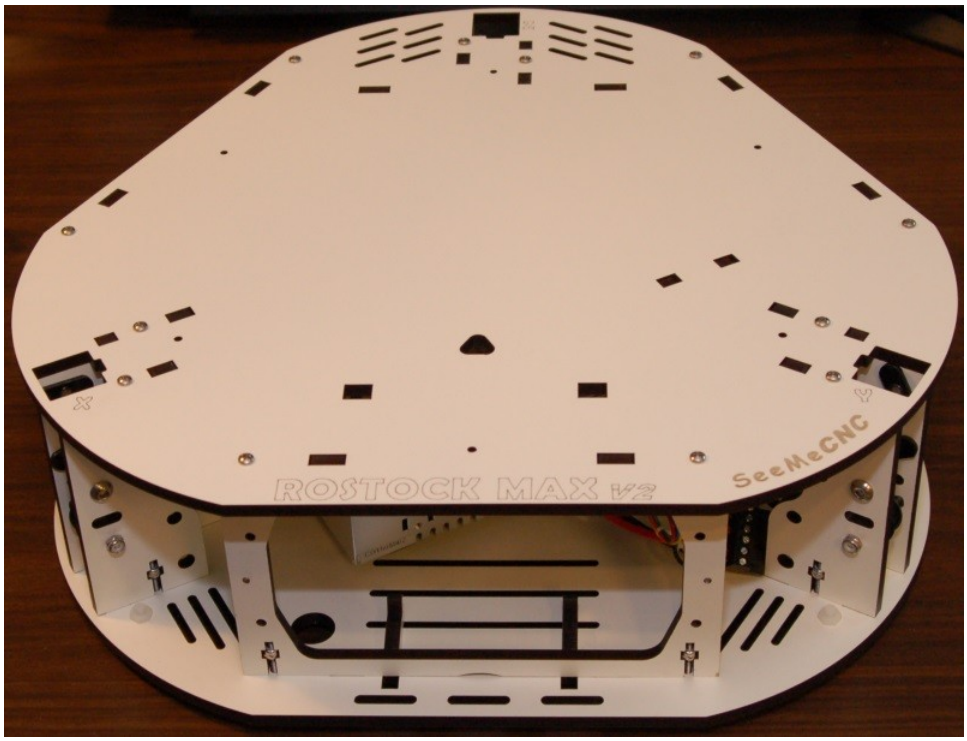


Fig. 6.9-4: Completed base!

Checkpoint Video #8

7 – Installing the Towers & Tower Wiring

7.1 – Running Wire in the Towers

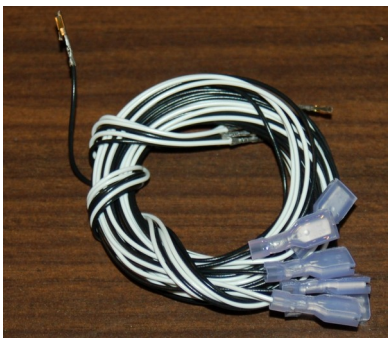
For this task, you'll need the following components:

3 Aluminum Towers

18ga & 26ga wire.- ***"A"***

22ga, 4 Conductor Wire

26ga wire, Red & Black



End Stop Wires

You may notice that some of the photos in this section show a white & green 18ga wire instead of two white 26ga wires. This is due to an engineering change that was done after the photos were taken.

Note that the end stop wires can be found in the same bag that contained the thermistor leads, in the RAMBo box.

The 26ga red & black wires are supplied as one continuous length. The wire is meant to be used to provide power for the PEEK and layer fans on the effector platform. Before you can run those wires in the tower, you'll need to cut the red & black wires in half so you have two red & black pair of equal length.

In the Rostock MAX v2, you'll be routing the hot end, extruder stepper, fan wires, and end stop wires 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.

Before you can start, you'll need to strip the four conductor wires from the one (or two!) gray-jacketed cables.

Inside the gray 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.

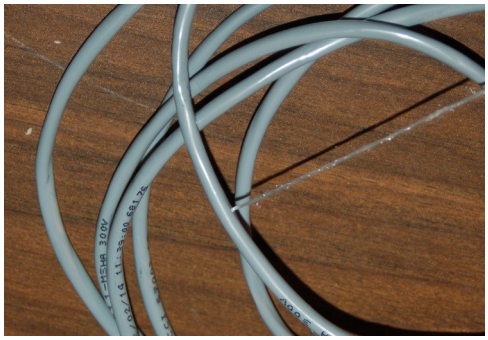


Fig. 7.1-1: Splitting the outer jacket.

When you're done, you can discard the outer jacket and the thin aluminum wrap. However, don't discard the bare wire that was woven around the four conductors. You're going to use that shortly as a pull line to get the thinner wires down the towers.

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

We're going to do the Z axis tower first. You'll need the 22ga wire as well as both black & red pairs of the 26ga wire.

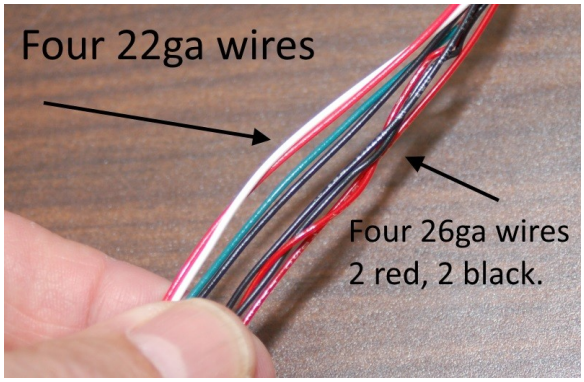


Fig. 7.1-2: Z Axis wires.

The simplest way to pull these wires down the center of the tower is to use a “fish” wire. This is why I had you hang on to that “extra” bare wire when you strip off the outer jacket. You'll wrap the bare wire around the grouped 22ga and 26ga wires, starting about 3” in from the end.

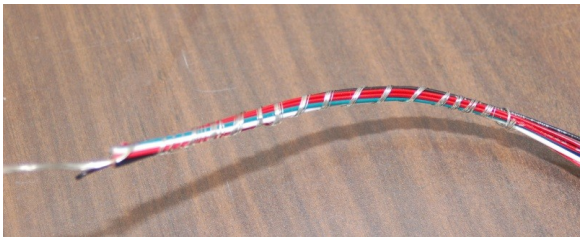


Fig. 7.1-3: Correct fish-wire wrapping.

At the other end of your fish-wire, fold over about 2” worth and spindle it. This will make the wire end more stiff and will allow it to be pushed through the center of the extrusion more easily. You'll want to flatten that little loop at the end as well.

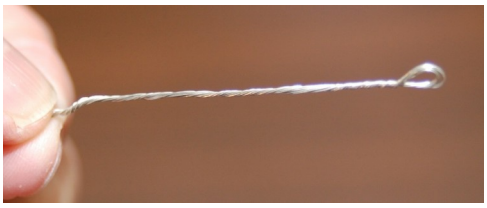


Fig. 7.1-4: Spindled wire end.

Carefully push the fish-wire through the extrusion until it comes out the other end. Grasp the end of the fish-wire and slowly pull it through. Guide the main wires into the opening in the extrusion as you pull. Once the wire has moved about an inch in, you can use the fish-wire to pull it the rest of the way through.

Once you've got the wires pulled, you need to identify the two pairs of 26ga wires. To do this grab one black 26ga wire from one end and find that wire on the other end. Tie a very loose knot in that wire on one end. Do the same thing to find a red 26ga wire. Take the knot out of the black wire and knot the black & red together. Tie the knot in BOTH ends. This pair will be for the PEEK fan.

Fig. 7.1-5: PEEK fan pair.

Leave the other wire pair without a knot. That pair will be for your layer fan.

Stick a note on the tower extrusion with “Z Axis” written on it.

Now cut the white 26ga wire in half, just as you did with the red & black 26ga wires. This will give you two 10ft pieces of white wire. Strip 1” of insulation from each of the four conductors (18ga red & black, 26ga white) and spindle them together tightly. You should be able to push the resulting wire bundle through the center of the tower extrusion. Take your time and push only ¼” to ½” at a time. If you're unable to get the wire routed through the tower, you can try using the drain wire from the previous step for the hot end wiring. When you're done, label the tower as “X Axis”.

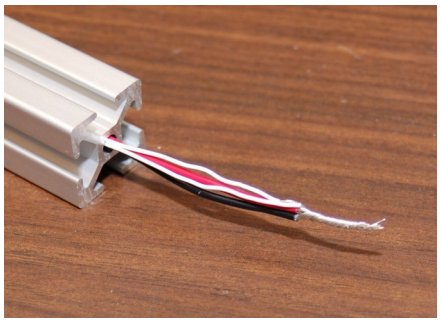


Fig. 7.1-5A: 18/26ga wire routing.

You'll run the end-stop wires through the last extrusion, the Y axis tower. You'll pull these the same way as the others, but take care to not damage the crimp on sockets that are installed on the ends of the end-stop wires. You'll also want to be careful as the sockets enter the hole in the end of the tower extrusion.

Fig. 7.1-6: End-stop wires ready to pull.

Identify three black & white pairs. Write the axis name on the spade connectors and on the opposite end using a printed label or a bit of tape.

Tie a loose knot in the spade connector end to make them more easily separated.

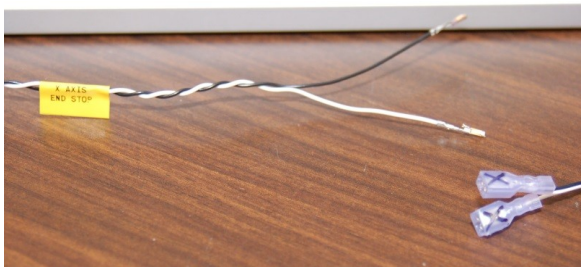


Fig. 7.1-7: End-stop ends marked.

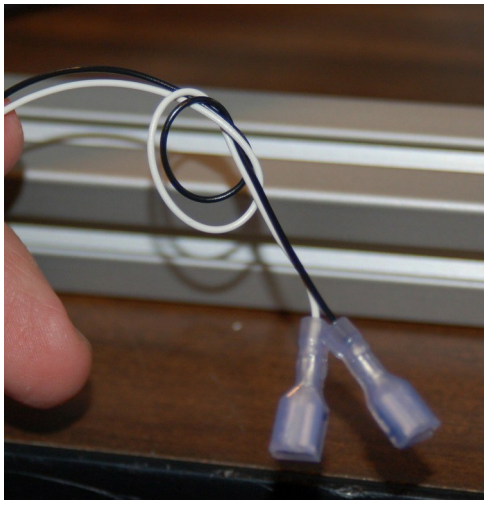


Fig: 7.1-8: End-stop pair.

Tower Wiring Summary

- X-axis – 18ga for the hot end & 26ga for the thermistor.
- Y-axis – end stop wires (from Rambo Kit)
- Z-axis – 22ga (4 wires) for extruder motor; 26ga (4 wires, 2 pairs) for PEEK fan, Layer fan.

7.2 – Setting the Towers

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

Note that when you're setting the Y axis tower to make sure that the spade connectors are on the top. They connect to the end stop switches at the top.

We're going to start with the Z axis.

In order to set the Z axis tower, you'll need to turn the T-Slot nut plates such that they're oriented vertically as shown below.

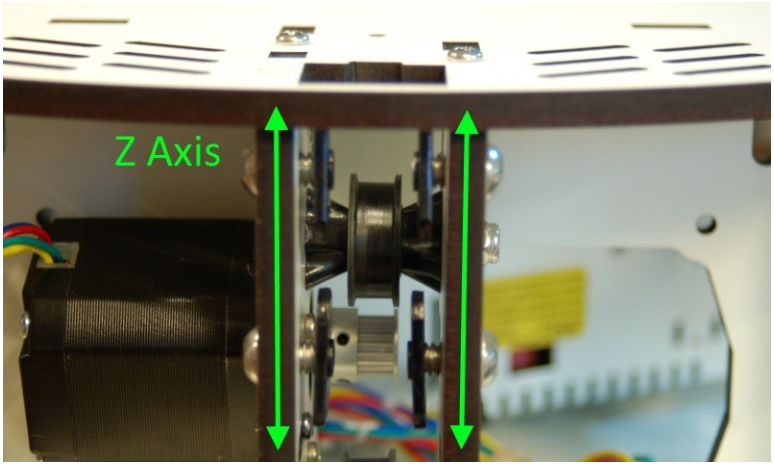


Fig. 7.2-1: Nut plates aligned vertically.

Next, you're going to thread the wires coming out of the Z axis tower through the square opening 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 opening 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.

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. Once the tower has covered the upper half of the lower t-slot nuts, route the wires through the rounded slot on the right side of the tower support, as shown. You'll want to drive it down until it comes into contact with the depth stop (green arrow in Fig. 7.2-2) that you installed in the tower assembly. After the tower is set, use a 5/32 Allen (hex) wrench to slightly tighten the ¼-20 cap screws (finger tight). You'll tighten them up after the top as been mounted.

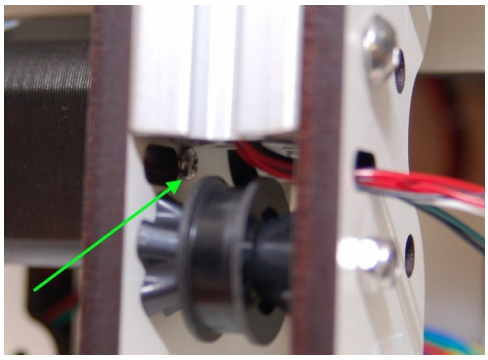


Fig. 7.2-2: Z Tower fully seated.

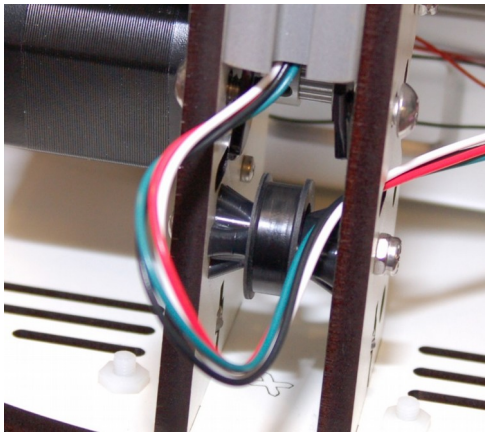


Fig. 7.2-3: Setting the X tower. ***(Old)***

While the Z and X tower wires exit to the right, the Y tower wiring exits to the left as you can see in Fig. 7.2-4.

Fig. 7.2-3 reflects the use of the older (4 conductor, 18ga) wire, but the path remains the same for the new 18/26ga wire pairs.

Now you can route the Z axis wiring forward through the hole on the right edge of the power supply mount as shown.

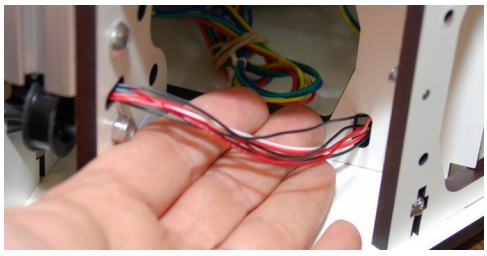


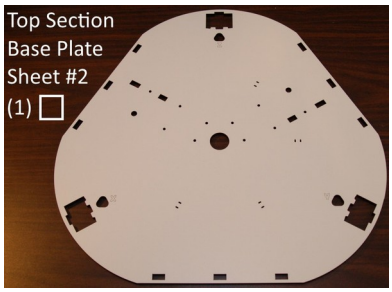
Fig. 7.2-5: Z Axis wiring routed forward.

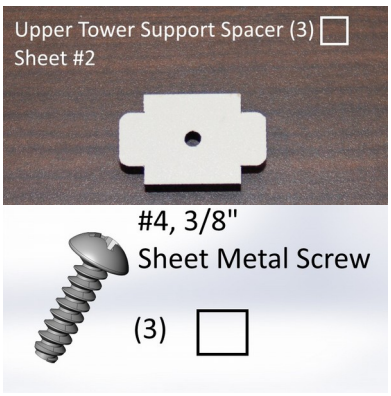
Fig. 7.2-4: Y tower wiring.

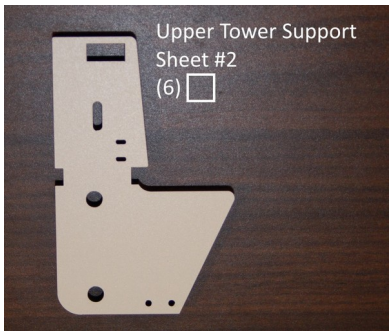
Checkpoint Video #9

8 – Assembling, Installing, and Wiring the Top Section

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







8.1 – 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.

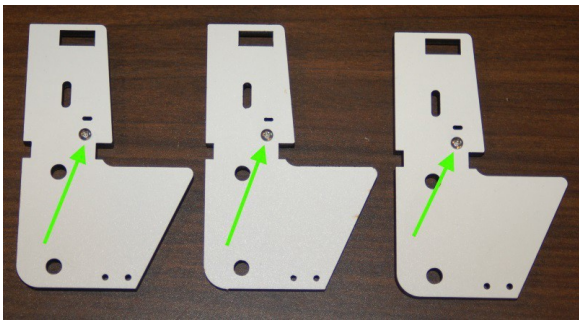


Fig. 8.1-1: Depth stop screws installed.

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.

Next, grab your handy-dandy Redneck Tapping Tool and tap the hole in each of the Upper Tower Support Spacers. It's easier to do this now instead of after they're installed.

Fig. 8.1-2: Threading the spacers.

8.2 – Installing the Upper Tower Mounts

When installing the Upper Tower Mounts, make sure that you've got the top plate base oriented so that the laser engraved axis labels are face-up.

The The upper tower mounts don't fit in the tower sockets without being a bit clever in the installation process. We'll start with the X axis tower support.

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. 8.2-1.

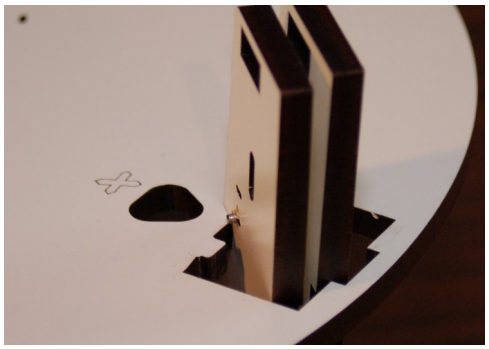


Fig. 8.2-1: Staged tower mounts.

Once you've gotten them “staged” as shown, carefully rotate the right-side mount's edge nearest the center of the top plate base “out”. This will result in the part being in the position shown below.

Fig. 8.2-2: Right mount in the correct position.

Now you can rotate the part into it's final position.

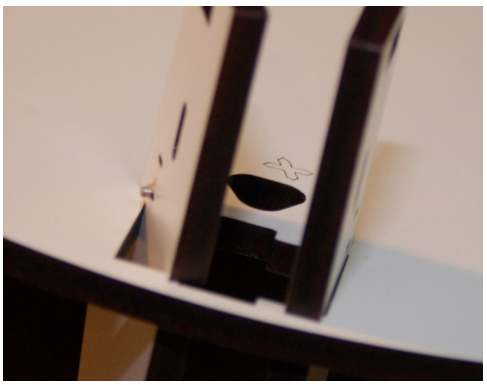


Fig. 8.2-3: Right mount in final position.

Now move the left mount into position the same way that you did for the right side.

Install the Y and Z tower supports in the same manner as you did here for the X axis.

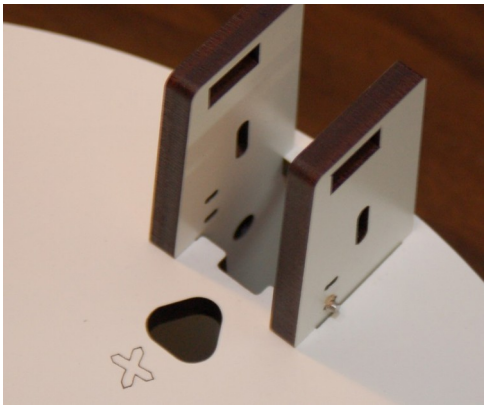


Fig. 8.2-4: X axis mount complete.

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

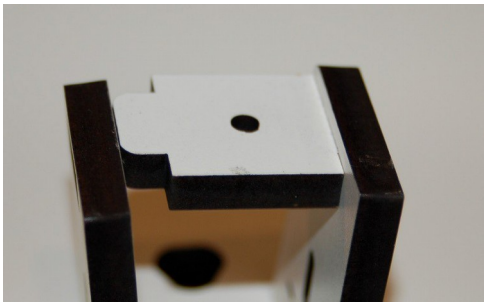


Fig. 8.2-5: First tab inserted.

The fit is very tight and requires that you spread the mount apart at the very ends to get the first tab of the spreader block set. It WILL fit, but be careful – you don't want to break the tower mounts.

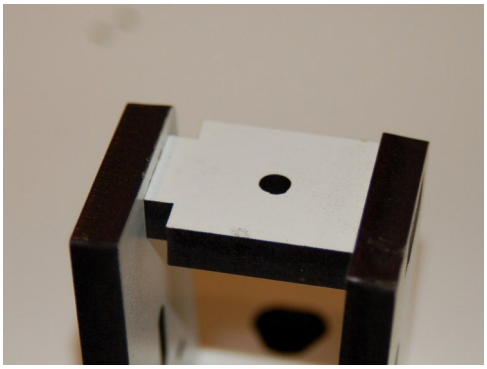


Fig. 8.2-6: Second tab set in place.

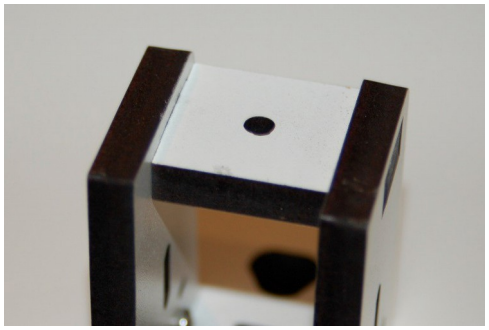


Fig. 8.2-7: Spreader fully seated.

Repeat the process for all three upper tower supports.

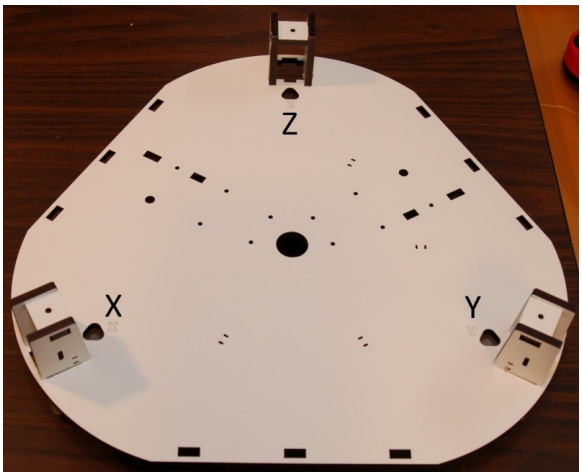
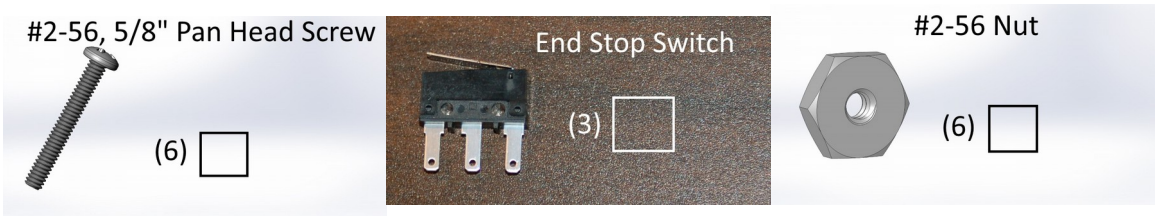


Fig. 8.2-8: Tower mounts installed!

8.3 – Installing the End Stop Switches

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



The end stop switches can be found in the zip lock baggie included with the RAMBo board.

Start the installation by inserting two #2-56, 5/8” pan head screws into the mounting holes on the right side of the over-turned tower mount as shown in Fig. 7-12.

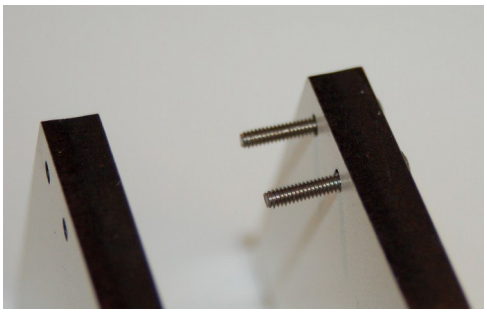


Fig. 8.3-1: Switch mounting screws.

Next, you'll slide the end stop switch over the two screws. Make sure you've got the switch properly oriented. The back of the switch should be closest to you as shown.

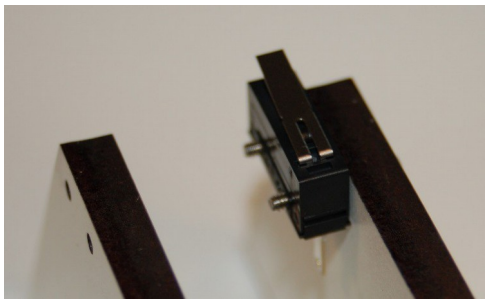


Fig. 8.3-2: End stop switch.

Finally, install one #2-56 finish nut on to each mounting screw. Use a little bit of thread-locker here.

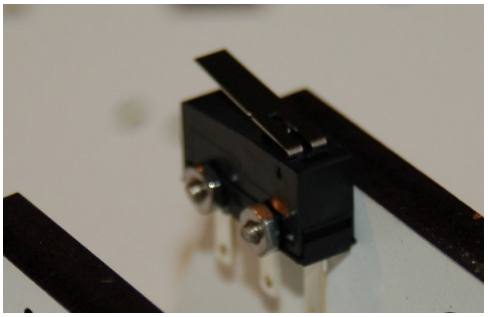


Fig. 7-15: Done!

Take special care to not over-tighten the screws or you'll crack the switch body, which could cause it to malfunction.

When you're finished, the underside of the top plate should look like the figure on the right.

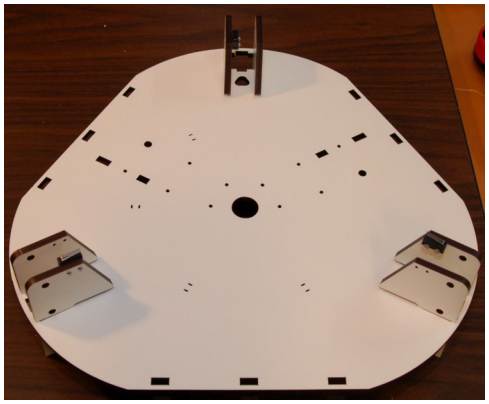
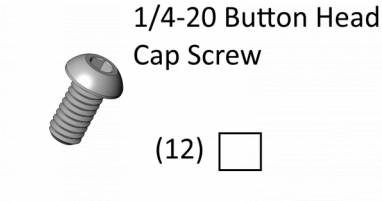
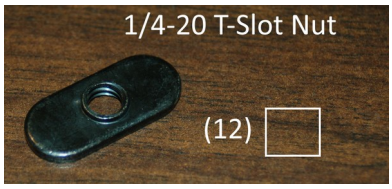


Fig. 8.3-4: Switches installed.

8.4 – Installing the Upper Tower Mounting Hardware

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





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.

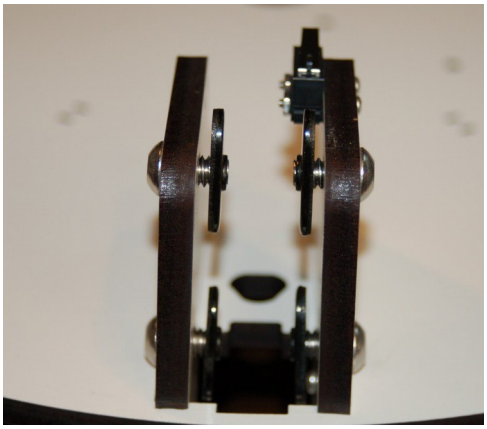


Fig. 8.4-1: Screws & nut plates installed.

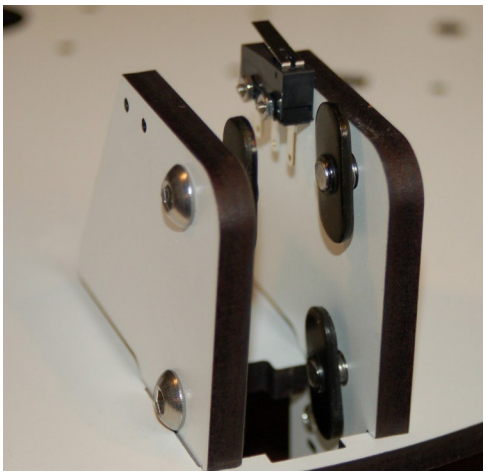
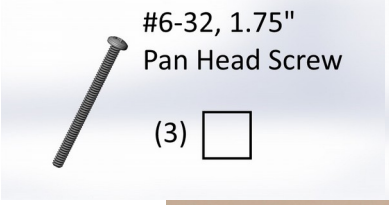
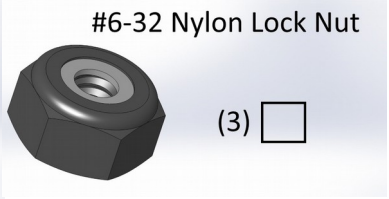


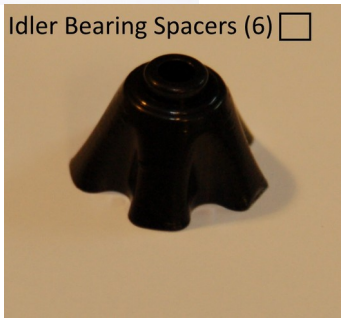
Fig. 8.4-2: Offset view.

8.5 – Installing the Upper Idler Bearings

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







The first thing you'll need to do is insert an R4 bearing into each one of the idler bearing sleeves.

Fig. 8.5-1: Assembled bearing sleeves.

Now hold two idler bearing spacers on to the bearing as shown and slip the whole thing into the upper tower mount as shown.

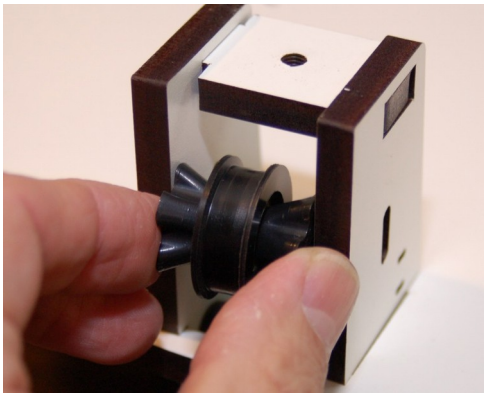


Fig. 8.5-2: Positioning the idler assembly.

Using your thumb and forefinger, hold the idler assembly in place as you insert a 1.75” Pan head screw in from the side.

Attach a #6-32 nylon lock nut on the screw, finger tight and then install the other two idlers the same way.

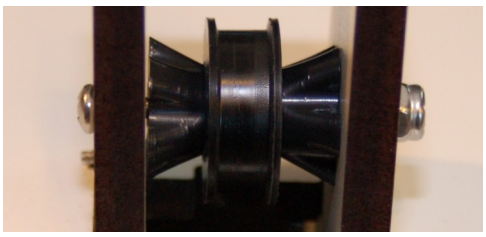


Fig. 8.5-3: Idler installed!

8.6 – Attaching the Top Plate

Installing the top plate is very simple, but it does take a little patience. Make sure that you've got the machine base turned so that the Z axis is farthest away from you and the X & Y axes are on your left & right, respectively.

In order to give yourself room to route the wires through the tower openings in the top plate, you'll want to rest the plate on top of the towers. We'll start the installation with the X axis tower wires.

Carefully route the wires through the opening under the idler bearing as shown in Fig. 8.6-1.

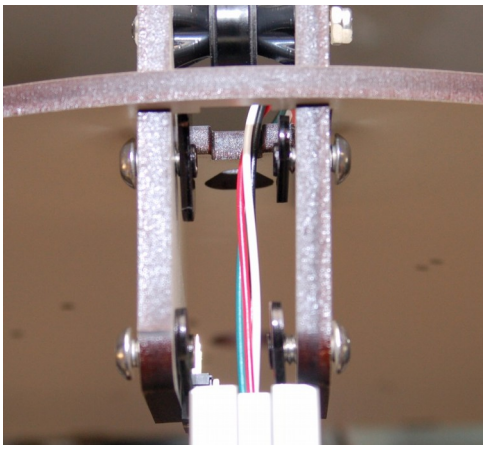


Fig. 8.6-1: X Axis wire path.

Now route the Y axis tower wires up underneath the idler the same way you did the X axis.

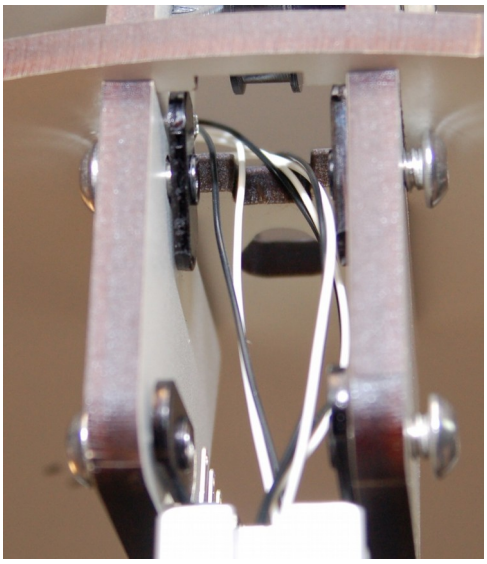


Fig. 8.6-2: Y Axis wire path.

Finally, route the Z axis wiring as you did the other two axes.

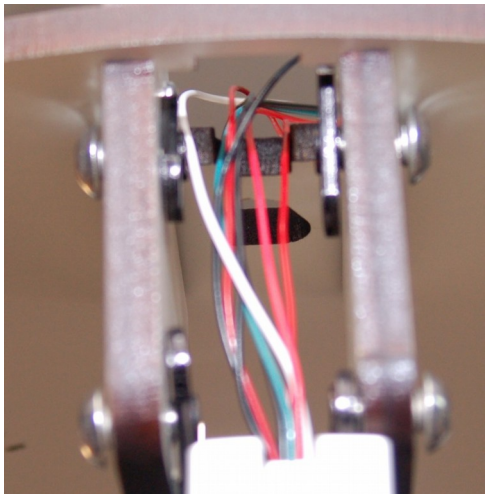


Fig. 8.6-3: Z Axis wire path.

Now it's time to get the top plate settled down on the towers. Orient the t-slot nuts so they're pointed vertically. This should allow them to slide into the slots on the tower. We'll start with the Z axis.

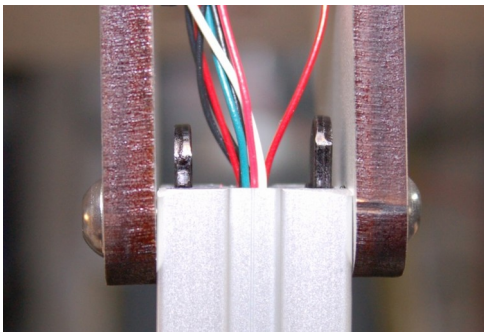


Fig. 8.6-4: Starting the Z axis.

If you gently tighten one of the screws, it'll keep the top from dropping down and making it difficult to get the other two positions set. The idea here is to prevent the top from settling too much on one axis until you get the others set to the same depth. If one or more axis settles completely, there will be too much of an angle to allow the other axes to slide onto the towers easily.

Once you've got the t-slot nuts in the other axes started, come back to the Z axis and settle the upper pair of t-slot nuts into the channels. Set the other two axes down the same way.

After you've got all three mounts set, tap them down gently so that the depth-stop screw in each tower mount makes solid contact with the top face of the tower below it.

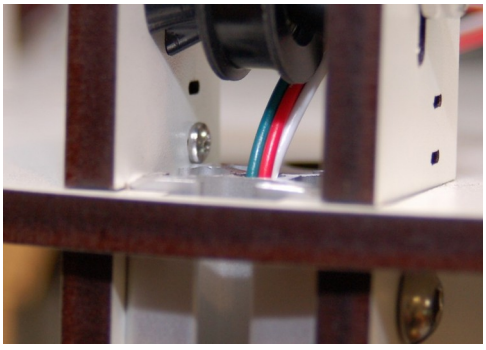


Fig. 8.6-5: Depth-stop screw touching the tower. ***(Old wire shown.)***

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 end stops are connected and the other wires are routed & tied down.

Checkpoint Video #10

8.7 – Connecting the End Stop Switches

For this task, you'll be routing the end-stop wires to the end-stop switches and connecting them up. At the “front” of each tower there is a small, triangular shaped opening that you're going to pass the end stop switch wires through. We'll start with the Z axis. Pull the leads you labeled “Z” across from the Y axis and route them through the hole shown in Fig. 8.7-1. If you need more wire to reach, gently pull it up at the top of the Y tower. You may need to lift the tower a little bit to lessen the bend radius the wire needs to feed.

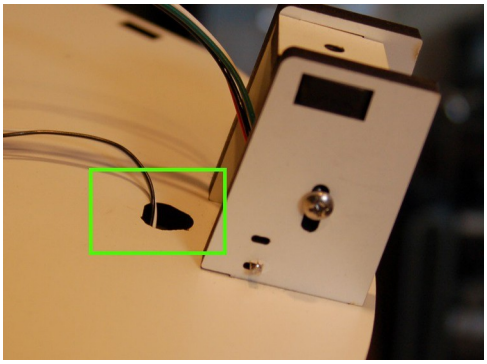


Fig. 8.7-1: Z axis end stop wire hole.

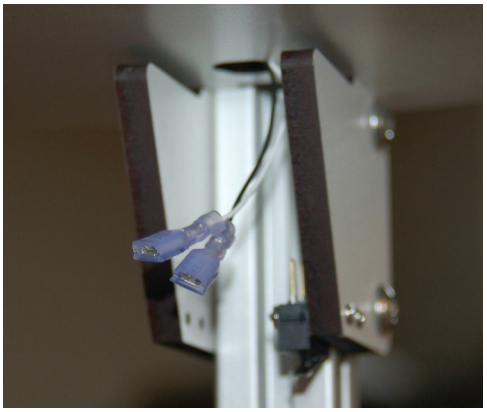


Fig. 8.7-2: Z axis wires ready to plug in.

Now carefully seat each spade lug connector on to the end stop switch as shown below. It doesn't matter where the white & black wires go, just as long as one is on the innermost spade lug and the other the outermost.

Repeat this process for the X and Y towers.

Once all three towers are done, ***carefully*** pull the wires at the bottom of the tower to pull out the slack in the Z and X axis end stop wires. Don't pull them too tight – you just want the wires to be fairly straight.

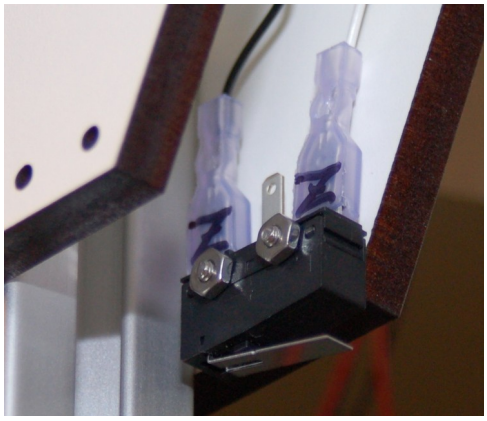


Fig. 8.7-3: Z axis end stop switch wired.

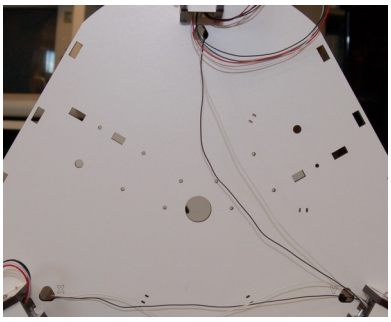


Fig. 8.7-4: End stops connected.

8.8 – Routing the wires & binding them.

For this task, you'll need seven small wire ties.

Before you can tie the wiring down, you'll need to make sure that you've got enough wire pulled through the towers. For the 18ga (and 26ga) wires coming out of the X tower and the 26ga wires coming from the Z tower, you'll need to ensure there's 30” of wire. Measure from the center hole in the top plate base to the outside edge of the base as shown.

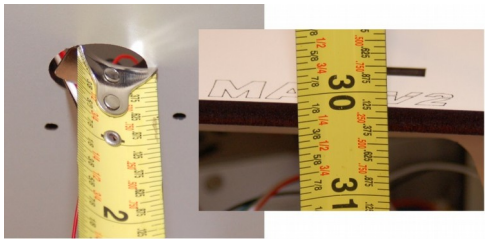


Fig. 8.8-1: Measuring points.

Having 30” of wire will ensure that there's enough to both reach the hot end & fans, as well as the RAMBo board.

In order to prevent the belts from rubbing on the wires coming out of the towers, they'll need to be tied out of the way.

Take a wire tie and bind the hot end wires to the side of the tower mount using a wire tie.

Lift the idler up to the top of its range of motion to give yourself a bit more room to work.

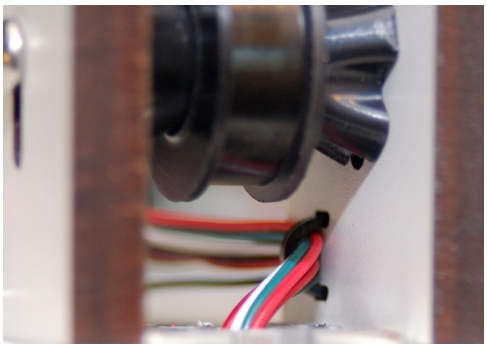


Fig. 8.8-2: Hot end wires tied down.
(Old wire style shown.)

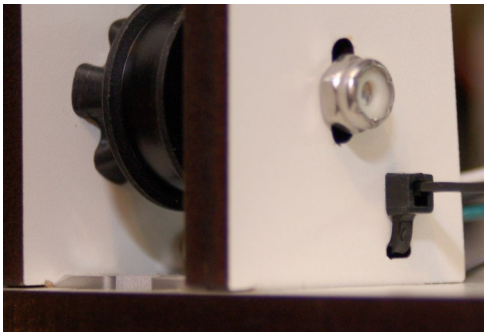


Fig. 8.8-3: Wire tie detail.

When you tie down the end-stop wires coming out of the Y tower, you should carefully take the slack out of the wires before you pull the zip tie fully tight.

Before you tie down the wires coming out of the Z tower, you'll want to pull the 22ga wires from the bottom until there's around 7” coming out of the top of the tower.

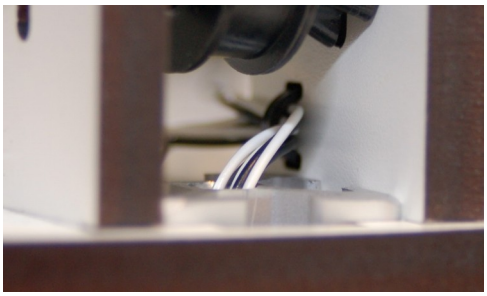


Fig. 8.8-4: End-stop wiring.

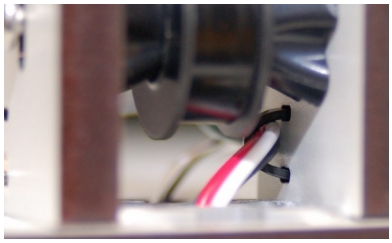


Fig. 8.8-5: Stepper & fan wiring.

With the wires tied securely to the inside faces of the tower supports, you can move on to tying down the X and Z axis end-stop wires. When I run the wire ties, I route them through the holes as shown in order to keep the head of the wire tie out of sight.

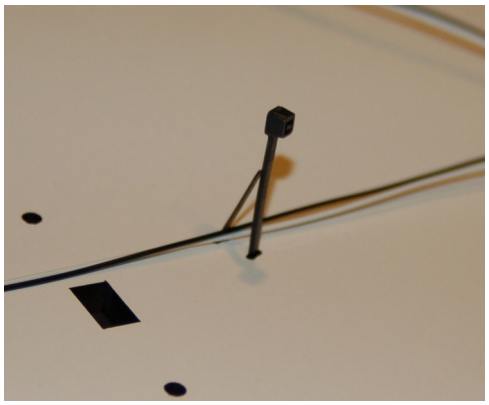


Fig. 8.8-6: Tie routing.

Tie down the end-stop wires at the locations indicated in green, below.

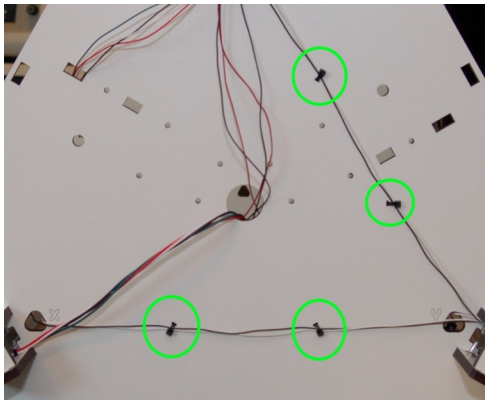


Fig. 8.8-7: End-stop wiring tie points.

8.9 – Tightening the Towers

Part of the this process involves making sure that the towers are square to the heated bed. You'll need a framing square for this task. Before you start, make sure the machine is sitting flat on the table with no wires under the feet, etc.

The first thing to remember about this process is to make sure that the tower is in contact with the depth stop screw BEFORE you begin to tighten down each tower (bottom & top). If you don't, the top of the machine won't be level and that will make calibrating the printer very, very difficult.

Grab your trusty 12” framing square and a clamp and use the clamp to hold the framing square to the center of the channel in the tower.

To square the tower, you'll need to push or pull the top of the tower in order to get the long arm of the square to contact the bed all the way across. Once you've got it square, tighten the screws using a 5/32” Allen wrench using the pattern shown in Fig. 8.9-2.

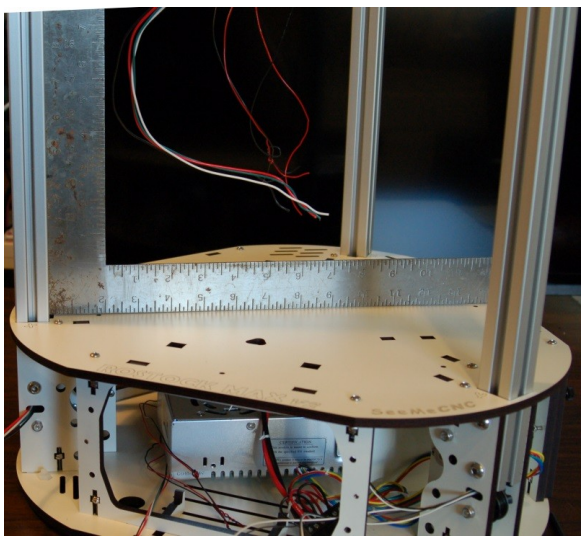


Fig. 8.9-1: Squaring the X tower.

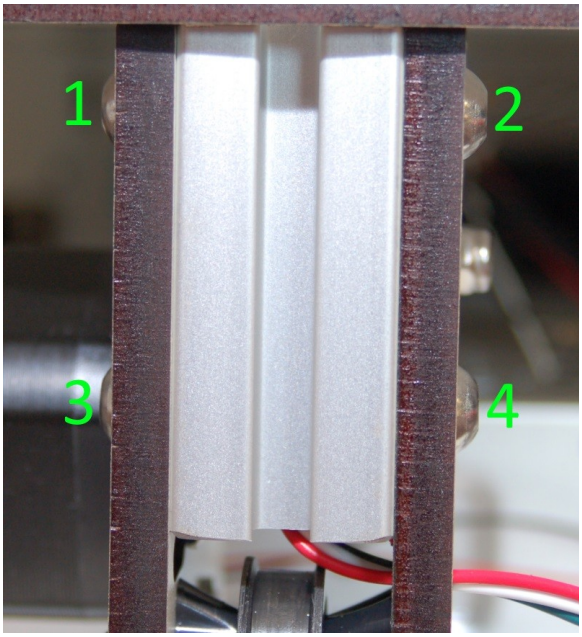


*Fig. 8.9-2: Lower tightening order. (**Old style wire shown.**)*

When you're done with the four screws at the bottom of the tower, move up to the top and tighten those four, using the same order as you did the bottom. *Make sure the top of the tower is in contact with the stop screw!*

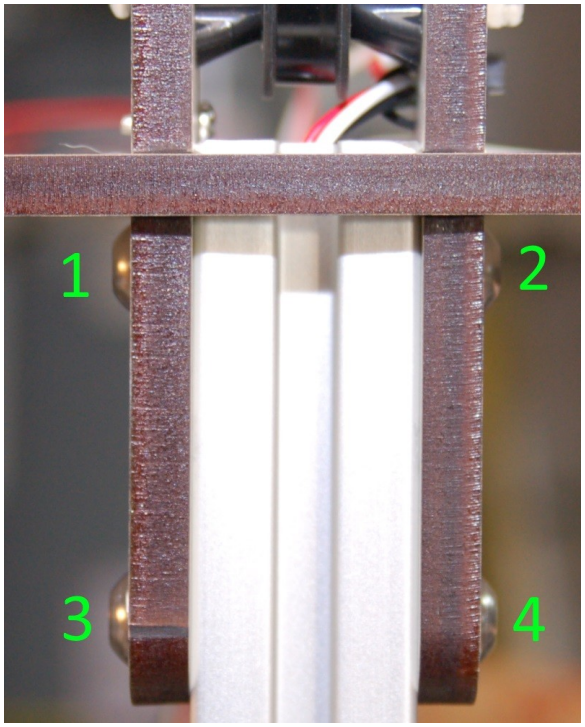


Fig. 8.9-3: Upper tightening order.

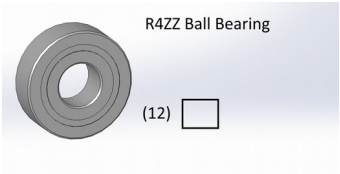
Repeat the square & tighten tasks for the Z and Y towers.

Checkpoint Video #11

9 – Assembling & Installing the Carriages & Belts

9.1 – Assembling the Carriage Rollers

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



The carriage rollers are made from two bearing sleeves and a single R4ZZ bearing. You'll need to apply sleeves to all 12 bearings used in this step. The tolerances on the sleeves are VERY tight. They may also have a sharp lip on the outer face. You might want to use some of the scrap Melamine to help you press the sleeves on to the bearings without leaving a ring on your palm.

Fig. 9.1-1: R4ZZ bearing and two sleeve halves.

Start by laying a sleeve half on the table, face up. Set an R4ZZ bearing into it and firmly press it into place.

Fig. 9.1-2: Pressed into the sleeve.

Now set another sleeve half on the table and press the R4ZZ bearing and sleeve into the new sleeve half to complete the carriage wheel.

Fig. 9.1-3: Assembled carriage wheel.

As mentioned before, the sleeves have a sharp edge as part of their manufacturing process. This sharp edge needs to be trimmed away using a razor knife.

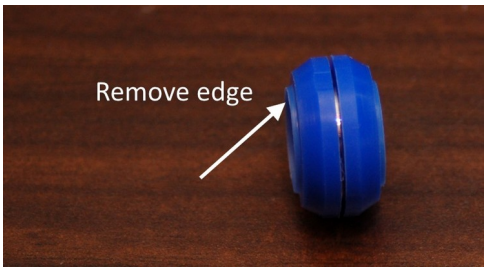


Fig. 9.1-4: Edge to remove.

The sharp edges are very easy to remove. Simply cut into the edge and then slowly rotate the bearing while holding your razor knife in place. This will shave away the edge without damaging the sleeve.

Fig. 9.1-5 Removing the edge.

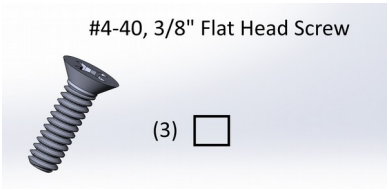
Fig. 8-6: Edge removed!

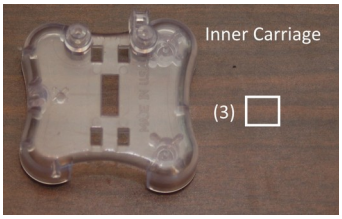
When you're done trimming the edges off the bearing sleeves, repeat the assembly & trimming process for the remaining 11 bearings.

Fig. 9.1-7: Completed carriage roller set.

9.2 – Installing the End Stop Screws

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





Install one #4-40, 3/8” flat head screw into the top of the inner carriage half as shown below. Make sure you drive the screw to the depth indicated by the green line. Do this task for all three inner carriage halves.

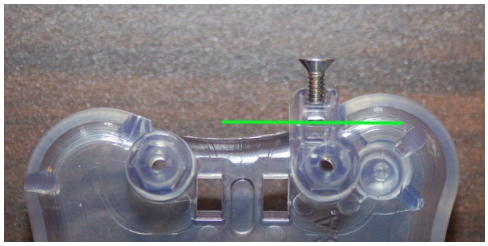
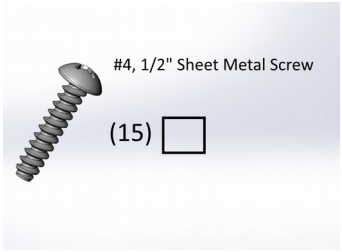
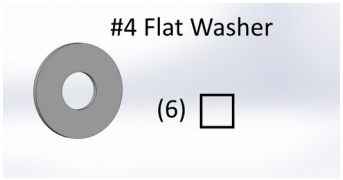


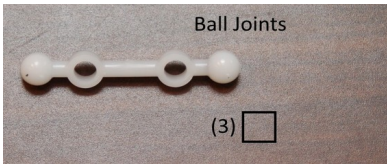
Fig. 9.2-1: Correct screw depth.

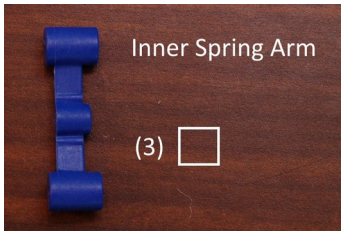
9.3 – Installing the Drive Belts and Carriages

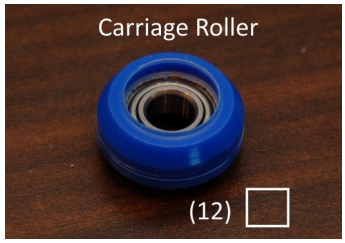
For this task, you'll need the following components:

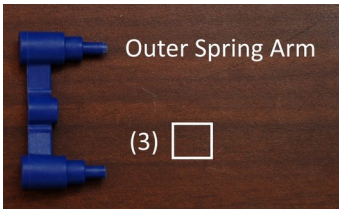


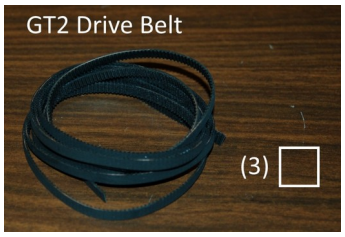


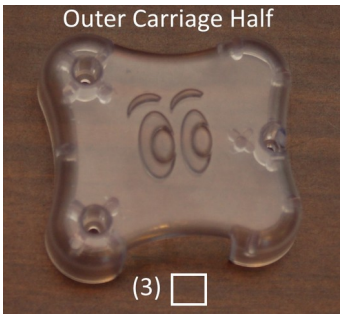












Take one of the GT2 drive belts and thread it into the notch at the base of the X tower as shown in Fig. 9.3-1. The belt shown below is slightly twisted, but please make sure that the belt teeth face ***in*** towards the tower.

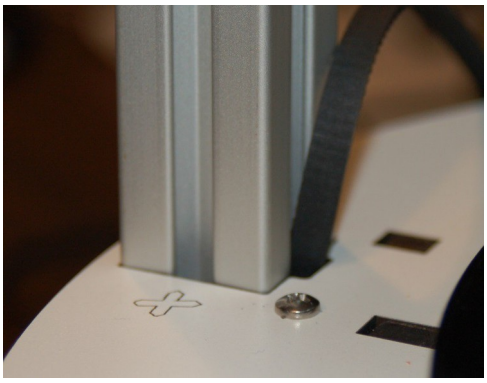


Fig. 9.3-1: Starting to route the belt.

Next, I want you to feed the belt down and under the upper idler and around the top of the GT2 drive gear as shown in Fig. 9-2.

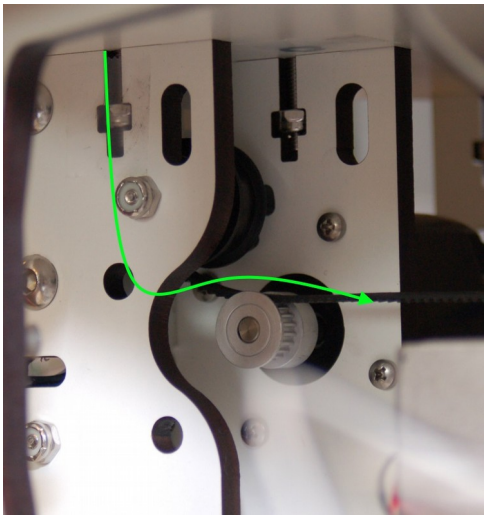


Fig. 9.3-2: Passing under the idler and over the gear.

Pass the belt around the gear and under the lower idler as shown below.

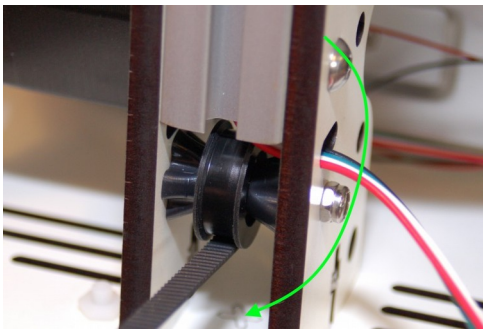


Fig. 9.3-3: Around the gear and under the idler...to Grandmother's house we go...

Now thread the belt through tower hole in the base plate.

Fig. 9-4: On our way to the top...

Now you can pull the belt up towards the top and route it between the tower and the top plate opening as shown.

Route the belt over the top of the idler and back down through the tower opening as shown.

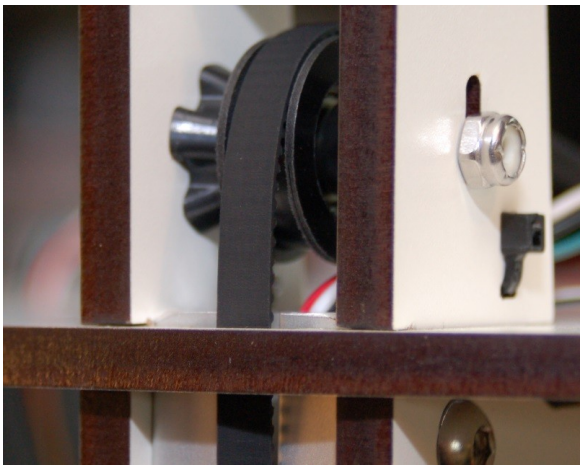


Fig. 9.3-5: Belt at the top...

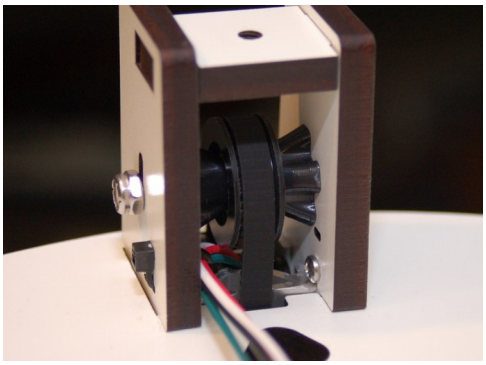


Fig. 9-6: On the way back down!

Make sure you've pushed the idler pulley to its lowest position. Pull about 10” of belt down from the top and let it hang. Do this for the other two belts and we'll move on to getting the carriages assembled and installed!

9.4 – Assembling the Carriage Spring Arms

The new injection molded carriage includes a plastic spring arm that provides a constant side force to the tower that requires no adjustment. Each spring arm assembly consists of an inner spring arm, an outer spring arm, and two sleeved R4ZZ bearings.

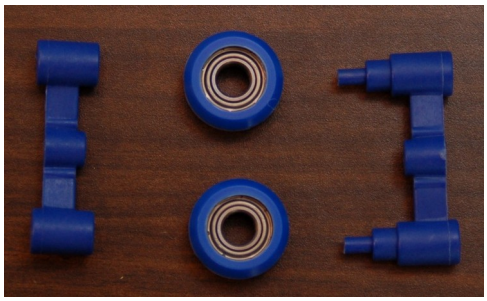


Fig. 9.4-1: Spring arm components.

The spring arm is easy to assemble, but the small posts are a very tight fit, so be careful when assembling them. Note that each arm half has an “inside” and “outside” to it. Assemble them matching the orientation shown in Fig. 9.4-2.

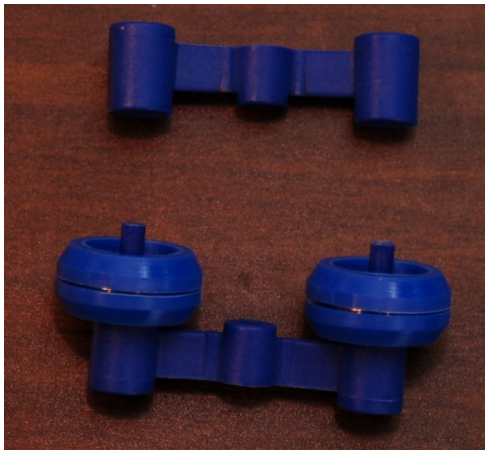


Fig. 9.4-2: Inner spring arm orientation.

Slide two sleeved R4ZZ bearings on to the outer spring arm posts as shown.

Next, press the inner spring arm on to the two mating posts that are on the outer spring arm.

As I said before, the fit is very tight. You can get each side started by aligning the holes in the inner spring arm over the posts in the outer spring arm and then tap them into place with the handle of your P2 screwdriver. You want the pins fully seated.

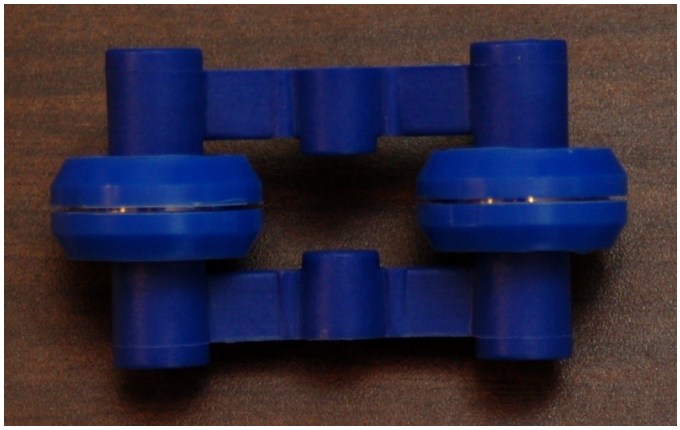


Fig. 9.4-3: Fully assembled spring arm.

Assemble the remaining spring arms as you did this one.

9.5 – Installing the Carriages on the Towers

The first thing you need to do is install two sleeved R4ZZ bearings and the assembled spring arm into one of the inner carriage halves as shown below.

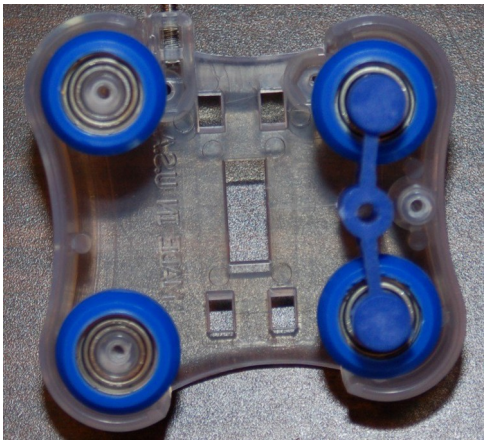


Fig. 9.5-1: Rollers installed.

Make sure that you install the spring arm assembly exactly as shown in Fig. 9.5-1. The center hole in the spring arm will fit on to a mounting post that's present on the inside of the inner carriage half. The spring arm is what keeps constant tension on the tower. If you install it facing the other direction, it will grip the tower too tightly and the carriage may not even move.

Grab one of the binder clips that were included in the kit. You're going to use it to hold the belt ends in place while you mount the carriage on the tower.

Slide the belt ends through the opening in the inner carriage half and clip the belt ends together with the binder clip as shown. You want to make sure that the belt teeth are *facing* the tower.

Now you can attach the partially assembled carriage to the tower. The easiest way is to start with the spring arm side and press down in order to compress the arms as you push the other side of the carriage into place. The sleeved R4ZZ bearings will fit into the slots on either side of the tower.

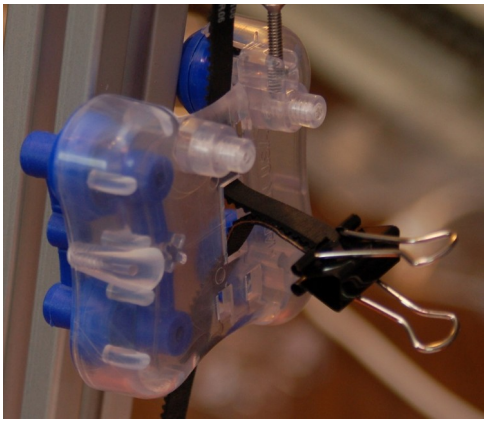


Fig. 9.5-2: Belts held in place.

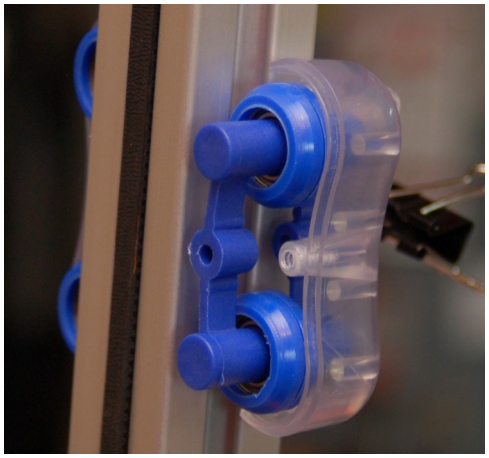


Fig. 9.5-3: Carriage attached to the tower.

Slide the outer carriage to the bottom of its travel and then attach the outer carriage half to the inner carriage half. Install 3 1/2” #4 machine screws into the three mounting holes in the back of the outer carriage half.

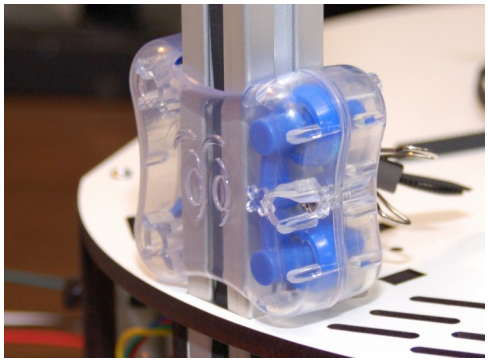


Fig. 9.5-4: Carriage installed!

9.6 – Attaching the Belts to the Carriage

Belt installation on the carriages is accomplished by inserting a pair of belt clamps into the inner carriage half. Each clip “rotates” into place, hinging on a pair of plastic legs. You'll start with the top belt clamp – the figure below demonstrates how the clamp is seated.

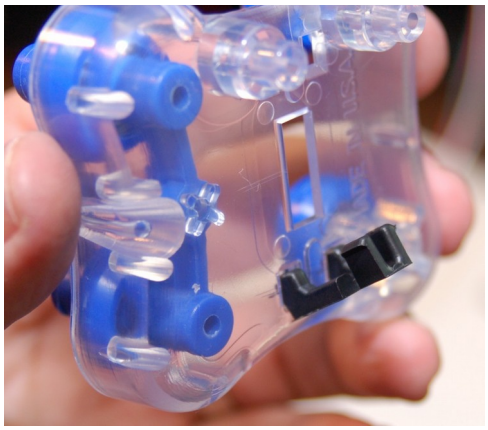


Fig. 9.6-1: Example clamp fit.

Install the top belt clamp as shown below. You may have to “pinch” the top of the clip slightly in order to get it to fit into the center opening in the inner carriage half, but it will fit.

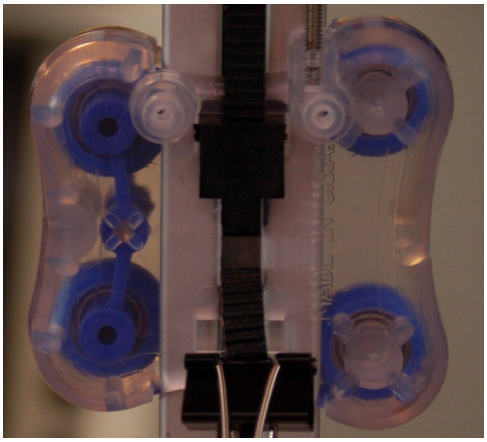


Fig. 9.6-2: Top clamp fitted.

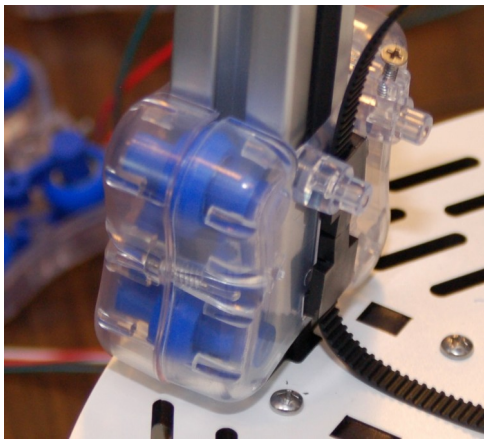


Fig. 9.6-3: Clamps installed.

When you're ready to install the bottom belt clamp, remove the binder clip from the belt end and pull the belt up and away from the carriage – this will help remove any slack in the belt. When you've got the slack out, install the bottom belt clamp in the same manner as the top clamp.

Repeat this process for the other two carriages.

9.7 – Installing the Axle Adapters

Set one Ball Joint Arm on the two mounting posts on the front face of the IM Carriage as shown below.

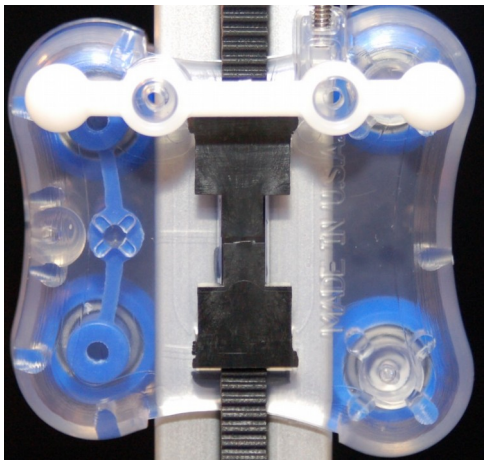


Fig. 9.7-1: Ball Joint Arm installation.

Next, install two #4 x 1/2” sheet metal screws along with two #4 flat washers to hold the Ball Joint Arm in place.

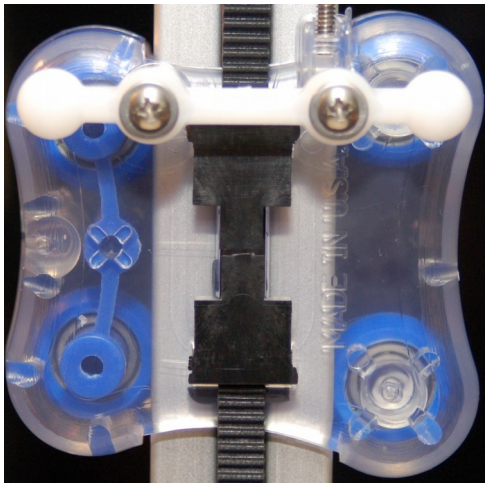


Fig. 9.7-2: Ball Joint Arm installed.

9.8 – 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. Setting proper belt tension is more magic than science at this point, but the following instructions will get you at a pretty good default tension.

Insert a P2 screwdriver diagonally through the tower, under the idler bearing as shown below. This technique depends on you having pulled the belt reasonably tight when you installed the last belt clamp into the carriage you're working on. If that wasn't the case, you should pop a clip out and tighten the belt a bit more and re-install the clamp.

When the screwdriver is under the pulley, you should see a small gap under the screw head as indicated by the green arrow in Fig. 9.8-1. Tighten the #6-32 nylon lock nut usng a 5/16” wrench and a screwdriver. ***DO NOT OVER-TIGHTEN THE SCREW! IT WILL PULL THROUGH THE MELAMINE AND WILL NO LONGER HOLD THE IDLER IN PLACE!***

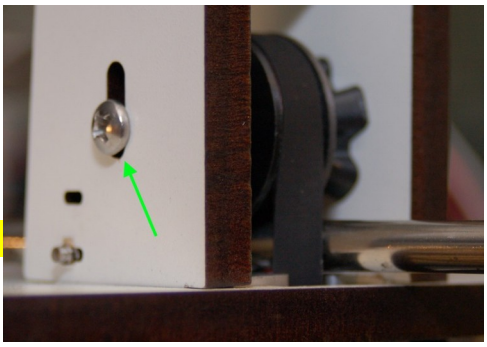


Fig. 9.8-1: Tensioning the belts.

Checkpoint Video #12

10 – Assembling and Installing the EZStruder

Before the EZStruder can be installed, you'll first need to assemble it.

10.1 – Assembling the EZStruder

In order to complete this task, you'll need the EZStruder hardware kit. This kit consists of the following components:

1. [___] Filament Tensioner
2. [___] Filament Guide Block
3. [___] Metric Stepper Motor Mounting Screws
4. [___] Std. Mounting Hardware (Unused)
5. [___] Hobbed Gear & Allen Wrench

You'll also need the remaining NEMA17 stepper motor:

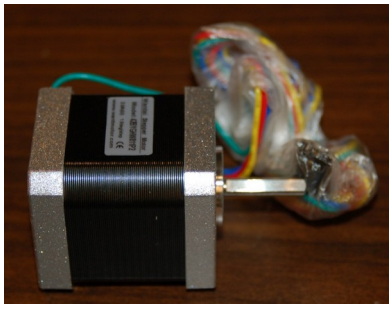


Fig. 10.1-1: EZStruder Hardware Pack.

The filament tensioner includes two mounting screws that are “captured” inside the assembly.

Fig. 10.1-2: Filament tensioner.

Rotate the stepper motor so that the wires are facing up and then set the filament tensioner against the face of the stepper motor and tighten the two screws.

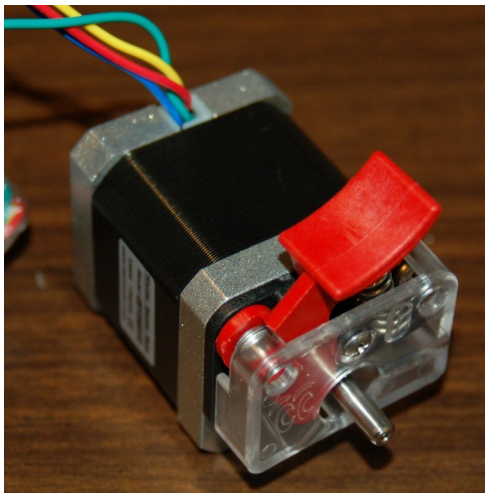


Fig. 10.1-3: Filament tensioner installed.

The next task will be to install the hobbed gear. Before you can do that, you'll need to turn the output shaft of the stepper motor so that the flatted portion of the shaft is facing the opening in the side of the filament tensioner as shown in Fig. 10.1-4.

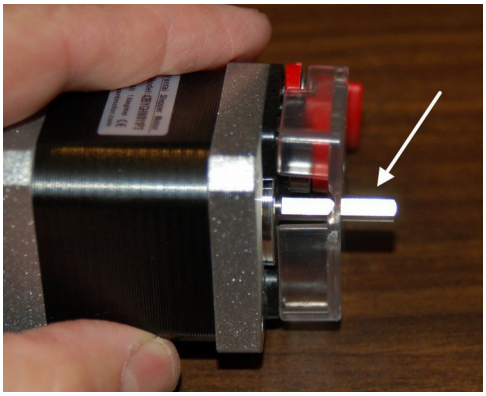


Fig. 10-4: Shaft aligned.

Remove the grub screw from the hobbed gear and set it aside.

Press your thumb against the red lever on the filament tensioner and slide the hobbed gear on to the shaft with the hobbed portion closest to the face of the stepper motor.

You want to align the hobbed portion of the gear with the steel bearing on the filament tensioner as shown in Fig. 10.1-5. The idea is to get the center line of that little bearing lined up with the center line of the hobbed portion of the gear. Guessing by the photo to the right, this is not an idea that's taken hold in my head as of yet. Please don't make the same mistake. :)

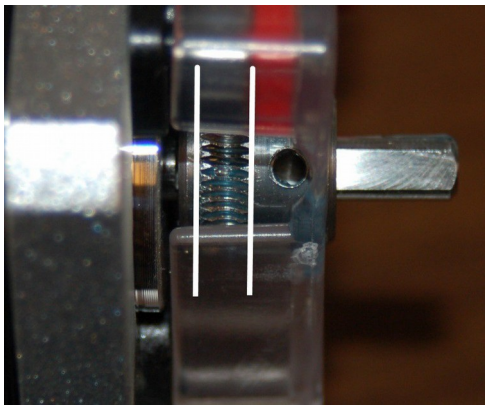


Fig. 10-5: Hobbed gear alignment.

You'll also want to rotate the hobbed gear so that the hole for the grub screw is aligned with the little rounded notch that's formed in the body of the filament tensioner. Put a small amount of thread locker on to the grub screw and install & tighten it.

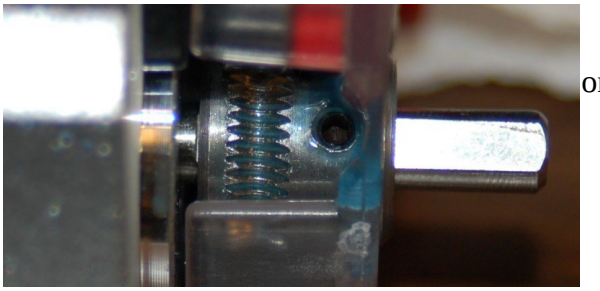


Fig. 10.1-6: Grub screw installed, mess with thread locker made.

Now you need to install the filament guide block on to the stepper motor.

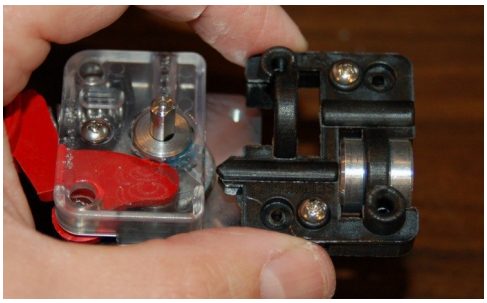


Fig. 10.1-7: Filament guide block orientation.

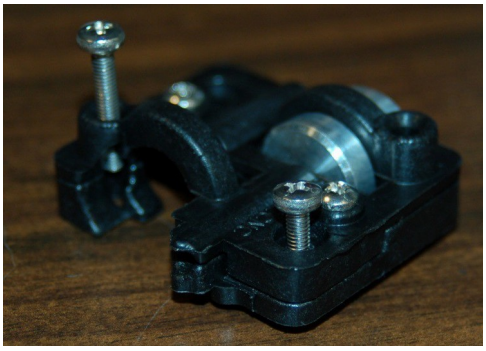


Fig. 10.1-8: Mounting screw locations.

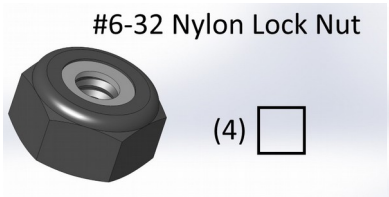
The filament guide block is installed on to the stepper motor using the two metric screws included in the hardware pack. Using Fig. 10.1-8 as a guide, insert the shorter screw in the hole to the right and the longer screw in the hole to the left.

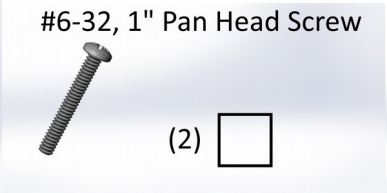
Set the filament guide block on to the stepper motor and tighten the attachment screws.

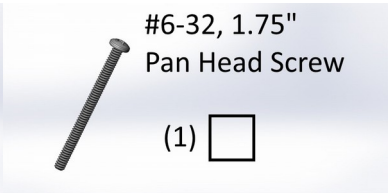
Fig. 10.1-9: Assembled EZStruder.

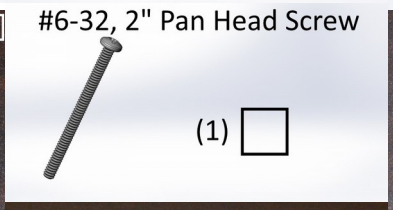
10.2 – Installing & Mounting the EZStruder

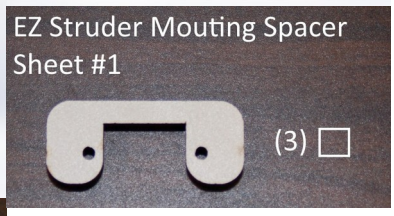
For this task, you'll need the assembled EZStruder as well as the following components:



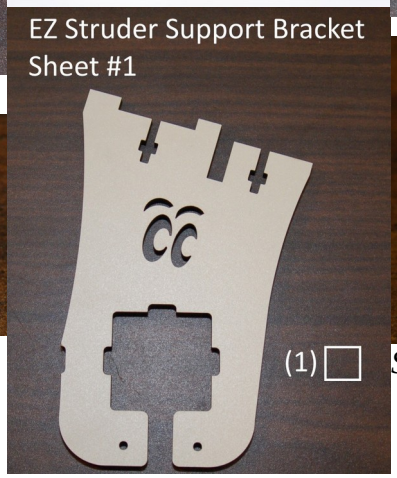








Push Fit Connector



Stepper Knob

The first thing you'll need to do is install the 1.75” and 2” pan head screws into the filament guide block. The holes for the screws are tight, so you'll need to drive them in with a power screwdriver in order to more easily cut threads into the plastic. When you've gotten them all the way in, run them in a bit more to strip out the threads you just cut. It will make installing the nylon lock nuts easier. The 1.75” screw goes in on the left, the 2” screw goes in on the right – see Fig. 10.2-1.

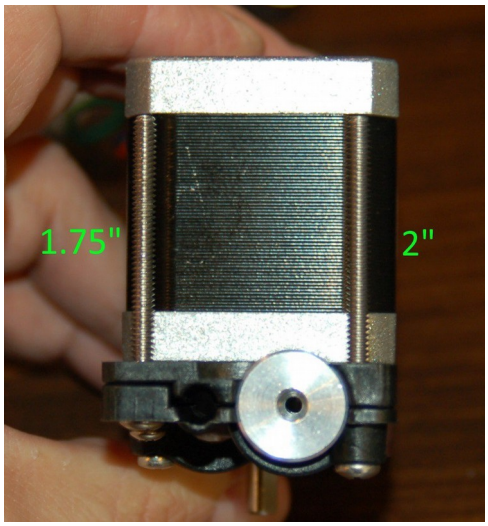


Fig. 10.2-1: Screw locations.

Now you can install the mounting spacers on the two screws.

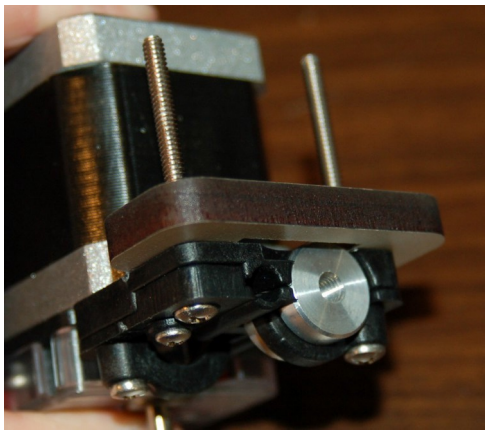


Fig. 10.2-2: Starting the spacer stack...

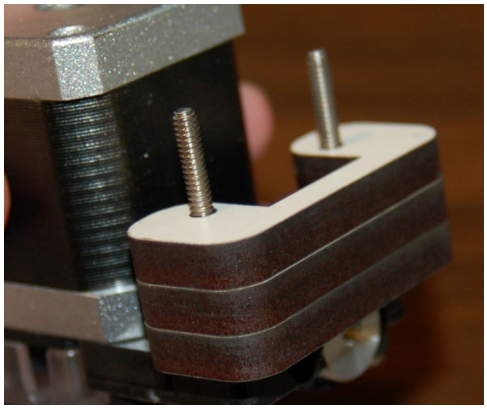


Fig. 10.2-3: ...and finishing it!

To install the EZStruder on to the support bracket, orient the EZStruder and support bracket as shown in Fig. 10-13.

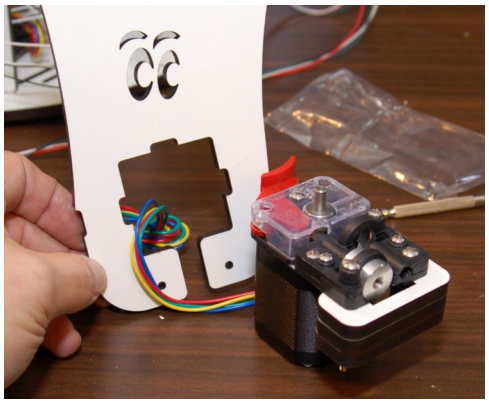


Fig. 10.2-4: Bracket & motor orientation.

Carefully slide the stepper motor through the square opening in the bracket and guide the two screws into their mating holes on the bracket as shown below. The stepper is a tight fit, but it does fit properly once the input angle is taken out of it.

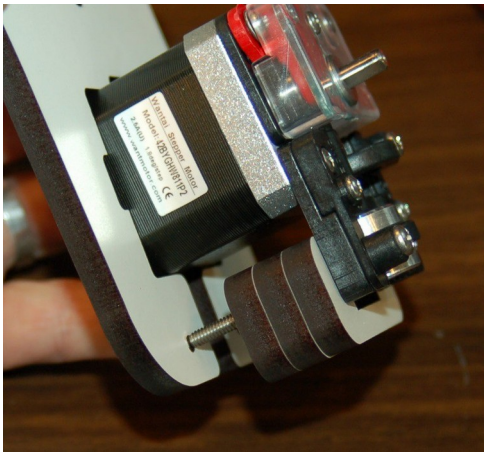


Fig. 10.2-5: Fitting the EZStruder to the bracket.

Now thread on and tighten two #6-32 nylon lock nuts as shown below.

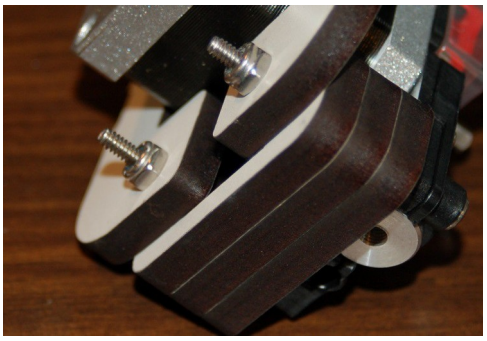


Fig. 10.2-6: EZStruder installed.

Before you can attach the EZStruder bracket to the printer, you'll need to do a few tasks first. First up, install the stepper motor knob on to the output shaft of the stepper motor. This knob will allow you to manually feed filament if you need to.

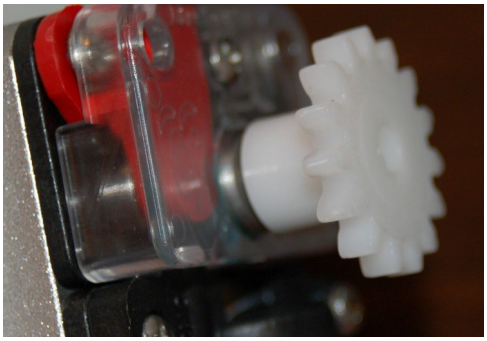


Fig. 10.2-7: Stepper knob installed.

Next, you'll need to install the brass push fit connector to the bottom of the filament guide as shown below. Use your fingers to tighten.

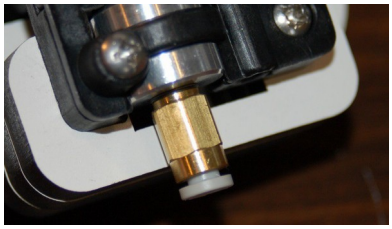


Fig. 10.2-8: Push fit connector.

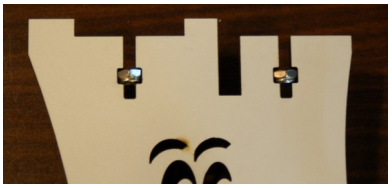


Fig. 10.2-9: Nuts installed.

Finally, you'll need to install two #6-32 nylon lock nuts into the nut capture pockets in the top of the EZStruder bracket, as shown.

Now we can move on to attaching the EZStruder bracket to the top of the printer!

Slide the EZStruder bracket support brace on to the EZStruder bracket as shown.

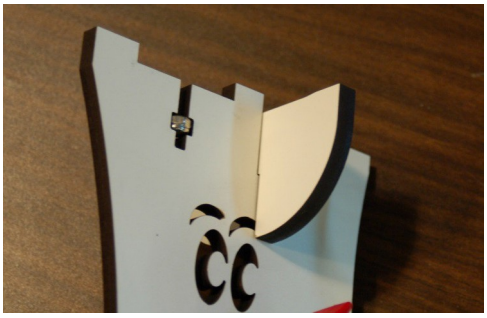


Fig. 10.2-10: Support brace in place.

Now set the EZStruder bracket into the mounting slots in the top of the printer. It may be easier to do this if you lay the machine down horizontally.

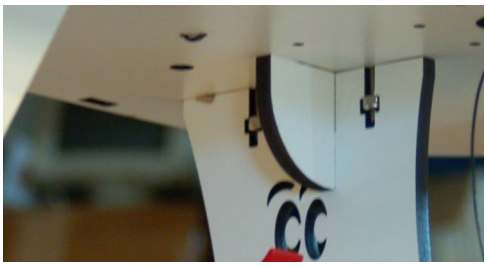


Fig. 10.2-11: Ready for screws!

Insert two #6-32, 1” pan head screws into the locations shown. They should fit into the nuts in the EZStruder bracket perfectly. Tighten them down and we'll move on to wiring up the stepper motor!

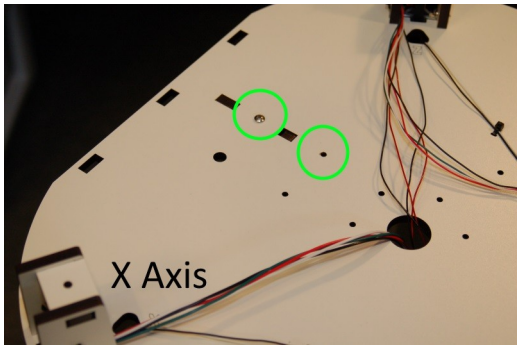


Fig. 10.2-12: Bracket screw holes.

I've labeled the X axis to help orient you.

(Wanna know why there's only one screw? Ask JJ!)

10.3 – Wiring the EZStruder Stepper Motor

Route the stepper motor wires through the center hole in the top plate. I've laid the machine horizontally to make working on the top end easier.

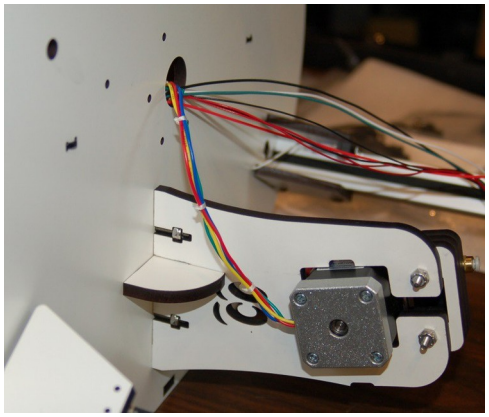


Fig. 10.3-1: Routing the stepper wires.

Now you'll want to use a short wire tie to bind the wiring of the stepper motor to the EZStruder bracket as shown below.

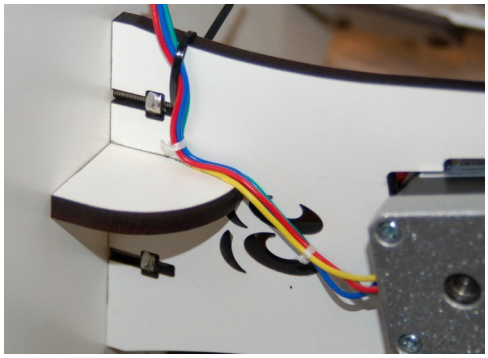


Fig. 10.3-2: Wires tied in place.

As shipped, the stepper motor wires are a lot longer than they need to be. Trim the stepper motor wires so they overlap with the ends of the Z tower fed wires by about 3 inches.

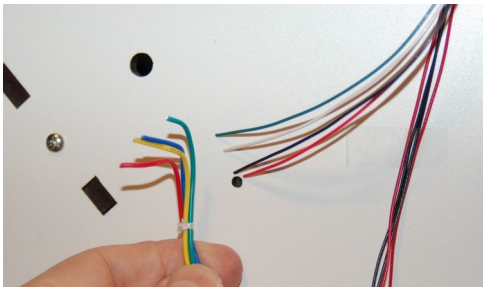


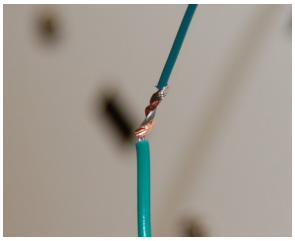
Fig. 10.3-3 Trimmed to length.

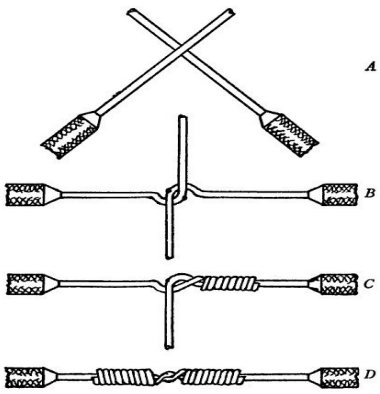
When you trim the wires down to length, hang on to the connector you'll be left with. We'll use that later to solder to the other end of the wires at the bottom of the tower.

Strip about 1/2” of insulation off both the stepper motor wires and the feed wires coming from the Z tower.

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. 10.3-1.

Below is an example of what the splice looks like.





Ill. 10.3-1:A Western Union Splice.

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

You can also use heat shrink tubing if you've got some handy – it's personal preference really.

When splicing the wires together, please follow the chart below. This is important in order to get the pin assignments correct when you solder the connector you just cut off back on to the bottom end of the wiring. :)

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 10.3-1:Wiring Color Chart.

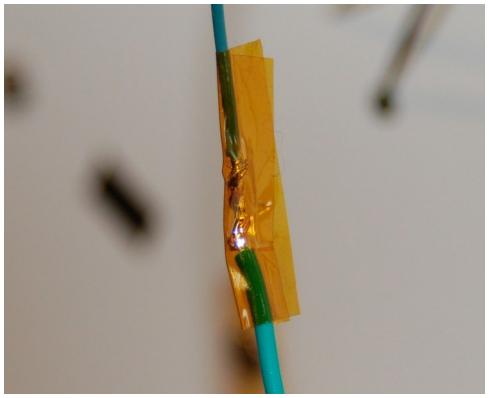


Fig. 10.3-4: Soldered & taped over.

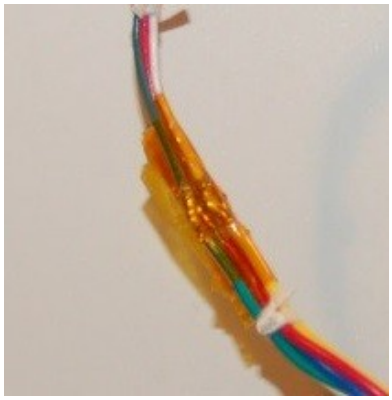


Fig. 10.3-5: Wiring completed.

Checkpoint Video #13

11 – Installing the Hot End and Bowden Tube

11.1 – 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.

Mesh wiring loom and heat shrink tubing.

Cut a 26” long section of mesh loom. The material will cover the 18ga and 26ga hot end and 26ga fan wires from the top plate to a point between 2.5” and 4” short of the end of the wires. Tape the hot end and fan wires together and slide the mesh loom section you just cut over them.

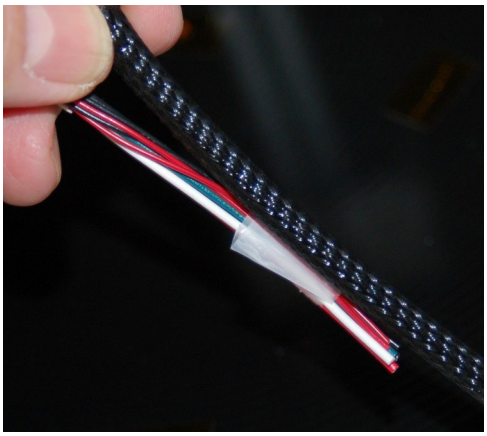


*Fig. 11.1-1:Wires and mesh loom. (“**B**” wire shown.)*

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

Now, I want you to cut a 1” piece of heat-shrink tubing. 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. See the image below for a general example.

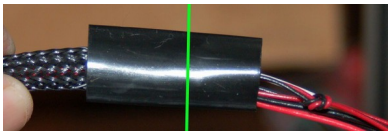


Fig. 11.1-2: Heat shrink location.

Using a hair dryer or heat gun, heat the tubing until it conforms to the loom & wires as shown in Fig. 11.1-3. Keep the heat source moving around the tubing as it shrinks to get an even shrink all the way around. You'll want to be careful to not melt the mesh, so don't leave your heat gun focused on one spot too long.

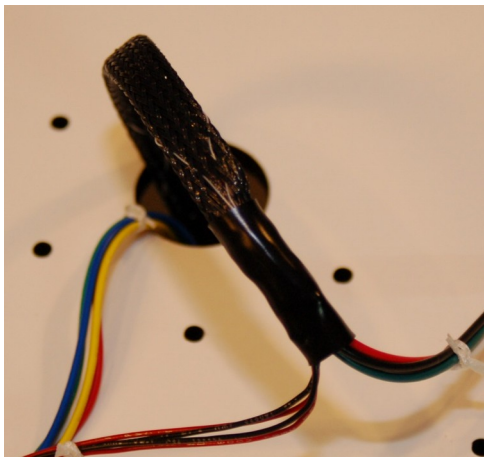


Fig. 11.1-3: Top end done.

Gently pull the mesh towards the end of the wire and add another 1” piece of heat shrink to the end. (Pull the mesh tightens it up and it lengthens as this happens.)

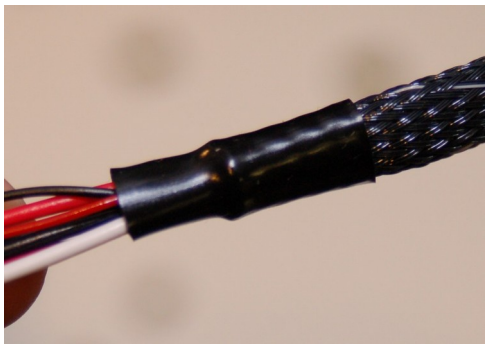


Fig. 11.1-4: Heat shrink on the business end.

Once you've done that, take a few minutes to tape down the hot end and fan wiring as shown.

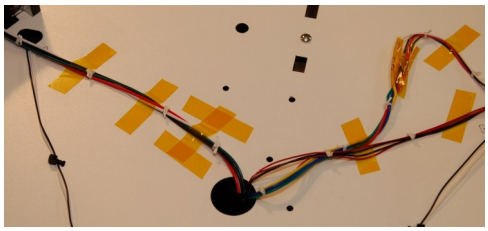


Fig. 11.1-5: Neat wiring!

Note that the photos here show the “B” hot end wires. For the “A” hot end wires, you'll have two each, red & black 26ga wires, one pair of white 26ga wires and one each red & black 18ga wires.

11.2 – Hot End Prep

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 the example in Fig. 11.2-1.:

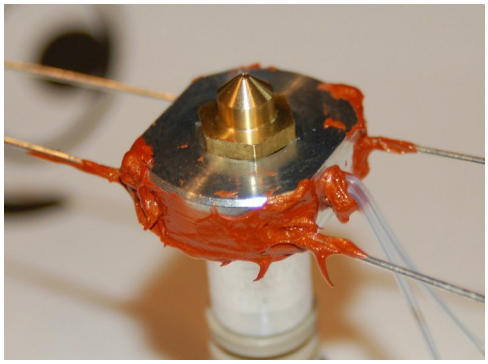


Fig. 11.2-1: RTV'd Hot End.

Before we start the wiring process, I want you to wrap the heater block of the hot end with a few loops of Kapton tape. This will help prevent the thermistor from being pulled out of the hot end if the wiring were to snag on something. If the thermistor comes out of the hot end while it's powered up, the PEEK section (the tan part) of the hot end *WILL BE DESTROYED* when the hot end temperature exceeds 247 degrees Celsius.

The reason this happens is due to the firmware on the controller trying to get the hot end to it's target temperature based on a thermistor input that is no longer close enough to the heater block to return a reliable reading.

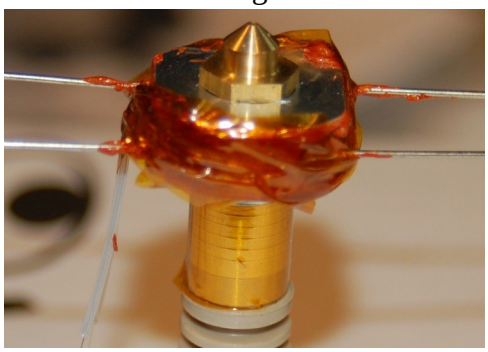


Fig. 11.2-2: Heater block and hot section wrap.

When you've got the heater block wrapped, go ahead and throw a loop around the upper hot section (the aluminum barrel portion). This will act as a bit of insulation to prevent the PEEK fan from inadvertently cooling down the hot end while in operation.

Checkpoint Video #14

11.3 – Wiring the Hot End

For this task, you'll need the completed hot end and two 22-16ga un-insulated crimp connectors.

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

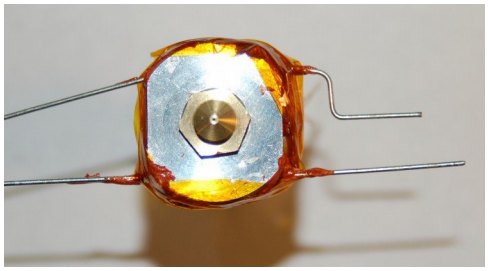


Fig. 11.3-1: Step #1.

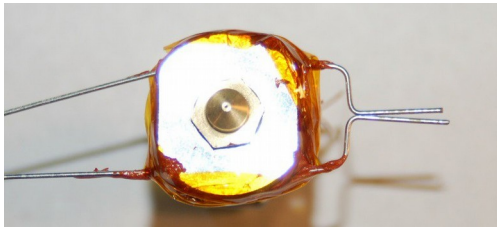


Fig. 11.3-2: Step #2.

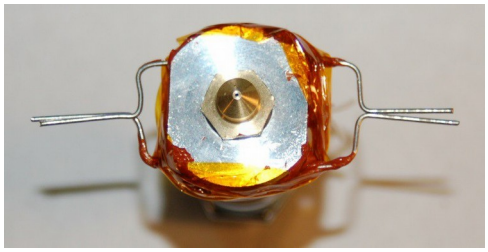


Fig. 11.3-3: Step #3.

The resistor leads on the hot end are too long to used right now. In order to trim them to the proper length, place one of the crimp connectors along side the wires and mark the wires just behind the center point of the crimp as shown below. Trim the leads off at that mark.

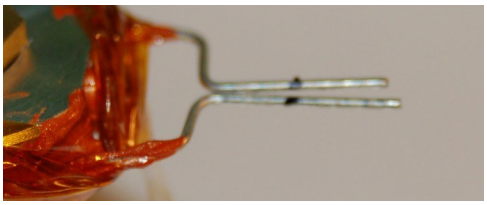


Fig. 11.3-4: Leads marked for cutting.

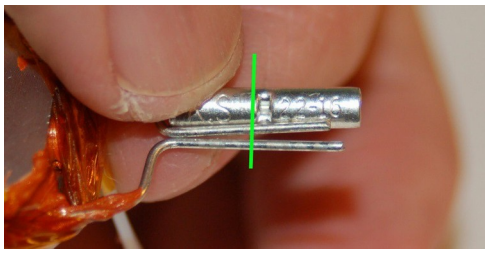


Fig. 11.3-5: Marking the trim point.

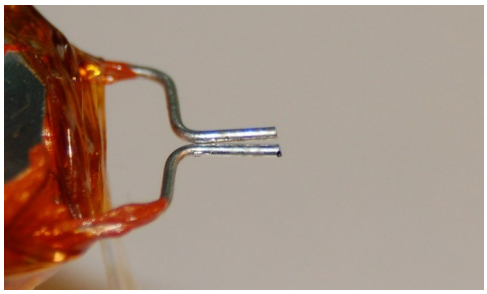


Fig. 11.3-6: Leads trimmed.

Finally, attach the crimp on connector to the freshly trimmed leads as shown.

Fig. 11.3-7: Crimp installed.

Repeat the process for the leads on the other side of the heater block.

Fig. 11.3-8: Ready for wires.

Now strip off about 3/8” from the two 18ga black & red wires coming out of the hot end loom. These will be attached to the crimps you've just installed. Note that it doesn't matter which side you pick for black and which for red. Resistors don't have a specific polarity, so connection orientation doesn't matter. Insert wires into the crimps and crimp 'em shut. Cover each crimp connector with Kapton to insulate them against shorts. Bend the leads “up” towards the top of the hot end.

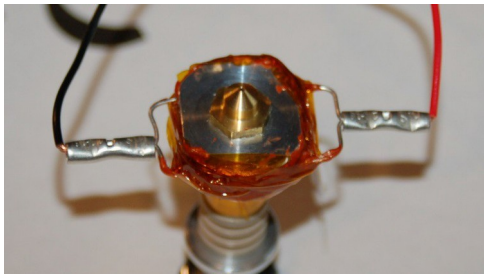


Fig. 11.3-9: Power wires attached.

Fig. 11.3-10: Insulated crimps.

Now you'll be attaching the thermistor leads to the 18ga green and white wires in the hot end loom. Please be careful with this task – the thermistor wires are delicate and can be broken easily.

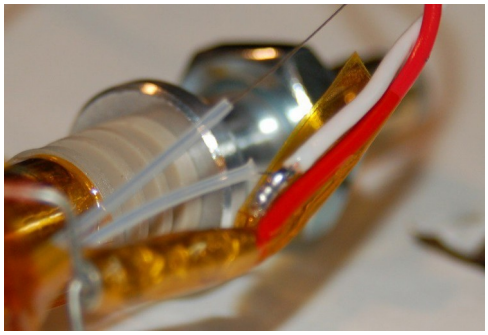


*Fig. 11.3-11: Thermistor lead soldered to white wire. **(Older wire style shown.)***

Note that the photos here show the older hot end wiring that used 4 18ga wires. For the new hot end wiring, you'll use the 18ga red & black wires as stated, but you'll use the white 26ga wires for the thermistor!

As soon as you finish soldering the white wire to the thermistor lead, cover the joint with Kapton tape. Solder the other thermistor lead to the green wire and also cover it with Kapton. After you've done that, I want you to use more Kapton and tape the two thermistor leads to the power lead feeding the thermistor side of the hot end as shown.

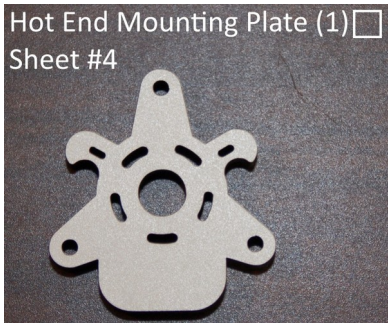
The reason for this is to provide additional strain relief to the thermistor wiring to help prevent it from being pulled out of the hot end on accident.

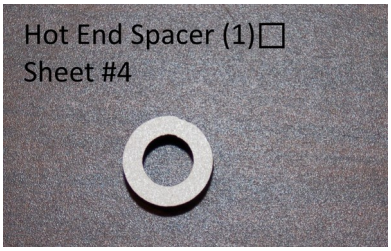
*Fig. 11.3-12: Thermistor leads bound tight. **(Older wire style shown.)***

Checkpoint Video #15

11.4 – Attaching the Hot End to the Hot End Mounting Plate

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





Please note that all the wiring shown in the following photographs are using the older, 4 conductor 18ga wire. The 2 18ga & 2 26ga wires are secured in the same fashion as the older style.

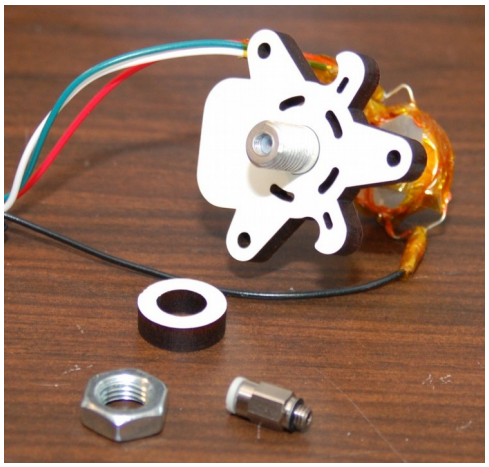


Fig. 11.4-1: Mounting plate in place.

You'll also need one short wire tie and the freshly wired up hot end.

Start by removing the large nut and the press fit connector from the hot end. Slide the mounting plate on to the hot end as shown on the left.

Next, slide the spacer on to the hot end and then thread the large nut back on to the hot end. Carefully tighen the nut with an 11/16” wrench. You don't have to treat like a lug nut – a little tightening goes a long way.

Fig. 11.4-2: Hot end tightened dwon.

Using a small wire tie, fix all four wires into place in one of the strain relief notches.

Fig. 11.4-3: Wires fixed in place.

Make sure that you've got the hot end oriented as shown in Fig. 11.4-4. The “back end” of the mount needs to remain clear in order to install the PEEK fan later on.

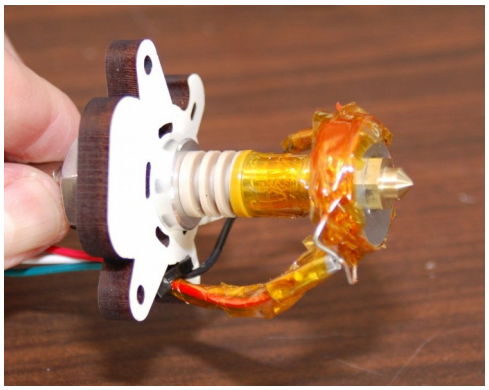


Fig. 11.4-4: Correct orientation.

11.5 – 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.

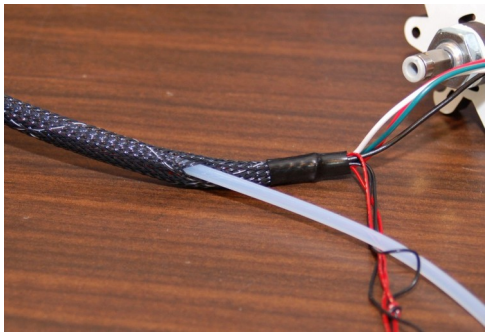


Fig. 11.5-1: Bowden insertion point.

Thread the Bowden tube up the loom to a point a few inches short of the press fit connector on the extruder. Open up the loom at that point and allow the Bowden tube to exit.

Fig. 11.5-2: Bowden exit point.

Now you can insert the Bowden tube into the press fit connectors on the hot end and the extruder. Push the tube in until it stops.

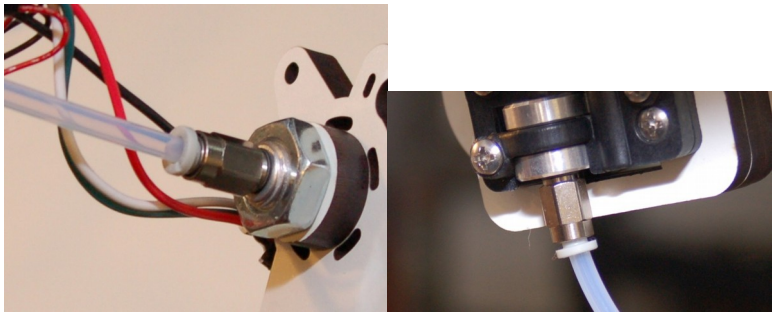


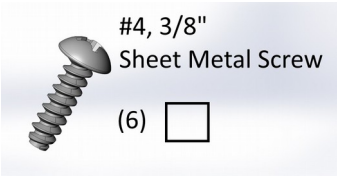
*Fig. 11.5-3: Bowden tube fitted. (“**B**” wire shown.”*

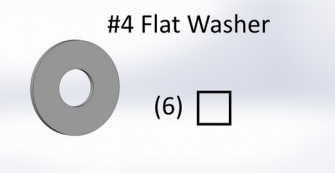
Checkpoint Video #16

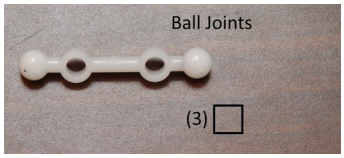
12 – Installing the Effector Platform and Delta Arms

12.1 – Assembling the Effector Platform

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







Do NOT sand or de-burr the ball joint arms or the sockets in the delta arms! Doing so will ruin the fit of the parts!

Assembling the effector platform consists of installing three Ball Joint Arms on to the Ball Joint Platform.

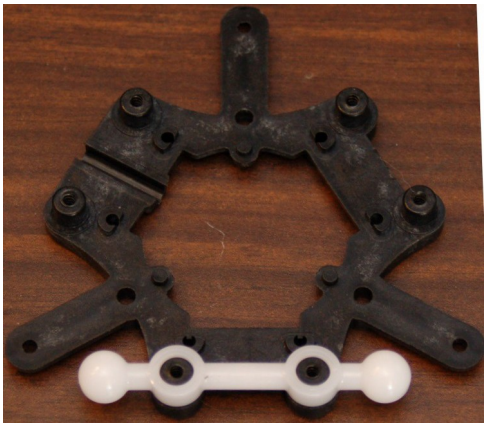


Fig. 12.1-1: Ball Joint Arm position

Start by pressing a Ball Joint Arm on to a pair of mounting posts as shown in Fig. 12/1-1.

Fix the Ball Joint Arm into place with two #4 x 3/8” machine screws and two #4 flat washers.

Fig. 12.1-2: Ball Joint Arm fixed in place.

Repeat this task for the other two Ball Joint Arms.

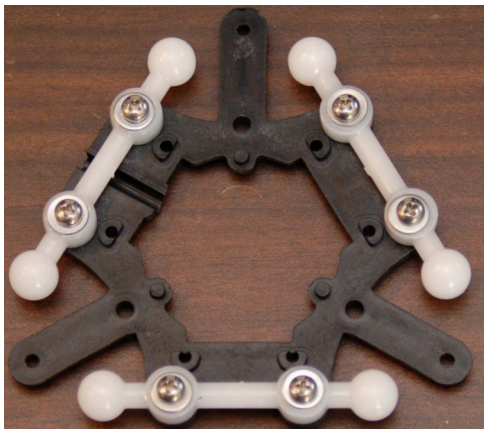
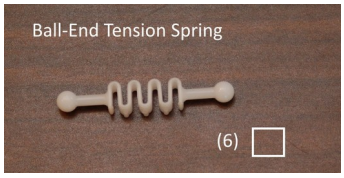
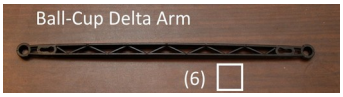


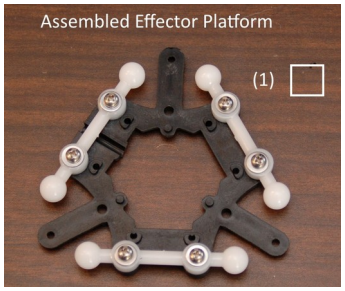
Fig. 12.1-3: Completed platform.

12.2 – Installing the Ball-Cup Delta Arms & Effector Platform

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







Before you begin this task I recommend that you move the hot end out of your way by looping it over the Y tower.

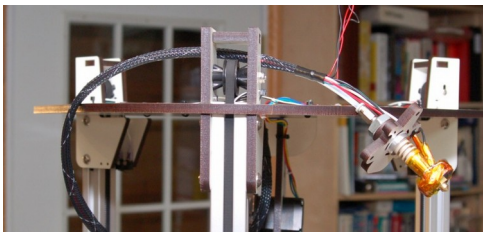


Fig. 12.2-1: Out of the way...

Make sure you've got each carriage moved to the bottom of the machine. It'll be easier to get the arms installed with them in that location.

Take two Ball-Cup Delta Arms and press them on to the Ball Joint Arms as shown.

The cup on the arm will make a soft click sound as it seats fully on the ball arm.

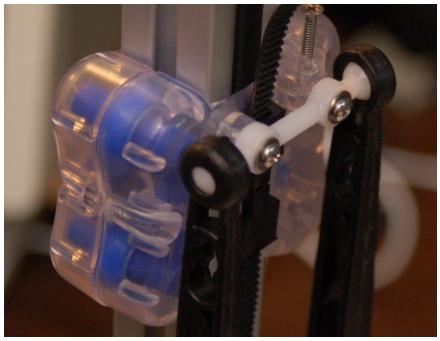


Fig. 12.2-2: Fitting the arms.

Next, you'll need a pair of the ball-end tension springs. These springs are used to keep a constant force on the arms so that they won't pop off during operation. They also have the added advantage of making the assembly mechanically “tight”.

The springs fit into the sockets that are located at the end of each ball-cup arm. Insert the ball through the larger hole and then move it to the “upper” position as shown in Fig. 12.-3.

Fig. 12.2-3: Example Ball-End Tension Spring installation.

Install a spring at the carriage end of the arm pair. The advantage here is that when you're attaching the other ends to the effector platform, the spring you just installed will help the arms “grip” the ball-arms until you can get the other spring installed.

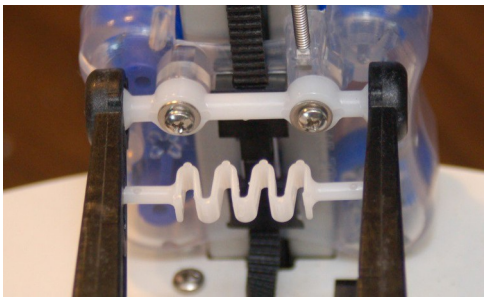


Fig. 12.2-4: Carriage end spring.

After you have the carriage end done, install the effector end as shown.

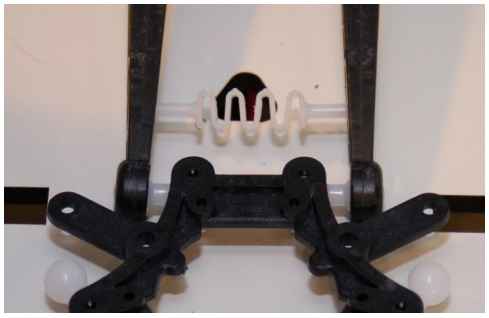


Fig. 12.2-5: Effector end spring.

Now install the other two arm sets in the same manner as you did this pair. When you're done, the machine should look like Fig. 12.2-6.

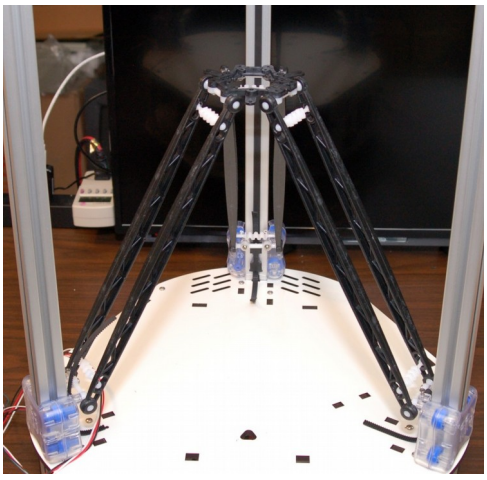
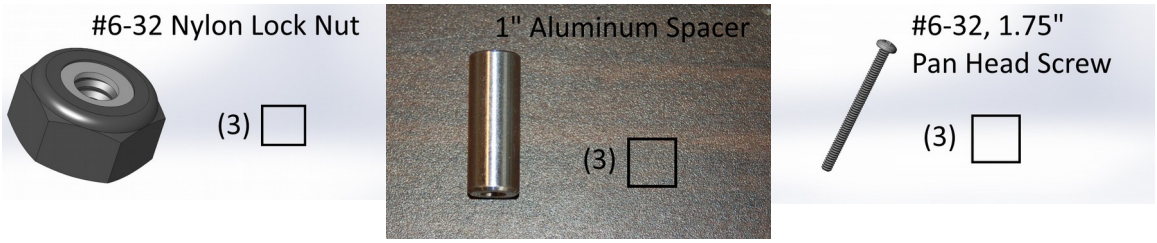


Fig. 12.2-6: Arms installed!

13 – Installing the Hot End

For this task you'll need the following components:



Start the installation by inserting a 1.75” pan head screw through the bottom of the platform and then slide a spacer over it as shown.

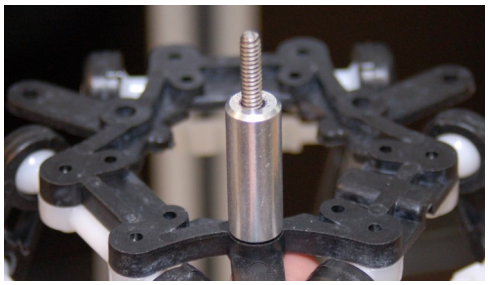


Fig. 13.1-1: First screw ready.

Next, set the hot end on the screw and thread a #6-32 nylon lock nut on the screw. It doesn't need to be tightened yet – we just want it there to keep the screw from falling out the bottom.

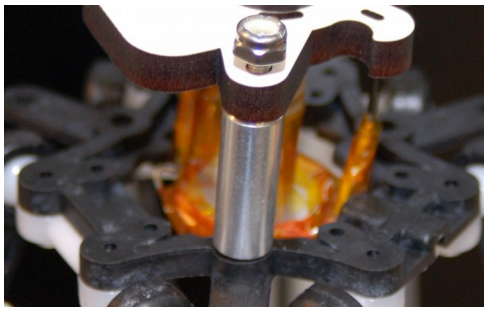


Fig. 13.1-2: First of three done.

Repeat that process for the other two screws & standoffs. Tighten it down with a 5/16” wrench when you're done.

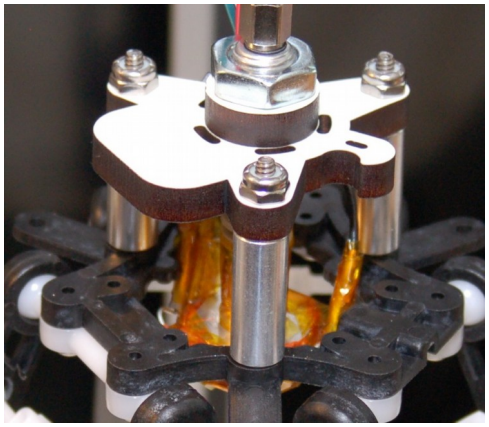


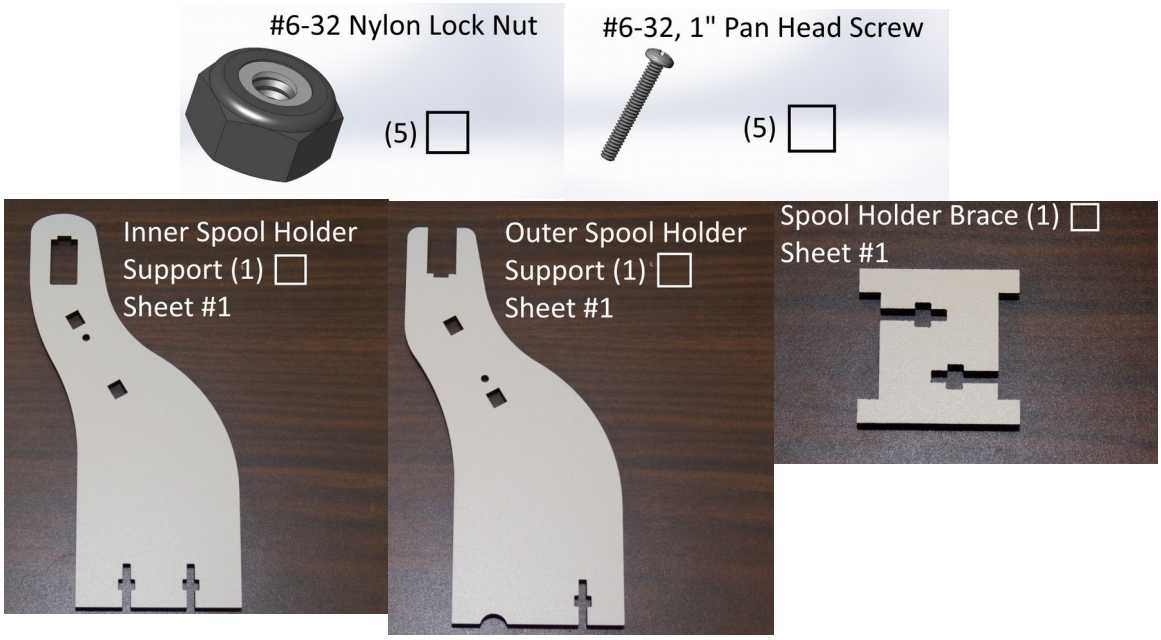
Fig. 13.1-3: Completed hot end mount.

Checkpoint Video #17

14 – Finishing the Top End

14.1 – Installing the Spool Holder

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



The first step is going to be installing two #6-32 nylon lock nuts into the spool holder brace as shown in Fig. 14.1-1.

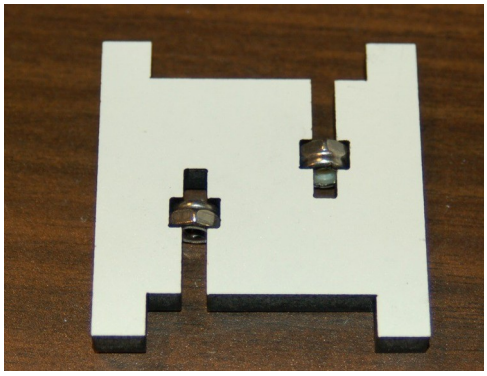


Fig. 14.1-1: Spool holder brace done.

Now install the brace into the inner spool holder support. Make sure you've got the support oriented as I show in the photo. Use a #6-32, 1” pan head screw to fix it in place.

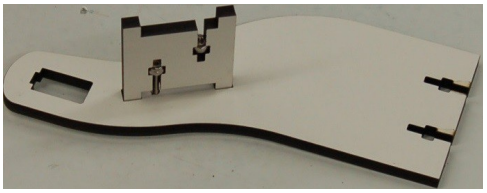


Fig. 14.1-2: Brace installed.

Now attach the outer spool holder support to the brace using a #6-32, 1” pan head screw as shown to the right.

Flip over the assembled spool holder and insert three #6-32 nylon lock nuts into the nut capture pockets.

Fig. 14.1-3: Nuts installed.

Fig. 14.1-4: Assembled spool holder support.

The spool holder support is attached to the printer's top plate using the three holes highlighted below.

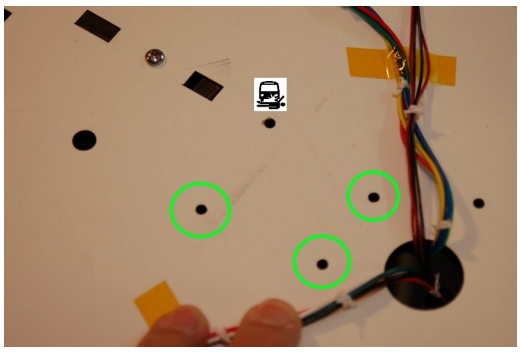


Fig. 14.1-5: Three mounting holes and JJ's Bus.

Set the spool holder support on top of the machine and fix in place using three 1”, #6-32 pan head screws.

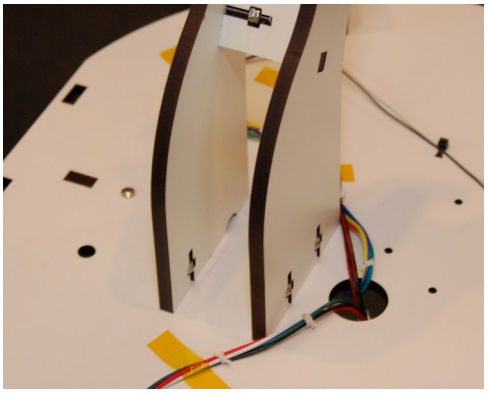
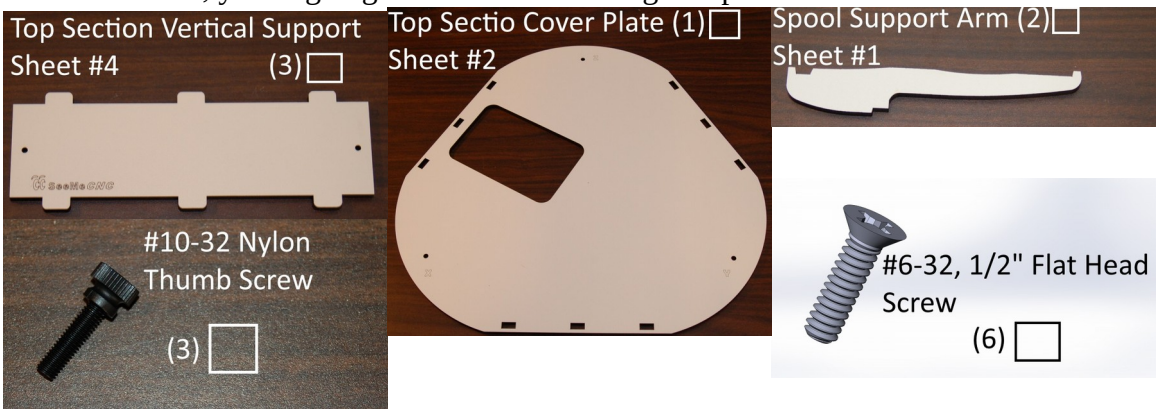


Fig. 14.1-6: Spool holder support mounted.

14.2 – Installing the Top Plate and Spool Support Arm

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



Before we can install the top section vertical supports, we'll need to install two #6-32, 1/2” flat head screws in each one. They need to be installed on the inside face (opposite of the SeeMeCNC logo engraving).

Remember that you only want to drive the screw in until the tip of the screw is flush with the outside face of the part, just like you did on the vertical supports in the base.

Now you can insert each one of the vertical supports on each “side” of the top. The tolerance for the tabs is VERY tight. If you're unable to get the tabs to seat properly, you can use a “squeeze” clamp to help fit the vertical support into place. Take care not to blow out the slots in the top though!

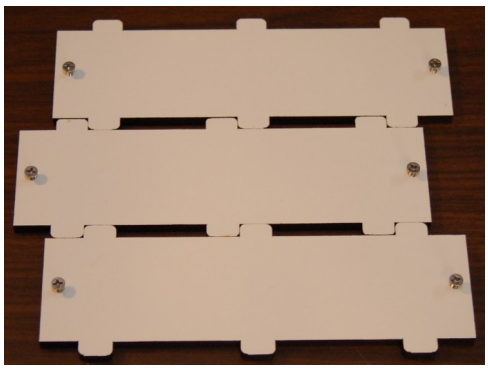


Fig. 14.2-1: Screws installed.

You should set the machine on the floor for these tasks – it'll make it them LOT easier to do!

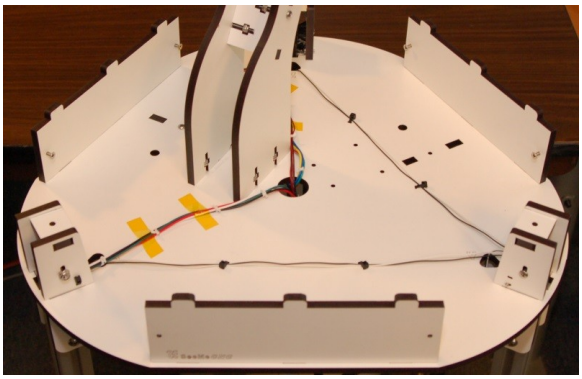


Fig. 14.2-2: Supports installed.

Install the top by aligning it as shown in Fig. 14.2-3 and fitting the tabs from the three vertical supports into the slots in the top. Work your way around the perimeter, doing a bit at a time until it's fully seated. When you've got the top fully seated, install a #10-32 nylon thumbscrew in the three mounting holes at the “corners” of the top.

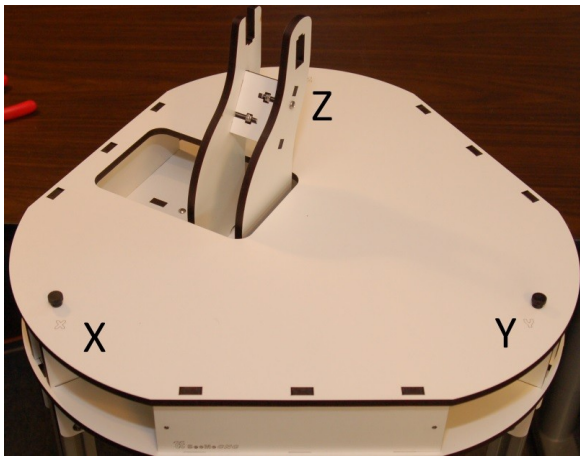


Fig. 14.2-3: Top on!

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.

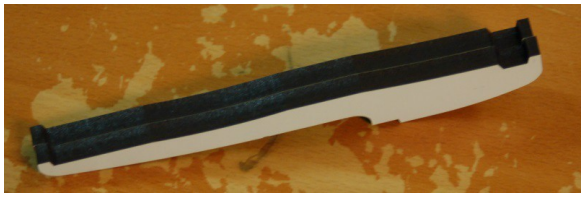


Fig. 14.2-4: Arms together now!

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

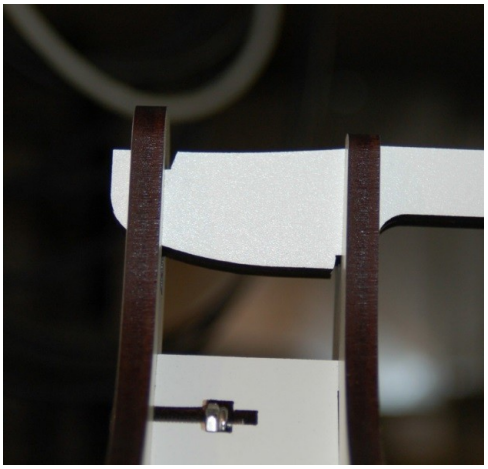


Fig. 14.2-5:Not your arms.

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

TA DA!

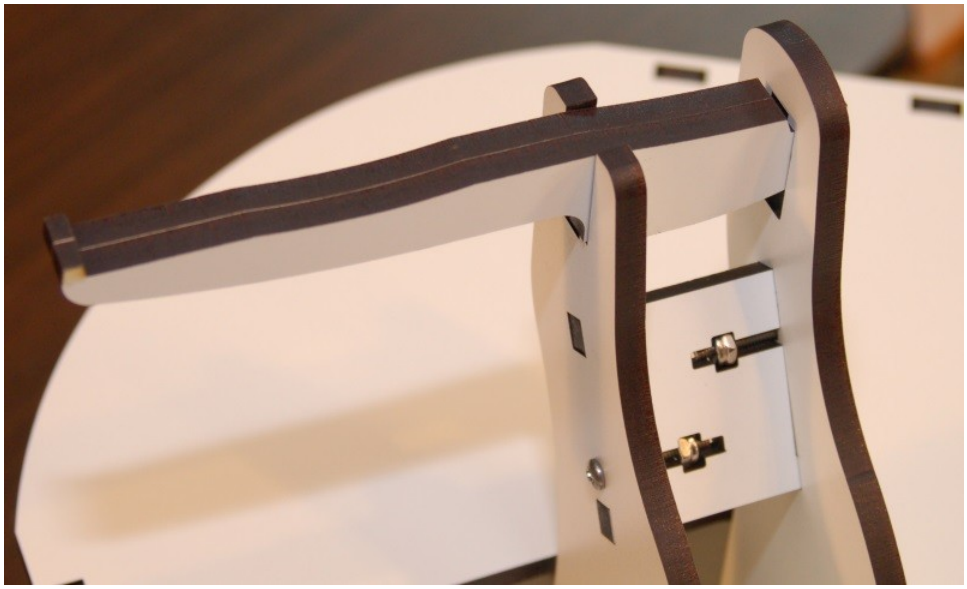


Fig. 14.2-6:Yer done.

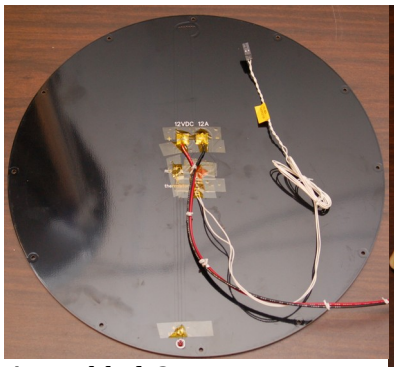
Okay, so I lied. You're not done yet. You're *almost* done.

Checkpoint Video #18

Checkpoint Video #19

15 – Installing the Onyx Heated Bed

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



Assembled Onyx

Onyx screw & spacer pack

The first thing you'll need to do is move the carriages into their normal operating position. To do this simply slide each carriage up to the top, one at a time.

Note that you'll want to move the carriages to the bottom when you're transporting your Rostock MAX v2. That will help ensure that the nozzle doesn't strike the heated bed during transport.

When you've got the arms moved, grab the assembled Onyx and the bed support. Route the two 18ga power wires and the thermistor leads through the center of the bed support, then thread them through the hole in the top of the machine base as shown.

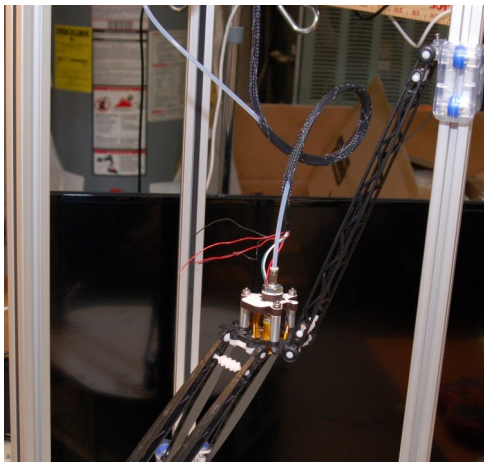


Fig. 15.1-1: Moving the arms up.

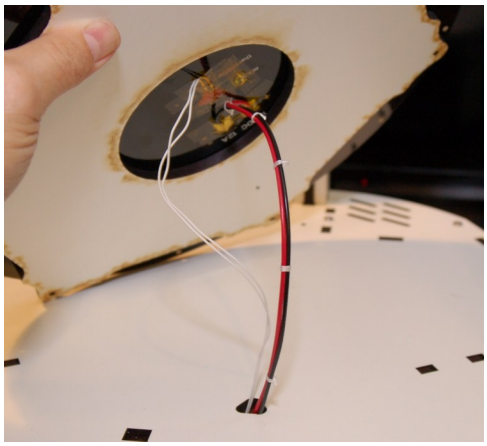


Fig. 15.1-2: Routing the wiring.

Now rotate the bed support such that the two notches in the “front” of the support is pointed towards the front of the machine. The notches allow the Onyx power LED to clear the support.

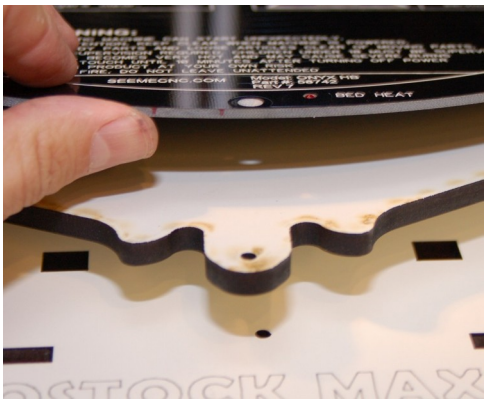


Fig. 15.1-3: Bed support aligned.

Get a #4 flat head screw and a spacer from the Onyx parts pack. Insert the screw through the Onyx, the bed support and finally the plastic spacer.

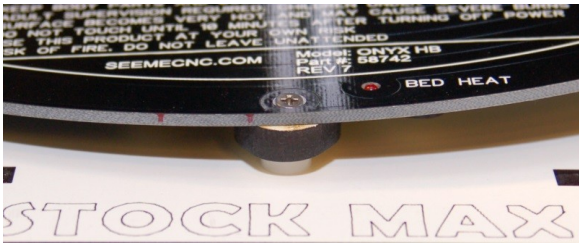


Fig. 15.1-4: First screw.

Turn the screw just enough that it grips the first threads in the t-nut that you installed when you built the base. The idea here is to keep the whole assembly from moving around while you finish the installation. Now you can install the remaining 5 remaining screws & spacers. What I do is work in a counter-clockwise direction around the Onyx. I set a screw and then slide a spacer under it with the tip of a small screwdriver until the screw falls through the spacer. You can then tighten the screw a little bit before moving on to the next screw. After you've got all the screws started, tighten them in the order shown below.

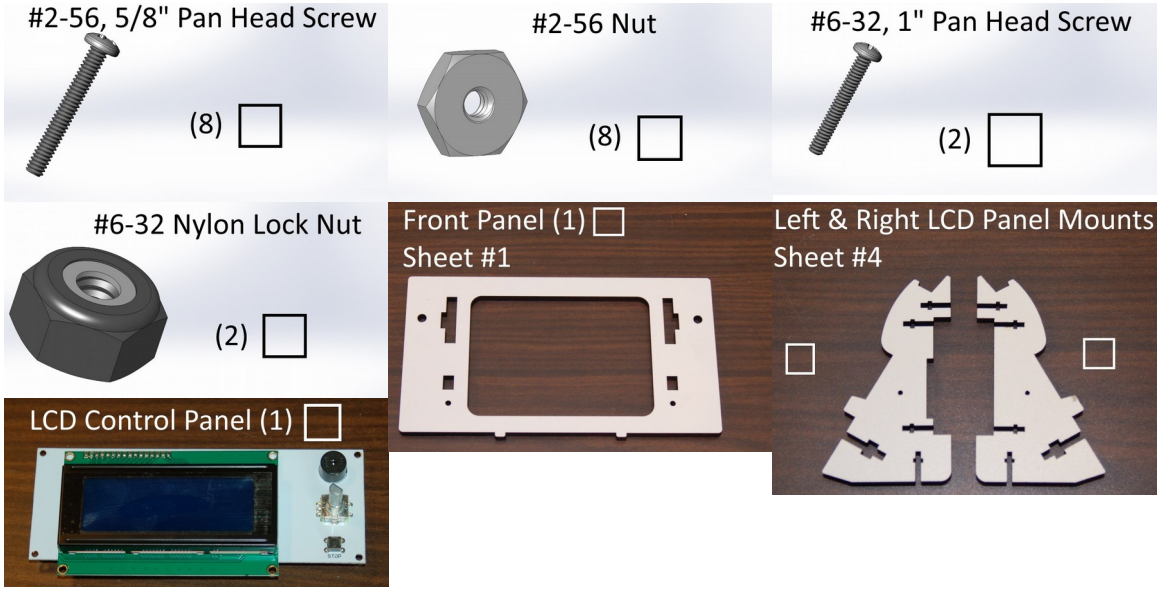
Fig 15.1-5: Screw tightening pattern.

Finally, carefully remove the little tab of Kapton tape you covered the center thermistor hole with. You want to remove it slowly so you don't pull the RTV out of the hole.

Checkpoint Video #20

16 – Assembling & Installing the LCD Panel Mount

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



The LCD control panel can be found wrapped in bubble wrap, inside the clear plastic box marked, “LCD Controller”.

16.1 – 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.

Keep in mind that the panel mounts come as left and a right part. The left side has a notch cut out to accommodate the SD card reader socket in the LCD panel itself. This notch is highlighted in green in Fig. 16.1-1.

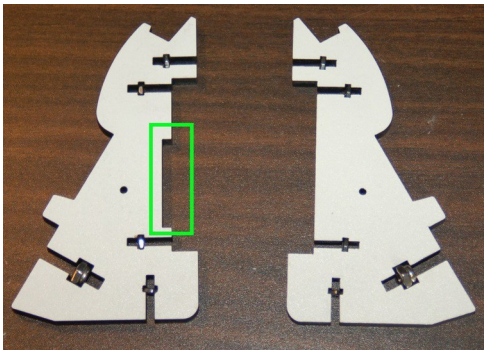


Fig. 16.1-1: NGIF! (Nuts Go In First)

04May16 – Note that your LCD panel may have a red or blue circuit board instead of a white one. The color change simply indicates the unit came from a different supplier. It will be installed the same as the white PCB version shown here.

Start with the left side first – the narrow end of the support fits into the front panel as shown below. Make sure that you've got the front panel oriented properly – the tab pointed to by the arrow should be pointing down when the front panel his held vertically.

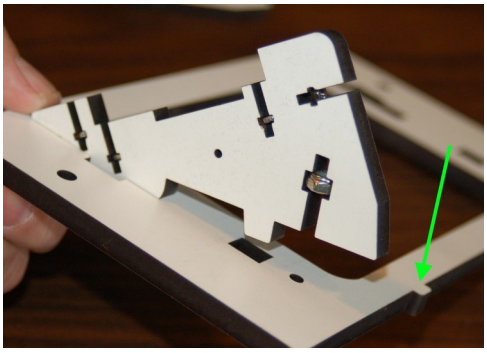


Fig. 16.1-2: Installing the left side.

Press the tab into place until the mount is flush with the face of the front panel as shown. Fix in place with a #6-32 pan head screw.

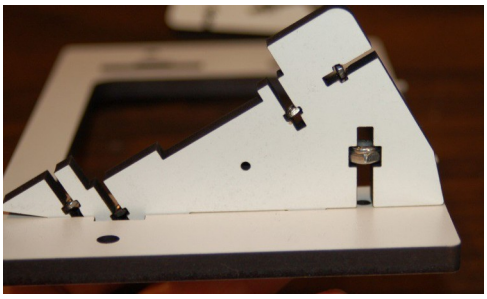


Fig. 16.1-3: Left side ready for a screw.

Now install the right side and fix it in place with another #6-32 pan head screw.

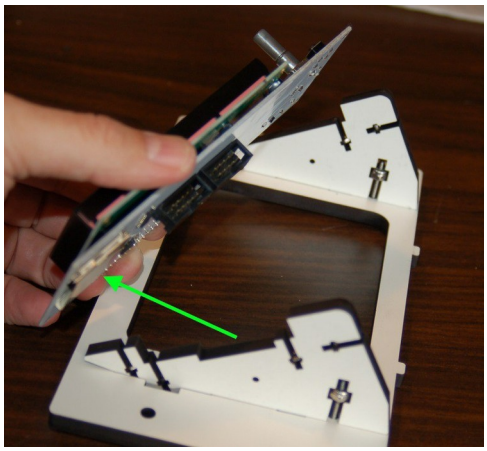


Fig. 16.1-4: LCD panel orientation.

Now you can attach the LCD control panel to the mounts. Orient the LCD panel as shown so that the SD card socket matches the notch for it.

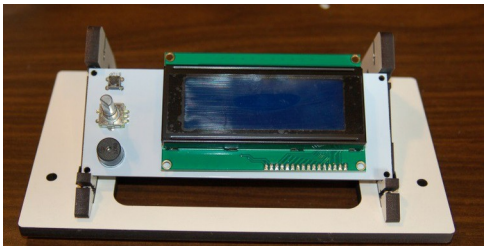


Fig. 16.1-5: Ready for screws!

Attach the LCD panel to the mount using four #2-56, 5/8” screws.

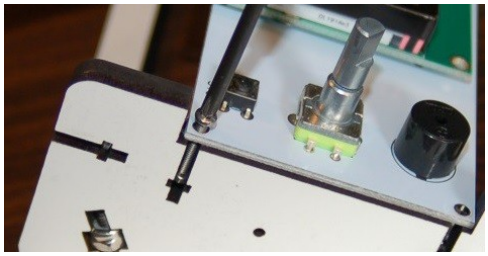


Fig. 16.1-6: Right side.

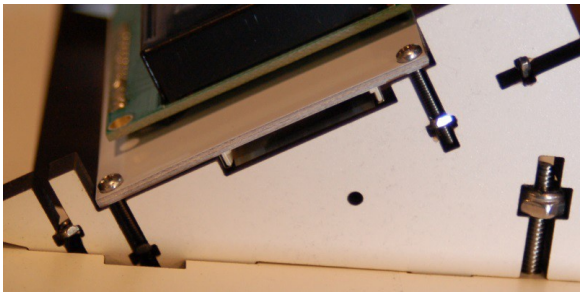
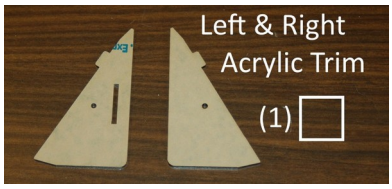
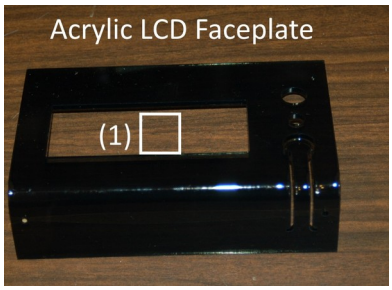


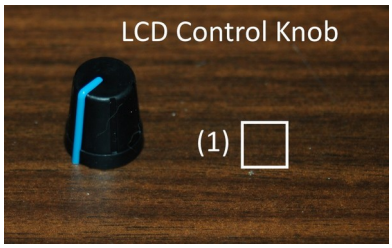
Fig. 16.1-7: Left side done.

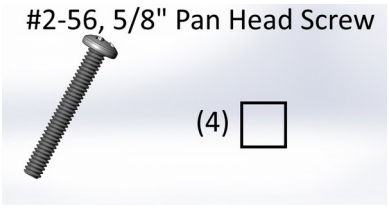
16.2 – Installing the LCD Trim Panels

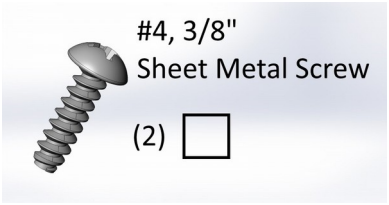
For this step, you'll need the following components:











Start by peeling the protective cover paper off the left & right acrylic side trim.

Install the left trim piece using a #4, 3/8” sheet metal screw as shown below.

Install the trim on the right side in the same manner as the left.

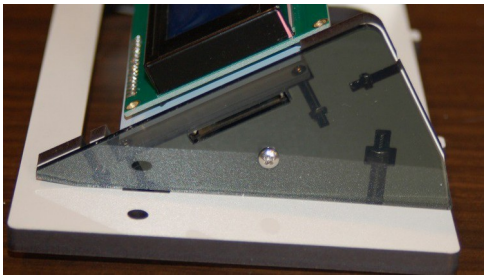


Fig. 16.2-1: Left side trim installed.

Set the acrylic face plate over the LCD (it should clear easily) and install two #2-56, 5/8” screws at the locations shown below. Do not tighten the screws all the way – leave them a few turns loose.

Fig. 16.2-2: Bottom faceplate screws.

Next, install two more of the #2-56, 5/8” screws at the top front of the faceplate and tighten.

Tighten the lower screws at this time. Install the knob last.

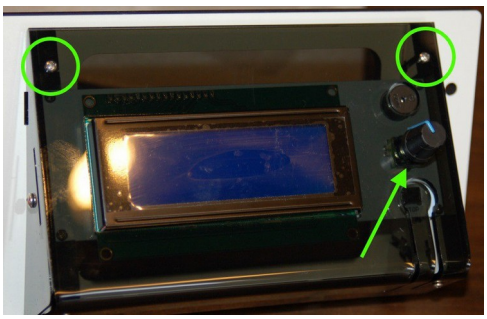


Fig. 16.2-3: Completed LCD panel.

Flip the LCD control panel over and mark the EXP1 and EXP2 connector positions as shown below. Use a Sharpie or other permanent marker.

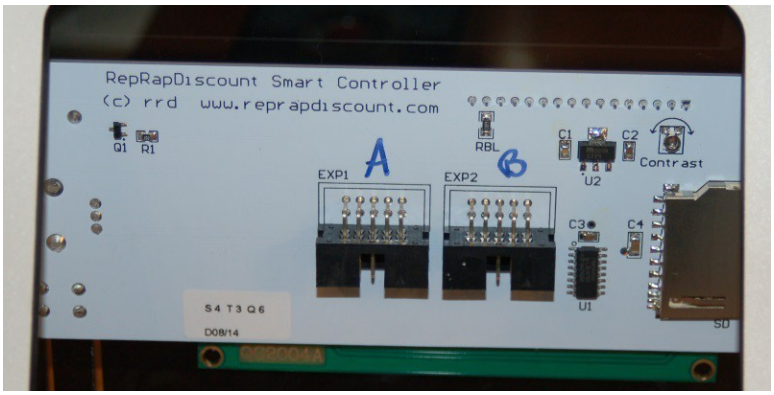


Fig. 16.2-4: Marked interface cable positions.

Put your newly completed LCD controller in a safe place – we'll get back to it soon enough.

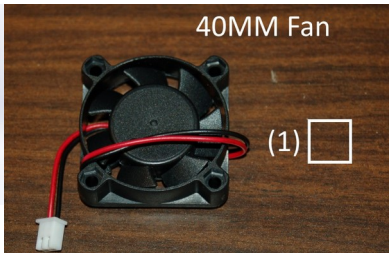
You should congratulate yourself at this point – the mechanical assembly of your Rostock MAX v2 kit is complete. Wander off and enjoy $ADULT_INTOXICANT, kick back and relax for a while. Next on the agenda is the electronics!

Checkpoint Video #21

17 – Installing & Connecting the RAMBo Controller

17.1 – Preparing the RAMBo Mounting Plate

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



You'll also need two short wire ties in order to attach the fan to the back of the RAMBo mounting plate.

Let's get the 40mm fan attached. Lay the mounting plate on your work surface so that the opening for the fan is on the left edge. Set the 40mm fan over the opening with the blades facing you.

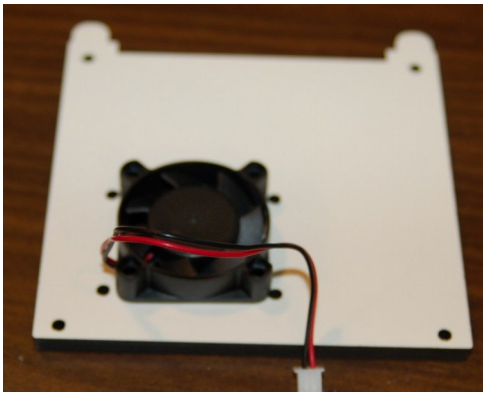


Fig. 17.1-1: Fan installation location

Fix the fan in place with two wire ties. First, attach the lower left corner as shown. Try not to capture the power wires when you close the wire tie. :)

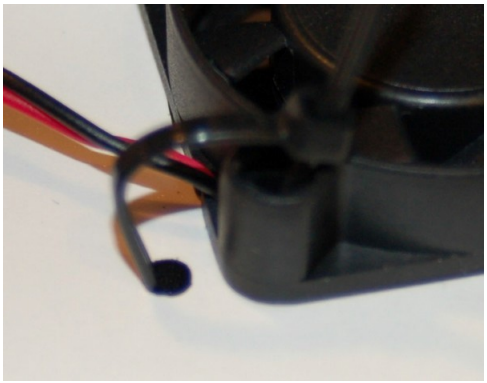


Fig. 17.1-2: Wire tie installed.

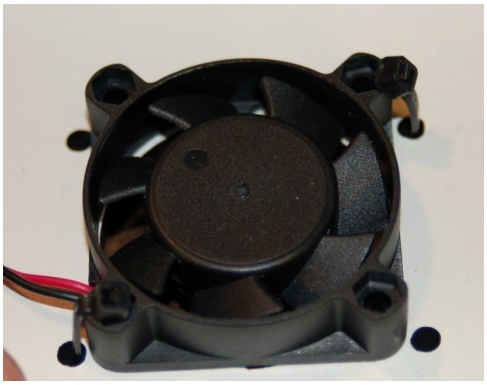


Fig. 17.1-3: Fan installed.

Install the second wire tie in the upper right mounting hole as shown.

Next, install a #4-40 T-Nut into the four corner holes in the RAMBo mount.

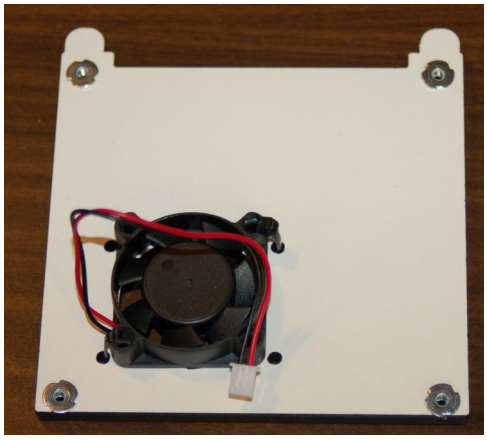
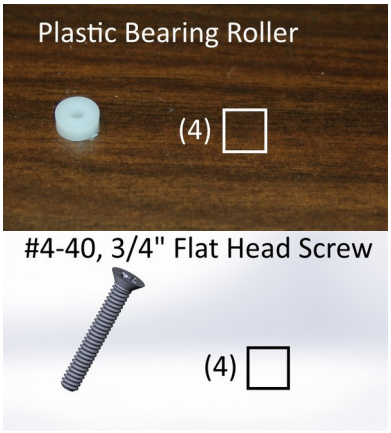
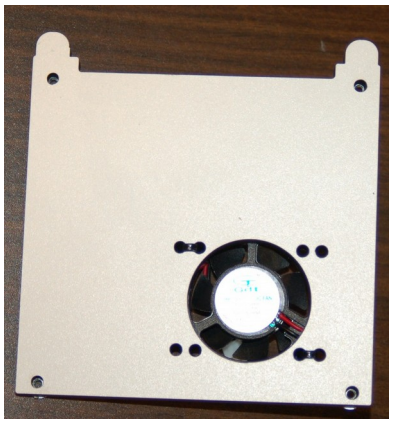


Fig. 17.1-4: Completed RAMBo mount.

17.2 – Mounting the RAMBo Controller

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





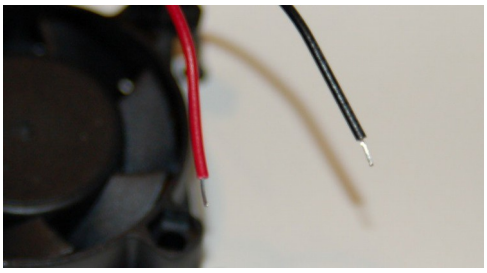


Fig. 17.2-1: Fan leads stripped.

The first thing you'll need to do is get the 40mm fan wires soldered to the RAMBo controller. Start by cutting off the connector at the end of the fan leads and strip off about 1/8” of insulation.

Get your soldering iron heating and insert the ends of the fan wires into the two solder pads on the bottom right hand corner of the RAMBo controller as shown.

Make sure that you install the wires as shown – the red wire needs to be in the pad marked with the "+" next to it. If you install it the other way, the fan may run in reverse and won't cool the MOSFET chips on the RAMBo very well. (The MOSFET chips are those little black squares in the photo in Fig. 17.2-2.)

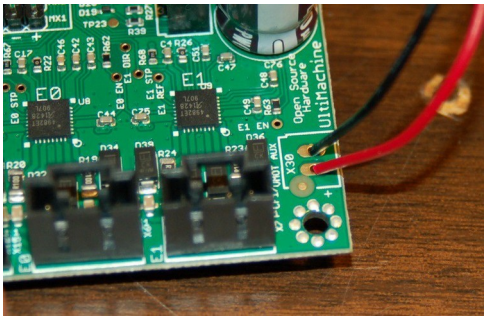


Fig. 17.2-2: Fan wire installation location.

Hold or tape the wires into place and flip the RAMBo controller upside down so you can reach the solder pads on the back side of the board. Solder the leads in place.

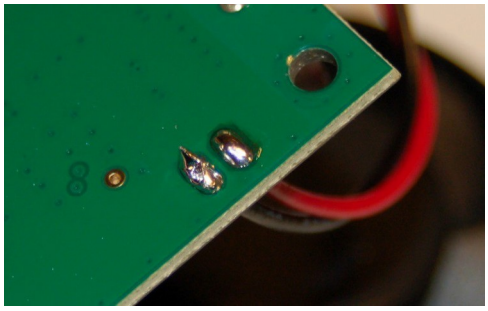


Fig. 17.2-3: Fan wires soldered in.

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. 17.2-4. Insert a #4-40, 3/4" flat head screw in the hole and tighten a few turns.

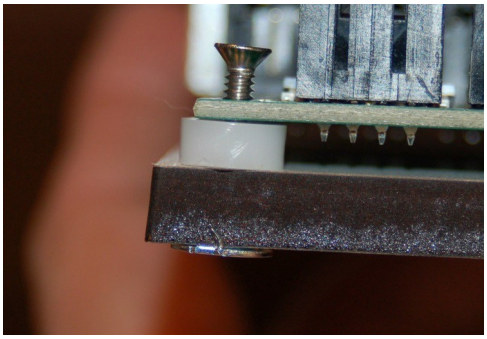


Fig. 17.2-4: Same idea, different screw.

When you've got all four screws started, go ahead and tighten them all down. Take care to not over tighten them or you'll damage the circuit board!

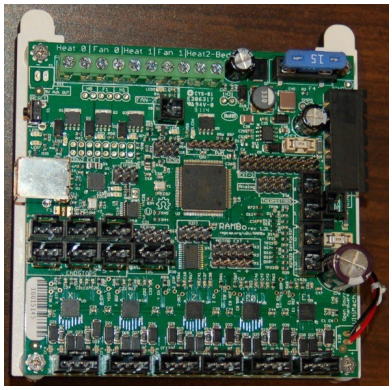
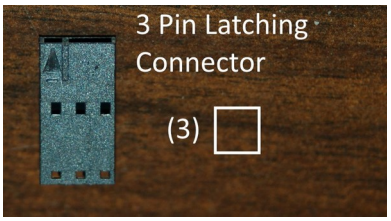


Fig. 17.2-5: Completed installation.

17.3 – Wire Prep: End Stops

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



The 3 pin latching connectors can be found inside the RAMBo parts baggie (marked “RAMBo v1.3 Kit” or similar).

The end stop wires came with female crimp connectors already attached. Each connector has a tiny little metal tab that points slightly away from the connector itself. This metal tab engages a little hole in the middle of each connector position on the 3 pin latching connector shell.

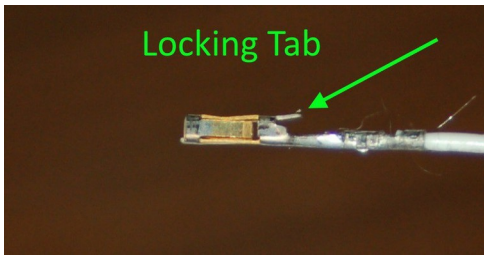


Fig. 17.3-1: Female crimp connector.

Insert the white wire from the X axis end stop into the pin #1 position on the connector as shown. Make sure that the locking tab is oriented in line with the locking tab retaining hole. You'll hear a soft “click” sound when the tab engages the hole. At that point, the connector is fully seated.

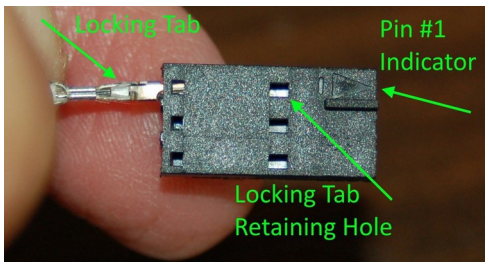


Fig. 17.3-2: Setting the first connection.

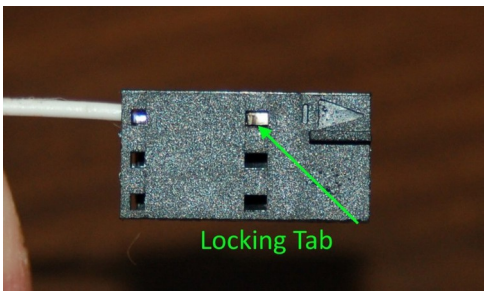


Fig. 17.3-3: Connector fully seated.

Insert the black wire from the X axis end stop into the second position, right below the first. Repeat this task for the Y and Z axis end stops.

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

Fig. 17.3-4: Finished end-stop wiring.

17.4 – Wire Prep: The Hot End Thermistor Connector

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

Thermistor leads.

The thermistor leads can be found inside RAMBo parts baggie (marked “RAMBo v1.3 Kit” or similar).

The first thing you'll need to do is trim the hot end thermistor and hot end power wires to their working length. You want about 8” of wire as measured from the front edge of the machine, as routed through the front vertical support.

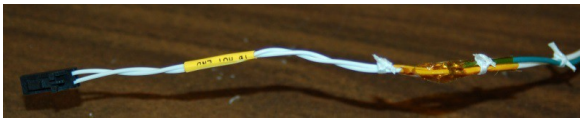
Unwrap the thermistor leads you got from the RAMBo box and cut them so you've got about 3” of wire after the 2 pin connector.

Fig. 17.4-1: Thermistor leads cut to length.

Solder the shortened thermistor leads to the 18ga white & green wires. Use the same splicing technique you used when working on the EZStruder stepper motor.

Note that if you have the white, 26ga “A” wires, you'll solder <u>those</u> to the thermistor connector instead of the 18ga white & green.

When you're done, cover the solder joints with Kapton tape and label the leads, “T0 HOT END THERMISTOR” (That's a “T” followed by a zero.)



*Thermistor leads finished & labeled. (“**B**” wire shown.)*

17.5 – Wire Prep: The Heated End Thermistor Connector

The Onyx heated bed wiring doesn't require a connector to be added, but you should label the wire and loop up the extra. Label the end of the wire “T2 BED THERMISTOR” I'm using a Brady IDPal label tool for my wiring, but a bit of masking tape does the same job. :)

You'll want to loop up and tie the extra thermistor lead as shown.

Fig. 17.5-1: Looped & labeled!

17.6 – Wire Prep: Extruder Motor Connector

For this task, you'll need the wiring and connector that you cut off the extruder stepper motor back in Section 10.

Solder the “tail” to the extruder motor wires that are coming out of the Z axis tower and cover the soldered joints with Kapton. Make sure you follow the wiring diagram shown in Table 10-1 in Section 10.

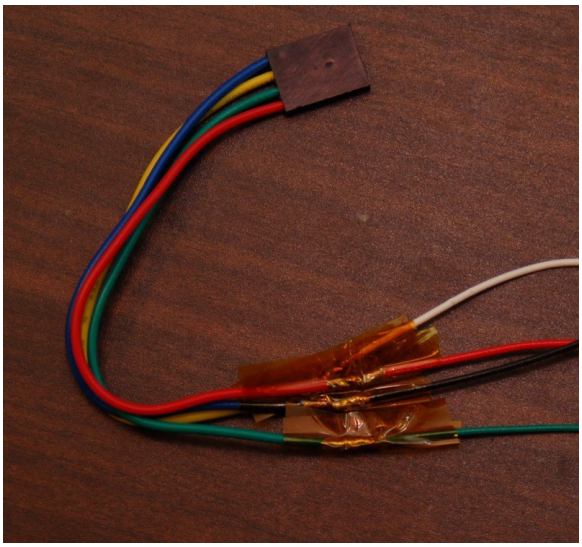


Fig. 17.6-1: Extruder stepper connector soldered on.

17.7 – Wiring the RAMBo Controller – Terminal Block

Note that all wiring should be brought through the center opening in the front (between the X and Y axes) 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. ***DO NOT, UNDER ANY CIRCUMSTANCES “TIN” THE LEADS GOING INTO THE TERMINAL BLOCKS! DOING SO CAN CREATE AN INTERMITTENT OR HIGH-RESISTANCE CONNECTION THAT COULD BECOME A FIRE HAZARD!***

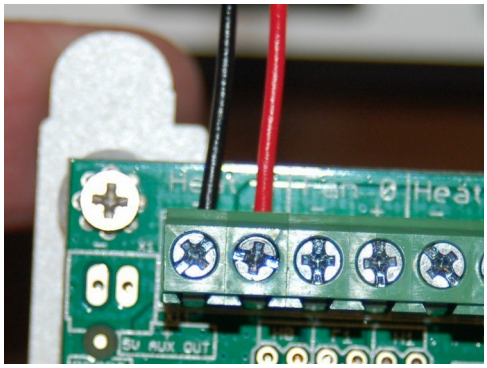


Fig. 17.7-1: Hot end wires installed.

The next pair of wires to be installed are the layer fan wires. These are the black & red, 26ga wires that do *not* have the knot tied in them. The layer fan wires should be inserted into the terminal block position marked “**Fan 0**”. Strip 1/4” of insulation off them and install them. You might want to label this pair “**Layer Fan**” so that you can readily tell them apart from the peek fan wires that you'll install next.

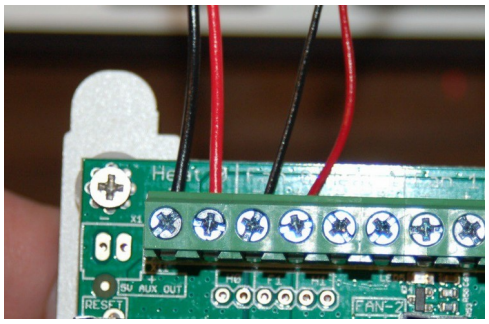


Fig. 17.7-2: Layer fan wires installed.

Next up is – yep, the PEEK fan wires. This is the pair of 26ga wires *with* the knot in them. The PEEK fan wires are installed in the terminal block at the location marked “**Heat 1**”. You may want to label this wire pair, “**PEEK Fan**” before you install them.

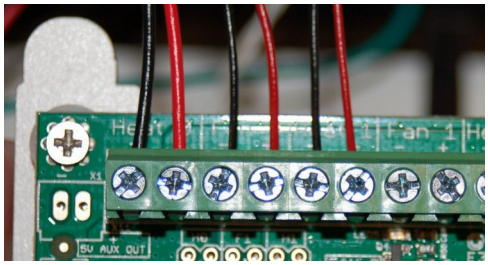


Fig. 16-27: PEEK fan wires installed.

A quick note about the PEEK fan wiring. The firmware used on the RAMBo is configured to use a single hot end. Because of this, the **Heat 1** terminal block position will automatically turn on the PEEK fan when the hot end is first heated and will automatically turn off when the hot end temperature falls below 50C. At some point in the future, you may want to install a second hot end. If you do this, you'll need to modify the firmware so you can use the **Heat 1** output for a hot end and the **Fan 1** output for one or more PEEK fans.

The last terminal connection you're going to make is for the Onyx heated bed. Like you did with the other wiring, strip 1/4" off the wires. Insert the heated bed wires into the terminal block at the position marked "**Heat2-Bed**" as shown below in Fig. 17.7-4.

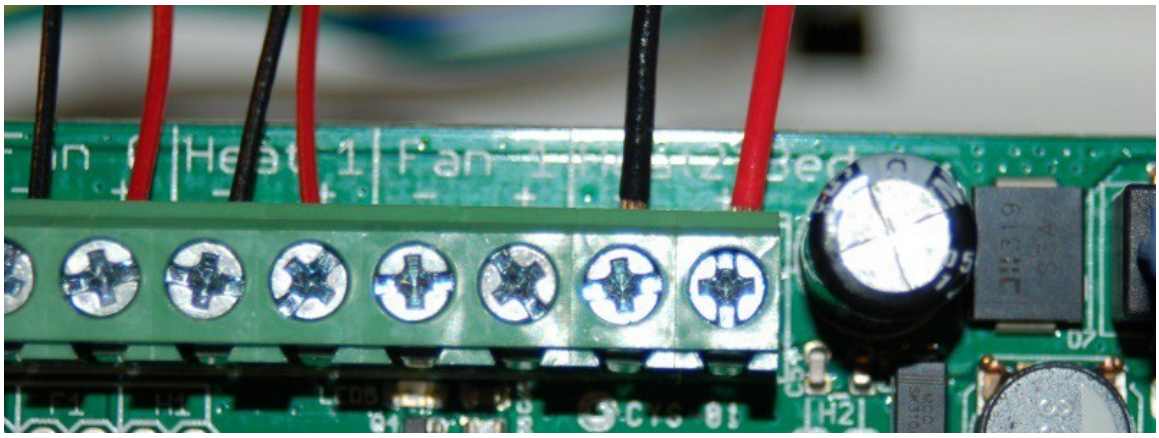


Fig. 17.7-4: Heated bed wires installed.

Warning: Improperly installed heated bed wiring can do catastrophic damage to the RAMBo board. Please make sure that the heated bed wires are fully seated and tightened down in the compression terminal.

So what's all the hubub, bub?[*] It's been discovered that folks are not properly installing the wiring into the compression terminals for the heated bed. There's either not enough wire in the terminal, it's not tightened enough, the terminal wasn't opened (loosened) before inserting, etc. Any one of these can cause a poor connection to the terminal. Poor connections equal high resistance and high resistance equals heat. A LOT of heat.

This kind of damage pretty much boils down to user error and SeeMeCNC will charge a $25 fee to repair the board.

Gaah! It burns!!!

* https://youtu.be/71NbODPietg

17.8 – Plugging cabling into the RAMBo

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 get the end stop wires plugged in.

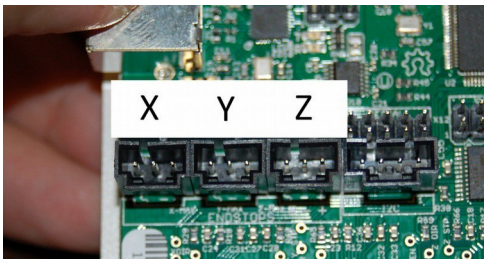


Fig. 17.8-1: End stop connector plugs.

Insert each of the three end-stop connectors into the sockets shown in Fig. 17.8-1. I've labeled each position in as the board silk screen can be difficult to read due to its small size.

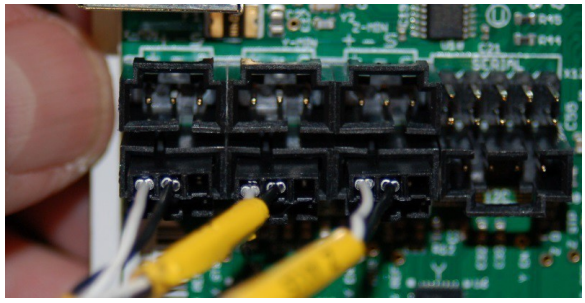


Fig. 17.8-2: End stops plugged in.

Now you can install the thermistor connectors. Remember how I had you label the thermistor leads with "**T0**" and "**T2**"? Well there was a method to that particular madness. The thermistor positions on the RAMBo are marked T0 through T3. By labeling them ahead of time, it eliminates any confusion about which is which and you won't have to refer to the manual to see who does what. :)

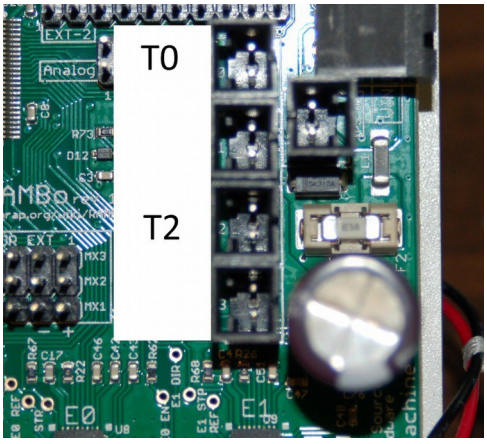


Fig. 17.8-3: Thermistor connectors.

I've marked the T0 and T2 positions for you, so go ahead and get the thermistors plugged in!

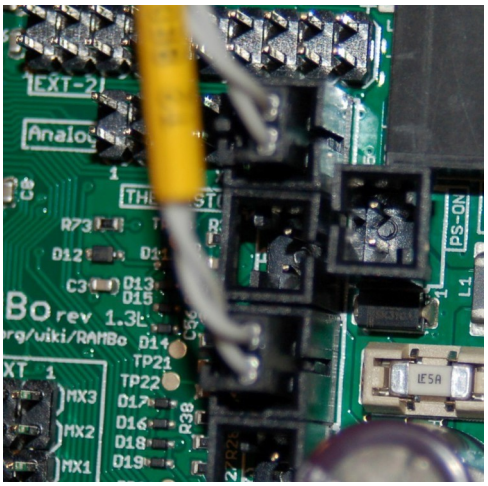


Fig. 17.8-4: Thermistors plugged in.

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 connects to.

You'll notice I've marked one of the connectors with a double red "X". This is because this connector is for an extra Z axis. Delta configuration printers don't require this – I pointed it out to ensure you didn't accidentally plug the extruder into it...like I did. ***ahem***

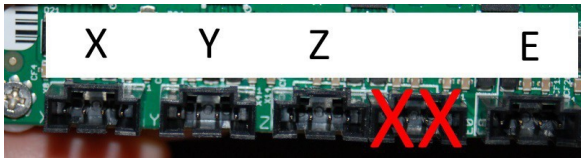


Fig. 17.8-5: Stepper motor connectors.

Just a quick note on the stepper motor connectors. The connectors you see in Fig. 17.8-6 are 4 pin latching connectors. That means they've got a little locking tab that positively engages a little ledge on the inside of the socket that's on the RAMBo. The motors provided do not use this locking feature, so you need to make sure you insert the connector with the proper pin #1 orientation.

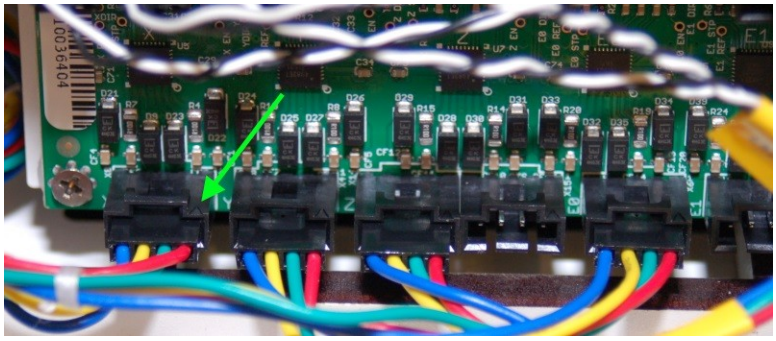


Fig. 17.8-6: Stepper motors plugged in.

In Fig. 17.8-6, I indicate the pin #1 position with a green arrow. If you look closely at the image, you'll see a small arrow point on the connector body itself. The stepper motor connector also has a little arrow that indicates where pin #1 is. Match these when you plug in the stepper motors.

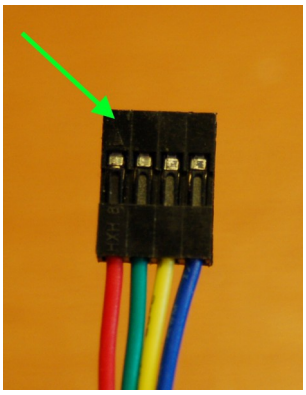


Fig. 17.8.-7 Pin #1.

Finally, you'll need to plug the big power connector into the side of the RAMBo as shown on the right.

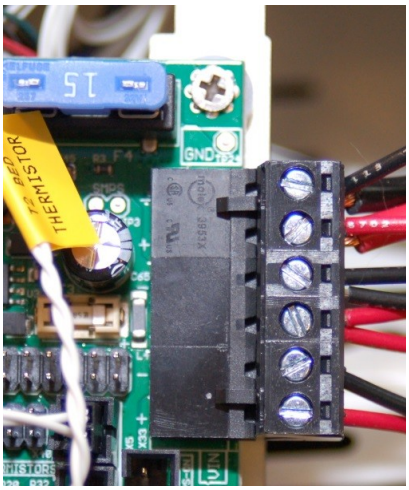


Fig. 17.8-8: Power connector attached.

17.9 – Installing the RAMBo Into The Machine Base

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 when you were building the base.

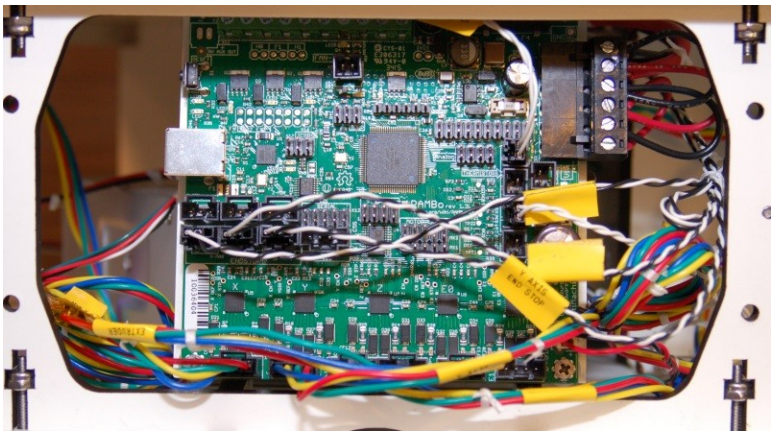


Fig. 17.9-1: RAMBo installed!

Fig. 17.9-2: Right slot.

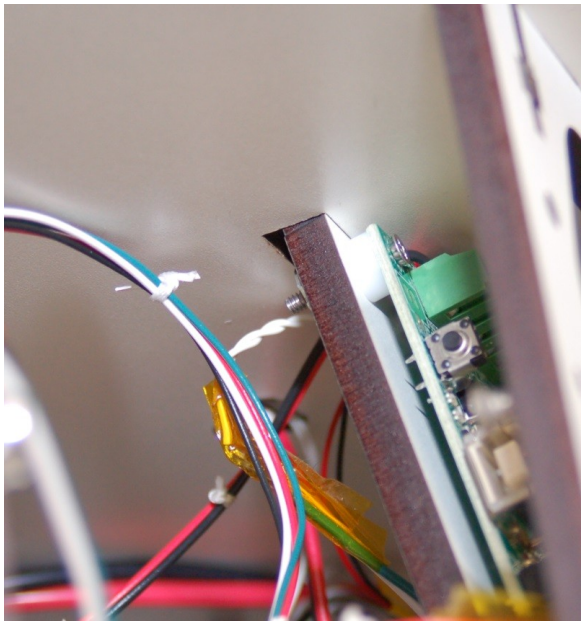


Fig. 17.9-3: Left slot.

Once you've got the two tabs on the top of the RAMBo mounting plate fitted into the two slots, you can lift up and the mount will slide into place along the two support legs. The X, Y and Z stepper motor wires can be routed directly under the board – there *is* room. Take care to not pinch a wire between the bottom of the RAMBo mount and one of the support legs. The extruder stepper wire can be routed to the right if you don't want to run it under the board.

17.10 – Installing the Power Switch and LCD Controller Cables

In the plastic box the LCD panel came in, you'll find two gray, flat ribbon cables and a small circuit board marked “RAMBo to SmartController adapter”. These cables connect the LCD to the RAMBo controller via the LCD interface board.

Label the adapter board's two 10 pin connectors as “A” and “B” as shown below.

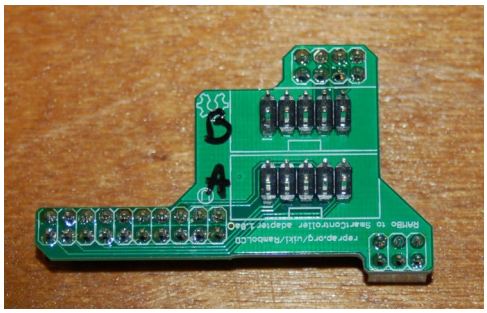


Fig. 17.10-1: Adapter labeled.

Next, label the two cables with “A” on both ends of one and “B” on both ends of the other.

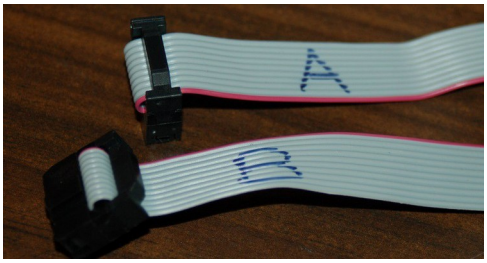


Fig. 17.10-2: Cables labeled.

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

Make sure that you've got the cables inserted on to the headers *exactly* as shown – you want the red line (pin 1) on each cable next to the labels you wrote, just like it shows in Fig. 17.10-3A (White PCB only)!

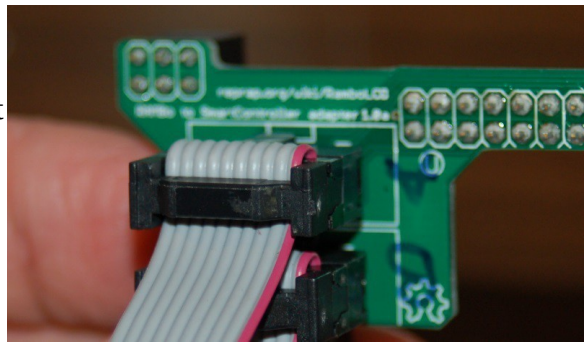


Fig. 17.10-3A: "A" & “B” cables installed (White PCB only!).

04May16 – Note that if your LCD panel has a red or blue PCB, it will connect to the interface board as shown in Figs. 17.10-3B and 17.10-3C.

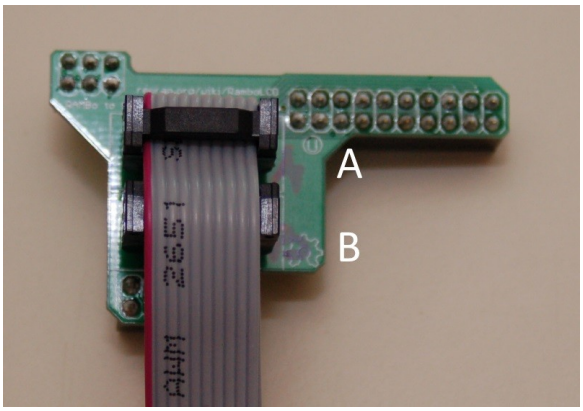


Fig. 17.10-3B: Red or Blue Display PCB cabling.

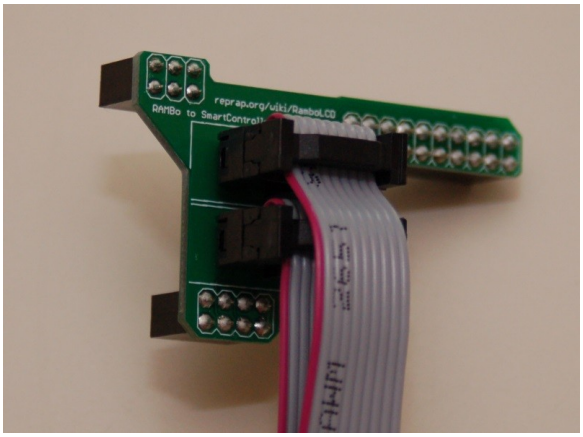


Fig. 17.10-3C: Red or Blue Display PCB cabling.

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

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.

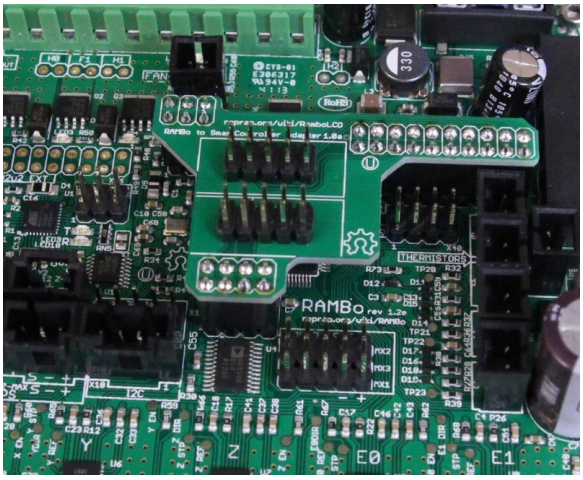


Fig. 17.10-4: LCD interface adapter installed.

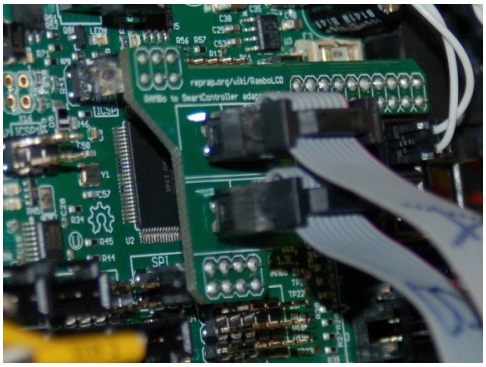


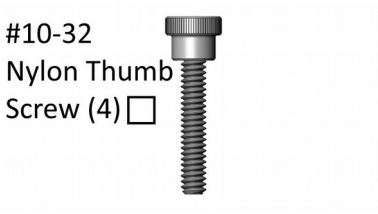
Fig. 17.10-5: Install complete!

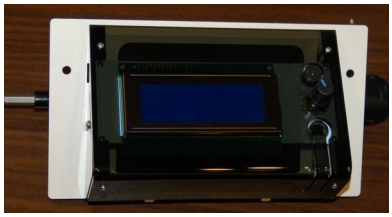
Checkpoint Video #22

18 – Final Assembly Tasks

18.1 – Attaching the Base Covers & LCD Panel

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





LCD Controller

Remember back when you built the base, I had you tap the two “top” holes in each vertical support? Now you get to use them! Install a side cover plate on the “left” side of the Rostock MAX v2 – between the X and Z axes. Use two #10-32 nylon thumbscrews to fix the cover in place.

Now install the “A” and “B” cables on to the back of the LCD controller in the locations you labeled when you first assembled it.

Fig. 18.1-1: Side cover plate installed.

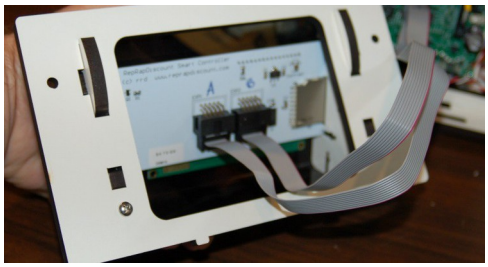


Fig. 18.1-2: LCD controller cables installed.

You'll notice two small tabs on the bottom edge of the LCD controller assembly. Those tabs fit a pair of slots in the center vertical support. Coil up the controller cables in the space at the bottom of the LCD controller and fit it to the front of the machine as shown.

Fig. 18.1-3: Installing the LCD panel.

Now tilt up the panel and fix it in place using two #10-32 nylon thumbscrews.

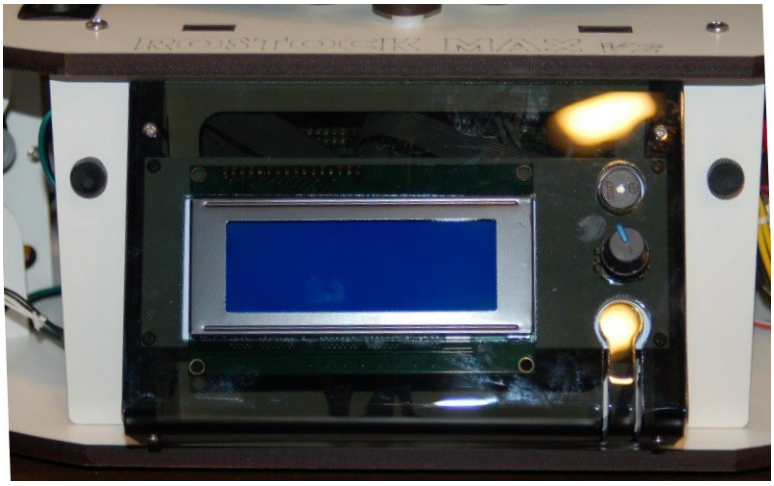


Fig: 18.1-4: LCD panel installed!

18.2 – Attaching the USB Cable

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

After you've got the USB cable installed, I want you to inspect all the wiring and belt paths to ensure that there's no interference between the wiring and the belts – make sure the belt paths are clear and no wiring is rubbing against a belt.

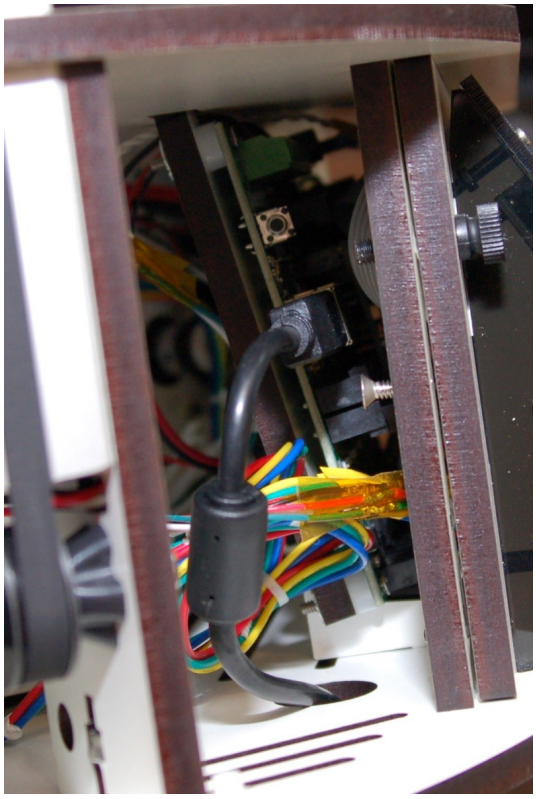
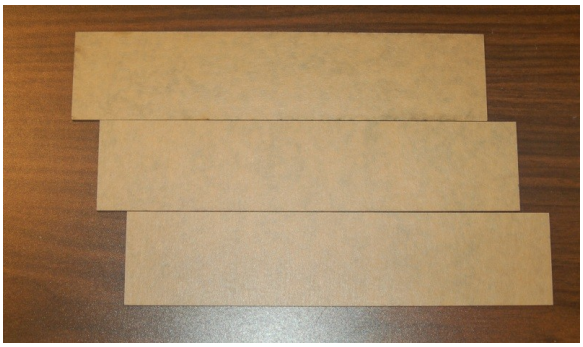


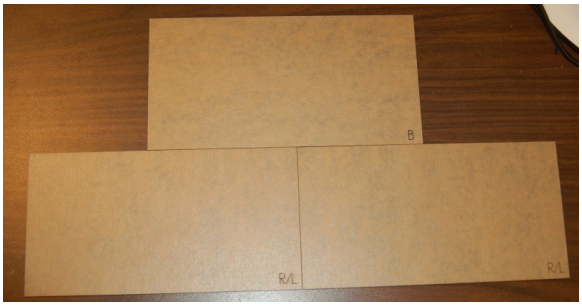
Fig. 18.2-1: USB cable installed.

18.3 – Installing the Acrylic Cover Panels

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



Top Acrylic Panels



Bottom Acrylic Panels

Both the top and bottom acrylic panels are covered with a paper protective covering. You'll need to peel this paper off before installing the panels.

We'll do the bottom first. Two of the bottom panels are marked “R/L” and are used to cover the X and Y axis spaces. The other panel is marked “B” and is used to cover the Z axis. Start with the Z axis. Insert the acrylic panel as shown – it will rest against the side of the #6-32 flat head screw you installed when building the base. Carefully bend the panel over the back of the Z axis tower and slide it into the open space on the right – it should come to rest on the #6-32 flat head screw on that side. The other retaining screw is indicated by the green arrow in Fig. 18.3-2. You'll want to make sure that the laser engraved “B” is facing inward so it can't be seen once the panel is installed.

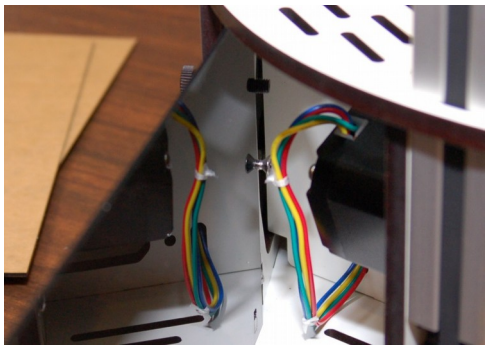


Fig. 18.3-1: Left retaining screw.

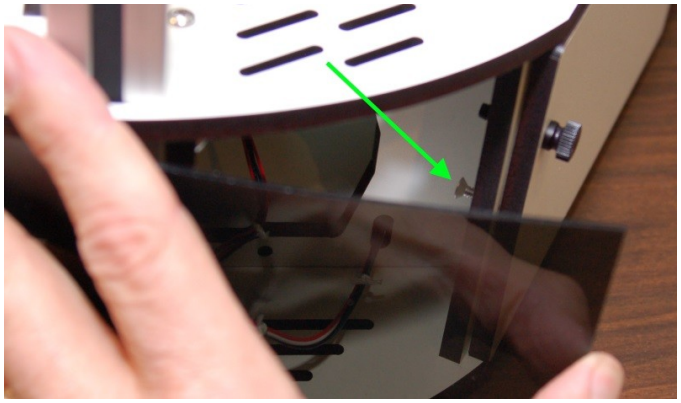


Fig. 18.3-2: Setting the Z axis cover into place.

Fig. 18.3-3: Z Axis cover installed.

Now install the “R/L” panels on the X and Y axes as shown below. Make sure you've got the laser engraved “R/L” marking facing inward so it can't be seen once installed.

The top acrylic covers are all the same size so you don't have to worry about which one goes where. Install all three in the same manner as you did the lower acrylic cover panels.

Fig. 18.3-4: Upper acrylic covers installed.

18.4 – Dem Feet...and the Borosilicate Glass Build Plate!

Hopefully you haven't lost the little rubber shoes for the feet, because you need to install them now. Each rubber shoe just presses on over the injection molded foot at each marked location.

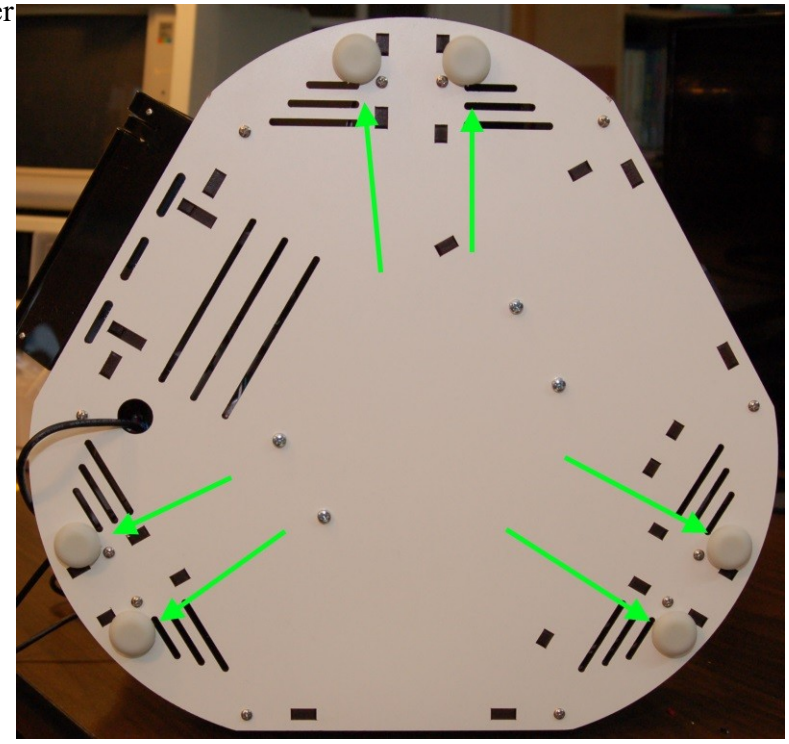


Fig. 18.4-1: Wrestle the feet away from the cat and install them.

For this task you're going to need the Borosilicate glass build plate. (But you knew this, right?)

Take the glass plate out of the protective shield and using a permanent marker, make a 1/4” wide mark on the edge of the glass.

Fig. 18.4-2: Glass edge marked.

The mark will give you a guide when replacing the Borosilicate glass build plate if you remove it for any reason. Even though the glass thickness is very consistent, tiny variations in the surface of the glass can introduce calibration issues if the glass isn't replaced in the exact spot it was when you first calibrated your printer. You may even want to make the mark a “T” to help ensure that you get it right side up when re-installing it.

I discovered this issue while working on Orange Menace (my original Rostock MAX v1) recently and thought it was important enough to let new builders know about the potential issue it could cause.

Carefully set the Borosilicate glass plate on top of the Onyx and rotate it so that the mark you put on the glass edge aligns with the center screw next to the bed heat LED as shown below.

Fig. 18.4-3: Glass alignment.

Now scare up the six document clips that were included in the kit and install them as shown.

(I bet the guy that invented those things is constantly amazed at their unintended uses!)

Fig. 18.4-4: Document clips installed.

18.5 – Smoke Test!

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 hear 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!

All we know is that he's called Walter "White" MAX!

At the beginning of this project, you'd probably questioned your sanity and your ability to get a 3D printer built from a box of funny smelling wooden parts and some bits of plastic and metal.

You need to appreciate what you've managed to accomplish here. You've not only built a pretty technical kit, but you've joined the ranks of many brilliant and distinguished people on the bleeding edge of 3D printing technology.

Kick back for a bit and relax. Have a beer or other drink of choice (Scotch!) and enjoy the moment. Congratulations on a job well done!

Hey! Put down that beer! We've got software to install!

(...AND ANOTHER MANUAL TO DOWNLOAD!)

Checkpoint Video #23

Rostock MAX v2 Calibration and User Guide