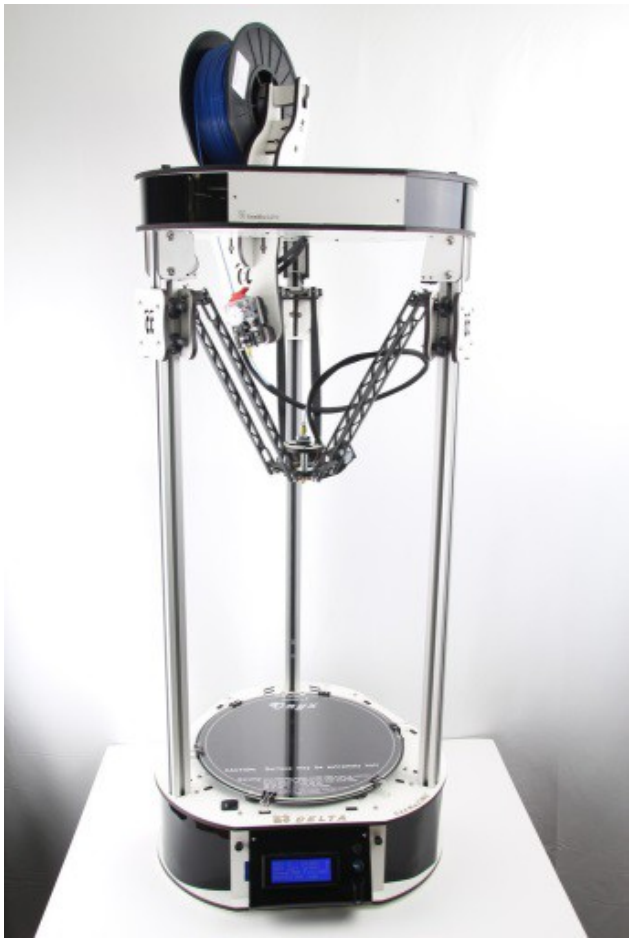
SeeMeCNC™
3D Printers & More

Welcome to the Assembly Guide for the Rostock MAX v2.0 3D printer.

Version .05, February 25th, 2014

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

Disclaimer text provided by LulzBot



READ ME FIRST!

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

Hazards and Warnings

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

Electric Shock Hazard

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

Burn Hazard

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

Fire Hazard

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

Pinch Hazard

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

Static Charge

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

Age Warning

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

Table of Contents

0 – Introduction and Acknowledgments

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

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

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

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

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

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

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

Acknowledgments

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

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

1 – Required and Optional Tools And Materials

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

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

- Wire strippers
- Wire cutters
- 5/16" open-ended wrench (Used primarily on the nuts that hold the Cheapskates together)
- 2 7/16" open end wrenches. (used to adjust Cheapskate Bearings)
- 11/16" open-ended wrench (used for hot-end mount)
- PermaTex Ultra Copper High Temp RTV
- A small razor knife like an X-Acto knife. This will be handy for cleaning the flashing off the

injection molded parts.

- 1/2” wide roll of Kapton tape
- Uninsulated crimp on connectors, sized for 22-18ga wire.

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

- A small squeeze clamp that can open at least 2”
- Thread locking glue. (Loctite, etc – it’s used on the stepper motors)
- Crimping tool (Jameco P/N 159266 is a good choice)

- Battery powered screwdriver. If you ever needed an excuse to buy one of these, THIS IS IT.
- Pencil.
- 40W Soldering Iron.
- Blue thread locking compound (Loctite or Permatex Threadlocker Blue)
- A small file.

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

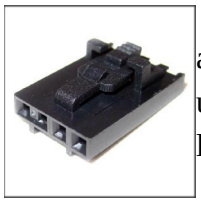
- Superglue (used instead of scotch tape to hold some T-Nuts in place)

- #6-32 Tap. Useful for threading the hole in the plastic component that the end stop adjustment screw fits into.
- Electrician's tape.
- Six small nails to help line up the Onyx heated bed during installation.
- Waxed lacing cord. You can use this in place of wire ties in pretty much any application. You can find it here: http://www.skygeek.com/wht-string.html. While expensive, you'll never really need to buy a wire tie again and it'll likely last you the rest of your life. :)
- .100” (2.54mm) Latching Polarized Male Housing (1x4) and matching crimp pins. This is used to add a connector to the end of the EZStruder extension cable and makes life a lot easier. You can purchase 2 of these connectors and their associated crimp pins from Hansen Hobbies (http://www.hansenhobbies.com/products/connectors/pt1inlpconnectors/pt1in_lp_1x4/) very inexpensively. The link for the pins is shown in the description for the male housing.

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

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

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



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

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

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

The use of these connectors is entirely optional! This is how *I* like to rig my printers and it's

entirely okay to not do this. The pre-built printers from SeeMeCNC don't include these connectors, so don't feel obligated to use them. Now that being said, having a quick-disconnect hot end is just *cool.* :)

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

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

The Latching Polarized connectors can be found here:

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

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

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

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

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

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

2 – Visual Bill of Materials

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

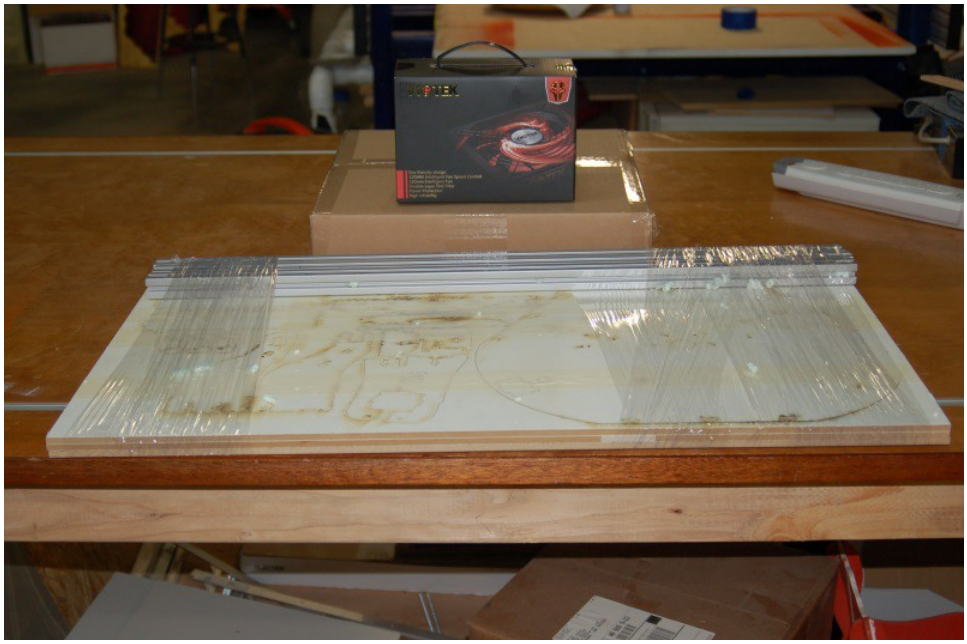


Fig. 1-1: Shipping box contents.

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

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

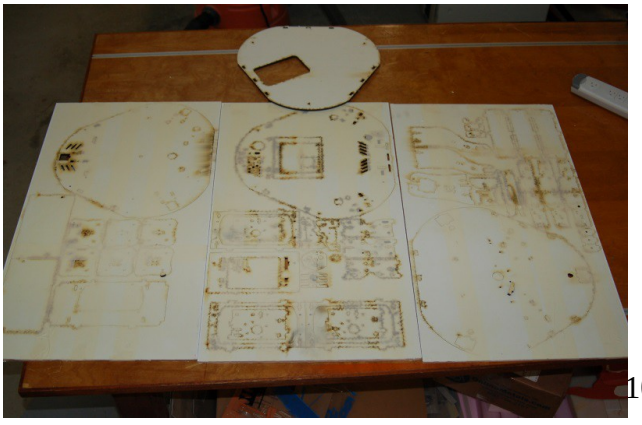


Fig. 1-2: Laser cut parts.

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

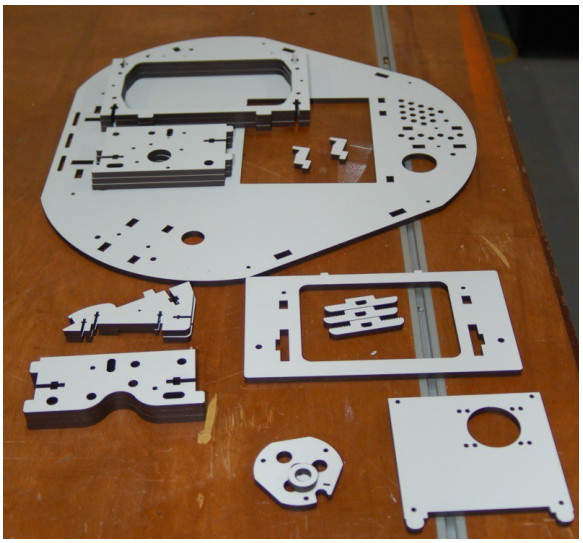


Fig. 1-3: Sheet #1 parts.

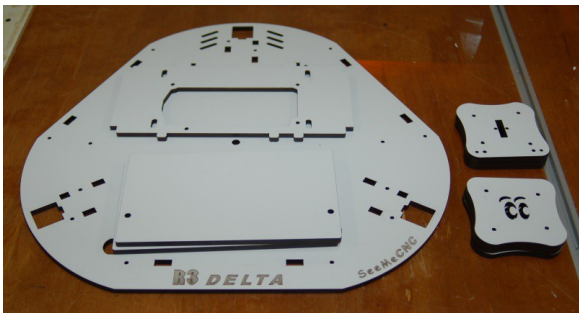


Fig. 1-4: Sheet #2 parts.

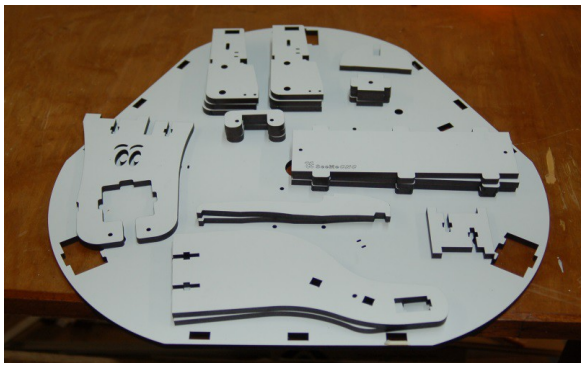


Fig. 1-5: Sheet #3 parts.

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

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

#10-32 x 5/8" Nylon Pan Head Screws

#10-32 Nylon Finish Nuts

Injection molded legs (black)

Soft rubber feet

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

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

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

These are used to mount the 450W ATX power supply

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

31 each, #6-32 x 1” Phillips Pan Head Screws. Used for general assembly.

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

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

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

14 each, #6-12 x 1” Phillips Pan Head Stainless Steel screws. Used for Cheapskate plates and EZStruder mount.

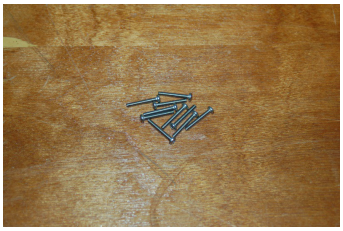
15 each, #6-32 x 1/2” 18-8 Stainless Steel Flathead screw. Used inside of base and top side plates, to retain acrylic panels and the three end-stop triggering screws installed in the Cheapskate U-Joint mounts.

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

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

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

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



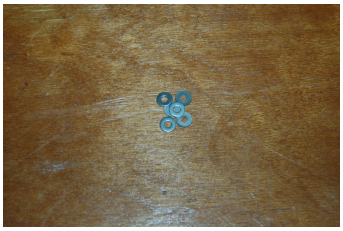
10 each, #2-56 x 5/8” Pan Head Phillips Machine screws. Used for LCD mounting and end-stop switch mounting.

10 each, 2-56 Finish Nuts. Used for LCD mounting and end-stop switch mounting.

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

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

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



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

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

1 each, RAMBo Electronic Control Board with screw terminals and end stop wires [REPLACE WITH CORRECT PHOTO]

1 each, USB Cable.

1 each, Onyx Heated Bed Kit.

1 each, 300mm x 3mm Borosilicate Glass Build Plate. Used with Onyx Heated Bed.

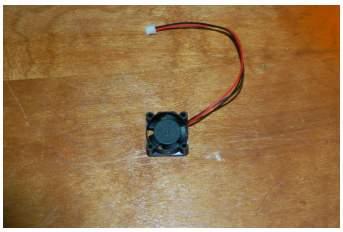
[REPLACE WITH CORRECT PHOTO]

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

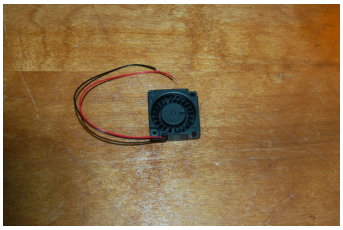
4 each, NEMA 17 Stepper Motors (4800cgm holding torque). Used for three motion axes and extruder drive.

1 each, 450W Power Supply.

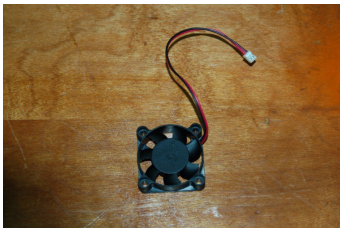
1 each, Rocker switch, including spade lug crimp terminals.



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



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



1 each, 40x40x10mm 12VDC fan. RAMBo cooling fan.

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

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

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

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

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

3 each, 76” GT2 Timing Belts.

3 each, T-Slot rails, 32” long. [REPLACE WITH CORRECT PHOTO]

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

1 each, GT2 2mm pitch belt pulley pack. Includes six grub screws and allen wrench.

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

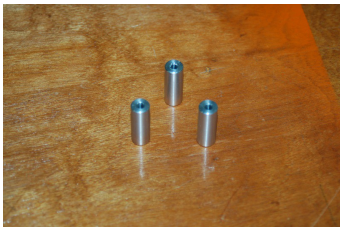
24 each, Bearing Sleeves. Used to cover 608ZZ bearings.

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

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

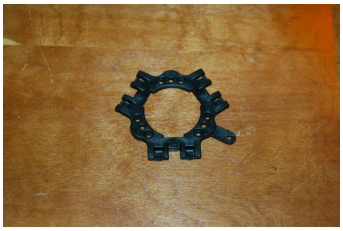
12 each, Universal Joints (machined aluminum).

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



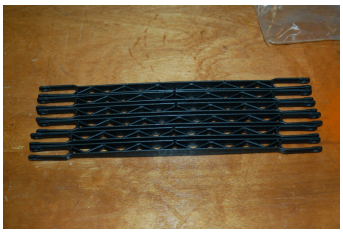
3 each, 1” long machined aluminum hot end platform spacers.

3 each, Cheapskate U-Joint mounts. Outer tabs have been removed to allow for spring clips.



1 each, Effector Platform (spring clip style).

6 each, U-Joint Spring Clips.



6 each, Rostock MAX Delta Arms.

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

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

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

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

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

3 – Prepping the Hot End and Power Supply

Preparing the Hot End

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

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

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

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

Fig. 3-1: RTV & heating resistor.

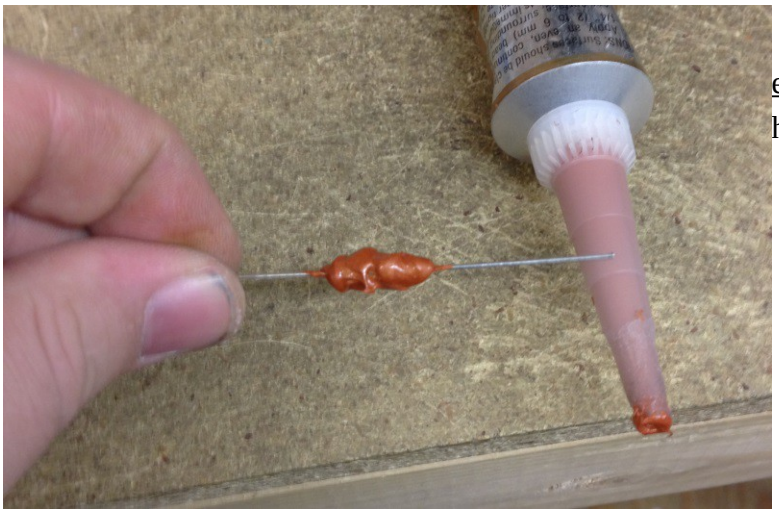


Fig. 3-2: Coating the heating resistor with RTV.

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

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

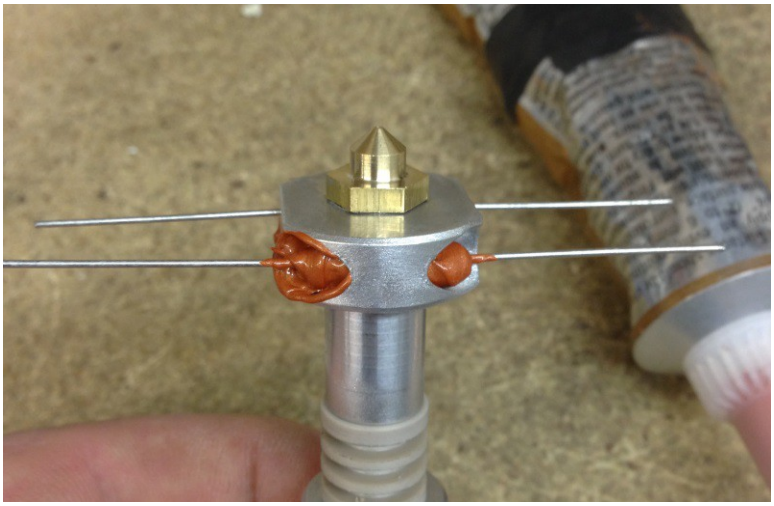


Fig. 3-3: Resistors installed in the hot end.

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

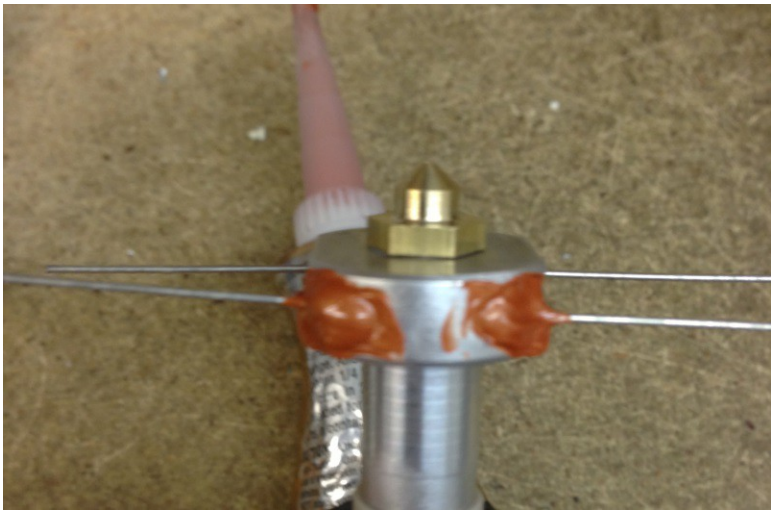


Fig. 3-4: Resistor cavities filled with RTV.

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

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

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

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

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

Fig. 3-6: Bending the thermistor.

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

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

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

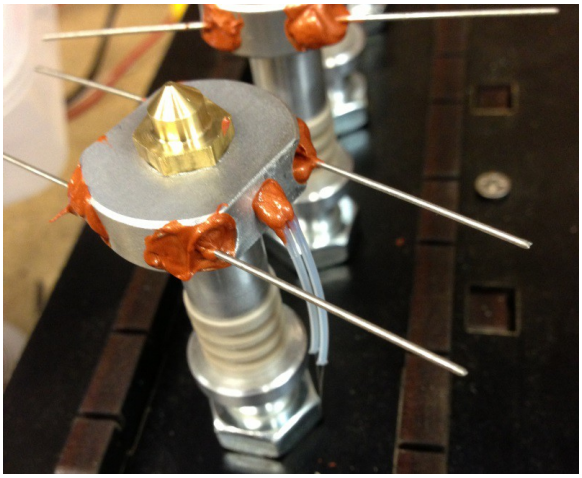


Fig. 3-8: Thermistor installed.

Preparing the Power Supply

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

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

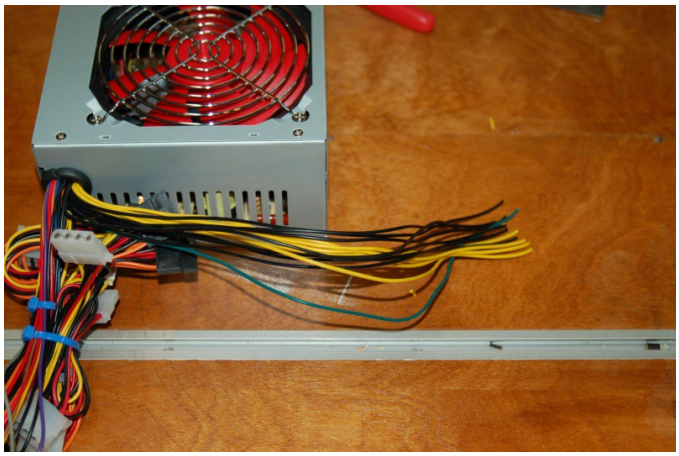


Fig. 3-9: Prepping the power wires.

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

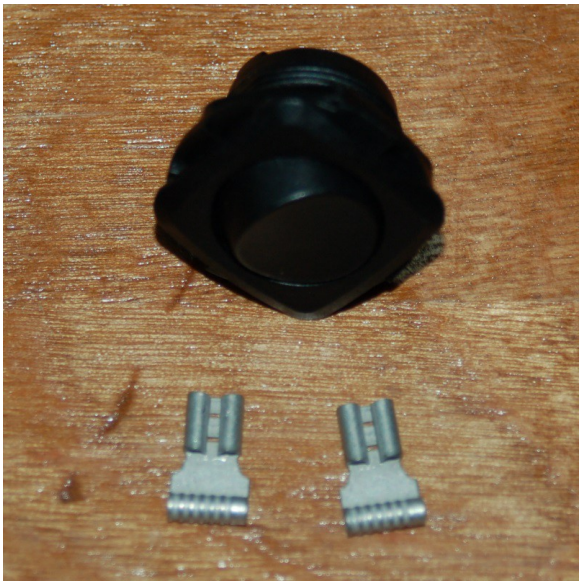


Fig. 3-10: Power switch and crimp-on spade lugs.

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

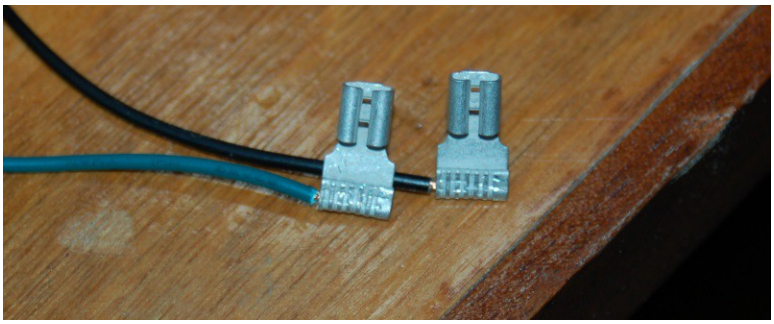


Fig. 3-11: Power switch connectors installed.

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

Fig. 3-13: Twisted Wires!

Now you need to get the RAMBo power connector and install the wires into it. The two yellow and two black wires only need about 3/8” of insulation stripped from them. Install them into the connector as shown below. Please pay careful attention to the order of installation! If you reverse the yellow and black locations, you'll destroy the RAMBo when you turn on the power.

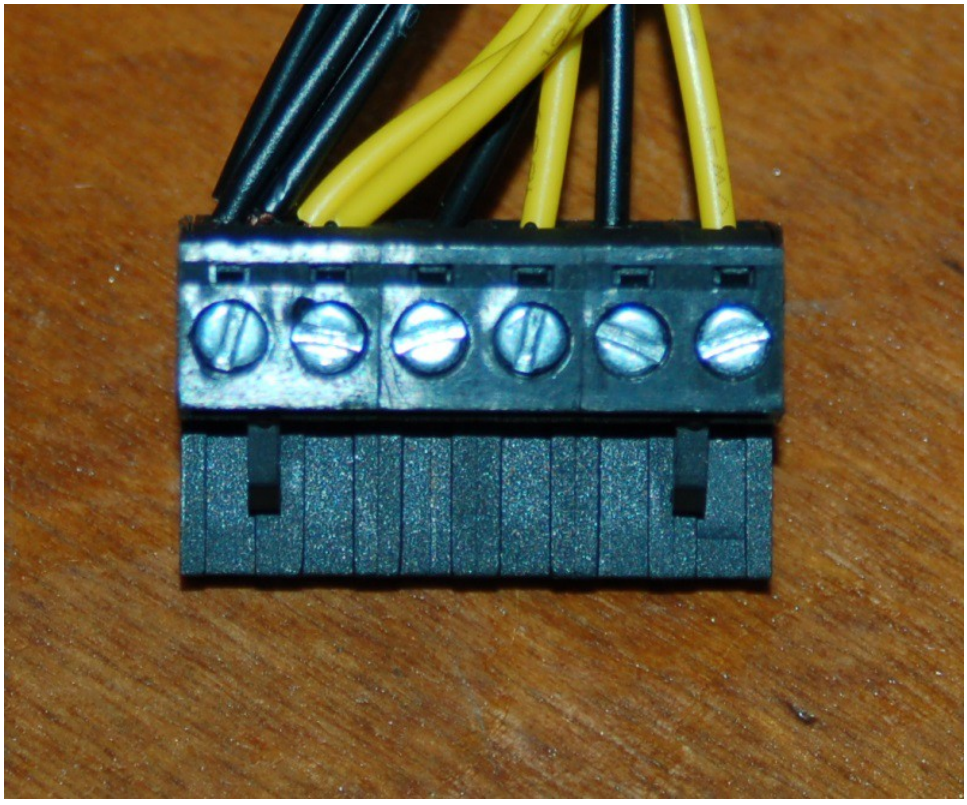


Fig. 3-13: Wires installed in the RAMBo power connector.

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

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

4 – Building the Base

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

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

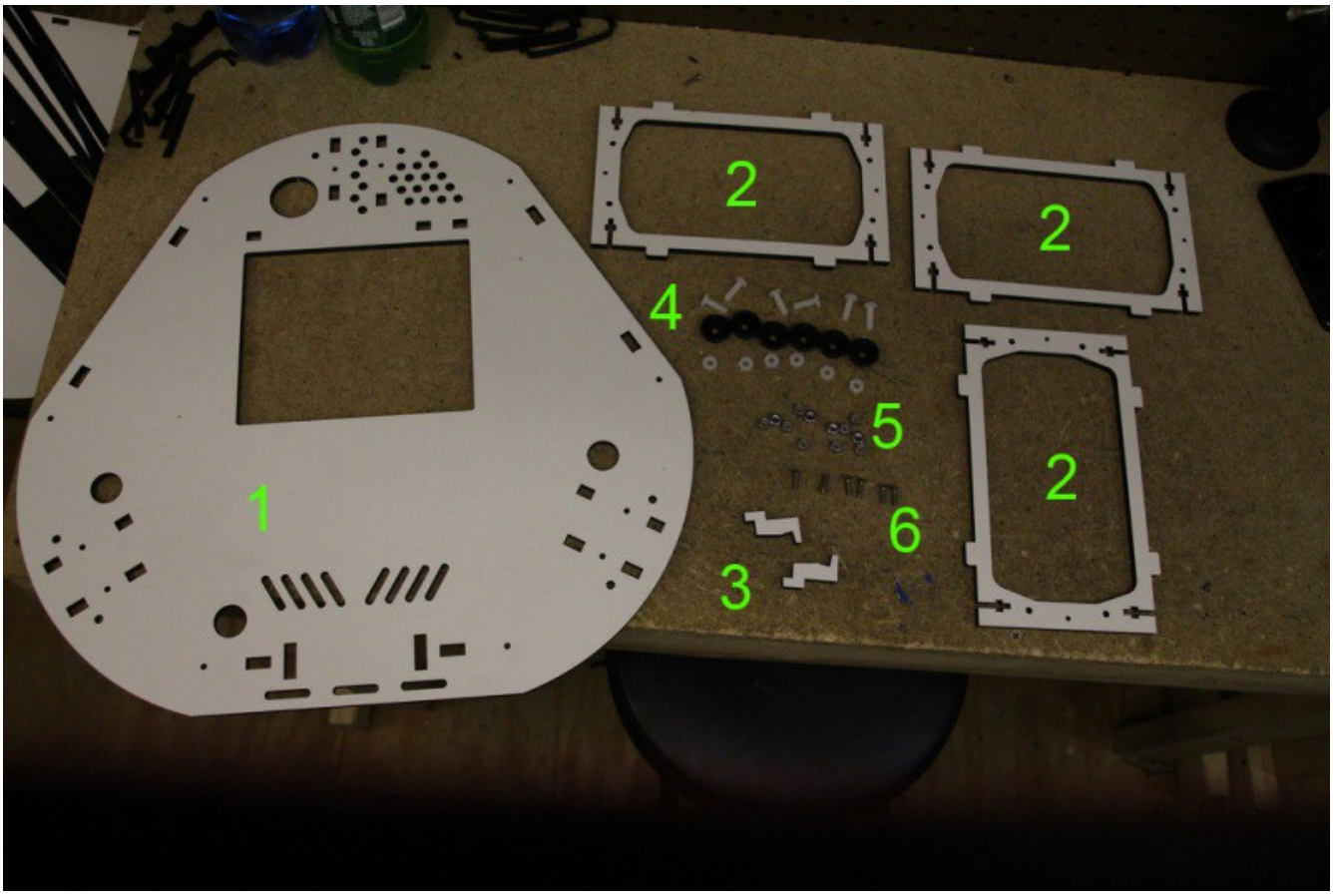


Fig. 4-1: Required base parts.

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

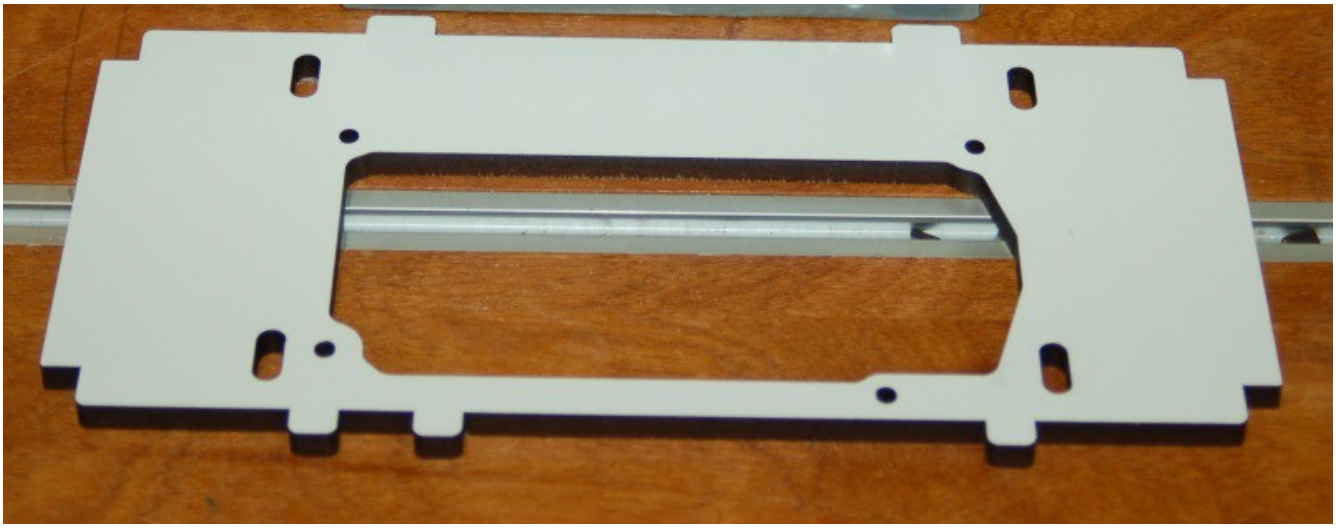


Fig. 4-2: Power Supply Mounting Plate.

Installing The Feet

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

will hamper your ability to spin the machine around on your table while building it.

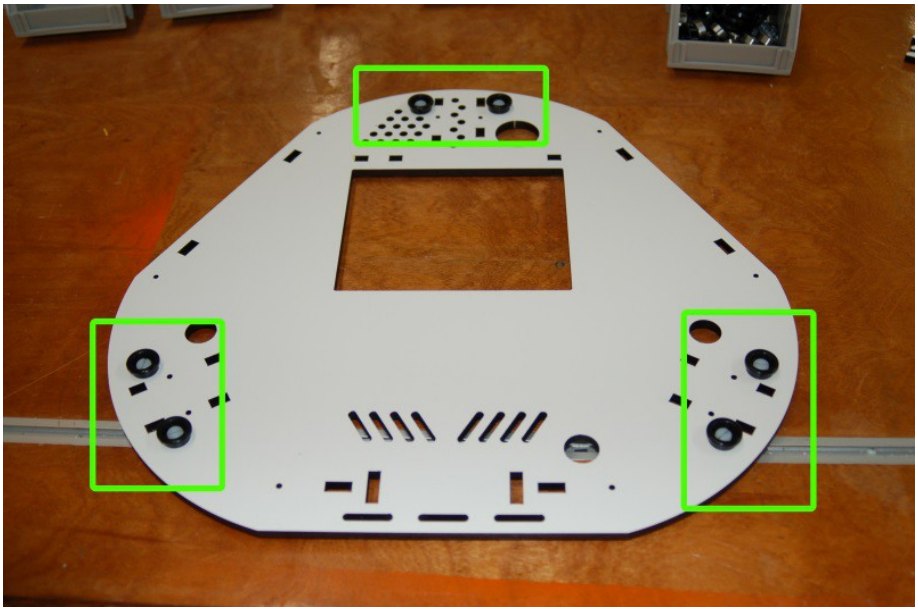


Fig. 4-3: Installing the foot assemblies.

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

Preparing the Vertical Supports

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

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

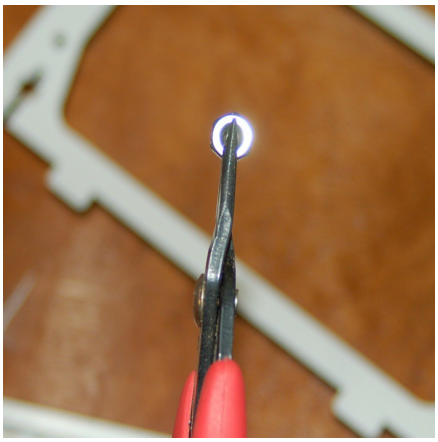


Fig. 4-4:Gripping a nut. (Quit snickering!)

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

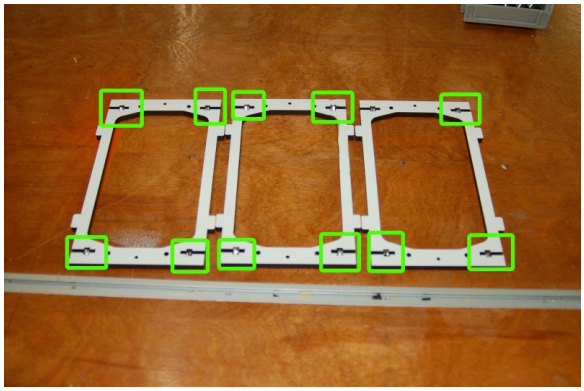


Fig. 4-5: Nut installation points.

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

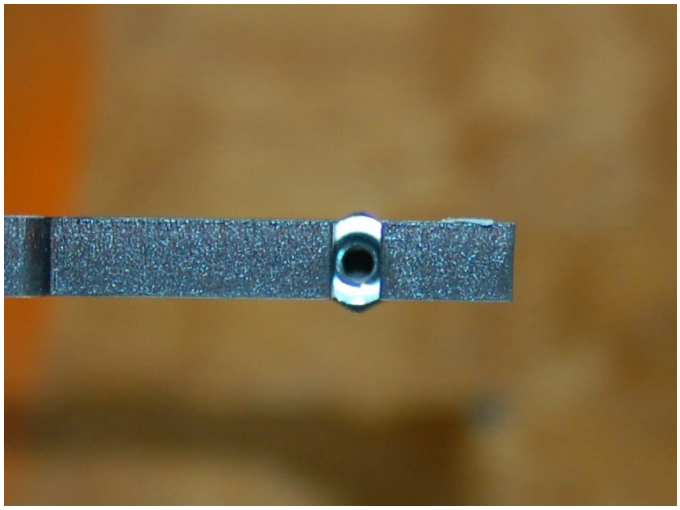


Fig. 4-6: Nut orientation.

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

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

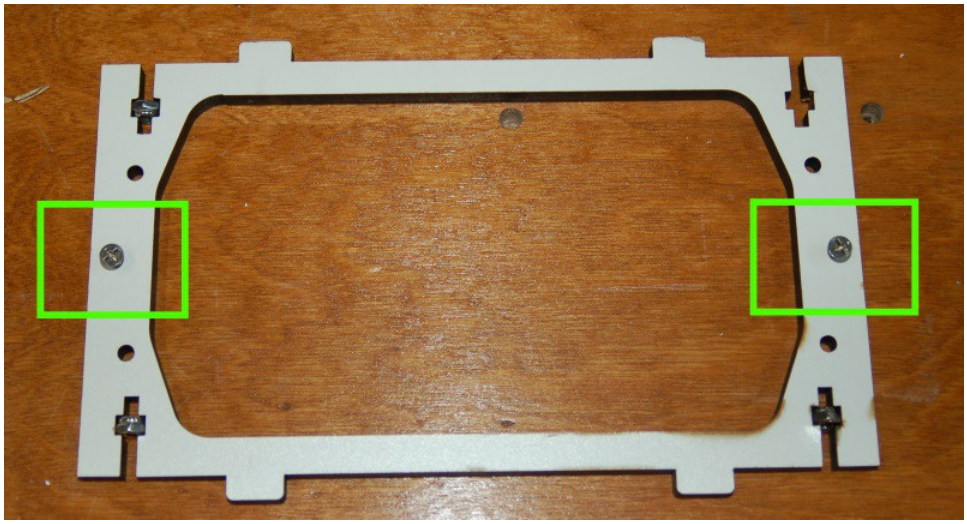


Fig. 4-7: Flat head screw locations.

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

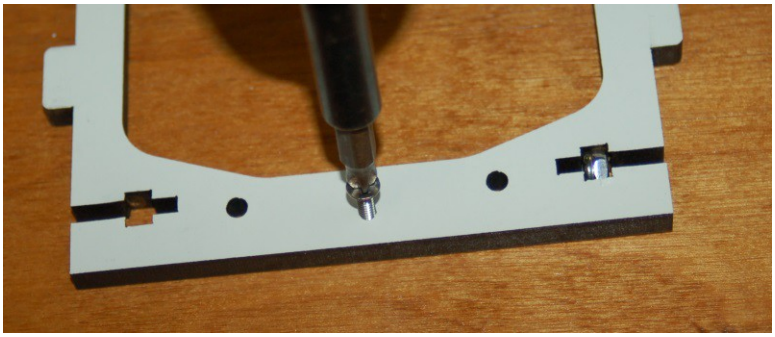


Fig. 4-8: Installing the screw.

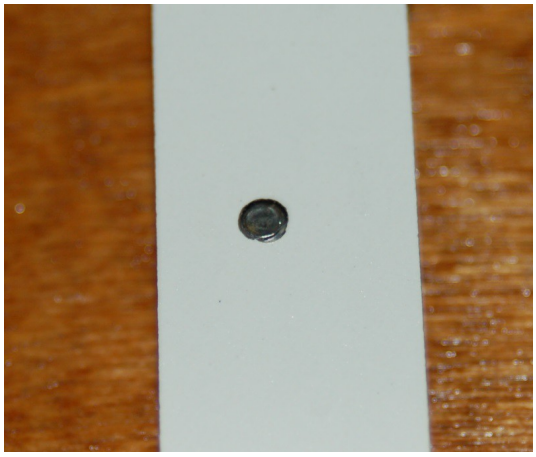


Fig. 4-9: Correct screw depth.

Installing the Vertical Supports and Power Supply

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

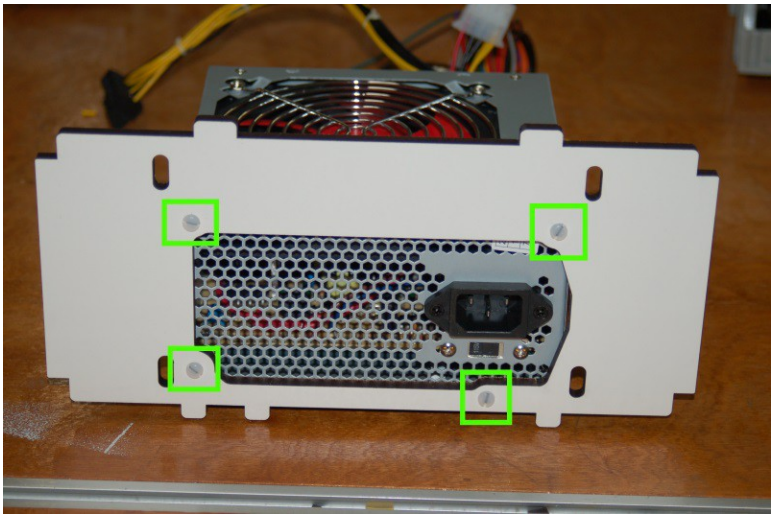


Fig. 4-10: Power supply attached to its mount.

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

The power supply base is held in place with the vertical supports that are installed to either side of it. You'll install all three parts at the same time – the fit tolerance is loose enough that they just drop in.

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

Figs. 4-12 and 4-13 are provided to give you a bit of additional detail as to how the mount rests on the vertical supports.

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

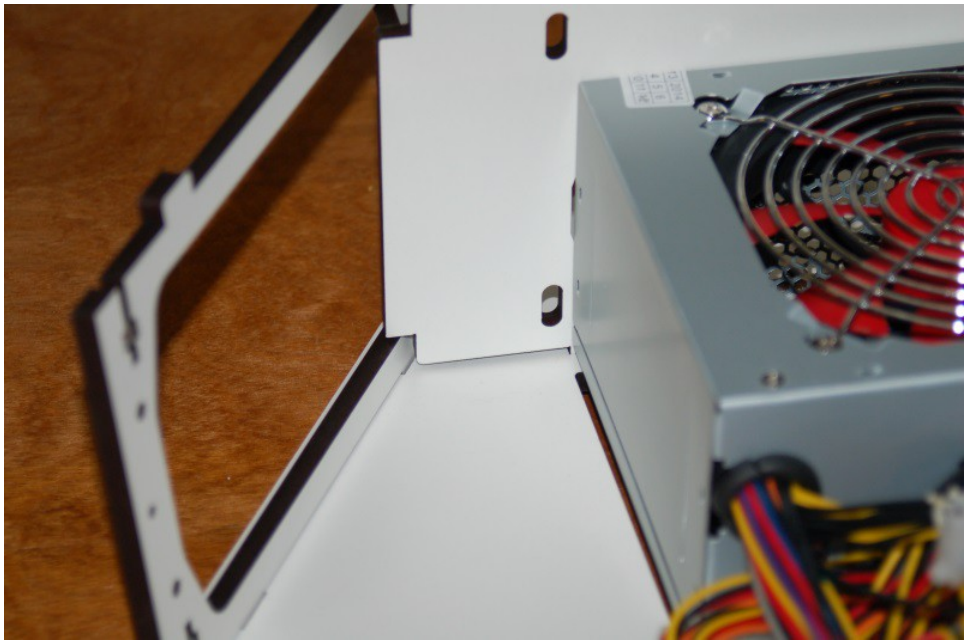


Fig. 4-13: Detail of power supply bracket, left side.

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

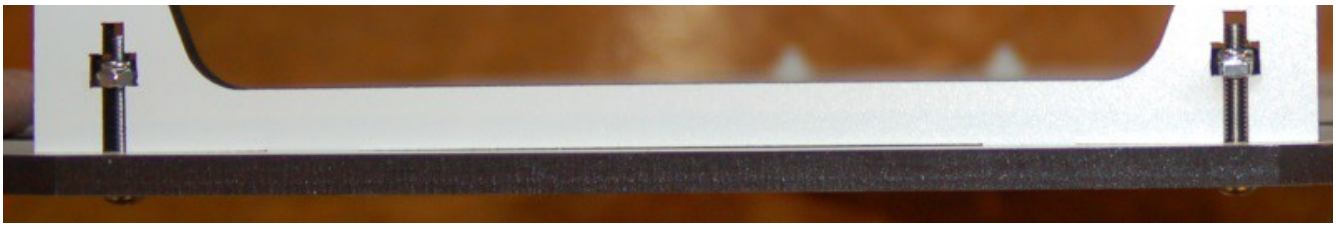


Fig. 4-14: Screws installed in vertical support

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

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

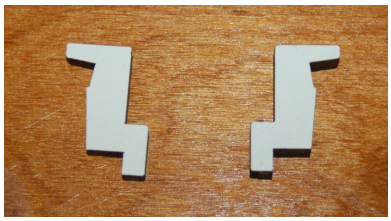


Fig. 4-15: Support Legs.

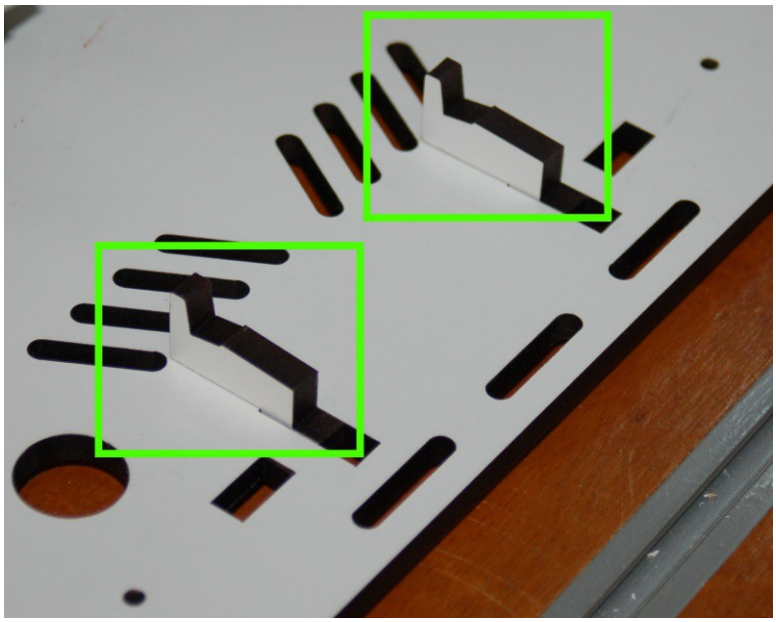


Fig. 4-16: Support legs installed.

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

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

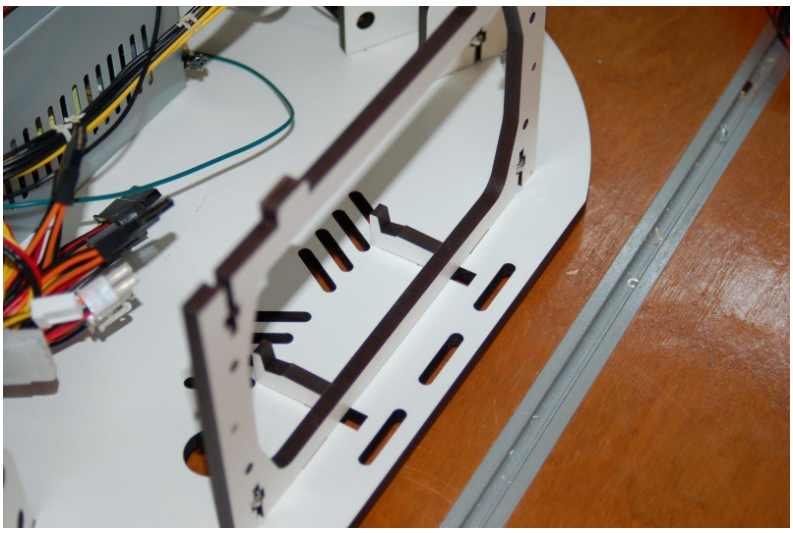


Fig. 4-17: Front vertical support and RAMBo legs installed.

Installing the Drive Gears on the Stepper Motors

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

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

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

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

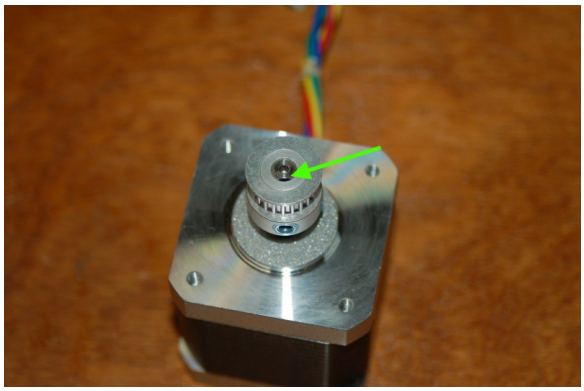


Fig. 4-19: Installing the first grub screw.

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

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

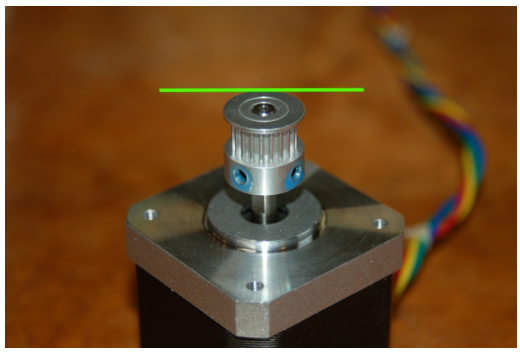


Fig. 4-20: Gear face even with shaft.

Assembling the Tower Supports

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

1. Stepper Motor Support Plates (3)

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

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

Fig. 4-22: Idler bearing parts.

Fig. 4-23: Assembled idler bearing.

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

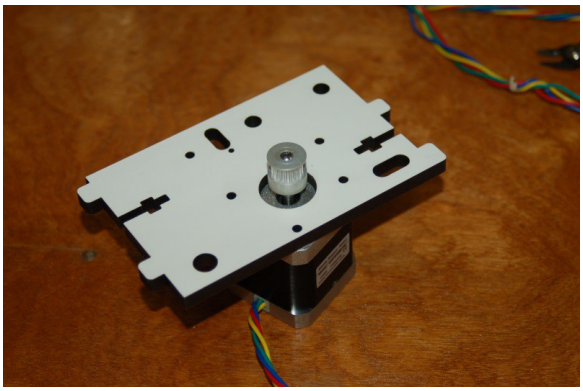


Fig. 4-24: Correct mounting plate alignment.

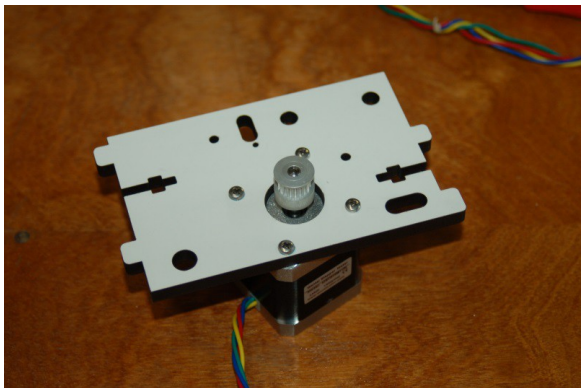
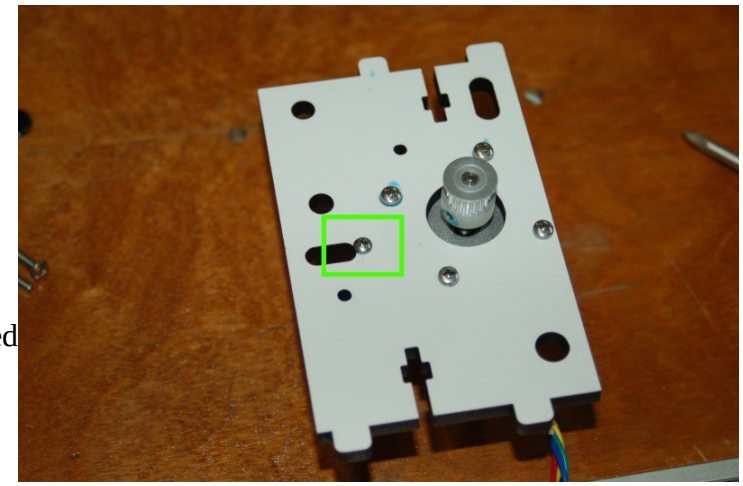


Fig. 4-25: Stepper motor screws installed.

Now you need to install a #4 5/8” machine screw where indicated in Fig. 4-26.

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

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



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

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

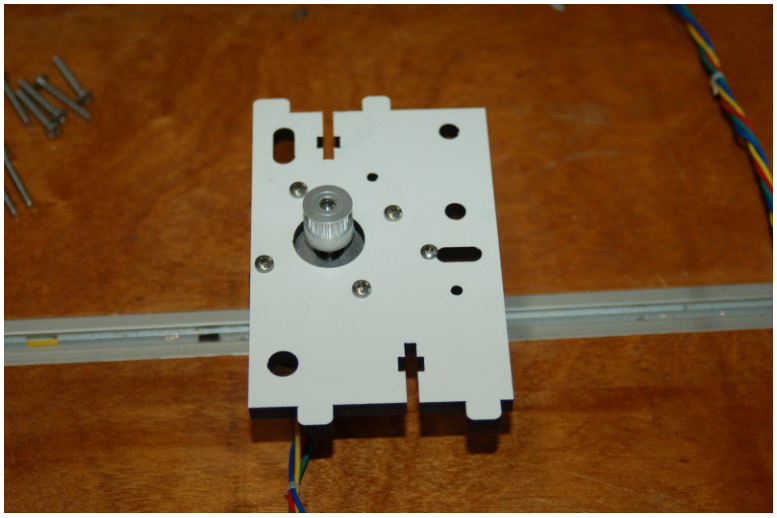


Fig. 4-27: Mirrored stepper motor plate.

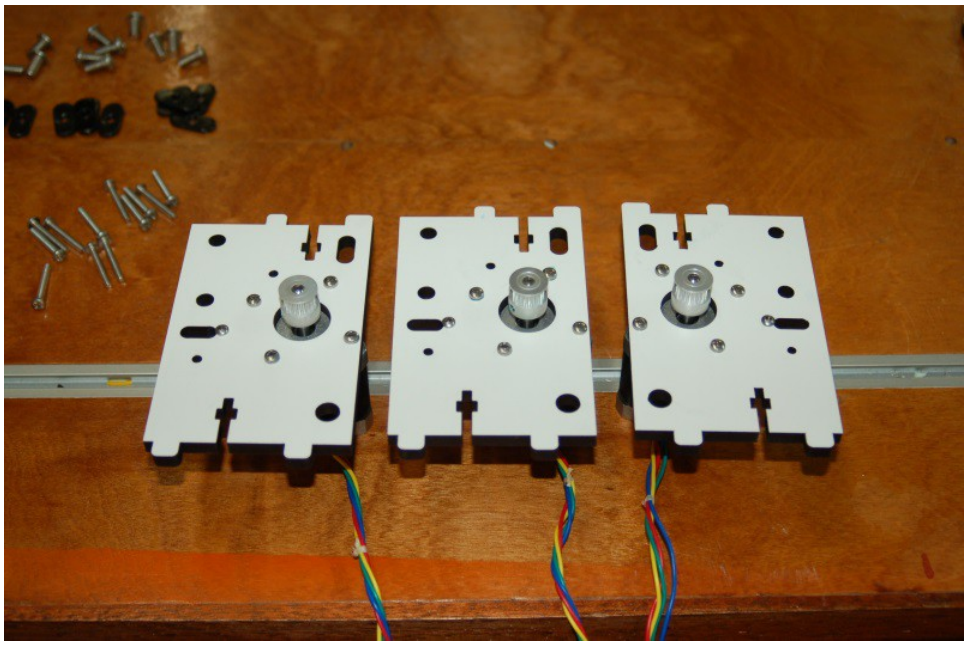


Fig. 4-28: Correctly assembled stepper mount plates.

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

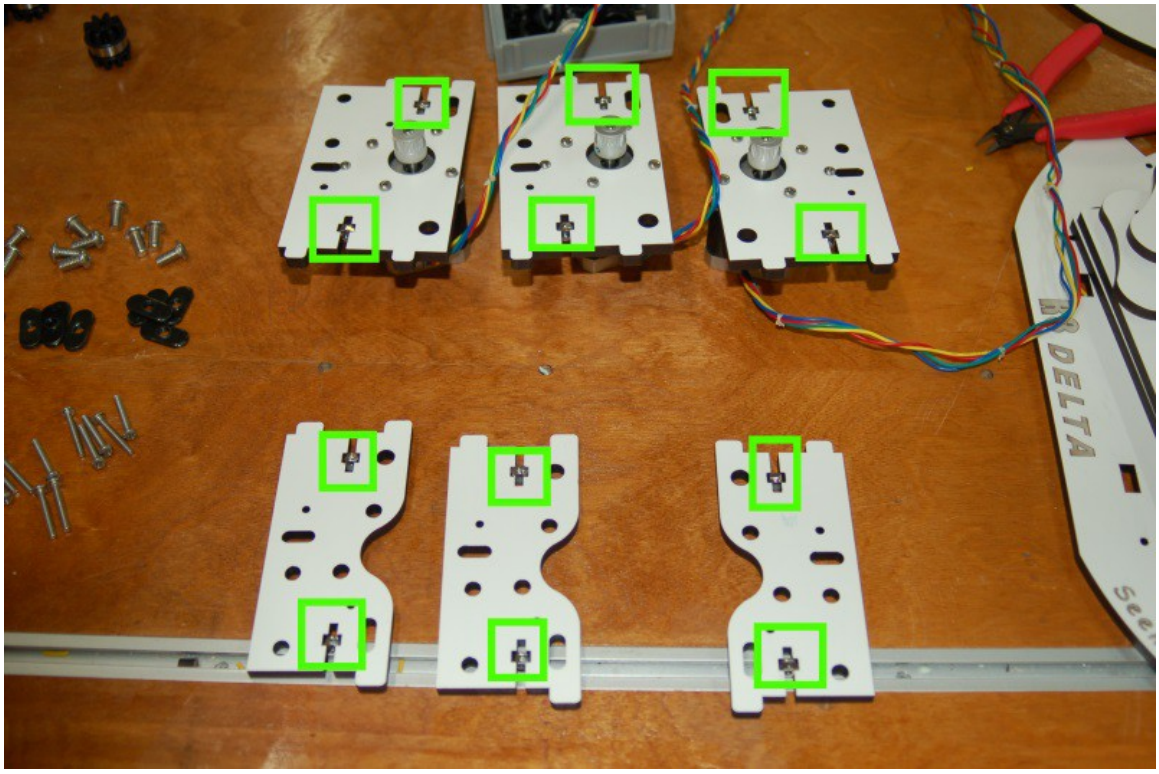


Fig. 4-29: Installation of the Nylon lock nuts.

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

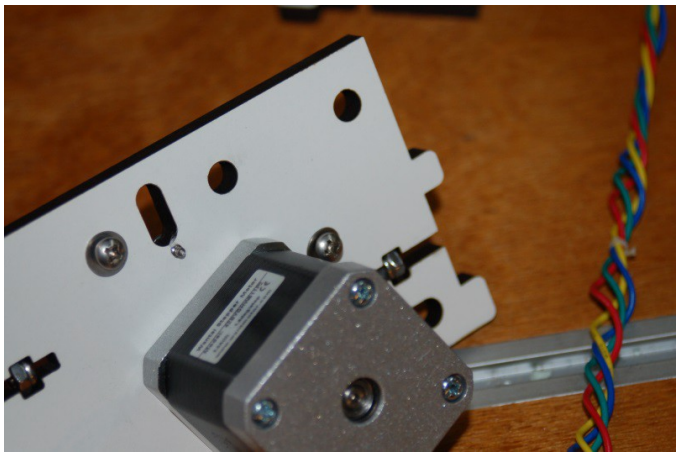


Fig. 4-30: Idler bearing screws installed.

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

and assist in fitting the top plate.

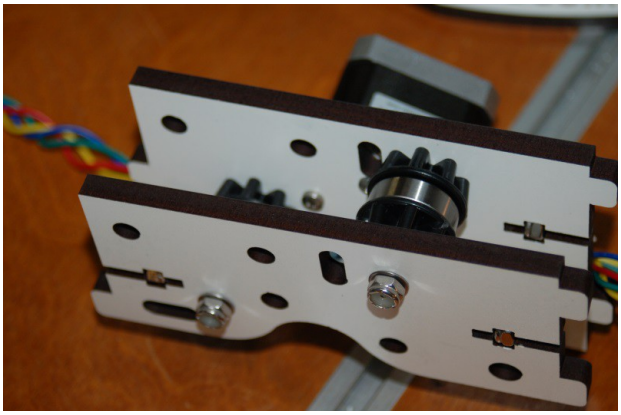


Fig. 4-31: Assembled Tower Support.

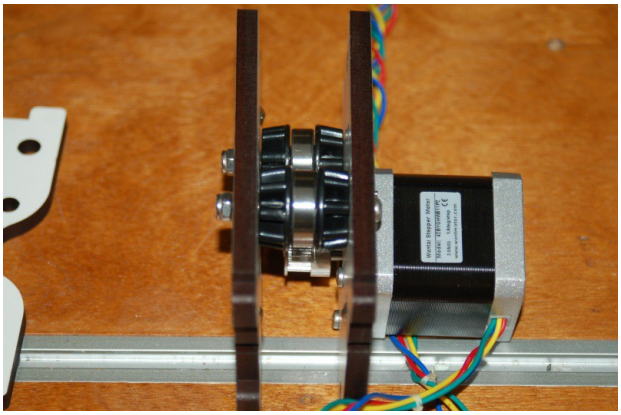


Fig. 4-32: Assembled Tower Support.

Finish assembling the other two tower supports. Install the three tower supports as shown in Figs. 4-33 and 4-34. The X (on the left) and Y (on the right) axis tower supports are opposites of one another as you can see in Fig. 4-33. Use six of the #6-32 x 1" Stainless Steel pan head screws to attach the tower supports to the base. Leave them a bit loose as you did with the other base plate mounted parts.

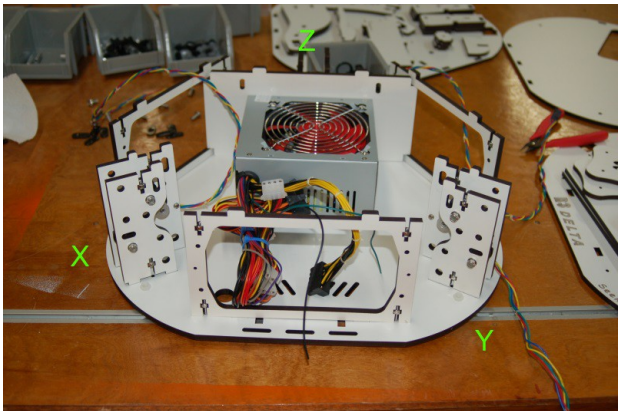


Fig. 4-33: X and Y tower supports installed.

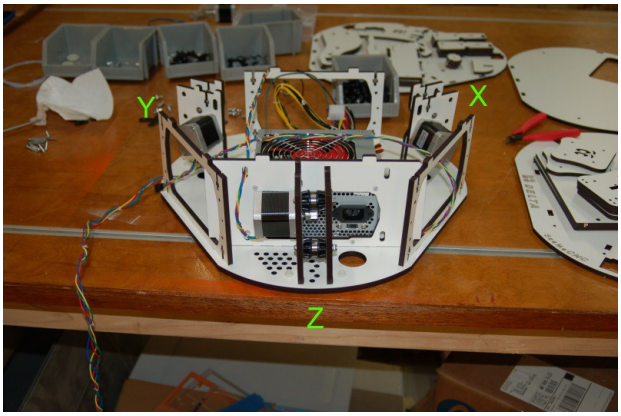


Fig. 4-34: Z axis tower support installed.

Now route the Z axis stepper motor wires through the hole in the power supply mounting plate as shown in Fig. 4-35.

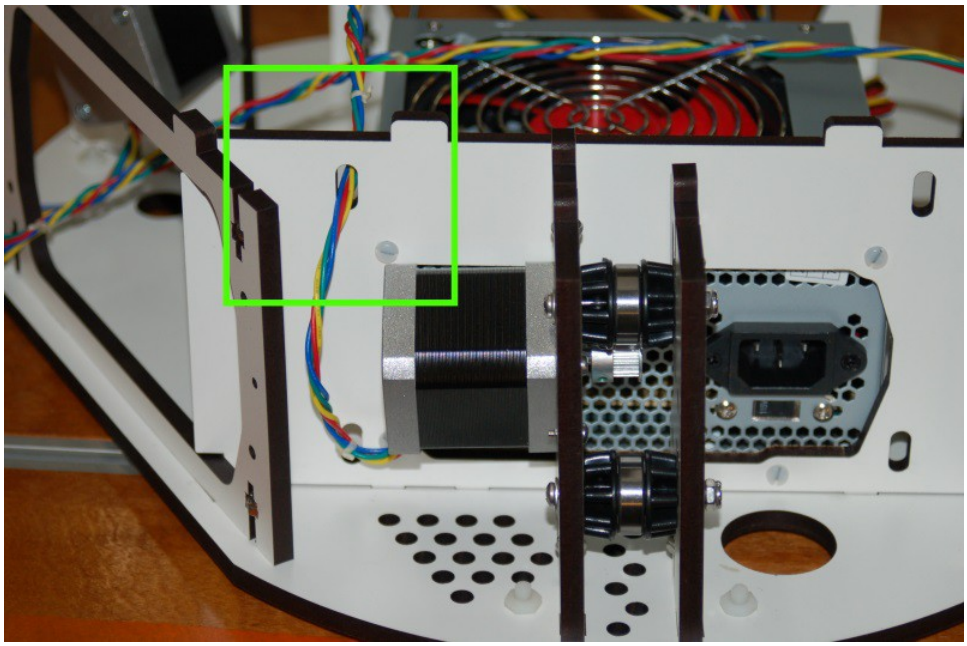


Fig. 4-35: Routing the stepper wiring.

Installing the Top Plate

The next step requires that you open up the Onyx Heated Bed package and remove the included #4-40 T-Nuts. These will be installed on the underside of the top plate as indicated by the green squares in Fig. 4-36. You'll also need 12 #6-32 1” Stainless Steel pan head screws in order to affix the top plate to the base.

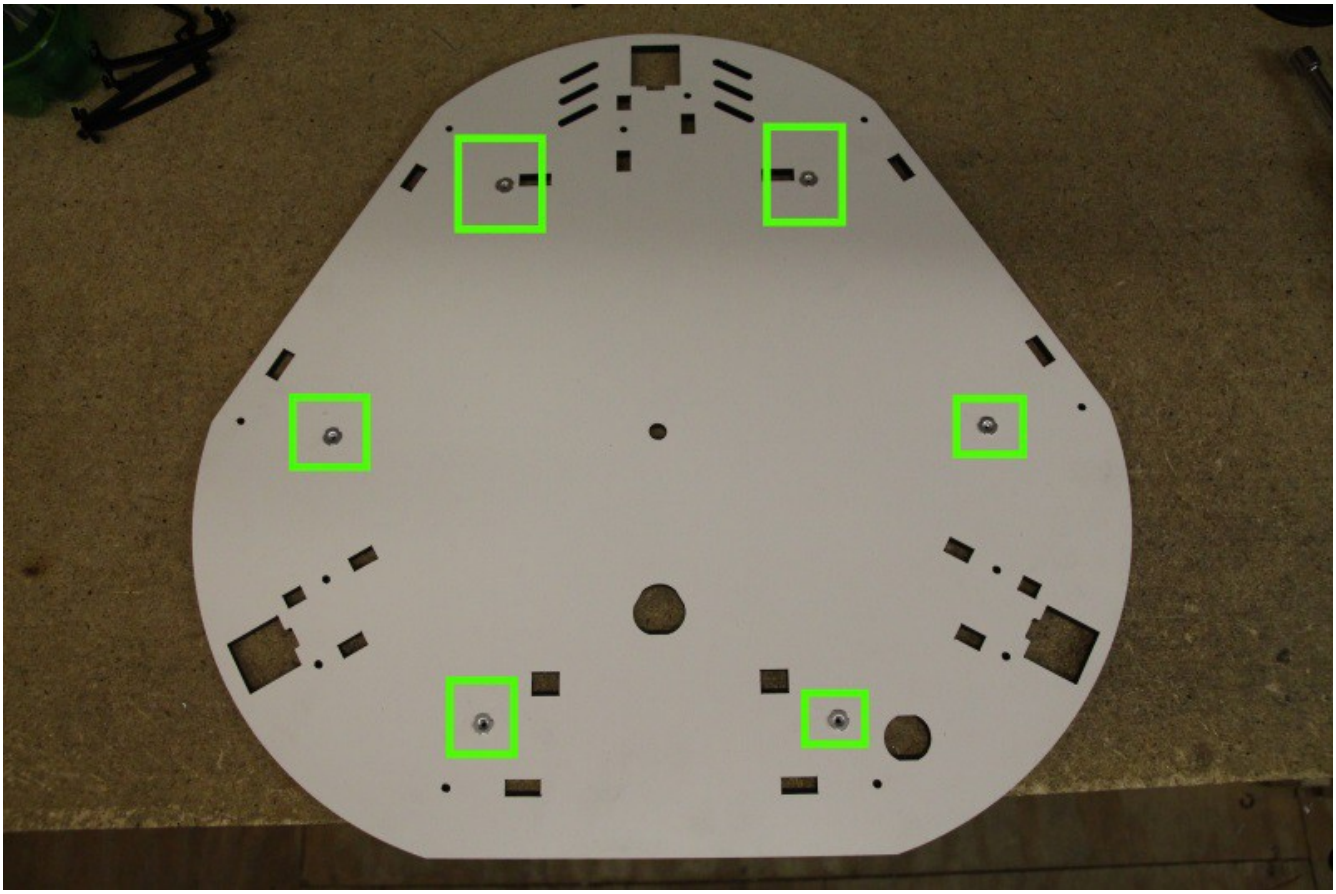


Fig. 4-36: T-Nut locations.

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

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

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

Fig. 4-36: Top Plate Installed.

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

5 – Installing the Onyx Heated Bed

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

1. Thermistor Pack. Includes a red LED, PTFE insulation tubing, a thermistor and a small

resistor.

2. Onyx Heated Bed
3. Star Mounting Plate (Not Shown)
4. Nylon Spacers (6) (Not Shown)
5. #4-40 3/4” Stainless Steel Flat Head Screws (6) (Not Shown)

Fig. 5-1: Onyx heated bed parts.

Installing the Thermistor, LED and Power Wires

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

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

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

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

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

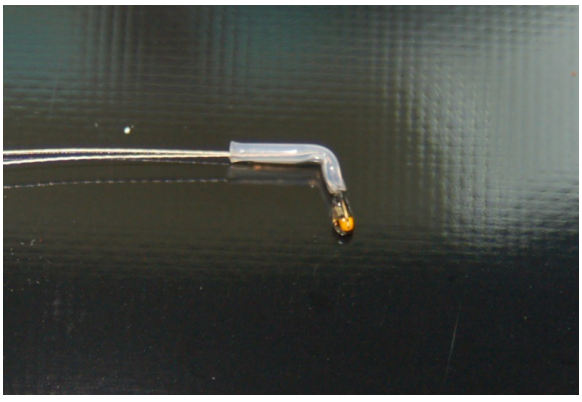


Fig. 5-3: Thermistor properly bent.

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

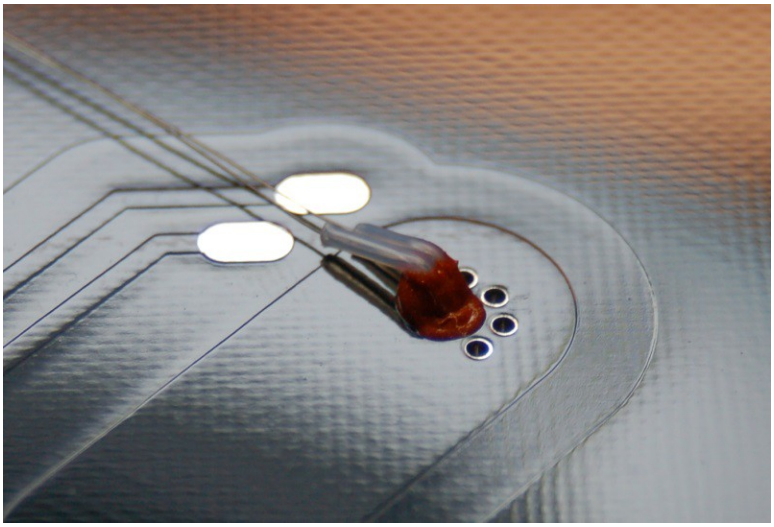


Fig. 5-4: Thermistor inserted in the Onyx heated bed.

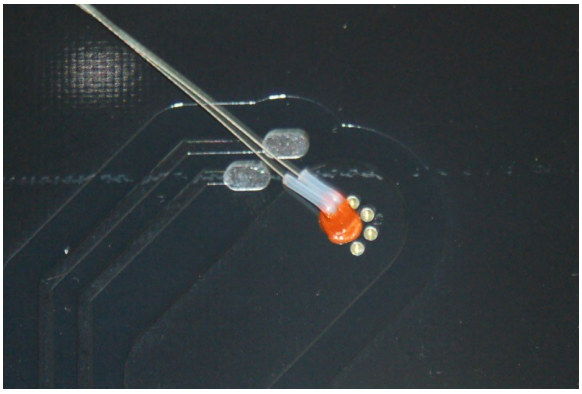


Fig. 5-5: Same thing, different view.

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

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

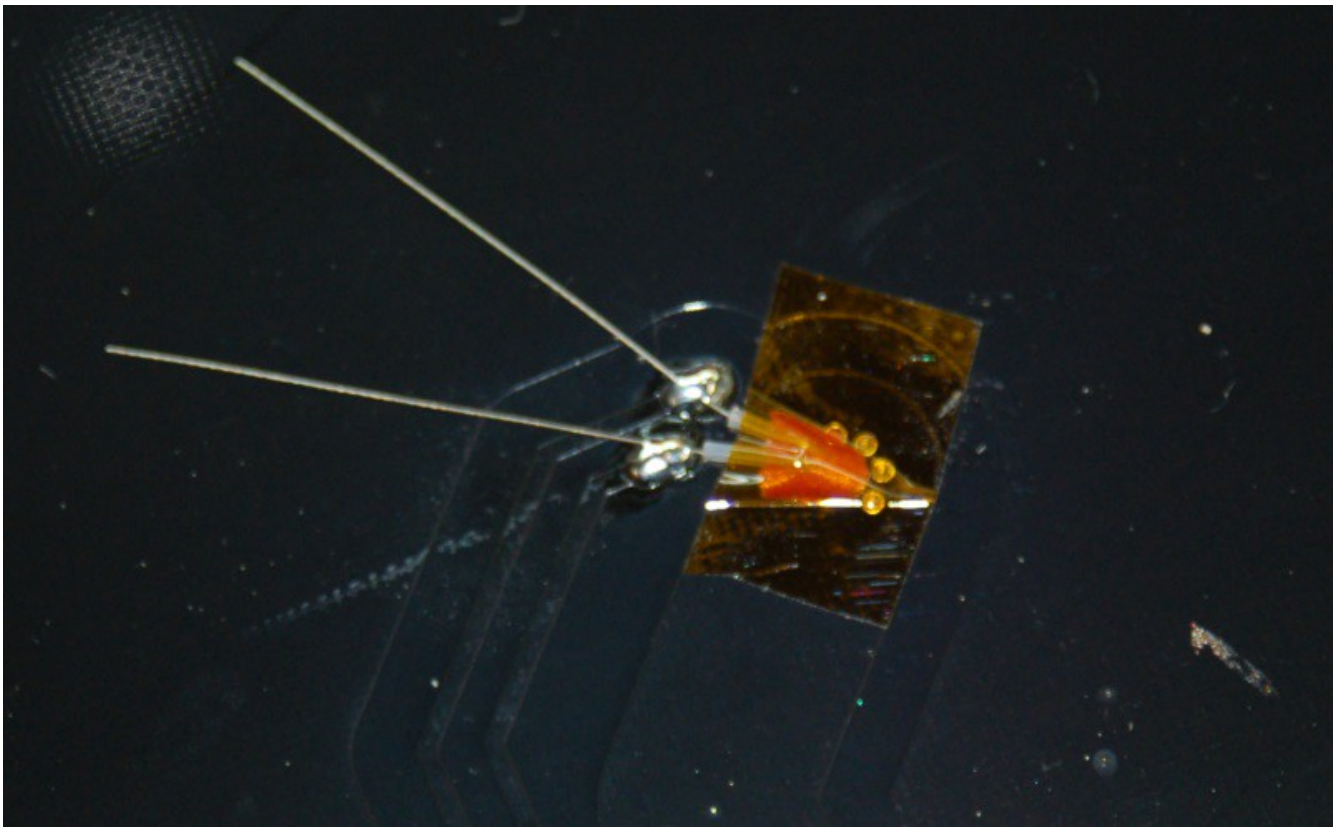


Fig. 5-6: Thermistor taped in place and soldered.

With the Onyx still upside down, I want you to install the resistor as shown in Fig. 5-7. The resistor is soldered from the side of the Onyx facing you, not the opposite side as you'd normally do when soldering in parts. After you finish soldering it in, clip the leads flush to the opposite side of the

Onyx and using a small file, ***carefully*** file away the remaining tips of the resistor leads that stand proud of the surface. The 300mm Borosilicate build plate covers this area and you don't want to scratch it or cause it to lift up.

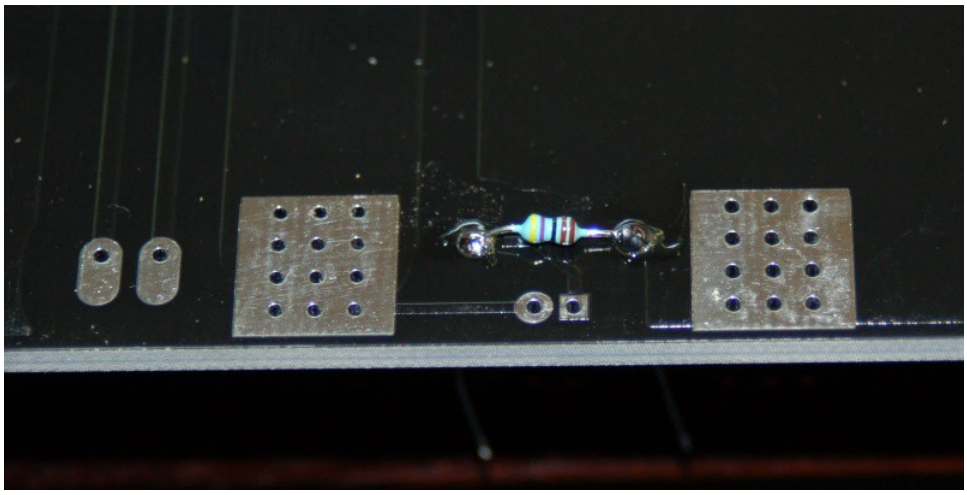


Fig. 5-7: Resistor soldered to the bottom of the Onyx.

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

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

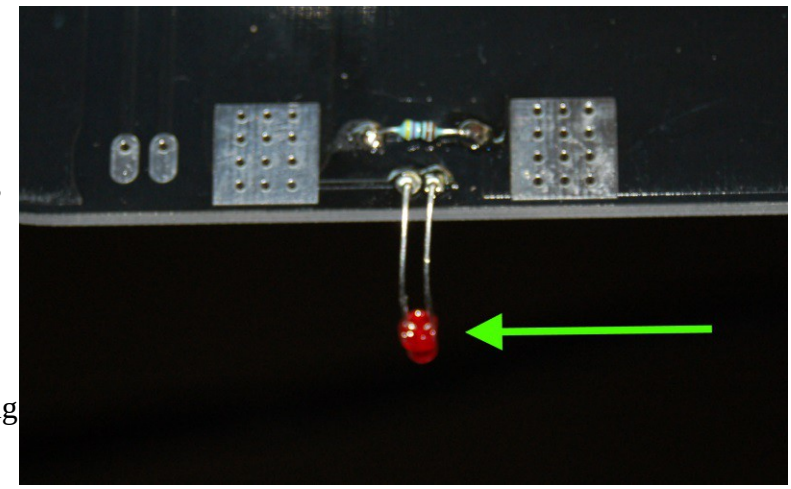


Fig. 5-8: LED installed.

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

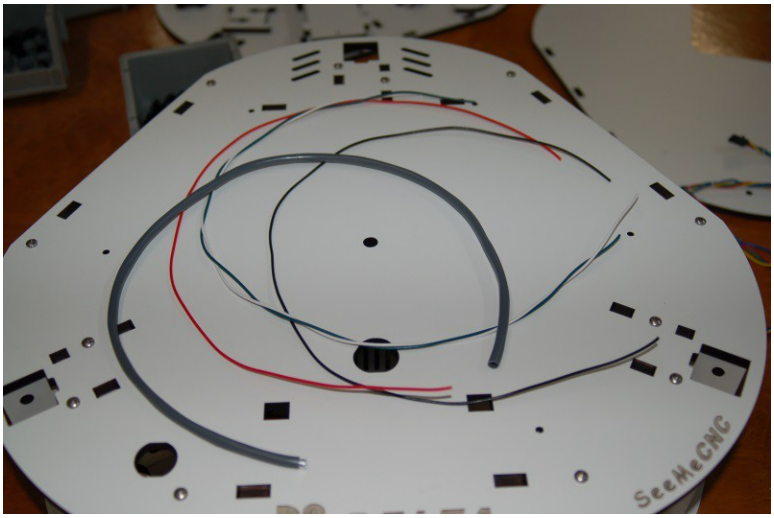


Fig. 5-9: Wire stripped out of the 4 conductor. cable.

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

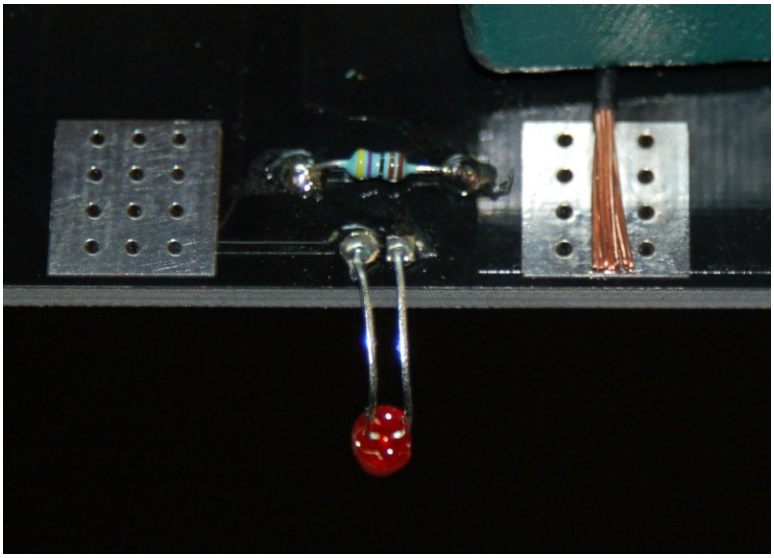


Fig. 5-10: Ground lead ready to be soldered down.

Repeat the process with the red wire as shown in Fig.

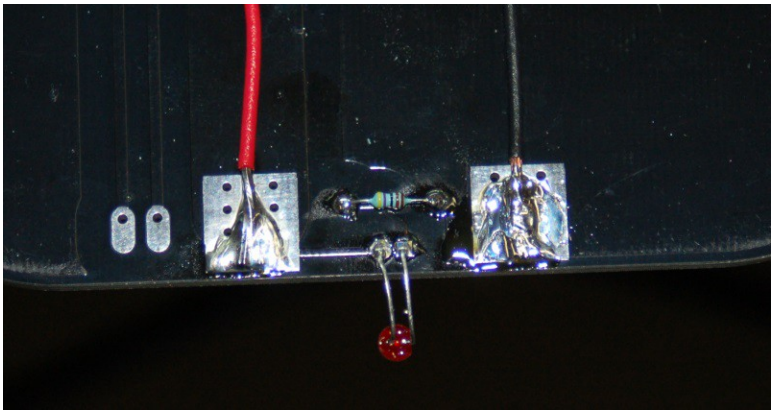


Fig. 5-11: Power wires soldered down.

5-11.

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

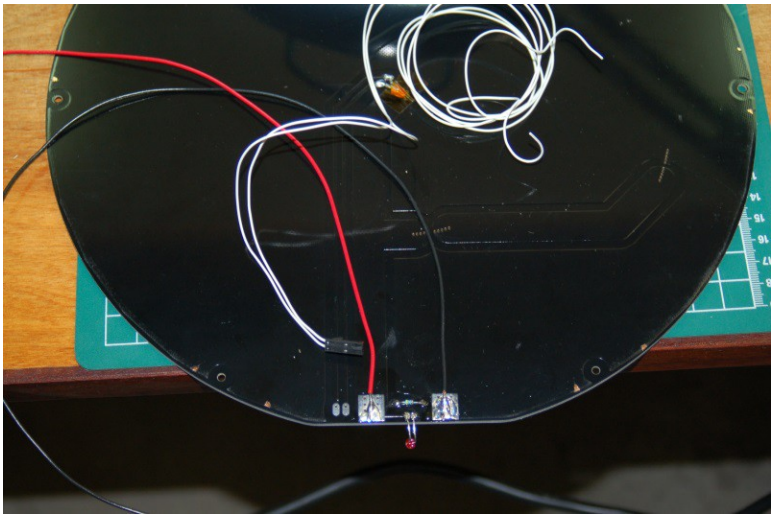


Fig. 5-12: Thermistor signal wires.

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

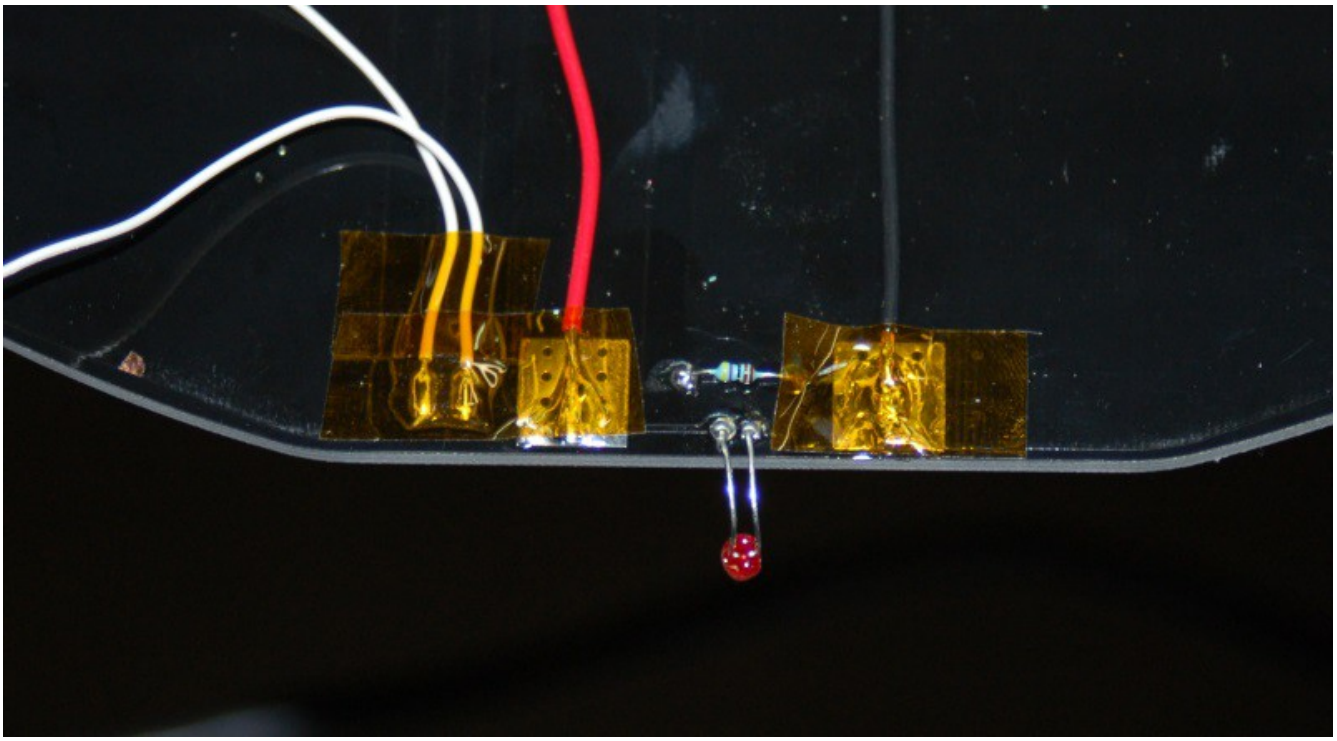


Fig. 5-13:Thermistor wires installed and covered with Kapton tape.