

## Rostock V2 Mod



The original SeeMeCNC Rostock V2 before mods.

*Hi and welcome to my log of upgrades I've created and installed on a SeeMeCNC Rostock V2. These modifications have stemmed from inspiration across multiple forums and hackers to create an incredibly reliable machine. All these modifications are modular and can be used separately. Let's get started!*

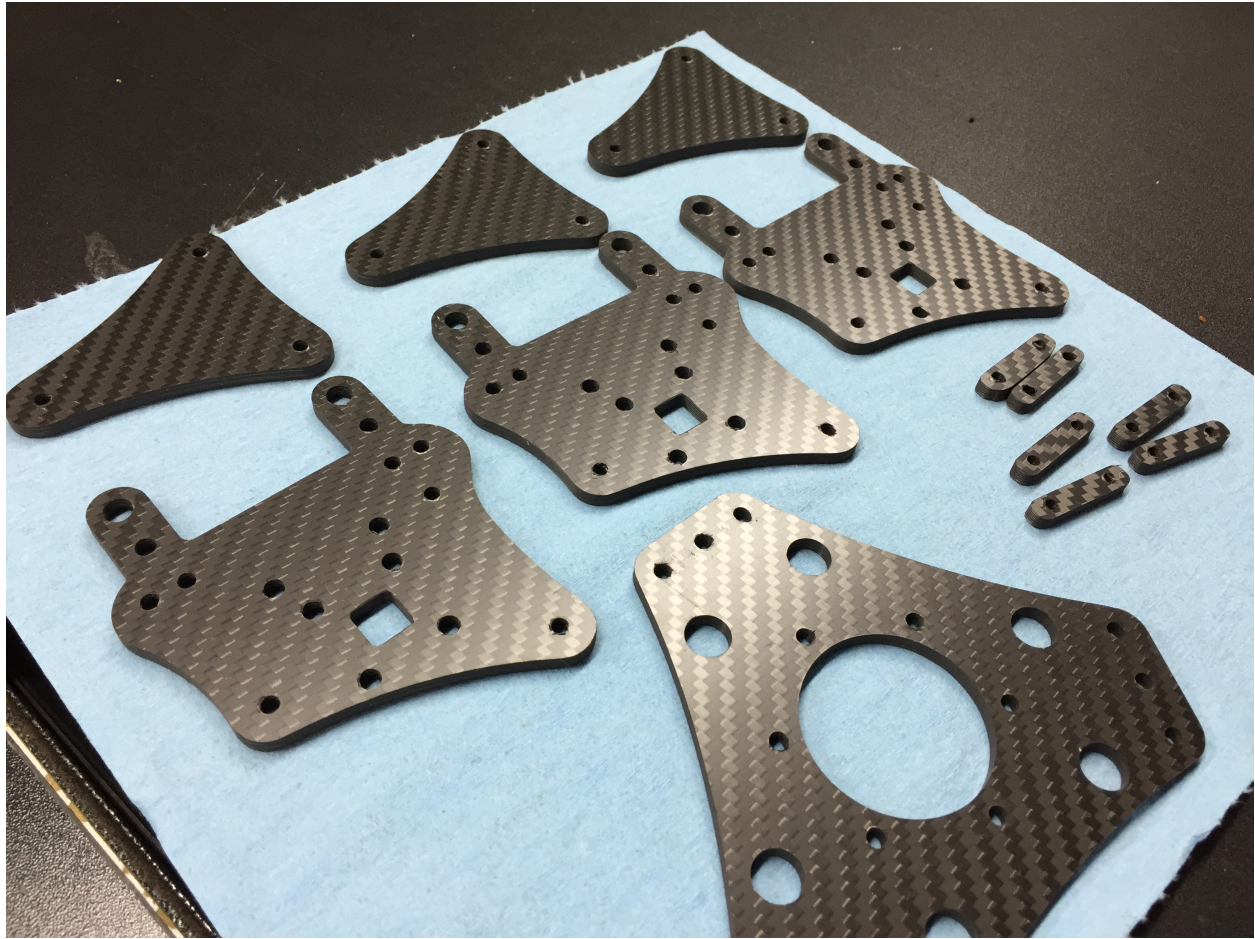
## The death of the Cheapskates

Cheapskates were good to start with, but they got annoying to deal with after a while. Having four rollers was unnecessary, and the rubber would hold a little indent after sitting for a few days. (Yes, I've gone a few days without printing 🤖) So off they came and into a bag.

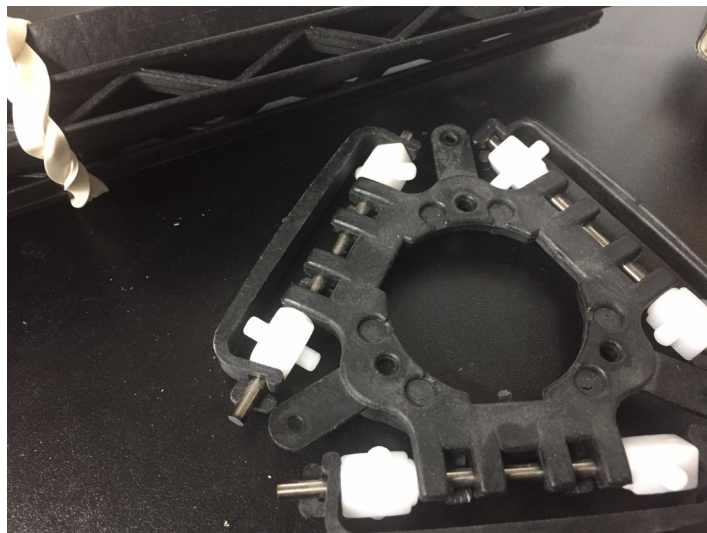


## Rostock V2 Mod

In place of the old Cheapskates, I designed some new plates to hold 3/8" steel V-Groove bearings and routed them out of carbon fiber on a CNC router.



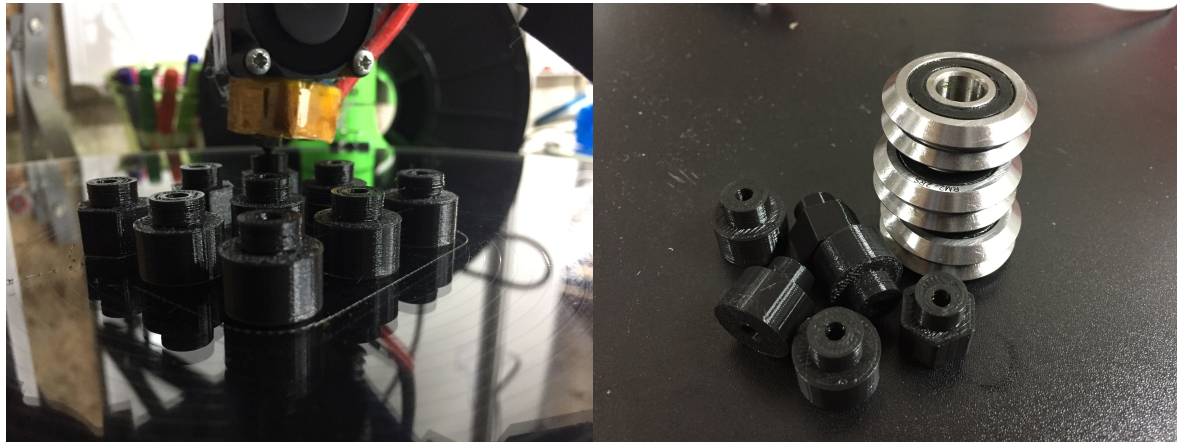
If you look closely, you'll see that each carriage only needs 3 bearings. Why use more when you don't need to. The effector was also cut out of 4mm carbon fiber since I'll be replacing the old plastic swivels and arms with steel and carbon fiber.





## Rostock V2 Mod

Let's start with the V-groove bearings. These are bigger than the ones that come with the Rostock, so the carriages need to be slightly wider. The old spacers also won't work, so I designed and printed concentric and eccentric spacers.



These spacers are then pressed into the bearings using the ol' arbor press from Harbor Freight (AKA Horrible Freight for you AVE guys). The eccentric ones needed to be lined up with a screw before pressing them in since the holes are off centered.



## Rostock V2 Mod

Here's a set for one carriage. Rinse and repeat for the other two sets. As a side note, these spacers were designed to compensate for the thickness of the plates to keep the inside surface of the plates at the same point in space from the aluminum extrusion. This lets me fit press nuts in the carbon without rubbing on the extrusions.



After that's all done, I did a little test fit for a sanity check.





## Rostock V2 Mod

Minus the extra long screws, they fit well! I'll trim those down in a bit. Let's move on to the pivoting points. These 5/8" steel bearing balls will do the trick.



Instead of drilling them, I'll epoxy them in place. They'll need a place to seat on the carriages, so I created these ball mounts. The balls will be spaced exactly 50mm apart to match the stock Rostock v2 carriages.



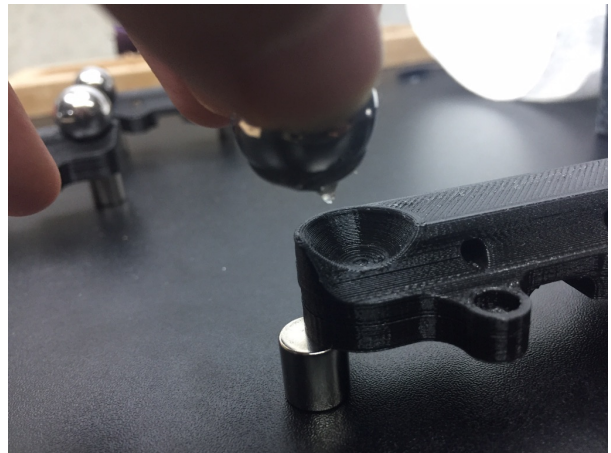
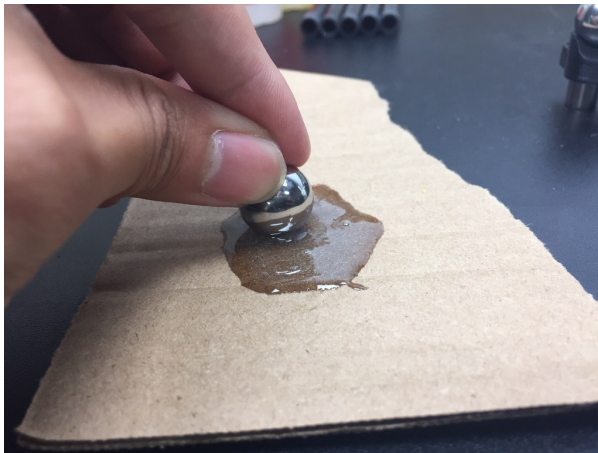
These mounts have end stop holes in them and a small channel underneath for the belt to pass through. They're printed in PLA with 50% rectilinear infill and secured using M3 screws and press-in nuts. You can use the new carbon fiber carriages without these as well. The stock Rostock parts will fit just fine.

## Rostock V2 Mod

Before we go ahead and epoxy the balls in place, I roughed up a patch on each steel ball with 220 grit sandpaper to increase the adhesion strength.



Once all the balls are scuffed up a little, I went ahead and mixed up some 5 minute epoxy. Dipping the balls in some epoxy, I set them into the mounts.



Placing a magnet under each ball helps pull it down and keep them snug against the mount. This just helps the build be more consistent.

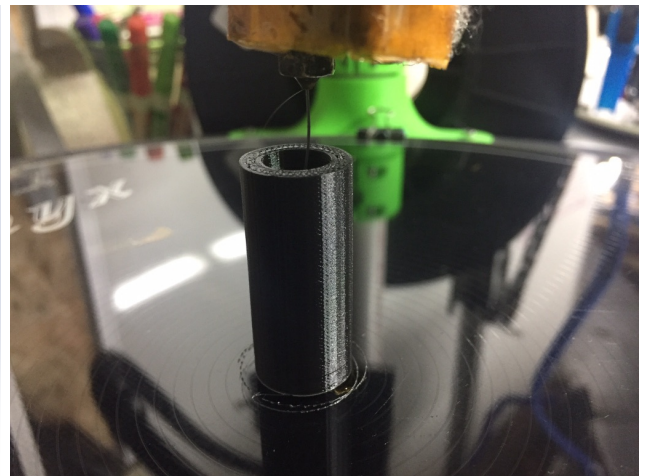
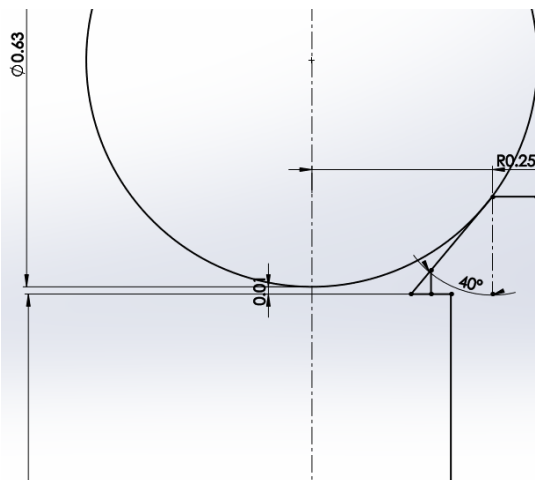




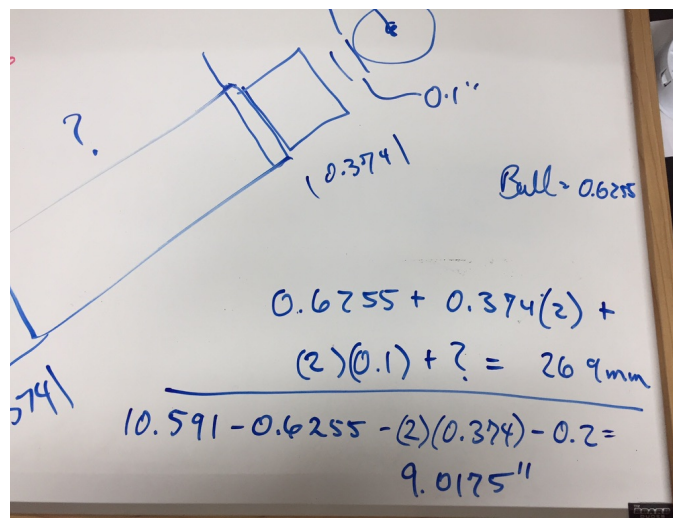
### Carbon Arms

Moving on down the printer, I started to build the carbon fiber magnetic arms that will be holding the effector. These arms are much stiffer than the plastic ones that come with the Rostock. This will help with print quality as it keeps the effector extremely stable and prevents it from overshooting during sharp corners.

First, I started printing these end pieces that will house the magnet and arm. I designed these to hold the magnet 0.01" away from the 5/8" steel balls. This gives it really good holding strength while keeping the friction down.



While printing 12 of these, I started cutting up the carbon tubes. Since I wanted to get exactly 10.591" (269mm) of total arm length, I did some whiteboard math to figure out approximately how long I needed the carbon tubes to be. This was done with the assumption of 0.1" of space between the steel ball and magnet. That gives me some wiggle room down the line if I wanted to change that distance. Also, the magnets were 0.374" long and I'd have two of them, one at

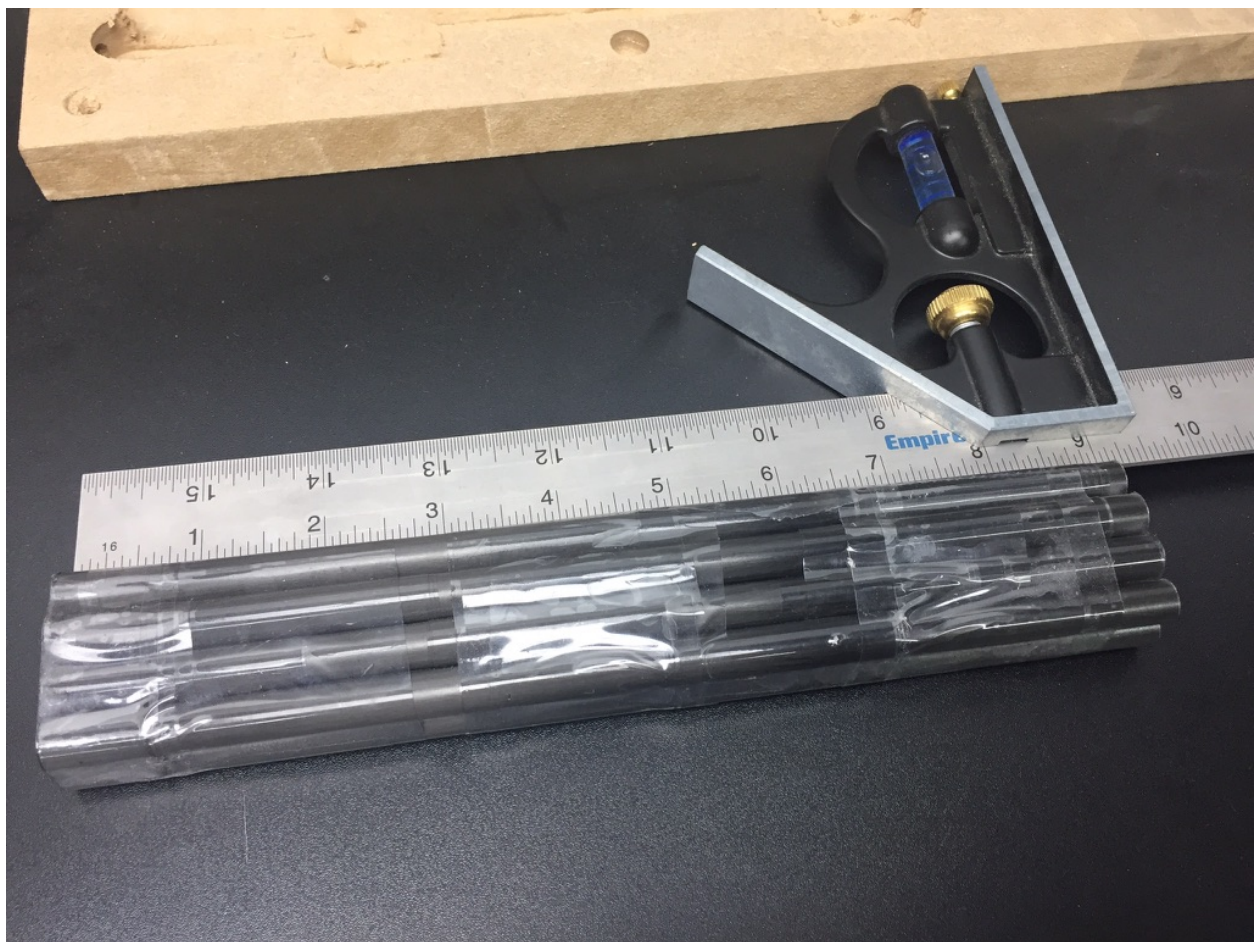


## Rostock V2 Mod

each end. This leaves me with a carbon tube length of just over 9". So I cut them at 9".

Before I chopped up the tubes, I needed to tape them together. Getting them all to the exact size will be more useful than getting them exactly at 9 inches. I'll be using a jig later to make sure they set at the length I need as the epoxy cures.

I took two 48" carbon rods at 3/8" diameter and chopped them into roughly 12" pieces. Then I taped them all together with packing tape before cutting as close to 9" as I could. I made sure to cut both ends so they would all line up and flat.

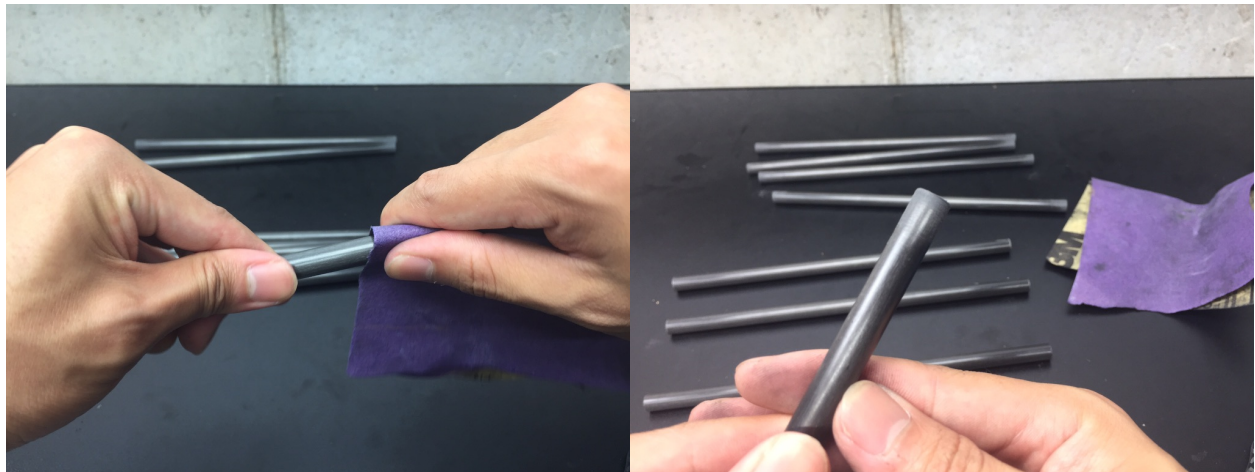


Once that was all done, it took a bit of patience to get them all out of the neat little package I wrapped them into. Then they were subjected to the same sandpaper treatment the steel balls got.



## Rostock V2 Mod

Using some 220 grit sandpaper, the ends of the carbon tubes were roughed up to help the epoxy bind to them better. I didn't go crazy, I just wanted some scuff.



With the tubes prepped and ends printed, I started making a jig to hold the arms as they set. My original idea was to cut 6 slots in a piece of wood to the exact length I needed, which was 11.235" from center of arch to center of arch. This accounted for the two 5/8" steel balls, two 0.01" gap between ball and magnet, and the original 10.59"(269mm) arm length. I cut this out using the CNC router on to a piece of MDF, but then I realized I made the width a little too tight, which didn't allow the piece to sit naturally inside. It was still on the router, so I re-ran the job to make the cutouts a little bigger. It kinda exploded...the thin pieces of wood between each slot didn't hold under the RPMs of the router. Oops. But hey, the length worked, so I just stuck some magnets on either end to pull the balls out so they butt up against the wood. On the left side, there's a hole drilled into the side with a magnet in it. The right side was easy, place magnet and done. Wasn't exactly the 6 slot setup I wanted but it works. Just do one at a time.



## Rostock V2 Mod

Assembling the arms was quite straightforward. I start by taking the printed end piece and inserting a magnet (making sure polarity is correct relative to the jig). I found it easier to grab the whole rod of magnets, push a section into the end piece, and bend it, letting the plastic piece pull the single magnet off.



Then I used a carbon rod to push that magnet all the way down until it hits the end stop. Now plop a steel ball bearing to the other side so it pulls the magnet to the end of the end piece.





## Rostock V2 Mod

The magnet should be a pretty snug fit as you don't want that to move at all. I would have added some epoxy before I pushed it in, but I didn't want any epoxy to squeeze out of the opening by the bearing. So instead, I'll just push some epoxy up behind it when I glue the carbon rod in place. I mixed some epoxy up and used a little stick to put some inside the end piece, just under the rim. It will ooze down and cover the length of the end piece on the inside. Plus, the carbon rod will help spread it out as it goes in.

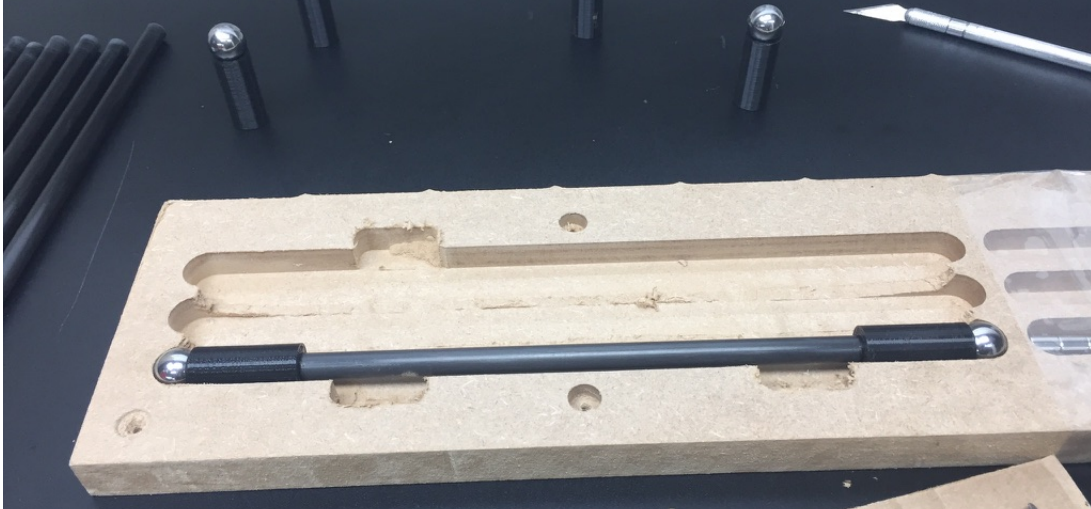


I coated the inside wall of the piece but didn't fill the whole thing. I guess you could as it will just force its way into the tube when you press it in. Next, I grabbed a carbon tube that has been roughed up and pressed it into the end piece, all the way up to the magnet. Repeat this for the other side.



## Rostock V2 Mod

Once both ends are assembled with epoxy in them, I pressed it into the jig and make sure both ends are butt up against the wood. The rod will be able to slide a little back and forth inside the end pieces, so I moved it until it was equidistance from both ends. This is the wiggle room I was talking about as I could have made the distance from magnet to ball bigger and not have to adjust the tube length. After sitting for 10 minutes, I did it again for the next 5 arms. Note: ball bearing isn't epoxied!



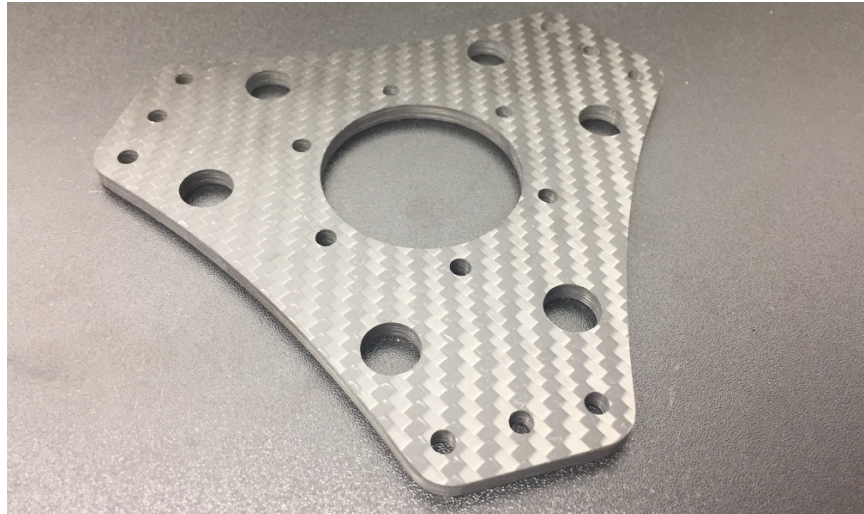
Once the arms were done drying, I tried it on the carriage balls to make sure they could articulate the full 90 degrees you'd need for printing edge to edge. It works!





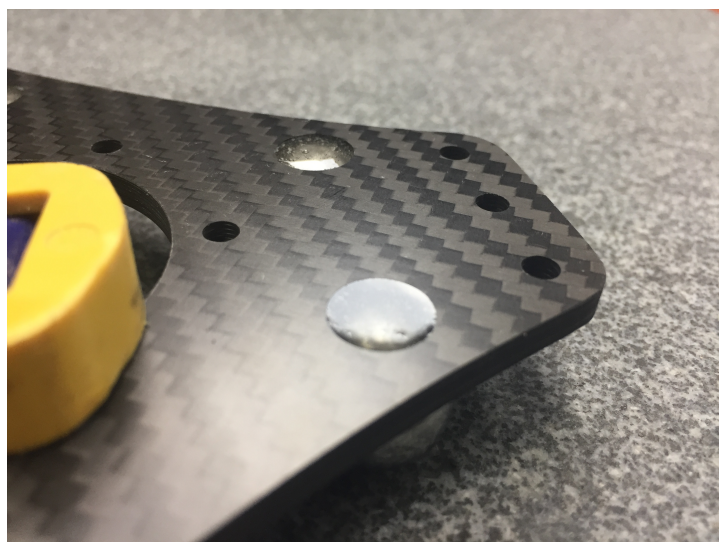
### The Effector

The original effector was injection molded with a lot of plastic pieces that bent and warped as you printed. The faster you printed, the more out of whack the prints got. This carbon fiber effector not only has much better stiffness over the plastic one, it also has plenty of mounting holes for all your cooling fans. The center is your standard 40mm opening with 50mm mounting hole spacing.



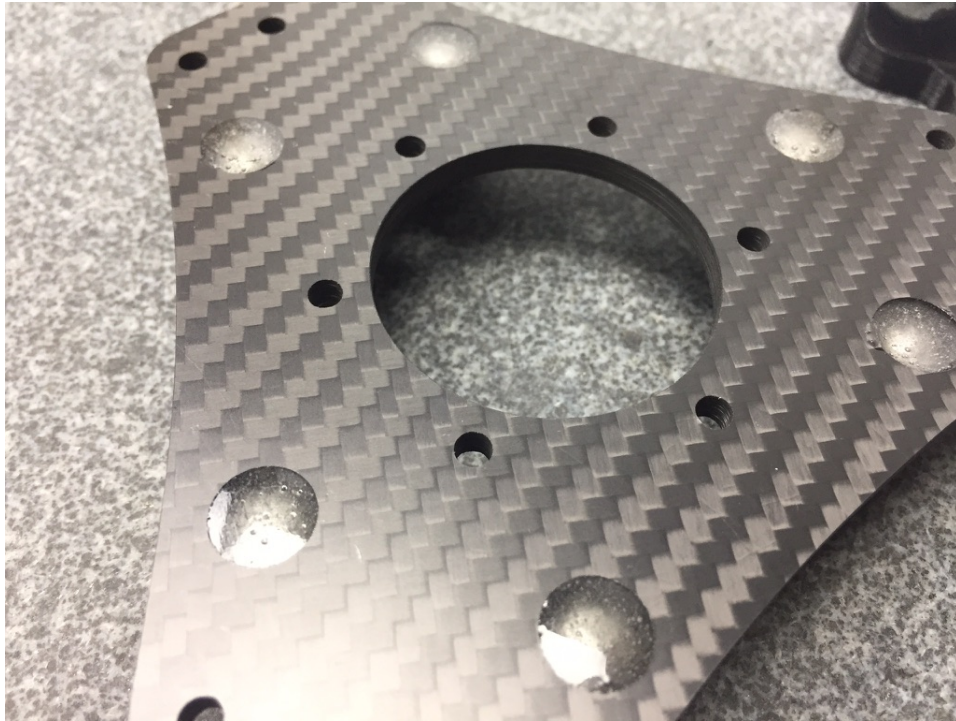
The big holes around the edge are precisely calculated to hold the 5/8" steel balls up high enough to allow a minimum print angle of 20 degrees, which is what you need to reach the white line on the edge of the print bed on a Rostock V2. The steel balls are secured in place by a bunch of epoxy from underneath.

Using a piece of granite as my flat surface (it's really really flat... less than 0.001" variation over the entire surface) I placed the effector over the 6 steel balls and clamped it down. I made sure the scuffed up part of each ball was showing through the hole as the epoxy will grab on to them from there. Then I mixed up a bunch of epoxy and carefully poured it into each cavity until they were flushed with the carbon.



## Rostock V2 Mod

I let it sit until the epoxy had fully cured before attempting to move it.



Once it was set, everything was rock solid. An unintentional drop test showed that the balls weren't going anywhere.





## Rostock V2 Mod

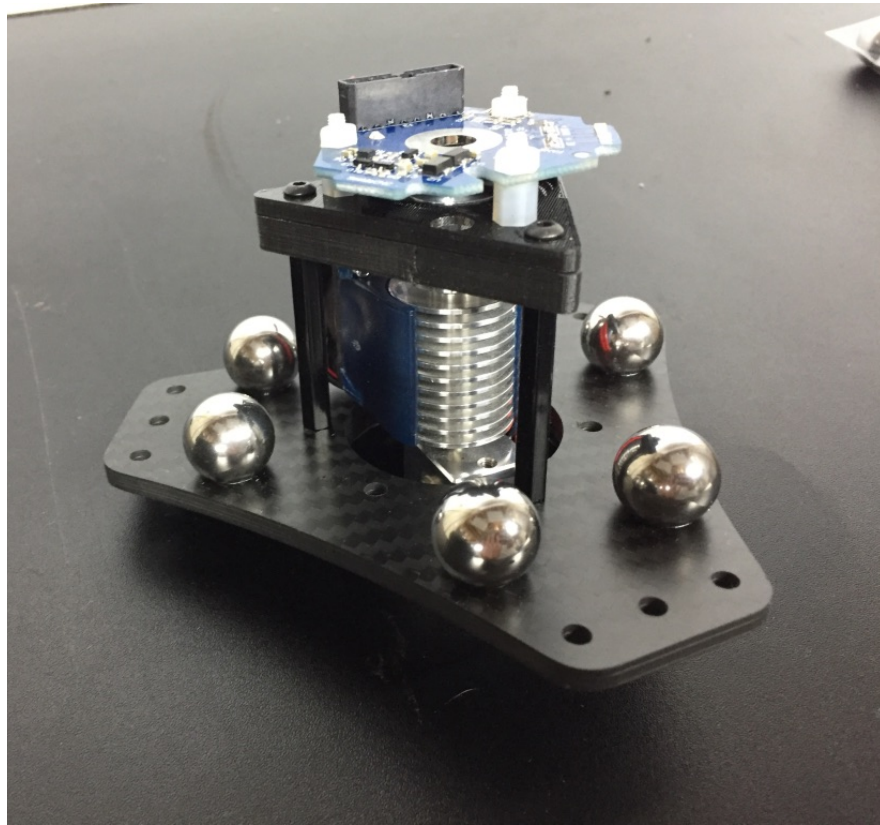
A quick test to see how the fit and finish will look.



It's a little twisted in the picture, hence why the arm's don't look perfectly parallel. Overall, the hold on the magnets are superb, and the smoothness they provide will certainly help with print quality.

### The Hot End

I've been using E3D's v6 hotend for a while now and they've been awesome. They have a standard 12mm/16mm end which was easy enough to make a mount for. The only reason I decided to create my own mount was because I wanted to try and add SeeMeCNC's new accelerometer to the effector as well. This is a little different mounting pattern than the 50mm ones on the effector, so it had to go on top. It cleaned up very nicely. This is actually all wired up and RTP



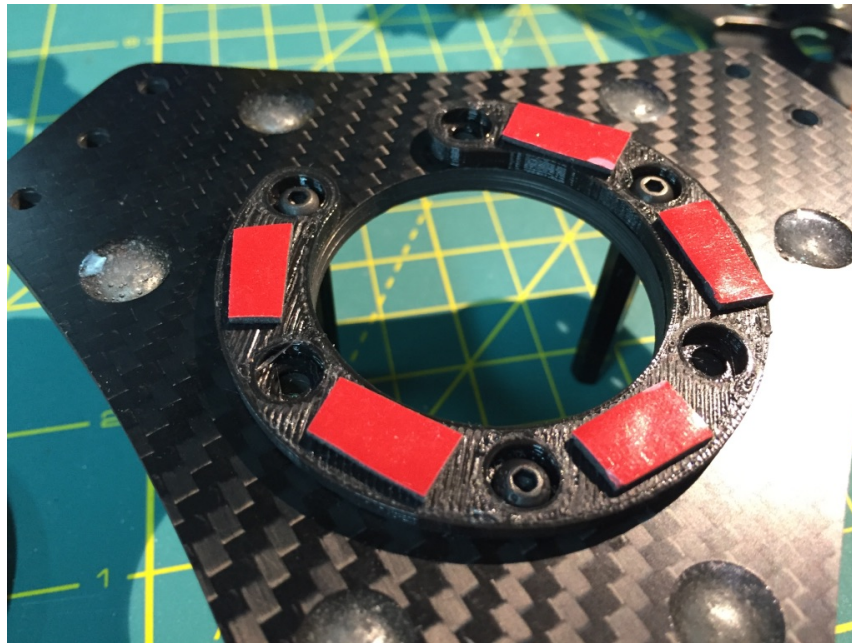
The top piece of the hot end mount has a countersunk hole for the screws to sit in as it attaches the nylon standoff to it. The accelerometer then sits on the standoffs to give it space underneath for all the wires to run.



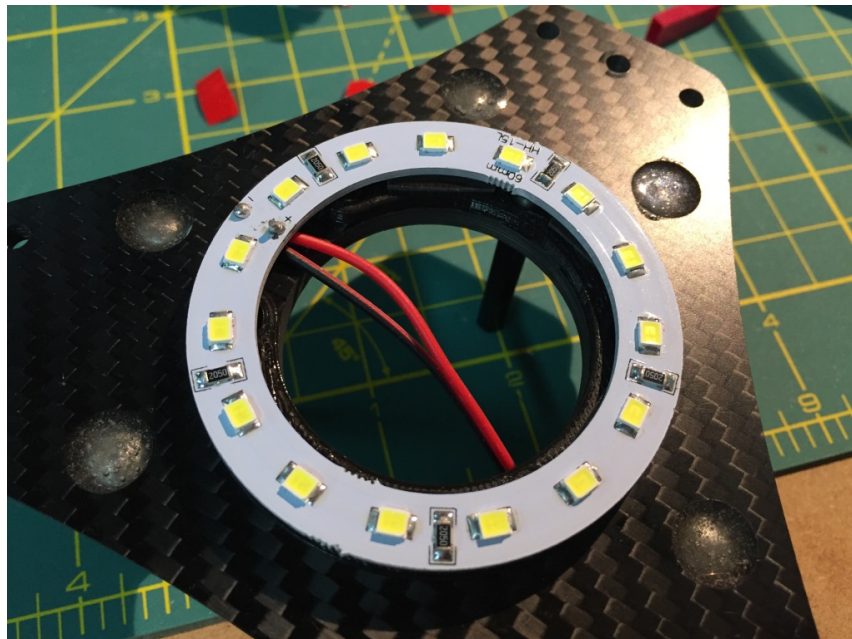


## Rostock V2 Mod

As an added touch, I went ahead and ordered an LED ring that fits perfectly around the effector's opening. To combat the screw heads poking out from underneath, I made this LED ring thing that helps make the surface more LED friendly.



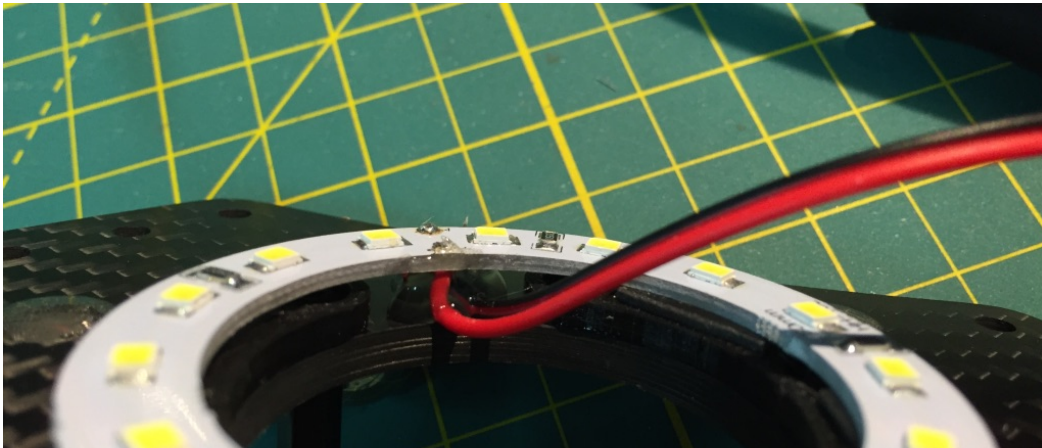
Add some double sided tape and plop the ring on top.



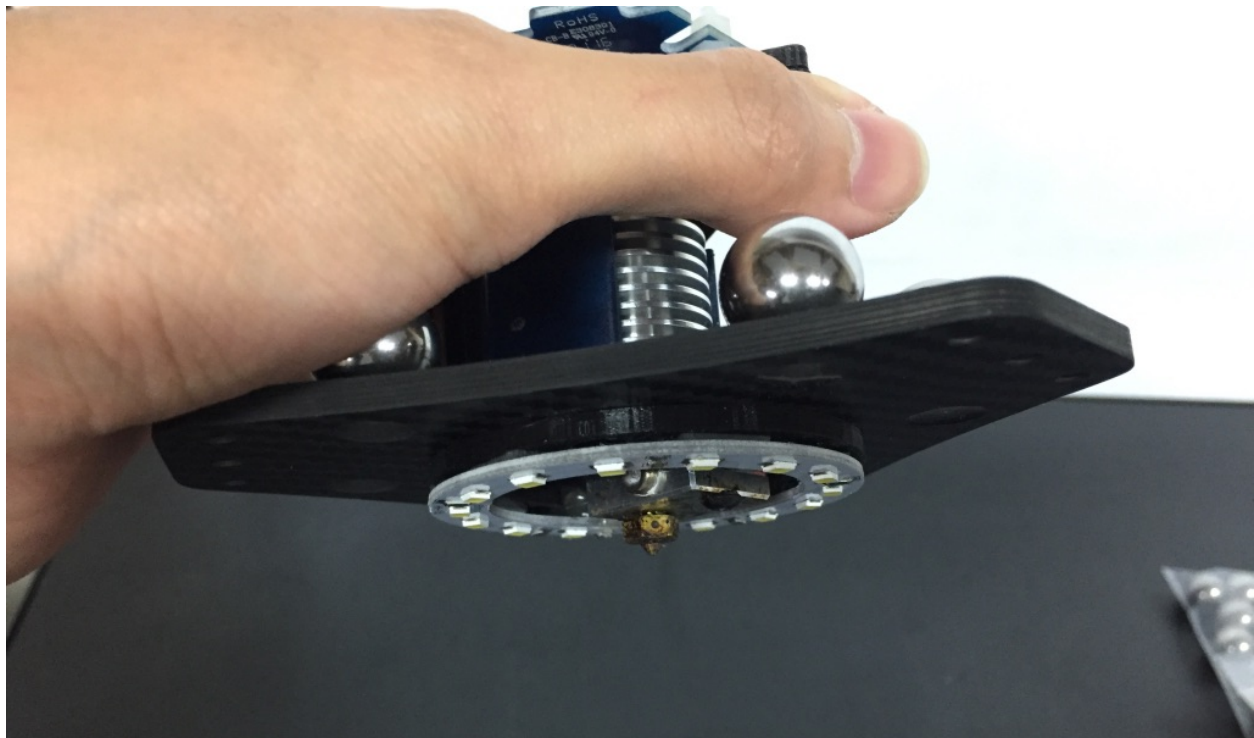
## Rostock V2 Mod

At this point, I learned something: never trust the solder on cheap parts. The wires you see above were the ones that came with it, along with the shoddy solder job that fell off the second I tugged on it to test it. So I had to rip this all apart again. Luckily, I was able to remove the ring without damaging anything and re-solder the wires.

Once I got everything put back together, I added a dab of hot glue around the solder and wires for strain relief.



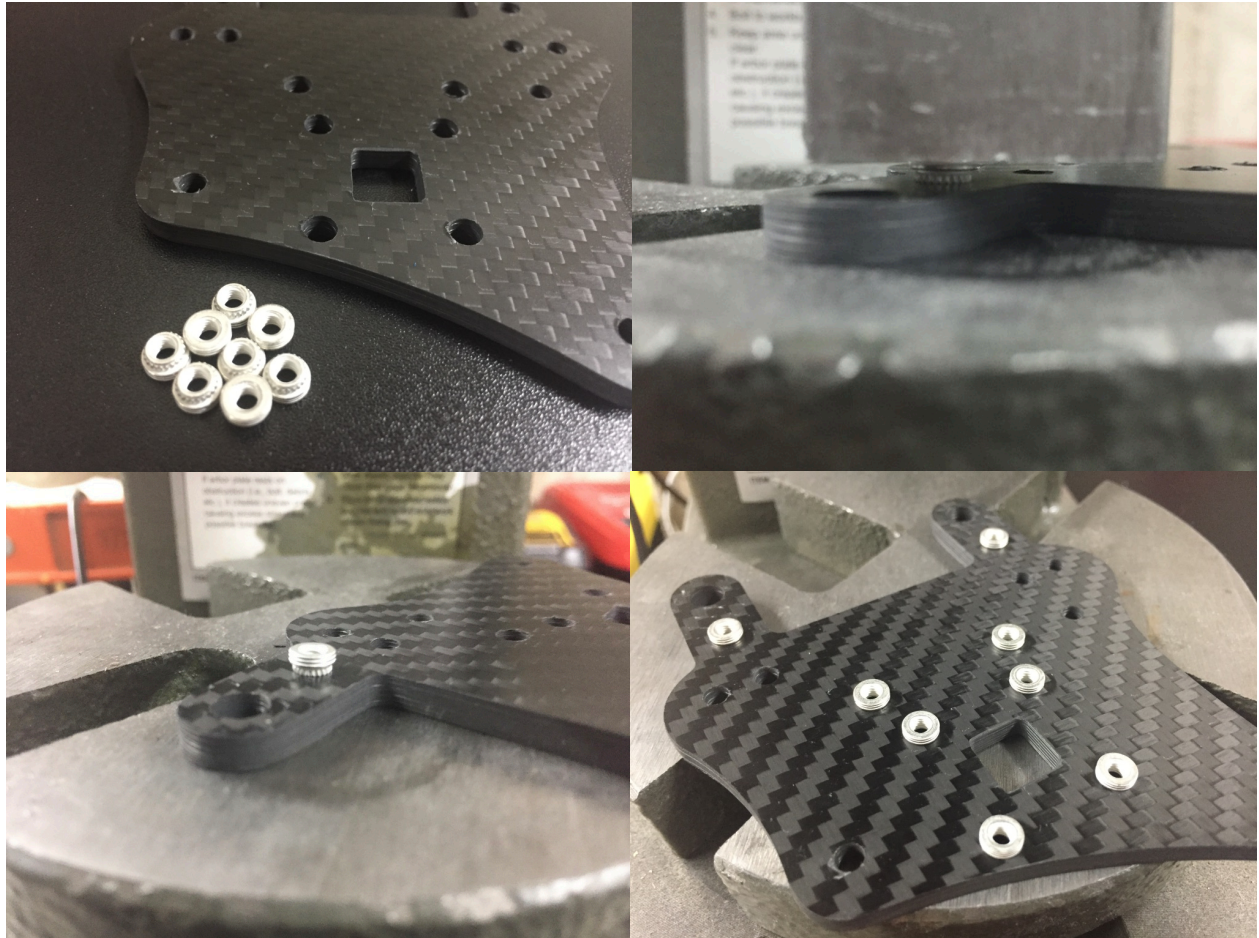
Ta daaa!! Carbon Carriage





## The Carbon Carriage

The entire carriage assembly could now be assembled on to the printer. One last preparation was pressing the M3 steel press nuts into the carbon. I used an arbor press to push 8 of them into each plate.

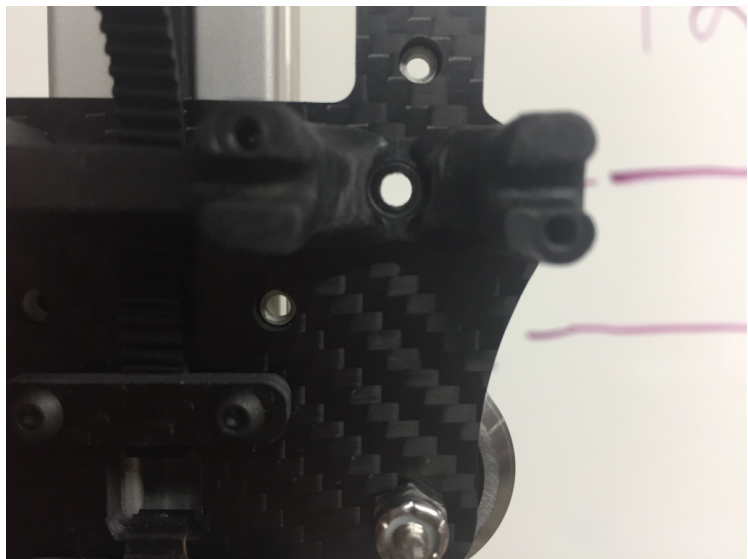


## Rostock V2 Mod

Now I can start attaching things to this plate. First, I attached the ball pillars using M3x8mm screws. They align with the top 4 press nuts on the carbon plate.



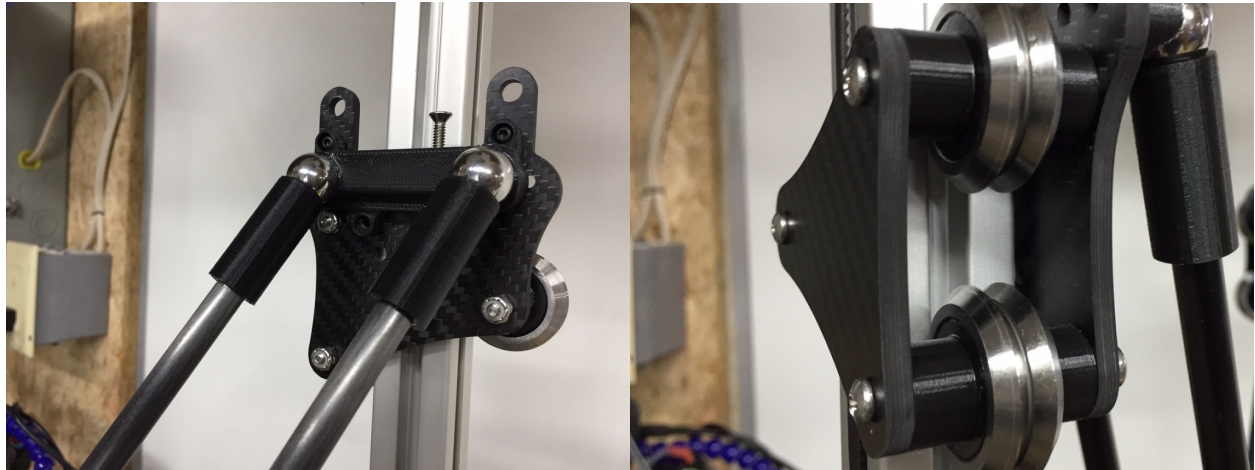
As a side note, there are holes to use the original parts from the Rostock if you'd rather not change to carbon arms.





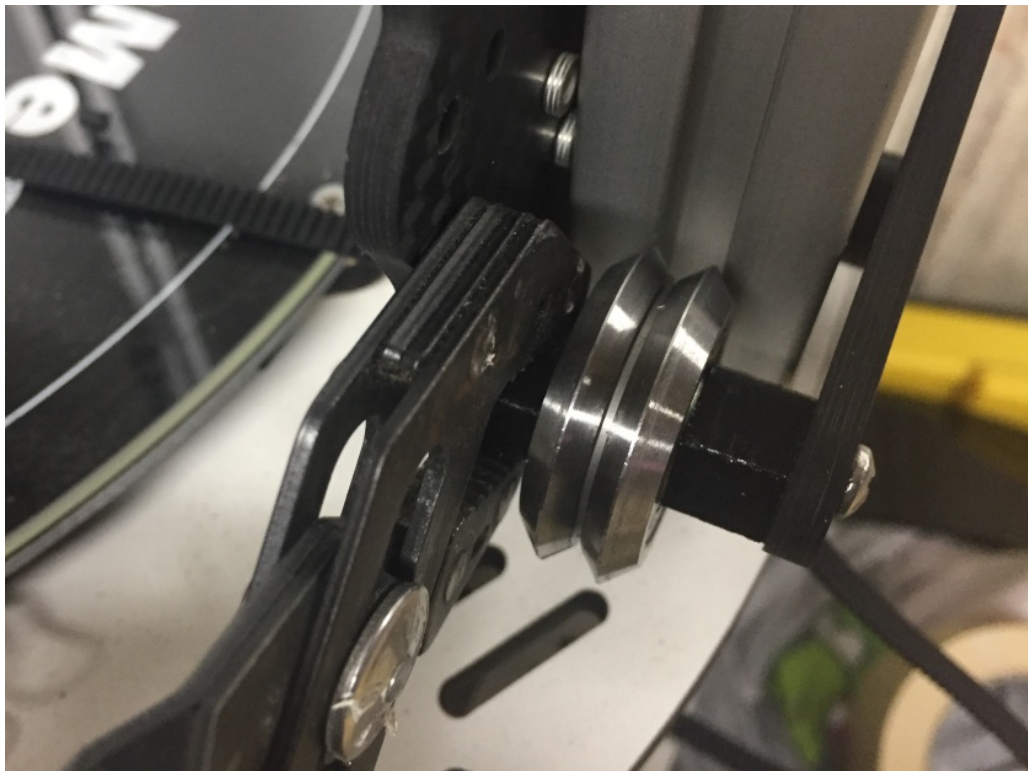
## Rostock V2 Mod

Next was the v-groove bearings and placing the carriage on to the aluminum extrusions.



When installing the bearings, I made sure to put the one with the eccentric spacer on the side with only one bearing. This lets you tighten it up against the extrusion without turning the carriage out of line. The original screws were cut

down so they did not stick out so far. After all the bearings were on, we can tighten it up against the extrusion by turning the eccentric spacer.



## Rostock V2 Mod

After the carriages were all in place, I started looping the belts through the hole and securing them to the remaining press nuts. Using forceps sped up the process as the hole is a little too small for a finger to fit through.



Now before I tightened the top belt holder, I used some pliers to grip the belt and pull it relatively taught while securing the screws (also M3x8).





## Rostock V2 Mod

Once that was all done, I tucked the lower belt end into the top belt slot in case I ever needed the extra length later. Then I tightened the bearings at the top of the towers to get good belt tension.



And with that, the carriages are all done and the arms just snap into place.



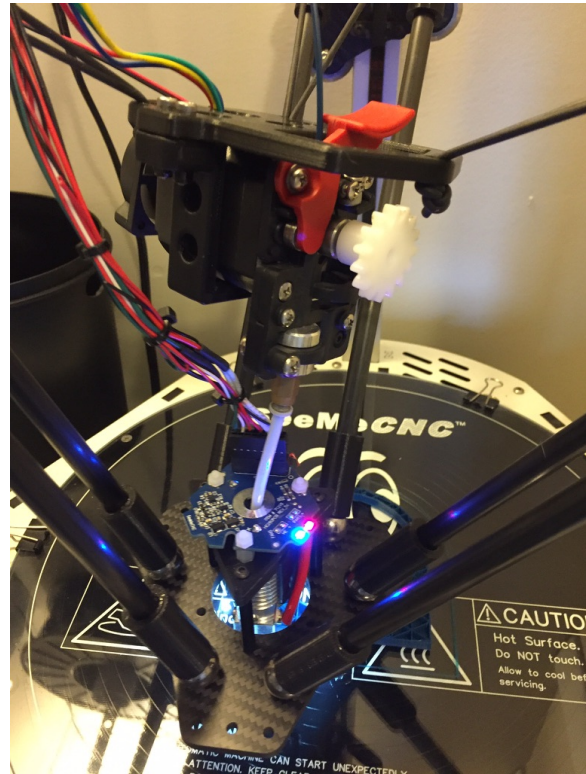
## Flying Extruder

While the machine is in pieces anyways, I decided to go ahead and make the conversion to a floating/flying extruder. It was a simple enough task and it will help with retraction issues in the future. Plus, the idea was already built into the carriages as the two prongs sticking up are meant for suspending an extruder.

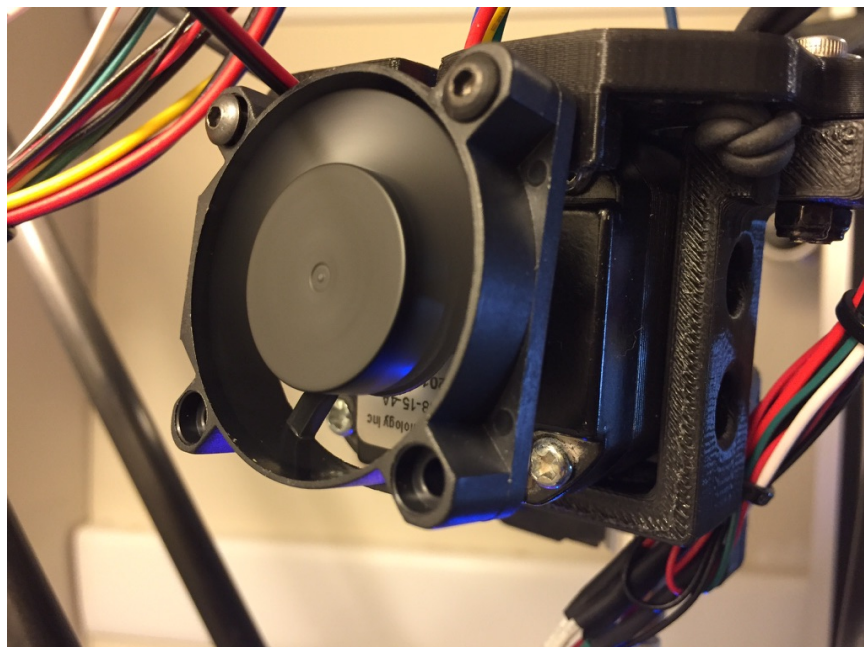
There was already a stellar model on Repables by Jassper, so I just used his design rather than reinvent the wheel. It worked great!

Link: <http://repables.com/r/531/>

The extruder was suspended by some o-ring gaskets.



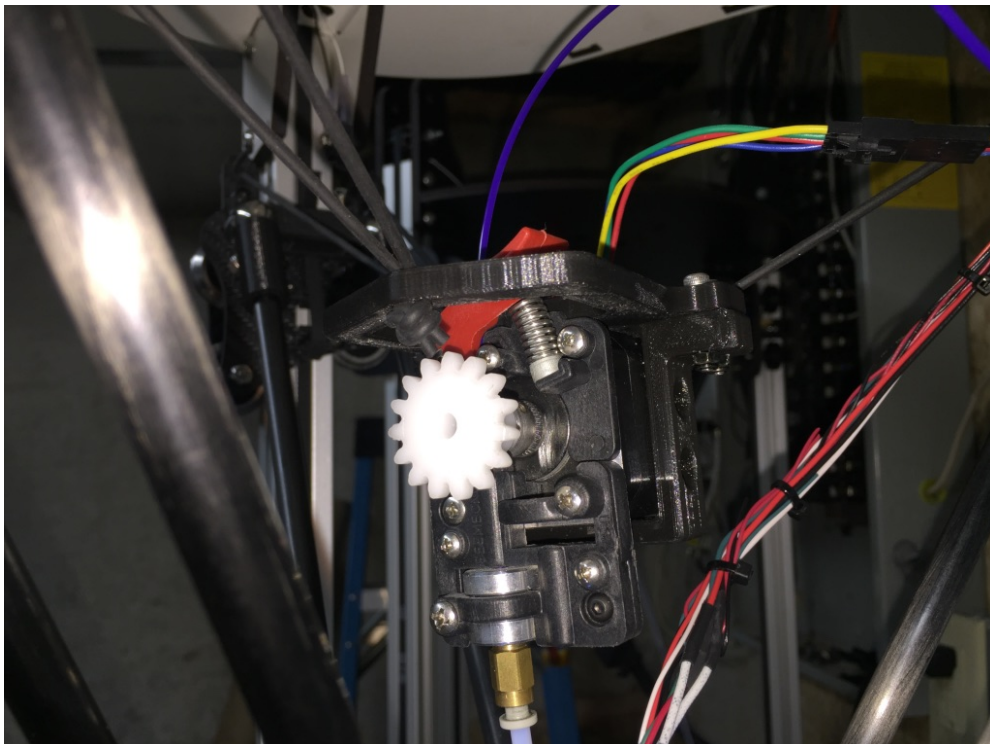
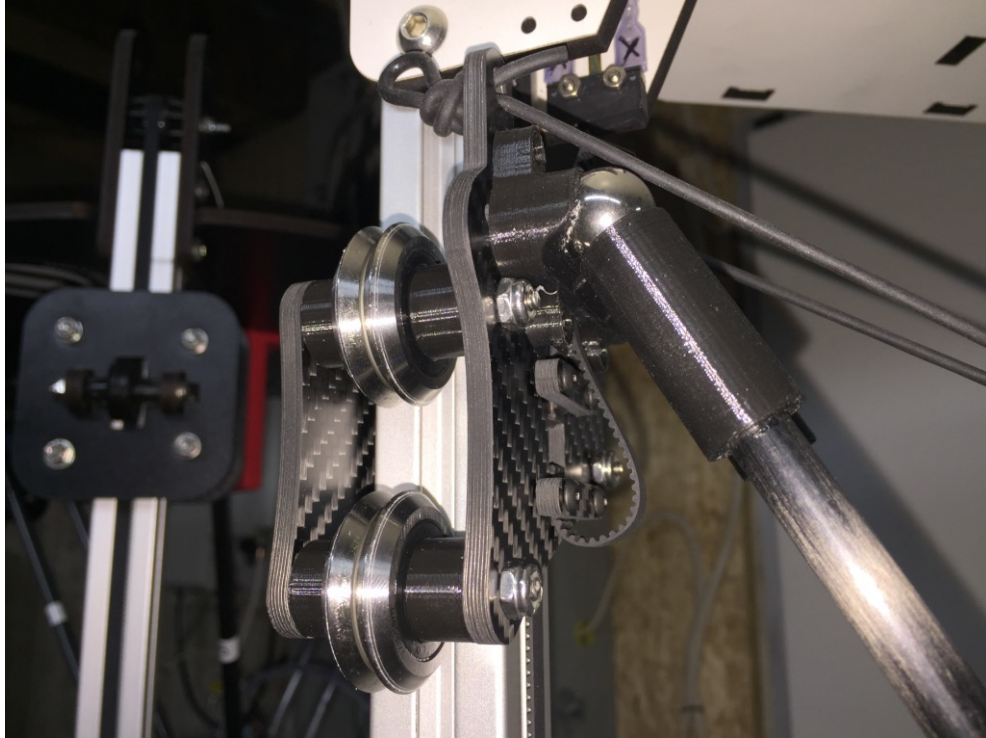
The Airstuder design allowed a fan to be installed on to the back of the extruder, so I went ahead and put one there. The power was taken from an independent 12V source as the accelerometer board was already getting near the max current it could provide. Plus I wanted it always on.



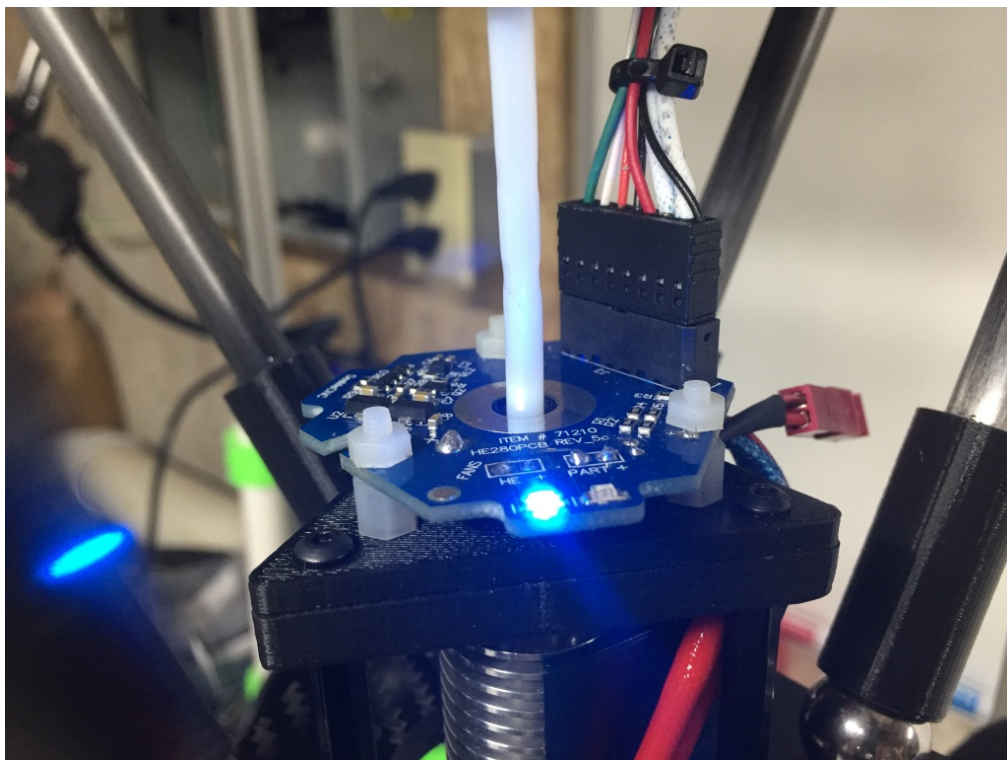


## Final Assembly

Here are some pictures of the final assembly as everything is ready to print!



## Rostock V2 Mod



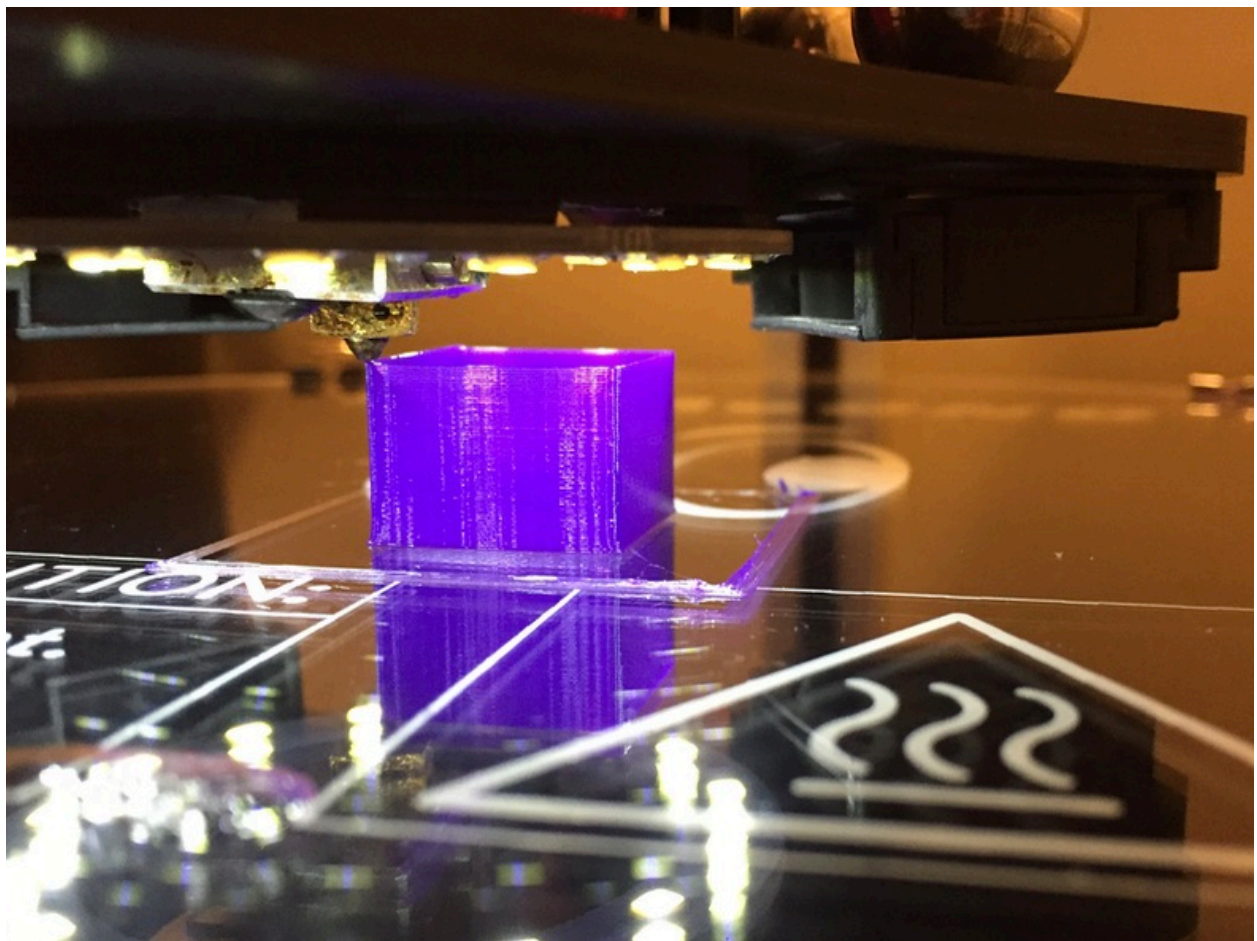


## Rostock V2 Mod



### The Software

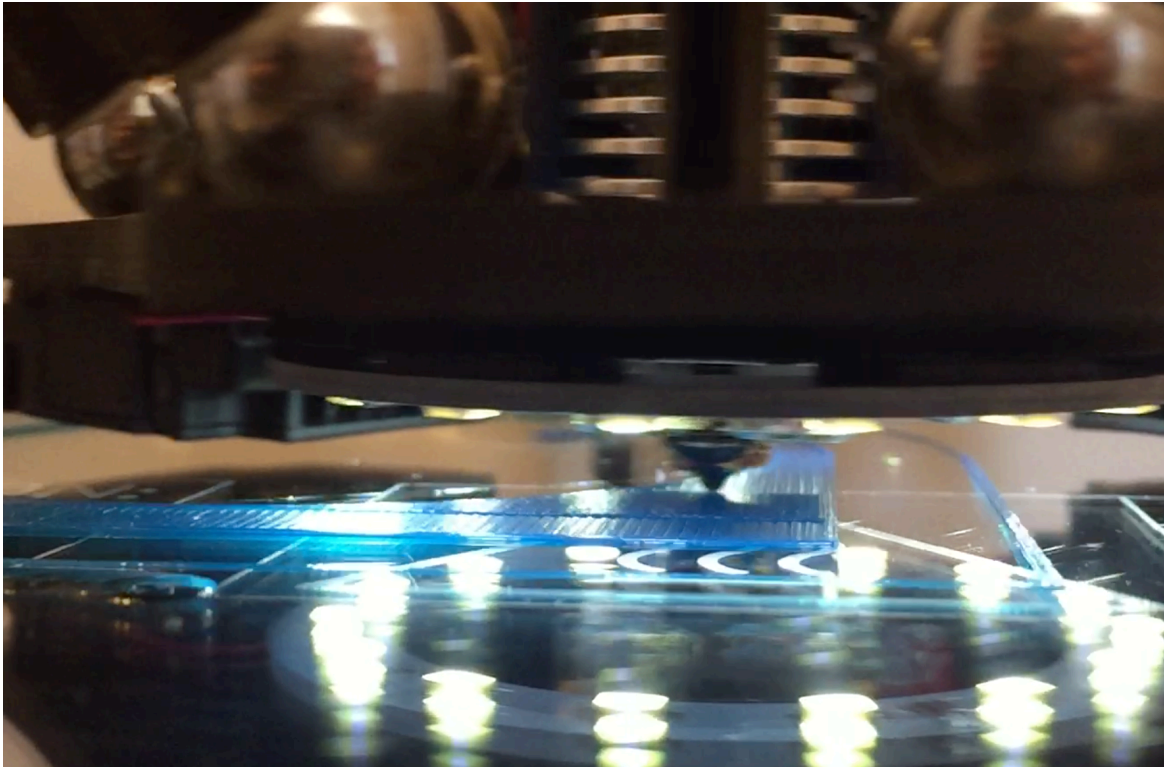
To get the accelerometer working, I updated the firmware to Rostock Max V3. The only thing I had to change was the arm length from 290mm to 269mm. I then ran their auto calibration G-code found in the download section. It was pretty cool! The nozzle came down and tapped 4 different spots on the print bed twice and homed a few times. The entire process took about 1 minute and it figured out the horizontal radius, end-stop offset, and max Z height. Here was the first calibration cube print! Even at 50mm/s, there was no overshoot on the corners. The machine was now a very solid and rigid printer.





## Rostock V2 Mod

The cube came out at 20.07mm x 20.03mm and 0.18 first layer. I dropped max z height by 0.03 to get exactly 0.15 layer height. The X and Y dimensions were in good tolerance for me. I've never seen such smooth layers before on the original Rostock setup.



## **Rostock V2 Mod**

Even though it could handle 50mm/s print speed, I dropped it down to 40mm/s just to get even better results. The shortened bowden tube allowed me to reduce retraction from 8mm to 3.5mm and still have no stringing. This really helped keep the extruder running cool as it didn't have to push so much filament around.

Overall, this was a very worthwhile upgrade to the Rostock Max V2. The print quality will last me a very long time and gets rid of the little nuances that came with the original V2. Everything is super rigid yet buttery smooth. No more calibration hassle either as the accelerometer can perform that function very quickly. Now back to printing



## Rostock V2 Mod