

Railcore II ZL Assembly Guide v0.1.0

Introduction

RailcoreII is a Core-XY based Reprap 3d printer designed by J. Steve White & Tony Akens. The initial idea to collaborate on a printer started in the #RepRap IRC channel, and centered on some common goals we both had in mind for a new printer design.

1. Core-XY motion.
2. All Linear rails for movement
3. Space & Cost Efficient, enclosable frame
4. Key components being printable, or able to be milled
5. Flexibility and Scalability in the design
6. A professional looking printer
7. Self Sourced and Easily customizable

Steve had previously built the “railcore”, the “alpha” version of this printer. We took what he’d learned from it, and began the design on the new printer. All design work was done in Fusion360.

As we progressed, we decided to “publish” this printer in an open, documented format for others to build as well.

The frame is designed to be 1515 aluminum extrusion. This was a space efficient choice, and it makes building the printer easy, as standard M3 hardware works like a T-Nut, fitting into the extrusion nicely. To add rigidity, we use melamine sides to stiffen the frame. (These can be cut out of any material you prefer, including plywood, acrylic, aluminum, etc). The total cost for the actual frame components (Extrusion, corner cubes, and sides) is roughly \$100.

From there, some key design decisions were to make the build volume a 250mm cube. This kept the total printer size to what we considered reasonable. The design is easily expandable to 300mm cubed. Some notable aspects of the design: dual leadscrew Z-Axis with a belt drive between them, Stacked idlers duo-planar belt path. The electronics in the design are the Duet (Wifi or Ethernet), 24v PSU, 0.9 degree steppers. We used an E3D v6 for the design, as it’s the most common hotend at this time. Support for other hotends will be forthcoming (needing only a different Y carriage). Semi-Direct drive or full bowden is supported.

A special thanks to Filastruder, Duet3d, E3D, SeeMeCNC, and 713Maker for supporting the project.

Link to BOM & Thingiverse Project

This is the BOM as we built the initial prototype and first “production”

[Bill Of Materials Spreadsheet](#)

Here's the thingiverse link for downloading all the printable parts, dxf's, etc
<https://www.thingiverse.com/thing:2407174>

THE RAILCORE IS A “DIY” PROJECT - BUILD SAFE, BUILD SMART, AND BE RESPONSIBLE. WHEN IN DOUBT, DOUBLE CHECK THINGS. 3D PRINTERS CAN GET VERY HOT, USE COMMON SENSE AND QUALITY COMPONENTS. BUILD AT YOUR OWN RISK.

Recommended tools, notes

To build this printer, there are some recommended tools you'll want. All of these are detailed in the “Tools” tab of the BOM. You'll need a 3mm tap to tap the ends of the extrusions. A quality tap from Irwin is recommended, and makes it go much faster. A 5.5mm Nut Driver is highly recommended, since most of the hardware is M3. It's recommended you run a 3mm or 5mm drill bit through the holes in the printed parts to make threading bolts through them easier.

A note on options to the build

We chose to build with fairly premium components where it made sense. This includes the Duet Wifi controller, PanelDue display, E3D v6 Hotend, 0.9 degree steppers, and 24v PSU, among other choices. Many of these items can be subbed out for cheaper components to save cost. Other components, such as the Linear Rails, can be improved in quality by being purchased from Misumi or Hiwin. The design is made to be customizable based on your budget and goals.

It's also very important that the frame extrusion cuts be **square** and **accurate**. We opted to have our extrusion pre-cut by Misumi; if you cut it yourself, be very, very obsessive about cutting them the proper length and having perfectly square end cuts.

Printed Parts

The printed parts list is available on thingiverse, and detailed in the BOM on a separate tab. For all structural parts, we recommend Atomic Filament's Carbon Fiber PETG, or ABS be used. 4 perimeters, 4 bottom and 4 top layers work well for adding a lot of structural integrity to the parts.

There are a few printed parts that can vary based on your hardware.

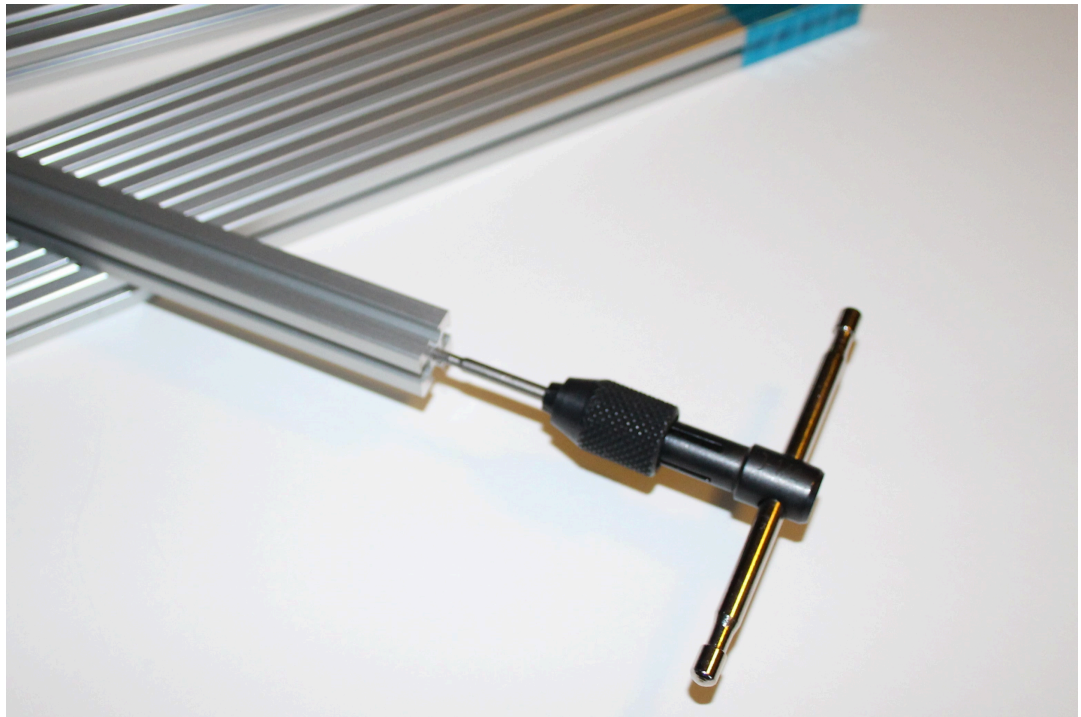
There are also two options for the switch plate cover, one for shorter power switches, one for longer switches, and a short & tall switch box.

Before You Build

There are some preparation steps that must happen before you start your build.

1. Tap the Extrusion Ends

Using your 3mm tap, tap the extrusion ends to a depth of at least 10mm. This is required for attaching the corner cubes to the extrusions. Take your time to get good threads cut, running the tap in slowly and backing it out to clear the cut aluminum. It will go more smoothly if you use a bit of cutting oil or light machine oil on the tap. The only ones that do not have to be tapped are the 390mm extrusions for the Z axis and the 344mm extrusions that support the bed. After tapping your extrusion ends it's a good idea to deburr them with a countersink.



2. <Recommended> Check your rails for any missing ball bearings, and replace them.

If you ordered genuine rails, this is not likely to be an issue. If you ordered from Ebay or similar, it's common for there to be some stiction from poor lubrication, missing ball bearings, etc. We recommend buying some 2/32" diameter G25 ball bearings to replace any that are missing. For lubrication, a PTFE based oil is recommended on the rails. Alternately, you can use light lithium grease, but the

loading applied to these rails is very low and the lighter PTFE impregnated machine oils move with a little less effort.

3. Sink the brass inserts into the printed parts

You need to use a soldering iron to carefully sink the brass inserts into the printed parts. After placing each insert you'll need to clear the channel by pushing an allen wrench through, or just run your tap down through the insert and into the plastic (be careful not to cross thread your tap!)

The Y Carriage gets 17 x 3mm brass inserts.

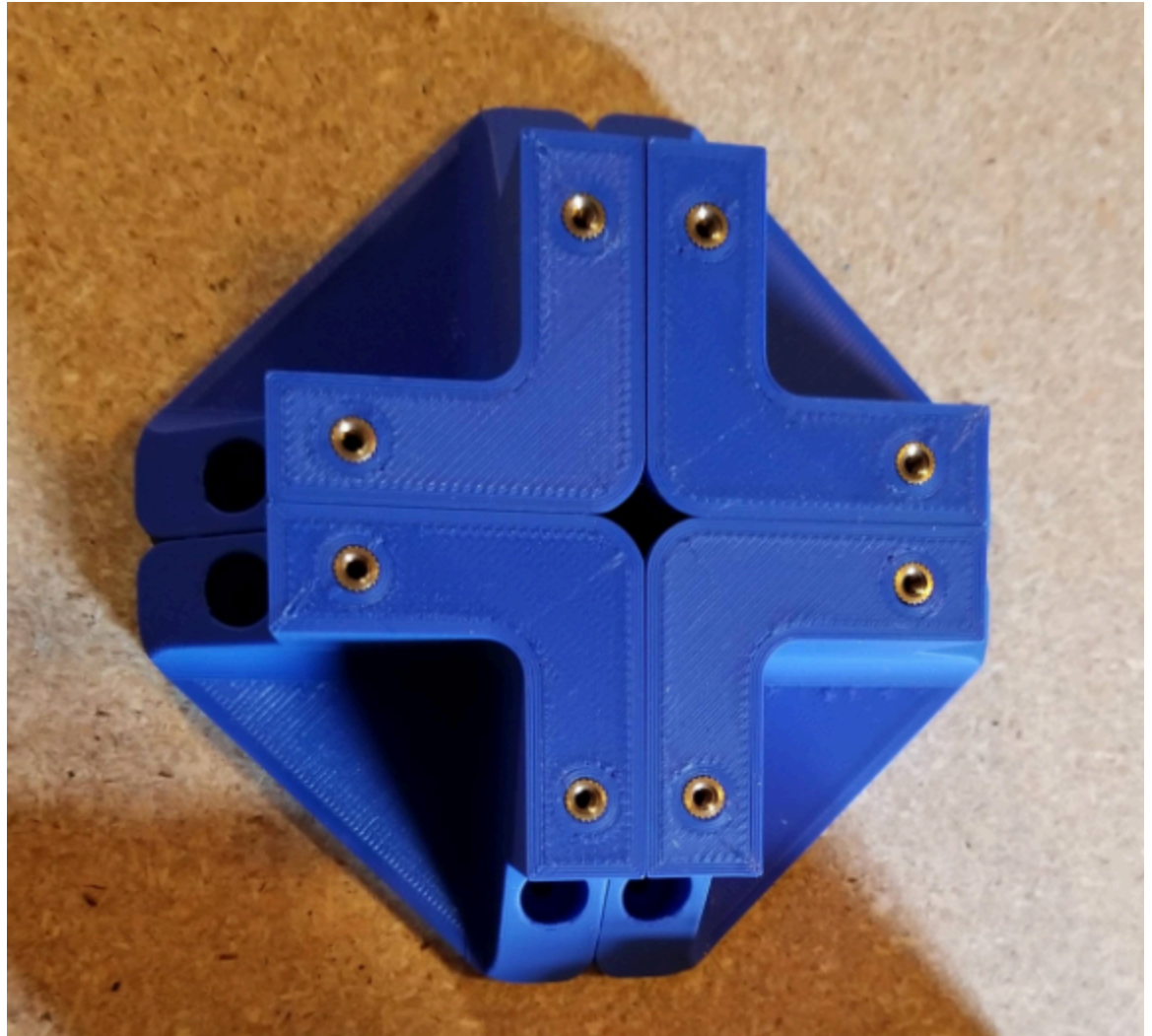


The X carriages get 1 x 5mm brass insert and 1 x 3mm brass inserts each. Both are inserted into the bottom of the Carriage. Be as precise as possible with the 5mm insert, as you want your idler bolt as straight up and down as possible.



Each Electronics Box Corner gets one brass insert. One end is thicker, to make putting the insert in easier.

If you plan to use the TPU pads on the bottom of the feet, which help reduce noise, you can add two 3mm brass inserts to the bottom of each foot.



Frame Assembly

1. Top Extrusions Assembly

Part List for this step:

(2) 400mm extrusion (front, back)

(2) 370 extrusion (left, right)

(53) 3mm nut

(16) M3 x 10mm hex head bolts

(9) M3 x 16mm hex head bolts

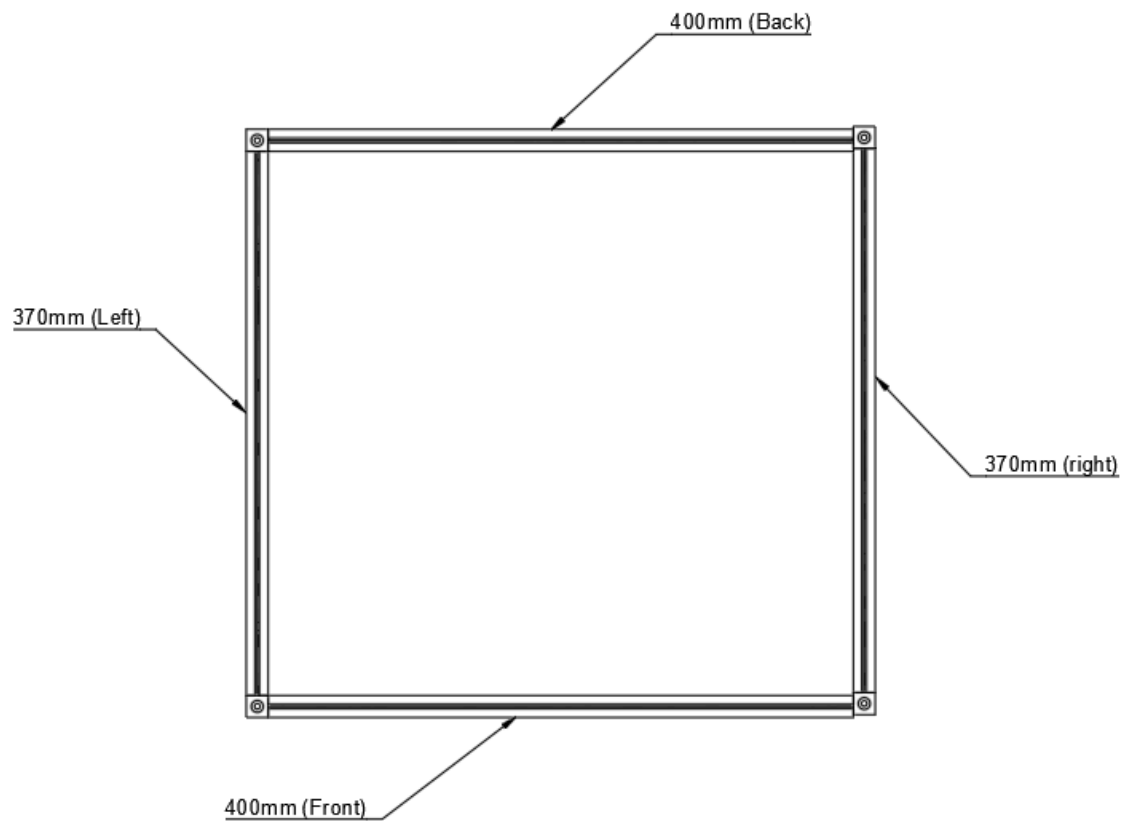
(8) M3 x 8mm button head bolts

(8) M3 x 8mm button head bolts (or 6mm, check your linear rail depth for fit)

(2) 350mm linear rail + carriage

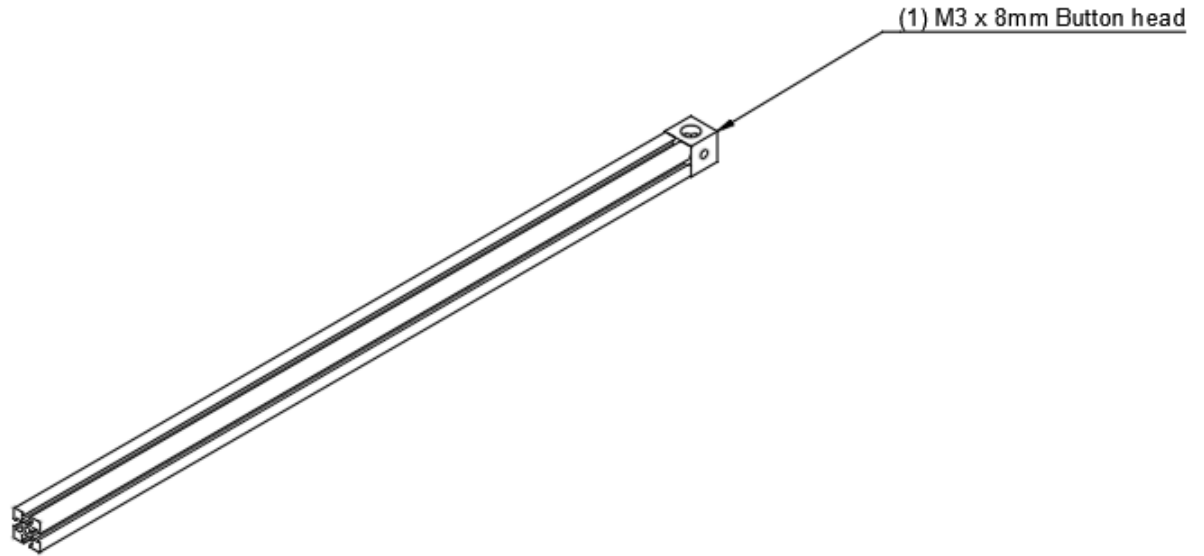
(4) Corner Cubes

Lay out your extrusion as shown in this picture.



The 400mm extrusions go in the front and back, and the 370mm extrusion goes on each side. Place a corner cube at each corner. Be sure to note the orientation of the corner cube. A small hole needs to face the end of each rail, and a small hole needs to point down. It can be helpful to use a pencil or marker to write a small mark to note what each is on the top of the Extrusion. I made a small letter on the top of each (F, R, B, L). Masking tape is another way to mark them.

Start with the 370mm Left Extrusion. Attach back left corner cube to left extrusion using an 8mm button head bolt. Just make the corner cube is snug for now.



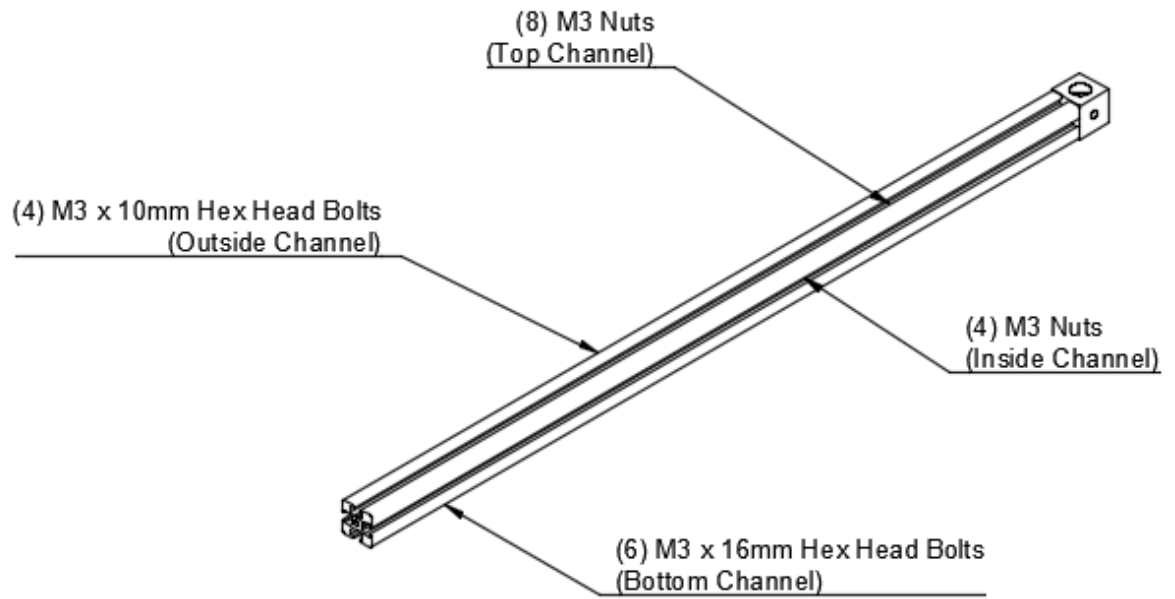
Holding the left extrusion as it will be oriented on the printer, slide the following parts into the extrusion. (if you marked it, I recommend keeping your markings on the top of each extrusion, so it's consistent)

(8) M3 nut into the top channel (this includes 4 spares for any optional components you may add later)

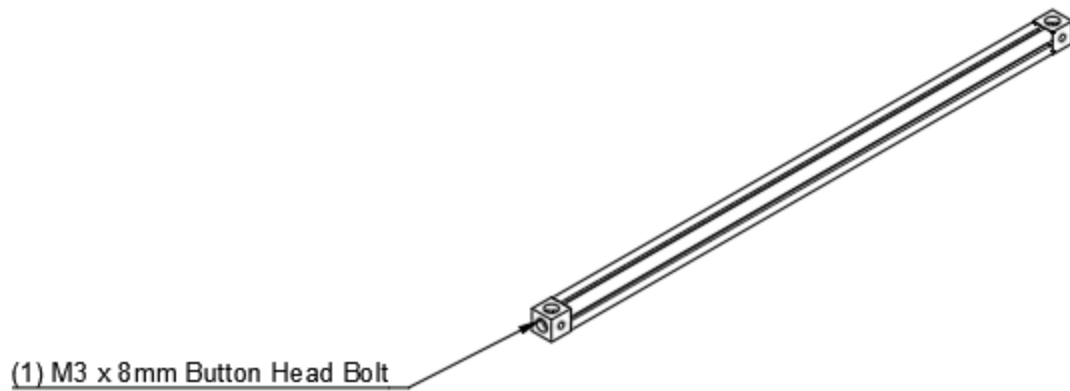
(4) M3 x 10mm Hex bolts in the outside channel

(4) M3 nut in the inside channel

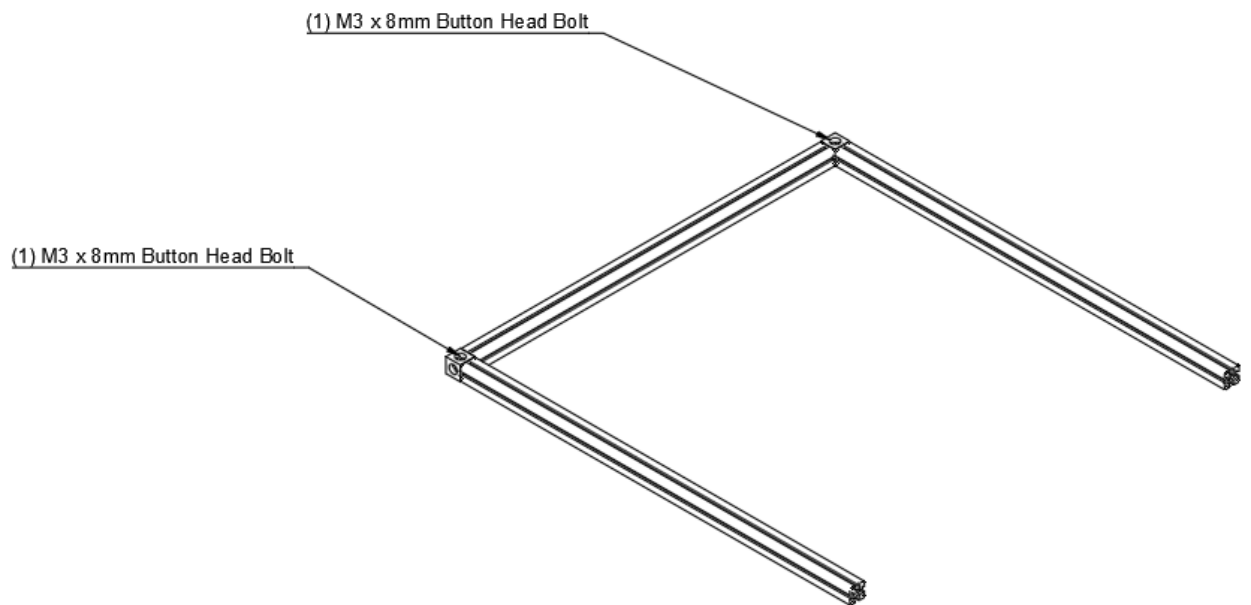
(6) M3 x 16mm hex head bolts in the bottom channel.



Attach front left corner cube to left extrusion using (1) 3mm x 8mm button head bolt.



Attach front & rear extrusions (400mm) to left extrusion using (2) 3mm x 8mm button head bolts.



You should now have a C shaped part made of 3 extrusions, and two corner cubes.

Now we're going to slide some hardware into the front extrusion.

(8) M3 nuts go in the top of the front extrusion. (All spare, 2 for optional panel due case)

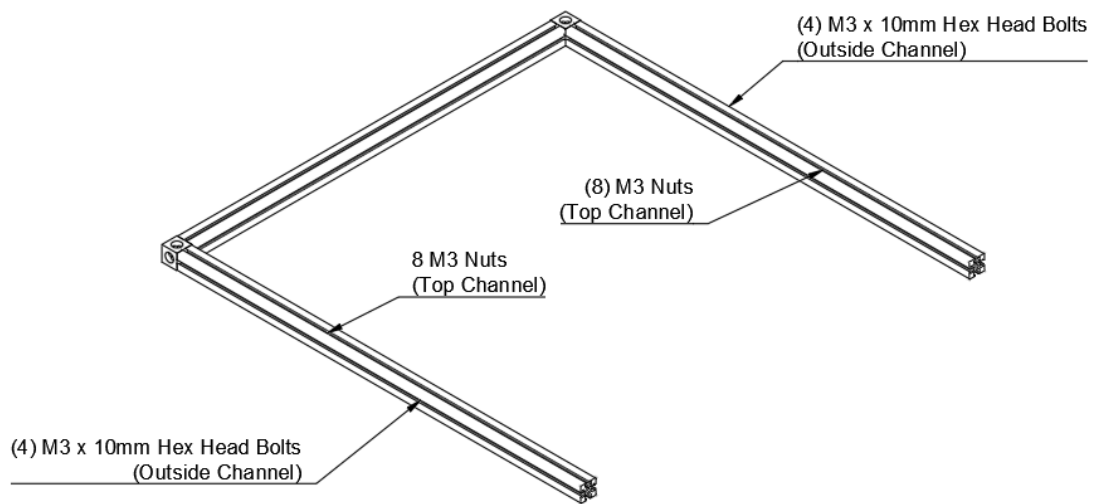
(4) M3 x 10mm hex head bolts go in the outside (facing you) of the front extrusion.

These will hold the front panel on later.

Now the same for the back extrusion.

(8) M3 nuts go in the top channel (6 spare)

(4) M3 x 10mm hex head bolts go in the outside channel (facing away from you) of the back extrusion. These will hold the back panel on later.

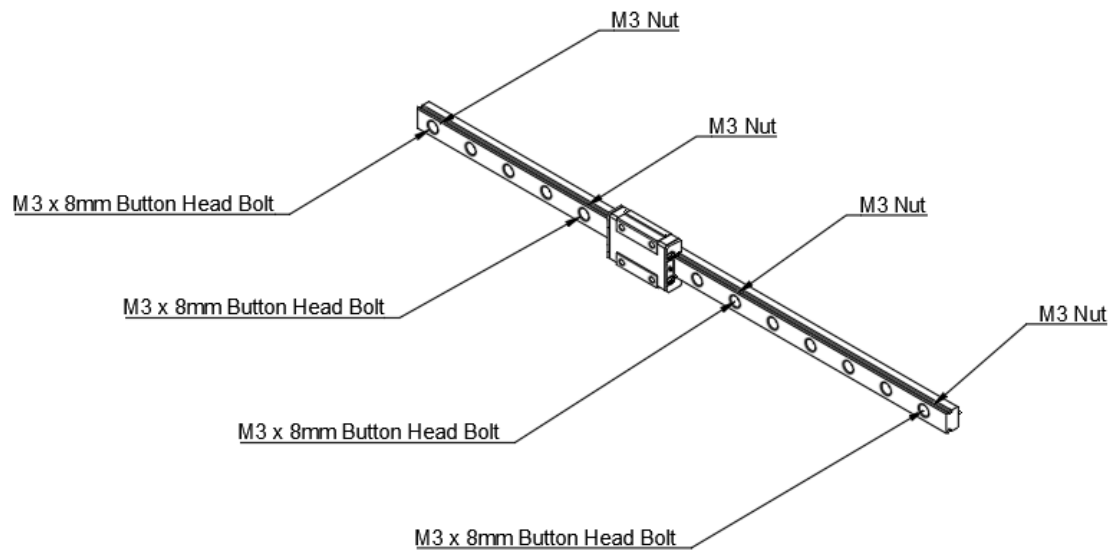


Now we're going to attach the linear rails to the front and back extrusions.

Take one of your 300mm linear rails and move the carriage to the center. Use a couple bits of easy to remove tape like masking tape or painters tape, and tape the carriage there so it doesn't slide freely (you don't want it falling off!) My rails came with zip ties to keep the carriages from coming off, just clip those off now. If your rails have little metal retainers, they can stay on - just move them to the ends of the rail.

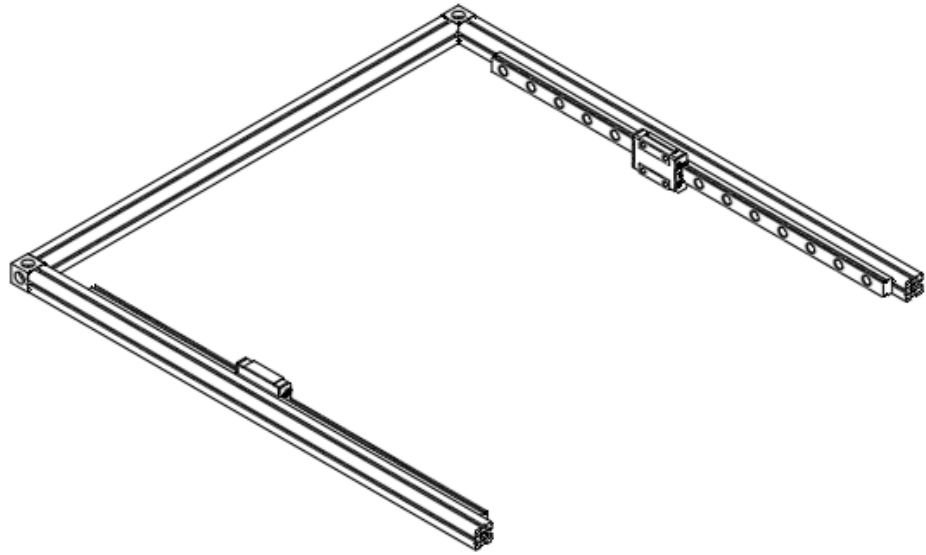
Now, select 4 evenly spaced holes on your rails (the two on the end, and two in the middle), and place in an 8mm button head bolt (if your rails are thinner, you may need to use a 6mm bolt - you can test fit one to know which you need before you do them all).

Now loosely thread a nut onto the bolt, leave a gap between the back of the rail and the nut.

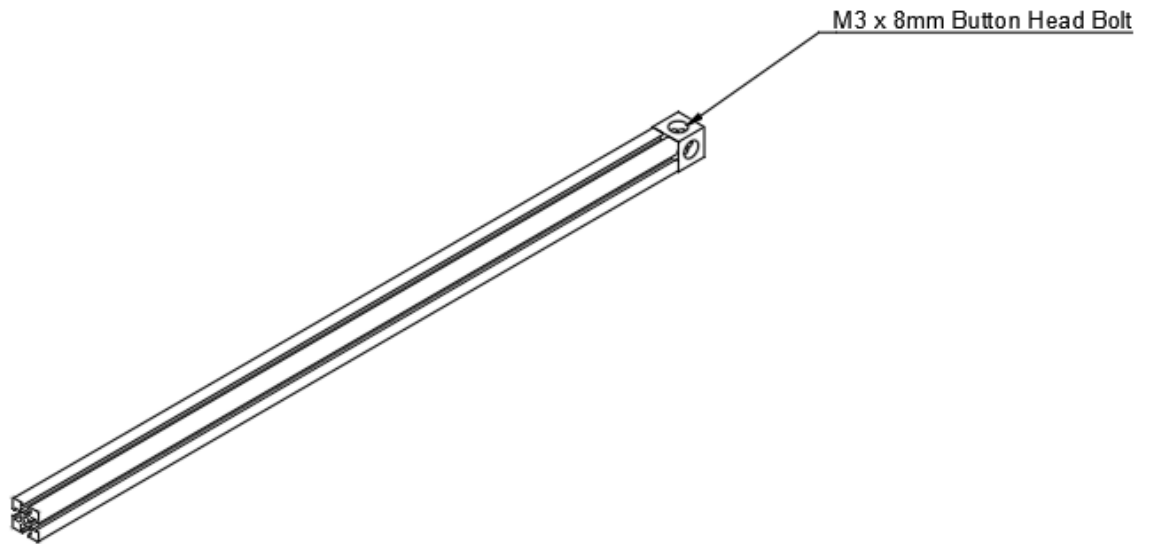


Now carefully line up the rail, and slide it onto the inside face of the back extrusion. Once it's fully on, use a allen wrench to snug up the bolts. They don't have to be tight just yet.

Now repeat the above steps with another 300mm linear rail, and attach it to the inside face of the front extrusion. Remember, it only needs to be snug, don't crank it down.



Now we put together the right Extrusion. First attach the rear corner cube using (1) 3mm x 8mm button head bolt (Snug)



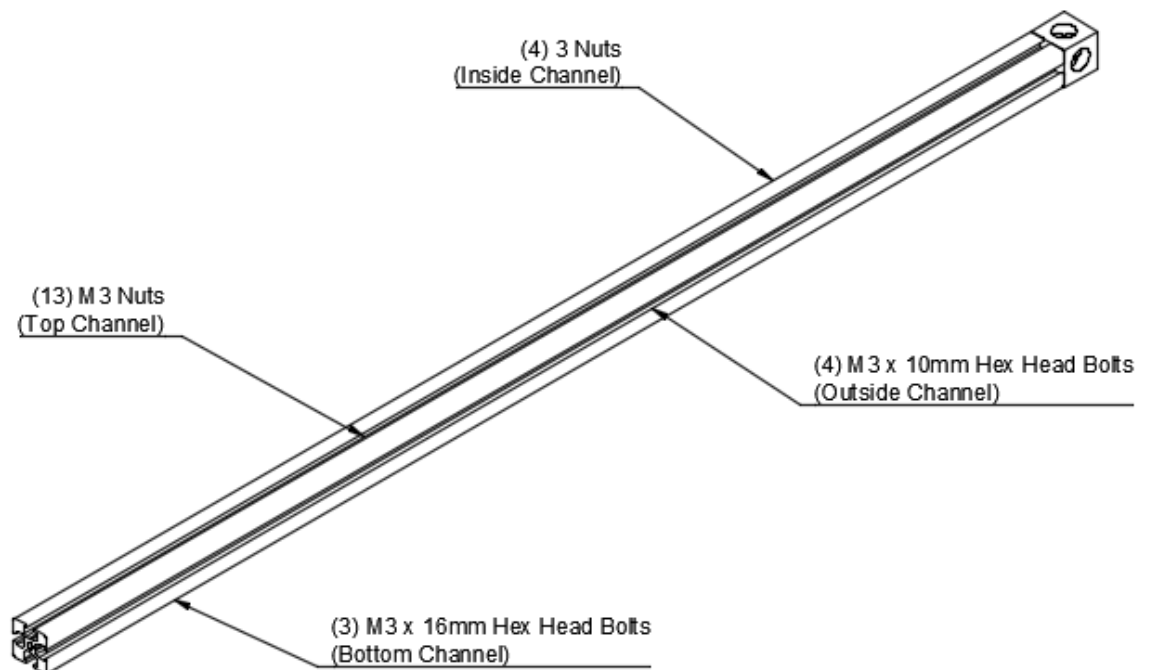
Now we slide in the hardware for this extrusion.

(13) M3 nuts in the top channel. This includes 4 spare for optional add ons later (add more if you wish)

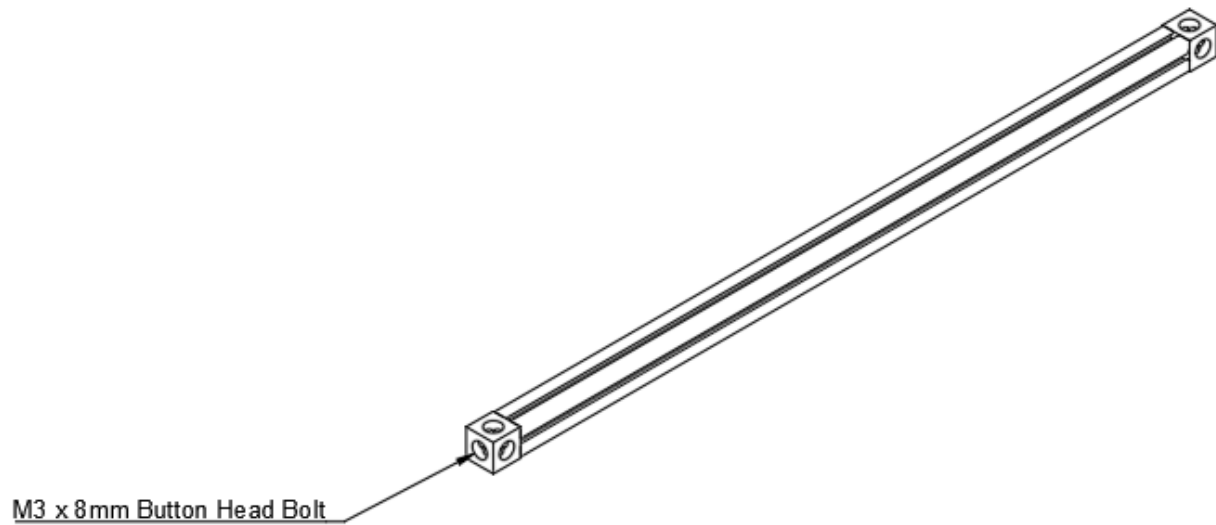
(3) M3 x 16mm hex head bolts in the bottom channel

(4) M3 x 10mm hex head bolts in the outside channel (these will hold the side panel on later)

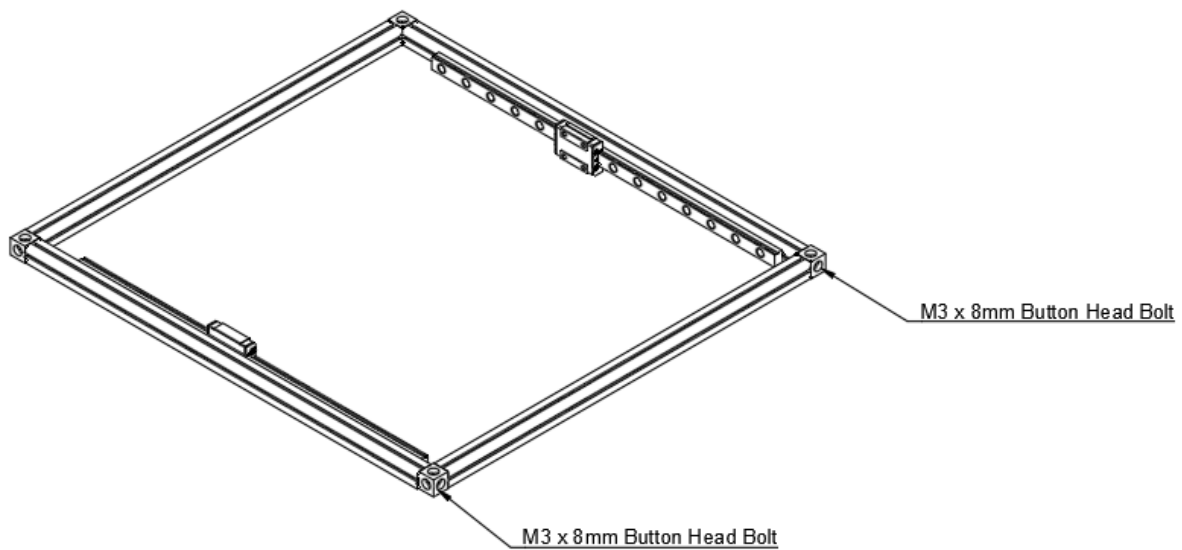
(4) M3 nut in the inside channel 2 are for holding the top of the bearing block in place (2 spare for optional add ons)



Once all the hardware is in, attach the front corner cube using (1) 8mm button head bolt



Now attach the right rail to the front and back rails using (2) 8mm button head bolts.



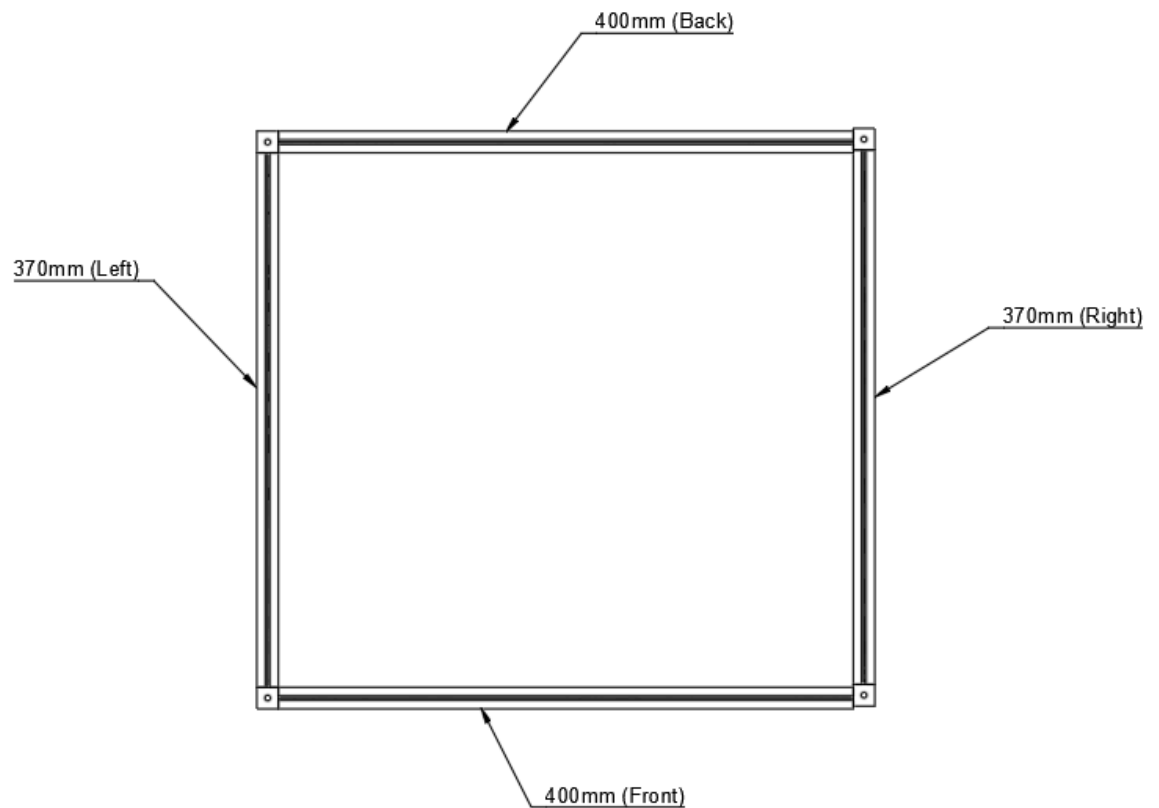
The top assembly should now be done! Set it aside for now.

2. Bottom Extrusions Assembly

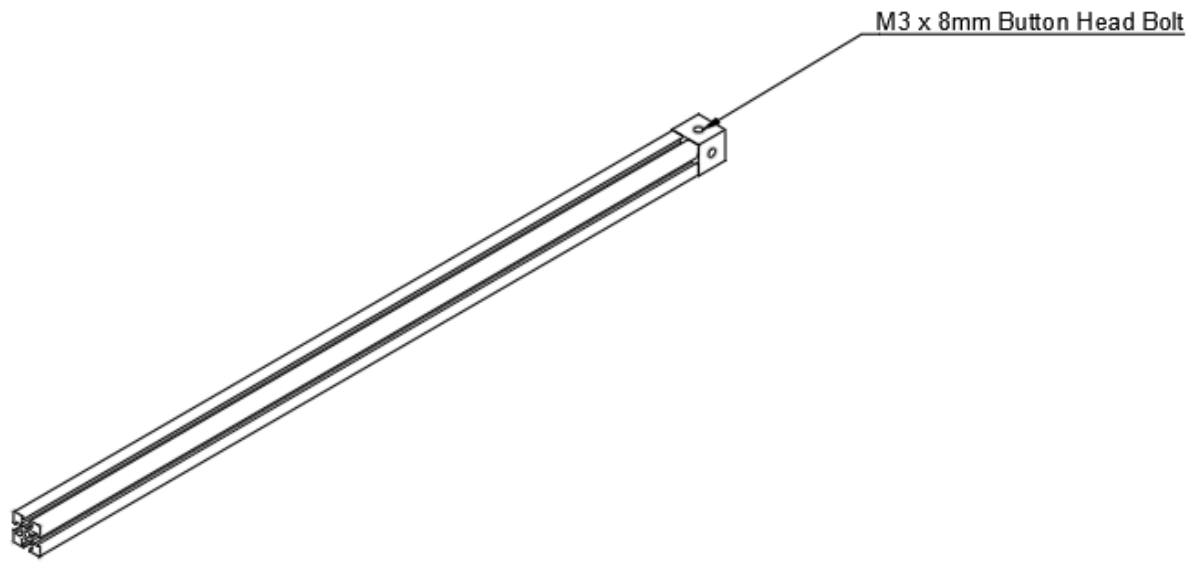
Parts list for this step:

- (2) 400mm (front, back)
- (2) 370mm (left, right)
- (4) corner cube
- (8) M3 x 8mm Button Head Bolts
- (24) M3 x 10mm Hex Head Bolts
- (17) M3 x 16mm Hex Head Bolts
- (8) M3 nuts

Lay out the parts like you did for the top extrusion assembly. Corner cubes on each corner, this time with a small hole pointing up. Put a 400mm extrusion for the front and back, and two 370mm extrusions for the sides.



We're going to start with the bottom left extrusion. Place the rear corner cube on using (1) 3mm x 8mm button head bolt.



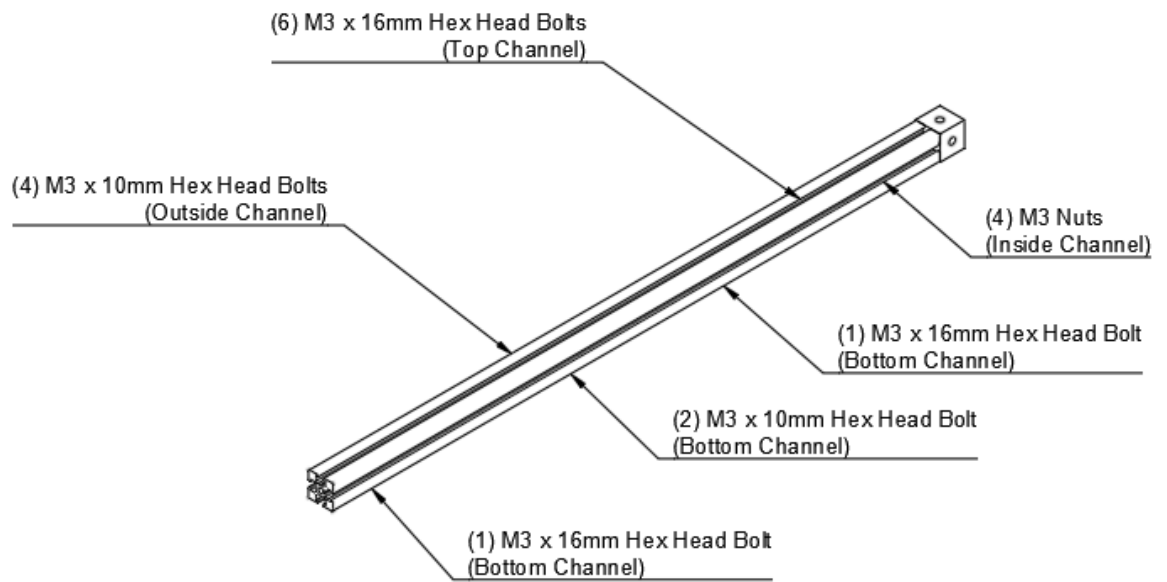
Now we're going to slide in some hardware.

In the top channel put in (6) M3 x 16mm Hex Head Head bolts.

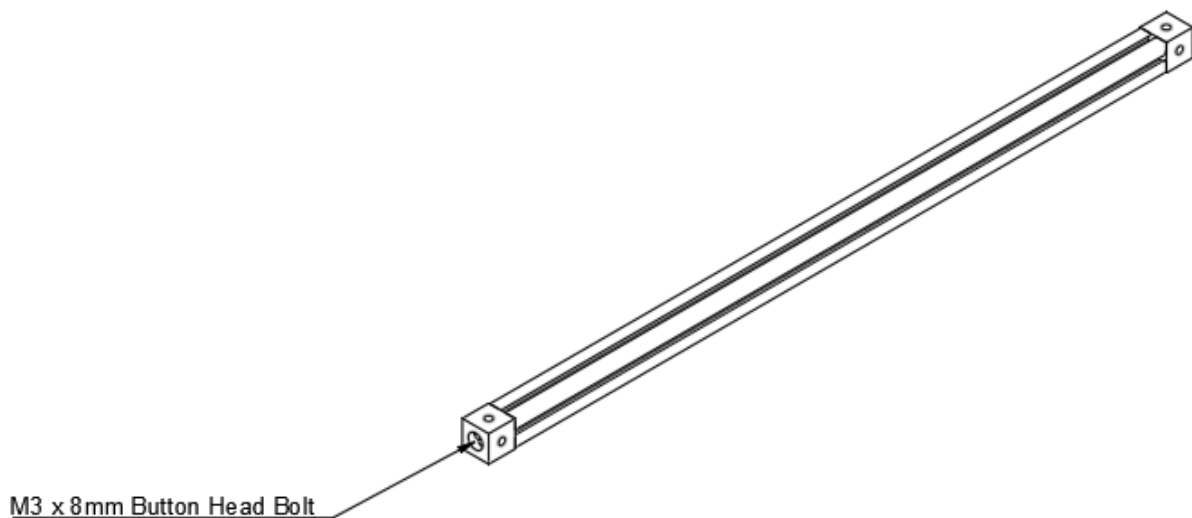
In the outside channel slide in (4) M3 x 10mm hex head bolts, these will later hold on the side panel.

In the inside channel slide in (4) M3 nuts (All optional for add ons later).

On the bottom slide in (1) M3 x 16mm hex head bolt, then (2) M3 x 10mm hex head bolts, then (1) M3 x 16mm hex head bolts. The longer two should be on the outside, and will be used to hold on the feet.

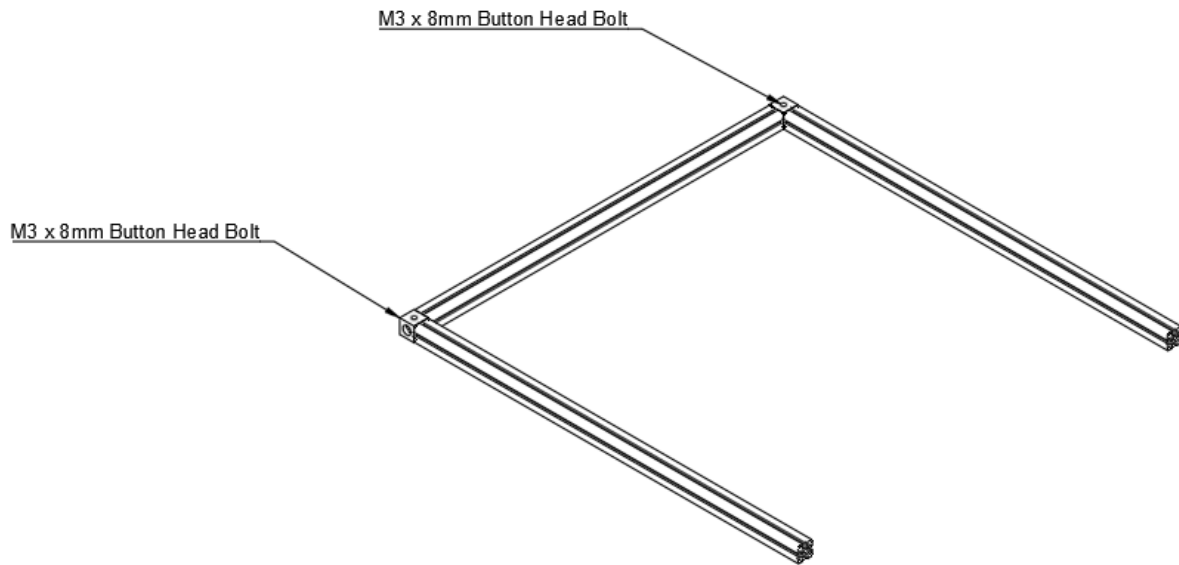


Add the Front corner cube to the bottom left extrusion using (1) M3 x 8mm Button head bolt.



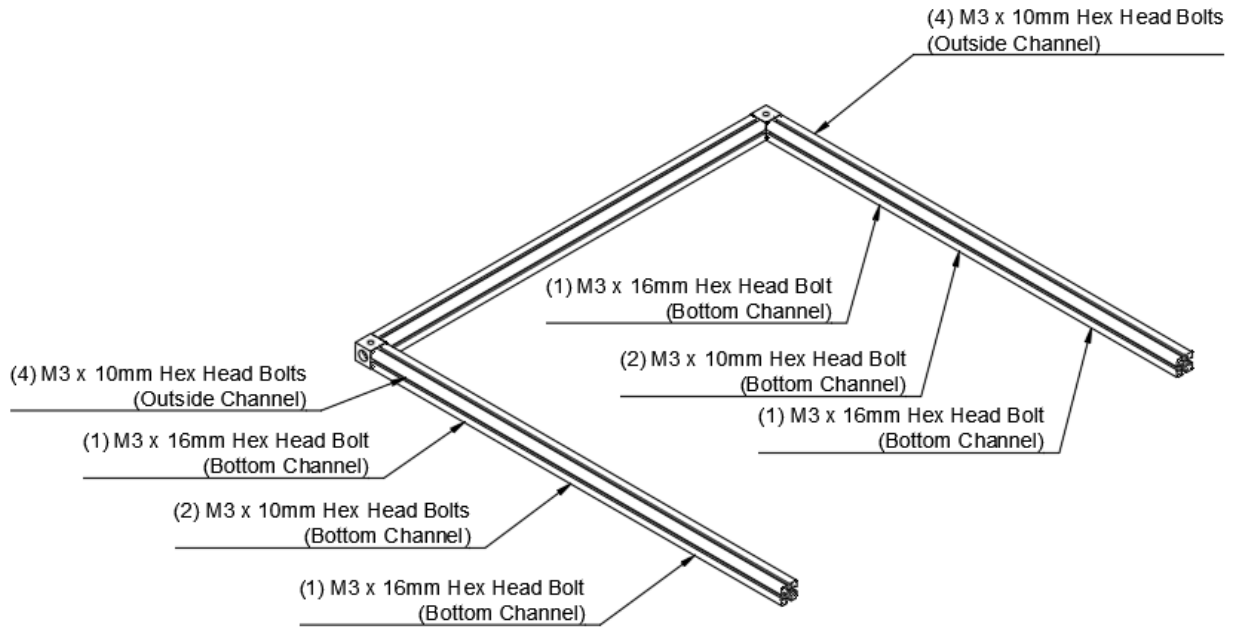
Attach the bottom back extrusion to bottom left using (1) M3 x 8mm button head bolt.
Attach the bottom front extrusion to bottom left (1) M3 x 8mm button head bolt.

You should now have a C shaped set of extrusions, and we can slide in some hardware.



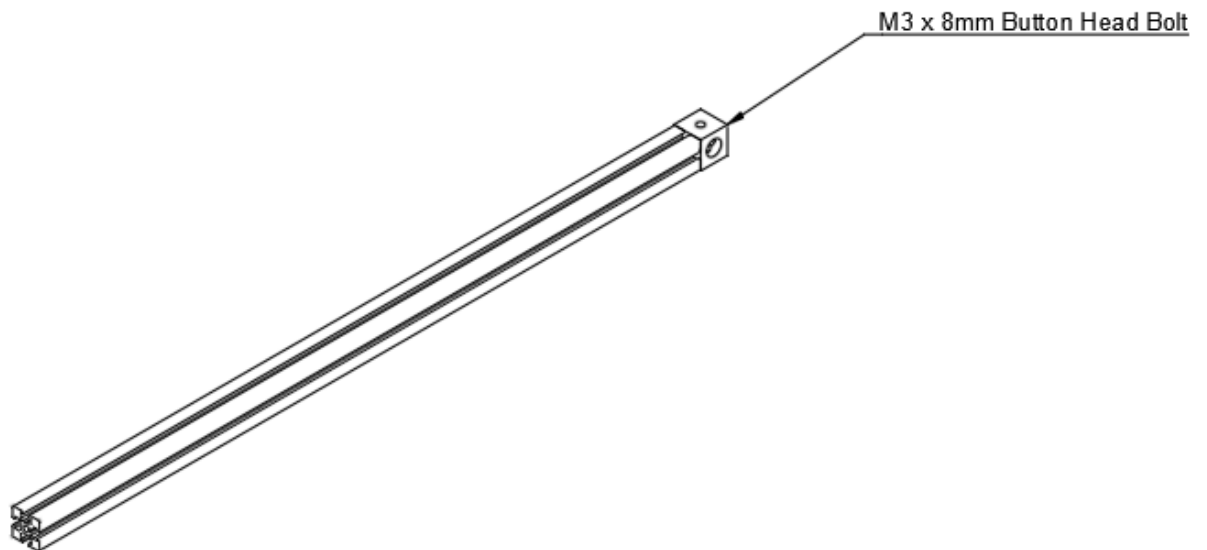
Place (4) M3 x 10mm hex head bolts in outside channel of the bottom back extrusion.
In the bottom channel of the back extrusion place (1) M3 x 16mm hex head bolt followed by (2) M3 x 10mm hex head bolts, then (1) M3 x 16mm hex head bolt.
You can place extra M3 nuts in the top or inside channel if desired.

In the outside (front) channel of the front extrusion place (4) M3 x 10mm hex head bolts.
In the Bottom channel of the front extrusion place (1) M3 x 16mm hex head bolt followed by (2) M3 x 10mm hex head bolts, then (1) M3 x 16mm hex head bolt.
You can place extra M3 nuts in the top or inside channel if desired.



You can set this assembly aside, so we can build the bottom right extrusion.

The bottom right extrusion is the same as the bottom left extrusion, just mirrored. Place the rear corner cube on using (1) 3mm x 8mm button head bolt.



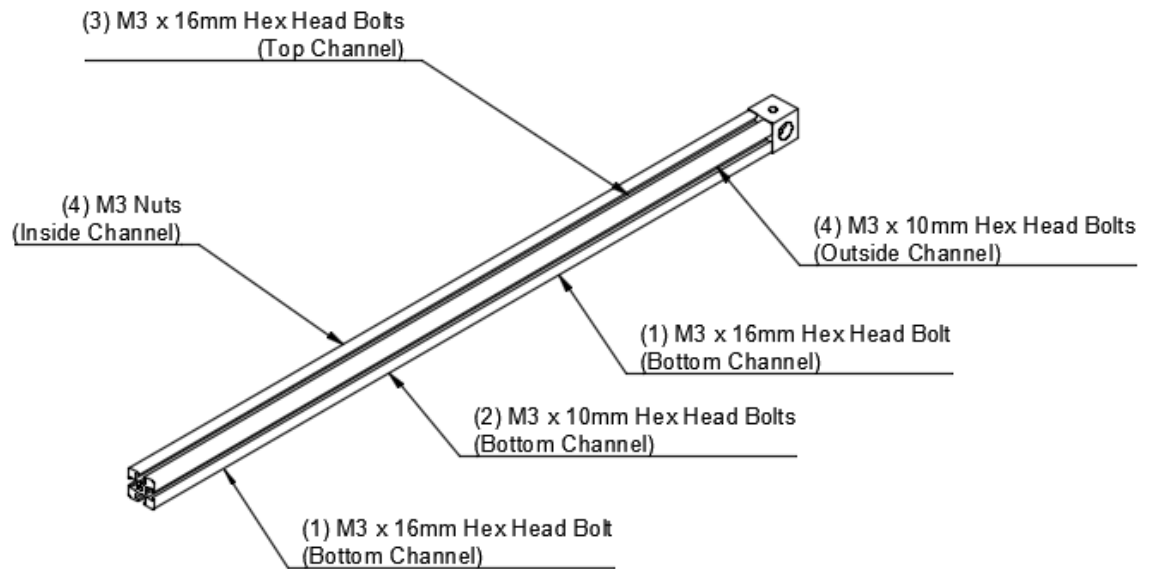
Now we're going to slide in some hardware.

In the top channel put in (3) M3 x 16mm Hex Head Head bolts.

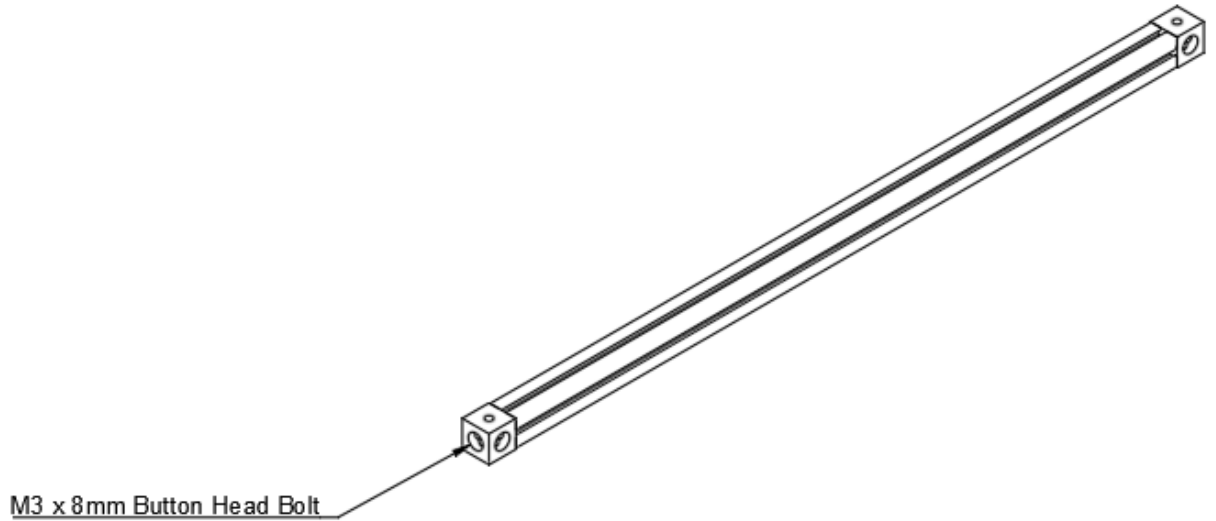
In the outside channel slide in (4) M3 x 10mm hex head bolts, these will later hold on the side panel.

In the inside channel slide in (4) M3 nuts (For optional add ons later).

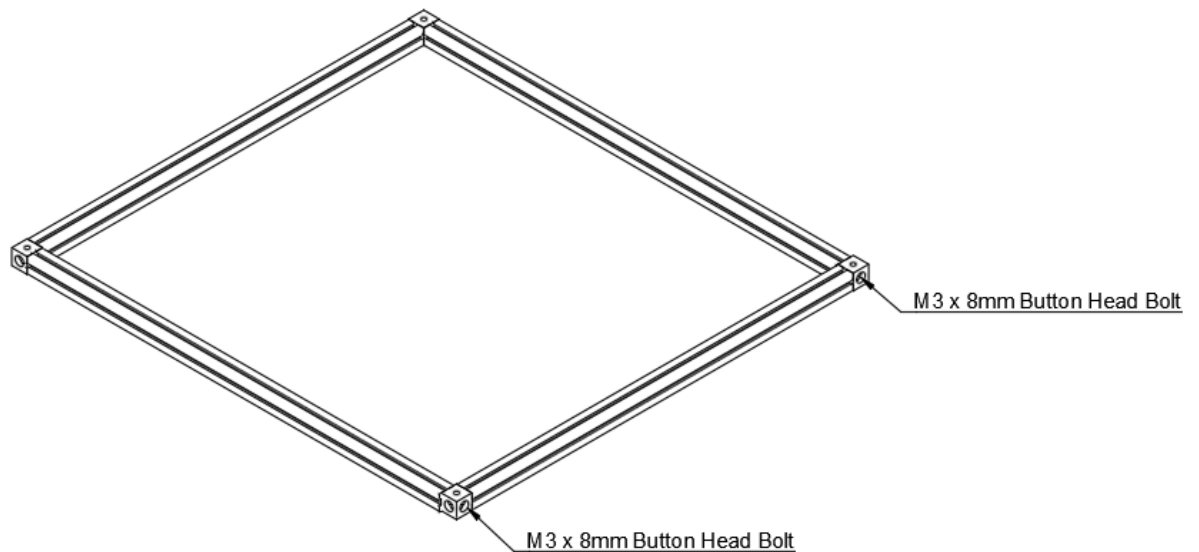
On the bottom slide in (1) M3 x 16mm hex head bolt, then (2) M3 x 10mm hex head bolts, then (1) M3 x 16mm hex head bolts. The longer two should be on the outside, and will be used to hold on the feet.



You can now put on the front corner cube using (1) 3mm x 8mm button head bolt.



Attach the bottom right extrusion to the bottom front & bottom rear extrusions using (2) M3 x 8mm button head bolts.



You've now completed the assembly of the bottom extrusions. Be sure to keep track of which is the front channel, it may help to mark it with a piece of tape if you haven't already..

At this point it can be helpful to prop the bottom up using the feet as stands, to keep the bolts from digging into your table or work surface. (Empty Filament spools work well, too)

3. Upright Extrusions Assembly

Parts needed in this step:

Bottom Frame Assembly (from Step 2)

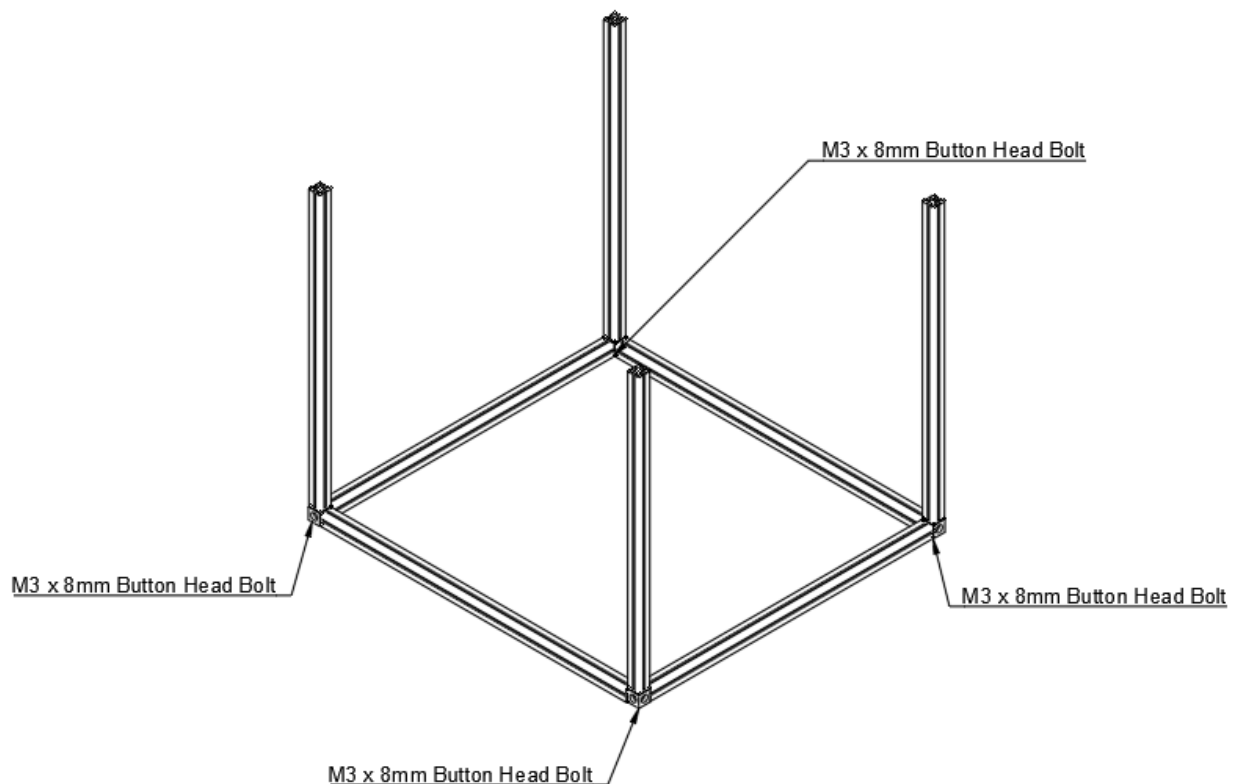
(4) 360mm Extrusions

(4) M3 x 8mm button head bolts

(34) M3 x 10mm hex head bolts

(32) M3 nuts (optional)

Bolt all four of the upright 360mm extrusions to your bottom assembly using (4) M3 x 8mm button head bolts. (One for each corner cube)



Now we're just going to drop some hardware down each of the channels. Again, be sure to keep track of which extrusion is which.

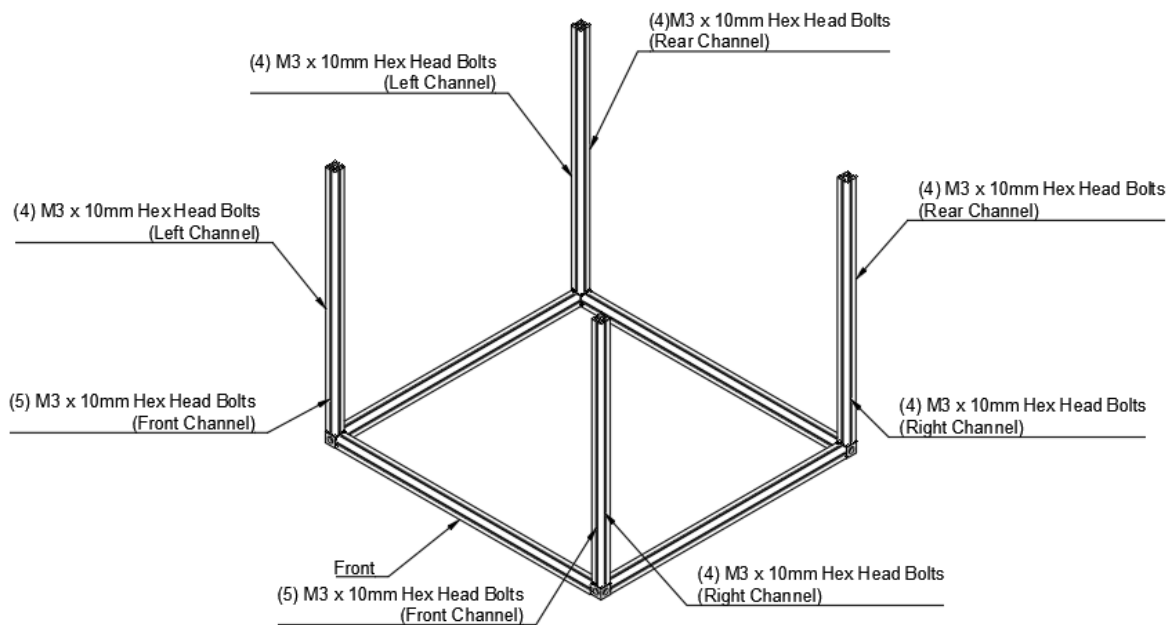
In the front channel of the front left extrusion place (5) M3 x 10mm hex head bolts.

In the left channel of the front left extrusion place (4) M3 x 10mm hex head bolts.

In the front channel of the front right extrusion place (5) M3 x 10mm hex head bolts.
In the right channel of the front right extrusion place (4) M3 x 10mm hex head bolts.

In the left channel of the rear left extrusion place (4) M3 x 10mm hex head bolts.
In the rear channel of the rear left extrusion place (4) M3 x 10mm hex head bolts.

In the right channel of the rear right extrusion place (4) M3 x 10mm hex head bolts.
In the rear channel of the rear right extrusion place (4) M3 x 10mm hex head bolts.



(Optional) If you want to be able to add things later such as camera mounts, etc, now's a good time to add M3 nuts. I added (4) M3 nuts to both of the inside channels for each upright extrusion. (32) M3 nuts total. These are not used in the build directly, but are much easier to add now than after the build is complete. (You can actually add M3 nuts to any inside facing channel you wish, if you think they may be useful later. The outside channels will be covered by your side panels, so M3 nuts in them won't be usable)

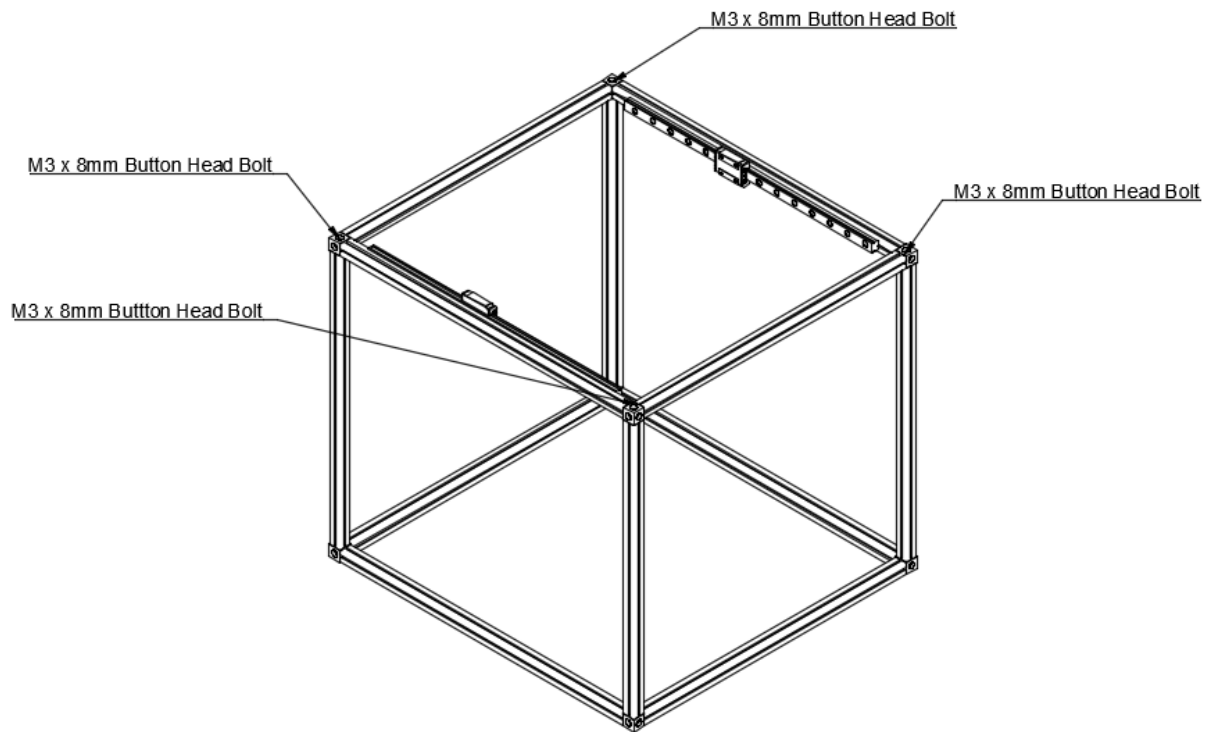
4. Attach top assembly to uprights

Parts used in this step:

(4) M3 x 8mm Button Head Bolts

Top Assembly from step 1

Take your completed top extrusion assembly, paying attention to which is the front extrusion, and put it on top of the uprights. Bolt it down with (4) M3 x 8mm button head bolts. Your frame is now complete! Up until now, we've been just snugging up the bolts in the corner cubes. Now is the time to tighten them all up. I suggest doing a review of the count for the nuts and bolts in each extrusion now, as it's hard to correct them later. You can optionally remove each corner cube bolt one at a time, and use a drop of blue loctite on them. (If you want to use loctite, now would be the time)



Z-Bracket installation

1. Attach the Z Brackets

Parts needed for this step:

(3) Z_Bracket_Top

(3) Z_Bracket_Bottom

(54) M3 Nuts

(12) M3 x 8mm Button Head Bolts

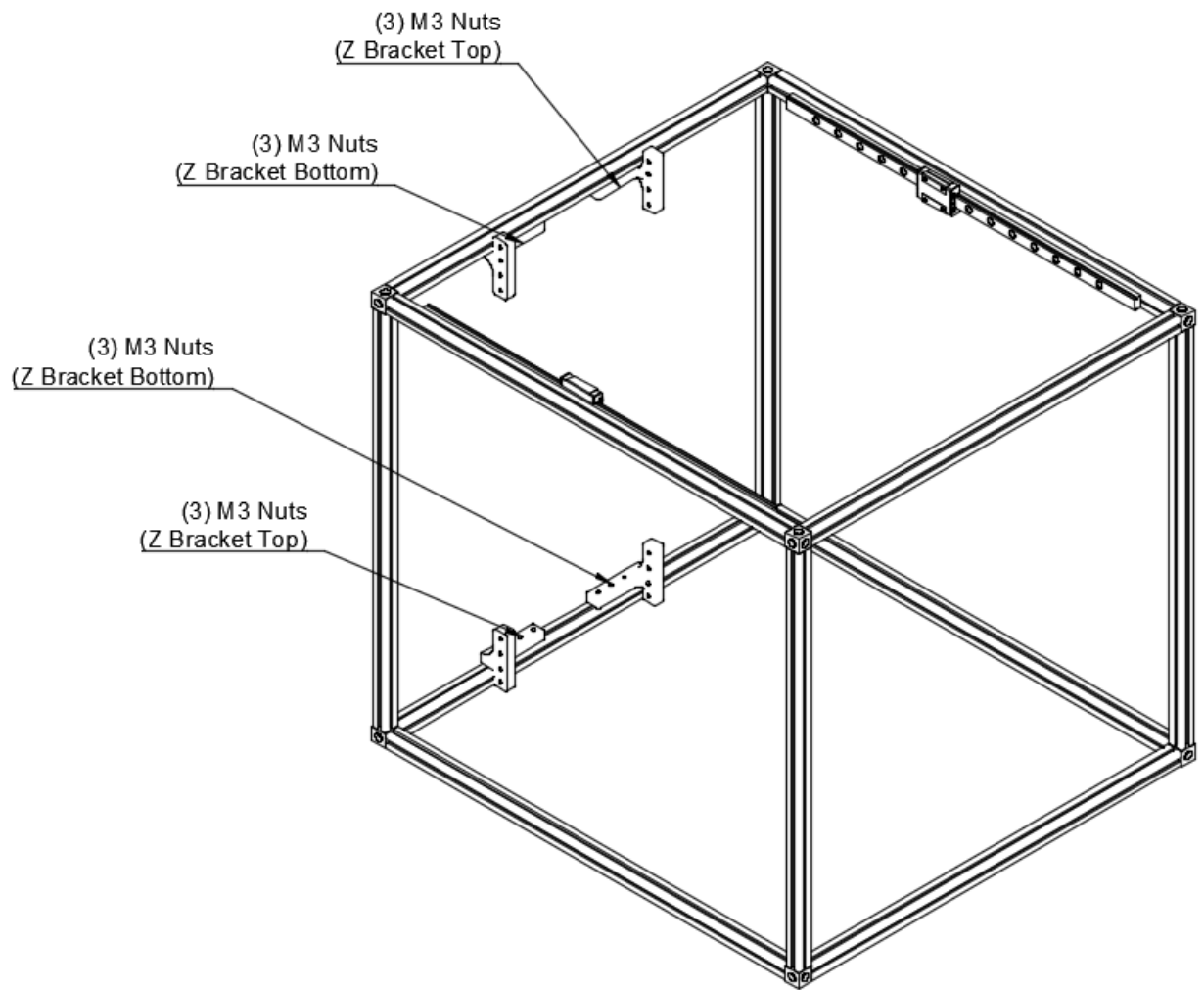
(24) M3 x 16mm Hex Head Bolts

Be sure not to get the “Z_Bracket_Top” and “Z_Bracket_Bottom” parts mixed up!

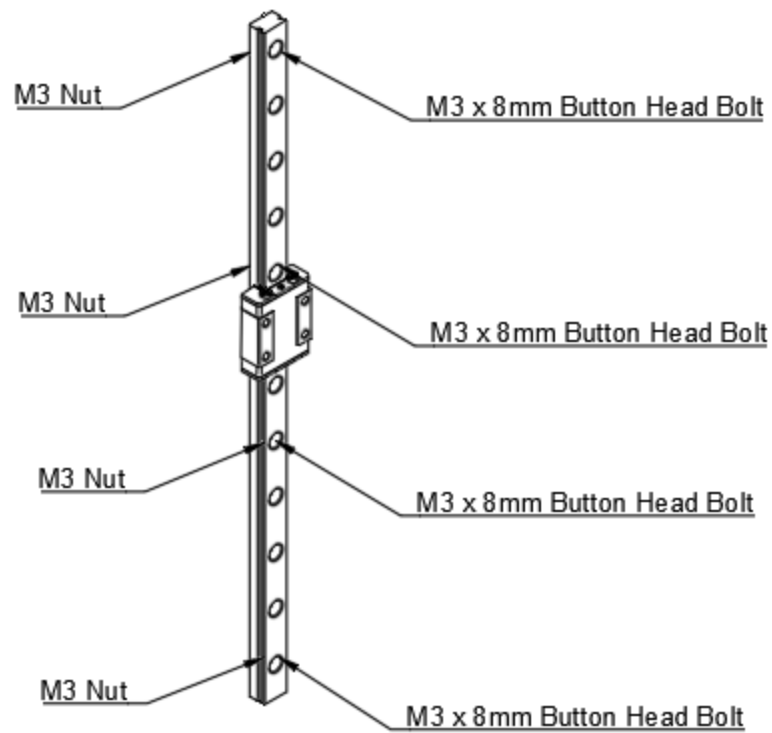
Starting on the left side, bolt on the following. Be careful to compare to the picture so you get the order correct.

Starting from the front, on the top left extrusion, bolt on a Z_Bracket_Bottom (with the “arm” facing the back of the printer) Z_Bracket_Top (with the “arm” facing the front of the picture). Each of these should attach to the bolts in the extrusion using (3) 3mm nuts. Leave them loose enough you can move them.

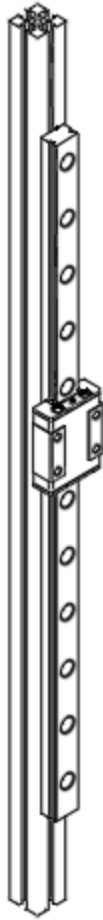
On the bottom left extrusion, starting from the front, attach a Z_Bracket_Top (with the “arm” pointing to the back) and a Z_Bracket_Bottom (with the arm pointing to the front).



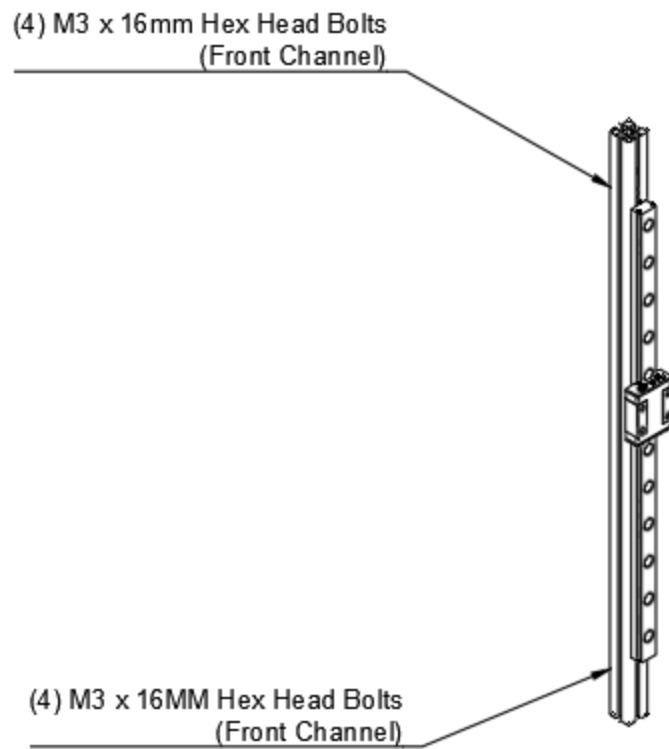
Next, attach the Linear rails for the Z axis to the extrusion. It's easier to bolt the linear rail to your extrusion before attaching it. Take one of the 300mm linear rails, and place (4) M3 x 8mm button head bolts in it. Loosely place (4) M3 nuts on, one per bolt as shown.



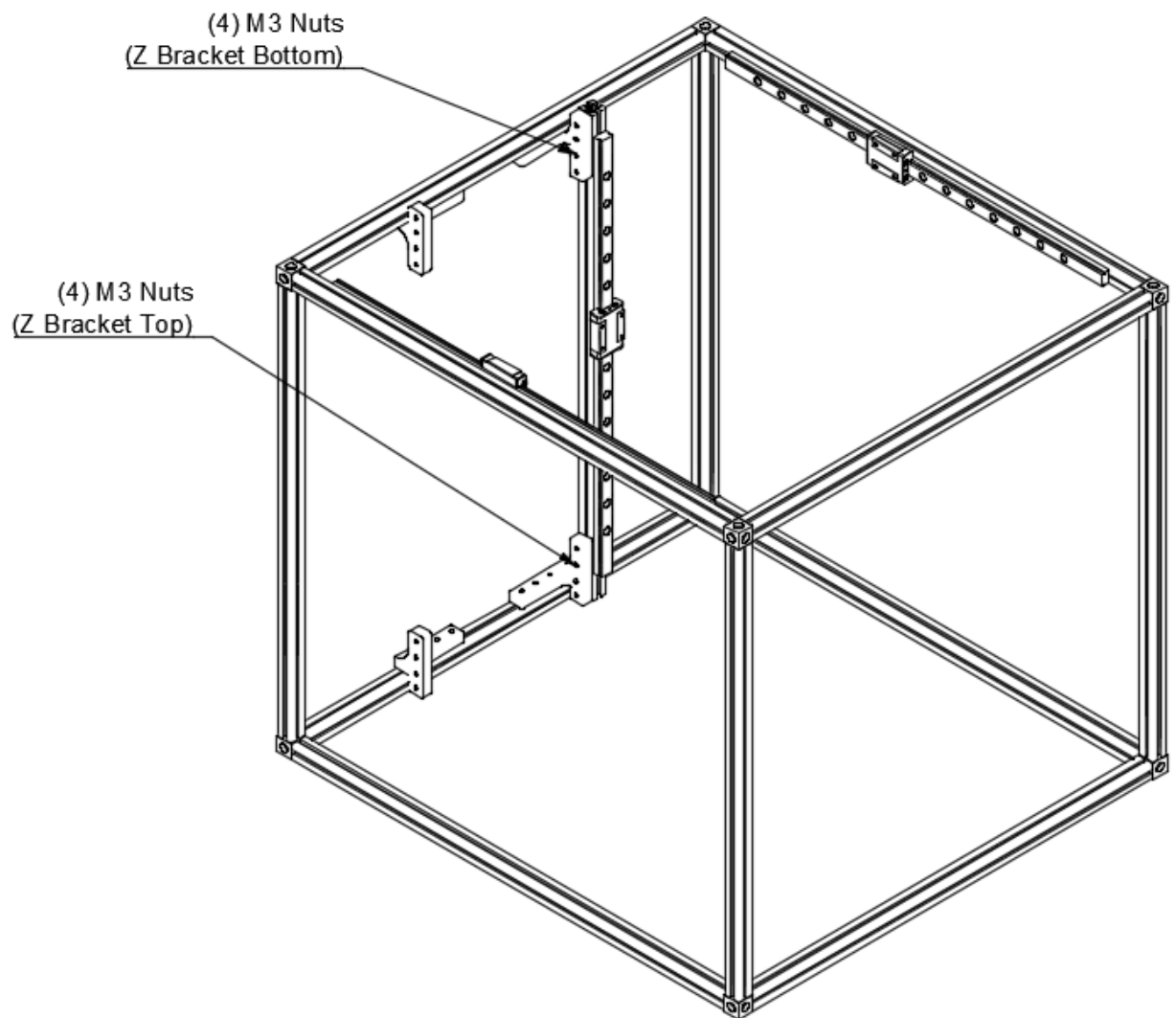
Now you can slide those M3 nuts into the channel one of the 390mm extrusions, and use an allen wrench to tighten it down. Don't make it too tight yet - we'll adjust it later. Use some masking tape to keep the carriage from falling off.



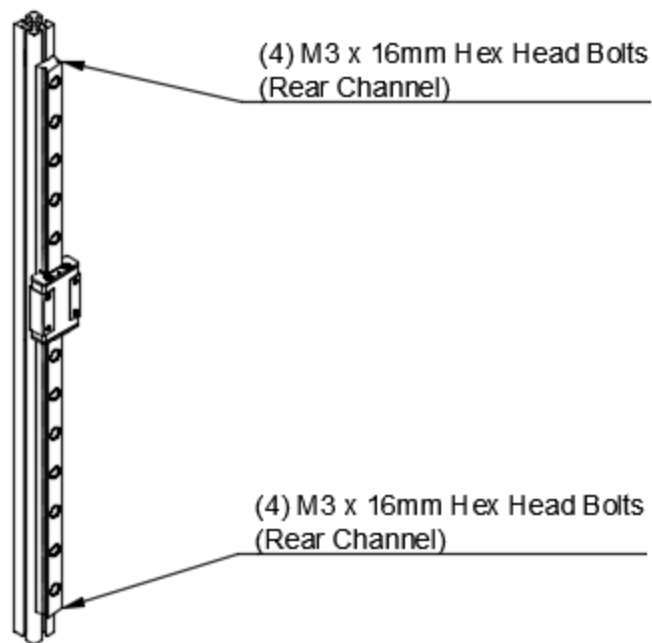
Now take your 390mm extrusion and place (8) M3 x 16mm hex head bolts into one of the channels at a 90 degree angle to the linear rail you attached.



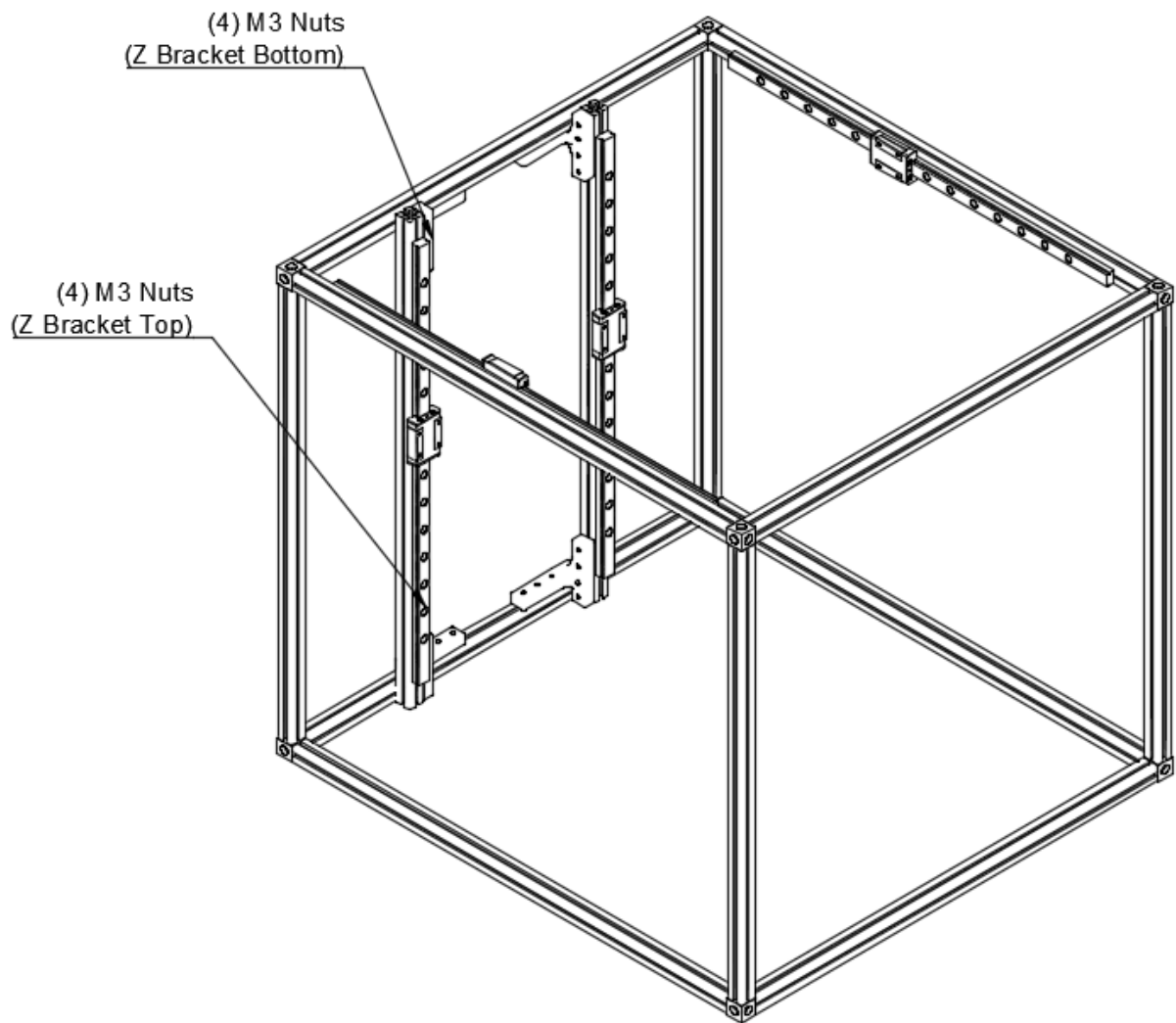
You then slide these M3 bolts through the rear two Z brackets you installed (it fits between the Z bracket and the bearing block), and attach them with (8) M3 nuts.



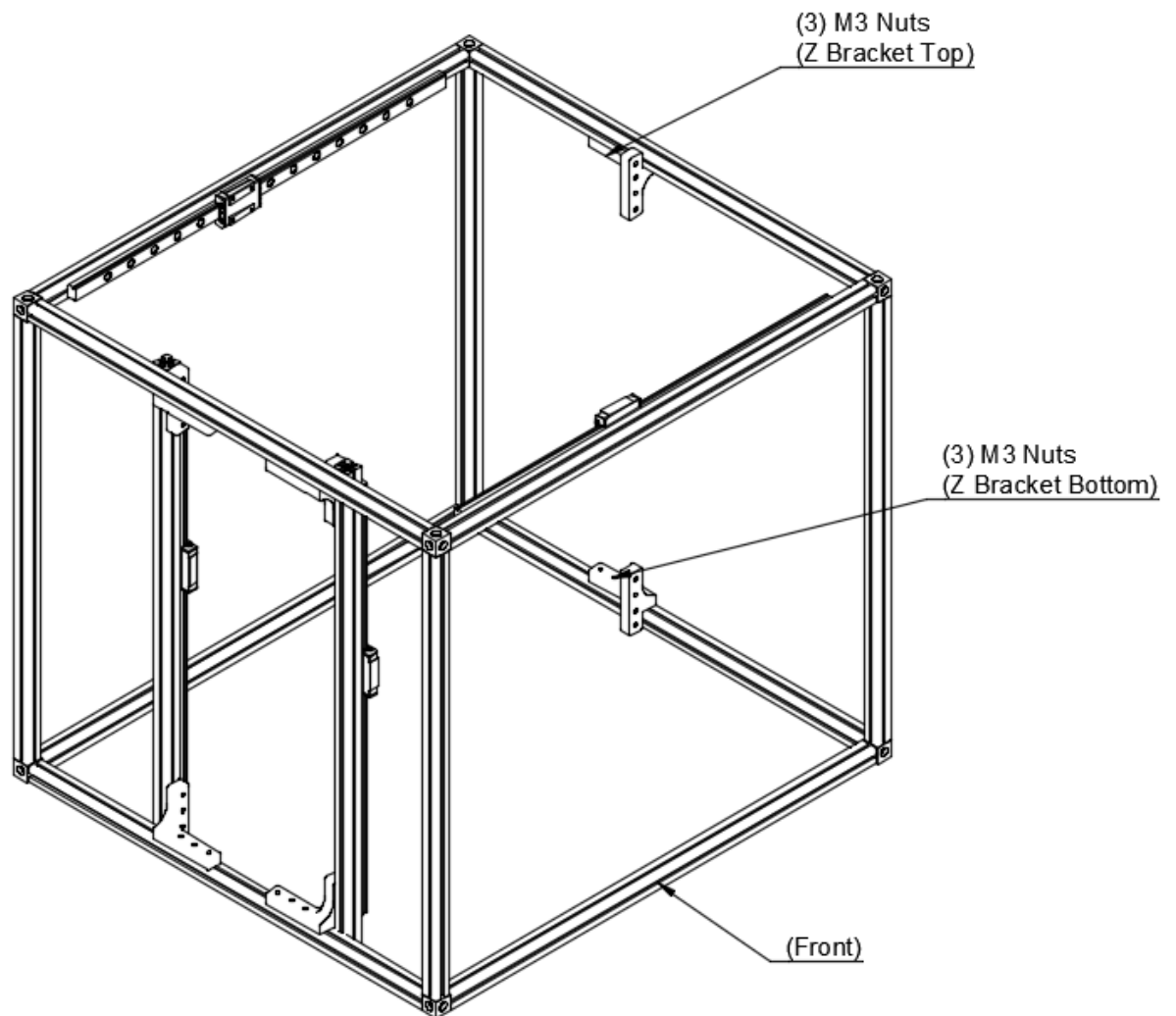
Repeat the above steps for the linear rail, attaching another to the Front set of Z brackets you installed. (The hex bolts will go in the rear slot of the extrusion)



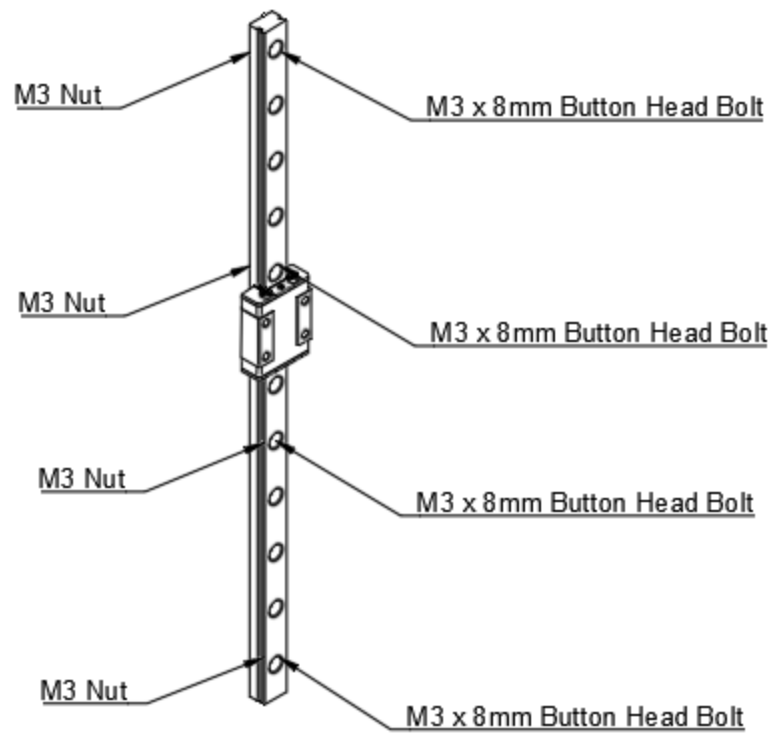
Now we'll bolt this extrusion to the front two Z brackets, just like we did the other one. Attach it using (8) M3 Nuts.



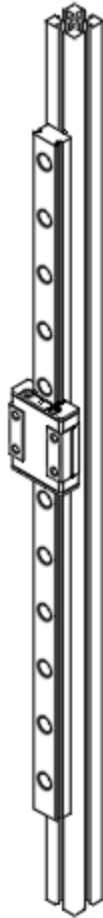
Repeat the above process for the right side. Begin by attaching Z_Bracket_Top to the top right extrusion using (3) M3 nuts. Note when attaching to the right side, this will mean the “arm” of the Z_Bracket_Top points towards the back of the printer, and you should use the 3 bolts closest to the back of the printer. Attach Z_Bracket_Bottom to the bottom right extrusion using (3) M3 nuts, again using the bolts closest to the back of the printer. The arm for this bracket should also point to the back of the printer.



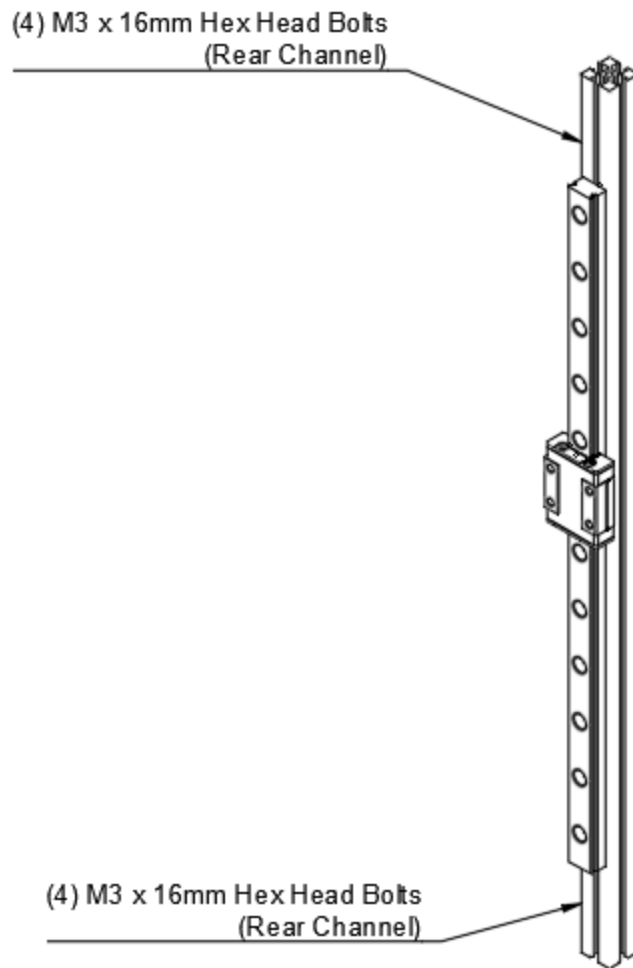
Use the other 390mm extrusion, attaching a 300mm linear rail using (4) M3 x 8mm button head bolts and (4) M3 nuts.



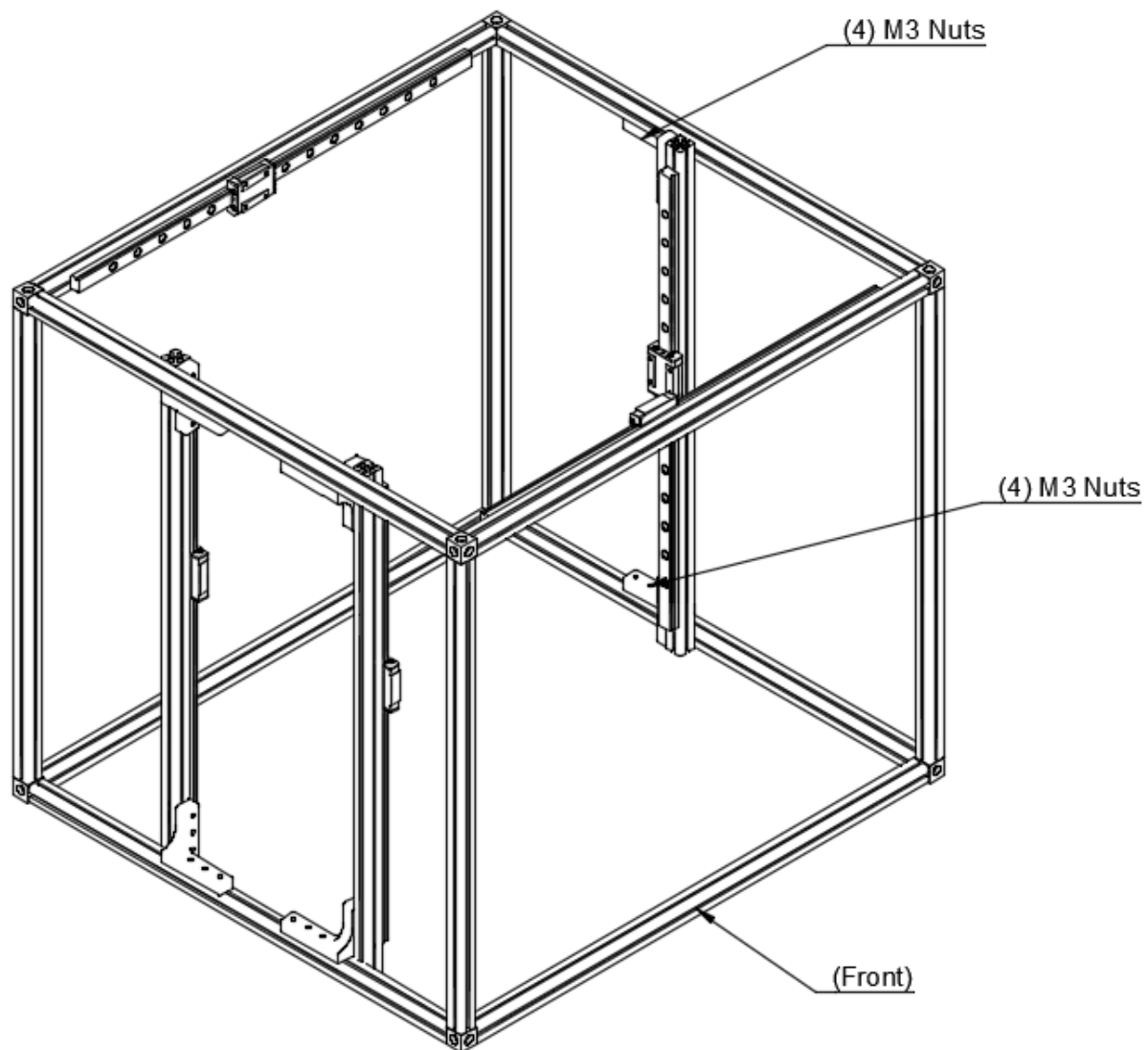
Loosely tighten the linear rail to the extrusion.



Insert (8) M3 x 16mm hex head bolts into the rear channel on the extrusion.



Attach the extrusion to the Z brackets using (8) M3 nuts. Don't forget some masking tape to hold the carriage and keep it from sliding off.



Sides installation

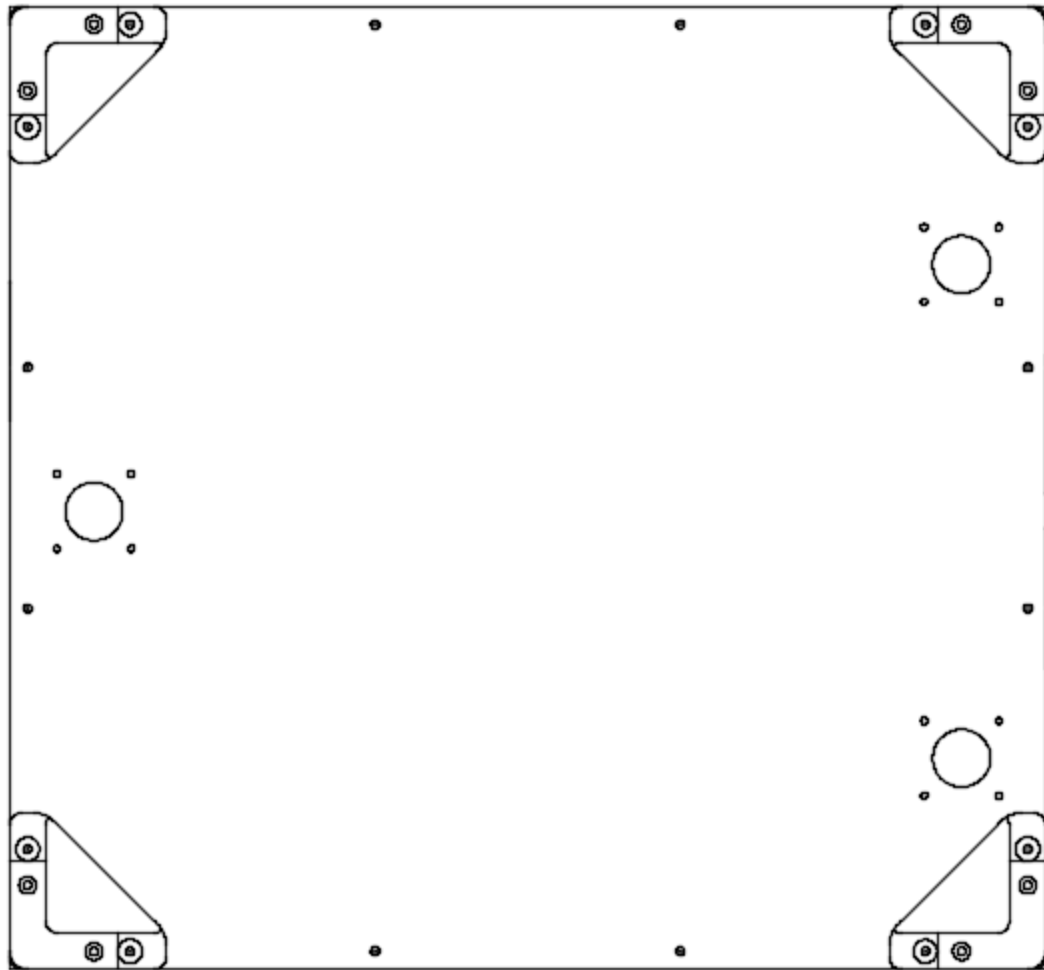
Parts Needed for this section:

(4) Foot

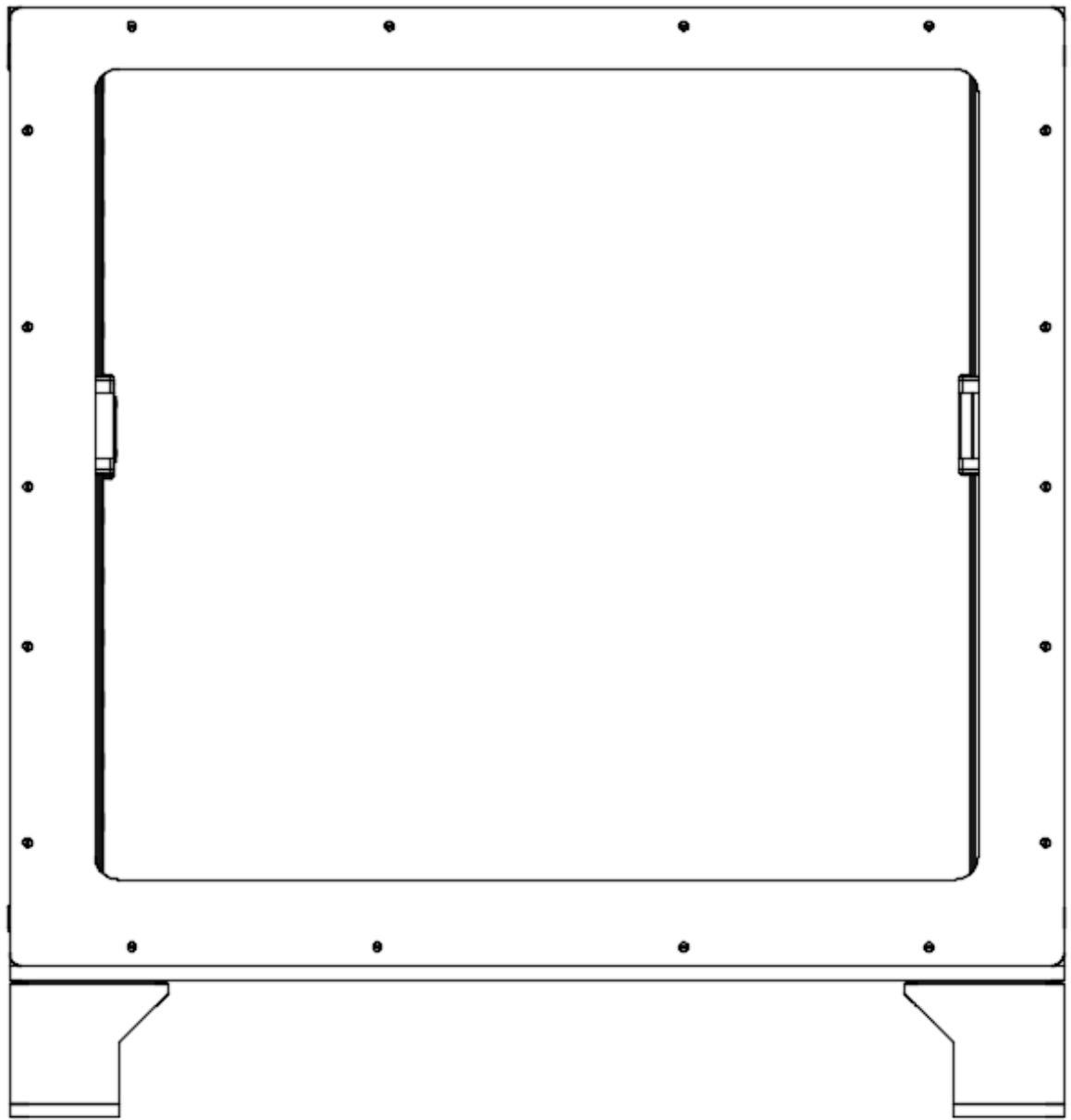
(82) M3 Nuts or M3 Nylon Lock Nuts

Before doing this step you can attach the small TPU foot pads onto the feet. To do this you need to sink M3 threaded inserts into the holes on the bottom of the feet. Then use (2) M3 x 8mm bolts to attach the inserts. This is entirely optional, and can be done later if you decide you want to add them.

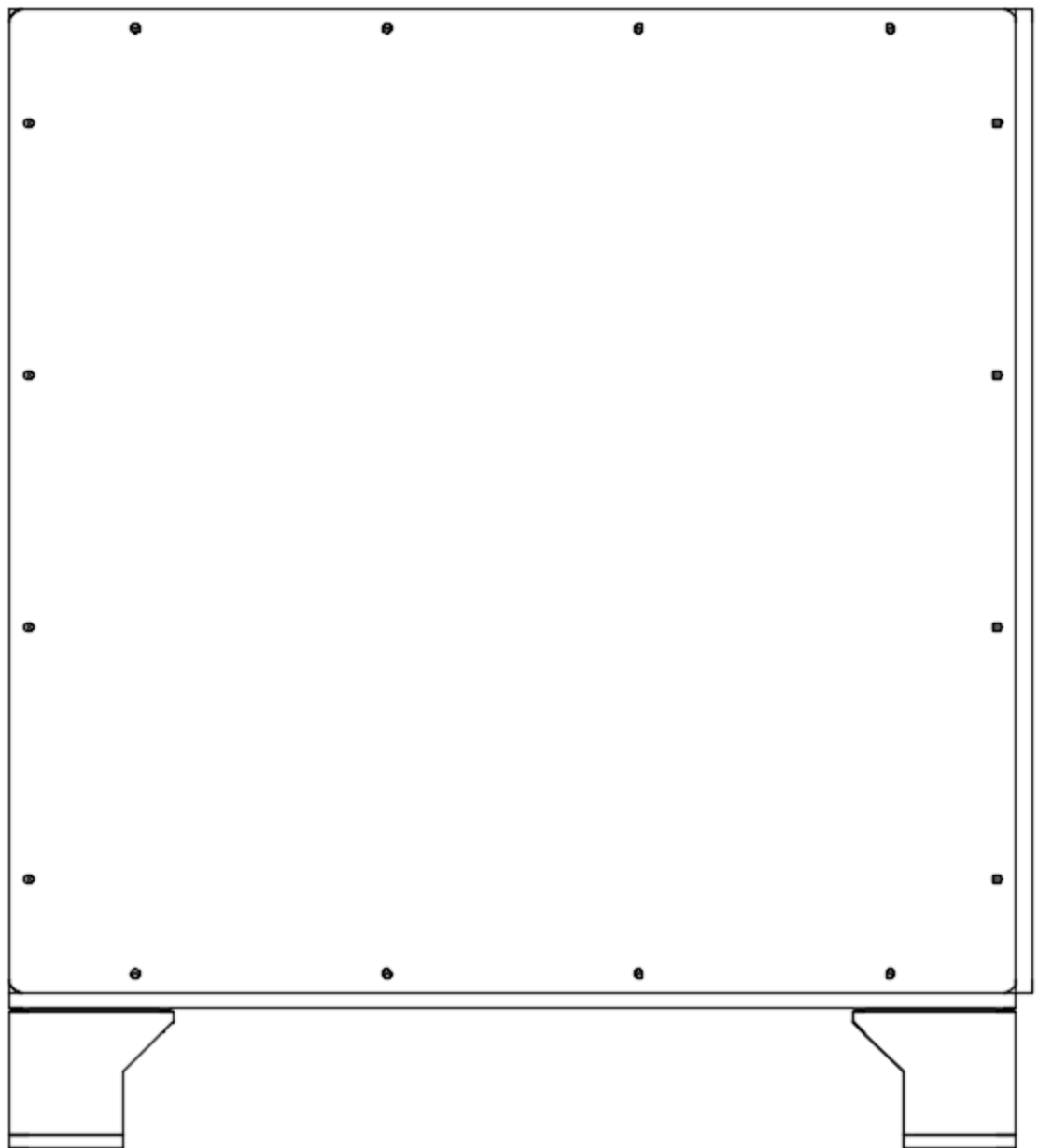
Turn your printer frame upside down, so the bottom is facing up. Place the bottom Bottom panel over the protruding bolts, the two small holes should be nearest the front and back of your printer. **It's very important that the two stepper holes be on the left side of your frame! (the same side that you put two rails on)** It can be tricky to line the bolts up with each hole, and may work better with someone assisting. Use needle nose pliers to straighten the bolts. Place the feet over the two bolts at each corner. You should be able to thread a nut onto each bolt. You can use either 16 Nylon Lock nuts, or 16 standard M3 nuts, it's really just a matter of aesthetic preference, as they don't come loose. Tighten them all down using your nut driver, making sure the panel is centered.



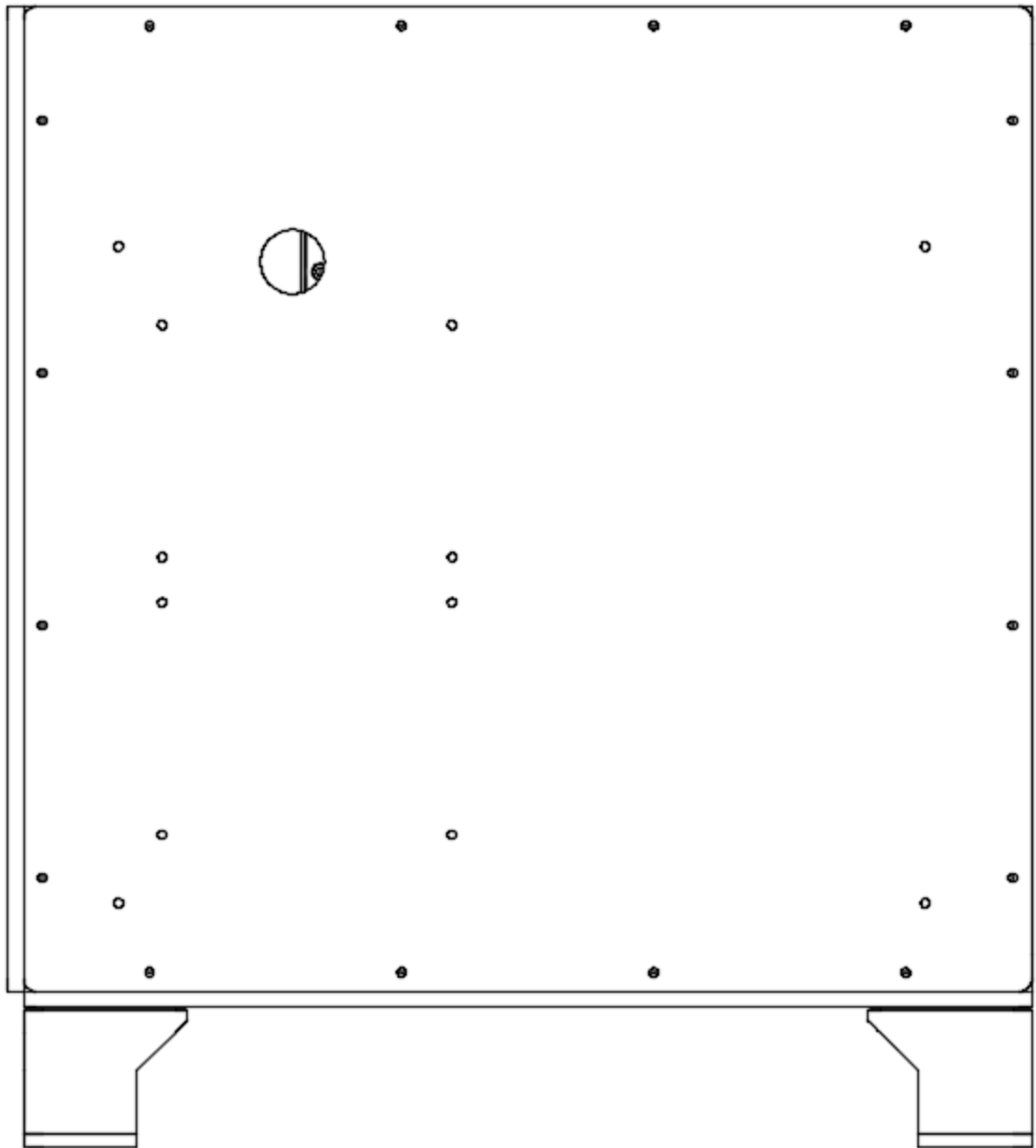
Next Turn your panel so the “back” is down, and place the front panel on. This is the one with the large cut out. It also has extra bolts, to make up for the lower surface area. Place it over the bolts, and once it’s centered, place 18 nylon lock nuts, or 18 M3 nuts on, and tighten them down.



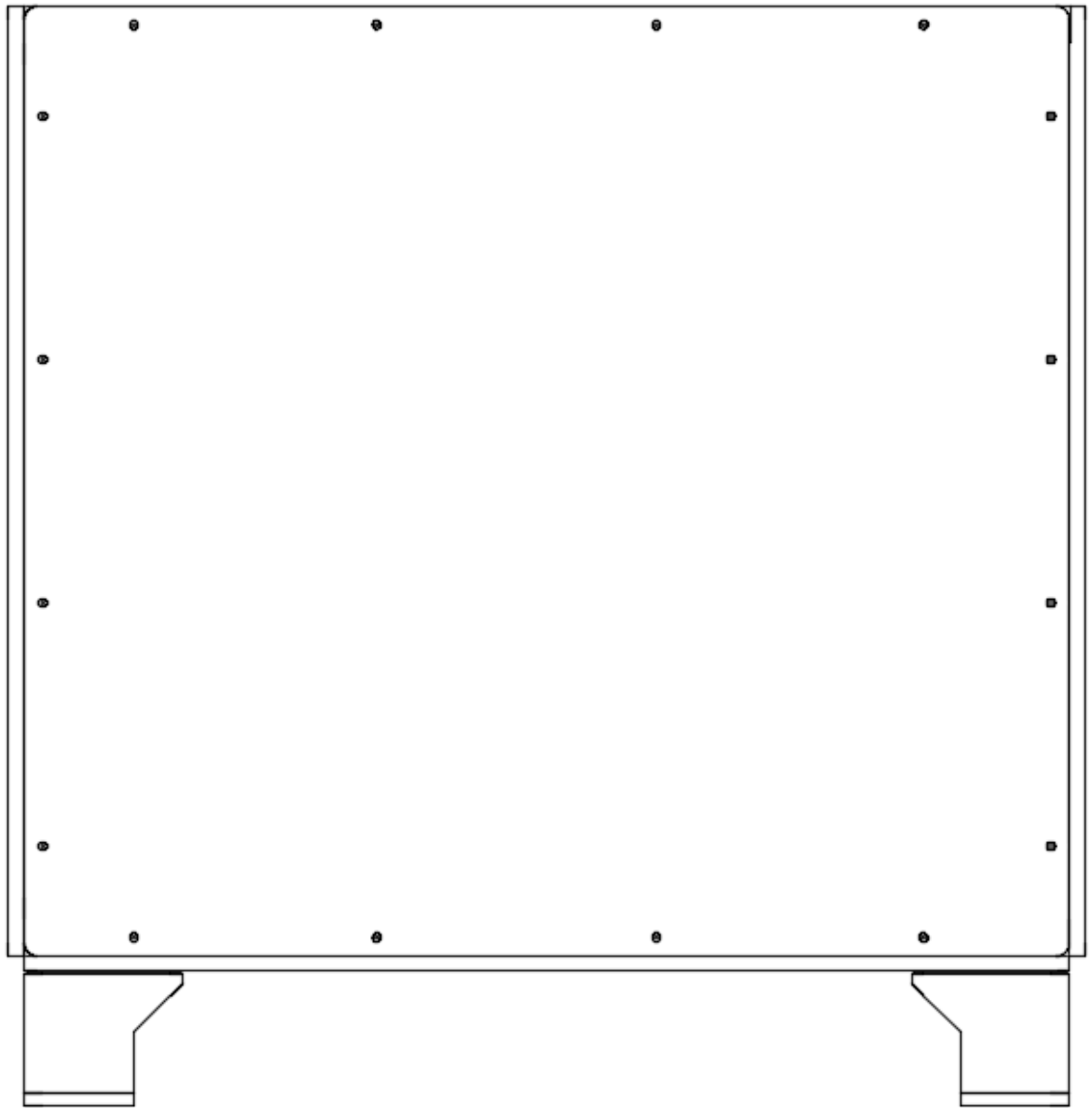
Now lay the printer with the right side down, and bolt on the left side the same way using either 16 M3 Nylon lock nuts, or 16 M3 nuts. The extra 4 holes in the panel aren't used at this time, but should be oriented as in the drawing below.



Now rotate the printer so the left side (the one you just put on) is facing down, and install the right panel using 16 M3 nylon lock nuts, or 16 M3 nuts. On this panel, the orientation of the holes is very important. The holes for mounting the duet and duex5, as well as the larger hole for your wiring bundle, should be near closer to the front of your printer, with the hole for the wiring at the top.



The last one is the back panel. Place the printer with the front side facing down, and install the back panel the same as the others using 16 nylon lock nuts, or 16 M3 nuts.

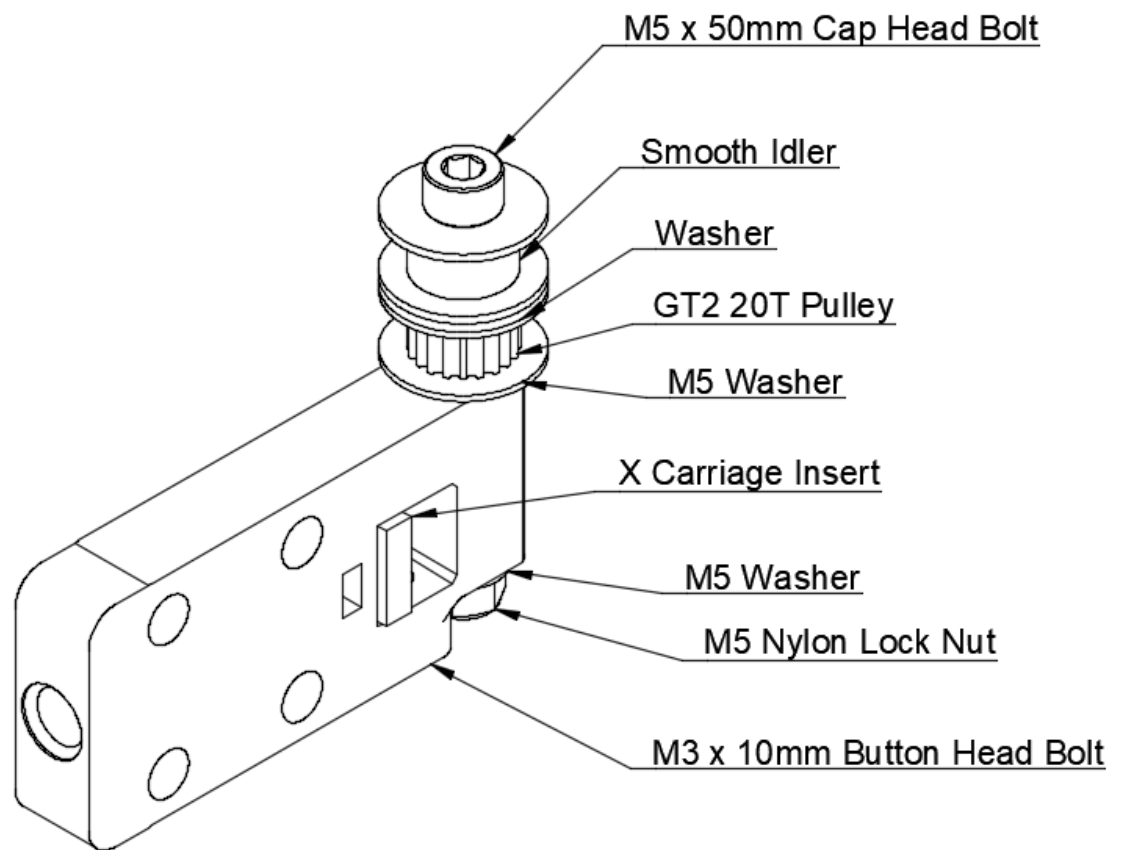


Your sides should all now be firmly attached and frame is complete. Before moving on, make sure that all of the side panels are flush with the top rail - if any protrude above or below, loosen up the nuts slightly and adjust the panel. This is especially critical for the left & right panels, having them too high or too low can affect the idler and stepper mounts.

Y Linear Rail Installation

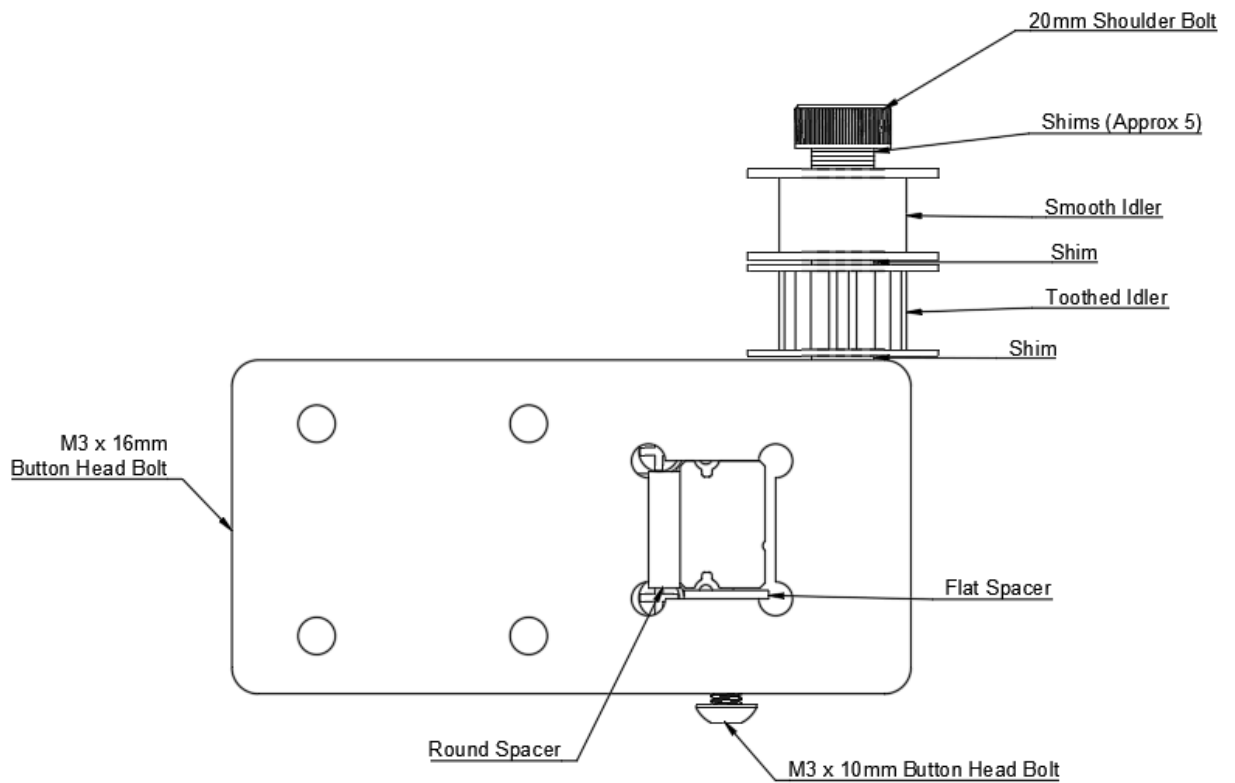
- (1) 350mm linear rail
- (1) Back_X_Carriage
- (1) Front_X_Carriage
- (2) M5 x 50mm cap head bolts
- (6) M5 washers
- (2) M5 nylon lock nuts
- (2) GT2 5mm bore smooth idler
- (2) GT2 20T x 5mm bore toothed idlers
- (8) M3 x 8mm button head bolts (possibly M3 x 6mm button head, test fit)
- (2) M3 x 10mm button head bolts
- (2) M3 x 16mm button head bolts
- (2) M3 nuts

Before putting on the Y rails, we need to put the idlers & pulleys on the X Carriages. The important part is to get the idlers and pulleys in the correct order. For the back X carriage the smooth idler goes on top. Start with an M5 x 50mm Cap Head Bolt. Place the smooth idler on, then an M5 washer, then the 20T pulley, then another washer. Pass it through the back X carriage, and then put on an M5 washer and M5 nylon Lock nut. It should all be snug, but both the idler and pulley should be able to turn freely. The X carriage insert is illustrated here to show where it goes, hang on to it for now. Insert one M3 x 10mm button head bolt into the bottom of the carriage, just far enough it's fully threaded into the insert.

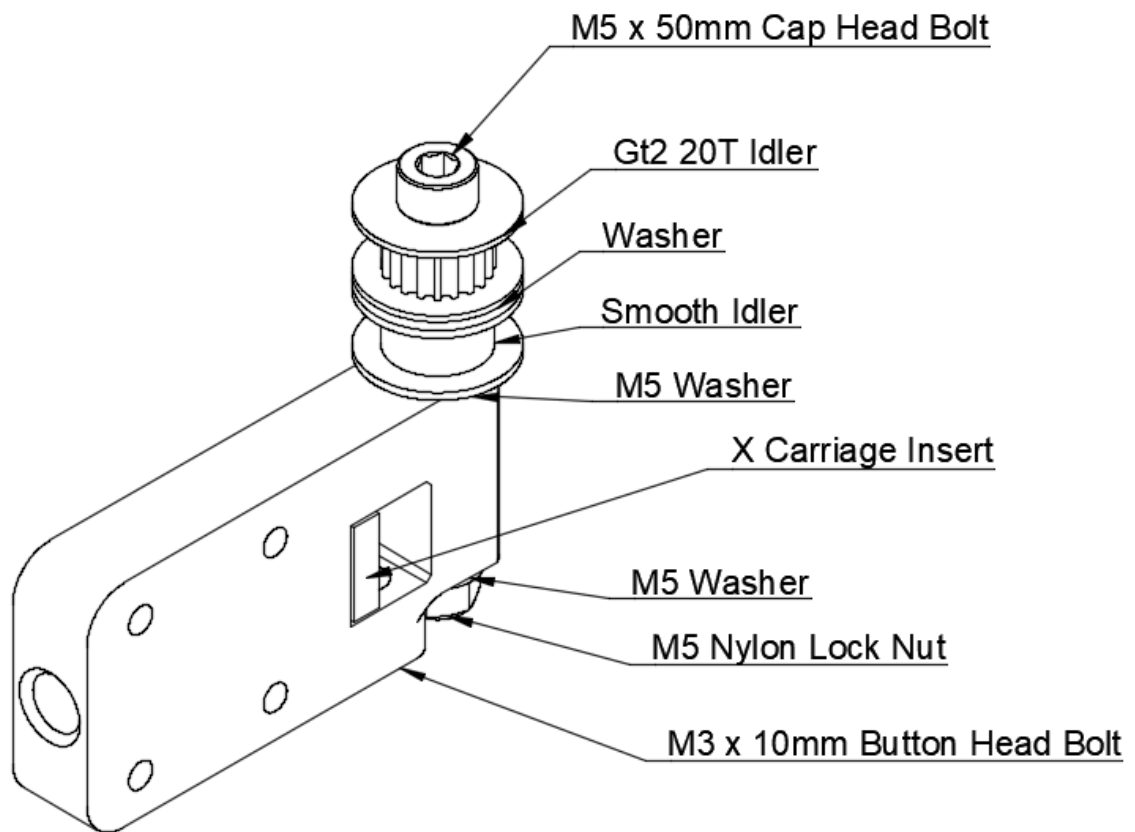


If you're using the aluminum parts, your rear X carriage will look like this

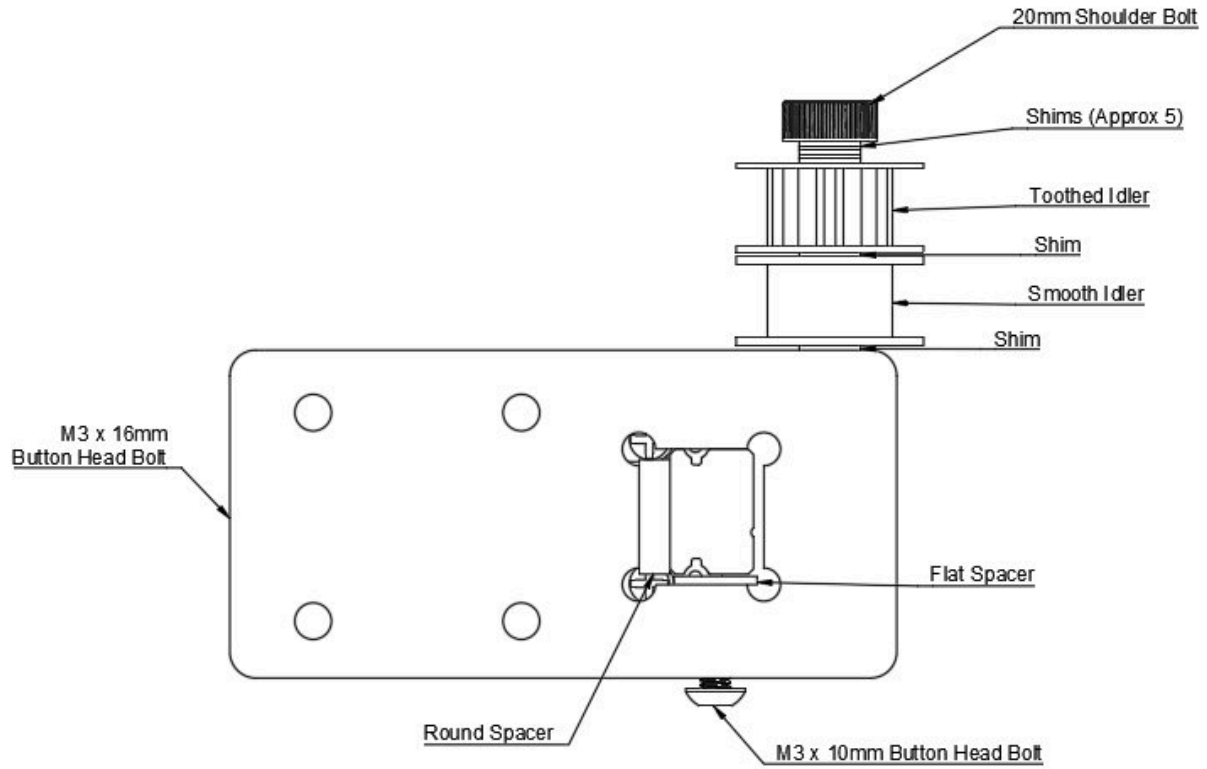
You need to adjust the number of shims above the top idler to eliminate any play in the stack



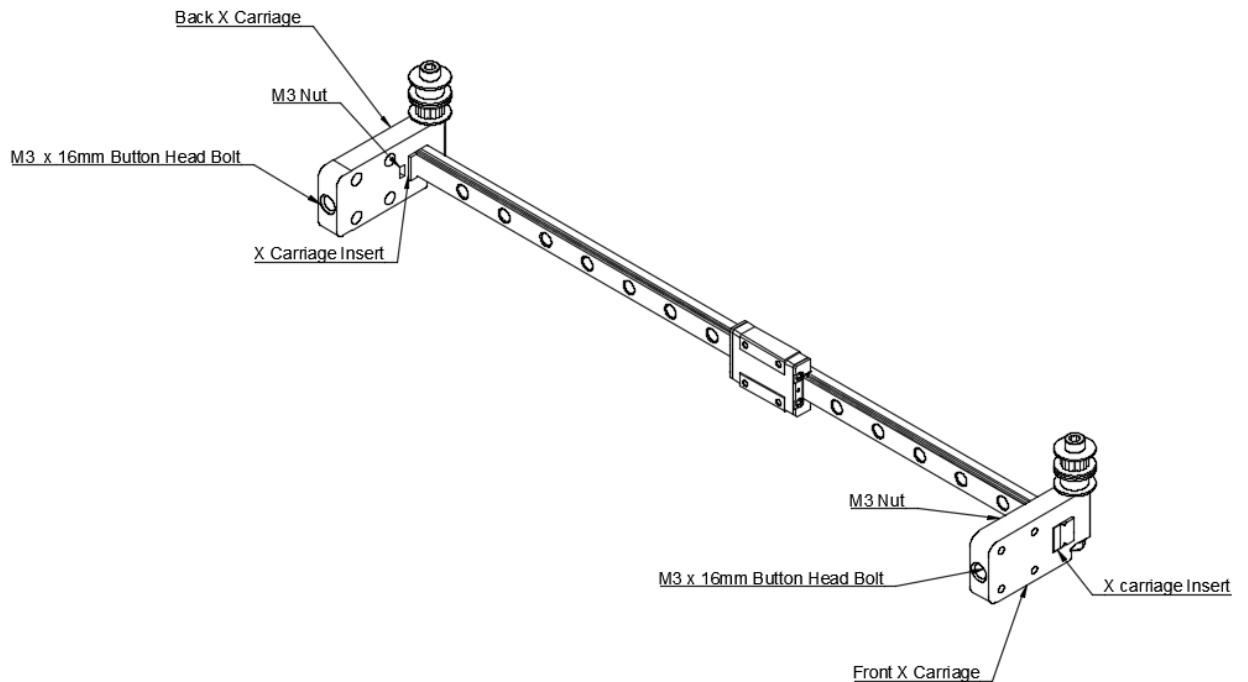
Repeat this process for the front X carriage but on the front one be sure the pulley is on top, and the smooth idler is on the bottom.



If you're using the aluminum parts, your front X carriage will look like this

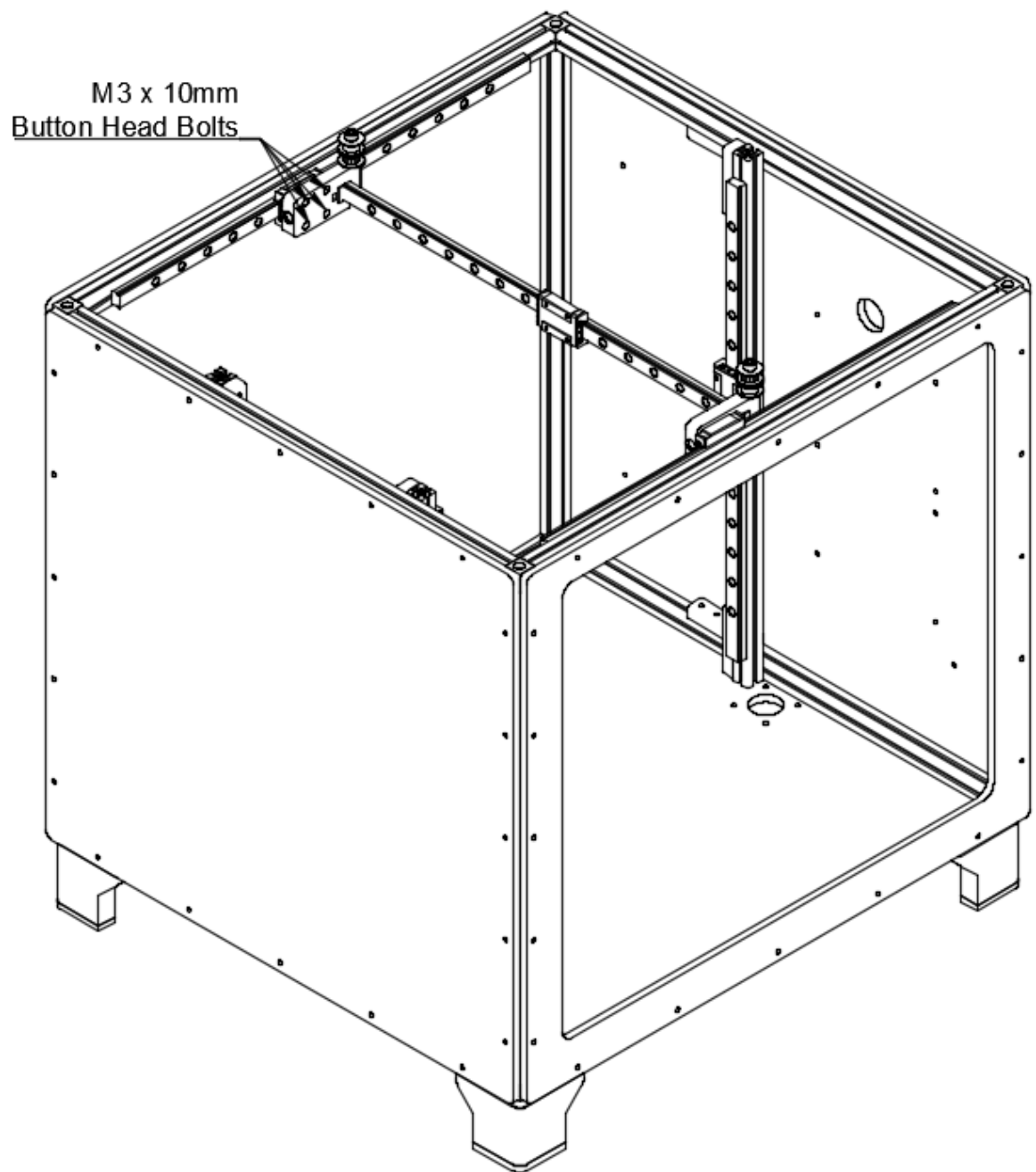


Now take your 350mm MGN 12 Y rail, and place the Back X Carriage and Front X Carriage over the ends of the rail. The bolt holes should face out, for attaching to the X carriages, and the X carriages should point out in the same direction as the carriage on the Y rail as in the picture below. Place an M3 Nut into the small slot in each of the carriers, and place an M3 x 16mm button head bolt in the side of each carrier. Do not tighten these down yet.



(The image shows M3 x10mm, should be M3 x 16mm)

Remove any tape you have holding down the MGN12 X carriages, then attach the X carriages to the two MGN12 X carriages using (4) M3 x 8mm Button head bolts each. The idlers should be towards the right side of your printer. Tape these back down so your Y axis doesn't slide off the rails!



You may wish to tape the Y carriage in place so it doesn't rattle around.

Steppers

Parts needed in this step:

Front_Motor_Mount

Rear_Motor_Mount

Z_Motor_Mount

(20) M3 x 10mm

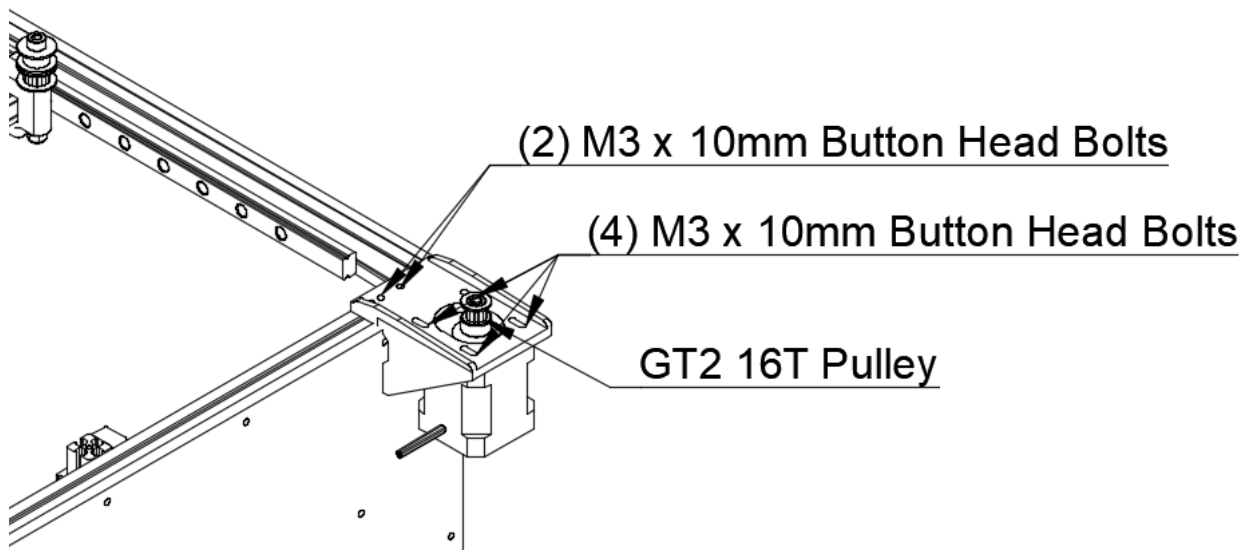
(14) M3 washers

(3) 16t pulleys

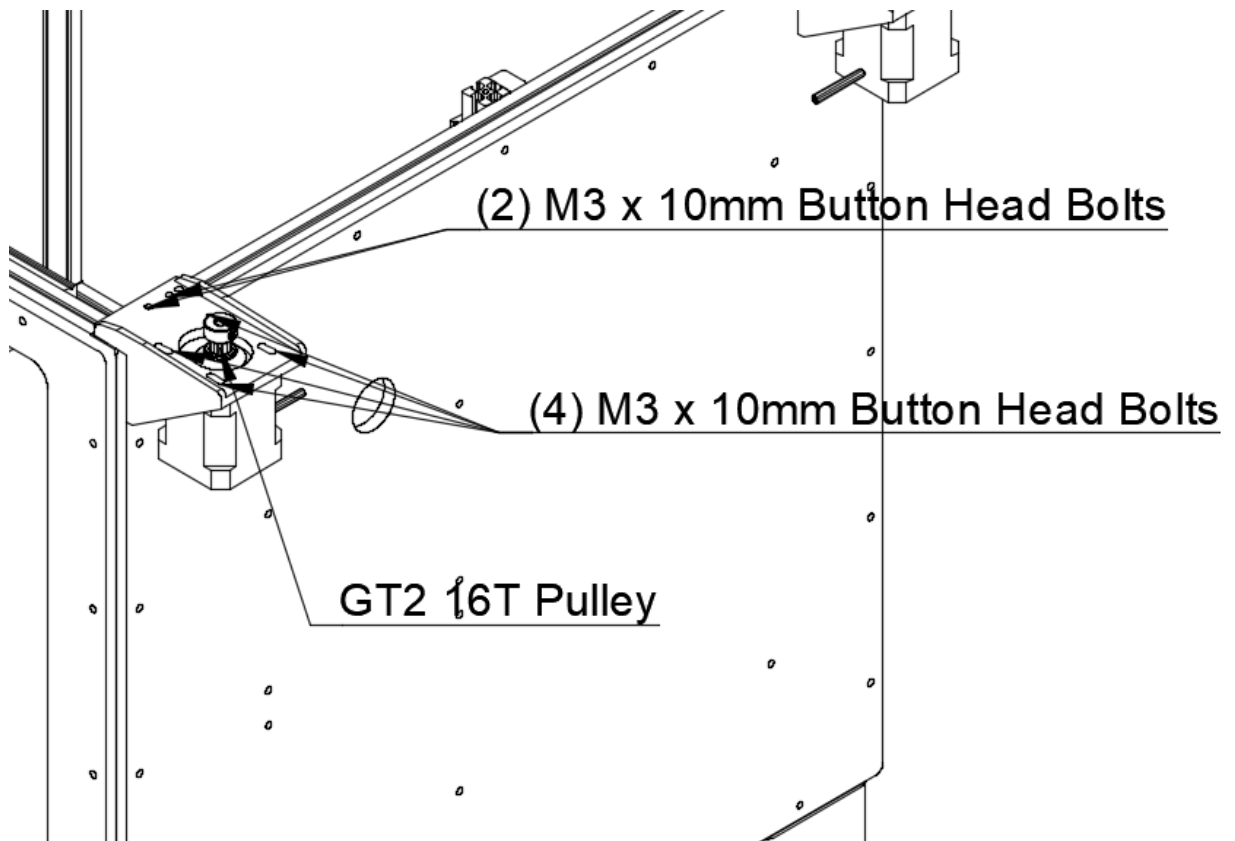
(1) 32t pulley

All of the steppers install on the upper right extrusion, when facing the front of the printer.

Starting with the back motor mount (the cutout for clearancing a bolt should be towards the center of the printer), begin by attaching it to the right side of the printer frame using (2) M3 x 10mm button head bolts. The bolts will go into two of the M3 nuts you dropped into the frame at the beginning. Use the two M3 nuts closest to the back of the frame! Then attach one of your steppers to it using (4) M3 x 10mm button head bolts. Position the stepper all the way in towards the printer body in the slots. Attach a 16T pulley to it. Orient the Pulley so the grub screw collar is down, and the threads are on top. Don't crank the stepper or the pulley down tight yet, as they'll be adjusted later.



Attach the front motor mount the same as you did the rear, using (2) M3 x 10mm button head bolts to attach it to the extrusion, and then (4) M3 x 10mm button head bolts to attach the stepper. Position the stepper all the way in towards the printer body in the slots. Get the bolts snug, but don't crank them down as you'll need to adjust the spacing later. Attach a 16 T pulley to the front stepper, this time with the grub collar towards the top and the teeth down.



Note the front pulley has its teeth to the bottom and the rear pulley has its teeth to the top. This is critical.

Idler Carriers

Front_Stationary_Idler_Carrier

Back_Stationary_Idler_Carrier

(2) Idler_Spacer

(4) M5 x 50mm cap head bolts

(4) M5 lock nuts

(4) GT2 20T x 5mm bore toothed idlers

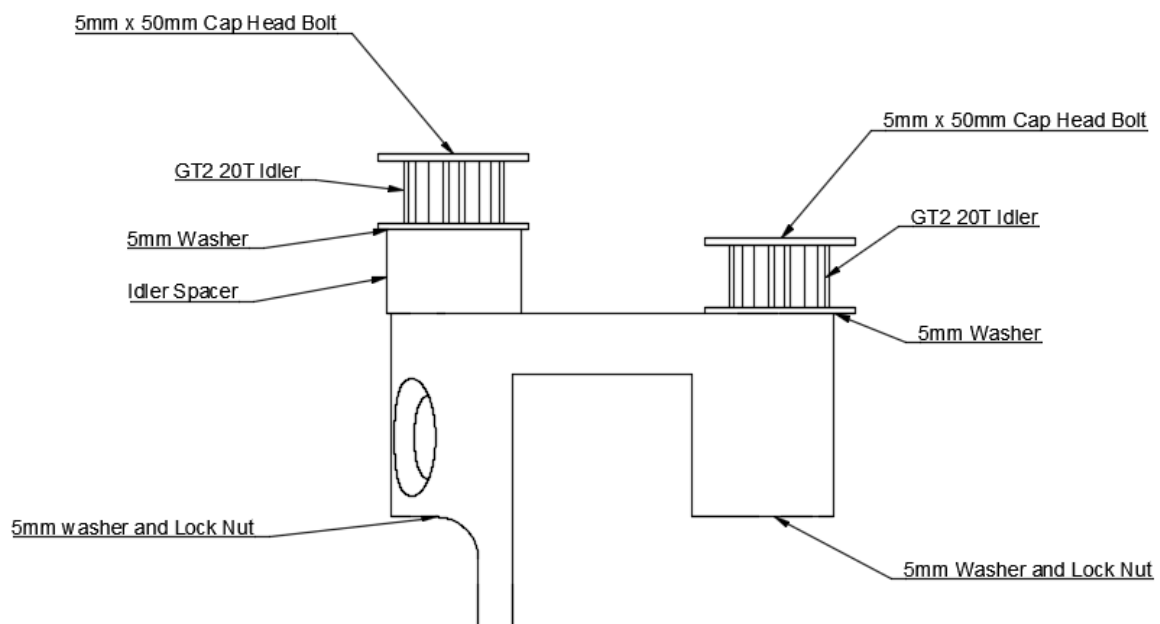
(8) M5 washers

(4) M3 x 10mm button head bolts

Back Stationary Idler Carrier

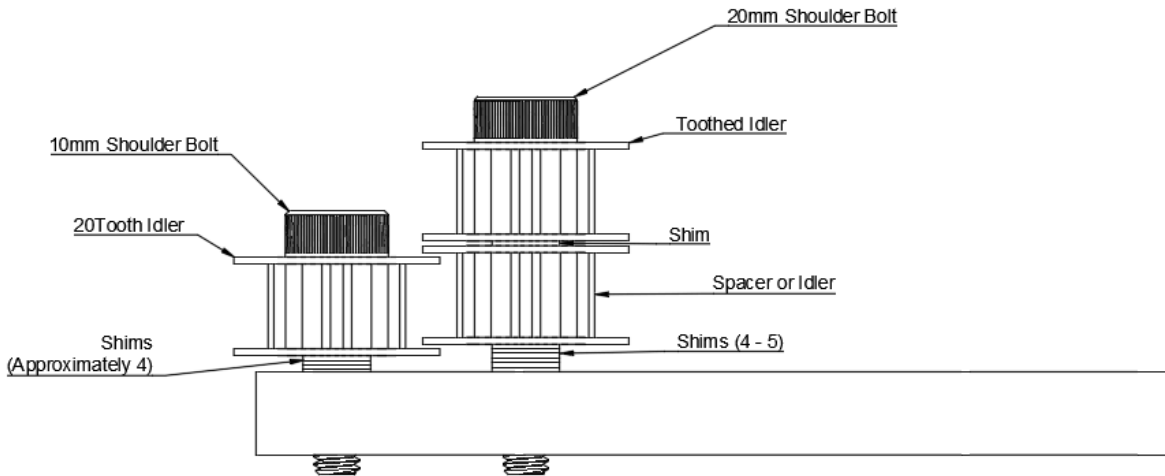
Begin by assembling the back idler carrier. The outside of the carrier has a longer tab that points down, with a screw hole. On the back carrier, that's the side that gets the Idler spacer. Take a 5mm cap head bolt, and place a GT2 20T idler on it, then an m5 washer, then your idler spacer. Insert this bolt into the outside of the carrier, and lock it on with an m5 washer & lock nut. You want it to be snug, but still allow the idler to spin freely.

Take another m5 x 50mm cap head bolt, and put a GT2 20T idler on, followed by an m5 washer. Put this through the 5mm hole on the inside of the carrier, and lock it on using an m5 washer and nylon lock nut. Again, make it tight, but so that the idler still spins freely.

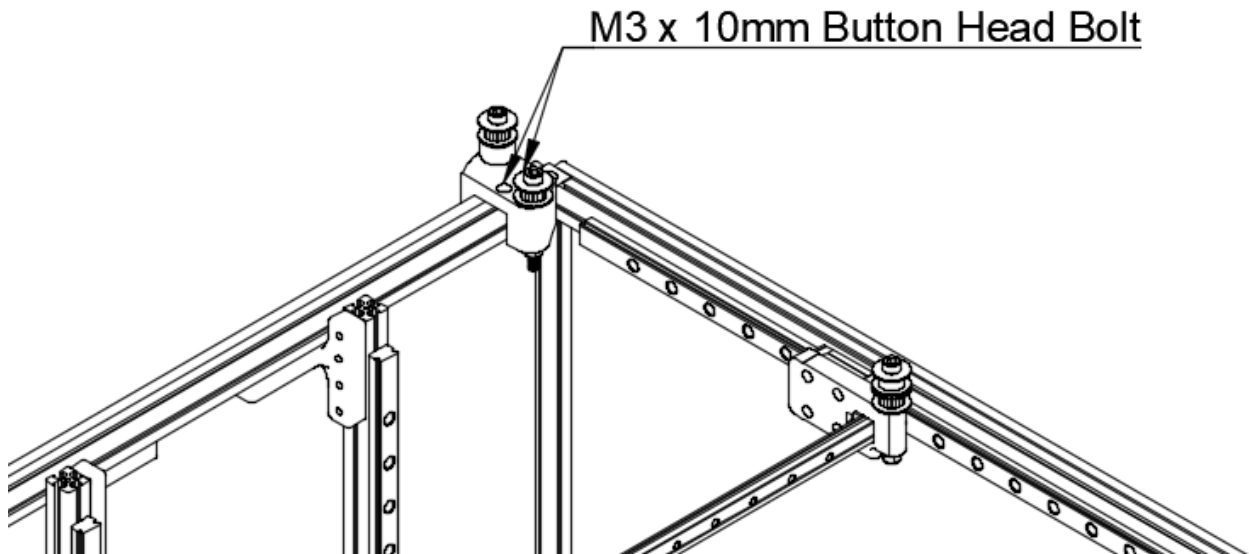


If you're using the aluminum idler carriers, they should look like this

You need to adjust the number of shims below the idlers to eliminate any play in the stack



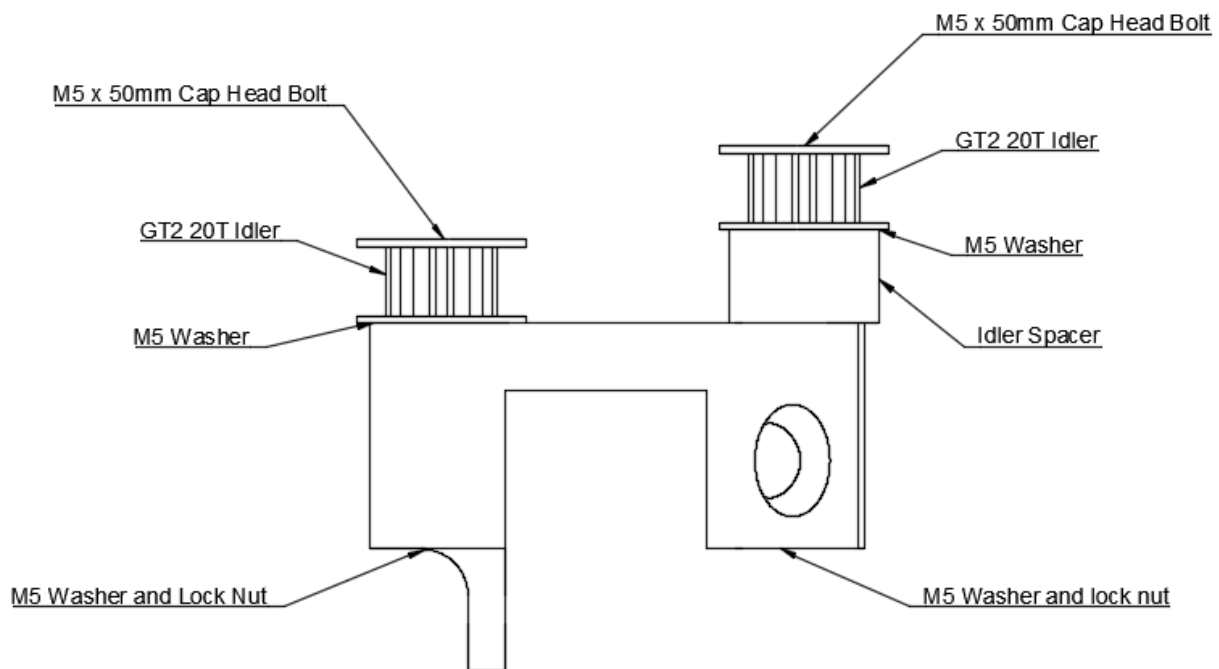
Place the back idler carrier over the top of the left extrusion, in the back corner of the printer. Be sure the tab is on the outside of the printer. Use (2) M3 x 10mm bolts to attach it to the two M3 nuts closest to the back of the printer. It should be against the back rail, we'll adjust it more later, so it only needs to be snug for now.



Front Stationary Idler Carrier

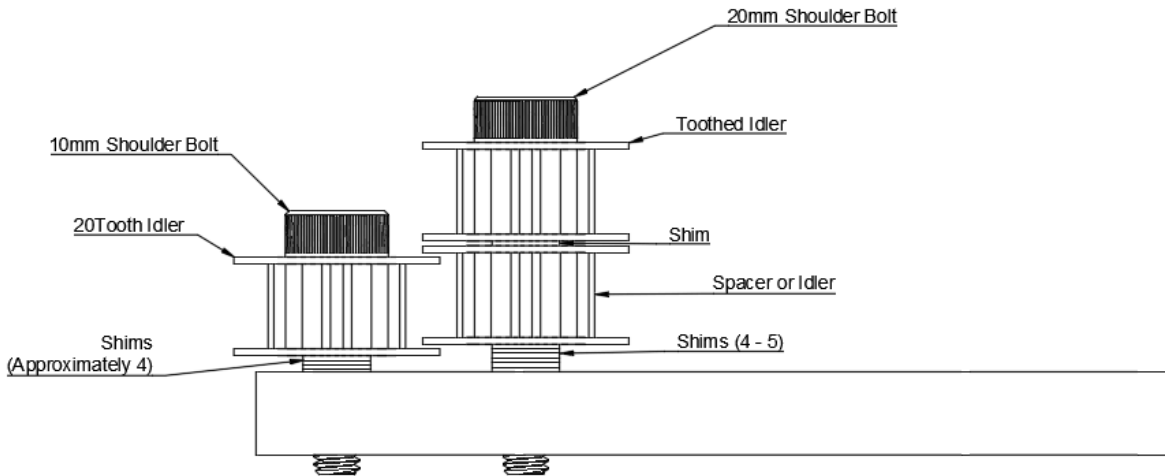
Now we'll assemble the front idler carrier much the same way, but the idler is reversed. The outside of the carrier has a longer tab that points down, with a screw hole. On the front carrier, it gets only a GT2 20T idler. Take a 5mm cap head bolt, and place a GT2 20T idler on it, then an m5 washer. Insert this bolt into the outside of the carrier, and lock it on with an m5 washer & lock nut. You want it to be snug, but still allow the idler to spin freely.

Take another m5 x 50mm cap head bolt, and put a GT2 20T idler on, followed by an m5 washer, then an idler spacer. Put this through the 5mm hole on the inside of the carrier, and lock it on using an m5 washer and nylon lock nut. Again, make it tight, but so that the idler still spins freely.

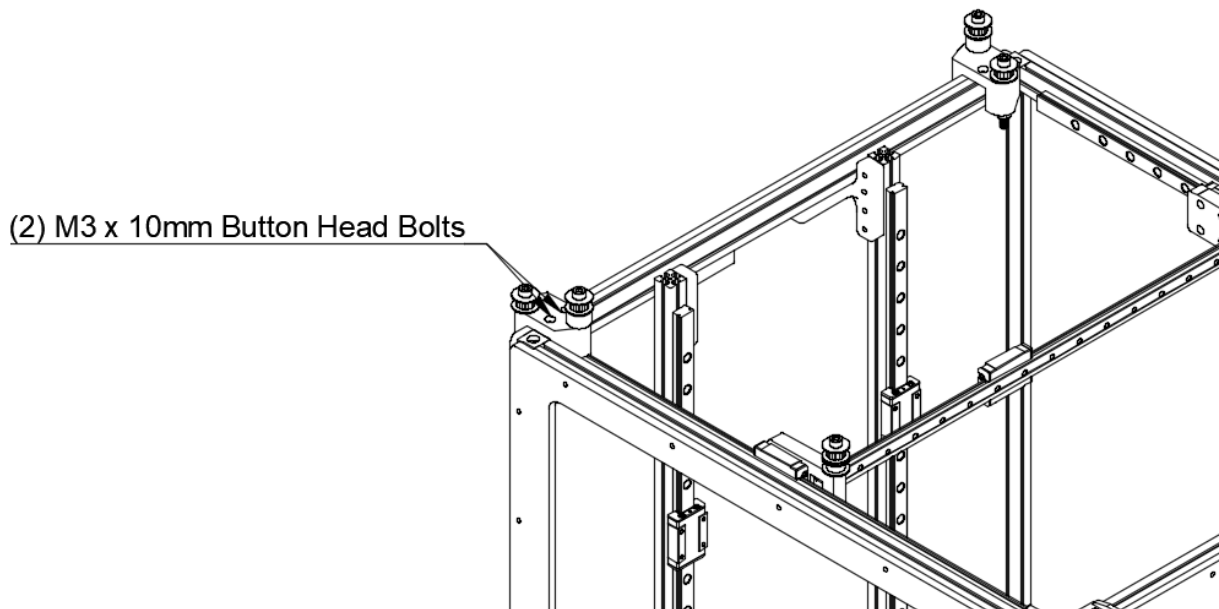


If you're using the aluminum idler carrier, it should look like this

You need to adjust the number of shims below the idlers to eliminate any play in the stack



Place the front idler carrier over the top of the left extrusion, in the front corner of the printer. Be sure the tab is on the outside of the printer. Use (2) M3 x 10mm bolts to attach it to the two M3 nuts closest to the front of the printer. It should be against the front rail. We'll adjust it more later, so it should only be snug for now.



Y Carriage Installation

Parts needed in this step:

Y_Carriage

E3DV6_Groove_Mount

Titan_Mount

Y_Endstop_Mount

IR_Probe_Mount

IR Probe

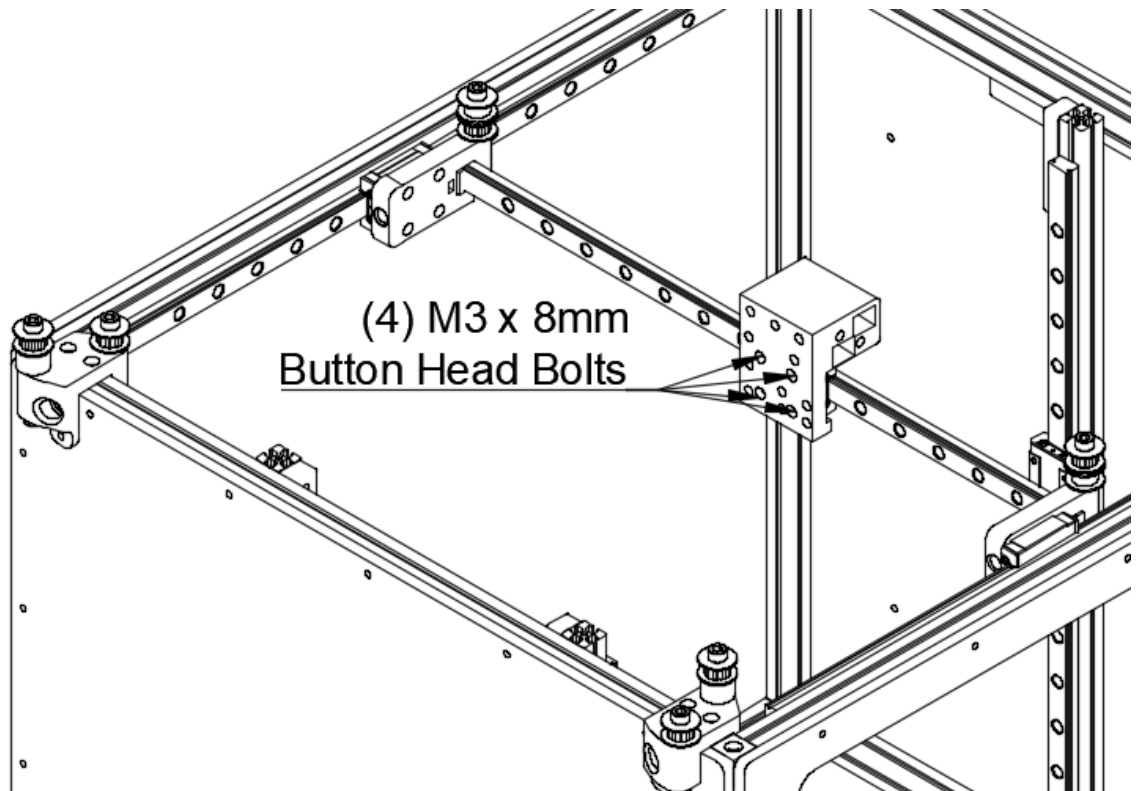
(15) M3 x 8mm button head bolts

(2) M3 Nuts

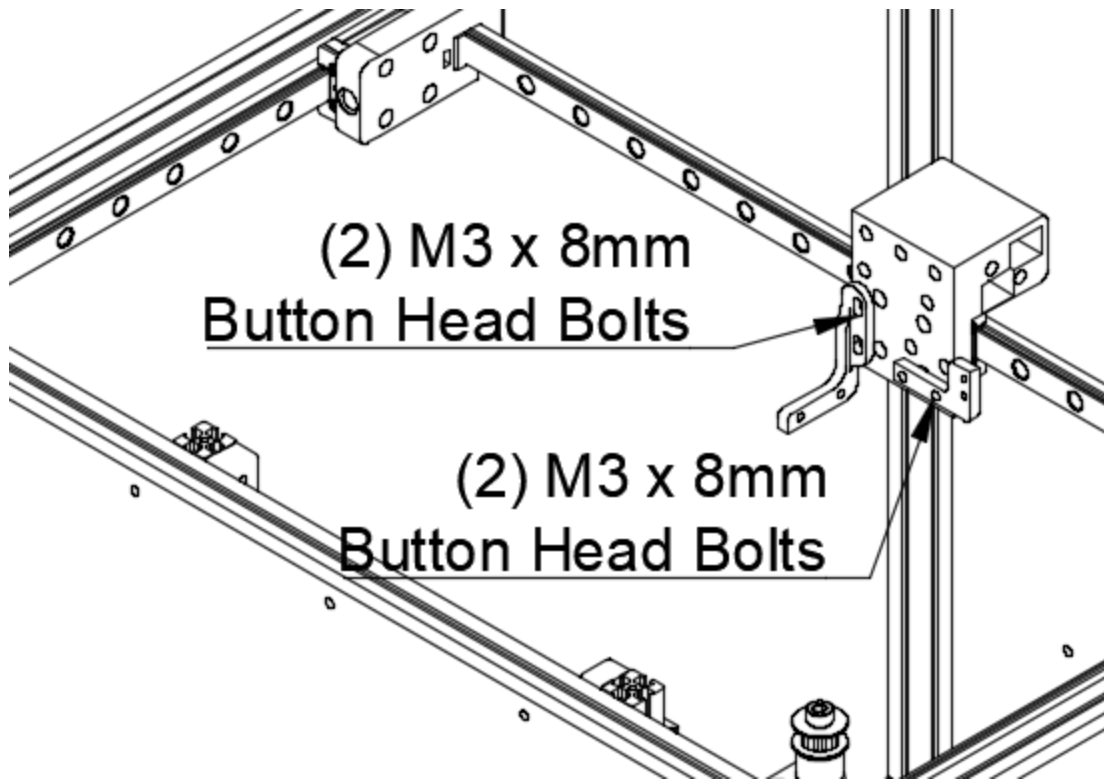
(2) m2.5 x 8mm bolts (from the IR probe kit)

(2) m2.5 nuts

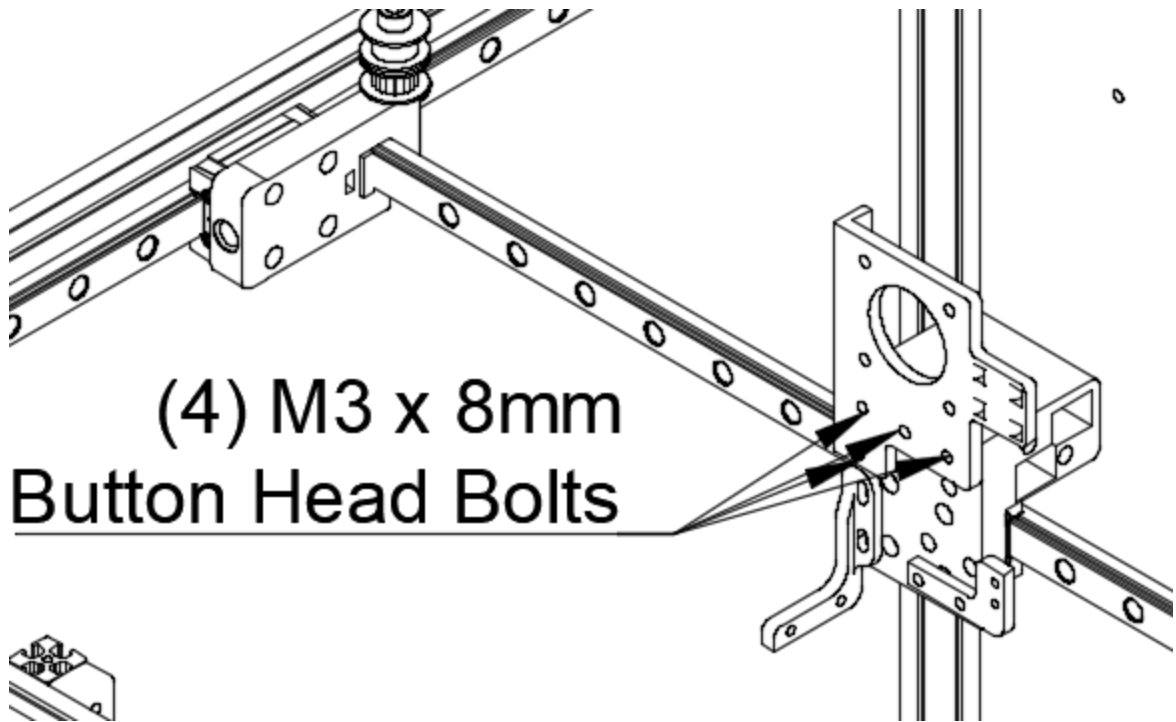
Taking your Y carriage, line it up with your Y linear rail carriage (remove any tape if you were holding it in place!) and attach it using (4) M3 x 8mm Button Head Bolts.



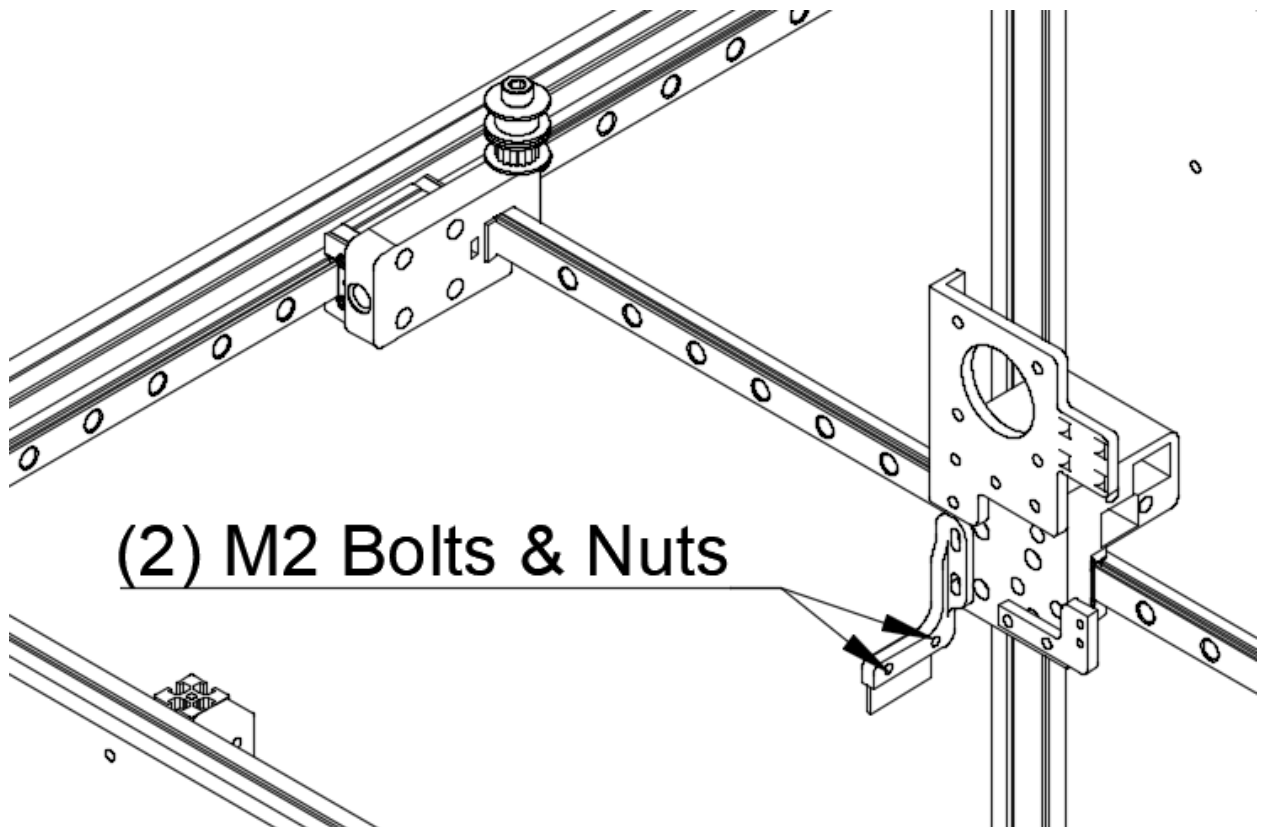
Attach the IR Probe mount to the lower two of the leftmost brass inserts) on the Y carriage using (2) M3 x 8mm Button head bolts. Attach the Y endstop mount to the bottom right two holes using (2) M3 x 8mm Button head bolts.



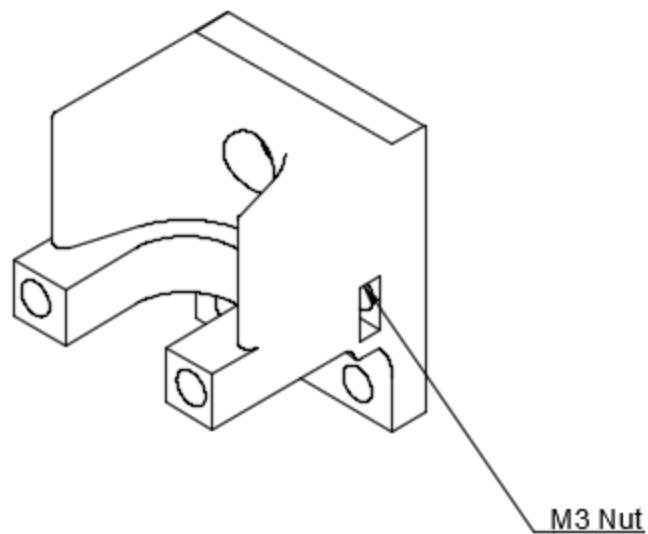
Attach the titan mount to the 4 brass inserts on the Y carriage using (4) M3 x 8mm button head bolts.



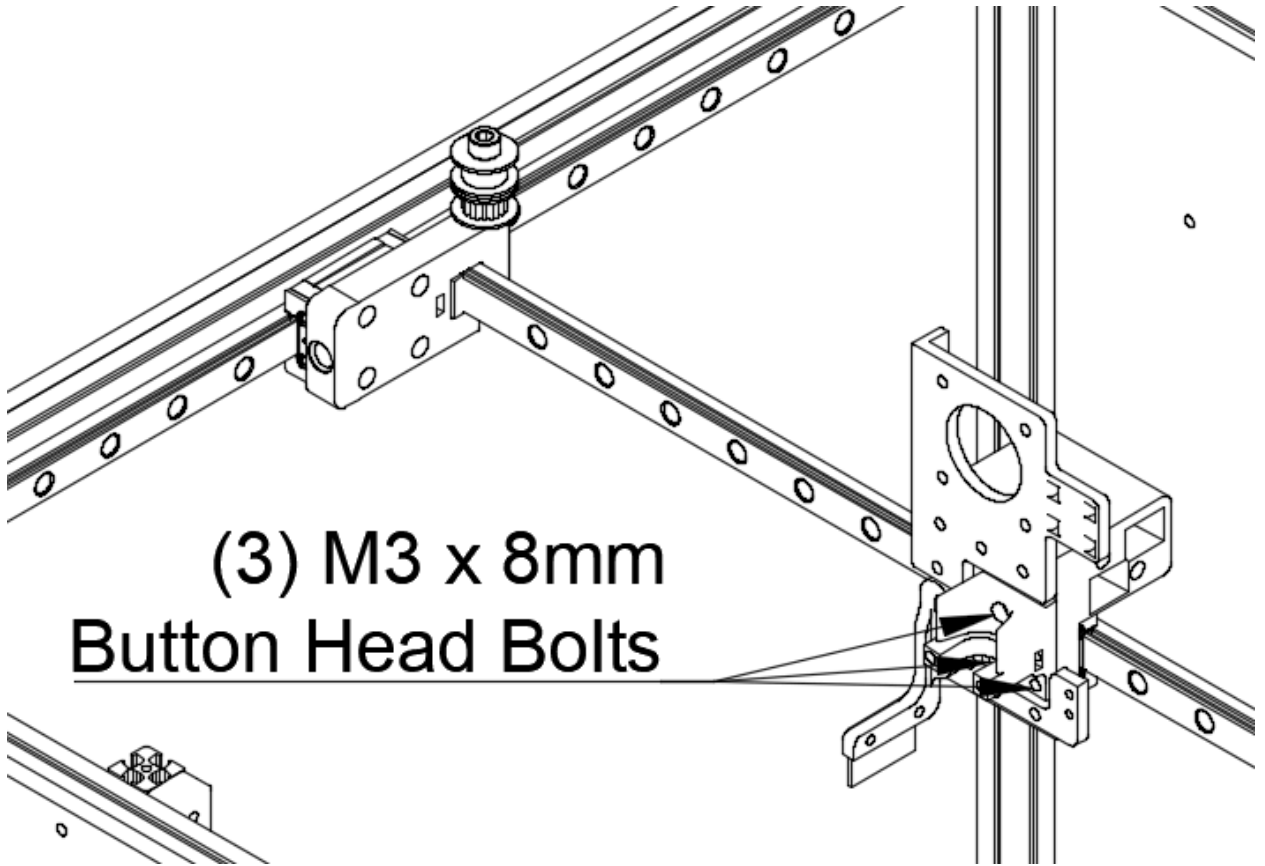
Attach the mini-IR probe to the IR Probe mount, attach it on the back side of the mount, with the wire headers pointed towards the rear of the printer. Use the m2 nuts and bolts that came with the IR probe (8mm m2 bolts)



Before installation of the groove mount, you need to insert (2) M3 nuts, one into the slot on each side of it.



Attach the groove mount using (3) M3 x 8mm button head bolts using the top hole in the groove mount, and the bottom two holes, match them up the the brass inserts in the Y carriage.



(3) M3 x 8mm
Button Head Bolts

X/Y Belts

Parts used in this step:

GT2 belt

(4) Belt_Retainer_Clip

(4) M3 x 45mm cap head bolts

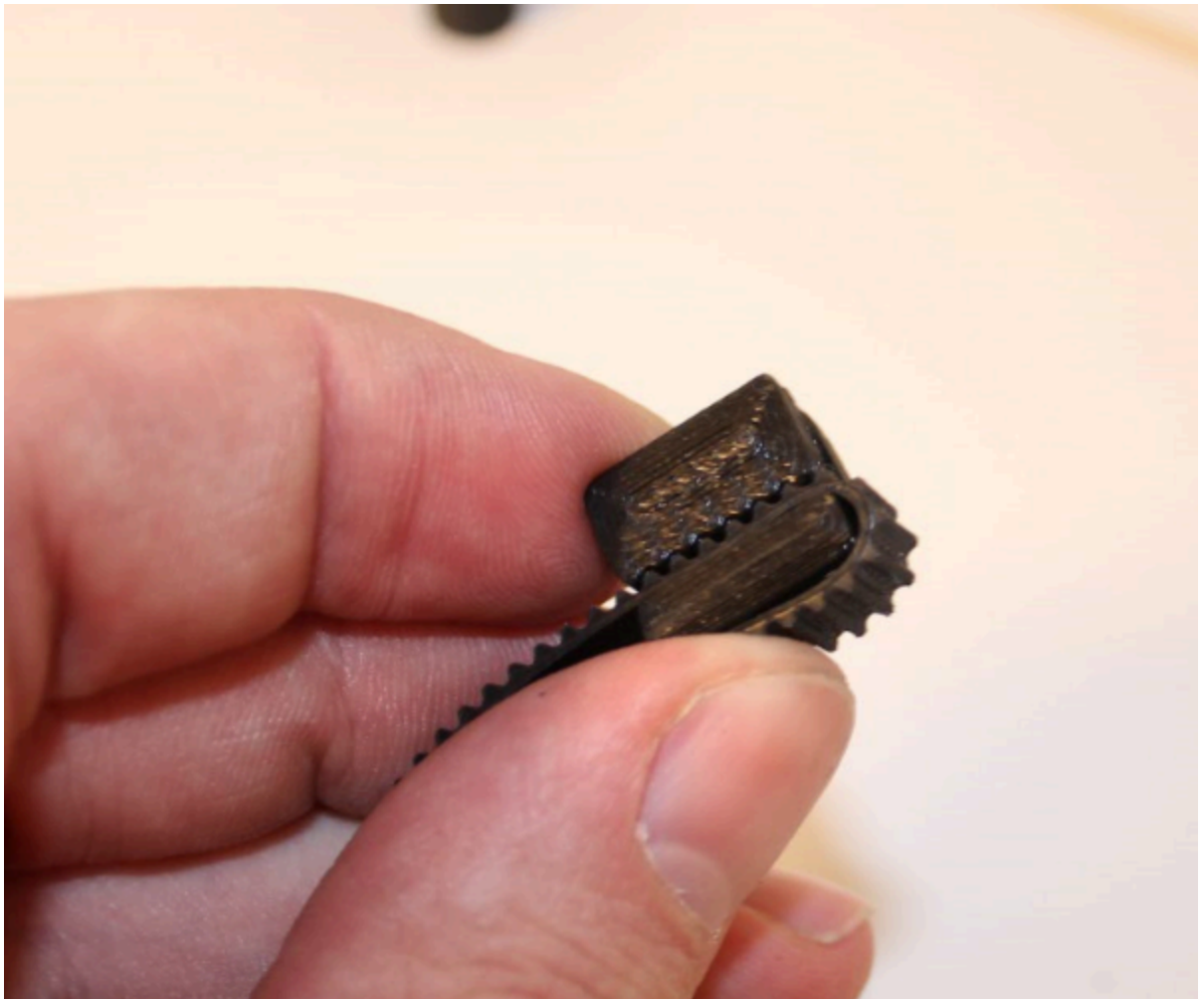
(4) M3 x 16mm button head

(8) M3 washers

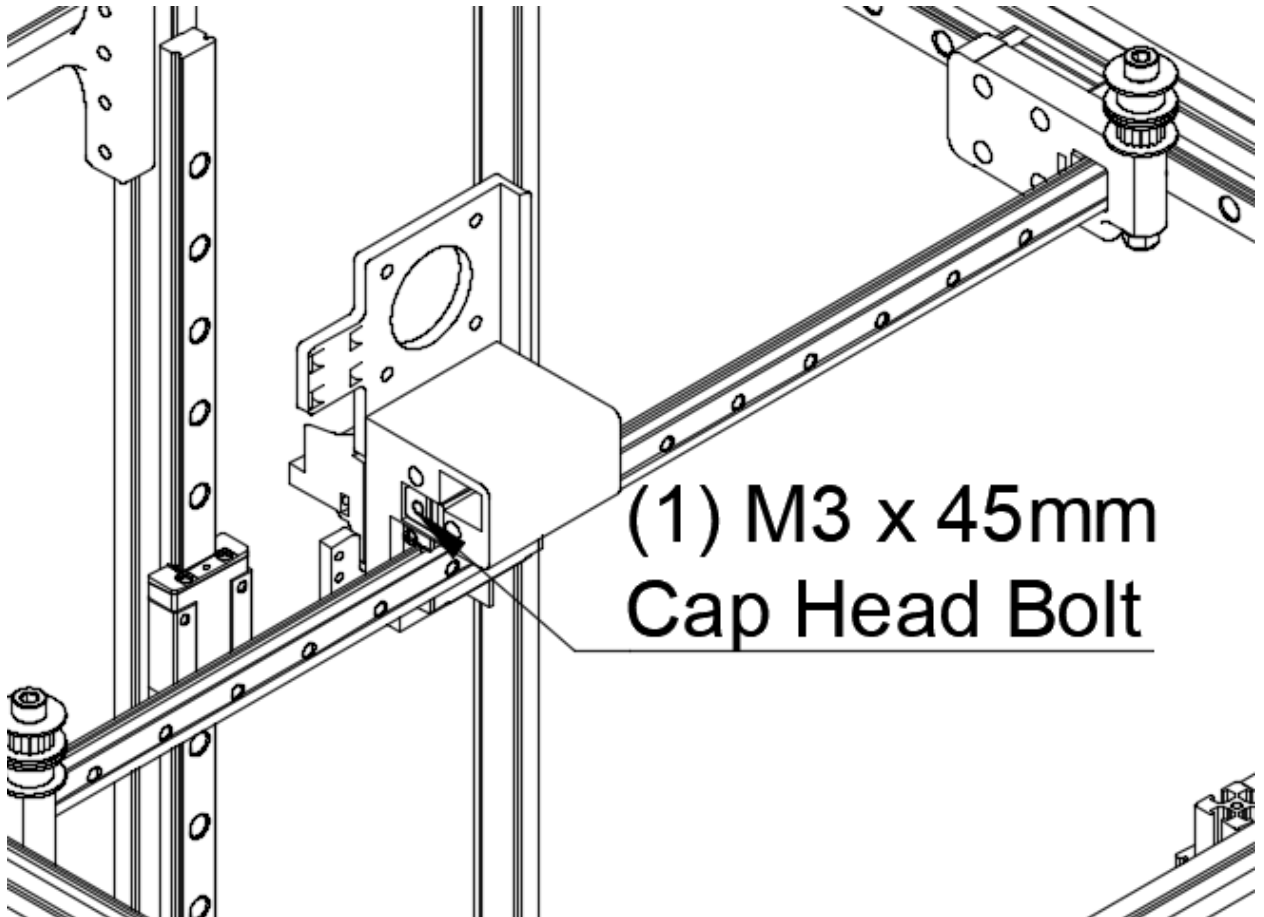
(4) M3 nylon lock nuts

Front / Lower Belt

Take one end of your GT2 belt (the 5m long spool of it) and clip it into one of the belt retainer clips. Match the teeth of the belt up to the teeth in the clips, and loop it around the shorter side. Leave about an inch extend past the edge of the clip.

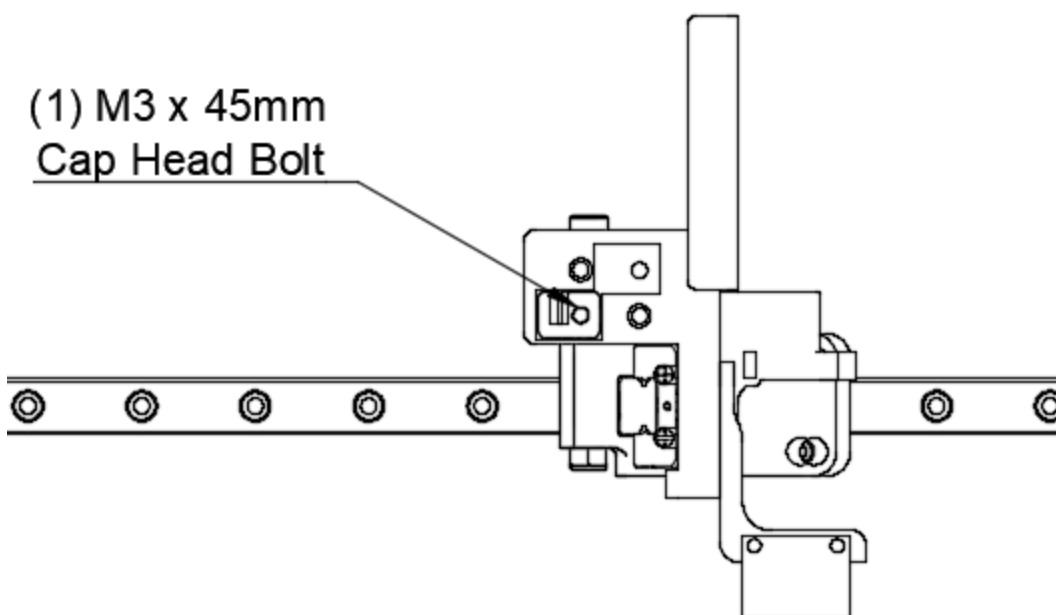


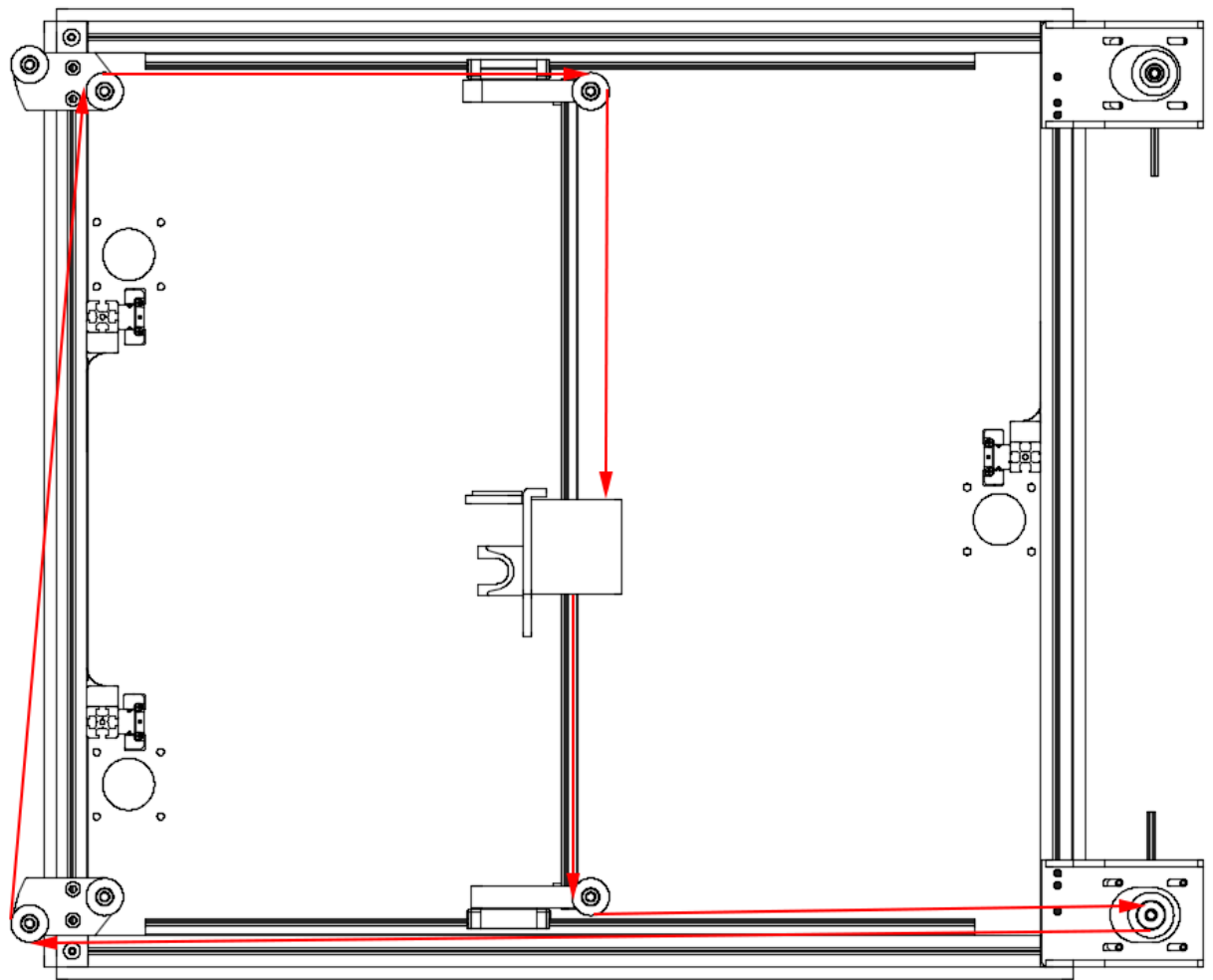
Using (1) 45mm cap head bolt, secure that into the Y carriage in the bottom hole facing the front of the printer. The teeth on the belt should be pointing towards the left side of the printer body. You should be able to tighten the clip down until it's flush with the front of the Y carriage.



Now we're going to thread this belt through. It comes straight out from the Y carriage, and around the smooth idler on the front X carriage. The back of the belt should be against the idler. It will bend at a 90 degree angle to the right around the idler, and go around the front stepper pulley. The teeth should grip the pulley. Come back across the front of the printer, and around the lower rear toothed idler on the front idler carrier. It then goes along the left side of the printer, and around the lower inside toothed idler on the rear idler carrier. It then passes along the back of the printer to the lower toothed idler on the back X carriage. It will then return to the Y carriage, in the lower belt retainer spot on the rear of the Y carriage. Attach another belt retainer clip, test the fit to make sure the belt is going to be tight. (Find tuning of the belt tension will come later, so don't worry about really cranking it down yet). Use (1) M3 x 45mm cap head bolt to attach the belt retaining clip into the Y carriage. Once you're satisfied with the position of the clip, cut the excess belt, leaving about an inch extending out from the clip.

(1) M3 x 45mm
Cap Head Bolt

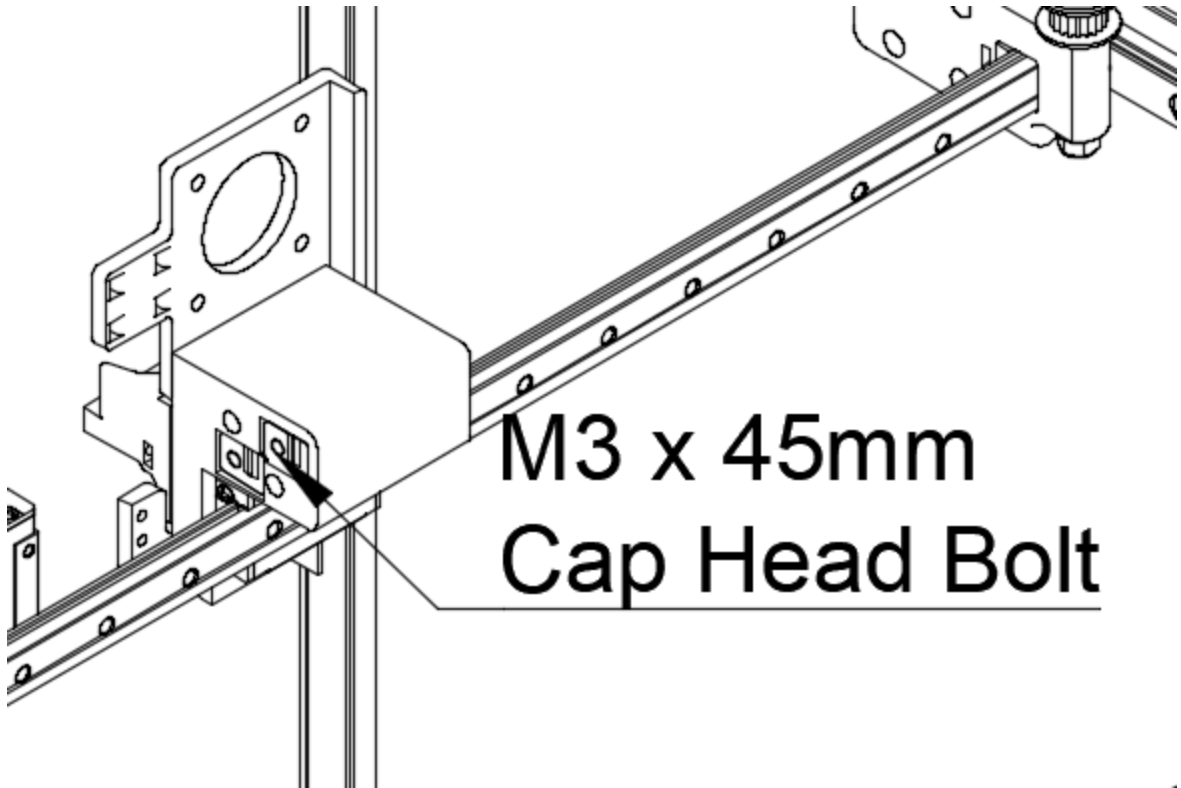




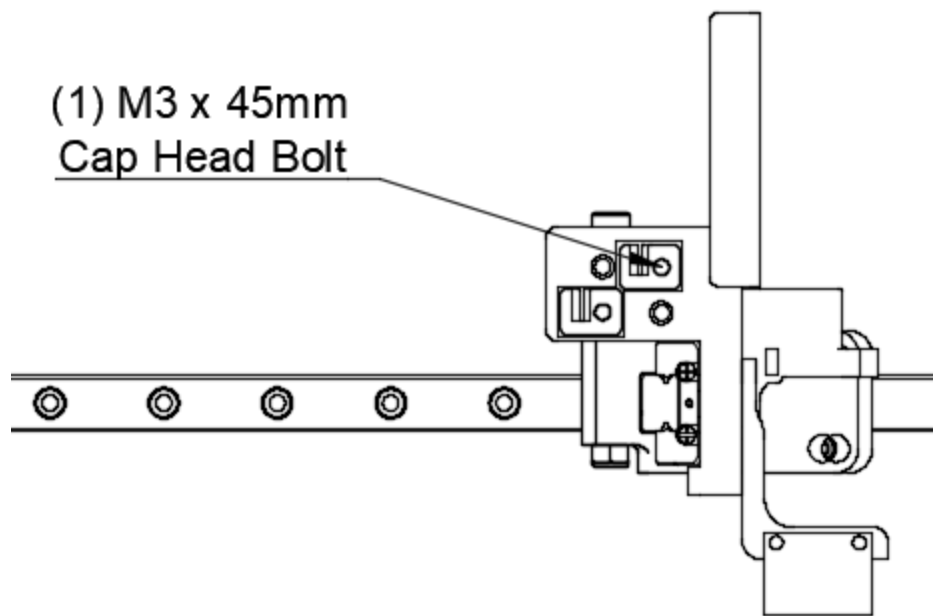
Front / Lower belt path

Rear / Upper belt

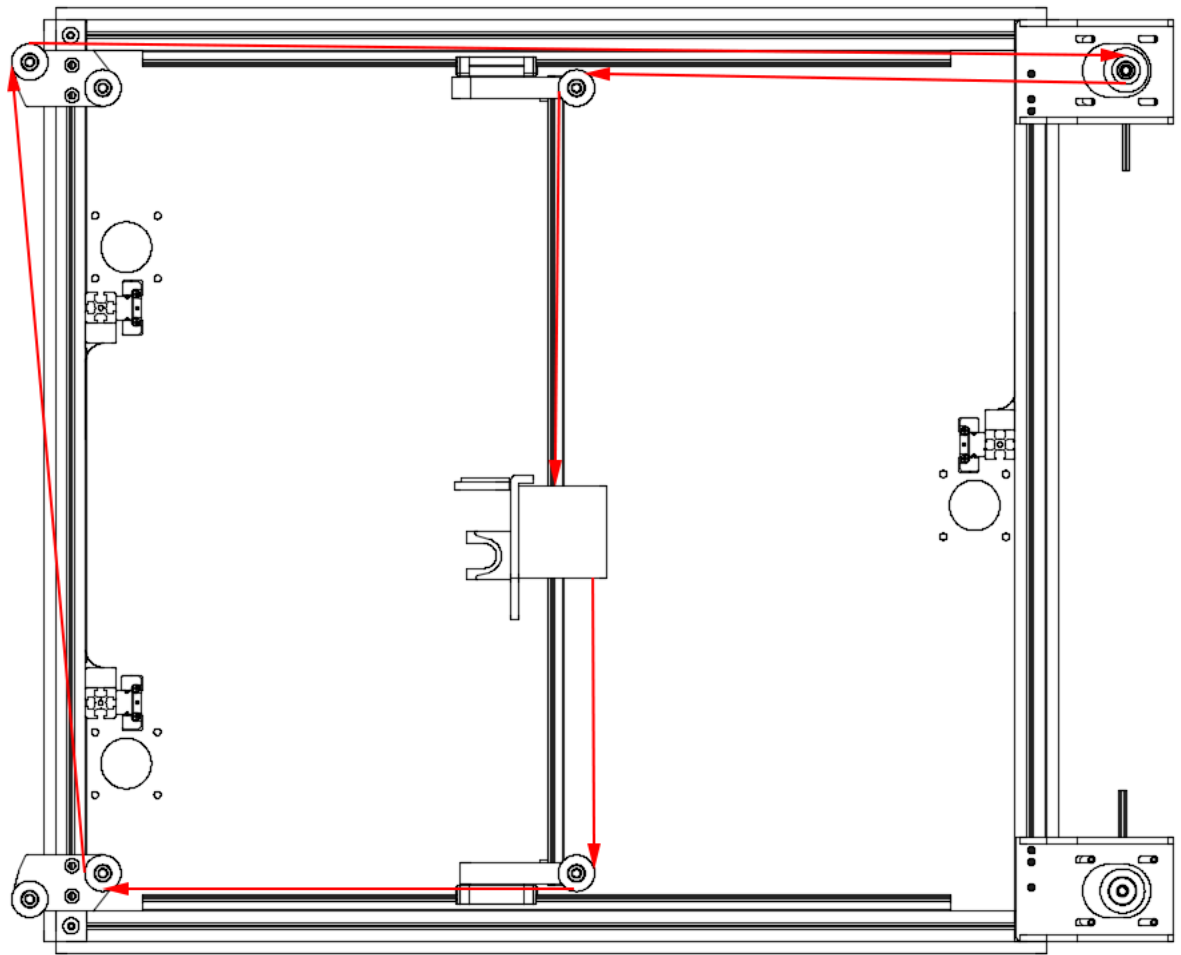
The rear stepper belt is installed much the same way. Begin by looping the belt over one of the belt retainer clips, again, leave an inch or so of extra. Using (1) 45mm cap head bolt, secure that into the Y carriage in the top hole facing the front of the printer. The teeth on the belt should be pointing towards the right side of the printer body. You should be able to tighten the clip down until it's flush with the front of the Y carriage.



Now we're going to thread this belt through. It comes straight out from the Y carriage, and around the toothed idler on the front X carriage. The teeth of the belt should be against the idler. It will bend at a 90 degree angle to the left around the toothed idler, and go back across the front of the printer, and around the upper toothed idler on the front idler carrier. It then goes along the left side of the printer, and around the upper outside toothed idler on the rear idler carrier. It then passes along the back of the printer to the toothed pulley on the rear stepper. The teeth should engage the pulley teeth. The belt then goes back along the rear of the printer, and around the upper smooth idler on the rear X carriage. The back of the belt should be against the idler. It will then return to the Y carriage, in the upper belt retainer spot on the rear of the Y carriage. Attach another belt retainer clip, test the fit to make sure the belt is going to be tight. (Fine tuning of the belt tension will come later, so don't worry about really cranking it down yet). Use (1) M3 x 45mm cap head bolt to attach the belt retaining clip into the Y carriage. Once you're satisfied with the position of the clip, cut the excess belt, leaving about an inch extending out from the clip.



Rear stepper / Upper Belt path



The rear stepper / upper belt path

Aligning the Belts

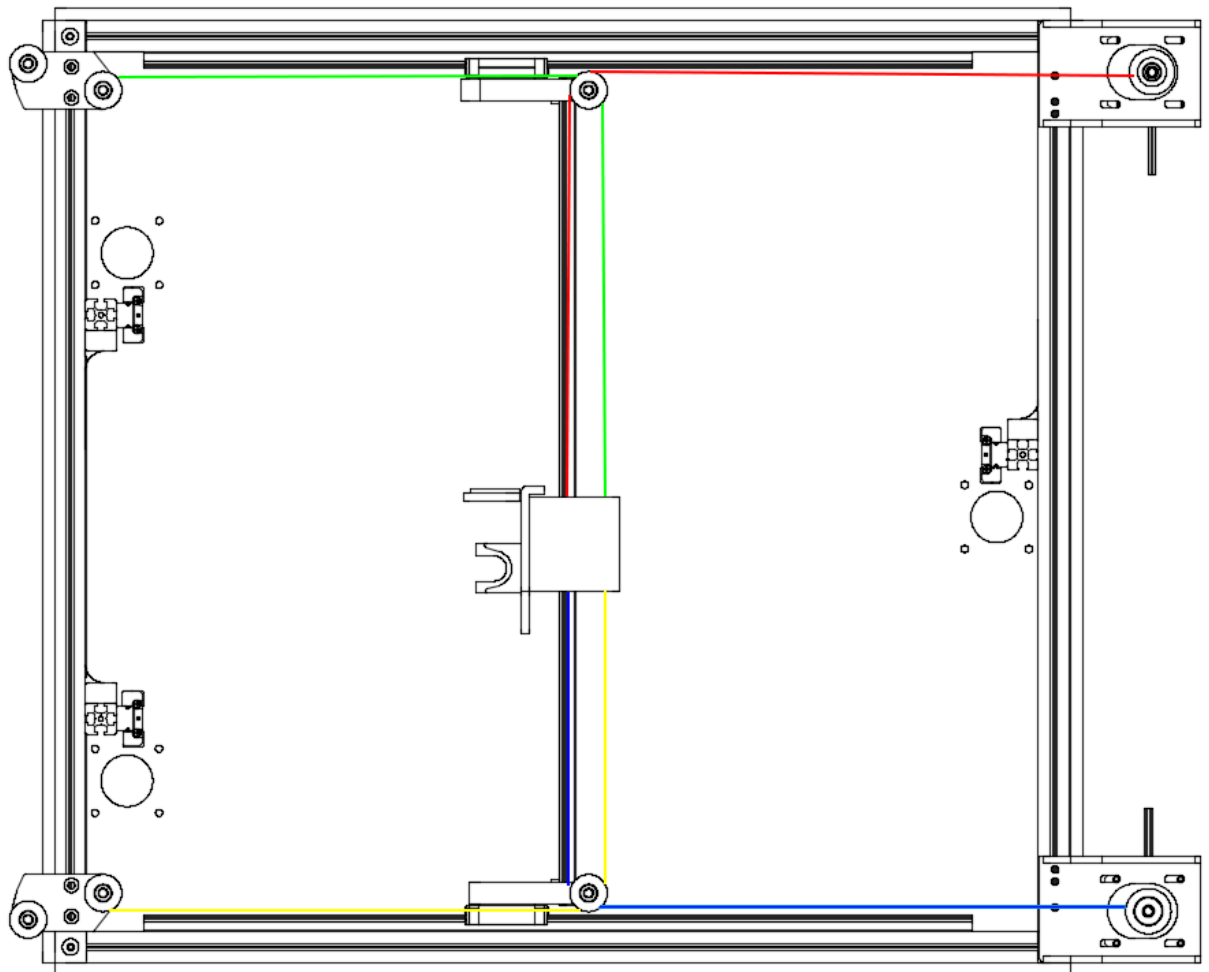
We now need to align the belts to get good precision out of your printer. This step is very critical, so take your time.

First, adjust the height of your stepper pulleys, so the belt paths are parallel to the frame. To do this, simply loosen up the pulley grub screws and move them up or down until the belts are parallel. I used a bubble level to be sure my frame was level, then levelled the belts to match.

Once both stepper pulleys are set, you need to adjust your steppers and idler carrier positioning so your belts are square. The idea is that the belt turns at exactly a 90

degree angle when it goes around the X carriages. You need to loosen up your M3 bolts holding your stepper and your idler carriers, and adjust them until the belts are at a 90 degree angle. (For the idler carriers, the belt should be at a 90 degree angle when the carrier is flush against the outside rail)

In the below drawing, the belts are highlighted to show the segments you'll be adjusting until they're at 90 degree angles. The two green segments should be at 90 degrees, the two red at 90 degrees, etc. In the end, the green and red at the back of the printer should be parallel to the frame.



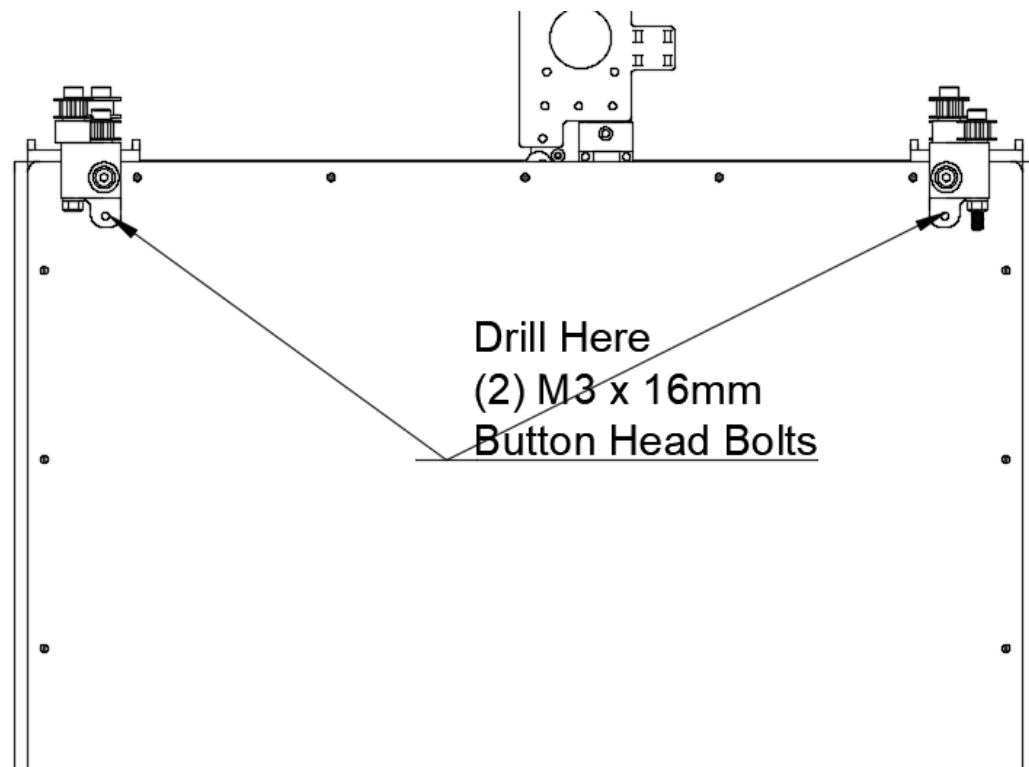
Once the belts are aligned, you should snug up the M3 bolts on the stepper and idler carriers connecting them to the frame - you don't want these to move now! (I put a little loctite on mine, but it's not required)

Reinforce the motor mounts and idler carriers

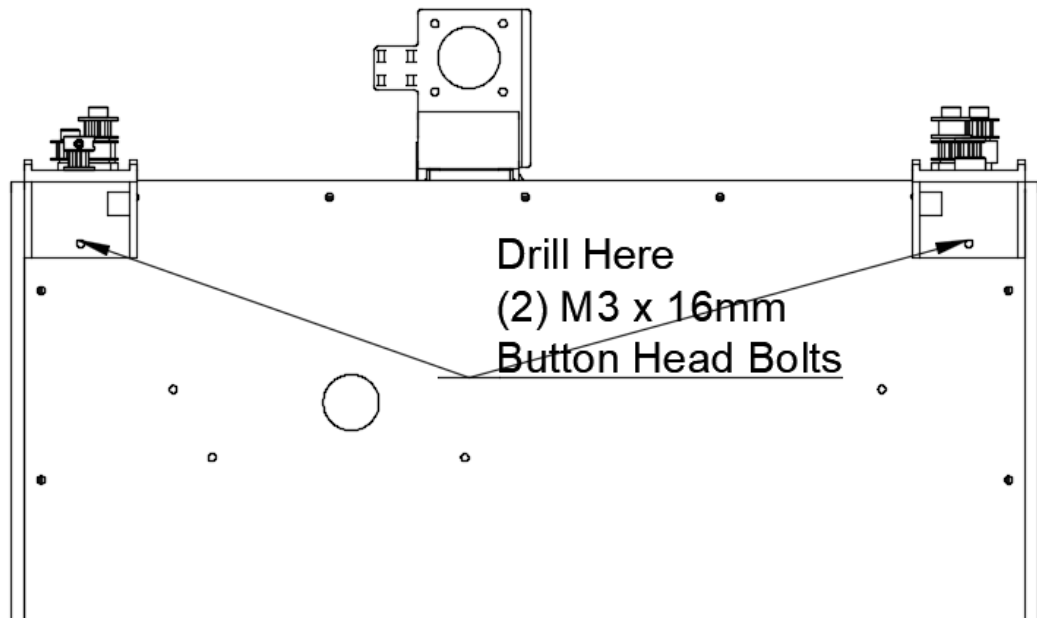
Once you're satisfied in the position of the belts, and have the idler carriers and motor carriers locked in place, we need to secure them with a bolt to help prevent them flexing. (If you have the optional aluminum motor mounts & idler carriers from 713Maker, you can skip this step).

First, take off your belts by removing the (4) M3 x 45mm cap head screws from the Y carriage (You can remove two, and leave two in, or even just loosen them up enough to slip the belts off of the stepper pulleys - you just need the belts off so you can remove the steppers). Then remove the X/Y steppers from their motor mounts by removing the (8) M3 x 8mm button head bolts.

Starting with the idler carriers, use a 3mm drill bit, and drill straight in through the hole in the tab. Once you've drilled the holes, use (2) M3 x 16mm button head bolts, and on the inside use an M3 washer & nylon lock nut to lock them in place.



Now we do the same with the X/Y stepper mounts. Drill a hole in the melamine through the hole in the printed part. Secure these with (2) M3 x 16mm button head bolts, (2) M3 washers, and (2) M3 nylon lock nuts.



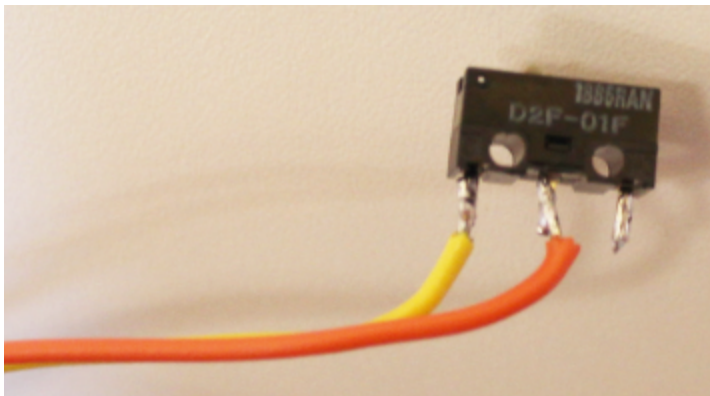
You can now reinstall the steppers, and then reinstall the X/Y belts.

Hotend, Endstops, Linear Rail adjustment

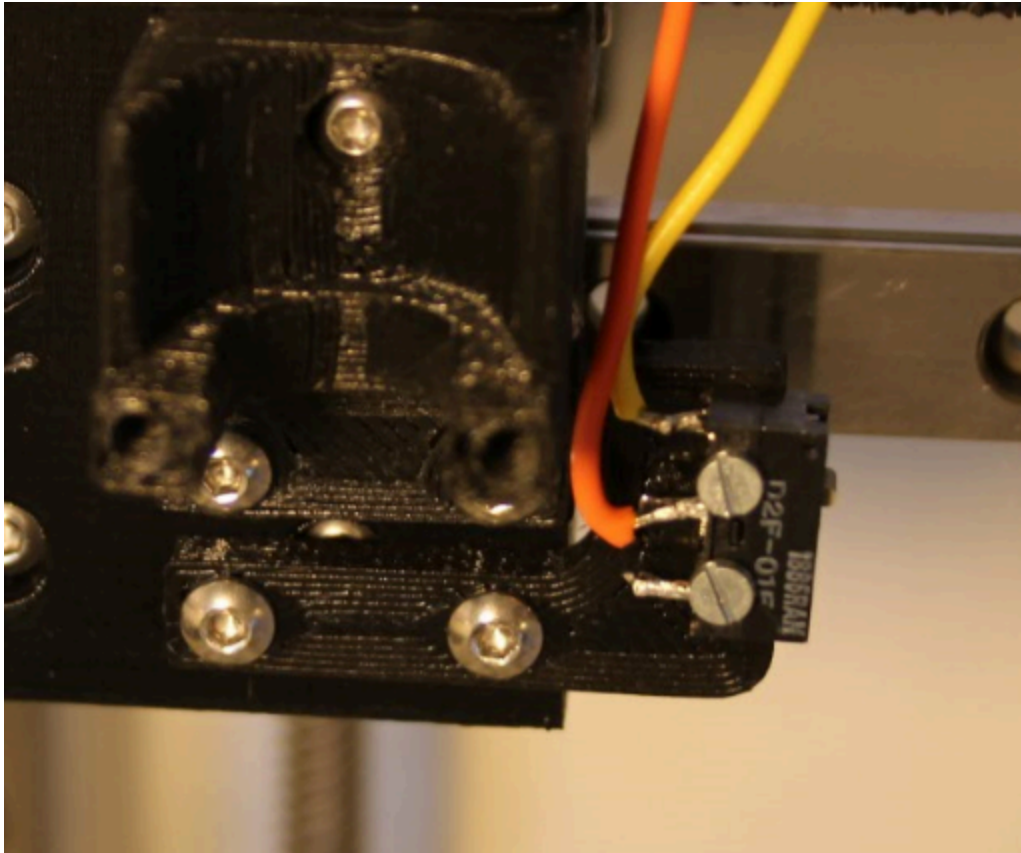
- Y_Endstop_Mount
- X_Endstop_Mount
- E3DV6_Hotend_Retainer
- E3D V6 Hotend
- E3D Titan extruder
- PTFE Tubing
- Extruder Stepper
- Cooling_Shroud
- 50mm Blower fan
- (2) Endstop switches
- (2) 2 pair wire, 22 gauge, 1m long
- (4) M2 x 12 bolts
- (4) M2 nuts
- (2) M3 x 30mm button head bolt
- (12) M3 washers
- (2) M3 x 10mm button head bolts
- (2) Rail_Alignment_Tool

Endstops

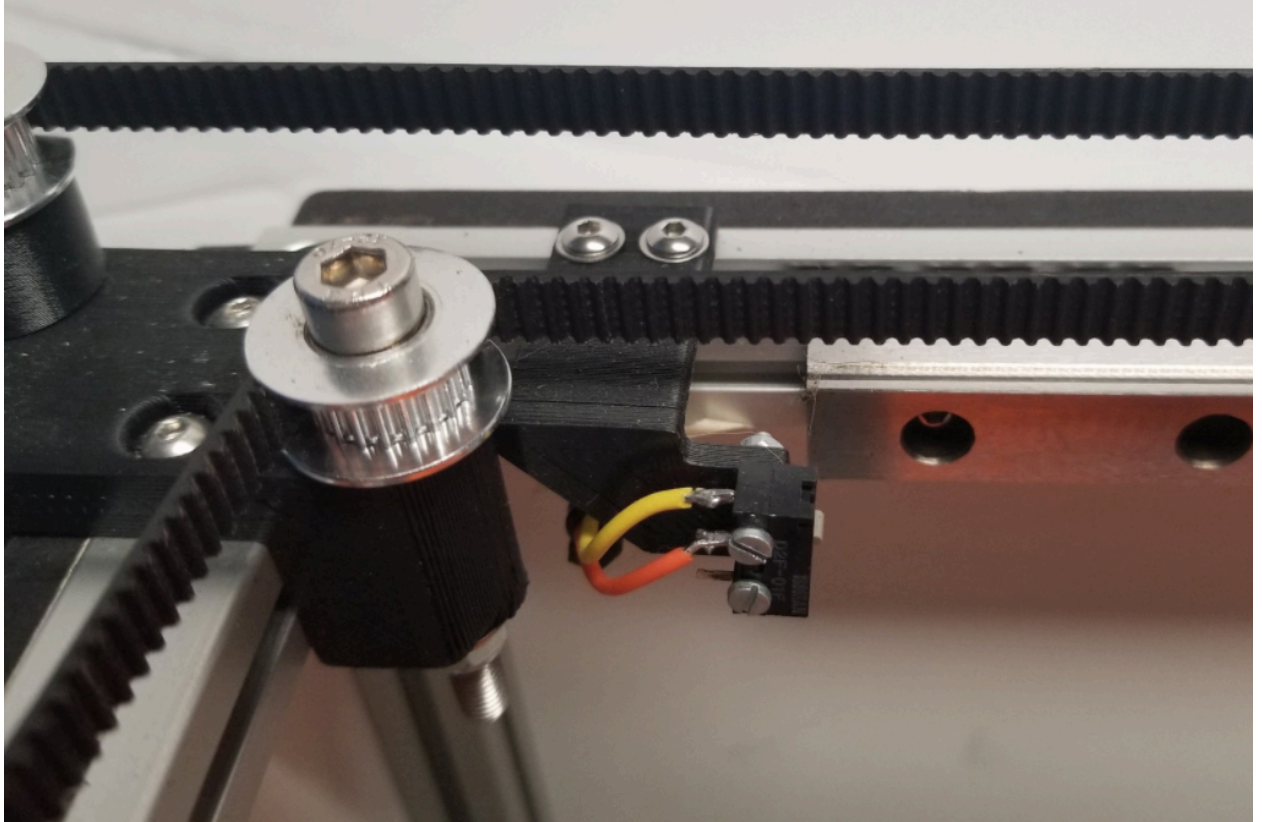
It's easiest to attach the wiring to the endstops before they're put on the printer. I soldered my wires to the directly. Attach a 1m lead of 2 pair wire by soldering it to the center post and one of the outside posts.(Optionally you can crimp on a micro spade connector instead of soldering)



Connect one of these to the Y endstop carrier that you installed earlier using (2) M2 x 12mm bolts and (2) M2 nuts.



Attach the second endstop switch to the X endstop mount using (2) M2 x 12mm bolts and (2) M2 nuts. Then attach your X endstop mount to the top of the top rear extrusion, all the way against the left end (it will be next to the rear idler carrier) using (2) M3 x 8mm button head bolts.

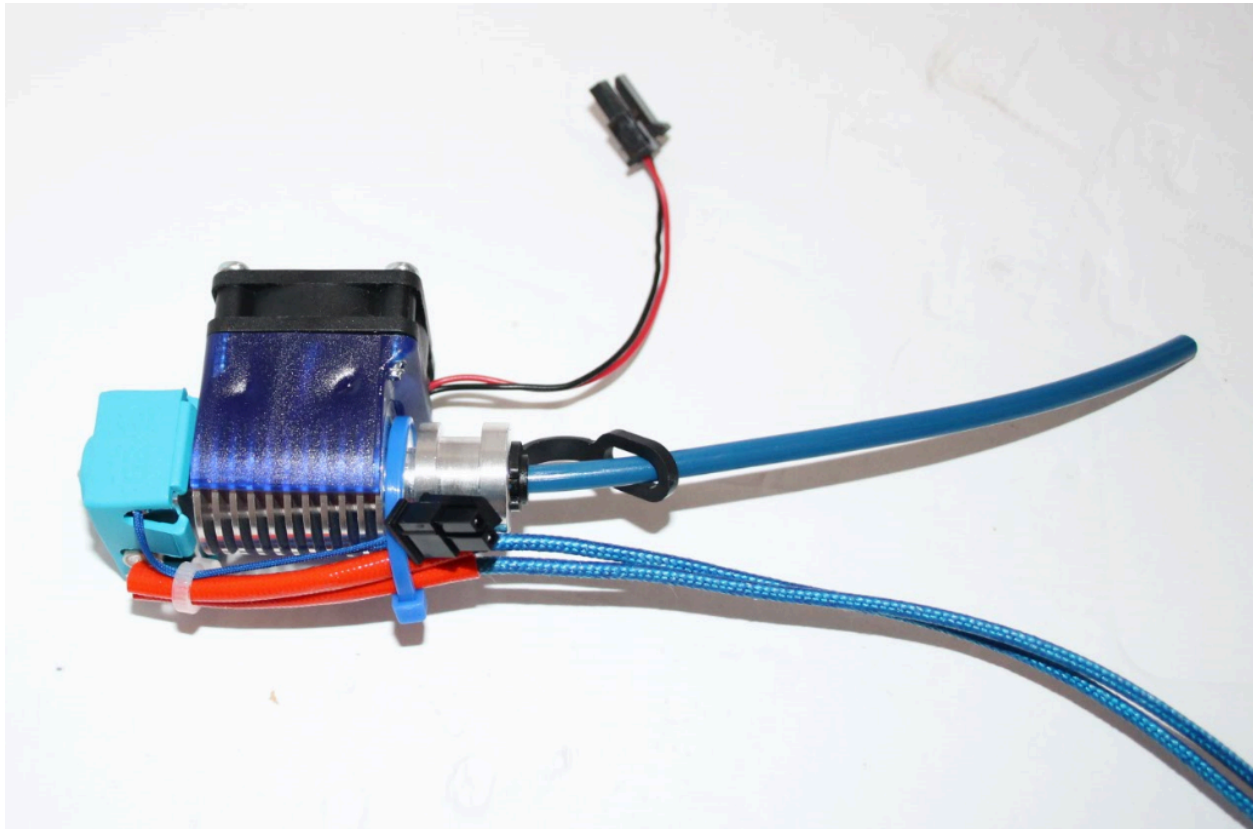


(Note: I've taped the wiring inside the bottom of the rear extrusion to hide it in this photo, just drape it over the back of the printer, below your belts, for now)

Hotend and Extruder

If you haven't already, you need to assemble your E3D V6. For that, follow E3D's instructions here: <https://e3d-online.dozuki.com/Guide/V6+Assembly/6>

Your hotend should now look something like this:



There might be a few differences - I like to tidy up my wiring using zip ties. I'm using a collet clip from seemecnc to keep the retaining collet locked in place. I also use (and highly recommend) Carpicorn's low friction PTFE tubing. You want a good bit of extra, we'll trip it down soon.

The next part is a little tricky, you'll need to assemble your E3D titan following the guide here for a bowden install: <https://e3d-online.dozuki.com/Guide/1.75mm+Bowden+Titan+Assembly/20>

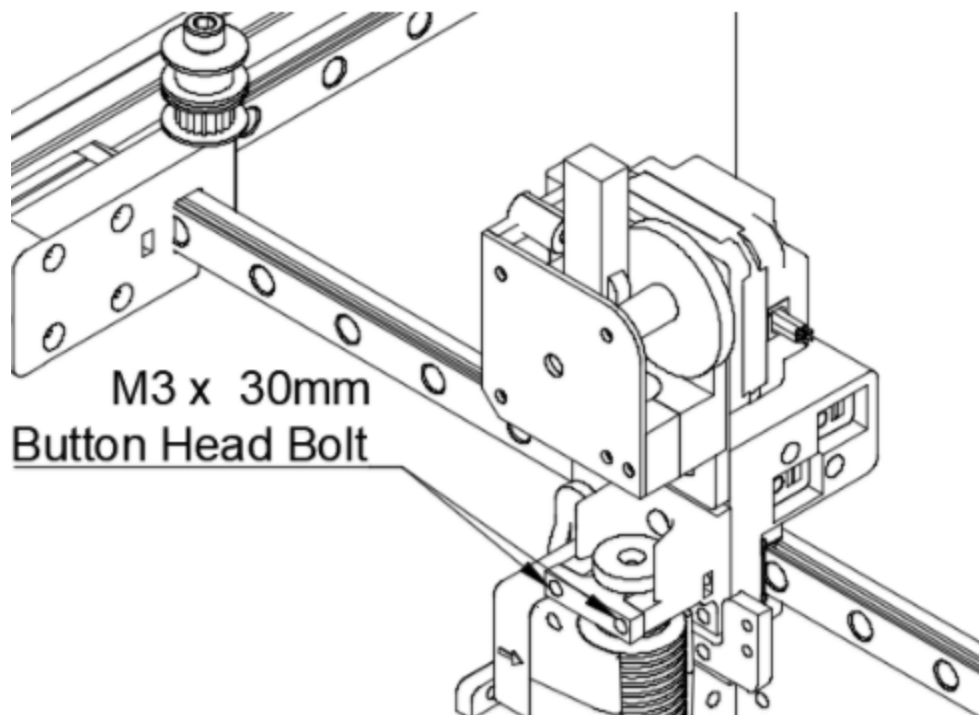
When you get to Step 10 & 11 of the Titan guide, it talks about cutting the tubing. This needs to be precise. On the railcore there is a 25mm gap between the top of the v6 and the bottom of the titan. You need to add that space to the 16mm they tell you to leave, for a total of 41mm extending out of the end of the v6. (The total length of the PTFE should be 91mm) Personally, I recommend cutting it even longer, and shortening it down as needed until it fits. You can always remove some, it's much harder to put it back together.

So, start with 45, or even 50mm. Slide the bowden coupler on, then the 1.75mm titan filament guide tube onto the end of the PTFE, and test fit the v6 in the groovemount. Cut a few mm off the PTFE at a time until it's a snug fit with no play. So as you slide the hotend into the groovemount on the Y carriage, you're sliding the bowden coupler into the groove on the titan at the same time.

Once that's done and fits snugly, proceed with the rest of the titan instructions. When you are putting the bolts on the titan to close it, you'll find you need (3) 3mm washers per each of the three bolts to tighten it down due to the spacing of the railcore's titan mount.

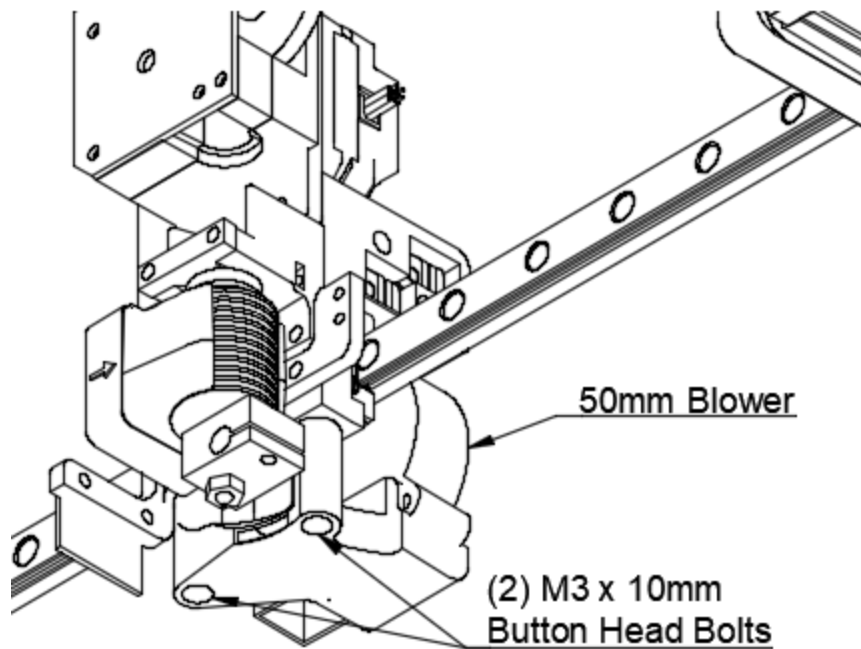


Once your titan is assembled, lock in your E3D v6 using (2) 30mm Button head bolts to attach the E3DV6 Retaining Clip to the groovemount.



Cooling Fan

Place the 50mm blower fan into the cooling shroud (it will friction fit) and then bolt the cooling shroud onto the bottom of the Y carriage using (2) M3 x 10mm Button Head Bolts. I cut a short length of GT2 belt to put above the fan, between the top of the fan and the bottom of the Y carriage, to keep it pressed in more firmly. You may need to add a couple of m3 washers between the fan shroud and Y carriage, to lower it until the shroud is pointing just at the tip of the v6 nozzle. (I use two washers per bolt on mine).



X Endstop and Rail Adjustment

You should now have all the components installed on your X/Y axis, it's time to align your X rails. Take off any masking tape you still have holding things in place. Carefully move your Y rail towards the left side of the printer, keeping the Y carriage centered on it. Watch that the carriages don't go off the end of the X rails - if they're close to doing so, stop, loosen up your X rail bolts, and adjust them to the left.

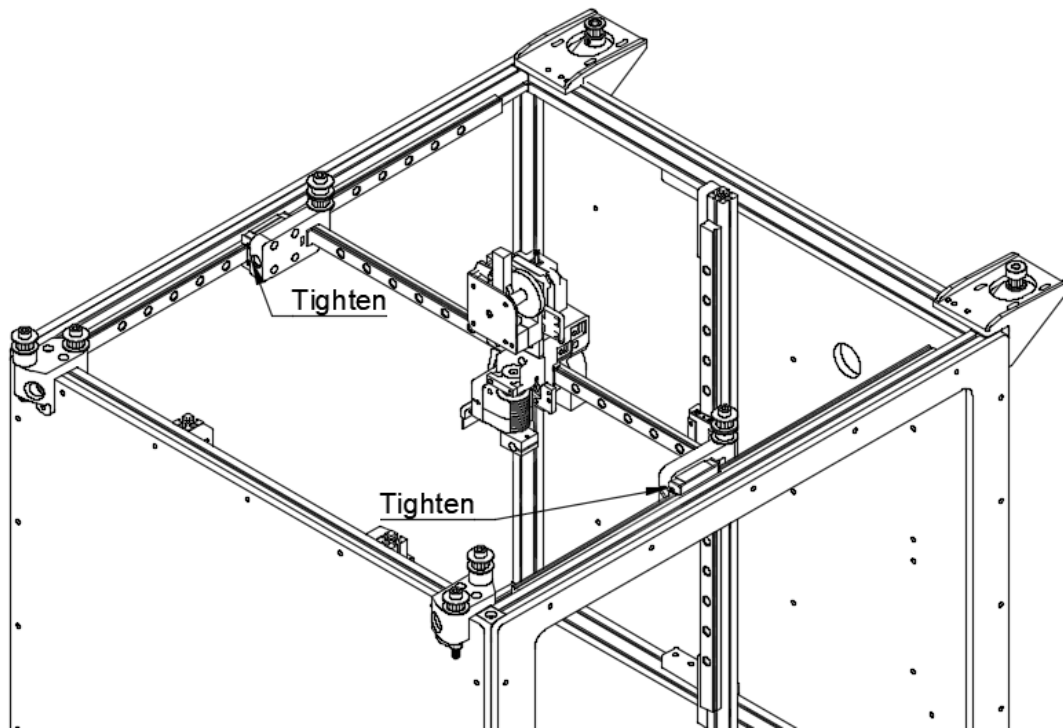
You should be able to just touch the hotend to the side of the bearing block on the left side of the printer. Move your Y rail back to the right a couple of mm. This will be the X=0 for you.

Loosen the two bolts on your X endstop, and move it towards the right side of your printer, until the button is triggered at your X=0 position. Tighten down the bolts for your X endstop.

Now, loosen up your X linear rails, and slight them to the right until the ends of the MGN12 carriages are even with the ends of the linear rails. Place your two linear rail

adjustment guides one on each of the rail to be sure it's centered on the extrusion, and then tighten down all 4 bolts. Repeat for the other rail.

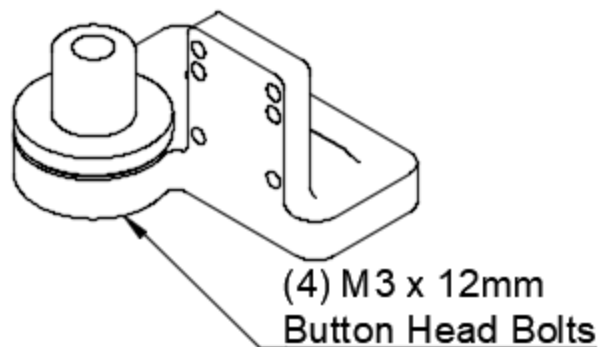
As a final step, make sure your Y MGN12 rail is centered in the X carriages, and tighten down the horizontal retaining screws you installed in them earlier.



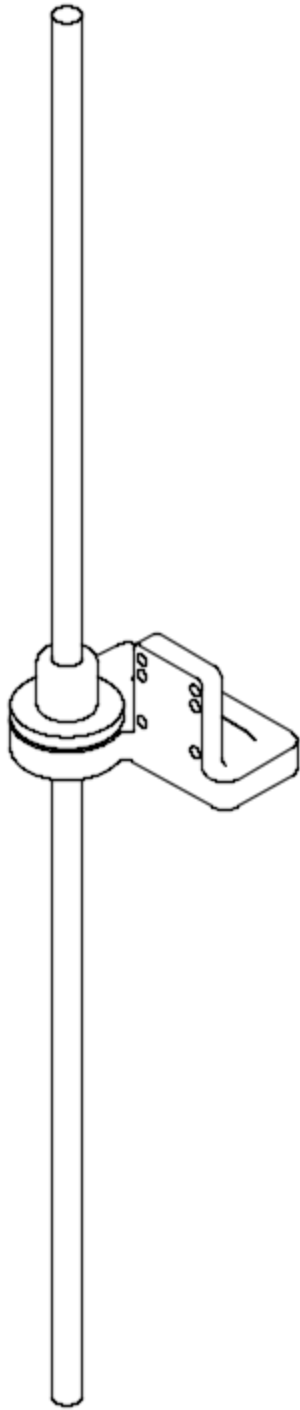
Z Axis Installation

- (3) Nema 17 Steppers
- (3) M5 / M8 Leadscrew Couplers
- (3) 450mm Leadscrews
- (3) Anti-Backlash leadscrew nut
- (24) M3 x 10mm Button Head Bolts
- (12) M3 x 12mm Button Head Bolts
- (1) Z_Yoke_1
- (2) Z_Yoke_2

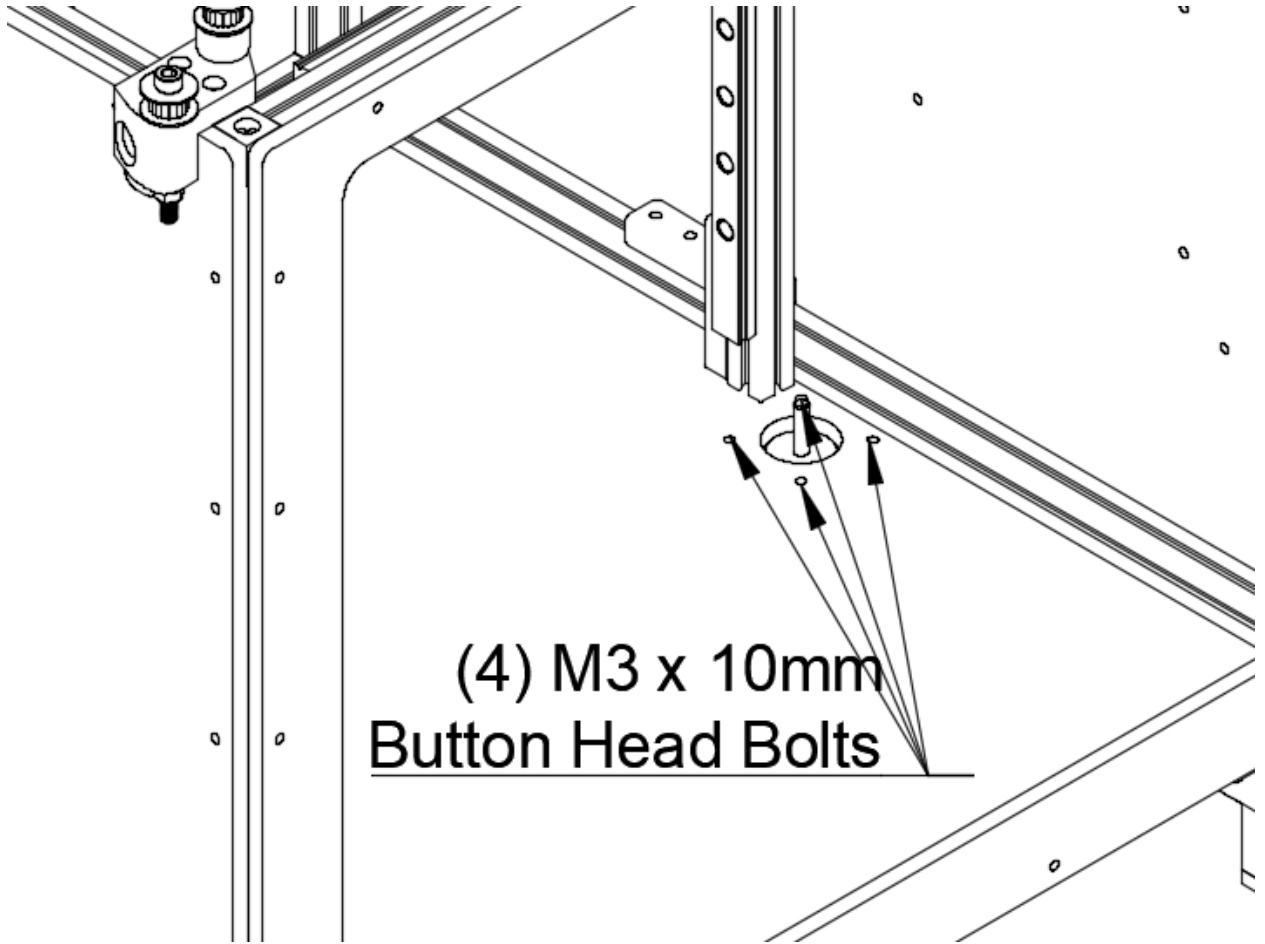
Begin by using (4) M3 x 12mm Button Head Bolts to attach the bottom of the leadscrew nuts to the Z Yokes. Repeat for all 3 yokes.

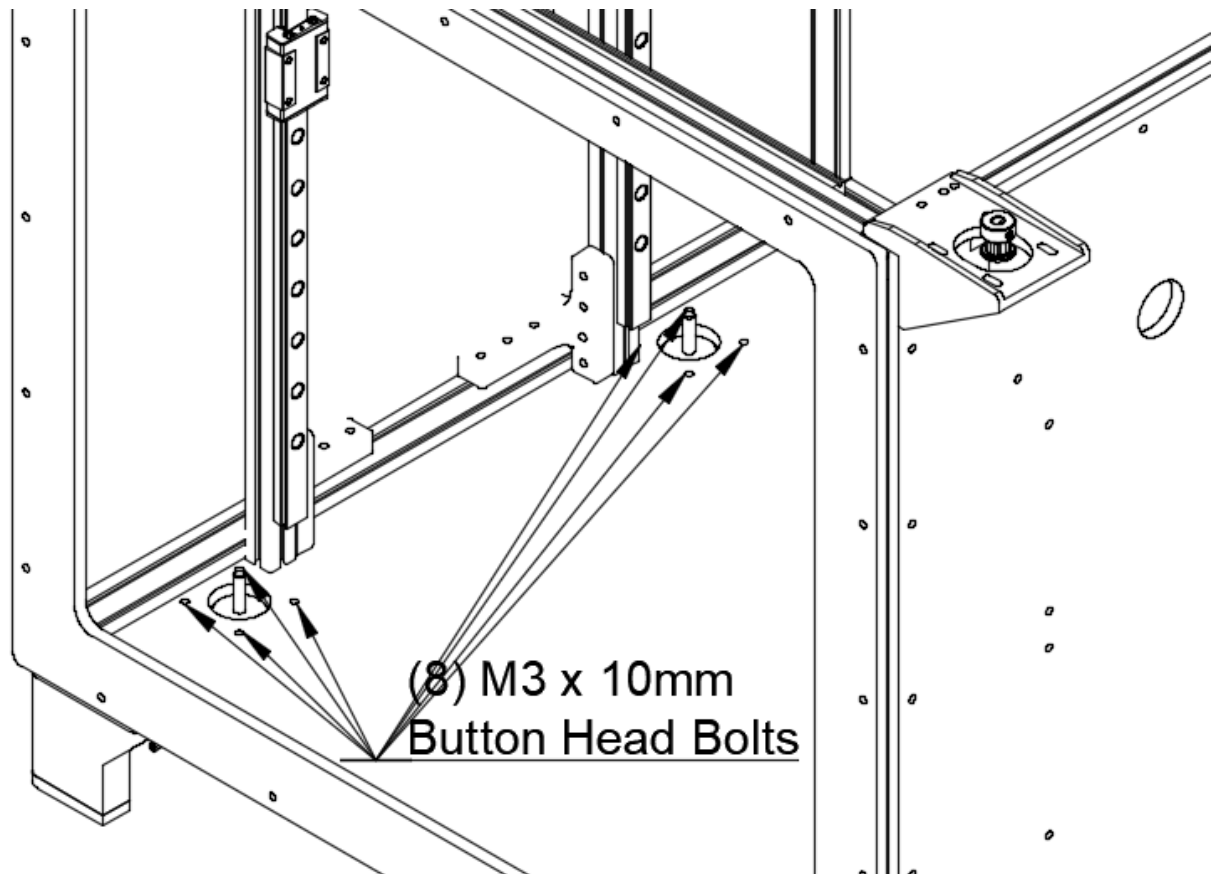


Thread the leadscrew into the leadscrew nut (install the spring and top of the anti-backlash nut). Repeat for all 3 Z yokes.

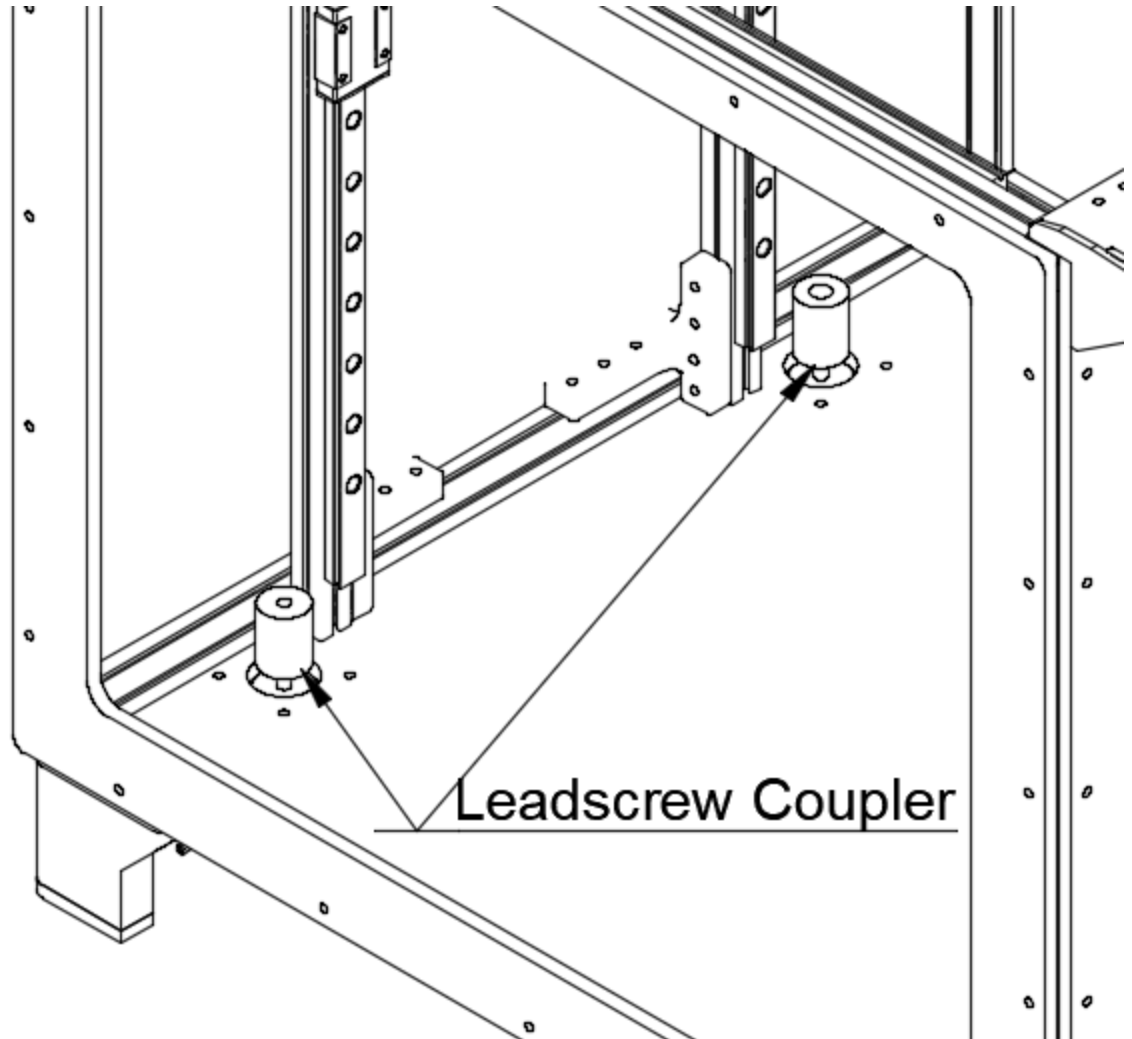


Next, attach the 3 Z steppers to the bottom panel using (12) M3 x 10mm Button Head bolts



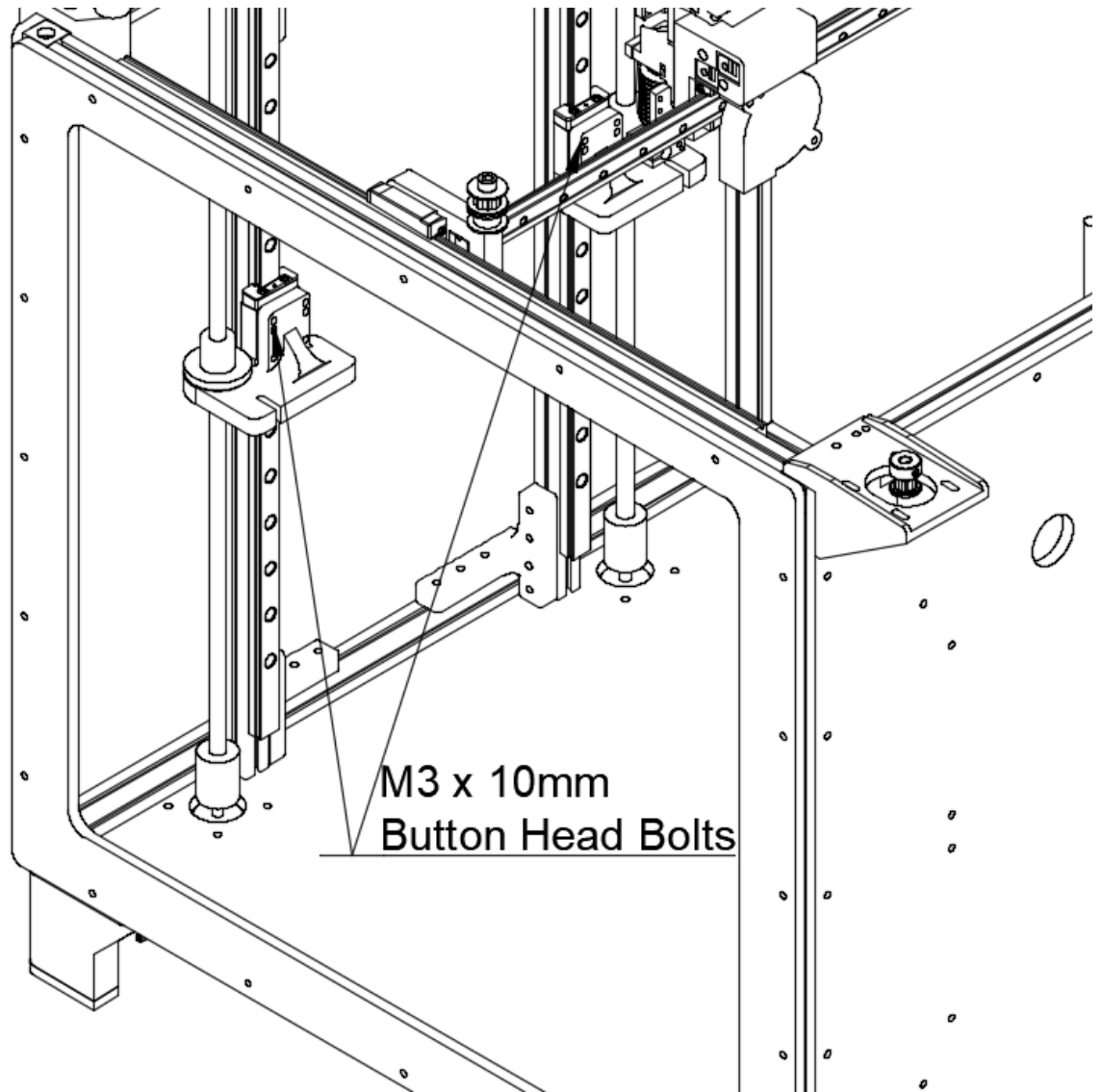


Install the leadscrew coupler on all three Z steppers using the included grub screws.
USE BLUE LOCTITE ON ALL OF THE LEADSCREWS FOR THE COUPLERS. They will vibrate out if you don't.



(Repeat for the Right side, not pictured)

Place the leadscrews into the Couplers, and attach the yokes to the linear rail carriages using (4) M3 x 10mm Button Head Bolts per yoke. The Front left gets the Z_yoke_1, the other two get Z_yoke_2. (They'll only match up to the carriages in one way.) **USE BLUE LOCTITE ON ALL OF THE LEADSCREWS FOR THE COUPLERS.** They will vibrate out if you don't.



To align the Z rails, move the yoke all the way to the bottom (don't let the carriage run off the rail). Tighten up the bottom of the extrusion. Use a square to align the extrusion at a 90 degree angle to the side extrusions. When you're done, ensure you can still run the yoke up and down smoothly by hand. (It can be difficult to fit a square behind the leadscrew. Once the bottom is locked in place, you can optionally remove the leadscrew temporarily to help square the Z extrusions)

Bed installation

Bed

Thermistor

RTV

LokBuild

(3) M3 x 20mm Button Head bolts (Optionally, 5/16 nylon bolts)

(3) M3 Nylon Lock Nuts

(3) M3 Washers

(3) Nylon Washers

(3) Nylon Spacers (or rubber washers)

Preparation

For the bed, we need to start with some prep.

There is a groove on the top of your bed - this is for the thermistor.

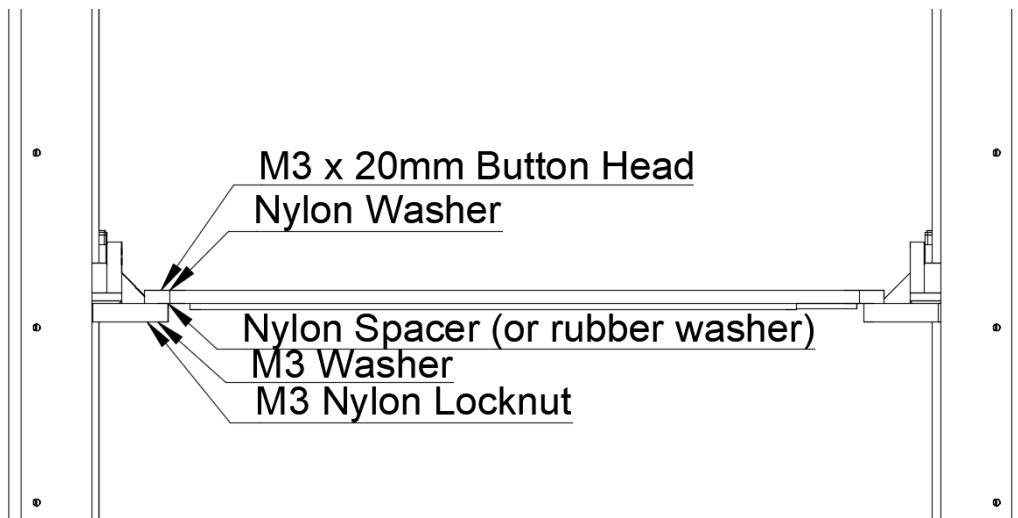
Install your thermistor in the channel on the top of the bed. If you bought the thermistors in the BOM, they have very long leads on them, and are protected in rubber all the way up to the bead. Be careful with the thermistor, the bead is glass, and if it's broken it won't give a reading, or will be way off. Place the thermistor into the channel in the top of the bed, it will be a snug fit at points, press it firmly in. Use some RTV silicone to hold the bead in - I covered about $\frac{3}{8}$ " of the thermistor in RTV - just the end near the glass bead. Use a razor blade to clean up the excess RTV and let it dry. (Kapton tape can be used to cover it until it's dry)

I cut my lokbuild so it matched the size of the entire bed surface, and carefully placed it over the bed. Be sure the thermistor is flush with the top surface, so you don't get a bump in the lokbuild. (If you used kapton to hold the RTV, remove it before installing the lokbuild) Start from one corner and slowly apply it to the bed.

Next install your Keenovo on the bottom of the heated bed. I tested the fit of mine with the backing on first, and marked with a pencil where it should go. It should be centered front to back, and approximately 5mm away from the left edge. The keenovo's adhesive is EXTREMELY sticky, so once it's placed you're not moving it. Be sure the leads exit the correct side of the bed. They should go in the same direction as the thermistor channel on the top of the bed.

Bed

Install the bed using the 20mm Bolts. They fit through the top of the slot on the bed, with a nylon washer. There should be a nylon spacer or rubber washer between the bed & yoke. Below the yoke install a M3 washer & Nylon lock nut. These should be snug, but not tight! It's important the bed and tilt slightly in the yokes, if not, the Z leveling will bind.



Electronics

Parts needed for this step:

(4) Electronics Box Corner

(2) Electronics Box Side Panels

Electronics Box Top Panel

Electronics Box Cover

PSU

Duet Wifi

Switch_Box or Switch_Box_Tall (switch box tall has more room for deeper switches)

Switch_Plate (For 29mm x 11mm switches)

Short_Switch_Plate (For 19.5 x 11mm switches)

Switch_Box_Cover

Filament Guide

PTFE Tubing

(4) M3 x 16mm button head bolts

(8) M3 Washers

(14) M3 Nuts

(6) M3 x 12mm Button Head Bolts

(4) M3 Fender washers

(4) M3 x 20mm button head bolts

(4) nylon or printed spacers

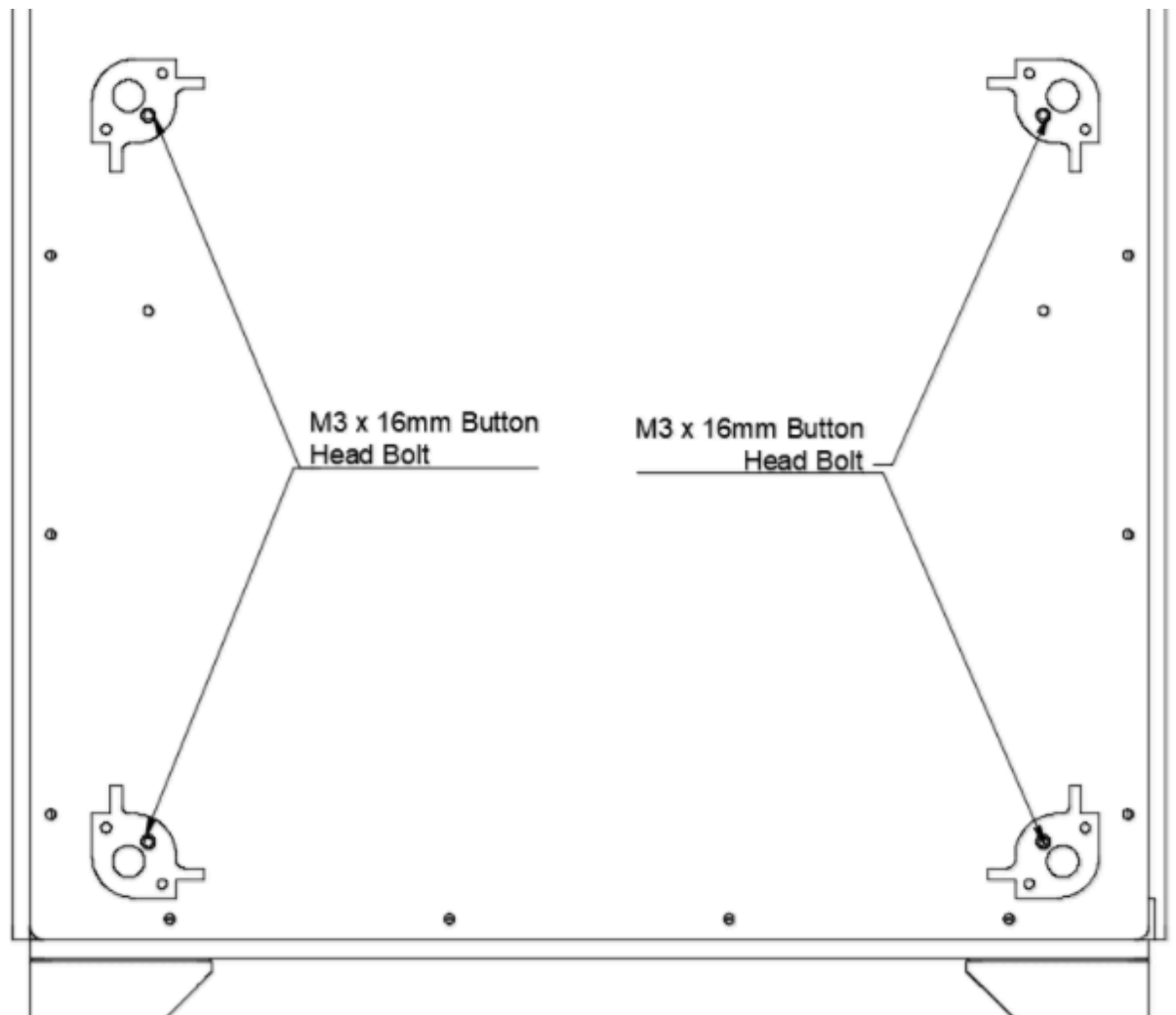
(4) M3 x 10mm button head bolts

SAFETY

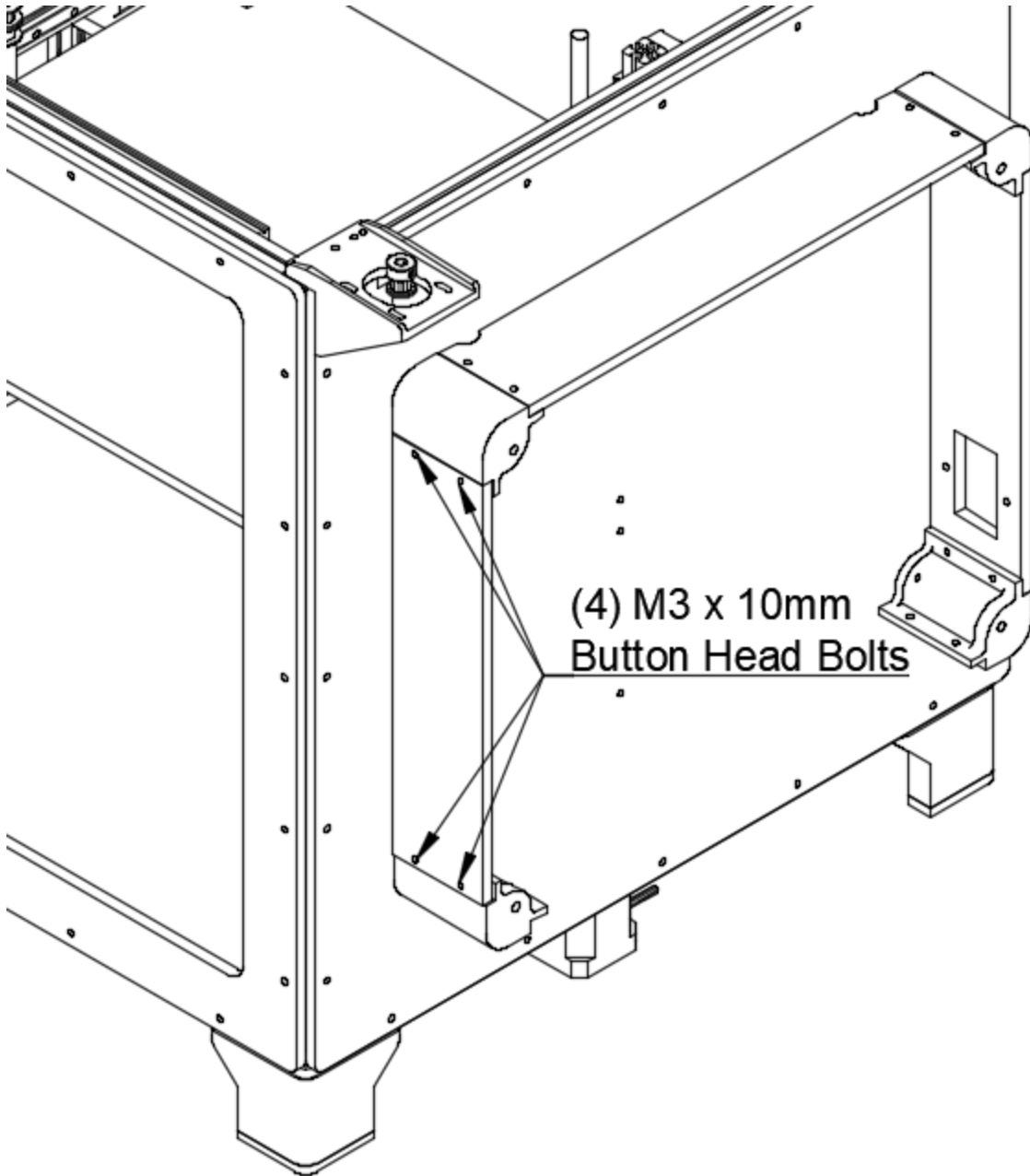
THE RAILCORE IS A “DIY” PROJECT - BUILD SAFE, BUILD SMART, AND BE RESPONSIBLE. WHEN IN DOUBT, DOUBLE CHECK THINGS. 3D PRINTERS CAN GET VERY HOT, USE COMMON SENSE AND QUALITY COMPONENTS. **BUILD AT YOUR OWN RISK!**

Electronics Enclosure

Bolt each of the 4 standoffs into the holes on the right side of the printer (Below the steppers) using (4) M3 x 16mm button head bolts, (4) M3 Washers and (4) M3 nuts. The brass inserts should face out away from the side panel. Note these go in the top & bottom most set of holes. There is a center set that is not currently used.

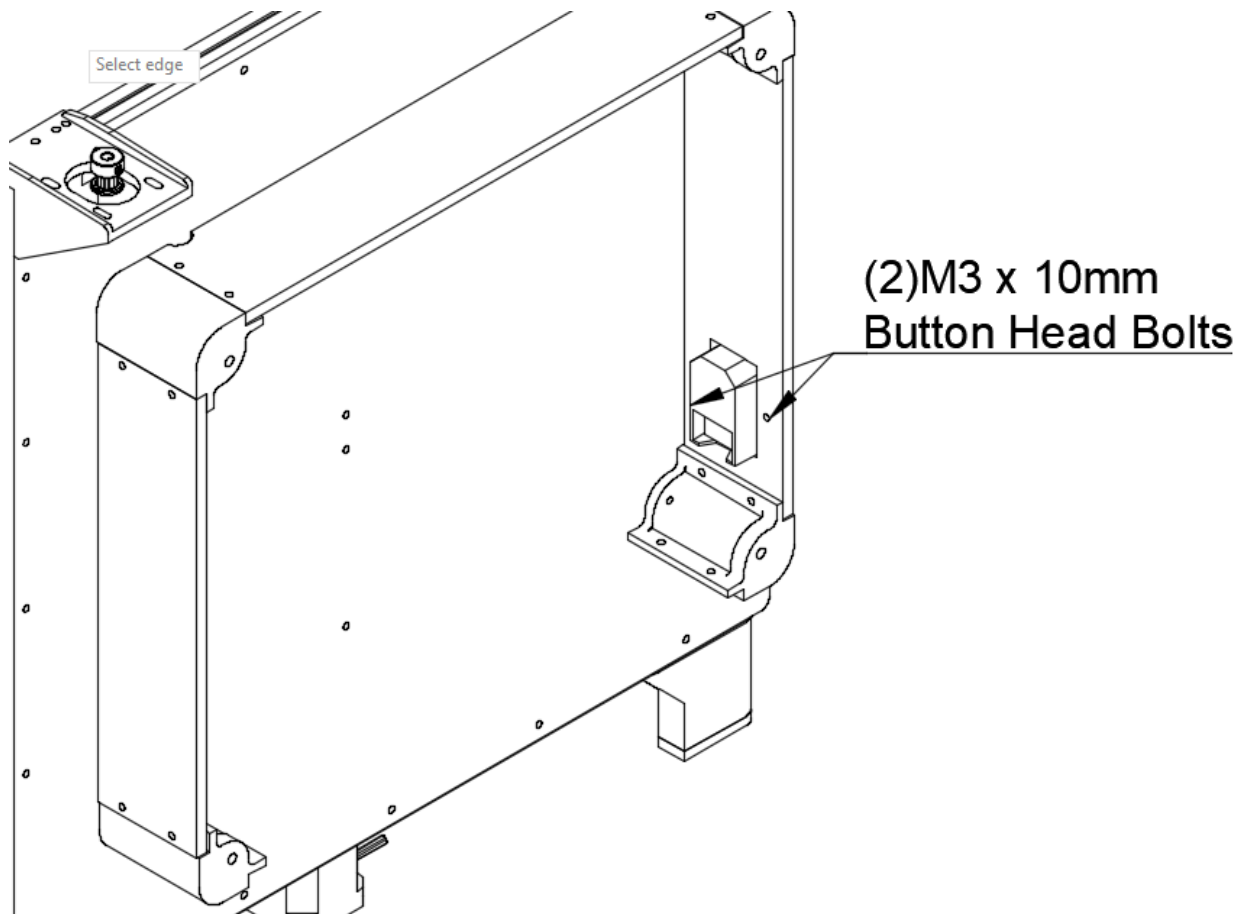


Attach the top and side panels to the Electronics box corners. Each Panel gets (4) M3 x 10mm Button head bolt and (4) M3 nuts.



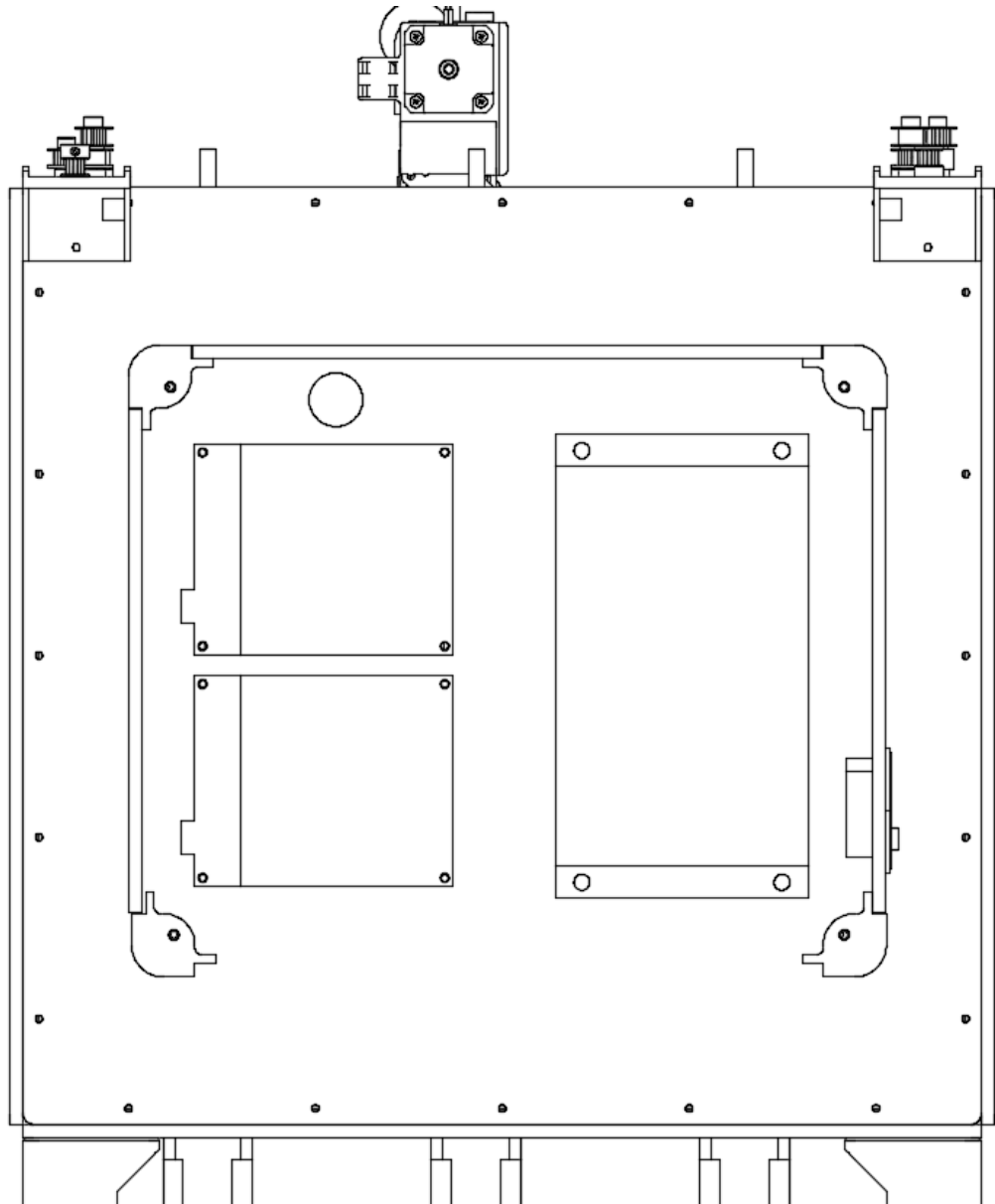
(Repeat for all 3 panels) You can put a bottom panel on, but for airflow we highly recommend leaving the bottom open.

Install the power switch in the rear panel using (2) M3 x 10mm button head bolts.



Mount the PSU & Duet

Assuming you bought the PSU & duet wifi controllers from the BOM, the suggested mounting locations are in the picture below. You'll need to line your PSU up and mark the holes and drill them (use a $\frac{1}{8}$ " drill bit).



I attached my Duet Wifi with (4) M3 x 20mm button head bolts, (4) M3 washers (4) M3 nuts, and used some nylon spacers as standoffs so it was not against the side panel.

For the PSU, I used (4) M3 x 10mm Button Head Bolts, (4) M3 Fender washers (so the bolts would not pull through the holes in the PSU), and (4) M3 nuts.

Wiring

This guide will not cover the intricacies of wiring the duet, but there are some recommendations. If you bought exactly what was in the BoM and followed this guide, these will help.

The duet wifi wiring diagram is here. We recommend you use the wiki as the guide to wiring your duet. https://duet3d.com/wiki/Duet_WiFi_and_Ethernet_wiring_diagrams

Crimp all your connections

- Connect your front stepper to the Y stepper connection
- Connect your rear stepper to the X stepper connection
- Connect your Extruder stepper to the E0 stepper connection
- Connect your Y endstop switch to the Y endstop Y Stop & GND pins
- Connect your X endstop switch to the X endstop X Stop & GND pins
- Connect your hotend to E0 Heater
- Connect your hotend thermistor to E0 Thermistor1
- Connect your bed heater to Heated Bed
- Connect your bed thermistor to Bed Thermistor 0
- Connect your Hotend Fan to one of the Always On Fans
- Connect your Layer fan to PWM Fan 0
- Connect your IR Probe to the Z Probe port

The Z steppers for the ZL version are very important. They all 3 go in the duex5 connectors, refer to the diagram here:

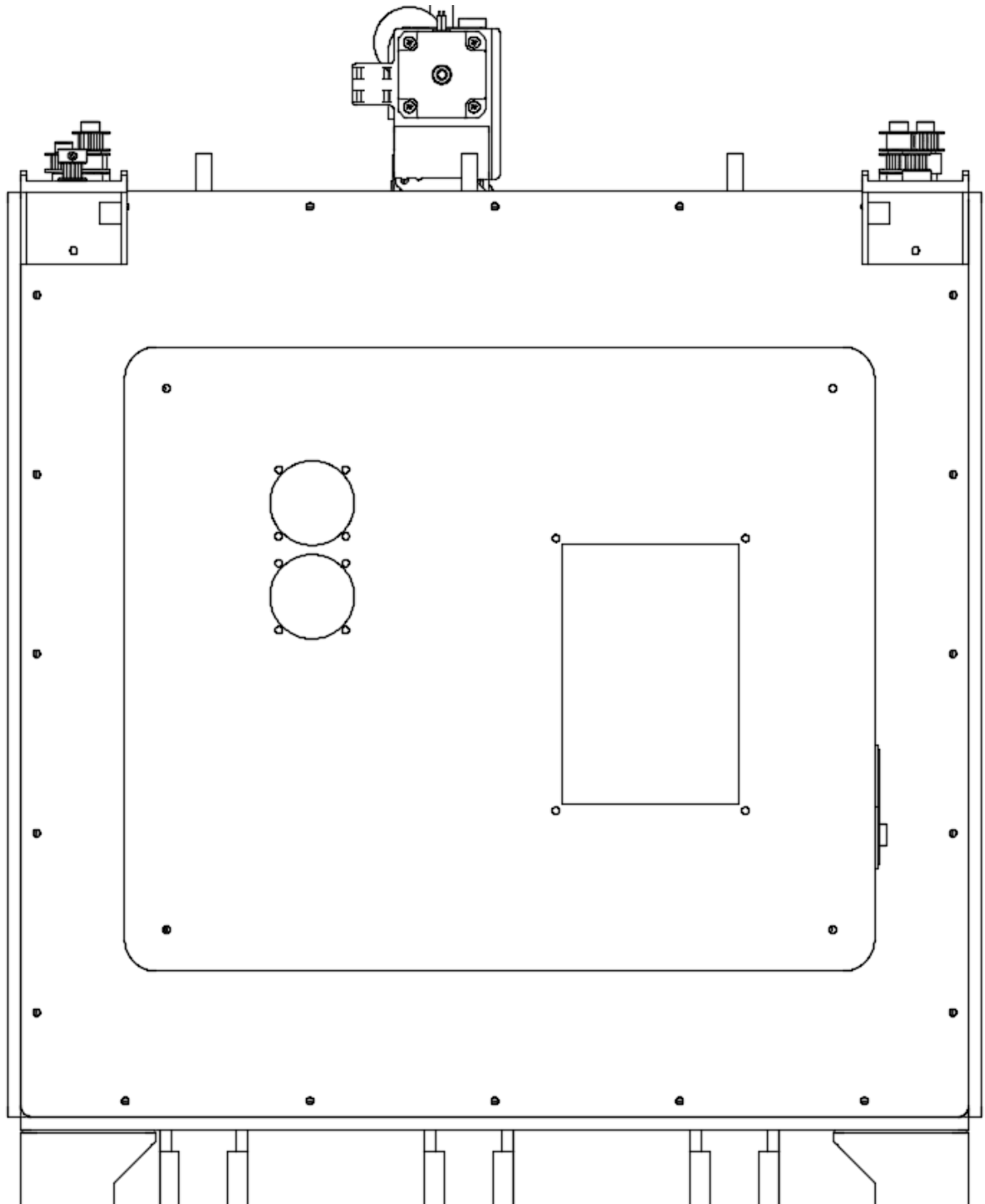
<https://d17kynu4zpq5hy.cloudfront.net/igi/duet3d/PbDcMOmnlLilAmUu>

- Connect the front left stepper to the Drive 5 connector
- Connect the rear left stepper to the Drive 6 connector
- Connect the right side stepper to the Drive 7 connector

Lastly connect your PSU to Power in. USE CRIMPED CONNECTORS for your 120v power connections.

Final Touches

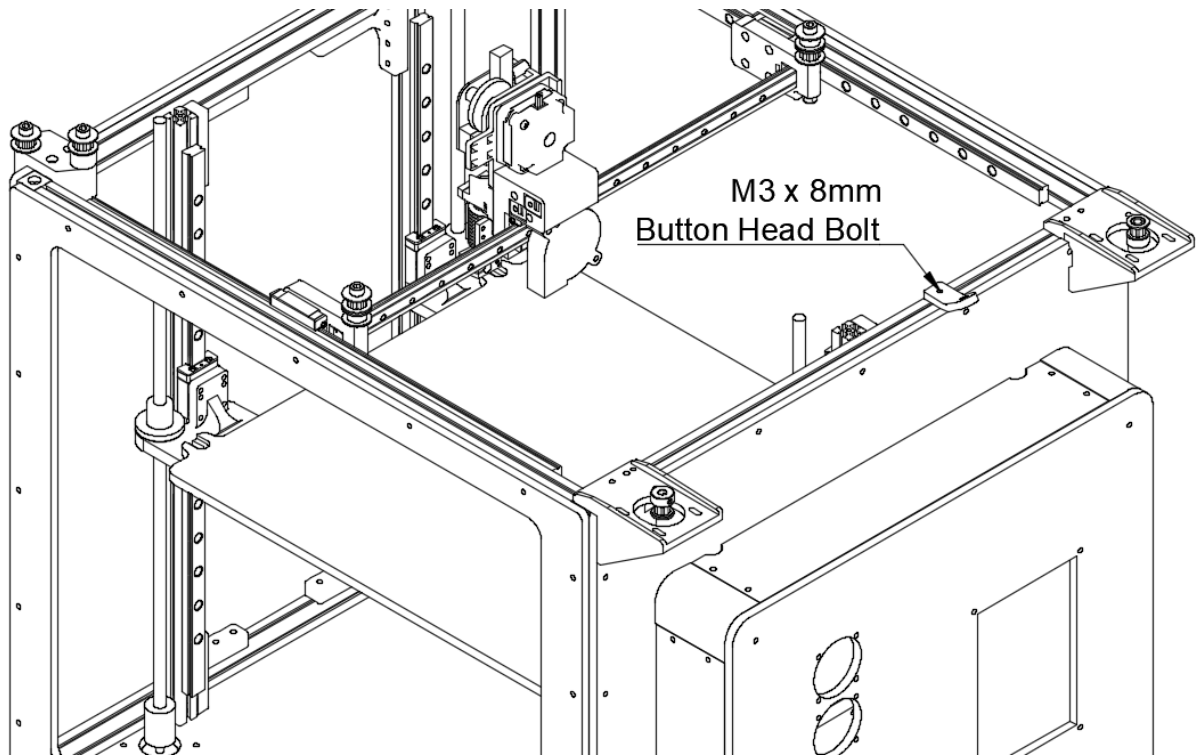
The electronics box cover is attached using (4) M3 x 8mm Button head bolts.



There are some sample prints that can be used for fan vent covers and a PSU vent cover - these can be attached to the electronics box cover using (4) M3 x 8mm Button head bolts each.

Do a power on (smoke test) Before closing up the printer.

The optional filament guide can be attached onto the top right extrusion using (1) M3 x 8mm button head bolt.



For my cabling, I ran a PTFE connection from the filament guide to the top of the titan, then used wire wrap to wrap the entire bundle of wiring to the PTFE. (along with a couple zip ties).



Adjusting Your belts and levelling your bed

Once your smoke test is done and good, you'll want to do the final belt tensioning. These steps should be done periodically as your belts stretch, etc. So it's a good idea to be familiar with them.

X/Y Belts

Loosen up both of your steppers, and make sure they're all the way in towards the printer. The belts should already be tight enough you can't just pop them off. If they're not, adjust your belt end clips until they are. Then, pull your rear stepper by hand to put a reasonable amount on tension in the belt. You'll cause the Y carriage to move, that's OK. You don't need this belt to be super tight. Tighten down the 4 button head bolts for the rear stepper. Now, pull the front stepper while checking if the Y rail is at a 90 degree angle to the X rail. When the two are precisely at 90 degrees to each other that's when your belts are correctly tensioned. This can be tricky to do with just one person.

Firmware

The provided firmware files should be considered a baseline starting point if you followed the BOM. These files are confirmed to work with RepRapFirmware v1.21rc5

https://www.dropbox.com/sh/9t33odsfx0a2s4t/AAA9A2BFR02D1TtZ_SRh0Swla?dl=0

First Moves

For your X/Y stepper direction, follow the instructions documented here:

https://www.duet3d.com/wiki/Configuring_RepRapFirmware_for_a_CoreXY_printer

Test each of your endstop switches to be sure they work. (Follow the RRF wiki)

Test your Z-Probe to be sure it is working. (Follow the RRF Wiki)

Test (with your finger on the power button) lowering your bed by sending:

```
G1 Z10 S2
```

If all three of the steppers down move down, power off and make corrections.

Calibrate and test your your Z probe. It can be raised and lowered by loosening the bolts in the IR Probe Mount.

If both of your endstops and Z probe are working, hit the home buttons (one at a time... and keep a hand near the power switch in case something doesn't work) to home the printer.

To level the bed, hit the "autolevel" button in the web interface, or send "G32" which will run bed.g Your printer should probe near each of the 3 leadscrews, and then you should see output similar to this in the gcode console:

```
Leadscrew adjustments made: 0.143 -0.071 0.027, points used 3, deviation before 0.082 after 0.000
```

For the following steps, you should home all 3 axis first. Make all of the moves slowly so you don't damage anything!

The max x/y/z are in the config.g provided are fairly conservative. To properly set them, temporarily raise them with this command:

```
M208 X260 Y260 Z300
```

Start with Y. Manually move to X125, Y230. Slowly increase Y, stopping before your Y axis makes contact with the X carriage. Change the Y value in the M208 command in your config.g to match.

Repeat this with X, moving to Y125, X230, and stopping before your Y carriage makes contact with the bearing block. Note your Max X value and adjust it in the M208 command in config.g.

For Z, simply lower the bed to 220, then step it down slowly. Watch that the screws on the bottom of the Z yoke don't bottom out. Stop before they make contact. Note your Z height, and set this in config.g for your max Z.

If your Z axis Binds

If you get binding in Z, you may need to make some adjustments. Repeat the process as when you installed the Z axis originally, running Z down to the bottom with the lower brackets loose. Tighten them down while the bed is near the bottom, then square the extrusions to the frame. It's critical the extrusions are squared to the rest of the frame.

Accessories & Extras

I use the filament holder here: <https://www.thingiverse.com/thing:21435>

Filament can either sit next to the printer, feeding up through the filament guide, or on a shelf above the printer.

If you bought the paneldue, you'll want an enclosure.

<https://www.thingiverse.com/thing:656884>

If you have the 5" paneldue I modelled a back panel that can mount to the front of the railcore, using some of the extra M3 nuts in the front extrusions. It's on thingiverse here:

<https://www.thingiverse.com/thing:2612173>

You'll need to use dc42's 5" paneldue case here:

<https://www.thingiverse.com/thing:656884>

