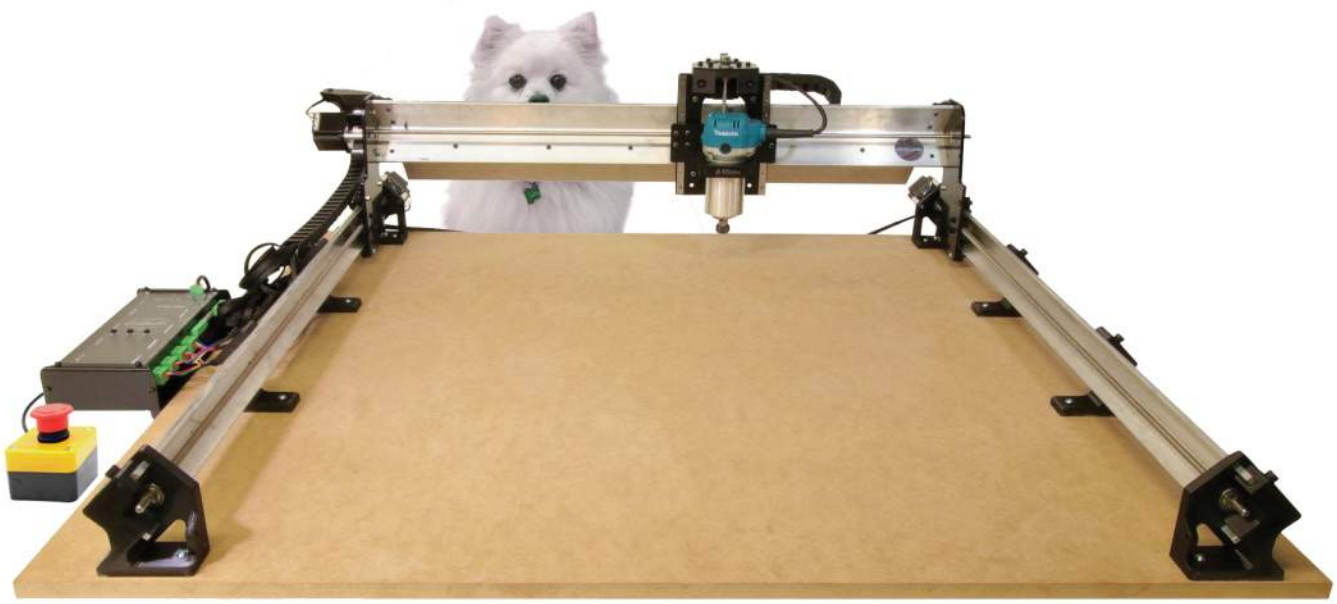
LONGMILL

LongMill V4b Assembly Manual



V4b

SIENCI LABS

IDEAS INTO REALITY

Table of Contents

Tools you need

Before you get started, here is a list of tools you should have on hand for assembly. Most people will have these tools in their shop:

- Metric Allen keys or a drill and Allen driver bits
- Pliers or metric wrenches
- A small flat head screwdriver
- Rubber mallet (optional)

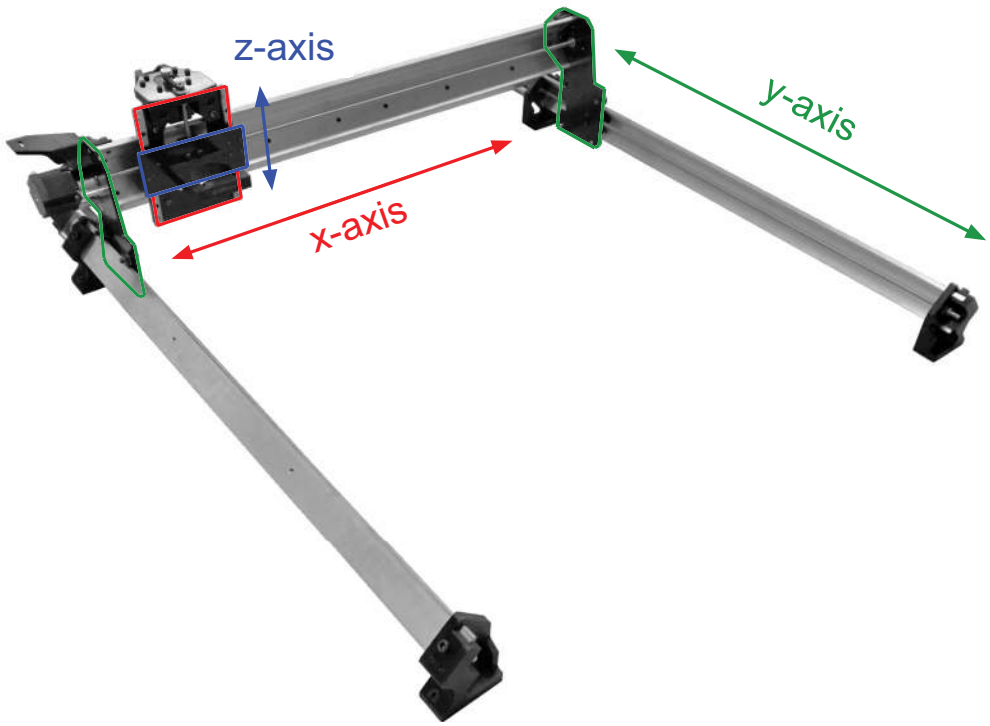
The LongMill comes with a specialized wrench which will assist you when putting your machine together and act as a dedicated maintenance tool once your machine is in operation. After you've opened your LongMill box, you'll find this wrench in the small white box accompanied by our Welcome letter and some stickers. One of these stickers shows Louis sitting atop a LongMill; Andy's dog and our unofficial mascot and CEO.

The LongMill comes with a lot of parts, but we've organized them to make it as easy as possible to find and put everything together; each kit comes with several cartons.

For the complete BOM, visit: https://docs.google.com/spreadsheets/d/1MqOwPg3VSUTMtn3ff6rXjfvliAWnFqg8ez2eZasJLCE/edit#gid=1110761832

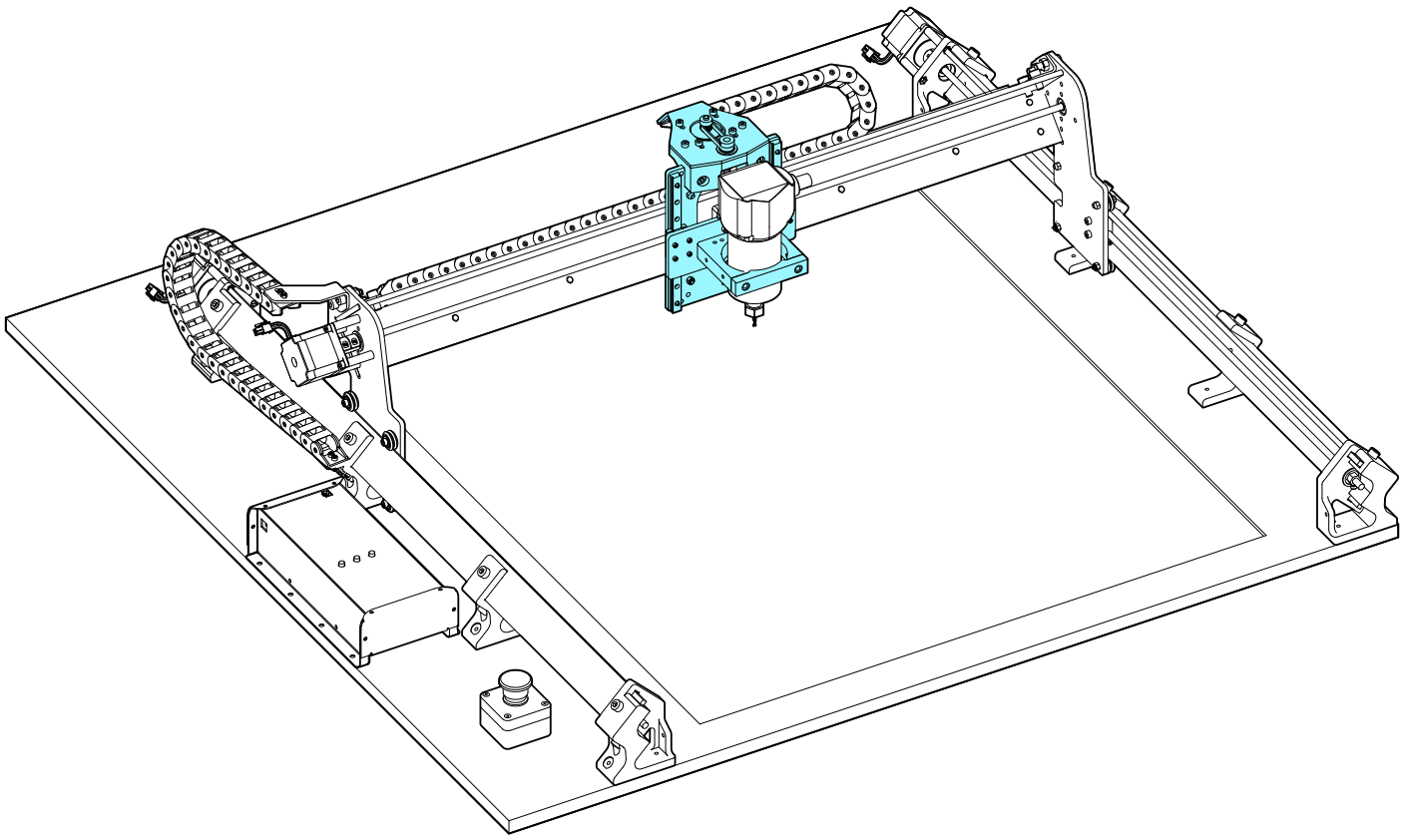
The following pages in the assembly section will guide you through how all these parts will fit together to make your LongMill. You should find that each major step is self-explanatory, but the required parts and quantities will still be written as an additional reference.

The diagram below shows the machine coordinate system of the LongMill. It's able to move in its **x**, **y**, and **z**-directions due to the rails and respective gantries it has on each of those axes. We'll start by assembling the **x** and **z** gantries which combine into a singular assembly; in the diagram these are coloured red and blue respectively.



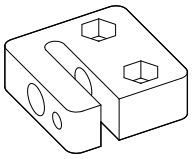
Part 1

XZ-Axis Gantry

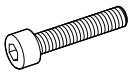


Nut Assemblies

Parts Needed:

 x4

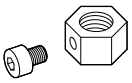
Delrin anti-backlash nut

 x4

M5-25mm bolt

 x8

M5-nylock nut

 x4

Locking ACME nut & set screw

Taking a look within your LongMill box, you should first look for a box at the bottom with a round orange sticker on it. Inside this box, you'll find three hardware bags which are distinguishable by their sticker colour. For this first step, we'll be using some of the hardware contained within the bags with the green and yellow stickers. In the yellow bag you'll find a bag labelled for 'M5-nylock nuts' and another for 'M5-25mm' bolts, this is the M5 hardware you need. The green dotted bag will also have a bag of interest within it which contains 4 rectangular plastic blocks, grab this as we'll be preparing these blocks for installing onto the XZ-axis gantry and eventually on the Y-axis as well.

Start by pressing the M5-nylock nuts into the hexagonal cutouts. Make sure that you point the round end of the nut towards you, as you want the first part of the thread to be metal before your bolt gets to the nylon locking part.

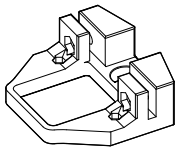
Install an M5-25mm bolt from the yellow hardware bag into the anti-backlash nut. This is used to tension and reduce backlash on the machine. Prepare 4 sets of these blocks and set them aside for later.

Looking back to the green bag, you should find a bag within it that contains 4 large nuts and some small screws. Take the contents out and loosely thread all the set screws into the nuts by about 2.5 turns (for now).

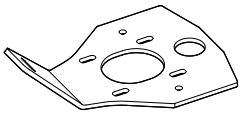
Prepare four sets of both these assemblies and set them aside for later.

Z-axis motor sub-assembly

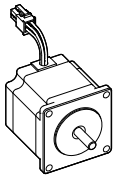
Parts Needed:



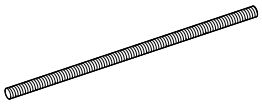
3D printed Z-axis mount



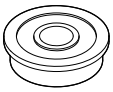
Steel Z-axis motor mount



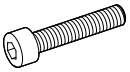
NEMA 23 motor (threaded)



200mm lead screw



608ZZ flange bearing

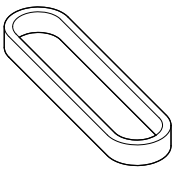


x6

M5-25mm bolt

x2

M5-nylock nut



132mm GT2 closed loop belt

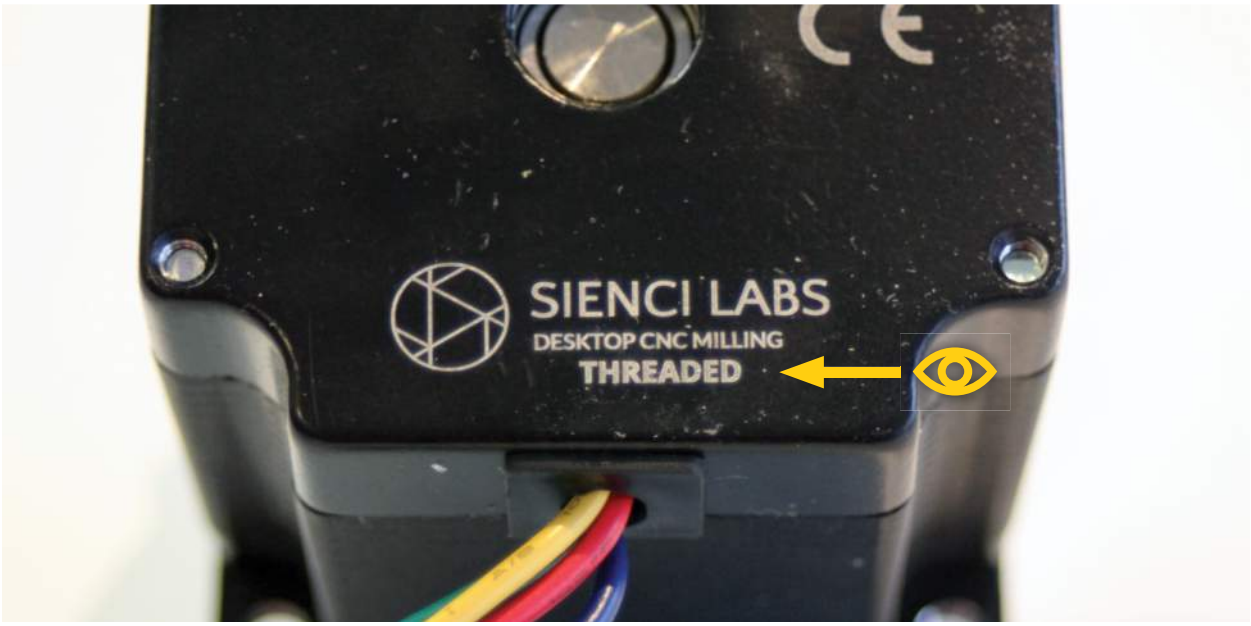
20T 6.35mm GT2 pulley

20T 8mm GT2 pulley

Previously Assembled

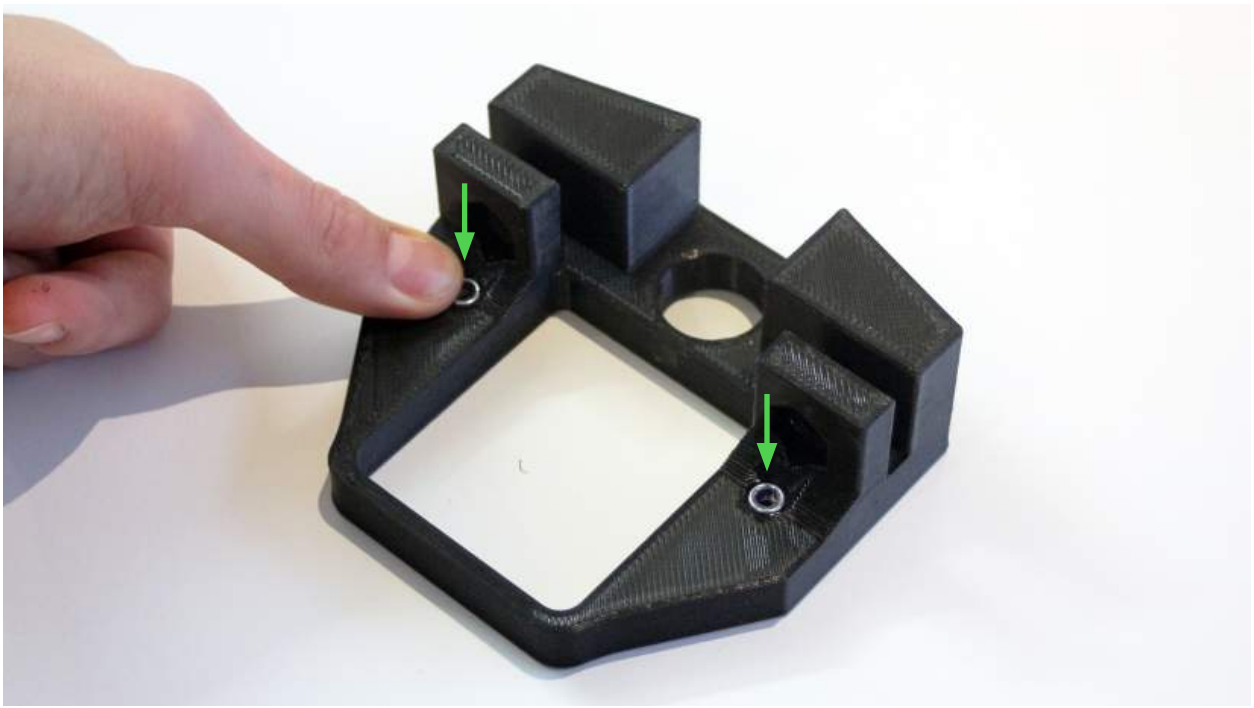
ACME locking nut assembly

Keep your M5 hardware nearby. Look back into the green bag to get the bag filled with flange bearings, and another containing two pulleys and a belt. In the orange-dotted box you'll want to grab the bubble-wrapped steel plate, and turning to the identical-looking green-dotted box you'll want to get the plastic Z-axis mount. Inside the short, wide box you'll find the stepper motors and their cables; you need the one that is specifically labelled on the back to be **threaded**.



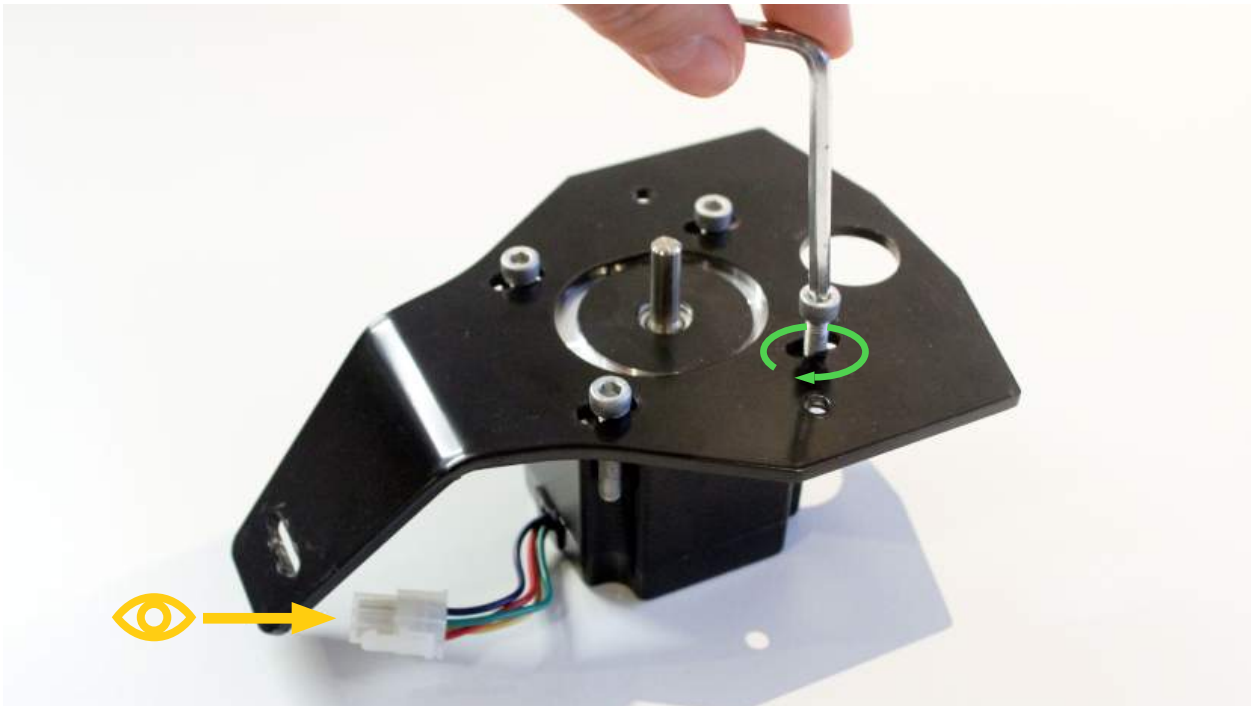
Labeled with THREADED

Start off by pushing in two M5-nylock nuts into the hexagonal holes in the 3D printed Z-axis mount. These will be used to mount the steel Z-axis motor mount.



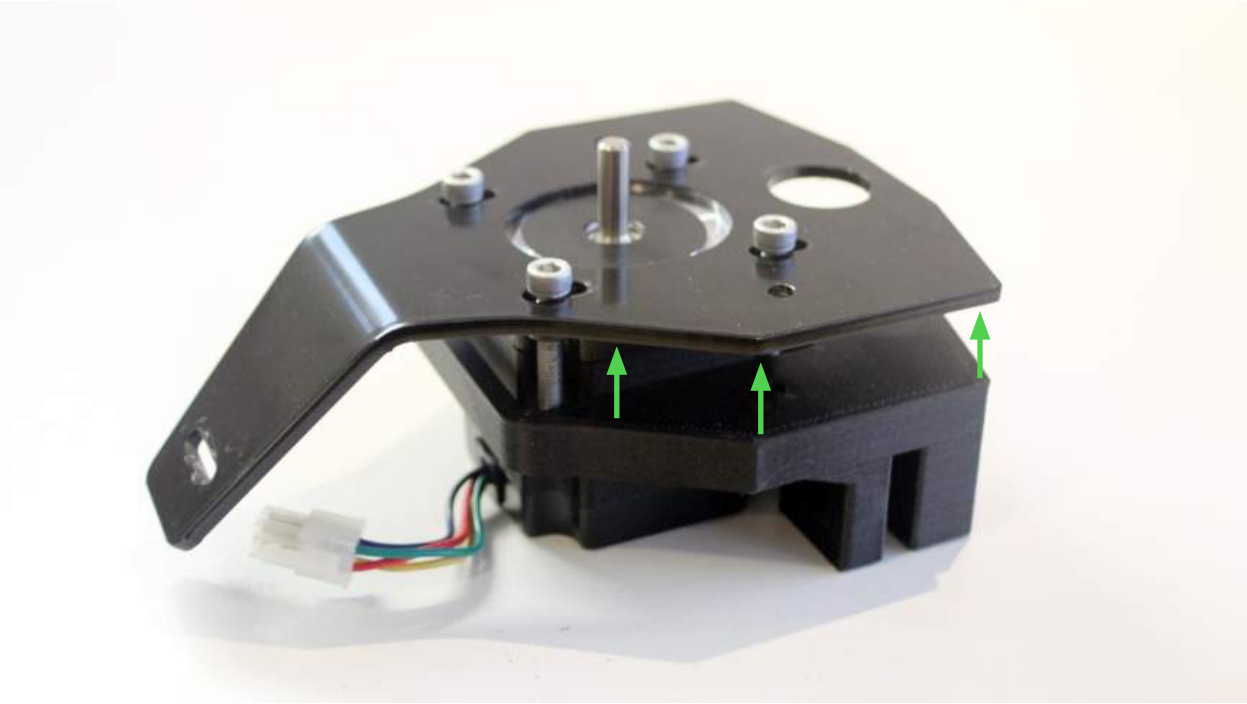
Make sure to keep the round part of the nut facing towards you when pushing them in.

To the side, put the steel plate on the top of the motor, ensuring that its cable bundle is **facing away** from the middle-sized hole on the plate. Loosely thread four M5-25mm bolts through the slots and the motor, the plate slots may be a little tight but that's fine; we'll be adjusting this part and re-tightening the bolts later in the assembly.



Screw the four M5 screws into the motor. Ensure that the connector is facing the correct direction to make wiring easier later.

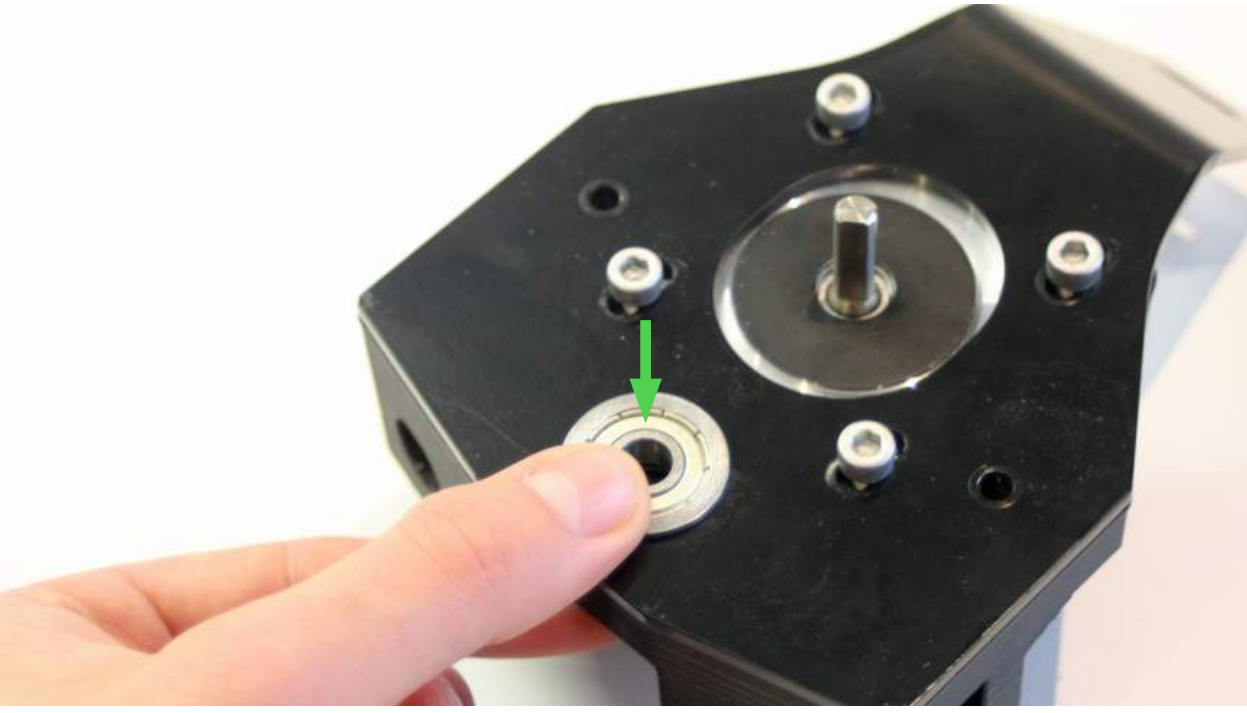
Fit the motor and plate assembly into the 3D printed Z-axis mount. If it doesn't slide in easily, try sliding the motor all the way forward, and tilting the plate back slightly. You'll know they're aligned when their profiles match and they lay flush against each other.



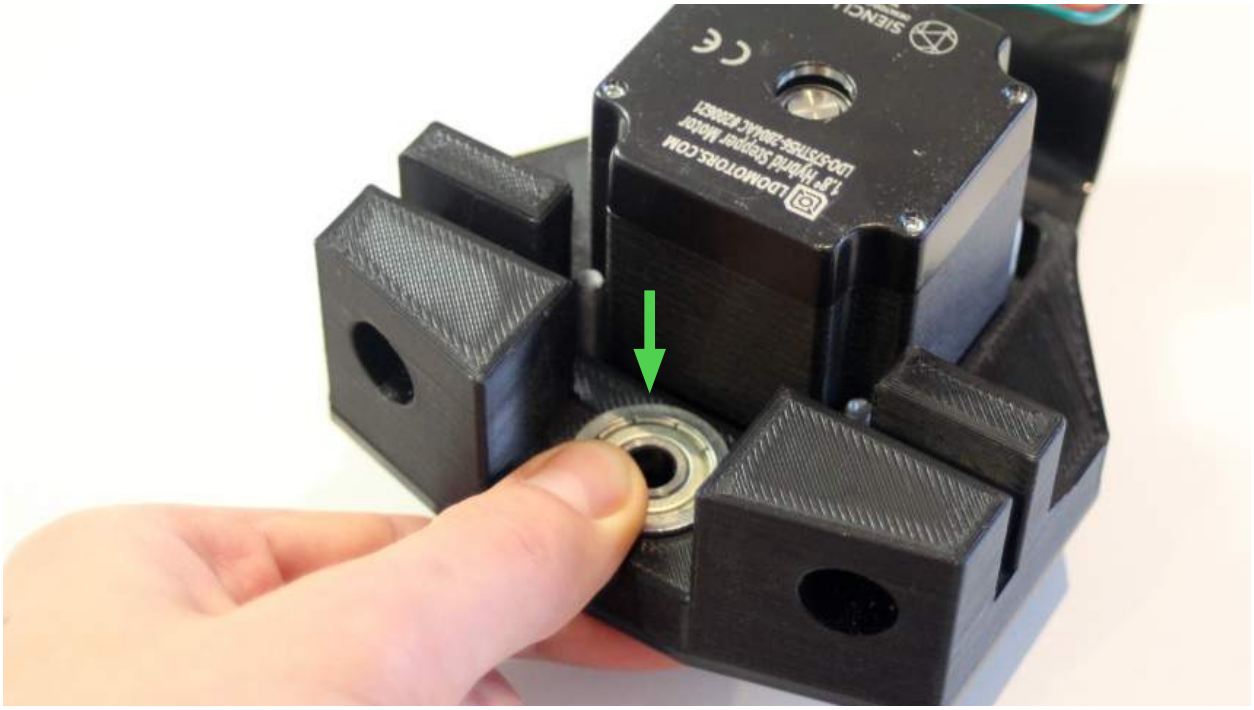
Moving the motor back and forth, and tilting the plate and motor back and forth can help get this part in place.

Get the bag with bearings in it and use two when pressing them into the top and bottom bore on your assembly. You should be able to get them on easily with your thumbs. If you find resistance, try adjusting the steel plate so that the bores on the plastic and steel line up.

Both flanges of each bearing should sit flush with no gap.

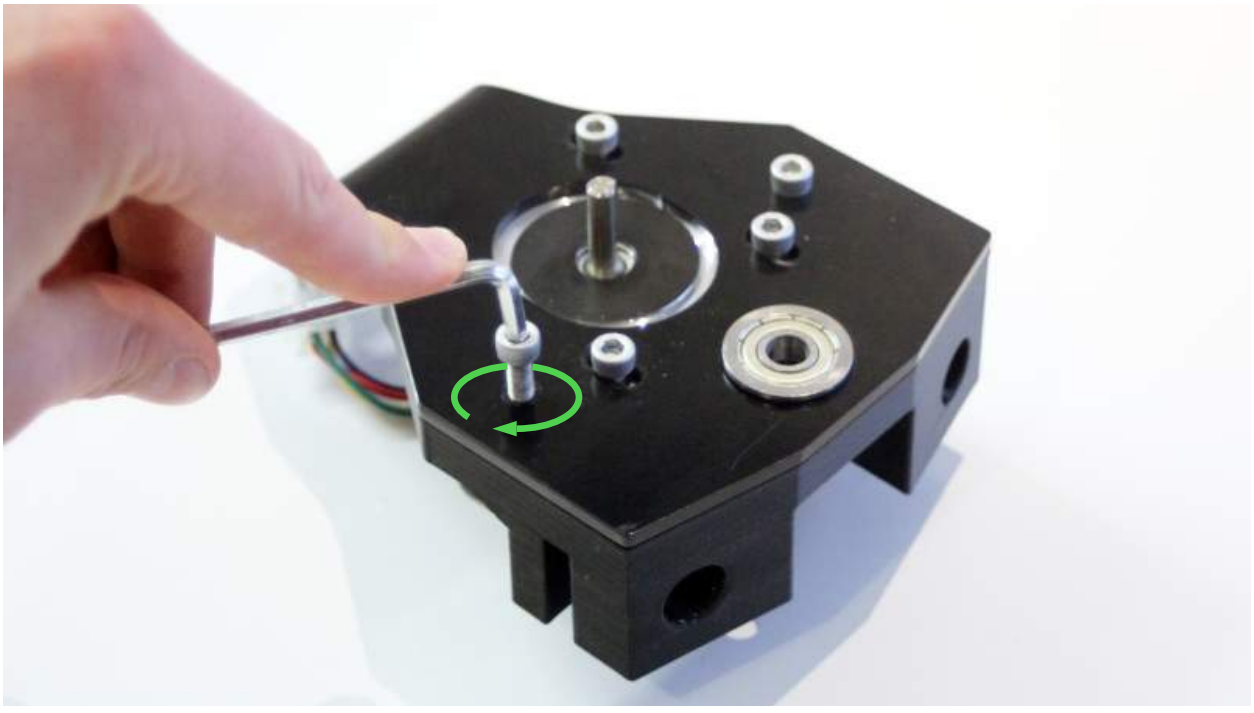


Bearing on the top



Bearing on the bottom

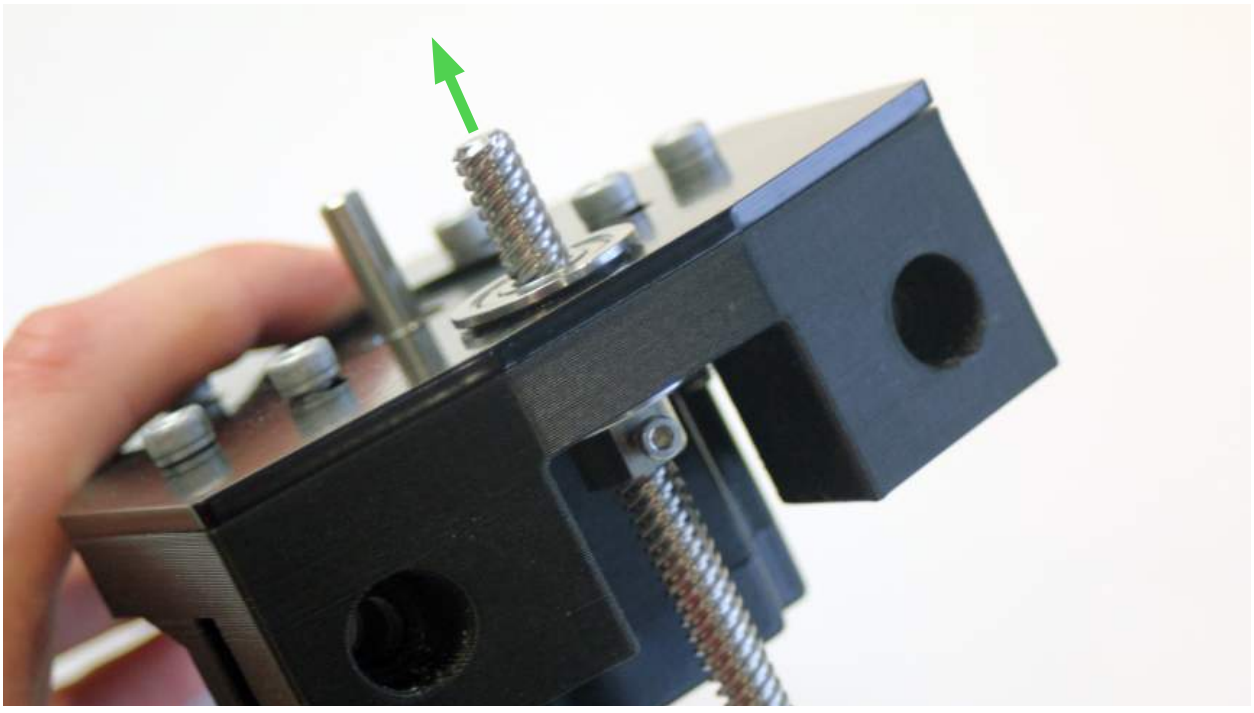
Using two more of the same bolts, secure the plate and the 3D printed part together. These should thread all the way through to the nuts that you placed earlier in the plastic mount.



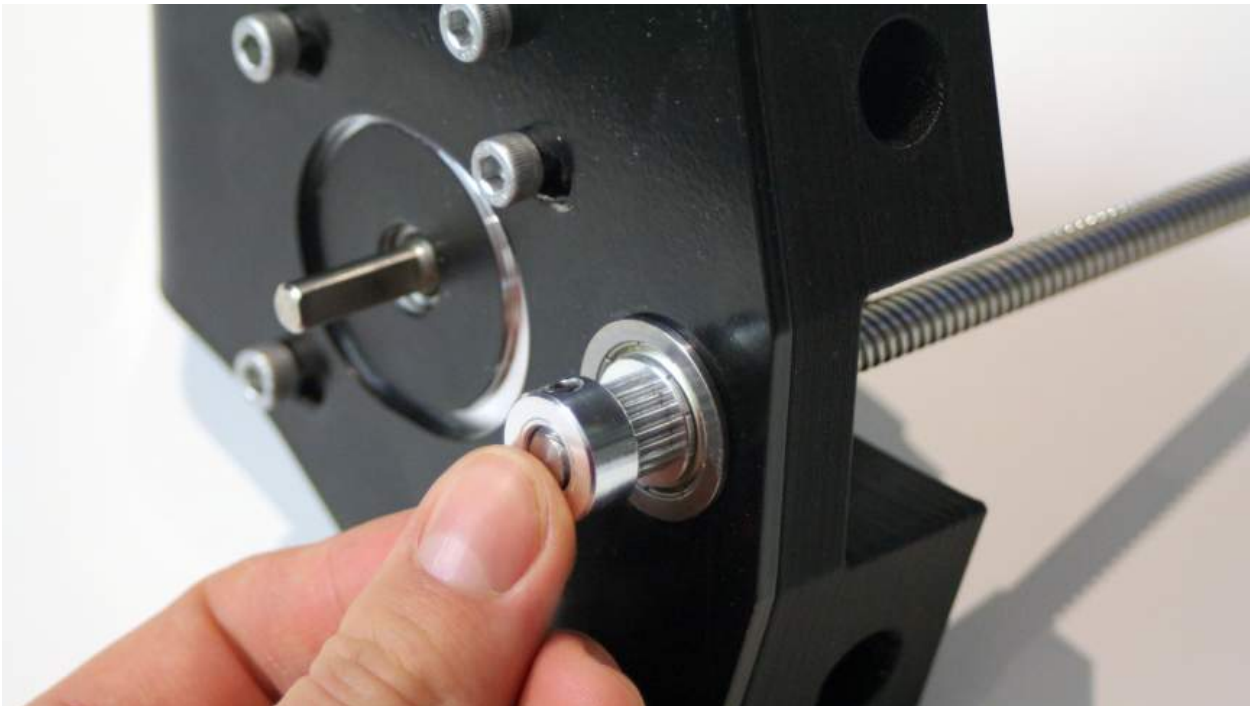
Mount the steel plate to the 3D printed part.

The long, heavy box contains the rails, drag chains, and lead screws. Cut it open, remove the protective cardboard and shrink-wrap, and inside the bundle of lead screws you should be able to locate a very short lead screw which is what's used for the Z-axis. With this in hand, get one of the ACME locking nut assemblies that you'd made before and thread the nut about 1.5 inches onto the lead screw. Make sure the nut still has its M3 set-screw.

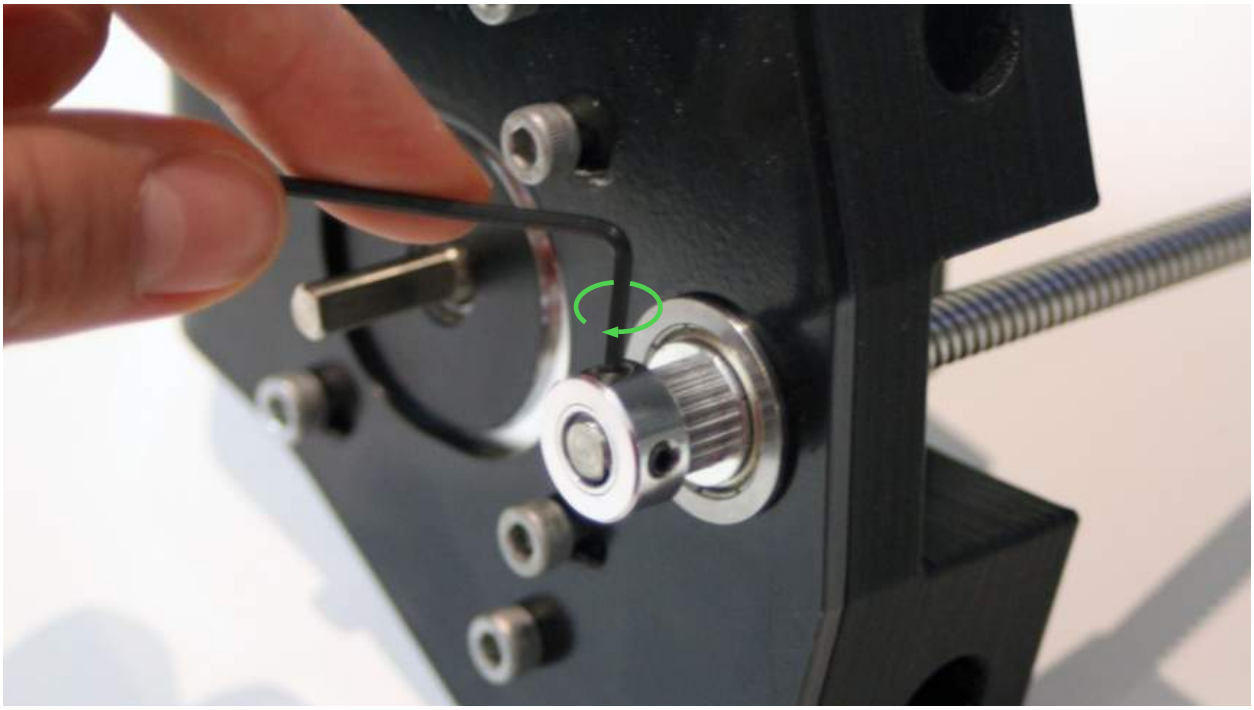
Next, slide the short end of the lead screw up through the flange bearings. The clearance between the bearing and the lead screw can be quite tight. Ensure that you are putting the bearing in straight before applying force to slide the bearing on. Some customers may need to wiggle the lead screw around or tap the lead screw with a mallet to get the bearing in all of the way.



Get the bag with a belt and two pulleys. You'll find that only one of the pulleys will be able to fit over the lead screw but you'll first have to unscrew the set screws a little with the included Allen key. Orient the pulley so that the base is flush with the end of the lead screw then tighten the screws into place.

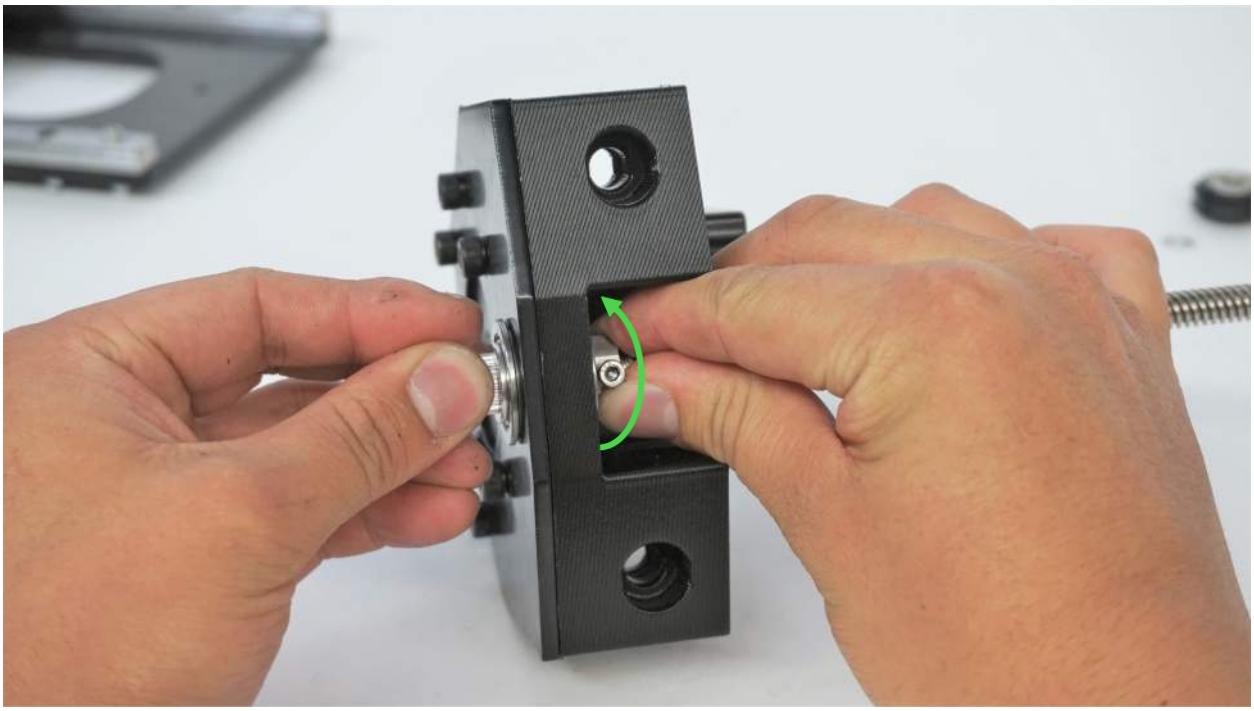


You might have to adjust the locking nut to make the lead screw and the top of the pulley flush.



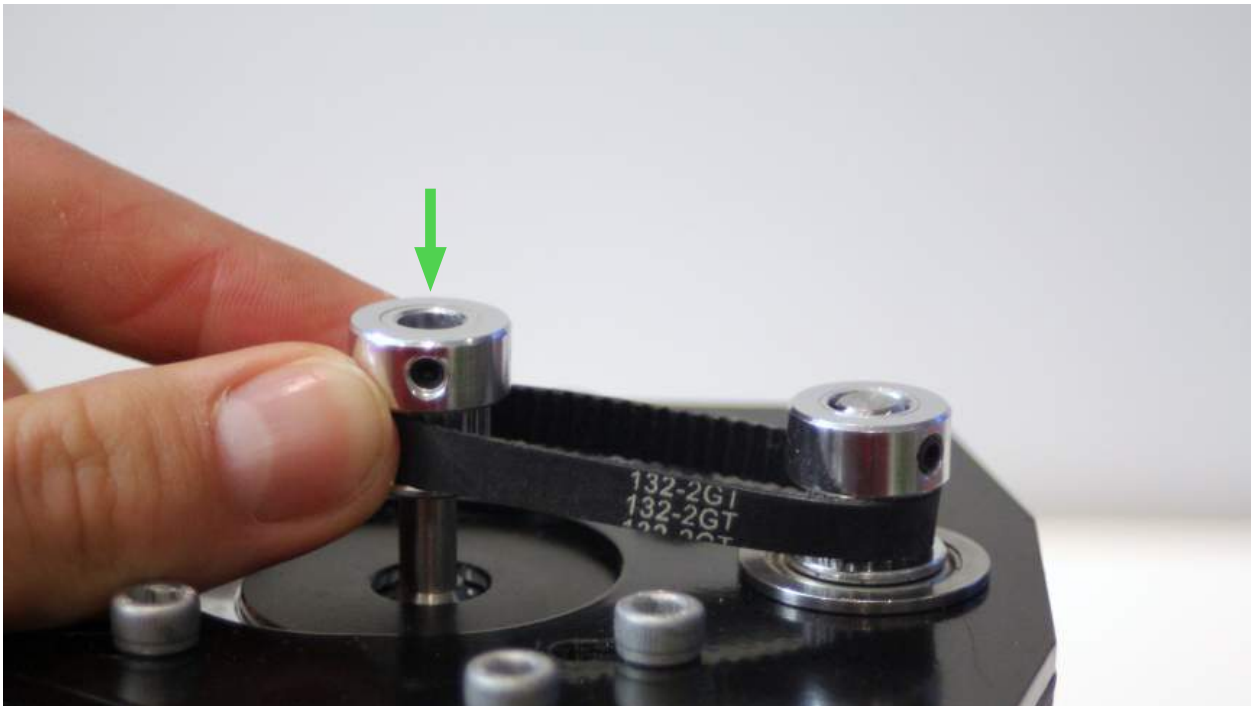
Use an Allen key to tighten the set screws to hold the lead screw.

Once the pulley is secure, twist the ACME locking nut in from the other side so that the pulley and the nut are sandwiching the two bearings. Once in place, tighten the M3 screw on the nut to hold it in place and ensure there's no play up and down. Adjust and tighten if necessary.

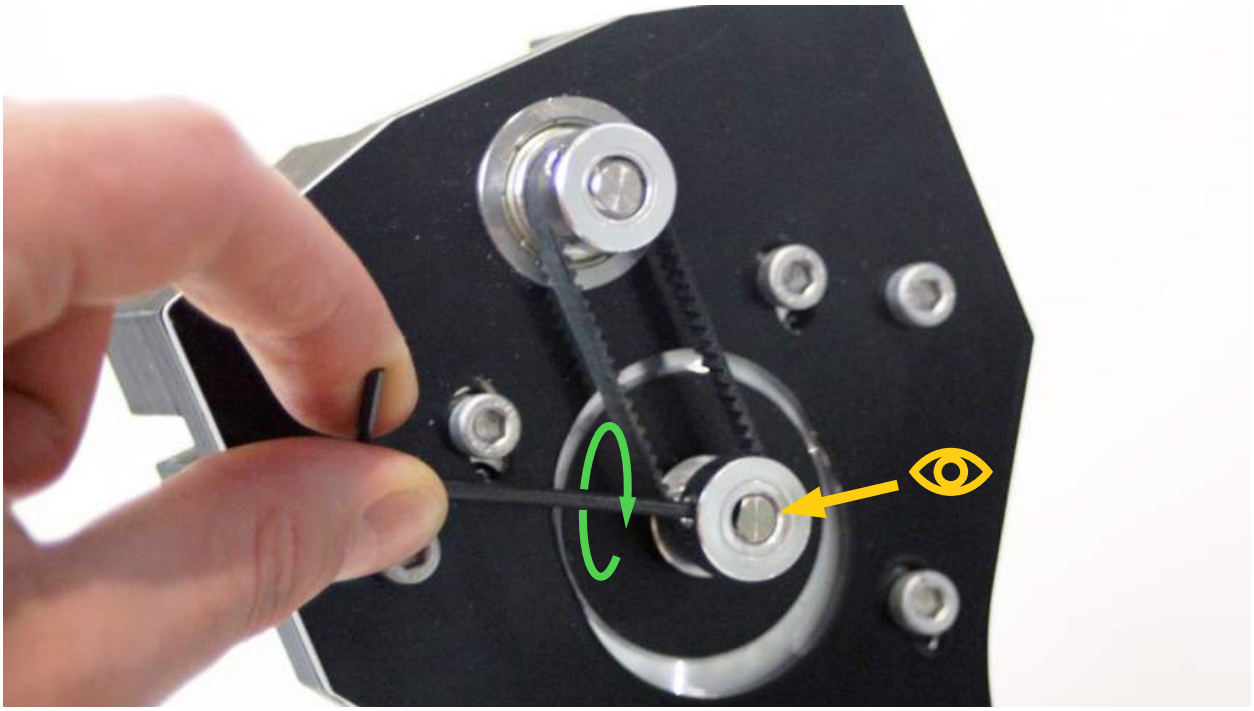


This step keeps the lead screw constrained in the z-axis.

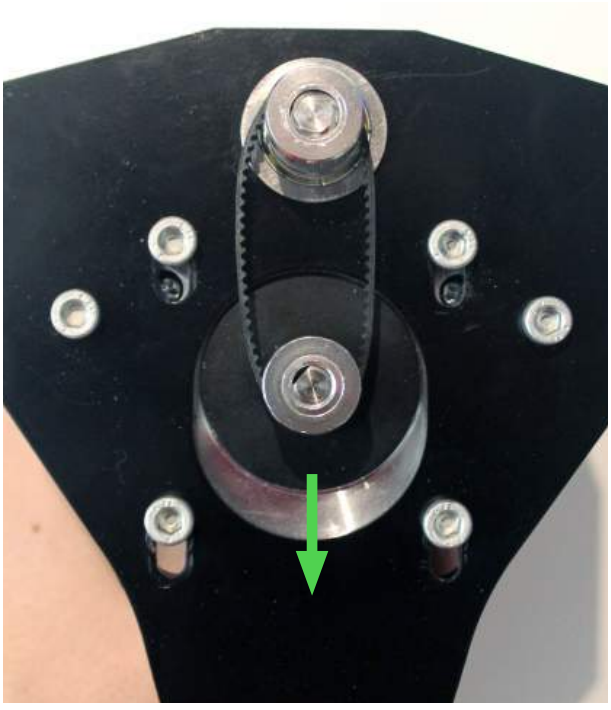
To put the belt into place: loosen the second pulley set screw, wrap the belt around it, slide the motor toward the lead screw, then wrap the belt around the first pulley and install the second pulley onto the motor shaft.



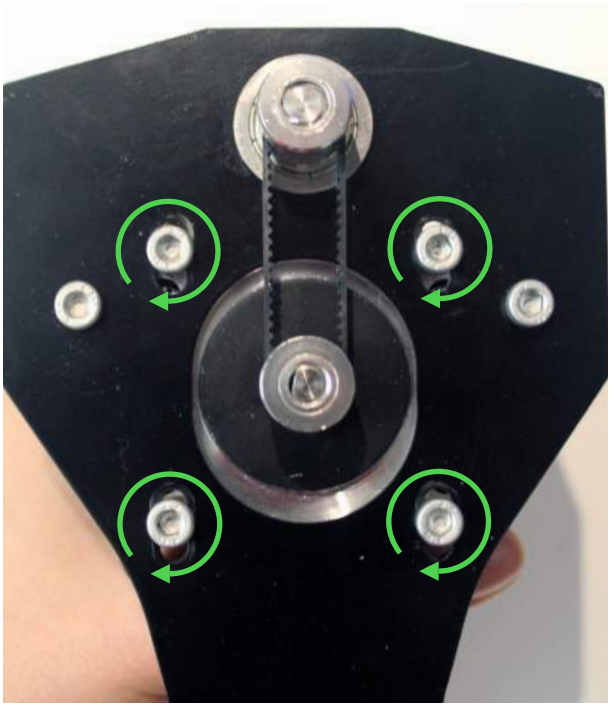
The base of the second pulley should be flush with the top of the motor shaft when tightened. Make sure to line up one of the set screws with the flat part of the motor shaft to provide extra holding strength (as shown in the photo).



Next, make sure that the belt is tight around the two pulleys by pulling back the motor in the slot then tightening the M5 bolts that are holding it in place.



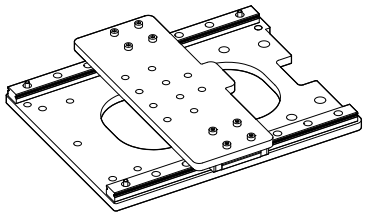
Loose belt



Tight belt

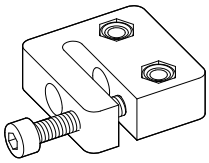
XZ-axis gantry sub-assembly

Parts Needed:



XZ-gantry assembly

Previously Assembled



x2

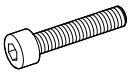
Anti-backlash assembly

x12

V Wheel

x12

M5 washer



x12

M5-25mm bolt

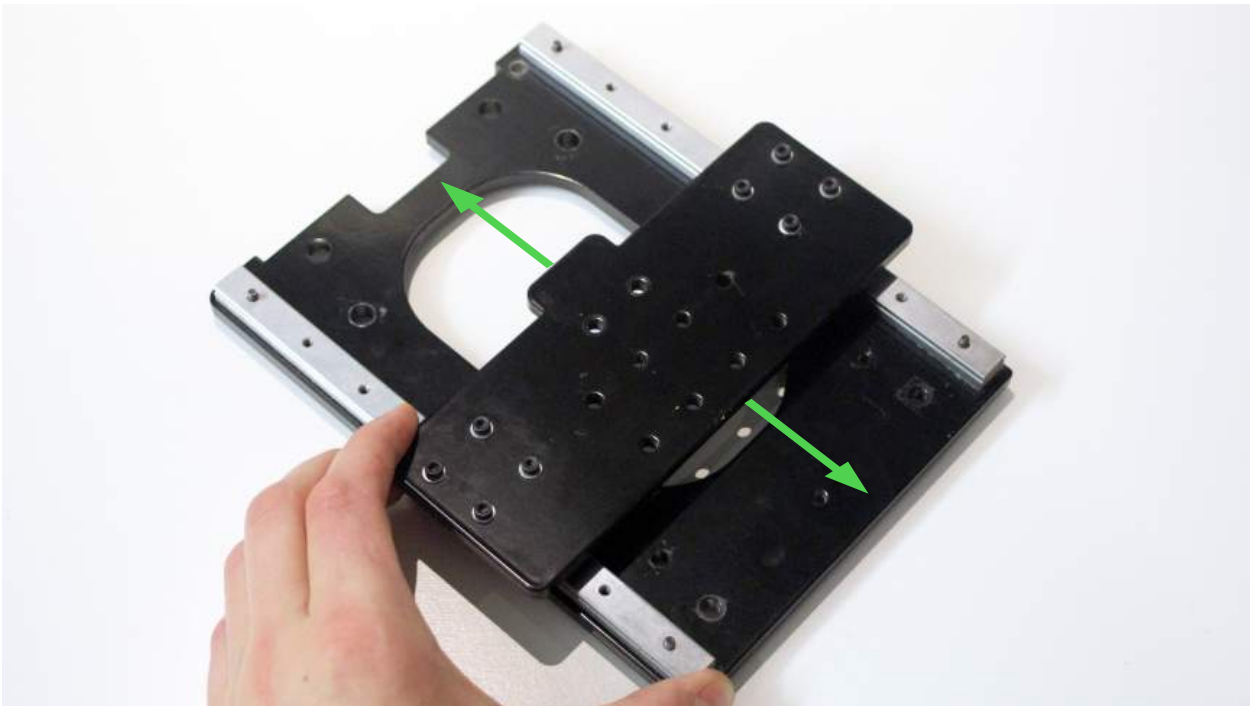
x2

Eccentric nut

x2

M5-nylock nut

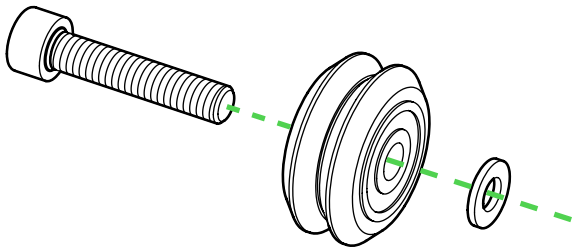
You should find the XZ-gantry assembly in a labelled bubble mailer. Once you take it out, you'll see there's a small steel plate (z-gantry) attached to big steel plate (x-gantry) via two sliding rails. First, check that the movement of your z-gantry is smooth by moving it up and down by hand. There should be no binding and the gantry should move relatively smoothly.



Gantry should move smoothly with no binding. Move up and down for a minute if tight.

Set the assembly to the side and get the green and yellow bags. In addition to the M5 bolts you have already used, the yellow bag should contain M5 washers. Inside the green bag is a set of 12 Delrin wheels. Spilling out the wheels, if you look down the center-hole you'll notice that they have a bronze-coloured inner ring which can sometimes off-center (pictured). Use the included small Allen key from the belt assembly to move the inner ring back into the center.

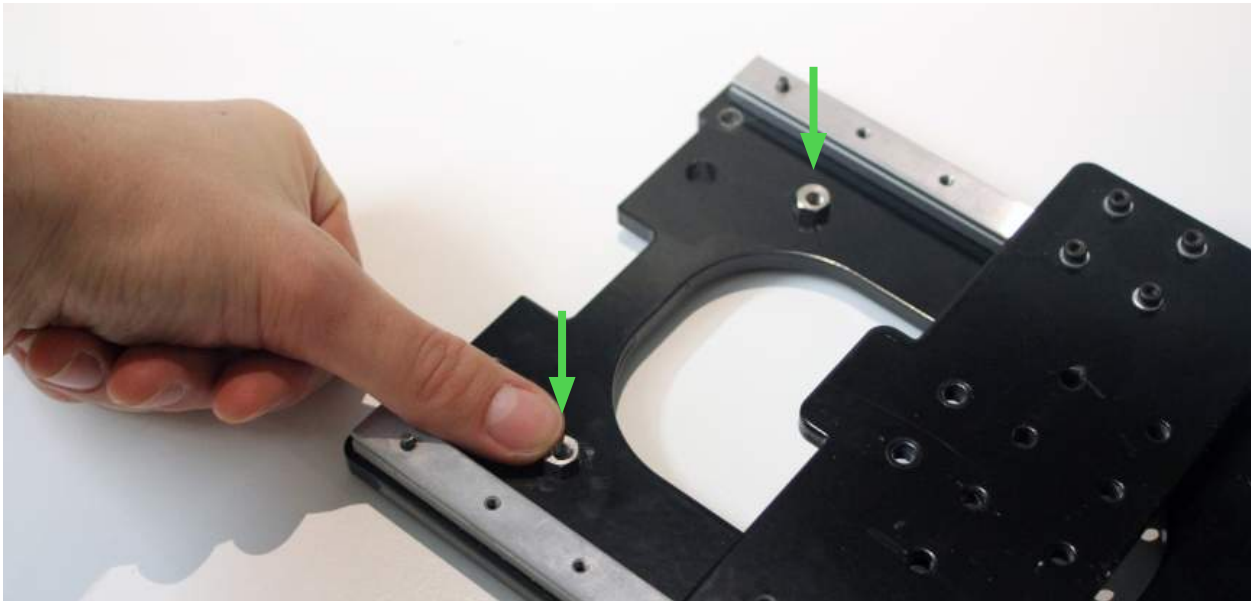
After this, make a small assembly with the wheel going onto the bolt, followed by a washer (pictured). There will be 12 of these sets total. It's very important that the washer is in the correct place, as it keeps the wheel from rubbing against the gantry, as well as providing the correct spacing between the gantry and the lead screw. You'll need four of these assembled sets for now.



You'll also need two of the medium-sized M5 nuts from the last step and you'll also need to grab eccentric nuts from the hardware bag labeled with an orange dot. These come in a small bag of 6 and are very odd looking so they should be easy to identify.

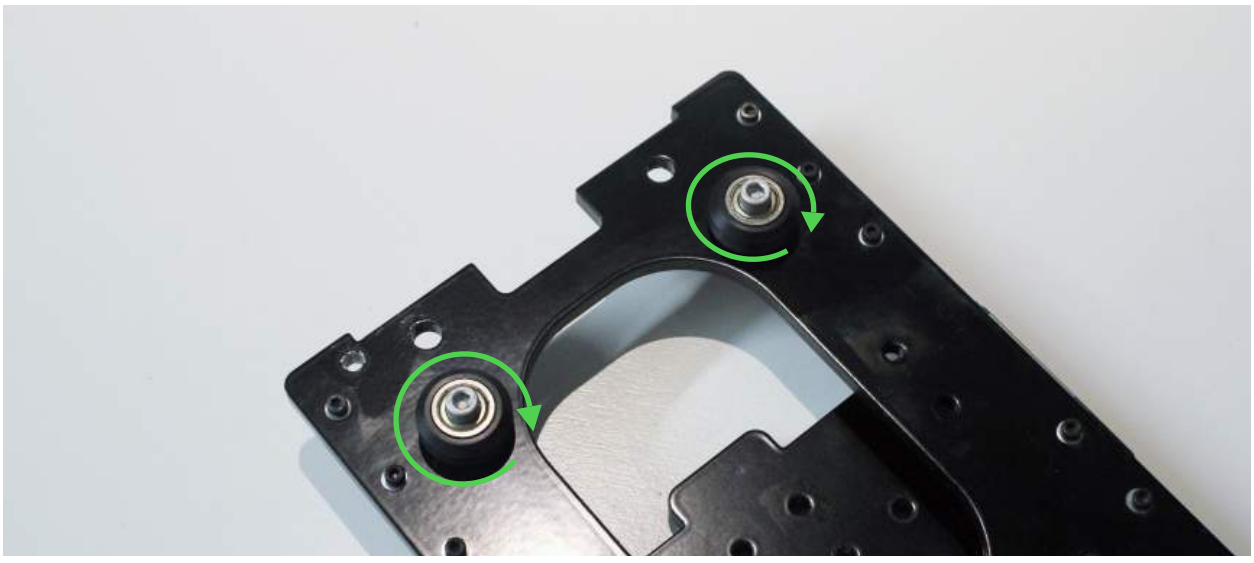
If you move the z-gantry to the middle on the XZ-gantry assembly, you'll notice 4 holes in a rectangular formation on the large steel plate. The 4 sets of wheel assemblies go into these holes from behind, the bottom two using a regular nut and the top two using an eccentric nut. Start by fitting the eccentric nuts into the top pair of holes. The round part of the bore should sit inside of the hole, with the hex part facing out.

If you have a hard time getting the nuts in, we recommend tapping them in with the back of a screwdriver or other dull object. This will help clear the excess paint that might still remain in the hole.



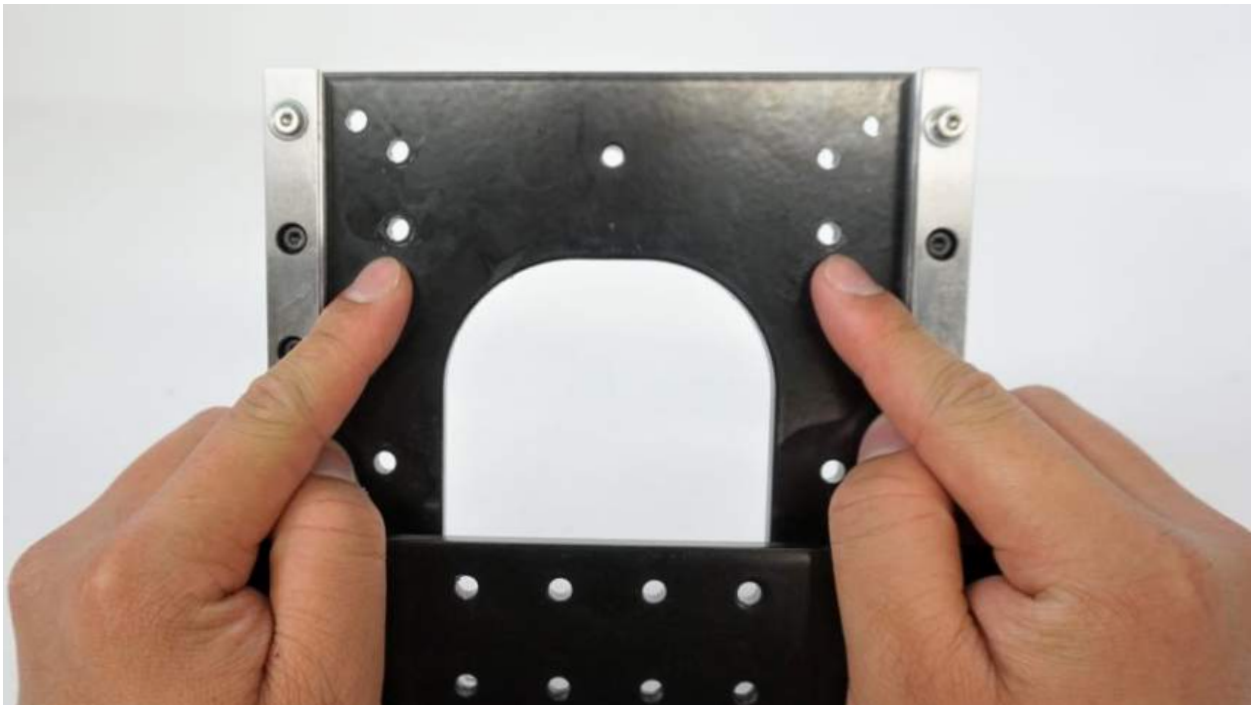
Make sure to have the eccentric nuts in the right holes, and that the bore is sitting inside the hole.

Twist two of the v-wheel sets into the eccentric nuts from the other side. These don't need to be tight yet, so just attach them by hand for now.

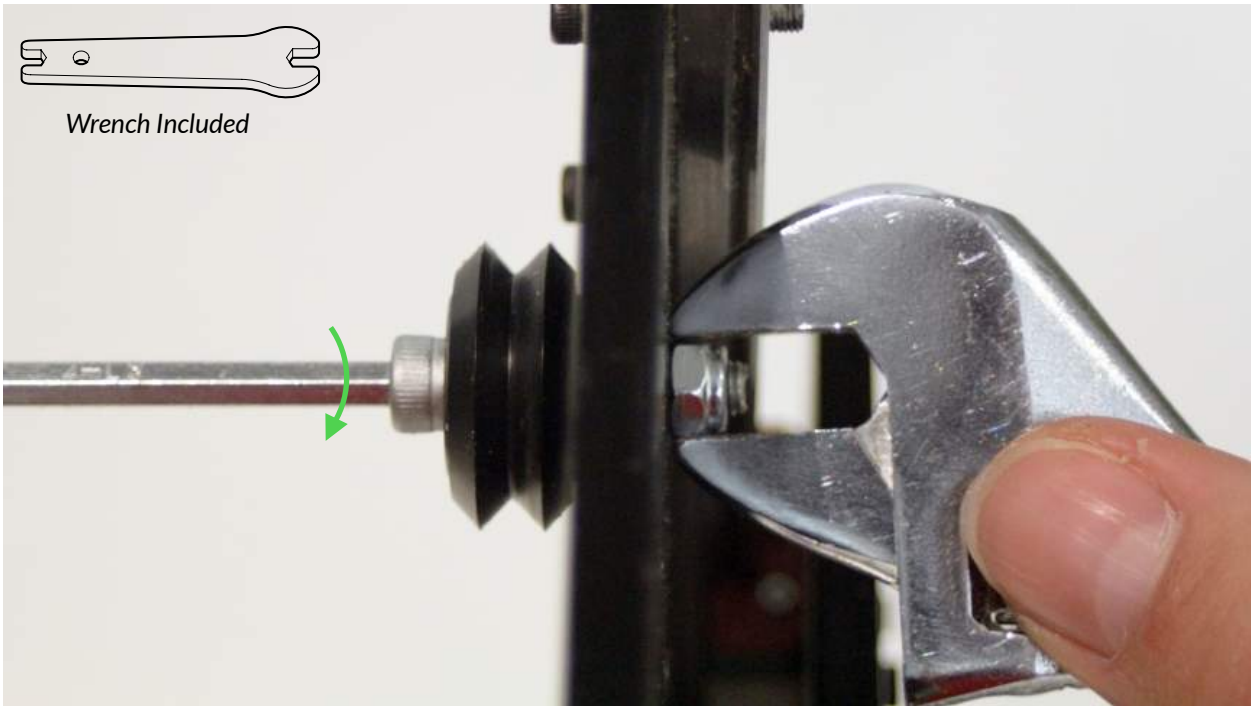


Install the first two v-wheels from the other side.

Now attach the bottom two v-wheel sets. These attach with regular M5-nylock nuts and need to be tightly fastened into place. You can do this with a size 4 Allen key and the included 8mm wrench.

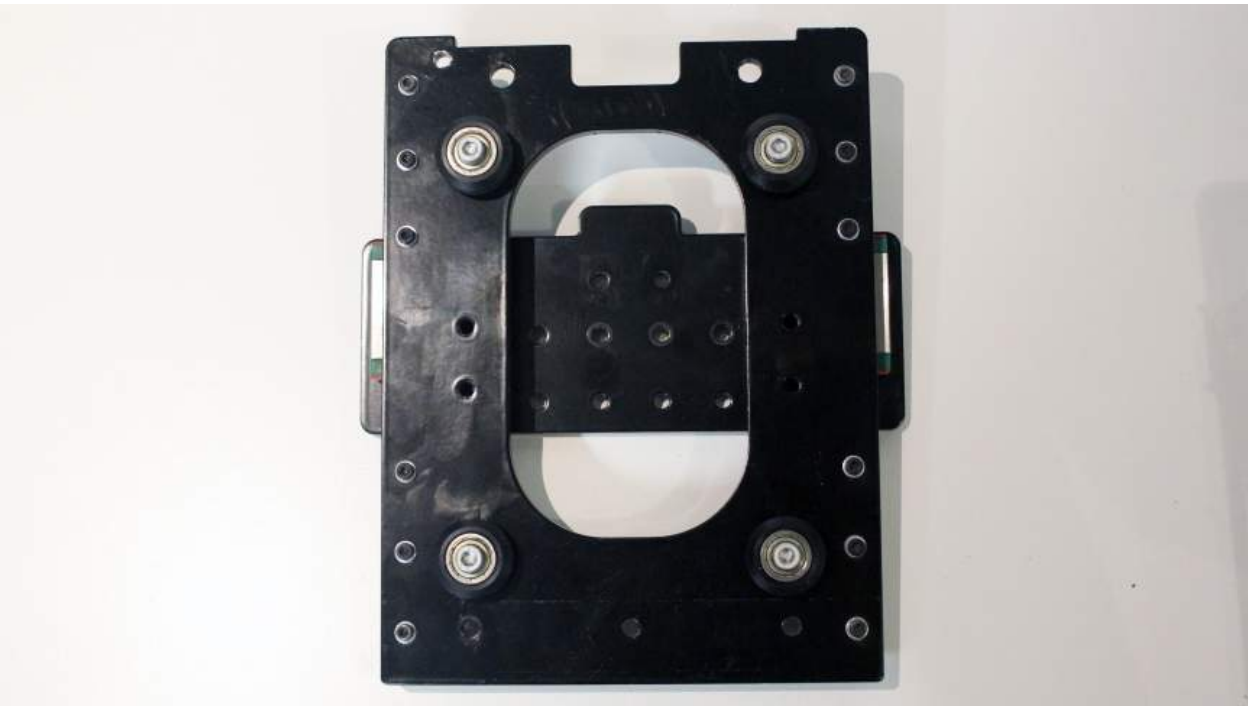


These are the two holes which we'll put the next two v-wheels into.



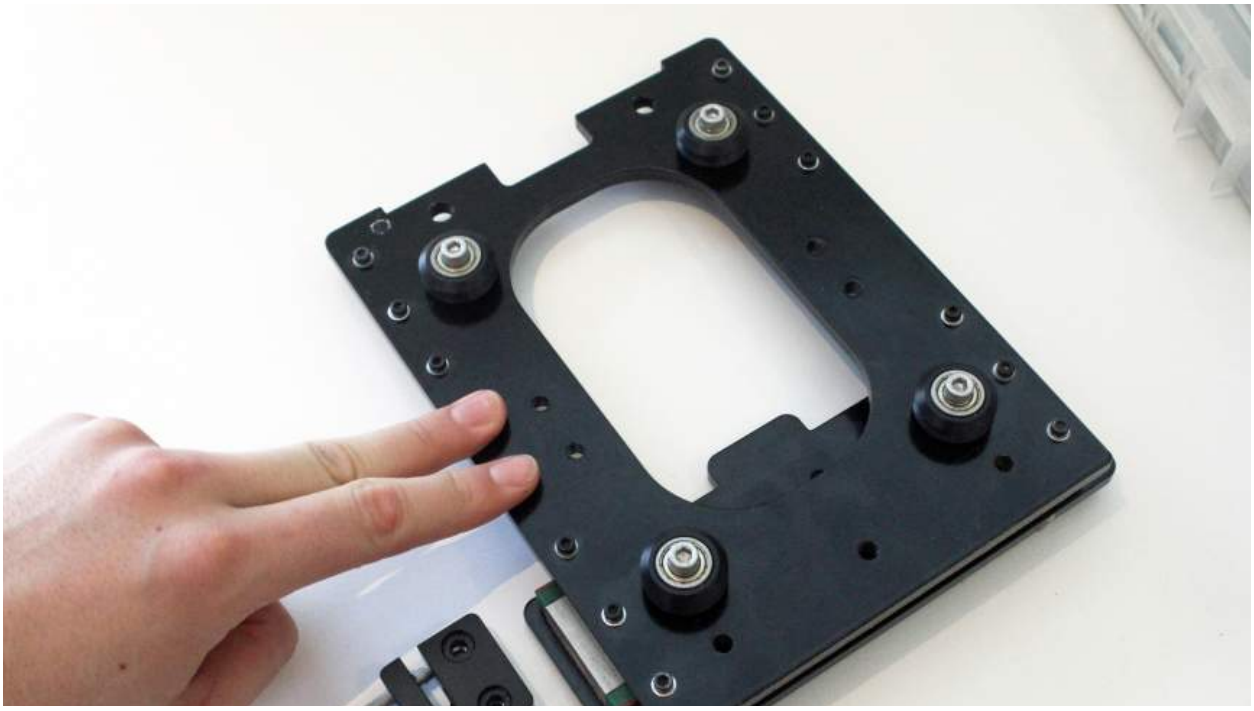
Install the v-wheels, ensuring that the washers are in place as well. Tighten until snug.

Once complete, all of your wheels will be facing the backside of your gantry.
Check to make sure that each wheel turns smoothly.



All of your wheels should be facing the same way.

There are two anti-backlash assemblies that attach to the XZ-gantry assembly.
The first one we will assemble goes on the X-gantry.

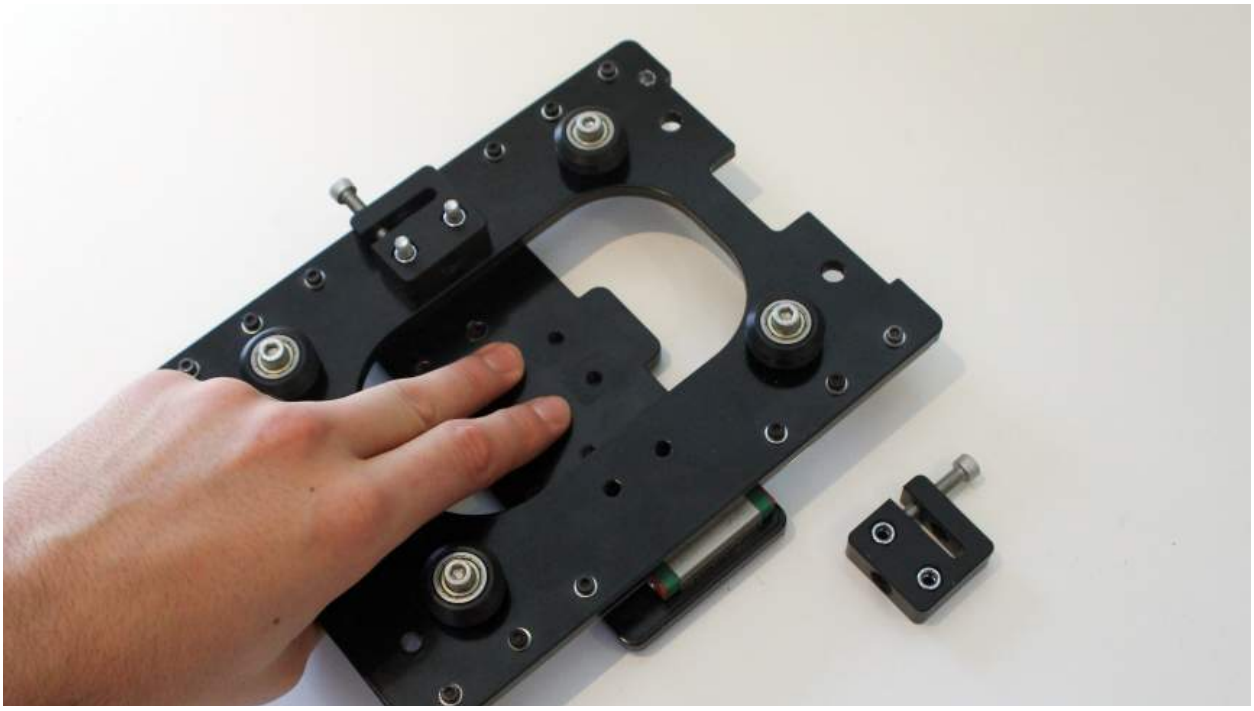


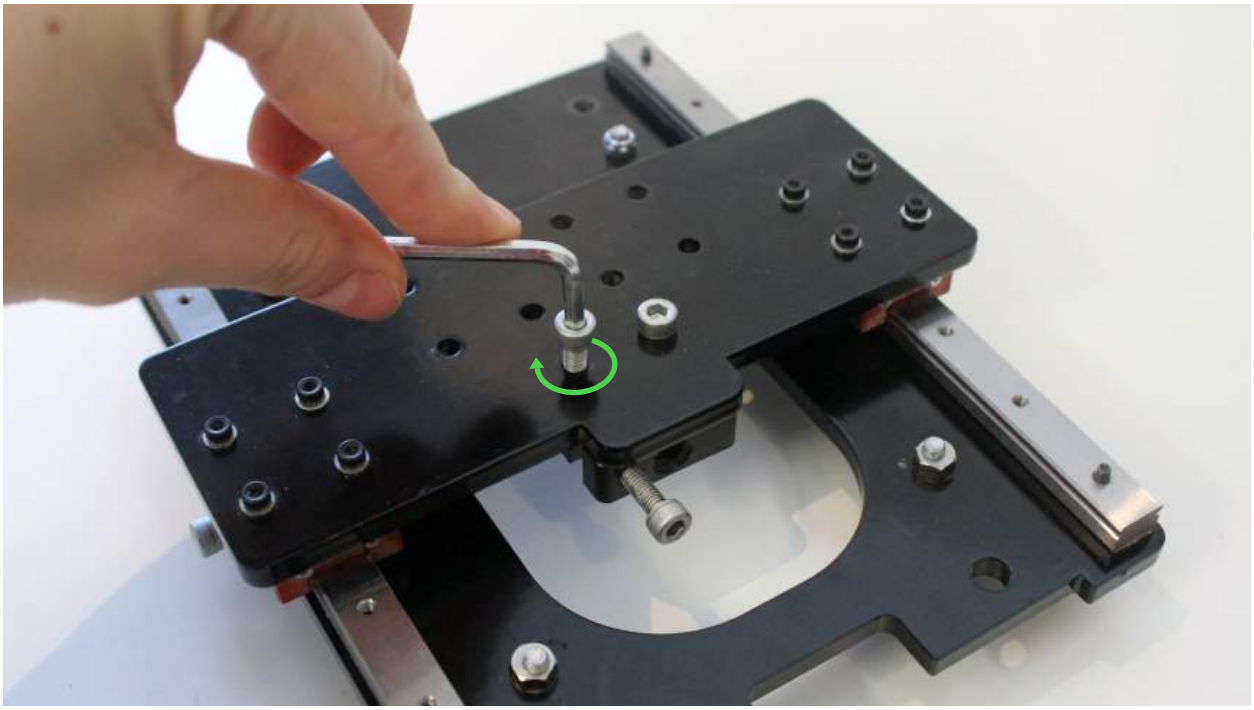
Two holes for mounting the anti-backlash nut block.

Use two M5-25mm bolts (the same ones used to make the v-wheel sets) to mount the nut block. Make sure that the M5 nuts are facing outwards (pictured) so that you can see them. The block **shouldn't** be tightened down really hard, just fasten it until it's snug.

Tighten until snug, but do not overtighten.

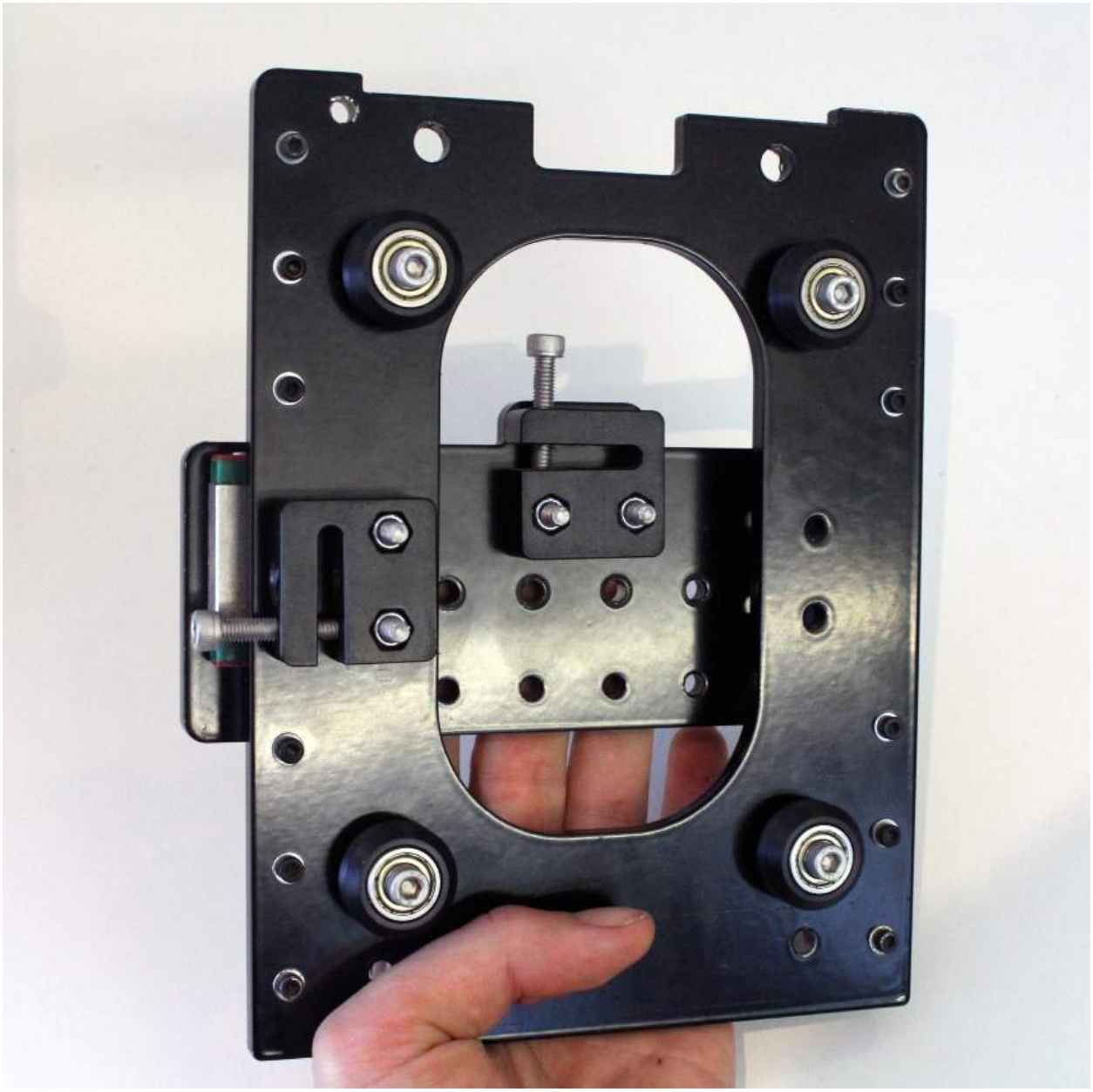
Now we'll do the same process on the Z-axis on the two holes shown.





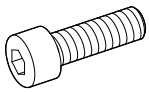
Screw in the next nut block, making sure not to overtighten.

The completed assembly should look like this.



Connecting the two major sub-assemblies

Parts Needed:



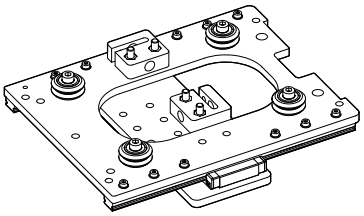
x2

M8-25mm bolt

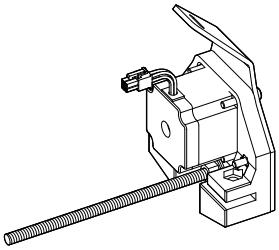
x2

M8 nut

Previously Assembled

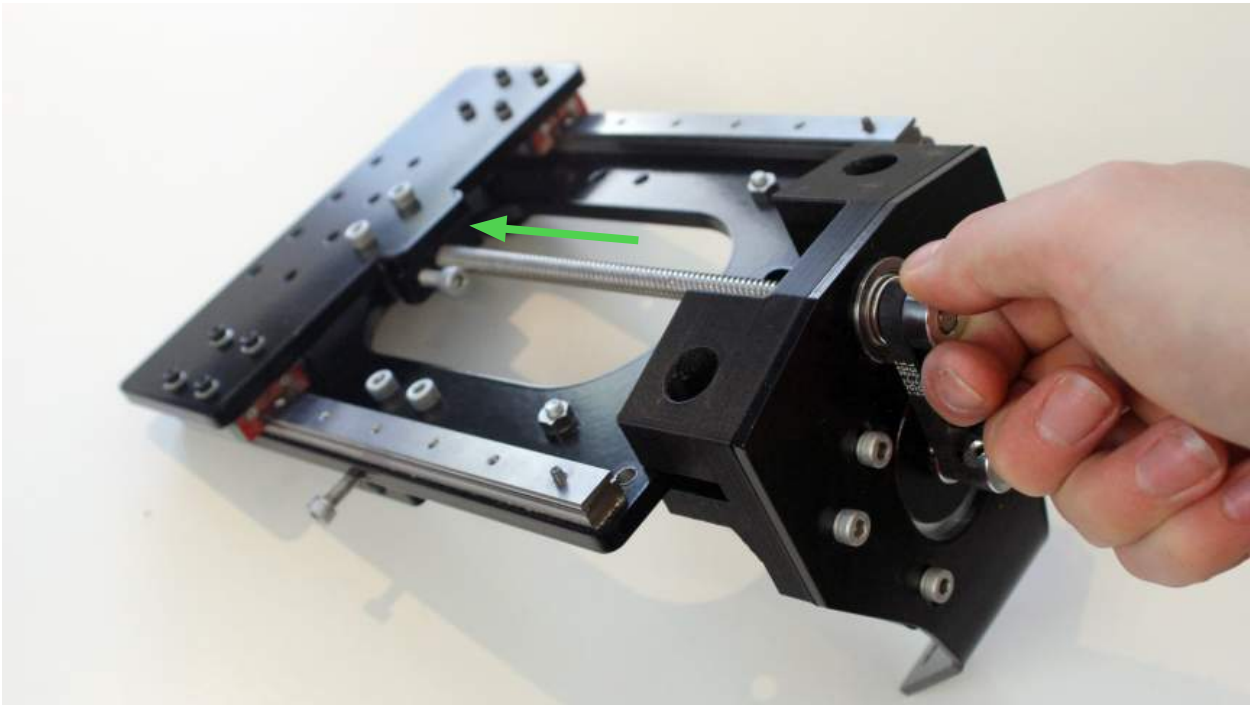


XZ-axis gantry sub-assembly



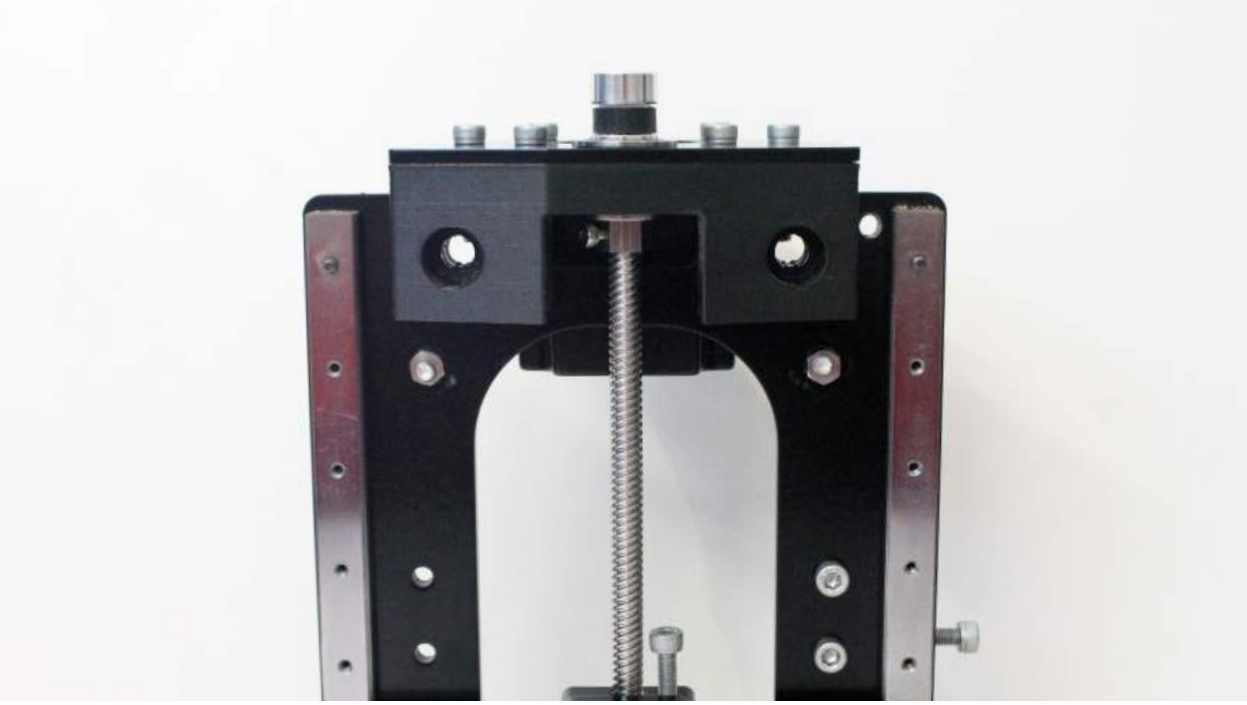
Z-axis motor sub-assembly

Get the motor sub-assembly from before. Holding it in one hand, and the gantry sub-assembly in the other, line up the lead screw from the motor assembly with the nut block of the gantry assembly. If you use your fingers to turn the lead screw, it will go into the nut. The plastic mount should be coming in from the side of the steel plate which has a rectangular notch cut out.



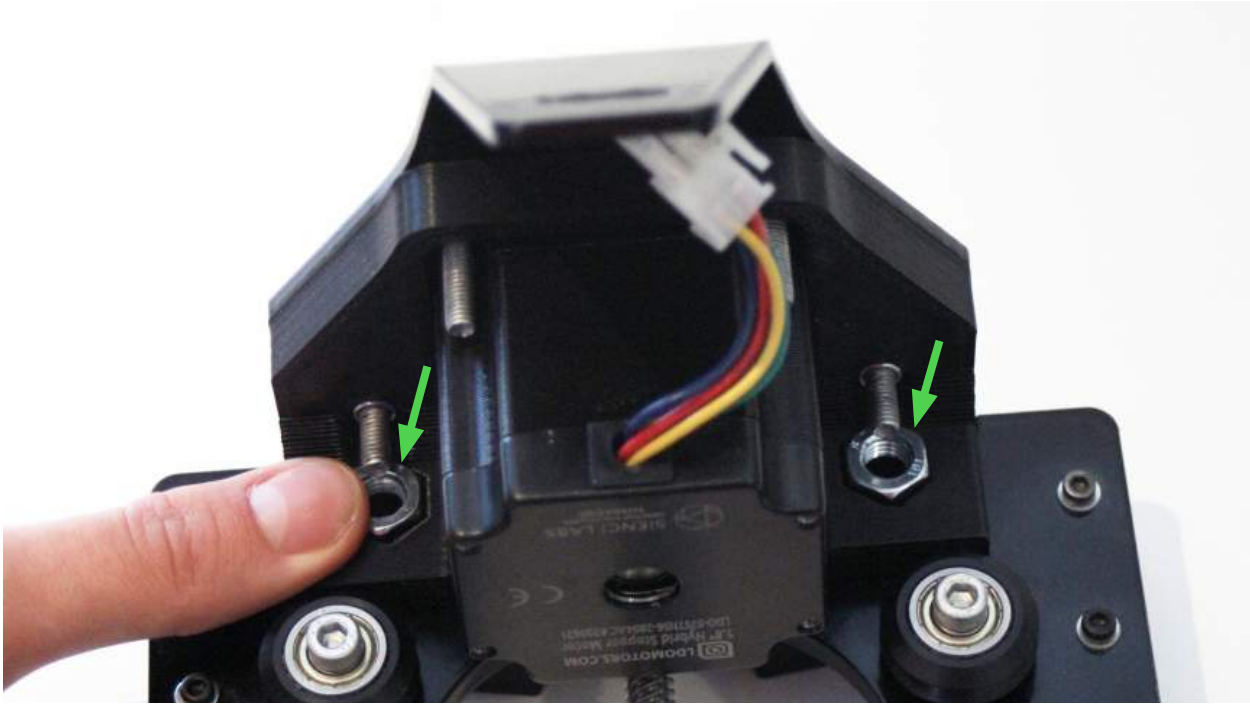
If you have trouble turning the lead screw into the nut, try loosening the bolts holding the nut to the plate. Also, be sure that the tensioning bolt (sticking upwards) is completely loose.

Continue turning the lead screw until the plastic, Z-axis mount is fully seated into the top of the plate and you can see the holes lining up.

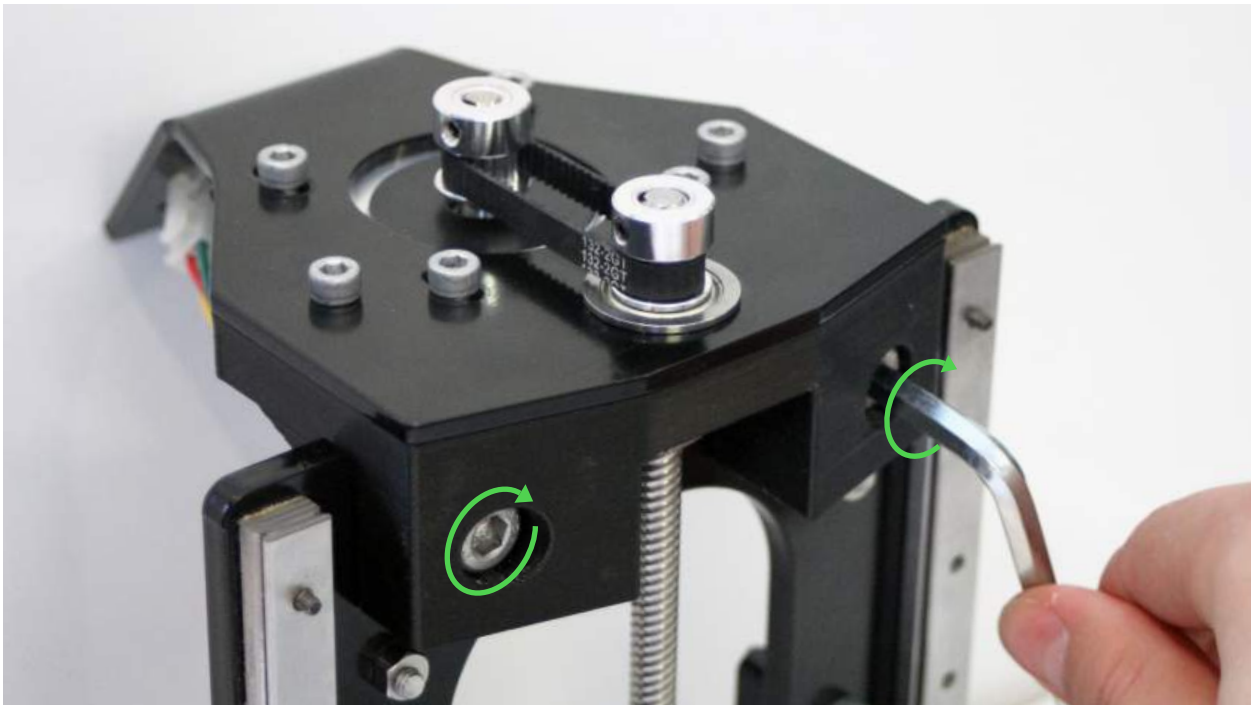


Shuffle the mount side-to-side or push it further into place to align the holes

Get the M8 nuts and M8-25mm bolts from the yellow hardware bag; you'll use a pair of each to fasten these two assemblies together. Take the two large nuts and push them into the back of the plastic Z-axis mount. If the nut fit is a little tight, then you can use a size 6 Allen key or other tool to press it into place.



Now with the two long bolts, slide them in from front through the two holes in the plastic mount. Turn them into place with a size 6 Allen key to secure the two assemblies together; the bolts should be reasonably tight.



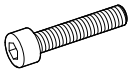
Fasten the M8 bolts. Keep a finger on the M8 nuts if you are finding they pop out when you first start tightening the bolt.

Your assembly should now look like this.

Completed assembly (up to this point).

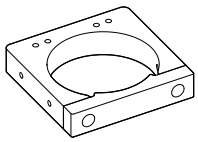
XZ-axis gantry sub-assembly

Parts Needed:



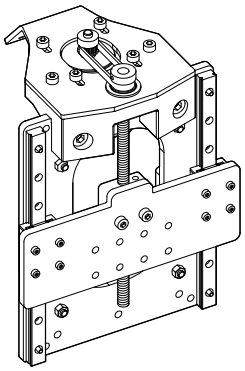
x4

M5-25mm bolt



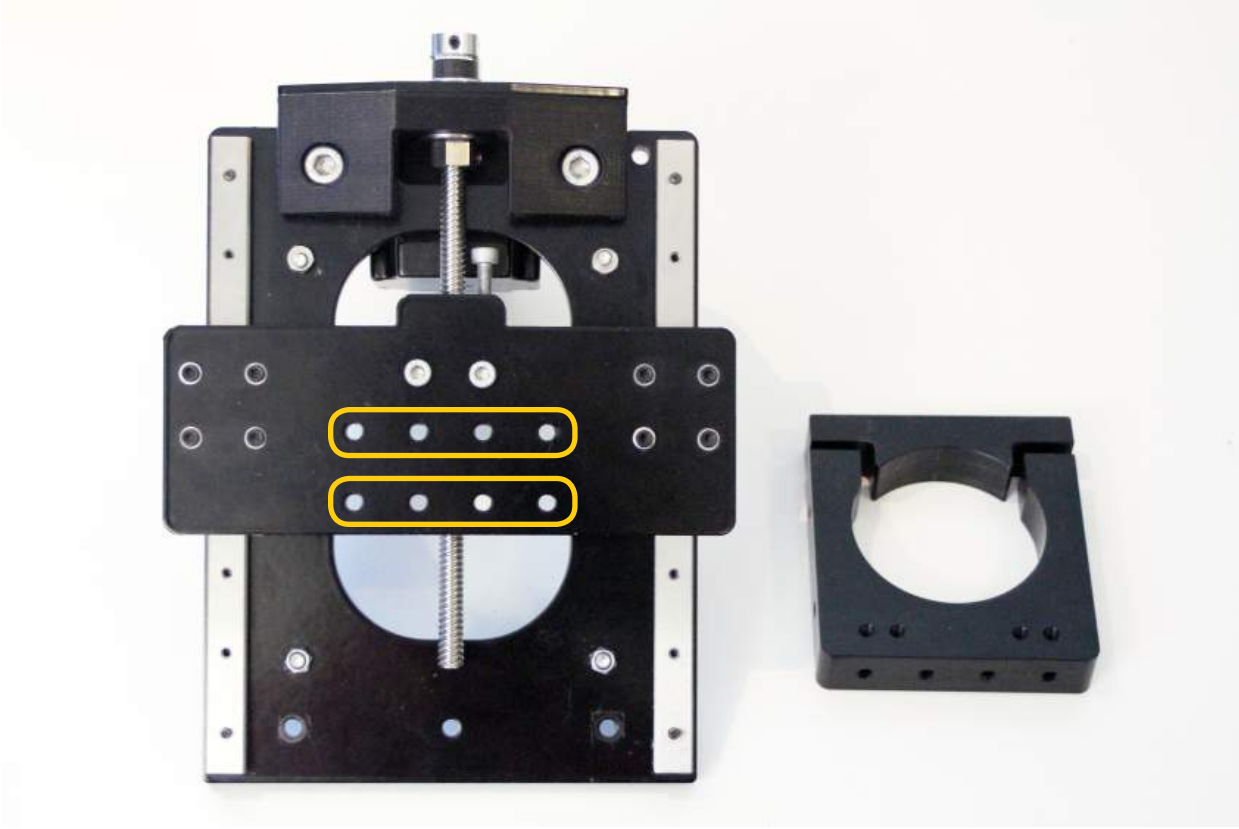
Aluminum router mount

Previously Assembled



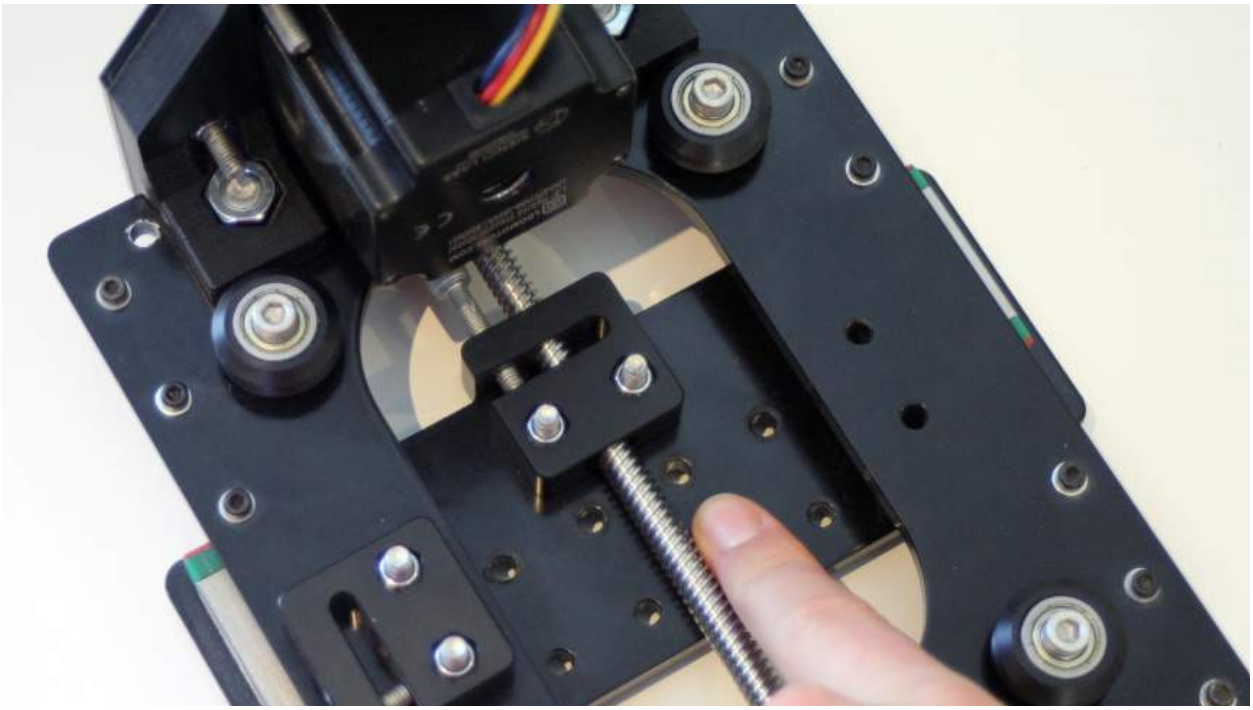
XZ-axis gantry assembly

Notice that the Z-axis gantry plate has two sets of four holes; these are positioned for mounting the aluminum router mount at two different heights. The lower set of holes will allow your router to gain more cutting depth, whereas the upper set will mount the router more rigidly and allow for the full height clearance. Use the upper set of holes to start.

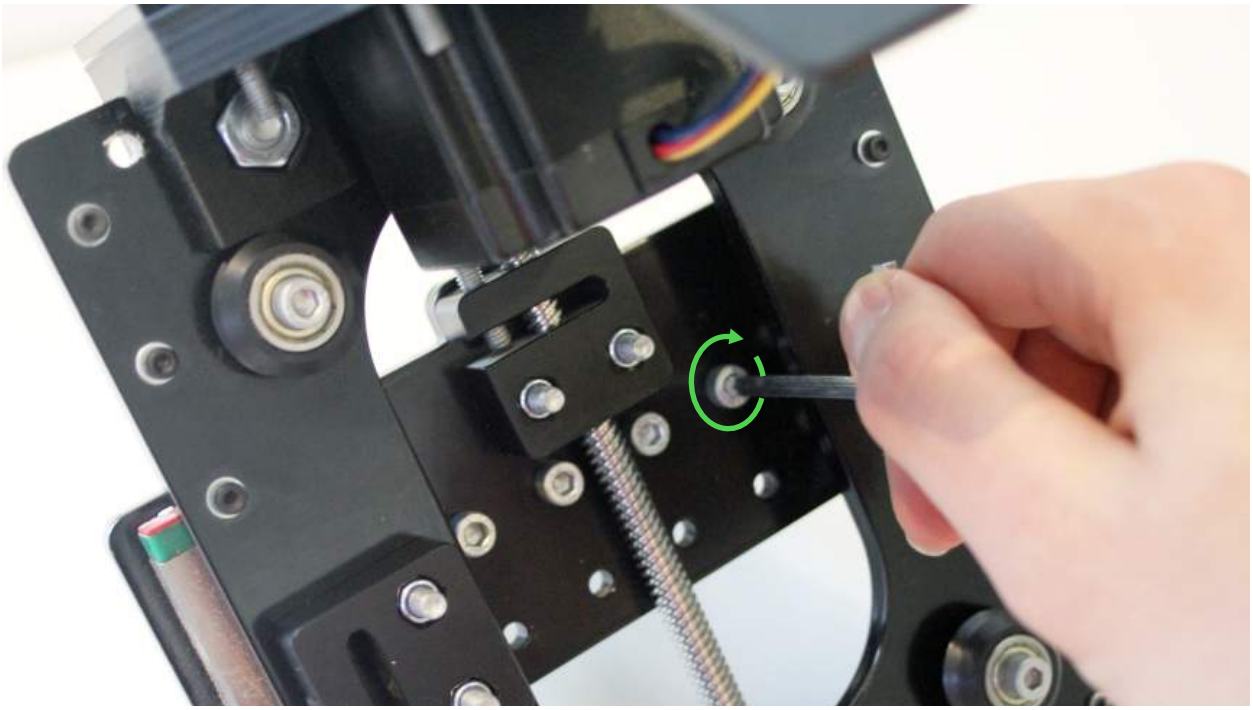


Find your machine's included aluminum router mount, it will be individually wrapped in paper and labelled appropriately (mount pictured). Also, find the M5-25mm bolts in the yellow hardware bag, these will be use to attach the aluminum mount.

With the current assembly turned around (looking in from behind) you'll be able to place the four shorter bolts into the upper set of holes. Holding the router mount up to the bolts, you should be able to fasten it into place with a size 4 Allen key.



The top set of holes in the Z-gantry looking in from behind the current assembly



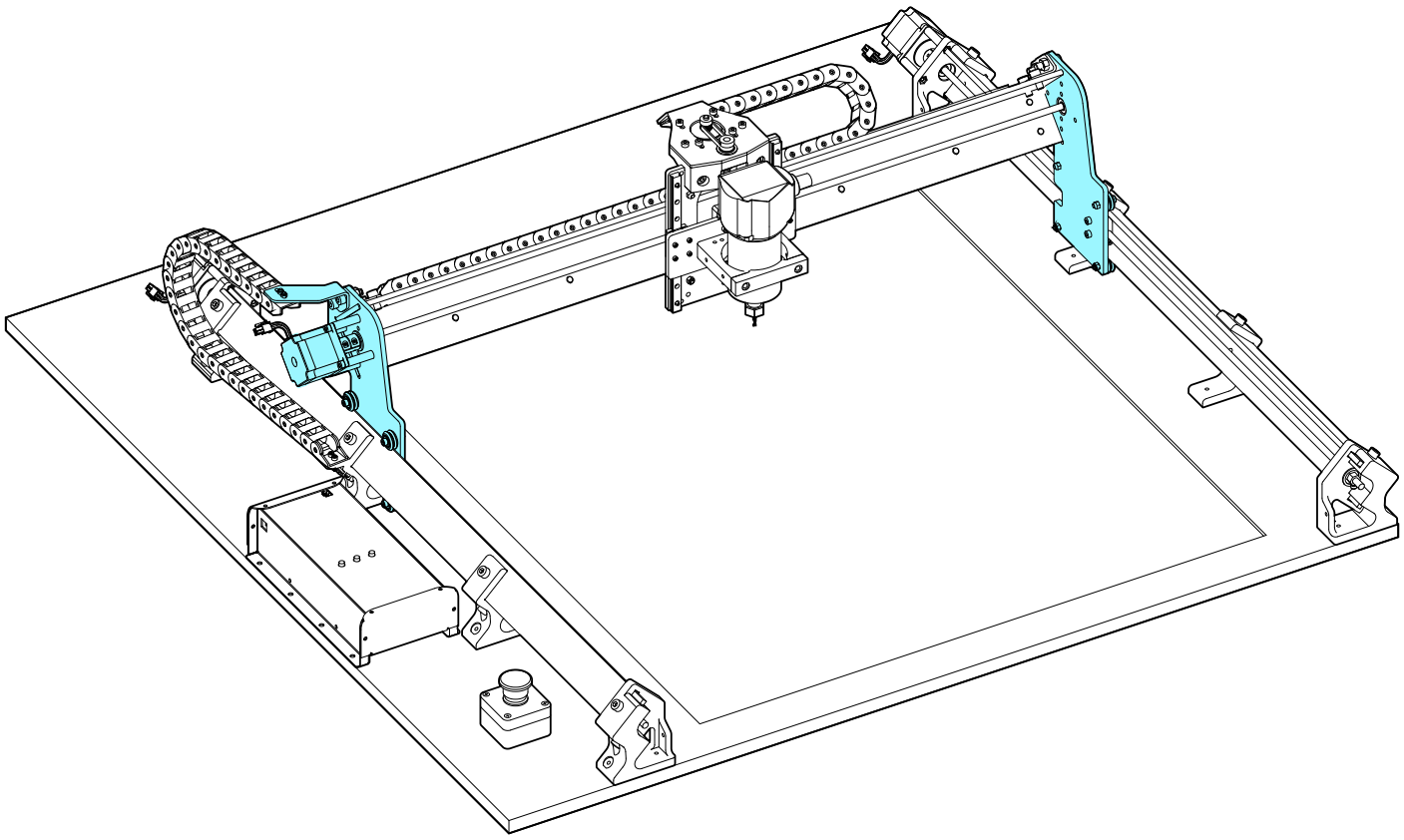
Use the four M5-25mm bolts to mount the router mount.

Your final assembly should look like this. Congrats, you've completed the assembly of the XZ-Axis Gantry!

That was fun, wasn't it?

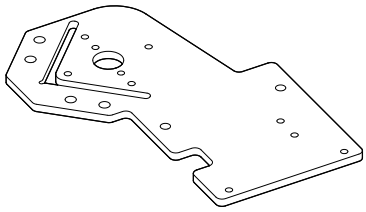
Part 2

Y-Axis Gantries



Y-axis gantries (wheels)

Parts Needed:



x2

Y-axis gantries

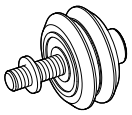
x4

Eccentric nut

x4

M5-nylock nut

Previously Assembled

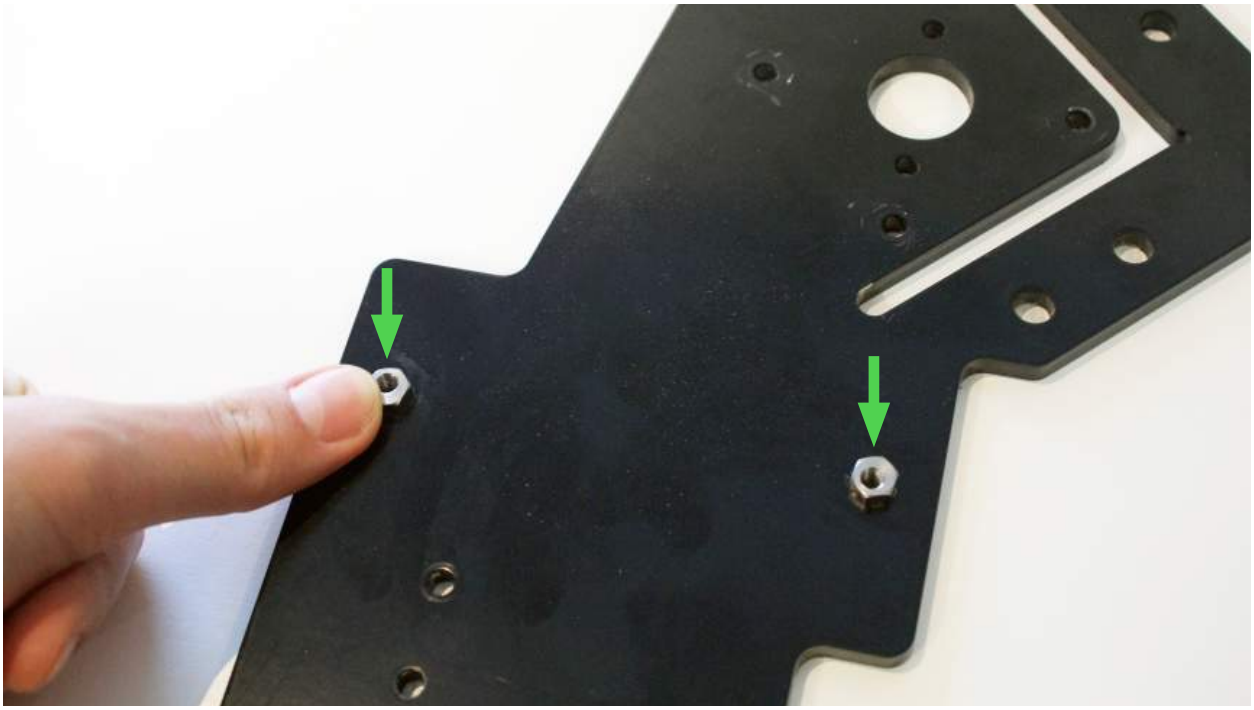


x8

V-wheel set

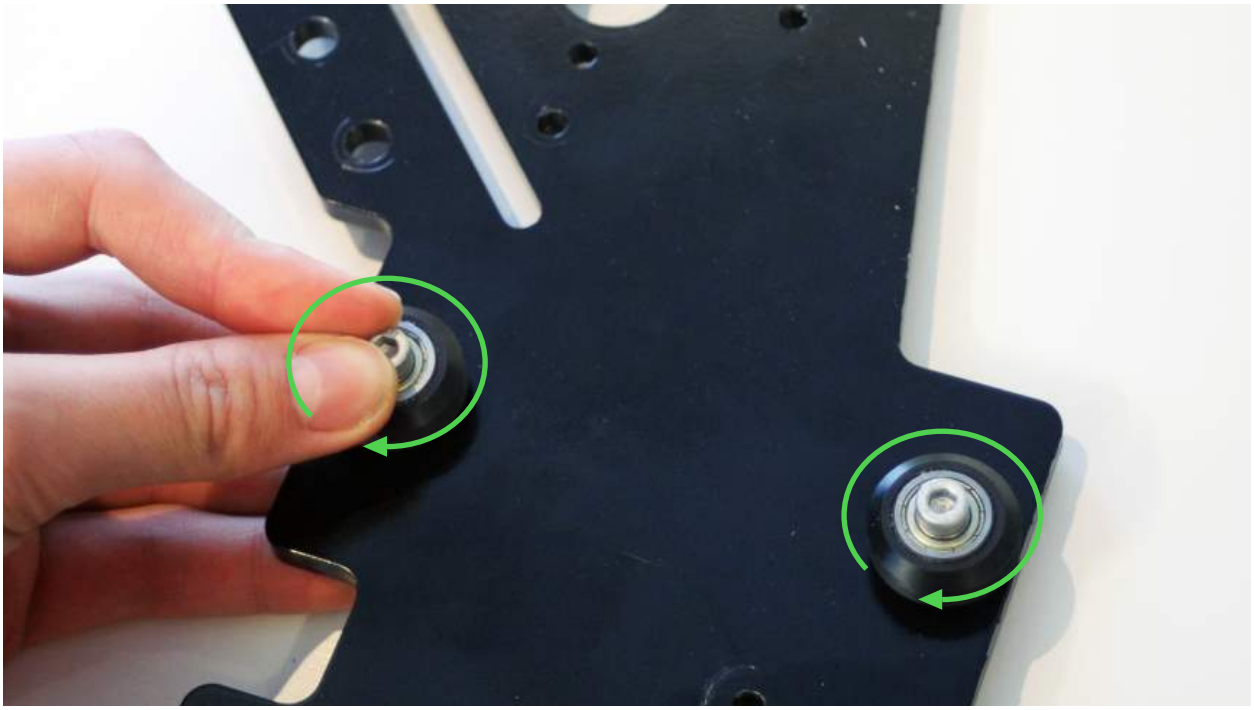
Grab the Y-axis gantries (wrapped in paper) and you'll see four holes on each steel plate in a square formation. Add the wheel sub-assemblies to these holes just like how you did before, with the eccentric nuts placed as pictures and the nylock nuts on the two lower holes; make sure that one is assembled as the mirror of the other. Use a size 4 allen key and the included 8mm wrench to tighten everything down, but leave the eccentric nuts slightly loose for now.

If you have a hard time getting the eccentric nuts in, we recommend tapping the nuts in with the back of a screwdriver or other dull object. This will help clear the excess paint that might still remain in the hole.



Install the eccentric nuts into the top two holes.

V-wheel sets with a washer to keep the v-wheel spaced from the gantry plate



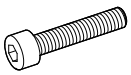
Fasten the wheels to the eccentric nuts, leave these slightly loose for now

Assemble the bottom two wheels with M5-nylock nuts and tighten all the way

Make sure you have both plates done, but with the wheels on opposite sides.

Y-axis gantries (anti-backlash)

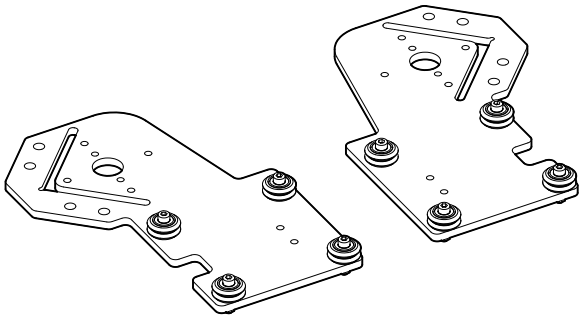
Parts Needed:



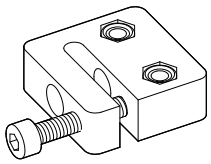
x4

M5-25mm bolt

Previously Assembled



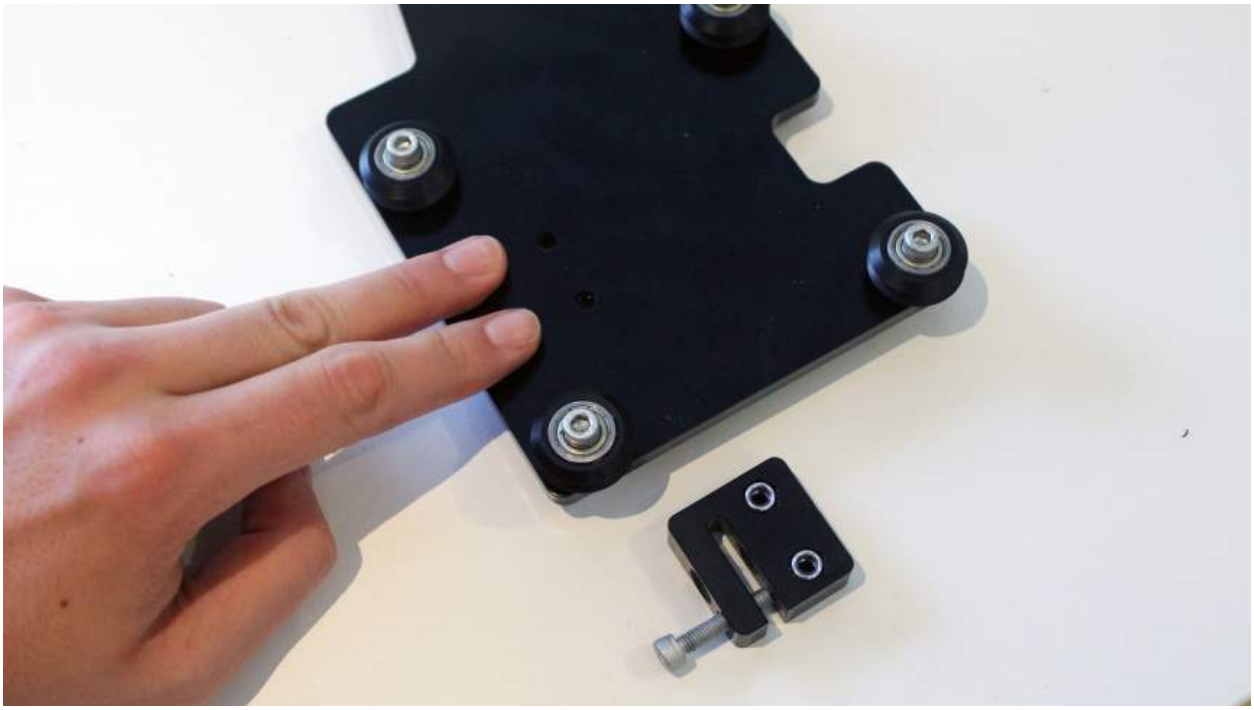
Y-axis gantries (with wheels)



x2

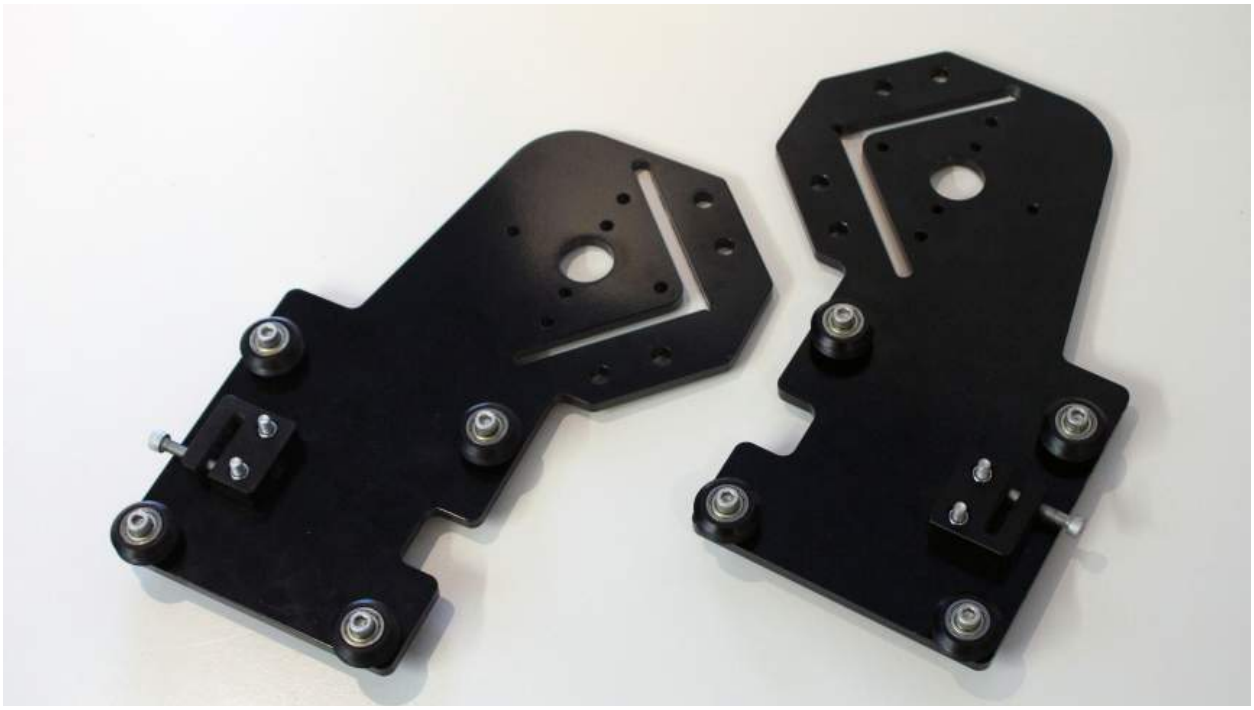
Anti-backlash assembly

On the Y-axis plates, there are two holes for the anti-backlash assemblies to mount. Line up the plastic blocks and secure them to the plate using the same medium-sized bolts that were used for the wheels. The blocks should be mounted on the same side as the v-wheels, and have the tensioning screw facing outwards.



The Delrin nuts go on the same side as the v-wheels do.

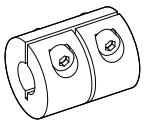
Tighten until snug. Don't overtighten!



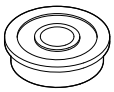
Both sides should be mirrored.

Mounting the X-axis motor to the left plate

Parts Needed:

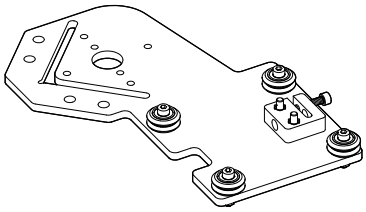


6.35mm to 8mm coupler



608ZZ flange bearing

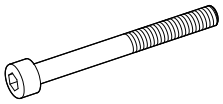
Previously Assembled



Left Y-Axis Gantry

x4

35mm aluminum spacer

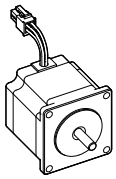


x4

M5-50mm bolt

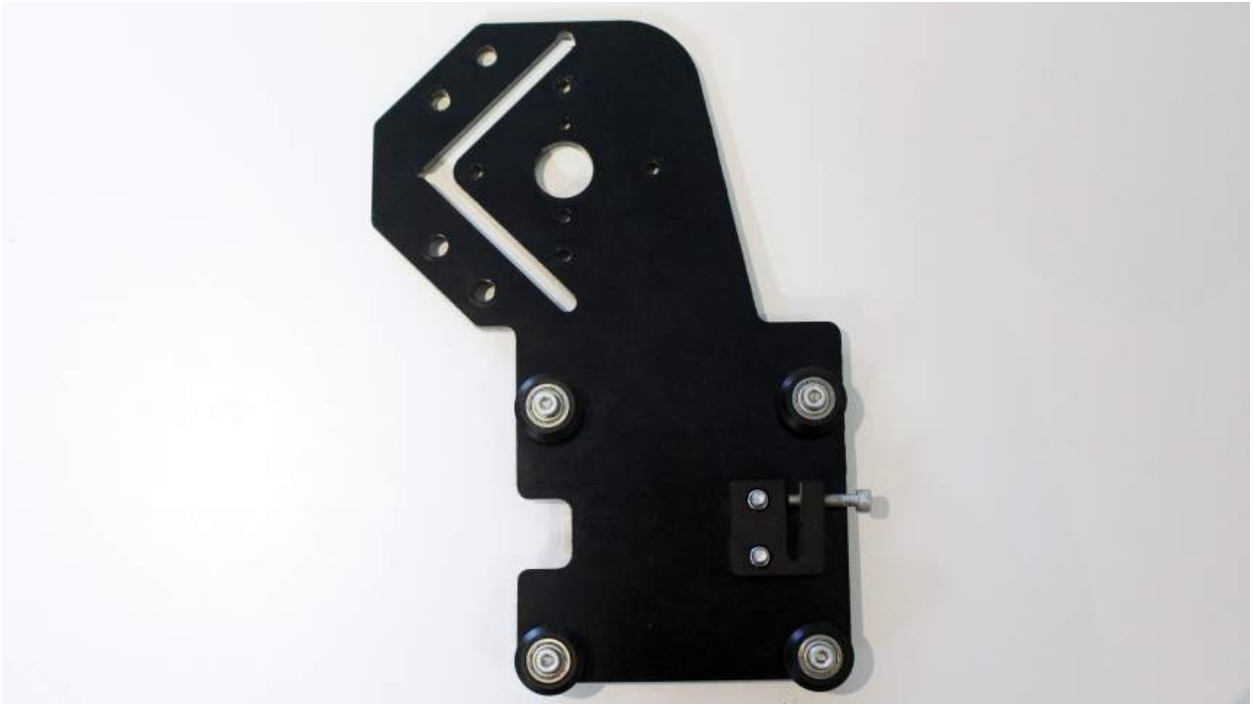
x4

M5-nylock nut

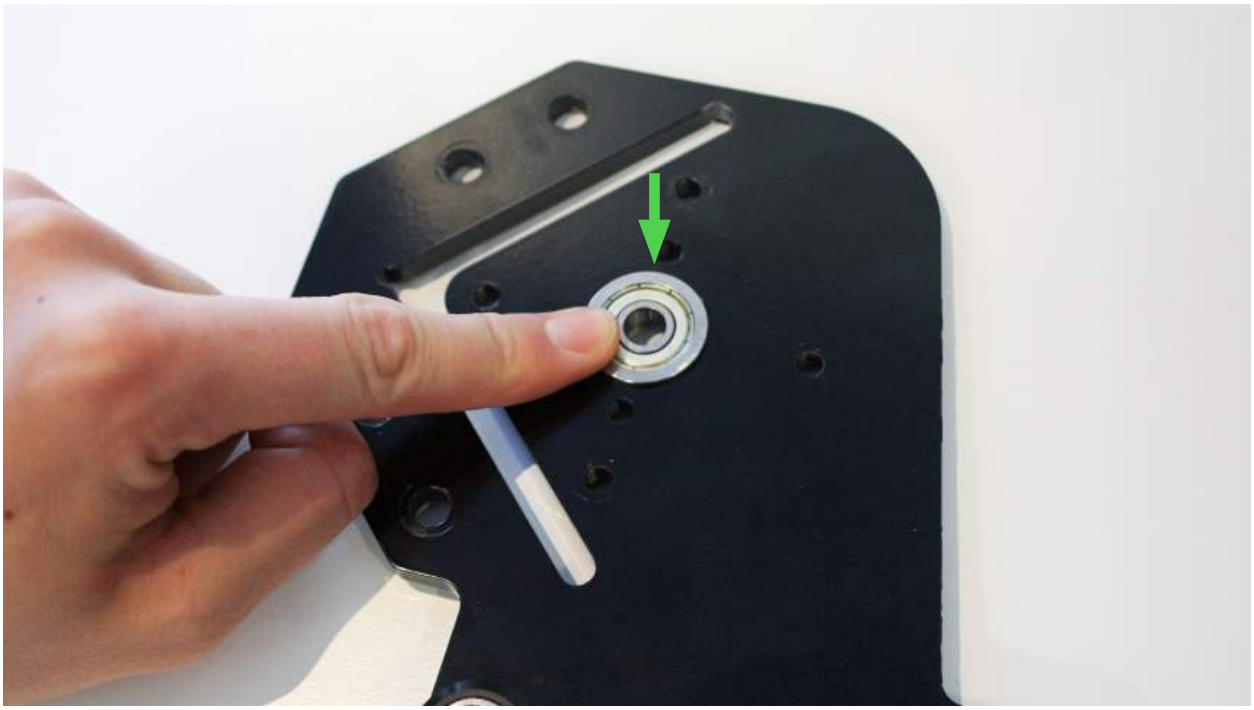


NEMA 23 motor

Make sure you have grabbed the correct gantry (pictured below).

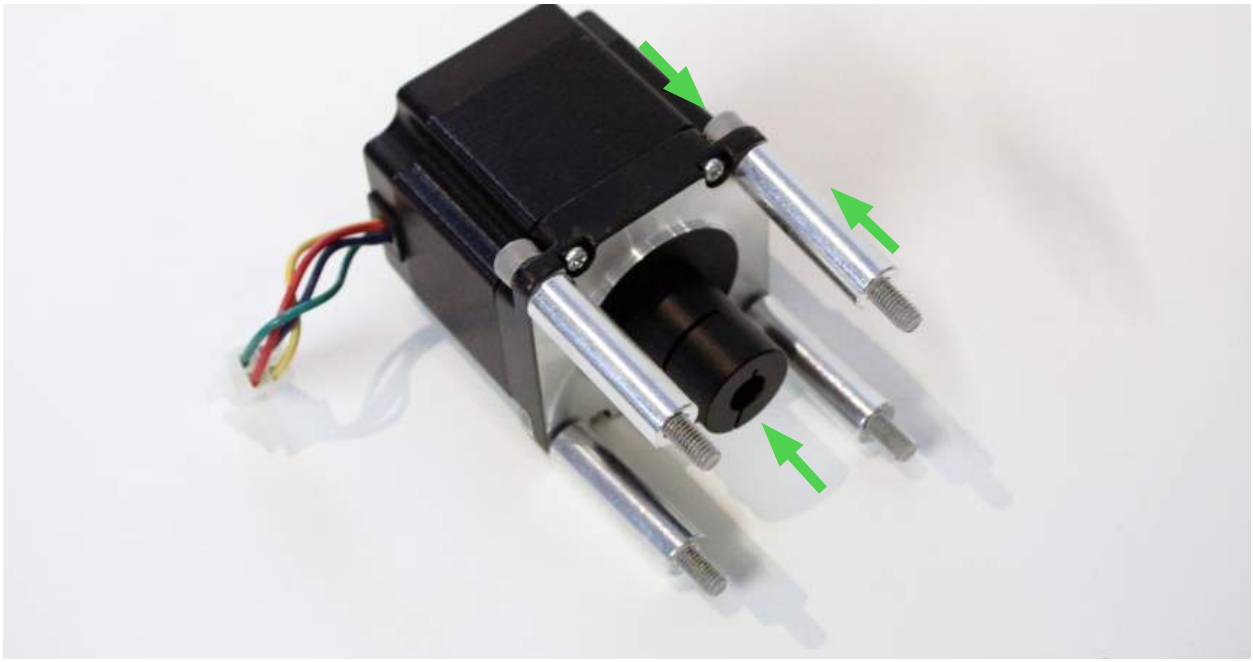


We will put a 608ZZ flange bearing into the hole.



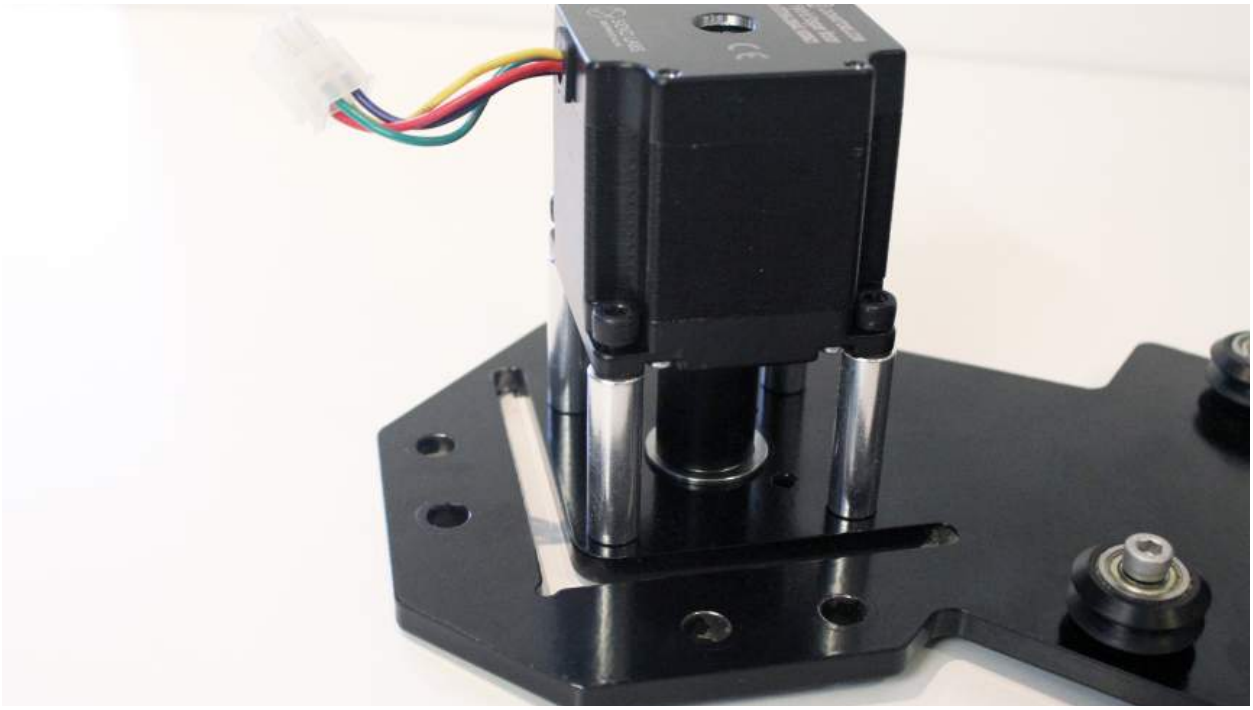
Get a motor, the M5 nylock nuts from before, and the bag of long bolts (M5-50) and aluminum spacers from the orange bag. You will also need a coupler and bearing for this assembly, found in the green bag.

Start off by sliding the coupler onto the motor shaft, making sure you have the smaller hole sliding onto the shaft and the larger hole facing out. You may have to loosen the set screws on the coupler if it doesn't slide on easily. Then put the long M5 bolts onto the motor, followed by the spacers.

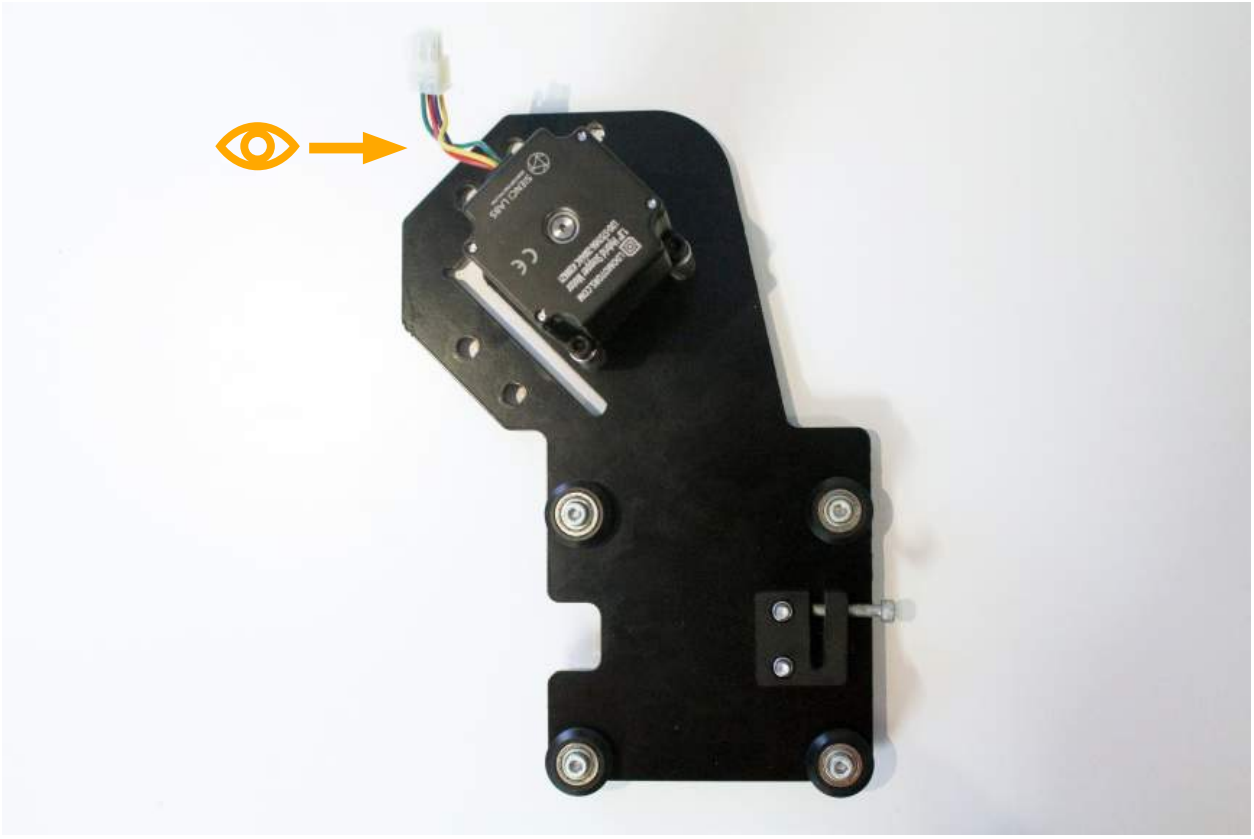


Attach the coupler, spacers, and M5-50mm bolts to the motor.

Carefully line up the screws into the four holes in the Y-axis gantry. Drop the motor, bolts, and standoffs into place. Take note of the position of the white motor connector in terms of its rotation and what side of the plate you are mounting it onto (the side with the wheels).

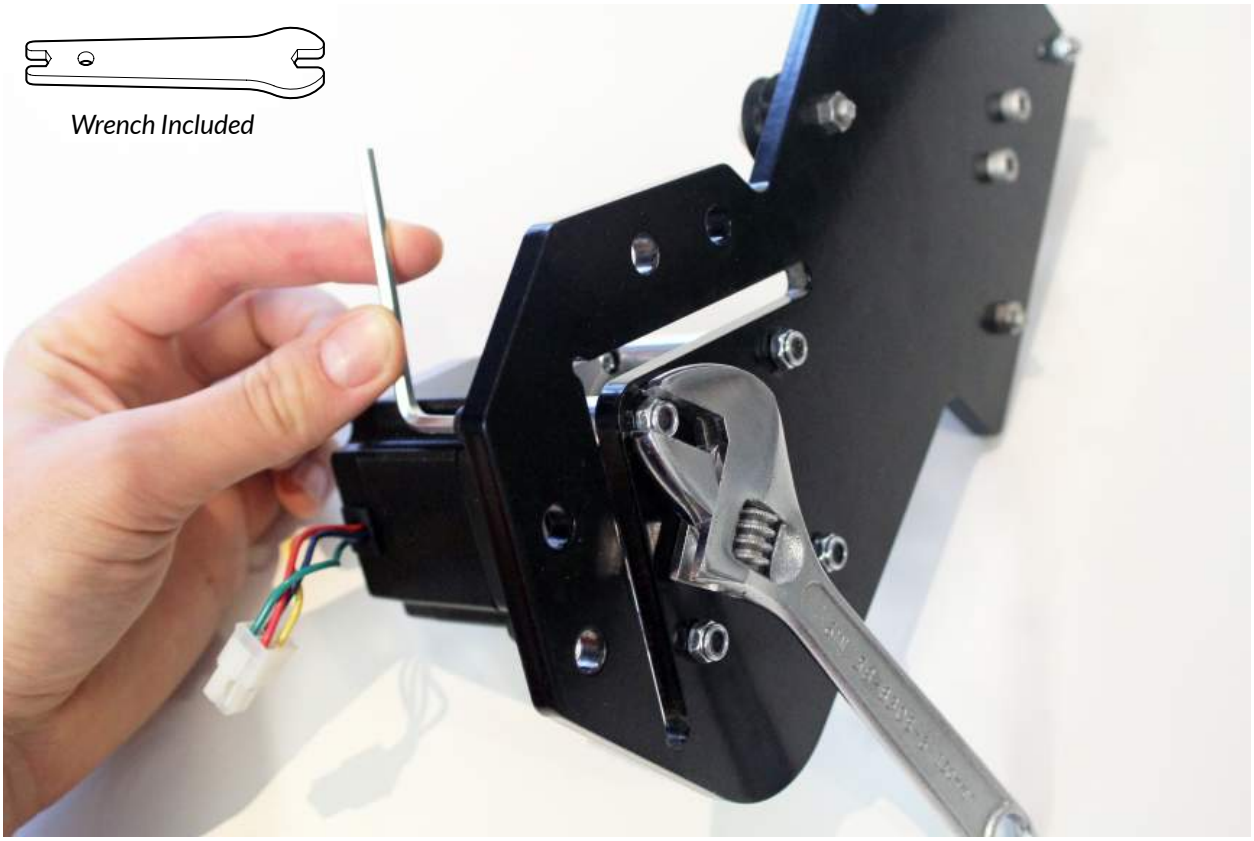


Attach motor using M5 nylock nuts.

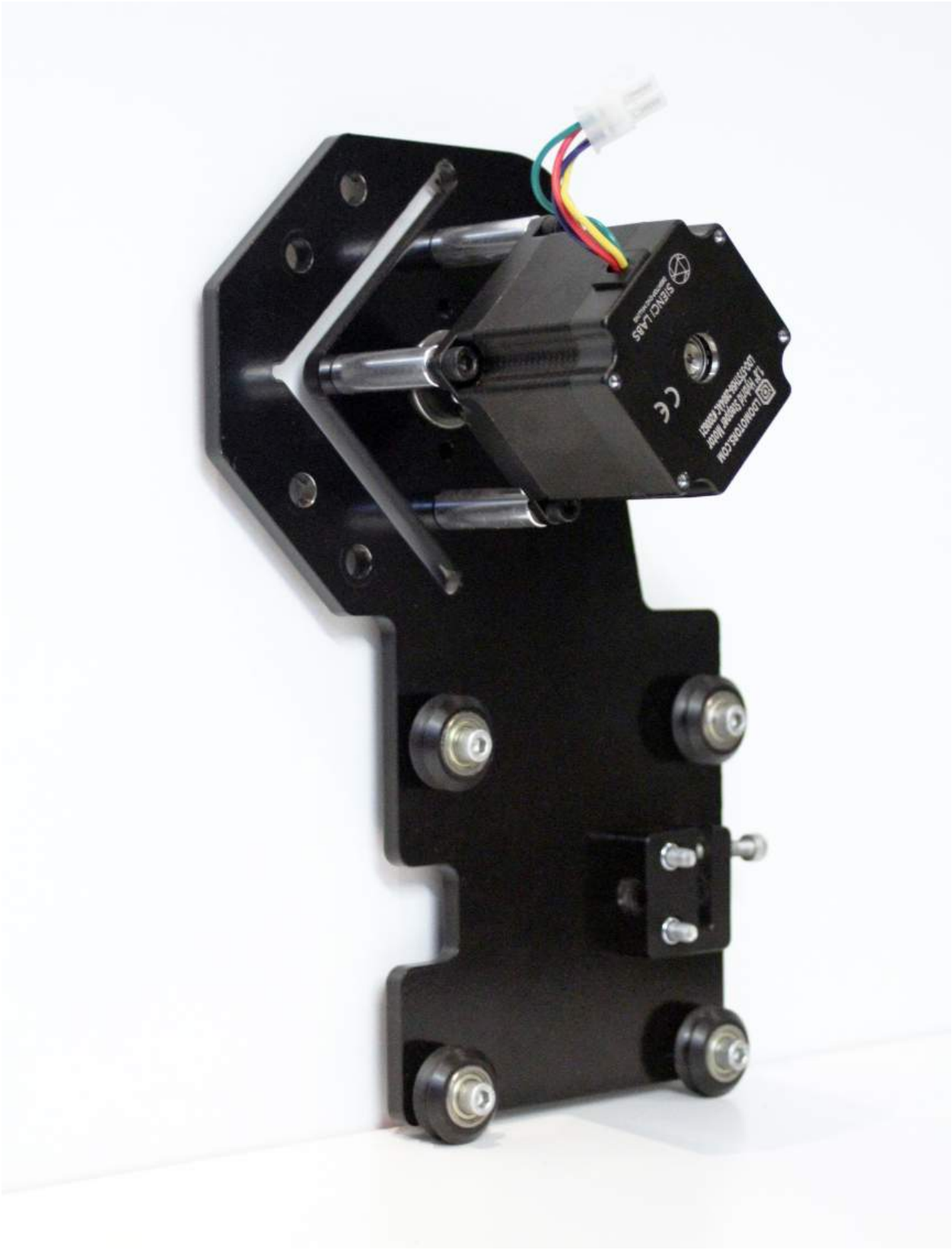


Take note of the direction of the motor cable bundle.

Use the four M5-nylock nuts to secure the plate-side of the M5 bolts. This requires a size 4 Allen key and the 8mm wrench. If it's easier, start by finger-tightening all four nuts to keep everything in place before using the pliers to finish tightening.

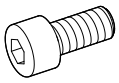


Once everything is finished getting put together, it should look like this:



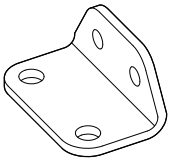
Attaching the shoulder brackets

Parts Needed:



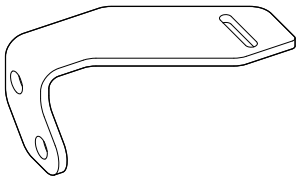
x8

M8-16mm bolt



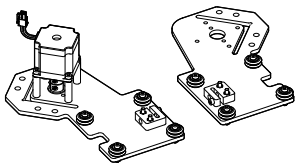
x4

Shoulder brackets



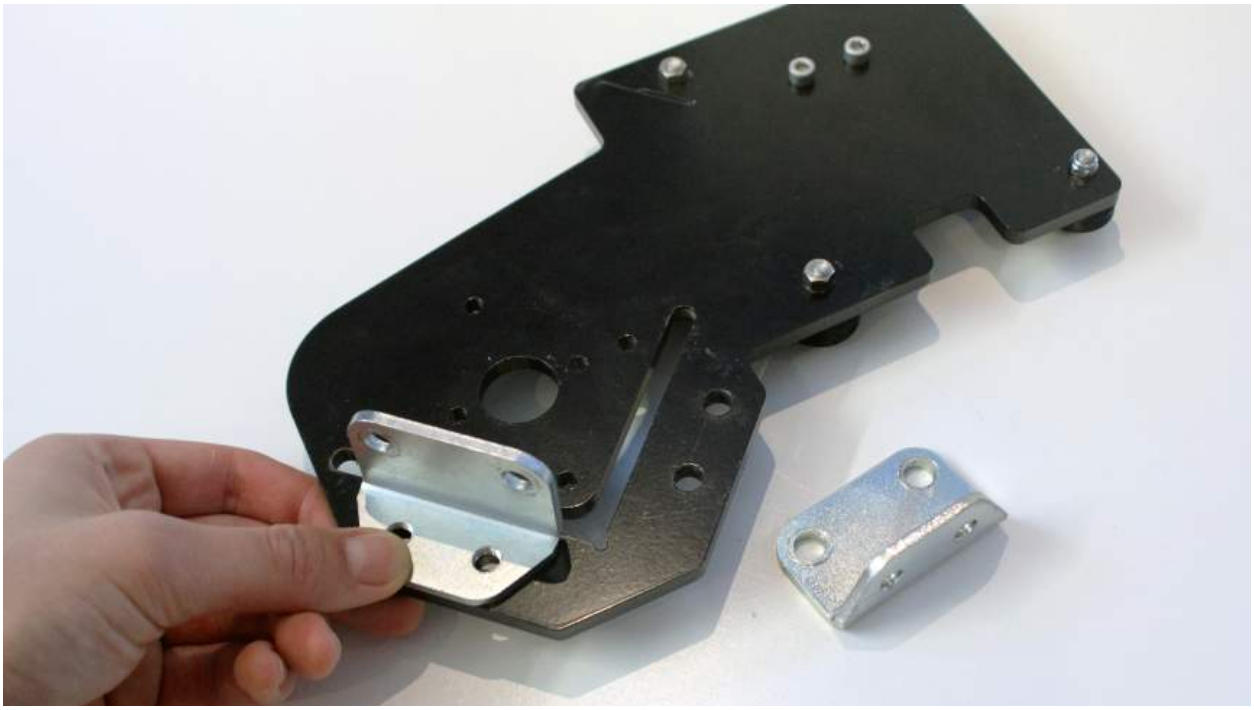
Drag chain mount

Previously Assembled

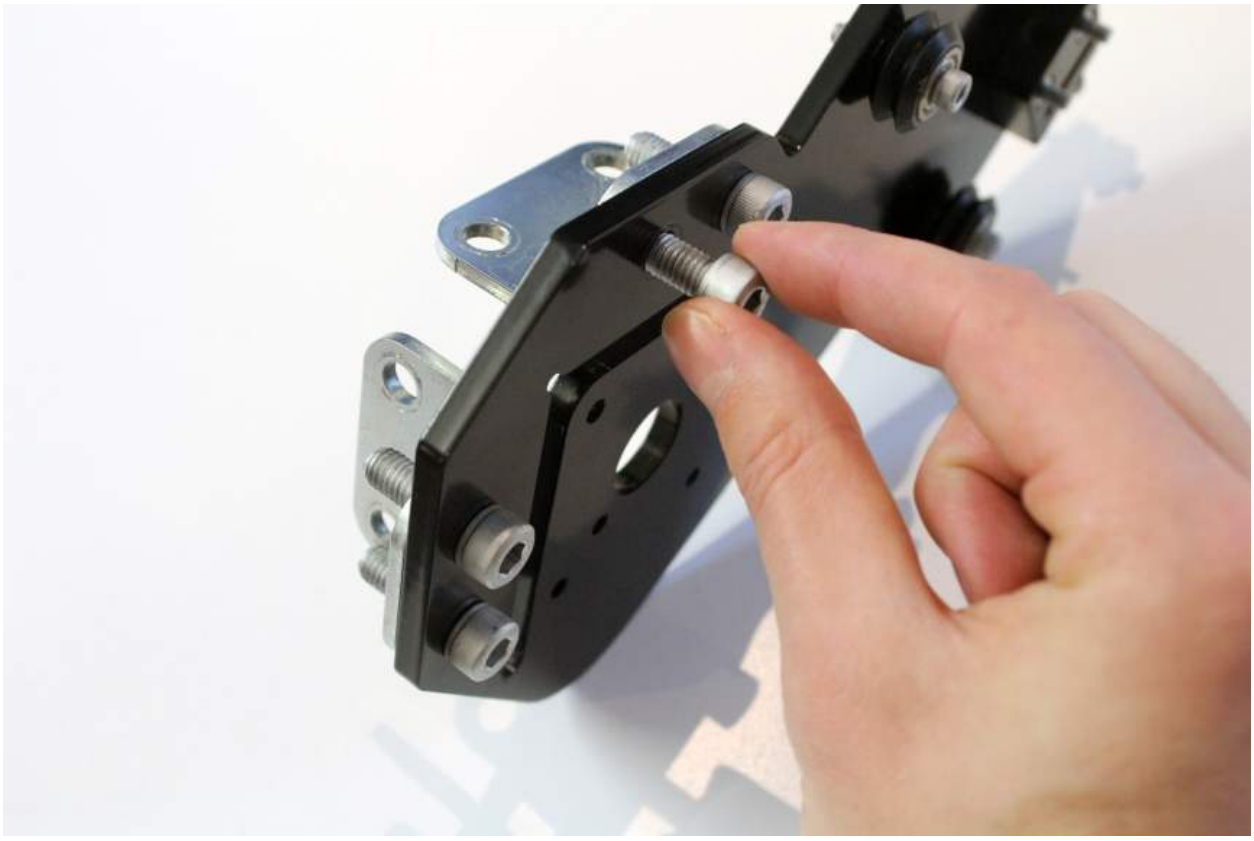


Y-axis gantries

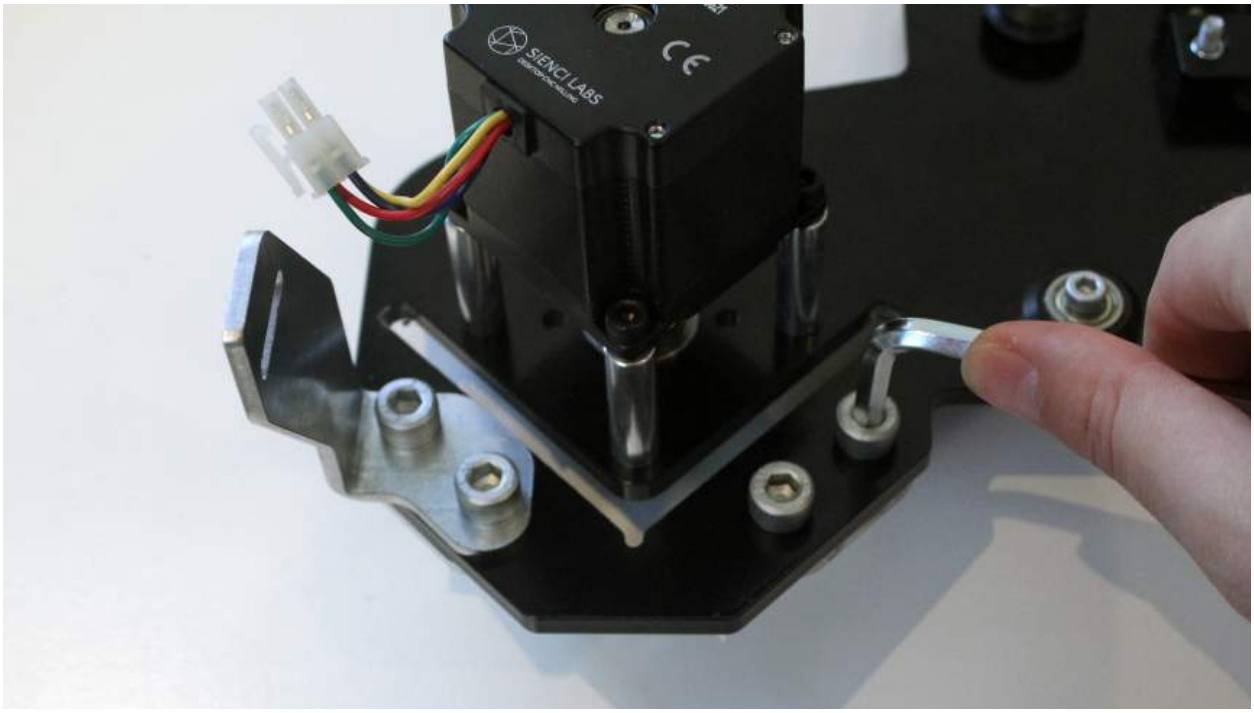
Get the four steel L-shaped ‘shoulder’ parts and the from the green box of plastic parts next. These attach two to each gantry using the M8-16mm bolts from the orange bag. Line the tapered sides of the brackets up against the edge of the inside face of the gantries (pictured) and then mount them in place using two bolts each. Start by turning them by hand and then finish securing them with a size 6 Allen key.



Make sure to point the bracket in the right direction.

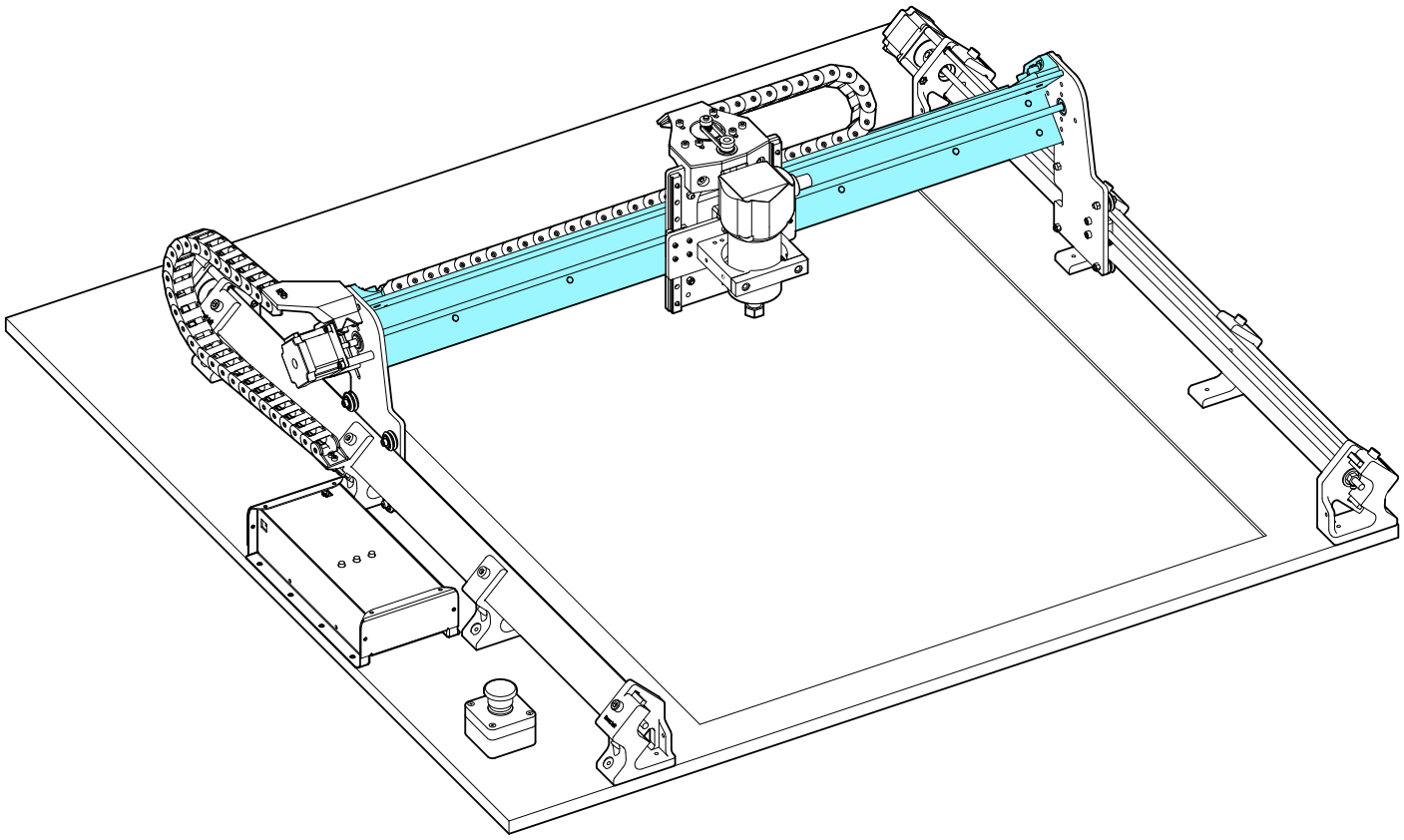


Do the same for the gantry with the motor, but this time adding the steel drag chain mount on the side with the bolt heads.



Part 3

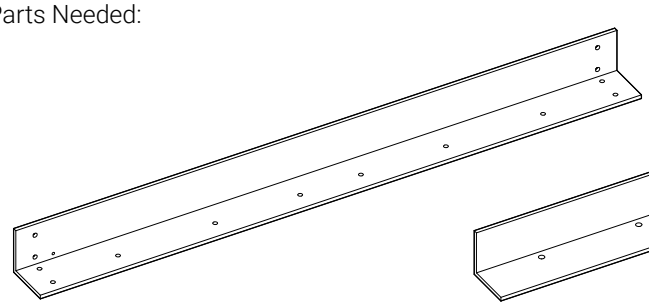
X-Axis Rail



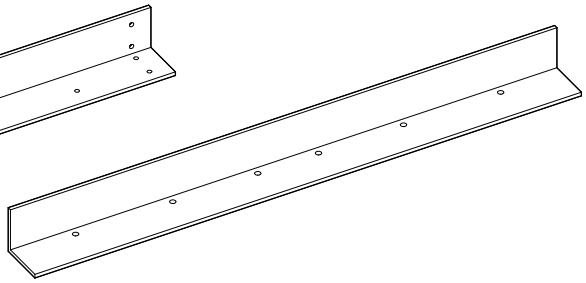
Preparing the X-axis rail

Note: The 12×12 LongMill is a smaller build envelope so it doesn't require an X-axis reinforcement bar. Move onto the next step "Attaching the Shoulder Brackets", but keep in mind that the remaining pictures may show another piece of angled aluminum attached to the back of the X-axis rail. Pay no mind to this since the assembly process is otherwise the same.

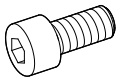
Parts Needed:



X-axis rail



Rail reinforcement

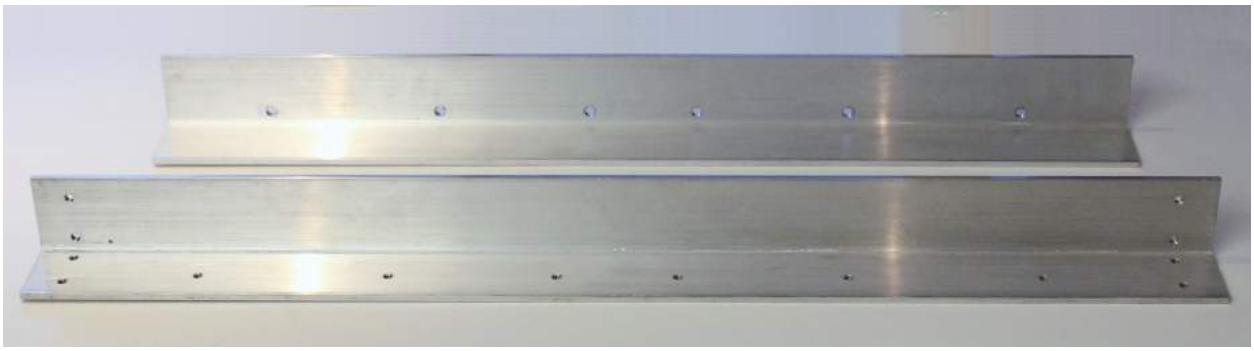


x6

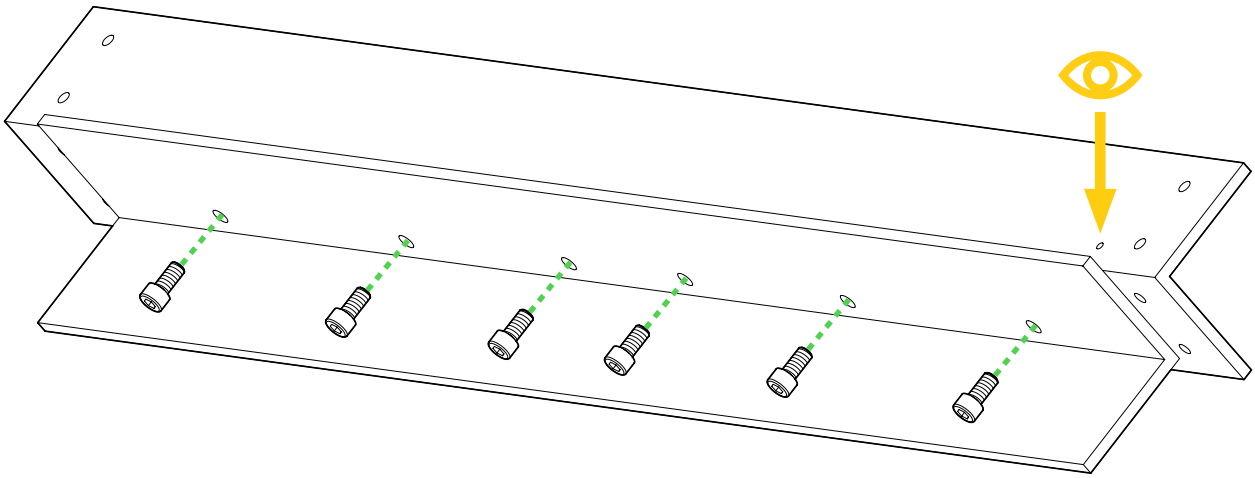
M8-16mm bolt

The 12×30 and 30×30 model LongMills use a second aluminum extrusion as a reinforcement bar to make the primary rail on the X-axis more rigid. These are the two longest and largest aluminum lengths on your machine and can be found in the heaviest long box alongside the other rails.

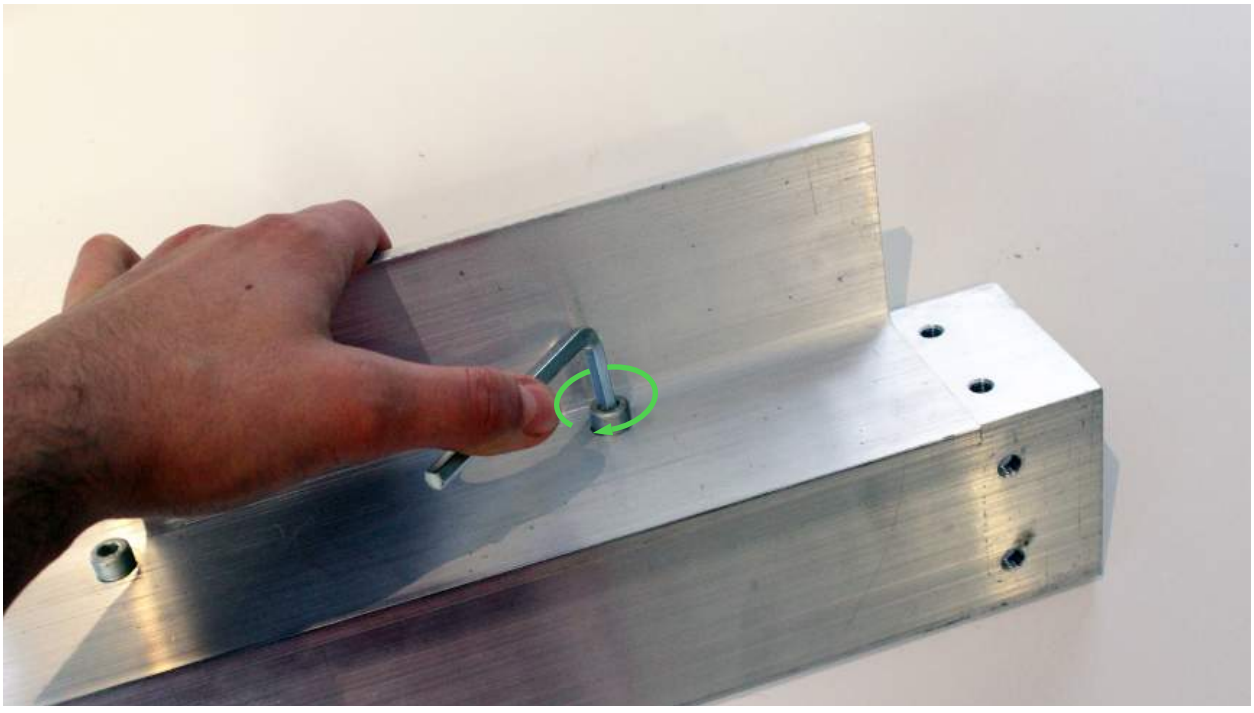
Of the two, the longer one is the X-axis rail and the shorter one is the reinforcement. You can also distinguish the two since the X-axis rail has sets of four threaded holes at its ends.



Start by orienting the rails into a ‘lighting bolt’ pattern like in the photo so that the set of six holes on both can be aligned. Also, make sure to check that the small threaded hole on the X-axis rail (yellow) is oriented as shown so that you’ll be able to attach your drag chain later on.



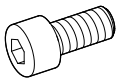
Grabbing the M8-16mm bolts from the orange bag, you can use six of these to fasten these parts together; the bolts will go through the larger holes on the reinforcement bar and thread into the X-axis rail from the back (pictured). Start by turning each of these short M8 bolts in by hand to get all the holes aligned, then go back and tighten each of them down well with a size 6 Allen key.



Your completed rail should now look something like this.

Sandwiching the rail with the Y-gantries

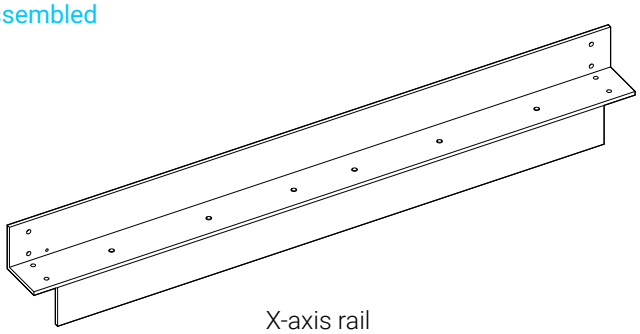
Parts Needed:



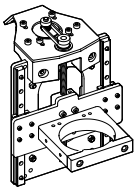
x8

M8-16mm bolt

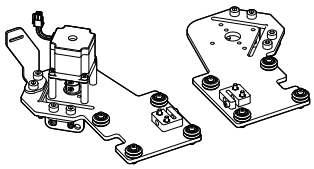
Previously Assembled



X-axis rail



XZ-axis gantry assembly



Y-axis gantries

After the previous step, you should now have four major assemblies completed: the XZ-axis gantry, the two Y-gantries, and the X-axis rail. These assemblies will all be coming together in this step, starting by sliding the XZ-axis gantry assembly onto the X-axis rail.

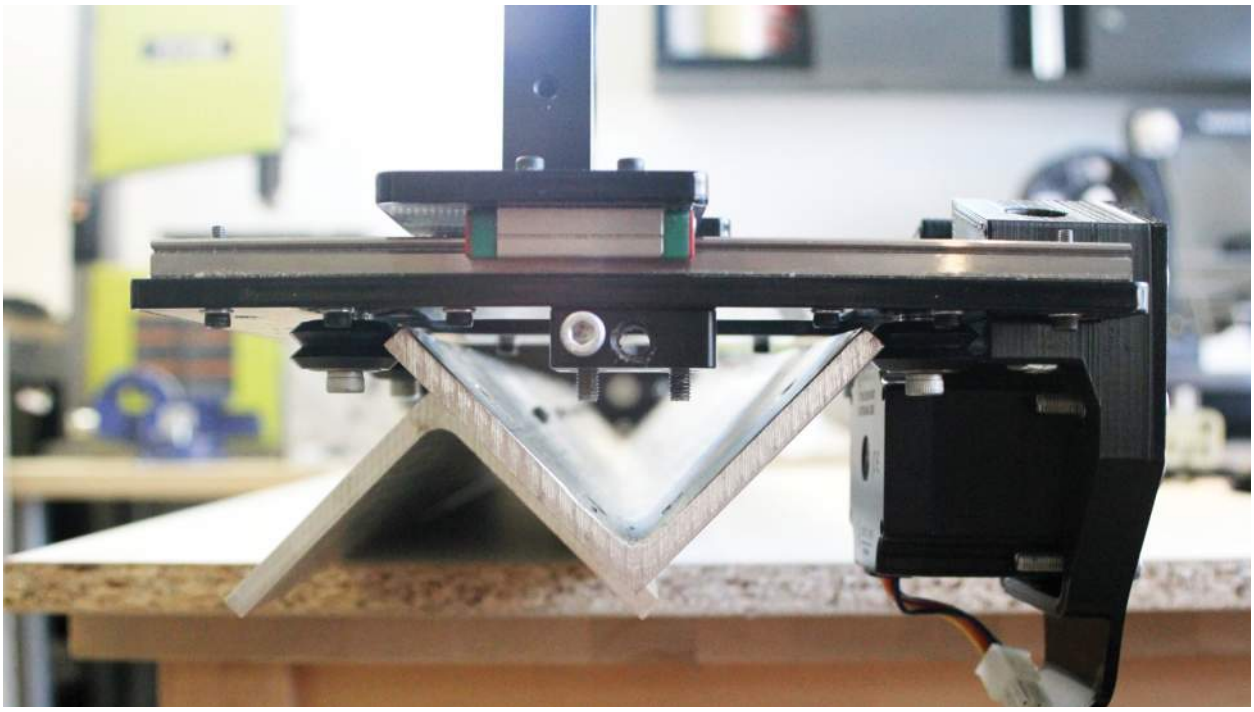
DO NOT stand the completed assembly up on the v-wheels, it can roll away or become unbalanced which may cause it to fall and become damaged; just leave it laying on its back for the next steps. You can consider propping it up at an angle as well if you don't want the weight of the assembly pressing on the back of the Z-axis motor mount.

Before we start, you want to make sure that the eccentric nuts on the XZ-gantry are positioned correctly; this can be checked visually. Since the eccentric nuts have an offset hole point, rotating the nut will change the hole position. Looking at the gantry assembly from the front, this pictures shows the top, right eccentric nut at its lowest position. This puts the v-wheel closest to the bottom v-wheel, making the wheel spacing too narrow to install onto the X-axis rail.

Below, the eccentric nut is in its highest position. This spreads the v-wheels furthest apart, making it easy to slide the gantry on. This is how you want your eccentric nuts to be oriented to proceed with the assembly. This should also demonstrate the concept of how these eccentric nuts can be used to 'clamp' the v-wheels onto the aluminum rail in order to have rolling movement along the rail while still being rigid in other directions.

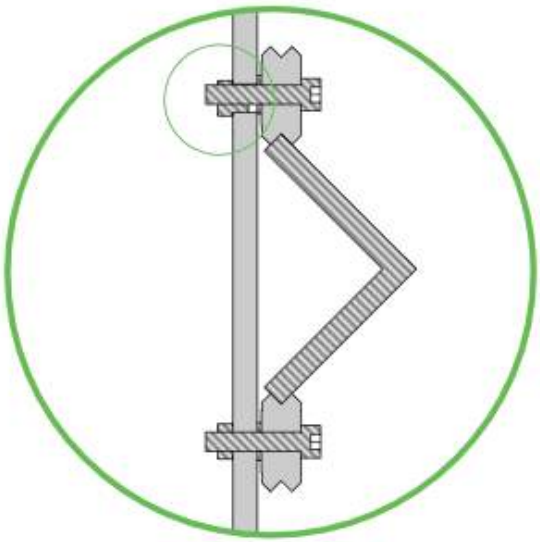
To adjust the eccentric nuts, you'll have to make sure that the bolts on the v-wheels are still loose, then you'll be able to use an 8mm wrench or a pair of pliers to rotate the nut into the correct position. Once the eccentric nut is where you want it, re-tighten the bolt with a size 4 Allen key to secure the nut into position. Do this for both nuts.

Lay the X-axis rail down along its length with the inside of the 'L' shape facing you and the small, tapped hole oriented to your left. Now take the XZ-axis gantry and slide it onto the rail.



XZ-axis gantry being slide onto the X-axis rail from the right-hand side

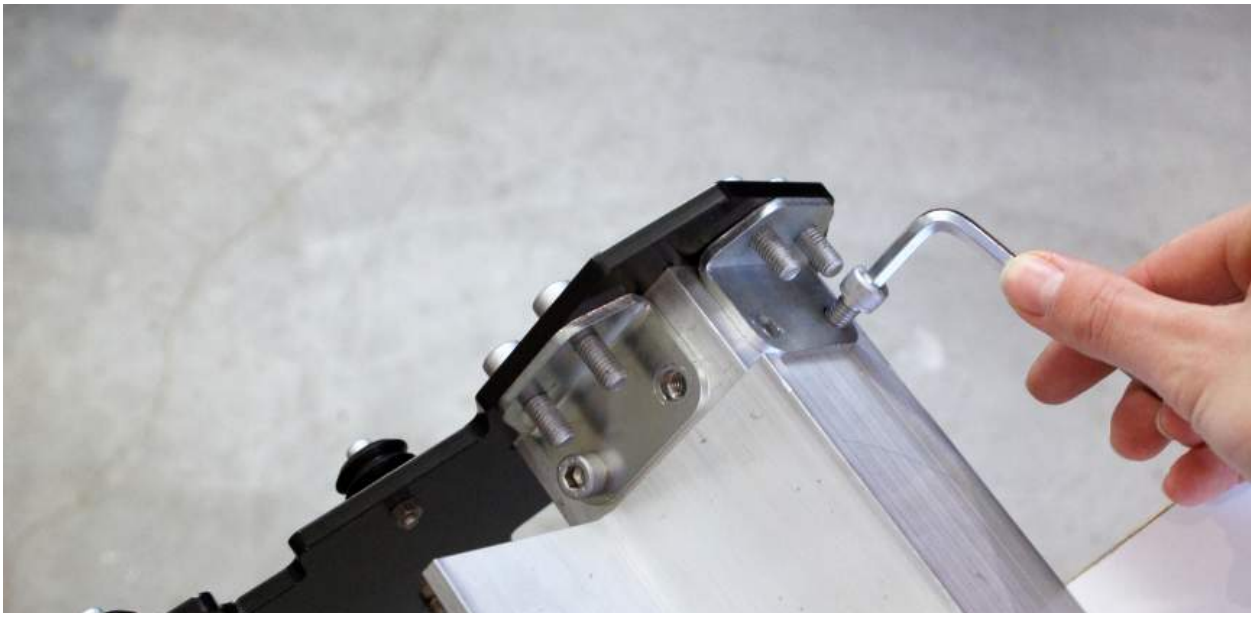
The v-wheels fit over the aluminum rail as pictured below. Check that they are sitting on the rail in the correct fashion and make sure that they roll along the edge of the rail properly.



Now the eccentric nuts need to be tensioned in order for the v-wheels to properly hold onto the X-axis rail. This process is just like before when you widened the eccentric nuts, except now you want to rotate the nuts so that the v-wheels are brought closer together. Follow the process of loosening the v-wheel bolts with an Allen key, rotating the nut a small amount, re-tightening the bolts, and then checking the looseness of the wheels with your fingers. A properly tensioned system should roll smoothly along the rail but it should be difficult to use your fingers to turn the wheels by hand while the gantry is stationary.

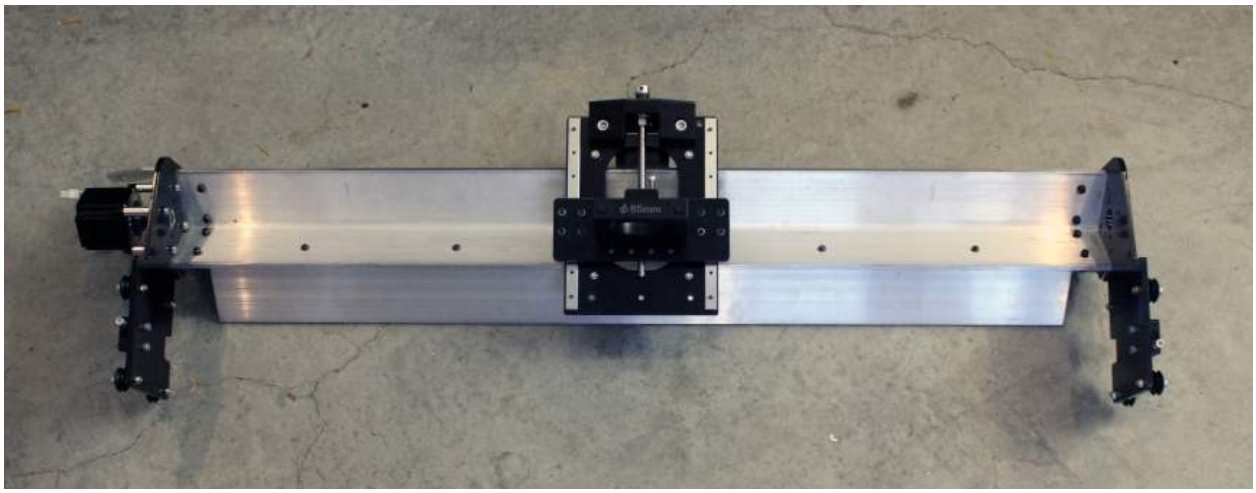
Next, we'll be putting the two Y-gantries onto each end of the X-axis rail. The orientation of each Y-gantry will be such that the wheels on the gantry will be facing towards the outside. Let's start with the right-hand side.

Line up the 'L'-shaped slot on the steel plate with the rail and tap the plate into place. It works best if you put the slot and the rail head-on so that the slot and the rail line up straight. Note that because of the variance of paint thickness in the slot, you'll chip some of it out as you mount the plate. These parts are a tight fit so that twisting in the X-axis can be kept to a minimum, so using a mallet and some coercion may be necessary but most importantly take your time.



Once you get the plate on, get the M8-16 bolts from the orange bag and use four of each to secure the steel brackets to the rail. Tighten the bolts down with a size 6 Allen key until snug.

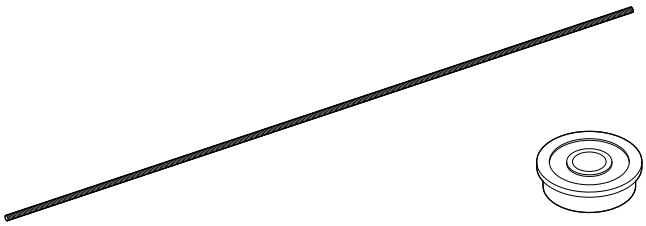
Repeat the same process on the other side, being careful not to cause damage to the motor or the drag chain mount in the process if you need to use some force.



Now that the larger X-axis assembly is done, this is what the completed assembly should look like!

Adding the power transmission components

Parts Needed:



Lead screw
(530mm or 1030mm)

608ZZ flange bearing

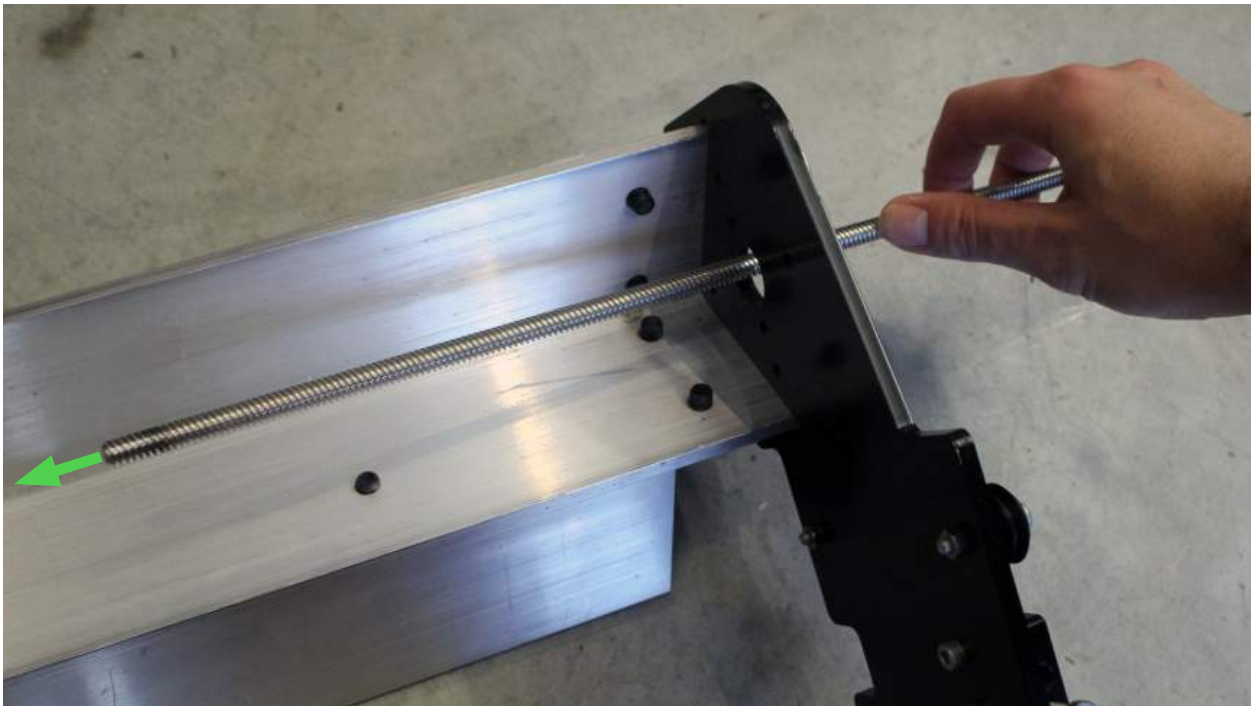
8mm washer

Previously Assembled

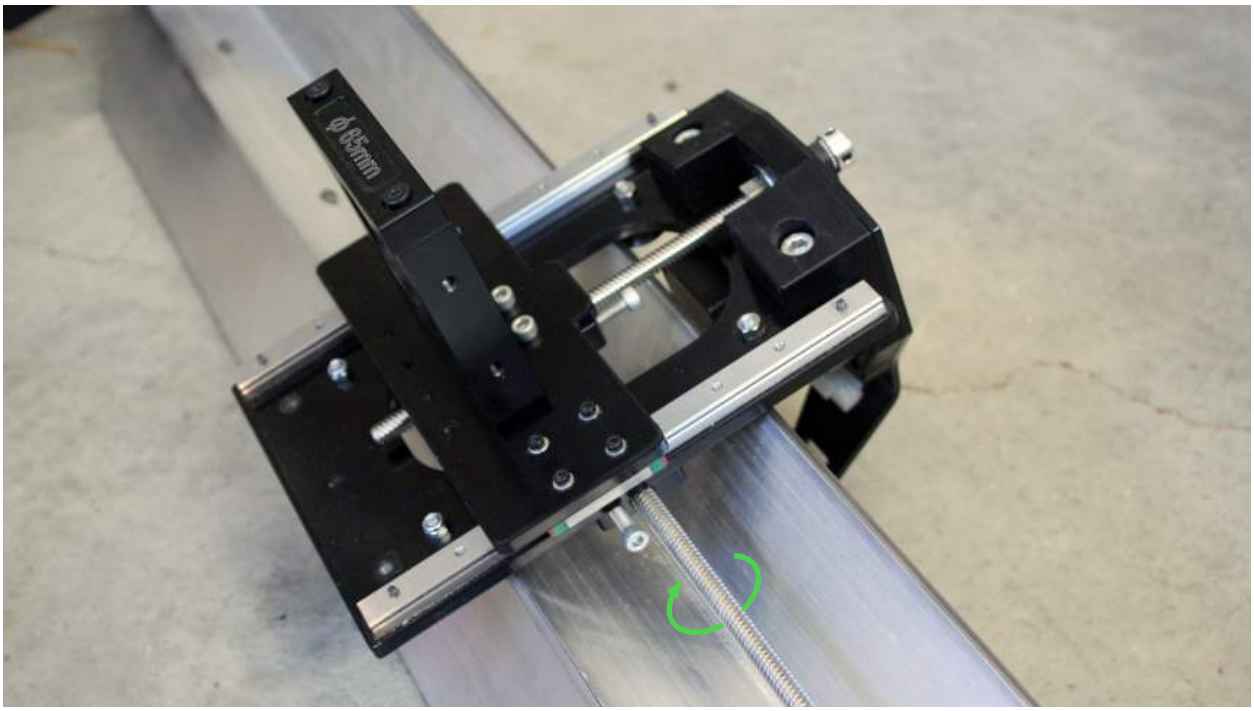
ACME locking nut
assembly

This step will attach the remaining components to the larger X-axis assembly.

Start by grabbing the lead screws which you set aside much earlier in the assembly. Your LongMill comes with three lead screws, not accounting for the earlier one which was used for the Z-axis. For the 12×12 and 30×30 they're all the same length and for the 12×30 the longer one is for this X-axis assembly. Get your lead screw and run it through the large hole on the right-side Y-gantry, threading it through the plastic block of the anti-backlash assembly as well.

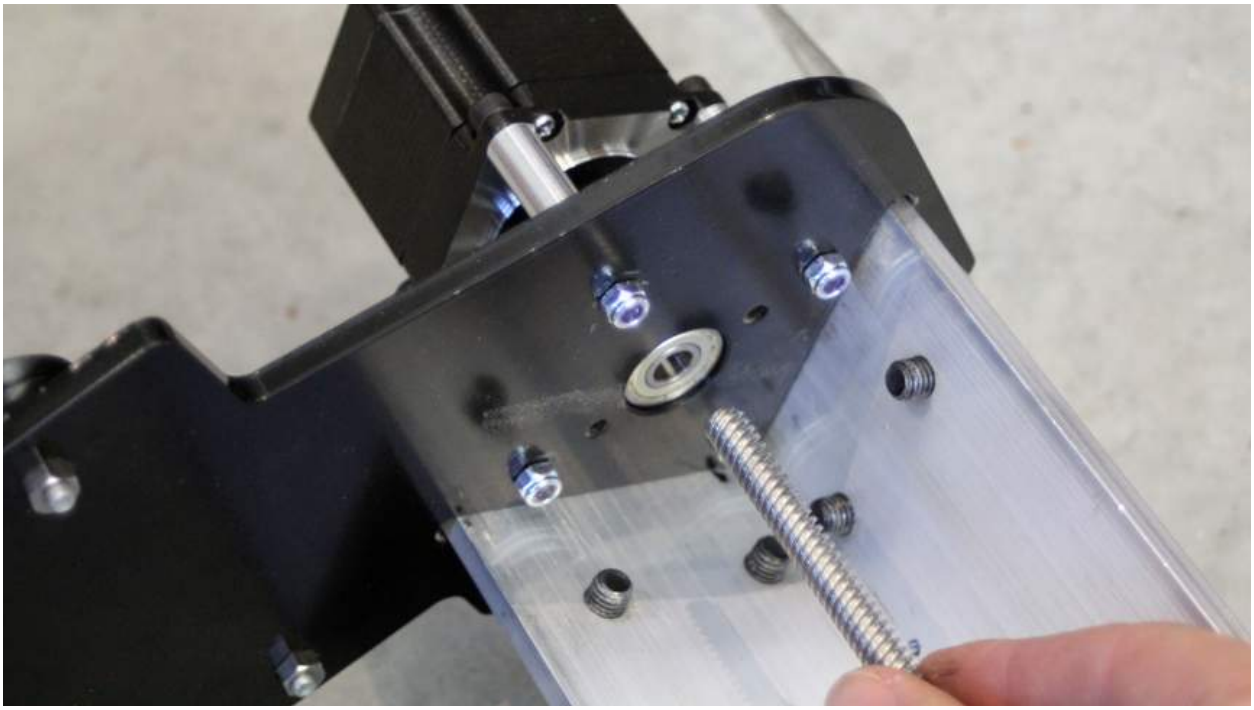


Slide the lead screw through the hole on the right side



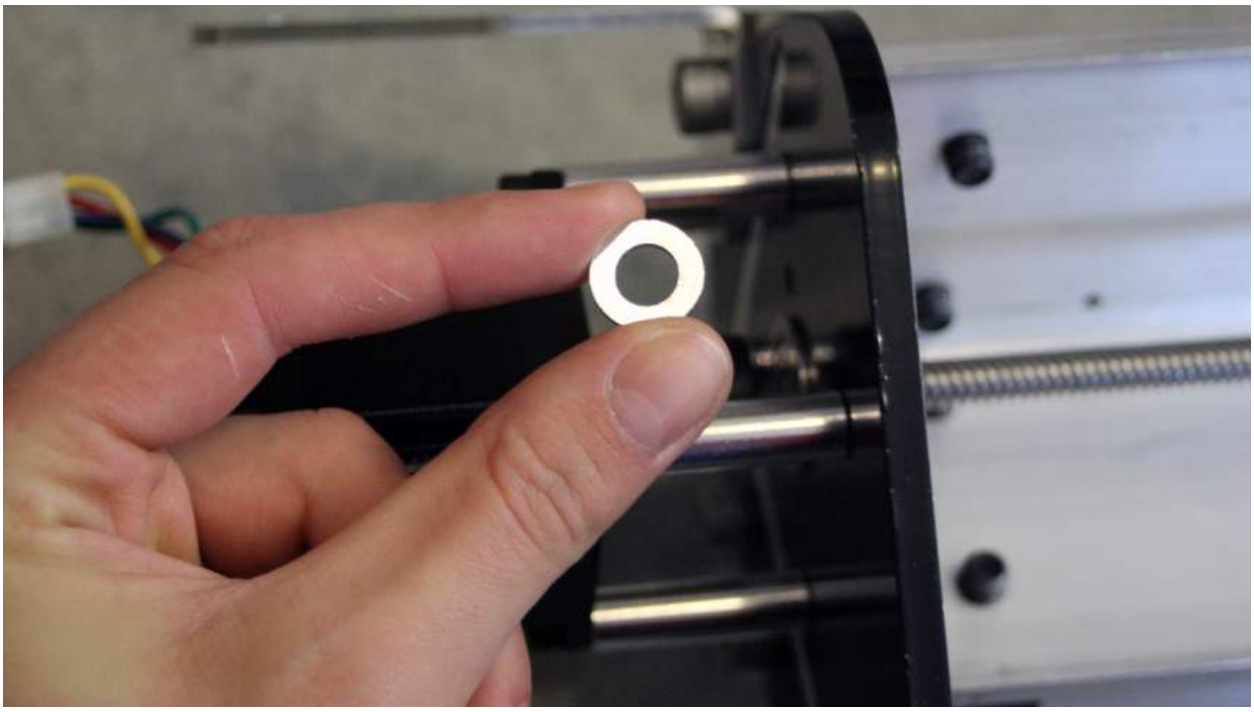
Turn the lead screw into the nut with your hand.

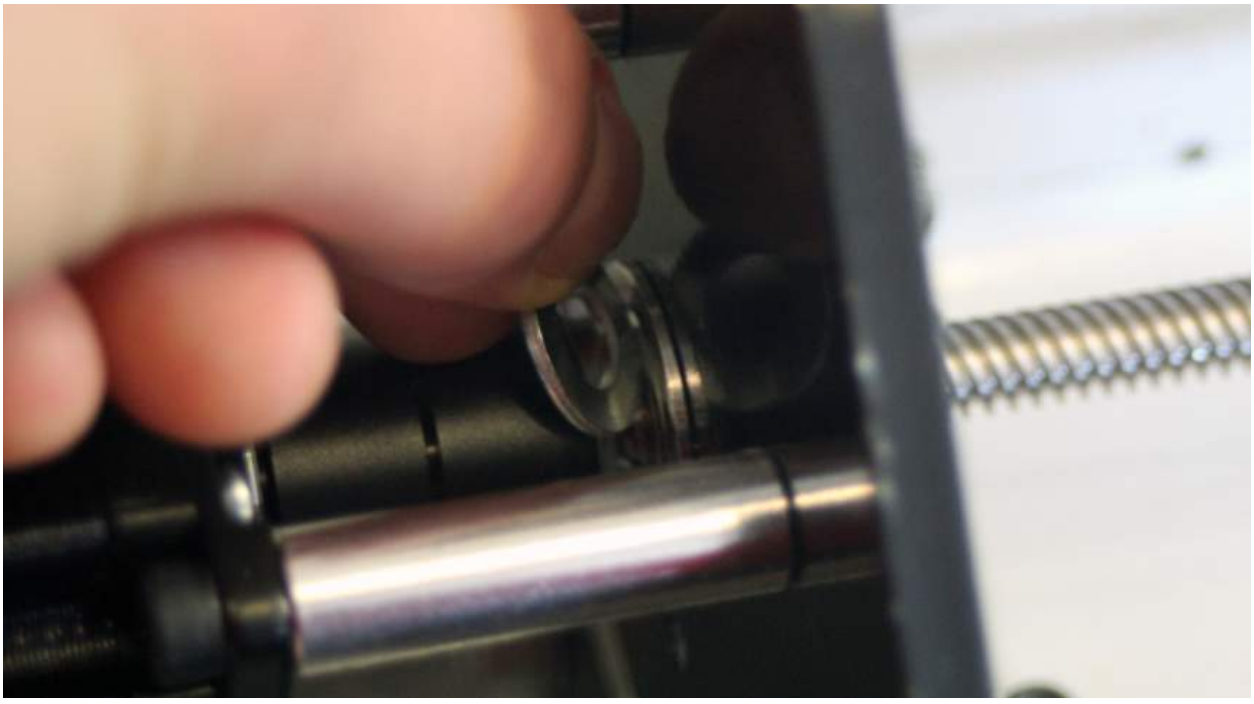
Push the lead screw into the opposite bearing. Dont push it all the way into the coupler just yet.



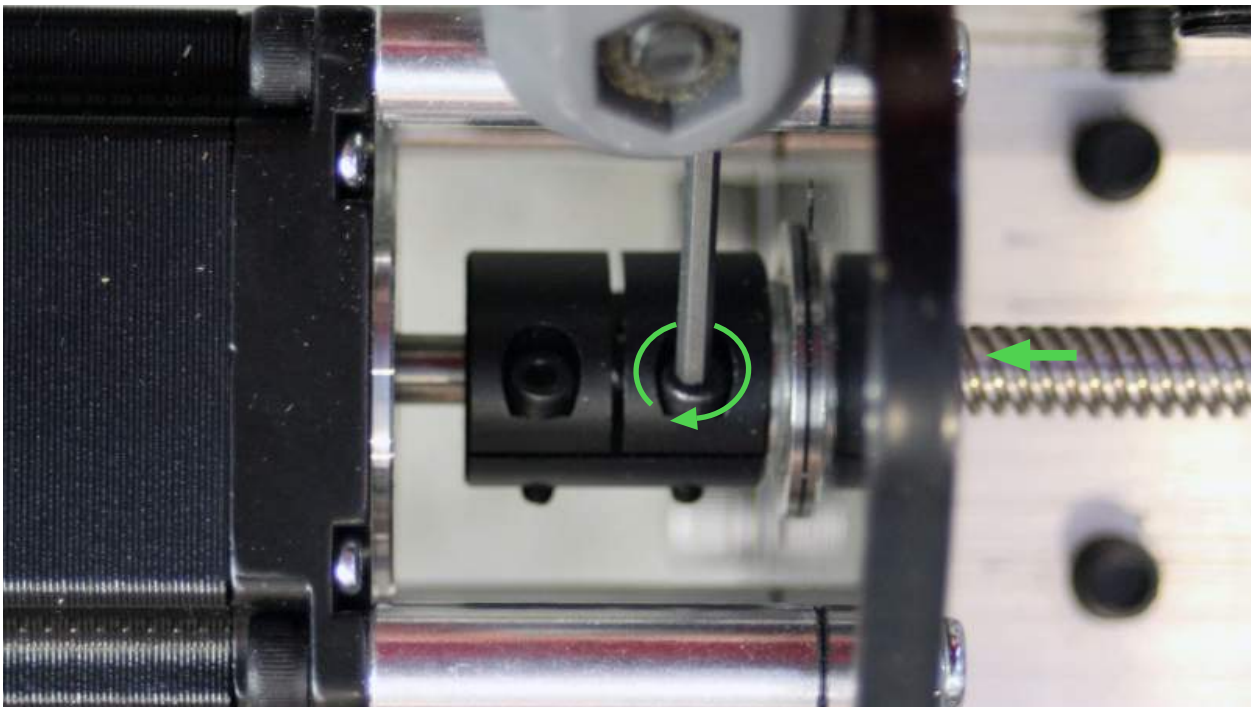
Push the lead screw into the bearing

Take an M8 washer (found in the orange bag) and slide it between the coupler and the bearing and then push the lead screw through all three.



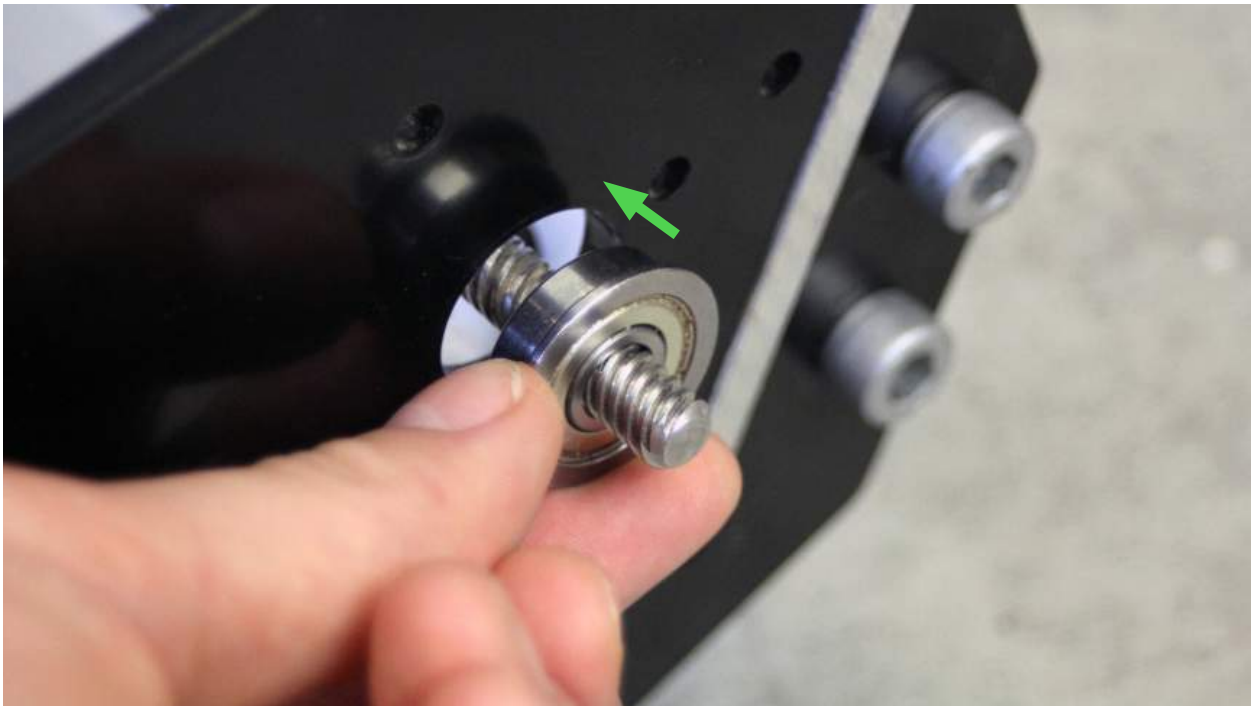


In addition, on the other end you'll want to push the coupler all the way into the lead screw while holding the lead screw in the other hand so that the coupler is pushes the washer into the face of the flange bearing. Then tighten the set screw - on the lead screw side of the coupler - using a size 2.5 Allen key.



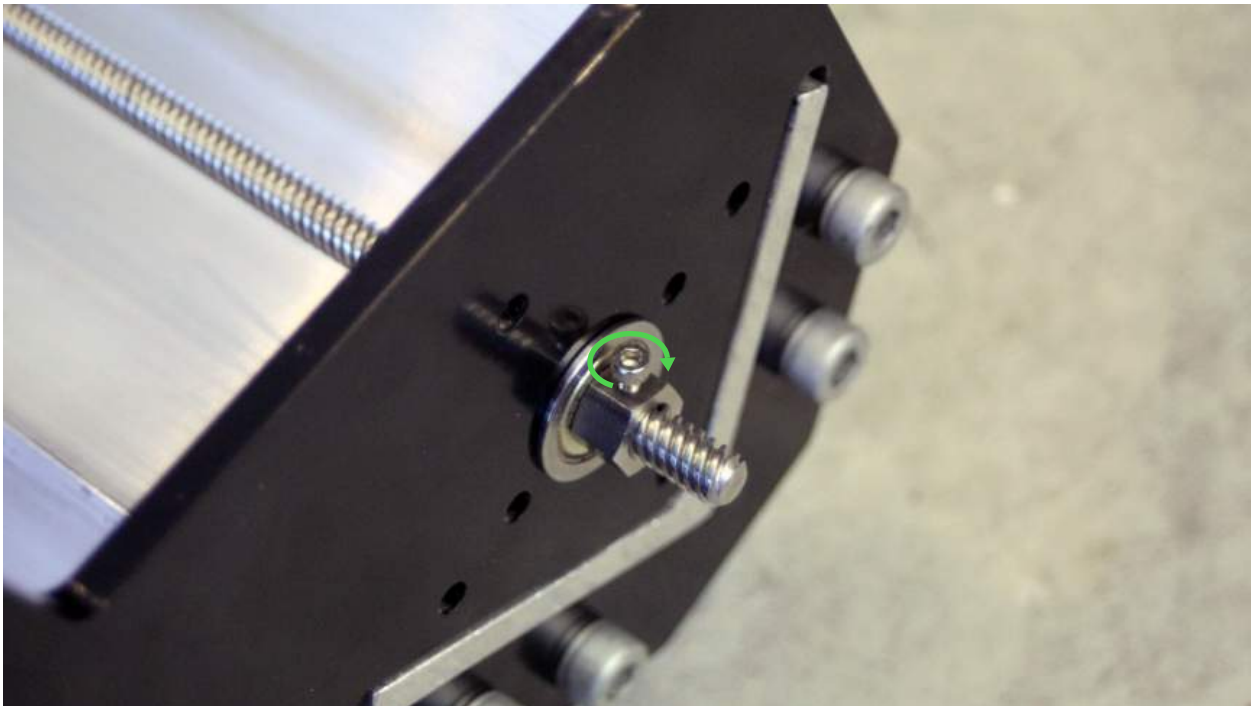
Fully seat and secure the lead screw.

Now on the other side of the X-axis rail assembly, take a second flange bearing and slide it into place as shown. It should fit into the bore on the right-hand side of the right-side steel plate and if the fit is a bit tight then you can wiggle it or tap it into place.



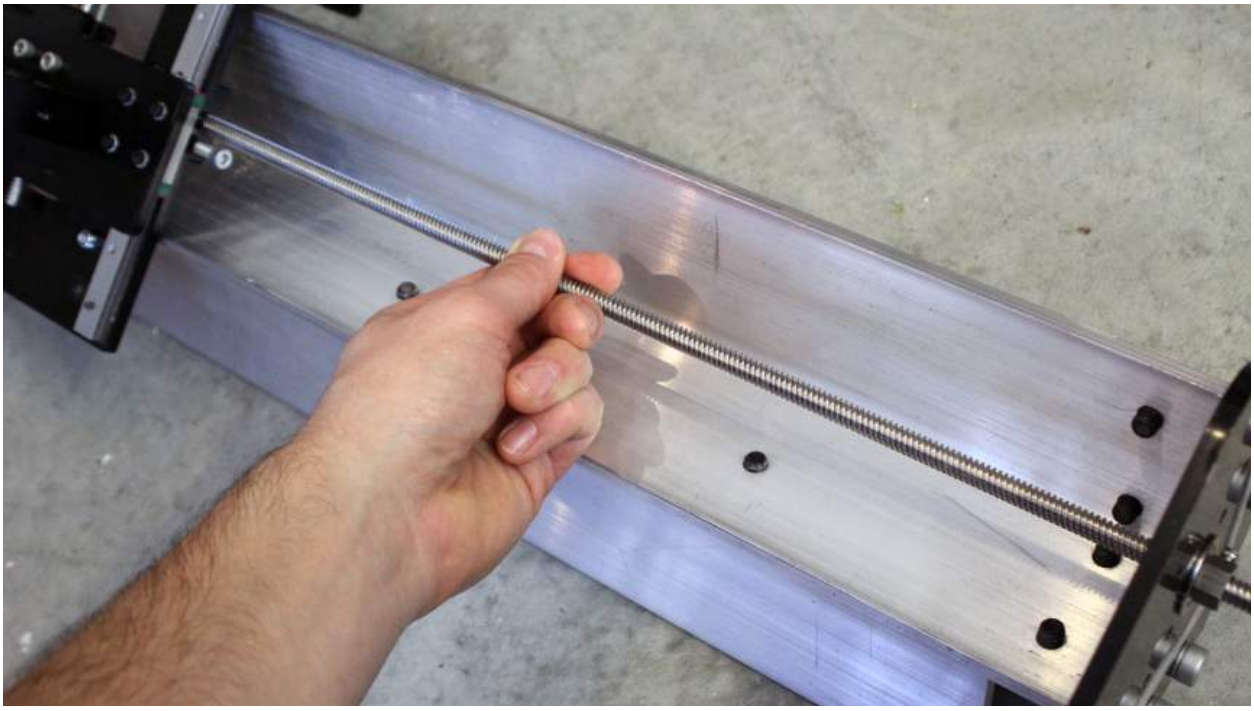
Push the coupler all the way into the bearing, and retighten screw

There should still be three ACME locking nut assemblies that you've previously assembled. Grab one of these and thread it onto the lead screw from the right, turning it all the way until it's against the bearing, then tighten the set screw to hold it in place. Make sure the nut is really tightened into place before tightening its set screw.



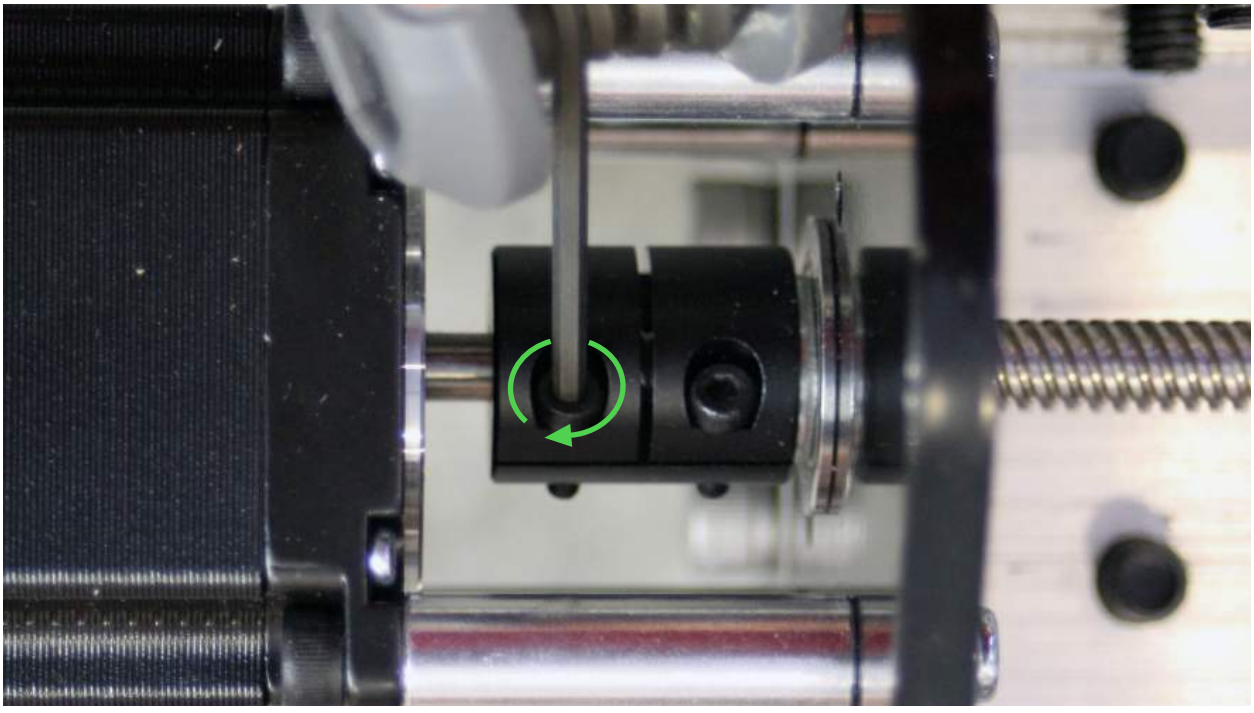
ACME lock nut on all the way

This nut is used in combination with the coupler at the other end of the assembly to constrain the lead screw on the X-axis from moving side-to-side. As such, it's a good idea to check that everything is secure by gently pulling on the lead screw to check for any looseness. Adjust the couplers and tighten the ACME lock nut more if you feel any play since you should be able to rotate the lead screw freely but not feel any side-to-side looseness.



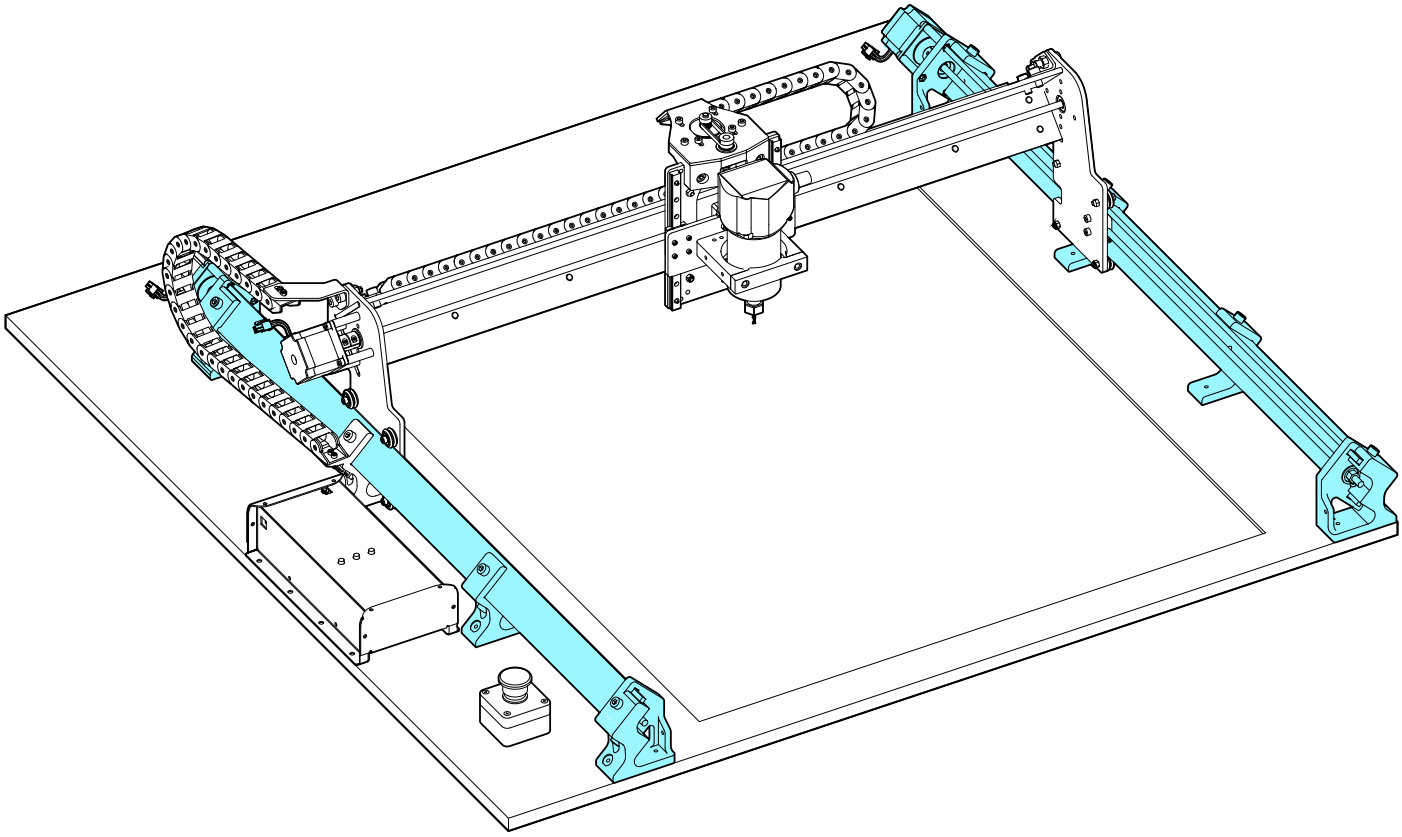
Check for play by gently pulling on the lead screw both ways

Once you're satisfied that the lead screw well mounted, you can revisit the X-axis motor coupler to finally tighten the set screw on the motor shaft side to properly couple the motor to the lead screw (pictured).



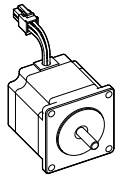
Part 4

Y-Axis Rails



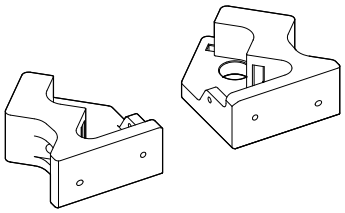
Feet sub-assemblies

Parts Needed:

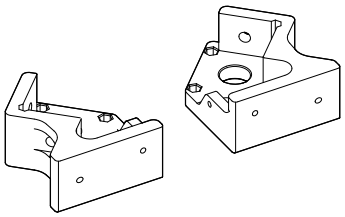


x2

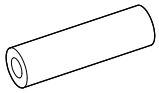
NEMA 23 motor



3D printed front feet

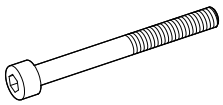


3D printed back feet



x8

35mm aluminum spacer

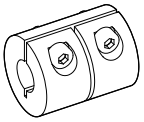


x8

M5-50mm bolt

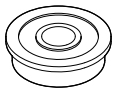
x8

M5-nylock nut



x2

6.35mm to 8mm coupler



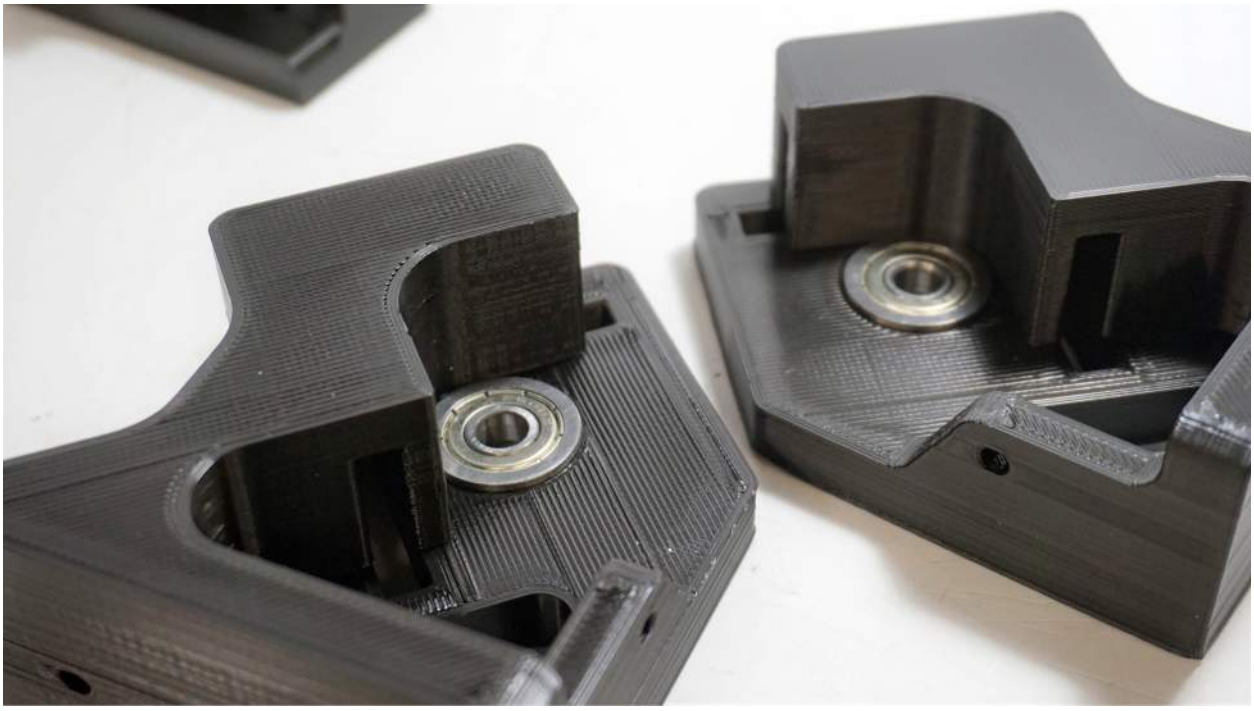
x4

608ZZ flange bearing

The two Y-axis rails mount to the machine base via a handful of plastic feet which require a bit of assembly before-hand. Start off by finding the front and back pairs among the plastic parts (pictured). These parts can be distinguished by their ‘zig-zag-like’ pattern with a thick base and by the embossed lettering denoting their position on the machine (e.g. “Back left” and “Back right”).

With the bearings still in hand from the last step, you'll need to push one of them into each of the four feet. The front feet should have the bearings pushed in from the front, and the rear feet from the rear (pictured); make sure that you get the orientation right on these.

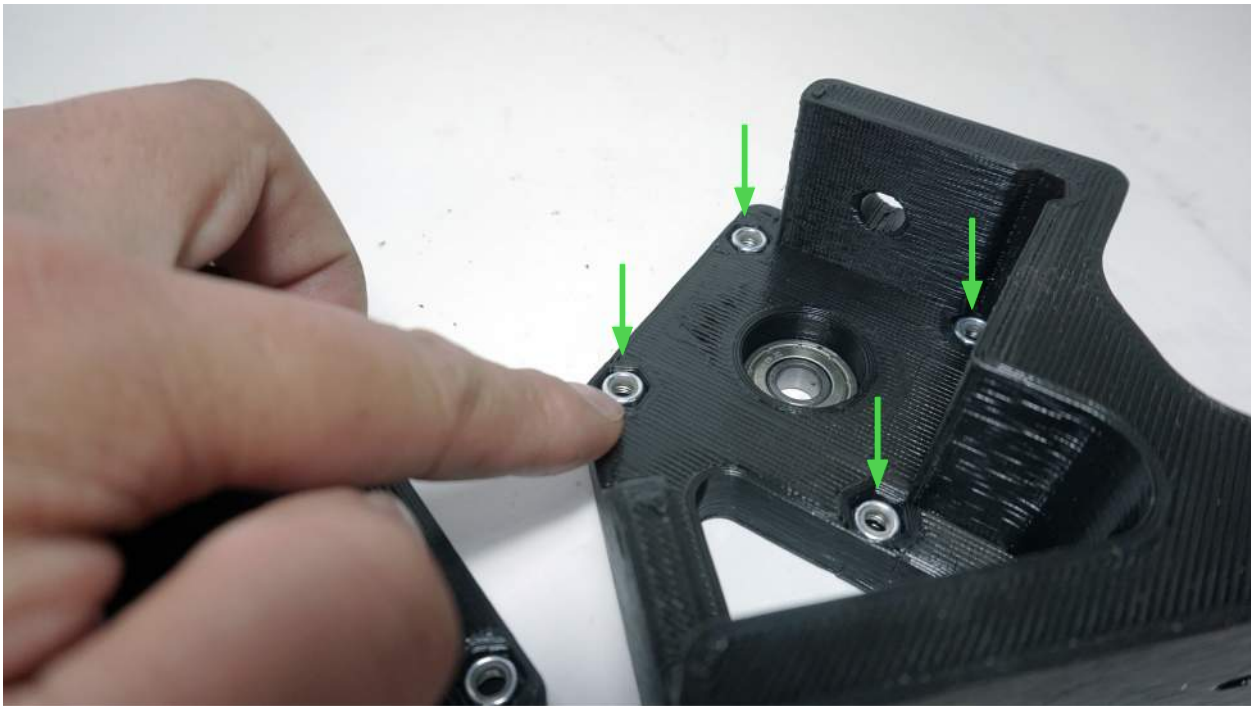
These bearings are meant to be quite a snug fit, so feel free to use a vise or a mallet against the outer flange of the bearing to get them properly seated into the feet. You'll know they're in all the way once the flange is completely flush with the surface.



Front feet with bearings

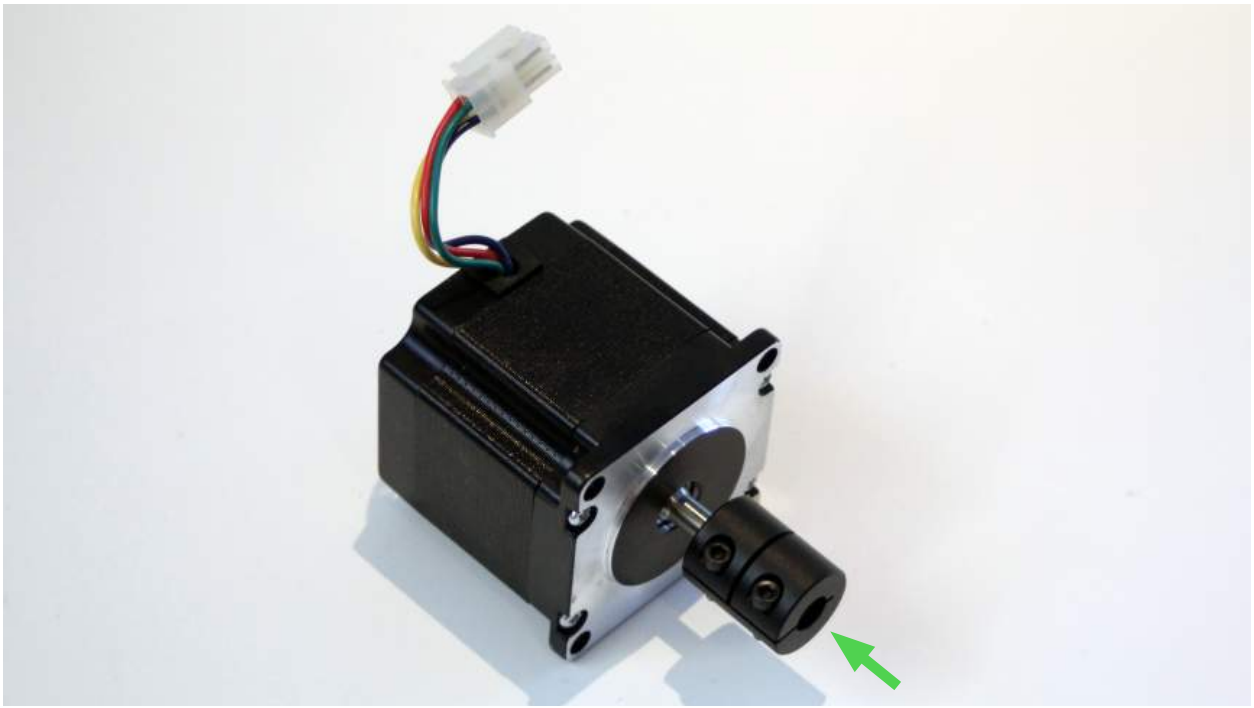
Rear feet with bearings

For the rear feet, we'll also press-fit in eight M5 nylock nuts with the rounded side facing outwards. You should already have the bag of these medium-sized nuts open from earlier in the assembly.

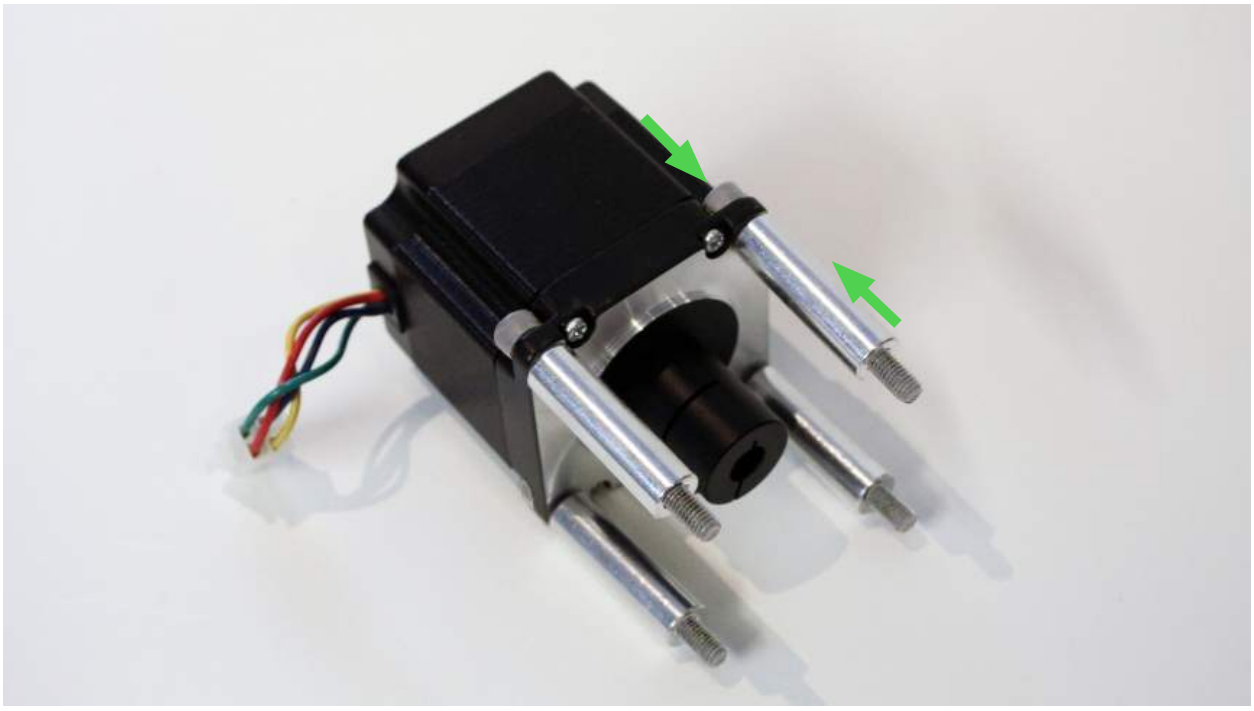


Put M5 nylock nuts into each nut catch on the rear feet

Now, we'll attach the two remaining motors to the rear feet. Install the coupler onto the motor first, followed by the long bolts and spacers that were used for the X-axis motor assembly.

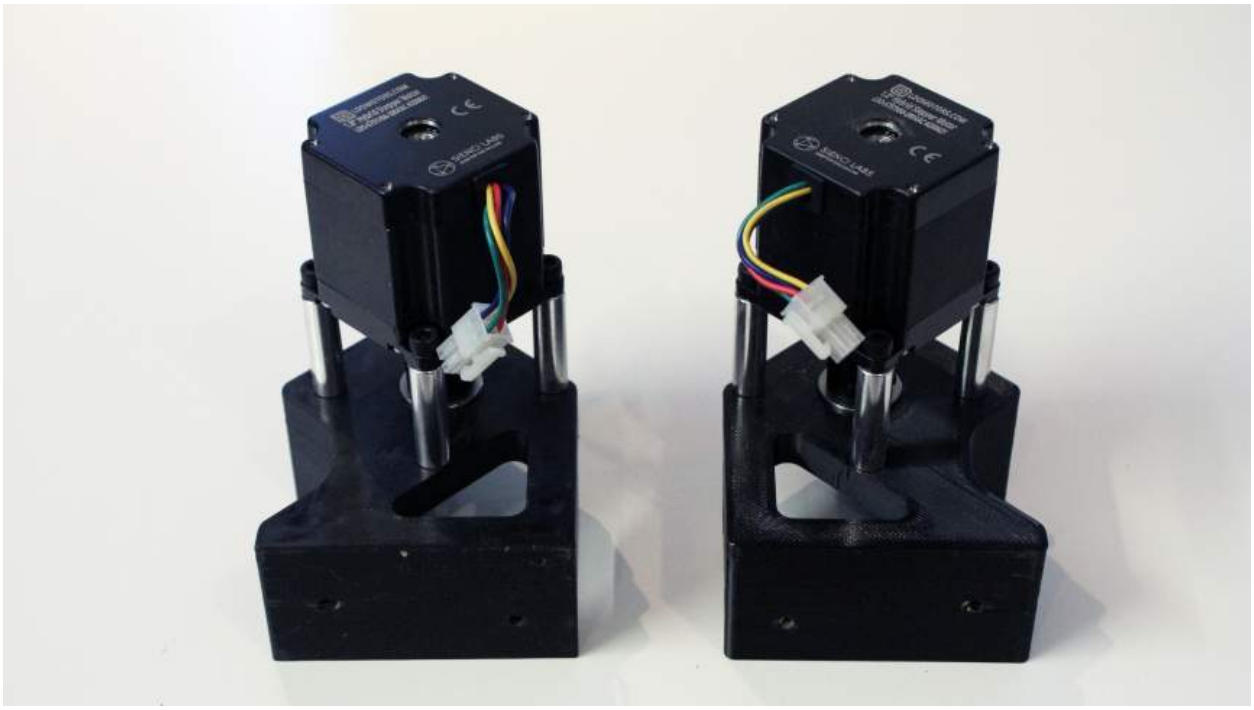


Loosely push the coupler over the motor shaft



Install the bolts and spacers

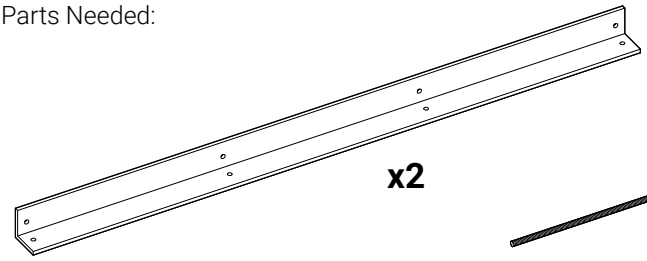
Move this over to the back of one of the rear plastic feet, orienting the cable bundle towards the flat base of the foot (pictured). Using a size 4 Allen key, you'll be able to bolt the motor in place. Repeat the process for the other foot.



Both feet with motors attached

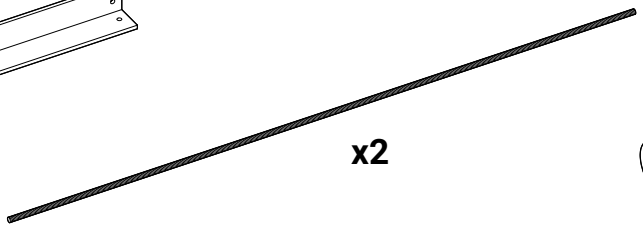
Completing the Y-axis

Parts Needed:



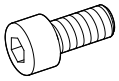
x2

Y-axis rails
(500mm or 1000mm)



x2

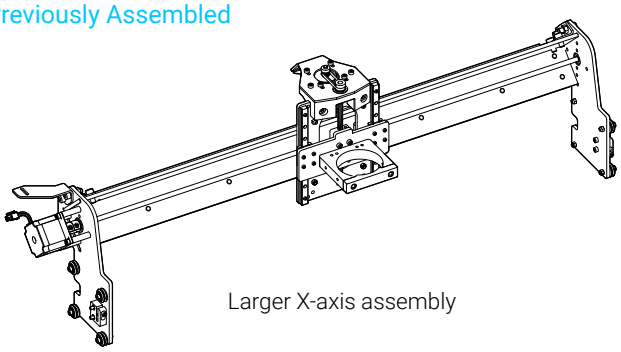
Lead screws
(530mm or 1030mm)



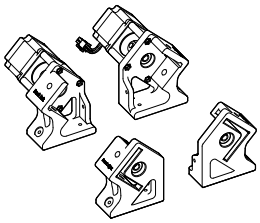
x8

M8- 16mm bolt

Previously Assembled



Larger X-axis assembly



Front and back feet assemblies

x2

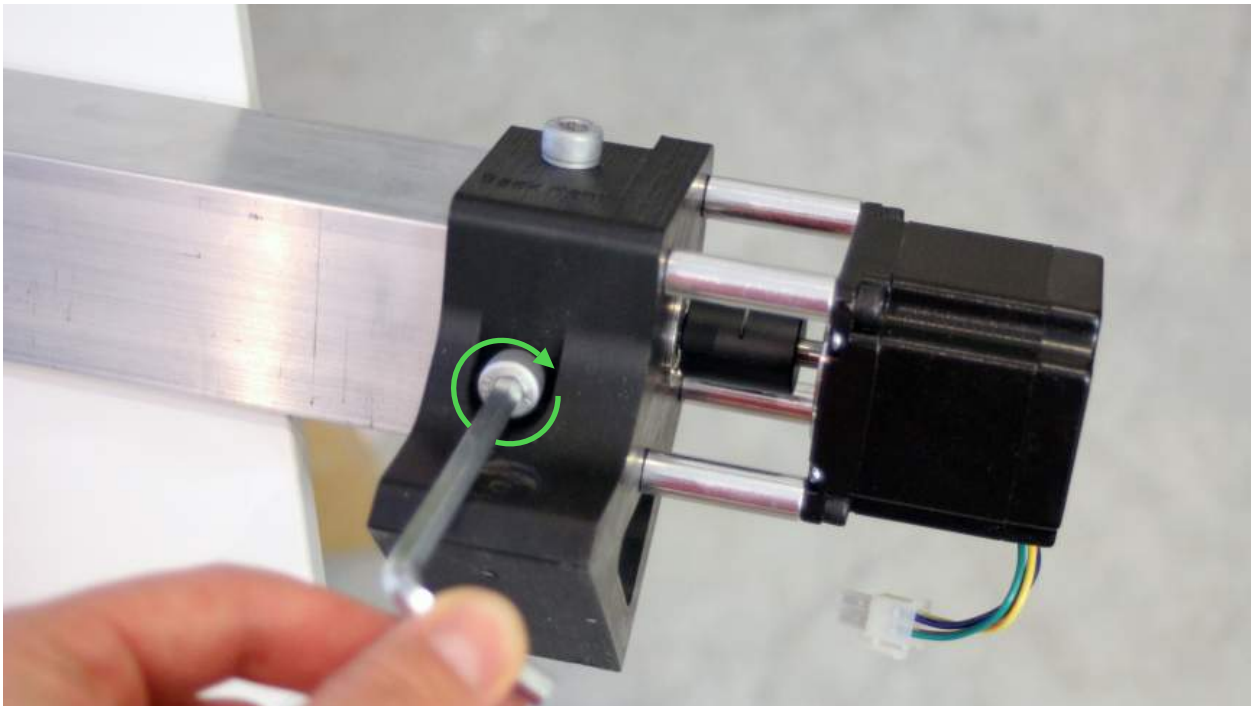
ACME locking nut assembly

The 30×30 LongMill comes with 1000mm long rails for the Y-axis, meanwhile the 12×12 and 12×30 models have 500mm long rails. These will be the last two remaining aluminum lengths in the kit, distinguishable by their 2” width compared to the 3” width of the X-axis rail.

We will be doing the assembly for the 30×30 here, but the assembly for all three versions is very similar. Start by grabbing the two Y-axis rails, the feet assemblies from the last step, and the bag of the largest, short bolts.

Note that your rails will be shorter if you don’t have the 30×30 LongMill

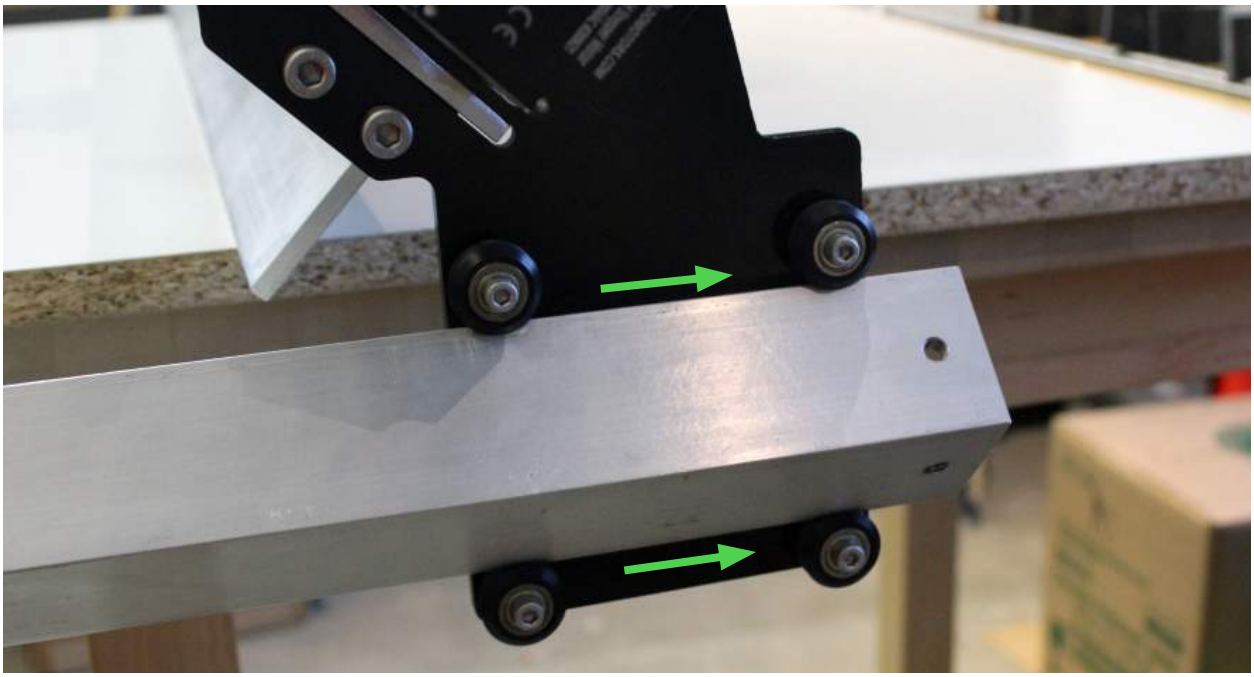
Secure the rear left and right feet assemblies (pictured) to one end of each rail. These can be secured using two of the short M8 bolts per foot assembly using a size 6 Allen key; the rails should be a mirror of each other.



These rails need to now slide onto the larger X-axis rail assembly that you have set aside. To prepare for this, flip the X-axis assembly onto its front so that the router mount is contacting the ground; be sure that it's stable in this position.

You should also check the current state of the eccentric nuts on both Y-gantries. Just like when you checked them on the XZ-axis gantry, they should be in their outer-most position so that there's enough space between the wheels for the rail to fit.

Now slide one rail onto the wheels of each of the Y-gantries from the back (pictured). Make sure that the flat side of the feet is pointing away from you so that, when completed, the machine is able to sit on the bottoms of the feet.

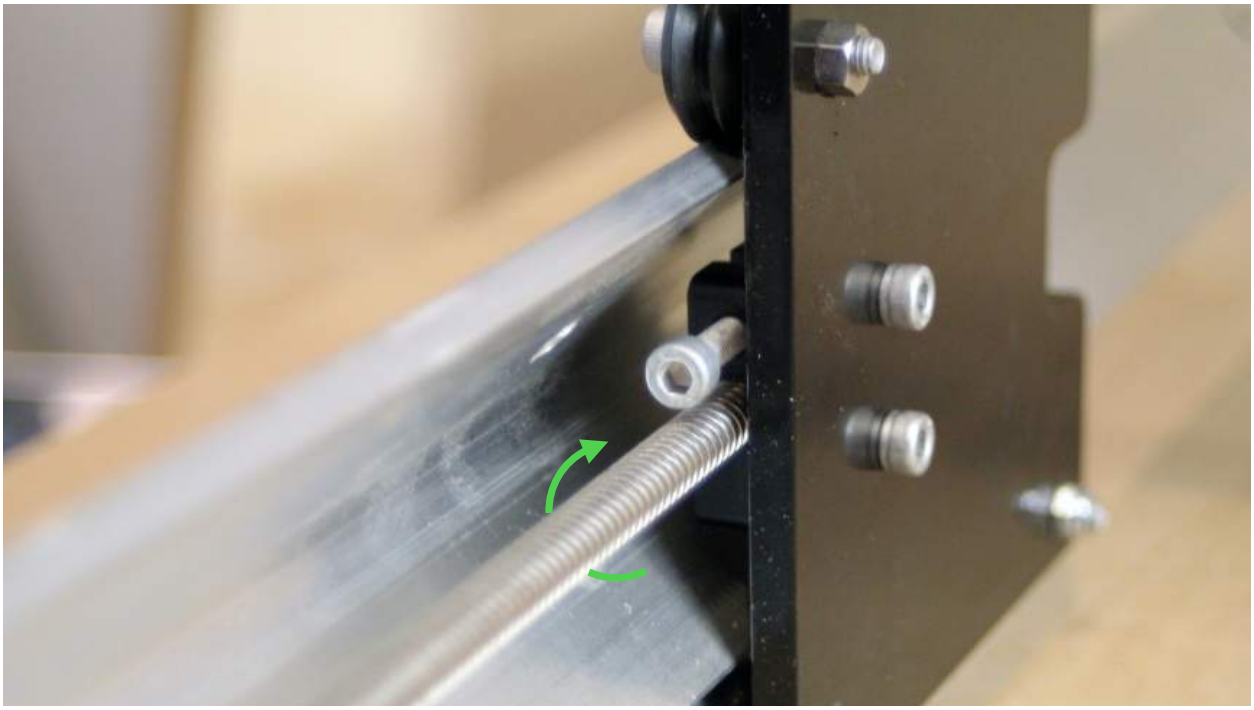


Line up the inner profile of both sets of v-wheels to the edges of the rails in order to slide them into place

Leave this sitting for a second while you collect the two front feet assemblies and four more M8-16 bolts (found in the orange bag) in preparation for this next step. You'll have to make a combined motion where you tilt the X-axis rail assembly backwards while you finish sliding the Y-axis rails all the way on. Be very careful while doing this. It's possible to loose control of the heavy components and have them fall away from you and become damaged.

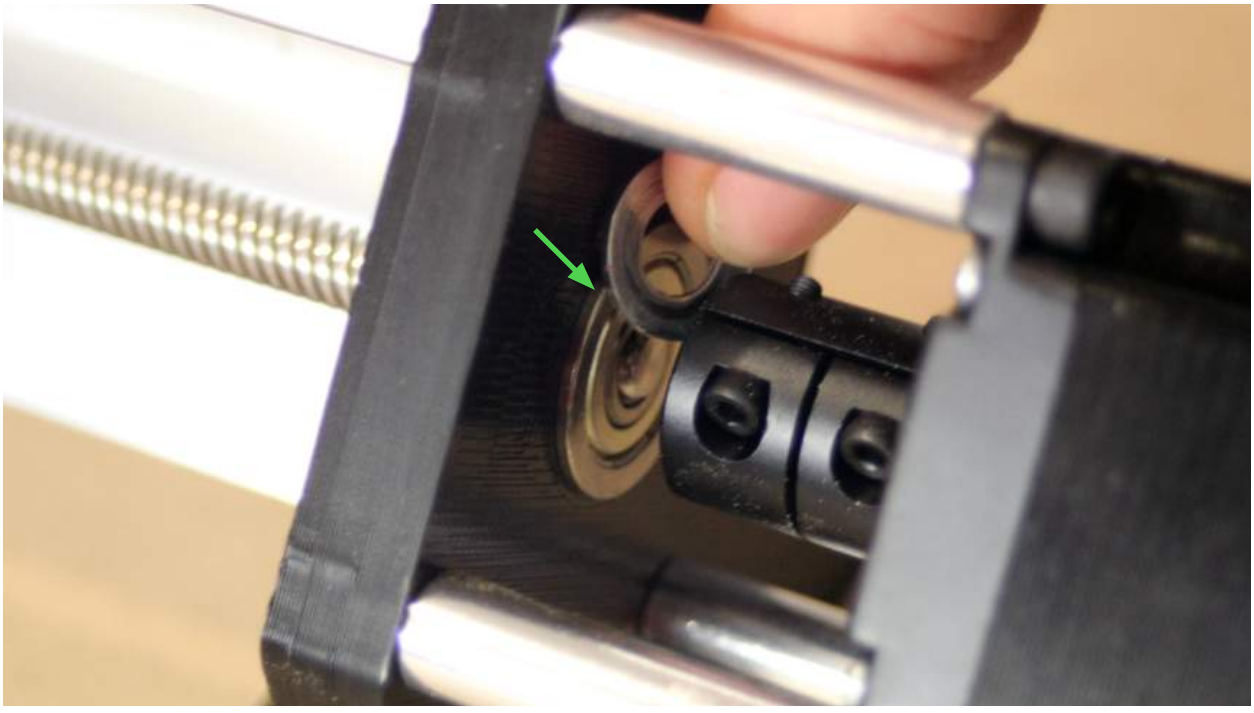
Once you've slid the rails all the way on to the X-axis rail assembly, use the two front foot assemblies we collected earlier. Sliding them into place and mounting them to the front of each rail on their respective sides with two bolts each and a size 6 Allen key will help to keep the large assembly more stable.

Next, thread the lead screws into place. It will go through the bearing on the front foot, threaded through the nut block on the Y-gantry, and through the bearing on the back foot. If you move the gantry to the back of the machine when doing this (pictured) it'll require less time to thread it through.

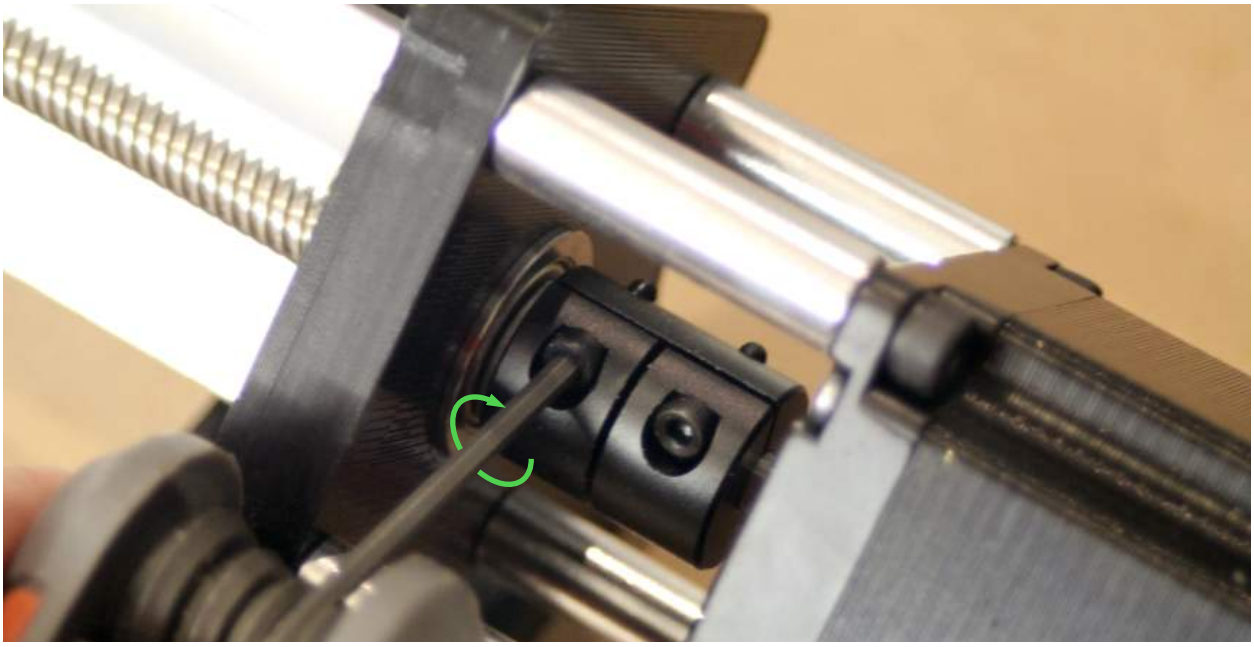


Thread the lead screw into the nut.

Just like for the X-axis assembly, put a washer between the coupler and the bearing on the motor-side of the back feet. If the lead screw is getting a bit stuck on the bearing or coupler, you may have to do some wiggling or lightly tap it into position with a mallet from the other end.

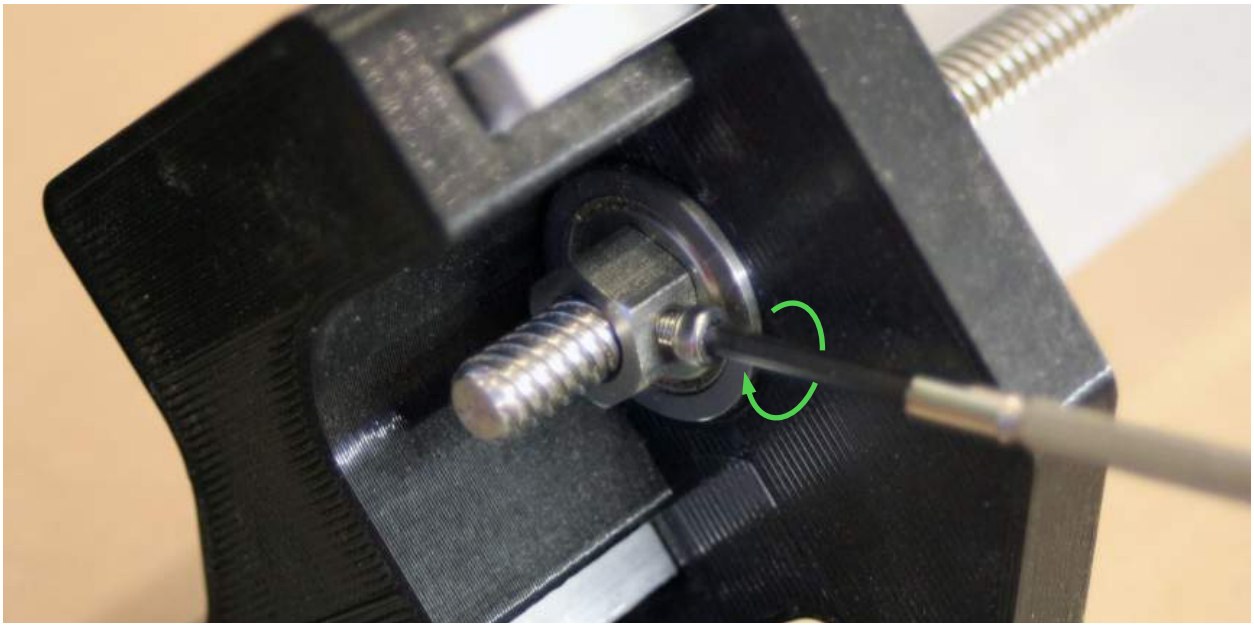


Tighten everything down by pushing the lead screw all the way towards the motor shaft while pushing the coupler all the way towards the bearing, then tightening down the coupler on the side of the lead screw.



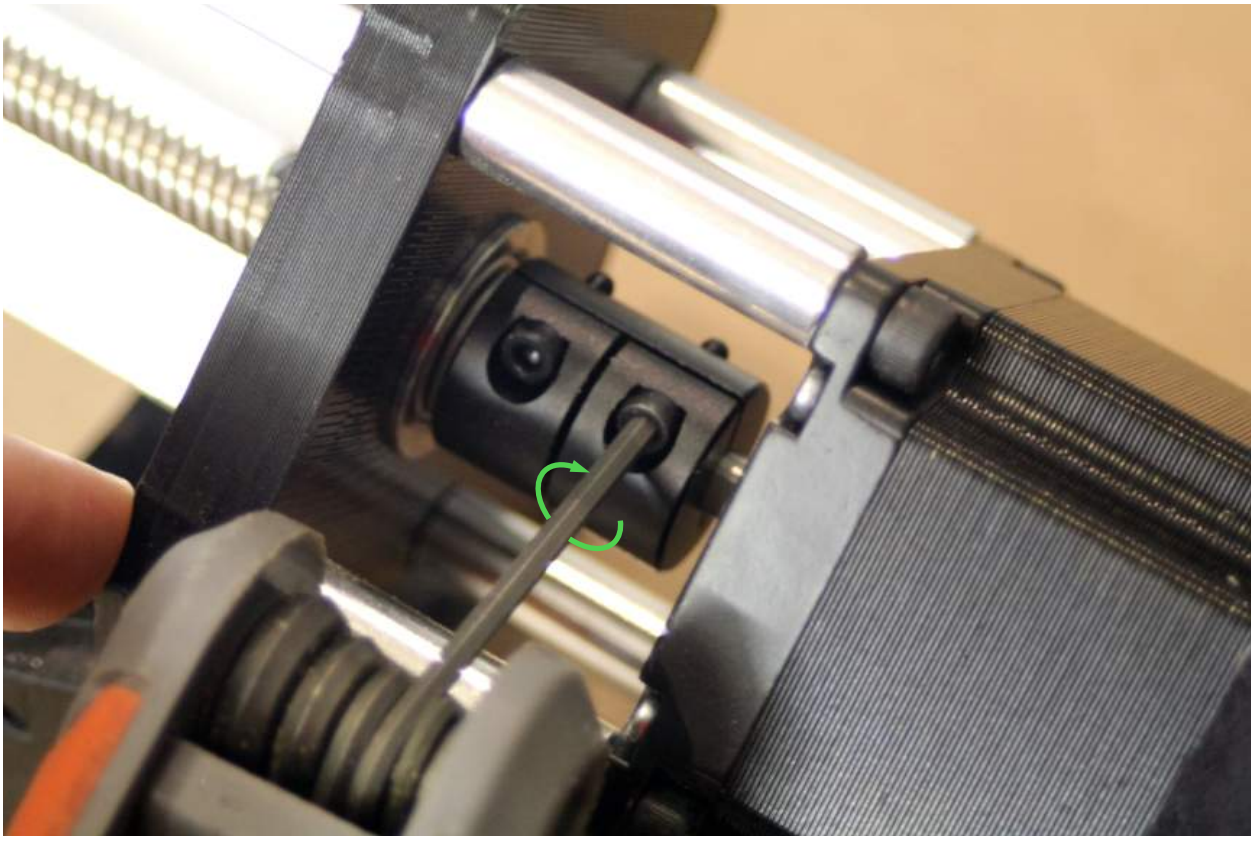
Everything tightened down

Back at the front of the machine, the last two of the ACME locking nut assemblies are going to be used to constrain the lead screws on the Y-axis. These share the same purpose with the locking nuts on the X and Z-axes, where the combination of the nut on one side and the coupler on the other side keeps the lead screws from moving side-to-side; so it's a good idea to check that everything is secure by gently pushing and pulling on the lead screw to check for any looseness. Adjust the couplers and tighten the ACME lock nut more if you feel any play, since you should be able to rotate the lead screw freely but not feel any side-to-side looseness.



Thread on the ACME lock nut, making sure it's tight against the bearing before tightening the screw to secure

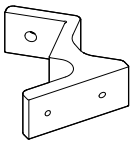
After making sure there is no play in the lead screw, tighten the coupler on the side of the motor. Repeat these steps on the other side of the other Y-axis rail.



Attaching the middle feet

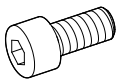
If you have a **12x12** or **12x30** LongMill, there will only be one foot to attach to the right rail, which will only require 2 of the M8 bolts to attach it

Parts Needed:



x3

3D printed middle foot

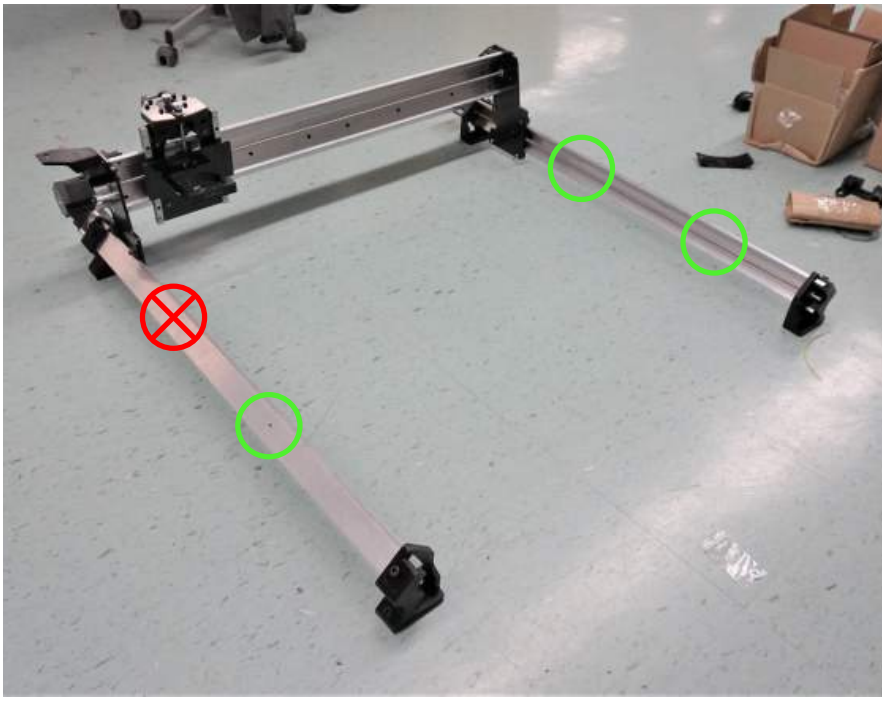


x6

M8- 16mm bolt

The last pieces to add are the middle feet. They look exactly like the back feet but exclude the backing. There are three of them and a fourth one that looks very similar but has another mounting point that juts out; this one will be used later in the assembly.

Attach the middle feet in the positions indicated in the below picture. Just like the other feet, they can be attached using two of the short M8 bolts and a size 6 Allen key. It's best to twist the bolts into place by hand first, then finish tightening them snug with the Allen key.

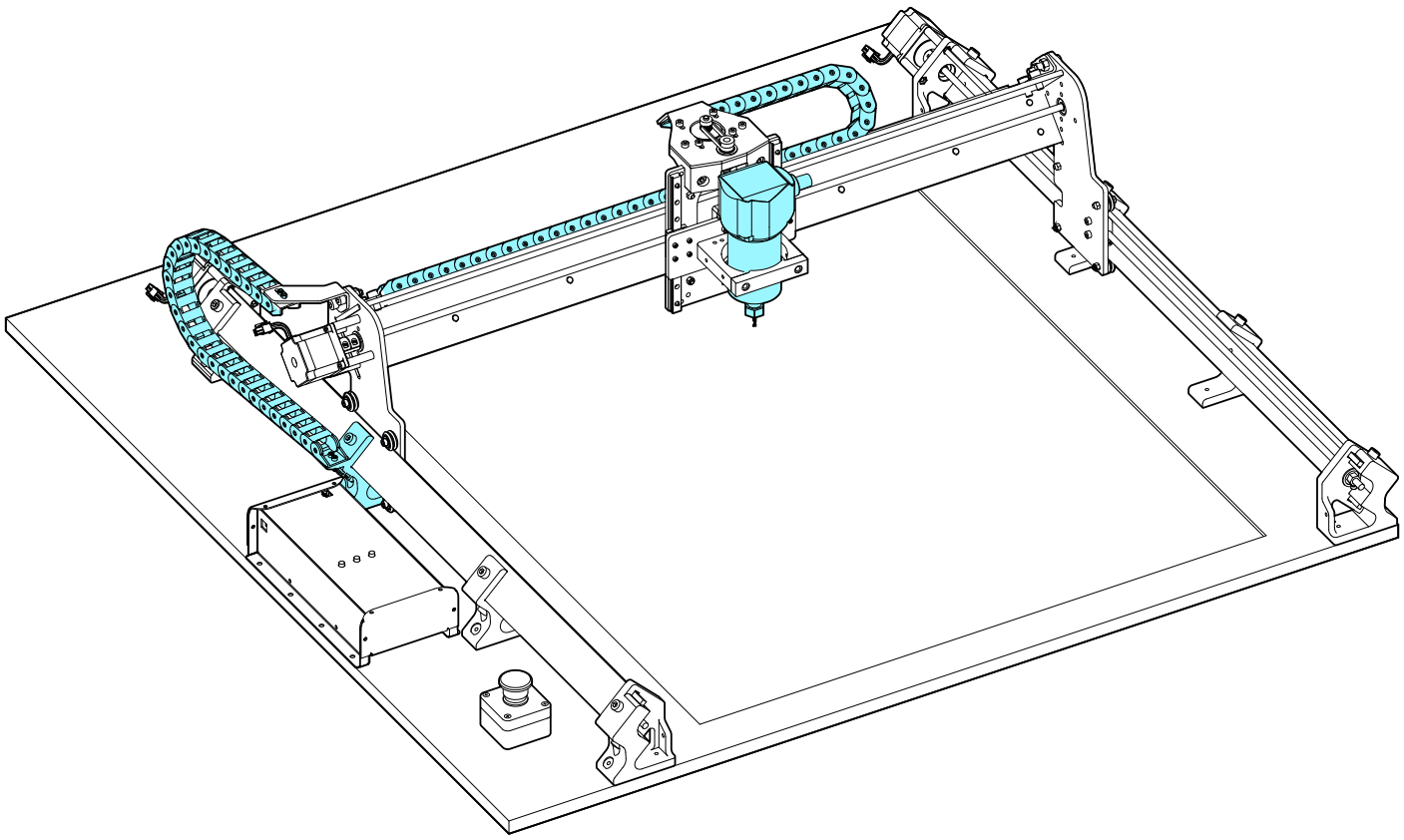


Mount the middle feet in the spots indicated

Single middle foot on right rail (LongMill 12x12 and 12x30)

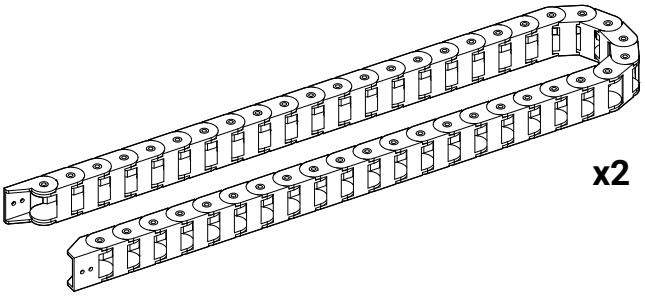
Part 5

Drag Chains and Wiring



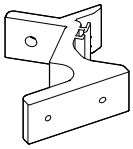
Drag Chains and Wiring

Parts Needed:

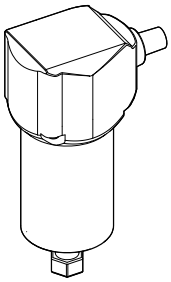


x2

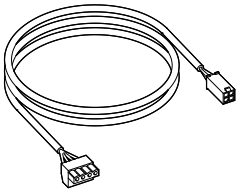
1000mm drag chains



3D printed drag chain foot

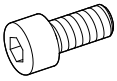


Router



x4

Motor wires



x2

M8-16mm bolt

x7

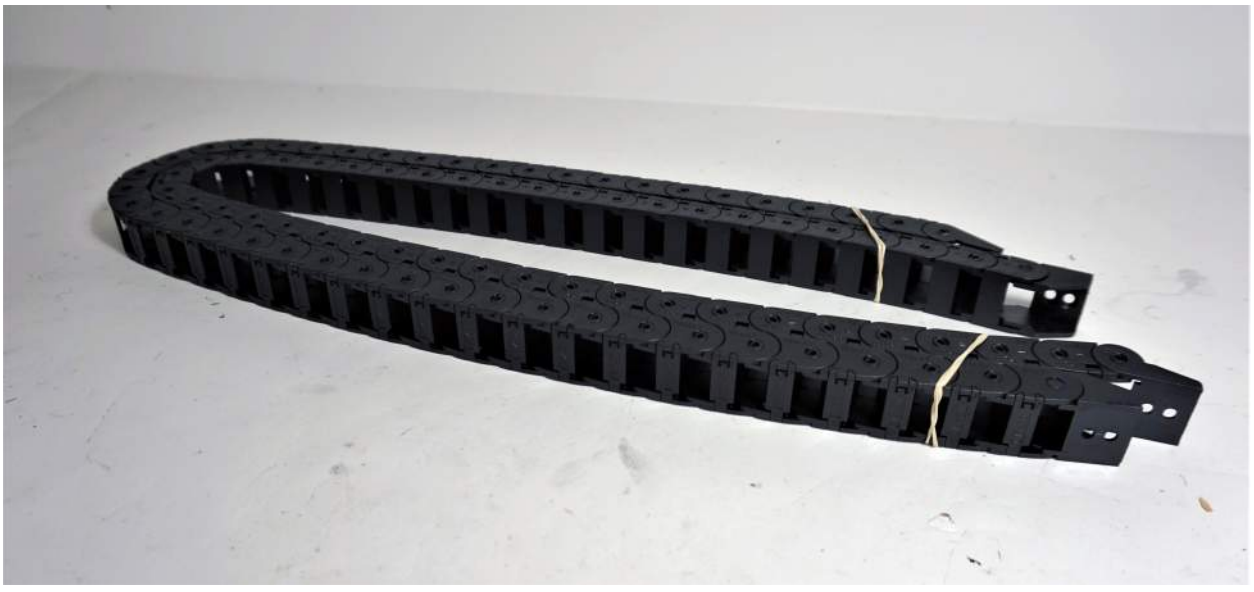
M4-16mm bolt

x6

M4 nylock nut

We will now be installing the drag chains; these contain and guide the wires on the LongMill so that they aren't in the way during cutting. They also keep wires from wearing out from bending or being cinched around corners.

As mentioned previously, the chains can be found in the lighter long box (pictured). They come with detachable links so that you can adjust their length depending on the size of your LongMill. You can save these links for later when you upgrade to a larger LongMill if you have the 12×12 or 12×30 versions.



We'll first start by removing the end connector links from both drag chains. You can either pull or squeeze off the connector as shown in the photos. A flat head screwdriver or thin shim can also be handy for this, just be careful not to cut yourself in the process.

For the pin-type end link, squeeze the two sides of the link together, then twist and pull to disconnect

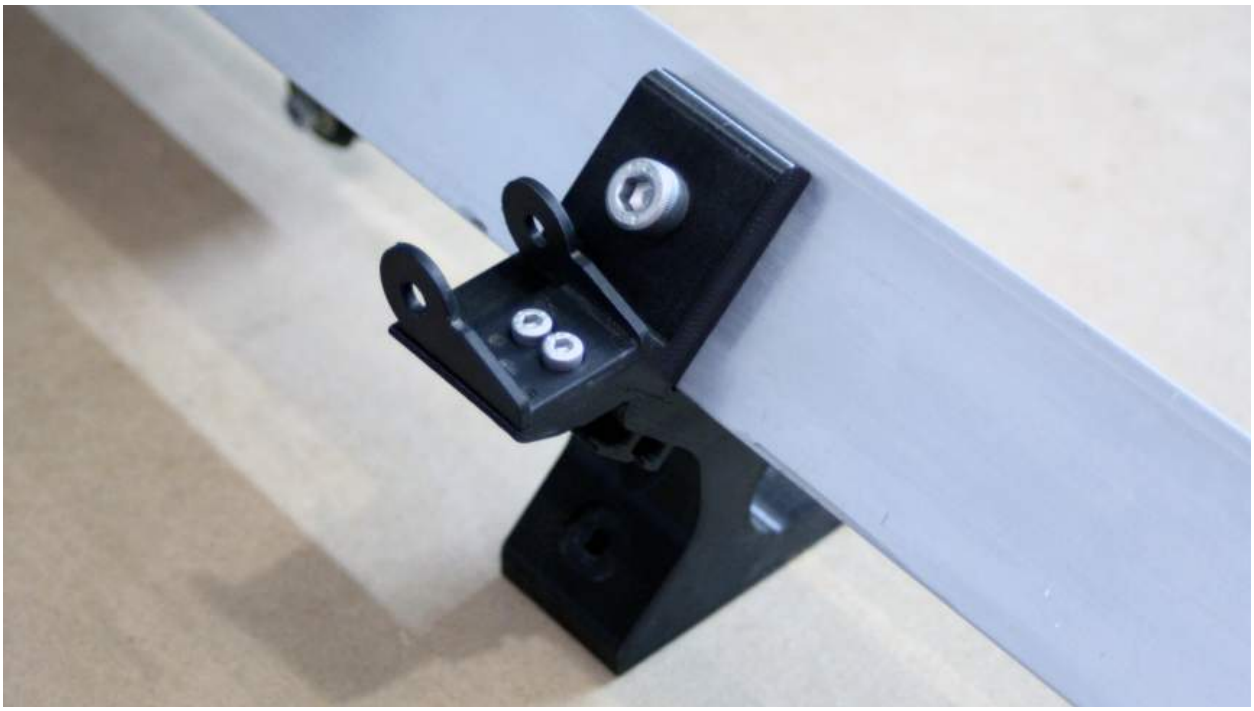
For the hole-type end link, pull on one side of the link then twist it away to separate it

Do this for all four end pieces, two hole-types and two pin types, and set them aside.

We will attach these links to the machine, starting with the drag chain foot you set aside in the last step. It can be identified by its lightning bolt shape and the nut catches and wire clips it has on its back side. Also find the smaller M4 bolts and nuts in the yellow bag, as these will be used to attach the links in the following steps.

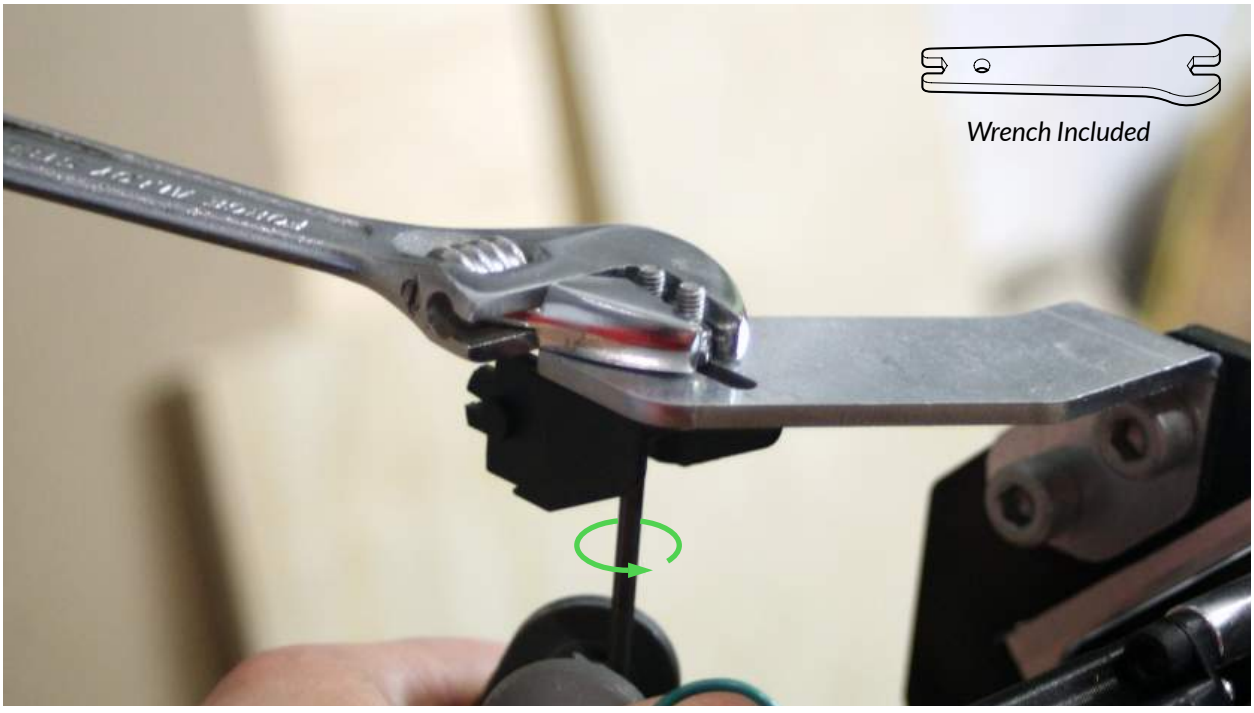
Use a pair of bolts and nuts to secure the hole-type end link onto the drag chain foot in the orientation shown by using a size 3 Allen key. The nuts should fit into the hexagonal cutouts underneath the mounting point, meaning a wrench won't be needed.

This last foot can now be attached to the Y-axis rails in the vacant space on the left side of the machine. Use two of the short M8 bolts to fasten it to the rail, similar to how all the other feet have been mounted.

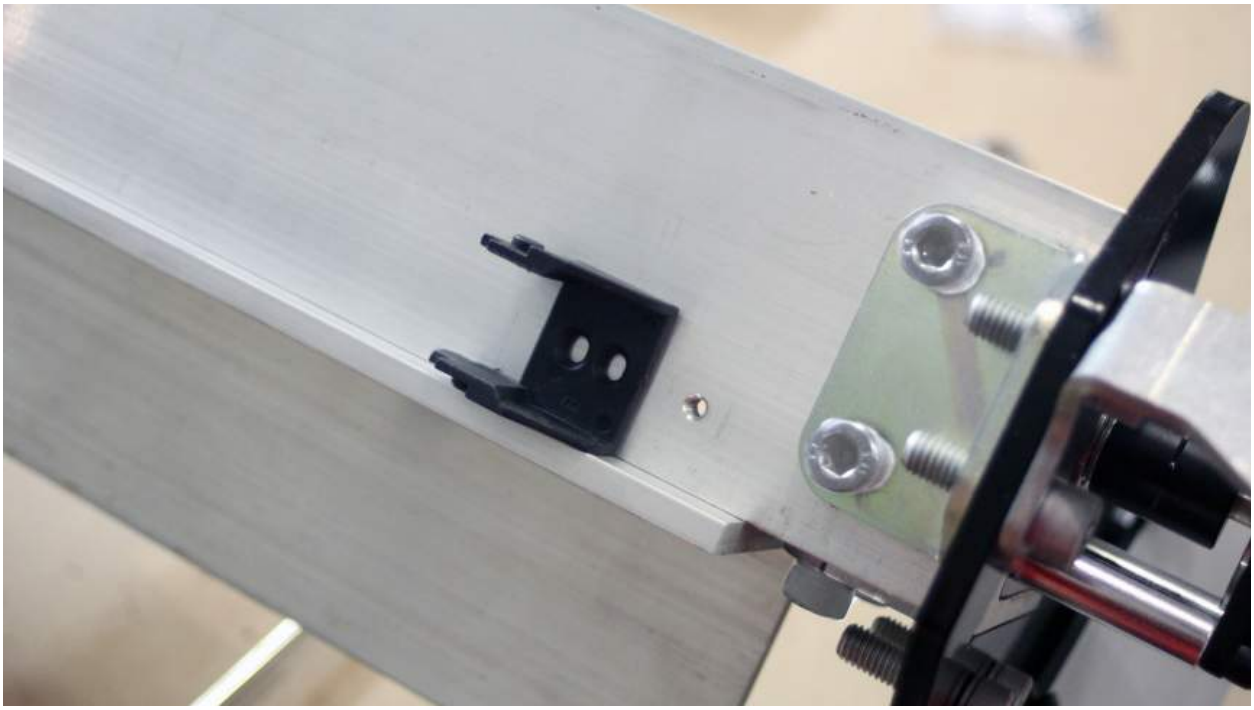


Drag chain foot mounted in place

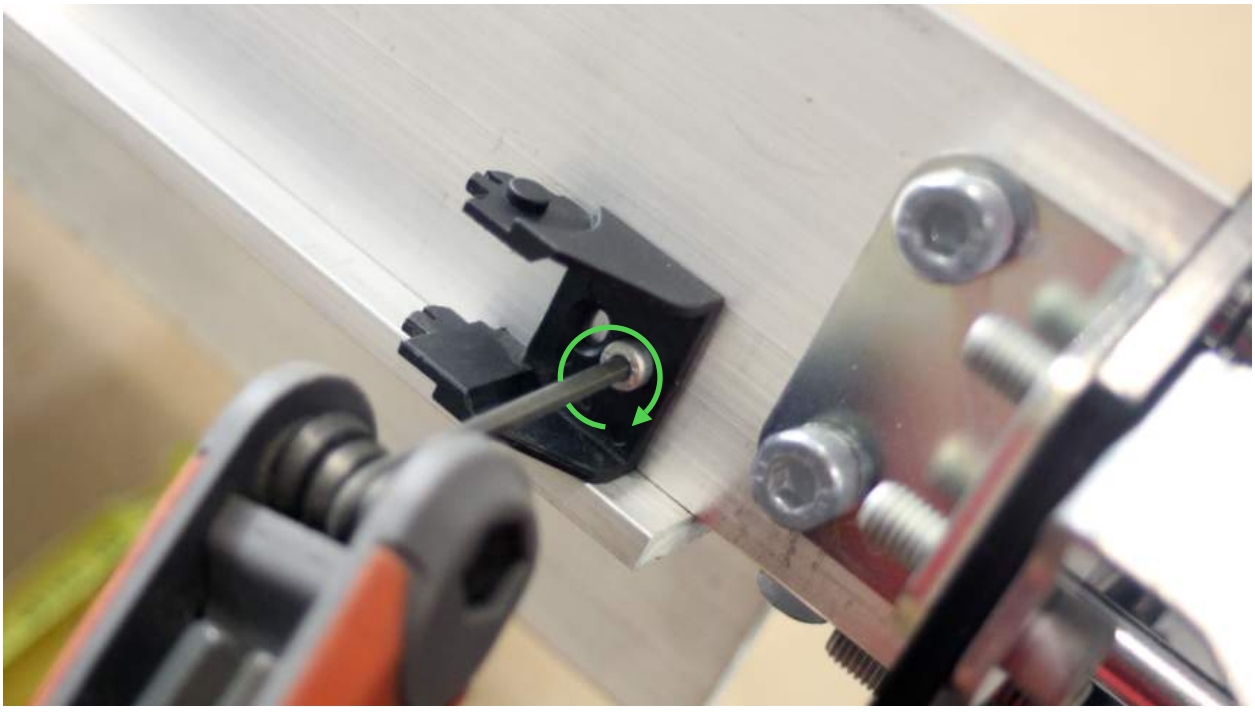
Now get a **pin-type** end link (pictured) to mount the other end of the drag chain. This one will attach the the X-axis steel mount where there's a slot for the two bolts to fit through. Use pliers or a 7mm wrench to hold the nuts from the top while you fasten the bolts from underneath with a size 3 Allen key.



On the back-left side of the X-axis rail, you'll find a hole to secure another drag chain link. You should only need one bolt to secure the pin-type end link using the tapped hole, but if your hole is not tapped, use an M4 nylock nut on the other side to secure the part.

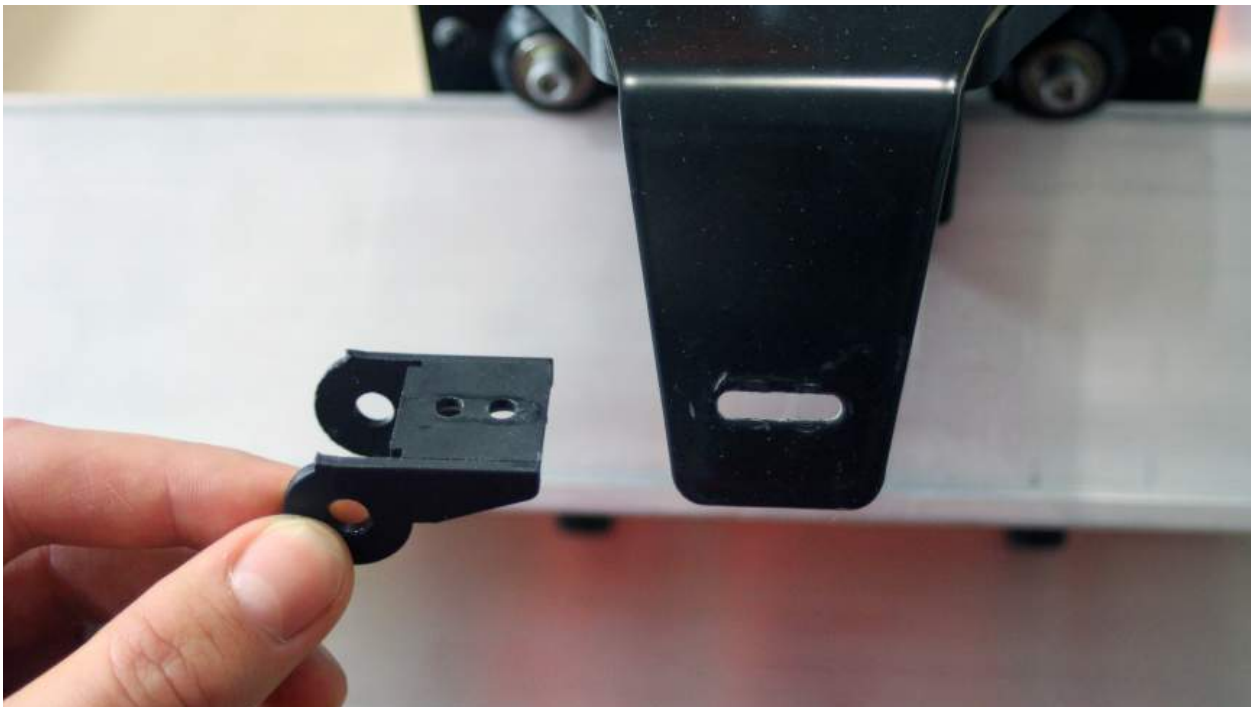


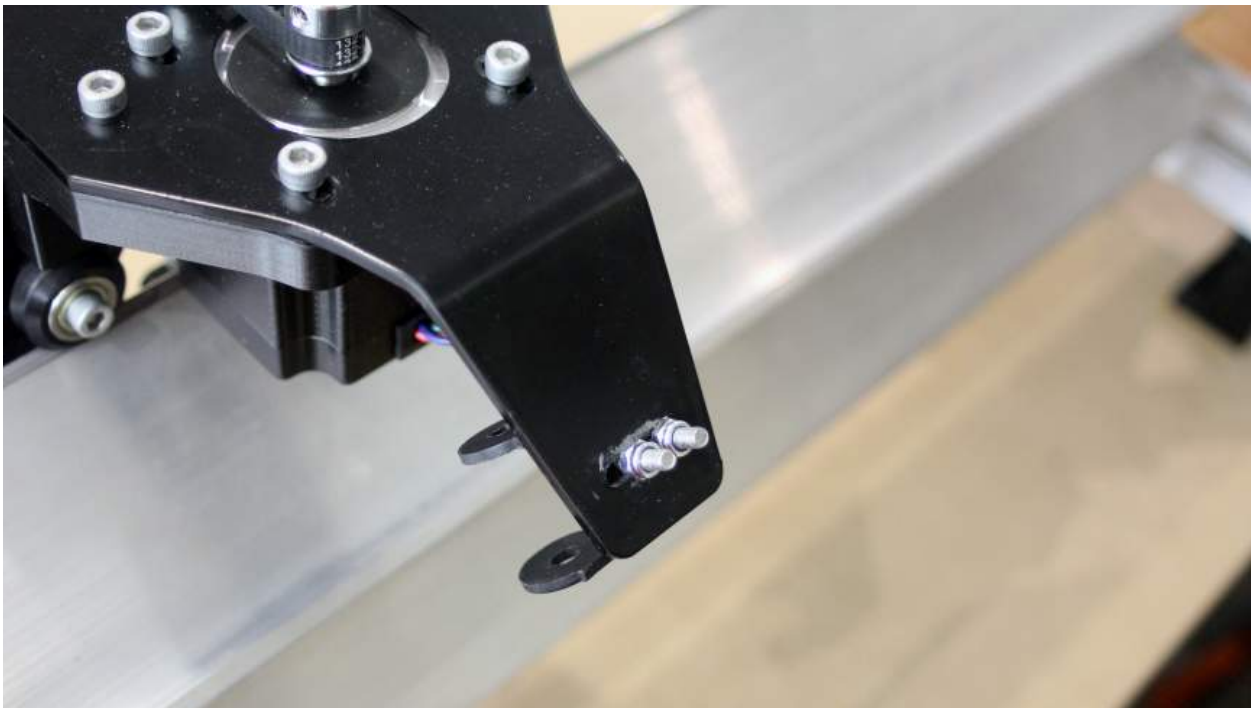
Find the hole on the X-axis rail to secure the drag chain link



Use an M4 nylock nut on the other side of the aluminum angle if needed

Lastly, we'll attach the final drag chain end link onto the 'arm' of the Z-axis mount using another pair of M4 bolts and nuts. Note the direction the link is facing before installing it.





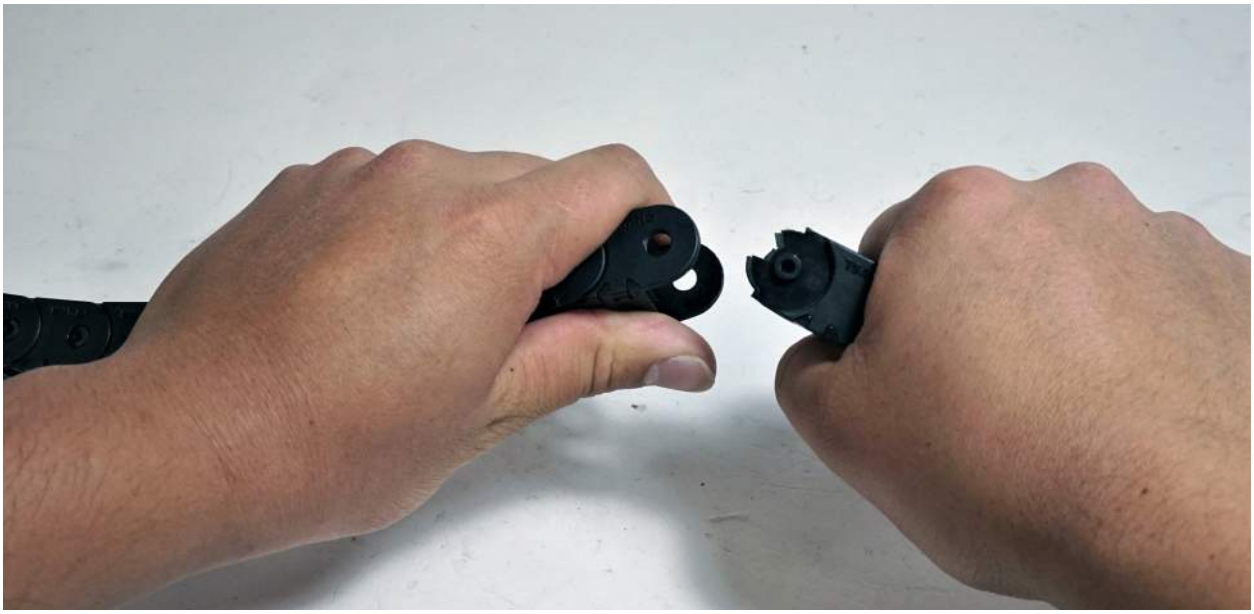
Link fastened into place

Next, we'll be removing a couple of links on the drag chain. To do this, put your hands on either side of the link you want to break, then twist and pull them apart to disconnect. Set aside the remaining, unused links for later; they can come in use if you're planning on upgrading to a larger sized LongMill later.

In the case of a **30×30** machine, we will remove 15 links off of the Y-axis drag chain, and none off of the X-axis drag chain. This will make it the correct length to mount at both ends when re-attached. Make sure to keep track of which chain is the shorter one so that you can re-attached them onto the correct axes.

On the **12×30** LongMill, only the Y-axis drag chain needs to be shortened to about 24 links long. This is a little over half the length of the existing drag chain so it's easiest to just fold it in half and add a couple links onto the halfway point.

On the **12×12** LongMill, both chains need to be shortened to about 24 links long. This is a little over half the length of the existing drag chains so it's easiest to just fold it in half and add a couple links onto the halfway point.



Use both hands to twist and disconnect the drag chain links.

We'll then start to unclip the tabs that hold the wires in the drag chain (pictured). These tabs are designed with clips on both side so that they can be removed to allow you to insert and remove wiring inside the drag chain. The clips on the tabs are quite strong, so sliding a flat head screwdriver or a long Allen key into the drag chain and using them as leverage to pop the tabs open works quite well.

Unclip the tabs on the drag chain

One quick note, if you plan on adding more wiring into the drag chains in the future, it's worthwhile to permanently remove every other cover tab since the wire will still be held in just as well but opening and closing them will take half the time. You can stick the extras into a baggy to save for later if you wish.

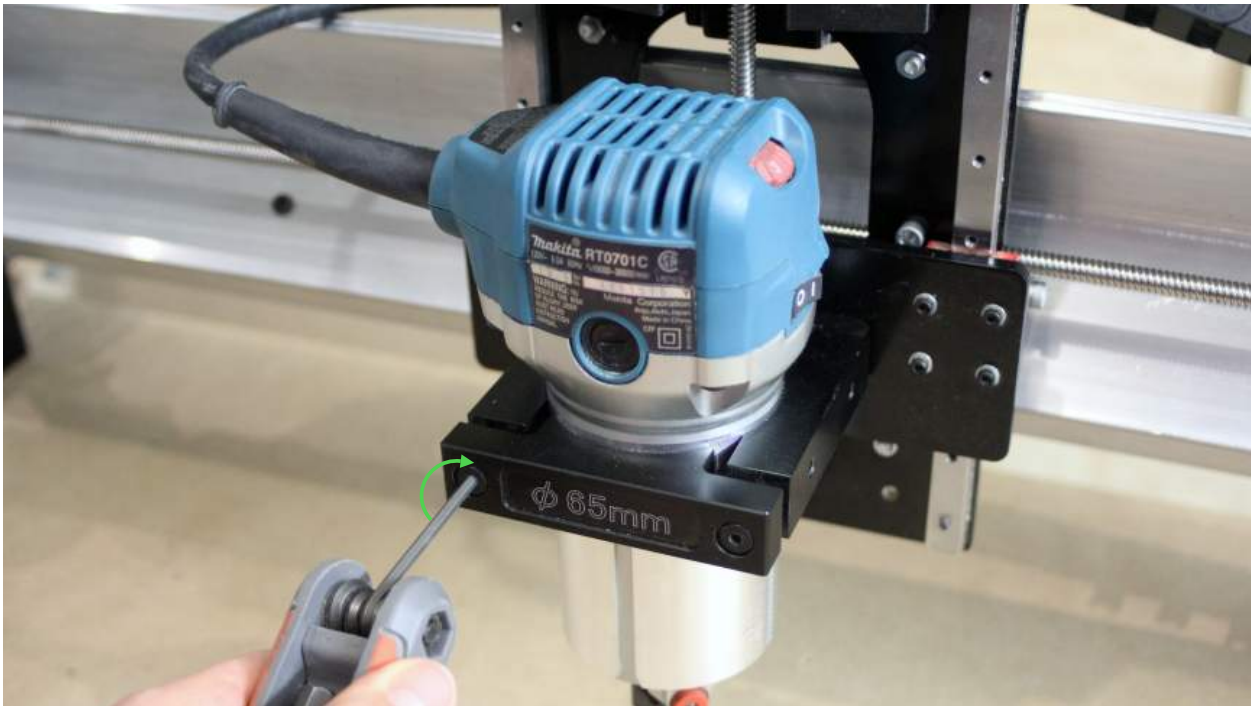
All of the tabs unclipped and ready for wiring

At this stage, it's a good idea to grab the router you'll be using with your machine. We'll show these steps using the Makita RT0700 / RT0701 trim router that we recommend. Also, grab the paper-wrapped motor wires while you're at it.

Get your router and motor wires to start wiring the machine

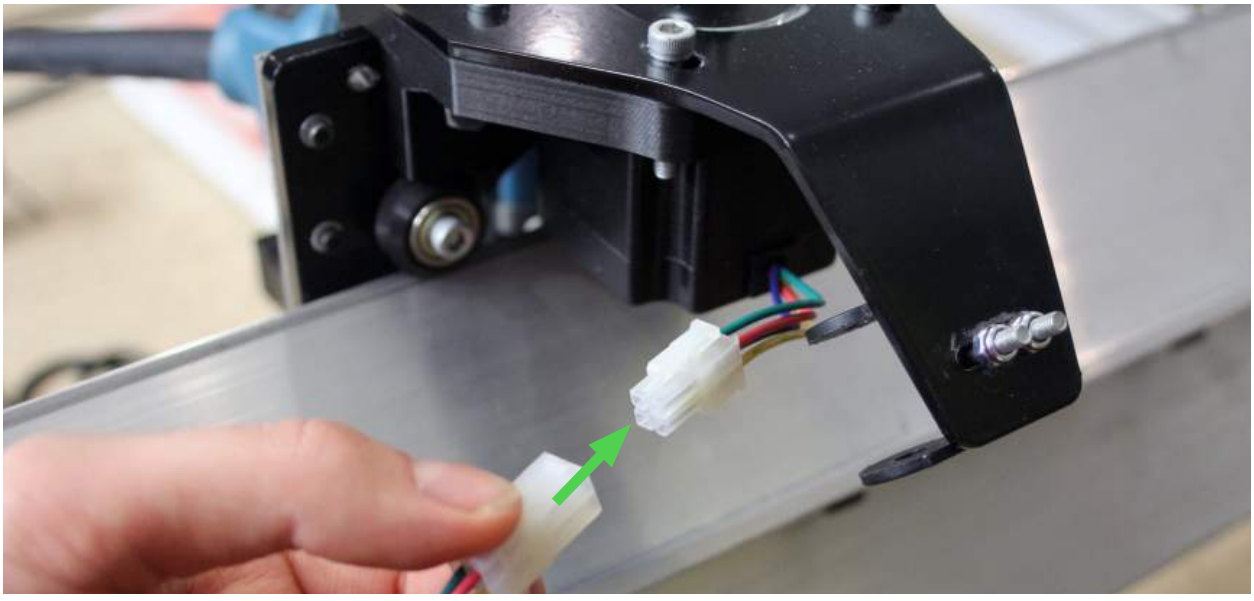
To mount your router, simply loosen off the two front bolts until you can fit the router in the mount, then tighten back up again to secure it. You can adjust the height later if needed.

We recommend going back and forth between the two bolts to keep them parallel; and make sure not to over-tighten them. If you do over-tighten these bolts and start to strip the bolt head, these bolts can be substituted with the M5 bolts that came with your machine if you have any extras. It's also best to face your router power cable towards the right side (pictured) since the dust shoe hose port sticks up on the left side of the router mount.

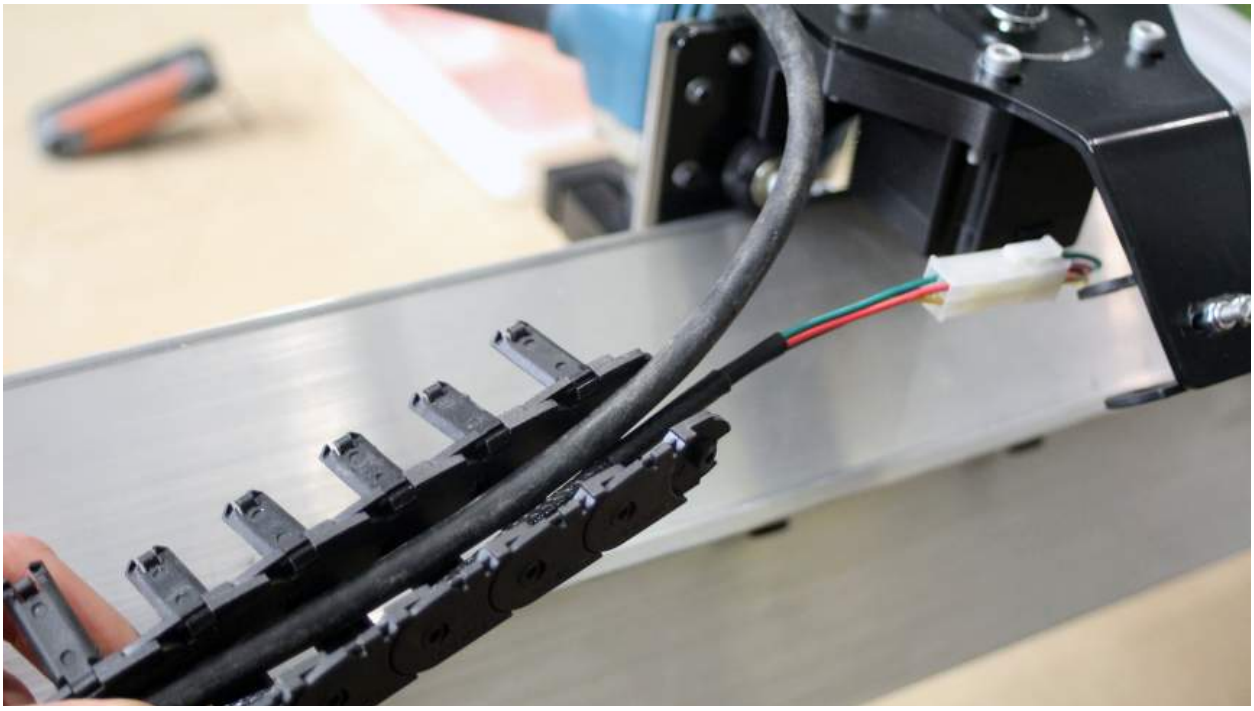


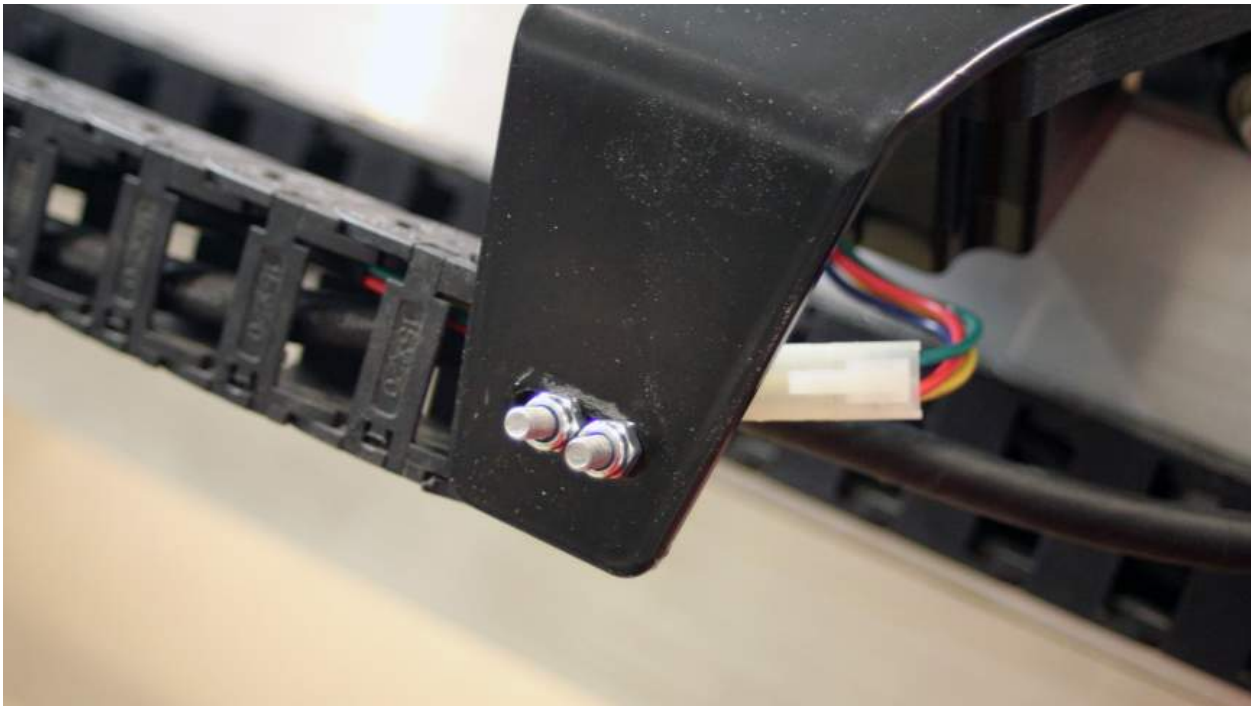
Mount your router with the power cable facing right

Grab a motor cable and connect it to the Z-axis NEMA 23 motor. The cable bundle is designed to only go in one way, so find the orientation where the connector attaches with ease.



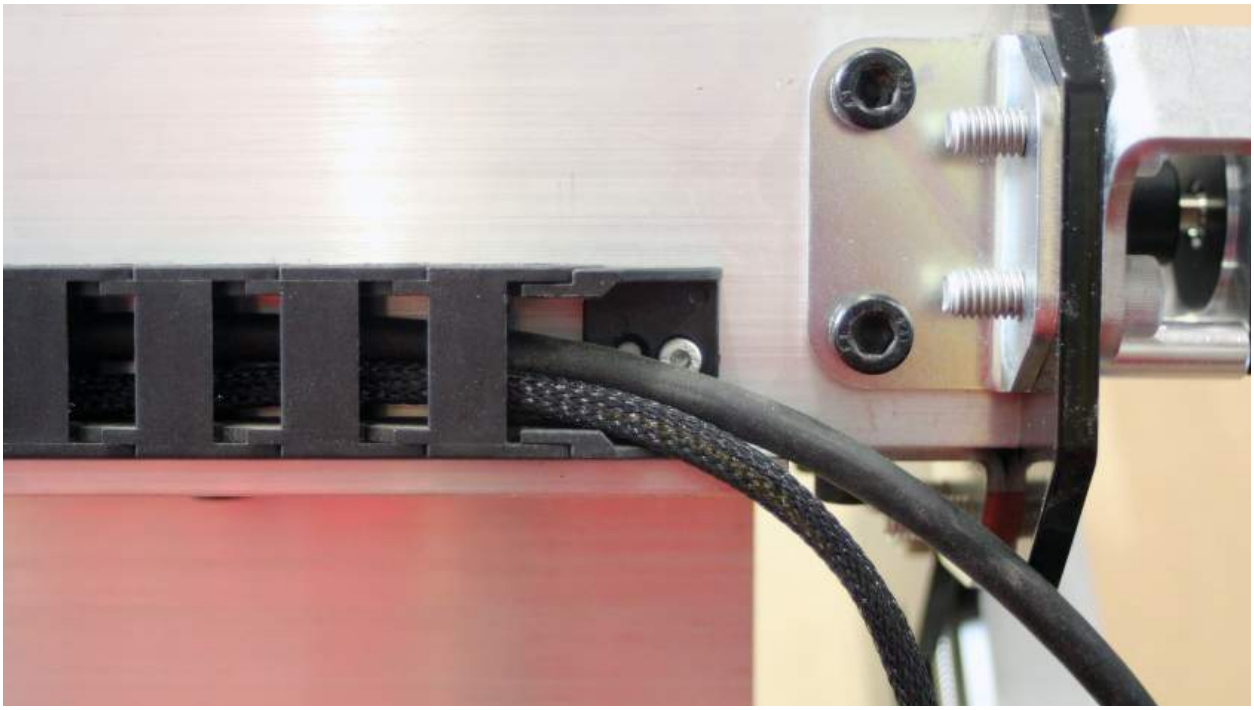
Grab the drag chain for the X-axis (the longer one for the 30×30) and seat the Z-axis motor and the router wire into the drag chain. Make sure that you have the correct end of the drag chain (with a pin-type link) so that you'll be able to connect it to the mounted end link (pictured), and so that the drag chain can bend in the right direction against the X-axis. You can start to re-clip the tabs in place.



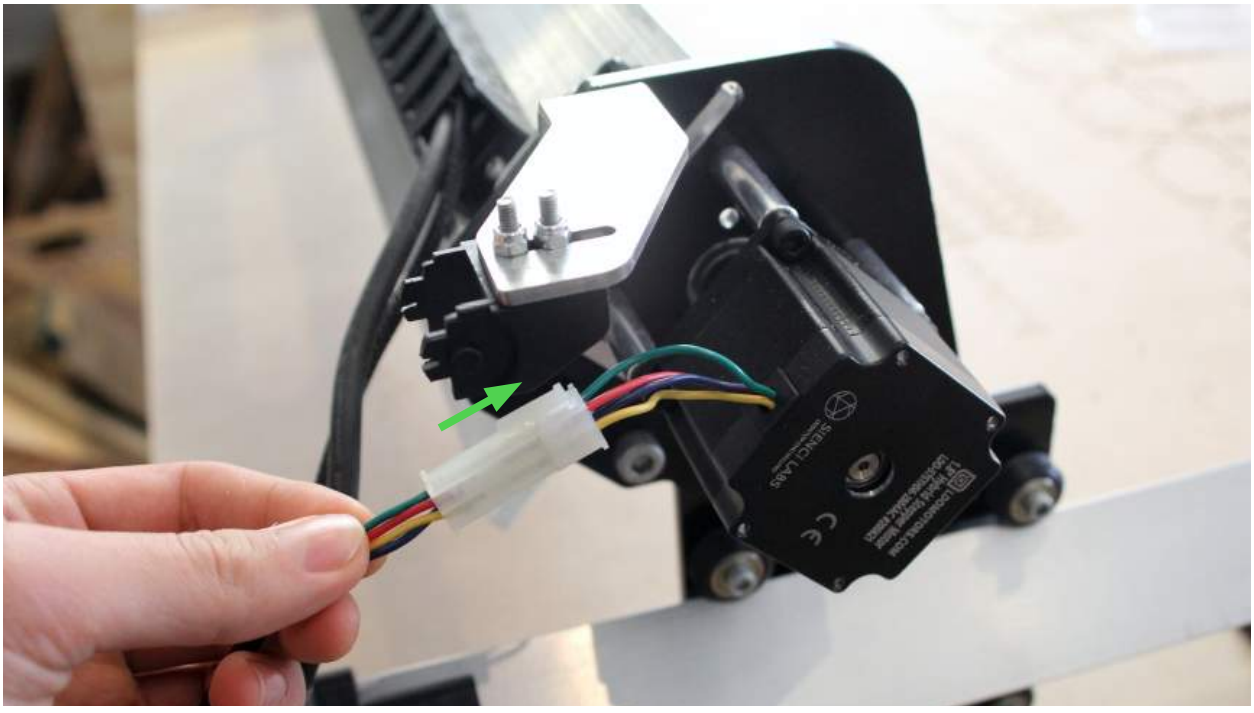


Clip the end of the drag chain to the end link on the Z-axis mount

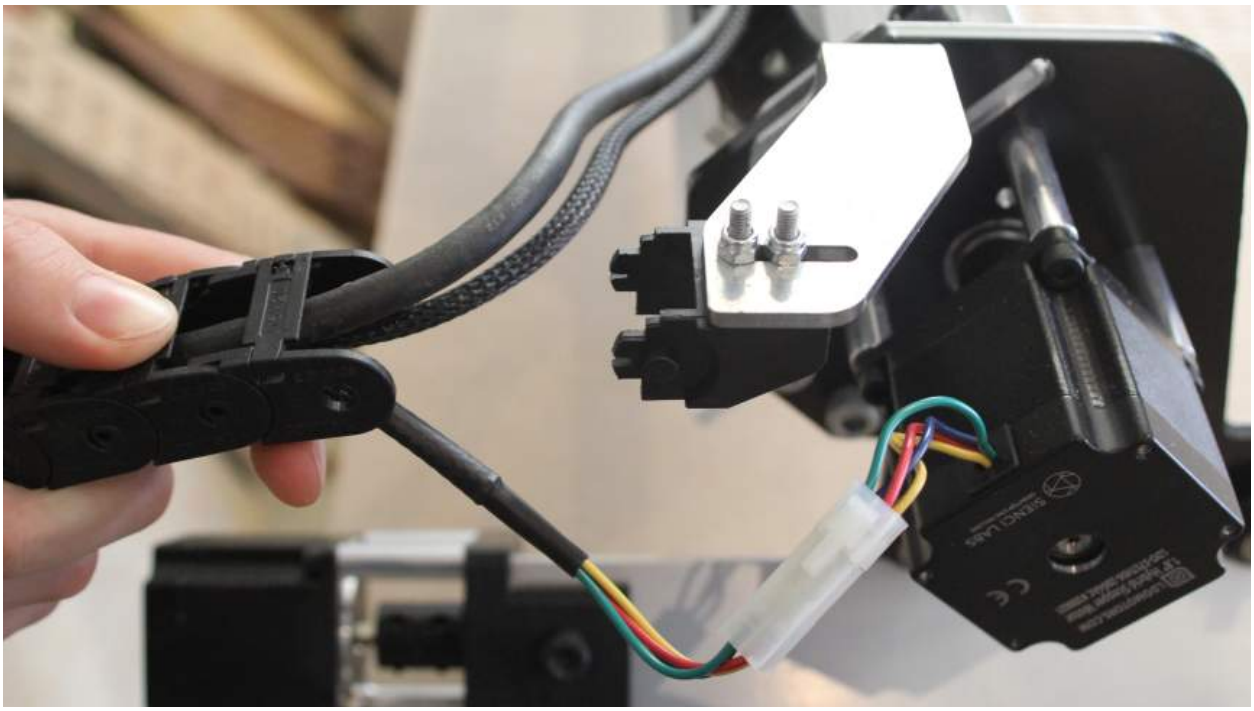
Swing the drag chain and clip it onto the end link attached to the X-axis rail. Pull the wires through.



Now attach a motor cable onto the X-axis NEMA 23 stepper motor.

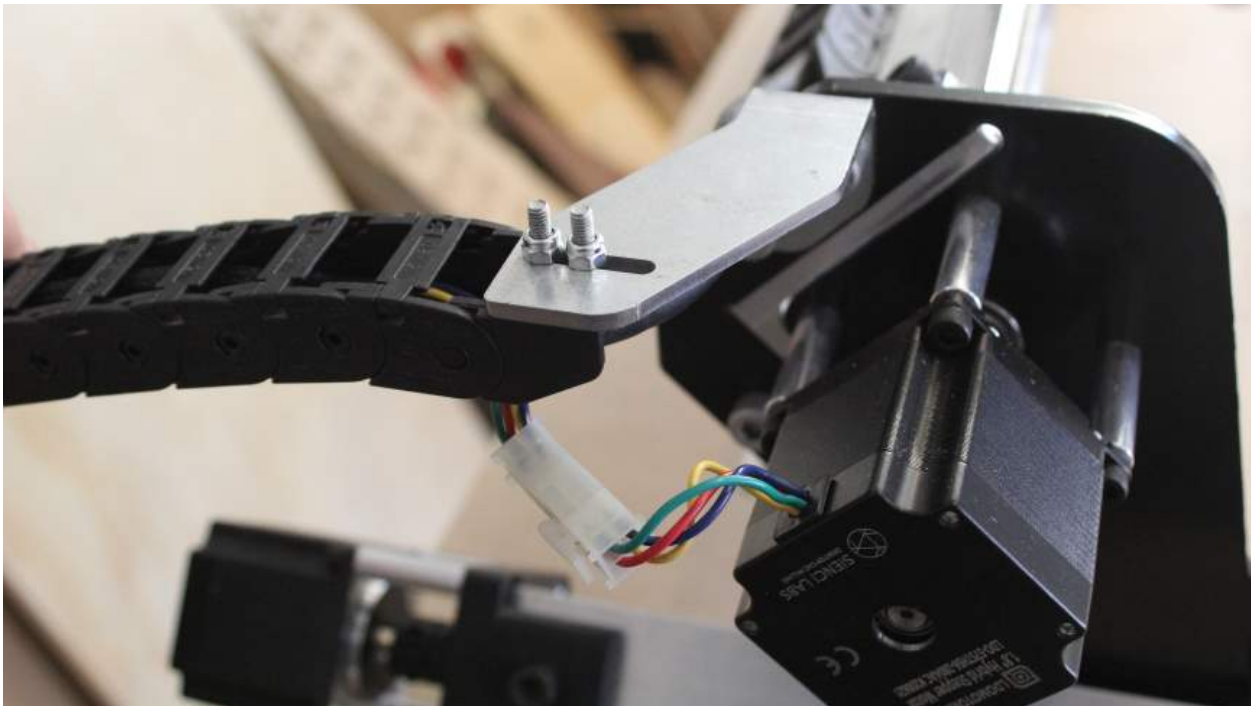


We will take the cable from the X-axis NEMA 23 stepper motor and the Z-axis NEMA 23 stepper motor, as well as the router cable and insert it into the Y-axis drag chain. Clip the tabs in to secure the wires, and make sure that the drag chain is facing the right direction (with the hole-type link, pictured) to fit into the correct end links.



Grab the Y-axis drag chain and insert the X and Z-axis motor cables and router cable

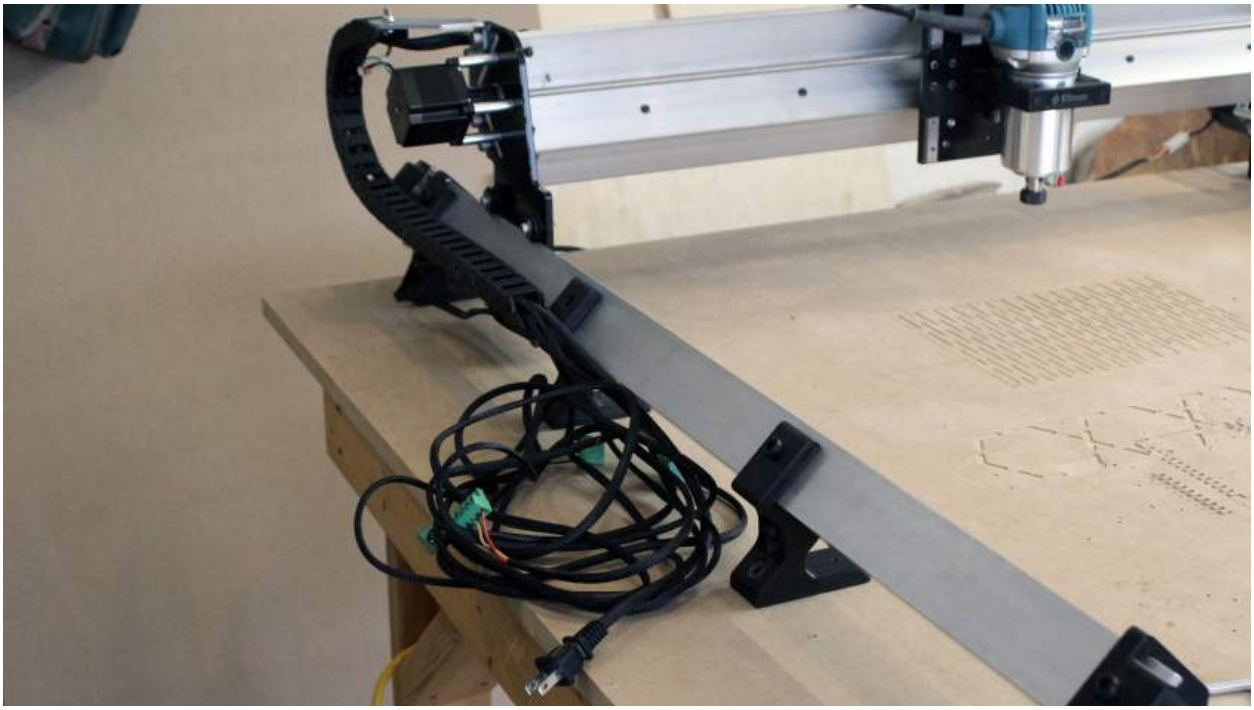
Clip the both ends of the drag chain into the previously mounted end links on the Y-gantry and the drag chain foot.



Now plug in the cables for the motors on the two Y-axis NEMA 23 stepper motors.

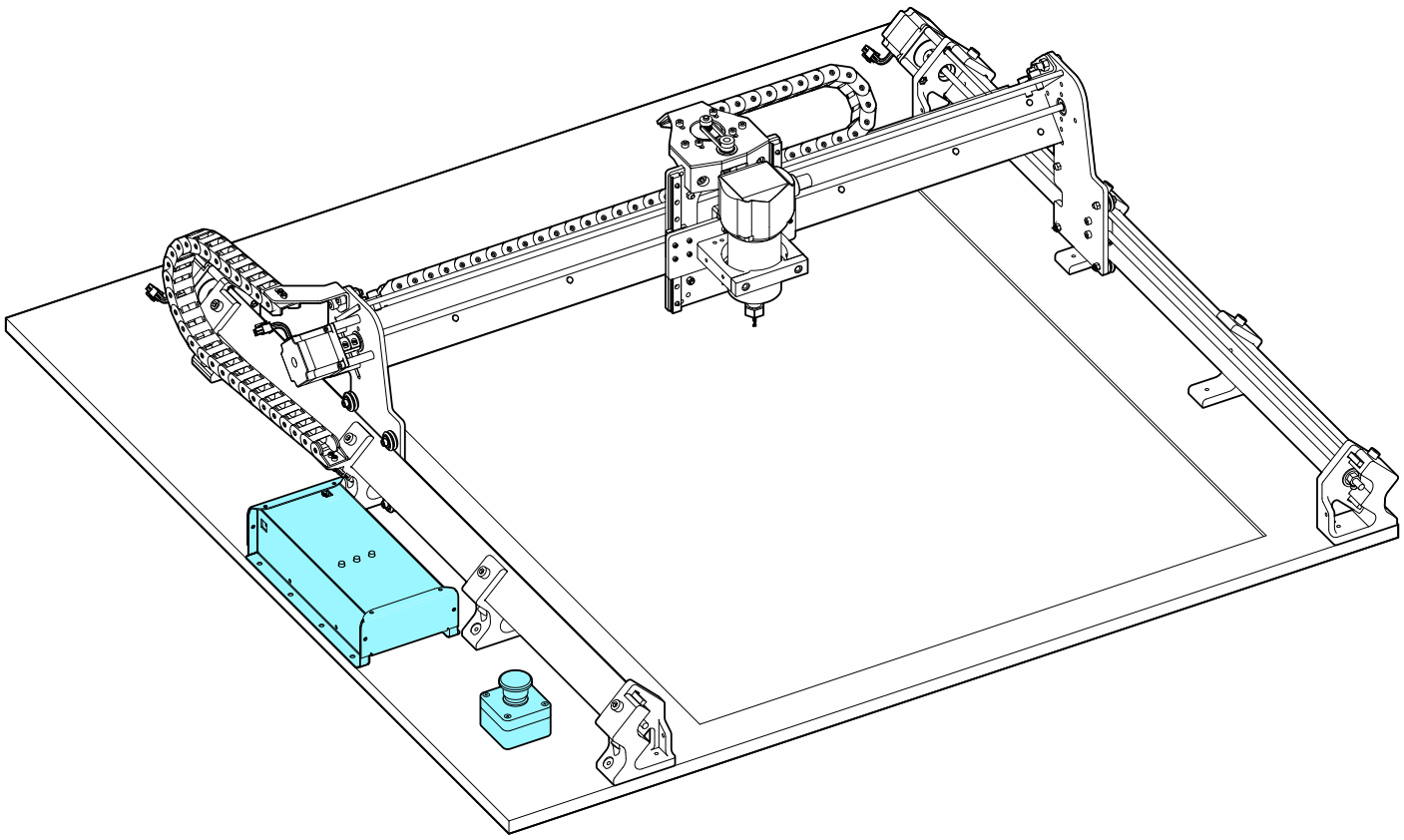
Bring the cables around to the left of the machine and slot them into the wiring cutouts in the drag chain foot.

With all of the wiring coming in from the left, he machine wiring should now be complete.



Part 6

Electronics



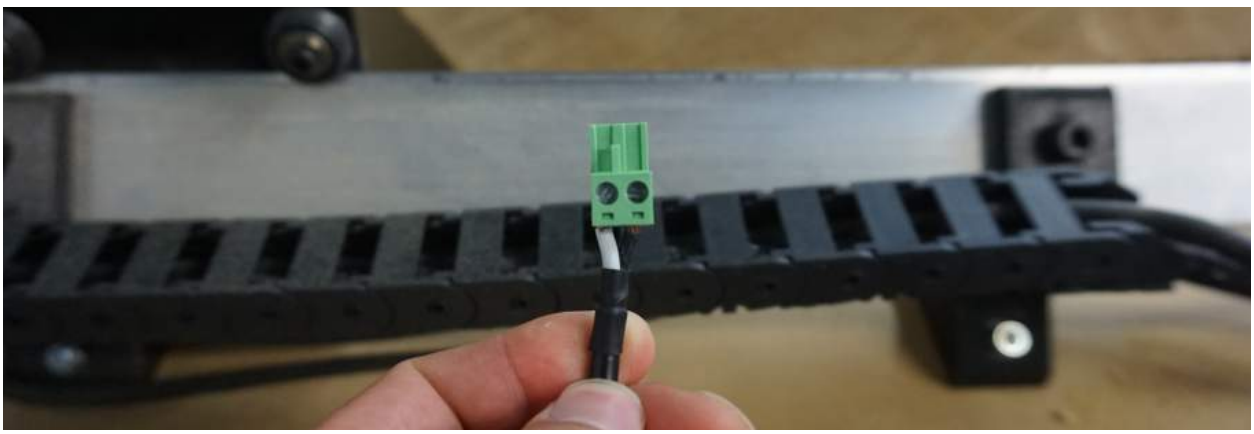
The LongMill electronics come pre-assembled and are pretty much ready to go out of the box. However, we recommend double-checking a few things before powering-on.

DC power supply connector polarity and E-stop connector

It's important that the connector coming from the DC power brick has a white or red wire on the left side and a black one on the right when the screw terminal is facing you (as pictured). Both this connector and the connector coming from the e-stop should have the wires attached very securely. The order of the wires going to the e-stop connector don't matter.

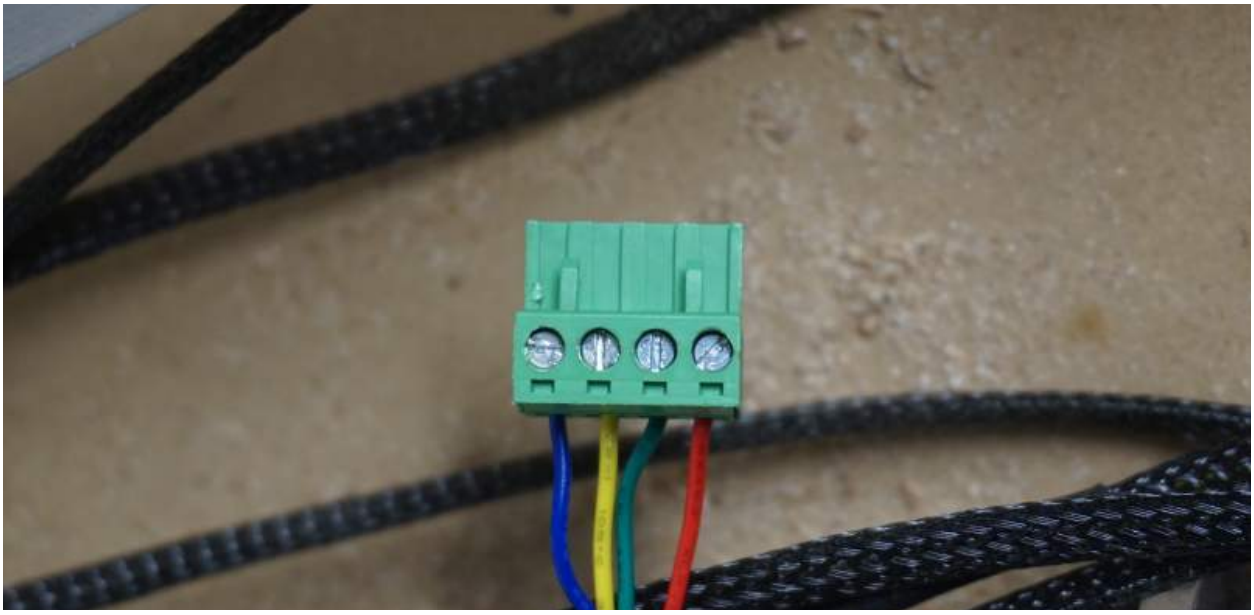
Check that the wires are connected appropriately by tugging on them. Secure them using the screw terminals and a flat head screwdriver if they're loose or disconnected.

For the DC power connector, if you're unable to get the tinned wire ends to clamp inside the connector securely then consider snipping the wires ends off and removing some more of the wire insulation to reveal a stranded length of wire. Once exposed, stick the wire back into the connector and clamp down onto the stranded cable tightly.



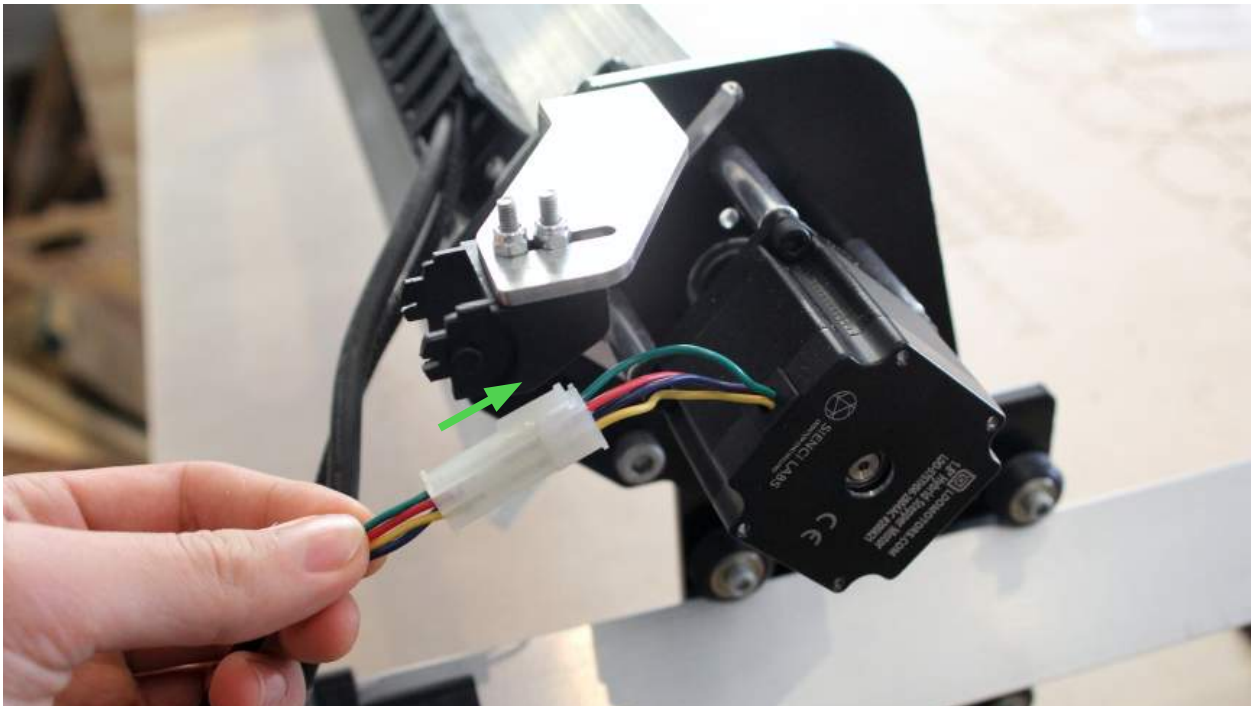
Motor connector wiring

The wires, looking down from the side with the screw heads, should be, from left to right, BLUE, YELLOW, GREEN, RED (pictured). Check if the color pattern on all four of your motor wires is correct and re-arrange them if needed. As previously, also check that the wires are connected securely to the connector.



The wiring color pattern should be blue, yellow, green, red.

While you're at it, double check that the motor cables are pushed all the way into the motor cable bundles to ensure a good connection.

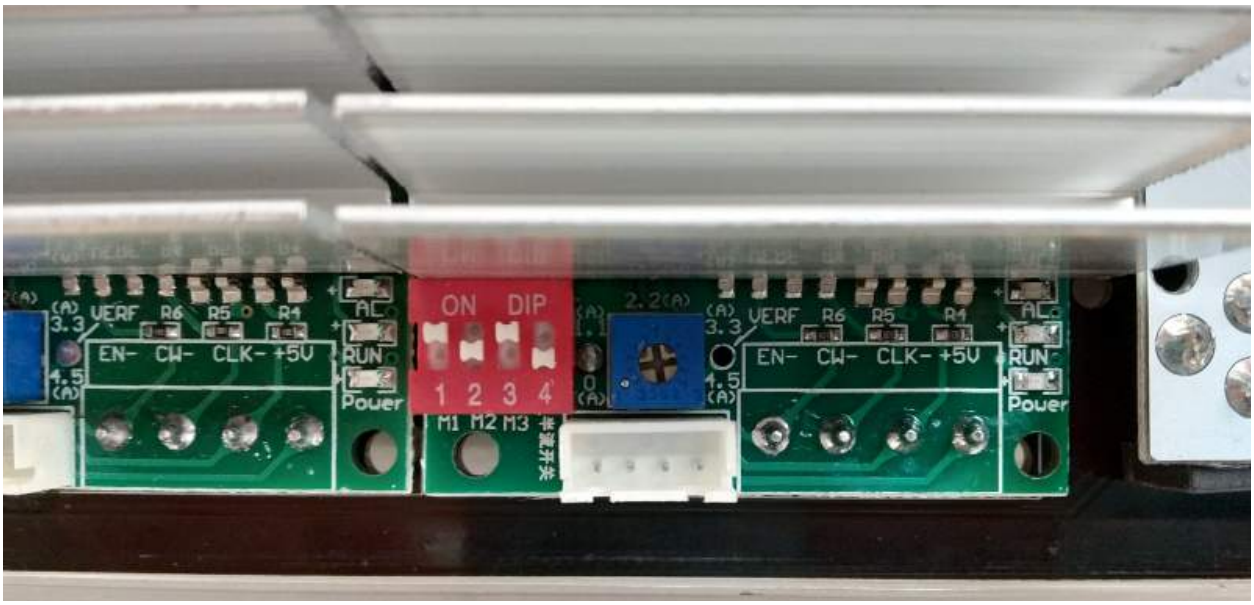


X-axis motor

Properly seated DIP switches

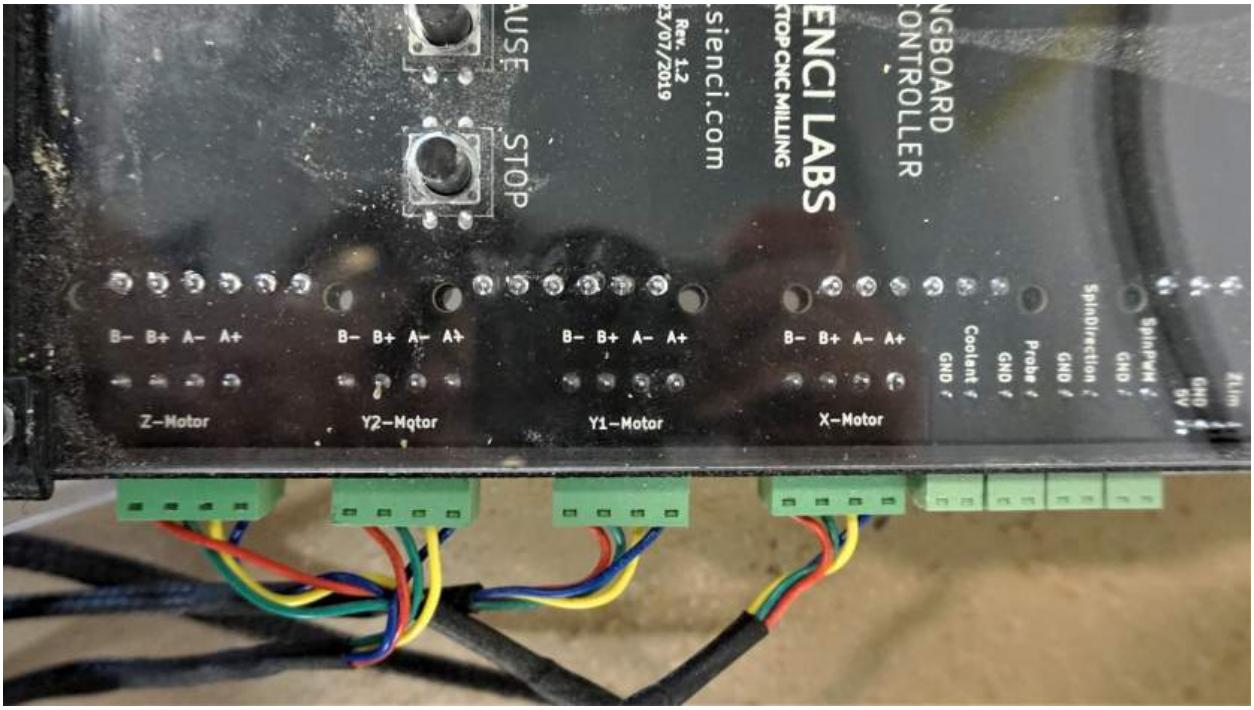
Looking at the underside of the control box, you should notice four red switch blocks on the circuit board through the slots in the steel (pictured). These are a way of toggling how the motors are controlled by their respective motor controllers, where the slots in the steel have been made wide enough so that you can reach in with a small flat head screwdriver or an allen key to adjust these switches without dissembling anything.

These DIP switches normally **look** like they've been properly switched when in reality they're 'floating' between the up and down positions, as is the case for switch 2 in the picture below. Because of this, it's a good idea to push every single switch into it's correct position before moving on to the next step, putting switches 1 and 3 into the 'up' position and switches 2 and 4 into the 'down' position (pictured).

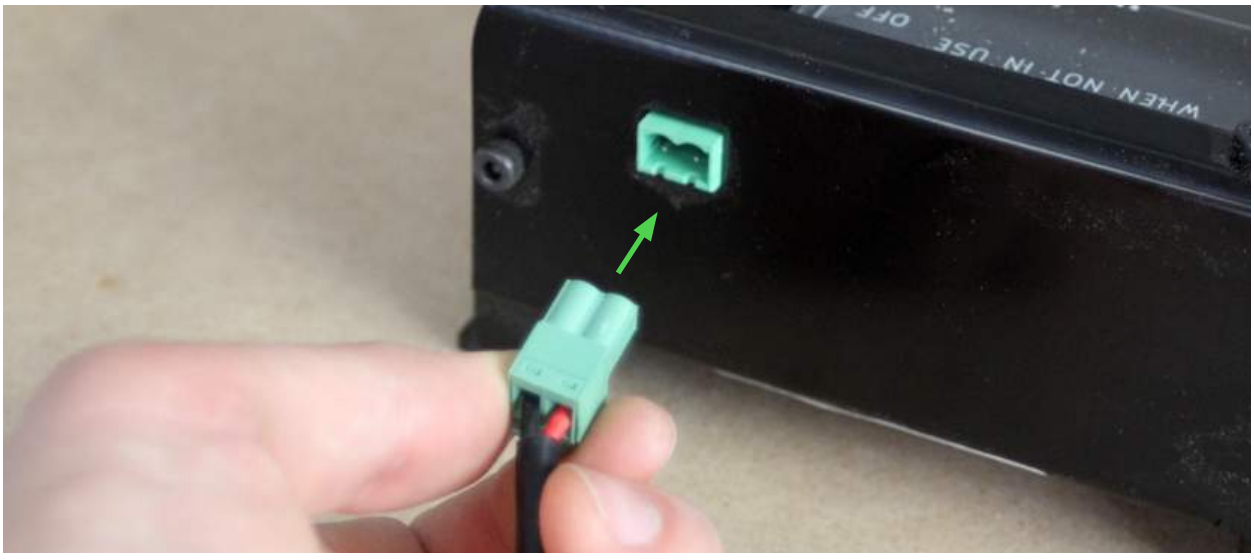


Plugging in the motors and power supply

With these checks done, start by connecting the motors. Track each cable from each motor to its corresponding green connector and connect it to the board. The fit of these connectors is tight but you need to be sure to push them ALL THE WAY in so that there is good contact between the plug and the connector. Each plug on the board is labelled on the top (note that there isn't a difference between the Y1 and Y2 plugs, the Y-axis motors can be connected to either of them).



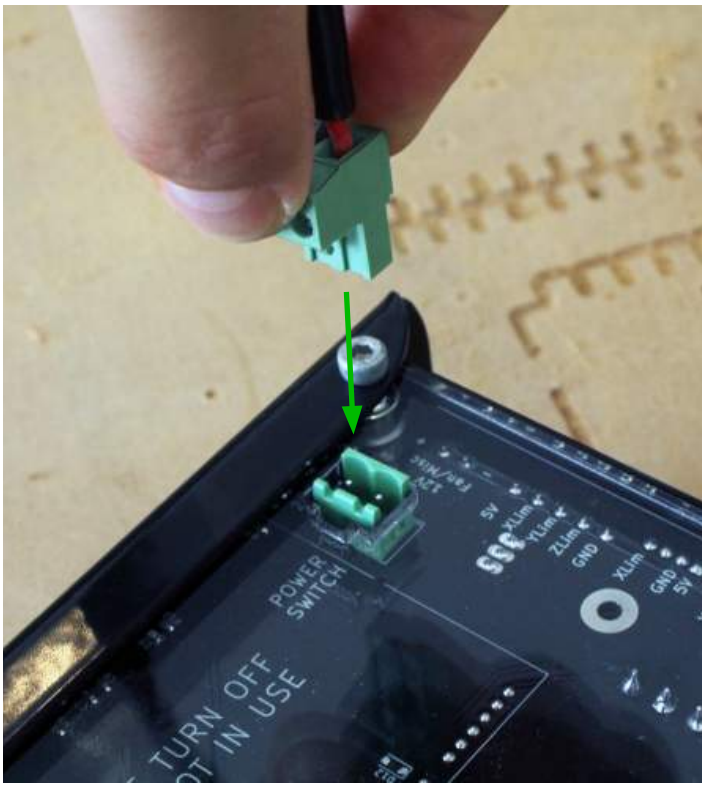
Next, plug the DC connector into the LongBoard before plugging the power supply into the wall; a green LED on the power supply brick should light up to indicate that it's receiving wall power.

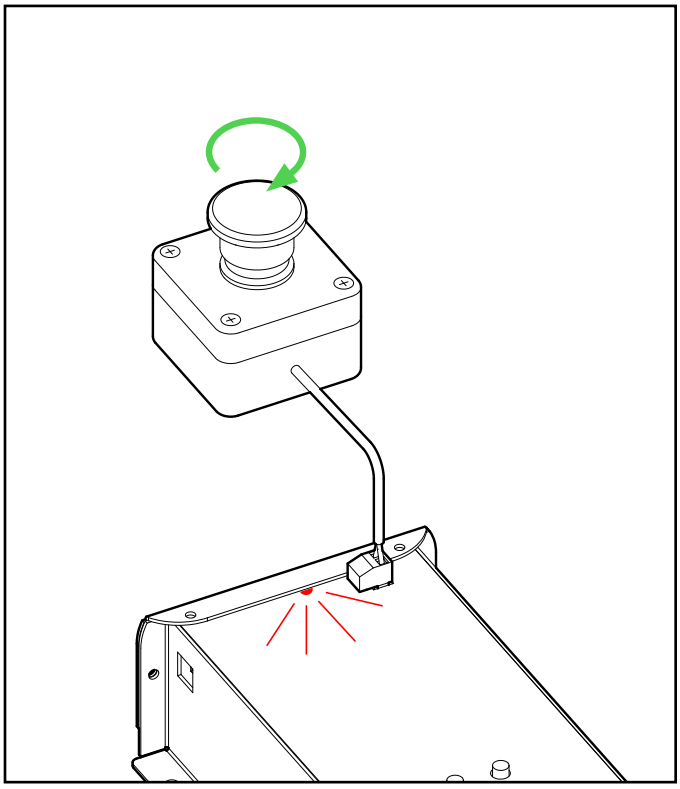


Now, Connect the emegency stop button to the control box. Turn it on by rotating the button clockwise. You should see a red light on top of the box light up to confirm that everything is receiving power.

Once you've checked that the lights are turning on, press the button to turn it back off.

A note on the control box is that it will be limited in it's placement due to the length of the Z-axis motor cable. If you wish to place it further from the machine, extending the wires for that cable is quite straightforward either through the use of a soldering iron or through crimp-able wire extenders.





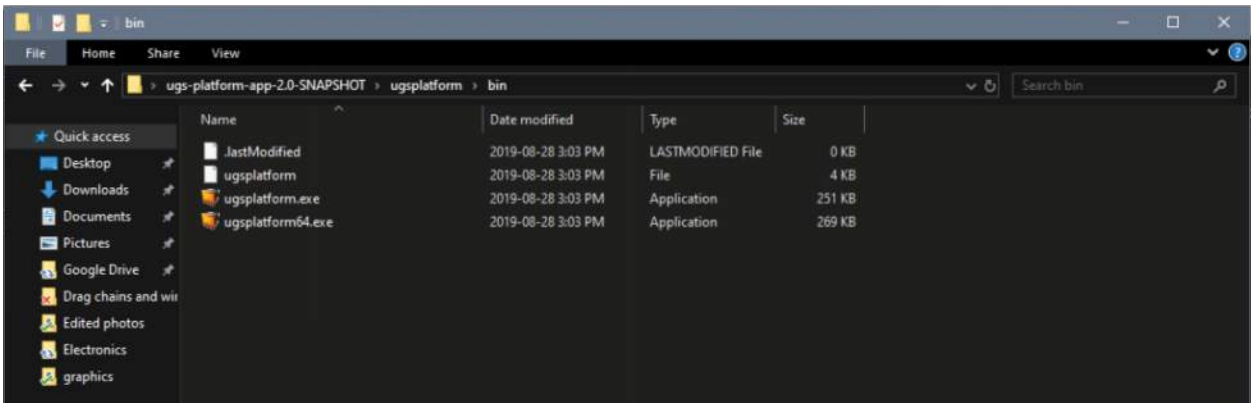
Connecting the LongMill to your computer

To manipulate your LongMill and send it files, you'll need a g-code sender which acts as the control software. We recommend using UGSPlatform, which is what we'll be using to show the next couple of steps and in the remaining part of the assembly. You can download UGSPlatform here: bit.ly/2Z3DIVC

Note: Some users have reported some bugs with the latest version (Dec 2019) of UGSPlatform. We recommend users to use the August 2019 version of UGSPlatform.

UGSPlatform works with any operating system (MacOS, Windows, Linux) that has Java installed. Most computers come with Java installed but if you don't have Java, you can download and install it here: https://www.java.com/en/download/

Once you have UGSPlatform downloaded: locate the downloaded file, 'un-zip' or 'extract' it (usually found when you right-click the file), then open the "ugsplatform" folder. There will be a folder inside called "bin" which will look like this once you open it up:



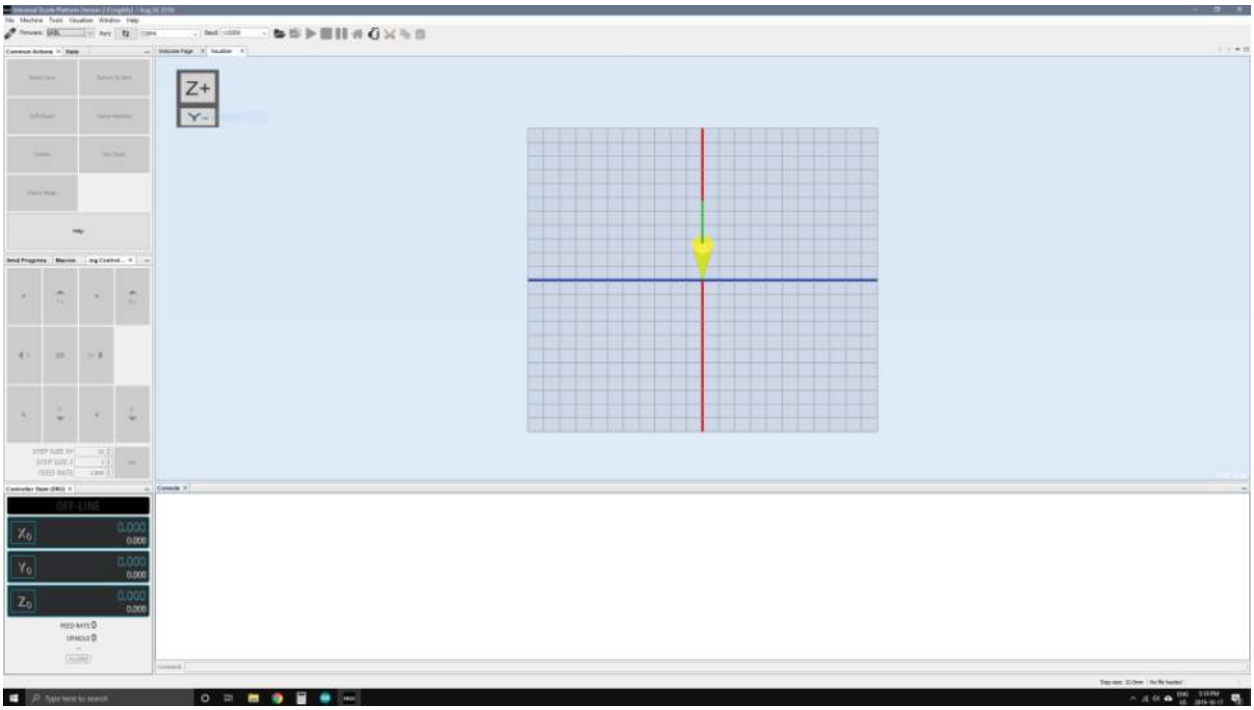
If you are using a 64 bit Windows computer, use **ugsplatform64.exe**

If you are using a 32 bit Windows computer, use **ugsplatform.exe**

If you are not sure which type of Windows you are using, you are most likely using a 64 bit computer. You can try both and see which one starts.

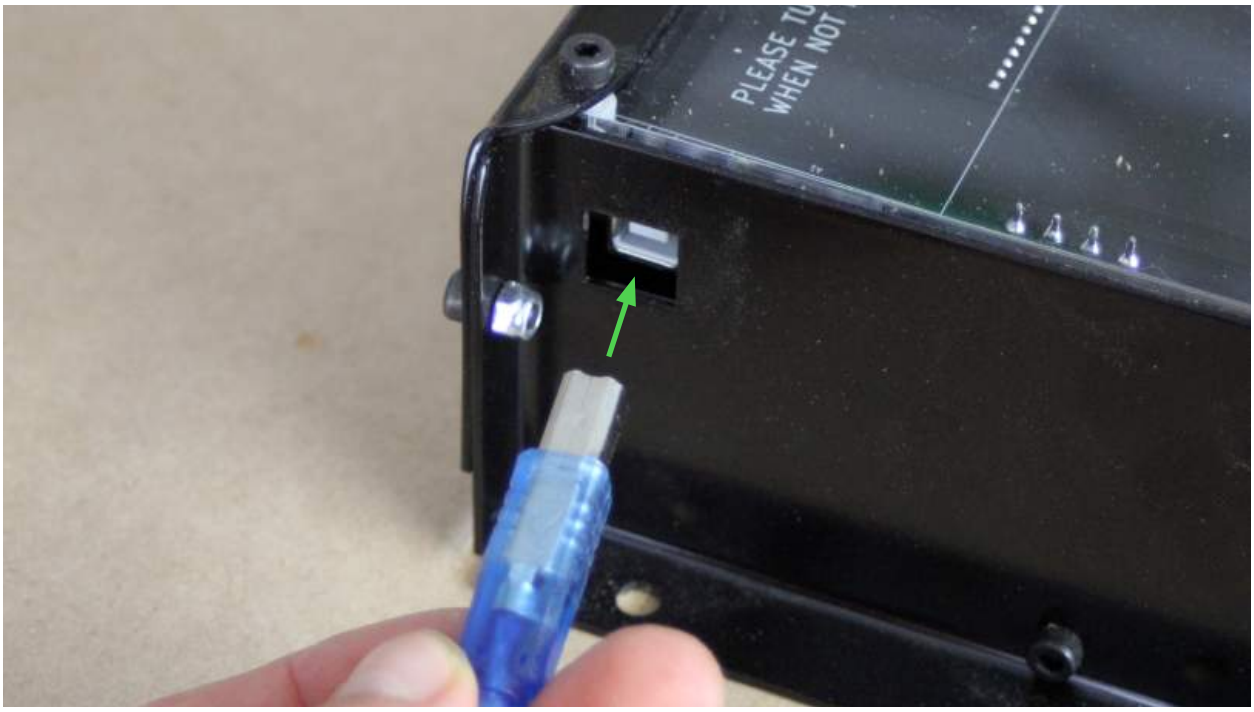
If you are using a Mac OS computer, use ugsplatform.

You should be greeted with a screen that looks like this. If you aren't and you encounter an error while opening UGS because it's not able to locate Java, then there is another program on your computer blocking UGS from opening properly; see the general fix for this here.



Connect your computer to the LongMill control box via USB.

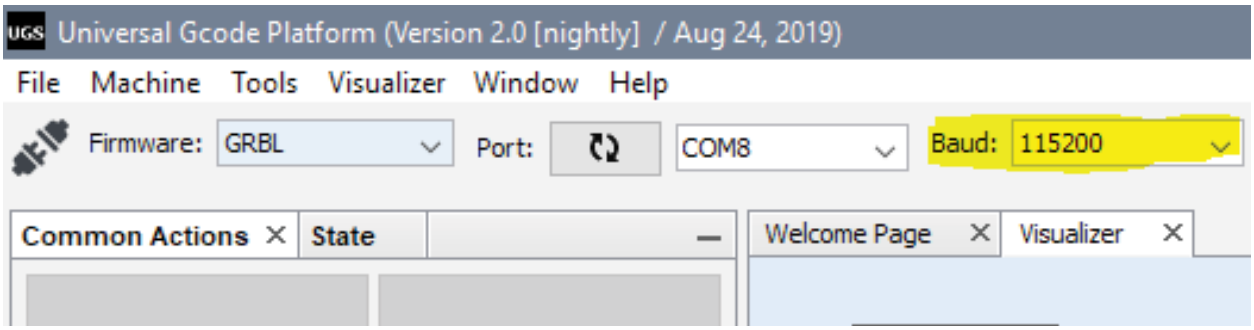
Note: Your computer will automatically install drivers for the Arduino at this point if they are not already on your computer (can take a minute or two). If you try to connect your machine but you cannot, you may need to manually install the drivers. You can do this by installing the Arduino IDE which will install the drivers during the installation, or you can follow the instructions on doing them manually for Windows.



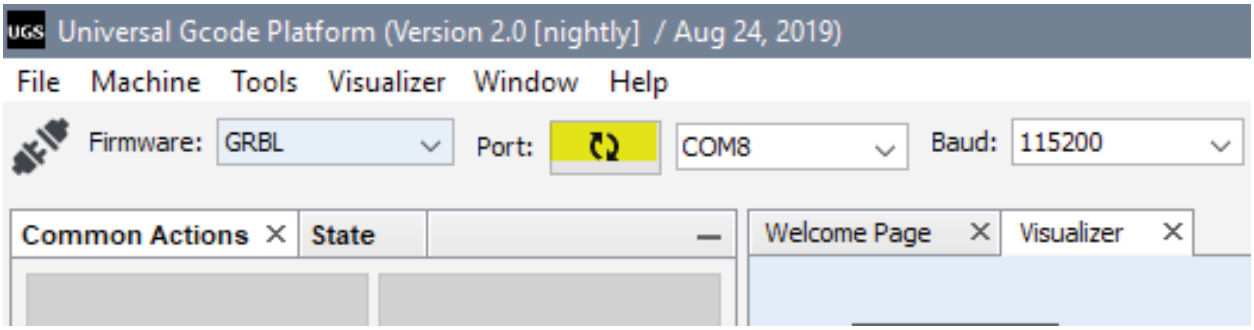
Plug in the USB cable onto the LongBoard.

Connect your USB cable to your computer.

Once that is done, go to the top left corner of the program. First, make sure that your baud rate is set to 115200.

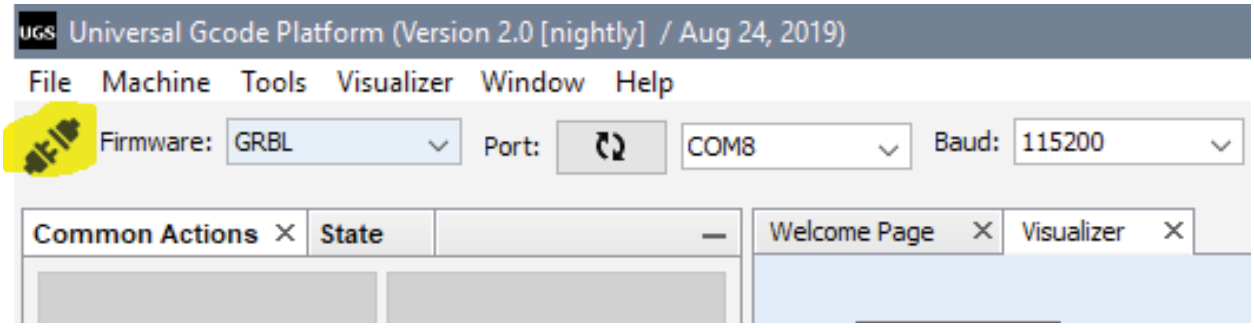


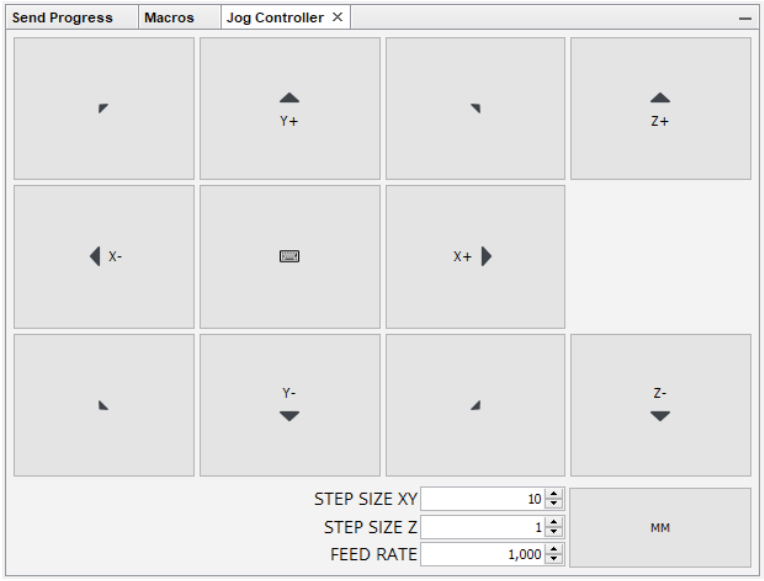
Then click on the refresh icon. This will go through and auto-detect which USB port your machine is connected to. If you have multiple things connected to your USB ports, you may have a few different options to choose from. You can either unplug the other items you have plugged in, or you can try connecting to each one to see if they make a connection.



At this stage, power on your machine.

Finally, click on the highlighted “Connect” button. If your machine connects successfully, you should see this icon turn orange and you should see in the console output a message like “Grbl 1.1g [‘$’ for more help]”





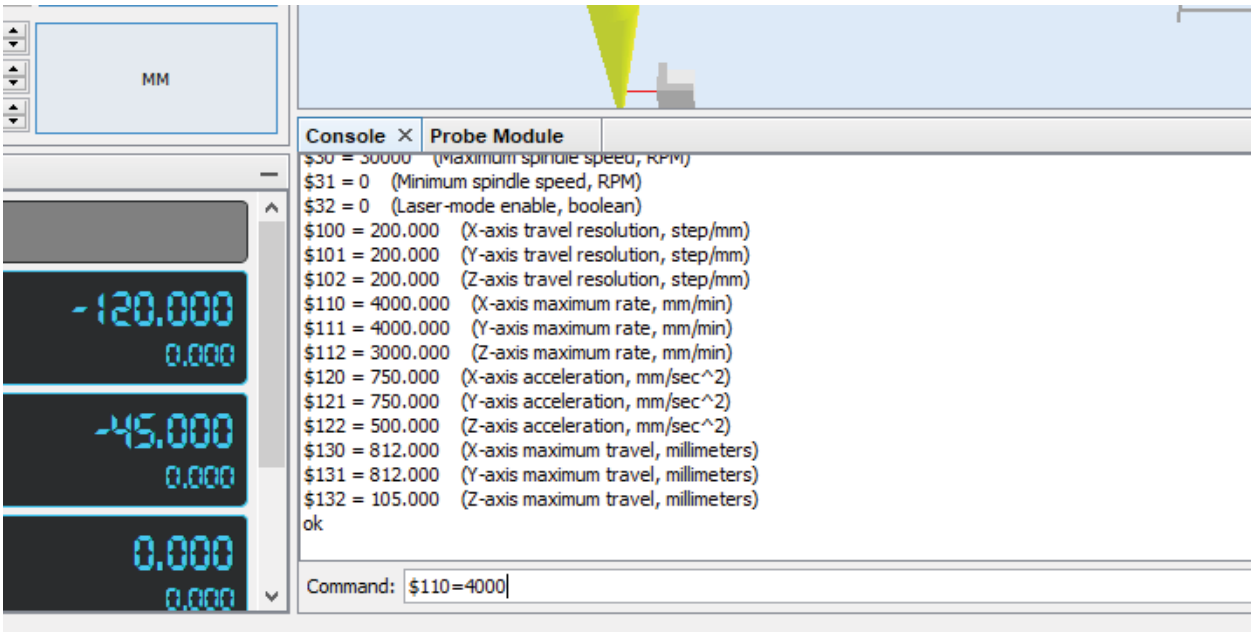
You will usually hear a gentle hiss and a thump noise when the machine connects. If so, you can now try playing around with moving the machine. You can jog the machine in the direction you want within the “jog controller” window.

You can choose the amount that the machine will move in the XY directions by changing the “STEP SIZE XY”, the amount in the Z direction with “STEP SIZE Z”, and the feed rate with the “FEED RATE” boxes.

We recommend starting with 10mm for the XZ and 1mm for the Z step size, as well as 1000mm/min for the feed rate. You can adjust this as needed.

Moving the machine around will be important for when we mount the machine to the wasteboard next!

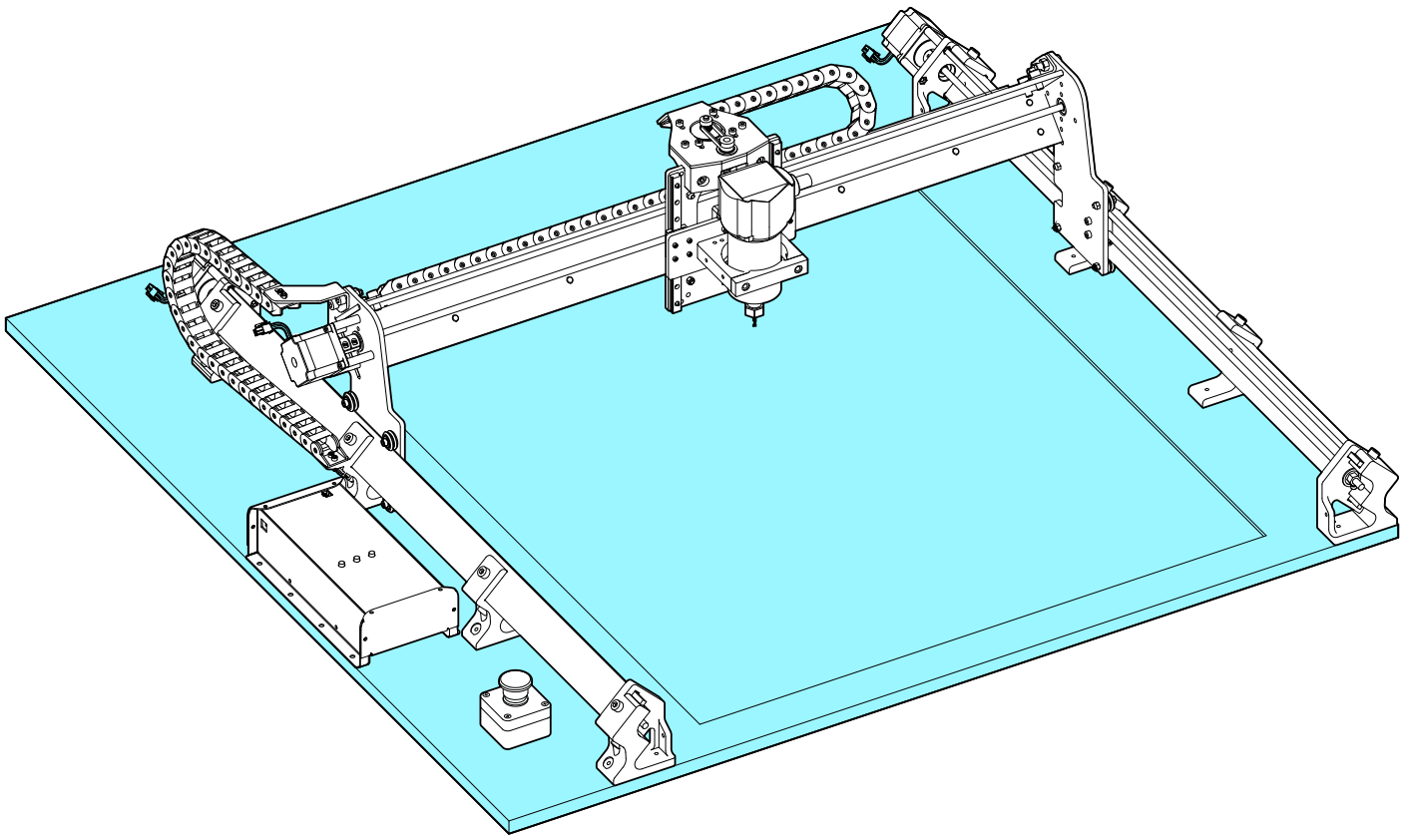
Note: Once you’ve connected to your machine via UGS or your preferred interface software, go to the console communication tab and type in: **“$110=4000”** and hit the ‘Enter’ key. This will modify the maximum feed rate of the X-axis to being 4000mm/min which we’ve found will help it to run more reliably. If you’d like to know more about this recent fix, see our post here: https://forum.sienci.com/t/fixing-the-x-axis-torque-out-issues/332



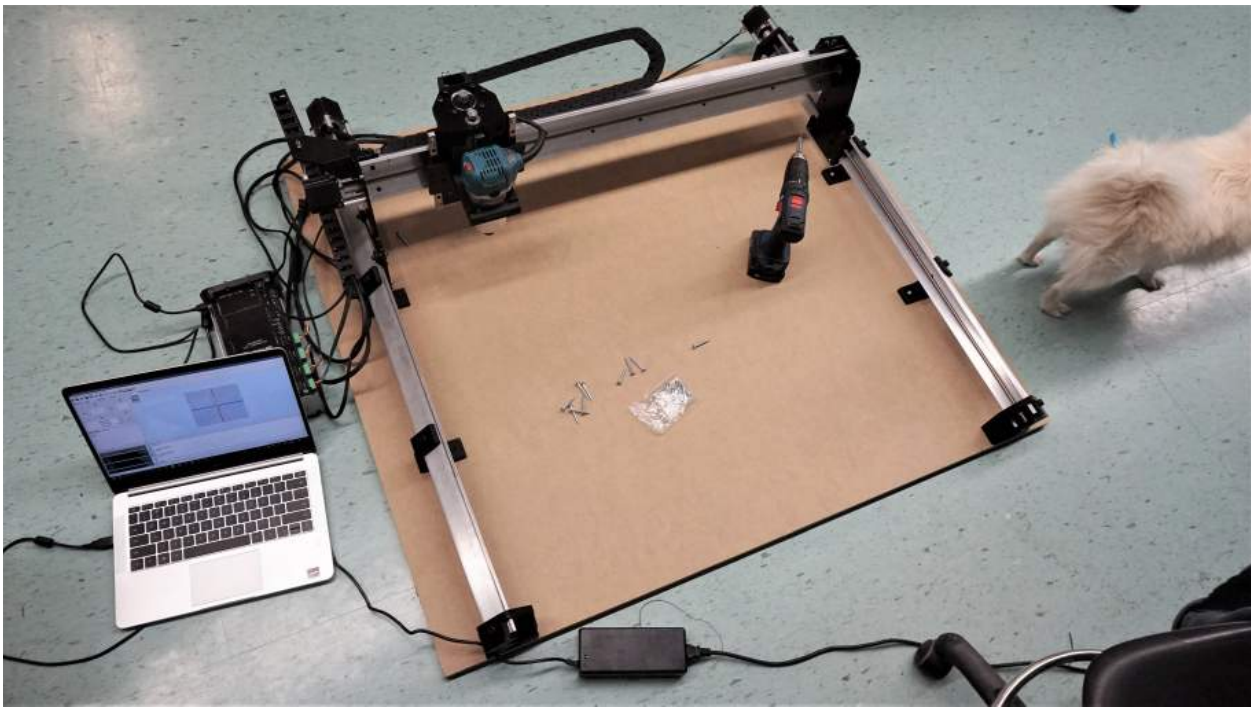
Anyway, on to the wasteboard mounting!

Part 7

Table Mounting



The LongMill is designed to be mounted to a flat surface which is provided by the user. This could be as simple as a single sheet of material, or as intricate as a multi-piece torsion table with t-tracks and threaded inserts. One thing is to ensure that you've got a flat sheet (or multiple flat sheets) of material within the cutting area of the machine. This "wasteboard" area is where the material you will cut will sit on and serves to be cut into and replaced when needed.



We do not ship LongMills with a wasteboard because:

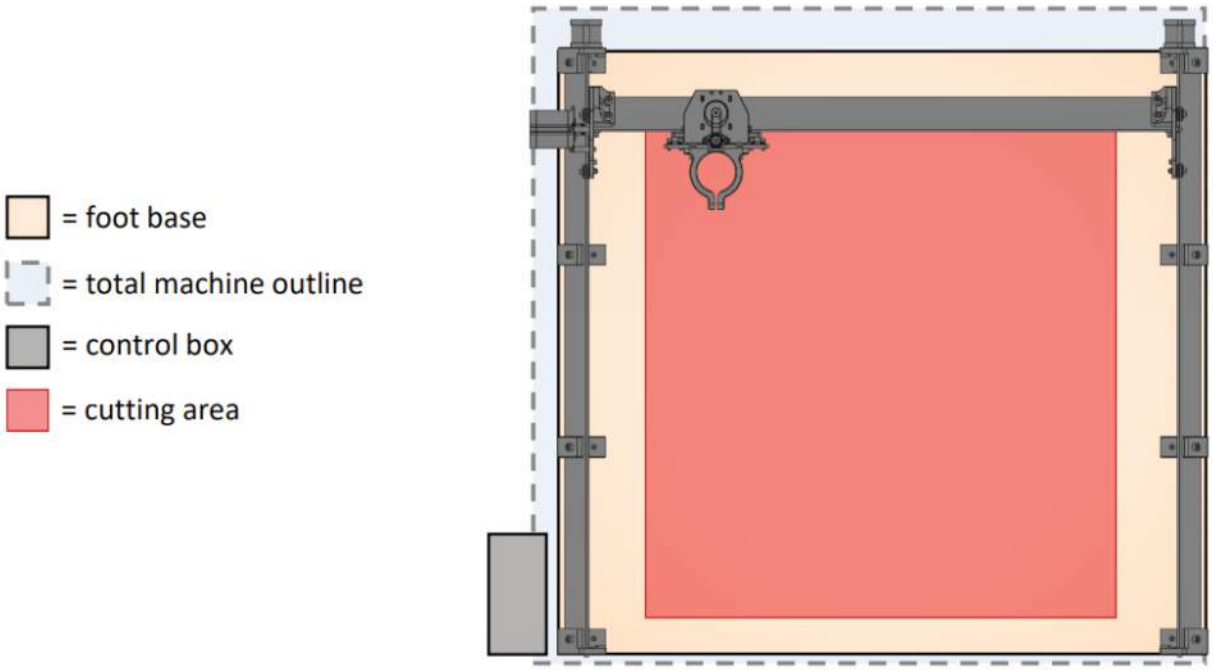
1. It saves the cost for shipping. For example, a 4ftx4ft piece of 3/4" MDF shipped often costs over a hundred dollars in shipping and is very easy to damage during transit. You can usually find a full 4ftx8ft sheet of 3/4" MDF for under $60 at your local lumber or hardware store.
2. Users can choose the size and material of the wasteboard to match their needs.

Suitable wasteboard materials

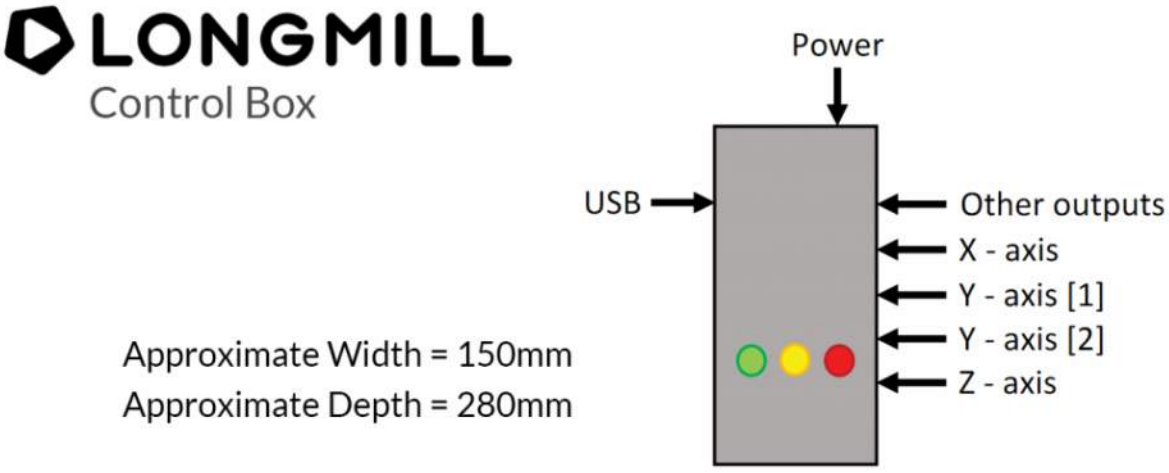
The easiest setup that we recommend is a flat, clean piece of 3/4" MDF to act as your mounting surface and your wasteboard. This is because 3/4" MDF is quite stiff and is readily accessible in 4'x4' and 2'x2' sizes from most big-box hardware stores or a lumber store. Any similar piece of thick, flat material would also suffice; you can choose at your own discretion. If you're looking for more of a flashy setup, you can check out some of our community members' table/wasteboard builds here for inspiration: https://sienci.com/dmx-longmill/community-table-builds/

Machine Dimensions

When getting ready to mount your LongMill, the most important dimensions you'll need to know are the size of its foot base and the total outline of the machine. As long as your mounting surface is at least the size of the foot base and you've left enough space around your mounting surface to account for the total machine outline, then your setup will be suitable.



The control box is also something you should plan for, as the design of the machine favours placing the control box on the left side of the machine whether it's sitting on the table or mounted to the side or underside of the surface. The control box has buttons on the top which can Play, Pause, and Stop the machine's motion so it's a good idea to keep it mounted near your CNC. It also has a USB input on the left side, motor and other outputs on the right side, and the power input on the back side, so make sure to keep some space around it for cable management.

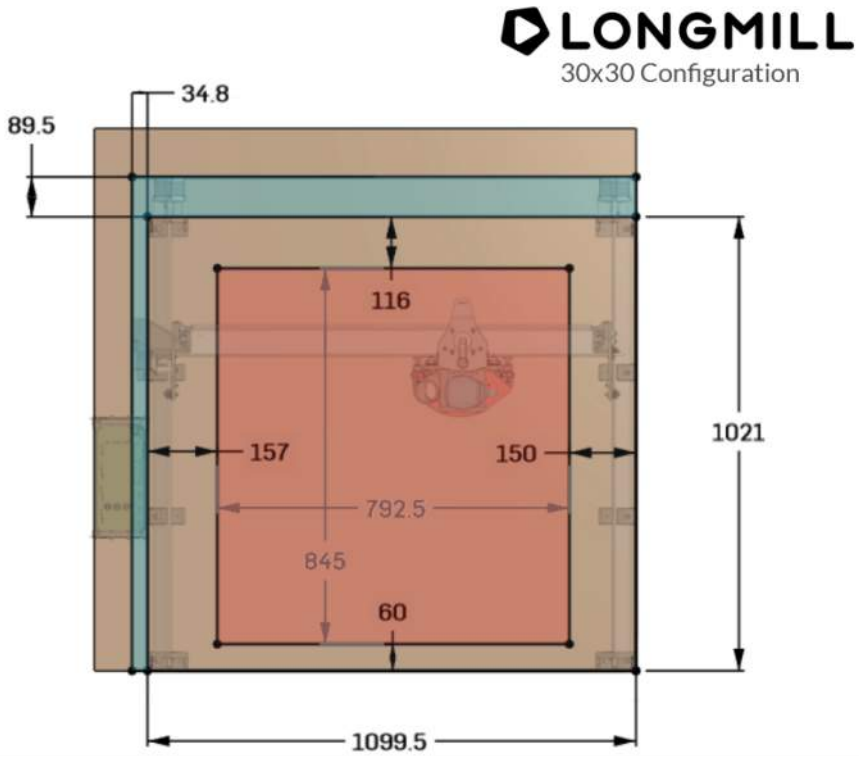


Generally, the sizes of each model of the LongMill have been designed to fit on the following surfaces as follows:

- LongMill 12×12: Fits on a 2ft x 2ft surface
- LongMill 12×30: Fits on a 2ft x 4ft surface
- LongMill 30×30: Fits on a 4ft x 4ft surface

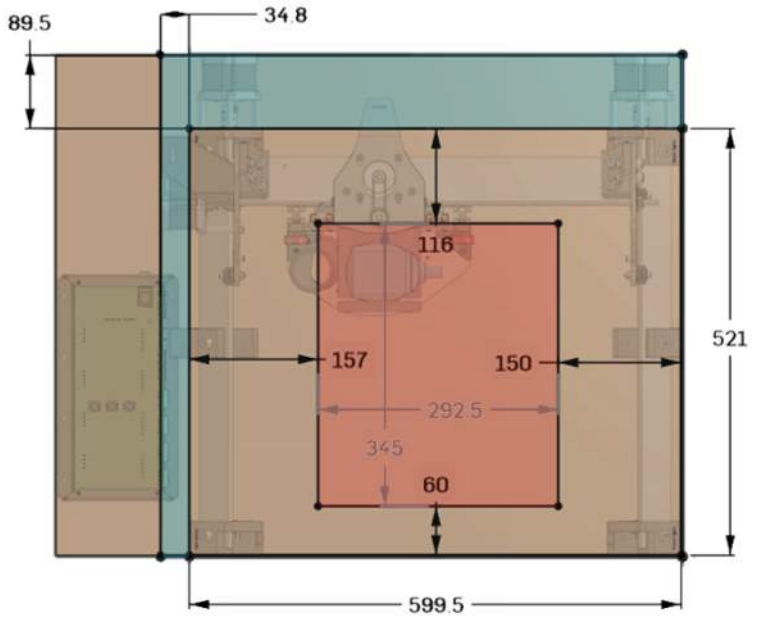
The diagrams below shows a more detailed view of each of the important dimensions. Note that:

1. The **red area** inside the main box shows the cutting area as an offset from the foot base
2. The **blue area** outside the main box shows the hanging parts as an offset from the foot base which makes up the total machine outline
3. The area taken up by the control box isn't accounted for in this diagram
4. If you have our **dust shoe** attached, your cutting area in the X-dimension will be shrunk by approximately 50mm (about 22.5mm off the left side and 27.5mm off the right side)
5. The width of the foot area is determined by the distance between the middle feet (not the front and back feet) since the middle feet sit slightly wider than the front and back feet do
6. The red cutting area is based about the center-point of the router, thus you can plane an area larger than what's stated if you're using a large surfacing bit (add your bit diameter to the width and depth of the cutting area to find the maximum)
7. These diagrams have got a small buffer on the cutting area (i.e. it's been shrunkened slightly) since each part has its own manufacturing tolerance and can come together differently in assembly so we want to ensure we're providing a reasonable guarantee on what can be expected from your machine
8. Although the working height of the LongMill is approximately 350mm, if you're planning an enclosure then we'd recommend having a height of 500mm at the minimum to ensure enough space for hose management, manipulating cutting material, etc."



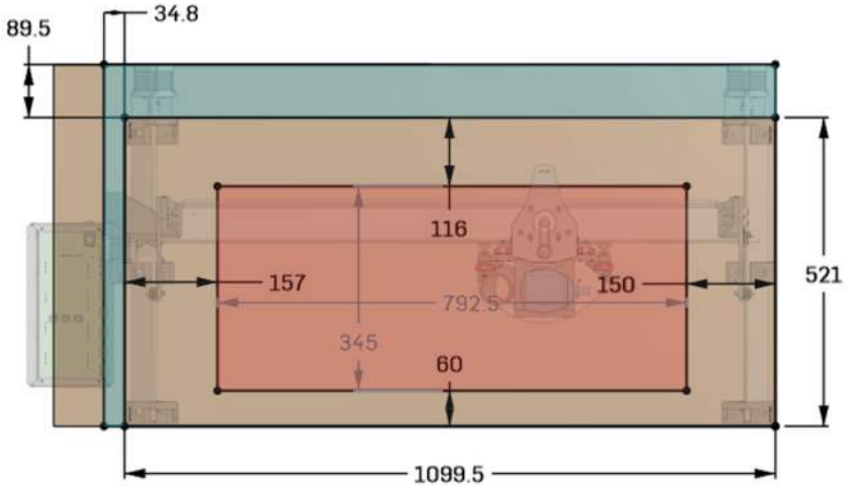
LONGMILL

12x12 Configuration



LONGMILL

12x30 Configuration



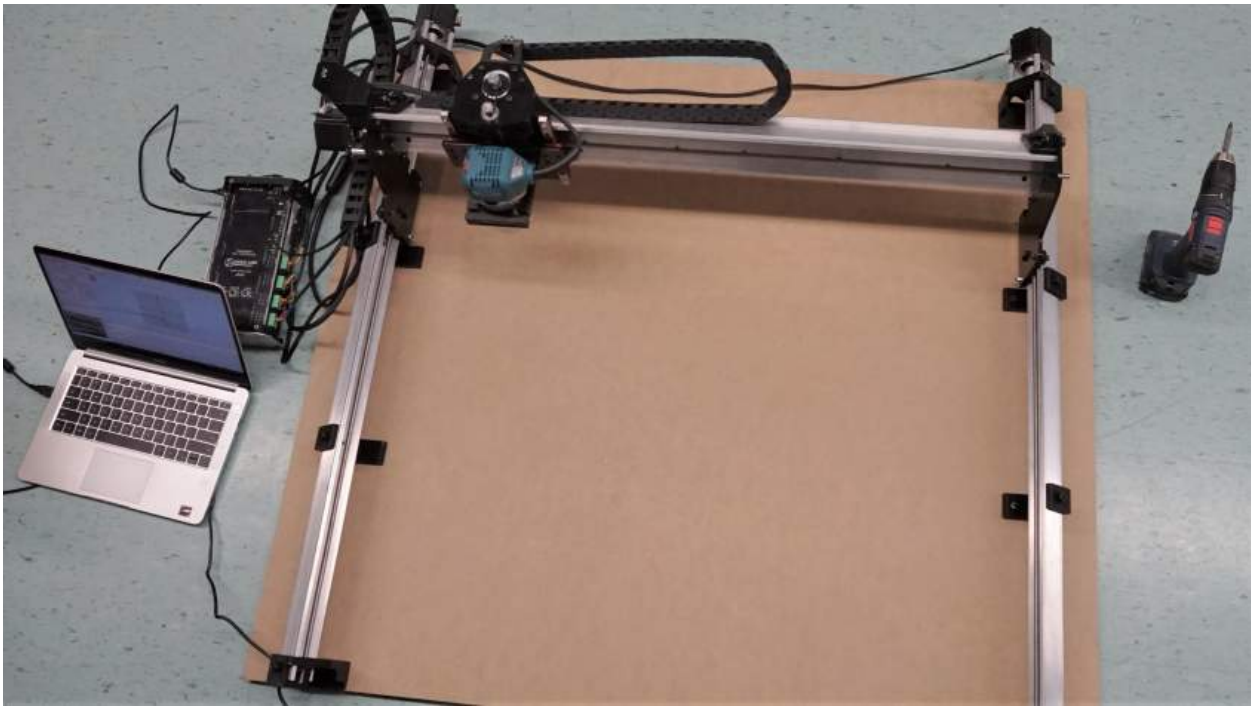
Mounting your LongMill

To ensure that your machine is mounted securely and accurately, we've created a series of steps to help you do so. We highly recommend following these steps exactly, as the order of these steps matter. You'll need a computer to be connected to the machine in order to align it properly.

We will start by checking the tension of the Delrin v-wheels. As we did in the previous steps, we want to make sure that the wheels barely turn with our fingers by adjusting the eccentric nuts.

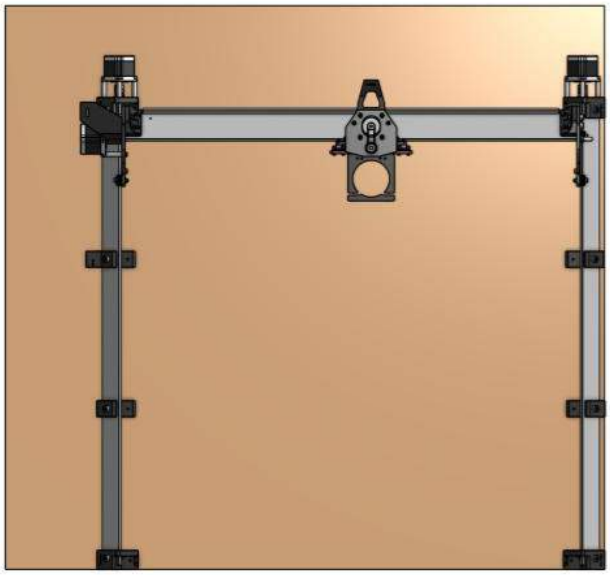
We will also properly tension the Delrin anti-backlash nuts. Turn the tensioning screw a little bit at a time. Check for play by moving the gantry back and forth and seeing if there is any excess movement. Do not over tighten, usually a half turn is more than enough.

Gently put your LongMill on the mounting surface and shuffle it over roughly where you want it. In this case we're using a 4'x4' MDF sheet as a combination mounting surface and wasteboard which we had cut to 42 inches to better fit in a car. We'll be mounting it in the middle and have the electronics box sit off the material to the side.



Move the machine onto your mounting surface. Position it to where you want it.

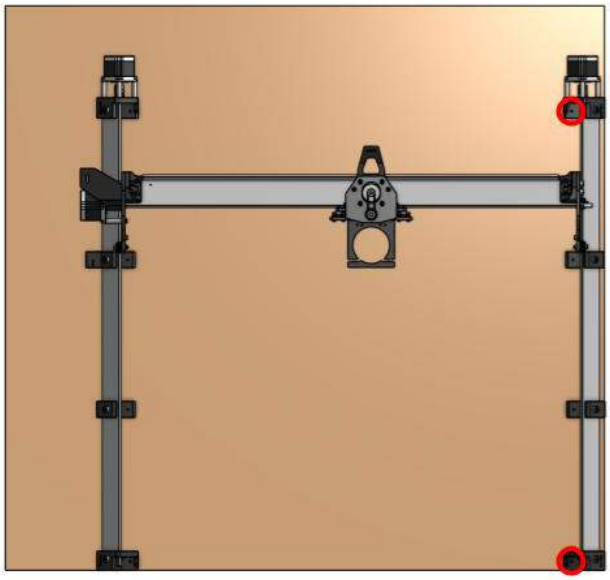
Once positioned, start by moving the machine all the way to the rearmost position by jogging in the y-axis on your control software. Keep moving backwards until you hear a grinding coming from the motors on both sides; this is to confirm that your machine is all the way back and it aligns the left-side feet to the right-side feet.



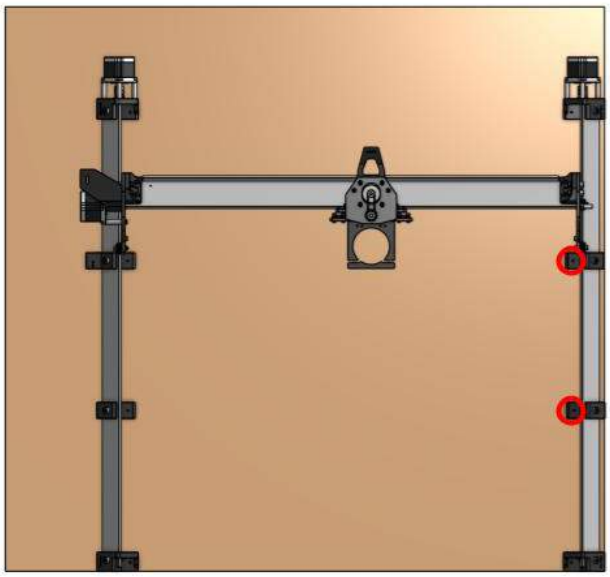
We'll start by mounting the right side of the machine. Using a drill with a long Robertson driver or a short one on a bit extender works best for driving in the screws so that you have the necessary reach. You can use the particle board screws provided, or use your own mounting hardware depending on your material or its thickness, but please ensure that you **don't use counter-sunk wood screws** to attach the feet as this will crack them.

The screws included are 1-1/4", 1-1/2", and 2" size #8 particle board screws. Each foot has two holes for mounting where the shortest screws are meant for the inside and the longer one are for the outside. Please note that the 2" screws WILL go through 3/4" MDF, but were still included since they can hold the LongMill feet down better. If you choose to use them, make sure that the surface under the board will not be damaged if you have screws coming out the bottom.

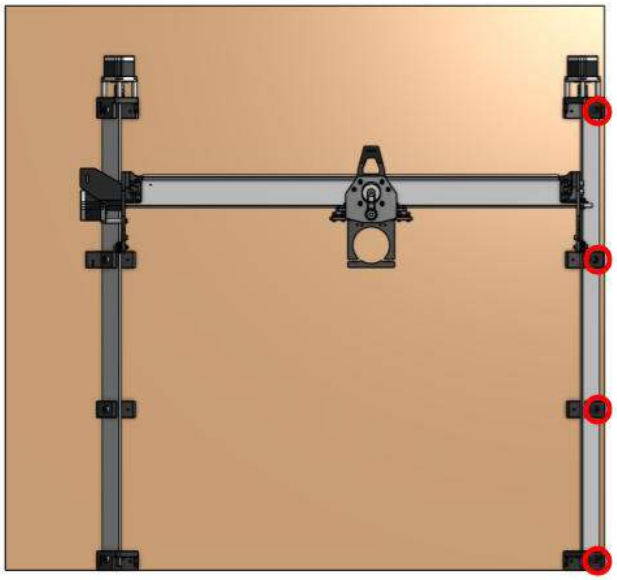
Alright, begin by moving the machine a couple of inches forward and mount the inside of the top and bottom feet using two wood screws (1-1/4”).



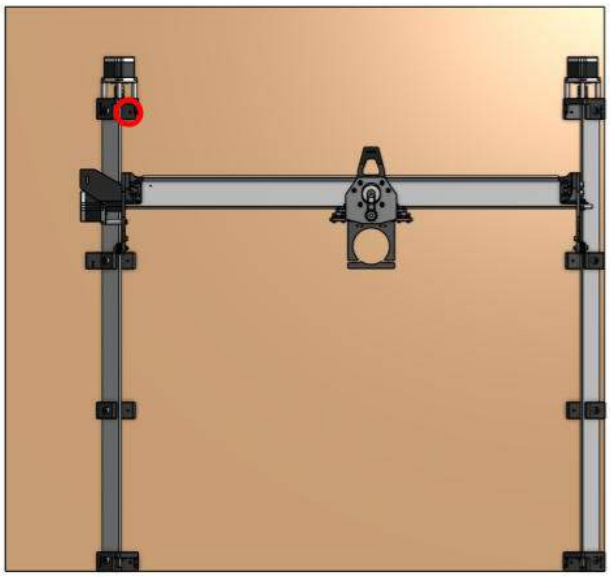
Next, we’ll put screws in the other two spots on the same side, this time on the middle feet.



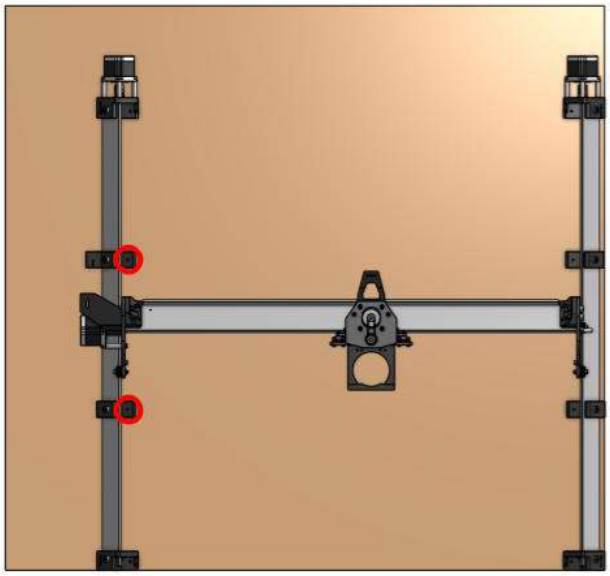
Now fasten the diagonal mounting points of all the right-side feet using the longer screws.



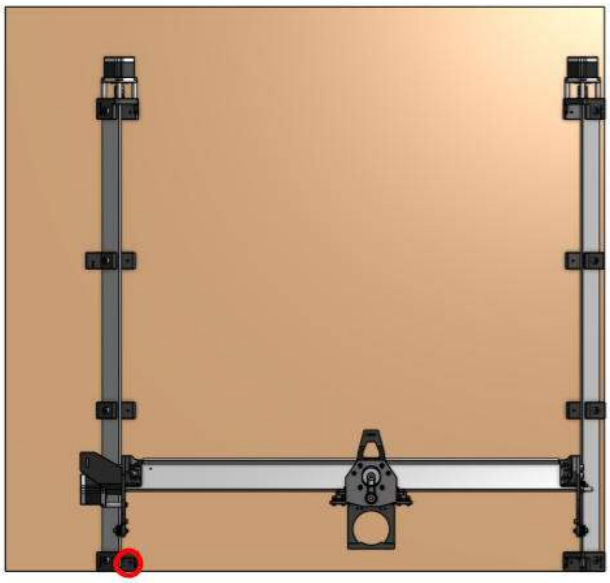
At this point, one side of your machine will be fully secure. The technique to make sure the other side is mounted parallel to the first side is by running the gantry between its limits and mounting the other side as you move it along the length. Start by mounting the top left foot on the inside:



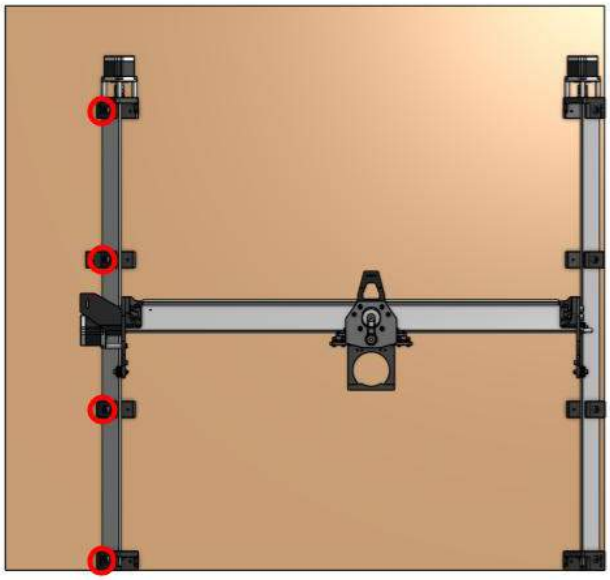
Move the machine down so that it is roughly in the middle of it's length, then secure the insides of the next two feet:



Finally, move it to the front and secure the inside of the front left foot:



Now move the machine again to the middle spot and use the longer screws to finish mounting the feet using their diagonal mounting holes.



Your machine should now be fully secure to its mounting surface. From this point, you should be ready to get cutting your first jobs! If you've got the touch plate or the dust shoe add-ons alongside your machine, you can see our pages on how to get those assembled and set up: https://sienci.com/dmx-longmill/dust-shoes/

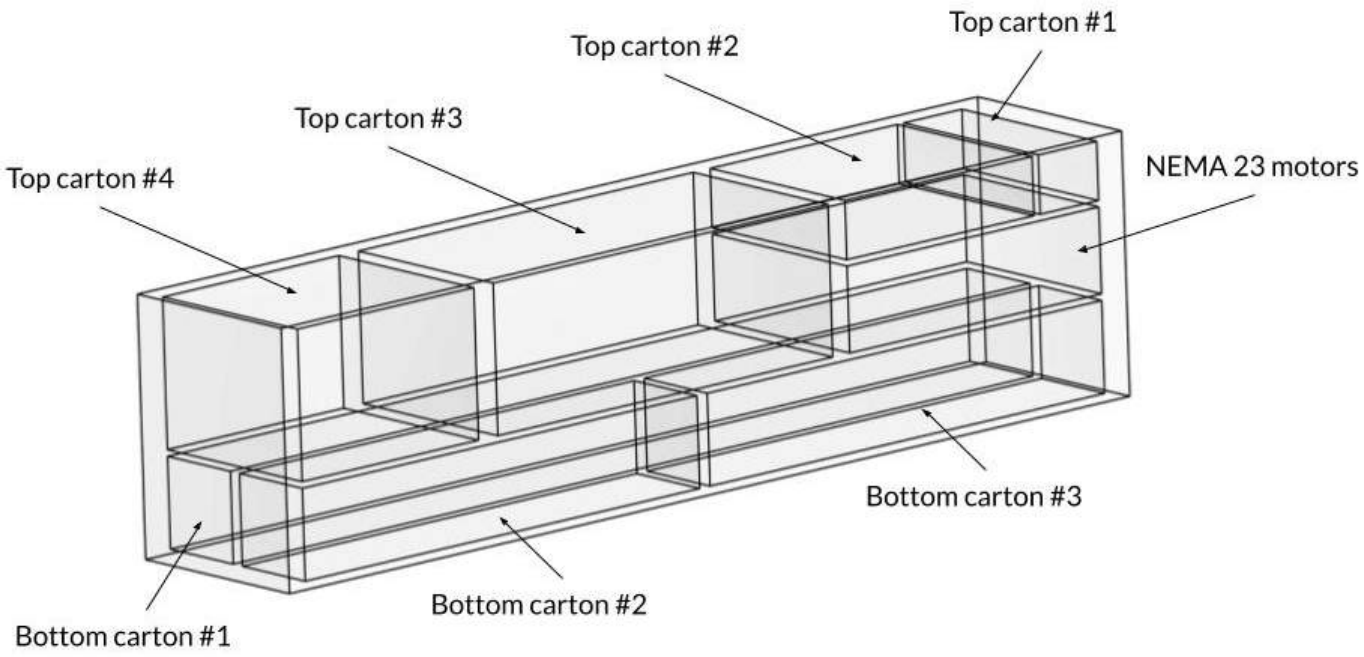
You can also navigate to the Post-Build section of the LongMill resources if you'd like to try out one of our easy starter projects, learn how to maintain your machine, or would like to address some issues you had during setup by visiting the page on 'Common Issues & Fixes'.

Appendix: Unboxing

The LongMill comes with a lot of parts, but we've organized them to make it as easy as possible to find and put everything together; each kit comes with several cartons.

For the complete BOM, visit: https://docs.google.com/spreadsheets/d/1MqOwPg3VSUTMtn3ff6rXjfvliAWnFqg8ez2eZasJLCE/edit#gid=1110761832

Please note that the carton layout may vary. Carton #2 is a bubble mailer.



Top Carton #1

Our first carton comes with stickers and a welcome letter with links to resources and safety information. If you ordered your machine with end mills or other parts, you may find them in here.

Top Carton #2

Our second carton holds our steel gantries and XZ gantry assembly. Inside you will find the XZ gantry assembly and Y-axis gantries..

Top Carton #3

Our third carton holds several different items, including router mount and the LongMill's controller. If you ordered your machine with any add-ons, such as the dust shoe, end mill add-on pack, or touch plate, you should find them here.

Top Carton #4

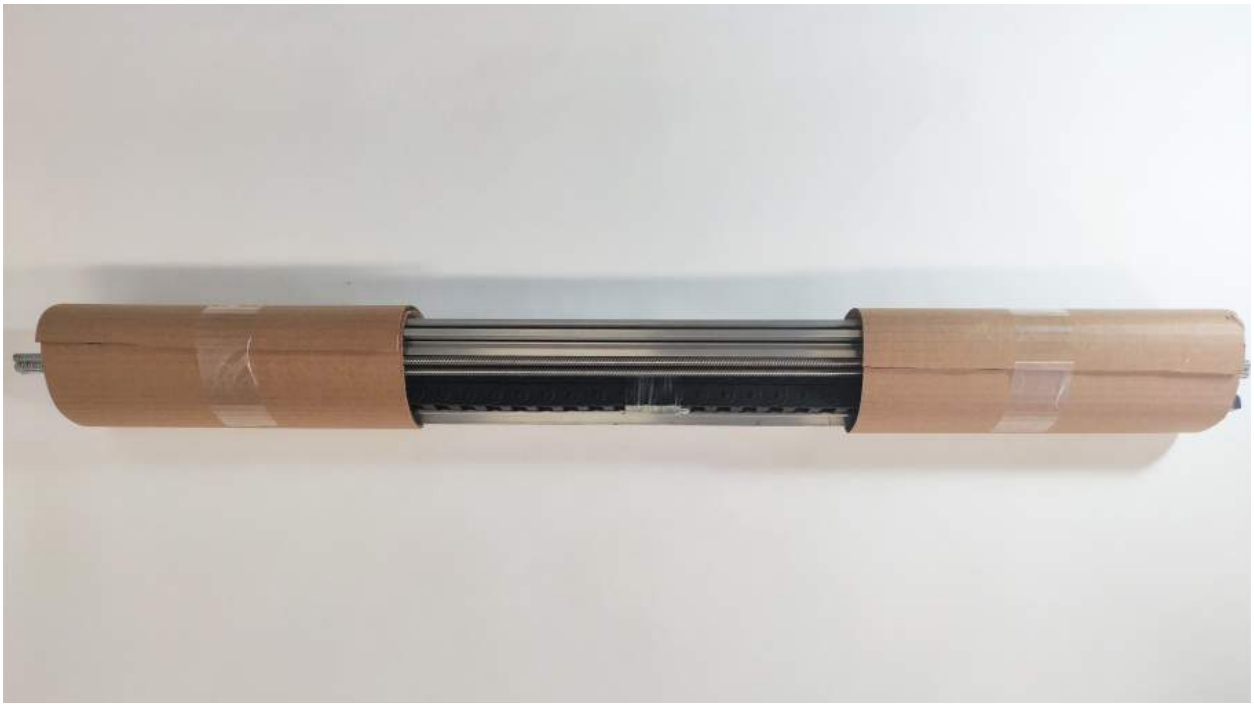
Our fourth carton will hold your Makita router if you ordered one. If not, it will be empty.

NEMA 23 Motors

Under carton #1 and #2, you will find a box containing the motors and wires.

Bottom Carton #1

Working our way through to the bottom cartons, our first carton holds all of the rails, lead screws, and drag chains.



Bottom Carton #2

In Bottom Carton #2, you will find your power supply and AC cable, USB cable, Z-axis motor mount plate, as well as bags holding all the fasteners and smaller components for your LongMill.

Bottom Carton #3

In our final carton, you will find all of your 3D printed parts.