Some general notes:

This printer is assembled almost entirely with metric hardware, either 3mm or 5mm diameter.

Generally you will use cap screws in one of two head styles – button head or socket head. In most cases either head style will work; when a particular one is required the screw will be denoted as SHCS (Socket Head Cap Screw) or BHCS (Button Head Cap Screw).

Nuts may be plain hex nuts or locknuts, which have a small plastic insert in one end that keeps any screw from vibrating loose over time. When using locknuts, install them so that when a screw is inserted into them, the screw engages the metal side first.
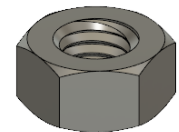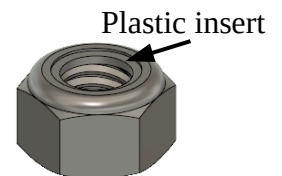
Button Head Cap Screw (BHCS)
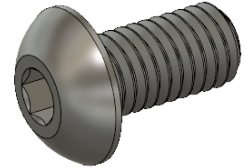
Socket Head Cap Screw (SHCS)
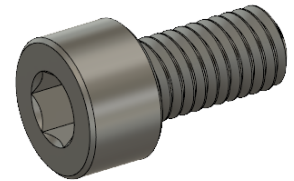
Plain hex nut

Plastic insert

Locknut

In most cases, screws are used to clamp one or more plastic parts together and thread into metal (a nut of one sort or another). These screws should be tightened until snug – don't leave them loose (except temporarily when instructed to do so), and don't tighten them with all your strength; if you do so you can crush or crack the plastic parts.

In a few cases, when a screw doesn't carry much axial load and shouldn't have to be unscrewed again, the screw threads directly into plastic. Be gentle with these screws, tighten them just enough to keep the clamped parts from moving around. If you overtighten them you will strip the threads in the plastic.

When you are assembling the frame extrusions together, go ahead and tighten the screws down hard – the aluminum extrusions can take more load, and you don't want them to shift.

XY Joiners assembly

Left XY Joiner assembly

1: Run 6mm drill through x-rod holes in body (A) to ensure rods will fit.
2: Insert long 8mm linear bearing into body.
3: Use 2x 3x12mm screws and 2x 3mm locknuts to secure y-belt clip (B) to body. Don't tighten down screws yet.
4: Use 4x 3x10mm screws to secure x stepper motor (C) to body.
5: Install 14-tooth pulley on stepper motor.
6: Use 2x 2x8mm wood screws to secure x-axis endstop to body.
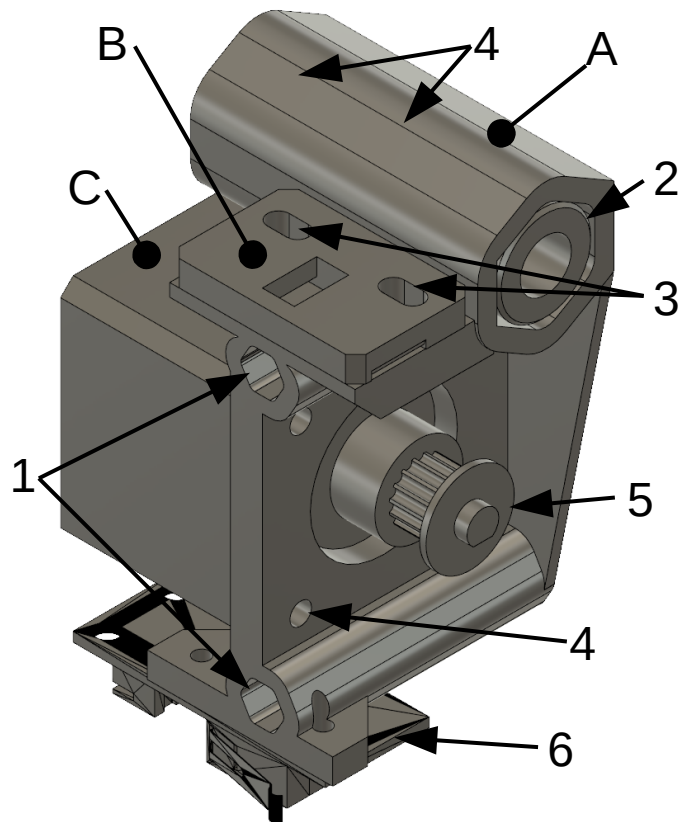
Right XY Joiner assembly

1: Run 6mm drill through x-rod holes in body (A) to ensure rods will fit.
2: Insert long 8mm linear bearing into body.
3: Use 2x 3mm locknuts and 2x 3x12mm screws to secure y-belt clip (B) to body. Don't tighten down screws yet.
4: Insert 3mm locknut in x idler bracket (C).
5: Use 1x 3mm locknut and 1x 3x20mm SHCS to secure 14-tooth idler in bracket. Don't over-tighten the screw; make sure the idler spins freely.
6: Use 1x 3x16mm SHCS to attach idler bracket to body. The head of the screw installed in step 5 should protrude through the oval slot in the body. Only insert the screw far enough to fully engage the locknut in the bracket; there should be a gap of ~5mm between bracket and outside of the body.
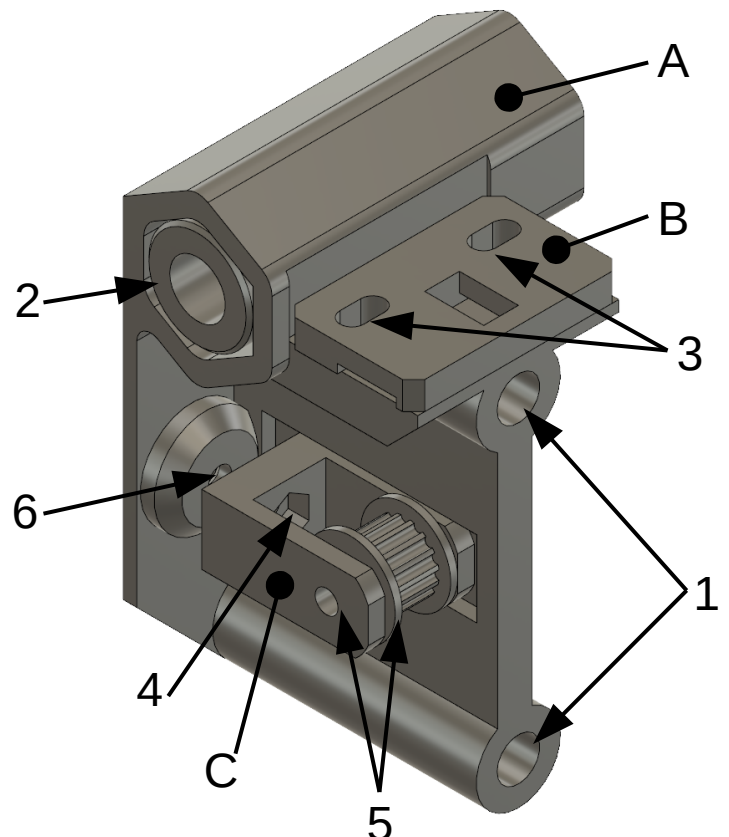
X Carriage initial assembly

1: Insert 2x 6mm linear long bearings (LM6LUU) into the carriage. The carriage is wider than the bearings; press them in until they are approximately centered.
2: Secure the fan duct (B) to the carriage with a 3mm hex nut and 3x8mm screw.
3: Install 2x 3mm nuts into the slots on the sides of the carriage, one on each side.
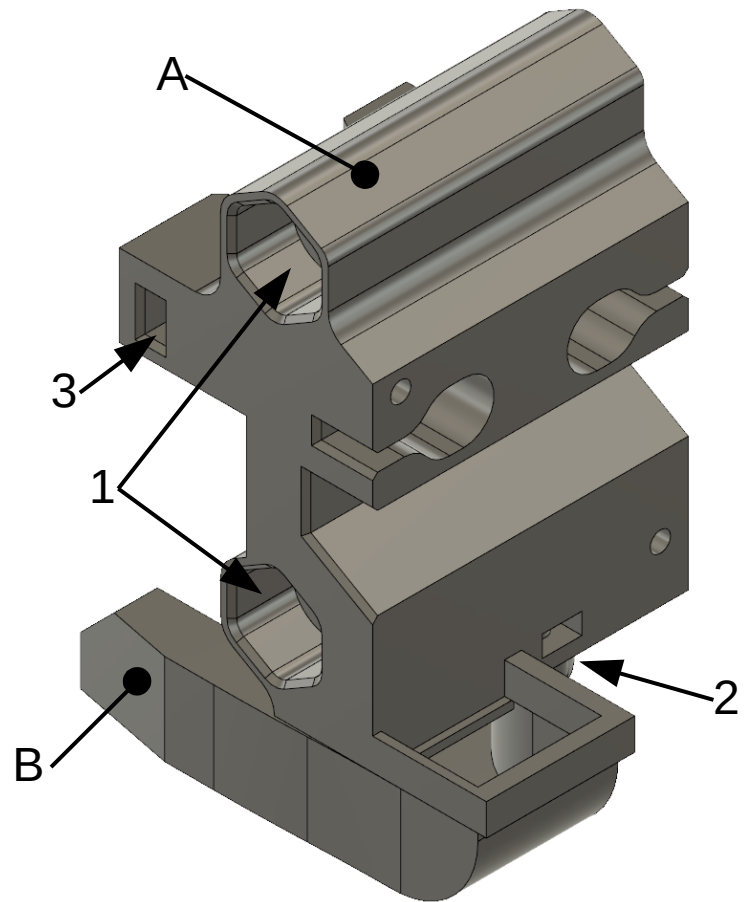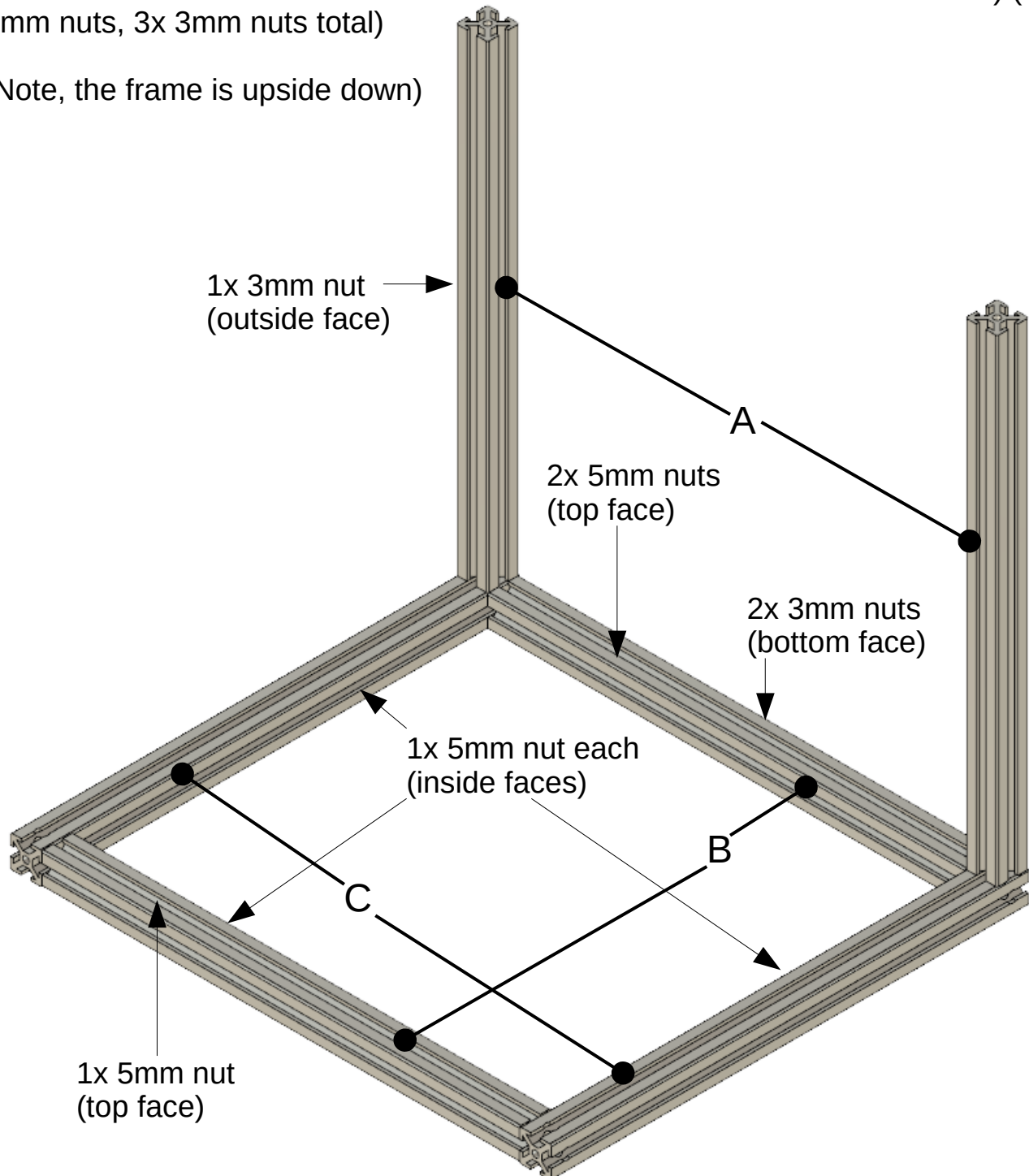
X axis initial assembly

1: Install 2x 6x250mm rods into the left XY joiner (A).
2: Install X carriage (B) onto the rods.
3: Install right XY joiner (C) onto the other end of the rods.
4: Ensure that the carriage travels smoothly along the entire length of the X rods.
5: We are done with the X axis for now; set it aside.
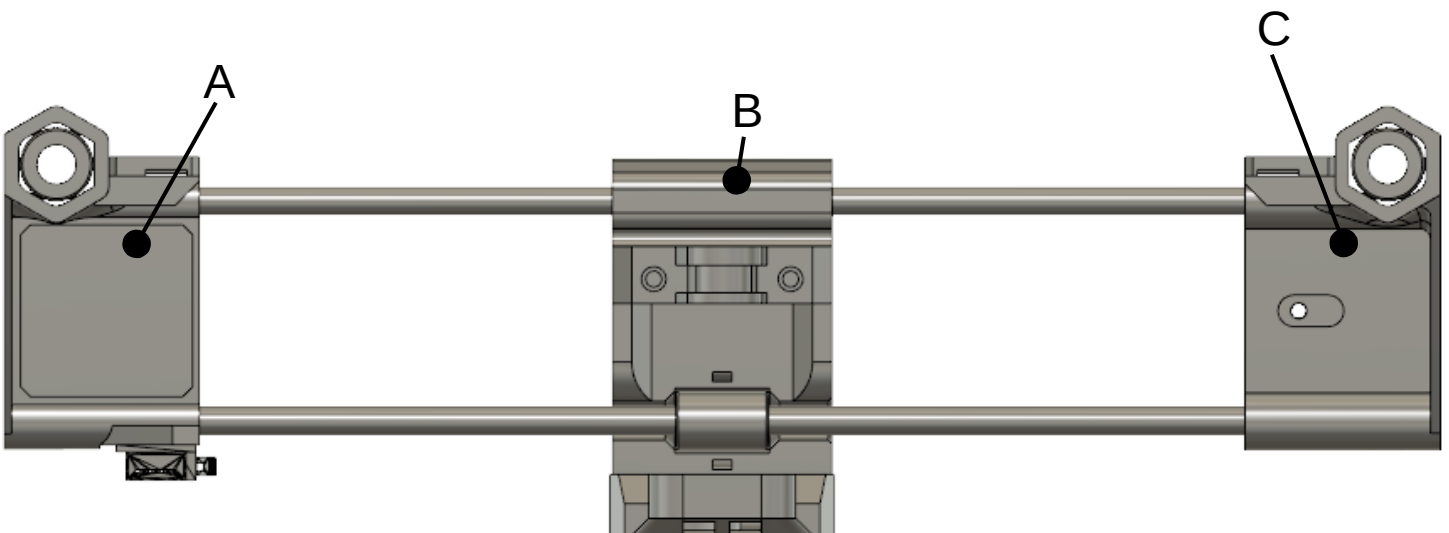
Upper frame assembly

- Assemble the upper half of the printer frame from 2x Z extrusions (A – 304mm long, ends tappped), 2x X extrusions (B – 300mm long, ends tapped), 2x Y extrusions (C – 300mm long, ends cross-drilled), and 6x 5x14mm BHCS.
- To assemble the extrusions, insert a screw into the end of a tapped extrusion until ~3mm of thread is left showing. Then slide the screw head into one face of a cross-drilled extrusion, and insert a hex key through the cross-drilled hole to tighten the screw.
- As you assemble the frame, insert T-slot nuts as shown below. (T-slot nuts are inserted from the end of an extrusion; the ones noted below cannot be added after the frame is assembled because the ends of the extrusions will be blocked.) (6x 5mm nuts, 3x 3mm nuts total)

(Note, the frame is upside down)

1x 3mm nut
(outside face)

A

2x 5mm nuts
(top face)

2x 3mm nuts
(bottom face)

1x 5mm nut each
(inside faces)

B

C

1x 5mm nut
(top face)

XY assembly 1

1: Install left and right-front Y anchors (B, C) onto front of the frame (A) using 4x 5x10mm screws and two more 5mm T-slot nuts. Tighten these screws until snug. Note that the screws pointed to in the figure below must be button heads; the others can be socket heads.
2: Insert 3x 3mm T-slot nuts in the top face of the left extrusion.
3: Insert 2x 3mm T-slot nuts in the top face of the right extrusion
4: Press 1x 6mm bearing into each of the left and right-rear Y anchors (D, E).
5: Install 3x 20-tooth pulleys on a 6x250mm rod (F). Note the orientation of the pulleys in the figure below. Notches ground into the rod should match the locations of the pulleys on the rod. Apply thread locker to the set screws in the pulleys and tighten them to lock the pulleys in place.
6: Place 2x 550mm belts and 1x 98mm belt around the rod assembly (F), insert the rod into the bearings of the rear anchors (D, E), and install the anchors onto the frame using 4x 5x10mm screws and 2 more 5mm T-slot nuts. Do not tighten these screws yet.
The rod should have ~1mm of play left-to-right between the anchors and should spin freely. If the pulleys are pressed into the anchors, loosen their set screws and nudge the pulleys in.
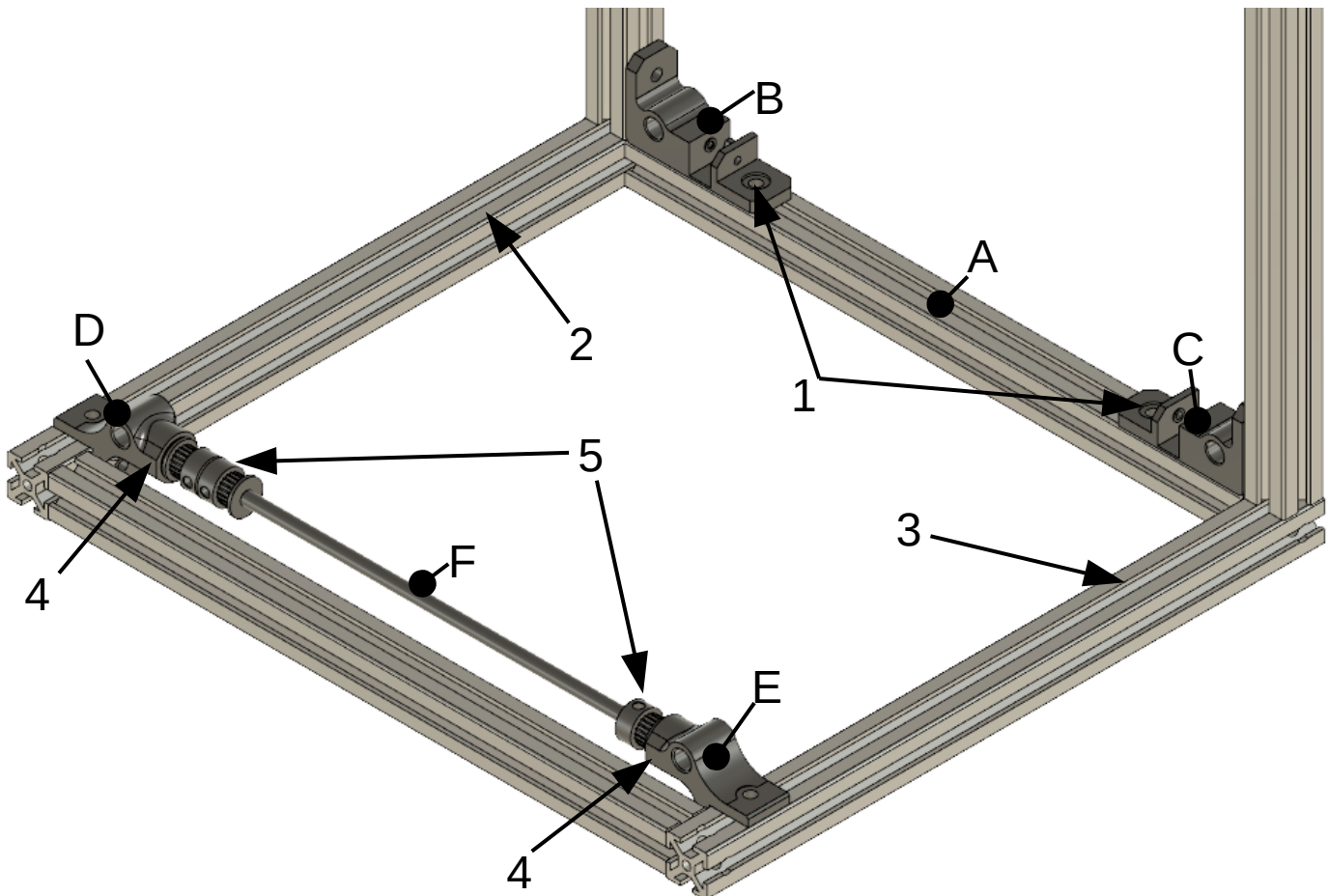
XY Assembly 2

1: Insert 2x 8x300mm rods (A) into the front Y anchors (B). Push them in until about the same length of rod is sticking out in front of and behind the anchors.
2: Slip the X axis assembly (C) onto the Y rods. Make sure the assembly is oriented as shown in the figure.
3: Continue to push the Y rods back and feed them through the rear anchors (D). The front of the Y rods should be flush with the front of the front anchors; about 20mm of rod will stick out the back of the rear anchors.
4: Install the Y-axis stepper motor (F) on its bracket (E) using 4x 3x10mm screws. Don't tighten down these screws yet.
5: Install a 14-tooth pulley onto the stepper motor (F).
6: Install the Y-axis motor assembly onto the rear extrusion of the frame using 2x 5x10 screws. Align the pulley on the motor with the middle pulley on the Y-axis axle, then tighten these screws until snug.
7: Loop one of the 550mm belts around a 14-tooth idler then insert the idler in the front Y anchor. Secure the idler with a 3x20mm SHCS. Insert the screw until the head is seated, but do not clamp the idler; make sure the idler can still spin freely. You may need to temporarily remove the adjacent 5x10 BHCS to install this screw. Repeat for the other 550mm belt and other front Y anchor.
8: Ensure the 550mm belts are seated on the pulleys on the Y axle and run under the belt clips on the XY joiners, then push the rear anchors (D) back until the Y belts are tensioned. Each belt should vibrate like a low-pitched guitar string. Tighten down the mounting screws for the rear Y anchors until snug.
9: Slip the 98mm belt around the middle pulley on the Y axle and the pulley on the Y motor, then tighten the Y motor screws while pulling up on the motor to tension the belt.
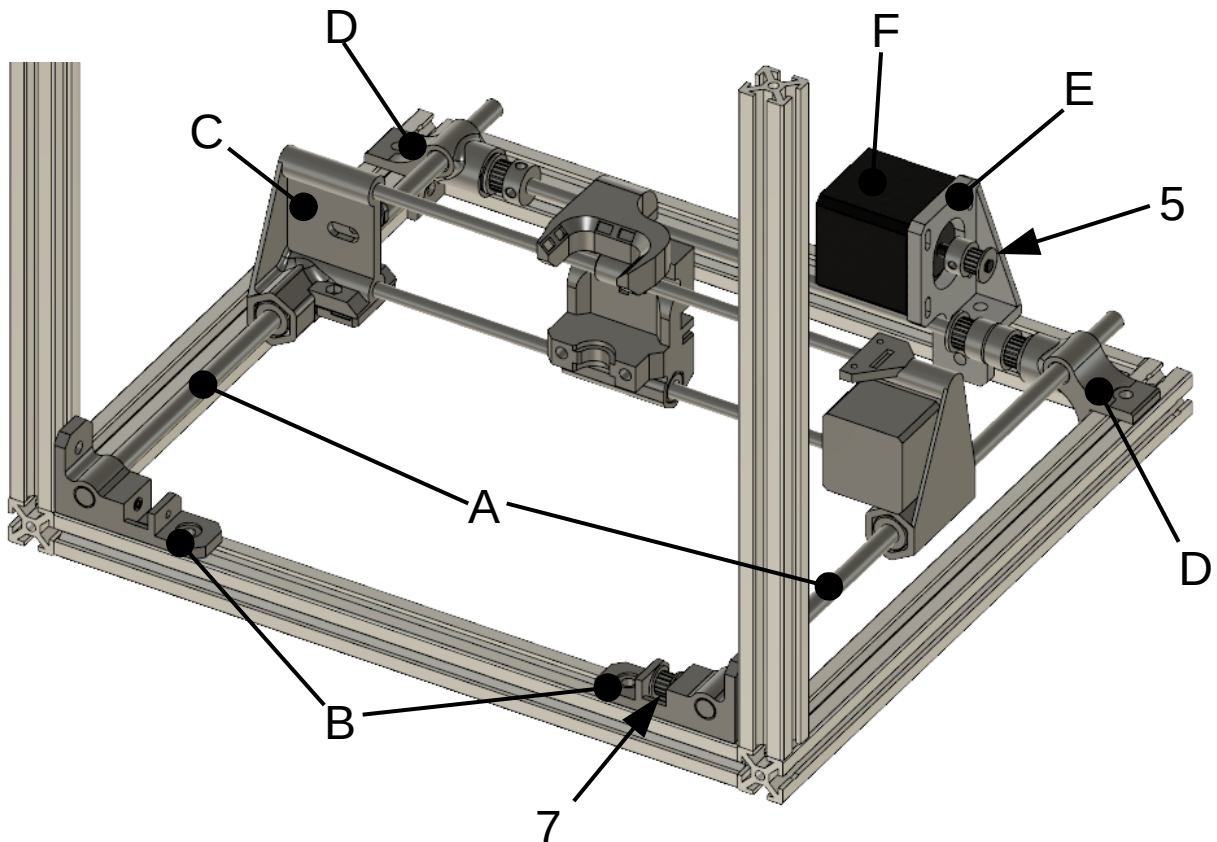
X axis final assembly

Start with a section of belt at least 540mm long.

1: Bend the end of the belt over on itself, so that the teeth mesh with each other, and place the loop into one recess in the X carriage (A).

2: Screw a 3x10mm SHCS into the recess until the head is approximately centered in the belt loop front-to-back.

A   2   1   B

3   4
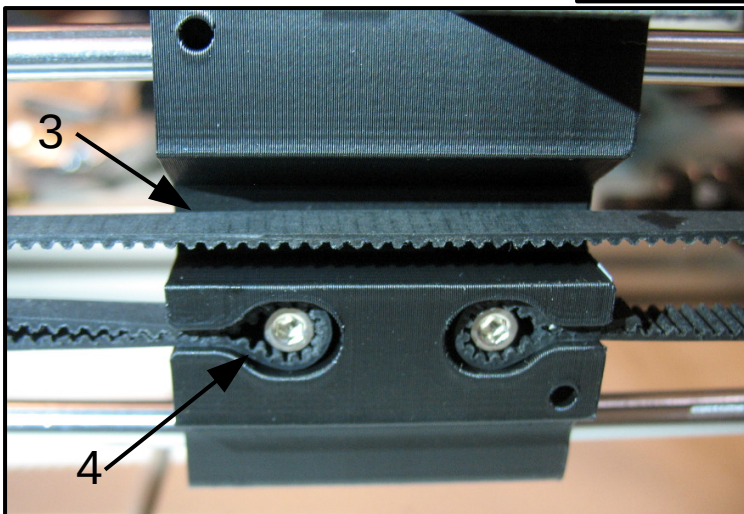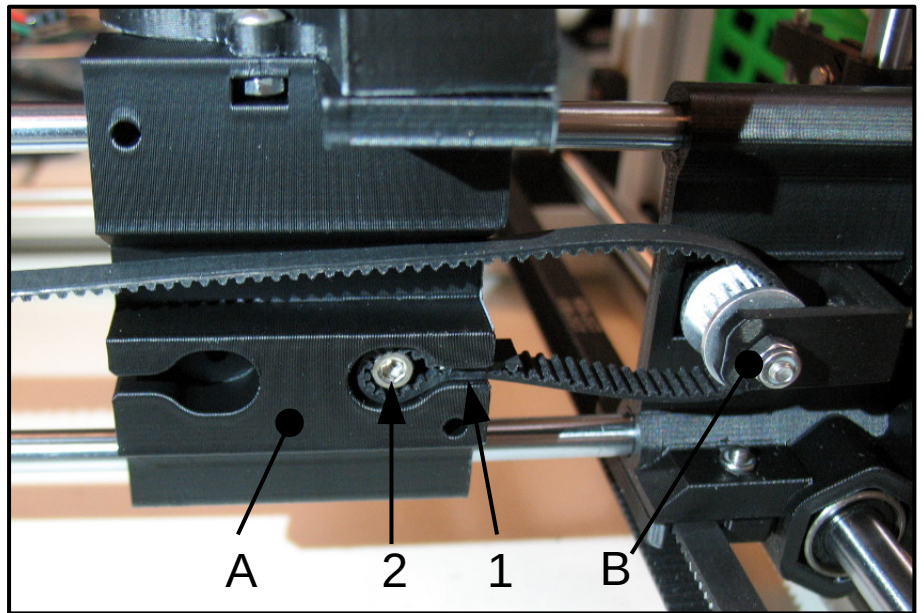
3: Loop the belt through the idler (B), over the X motor pulley (not shown), and back to the X carriage. The upper side of the belt loop should fit in the notch in the X carriage.

4: Repeat steps 1 and 2 with the other end of the belt in the other recess of the X carriage. Don't leave any more slack in the belt than necessary.

5: Tension the belt by tightening the screw that secures the X idler.

6: Adjust the pulley on the X motor so that it is aligned with the belt anchor on the X carriage and the X idler, and the upper side of the belt is centered front-to-back in the notch in the carriage. (Not shown.)

7: Install the part cooling blower (C) onto the X carriage with 2x 3x16mm screws. These screws are threading into soft plastic. Tighten them just enough to keep the fan from moving; overtightening will strip the threads in the plastic.

7

C
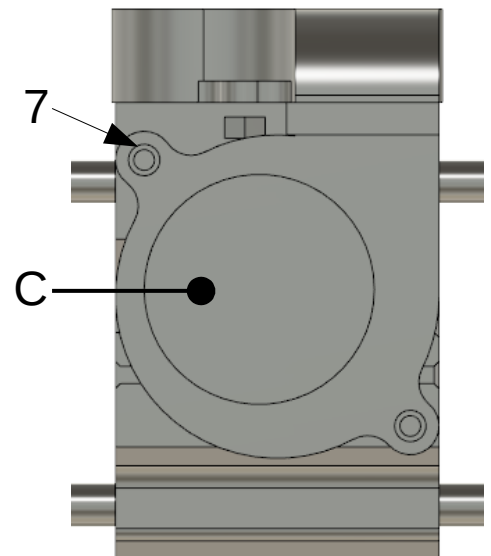
XY final assembly

1: Install an endstop switch on the Y axis endstop holder (A) with 2x 2x8 mm wood screws.
2: Install the Y endstop assembly on the frame with a 3x10mm screw and the rear-most T-slot nut. Slide the endstop assembly all the way back until it contacts the rear Y anchor, then tighten the screw until snug.
3: Install the RAMPS case base (B) on the frame with 3x 3mm T-slot nuts and 3x 3x10mm screws. If using different electronics, install the appropriate base at this time. (If the electronics case has already been assembled, install the entire assembly at this time.)
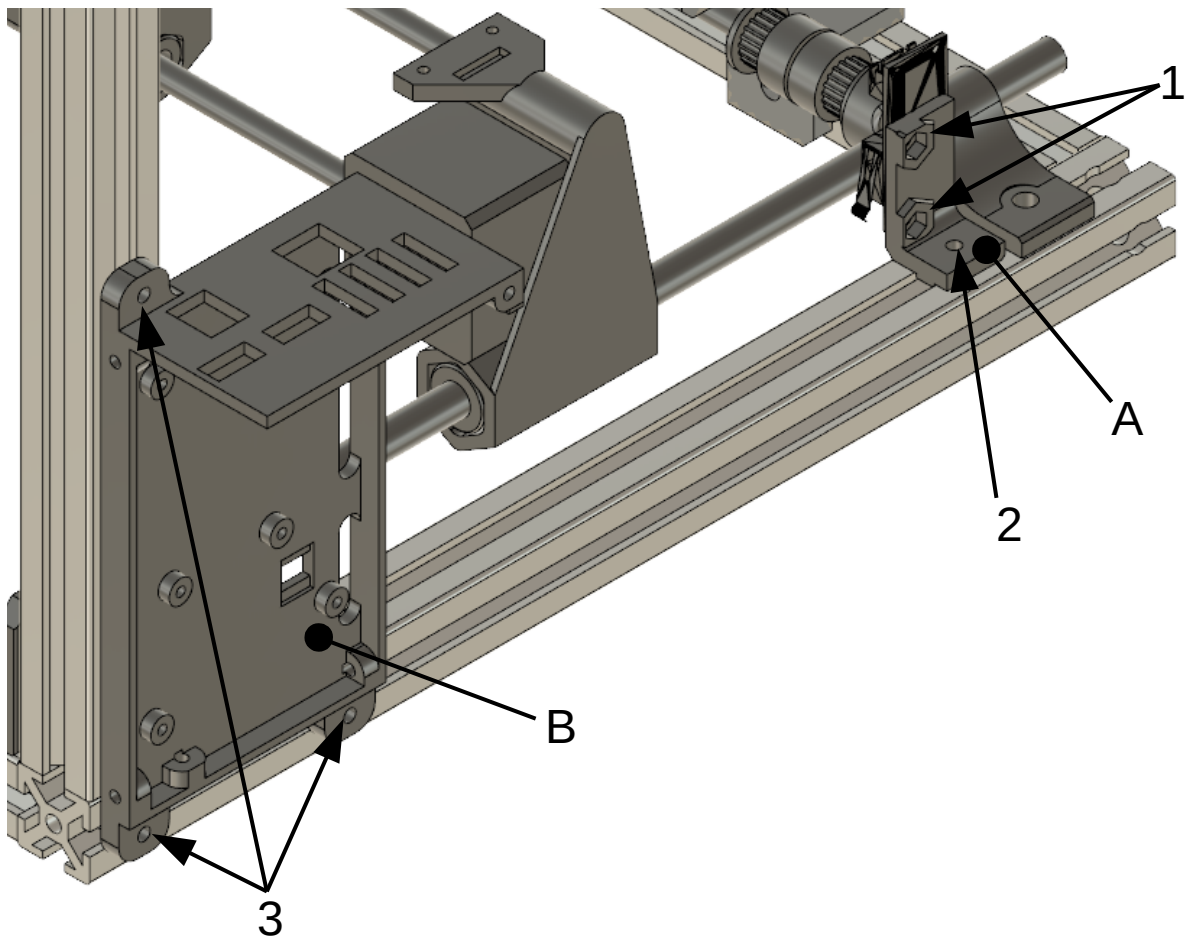
Lower frame assembly

- Assemble the lower half of the printer frame from 2x Z extrusions (A – 304mm long, ends tappped), 2x X extrusions (B – 300mm long, ends tapped), 2x Y extrusions (C – 300mm long, ends cross-drilled), and 6x 5x14mm BHCS.
- As you assemble the frame, insert T-slot nuts as shown below. (These nuts are installed from the end of an extrusion; the ones noted below cannot be added after the frame is assembled because the ends of the extrusions will be blocked.) (4x 5mm nuts total)
- The two nuts at the back of the frame are for the 12V power supply. If not using a Meanwell LRS-350-12 type power supply, you may need T-slot nuts in different locations for a different set of power supply mounts.

A

2x 5mm nuts
(outside face)

1x 5mm nut each
(inside face)

B

C
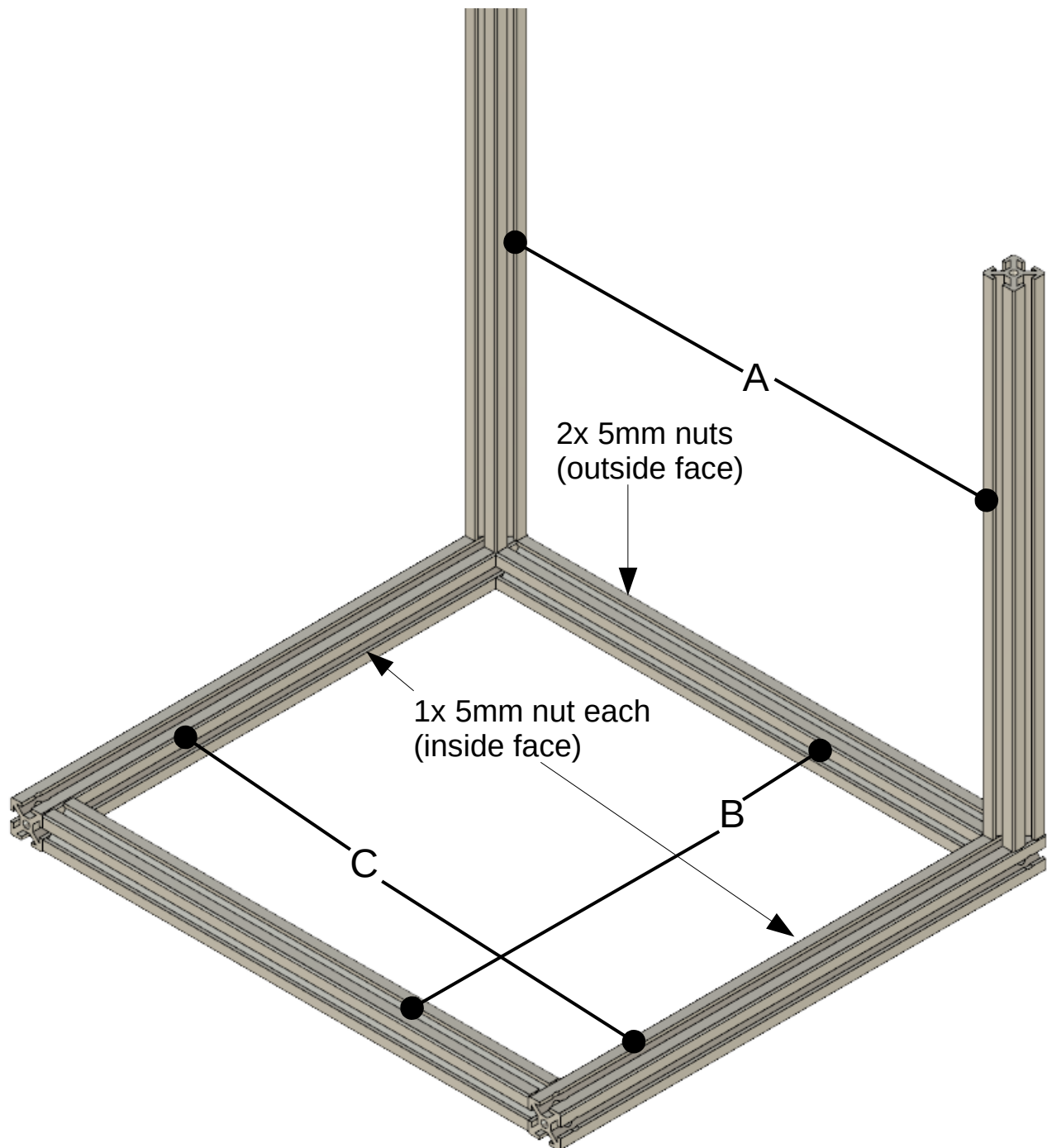
Z axis assembly 1

1: Using 4x 3x8mm screws, install Z axis motor (A) onto Z motor bracket (B).
2: Install a 20-tooth pulley on the Z axis motor – make sure this pulley has a 5mm bore; it should fit snugly on the motor axle.
3: Install Z motor assembly onto frame using 2x 5mm T-slot nuts and 2x 5x10mm screws. Slide the motor towards the back of the frame but do not tighten these screws yet.
4: Press a 6mm bearing into a Z axis base block (C).
5: Install the base block assembly on the frame using 1x 5x10mm screw (using the front hole on the side of the base block), 2x 3mm T-slot nuts, and 2x 3x10mm screws. Do not tighten these screws yet.
6: Place the shorter Z axis spacer (D) against the inside of the frame in front of the base assembly.
7: Slide the base assembly forwards against the spacer and tighten its screws until snug.
8: Remove the spacer, then repeat steps 4-7 with the other Z base on the other side of the frame (not shown).
9: Install 4x feet on the bottom of the frame (not shown).
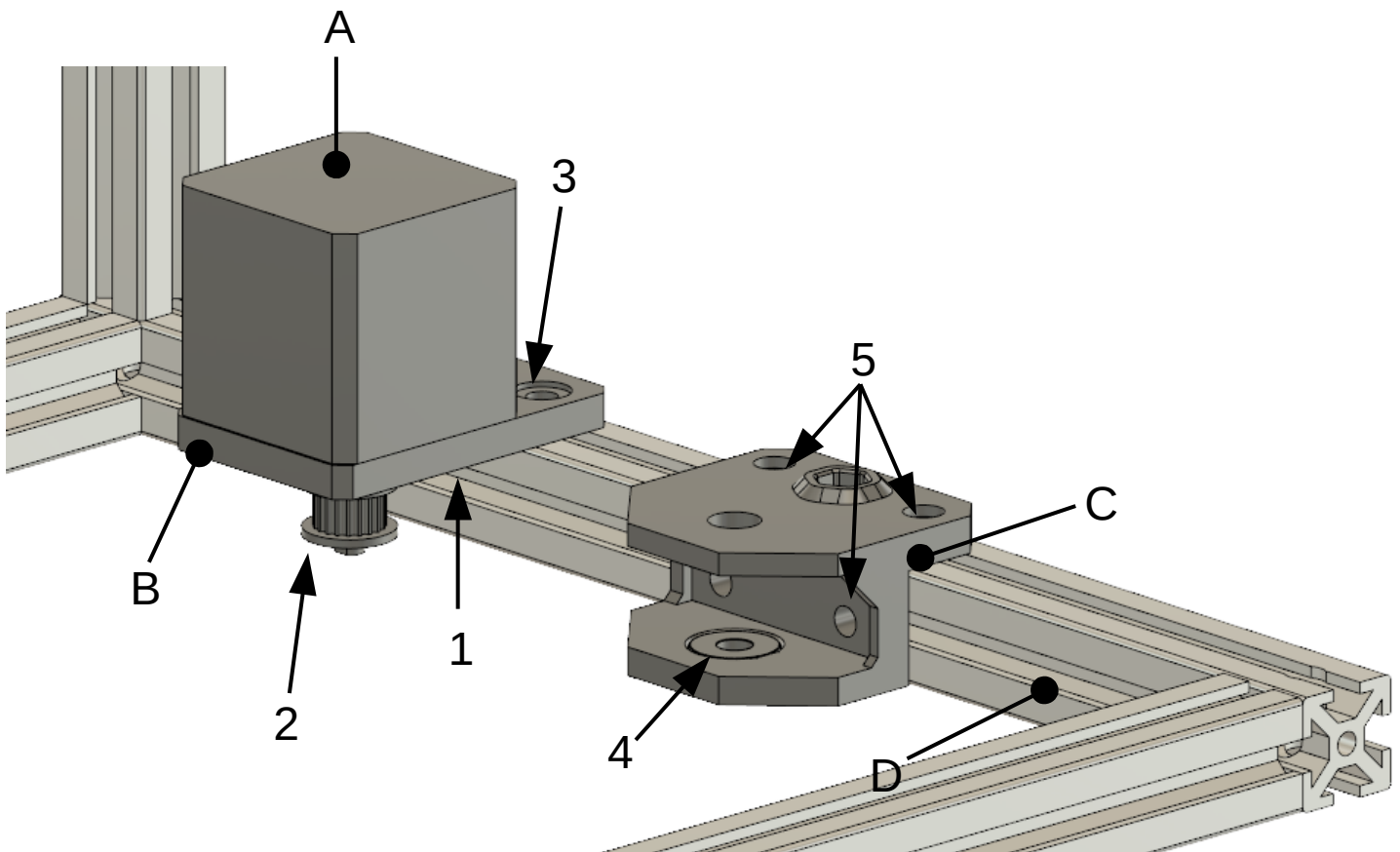
Z axis assembly 2

1: Place a washer on the 6mm bearing in the Z base block.
2: Wrap the 700mm belt around a 20-tooth pulley and hold the pulley in place above the bearing and washer. Placing the pulley without dislodging the washer is tricky; you can use a skinny tool such as a small screwdriver to reach down through the bore of the pulley and nudge the washer back into position.
3: Insert a 6x250mm leadscrew down through the base block, pulley, washer, and bearing. One side of the leadscrew has a notch ground in it; that notch should line up with a set screw in the pulley. About 3mm of the leadscrew will protrude from the bottom of the bearing when it is properly aligned.
4: Apply thread locker to the set screws in the pulley and tighten them down to secure the rod in place.
5: Repeat steps 1-4 with the other Z base assembly. (The same 700mm belt should be wrapped around the other pulley; make sure the belt is not twisted or tangled.)
6: Thread one leadscrew nut on each leadscrew, with the flange on the bottom. (Not shown.)
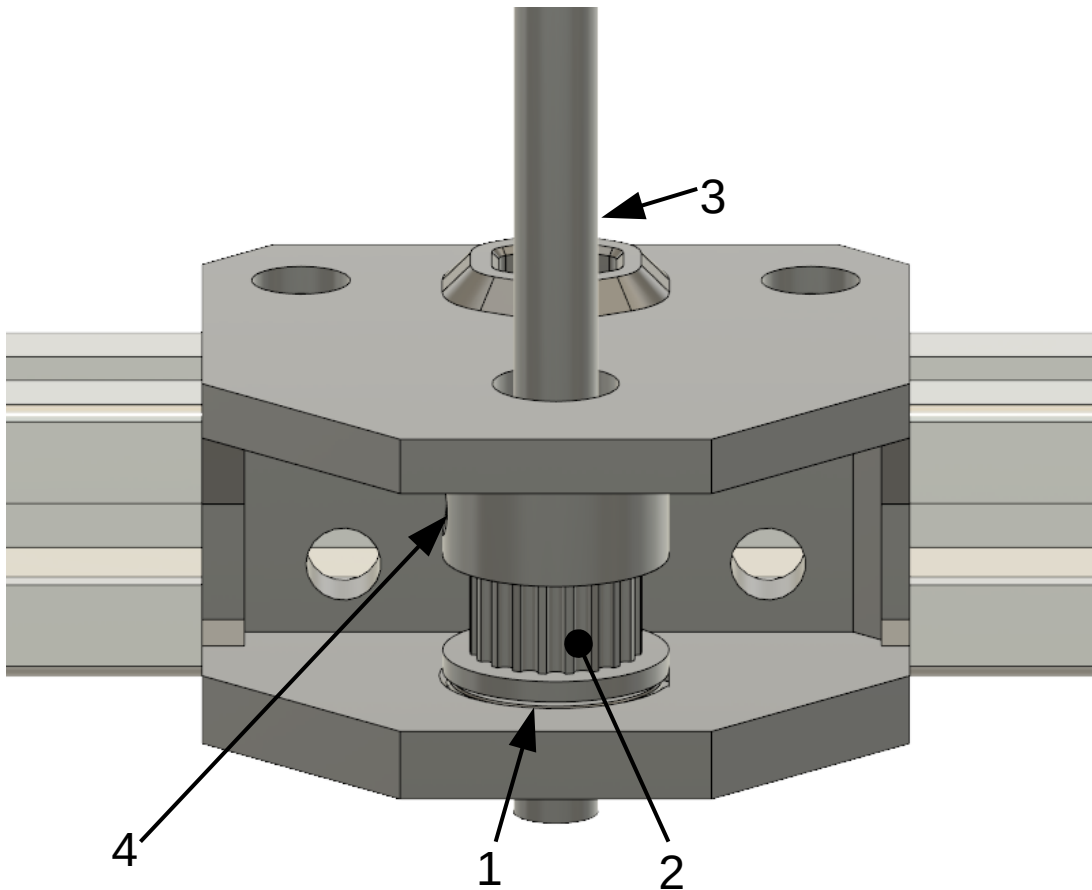
Bed assembly

1: Press a bearing block bottom half (A) and top half (B) together with a long 8mm linear bearing. Repeat to make two bearing block assemblies.

2: Install 2x 3mm lock nuts into each of the bearing block assemblies (4 total).

3: Install 2x bed extrusions (C, 300mm length, not threaded or cross-drilled) onto the lefthand bearing block assembly with 2x 5mm T-slot nuts and 2x 5x10mm screws.

4: Slide 2x 3mm T-slot nuts into the top side of each bed extrusion (4 total).

5: Install the righthand bearing block assembly and Z endstop bracket (D) with 2x 5mm T-slot nuts, 1x 5x10mm screw, and 1x 5x14mm screw.

6: Install endstop on the bracket with 2x wood screws. Don't over-tighten these screws.

7: Install heatbed (E) with 4x 3x20mm screws, 4x springs, 4x washers, and the T-slot nuts installed in step 4. The heatbed's connector should be on the lefthand side. From top to bottom, each screw goes through the heatbed, spring, washer, then nut. If the springs are particularly short, you may also need to install spacers.

8: One screw at a time, remove each heatbed screw and apply thread locker to it, then reinstall the screw and tighten it until its end bottoms out on the extrusion, then back the screw off 1mm (2 complete rotations).
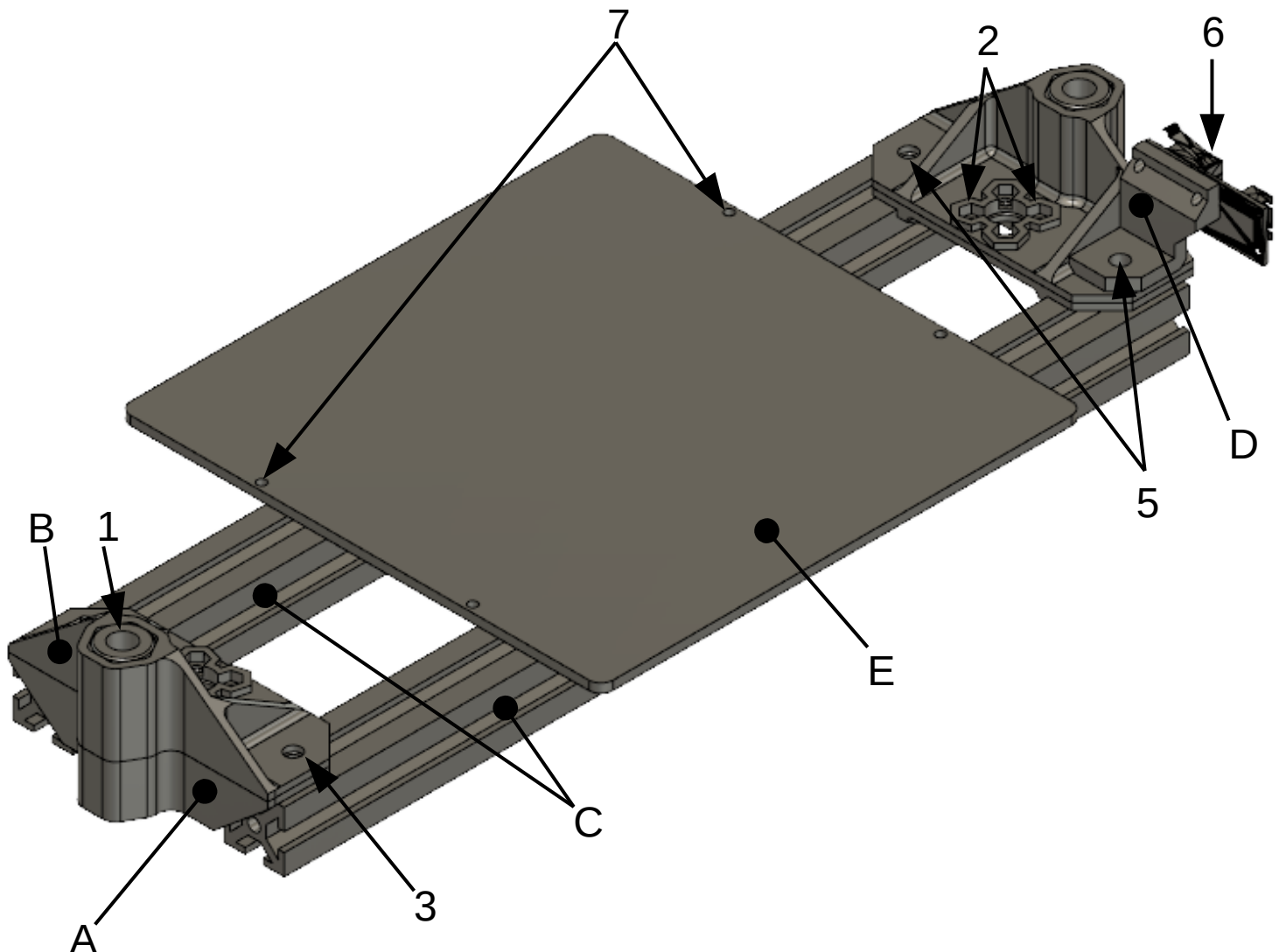
Z axis assembly 3

1: Install a 8x300mm rod in each Z base.

2: Install the bed assembly onto the Z rods.

3: Slide the Z endstop onto the righthand Z rod. Install a 3x16mm SHCS on the end of the endstop, with the head of the screw on the bottom and about 5mm of thread between the screw head and endstop. Install a 3mm hex nut and 3x10mm screw in the endstop to secure it in place. Don't tighten this screw yet.

4: Place a Z axis top anchor (D) on the top of each Z rod.

5: Spin the leadscrew nuts down near to the bottom of the leadscrews so that the bed sits near the bottom of the printer.
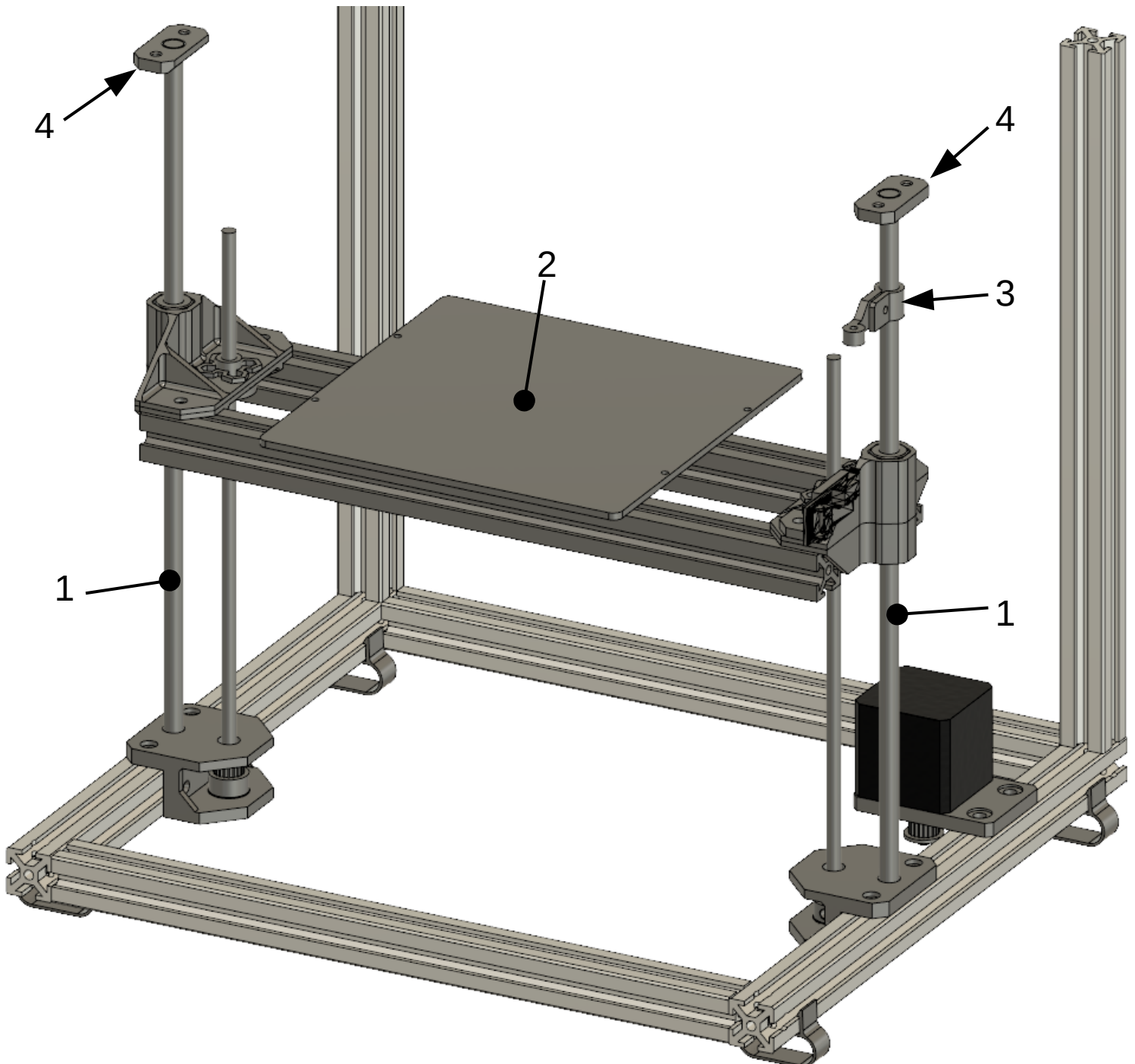
Power supply assembly

1: Wire together the power inlet (not shown), snap it into the power supply case (A), and wire it to the input terminals of the power supply (not shown). If you are not 100% comfortable with this step, get someone to help you. Mains wiring is hazardous!
2: Attach the power supply case to the power supply (B) with 2x 4x8mm screws.
3: Attach the bottom cover to the case with 2x 3x8mm screws (not shown).
4: Attach the power supply bracket (C) to the power supply with 1x 4x8mm screw and 1x 4x5mm screw.
5: Mount the power supply to the frame with one more 5mm T-slot nut and 3x 5x10 screws.
(Leave the top cover off of the power supply case until the 12V wiring is done.)
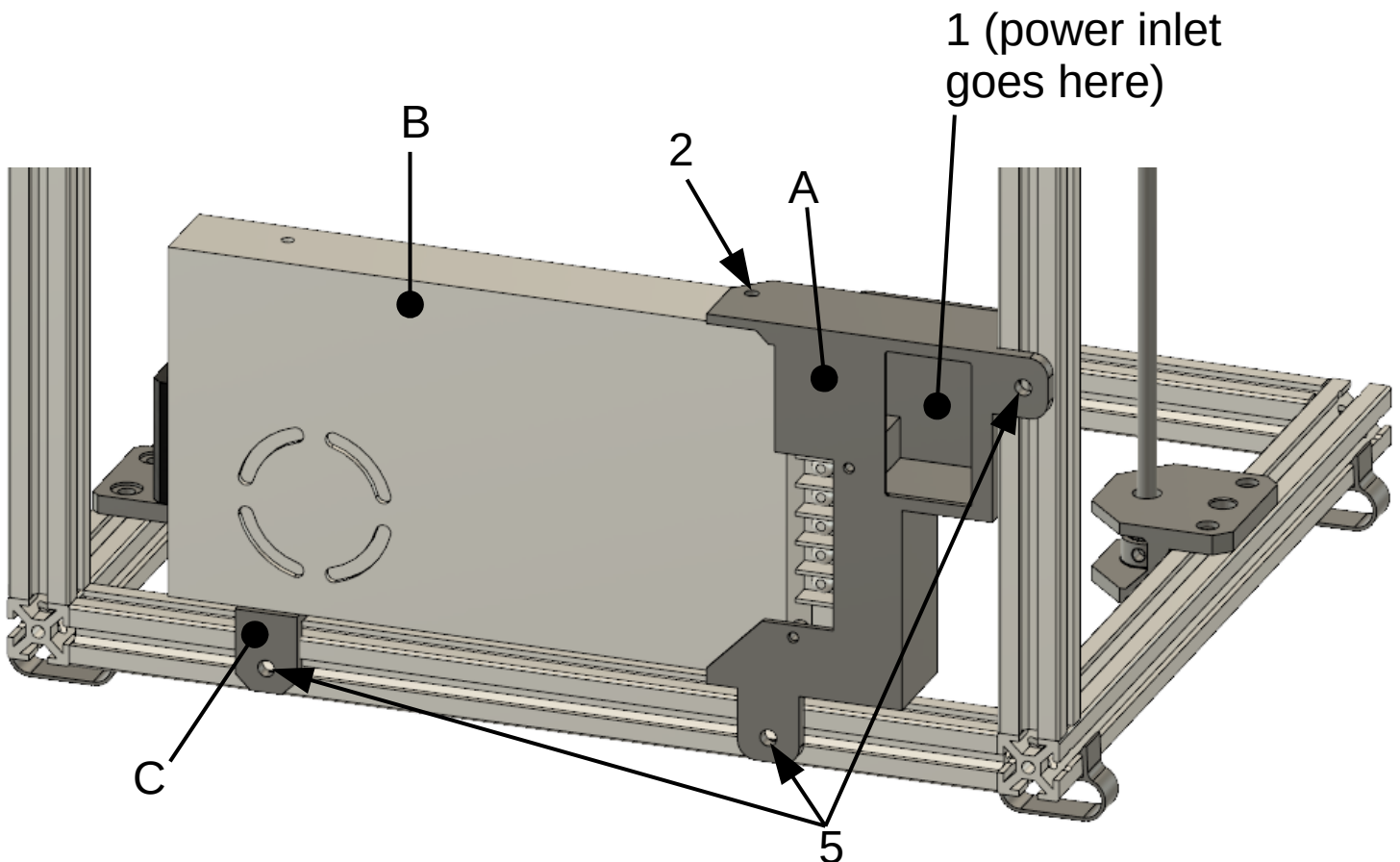
Frame final assembly

1: Assemble the top and bottom frame halves. Insert 4x 5x14mm BHCS in the unconnected ends of the Z extrusions, then slide the top half of the frame onto the bottom half. Tighten down the screws, and take this opportunity to ensure all of the other screws fastening the frame together are tight.

2: Use 4x 3x10mm screws to fasten the Z axis top anchors to the top frame. Use the longer Z axis spacer to ensure the anchors are the correct distance from the front of the frame. If you have trouble getting the anchors to line up left-to-right, loosen the two 5mm bolts that attach the left Z bearing block to the bed extrusions.
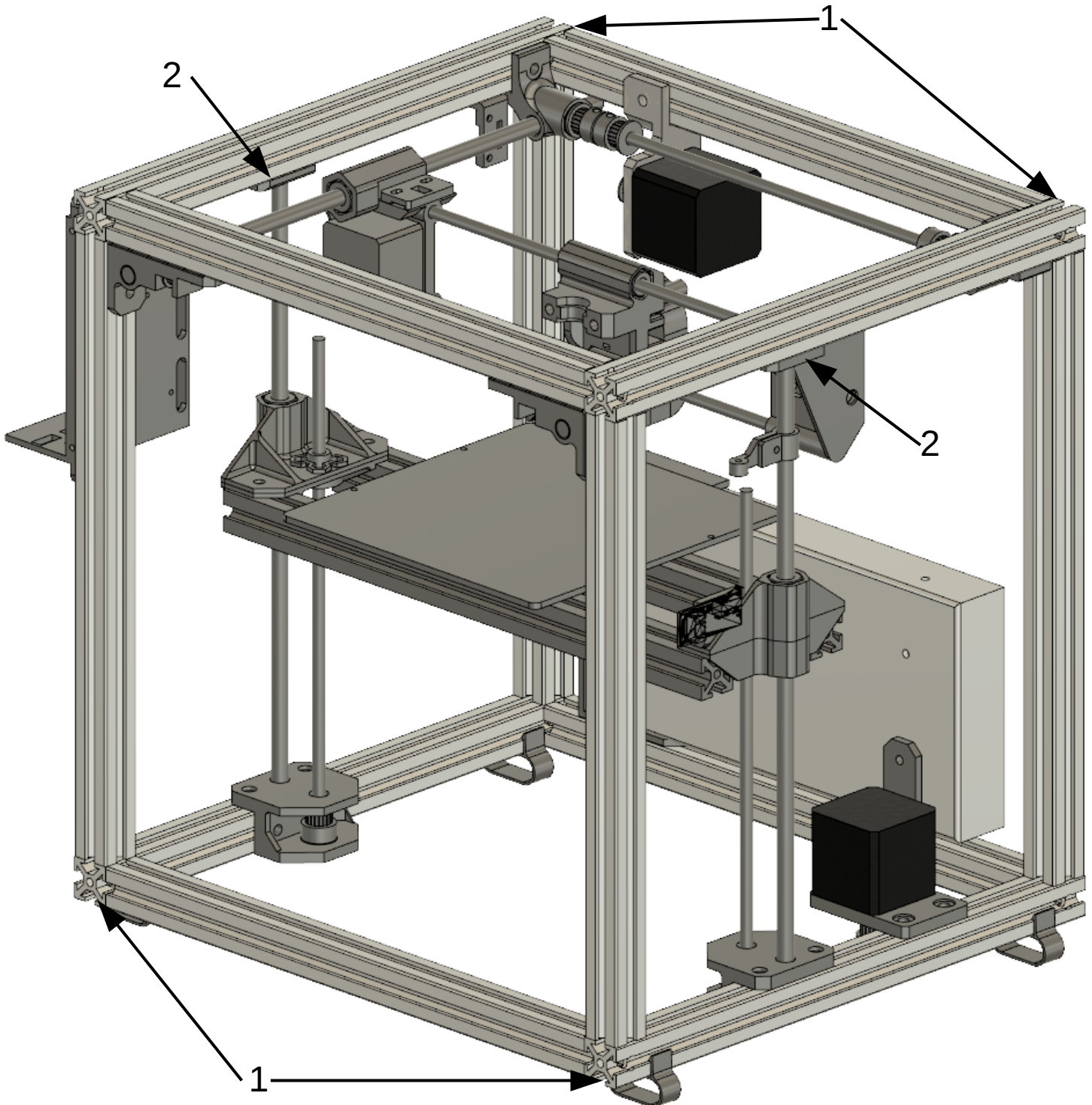
Z axis final assembly

1: Re-tighten the 5mm screws in the bed assembly, if needed. Ensure that the bed assembly slides smoothly over the whole length of the Z rods.
2: Tension the Z axis belt – ensure that the 700mm belt for the Z axis is seated on both pulleys on the leadscrews and the pulley on the Z axis motor, then tighten the screws on the Z motor assembly while pushing back on the assembly. Tension on this belt is important to ensure that the leadscrews always rotate together. If one rotates while the belt skips on the other, the bed can become skewed and, in extreme cases, bend or damage part of the Z assembly.
3: Check that the height of the pulley on the motor is correct; loosen its set screws and adjust if needed.
4: Hold the bed assembly up and spin both leadscrew nuts upwards a few inches, then let the bed rest on the nuts.
5: Fasten one leadscrew nut to its bearing block assembly with 2x 3x12mm screws.
6: Rotate the other leadscrew to adjust the angle of the bed until it is level with respect to the printer's frame, then fasten it to its bearing block assembly as well.


Last assembly steps

1: Secure a E3D V6-style hotend to the X carriage with the hotend clamp and 2x 3x20mm screws. Hotend wires should run up the left side of the X carriage; secure wires to the post on the hotend clamp with a ziptie if necessary.
2: Install an extruder to the left side of the frame just behind the electronics with appropriate hardware.
3: Install the filament hook at the left-rear corner of the frame with a 5mm T-slot nut and 5x10mm screw.
4: Cut Bowden tube to correct length and install between extruder and hotend.
5: Screw Arduino to the RAMPS case base with 6x 2.5x6mm SHCS if not already done.
6: Install RAMPS board, stepper drivers, and display adapter, if not already done.
7: Attach RAMPS case lid with 4x 3x8mm screws.

Cable routing 1

Bundle the X motor and X endstop wires together. Arrange them so that they come straight forwards from the X axis assembly, then turn back and enter the RAMPS case through the uppermost hole in its base. There is a small rectangular slot in the base for attaching a cable clip to secure the wires. The excess length of the X endstop wires should be coiled up and secured inside the RAMPS case.

The bed heater wires should be secured to the front bed extrusion, then routed down to the front-left corner of the printer frame and up to the appropriate terminals in the end of the RAMPS case.
The Z endstop and bed thermistor wires can be bundled together with the heater wires or, if they aren't long enough for that, they can be routed up along the front-left Z extrusion and into the RAMPS case through its base. Leave a loop of wire under the bed so there is sufficient slack when the bed moves to the bottom of the printer.
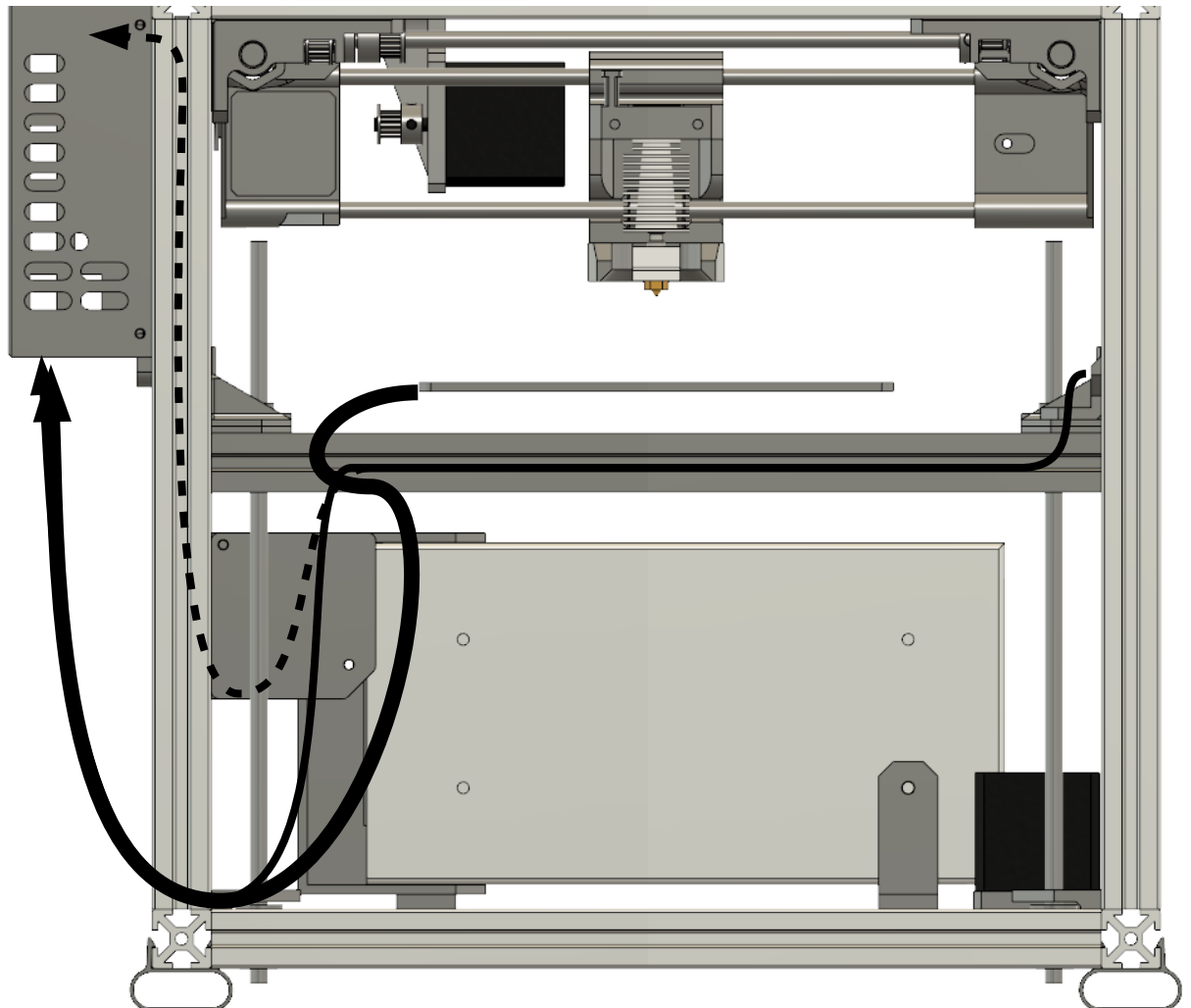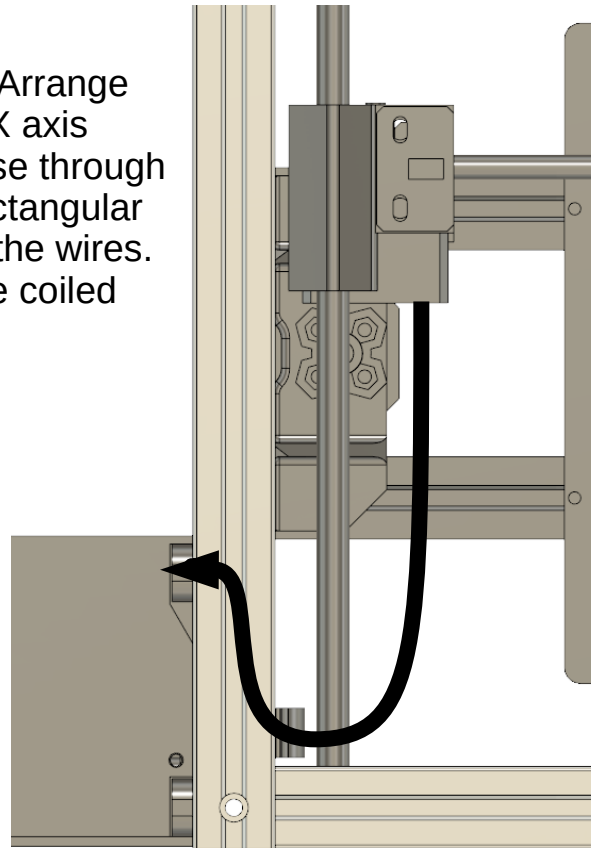
Cable routing 2

Other wires in the printer should be routed to the bottom-left corner of the frame, then forwards and up to the RAMPS case. This includes the Z motor wires (route along the rear-bottom X extrusion), Y motor and endstop wires (bundle together at the top-left-rear corner then route down to the corner), and power supply wires.

After connecting the power supply wires to the 12V terminals of the power supply, fasten the power supply case top cover to the case with 2x 3x8mm screws (not shown).

Wires from the X carriage (not shown) should be bundled along the Bowden tube to the extruder, then routed into the RAMPS case.
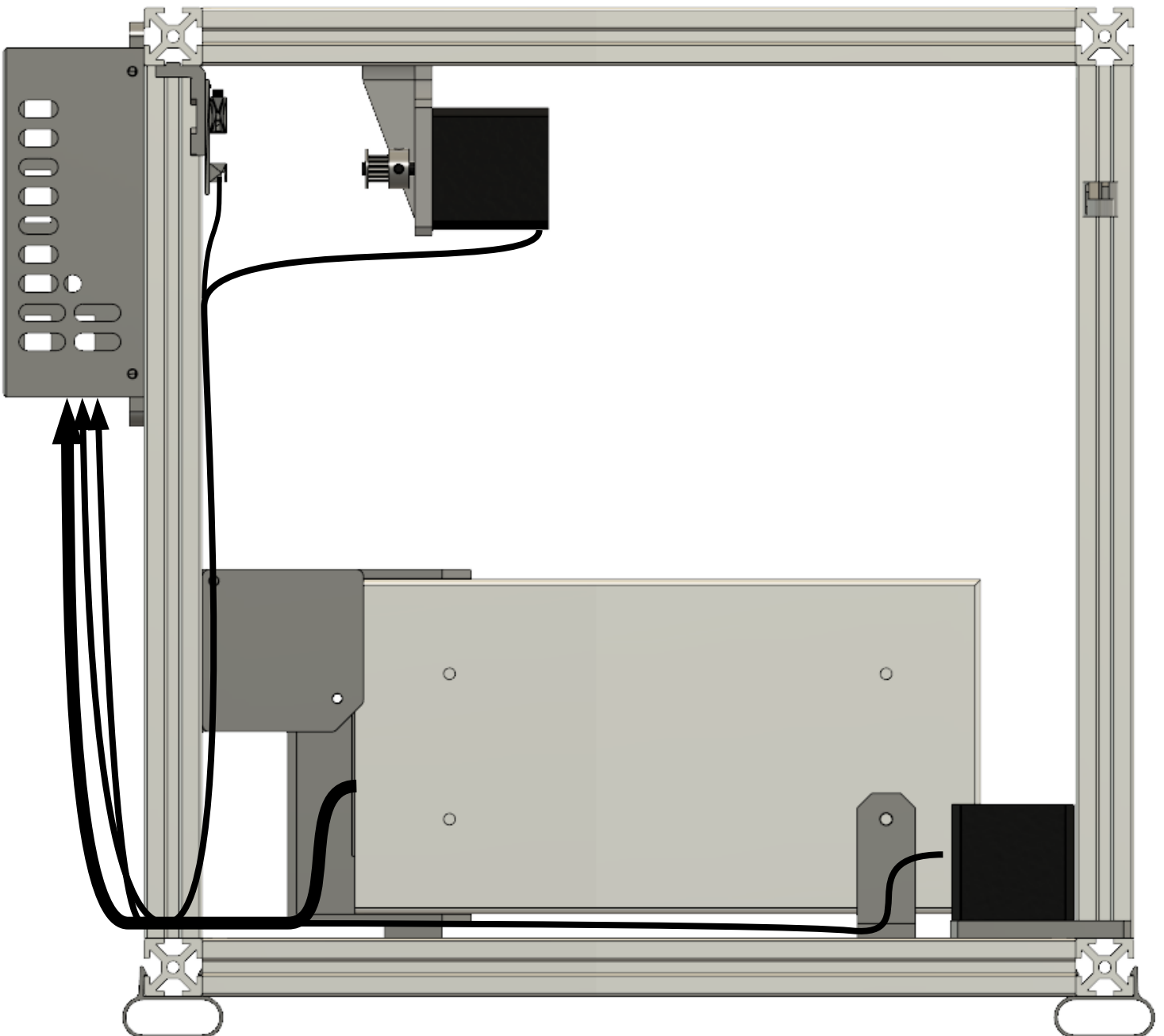
Bed leveling

1: Move the bed upwards until it is very close to touching the hotend nozzle (~1mm gap).
2: Move the Z endstop down the Z rod until the head of the screw on the endstop just triggers the Z endstop switch.
3: Tighten the screw on the Z endstop to fix its position. Fine adjustment of the level of the bed will be done by rotating the vertical screw in the endstop.
4: Now the bed can be leveled using the paper gap method, which unfortunately is a bit too involved to describe here. Look online for guides to this leveling method.

You should now be ready to try out the printer!