


# ASSEMBLY MANUAL



# CONTENTS

Safety Instructions	3
Ditto at a Glance	4
Bill of Materials	6
Before You Start	7
Z-Platform	8
Ditto Frame pt.1	13
Ditto Frame pt.2	21
Gantry pt.1	27
Gantry pt.2	37
Gantry pt.3	45
Extruder	49
Electronics / Spool Holder	67
Print Bed	68
Wiring	71
Preliminary Run Through	75


# IMPORTANT SAFETY INSTRUCTIONS



**WARNING**

**SHARP EDGES**

Use caution during assembly and operation of the 3D printer to ensure no sharp edges will cut you. Inspect the printer for any damage prior to use.




**WARNING**

**FIRE**

Use caution to minimize risk of fire.

Always operate the printer a safe distance away from flammable items. Use in well-ventilated areas.

DO NOT place a storage cover on the unit during operation. Only place a cover on the printer after it has thoroughly cooled down.



**WARNING**


**HOT SURFACE**

Motor surfaces become hot during operation.

Hotend and heater cartridge become hot during operation.

DO NOT touch hot surfaces, because they can cause severe burns.

Allow the hotend to cool before touching it without proper tools.



**WARNING**

**SHOCK**

There is a danger of electric shock.


Use only undamaged electrical chords.

DO NOT touch bare wires or receptacles.

DO NOT touch the 3D printer or chords if hands are wet.

Ensure that all cords are free of damage before connecting to the power supply.

Ensure that you have a sufficient electrical supply for supporting the requirements of the motor.



**WARNING**


**RISK TO BREATHING**

Always use your 3D printer in a well-ventilated and clean area.

Gas emitted by melting of Polylactide (PLA) or Acrylonitrile butadiene styrene (ABS) can contain contaminants that are harmful to breathe.

Never breathe the air that comes directly out of the hotend. This air is not suitable for breathing.

If you feel ill from breathing while operating your 3D printer, stop and seek medical attention immediately.



**WARNING**

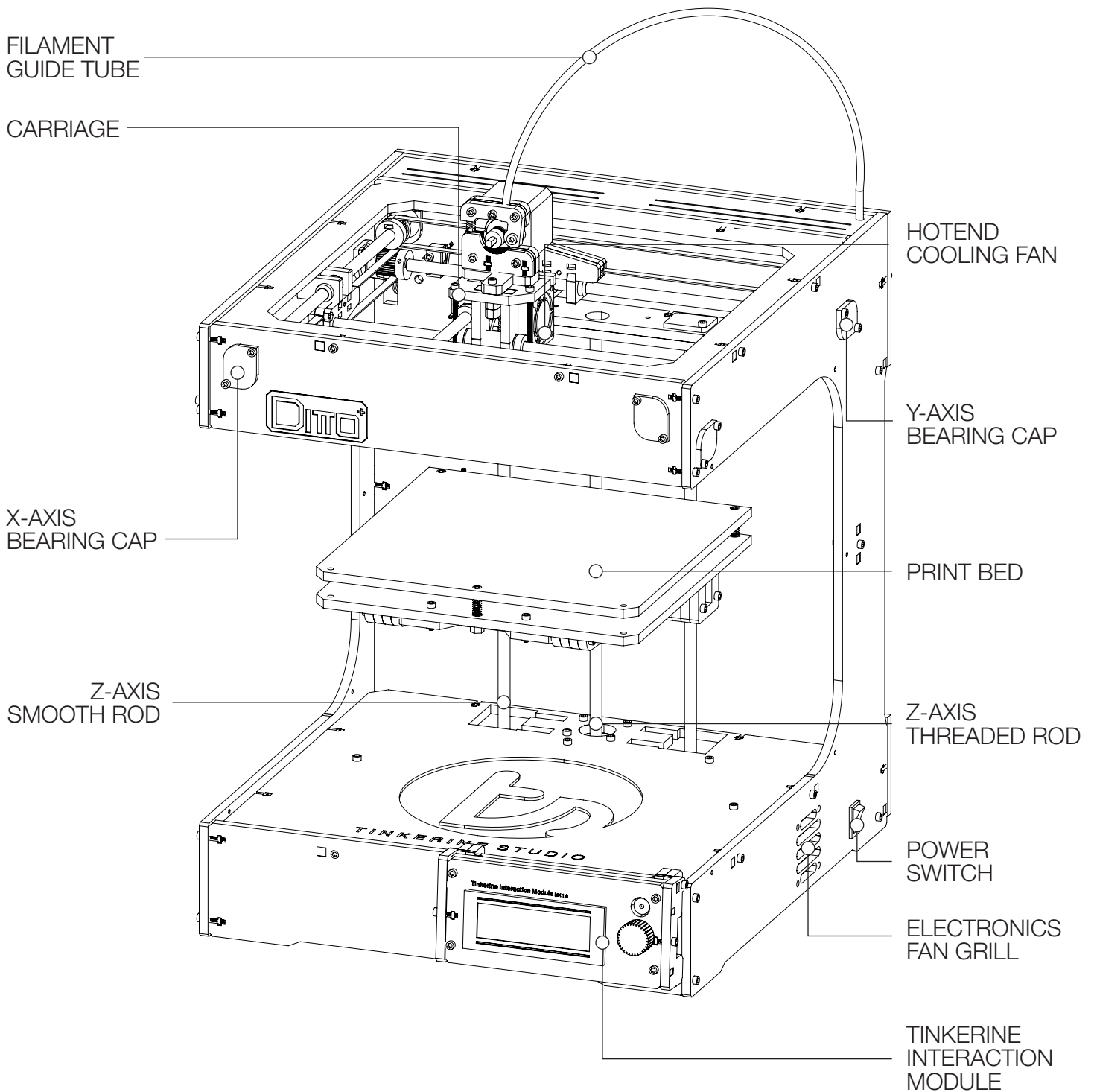
**Fragile**

Electrical pins and sensors are delicate. Handle with care.

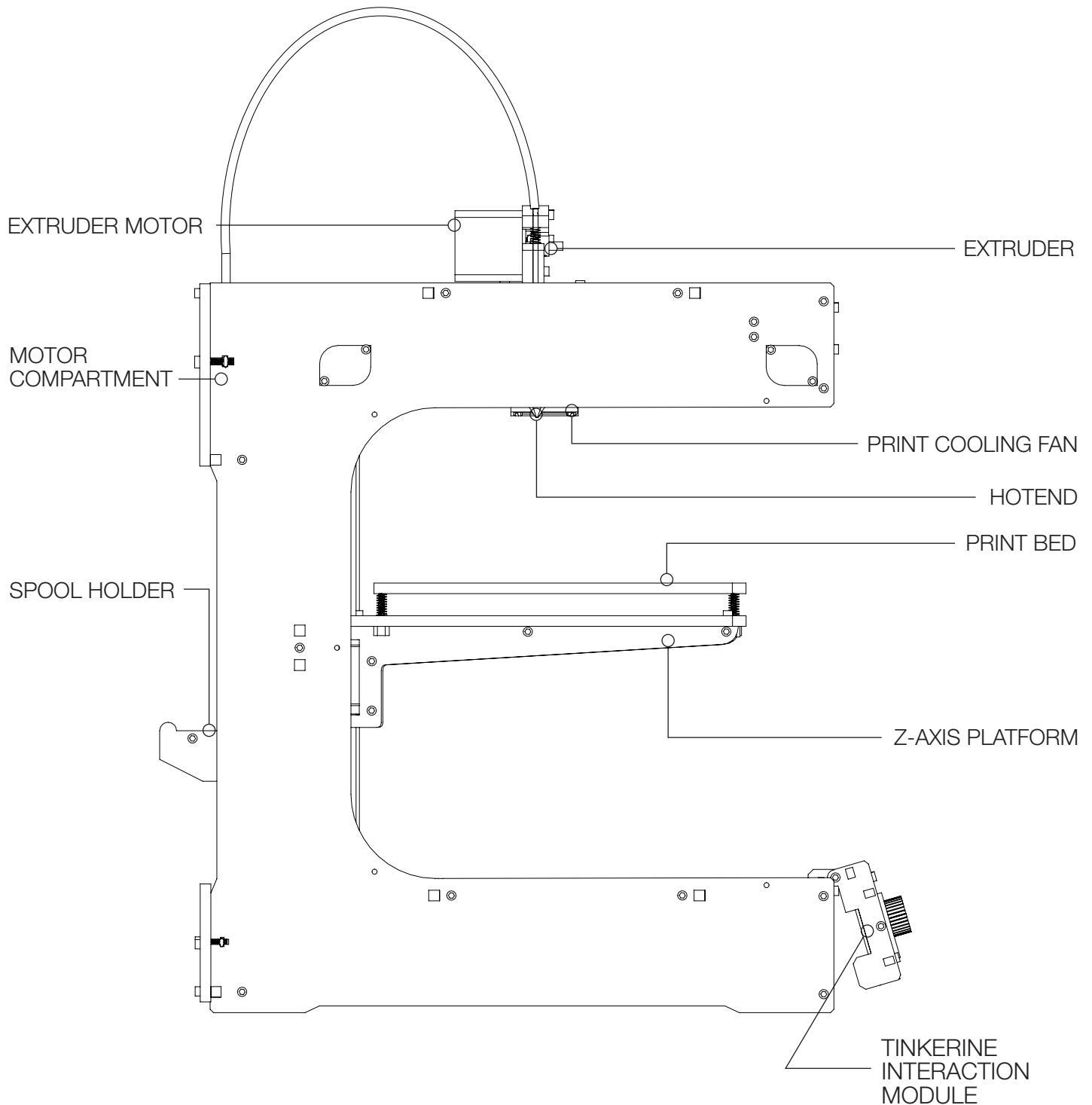
Unless instructed, DO NOT force components together.

Read the instructions carefully to prevent damaging parts during assembly or operation.

# DITTO AT A GLANCE



## DITTO AT A GLANCE



## Ditto+ Bill of Material








Ditto Laser Panels	(30) M3 x 10 screws
(1) Hotend	(85) M3 x 16 screws
(1) Cartridge heater	(12) M3 x 20 screws
(1) Thermistor	(8) M3 x 25 screws
(1) Extruder motor	(15) M3 x 35 screws
(1) "Tensioning" bearing	(3) M3 x 50 screws
(1) Cooling fan ducts	(3) M3 x 25 flathead
(1) Filament guiding tube	(1) M4 x 16 screws
(1) 158mm GT2 belt	(3) M4 x 20 screws
(1) 188mm GT2 belt	(10) M3 washers
(2) 610mm GT2 belts	(100) M3 nuts
(2) 555mm GT2 belts	(1) M4 washers
(8) Brass slider bushing	(10) M4 nuts
(8) 608ZZ ball bearings	(2) Wires (Arduino to Power)
(4) LM8 linear bearings	
(8) Pulleys + (8) 3x5mm set screws	
(2) 36-tooth pulleys	
(8) Aluminum rods	
(1) Bed plate	
(3) Calibration springs	
(3) Mechanical endstops	
(3) Brass Thumb Screw	
(2) LED strips	
(2) 40mm cooling fans	
(1) 50mm cooling fans	
(3) NEMA17 stepper motors	
(1) NEMA17 stepper motor with threaded rod	
(1) Arduino MEGA 2560	
(1) RAMPS 1.4	
(4) A4988 stepper drivers	
(1) Power supply	
(1) Power switch	
(1) Female power plug	
(1) Power cord	
(1) USB cable	

## Tool List

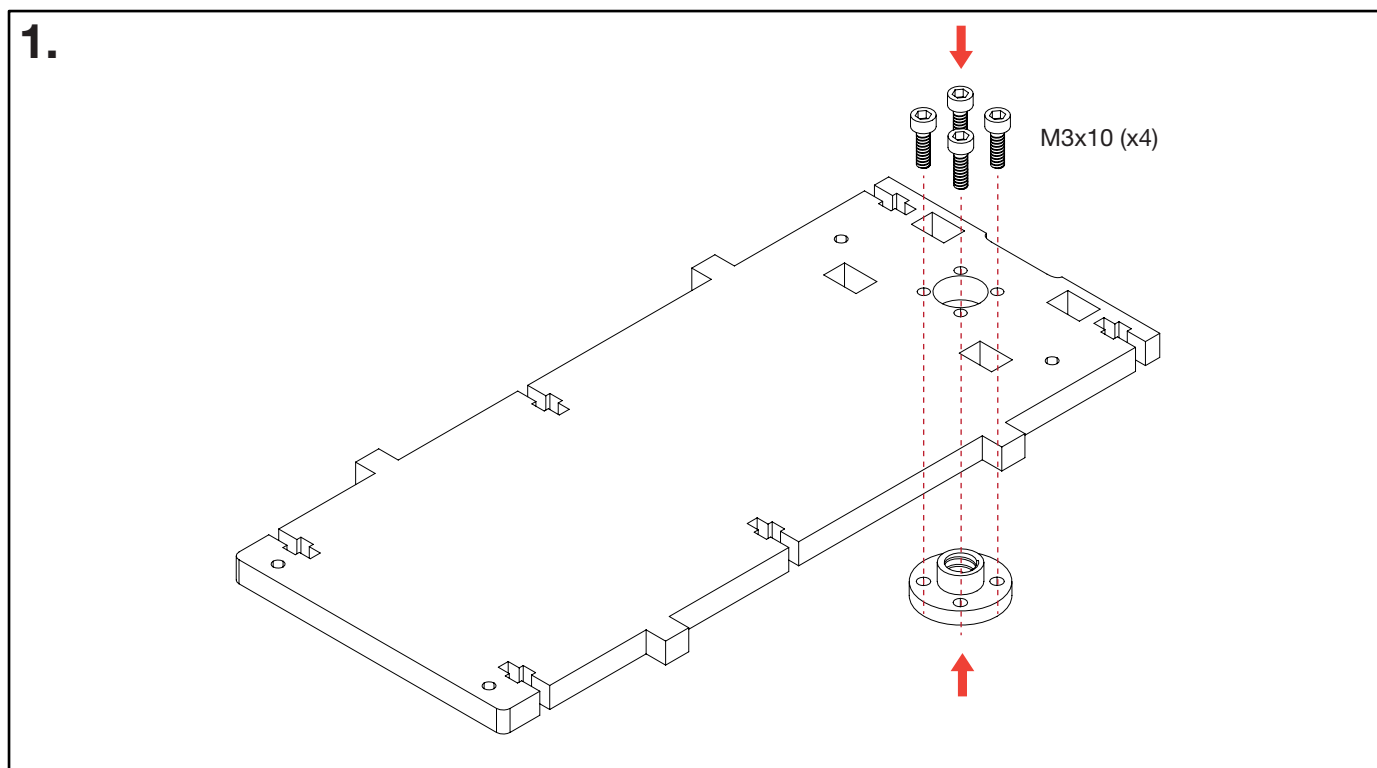
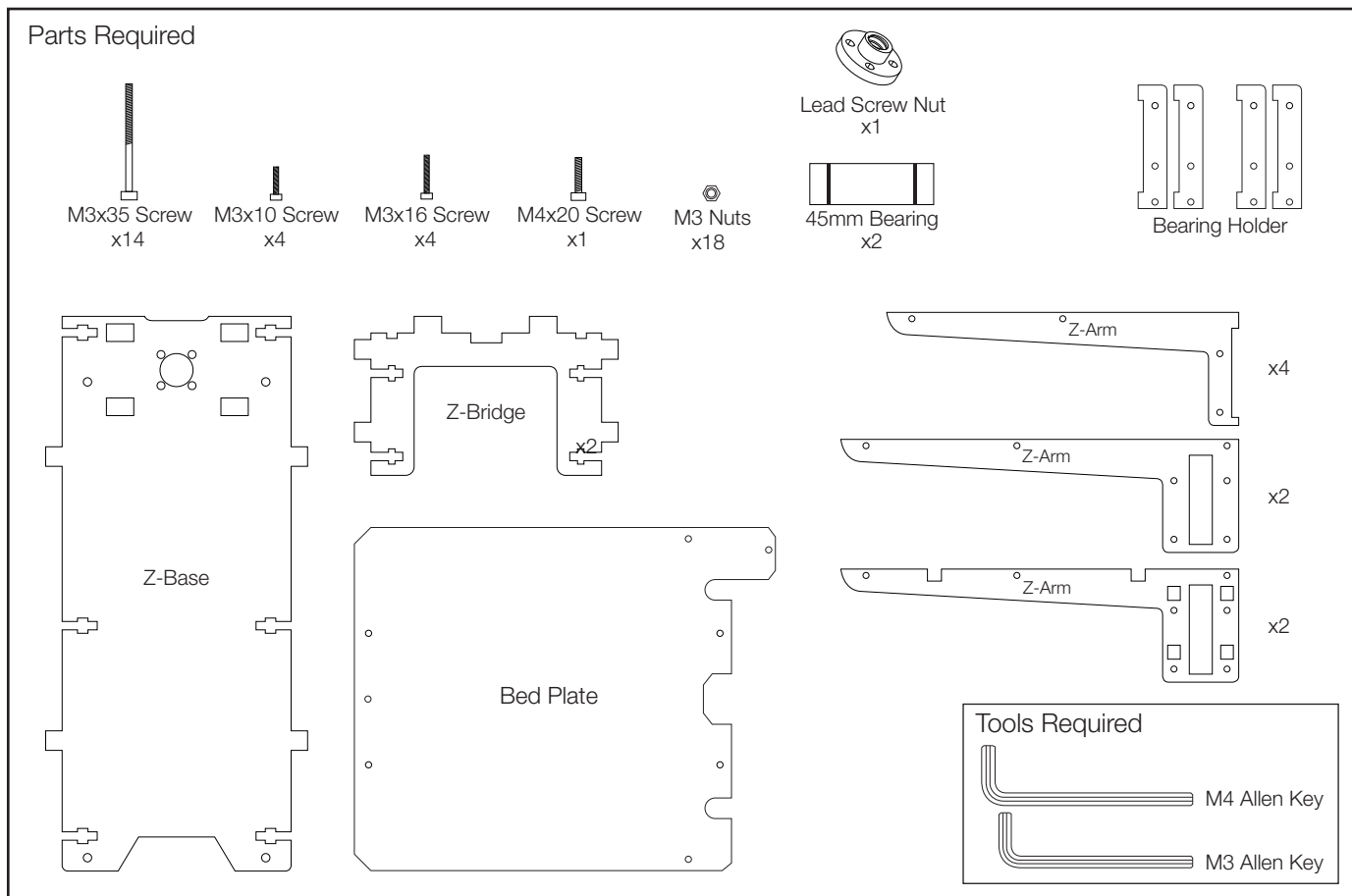
### Included In Kit

- (1) M4 Allen Key
- (1) M3 Allen Key
- (1) 1.5mm Hex Key
- (2) Zip Ties

# Before you Start

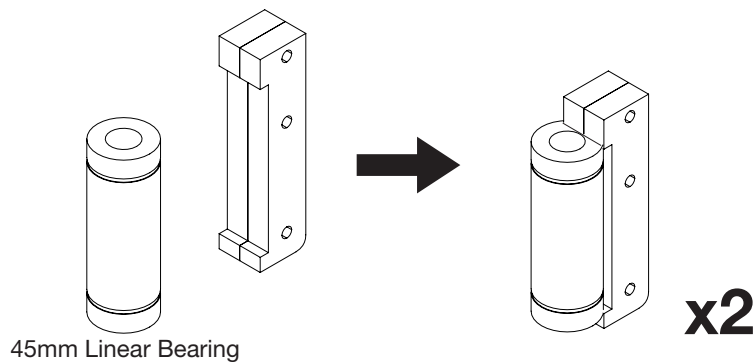
-  Before you attempt to assemble any of part the Ditto / Litto 3D Printer, it is imperative that you read the build instructions fully and ensure you understand every part of the instruction. While Tinkerine Studio provides warranty for all parts of the 3D printer, this does not cover damage caused by not following the instruction manual or other end-user error.
-  Go down the BoM (Bill of Material) and tools checklist and ensure that you have all the required parts to assemble the Ditto 3D Printer. Extra screws have been included into the kit. If you find anything missing, please contact us via e-mail at [support@tinkerines.com](mailto:support@tinkerines.com)
-  Give yourself plenty of room and clean space during the assembly process. This prevents delicate components like the electronics or bearings from being damage by dust or blunt force.
-  To ensure proper alignment of the panel and overall rigidity of the printer, it is highly recommended that the assembly is done on a flat surface.
-  Wipe off any excess grease you find on the screws with a napkin or an old towel. Screws are generally greased in order to prevent rusting during production. Cleaning off excess grease will keep your hands and printer clean during assembly.
-  Ditto is a rigid and robust 3D printer once assembled, however during the assembly process, extra care needs to be taken to make sure delicate parts require more precision than force to come together. If during the assembly process, you are unsure of the instructions, please contact us for support. Remember, unless instructed, no part in the assembly process should you need to exert a high amount of force to fit pieces together.
-  Before starting calibration, ensure that all screws and pulley setscrews are properly tightened. Common calibration issues such as skipping and backlash are usually caused by loose pulleys and unsecured components.

# Z - Platform Assembly



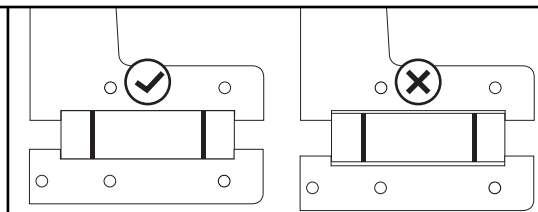
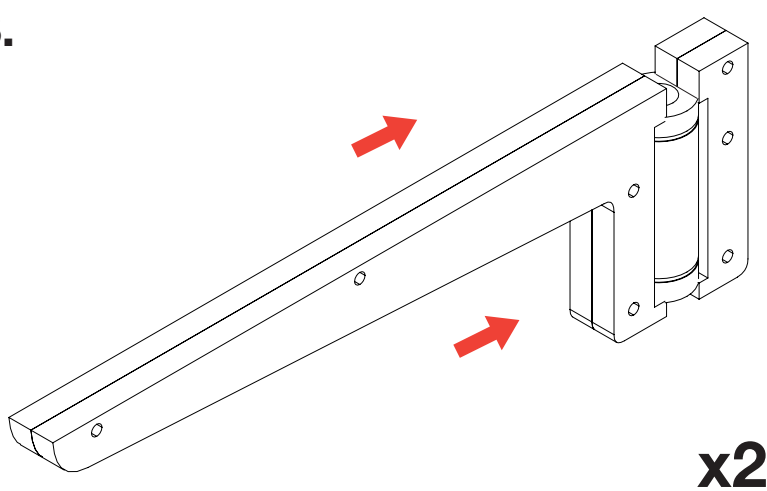


2.



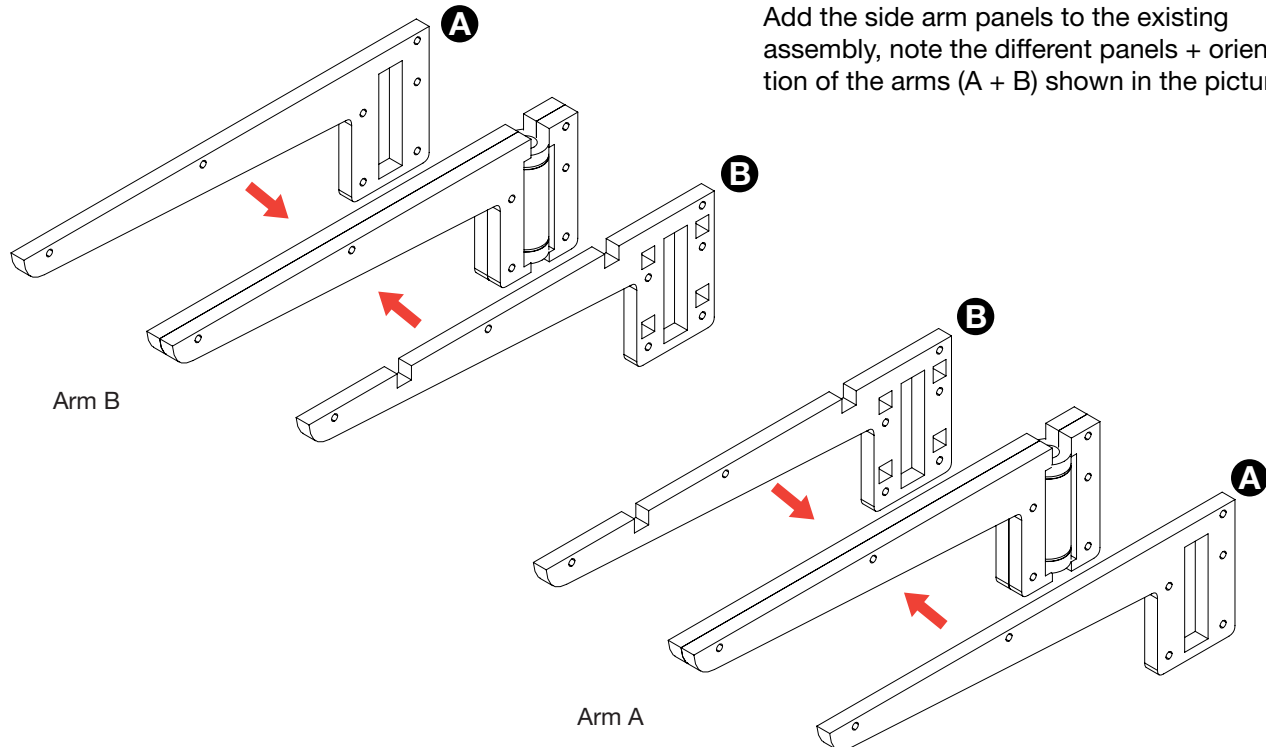
Insert a 45mm linear bearing into two bearing clips. Note the rounded edge on the clips should be facing the same direction for both pieces. Check to make sure the bearing is fully seated into the clip and aligned in the middle. You will need two sets.

3.



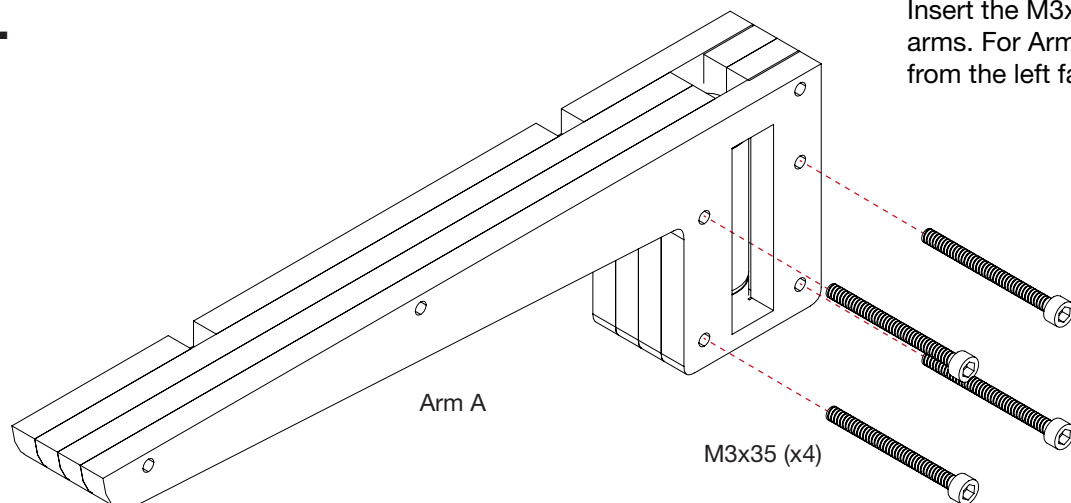
Similar to Step 2, take two z-axis arms and wedge it into the other side of the linear bearing. At this point, check to see that there is no gaps and both sides are evenly press fitted into the linear bearing. Do this for both sets. Rounded edges for all pieces should be facing downward.

4.



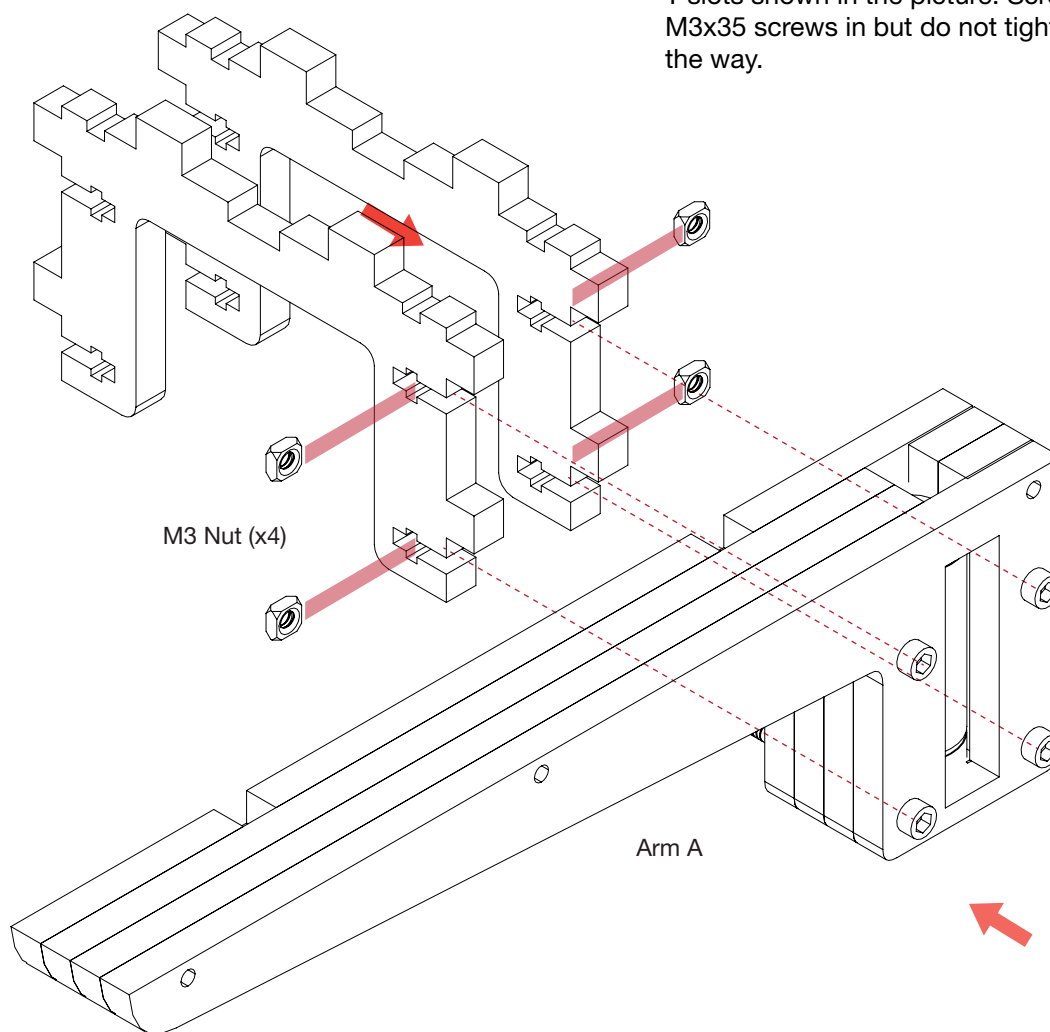
Add the side arm panels to the existing assembly, note the different panels + orientation of the arms (A + B) shown in the picture.

5.



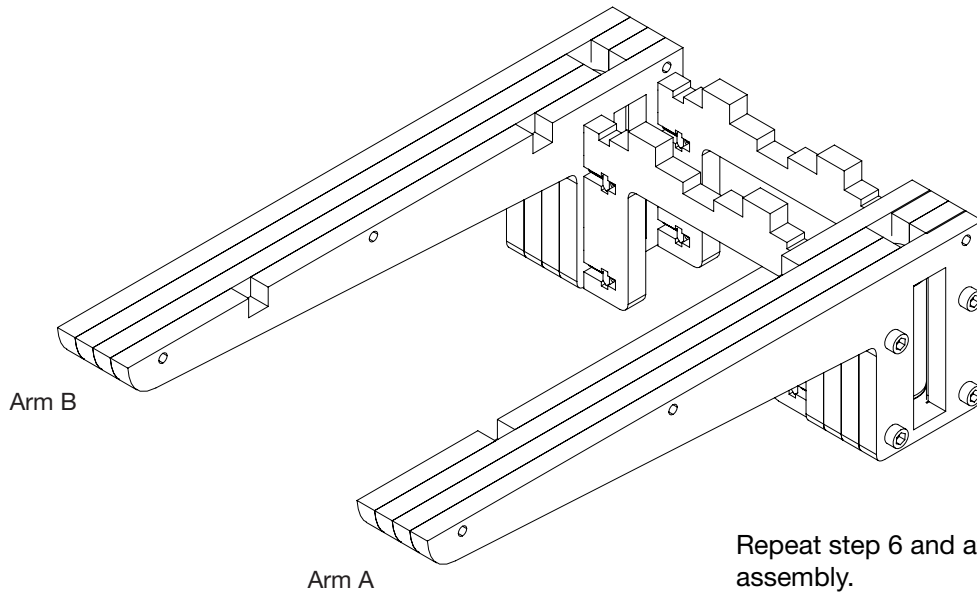
Insert the M3x35 screws into the arms. For Arm B, insert the screws from the left face.

6.



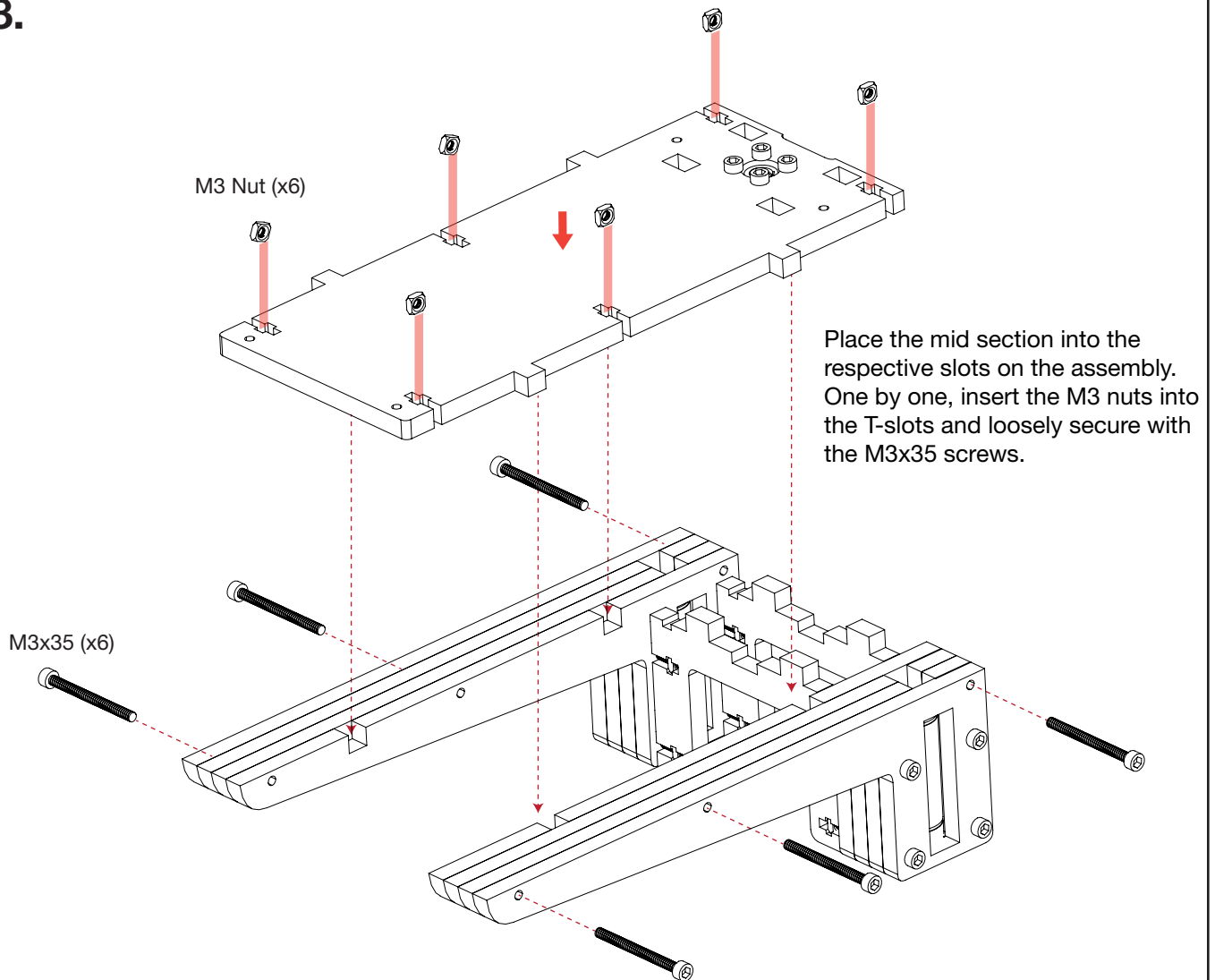
One by one, insert the M3 Nut into the T-slots shown in the picture. Screw the four M3x35 screws in but do not tighten them all the way.

7.

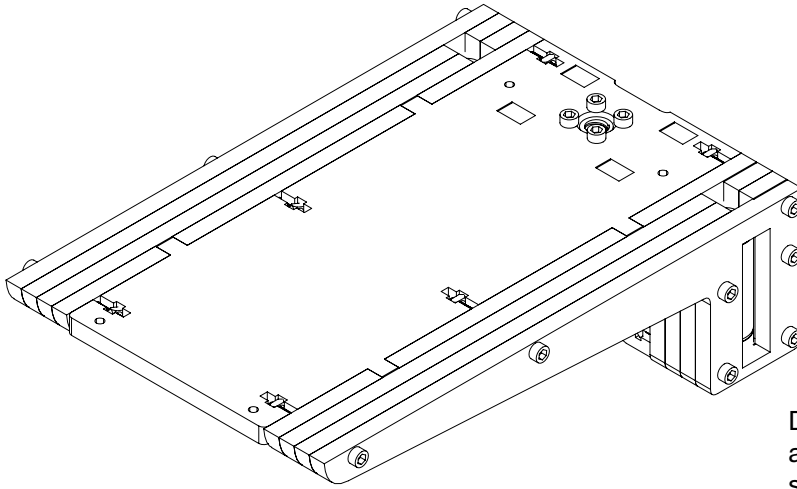


Repeat step 6 and attach arm B to the assembly.

8.

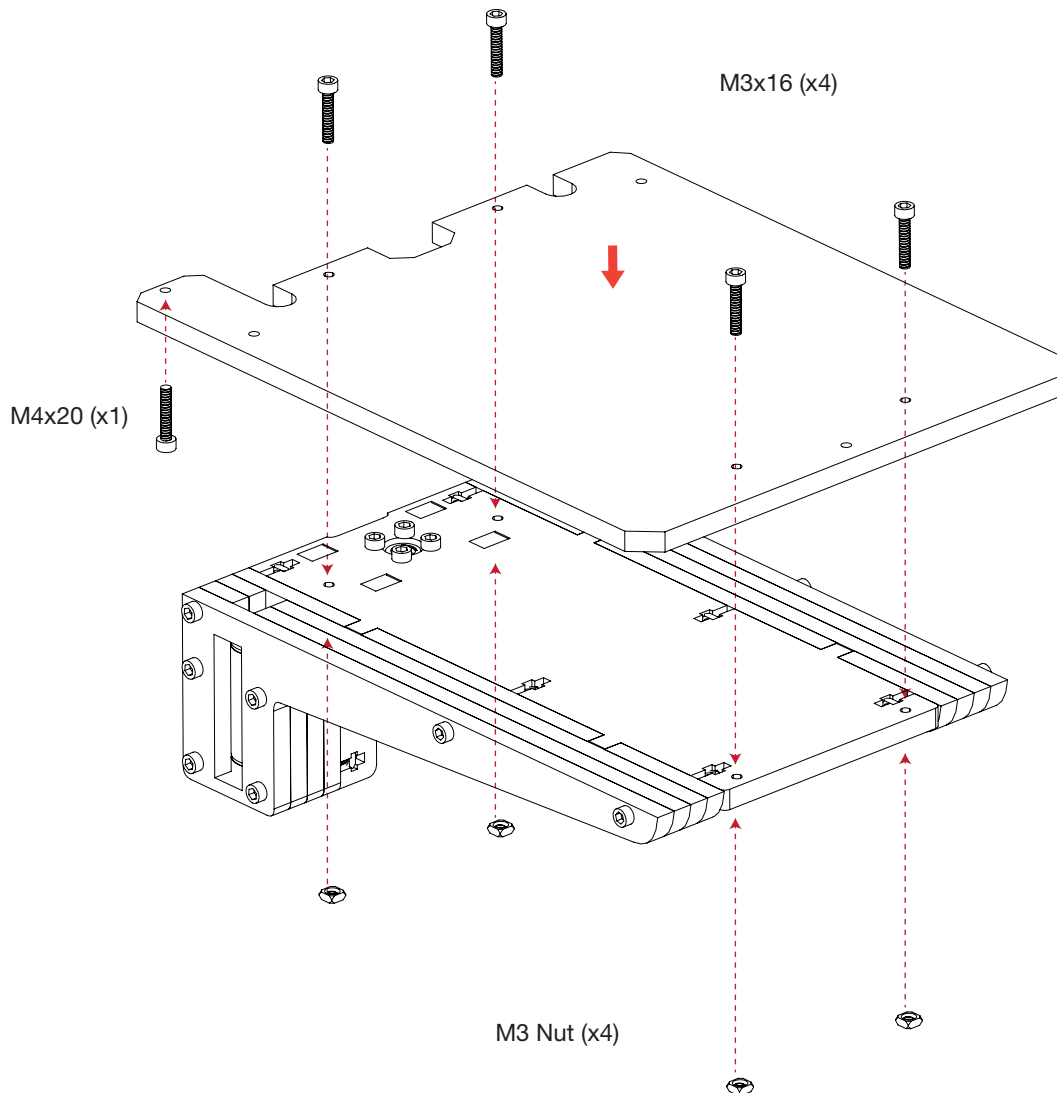


9.

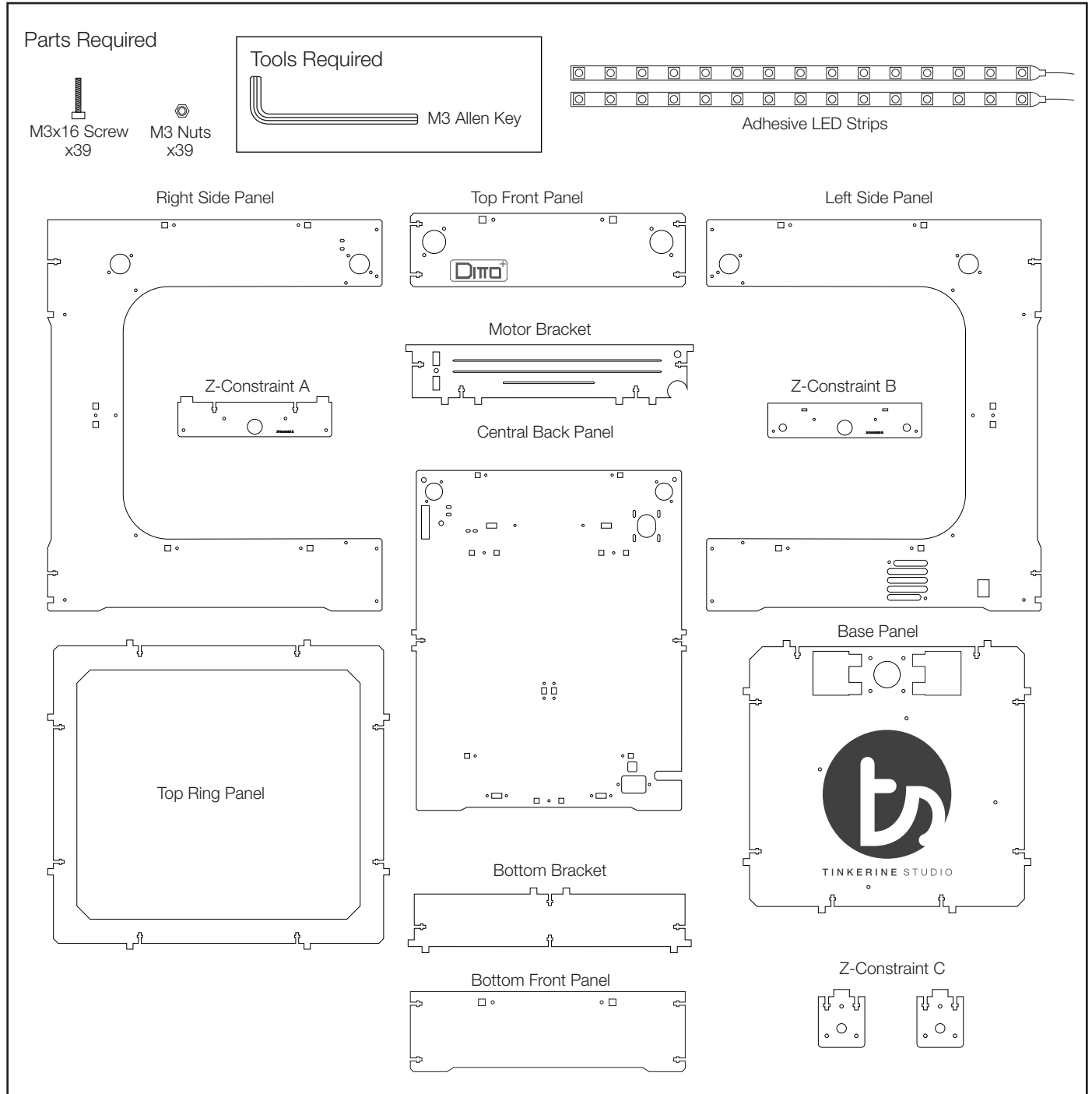


During this point, double check to make sure all panels are properly aligned and the top side of the bed is leveled with the arms. Tighten all screws evenly.

10.

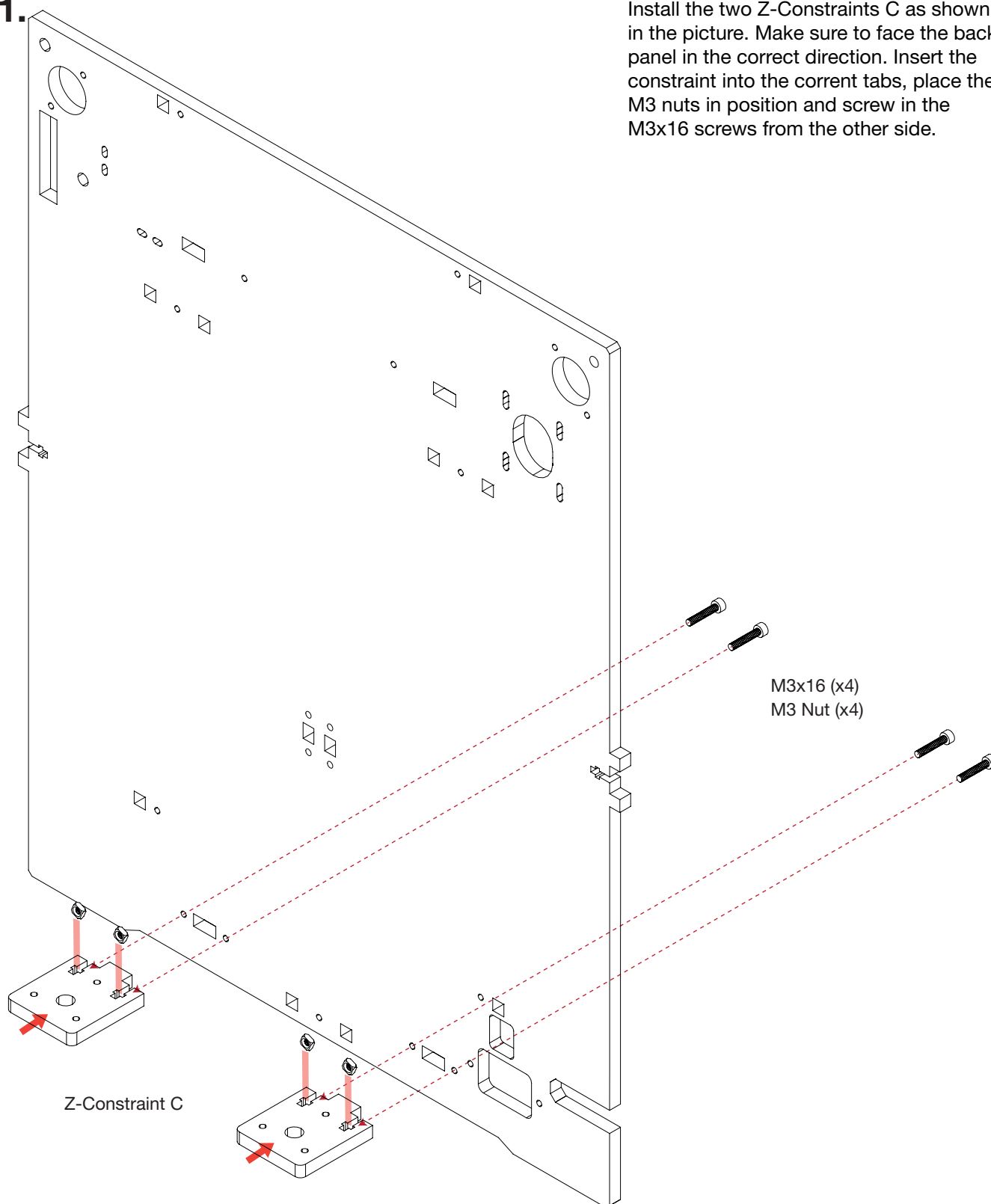


# Ditto Frame Assembly pt.1

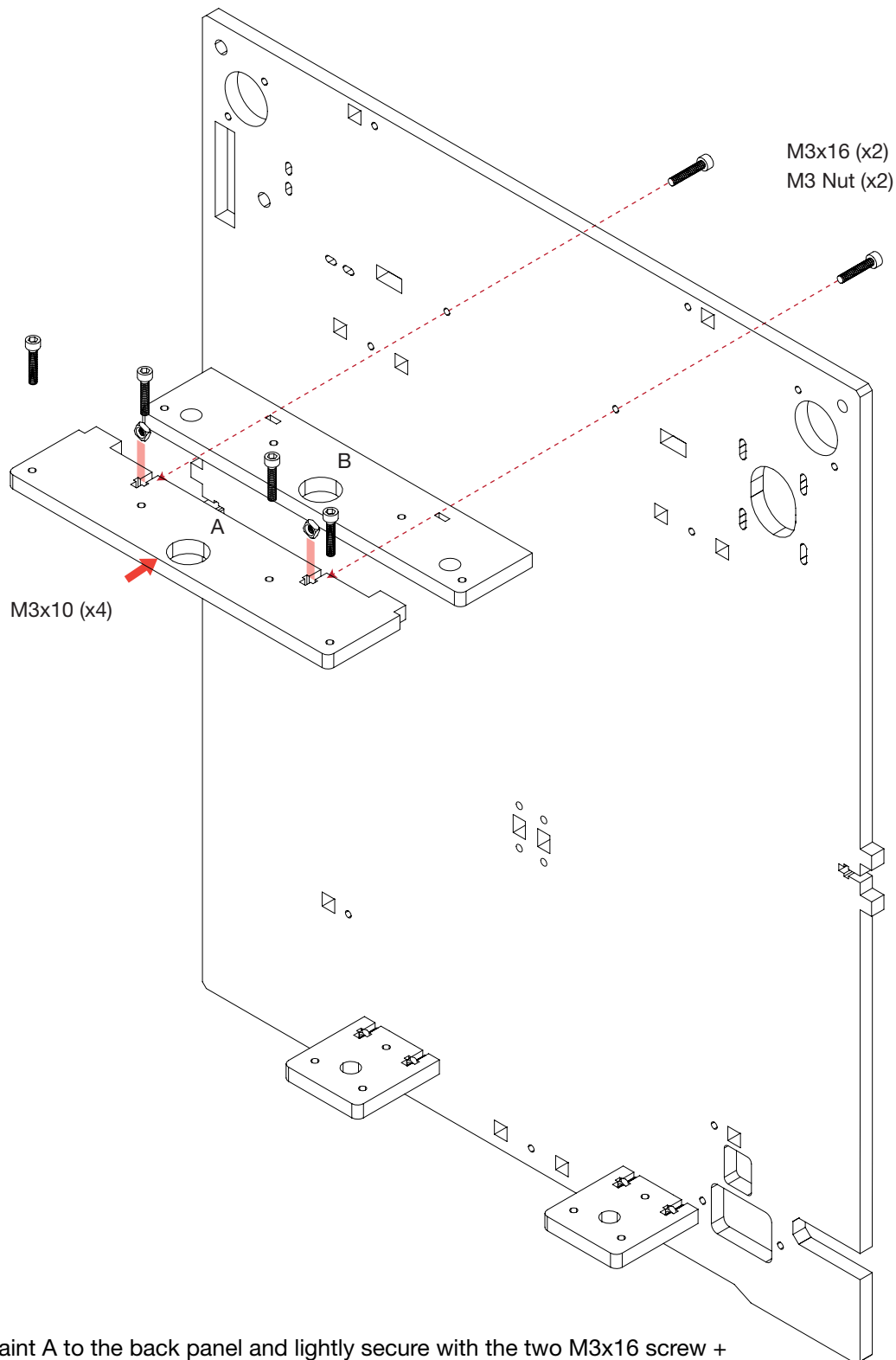


1.

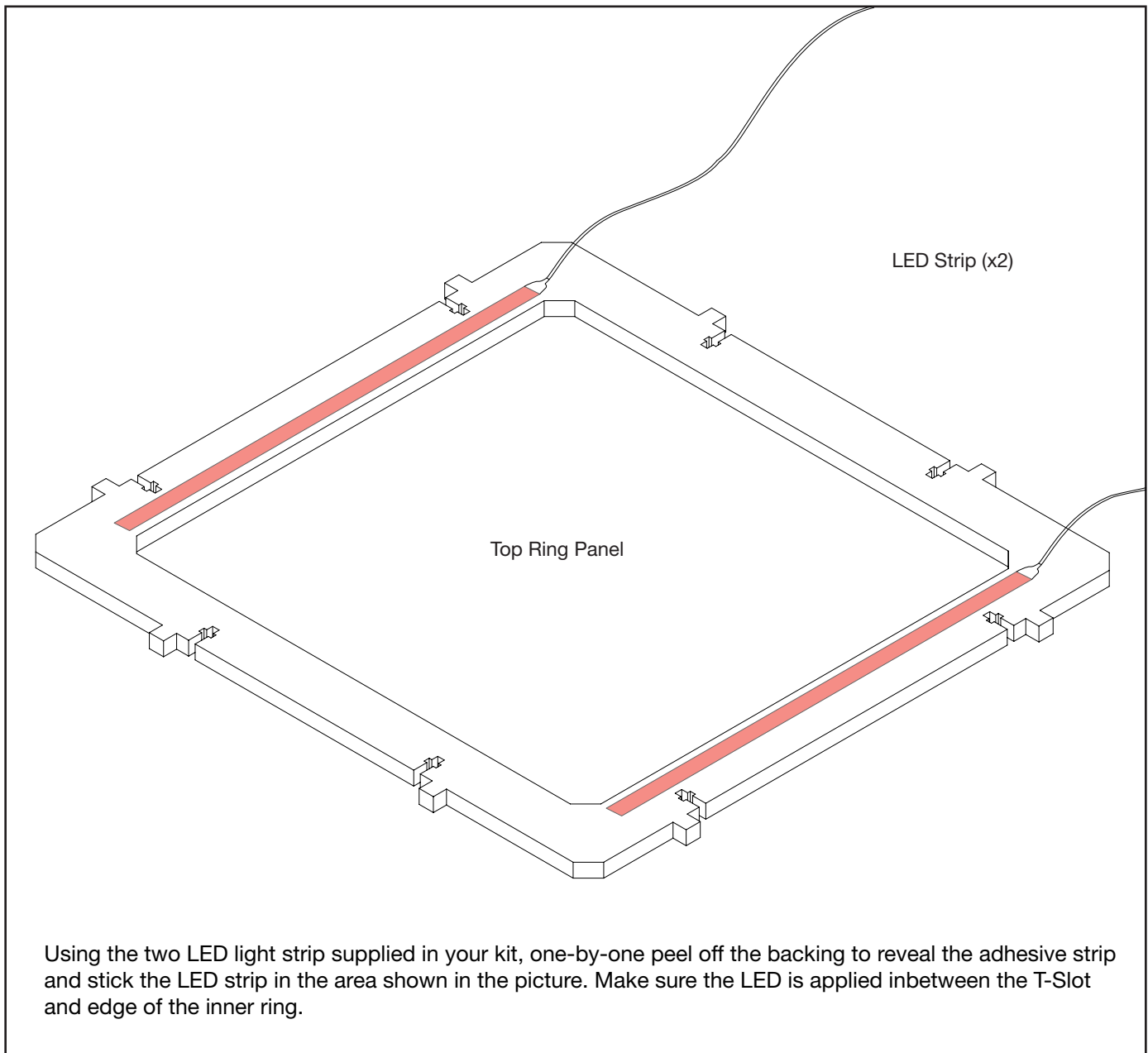
Install the two Z-Constraints C as shown in the picture. Make sure to face the back panel in the correct direction. Insert the constraint into the correct tabs, place the M3 nuts in position and screw in the M3x16 screws from the other side.



2.



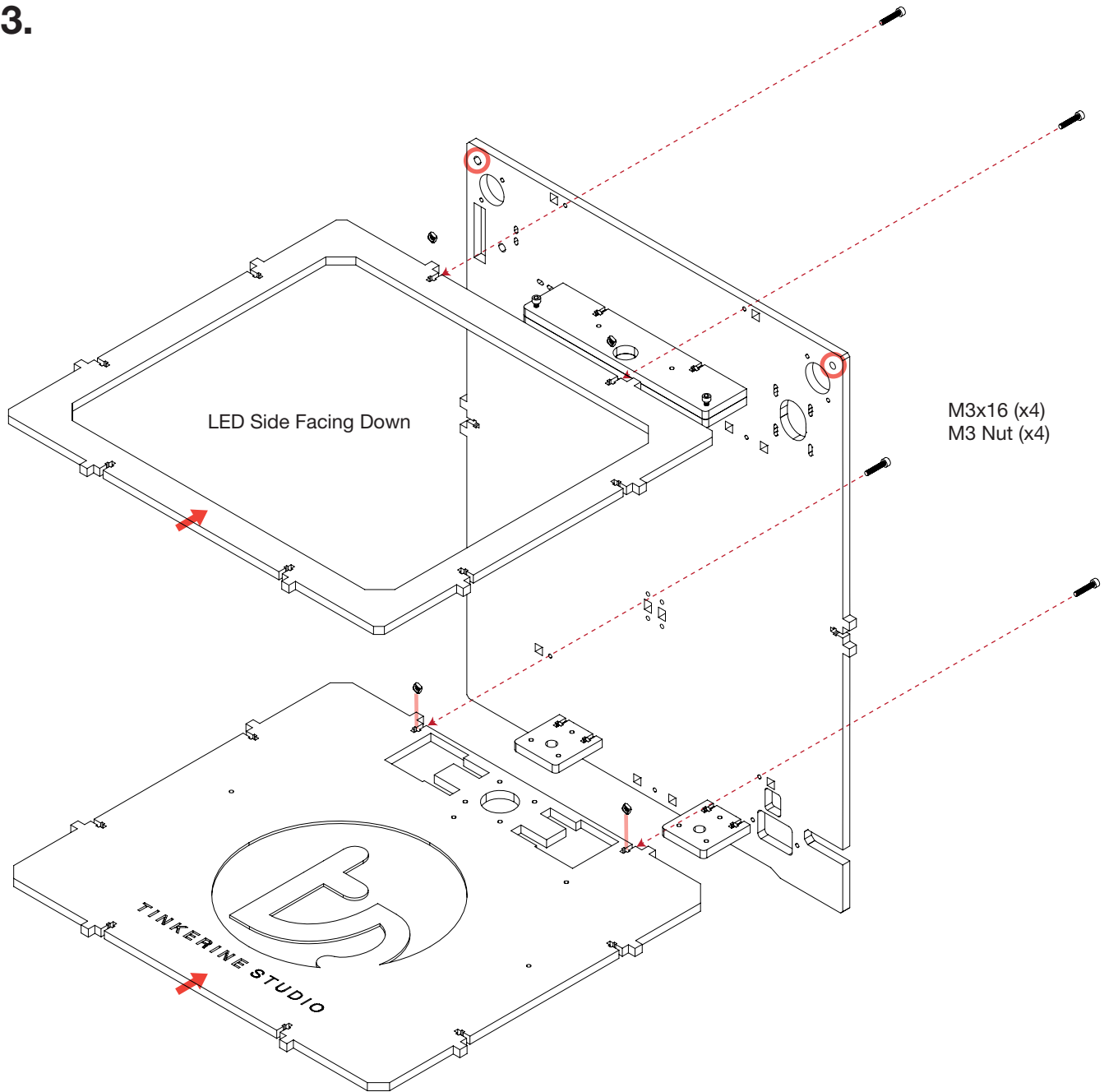
Install Constraint A to the back panel and lightly secure with the two M3x16 screw + nut. Insert Constraint B underneath Constraint A and secure with four M3x10 screws. Tighten all screws once everything is aligned and in place.



Using the two LED light strip supplied in your kit, one-by-one peel off the backing to reveal the adhesive strip and stick the LED strip in the area shown in the picture. Make sure the LED is applied inbetween the T-Slot and edge of the inner ring.

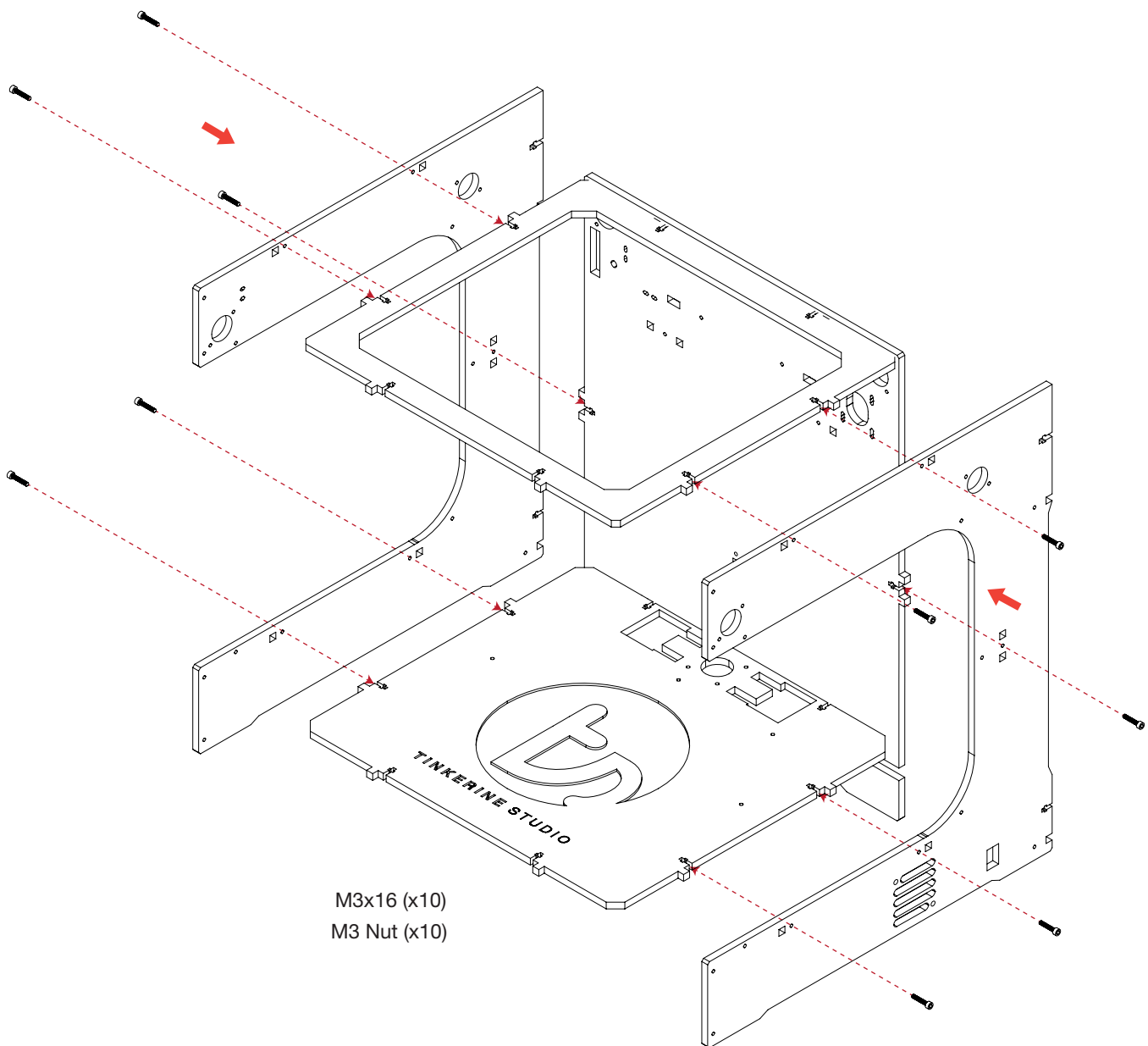


3.



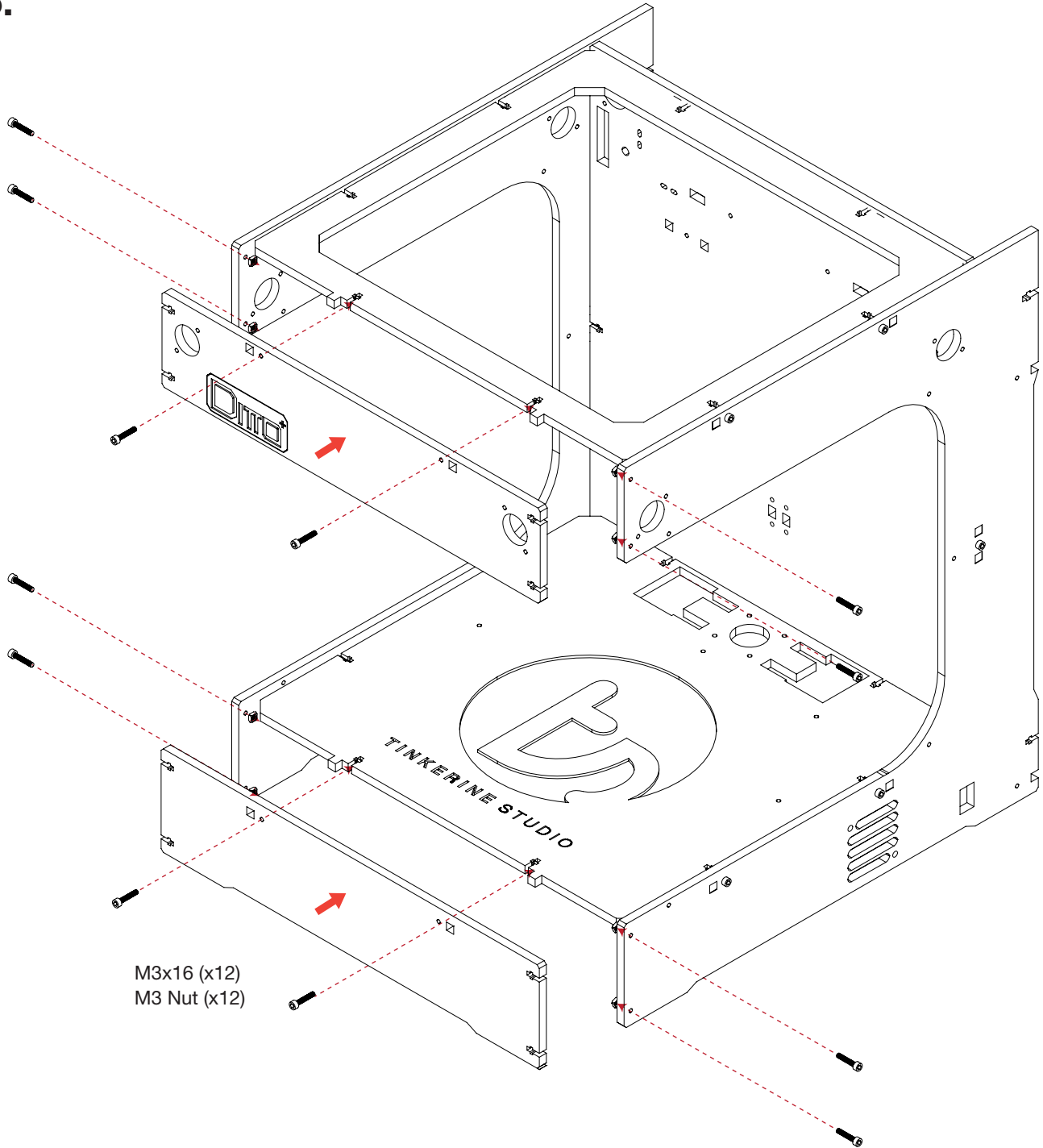
Insert the top ring and bottom plate into the back plate, then secure with M3x16 and nuts in the T-Slots. For the top ring, the side with the led should be facing downward. Thread the LED wires into the hole shown in the picture.

4.



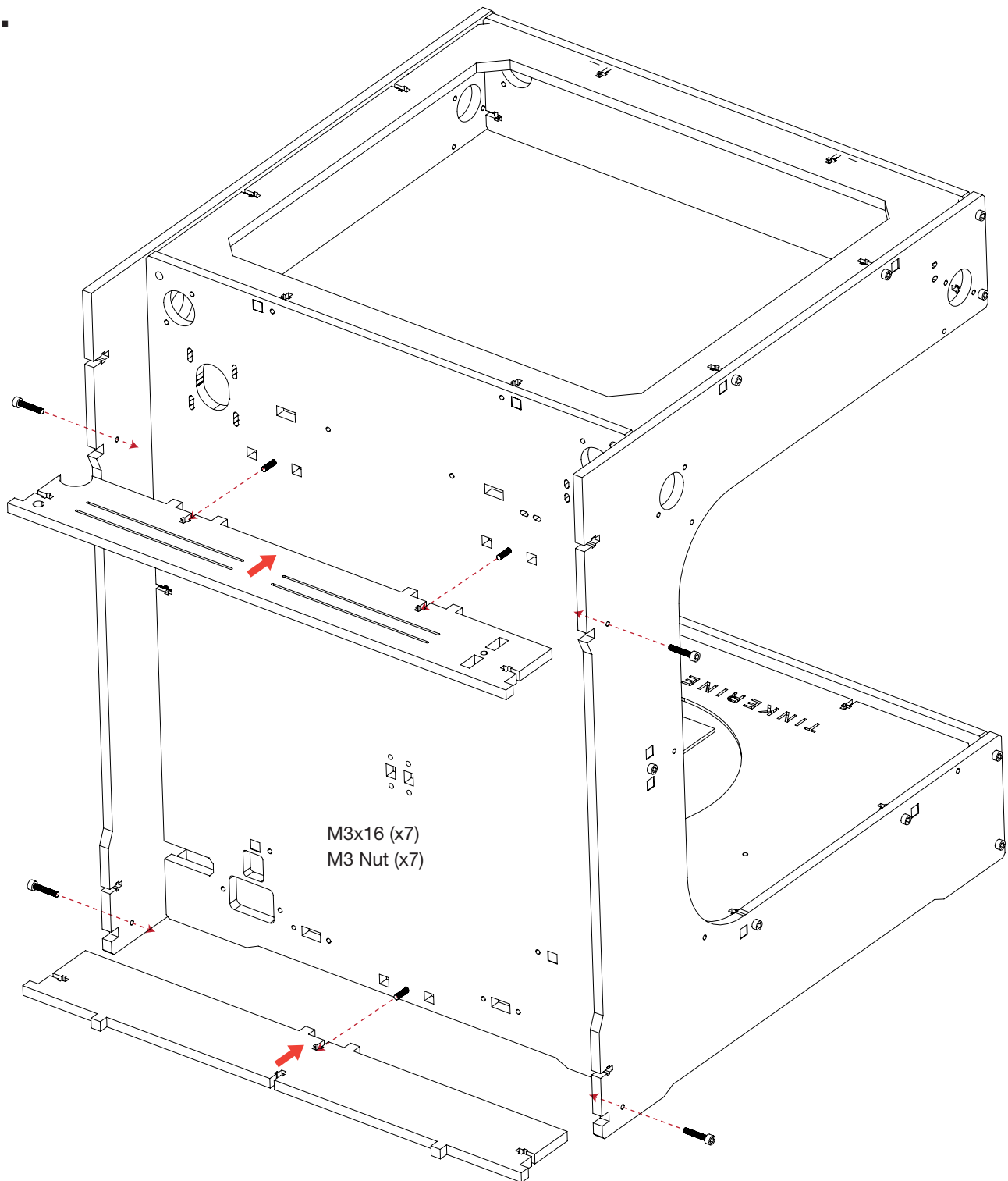
Install the two side panels into the main body. Secure each side with five M3x16 screws and nut. Make sure the panel with the power switch and fan grill cutout is on the right side.

5.



Install the top front and top bottom panels. At this point, you will want to make sure all the panels are properly aligned and leveled to a flat surface. Due to the natural property of wood your wooden frame may not be perfectly tapered to the surface, however we can correct this later on once the other components are installed.

6.

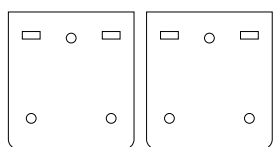


Install the top and bottom brackets into the main body. You will need to insert some screws from the front of the machine.

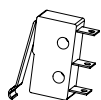
## Ditto Frame Assembly pt.2

### Parts Required

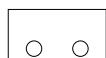
M3x10 Screw x4  
M3x16 Screw x6  
M3x20 Screw x4  
M3x25 Screw x2  
M3 Nuts x12



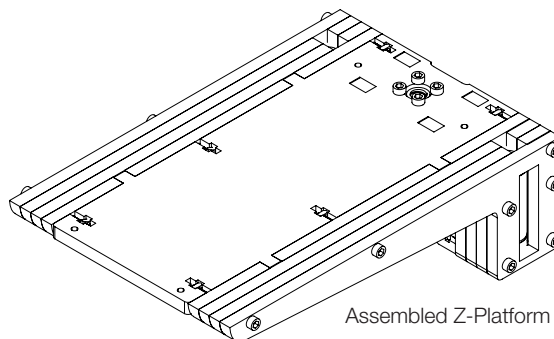
Z-Constraint D



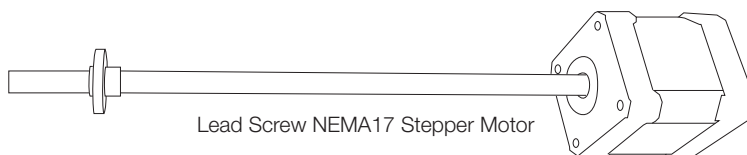
Endstop Switch  
x3



Endstop Spacer  
x5



Assembled Z-Platform



Lead Screw NEMA17 Stepper Motor



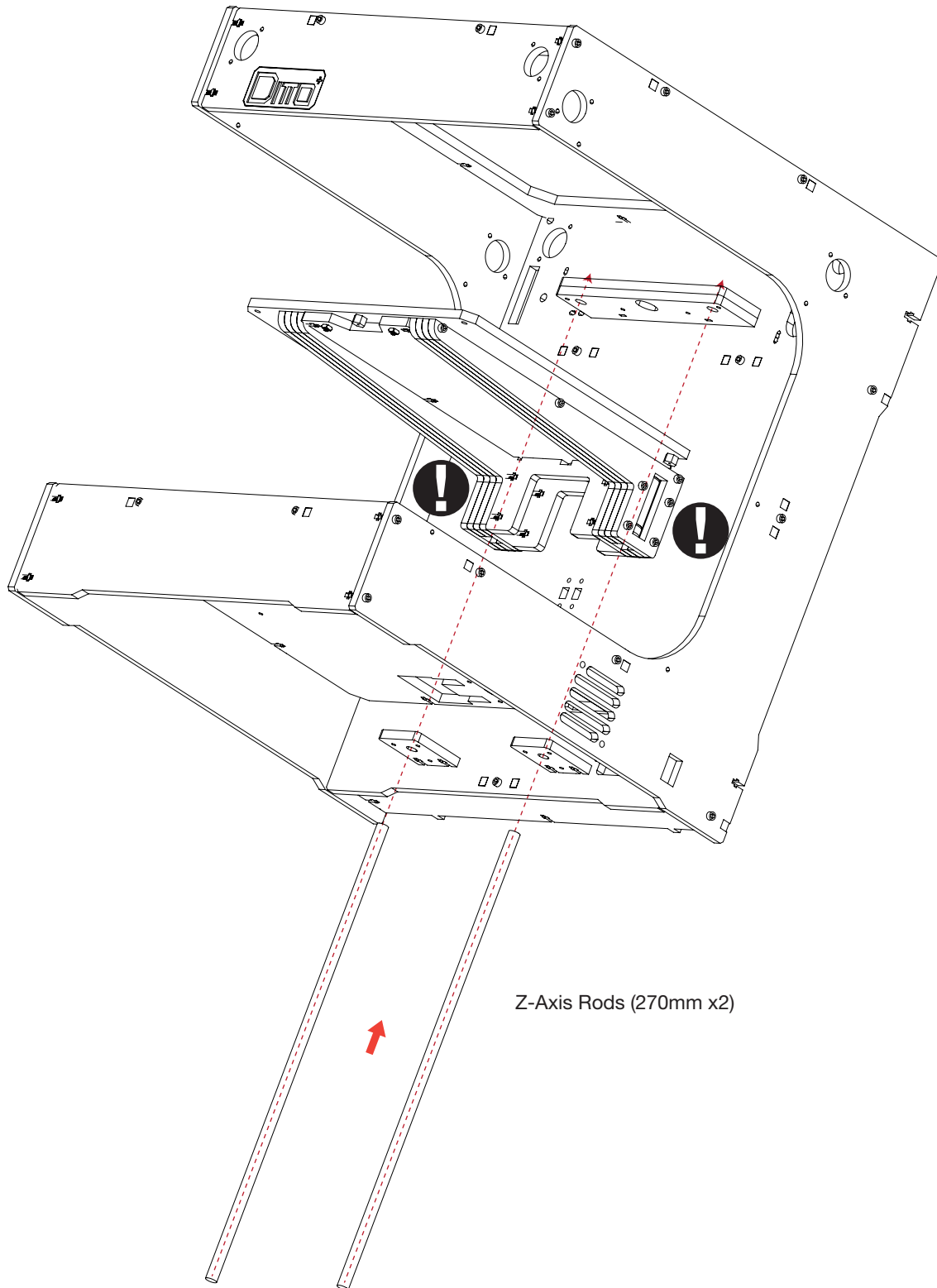
Z-Axis Smooth Rod (270mm)  
x2

### Tools Required



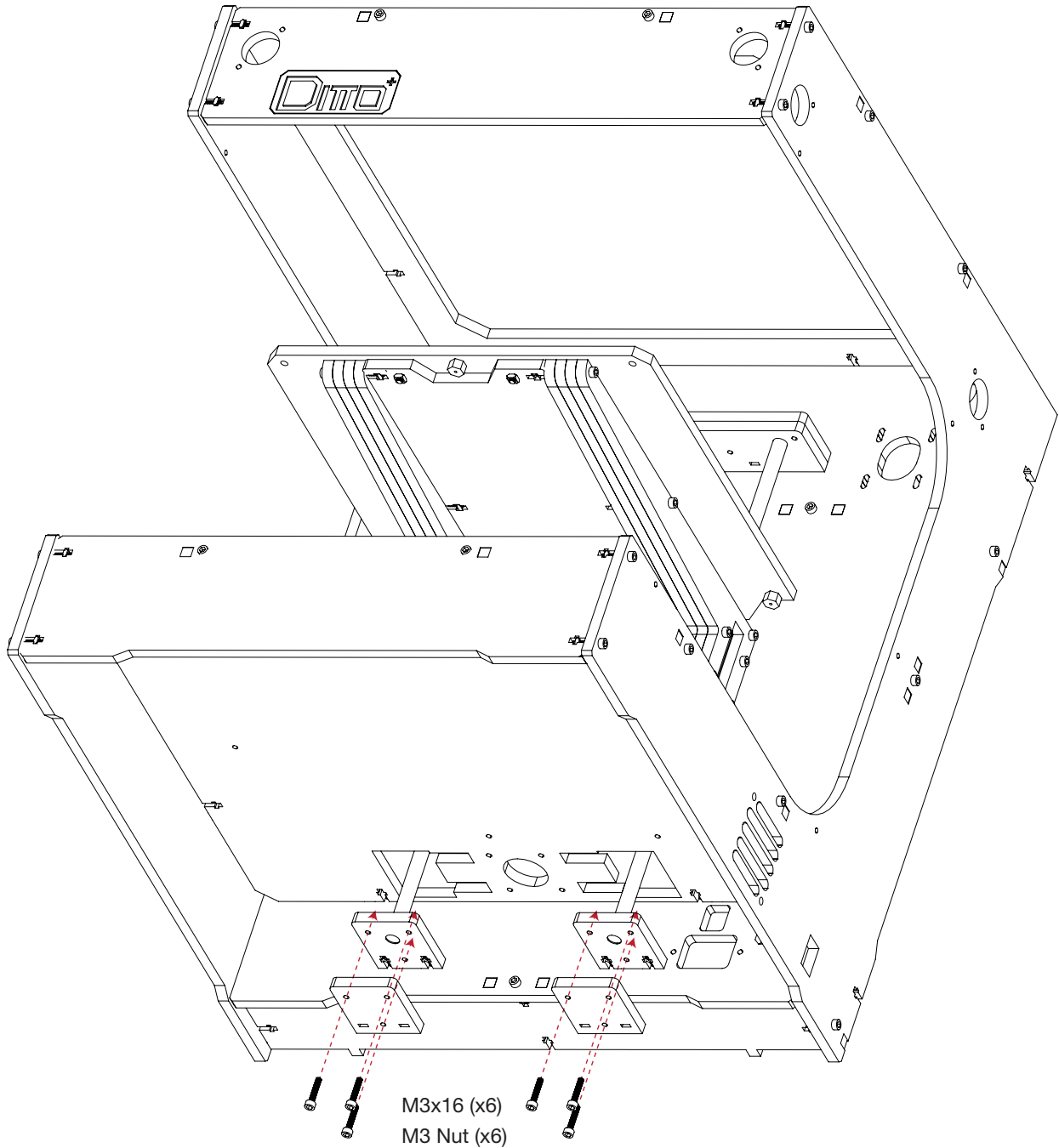
M3 Allen Key

1.



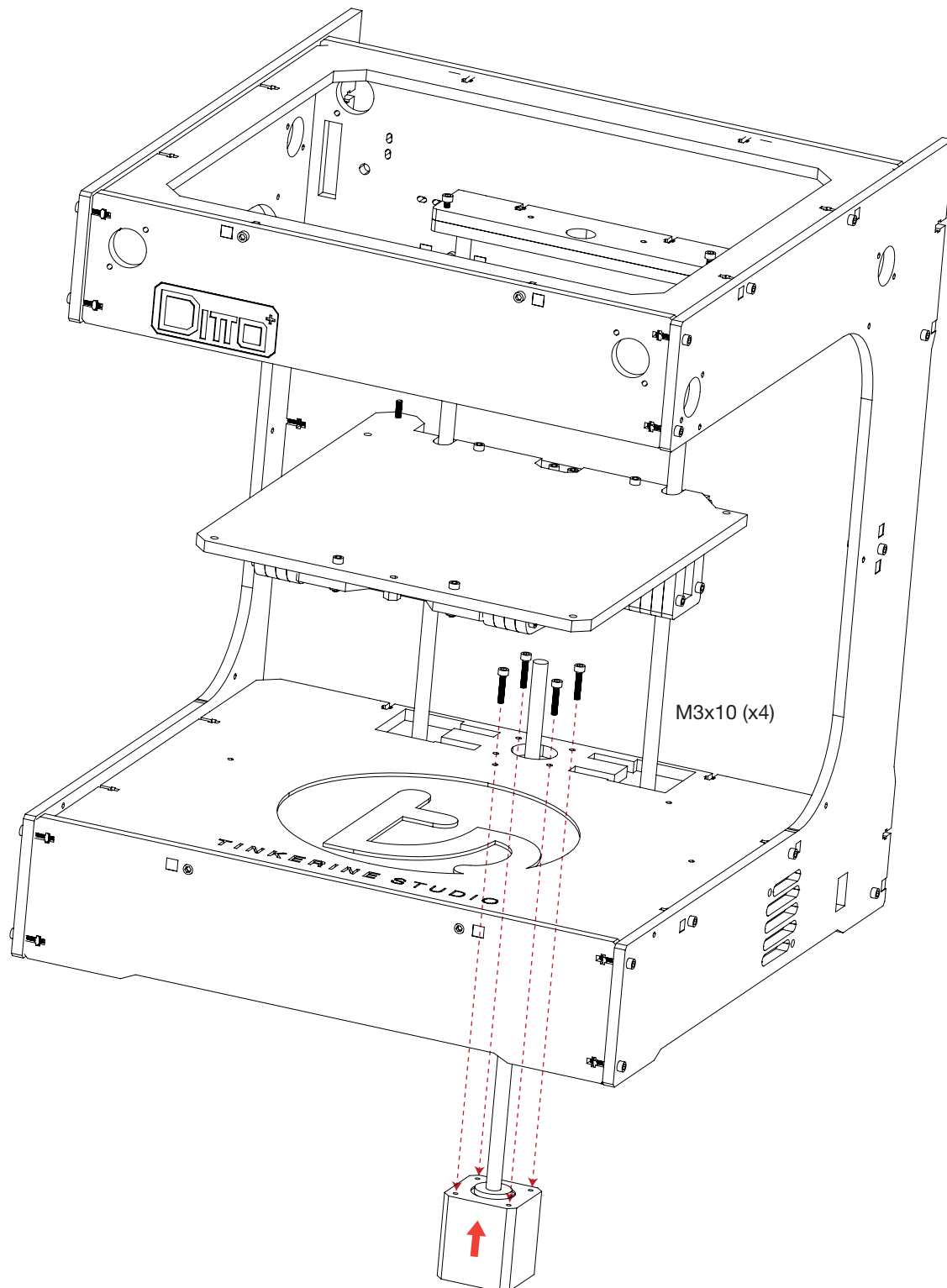
Gently insert the Z-Axis smooth rods through the bottom Z-Constraint, linear bearing of the Z-Axis bed and finally the top Z-Constraint. If you feel there is any amount of resistance once you reach the linear bearings within the z-axis arms, do not force it in. Pull the rod backwards gently and retry. Rotating the rod gently while inserting may help it slide in more easily. Take your time with the bearing, forcing the rod in will cause the bearing balls to dislodge.

2.



The Z-Axis rods should now sit flush within the bottom and top Z-Constraint. Attach Z-Constraint D to C, secure the two pieces together with three M3x16 screws each.

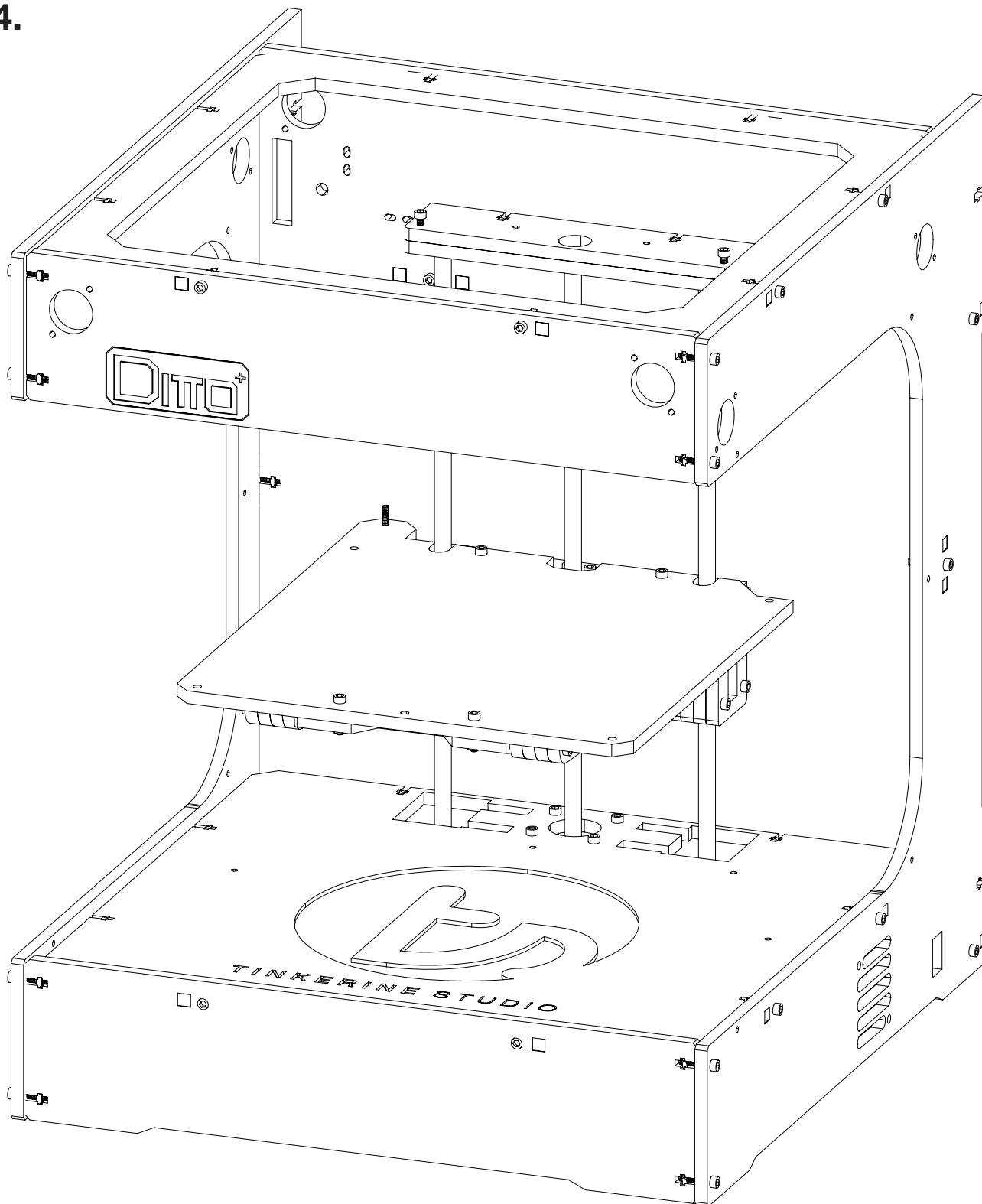
3.



Lay the printer on its back. Insert the Z-Axis Motor and lead screw from the bottom and into the Z-Axis platform. To connect the the lead screw into the nut within the platform you will need to manually turn the lead screw rod until it threads into the nut. Secure the motor to the frame with four M3x10 screws.

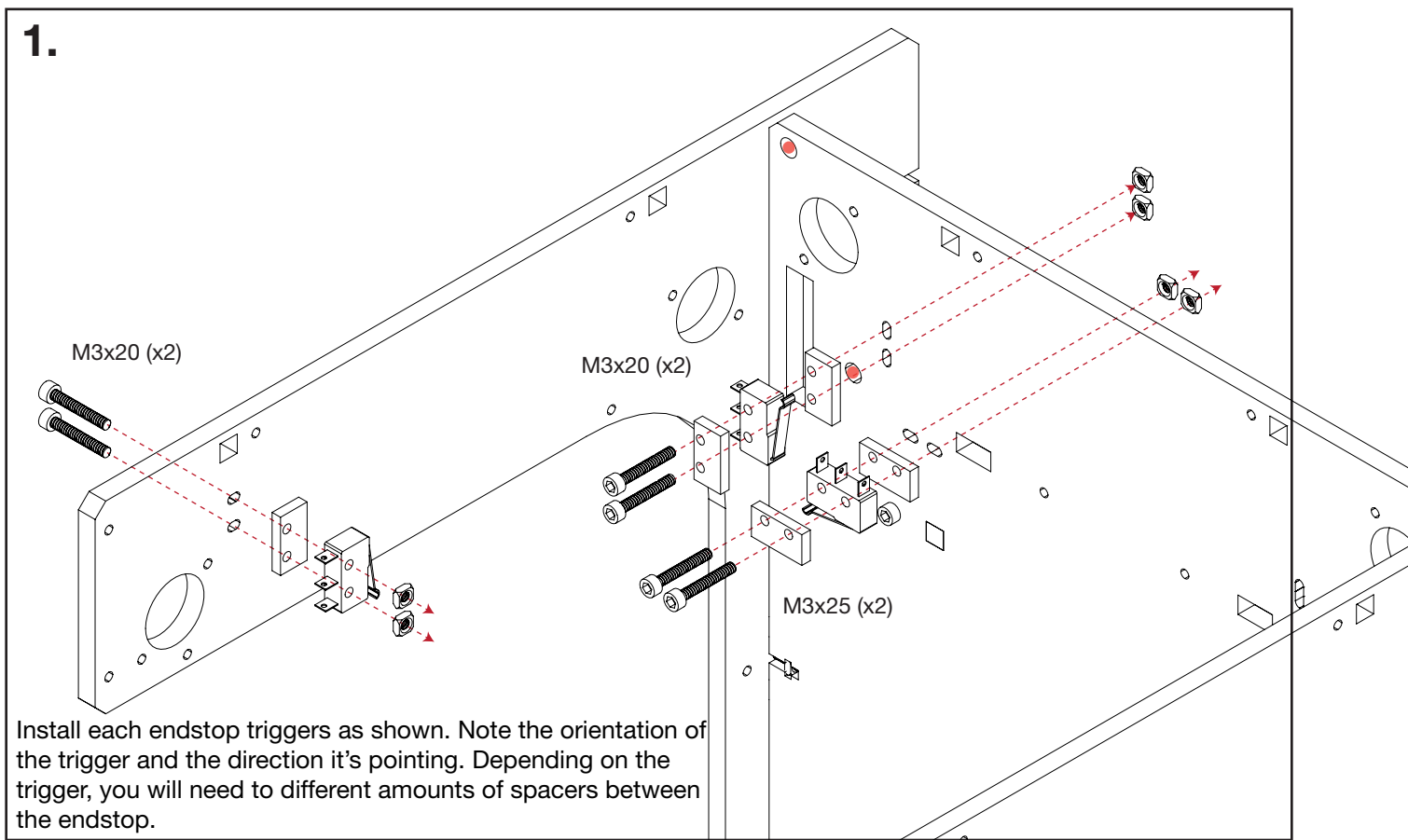


4.

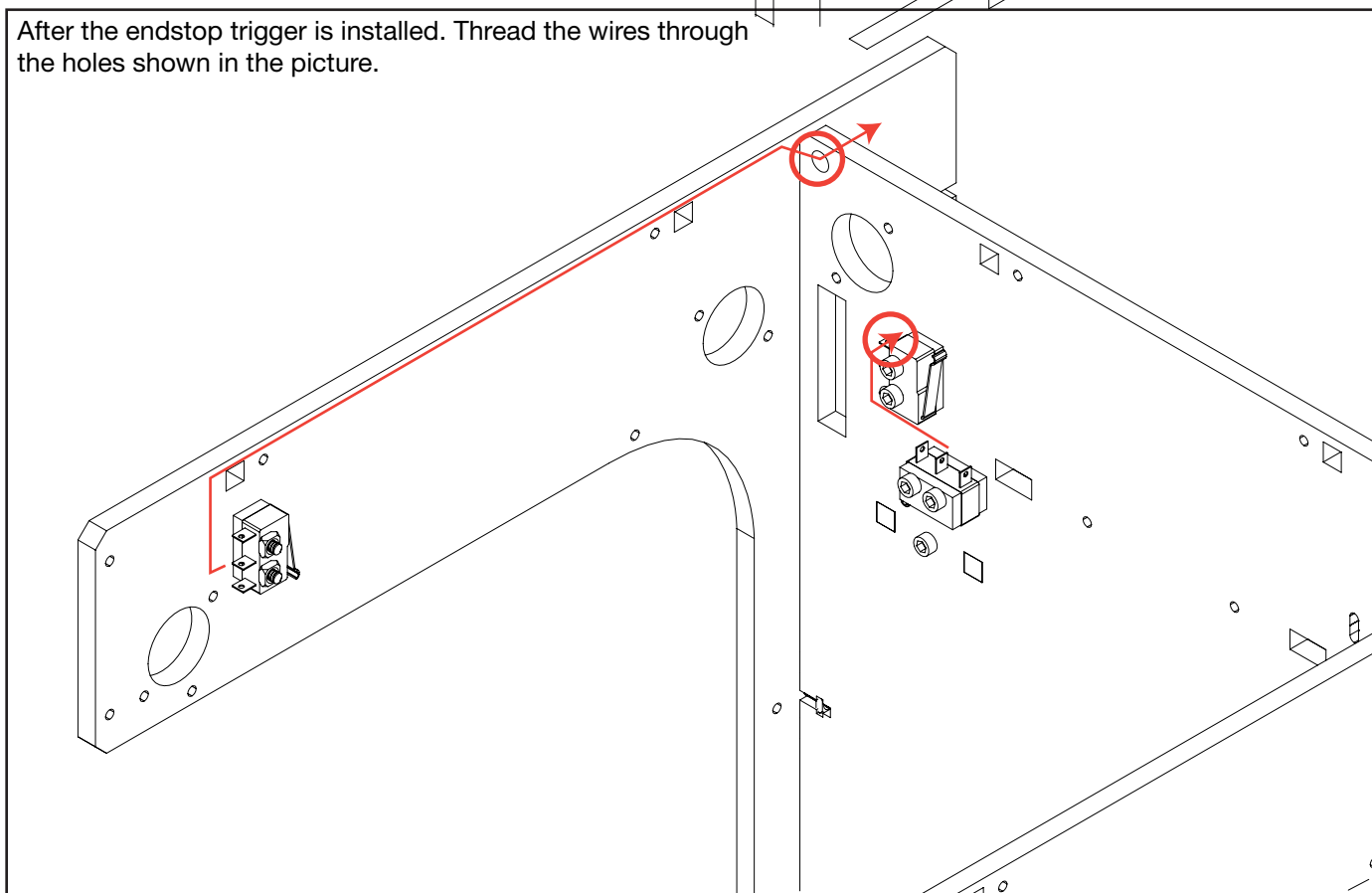


At this point, the printer's top and bottom Z-Constraint should be in place and secured. The bed assembly is installed and threaded onto the Z-Axis motor and the motor is secured to the bottom panel. Double check to ensure that all screws are tightened. You may wish to manually adjust the bed by turning the lead screw to get better access to parts of the printer.

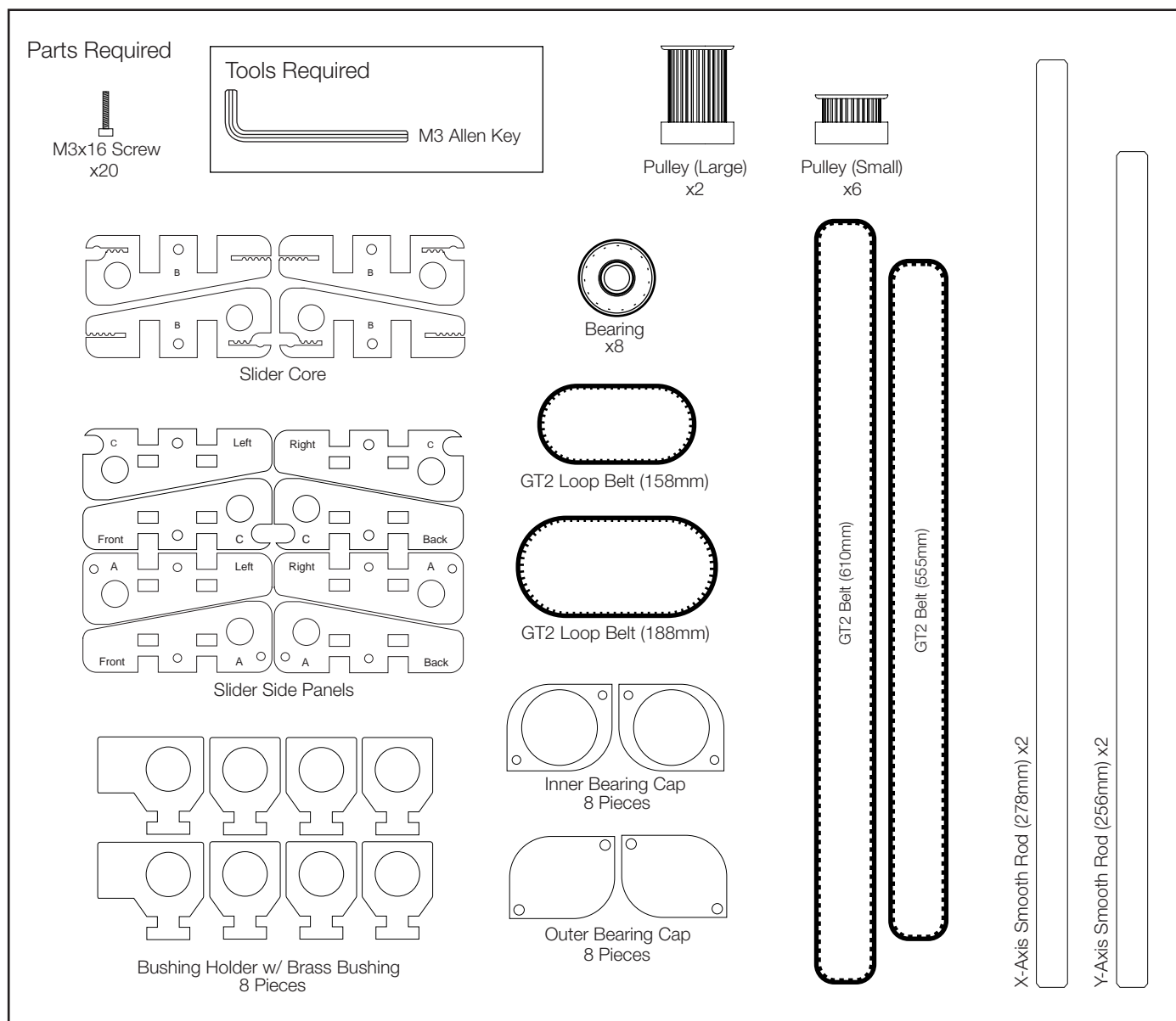
1.



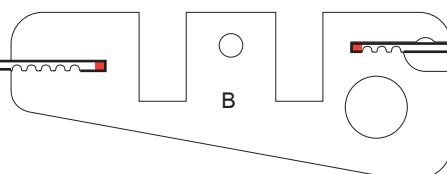
After the endstop trigger is installed. Thread the wires through the holes shown in the picture.



# Gantry Assembly pt.1

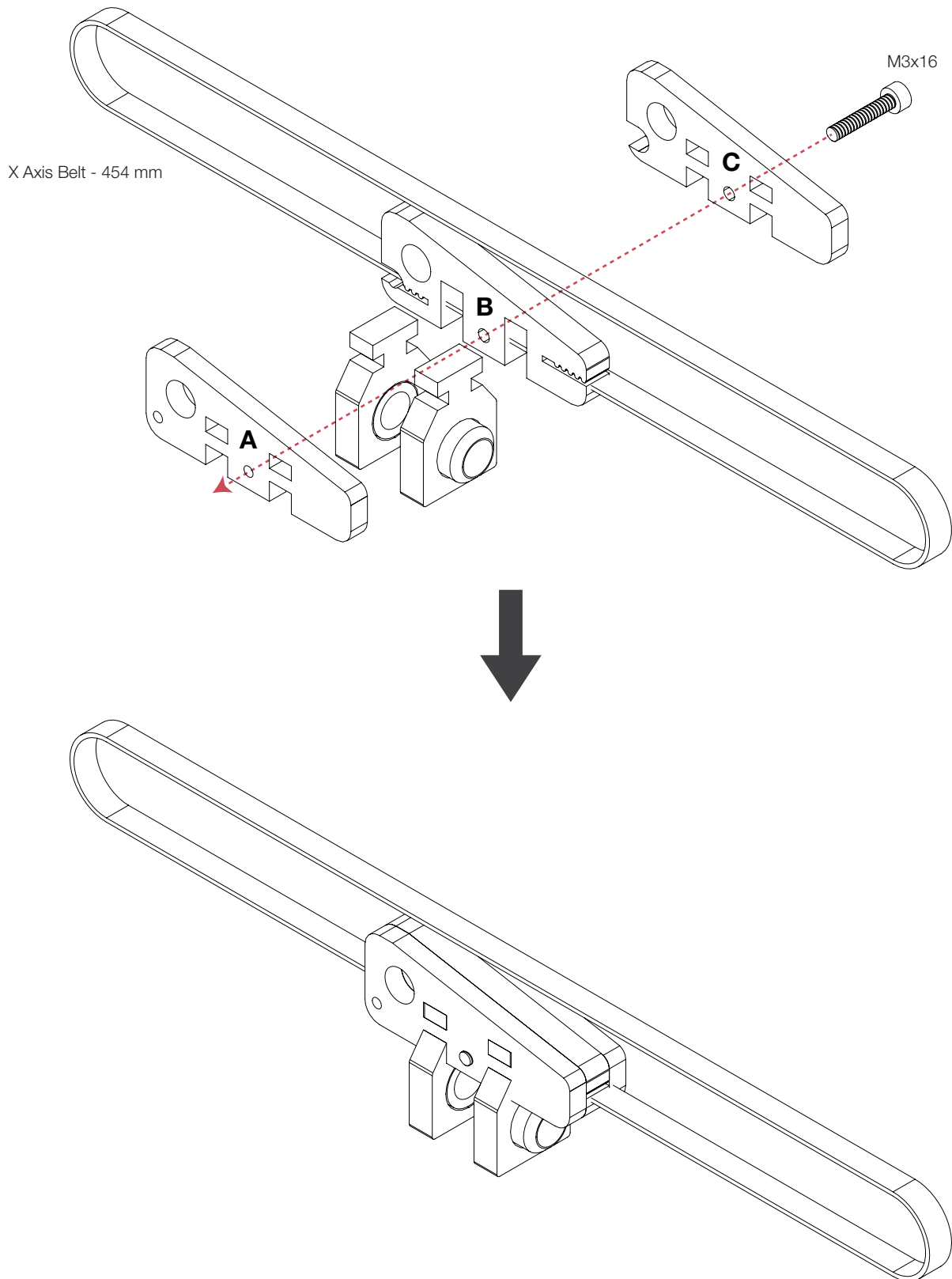


1.

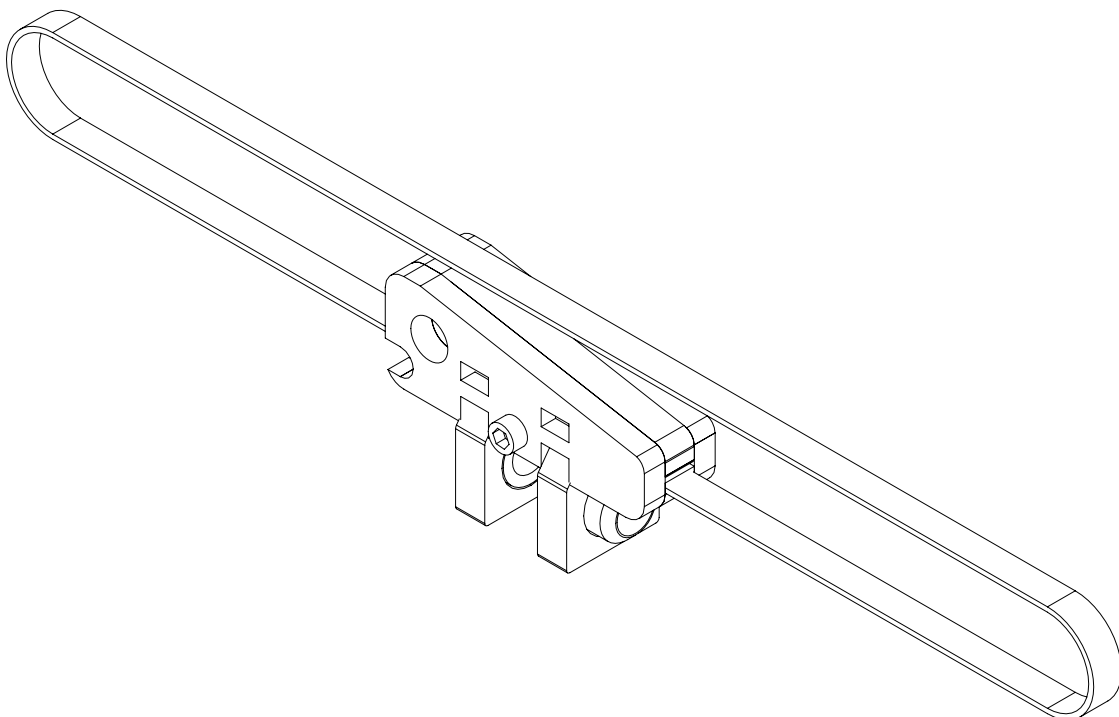
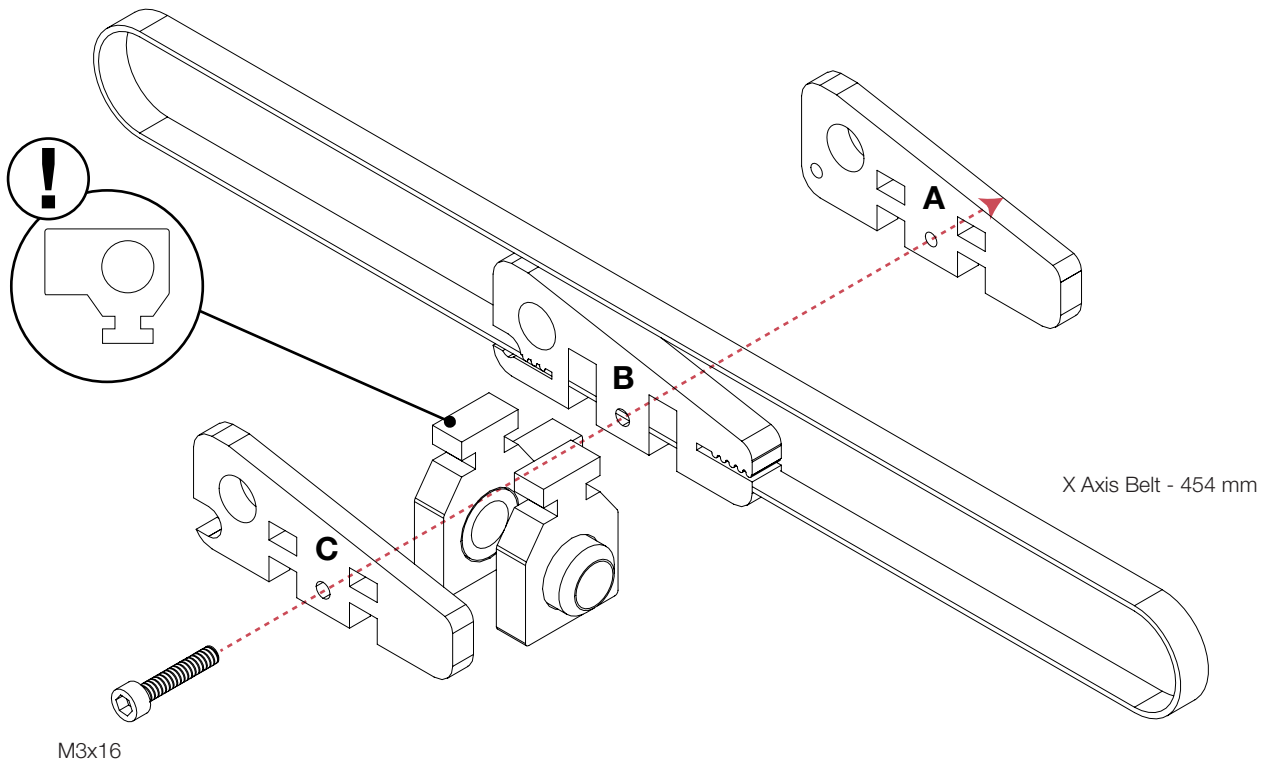


Insert both ends of the belt onto the Slider B piece. Make sure to line up the belt with the teeth so that there is no spaces left at the end of the slots.

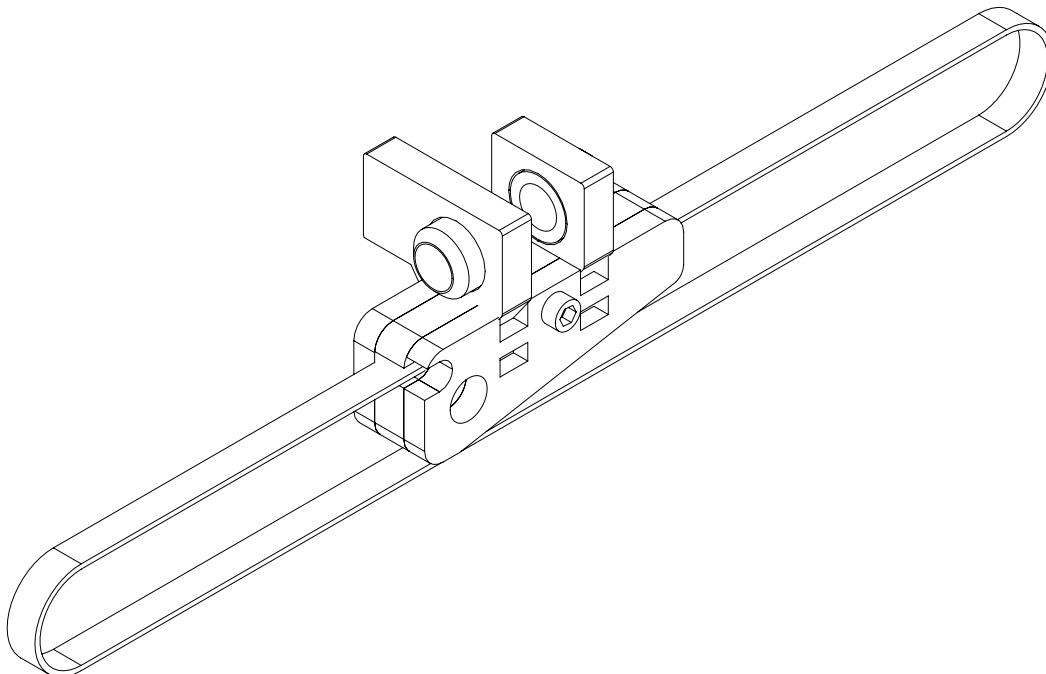
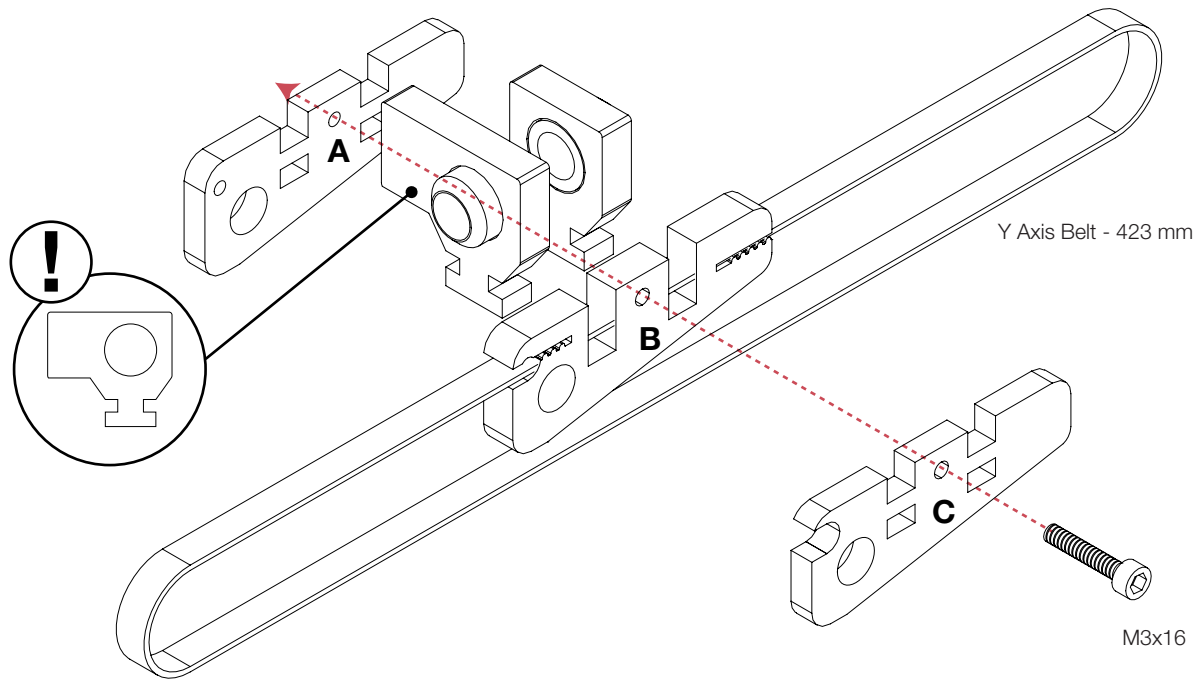
## 2. Front Slider



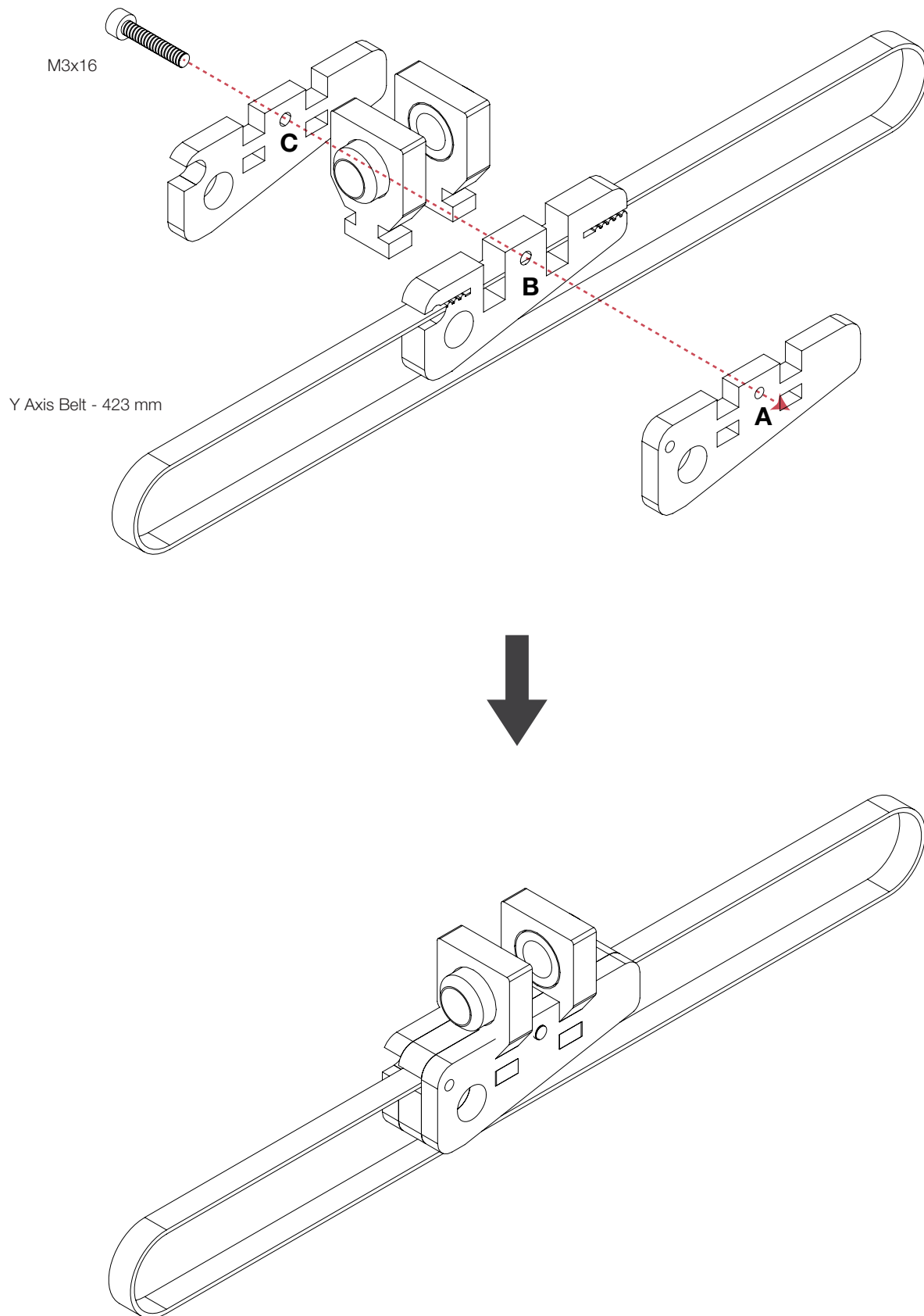
### 3. Back Slider



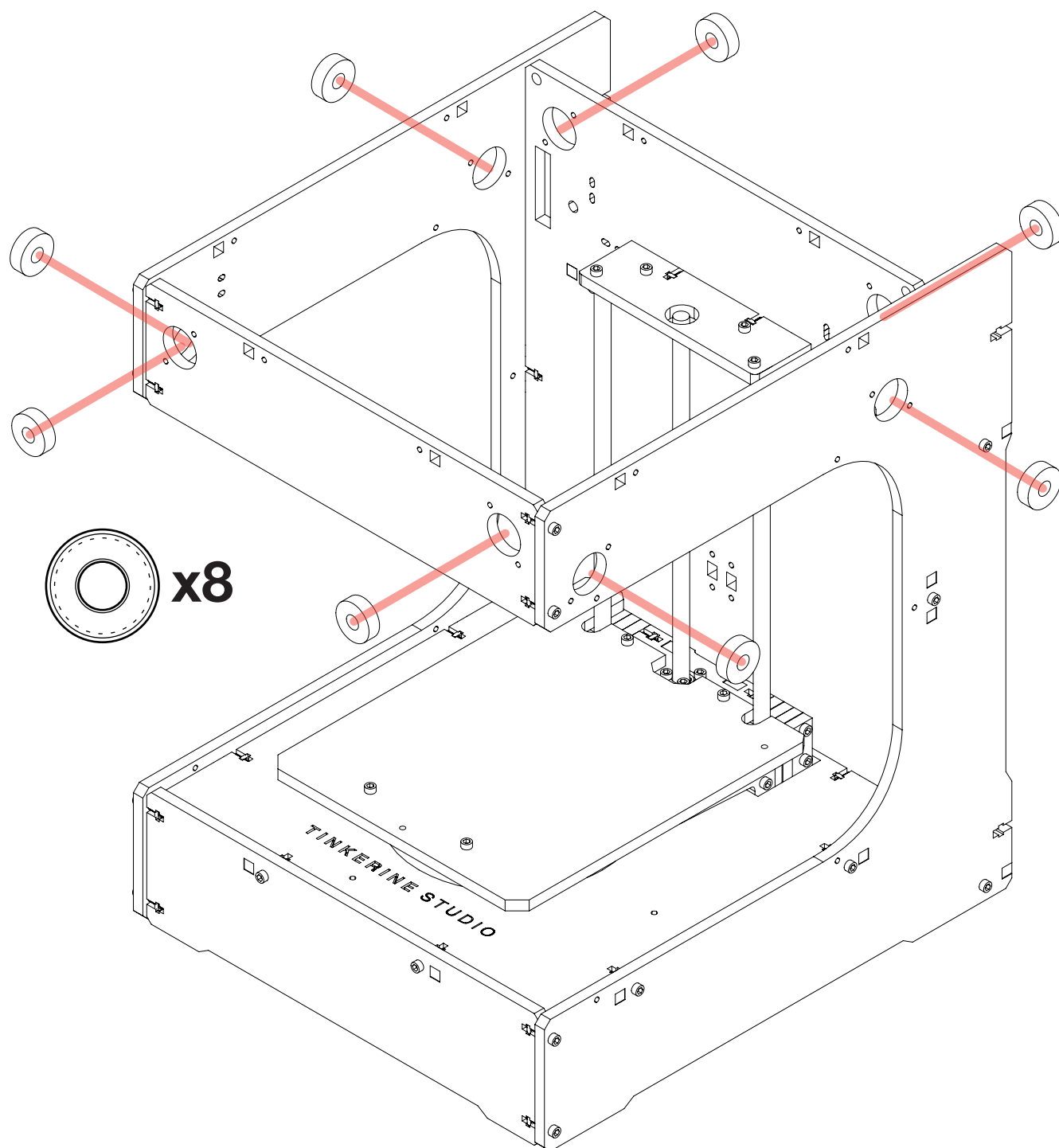
## 4. Left Slider



## 5. Right Slider

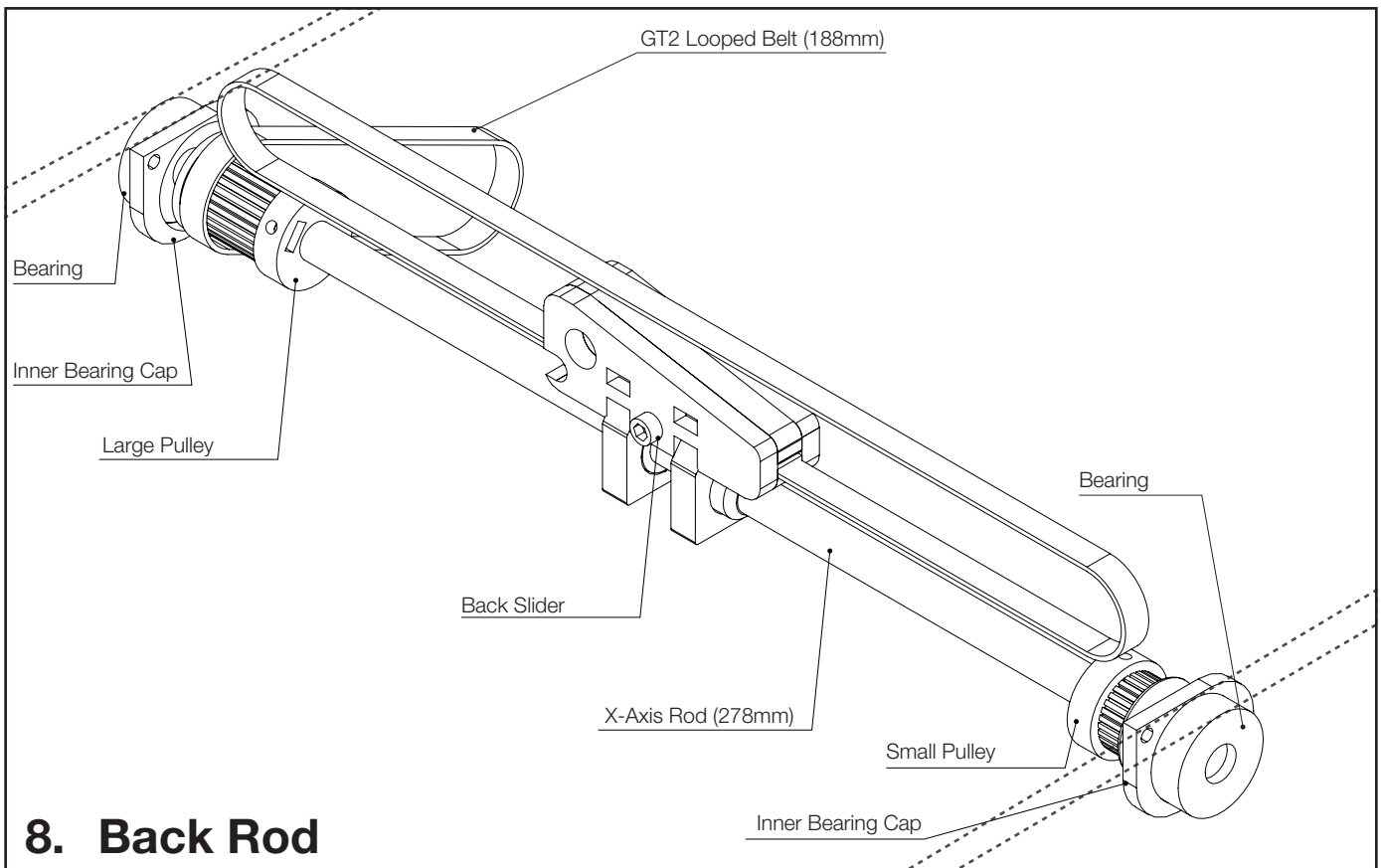
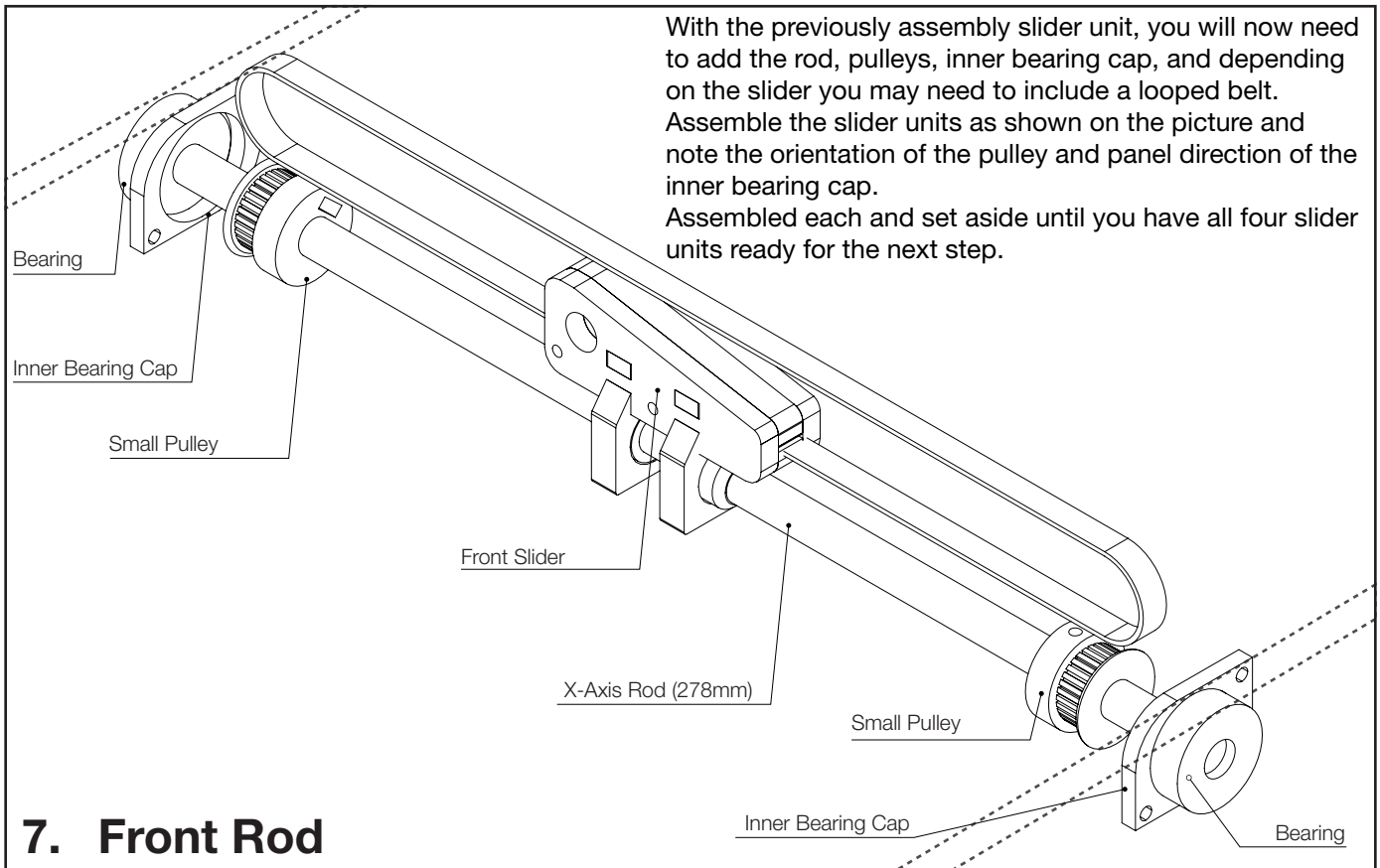


6.

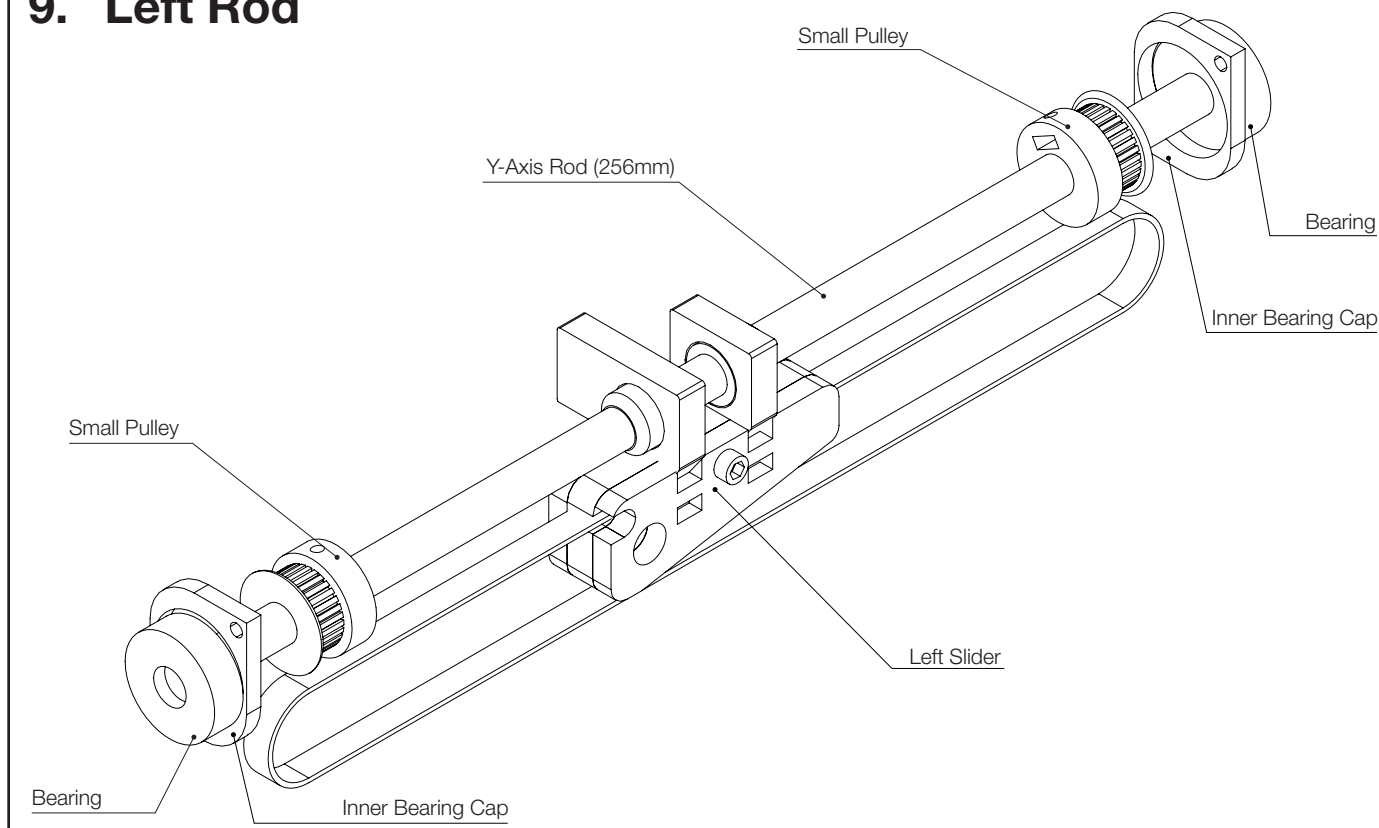


Insert eight bearing into the respective slots within the frame. The cutouts are meant to be a snug fit with the bearings, however if you have trouble putting the bearings in there, give the wooden inner ring a very light sand with some sand paper.

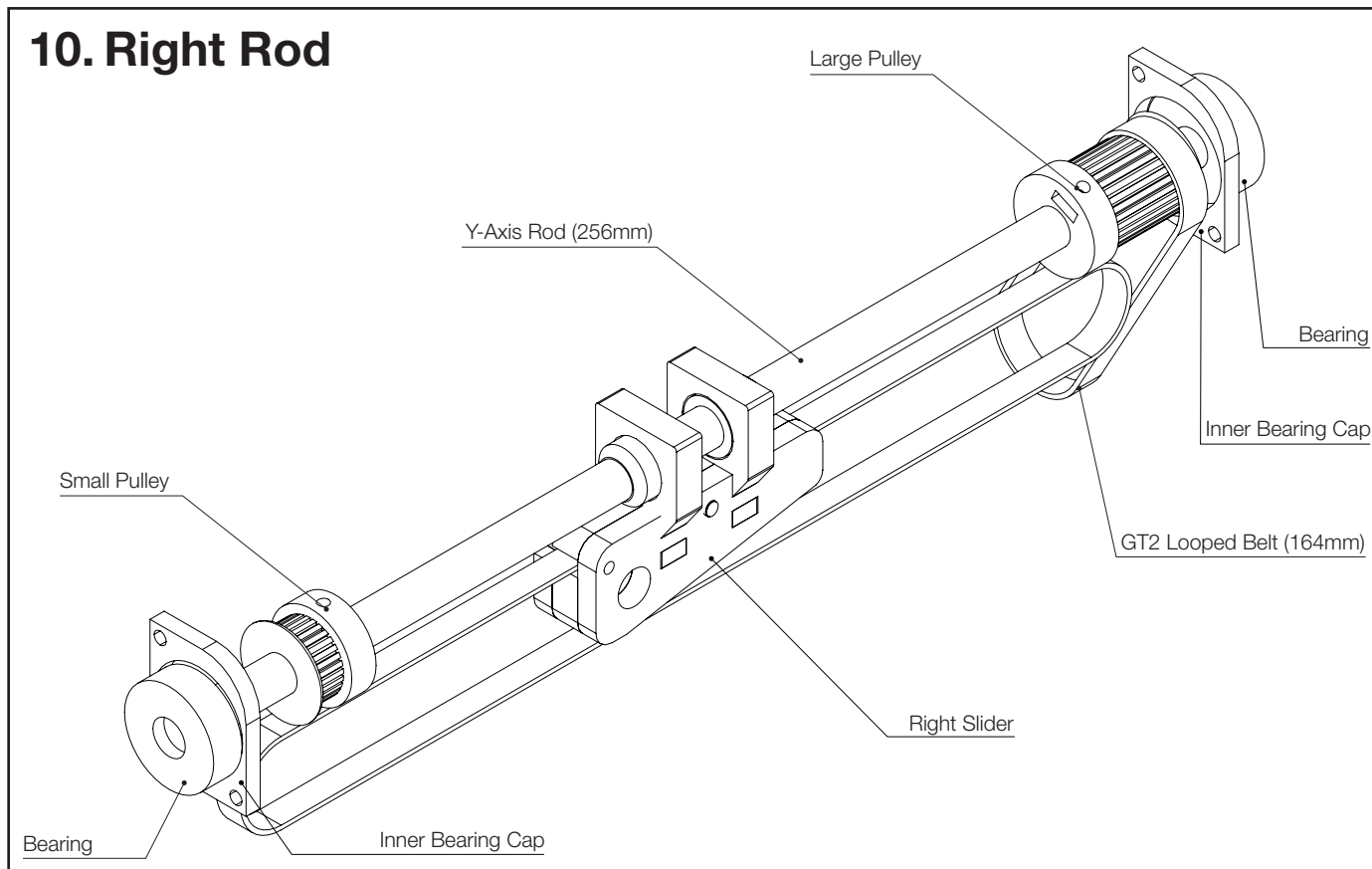




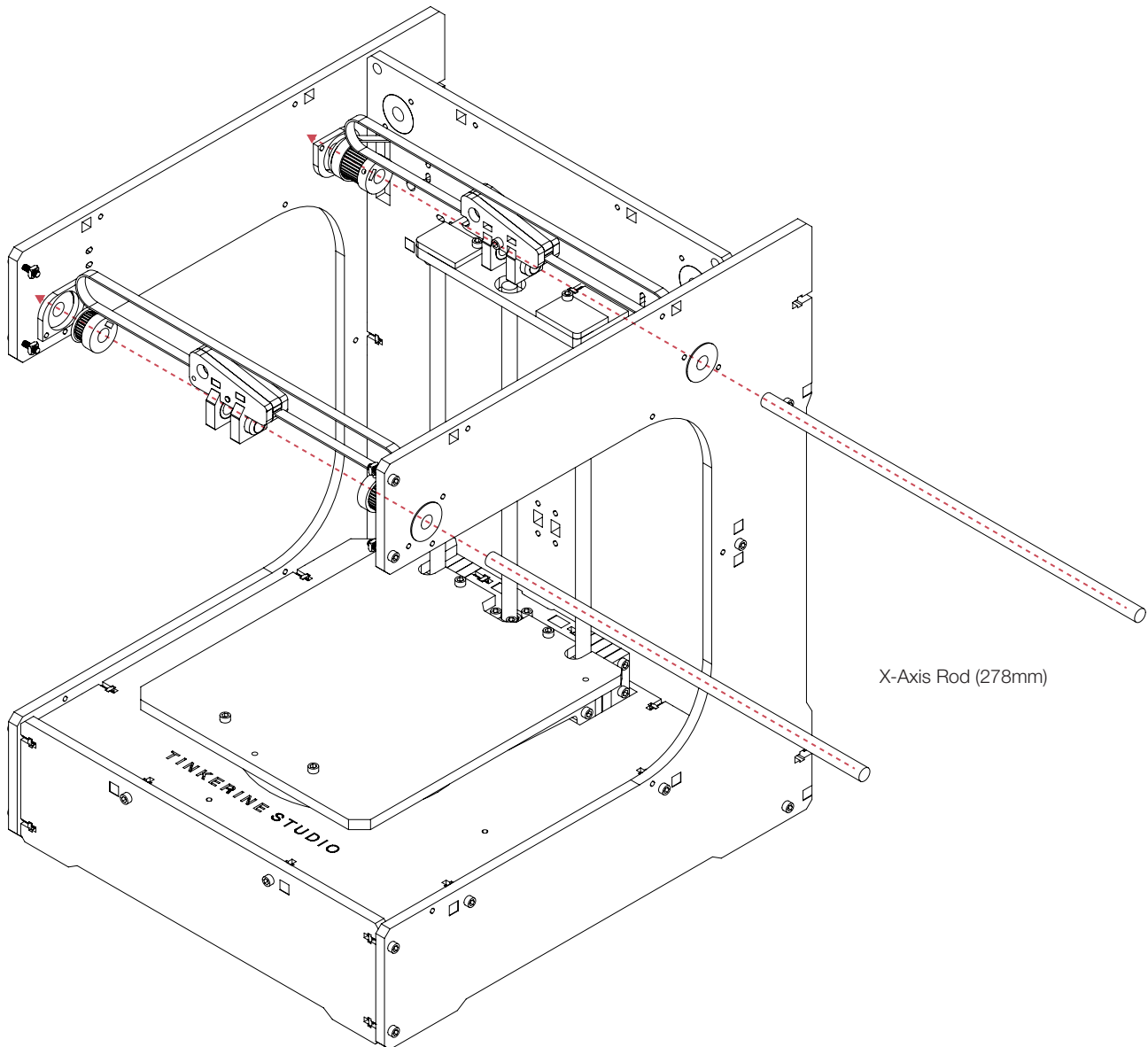
## 9. Left Rod



## 10. Right Rod



## 11. Font + Back Slider



\* Front panel has been hidden to show gantry\*

Using the previous slider assembly pictures as a reference. Insert the Front and Back slider assembly into the frame. One way to do this would be to skewer the items on one by one as you insert the rods from one end.

For example, to insert the back rod from the right side of the frame, the order would be:

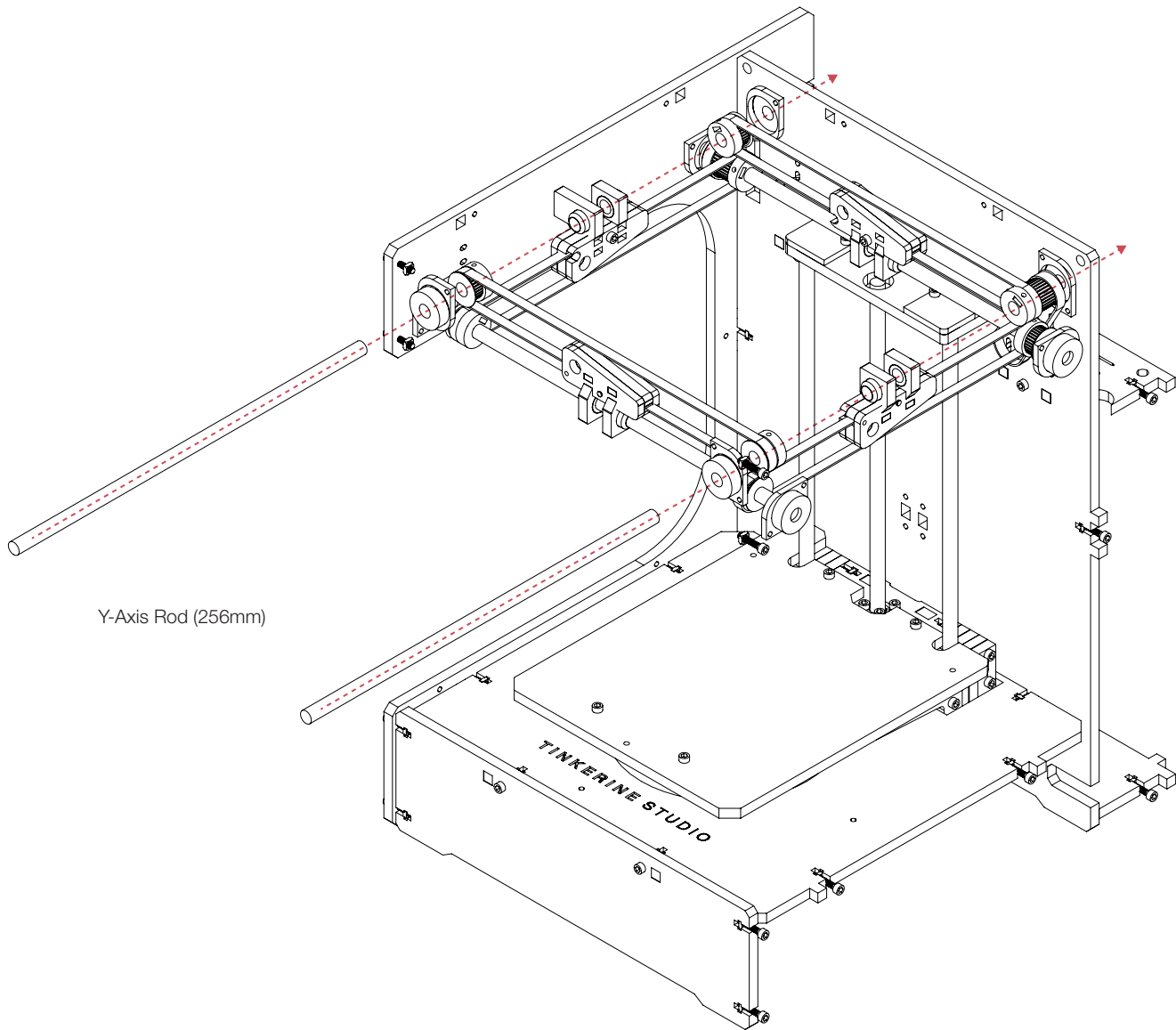
**Right Inner Bearing Cap > Small Pulley > Back Slider > Large Pulley > Looped Belt > Left Inner Bearing Cap**

To insert the front rod from the right side of the frame, the order would be:

**Right Inner Bearing Cap > Small Pulley > Back Slider > Small Pulley > Left Inner Bearing Cap**

Make sure to note the orientations of the inner bearing caps, and directions of the pulleys.

## 12. Left + Right Slider



\* Side panel has been hidden to show gantry\*

Similar to the Front and Back rod assembly, installing the Left and Right rods will require you to insert the rod from one end while inserting the parts in order. Here is the tricky part: While skewering the pulleys onto the left and right rods, you will also need to skewer the belts from the front and back sliders.

To insert the left rod from the front side of the frame, the order would be:

**Front Inner Bearing Cap > Small Pulley > Back Slider > Small Pulley > Back Inner Bearing Cap**

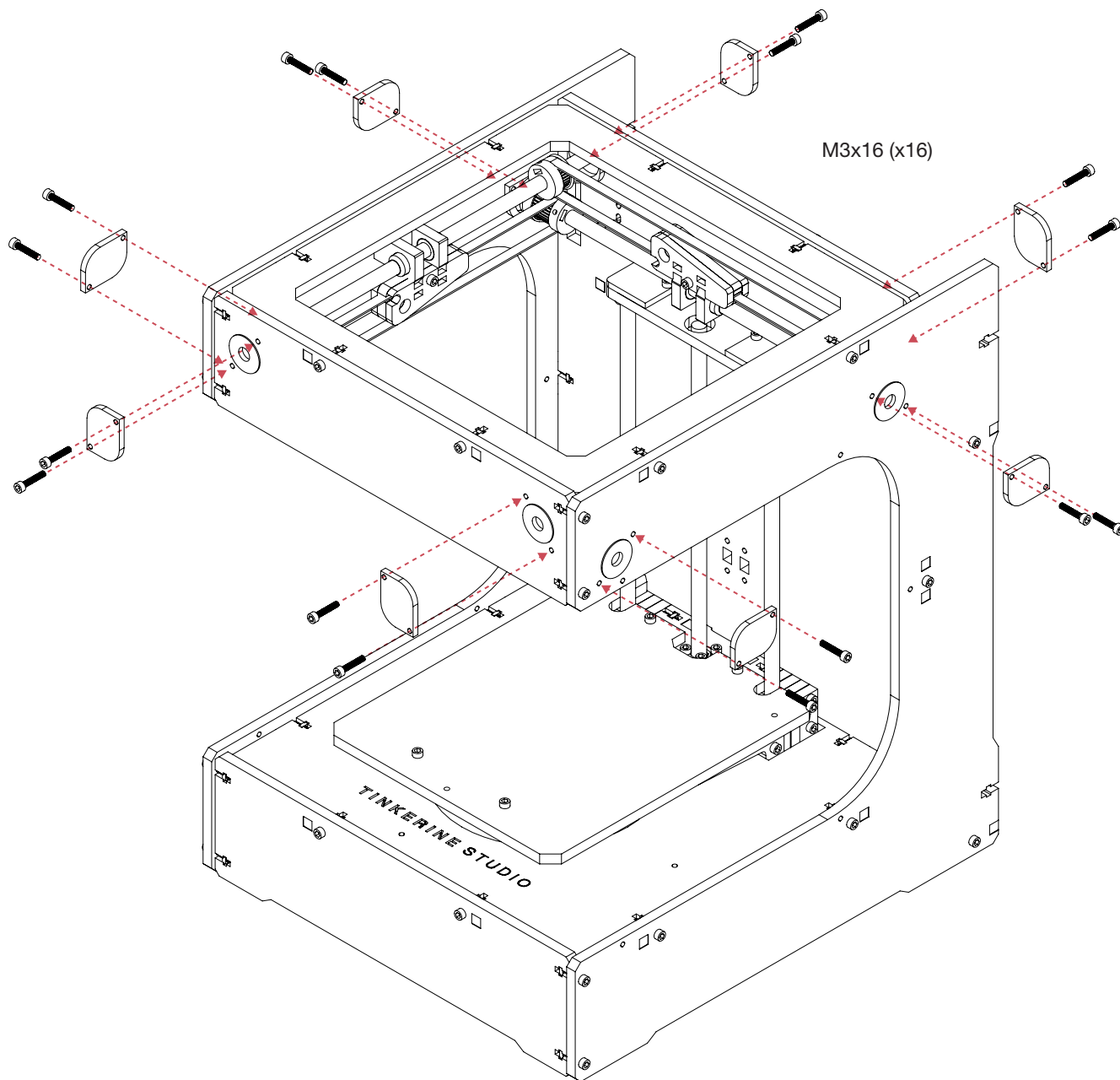
To insert the right rod from the front side of the frame, the order would be:

**Front Inner Bearing Cap > Small Pulley > Back Slider > Large Pulley > Looped Belt > Back Inner Bearing Cap**

Once the Left and Right rods are installed, you will need to pop the Front and Back rods back out slightly to loop the belts onto the pulleys. Once the belts are seated onto the pulley, you will need to use a bit of force to insert the rods into the bearing.

After installing the gantry, all the belts (except for the closed loop belts) should be looping across a pulley on each end.


13.




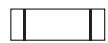
Install the outer bearing caps to cover the exposed bearing and prevent the rods from sliding out. If you have oriented the inner bearing caps correctly in the previous steps, it will align with the outer bearing caps. If not, you need need to flip the inner bearing cap.

## Gantry Assembly pt.2

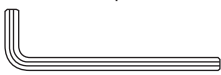
### Parts Required

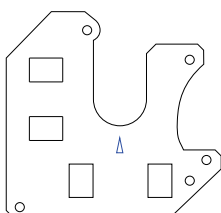
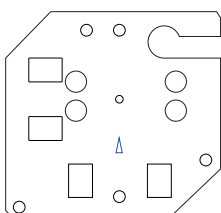
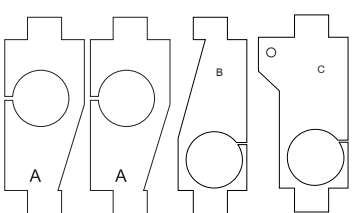
 M3x10 Screw  
x4

 M3x50 Screw  
x3

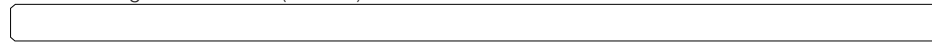
 45mm Bearing  
x2

### Tools Required

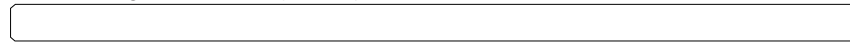
 M3 Allen Key


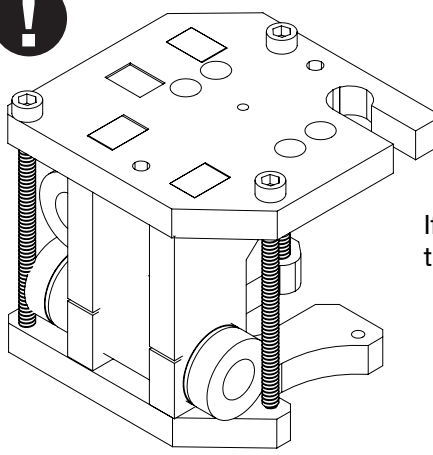
 Carriage Bottom
  Carriage Top
  Linear Bearing Holder

X-Axis Carriage Smooth Rod (230mm)



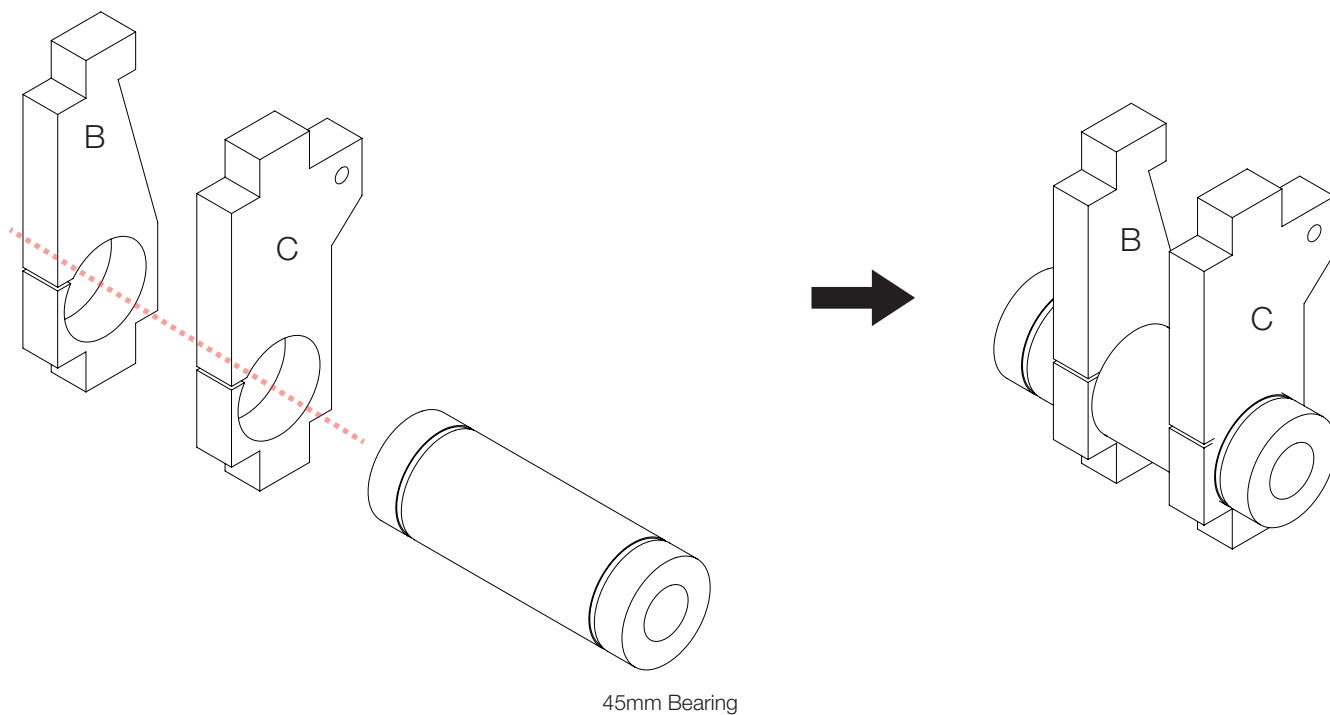
Y-Axis Carriage Smooth Rod (220mm)



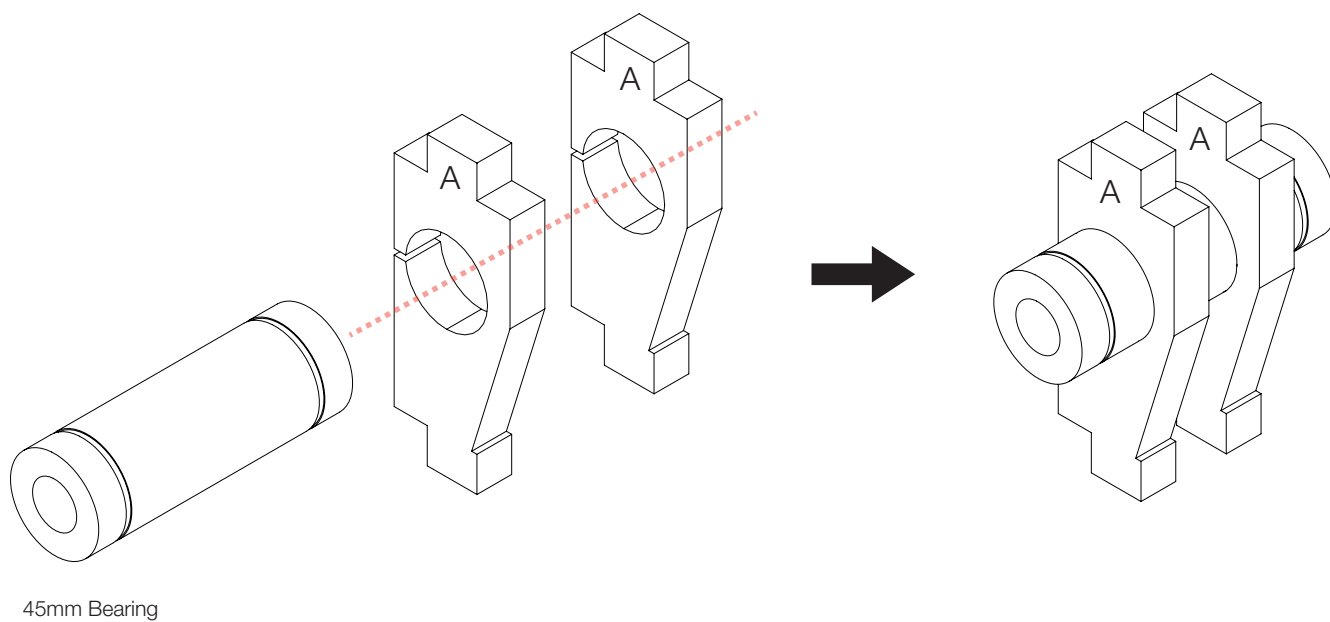



If your carriage comes to you partially assembled. Skip ahead to page 40 of the assembly manual and follow the instructions listed for assembled units.

## 1. Carriage (X-Axis Bearing)



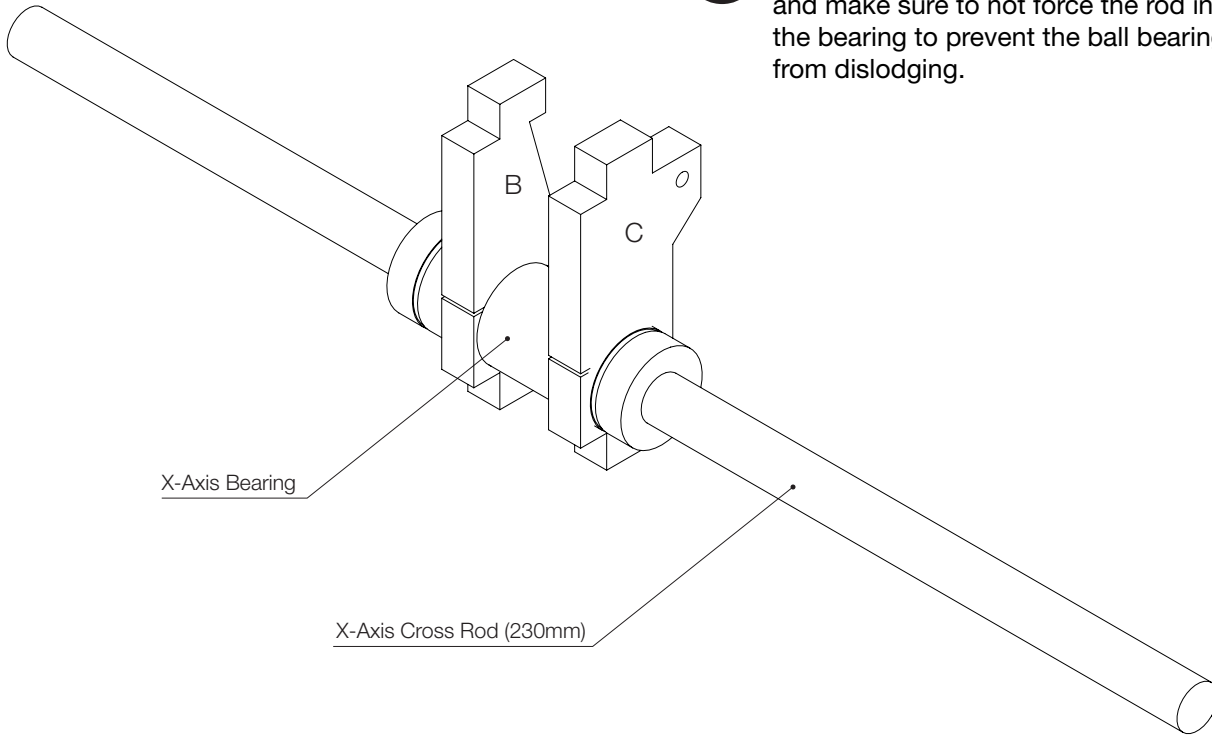
## 2. Carriage (Y-Axis Bearing)



3.

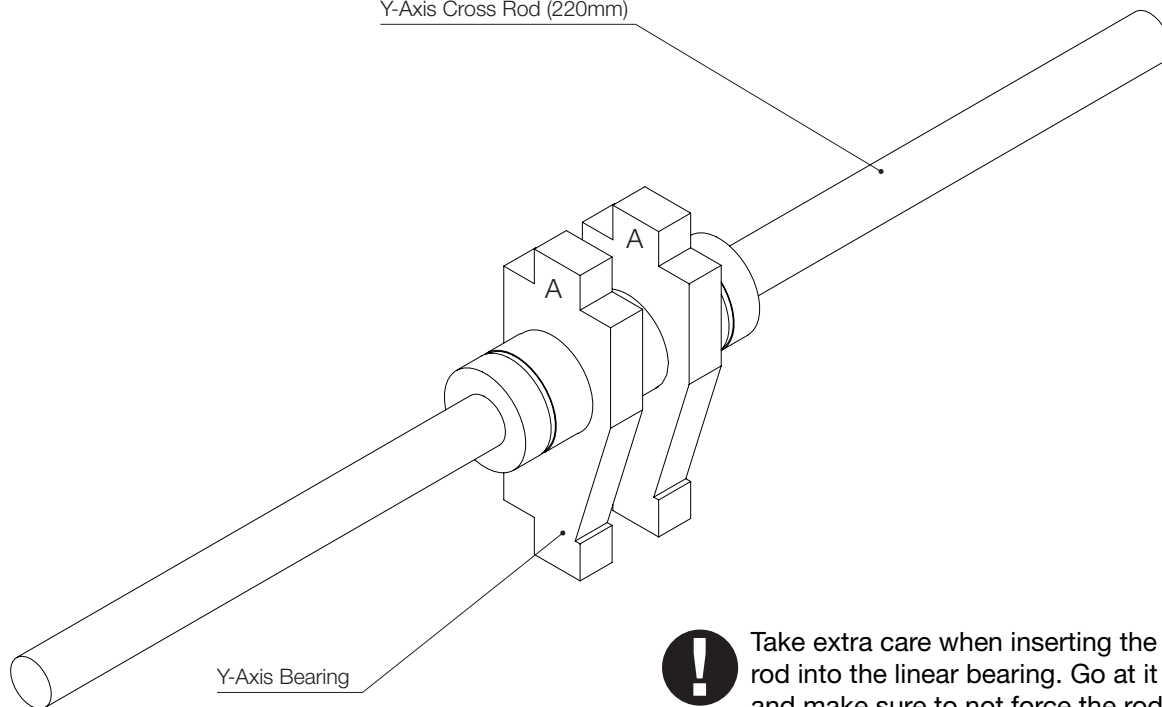


Take extra care when inserting the smooth rod into the linear bearing. Go at it slowly and make sure to not force the rod into the bearing to prevent the ball bearings from dislodging.



4.

Y-Axis Cross Rod (220mm)



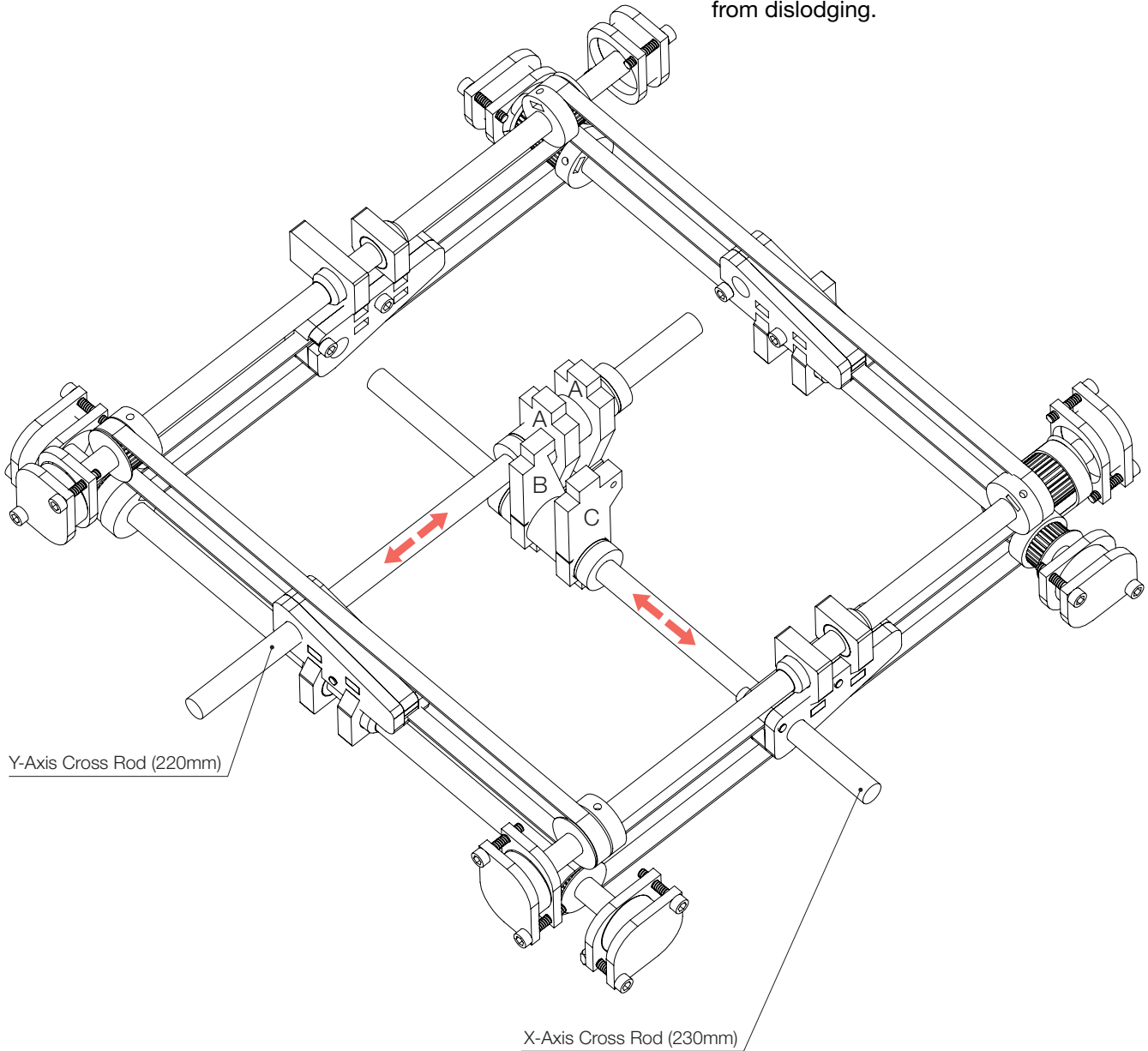
Take extra care when inserting the smooth rod into the linear bearing. Go at it slowly and make sure to not force the rod into the bearing to prevent the ball bearings from dislodging.



5.



Take extra care when inserting the smooth rod into the linear bearing. Go at it slowly and make sure to not force the rod into the bearing to prevent the ball bearings from dislodging.

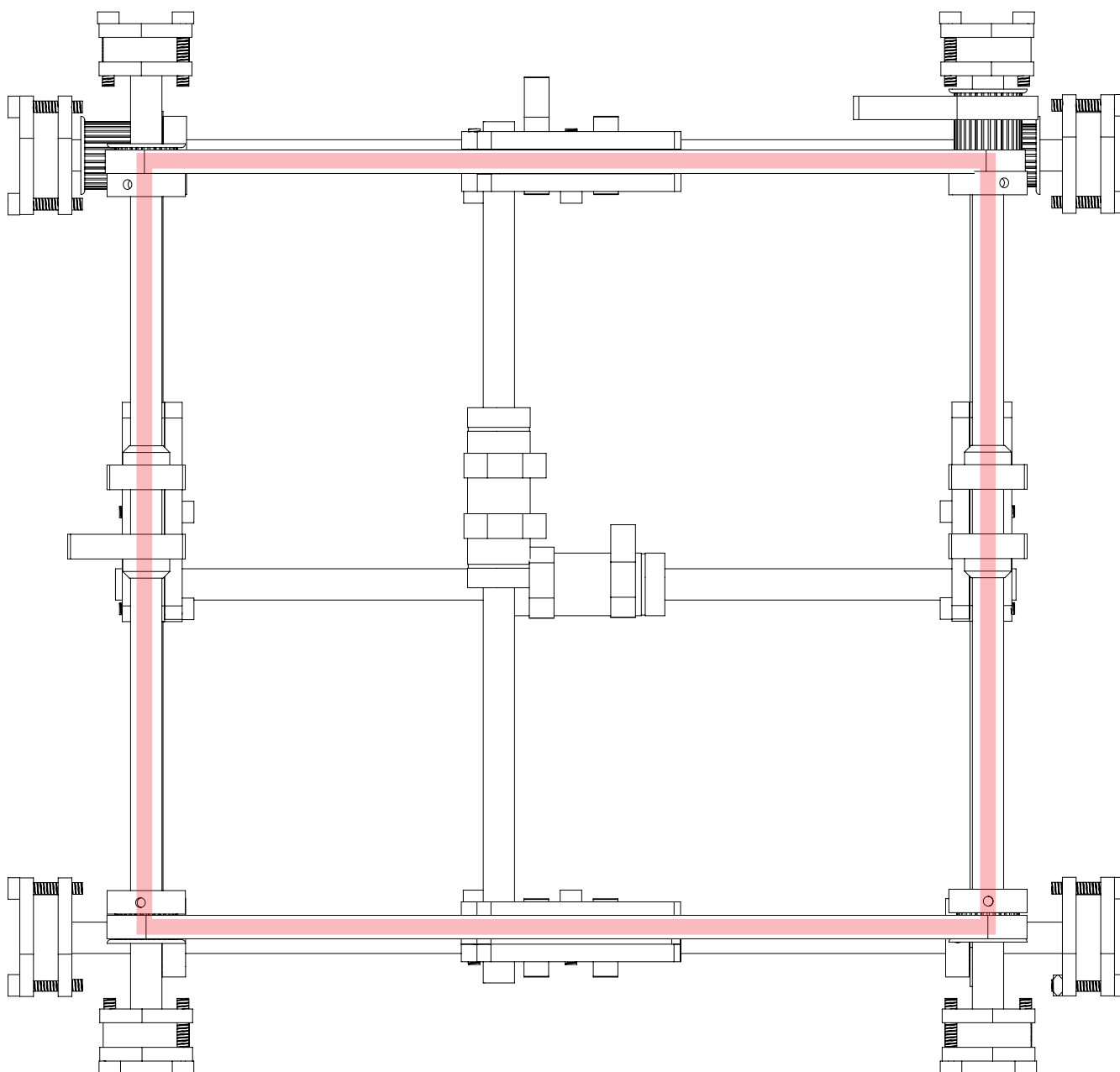


The frame has been hidden to give you a clearer view. To insert the cross rods, one by one take the rods and insert it into one end of the slider. Push the rod into the first slider to give you enough room to bring the rod up into the gantry so it becomes leveled with the second slider. Then retract the rod so it can be inserted into the second slider.

For Pre-Assembled Carriage:

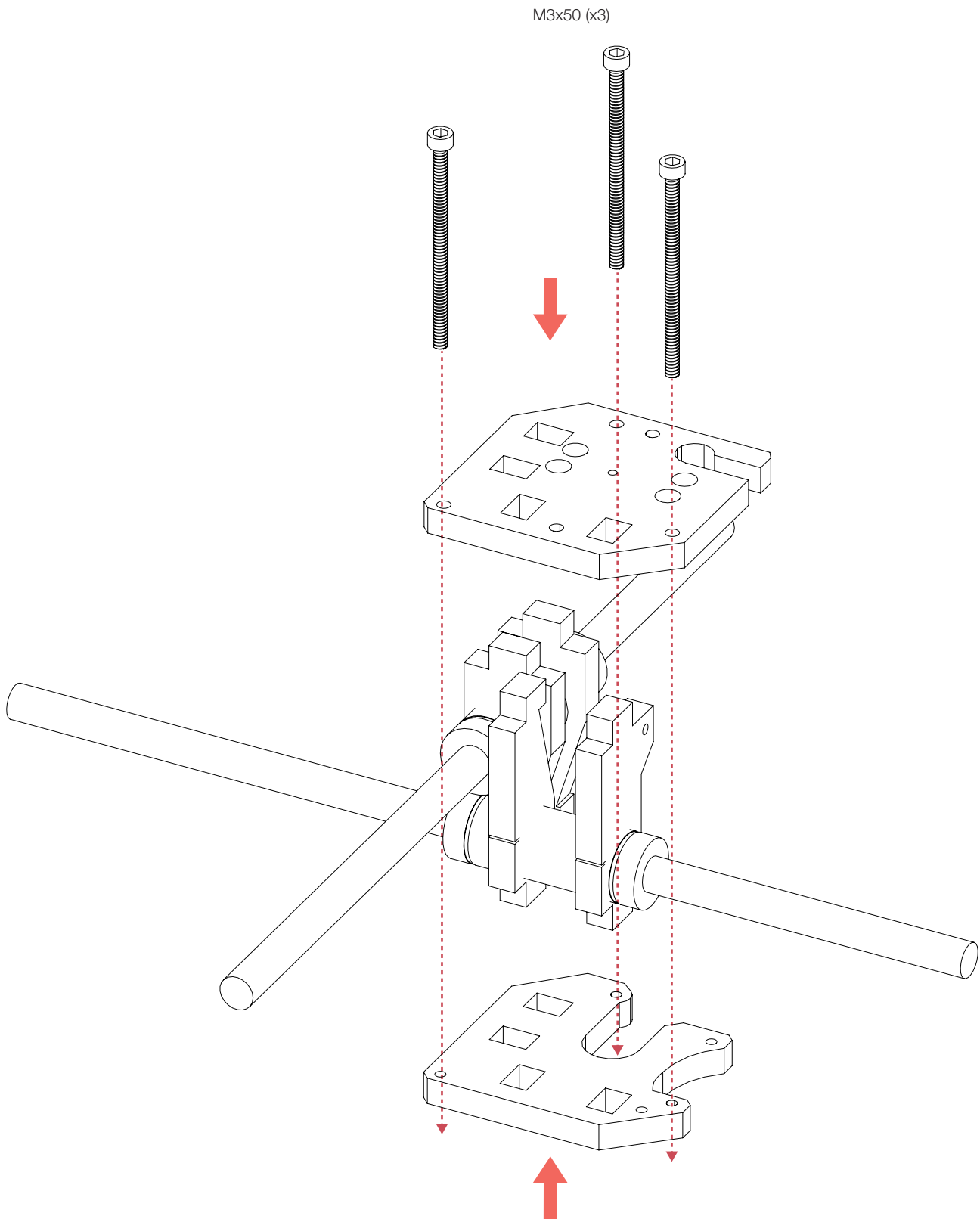
Position the carriage in the right direction (Arrow on assembly pointing toward back of printer), take any of the two rods and insert it carefully into the respectively linear bearing. Bring the rod and carriage into the gantry space, and insert one end of the rod into the slider, twist the rod while supporting the slider will help you move the rods easier. Once you have enough clearance to insert the other of the rod into the slider, twist the rod again to insert into the slider on the opposite side. Repeat with second rod.

6.

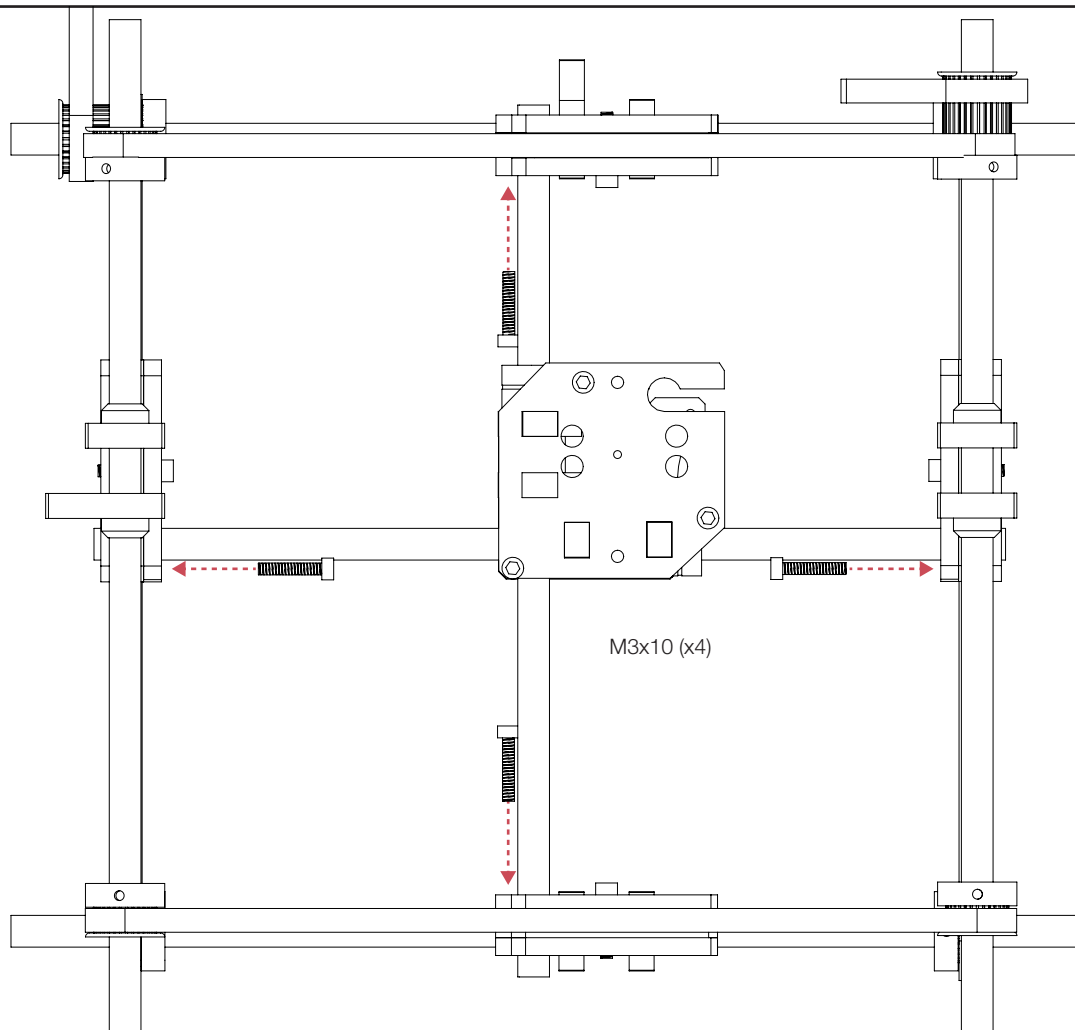


At this point this is what your gantry should look like from the top. Make sure to aligned the pulleys on both sides of the belt so the belt is sitting parallel with the middle of the sliders. Tighten the sets screws on the pulleys once you have aligned them all.

7.

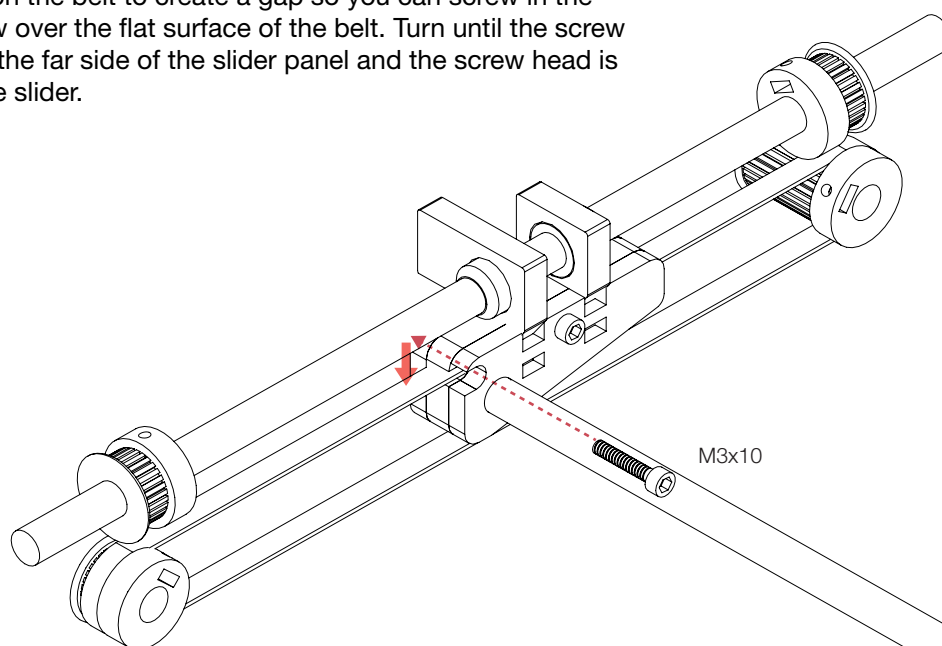


8.

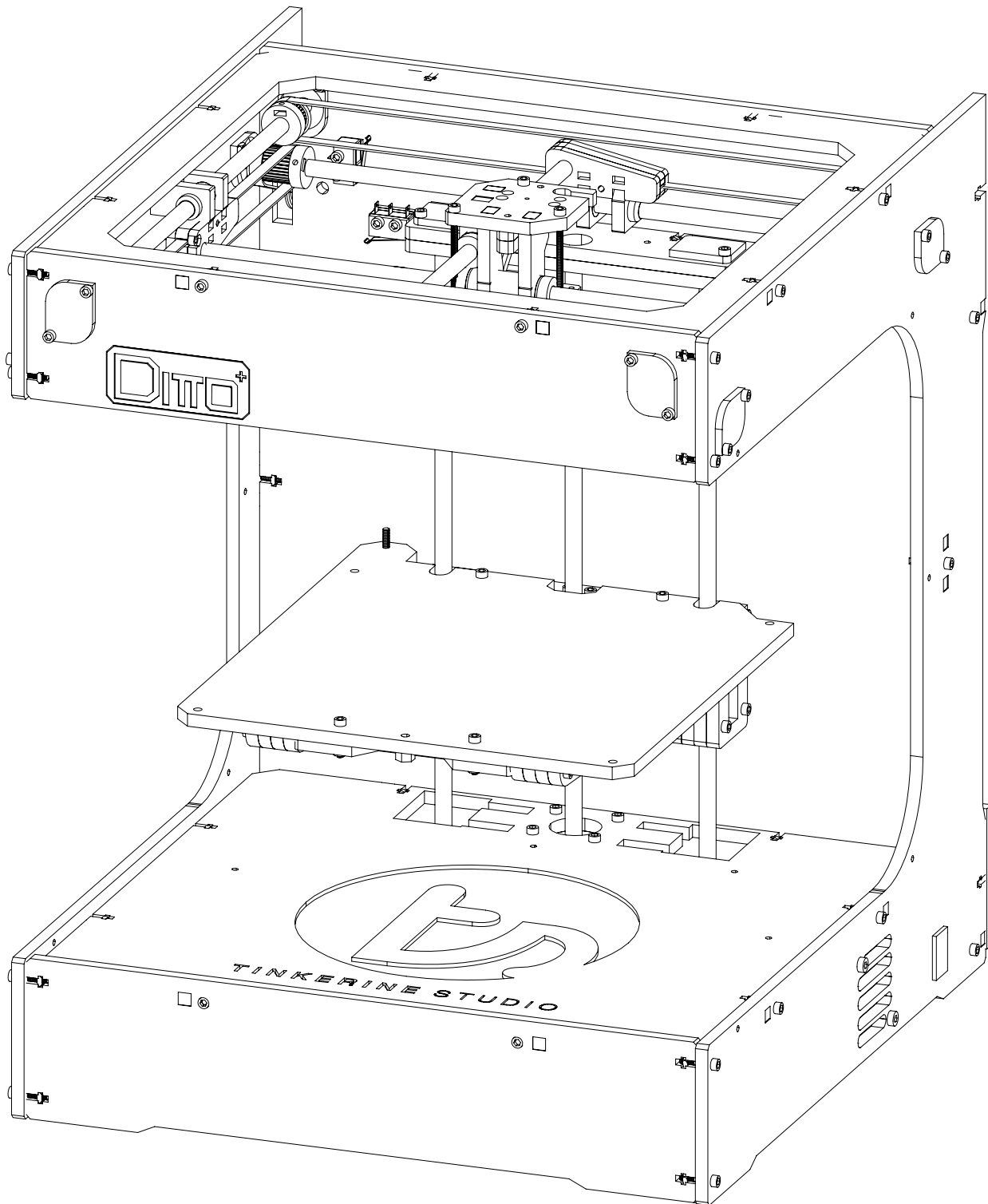


Insert the belt tensioning screws as shown into the four sliders. Refer to the image below to see a closer view.

Push down on the belt to create a gap so you can screw in the M3x10 screw over the flat surface of the belt. Turn until the screw threads into the far side of the slider panel and the screw head is flush with the slider.



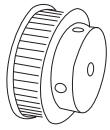
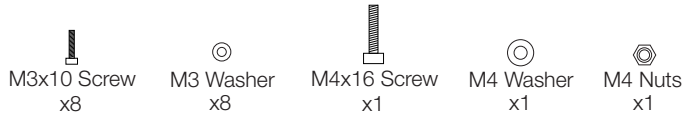
9.



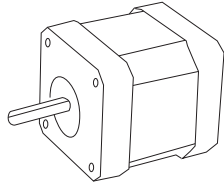
You're almost done with the gantry assembly. For the most part you should now have a gantry system that you can move manually by hand. Move on to part three of the gantry assembly to complete the gantry system.

# Gantry Assembly pt.3

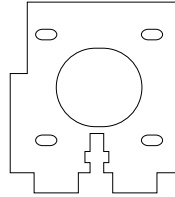
## Parts Required



36 Tooth Timing Pulley  
x2



NEMA17 Stepper Motor  
x2

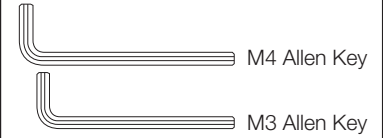


Motor Bracket

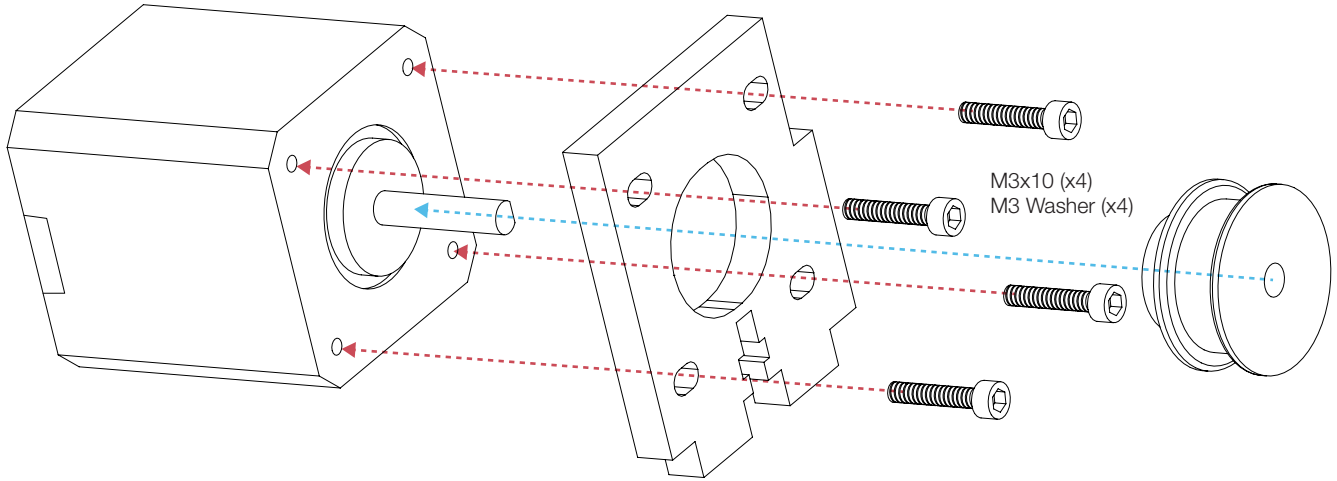


Motor Wedge

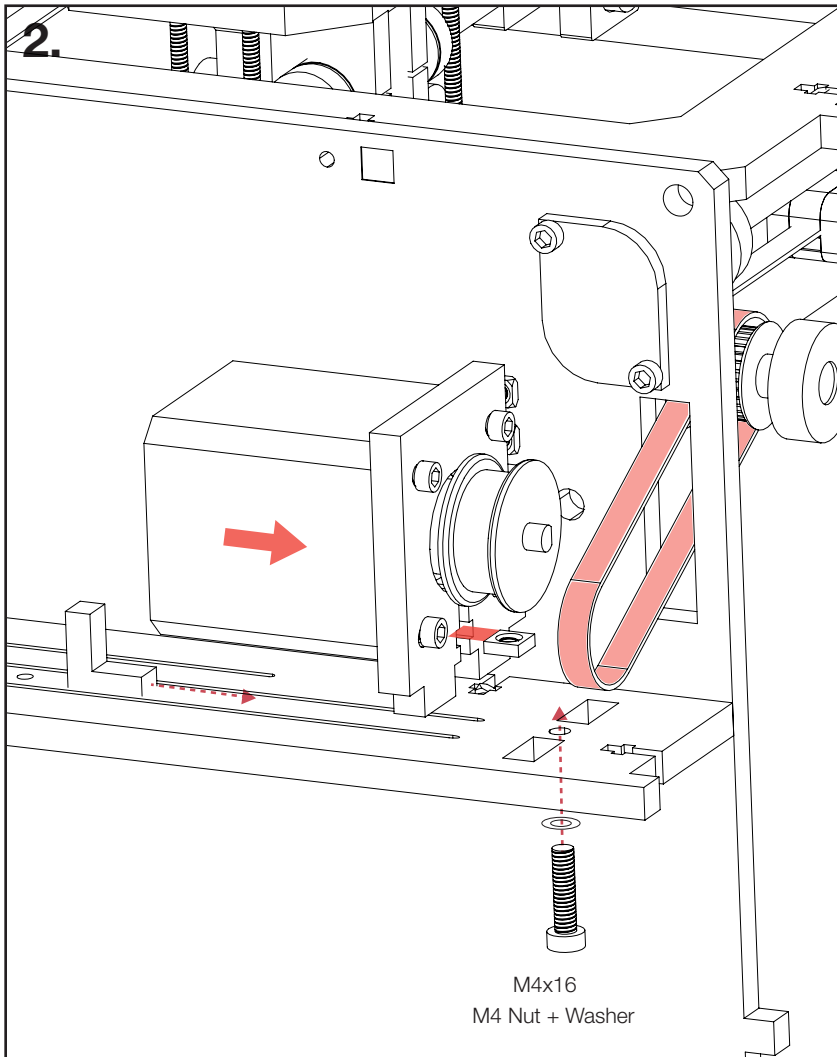
## Tools Required



1.



2.



A. Fasten the motor bracket to the motor and slide the pulley onto the motor shaft. Lightly tighten the motor bracket screws as you will need to make minor adjustments in the second step.

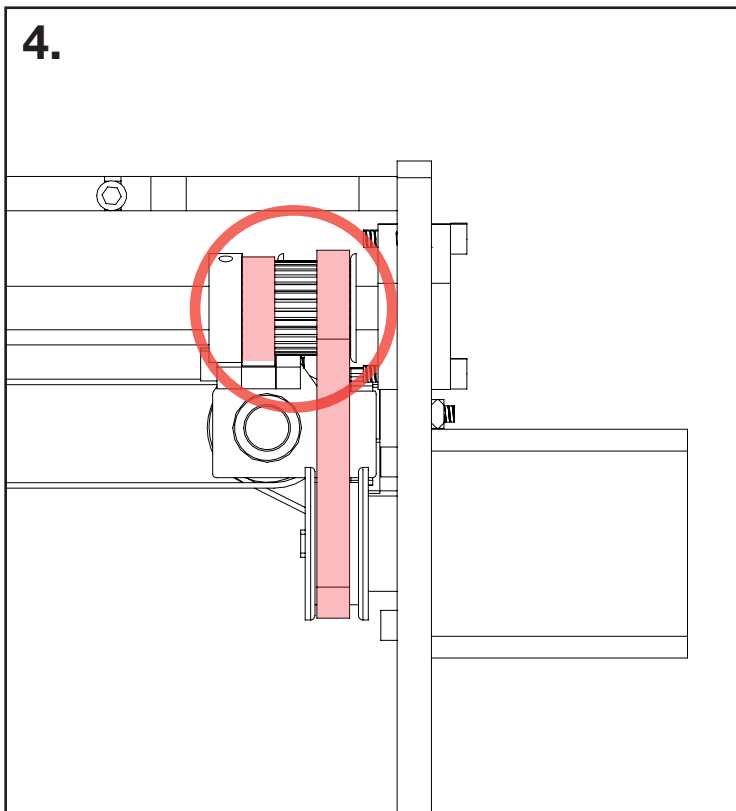
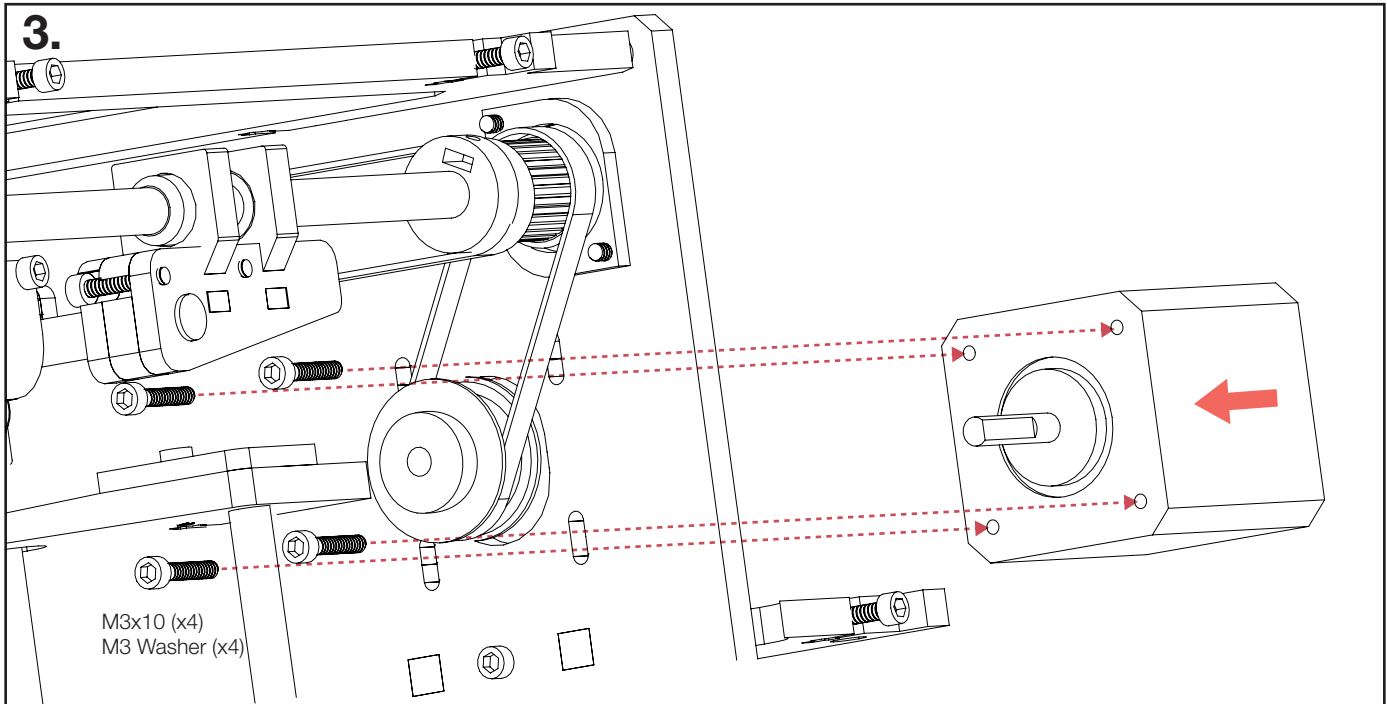
B. Before inserting the motor bracket into the slot on the frame, insert a M4 nut into the T-slot.

C. Loop the belt around the pulley and seat the motor into the slot. You may need to shift the motor forward or backward within the bracket to make sure the belt is tensioned and does not have extra slack. Tighten the screws once the motor is in the correct position.

D. Position the pulley so the belt is perpendicular and not angled in a way so that the belt is rubbing against the pulley or the wooden frame. Tighten the set screw of the pulley on the flat edge of the motor shaft once you have positioned the pulley.

E. Insert the M4 screw from the bottom and secure the motor bracket to the frame. Insert the motor wedge to tuck it under the other side of the motor.

F. Connect the 4-pin motor wire to the port located on the bottom edge of the motor.



A. As shown in Step 3, insert the motor from the back with the pulley already sitting in the looped belt from the front. The tapered end of the pulley should be pointing away from the motor.

B. Insert the M3 screws to secure the motor to the frame. Make sure to position the motor on the frame at a point where the belt is properly tensioned to avoid giving the belt any slack.

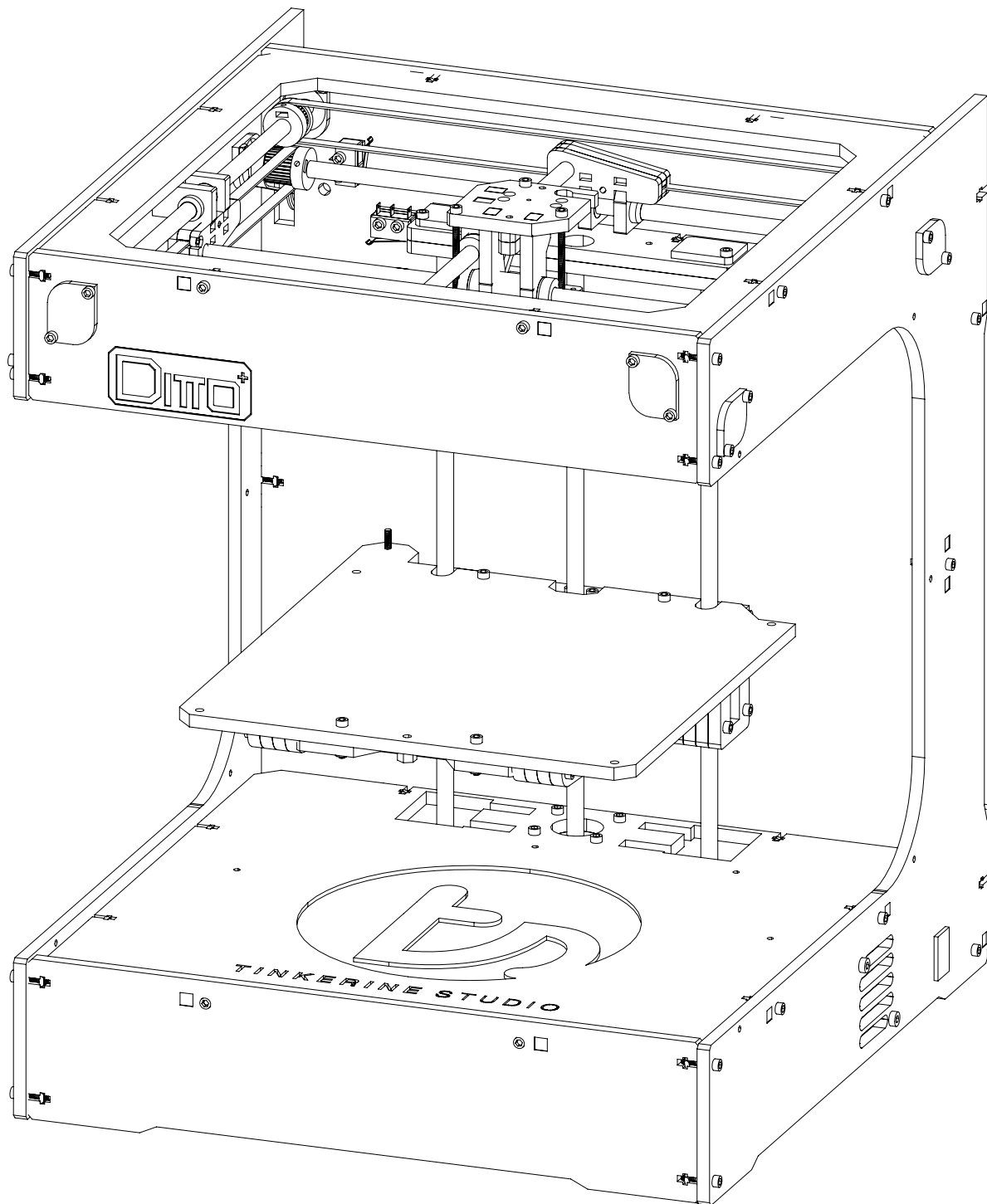
C. Tighten the setscrew within the pulley on the flat edge of the motor shaft to secure the pulley.

D. As shown in Step 4, take a minute to ensure that all belts are properly aligned. Belt should always sit perpendicular to the pulley and should not be angled in any way. Also make sure the belt teeth are fully seated into the grooves of the pulley and not chewing into the walls of the pulley. You may need to loosen the setscrews on the pulley to re-adjust the positions. Check all belts.

E. Connect the 4-pin motor wire to the port located on the bottom edge of the motor.



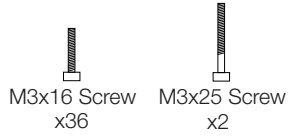
5.



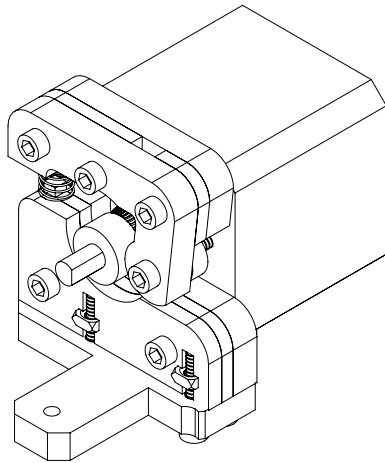
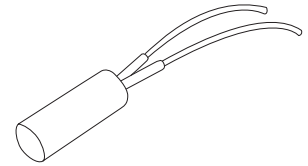
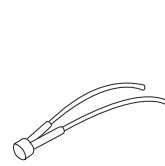
Your printer's gantry system should be fully assembled now. You should be able to manually move the carriage around on the X+Y axis. Double check to make sure all belts are properly secured + tensioned, and that all setscrews are properly tightened.

# Extruder Assembly

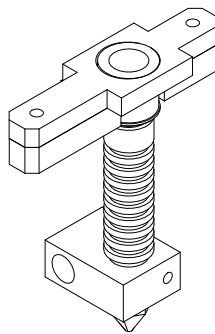
## Parts Required



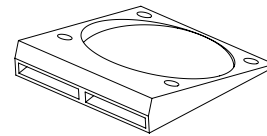
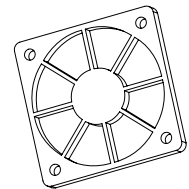
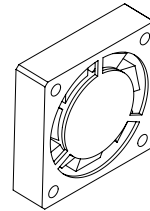
## Tools Required



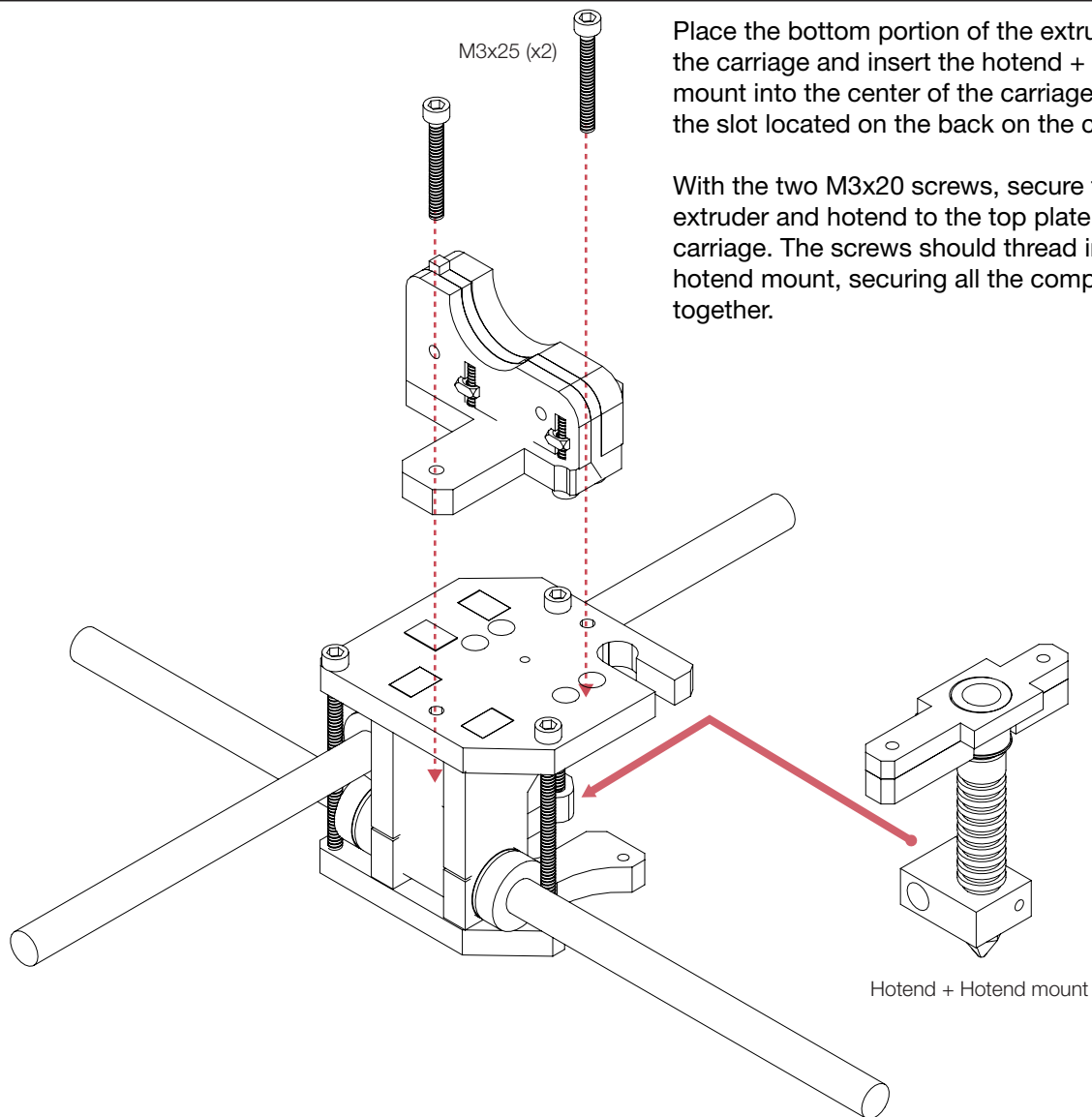
Extruder Assembly



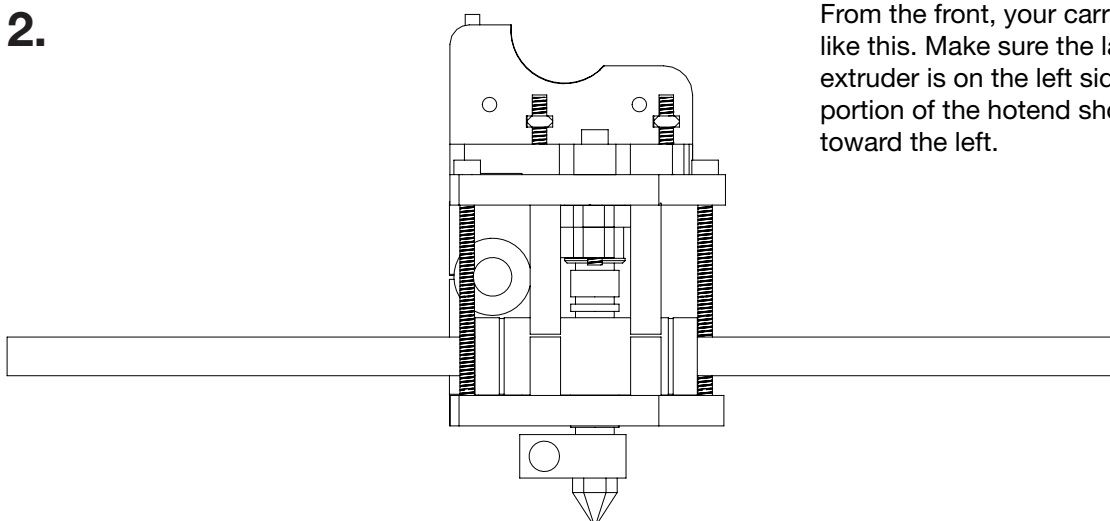
Hotend Assembly



1.

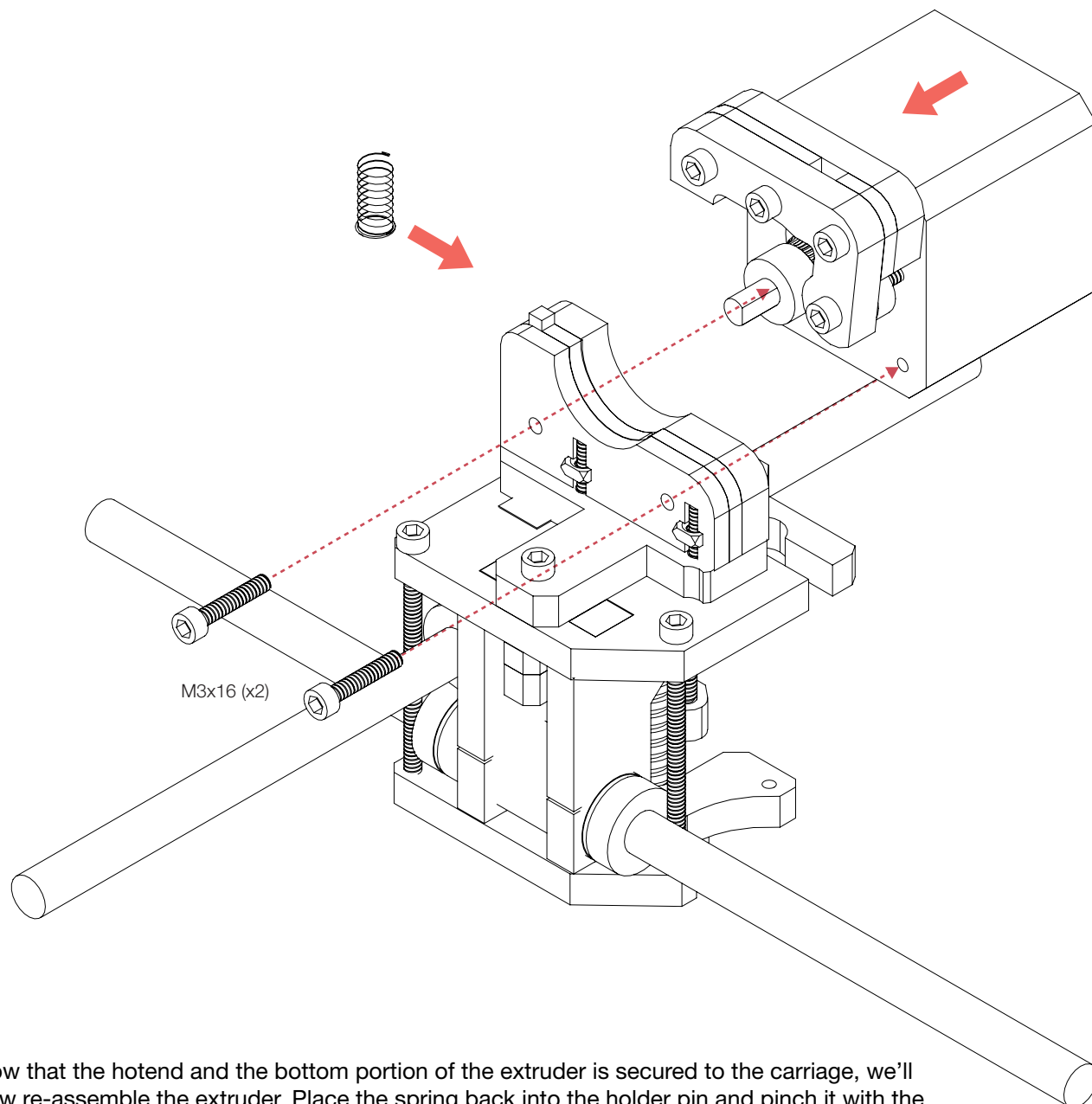


2.



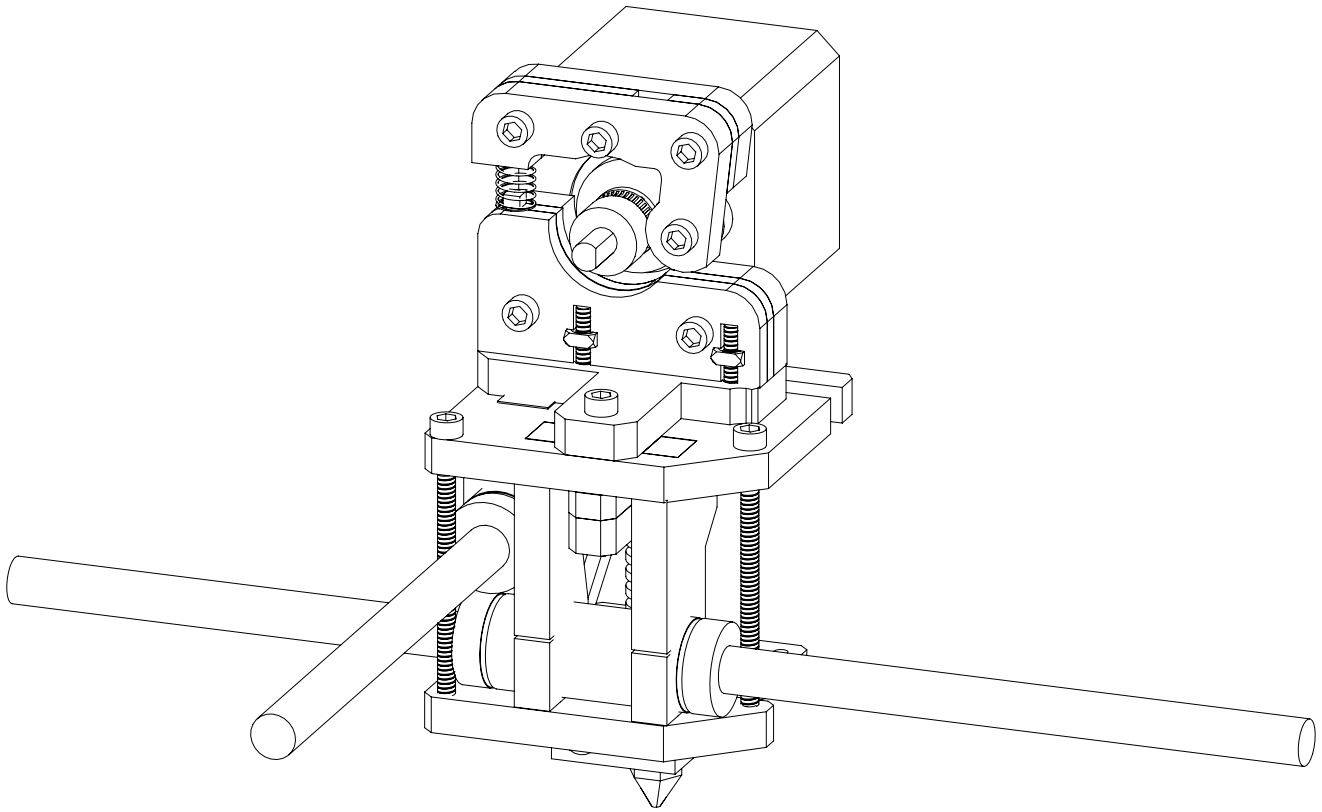
From the front, your carriage should now look like this. Make sure the larger portion of the extruder is on the left side. The extended portion of the hotend should also be pointing toward the left.

3.



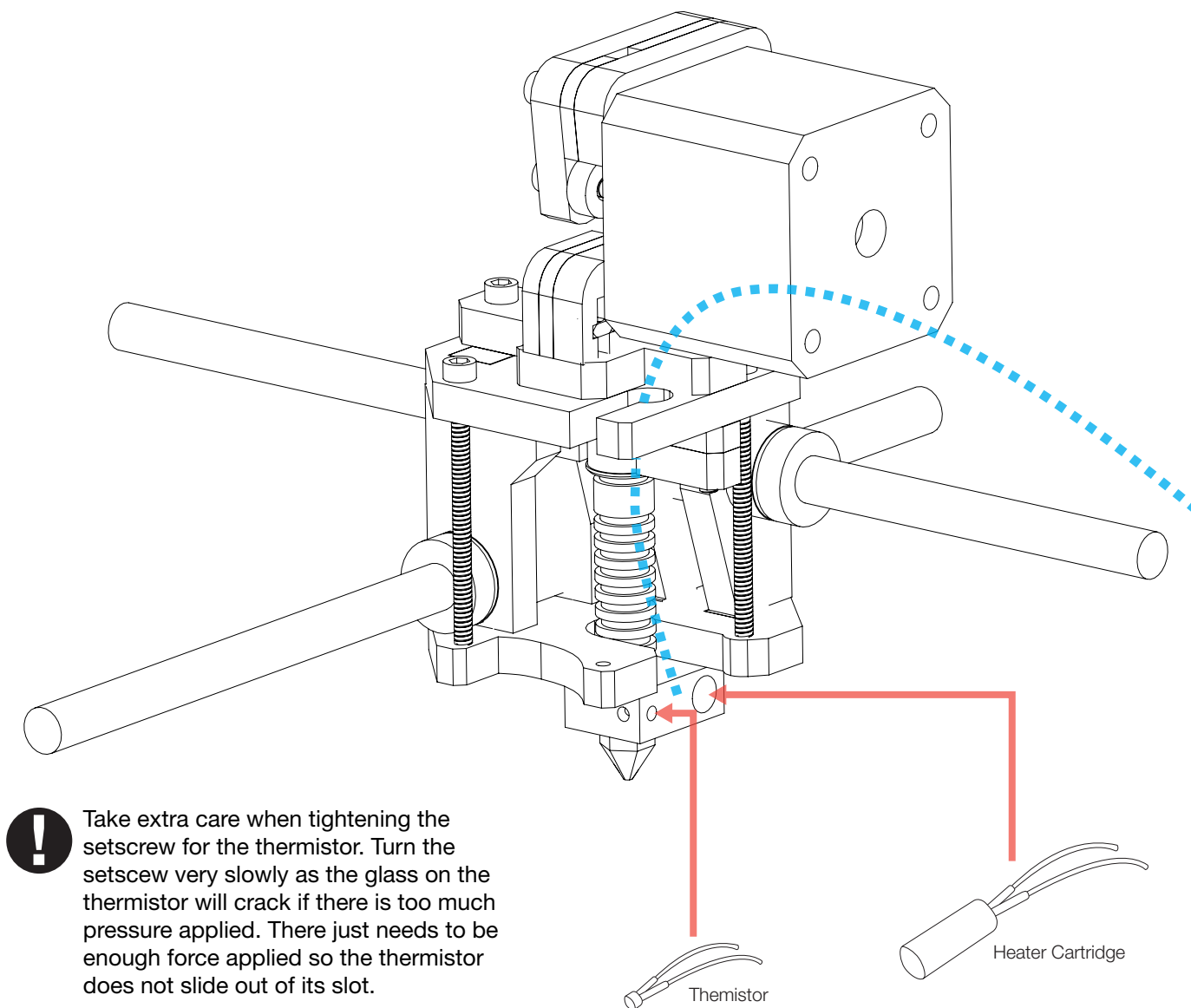
Now that the hotend and the bottom portion of the extruder is secured to the carriage, we'll now re-assemble the extruder. Place the spring back into the holder pin and pinch it with the top portion of the extruder. Line up the mounting hole and screw in the two M3 screws that we have removed earlier.

4.



The extruder assembly is complete. Confirm that the extruder is securely attached to the carriage and the hotend + mount are also secured to the carriage.

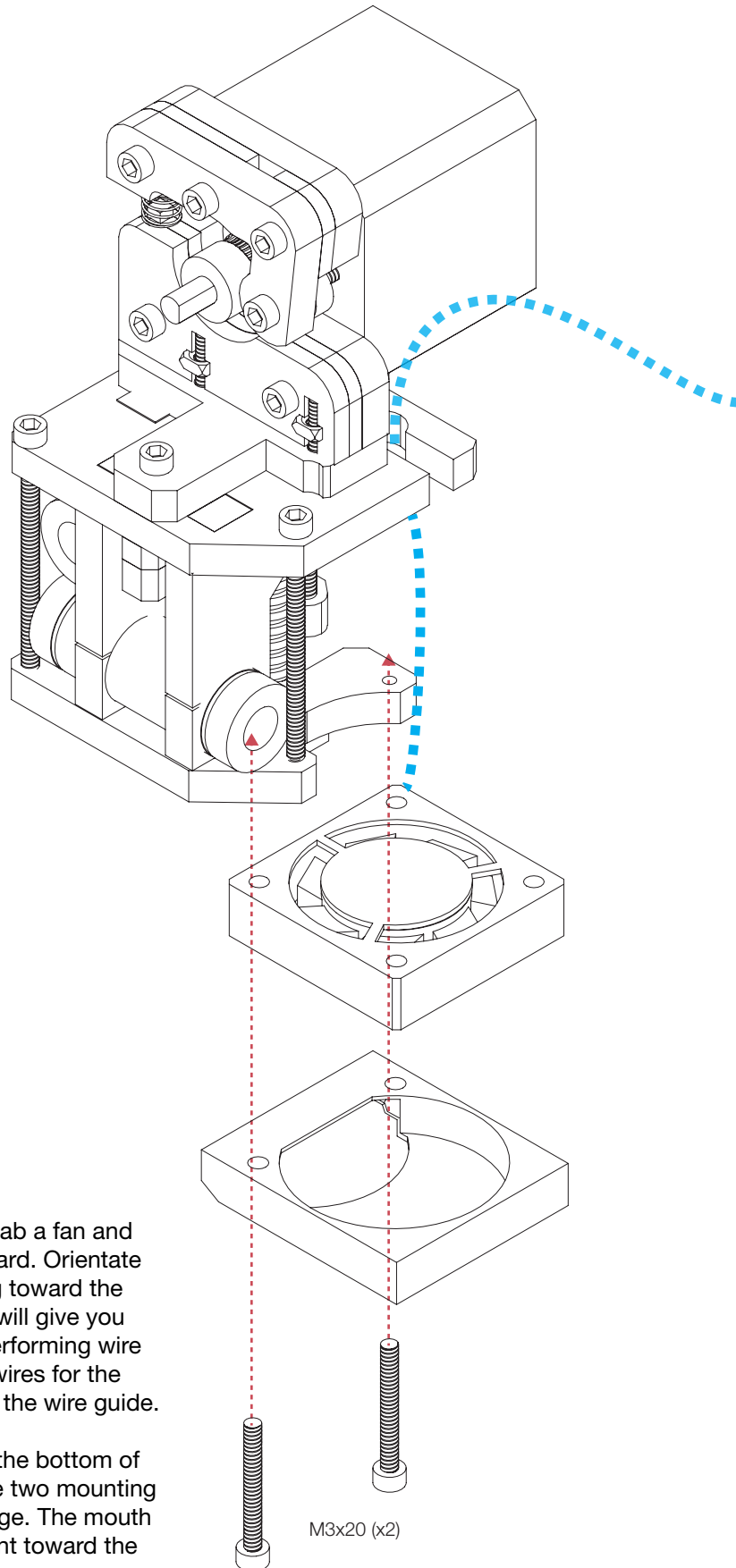
5.



**!** Take extra care when tightening the setscrew for the thermistor. Turn the setscrew very slowly as the glass on the thermistor will crack if there is too much pressure applied. There just needs to be enough force applied so the thermistor does not slide out of its slot.

On the back face of the hotend, there will be two slots. The large of the two slot will be for the heater cartridge, and the smaller one is designated for the thermistor. Insert the heater cartridge and thermistor into their respective slots and secure them in place using the setscrews located on the sides of the hotend. Once the thermistor and heater cartridge are in place, route the wires into the wire guide shown in the picture (blue path).

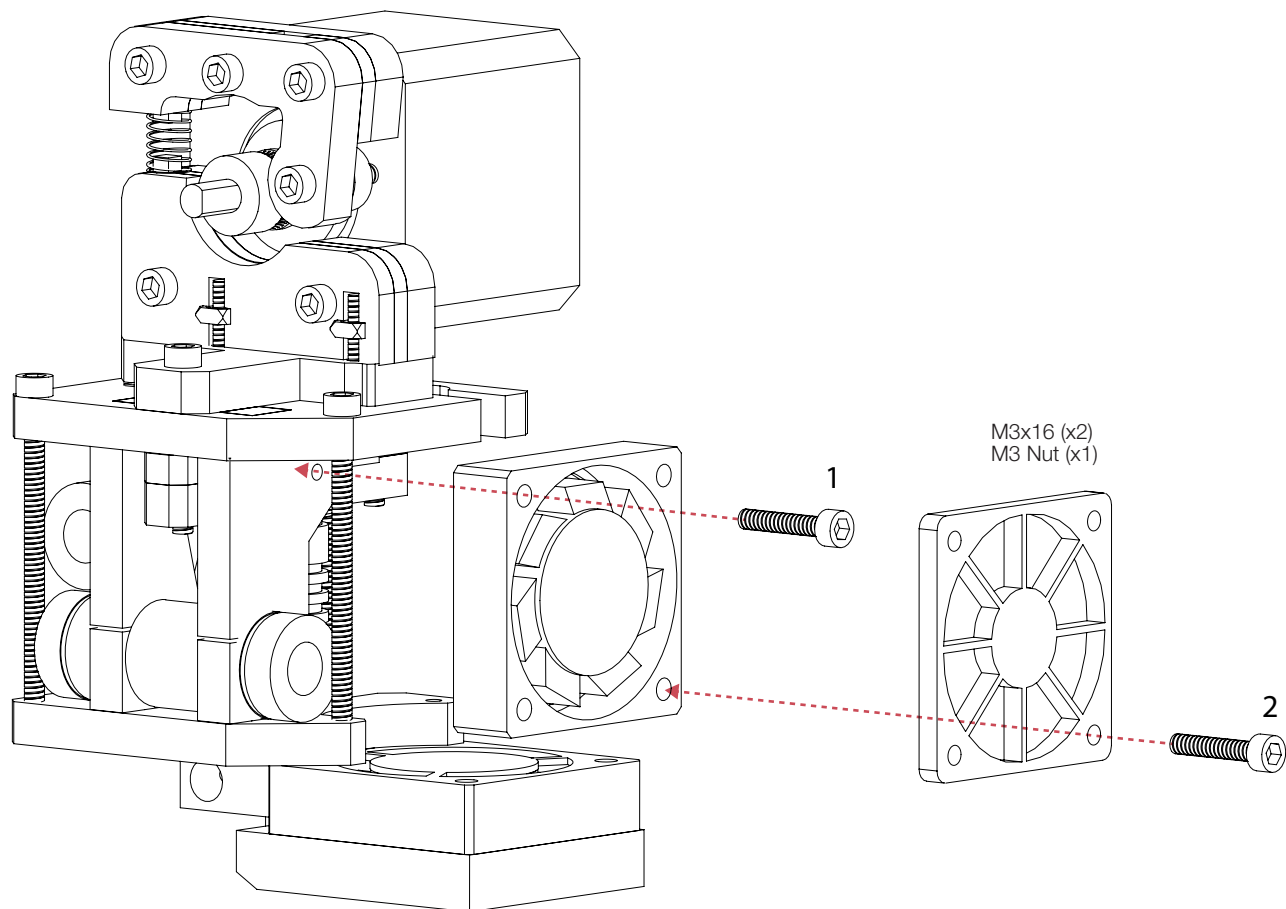
6.



To install the print bed fan, grab a fan and point the sticker side downward. Orientate the fan so the wire is pointing toward the back of the printer, doing so will give you cleaner look when you are performing wire management. Similar to the wires for the hotend, route the fan wire up the wire guide.

Insert the M3 screw through the bottom of the air duct and fan, there are two mounting holes on the bottom of carriage. The mouth of the fan duct should be point toward the hotend.

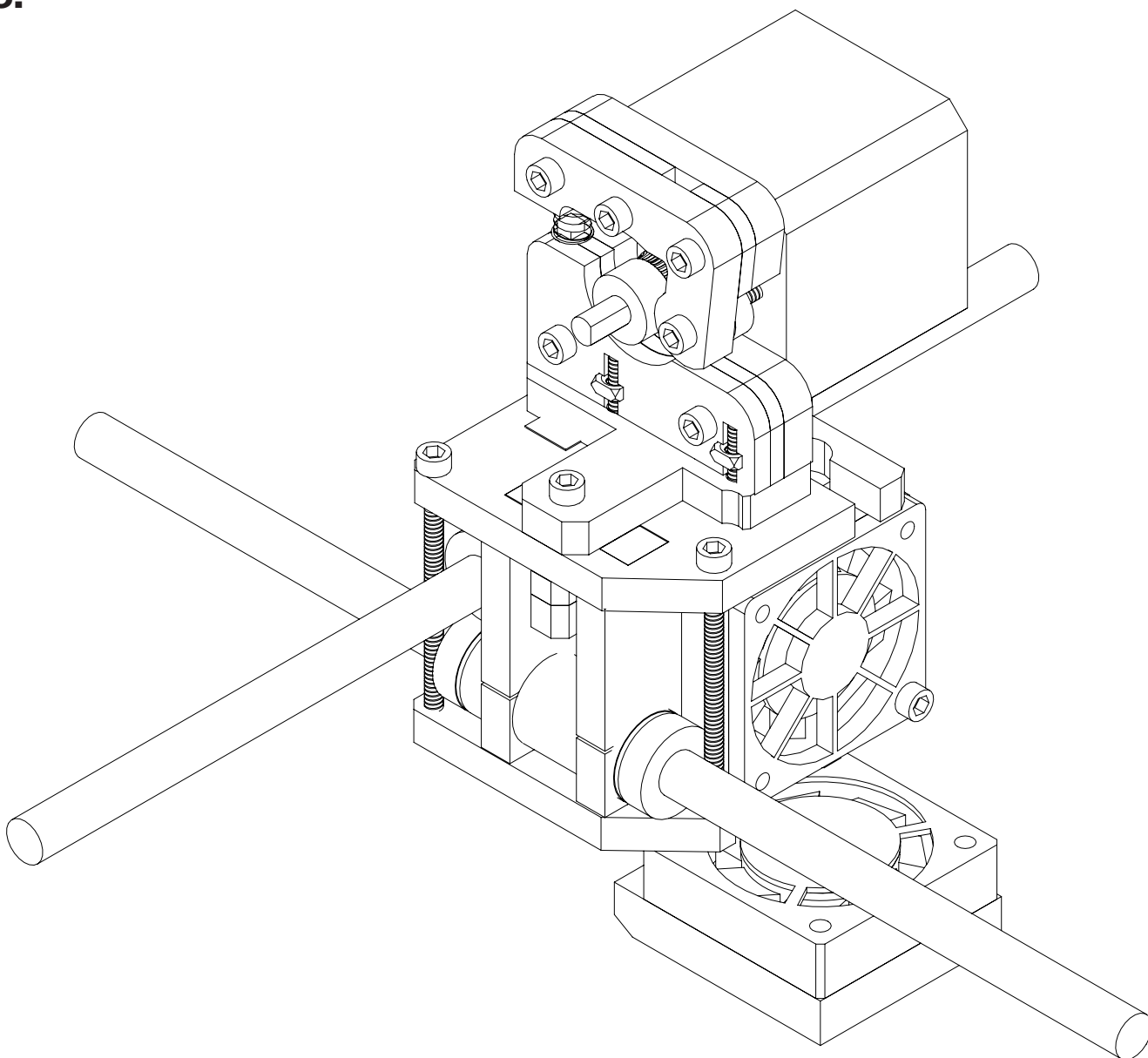
7.



To install the hotend cooling fan, grab the fan and point the sticker side toward the hotend. The fan should sit between the two carriage plates so if it does not fit, you will need to loosen the carriage screws. Route the fan wires so that it comes out of the top right corner and sits in front of the fan and wire guide. Secure the fan to the carriage with screw 1 and attach the fan guard to the carriage with screw 2 + M3 Nut.

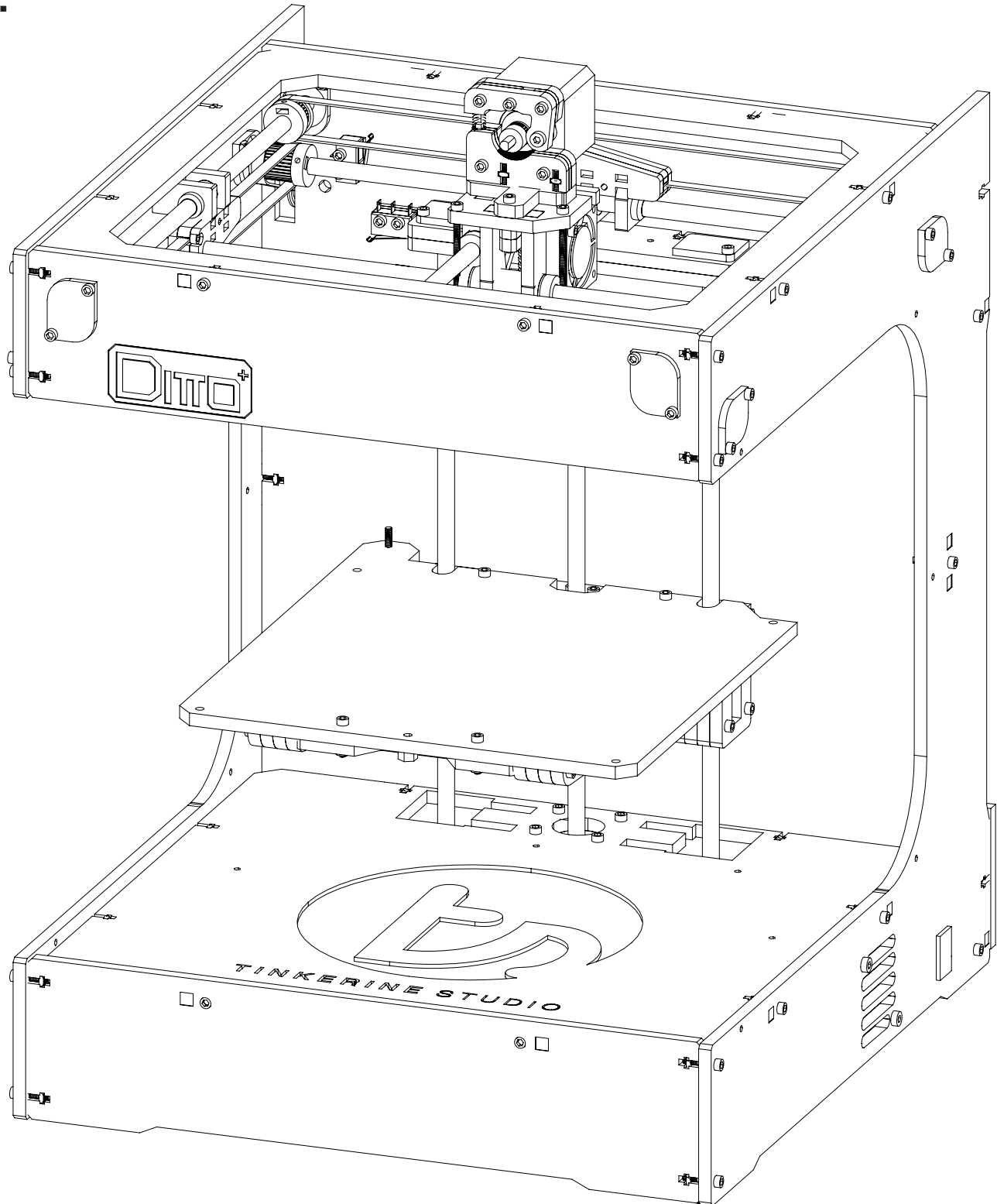


8.



You have completed the extruder and fan assembly. Double check to make sure all the fans are facing the right way and that all the wires are properly routed to go up the wire guide. All components on the carriage (hotend, motor, fan) should be properly secured and tightened. Connect the 4-pin motor wire to the extruder motor.

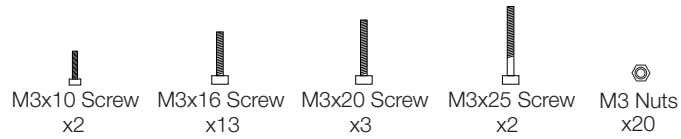
9.



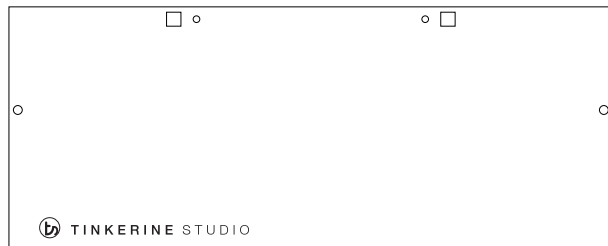
You are almost done assembling your printer. Move on to the next step to install the power supply and electronics to the printer.

# Electronics / Spool Holder Assembly

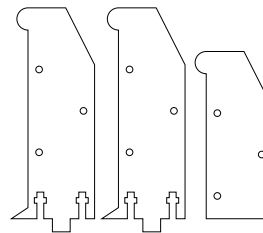
## Parts Required



## Tools Required



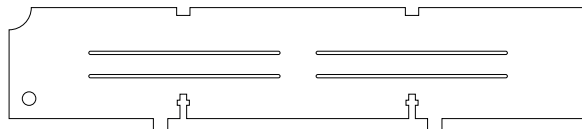
Motor Compartment 1 of 2



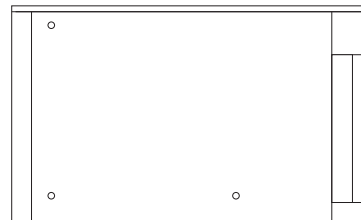
Spool Holder



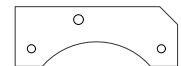
Arduino Mega 2560



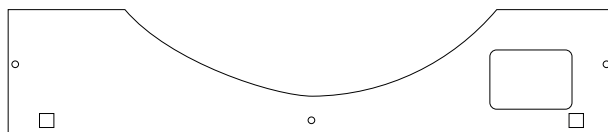
Motor Compartment 2 of 2



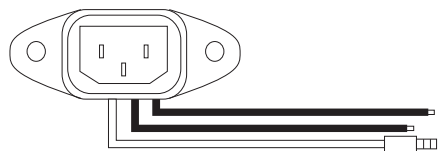
Power Supply



Fan Mount



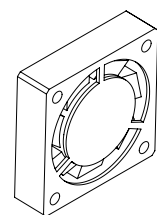
Back Bracket



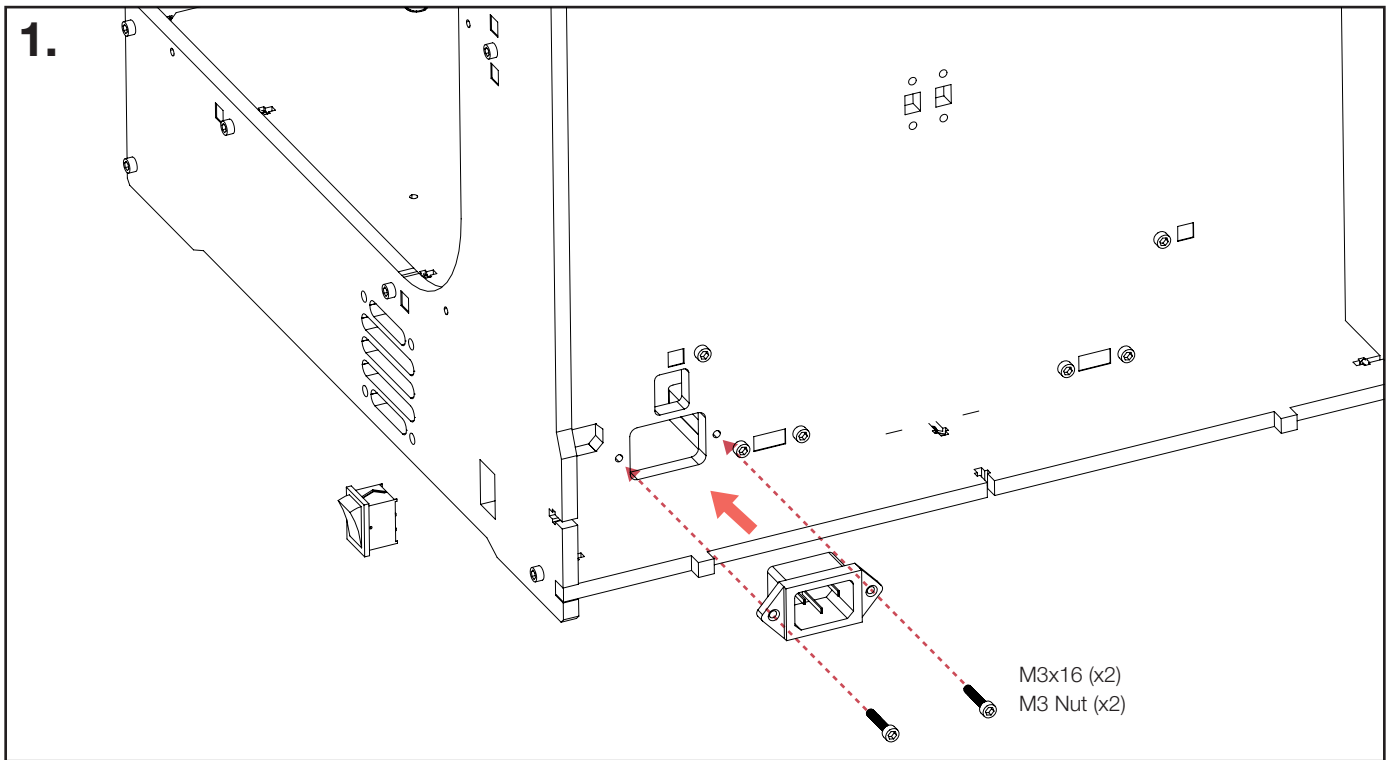
Electric Socket



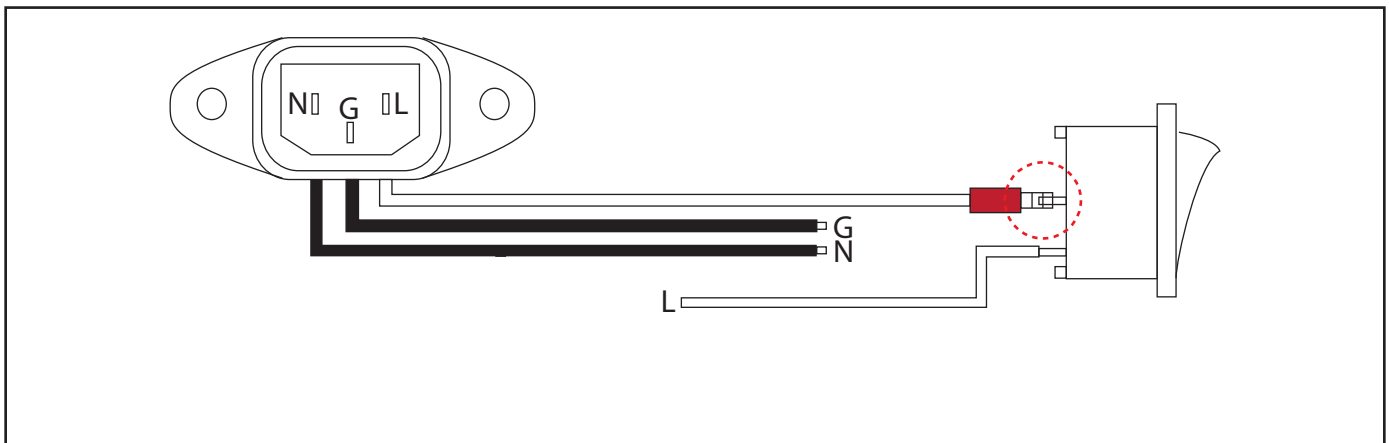
Power Switch



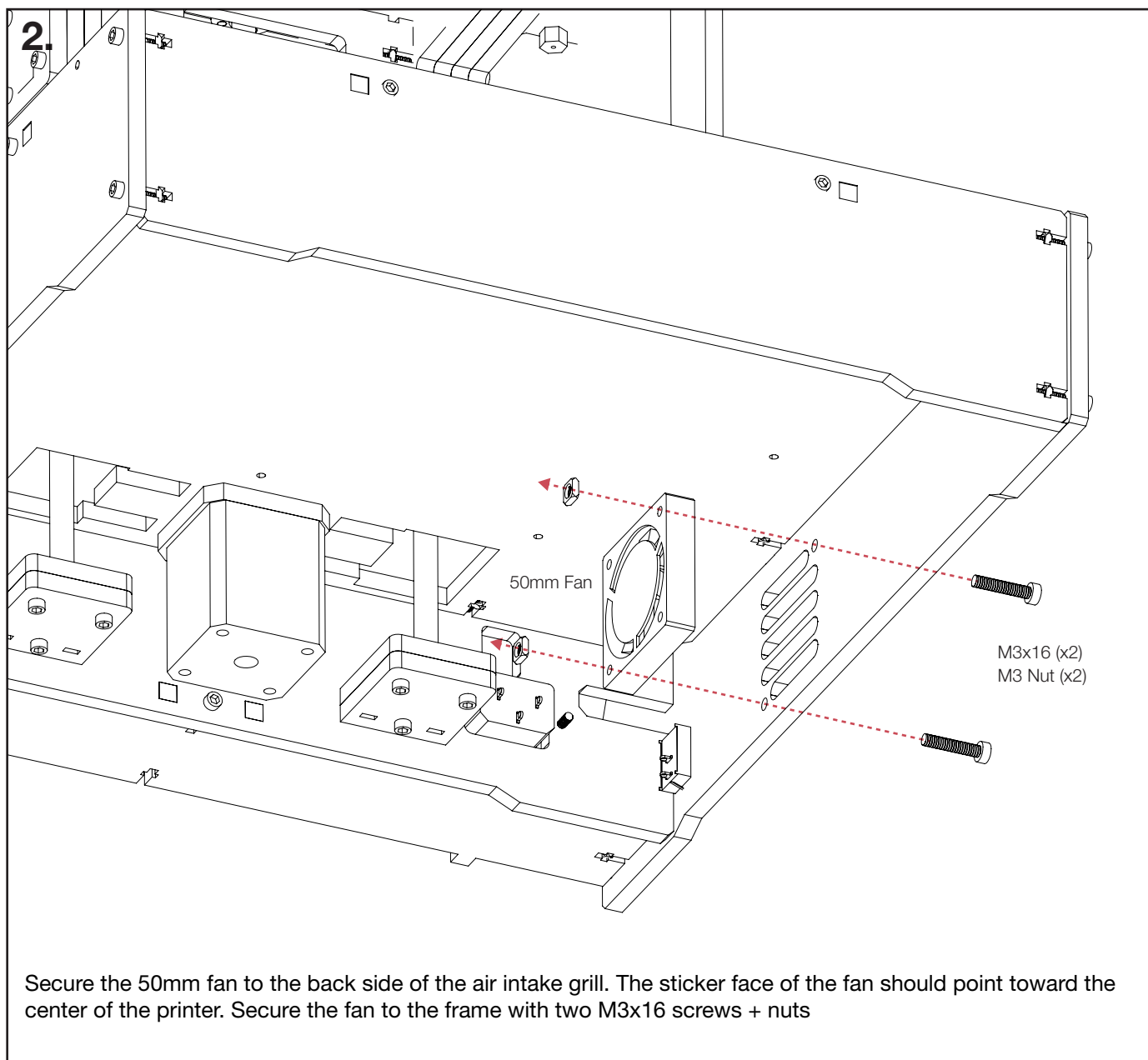
50mm Electric Fan x1



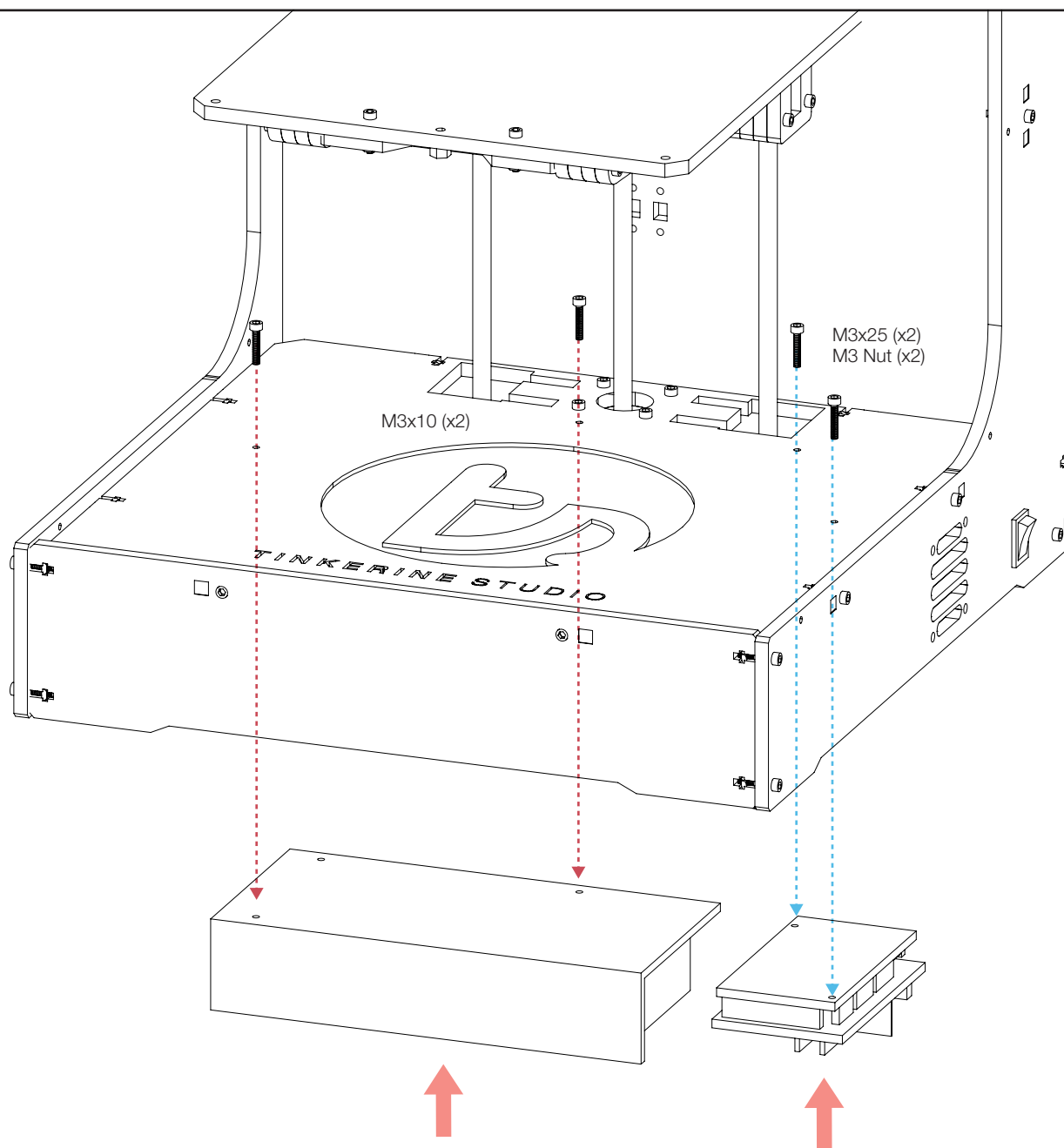
Insert the power socket and power switch as shown. The power switch is pressure fitted and the power socket will need to be secured by two M3x15 screw + M3 nut.



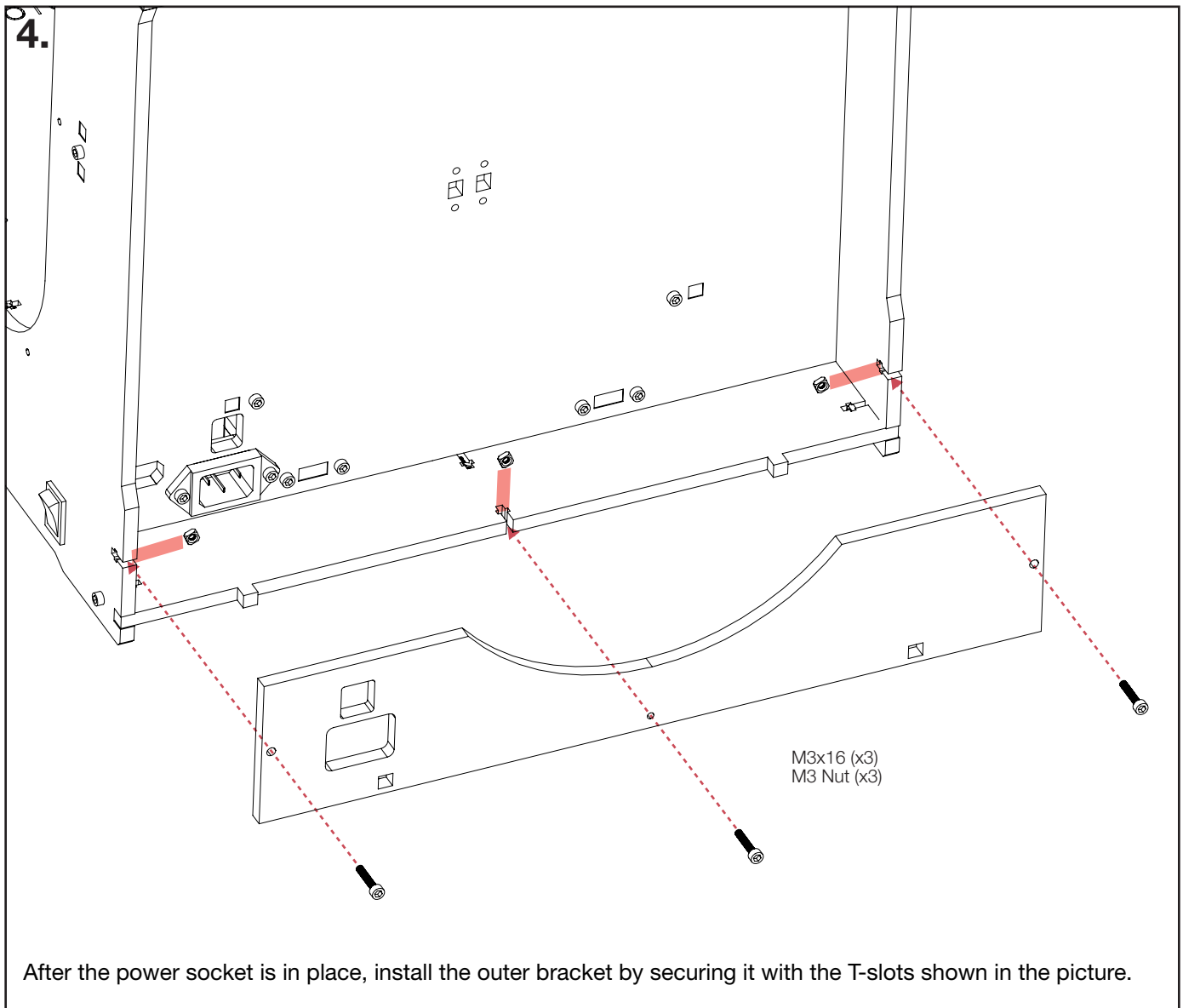
Connect the L line (White) from the power socket to the middle prong on the power switch. Leave the other wires along for now as they will be connected to the power supply later.



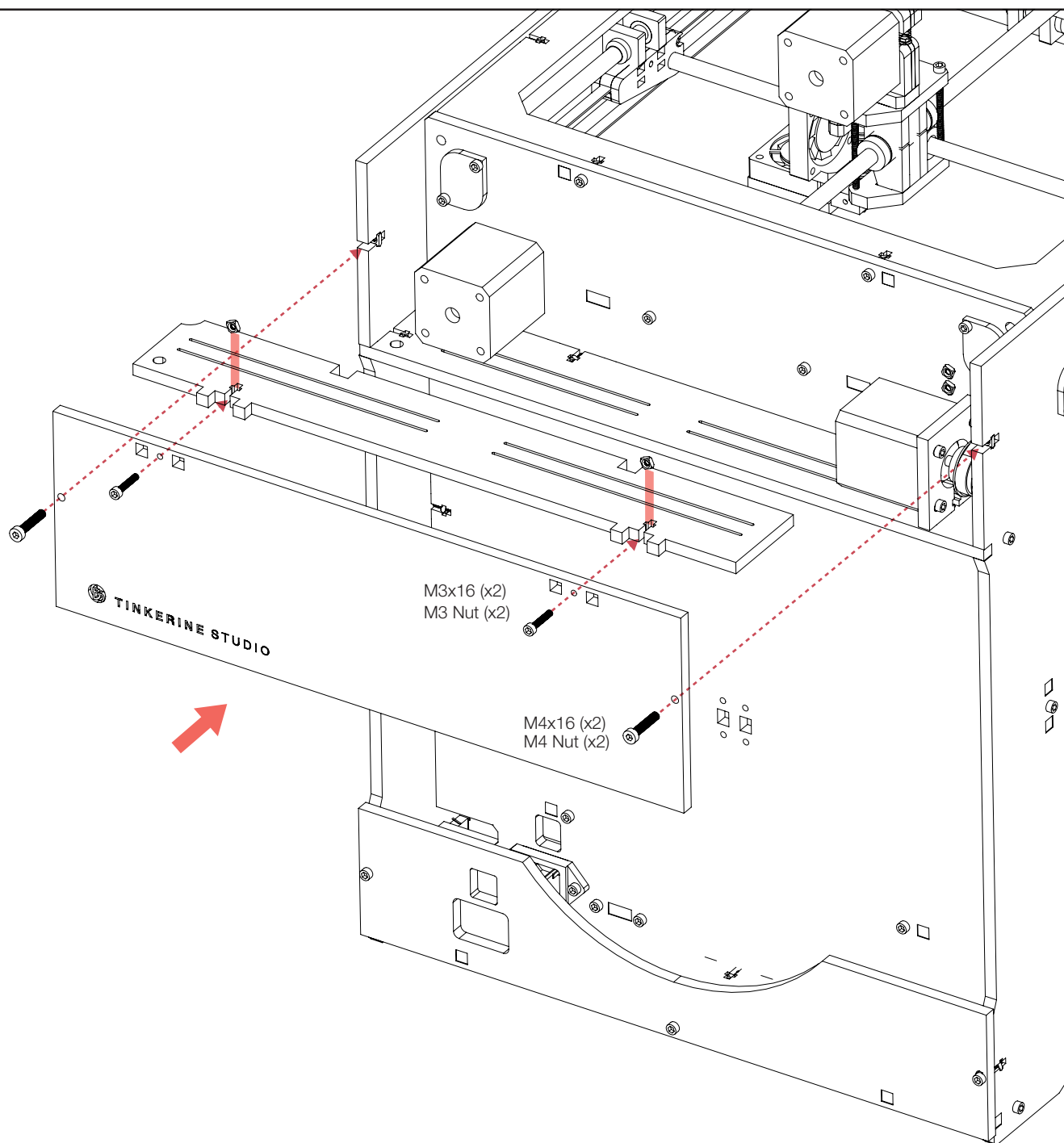
3.



Secure the power supply and Arduino board to the bottom of the face plate. You will need to use M3 nuts to secure the Arduino board. Orientate the power supply so the port are pointing toward the Arduino, and orientate the Arduino board so the USB ports are pointing toward the back of the printer.



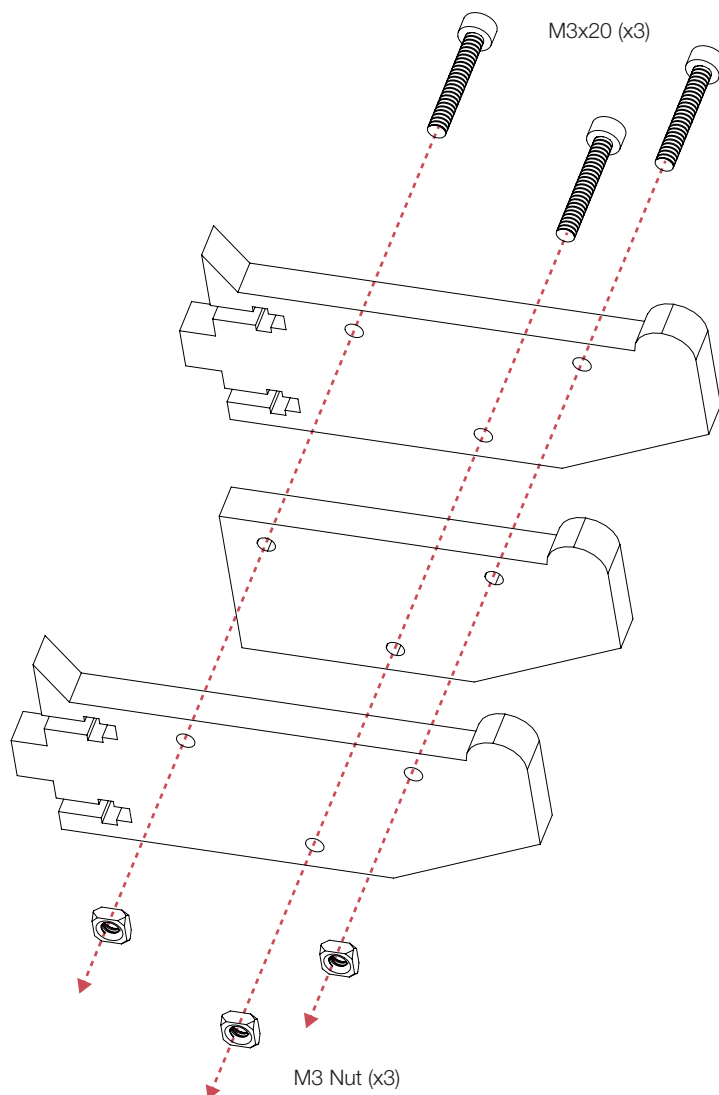
6.



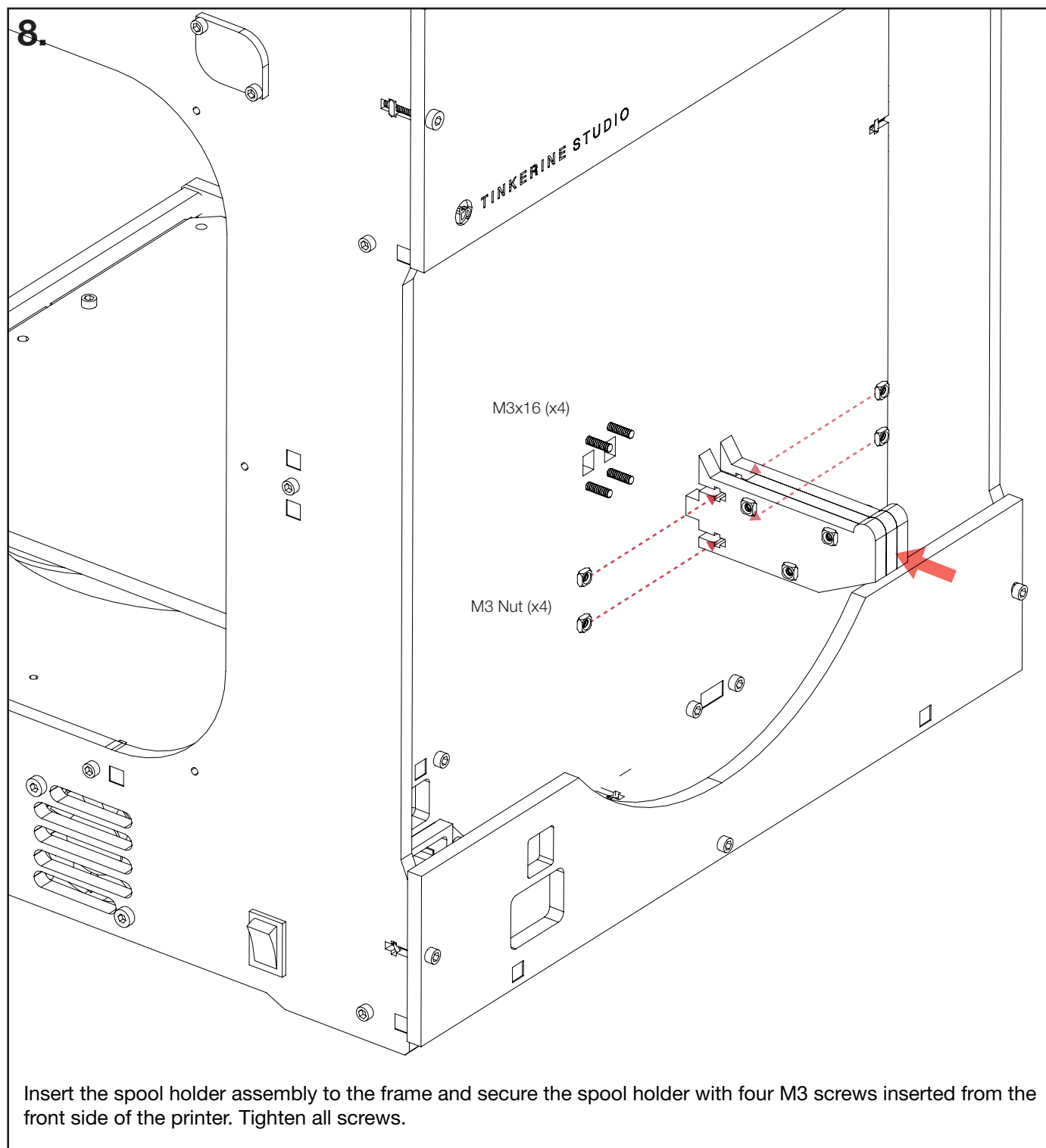
The back motor cover is composed of two pieces, assemble and secure with the two T-Slots on the top edge. The motor cover is then secured with two T-Slots on the sides. The nuts on the side will require more effort to push in as they were intended to be pressure fitted.



7.



To assemble the spool holder, sandwich the smaller of the three spool holder pieces with the other two and secure it with the M3 screw and M3 nut. Do not tighten this yet as it will make it hard to insert the assembly into the main body.

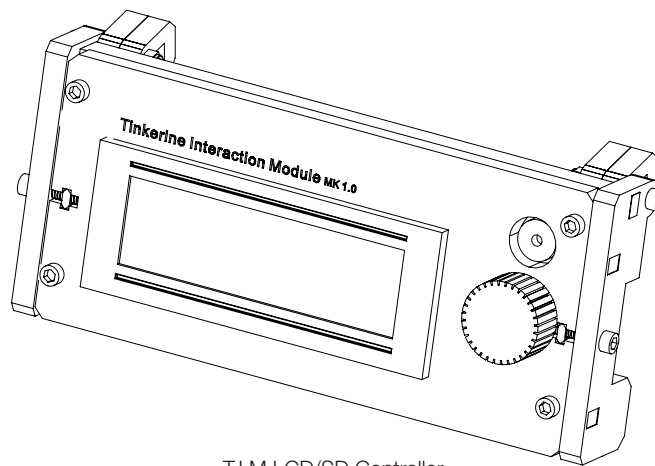
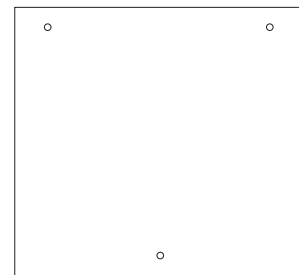


# Print Bed Assembly

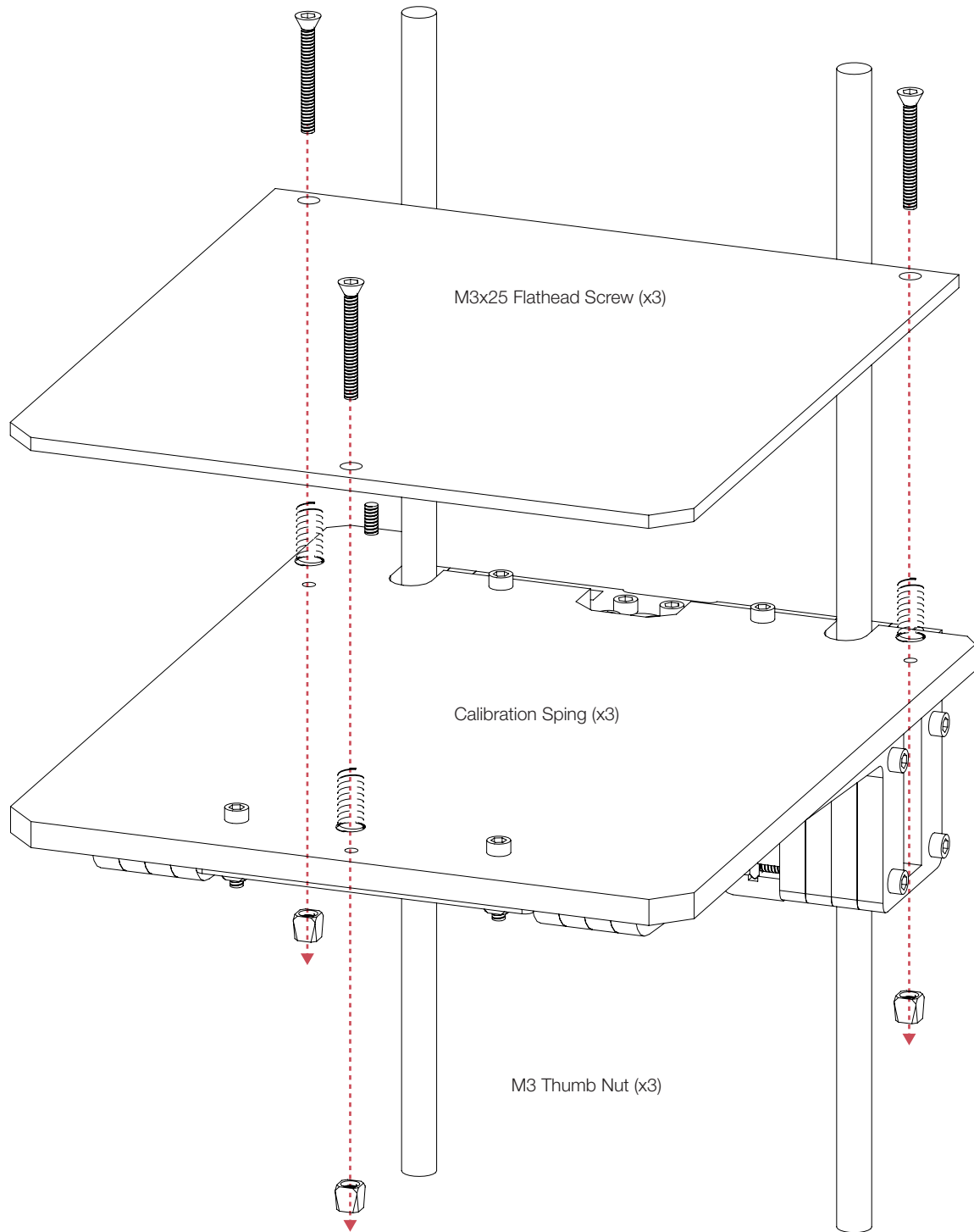
## Parts Required



## Tools Required

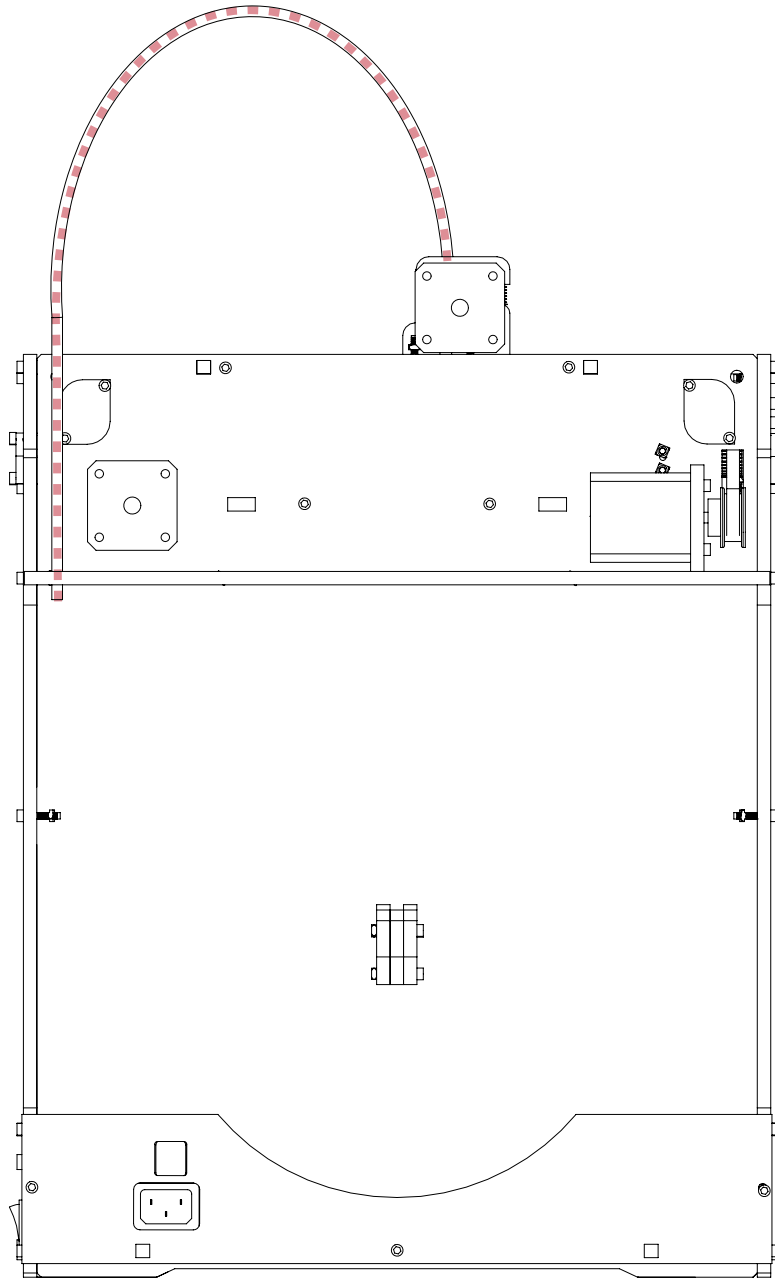


1.



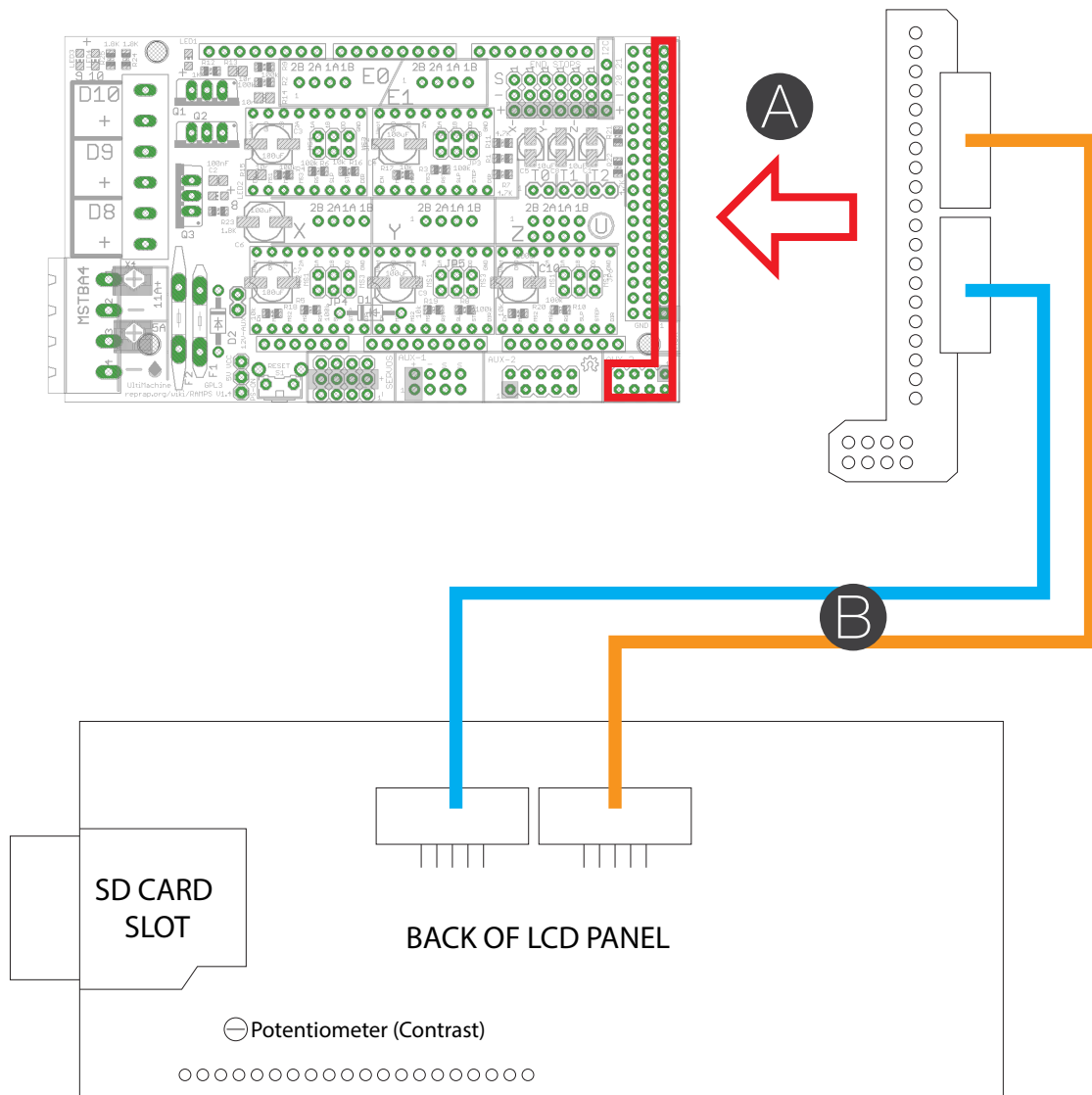
One by one, place a spring between the metal print bed and the wooden platform. Insert the flathead M3x25 screw from the top and secure it with a thumb nut. Repeat until you have all three points secured. Turn the thumb nut to tension the spring, ideally you will want the spring to be compressed so the bed is firmly planted onto the platform.

2.



Take the filament guide tube and thread it through the cut out located on the corner of the motor cover and motor bracket. Insert the other end into the top of the extruder. Remove the motor cover to thread the the guide tube through more easily.

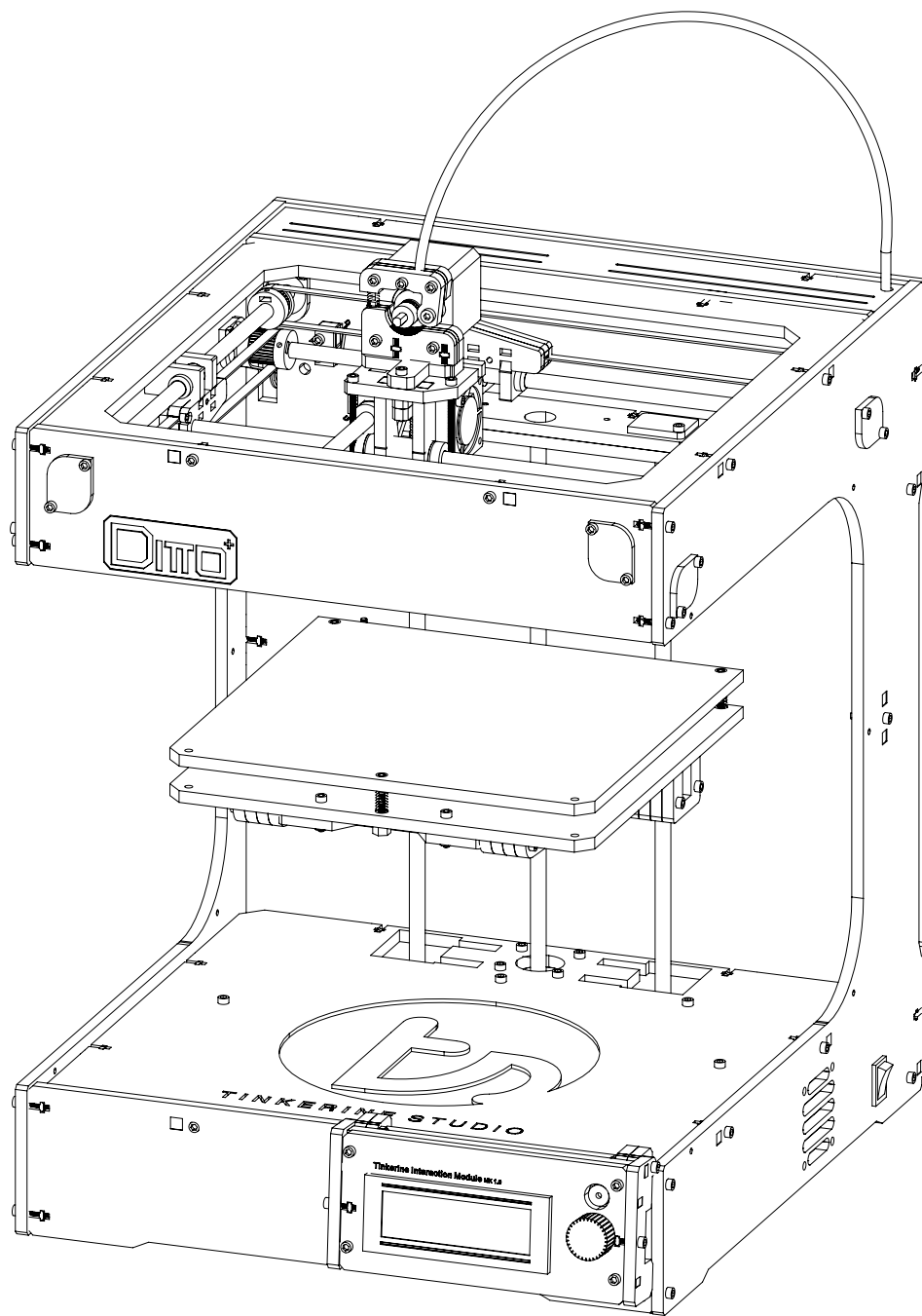
3.



To install the T.I.M LCD controller to Ditto:

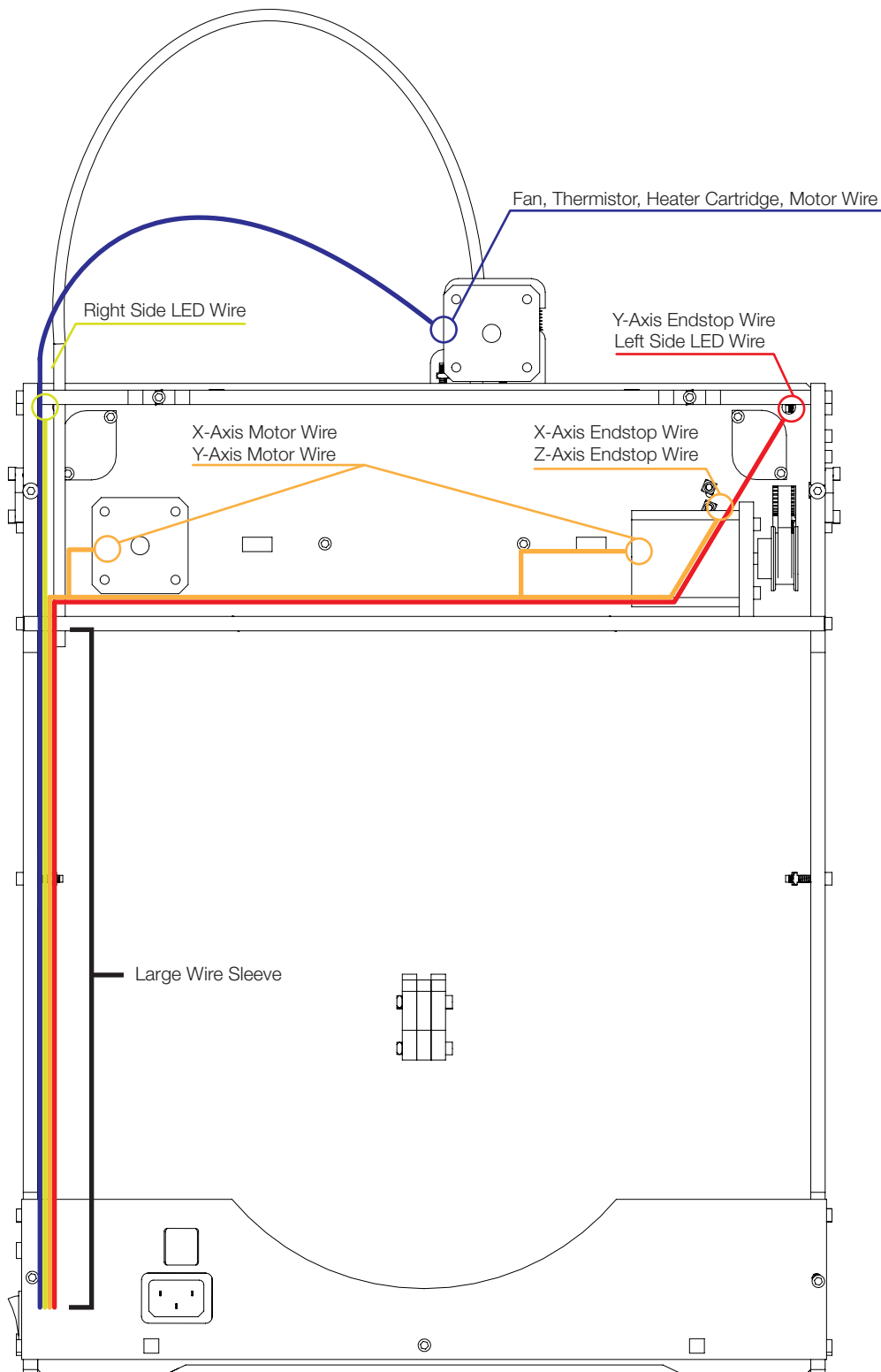
1. Connect the Smart Adapter onto the Arduino board.
2. Connect the ribbon cables from the Smart Adapter to the back of the LCD control unit as shown above.

3.



You've finished assembly your very own 3D printer (well almost!). With all of the components in the printer, move on to the next step to begin the wiring portion of the assembly.

# Wire Management



1. Route the wires from the Left Side LED, X+Y+Z-Axis Endstop, X+Y Motor wire through the wire holes from the front side of the machine to the back. Route the wire so it runs behind the Y-Axis motor and underneath the X-Axis motor. Run all wires through the hole located on the back corner of the motor bracket.

2. Gather all the wires from the carriage fan, heater cartridge, thermistor, Right Side LED, and extruder and route the wires through the hole located on the motor bracket.

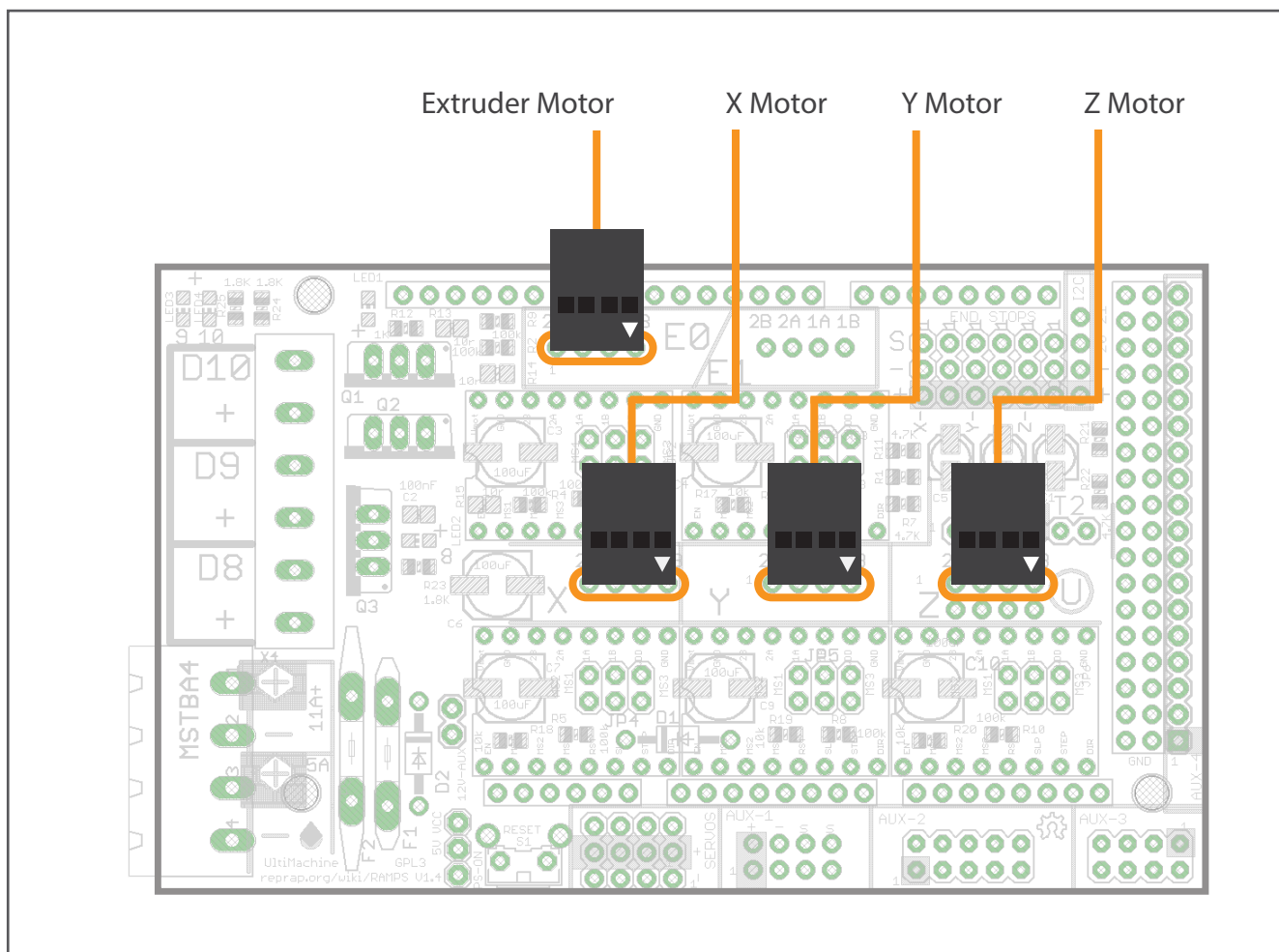
3. You may choose to label the wires with masking tape before you route them through the hole located on the bottom right corner of the printer. This will help you identify the wires later on.

**NOTE 1:** For the wires coming from the extruder units, make sure to leave enough slack so the wires still have some slack once the extruder moves to it's homing location (Front left corner).

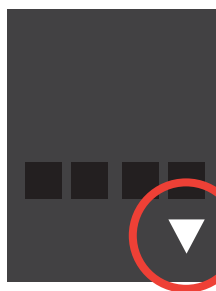
**NOTE 2:** Once the wires are all routed and connected to the electronics, use the supplied wire sleeve to clean up the exposed wires on the back and top of the machine. Use the larger sleeve for the back portion of the machine and the smaller wire sleeve to wrap the wires coming from the extruder.

**NOTE 3** After you have finished sleeving all the wires and have confirmed that all electronic components are in working order. Use the supplied zip-ties to secure the ends of the wire sleeve.





## IMPORTANT

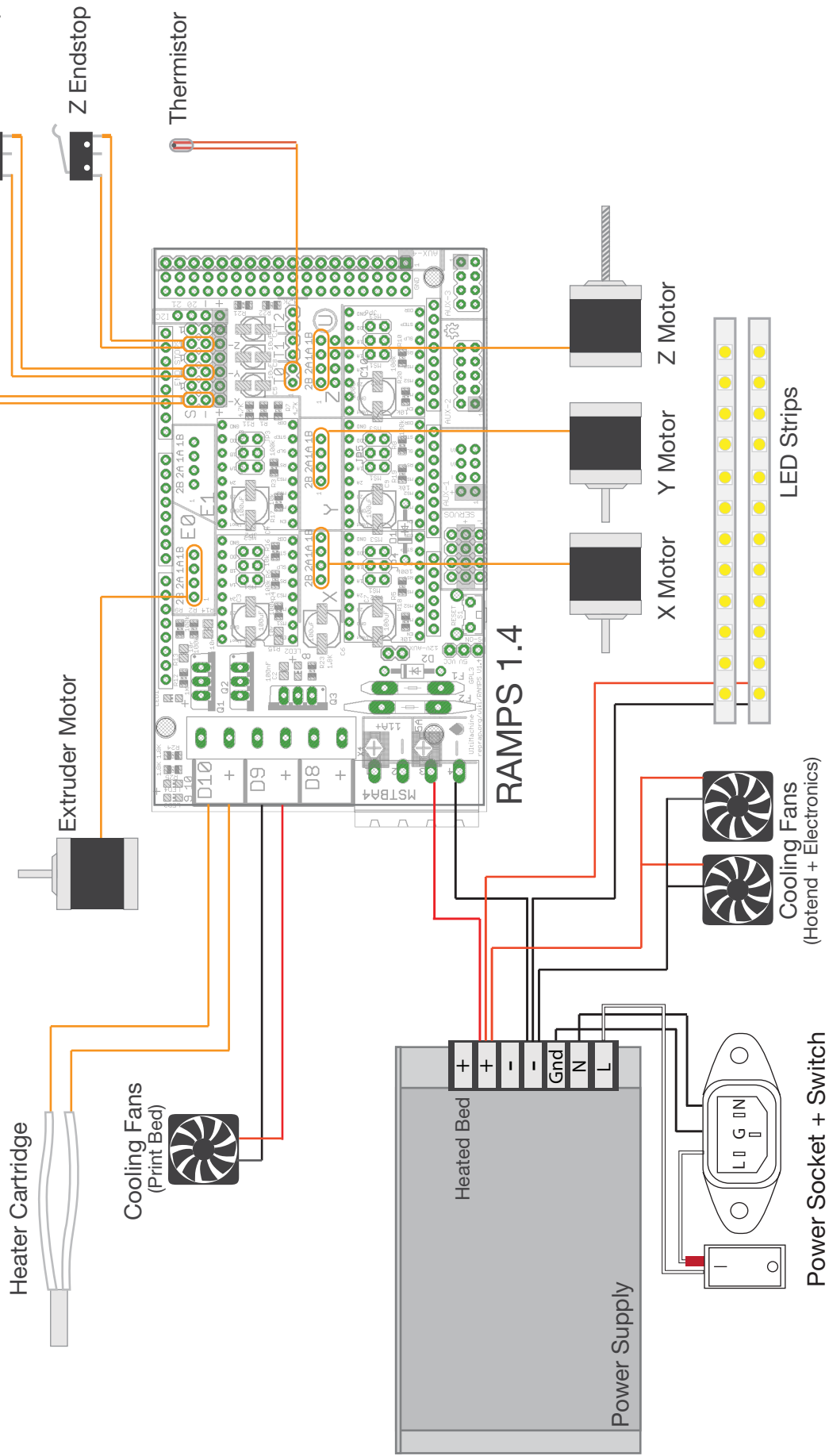


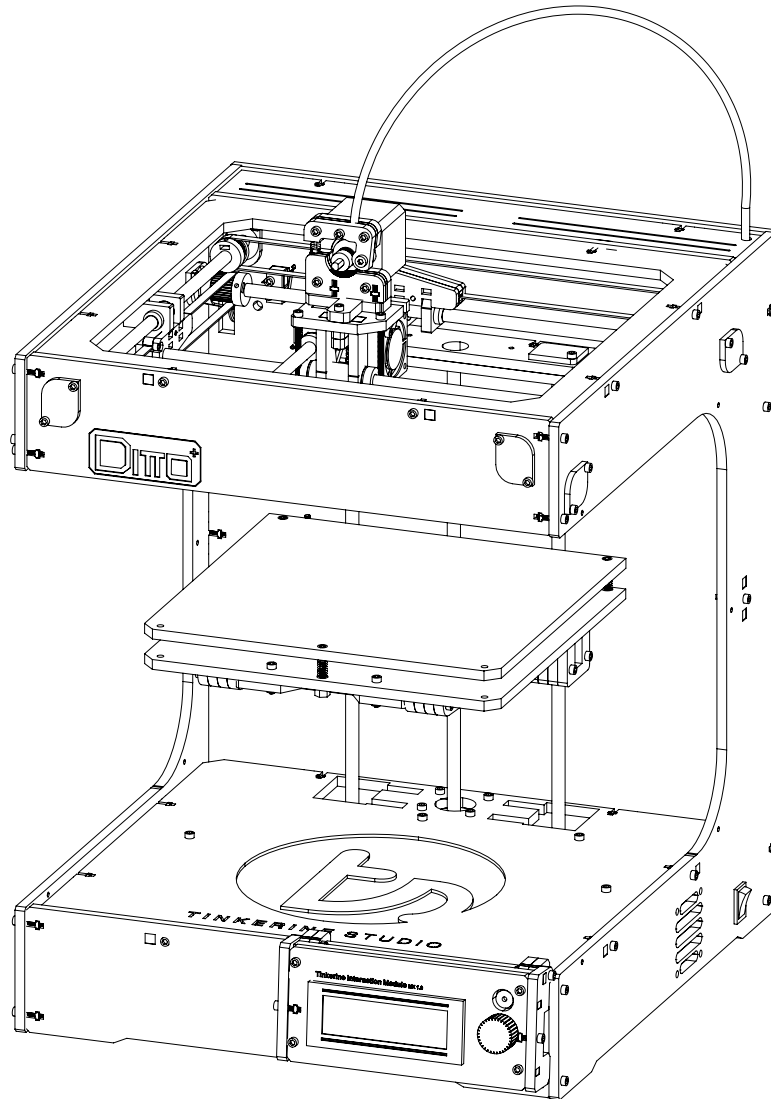
There is a small triangle on the rightmost side. Make sure it aligns as shown in the diagram.

\*Negative ends of the wire that do not have connector pins are marked with a black ink on the ends\*



\*After you have thread the endstop wires through the black plate, attach the pins into the connector housing before you plug them in.





That's it! You have just finished assembling your very own Ditto 3D printer. However there are just a few things to check before you power-up the printer for the very first time:

1. Make sure all screws and components are properly screwed down and secured.
2. While manually moving the the gantry system (extruder, belts, pulley, smooth rods, bearings), all components should operate smoothly and not interfere with one another. Check that all sets screws on the pulley are tightened, and all belts are aligned so they are seating fully in the teeth of the pulley.
3. All electronics are properly plugged in and seated into their correct ports. Make sure there are no exposed wires in contact with electronic components, and the electronic cooling fan is properly mounted and directing airflow to the A4988 Stepper Driver.
4. Make sure there is no foreign objects along the path of moving components. Avoid using lubricant on the linear bearing (Z Axis + Carriage). Most lubricants (especially ones that contain propellants) might absorb dirt and become more viscous over time, which can cause more friction and cause damage to the bearings.

# Preliminary Run-Through

## Stage 1

1. Plug in the printer. Do not turn on the printer yet.
2. Connect the USB from the printer to the USB port on your computer. If you have an LCD/SD card unit, connect it to your printer.
3. Test the X-Axis endstop. Manually move the carriage by hand and push it to the left side of the printer and check to see if the slider will trigger the endstop. You will hear a click when endstop is trigger. Repeat the test with the Y-Axis Endstop. If the endstop does not trigger, you will need to re-adjust the position of the endstop so it makes contact with the trigger pieces on the slider.
4. Tighten the thumb screws underneath the print bed springs. This will tension the springs and prevent the bed from moving around during printing.
5. Test the Z-axis endstop. Manually turn the lead screw to bring the bed upward. As the bed approaches the nozzle, adjust the Z-axis trigger screw located on the back corner of the printer bed so that it makes contact with the endstop lever before the nozzle touches the surface of the bed. The ideal distance between the nozzle and print surface should roughly be the thickness of a piece of paper.
6. Calibrate the print bed. Using the 3-point leveling system, manually move the hotend to the each of the four corners on the print bed. At each of the four point, adjust the thumb screws so the bed is evenly leveled on all sides.

## Stage 2

1. Turn on the printer.
2. Check that both LED light strip are lit.
3. Check that the hot-end cooling fans are on and directing airflow to the hot-end within the carriage unit.
4. Check that the electronics cooling fans are on and directing airflow to the Arudino + A4988 Stepper drivers.
5. Check that the print bed cooling fan isn't on. The fan for the print bed should only activate during printing.
6. If the LED or fan do not turn on, turn off the printer and disconnect the power source. Check your wiring to see if all wire are properly seated and secured in their sockets.

## Stage 3

1. Using Coordia (Control Software) or the T.I.M Controller, connect to the printer and test move each axis.
2. Home all axis. If the printer triggers any of the endstop but doesn't stop, shut off the printer immediately. Check the enstop pin connector to see if the pins are fully seated into the housing, then make sure the housing are properly connected to the pins on the electronics board. Since the X and Z axis endstop are grouped together, there might be a chance that you have them plugged in reversed.
3. Using Coordia or T.I.M, set the preheat temperature for PLA (180c). Monitor the temperature level and check that the heater cartriged and thermistor is working properly. If the hotend does not heat up, check that the heater cartridge and thermistor is plugged in correctly. Do not touch hotend with your finger to check the temperature as the cartridge can be functioniing correctly while the thermistor is providing a false reading.
4. Your printer is ready to start printing. Follow the calibration guide to start printing your first object!