



SWITCHWIRE ASSEMBLY MANUAL

We build space shuttles with gardening tools
so anyone can have a space shuttle of their own.

VERSION 2021-01-30



Before you begin on your journey, a word of caution.

In the comfort of your own home you are about to assemble a robot. This machine can maim, burn, and electrocute you if you are not careful. Please do not become the first VORON fatality. There is no special Reddit flair for that.

Please, read the entire manual before you start assembly. As you begin wrenching, please check our Discord channels for any tips and questions that may halt your progress.

Most of all, good luck!

THE VORON TEAM

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PART PRINTING GUIDELINES

The Voron Team has provided the following print guidelines for you to follow in order to have the best chance at success with your parts. There are often questions about substituting materials or changing printing standards, but we recommend you follow these.

3D PRINTING PROCESS

Fused Deposition Modeling (FDM)

MATERIAL

ABS

LAYER HEIGHT

Recommended: 0.2mm

EXTRUSION WIDTH

Recommended: Forced 0.4mm

INFILL TYPE

Grid, Gyroid, Honeycomb, Triangle or Cubic

INFILL PERCENTAGE

Recommended: 40%

WALL COUNT

Recommended: 4

SOLID TOP/BOTTOM LAYERS

Recommended: 5

PRINT IT FORWARD (PIF)

Often times our community members have issues printing ABS will bootstrap themselves into a VORON using our Print It Forward program. This is a service where approved members with VORON printers can make you a functional set of parts to get your own machine up and running.

Check Discord if you have any interest in having someone help you out.

HOW TO GET HELP

If you need assistance with your build, we're here to help. Head on over to our Discord group and post your questions. This is our primary medium to help VORON Users and we have a great community that can help you out if you get stuck.



<https://discord.gg/voron>

THIS IS JUST A REFERENCE

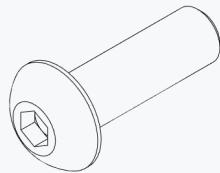
This manual is designed to be a simple reference manual. Building a Voron can be a complex endeavour and for that reason we recommend downloading the CAD files off our Github repository if there are sections you need clarification on. It can be sometimes be easier to follow along when you have the whole assembly in front of you.



<https://github.com/vorondesign>

HARDWARE

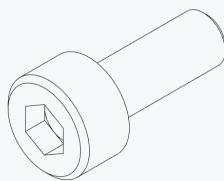
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BUTTON HEAD CAP SCREW (BHCS)

Metric fastener with a domed shape head and hex drive. Most commonly found in locations where M5 fasteners are used.

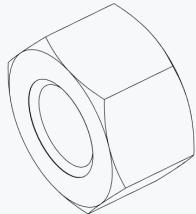
ISO 7380-1



SOCKET HEAD CAP SCREW (SHCS)

Metric fastener with a cylindrical head and hex drive. The most common fastener used on the Voron.

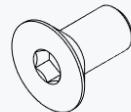
ISO 4762



HEX NUT

Hex nuts couple with bolts to create a tight, secure joint. You'll see these used in both M3 and M5 variants throughout this guide.

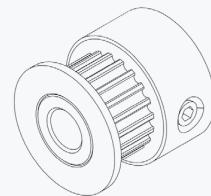
ISO 4032



FLAT HEAD COUNTERSUNK SCREW (FHCS)

Metric fastener with a cone shaped head and a flat top.

ISO 10642



PULLEY

GT2 pulley used on the motion system of the Voron.



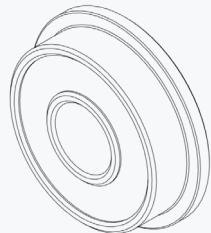
SHIM

Not to be confused with stamped washers. These are used in all M5 call-out locations in this manual.

DIN 988

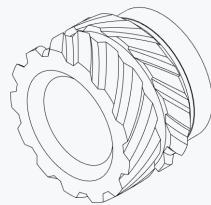
HARDWARE

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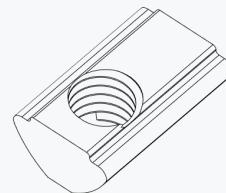
F695 BEARING

A ball bearing with a flange used in various gantry locations.



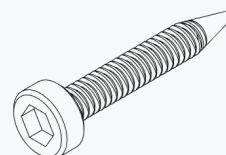
HEAT SET INSERT

Heat inserts with a soldering tip so that they melt the plastic when installed. As the plastic cools, it solidifies around the knurls and ridges on the insert for excellent resistance to both torque and pull-out.



POST INSTALL T-SLOT NUT

Nut that can be inserted into the slot of an aluminium profile. Used in both M3 and M5 variants throughout this guide.



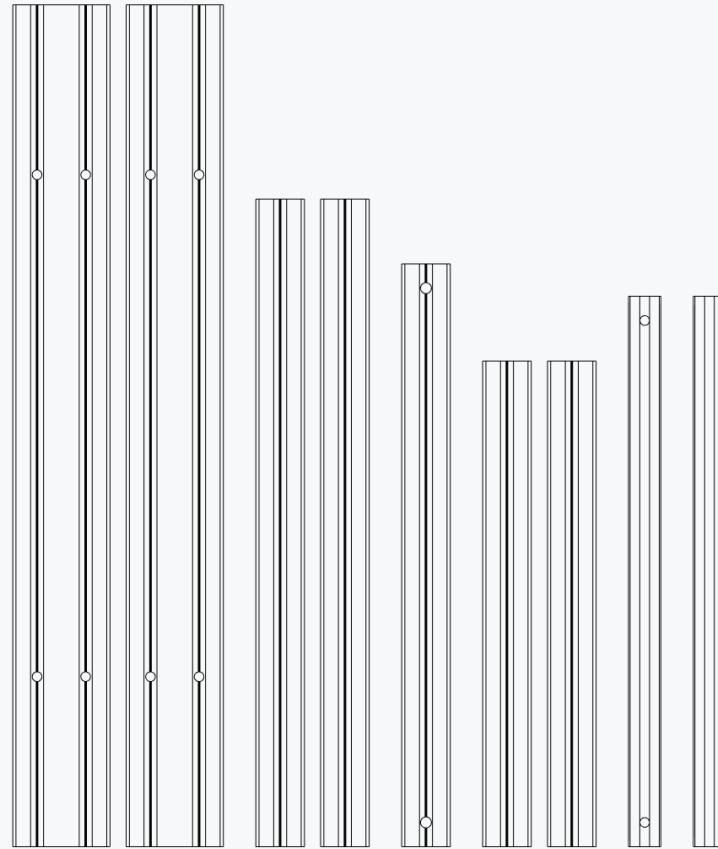
SELF TAPPING SCREW

Fastener with a pronounced thread profile that is screwed directly into plastic.

FRAME

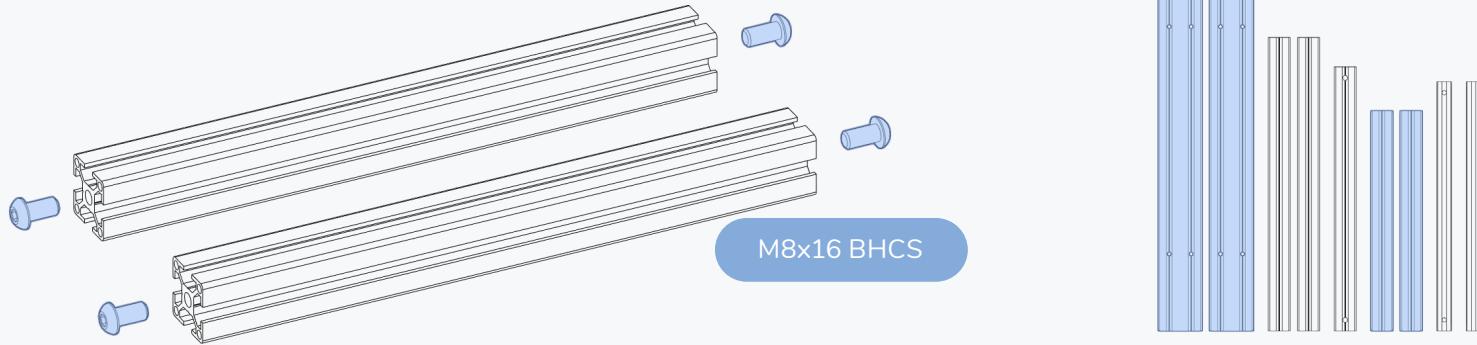
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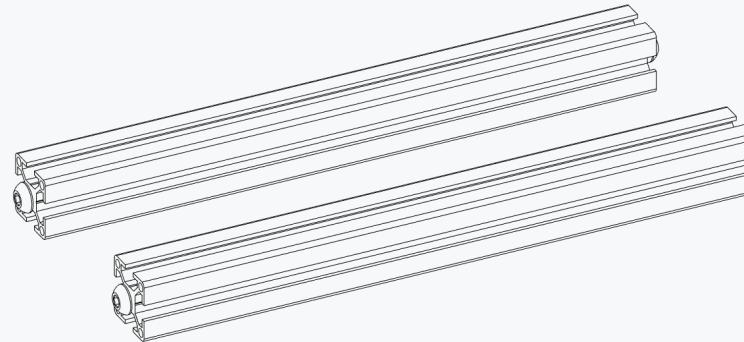
GETTING EXTRUSIONS TOGETHER

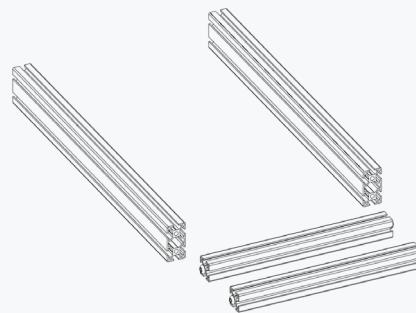
Separate the extrusions you're going to need for this section of the build. We've laid out all the parts you should have and highlighted the ones that will be used in the following sections.



BLIND JOINT BASICS

Blind Joints provide a cost effective and rigid assembly method. The head of the BHCS is slid into the channel of another extrusion and securely fastened through a small access hole in the other extrusion.

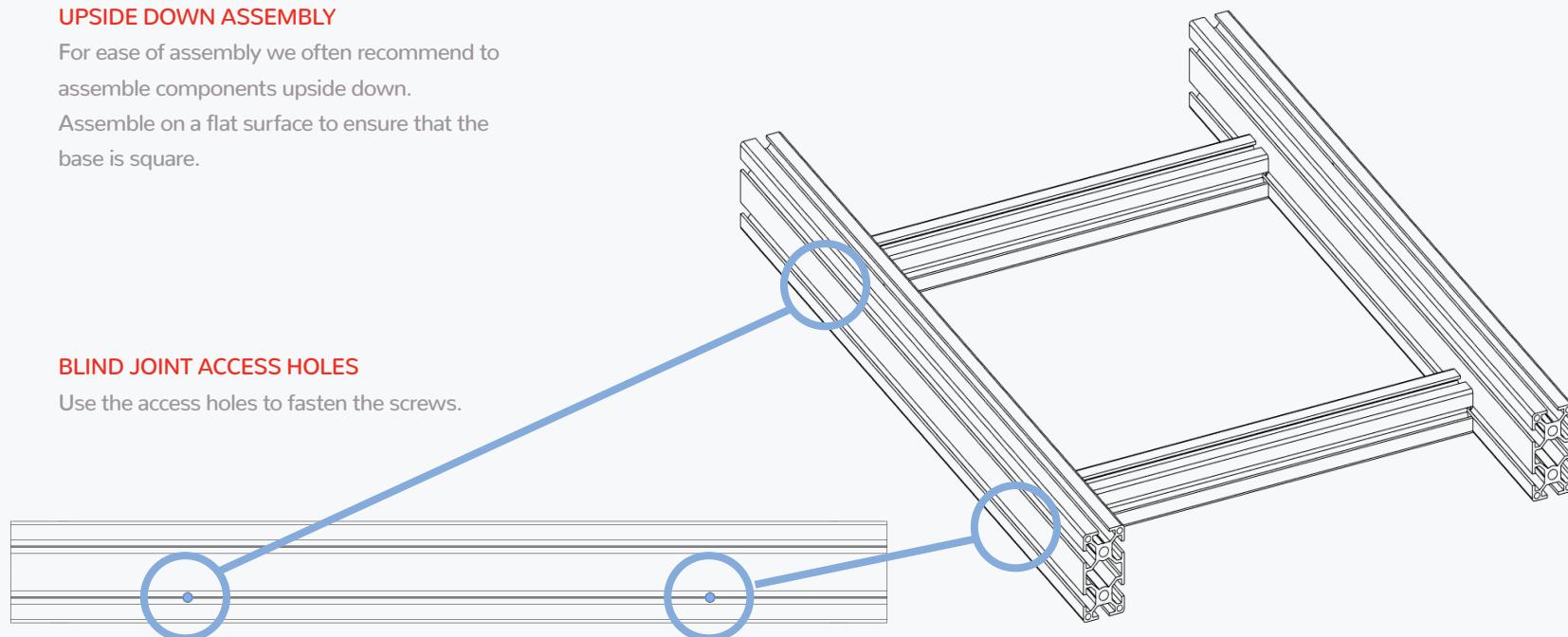


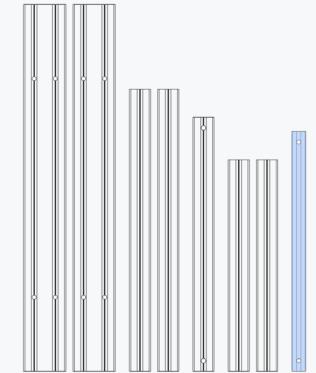
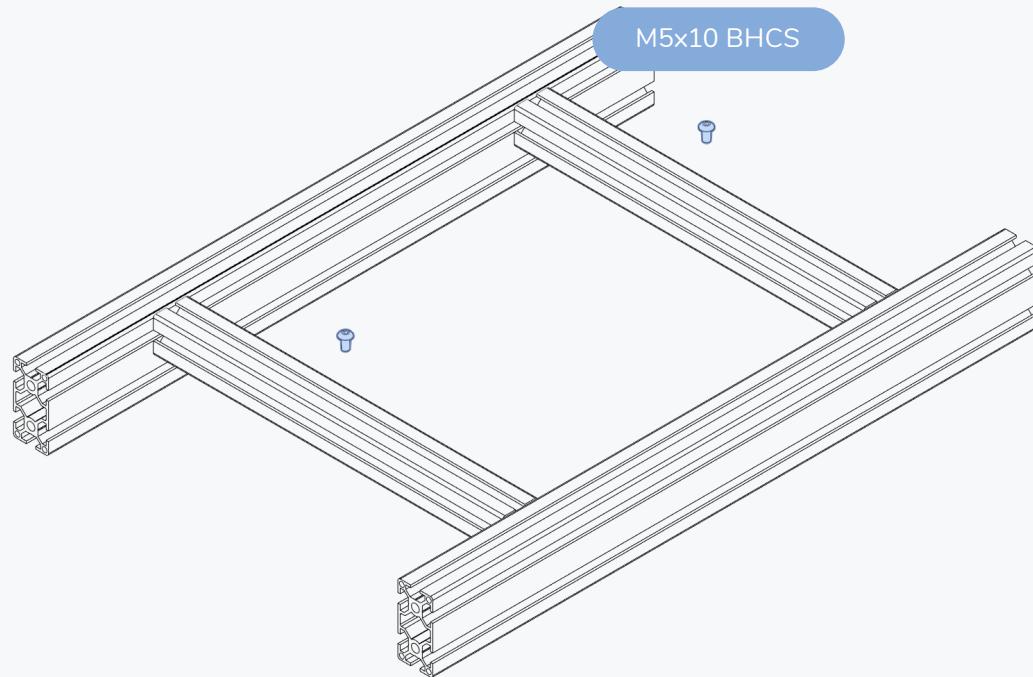
**UPSIDE DOWN ASSEMBLY**

For ease of assembly we often recommend to assemble components upside down. Assemble on a flat surface to ensure that the base is square.

BUILD ON A FLAT SURFACE

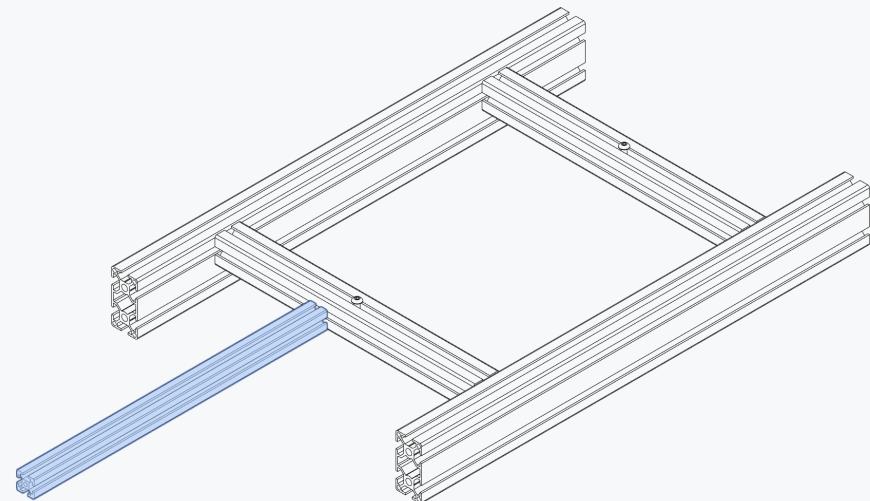
Build the frame on a glass or granite surface to ensure you can get it as square as possible.

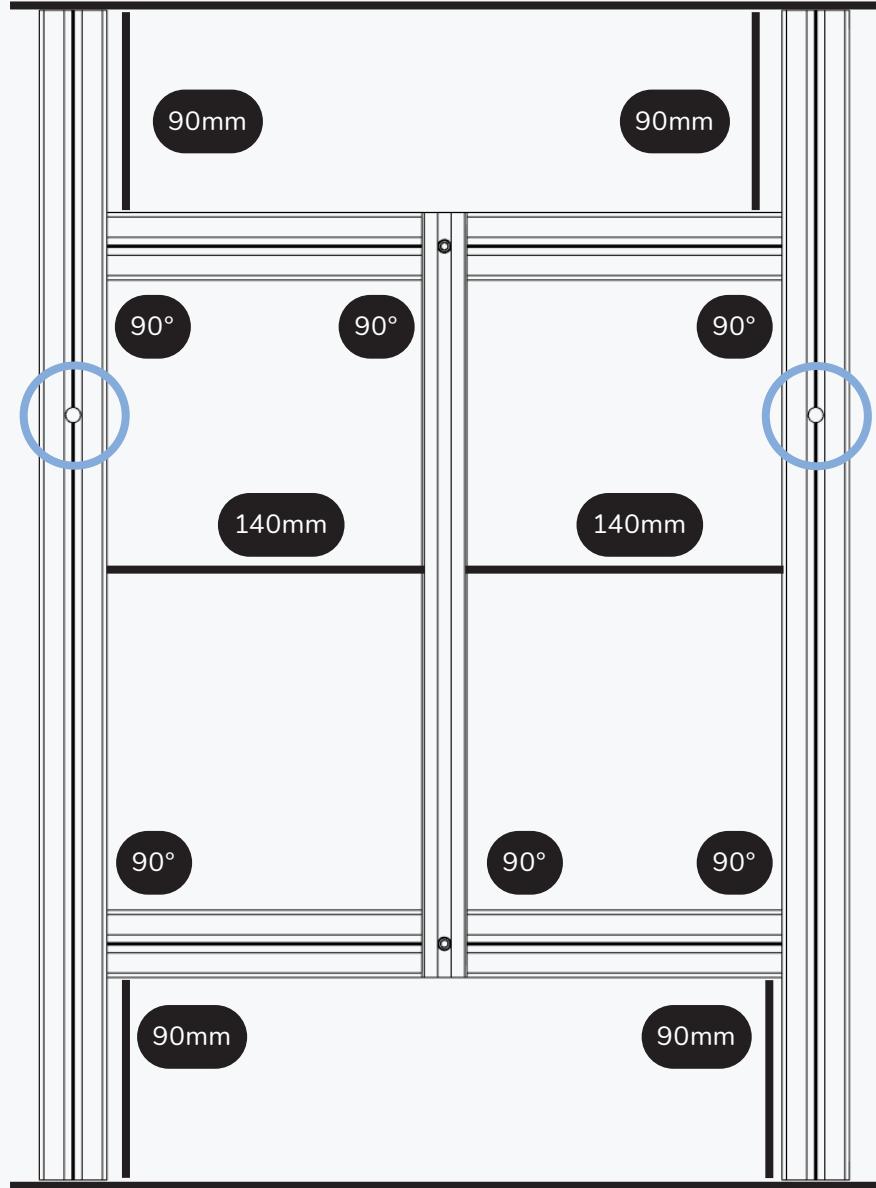


**T-NUTS?**

We don't show the insertion of T-Nuts in our assembly manuals.

The Post Install T-Nut's we recommend can be inserted at any point during the installation.



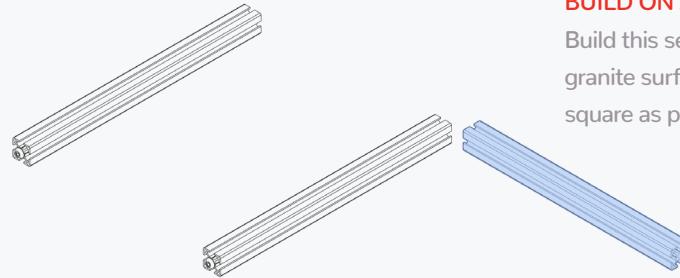
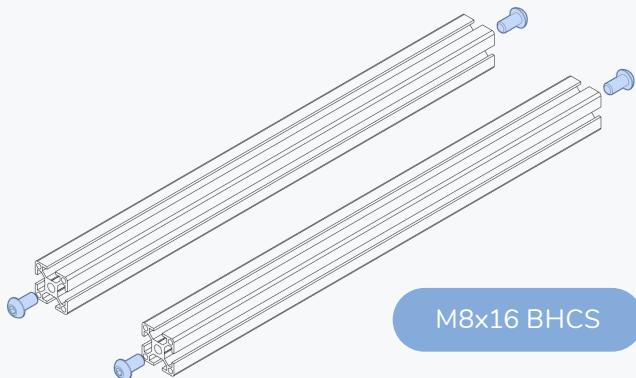


VERIFY DIMENSIONS

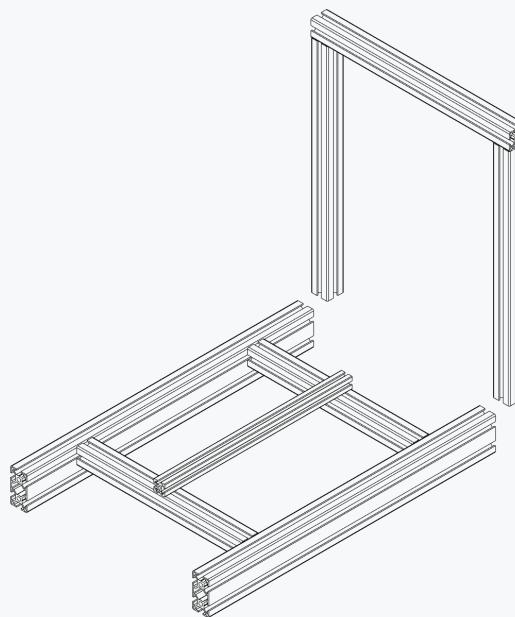
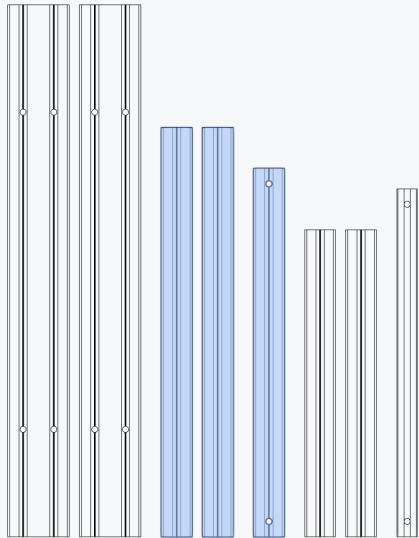
Make sure the frame is square and that all positions are set correctly before moving on. Check the 90° angles with a machinist square.

MIND ACCESS HOLE POSITION

We do our best to call out things that may bite you later in the assembly process but may skip things that seem obvious to us. If in doubt please refer to the CAD model, it might save you some considerable time down the road.

**BUILD ON A FLAT SURFACE**

Build this section of the frame on a glass or granite surface to ensure you can get it as square as possible.

**TILT FRAME 90°**

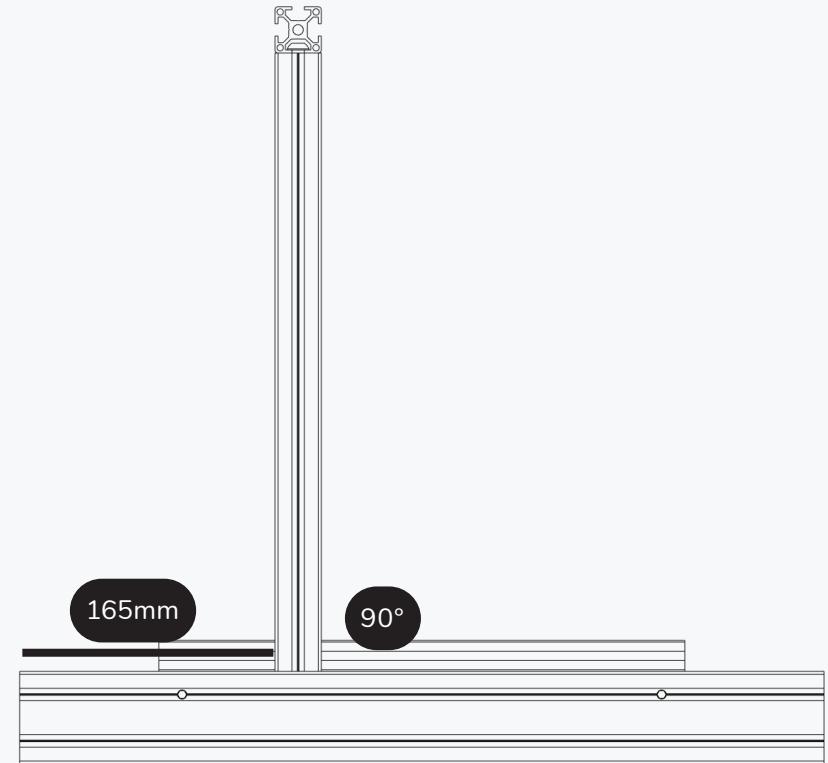
The access holes for the Blind Joints are at the bottom. Lay the frame flat on its side to access them. This also helps in mounting the uprights flush to the base.

VERIFY DIMENSIONS

Check the corners and make sure that they are at 90° angles. Use a small machinist square.

If you have the measuring equipment verify that both uprights are dead on parallel.

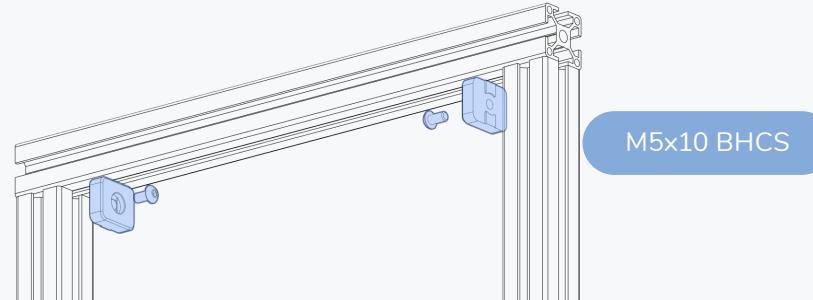
Correct the angle is required. Failure in doing so may result in a sticky Z Axis.



MIND THE CARRIAGE

The carriages are designed to slide along the rail easily.
This unfortunately also includes sliding off the rails.

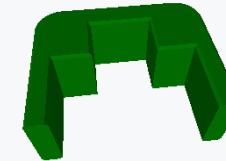
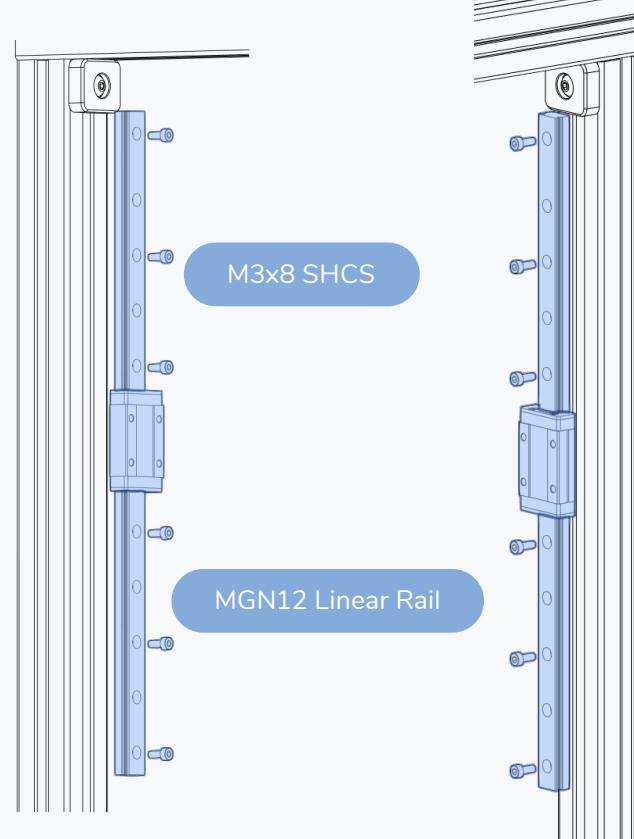
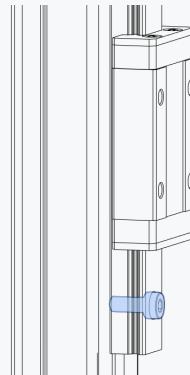
Dropping the carriage likely irreparably damages it.

**NO STOPPER ON LEFT RAIL**

The left rail does not have a stopper in place to prevent the carriage from sliding off the rail.
Some rails come with little plastic stop pins, you can leave the bottom one in place.

If your rail does not have these stop pins leave the last screw slightly loose to act as a stopper.

Tip: Mark the location with some tape to draw your attention to it later.

**CENTERED RAIL INSTALLATION GUIDE**

Use the guides to position the rail in the center of the extrusion prior to fastening the screws.

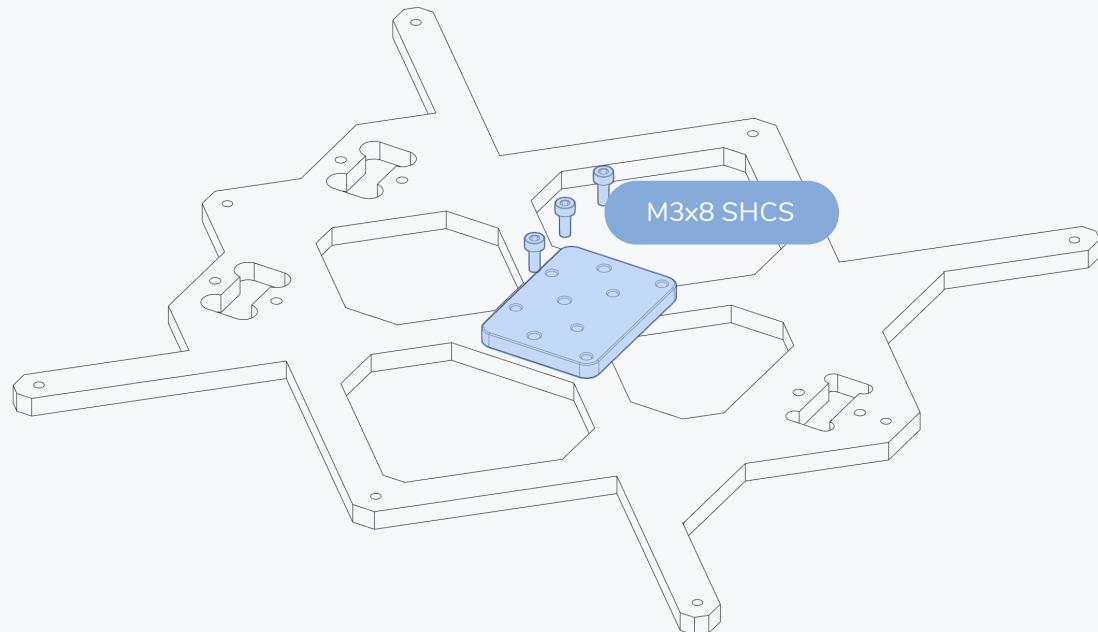


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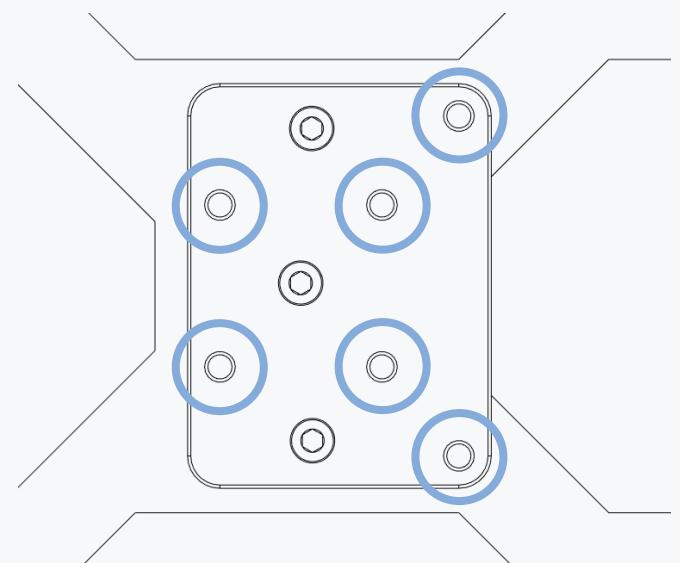
Y AXIS

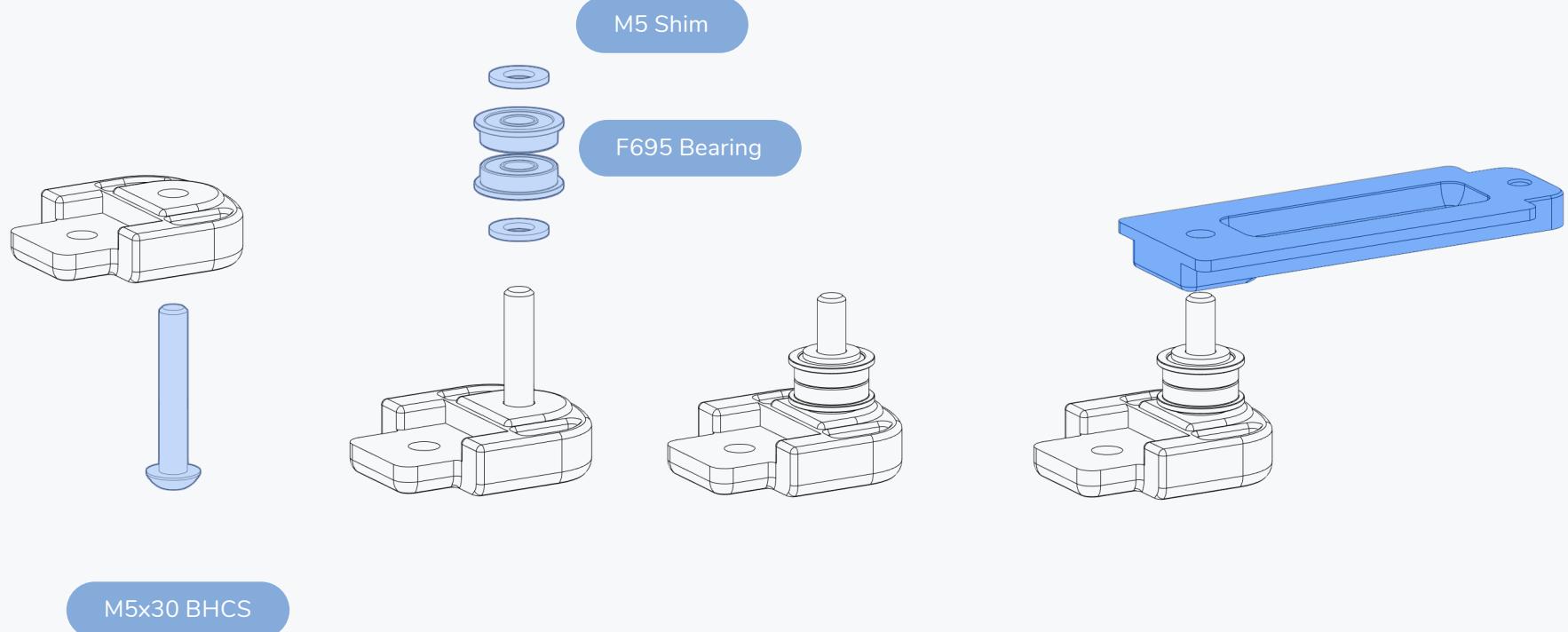
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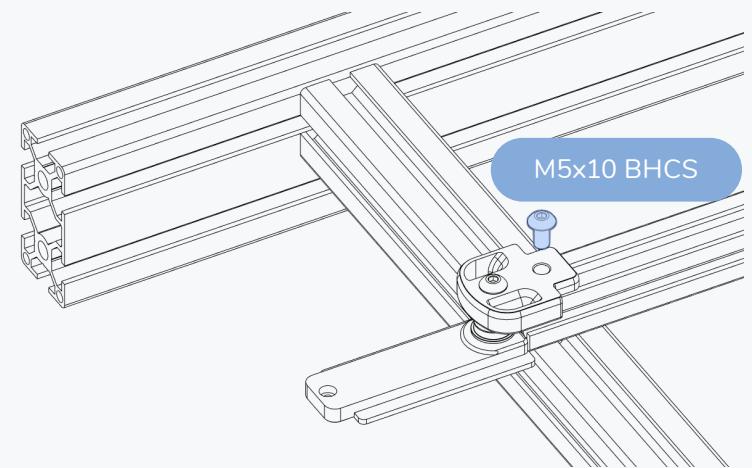
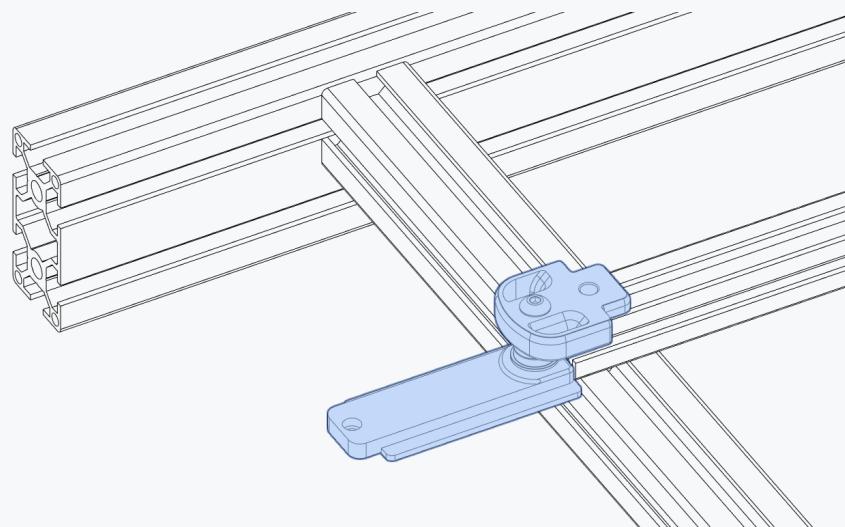
**CARRIAGE MODIFICATION**

Temporarily mount the drill template to the carriage.
Drill the 6 holes marked on the right with a 3mm or 3.2mm
drill bit.
Remove the template after you drilled the holes.

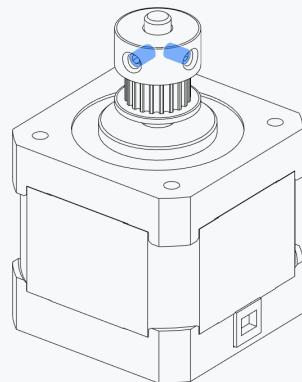
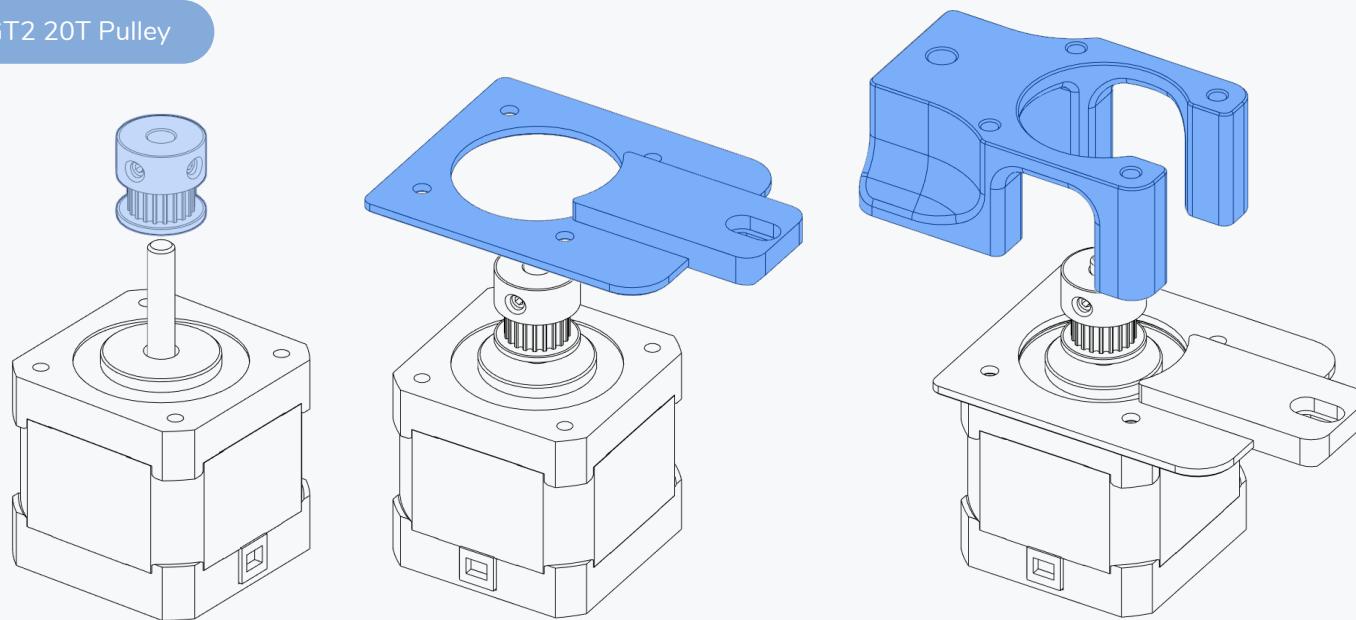


**UPSIDE DOWN ASSEMBLY**

Why fight gravity if it can work for us.



GT2 20T Pulley



GRUB SCREWS

AKA THE ROOT OF ALL ISSUES

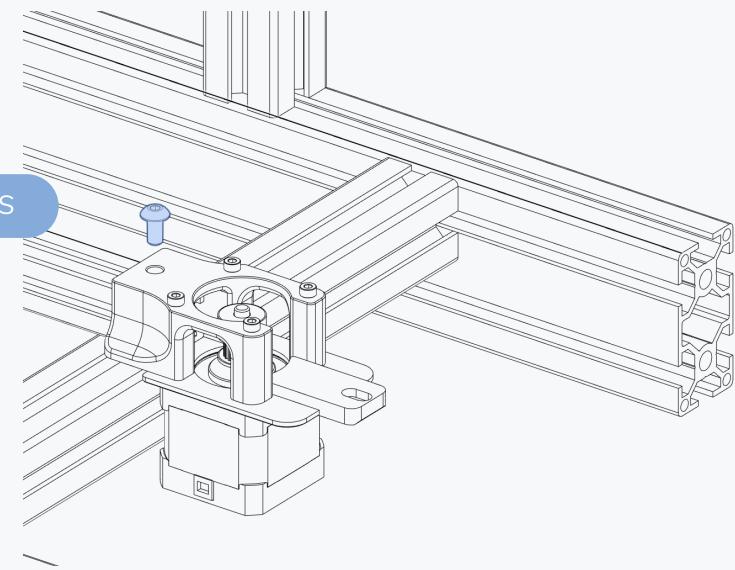
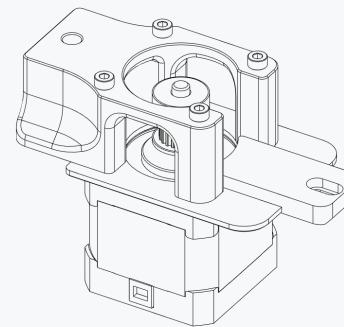
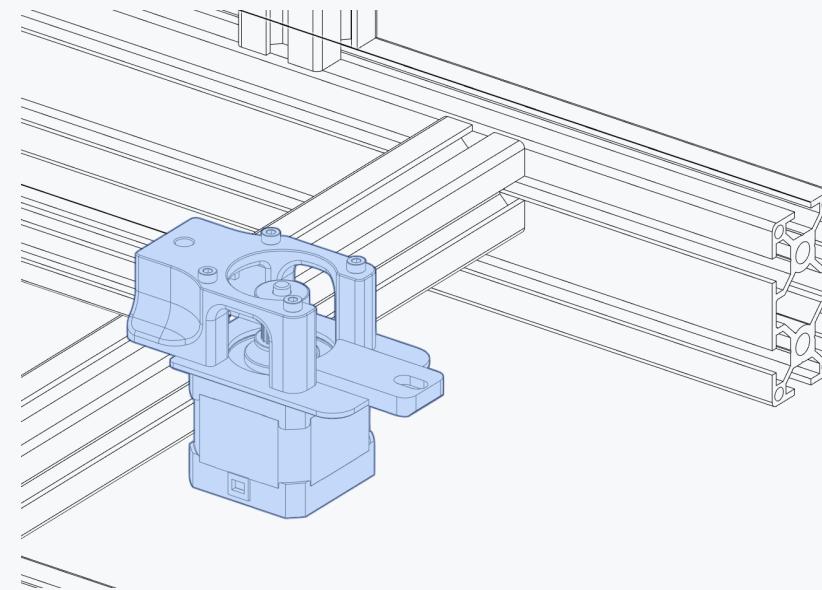
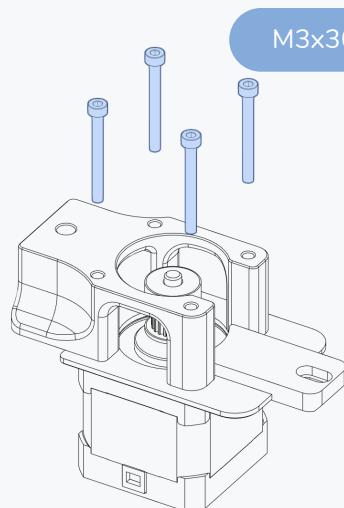
Use thread locker on all grub screws after you set their position.

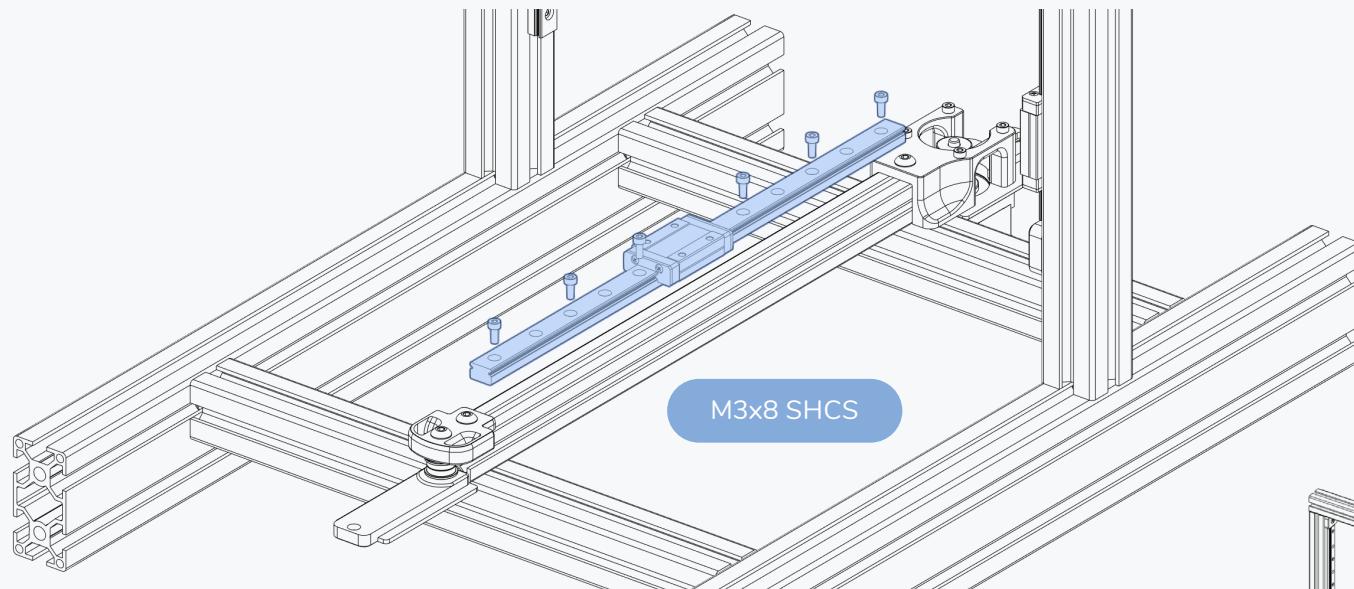
Loose grub screws account for the majority of issues that our users report. Save yourself hours of troubleshooting and apply thread locker to all grub screws during the build.

See the products application notes for instructions.

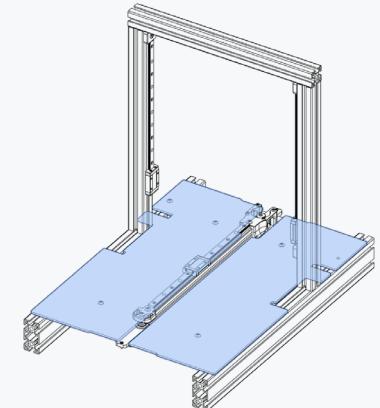
Y MOTOR

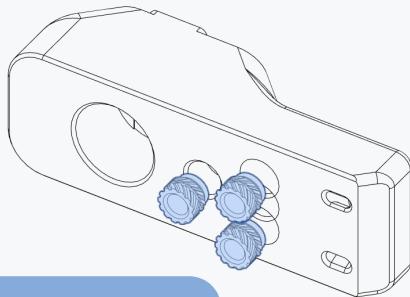
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**DECK PANELS?!**

You can install the deck panels at this point if you like.
We didn't show them to make some captures easier.



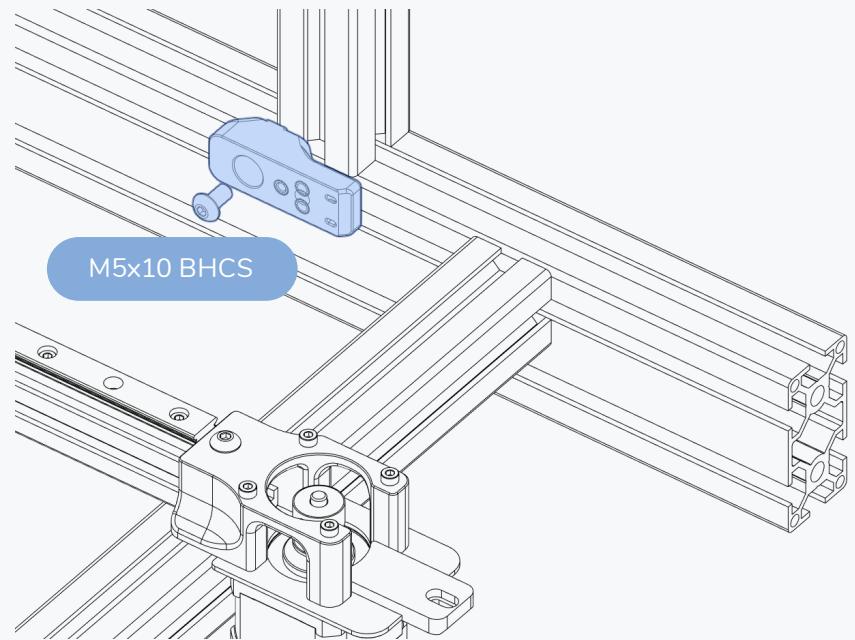
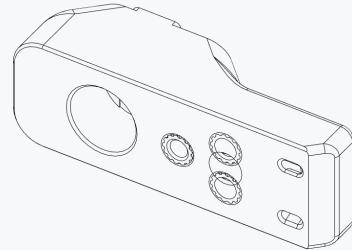


Heat Set Insert

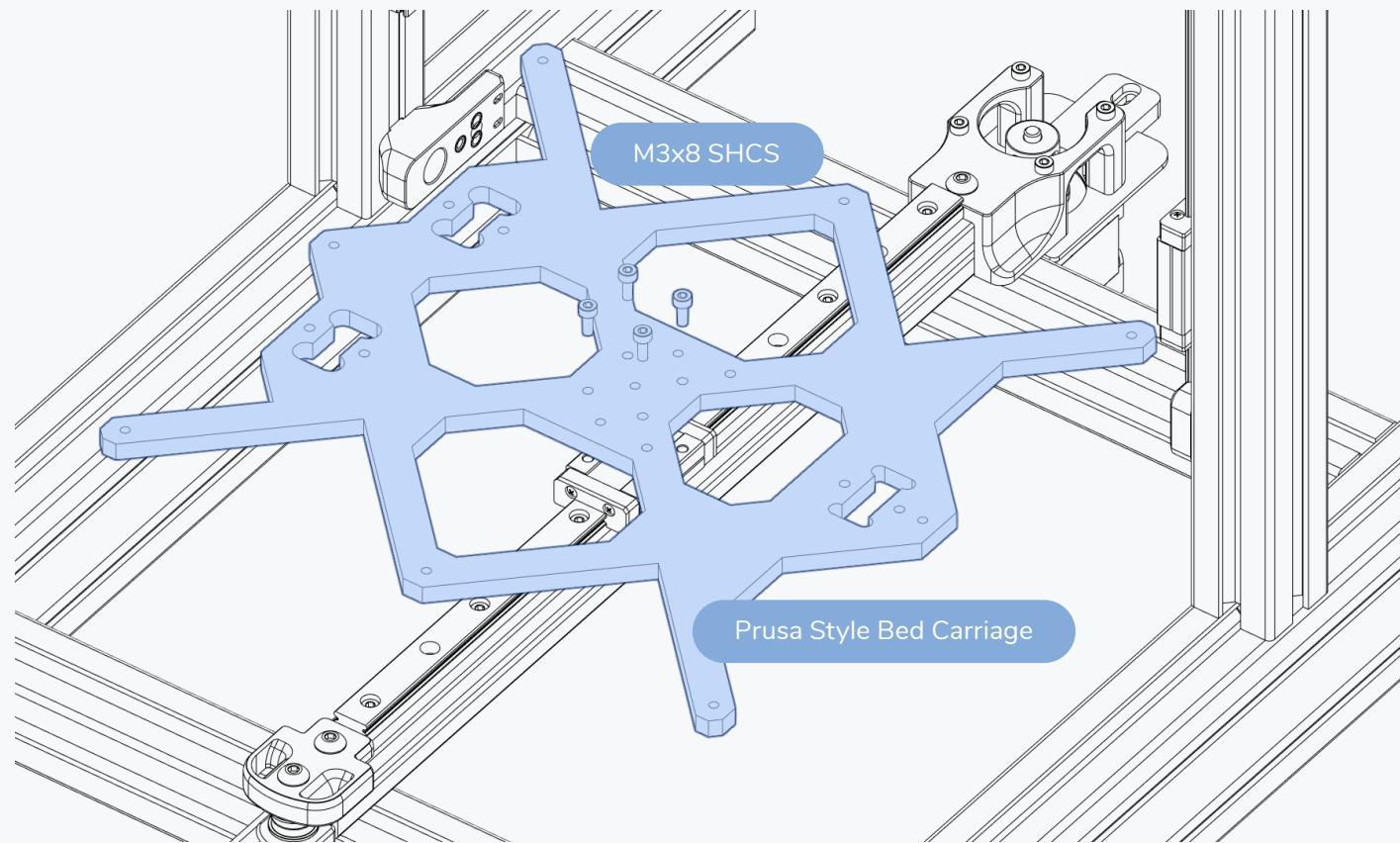
HEAT SET INSERTS

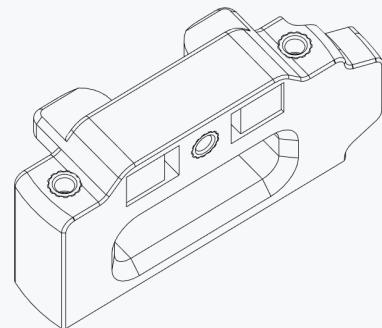
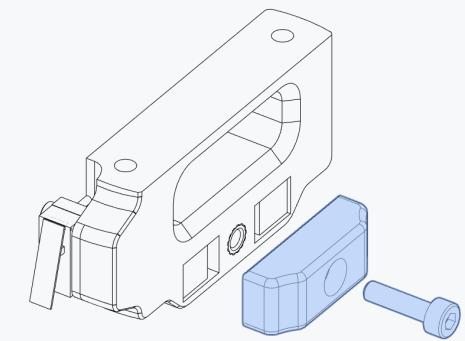
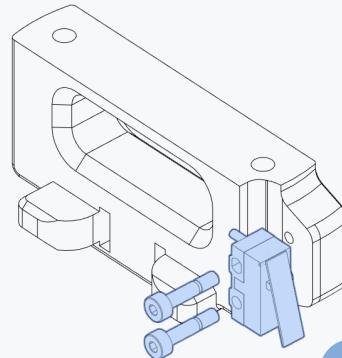
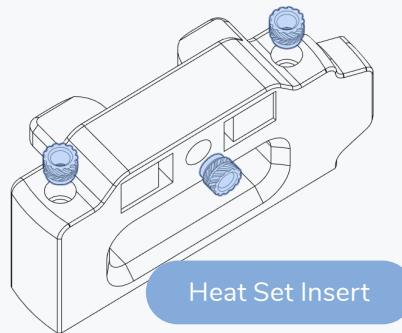
You will need to install heat set inserts into the cable chain mount.

If you need help on the correct procedure, ask in Discord.

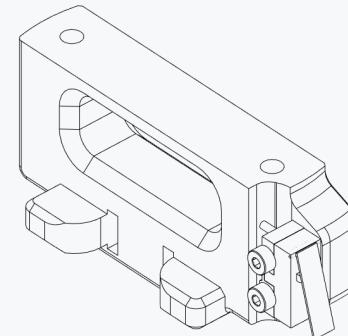


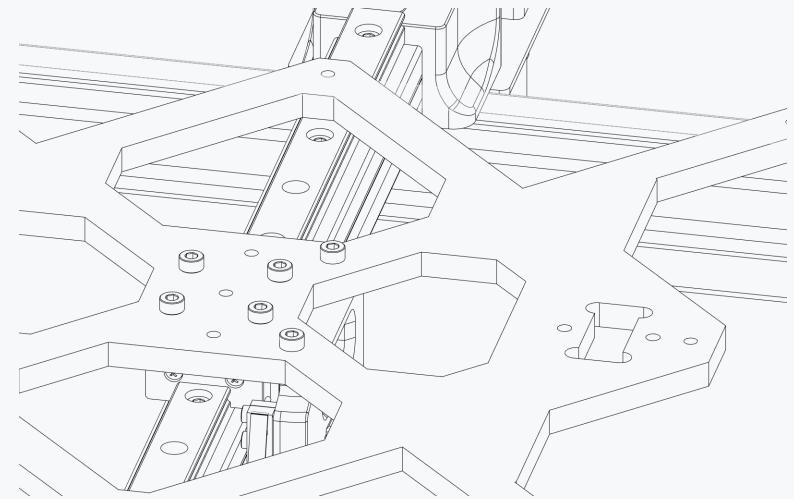
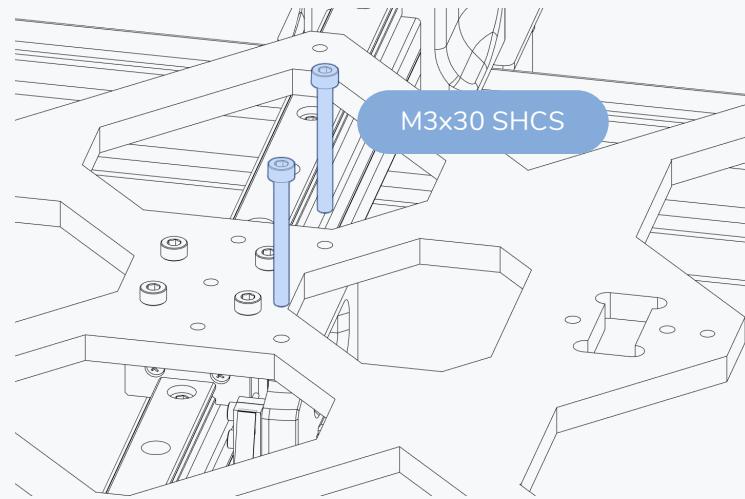
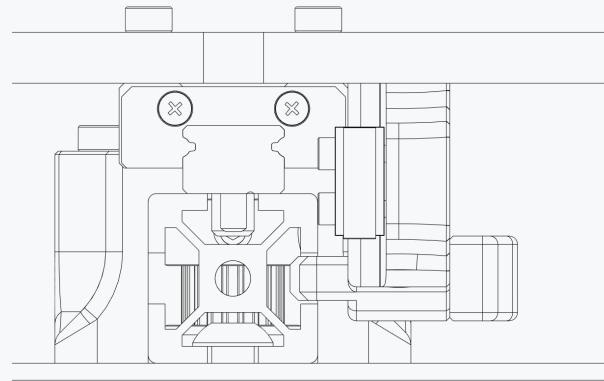
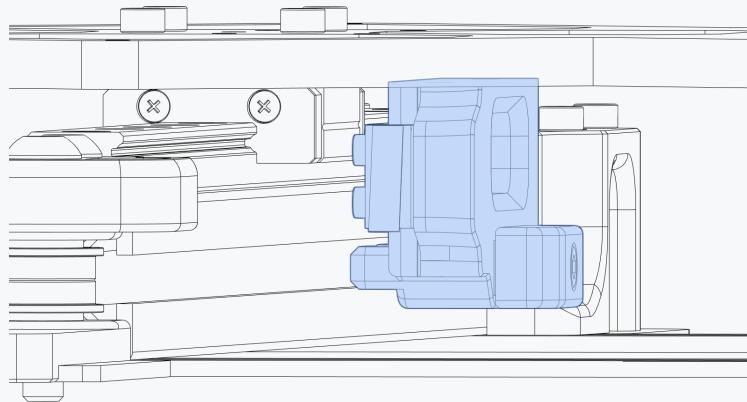
M5x10 BHCS

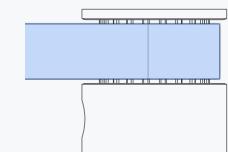
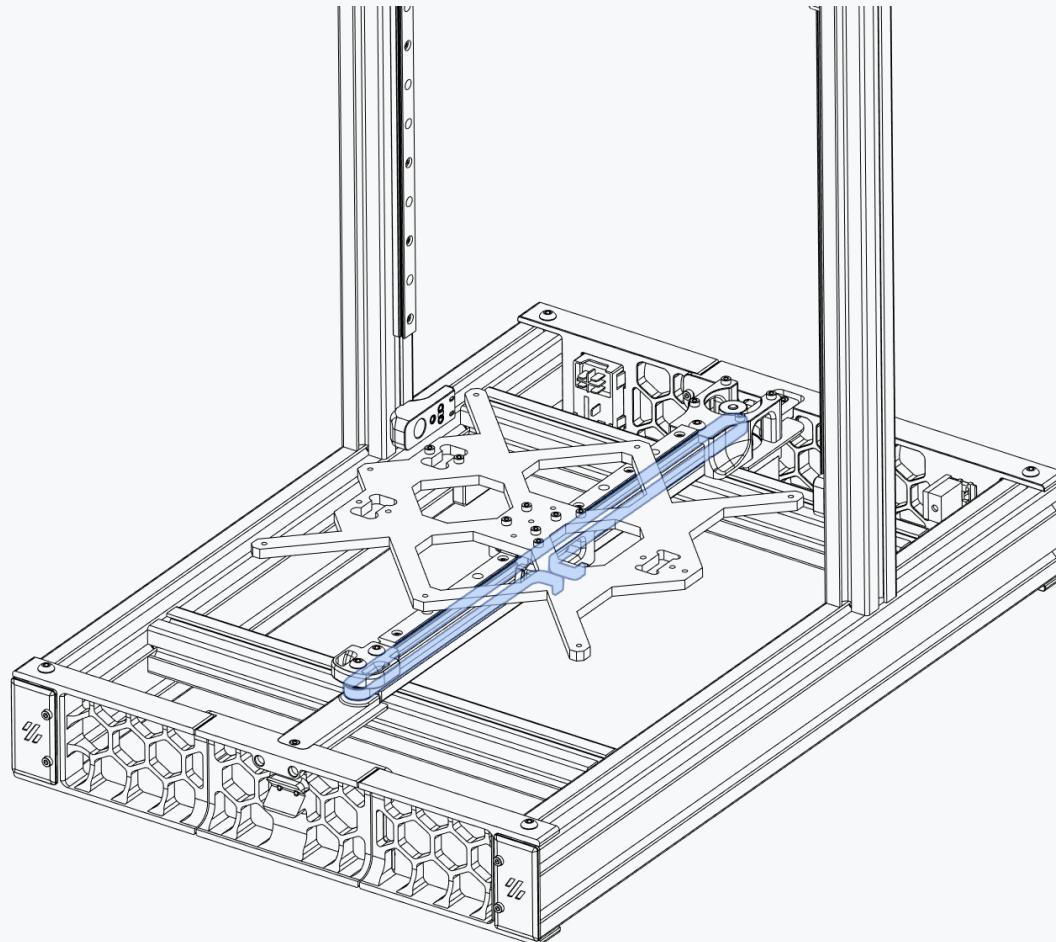


**SOLDER WIRES**

Solder approx. 100mm of wire to the mircoswitch before installing it.
See setup guide for details.





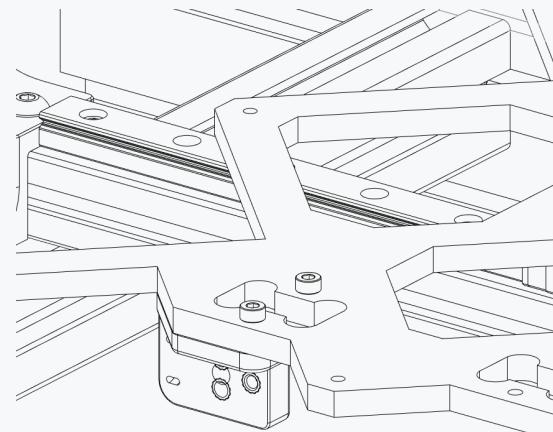
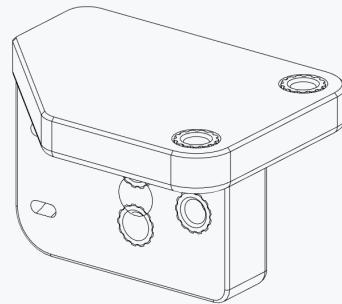
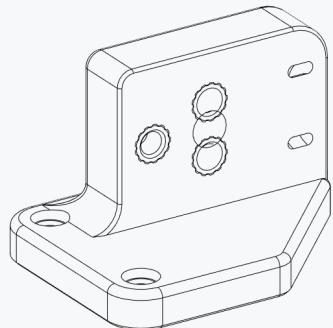
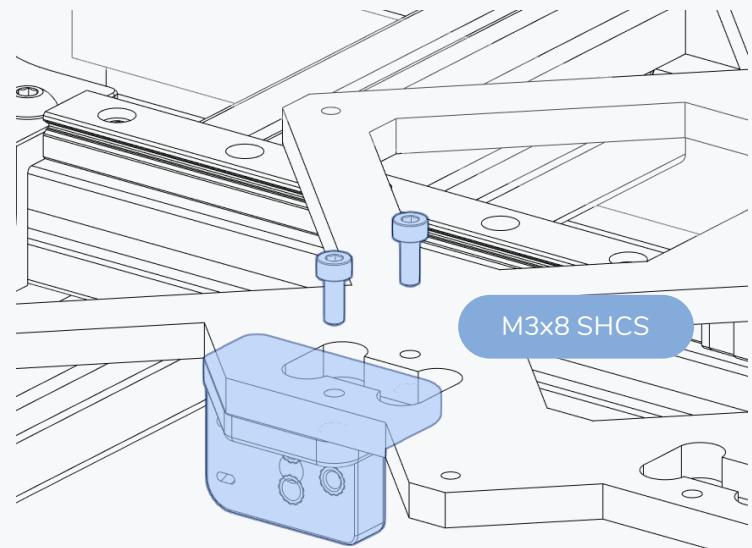
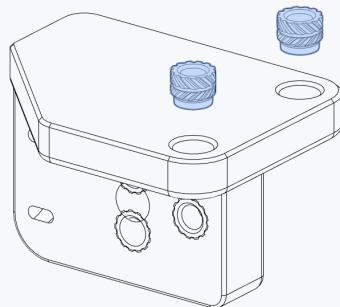
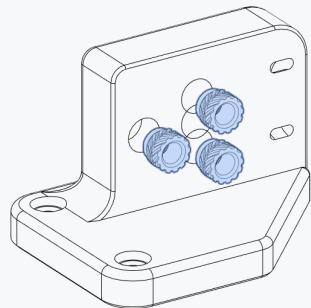
**BELT POSITION**

Adjust the position of the pulley if required. Heavy contact with the flanges will introduce artifacts into your prints.

Y CABLE CHAIN

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Heat Set Insert



HOLE PATTERN

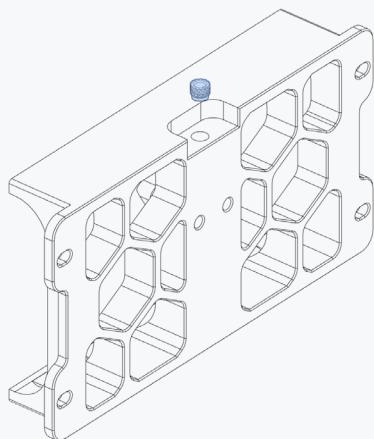
Cable chains with a variety of mounting hole pattern. We offer mounts for both the in line pattern found on IGUS chains and the triangle pattern on budget chains.

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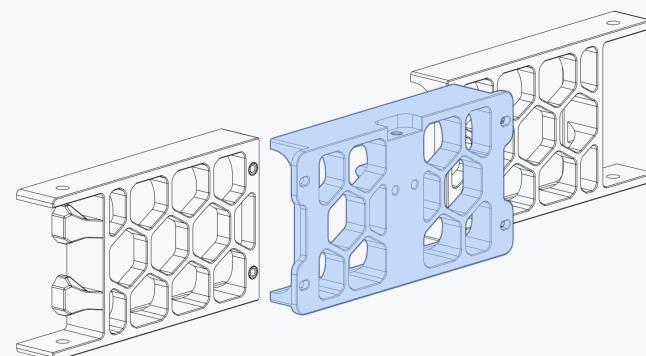
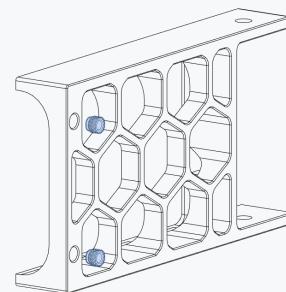
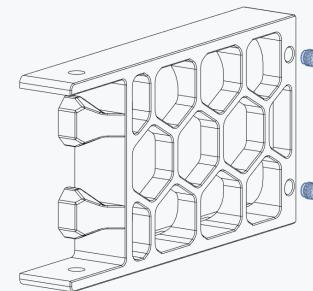
SKIRTS

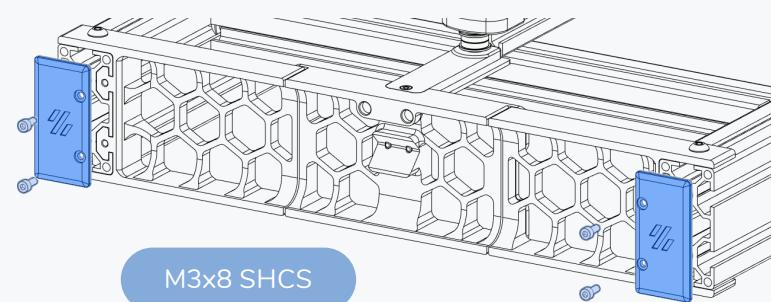
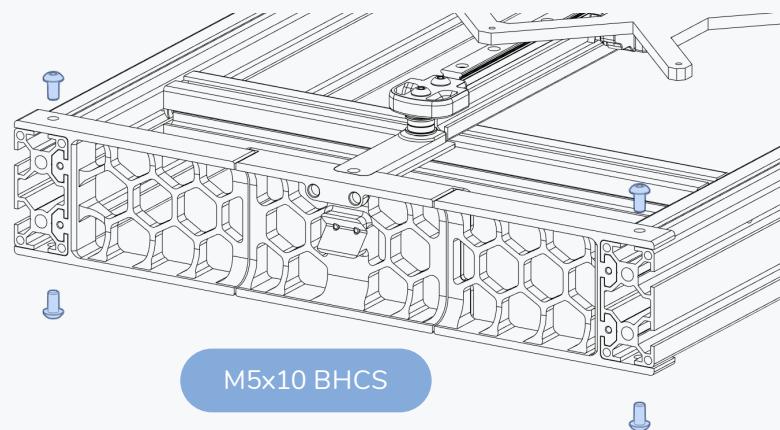
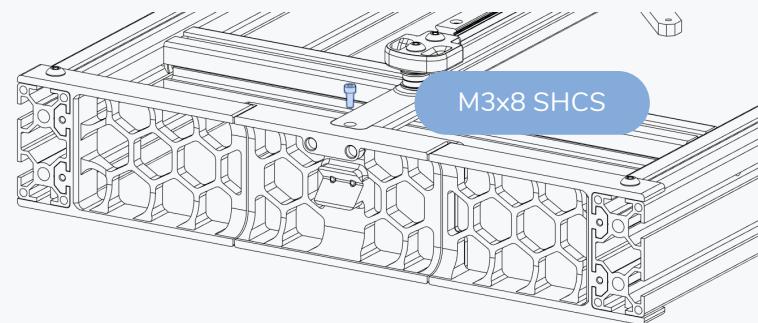
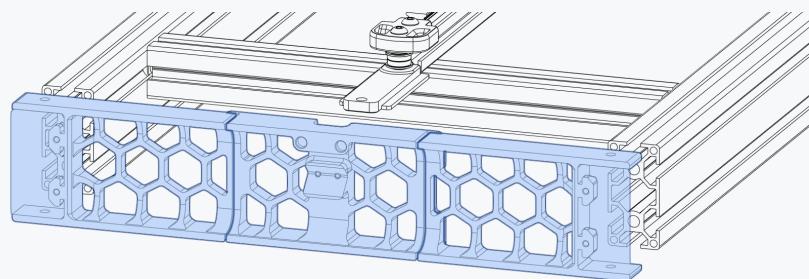
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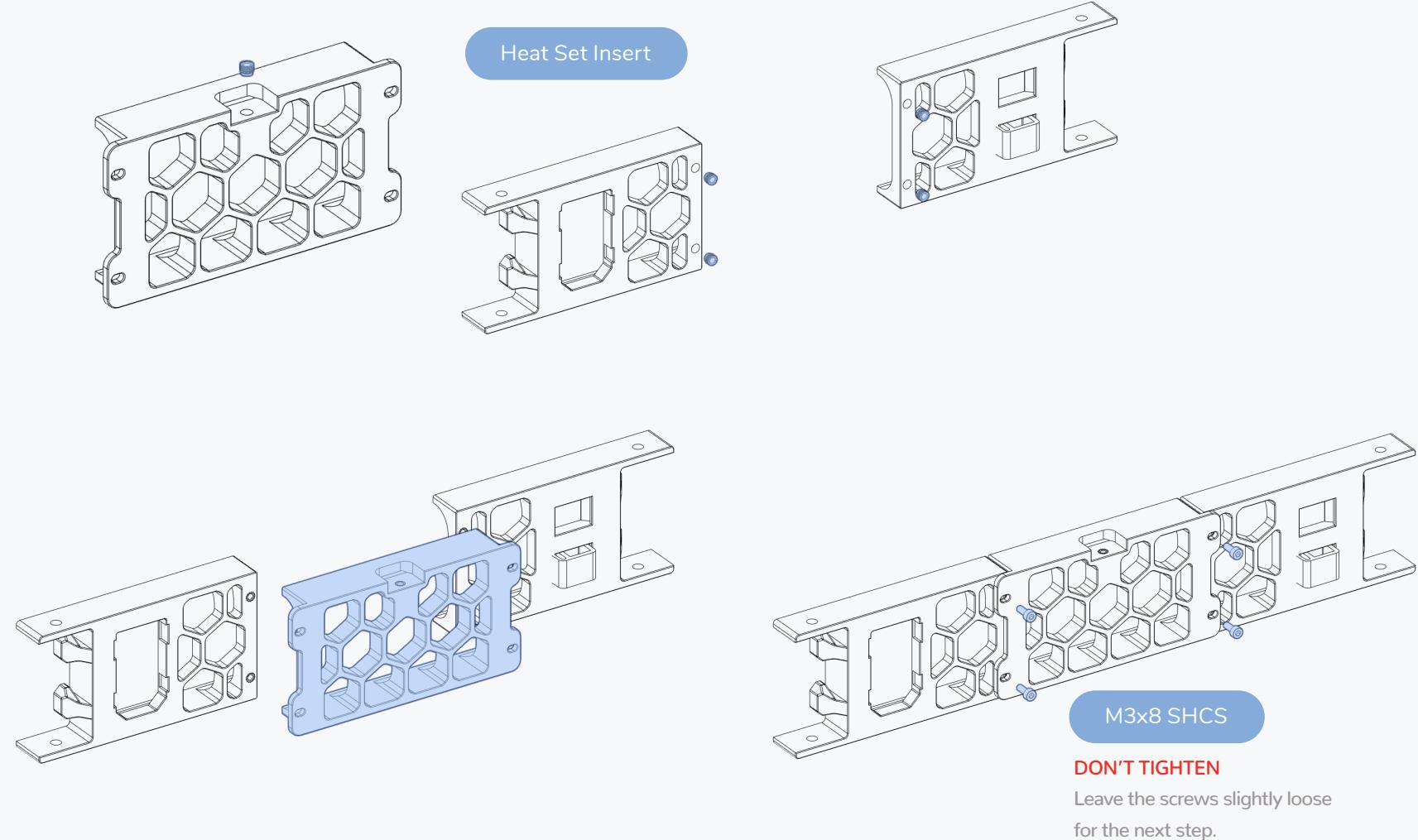


Heat Set Insert



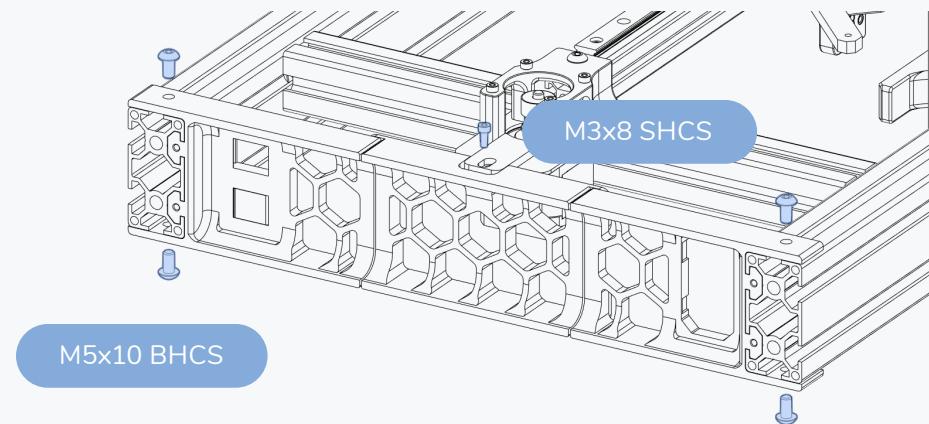
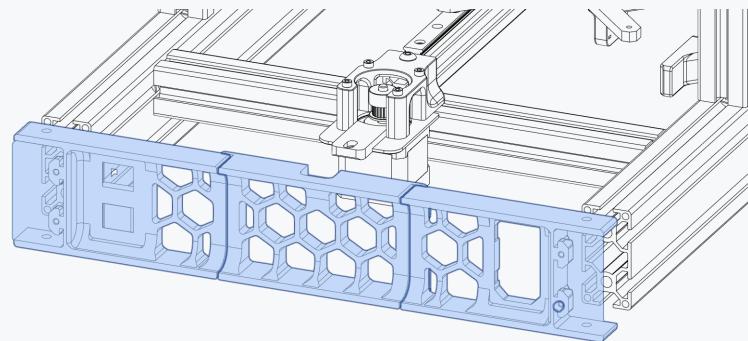
**TIGHTEN SCREWS**

Tighten the screws that connect the centre piece once installed on the frame.



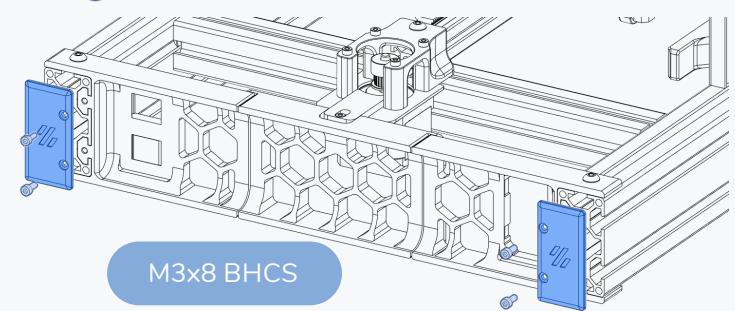
BACK SKIRT

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TIGHTEN SCREWS

Tighten the screws that connect the centre piece once installed on the frame.



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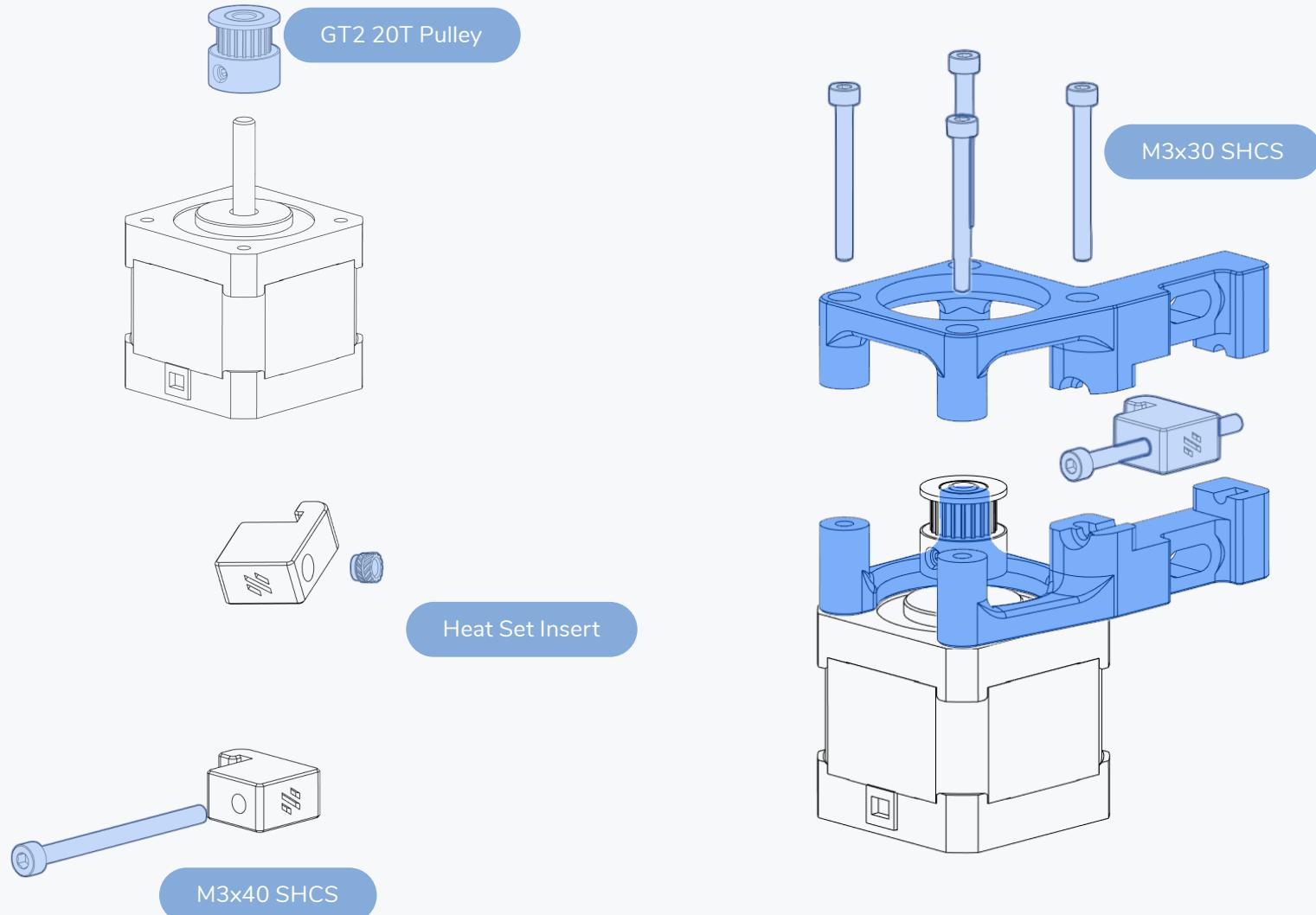
X&Z AXIS

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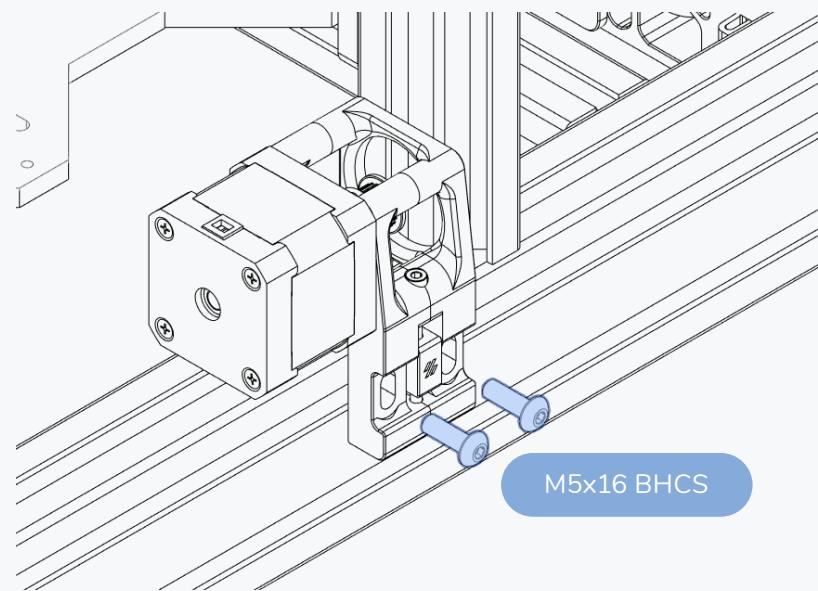
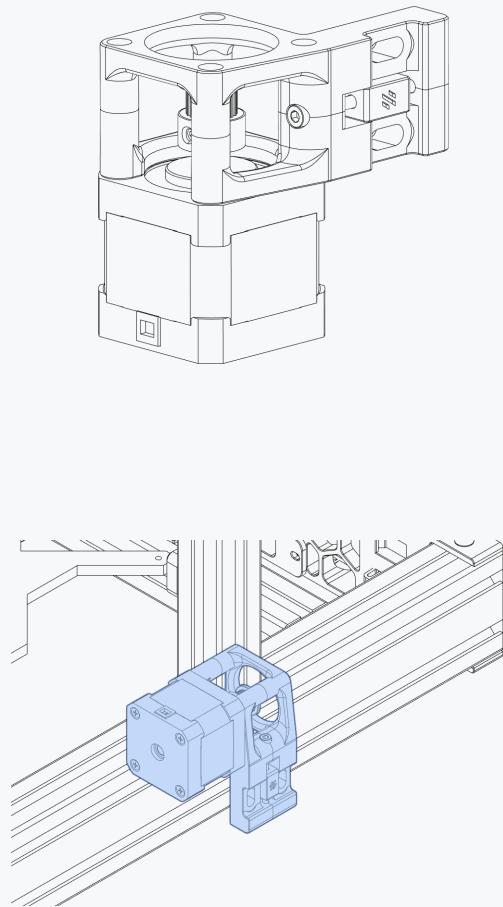
“Z” MOTOR MOUNT

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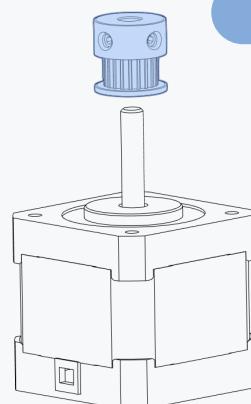
“Z” MOTOR MOUNT

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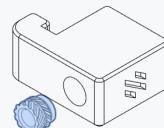


“X” MOTOR MOUNT

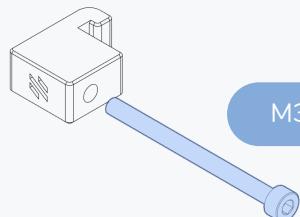
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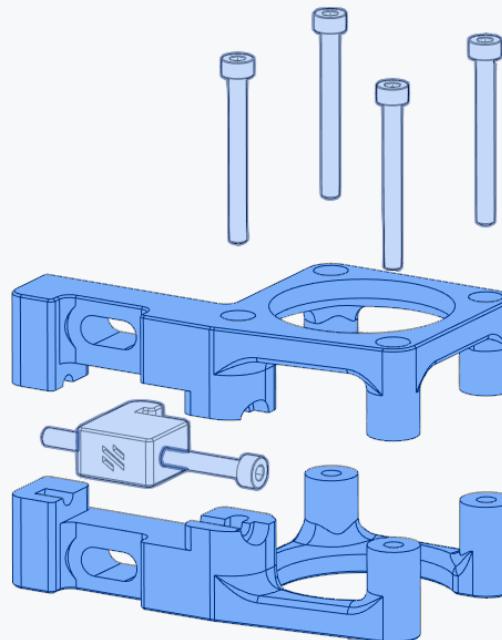
GT2 20T Pulley



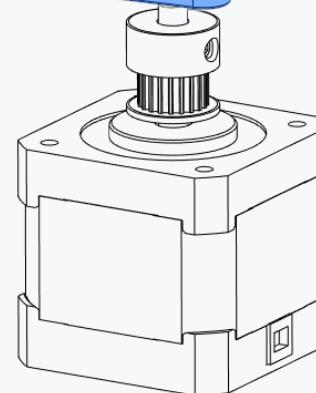
Heat Set Insert



M3x40 SHCS

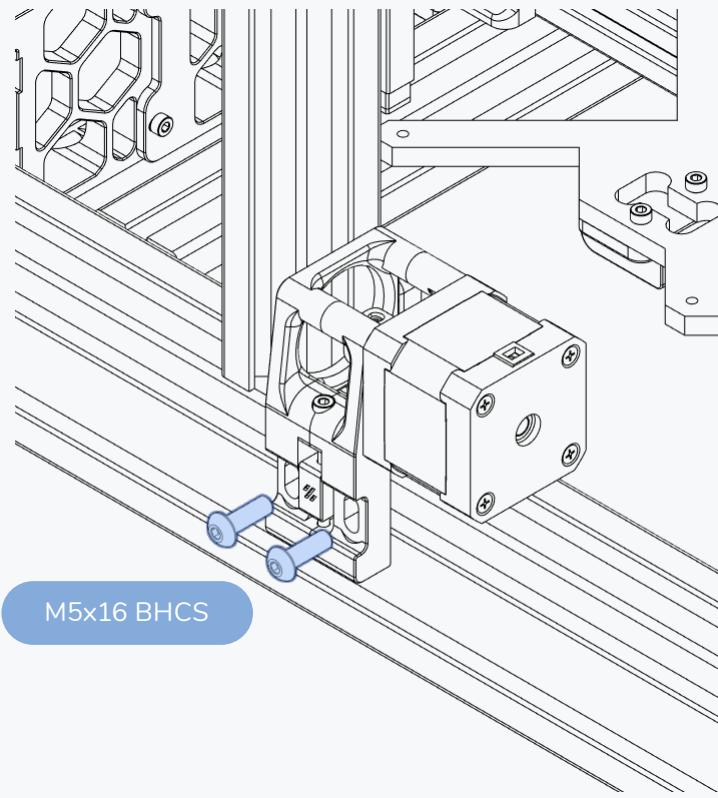
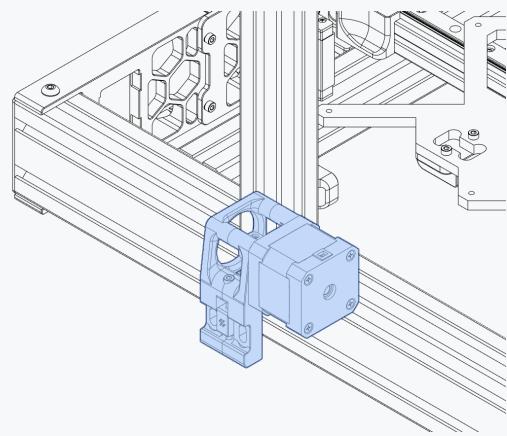


M3x30 SHCS



“X” MOTOR MOUNT

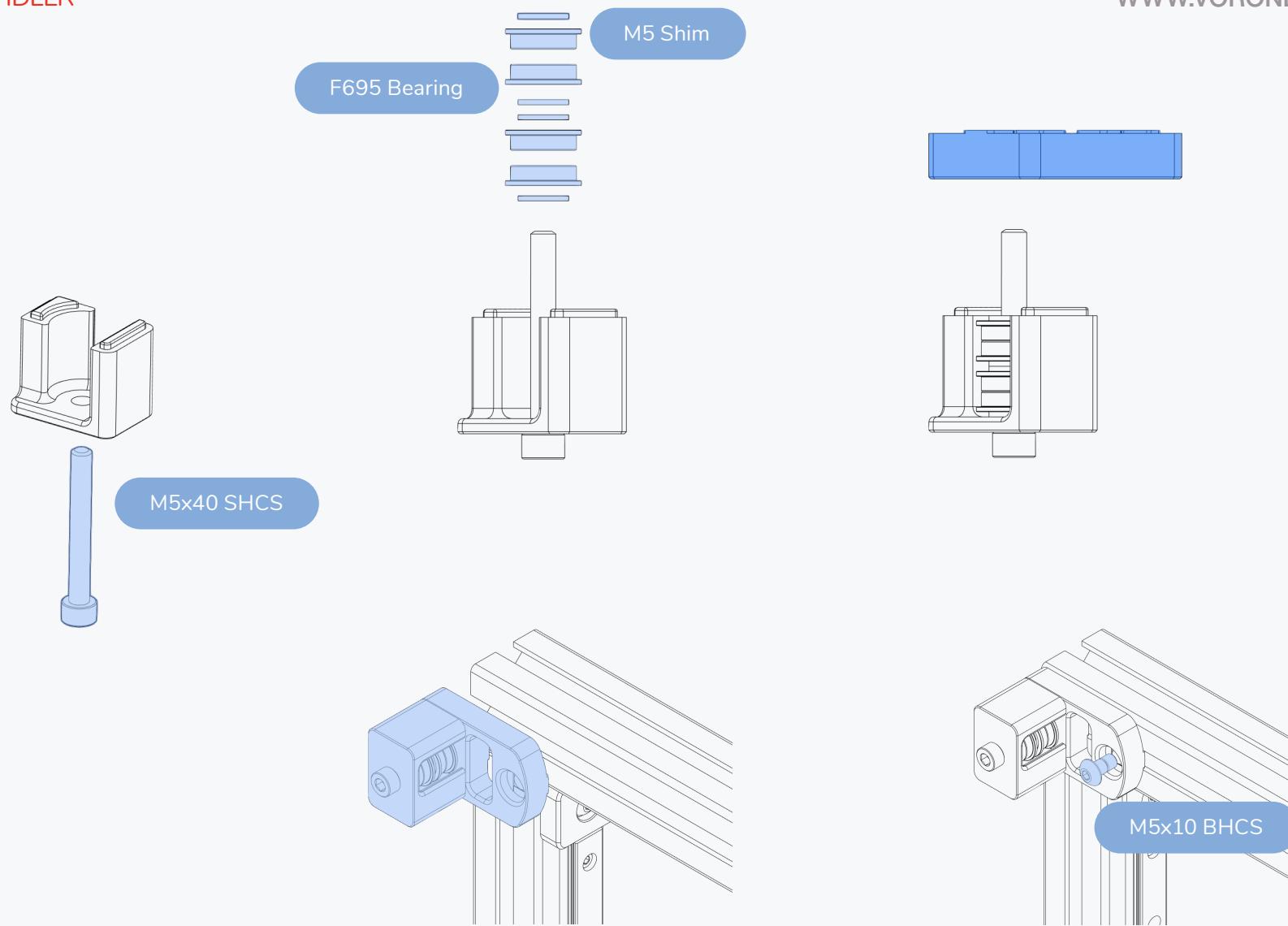
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M5x16 BHCS

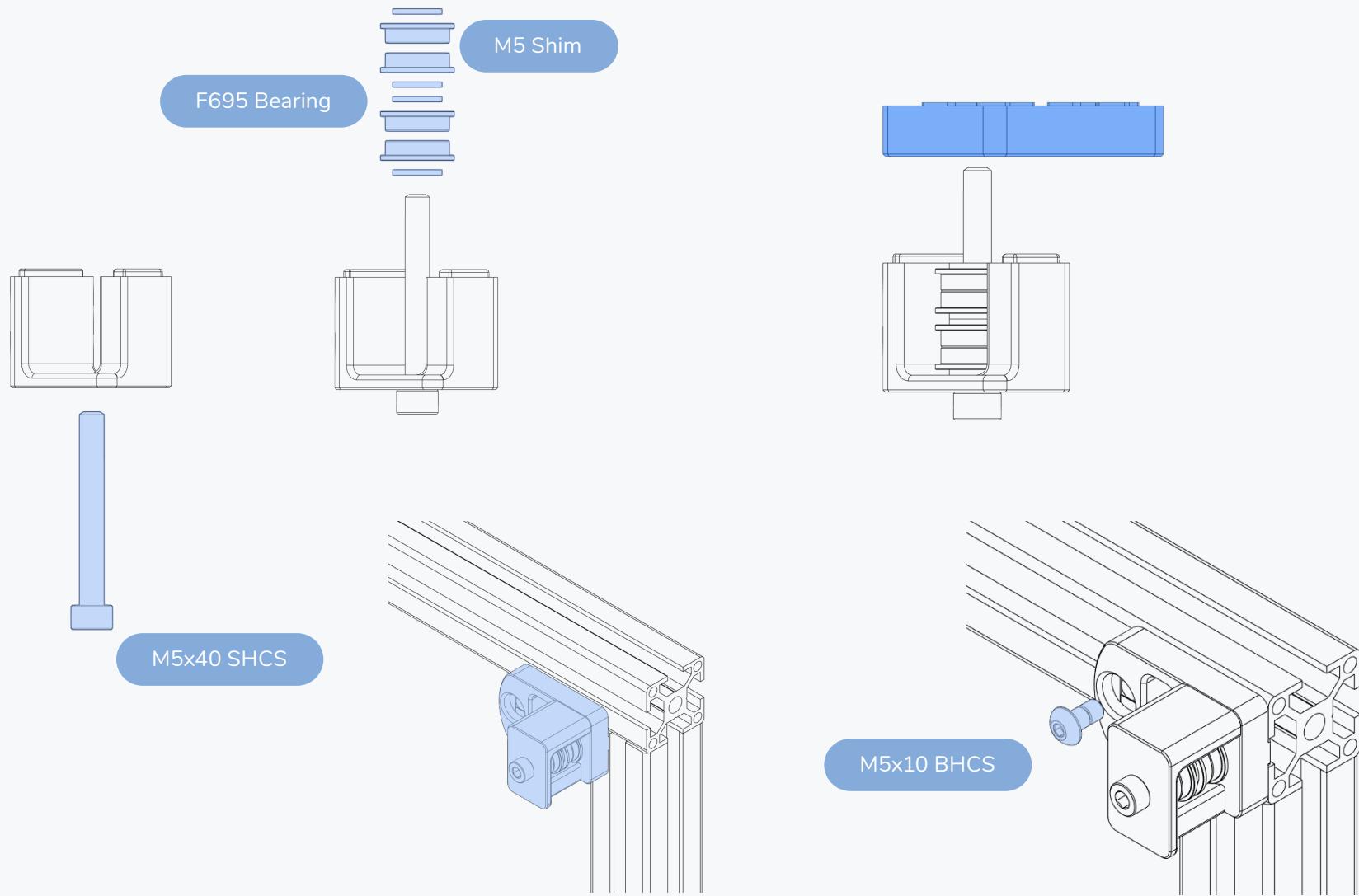
LEFT IDLER

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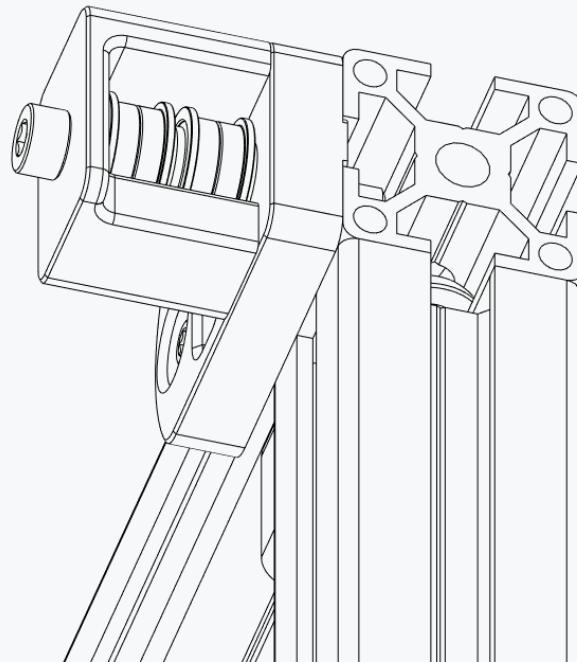
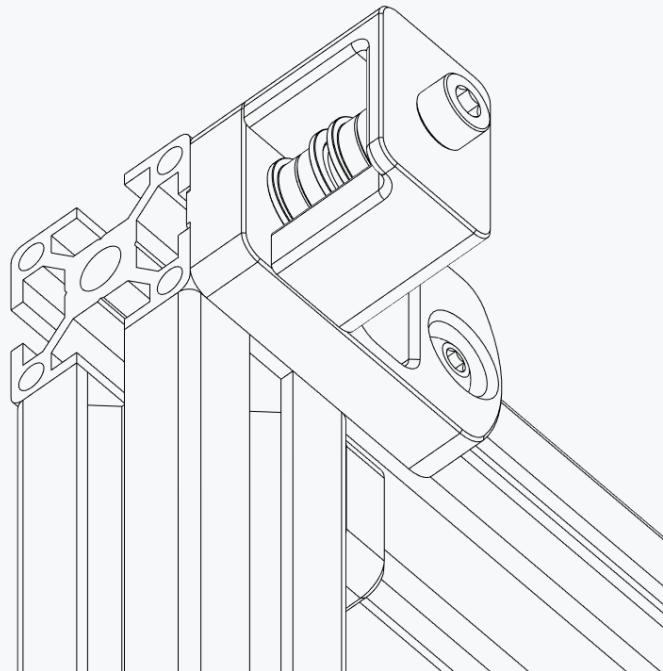
RIGHT IDLER

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CHECK ORIENTATION

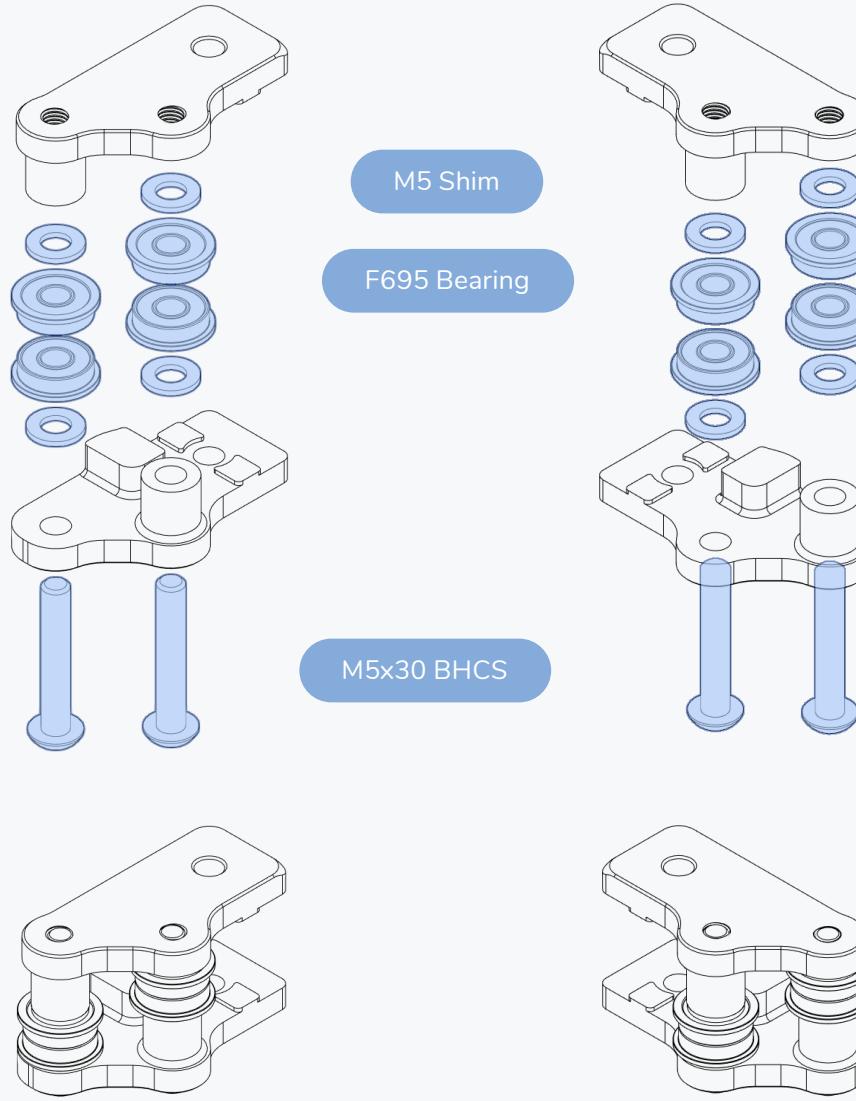
Make sure the cut-out is facing down.



UPSIDE DOWN ASSEMBLY

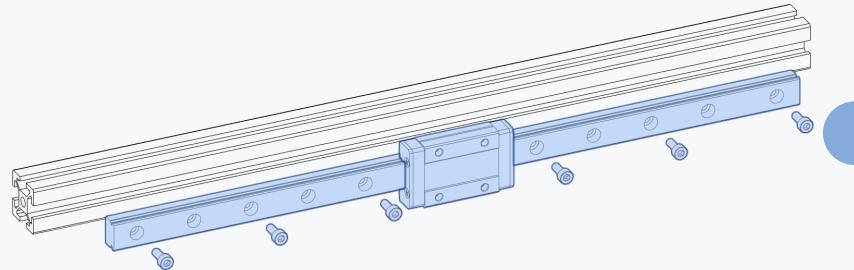
We'll flip these components a few times.

Pay attention to their final orientation



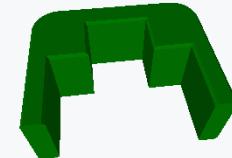
X AXIS

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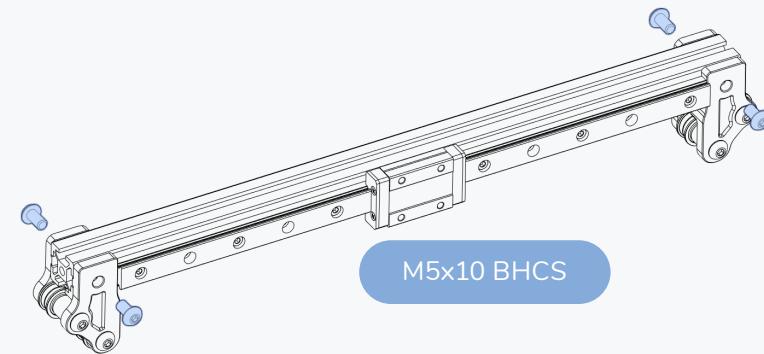
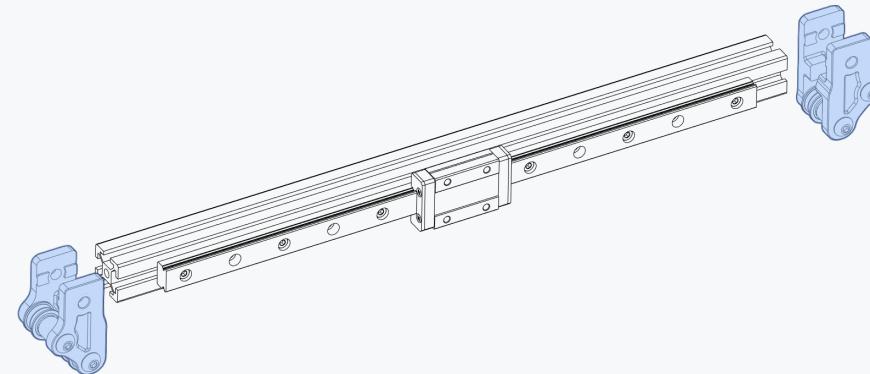
MGN12 Linear Rail

M3x8 SHCS

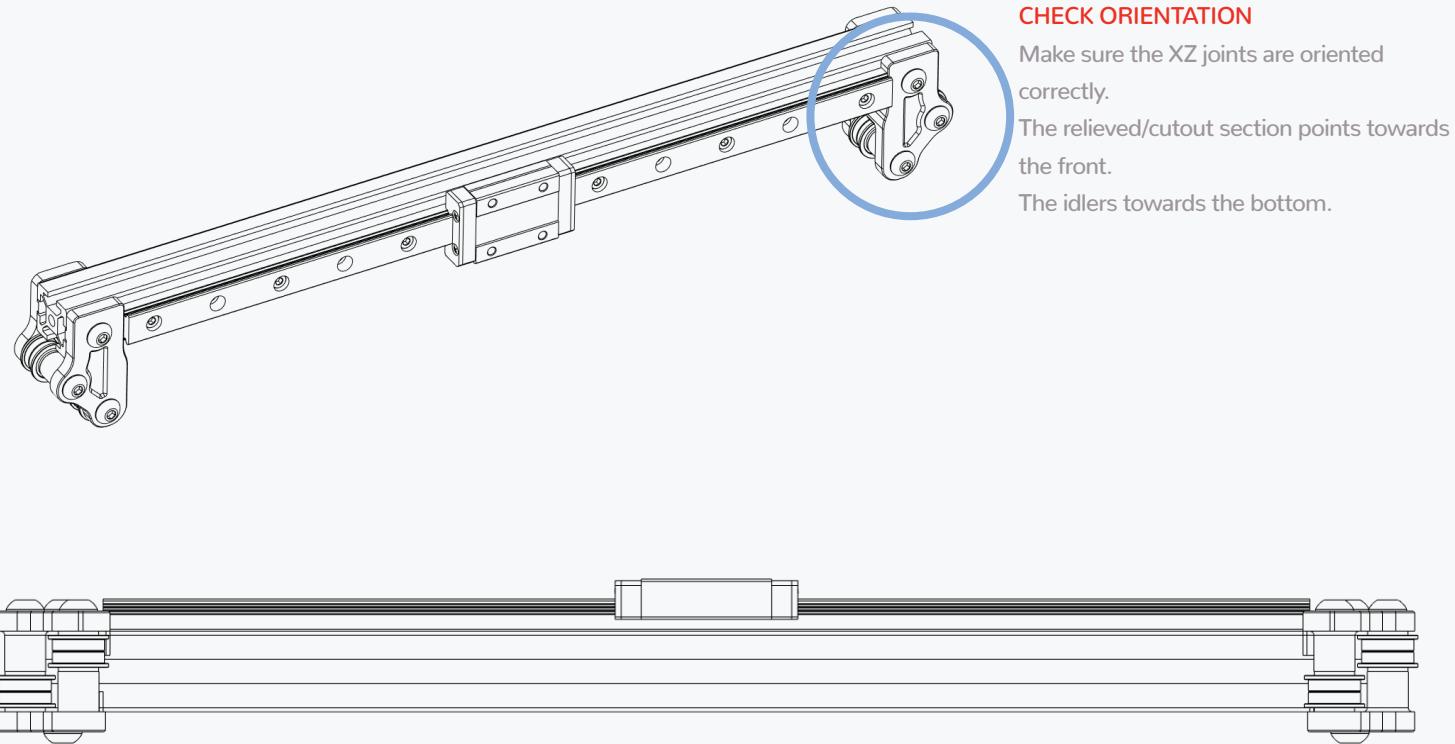


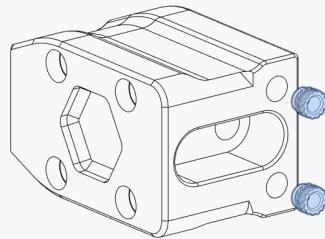
CENTERED RAIL INSTALLATION GUIDE

Use the guides to position the rail in the center of the extrusion prior to fastening the screws.

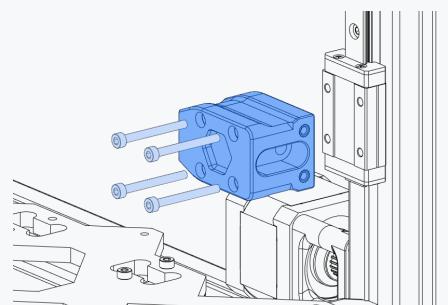
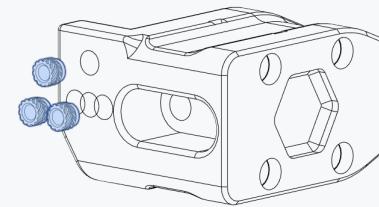


M5x10 BHCS

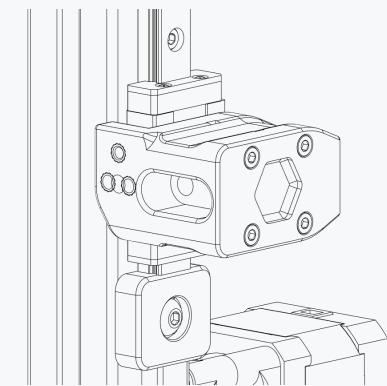
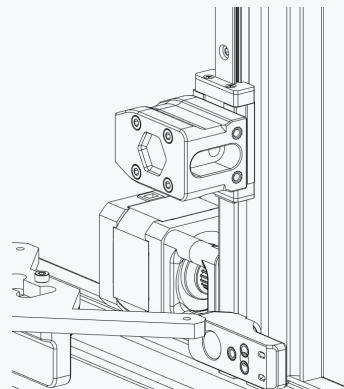
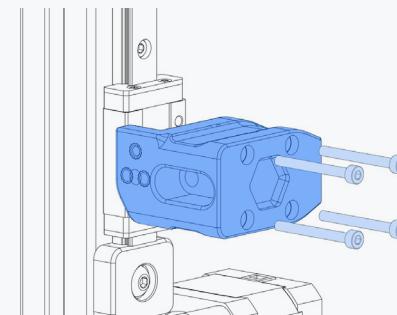


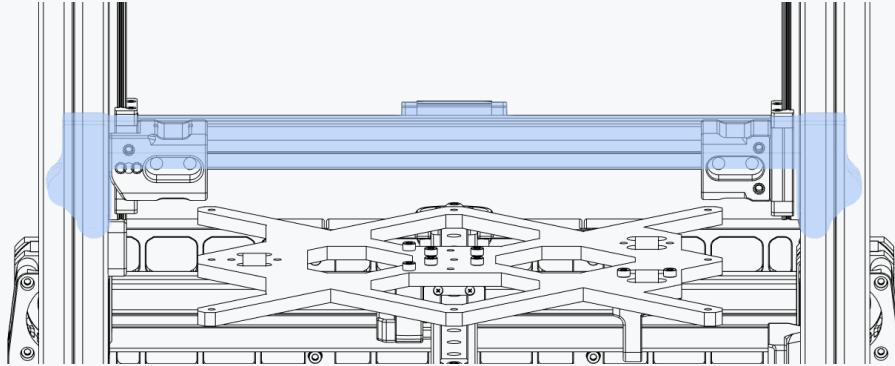


Heat Set Insert



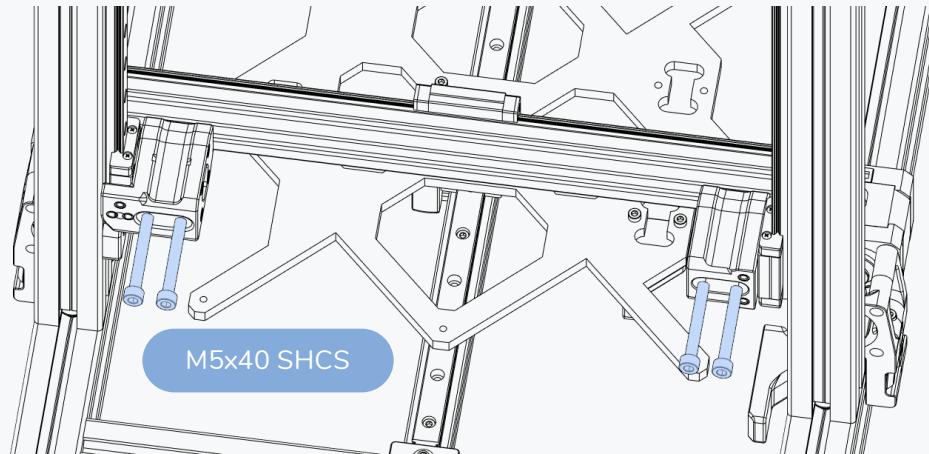
M3x30 SHCS



**X AXIS INSTALLATION**

Lightly tighten the M5x40 screws and align the X axis horizontally by moving it all the way to the top. Hold the X axis against the stoppers and fully tighten the screws.

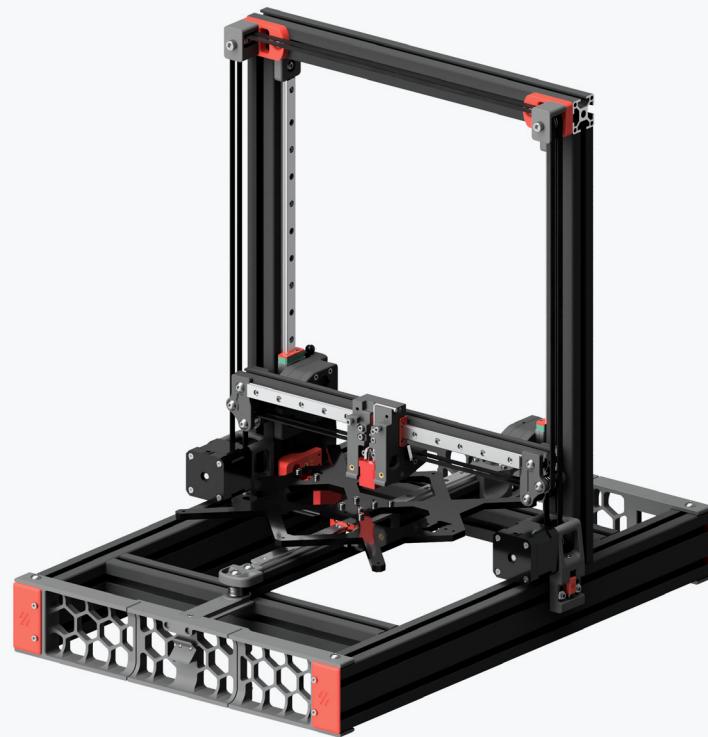
Move the axis up and down and check for binding.



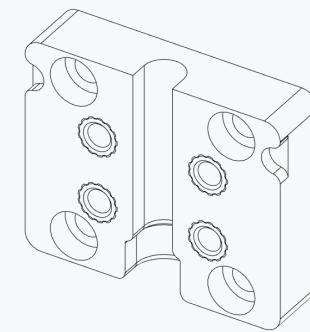
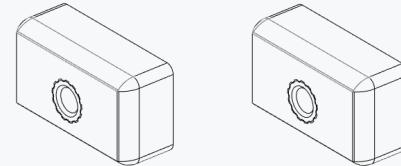
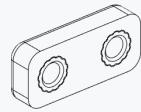
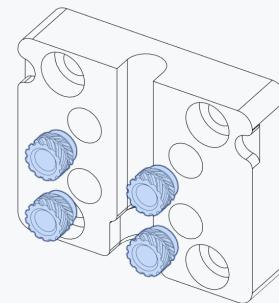
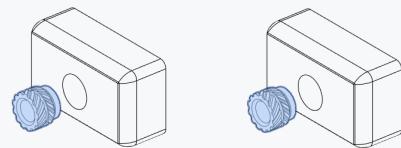
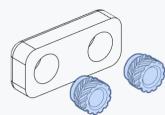
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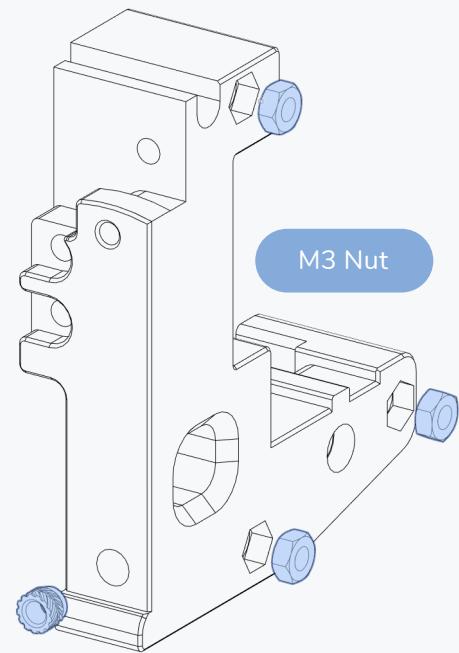
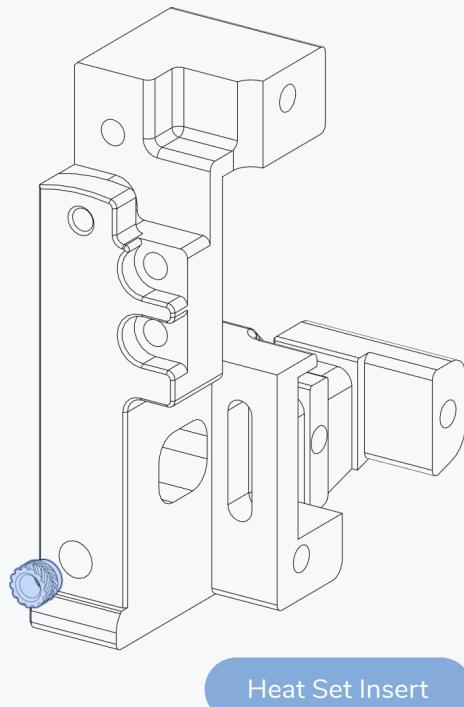
X CARRIAGE

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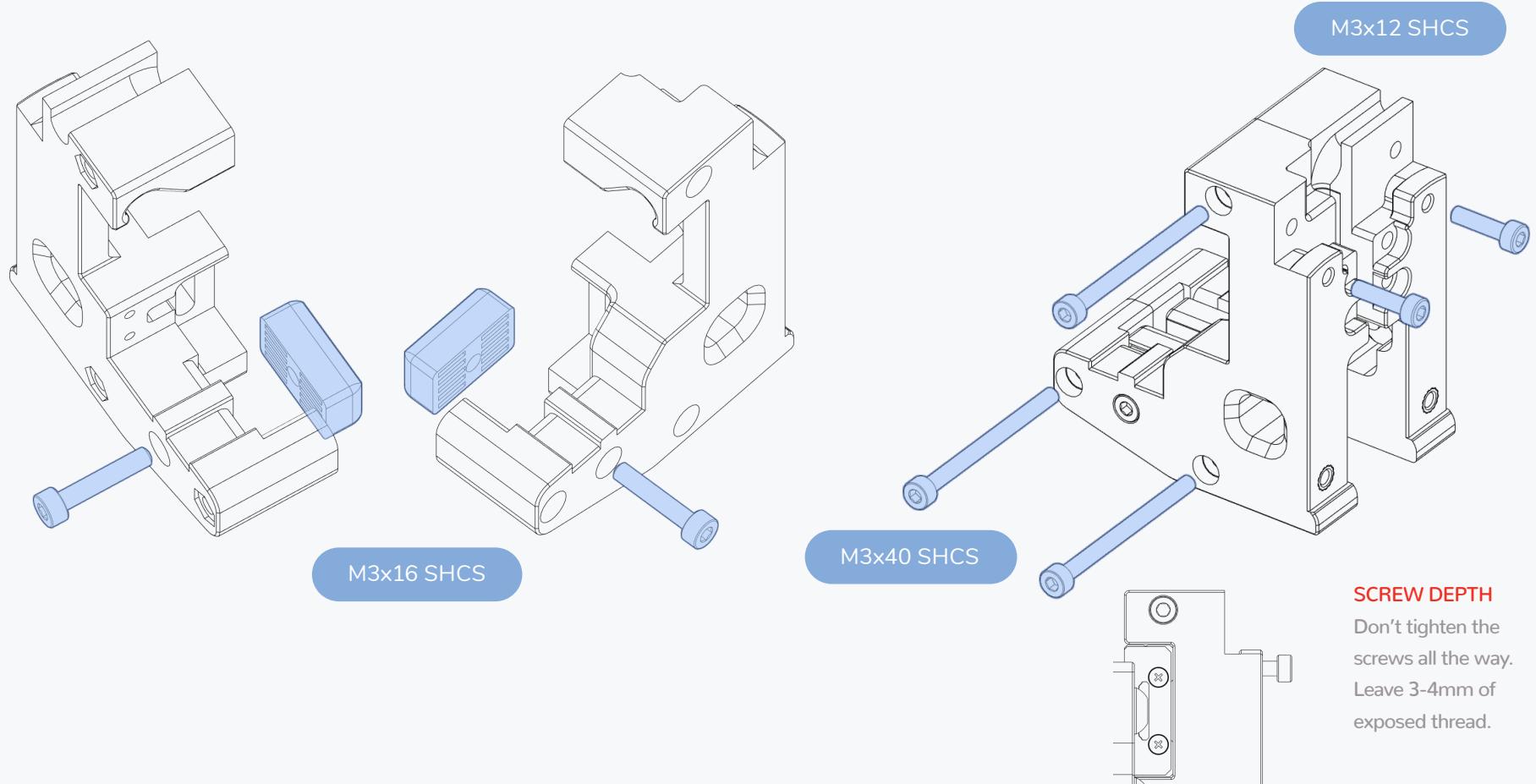
Heat Set Insert

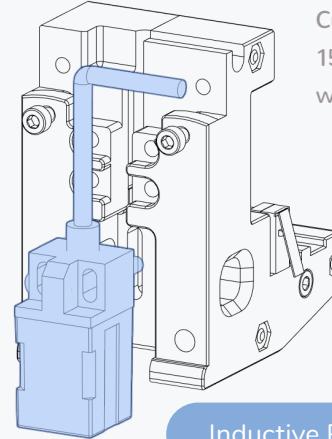
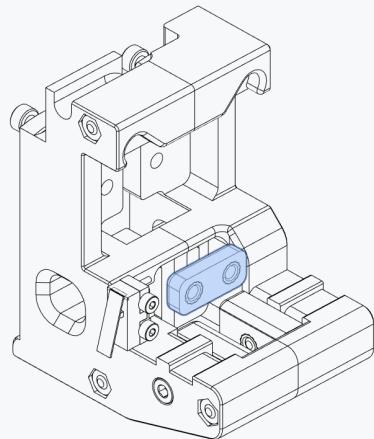


**SOLDER WIRES NOW**

Solder approx. 150mm of wire to the mircoswitch before installing it.

See setup guide for details.





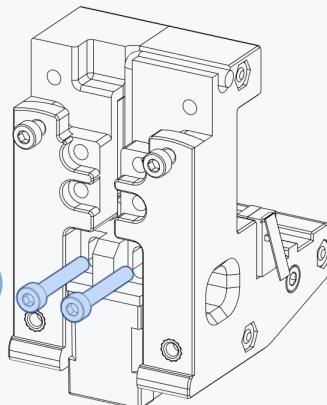
PROBE WIRES

Cut the probes wires to about 15cm. Don't cut them flush with the carriage frame.

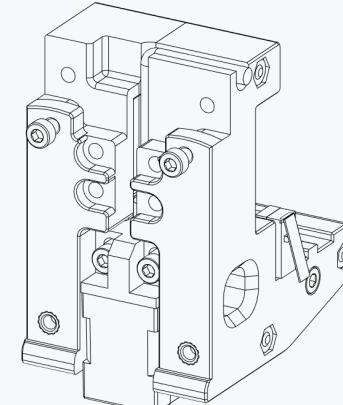
OTHER PROBE TYPES

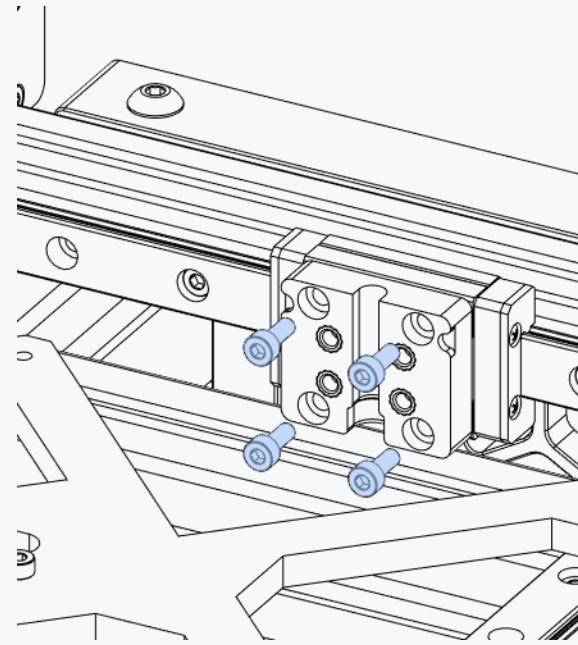
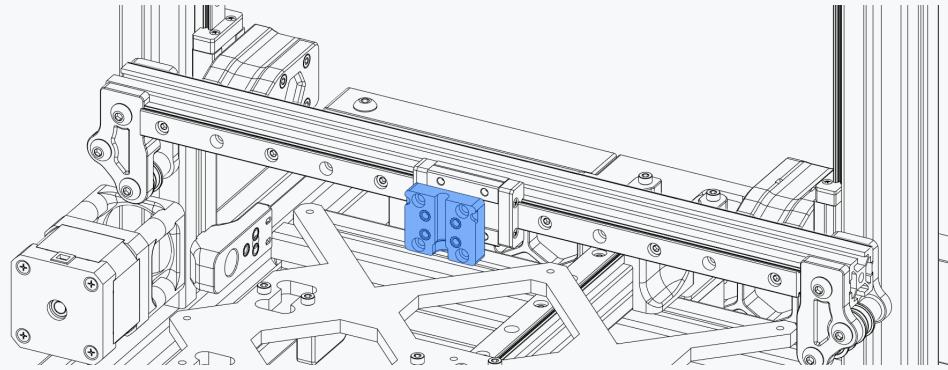
The picture shows a PL-08 probe. The recommended Omron TL-Q5MC probe will fit in the same space but require M3x25 SHCS.

Other probes with a similar form factor and characteristics might work as well.

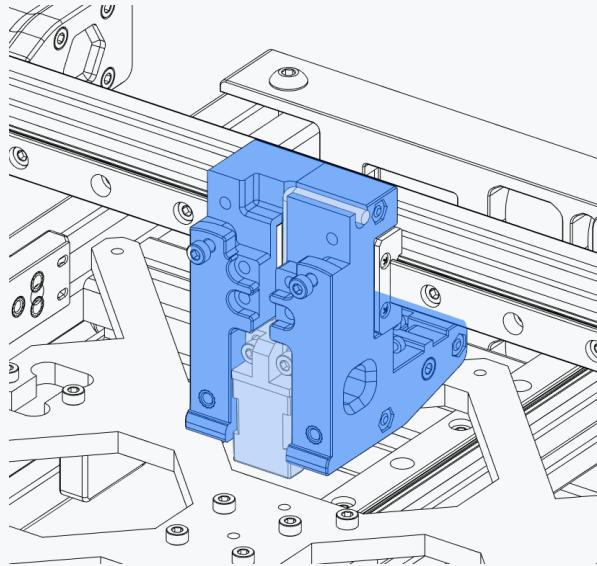


M3x20 SHCS

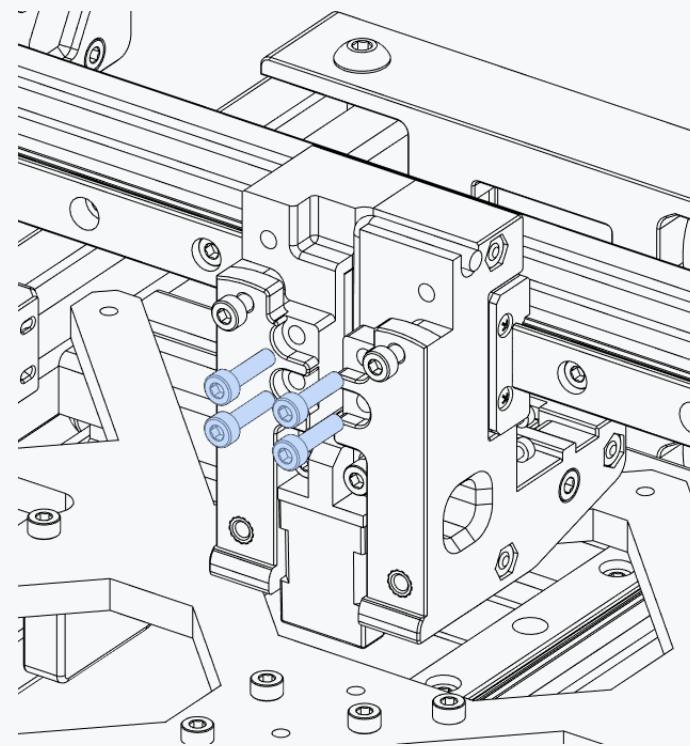


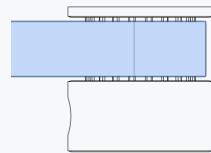


M3x8 SHCS

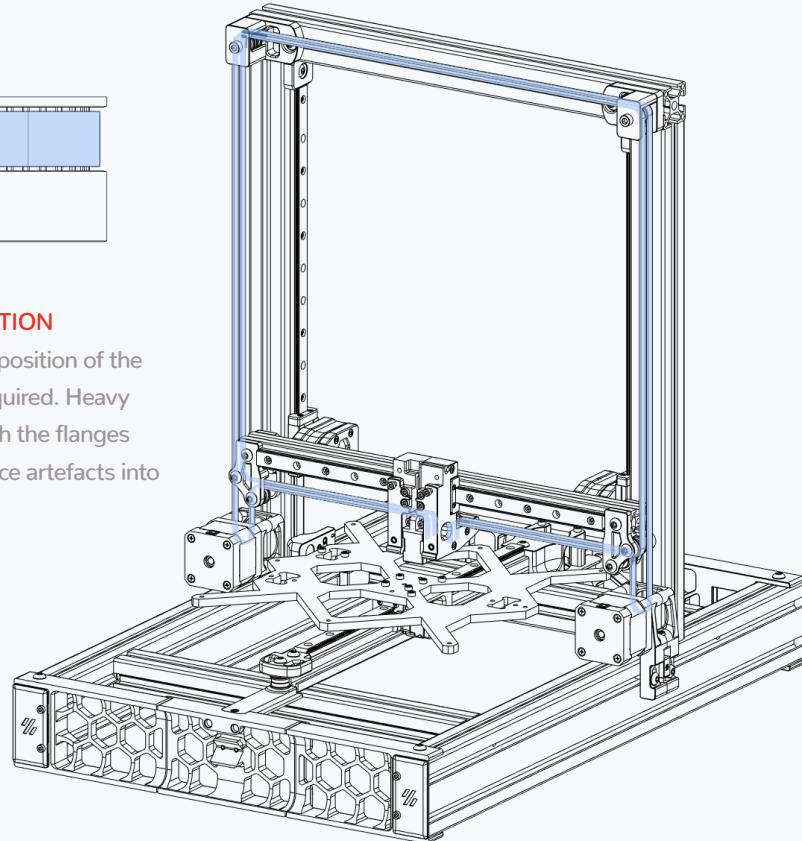


M3x12 SHCS

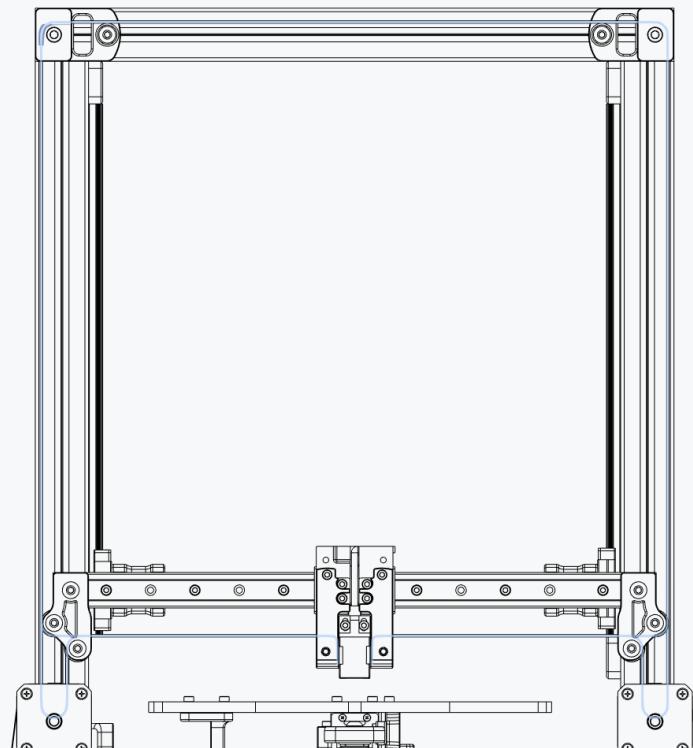


**BELT POSITION**

Adjust the position of the pulley if required. Heavy contact with the flanges will introduce artefacts into your prints.

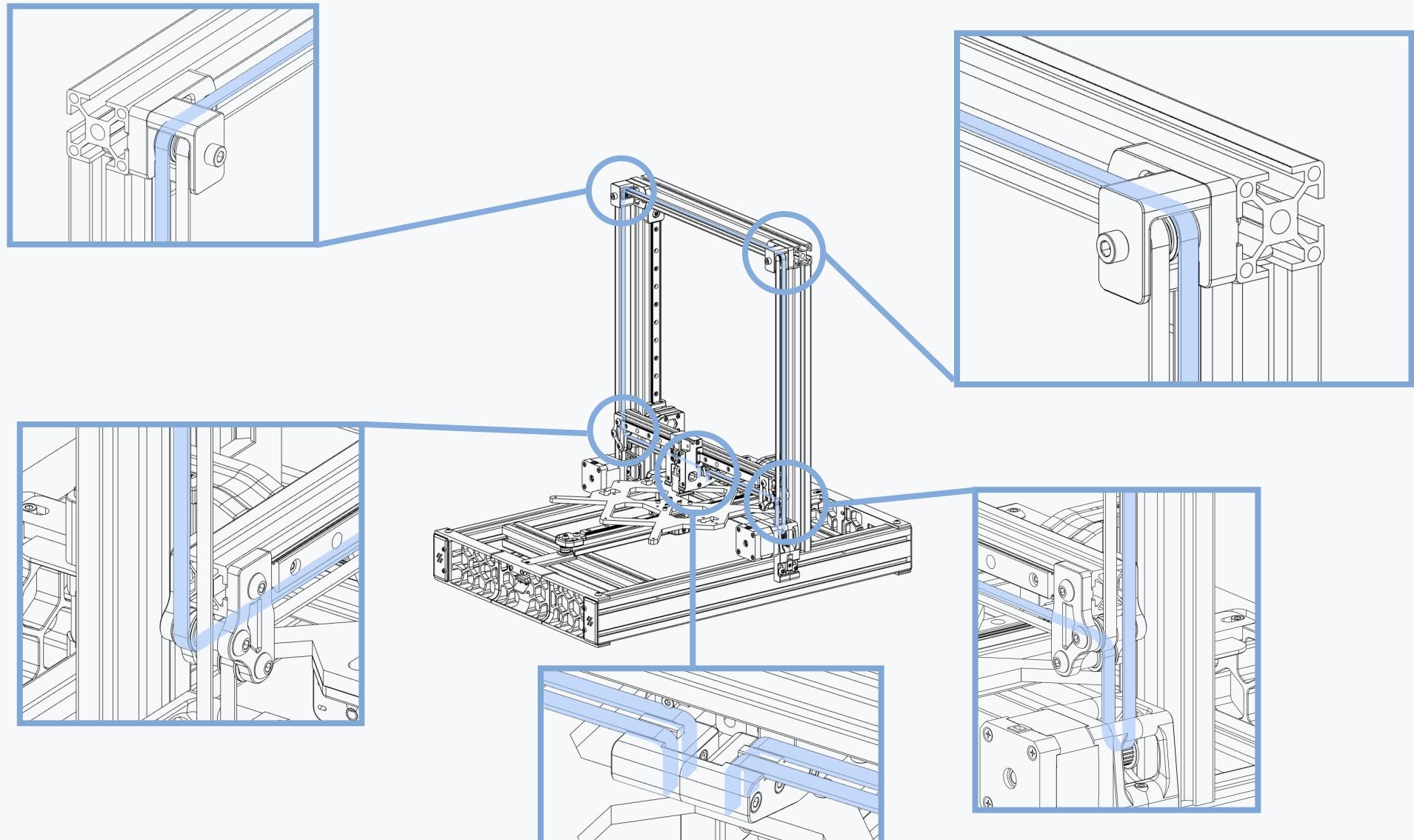
**BELT PATH**

Take your time and make sure your belt routing is as intended. Belts should never rub on plastic parts.



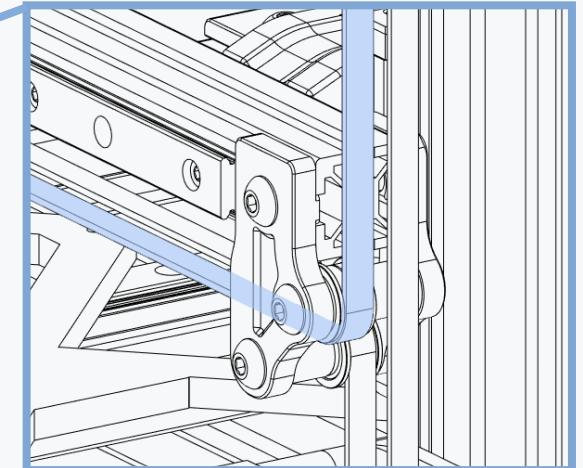
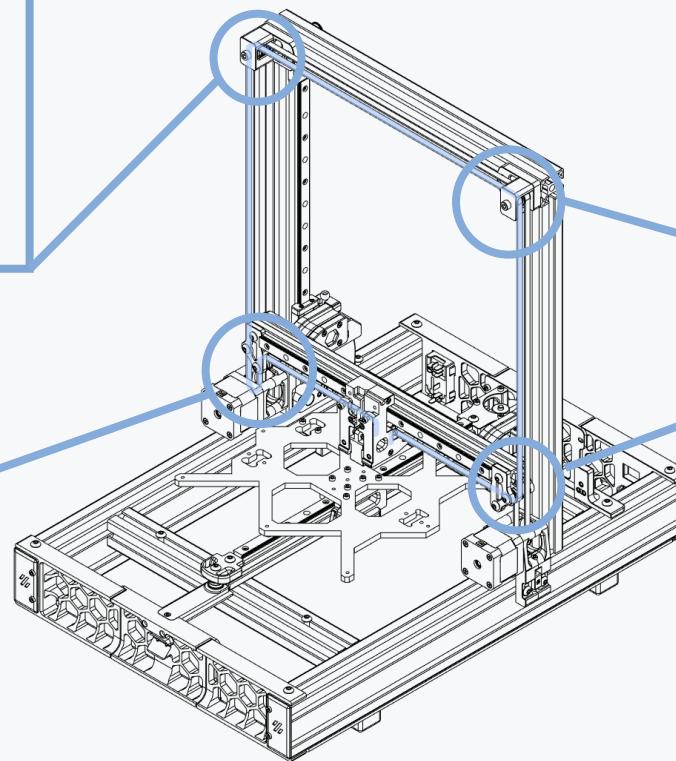
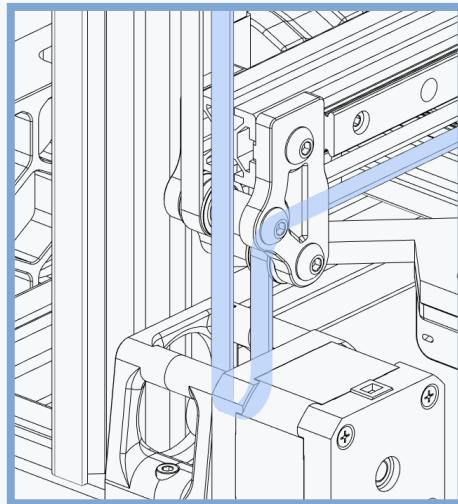
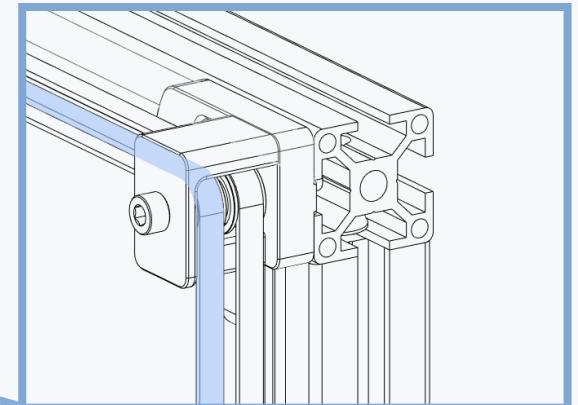
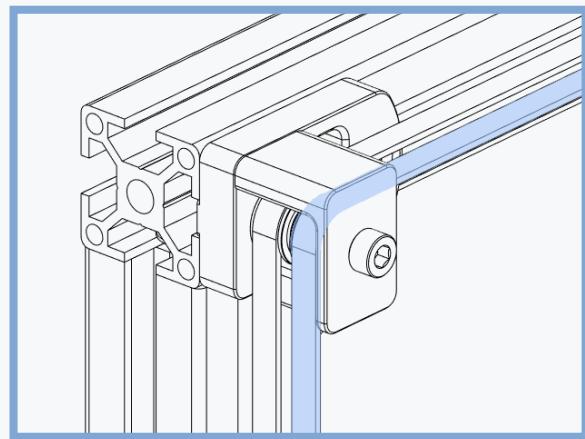
"Z" BELT

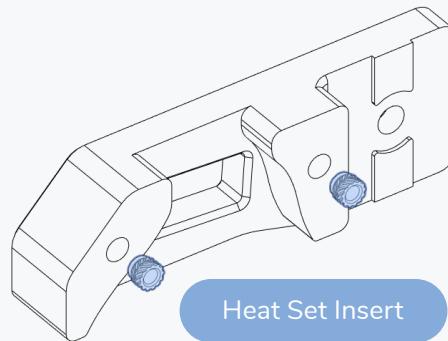
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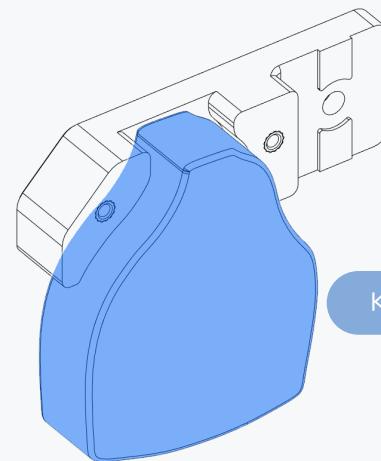
"X" BELT

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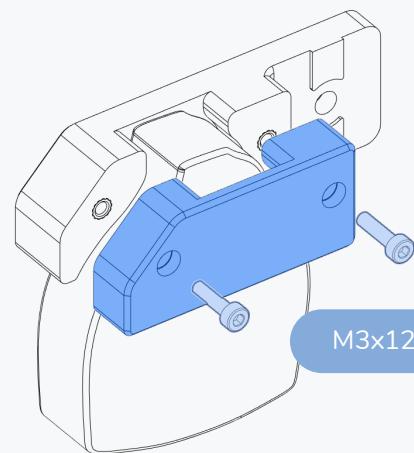




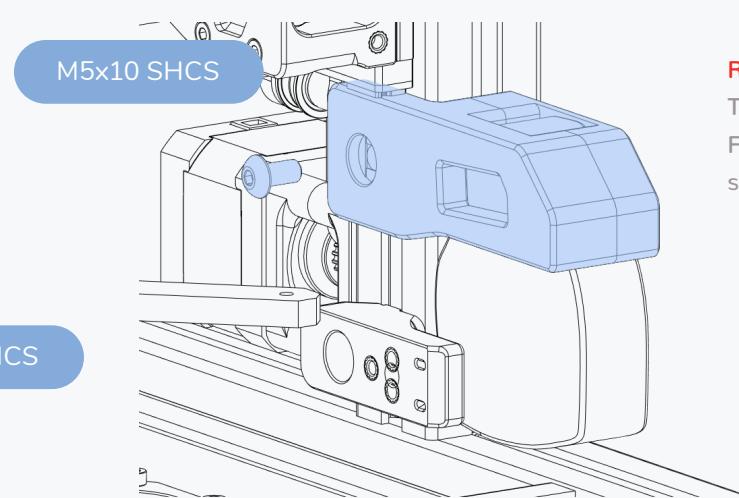
Heat Set Insert



Key-Bak Super 48



M3x12 SHCS



M5x10 SHCS

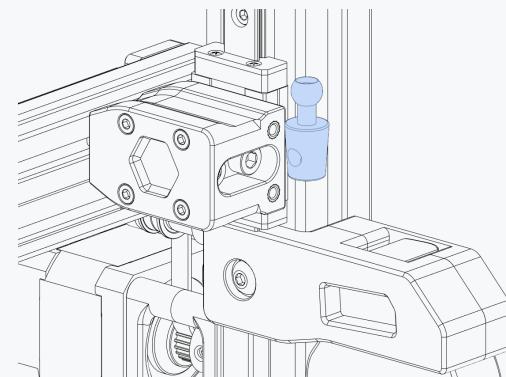
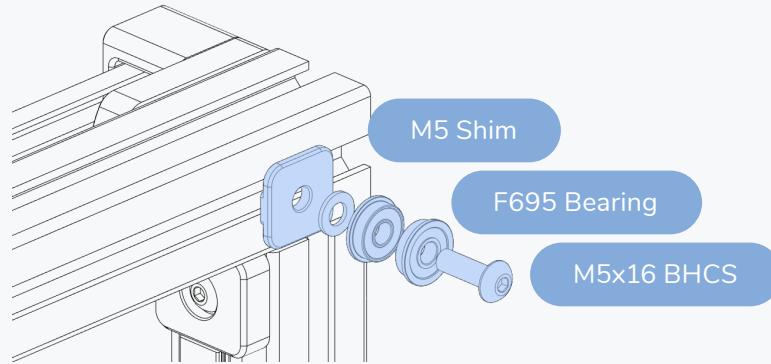
WEAR EYE PROTECTION

The Key-Bak will violently retract if you loose grip of the end piece.

Wear eye protection or a face shield until it is securely mounted.

RAIL CARRIAGE

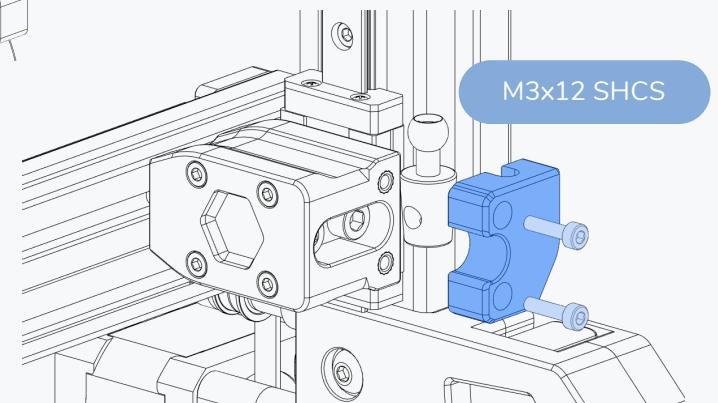
The rail carriage is now secure.
Fully fasten the bottom most screw.



MOUNTING THE KEYBACK END PIECE

Pull the end piece of the Key-Bak and mount it as shown.

Extend more of the cord and hook it in the idler mounted above.



AFTERBURNER

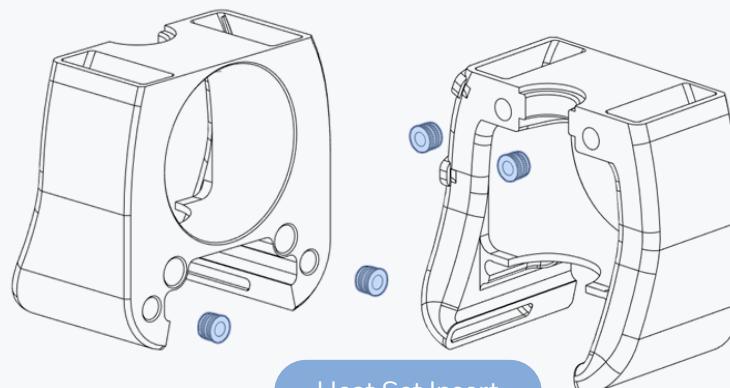
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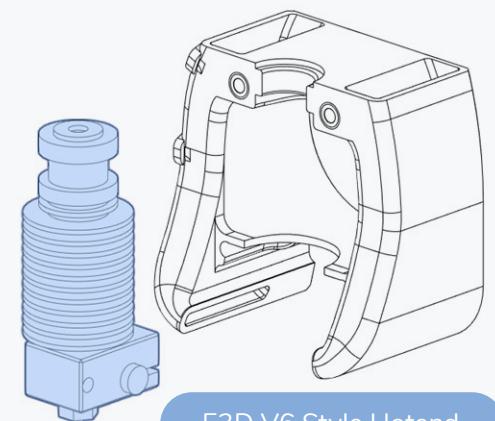
AVAILABLE MOUNTS

We also provide mounts for the Slice Engineering Mosquito and TriangleLab/Phaetus Dragon Hotend.

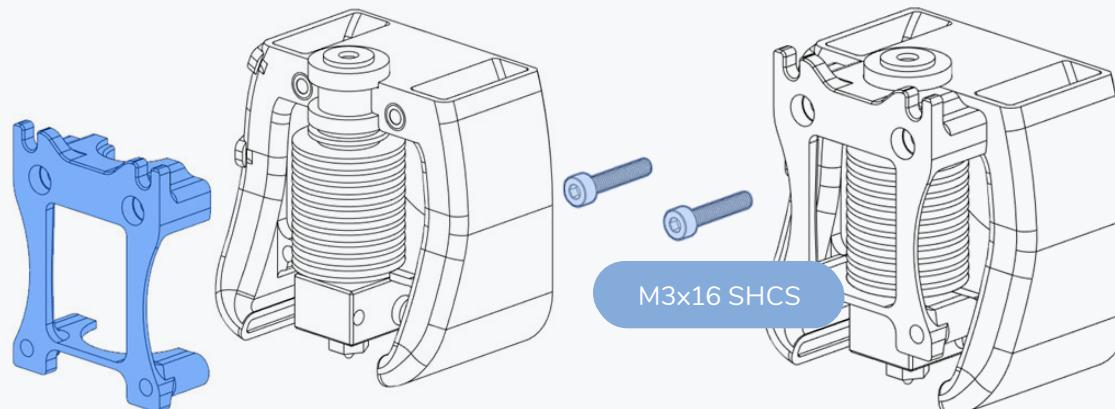
They are assembled in a similar manner.



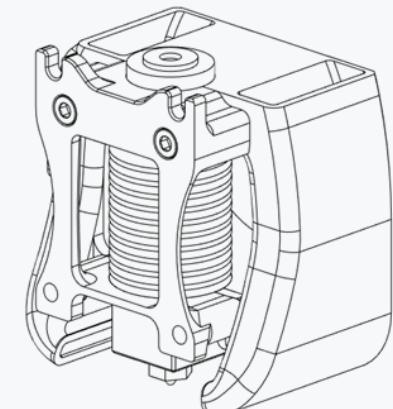
Heat Set Insert

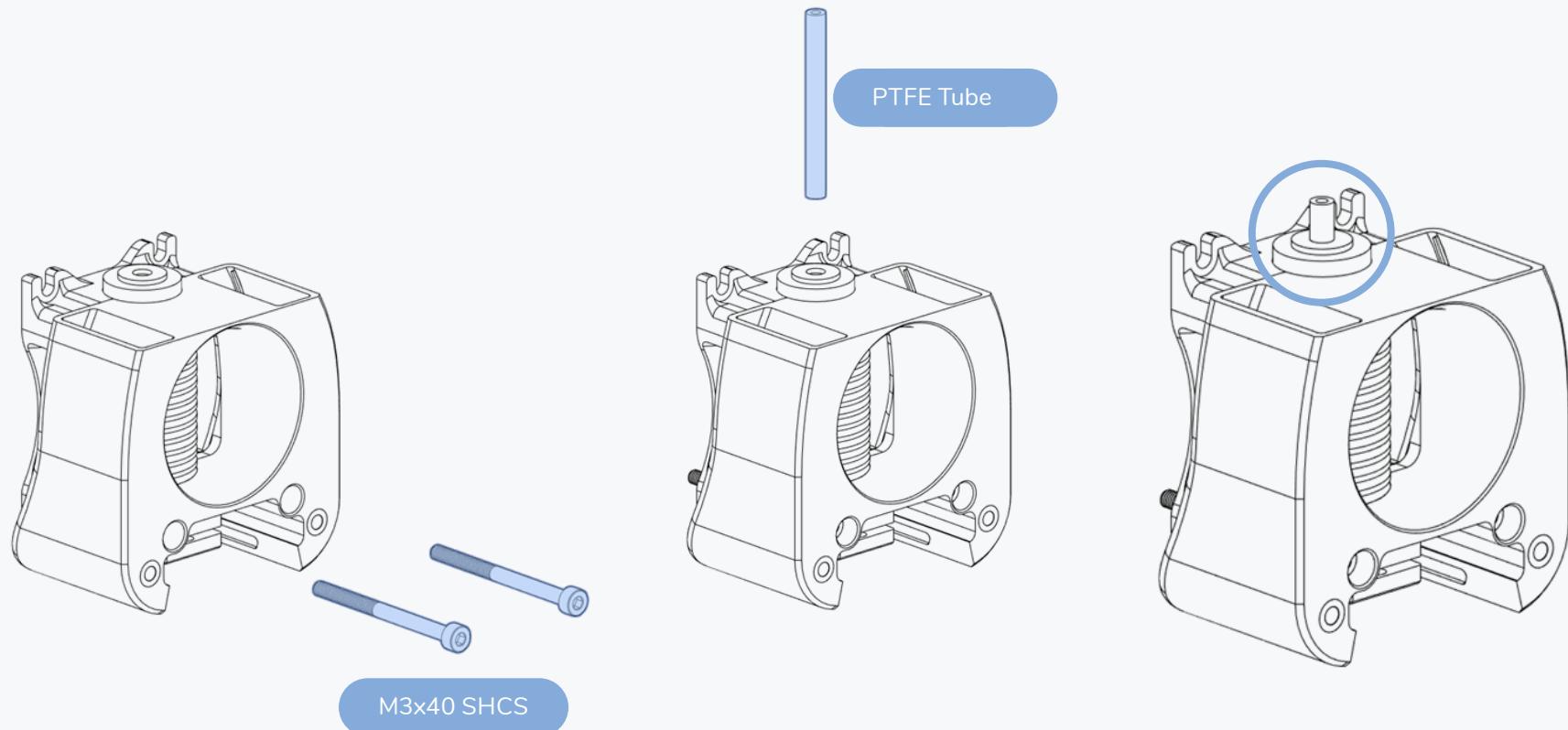


E3D V6 Style Hotend

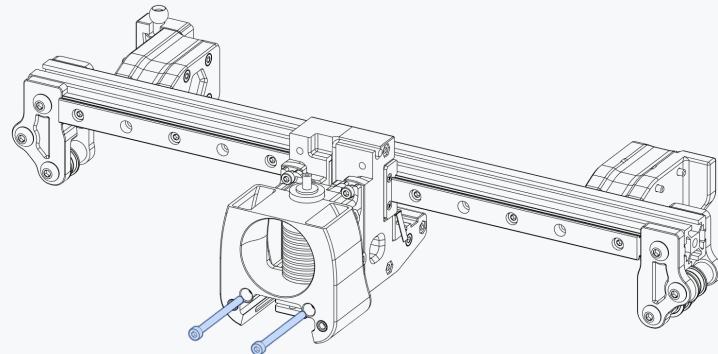


M3x16 SHCS

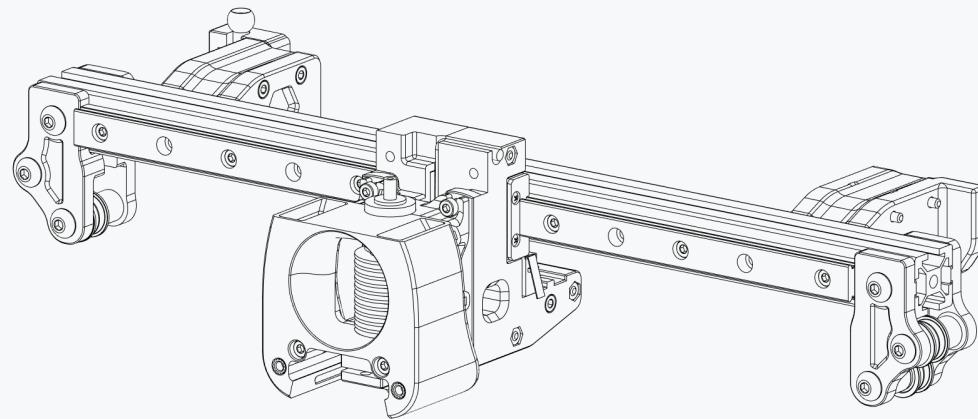


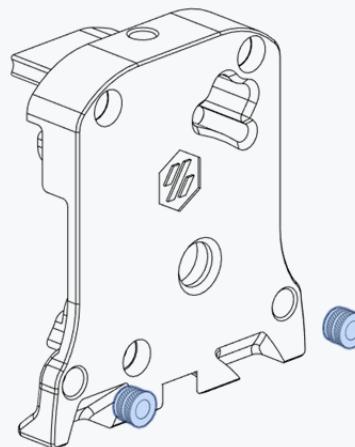
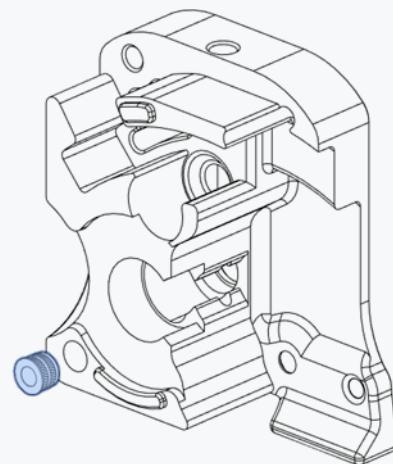
**PTFE STICKOUT**

The PTFE tube should end 10mm above the surface of the printed part.

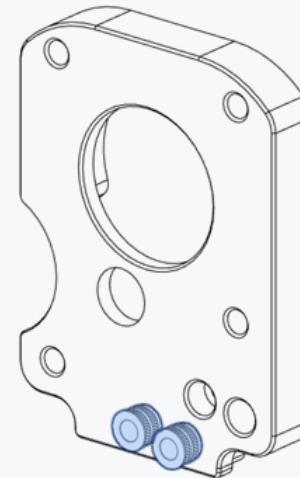
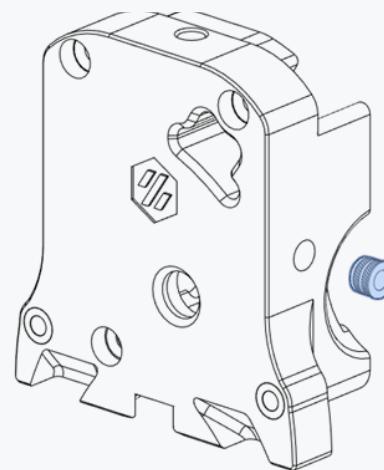


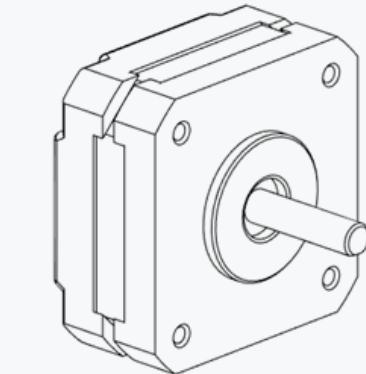
M3x40 SHCS





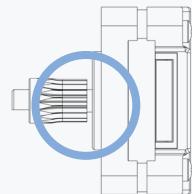
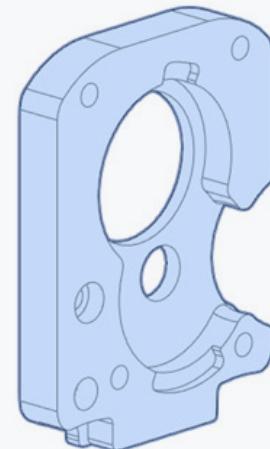
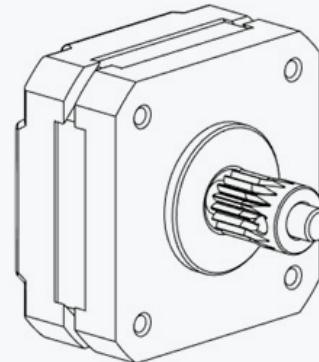
Heat Set Insert





Stepper Motor

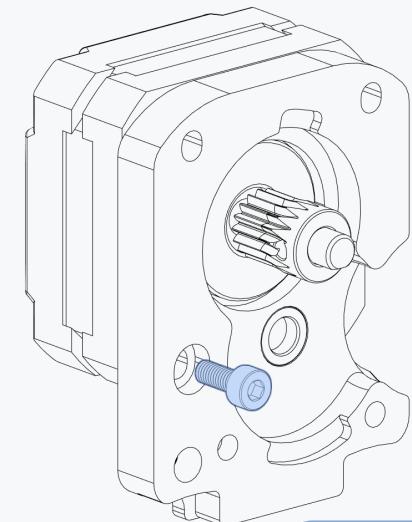
BMG Drive Pinion

**PINION POSITION**

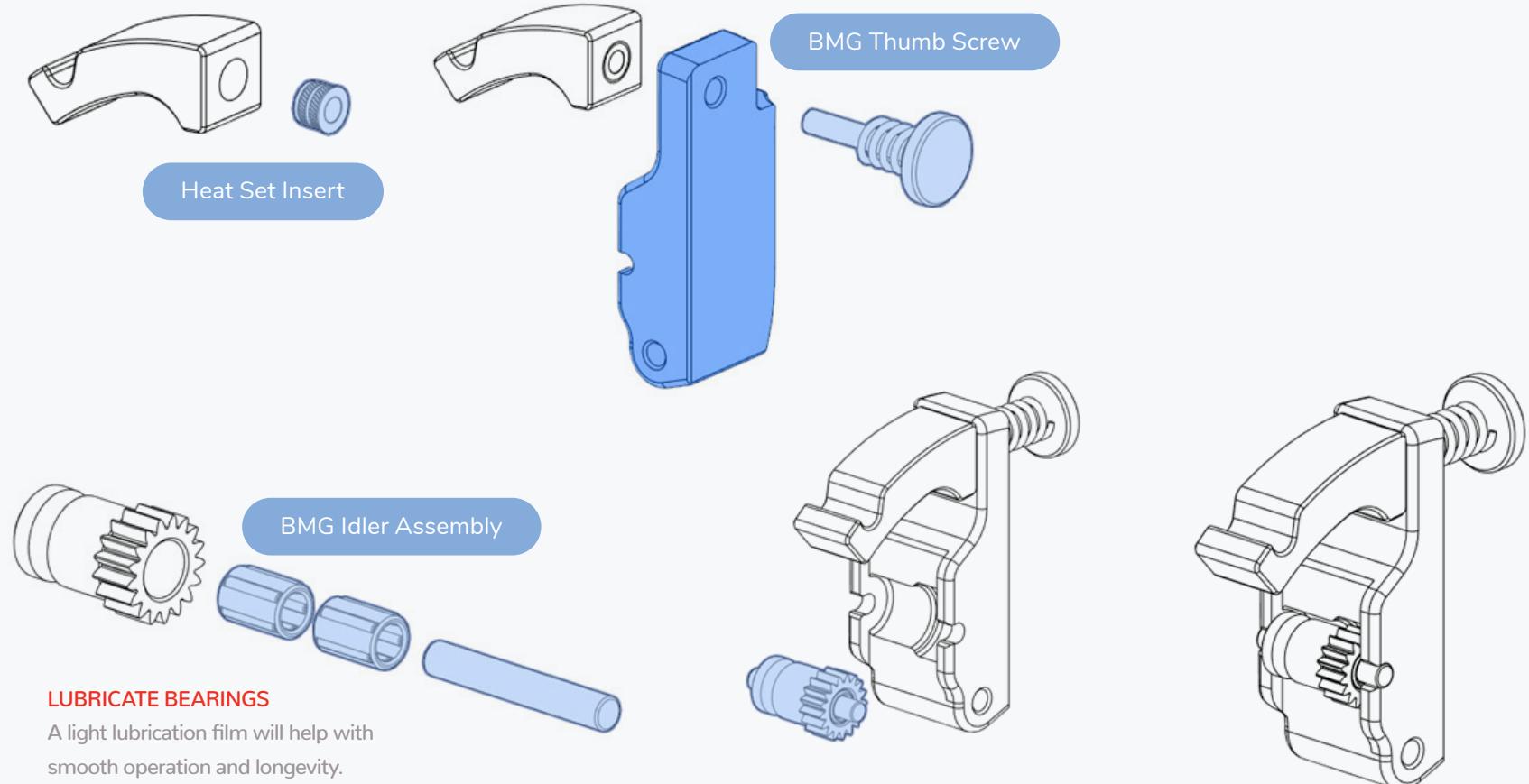
The exact position of the pinion gear is not critical.
Leave a 1-2mm gap.

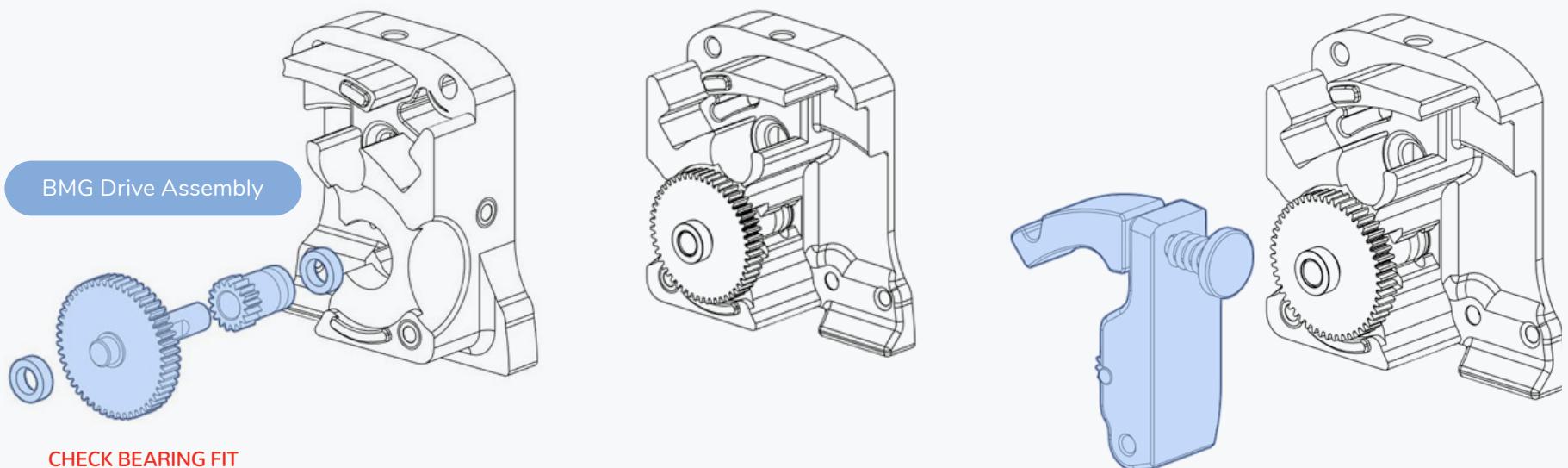
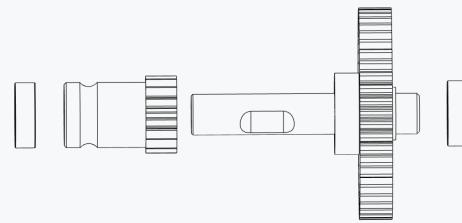
STEPPER WIRES

If the steppers has wires cut them to approximately 150mm.
Wires/connector to the right hand side.



M3x8 SHCS

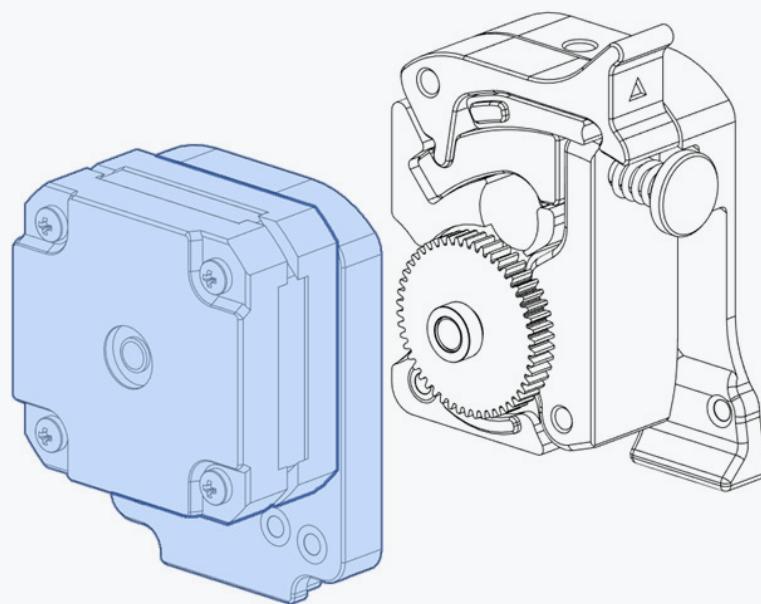
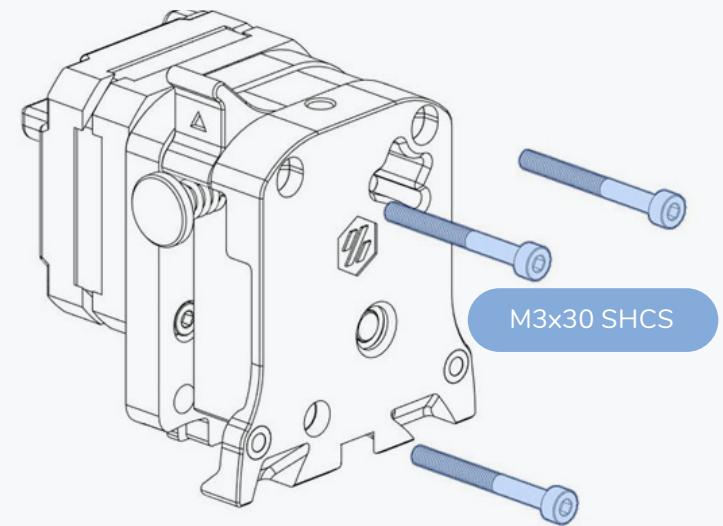
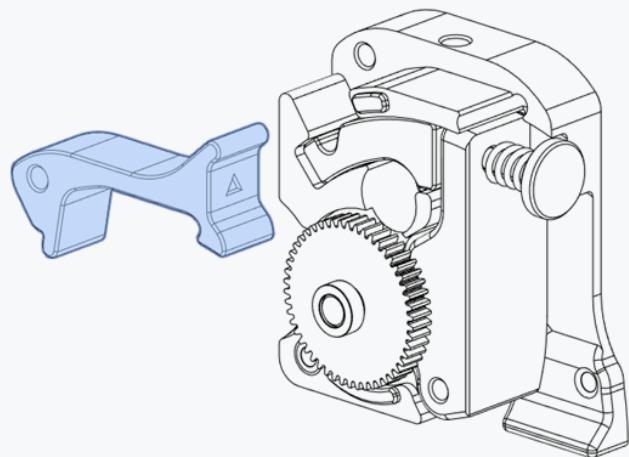


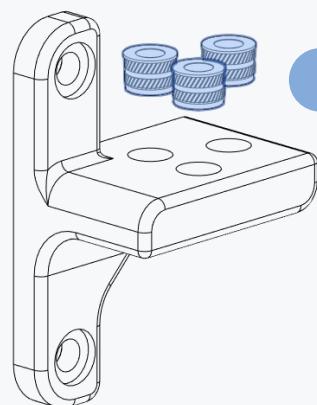
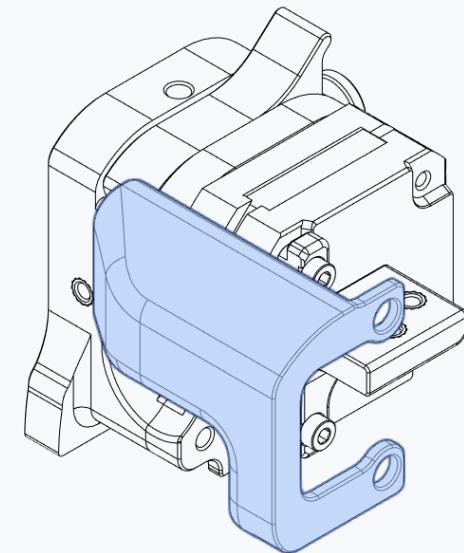
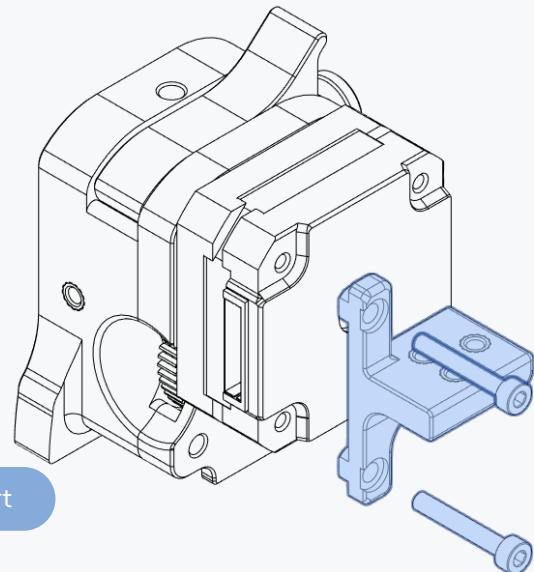
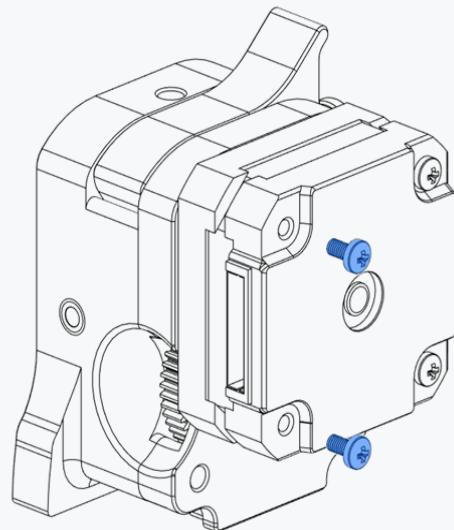
**CHECK BEARING FIT**

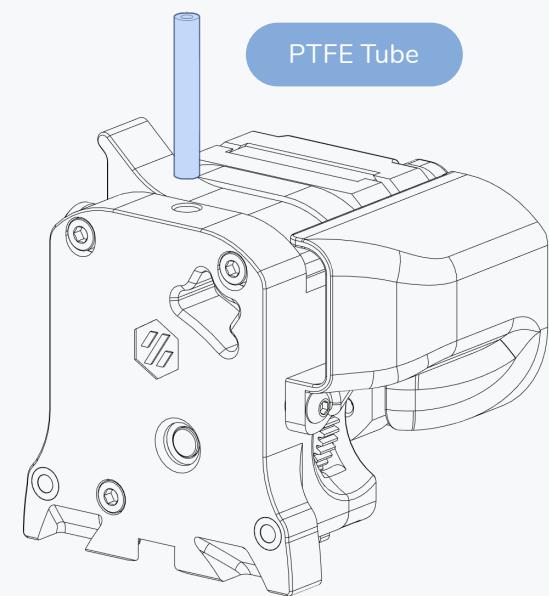
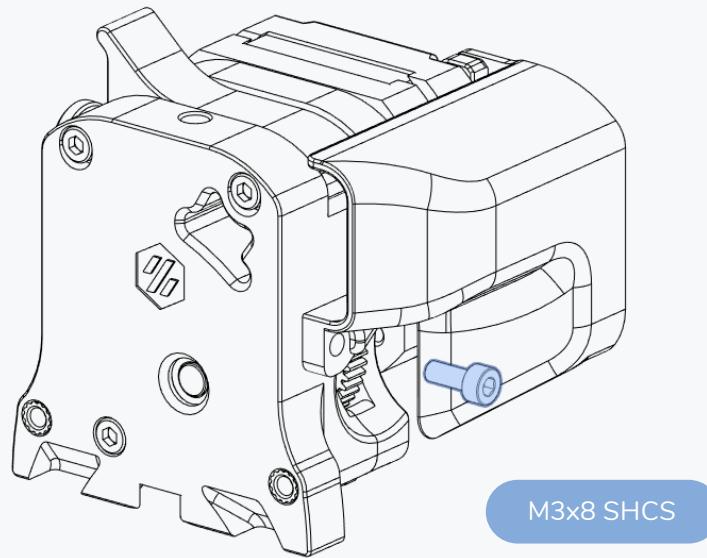
The bearings must slip on and off the shaft easily. Pressing the bearings on the shaft will damage them. Lightly sand the shaft if required.

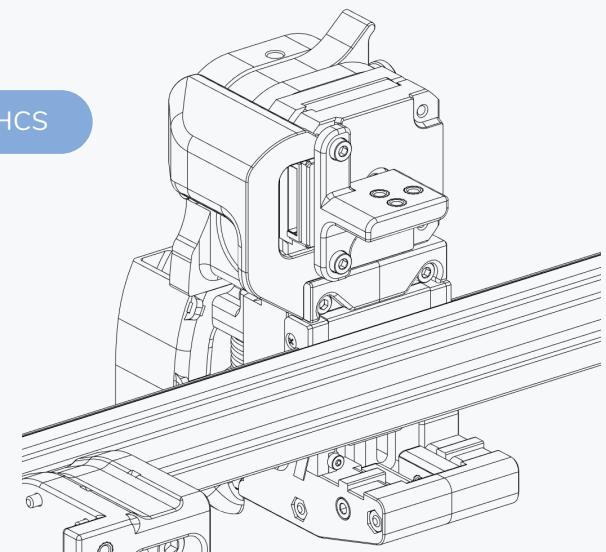
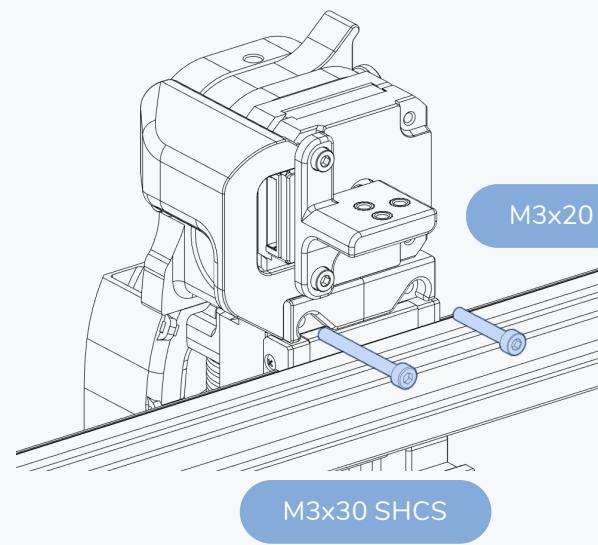
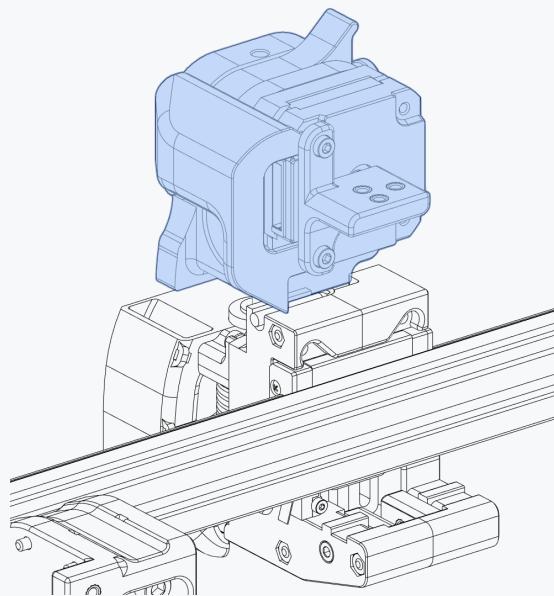
CLOCKWORK

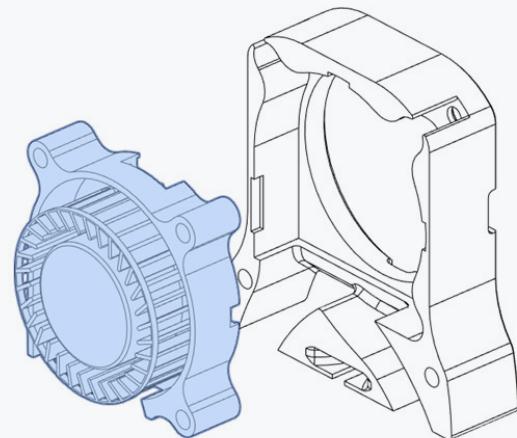
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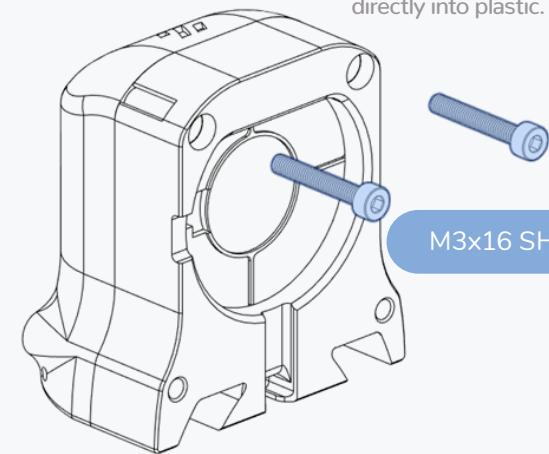
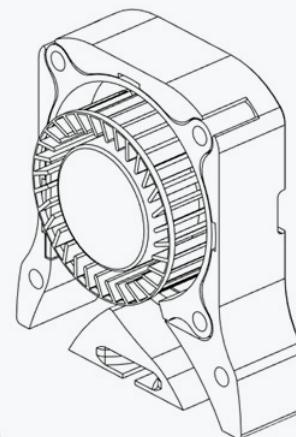
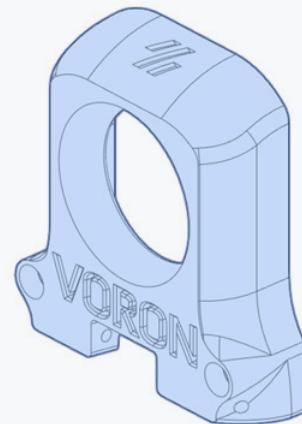






**REMOVE TOP COVER**

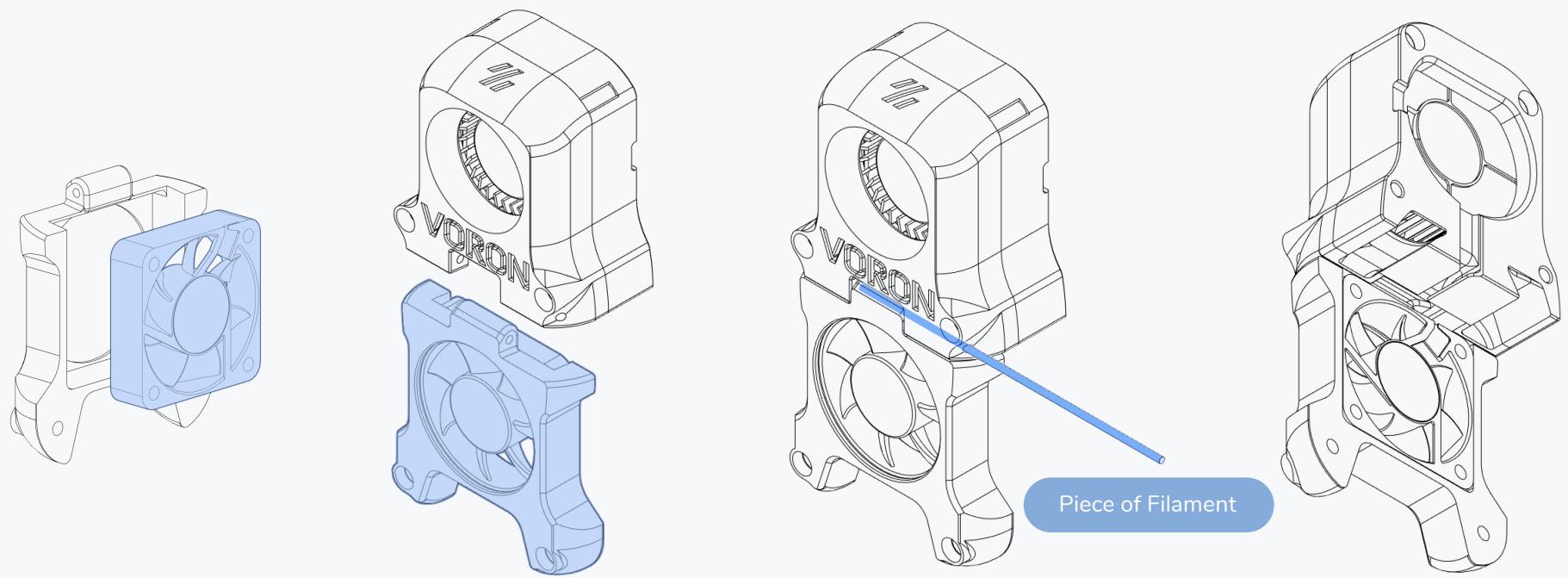
Split the fan open by bending the tabs on the side.

**DON'T OVER TIGHTEN**

The screws are screwed directly into plastic.

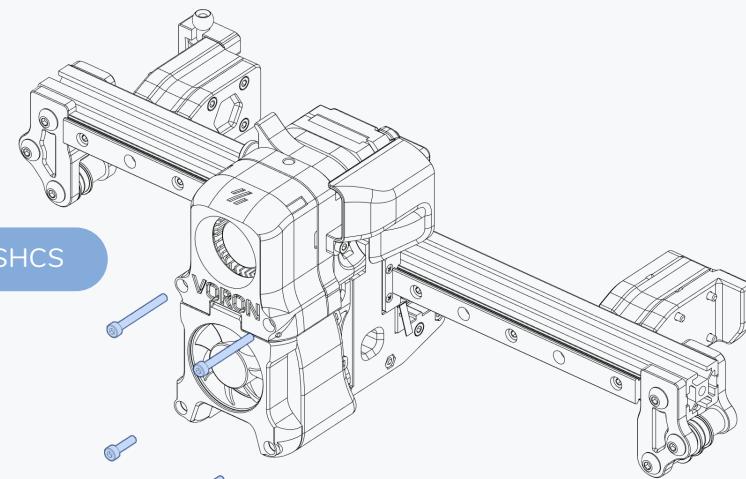
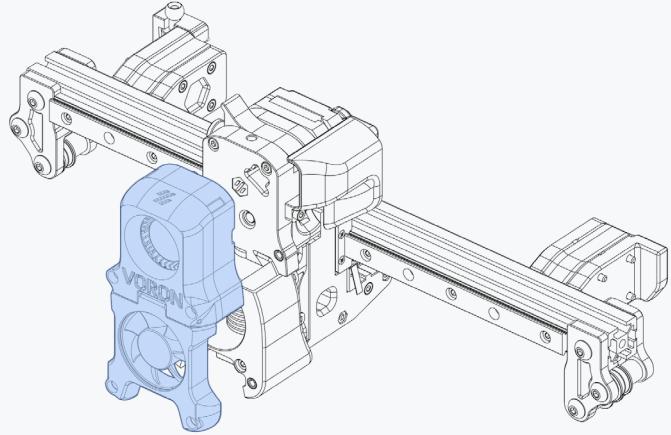
FAN ASSEMBLY

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FAN ASSEMBLY

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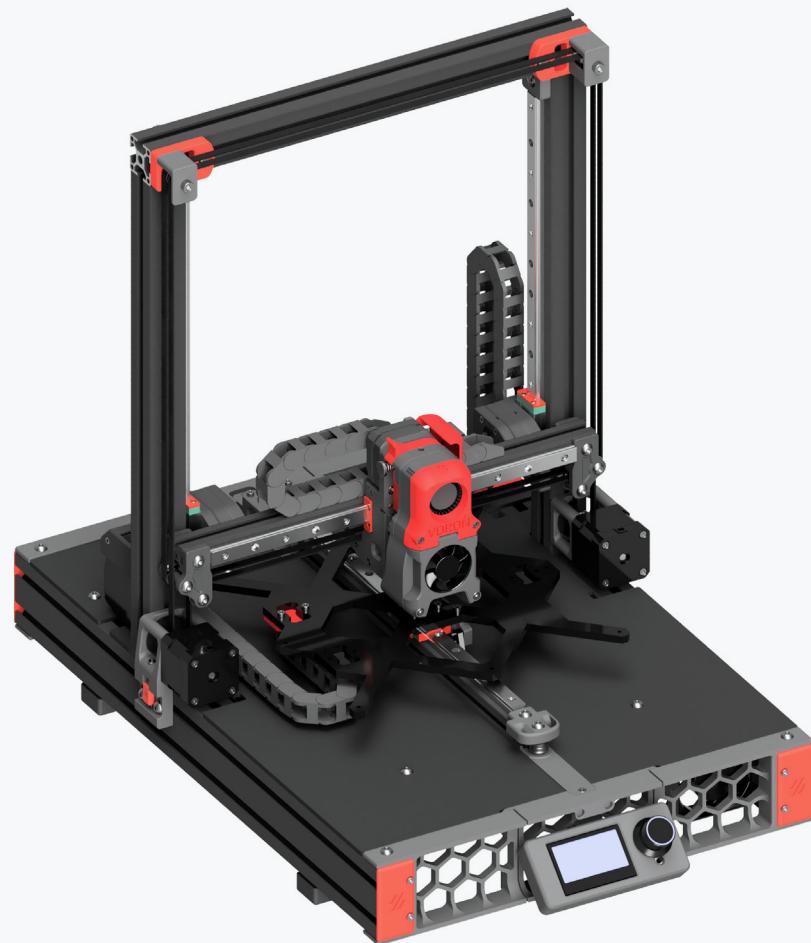
M3x30 SHCS

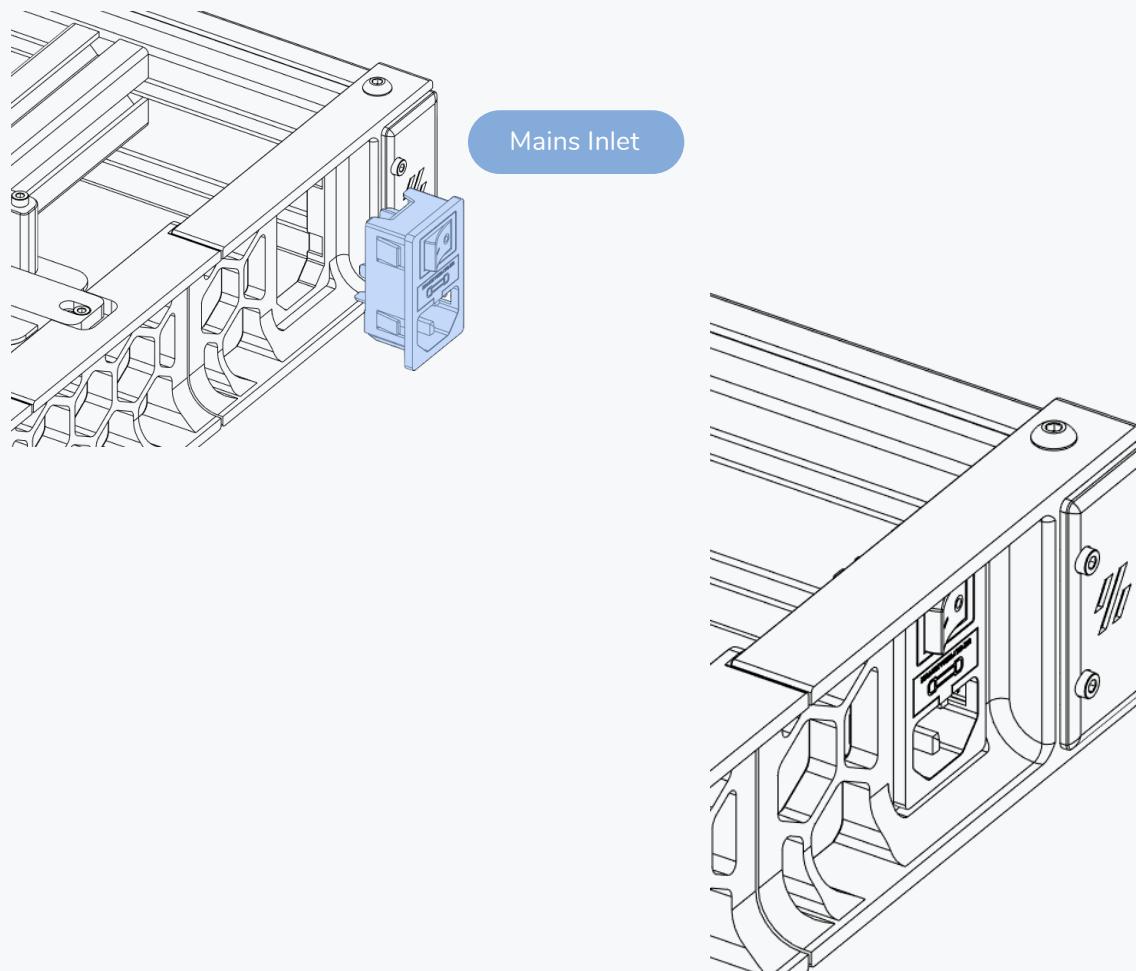
M3x12 SHCS

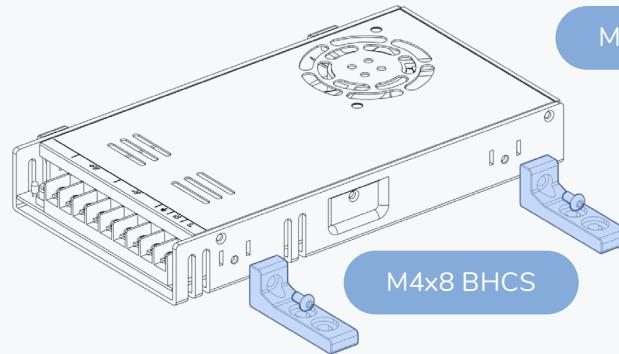
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ELECTRONICS AND PANELS

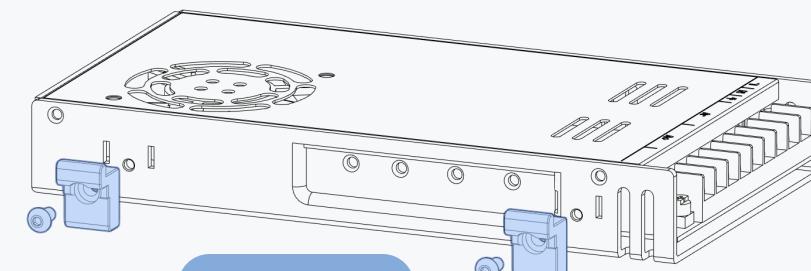
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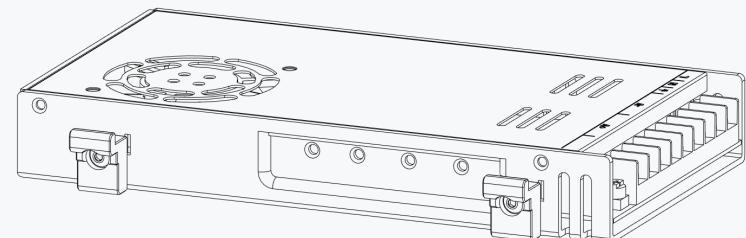


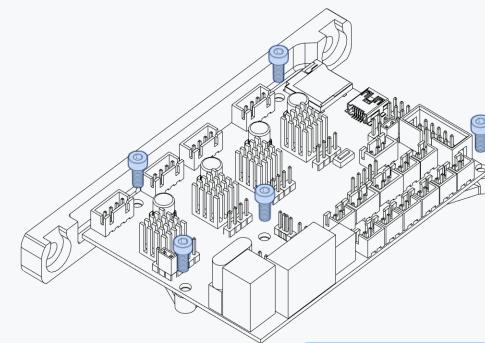
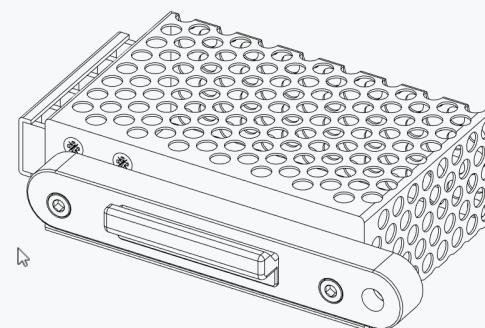
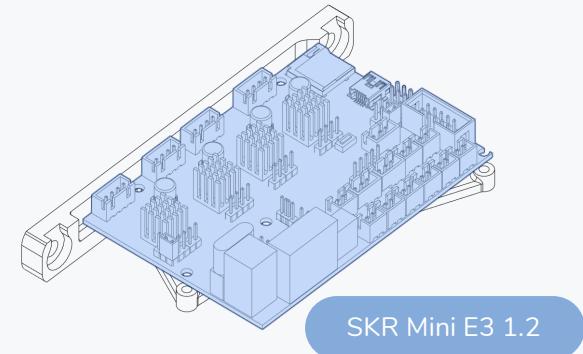
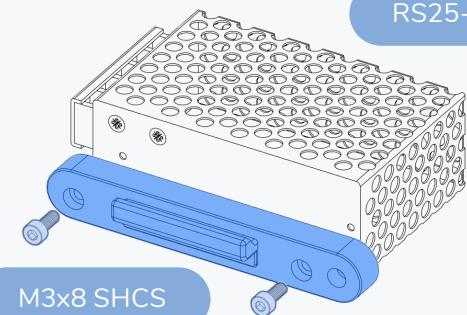
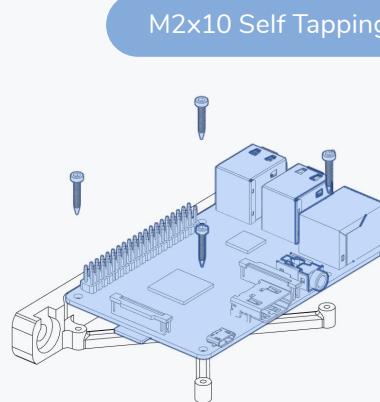


Meanwell LRS350-24



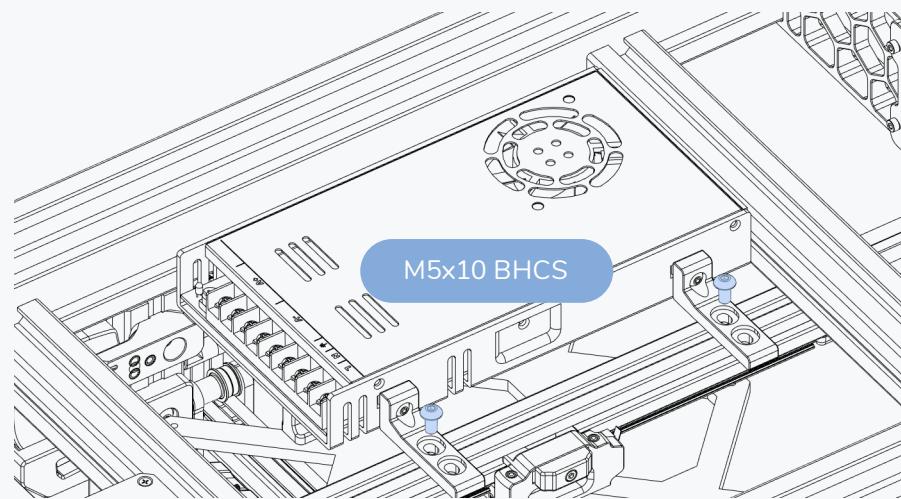
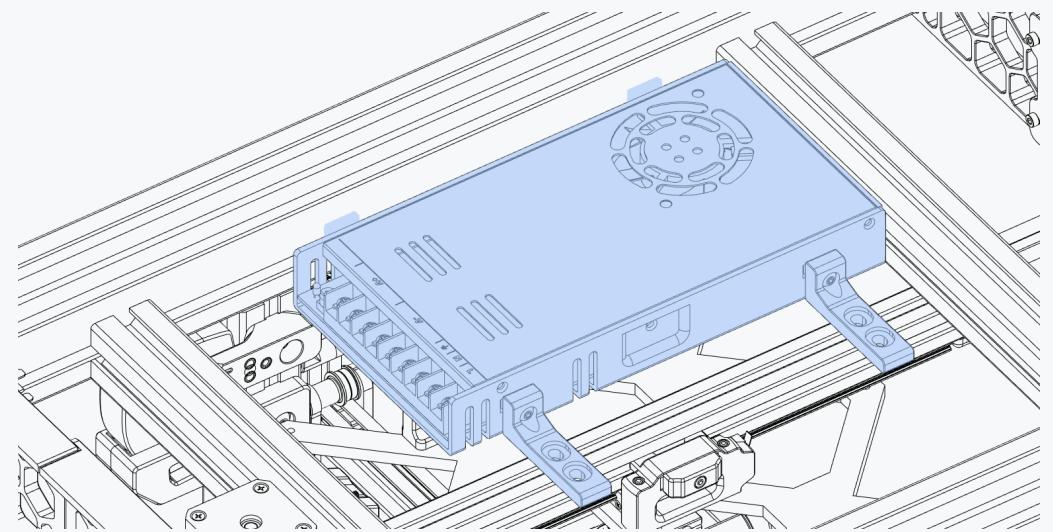
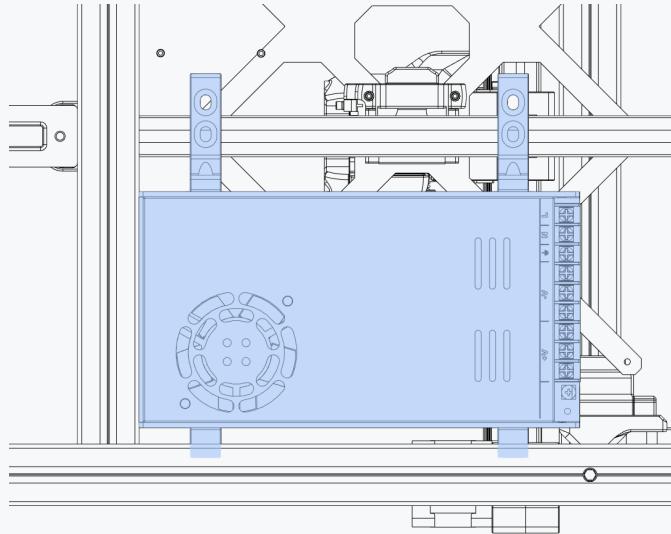
M4x8 BHCS





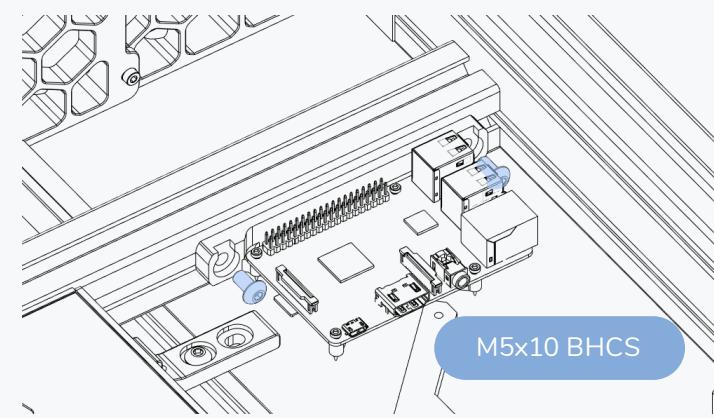
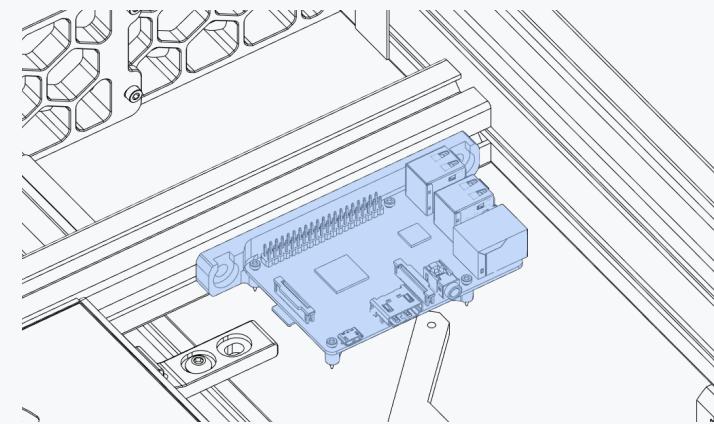
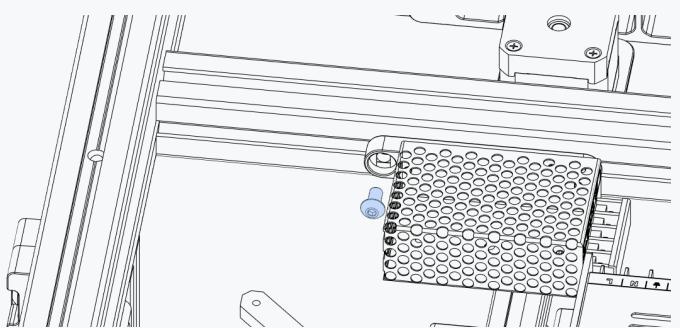
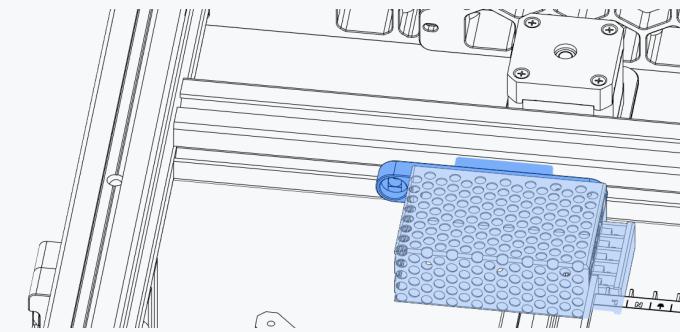
PSU INSTALLATION

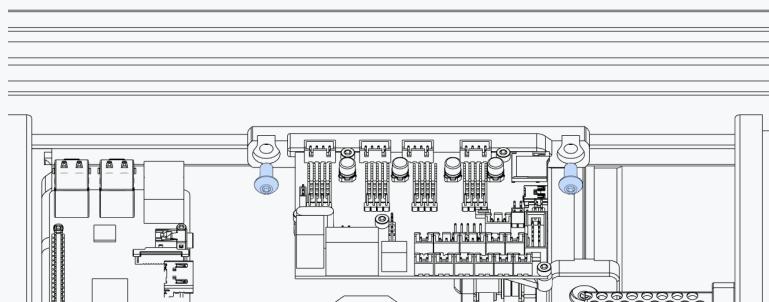
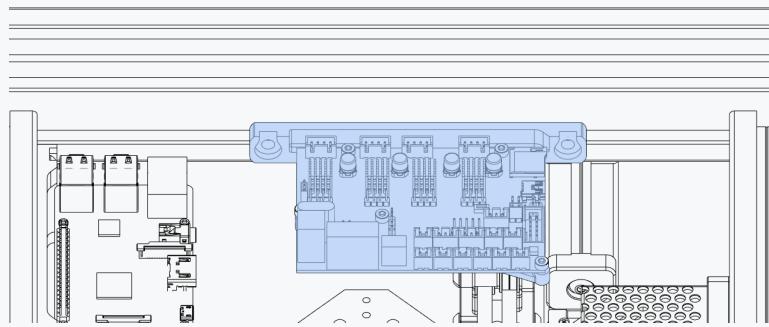
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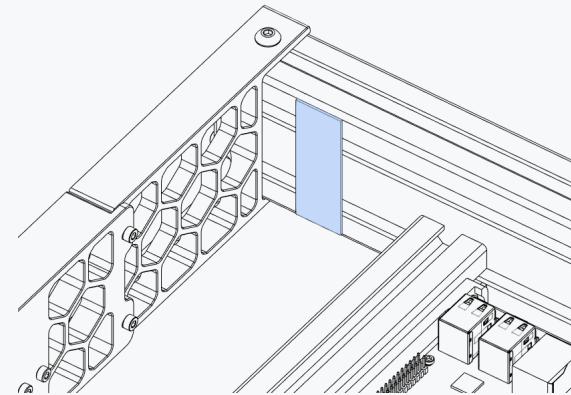
SECONDARY PSU/PI INSTALLATION

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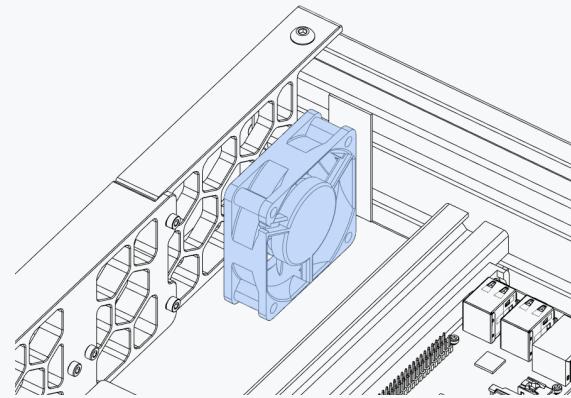




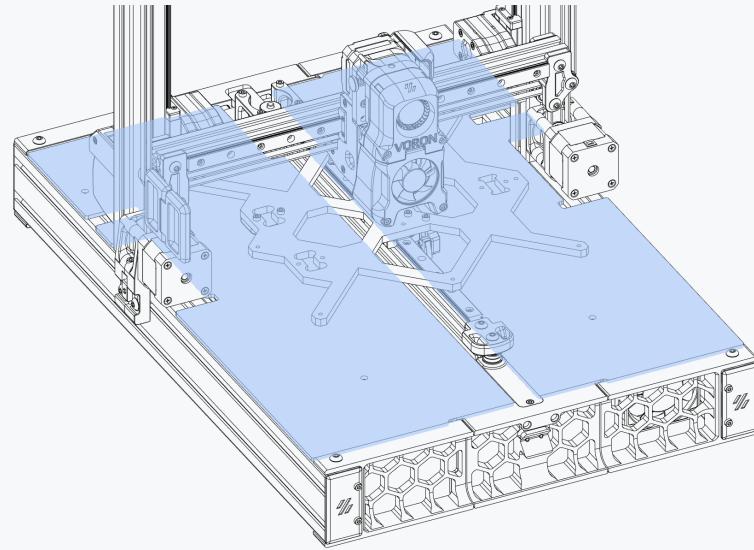
M5x10 BHCS



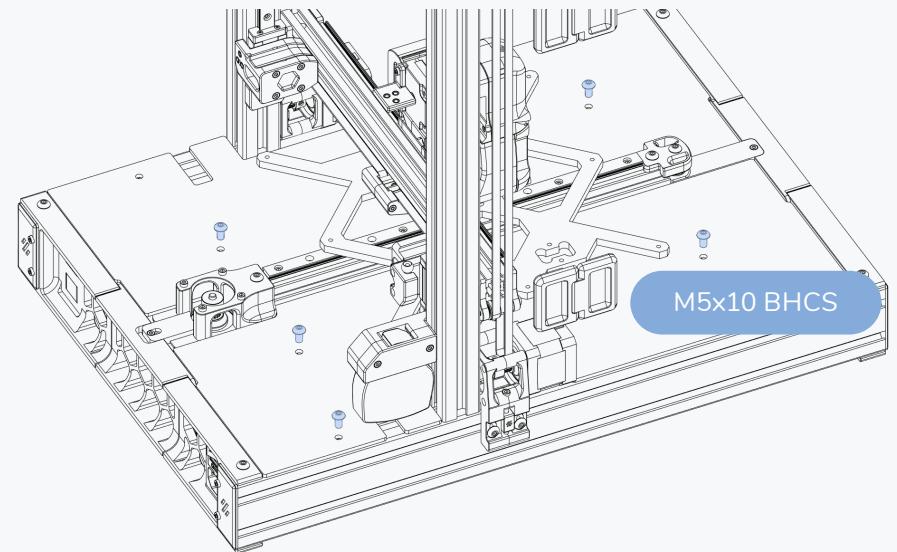
APPLY VHB TAPE
3M VHB tape is a double sided adhesive tape. Other vendors have similar products that you can use as a substitute.

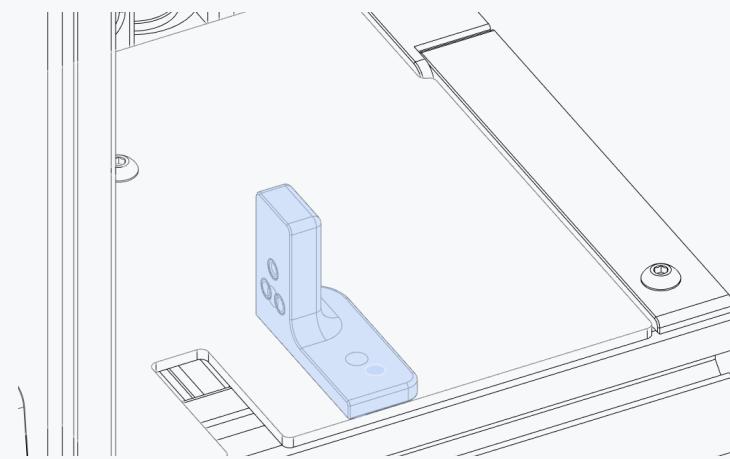
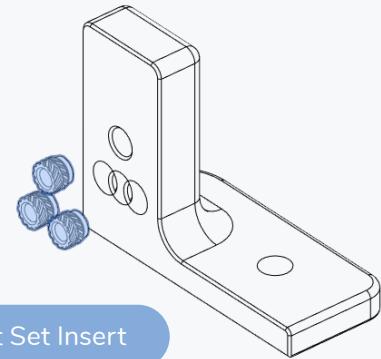


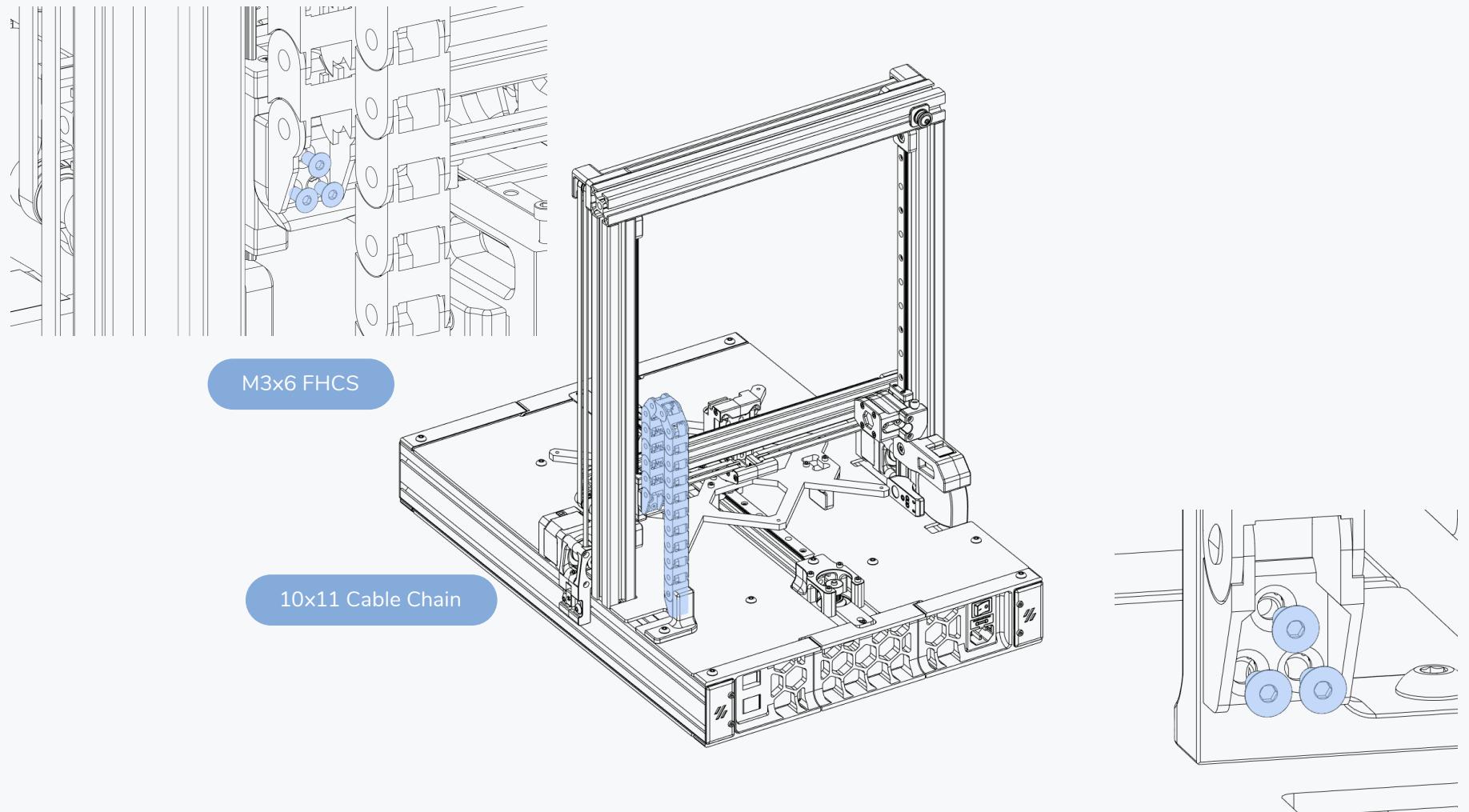
6020 Fan

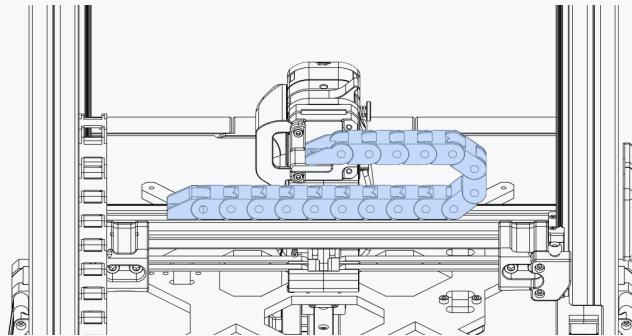
**DECK PANELS**

Unless you installed the panels earlier undo the 6 screws on the bed carriage and remove the bed carriage to install the panels.

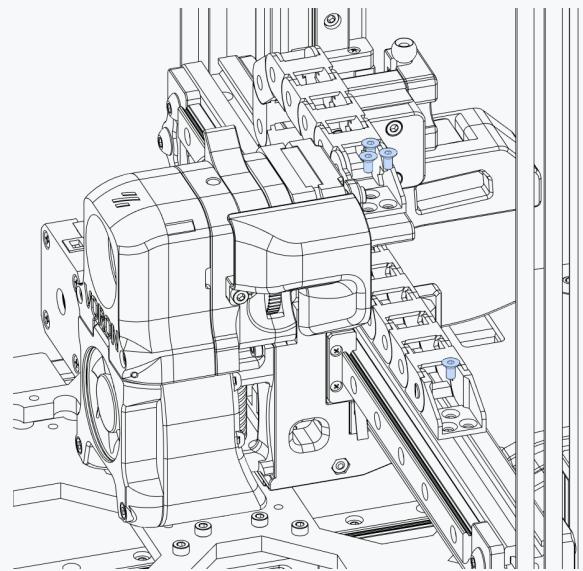








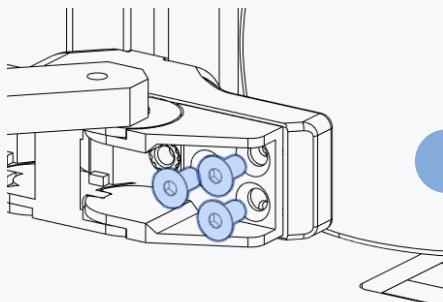
10x11 Cable Chain



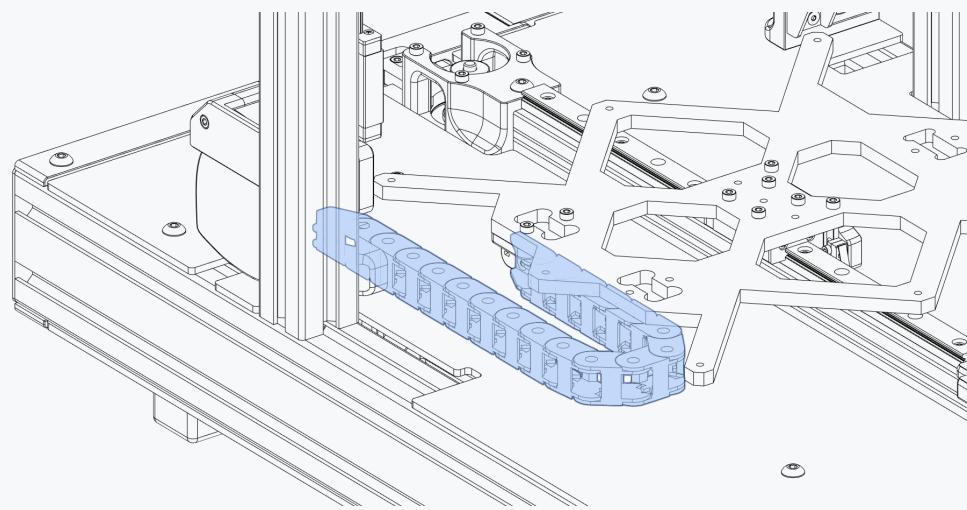
M3x6 FHCS

Y CABLE CHAIN

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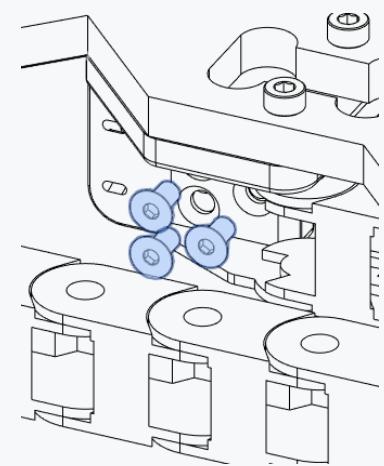


M3x6 FHCS

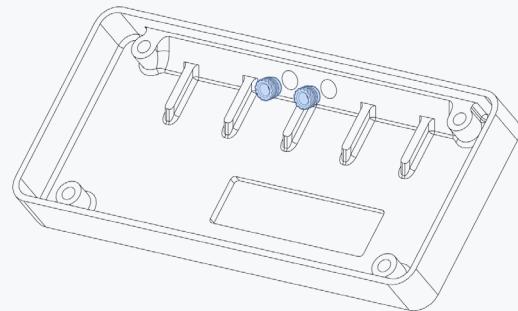


M3x6 FHCS

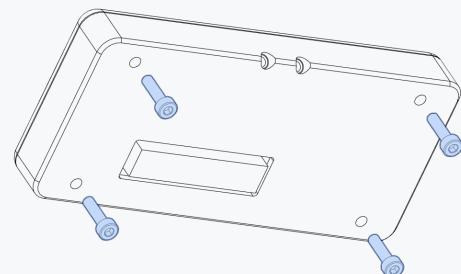
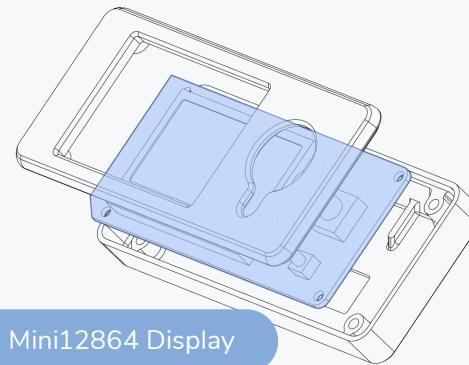
10x11 Cable Chain



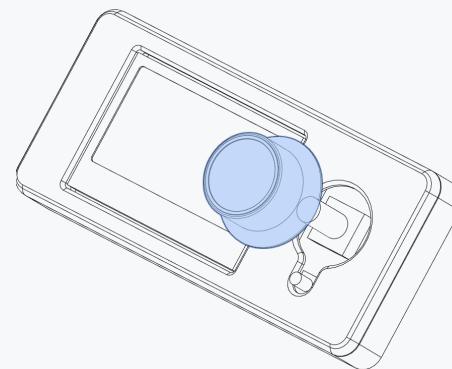
Heat Set Insert

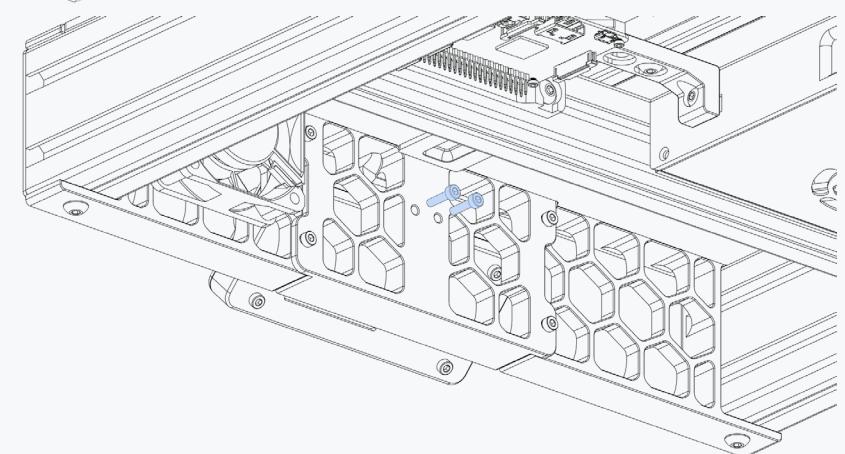
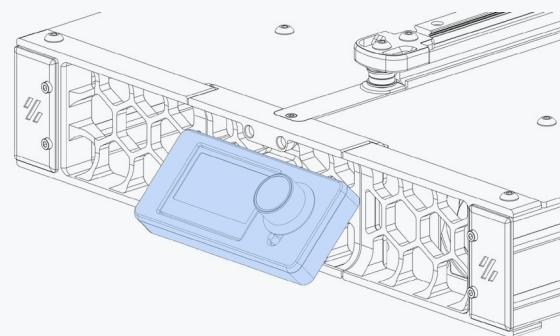
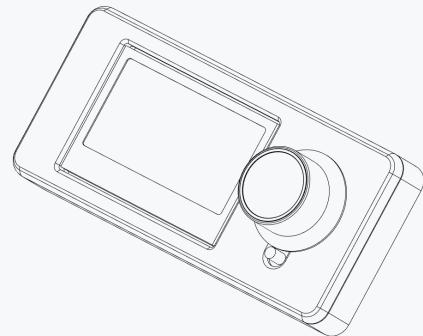


Mini12864 Display



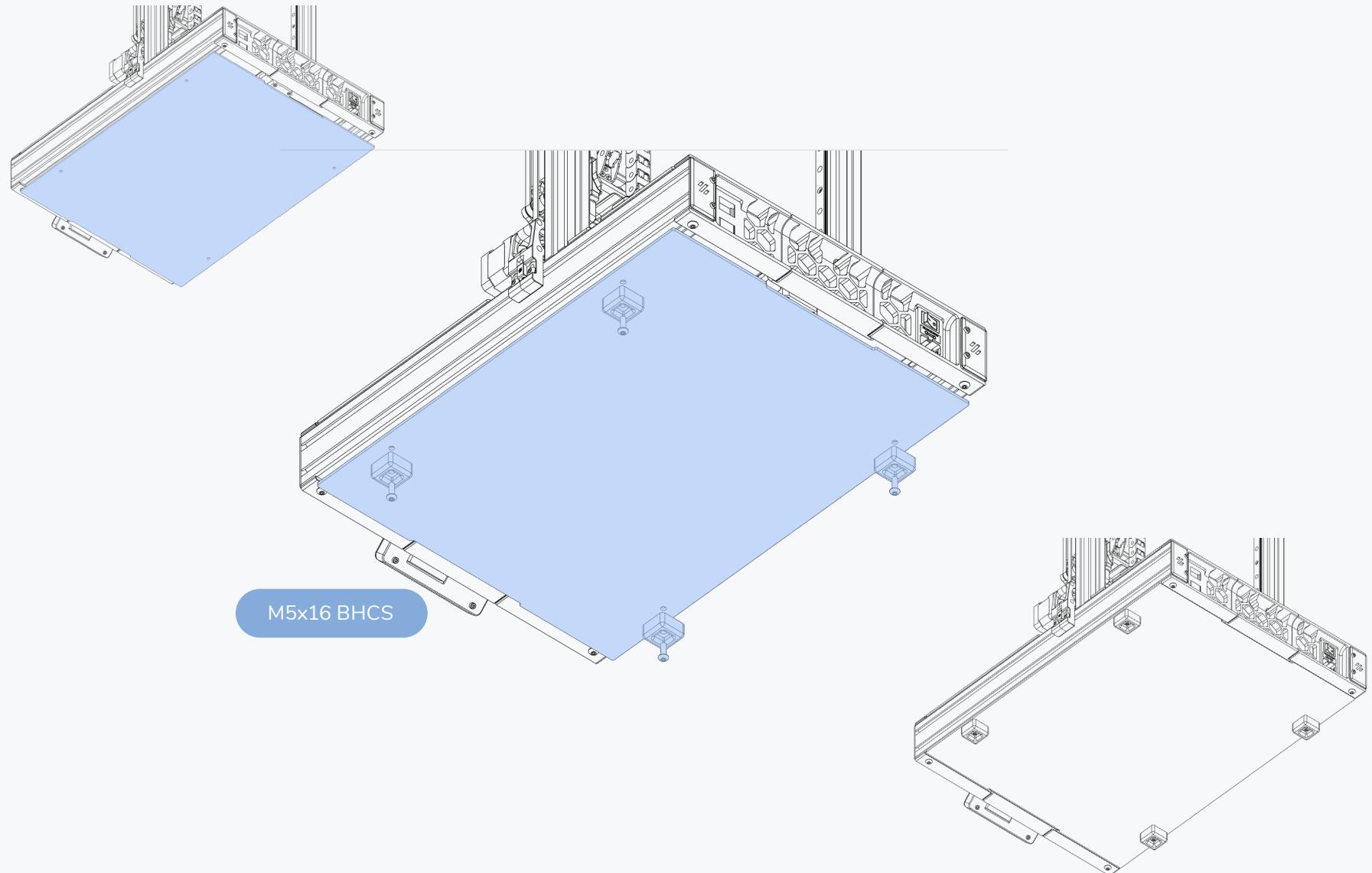
M3x12 SHCS





BOTTOM PANEL

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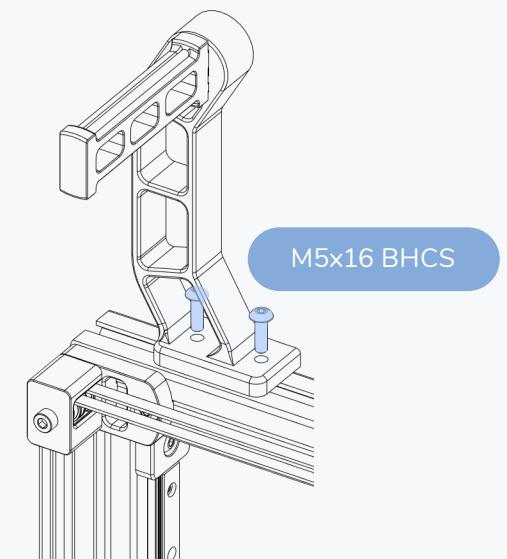
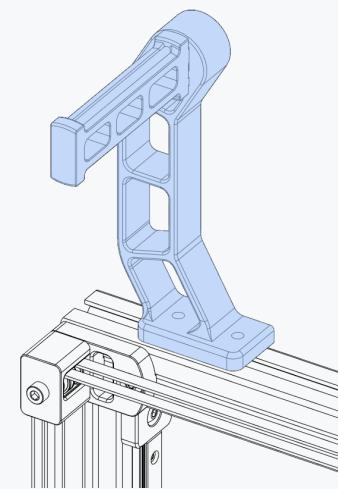
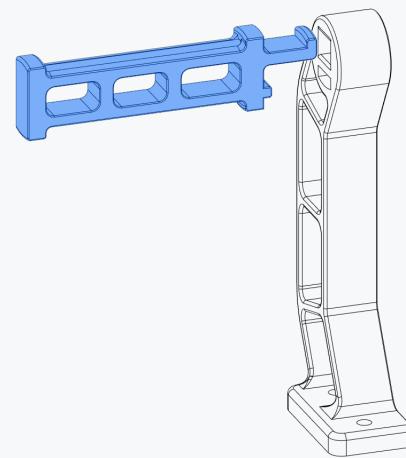
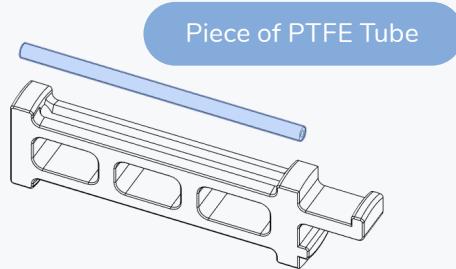
FINAL TOUCHES

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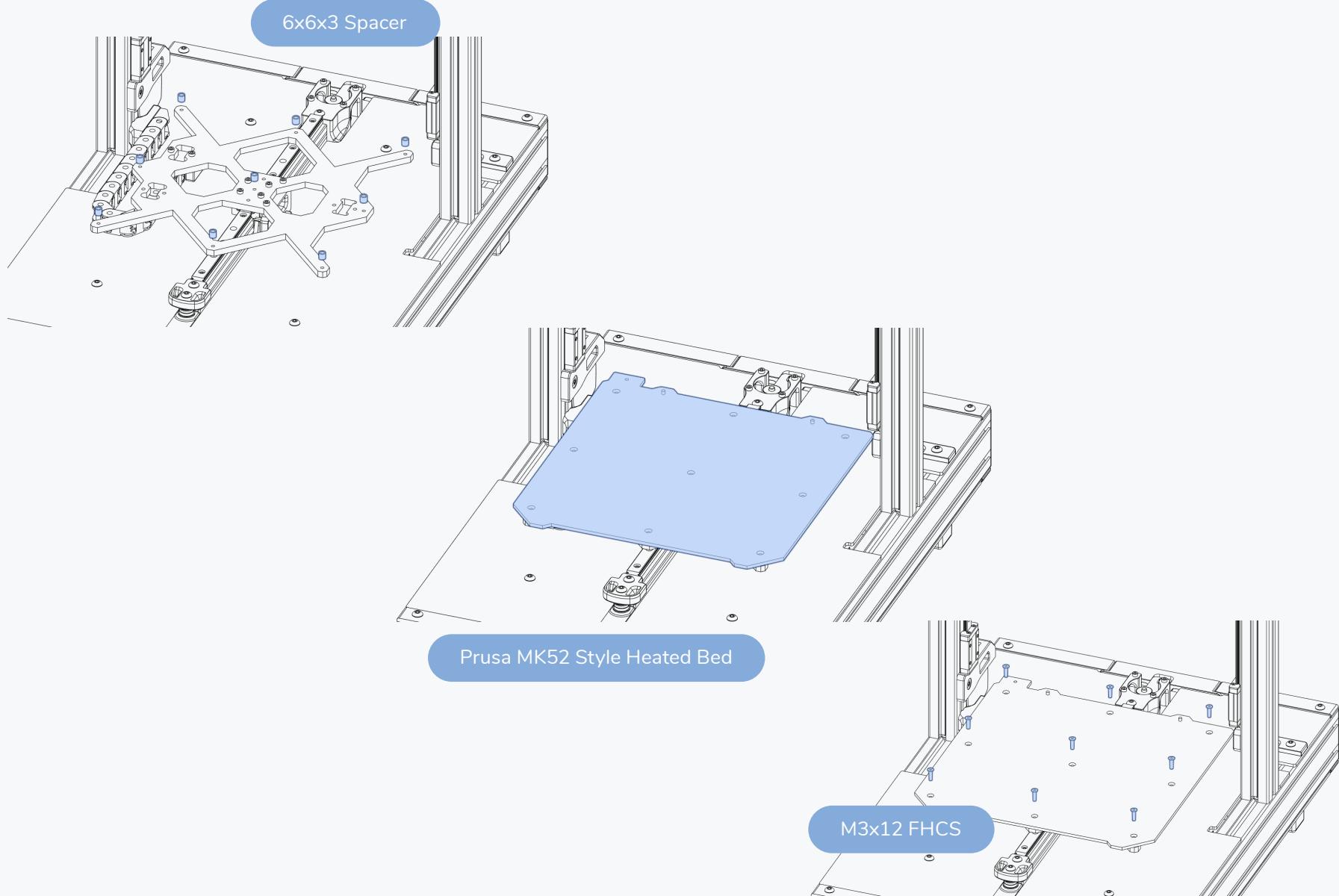
SPOOL HOLDER

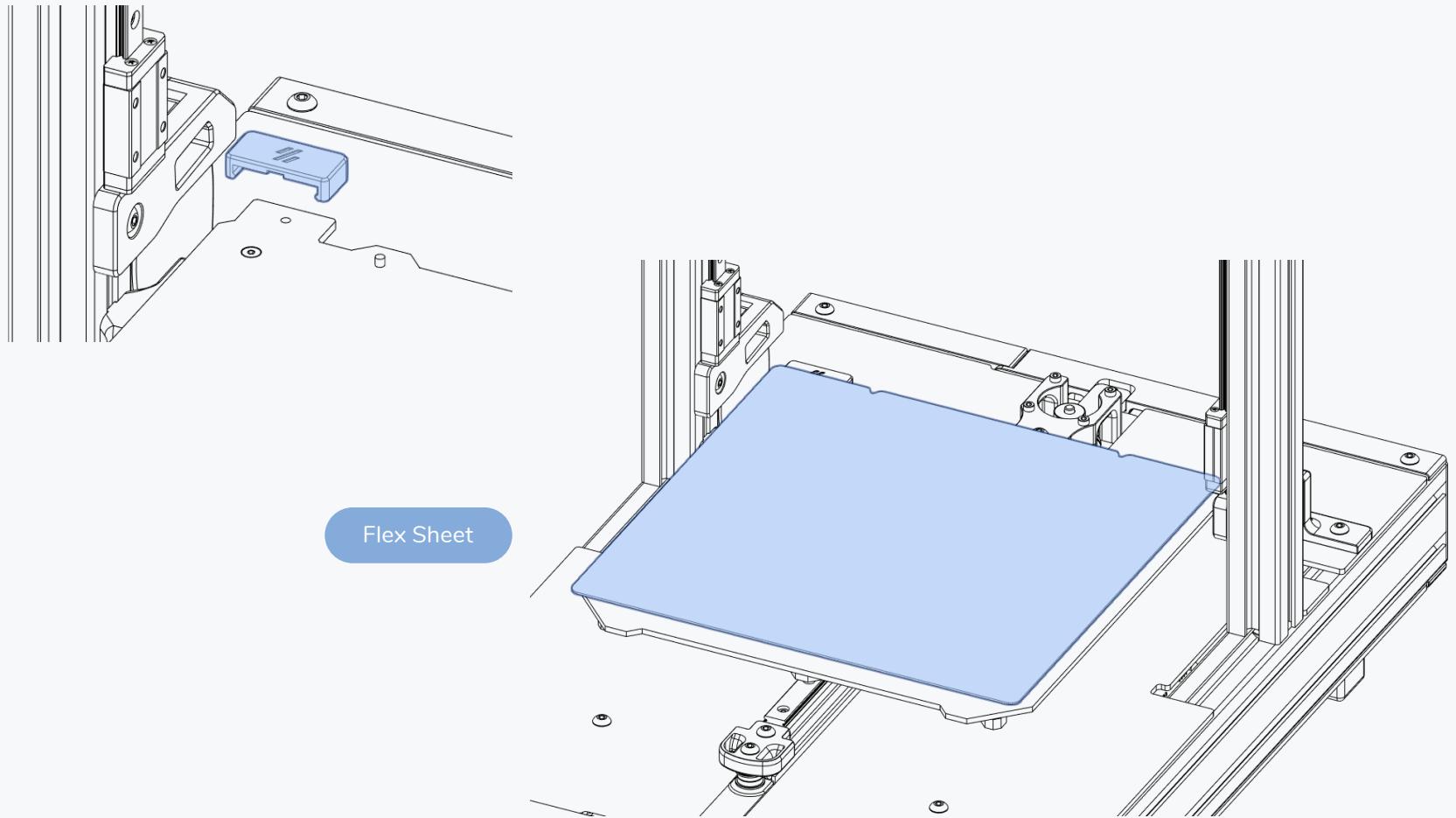
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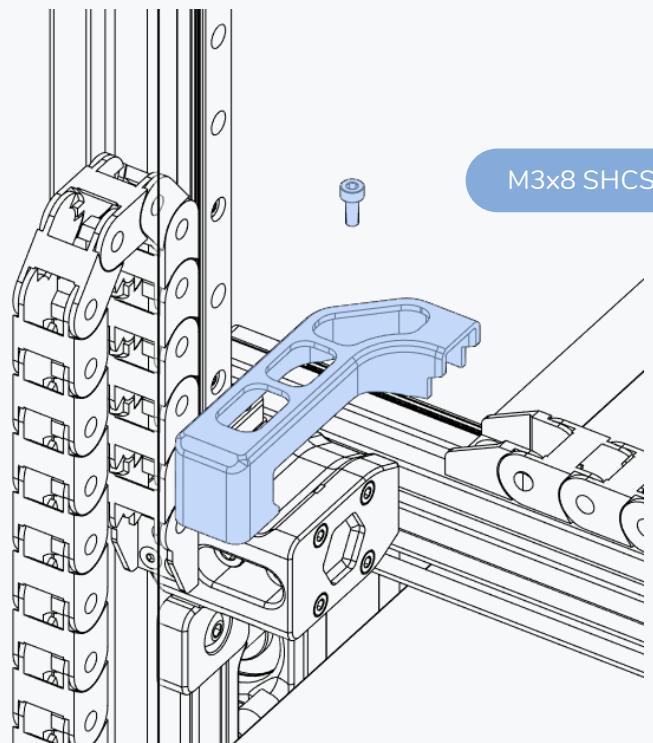


HEATED BED

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MECHANICAL ASSEMBLY COMPLETED ... NEXT STEP WIRING & ELECTRICAL

This manual is designed to be a simple reference manual for the build process. Wiring and the initial setup of your printer is not included.

For details on wiring, setup of the electronics and other initial steps of your new printer please visit our documentation available on github.



<https://vorondesign.github.io/Voron-Documentation>

<https://github.com/VoronDesign/Voron-Switchwire>

HOW TO GET HELP

If you need assistance with your build, we're here to help. Head on over to our Discord group and post your questions. This is our primary medium to help VORON Users and we have a great community that can help you out if you get stuck.



<https://discord.gg/voron>



Website
www.vorondesign.com

Github
<https://github.com/vorondesign>

Discord
<https://discord.gg/voron>

