BRS-AWD v1.35a Drive

Evolutions

Rédacteur	Responsable	Qualité
FBR	FBR	FBR

Indice	Date	Description de l'évolution	Auteur
1.0	01/08/2023	Création / POC	FBR
1.1	17/08/2023	POW	AVJ
1.2	20/08/2023	Release	FBR
1.32	11/09/2023	Manual 1.0 release	FBR
1.33	18/09/2023	Corrections / SFUs	FBR
1.33a	04/10/2023	Rear mirroring details / BOM	FBR
1.34	Unreleased yet	« No-coupler » version a (still work in progress)	FBR
1.35a	05/12/2023	Nema mount reinforced + shapes modified	FBR
-	05/04/2024	Manual updates after feedbacks	FBR

Etat	1.0	1.1	1.2	1.35a	
Statut	POC	Fonctionnel, POW	Release	Main revision	

BOM :

Printed parts list

Lower part R (All variations)	X1 Only for Stock VC
X1 Only for Stock VC	X1 Only for Stock VC
Upper Part R (All variations)	X1
Upper Part L (All variations)	X1
Bearing Lockers (All variations)	X3
Nema top holder	X2
Nema Mount	X2
Retainer 1204 L	X1
Retainer 1204 R	X1 Only for Z-Upgrade
Retainer 1605 L	X1 Only for Z-Upgrade
Retainer 1605 R	X1 Only for Z-Upgrade
Underplate 1204/1605 L	X1 Only for Z-Upgrade
Underplate 1204/1605 R	X1 Only for Z-Upgrade

Hardware

Heat inserts M6 Short	X4 (For open version)
Heat inserts M4 Short	X4
Heat inserts M3 short	X16
M6x40	X4 (For open version)
Tnut M6	X16 (+- depending the variations)
F695-rs	X12
M3x12	X14
Shoulder bolt 5x35mm m4	X4
8x5x1mm microshim	X5
GT2 9mm Pulley	X2
5mmx(60/65mm) steel shaft	X2
Micro shim 1mm	X15
M6x12mm	X20 (+- depending the variations)
M3x30mm	X10
NEMA 17 (same as your back Nema)	X2 (Not in BRS Orders)
Driver (same as your back Nema)	X2 (Not in BRS Orders)
Nema Cable	X2 (Not in BRS Orders)
Countersunk M6x12mm	X0 / x4 (depending the variations)

INTRO:

The BRS-AWD Drives feature an integrated 4 motors solution, adaptable to ANY Vcore 3.x iteration, with or without enclosure, without any structural modification needed. The time to set it up will be between 1-2 hours depending the skill level.

What are the advantages of an AWD setup?

Having two motors on one belt allows for a shorter effective belt length. This leads to less belt stretch, which usually gives better input shaper results.

The maximum useable acceleration is about 1.5x higher compared to 2WD due to the added torque.

I recommend using the LDO-42STH48-2504AC or 2504AH 1.8deg motors, as they give the best performance ratio

This upgrade is based on high quality hardware, with a specific attention to the quality of the motion; Precision Shoulder bolts, ABEC 5-7 Bearings, and Precision GT2 pulleys! Motors are silent with the decoupling (you can use N17 dampers on this mod, like the M2 L3ver).

The Installation is the same regarding the Opened Frame, Closed frame, VC 3.0 and 3.1 iteration. Here for the sake of the example the manual is made upon the VC3.1 Opened version! I will track the R block here, the L block follow the exact same symmetrical assembly.

Some pictures of this manual can be from older revision, It won't affect the logic of assembly.

In this manual, There is 2 big installatios sections,

-I/ DIY for everyone making themselves the kit

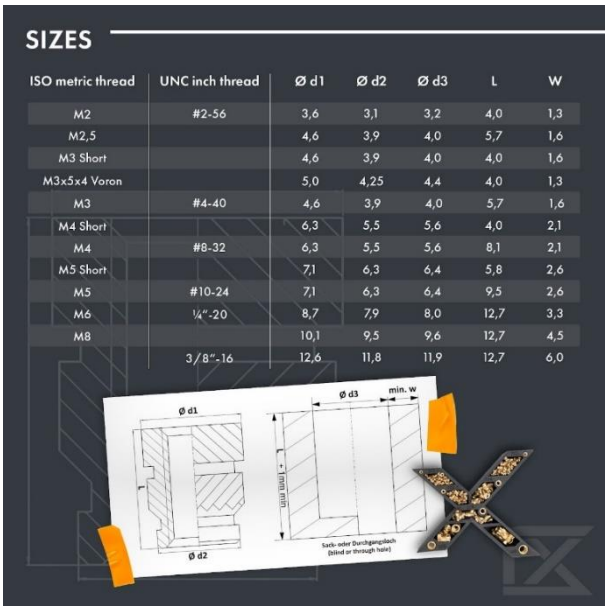
-II/ BRS Ordered, dedicated to those who bought theproduct in the BRS-ENGINEERING STORE.

In any cse, both methods are globally the same, you can use the content you want to recheck anything

INSERTS:

Be aware the CAD has bee made upon Ruthex Heat inserts. Some insert you may have may not fit the holes. Here a diagram used to check dimensions of yours

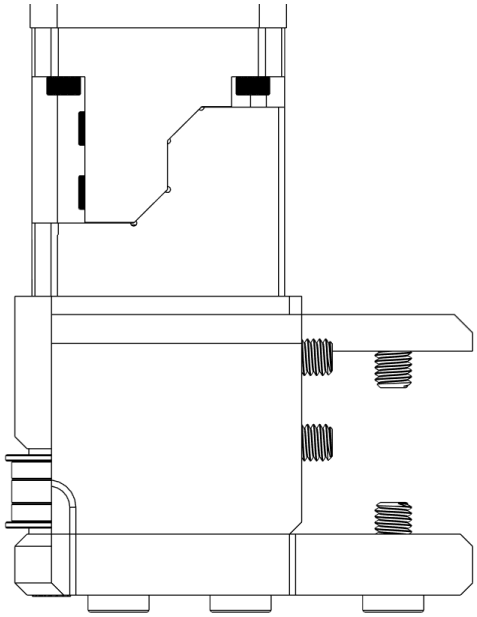
BE CAREFUL DON'T OVERTIGHT THEM, INSERTS ARE NOT DESIGNED FOR THAT



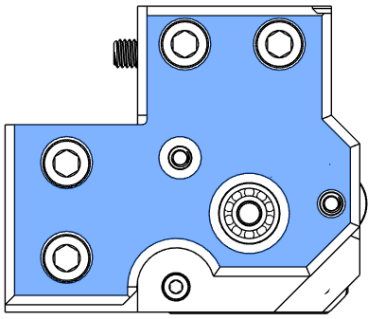
V1.35a Changelog

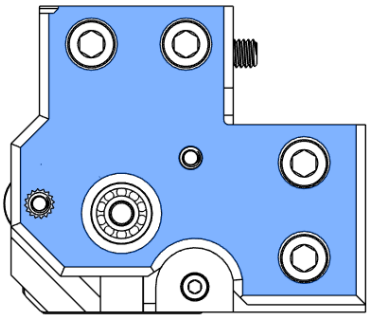
-[aesthetic] Edges optimized

-[fonctionnal] Notches added to comply with the handle of the front door



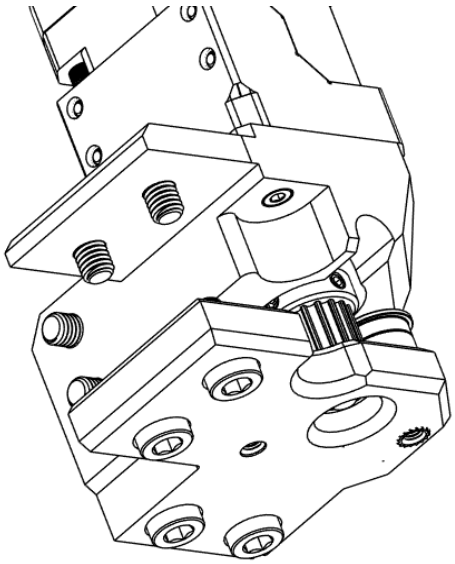
-[aesthetic] M6 head holes refited to a smaller design

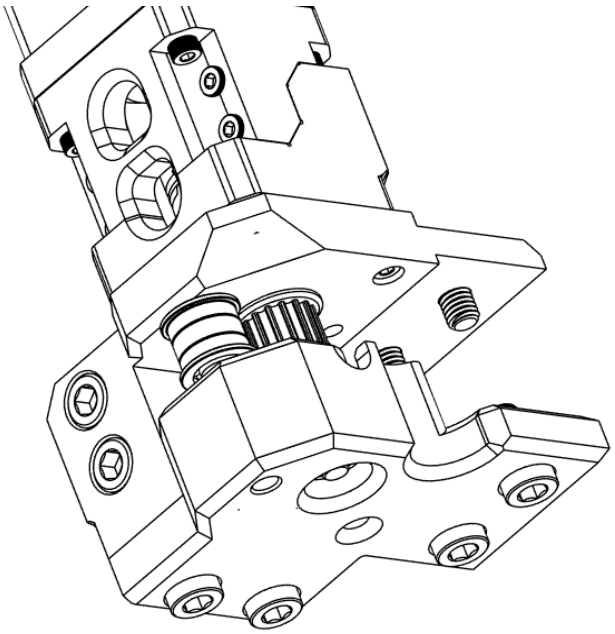




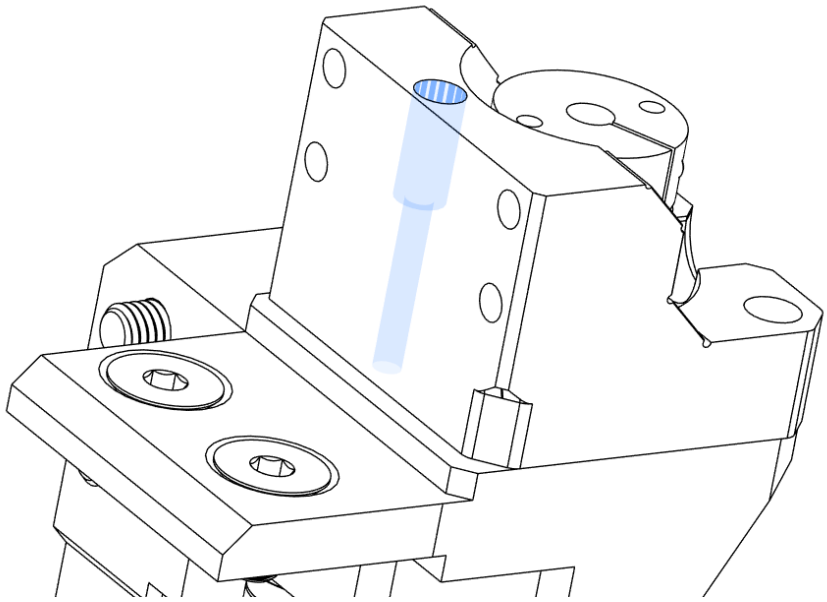
-[aesthetic] Shape redesign, less material, less volume

-[confirmation] EVA 3.0 toolhead does comply with a full stock print volume, no X or Y loss except for front lateral probe position. Relocation of the probe will make you recover the few mm of X loss. (BEACON/ rear EUCLID probe advised)

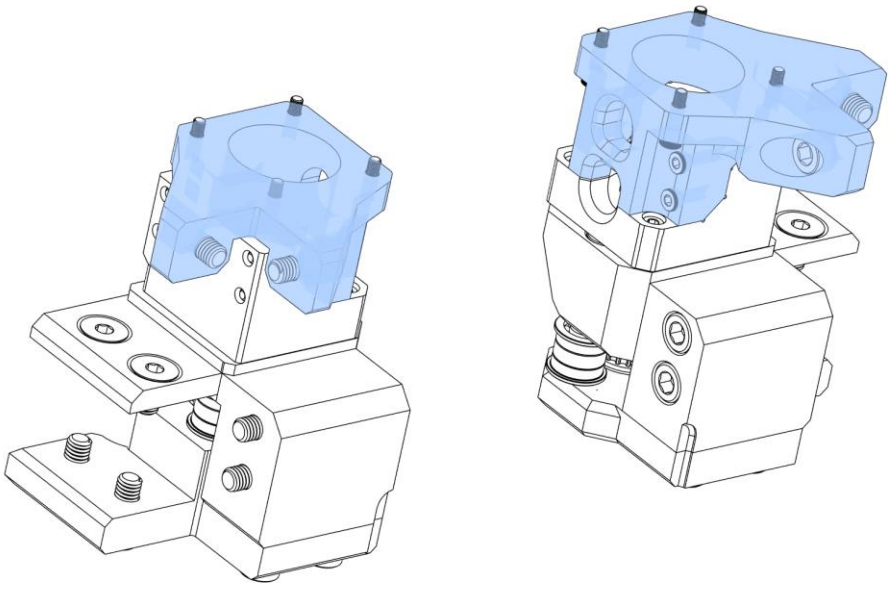




-[aesthetic] some small internal dimensions changes, some simplifications over the overhang positions

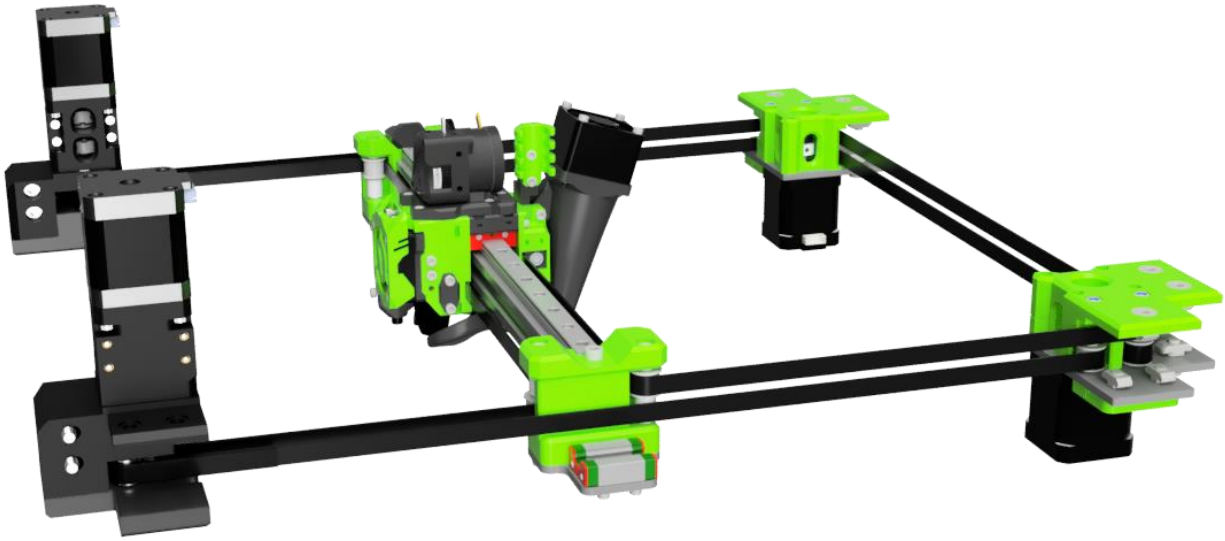


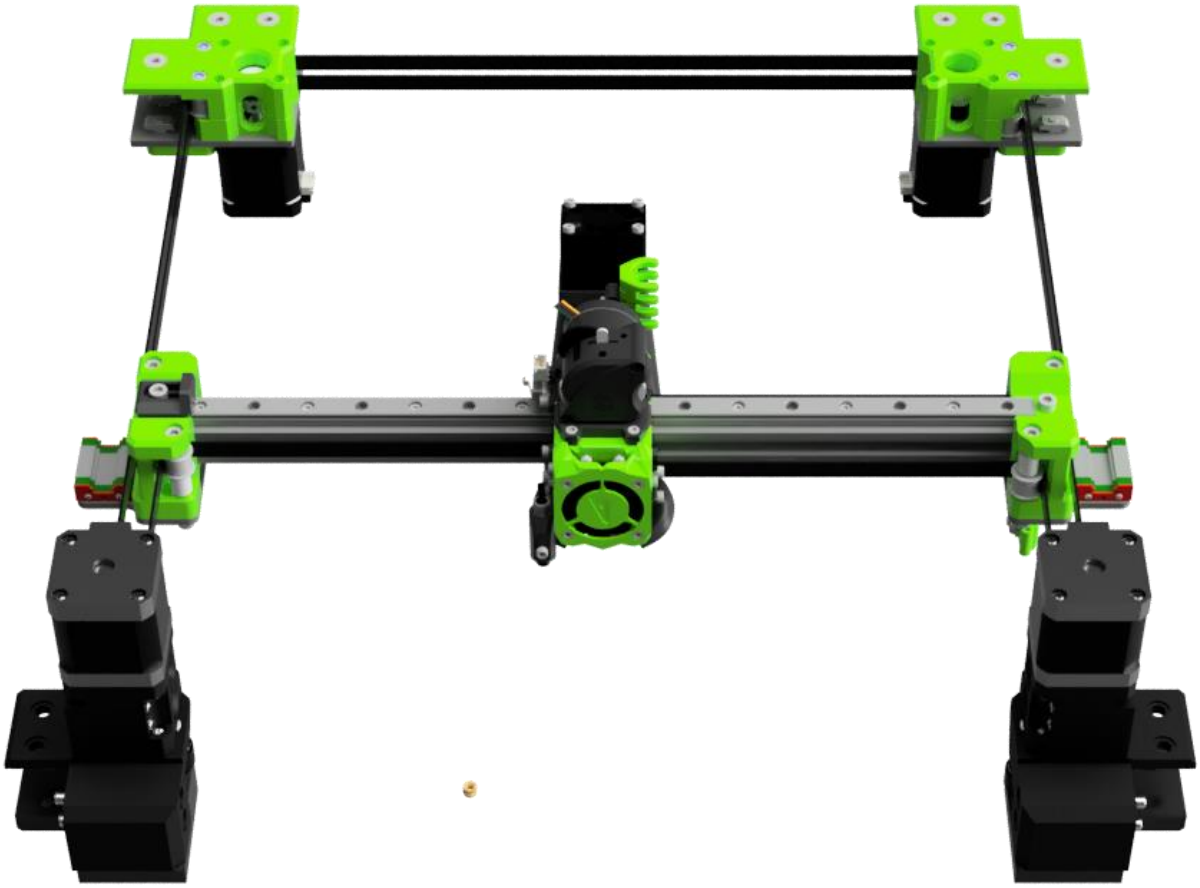
-[fonctionnal] Add of a m3x30mm screw to add an anchor point of the motor block, total of 4 fixations instead of 3

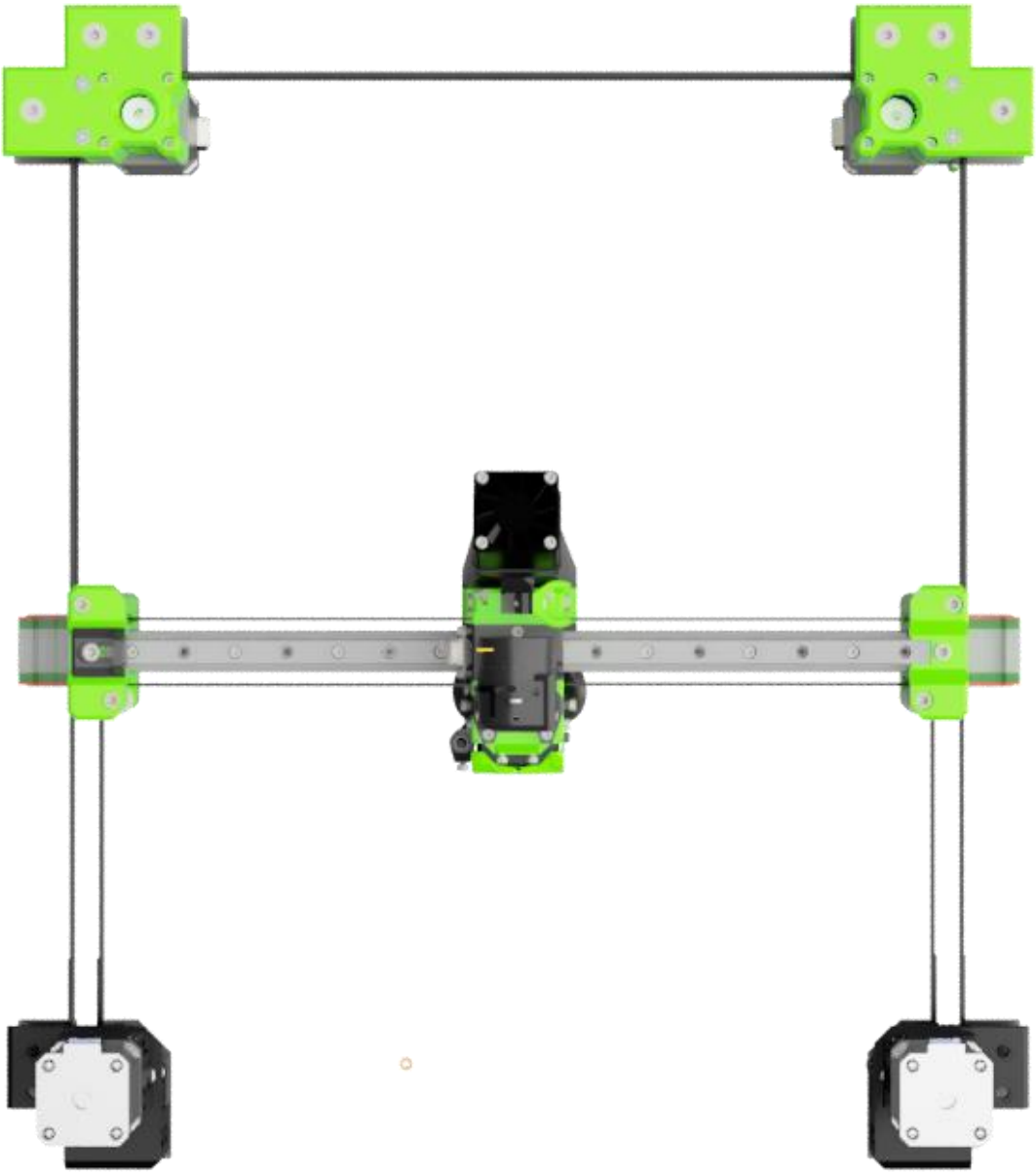


New Nema top holder for a reinforced mount

GENERAL OVERVIEW





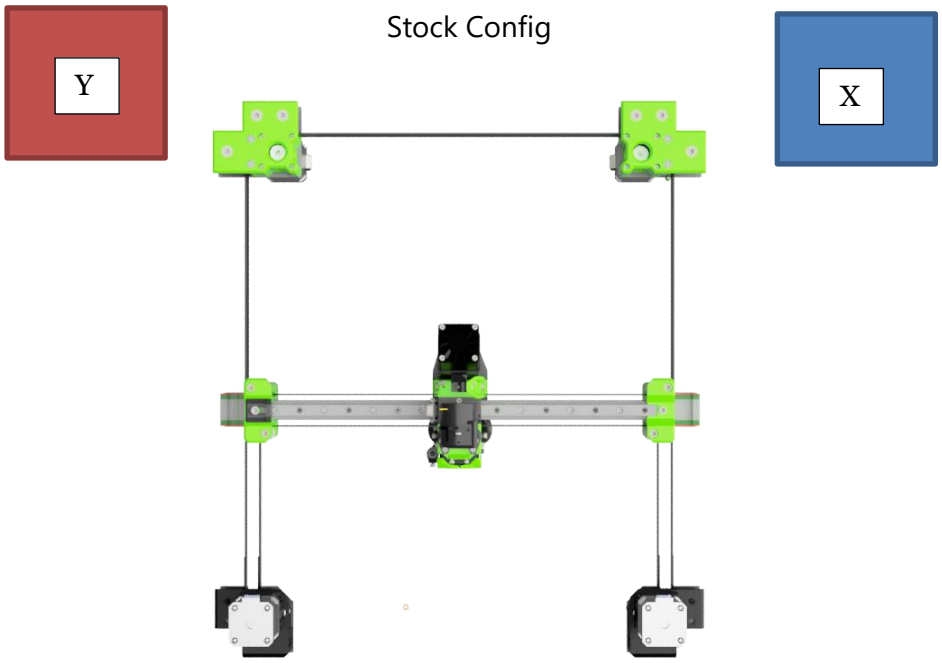


First thing first!

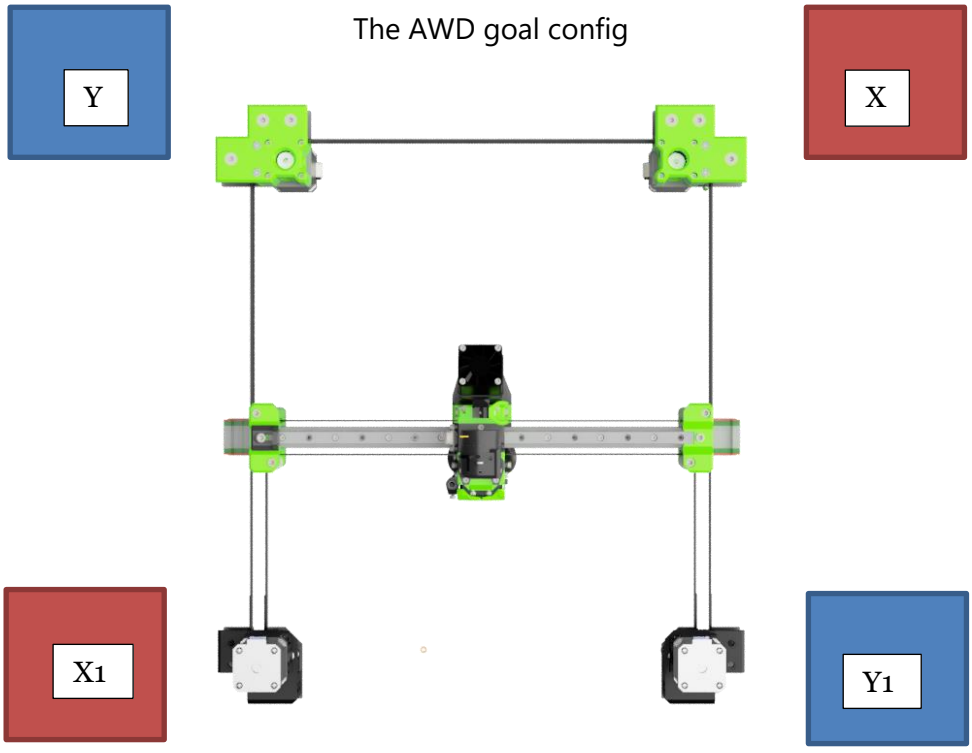
The **RED** case represent to Upper belt

The **BLUE** represent the bottom belt

Stock Config



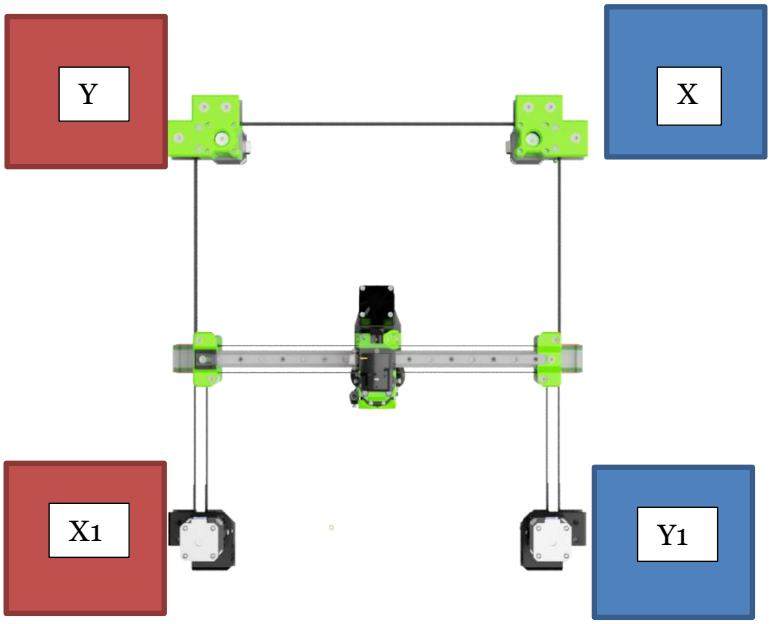
The AWD goal config



In the Stock Vcore, The rear block are not fit to drive the belt in the diagonal setup from the previous figure. Because the belt drive is wrong to setup the AWD in a diagonal layout

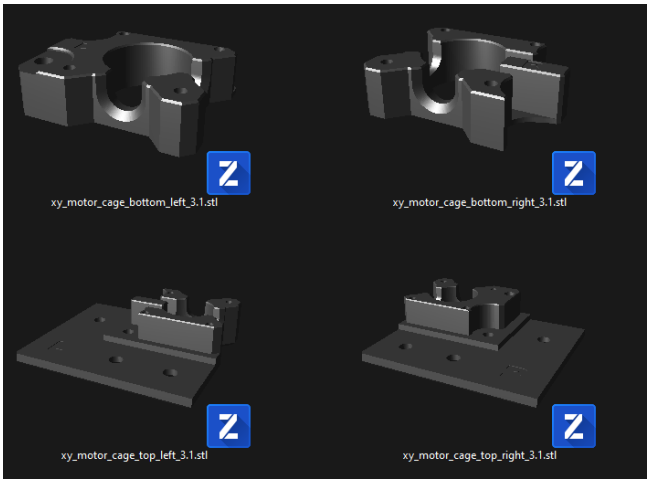
X1 needs to second X on the bottom belt, Y1 need to second Y on the upper belt

Here an exemple of what we will have if you install the AWD without mirroring the rear blocks: **THIS SETUP IS WRONG**



You will need to mirror the rear parts of the block to be able to drive correctly the thing

If you have a stock Vcore with or without a L3ver M1 you have to mirror the next parts (CAD editor, or Slicer)



If you have the L3ver M2, You will need to mirror all parts of it to reach the same result

I have made a specific Store item to the conversion from a regular M2 to an AWD M2 layout

All customers who have bought the L3ver M2 CAD have received an Email with the mirrored version added.

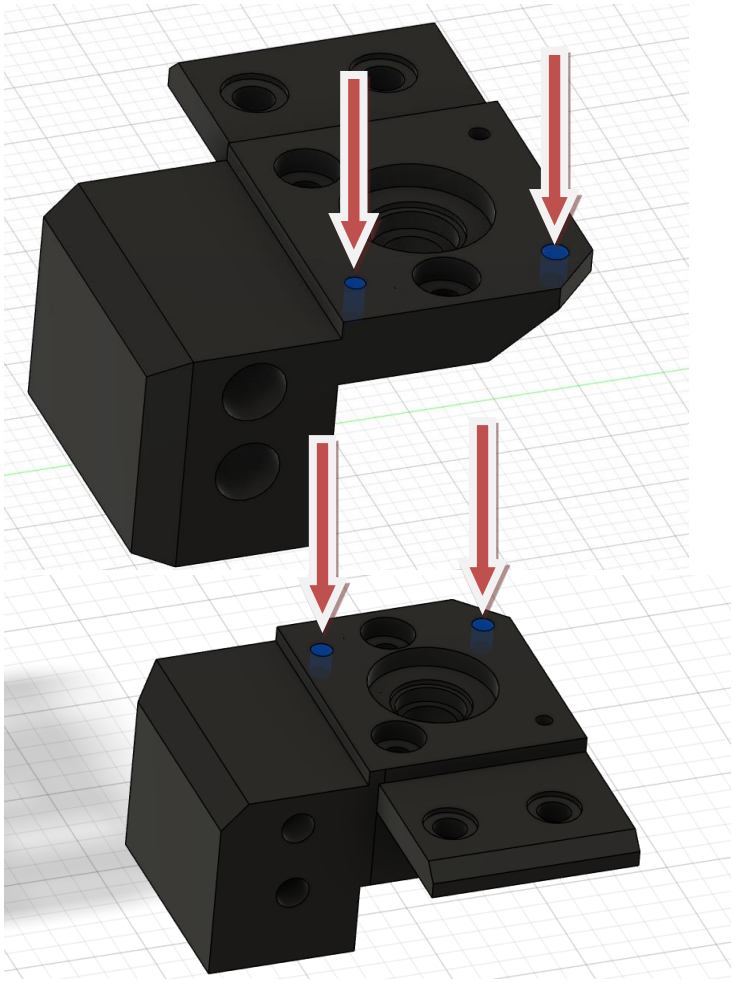
All customers who have bought the L3ver M2 product, and want to go for the AWD can reclaim the conversion parts with 20% of discount (Direct message to BRS-Engineering or Florent Broise)

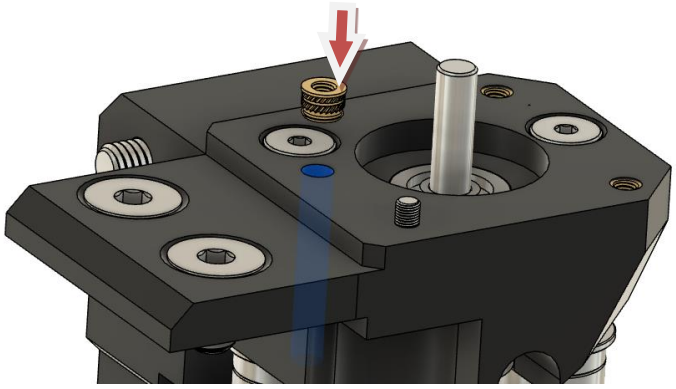
I-For DIY kit

1-Part preparation

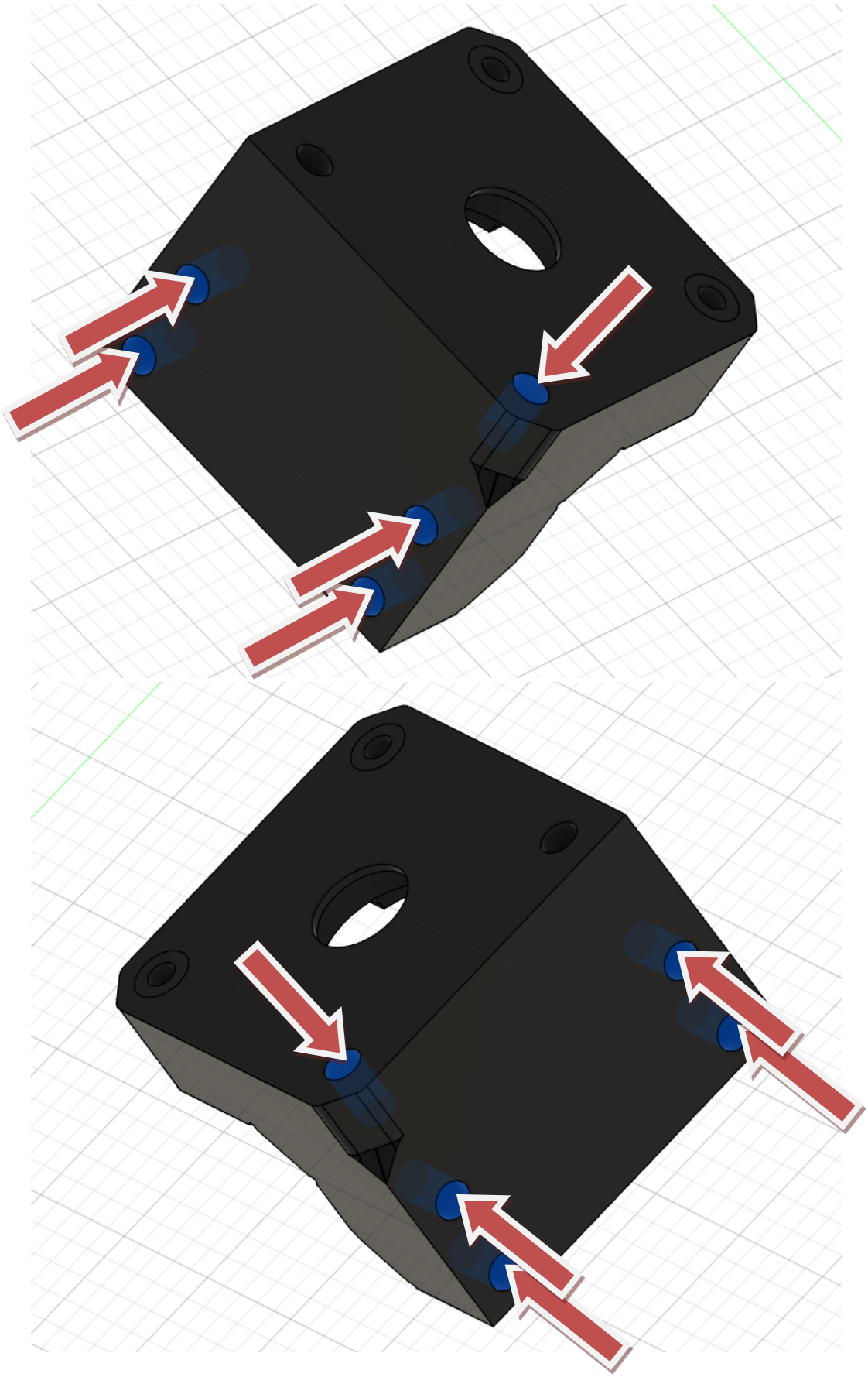
Before assembly, Install all heat inserts (for BRS Order it is already done)

Here All the M3



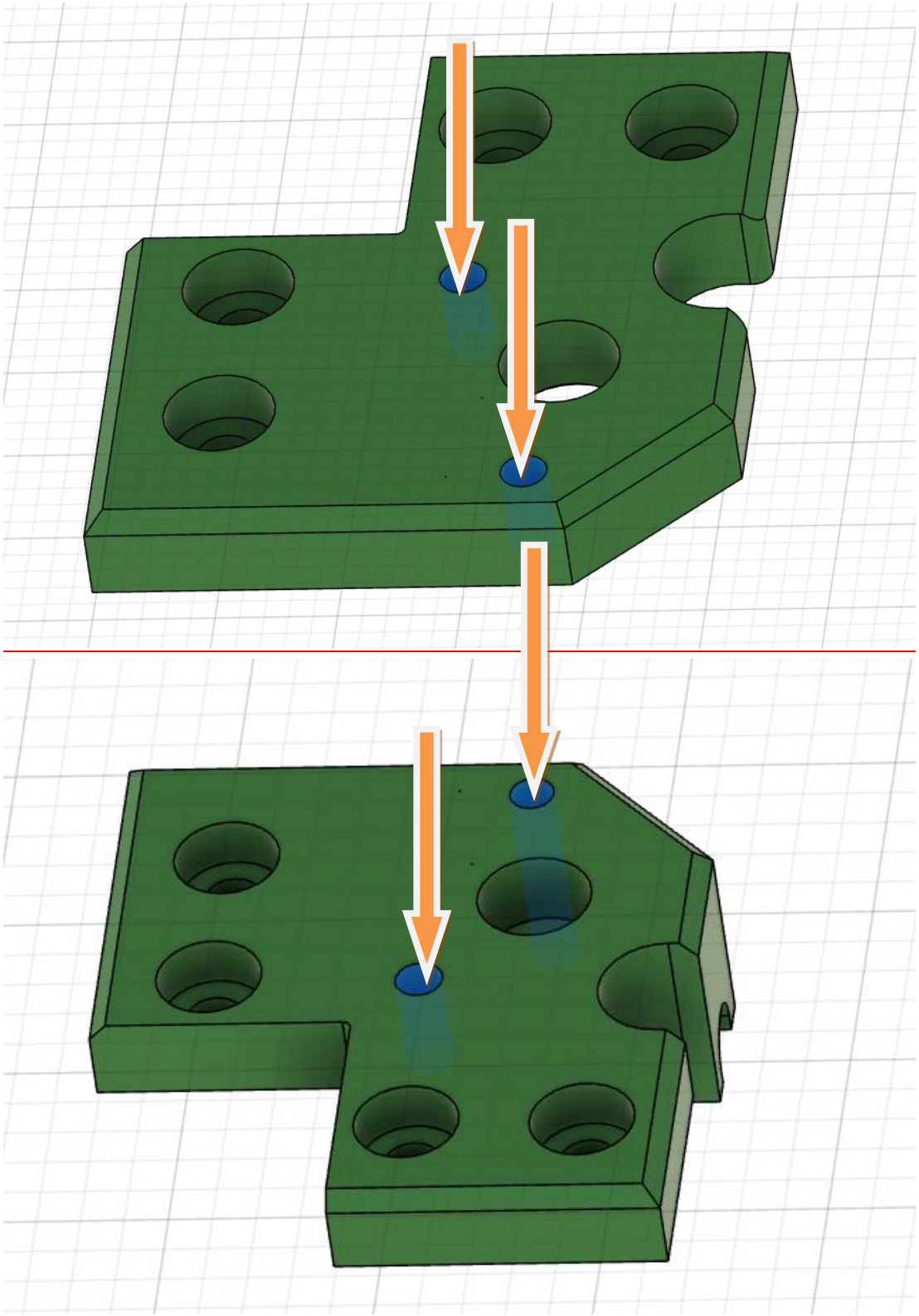


Since V1.35a, an additionnal m3 insert is needed here

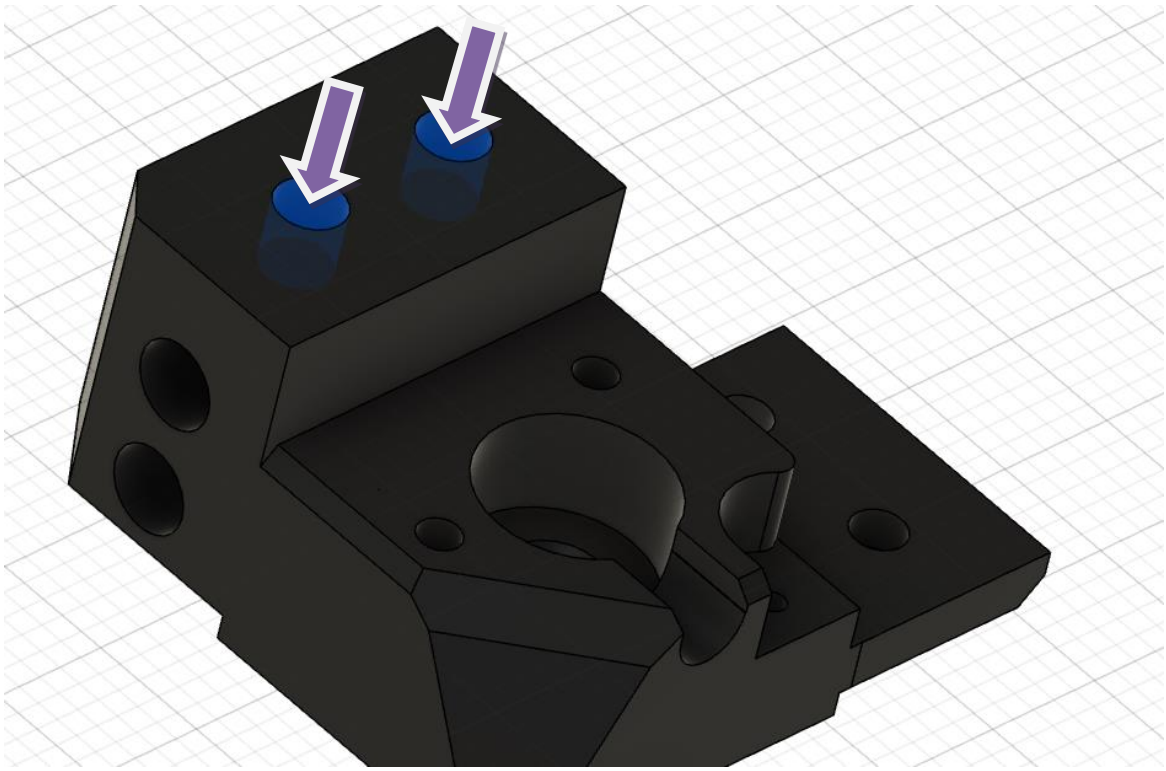


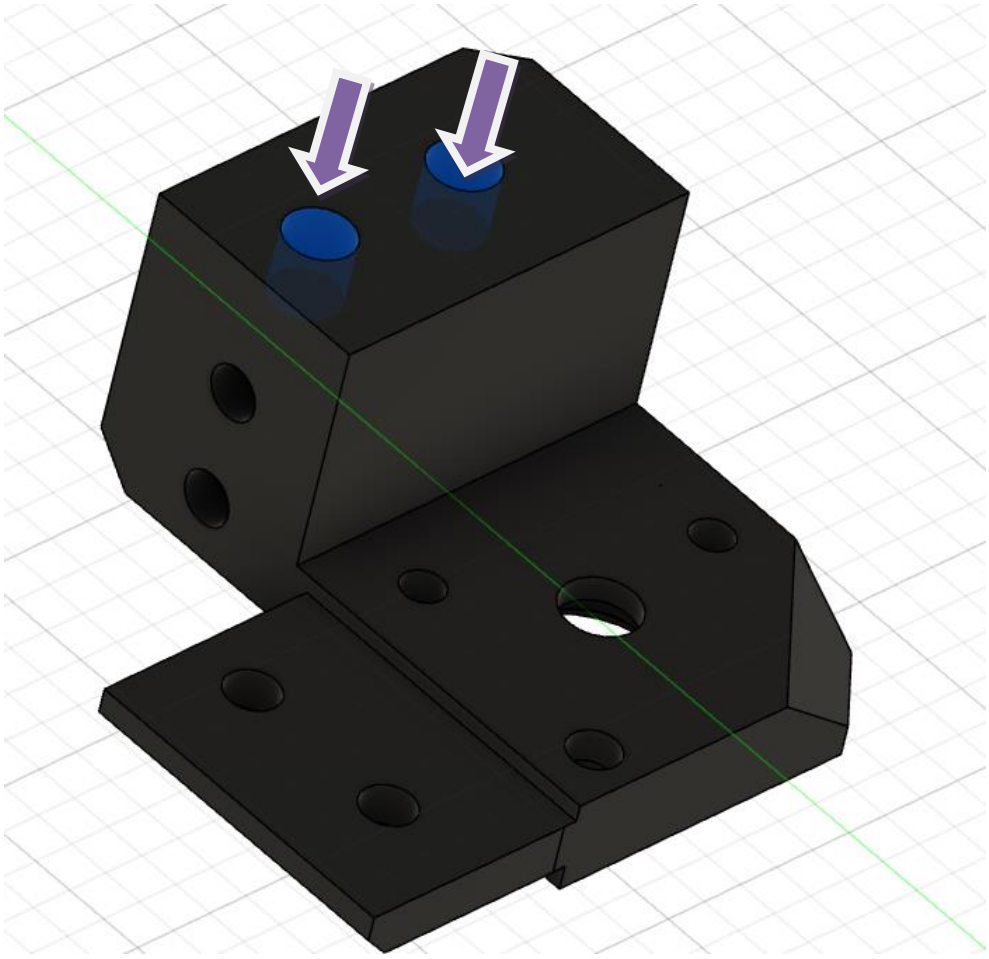
Here all the M4S (Short) **(Insertion FROM BELLOW)**

On BRS Order, You will find this insert not fully engage in the parts, It is mainly because some shoulderbolts can have different threadlenghs, and we need some clearances.

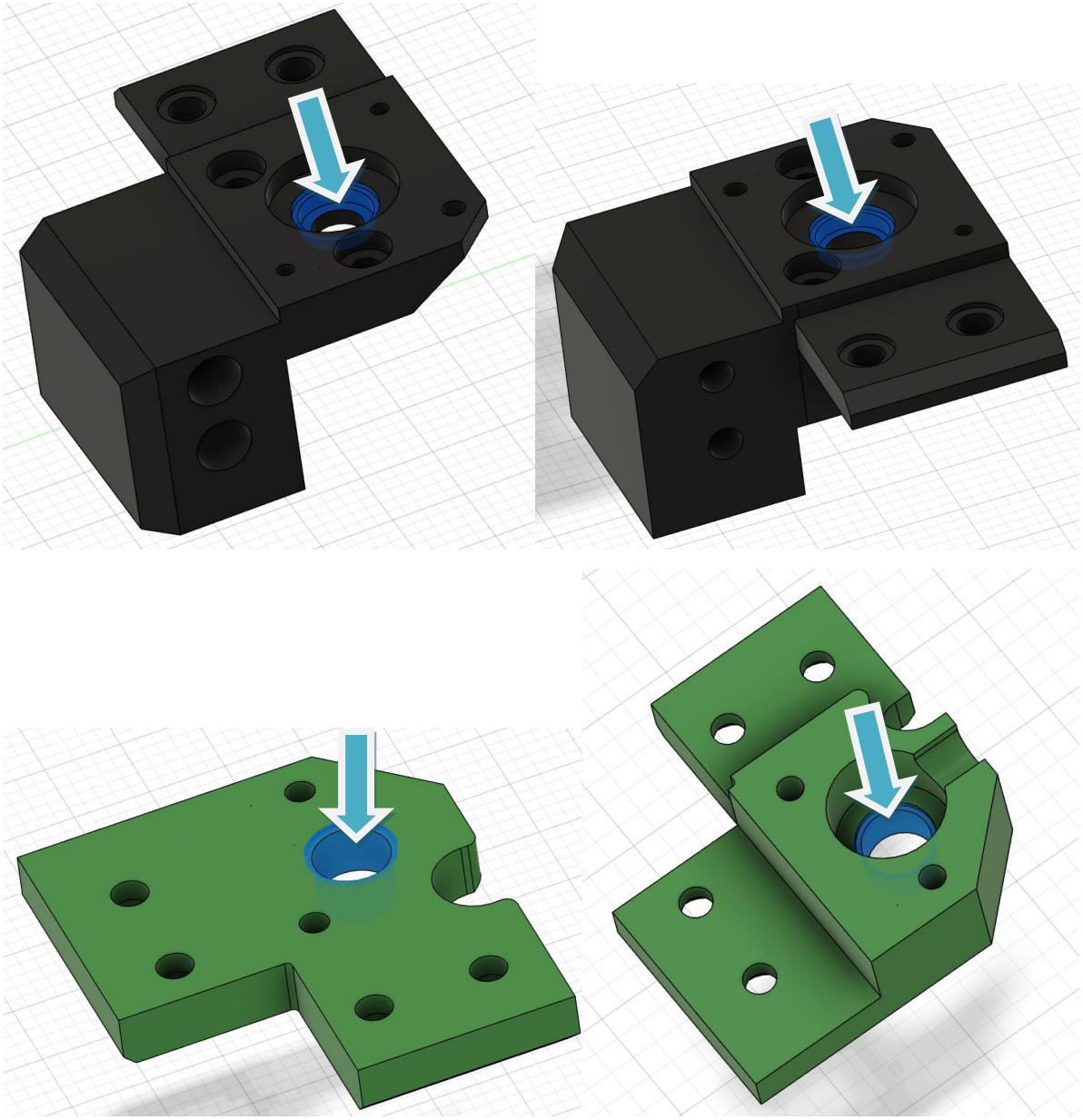


Here all the M6s (Short) (For opened version ONLY)



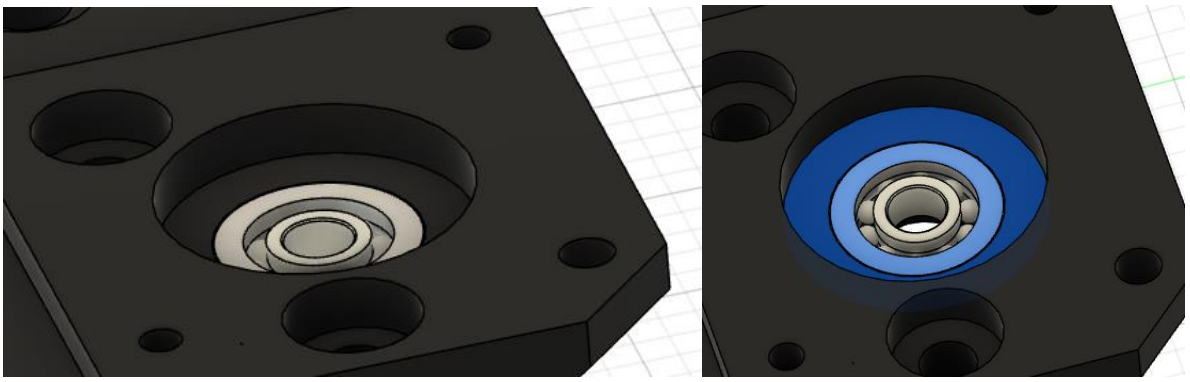


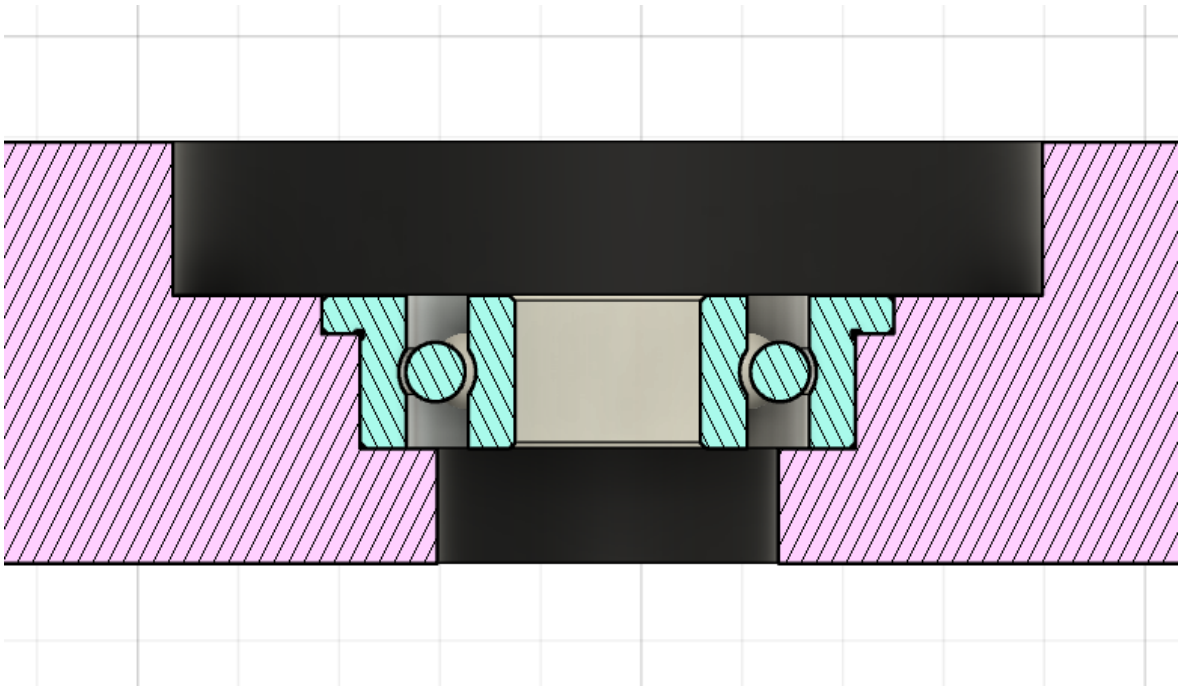
Bearings and Locks



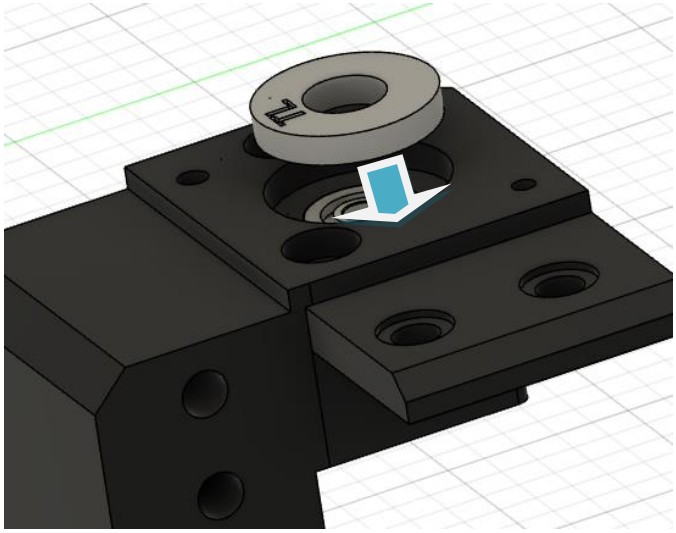
Each flanged spot on any Bottom and top parts need a F695 bearing installed here. You can use a 12mm cylindre tool (printed,...) to make the pressfit without damaging the bearings.

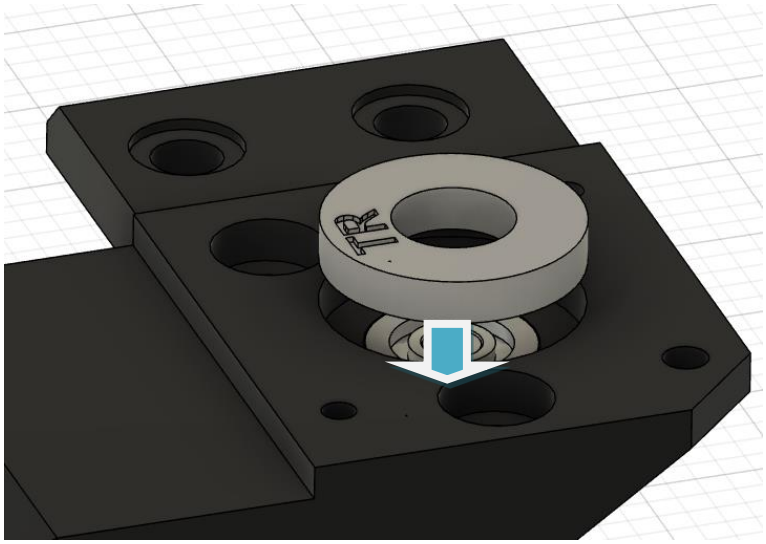
Bearing and laterial side must be flush in each parts

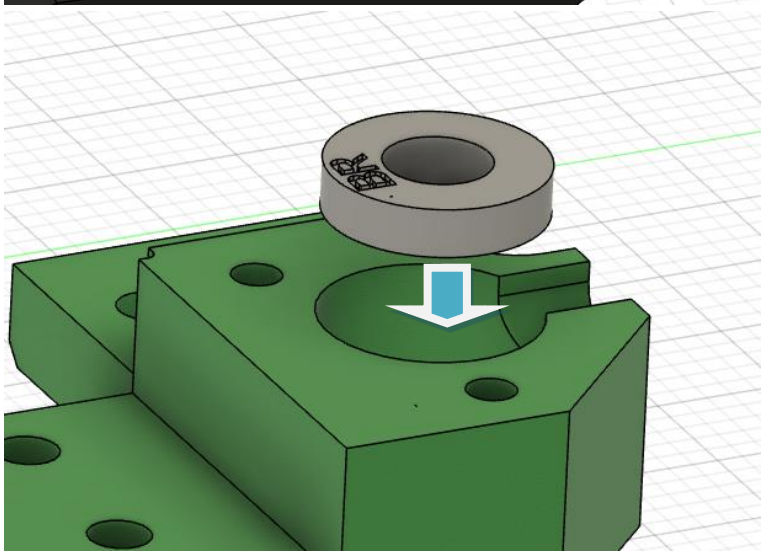




Once done you can install the Bearing locks, there is 3 of them



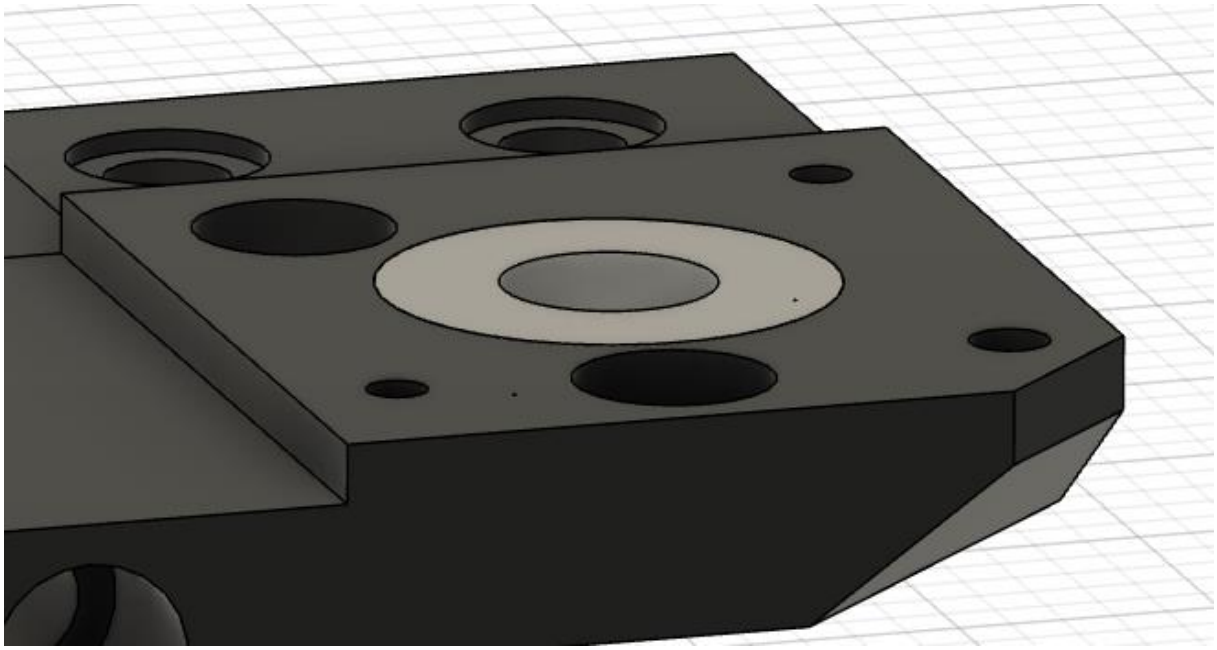


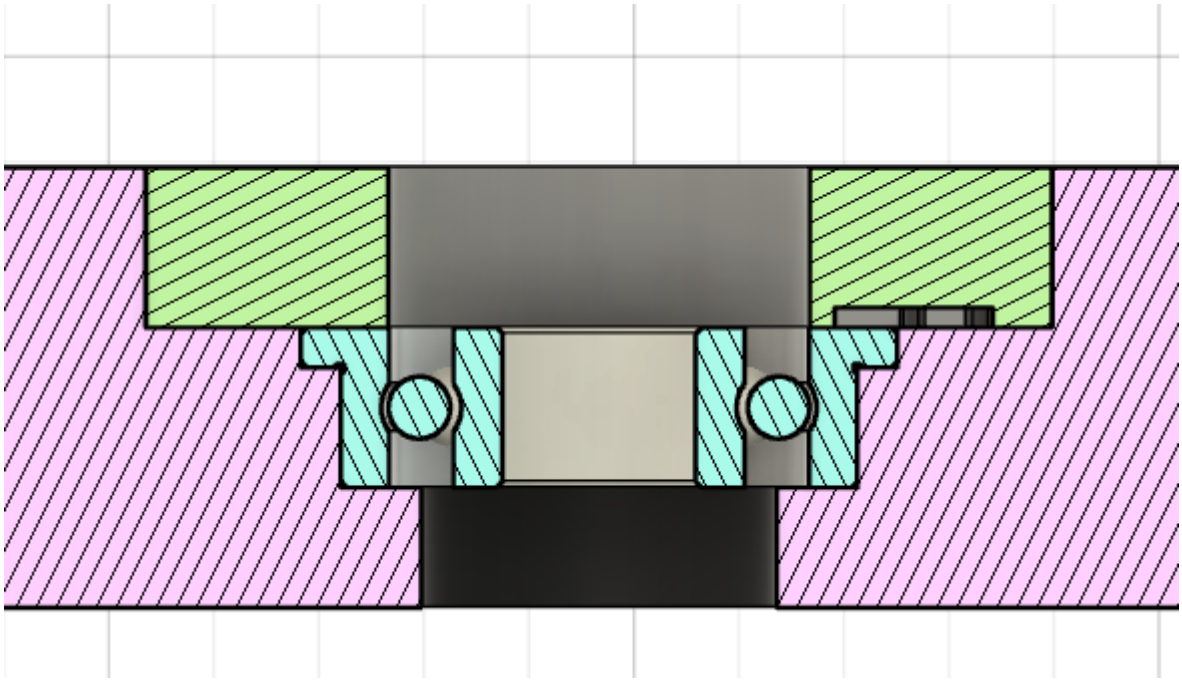


Now we need to pressfit them (Already done in all BRS orders)

Same logic, the top must be flush to the parts

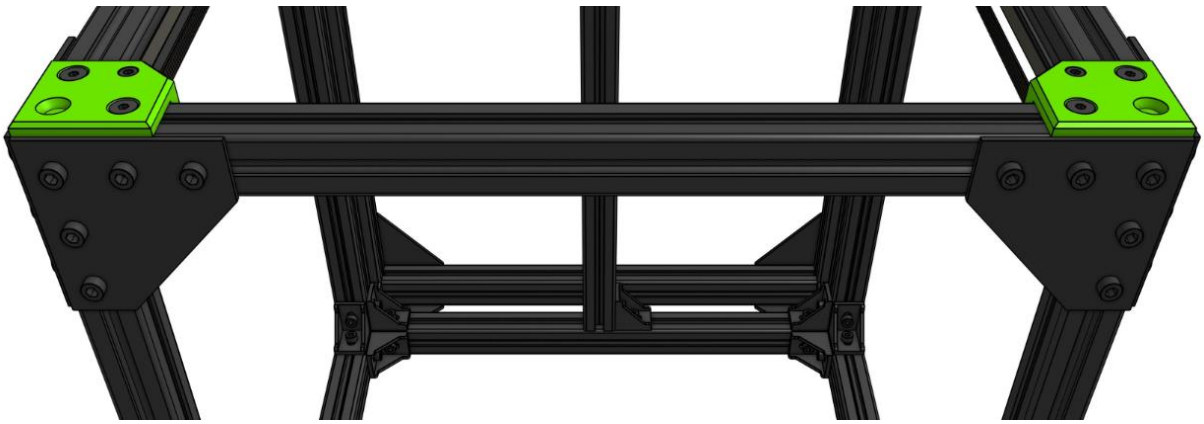
The goal here is to secure the bearing completely, I can be removed to make maintenance aftewards if necessary. It can be glue, howevert the top mount will fixe them in place



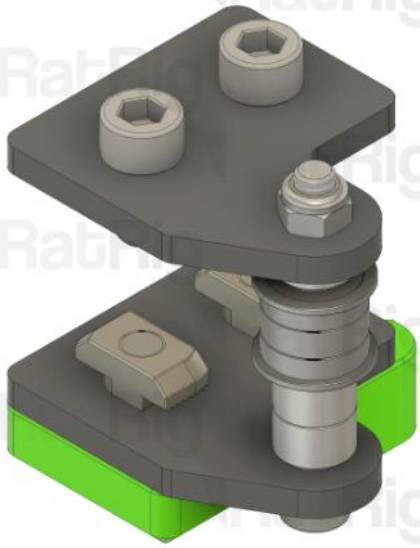


Prepare the front of the Frame

- For Vcore 3.0 you need to remove the corner idler assembly:

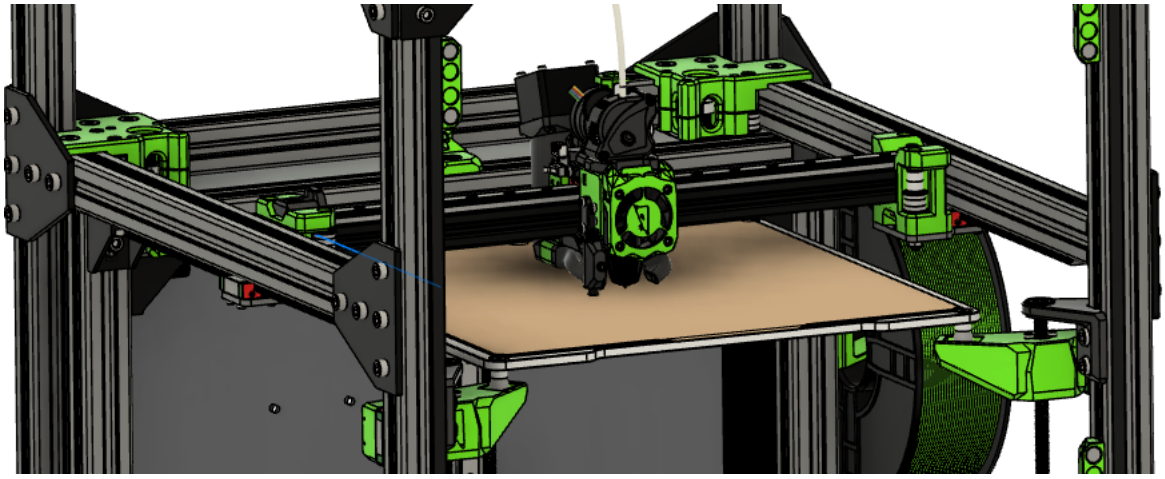


- For Vcore 3.1 and 2.0 frame extension, remove the idler in the front



- For the Z-Ugrade 2.0, remove the Top retainer parts + the idlers ensemble

2-General installation



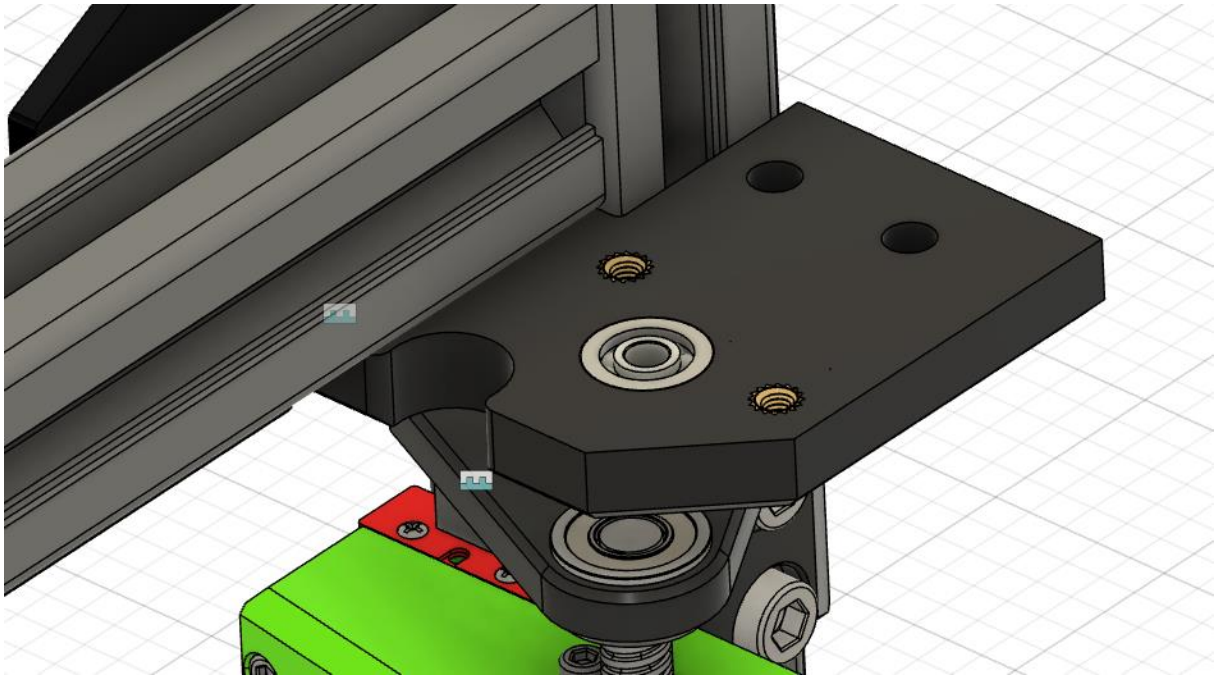
You should start with a clean empty front machine

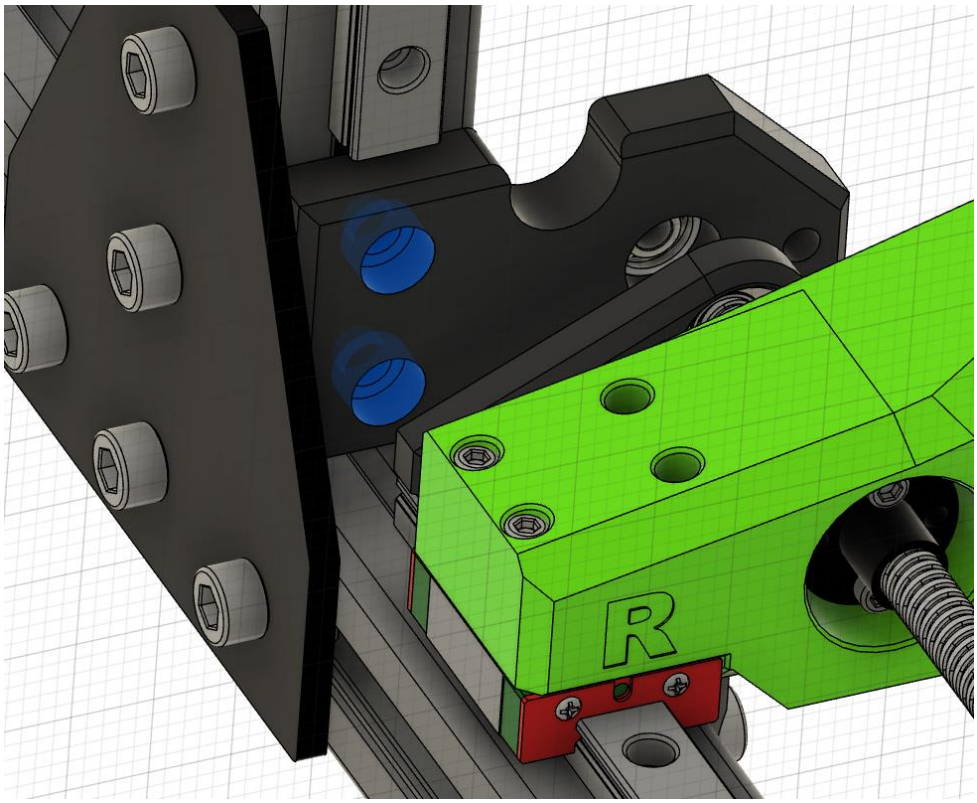
To ease the guide, I will remove some 3.1 part for a clear view

A/ Underplates

Slide the undeplate in the corner between the leadscrew retainer and the crossed frame join

Secure it with 2 M6 screws with according Tnuts

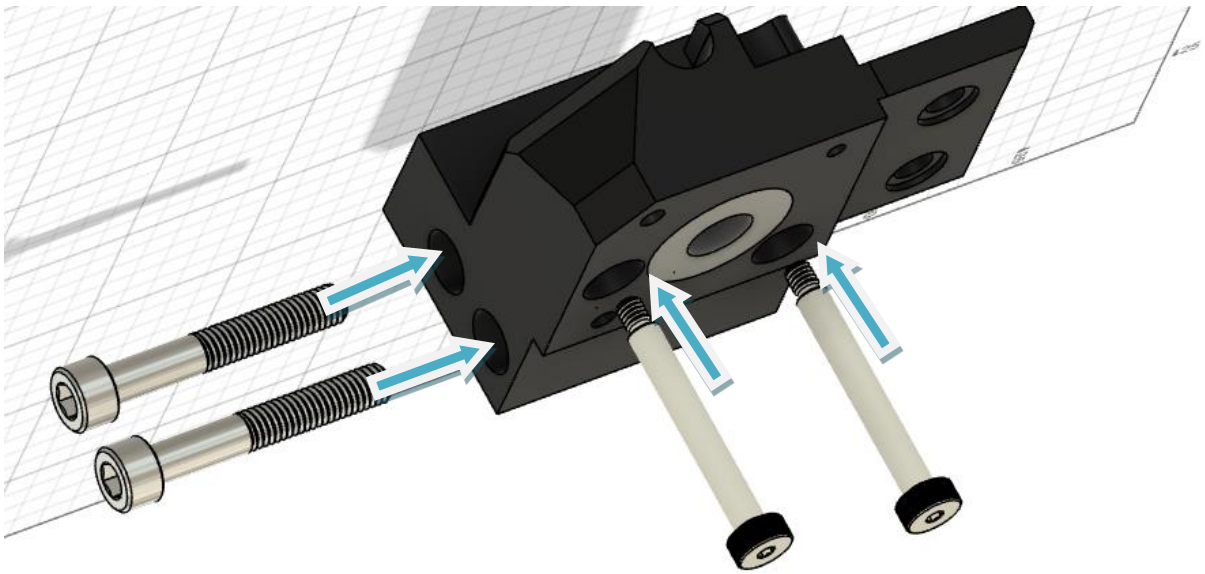


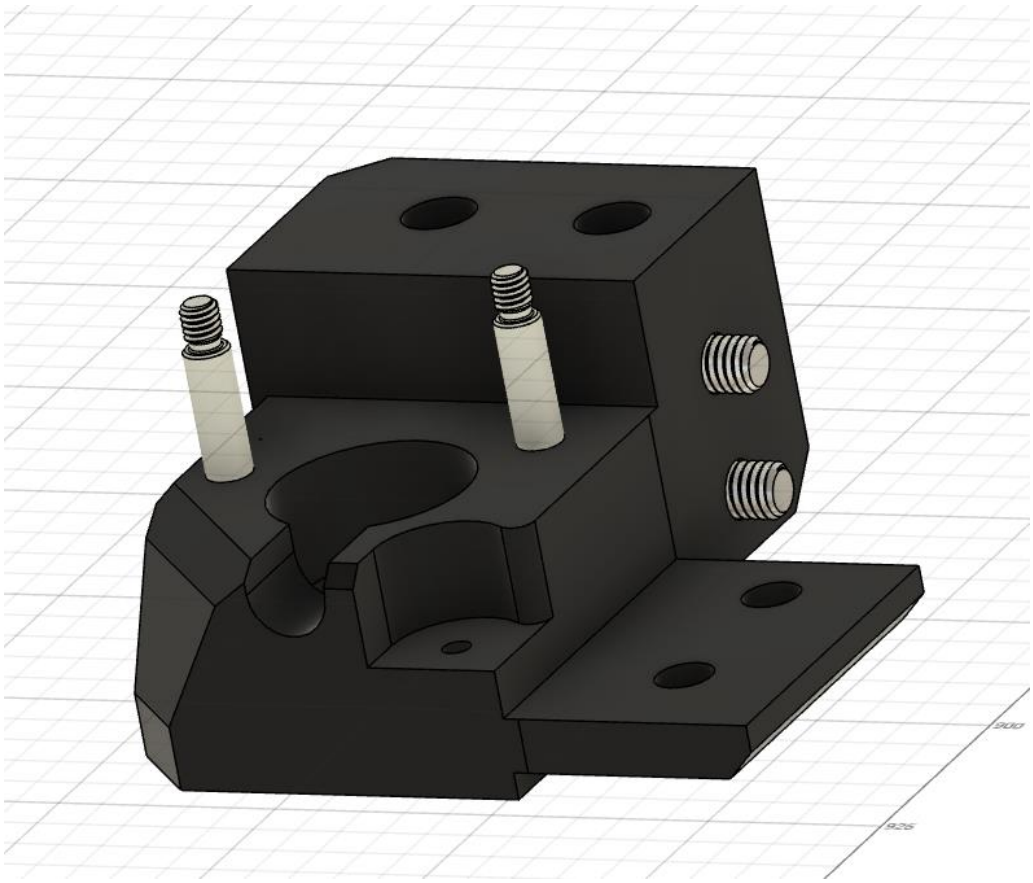


Repeat the operation for the L side

B/ Top parts

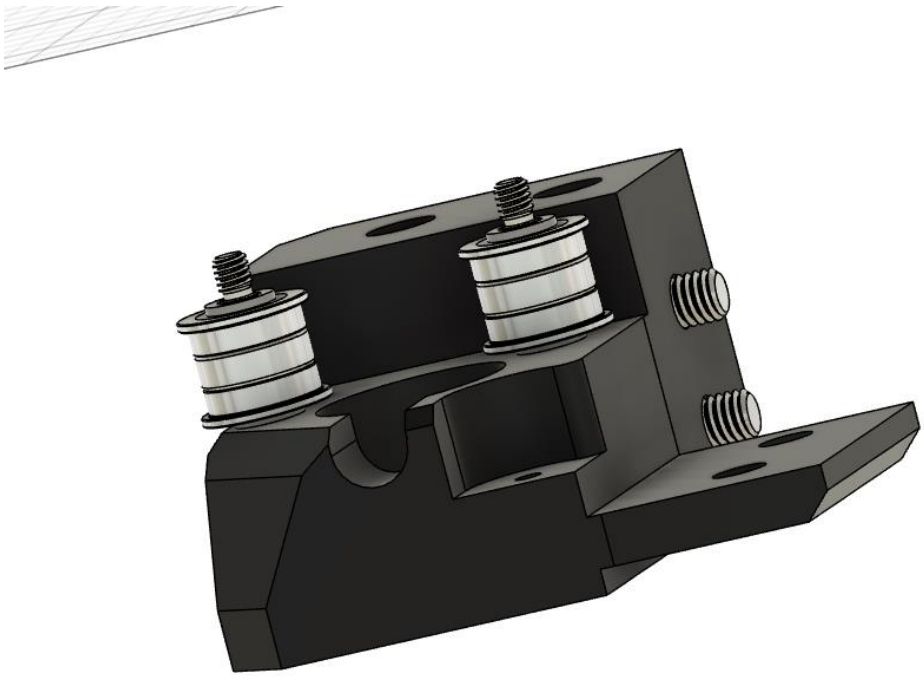
Here we need to install some Shoulderbolt and M6x40





Install 2 Stacks of bearings

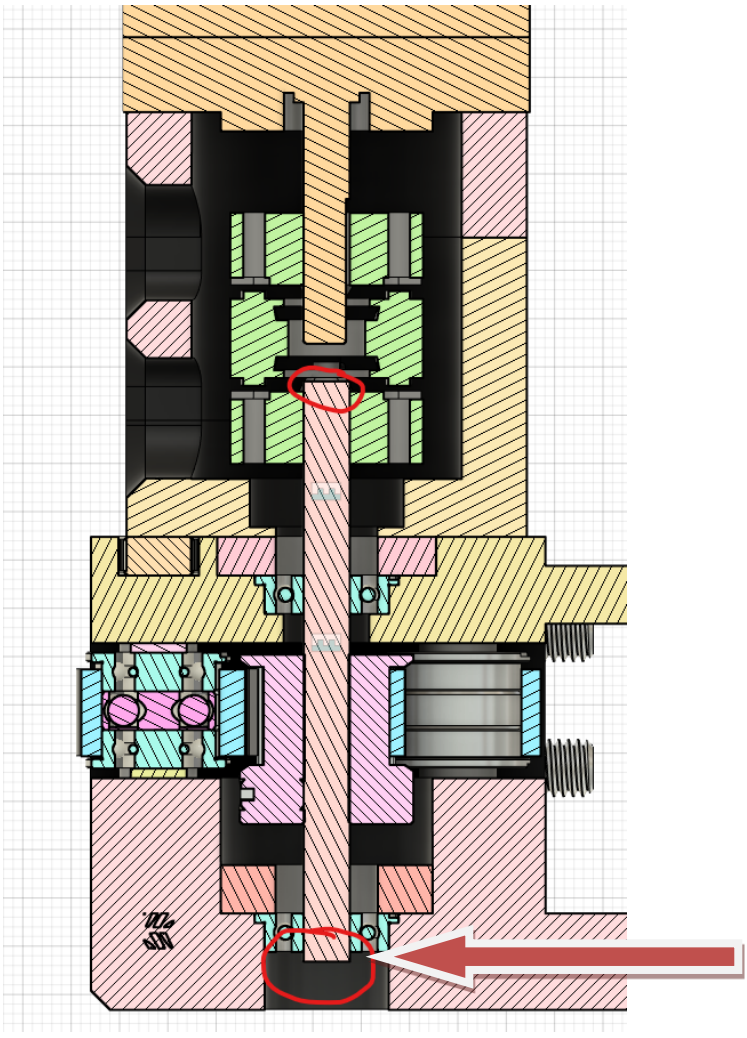
1 stack= microshim-F695-695-F695-microshim

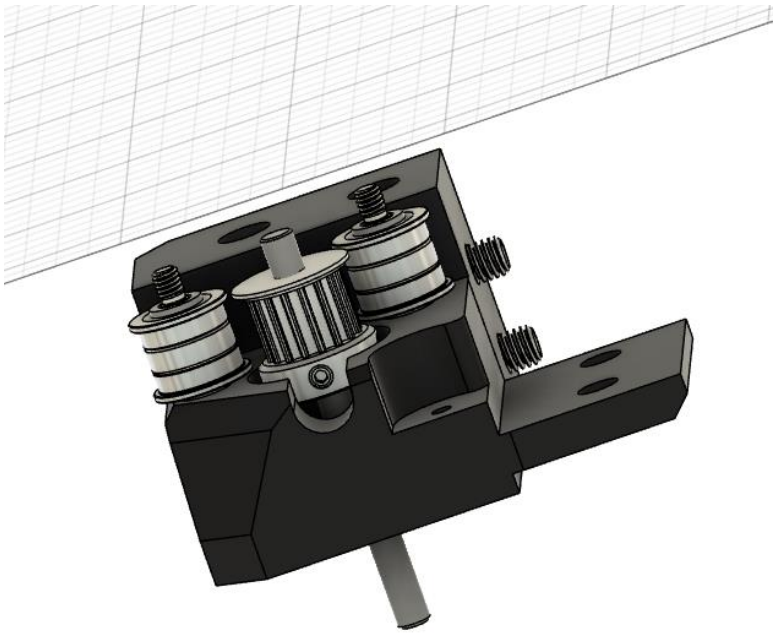


Install the shaft with the pulley

Note: Depending the Coupler outer size you are using, you can choose between 55, 60, 65mm long shaft

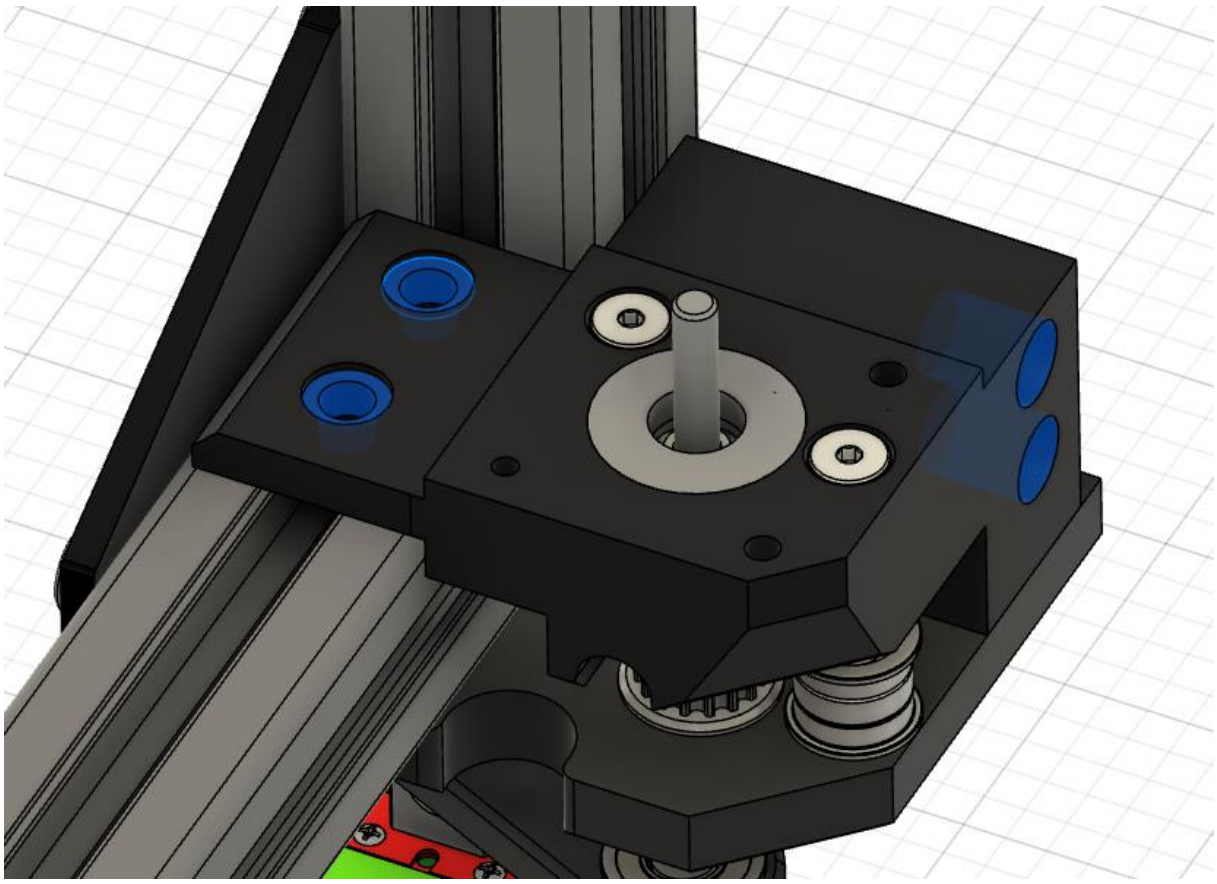
You only need to be sure the shaft is grabbed enough by the coupler used, ans be sure that the 2 F695 top and bottom bearing are on it fully:





Place everything and secure the assembly with the 2x Shoulder bolts

The 2x m6x40, and the 2x m6x14

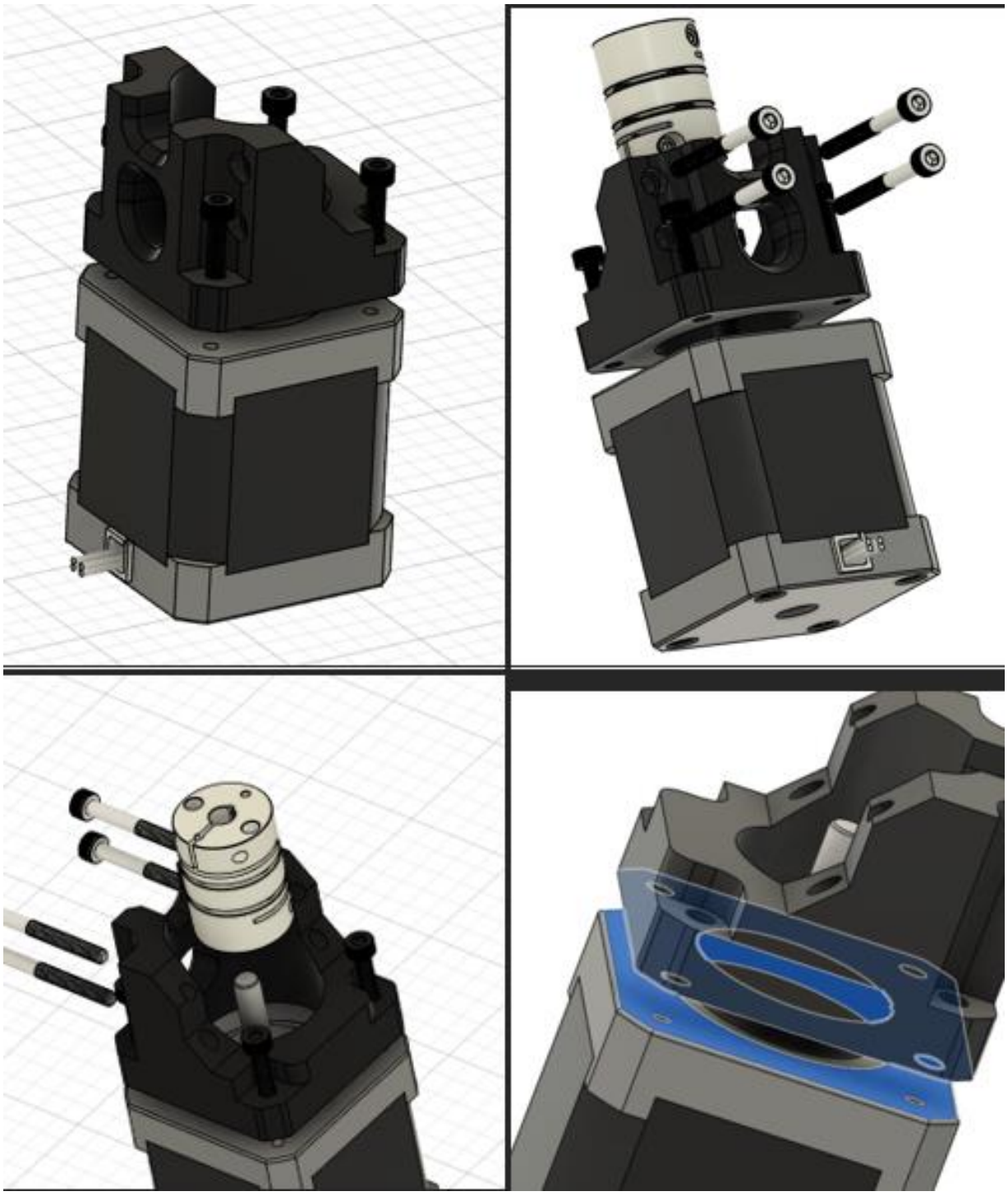


C/ Nema mounts

Install the Nema with the 4x m3x12mm

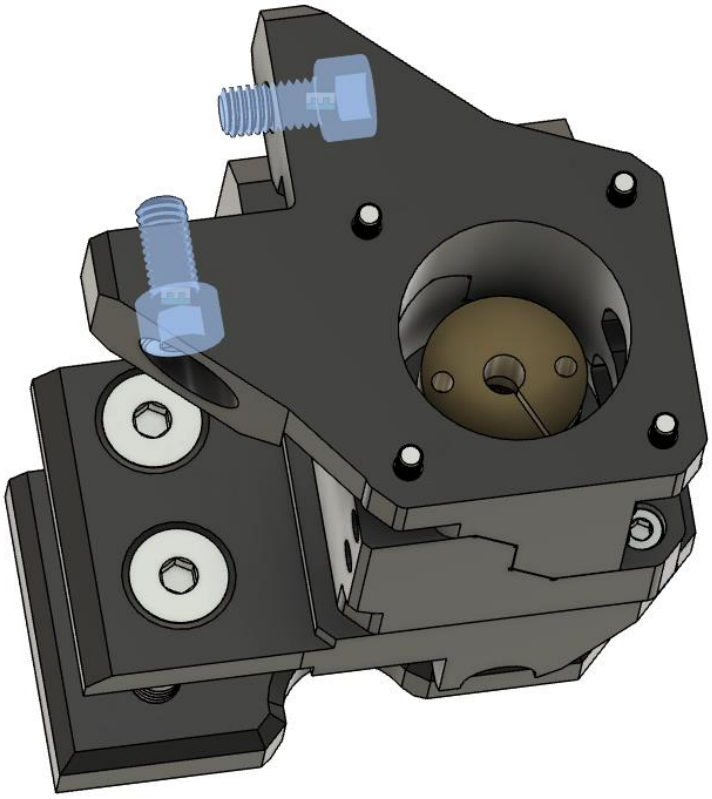
Preinstall the 4x m3x30mm

Between the NEMA and this block, you can install a damper, it is compatible



Since V1.35a, a new Nema holder is available to stabilize the assemble (Only compatible with Extented frame on a Vcore 3.x).

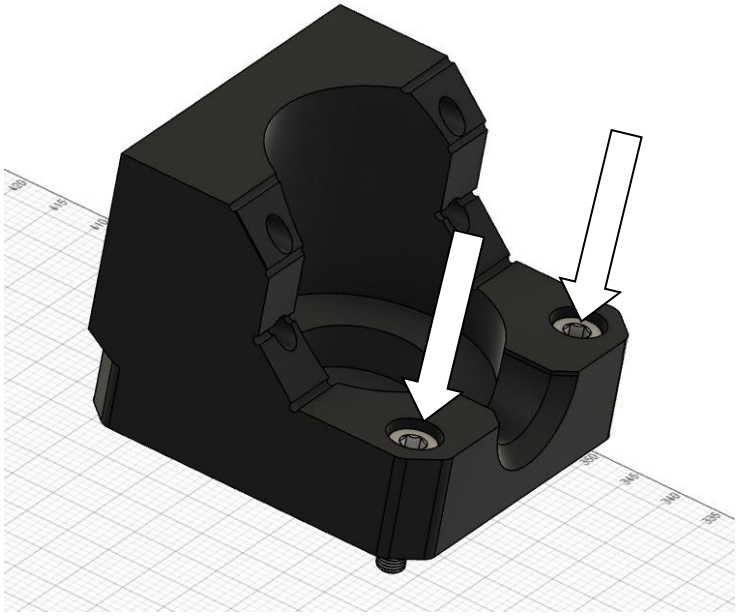
Assembly is the same, you must add 2x M6x12mm with t-nuts to each side fixation points



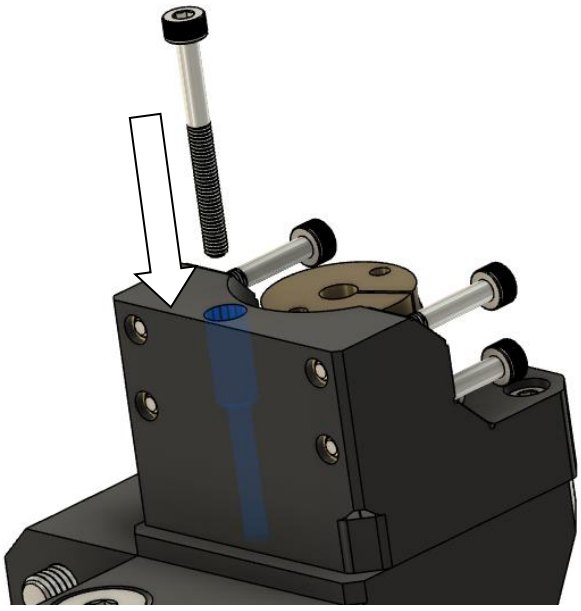
D/ Final assembly

Preinstall the Disk coupler on a shaft end (NEMA side or Block side)

In this part you have a 625zz bearing socket. It can be used



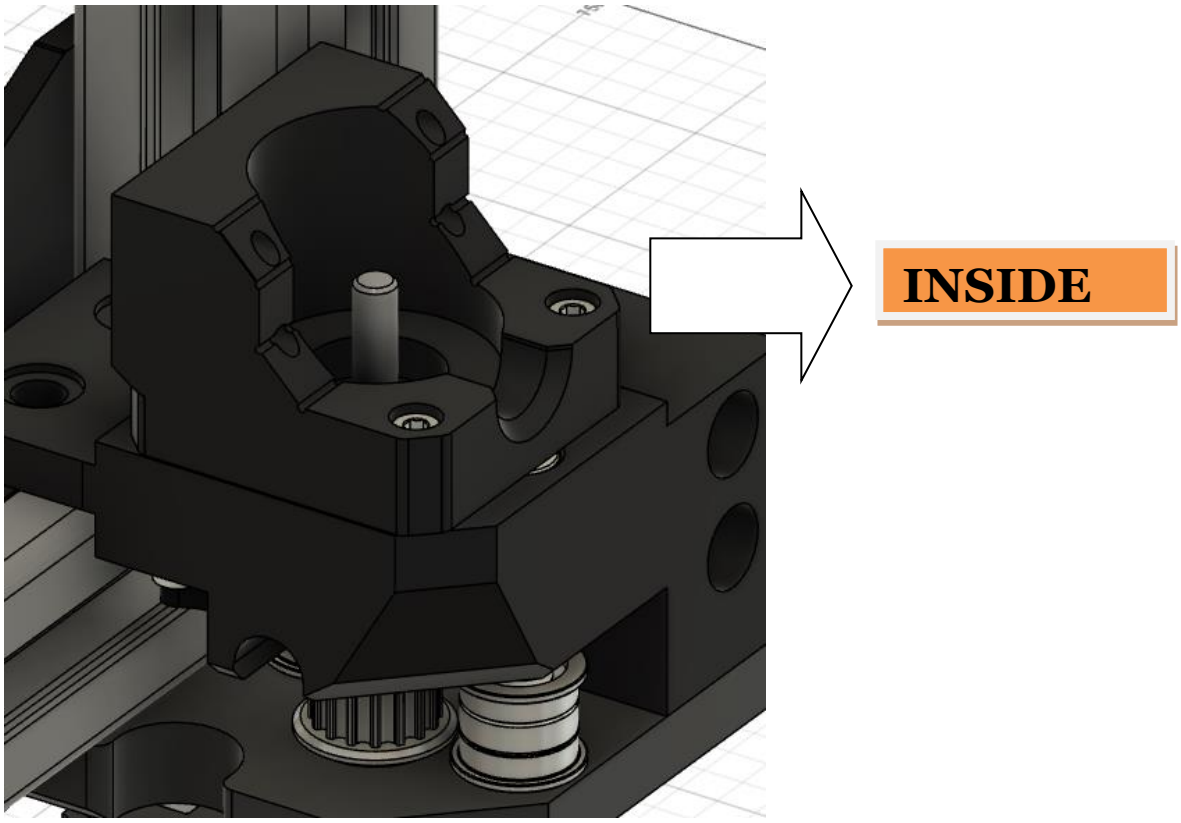
Since v1.35a, a M3x30mm is needed here too



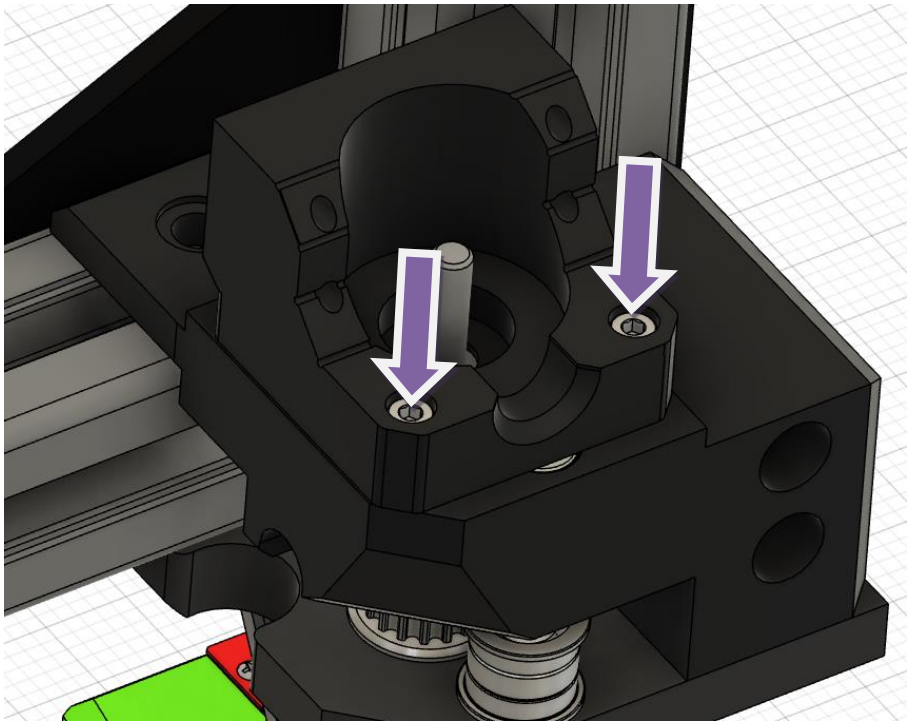
Install 2x m3x12mm in this part

Recheck the 2 M4 Shoulderbolt, tightening them now for good is advised since it will not be available after without some disassembling.

BE CAREFUL DON'T OVERTIGHT THEM, INSERTS ARE NOT DESIGNED FOR THAT

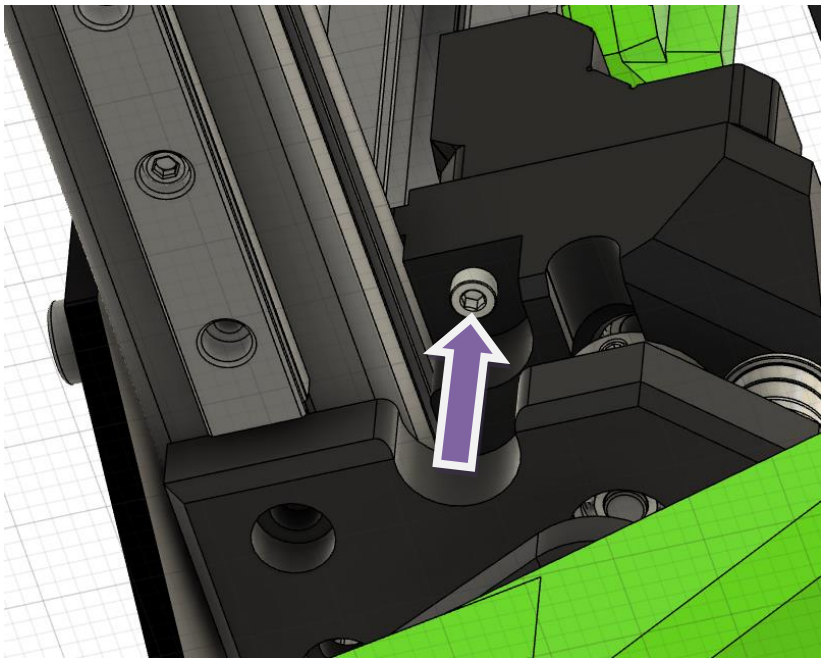


Then place it the opening toward the inner side of the machine

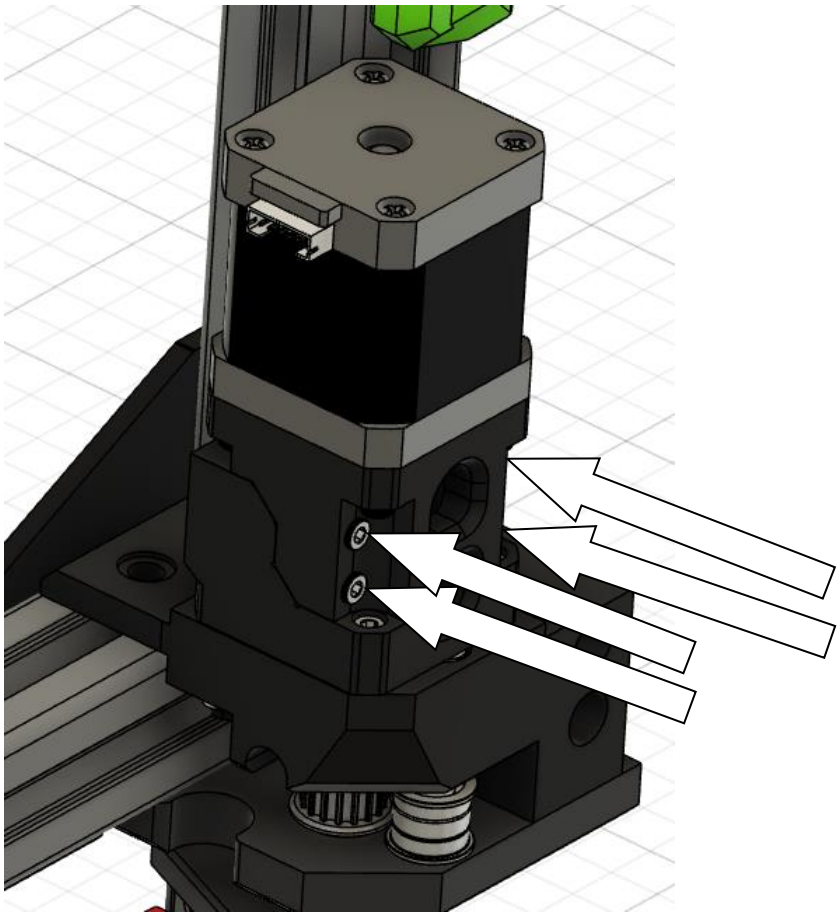


Secure the 2x m3x12mm

BE CAREFUL DON'T OVERTIGHT THEM, INSERTS ARE NOT DESIGNED FOR THAT

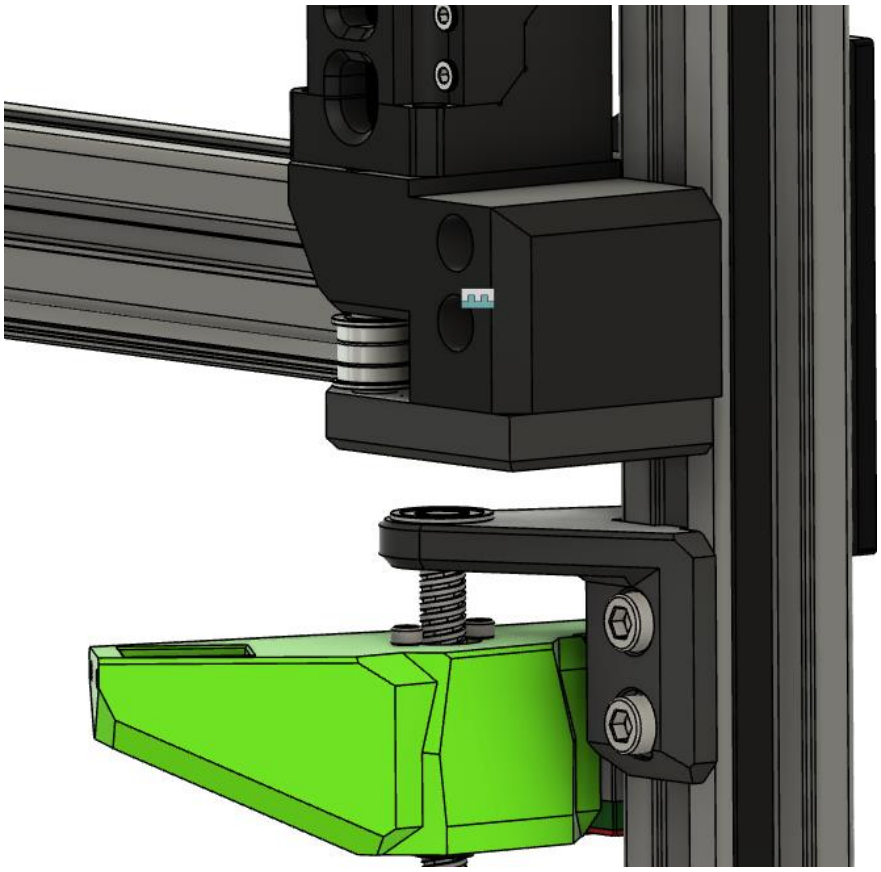


Add a m3x12mm from under, an opening has been made to access it easily

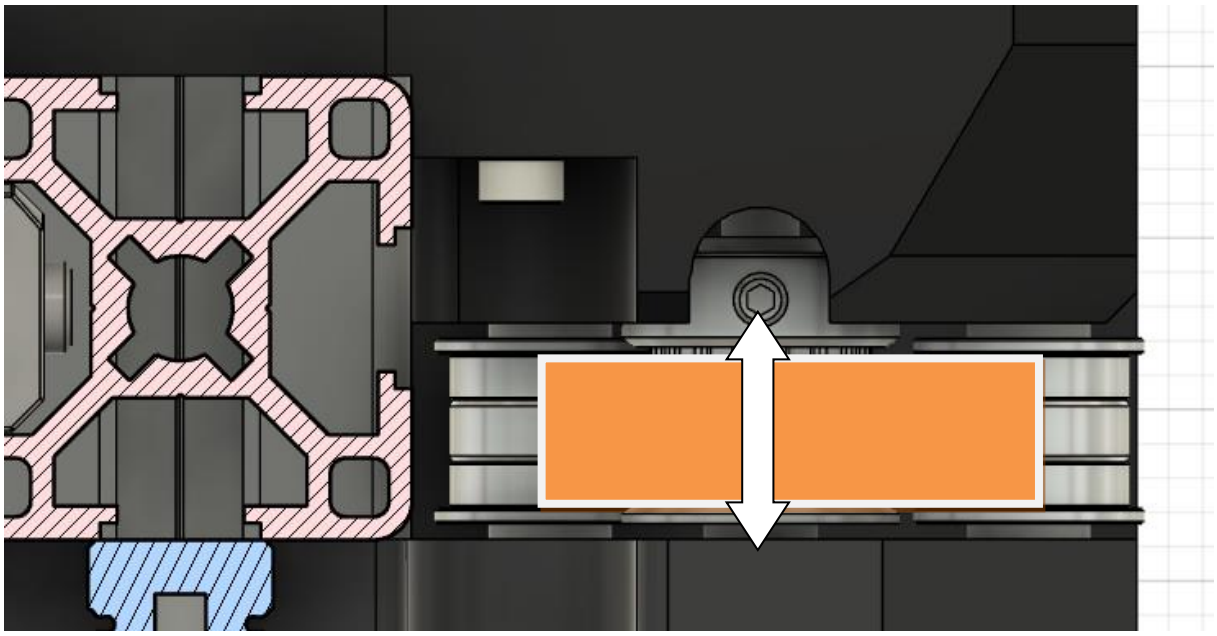


You can install the motor (Same mounting technique than the L3ver M2), secure the 4x m3x30

BE CAREFUL DON'T OVERTIGHT THEM, INSERTS ARE NOT DESIGNED FOR THAT



Check the clearances, and re-tight a bit the screws to secure the assembly.



Check the alignments, the pulley can be easily adjusted with the notches to access all the headless screws.

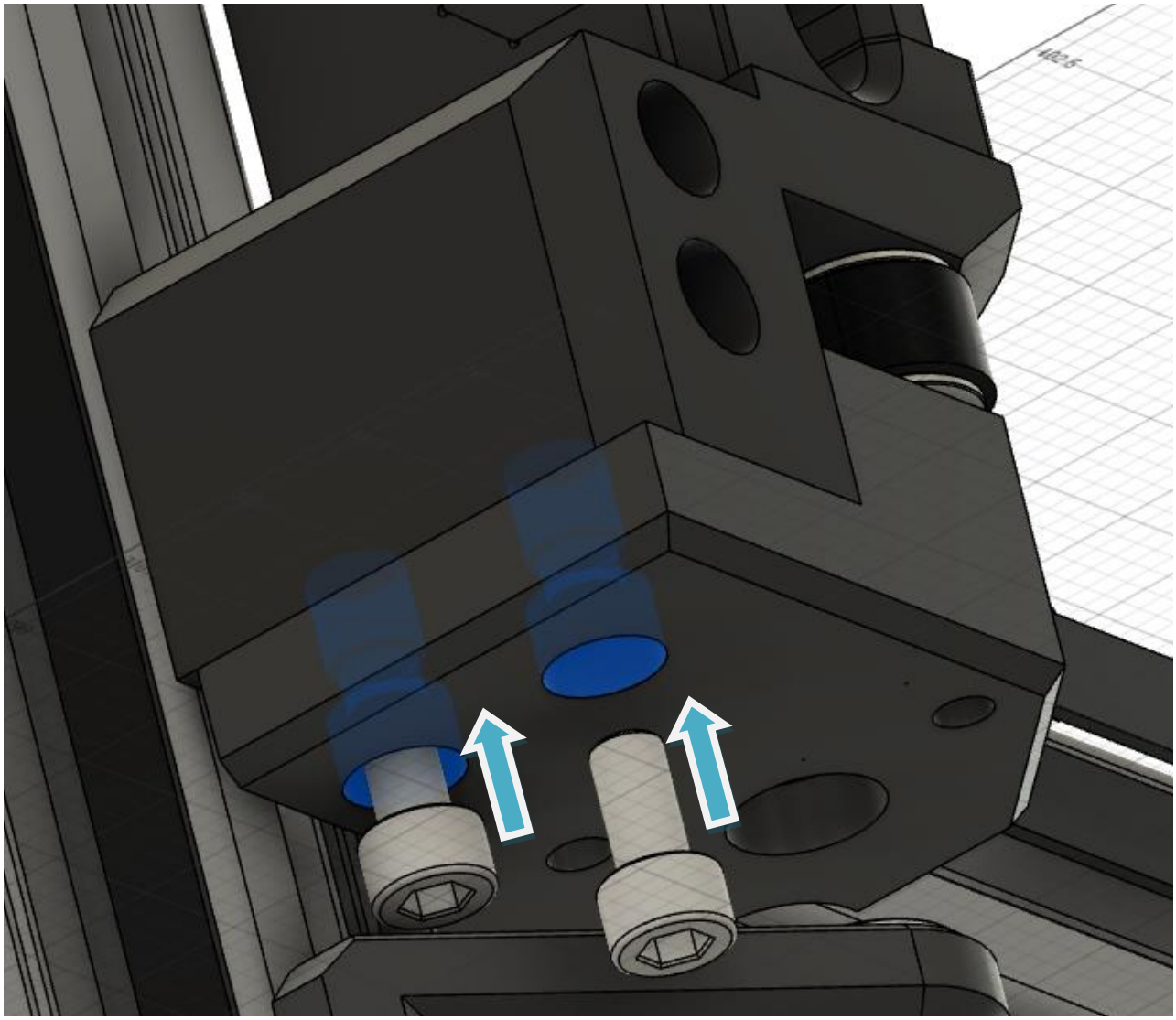
Here the Shaft are rounf without flat spot, It is a personal choice, but if you use a flat spot shaft, be sure it will need to be finer tuned to avoid so concentricity issues.

3-Under plates: Stock, SFU1204 and SFU1605 modules

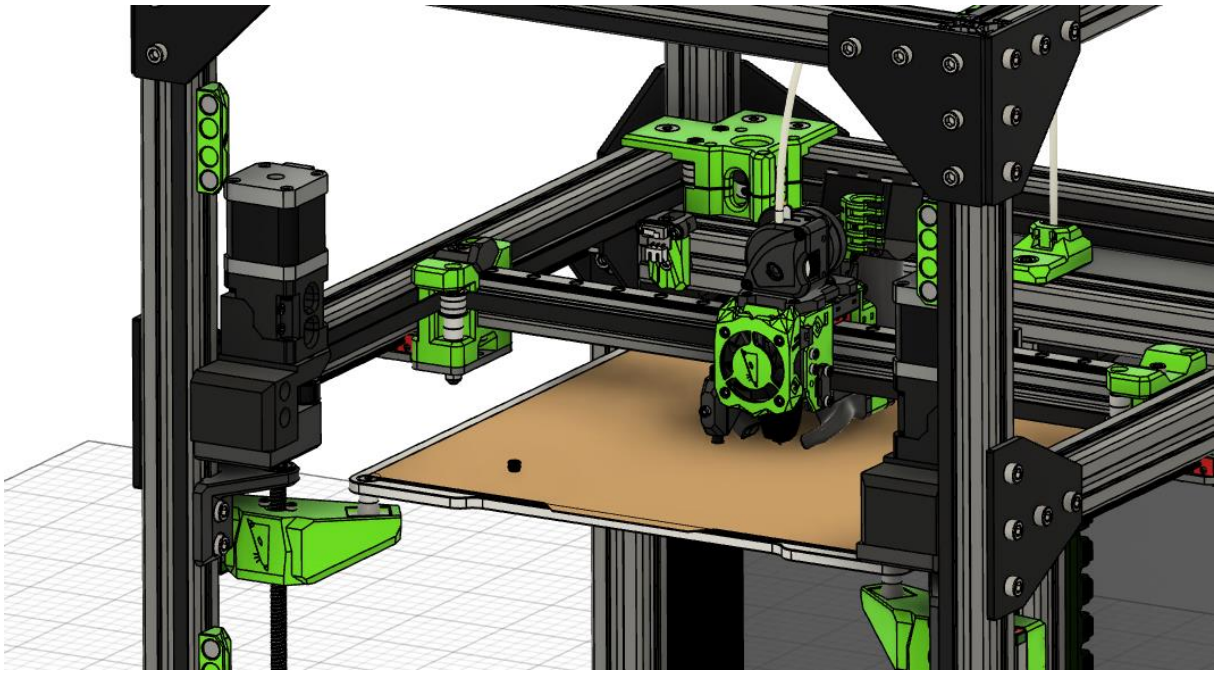
This AWD design has been made to worki with a stock VC3.0, a stock VC3.1, A VC equipped with either Zupgrade 1.0 or 2.0 with 1204 or 1605 ballscrews size/

A/ Stock

The actual manual is base on the stock plate mount, At the end you need to secure the last 2 M6 screws here: BE CAREFUL DON'T OVERTIGHT THEM, INSERTS ARE NOT DESIGNED FOR THAT

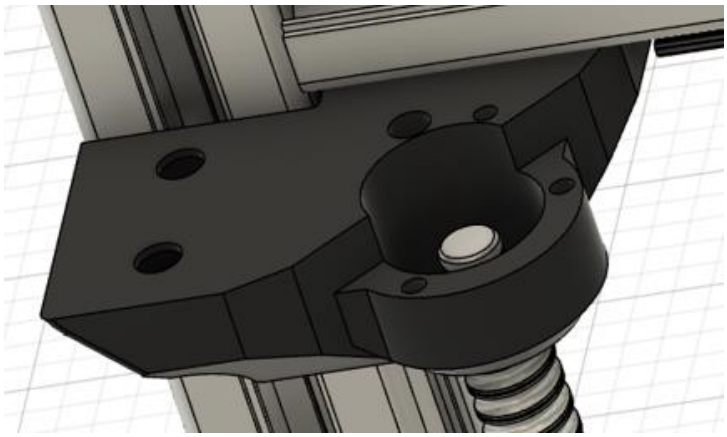


The result:



B/ Z-Upgrade (1.0/2.0) with SFU1204

Same method than the Z-Upgrade 1.0/2.0 retainers parts, here the original parts is splited in 2 section, to accommodate the AWD modules

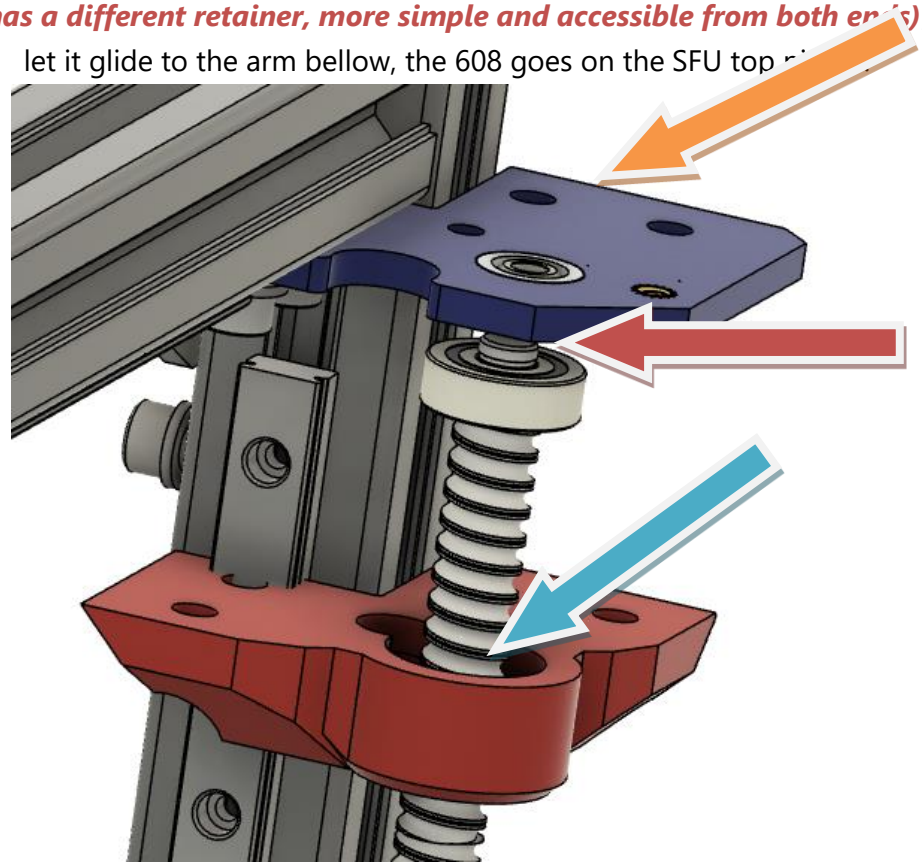


The Stock Z-upgrade retainer (to be removed)

You need to remove the Open front V2 (or else).

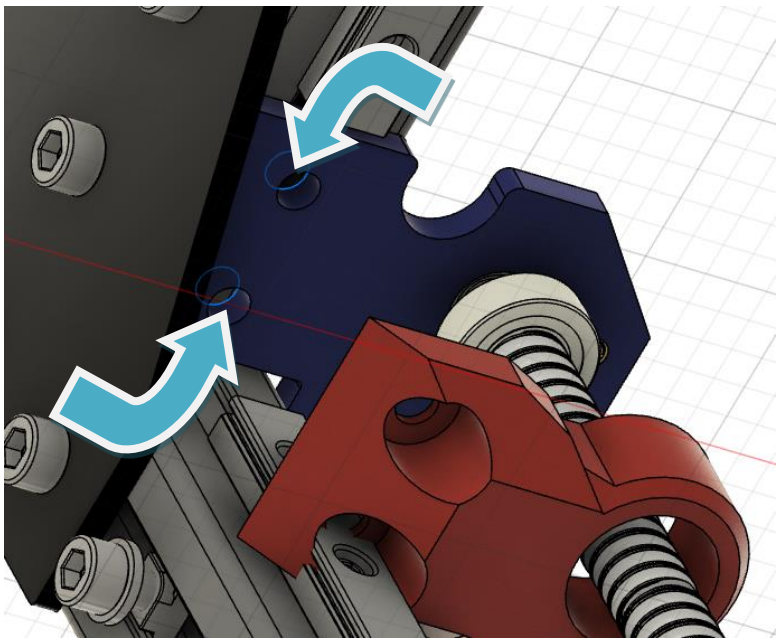
The installation is globally the same; The Blue part is where the Shoulder bolt grab the insert, and just bellow you have the red part, the retainer

First, put the red part on the SFU, **and then the 608zz bearing** ***(since the release, SFU1204 has a different retainer, more simple and accessible from both ends)***, you can let it glide to the arm bellow, the 608 goes on the SFU top [illegible]



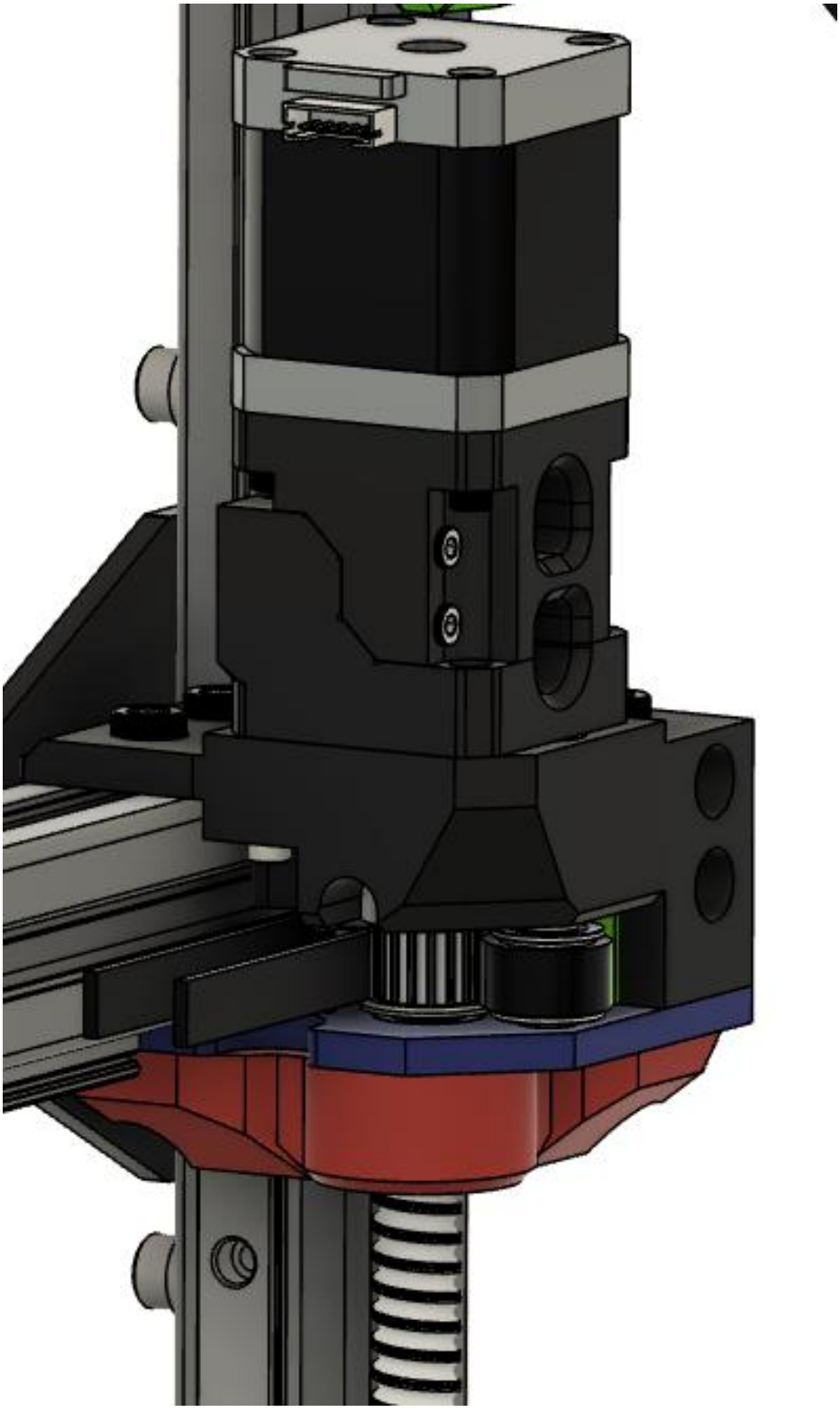
Now you can make a normal assembly with the blue plate as the bottom AWD Section.

I suggest using Tnut with ball lock to fix them in position to be locked later tout the red and blue part. Standard TNUT works but is more tricky to place



As the clearances are more tight in this SFU configuration, a bit of patience and wiggle job may be needed

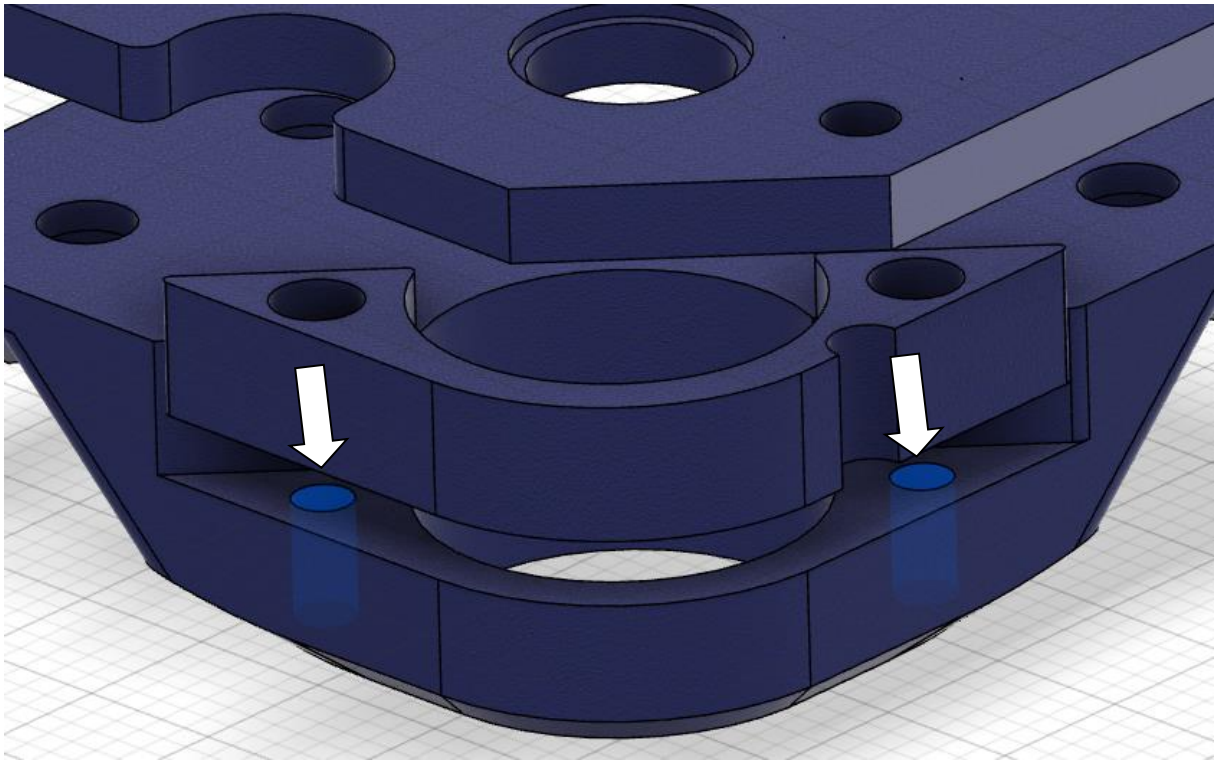
The final result:



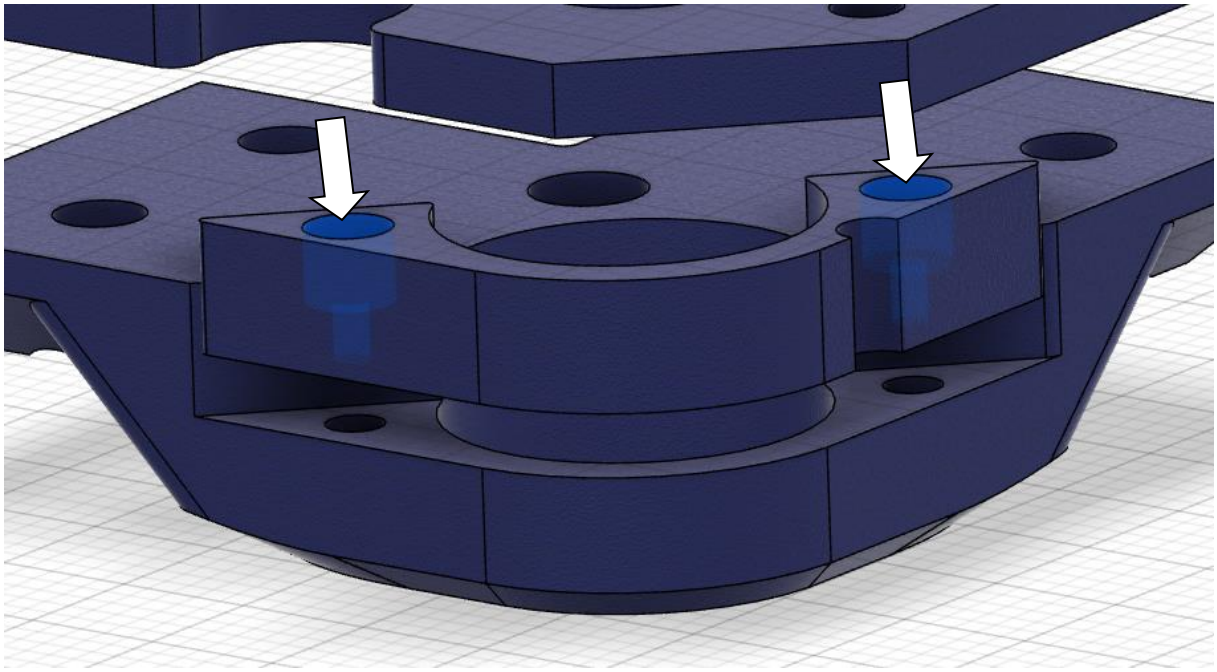
C/ Z-Upgrade (1.0/2.0) with SFU1605

Basically the same methode than 1204, Only a part need to be fix to cover the bearing section (this part isn't mandatory) **Since v1.35a, this part is in one piece only**

2x M3s inserts here



Fix the part with 2x m3x5



II-BRS-ENGINEERING Store unit

When you will receive the package, it will look like this (depending the options chosen):

A small secondaty bag will contain the 2x Couplers, Nema screws, main shaft and Pulleys.

The units are preassembled, the main shoulder bolts are tightened at the correct torque, the M3 too.

In this setup you are not obliged to full disassemble the whole things down

I include standard T-NUT, but you can use slot in ballspring nuts (will replace the TNUTs in the incoming revision)

This will allow you to slot in the upgrade, bolt it and make the belt path to make the installation under 20min

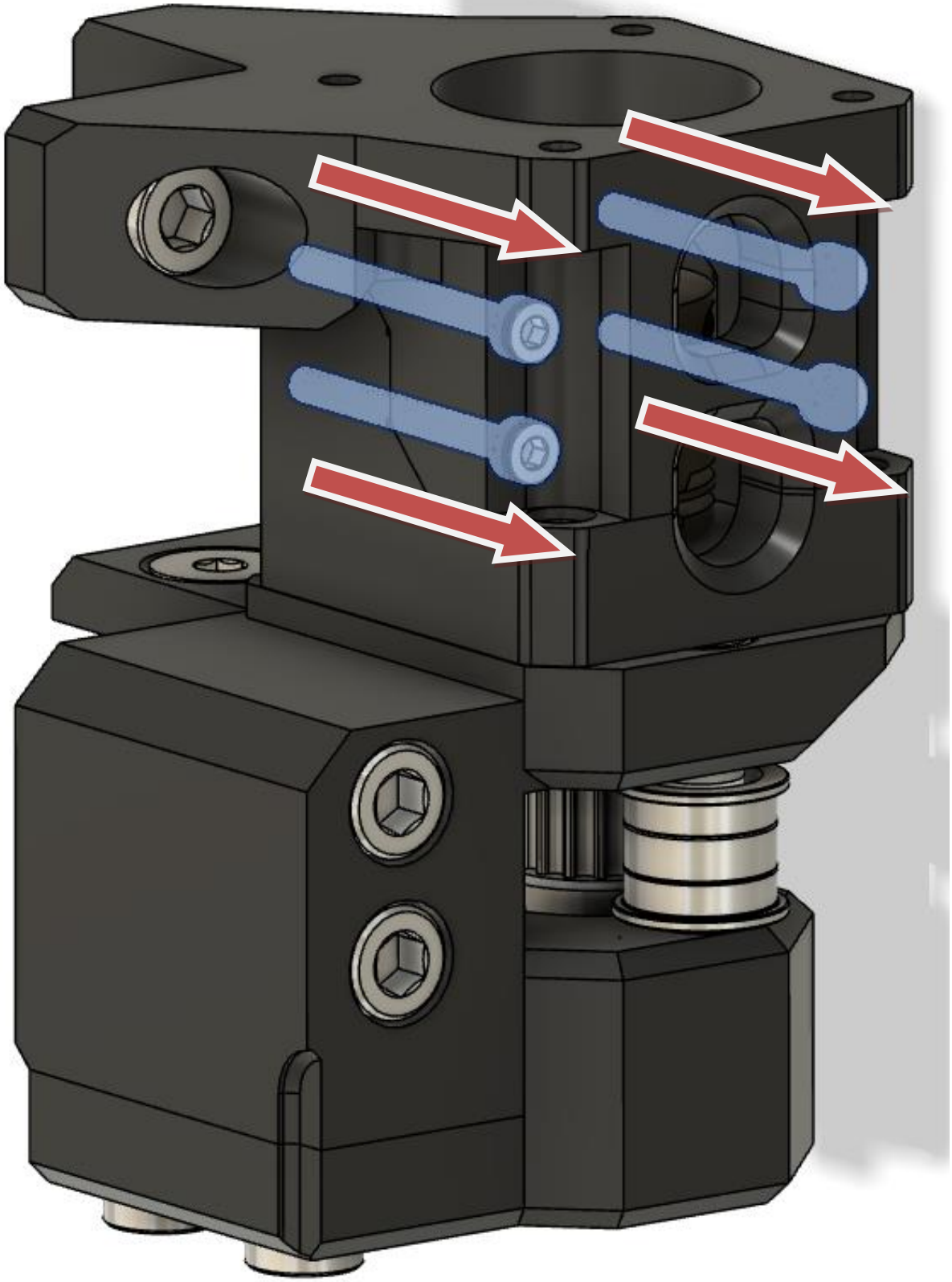
You can try to make it fit to the extrusion by slotting the Tnuts in place by hands, can be a pain but can make you gain time.

1-Prepare the received parts:

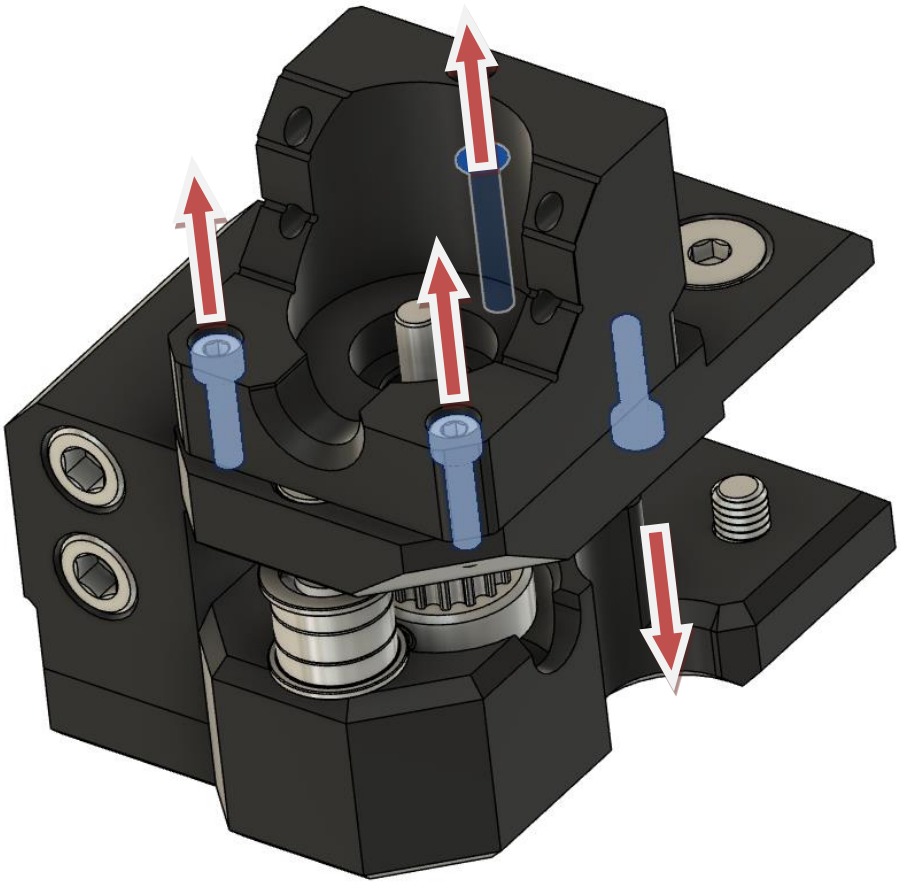
Everything is already preassembled.

To make it easy we will disassemble the minimum.

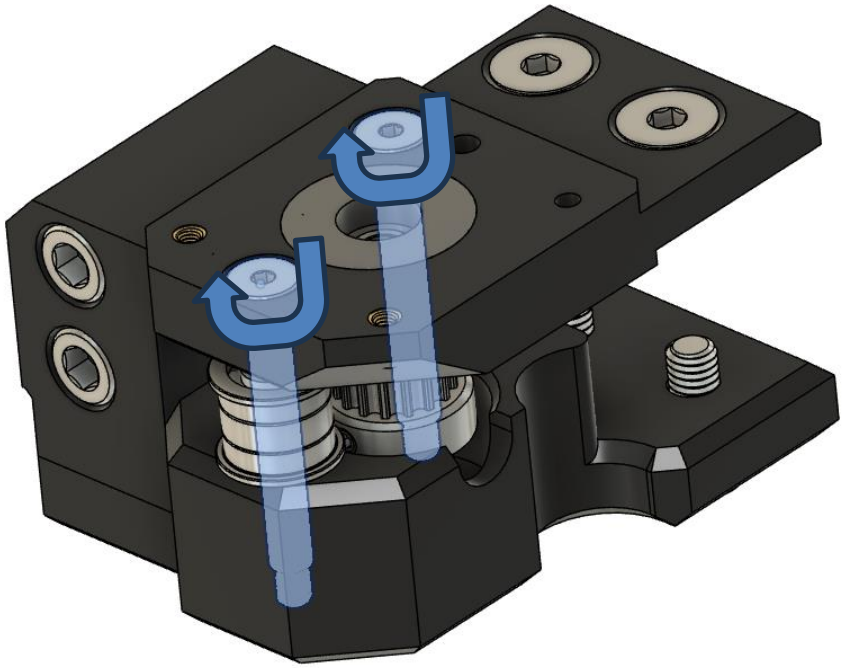
Remove the 8x M3x30 screws and the motor mount



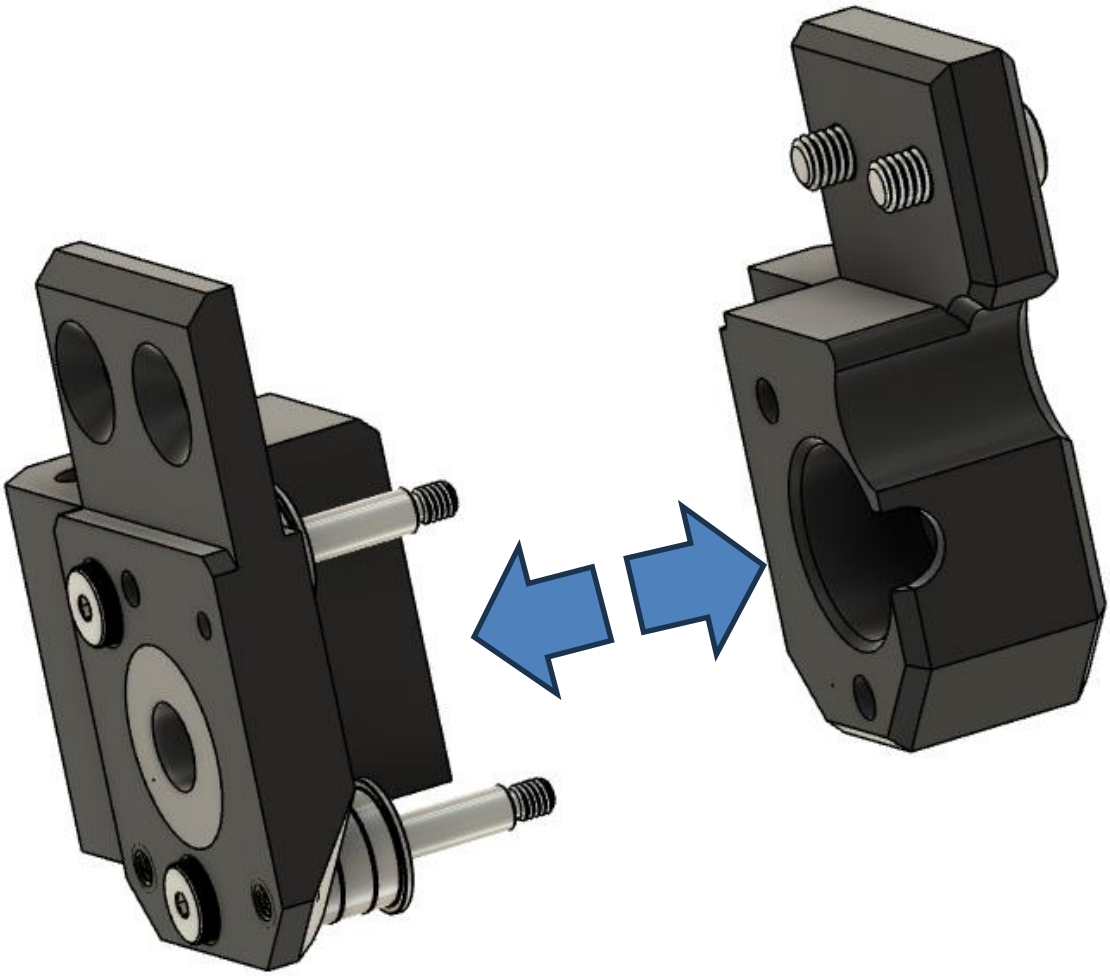
Then the M3x30, 3x m3x12 and remove the lower motor section



Then untight the 4 shoulderbolt



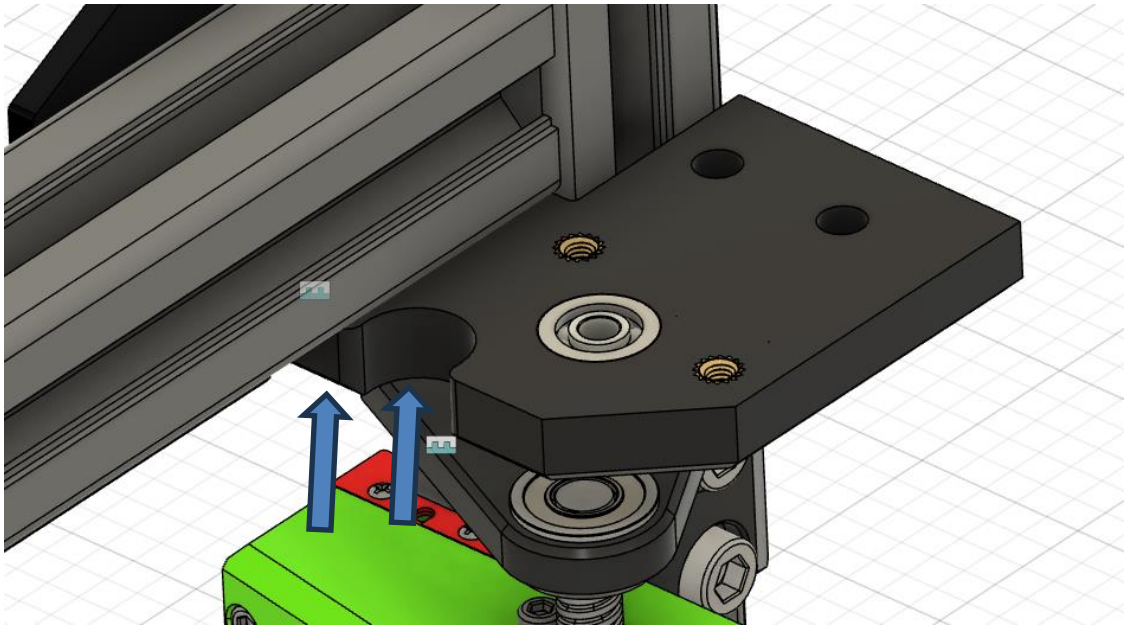
You can now split the assembly in half



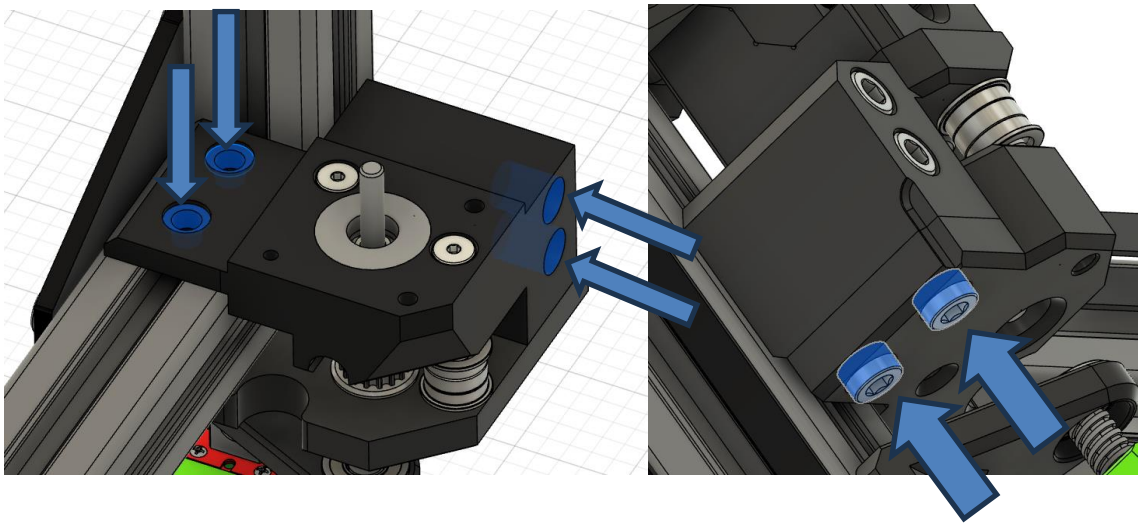
Try to keep all the bearing and ship in place

2-Make the assembly:

Install the lower section in place: use the M6x12mm with Tnuts so secure it to the lateral rail position. It should be holding itself

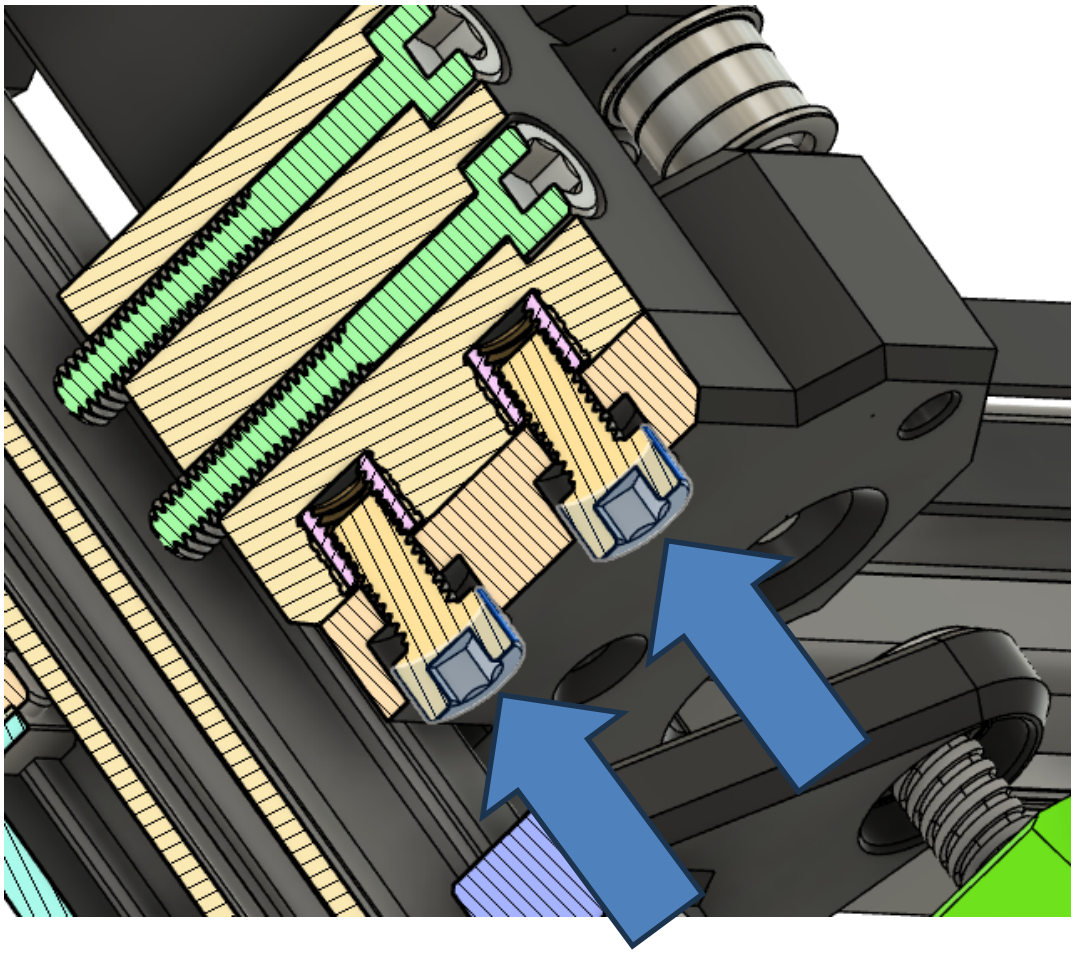


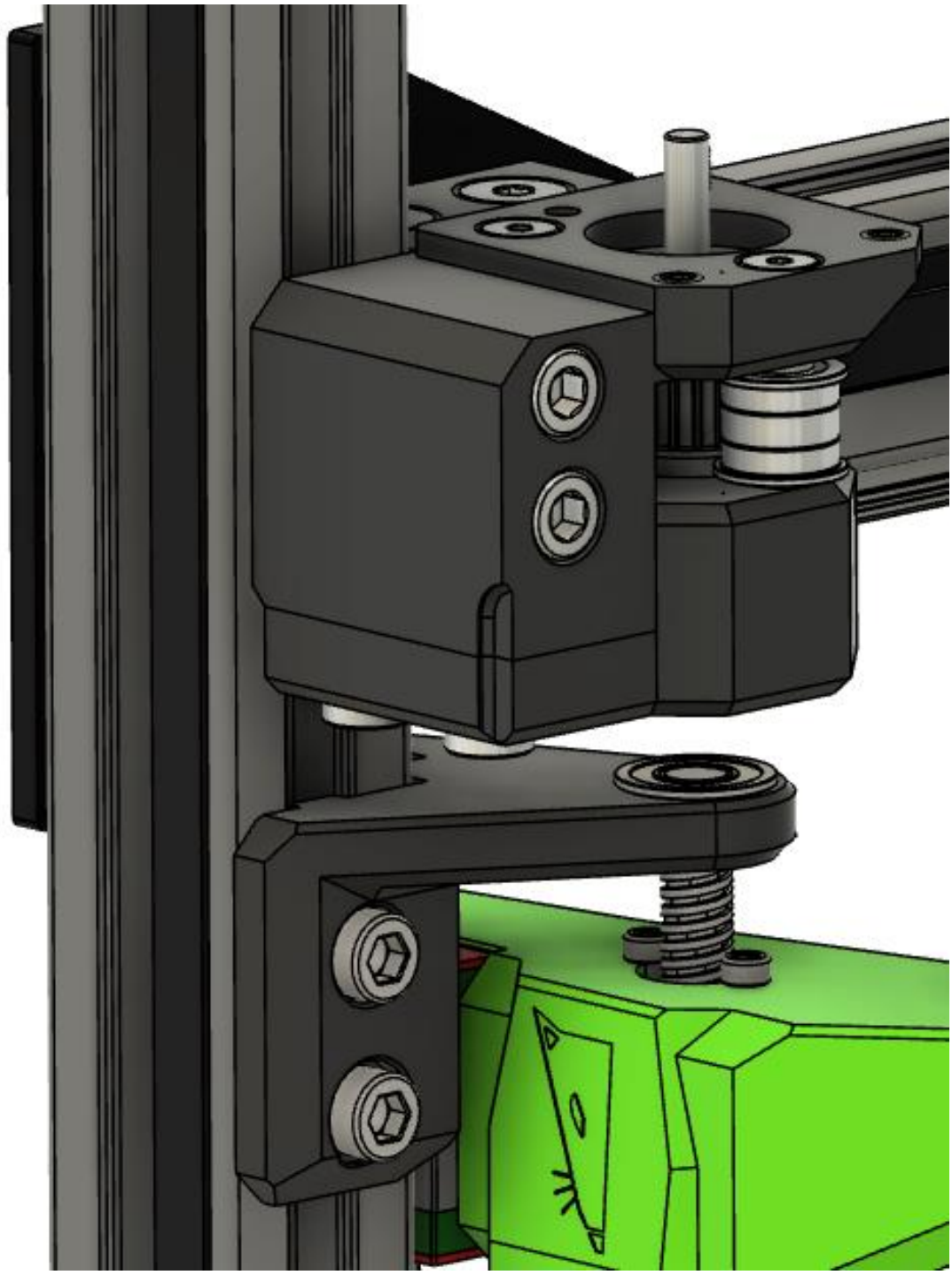
Then by retaining the top section bearing stacks, Install the top sections, secure it with the 2x countersunk m6x12mm



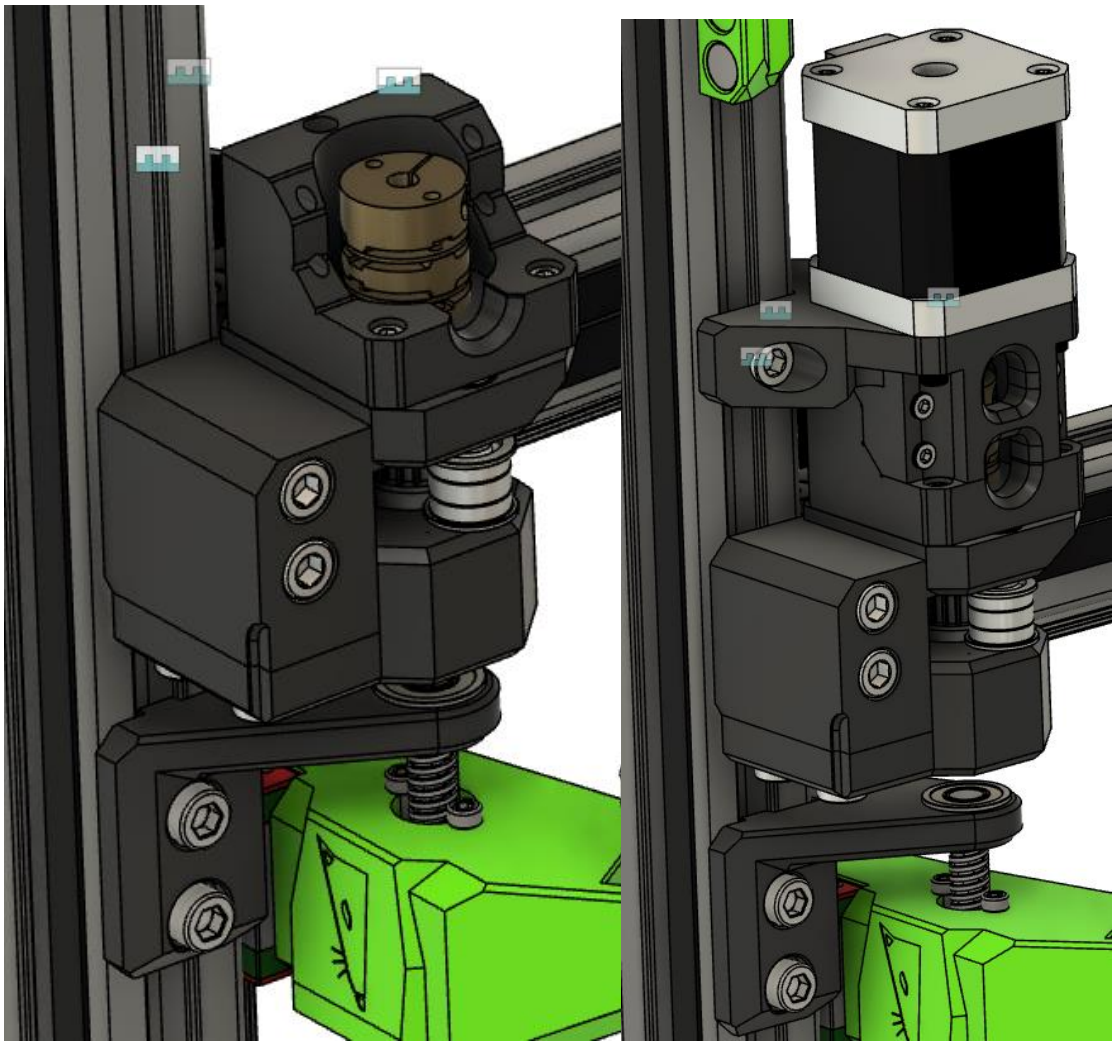
For the ENCLOSED version, slide the 2 plain m6 nut and secure it with the m6x40mm

Don't forger the 2 under M6x12 going inside in the Inserts BE CAREFUL: M6 Insert torque must be very light, DON'T force

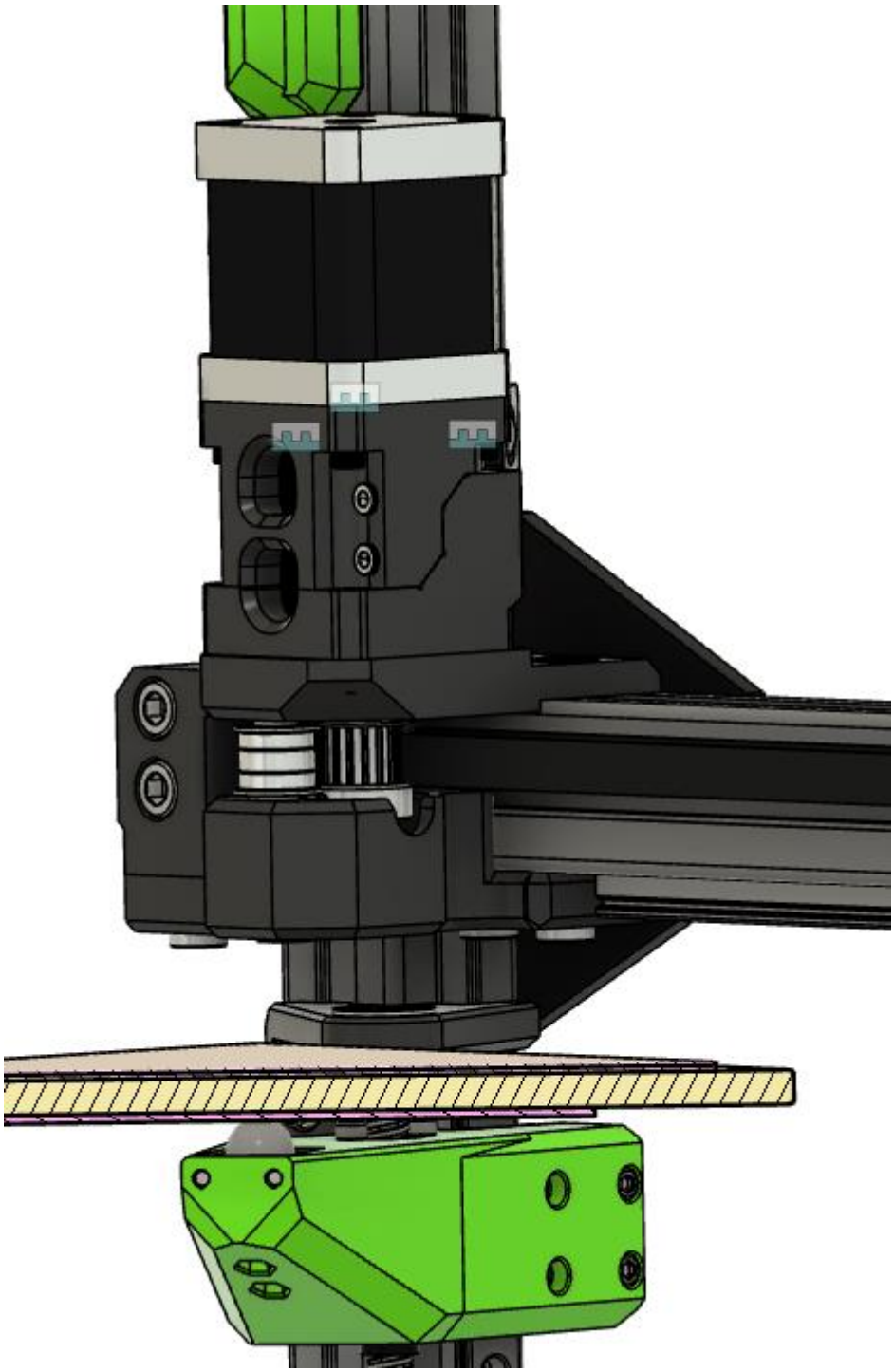




Once the module secured, add the pulley in the interspace, install the 60mm shaft, and the couplers



Reassemble the top mount with the M3x30 BE CAREFUL DON'T OVERTIGHT THEM, INSERTS ARE NOT DESIGNED FOR THAT, 3x M3x12, on each side, you can secure the top mount to the 3030 Z extrusion after the Nema installation done with 4x m3x12mm



You can the secure the 2x m3 screws per coupler, DON'T TIGHT THE PULLEYS YET

III-Belts routing :

Belt routing on this mod has been made to maximize the grip and the torque transmission of the 9mm toothed pulley (90% compared to a 180 degrees rotation) without the need of a big block in the front and to keep the belt length as close as the stock one.

All this fact make it quite polyvalent for the usage we need:

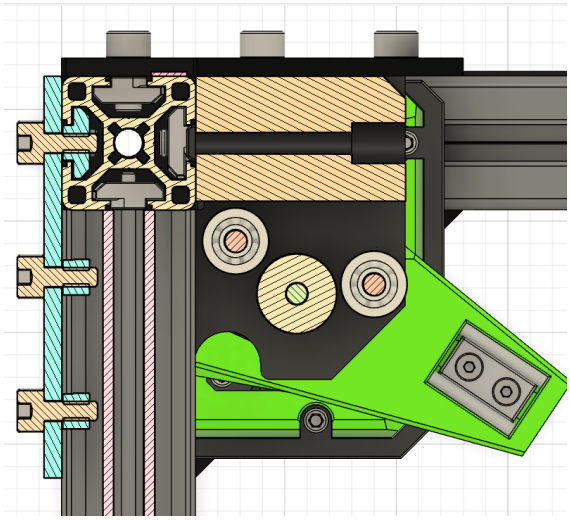
Enclosures are compatible, nothing outside, Printing volume clearances still at 100% (Vz toolhead)

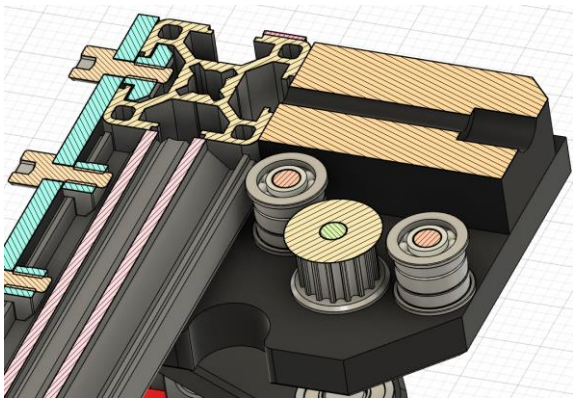
You need to make sure X and X1 share the same belt

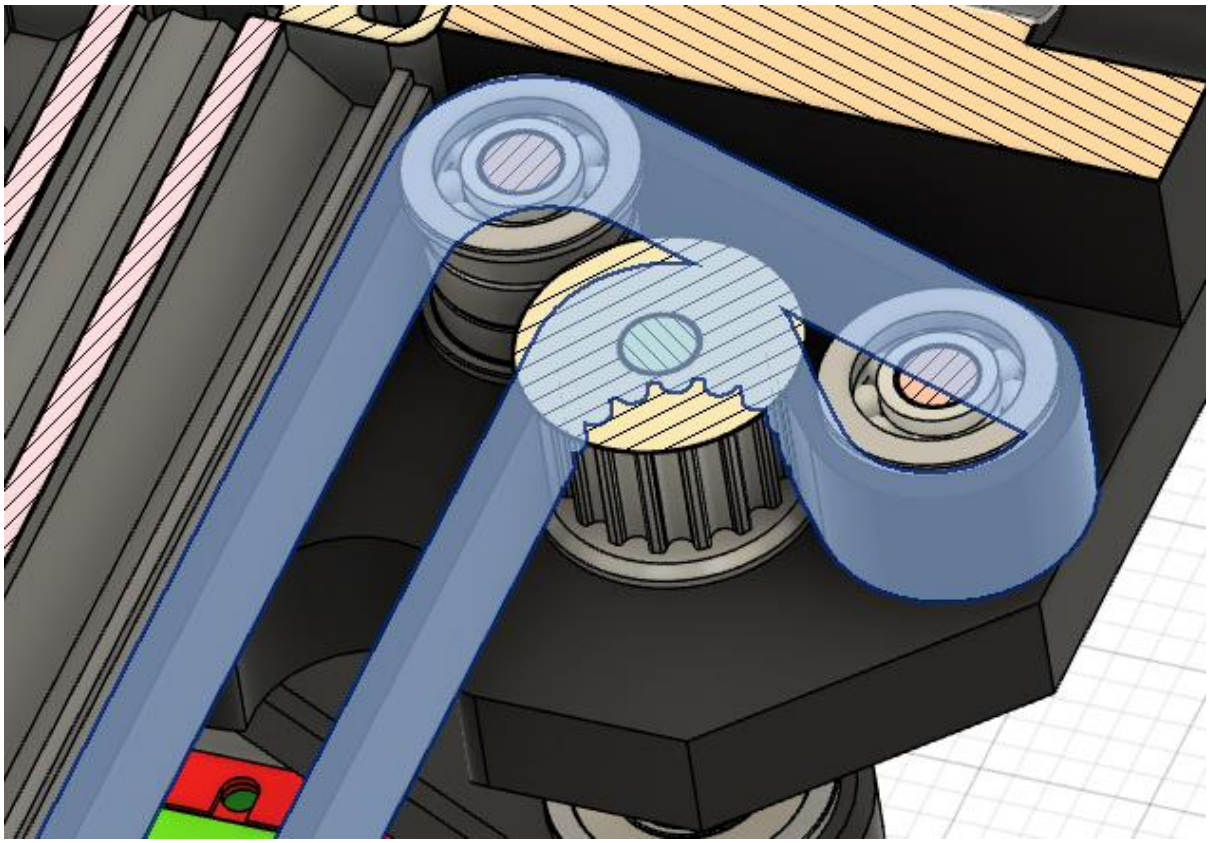
You need to be sure Y and Y1 share the same belt

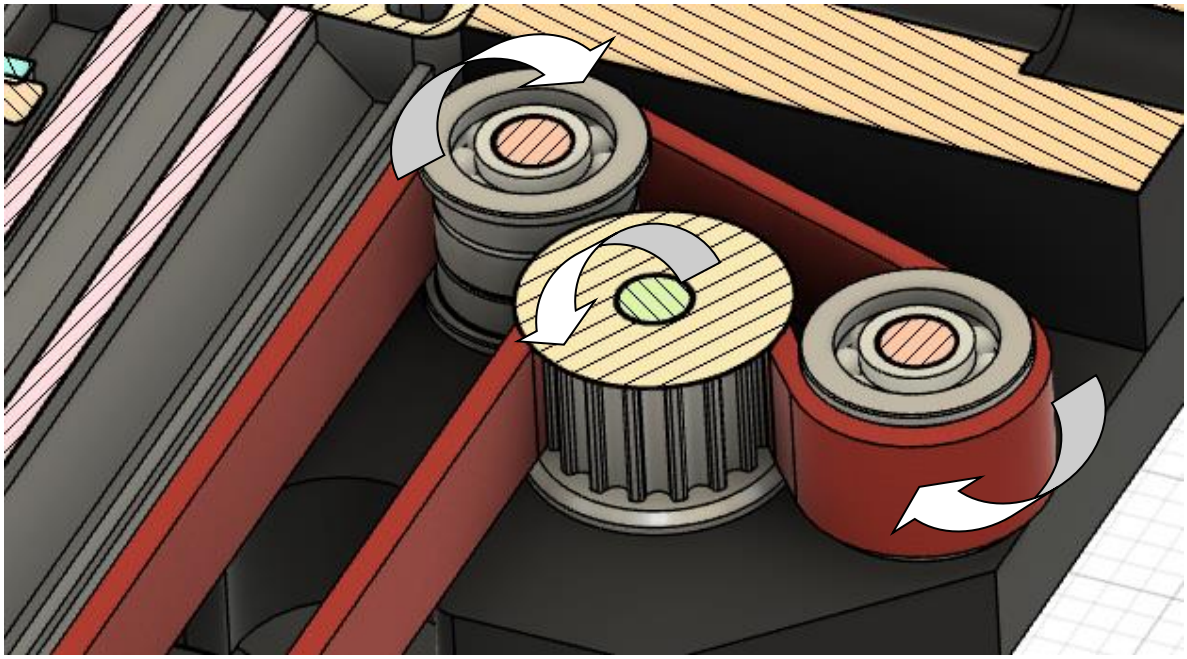
Note: in order to help the motor sync later, try to pre orient the pulleys headless screws in an accessible way

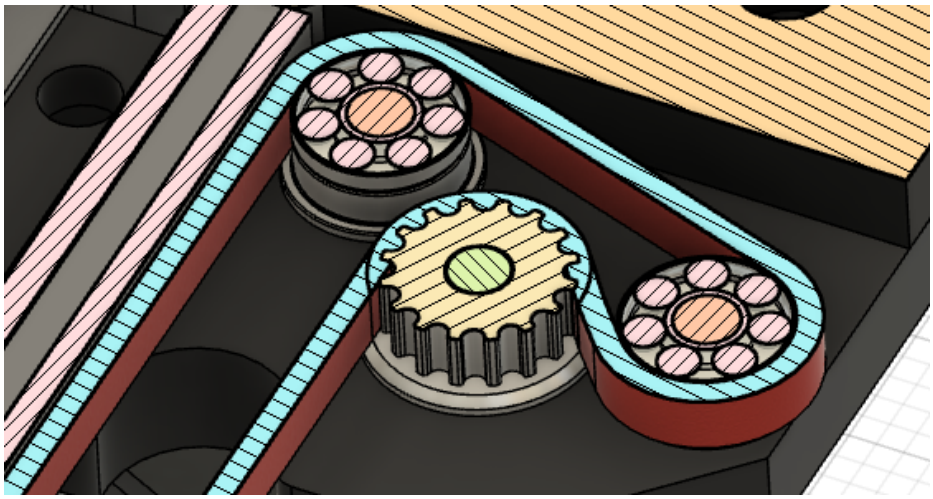
Here the layout we have to route the belt, no need to redo a full routing from the beginning, the mod adapt to any Vcore! As the assembly is done at this point, I advise the usage of a zip tie to help you routing the belt. Using a zip tie help and will allow the belt passage within the minute 😉

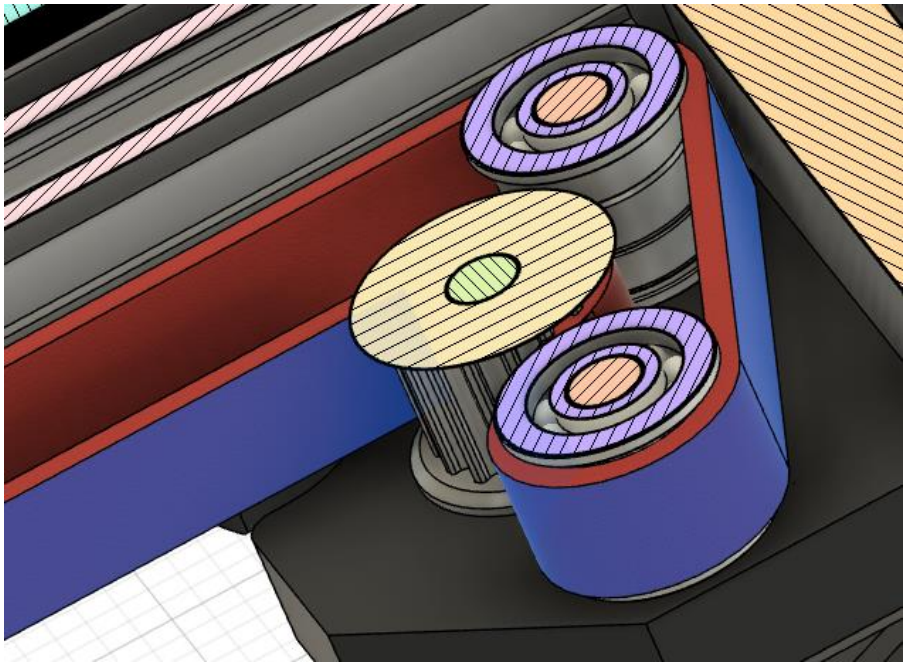












The blue face is the toothed face

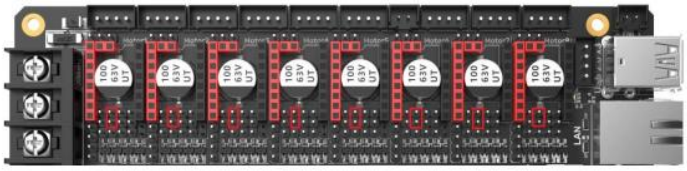
Refer to the instruction to tune the Tension on the GITHUB Belt-tension.pdf

5-Wiring

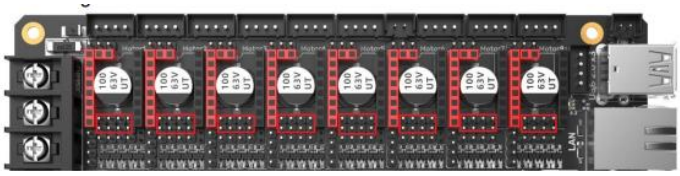
You need to add the 2 drivers to your board, then make sure the wiring is correctly made to allow X and X1 to run in the same motion logic, same for Y and Y1

ALL Wires should be wired that same way across the 4 motor

Depending your TMC configuration, you will need to address the setup accordingly to your board



Here a BTT M8P Manta 2.0 in UART mode for TMC2209



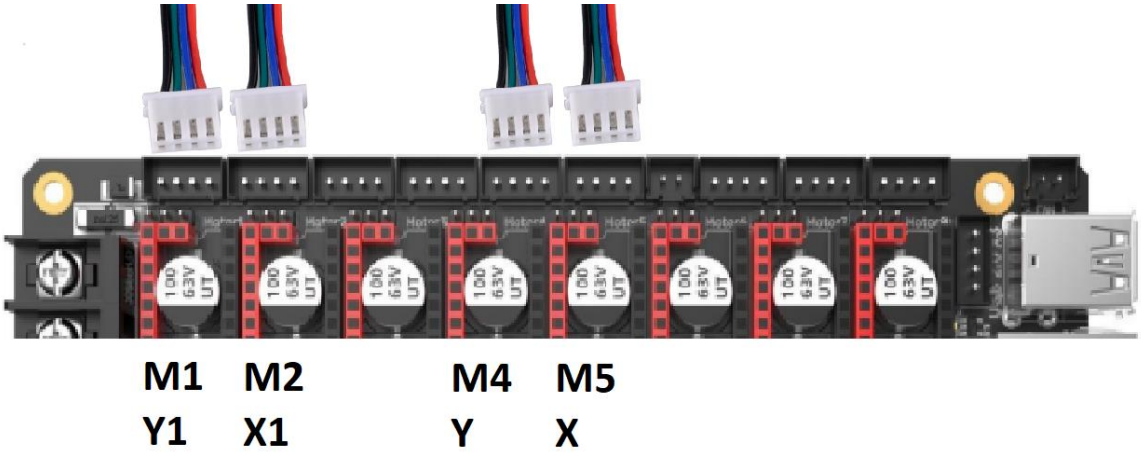
Here a BTT M8P Manta 2.0 in SPI mode for TMC5160/Pro

In order to setup everything without being lost, All 4 AWD Nema need to be wired accordingly with the **same color order** (This way we know all motors pairs are corrects)

Be sure of your crimping too!

Find the pairs following your board and Nema model.

Here a figure to show you my actual configuration (can be cross compared with the cfg at the 6th section)



-Now the placement for each motor

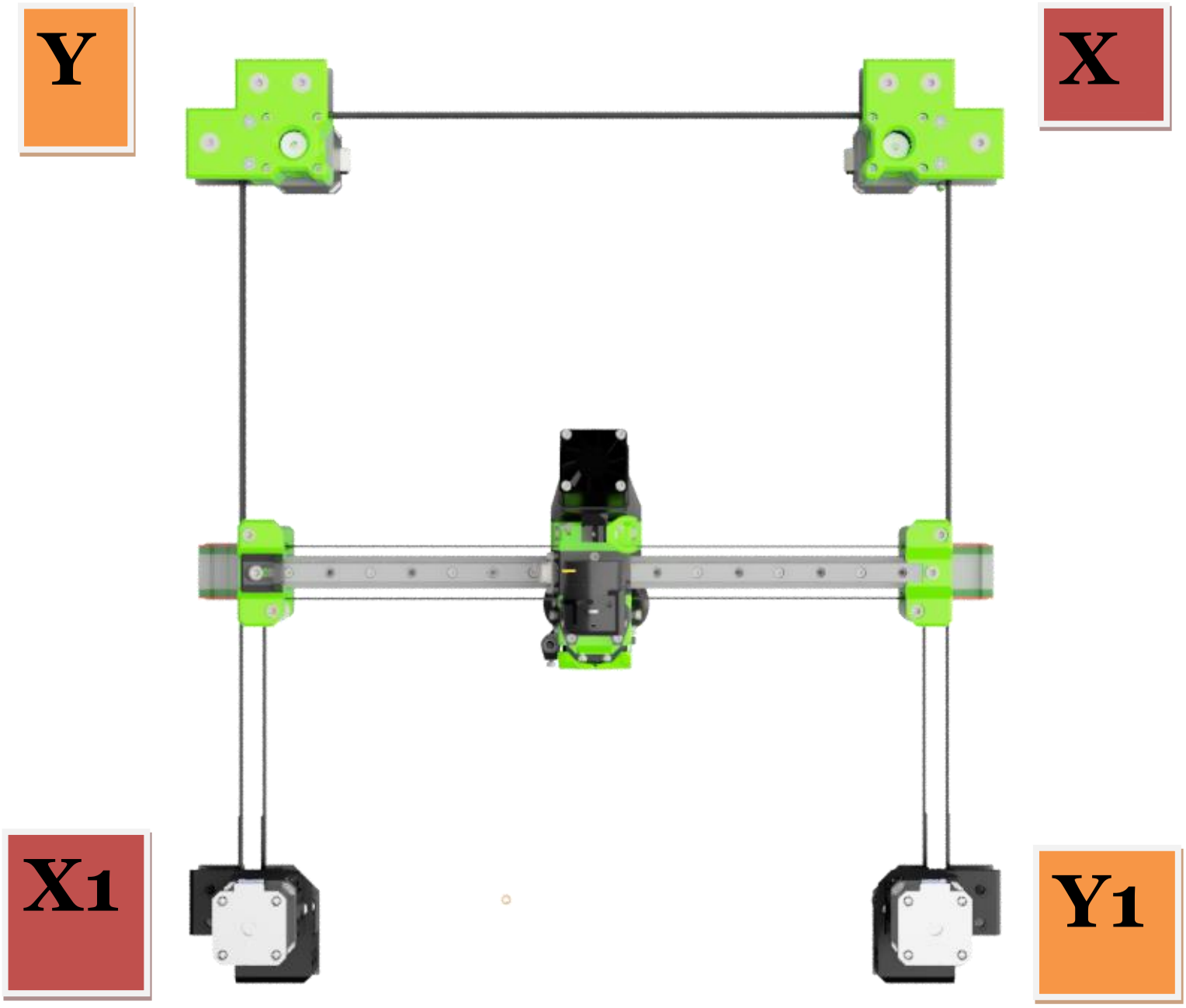


Figure: motor places

6-Printer.cfg implementations

You will find here the template to accommodate the AWD in the CFG

https://github.com/FlorentBroise/BRS-Printers-Mod/blob/main/manuals/KlipperconfAWD.pdf

DON'T FORGET THAT ALL THE MOTORS NEED THE SAME ROTATION DISTANCES, SAME MICROSTEPPING SETUP, SAME TMC SETUP, If not you will be surprised by heavy noises and vibrations.

- X, X1, Y, Y1 motor should be wired the same way (color code)
- X and Y don't feature a "**!**" in the DIR_PIN section
- X1 and Y1 need a "**!**" in the DIR_PIN section

7-Motion checks

Once all cables connected, we will need to see if X,X1,Y,Y1 adress to the correct motor

I encourage you to implement those MACROS in your printer.cfg to make the check:

```
[gcode_macro stepper_buzz_x]
gcode:
    STEPPER_BUZZ STEPPER=stepper_x
[gcode_macro stepper_buzz_x1]
gcode:
    STEPPER_BUZZ STEPPER=stepper_x1
[gcode_macro stepper_buzz_y]
gcode:
    STEPPER_BUZZ STEPPER=stepper_y
[gcode_macro stepper_buzz_y1]
gcode:
    STEPPER_BUZZ STEPPER=stepper_y1
```

Now place yourself in the front of the machine and run those macros in the order and verify it addresses the correct motor: (refer to the "motor place" figure at page 41)

X: Rear right

Y: Rear left

X1: Front left

Y1: Front right

Keep in mind X must match diagonally with X1, and Y with Y1.

Don't make a reverse layout, the machine will then "home" reversed and fails, or even with double incorrect settings, will print the parts reversed, and even eventually implement a reversed BED_Mesh.

8-Motor Sync

To have a clear motion, we need to synchronize all the motors, this step is mandatory for a smooth running system.

I encourage you to make a specific macro to call those gcode arguments:

[gcode_macro enable_stepper]

gcode:

SET_STEPPER_ENABLE STEPPER=stepper_x ENABLE=1

SET_STEPPER_ENABLE STEPPER=stepper_x1 ENABLE=1

SET_STEPPER_ENABLE STEPPER=stepper_y ENABLE=1

SET_STEPPER_ENABLE STEPPER=stepper_y1 ENABLE=1

AND

[gcode_macro disable-steppers]

gcode:

m84

Prior to this, try to align each pulley grubscrew to the AWD-Rear blocks opening

Step 1: Set belt tension like on a normal machine, following this documentation

Step 2: Loosen the toothed pulleys grubscrews on one of each set of motors, it can be done in few steps in order to reach each grubscrews

Step 3: Start up the printer and order "enable stepper".

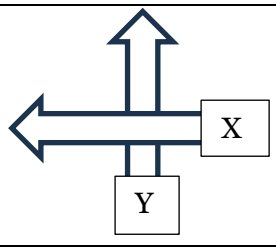
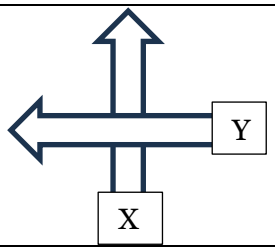
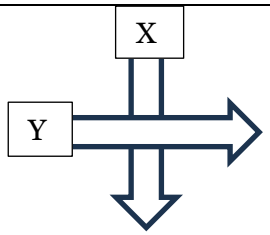
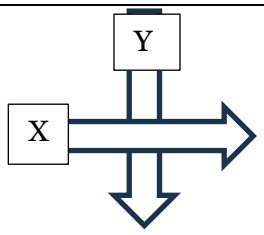
Step 4: Then tighten the stepper grub screws and disable steppers again.

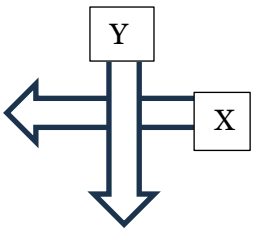
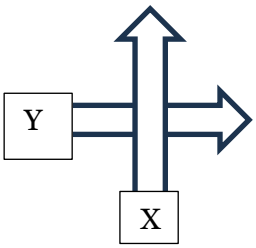
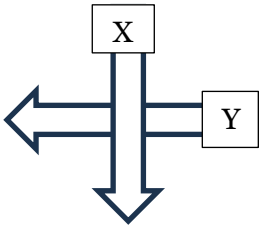
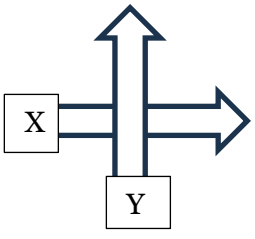
9-Motion Troubleshoot

First be sure to have a proper printer.cfg, check the X-X1-Y-Y1 DIR pin

Check the Y endstop position

Your make you first home, but: (use this diagram to sort the issue)

STEPPER X	STEPPER Y	STEPPER X	STEPPER Y	STEPPER X	STEPPER Y	STEPPER X	STEPPER Y
OK	OK	OK	Inverted	Inverted	OK	Inverted	Inverted
							

Steppers are swapped	Steppers are swapped	Steppers are swapped	Steppers are swapped
			

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Assistance

Like always, I provide an lifetime assistance;

As this manual is the first release, even after having made the assembly myself, I could have missed some specificities, don't hesitate to ask me if something seems wrong!

Any question or issue can be submited to Florent Broise on Facebook/Discord or at contact@brs-engineering.com