

BRS-AWD 2.0 Drives

Evolutions

Rédacteur		Responsable	Qualité
FBR		FBR	FBR
Indice	Date	Description de l'évolution	Auteur
1.0	28/02/2025	Création / POC	FBR
1.1	17/03/2025	POW	AVJ
1.2	10/04/2025	Release	FBR
1.32	26/05/2025	Manual 1.0 release	FBR



Manual for BRS-AWD Drive

BOM :

Printed parts list

Top R	X1
Top L	X1
Bottom R	X1
Bottom L	X1
Lever R A part	X3
Lever R B part	X2
Lever L B part	X2
Lever L A part	X1
Top R	X1
Top L	X1
Bottom R	X1
Bottom L	X1
Lever R A part	X1

Hardware

M6x12mm	8
M5x70mm	2
M3x10mm	9
M3x30mm	4
M3x25mm	2
Washer m5	2
Insert M4	8
Insert M6	4
M6x25mm	2
Square nut 11x11	2
Insert M3	7
Shoulder bolt 35mm	4
Tnut 3030 M6	4
Tnut 3030 M5	2
F695 Bearing	18
695 Bearing	6
1mm Microshim	16
9mm Pulley	2
5x30 rod	4



INTRO:

The basics:

The BRS-AWD 2.0 Drives feature an integrated 4 motors solution, adaptable to CoreXY (non hybrid) Vcore 4.0 iteration, but with Vcore 3.0/3.1 too. Can be used 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 on a VC4.0?

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.

Why this mod? The VC4 get the Hybrid layout...

Well most people are focused on the single toolhead setup, Hybrid CoreXY is focused for IDEX layouts. Here the BRS-AWD V2 will unlock some cool specs:

-Way less complex than the Hybrid layout: you keep only the 2 CoreXY belts (XY), no need to add 2 others for Y. This give you less parts, less variables, leading to a better reliability, a better calibration, and way less maintenance. Beside that, the system is more balanced.

-On the performance side, no need to prove AWD layouts legendary performances, it improves single toolhead acceleration, speed, but more importantly the print quality

-Easy assembly, no modifications of the Frame needed, no need of Enclosure modifications. Require at least 30-60mm more belt length

-Integrated brand new coaxial belt tensionner

-The more dense mechanism made on any BRS upgrade so far for a small form factor

1 The New COAXIAL TENSIONNER:

As the metal VCORE 4.0 stock tensionner will be removed, a new coaxial tensionner mechanism has been developped to fit the need, and to make the system as dense as possible:

2 Design keypoints:

-Use **LDO-42STH48-2504AH(S37)(Speedy power HT)** for this setup, you can use another motor type but it needs to match the rear motors (same brand same model) and need at least a 37mm shaft

-Delete the need of couplers and shafts like the AWD 1.36 for the previous VCORE 3.0/3.1, (less parts, less problems)



Manual for BRS-AWD Drive

-2x M6, 1x M5, and 2x M4(used by the stock tensionner) anchor points to ensure a perfect stability

-Optionnal: Used with 48V TMC5160Pro, unlock the full potential of a sprinter machine

-No Y loss, the Y endstop need to be relocated in the AWD lower section, with a cfg correction for Y max in the printer.cfg, the VC4.0 got some margin

3 **The Kit:**

It features all the bolts, screws, bearings, always with premium quality, and PA12CF15 annealed printed parts. But **without** the 2x drivers and the 2x motors.

I recommend using the LDO-42STH48-2504AH(S37) 1.8deg motors, as they give the best performance ratio (The long shaft of 35mm MINIMUM is mandatory required)

Pairing all motor on the same brand, same model, will ensure the best performances

TMC2209 drivers will perform perfectly, if you want to get the machine at the best spec level, use external 48V TMC5160Pro.

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!

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

In this manual, I show you the R side for all assembly, the same process is to be done on the Left, mirrored!



Manual for BRS-AWD Drive

INSERTS:

Be aware the CAD has been made upon Ruthex Heat inserts. Some inserts 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

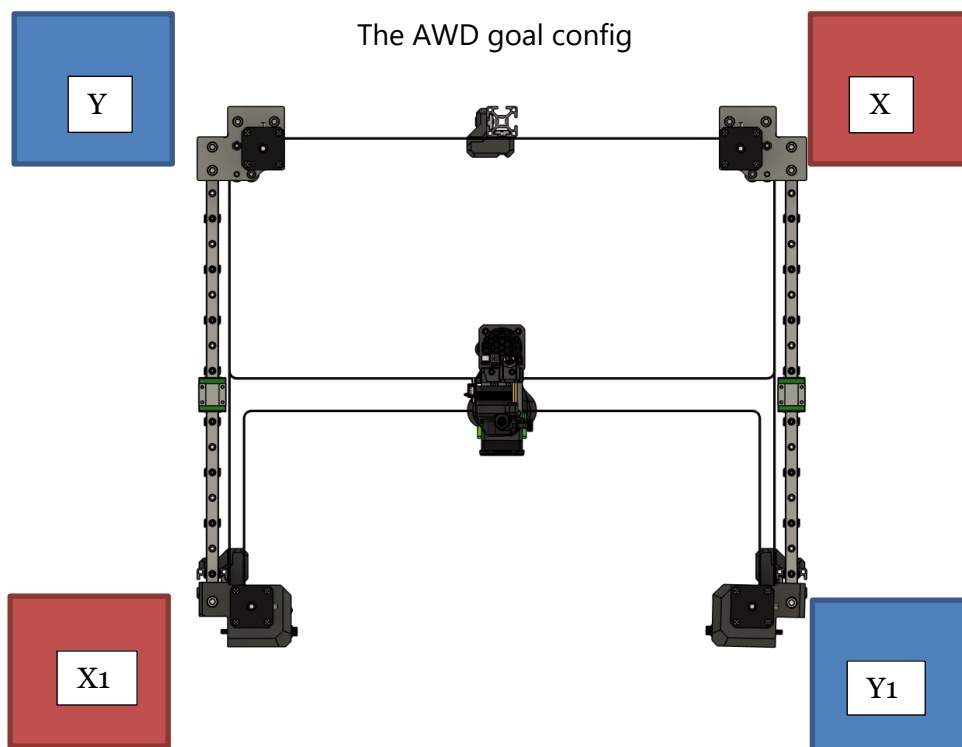
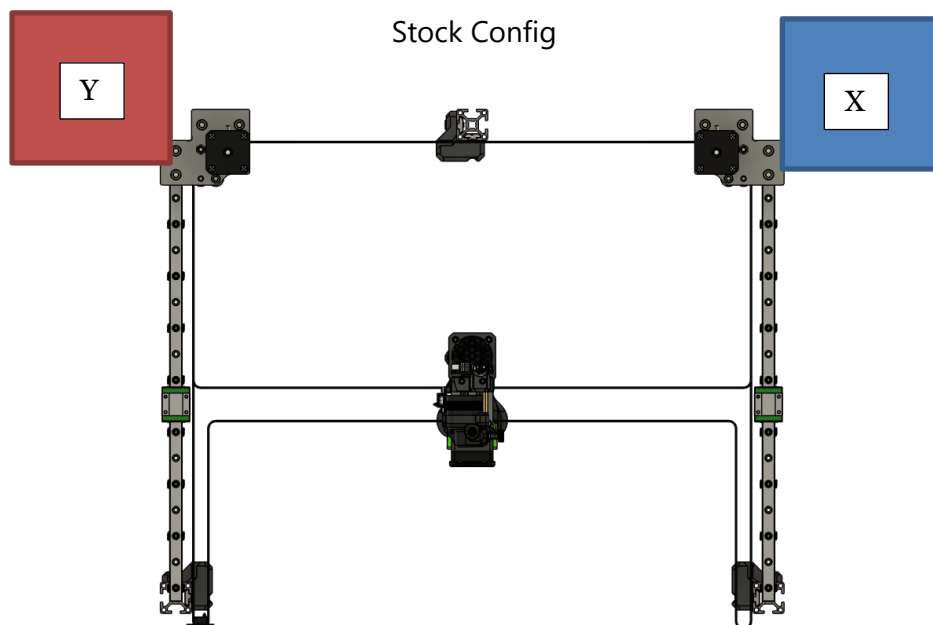
SIZES						
ISO metric thread	UNC inch thread	Ø d1	Ø d2	Ø d3	L	W
M2	#2-56	3,6	3,1	3,2	4,0	1,3
M2,5		4,6	3,9	4,0	5,7	1,6
M3 Short		4,6	3,9	4,0	4,0	1,6
M3x5x4 Voron		5,0	4,25	4,4	4,0	1,3
M3	#4-40	4,6	3,9	4,0	5,7	1,6
M4 Short		6,3	5,5	5,6	4,0	2,1
M4	#8-32	6,3	5,5	5,6	8,1	2,1
M5 Short		7,1	6,3	6,4	5,8	2,6
M5	#10-24	7,1	6,3	6,4	9,5	2,6
M6	1/4"-20	8,7	7,9	8,0	12,7	3,3
M8		10,1	9,5	9,6	12,7	4,5
	3/8"-16	12,6	11,8	11,9	12,7	6,0



First thing first!

The **RED** case represent to Upper belt

The **BLUE** represent the bottom belt



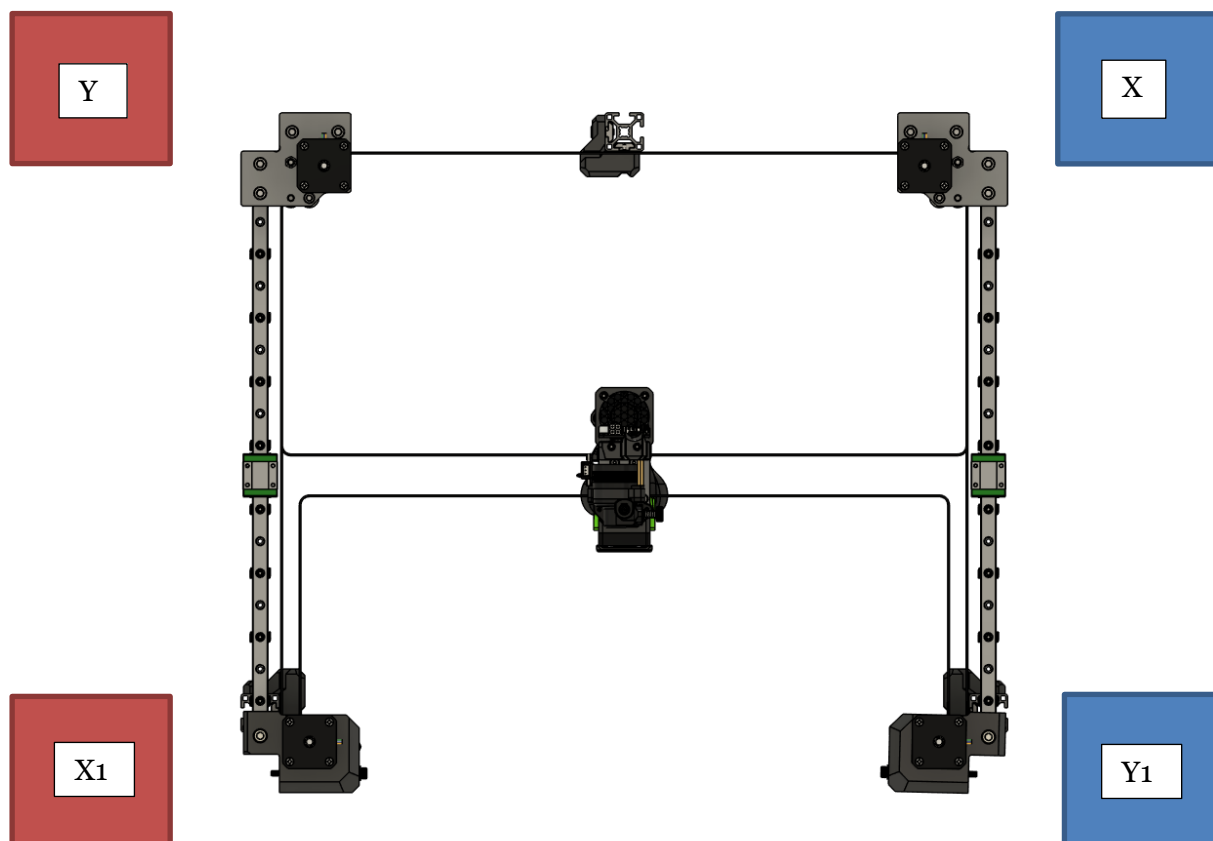


Manual for BRS-AWD Drive

In the Stock Vcore 4.0, The rear blocks 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**



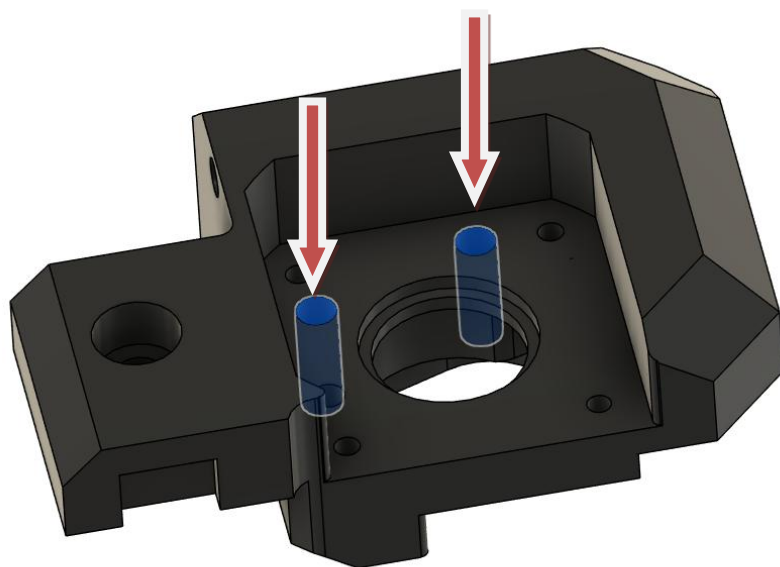
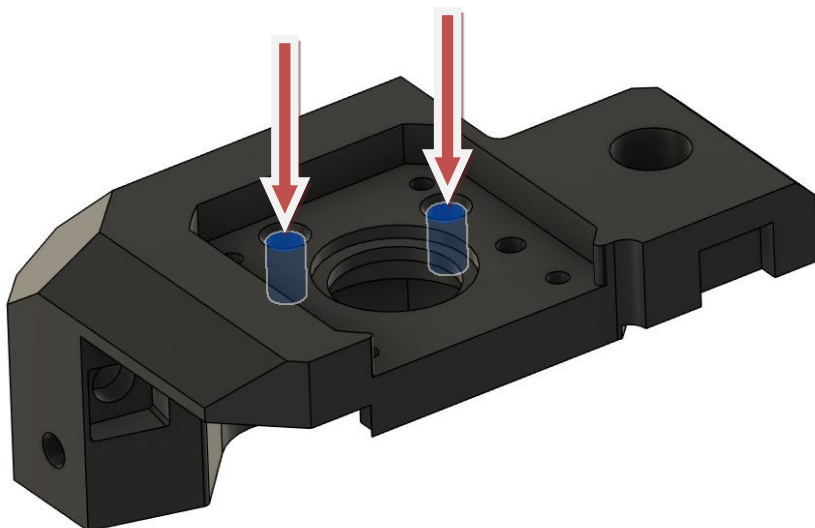
You will need to mirror the rear bearing order to be able to drive correctly the thing



1-Part preparation

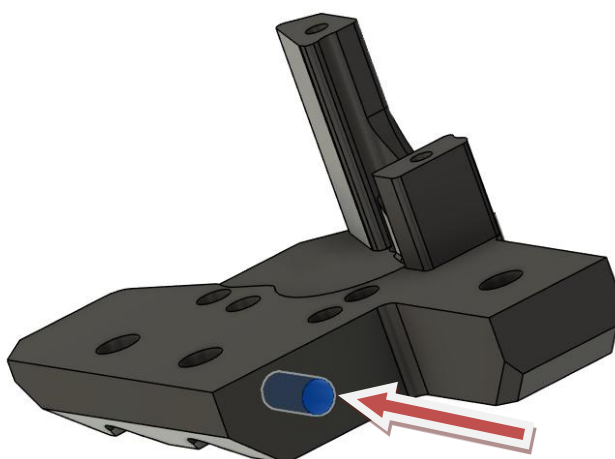
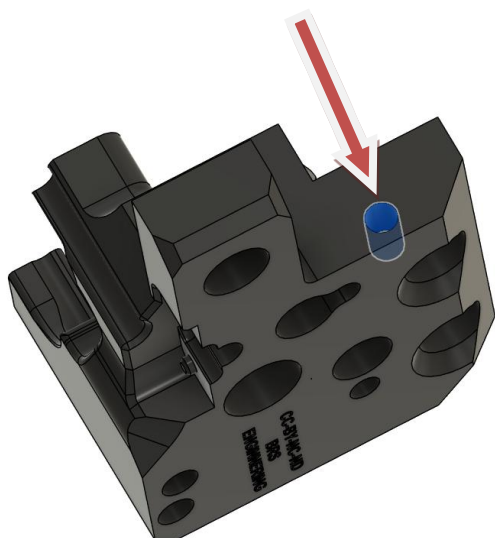
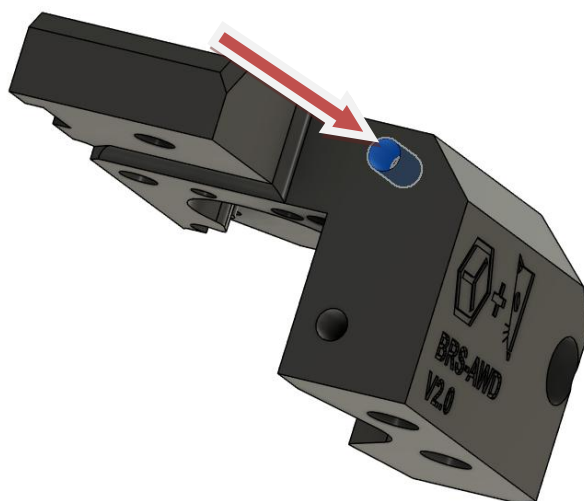
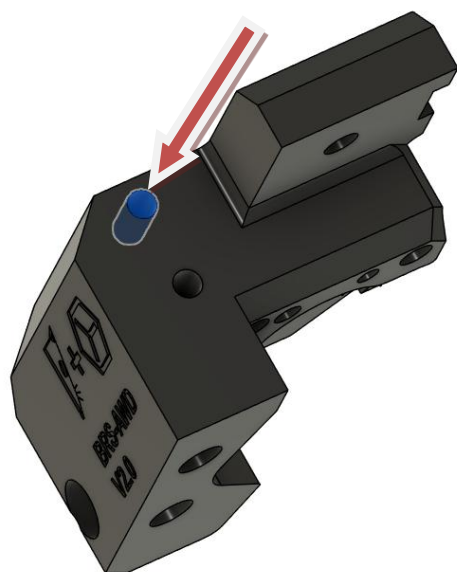
Before assembly, Install all heat inserts (for BRS Order it is already done)

[Here All the M4 inserts](#)





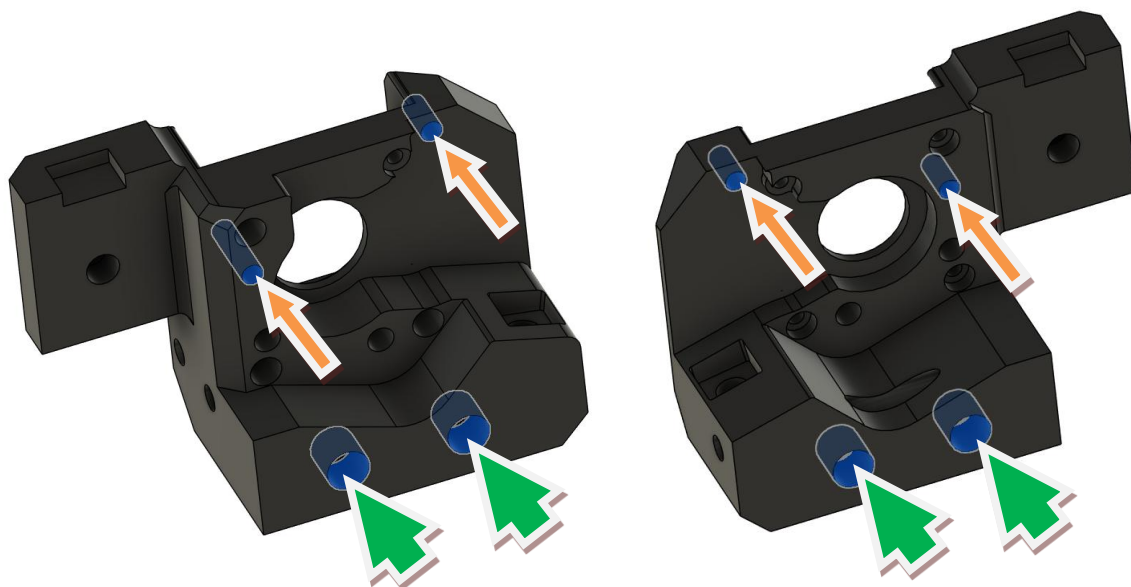
Manual for BRS-AWD Drive



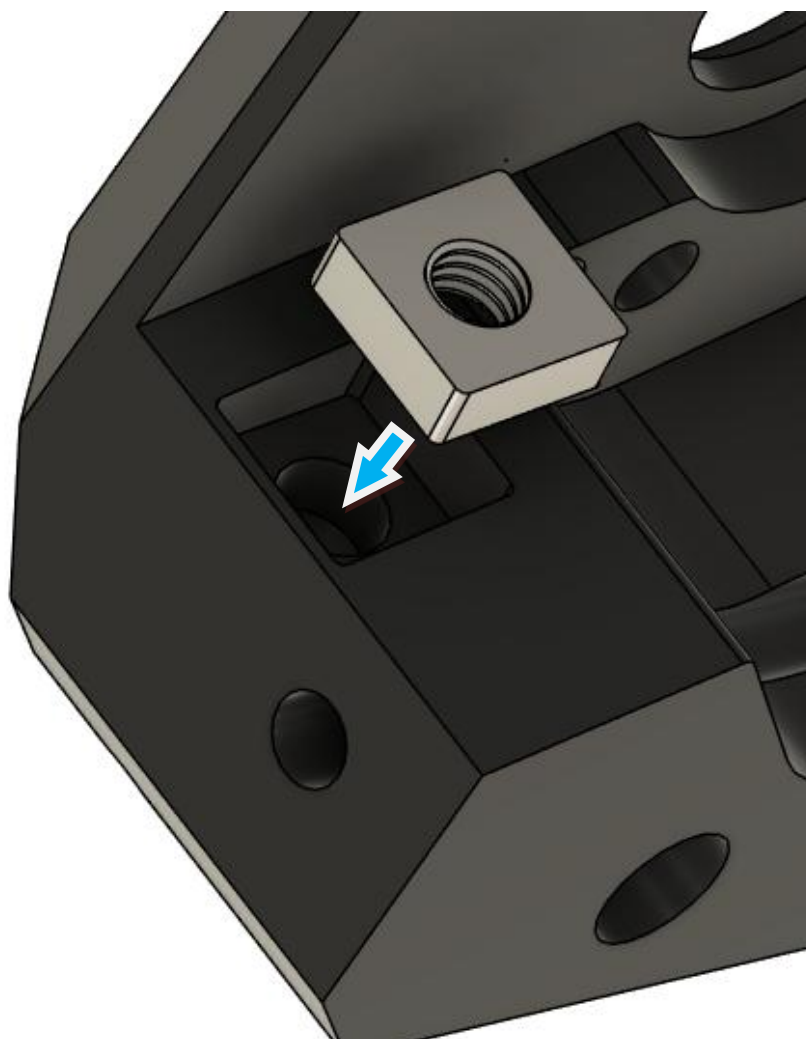


Manual for BRS-AWD Drive

Here All the M4 inserts, and all the M6 inserts

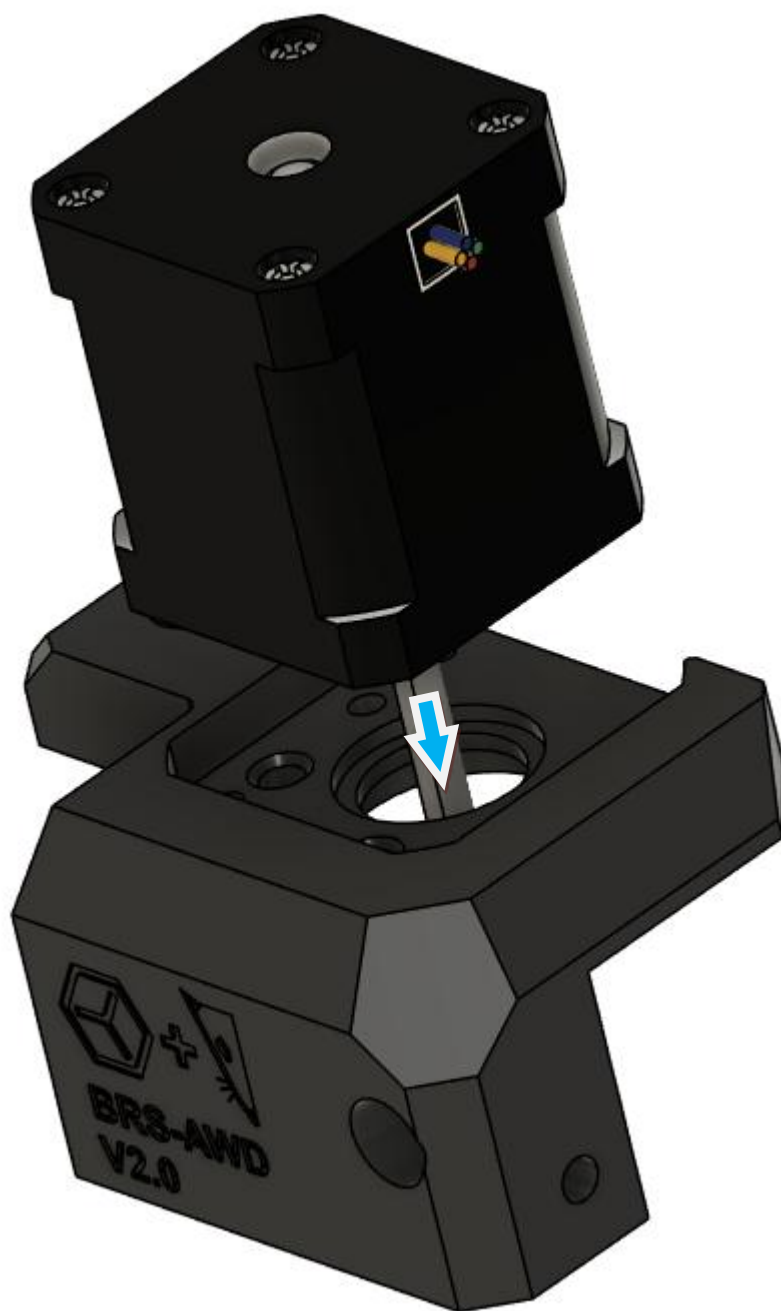


Then the squared M6 nut





2-Motors assembly

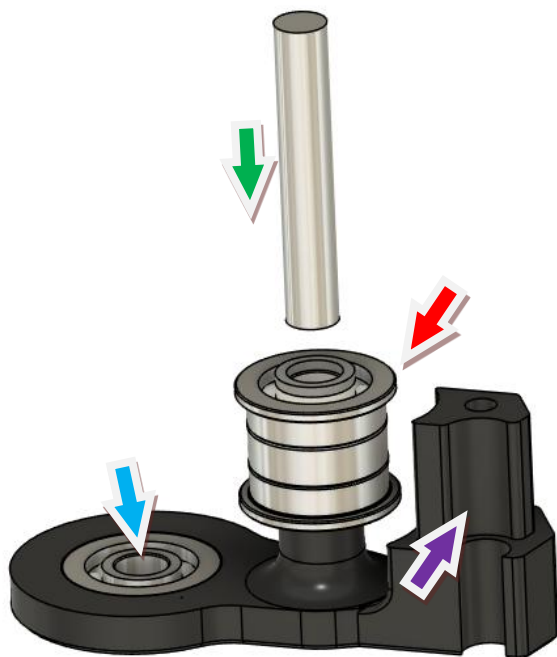




Manual for BRS-AWD Drive

Install the motors to each top blocks, secure it with the M3x10mm screws (4x each)

3-Coaxial L3ver assembly:



An F695 in the coaxial section, then a classic pulley stack (8x5x1mm shim – F695 – 695 – F695- 8x5x1mm shim), secure it with the 5x30mm shaft

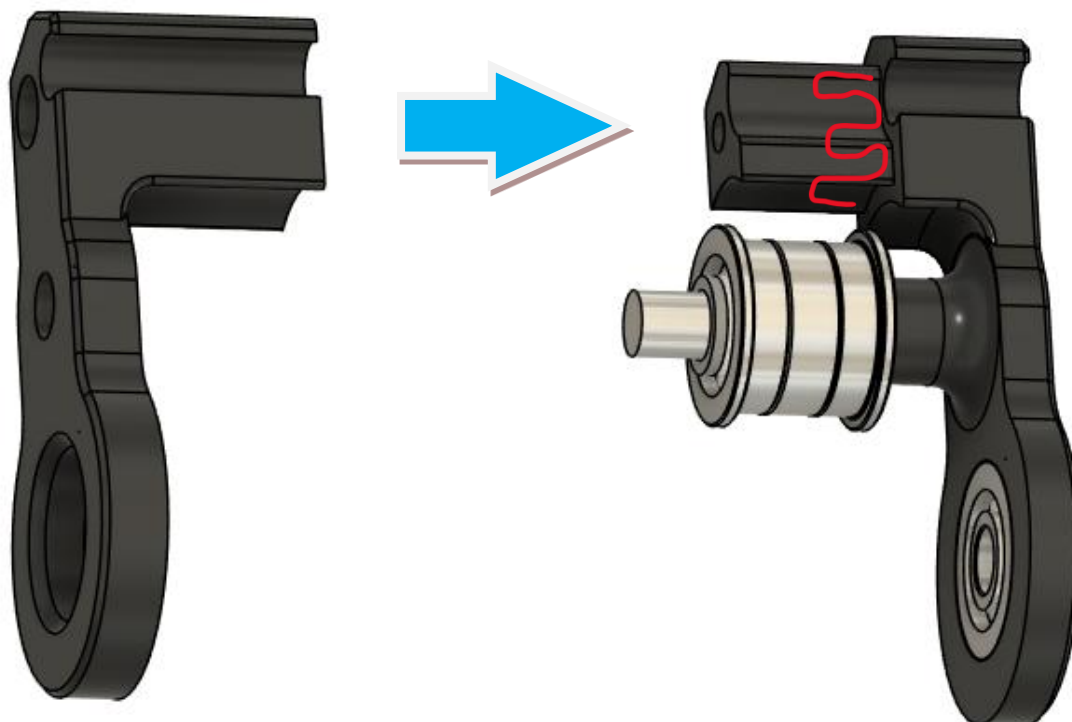
A dip of superglue on the join section





Manual for BRS-AWD Drive

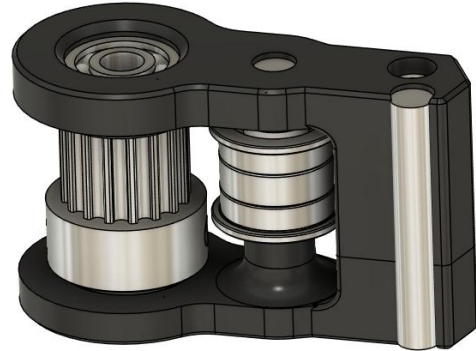
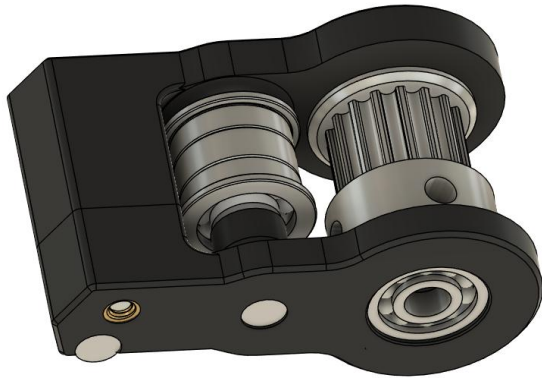
As an M3 insert here



Assemble the 2 parts, secure it with a M3x25mm



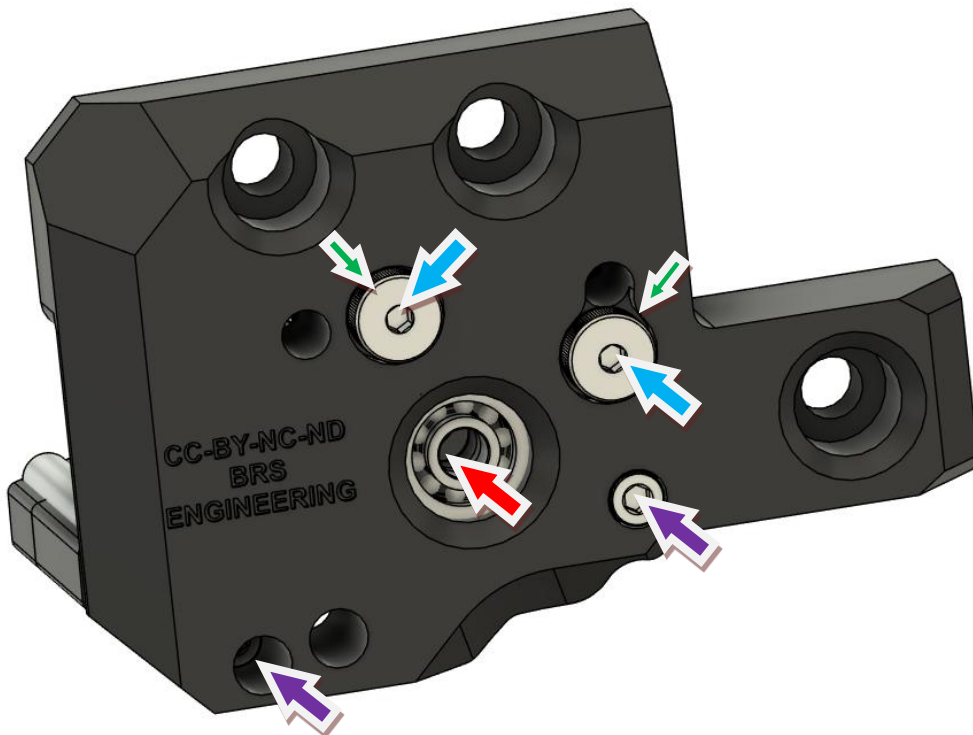
Add the 5x30mm pit by gliding it



Final result

Do each Coax l3ver (2x)

4-Lower sections:



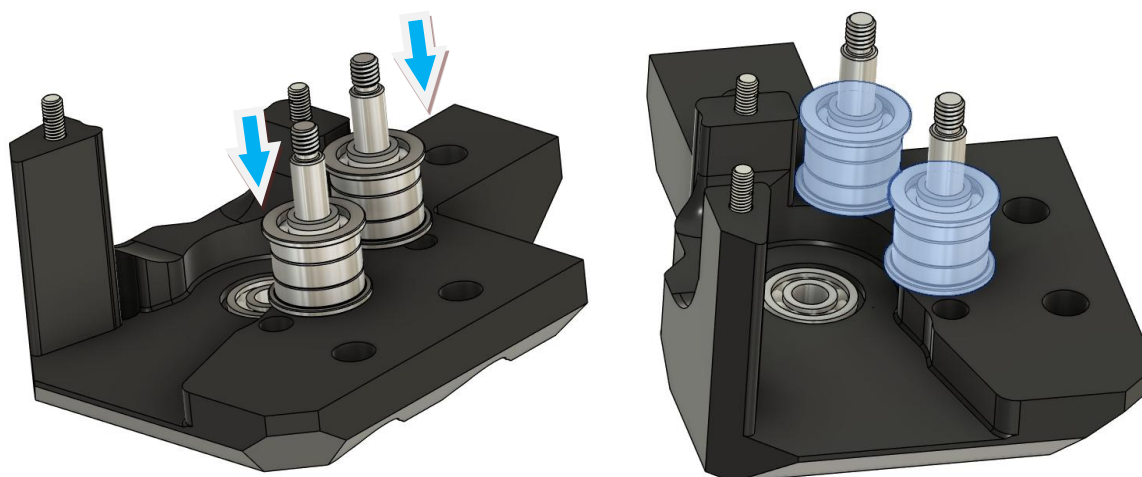
Add the 2x D5M4x35mm Shouldbolts (per side), then the F695 bearing

On the right side, you must add 2 8x5x1mm washers on the shouler bolts to avoid issues later

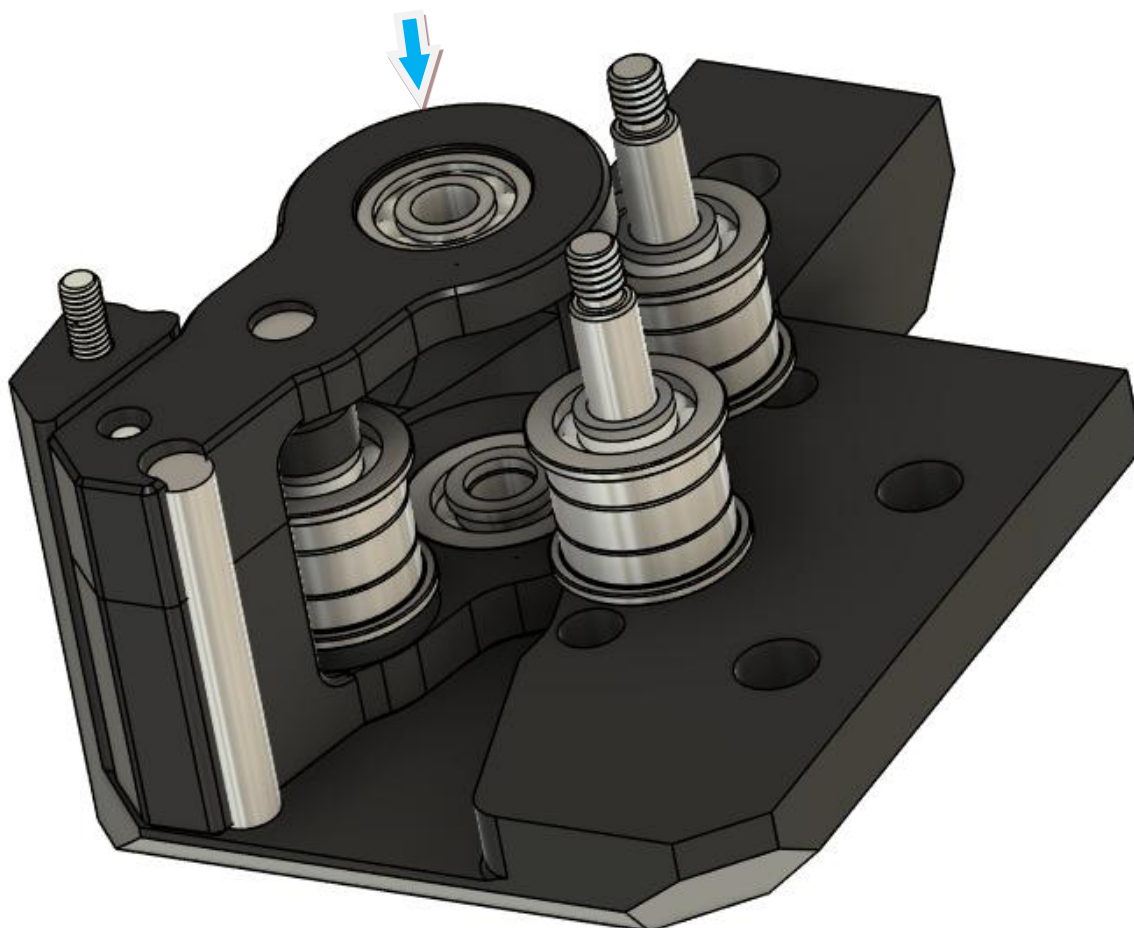
Then 2x m3x30mm (per side)



Manual for BRS-AWD Drive



Add the 2x pulley stacks



Add the Coaxial L3ver, wigling it a bit to fit the space. Place the Pulley, matching the belt path



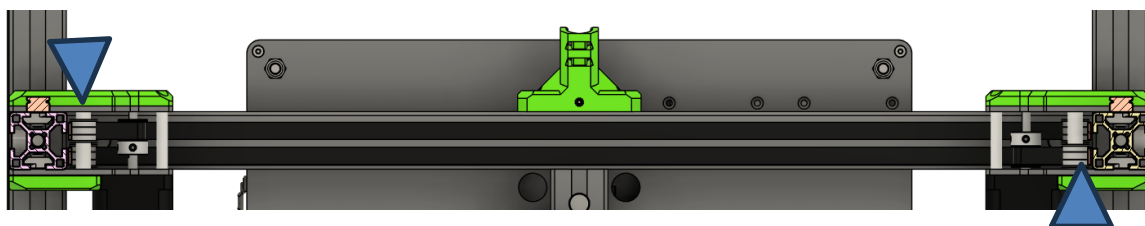
5-Machine modification:

As said earlier, the Stock Vcore 4.0, The rear blocks 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

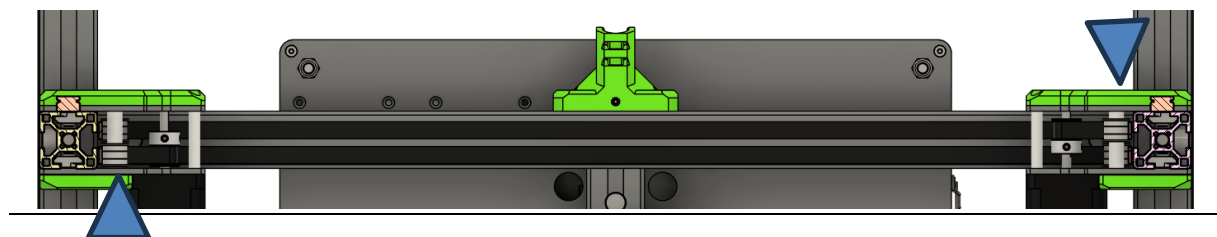
X1 needs to second X on the bottom belt, Y1 need to second Y on the upper belt

So we need to mirror the Rear layout:

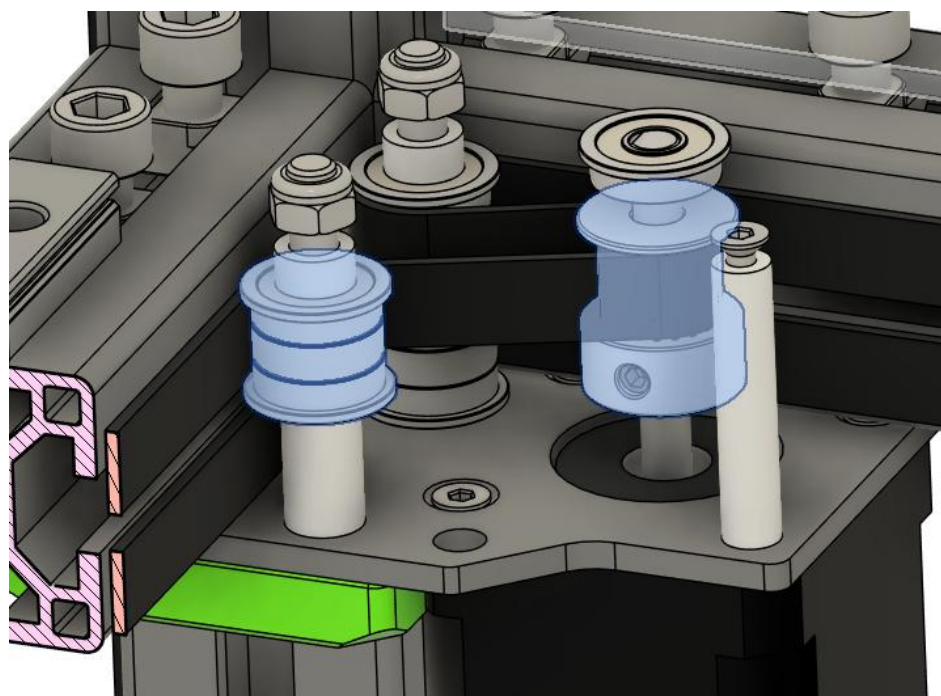
STOCK



AWD 2.0



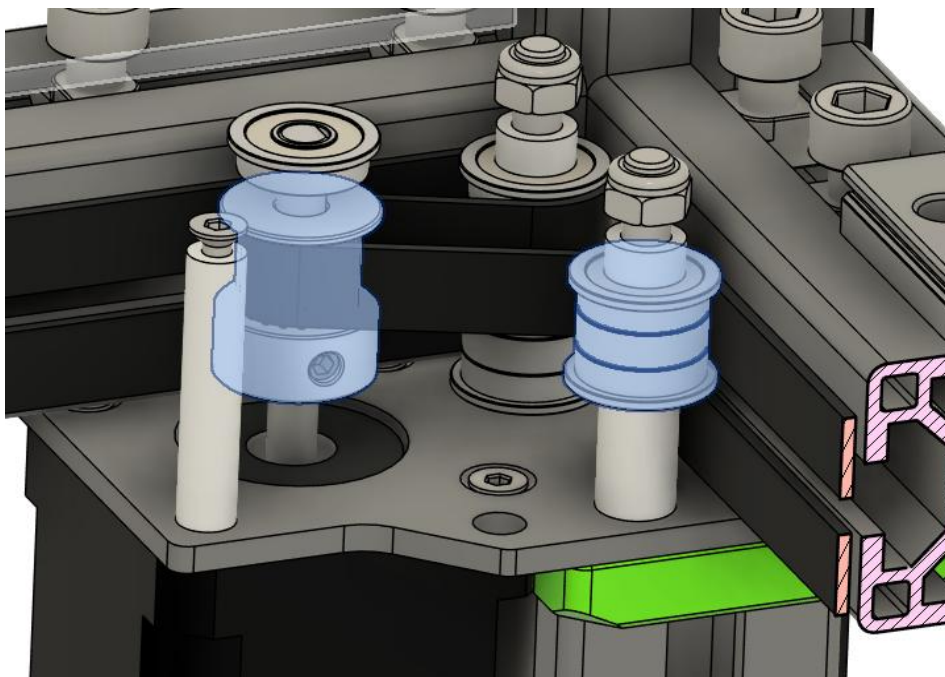
We need to get the R side going from





Manual for BRS-AWD Drive

To this



You basically only need to mirror the bearing layout from Right to Left. Simple task.

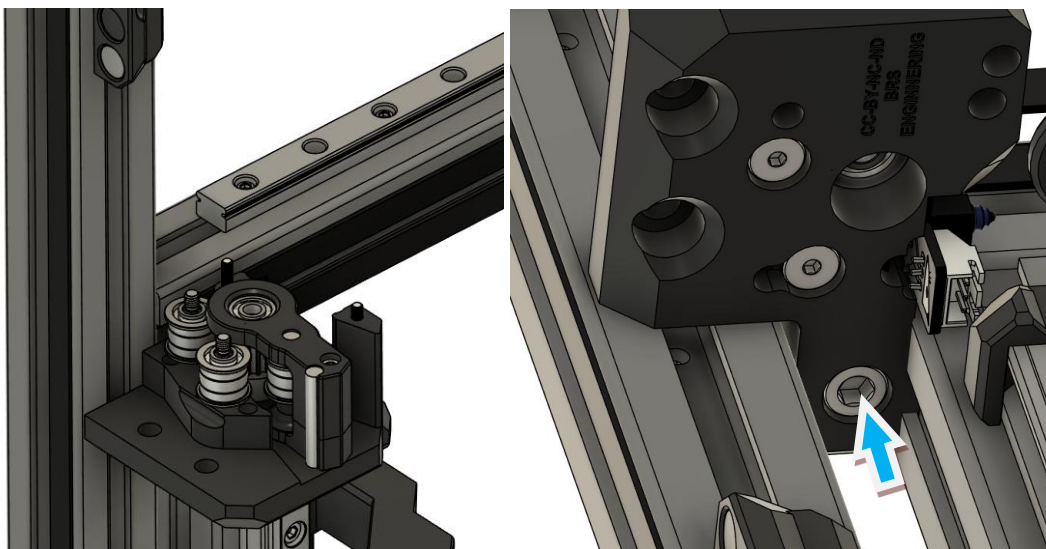


6-General installation

A/ Underplates

Prepare the front of the Frame

- Remove the front tensionner
- Remove the Y endstop + his holder



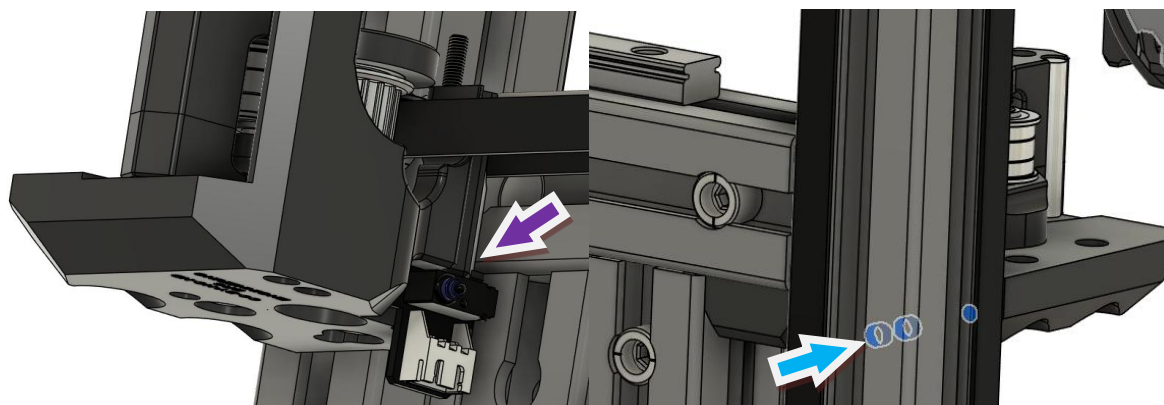
You should start with a clean empty front machine

Place the lower sections on both sides

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

Secure it with an M6 screws with according Tnuts

Replace the Y endstop to the new spot with an M3x5mm



Secure the lower plate with the M4 bolt from the tensionner (NO NEED TO OVERTIGHT IT)



B/ 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° 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

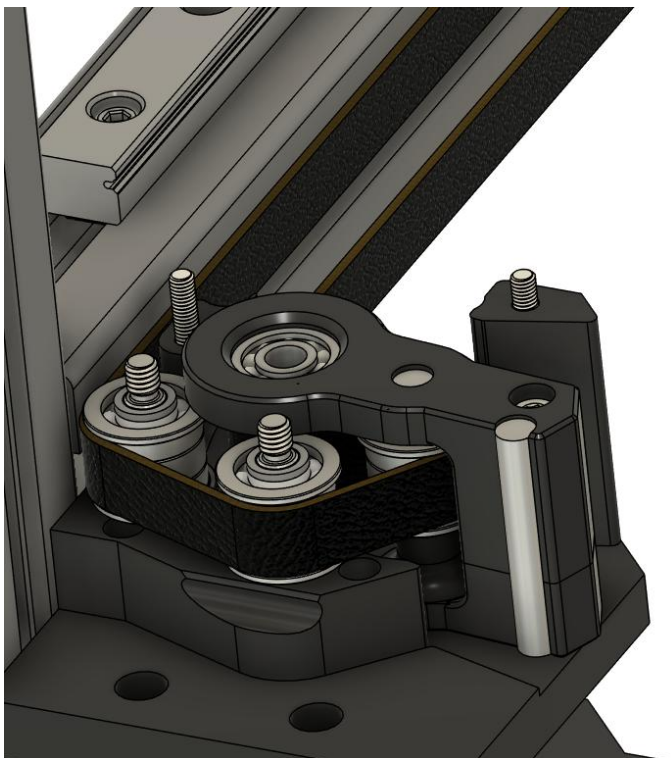
Note: in order to help the motor sync later, try to pre orient the pulleys headless screws in an accessible way

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 😊

Add the pulleys in the Coaxial L3ver (No need for shims here)

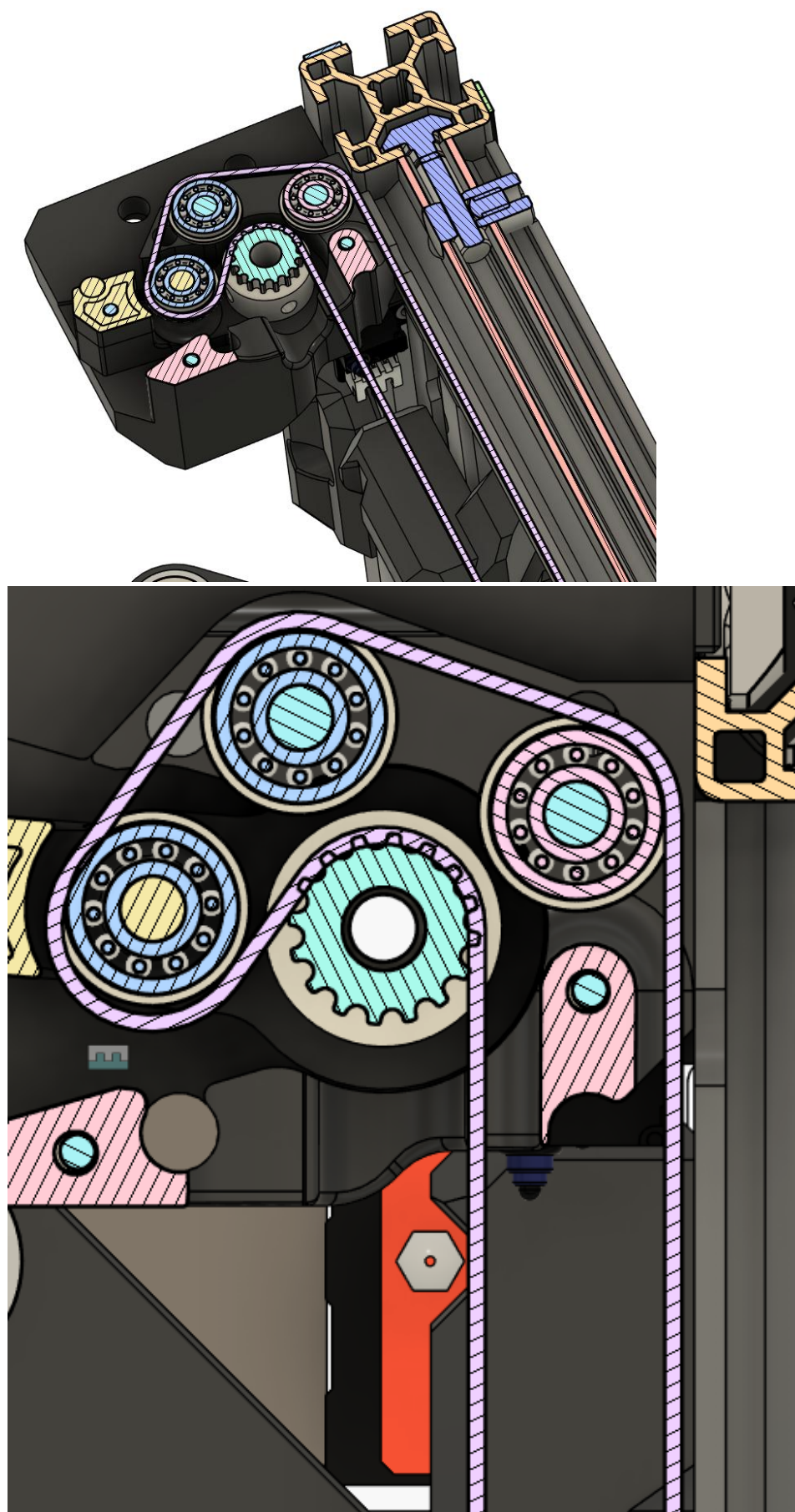
DO NOT TIGHT THE PULLEYS GRUB SCREWS

We will do the sync later.





Manual for BRS-AWD Drive

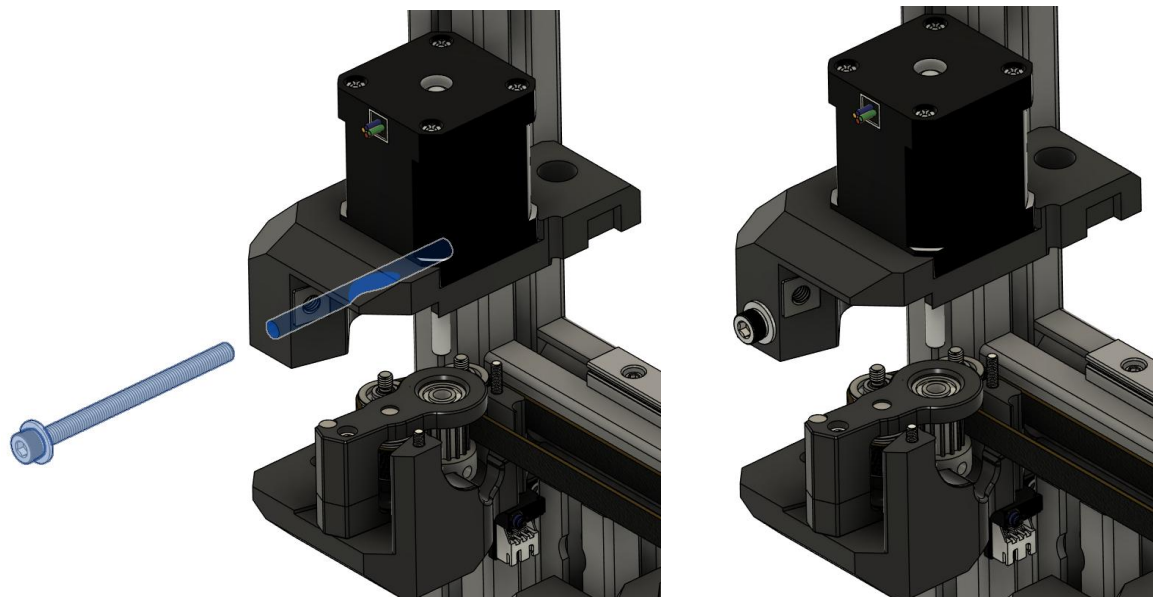




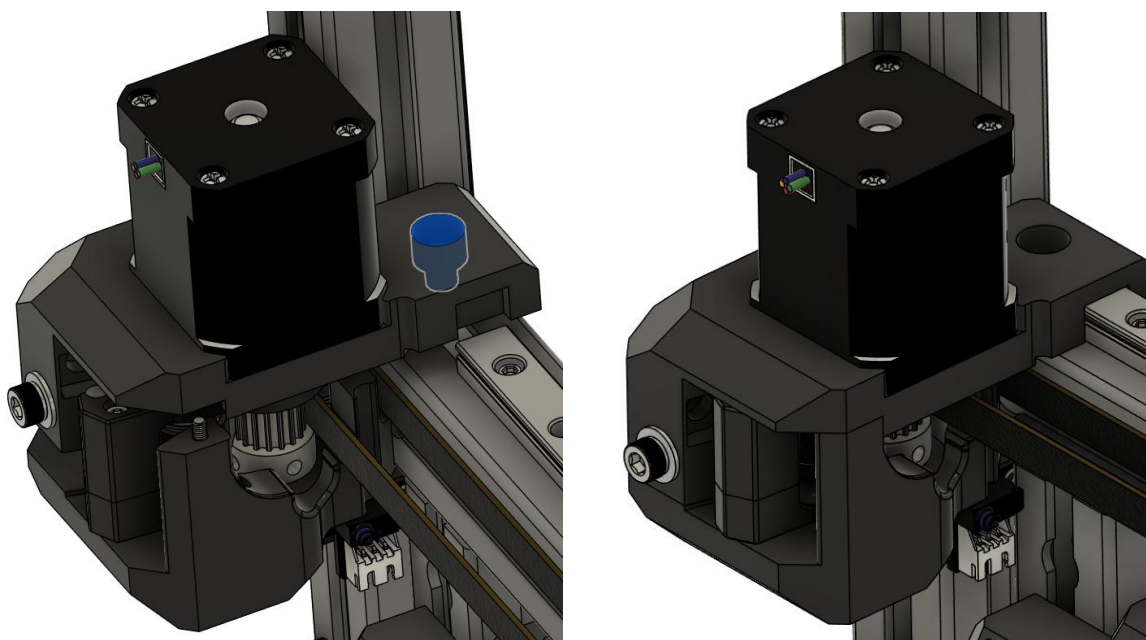
Manual for BRS-AWD Drive

C/ Top sections:

On the top sections, insert the M5x70 with an m5 washer and an m5 Tnut,



Lower the Shoulder bolts to flush the 1mm shim. Add an M6x12mm + a tnut to secure the TOP

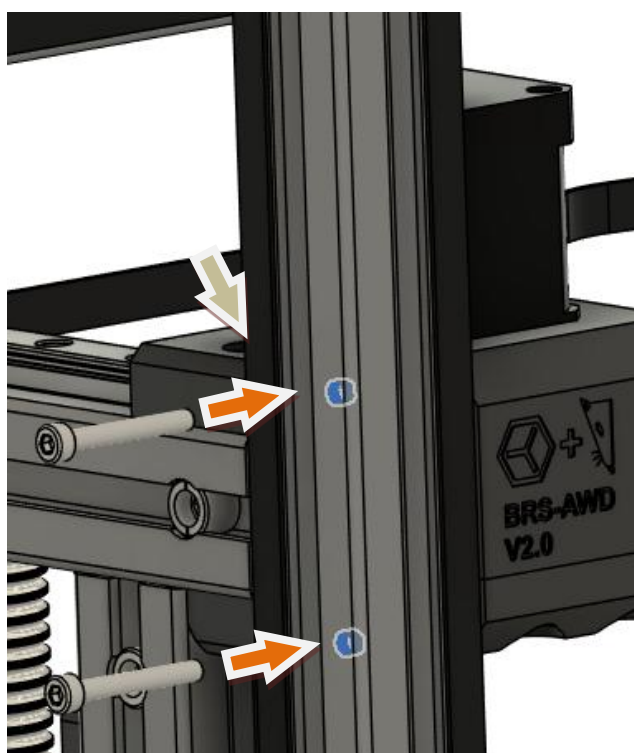




Manual for BRS-AWD Drive

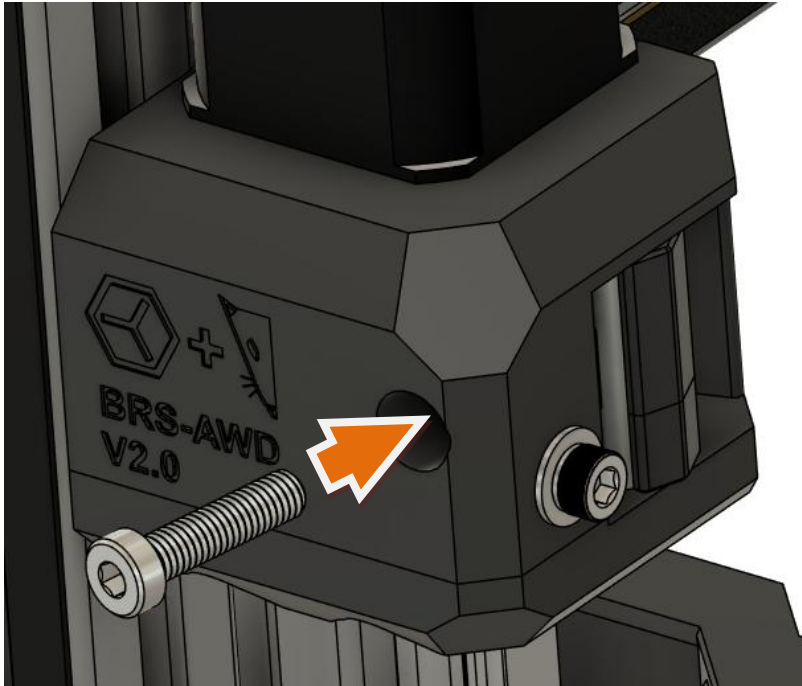
Tight the Shoulter bolt, do not overtight it, then you can tight in that order:

Top M6x12mm > **2x M3x30mm** > **Bottom x2 M6x12** > **Lateral M5x70mm** > **Lateral M4**

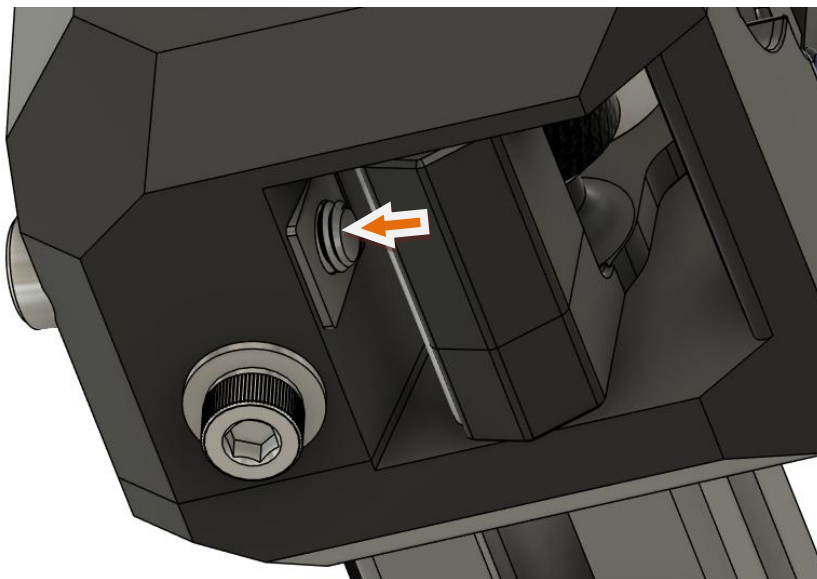




C/ Tension:



Add the M6x25mm in the Hole with the M6 square nut



Place the l3ver against the tip of it, at the lower position

At this point you will need to fix the belts ends on the toolhead fixing points. Try to make a correct pre-tension, we don't want the belts to be loose

Then you can use the M6 to increase tension, as you will normally do with any tensioner until the best value is found

See the BRS-Belt tensioning procedure here:

<https://github.com/FlorentBroise/BRS-Printers-Mod/blob/main/procedures.md>

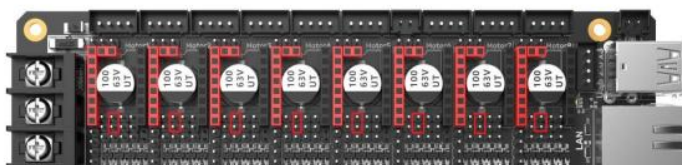


5-Wiring

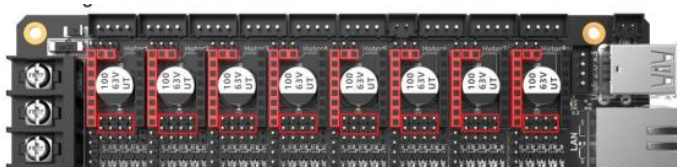
You need to add the 2 drivers to your board, then make sure the wiring is correctly made to allow X and X1 to run in the same motion logic, same for Y and Y1

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



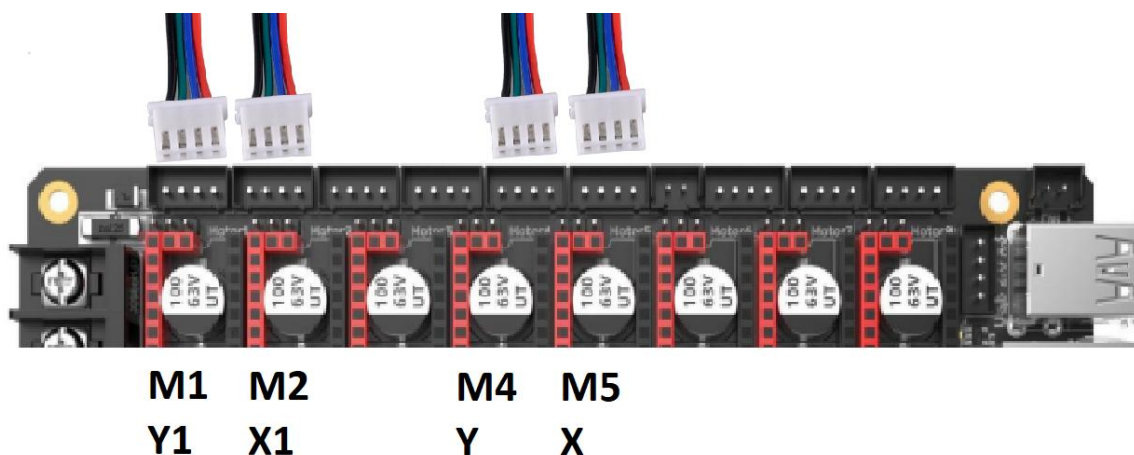
Here a BTT M8P Manta 2.0 in SPI mode for TMC5160/Pro

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

Y

X

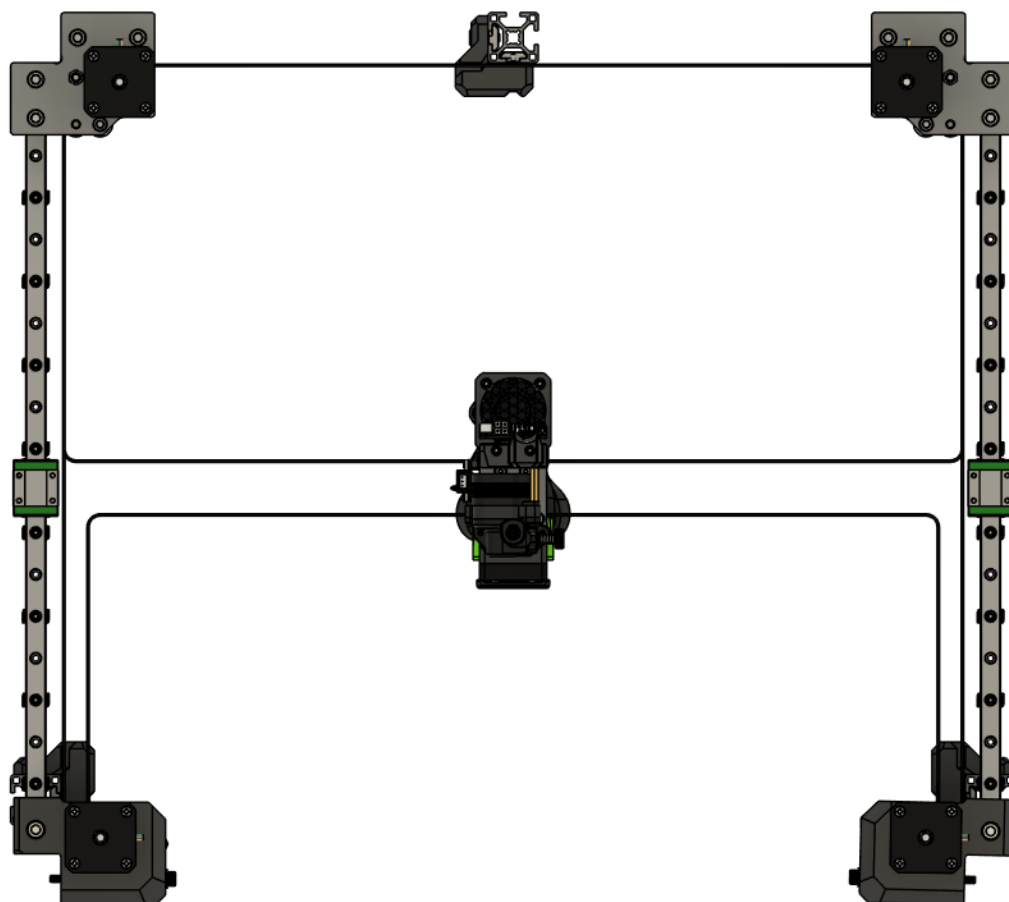


Figure: motor places

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)



Manual for BRS-AWD Drive

- X and Y don't feature a "!" in the DIR_PIN section

Override with:

```
[stepper_y]
```

```
dir_pin:«Y-PIN»
```

```
[stepper_x]
```

```
dir_pin:«X-PIN»
```

- X1 and Y1 need full setup in the printer CFG since they are not existing yet; plus we need a "!" in their DIR_PIN section

```
[stepper_y1]
```

```
step_pin:
```

```
dir_pin:!«Y1-PIN»
```

```
enable_pin:
```

```
rotation_distance:
```

```
microsteps:
```

```
[stepper_x1]
```

```
dir_pin:!«X1-PIN»
```

```
[tmc2209 stepper_y1]
```

```
uart_pin:
```

```
stealthchop_threshold: 0
```

```
sense_resistor: 0.110
```

```
run_current:
```

```
driver_TBL: 2
```

```
driver_TOFF: 3
```

```
driver_HEND: 0
```

```
driver_HSTRT: 5
```

```
[tmc2209 stepper_x1]
```

```
uart_pin:
```

```
stealthchop_threshold: 0
```

```
sense_resistor: 0.110
```

```
run_current:
```

```
driver_TBL: 2
```

```
driver_TOFF: 3
```

```
driver_HEND: 0
```

```
driver_HSTRT: 5
```

DON'T FORGET HERE IS AN EXEMPLE, YOU MUST FIT THIS SETUP TO YOUR BOARD:



Manual for BRS-AWD Drive

General rule is to match the rear motors setting for the section `[stepper]` and `[TMCxxxx]` for the front

You may have to change:

- TMC version (2209,5160,...)
- Rotation_distance **MUST BE THE SAME** across all X, X1, Y, Y1 motors
- Those settings must be the same across all X, X1, Y, Y1 motors
- driver_TBL:
driver_TOFF:
driver_HEND:
driver_HSTRT:

stealthchop_threshold:
sense_resistor:
run_current:
- The Y endstop is relocated a bit further within the machine; +-12mm:
This does not restrain Y max length of potential print, You will need to add this in the printer.cfg; it will override any other value about this parameter.

`[stepper_y]`

`position_max: OLD POSITION-12`

`position_endstop: OLD POSITION +12`

NOTE:

ALL NEMA on the X-Y-X1-Y1 needs to be the same model

ALL DRIVERS on the X-Y-X1-Y1 needs to be the same model

ROTATION DISTANCE NEED TO BE THE SAME

ADAPT YOUR SETTING TO WHAT YOU HAVE, If you have doubt or question, don't hesitate to contact me.



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

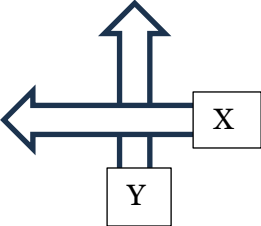
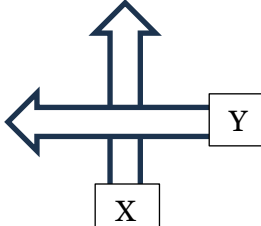
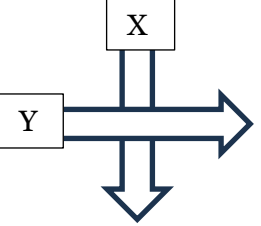
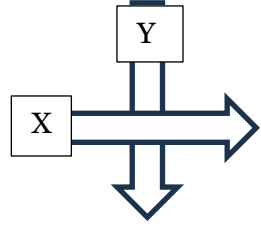
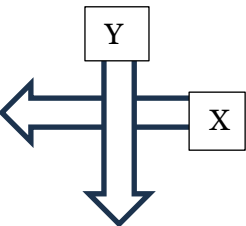
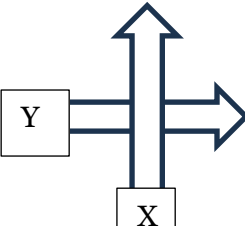
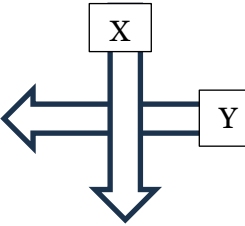
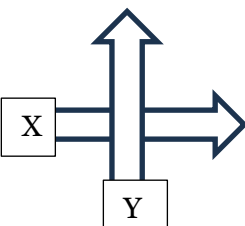
Step 3: Start up the printer and order "enable stepper".

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	
							



10-License :

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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 submitted to Florent Broise on Facebook/Discord or at contact@brs-engineering.com