

Rhino FFB Clone DIY Assembly Instructions

Introduction and Notes

- This instruction set is for a DIY clone version of the VPForceControls force feedback joystick base.
- This build is based on the motor kit from VPForce, 2x57BLF03 + USB kit.
- Belt sizes are based on 74tx12t pulleys.
- All 3d Printed parts are adapted from the Mabo1972s design Github.
<https://github.com/mabo1972/FFB-Joystick-Base-Plywood>
- Links for parts purchase have not been provided due to possible vendor changes and people needing to source from many countries. Therefore I have tried to use the most correct and common names for parts.
- Parts have been sourced form Amazon, Digikey and the Nutty Company, but can likely be found elsewhere.
- All instructions are based on the included parts list and required 3d Printed parts in this guide and Github.
- These instructions include the 20 degree throw limiters which can be omitted if desired, and the spacer printed to then mount the boot assembly.
- **BUILD NOTES**
 - The E-Stop button interrupts the **POSITIVE** side of the 12vdc power to the motors. **POLARITY MATTERS.** Pay attention to motor power connections!
 - Motor data cable polarity is already correct with included cables. **BE SURE THEY ARE PLUGGED INTO PROPER DATA PORT FOR EACH MOTOR. Motors are labeled.**
 - The USB connector in the VPForce kit is already terminated properly. Just plug into the proper port on the main board.

These instructions assume you are familiar with things like bearings, soldering, basic circuit wiring and 3D printing.

Parts List

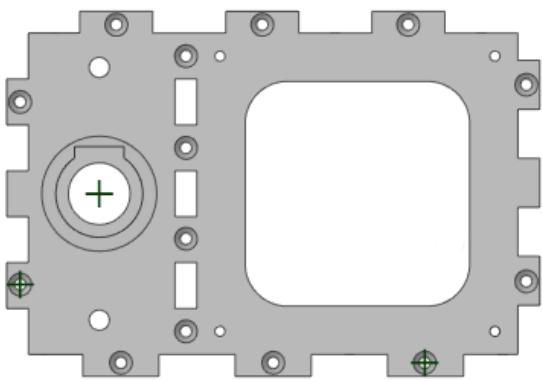
Electronics

- (1) 2x57BLF03 + USB kit from VPforce
- (1) Cuedevices MD-50PL100 is required to terminate grip connection
- (1) H2.5 JST connector kit
 - 2P and 5P needed
- (1) 22mm Latching Emergency Stop Push Button
- (2) 10K Ohm Rotary Potentiometer
- (1) 80mm x 15mm PC cooling Fan
- (1) 5.5mm x 2.1mm 2 Pin DC Power Female Panel Mount Jack Socket Connector
- (1) 20VDC 9a Power Supply with 5.5mm male plug

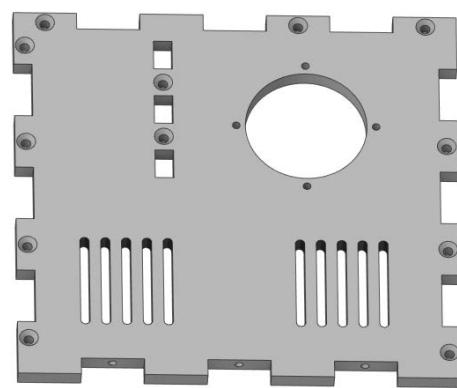
Bearings, Screws and Mecahnicals

- (8) 15x24x5mm 6802RS Bearing (Gimbal Pillow Block Bearings)
- (2) 5x16x5mm F625ZZ Flanged Bearing (Core Joint to Stick Adapter Bearings)
- (4) 40x52x7mm 68082RS Bearing (Gimbal Arm to Case Bearings)
- (1) M5x60 Socket Head Screw (Stick Connector to Core Joint)
- (2) M5 Nut (Stick Connector to Core Joint)
- (3) M5 washer (Stick Connector to Core Joint)
- (4) M5x10 Button Head Socket Cap Screw (Stick Core to Pillow Block Bearings)
- (8) M5x10 Button Head Socket Cap Screw (Gimbal Pillow Blocks)
- (12) M4x35 Socket Head Screw (74T Pulleys)
- (12) M4 Nut (74T Pulley to Main Gimbal Mounts)
- (24) M4 washer (74T Pulleys)
- (40) M4x12 Flat Head Socket Cap Screw (Case Edges)
- (8) M6x16 Button Head Socket Cap Screw (Motor Mounts)
- (20) M3x16 Socket Head Screw (Bearing Retainers and Boot Collar)
- (4) M3x25 Socket Head Screw (Cooling Fan)
- (16) M3 Nut (Cooling Fan and Bearing Retainers)
- (4) M3 washer (Cooling Fan)
- (2) HTD-15 12tooth Aluminum Pulley 8mm Bore **WITH GRUB SCREWS**
- (1) 420-5M-15 HTD 420mm Timing Belt (Roll)
- (1) 465-5M-15 HTD 465mm Timing Belt (Pitch)

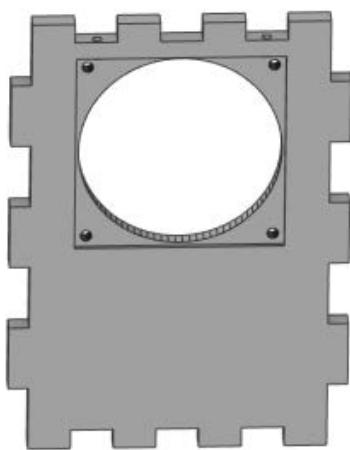
Printed Parts Reference



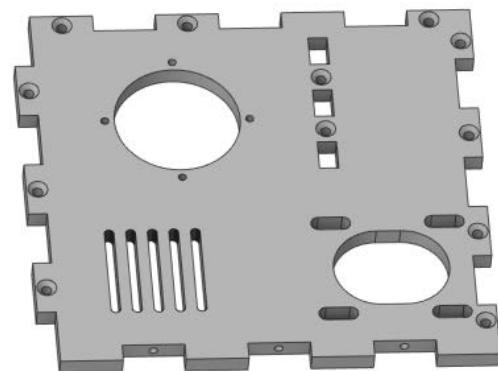
Top Panel



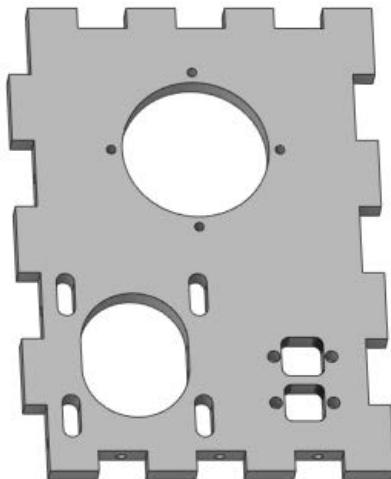
Left Panel



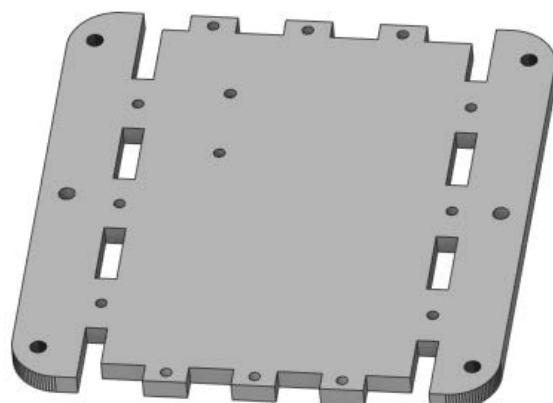
Front Panel



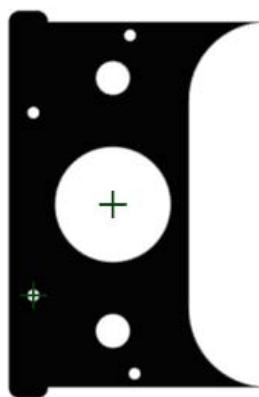
Right Panel



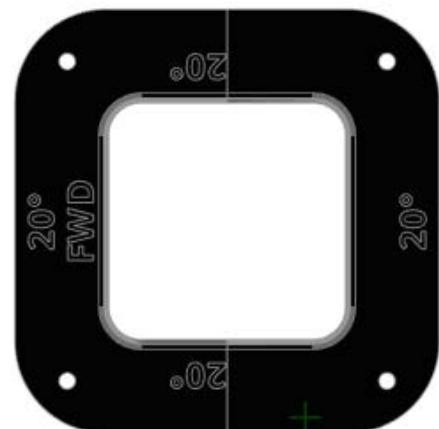
Rear Panel



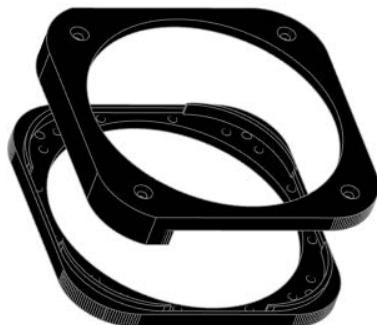
Bottom Panel



Top Panel Cover



Throw Limiters



Boot Clamps



Stick Boot Collar



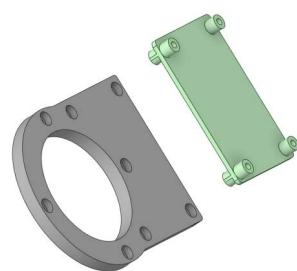
Knobs



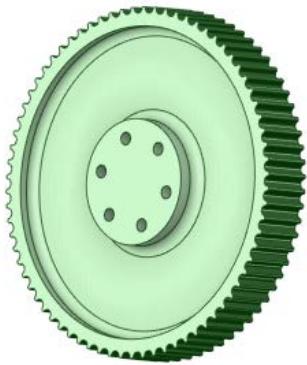
Inner Bearing Retainers



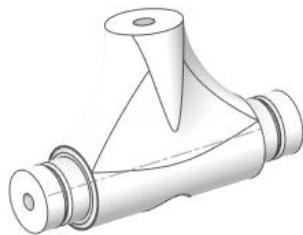
Outer Bearing Retainers



Front Outer Bearing Retainer
and Mainboard mount



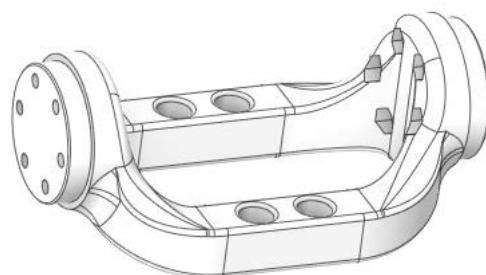
74 Tooth Pulley (X2)



Core Joint



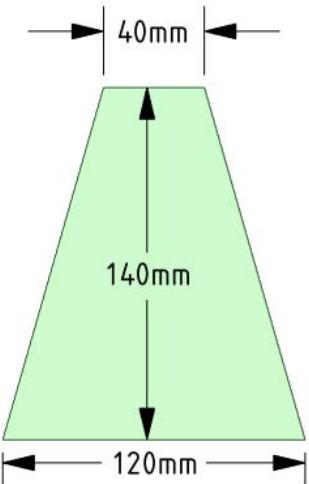
Thrustmaster Stick
Connector



Main Gimbal Arm (X2)



Core Joint and Stick Connector
Gimbal Pillow
Blocks
(X4)

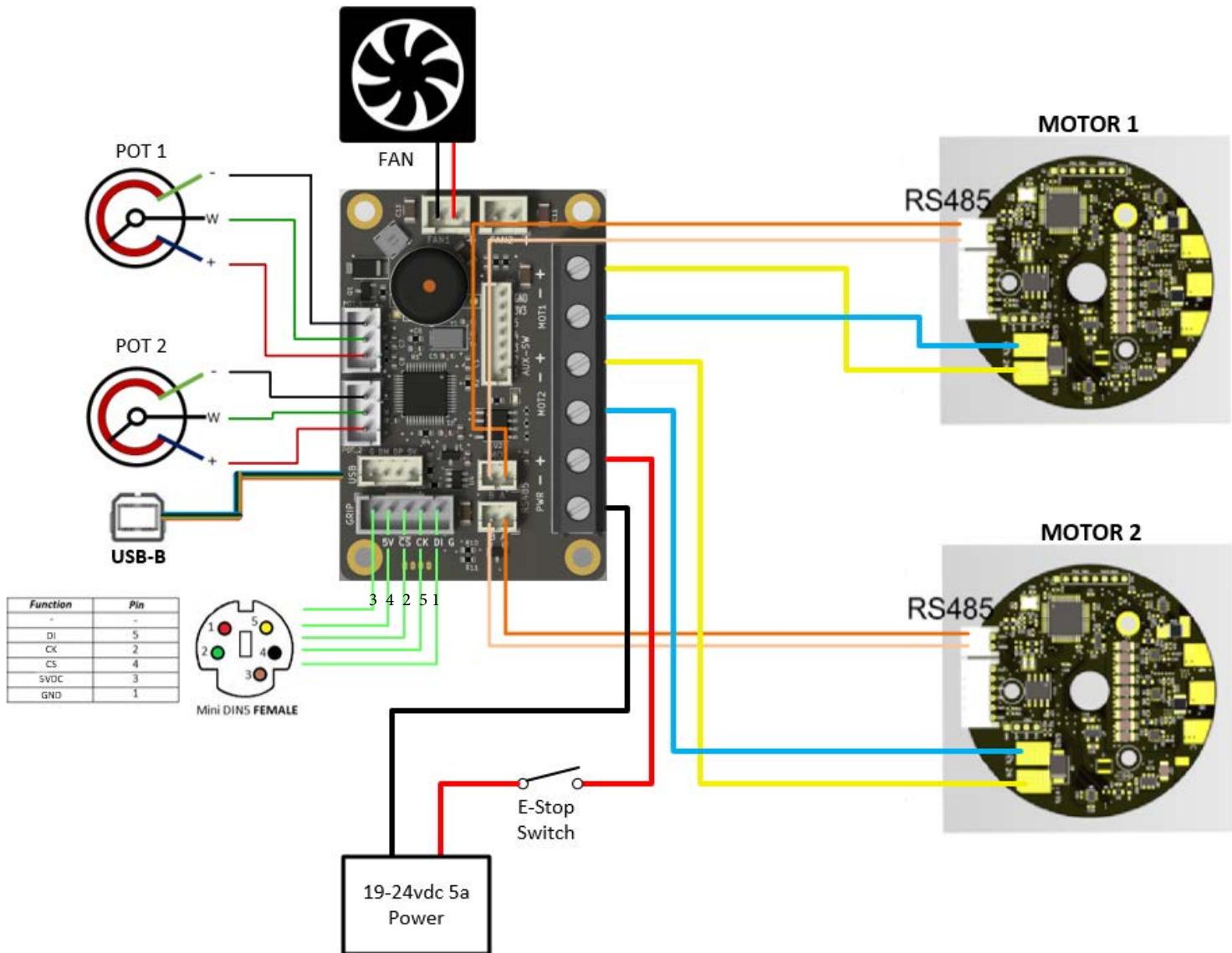


Boot Template

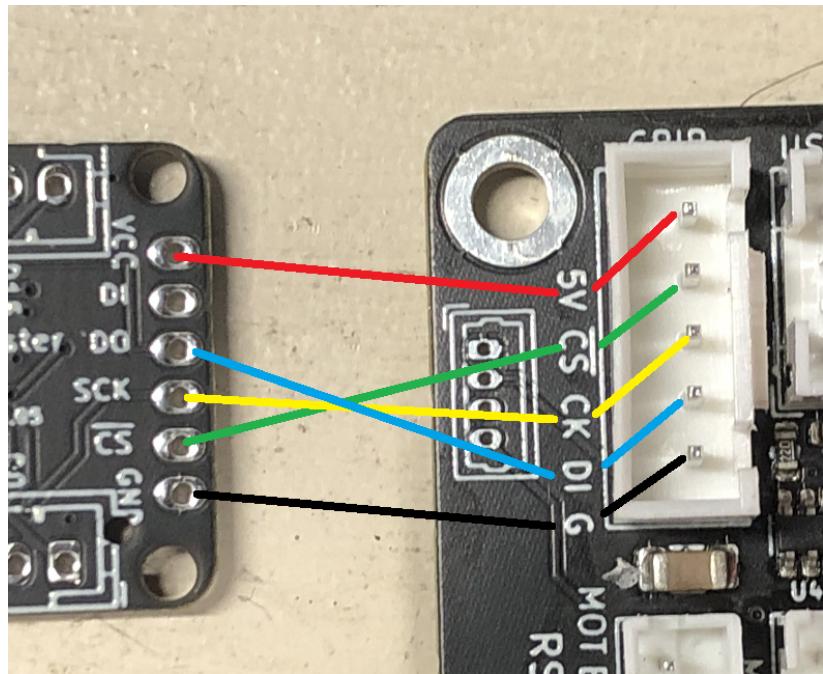
Assembly

Electrical Connections

- 5pin mini din soldered to 5pin JST for grip buttons
- Fan(s) soldered to 2pin JST plug and connected to main board
- Potentiometers connected to 3pin JST on main board
- Power positive soldered to E-Stop switch and then connected to main board terminal
- Power ground soldered to power plug and then connected to main board terminal
- Motor Power leads connected to main board terminals
- Motor Data leads plugged into corresponding 2pin JST on main board



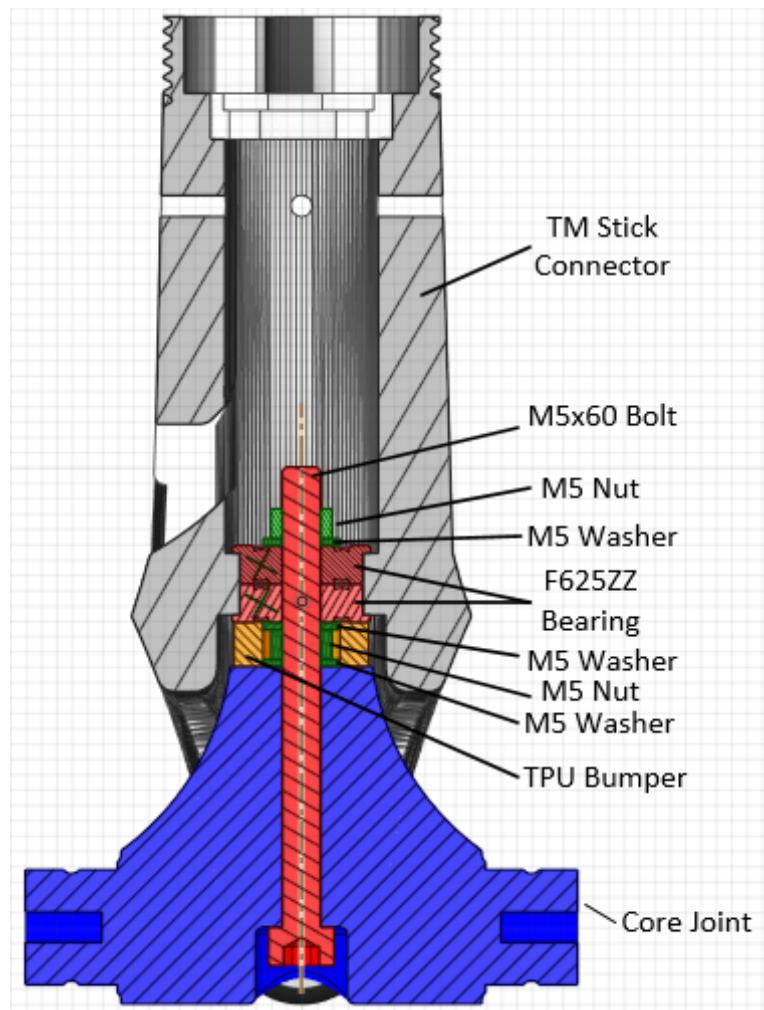
- Below is shift register wiring to the VPC mainboard, if using a shift register.



STEP 1

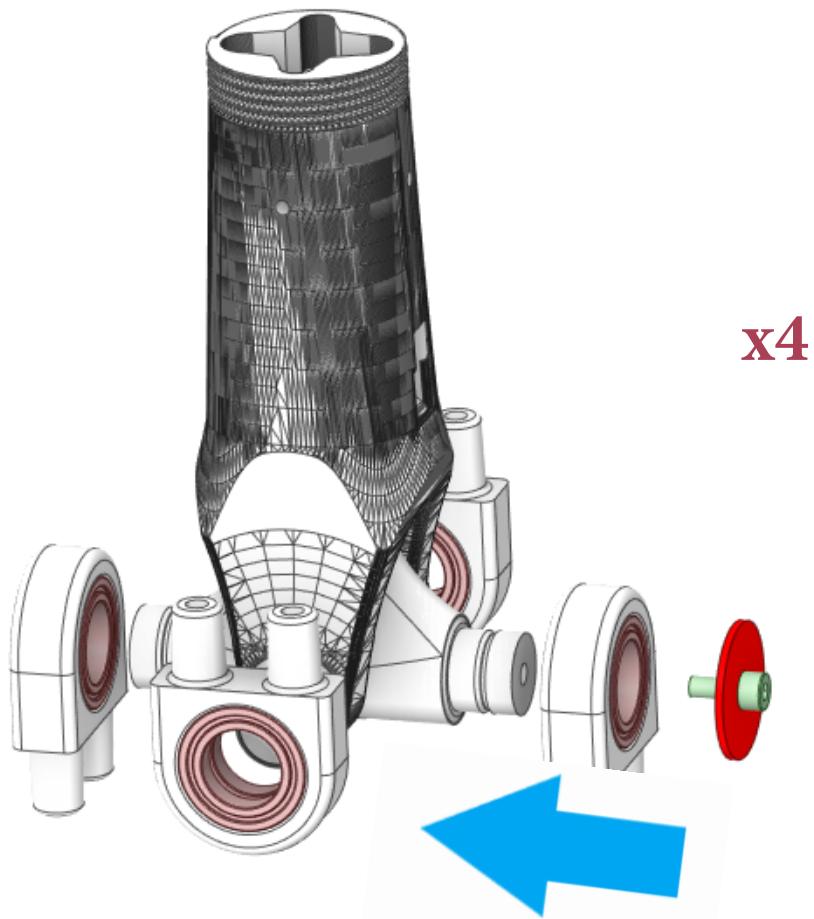
Assemble Stick Connector/Core Joint

- Wire the 5pin mini din connector for the grip wiring to the jst connector for the mainboard.
 - Be sure to extend the wires for enough reach to the mainboard.
 - Extend the wires and solder them to the loose wires for the jst connector.
 - Run the extended wires through the stick connector and out the front hole.
 - Insert the wires into the connector in the proper locations.
- Mount TM Stick Connector to Core Joint as show
- Insert M5x60 bolt into Core Joint
- Snug M5 nut and washer down onto Core Joint
- Place M5 washer on top of M5 nut
- Place TPU bumper on Core Joint around M5 Nut and Washers
- Snap F625ZZ bearing into base of Stick Connector
- Place a dab of loctite on the top 9mm of the M5x60 Bolt
- Press Stick Connector onto Core Joint
- Drop second F625ZZ bearing into Stick Connector and press down as shown
- Drop M5 washer onto M5x60 Bolt and thread M5 Nut onto Bolt and make snug (no need to HULK it)
- **DO NOT USE A WASHER DIAMETER WHICH REACHES THE OUTER BEARING RACE EDGE AS THIS WILL LOCK UP THE JOINT**
- **IT NEEDS TO BE ABLE TO ROTATE SLIGHTLY**



STEP 2

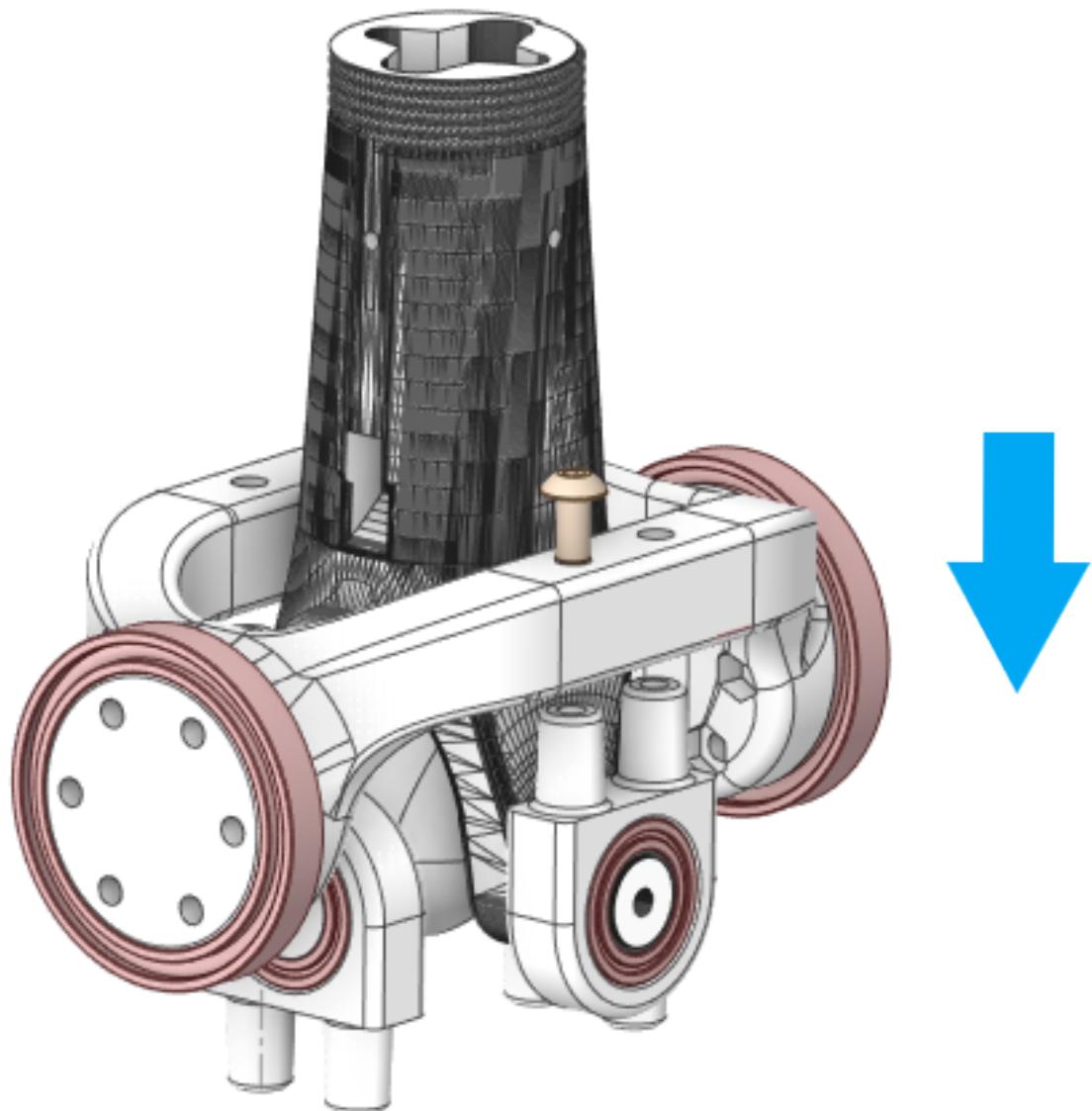
Insert 6802 bearings into core joint pillow blocks and mount four gimbal pillow blocks to stick and core joints and secure with 19mm washers and M5 screws.



STEP 3

Press 6808 bearing on to each end of the roll gimbal.

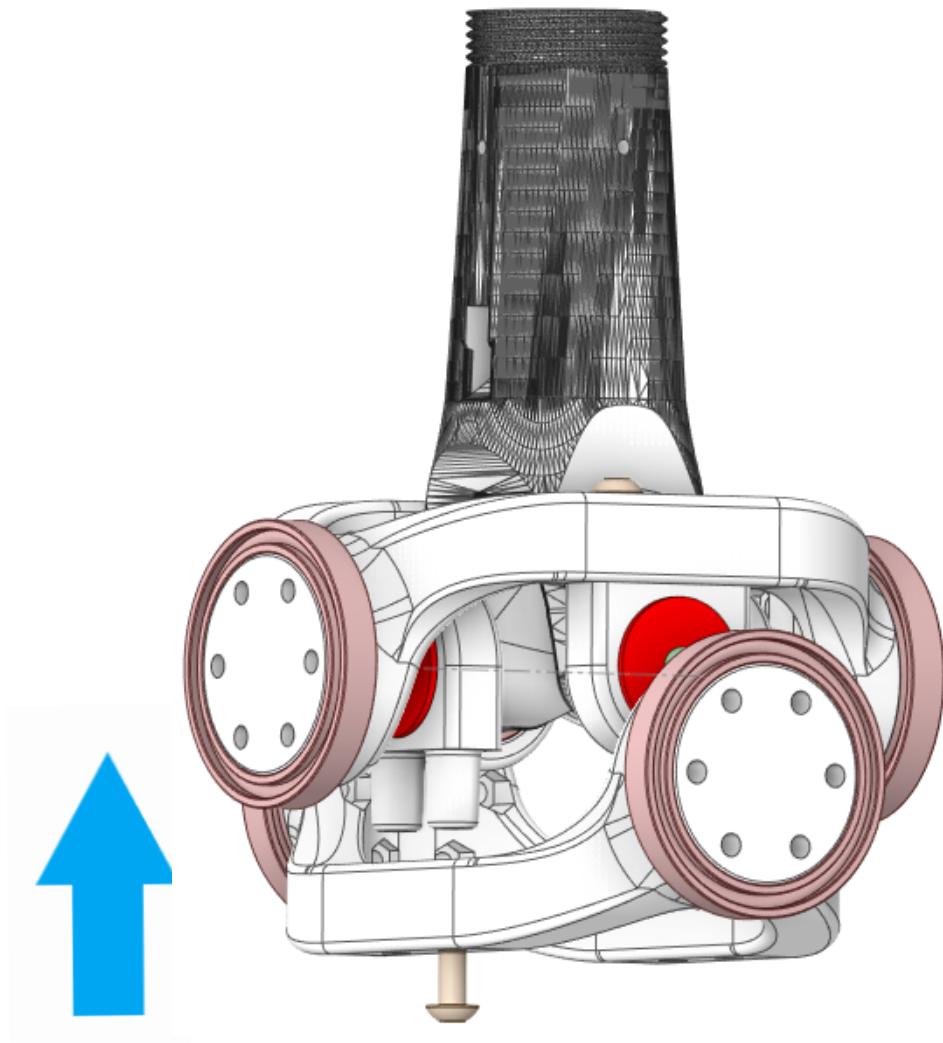
Push down and mount roll gimbal frame to pillow blocks with four M5 bolts



STEP 4

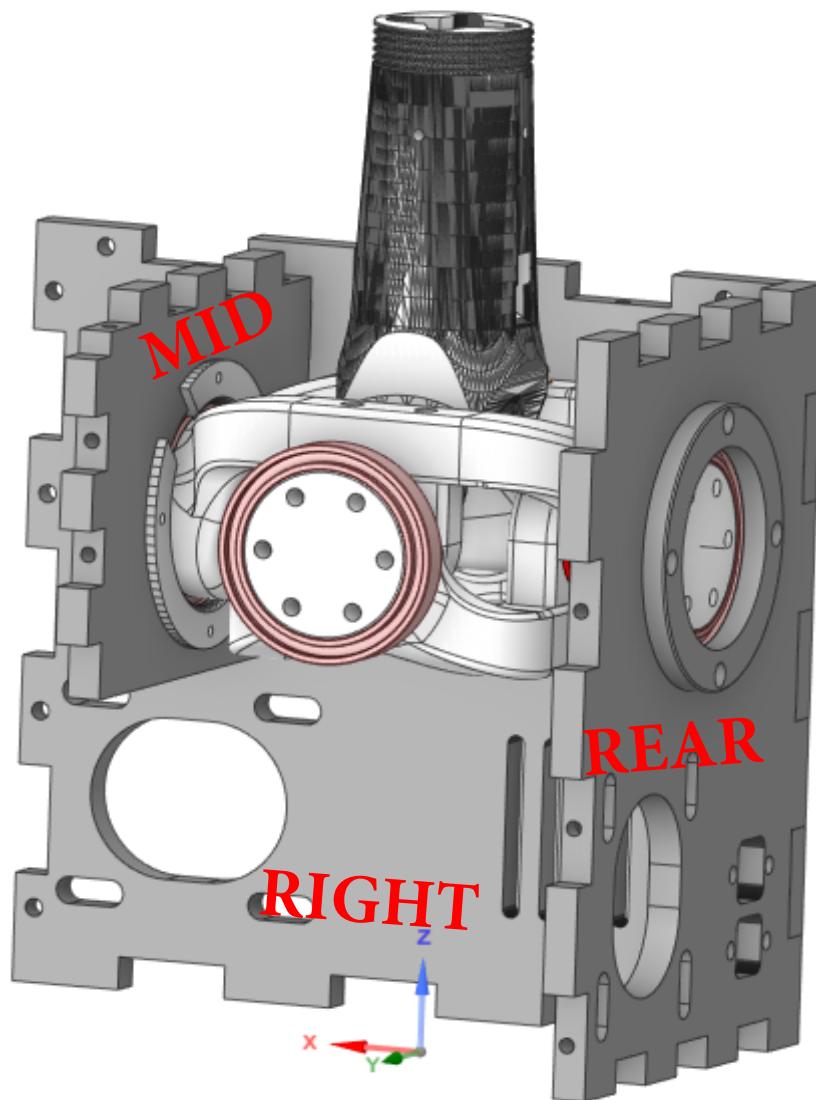
Press 6808 bearings on to each end of the pitch gimbal.

Mount pitch gimbal frame to pillow blocks with four M6 bolts



STEP 5

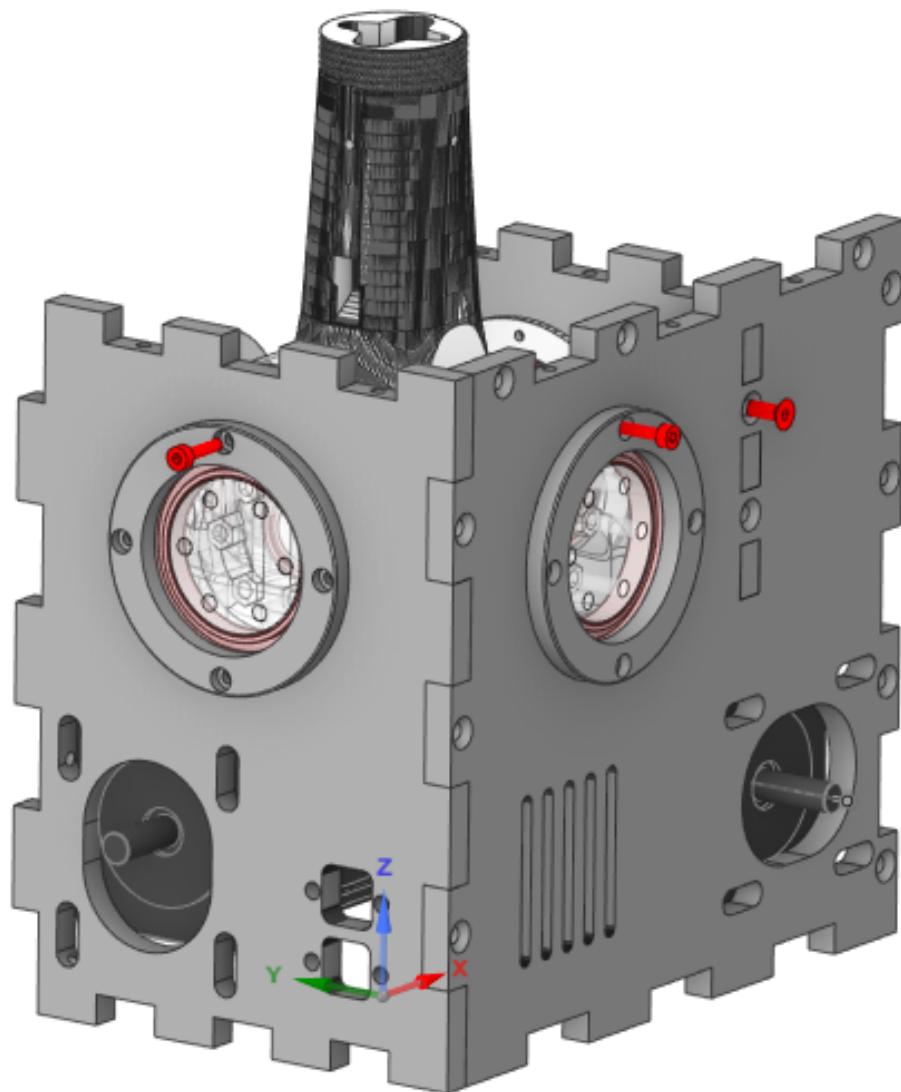
Slide the Gimbal Group into rear, mid, and right panel mounting holes

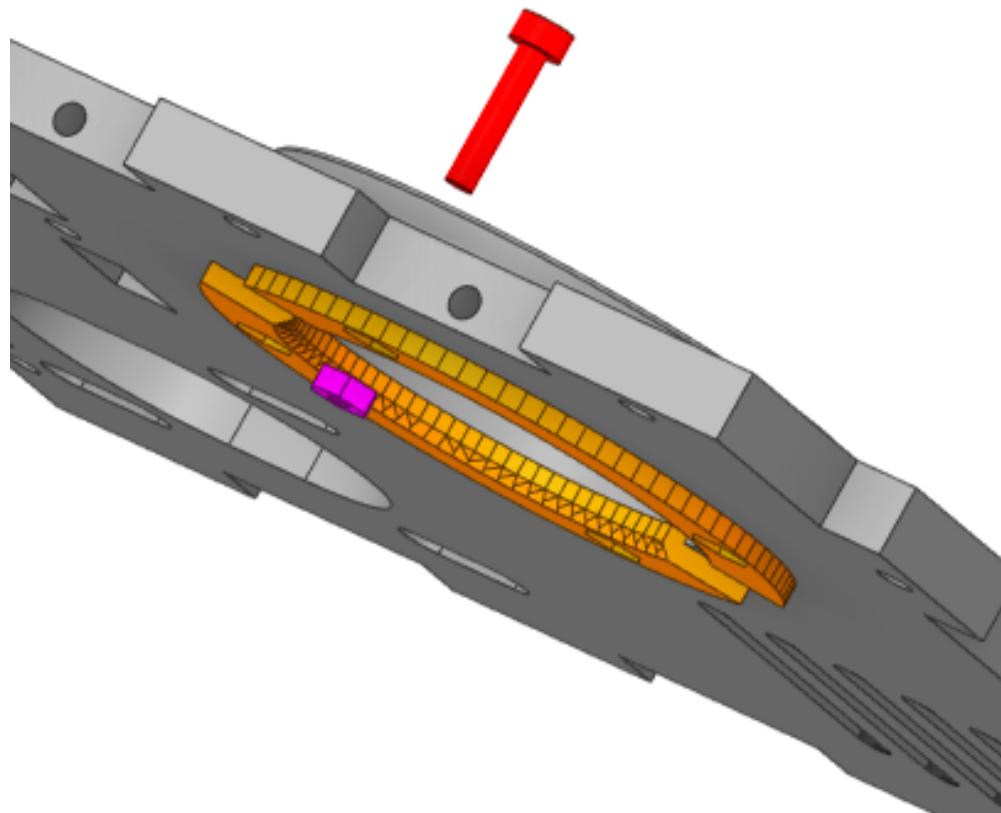


STEP 6

Secure mid panel with 3 M4x8 screws and mid, right and rear gimbal bearings with retainers using 4 M3x16 screws each

Squeeze the outer retainer rings flush against the case panel while tightening screws





Gimbal Bearing Retainer assembly detail

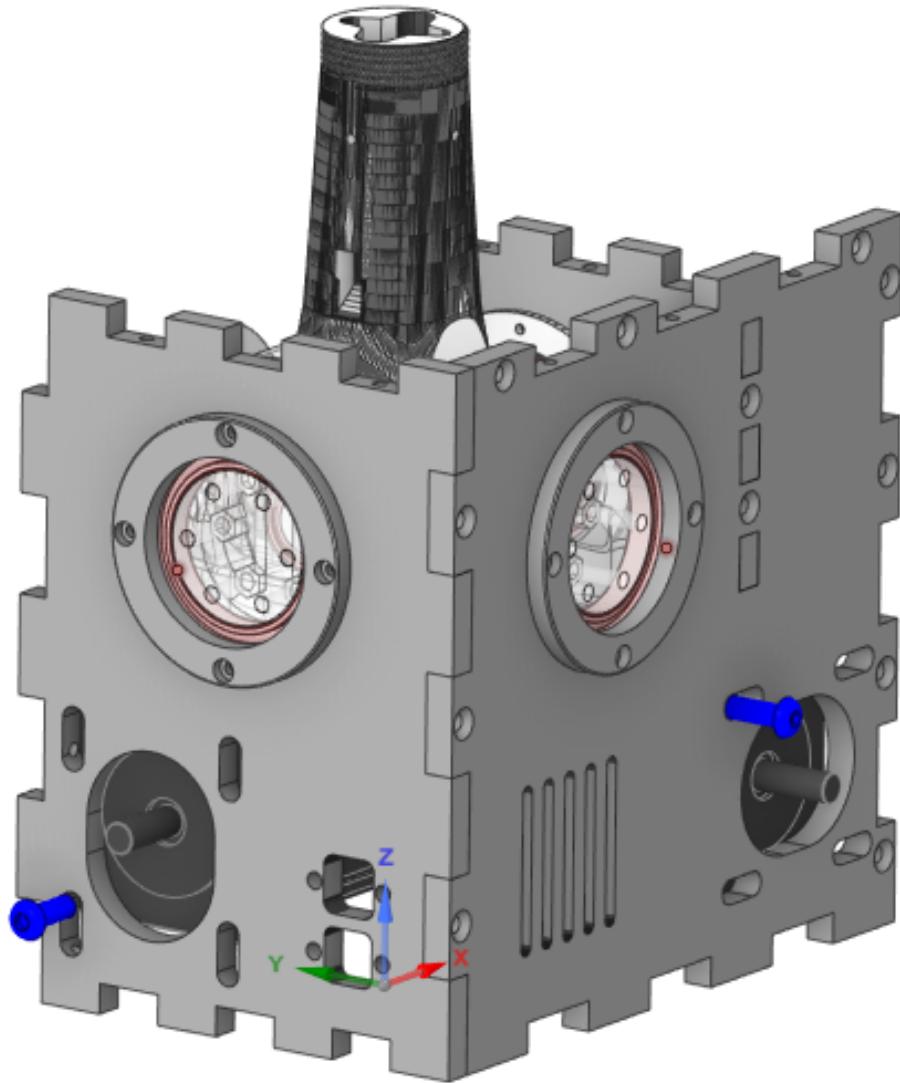
STEP 7

Mount motors to Right and Rear Panel with 4 M6x16 screws each , snug but not tight
(you will adjust position later)

MOTORS ARE MARKED "PITCH ID2" and "ROLL ID1" BE SURE TO MOUNT THEM PROPERLY.

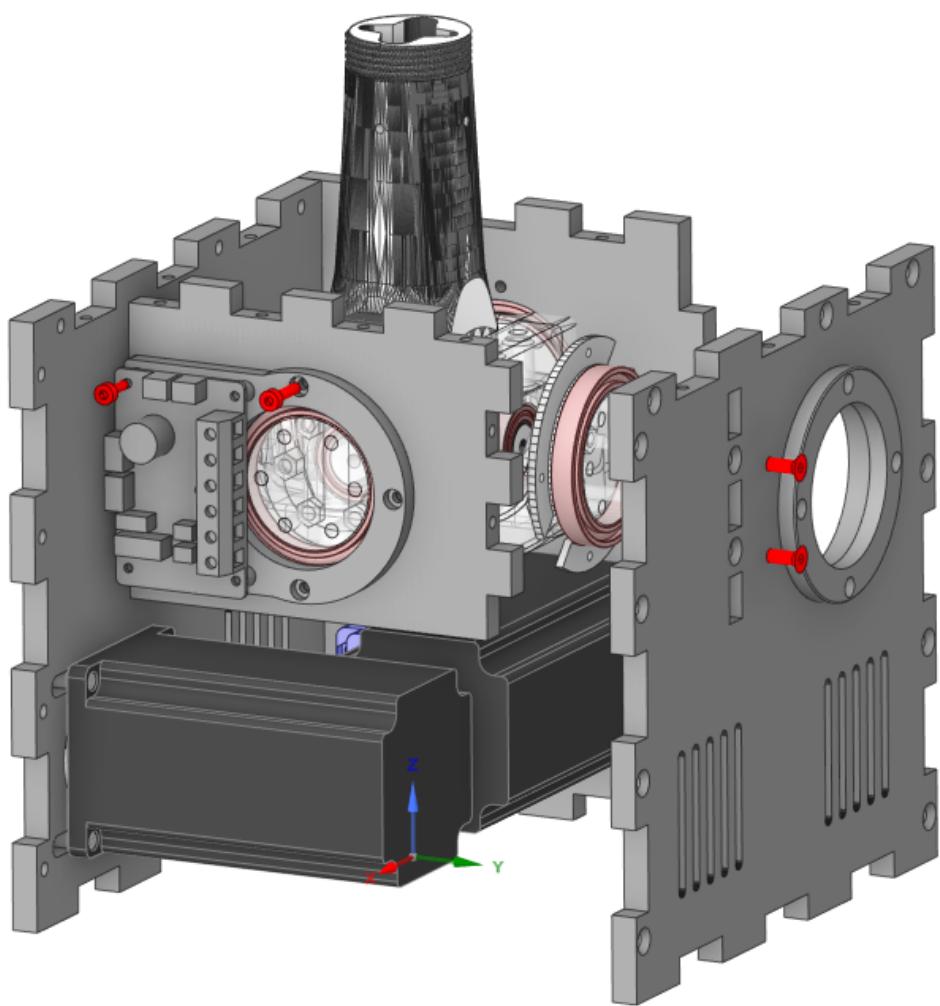
Pitch motor mounts to the Right panel

Roll motor mounts to the Rear Panel



STEP 8

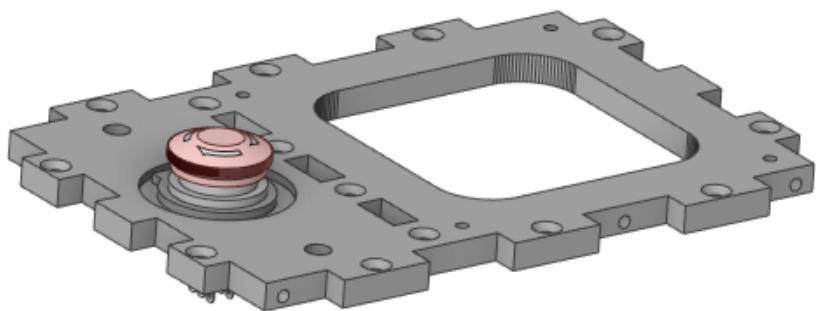
- Mount left panel to rear and mid panel with M4x8 screws and secure gimbal bearing with retainer and M3x14 screws.
- Mount mid panel retainer with M3x14 screws.
- Glue mainboard mount into gimbal bearing retainer
- Mount mainboard with M3x4 screws
- Connect motor power and data leads to mainboard
- Connect stick data wire to mainboard



STEP 9

Mount reset switch and potentiometers to top

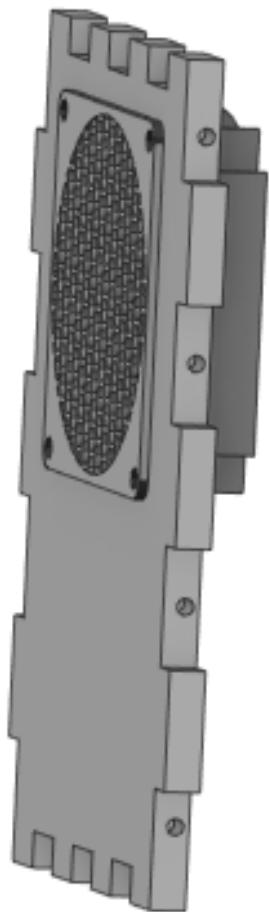
panel



STEP 10

Mount fan and grill to front panel with M3x20 screws and

nuts



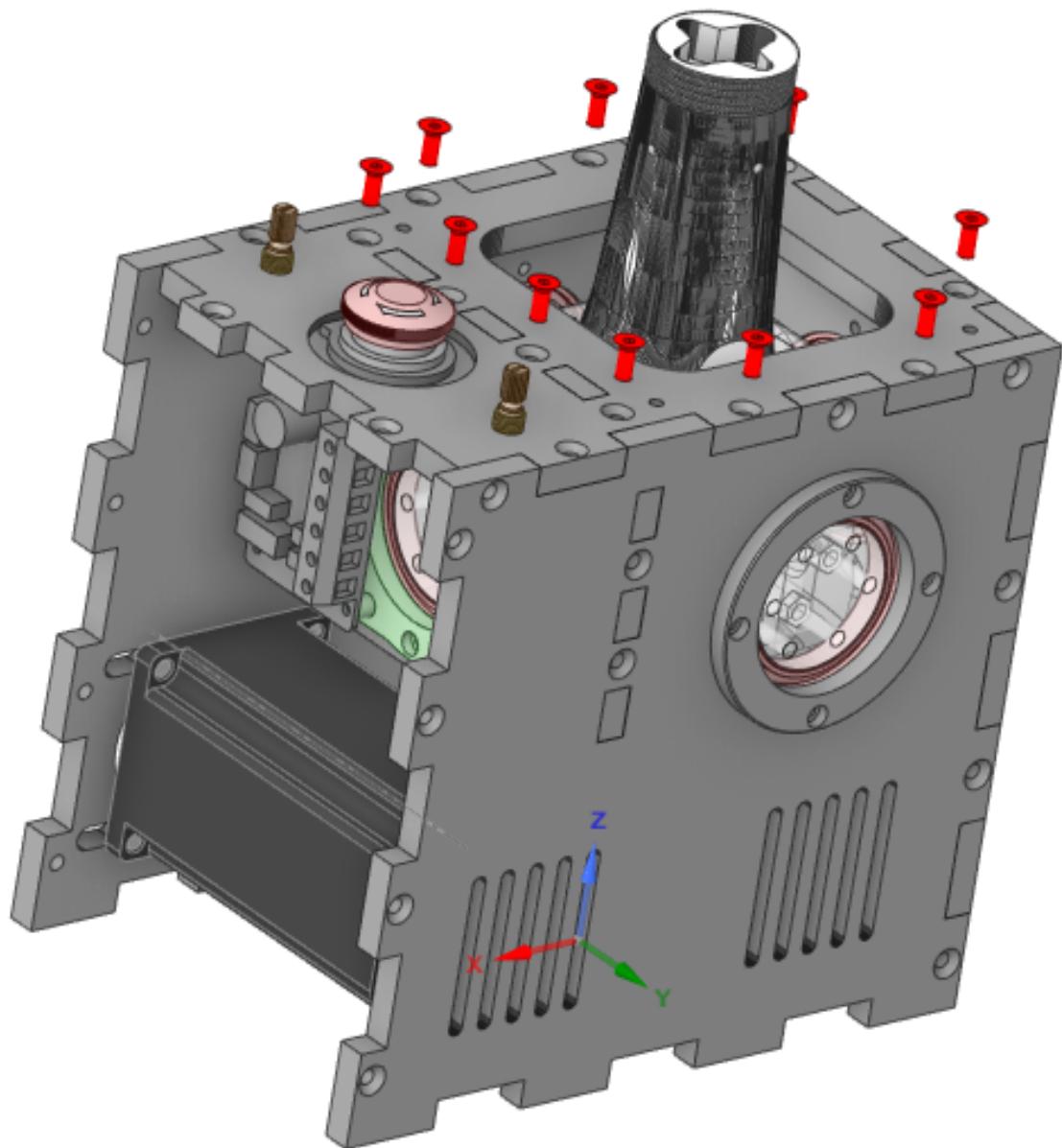
STEP 11

Insert potentiometers into top panel and mount top panel and plug leads into mainboard

Securing top panel only with M4x8 screws shown

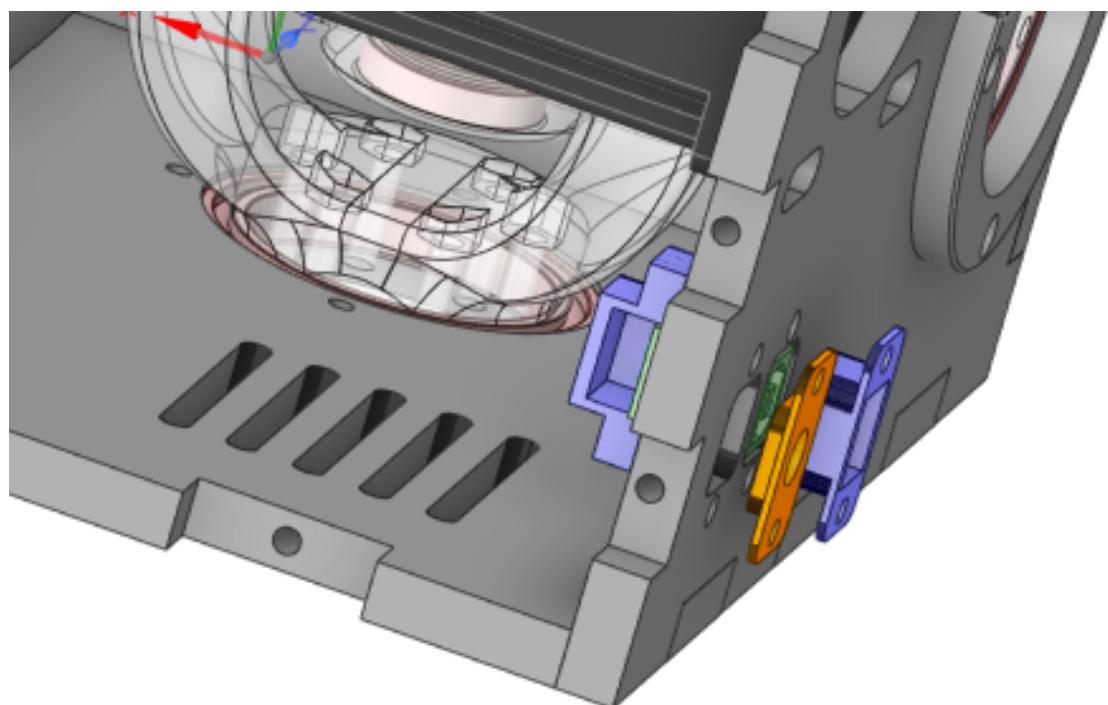
Connect E-Stop switch plug.

Make sure wires to potentiometers and E-Stop switch are tucked as close to mid panel as possible to be clear of fan when installed



STEP 12

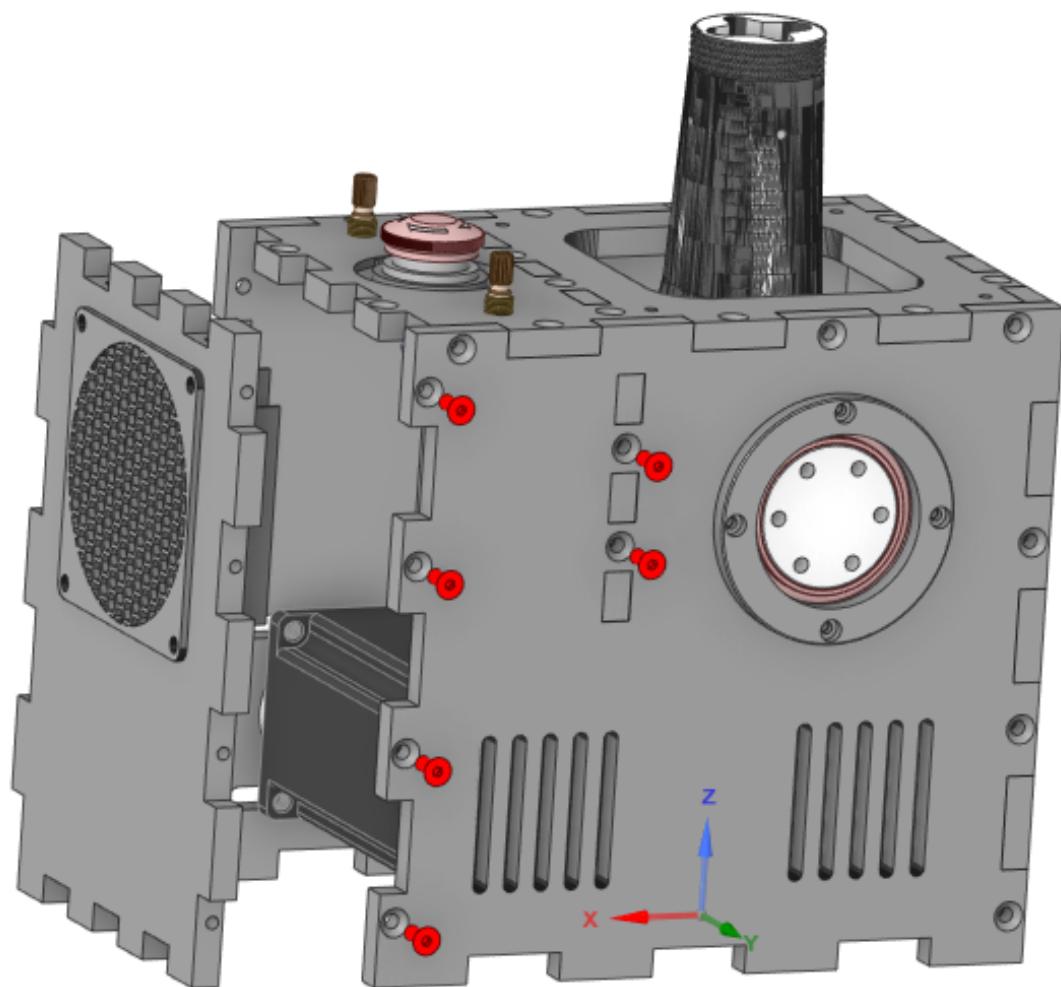
Install USB and Power plugs and retainers into rear panel and connect to mainboard and E-Stop switch



STEP 13

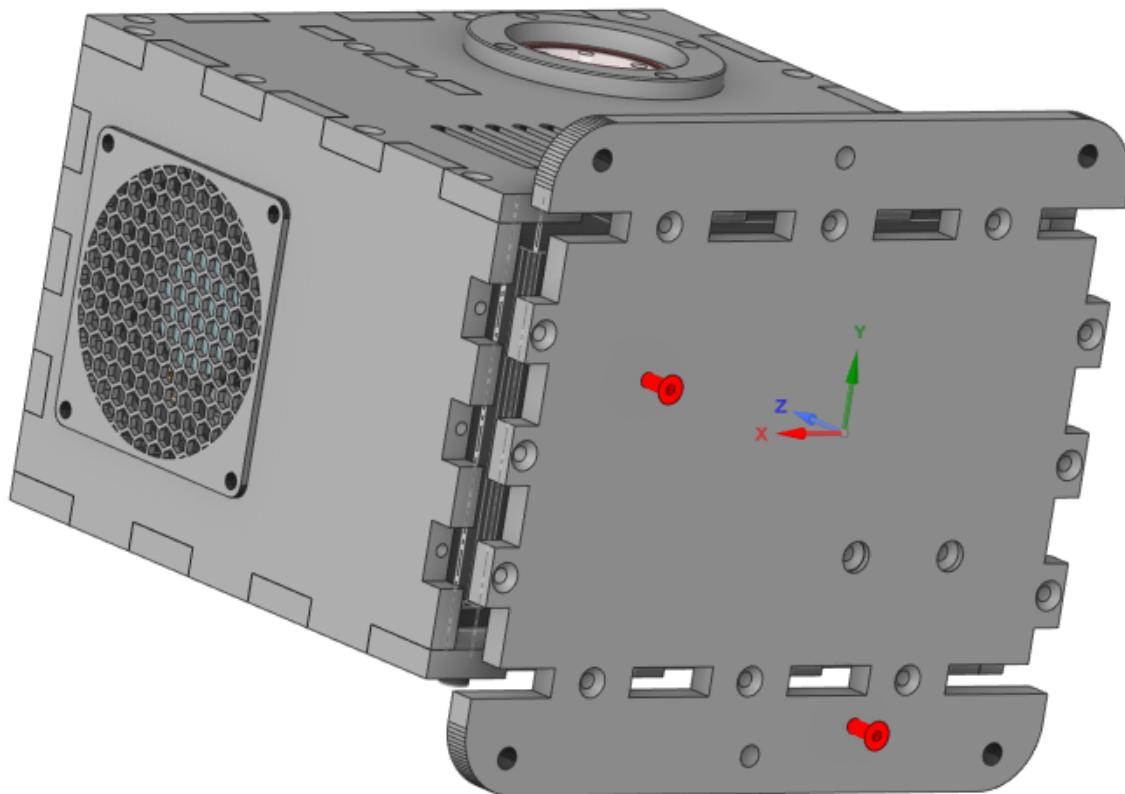
Mount front panel to top and side panels.

Only secure with M4x8 screws on the side panels, left and right



STEP 14

Mount bottom panel



STEP 15

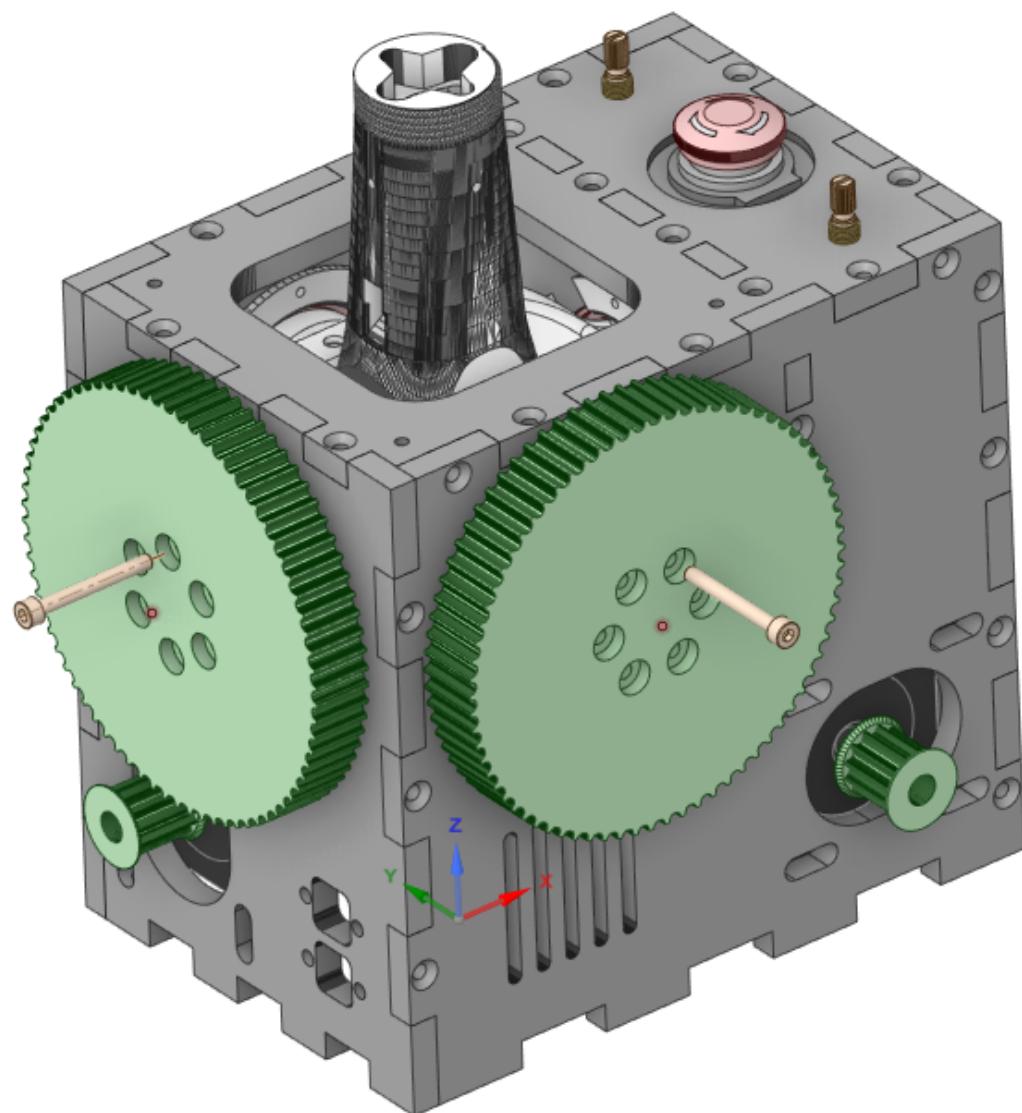
Mount pitch and roll gimbal 74T pulley to gimbals with M4x35 screws.

Use one or two washers on the screw head to keep screw end flush on the inside of the gimbal.

Install the motor drive pulley on the motor shaft.

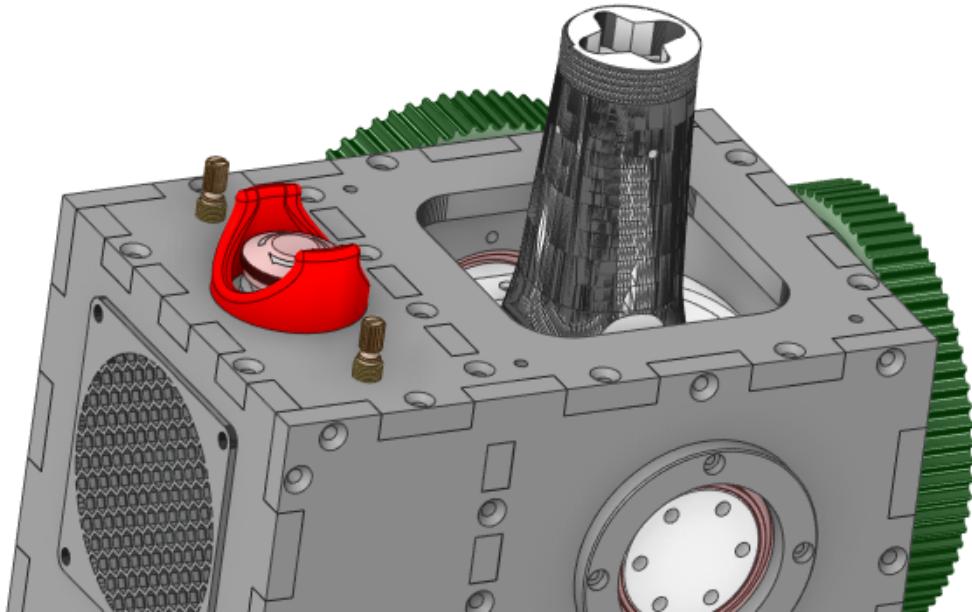
Align the pulley so the outer lip of the drive pulley is in line with the outer lip of the gimbal pulley.

Use blue loctite on the drive pulley grub screws and secure it to the flat of the motor shaft.



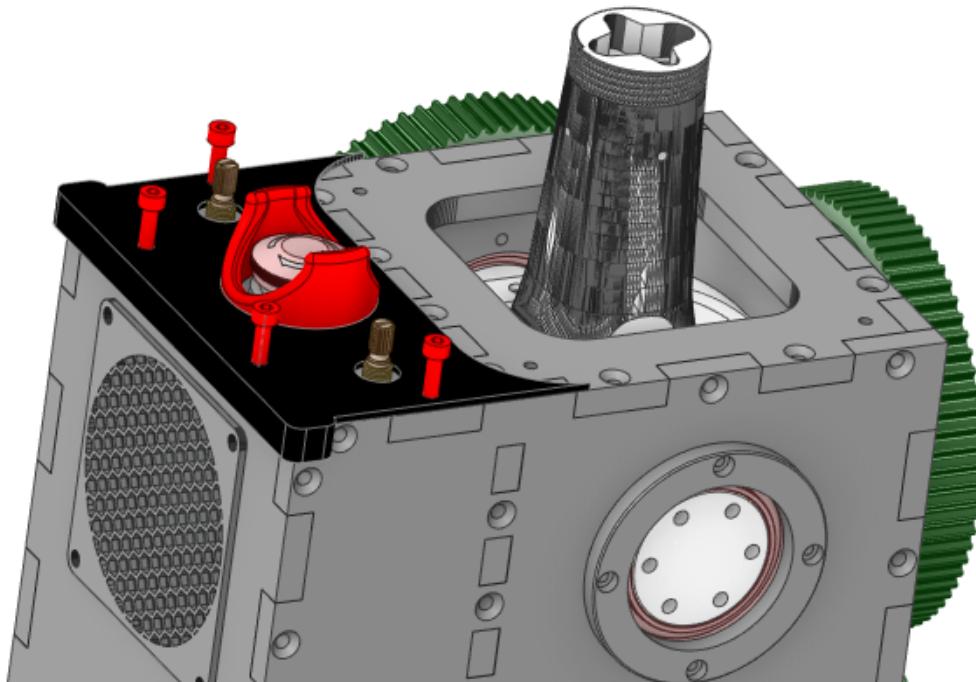
STEP 16

Glue E-Stop guard into slot on top panel



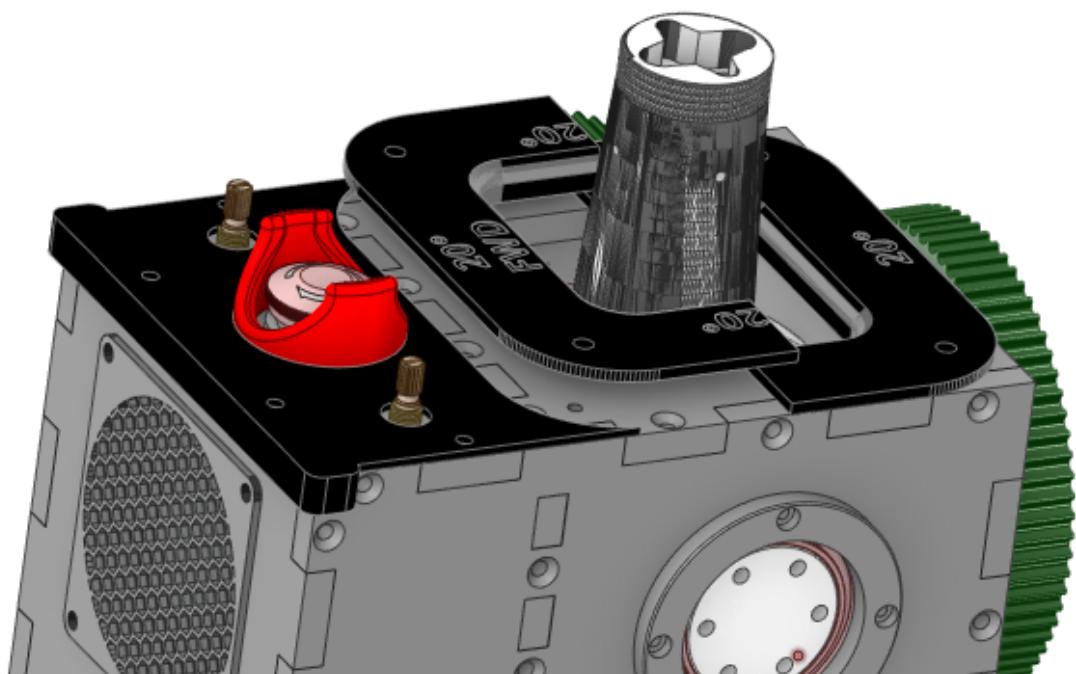
STEP 17

Mount top panel cover corner guard to top panel



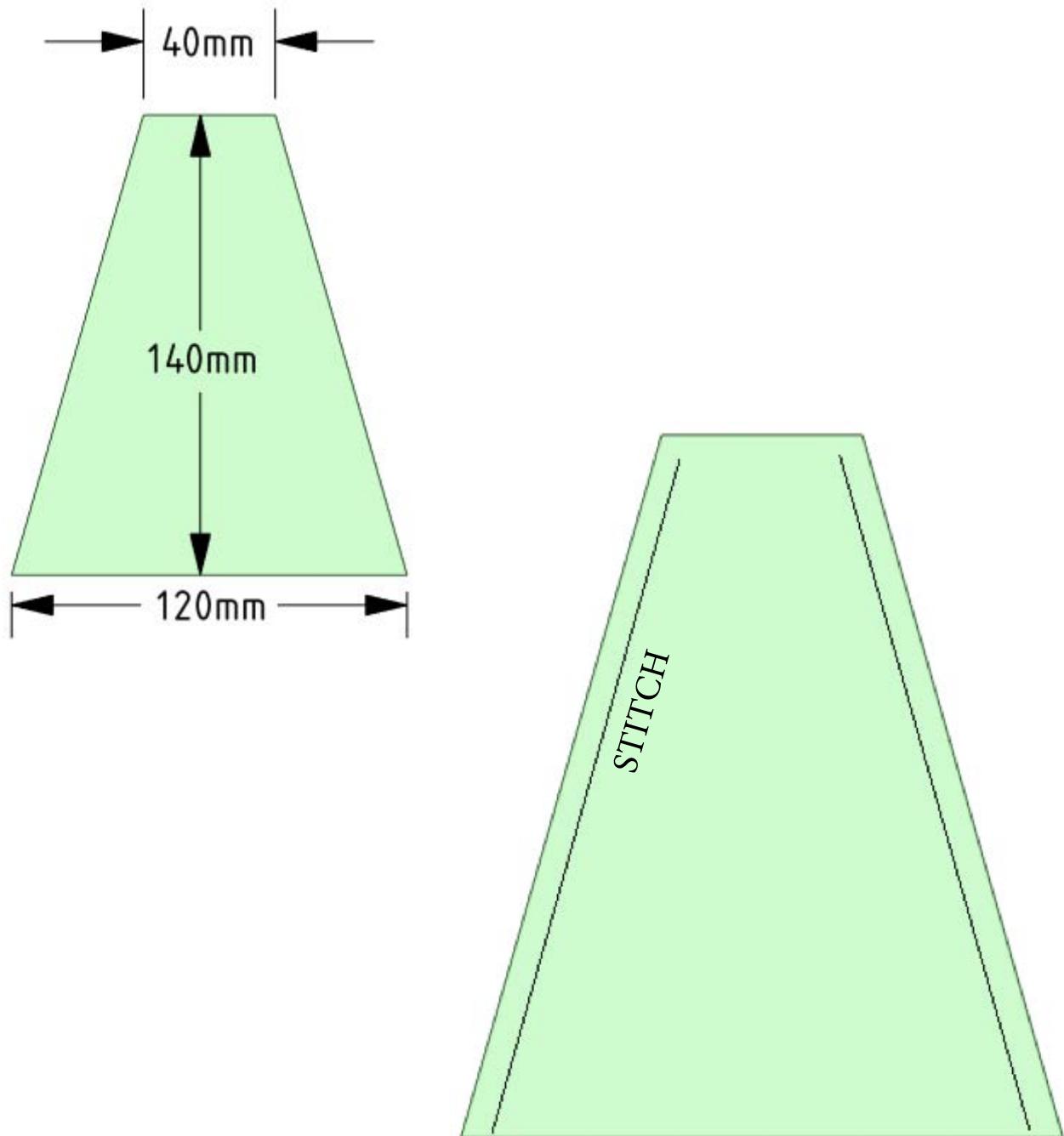
STEP 18

Place throw limiters onto top panel



STEP 19

Stitch together 4 panels of the textile of your choice based on the template measurements
Be sure to sew the panels together inside out



4 Panels

STEP 20

Place lower boot clamp on top panel

Turn boot inside out

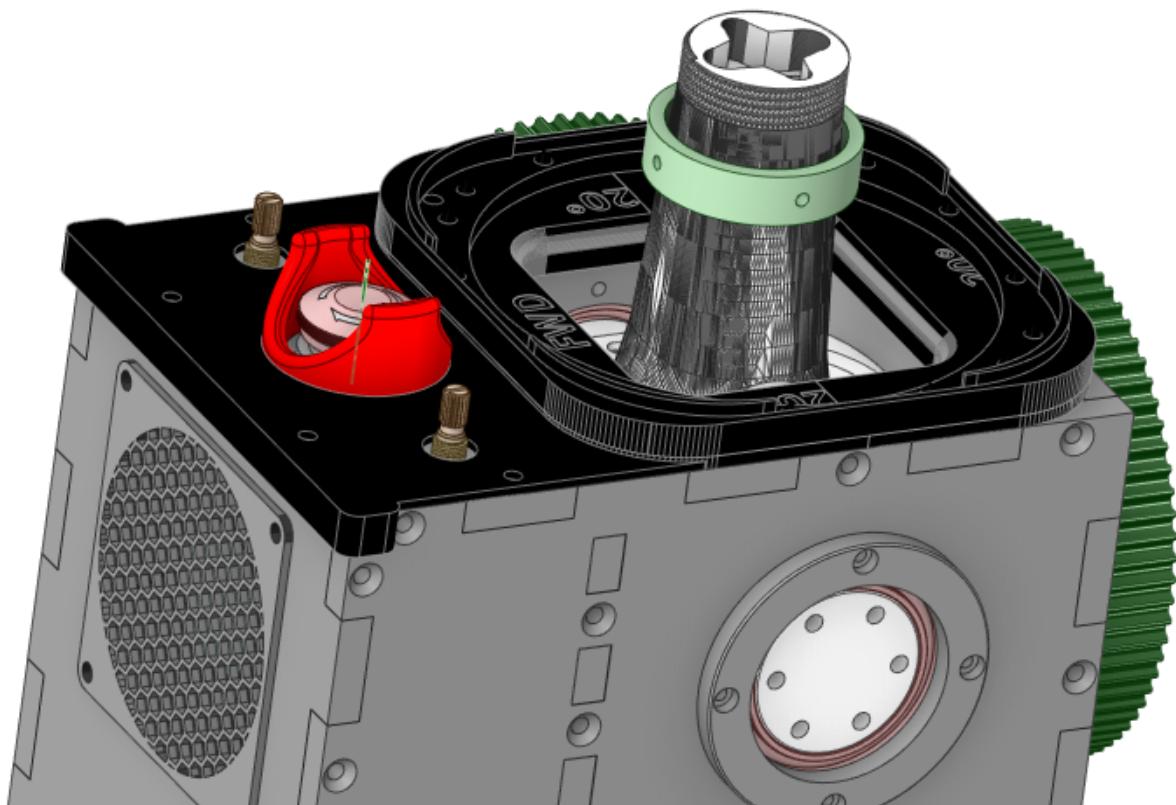
Slide top of boot over stick connector

Punch holes into boot to secure with boot ring and M3 screws

Fold boot down and hot glue to lower boot clamp leaving enough slack for full stick deflection

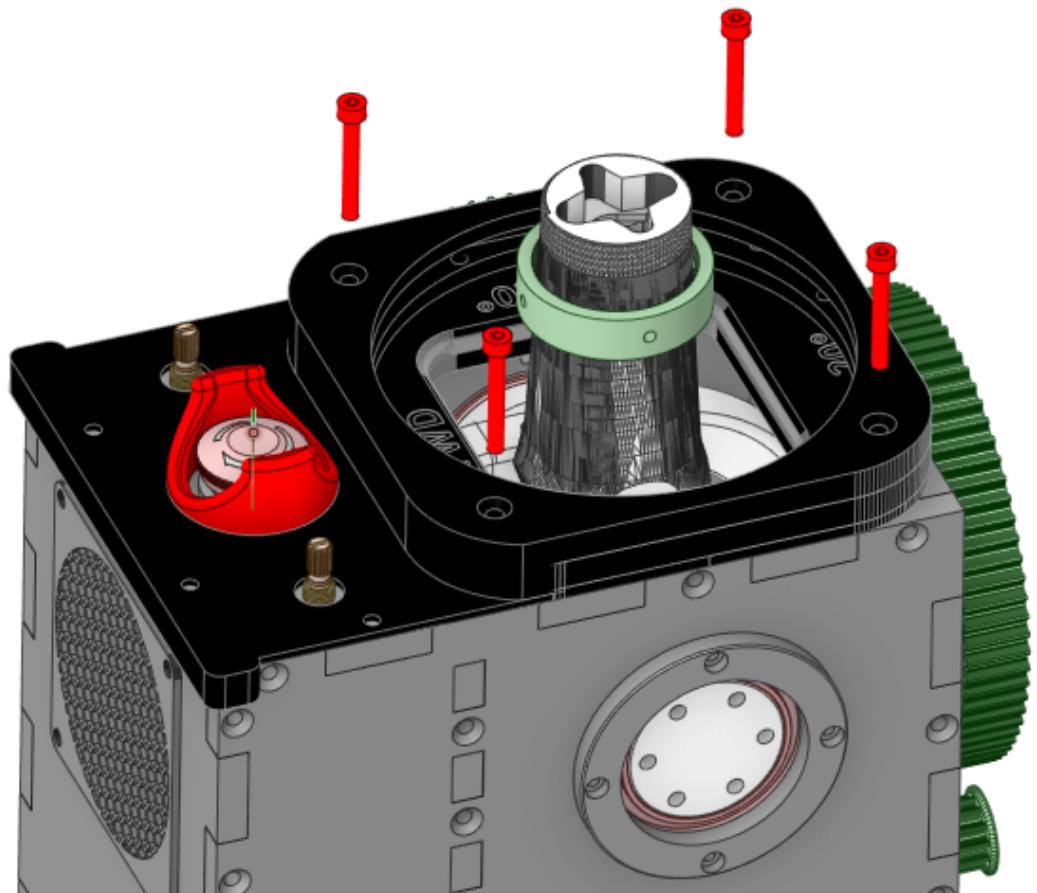
Punch holes in boot for clamp mount screws

Trim excess boot material from outside of lower clamp



STEP21

Place upper boot clamp on top panel and secure with four M4x12 bolts



Belts install and Basic Stick Calibration

Congratulations, you made it this far. Now it is time to connect the stick base to power and your PC USB port.

- Install and open the latest VPForce FFB Configurator
- With the Emergency Stop Switch Depressed, plug the 24V power into the base
- Plug in the USB connector to the base, the base should beep and be detected by the PC.
- Twist the Emergency Stop Switch to unlock it and energize the motors.
- In the VPForce software, click "Auto Calibrate".

FFB Axes Setup

X: min 493 max 2796 Force Comp.: 0 C:1644 R:2303 Axis Invert Disable Axis Swap
Y: min 810 max 3160 Force Comp.: 0 C:1985 R:2350 Axis invert Disable Axis

Center value is recommended to be around 2048 when axis is physically centered to ensure proper home position when powering the motors.

	1	3
	2	4
x	1192	
y	0168	
dx	0000	
dy	0000	
d2x	0000	
d2y	0000	
fxout	-777	9
fyout	-049	
raw_x	2013	
raw_y	2022	
cycle_time	576μs	
pot_1	100.0%	

- Set the X:min and Y:min to 0.
- Set X:max and Y:max to 4096
- Click on "Apply Settings" and then "Store Settings".
- Loosen the PITCH (side) motor mount bolts and slide motor as close to the gimbal pulley as possible.
- Physically set and maintain the stick pitch position in the center
- Slide the pitch belt over the pulleys. Motor pulley first, then gimbal pulley. Keep the stick centered in PITCH.
- Slide motor away from the gimbal pulley to tension the belt as much as you can by hand and tighten the motor mount bolts. Tighten a bolt further from the gimbal pulley first, and then one closer. This will add a little more tension to the belt as you tighten.
- You can monitor motor position in the VPForce software while you do this. TRY TO KEEP IT CLOSE TO A VALUE OF 2000
- Repeat the process for the Roll pulleys.
- Once all the motor mount bolts are tight, move on to the VPForce Configurator calibration process.