

# 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.
- 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.

# Parts List

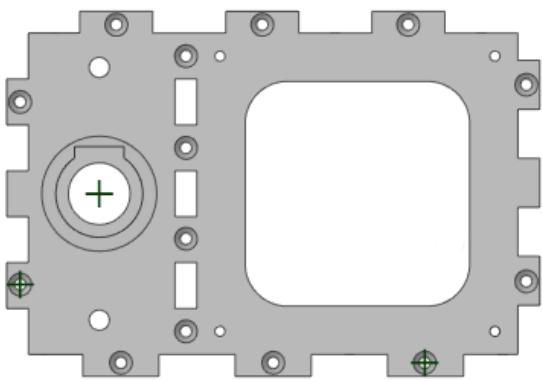
## Electronics

- (1) Cuedevices MD-50PL100 is required to terminate grip connection
- (1) H2.5 JST connector kit
  - 2P and 5P needed
- (1) 420-5M-15 HTD 420mm Timing Belt (Roll)
- (1) 465-5M-15 HTD 465mm Timing Belt (Pitch)
- (2) HTD15 12tooth flanged pulley
- (1) 22mm Latching Emergency Stop Push Button
- (2) 10K Ohm Rotary Potentiometer
- (1) 80mm x 15mm PC cooling Fan
- 5.5mm x 2.1mm 2 Pin DC Power Female Panel Mount Jack Socket Connector
- (1) 12VDC 5a(min) Power Supply with 5.5mm male plug

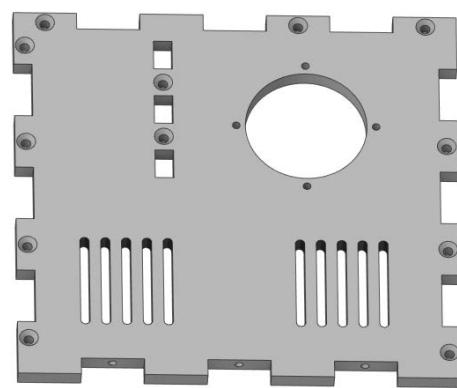
## Bearings and Screws

- (8) 15x24x5mm 6802RS Bearing (Gimbal Core)
- (2) 5x16x5mm F625ZZ Flanged Bearing (Gimbal Core to Stick Adapter)
- (4) 40x52x7mm 68082RS Bearing (Gimbal Arm to Case)
- (1) M5x60 Socket Head Screw (Gimbal Core)
- (2) M5 Nut (Gimbal Core)
- (3) M5 washer (Gimbal Core)
- (8) M5x10 Button Head Socket Cap Screw (Gimbal Core Pillow Blocks)
- (12) M4x35 Socket Head Screw (74T Pulleys)
- (12) M4 Nut (74T Main Gimbal Mount)
- (24) M4 washer (74T Pulleys)
- (40) M4x12 Flat Head Socket Cap Screw (Case Edges)
- (8) M6x10 Button Head Socket Cap Screw (Motor Mounts)
- (16) M3x16 Socket Head Screw (Bearing Retainers)
- (4) M3x25 Socket Head Screw (Cooling Fan)
- (16) M3 Nut (Cooling Fan and Bearing Retainers)
- (4) M3 washer (Cooling Fan)
- (1) 12tooth Aluminum Pulley

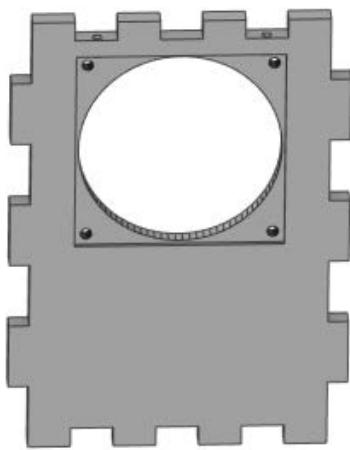
# Printed Parts Reference



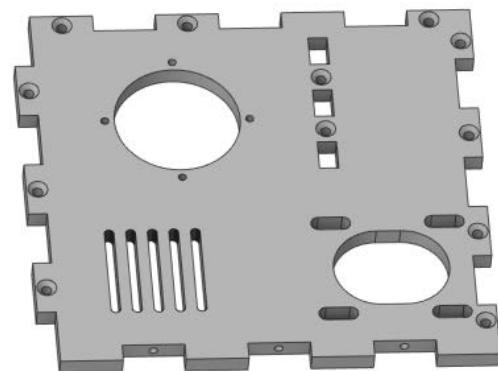
Top Panel



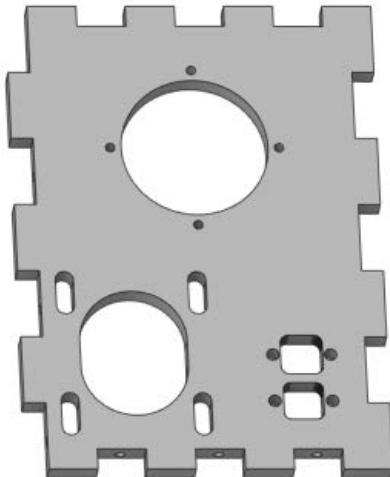
Left Panel



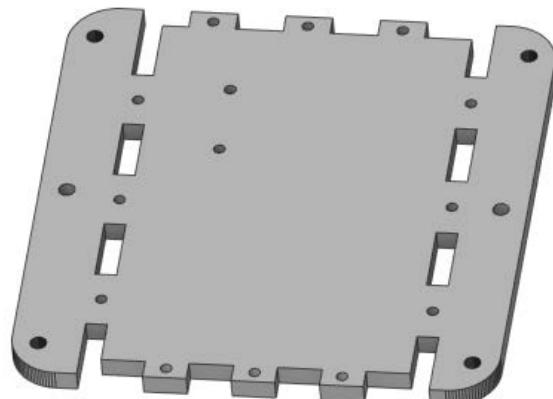
Front Panel



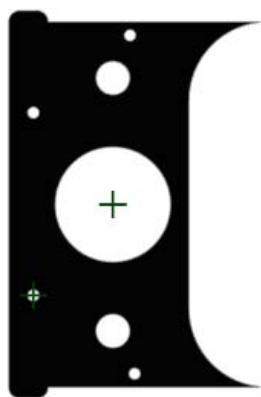
Right Panel



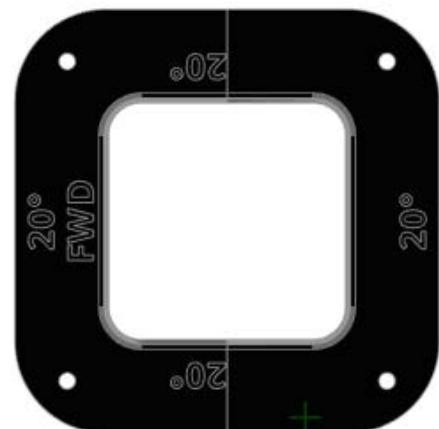
Right Panel



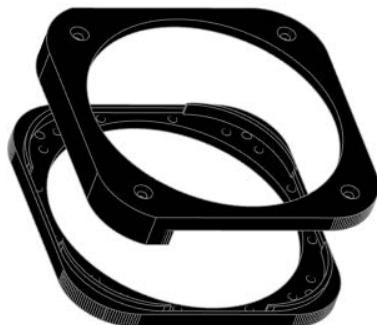
Bottom Panel



Top Panel Cover



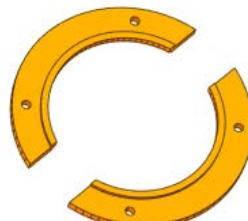
Throw Limiters



Boot Clamps



Stick Boot Collar

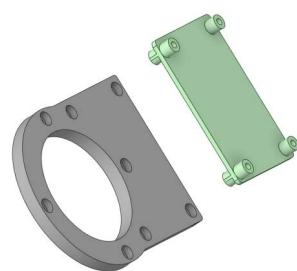


Inner Bearing Retainers

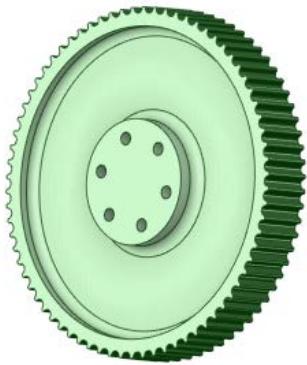
Boot Clamps



Outer Bearing Retainers



Front Outer Bearing Retainer  
and Mainboard mount



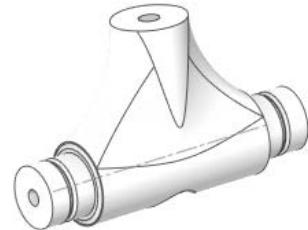
74 Tooth Pulley



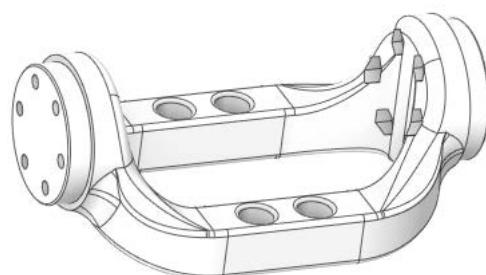
12 Tooth Flanged Pulley



Thrustmaster Stick  
Connector



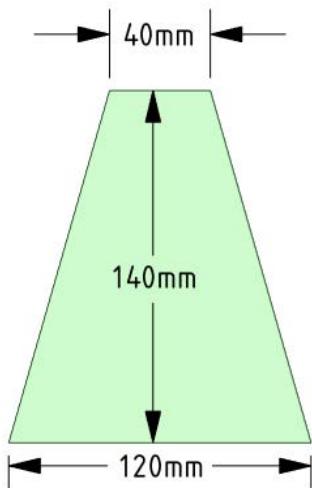
Core Joint



Gimbal Arm



Core Joint and  
Gimbal Pillow  
Blocks

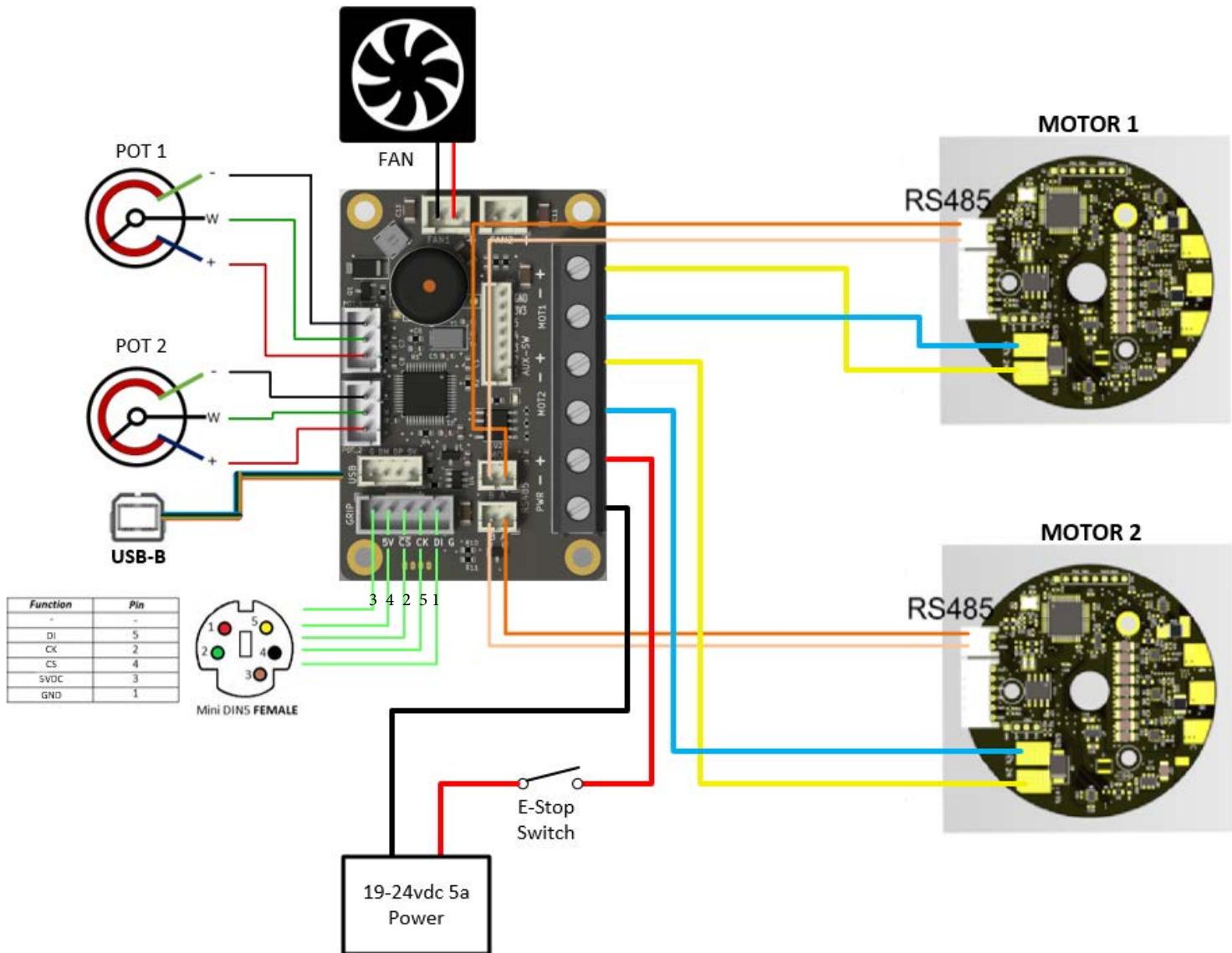


Boot Template

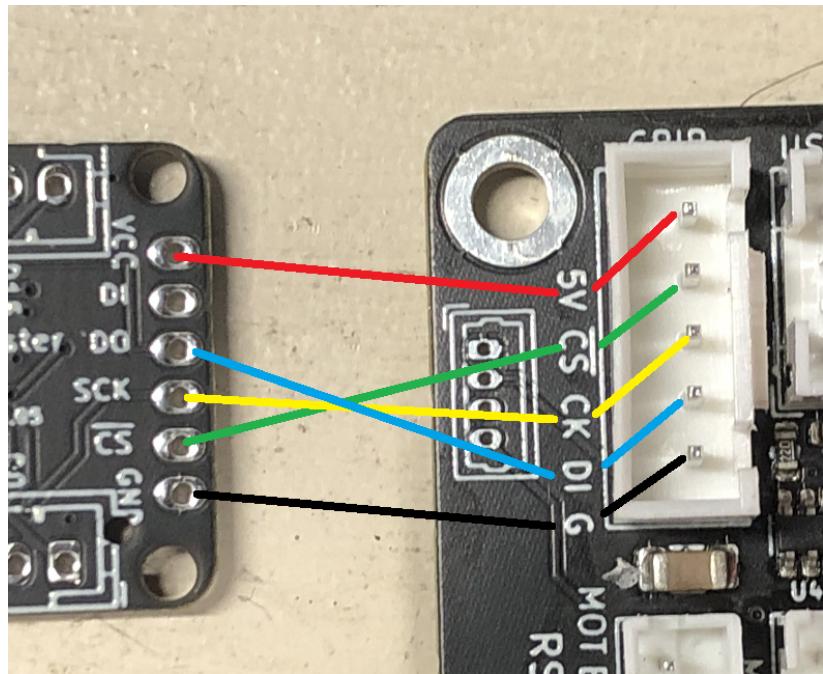
# **Assembly**

# 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



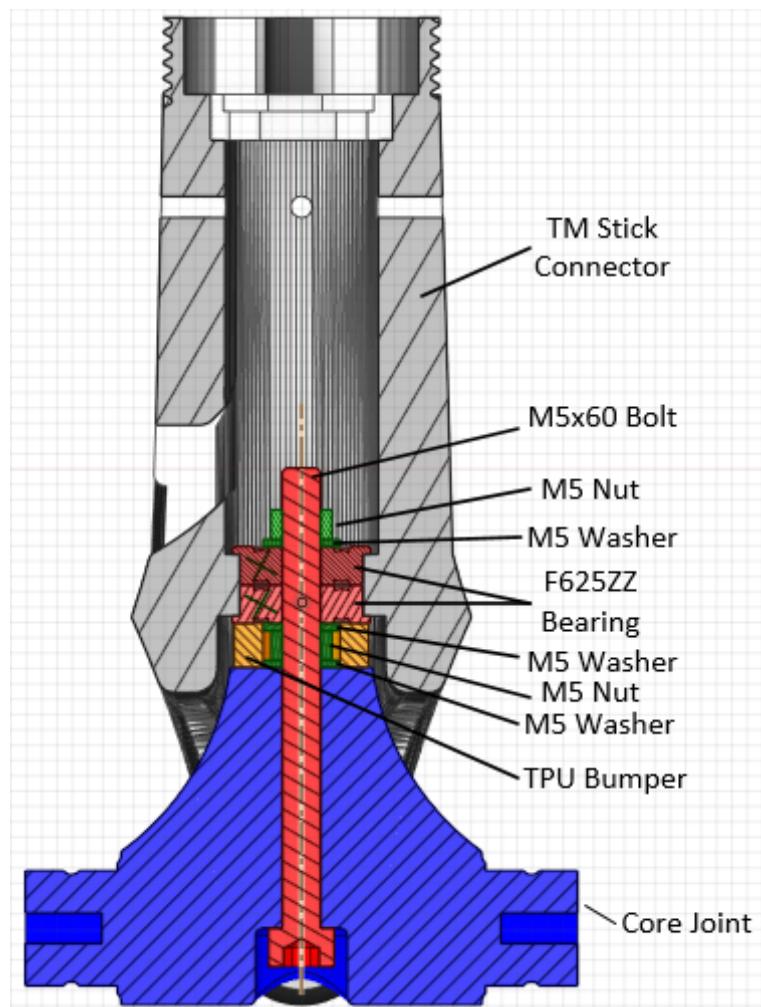
- Below is shift register wiring to the VPC mainboard, if using a shift register.



## STEP 1

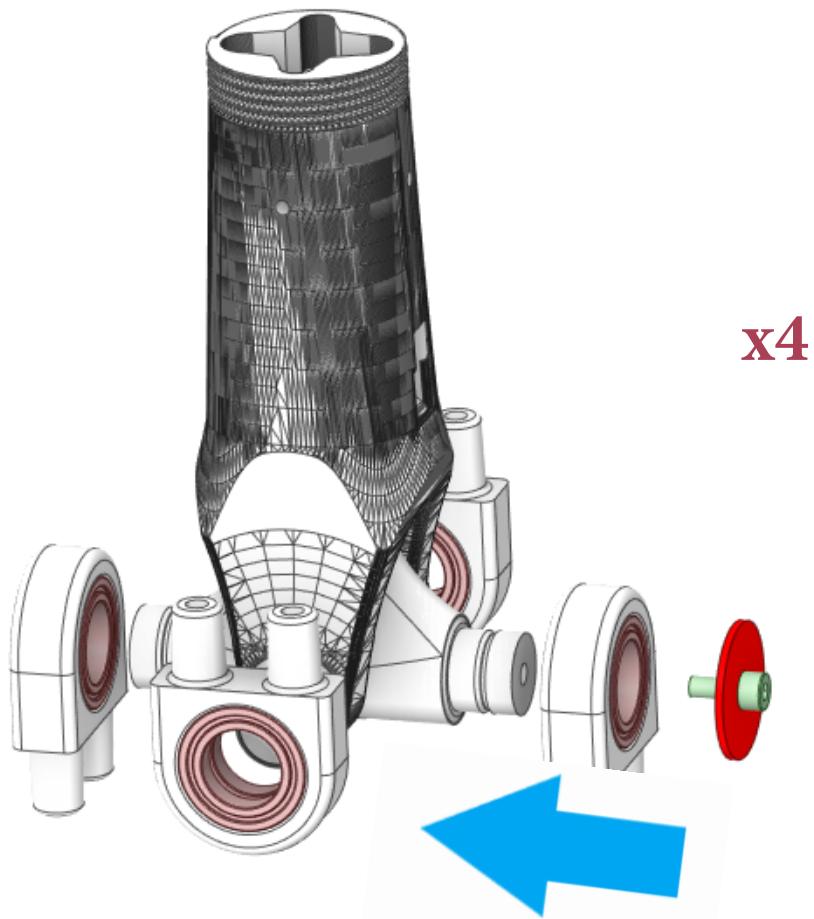
### Assemble Core Stick/Core Joint

- 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)



## STEP 2

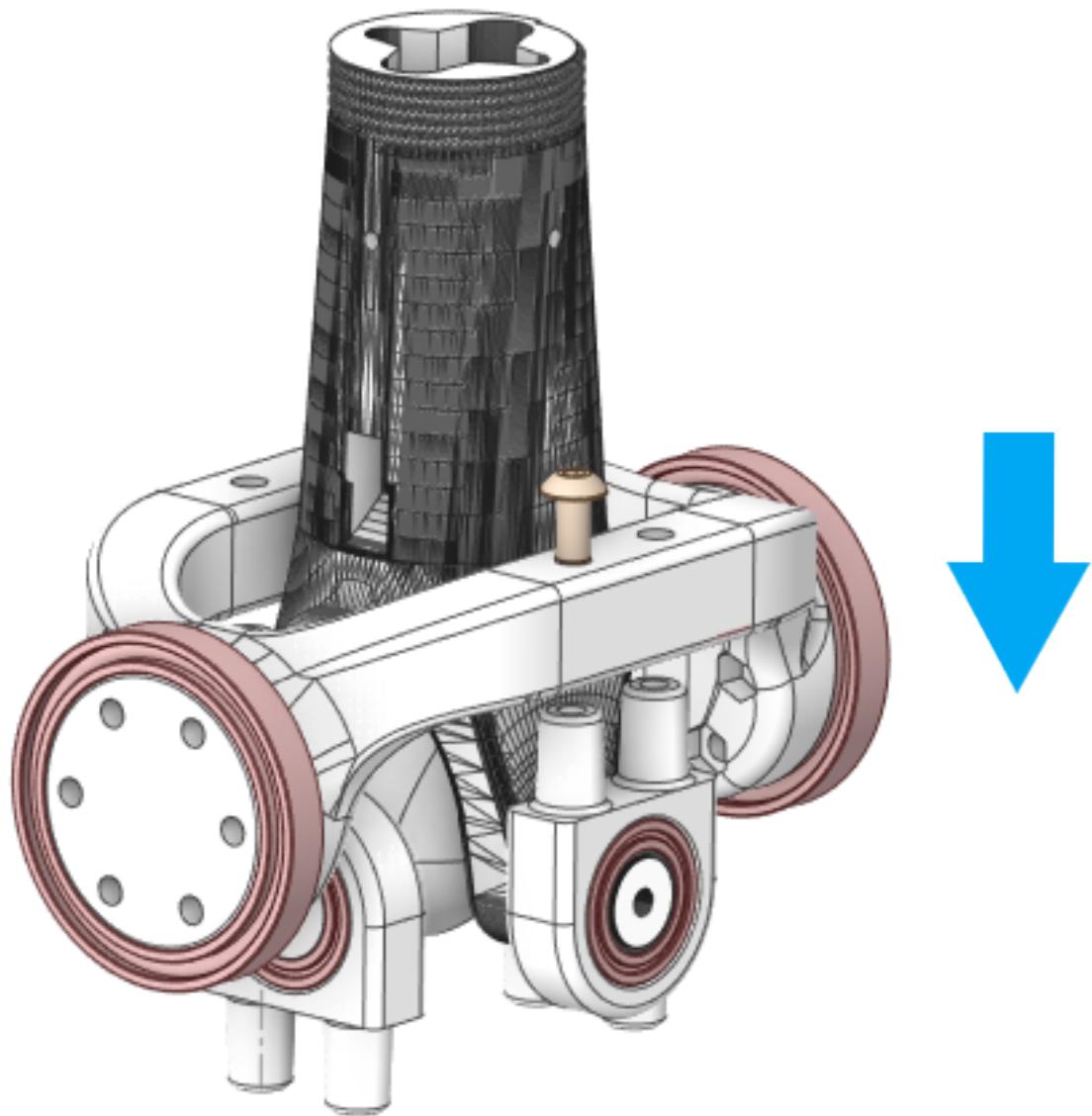
Insert 6802 bearings into core joint pillow blocks and mount four gimbal pillow blocks to stick and core joints and secure with 19mm washers and M5 screws.



**STEP 3**

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

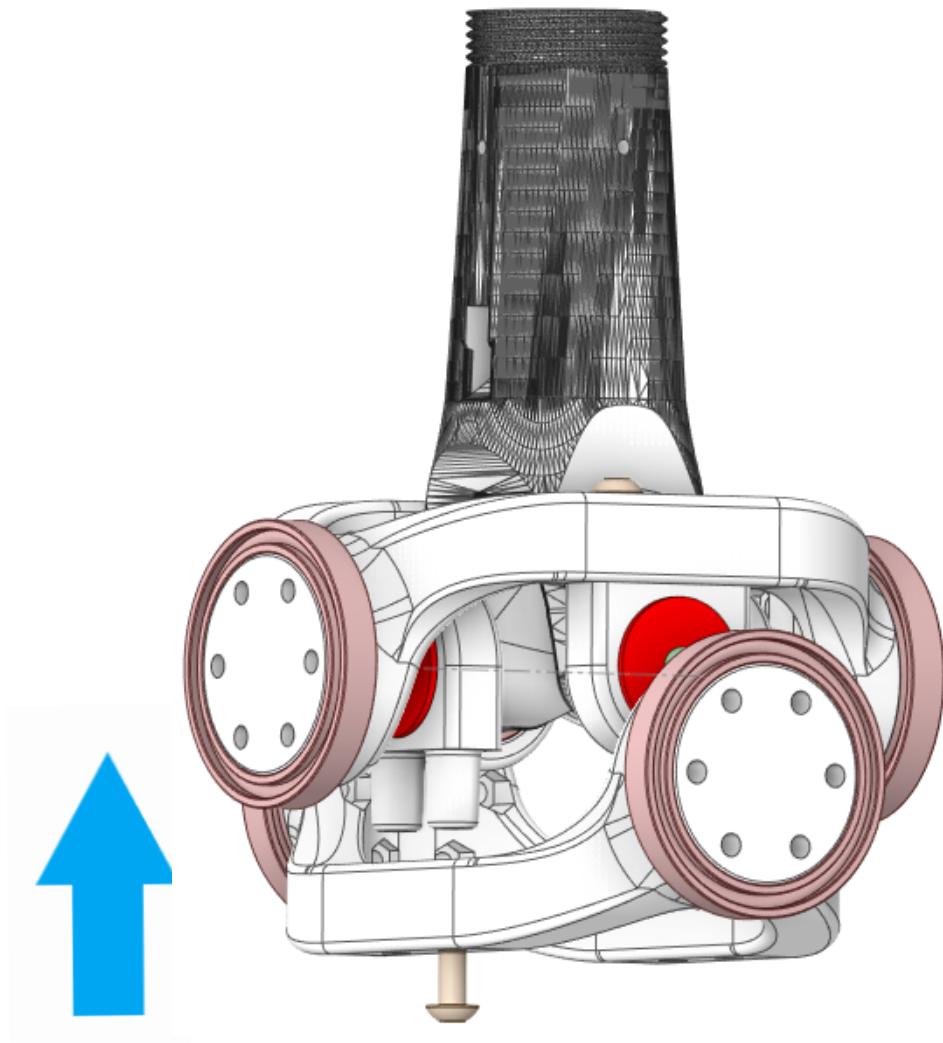
Push down and mount roll gimbal frame to pillow blocks with four M6 bolts



**STEP 4**

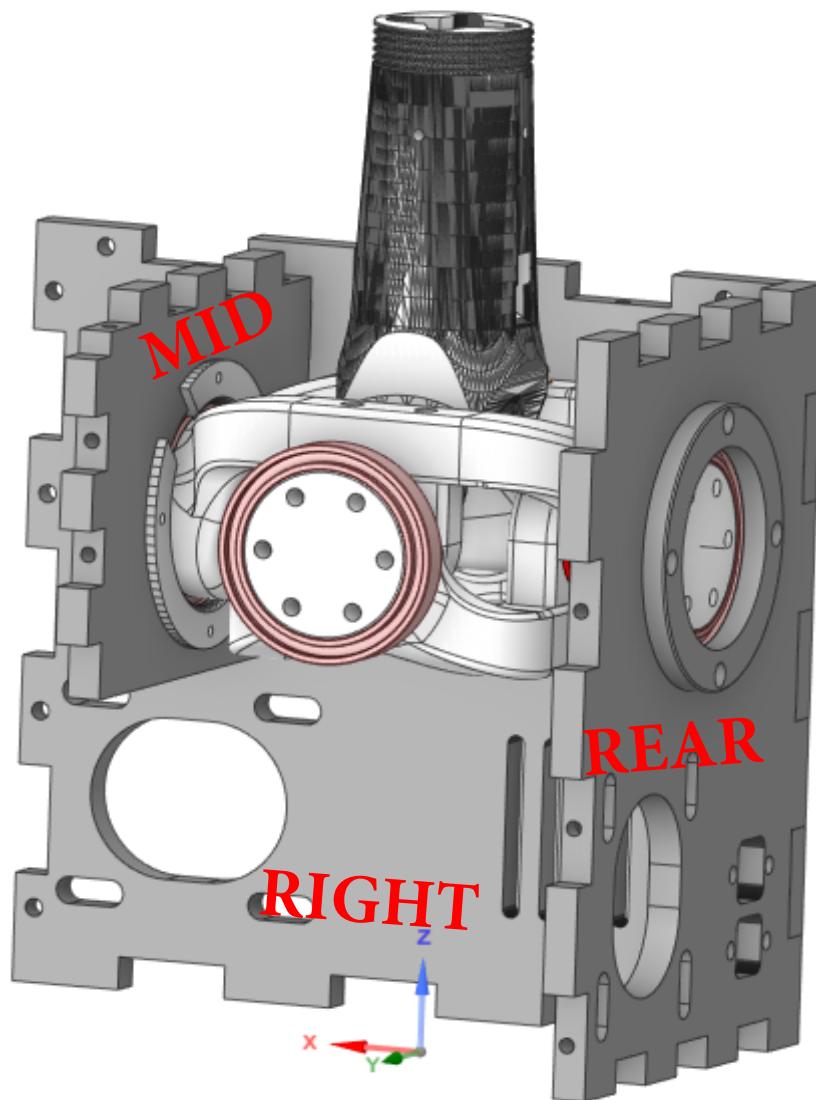
Press 6808 bearings on to each end of the pitch gimbal.

Mount pitch gimbal frame to pillow blocks with four M6 bolts



STEP 5

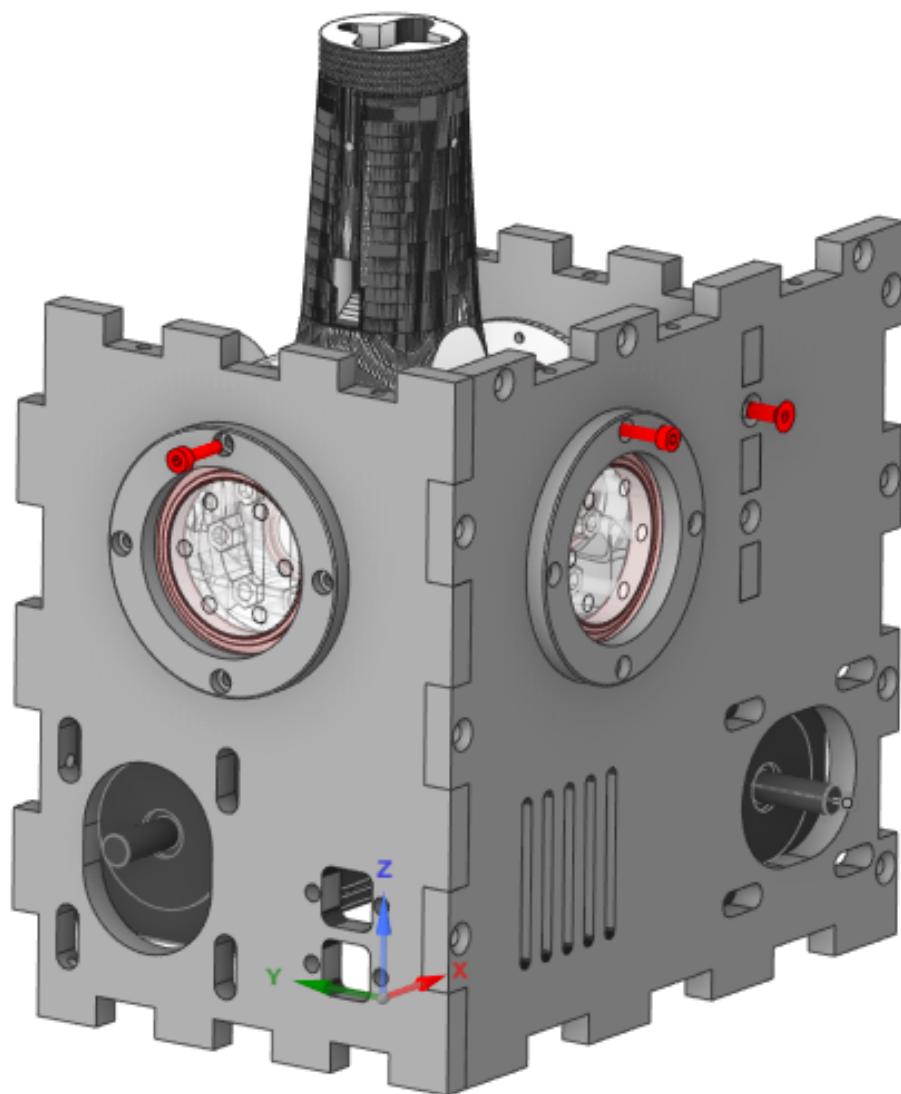
Slide the Gimbal Group into rear, mid, and right panel mounting holes

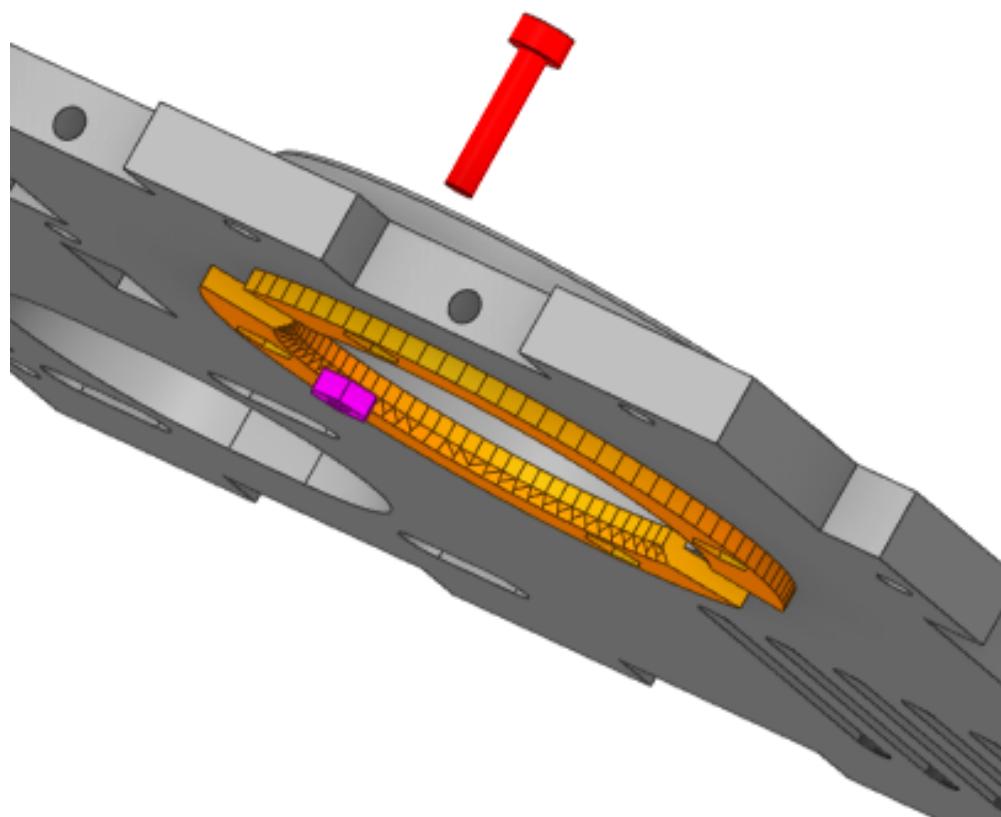


## STEP 6

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

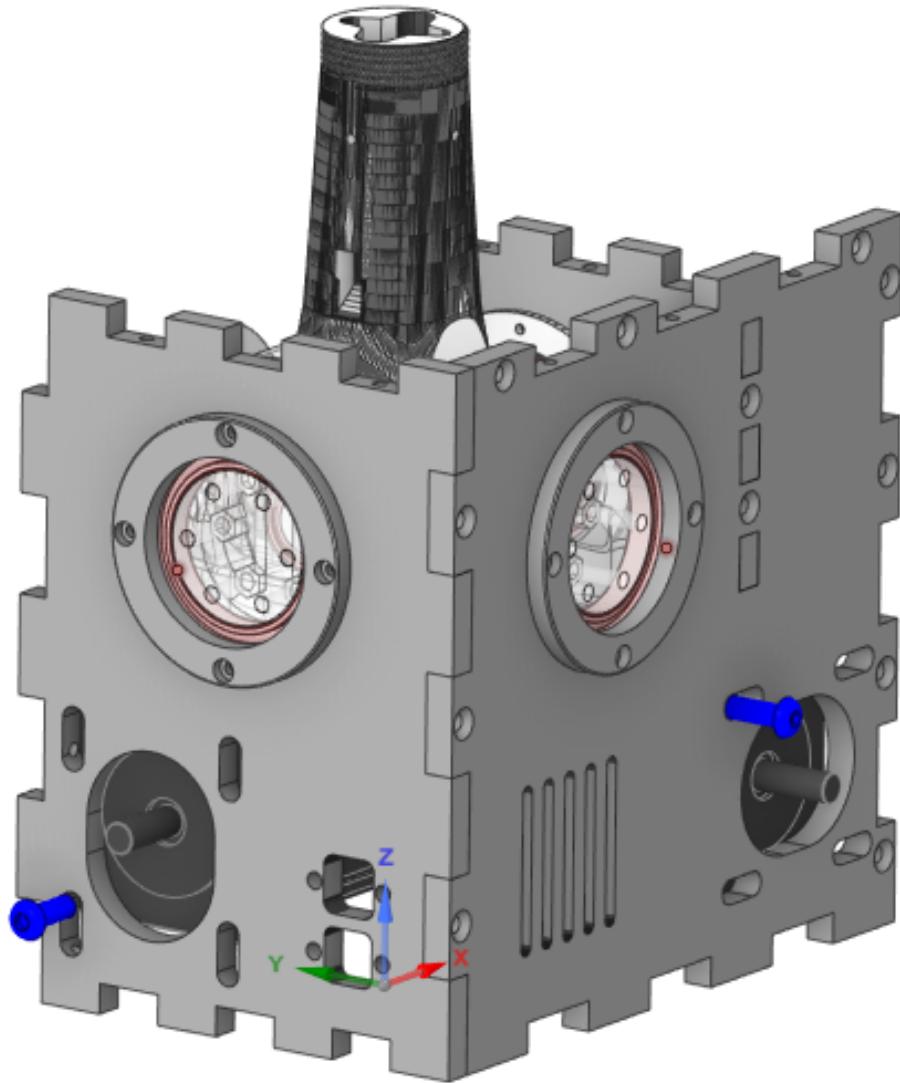
STEP 7

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.

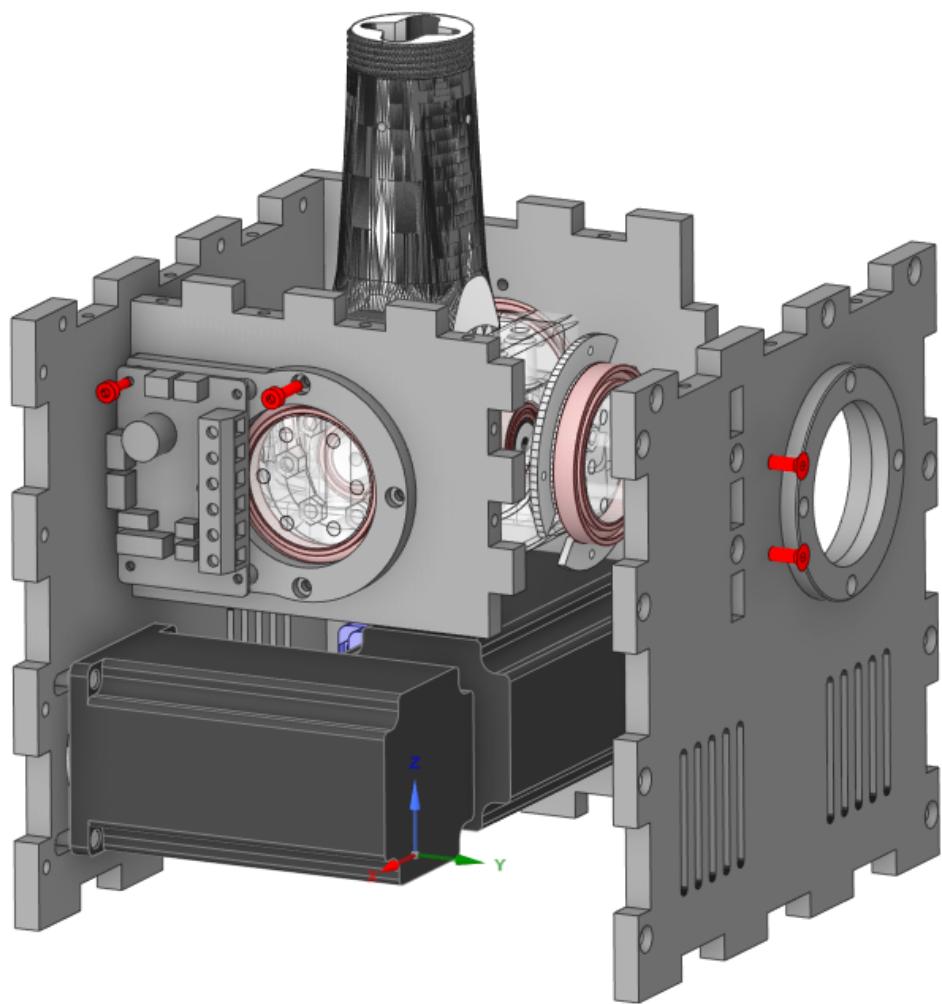
Mount mid panel retainer with M3x14 screws.

Glue mainboard mount into gimbal bearing retainer

Mount mainboard with M3x4 screws

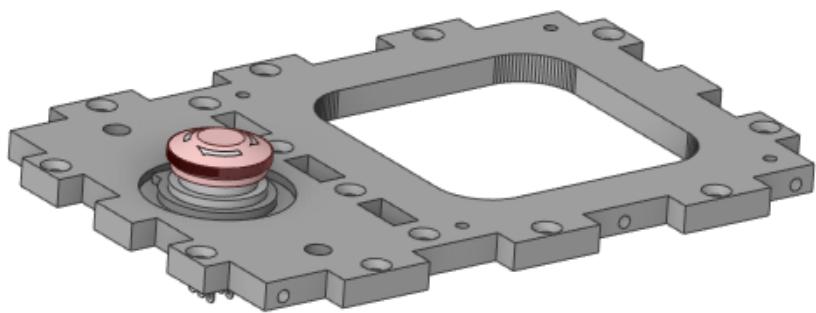
Connect motor power and data leads to mainboard

Connect stick data wire to mainboard



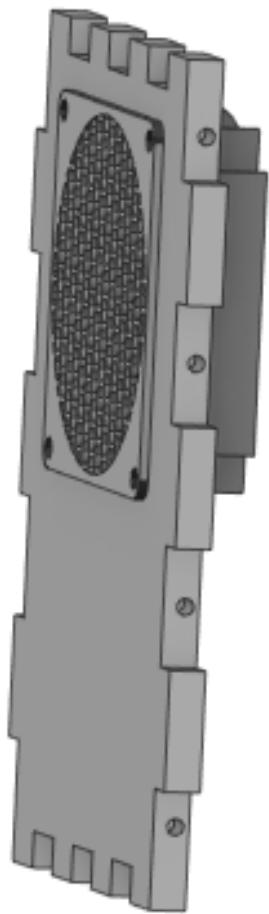
**STEP 9**

Mount reset switch and potentiometers to top panel



**STEP 10**

Mount fan and grill to front panel with M3x20 screws and nuts



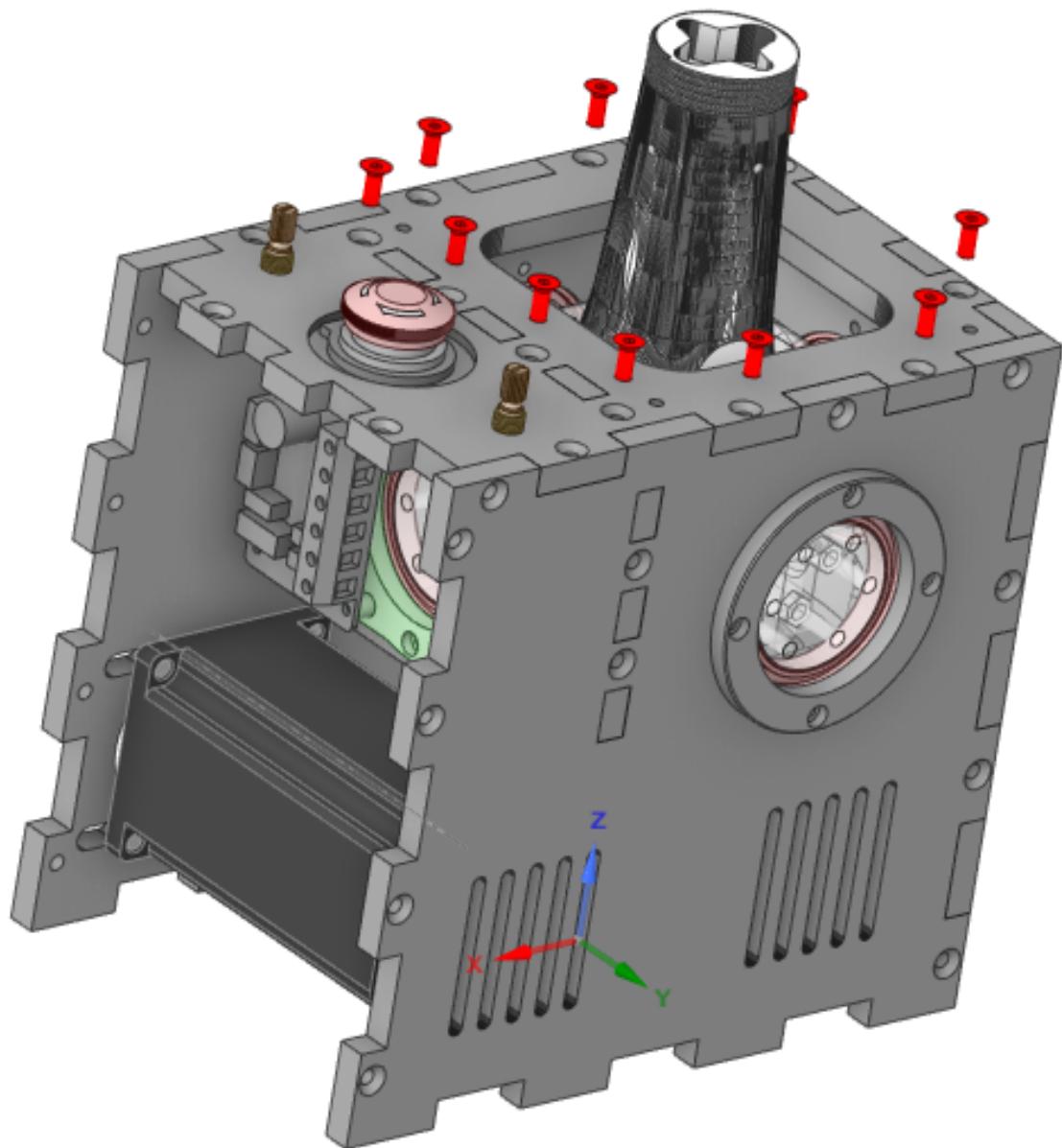
## STEP 11

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

Securing top panel only with M4x8 screws shown

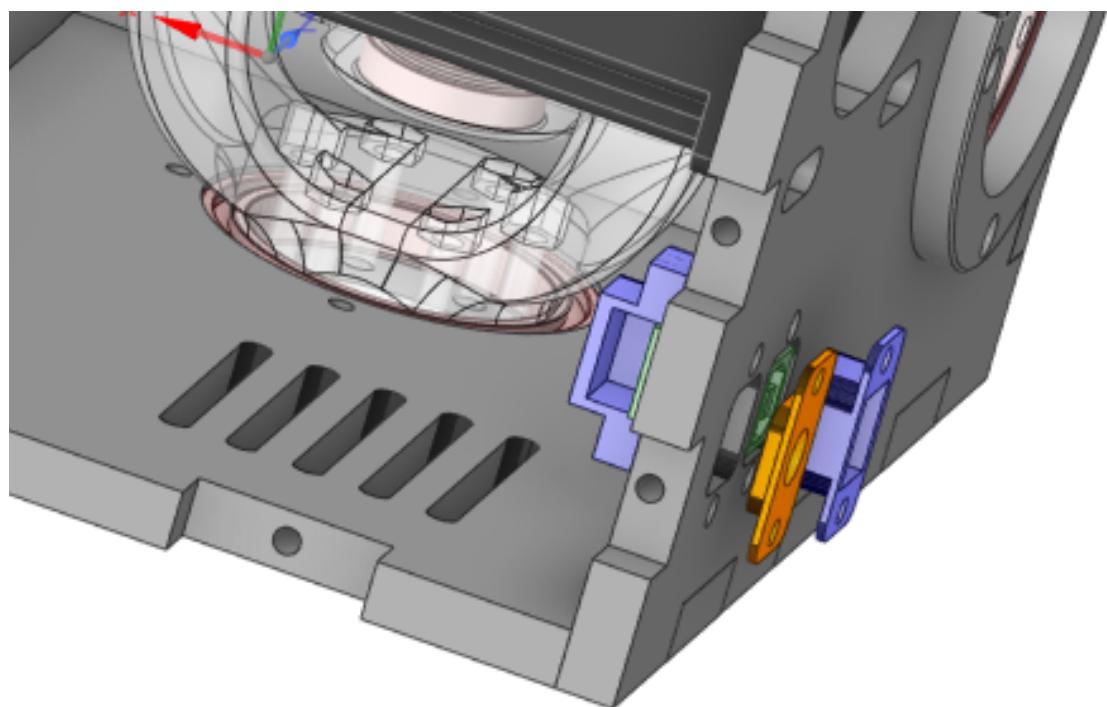
Connect E-Stop switch plug.

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**

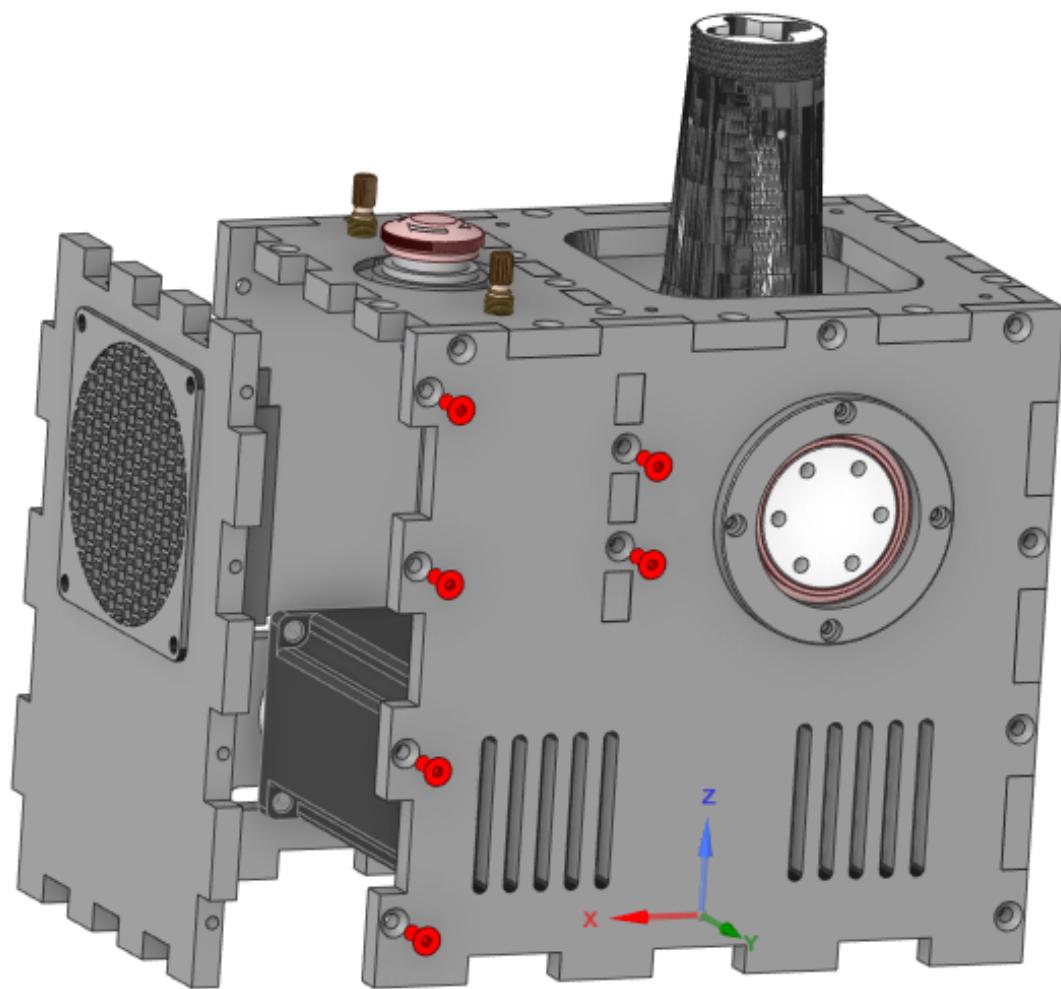
Install USB and Power plugs and retainers into rear panel and connect to mainboard and E-Stop switch



STEP 13

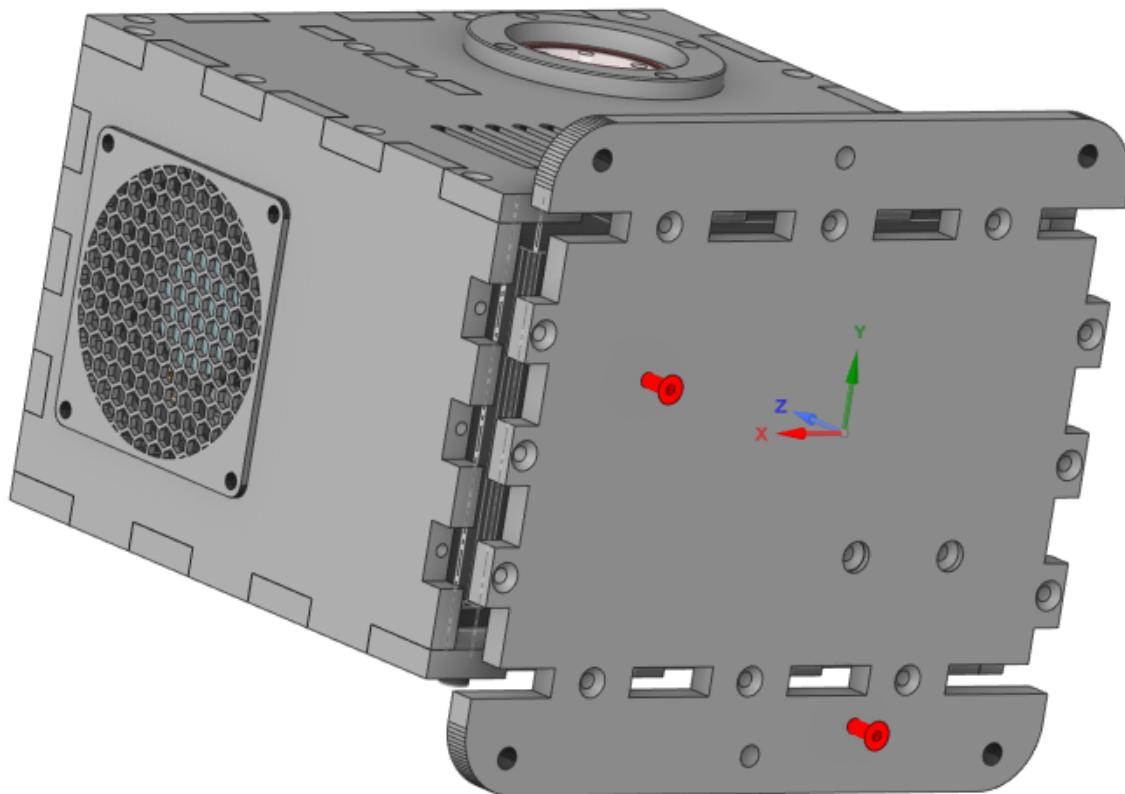
Mount front panel to top and side panels.

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



STEP 14

Mount bottom panel



## STEP 15

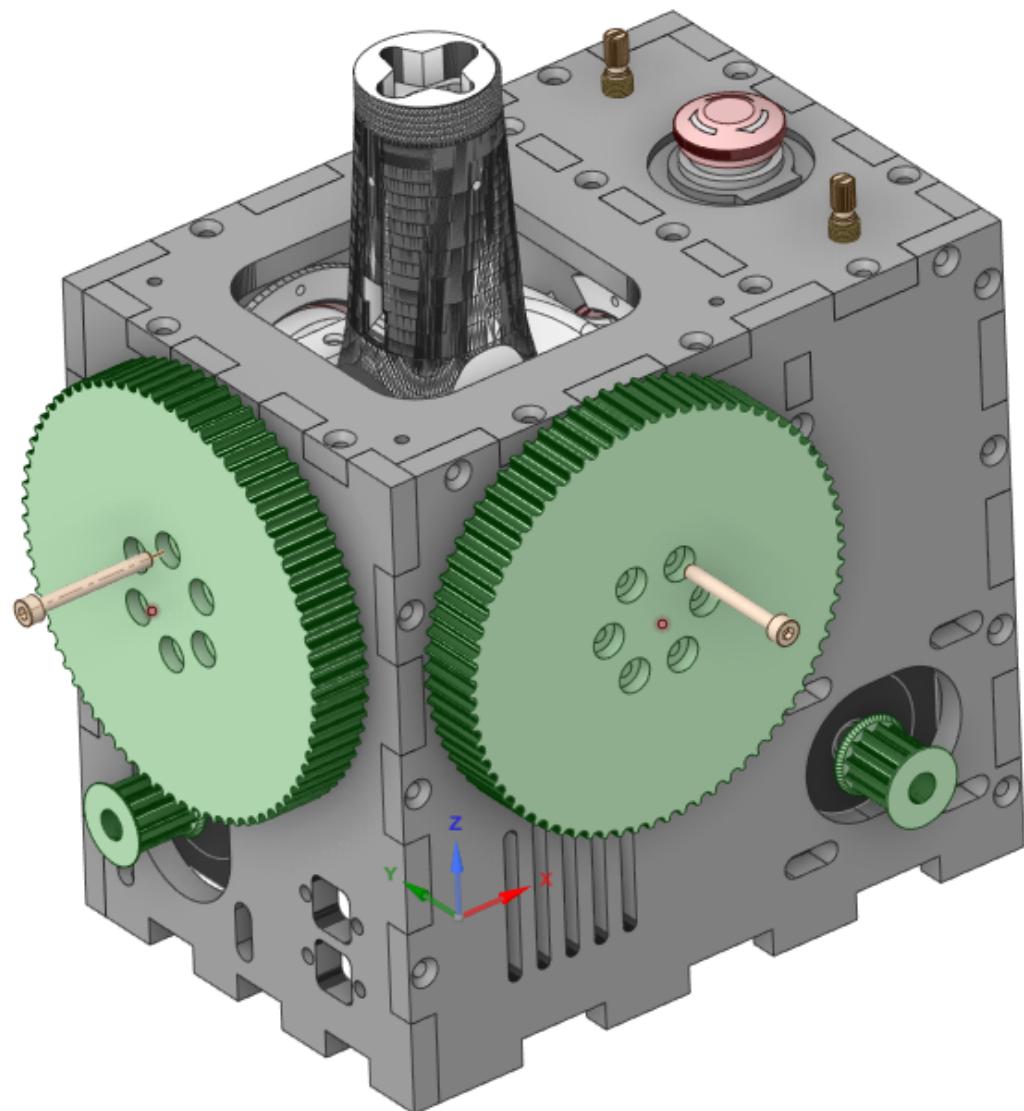
Mount pitch and roll gimbal 74T pulley to gimbals with M4x35 screws.

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.

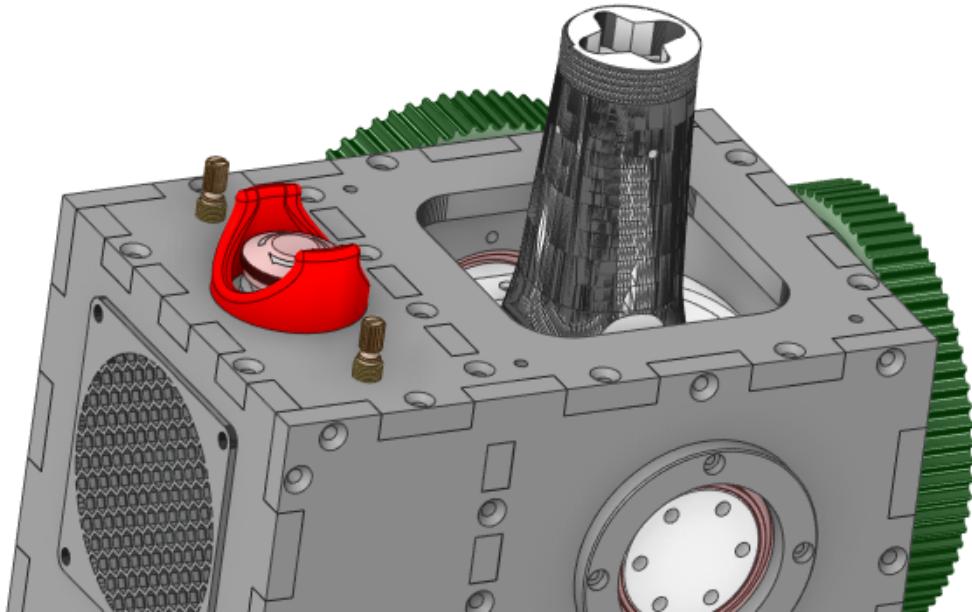
Align the pulley so the outer lip of the drive pulley is in line with the outer lip of the gimbal pulley.

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



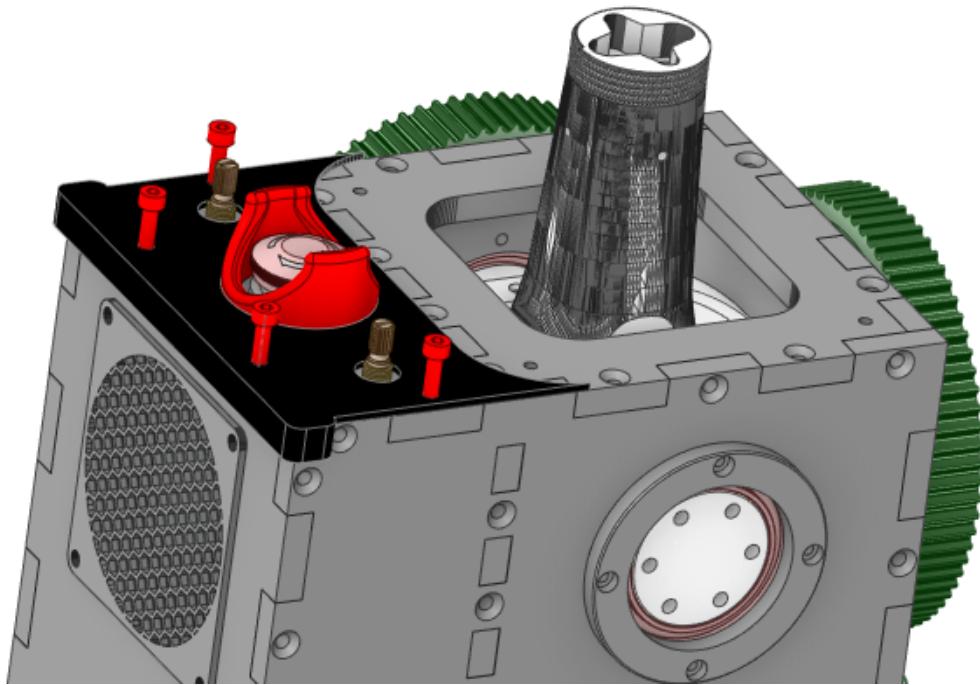
**STEP 16**

Glue E-Stop guard into slot on top panel



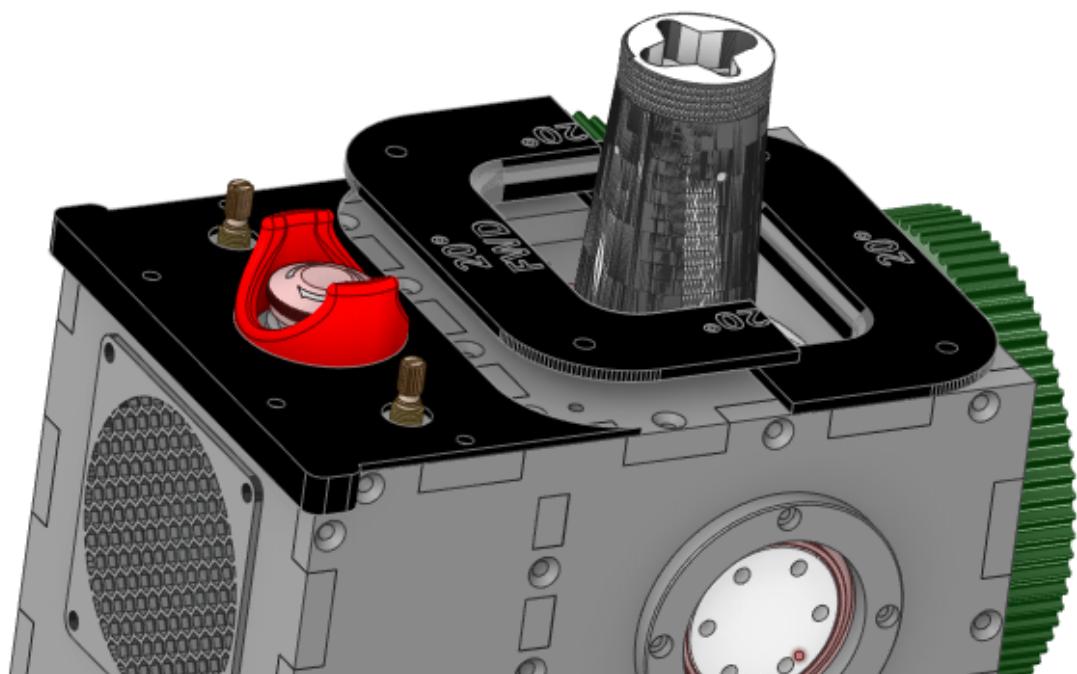
**STEP 17**

Mount top panel cover corner guard to top panel



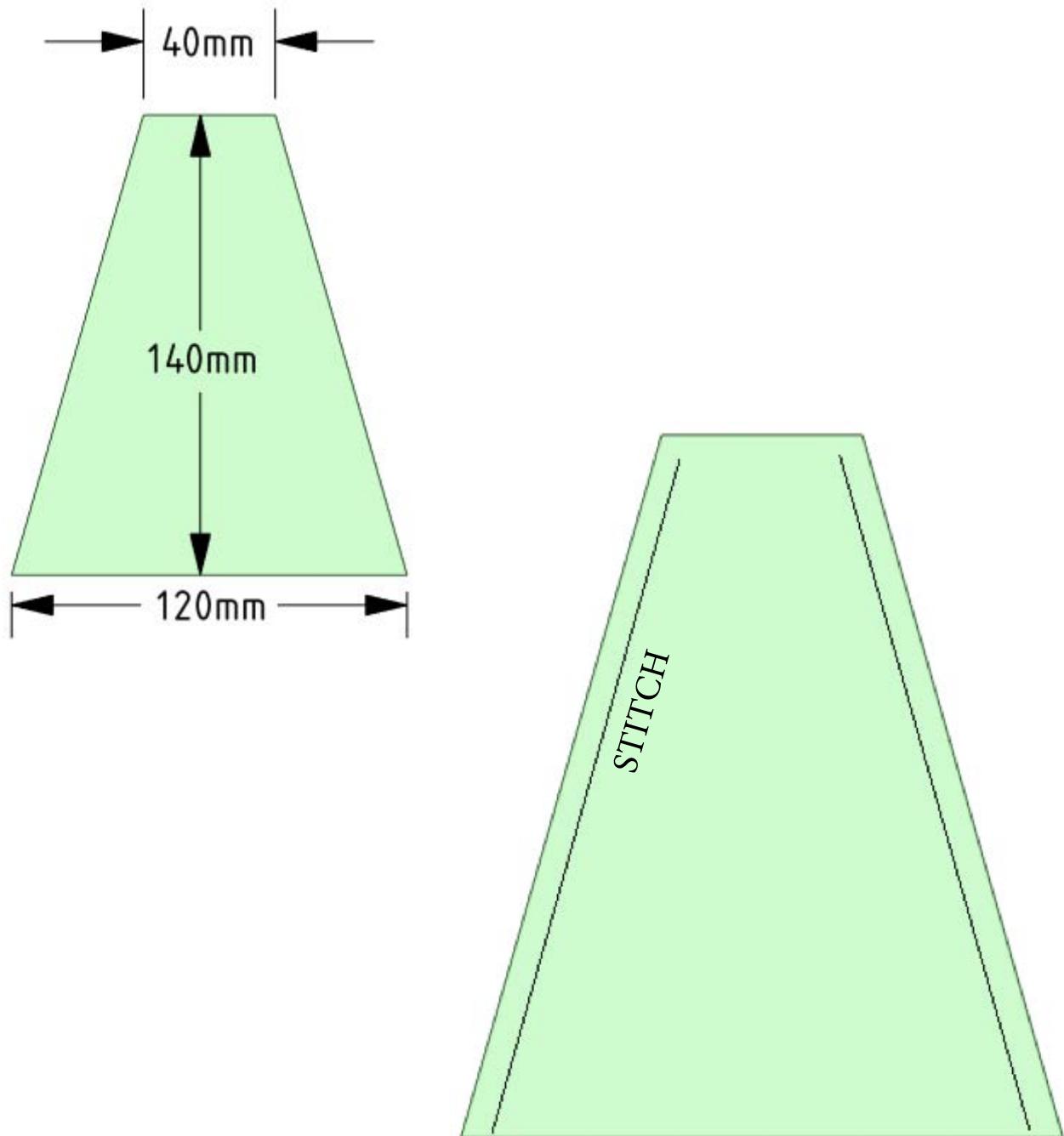
STEP 18

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

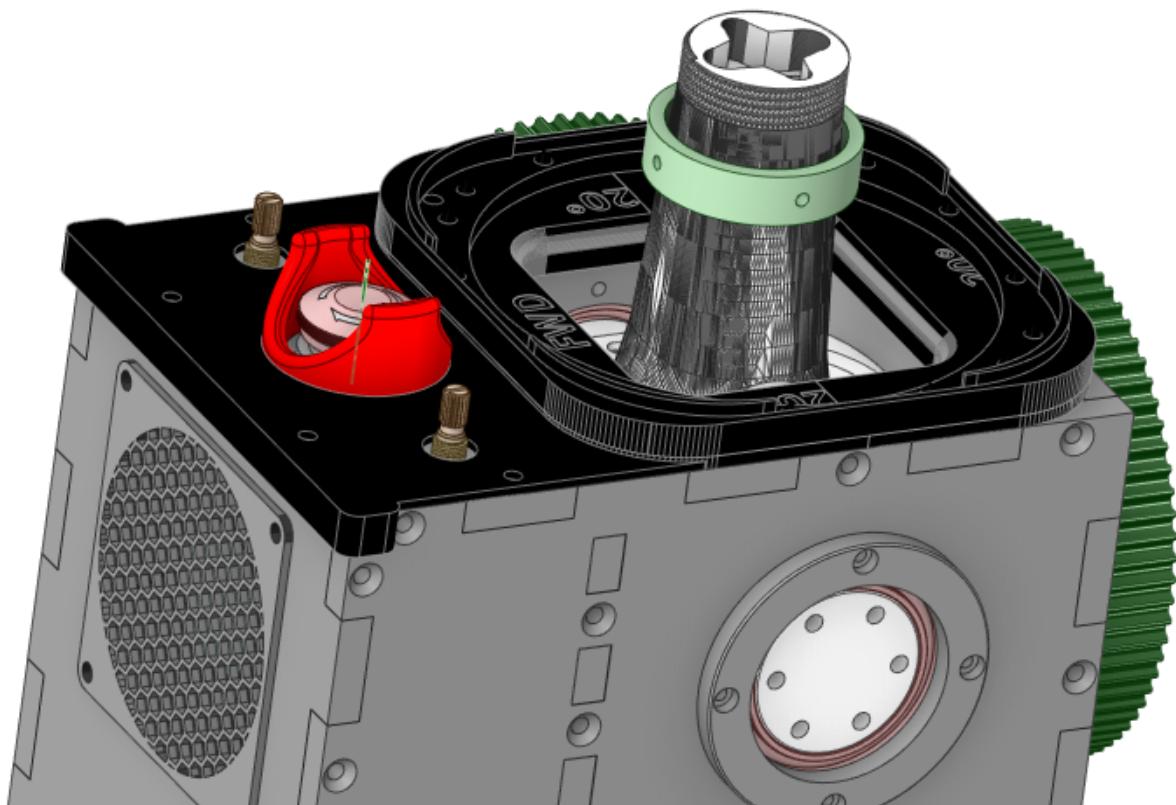
Slide top of boot over stick connector

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

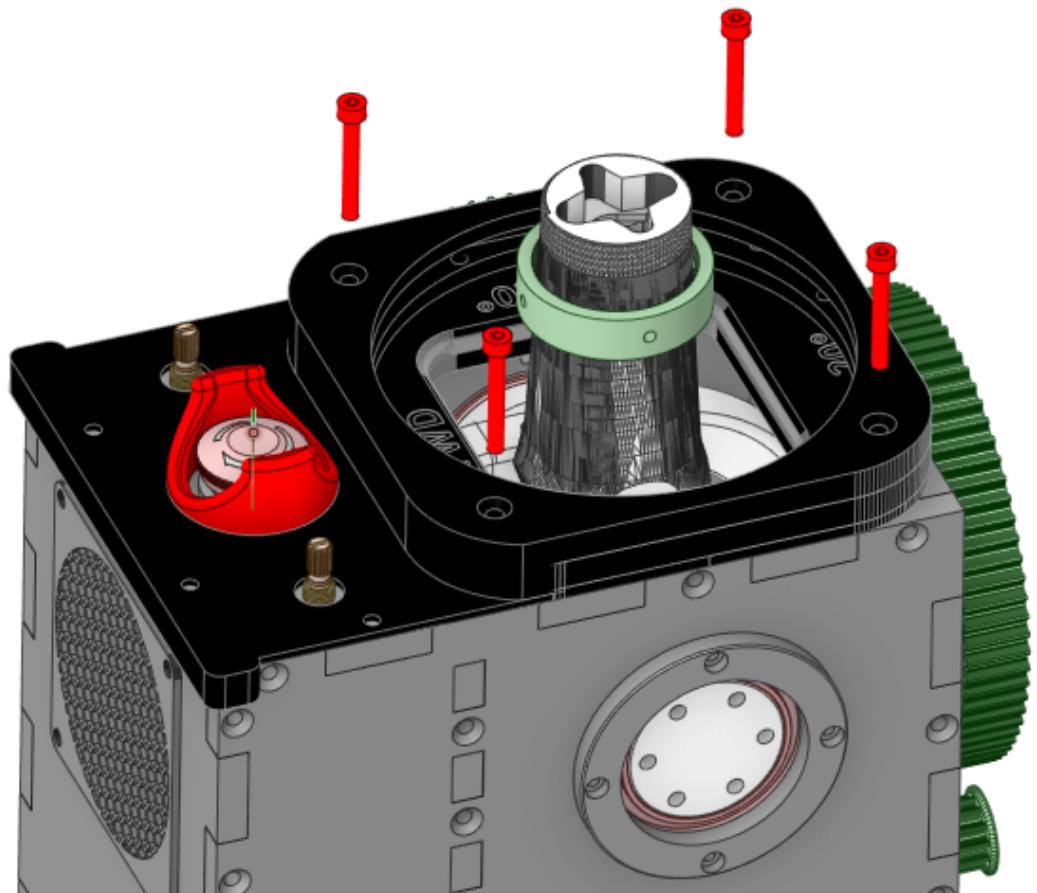
Punch holes in boot for clamp mount screws

Trim excess boot material from outside of lower clamp



STEP21

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

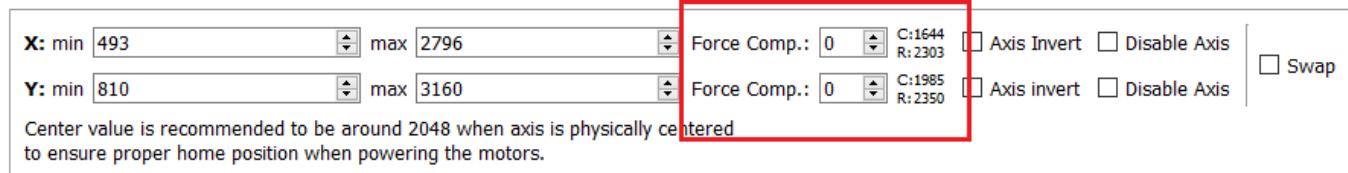


# Belts install and Basic Stick Calibration

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



VPForce	
x	1192
y	0168
dx	0000
dy	0000
d2x	0000
d2y	0000
fxout	-777
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.