Assembly Manual

V23 Falcon 500 - Neo 550 Coaxial Swerve Pod

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Main components

1. Preparing Plates
2. Wheel fork assembly
3. Azimuth Assembly
4. Motor and gearbox preparation
5. Main Plate and Encoder mounting plate
6. Falcon 500 and encoder Mounting

Implementation

Overview

This is an assembly manual for constructing Team 3176's V23 Swerve Pods. This manual will go over materials needed, fabrication instructions, chassis integration, and provide a bill of materials and CAD files.

IMPORTANT NOTE - PUT LOCKTITE ON ALL BOLTS THAT ARE BEING THREADED

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Parts List - Per One Pod

Part Name	Quantity	notes/comments
Mechanical Parts		
MainPlate	1	.25 alum.
BearingReatinerPlate	1	.125 alum
EncoderPlate	1	3/16 alum
TopPlate	1	0.090 alum
3in Billet Wheel	1	
15t Bevel Gear	1	
45t Bevel Gear	1	
22t Spur Gear	1	
14t Pinion Gear	1	
4:1 UltraPlanetary Stage	1	
3:1 UltraPlanetary Stage	1	
UltraPlanetary Output	1	
UltraPlanetary 550 Input	1	
UltraPlanetary 8mm Output	1	
DriveShaft	1	Drawing Attached At the End
Wheel Axle	1	Drawing Attached At the End
⅜ Thunder Hex Bearing	3	
8mm ID Round Bearing	3	
3in ID x Contact Bearing	1	
⅛ ID round bearing	1	
90t GT2 Belt	1	
Aluminum Wheel Forks	2	

Electrical Parts		
Falcon 500	1	
Neo 550 w Small Pinion Attached	1	Use Vice or Arbor Press to push pinion on - Should align flush with the top of the shaft
CanCoder	1	
CanCoder Magnet	1	
SparkMax	1	

Spacers		
Bevel Spacer	1	PLA
Large Wheel Spacer	1	PLA
Small Wheel Spacer	1	PLA
Small Spacer	2	PLA
M4 30mm Hex Standoff	3	
M3 30mm Round Standoff	2	
8-32 1.75in Round Standoff	3	
Spacer Set for Falcon Pinions	1	
10-32 ID Washer	3	
8mm ID Washer	1	

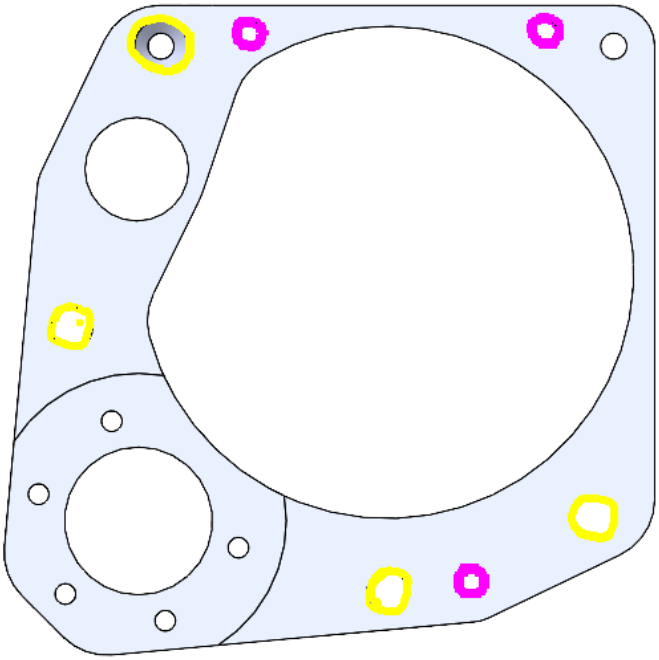
Hardware		
M3 * 30mm Socket Head	6	
M3* 8mm Button Head	7	
M4* 15mm Socket Head	5	
M4*15mm Flat Head	1	
10-32 Threaded Insert	4	
8-32 Threaded Insert	3	
6-32 ½ in Button Head	6	
10-32 * ¼ in Button Head	5	
10-32 * ½ in Button Head	3	
10-32 * 2in Socket Head	4	
8-32 * 2 ¼ in Socket Head	2	
8-32 * 2 ½ in Socket Head	1	
8-32 * .½ in Socket Head	4	
8-32* ¾ in Socket Head	1	
⅜ External Retaining Ring	1	
2mm - 8mm Key Shaft	1	Cut from Stock
M3 * 45mm socket head	2	

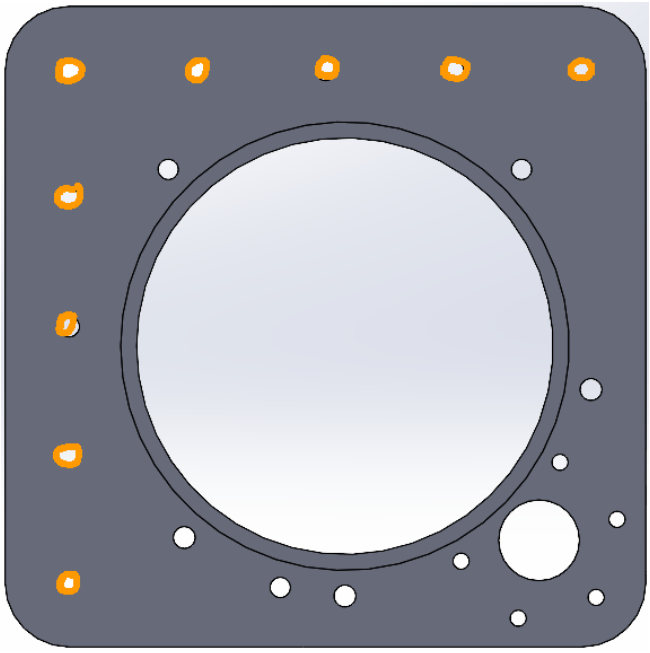
Printed Parts		
Azimuth Pulley	1	onyx
Small 16t Pulley	1	onyx
Azimuth Top	1	onyx
EncoderMount	1	PLA
66t 40Dp Spur	1	onyx

66t With Magnet	1	onyx

Plate Preparation - Refer to the drawings below in order to get plates ready for the creation of the pods

Note: Make sure to confirm that all bolts can fit freely through holes! Tolerances might be tight if the part was cut on the cnc.





Yellow - Check FeatureBefore Assembly

Orange - Tap to a 10-32 or drill out to 13/64

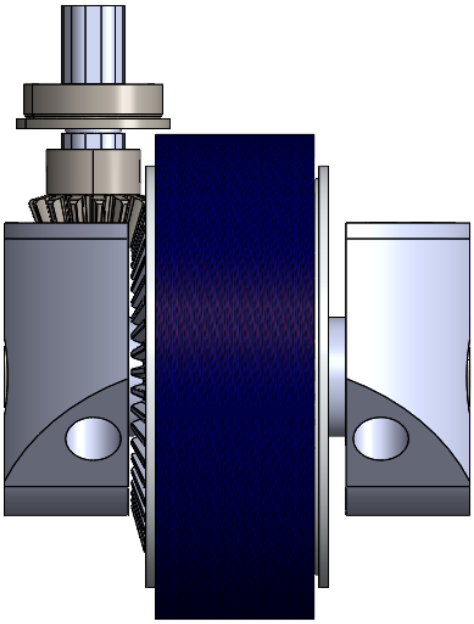
Pink - Tap to a 8-32

Be sure to check all bearings and clean debris out of recessed features

Wheel Fork Assembly

Parts Needed

- 2 x Wheel Forks
- Axle
- Drive Shaft
- Small ⅛ ID Bearing
- 2 x ⅜ ThunderHex Bearing
- Small Wheel Spacer
- Large Wheel Spacer
- 3in Billet Wheel
- 45t Bevel Gear
- 15t Bevel Gear
- 6 x 6-32* .5in Button Heads
- 2 x 10-32 * .5 Button Heads
- ⅜ External Retaining Ring
- Bevel Spacer



Step 1: Start by Preparing the wheel forks for the assembly, and confirming that shafts needed are cut to specified lengths.

- Use the ⅞ OD Honing tool to bore out the ⅜ Thunder Hex Bearing Hole on each wheel fork. Use cutting oil on the hone and a hand drill, going back and forth with the hone, checking every 2 seconds of drilling until the bearing can be snapped in

  - Do not make this bore lose! Make sure to have a mentor help you

- Referring to the drawings in CNC/lathe>Swerve>Shafts>Shaft Drawings, use a lathe to modify a piece of regular ⅜ hex shaft into the drive shaft - regular ⅜ hex is used due to the end of the shaft needing to be machined down (thunderhex has a tap hole for a 10-32)
- Referring to the drawings on page ____ use a chop Saw or vertical bandsaw to Create the axle - Note: It may be beneficial to undesize this shaft by a couple thousands as if the shaft is oversized it will not be properly retained.

Step 2: Adding in Bearings

- Snap in a ⅜ Thunder Hex Bearing to both wheel forks, ensuring that the flange is in the recessed portion of the wheel fork
- Snap in the .125 ID Bearing to one of the wheel forks(Doesn't matter which one, in the recess on the top side of the wheel fork - Make sure this has been snapped all the way in!

Step 3: Preparing the Wheel

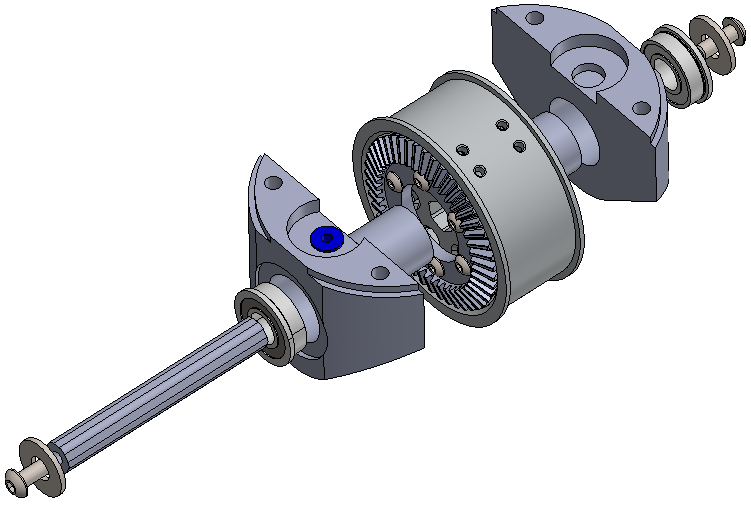
- Start by using the 3d printed tread cutting tool to cut a piece of the 1in wide blue nitrile tread
- You then can use the layout to drill holes in the tread, matching the pattern on the tread cutting tool.
- To attach the tread to wheel, use the 6-32*.375 in button head bolts to thread the tread onto the wheel
- When complete, confirm that the tread is tight and all bolts are fully tightened
- Next, take the 45 tooth bevel gear and attach it the 3 in billet wheel with 6, 6-32 * .5 in button head bolts. - Important: confirm that you are attaching it to the recessed side of the wheel

Step 4: Preparing the drive shaft

- With the lathed drive shaft, use a pair of retaining ring pliers(.037 tip) to slide the retaining ring over the shaft and into the groove on the drive shaft. Ensure that this ring is fully set within the groove.
- Next, slide the bevel spacer onto the shaft(colored white), pressing up against the retaining ring.
- Following this, slide the 15 tooth bevel gear on, and check to make sure the face of the gear is flush with the ⅜ hex shaft face.

Step 5: Putting it all together

- Following the picture below, retain one end of the axle using a 10-32* .5 in button head bolt and a washer, pressing against the inner race of the ⅜ thunder hex bearing(flange side). Important - make sure this is the wheel fork with the small, ⅛ ID bearing.
- Slide the large wheel spacer(colored purple) onto the axle on the non-retained side.
- Following this, slide the wheel assembly onto the shaft, with the teeth of the 45t bevel gear facing towards the wheel fork.
- Add the small wheel spacer to the end of the shaft and cap the assembly off with the second wheel fork, retaining it the same as the first one.
- Insert the drive shaft end into the small ⅛ ID bearing, hooking the bevel set together. Ensure that the teeth are meshing properly with no interference, and check that the wheel can spin properly without interference.



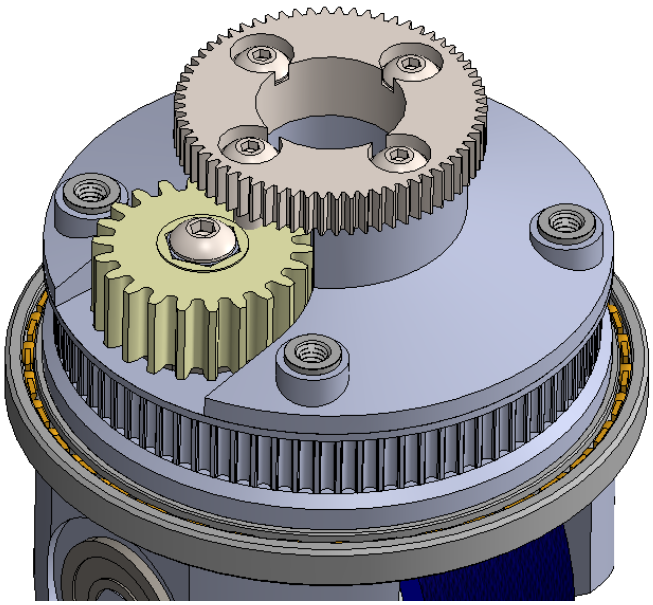
With that you should have a proper wheel fork assembly!

Note That drive shaft is not shown, but should be included

Azimuth Assembly

Parts Needed

- 22t aluminum Spur Gear
- Azimuth Pulley(onyx)
- Azimuth Top(onyx)
- 4 x 10-32*2in Socket Head Bolts
- 3in ID x Contact Bearing
- 1 x 10-32 * .25 in Button Head Bolt
- 44t 40Dp Encoder Gear
- 3 x 8-32 .5in Button Heads
- 3 x 8-32 Threaded Insert
- 4 x 10-32 Threaded Insert
- 1 x ⅜ Thunder Hex Bearing



Step 1: Preparing the parts

- Begin By inserting the ⅜ thunder hex bearing into the azimuth pulley, as shown below. Confirm the bearing flange is inset into the recess on the non ‘flat’ side of the pulley.
- Next, take the 4 10-32 threaded inserts and press them into the pulley top, ensuring that they are all the way in. Do the same with the 3 8-32 inserts. Make sure that you can thread a bolt into both the top and bottom of the inserts. You may hear a squeaking noise, but this is okay.

Step 2: Attaching the wheel forks

- Align the wheel forks into the same orientation and insert them into the 3in ID x-contact bearing. Ensure that the wheel forks are all the way into the grooves all the way around
- Next, Insert the pulley top into the other side of bearing, aligning the ⅜ in thunder hex bearing with the drive shaft, pushing the drive shaft through the bearing
- Align the pulley top cutout with the flange of the 3/8in thunder hex bearing, and then use 4x 10-32 2in Socket head bolts to secure the assembly together, referring to the image.

Step 3: Attaching the Spur Gears

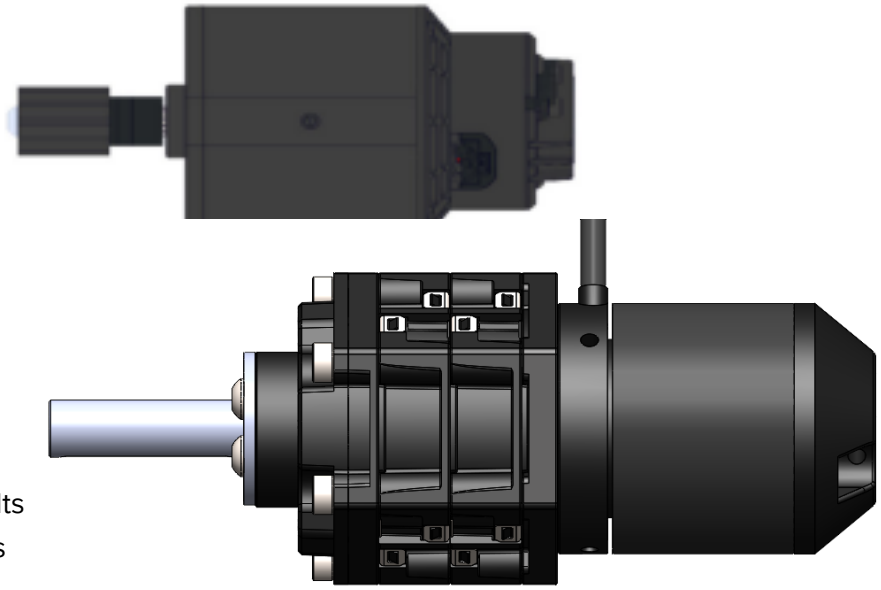
- Take the 22t spur gear and slide it over the driveshaft. Retain the spur using a 10-32 * 1/4in Button Head Bolt and a washer.
- Take the 44t 40DP spur gear(White PLA) and align the centering ring into the pulley top. Attach the spur to the pulley top with 3x 8-32 * ½ in button head bolts

You now have a finalized Azimuth Assembly!

Motor and Gearbox Preparation

Parts Needed

- Falcon Spacer Kit
- Falcon 500
- 14 tooth pinion
- Neo 550
- 550 Mounting Plate
- UltraPlanetary 4:1
- UltraPlanetary 3:1
- UltraPlanetary Output Stage
- 8mm Output Shaft
- 2 x M3 * 30mm Socket head Bolts
- 7 x M3 * 8mm Button Head Bolts



Step 1: Preparing the Falcon 500

- Slide the Following spacers from the falcon spacer kit onto the shaft of the Falcon 500:

  ¼ in Spacer, ⅛ in Spacer, 1/16 in Spacer

- After the Spacers slide the 14 tooth pinion onto the shaft and retain it with the included 8-32 bolt.

Step 2: Preparing the Neo 550 and UltraPlanetary

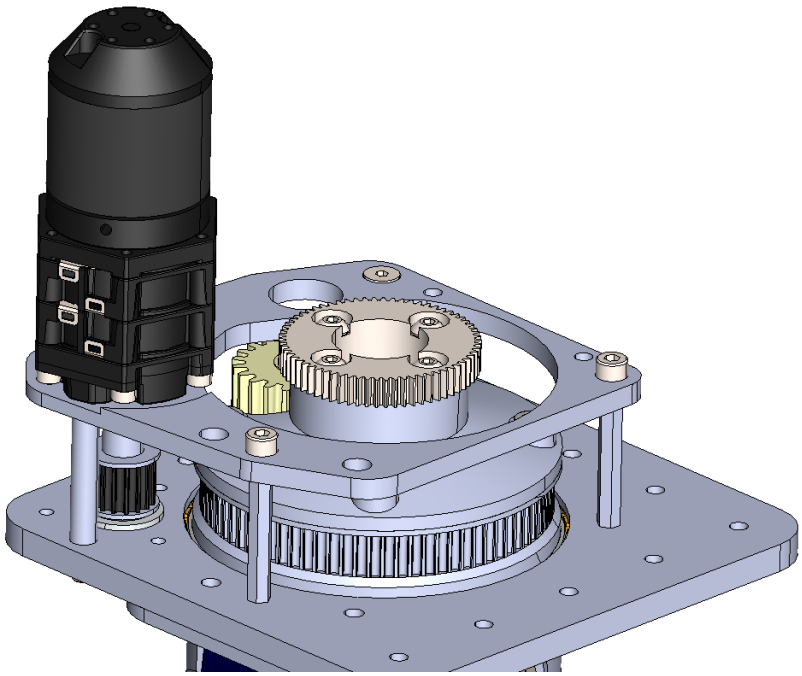
- Attach the 550 motor mounting plate to the neo 550 using 2 x M3 * 8mm button head bolts.
- Slide the 4:1 and 3:1 reductions onto the output shaft, with the 3:1 reduction being closest to the motor.
- Attach the 8mm output shaft to the UltraPlanetary output stage using 5 x M3 * 8mm bolts.
- Cap the rest of the assembly with the output stage and join the assembly with 6x M3 * 30mm Socket head bolts

Both motors are now prepared for the next steps.

Main Plate and Encoder Plate Assembly

Parts Needed

- Main Plate
- Bearing Retainer Plate
- Encoder Plate
- 90t Gt2 Belt
- 8mm ID bearing
- 2 x 30mm round M3 spacers
- 3 x 30mm Hex M4 Spacers
- 5 x 15mm M4 Socket Head Bolts
- 1 x 15mm M4 flat head bolt
- 2 x 45mm M3 socket head bolts
- UltraPlanetary + 550 Assembly
- 16t printed pulley



Step 1: Attaching the Main Plate and Bearing Retaining Plate

- Slide the main plate over the azimuth assembly, with the recess in the plate facing towards the wheel
- Slide the bearing retaining plate over the wheel fork assembly, with the recess facing towards the main plate, and click the 2 plates over the bearing - ensure the bearing is all the way into the recess on the main plate - it can easily get stuck.
- Insert 3 x M4 * 15mm Socket head screws through both plates in the holes specified below. Tighten 3 x 30mm M4 spacers onto the M4s
- Insert a 8mm ID Bearing into the main plate with the flange on the side opposite of the wheel

Step 2: Attaching the Encoder Plate and Motor

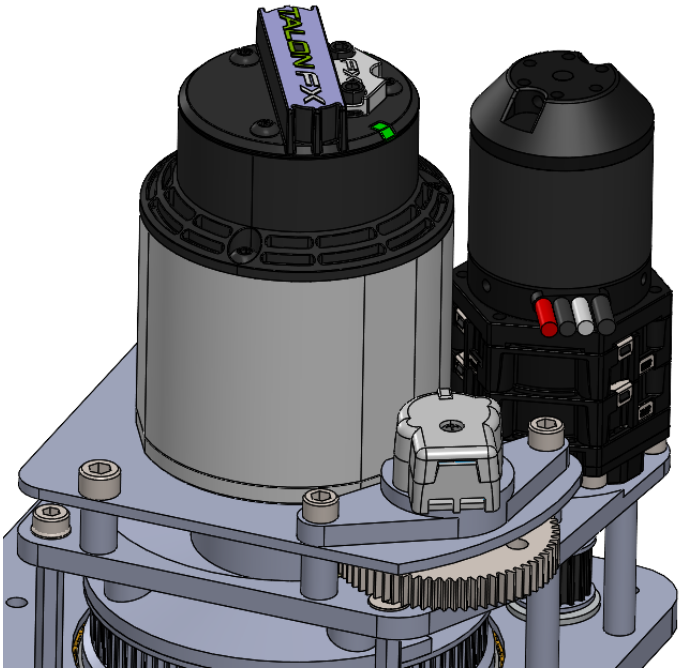
- Slide a 2mm key into the keyway on the 8mm output shaft of the planetary, and slide the small 16t printed pulley onto the shaft, with the spacer going first
- Place the UltraPlantary + 550 Assembly into the recess on the encoder plate, and slide the belt over the small pulley and azimuth pulley.
- Insert the end of the 8mm shaft into the 8mm ID bearing on the main plate (You have to stretch the belt a little bit).
- Align the encoder plate on the Hex Standoffs and thread 2 x M4 * 15mm socket head bolts into the hex spacers
- On the hole with the countersink hole, thread the M4*15mm Flat Head bolt into the hex spacer
- Using pliers, align the 2x 30mm round M3 spacers between the encoder plate and main plate, and align with the M3 holes for mounting the UltraPlanetary + 550 assembly.
- Slide 2 x M3 * 45mm Socket Head Bolts through the spacers from the bottom of the main plate and thread them into the UltraPlanetary
    - Note : ensure that the 550 wires are facing away from the rest of the assembly

You have now attached the encoder plate and main plate to the assembly.

Encoder and Falcon Mounting

Parts Needed:

- Falcon 500 Assembly
- CanCoder
- Can Coder Magnet
- 44t 40DP with magnet mount
- 2 x 8mm ID bearings
- 3 x 1.75 in 8-32 round Spacers
- 2 x 8-32 * 2 ¼ in Socket Head Bolts
- 1 x 8-32 * 2 ½ in Socket Head Bolt
- 1 x 8-32 * ¾ in Socket Head Bolt
- 1 x 8-32 * ½ in Socket Head Bolt
- 2 x Small printed Spacer
- Top Plate
- 5 x 10-32 * ¼ in Button Head Bolts

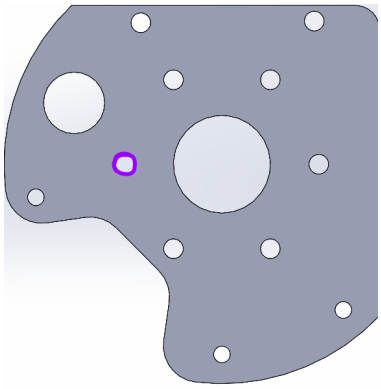


Step 1: Encoder Gear and Spacer Alignment

- Drop 3 x 1.75in 8-32 Spacers into the 3 ¼ in holes on the encoder plate, pushing them through until they contact the main plate.
- Insert the CanCoder Magnet into the 44t 40Dp spur with magnet mount, ensuring it is pushed all the way down.
- Insert the side without the magnet into the free 8mm ID bearing located on the encoder plate

Step 2: Top Plate Preparation

- Align the top plate so the cut out is facing the 550 Assembly. Insert a 8mm ID bearing into the plate, with the flange facing upwards.
- Slide the falcon 500 through the center bore in the top plate, with the motor on the same side as the flange.
- Flipping the plate over, attach the falcon to the plate with 5 x 10-32* ¼ in bolts, Ignoring the hole shown below.



Step 3: Encoder Preparation

- Note: It is extremely important that you are careful when handling the pcb board on the encoder.
- Use the included 4-40s to attach the bottom of the encoder housing the printed encoder mount.
- Place the pcb into the housing and then attach the cover with the provided screw - DO NOT OVERTIGHTEN

Step 4: Putting in together

- Align the top plate onto the spacers and encoder spur shaft - the top of the encoder shaft should slide into the 8mm ID bearing - confirm the plate is fully set onto the spacers.
- Align the encoder mount assembly over the shaft, and thread the 8-32 * 2 ½ in through the mount, spacer, and into the main plate
- Thread 2 x 8-32 * 2 ¼ in Bolts through the long spacers into the main plate
- Using pliers, align 2 small spacers between the top plate and encoder plate, underneath the 2 remaining holes. Attach the encoder mount with the 8-32*¾ in bolt, threading it into the encoder plate. With the 1 remaining hole, take the 8-32 * ½ in bolt and thread it through the spacer into the encoder plate.

You Have now Completed the V23 Falcon 500 + Neo 550 Coaxial Swerve Pod Assembly.