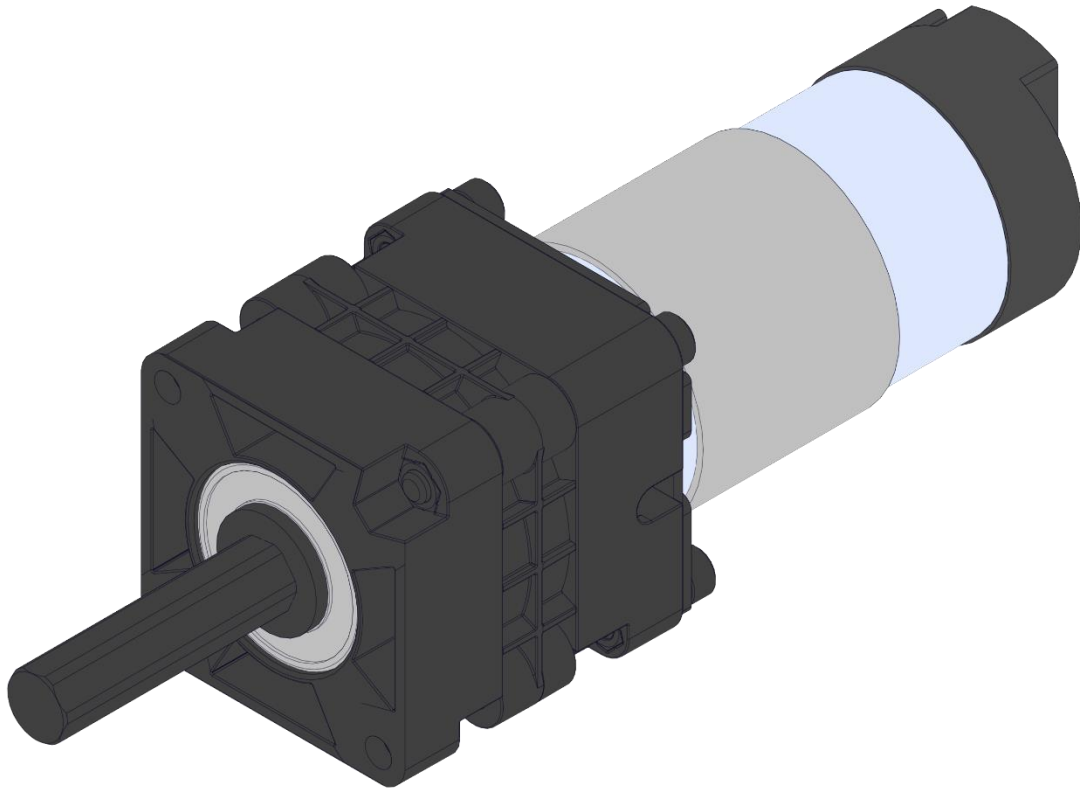


217-5823-751

VersaPlanetary Lite User Guide

VersaPlanetary Lite

User Guide



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2017-12-11

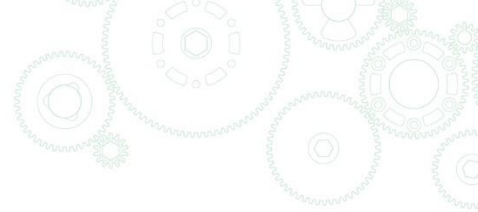


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VersaPlanetary Lite FAQ

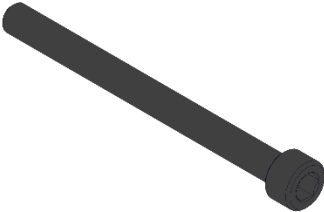
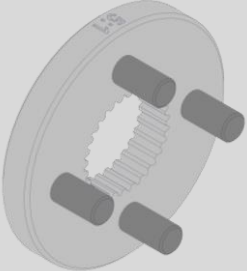
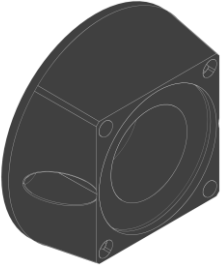
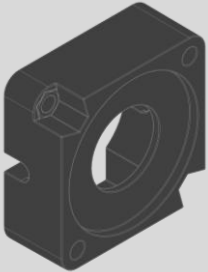
VersaPlanetary Lite Single Stage Exploded View

VersaPlanetary Lite User Guide

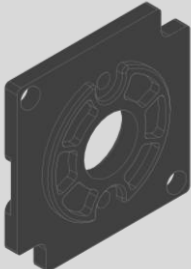

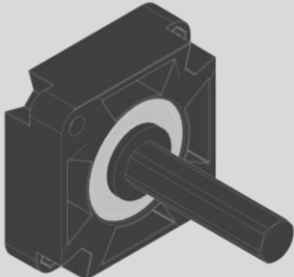
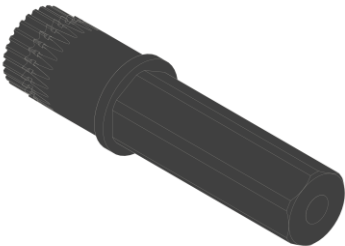

VersaPlanetary Introduction

The VersaPlanetary is a modular planetary gearbox system designed specifically for use by *FIRST®* Robotics Competition and *FIRST®* Tech Challenge teams. This modularity allows the VersaPlanetary to be compatible with almost every legal FRC motor and most FTC motors. In addition, the modularity of the system allows teams to have a wide range of gear ratios and output shafts to use in their designs.

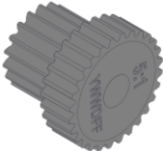
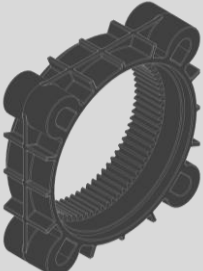


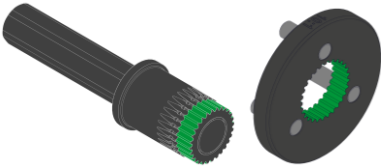
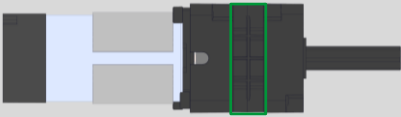
Nomenclature

Picture	Name / Description
	ASSEMBLY SCREW These are the screws that hold the VersaPlanetary together.
	CARRIER PLATE The Carrier Plate is the part of the gear set that helps transfer motion from the Planet Gears to the next stage of the VersaPlanetary.
	CIM ADAPTER The CIM Adapter replaces the input block and allows CIM and Mini-CIM motors to be mounted to a VersaPlanetary.
	Input Block The Input Block allows non-CIM motors to mount to the VersaPlanetary

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	<p>Gear Set Gear Sets reduce speed and increase torque. Each Gear Set is interchangeable. This allows teams to swap between a 3:1, 4:1, 5:1, 7:1, 9:1 & 10:1 Gear Set without changing anything else about the VersaPlanetary.</p>
	<p>Motor Mounting Plate(s) Non-CIM motors mount to these plates. This is mounted to the Input Block using (2x) #8-32 x 1/2" Button Head Cap Screws. In addition, the plate is piloted to the Input Block, helping with concentricity between the motor and the VersaPlanetary.</p>
	<p>Motor Mounting Screw These are the screws that hold the motor to the Motor Mounting Plates.</p>
	<p>Output Block The Output Block contains the two radial bearings and Output Shaft.</p>
	<p>Output Shaft Users interface to the output shaft to transfer motion from the VersaPlanetary to their mechanism. All Output Shafts are interchangeable, allowing customers to use a variety of different Output Shafts to meet their needs.</p>
	<p>Planet Gear The Planet Gear transfers motion from the Sun Gear to the Carrier Plate.</p>

VersaPlanetary Lite User Guide

	<p>Sun Gear The Sun Gear transfers motion from the previous stage to the Planet Gear.</p>
	<p>Ring Gear The Ring Gear meshes with the Planet Gears on the Gear Set</p>
	<p>Shaft Adapter The Shaft Adapter is a split collar that clamps onto a non-CIM motor shaft. The OD is 8mm which is the bore of the Shaft Coupler.</p>
	<p>Shaft Coupler The Shaft Coupler has an 8mm bore and an internal spline. The purpose is to transfer motion from the motor to the first stage of the VersaPlanetary.</p>
	<p>Spline Splines are used throughout the VersaPlanetary to transfer motion between stages.</p>
	<p>Stage Stages are used to describe every section of the VersaPlanetary between the Input Block and the Output Block. Each Stage is 1/2" thick.</p>

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VersaPlanetary vs. VersaPlanetary Lite

The VersaPlanetary Lite is a version of the VersaPlanetary that is intended for lower load applications, such as FTC robots. This version was designed to be compatible with existing VersaPlanetary v2 components so it's possible to mix and match parts from both systems.

Note: FRC teams should use VersaPlanetary Lite with extreme caution. Please consult the VersaPlanetary Lite Load Ratings Guide before using the VersaPlanetary Lite in your design.




Motor Compatibility

The VersaPlanetary is compatible with the following motors:

Picture	Description	Mounting Screws
	CIM Motor*	#10-32
	Mini CIM Motor*	#10-32
	775pro	M4 x 10MM
	BAG Motor	M4 x 10MM
	AndyMark RS775-125	M4 x 10MM

* = Requires motor shaft to be cut down.

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Picture	Description	Mounting Screws
	Banebots RS-775 18V	M4 x 10MM
	AndyMark NeveRest Motor	M3 x 8MM
	AM 9015	M3 x 8MM
	Banebots RS-550	M3 x 8MM

VersaPlanetary Lite User Guide

Gear Ratios

The VersaPlanetary has 6 available gear sets: 3:1, 4:1, 5:1, 7:1, 9:1 & 10:1. Each gear stage is going to decrease speed while increasing torque. You calculate this change by dividing the input speed by the size of the ratio and multiplying the input torque by the size of the ratio:

$$\frac{\text{Input Speed}}{\text{Gear Ratio}} = \text{Output Speed}$$

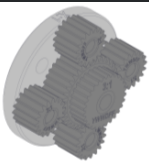


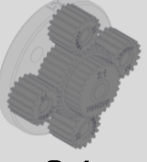


$$\text{Input Torque} * \text{Gear Ratio} = \text{Output Torque}$$

For example, if you have a motor spinning at 10,000 RPM with a stall torque of 0.1 Nm going through a 5:1 gear ratio:

$$\frac{10,000 \text{ RPM}}{5} = 2,000 \text{ RPM}$$

$$0.1 \text{ Nm} * 5 = 0.5 \text{ Nm}$$

These gear ratios can be used together to create larger reductions. For example:

Stage	Example 1	Example 2	Example 3
STAGE 1	 3:1	 4:1	 7:1
Stage 2	-	 3:1	 5:1
Stage 3	-	-	 3:1
Overall Reduction	3:1	12:1	105:1

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As you can see, each new stage is a factor in the overall reduction:

$$4 * 3 = 12:1$$

$$7 * 5 * 3 = 105:1$$

In theory, you can create infinitely large gear ratios. However, there are some limiting factors:

1. Can the chosen output shaft handle the output torque?
2. Can an individual gear ratio & ring gear combination handle the output torque?

We've summarized recommended configurations in our load rating guide for both the VersaPlanetary and VersaPlanetary Lite.

VersaPlanetary Load Rating Guide:

<http://link.vex.com/vexpro/pdf/VersaPlanetary-LoadRatings>




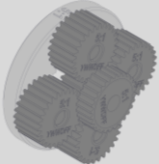


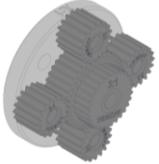



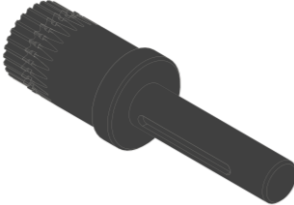
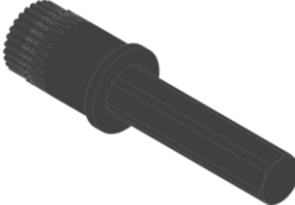
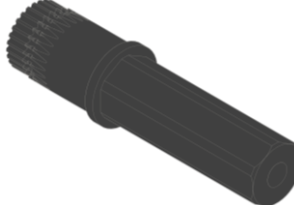
VersaPlanetary Lite Load Rating Guide:

<http://link.vex.com/vexpro/pdf/VersaPlanetary-Lite-LoadRatings>

VersaPlanetary Lite User Guide

Order of Gear Sets

A VersaPlanetary gearbox can have its gear stages assembled in any order. However, we do recommend that users put the largest gear reductions closest to the motor. For example:

Stage	Example 1	Example 2	Example 3
MOTOR	 775pro	 NeveRest Motor	 BAG Motor
STAGE 1	 5:1	 10:1	 9:1
Stage 2	 3:1	 4:1	 7:1
Stage 3	-	-	 4:1
Output Shaft	 CIM Output Shaft	 3/8" HEX SHAFT	 1/2" Hex
Overall Reduction	15:1	40:1	252:1

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Lubrication

You **must lubricate** your VersaPlanetary gear sets. VEX recommends using White Lithium Grease (McMaster P/N 1380K35) as a lubricant. Without lubrication, the VersaPlanetary will be less efficient and may not run smoothly.

Before running your VersaPlanetary, each gear mesh (planet gear/ring gear, planet gear/sun gear) should be lubricated.

In addition, lubrication should be added to each pin on the carrier plate. This will help prevent planet gears from seizing on the carrier plate pins.

While you want to be liberal in how much grease you are using, it is possible to overlubricate your VersaPlanetary and create additional drag on the gearbox, or worse seize the gearbox entirely.

A good rule of thumb is to apply enough grease that the surface has a light film of grease on it. You should never pack the entire gearbox full of grease.

Running in a VersaPlanetary


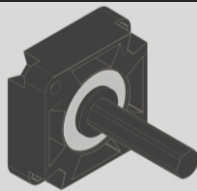

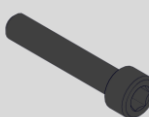
Before you use your VersaPlanetary VEX recommends doing an initial run in. This run in will help wear the gear teeth so they run smoother, with less drag and improved efficiency.

In industry, this run-in procedure would be part of the assembly process before the gearbox is shipped to a customer. Due to the modular nature of the VersaPlanetary system, this step must be done by the customer after they've completed assembly.

VersaPlanetary Lite User Guide

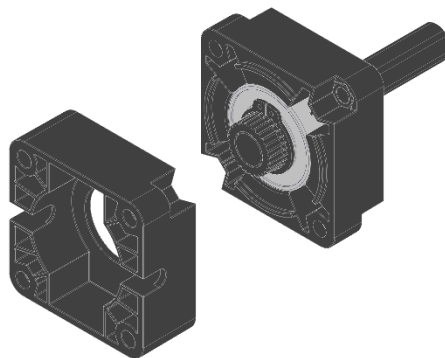
VersaPlanetary Lite 1:1 Assembly

What You Will Need

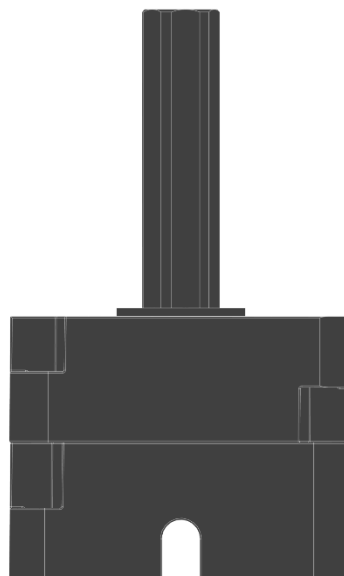
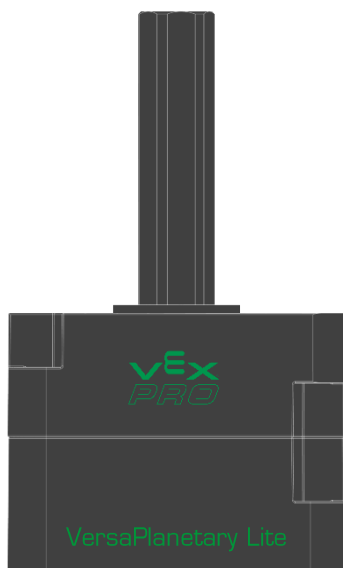
Part Number	Picture	Name	QTY	Kit
N/A		9/64" Hex Key	1	-
217-5823-200 217-5995-200		VersaPlanetary Lite Output Block	1	217-5823 217-5995
217-5823-150		VersaPlanetary Lite Input Block	1	217-5823 217-5995
SSA0832-0875ZB		#8-32 x 7/8" Socket Head Cap Screw	2	217-5994

Step 1

Line Up the VersaPlanetary Lite Input and Output Blocks



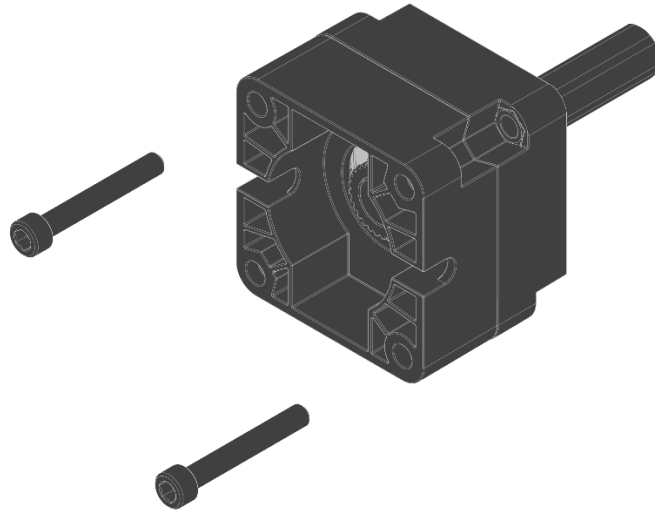
Note: Please pay attention to the orientation of the output and input block. Look for the VEXpro logo on the output block and the "VersaPlanetary Lite" text on the input block to be on the same face.



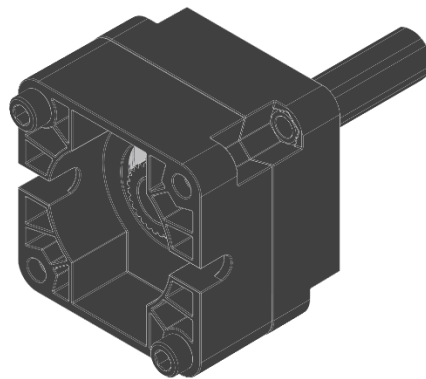
VersaPlanetary Lite User Guide

Step 2

Install Assembly Screws.




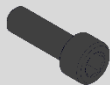
Find the (2x) #8-32 x 7/8" long socket head cap screws in the "VersaPlanetary Q-2 Stage Screw Kit". These should go in the two holes of the Input Block that do not have the #8-32 hex insert.



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VersaPlanetary Lite Non-CIM Motor Mounting

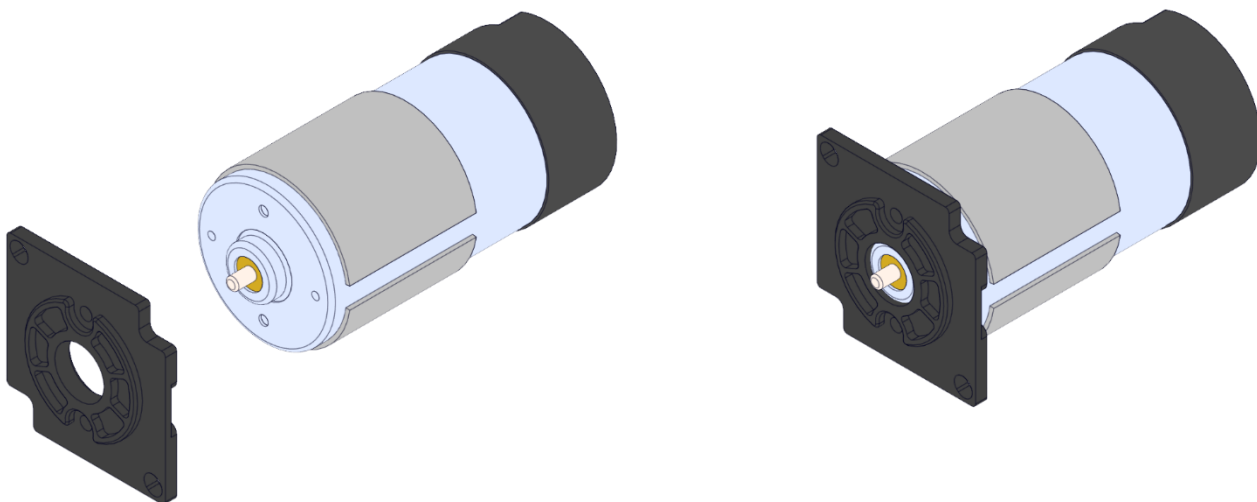
What You Will Need

Part Number	Picture	Name	QTY	Kit
N/A		9/64" Hex Key	1	N/A
N/A		Motor Mounting Screw Hex Key: M3 = 2.5mm M4 = 3mm	1	N/A
N/A		3/32" Hex Key	1	N/A
N/A		Non-CIM Motor (See Motor Compatibility Table)	1	N/A
217-2822-001 217-2822-002 217-2822-003 217-2822-004		Motor Mounting Plate	1	217-5823 217-5995 217-3564
217-2526-011 217-2625-012 217-2625-013 217-2625-014		Motor Shaft Adapter	1	217-4649 217-5941
217-4649-001		Motor Shaft Coupler	1	217-4649 217-5941
SNA1032-0125ZB		Motor Shaft Coupler Set Screw	1	217-4649 217-5941
SSA0832-0500ZB		#8-32 x 1/2" Socket Head Cap Screw	2	217-4649 217-5941
SSAM3-08MMZB SSAM4-10MMZB		Motor Mounting Screw	2	

VersaPlanetary Lite User Guide

Step 1

Mate your Motor in the appropriate Motor Mounting Plate.

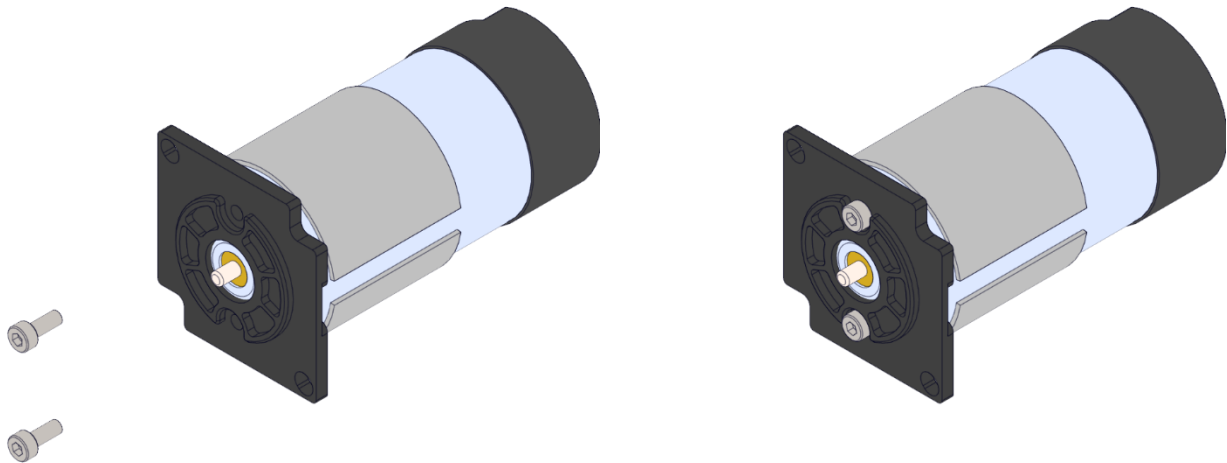


Note: The VersaPlanetary Lite comes with the RS-550 Motor Mounting Plate. Additional Motor Mounting Plates for other motors will have to be purchased separately at VEXpro.com (P/N 217-3564) .

VersaPlanetary Lite User Guide

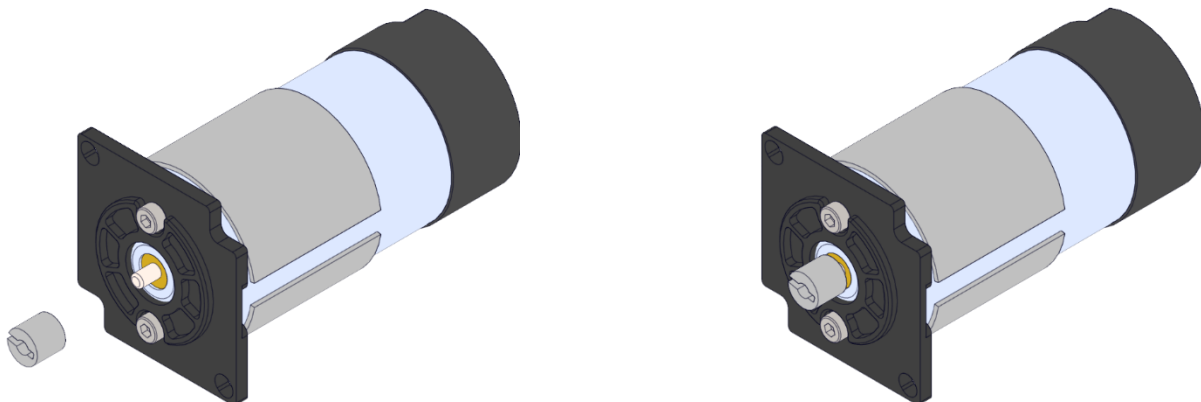
Step 2

Secure Motor to Motor Mounting Plate using the appropriate Motor Mounting Screws.



Step 3

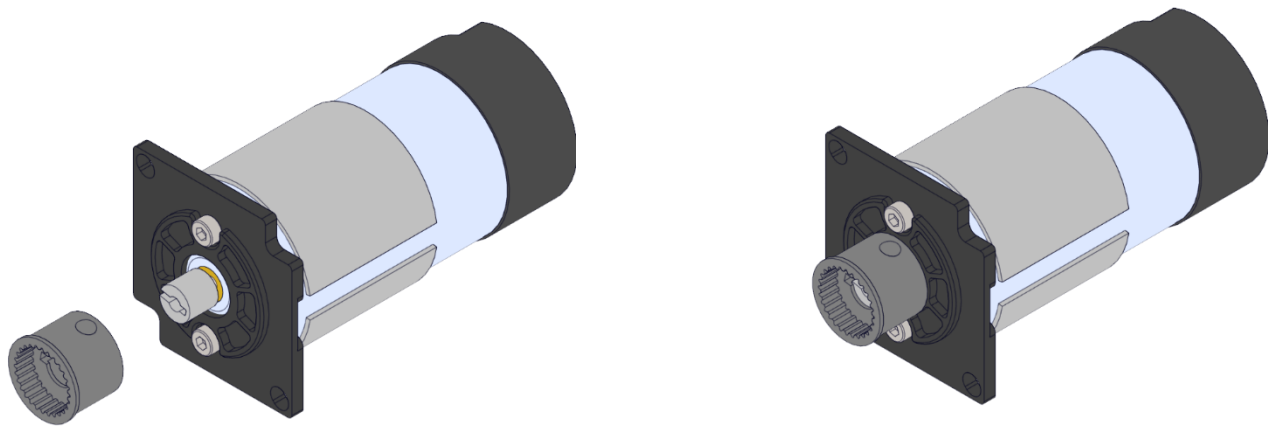
Slide the appropriate Motor Shaft Adapter on the motor shaft.



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Step 4

Slide the Motor Shaft Coupler over the Motor Shaft Adapter.



Note: Make sure the Motor Shaft Coupler and Motor Shaft Adapter are not bottoming out on the face of the motor or the Motor Mounting Plate. These should not be dragging and should spin freely.

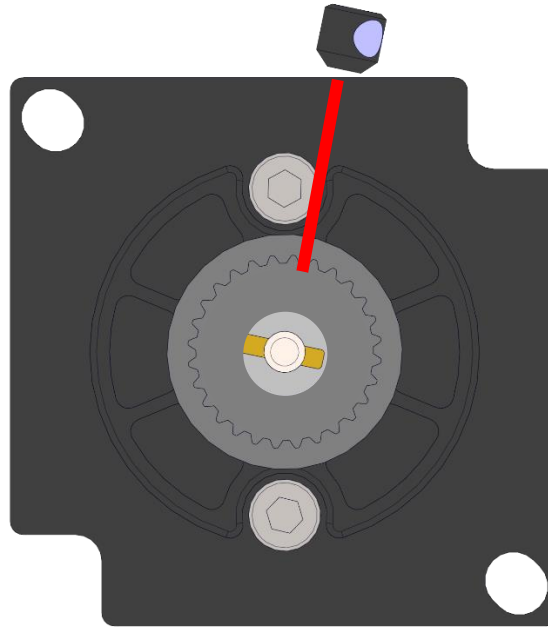
Step 5

Use #10 x 1/4" Set Screw to secure Motor Shaft Coupler & Motor Shaft Adapter to motor shaft.



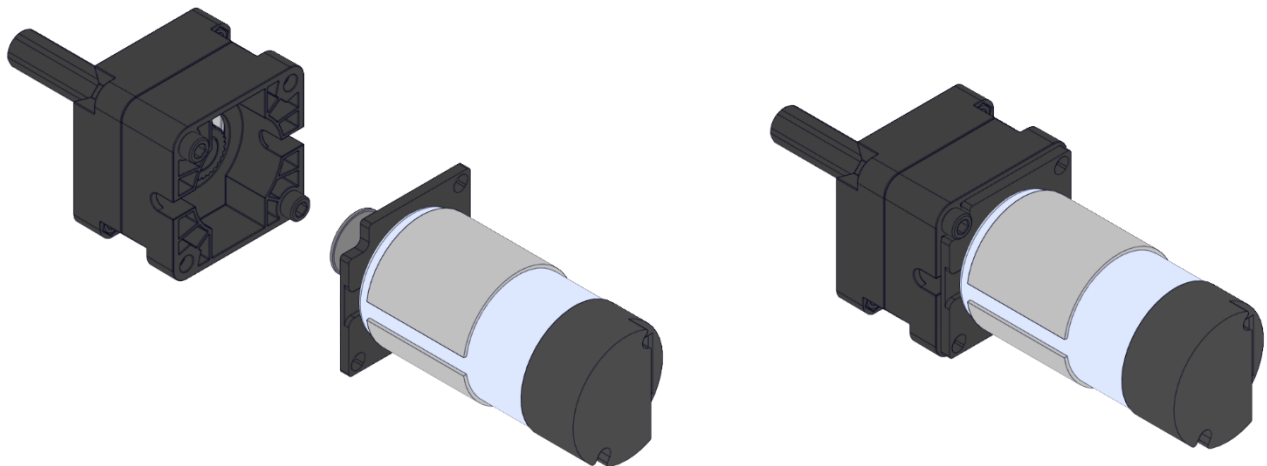
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Note: The set screw should be approximately perpendicular to the split on the Motor Shaft Adapter. If the set screw is running inline with the split, the Motor Shaft Adapter will not clamp on to the motor shaft.



Step 6

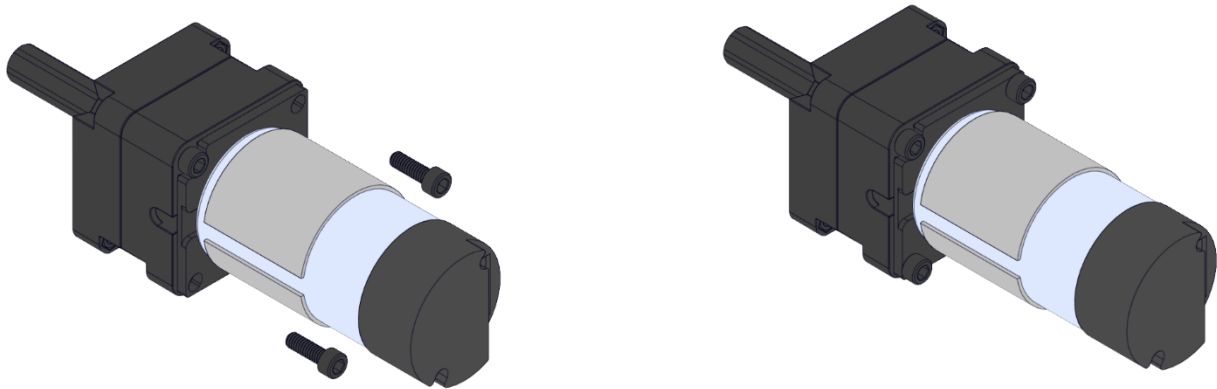
Line up Motor Mounting Plate and Motor to VersaPlanetary Assembly.



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Step 7


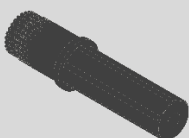
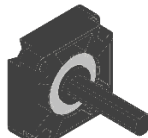
Use the (2x) #8-32 x 1/2" Socket Head Cap Screws to secure the Motor Mounting Plate to the VersaPlanetary Assembly.



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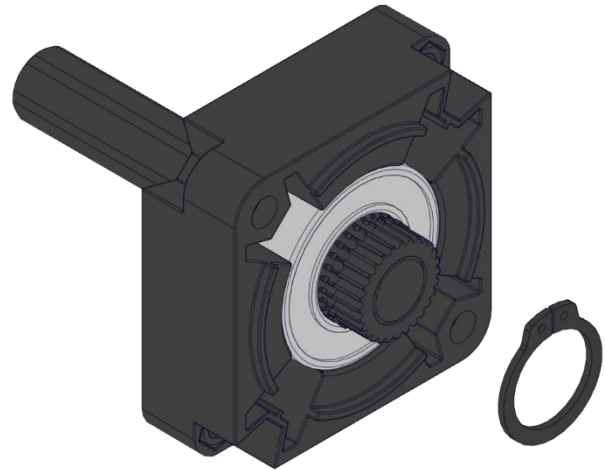
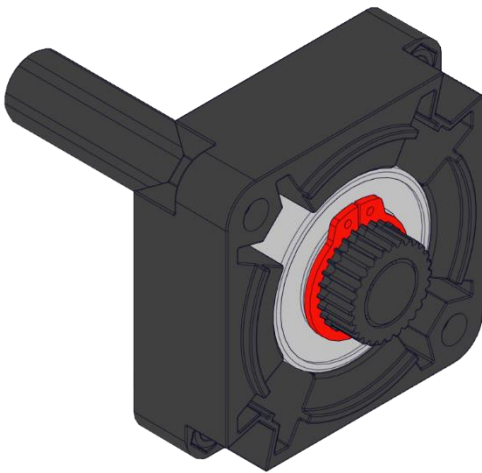
VersaPlanetary Lite Output Shaft Change

What You Will Need

Part Number	Picture	Name	QTY	Kit
-		Snap Ring Pliers	1	-
217-2625-003 217-2625-020 217-2625-021 217-2625-022 217-5839		New Output Shaft	1	217-2897 217-2895 217-2894 217-2893 217-5839
217-5823-200 217-5995-200		VersaPlanetary Lite Output Block	1	217-5823 217-5995

Step 1

Remove the snap ring from the Output Shaft in the VersaPlanetary Lite Output Block.

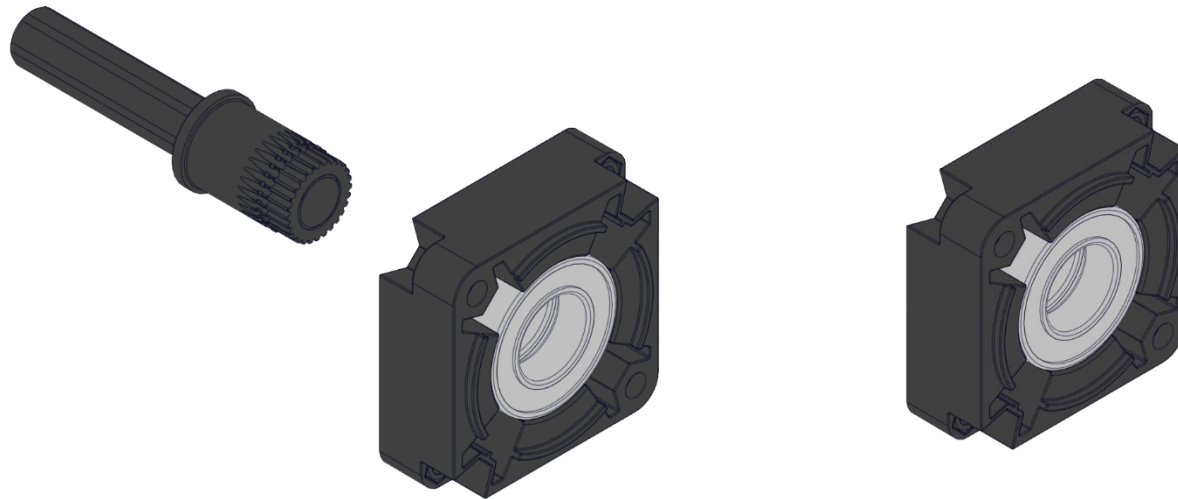


Note: Be careful not to open the snap ring too far, as it can be damaged. If you damage the snap ring, do not reuse it. Replacement snap rings can be purchased from McMaster-Carr (P/N: 98541A410).

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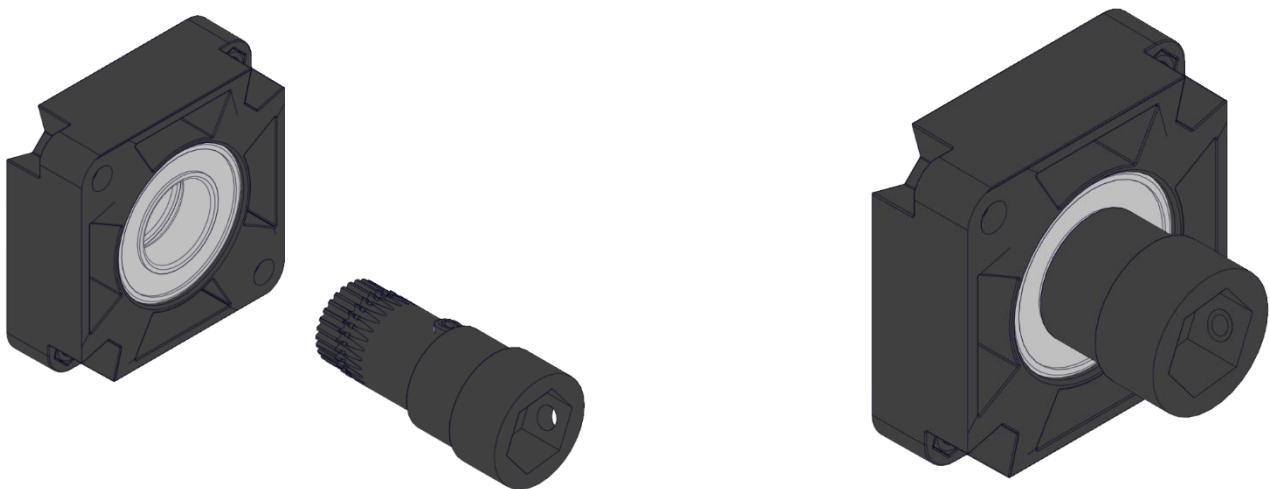
Step 2

Slide the Output Shaft out of the VersaPlanetary Lite Output Block.



Step 3

Insert the new Output Shaft in the VersaPlanetary Lite Output Block.



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Step 4



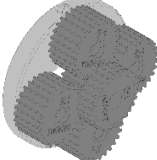

Put the snap ring you removed from Step 1 onto the new Output Shaft.



Note: Make sure the snap ring is properly seated in the snap ring groove. If it is not seated properly, the output shaft will eventually fall out. You can make sure the snap ring is properly seated by making sure the ends of the snap ring are no more than ~2.3mm apart or by trying to pull out the output shaft. When the snap ring is not seated in the groove, the shaft can be pulled out by hand.

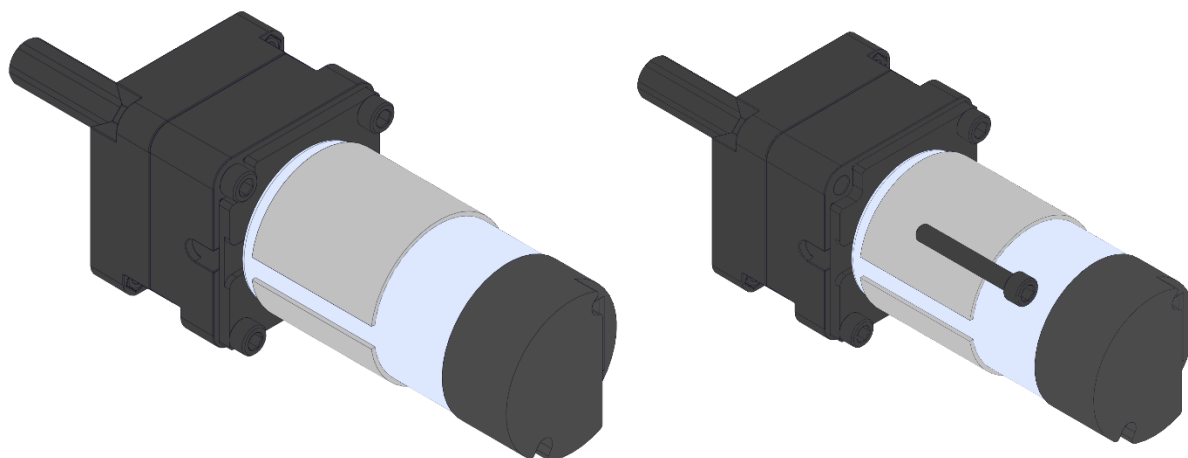
VersaPlanetary Lite Gear Set Installation

What You Will Need

Part Number	Picture	Name	QTY	Kit
N/A		9/64" Hex Key	1	N/A
217-5832-001 217-2816-001		Ring Gear	1	217-5832 217-2816
217-5823-150		VersaPlanetary Gear Set	1	217-5823 217-5995
SSA0832-1375ZB SSA0832-1875ZB		#8-32 Socket Head Cap Screws (Length Based On # of Stages) 1 Stage = 1-3/8" 2 Stage = 1-7/8"	2	217-5994

Step 1

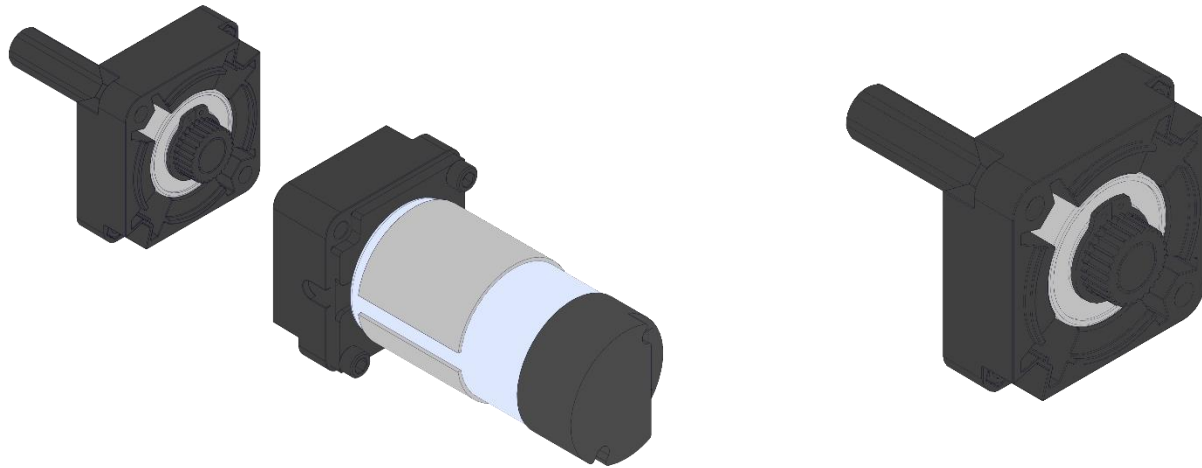
Remove the #8-32 Socket Head Cap Screws that are used for assembly.



VersaPlanetary Lite User Guide

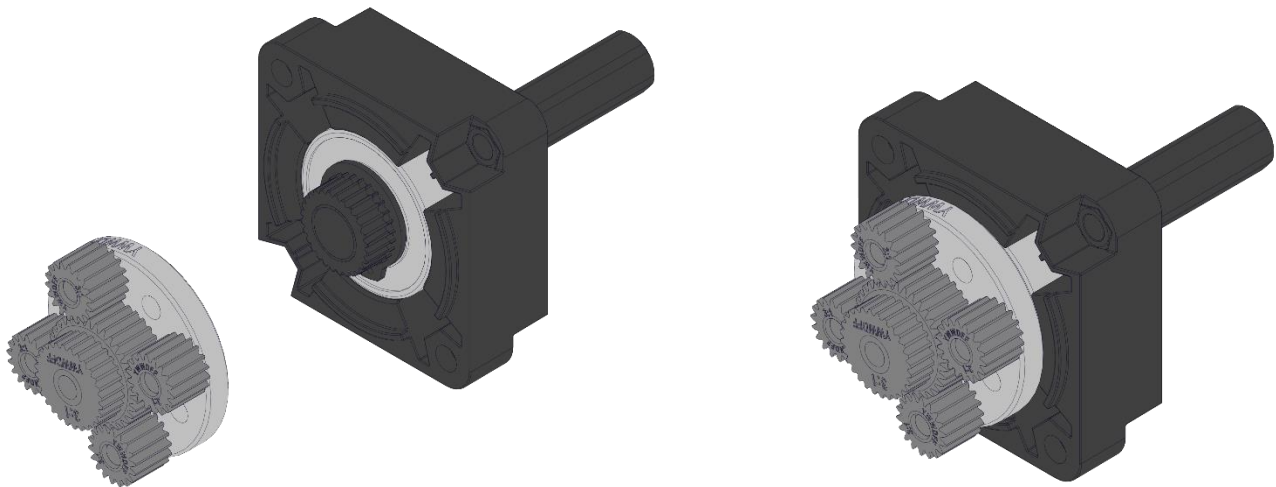
Step 2

Remove the Input Block from the Output Block.



Step 3

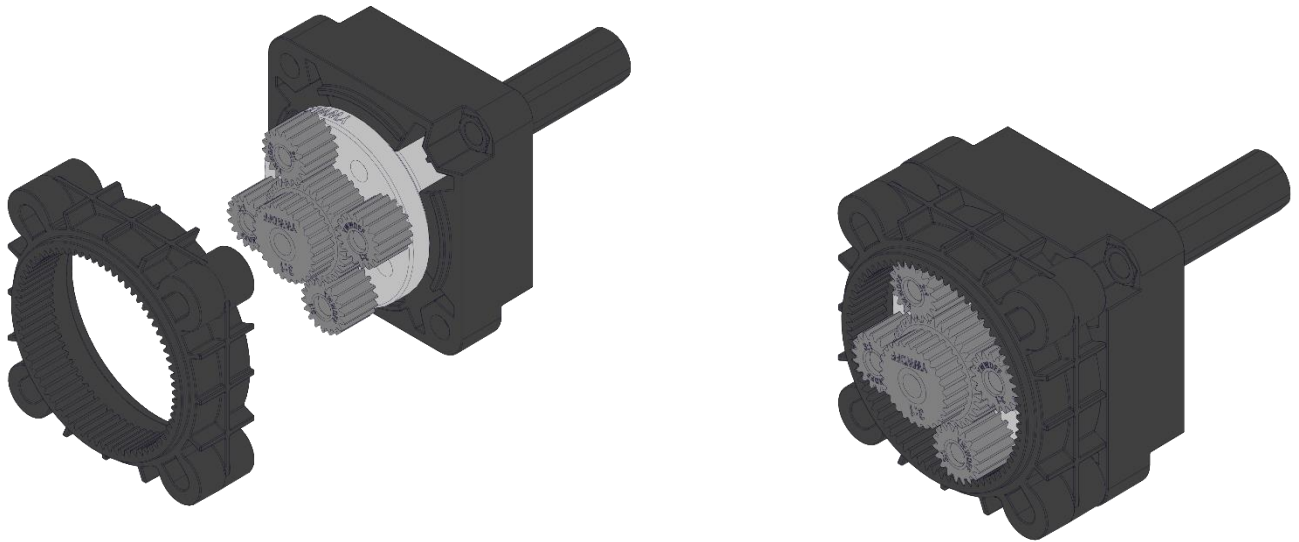
Place the VersaPlanetary Gear Set on the spline of the Output Shaft.



VersaPlanetary Lite User Guide

Step 4

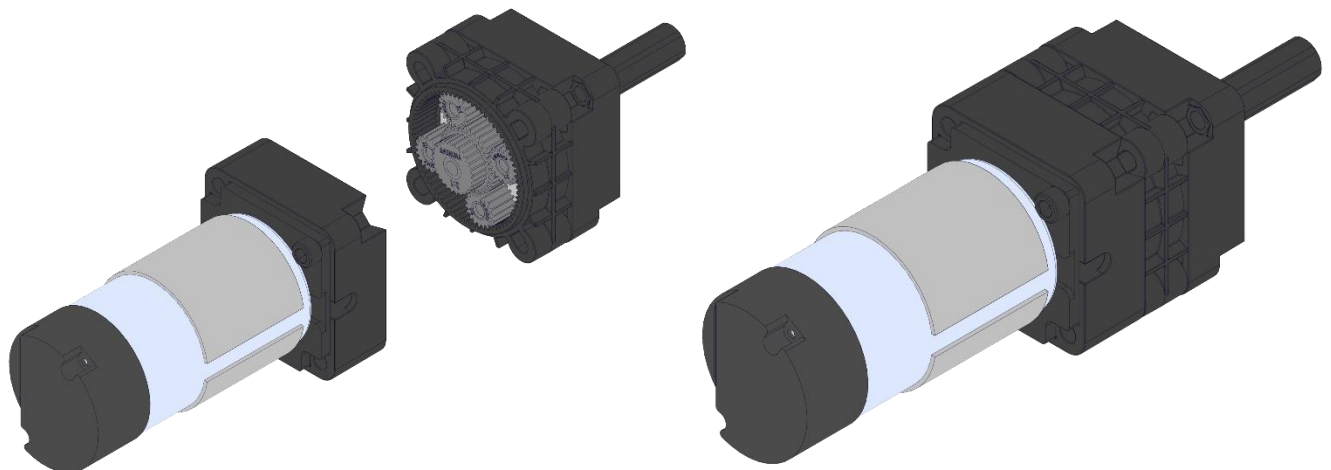
Place the Ring Gear over the Gear Set. When using a VersaPlanetary Lite Ring Gear, the orientation doesn't matter.



Note: This is a good time to lubricate your VersaPlanetary. We recommend lubricating every gear stage with White Lithium Grease (McMaster-Carr P/N 1380K35). This lubrication helps the gearbox run in and extend the life of the gear teeth. Please see our notes on lubricating your VersaPlanetary on Page 11.

Step 5

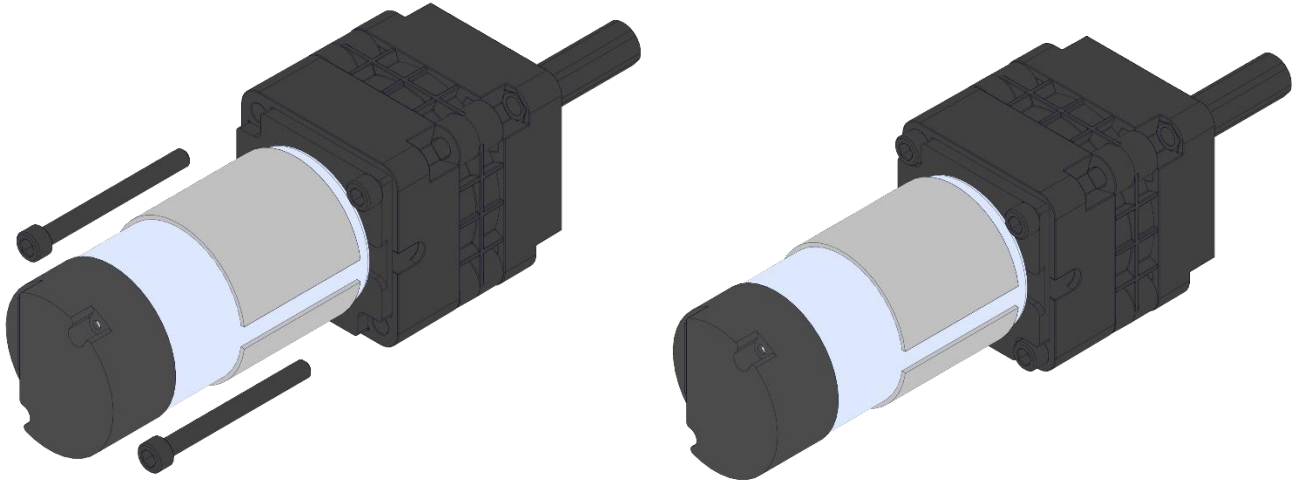
Place the Input Block into the Ring Gear.



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Step 6



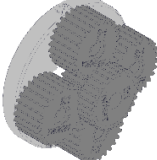

Install the new assembly screws.



Note: The length of the (2x) assembly screws will change based on the length of the VersaPlanetary. Each stage adds $1/2$ " to the length of the assembly screw. For example, if a 0 stage gear box uses $7/8$ " assembly screws, a 1 stage will use $1-3/8$ ", a 2 stage will use $1-7/8$ " and so on.

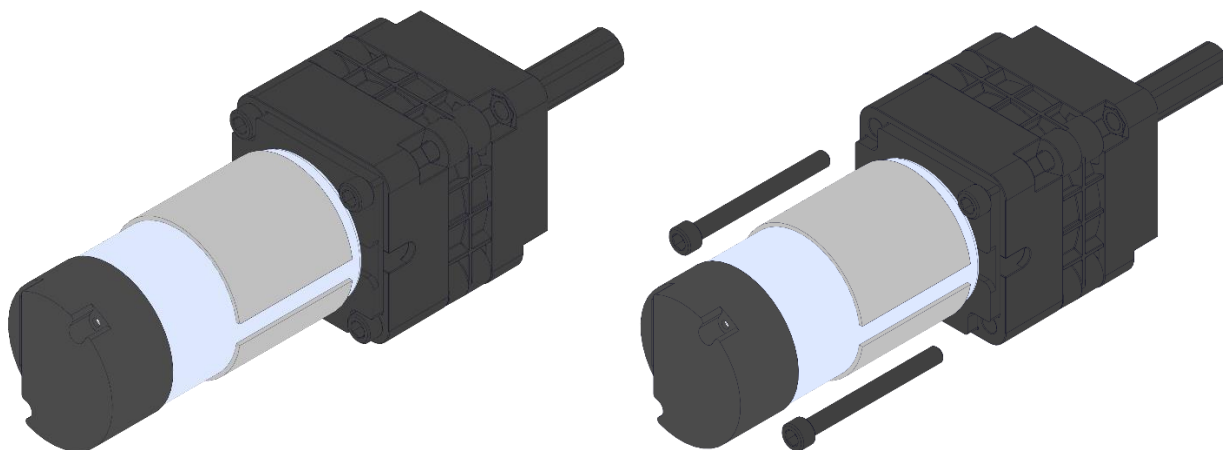
VersaPlanetary Lite Second Gear Set Installation

What You Will Need

Part Number	Picture	Name	QTY	Kit
N/A		9/64" Hex Key	1	N/A
217-5832-001 217-2816-001		Ring Gear	2	217-5832 217-2816
217-5823-150		VersaPlanetary Gear Set	2	217-5823 217-5995
SSA0832-1375ZB SSA0832-1875ZB		#8-32 Socket Head Cap Screws (Length Based On # of Stages) 1 Stage = 1-3/8" 2 Stage = 1-7/8"	2	217-5994

Step 1

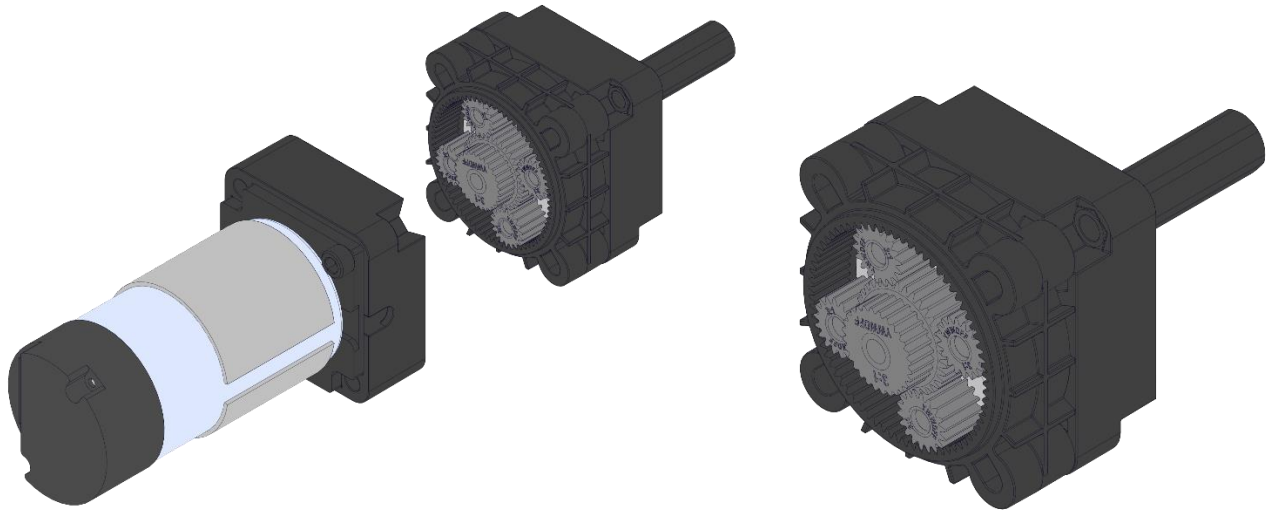
Remove the #8-32 Socket Head Cap Screws that are used for assembly.



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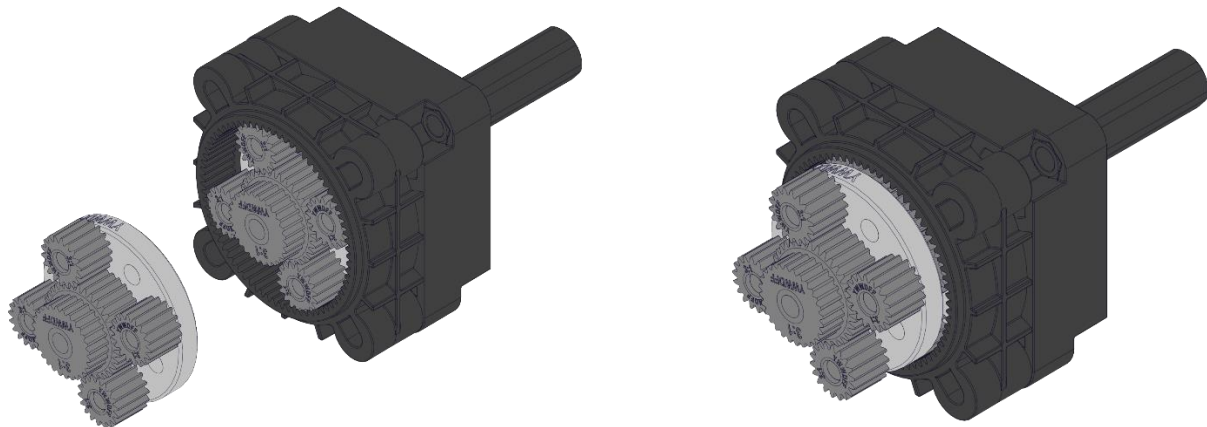
Step 2

Remove the Input Block from the Ring Gear.



Step 3

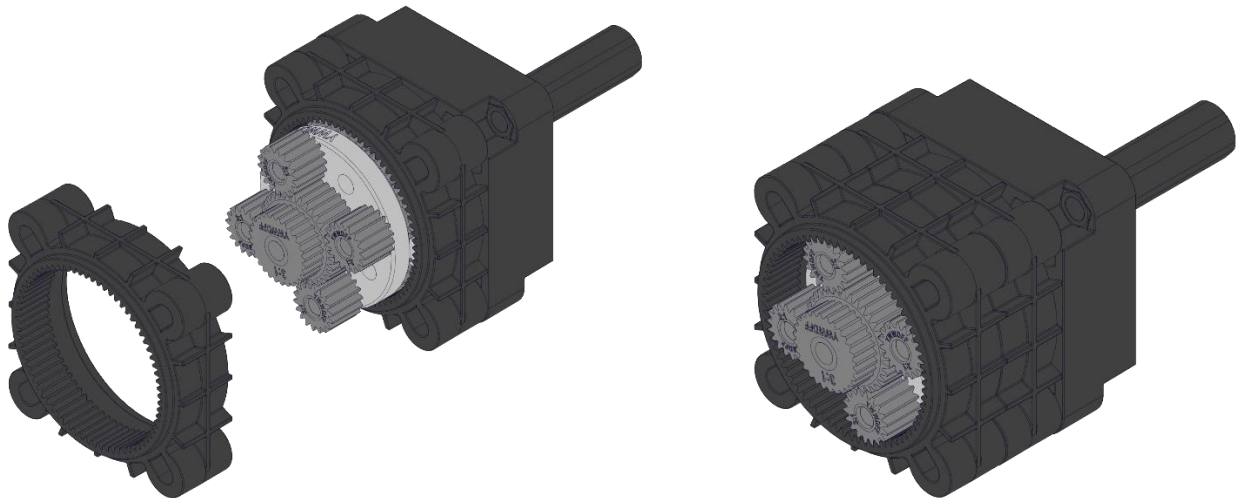
Place the VersaPlanetary Gear Set on the spline of the sun gear spline.



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Step 4

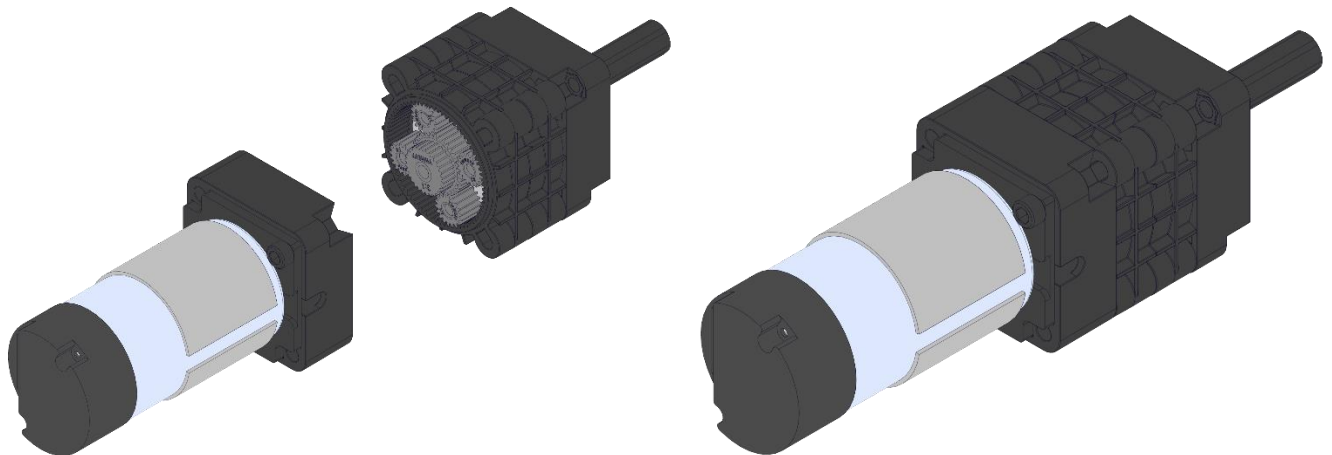
Place the Ring Gear over the new Gear Set.



Note: This is a good time to lubricate your VersaPlanetary. We recommend lubricating every gear stage with White Lithium Grease (McMaster-Carr P/N 1380K35). This lubrication helps the gearbox run in and extend the life of the gear teeth. Please see our notes on lubricating your VersaPlanetary on Page 11.

Step 5

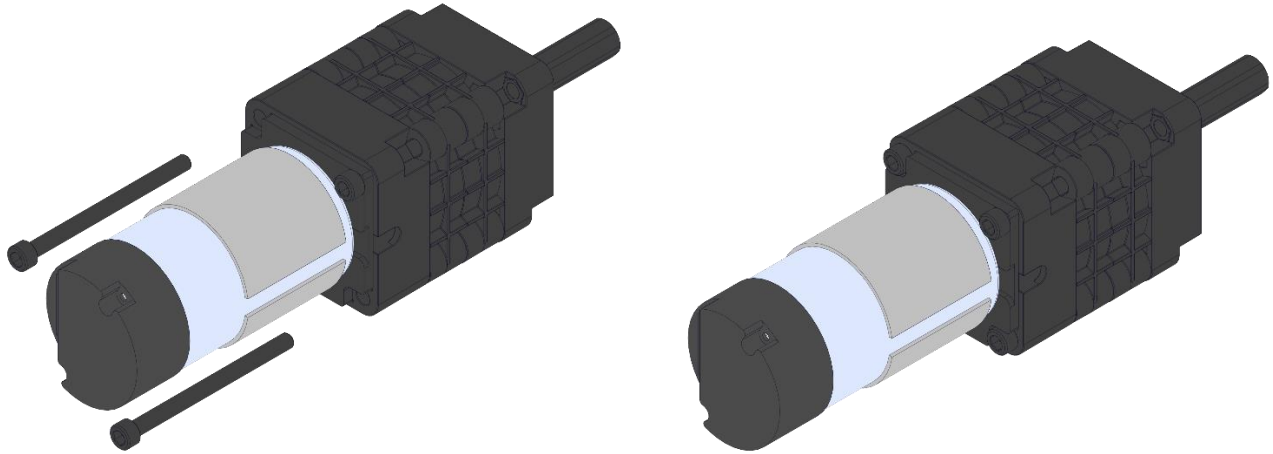
Place the Input Block into the new Ring Gear.



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Step 6

Install the new assembly screws.

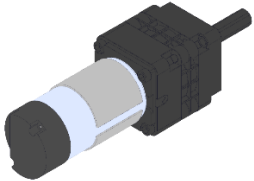


Note: The length of the (2x) assembly screws will change based on the length of the VersaPlanetary. Each stage adds $1/2$ " to the length of the assembly screw. For example, if a 0 stage gear box uses $7/8$ " assembly screws, a 1 stage will use $1-3/8$ ", a 2 stage will use $1-7/8$ " and so on.

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VersaPlanetary Lite Run In

What You Will Need

Picture	Description	Part Number
	Assembled VersaPlanetary (w/ at least 1 gear stage)	-
-	DC Power Supply or Battery (min. 6A continuous output)	-
-	Leads To Connect Battery To Power Supply / Battery	-

Note: Make sure the VersaPlanetary is lubricated prior to running in the gearbox.

Step 1

Using the leads, connect the Power Supply/Battery to the motor and VersaPlanetary assembly.

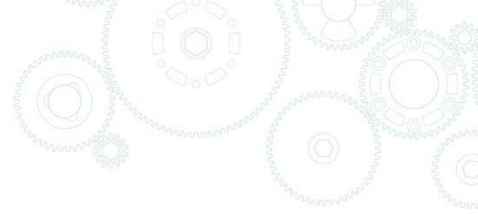
Note: If using a variable voltage Power Supply, turn the voltage down to zero before turning on.

Step 2

If using a Power Supply, turn it on.

Note: If the voltage was set to zero, gradually turn the voltage up. Do not exceed the motor's rated voltage or you may cause damage to the motor. If you are using an FRC or FTC motor, do not exceed 12 VDC.

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Step 3

Run the motor and VersaPlanetary assembly for 5-10 minutes.

Note: If you are concerned about damaging the motor's brushes, you can set the Power Supply to ~6VDC.

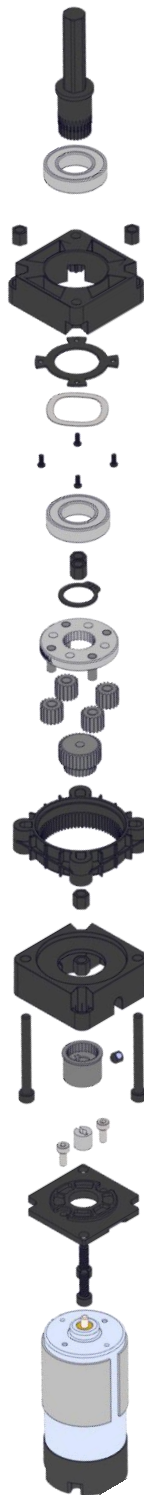
Step 4

Reverse the leads to run the motor backward. Run the motor and VersaPlanetary assembly for another 5-10 minutes.

217-5823-751

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VersaPlanetary Lite Single Stage Exploded View



217-5823-751

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Support

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