



Bill of Materials

PART NUMBER	DRIVETRAIN ASSEMBLY	QTY.
REV-41-1432	15mm extrusion - 420mm	3
REV-41-1359	M3 x 8mm Hex Cap Screw	14
REV-41-1361	M3 Nyloc Nuts	14
REV-41-1305	Plastic 90 Degree Brackets	2
REV-41-1431	15mm Extrusion - 225mm	1

LIFT ASSEMBLY	QTY.
15mm extrusion - 420mm	6
15mm Metal Bent Core Hex Motor Bracket V2	2
15mm Bearing Pillow Block	14
Through Bore Bearing - Long	10
20 Tooth #25 Sprocket	2
72 Tooth Plastic Gear	2
5mm x 90mm Hex Shaft	1
Through Bore Bearing - Short	5
125 Tooth Plastic Gear	2
Shaft Collars	16
5mm x 400mm Hex Shaft	1
15 Tooth Plastic Gear	2
Core Hex Motor	2
M3 x 16mm Hex Cap Screws	6
M3 x 8mm Hex Cap Screw	62
M3 Nyloc Nuts	64
15mm Spacer	2
#25 Roller Chain	1
15mm extrusion - 120mm (see cut list)	1
73mm long 15mm Extrusion (see cut list)	2
Plastic 90 Degree Brackets	2
Lap Corner Brackets	8
	LIFT ASSEMBLY15mm extrusion - 420mm15mm Metal Bent Core Hex Motor Bracket V215mm Bearing Pillow BlockThrough Bore Bearing - Long20 Tooth #25 Sprocket72 Tooth Plastic Gear5mm x 90mm Hex ShaftThrough Bore Bearing - Short125 Tooth Plastic GearShaft Collars5mm x 400mm Hex Shaft15 Tooth Plastic GearCore Hex MotorM3 x 16mm Hex Cap ScrewsM3 x 8mm Hex Cap ScrewsM3 x 90ker#25 Roller Chain15mm extrusion - 120mm (see cut list)73mm long 15mm Extrusion (see cut list)Plastic 90 Degree BracketsLap Corner Brackets

PART NUMBER	ULTRAPLANETARY GEARBOX ASSEMBLY	QTY
REV-41-1291	HD Hex Motor (with REV-41-1608 pinion installed)	1
REV-41-1607	550 Motor Plate	1
REV-41-1609	M3 x 8mm Button Head Screws	2
REV-41-1603	5:1 UltraPlanetary Cartridge	1
REV-41-1602	4:1 UltraPlanetary Cartridge	1
REV-41-1615	UltraPlanetary 5mm Hex Output	1
REV-41-1609	M3 x 30mm Socket Head Screws	6
REV-41-1359	M3 x 8mm Hex Cap Screw	3

		QTY
PART NUMBER	INTAKE ASSEMBLY	
	15mm extrusion - cut to 120mm (see cut list)	3
REV-41-1320	15mm Plastic Inside Corner Bracket	2
REV-41-1359	M3 x 8mm Hex Cap Screw	16
REV-41-1361	M3 Nyloc Nuts	18
REV-41-1319	15mm Plastic Servo Bracket	1
REV-41-1316	15mm Hex Pillow Block	1
REV-41-1317	15mm Bearing Pillow Block	2
REV-41-1328	Servo Shaft Adapter	1
REV-41-1097	Smart Robot Servo	1
REV-41-1360	M3 x 16mm Hex Cap Screws	2
REV-41-1327	Shaft Collars	7
REV-41-1337	90 Tooth Plastic Gear	1
REV-41-1348	5mm x 90mm Hex Shaft	1
REV-41-1334	45 Tooth Plastic Gear	1
REV-41-1353	30mm Traction Wheel	4
REV-41-1324	3mm Spacer	3
REV-41-1326	Through Bore Bearing - Short	2
REV-41-1329	Through Bore Bearing - Long 2	2
REV-41-1324	3mm Spacer	2

Bill of Materials

PART NUMBER	DRIVERAIL ASSEMBLY	QTY	PART NUMBER	DRIVERAIL ASSEMBLY	QTY
REV-41-1325	1.5mm Spacers	9	REV-41-1320	Inside Corner Bracket	2
REV-41-1338	10 Tooth Sprocket	3	REV-41-1321	Lap Corner Brackets	12
REV-41-1323	15mm Spacer	3	REV-41-1492	M3 40mm Standoff	2
	375mm long 15mm Extrusion (see cut list)	2	REV-41-1359	M3 8mm Hex Cap Screws	110
REV-41-1343	40 Tooth Sprocket	2	REV-41-1907	M3 8mm T-Slot Screw	18
REV-41-1762	408mm C Channel	4	REV-41-1361	M3 Nyloc Nuts	110
REV-41-1432	420mm long 15mm Extrusion	2	REV-41-1480	Metal 90 Degree Bracket	6
REV-41-1365	#25 Roller Chain	1	REV-41-1433	Metal Bent Core Hex Motor Bracket	2
REV-41-1267	90mm Grip Wheels	4	REV-41-1305	Plastic 90 Degree Brackets	4
REV-41-1348	90mm Long 5mm Hex Shaft.	3	REV-41-1327	Shaft Collars	8
REV-41-1190	90mm Omni Wheel	2	REV-41-1326	Short Through Bore Bearing facing left	6
REV-41-1317	Bearing Pillow Blocks	4	REV-41-1702	Tensioning Bushing	2
REV-41-1316	Hex Pillow Block	2	REV-41-1687	U Channel Endcaps	4

PART NUMBER	ELECTRONICS AND PLASTICS ASSEMBLY	QTY.
REV-41-1839	400mm x 350mm x 4mm Cor Plastic Sheet	1
REV-41-1166	battery holder plate	2
REV-41-1907	M3 X 8MM T-Slot Screw	25
REV-41-1361	M3 Nyloc Nuts	23
REV-41-1492	M3 Standoff - 40mm	3
REV-41-1359	M3 x 8mm Hex Cap Screw	4

PART NUMBER	INTAKE ON LIFT ASSEMBLY	QTY.
REV-41-1163	Surgical Tubing, 3mm	1
REV-41-1907	M3 X 8MM T-Slot Screw	2
REV-41-1161	Zip Ties, Black, 160mm 50 Pack	1
REV-41-1349	5mm x 135mm Hex Shaft	1
REV-41-1317	15mm Bearing Pillow Block	2
REV-41-1329	Through Bore Bearing - Long	2
REV-41-1327	Shaft Collars	4

Cut List

Extrusion and Hex Shaft can be cut with either a hand-held hacksaw or with a band saw. Be sure that pieces are properly secured, ideally with clamps, before cutting. Using a circular or chop saw is NOT recommended.

15mm Extrusion

Length	QTY.	ASSEMBLY
73mm	2	Lift
120mm	4	Lift & Intake
375mm	2	Structure

5mm Hex Shaft

Length	QTY.	ASSEMBLY
50mm	1	Intake
90mm	1	Intake

#25 Chain*

Length	QTY.	ASSEMBLY
56 Links	2	Drivetrain
148 Links	2	Lift

*see pages 20-25 of this guide for instructions on breaking chain



Motor Mounts (2x) - Bill of Materials

PART NUMBER	ULTRAPLANETARY GEARBOX ASSEMBLY	QTY
REV-41-1291	HD Hex Motor (with REV-41-1608 pinion installed)	1
REV-41-1607	550 Motor Plate	1
REV-41-1609	M3 x 8mm Button Head Screws	2
REV-41-1603	5:1 UltraPlanetary Cartridge	1
REV-41-1602	4:1 UltraPlanetary Cartridge	1
REV-41-1615	UltraPlanetary 5mm Hex Output	1
REV-41-1609	M3 x 30mm Socket Head Screws	6
REV-41-1359	M3 x 8mm Hex Cap Screw	3







- 1 HD Hex Motor with UltraPlanetary Pinion installed
- 1 550 Motor Plate

Take the UltraPlanetary Mounting Plate and press it against the HD Hex motor with pinion.



Get:

• 2 - M3 x 8mm Button Head Screws

Take the two M3 x 8mm Button head screws and insert them into the mounting plate. Tighten the mounting plate to the motor.





• 1 - 5:1 UltraPlanetary Cartridge

Take the 5:1 Cartridge and place it onto the input pinon.

Note: Placing a finger on the output of the Cartridge helps for placement.



Get:

• 1 - 4:1 UltraPlanetary Cartridge

Repeat the above step with the 4:1 Cartridge and place it onto the output of the 5:1 cartridge.

Note: Placing a finger on the output of the Cartridge helps for placement.





• 1 - UltraPlanetary 5mm Hex Output

Take the Output Cartridge and place it onto the output of the 4:1 Cartridge. Placing a finger on the output of the Cartridge helps for placement.



Get:

• 6 - M3 x 30mm Socket Head Screws

Take 6 of the M3 x 30mm screws and insert them into the outer recessed ring of the UltraPlanetary Gearbox.





UltraPlanetary Gearbox assembly is complete and ready for mounting and shaft selection.

Note: If using a 5mm Hex Shaft an M3 Set Screw is needed to secure the hex shaft in the output.



Get:

- 1 UltraPlanetary Outside Mounting Bracket
- 3 8mm Hex Cap Screws

Attach the UltraPlanetary Outside Mounting Bracket to the UltraPlanetary Gearbox using 3, 8mm Hex Cap Screws in a triangular pattern. The bracket should be oriented so that the bump is facing the motor.



Drive Rail Assemblies - Bill of Materials

PART NUMBER	DRIVERAIL ASSEMBLY	QTY	PART NUMBER	DRIVERAIL ASSEMBLY	QTY
REV-41-1325	1.5mm Spacers	9	REV-41-1320	Inside Corner Bracket	2
REV-41-1338	10 Tooth Sprocket	3	REV-41-1321	Lap Corner Brackets	12
REV-41-1323	15mm Spacer	3	REV-41-1492	M3 40mm Standoff	2
	375mm long 15mm Extrusion (see cut list)	2	REV-41-1359	M3 8mm Hex Cap Screws	110
REV-41-1343	40 Tooth Sprocket	2	REV-41-1907	M3 8mm T-Slot Screw	18
REV-41-1762	408mm C Channel	4	REV-41-1361	M3 Nyloc Nuts	110
REV-41-1432	420mm long 15mm Extrusion	2	REV-41-1480	Metal 90 Degree Bracket	6
REV-41-1365	#25 Roller Chain	1	REV-41-1433	Metal Bent Core Hex Motor Bracket	2
REV-41-1267	90mm Grip Wheels	4	REV-41-1305	Plastic 90 Degree Brackets	4
REV-41-1348	90mm Long 5mm Hex Shaft.	3	REV-41-1327	Shaft Collars	8
REV-41-1190	90mm Omni Wheel	2	REV-41-1326	Short Through Bore Bearing facing left	6
REV-41-1317	Bearing Pillow Blocks	4	REV-41-1702	Tensioning Bushing	2
REV-41-1316	Hex Pillow Block	2	REV-41-1687	U Channel Endcaps	4







Slide the following on to a 90mm Long 5mm Hex Shaft. Make two of Shaft Assembly A.

- Short Through Bore Bearing facing left
- 10 Tooth Sprocket
- 15mm Spacer
- Short Through Bore Bearing facing right
- 3 x 1.5mm Spacers

Note: Store this carefully as there is nothing retaining the components on the shaft

Slide the following on to a 90mm Long 5mm Hex Shaft. Make two of Shaft Assembly B.

- Short Through Bore Bearing facing left
- 10 Tooth Sprocket
- 3 x 1.5mm Spacers
- Shaft Collar
- Short Through Bore Bearing facing right
- 3 x 1.5mm Spacers

Note: Store this carefully as there is nothing retaining the components on the shaft





Slide the following on to a 90mm Long 5mm Hex Shaft. Make two of Shaft Assembly C.

- Short Through Bore Bearing facing left
- 15mm Spacer
- 2 x 3mm Spacers
- 15mm Spacer
- Short Through Bore Bearing facing right
- 3mm Spacer

Note: Store this carefully as there is nothing retaining the components on the shaft



Get:

- 1 408mm C Channel
- 4 M3 x 8mm Hex Cap Screws
- 4 M3 Nyloc Nuts

Fasten Motor Mount assembly with 4 M3 x 8mm long Hex Cap Screws. The output of the UltraPlanetary Gearbox will line up with the 13th large (9mm) hole from the end of the C Channel.





- 3 Lap Corner Brackets
- 6 M3 x 8mm Hex Cap Screws
- 6 M3 Nyloc Nuts

Attach 3 lap corner brackets as shown to the top side of the C Channel. Use 2 Screws and 2 Nuts for each bracket. Be prepared to loosen and adjust lap corner brackets in later steps.



Get:

- 2 Plastic 90 Degree Brackets
- 10 M3 x 8mm Hex Cap Screws
- 10 M3 Nyloc Nuts

Fully preload two Plastic 90 Degree Brackets with 8mm Hex Cap Screws and Nyloc Nuts. Then fasten the brackets to the top and bottom rails of the C Channel as shown in the image.





- 1 420mm long 15mm Extrusion
- 2 M3 x 8mm Hex Cap Screws
- 2 M3 Nyloc Nuts

Fasten the Extrusion to the front Lap Bracket and the C Channel with 2 Hex Cap screws and Nuts. The extrusion should be centered between the first two large (9mm) holes in the C Channel.



Get:

- 2 Bearing Pillow Blocks
- 4 M3 x 8mm Hex Cap Screws
- 4 M3 Nyloc Nuts

Fasten two Bearing pillow blocks to the end of the 420mm extrusion using 4 M3 8mm Hex Cap Screws and Nyloc Nuts.





- 1 40 Tooth Sprocket
- 3 M3 8mm Hex Cap Screws
- 3 M3 Nyloc Nuts

Fasten a 40T sprocket to the top of the 15mm Extrusion using 3 M3 8mm Hex Cap Screws and Nyloc Nuts.



Get:

- 1 408mm C Channel
- 3 Lap Corner Brackets
- 1 Inside Corner Bracket
- 10 M3 8mm Hex Cap Screws
- 10 M3 Nyloc Nuts

Attach the Brackets to the top of the C Channel as shown using Hex Cap Screws and Nyloc Nuts.





- 1 Metal 90 Degree Bracket
- 4 M3 8mm Hex Cap Screws
- 4 M3 Nyloc Nuts

Attach the 90 Degree Bracket to the C Channel as shown with 2 Screws and Nuts. Then pre-load the top two holes of the 90 Degree Bracket with 2 hex cap screws and nyloc nuts.



Get:

• 1 - 375mm long 15mm Extrusion

Fasten a piece of 375mm long 15mm extrusion to the 3 brackets in the front of this assembly.





- 1 Metal Bent Core Hex Motor Bracket
- 2 M3 8mm Hex Cap Screws
- 2 M3 Nyloc Nuts

Attach motor mounting bracket to the 375mm extrusion using 2 Hex Cap Screws and Nyloc Nuts.



Get:

- 1 Hex Pillow Block
- 2 M3 8mm Hex Cap Screws
- 2 M3 Nyloc Nuts

Attach Hex Pillow Block to the 375mm extrusion using 2 Hex Cap Screws and Nyloc Nuts.





- 2 Metal 90 Degree Bracket
- 8 M3 8mm Hex Cap Screws
- 8 M3 Nyloc Nuts

Pre-load 4 Hex Cap Screws and Nyloc Nuts each into 2 Metal 90 Degree Brackets and fasten them to the back of the C Channel facing outward.



Get:

- Shaft Assemblies A, B, and C from earlier
- 2 Shaft Collars

Place Shaft Assemblies A, B, and C in the C Channel. Retain Shaft assembly A and C with Shaft Collars on the opposite side of the C Channel.





- 1 M3 40mm Standoff
- 1 M3 8mm T-Slot Screw

Attach 40mm Standoff to the C Channel with a T-Slot Screw as shown in the image.



Get:

- 1 Tensioning Bushing
- #25 Chain and Chain Tool

Slide the Tensioning Bushing on to the Standoff.

Make a 56 link chain loop using #25 Chain and the Chain Tool.



19

Breaking and Reforming Chain

Basics of Chain

This drivetrain uses sprockets and chain to transmit motion from the UltraPlanetary Gearbox and Drive Shaft to the rest of the drivetrain. The figure below shows the major components of chain.



Outside Links consist of two outside plates which are connected by two *pins* that are pressed into each plate. The *pins* in the outside link go through the inside of the hollow *bushings* when the inner and outer links are assembled. The *pins* can freely spin on the inside of the *bushings*.

Inside Link consist of two inside plates that are connected by two hollow *bushings* which are pressed into each plate. The teeth of the sprocket contact the surface of the *bushings* when the chain is wrapped around a sprocket.

Pitch is the distance between the centers of two adjacent *pins*. The REV 15mm Build System uses #25 (0.25") chain.



Introduction to the Chain Tool

This custom-designed tool allows users to easily break and re-assemble #25 chain. The mandrel is used to push out the chain pin. If using master links, the pin can be completely removed, but the depth guide screw allows the option of partially pressing out the pin and then re-assembling without master links.



For more information on the #25 Chain Tool, see the Chain Tool product page for the User's Manual and How To video.



Creating the Chain Loops

For this drivetrain, four chain loops that are 56 links long are needed. When counting chain length, count the number of bushings to get the correct length. To successfully reform chain, the total count of bushings must be an even number with one inner link and one outer link exposed. This allows the chain tool to press the pin back into the bushing, through an inner and outer link, reconnecting the chain. Below are the steps to use the #25 Chain Tool to reset the pin into the chain. If you would like to use master links see the #25 Chain Tool User's Manual for more information.

For these steps you will need the #25 Chain Tool and #25 Chain.



Unscrew the Pin Screw and Compression Screw such that they are flush with the chain channel.

Ensure the Cup Point Set Screw is fully engaged in the Chain Tool.





Insert #25 chain into the chain channel and align the desired link between the two vertical pins in the channel.

Note: Count 56 bushings from an exposed inner link.



Next secure the chain in place with the compression screw. Tighten until the chain cannot shift within the channel.

Note: Be **careful** to not overly push the pin out in the next step it will be impossible to put it back in, and a master link will be needed. As result of manufacturing tolerances, the cup point set crew may not be close enough to use as a hard stop for the pin.





Screw the Pin Screw down until the pin almost touches the Cup Point Set Screw. The user should stop pushing the pin out before it leaves the back plate the outer link. Considerable pressure will be felt before the pin comes all the way out. Removing the chain from the tool to check if the pin is fully unseated from the bushing is recommended.



Put the Inner Link bushing into the Outer Link. Align the Pin in the Compression Screw hole.





Turn the Compression Screw until the Pin is fully seated back into the chain channel.

56 Link Chain Assembly Complete

Repeat these steps starting on page 21 until you have four 56 Link Chain Assemblies.









• 1 - 56 Link #25 Chain Loop

Place #25 Chain loop on the sprockets making sure to have both sides of the loop above the Tensioning Bushing. Once placed, your chain should look like the image.



Get:

- 2 U Channel Endcaps
- 4 M3 8mm T-Slot Screws

Secure U Channel Endcaps to the end of your C Channel with 2 T-Slot Screws on each end.





- Outer C Channel Assembly
- 4 M3 8mm T-Slot Screws

Attach outer C Channel Assembly to the Drive Rail with 2 T-Slot Screws in each U Channel Endcap.



Get:

- 2 90mm Grip Wheels
- 1 90mm Omni Wheel

Slide wheels onto the 5mm Hex axles. The 90mm Grip wheels should be attached to the axles driven by chain.





• 3 - Shaft Collars

Secure each wheel on its 5mm Hex Axle with a Shaft Collar.



Get:

- 1 408mm C Channel
- 4 M3 x 8mm Hex Cap Screws
- 4 M3 Nyloc Nuts

Fasten Motor Mount assembly with 4 M3 x 8mm long Hex Cap Screws. The output of the UltraPlanetary Gearbox will line up with the 13th large (9mm) hole from the end of the C Channel.



28



- 3 Lap Corner Brackets
- 6 M3 x 8mm Hex Cap Screws
- 6 M3 Nyloc Nuts

Attach 3 lap corner brackets as shown to the top side of the C Channel. Use 2 Screws and 2 Nuts for each bracket. Be prepared to loosen and adjust lap corner brackets in later steps.



Get:

- 2 Plastic 90 Degree Brackets
- 10 M3 x 8mm Hex Cap Screws
- 10 M3 Nyloc Nuts

Fully preload two Plastic 90 Degree Brackets with 8mm Hex Cap Screws and Nyloc Nuts. Then fasten the brackets to the top and bottom rails of the C Channel as shown in the image.





- 1 420mm long 15mm Extrusion
- 2 M3 x 8mm Hex Cap Screws
- 2 M3 Nyloc Nuts

Fasten the Extrusion to the front Lap Bracket and the C Channel with 2 Hex Cap screws and Nuts. The extrusion should be centered between the first two large (9mm) holes in the C Channel.



Get:

- 2 Bearing Pillow Blocks
- 4 M3 x 8mm Hex Cap Screws
- 4 M3 Nyloc Nuts

Fasten two Bearing pillow blocks to the end of the 420mm extrusion using 4 M3 8mm Hex Cap Screws and Nyloc Nuts.





- 1 40 Tooth Sprocket
- 3 M3 8mm Hex Cap Screws
- 3 M3 Nyloc Nuts

Fasten a 40T sprocket to the top of the 15mm Extrusion using 3 M3 8mm Hex Cap Screws and Nyloc Nuts.



Get:

- 1 408mm C Channel
- 3 Lap Corner Brackets
- 1 Inside Corner Bracket
- 10 M3 8mm Hex Cap Screws
- 10 M3 Nyloc Nuts

Attach the Brackets to the top of the C Channel as shown using Hex Cap Screws and Nyloc Nuts.





- 1 Metal 90 Degree Bracket
- 4 M3 8mm Hex Cap Screws
- 4 M3 Nyloc Nuts

Attach the 90 Degree Bracket to the C Channel as shown with 2 Screws and Nuts. Then pre-load the top two holes of the 90 Degree Bracket with 2 hex cap screws and nyloc nuts.



Get:

• 1 - 375mm long 15mm Extrusion

Fasten a piece of 375mm long 15mm extrusion to the 3 brackets in the front of this assembly.





- 1 Metal Bent Core Hex Motor Bracket
- 2 M3 8mm Hex Cap Screws
- 2 M3 Nyloc Nuts

Attach motor mounting bracket to the 375mm extrusion using 2 Hex Cap Screws and Nyloc Nuts.



Get:

- 1 Hex Pillow Block
- 2 M3 8mm Hex Cap Screws
- 2 M3 Nyloc Nuts

Attach Hex Pillow Block to the 375mm extrusion using 2 Hex Cap Screws and Nyloc Nuts.





- 2 Metal 90 Degree Bracket
- 8 M3 8mm Hex Cap Screws
- 8 M3 Nyloc Nuts

Pre-load 4 Hex Cap Screws and Nyloc Nuts each into 2 Metal 90 Degree Brackets and fasten them to the back of the C Channel facing outward.



Get:

- Shaft Assemblies A, B, and C from earlier
- 2 Shaft Collars

Place Shaft Assemblies A, B, and C in the C Channel. Retain Shaft assembly A and C with Shaft Collars on the opposite side of the C Channel.





- 1 M3 40mm Standoff
- 1 M3 8mm T-Slot Screw

Attach 40mm Standoff to the C Channel with a T-Slot Screw as shown in the image.



Get:

- 1 Tensioning Bushing
- #25 Chain and Chain Tool

Slide the Tensioning Bushing on to the Standoff.

Make a 56 link chain loop using #25 Chain and the Chain Tool.





• 1 - 56 Link #25 Chain Loop

Place #25 Chain loop on the sprockets making sure to have both sides of the loop above the Tensioning Bushing. Once placed, your chain should look like the image.

Get:

- 2 U Channel Endcaps
- 4 M3 8mm T-Slot Screws

Secure U Channel Endcaps to the end of your C Channel with 2 T-Slot Screws on each end.





- Outer C Channel Assembly
- 4 M3 8mm T-Slot Screws

Attach outer C Channel Assembly to the Drive Rail with 2 T-Slot Screws in each U Channel Endcap.



Get:

- 2 90mm Grip Wheels
- 1 90mm Omni Wheel

Slide wheels onto the 5mm Hex axles. The 90mm Grip wheels should be attached to the axles driven by chain.





• 3 - Shaft Collars

Secure each wheel on its 5mm Hex Axle with a Shaft Collar.

Intentionally Left Blank



Drivetrain Assembly- Bill of Materials

PART NUMBER	DRIVETRAIN ASSEMBLY	QTY.
REV-41-1432	15mm extrusion - 420mm	3
REV-41-1359	M3 x 8mm Hex Cap Screw	14
REV-41-1361	M3 Nyloc Nuts	14
REV-41-1305	Plastic 90 Degree Brackets	2
REV-41-1431	15mm Extrusion - 225mm	1







- 1 420mm Long 15mm Extrusion
- 2 Inside Corner Brackets
- 8 M3 8mm Hex Cap Screws
- 8 M3 Nyloc Nuts

Slide two Inside Corner Brackets pre-loaded with 4 Hex Cap Screws and Nyloc Nuts each. Temporarily fasten them to the center.



Get:

- 2 420mm Long 15mm Extrusion
- 1 Drive Rail Assembly

Slide the Extrusion into the open brackets on the Drive Rail as shown. The Extrusion with 2 Inside Corner Brackets should be on the top pair of 90 Degree Brackets. Then, Secure the Drive Rail.





• 1 - Drive Rail Assembly

Slide 2nd Drive Rail onto the 3 pieces of 15mm Extrusion and secure.



- 1 225mm long 15mm Extrusion
- 2 Plastic 90 Degree Brackets
- 6 M3 8mm Hex Cap Screws
- 6 M3 Nyloc Nuts

Attach two Plastic 90 Degree Brackets to the top of the Extrusion. Secure with 3 M3 Hex Cap Screws and Nyloc Nuts on





Place the assembly from the previous step into the 2 Inside Corner Brackets on the back of the Drivetrain. Secure using the Nyloc Nuts.

Intentionally Left Blank



Lift Assembly- Bill of Materials

PART NUMBER	LIFT ASSEMBLY	QTY
REV-41-1432	15mm extrusion - 420mm	6
REV-41-1433	15mm Metal Bent Core Hex Motor Bracket V2	2
REV-41-1317	15mm Bearing Pillow Block	14
REV-41-1329	Through Bore Bearing - Long	10
REV-41-1340	20 Tooth #25 Sprocket	2
REV-41-1336	72 Tooth Plastic Gear	2
REV-41-1348	5mm x 90mm Hex Shaft	1
REV-41-1326	Through Bore Bearing - Short	5
REV-41-1333	125 Tooth Plastic Gear	2
REV-41-1327	Shaft Collars	16
REV-41-1362	5mm x 400mm Hex Shaft	1
REV-41-1331	15 Tooth Plastic Gear	2
REV-41-1300	Core Hex Motor	2
REV-41-1360	M3 x 16mm Hex Cap Screws	6
REV-41-1359	M3 x 8mm Hex Cap Screw	62
REV-41-1361	M3 Nyloc Nuts	64
REV-41-1323	15mm Spacer	2
REV-41-1365	#25 Roller Chain	1
	15mm extrusion - 120mm (see cut list)	1
	73mm long 15mm Extrusion (see cut list)	2
REV-41-1305	Plastic 90 Degree Brackets	2
REV-41-1321	Lap Corner Brackets	8







- 4 420mm long 15mm Extrusion
- 8 Bearing Pillow Blocks
- 16 M3 x 8mm Hex Cap Screws
- 16 M3 Nyloc Nuts

Fasten a Bearing Pillow Block to each end of the 15mm Extrusion using the M3 Hardware. One should be positioned on the top and the other on the bottom.

Get:

- 8 Lap Corner Brackets
- 16 M3 x 8mm Hex Cap Screws
- 16 M3 Nyloc Nuts

Attach 2, pre-loaded Lap Corner Brackets facing each other to each piece of 15mm Extrusion using the M3 Screws and Nuts. Set 2 pieces aside at this point for steps on page 50 and 51.





- 1 125 Tooth Gears
- 3 M3 x 16mm Hex Cap Screws
- 3 M3 Nyloc Nuts

Attach a 125 Tooth gear to 1 of the 4 pieces of Extrusion from page 44 using 3 sets of M3 Hardware. Use the closer image as a guide for which holes to attach to.



Get:

- 1 125 Tooth Gears
- 3 M3 x 16mm Hex Cap Screws
- 3 M3 Nyloc Nuts

Attach a 125 Tooth gear to the final piece of Extrusion from page 44 using 3 sets of M3 Hardware. Use the closer image as a guide for which holes to attach to.





- 1 420mm long 15mm Extrusion
- 2 Bearing Pillow Blocks
- 4 M3 x 8mm Hex Cap Screws
- 4 M3 Nyloc Nuts

Fasten a Bearing Pillow Block to each end of the 15mm Extrusion using the M3 Hardware. One should be positioned on the top and the other on the bottom.

Get:

- 1 72 Tooth Gear
- 2 M3 x 8mm Hex Cap Screws
- 2 M3 Nyloc Nuts

Attach a 72 Tooth Gear to the left side of the Extrusion, in line with the Bearing Pillow Block using 2 sets of M3 hardware.





- 1 420mm long 15mm Extrusion
- 2 Bearing Pillow Blocks
- 4 M3 x 8mm Hex Cap Screws
- 4 M3 Nyloc Nuts

Fasten a Bearing Pillow Block to each end of the 15mm Extrusion using the M3 Hardware. One should be positioned on the top and the other on the bottom.



Get:

- 1 72 Tooth Gear
- 2 M3 x 8mm Hex Cap Screws
- 2 M3 Nyloc Nuts

Attach a 72 Tooth Gear to the right side of the Extrusion in line with the Bearing Pillow Block using 2 sets of M3 hardware.



- 1 Metal Bent Core Hex Motor Bracket
- 2 M3 8mm Hex Cap Screws

Attach a Bent Core Hex Motor Bracket to the right side of a Core Hex Motor using 2 Hex Cap Screws.

Pre-load the Motor Bracket with 2 - M3 8mm Hex Cap Screws and Nyloc Nuts. Then, slide the following on to a the Motor's Hex Shaft.

- Shaft Collar
- Short Through Bore Bearing
- Bearing Pillow Block (pre-loaded with 2 M3 8mm Hex Cap Screws and Nyloc Nuts)
- Long Through Bore Bearing
- Shaft Collars x 2 with a space between them
- 15 Tooth Gear
- Shaft Collar





- 1 Metal Bent Core Hex Motor Bracket
- 2 M3 8mm Hex Cap Screws

Attach a Bent Core Hex Motor Bracket to the left side of a Core Hex Motor using 2 Hex Cap Screws.



Pre-load the Motor Bracket with 2 - M3 8mm Hex Cap Screws and Nyloc Nuts. Then, slide the following on to a the Motor's Hex Shaft.

- Shaft Collar
- Short Through Bore Bearing
- Bearing Pillow Block (pre-loaded with 2 M3 8mm Hex Cap Screws and Nyloc Nuts)
- Long Through Bore Bearing
- Shaft Collars x 2 with a space between them
- 15 Tooth Gear
- Shaft Collar





• 2 - Core Hex Motor Assemblies

Slide the Core Hex Motor Assemblies into the outer, upright Extrusion. Temporarily tighten the the nuts to secure the pieces.



Note: Hex Shaft will not clear through the gear

Slide the following on to a 90mm Hex Shaft from left to right to mount Stage 1 of the lift.

- Shaft collar
- Outer Lift Upright
- Short Through Bore Bearing
- Lift Extrusion piece that does not have a gear
 - $\circ \qquad \text{This piece was set aside on page 44}$
- Long Through Bore Bearing
- Shaft Collar
- Long Through Bore Bearing
- Inner Lift Upright and attached Sprocket
- Long Through Bore Bearing
- Lift Extrusion with 125 Tooth Gear





Note: Hex Shaft will not clear through the gear

Slide the following on to a 90mm Hex Shaft from right to left to mount Stage 1 of the lift.

- Shaft collar
- Outer Lift Upright
- Short Through Bore Bearing
- Lift Extrusion piece that does not have a gear
 This piece was set aside on page 44
- Long Through Bore Bearing
- Shaft Collar
- Long Through Bore Bearing
- Inner Lift Upright and attached Sprocket
- Long Through Bore Bearing
- Lift Extrusion with 125 Tooth Gear



Get:

• 2 - 73mm long 15mm Extrusion

Attach a 73mm long piece of 15mm Extrusion to the Lap Corner Brackets on the underside of each half of Stage 1.



Slide the following on to a 400mm Hex Shaft from left to right to mount Stage 2 of the lift.

- Shaft Collar
- Long Through Bore Bearing
- Outer Left piece of Stage 1
- Shaft Collar
- 20 Tooth Sprocket
- Long Through Bore Bearing
- Inner Left piece of Stage 1
- Short Through Bore Bearing
- 15mm Spacer
- Stage 2 Extrusion with 72 tooth gear on left side
- Long Through Bore Bearing
- Shaft Collar x 2
- Long Through Bore Bearing
- Stage 2 Extrusion with 72 tooth gear on right side
- 15mm Spacer
- Short Through Bore Bearing
- Inner Right piece of Stage 1
- Long Through Bore Bearing
- 20 Tooth Sprocket
- Shaft Collar
- Outer Right piece of Stage 1
- Long Through Bore Bearing
- Shaft Collar





- 1 120mm long 15mm Extrusion
- 2 Plastic 90 Degree Brackets
- 10 M3 x 8mm Hex Cap Screws
- 10 M3 Nyloc Nuts

Attach the 120mm long piece of Extrusion to Stage 2 of the lift with 2 Plastic 90 Degree Brackets and M3 Hardware.



Get:

• 2 - 148 Link Chain Loops

Place the 148 Link Chain Loops on each side of the lift. Connect the 20 Tooth Sprockets to the 40T Sprockets.



Intake Assembly- Bill of Materials

		QTY
PART NUMBER	INTAKE ASSEMBLY	
	120mm long 15mm Extrusion (see cut list)	3
REV-41-1320	15mm Plastic Inside Corner Bracket	2
REV-41-1359	M3 x 8mm Hex Cap Screw	16
REV-41-1361	M3 Nyloc Nuts	18
REV-41-1319	15mm Plastic Servo Bracket	1
REV-41-1316	15mm Hex Pillow Block	1
REV-41-1317	15mm Bearing Pillow Block	2
REV-41-1328	Servo Shaft Adapter	1
REV-41-1097	Smart Robot Servo	1
REV-41-1360	M3 x 16mm Hex Cap Screws	2
REV-41-1327	Shaft Collars	7
REV-41-1337	90 Tooth Plastic Gear	1
REV-41-1348	5mm x 90mm Hex Shaft	1
REV-41-1334	45 Tooth Plastic Gear	1
REV-41-1353	30mm Traction Wheel	4
REV-41-1324	3mm Spacer	3
REV-41-1326	Through Bore Bearing - Short	2
REV-41-1329	Through Bore Bearing - Long	2
REV-41-1324	3mm Spacer	2





54



- 3 120mm long 15mm Extrusion
- 2 Inside Corner Brackets
- 8 M3 8mm Hex Cap Screws
- 8 M3 Nyloc Nuts

Connect 3 pieces of Extrusion in a U shape using 2 Inside Corner Brackets and M3 hardware.



Get:

- 1 Plastic Servo Bracket
- 1 Hex Pillow Block
- 2 Bearing Pillow Blocks
- 8 M3 8mm Hex Cap Screws
- 8 M3 Nyloc Nuts

Attach Brackets to the Intake's structure as shown in the image.





- 1 Smart Robot Servo
- 1 Servo Shaft Adapter
- 2 M3 16mm Hex Cap Screws
- 2 M3 Nyloc Nuts

Attach the Smart Robot Servo to the Servo Bracket using 16mm M3 Screws and Nyloc nuts, then connect the Servo shaft adapter to the output.



Get:

- 1 Plastic Motion Bracket
- 1 50mm long 5mm Hex Shaft
- 2 M3 8mm Hex Cap Screws
- 2 M3 Nyloc Nuts

Fasten the Plastic Motion Bracket to the Intake frame, then insert the Hex Shaft into the Servo Shaft Adapter.





- 2 Shaft Collars
- 1 90 Tooth Gear

Slide a Shaft Collar, 90 Tooth Gear, and then another Shaft Collar onto the 5mm Hex Shaft. You may need to adjust the shaft collars to align the gear later.



Slide the following on to a 90mm Hex Shaft from left to right.

- Shaft Collar
- 45 Tooth Gear
- 30mm Traction Wheel
- 3mm Spacer
- Short Through Bore Bearing
- Intake Frame (via a Bearing Pillow Block)
- Long Through Bore Bearing
- 3mm Spacer
- 30mm Traction Wheel
- Shaft Collar





Slide the following on to a 90mm Hex Shaft from left to right

- Shaft Collar
- 30mm Traction Wheel
- 3mm Spacer
- Short Through Bore Bearing
- Intake Frame (via a Bearing Pillow Block)
- Long Through Bore Bearing
- 3mm Spacer
- 30mm Traction Wheel
- Shaft Collar



Intake Complete



Intake on Lift Assembly - Bill of Materials

PART NUMBER	INTAKE ON LIFT ASSEMBLY	QTY.
REV-41-1163	Surgical Tubing, 3mm	1
REV-41-1907	M3 X 8MM T-Slot Screw	2
REV-41-1161	Zip Ties, Black, 160mm 50 Pack	1
REV-41-1349	5mm x 135mm Hex Shaft	1
REV-41-1317	15mm Bearing Pillow Block	2
REV-41-1329	Through Bore Bearing - Long	2
REV-41-1327	Shaft Collars	4







Slide the following on to a 135mm Hex Shaft from left to right

- Lift Stage 2 Left side Bearing Pillow Block
- Long Through Bore Bearing
- Shaft Collar x 2
- Intake Assembly via Hex Pillow Block
- Shaft Collar x 2
- Long Through Bore Bearing
- Lift Stage 2 Right side Bearing Pillow Block



Get:

- Surgical Tubing
- 2 M3 8mm T-Slot Screws

Replace the set screw in the outer Shaft collars with T-Slot Screws. Then, wrap Surgical Tubing around the post of the screw and extrusion on both sides of the intake. The intake should be able to pivot, but easily bounce back to center.





- Surgical Tubing
- Zip Ties

Tension your virtual four-bar chain with surgical tubing to help balance your lift.



Create a loop with the zip ties through the chain to which you can tie your surgical tubing. The other end of your surgical tubing will be looped around the extrusion support as shown in the image above.



Electronics and Plastics Assembly - Bill of Materials

PART NUMBER	ELECTRONICS AND PLASTICS ASSEMBLY	QTY.
REV-41-1839	400mm x 350mm x 4mm Cor Plastic Sheet	1
REV-41-1166	battery holder plate	2
REV-41-1907	M3 X 8MM T-Slot Screw	25
REV-41-1361	M3 Nyloc Nuts	23
REV-41-1492	M3 Standoff - 40mm	3
REV-41-1359	M3 x 8mm Hex Cap Screw	4







- 1 Battery Holder Plate
- 6 M3 8mm T-Slot Screws
- 3 M3 Nyloc Nuts
- 3 40mm Standoffs

Attach 3 40mm standoffs to the corners of the Battery Holder Plate. Then, mount the plate to Drivetrain using 3 - 8mm T-Slot Screws and Nyloc nuts.



Get:

- 1- Battery Holder Plate
- 3 M3 8mm T-Slot Screws

Attach the 2nd Battery Holder Plate to the 3 Standoffs using T-Slot Screws.





- 1 Switch Cable and Bracket Set
- 3 M3 8mm T-Slot Screws
- 3 M3 Nyloc Nuts

Attach the Switch Bracket to the extrusion in between the Drive Rails using 3 T-Slot Screws and Nyloc Nuts.



Get:

Corrugated Plastic Sheet

Cut a 319mm x 123mm rectangle out of corrugated plastic. Then, trim the corners to clear the 90 Degree Brackets on the bottom of the robot.





Corrugated Plastic Sheet

Cut a 319mm x 300mm rectangle out of corrugated plastic.



Get:

Corrugated Plastic Sheet

Cut a 319mm x 165mm rectangle out of corrugated plastic.





- 13 M3 8mm Hex Cap or T-Slot Screws
- 13 M3 Nyloc Nuts

Poke holes in the corrugated plastic sheets to attach them to the extrusion using M3 hardware as shown in the images. You will be cutting the alignment notch in the next step.



On the 319mm x 300mm corrugated plastic sheet, mark the center of where the intake meets the plastic. Place a cone centered on the mark you just made, then trace the rim of the cone to create an alignment notch.





- Control Hub
- 4 M3 Screws
- 4 Nyloc Nuts

Attach the Control Hub to the Corrugated plastic using 4 M3 Screws and Nyloc Nuts.

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Starter Bot Build Complete

