

SHAPEOKO XXL

ASSEMBLY GUIDE



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Have Questions? Need Help?

We have a fully-staffed support department waiting to help you if you run into trouble while assembling your Shapeoko XXL. Just send us an email at support@carbide3d.com and we'll get back to you on the quick!

Welcome and Congratulations!

You are now the proud owner of the Shapeoko XXL, an incredibly powerful and easy-to-use CNC machine. In this guide we will walk you through the assembly of your Shapeoko XXL, step-by-step. If you run into problems as you go, send us an email at support@carbide3d.com and we'll help get you back on track!

Important Notes Used in This Guide

Throughout the guide, you will find information that we've called out for you to pay particular attention to. We use three types of call-outs: **Warnings**, **Notes**, and **Pro Tips**:

WARNING: This is a warning. Information in these boxes is **VERY** important. Pay close attention.

NOTE: This is a note—information that points out critical steps or information for future reference.

PRO TIP: This is a Pro Tip. Anytime you see one of these, you will find helpful additional information.

Do NOT Use Power Tools

Only use the provided tools and hand tools. **Do NOT use power tools to assemble your Shapeoko XXL.**

Finger Tight Only

Several steps rely on “non-tightened fasteners.” Do not tighten fasteners beyond finger tight until instructed to do so.

Firmware

The Shapeoko XXL controller unit ships with GRBL 1.1 firmware, which must be used with Carbide Motion 5. This document supersedes any information you may find on the Carbide 3D website.

Stepper Motors

Your Shapeoko XXL is powered by stepper motors. When the power is off, moving the motors by hand will cause them to generate electricity.

WARNING: When moving the stepper motors by hand, go slow. The power generated when moving the motors by hand will feel like bumps. If the lights on the control board are lighting up, it's very important to move the motors slower because you are pushing electricity back through the controller. Too much back flow could damage the controller unit.

Important Safety Instructions

The Shapeoko is a machine tool and requires the same caution that should be exercised with any power tool.

Eye Protection

Always wear safety glasses or goggles which are suitably impact resistant.

Hearing Protection

Always wear ear plugs or ear muffs. For long jobs, it may be desirable to wear both. Hearing damage is cumulative and irreversible, so one should always err on the side of caution.

Respiratory Protection

Always wear a filter or respiratory mask suitable for the type of dust generated by the material being cut. If necessary, arrange for dust collection and proper ventilation.

Clothing, Hair, and Jewelry

Always ensure that clothing, hair, and jewelry cannot become caught in the machine. Always wear appropriate clothing: long-sleeved shirts, pants, and suitable footwear are recommended. When doing metal-working, gloves and an apron are also recommended.

Machine Safety

Never reach into the machine's working envelope while it is running. Always shut off and unplug the router to perform tool changes, adjustments, and maintenance. Never leave the machine running unattended. Always inform someone before operating the machine and check in with them after successfully completing work. Never allow children to use the Shapeoko XXL unsupervised.

Fire Prevention

Consider the possibility of a fire caused by friction from the router and take suitable fire prevention precautions (e.g. having a fire extinguisher handy and other suitable precautions).

Outlet Requirements

Plug the router into an outlet that has a dedicated on/off switch. Be sure this is accessible while the machine is running, in case you should need to shut the Shapeoko XXL off immediately.

End Mill Safety

Use care when handling end mills—both to avoid being cut and to avoid damaging them. Handling end mills with suitable gloves, or using a cloth to avoid contaminating them, is recommended. Inspect end mills carefully before each use and ensure that they are securely held by the collet.

Debris Disposal

Recycle or safely dispose of milling debris and dust, keeping in mind flammability, (potential) spontaneous combustion, and chemical considerations. Even natural materials can have surprising disposal implications. For example, walnut wood dust is allelopathic (it inhibits plant growth), an irritant to the skin and respiratory tract, and potentially poisonous to some animals. All of these possible disposal implications are in addition to the spontaneous combustion hazard posed by all types of sawdust.

Machine Operating Checklist

1. Be Safe

Always follow the safety guidelines listed on the previous page. Always wear appropriate safety equipment, especially safety glasses/goggles, hearing protection, and respiratory protection.

2. Check the Machine

Check that all bolts and set screws are tight, v-rails are in good condition with no nicks or other damage, belts are tight and in good shape, wiring is in good condition with continuity and securely fastened, and that nothing is frayed or broken and everything is clear and safe.

PRO TIP: The belts can be difficult to inspect because they are assembled “teeth-down” along the extrusion rails. Use a mirror to examine the underside of the belts while moving the machine along its full range of movement.

NOTE: It is especially important to check the machine after a crash, a failed cut, or a cut that induces chatter or excessive vibration.

3. Secure the Workpiece

Secure the workpiece (the material being milled) right-side up and in the desired orientation to the worksurface using a technique appropriate to the material. After securing the workpiece, be certain that the machine is still able to move.

4. Mount the Router

Mount an appropriate compact router; ensure that it is vertical, square to the machine, and well-secured.

5. Examine the End Mill

Examine each end mill prior to use to ensure that it is sharp, in good condition, and not chipped (this is best done with a loupe or magnifying glass). Install the end mill per the compact router manufacturer’s directions so that it projects at least as much as the deepest intended cutting depth. Check to make certain that the collet is tight and will not work loose during operation (it needs to be more than finger-tight—the machine will take no notice or care if it works loose).

6. Clear the Work Area

Ensure the work area is clear and all cables run without interference. Most importantly, check that there is nothing beneath the rails which might interfere with the movement of the carriages.

7. Connect to a Computer

To connect the Shapeoko XXL to a computer:

- a. Power up the computer.
- b. Connect the USB cable to your computer.
- c. Start Carbide Motion 5 on your computer.
- d. Turn the Shapeoko XXL on by flipping the in-line rocker switch on the power supply cord to the ON position. Once powered on, you will be able to see a steady blue LED light on the controller unit.
- e. Open the connection to the machine (it should connect and afford one control).
- f. If necessary, home the cutting tool to the proper place in relation to the workpiece.

8. Disconnect the Touch Probe

If you're using a Touch Probe, remove the ground clip and secure it safely outside of the machine's working area.

9. Double Check the Work Area

Ensure that nothing has been left in the work area. Optionally, you may traverse the working boundary of the job as a final check.

10. Send NC File to Machine

Browse for the NC file (the G-code which gives the machine its instructions) which you have already simulated and send it to the machine, following all prompts for tool changes and starting the compact router as required and setting it to the correct speed.

11. Monitor the Machine During Operation

While staying clear of the work area, monitor the machine during operation. Ensure there is no build-up of dust, debris, or fumes, and that nothing works loose. Do not reach into the machine's working envelope or insert any object into it while the machine is operating.

12. Finish and Clean Up

Once the job is complete, turn off the router, return the gantry to the home position or a known offset from home, and ensure the end mill has stopped spinning before removing the finished piece and any waste.

Store end mills carefully when not in use to protect the cutting edges. Collets and accessories should be cleaned between uses. Wipe them off with a suitable solvent such as isopropyl alcohol.

NOTE: It's a good idea to keep a log of machine usage, making note of when adjustments are made and fasteners are (re)tightened. Also keep a tally of usage time, including time for specific end mills, to determine when parts need to be lubricated and when end mills should be relegated to rough work, re-sharpened, or recycled and replaced. Finally, record machine settings and specifics of each tool chain used with the machine.

Glossary of Terms

Collet: A collet is a cone-shaped sleeve that holds an end mill in place in the router.

Eccentric Nut: Eccentric nuts are off-center nuts which allow you to adjust the tension of your V-wheels. Adjusting the tensioning of the eccentric nuts allows the V-wheels to slide smoothly along the v-rails, which as you'll see as we begin to assemble the Shapeoko XXL, that this allows the carriages to slide easily along the rail system.

End Mill or End Mill Cutter: End mills (or cutters) are the cutting tools used by a CNC machine. End mills are similar to drill bits, though, typically they can cut in all directions. End mills come in several varieties (including square, ball-nose, and v-carving) and lots of sizes. Learn more about end mills here: docs.carbide3d.com/tutorials/tutorial-tooling.

G-code: G-code (general, or geometric, code) is a CNC programming language that controls when, where, and how the machine tools move (for example, when to turn on or off, how fast to travel to a particular location, what paths to take, etc.) across the workpiece.

Gantry: A gantry is an overhead motion system for use in multi-axis operations. It is the three extrusion rails that make up the Shapeoko XXL's rail system.

PEM nut: Penn Engineering & Manufacturing Corp. brand fastener providing self-clinching, permanent threads and mounting points in thin sheet metal.

Toolpath: A toolpath is the "route" the cutting tool will follow as it shapes the workpiece. We use Carbide Create, Carbide 3D's cross-platform CAD/CAM program, to define the toolpaths for a project.

Working envelope: A working envelope is the CNC machine's range of movement across each of its three axes, X, Y, and Z.

Workpiece: A workpiece is a stock piece, the sheet of material to be milled.

Step 1: Inventory

Unpack Components

Let's begin by making sure that all components are accounted for and free from any shipping damage.

Remove all of the boxes and wrapped hardware from the shipping container.

Once you have unpacked everything you should have the items listed below and shown in *Figure 1-1*.



Figure 1-1

Item	Description	Qty	Other Info
A	Shapeoko XXL Assembly Guide	1	This Printed Assembly Guide
B	Sweepy (65mm or 69mm)	1	Sweepy Dust Boot
C	Y-Axis Right Assembly Box	1	Contains Y-Axis Right Carriage
D	Pre-Assembled Wiring Harness Box	1	Contains Wiring Harness, Kits, and Hardware
E	Y-Axis Left Assembly Box	1	Contains Y-Axis Left Carriage
F	XXL Final Assembly Box	1	Contains Hardware and Components Needed for Assembly
G	X/Z+ Box	1	Contains the Z-Plus Carriage, Components, and Hardware
H	Cross Strap Package	1	40" x 7" x 1.5" Package Contains 3 Identical Cross Straps
I	Aluminum Extrusion Rail Package	1	40" x 7.5" x 3.5" Package Contains 3 Unique Extrusion Rails
J	Endplate Package	1	45.5" x 8" x 2" Package Contains 2 Identical Endplates
K	MDF Baseplate Board	2	42" x 29.75" x 0.75"; 2 Identical Boards (Under Divider)

Optional Items

L	Carbide Compact Router Box	1	Contains the Compact Router and Accessories/Tools
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Now, let's take a closer look at the contents of each box and the wrapped components. Use the checklists on the following pages to verify all major components and small parts, including all hardware and tools, are accounted for and free from damage. Once verified, carefully set aside until needed for assembly.

PRO TIP: Your Shapeoko XXL kit has been carefully packaged by hand and double checked for accuracy. However, sometimes errors are made. If, after completing your inventory, you find that something is missing or damaged, contact us at support@carbide3d.com and we'll ship it to you ASAP.

Final Assembly Box

Carefully open the box labeled XXL Final Assembly and inspect its contents. Many parts are packaged in small plastic bags, and smaller bags may be inserted into larger bags for shipping purposes. This box should contain all of the items shown in *Figure 1-2* and listed in the table on the next page.



Figure 1-2

Final Assembly Box contents, see **Figure 1-2**:

Item	Description	Qty
A	Baseframe Hardware: M5 x 25mm Button Head Cap Screws	18
B	Baseframe Adjustable Leveling Feet	4
C	Router Mount	1
D	Router Mount Adapter Ring	1
E	Router Mount Hardware: M5 x 55mm Socket Head Cap Screws (2) and M5 x 16mm Button Head Cap Screws (2)	4
F	Loctite 242 Threadlocker (non-permanent)	1
G	Extrusion Rail Hardware: M6 x 12mm Button Head Cap Screws	24
H	Belt Clips (6) and Belt Hardware: M5 x 10mm Socket Head Cap Screws (6)	12
I	Toothed Belt (1200mm each)	3
J	Controller Unit and Hardware (inside): M6 x 8mm Button Head Cap Screw (2)	3
K	Shapeoko Decal	1
L	Power Cord	1
M	Power Supply	1
N	USB Cable	1
O	Large Zip Tie	2
P	Permanent Marker	1
Q	#201 ¼-inch Square End Mill Cutter	1
R	Tool Kit: 5, 4, 3, 2.5, 2, and 1.5mm Hex Keys*; 10 and 8mm Wrenches	8

*The 5mm hex key is provided in case you need to adjust the stepper motor idlers; the 1.5mm hex key is provided in case you need to adjust the motor pulley set screws.

Y-Axis Left Assembly & Y-Axis Right Assembly Boxes

Open the boxes labeled Y-Axis Right Assembly and Y-Axis Left Assembly and visually verify they match the carriages as shown in **Figure 1-3**.

The Right and Left Assembly components are mirror images.

NOTE: We'll need these two boxes and the two foam blocks inside them to help with assembling the gantry. Set them aside for later use.

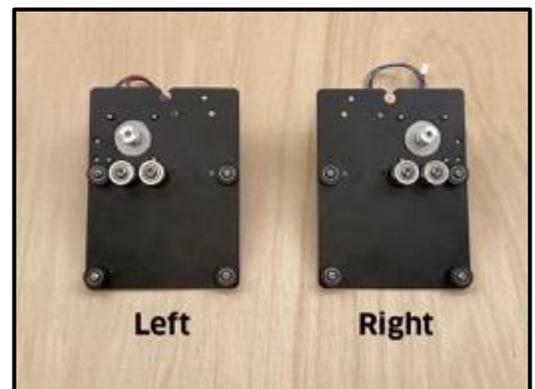


Figure 1-3

Pre-Assembled XXL Wiring Harness Box

This box should contain all the items listed in the table below and shown in **Figure 1-4**.



Figure 1-4

Item	Description	Qty
A	Pre-assembled Wiring Harness (X-Axis and Y-Axis Drag Chains and Cables)	1
B	Drag Chain Support Brackets (7) and Hardware: M4x6mm (10), M5x8mm (2), M5x16mm (2) Socket Head Cap Screws; M5 Nuts (2); M3x4mm Flat Head Screws (6)]	29
C	Proximity Switch Plates (2) and Hardware: M3x18 (4), M5x8mm (4) Socket Head Cap Screws; 30mm Male-to-Female Standoffs (2)	12
D	Cable Tie Mounts (5), Cable Ties (25), and Hardware: M4x6mm Socket Head Cap Screws (5)	35
E	PCB Riser Board (Adapter Board for Proximity Switches)	1

X/Z+ Box

Open the box labeled X/Z+ and visually verify that the items inside match those shown in **Figure 1-5**.

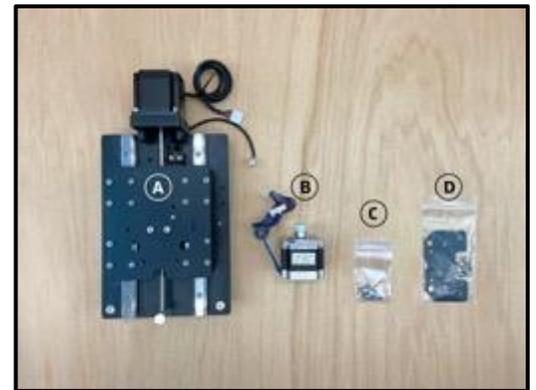


Figure 1-5

Item	Description	Qty
A	Z-Plus Carriage with Z-Axis Stepper Motor and Z-Axis Proximity Switch Attached	1
B	X-Axis Stepper Motor	1
C	M5 x 10mm Socket Head Cap Screw	4
D	Tramming Plate and Hardware: M5 x 8mm Socket Head Cap Screws (4)	5

Sweepy Box

The Sweepy Dust Boot is available for 65mm and 69mm routers. Open the Sweepy box and verify its contents match those shown in *Figure 1-6*.

Aluminum Extrusion Rails

The three aluminum extrusion rails are packed together. Carefully cut the plastic bands holding the rails together and remove the cardboard shell.

WARNING: The extrusion rails may look the same, but there are subtle differences that you need to pay attention to.

Examine the three rails, shown in *Figure 1-7*, and identify the following:

- **X-Axis Rail (X-rail):** in addition to the Shapeoko/warning decals on the front, the rail has sixteen (16) pre-drilled M4 screw holes along the back.
- **Y-Axis Left Rail (Y1-rail):** has two (2) M6 and four (4) M4 pre-drilled screw holes along one side.
- **Y-Axis Right Rail (Y2-rail):** has two (2) M6 pre-drilled screw holes along one side.

Endplates

The two (2) identical endplates are packed together. Remove the cardboard shell and identify the two endplates shown in *Figure 1-8*.

NOTE: Each endplate has several integrated PEM nuts. Inspect each one to verify that the threads are properly formed and that it is firmly and squarely in place.

Cross Straps

The three (3) cross straps are identical and are packed together in a cardboard shell. Remove the packaging and identify the three cross straps pictured in *Figure 1-9*.



Figure 1-6

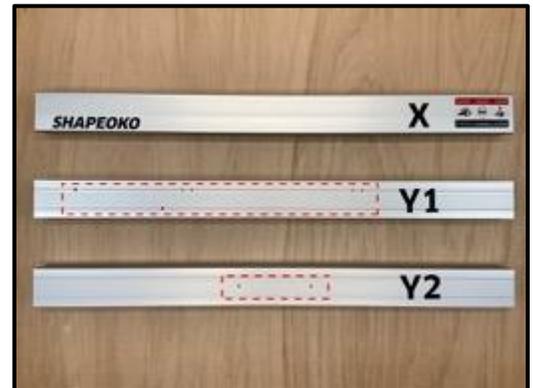


Figure 1-7



Figure 1-8



Figure 1-9

MDF Baseplates

The two (2) MDF baseplates are identical and packed in the bottom of the shipping box. Identify the two MDF baseplates pictured in *Figure 1-10*.

WARNING: Store your MDF baseplates where high humidity or the risk of liquids spilling on them is low. MDF is sensitive to moisture. You may want to consider sealing the baseplates with a suitable finish (e.g. spar urethane or lacquer).

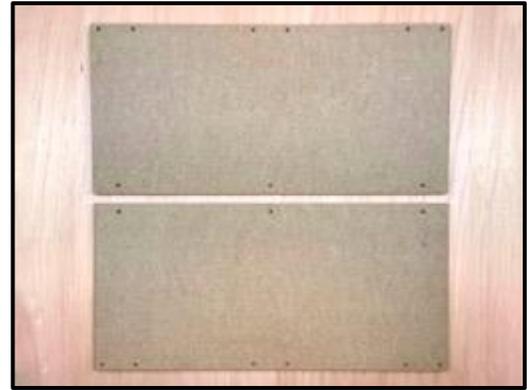


Figure 1-10

Carbide Compact Router Box

You will only have this box among your items if you ordered a separate router with your Shapeoko XXL kit. This box should contain all of the items shown in *Figure 1-11*.

Additional Required Tools

The following tools are not included in your Shapeoko kit, but are required for assembly (see *Figure 1-12*):

Item	Description	Qty
A	Flush Cut Pliers or Scissors	1
B	Level	1



Figure 1-11

Recommended Tools

The following tools are recommended for assembly, but not included (see *Figure 1-12*):

Item	Description	Qty
C	8 and 10mm Combination Wrench	2
D	Easy-Peel Masking Tape (e.g. blue painter's tape; nothing that leaves a residue behind)	1
E	Flashlight	1
F	Tape Measure	1
G	Ruler	1

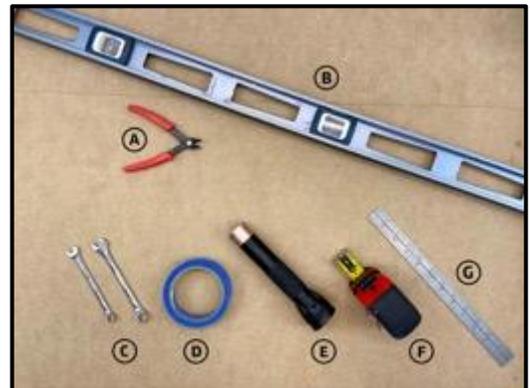


Figure 1-12

Before You Begin Assembly

As you work your way through the assembly guide you will be instructed to layout, place, or position components in a specific location or direction, such as: *up, down, left, right, front, back, rear, inside, outside, under, over*, etc. For example, “drag chain support brackets are attached to the **BACK** of the X-rail,” or “the controller unit is mounted to the **OUTSIDE** and to the **REAR** of the Y1-rail.” To help avoid confusion, all such references are given from the perspective of one standing in front of, and looking at, the machine as shown in **Figure 1-13**. As much as possible the words “left” and “right” are replaced with “Y1” and “Y2” respectively—in reference to the Y-Axis LEFT extrusion rail (Y1) and the Y-Axis RIGHT extrusion rail (Y2). Take a minute to familiarize yourself with this view of the machine.

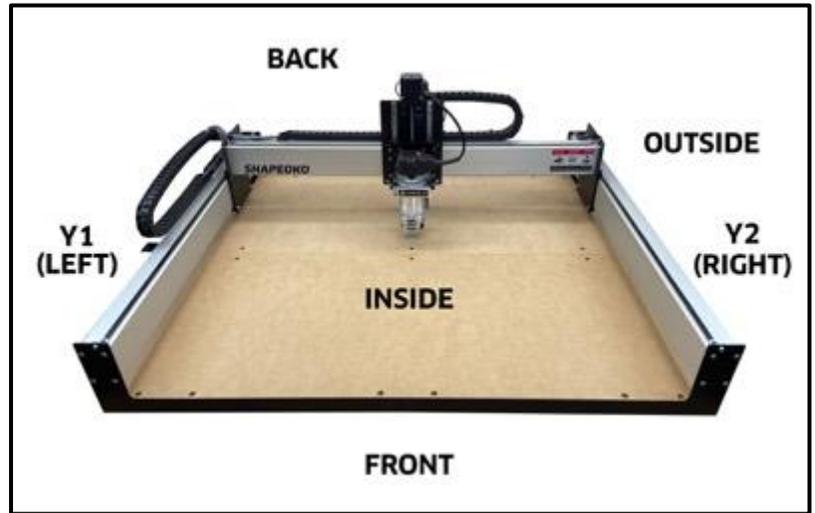


Figure 1-13

In addition to adopting a front view perspective, it is very helpful to familiarize yourself with the machine’s directional axes: the X-Axis moves left and right, the Y-Axis moves front and back, and the Z-Axis moves up and down. See **Figure 1-14**.

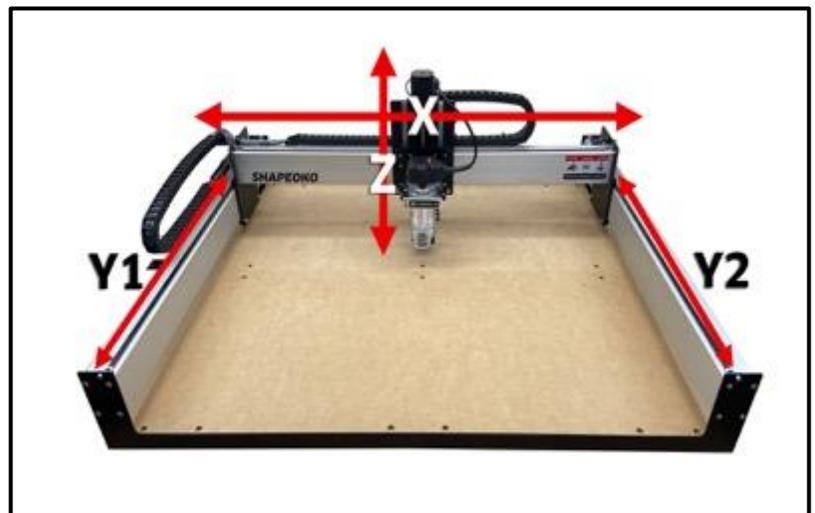


Figure 1-14

Step 2: Baseframe

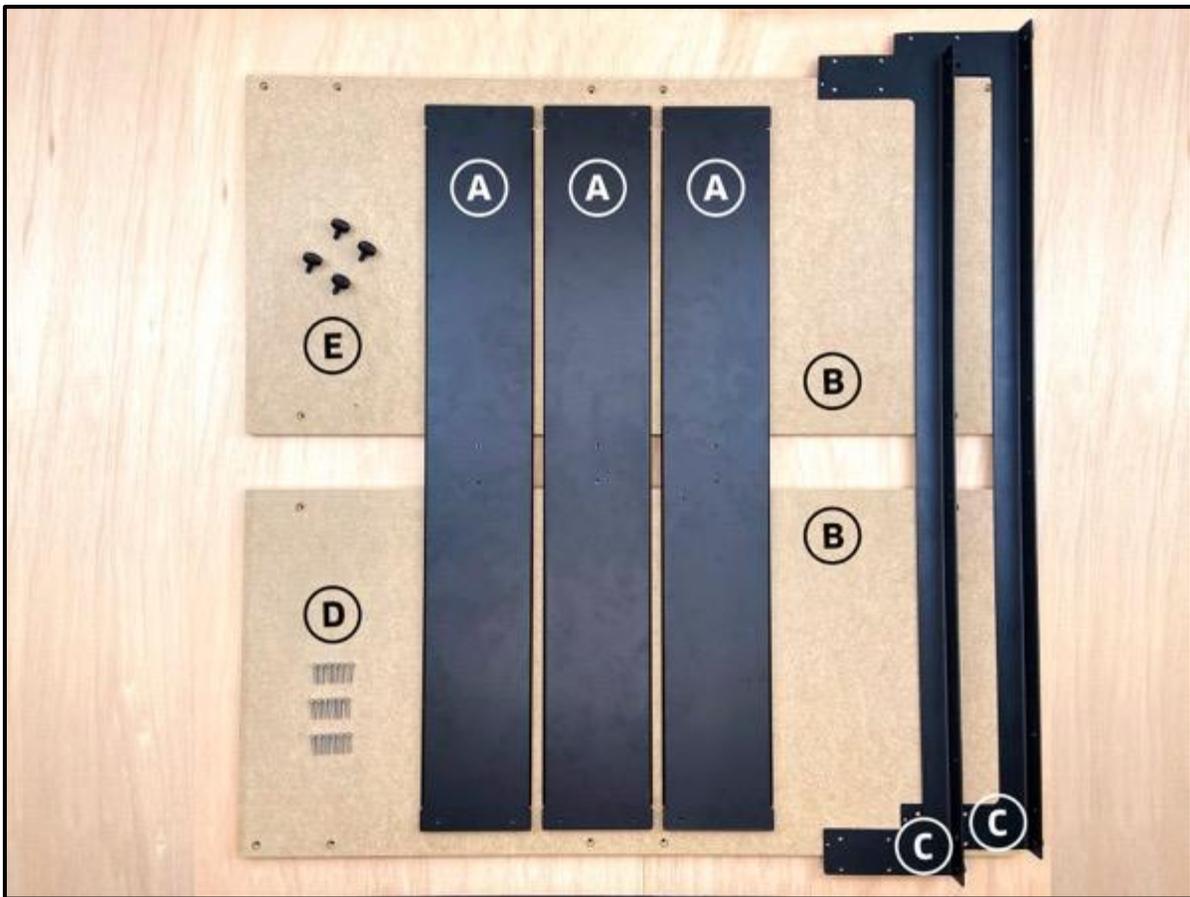


Figure 2-2

Required Components

See *Figure 2-2*:

Item	Description	Location	Qty
A	Cross Strap	N/A	3
B	MDF Baseplate	N/A	2
C	Endplate	N/A	2
D	M5 x 25mm Button Head Cap Screw	XXL Final Assembly Box	18
E	Adjustable Leveling Foot	XXL Final Assembly Box	4

Required Tools

See *Figure 2-3*:

Item	Description	Qty
A	3mm Hex Key	1
B	Level (not included)	1

Recommended Tools

See *Figure 2-3*:

Item	Description	Qty
C	Spare Hex Key (included)	2 or 3
D	Flashlight	1
E	Tape Measure	1

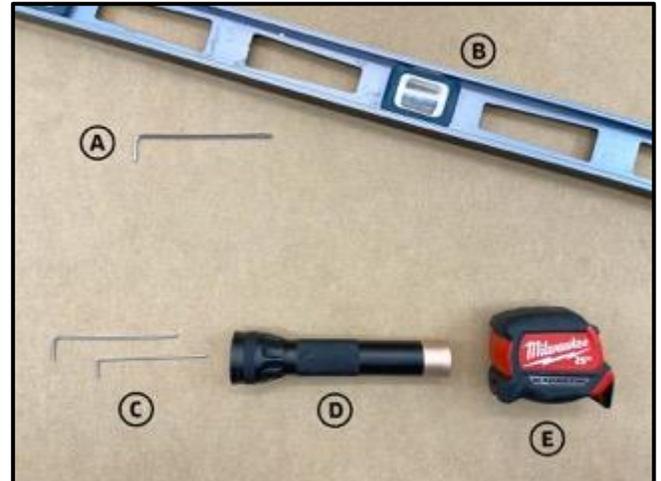


Figure 2-3

Important Assembly Information

WARNING: Assembly should not be done on the floor; a large table or workbench is essential for assembly. The completed dimensions of the Shapeoko XXL are 44.8" W x 40.3" L x 16.6" H. We recommend that you assemble the machine on a table slightly larger than the machine itself.

WARNING: Be careful to avoid cross threading screws.

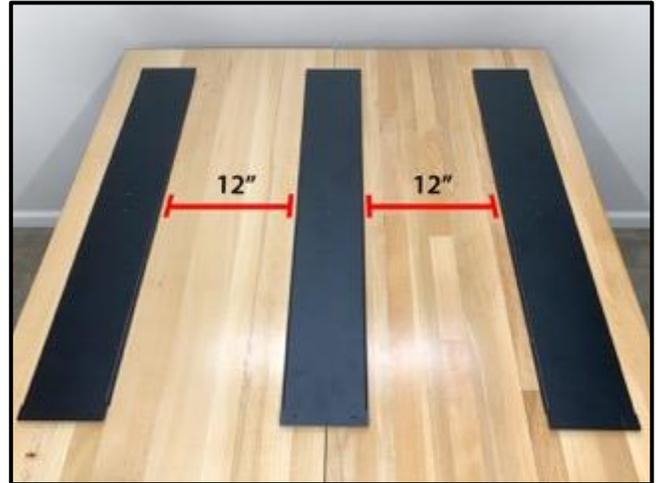


Figure 2-4

Lay Out the Cross Straps

1. Lay out the three (3) cross straps parallel to each other, with the flanged edges facing down and 12 inches of space between them. See *Figure 2-4*.

Attach the Rear MDF Baseplate

1. Select one of the MDF baseplates, ensuring that the countersunk holes are facing up.
2. Place the MDF baseplate across the back half of the three cross straps and line up the screw holes, six across the back and three across the middle as shown in *Figure 2-5*.

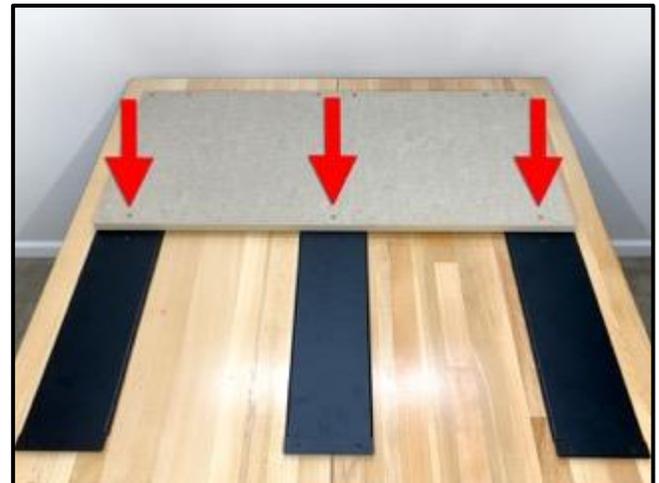


Figure 2-5

PRO TIP: Use one or more of the spare hex keys to align the screw holes as shown in *Figure 2-6*.

3. Use the 3mm hex key to insert three (3) M5x25mm button head cap screws through the three middle countersunk holes in the MDF baseplate and into the integrated nuts in the three cross straps as shown in *Figure 2-6*.
4. Turn the screws until they stop but do not fully tighten.

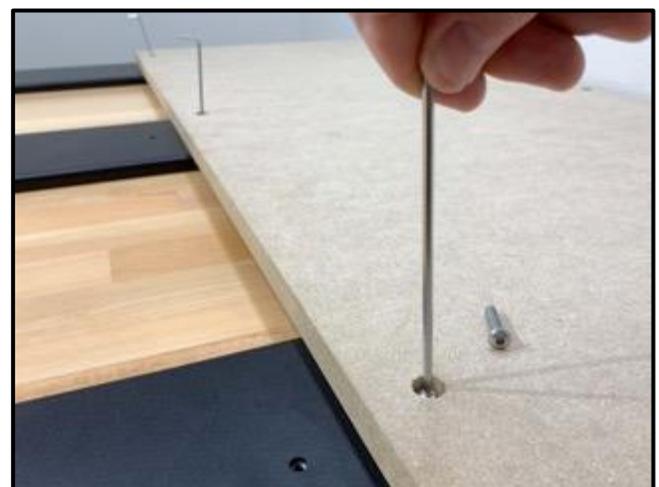


Figure 2-6

NOTE: We'll come back and tighten all of the baseframe screws later on when squaring the machine.

Attach the Front MDF Baseplate

1. Place the second MDF baseplate across the front half of the cross straps and line up the screw holes, six across the front and three across the middle as shown in *Figure 2-7*.
2. Use the 3mm hex key to insert three (3) M5x25mm button head cap screws through the baseplate and into the cross straps.
3. Turn the screws until they stop but do not fully tighten.



Figure 2-7

Attach the Rear Endplate

1. Select one of the two (2) identical endplates.
2. Place the endplate along the back of the machine and slide it under the three cross straps. See *Figure 2-8*.
3. Adjust the endplate, cross straps, and MDF baseplates so that all six holes align. Use one or more of the spare hex keys to help with alignment as shown in *Figure 2-9*.
4. Use the 3mm hex key to insert six (6) M5x25mm button head cap screws into the six countersunk holes in the MDF baseplate, through the cross straps, and into the integrated nuts of the rear endplate. See *Figure 2-9*.
5. Turn the screws until they stop but do not fully tighten.



Figure 2-8

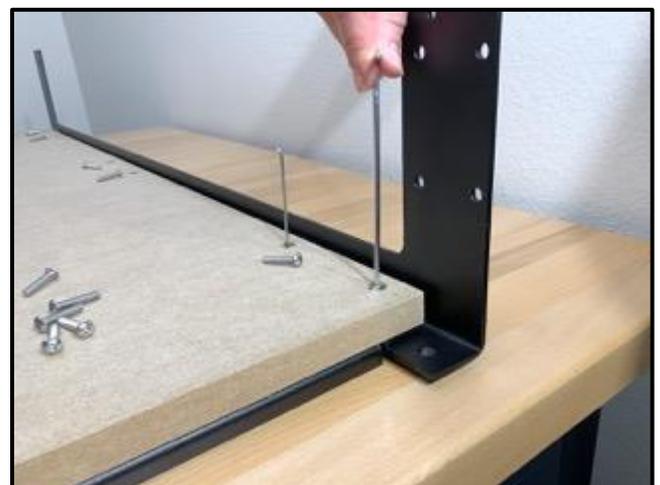


Figure 2-9

NOTE: If you are having trouble getting any of these screws started, make sure the machine is square and apply a little bit more downward pressure. However, be very careful not to cross thread any of the screws.



Figure 2-10

PRO TIP: To further help with hole alignment, shine a flashlight under the assembly to illuminate the holes from the bottom. Adjust as necessary. See *Figure 2-10*.

PRO TIP: You can also try loosely inserting screws from the center and working your way out (i.e. center, left 1, right 1, left 2, right 2). Then slowly tighten each screw in the same order. If you are still having trouble getting the holes to line up, contact us at support@carbide3d.com.



Figure 2-11

Attach the Front Endplate

1. Place the other endplate along the front of the machine and slide it under the three cross straps as shown in *Figure 2-11*.
2. Adjust the endplate, cross straps, and MDF baseplates so that all six screw holes align. See *Figure 2-12*.
3. Use the 3mm hex key to insert six (6) M5x25mm button head cap screws into the baseplate, through the cross straps, and into the front endplate.
4. Turn the screws until they stop but do not fully tighten.



Figure 2-12

Screw in the Adjustable Leveling Feet

WARNING: The baseframe assembly is heavy. It is recommended you complete this step with the help of another person. When lifting only one corner of the machine at a time, do not lift any higher than is necessary to insert the leveling foot. Alternately, lifting from the center of one endplate and inserting a suitable wedge is acceptable.

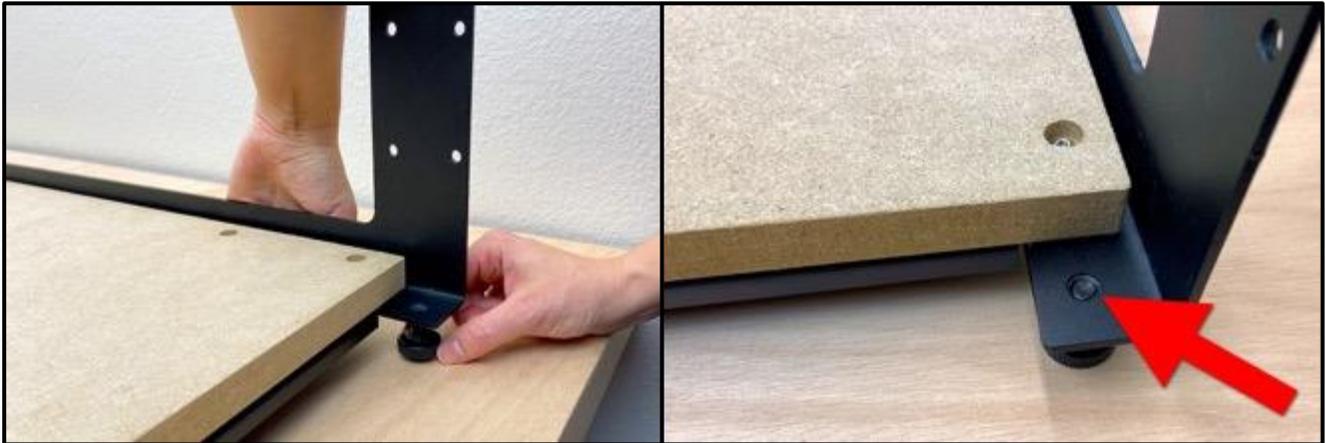


Figure 2-13

1. Carefully lift each corner of the baseframe and screw in the four adjustable leveling feet, two per endplate, as shown in **Figure 2-13**.
2. Screw in each adjustable leveling foot until it is flush with the endplate as shown in **Figure 2-13**.

Level the Machine

1. Adjust the leveling feet to bring the fully assembled baseframe into level. Check front-to-back, side-to-side, and diagonally. See **Figure 2-14**.

Optionally, if you wish to check for square now, you can do so by measuring diagonally across the baseframe from the outside edges of the endplates. Check both sides. The machine is square when the two measurements are equal. See **Figure 2-14**.

Approximates are acceptable at this stage as the machine is not fully tightened. A final and more comprehensive leveling and squaring of the machine will be completed in **Step 11: Level and Square**.

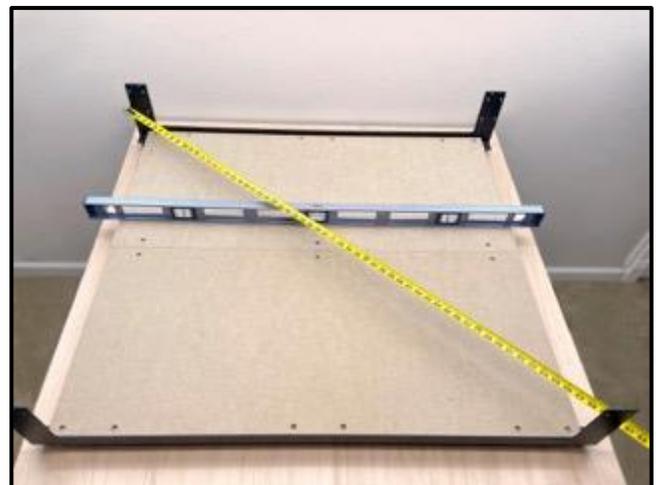


Figure 2-14

Step 3: Carriages

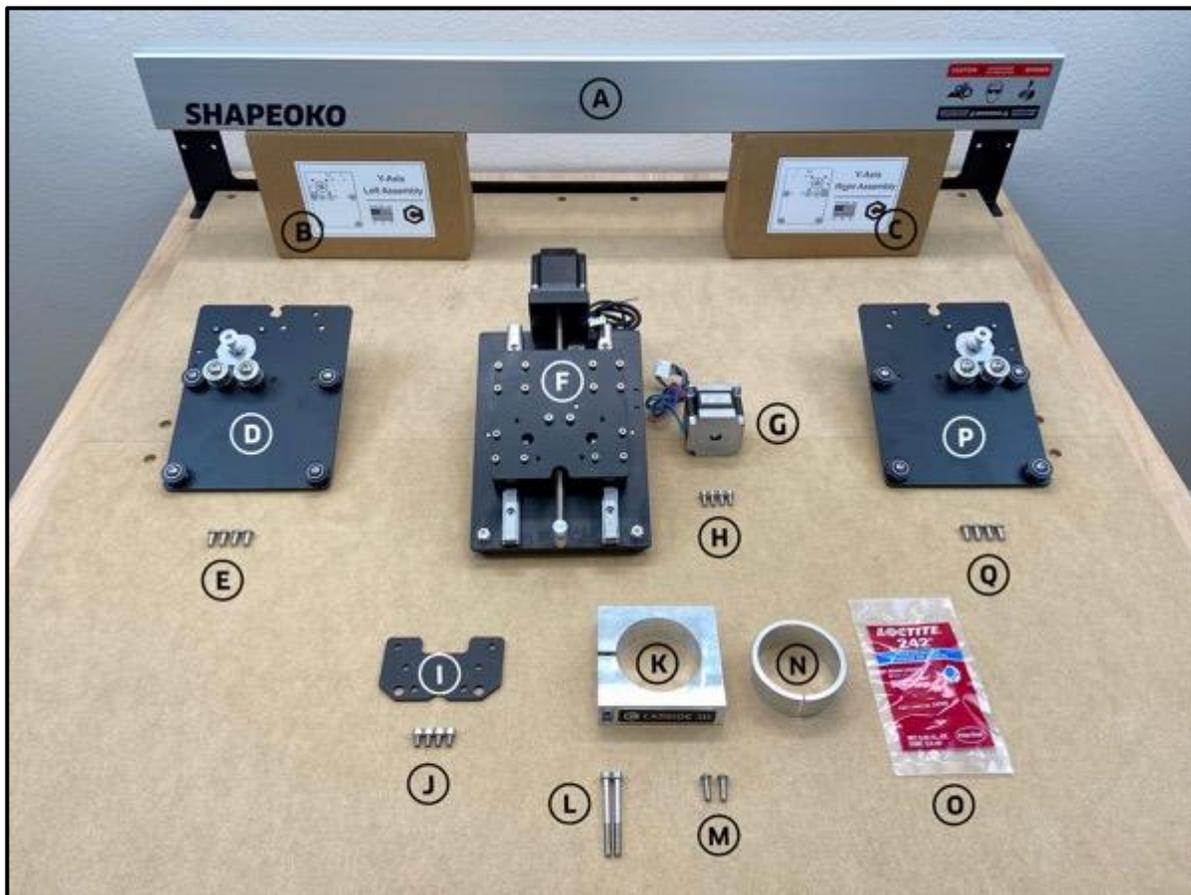


Figure 3-2

Required Components

See *Figure 3-2*:

Item	Description	Location	Qty
A	X-Axis Aluminum Extrusion Rail (X-Rail)	N/A	1
B	Y-Axis Left Assembly Box (empty)	N/A	1
C	Y-Axis Right Assembly Box (empty)	N/A	1
D	Y-Axis Left Carriage (Y1-Carriage)	Y-Axis Left Assembly Box	1
E	M6 x 12mm Button Head Cap Screw	XXL Final Assembly Box	4
F	Z-Plus Carriage (Z-Plus)	X/Z+ Box	1
G	X-Axis Stepper Motor (X-Motor)	X/Z+ Box	1
H	M5 x 10mm Socket Head Cap Screw	X/Z+ Box	4
I	Tramming Plate	X/Z+ Box	1
J	M5 x 8mm Socket Head Cap Screw	X/Z+ Box	4
K	Router Mount	XXL Final Assembly Box	1
L	M5 x 55mm Socket Head Cap Screw	XXL Final Assembly Box	2
M	M5 x 16mm Button Head Cap Screw	XXL Final Assembly Box	2
N	Router Mount Adapter Ring	XXL Final Assembly Box	1
O	Loctite 242 Threadlocker	XXL Final Assembly Box	1
P	Y-Axis Right Carriage (Y2-Carriage)	Y-Axis Right Assembly Box	1
Q	M6 x 12mm Button Head Cap Screw	XXL Final Assembly Box	4

Required Tools

See *Figure 3-3*:

Item	Description	Qty
A	3 and 4mm Hex Key	2
B	10mm Wrench	1

Recommended Tools

See *Figure 3-3*:

Item	Description	Qty
C	10mm Combination Wrench	1
D	Masking Tape	1

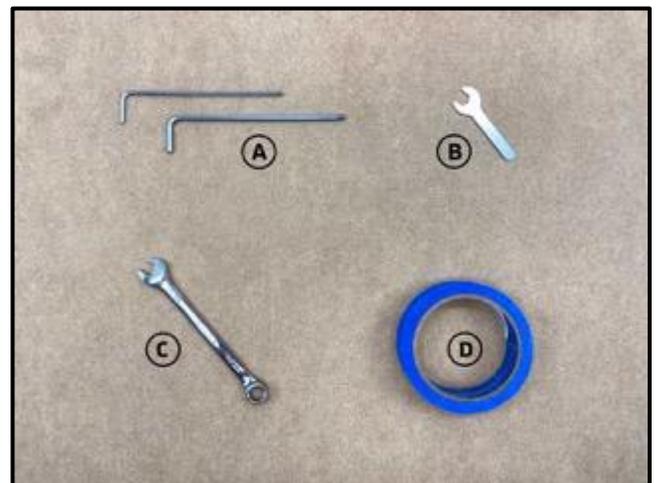


Figure 3-3

ECCENTRICS AND V-WHEELS EXPLAINED

Eccentric nuts and V-wheels are a quick and reliable way of eliminating carriage “slop,” unwanted movement between the carriages and rails. When tensioning eccentrics, try to only turn the nuts clockwise. Rotating counter-clockwise could cause the bolted connection to come loose. If this occurs, re-tighten bolts using both the 10mm wrench and either the 3mm or 4mm hex key.

Our HD eccentric nuts consist of a heavy-duty 10mm nut attached to a central post/spacer with threads slightly off-center. The spacer end fits snugly into the carriage plate from one side and a V-wheel is tightly screwed on from the other. The central spacer with offset threads now acts as a cam, converting the rotational motion of turning the eccentric nut into linear motion at the V-wheel.

The dimple on the side of the nut is a reference point to the widest distance to the offset threads. When the dimple is facing up, the lower V-wheel is at its farthest distance from the fixed upper V-wheel; the V-wheel is **OPEN**. When the dimple is down, the V-wheel is at its closest distance to the fixed upper V-wheel and the V-wheel is **CLOSED**. See *Figures 3-4* and *3-5*.

Not much tension is needed in order for the carriage to be secure. The wheels should only be snug against the rail. Reach under and spin the V-wheel with your finger. If it rotates freely, keep tightening the eccentric nut until you feel some friction against the v-rail. The carriage should be free from slop and travel smoothly without bumps.



Figure 3-4



Figure 3-5

Open the V-Wheels

1. Gather the three (3) carriages (see **Figure 3-6**):
 - a. Y-Axis Left Carriage (Y1-carriage)
 - b. X/Z-Axis Carriage (Z-Plus)
 - c. Y-Axis Right Carriage (Y2-carriage)

At the bottom of each carriage are two (2) eccentric nuts securing two (2) V-wheels.

2. Use the 10mm wrench to turn each HD eccentric nut **CLOCKWISE** until the dimple is facing up. Refer back to **Figure 3-4** if needed.

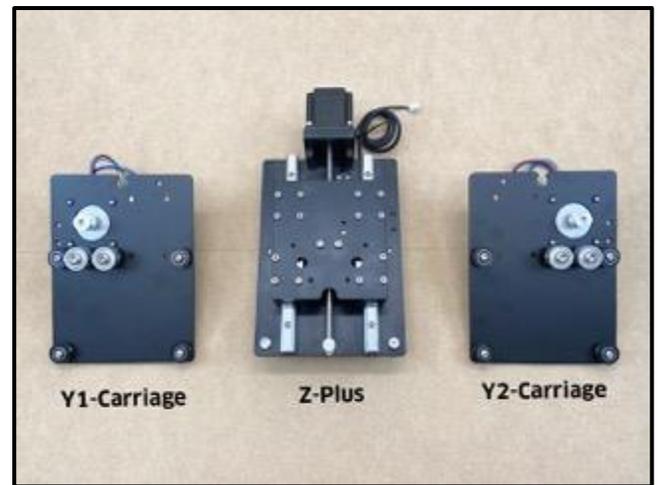


Figure 3-6

Assemble the Z-Plus

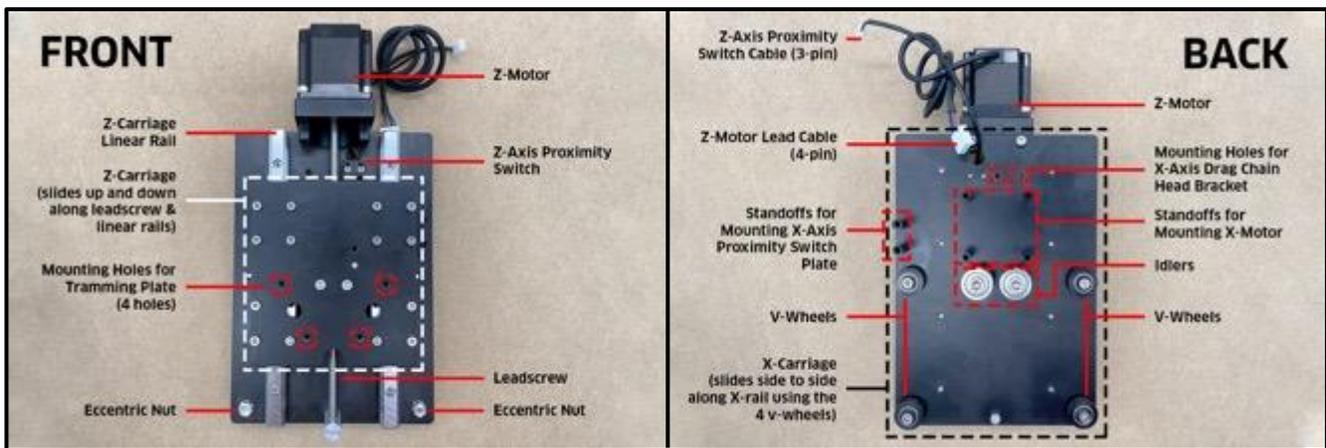


Figure 3-7

Attaching the X-Motor

Take a minute to familiarize yourself with the features and layout of the Z-Plus. See **Figure 3-7**.

1. Place the Z-Plus face down, with the six (6) pre-installed 30mm standoffs pointing up.
2. Set the X-motor onto the four (4) evenly spaced 30mm standoffs in the center of the Z-Plus between the Z-motor and the idlers with the Carbide 3D label facing down (toward the idlers). See **Figure 3-8**.
3. Use the 4mm hex key and four (4) M5x10mm socket head cap screws to secure the X-motor to the Z-Plus.

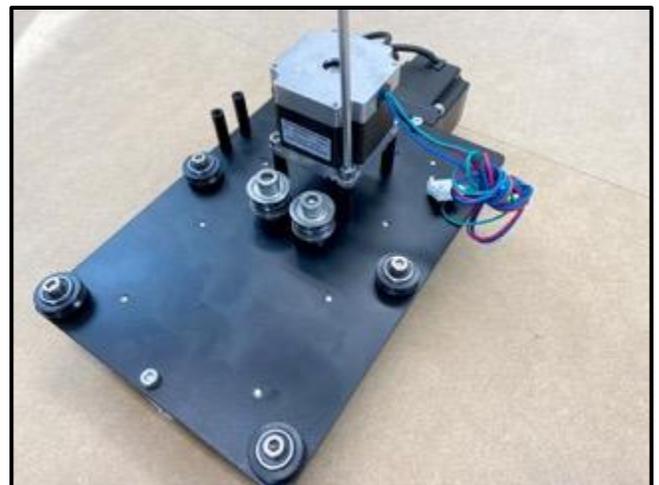


Figure 3-8

Identifying Front of Tramming Plate

The tramming plate which mounts to the front of the Z-Plus is a feature that makes it easier to adjust left/right tilt of the router. Tramming the machine before each new project provides you with the most accurate cuts and highest quality finish.

Of the four (4) mounting holes that fix the tramming plate to the Z-Plus (see **Figure 3-9**) one is 0.75mm smaller than the other three. The smallest hole is a fixed point around which the plate can be adjusted by +/- 0.375mm left or right. This allows you to get the tramming plate and the router mount perfectly parallel with the X-Axis.

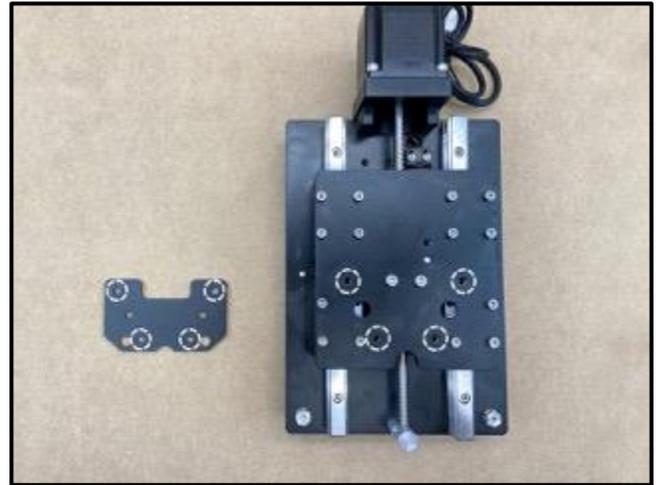


Figure 3-9

Before attaching the tramming plate to the router mount and Z-Plus, it must be properly oriented with the smallest hole (fixed point) in the top-left corner. This is the **FRONT** of the tramming plate.

PRO TIP: An easy way to spot the smallest hole in the tramming plate is to closely compare the top two holes, as shown in **Figure 3-10**. Insert two of the tramming screws into the top two holes and look closely at the difference in space around each screw. The larger hole has space around the screw (right) and the smaller hole does not (left). Once you've determined the **FRONT** of the tramming plate, mark it with a piece of masking tape to ensure correct installation as shown in the figure.

1. Position the tramming plate with the short legs extending up in a "U" shape.
2. Carefully inspect the top two holes shown in **Figure 3-10**.
3. Determine which of the holes is smaller and position the tramming plate with this hole at **TOP-LEFT**. This is the **FRONT** of the plate.

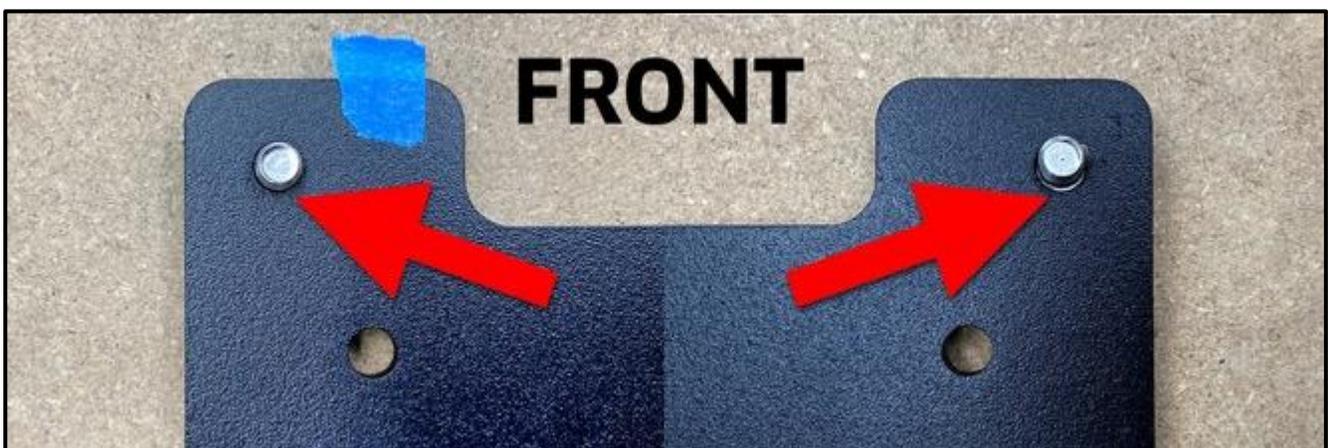


Figure 3-10

Attaching Router Mount to Tramming Plate

PRO TIP: This step requires use of Loctite 242 Threadlocker. You may find it helpful to dry fit the router mount to the tramming plate before adding Threadlocker to ensure proper orientation before final assembly.

1. Align the router mount to the **FRONT** of the tramming plate with the Carbide 3D logo facing **UP**.
2. Line up the two (2) **central** through-holes of the tramming plate with the two (2) screw holes at the **BACK** of the router mount.
3. Add one drop of Loctite 242 Threadlocker to the threads of the two (2) pocketed screw holes at the back of the router mount **AND** the threads of the two (2) M5x16mm button head cap screws. See *Figure 3-11*.
4. Use the 3mm hex key and the two (2) M5x16mm button head cap screws to secure the router mount to the **FRONT** of the tramming plate and fully tighten. See *Figure 3-11*.



Figure 3-11

Attaching Tramming Plate to Z-Plus

1. Place the Z-Plus face **UP**, resting on the X-motor, Z-motor pointing away from you.
2. Position the router mount with “Carbide 3D” logo upright and tramming plate resembling the letter “U.” Place it onto the front of the Z-Plus and align the four (4) tramming plate through-holes with the four (4) available M5 screw holes on the front of the Z-Plus.
3. Use the 4mm hex key and the four (4) M5x8mm socket head cap screws to secure the router mount and tramming plate to the Z-Plus and tighten. *Figure 3-12*.

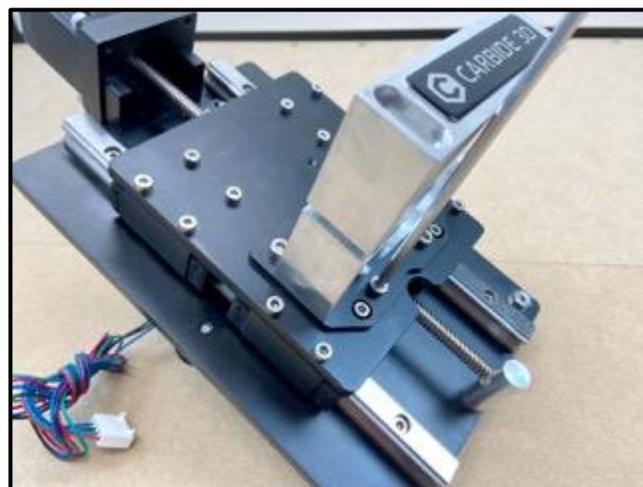


Figure 3-12

4. If you have a 65mm router (including the Carbide 3D Compact Router), install the router mount adapter ring into the router mount. If you have a larger router, you won't need the adapter and can set it aside.
5. Use the 4mm hex key to insert the two M5x55mm socket head cap screws into the front of the router mount. Hand tighten only. *Figure 3-13.*
6. With both hands firmly grasp the sides and, slowly but firmly, lower the Z-carriage with your thumbs until it stops at the bottom. See *Figure 3-14.*

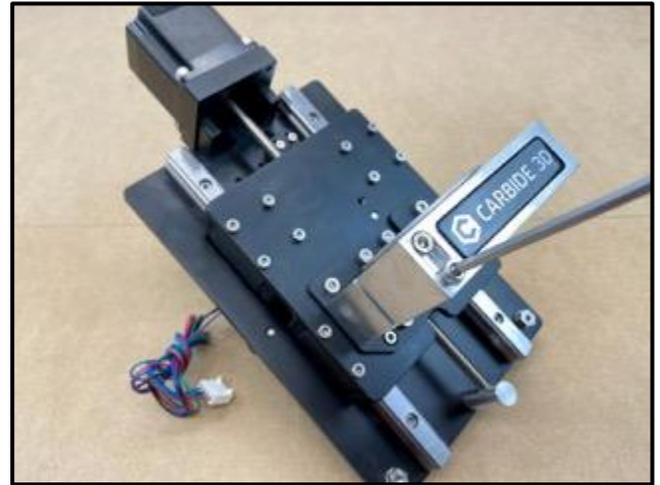


Figure 3-13

Identify and Position the X-Rail

WARNING: The three aluminum extrusion rails are **NOT** identical or interchangeable. It is very important to identify and install each rail in its proper place. If the rails are misidentified now, it could mean having to undo work later.

1. Identify the extrusion rails (see *Figure 3-15*):
 - a. **X-Axis aluminum extrusion rail (X-rail):** has Shapeoko and safety decals on the front and sixteen (16) pre-drilled M4 screw holes along the back. It will be positioned left to right with the v-rail facing front.
 - b. **Y-Axis left aluminum extrusion rail (Y1-rail):** has two (2) pre-drilled M6 screw holes and four (4) pre-drilled M4 screw holes along the outside. It will be installed on the left side of the machine, running front to back, with the v-rail facing to the inside.
 - c. **Y-Axis right aluminum extrusion rail (Y2-rail):** has two (2) pre-drilled M6 screw holes along the outside. It will be installed on the right side of the machine, running front to back, with the v-rail facing to the inside.

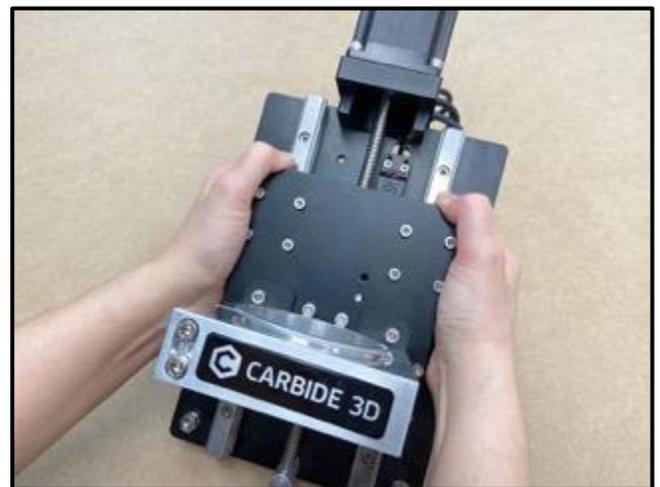


Figure 3-14



Figure 3-15

NOTE: Each aluminum extrusion has a pair of integrated v-rails running the entire length of one side. These v-rails serve as linear tracks for the V-wheels, securing the carriages to the gantry, while at the same time allowing them to glide along smoothly. When properly assembled the v-rails will face to the inside (Y1 and Y2) or forward (X). See *Figure 3-16*.

2. Place the X-rail, with the decals facing the front, across the top of the two empty Y-Axis carriage boxes, as shown in *Figure 3-17*.

Install the Y1-Carriage

1. Identify the Y1 carriage. See *Figure 3-17*.

PRO TIP: Screws going into the ends of the extrusion rails are prone to cross-threading. Pre-screw without the carriage present to clear any debris from the threads. Screws should thread easy with little resistance and without wobble. Also, when attaching the carriage, partially insert each of the four (4) screws before tightening. Tighten a little at a time in a cross-pattern.

2. Use the 4mm hex key and four (4) M6x12mm button head cap screws to attach the Y1-carriage to the left end of the X-rail as shown in *Figure 3-18*.

When properly attached, the motor body will be to the inside and behind the X-rail. The V-wheels, idlers, and motor pulley will be facing out as shown in *Figure 3-18*.

3. Snug the Y1-carriage to the X-rail, but do not fully tighten the screws.

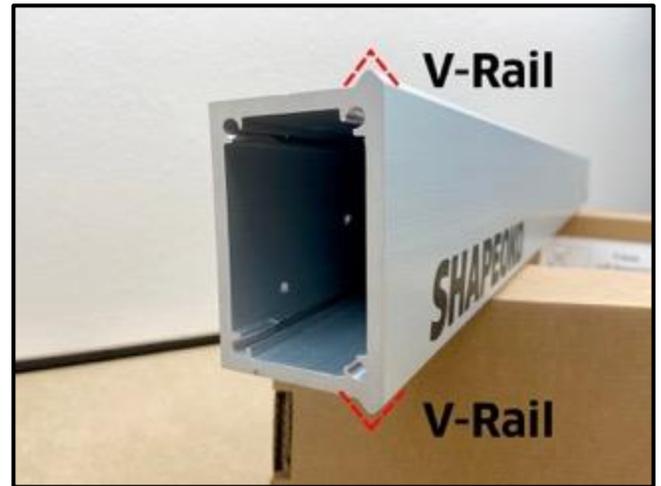


Figure 3-16



Figure 3-17



Figure 3-18

Install the Z-Plus

1. With the router mount facing front, line the four V-wheels up with the two v-rails, and slide the Z-Plus onto the open end of the X-rail. See **Figure 3-19**.

Pay special attention to all four V-wheels making sure they are seated properly on the v-rails. Once the Y2-carriage goes on, the Z-Plus is locked in place.

PRO TIP: Use masking tape to prevent the Z-Plus from rolling back and forth along the X-rail and hitting the other carriages.

Install the Y2-Carriage

1. Locate the Y2-carriage.
2. Use the 4mm hex key and four (4) M6x12mm button head cap screws to attach the Y2-carriage to the right end of the X-rail. See **Figure 3-20**.

When properly attached, the motor body will be to the inside and behind the X-rail. The V-wheels, idlers, and motor pulley will be facing out as shown in **Figure 3-20**.

3. Snug the Y2-carriage to the X-rail, but do not fully tighten the screws.

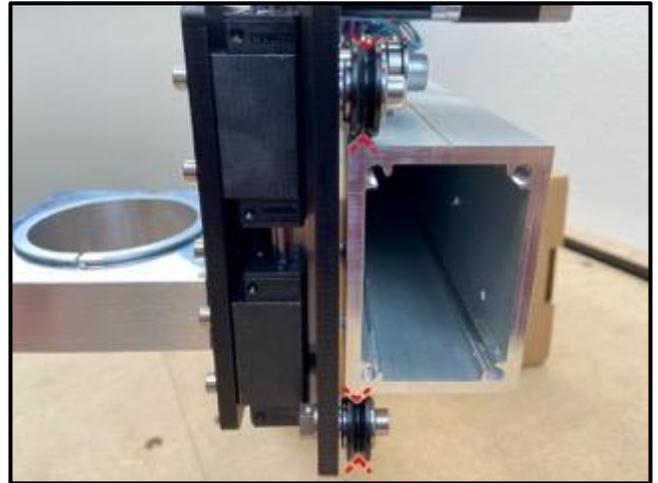


Figure 3-19

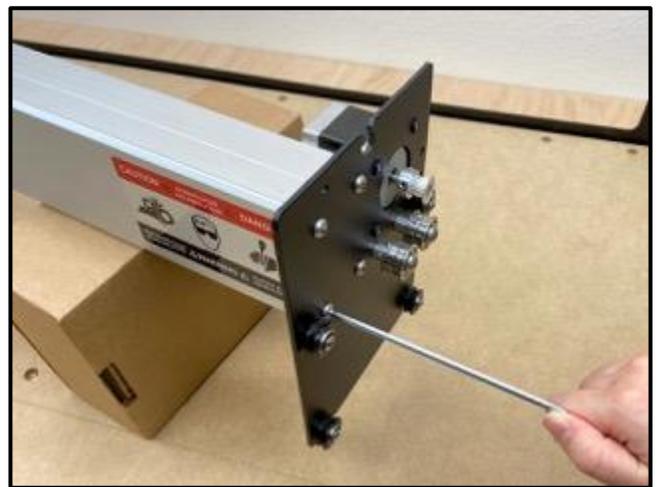


Figure 3-20

Step 4:
Gantry

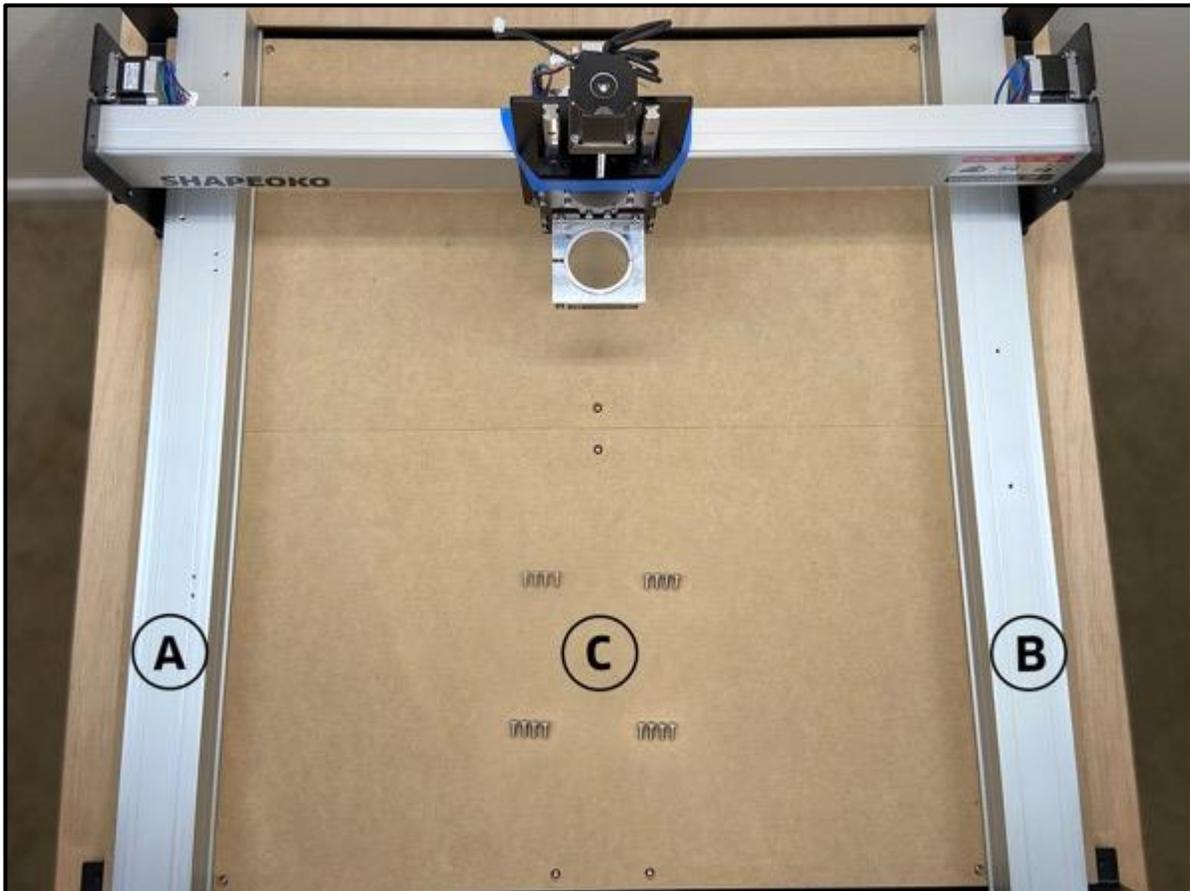


Figure 4-2

Required Components

See *Figure 4-2*:

Item	Description	Location	Qty
A	Y-Axis Left Aluminum Extrusion Rail (Y1-Rail)	N/A	1
C	M6 x 12mm Button Head Cap Screw	XXL Final Assembly Box	8
B	Y-Axis Right Aluminum Extrusion Rail (Y2-Rail)	N/A	1
C	M6 x 12mm Button Head Cap Screw	XXL Final Assembly Box	8

Required Tools

See *Figure 4-3*:

Item	Description	Qty
A	4mm Hex Key	1
B	10mm Wrench	1
C	Foam Packing Block (From the Two Y-Carriage Boxes)	2

Recommended Tools

See *Figure 4-3*:

Item	Description	Qty
D	10mm Combination Wrench	1

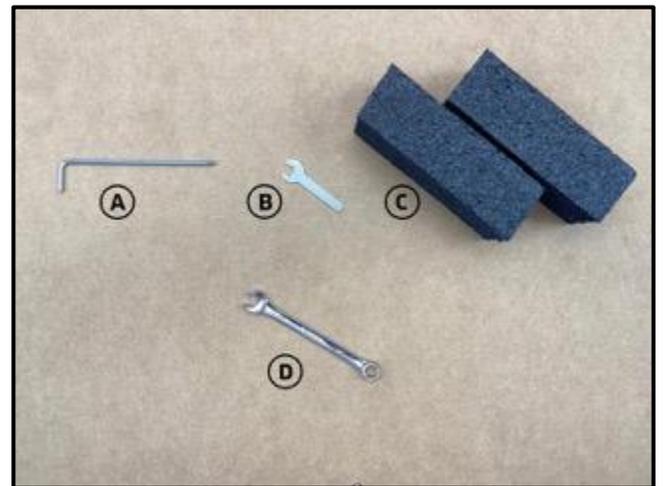


Figure 4-3

Assemble the Gantry

In this step, we'll be connecting the Y1- and Y2-rails to their respective carriages, and then to the baseframe.

Pay very close attention to the positioning of the two rails in **Figure 4-4**. Proper identification of the Y-rails is crucial. The Y1-rail will be installed on the left, the Y2-rail on the right.

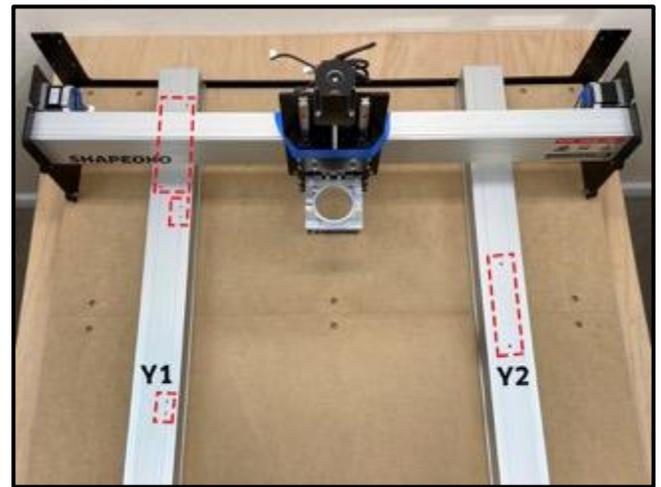


Figure 4-4

PRO TIP: Test fit the Y1- and Y2-rails between the endplates. If the fit is too tight, loosen the twelve (12) screws holding the MDF baseplates to the endplates to give you more room to “tilt” the endplates apart. See **Figure 4-5**.



Figure 4-5

Positioning the X-Rail

1. Position the X-rail with attached carriages diagonally across the baseframe. See **Figure 4-6**.



Figure 4-6

Inserting the Y1-Rail

WARNING: Be sure to insert the Y1-rail right-side up: M6 holes towards the **REAR** and M4 holes along the **TOP**.

1. Slide the integrated v-rails of the Y1-extrusion rail between the four (4) V-wheels of the Y1-carriage. Center the rail with the carriage plate. See *Figure 4-7*.

Inserting the Y2-Rail

1. Slide the integrated v-rails of the Y2-extrusion rail between the four (4) V-wheels of the Y2-carriage. Center the rail with the carriage plate. See *Figure 4-8*.

Secure the Gantry

PRO TIP: During this stage of the assembly, it is helpful to have another set of hands. The gantry system is large, heavy, and awkward for one person to handle alone.

Positioning the Gantry

1. With the help of another person, very carefully lift, rotate, and lower the gantry so that the Y1- and Y2-rails are positioned between the front and rear endplates. The Y1-rail should be along the left, the Y2-rail along the right, and the Z-Plus facing front. See *Figure 4-9*.

Securing the Y1-Rail

The Y1- and Y2- rails will be raised into place one at a time. The first rail to be lifted (the Y1-rail) is loosely attached to the endplates with two (2) screws, one front and one back. This creates a pivot point for rotating the Y2-rail up and into place

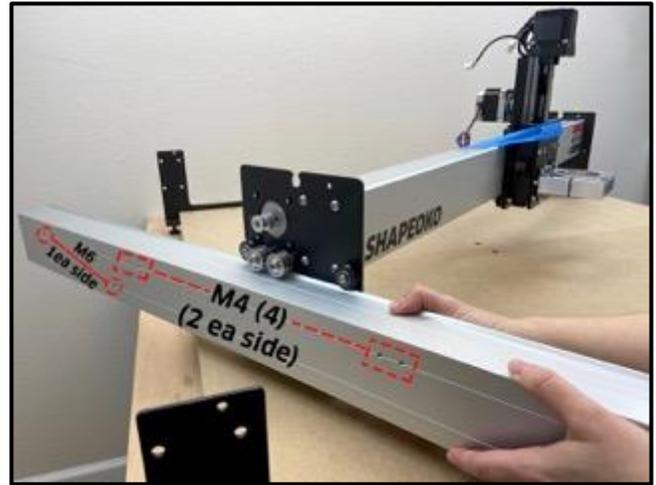


Figure 4-7

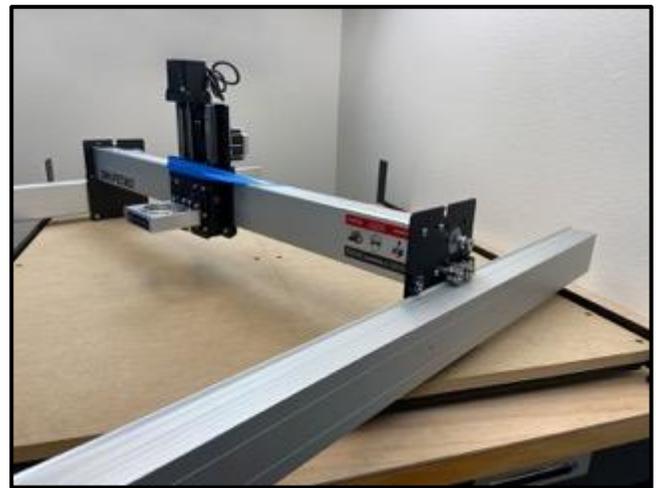


Figure 4-8

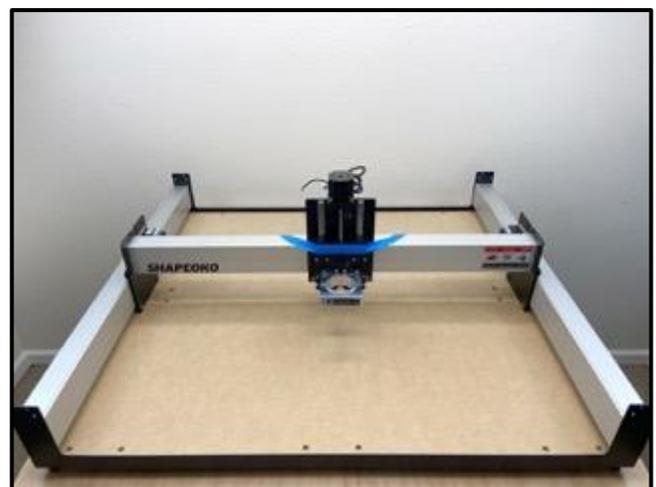


Figure 4-9

PRO TIP: Prop up the extrusions with the two foam blocks from the Y-Axis Left and Right Assembly boxes to help line up the mounting holes. See **Figure 4-10**.

1. Line up the Y1-rail with the **UPPER-INSIDE** mounting holes of the front and rear endplates. See **Figure 4-10**.
2. Use the 4mm hex key and two (2) M6x12mm button head cap screws to loosely secure the Y1-rail to the front and rear endplates. See **Figure 4-10**.

Keep these two (2) screws loose for now. They provide support and create the pivot point needed to rotate the Y2-rail into place.

Securing the Y2-Rail

1. Remove the two foam blocks from under the Y1-rail and use them to prop up the Y2-rail.
2. Use the 4mm hex key and eight (8) M6x12mm button head cap screws to secure the Y2-rail to the front and rear endplates. See **Figure 4-11**.

Completing Rail Assembly

1. Use the 4mm hex key and the remaining six (6) M6x12mm button head cap screws to completely secure the Y-1 rail to the front and rear endplates.
2. Snug all sixteen (16) screws, leaving no gap between the rails and endplates, but do not fully tighten.

Tension the V-Wheels

1. Use the 10mm wrench to turn the two (2) eccentric nuts of all three carriages (Z-Plus, Y1, and Y2) clockwise until the V-wheels engage with the v-rails. See **Figure 4-12**.

Refer back to the eccentric nut information on page 20 and **Figures 3-4** and **3-5**, if needed.

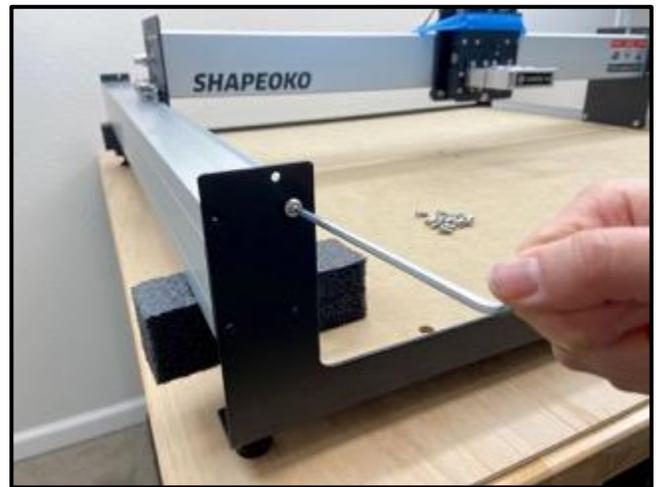


Figure 4-10

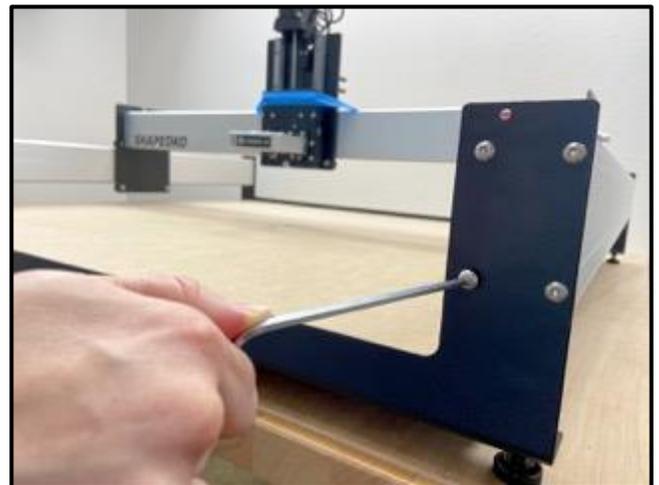


Figure 4-11



Figure 4-12

Step 5: Belting

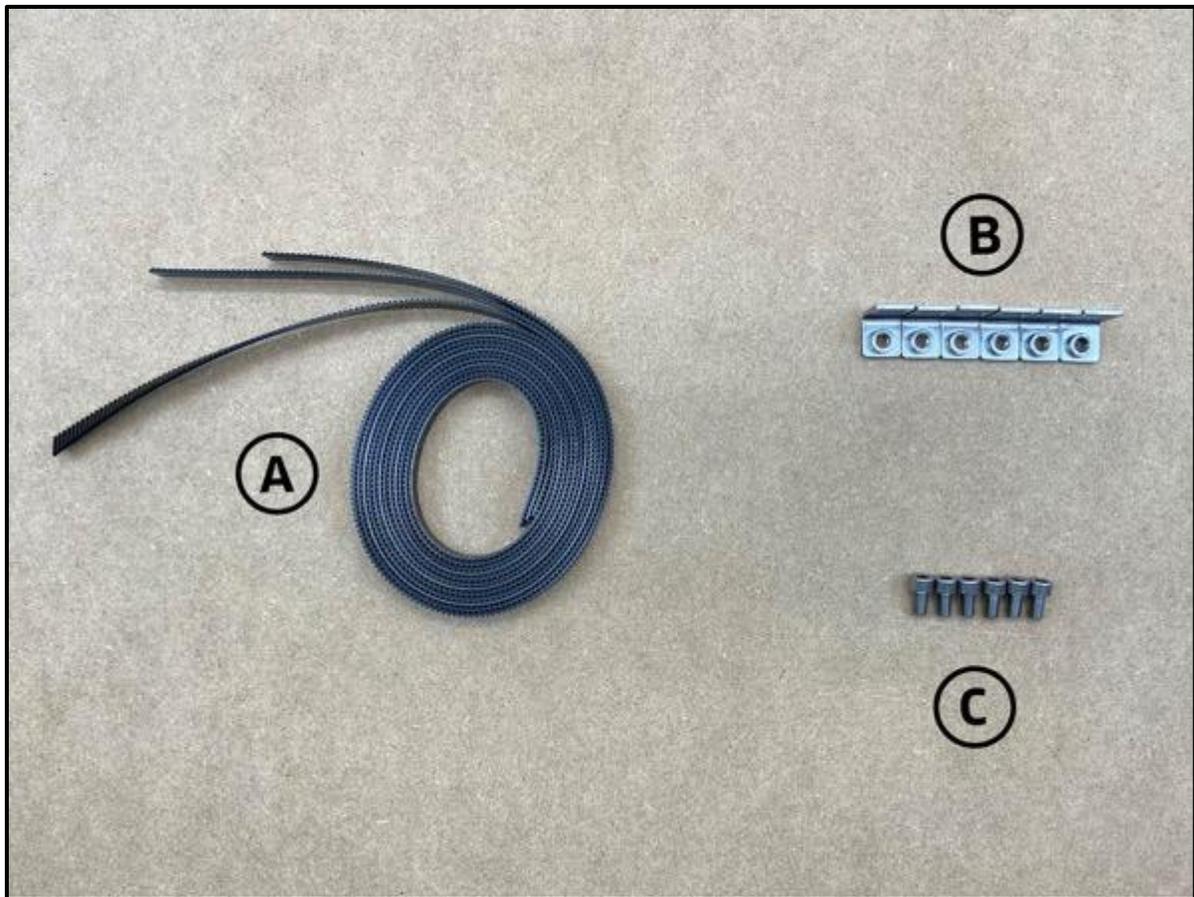


Figure 5-2

Required Components

See *Figure 5-2*:

Item	Description	Location	Qty
A	Toothed Belt (1200mm each)	XXL Final Assembly Box	3
B	Belt Clip	XXL Final Assembly Box	6
C	M6 x 12mm Button Head Cap Screw	XXL Final Assembly Box	6

Required Tools

See *Figure 5-3*:

Item	Description	Qty
A	3 and 4mm Hex Key	2
B	Tape Measure or Ruler (not included)	1

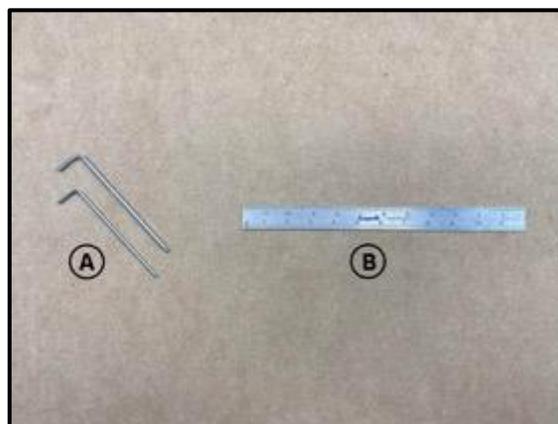


Figure 5-3

Belts and Belt Clips

The Shapeoko XXL ships with three 1200mm steel-core toothed belts. These belts engage with the stepper motors to drive the gantry. Belts are secured to the rail using belt clips. Each right-angle belt clip has an integrated PEM nut on the short leg and two parallel slots on the long leg. All six belt clips attach to the belts in the same way; follow the process described below and shown in *Figure 5-4*.

Each right-angle belt clip has an integrated PEM nut on the short leg and two parallel slots on the long leg. All six belt clips attach to the belts in the same way; follow the process described below and shown in *Figure 5-4*.



Figure 5-4

1. Thread 2-1/2 inches of belt through the outer slot of the belt clip with teeth facing in toward the PEM nut.
2. Loop this end of belt down and through the inner slot of the clip. Pull the belt tight against the belt clip. The length of the short end should now be about 2 inches.
3. Bring the two sections of belt together. Interlock the teeth and extend belt away from the PEM nut.

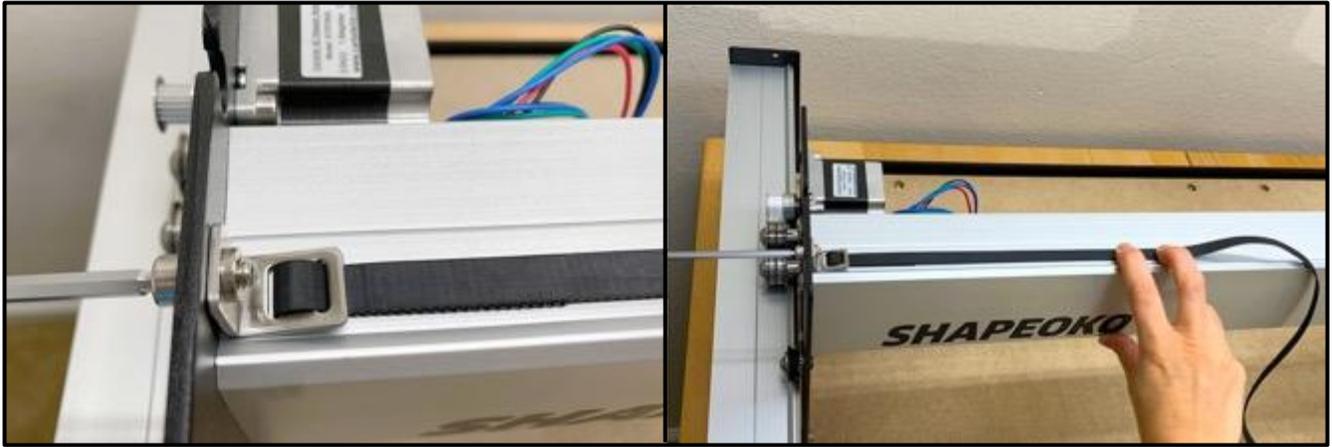


Figure 5-5

Install the X-Rail Belt

1. Attach a belt clip to one end of a belt. (Refer back to *Figure 5-4*.)
2. Set the belt clip on top of the X-rail next to the Y1-carriage. The belt should lay flat, teeth down, and extend along the X-rail towards the Z-Plus. Ensure the teeth of the bottom 2-inches of belt interlock with the top. See *Figure 5-5*.
3. Use the 4mm hex key and one (1) M5x10mm socket head cap screw to attach the belt clip to the Y1-carriage. Insert the screw from the **OUTSIDE** and tighten. See *Figure 5-5*.
4. Feed the belt under the two idlers on the back of the Z-Plus. Make sure the belt does not twist and the teeth remain facing down all the way to the Y2-carriage. See *Figure 5-6*.



Figure 5-6

Do not attach the other end of the belt just yet.

5. Slide the 3mm hex key under the belt, between the two idlers. Use the hex key as a lever against the X-rail to push a loop of belt up between the two idlers as shown in *Figure 5-7*.

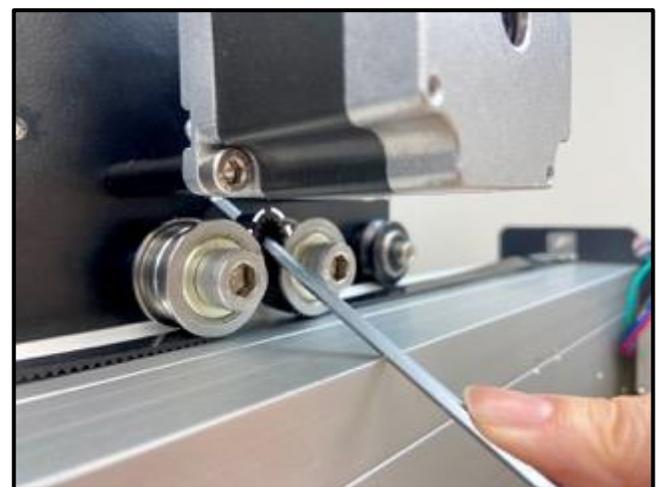


Figure 5-7

6. Use the 3mm hex key to reach in between the X-motor and carriage plate, hook the loop, and pull it up and out towards you. See *Figure 5-8*.

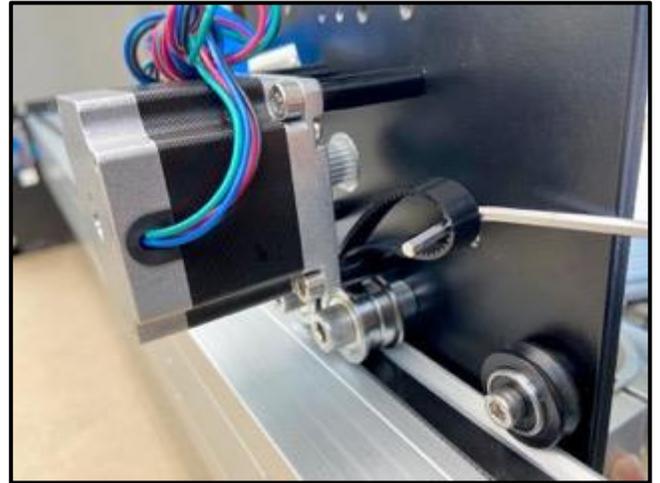


Figure 5-8

Make sure the belt has not twisted and the teeth are still facing down, then place the belt loop over the X-motor pulley. See *Figure 5-9*.

7. Very gently take the slack out of the belt by slowly pulling the free end toward the Y2-carriage.

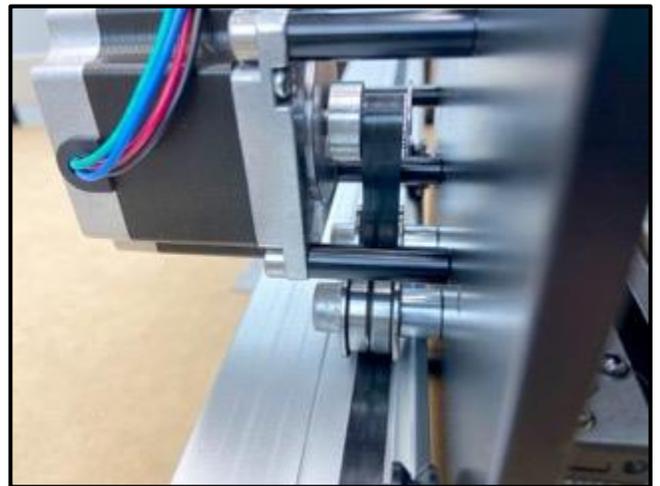


Figure 5-9

8. Attach another belt clip to the other end of the belt. (Refer back to *Figure 5-4*.)
9. Adjust the amount of belt you feed through the second belt clip so that when it's laid flat against the X-rail (with the slack removed, but without stretching it), a 1/4-inch gap exists between the belt clip and the Y2-carriage. Ensure the teeth of the bottom few inches of belt interlock with the top. See *Figure 5-10*.

NOTE: The belt should be tight enough to snap against the Y1-rail when gently lifted.

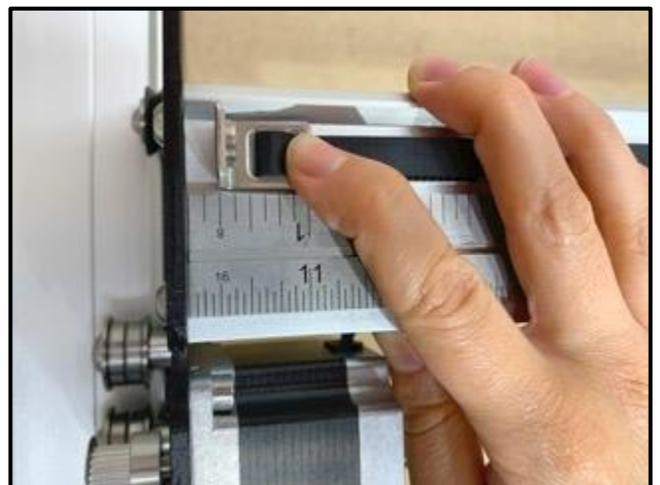


Figure 5-10

10. Use the 4mm hex key and one (1) M5x10mm socket head cap screw to attach the belt clip to the Y2-carriage. Insert the screw from the **OUTSIDE** and tighten. Do not over tighten as this could bend the X-motor pulley. See *Figure 5-11*.

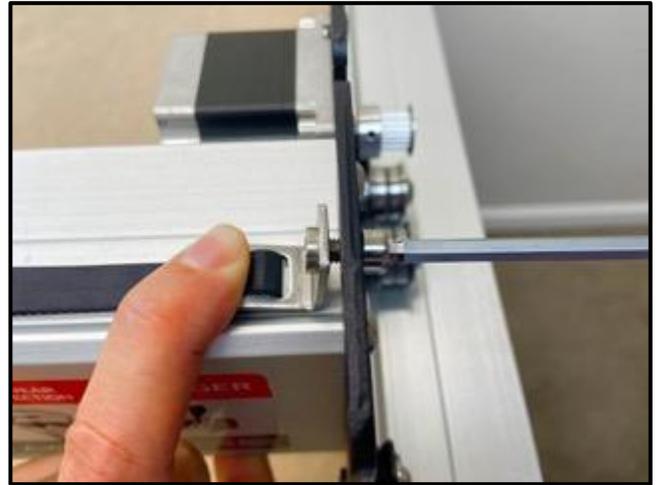


Figure 5-11

Install the Y1-Rail Belt

1. Attach a belt clip to one end of a second belt. (Refer back to *Figure 5-4*.)
2. Set the belt clip on top of the Y1-rail next to the front endplate. The belt should lay flat, teeth down, and extend along the Y1-rail towards the Y1-carriage. Ensure the teeth of the bottom 2-inches of belt interlock with the top. See *Figure 5-12*.
3. Use the 4mm hex key and one (1) M5x10mm socket head cap screw to attach the belt clip to the front endplate. Insert the screw from the **FRONT** and tighten. See *Figure 5-12*.
4. Feed the belt under the two idlers on the outside of the Y1-carriage. Make sure the belt does not twist and the teeth remain facing down all the way to the rear endplate. See *Figure 5-13*.

Do not attach the other end of the belt just yet.



Figure 5-12



Figure 5-13

5. Slide the 3mm hex key under the belt, between the two idlers, and use it as a lever against the X-rail to push a loop of belt up between the two idlers as shown in *Figure 5-14*.
6. Use the 3mm hex key to hook the belt and pull it up between the two idlers.
7. Make sure the belt has not twisted and the teeth are still facing down, then place the belt loop over the Y1-motor pulley. See *Figure 5-15*.
8. Very gently take the slack out of the belt by slowly pulling the free end toward the rear endplate.
9. Attach a belt clip to the free end of the belt. (Refer back to *Figure 5-4*.)
10. Adjust the amount of belt you feed through the second belt clip so that when it's laid flat against the Y1-rail (with the slack removed, but without stretching it) a 1/4-inch gap exists between the belt clip and the rear endplate. Ensure the teeth of the bottom few inches of belt interlock with the top.
11. Use the 4mm hex key and one (1) M5x10mm socket head cap screw to attach the belt clip to the rear endplate. Insert the screw from the **BACK-SIDE** and tighten. Do not over tighten as this could bend the Y1-motor pulley. See *Figure 5-16*.

NOTE: The belt should be tight enough to snap against the Y1-rail when gently lifted.

Install the Y2-Rail Belt

PRO TIP: The Y2-belt installation process is a mirror image of the Y1-belt installation process.

1. Install the remaining belt on the Y2-rail, following steps 1-11 of the "Install the Y1-Rail Belt" section above.

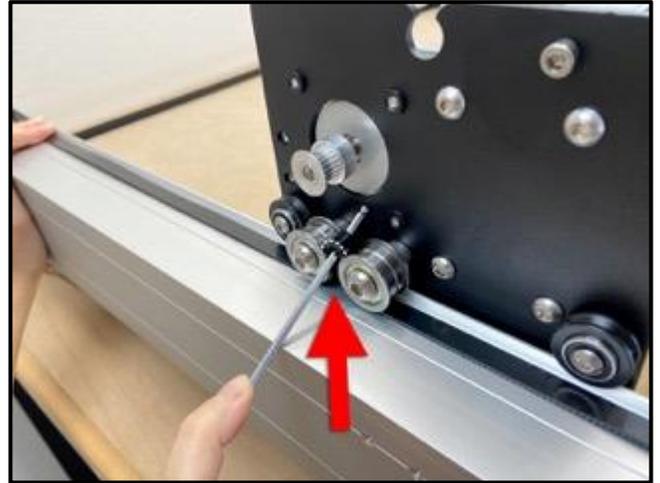


Figure 5-14

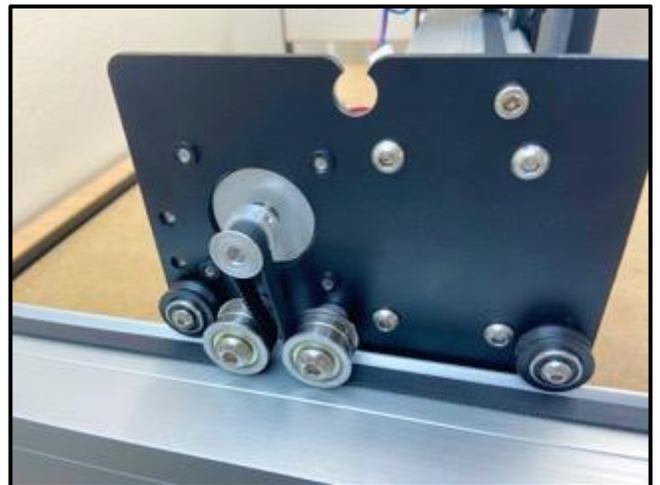


Figure 5-15

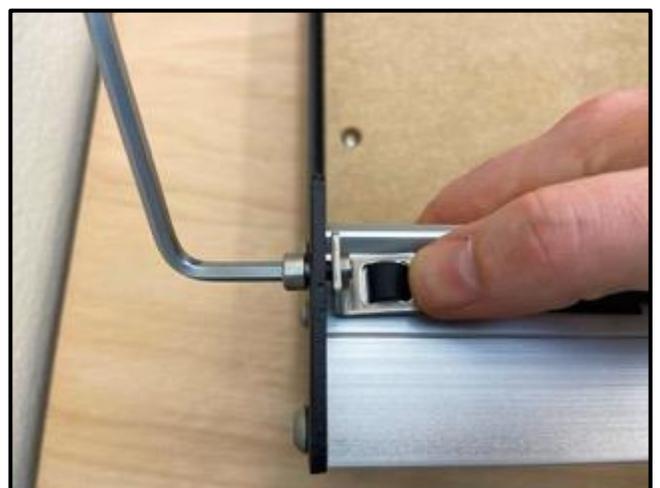


Figure 5-16

Step 6: Drag Chains

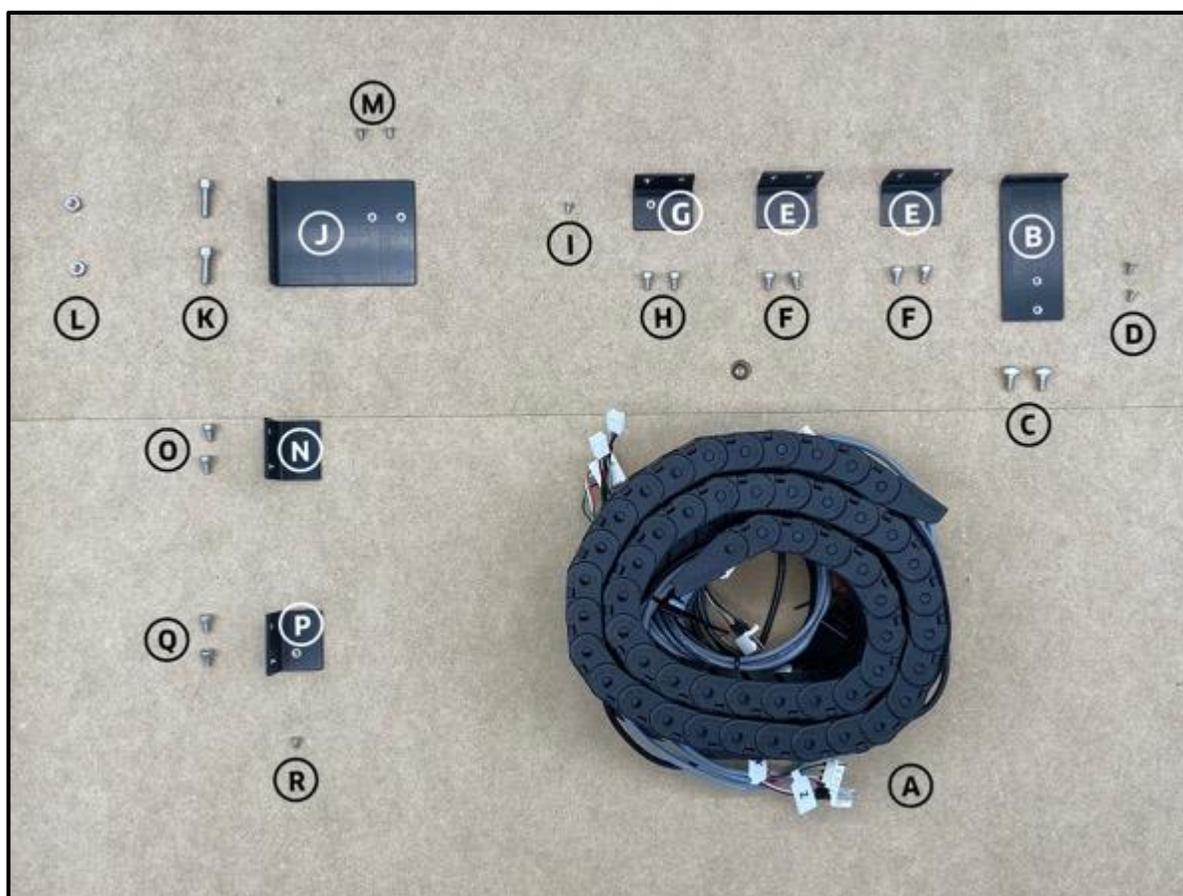
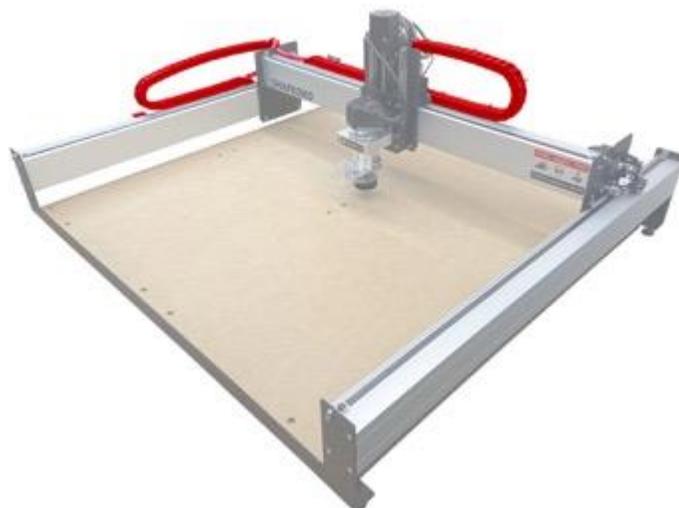


Figure 6-2

Required Components

See *Figure 6-2*:

Item	Description	Location	Qty
A	Wiring Harness (X-Axis Drag Chain & Y-Axis Drag Chain)	Wiring Harness Box	1
*** ** X-AXIS DRAG CHAIN SUPPORT SYSTEM *** **			
B	X-Axis Drag Chain Head Bracket	Wiring Harness Box	1
C	M5 x 8mm Socket Head Cap Screw	Wiring Harness Box	2
D	M3 x 4mm Flat Head Screw	Wiring Harness Box	2
E	Drag Chain Support Bracket	Wiring Harness Box	2
F	M4 x 6mm Socket Head Cap Screw	Wiring Harness Box	4
G	Drag Chain Tail Bracket	Wiring Harness Box	1
H	M4 x 6mm Socket Head Cap Screw	Wiring Harness Box	2
I	M3 x 4mm Flat Head Screw	Wiring Harness Box	1
*** ** Y-AXIS DRAG CHAIN SUPPORT SYSTEM *** **			
J	Y-Axis Drag Chain Head Bracket	Wiring Harness Box	1
K	M5 x 16mm Socket Head Cap Screw	Wiring Harness Box	2
L	M5 Nut	Wiring Harness Box	2
M	M3 x 4mm Flat Head Screw	Wiring Harness Box	2
N	Drag Chain Support Bracket	Wiring Harness Box	1
O	M4 x 6mm Socket Head Cap Screw	Wiring Harness Box	2
P	Drag Chain Tail Bracket	Wiring Harness Box	1
Q	M4 x 6mm Socket Head Cap Screw	Wiring Harness Box	2
R	M3 x 4mm Flat Head Screw	Wiring Harness Box	1

Required Tools

See *Figure 6-3*:

Item	Description	Qty
A	2, 3, and 4mm Hex Key	3
B	8mm Wrench	1

Recommended Tools

See *Figure 6-3*:

Item	Description	Qty
A	8mm Combination Wrench	1

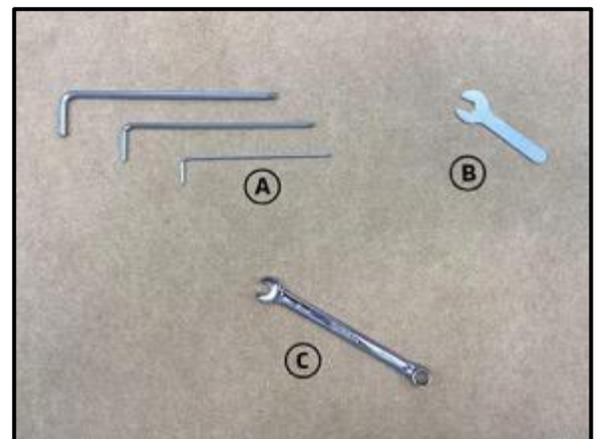


Figure 6-3

Install Drag Chain Supports

There are three types of drag chain supports: head brackets, tail brackets, and support brackets. The longer head brackets are unique. However, the two (2) tail brackets and three (3) support brackets respectively are identical and interchangeable. Tail brackets are identified by their single PEM nut. All supports install flange down. The tail and support brackets attach to the X- and Y1-rails via the horizontal sets of M4 screw holes.

Installing the X-Axis Supports

1. Gather the X-Axis drag chain head bracket (the narrower of the two black head brackets), a tail bracket (single PEM nut) and two (2) support brackets (no PEM nut).
2. Use the 3mm hex key and two (2) M5x8mm socket head cap screws to secure the head bracket to the back of the Z-Plus, just above the X-motor. See *Figure 6-4*.
3. Use the 3mm hex key and two (2) M4x6mm socket head cap screws to attach one (1) drag chain support bracket to the back of the X-rail, closest to the Y2-carriage.
4. Repeat with the second support bracket in the center of the X-rail. See *Figure 6-5*.
5. Use the 3mm hex key and two (2) M4x6mm socket head cap screws to attach one (1) drag chain tail bracket to the back of the X-rail closest to the Y1-carriage. See *Figure 6-5*.

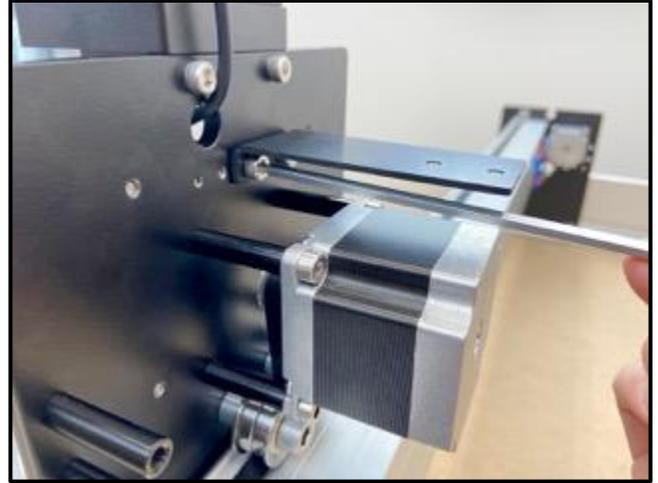


Figure 6-4

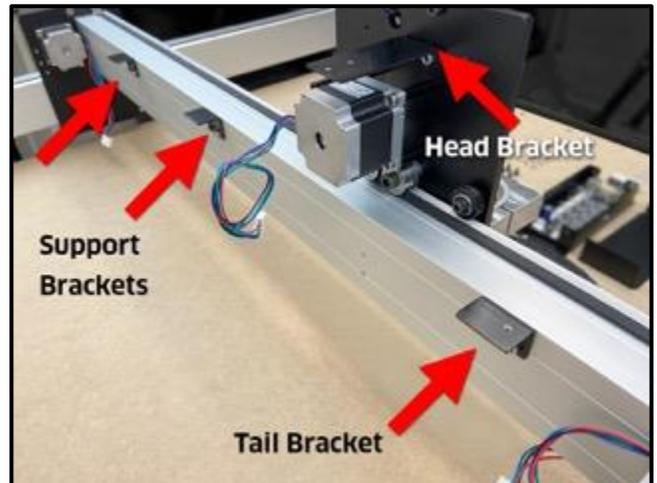


Figure 6-5

Installing the Y-Axis Supports

NOTE: To accommodate the other two sizes of Shapeoko machines, the Y1-motor is mounted to the Y1-carriage with four (4) M5x10mm socket head cap screws. However, to attach the drag chain head bracket to the Shapeoko XXL, the top two (2) motor-mount screws will need to be replaced by two (2) longer M5x16mm socket head cap screws. Once replaced, the shorter screws will no longer be needed. See *Figure 6-6*.

Use the 4mm hex key to remove the top two (2) M5x10mm socket head cap screws mounting the Y1-motor to the Y1-carriage plate and replace them with the longer two (2) M5x16mm socket head cap screws. See **Figure 6-6**. Once replaced, you will be able to see the screws protruding through the Y1-carriage as shown in **Figure 6-6**.

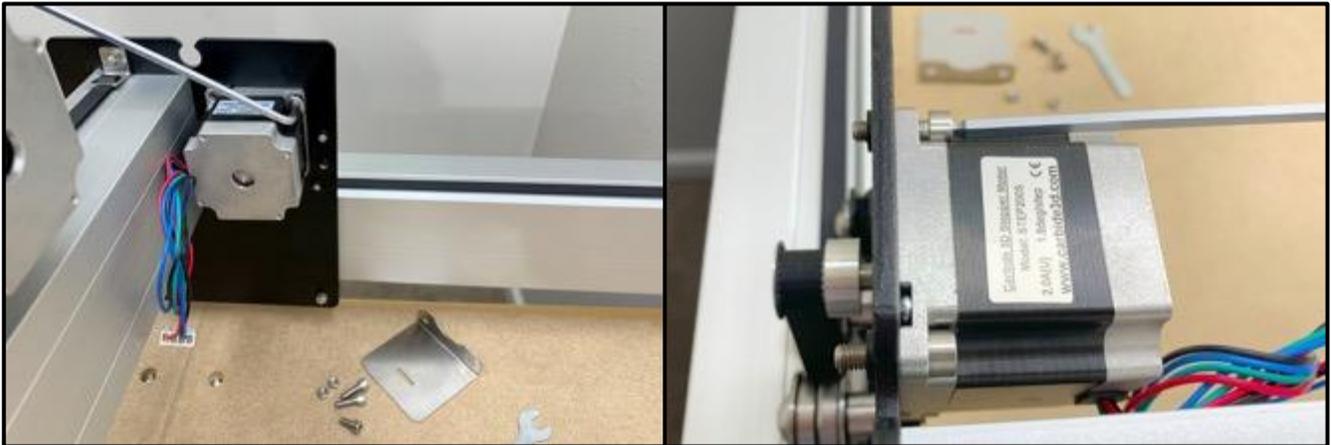


Figure 6-6

1. Gather the remaining Y-Axis drag chain support brackets.
2. Use the 8mm wrench and two (2) M5 nuts to secure the head bracket to the two protruding M5x16mm socket head cap screws on the Y1-carriage above the Y1-motor pulley. See **Figure 6-7**.

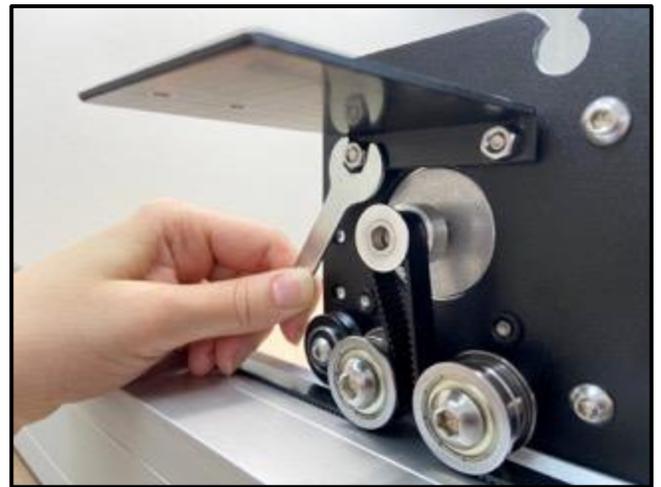


Figure 6-7

3. Use the 3mm hex key and two (2) M4x6mm socket head cap screws to attach the support bracket (no PEM nut) to the outside of the Y1-rail. Install closest to the front endplate. See **Figure 6-8**.
4. Use the 3mm hex key and two (2) M4x6mm socket head cap screws to attach the tail bracket (single PEM nut) to the outside of the Y1-rail closest to the rear endplate. See **Figure 6-8**.

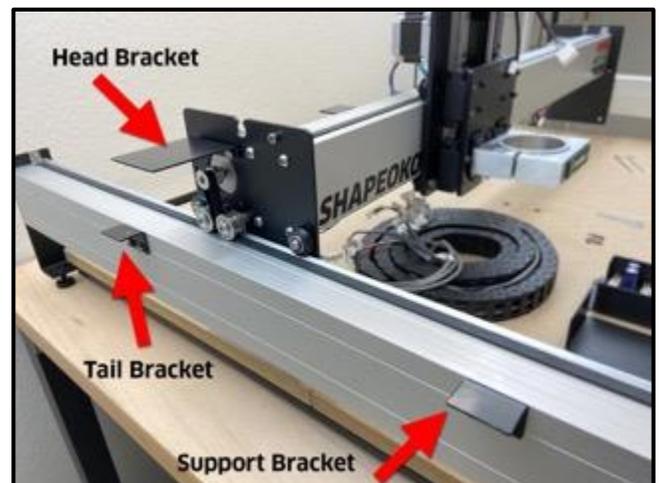


Figure 6-8

Install the Wiring Harness

WARNING: Be careful when handling the wiring harness not to damage any of the proximity switches or stepper motor extensions and connectors. Also, the drag chains will only curl in one direction. Do not force the drag chain to bend; if it doesn't curl easily, simply turn it over and try again.

Important Wiring Harness Information

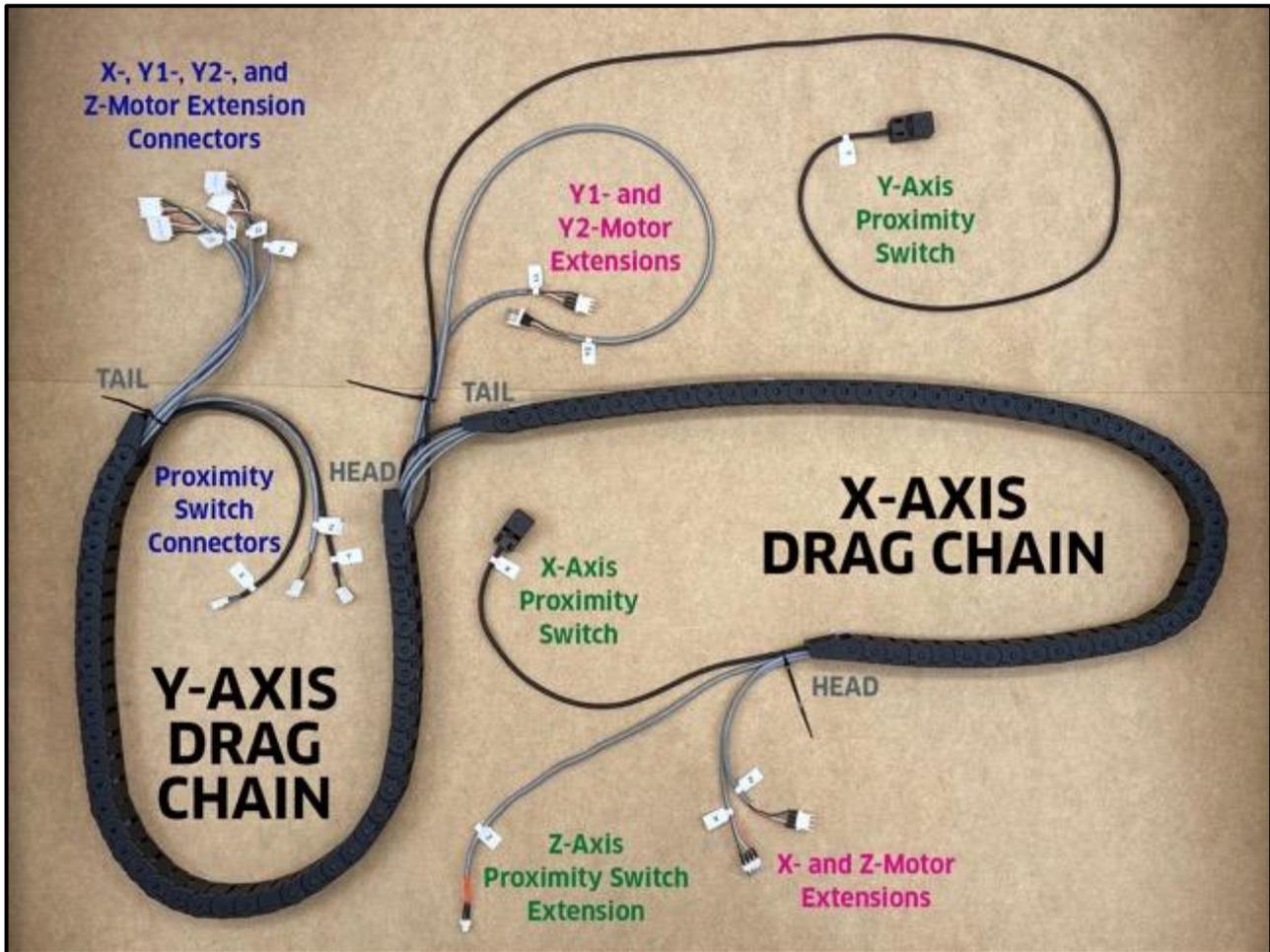


Figure 6-9

THE WIRING HARNESS

The complete wiring harness consists of the Y-Axis drag chain, X-Axis drag chain, four stepper motor extension cables, two proximity switches with cables, and one proximity switch extension cable. The drag chain organizes and protects all the cables needed to operate the machine. It distributes power, and connects the controller unit (the brains), to all the moving parts (the muscles). Although one unit, we often break it up into the Y-Axis drag chain and the X-Axis drag chain. Take a minute to familiarize yourself with all of its components described below and shown in *Figure 6-9*.

Y-Axis Drag Chain

The Y-Axis drag chain rests on the Y1-rail and serves as the protective housing for all seven of the extension cables. It has 44 chain links with its tail being next to the controller unit and head on the Y1-carriage.

X-Axis Drag Chain

The X-Axis drag chain rests on the X-rail and serves as the protective housing for only four of the cables, the X- and Z-extension cables, the X-Axis proximity switch, and the Z-Axis proximity switch extension. It has 54 chain links with its tail being next to the Y1-carriage and head on the Z-plus.

Stepper Motor Extension Cables

There are four stepper motors, the Y1-, Y2-, X- and Z-Axis stepper motors. The Y1- and Y2-motors work in tandem to drive the gantry forward and backward. The X-motor moves it left and right. The Z-motor moves it up and down. They are all connected to the controller unit by four gray 4-pin extension cables, pre-installed in the wiring harness.

Proximity Switches and Cables

There are three inductive proximity switches, one each for the X-, Y-, and Z-Axis. They set the origin for the machine and determine the limits of the work area. The X- and Y-switches, attached to the ends of their black 3-pin extension cables, are labeled and routed through the drag chains. The Z-Axis switch comes pre-installed on the front of the Z-Plus. It has a separate grey 3-pin extension cable that is routed through the drag chains.

Installing the Y-Axis Drag Chain

1. Unroll and lay out the wiring harness on the baseframe, move the X-rail all the way to the FRONT, and move the Z-Plus 8 to 10-inches from the Y2-carriage as shown in *Figure 6-10*.

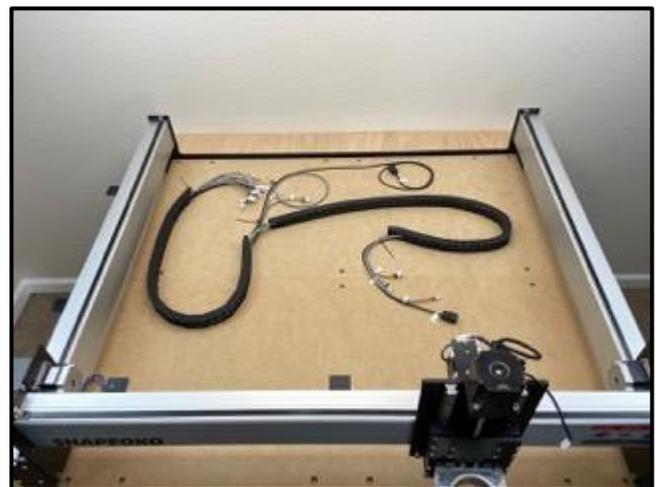


Figure 6-10



Figure 6-11

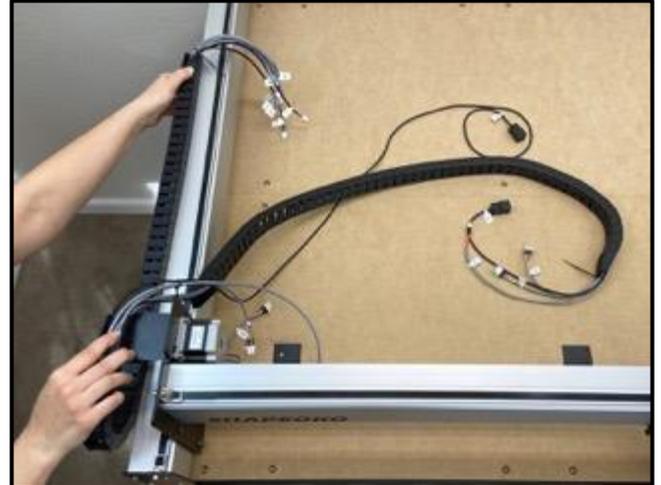


Figure 6-12

2. Reach over the X-rail and lift the tail of the Y-Axis drag chain with your left hand and the head with your right, as shown in **Figure 6-11**.
3. Rest the tail flat on the tail bracket (has single PEM nut) at the rear, and head on the Y-Axis drag chain head bracket at the front. See **Figure 6-12**.
4. Use the 2mm hex key and two (2) M3x4mm flat head screws to secure the Y-Axis drag chain to the head bracket as shown in **Figure 6-13**.

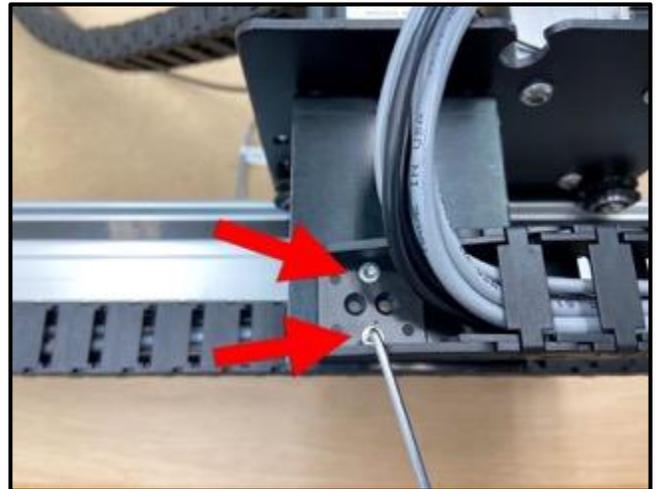


Figure 6-13

5. Use the 2mm hex key and one (1) M3x4mm flat head screw to attach the drag chain to the single PEM nut in the tail bracket at the rear. Use the center through-hole closest to the end of the drag chain. See **Figure 6-14**.

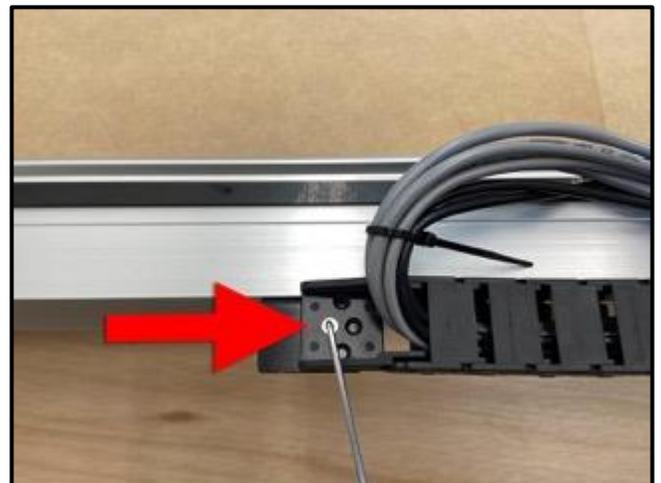


Figure 6-14

Installing the X-Axis Drag Chain

1. Reach over the X-rail and lift the X-Axis drag chain. Lay it flat along the length of the X-rail with the head near the Y2-carriage curling upwards. See **Figure 6-15**.
2. Curl the head of the drag chain up and towards the Z-Plus and rest it on top of the X-Axis drag chain head bracket. See **Figure 6-15**.
3. Use the 2mm hex key and two (2) M3x4mm flat head screws to secure the X-Axis drag chain to the head bracket. See **Figure 6-15**.

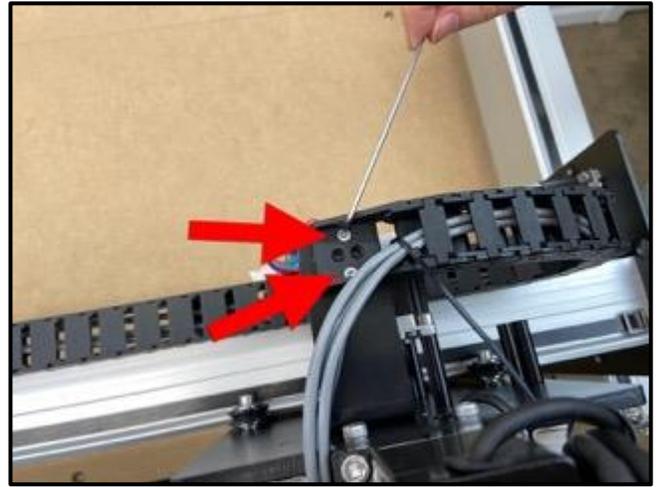


Figure 6-15

4. Use the 2mm hex key and one (1) M3x4mm flat head screw to attach the tail of the drag chain to the single PEM nut in the tail bracket. Use the center through-hole closest to the end of the drag chain. See **Figure 6-16**.



Figure 6-16

Step 7: Proximity Switches

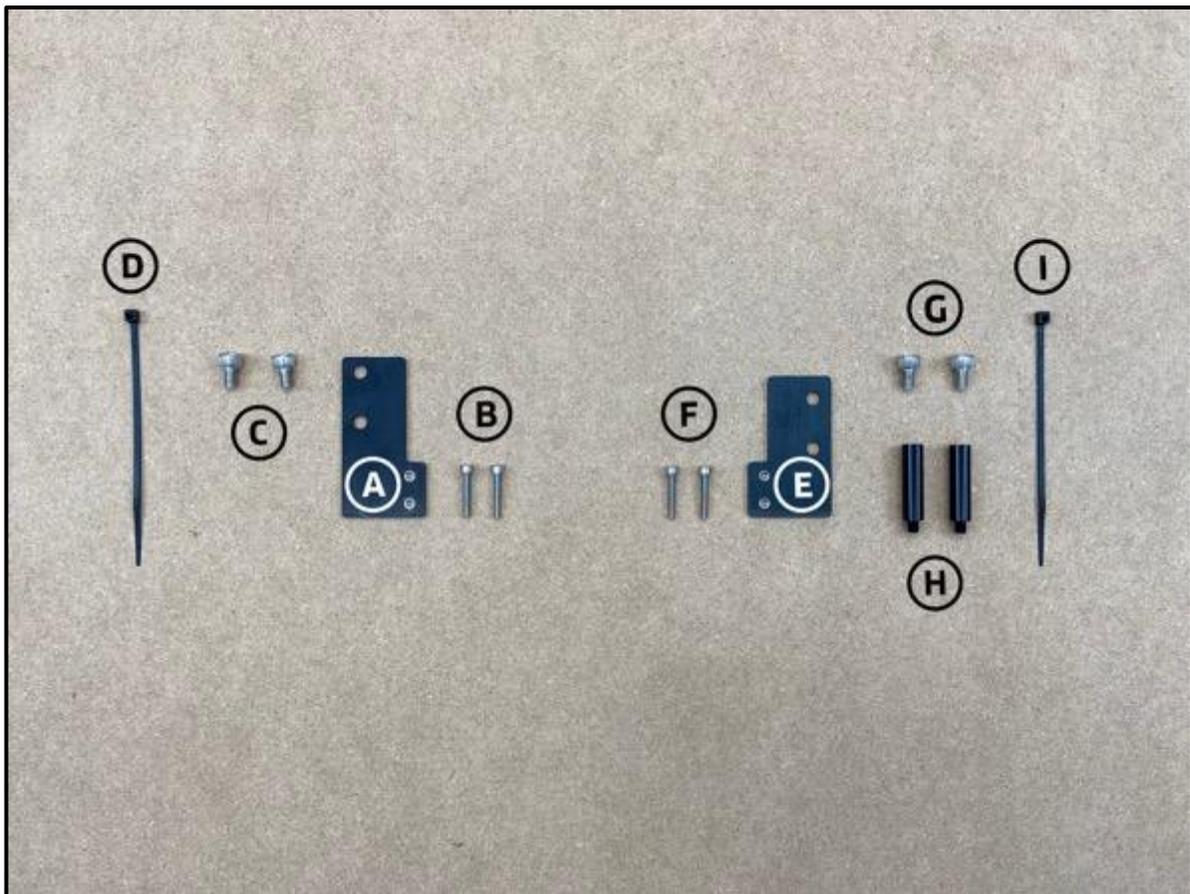


Figure 7-2

Required Components

See *Figure 7-2*:

Item	Description	Location	Qty
A	X-Axis Proximity Switch Plate	Wiring Harness Box	1
B	M3 x 18mm Socket Head Cap Screw	Wiring Harness Box	2
C	M5 x 8mm Socket Head Cap Screw	Wiring Harness Box	2
D	Cable tie	Wiring Harness Box	1
E	Y-Axis Proximity Switch Plate	Wiring Harness Box	1
F	M3 x 18mm Socket Head Cap Screw	Wiring Harness Box	2
G	M5 x 8mm Socket Head Cap Screw	Wiring Harness Box	2
H	Male to Female 30mm Standoff	Wiring Harness Box	2
I	Cable tie	Wiring Harness Box	1

Required Tools

See *Figure 7-3*:

Item	Description	Qty
A	2.5 and 4mm Hex Key	2

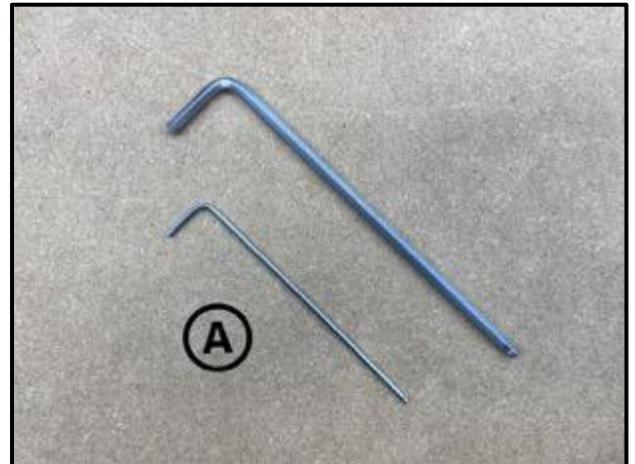


Figure 7-3

Install the Proximity Switches

The Shapeoko XXL includes three inductive proximity switches. The Z-Axis proximity switch is pre-installed on the front of the Z-Plus. The X- and Y-Axis switches are pre-installed in the wiring harness. See *Figure 7-4*.

Installing the X-Axis Proximity Switch

The X-Axis proximity switch exits the X-Axis drag chain behind the Z-Plus. It attaches to the X-Axis proximity switch mounting plate then mounts to the **BACK** of the Z-Plus.

1. Locate the X-Axis switch plate, the taller of the two plates, and the proximity switch labeled "X."



Figure 7-4

- Align the switch and plate, with the switch facing left and the plate's two PEM nuts in the **BOTTOM-RIGHT** corner. Flush the face of the switch with the edge of the plate. See *Figure 7-5*.
- Use the 2.5mm hex key and two (2) M3x18mm socket head cap screws to attach the switch to the plate. Make sure the front edge of the proximity switch and plate stay flush. See *Figure 7-5*.

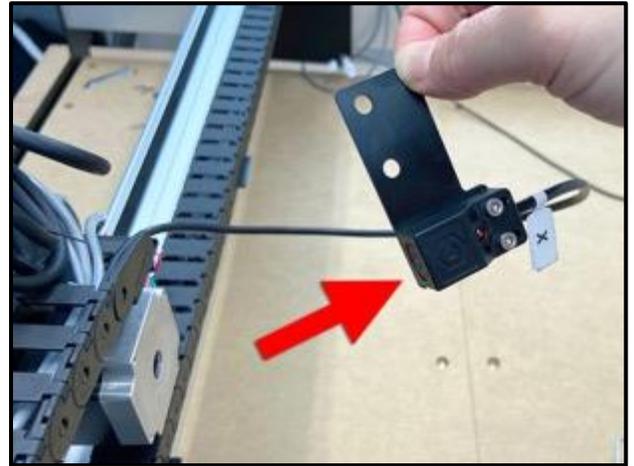


Figure 7-5

- Route the proximity switch cable and mounting plate behind, then through the loop of the X-Axis drag chain. See *Figure 7-6*.
- Use the 4mm hex key and two (2) M5x8mm socket head cap screws to install the mounting plate to the two 30mm standoffs at the rear of the Z-Plus. See *Figure 7-6*.
- Use one (1) cable tie to secure the proximity switch cable to the upper standoff. See *Figure 7-6*.

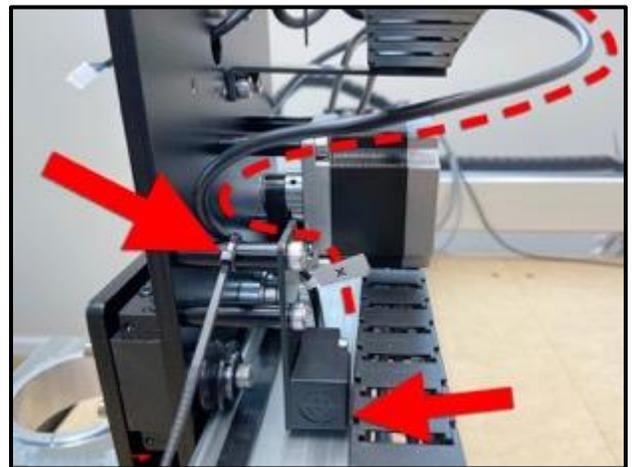


Figure 7-6

Installing the Y-Axis Proximity Switch

The Y-Axis proximity switch exits the Y-Axis drag chain at the Y1-carriage. It attaches to the Y-Axis switch plate then mounts to the **OUTSIDE** of the Y2-carriage.

- Locate the Y-Axis proximity switch mounting plate and the proximity switch labeled "Y."
- Align the switch and plate, with the switch facing right and the plate's two PEM nuts in the **BOTTOM-LEFT** corner. Flush the face of the switch with the edge of the plate. See *Figure 7-7*.
- Use the 2.5mm hex key and two (2) M3x18mm socket head cap screws to attach the switch to the plate. Make sure the front edge of the proximity switch and plate stay flush. See *Figure 7-7*.



Figure 7-7

4. Install the two (2) male to female 30mm standoffs to the **OUTSIDE** of the Y2-rail. See *Figure 7-8*.
5. Route the proximity switch cable and mounting plate all the way across the machine, behind the X-rail, to the **OUTSIDE** of the Y2-carriage.
6. Use the 4mm hex key and two (2) M5x8mm socket head cap screws to install the mounting plate to the two 30mm standoffs on the **OUTSIDE** of the Y2-rail with the switch to the outside of the plate and facing the rear. See *Figure 7-9*.
7. Use one (1) cable tie to secure the proximity switch cable to the upper standoff. See *Figure 7-9*.

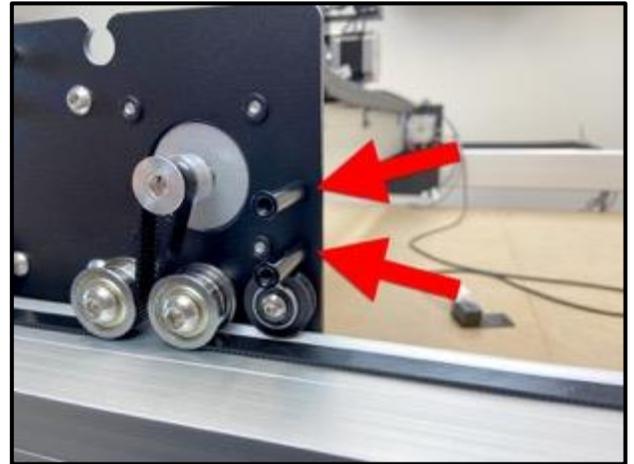


Figure 7-8

Connecting the Z-Axis Proximity Switch

1. Locate the short black Z-Axis proximity switch cable exiting the back of the Z-Plus and the long gray 3-pin extension cable labeled "Z" exiting the head of the X-Axis drag chain.

NOTE: The connections on the 3-pin (proximity switch cables) and 4-pin connectors (motor extension cables) are polarized and can only be connected one way. Do not force a connection. If you encounter resistance, make sure you have the correct orientation. See *Figure 7-11*.

2. Properly align and connect the two cables. See *Figures 7-10* and *7-11*.

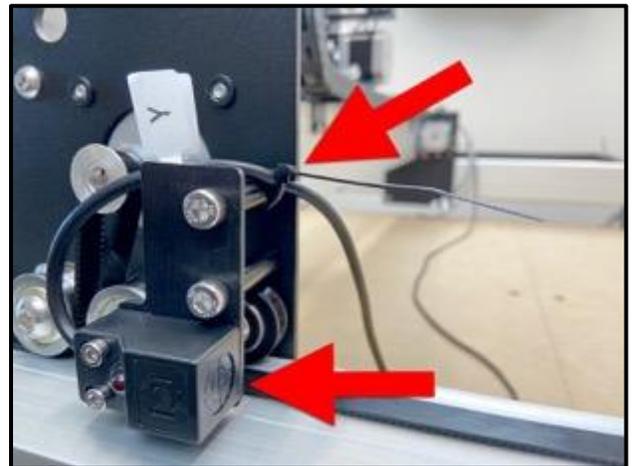


Figure 7-9

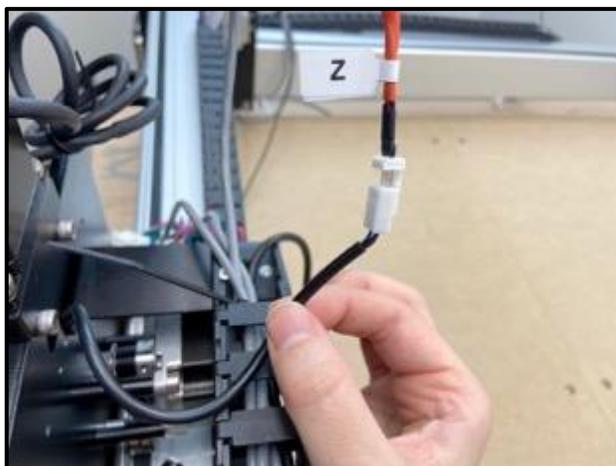


Figure 7-10

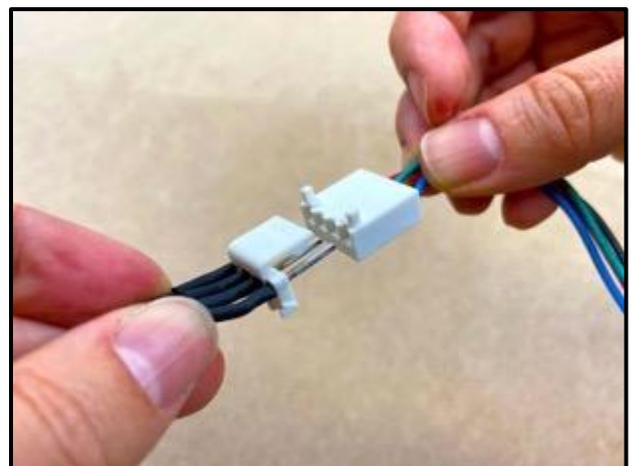


Figure 7-11

Step 8: Wiring

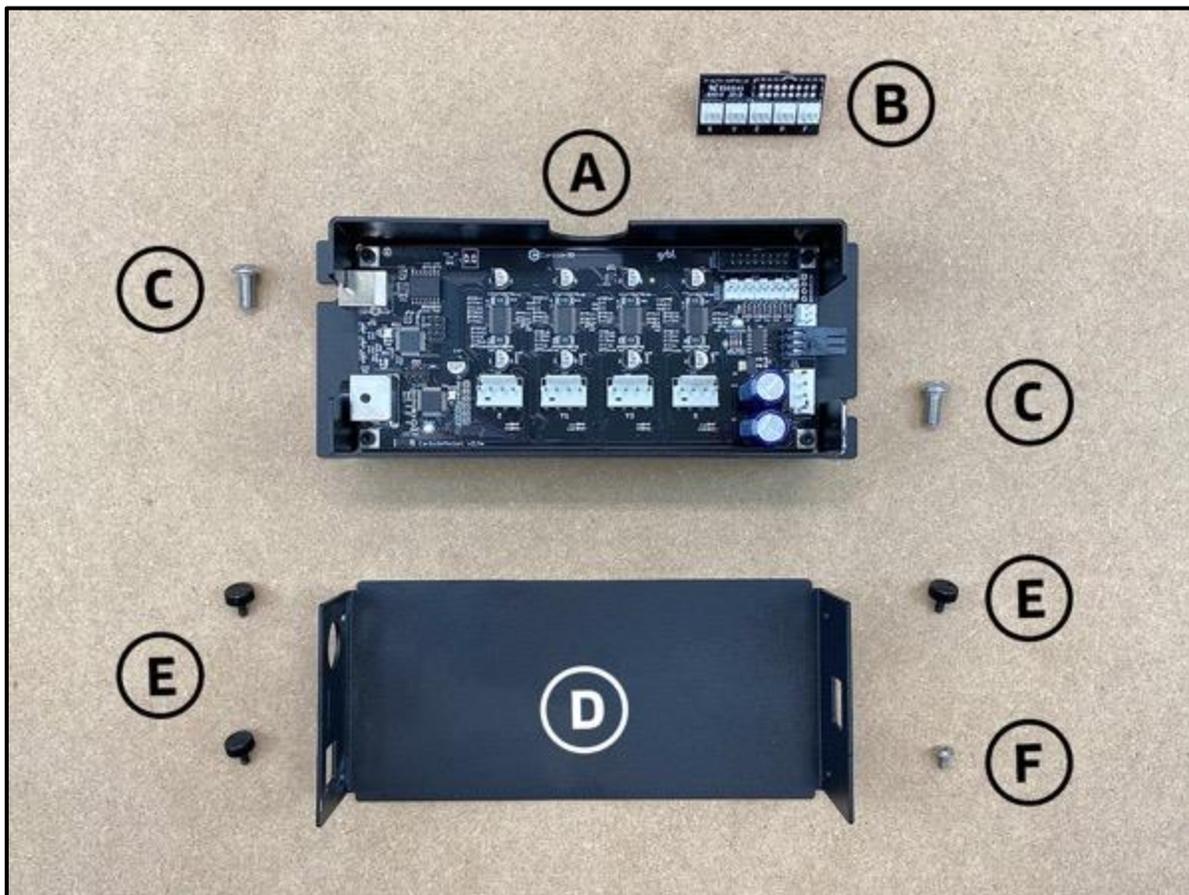


Figure 8-2

Required Components

See *Figure 8-2*:

Item	Description	Location	Qty
A	Controller Unit	XXL Final Assembly Box	1
B	PCB Riser Board (Adapter)	XXL Final Assembly Box	1
C	M6 x 12mm Button Head Cap Screw	XXL Final Assembly Box	2
D	Controller Unit Cover	XXL Final Assembly Box	1
E	3 Thumb Screws	XXL Final Assembly Box	3
F	M3 x 6mm Flanged Button Head Cap Screw	XXL Final Assembly Box	1

Required Tools

See *Figure 8-3*:

Item	Description	Qty
A	2 and 4mm Hex Key	2

WARNING: When removing the cover, be careful not to jar or damage the BitRunner adapter extending out of the side of the controller (see *Figure 8-4*). You may find it helpful to remove the Power/USB end first.

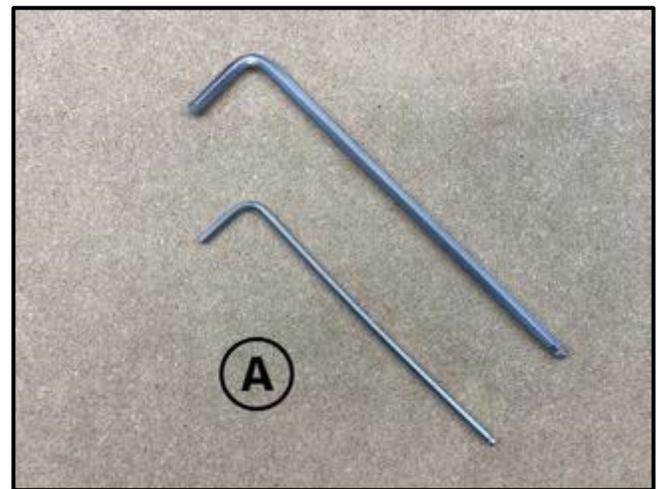


Figure 8-3

Install the PCB Riser Board

The PCB requires an adapter to wire the polarized 3-pin inductive proximity switches to the controller board.

1. Remove the three (3) thumb screws holding the cover in place.
2. Use the 2mm hex key to remove the one (1) M3x6mm flanged button head screw.
3. Carefully remove the controller unit cover.

Inside the controller unit you will find two (2) M6x12mm button head cap screws which are used to mount the controller unit to the Y1-rail. Set these aside for a later step.

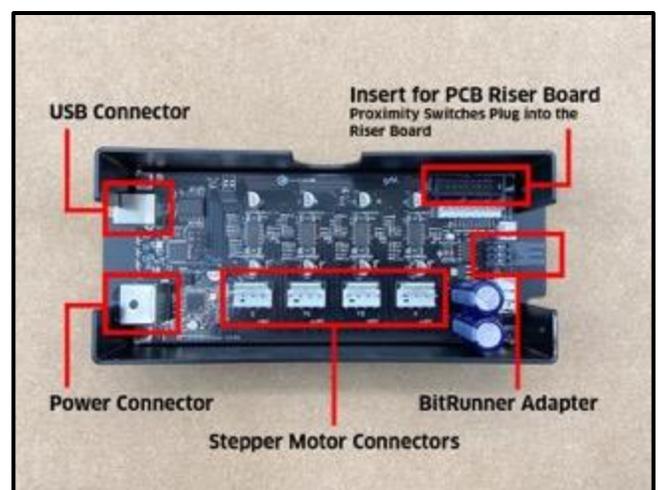


Figure 8-4

4. Connect the PCB riser board to the set of open pins in the **TOP-RIGHT** corner of the controller board. See *Figure 8-5*



Figure 8-5

Mount the Controller Unit

The controller unit mounts to the outside of the Y1-rail.

1. Position the controller unit with the USB and power ports facing the **REAR** of the machine. See *Figure 8-6*.
2. Use the 4mm hex key and the two (2) M6x12mm button head cap screws to mount the controller unit to the outside of the Y1-rail. See *Figure 8-6*.

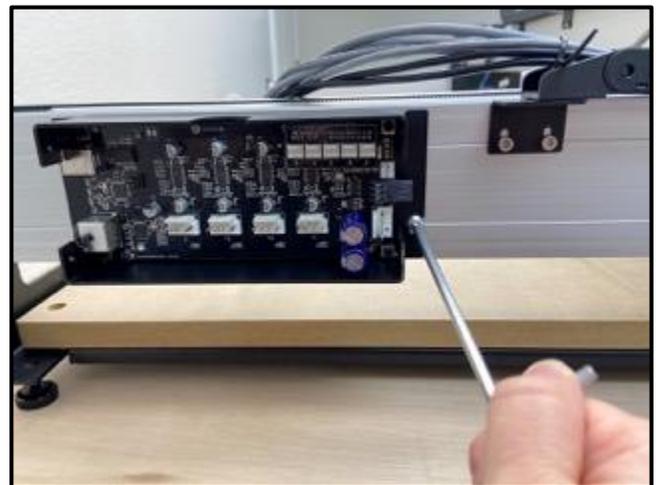


Figure 8-6

Wire the Controller Unit

All of the proximity switch and stepper motor extension cables exit the drag chain at the Y-Axis drag chain tail bracket, just above the controller unit.

Proximity switches use the 3-pin ports of the PCB riser board in the top-right corner of the controller board.

Stepper motors use the 4-pin ports along the bottom of the controller board. Refer back to *Figure 8-4*.

Wiring Proximity Switches

1. Plug the 3-pin proximity switch extension cables labeled “X,” “Y,” and “Z” into their respective ports on the PCB riser board. Be sure to match the labels on the cables with those of the board. The “P,” and “F” ports to the right remain empty. See *Figure 8-7*.

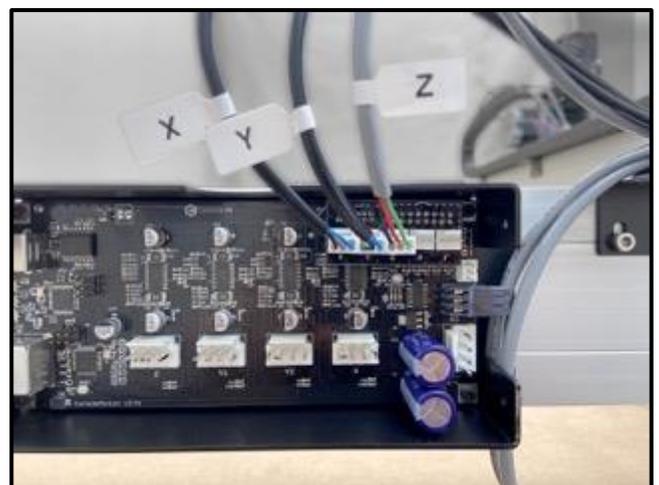


Figure 8-7

Wiring Stepper Motors

1. Plug the 4-pin stepper motor extension cables labeled “Z,” “Y1,” “Y2,” and “X” into their respective ports along the bottom of the controller board. Be sure to match the labels on the cable with those of the board. See **Figure 8-8**.
2. Carefully gather all seven connected cables into a bundle and direct them into the notch at the top of the controller unit.
3. Use the 2mm hex key, one (1) M3x6mm flanged button head screw and the three (3) thumb screws to re-install the controller unit cover.

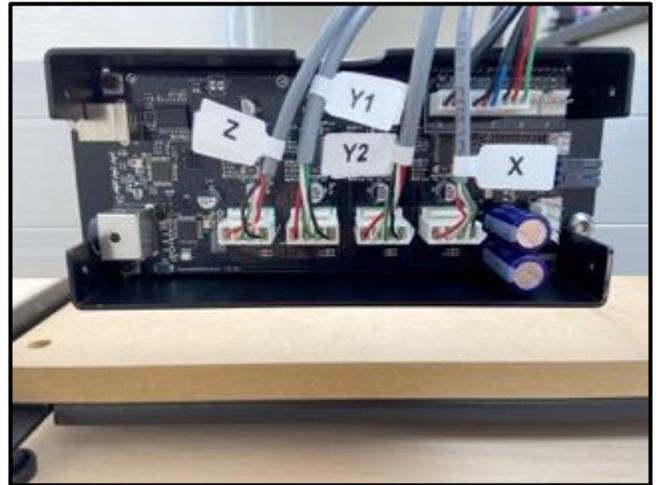


Figure 8-8

Connect the Stepper Motors

Shapeoko XXL comes equipped with four stepper motors: X, Y1, Y2, and Z. Each motor connects to the controller unit via a gray extension cable installed in the wiring harness at the factory. Each cable has been labeled with its proper connection. The X- and Z-motor extension cables exit the X-Axis drag chain behind the Z-Plus and the Y1- and Y2-motor cables exit the Y-Axis drag chain at the Y1-carriage. See **Figure 8-9**.

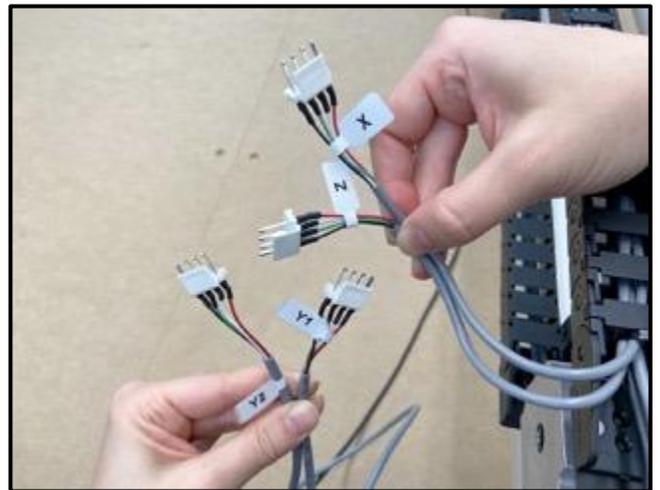


Figure 8-9

Connecting Z-Axis Stepper Motor

The Z-motor sits atop the Z-Plus. Its extension cable exits the head of the X-Axis drag chain.

1. Connect the black Z-motor leads to the gray 4-pin extension cable labeled “Z.” See **Figure 8-10**.

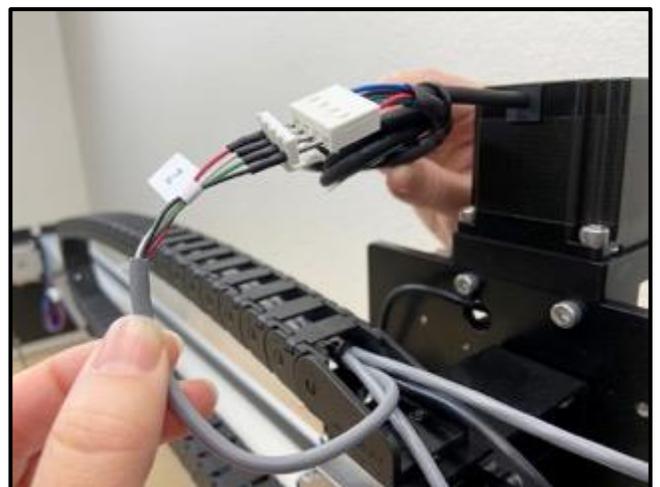


Figure 8-10

Connecting X-Axis Stepper Motor

The X-motor is on the back of the Z-Plus. Its extension cable exits the head of the X-Axis drag chain.

1. Connect the X-motor leads to the gray 4-pin extension cable labeled "X." See **Figure 8-11**.

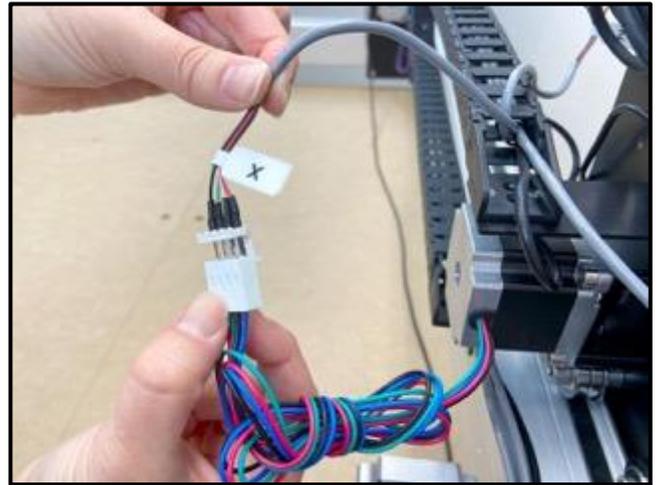


Figure 8-11

Connecting Y1-Axis Stepper Motor

The Y1-motor is attached to the Y1-carriage. Its extension cable exits the head of the Y-Axis drag chain.

1. Unravel the Y1-motor leads.
2. Connect the Y1-motor leads to the short gray 4-pin extension cable labeled "Y1." See **Figure 8-12**.

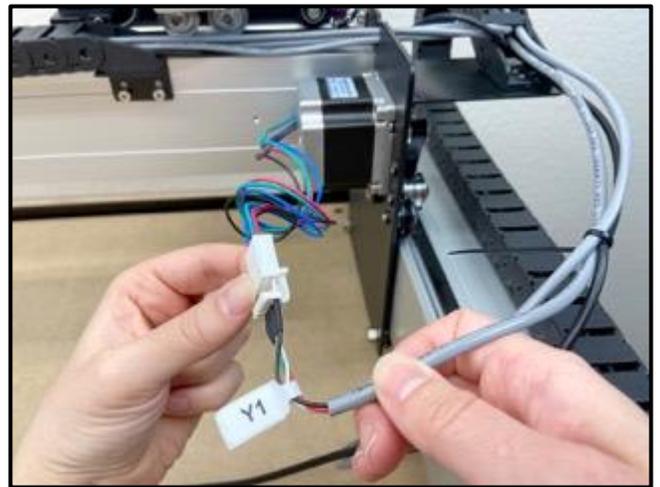


Figure 8-12

Connecting Y2-Axis Stepper Motor

The Y2-motor is located on the Y2-carriage. Its extension cable exits the head of the Y-Axis drag chain.

1. Unravel the Y2-motor leads.
2. Extend the long gray 4-pin extension cable labeled "Y2" about 3/4 of the way across the machine and connect it to the Y2-motor leads as shown in **Figure 8-13**.

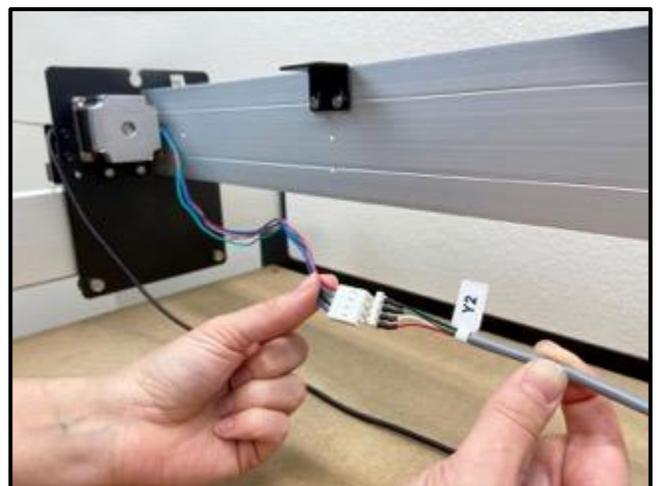


Figure 8-13

Step 9: Cleanup

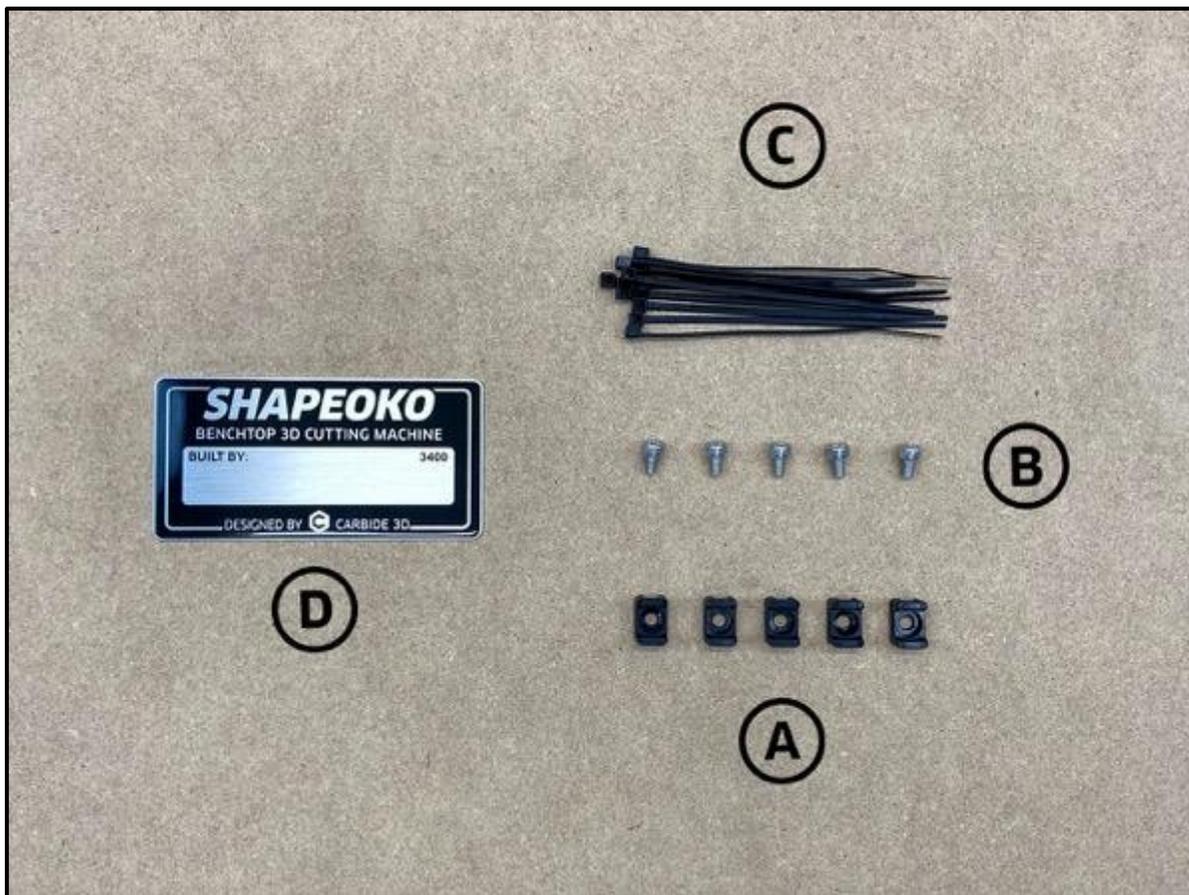


Figure 9-2

Required Components

See *Figure 9-2*:

Item	Description	Location	Qty
A	Cable Tie Mounts	Wiring Harness Box	5
B	M4 x 6mm Socket Head Cap Screw	Wiring Harness Box	5
C	Cable Ties	Wiring Harness Box	11
D	Shapeoko Decal	XXL Assembly Box	1

Required Tools

See *Figure 9-3*:

Item	Description	Qty
A	3mm Hex Key	1
B	Cut Pliers or Scissors (not included)	1
C	Sharpie Permanent Marker	1

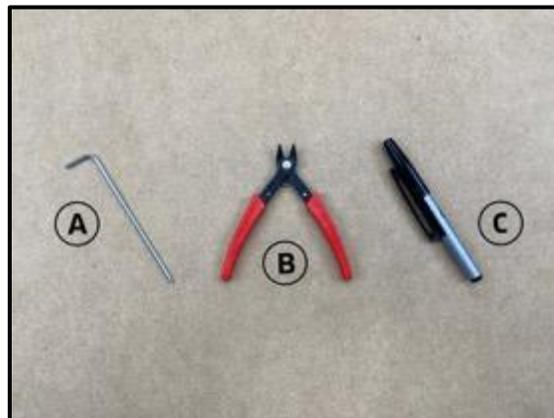


Figure 9-3

Cleanup the Gantry Cables

In this step, we'll be securing loose cables with cable ties and cable tie mounts.

Securing Cables at the Y1-Carriage

All seven (7) cables crossing the Y1-carriage plate, are bundled into the circular cutout at the top of the carriage.

1. One at a time insert the cables, beginning with the three Y-cables, followed by the four X/Z-cables. See *Figure 9-4*.
2. Use two (2) cable ties, one on each side of the cutout, to secure the cables in place as shown in *Figure 9-4*.

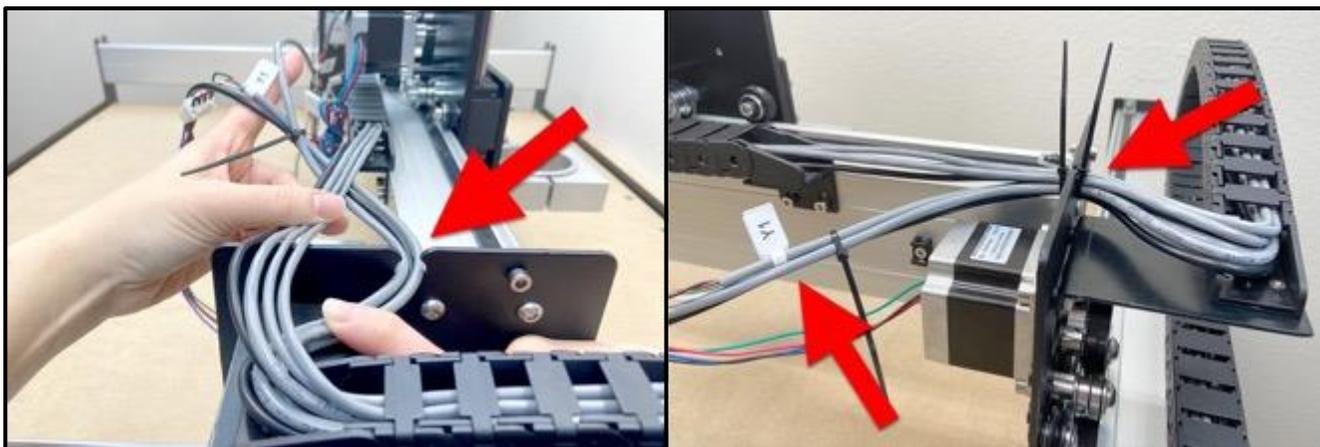


Figure 9-4

Securing Cables Along the X-Rail

Y-Axis motor and proximity switch cables are secured to the back side of the X-rail using cable tie mounts and cable ties.

PRO TIP: Neatly securing cables is more of an art than a science. Important things to note are: It's ok to loop cables in tight circles, but avoid kinks. Give the cables slack next to motors, switches, and plugs, and ensure they won't get snagged on a corner or sucked into a motor.

1. Use the 3mm hex key and one (1) M4x6mm socket head cap screw to attach each of the five (5) cable tie mounts to the upper M4 screw holes across the back of the X-rail. Position the cable tie mounts vertically. See *Figure 9-5*.
2. Use five (5) cable ties to secure the cables to the five (5) cable tie mounts along the back of the X-rail. See *Figure 9-6*. The cable tie mounts have two attachment points. For **the center cable tie mount**, use only one of the two attachment points to secure the Y-cables; the other will be used to secure the router's power cord.
3. Trim the ends of all the cable ties with a pair of flush cut pliers or scissors (not included).

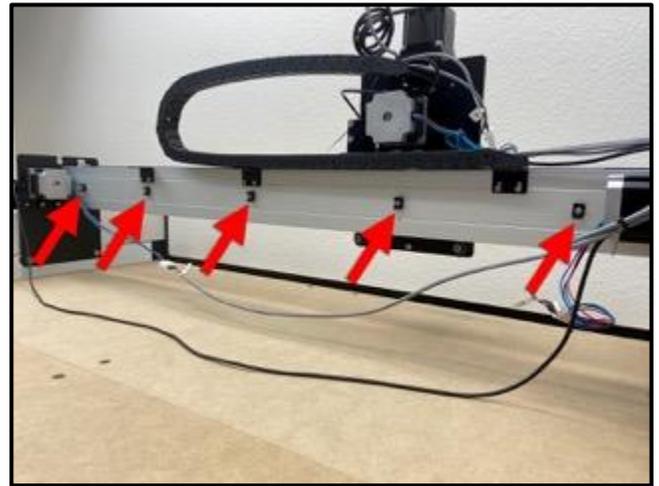


Figure 9-5

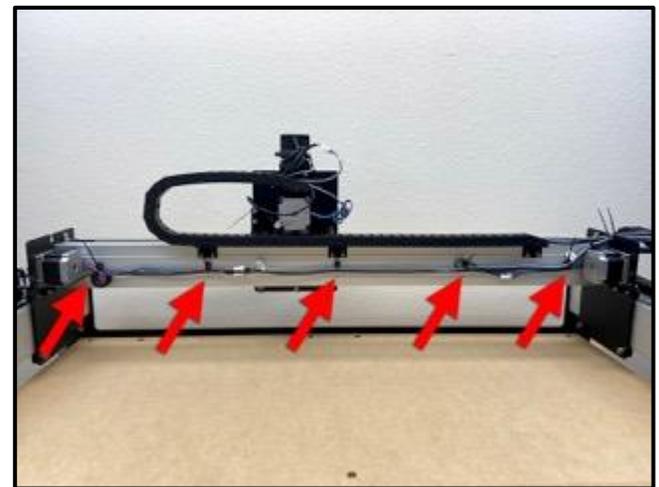


Figure 9-6

Securing the Cables at the Z-Plus

The X/Z-cables are bundled neatly behind the Z-Plus.

1. Collect the X-cables and neatly bundle them behind the X-motor. See *Figure 9-7*.
2. Use one cable tie to secure the X-cables to the first link of the drag chain and a second to keep the bundle tidy.
3. Collect the Z-cables and neatly bundle them behind the Z-motor. See *Figure 9-7*.
4. Use two (2) cable ties to secure the Z-cables.
5. Use flush cut pliers or scissors (not included) to trim the ends of all the cable ties

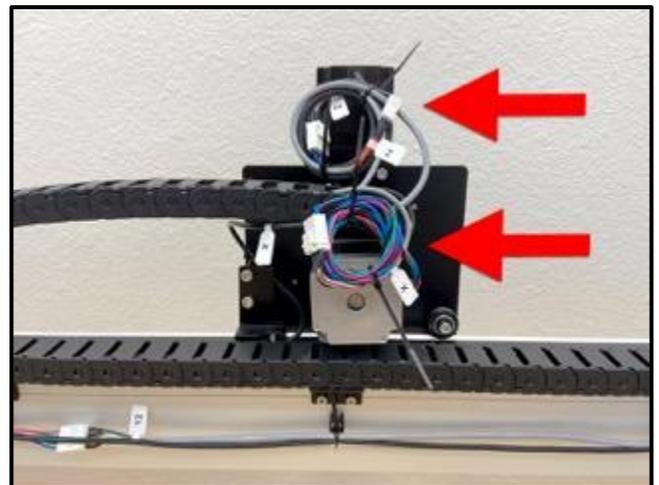


Figure 9-7

Apply the Shapeoko Owner's Decal

1. Write your name on the decal with the included permanent marker and apply it to the inside of the Y1-rail.

Step 10: Compact Router



Figure 10-2

Required Components

See *Figure 10-2*:

Item	Description	Location	Qty
A	Compact Router	Wiring Harness Box	1
B	Cable Ties	Wiring Harness Box	6\8
C	#201 ¼-inch Square End Mill Cutter	XXL Final Assembly Box	1
D	Sweeepy Dust Boot	Sweeepy Box	1

Required Tools

See *Figure 10-3*:

Item	Description	Qty
A	4mm Hex Key	1
B	Cut Pliers or Scissors (not included)	1
C	13mm Wrench*	1
D	22mm Wrench*	1

*Found in the Carbide Compact Router box.

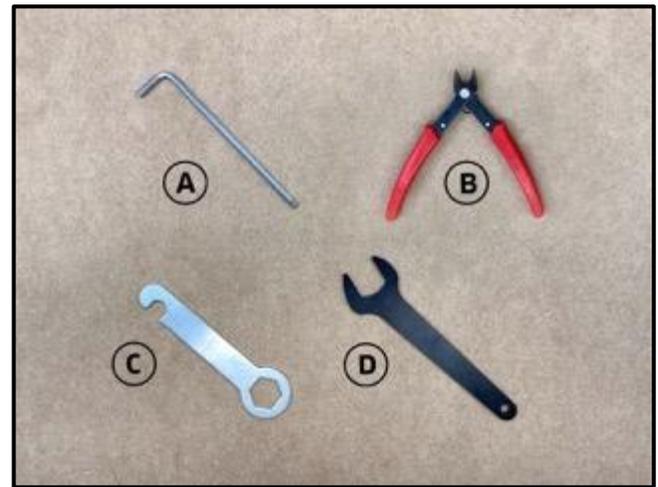


Figure 10-3

Install the Carbide Compact

The Z-Plus supports routers with a diameter of 65mm and 69mm.

Following are the installation steps for our 65mm Carbide Compact Router. 65mm routers require the use of the included router mount adapter ring, which we installed in a previous step. In a previous step we also lowered the Z-carriage on the front of the Z-Plus to its lowest point.

1. Use the 4mm hex key to loosen the two (2) M5x55mm socket head cap screws on the front of the router mount
2. Insert the router into the mount until the taper of the router's body meets the adapter ring. Ensure the power cord extends to the right. See *Figure 10-4*.



Figure 10-4

3. Use the 4mm hex key to secure the compact router by tightening the two (2) M5x55mm socket head cap screws on the front of the router mount as shown in *Figure 10-5*.



Figure 10-5

Secure the Router Power Cable

The power cord routes back through the drag chain, loosely snakes along the back of the X-rail, then up and over the Y2-carriage. Cable ties are used to secure it in place.

1. Loop the router cable behind the Z-Plus as shown in *Figure 10-6*.
2. Use one (1) cable tie to secure the power cord to the **TOP-RIGHT** X-motor standoff at the back of the Z-Plus. See *Figure 10-6*.

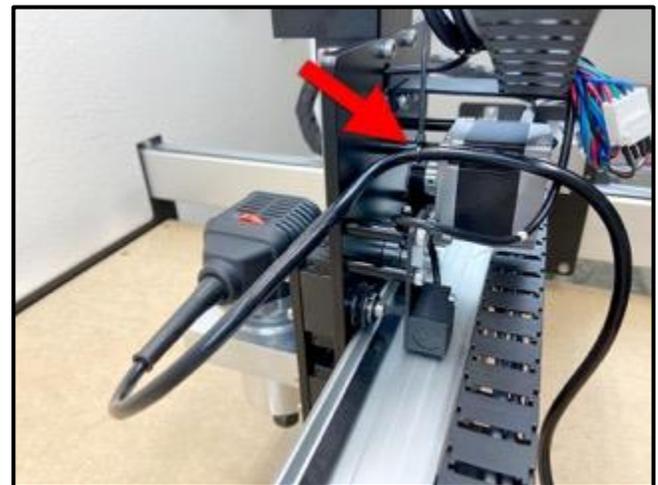


Figure 10-6

The router's power cord can cause electromagnetic interference (EMI) for the motor extension cables and the USB cable, so we want to route it as far away from these cables as possible.

To begin, we're going to create a two-link cable tie chain, with each link about 1-inch in diameter.

3. Collect three (3) cable ties.
4. Create the first 1-inch loop at the open attachment point on the center cable tie mount. Loop the second cable tie through the first, and create another 1-inch loop. Finally, use a third cable tie to secure the router power cable to the cable tie chain. See *Figure 10-7*.
5. Route the power cord through the circular cutout at the top of the Y2-carriage. See *Figure 10-7*.



Figure 10-7

Now, we're going to use three (3) cable ties—two on one side of the Y2-carriage plate and one on the other—to secure the power cord in place.

6. Collect three (3) more cable ties.
7. Insert one cable tie into a second. Loop the end of the second cable tie around the router cable and through the head of the first. Don't tighten the loop yet. This double-cable-tie loop will secure the cable on the outside of the Y2-carriage plate. See **Figure 10-8**.
8. Loop a third cable tie around the router cable and close the ends but do not tighten yet. This cable tie will secure the cable from the inside of the Y2-carriage plate. See **Figure 10-8**.
9. Once the router cable is positioned in the cutout, tighten the all three (3) cable ties to secure the router in place. See **Figure 10-8**.
10. Trim down the ends of the two (2) cable ties on the outside of the Y2-carriage, leaving about 1/2-inch at the end of each as shown in **Figure 10-9**. (The short ends help hold the cable in place.) Do not trim the cable tie on the inside of the Y2-carriage at all.

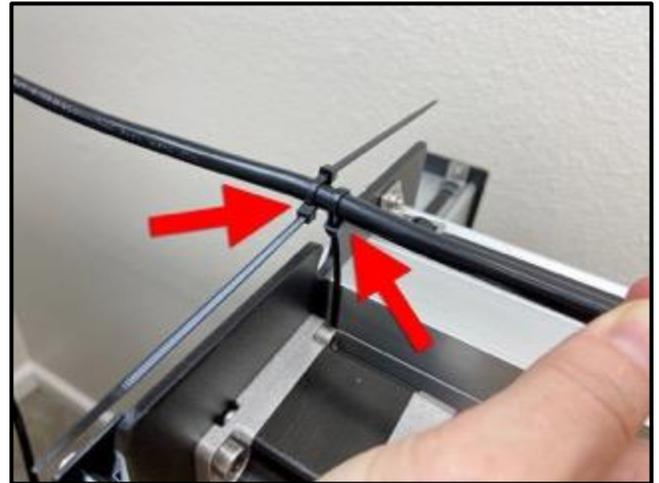


Figure 10-8

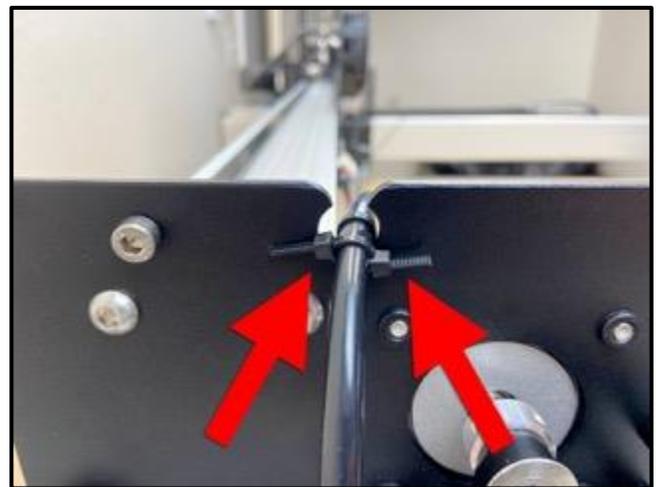


Figure 10-9

11. Trim the ends of all the remaining cable ties. See **Figure 10-10**.

NOTE: Plug the compact router into an outlet that has a dedicated on/off switch. Be sure this is accessible while the machine is running, in case you should need to shut the Shapeoko off immediately.

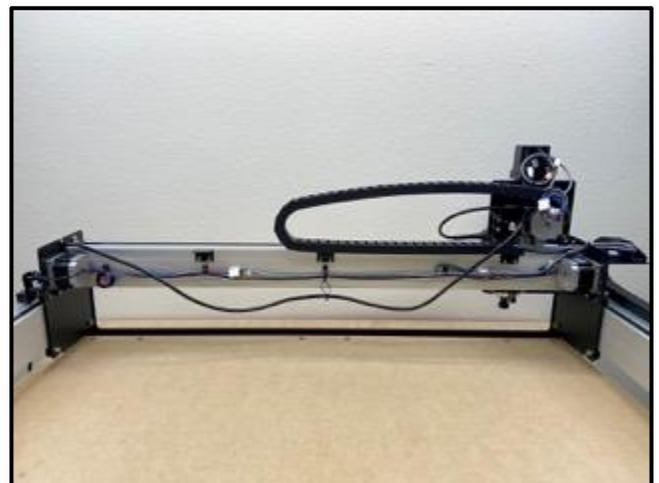


Figure 10-10

Install Sweeepy Dust Boot

Sweeepy clamps directly to the router with a machined quick-release.

1. Fully seat the upper dust boot onto the router body with the 36mm diameter dust port facing forward and toggle the quick release to tighten. See **Figure 10-11**.
2. The lower half locks into place using neodymium magnets for easy install and removal during tool changes.



Figure 10-11

Install an End Mill

The Carbide Compact Router includes a 0.25" collet cone, a collet nut, a 22mm collet nut wrench, a 13mm spindle wrench, and the XXL kit comes with a #201 0.25" flat end mill.

WARNING: Never tighten the collet nut without first inserting an end mill or the collet cone could break.

Installing the End Mill

1. Clean and insert the end mill shank into the loosened collet a minimum of 0.75" (20mm), the entire length of the collet cone and nut. See **Figure 10-12**.
2. Use the 22mm collet nut wrench and the 13mm spindle wrench to tighten the collet nut securely. See **Figure 10-13**. Alternatively, you can press and hold the shaft lock while tightening with the 22mm collet nut wrench.



Figure 10-12

Removing the End Mill

1. To remove the end mill, follow the installation procedure in reverse.



Figure 10-13

Step 11: Level and Square

Required Tools

See *Figure 11-1*:

Item	Description	Qty
A	3 and 4mm Hex Key	1
B	10mm Wrench	1
C	Level (not included)	1

Recommended Tools

See *Figure 11-1*:

Item	Description	Qty
D	Tape Measure	1
E	10mm Combination Wrench	1

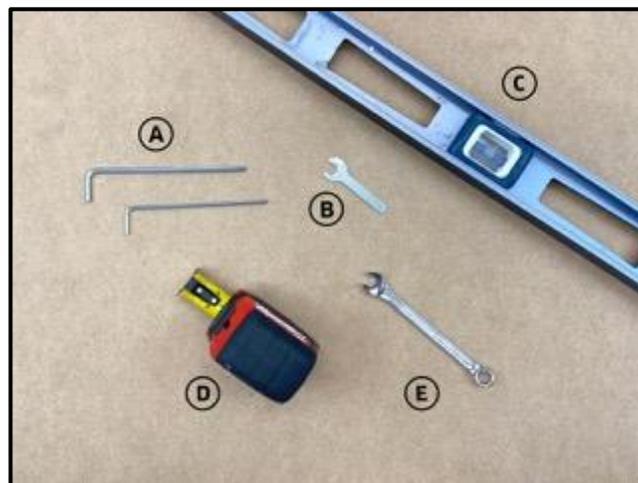


Figure 11-1

Confirm Tension of the V-Wheels

The V-wheels were tensioned in step 4. Confirm that they have maintained proper tension throughout the assembly process and that they are not over- or under-tensioned. Refer back to *Figure 3-4* and *3-5* (page 20) for more tips on eccentric nuts and tensioning V-wheels.

1. If needed, use a 10mm wrench to turn the eccentric nuts **CLOCKWISE** until the wheels engage with the v-rail.

Confirm Level

The baseframe assembly was given a preliminary leveling at the end of step 2.

1. Use a level (not provided) to perform a comprehensive leveling of the machine now.
2. Adjust the four (4) leveling feet up or down as needed.
3. Check for level in several spots across the baseframe. Front-to-back, side-to-side, and diagonally across.

Refer back to *Figure 2-14* (page 17) if needed.

Square the Machine

Squaring ensures the X-rail and Y-rails are perpendicular and that the Y1- and Y2-rails are parallel.

1. Use the 4mm hex key to loosen the eight (8) M6x12mm button head cap screws securing the X-rail to the Y1-carriage and Y2-carriage. **Do not remove the screws; a 1/4 to 1/2 turn will suffice.**

2. Use the 4mm hex key to loosen the sixteen (16) M6x12mm button head cap screws that hold Y1-rail and Y2-rail to the endplates. **Again, just a 1/4 to 1/2 turn.**

In step 2, you were instructed not to fully tighten the eighteen (18) M5x25mm button head cap screws securing the MDF baseplates. If these screws remained loose, continue with squaring. If not, loosen them now, but do not remove.

PRO TIP: During this process it's helpful to have another set of hands. To achieve the best results, constant pressure should be maintained at the center of the X-Axis as the gantry screws are being tightened.

3. Move the X-rail all the way to the **FRONT** of the machine.
4. Place steady, even, forward pressure at the center of the X-rail, so that both Y-carriages touch the **FRONT** endplate as shown in *Figure 11-2*.
5. Use the 4mm hex key to fully tighten the eight (8) M6x12mm button head cap screws of the Y1-carriage and Y2-carriage, four (4) per carriage.

NOTE: Pay close attention to the Y-carriages and ensure they **BOTH** continue to touch the endplates as you tighten the screws.



Figure 11-2

6. Maintain forward pressure on the X-rail.
7. Use the 4mm hex key to fully tighten the eight (8) M6x12mm button head cap screws of the **FRONT** endplate, four (4) per side.
8. Move the X-rail all the way to the **BACK** of the machine.
9. Place steady, even, rearward pressure on the X-rail, so that both Y-carriages touch the **REAR** endplate.
10. Use the 4mm hex key to fully tighten the eight (8) M6x12mm button head cap screws of the **REAR** endplate, four (4) per side.
11. Use the 3mm hex key to tighten the eighteen (18) M5x25mm button head cap screws securing the MDF baseplates to the baseframe.

Optional: Use a tape measure to confirm square by comparing measurements corner to corner.

Your assembly is now complete!

Next Steps

On the following pages you will find helpful information to get you ready to use your Shapeoko XXL.

1. Connect to Power
2. Download the Software
3. Configure Carbide Motion 5
4. Run the Test Project
5. Workholding
6. Cutting Tutorials and Projects
7. User Guides and Video Tutorials
8. Glossary of Terms

Connect to Power

Required Components

See *Figure 12-1*:

Item	Description	Qty
A	Power supply	1
B	Power cord	1

1. Connect the power cord to the power supply.
2. Connect the power supply to the input on the rear of the controller unit as shown in *Figure 12-2*.
3. Plug power cord into an outlet. A green LED on the power supply will light up when connected to power. See *Figure 12-2*.
4. Flip the in-line rocker switch on the power cord to the ON position. You will hear the motors begin to hum and a blue LED on the controller unit will be visible through a slit in the cover. See *Figure 12-2*.

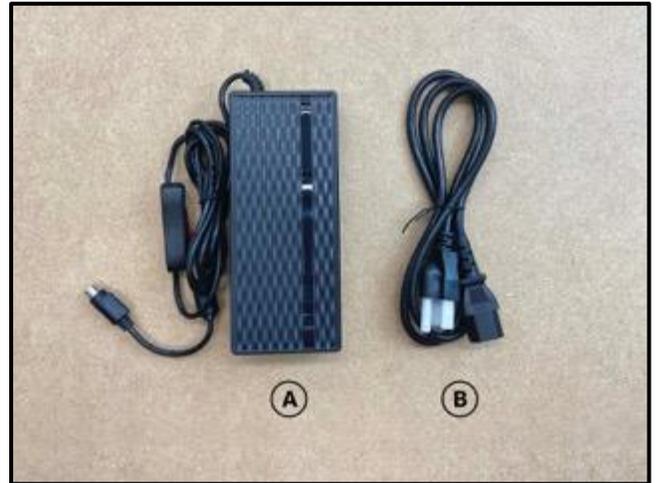


Figure 12-1



Figure 12-2

Download the Software

1. Download **Carbide Motion 5** from: carbide3d.com/carbidemotion/download.
2. Download **Carbide Create** from: carbide3d.com/carbidcreate.
3. Install both programs to your computer.

Carbide Motion lets you control your machine by jogging it around, setting zeroes, and loading and running G-code. Carbide Create is a cross-platform CAD/CAM program used to design projects for the Shapeoko. It allows you to create 2D sketches, generate toolpaths, and export G-code which you will run in Carbide Motion to implement your design.

Configure Carbide Motion 5

WARNING: The controller unit uses firmware GRBL v1.1 which is **ONLY** compatible with Carbide Motion 5.

Required Components

See *Figure 13-1*:

Item	Description	Qty
A	USB Cable	1



Figure 13-1

Connect to Carbide Motion 5

1. Turn your computer on.
2. Connect the USB cable to the back of the controller unit and to your computer.
3. Start Carbide Motion 5 on your computer.
4. Flip the in-line rocker switch on the power cord to the ON position to turn on the Shapeoko XXL.
5. In Carbide Motion, click **Connect to Cutter** button.

Upload Your Settings

1. Once your screen reads “Job Info,” click the **Settings** button in the top menu bar to open Settings. See *Figure 13-2*.
2. Choose “XXL” from the **Size** dropdown list, “Z-Plus (Leadscrew)” from the **Z-Axis Type** dropdown list, and “Inches” from the **Units** dropdown list. See *Figure 13-3*.
3. Click the **Update Shapeoko Configuration** button in the middle of the dialog window. See *Figure 13-3*.
4. A progress bar will appear at the top of the window. When the configuration settings have finished sending, click the **Ok** button to close the Settings window.

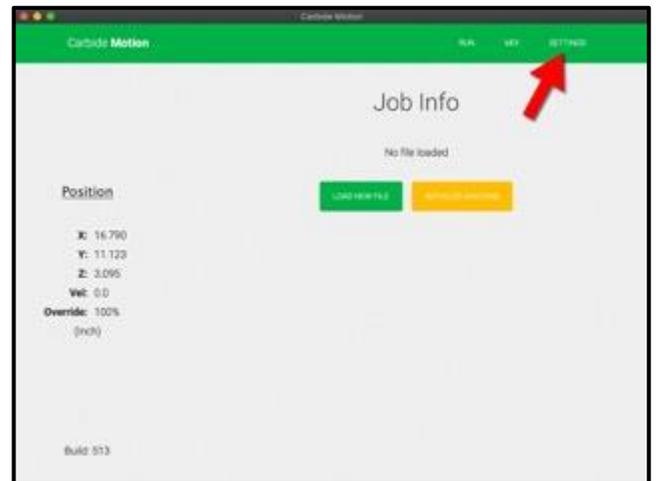


Figure 13-2

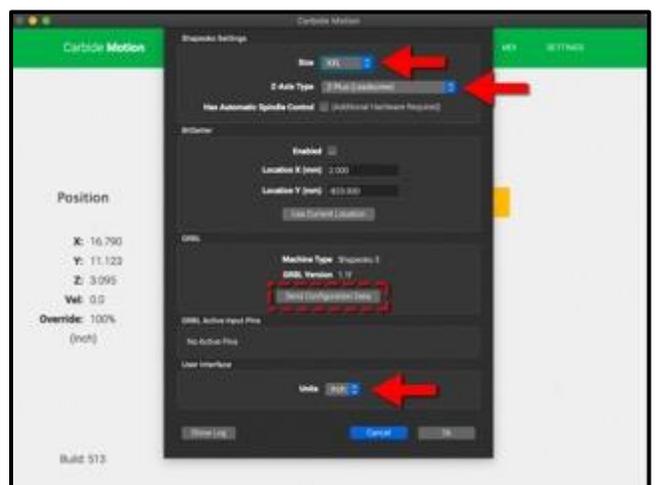


Figure 13-3

Initialize the Proximity Switches

1. Click the yellow **Initialize Machine** button. See **Figure 13-4**. This activates the homing sequence and your machine will do the following:

The **Z-Axis** will move up (the positive direction) until the Z-Axis proximity switch is engaged. The Z-Axis will then back off slightly before re-engaging the switch and then backing off for a final time and setting the Z-Axis to machine origin.

The **X- and Y-Axis** will begin to move. The X-Axis will move to the right (the positive direction) and the Y-Axis will move to the back (the positive direction).

The **X- and Y-Axis** will continue to move until one of their switches is triggered, at which time they will follow the same pattern as the Z-Axis: engage the homing switch, back off, re-engage, and then back off again.

2. When **all three axes** have homed, your router will be in the back-right corner.

Troubleshooting Homing Issues: docs.carbide3d.com/software-faq/home-switch-troubleshooting

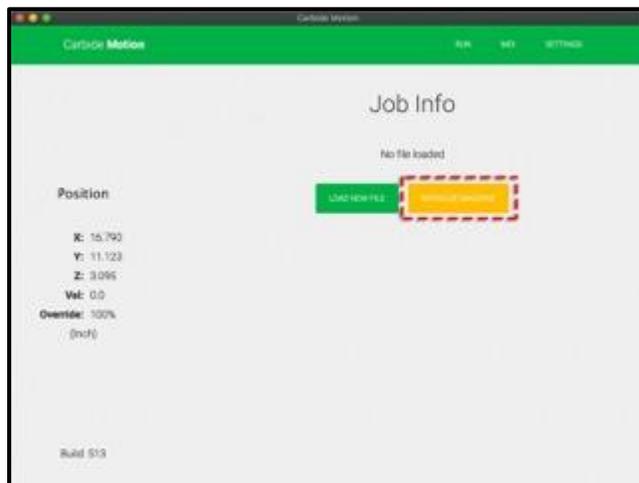


Figure 13-4

Run the Test Project

Required Components

NOTE: We recommend you use the test project as a practice run before moving on to cutting projects.

See **Figure 14-1**:

Item	Description	Qty
A	Permanent Marker	1
B	Large Zip Tie	2
C	Letter-Sized, A4, Paper (not included)	1
D	Masking Tape (not included)	1
E	Piece of Cardboard (not included)	1

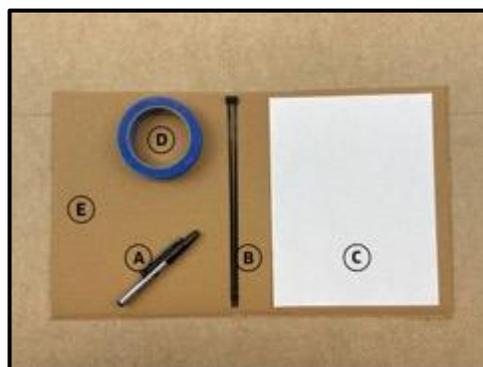


Figure 14-1

Complete the Test Project

To complete this test project (see **Figure 14-2**) on your Shapeoko XXL, follow the project instructions at:

docs.carbide3d.com/tutorials/hello-world.

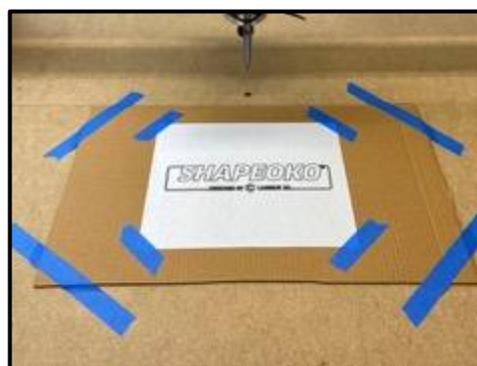


Figure 14-2

Workholding

Regardless of what type of project you are making, the first thing to figure out is how you will secure the material to the machine. This concept is called workholding. There are several common ways to hold material down. The specifics of your project, part, material, and other requirements will determine which method you should use. The main objective for workholding is to secure your material to the machine in a way that will not yield to the forces of machining. The most common forms of workholding are:

- Double-sided tape
- Direct fastening (screws, brad nails, etc.)
- Top clamps
- Vise
- Machinable fixturing wax
- Vacuum table

DIY Workholding Projects

Hold-Down Solution: Make a DIY hold-down solution to put on top of your baseplates: cutrocket.com/p/5df928247387d.

Hold-Down Clamps: Make a set of clamps to use with the DIY hold-down: docs.carbide3d.com/tutorials/shapeoko-clamps.

Workholding Solutions Available in the Carbide 3D Store



T-Track and Clamp Kit

The T-track system sits on top of your baseframe and provides a flexible, reliable way to hold down material to your Shapeoko XXL. The kit includes everything you need to add this system to your machine!

Purchase: shop.carbide3d.com/collections/accessories/products/t-track-table



Gator Tooth Clamps

Gator Tooth Clamps are ultra-low-profile. Use them as a backstop, a side clamp, or a toe clamp. With over 30mm of lateral travel, these beasts will hold your job down safely and securely. Clamps come in anodized aluminum or stainless steel.

Purchase: shop.carbide3d.com/collections/accessories/products/gatortooth



Threaded Inserts

Create a simple DIY workholding solution: turn your baseplates into a threaded table by installing these inserts in a grid pattern. Or use a few to hold down material in a jig. Inserts come in packs of 100.

Purchase: shop.carbide3d.com/collections/accessories/products/threaded-inserts-qty-100



Double-Sided Tape

This high-quality double-sided tape is ideal for holding down PCBs or other flat stock for machining. Tape is 0.75" wide, 5 mil thick, 36 yards long, and it has 66 ounces per inch (adhesion).

Purchase: shop.carbide3d.com/collections/accessories/products/double-side-tape

Cutting Tutorials and Projects

Once you have implemented a workholding solution, you're ready to tackle some beginner tutorials and projects! The Star Wars Coaster Project is an excellent crash course on how to use your Shapeoko XXL. The tutorial walks you through designing a simple set of coasters in Carbide Create and then executing the project with Carbide Motion. Follow the complete project tutorial at: docs.carbide3d.com/tutorials/project-coaster.

More Beginner Tutorials

Once you've completed the coaster project, you can find more beginner cutting tutorials on the Carbide 3D docs site. Each tutorial will get you more comfortable using Carbide Create to set up your design and Carbide Motion to run the cutting project. Here are a few great tutorials to get you started:

MAKE Makey Wall Plaque: docs.carbide3d.com/tutorials/makey

Weber Sign: docs.carbide3d.com/tutorials/tutorial-signs/weber-sign

Nerd Coasters: docs.carbide3d.com/tutorials/project-nerdcoasters

Projects on CutRocket

Visit cutrocket.com, the Carbide 3D project site, to explore even more cutting projects for your Shapeoko XXL. On CutRocket you'll find a wide variety of projects: signs, toys, games, tools, art, and storage and organization—and the complete project files for each. These projects will level up your machining skills and get you inspired to create your own projects!

User Guides and Video Tutorials

As you get started running beginner projects with your Shapeoko XXL, we also recommend you browse through our Carbide 3D docs pages: docs.carbide3d.com. We've packed the docs site full of all kinds of useful information to help you get up and running with your Shapeoko XXL, and to help answer common questions you might run into.

User Guides and Videos

Carbide Create Video Tutorials: Watch the videos at docs.carbide3d.com/assembly/carbidecreate/video-tutorials

Carbide Motion User Guide: Check out the User Guide at docs.carbide3d.com/assembly/carbidemotion/userguide

YouTube Channel: Check out the Carbide 3D YouTube channel for awesome tips and tricks, video tutorial projects, machining how-tos, and new product releases at youtube.com/carbide3d

Tooling and Tool-Change

Carbide 3D Tooling Guide: Learn about the different types of end mills (square, ball nose, and v-shaped) and how to choose the right tool for your project at docs.carbide3d.com/tutorials/tutorial-tooling

Tool Change Tutorial: Learn how to use multiple tools on a single job (excellent information about homing, job zero, and creating a repeatable offset) at docs.carbide3d.com/tutorials/tool-change

Shapeoko Feeds and Speeds Chart: This chart shows the cutting speed (how fast the machine goes through a given material using a given cutting tool) and feed rate for different types of materials and different sizes and types of end mills.

docs.carbide3d.com/support/supportfiles/S3_feeds_250.jpg

Troubleshooting and How-To Guides

Can't Connect to Machine or Jog: docs.carbide3d.com/software-faq/can-t-connect-to-machine-or-jog

Tightening Eccentric Nuts to Tension V-Wheels: docs.carbide3d.com/support/tensioning-eccentrics

Power Supply Usage (Is it Working?): docs.carbide3d.com/shapeoko-faq/power-supply-usage