

# Z-Plus Upgrade

ASSEMBLY GUIDE

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# Introduction

We're here to help! If you encounter any issues during assembly, please contact us at: [support@carbide3d.com](mailto:support@carbide3d.com).

The Z-Plus kit includes everything you need to upgrade your existing X/Z-carriage to the Z-Plus (X/Z+). The Z-Plus kit also includes new inductive proximity switches to replace the original homing switches. There are minor differences in the installation procedures between Shapeoko 3, XL, and XXL models AND between Shapeoko models shipped pre-Dec 2019 and post-Dec 2019. We've added special notes to guide you whenever these differences require alternate instructions:

**SPECIAL INSTRUCTIONS:** These call-outs will draw your attention to special instructions for different models.

Throughout the guide you will also 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—pay close attention. Information in these boxes is very important.

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

**PRO TIP:** This is a pro tip—helpful additional information.

In this guide, any reference or instructions with regard to direction or placement, such as: Front, Back, Left, Right, etc. are given from the perspective of one standing in front of and facing the machine. This is true, even when a photo is taken from the rear of the machine.

## IMPORTANT Software Information

Run Carbide Motion 4.17 or later with the Z-Plus. Download Carbide Motion: [carbide3d.com/carbidemotion/download](http://carbide3d.com/carbidemotion/download)

**WARNING:** After installing the Z-Plus, you must update your GRBL settings. **DO NOT HOME UNTIL YOUR SETTINGS HAVE BEEN UPDATED!**

## Assembly Requirements

To carry out this upgrade, you need basic mechanical skills and an understanding of how the Shapeoko is assembled. Installation takes approximately 2 hours.

Required tools:

- Metric hex keys: 1.5mm – 6mm
- Wrenches: 8mm and 10mm
- Needle nose pliers
- Permanent marker
- Tape measure or ruler
- Scissors
- Flush cut pliers
- Masking tape

# Inventory

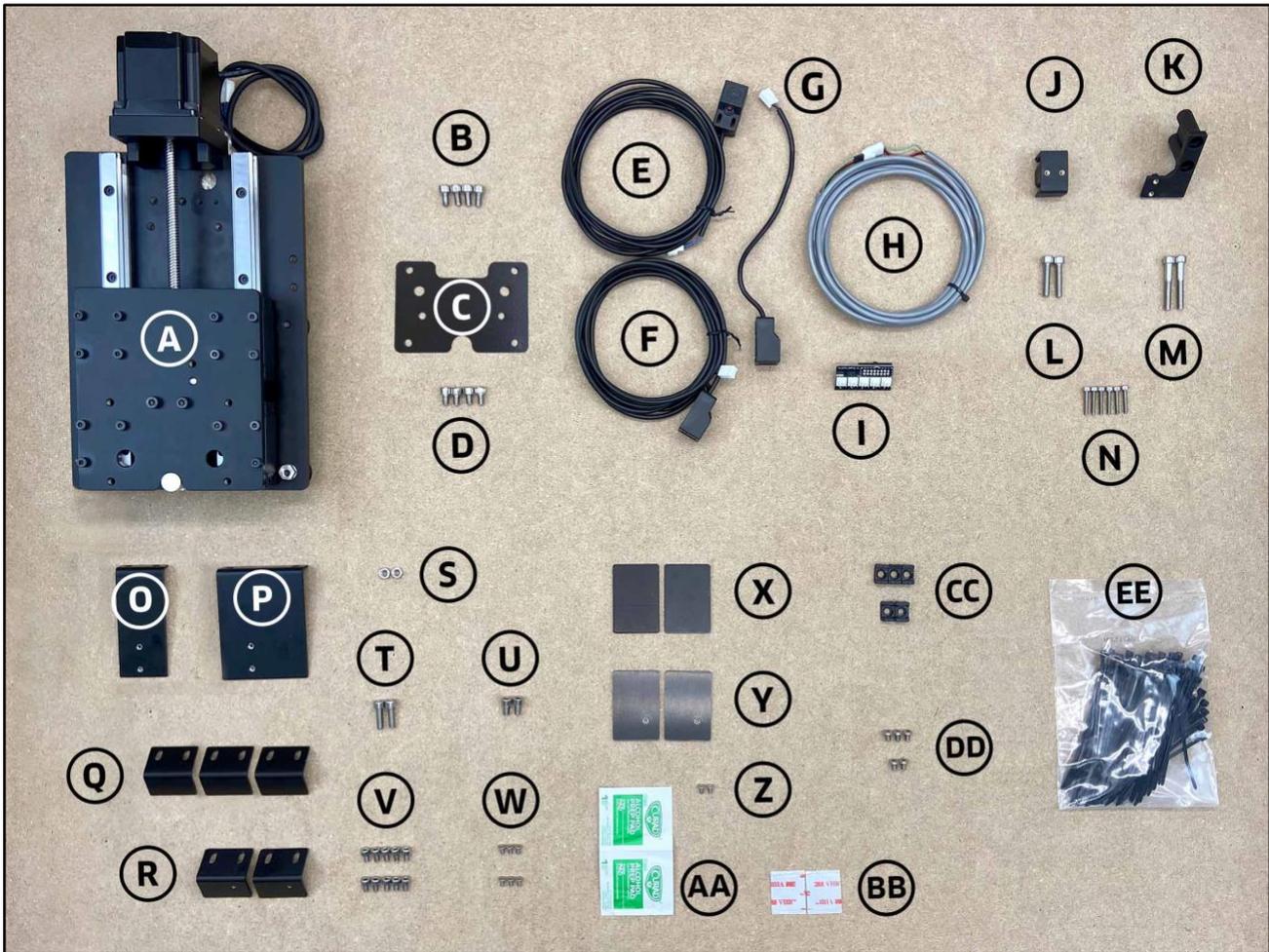


Figure 1

## Z-Plus Upgrade Kit Contents

The Z-Plus upgrade comes with the components listed in the table below and shown in *Fig. 1*.

Item	Description	Qty
A	X/Z+ Carriage (Z-Plus)	1
B	M5 × 10mm Socket Head Cap Screw	4
C	Tramming Plate	1
D	M5 × 8mm Socket Head Cap Screw	4

<b>Proximity Switch Cable Kit</b>		
E	X-Axis Proximity Switch (2675mm for XXL, 2350mm for XL, and 712mm for Shapeoko 3)	1
F	Y-Axis Proximity Switch (2540mm for XXL, 2200mm for XL, and 610mm for Shapeoko 3)	1
G	Z-Axis Proximity Switch (200mm for XXL, 200mm for XL, and 610mm for Shapeoko 3)	1
H	Z-Axis Proximity Switch Extension Cable (2438mm for XXL, 2235mm for XL, no extension for Shapeoko 3)	1
I	<b>PCB Riser Board</b>	1
<b>Proximity Switch Mounting Kit</b>		
J	X-Axis Proximity Switch Mount	1
K	Y-Axis Proximity Switch Mount	1
L	M5 × 25mm Socket Head Cap Screw	2
M	M5 × 35mm Socket Head Cap Screw	2
N	M3 × 18mm Socket Head Cap Screw	6
<b>Drag Chain Support Bracket Kit</b>		
O	X-Axis Drag Chain Head Bracket	1
P	Y-Axis Drag Chain Head Bracket	1
Q	Middle Support Bracket <b>[Used with Post-Dec 2019 Extrusion Rails Only]</b>	3
R	Tail Support Bracket <b>[Used with Post-Dec 2019 Extrusion Rails Only]</b>	2
S	M5 Nut	2
T	M5 × 16mm Socket Head Cap Screw	2
U	M5 × 8mm Socket Head Cap Screw	2
V	M4 × 6mm Socket Head Cap Screw <b>[Used with Post-Dec 2019 Extrusion Rails Only]</b>	10
W	M3 × 4mm Flat Head Cap Screw <b>[Used with Post-Dec 2019 Extrusion Rails Only]</b>	6
<b>Drag Chain Support Plate Kit [Used with Pre-Dec 2019 Extrusion Rails Only]</b>		
X	Middle Support Plate	2
Y	Tail Support Plate	2
Z	M3 × 4mm Flat Head Cap Screw	2
AA	Alcohol Wipes	2
BB	Double-Sided VHB Tape	2
<b>Cable Tie Cleanup Kit [Used with Post-Dec 2019 Extrusion Rails Only]</b>		
CC	Cable Tie Mount	5
DD	M4 × 6mm Button Head Cap Screw	5
EE	<b>Cable Ties</b>	100

## Shapeoko Carryover Components

The Z-Plus upgrade requires several parts from the existing machine. All components and hardware to be carried over are listed in the table below and shown in **Fig. 2**. Throughout this guide, carryover parts will be called out by the words: **CARRY OVER**.

**NOTE:** Please use the replacement screws provided in the Z-Plus Kit.

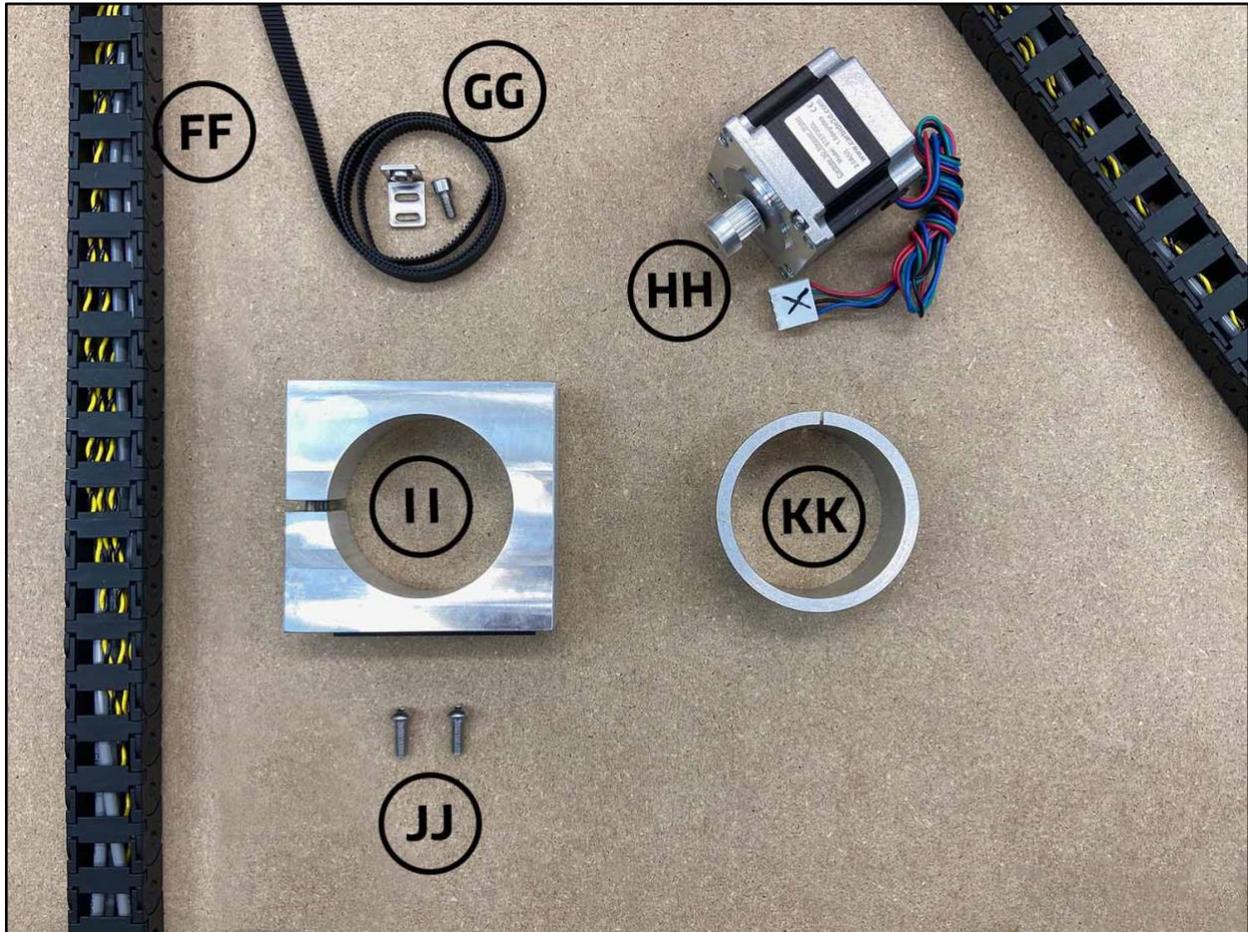


Figure 2

Item	Description	Qty
FF	Drag Chain	1
GG	X-Rail Belt and Hardware: Belt Clip (1) and M5 × 10mm Socket Head Cap Screw (1)	3
HH	X-Motor	1
II	Spindle/Router Mount	1
JJ	M5 × 16mm Button Head Cap Screw	2
KK	Router Mount Adapter Ring (Optional)	1

# Disconnect the BitSetter

**Machines With BitSetter:** Please complete the following steps before moving on to Disassembly on page 8.

Before beginning the Z-Plus upgrade:

1. Connect your machine to Carbide Motion.
  - a. Plug in your USB cable.
  - b. Open Carbide Motion.
  - c. Turn on your Shapeoko.
  - d. Click the **Connect to Cutter** button.
2. Click **Settings** in the top menu bar.
3. If you have the BitSetter checkbox checked, go ahead and uncheck it.

You will need to re-setup your BitSetter after successful homing with your new Z-Plus.

# Part 1: Disassembly

## Disassemble the Existing X/Z-Carriage

**NOTE:** As you complete the disassembly process, you may find it helpful to keep each **CARRY OVER** component and its associated hardware together and away from the new Z-Plus parts to avoid any mix ups.

### Disconnect Cables and the X-Axis Belt

1. Turn off your machine, unplug it, and disconnect the USB and power cables.
2. Clip all cable ties.
3. Unplug the router/spindle and remove it from the spindle mount.
  - a. Use a 4mm hex key to loosen the two (2) M5×55mm SHCS on the face of the mount.
  - b. If you are using the adapter ring: loosen the router mount, slide the router up, then lift the adapter ring to free it from the mount.
4. Free the Y2-end of the X-Axis belt from the Y2-carriage. (No need to remove the Y1-end.)
  - a. Use a 4mm hex key to remove the M5×10mm SHCS securing the belt clip.
  - b. Remove the clip from the end of the belt and pull the belt free from the X-motor pulley and idlers.
  - c. **CARRY OVER** the **belt**, **belt clip**, and **M5×10mm SHCS**.
5. Label all motor lead cables AND their extension cables.
  - a. Use a permanent marker or piece of tape to label all the white male/female connectors of the X-, Y1-, Y2-, and Z-stepper motor lead cables AND the X-, Y1-, Y2-, and Z-stepper motor extension cables.
6. Disconnect all cables.
  - a. Remove the Carbide Motion board enclosure cover.
  - b. Disconnect the X-, Y1-, Y2-, and Z-motor leads from their extension cables AND disconnect all extension cables and homing switches from the Carbide Motion board.

**WARNING:** Do NOT disconnect motor connectors by pulling on the wires or by prying at the latch. Use pliers to gently grip the base of each white connector and pull apart.

## Remove the Homing Switches, Drag Chain, and X/Z-Carriage

1. Remove the Z-Axis homing switch plate from the front of the X/Z-carriage. See **Fig. 3**.
  - a. Use a 3mm hex key to remove the four (4) M5×10mm BHCS securing the plate. (No need to separate any of the switches from their mounting plates.)
2. Remove the X-Axis homing switch plate from the rear of the X/Z-carriage.
  - a. Use a 4mm hex key to remove the two (2) M5×35mm SHCS and two (2) 1-inch spacers.
3. Remove the Y-Axis homing switch plate from the outside of the Y2-carriage.
  - a. Use a 4mm hex key to remove the two (2) M5×35mm SHCS and two (2) 1-inch spacers.
4. Disconnect the X-Axis drag chain from the X-Axis head bracket on the rear of the X/Z-carriage. See **Fig. 4**.
  - a. Use a 2mm hex key and needle nose pliers to remove the two (2) M3×8mm FHS and two (2) nylon lock nuts securing the drag chain to the head bracket.
5. Disconnect the Y-Axis drag chain from the Y-Axis head bracket on the outside of the Y1-carriage.
  - a. Use a 2mm hex key and needle nose pliers to remove the two (2) M3×8mm FHS and two (2) nylon lock nuts securing the drag chain to the head bracket.
6. Remove the drag chain from the rails and lay it on the baseframe as shown in **Fig. 5**.
  - a. Pry the tail ends of the drag chain from the VHB tape securing them to the rails.
  - b. Remove the VHB tape from the rails.
  - c. **CARRY OVER** the drag chain.
7. Remove the Y-Axis drag chain head bracket from the outside of the Y1-carriage.

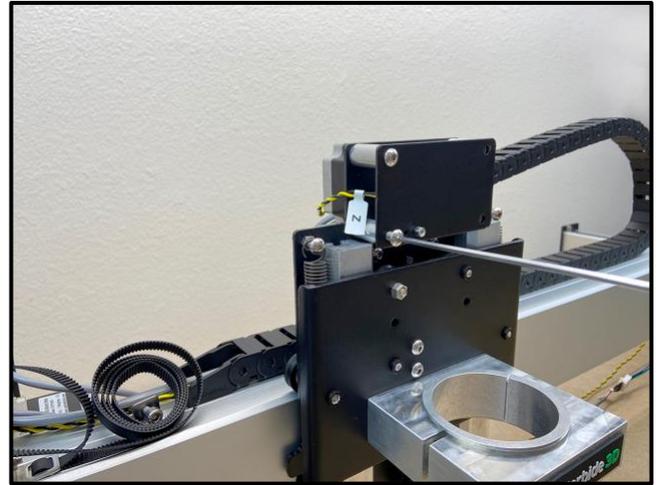


Figure 3

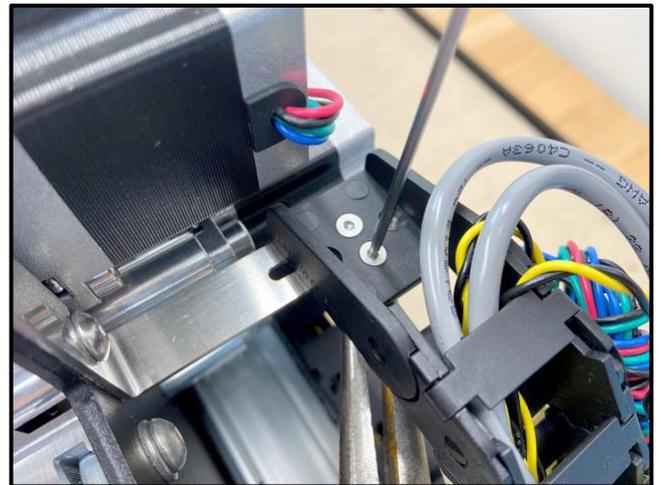


Figure 4

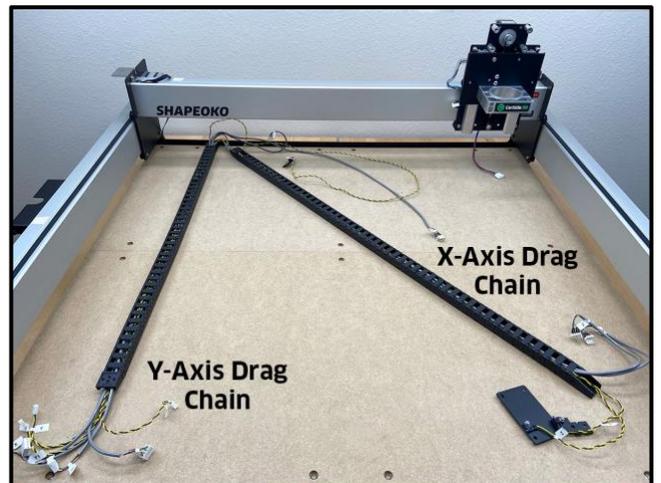


Figure 5

- a. Use an 8mm wrench and a 4mm hex key to remove the two (2) M5 nuts and two (2) M5×16mm SHCS.
8. Remove the lower two V-wheels from the X/Z-carriage.
  - a. Hold the eccentric nuts steady with an 8mm wrench and use a 3mm hex key to remove the V-wheels.
9. Lift the X/Z-carriage away from the X-rail and lay it on the baseframe.

## Disassemble the X/Z-Carriage

1. Separate the Z-carriage from the X-carriage. *Fig. 6.*
  - a. Remove the springs from both sides of the X/Z-carriage.
  - b. Loosen the tensioning screw at the bottom of the X-carriage plate.
    - i. Use a 3mm hex key to loosen the tensioning screw.
  - c. Loosen the idler assembly at the bottom of the X-carriage and free the belt.
    - ii. Use a 4mm hex key and a 10mm wrench to loosen the nut holding the idler in place.
    - iii. Free the belt from the idler and the Z-motor pulley.
  - d. Slide the smaller Z-carriage down and away from the larger X-carriage.
2. Remove the router/spindle mount from the Z-carriage plate.
  - b. Use a 3mm hex key to remove the two M5×16mm BHCS securing the mount.
  - c. **CARRY OVER** the router/spindle mount and M5×16mm BHCS.
3. Remove the X-motor (lower motor) from the back of the X-carriage plate.
  - d. Use a 4mm hex key to remove the four M5×10mm SHCS securing the motor.
  - e. **CARRY OVER** the X-motor.

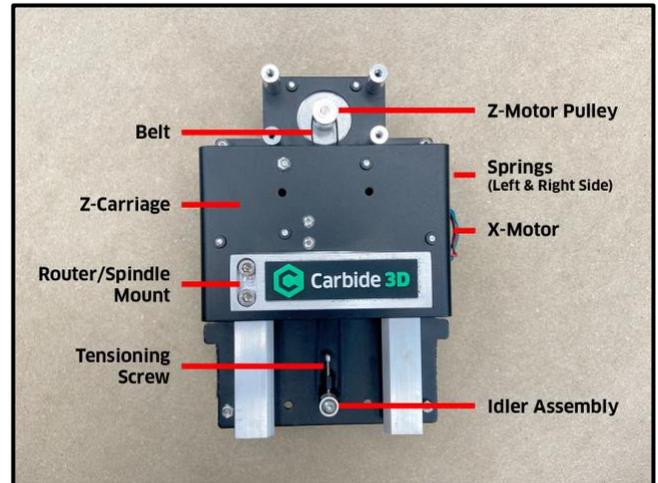


Figure 6

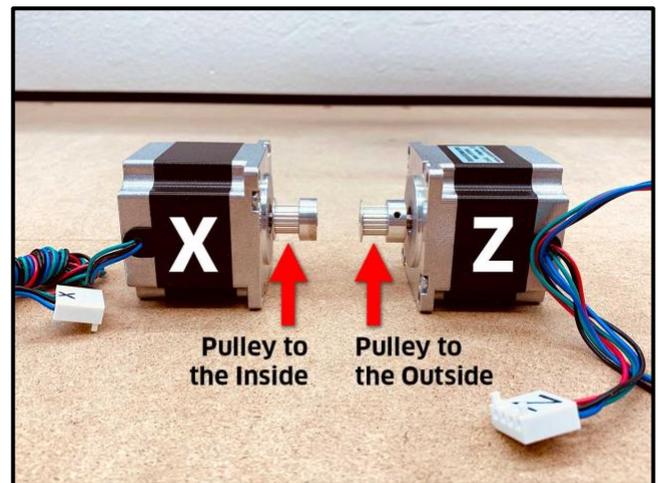


Figure 7

**WARNING:** Do not mix up the X- and Z-motors. The orientation of the X-motor's drive pulley on the drive shaft is very important for Z-Plus assembly. See *Fig. 7.*

# Part 2: Assembly & Installation

## Assembly Tips

We recommend assembling as much of the Z-Plus as possible before installing it onto the Shapeoko; this process is described in the steps below.

**NOTE:** The application of a blue (i.e. light/medium grade) thread locker is at your discretion. We suggest adding it post-assembly if any screws happen to work their way loose during use.

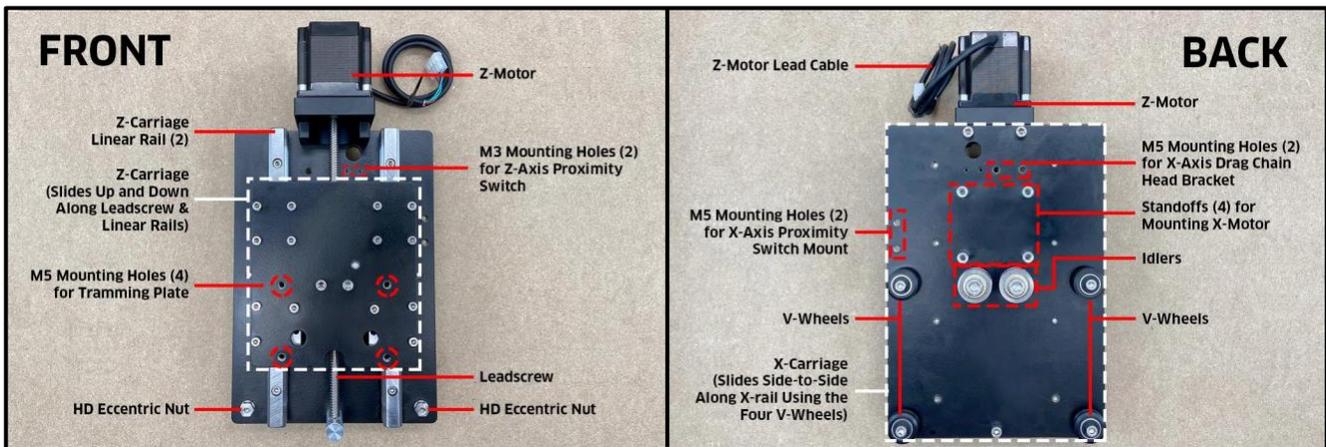


Figure 8

## Get Familiar with the Z-Plus

1. Take a minute to familiarize yourself with the front and back of the Z-Plus. See *Fig. 8*.

## Assemble the Z-Plus — Back

Z-Plus Upgrade Kit + Carryover Components:

Item	Description	Qty
B	M5 × 10mm Socket Head Cap Screw	4
J	X-Axis Proximity Switch Mount	1
L	M5 × 25mm Socket Head Cap Screw	2
O	X-Axis Drag Chain Bracket	1
U	M5 × 8mm Socket Head Cap Screw	2
HH	X-Motor [CARRYOVER]	1

**Shapeoko 3 Machines:** Skip installation of the X-Axis drag chain head bracket (#1 below).

1. Install the X-Axis drag chain head bracket (long, narrow head bracket) on the rear of the Z-Plus. See **Fig. 9**.
  - a. Align bracket with the M5 screw holes at the top of the Z-Plus, flange down.
  - b. Use a 3mm hex key and two (2) M5×8mm SHCS to secure.
2. Install the X-Axis proximity switch mount. See **Fig. 9** and **Fig. 9 inset**.
  - a. Align the mount with the two M5 holes next to the X-motor standoffs.
  - b. Use a 4mm hex key and two (2) M5×25mm SHCS to secure. There are outer and inner screw slots in the mount; use the OUTER screw slots.
3. Remove the lower two V-wheels. See **Fig. 9**.
  - a. Use a 4mm hex key and 10mm wrench to remove the M5×25mm SHCS, V-wheels, and M5 washers (shims). Set them aside.
4. Install the X-motor. See **Fig. 10**.
  - a. Align the X-motor with the four (4) standoffs, Carbide 3D label facing down toward the idlers.
  - b. Use a 4mm hex key and four (4) M5×10mm SHCS to secure the X-motor.

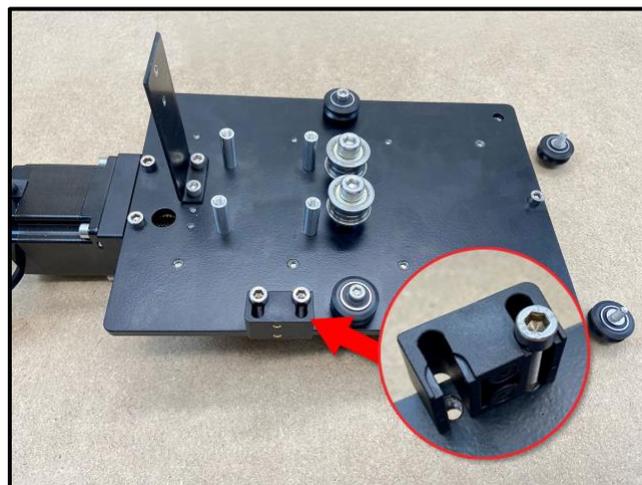


Figure 9

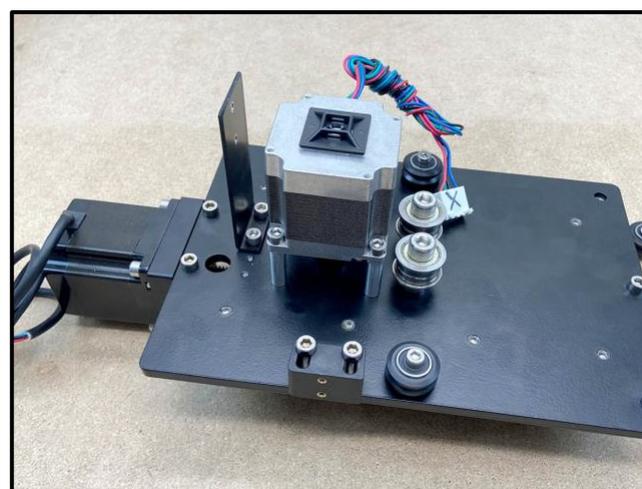


Figure 10

## Assemble the Z-Plus — Front

Z-Plus Upgrade Kit + Carryover Components:

Item	Description	Qty
C	Tramming Plate	1
D	M5 × 8mm Socket Head Cap Screw	4
G	Z-Axis Proximity Switch (200mm XXL, 200mm XL, and 610mm Shapeoko 3)	1
N	M3 × 18mm Socket Head Cap Screw	2
II	Spindle/Router Mount <a href="#">[CARRYOVER]</a>	1
JJ	M5 × 16mm Button Head Cap Screw <a href="#">[CARRYOVER]</a>	2
KK	Router Mount Adapter Ring (Optional) <a href="#">[CARRYOVER]</a>	1

The tramming plate is a feature of the Z-Plus which allows you to easily adjust left/right tilt of the router/spindle. The tramming plate's four mounting holes are slightly enlarged providing a small amount of wiggle room around the screws and allowing you to tram your router/spindle in relation to the X-Axis. See *Fig. 11*.

**NOTE:** See Tramming Instructions at the end of this guide for more information on tramming.

### Install the Spindle/Router Mount to the Tramming Plate

1. Attach the spindle/router mount to the tramming plate. See *Fig. 12*.
  - a. Position the tramming plate with the larger notch at the top.
  - b. Align the router mount with the two available screw holes across the center of the plate.
  - c. Use a 3mm hex key and the two (2) M5×16mm BHCS to secure the mount to the plate.

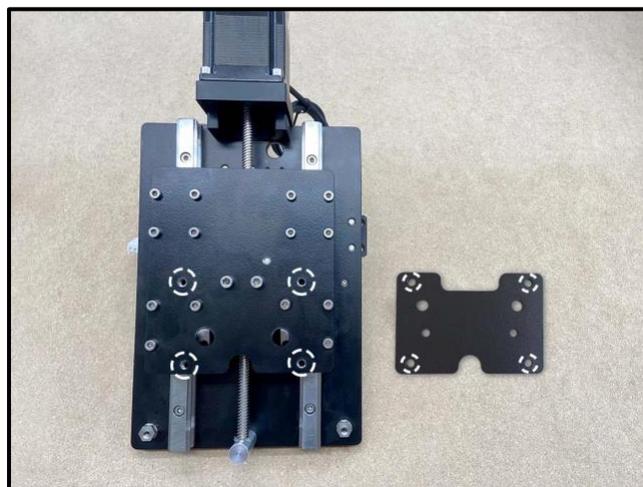


Figure 11



Figure 12

## Install the Tramming Plate to the Z-Plus

1. Install the tramming plate to the front of the Z-Plus. See **Fig. 13**.
  - a. Align the tramming plate with the four available M5 holes.
  - b. Use a 4mm hex key and four (4) M5×8mm SHCS to secure.
2. Install the router mount adapter ring if you have a 65mm router.



Figure 13

## Install the Z-Axis Proximity Switch to the Z-Plus

1. Install the Z-Axis proximity switch to the front of the Z-Plus. See **Fig. 14**.
  - a. Check to make sure the lead screw stopper, the silver cylinder at the bottom of the lead screw, is present and tighten if necessary.
  - b. With both hands grasp the sides of the Z-Plus and, slowly but firmly, lower the

**NOTE:** If the lead screw stopper is missing from your Z-Plus, please stop the assembly process here and contact us at [support@carbide3d.com](mailto:support@carbide3d.com). If you continue with the assembly process, you could damage your Z-Plus.

Z-carriage with your thumbs until it stops at the bottom.

- c. Insert the Z-Axis proximity switch cable through the hole at the top of the Z-Plus, just under the Z-motor.
- d. Position the proximity switch with the red LED facing front and the target pointing down.
- e. Align the proximity switch's mounting slots with the two M3 holes at the top of the Z-Plus.
- f. Use a 2.5mm hex key and two (2) M3×18mm SHCS to secure the proximity switch.
  - i. Before fully tightening the screws, slide the switch up as far as it will go.



Figure 14

# Install the Drag Chain Support System

**Shapeoko 3 Machines:** Skip ahead to the “Install the Z-Plus” section on page 21.

## Install the Y-Axis Head Bracket

Z-Plus Upgrade Kit:

Item	Description	Qty
P	Y-Axis Drag Chain Head Bracket	1
S	M5 Nut	2
T	M5 × 16mm Socket Head Cap Screws	2

1. Install the Y-Axis drag chain head bracket to the outside of the Y1-carriage. See **Fig. 15**.
  - a. Use a 4mm hex key and two (2) M5×16mm SHCS to attach the head bracket to the Y1-carriage plate.
  - b. Use an 8mm wrench and two (2) M5 nuts to secure the bracket, flange down, to the M5×16mm SHCS.



Figure 15

## Identify Your Extrusion Rail Version

1. Examine your X- and Y1-Rails. You will have either:
  - Pre-Dec 2019 extrusion rails. See **Fig. 16**.
    - **X-Rail:** No screw holes.
    - **Y1-Rail:** Two M5 threaded screw holes in the center.

**Pre-Dec 2019 Rails:** Your setup may look slightly different than the setup pictured in this document.

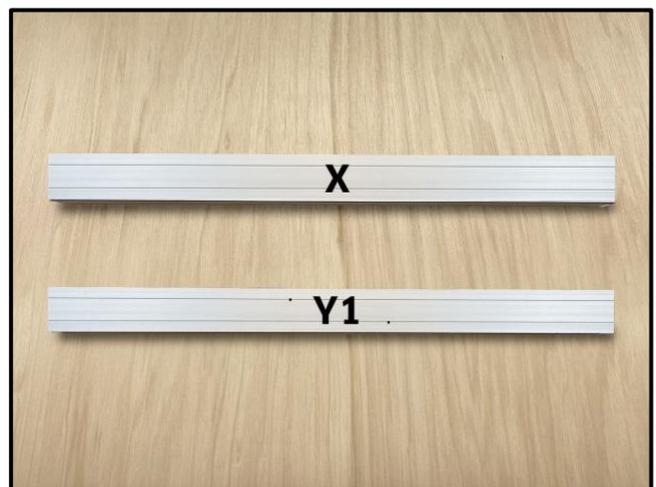


Figure 16

- Post-Dec 2019 extrusion rails. See **Fig. 17**.
  - **X-Rail:** Sixteen M4 threaded screw holes.
  - **Y1-Rail:** Two M5 threaded screw holes on the left-side of the rail and four M4 threaded screw holes along the top of the rail.



Figure 17

## Install Drag Chain Supports

**Pre-Dec 2019 Rails:** You will need to install the four (4) included drag chain support PLATES. Complete the instructions in “Install the Drag Chain Support Plates” below.

**Post-Dec 2019 Rails:** You will need to install the five (5) included drag chain support BRACKETS. Skip ahead to “Install the Drag Chain Support Brackets” on page 18.

### Install the Drag Chain Support Plates [Pre-Dec 2019 Rails ONLY]

Z-Plus Upgrade Kit:

Item	Description	Qty
X	Drag Chain Middle Support Plate	2
Y	Drag Chain Tail Support Plate	2
AA	Alcohol Wipe	2
BB	Double-Sided VHB Tape	2

Drag chain support plates install onto the top of the rail with the long edge perpendicular to the rail. The short edge of the plate lines up with the rail’s centerline, allowing the plate to overhang the back side of the rail by 1”. The PEM nuts in the drag chain tail support plates overhang the rail.

1. Attach one (1) middle support plate and one (1) tail support plate onto the X-rail. See **Fig. 18** (image from rear).

- a. Measure and mark 5" and 19 1/2" from the Y1-carriage.
- b. Clean support plates AND rail, on the far side (Y2-side) of each mark, with an alcohol wipe.
- c. Cut a piece of double-sided VHB tape in half.
- d. Stick both tape halves to the top of the rail, to the far side of each mark, between the centerline and back of the rail.

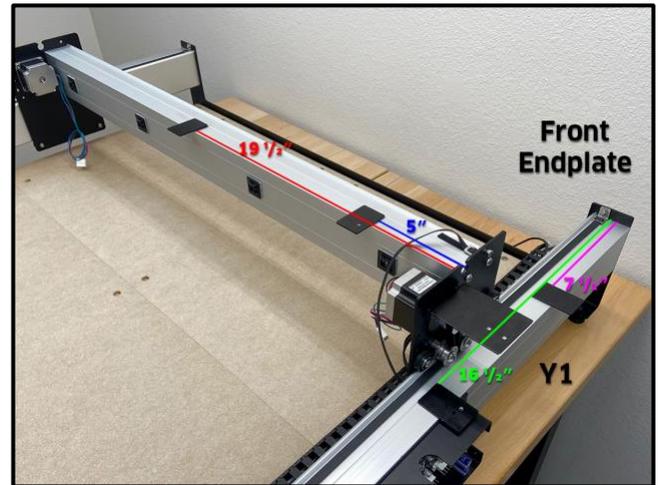


Figure 18

- e. Stick the middle support plate (no PEM nut) to the tape at the 19 1/2" mark.
- f. Stick the tail support plate (with PEM nut) to the tape at the 5" mark. Orient the plate with the PEM nut overhanging and toward the Y1-side of the rail.
- g. Press each plate firmly to the rail for 30 seconds.

2. Attach one (1) middle support plate and one (1) tail support plate onto the Y1-rail. See **Fig. 18**.

- a. Measure and mark 7 1/2" and 16 1/2" from the front endplate.
- b. Clean support plates AND rail, on the far side (rear-endplate-side) of each mark with an alcohol wipe.
- c. Cut the remaining piece of double-sided VHB tape in half.
- d. Stick both tape halves to the top of the rail, to the far side of each mark, between the centerline and outside of the rail.
- e. Stick the middle support plate (no PEM nut) to the tape at the 7 1/2" mark.
- f. Stick the tail support plate (with PEM nut) to the tape at the 16 1/2" mark. Orient the plate with the PEM nut overhanging and toward the front endplate.
- g. Press each plate firmly to the rail for 30 seconds.

## Install the Drag Chain Support Brackets [Post-Dec 2019 Rails ONLY]

Z-Plus Upgrade Kit:

Item	Description	Qty
Q	Drag Chain Middle Support Bracket	3
R	Drag Chain Tail Support Bracket	2
V	M4 × 6mm Socket Head Cap Screw	10

Drag chain support brackets install flange down to the horizontal sets of M4 screw holes on the extrusion rails. The top of the bracket sits flush with the top of the rail.

1. Install two (2) middle support brackets (no PEM nut) and one (1) tail bracket (with PEM nut) to the back side of the X-rail. See **Fig. 19** (image from rear).
  - a. Install the tail bracket to the set of M4 holes closest to the Y1-carriage.
  - b. Use a 3mm hex key and two (2) M4×6mm SCHS to secure each support bracket to the rear of the X-rail.
2. Install one (1) middle support bracket (no PEM nut) and one (1) tail bracket (with PEM nut) to the outside of the Y1-rail. See **Fig. 19** (image from rear).
  - a. Install the tail bracket to the set of M4 holes closest to the Carbide Motion board enclosure.
  - b. Use a 3mm hex key and two (2) M4×6mm SCHS to secure each support bracket to the outside of the Y1-rail.

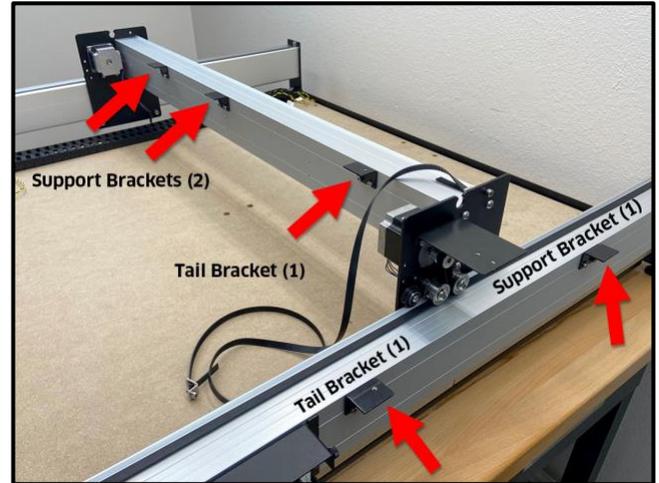


Figure 19

# Insert the Proximity Switch Cables into the Drag Chain

## Install the Proximity Switch Cables

Z-Plus Upgrade Kit:

Item	Description	Qty
E	X-Axis Proximity Switch Cable (2675mm XXL and 2350mm XL)	1
F	Y-Axis Proximity Switch Cable (2540mm XXL and 2200mm XL)	1
H	Z-Axis Proximity Switch Extension Cable (2438mm XXL, 2235mm XL)	1

1. Open up the drag chain and remove the homing switch cables. See *Fig. 20* and *Fig. 21*.
  - a. Position the drag chain on the baseframe as shown in *Fig. 21*, with the chain's clip-on panels facing up. (Only one side of the chain will open; be sure this side is facing up.)
  - b. Use a hex key or screw driver as a lever to pry open one side of each drag chain link. Start from the rear of the machine and work your way forward (as shown in *Fig. 20*).
  - c. Remove the three black and yellow X-, Y-, and Z-Axis homing switch cables.
2. Label the proximity switches AND gray 3-pin extension cable.
  - a. Identify the X- and Y-Axis proximity switches by comparing the length printed on the switch body with the table above.
  - b. Use a permanent marker or piece of tape to label the white female connectors of X- and Y-Axis proximity switch cables AND the gray Z-Axis proximity switch extension cable.

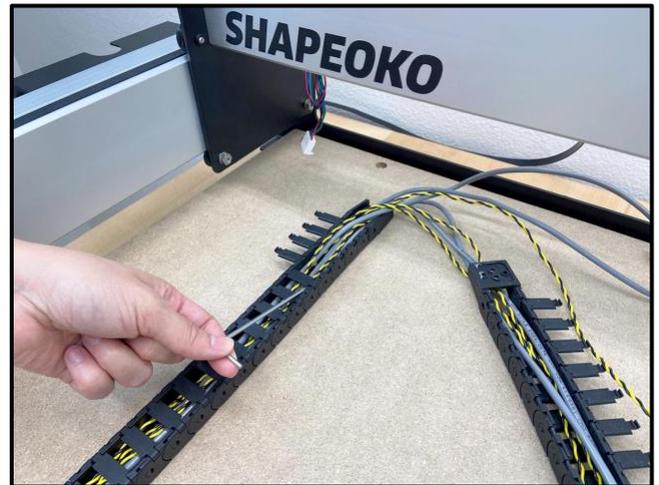


Figure 20

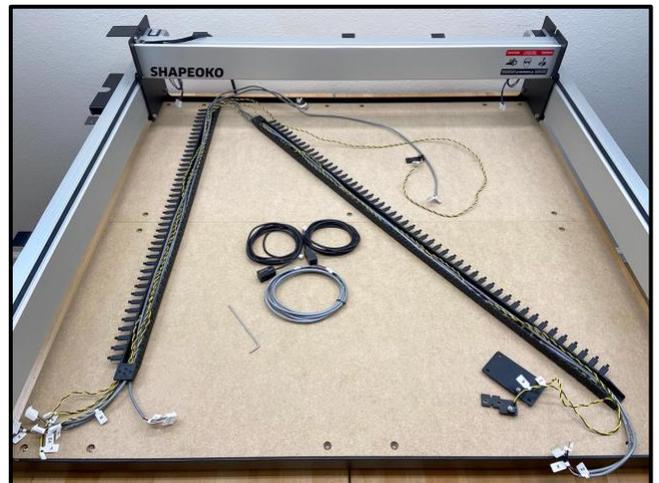


Figure 21

3. Insert the proximity switches and extension cable into the drag chain. See *Fig. 22*.

**NOTE:** Position the female end of the gray Z-Axis proximity extension cable at the tail of Y-Axis drag chain.

- a. Insert the X-Axis proximity switch cable and the gray Z-Axis proximity switch extension cable through both the Y-Axis and X-Axis portions of the drag chain.
  - b. Insert the Y-Axis proximity switch cable through the Y-Axis drag chain ONLY.
4. Close up the drag chain. Do not install onto the rails just yet.

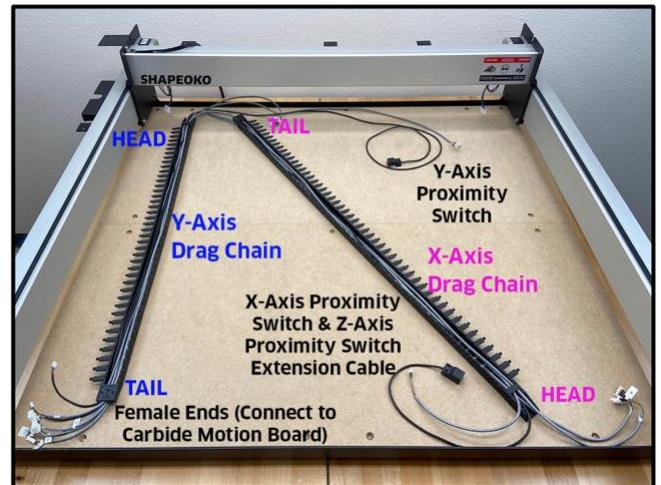


Figure 22

# Install the Z-Plus

## Install the Z-Plus onto the X-Rail

Z-Plus Upgrade Kit (removed from the Z-Plus in a previous step):

Item	Description	Qty
N/A	V-Wheel	2
N/A	M5 Washer (Shim)	2
N/A	M5 × 25mm Socket Head Cap Screw	2

1. Place the Z-Plus onto the front of the X-rail, aligning the top V-wheels with the upper V-rail.
2. Re-install the bottom two V-wheels you removed in the “Assemble the Z-Plus — Back” section. See **Fig. 23**.
  - a. If you need to re-assemble the V-wheels, assemble in this order:
    - i. M5×25mm SHCS
    - ii. V-wheel
    - iii. M5 washer (shim)
  - b. Use a 10mm wrench to hold the HD eccentric nuts steady in the fully open position (dimples up).
  - c. Be sure the V-wheels are properly seated on the lower V-rail.
  - d. Use a 4mm hex key to secure both V-wheels to the HD eccentric nuts.
  - e. Check wheel spin. If shims are properly placed between wheels and carriage plate, the wheels will spin with little to no resistance.
2. Tension the HD eccentric nuts.
  - a. Rotate the eccentric nuts **CLOCKWISE** to tension. Reach under and spin the V-wheel with your finger. If it rotates freely, keep tightening until you feel some friction against the rail.

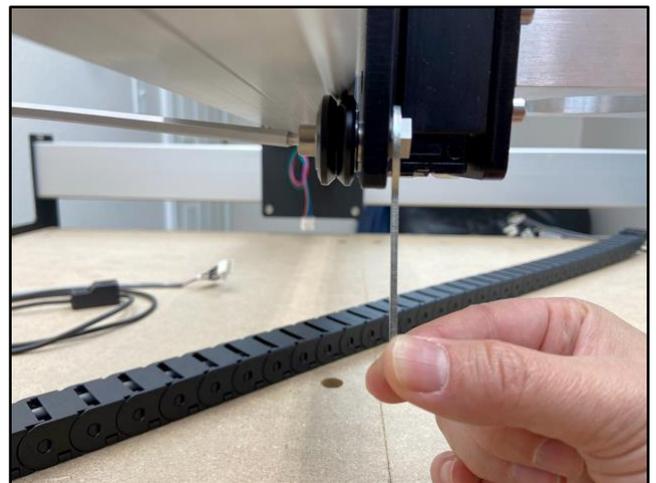


Figure 23

**NOTE:** If your V-wheels are not turning freely, check to make sure the shims are correctly positioned between the V-wheel and carriage plate.

## Install the X-Axis Belt

Carryover Components:

Item	Description	Qty
GG	X-Axis Belt and Hardware: Belt Clip (1), and M5 × 10mm Socket Head Cap Screw (1) [CARRYOVER]	3

1. Install and tension the X-Axis belt. See **Fig. 24** and **Fig. 25**.
  - a. Feed the free end of the belt under the idlers on the back of the Z-Plus.
  - b. Use a small hex key to push a loop of belt up between the idlers. See **Fig. 24**. Then, loop the belt around the X-motor pulley.
  - c. Take the slack out of the belt. Attach the belt clip to the free end of the belt.
  - d. Place the belt flat along the rail, leaving a ¼-inch gap between the clip and carriage plate.
  - e. Use a 4mm hex key and the M5×10mm SHCS to secure. See **Fig. 25**.
  - f. Tighten until an audible tone can be heard when the belt is plucked.



Figure 24

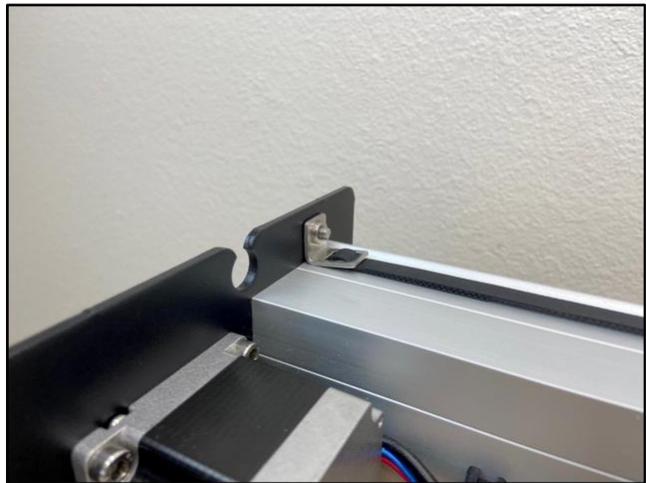


Figure 25

# Install the Drag Chain

**Shapeoko 3 Machines:** Skip ahead to the “Install the Proximity Switches” section on page 25.

## Install the Drag Chain to the X- and Y1-Rails

Z-Plus Upgrade Kit:

Item	Description	Qty
W	M3 × 4mm Flat Head Screw	6

1. Position the X-rail to the back of the machine.
2. Lay the drag chain on the rails. See **Fig. 26**.
  - a. First, place the three cables not threaded through the X-Axis drag chain (the Y-Axis proximity switch cable and the Y1- and Y2-motor leads) over and behind the X-rail
  - b. Second, lift the drag chain and place it across the Y1- and X-rails.
  - c. Lay the drag chains so that the tail of the Y-Axis drag chain will curl under and the head of the X-Axis drag chain will curl up.

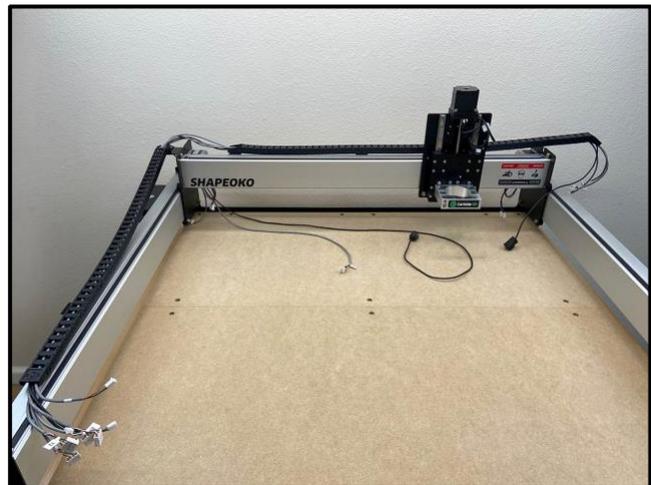


Figure 26

3. Secure the drag chain to the rails. See **Fig. 27**.

- a. Secure the head of the Y-Axis drag chain to the head bracket on the outside of the Y1-carriage.
  - i. Use a 2mm hex key and two (2) M3×4mm FHS to secure.
- b. Secure the tail of the Y-Axis drag chain to the tail bracket (or tail plate) next to the Carbide Motion Board enclosure.
  - i. Curl the tail of the drag chain under and toward the enclosure.
  - ii. Use a 2mm hex key and one (1) M3×4mm FHS to secure.

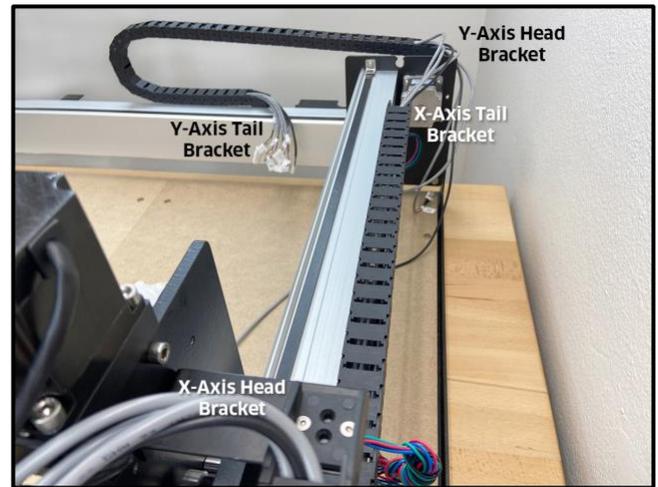


Figure 27

- c. Secure the tail of the X-Axis drag chain to the tail bracket (or tail plate) near the Y1-motor.
  - i. Use a 2mm hex key and one (1) M3×4mm FHS to secure.
- d. Secure the head of the X-Axis drag chain to the head bracket on the rear of the Z-Plus.
  - i. Curl the head of the drag chain up and toward the Z-Plus.
  - ii. Use a 2mm hex key and two (2) M3×4mm FHS to secure.

# Install the Proximity Switches

## Install the X-Axis Proximity Switch to the Mount

Z-Plus Upgrade Kit:

Item	Description	Qty
E	X-Axis Proximity Switch (2675mm XXL, 2350mm XL, and 712mm Shapeoko 3)	1
N	M3 × 18mm Socket Head Cap Screw	2

1. Attach the X-Axis proximity switch to the mount installed on the rear of the Z-Plus. See **Fig. 28**.
  - a. Locate the X-Axis proximity switch exiting the drag chain at the X-Axis head bracket.
  - b. Position the proximity switch with the red LED facing the Y2-carriage and the target pointing down.
  - c. Align the proximity switch's mounting slots with the two M3 holes on the face of the mount.
  - d. Use a 2.5mm hex key and two (2) M3×18mm SHCS to secure the proximity switch.
  - e. Before fully tightening the screws, slide the switch up as far as it will go.

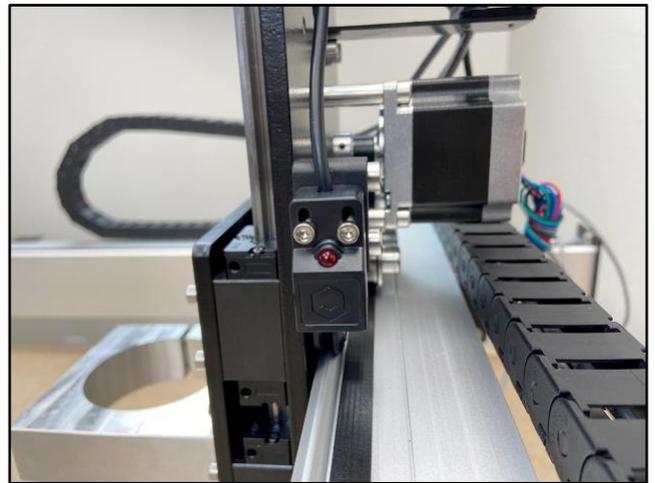


Figure 28

## Install the Y-Axis Proximity Switch

Z-Plus Upgrade Kit:

Item	Description	Qty
F	Y-Axis Proximity Switch (2540mm XXL, 2200mm XL, 610mm Shapeoko 3)	1
N	M3 × 18mm Socket Head Cap Screw	2
K	Y-Axis Proximity Switch Mount	1
M	M5 × 35mm Socket Head Cap Screw	2

1. Install the Y-Axis proximity switch mount to the outside of the Y2-carriage. See **Fig. 29**.
  - a. Use a 4mm hex key and two (2) M5×35mm SHCS to secure the mount to the outside of the Y2-carriage.
2. Attach Y-Axis proximity switch to the mount. See **Fig. 29**.
  - a. Locate the Y-Axis proximity switch exiting the drag chain at the Y1-Axis head bracket.
  - b. Position the proximity switch with the red LED facing out and the target pointing to the rear.
  - c. Align the switch's two mounting slots with the two M3 PEM nuts on the mount.
  - d. Use a 2.5mm hex key and two (2) M3×18mm SHCS to secure.
  - e. Before fully tightening the screws, slide the switch as far to the FRONT as it will go.

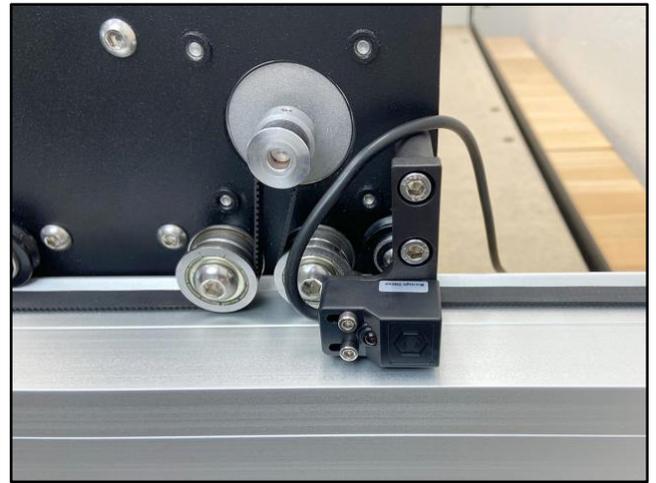


Figure 29

## Connect Z-Axis Proximity Switch to Extension Cable

**Shapeoko 3 Machines:** Skip ahead to the “Connect Cables to the Carbide Motion Board: Shapeoko 3 Instructions” section on page 29.

Z-Plus Upgrade Kit:

Item	Description	Qty
G	Z-Axis Proximity Switch (200mm XXL, 200mm XL, 610mm Shapeoko 3)	1
H	Z-Axis Proximity Switch Extension Cable (2438mm XXL, 2235mm XL, no extension Shapeoko 3)	1

1. Connect the Z-Axis proximity switch to the gray extension cable. See **Fig. 30**.
  - a. Locate the Z-Axis proximity switch exiting the rear of the Z-Plus.
  - b. Locate the Z-Axis proximity switch extension cable exiting the drag chain at the X-Axis head bracket.
  - c. Connectors are polarized. Be sure to align them properly.

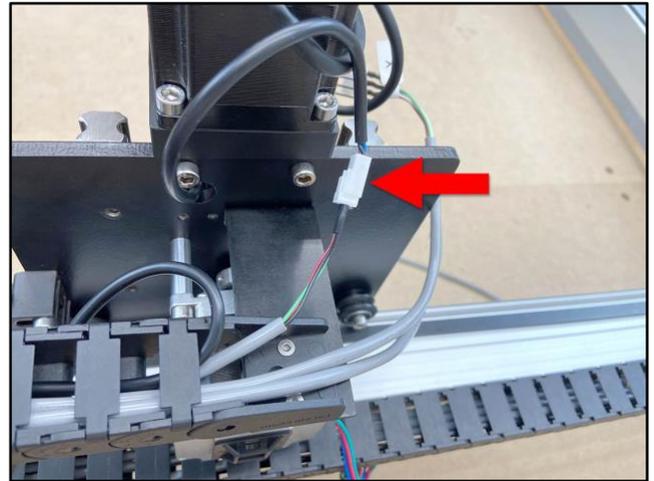


Figure 30

# Connect the Wiring

## Connect the Motors

1. Connect the X- and Z-motor lead cables to their labeled extension cables at the rear of the Z-Plus.
  - a. Both the X- and Z-motor extensions exit the head of the X-Axis drag chain behind the Z-Plus.
  - b. Connectors are polarized. Be sure to align them properly.
2. Connect the Y1- and Y2- motor lead cables to their extension cables.
  - a. Both the Y1- and Y2-motor extensions exit the head of the Y-Axis drag chain at the Y1-carriage.
  - b. The Y2-motor lead cable stretches across the machine, behind the X-rail.
  - c. Connectors are polarized. Be sure to align them properly.

## Connect Cables to the Carbide Motion Board

Z-Plus Upgrade Kit:

Item	Description	Qty
I	Riser Board	1

### Shapeoko XXL and XL Instructions

1. Plug the PCB riser board into the Carbide Motion board. See **Fig. 31**.
  - a. Plug the PCB riser board into the 2x8 open bank of pins in the top-right of the Carbide Motion board.
2. Plug the proximity switch cables and stepper motor extension cables into the Carbide Motion board. See **Fig. 31**.
  - a. Plug each of the 3-pin proximity switch cables, X, Y, and Z, into the PCB riser board, as labeled.
  - b. Plug each of the 4-pin motor extension cables Z, Y1, Y2, X, into the connectors across the bottom of the Carbide Motion board, as labeled.
  - c. Connectors are polarized. Be sure to align them properly.

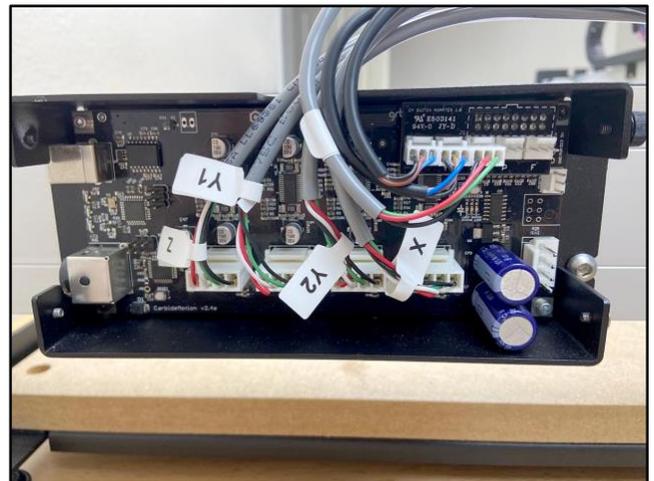


Figure 31

## Shapeoko 3 Instructions

**Shapeoko 3 Machines:** Your Carbide Motion board should be installed upside down.

1. Plug the PCB riser board into the Carbide Motion board. See *Fig. 32*.
  - a. Plug the PCB riser board into the 2x8 open bank of pins in the bottom-left of the Carbide Motion board.
2. Plug the proximity switch cables and stepper motor extension cables into the Carbide Motion board. See *Fig. 32*.
  - a. Plug each of the proximity switch cables, Z, Y, and X, into the PCB riser board, as labeled.
  - b. Plug in the stepper motor extension cables X, Y2, Y1, Z, into the connectors across the top of the Carbide Motion board, as labeled.
  - c. Connectors are polarized. Be sure to align them properly.



Figure 32

# Cleanup the Cables

## Secure Cables at Y1-Carriage and Z-Plus

**Shapeoko 3 Machines:** Skip ahead to the “Secure Cables Along the X-Rail” section on page 31.

Z-Plus Upgrade Kit:

Item	Description	Qty
EE	Cable Ties	Several

1. Secure the cables crossing the Y1-carriage plate. See **Fig. 33**.
  - a. Tuck all seven cables, one at a time, into the cutout at the top of the Y1-carriage plate.
  - b. Use two (2) cable ties, one on each side of the cutout, to secure the cables in place.
2. Secure the cables at the rear of the Z-Plus. See **Fig. 34**.
  - a. Bundle the X- and Z-cables at the rear of the Z-Plus.
  - b. Use two (2) cable ties to secure the cables to the self-adhesive cable tie mount already on the back of the X-motor.

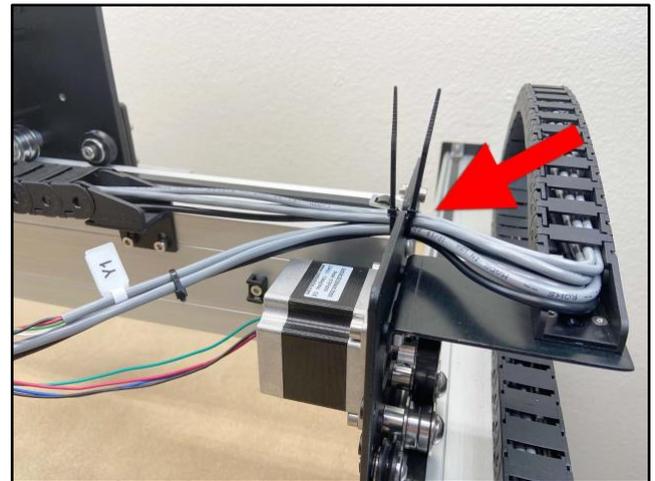


Figure 33

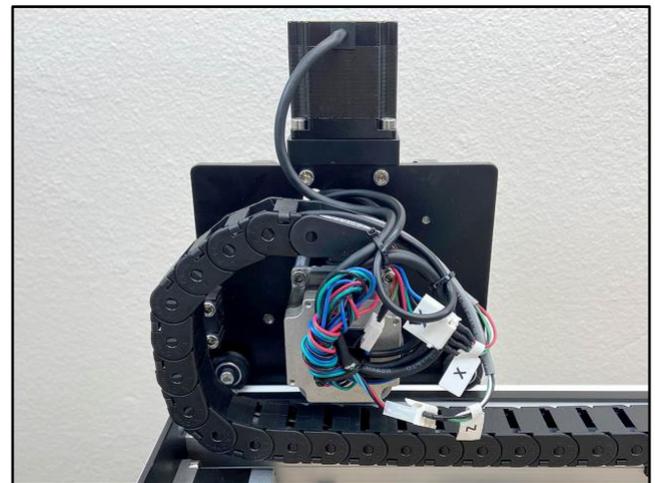


Figure 34

## Secure Cables Along the X-Rail

**Pre-Dec 2019 Rails (see page 15-16):** Clean up cables at the rear of the X-rail using the self adhesive cable tie mounts already attached to your X-rail. Complete the instructions in “Cable Cleanup — Pre-Dec 2019 Rails ONLY” below.

**Post-Dec 2019 rails (see pages 15-16):** Clean up cables at the rear of the X-rail using the five (5) cable tie mounts included with the Z-Plus upgrade kit. Skip ahead to “Cable Cleanup — Post-Dec 2019 Rails ONLY” below.

### Cable Cleanup — Pre-Dec 2019 Rails ONLY

Z-Plus Upgrade Kit:

Item	Description	Qty
EE	Cable Ties	Several

1. Tidy up the cables along the rear of the X-rail. See *Fig. 35*.
  - a. Secure the loose cables to the four self-adhesive cable tie mounts already attached to the back of the X-rail.

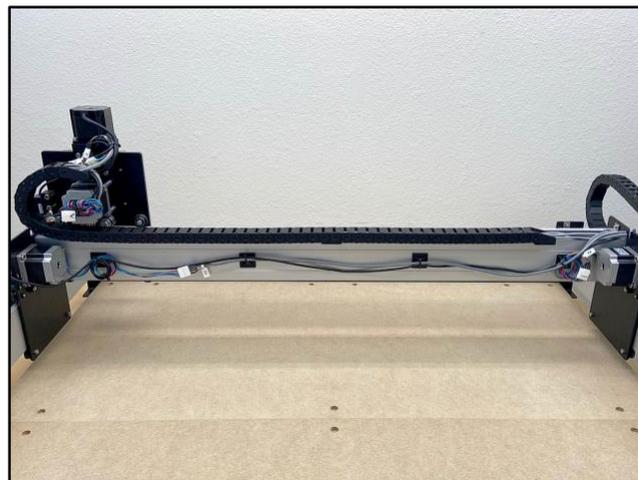


Figure 35

**Pre-Dec 2019 Rails:** The five (5) cable tie mounts and five (5) M4 × 6mm BHCS, are not needed for this rail setup.

**Shapeoko 3 Machines:** You will only use four (4) cable tie mounts and four (4) M4×6mm BHCS.

Z-Plus Upgrade Kit:

Item	Description	Qty
CC	Cable Tie Mounts	5
DD	M4 × 6mm Button Head Cap Screw	5
EE	Cable Ties	Several

1. Install cable tie mounts to the back of the X-rail. See **Fig. 36**.
  - a. Remove the four self-adhesive cable tie mounts from the rear of the X-rail.
  - b. Cable tie mounts install vertically.
  - c. Install the five (5) mounts to the upper five M4 threaded screw holes along the middle of the rail.
  - d. Use a 3mm hex key and one (1) M4×6mm BHCS to secure each mount.
2. Tidy up the cables along the rear of the X-rail. See **Fig. 36**.
  - a. Secure loose cables to the cable tie mounts using cable ties.

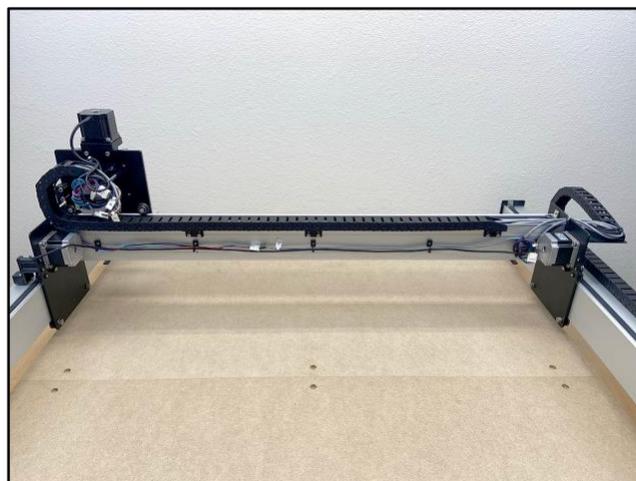


Figure 36

# Part 3: Post Installation

## Tramming Instructions

### Tramming the Z-Plus

Tramming your spindle means ensuring the cutter head (Z-Axis) is perfectly perpendicular to the level work surface in both left-to-right tilt (tilt about the Y-Axis) and front-to-back tilt (tilt about the X-Axis).

Another way to look at it is: you are ensuring the spindle *MOUNT* is completely parallel to the level work surface.

#### Before you Begin

Level and square the baseframe. Tension all the V-wheels. Tighten all the belts. Optionally, you may also want to resurface your waste board.

Move the Z-Plus to the center of the machine and lower the spindle mount to approximately 6" above the surface.

Optionally, if you are working on top of a wasteboard or other potentially uneven surface, you may want to lay a large, rigid, and perfectly level piece of material over the top of it for best results.

For tramming you will need:

- Aluminum foil (for shimming)
- A perfectly square 6" x 6" x 3/4" piece of wood (or other leveling aid such as precision 1-2-3 Gauge blocks)

#### Adjusting for Front-to-back Tilt

There are two methods for adjusting front-to-back tilt – the aluminum foil shim method or the X-rail rotation method. Here we will focus only on the foil shim method.

To adjust tilt front-to-back, use aluminum foil as a shim between the tramming plate and the Z-carriage.

1. Place your square block on edge, in the direction of the Y-Axis, underneath the spindle mount.
2. Lower the Z-Axis carriage with your hands until the spindle mount contacts your block.
3. Check the spindle mount for level (level about the X-Axis) against the block. If adjustments are needed:
  - a. Loosen the four tramming plate mounting screws.
  - b. Shim the top half for forward tilt or the bottom half for back tilt.
    - i. Place one piece of aluminum foil between the tramming plate and Z-carriage and tighten the mounting screws. Add pieces of foil as necessary.

#### Adjusting for Left-to-Right Tilt

Once you have accounted for front/back tilt, the tramming plate allows you to easily adjust left-to-right tilt.

1. Place your square block on edge, in the direction of the X-Axis, underneath the spindle mount.

2. Lower the Z-Axis carriage with your hands until the spindle mount contacts your block.
3. Check the spindle mount for level (level about the Y-Axis) against the block. If adjustments are needed:
  - a. Loosen the four tramming plate mounting screws.
  - b. “Wiggle” the tramming plate left or right to level.
  - c. Tighten all four tramming plate mounting screws.

You might need to repeat this process a few times doing a small surface cut in between each adjustment to analyze your level.

A detailed video on tramming your Shapeoko can be found here: <https://www.youtube.com/watch?v=rGOGINurgIE>. For additional advice on tramming, check out the Carbide 3D community: [community.carbide3d.com](https://community.carbide3d.com).

# Update Your Machine Settings

## Update Software

**WARNING:** The Z-Plus is supported by Carbide Motion 4.17 onwards. Do NOT use an older version of Carbide Motion.

1. Download and install Carbide Motion from: <https://carbide3d.com/carbidemotion/download/>.
2. Confirm all of the proximity switches and motors are connected correctly, then, ensure that there is nothing restricting the Shapeoko's movement.

## Update Settings

**WARNING: DO NOT** try to home or jog the Shapeoko before applying the updated settings.

Now, you're ready to turn the Shapeoko on and make the required software changes.

1. Connect your machine to Carbide Motion.
  - a. Plug in your USB cable.
  - b. Open Carbide Motion.
  - c. Turn on your Shapeoko.
  - d. Click the **Connect to Cutter** button.
2. Update your machine settings. See *Fig. 37*.
  - a. Click **Settings** in the top menu bar.
  - b. In the Settings window, choose your Shapeoko size from the **Size dropdown list**, then choose "Z-Plus (Leadscrew)" from the **Z-Axis Type dropdown list**, then choose "Inches" or "MM" from the **Units dropdown list**.

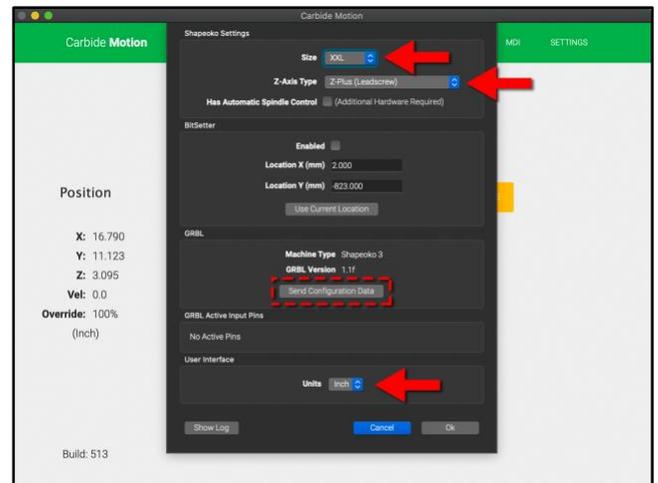


Figure 37

- c. Click the **Send Configuration Data** button in the middle of the dialog window.
- d. The configuration data will send. Wait until this has finished before moving on to test your proximity switches.

## Test Proximity Switches

Double check that your proximity switches are installed and functioning correctly.

1. Place a metal object, such as a wrench, in front of each proximity switch target in turn
2. Check to see if the red LED on the switch lights up. You can also check to see that a blue LED lights up on the Carbide Motion board.

A detailed video on proximity switch testing is available here: <https://youtu.be/Zf8NPmxrEDs>.

## Home Your Shapeoko

Once all switches have been checked, your Shapeoko is ready to home.

1. Click the yellow **Initialize Machine button** to home your Shapeoko.

Happy milling!

