

# BitRunner Quick-Start Guide

The Carbide 3D BitRunner automates your router's on/off functionality in Carbide Motion. No more reaching into the working envelope with a moving end mill. Power down your router with the touch of a button from your computer to perform tool changes quickly and safely.

Use the BitRunner in conjunction with the BitSetter and BitZero to automate your cutting process even more.

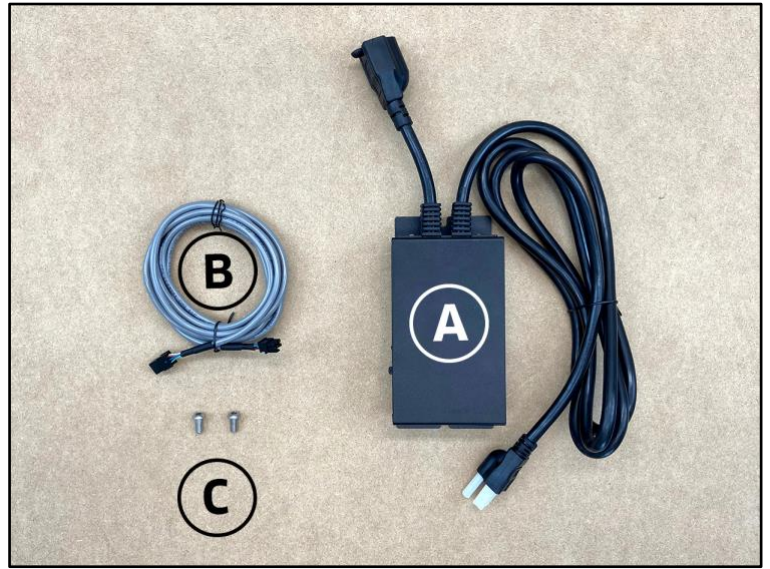


Figure 1

## BitRunner Kit

Item	Description	Qty	Note
A	BitRunner	1	BitRunner enclosure and attached power cords
B	Communications Cable	1	Gray 6-pin male-to-female extension cable
C	Mounting Hardware	2	M6 x 12mm button head cap screws

### Kit Option 1:

Description	Qty	Note
Carbide Motion Board with BitRunner Connector	1	BitRunner connector already installed ( <i>not pictured</i> )
Cover for Carbide Motion Enclosure	1	Replacement for existing cover ( <i>not pictured</i> )

### Kit Option 2:

Description	Qty	Note
BitRunner Connector	1	Must be soldered to current Carbide Motion board ( <i>not pictured</i> )
Cover for Carbide Motion Enclosure	1	Replacement for existing cover ( <i>not pictured</i> )

## Which Shapeoko Model Do You Have?

Installation procedures differ for older and newer versions of Shapeoko XXL, XL, and 3. Models that shipped prior to the addition of the Z-Plus (our latest X/Z-axis carriage) in late 2019 require an upgrade to the Carbide Motion board, its enclosure cover, and the Y-axis right aluminum extrusion rail (Y2-rail).

Models that shipped with the Z-Plus as standard equipment are ready for BitRunner right out of the box—no modifications needed. They come standard with an upgraded Carbide Motion board, enclosure cover, and a Y2-rail that is tapped and ready to mount the BitRunner with the included hardware.

This guide will show you how to install BitRunner on both newer and older versions of the Shapeoko. If you run into any problems along the way, please send us an email at [support@carbide3d.com](mailto:support@carbide3d.com) and we will get you back on track.

## Install the BitRunner

### Attach BitRunner to Y2-Rail: Newer Models With Z-Plus

The BitRunner attaches to the two M6 holes on the outside of the Y2-rail, with the switch and LED on **TOP**, and the power cords to the **REAR**. See *Figure 2*.

1. Use a 4mm hex key and the two (2) provided M6x12mm button head cap screws to secure the BitRunner to the Y2-rail as described above and shown in *Figure 2*.

New models include an upgraded Carbide Motion board and enclosure. You can jump directly to the **Connect the Communications Cable** section for instructions on how to connect the BitRunner to the Carbide Motion board.



Figure 2

### Attach BitRunner to Y2-Rail: Older Models (Pre-Z-Plus)

Similar to the newer models, the BitRunner attaches to the outside of the Y2-rail with the switch and LED on **TOP**, and the power cords to the **REAR**. See *Figure 2*. There are two methods for attaching the BitRunner to the Y2-rail: taping or tapping. Choose the one that works best for you based on your comfort level and experience.

## Method 1: VHB Tape (Not Included)

Use a high-quality, double-sided, multi-purpose acrylic tape, with a service temperature of up to 200F, such as 3M Scotch RP45 VHB Tape.

**NOTE:** VHB tape is pressure activated. To permanently bond to the extrusion rail, you must use clamps.

1. Clean the back of the BitRunner enclosure AND the outside of the Y2-rail (roughly in the center) with rubbing alcohol or mineral spirits. Both must be free from contaminants for maximum adhesion.
2. Apply two strips of VHB tape lengthwise to the back of the BitRunner: one across the top and bottom.
3. Peel the backing from the VHB tape, position the BitRunner with the LED on **TOP**, and adhere it squarely to the center of the Y2-rail.
4. Apply a set of clamps to the BitRunner, ensuring even pressure across the face.
5. Leave clamps in place for at least 15 minutes.

## Method 2: Drill / Tap

1. Hold the notched-side of the BitRunner squarely against the outside of the Y2-rail (roughly in the center) and use it as a template to locate the position of the tap holes.
2. Use a center punch or transfer punch to mark the Y2-rail at the center of each notch. The center-to-center distance between mounting holes is 6.10" (155mm).

**PRO TIP:** A good mark from the center punch will prevent your drill bit straying from its mark. Pre-drill your tap hole with a 3mm bit first, then step up to the 5mm bit.

3. Use a 5mm drill bit for the tap hole and an M6 tap to form the threads. Be sure to drill all the way through the outer wall of the extrusion and into the cavity.
4. Use a 4mm hex key and two (2) M6x12mm button head cap screws (included) to secure the BitRunner to the Y2-rail with the LED on **TOP**.

## Carbide Motion Board and Enclosure Upgrade

**WARNING:** The "Carbide Motion board" is the printed circuit board (PCB) that shipped with your Shapeoko. It is located in the black enclosure attached to the Y1-rail (Shapeoko XXL & XL) or the X-rail (Shapeoko 3). Do not confuse it with the BitRunner's PCB. Do not open the BitRunner or modify its PCB in any way.

For late 2019 and earlier Shapeoko models (pre-Z-Plus), there are two options for upgrading the Carbide Motion board. The option you choose will depend on which BitRunner Kit you ordered.

Option 1 is a complete replacement of the Carbide Motion board and enclosure cover. Option 2 is a modification to the existing Carbide Motion board and a replacement of the enclosure cover.

Both options require the removal of the Carbide Motion board enclosure from the Y1-rail and the removal of the Carbide Motion board from the enclosure.

### Carbide Motion Board Removal

1. Turn off and unplug your Shapeoko.
2. Disconnect the USB and power cables from the Carbide Motion board (located on the Y1-rail).
3. Remove the cover from the Carbide Motion board's enclosure and disconnect the three (3) homing/proximity switch cables and four (4) stepper motor extension cables.
4. Use a 4mm hex key to remove the enclosure from the Y1-rail.
5. Use an SAE  $\frac{3}{32}$ -inch hex key to remove the four (4) socket head cap screws in the corners of the Carbide Motion board.

The Carbide Motion board is taped to the enclosure and will need to be gently pried away.

6. Gently pry the board away from the enclosure with your fingers. Pry from the **FRONT** end (opposite the USB and power ports) as shown in **Figure 3**. If you're having trouble getting the board out, use an ESD flat head screwdriver or suitable implement to gently pry away. Do not remove the old thermal tape unless instructed to do so.

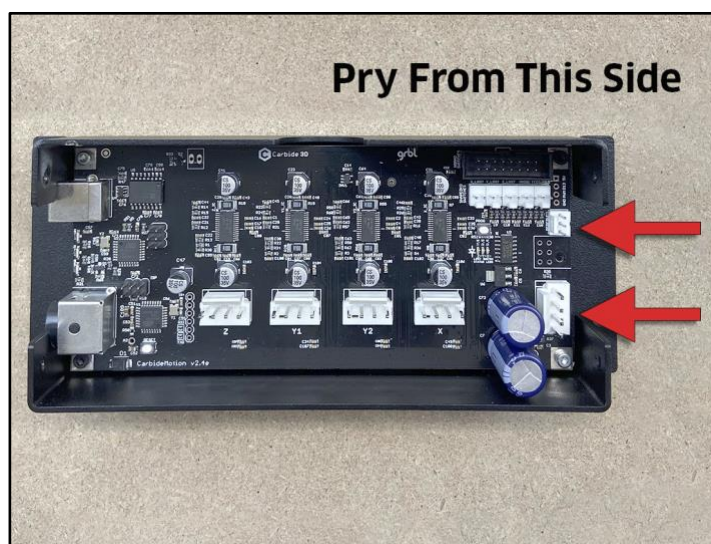


Figure 3

### Option 1: Carbide Motion Board Replacement

Kit Option 1 includes a new Carbide Motion board with integrated BitRunner connector.

To replace the Carbide Motion board:

1. Remove the old thermal tape from the enclosure's aluminum heat-sink.

2. Peel the backing from the new tape on the back of the new Carbide Motion board.
3. Insert the USB/power end of the board into the enclosure first. The USB and power ports will slightly protrude from the **BACK** (left) of the enclosure. The 6-pin BitRunner connector protrudes from the **FRONT** (right). See *Figure 4*.
4. Use an SAE  $\frac{3}{32}$ -inch hex key and the four (4) existing socket head cap screws to secure the new Carbide motion board to the enclosure.
5. Use a 4mm hex key and two (2) M6x12mm button head cap screws to attach the Carbide Motion board enclosure to the Y1-rail with the USB and power ports at the **BACK** and the 6-pin BitRunner connector at the **FRONT**.
6. Reconnect the three (3) homing/proximity switch cables and four (4) stepper motor extension cables.

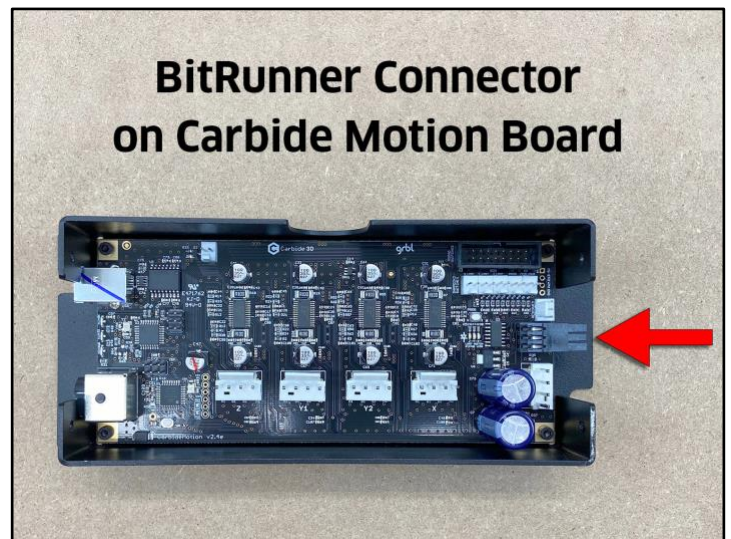


Figure 4

**WARNING:** The new 6-pin BitRunner connector protrudes from the front of the Carbide Motion board enclosure. When installing the new cover, place it carefully over the BitRunner connector first, then bring it down over the USB and power ports. If you should ever need to remove the cover, pry it open from the USB/power end first, then open like a book to avoid damaging the Bitrunner connector.

7. Install the new enclosure cover included in the BitRunner kit and secure with existing hardware.
8. Reconnect the power and USB cables at the rear of the Carbide Motion board.

## Option 2: Carbide Motion Board Modification

Kit Option 2 includes a 6-pin BitRunner connector which needs to be soldered onto your existing Carbide Motion board. Use best practices when soldering onto the PCB.

To modify the Carbide Motion board:

1. Solder the male 6-pin BitRunner connector to the board. Insert the connector's alignment peg and six (6) solder pins into the six available thru-holes on the right edge of the board. See *Figure 5*. The connector points away from the enclosure (toward the **FRONT** of the machine).
2. Re-insert the modified board, USB/power end first, into the enclosure. The USB and power ports will slightly protrude from the **BACK** (left) of the enclosure. The 6-pin BitRunner connector protrudes from the **FRONT** (right).
3. Use an SAE  $\frac{3}{32}$ -inch hex key and the four (4) existing socket head cap screws to secure the modified Carbide Motion board to the enclosure.
4. Use a 4mm hex key and two (2) M6x12mm button head cap screws to attach the enclosure to the Y1-rail with the USB and power ports at the **BACK** and the 6-pin BitRunner connector at the **FRONT**.
5. Reconnect the three (3) homing/proximity switch cables and four (4) stepper motor extension cables.

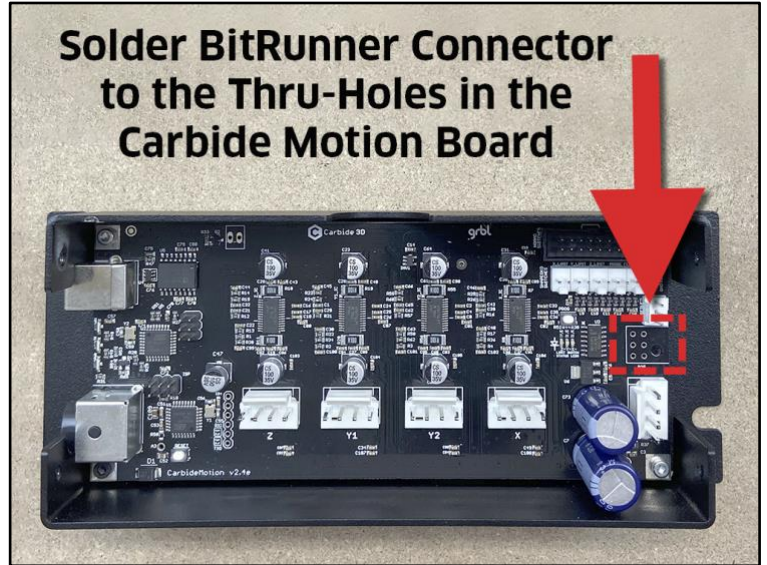


Figure 5

**WARNING:** The new 6-pin BitRunner connector protrudes from the front of the Carbide Motion board enclosure. When installing the new cover, place it carefully over the BitRunner connector first, then bring it down over the USB and power ports. If you should ever need to remove the cover, pry it open from the USB/power end first, then open like a book to avoid damaging the Bitrunner connector.

6. Install the new enclosure cover included in the BitRunner kit and secure with existing hardware.
7. Reconnect the power and USB cables at the rear of the Carbide Motion board.

## Connect the Communications Cable

**WARNING:** Use **CAUTION** when plugging in the communications cable. The connectors are polarized and **MUST** be inserted properly. Failure to do so, will ruin both the Carbide Motion board and the BitRunner.

### Routing the Communications Cable

The communications cable has a **MALE** and a **FEMALE** connector. The male end of the cable connects to the BitRunner (on the Y2-rail) and the female end connects into the Carbide Motion board (on the Y1-rail). The cable can be routed across the machine one of two ways:

- Directly under the machine.
- Through the gap between the MDF baseplate and the front **OR** rear endplate.

**NOTE:** Avoid kinking the cable and ensure it will not be snagged or pinched by any moving parts. Bundle any excess cable and secure with a cable tie.

### Connect the Male End to the BitRunner

The **MALE** end of the communications cable connects to the front of the BitRunner on the Y2-rail. It has a plastic latch on one side to secure it in place. Each of the six prongs of the connector are molded to fit into the BitRunner in only **ONE WAY**.

1. Plug the male end of the cable into the BitRunner with the plastic latch facing **OUT** (**AWAY** from the Y2-rail). See **Figure 6**. Make sure the plug is fully seated. You will hear the latch click into place.



Figure 6

### Connect the Female End to the Carbide Motion Board

The **FEMALE** end of the communications cable connects to the Carbide Motion board on the Y1-rail. There is a small triangular-shaped peg on one side, towards the end of the connector, which you can feel with your fingers. Like the male end, this connector is molded to fit into the Carbide Motion Board in only **ONE WAY**.

1. Plug the female end of the cable into the BitRunner connector protruding from the Carbide Motion board, with the small triangular peg facing **OUT** (**AWAY** from the Y1-Rail). See **Figure 7**. Press in and down to get the plug to seat fully.

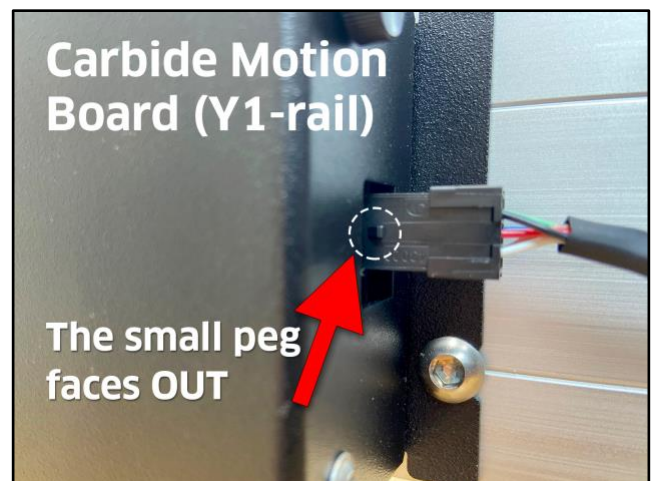


Figure 7

## Connect to the Router and Power

1. Plug the spindle/router power cord into the BitRunner.
2. Plug the BitRunner power cord into a wall outlet.

## Upgrade Carbide Motion (If Necessary)

If your kit contains a new Carbide Motion board, you need at least Carbide Motion 4. Check for the build number in the bottom-left corner of Carbide Motion—build numbers higher than 400 do not need to be upgraded. If you have an older version of Carbide Motion, to upgrade your software, download the updated version from: [carbide3d.com/carbidemotion/download](https://carbide3d.com/carbidemotion/download) and install it to your computer.

# How to Use the BitRunner

**NOTE:** If you experience any problems with your BitRunner, don't worry, we've got you covered! Just send an email to us at: [support@carbide3d.com](mailto:support@carbide3d.com) and we'll get you taken care of ASAP.

## Power Switch Options

The BitRunner power switch has three (3) positions (see *Figure 8*):

1. **Left (Forward):** Auto On/Off, the LED is green or red. The G-code (or absence thereof) determines when BitRunner cuts or supplies power to the router. If there is no G-code/.nc file being executed in Carbide Motion, then no power is supplied to the router. When G-code is being executed in Carbide Motion, the commands will determine if power is on or off.
  - a. An M3 S command of 1000 or greater (1000 is the RPM) automatically turns the router on. M3 S2800 is an example M3 S command. Alternately, you might see commands written like this: M3S2800.
  - b. An M5 command turns the router off.
  - c. An M6 command indicates a tool change.
2. **Middle:** Always Off, the LED is red. Power is cut to the router.
3. **Right (Rear):** Always On, the LED is green. Power is supplied to the router.



Figure 8



**WARNING:** For safety, it is best practice when installing or changing out an end mill, to completely power OFF the BitRunner and the router, via their respective power switches.

## Install an End Mill

1. Slide the BitRunner power switch to the OFF position (middle).
2. Flip the power switch on the router to the OFF position.
3. Install the end mill.

## Run the G-code

1. Slide the BitRunner's power switch to the Auto position (left/forward).
2. Flip the power switch on the router to the ON position.
3. Load the G-code (.nc file) in Carbide Motion. The G-code instructs BitRunner to automatically supply power to the spindle when appropriate. The G-code also triggers alert boxes to open in Carbide Motion which provide you with information about changes you need to make to the router RPM and end mills.

**NOTE:** If you're using Carbide Create to design your project, all of the G-code commands for tool change and spindle control are baked in; so, there's no need to change anything.

## Perform Tool Changes

1. When the G-code reaches a tool-change command, M6, Carbide Motion will pause the job, cut power to the router, and alert you that it's time to change the tool.
2. For safety, flip the power switch on the router to the OFF position and slide the power switch on the BitRunner to the OFF position.
3. Change the end mill.
4. Flip the power switch on the router to the ON position and slide the BitRunner's power switch to the Auto position.
5. In Carbide Motion, click the Resume button to resume cutting. Carbide Motion will continue cutting until it's time to perform another tool change, load the next G-code file, or until the project is done.