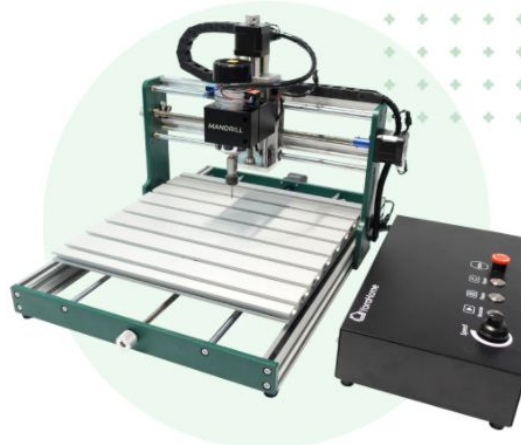




YORA MANDRILL 3036 CNC ROUTER

USER MANUAL

Version 1.0 • February, 2022



Purpose

This Manual is intended for assembly of the Yora Mandrill 3036 CNC Router. This manual is designed to cover the basic functionality of the machine and software, and may not address every aspect or option present.

Before beginning assembly, we recommend conducting an inventory using the Packing List to ensure all components are present. NOTE - there may be extra hardware included; this is normal, in case items get dropped or lost.

Please read these instructions carefully before assembling your machine to prevent possible damage to your machine.

Safety^{1/3}

- Read and understand the entire user manual before attempting assembly or operation
- Do not use the CNC router for other than its intended use. If used for other purposes, YoraHome disclaims any real or implied warranty and holds itself harmless from any injury that may result from that use.
- Always wear approved safety glasses/face shield while using CNC router machine. Everyday eyeglasses only have impact resistant lenses, they are not safety glasses
- Before operating CNC router, remove tie, rings, watches and other jewelry, and roll sleeves up past the elbows.
- Do not wear loose clothing. Confine long hair. Non-slip footwear or anti-skid floor strips are recommended. Do not wear gloves.
- Wear ear protectors (plugs or muffs) during extended periods of operation. Do not operate CNC router while tired or under the influence of drugs, alcohol or any medication.

Safety^{2/3}

- Make certain the switch is in the OFF position before connecting CNC router machine to the power supply
- Make all machine adjustments or maintenance with CNC router unplugged from the power source.
- Give your work undivided attention. Looking around, carrying on a conversation and “horseplay” are careless acts that can result in serious injury.
- Use the right tool at the correct speed and feed rate. Do not force a tool or attachment to do a job for which it was not designed. The right tool will do the job better and more safely.
- Do not touch a bit immediately after use, it will be hot and may cause skin burns.
- Never leave CNC router running unattended. Turn the power off and do not leave CNC router until it comes to a complete stop.
- Remove loose items and unnecessary work pieces from the area before starting CNC router.

Safety ^{3/3}

- Always secure workpiece to spoil board using clamps or double-sided tape. Never hold workpiece down by hand while operating.
- Make sure workpiece is free from nails or other foreign objects.
- After installing a bit, make sure collet is securely tightened. An unsecured bit may fly loose from the collet and cause injury.
- The Mandrill CNC router is intended for carving and cutting wood, acrylics, plastics and soft metal, etc. Do not use it to cut hard metals.
- Be within reach of the Emergency Stop or pause button when the machine is in operation. In the event of an emergency, or if there are any conditions that may result in injury to yourself or others, the Mandrill is equipped with an Emergency Stop button on top of the Controller. When pressed, this button will latch in the Stop position. To reset, twist the red knob clockwise.



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Part 3: Software Installation

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Part 5: Recommended Settings

Part 6: Optional Laser

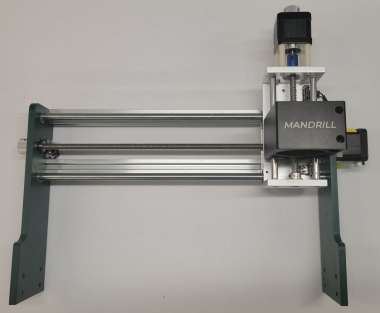

Part 7: Best Practices

Part 8: Terminology


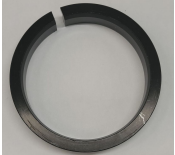
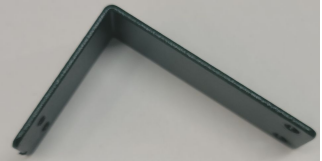
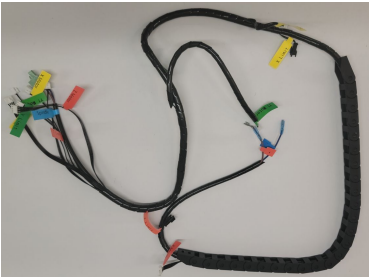
Part 1 Packing List_{1/7}

Item	Size	Picture	Quantity
Mandrill Controller		 A black control panel for a Mandrill Controller. It features the 'YoraHome' logo at the top left. Below the logo, there are five controls: a 'Speed' knob, a 'Resume' button with a play icon, a 'Pause' button with a pause icon, a 'Reset' button with a circular arrow icon, and a red 'STOP' button with a stop sign icon.	1

Part 1 Packing List_{2/7}

Item	Size	Picture	Quantity
Z/X Axis Assembly		 A photograph of the Z/X axis assembly, showing a motorized carriage mounted on a metal frame with two parallel rails. The motor is labeled 'MANDRILL'.	1
Base/Y Axis Assembly		 A photograph of the base/Y axis assembly, showing a metal frame with several vertical support rails and a horizontal base rail.	1

Part 1 Packing List_{3/7}

Item	Size	Picture	Quantity
Spindle Motor		 A cylindrical spindle motor with a black cap on the left and a silver body. A label on the side reads "YoraHome".	1
Laser Adapter Sleeve		 A black, circular, ring-shaped laser adapter sleeve.	1
Drag Chain Bracket		 A black, L-shaped metal drag chain bracket.	1
Drag Chain/Wire Harness Assembly		 A black drag chain assembly with a wire harness. The harness has several colored wires (yellow, green, blue, red) with connectors.	1




Part 1 Packing List_{4/7}

Item	Size	Picture	Quantity
Socket Head Cap Screws	M5 x 8mm		8
	M4 x 10mm		2
	M3 x 6mm (Countersunk)		3
	M4 x 8mm (Countersunk)		3
Square Nut	M4		2



Part 1 Packing List_{5/7}

Hardware Box - continued			
Item	Size	Picture	Quantity
Hold-down Clamps	Including M5 bolts		4
Clamp Thumbscrews	M5; including wing nuts and washers		4
Wrenches	13mm x 15mm		1
	14mm x 17mm		1
Z Probe Assembly	20mm		1

Part 1 Packing List_{6/7}

Hardware Box - continued			
Item	Size	Picture	Quantity
Hex Key	2mm, 2.5mm, 3mm, 4mm		1 of each
Power Cable			1
USB Cable			1

Part 1 Packing List_{7/7}

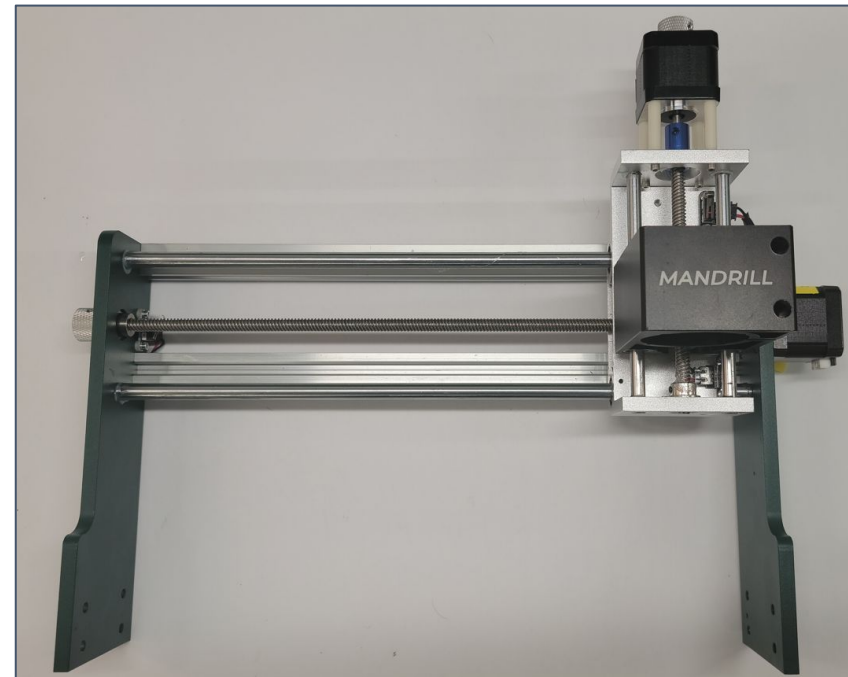
Hardware Box - continued			
Item	Size	Picture	Quantity
Shank Blue Corn Milling Bits	0.8/1.0/1.2/1.4/1.6/1.8/2.0/2.2/ 2.4/3.17 mm		1 pack of 10
Engraving Bits	30 deg bit, 0.1mm cutting tip		1 pack of 10

Part 2 Mechanical Assembly

Step 1 - Assemble Base & Z/X Assembly ^{1/4}

Parts Required:

→ 8 M5 x 8mm Screws

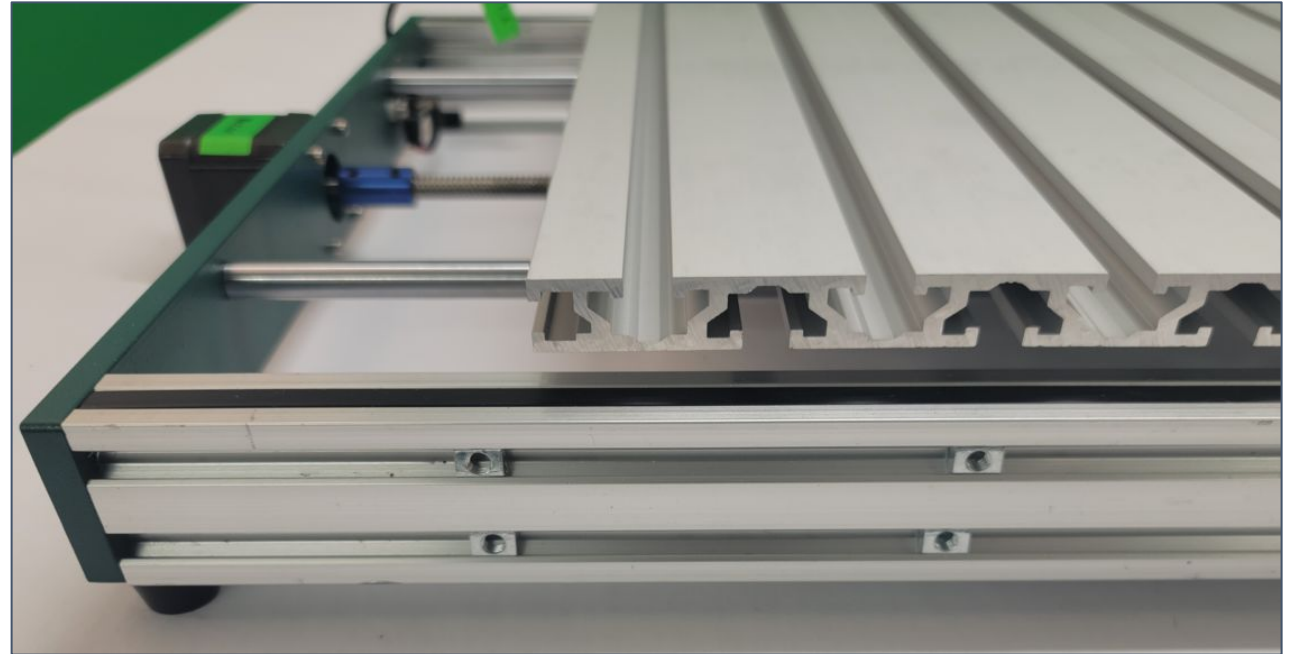


Part 2 Mechanical Assembly

Step 1 - Assemble Main Frame 2/4

→ Place the Base Assembly on a flat level surface

On either side of the Base Assembly, space the 4 captive nuts so that they are easily accessible. Exact positioning is not critical, this will be adjusted in a later step.



Part 2 Mechanical Assembly

Step 1 - Assemble Main Frame ^{3/4}

- Carefully place the Z/X Assembly over the Base Assembly - ensuring that the Y Axis motor on the Base is OPPOSITE the Spindle Motor.
- Fasten the Z/X Assembly to the Base Assembly with the M5 x 8 screws

NOTE - Do NOT tighten the screws at this time.

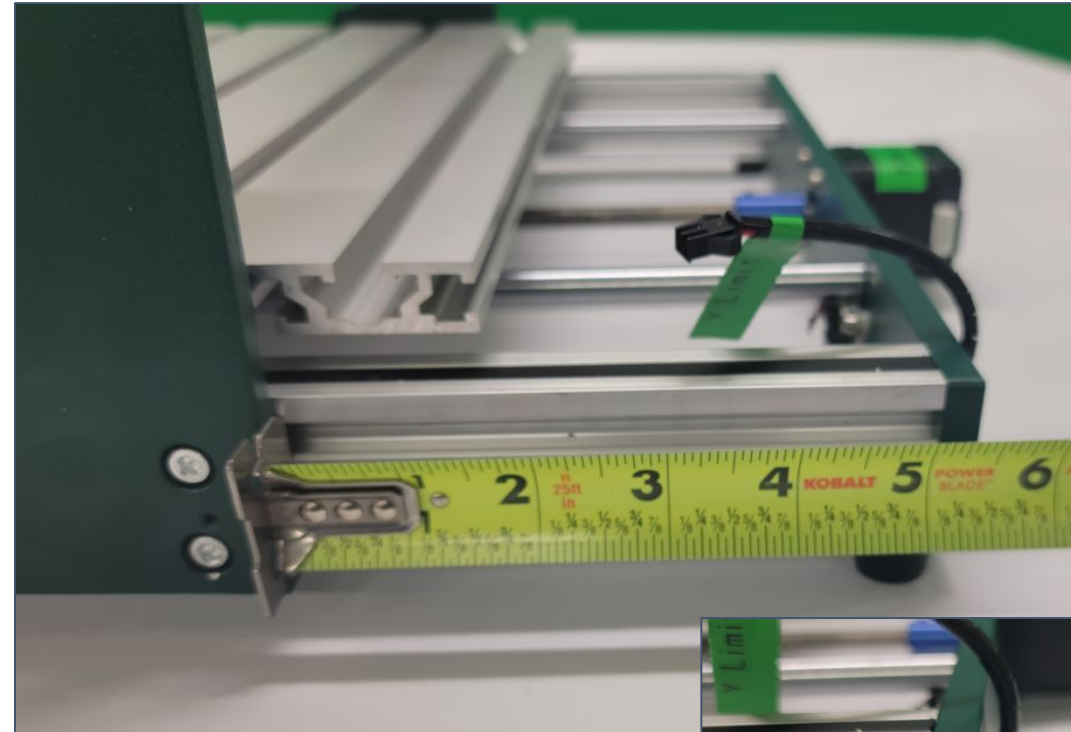


Part 2 Mechanical Assembly

Step 1 - Assemble Main Frame 4/4

Adjust the Z/X Assembly so that the rear edge of the mounting plate is 5-½ inches from the rear edge of the Base Assembly; and tighten the M5x8mm mounting screws.

NOTE - Check the adjustment on both sides of the machine before tightening the screws.



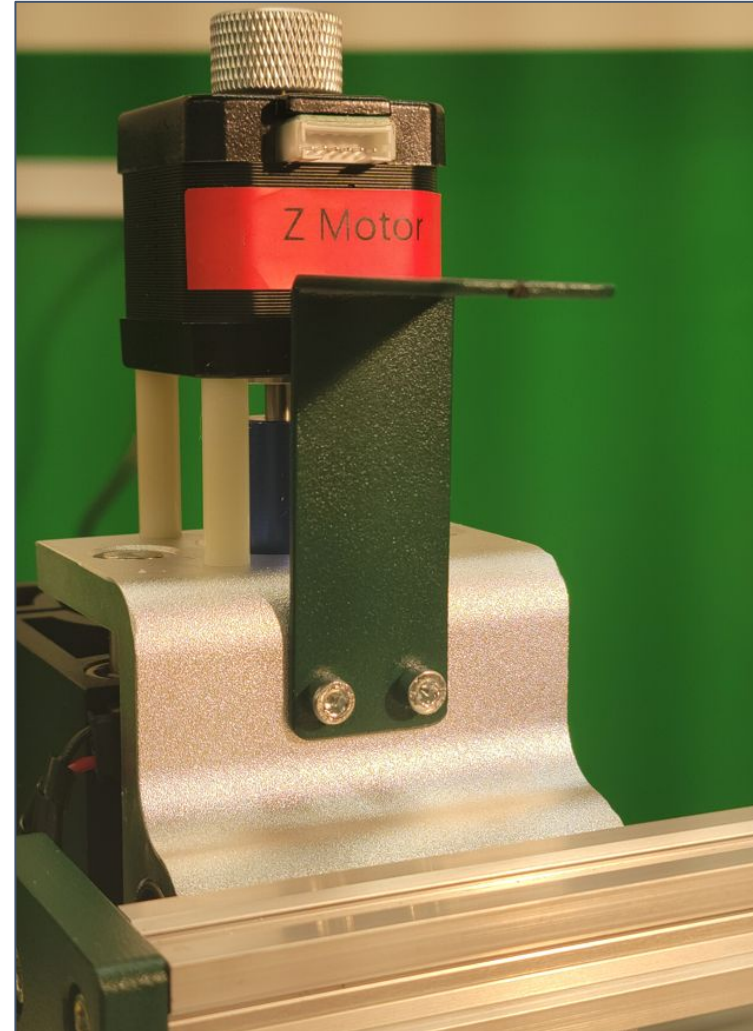
Part 2 Mechanical Assembly

Step 2 - Install Drag Chain Bracket

Parts Required:

- 2 M4 x 10mm Screws
- Drag Chain Bracket

Install the Drag Chain Bracket to the rear of the Z Axis assembly, as shown.



Part 2 Mechanical Assembly

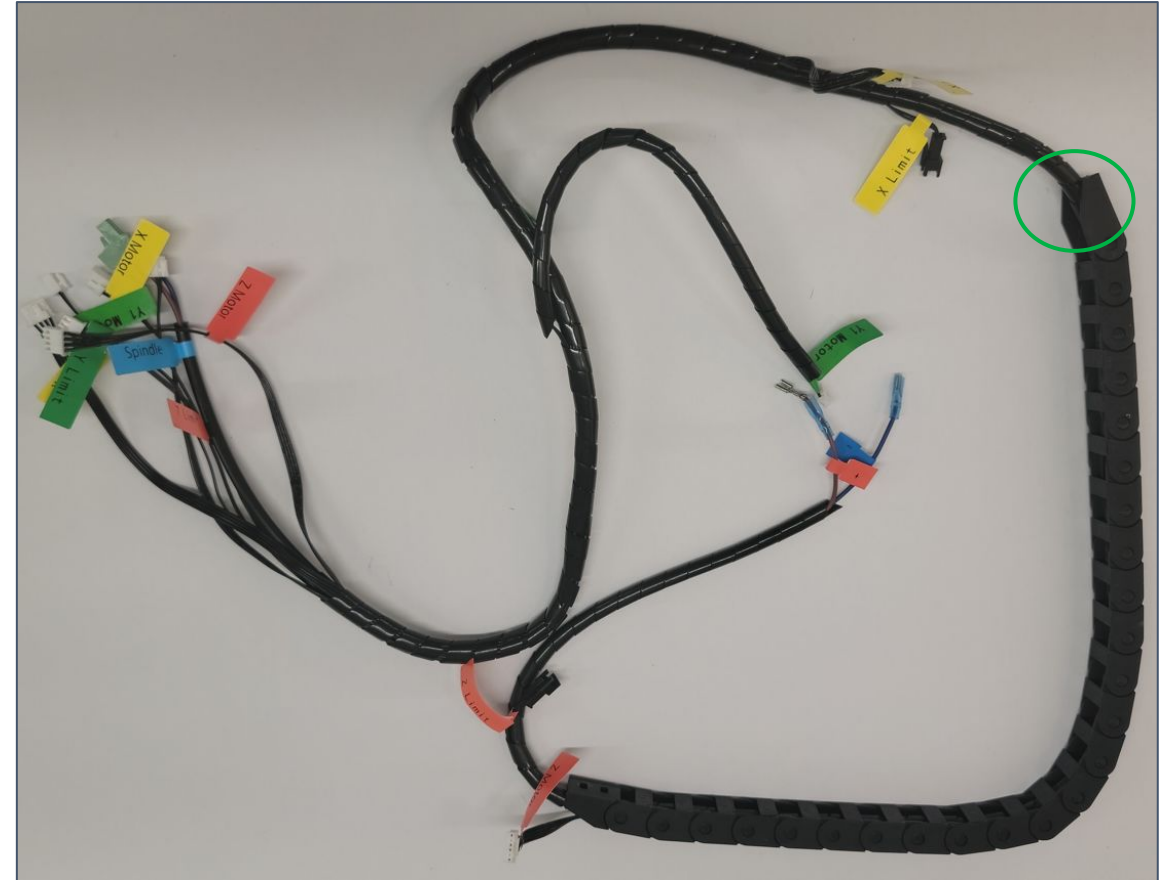
Step 3 - Install Drag Chain/Wire Harness 1/4

Parts Required:

- 2 Countersunk M4 x 8mm Screws
- 2 Countersunk M3 x 6mm Screws
- 2 M4 Square Nuts
- Drag Chain/Wire Harness Assembly

Lay out the Drag Chain/Wire Harness Assembly on the table to prepare the end for installation.

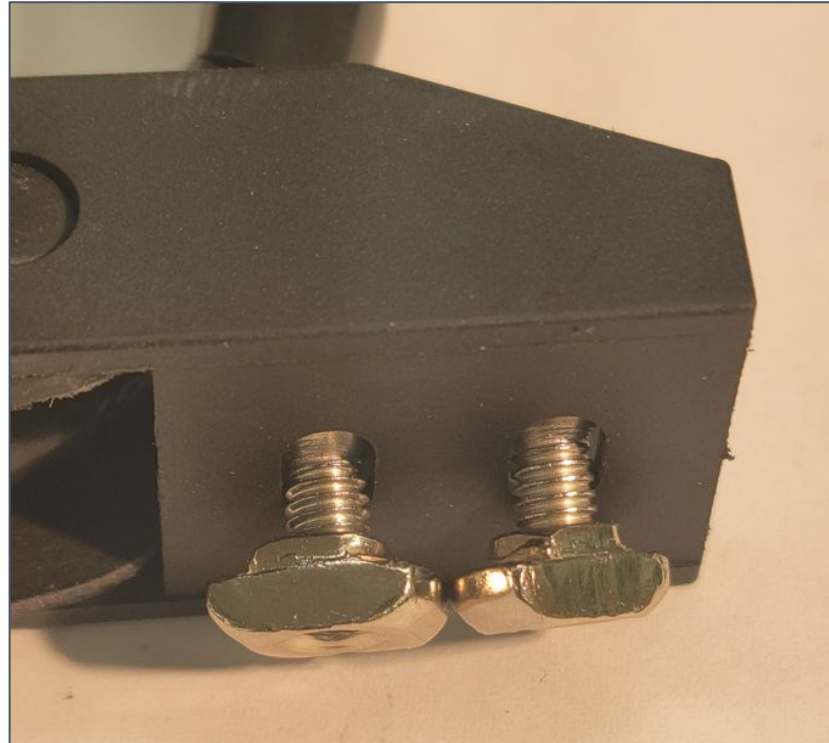
The end of the drag chain with the bulk of the wiring goes to the right of the machine (circled in the photo).



Part 2 Mechanical Assembly

Step 3 - Install Drag Chain/Wire Harness 2/4

Using the Countersunk M4 x 8mm Screws and M4 Square Nuts, install the screws and nuts as shown below in preparation for installation on the top rail. Do NOT tighten the screws at this time.



Part 2 Mechanical Assembly

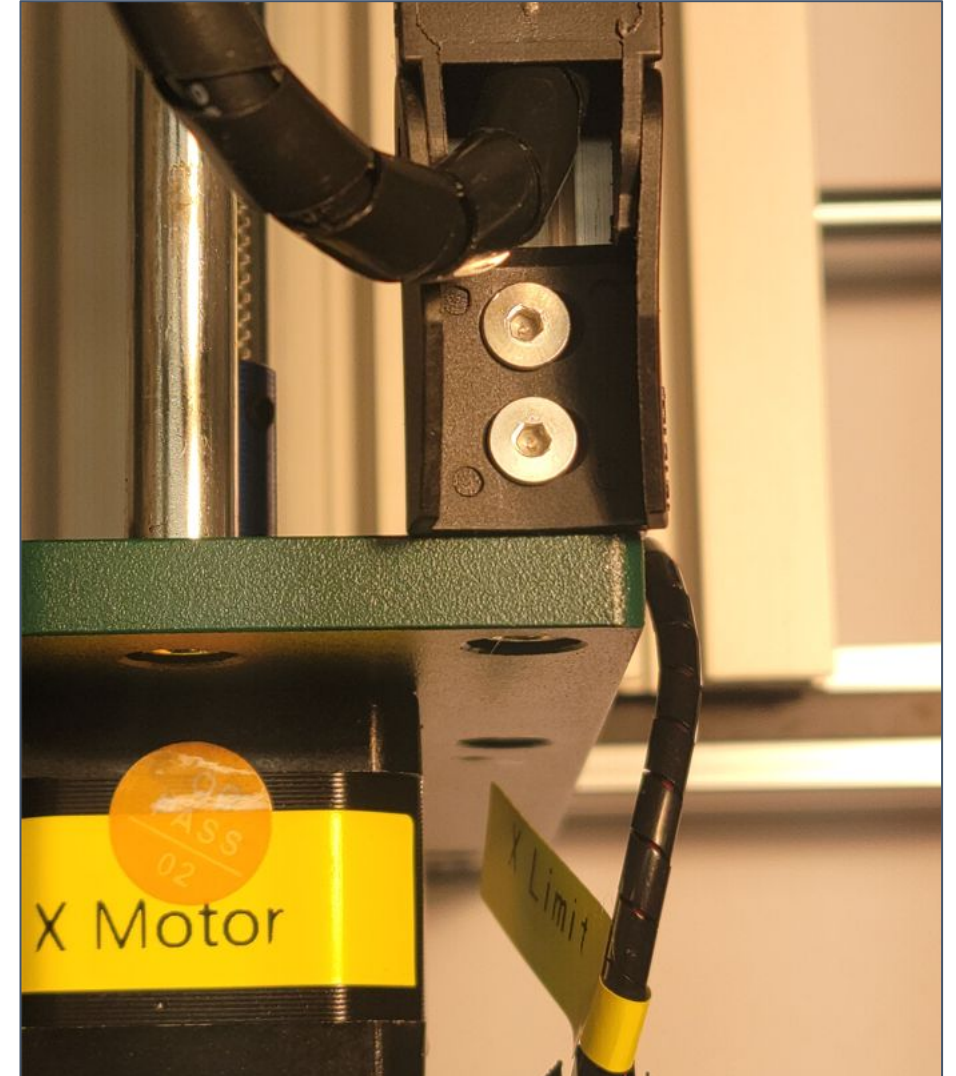
Step 3 - Install Drag Chain/Wire Harness ^{3/4}

Lay the Drag Chain on the top rail of the Mandrill as shown.

The M4 Square Nuts will fit into the open channel on the rail.

Using the appropriate hex key, tighten the 2 screws to attach the end of the drag chain to the rail, above the X Axis motor.

HINT - A quick turn of the screws will position the Square Nuts correctly in the rail to allow them to tighten.

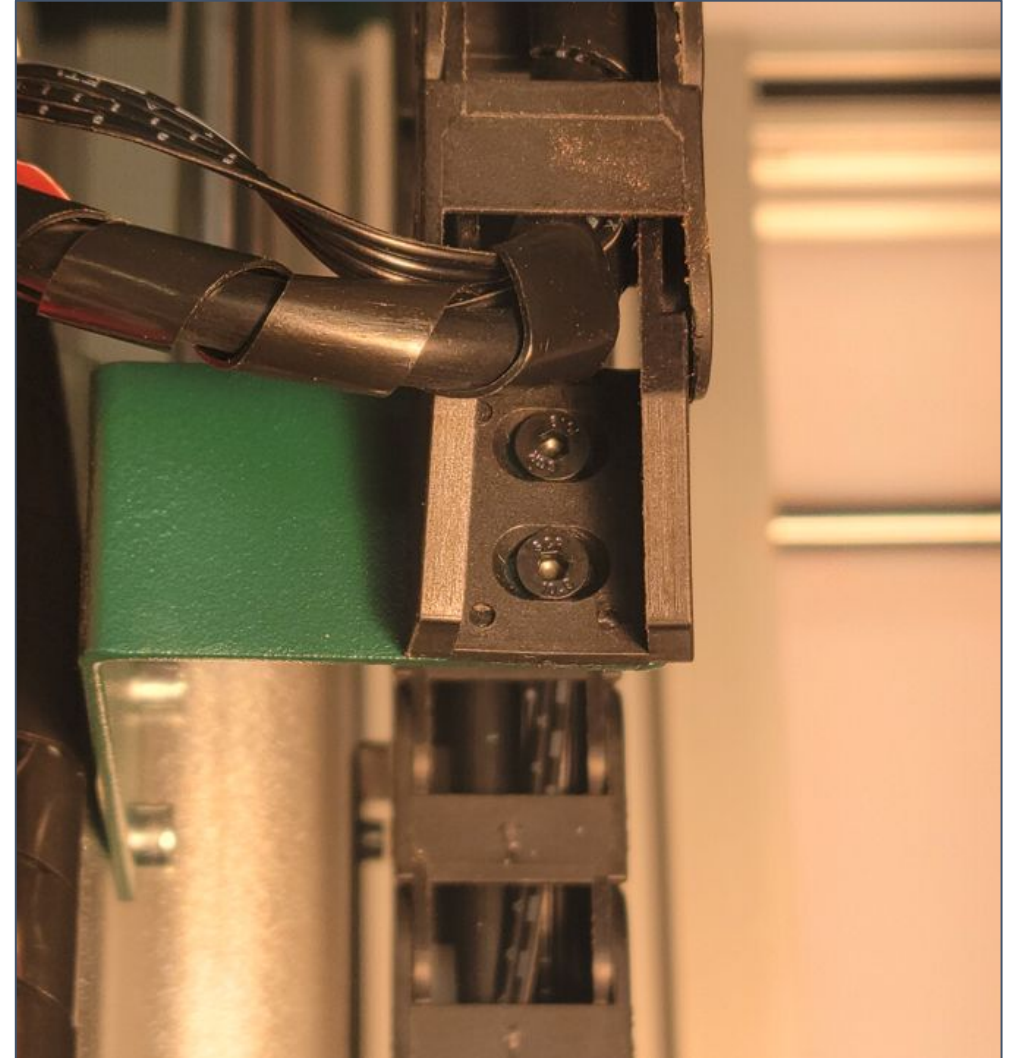


Part 2 Mechanical Assembly

Step 3 - Install Drag Chain/Wire Harness 4/4

Bring the other end of the Drag Chain in a loop, aligning the end of the Drag Chain with the previously installed bracket.

Using the Countersunk M3 x 6mm Screws, attach the end of the Drag Chain to the Drag Chain Bracket at the rear of the Z/X Axis Assembly

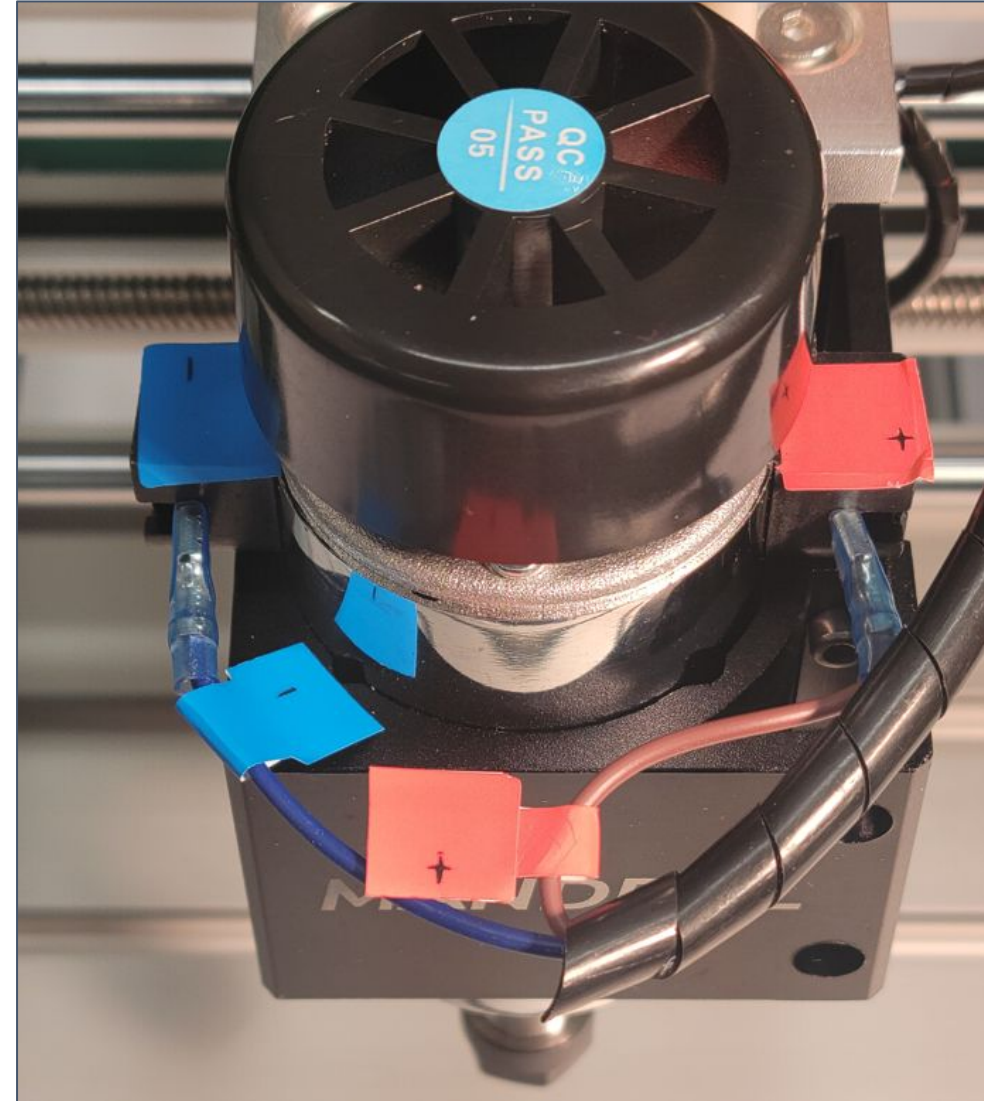


Part 2 Mechanical Assembly

Step 4 - Install Spindle Motor ^{1/2}

Carefully slide the Spindle Motor into the bracket on the Mandrill.

NOTE - Do not allow the Spindle Motor to “drop” into the bracket; damage to the motor brush holders may result.



Part 2 Mechanical Assembly

Step 4 - Install Spindle Motor 2/2

Using the appropriate hex key, tighten the screws on the Spindle Motor bracket to secure the motor.

These do not need to be tightened to the point that the gap in the bracket is closed; tighten only to the point that the Spindle Motor cannot be raised or twisted by hand.



Part 2 Mechanical Assembly

Step 5 - Install Wiring Connections ^{1/5}

Right end of X Axis Assembly:

- X Motor
- X Limit

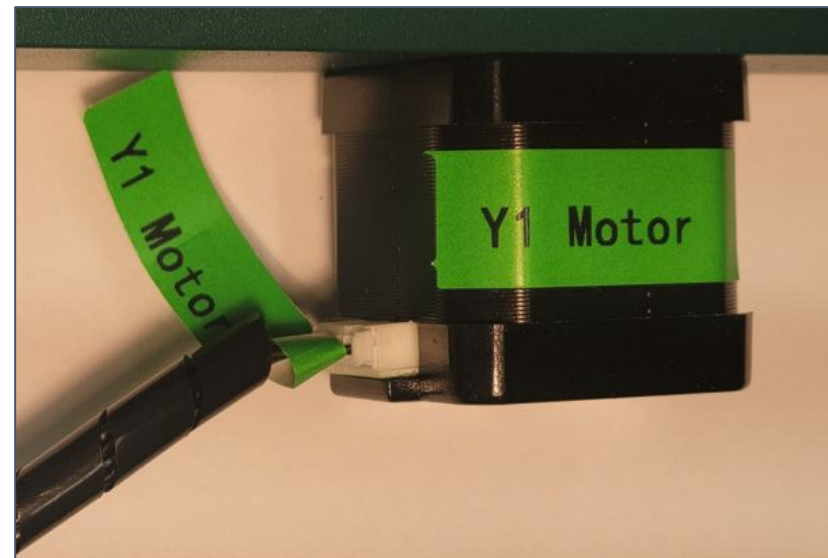
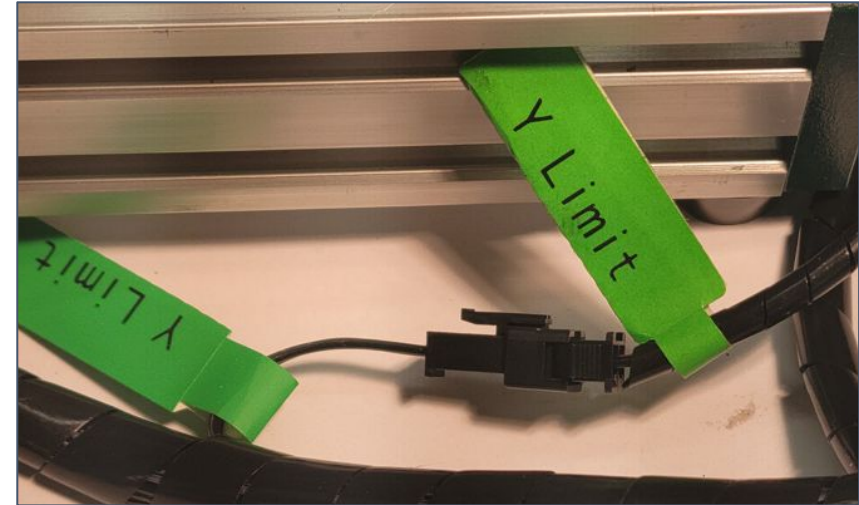


Part 2 Mechanical Assembly

Step 5 - Install Wiring Connections ^{2/5}

Rear of Base Assembly:

- Y Motor
- Y Limit

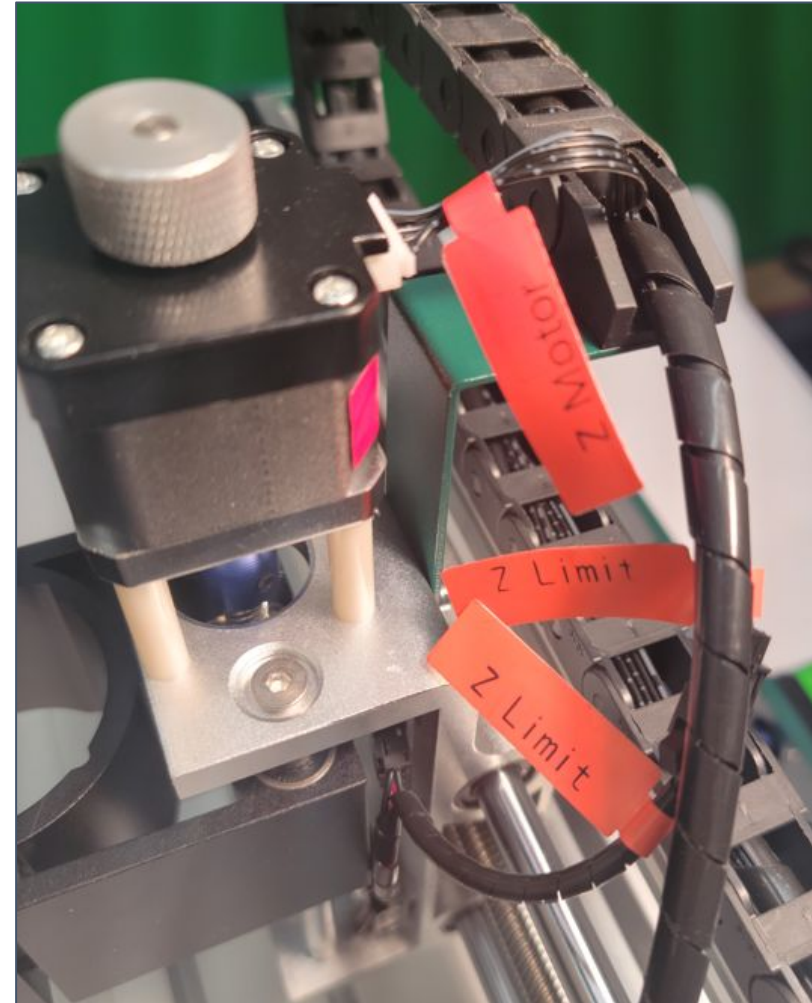


Part 2 Mechanical Assembly

Step 5 - Install Wiring Connections ^{3/5}

Top of Z/X Axis Assembly:

- Z Limit
- Z Motor



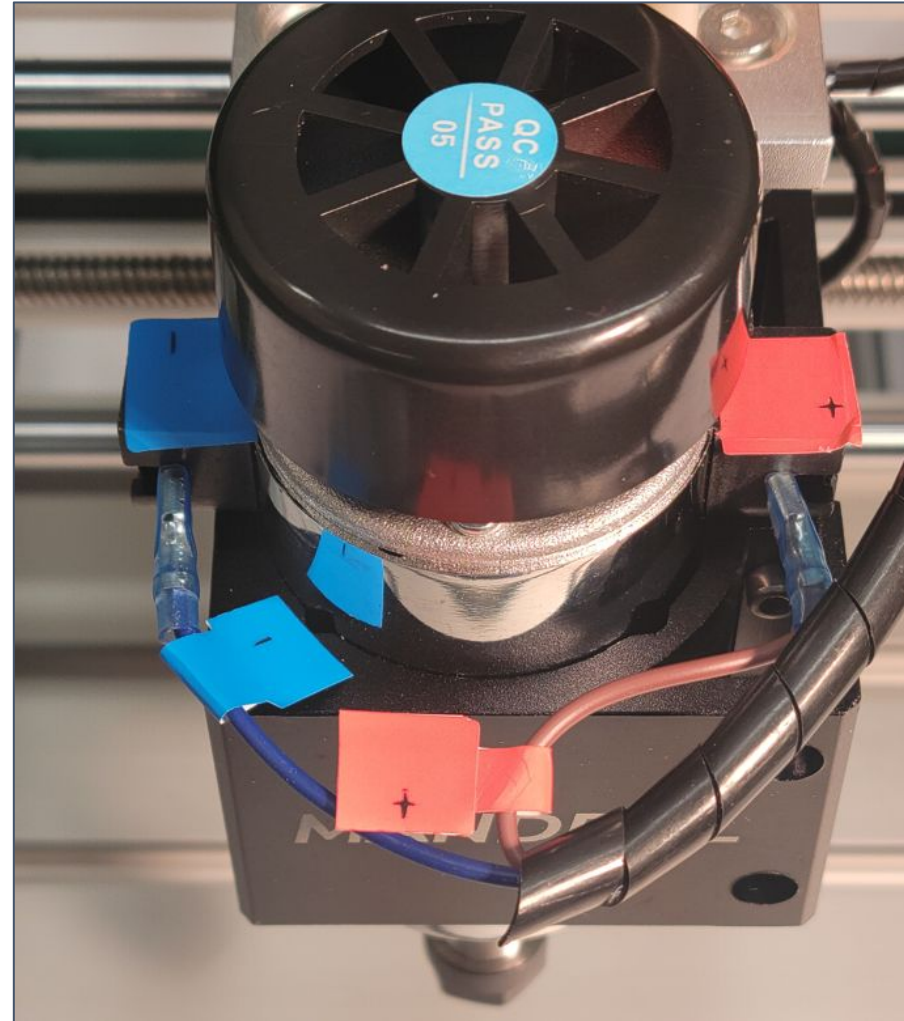
Part 2 Mechanical Assembly

Step 5 - Install Wiring Connections 4/5

Front of Z/X Assembly:

- Spindle Motor

Match Positive (+) and Negative (-) terminals to ensure proper rotation.



Part 2 Mechanical Assembly

Step 5 - Install Wiring Connections 5/5

Rear of controller:

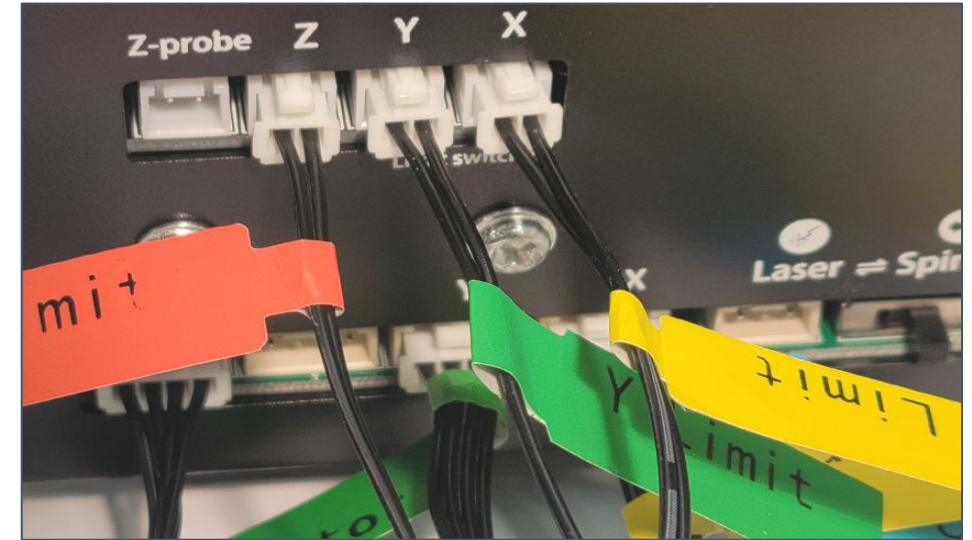
- Axis Motors
- Spindle
- Limit Switches

All connections are indexed for proper insertion.

Ensure the Laser/Spindle switch is in the “Spindle” position.

Plug in power cord and turn power switch on.

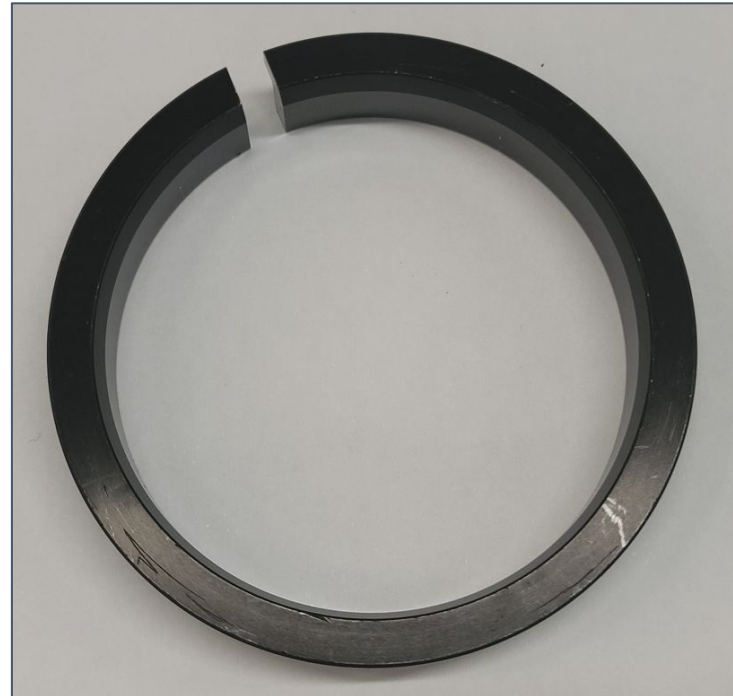
Twist the Emergency Stop switch clockwise to reset - will not connect when depressed!



Part 2 Mechanical Assembly

Step 6 - Accessory Installation

Using the included Laser Adapter Sleeve, the Mandrill holder can also accommodate the laser accessory.



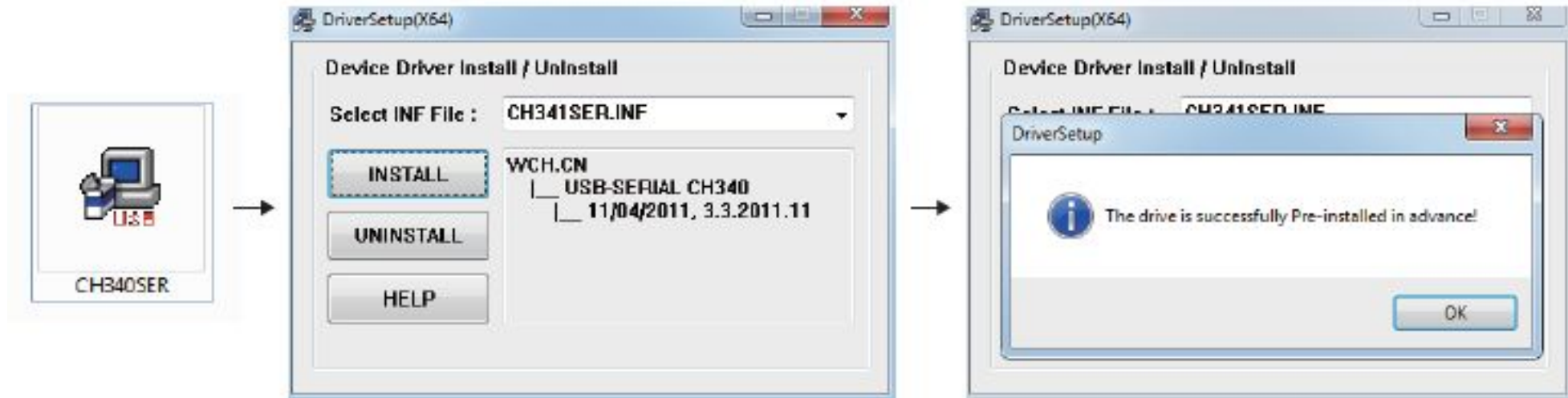
The Yora Diode Laser Modules are available separately:
<https://yorahome.com/products/yora-laser-module>

Part 3 Software Installation

Step 1 - Install the machine's driver (CH340SER)

If not available on the USB drive, you may download it here: <https://bit.ly/3gFOhVG>

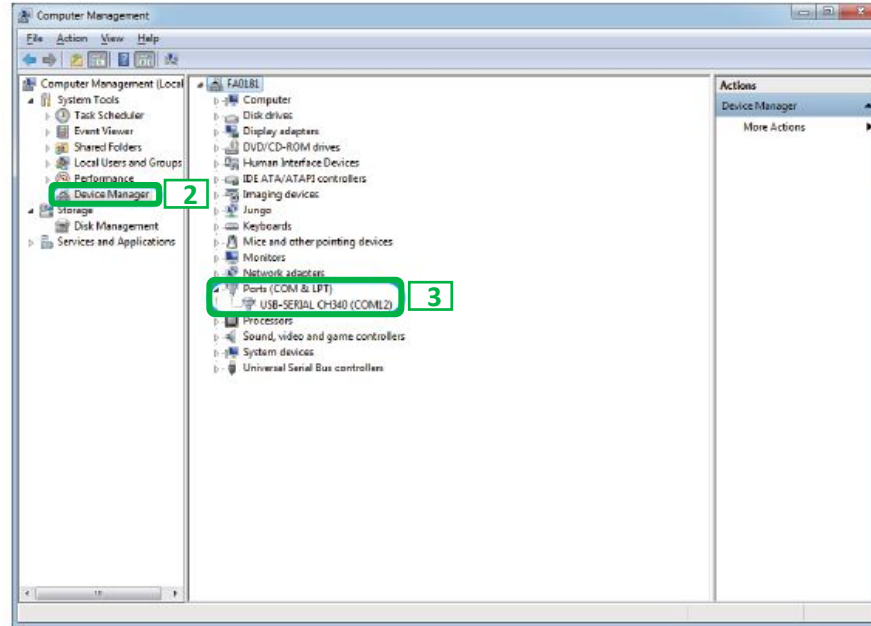
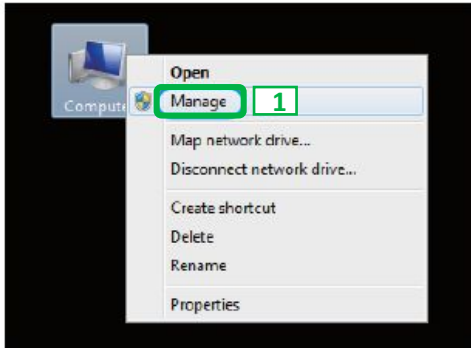
NOTE FOR MAC USERS: If your Mac is running Mojave OS or higher, do NOT install the driver, as the OS has native support for the CH340. If you are running Sierra or High Sierra, please contact YoraHome Technical Support for additional guidance.



Part 3 Software Installation

Step 2 - Determine your machine COM's port (Windows computers)

- **Windows XP:** Right click on *My Computer*, select *Manage*, then *Device Manager*.
- **Windows 7:** Click on *Start* on the taskbar, right click on *Computer*, select *Manage*, then *Device Manager*.
- **Windows 10:** In the search box on the taskbar, type *Device Manager*, then select it from the menu.



In the tree, expand *Ports (COM & LPT)*. Your machine will be identified by the USB Serial Port (COMX), where the "X" represents the COM number, for example COM3.

If there are multiple USB serial ports, right click on each one and check the manufacturer, the machine's should be "CH340".

Note - Machine must be connected to your computer in order for a COM port to be assigned.

Part 3 Software Installation

Step 3 - Log into Easel

We recommend that our customers use a web application called **Easel**, which is developed by Inventables for their X-carve machines.

It works great with the the SilverBack too. It is free (the pro version is not really needed), powerful and easy to use to design and carve your projects.

Go to [Easel.inventables.com](https://easel.inventables.com) and click on the blue **Sign in through Inventables** button.

The logo for Easel, featuring the word "EASEL" in a blue, sans-serif font. The letter "A" is replaced by a blue icon of a 3D printer or carving machine.

Easel is the all-in-one software solution for 3D carving machines.

Designed by [Inventables](https://www.inventables.com), Easel is the easiest way to get started in the world of 3D carving.

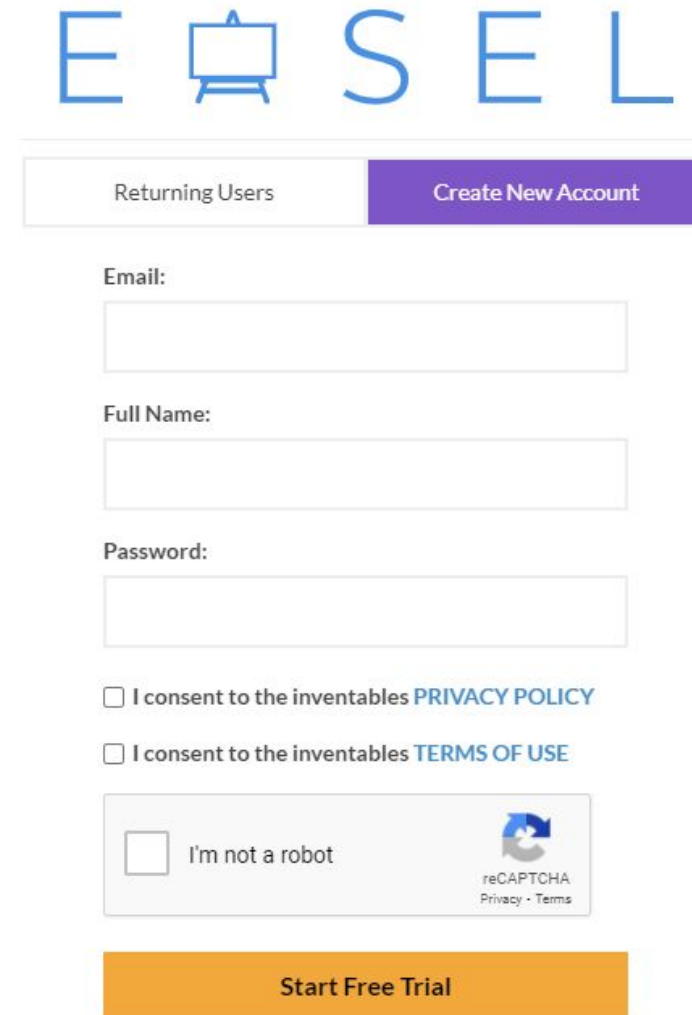
[Sign in through Inventables](#)

Part 3 Software Installation

Step 4 - Create your account in Easel

- Click on the “Create New Account” option
- Enter your personal information
- When you are done, click on the orange **Start Free Trial** button

NOTE - Inventables defaults all new accounts to a free 30-day trial of Easel Pro. At the end of that trial, you can continue with a paid Pro subscription, or revert to a FREE Easel account.

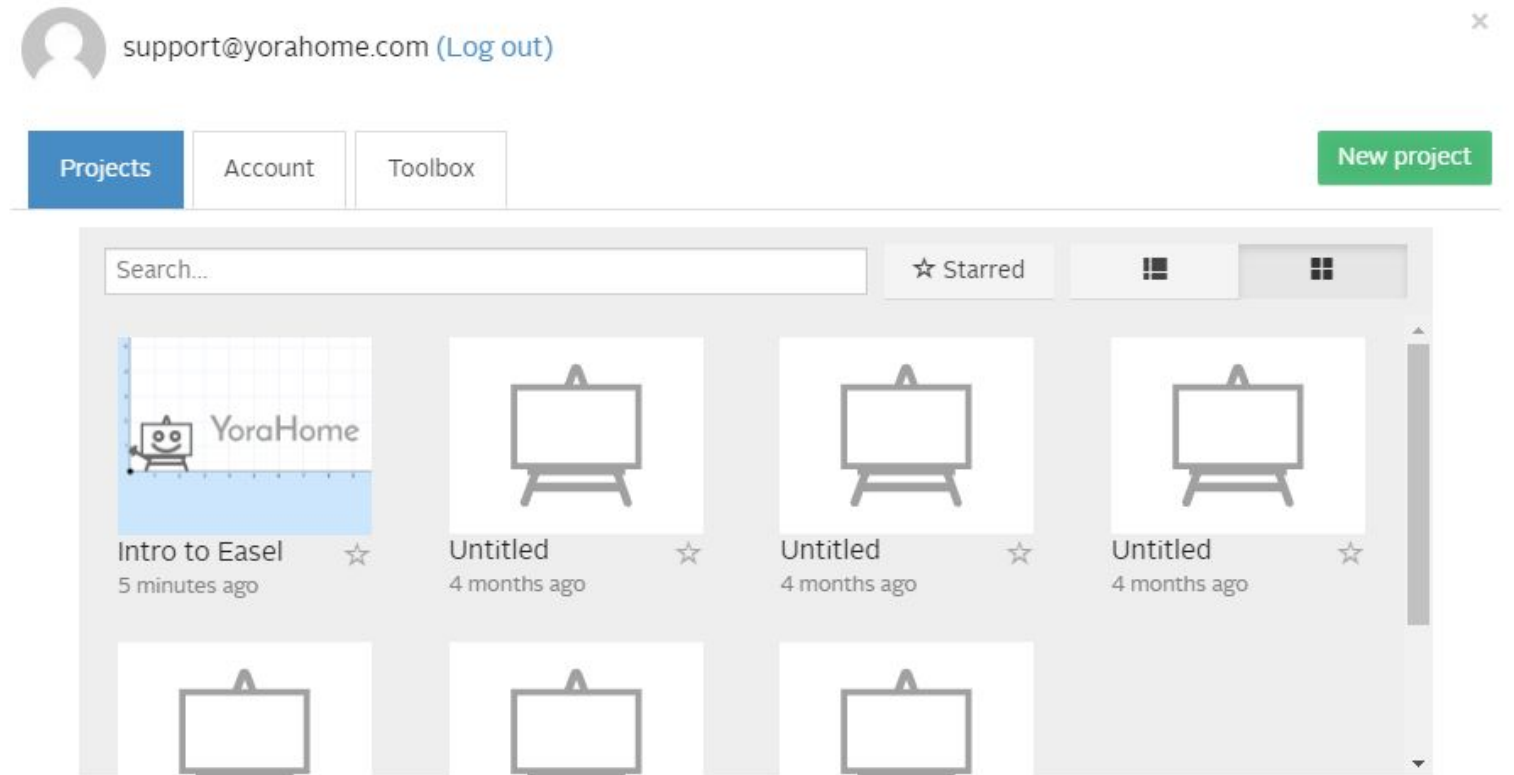


The screenshot shows the Easel account creation interface. At the top, the word "EASEL" is displayed in blue, with a white icon of a tablet on the letter 'A'. Below this, there are two buttons: "Returning Users" and "Create New Account". The "Create New Account" button is highlighted in purple. Underneath, there are three input fields labeled "Email:", "Full Name:", and "Password:". Below the "Email:" field, there are two checkboxes: "I consent to the inventables [PRIVACY POLICY](#)" and "I consent to the inventables [TERMS OF USE](#)". At the bottom, there is a reCAPTCHA widget with the text "I'm not a robot" and a checkbox. To the right of the reCAPTCHA is the reCAPTCHA logo and the text "reCAPTCHA Privacy - Terms". At the very bottom, there is a large orange button labeled "Start Free Trial".

Part 4 Machine Setup

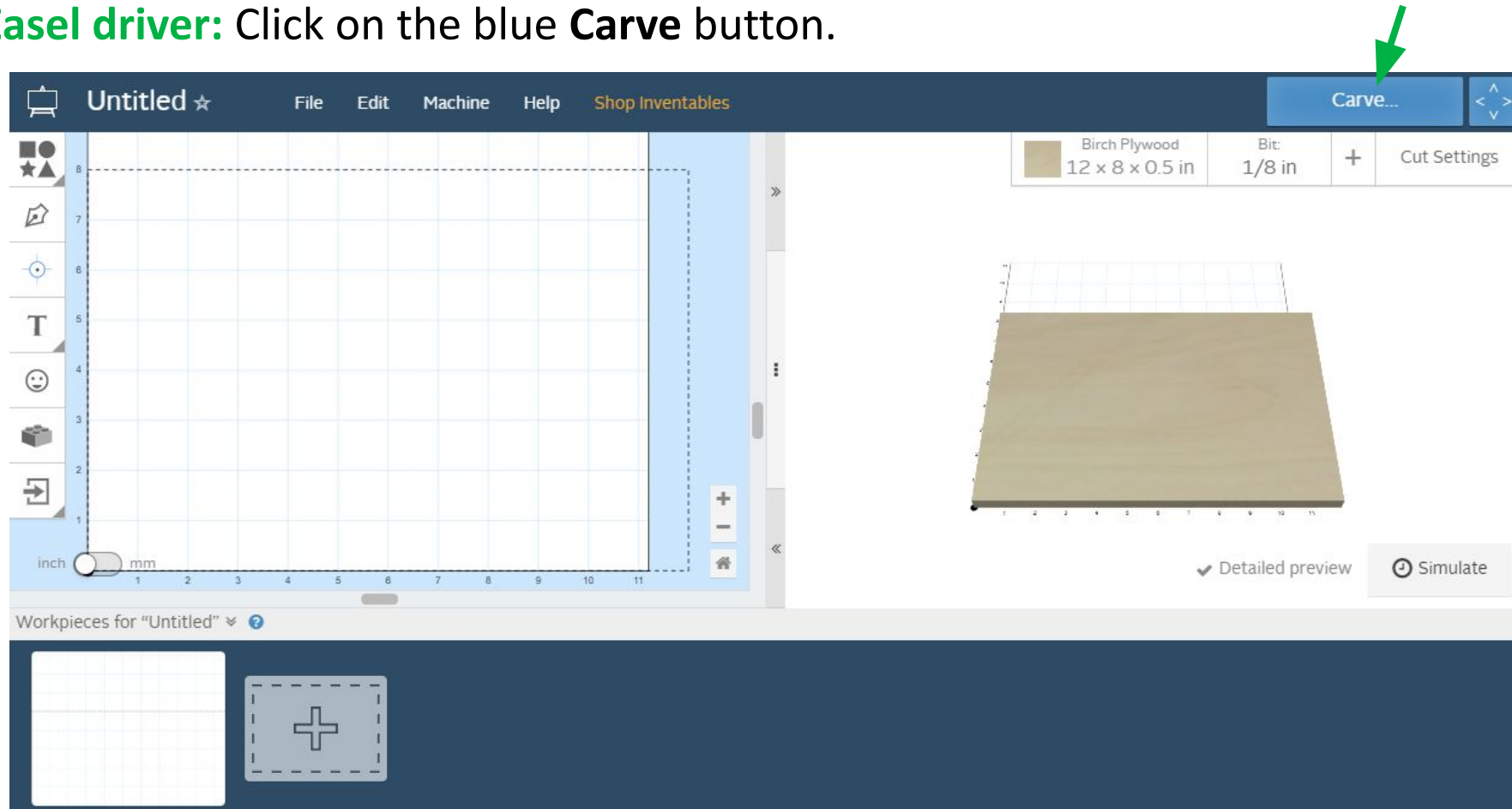
Step 1 - Your first project in Easel!

Create a new project by selecting one document in the Projects tab (it can be “Intro to Easel” or any “Untitled”)



Part 4 Machine Setup

Step 2 - Easel driver: Click on the blue **Carve** button.



Part 4 Machine Setup

Step 3 - Easel driver (Windows): You will be automatically prompted to download and install Easel driver; whether you're on a Mac or a Windows computer. This driver will allow Easel to talk to the USB port on your computer. If the window below doesn't open, you can access the driver version here: http://easel.inventables.com/sender_versions

W1. Click the green Download for Windows button, the Easel driver will automatically download to your computer. Most downloads are saved to the Downloads folder.

Install the Easel Driver ×

Before you carve, you'll need to install the Easel Driver, a small program that allows the browser to communicate with your X-Carve.

No need to worry about configuration—just run the installer and you'll be ready to carve.

Technical note: The Easel Driver will connect with Carvey, and Grbl versions 0.8c or newer.

Already installed the Easel Driver? [View troubleshooting info.](#)

[Download for Windows](#)

[Download for Mac](#)

[Download for Linux](#)

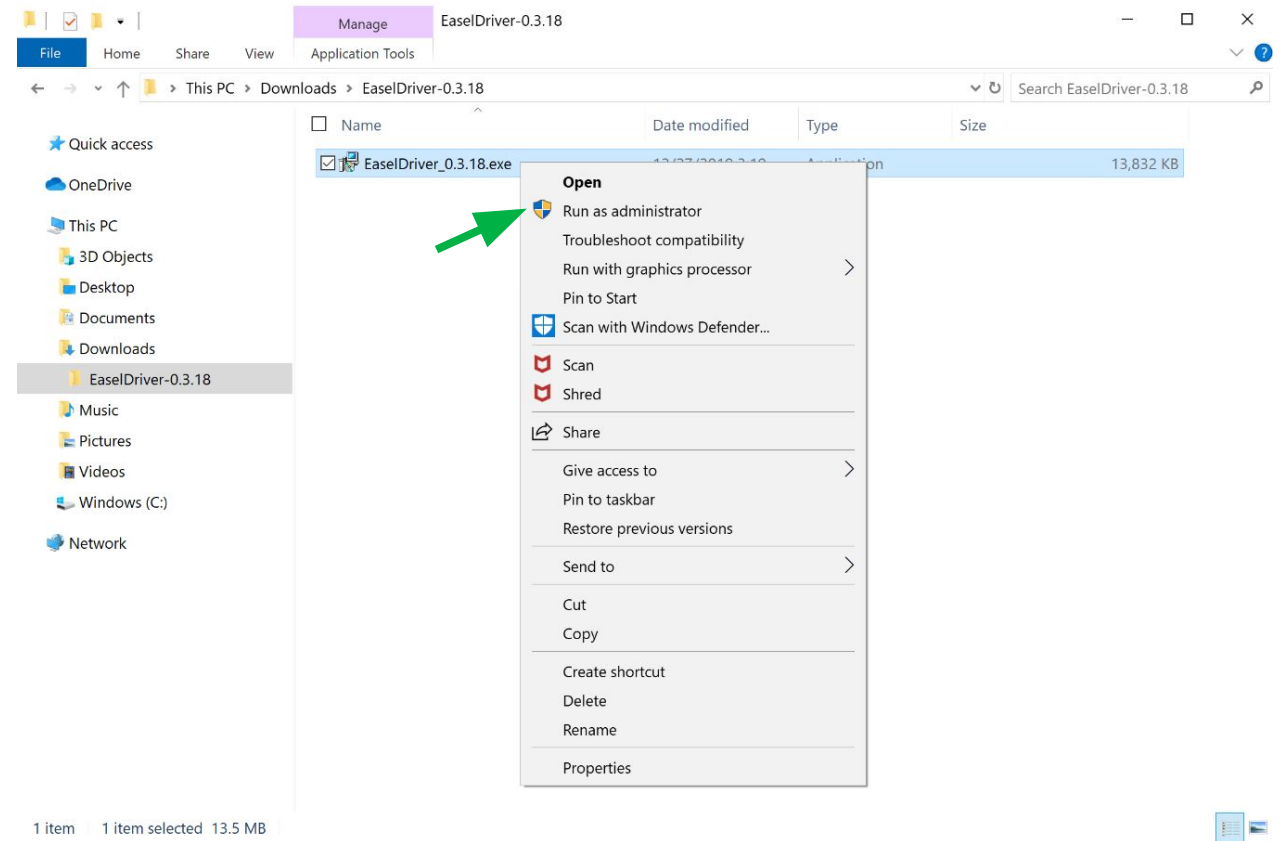
Part 4 Machine Setup

Step 4 - Install Easel driver (Windows)

W2. Go to your Downloads folder, open the download and you should see the file **EaselDriver-0.3.18.exe**.

W3. Then, right-click on it, select "Run as administrator" and follow the installation prompt. Follow the Installer instructions to complete the installation. You may need to refresh your browser and, in some cases, restart your computer.

Important: Windows 10 security settings may pop up to confirm if you want to install the driver. You will need to click "More Info" and select "Run Anyway" to proceed with the installation.



Part 4 Machine Setup

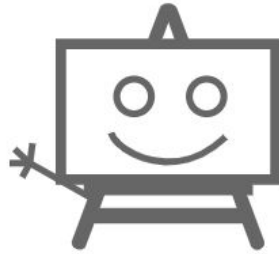
Step 5 - Download and Install Easel driver (MacOS)

M1. Click the green Download for Mac button. Easel driver will automatically download to your computer. You may also see the download at the bottom of your browser.

Congratulations on assembling your X-Carve!

Before you start carving with Easel, we'll make sure everything is set up correctly.

But first, you'll need to install the Easel Driver. This is a small program that lets Easel connect to your machine.

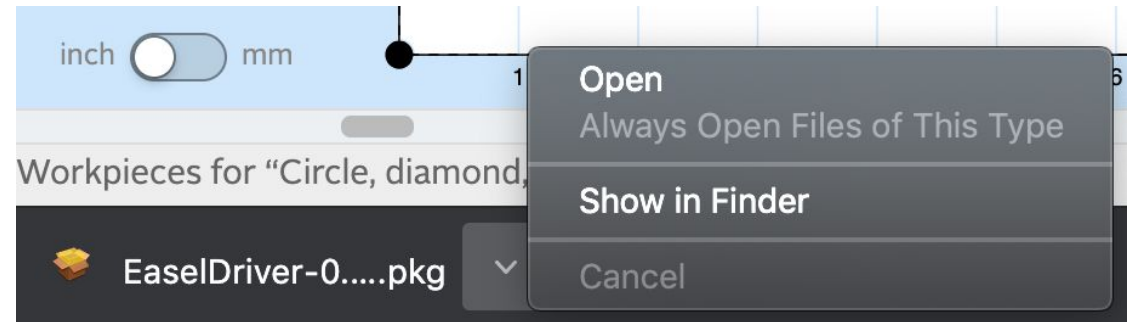


[Download for Mac](#)

[Download for Windows](#)

[Download for Linux](#)

M2. Click the EaselDriver-0.3.18.pkg file and open it to run the installer. Follow the Installer instructions to complete the installation. You may need to refresh your browser and, in some cases, restart your computer.



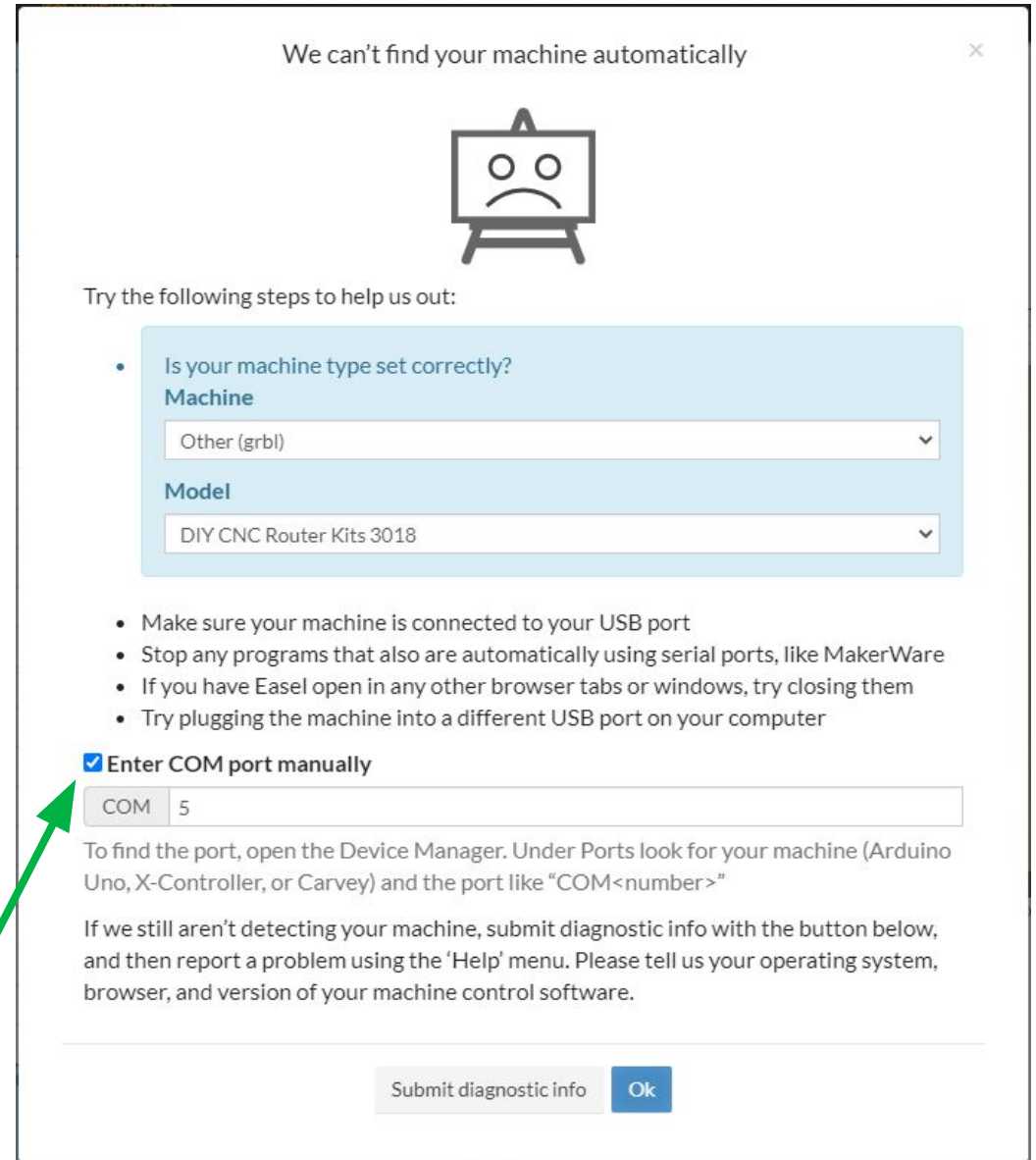
Part 4 Machine Setup

Step 6 - Set up your machine:

Now that Easel driver is installed, you need to initiate communication your machine. On the menu bar, click on the blue Carve button again, to prompt for a COM port assignment, as shown.

Check the box for “Enter COM port manually; enter the COM port previously determined, and click the “OK” button to continue.

The “Carve” button on the screen should now turn green.

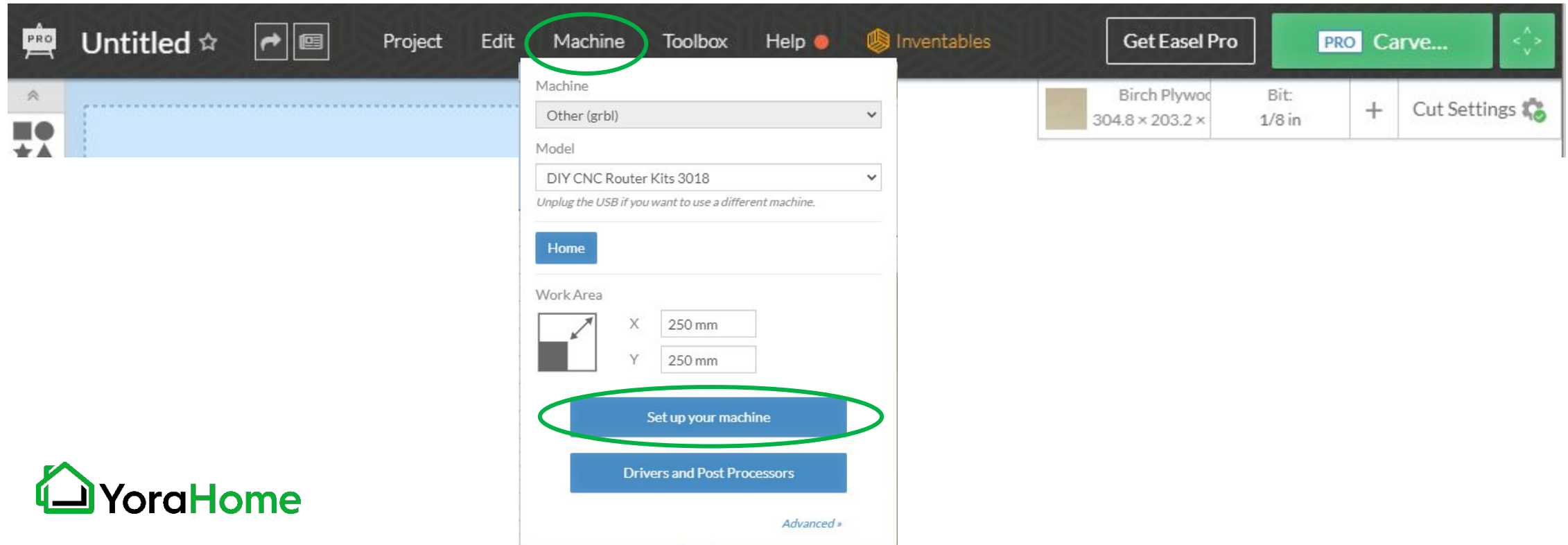


Part 4 Machine Setup

Step 7 - Set up Machine Settings

Now that the “Carve” button is green, this indicates that the computer and website are communicating with your machine.

Click on the “Machine” menu, and select the blue “Set up your machine” button.



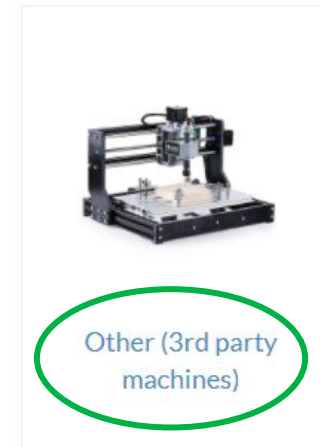
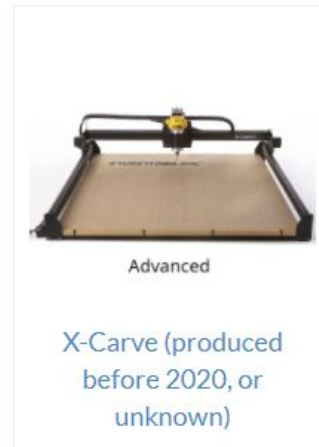
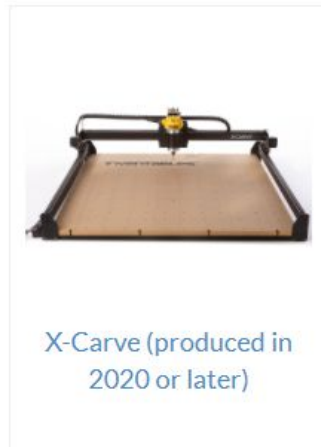
The screenshot displays the YoraHome software interface. The top navigation bar includes 'Project', 'Edit', 'Machine', 'Toolbox', and 'Help'. The 'Machine' menu is highlighted with a green circle. Below the navigation bar, the 'Machine' settings panel is open, showing a dropdown menu for 'Machine' set to 'Other (grbl)', a dropdown for 'Model' set to 'DIY CNC Router Kits 3018', and a 'Home' button. The 'Work Area' section shows X and Y dimensions both set to 250 mm. A blue button labeled 'Set up your machine' is circled in green. Below it is a 'Drivers and Post Processors' button. The background shows a 'Carve...' button and a material selection panel with 'Birch Plywood' and '1/8 in' bit.

Part 4 Machine Setup

Step 8 - Choose your machine

On the Choose your machine type screen, select the “Other (3rd Party Machines)” option.

Choose your machine type:



Part 4 Machine Setup

Step 9 - Enter your machine details

Choose the options as shown in the picture.

NOTE - Inventables is working to add the Mandrill as a selectable option - if present, please select the specific machine model.

Then, click on the blue Confirm settings button.



Enter your machine details

Select the settings that match your machine.

Machine type	Other (grbl) ▼
Make	YoraHome ▼
Model	Other ▼
Work Area X (mm)	300
Work Area Y (mm)	360
Dust shoe	<input type="checkbox"/>

You must use the correct settings for your machine to run correctly.

Confirm settings

(You can always change them later.)

Part 3 Machine Setup

Step 10 - Re-enter COM port

Easel will automatically prompt to enter the COM port again; this is a limitation of the software

Enter your COM port number, and the setup routine will advance automatically.

Connecting to Other (grbl)...

Enter the COM port your machine is connected to

COM

To find the port, open the Control Panel and click "View devices and printers". Your Arduino should be listed with the COM port. [Having trouble?](#)

Cancel

Part 4 Machine Setup

Step 11 - Test your wiring

When the machine successfully connects, you'll be presented with a set of controls for jogging your machine. Try jogging the machine using the directional arrows.

If everything is wired correctly you should get proper motion on each axis. If so, press on the Yes buttons for the X, Y and Z axis.

If you press No, it will swap the directions and fix the issue for you.

Test your wiring

Now we'll test that your motors are wired correctly. Test each axis using the controls and confirm that each axis moves correctly. We'll troubleshoot any axes that aren't working in the next step.

If you have homing switches, be careful jogging your machine. The switches are currently disabled and can easily be crushed.

Working correctly?

X	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No
Y	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No
Z	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No

Continue

Part 4 Machine Setup

Step 12 - Set your spindle settings

Select “Automatic” for your spindle control preference.

This will allow the controller to turn the Spindle Motor on and off; the actual speed will be set using the control knob on the controller box.

Spindle settings

If your machine is capable of automatic spindle control select automatic control to enable Easel to turn on/off the spindle. This setting can also be changed after setup in Machine>General Settings. If you are unsure please confirm with your machine manufacturers documentation.

Spindle control preference

Automatic ▼

Save spindle preference

Part 4 Machine Setup

Step 13 - Test spindle

Easel will prompt for a test of the spindle control.

Ensure nothing is in contact with the Spindle Chuck, and click the “Turn spindle on” button; the spindle will turn on for a few seconds, then automatically turn off.

After the test, click the blue “Continue” button.

Test the spindle

Let's make sure your spindle is hooked up for automatic control.

Turn spindle on

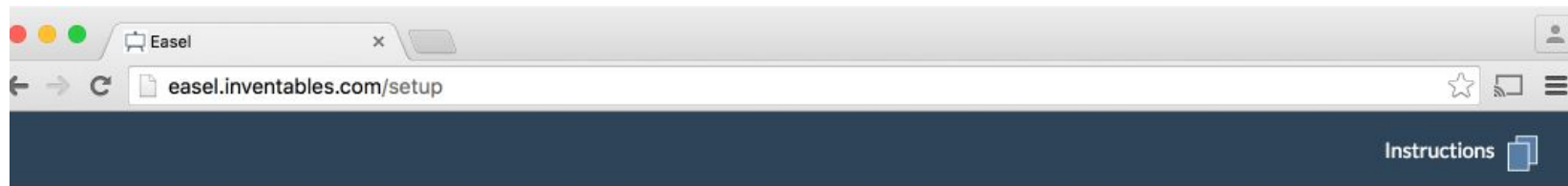
Spindle not turning on?

Continue

Part 4 Machine Setup

Step 14 - Limit switch setup

After you confirm your spindle setting, you'll be prompted to enable or disable homing. Since the Mandrill is equipped with limit switches, select the "Yes, enable homing" option.



Limit switch setup

Does your machine have limit switches?

Yes, enable homing

No, disable homing

Part 4 Machine Setup

Step 15 - Homing confirmation

After you confirm your homing option, the machine will go through a homing sequence to verify the limit switches.

Ensure there is nothing in the way of any axes movement during this process.

Test the limit switches

Starting the homing sequence should move your machine towards the limit switches. Press "Stop" immediately if the axes move the wrong direction or continue to move after hitting the limits.

Start homing sequence

Part 4 Machine Setup

Step 16 - Z-Probe setup

The Mandrill does have a Z-Probe. Click on the blue “Yes” button.

Do you have a Z-Probe?



Yes

No

Part 4 Machine Setup

Step 17 - Z-Probe configuration

Follow the prompts on the screen to confirm operation of the Z-Probe. Connect the clip to the collet of the spindle, and touch the probe plate to the collet.

The indicator will turn green when contact is made.

Before continuing past this step, click on the “Advanced Settings” option to set the Z-Probe parameters.

Setting up your Z-Probe

Plug the leads into the carriage



Attach the clip to the collet

Clip is attached

Touch the touch plate to the collet



Not available

Advanced Settings

Continue

(To continue, make contact with the probe)

Part 4 Machine Setup

Step 18 - Z-Probe Advanced Settings

Ensure the Touch plate thickness is set to 19.99 mm. (You may need to select the “mm” option at the top of the screen.)

All other options can be left at default.

Click on the “Continue” button.

Setting up your Touch Plate

Select Units in mm

Touch plate thickness
19.99 mm

Probe rate
127 mm / min

Retract height
6.35 mm

Maximum probing distance
78.74 mm

(Sends the below gcode. Ensure leads are plugged in, clip is attached, and touch plate is under bit)

```
G21
G91
G38.2 Z-78.74 F127
G10 L20 P0 Z19.99
G91 G21 G0 Z6.35
```

No contact

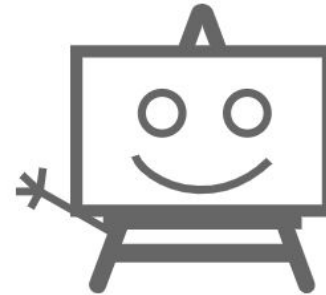
Part 4 Machine Setup

Step 19 - Run the test carve

After setting up your machine, you can run a test carve to ensure that the machine is operating properly. Clicking on the green button here will take you to the test carve project itself.

That's it! You're ready to carve!

Hooray! You finished setting up your machine!



Run the test carve

Finish

Part 5 Recommended Settings - Router



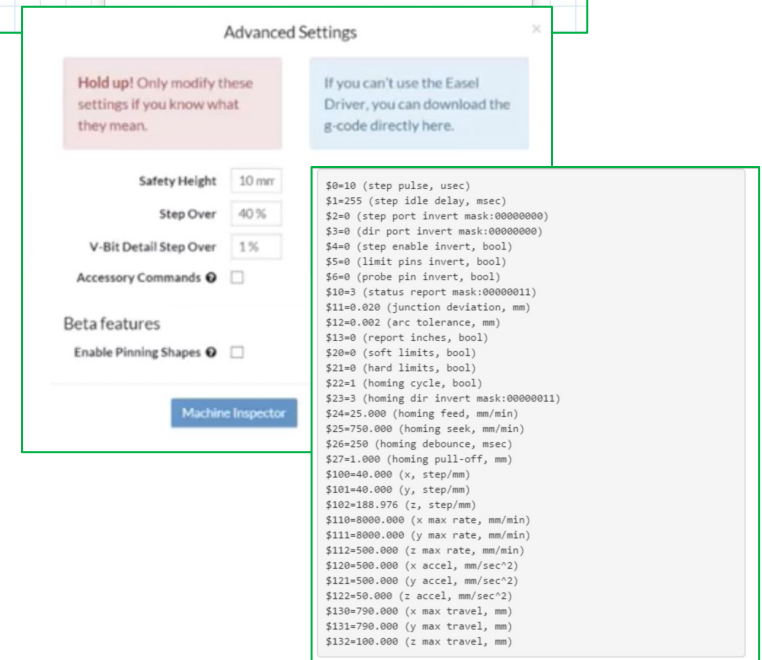
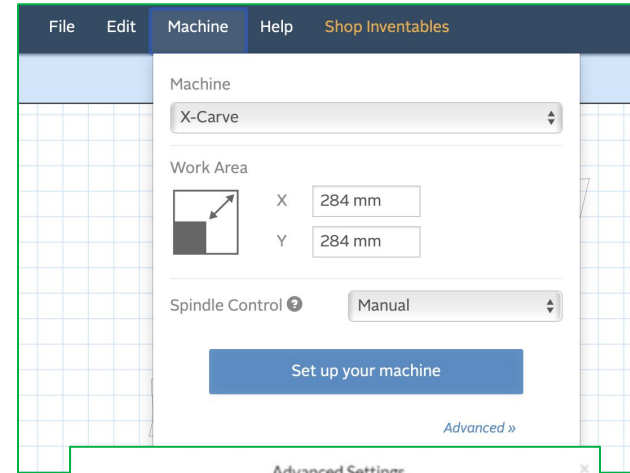
Key GRBL Settings

Intro

The Mandrill motherboard has a series of settings on it that allow your machine to work correctly. We typically recommend that the end user not alter these settings, except as directed by Technical Support.

Go to Easel » Advanced » Machine » Machine Inspector » Settings. This will display all the Grbl settings values from the router. Copy these into a text editor and save the file somewhere as a baseline. No matter how much you may mess up the settings, you will always have a previous set to go back to.

You will see a list of $\$xx=yy$ lines where xx is the setting number and yy is the current value. To change a value send the command of $\$xx=zz$ in the console, where xx is the setting number and zz the new value. These will be permanently stored on the motherboard so they only need to be changed once.



Part 5 Recommended Settings - Router



Key GRBL Settings

\$3 - Direction port invert mask ^{1/2}

If an axis is moving in the wrong direction, you need to change one of the settings, namely \$3, the direction port invert mask to be precise.

This is very easy to do. But before doing that:

- Check the connections from the stepper motors and make sure they are plugged into the correct X, Y and Z axis connections on the router board.
- Check that the axis is not binding by turning the screw by hand (disconnect the coupler first).
- Check that the grub screw on the coupler connecting the threaded rod to the stepper motor are tight and the coupler is not slipping.
- Swap the connection for the stepper motor into the router motherboard for that axis with another one. If it now moves (remember it is now a different axis) and the other one doesn't then it is likely to be a motherboard failure. Or possibly a faulty cable, so swap the cable with a working one just to be sure.

If your connections are fine along with your cables, stepper motors and board, then you need to change your \$3 value stored in the motherboard.

Part 5 Recommended Settings - Router



Key GRBL Settings

\$3 - Direction port invert mask ^{2/2}

Use the following table: Select the row for your current \$3 value, go across to the column for the axis to change and the value there is your new \$3 value. This only allows you to change one axis at a time. If you need to change more than one, make multiple passes through the process.

Examples:

- Current \$3 value is 2 and the X axis needs inverting: Select the 2 row and the X column, the new \$3 value is 6.
- Current \$3 value is 3, and the Y and Z axes need inverting: To invert the Y axis, select the 3 row and the Y column, the new \$3 value is 1. To invert the Z axis, select the 1 row and the Z column, the new \$3 value is 0.

<u>Current \$3 Value</u>	<u>New \$3 Value</u>		
	<u>Invert X</u>	<u>Invert Y</u>	<u>Invert Z</u>
0	4	2	1
1	5	3	0
2	6	0	3
3	7	1	2
4	0	6	5
5	1	7	4
6	2	4	7
7	3	5	6

In Easel, type \$3=x in the console command box where x is the revised number and hit enter to send it to the route motherboard. Everything should now be moving in the correct direction. If you changed any settings, make a note in your file containing your original settings just in case.

Part 5

Recommended Settings - Router

grbl

Key GRBL Settings

\$100,\$101,\$102 - [X,Y,Z] steps/mm

These parameters controlled the distance travelled by each axis. These values are the number of microsteps required to move the spindle on each axis by 1mm. \$100 sets the X axis, \$101 the Y axis, and \$102 the Z axis.

\$30 and \$31 – Max and Min Spindle Speed (RPM)

This sets the spindle speed range between 0.0% and 100%. Since the Mandrill has an external speed control, these values should not require adjustment.

\$32 – Laser Mode

This is a Boolean value or on/off. 1 is on (laser connected) and 0 is off (spindle connected). If you don't have a Laser module then just leave this set to 0. If you do wish to use the optional laser module, you will need to set Laser Mode on (1) when using the laser module.

Part 5 Recommended Settings - Router



Key GRBL Settings

\$110, \$111 and \$112 – [X,Y,Z] Max rate, mm/min

Set in mm/min, these set the maximum rate each axis can move. Whenever Grbl plans a move, it checks whether or not the move causes any one of these individual axes to exceed their max rate. If so, it'll slow down the motion to ensure none of the axes exceed their max rate limits. This means that each axis has its own independent speed, which is extremely useful for limiting the typically slower Z-axis.

You can check all the defined GRBL settings and what they mean using the link below:

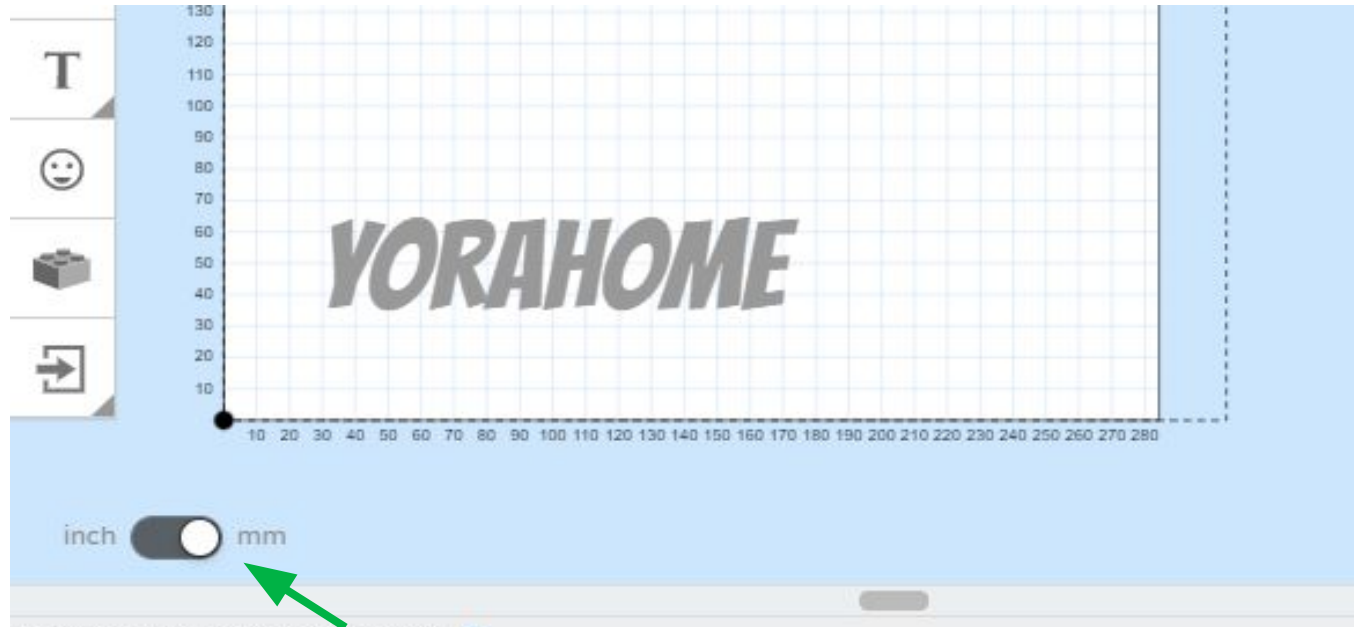
<https://github.com/gnea/grbl/wiki/Grbl-v1.1-Configuration>

Note – changing GRBL settings beyond those mentioned above is not recommended by YoraHome, and is done at your own risk.

Part 5 Recommended Settings - Easel

Metric system settings in Easel

We recommend that our customers use the mm (metric) settings for better readings and precision, especially in the CNC world.



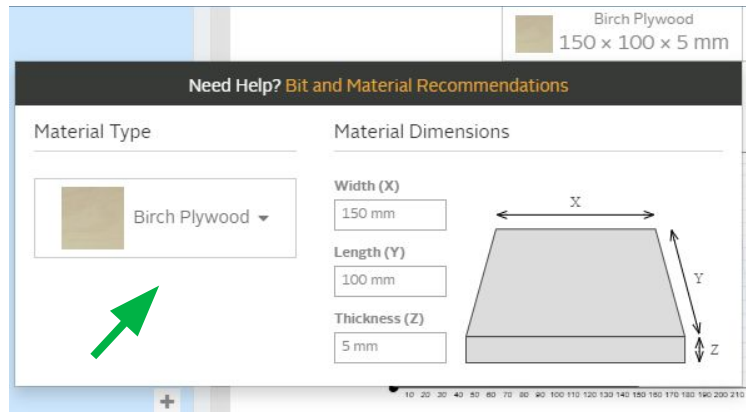
Part 5 Recommended Settings - Easel

Material type and Dimensions

1. Find the piece of wood or material you want to carve



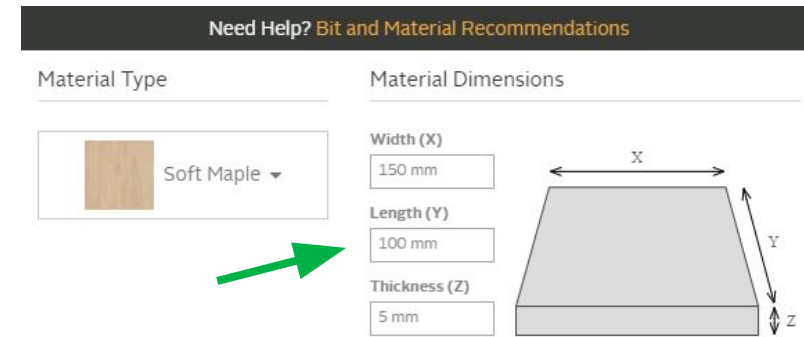
2. Select the material type in Easel



3. Take the measurements (Length, Width, Depth) of your material



4. Enter the Material Dimensions in Easel










Part 5 Recommended Settings - Easel

Bit settings

5. Clamp your material down on your machine's table.

6. Insert your bit into your ER11. Specify the type of End Mills you inserted using Other in Easel for any of the bits you have. (This will allow you not to have to purchase the Easel Pro Version)

If you don't know the width or diameter of the bits you bought from YoraHome, check the product page description of the bits in our [Router Bits](#) category.

End Mills	
Type	Size
Straight cut 	1/8 in 
	1/32 in 
Upcut 	1/16 in 
	1/8 in 
	Other <input type="text" value="0.1"/> Width <input type="text" value="in"/> <input type="text" value="mm"/>

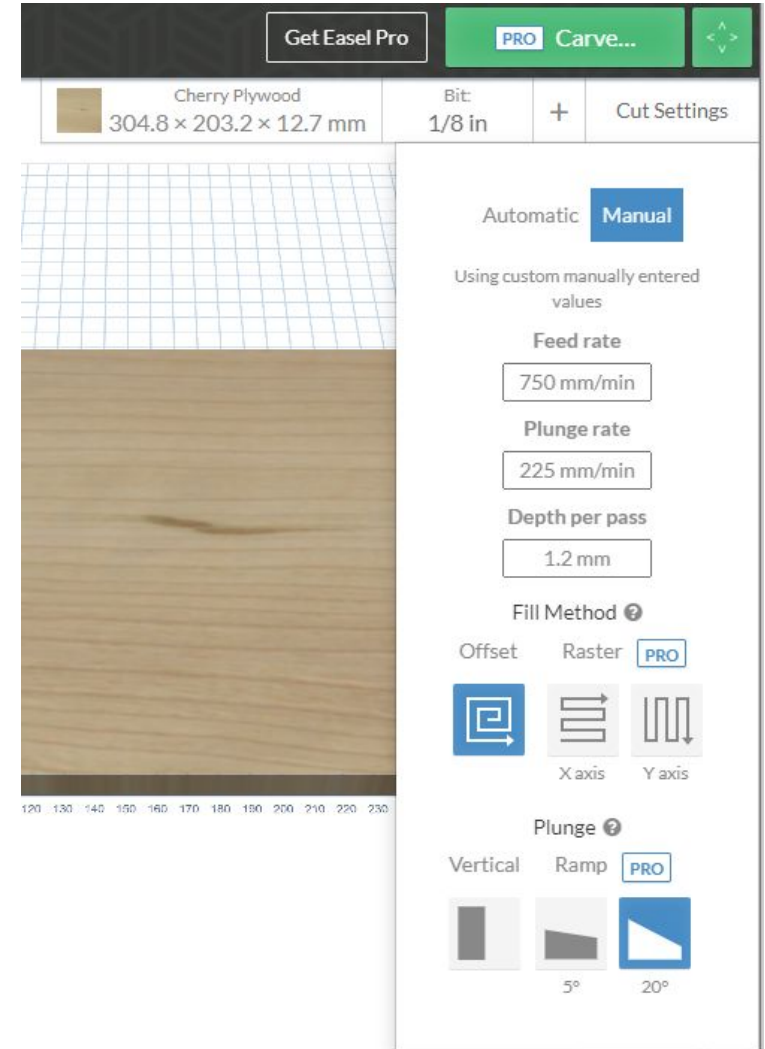
Part 5 Recommended Settings - Easel

Cut settings

Selecting the material type in Easel allows the software to calculate cut settings. Preliminary testing has shown that these Automatic settings may be too aggressive for most users.

The user will need to adjust settings based on their personal experience and how the machine is operating. For smaller diameter bits, speeds WILL need to be drastically reduced to prevent bit breakage.

As Inventables gets our machines loaded in their database, Automatic Cut Settings will be accurate.



Part 5 Recommended Settings - Easel

Cut settings - Spindle Speed

Spindle speed is controlled by the user, not the Controller.

The Controller will turn the Spindle Motor On/Off.

Speed is controlled using the adjustment knob on the top of the Controller.



Part 6 Optional Laser Installation

Laser Engraving with your Mandrill

To utilize the laser engraving functionality of the Mandrill, the [Yora Laser Module](#) will need to be installed in the Spindle Mount, as described in Part 2.

The user will also need to change the controller configuration, in particular the \$32 setting will need to be set to a “1” to enable proper laser operation.

Please note that the default \$30 value of the controller is 10000 - this means that the S-MAX value for laser engraving will need to be set to 10000 to equal 100% power to the laser module.

The laser module cable connects to the rear of the Controller, and the Laser/Spindle Selector Switch will also need to be set to “Laser”.



Part 7

Best Practices For Assembly & Setup

Quick Guide

1. Ensure everything is **wired and powered correctly** per the manufacturer guidelines.
2. Ensure your axes **move freely** and don't obviously bind. If you can't easily tell, try removing your steppers and check if they run under no load.
3. Ensure your stepper motors and axes linear mechanisms are all tight and secure. Small set screws on drivetrain components becoming loose is a very common problem. Re-tighten and try applying some non-permanent thread locker (**Loctite blue**) if it continually loosens.
4. For more difficult issues, try the process of elimination to quickly **isolate the problem**. Start by disconnecting everything from the Arduino (controller board). Test if Grbl is operating ok by itself. Then, add one thing at a time and test.
5. If your steppers are powered and making a grinding noise when trying to move, try to **low the '\$' acceleration and max rate settings**. This sound is a sign that your steppers are losing steps and not able to keep up due too much torque load or going too fast.
6. Next, you need to make sure your machine is moving in the correct directions according to a Cartesian(XYZ) coordinate frame. Check all axes. If an axis is not moving correctly, **alter the \$3 direction port mask setting to invert the direction**. Just keep in mind that motions are relative to the tool. So on a typical CNC gantry router, the tool will move rather than the fixed table. If the x-axis is aligned positive to the right, a positive motion command will move the tool to the right. Whereas, a moving table with a fixed tool will move the table to the left for the same command, because the tool is moving to the right relative to the table.
7. Finally, tune your settings to get close to your desired or max performance. Start by ensuring your **\$100,\$101, and \$102 axes step/mm** settings are correct for your setup.

Part 8 Terminology

CNC (Computer Numerical Control): A CNC machine is a motorized platform controlled by a computer according to specific input instructions.

Units (mm or inches): It is imperative that the units match. If you tell your software to work in inches and the router works in mm, you are going to get very bad or compressed results.

G-code: G-code stands for “Geometric Code”. It is a programming language for CNC that instructs machines where and how to move. Most machines speak a different “dialect” of g-code, so the codes vary depending on type, make, and model.

Controller or Motherboard: This is the brain of your CNC working with an Arduino microprocessor. This is the bit of electronics that controls everything: stepper motors (axis movements), spindle motor (cutting speeds), laser (power settings), jogging, G-code commands received via USB or an offline controller, etc.

Grbl : This is the software which runs on the motherboard. It takes the G-code and translates it into the movements and speeds needed to cut a line for example.

Stepper motor: A motor that is told to turn in small steps like turn clockwise 1.7° as opposed to a normal motor that will continue to rotate as long as the power is supplied. Each step of the motor will turn the threaded rod which will move the the axes connected to it.

Spindle Motor: This is the big electric motor which holds the cutting bit.

Stock: Whatever you are trying to engrave, cut or carve.

Bed: This is the flat MDF plywood or aluminium bed which holds the stock with slots in it to allow clamps to hold the stock down.

Part 8 Terminology

ER11: This is the piece that fits onto the end of the spindle and holds the bit.

Collet: The piece inside the tool holder (ER11) which as it is tightened into a tapered hole contracts around the bit so holding it.

Bit (or Tool): The sharp blade which rotates and cuts bits out of the stock.

Shank: The part that goes into the collet of the tool holder.

Flute: A cutting edge at the end of the bit.

Limit Switches or End Stops: Switches which trigger at the limits of movement for each axis. During the operation, they will stop the router from trying to move past its physical limits by generating an alarm.

Toolpath: The path that the tool is moved along in order to do the job. Your software will provide a toolpath simulation so you can see on your computer what is going to happen before you send it to the router.

Passes: This is the number of times you tell the router to retrace the same path. If you want to cut a groove or pocket in a piece of wood 5mm deep you are not going to do it in one single, go down 5mm then cut! If the wood is very soft and the bit is very sharp, maybe, but you take the risk of overloading the router, wearing out or breaking the bit by trying to make it do too much work in one go. You can get round this by telling your Easel to make multiple passes cutting out a little each time. As a general rule, the less material you take out the better the finish quality but the longer it takes.



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