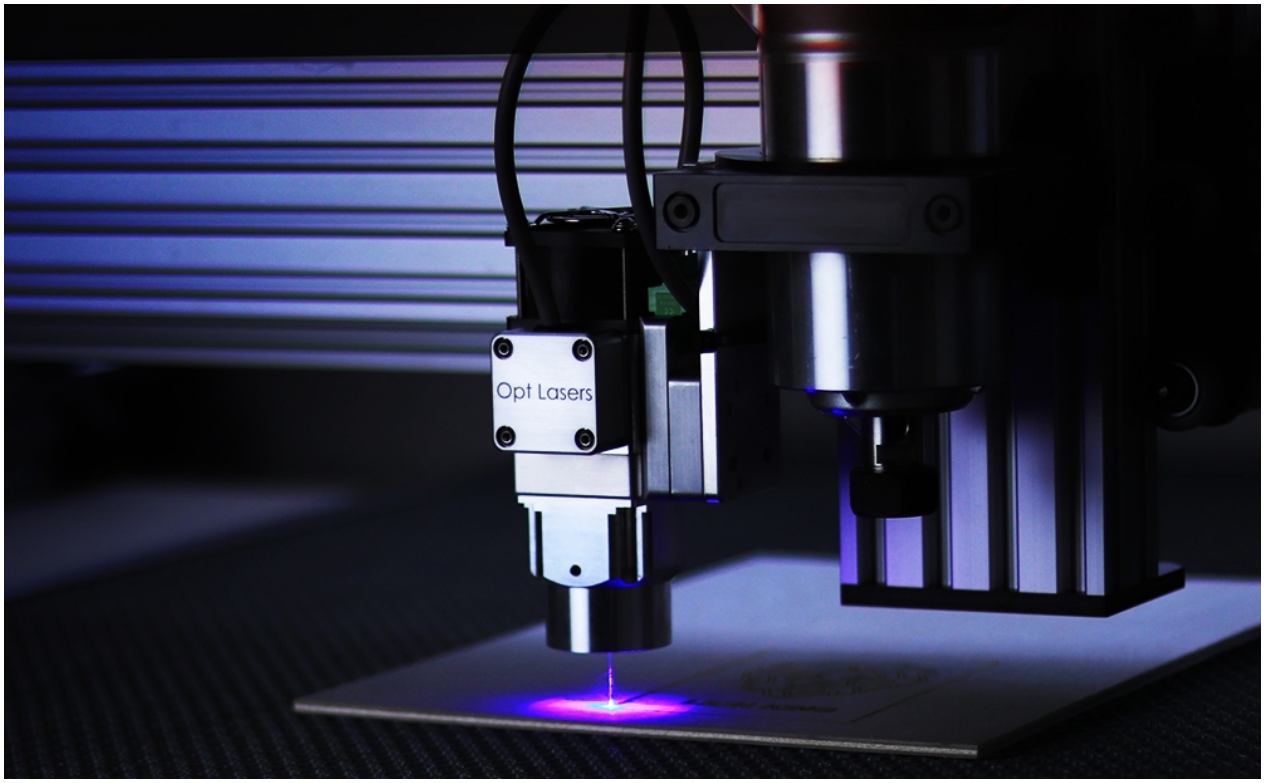
Opt Lasers GRAV

CNC Machines Laser Upgrade Instructions



This part of the documentation is connected with popular CNC machines Laser Upgrades.
Basically, with the help of the PLH3D-CNC Adapter, it is possible to connect the laser head to almost any CNC machine and turn it into laser engraver. A very important thing besides the connection is G-Code generating. It differs from the standard G-Code. The laser needs to be switched off during the idle movement while spindle can be left rotating. The most similar thing in Laser and Spindle G-code is the power and the rotation speed. PWM signal is controlling the rotation speed of the spindle while the same signal can be used to control the laser power. Usually, it is done with S0 - S255 command but different CNC Software and Controllers are using different values, for example, S0 - S1000.

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LEAD/WorkBee CNC Laser Upgrade Setup Guide for PLH3D-6W-Series Laser Heads

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Introduction

The OpenBuilds LEAD CNC is a machine with greatly enhanced functionalities and a vast range of applications. Thanks to its build, it is very rigid and therefore very accurate. It can be used by amateurs, hobbyists, and professionals alike for processing various types of soft and hard materials at scale and with an even higher degree of precision than ever before. Extending the machine by adding a quality laser head to it, such as Opt Lasers PLH3D-6W-Series laser head, enables unmatched fast precision engraving and cutting of various types of materials.

The OpenBuilds LEAD CNC machine is available in two versions:

- OpenBuilds LEAD CNC Machine 1515 (60" x 60")
- OpenBuilds LEAD CNC Machine 1010 (40" x 40")

The Z-axis position of the cutting and engraving laser head can be changed at will to enable this machine to efficiently cut and engrave taller specimens.
The OpenBuilds LEAD CNC machine prices range from $1300 to $1800 depending on the version of choice. With the amazing material processing capabilities it offers, it is definitely worth the price.

The PLH3D-6W-XF Laser OpenBuilds LEAD CNC Upgrade Kit includes a high-power engraving laser head equipped with thermal protection and a professional high-speed driver. Its design ensures that the laser head doesn't require any additional cooling. The fan and airflow have been designed to function as an air nozzle, protecting the lens from dirt while cooling the laser head at the same time. Attaching a magnetic nozzle makes it even more convenient to use.
The laser head, combined with the LEAD CNC machine and the BlackBox controller, allows you to cut or engrave materials such as rubber, wood, paper, leather, plastic, cardstock, and many others.
Thanks to its PWM/TTL power modulation modes support, it's possible to engrave in shades of grey or change the output power between consecutive runs. High-speed modulation (the PLH3D-6W-XF laser head can handle frequencies up to 100 kHz) allows for a high movement rate during engraving, even when engraving sophisticated patterns. This rate is more than enough to take advantage of the BlackBox controller's speed.
Using the PLH3D-CNC Adapter guarantees reliable and safe work via overcurrent protection, an independent power supply, a key switch, and an arm button. Furthermore, using the Magnetic Docking station to mount the laser head on the LEAD CNC machine reduces the time needed to mount/dismount and to secure the laser head to just a few seconds (while it requires no additional tools). Moreover, it enables a person to operate the laser without the need for disassembling the spindle. This module operates a brand new NUBM44 450nm diode (capable of emitting up to 6 Watts of power), which is the strongest blue laser diode that is available on the market. The lifetime of this laser diode amounts to 10 000 hours according to the manufacturer.

Included Parts

Laser Safety

Only person with specialized training and appropriate laser safety knowledge can use and maintain the laser head. The laser head operator must be aware of laser radiation hazard.
While laser head is operating protection Laser Glasses designed for 190 – 540 nm (OD 7+) should be used. Make sure that all personnel in the same room worn protection glasses.
Eye exposure to the direct or diffusely reflected laser beam is a hazard. The laser head beam may cause permanent eye damage.
Skin exposure to the laser beam is a hazard. The laser beam may cause serious skin burns. Laser beam may easily burn cloth.
It is possible to get serious injury while using this product or being in the vicinity of an individual using it. Improper use of the laser head can result in injury or death.
Flammable substances exposure to the laser beam may pose fire hazard. The laser head operation in an explosive atmosphere may be dangerous. The working area must be well ventilated. During the operation laser beam may ignite gases or flammable liquids.
Before making any adjustments, changing accessories or performing maintenance, the laser should be powered off and disconnected from the power supply and CNC main board.
The laser head must be properly mounted to a rigid body such that it cannot be moved unintentionally. Unintentional move of the laser head is dangerous.
The unauthorized personnel must have no access to the system into which the laser head is integrated. The laser head must be stored out of the reach of children. Untrained persons are not allowed to operate, maintain and observe operation of the laser head.
Specular reflection materials should not be placed in front of operating lasers head. Remember, diffused reflection of the laser beam is uncontrolled and may pose hazard to eye.
Appropriate shielding should be used around the system into which the laser head is integrated. The system in which laser head is used must be equipped with key switch and safety interlock.

Responsibility of use or misuse belongs to the end user. Tomorrow's System and its affiliates accept no responsibility for use or misuse by the user. If you may not be able to use this product properly, we recommend that you do not begin use or cease use immediately.

Mounting Setup

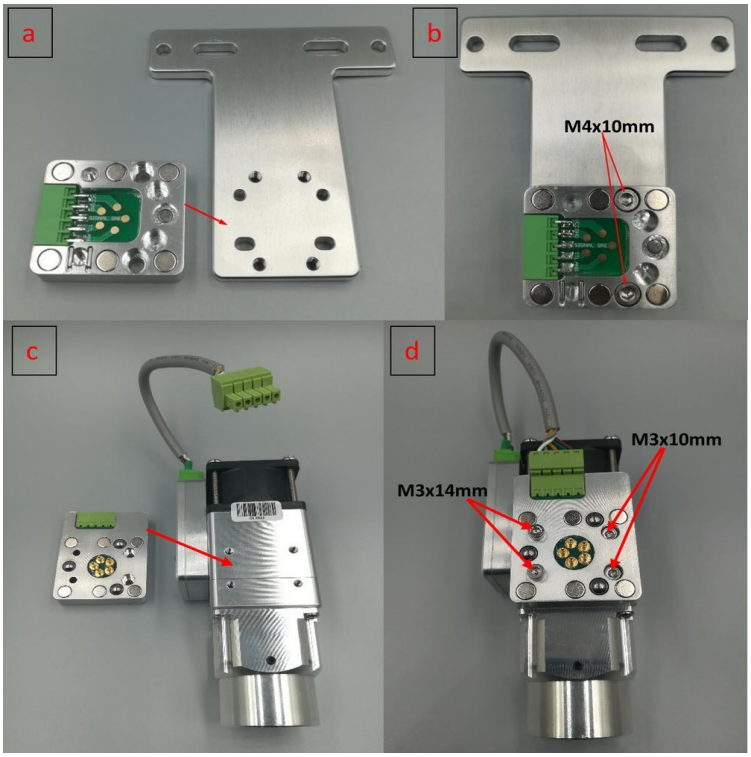
To mount the PLH3D-6W-Series laser head, the following tools are required:

- Small flat-head screwdriver;
- H2.5 hex key;
- H3 hex key;
- H4 hex key;
- 8 mm spanner;
- A few zip ties (optional).

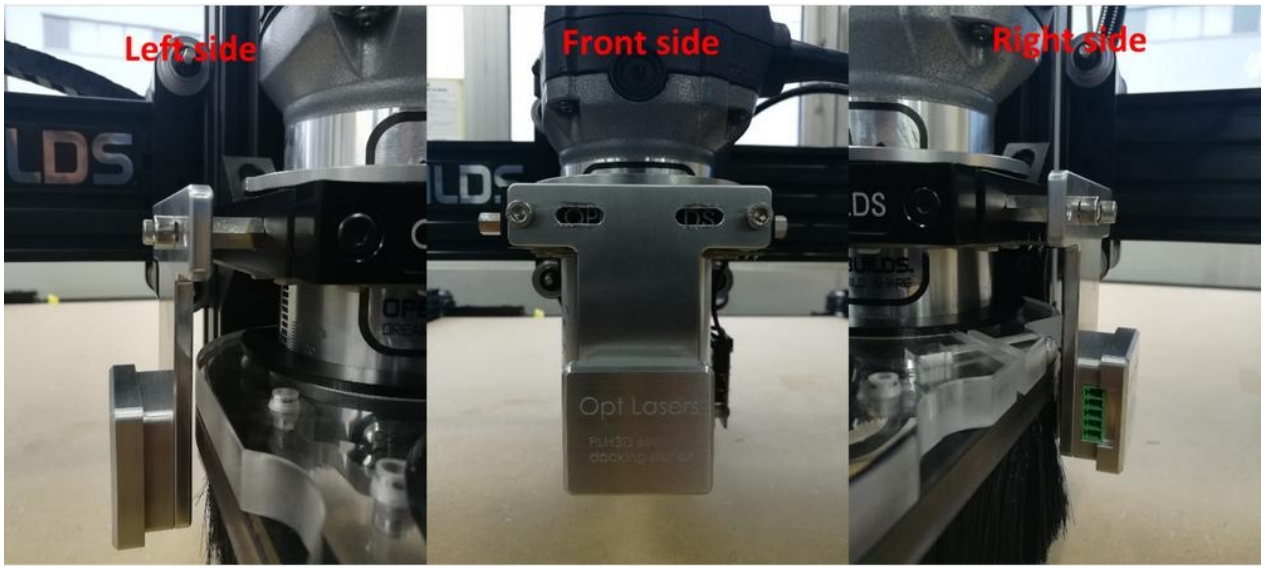
1. Unpack the LEAD PLH3D Mount. All necessary screws have been provided.

2. Unpack the LaserDock Magnetic Docking Station.

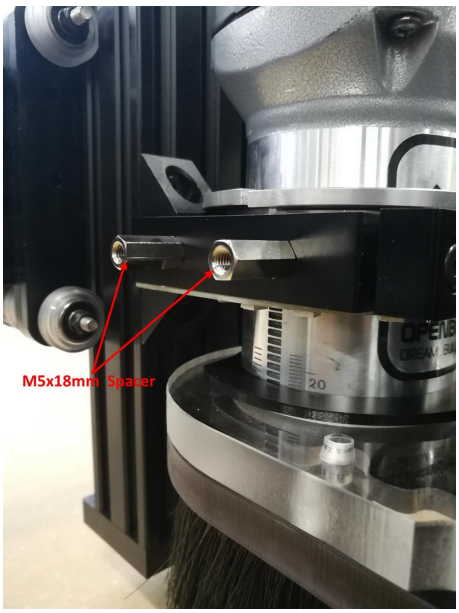
3. Screw one side of the docking station onto the LEAD PLH3D Mount and then sandwich the laser head between the two parts of the docking station as depicted in the steps “a” to “d” below. Finish by screwing the second element of the docking station onto the laser head.



4. Install the LEAD mount (with a relevant element of the docking station) onto the spindle holder. The LEAD mount is designed to be installed on the left, right, or front side of the spindle holder.

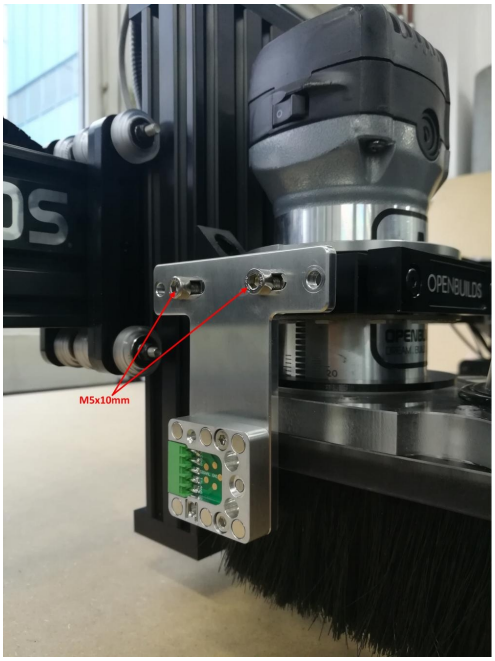


- For mounting the docking station on the front side you have to remove the dust shoe. There is no risk that the laser head would collide with machine parts.



- Use an M5x18mm spacer to be able to install the laser mount without removing the dust shoe (possible only for mounting on the left- and right-hand sides). Mounting the docking station on the left-hand side is the recommended option, because, in this scenario, the laser cable will not face the user. Nevertheless, both left- and right-hand side mounting will decrease the workspace.

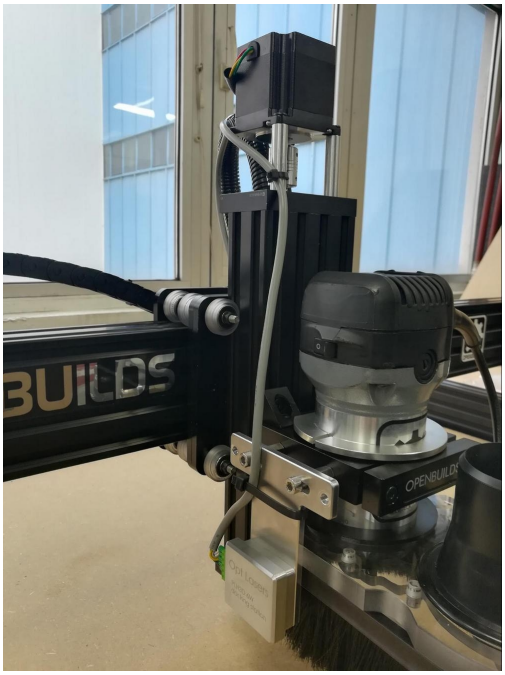
- Use an M5x10mm screw to screw the LEAD PLH3D Mount onto the spacers.

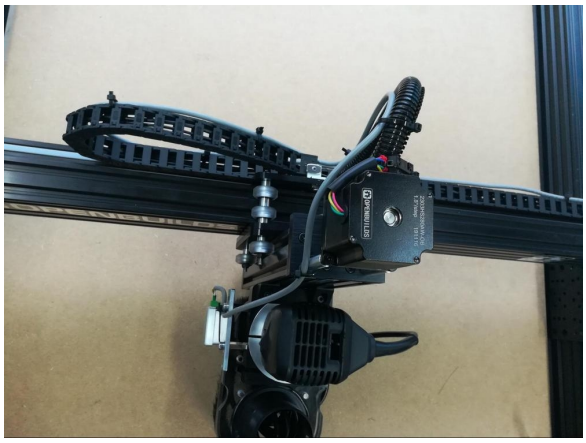


Wiring Setup

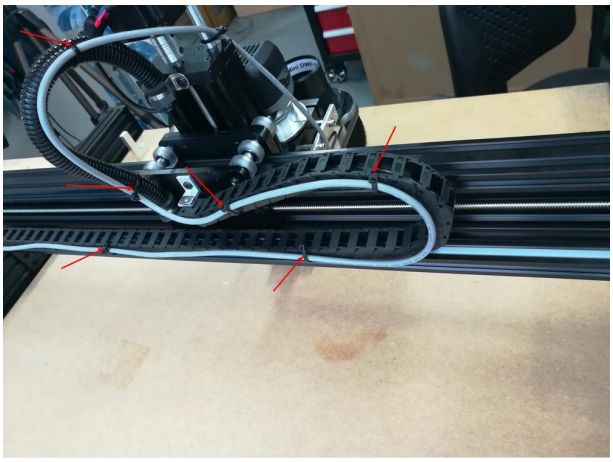
1.Connect one end of the PLH3D-CNC Adapter-to-Laser-Head Cable to the docking station on the LEAD PLH3D Mount. Secure this cable to the mount with a zip tie.

2. Further zip ties can be utilized to fasten the cable at the top of the Z-axis and then along the other side of the X-axis, as shown below:

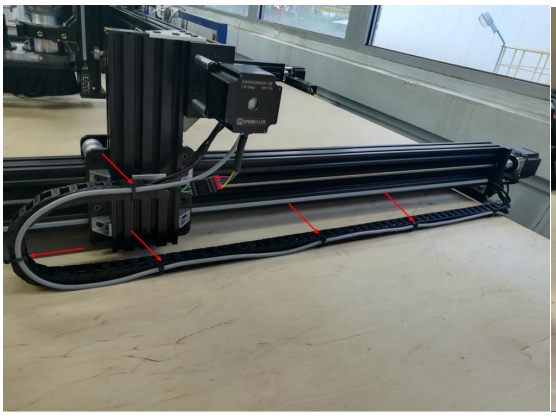




3. Next, secure the cable along the X-axis drag chain using zip ties or by putting it through it.

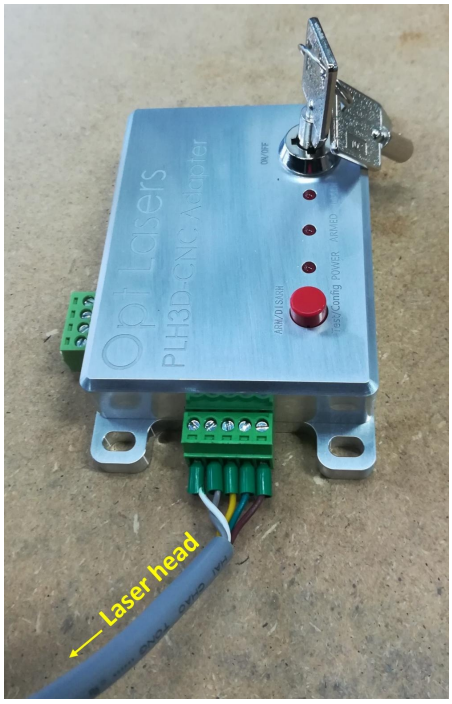


4. For the next step, pass the cable around the X-axis motor and then secure the cable along the Y-axis drag chain in a similar fashion as in the previous step.

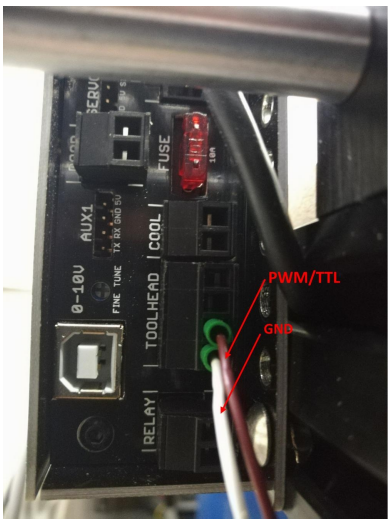


For the users who prefer to put the cable through the drag chain, bear in mind that you will have to remove one of the end connectors in the PLH3D-CNC Adapter to Laser Head Cable. Also, remember that the 5 wires' connection is mirrored on the opposite side of the cable (and, thus, the order of the wires is flipped).

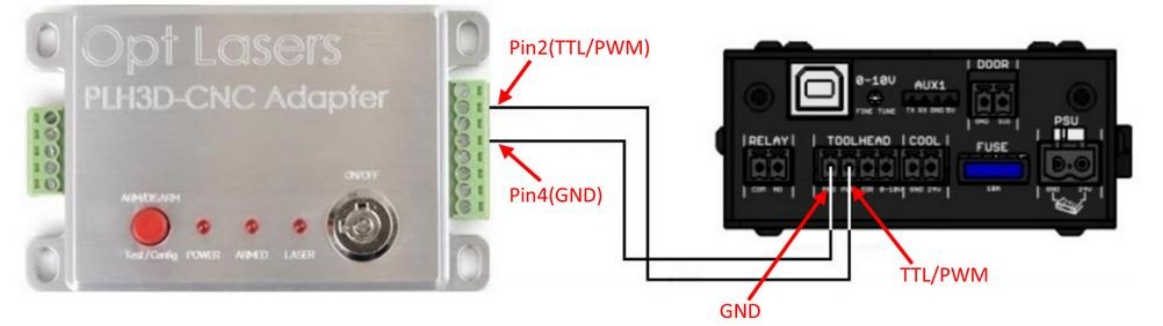
5. Next, connect the laser head cable to the output of the PLH3D-CNC Adapter.



6. Then, connect the LEAD Signal Cable to the output (TOOL HEAD) of the BlackBox controller.

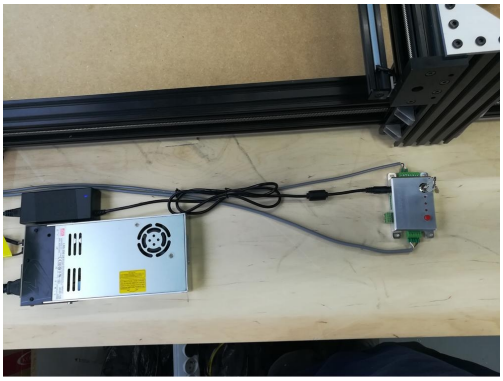


The appropriate connection diagram between the PLH3D-CNC Adapter and the BlackBox Controller is as follows:



7. Please follow it by connecting the BlackBox signal cable to the input of the PLH3D-CNC Adapter.

8. Finally, plug the 19 V, 2.5 A desktop power supply into the socket on the PLH3D-CNC Adapter.



PLH3D-CNC Adapter Settings

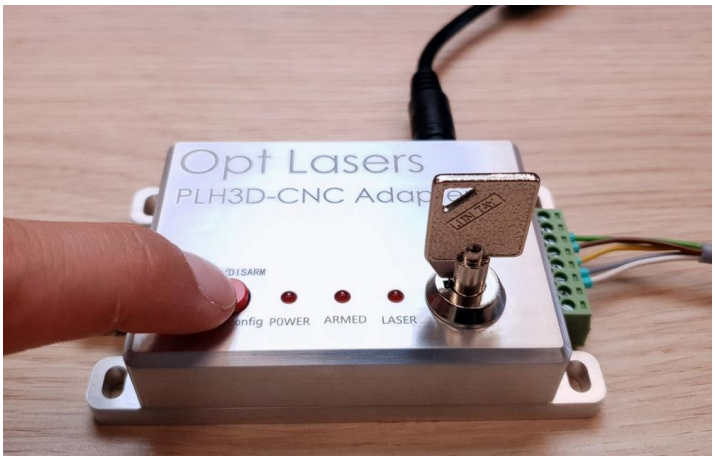
The PLH3D-CNC Adapter should have the “0” program set. A detailed description can be found in the CNC Adapter Manual on the Opt Lasers’ website.

BlackBox Motion Control System	0	POWER ARMED LASER	ENABLE1=any ENABLE2=any

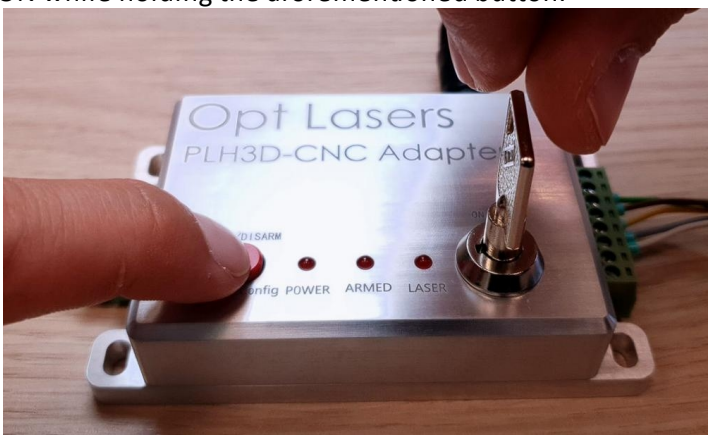
How to Check Enable Option in PLH3D-CNC Adapter

Note: After turning the key switch On, the current Enable Option setting will be displayed with indication LEDs for a second. Applicable for PLH3D-CNC adapter sold after 20-July-2020. For older version of PLH3D-CNC Adapter please follow the instruction below.

1. Turn the key switch OFF.
2. Press and hold the mode button.



3. Turn the key switch ON while holding the aforementioned button.

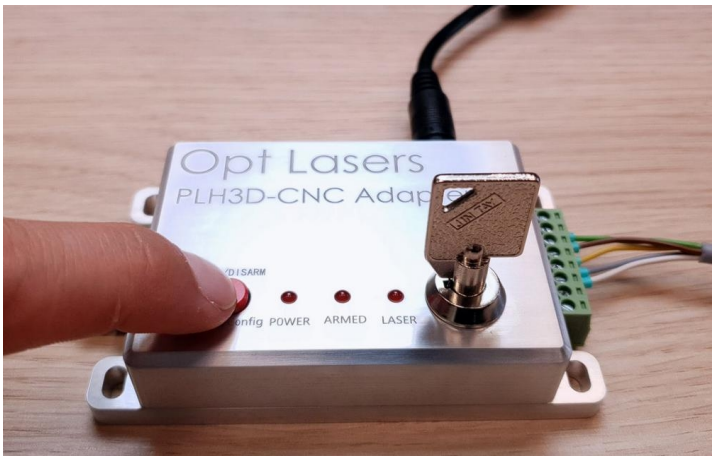


4. Wait approximately one second until any LED is lit and release the button.

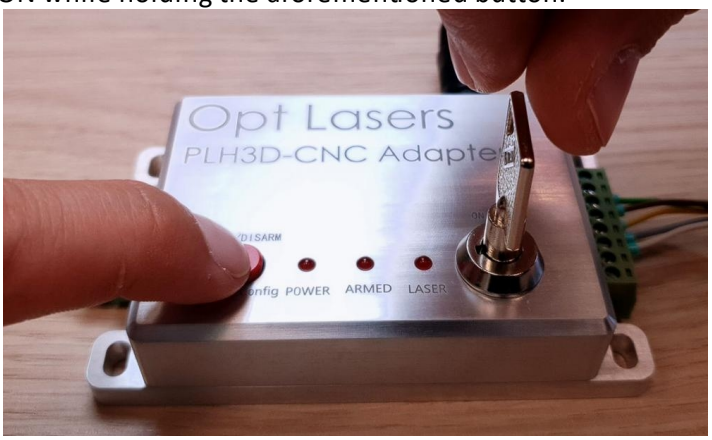
5. LEDs will show a combination corresponding to the current setting. Do not press Mode button again.
6. To quit without saving, wait for five seconds until Power LED is lit or turn the switch key off.

How to Set Enable Option in PLH3D-CNC Adapter

1. Turn the key switch OFF.
2. Press and hold the mode button.

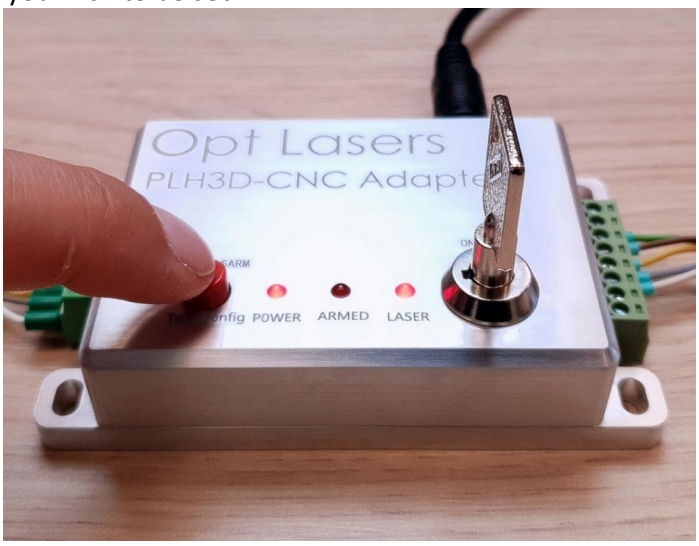


3. Turn the key switch ON while holding the aforementioned button.



4. Wait approximately one second until any LED is lit and release the button.

5. LEDs will show a combination corresponding to the current setting.
6. To step to the next setting, press the mode button once. Keep pressing the mode button till you find the settings that you wish to be set.



7. To save the current setting, wait five seconds with the button released. To quit without saving, turn the key switch off before five seconds elapse.

The chosen setting is kept in non-volatile memory and remains unchanged during power-off.

Software Setup

To cut or engrave, it is necessary to generate the appropriate G-code using the following commands:

M4	Laser ON
M5	Laser OFF
SXXX	PWM duty, where XXX is a number between 0 and 1000 (e.g.: 0 = 0% and 255 = 100%.

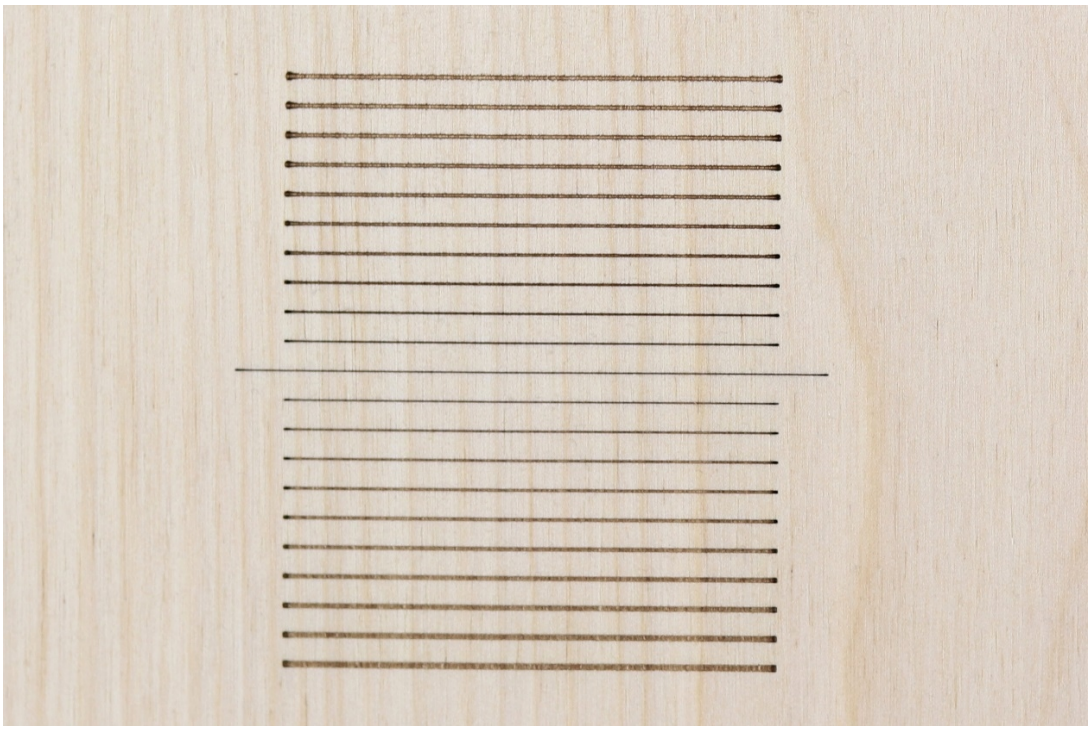
Setting Working Distance

Some engraving applications may require small focus spot, i.e. high-resolution engraving, detailed engraving. PLH3D-6W Series laser head has adjustable focal length and exchangeable lens. This future allows it to fulfill broad range of engraving applications. Shorter focal length of the laser head produces a smaller beam spot (higher power density).
You can adjust focus spot distance from the front of the laser head by rotating the lens clockwise or counterclockwise. Note: it is necessary to ensure that the mounted lens is sufficiently deep inside the laser head, so the lens does not move before powering on the unit.

Once you changed the position of the lens use your CNC machine to find where is the focus spot. Using the methods described above calibrate the laser head position.

- **Coarse adjustment:**

a. Set current position as a zero position in your CNC software.
b. Engrave “zero position” line on the engraving material. Hint: make this line longer compares to the next engraved line, it’s going to be easier to find “zero line”.
c. Engrave (on the engraving material) 10 lines with step 1 mm in the positive direction of Z-axis and 3 mm step in X-axis.
d. Go back to zero position.
e. Engrave (on the engraving material) 10 lines with step 1 mm in the negative direction of Z-axis. and 3 mm step in X-axis.
f. Inspect engraved lines, find the thinnest engraved line.
g. Count how many lines away is the thinnest line from “zero line”, and in which direction it is placed. Let’s consider case when the thinnest line is located 5 lines from zero line and in positive direction of X-axis. In such a case calibration parameter is +5mm.
h. In the CNC software, move “zero position” of the laser head by calibration parameter.

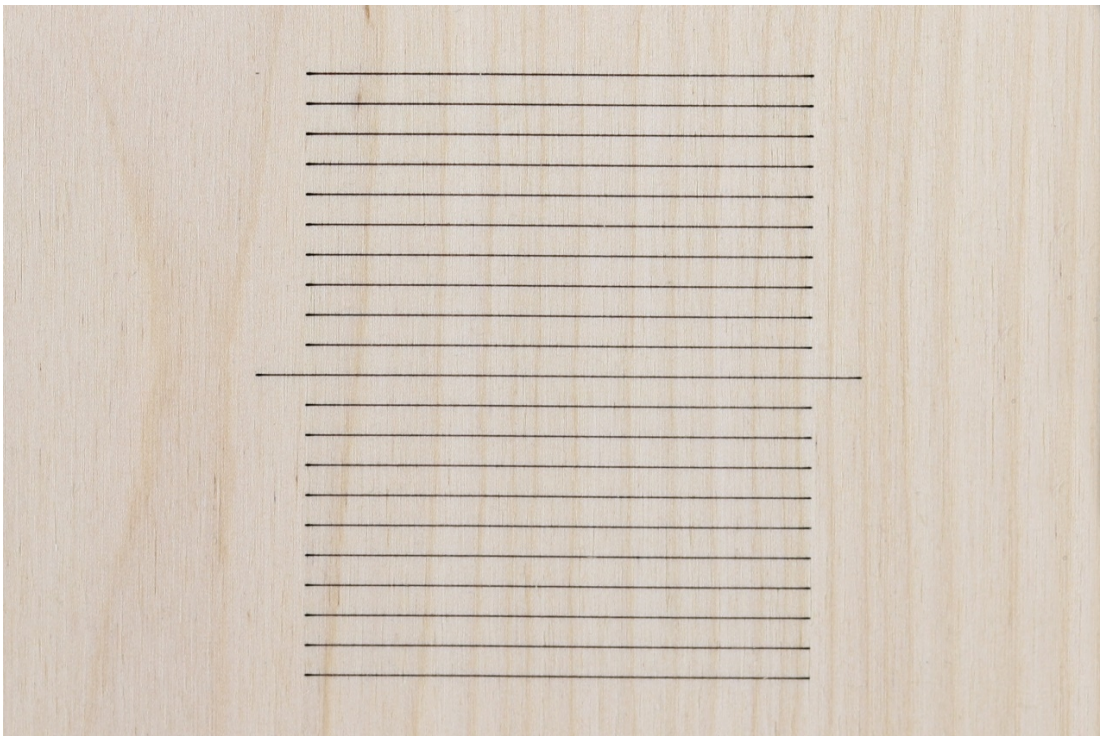


- **Fine adjustment:**

To obtain the highest power density, which results in the better engraving performance, we recommend making fine adjustments to the distance of the laser head and the engraving material. This adjustment should be done after performing coarse adjustment.

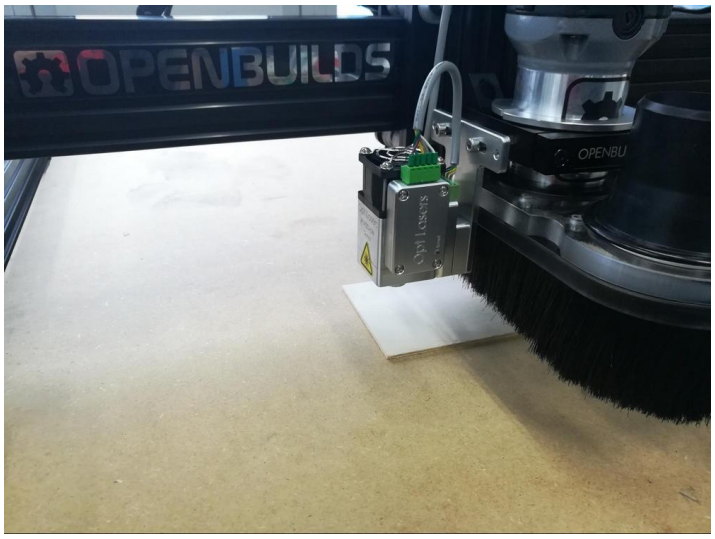
The process is similar to the coarse adjustment process expect steps in Z-axis, they are smaller to make adjustment precise.

a. Set laser head at a zero position, which must be calibrated by know.
b. Engrave “zero position” line on the engraving material. Hint: make this line longer compares to the next engraved line, it’s going to be easier to find “zero line”.
c. Engrave (on the engraving material) 10 lines with step 0.1mm in the positive direction of Z-axis and 3 mm step in X-axis. We recommend engraving lines with 50mm length, it is easier for eye to compare thickness of a line on longer range.
d. Go back to “zero position”.
e. Engrave (on the engraving material) 10 lines with step 0.1 mm in the negative direction of Z-axis. and 3 mm step in X-axis.
f. Inspect engraved lines, find the thinnest engraved line.
g. Count how many lines away is the thinnest line from “zero line”, and in which direction it is placed. Let’s consider case when the thinnest line is located 2 lines from zero line and in negative direction of X-axis. In such a case calibration parameter is -0.2 mm.
h. In the CNC software, move “zero position” of the laser head by calibration parameter.

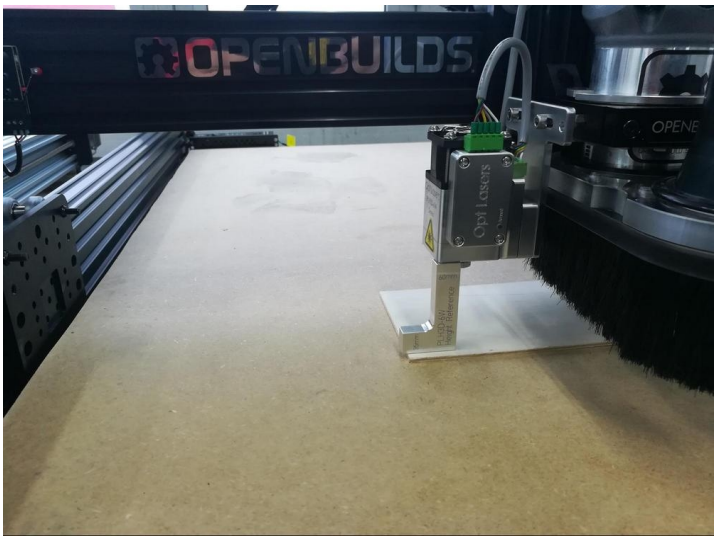


First Job

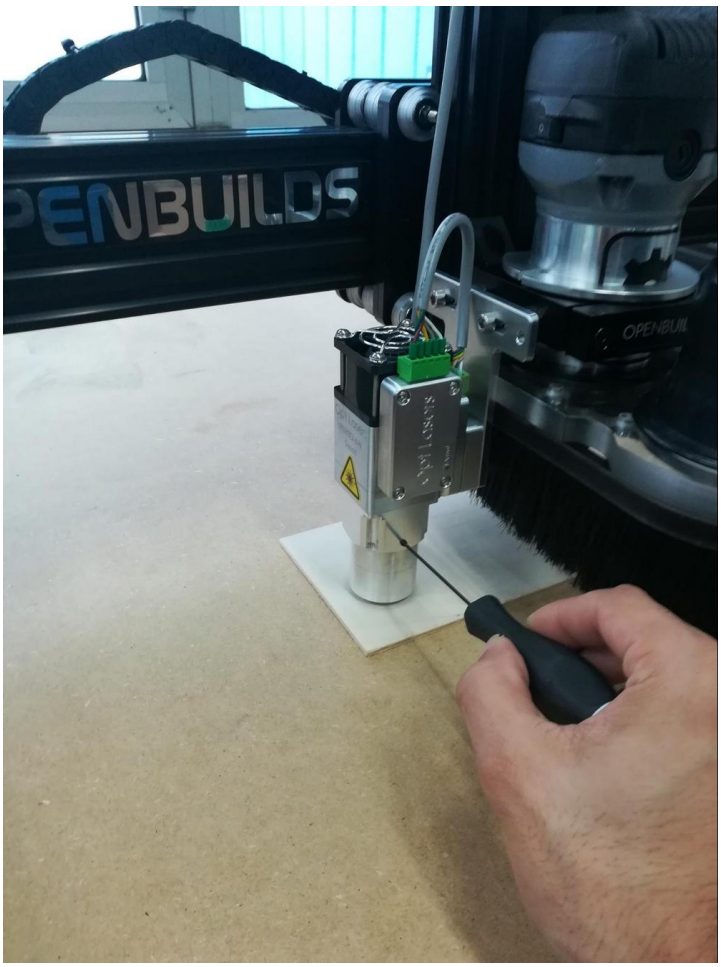
1. Once the PLH3D laser head has been properly connected, place a piece of plywood on the table within the working range of your LEAD CNC machine. Move the laser head in the X- and Y-axis to have the laser module stationed just above the bottom left corner of the plywood fragment.



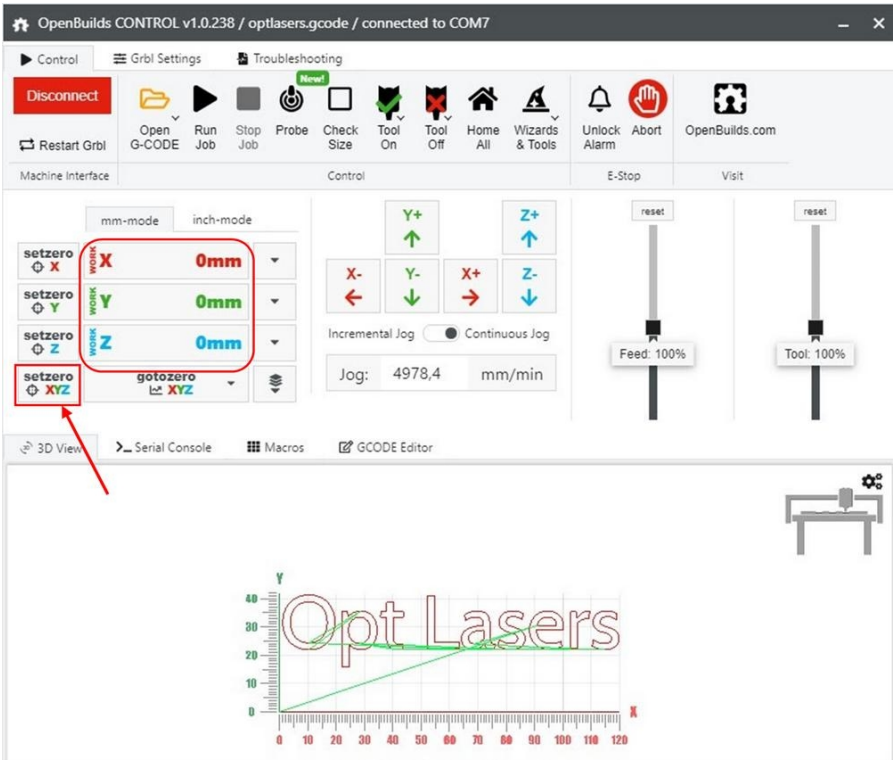
2. Using the PLH3D-6W Height Reference Tool, position the laser head 60 mm above the plywood specimen's surface.



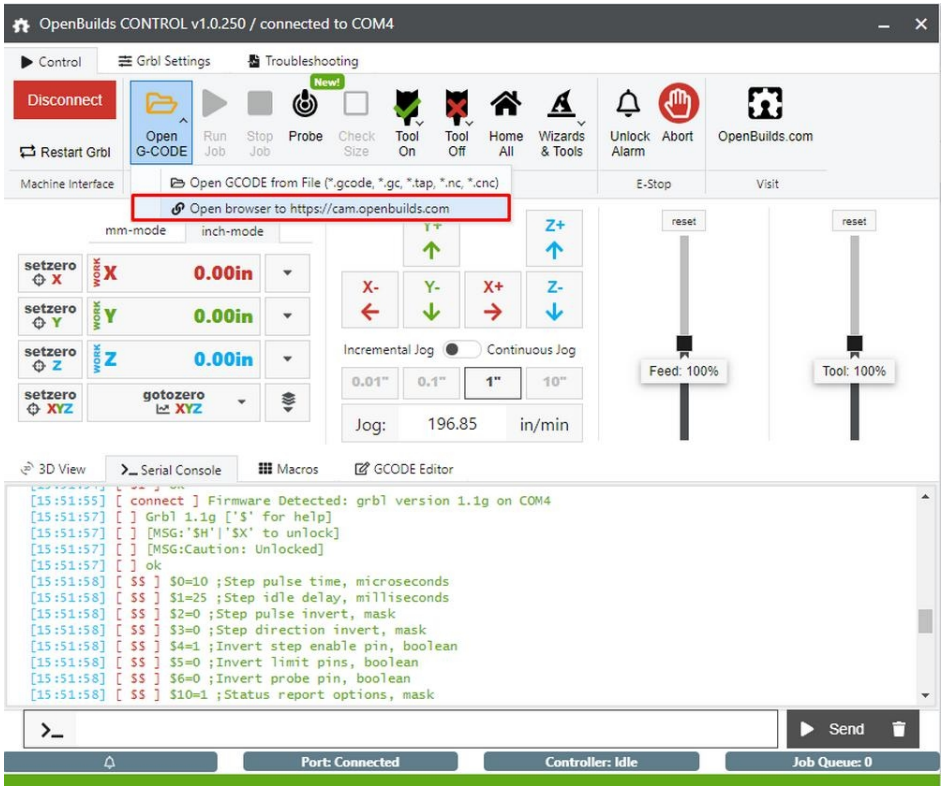
3. Attach the nozzle to the laser head using their natural magnetic attraction. Adjust the length of the nozzle by loosening the screw as shown in the picture below. The distance between the nozzle and the surface of the material being engraved should be around 5-8 mm.



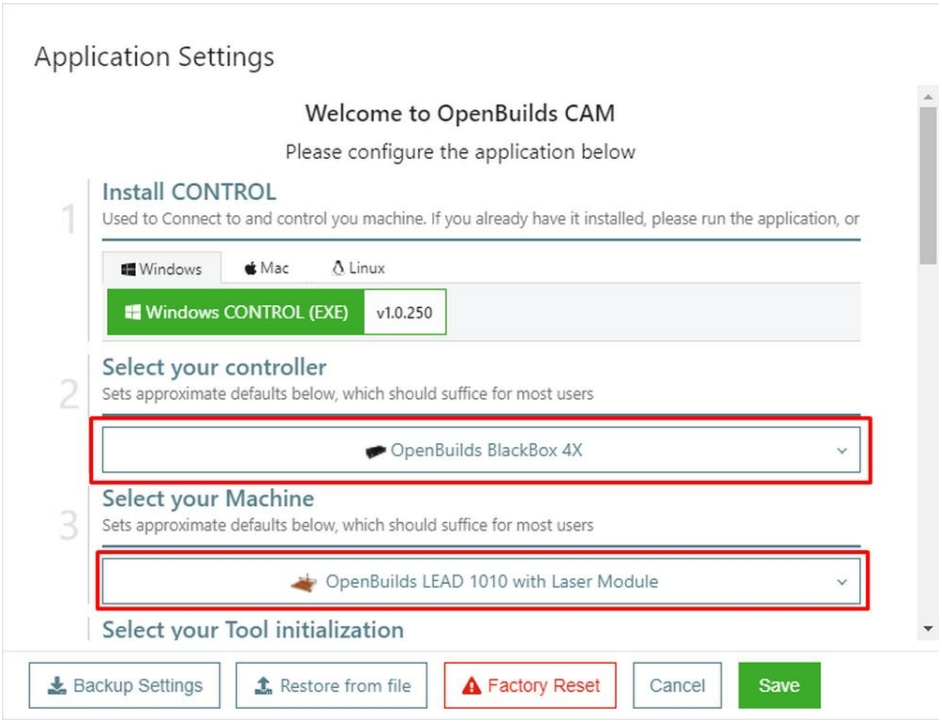
4. Click the "*setzero XYZ"* button. Doing so will set the XYZ coordinates to zero at this chosen position.



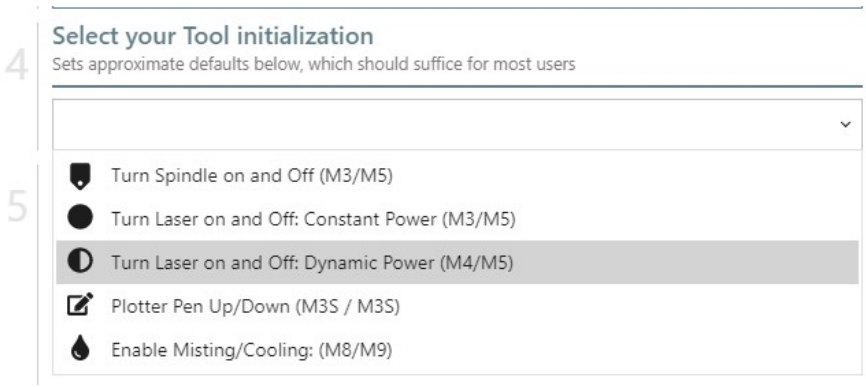
5. Open the OpenBuilds G-CODE generator.



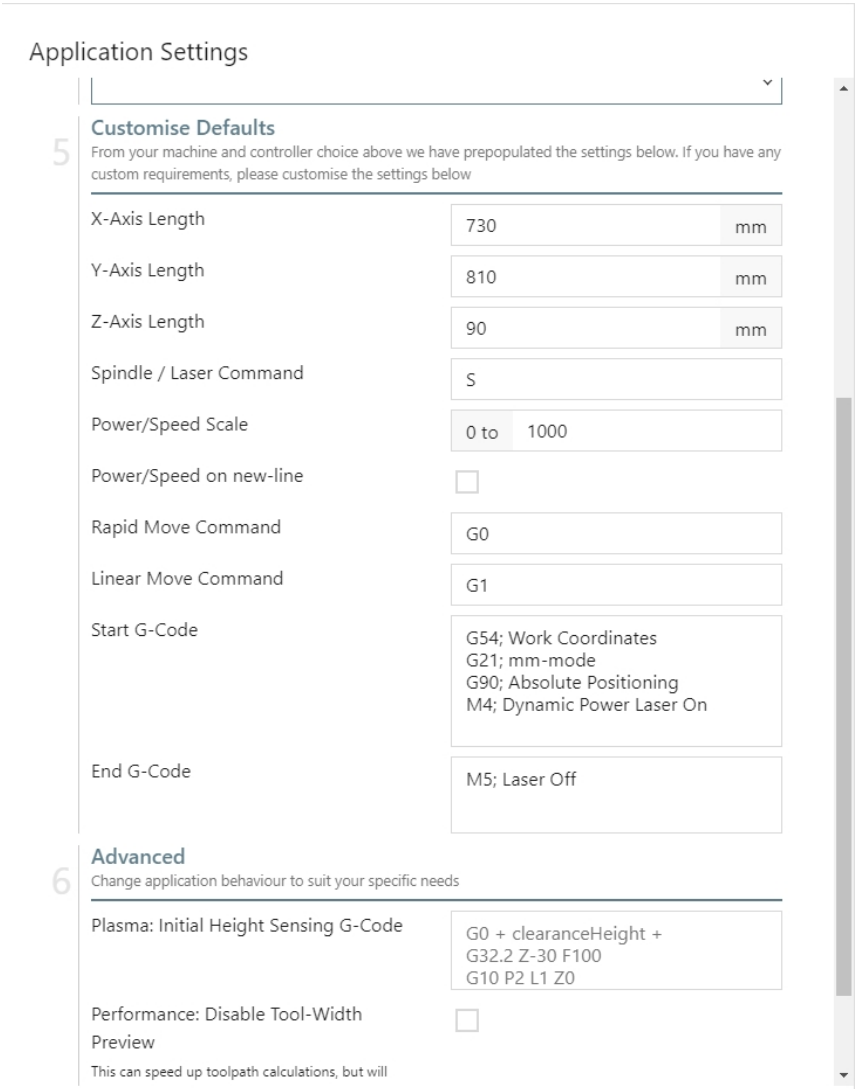
6. A window will pop up, prompting for a machine configuration. Please select the correct controller and the appropriate machine model as shown in the picture below:



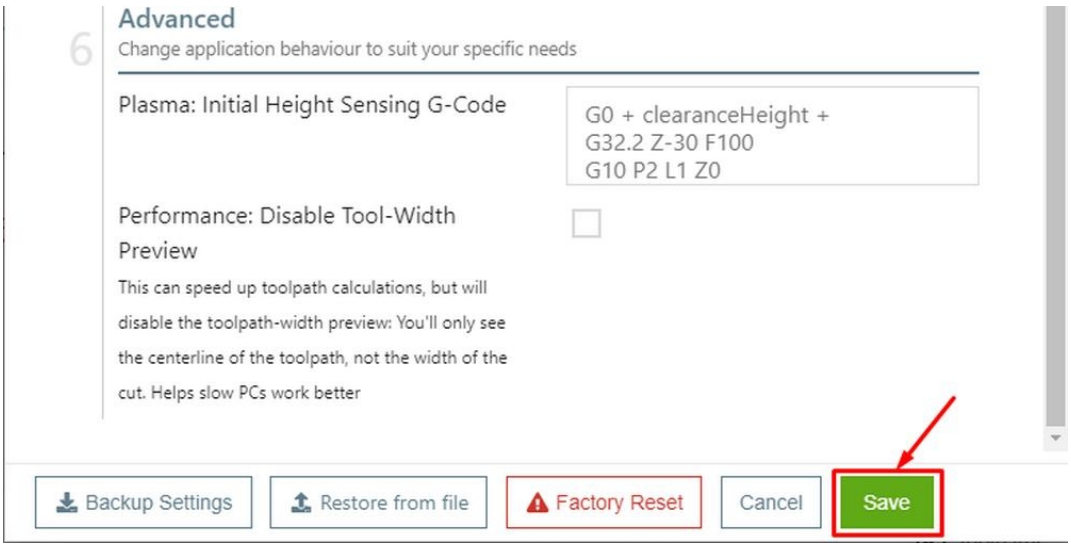
7. In the fourth section of the machine configuration, namely “Tool initialization”, select "Turn Laser on and Off: Dynamic Power (M4 / M5)".



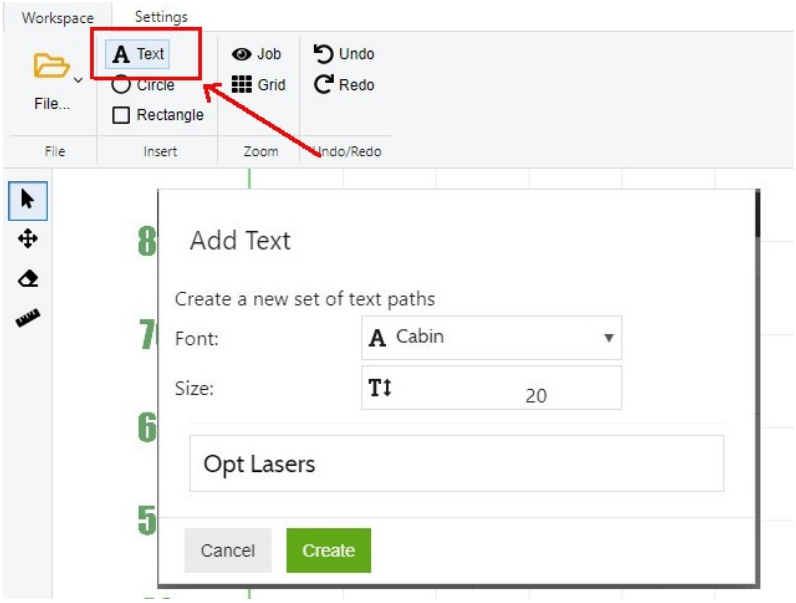
8. In the subsequent section of the machine configuration, you can set customized parameters for the machine working area and laser power. Furthermore, it also shows the G-code commands and settings.



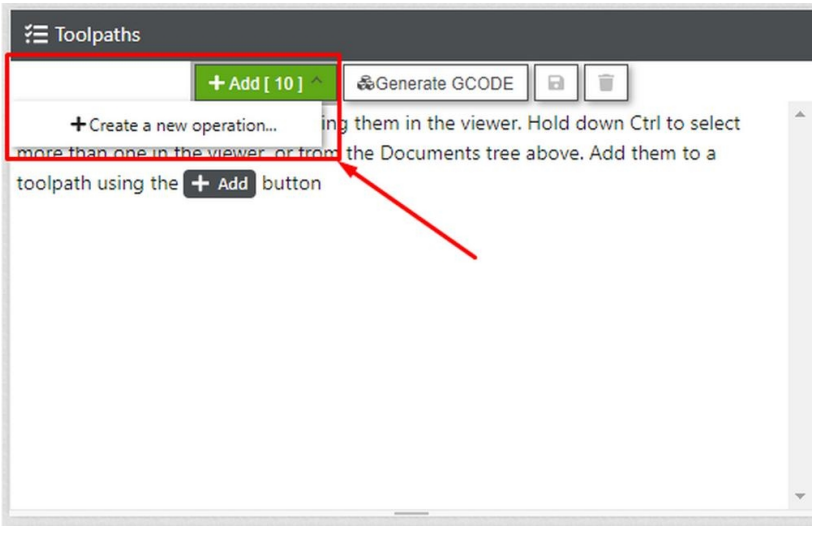
9. Once all desired settings for the machine configuration have been set, click on the “Save“ button.



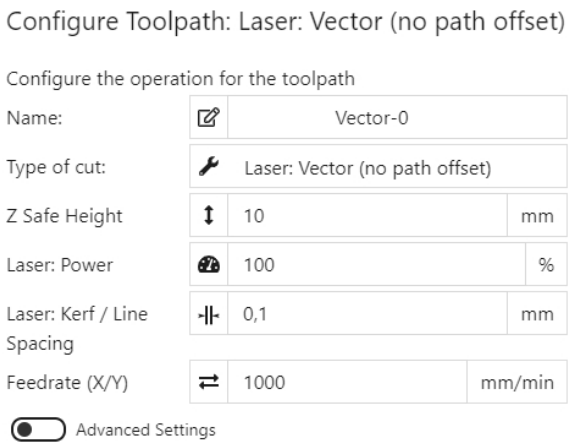
10. You can create a text or an image or a DXF file.



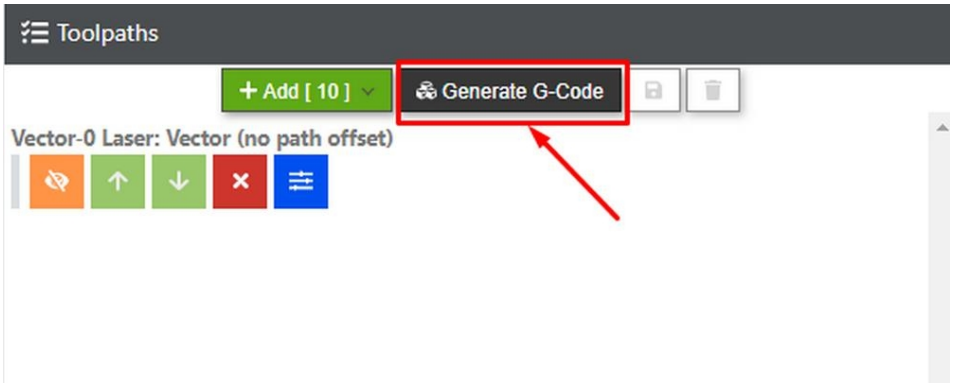
11. Select the text and then click on the "+ Add" button in the Toolpaths section. Next, click on the "Create a new operation" button.



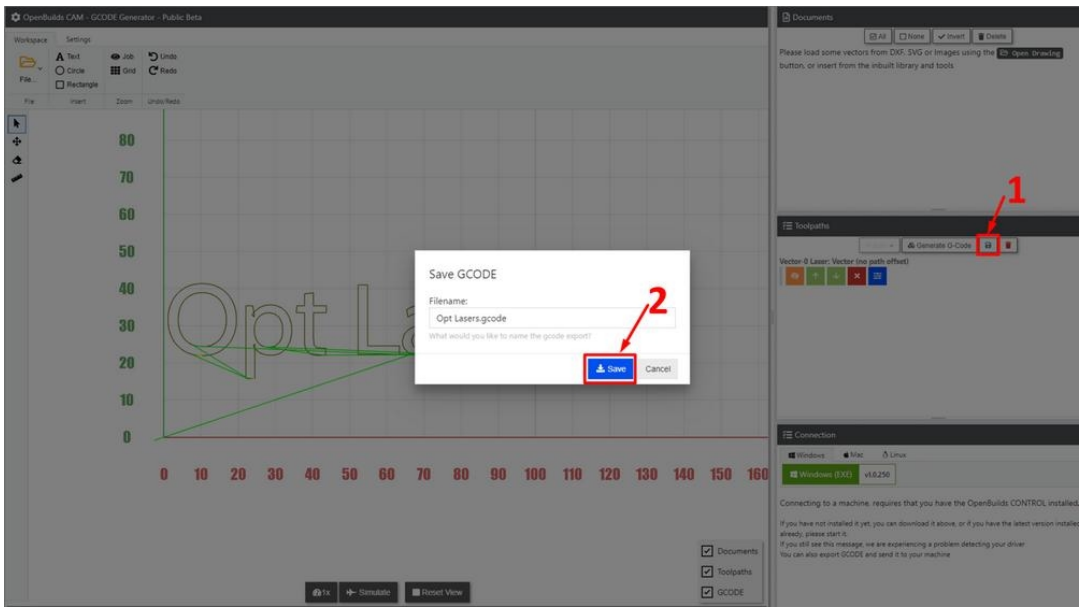
12. Select the “Type of cut”, the cutting speed and the desired laser power. Once that’s been done, you can save the settings by clicking on the “Apply and Preview Toolpath”.



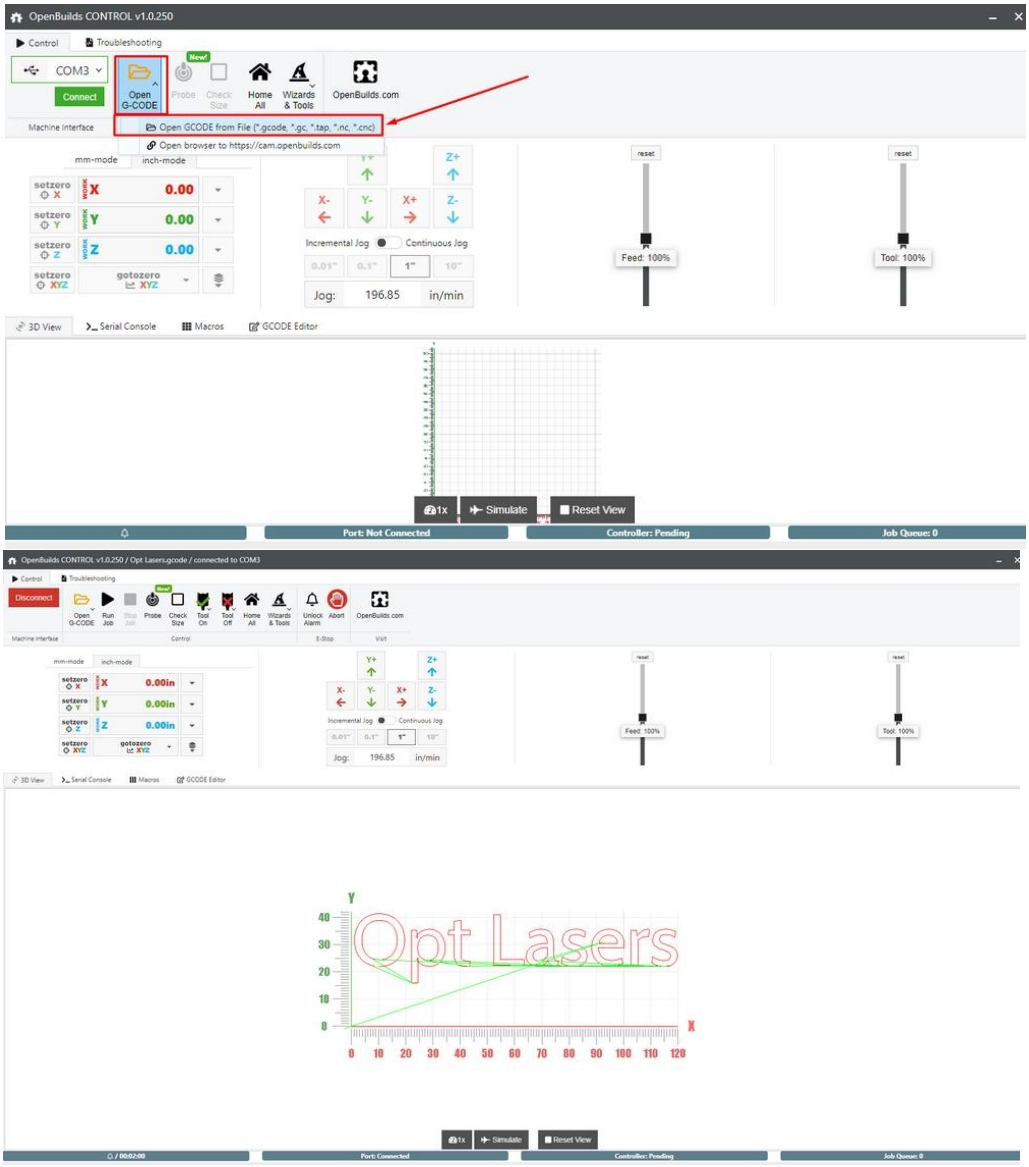
13. After saving the settings generate the relevant G-Code by clicking on the "Generate G-Code" button and save it.



14. Save the generated G-Code by clicking on the save button, labeled with "1". Having written the file name of choice, click on the save button, labeled with "2", as depicted in the picture below.

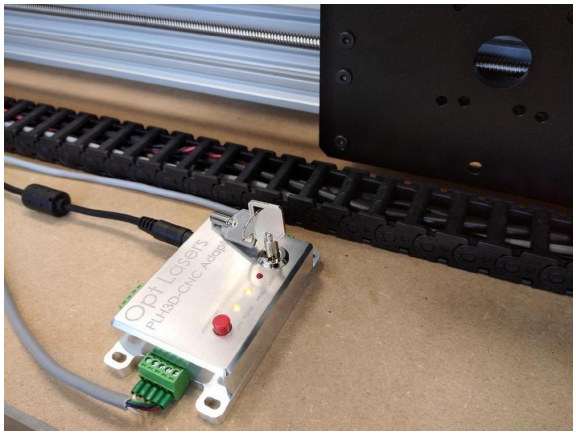


15. Open the “OpenBuild Control”. Then, upload the generated G-Code.



16. Put the Laser Safety Glasses on!

17. Use the key and the ARM/DISARM button to turn on the PLH3D-CNC Adapter and to arm the laser head. POWER and ARMED LEDs should light up.



18. Finally, click on the “Run Job” button and enjoy the results of your hard work.