PLH3D-2W-Series Operating Manual

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General Laser Safety

Only a person with specialized training and appropriate laser safety knowledge can use and maintain the laser head. The laser head operator must be aware of the laser radiation hazard.
While the laser head is operating protection Laser Glasses designed for 190 – 540 nm 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. The laser beam may easily burn clothes.
It is possible to get a 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 a fire hazard. The laser head operation in an explosive atmosphere may be dangerous. The working area must be well ventilated. During the operation, the 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 mainboard.
The laser head must be properly mounted to a rigid body such that it cannot be moved unintentionally. An 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, or observe the operation of the laser head.
Do not place high-reflectivity materials in front of the operating laser head. Remember, a diffused reflection of the laser beam is uncontrolled and may pose a hazard to the 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.

Product Description

This is a medium-power engraving laser head with a thermal protection function and a high-speed laser diode driver. Laser head design ensures that the laser diode doesn't require any additional cooling. Fan design makes it work as a fully customized air nozzle, protecting the lens from dirt and cooling the laser head.

The laser diode driver ensures appropriate operation of the laser head and protects the laser diode from overheating. During normal work green indication LED is turned on. When ambient temperature is over 40^{o}C, indication LED starts to glow and the laser head is shut down.

Turning lens objective allows the user to change the working distance of the laser head. Note: beam spot size will change with working distance, smaller working distance – smaller beam spot size.

Air flow from the fan assures that the lens stays clean.

PLH3D-2W-Series laser head comes with a High Resolution Mounted Triplet Lens. The High-Resolution Mounted Triplet Lens has a relatively long effective focal length (EFL) of 8 mm, which allows it to focus laser light to a small spot. All 6 lens surfaces are coated with anti-reflection (AR) coating centered at 450 nm. It is works well for engraving a thinner line, cutting a thicker material due to the reduced convergence and divergence, or when a longer distance between the laser head and the plane of the object to be engraved is necessary.

The laser head allows to cut or engrave materials such as rubber, wood, paper, leather, plastic, cardstock and many other. Thanks to the full analog modulation it is possible to engrave in shades of grey or change the output power during turns. The same effect can be achieved by using PWM signal which is fully compatible with the PLH3D driver. High speed modulation (up to 100 kHz) allows it to perform at high movement speeds for engraving even the most complicated of patterns.

Main key-features of the PLH3D-2W Engraving Laser Head:

- Easy connection to all 3D printers and CNC machines.
- Lightweight
- Integrated cooling and thermal protection
- Simple mounting to all 3D printers and CNC routers
- Integrated Laser Diode Driver

Product Specification

Specification	Value
Dimensions (L x W x H)	30 x 30 x 69 mm (1.2 x 1.2 x 2.7 in.)
Modulation Input	0 – 5 V (Analog / PWM / TTL)
Recommended PWM Base Frequency	5 – 10 kHz
Max. Modulation Bandwidth	30 kHz
Input Voltage	12 – 24 V
Max. Power Consumption	16 W
Laser Diode Optical Power[1]	2.0 W
Laser Diode Wavelength	445 nm (±10 nm)
Working Distance	30 - 120 mm / 1.18 - 4.72”
Focused Beam Spot Size, WD = 60 mm (2.36”)	0.07 x 0.15 mm (0.004” x 0.012”)
Focused Beam Spot Size, WD = 30 mm (1.18”)	0.07 x 0.1 mm (0.004” x 0.008”)
Power Density	160 kW/cm^2
Noise Level	23 dBA
Max. Operating Amb. Temperature	40°C (104°F)
Weight	70g (2.5 oz.)

[1]Since the working distance can have a slight effect on the amount of power of the laser beam, it is difficult to specify the exact power value of the laser head.

Connection of the laser head

Connecting this engraving laser head is very simple and can be done with a 4-pin connector. Each device is shipped with a 4-pin connector. Pins #2 and #3 should be connected to an appropriate power supply unit (please see the requirements and recommendations section).

Pin #	Function
1	Modulation Input (0 – 5 V Analog / PWM / TTL)
2	Power Supply (12 – 24 VDC)
3	Ground
4	Modulation Input Ground

Working Distance

The PLH3D-2W Series laser head ships with the High-Resolution Triplet Lens installed and preset to a working distance of 60.0 mm (measured from the front-face surface of the laser head to the engraving plane). This working distance has a well-optimized focal spot size to output light power ratio which is suitable for many engraving and cutting applications. We recommend keeping the working distance of the laser set to the default of 60.0 mm as a starting point.

Mount the laser head on the CNC machine with front side (side on which lens is installed) pointing towards engraving material.

Note: Make sure that the laser head is well-secured and does not move under the influence of external forces. Engraving material should be in a stable position as well. It should not move during engraving. Using your CNC machine, set laser head position at 60 mm as measured from the front side of the laser head to the material being engraved.

Hint: Use a Vernier caliper or a 60 mm long piece of material to measure the distance precisely. Once the position is set, zero the Z-axis on the CNC machine and use the laser in XY plane without changing the Z value.

Setting the Working Distance

Some engraving applications (i.e. high-resolution engraving or detailed engraving) may require a small focal spot.
The PLH3D-2W-Series laser head has an adjustable focal length and an exchangeable lens. This feature allows it to fulfill a broad range of engraving applications. Shorter focal length of the laser head produces a smaller beam spot (hence higher power density).
You can adjust the focal spot distance, as measured from the front of the laser head, by rotating the lens clockwise or counterclockwise.

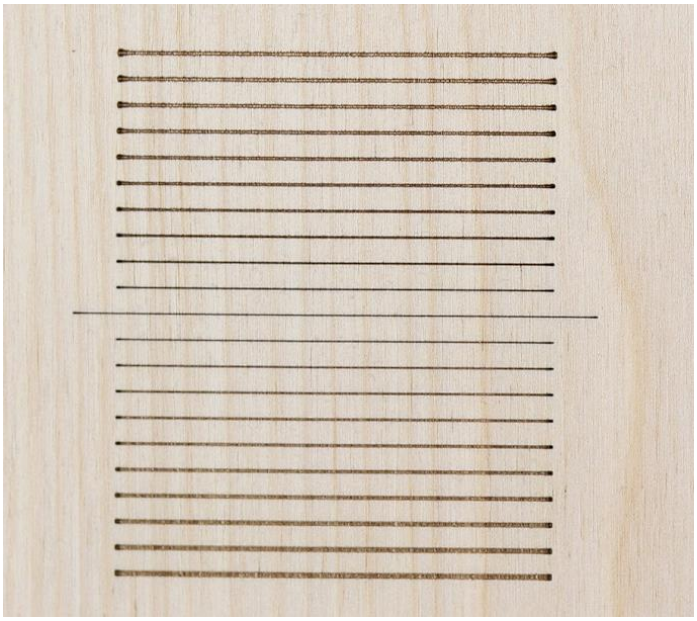
Note: it is necessary to ensure that the mounted lens is sufficiently deep inside the laser head, so the lens does not move before powering on the unit.

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

Coarse adjustment:

a. Set current position as a zero position in your CNC software.
b. Engrave the “zero position” line on the engraving material. Hint: make this line longer compared to the next engraved line. This will simplify finding the “zero line”.
c. Using the engraving material, engrave 10 lines with steps equal to 1 mm and 3 mm in the positive direction of Z-axis and the positive direction of X-axis respectively.
d. Go back to your zero position.
e. Using the engraving material, engrave 10 lines with steps equal to 1 mm and 3 mm in the negative direction of Z-axis and the positive direction of the X-axis respectively.
f. Inspect engraved lines. Find the thinnest engraved line.
g. Count how many lines away the thinnest line from the “zero line” is, and in which direction it is placed. Let’s assume the thinnest line is located 5 lines from the zero line, and in the positive direction of X-axis. In such a case the calibration parameter is +5 mm.

h. In the CNC software, move the “zero position” of the laser head by this calibration parameter.



Fine adjustment:

To obtain the highest power density, which results in the best 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 the coarse adjustment.
This process is similar to the coarse adjustment but for the steps in Z-axis. These are smaller to make the adjustment precise.

a. Set the laser head at a zero position, which must be calibrated by know.
b. Engrave the “zero position” line on the engraving material. Hint: make this line longer compared to the next engraved line. This will simplify finding the “zero line”.
c. Using the engraving material, engrave 10 lines with steps equal to 0.1 mm and 3 mm in the positive direction of Z-axis and the positive direction of X-axis respectively. We recommend engraving 50 mm long lines as it is easier for human eye to compare thicknesses of lines over a longer distance.
d. Go back to the “zero position”.
e. Using the engraving material, engrave 10 lines with steps equal to 0.1 mm and 3 mm in the negative direction of Z-axis and the positive direction of the X-axis respectively.
f. Inspect the engraved lines. Find the thinnest engraved line.
g. Count how many lines away the thinnest line from “zero line” is, and in which direction it is placed. Let’s assume that the thinnest line is located 2 lines from the zero line and in the negative direction of X-axis. In such a case the calibration parameter is - 0.2 mm.
h. In the CNC software, move the “zero position” of the laser head by the calibration parameter.

Recommendations and Requirements

Important: PLH3D-2W-Series engraving laser head should be powered from a high-quality power supply without anything else connected. Please note: connecting the laser head to the same power supply unit as a stepper motor or any other high-impedance equipment is not recommended. Doing so may cause damage to the laser diode.

We recommend inspecting the cleanliness of the lens surface before operating the laser. It is easy to clean the front surface of the lens if it becomes dirty during engraving. This may be done with Isopropyl Alcohol (IPA) and an optical wipe. However, in some cases, it might be necessary to replace the lens. It is recommended to purchase an extra lens with PLH3D-Series laser heads if they will be used in an environment where dust, smoke or oil are generated.

Regular maintenance of the laser head cleanliness positively affects its lifetime. In some cases it may prevent wear of the lens. Ventilation openings and fan must be kept clean and free of any physical contamination. Remember to close the lens while cleaning the laser head. Kanton tape can be utilized for this purpose. We recommend using compressed air for cleaning ventilation channels or cotton swab (cotton buds) with Isopropyl Alcohol.