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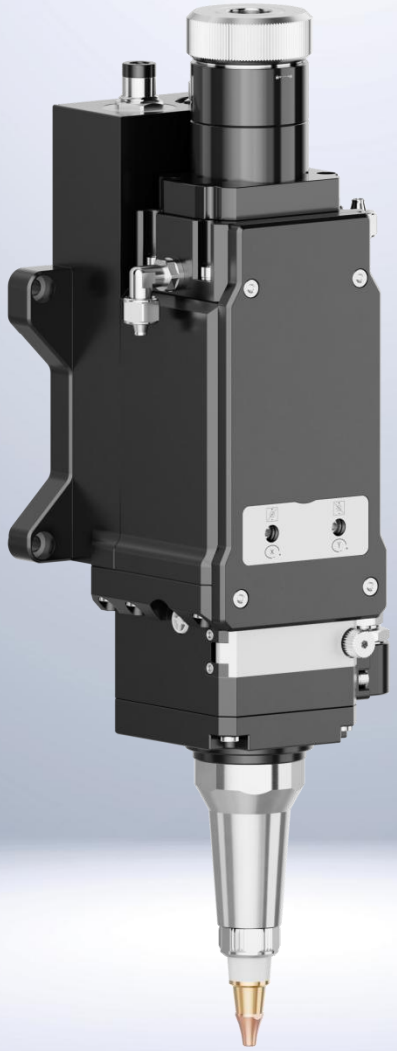

Intelligent Cutting Head
BLT 421TS Product Manual

Document Version: 1.0.0

www.bochu.com

Foreword

Thank you for choosing the BLT intelligent cutting head. This manual provides you with important information such as product parameters, installation, and maintenance. Please read this manual carefully before using the product. At the same time, to ensure both operational safety and optimal product performance, please carefully adhere to the precautions outlined in this manual.

BOCHU is constantly updating/upgrading products, so our company reserves the right to modify the product models and descriptions in this manual without prior declaration.

If you have any questions or suggestions during use, please contact us using the information provided in this manual.

Symbol Definitions

Notice: Provides supplementary explanations or clarifications for the product.

Caution: Indicates that non-compliance with the instructions may result in minor injuries or equipment damage.

Warning: Indicates that non-compliance with the instructions may result in severe injuries or death.

Danger: Indicates that non-compliance with the instructions will result in severe injuries or death.

Declaration

Disassembly of the product is strictly prohibited without the technical authorization from BOCHU, otherwise the warranty will be invalid!

Revision History

Version No.	Date	Description
V1.0.0	2025/1/13	First version

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Chapter 1 Product Specification

1.1 **Product View**

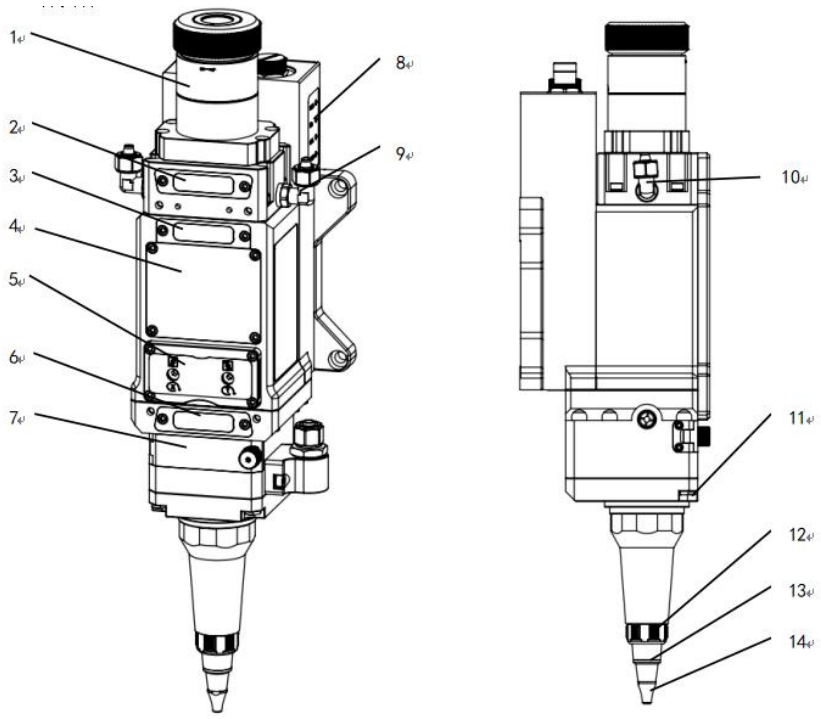

Figure 1-1 Product view

1. Fiber optic interface;
2. 1st upper protective window;
3. 2nd upper protective window;
4. Collimating module;
5. Focusing module;
6. 2nd lower protective window;
7. 1st lower protective window;
8. Work indicator light;
9. Cooling water outlet;
10. Cooling water inlet;
11. Protective screw;
12. Ceramic body locking ring;
13. Ceramic body;
14. Nozzle;

1.2 Technical Parameters

Table 1-1 **BLT 421TS Cutting Head Technical Parameters**

Cutting Head Parameters	Values
Laser Wavelength	1030 ~ 1090 nm
Laser Power	≤ 8 kW
Fiber Interface	QBH, EOC
Spot Magnification	M = 2.0/2.5 (100:200/100:250)
Max Focusing Adjustment Range	±50 mm (Optical ratio 1:2/100:200)
NA	Max 0.13 at Fc100
Alignment Adjustment Range	±1.5 mm
Focusing Acceleration	7.5 m/s²
Cutting Gas Interface	ø10，max 25 bar (2.5 MPa)
Water Cooling Interface	ø8，max 5 bar (0.5 MPa)，min flow 2.0 L/min
Working Temperature	5 ~ 55℃
Storage Temperature	-25 ~ +55℃
Dimension	403.6 x 125.5 (QBH Interface Version)
Weight	About 5.1 kg

To avoid the damage of cutting head during storage or transportation, the following shall be taken into consideration.

Caution：

1. The cutting head should be stored in the environment within the allowed temperature and humidity range.

2. Avoid storing in magnetic fields (such as permanent magnets or strong alternating fields) and their vicinity.

3. Avoid collision during transportation or usage.

1.3 LED Indicators

Icon	Status and Indication
	Green: The power is normal. Red: Under-voltage alarm due to insufficient electrical power. Light Off: Power off. The cause might be no power is on, the connecting wires are damaged or malfunctioning, or the interface is loose.
	Green: The system is normal. Red: Motor exception. The motor current consumption is too high, and the mechanical components cannot operate smoothly. Light off: The connecting wires are damaged or malfunctioning, or the interface is loose.
	Green: The communication is normal. Red: Communication exception. Light off: The connecting wires are damaged or malfunctioning, or the interface is loose.
	Green: The readings of each sensor are normal. Red: There are exceptions in the readings of the sensors. Light off: The connecting wires are damaged or malfunctioning, or the interface is loose.

Chapter 2 Gas Interfaces

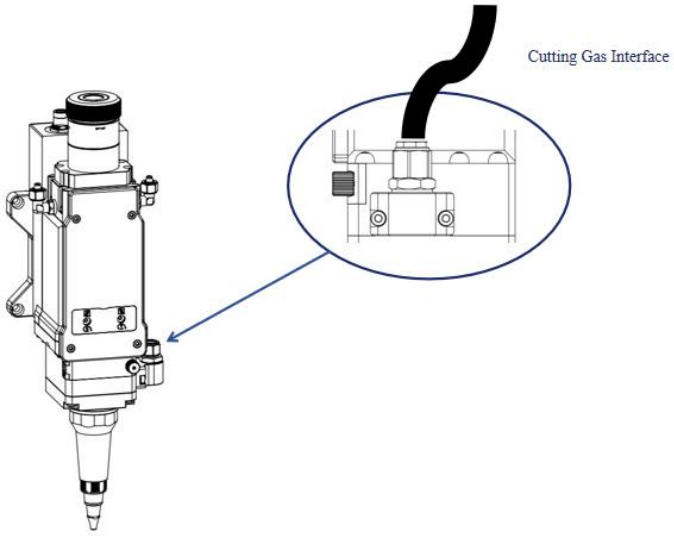

Figure 2-1 Installation connection: Cutting gas

Caution:

1. The maximum pressure of the cutting gas is 25 bar (2.5 MPa)

2. The quality of cutting gas should meet the requirements of ISO 8573-1:2010: solid particles - class 2, water - class 4, oil class 3. The purer the cutting gas, the longer the service life of the protective window.

3. Cutting gas diameter (outer diameter) is 10 mm, while the nozzle cooling gas diameter (outer diameter) is 6 mm.

Chapter 3 Water Cooling Interfaces

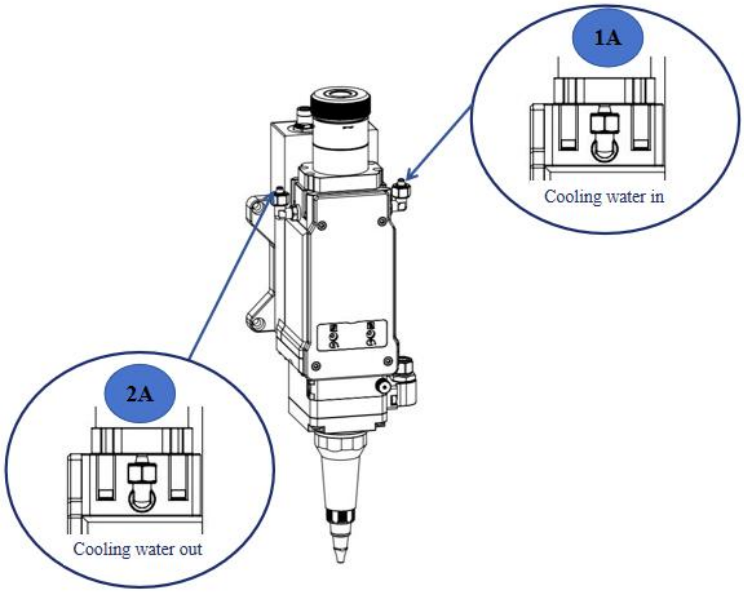

Figure 3-1 Cooling water interface: Inlet1A, Outlet: 2A.

Caution:

1. Use purified water for the cooling water; purified drinking water is adoptable.

2. To prevent the pipeline blockage caused by mold growth in the water of the water cooler, it is recommended to add alcohol in purified water, with an alcohol content of 10% of the purified water.

3. When the temperature around the device is between -10 ~ 0℃, a 30% ethylene glycol solution must be used and replaced every two months.

4. When the temperature around the device is below -10℃, a water cooler machine with dual functioning system must be used, and the cooling system must operate continuously.

5. Recommended settings for cooling water: cooling water pressure ≤ 5 bar (0.5 MPa), water flow rate ≥ 2.0 L/min.

6. Please refer to the dew point table for setting the cooling water temperature to prevent condensation on optical components.

Table 3-1 **Dew point temperature at different temperatures and humidity levels**

Air Temperature ℃	Relative Humidity																		
	100	95	90	85	80	75	70	65	60	55	50	45	40	35	30	25	20	15	10
43	43	42	41	40	39	38	37	35	34	32	31	29	27	24	22	18	16	11	5
41	41	39	38	37	36	35	34	33	32	29	28	27	24	22	19	17	13	8	3
38	38	37	36	35	34	33	32	30	29	27	26	24	22	19	17	14	11	7	0
35	35	34	33	32	31	30	29	27	26	24	23	21	19	17	15	12	9	4	0
32	32	31	31	29	28	27	26	24	23	22	20	18	17	15	12	9	6	2	0
29	29	28	27	27	26	24	23	22	21	19	18	26	14	12	10	7	3	0	
27	27	26	25	24	23	22	21	19	18	17	15	13	12	10	7	4	2	0	
24	24	23	22	21	20	19	18	17	16	14	13	11	9	7	5	2	0		
21	21	20	19	18	17	16	15	14	13	12	10	8	7	4	3	0			
18	18	17	17	16	15	14	13	12	10	9	7	6	4	2	0				
16	16	14	14	13	12	11	10	9	7	6	5	3	2	0					
13	13	12	11	10	9	8	7	6	4	3	2	1	0						
10	10	9	8	7	7	6	4	3	2	1	0								
7	7	6	6	4	4	3	2	1	0										
4	4	4	3	2	1	0													
2	2	1	0																
0	0																		

Chapter 4 Electrical Interface

Waterproof cautions for PWE and aviation plug interfaces:

1. The PWE interface and aviation plug interface come with dust plugs at the factory, which can achieve a protection level of IP64 with the dust cap securely in place. At the same time, with the PWE cable and aviation plug line connected properly, the protection level of IP64 can also be achieved.

2. After the dust plug is removed, it cannot achieve the protection level of IP64. If it encounters spraying or flushing, it will cause water to ingress into the product, affecting its function.

3. Ensure that the waterway is properly connected and the water pipe interface is tightened before removing the dust plug to prevent the water pipe from accidentally loosening and causing water to rush into the interface, resulting in water ingress into the product.

4. When adjusting the machine wiring, remove the dust plug for wiring, and it is recommended to keep the removed dust plug of the PWE interface. Install the dust plug immediately after removing the wire to prevent accidental water ingress during transportation, water connection, and other processes.

4.1 Bus System

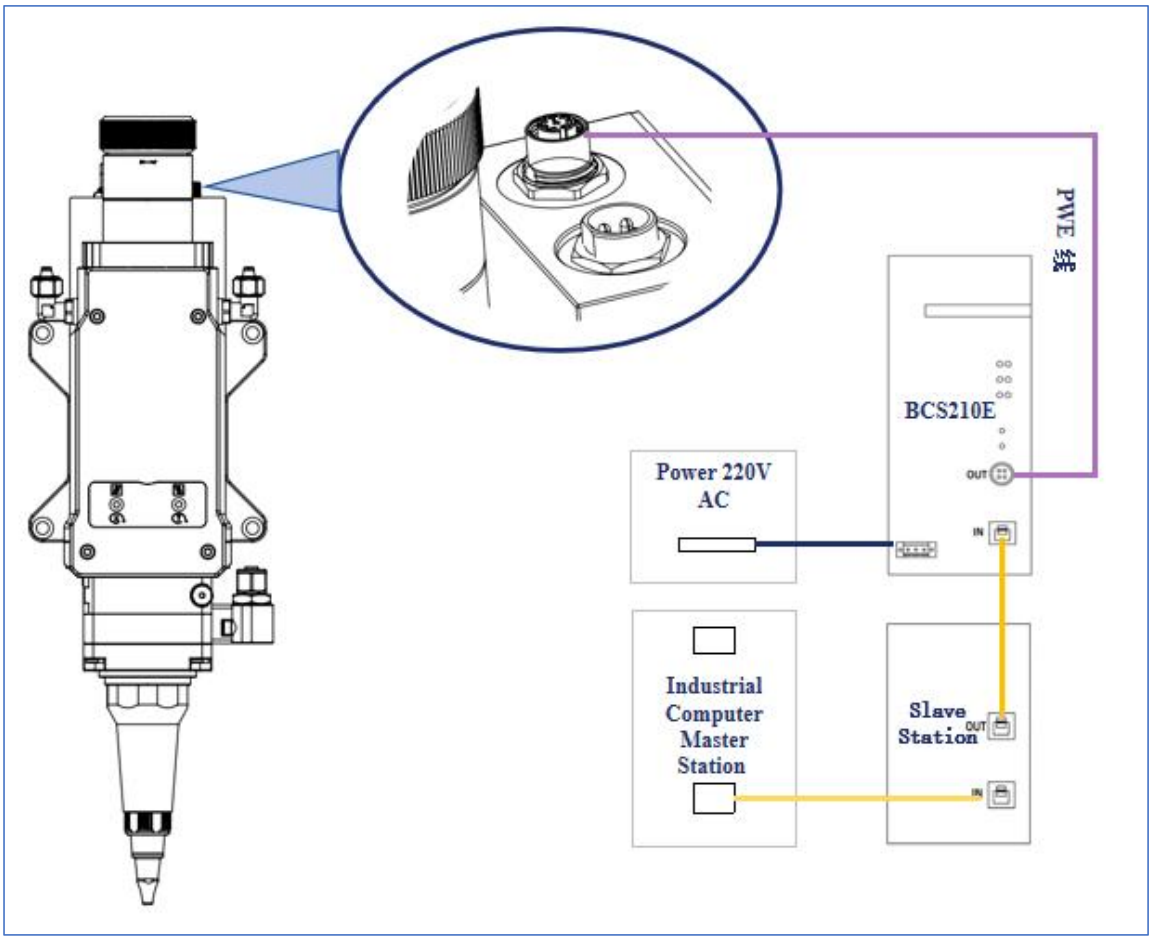

Figure 4-1 Bus system

Caution:

1. Only the personnel who has received the training and has the professional knowledge can perform the operations above.

2. BCS210E shall be powered off when connecting the cutting head.

4.2 Non-Bus System

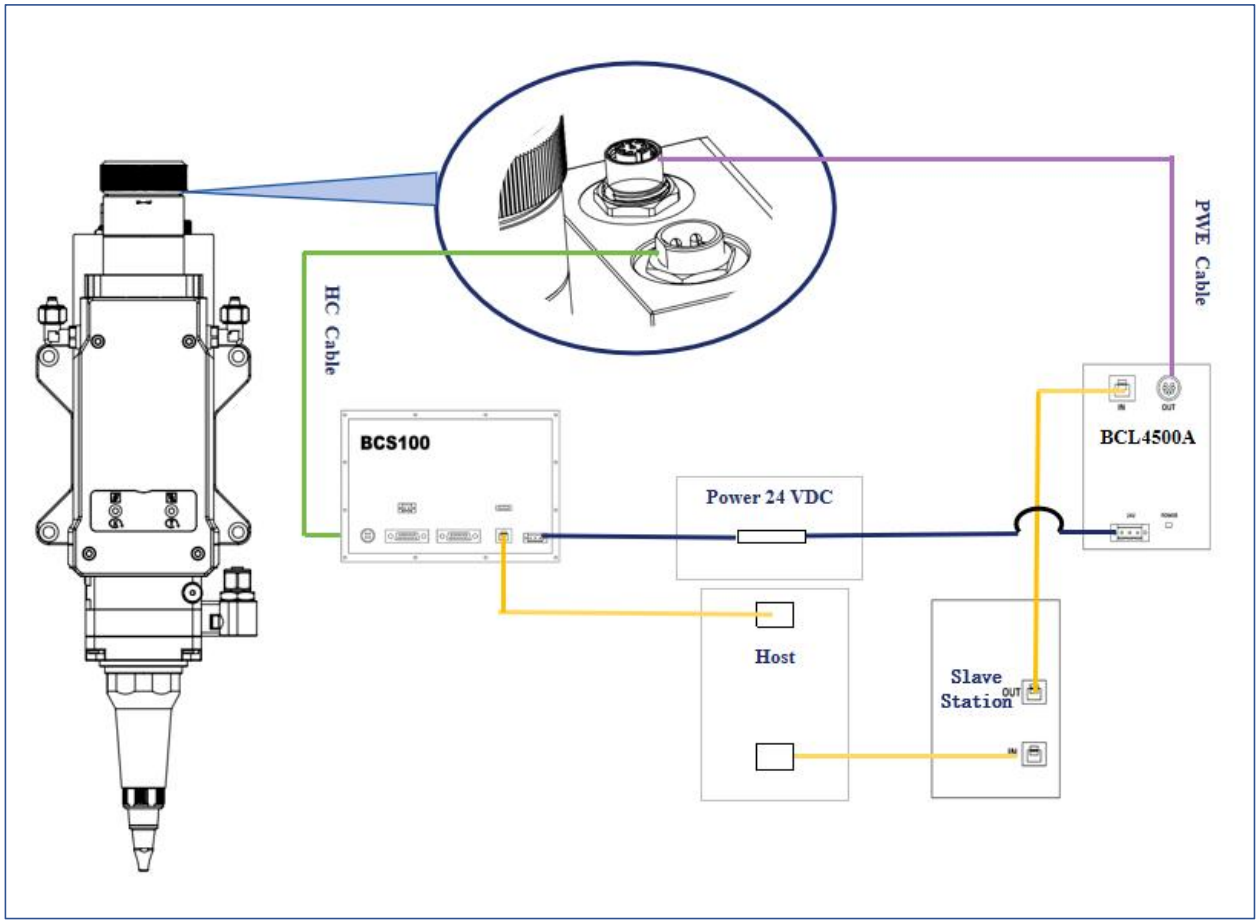

Figure 4-2 Non-Bus system

Caution:

1. Only the personnel who has received the training and has the professional knowledge can perform the operations above.

2. BCL4500A shall be powered off when connecting the cutting head.

Chapter 5 Cutting Head Installation

During the installation of the cutting head, dust or dirt may accidentally enter the cutting head and contaminate the optical window, affecting its normal use. Please refer to the following installation methods to avoid contamination.

5.1 **Preparations before Installation**

Please prepare the following items below:

- Cutting head;
- Clean workbench (Type of clean workbench: vertical purification; Cleanliness level: ISO 5, 100; Average airspeed ⩾ 0.4 m/s);
- Clean kit: high-intensity flashlight, anhydrous ethanol (or IPA), lint-free purification swabs, lint-free cloth, compressed air dust removal can (or air blower).

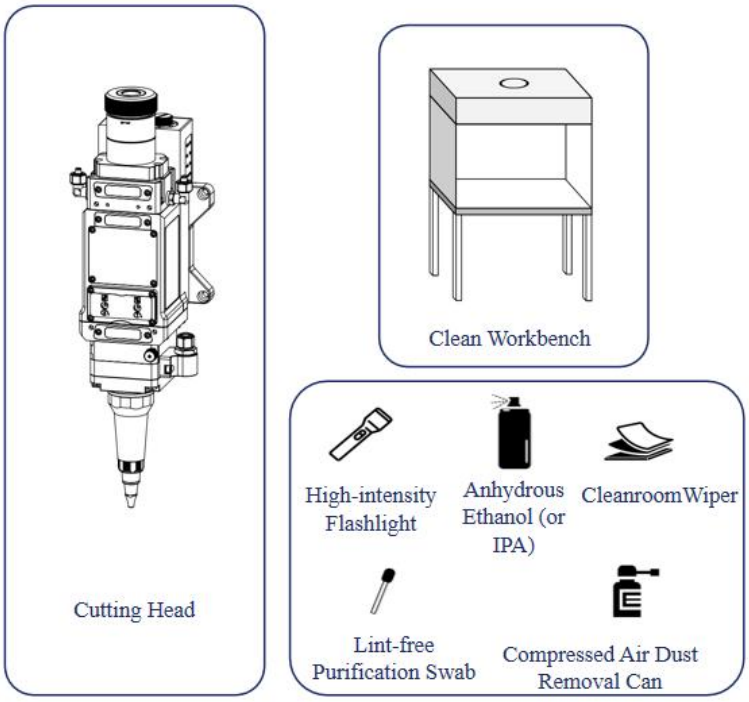

Figure 5-1 Example

Caution:

1. Only the personnel who has received the training and has the professional knowledge can perform the operations above.

2. For the normal performance of the laser equipment and the safety of the operating personnel, please adhere to the relative operation guidance.

5.2 Specified Procedures

5.2.1 Prepare the Clean Workbench

Prepare the clean workbench and start it to work properly.

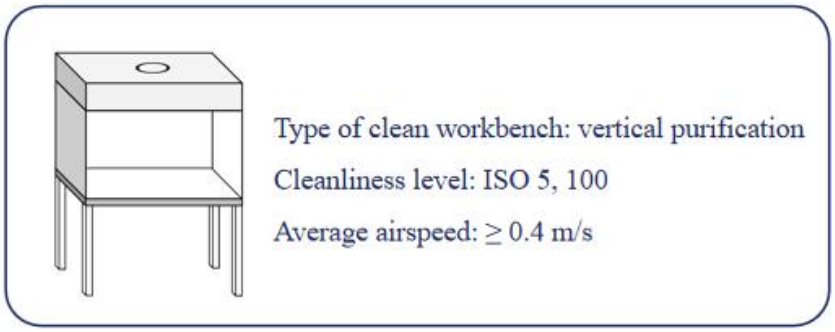

Figure 5-2 Clean workbench

Step 1 Check the cleanliness of the equipment (use a particle counter to check cleanliness) and confirm that the FFU (Fan Filter Unit) is within its validity period (measure the average airflow speed in the work area; if the airflow speed cannot reach 0.3 m/s, the FFU must be replaced).

Step 2 Check whether all switches are functioning properly and verify that the fan is operating normally.

Step 3 Unnecessary items should not be installed in the clean workbench to prevent the clean airflow from being obstructed.

Step 4 For newly installed or long-unused clean workbenches, clean the surface with a lint-free cloth and anhydrous ethanol before use.

Startup Procedures:

Step 1 Turn on the power and pull the glass sliding door of the clean workbench to the lowest position (leaving a gap of approximately 10 cm).

Step 2 Start the fan and it is recommended to allow the workbench to purify for about 30 minutes before use.

Step 3 After normal operation, turn on the clean workbench's lighting.

5.2.2 Put the Cutting Head inside the Clean Workbench

Put the cutting head horizontally inside the clean workbench.

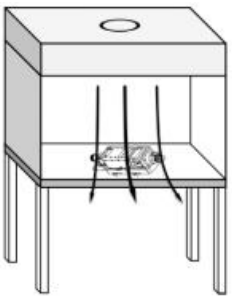

Figure 5-3 Cutting head inside the workbench

⚠ Caution: To prevent dust from falling inside the chamber, please check the integrity of the specified protection film/cap for the fiber interface.

5.2.3 Clean and Wipe the Fiber Optic Interface of the Cutting Head

Wipe the fiber interface with the cleanroom wiper with anhydrous ethanol.

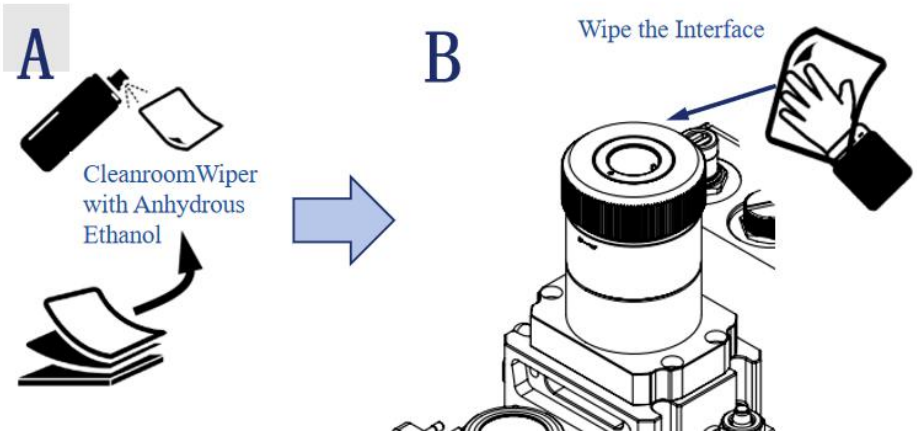

Figure 5-4 Clean the interface

5.2.4 Check the Laser Fiber Optic Connector End Face

Remove the protective cap from the laser fiber optic connector. Use the high-intensity flashlight to inspect the fiber end face for contamination. If clean, the fiber can be directly inserted; if not clean, clean it with a swab dipped in anhydrous ethanol or IPA.

5.2.5 Remove the Protective Film / Remove the Protective Cap

Remove the dedicated protective cap or protective plug from the fiber optic connector on the cutting head.

5.2.6 Insert the Laser Fiber Connector into the Cutting Head

Align the red point with on the fiber optic plug, and then insert it into the unlocked fiber optic connector, ensuring it is fully inserted. Rotate the locking cap until it is tightly secured.

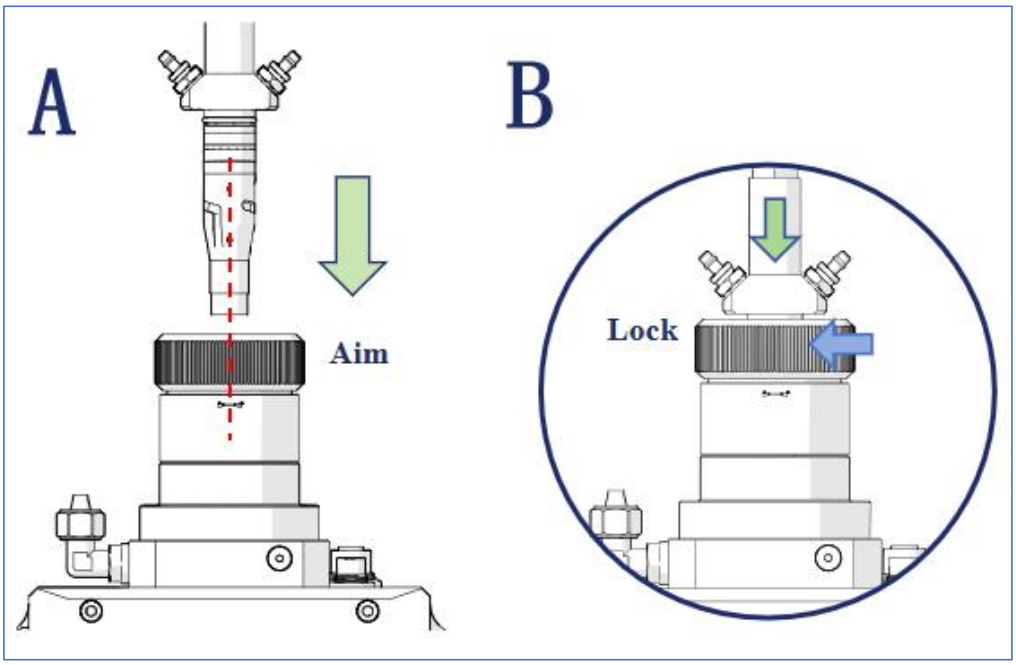

Figure 5-5 Inset the fiber connector

5.2.7 Wrap and Seal

After inserting the fiber, wrap the connection between the fiber and the interface of the cutting head with tape.

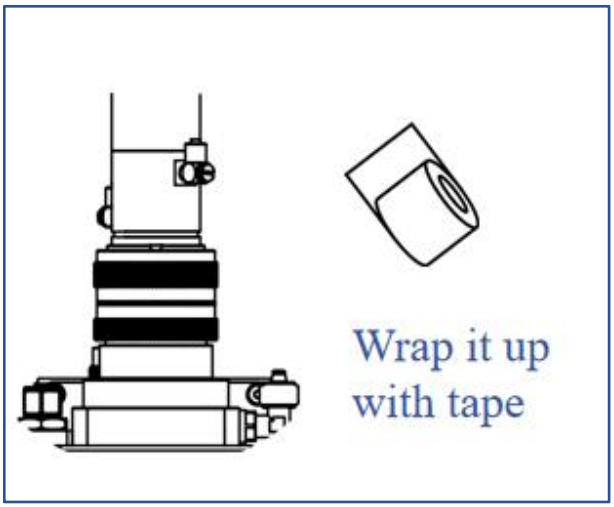

Figure 5-6 Wrap & seal

Caution: To ensure a proper seal, it is recommended to wrap at least three layers of tape for sealing.

5.2.8 Install the Cutting Head on the Back Plate

The cutting head can be mounted onto the machine's Z-axis back plate using four screws: A, B, C, and D. When securing the cutting head to the machine, it is essential to ensure that the cutting head is properly tightened and free from any wobbling.

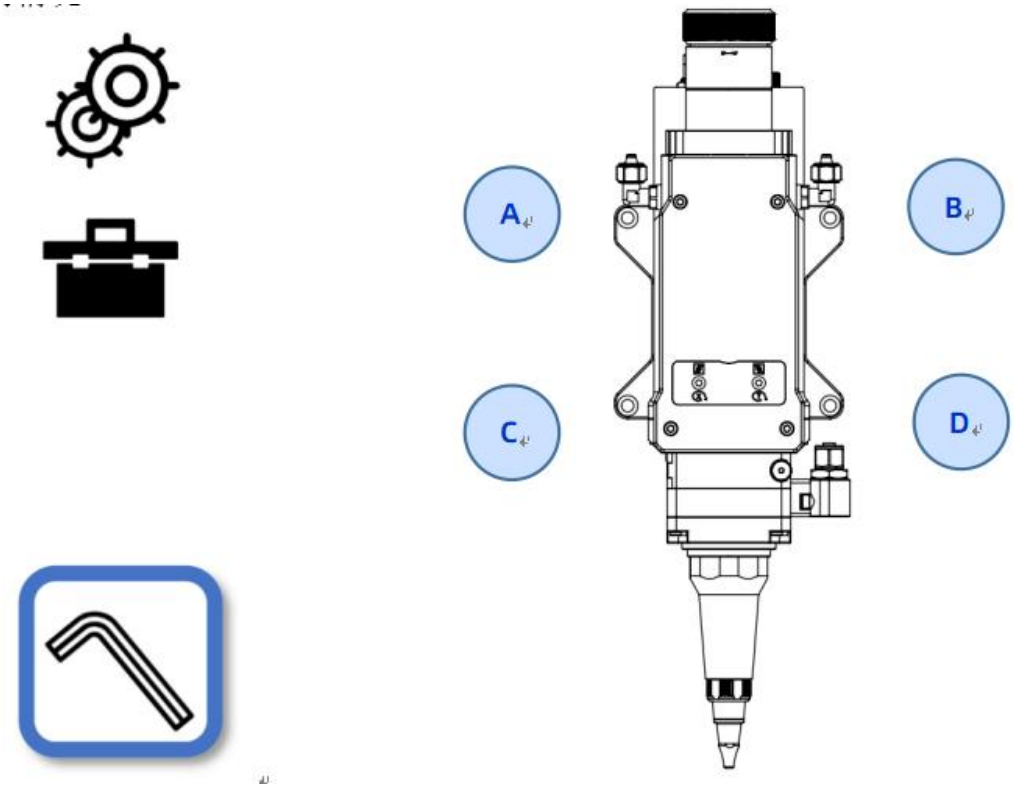

Figure 5-7 Install the cutting head on the back plate

5.2.9 Install the Ceramic Body and Nozzle

Install the ceramic body, and tighten it by the locking ring. Then, install the nozzle.

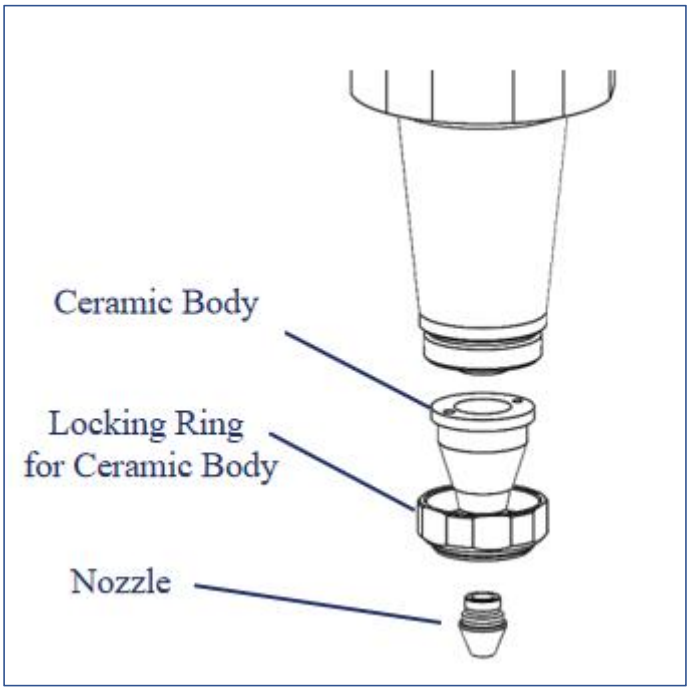

Figure 5-8 Ceramic body and nozzle

5.2.10 Laser Beam Centering

Adjust the X-Y alignment knobs using low-power pinpointing to ensure the focus is at the center of the nozzle.

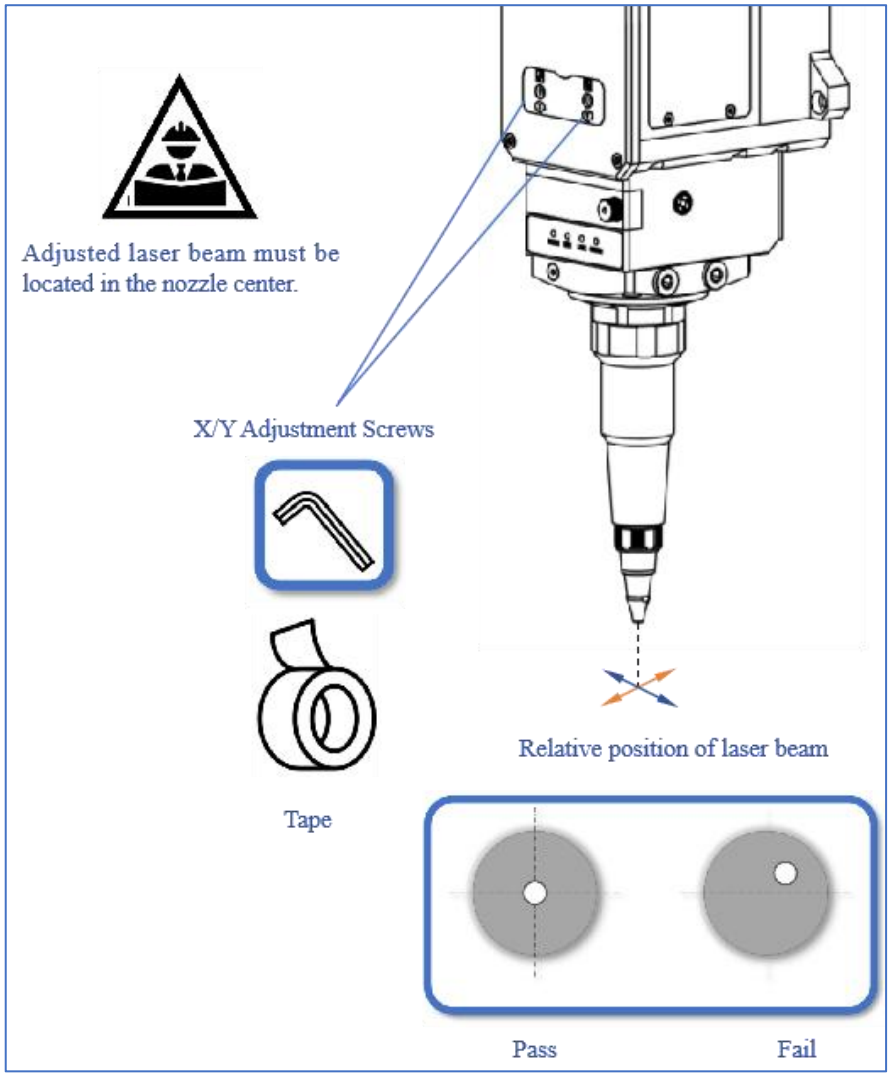

Figure 5-9 Beam centering

Manual Operations for Beam Centering:

Step 1 Make sure the laser beam has been turned off.

Step 2 Put the tape below the nozzle.

Step 3 Click to trigger a low-power laser pulse and assess the position of the laser beam relative to the nozzle based on the penetration of the tape.

Step 4 Adjust the X/Y alignment screws to position the laser beam at the center of the nozzle.

Chapter 6 Appendix A Maintenance

A.1 Product Structure Diagram

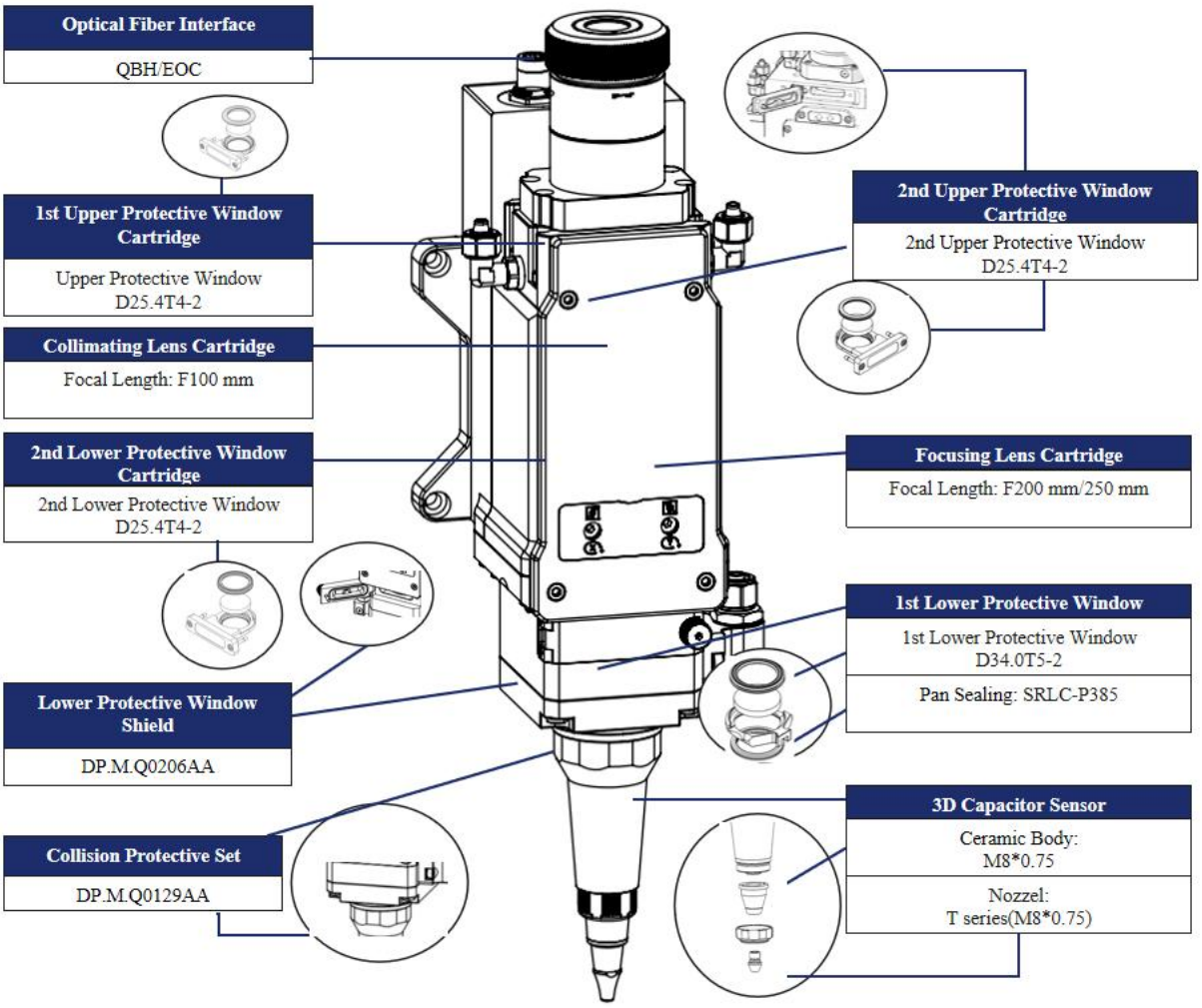

Figure 6-1 Product structure diagram

A.2 Change the Upper Protective Window

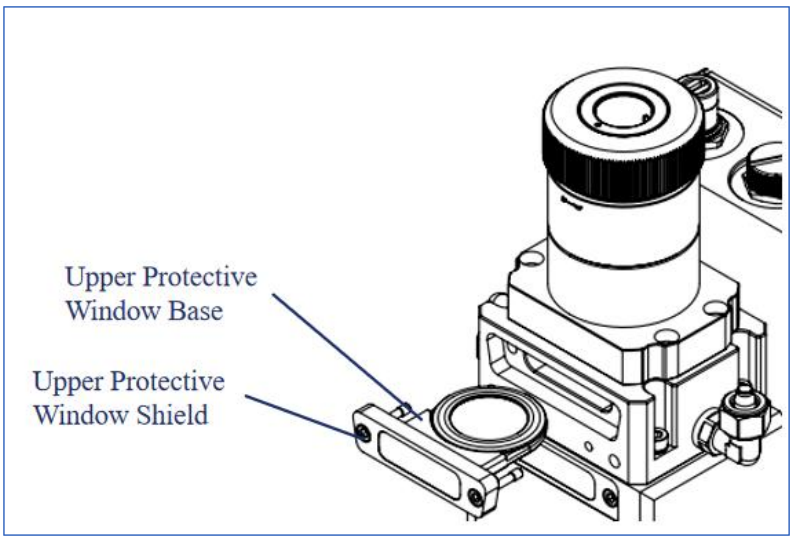

Figure 6-2 Change protective window

Procedures to change the upper protective window are shown below:

Step 1 Unscrew the upper protective window shield.

Step 2 Pull out the upper protective window cartridge.

Step 3 Use the masking tapes to cover the protective window cartridge chamber to prevent dust from entering.

Step 4 Remove the pressing ring from the protective window.

Step 5 Replace the upper protective window.

Step 6 Insert the upper protective window cartridge with the window into the cutting head.

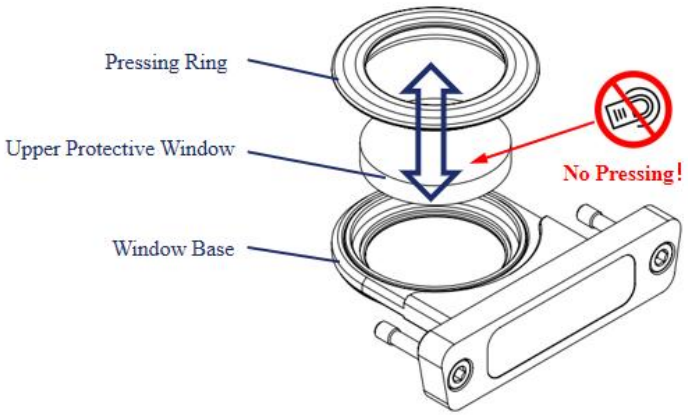

Figure 6-3 Insert window cartridge

A.3 Change the Lower Protective Window

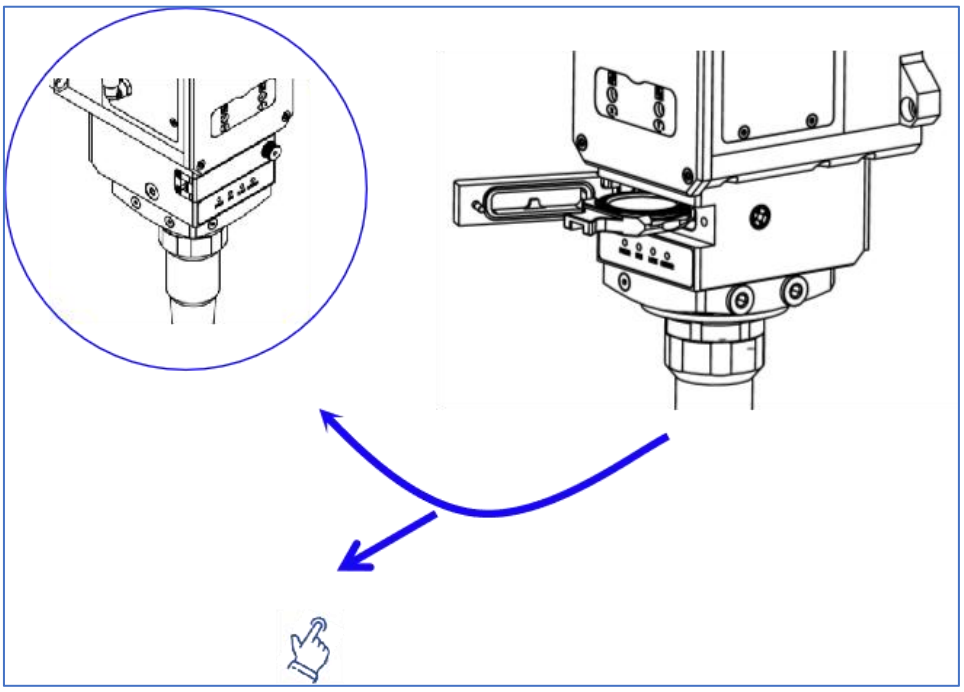

Figure 6-4 Change the lower protective window

Procedures to change the lower protective window are shown below:

Step 1 Unscrew to open the lower protective window cartridge shield.

Step 2 Pull out the lower protective window cartridge.

Step 3 Close the lower protective window cartridge shield to prevent dust from entering.

Step 4 Remove the pressing ring from the protective window.

Step 5 Replace the lower protective window.

Step 6 Open the lower protective window cartridge shield.

Step 7 Insert the lower protective window cartridge with the window into the cutting head.

Chapter 7 Appendix B Mechanical Size

B.1 Installation Size for Cutting Head

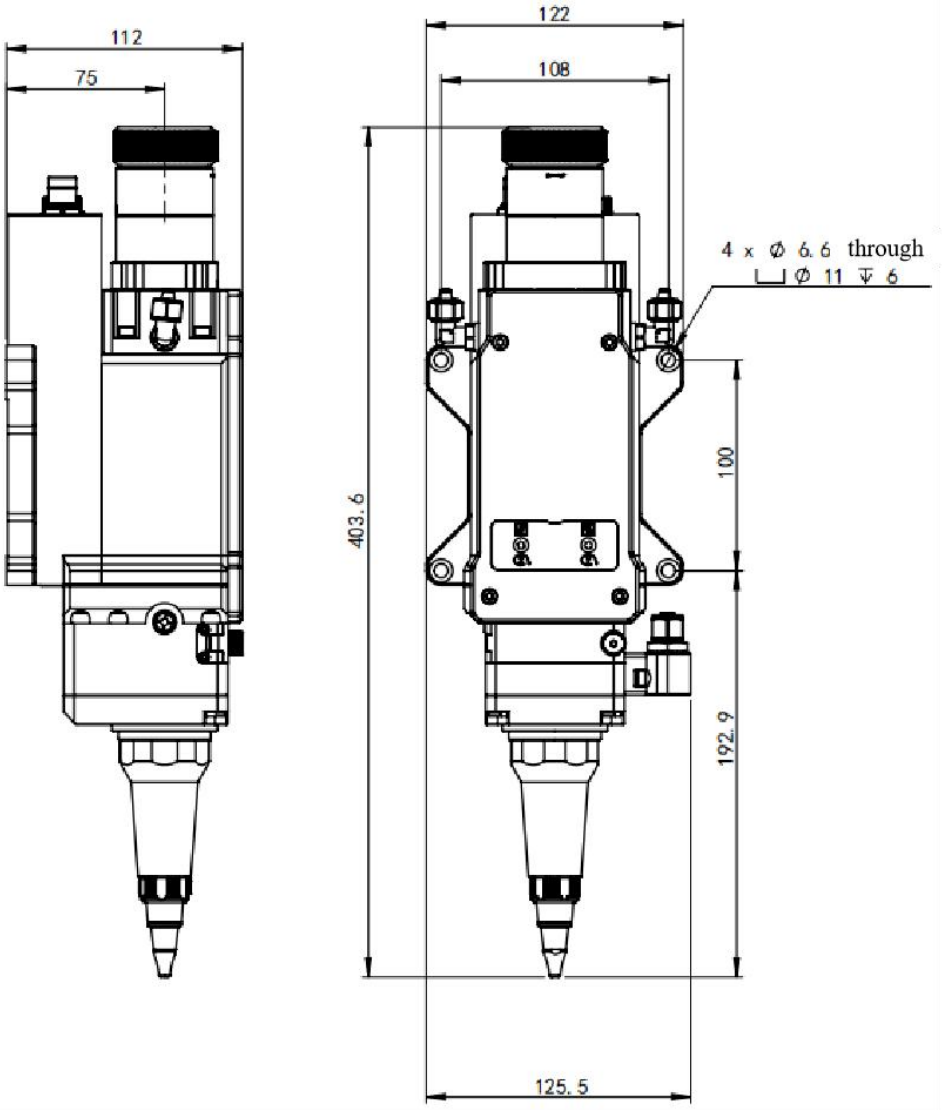

Figure 7-1 BLT 421TS-QBH-200

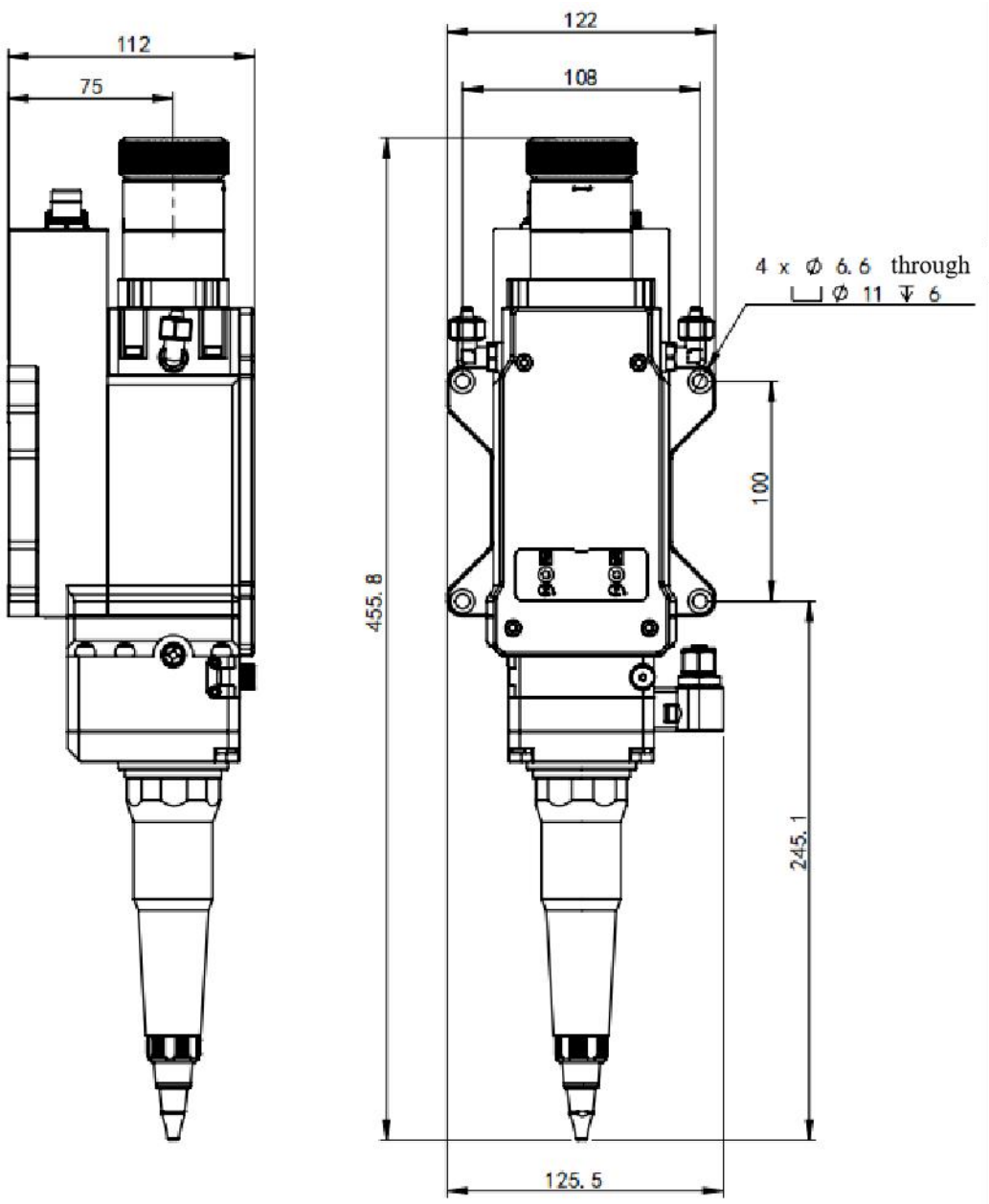

Figure 7-2 BLT 421TS-QBH-250

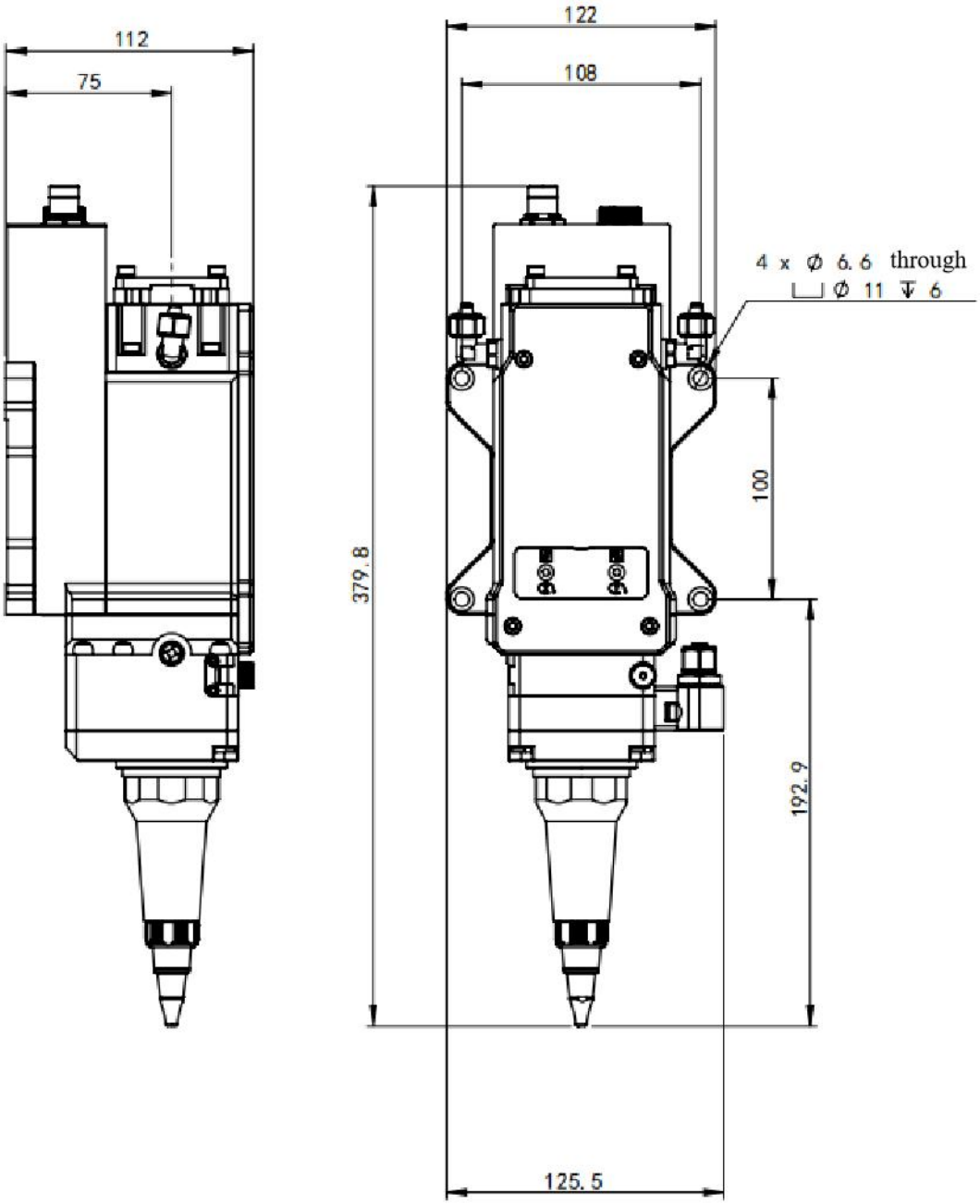

Figure 7-3 BLT421TS-EOC-200

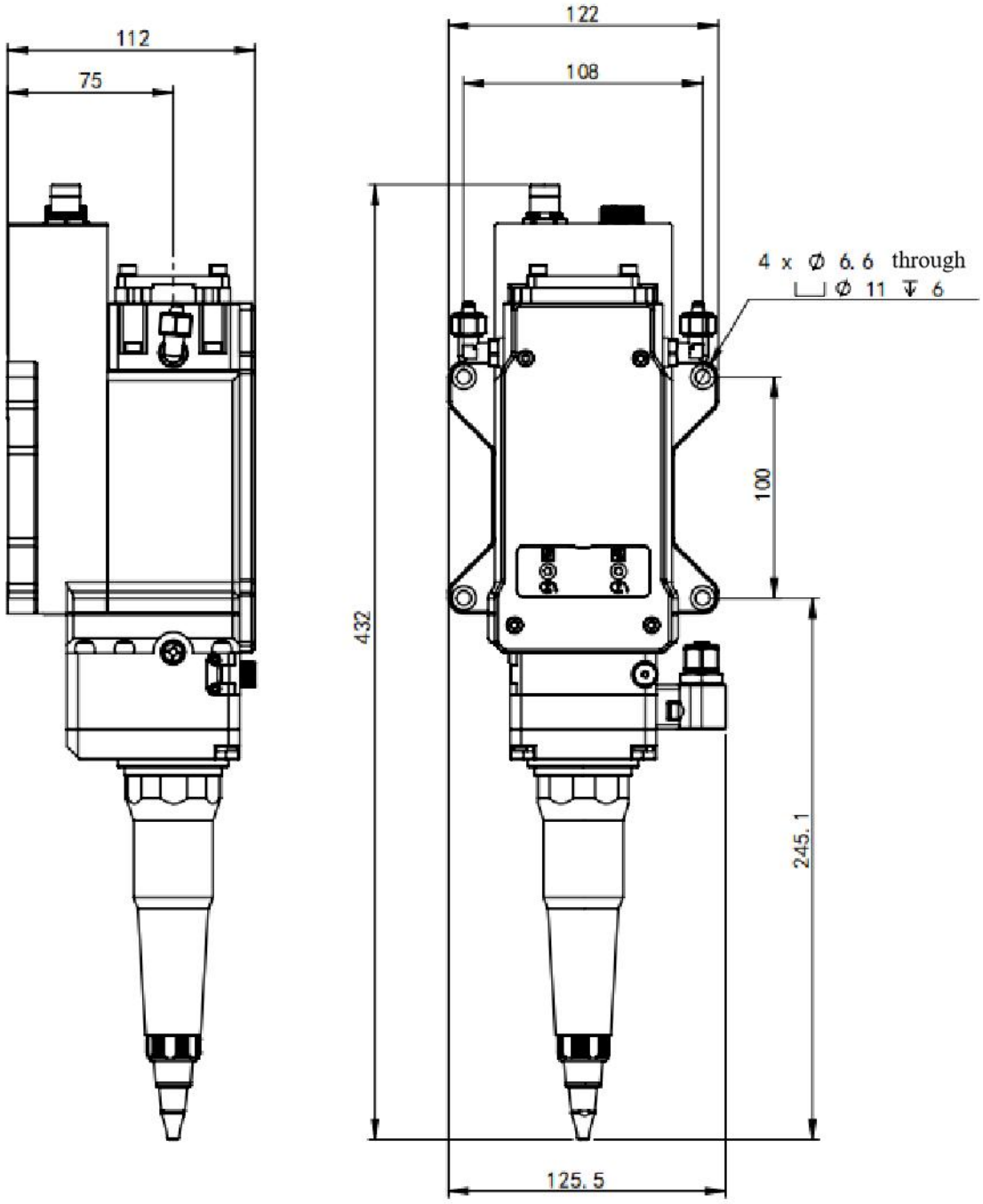

Figure 7-4 BLT421TS-EOC-250

B.2 Interface Types

Table 7-1 **Interface Types of BLT421TS**

General Type	Image	Other Compatible Interface Types
QBH		● Trumpf LLK-Q ● IPG HLC-8/LC-8
EOC		● Maxphotonics G5

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