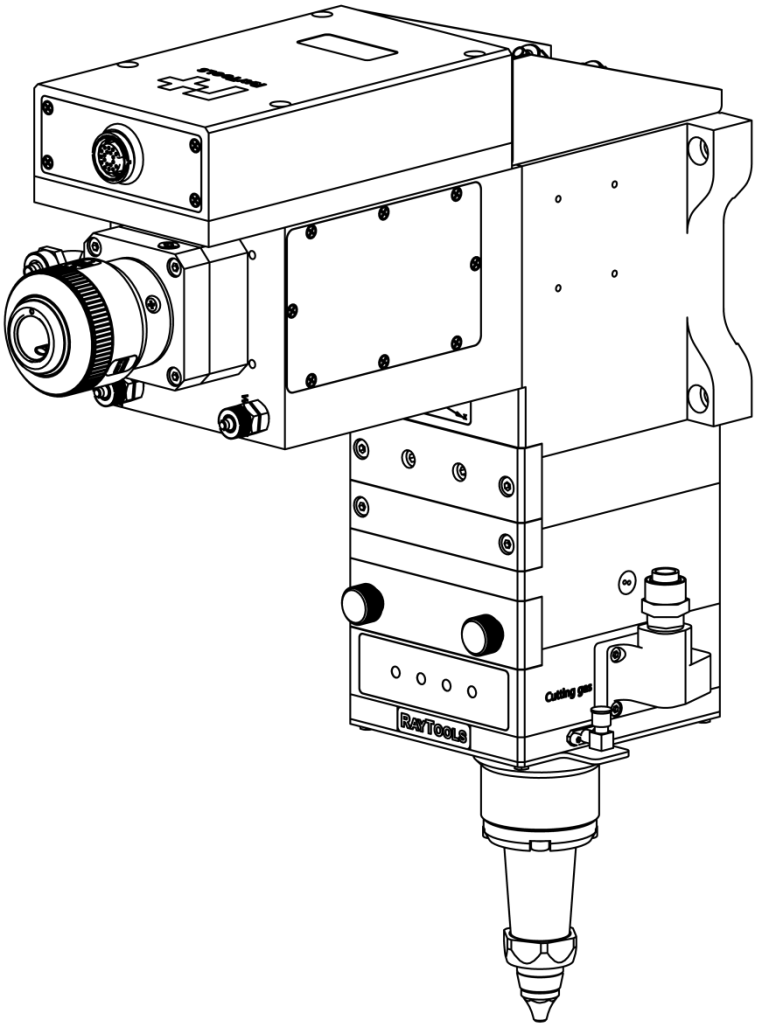
RAYTOOLS

BS06K 90 ° SERIES

6kW Auto Focus Smart Laser Cutting Head - User Manual



Document History

Edit date	Version	Topic, revision, action taken
2024/10/17	V1.0	First edition

Thank you for choosing our product!

This manual describes the installation and commissioning of laser cutting head in details so that you can use this product quickly. You can consult us directly for more details.

Due to the continuous updating of product functions, the product you receive may differ from the introduction in this manual in some aspects.

If you find any errors in this document, please inform us as soon as possible. The data contained in this manual is only used to describe the product and shall not be regarded as a statement of security interest.

For the benefit of our customers, we will constantly try to ensure that the products we develop comply with the latest technology.

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Disclaimer

- We reserve the right to change the design in order to improve the quality or expand the application or comply to manufacturing workmanship.
- We will not bear any responsibility for losses and accidents caused by wrong operation or improper handling of our products.
- Dismantling of product will lose all warranty claims excluding the normal replacement of worn parts and components required for maintenance or commissioning operations.
- Unauthorized modification of products or use of non-original spare parts will directly lead to the invalidation of warranty and liability exemption.
- It is recommended to only use the spare parts provided by us or submit them to us or the designated professional team for installation.

Use Regulations

- Ensure that the product is used in a dry environment.
- Ensure that the product is used in the environment required by EMC standards.
- The product is only allowed to run within the parameters specified in the technical data.

Personnel Responsibilities

- Be familiar with the basic provisions of work safety & accident prevention and have received equipment operation guidance.
- Read and understand basic safety instructions and operations.
- You must have studied the relevant regulations and safety instructions and understand the possible hazards.
- Comply with relevant regulations and implement corresponding protective measures.

Safety Instructions

Prevent Electric Shock

-  Parts of the laser head such as nozzle, sensor, sensor interface and attached fasteners may not be fully protected by the ground wire due to function fault. These parts may have low voltage. When installing electrical equipment, please pay attention to taking anti electric shock measures for relevant personnel.
-  Note that the equipment shall be grounded as specified.

Guard against Danger

- Never put your hands or other body under the laser head.
- Repair and maintenance work can only be carried out after the power is turned off.
- Do not exceed the specified maximum pressure.
- It must be ensured that the laser head is in normal condition at all times.
- All fasteners such as bolts and nuts must be tightened.

 Laser Caution

- Avoid direct laser radiation or scattering to the skin.
- Do not stare at the laser beam even when wearing optical equipment.
- Use special laser protective eyeglasses that meet the requirements of safety standards IEC 60825-1.

Prevent Waterway Corrosion

- In order to avoid corrosion, use the specified coolant and comply with relevant requirements and specified maintenance intervals.

Noise Prevention

- The corresponding measures shall be specified or explained and observed in order to prevent personnel from being harmed by noise when the cutting air pressure is high.

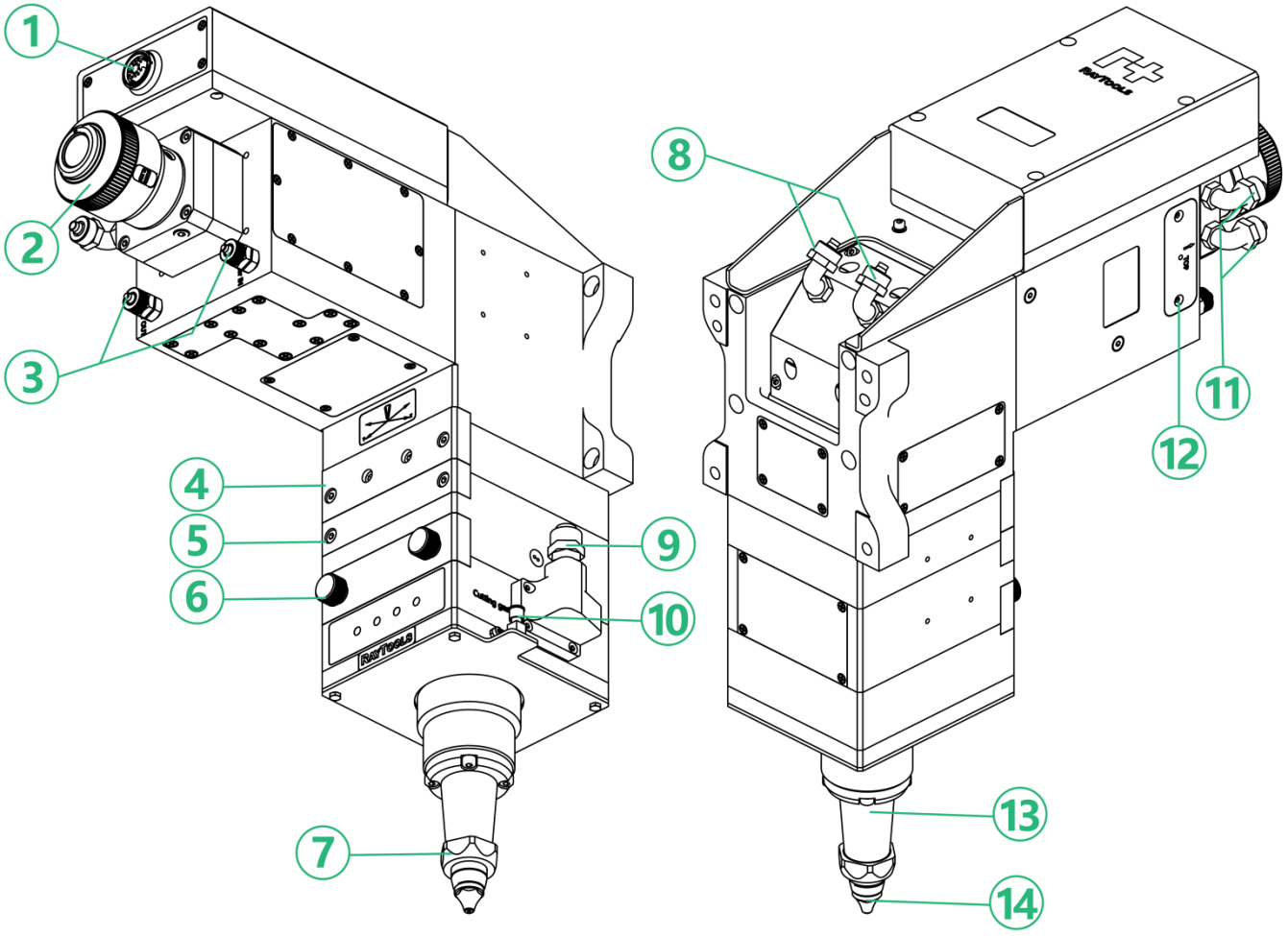
Storage and Transportation

- Observe the storage temperature range allowed by the technical data.
- Take reasonable measures to prevent fire, vibration or impact.
- Do not store in or near the magnetic field.

Contents

1 Product Description

1. 1 Product view (QBH interface)



1 Control Interface
2 Fiber Interface
3 Water Cooling Interface (□6)
4 Focus Module/XY Alignment
5 Bottom 2 Cover Glass Assy
6 Bottom 1 Cover Glass Assy
7 Retainer Ring
8 Water Cooling Interface (□6)
9 Cutting Gas Interface (□10)
10 Preamplifier Interface
11 Water Cooling Interface (□6)
12 Top 1&2 Cover Glass Assy
13 TRA (Nozzle Assy)
14 Ceramic Body & Nozzle

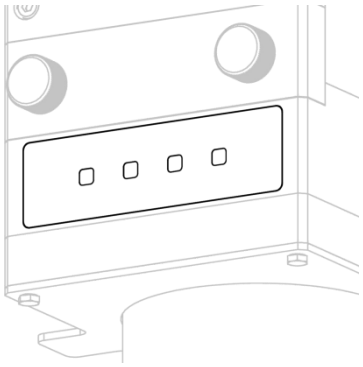
1. 2 Product Features

1. 2. 1 Protection and Monitoring

- Laser head gravity detection
- Cutting gas pressure detection
- Bottom cover glass ready detection
- Temperature detection of bottom cover glass
- Temperature detection of top cover glass
- Cavity gas pressure detection
- Cavity temperature detection
- Dual top cover glass

1. 2. 2 Intelligent monitoring

- PC compatible
- Android compatible
- IOS system compatible



1. 2. 3 LED

From left to right:

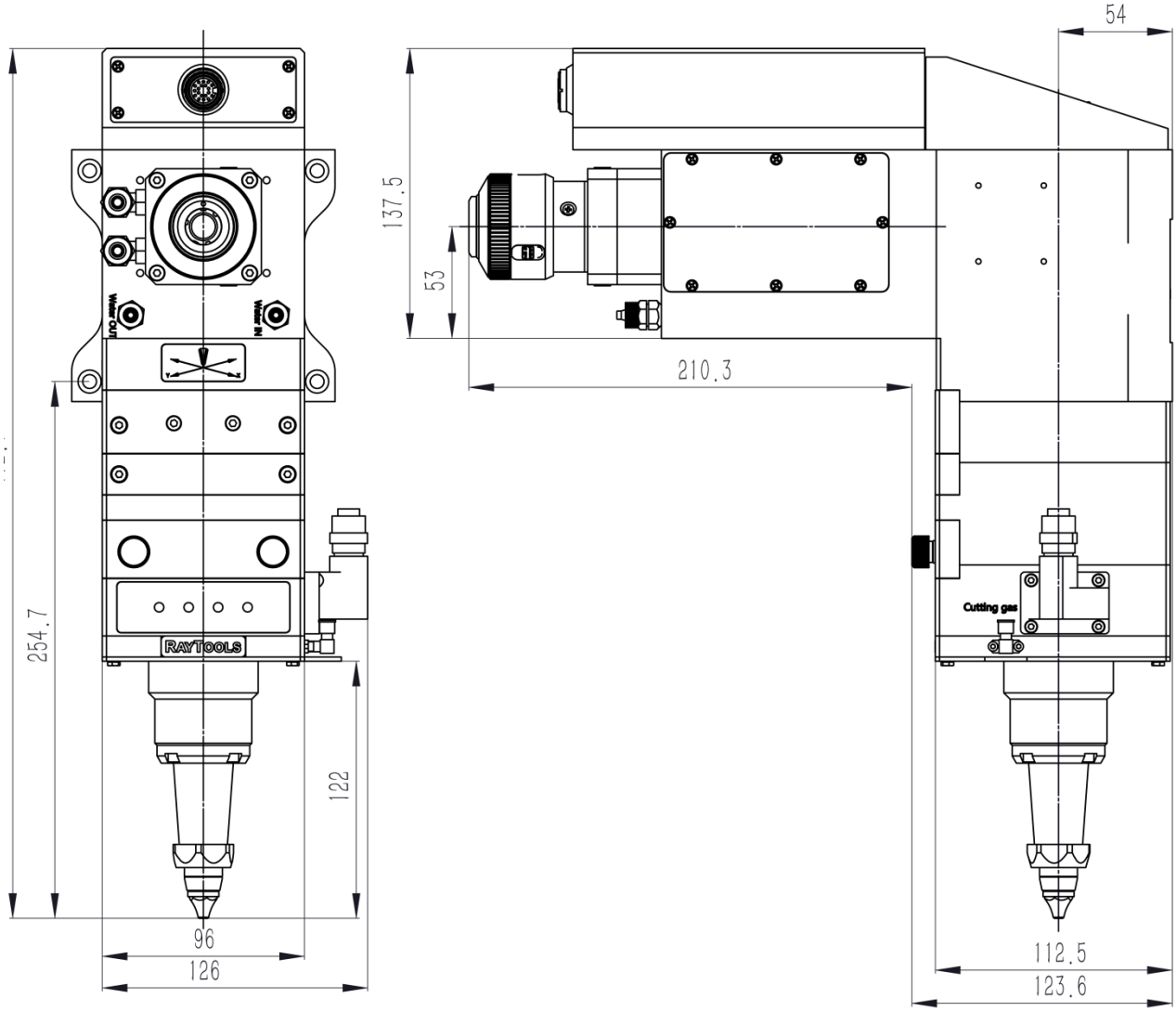
LED No.	LED Status	Status Definition
LED 1	Light off	Focus not homed or homing failed
	Green on	Running normally
	Green blinks	Focus motor homing
	Red on	Cavity fault
LED 2	Light off	Dew point alarm (closable)
	Green on	Running normally
	Red on	Abnormal temperature of top cover glass/ temperature rise alarm
	Red blinks	Abnormal temperature of top cover glass/ temperature rise precaution
LED 3	Light off	Cavity pressure alarm
	Green on	Running normally
	Red on	Abnormal temperature of focus lens/ temperature rise alarm
	Red blinks	Abnormal temperature of focus lens / temperature rise precaution
LED 4	Light off	Bottom cover glass not ready for operation
	Green on	Running normally
	Red on	Abnormal temperature of bottom cover glass/ temperature rise alarm
	Red blinks	Abnormal temperature of bottom cover glass/ temperature rise precaution
Remark: 4-green LED and 4-red LED will blink alternately while online upgrading.		

1. 3 Technical data

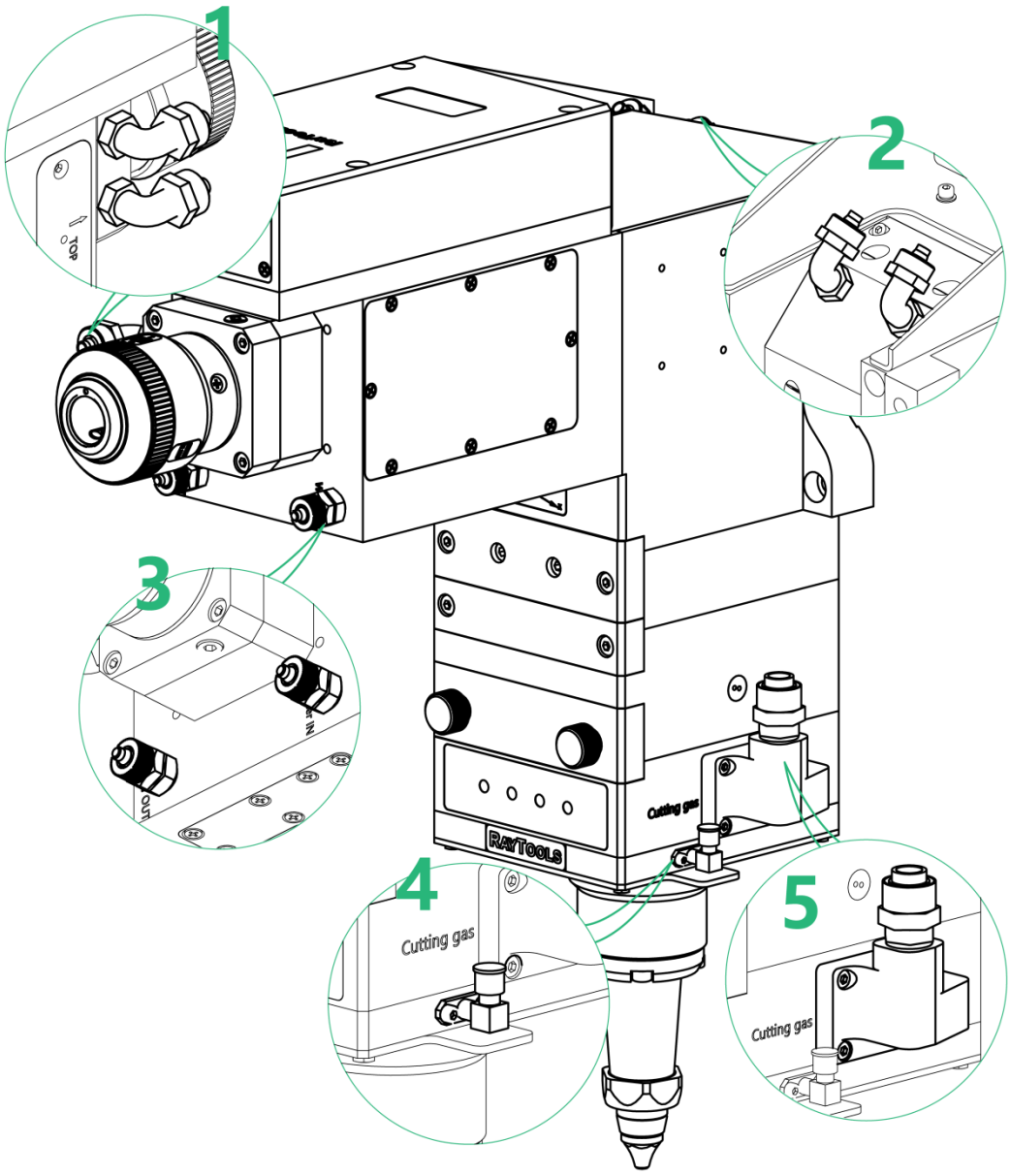
Model	BS06K 90°
Wavelength	1080nm
Fiber Interface	QBH/G5
Power Rating	6kW
Collimation Length (fC)	100mm
Focusing Length (fF)	200mm
NA	0.13
Auto Focus Range	-32mm…+32mm
Beam Alignment Range	-1.5mm…+1.5mm
Mounting Size of Cutting Head	4xM6
Mounting Size of Preamplifier	4xM3
Cutting Gas	⌀10, max. 25bar
Nozzle Cooling Gas	⌀8, max. 5bar
Water Cooling	⌀6, max. 5bar, min. 1.5L/min
Operating Voltage	24V±10%, max. 4A
I/O Interface (19-Pin)	Output current must be less than 30mA
Operating Temperature	5℃ ~ 55℃
Humidity	30% ~ 95%, without condensing
Weight	6.5kg ~ 7.0kg

Mechanical dimensions

Optical Configuration: 100:200



1.5 Interface Description



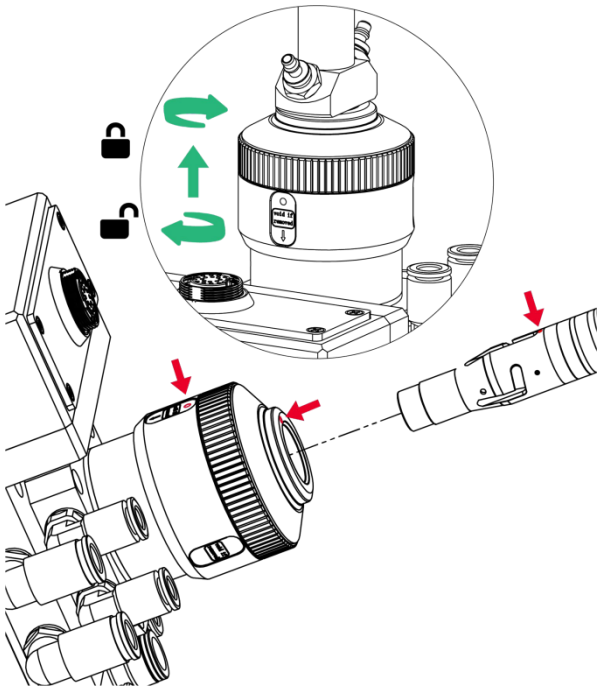
No. 1 Cooling water (⌀6)
No. 2 Cooling water (⌀6)
No. 3 Cooling water (⌀6)
No. 4 Preamplifier (SMA)
No. 5 Cutting gas (⌀10)

2 Install

2. 1 Connect laser fiber

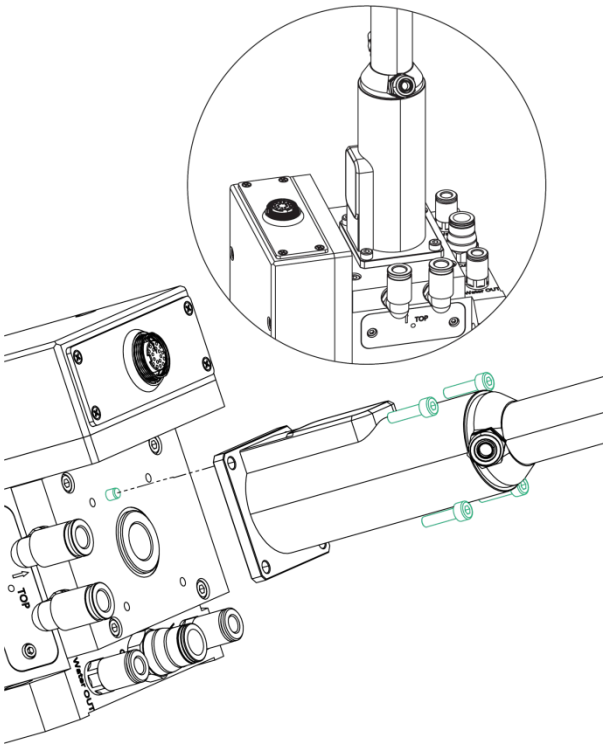
Perform all maintenance and repair work on the laser head only at a clean station.
Remove all dirt and dirt from the fiber plug each time before connecting the laser fiber.
In order to avoid dust and dirt accidentally entering the fiber socket, it is recommended to position the laser head horizontally when connecting the fiber.

2. 1. 1 Connect QBH interface



- Align the red dot on the end face of the QBH interface with the red dot on the rotary handwheel
- Remove the protective cover from the fiber optic socket
- Align the red mark at the fiber output end QBH red mark inserted straight to bottom
- Rotate the QBH handwheel clockwise, get in place after hearing the "Da" sound, then pull the handwheel up, and rotate it clockwise again to the bottom

2. 1. 2 Connect G5 interface

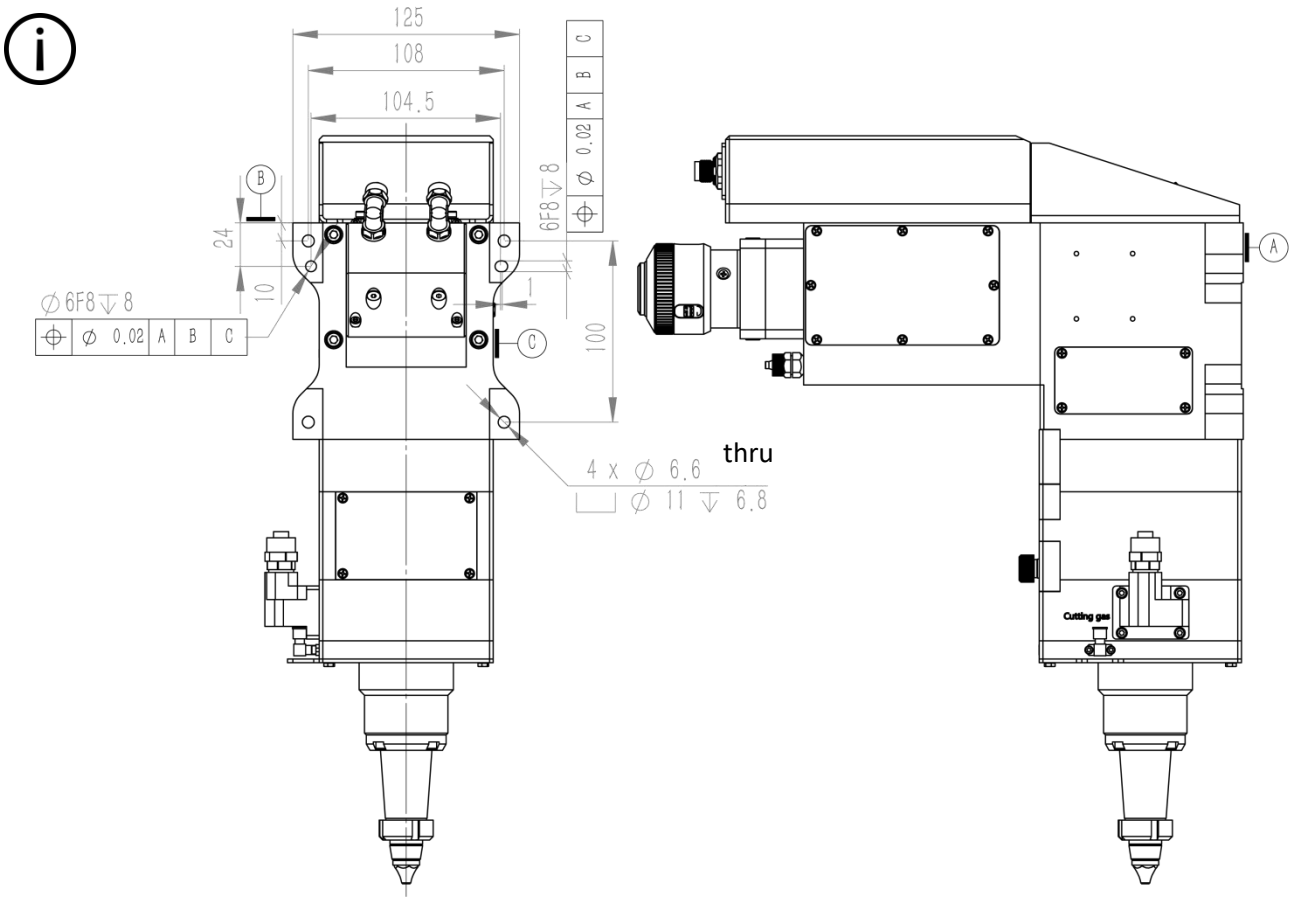


- Remove the dust cover of the laser head G5 adapter plate
- The positioning pin hole of the optical fiber output end is aligned with the pin hole position of the laser head,
- Use matching fastening screws to lock the corresponding screw hole position between the output end of the optical fiber and the laser head
- After locking, shake the optical fiber slightly with your hands until it does not loosen.

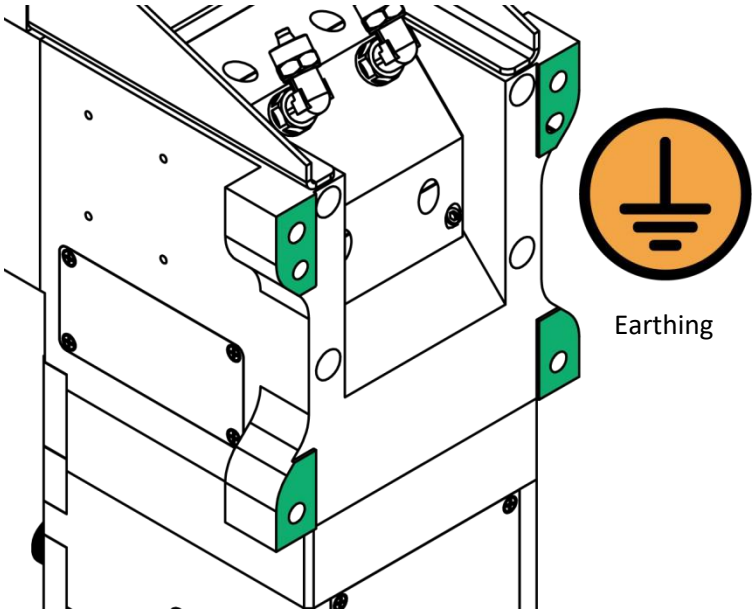
ⓘ In dusty situations, it is necessary to make a special seal of the optical fiber plug/optical fiber socket connector. It is recommended to use insulating tape to wrap the optical fiber plug and optical fiber socket.

2. 2 Fixed laser head

It is recommended to install the laser head perpendicular to the machining surface according to the requirements, and ensure that the screws are tightened to avoid vibration of the laser head.



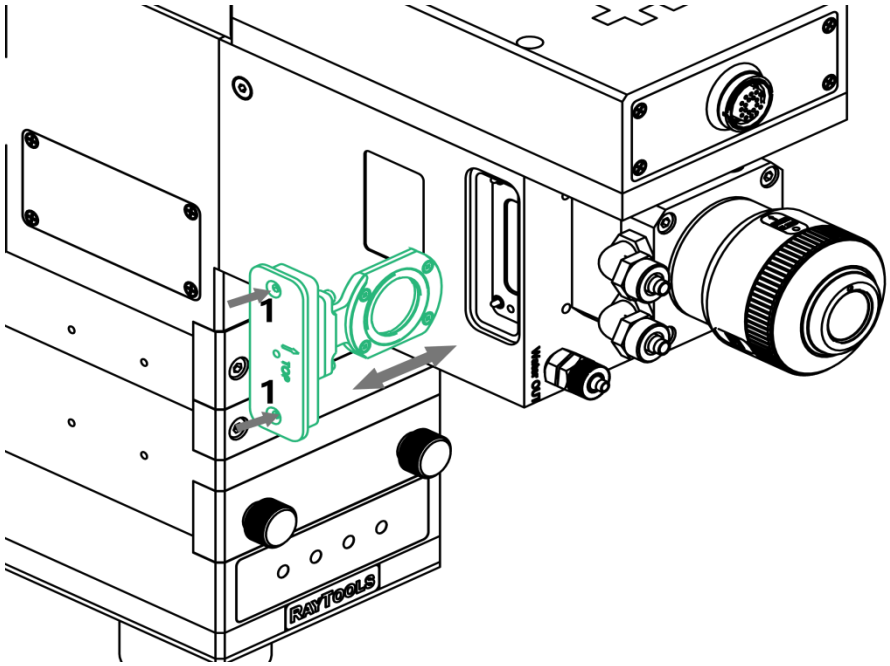
2. 3 Laser head grounding



Improper grounding may cause sensing mechanism failure and equipment damage due to part movement (jitter or vibration of the laser head).

2. 4 Check Top 1 cover glass (first installation/replacement of fiber)

Perform all maintenance and repair work on the laser head only at a clean station.

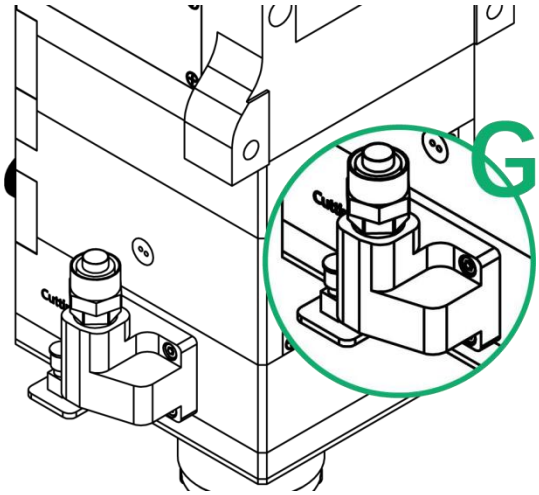


- Loosen the screw (at position 1), the protective mirror drawer will automatically pop up, pull it out until the protective lens is fully visible
- Check the protective lens for dust and dirt, and if necessary, blow the protective lens with clean air until the surface of the protective lens is clean

If the cover glass cannot be cleaned or if it is damaged, the protective lens must be replaced

2. 5 Connect gas and water

2. 5. 1 Connect cutting gas



Only clean and dry gas is allowed Maximum pressure of 25bar (2.5 MPa)

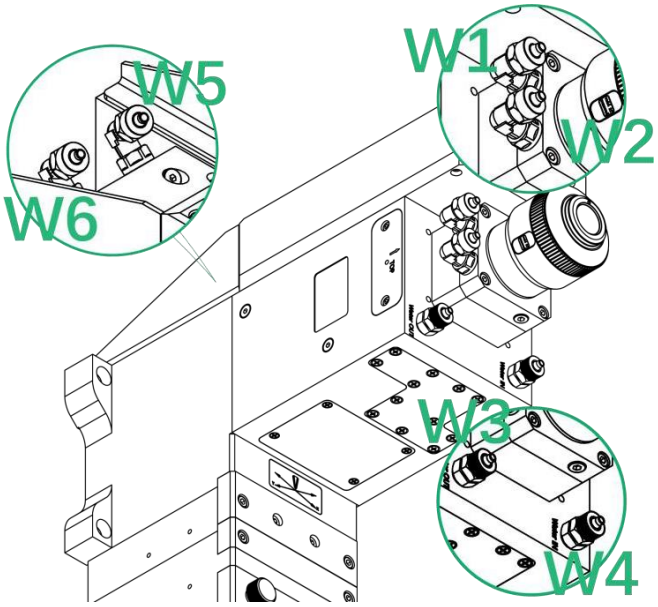
Impurities in the gas, such as hydrocarbons and water vapor, can damage the lens, cause fluctuations in cutting power, and also cause inconsistent cutting planes of the workpiece. The table below is the recommended cutting gas specifications

Cutting gas	Purity	Maximum water vapor content (ppm)	Maximum content of hydrocarbons (ppm)
Oxygen	＞99.5%	< 5 ppm	< 1 ppm
Nitrogen	＞99.95%	< 5 ppm	< 1 ppm

- Connect gas to interface (Φ10) (G).

Do not replace the gas pipe joint at will, especially do not use raw material tape to seal the joint, otherwise the gas path will be blocked, normal cutting will not be possible, and the laser head components will be damaged

Connect cooling water



The directions in and out of the cooling water can be connected with reference to the illustration.

- Connect cooling water to interface (Φ6).
- W1 and W2 are optical fiber interface cooling pipes
- W3 and W4 are collimated cooling lines
- W5 and W6 are body cooling pipelines

The cooling water must meet the technical requirements criteria in the table below.

Minimum flow rate	1.5 L/min
Inlet pressure	170-520kPa
Inlet Temperature	≥ room temperature/> condensation point
Hardness (vs. CaCO3)	< 250 mg/L
PH range	6 to 8
Passable particle size	Diameter less than 200 microns

To avoid corrosion, the relevant regulations and prescribed maintenance intervals of the manufacturer of the machine equipment or laser source and the manufacturer of the cooling equipment must be observed.

Water cooling is recommended for laser power higher than 500 watts.

3 Connection Debugging

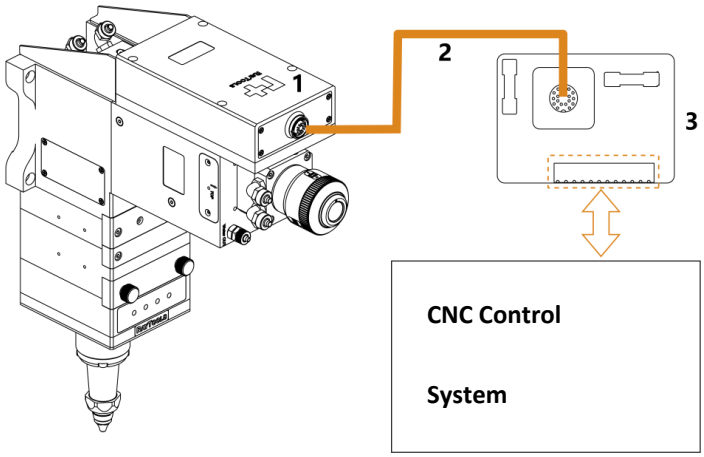
3. 1 Installation and debugging (Non-EtherCAT)

I/O-CAN adapter

Terminal Description

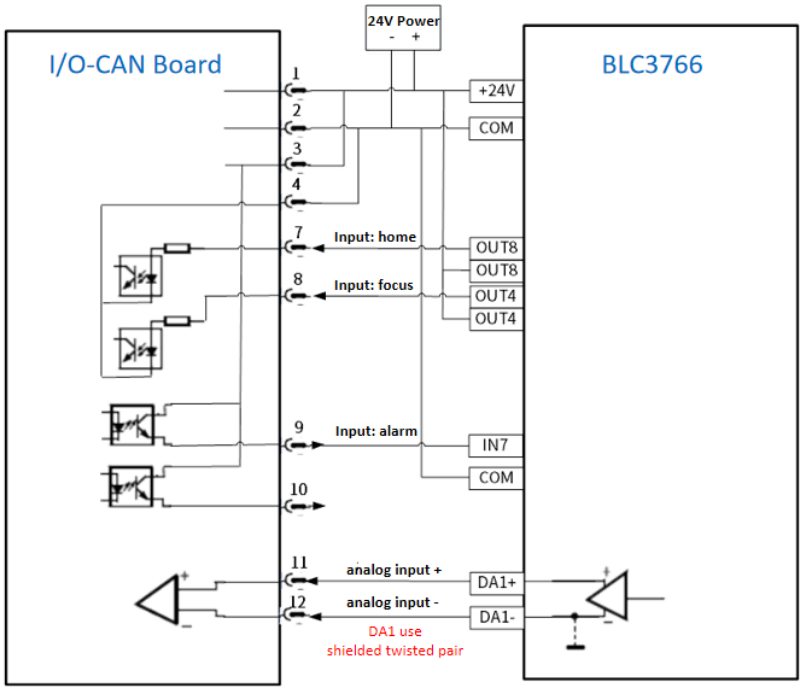
Pin No.	Item	Definition
1	Power supply 24V	24V to power supply
2	Power supply 0V	0V to power supply
3	I/O 24V	24V to I/O
4	I/O 0V	0V to I/O
5	RS485+	Communication 485
6	RS485-	Communication 485
7	Input-Home	24V (Uperedge): Manual homing enable (keep PNP while homing) Else: Home disable
8	Input-Focus	24V (Uperedge): Focus enable Else: Focus disable
9	Output-Alarm	Floating: Alarm 0V: no alarm
10	Output-Focus reached	0V: Focus reached Floating: Focus unreached
11 12	Input-Analog + Input-Analog -	0.3V-9.7V Auto focus

Remark: connect Pin 11, Pin 12 by the complimentary shielded twisted pair.



- Connect 19P plug (1) (laser head) to I/O-CAN adapter (3) with control cable (2)
- Connect all necessary I/O interfaces of the laser head to the CNC
- Connect 24V power to I/O lead board (I/O-CAN adapter)
- Jiaqiang system, you only need to select the default parameters
- Configuration and debugging according to third-party system instructions (Baichu, Weihong, etc.)

Take the connection to *FSCUT* system as an example:

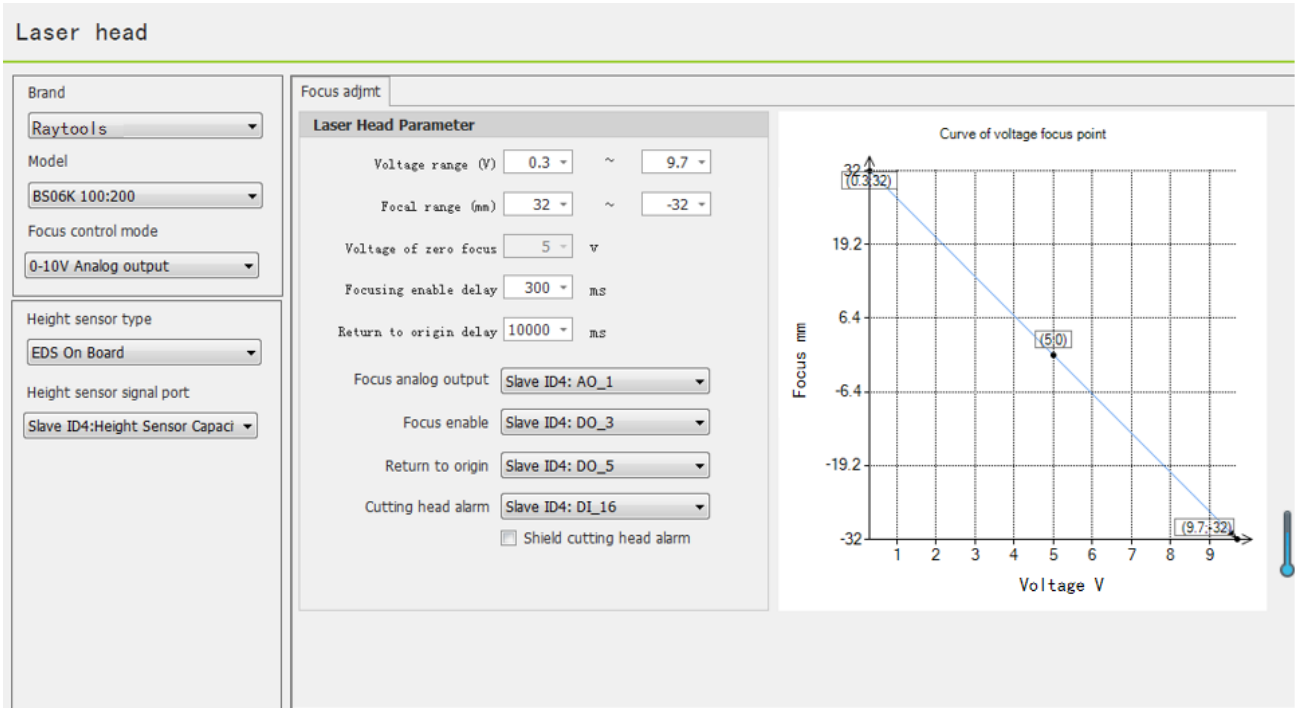


Wiring diagram

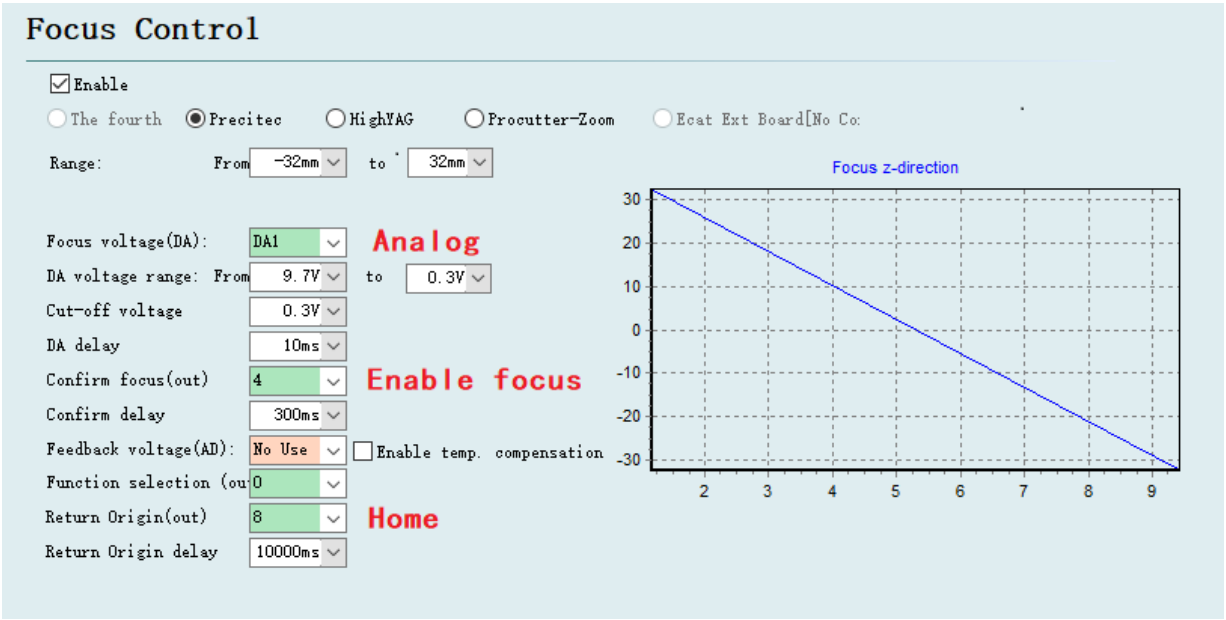
After the wiring is completed, enter the system setting. The following parameters are only for reference.

Raytools system setting:

Optical configuration: **100:200**



FSCUT system setting:



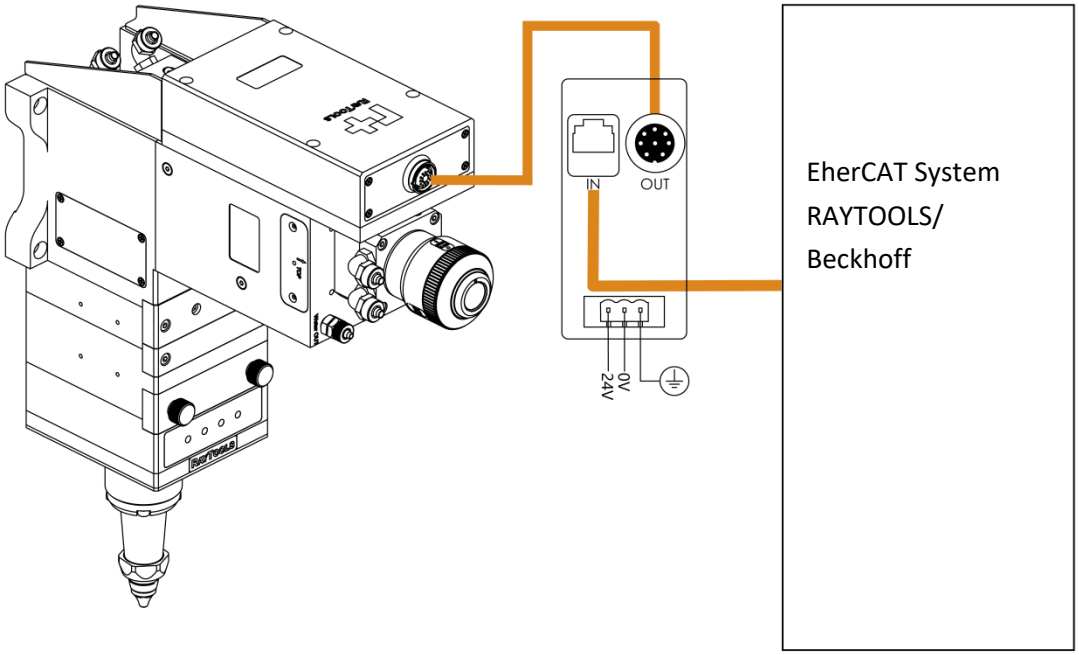
The connections and settings may differ from one CNC control system to another.
Once the setting is modified, the corresponding wiring method may need to be changed.

3. 2 Installation and commissioning (EtherCAT)

EPOE24

Description

Serial number	Description	Remark
IN	Input interface	Signal input
OUT	Output interface	Signal Output
24V	Power supply 24V	For 24V at the power interface
GND	Power Supply 0V	For 0V at the power interface
PE	Grounding	For grounding



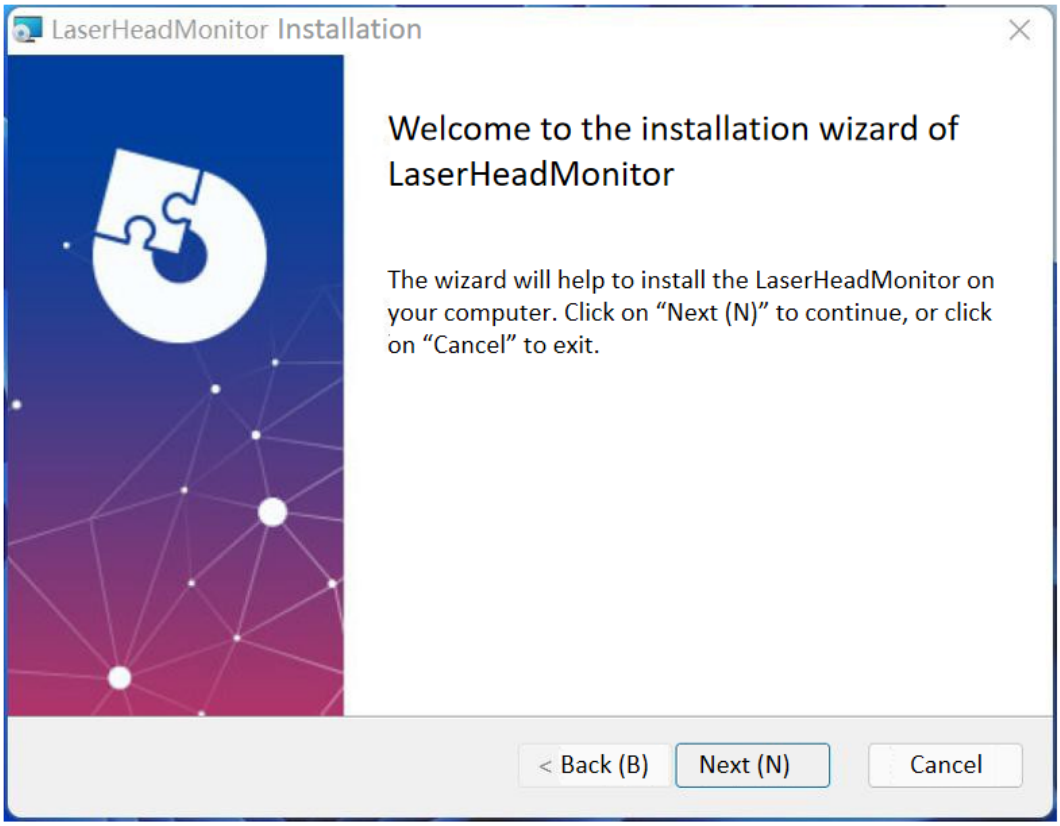
- Connect the 24V power supply to the I/O wire board (EPOE24).
- Connect via network cable as shown
- Configuration and debugging according to the system instructions (Jiaqiang, Beckhoff)

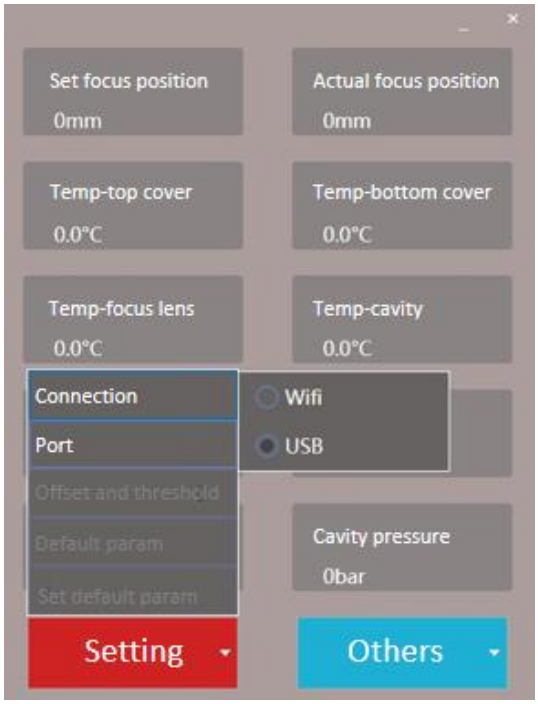
3. 3 APP configuration connection

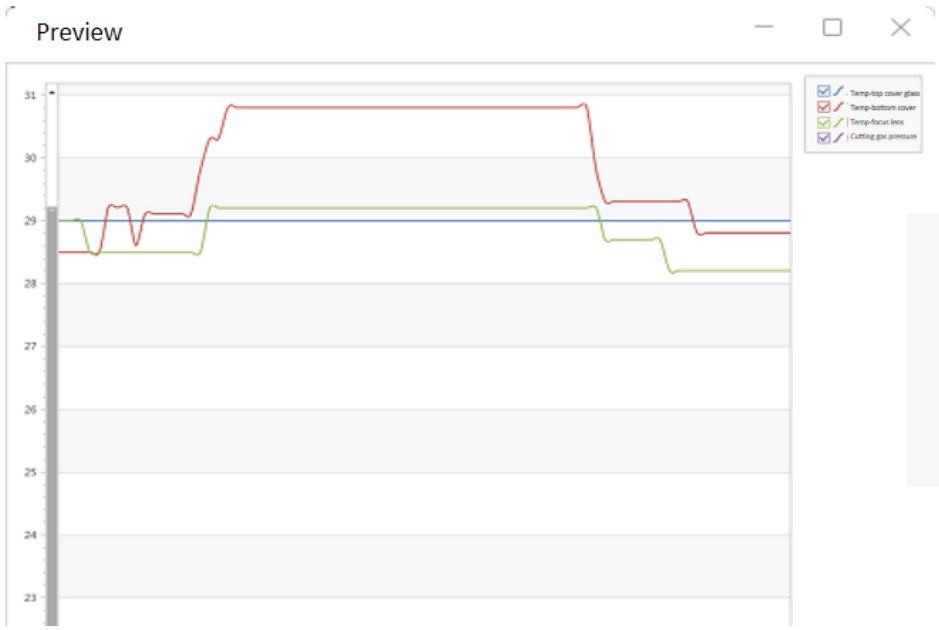
- Follow instructions to start APP and connect
- Manual input and setting according to actual needs, such as

Intelligent detection data setting details	Remark	Set Value
Zero focus offset	Setting by actual zero focus position	
Cavity air pressure	Alarm threshold 1.5 bar	1.5 bar
Upper protective mirror temperature	Alarm threshold 45 ℃	45℃
Lower protective mirror temperature	Alarm threshold 45 ℃	45℃
Temperature of focusing lens	Alarm threshold 45 ℃	45℃
Cavity Temperature	Alarm threshold 45 ℃	45℃

- PC-side monitoring can display data after connecting the cutting head hotspot using computer USB or WIFI.




Set focus position
0mm
Actual focus position
0mm
Temp-top cover
0.0°C
Temp-bottom cover
0.0°C
Temp-focus lens
0.0°C
Temp-cavity
0.0°C
Connection
Wifi
Port
USB
Offset and threshold
Default param
Set default param
Cavity pressure
0bar
Setting
Others


Preview
31
30
29
28
27
26
25
24
23


0mm
Temp-focus lens
23.7°C

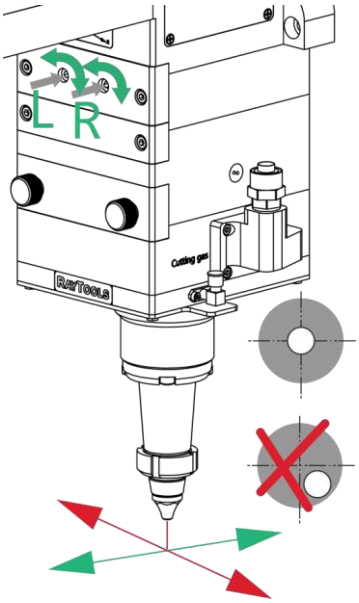
3. 4 Beam Alignment and Focus Position Setting

3. 4. 1 Beam Alignment

Cutting quality in a great extent depends on whether the lens is in the middle. If the lens is not in the middle, the laser beam may contact with nozzle or inner wall to produce high temperature deformation. Lens alignment operation should be considered when nozzle is replaced or the cutting quality declines.

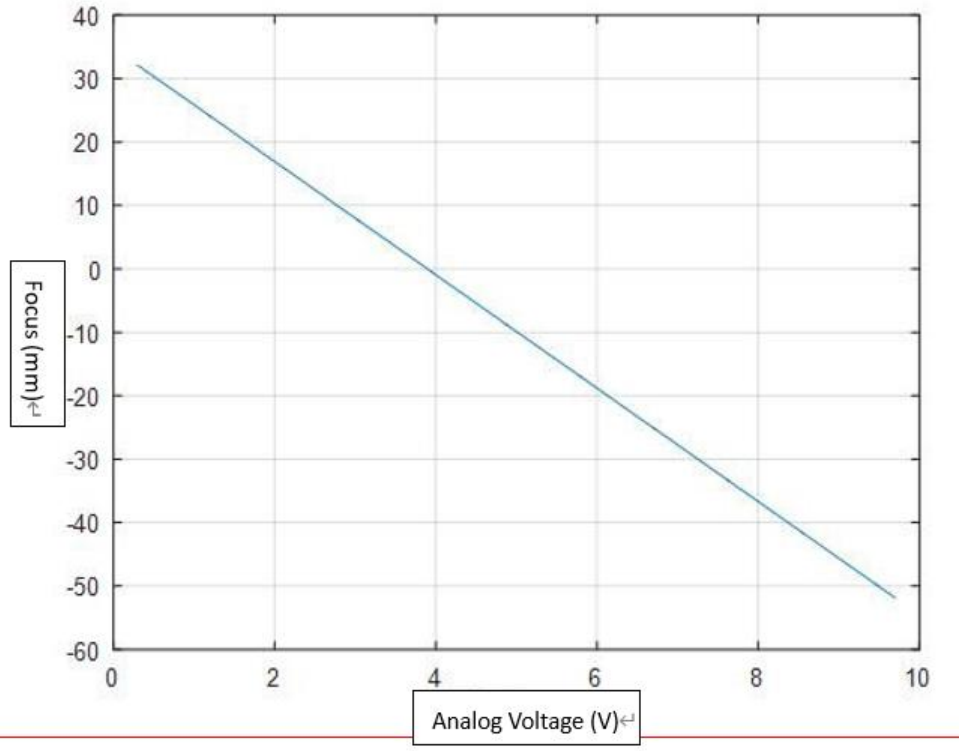
Lens alignment of laser cutting head can be finished by adjusting focus lens, X-Y direction. The X/Y adjusting knob is located above bottom cover glass as shown below. Adjusting the 2 knobs until the beam is located in the middle of nozzle. Make sure the laser beam output from the center of nozzle. A method commonly used is tape dotting method as below:

- Fix the cutting head with a big size nozzle (tip size shall be larger than beam size) or adjust to nearly zero focus.
- Pick a scotch tape, flatten it and stick it to the nozzle tip.
- Open the red light of the laser. Find and observe the position of red light in the scotch tape.
- Shoot laser at low power to check beam penetration size. Beam penetration shall be circle and located in the nozzle tip center.
- Adjust the 2 X/Y adjusting knobs to get beam aligned. The max X/Y adjusting range is roughly from -1.5mm to +1.5mm.
- Tear off the tape and check the shooting hole position in tape.
- Repeat the above steps to find out relatively centered position.



3. 4. 2 Set focus position

The focus position is set by an external analog signal between 0.3 and 9.7 V.



Note: 100/200 optical ratio 0.3 V corresponds to the positive limit value of the focal point +32mm, and 9.7 V corresponds to the negative limit value of the focal point-32mm;

Mechanical manufacturing tolerances, manufacturing tolerances of optical components, and tolerances of imaging scale and fiber fit can have other effects on the actual focal position. Adjust the focus offset according to the actual situation.

4 Maintenance

4. 1 Maintenance work (overview)

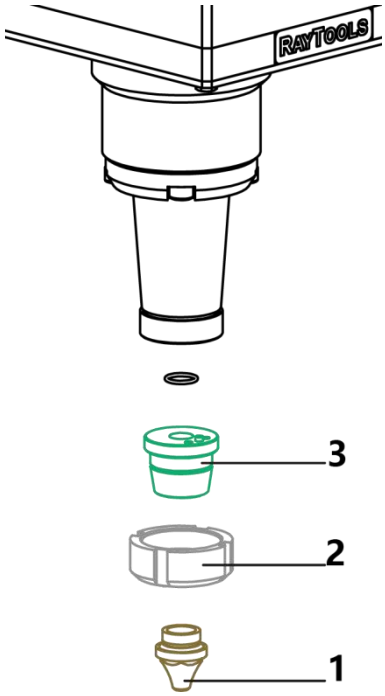
It's necessary to maintain lenses regularly because of the characteristic of laser cutting process. Cleaning to the cover glass once a week is recommended. The collimating lenses and focusing lenses are recommended to be cleaned once every 2~3 months. In order to facilitate the maintenance of the cover glass, the cover glass holder adopts a drawer type structure.

Tools: Dust-proof gloves or fingertip, polyester swab, absolute ethanol, rubber gas blow (purely compressed air).

Cleaning instruction:

- To put fingertip onto left thumb and index finger.
- Spray absolute ethanol onto the polyester swab.
- Hold the edge of the lens with left thumb and index finger gently. (note: avoid touching the surface of the lens by fingertip in case of trace)
- Hold the lens to face eyes by left hand and hold the polyester swab by right hand. Wipe the lens gently in single direction, from bottom to top or from left to right (Should not wipe back and forth in case of secondary pollution to lens) and use rubber blow (purely compressed air) to blow the surface of the lens. Both surfaces should be cleaned. After cleaning, make sure that there is no residual like detergent, floating ash, foreign matters and impurities.

4. 2 Replace ceramic body/ring, nozzle



The nozzle is required to be replaced if it gets crash or damaged by laser beam. The dirt on ceramic body is required to be cleaned or to replace the ceramic body if it gets crash.

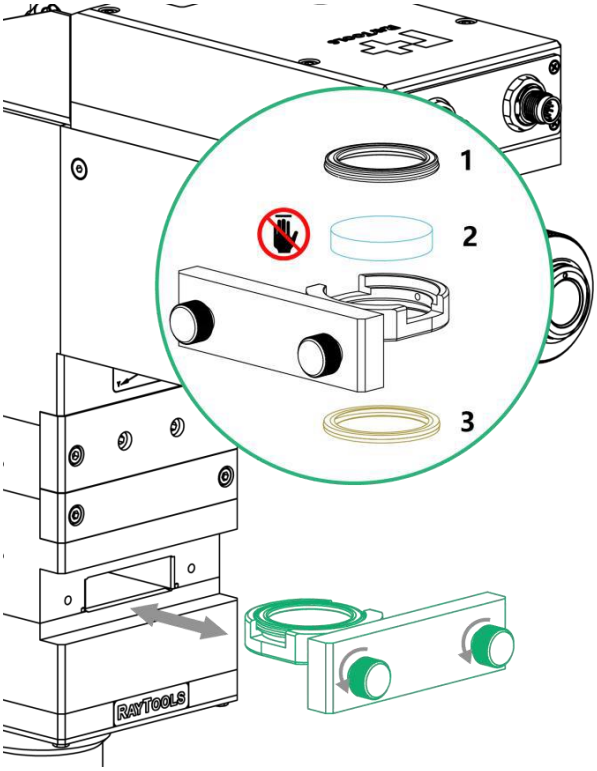
- Unscrew the nozzle (1).
- Press the ceramic body (3) upward by hand to make it fixed without deflection and then unscrew the retaining ring (2).
- Align the pin hole of the new ceramic body with the locating pin. Press the ceramic body (3) upward by hand and tighten the retaining ring (2).
- Screw the new nozzle (1) and get it properly tightened.
- Do the capacitance calibration once again after replacing the nozzle or ceramic body.

ⓘ Only tighten the nozzle and ceramic ring by hand (without tools) otherwise it could damage the ceramic body.

ⓘ Keep the contact surface of all parts clean.

4. 3 Removal and Installation of Lenses

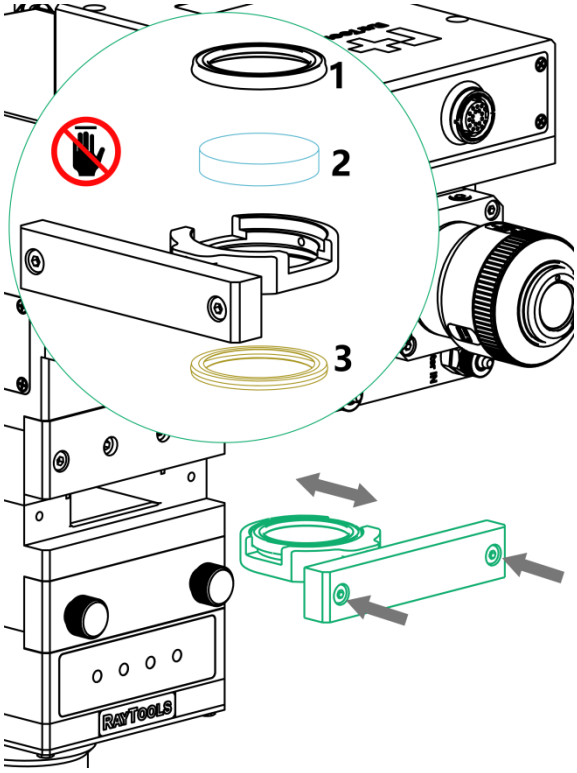
4. 3. 1 Removal and Installation of Bottom Cover Glass/Protection Glass



- As shown above, loose the bolts to pull out cover glass holder by pinching 2 edges of drawer type holder.
- Seal the mounting openings by textured tape immediately.
- Remove the pressing ring (1) and cover glass (2) after wearing fingertips.
- Clean the cover glass holder and seal ring (3). The elastic seal ring (3) should be replaced if it is damaged.
- Install the cleaned or new cover glass (regardless of the front or back surface) into the holder of cover glass.
- Install the pressing ring.
- Insert the cover glass holder back to the laser head and tighten the bolts.

The whole process should be completed in a clean place, and dust-proof gloves or finger covers must be worn when disassembling and assembling the lenses.

4. 3. 2 Removal and Installation of Middle Cover Glass/Protection Glass



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- Seal the mounting openings by textured tape immediately.
- Remove the pressing ring (1) and cover glass (2) after wearing fingertips.
- Clean the cover glass holder and seal ring (3). The elastic seal ring (3) should be replaced if it is damaged.
- Install the cleaned or new cover glass (regardless of the front or back surface) into the holder of cover glass.
- Install the pressing ring.
- Insert the cover glass holder back to the laser head and tighten the bolts.