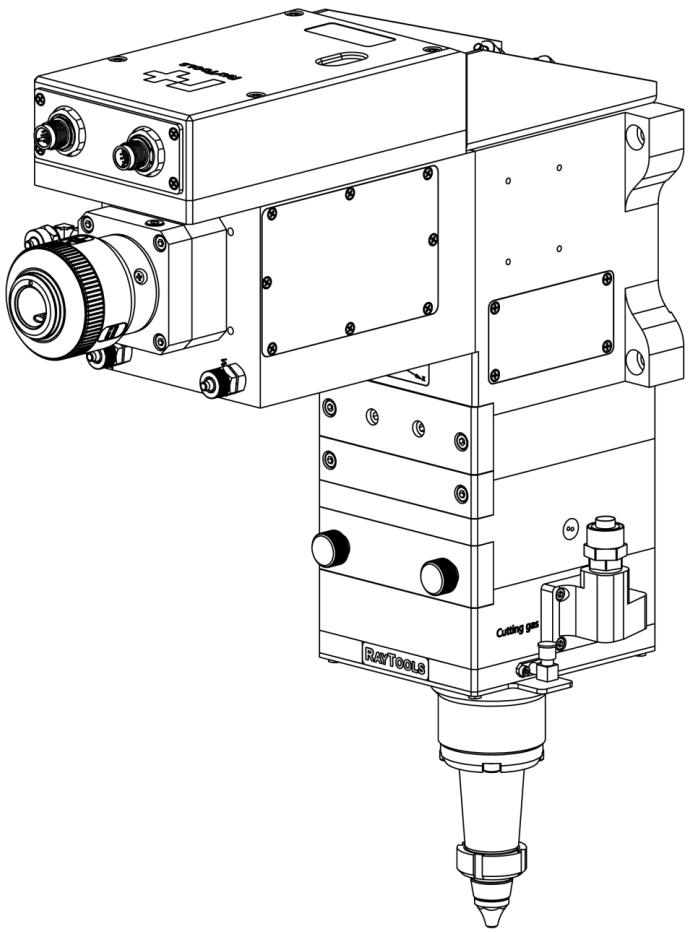
RAYTOOLS

BM06K 90° SERIES

6kW Auto Focus Laser Cutting Head - User Manual



Document History

Edit date	Version	Topic, revision, action taken
2023/2/16	V2.0	First edition
2023/11/28	V3.0	1. EtherCAT driver- pulse number modification. 2. Add common consumables.

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.

Raytools AG

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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.

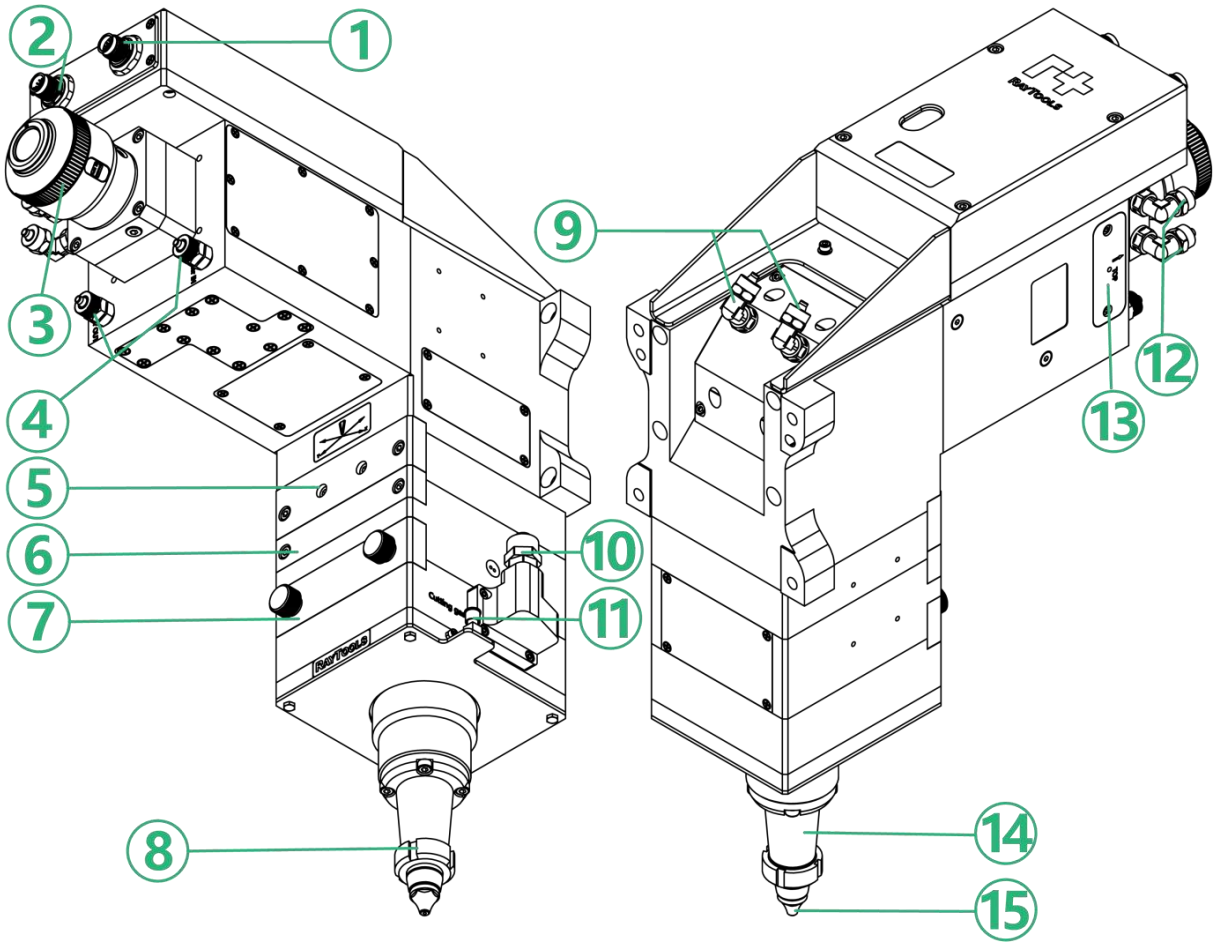
Storage and Transportation

- 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 Summary

1.1 View (with QBH Interface)



01 Power Wiring Interface (12-Pin)
02 Encoder Wiring Interface (8-pin)
03 Fiber Interface
04 Water Cooling Interface (⌀6)
05 Focus Module/XY Alignment
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09 Water Cooling Interface (⌀6)
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13 Dual Top Cover Glass
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1.2 Functions

1.2.1 Protection and Monitoring

- Temperature monitoring to bottom cover glass
- Dual cover glass of collimation lens

1.2.2 Smart Monitoring

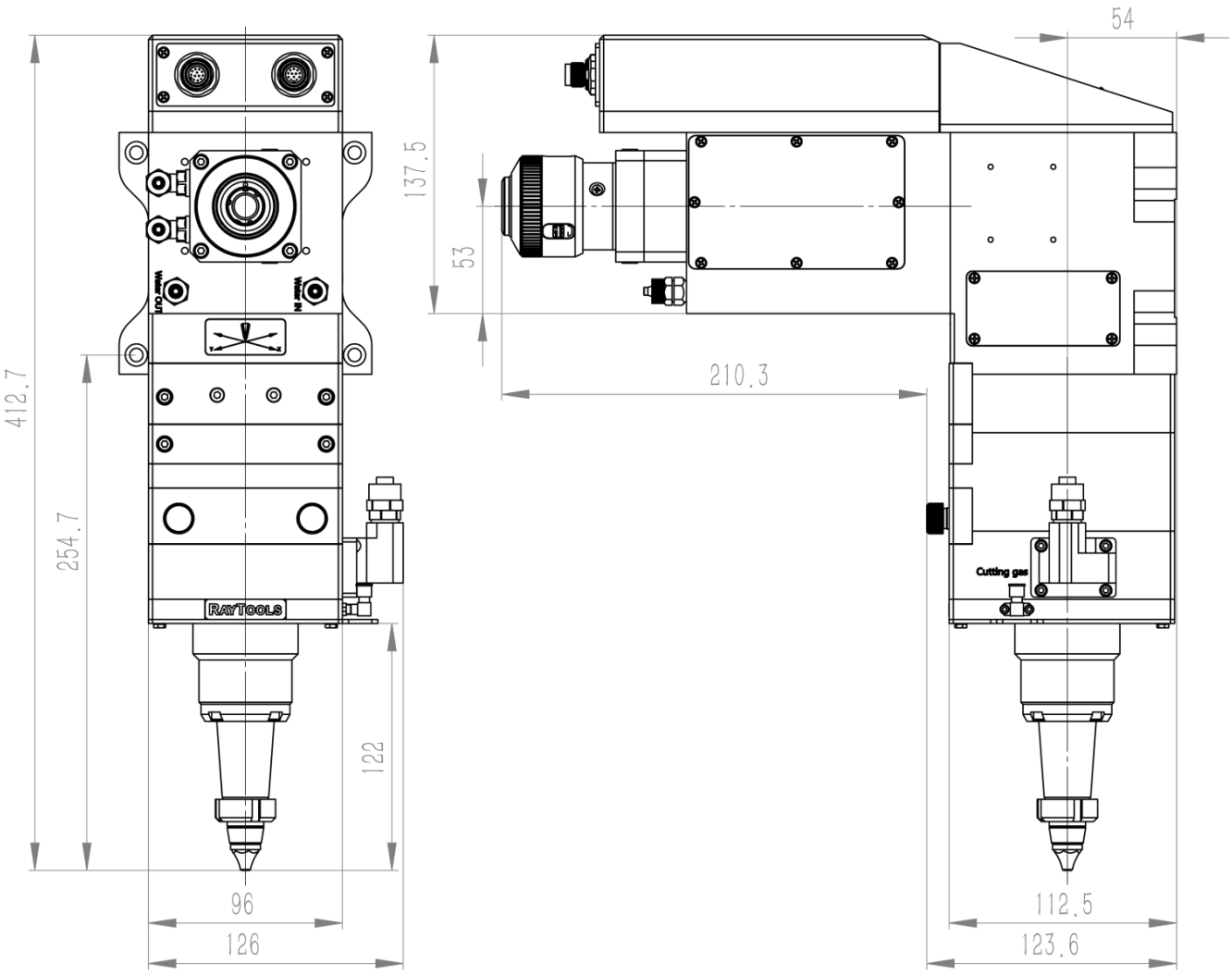
- Compatible with Android

1.3 Technical Datasheet

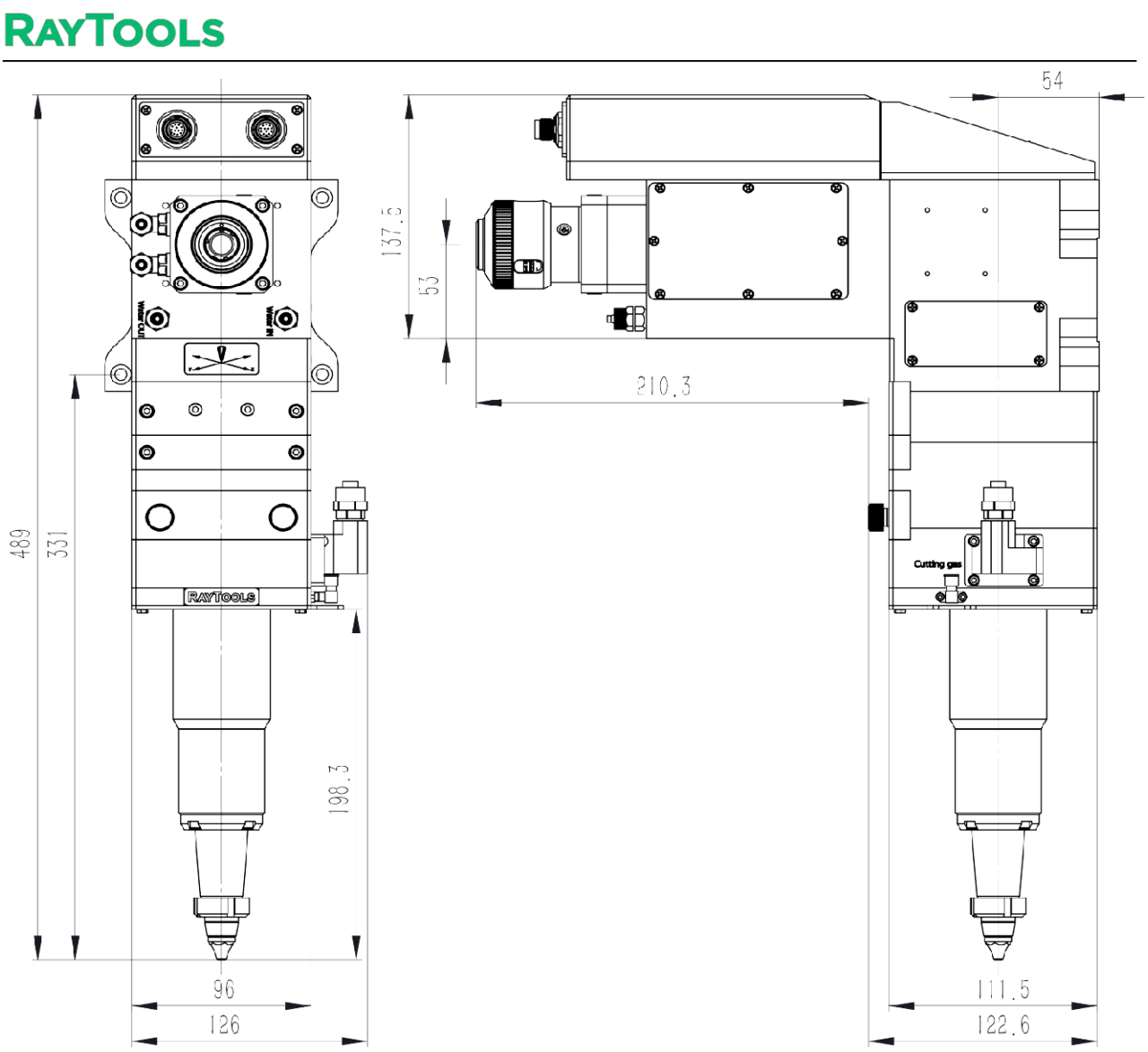
Model	BM06K
Fiber Interface	QBH/G5
Wavelength	1080nm
Power Rating	6kW
NA max	0.14
Collimation Length (fC)	100mm
Focusing Length (fF)	200/300mm
Auto Focus Range	-40～+40mm (F150mm), -72～+72mm (F200mm)
Beam Alignment Range	-1.5mm…+1.5mm
Mounting Size of Cutting Head	4×M6
Mounting Size of Preamplifier	4×M3
Cutting Gas	⌀10, max. 25bar
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	9.9kg ~ 10.9kg

1.4 Mechanical Size

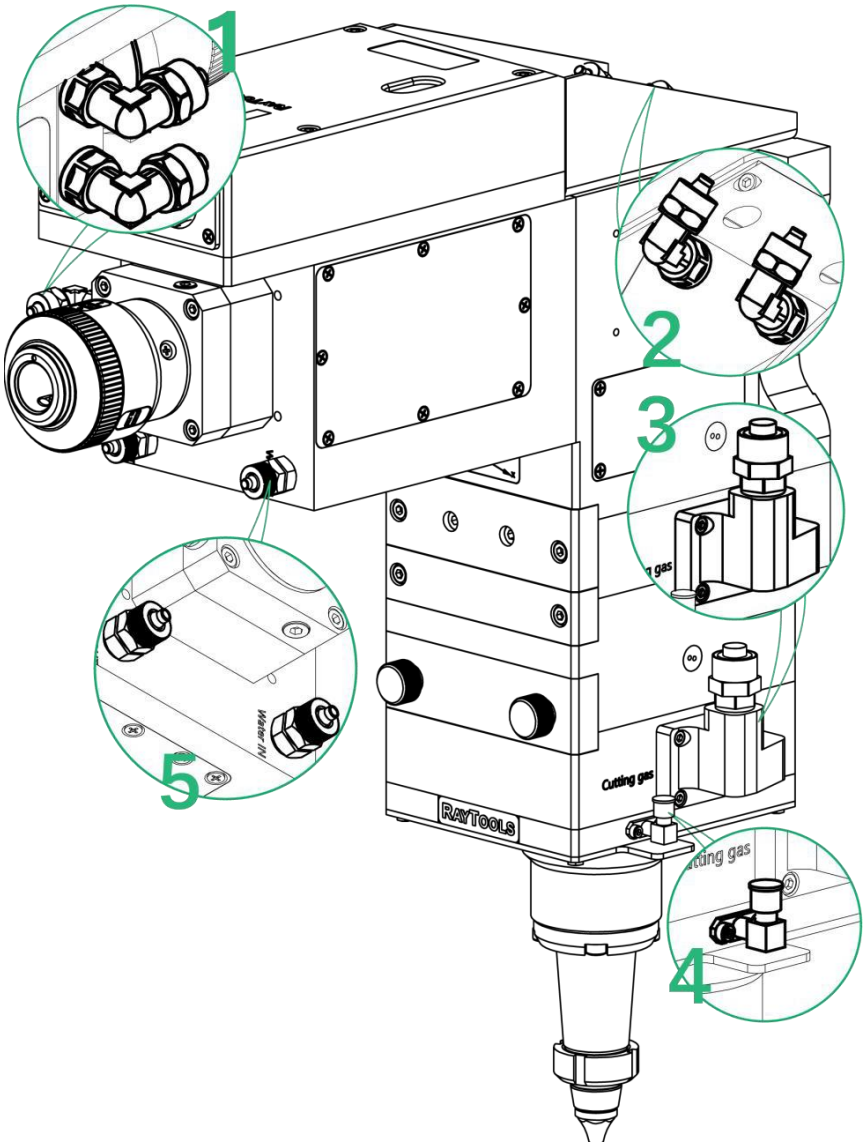
Optical Configuration 100:200



Optical Configuration 100:300



1.5 Interface Instruction



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

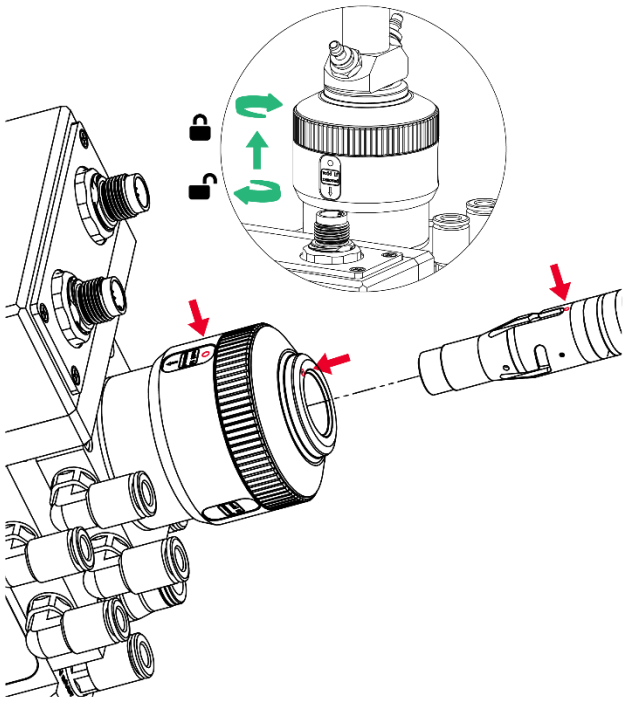
Please note the connector size and the maximum load capacity of interfaces.

2 Mechanical Installation

2.1 Fiber Insertion

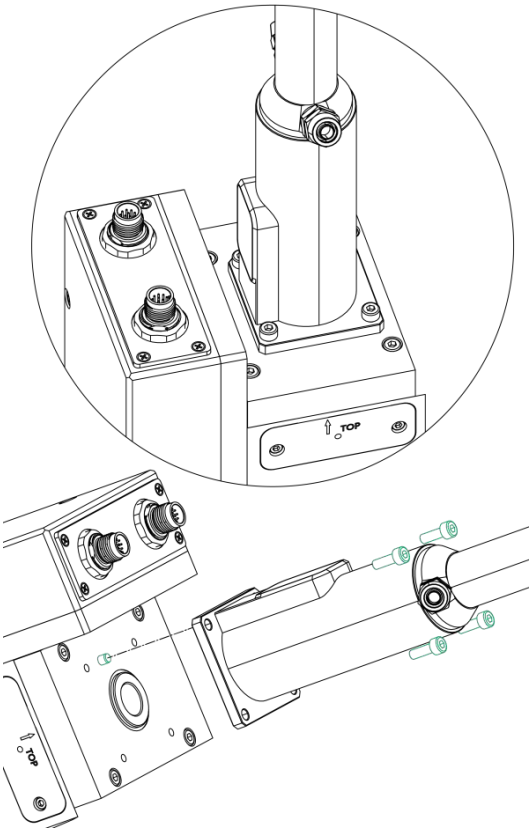
WARNING: The optical components must be dust free and all dust must be cleaned before use. The fiber shall be horizontally inserted into the fiber interface to prevent dust from entering the interface and falling on the surface of the lens. Upper limit in the fiber before fixing the laser head.

2.1.1 QBH Fiber Insertion



- Align the red point at the end of the QBH interface to the red point of the handwheel.
- Remove QBH dustproof cover.
- Align the red mark of fiber end to the red mark on QBH and insert the fiber straightly to the bottom of the QBH interface.
- Turn the QBH handwheel clockwise. It is in place when you hear the "Da" voice, then pull the handwheel up and turn clockwise to end.

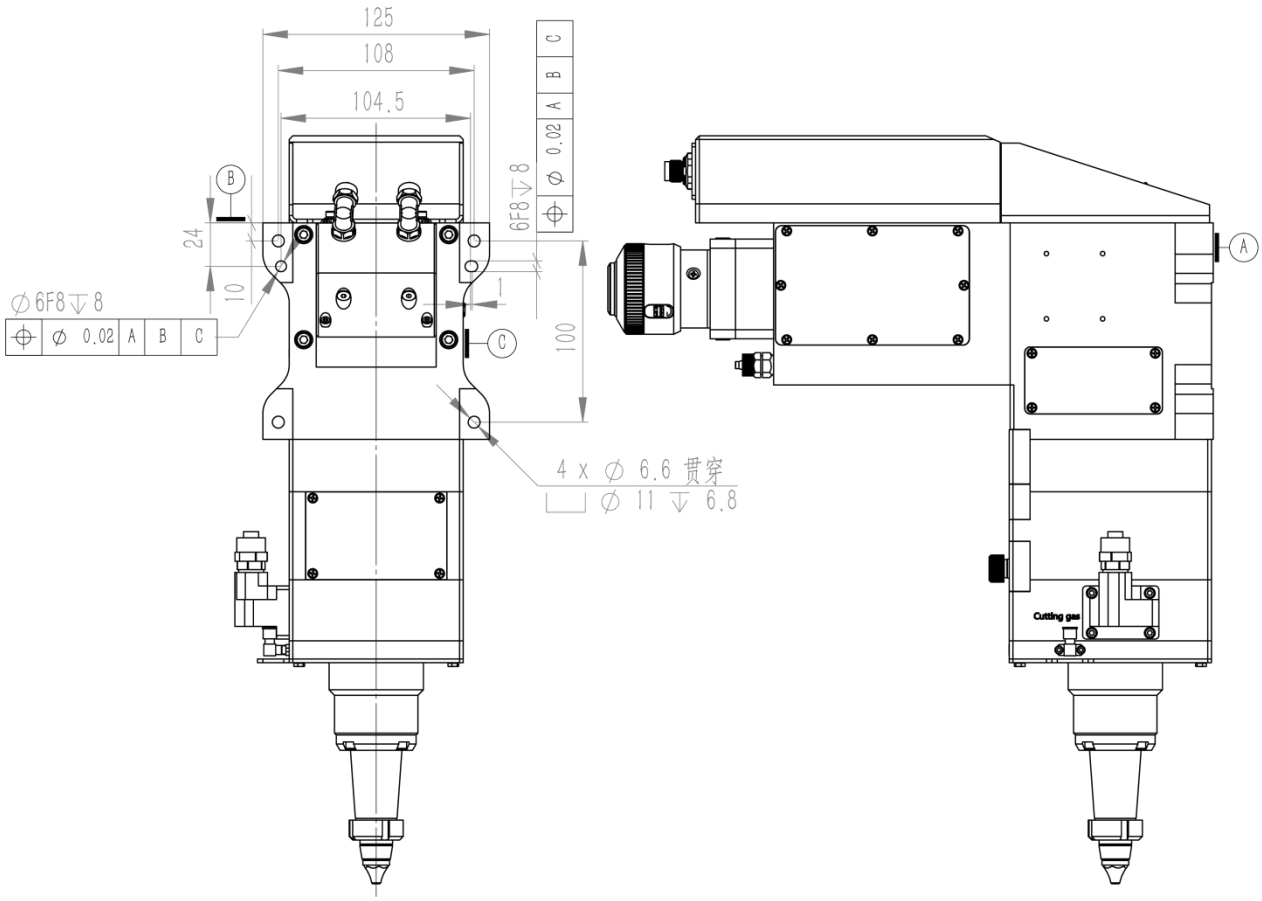
2.1.2 G5 Fiber Insertion



- Remove the dust cover of G5 adaptor.
- Align the locating pin holes of the fiber end and the laser head.
- Lock the fiber end and the laser head with locking screws tightened to the corresponding screw holes.
- Shake the fiber gently after locked, to confirm it is tightened prior to use.

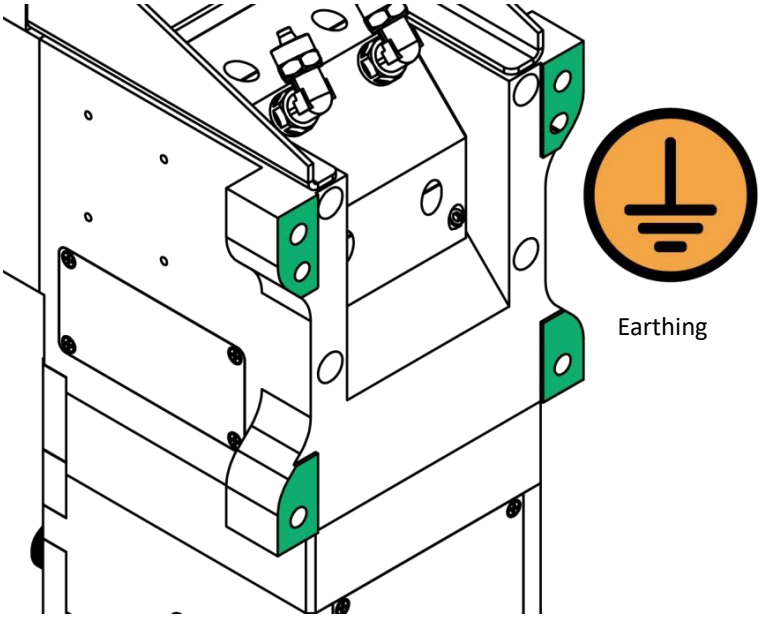
It is recommended to use insulating tape to seal the connection of female and male fiber interface after the installation is finished in order to prevent from dust as much as possible in critical dusty environment.

2.2 Mounting of Laser Cutting Head



It is advised to Install the laser head perpendicular to the machined surface as requested and make sure the laser head is locked, which is one of the premises to ensure the stable cutting effect.

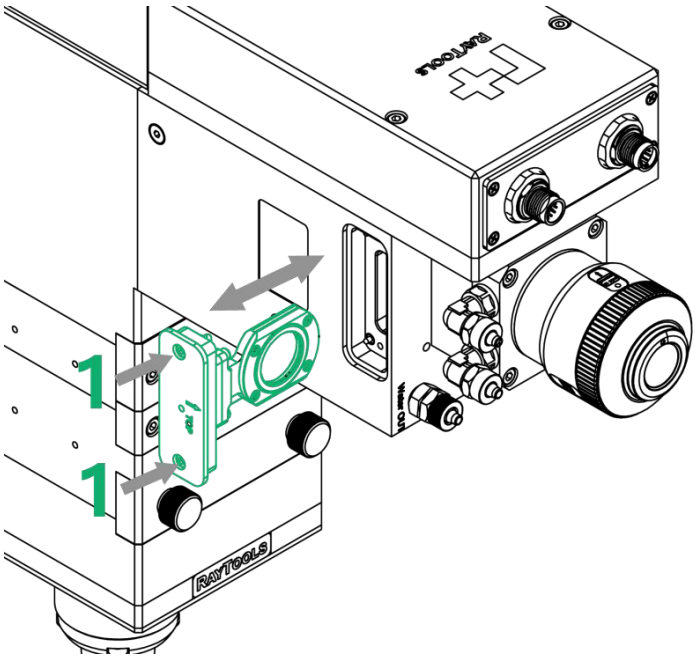
2.3 Earthing of Laser Cutting Head



The shaking or vibration of cutting head due to incorrect earthing will cause damage to sensor mechanism and machine.

2.4 Inspection of Top Cover Glass (1st Installation/Replacement of Fiber)

Maintenance or repair shall be only implemented at dust free workstation.

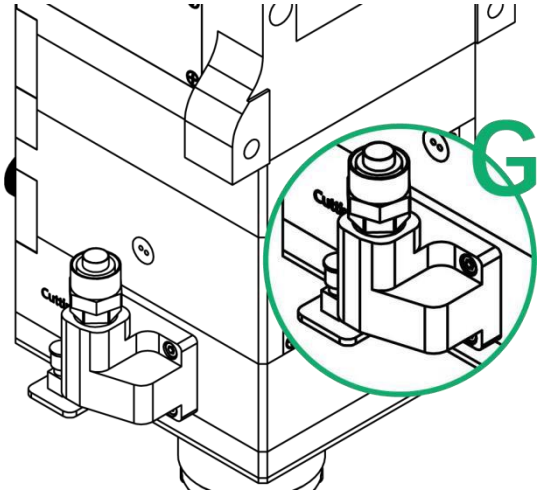


- Loose bolts (item 1), and the drawer of glass holder will pop up automatically. Pull out the glass holder until the glass can be seen completely.
- Check if there is any contamination on the glass and blow off the dust on cover glass with clean air if it's needed till the glass surface is clean.

The cover glass shall be replaced if it cannot be cleaned or damage happens.

2.5 Connection of Cooling Water and Assist Gas

2.5.1 Connection of Cutting Gas



Only use clean and dry gas.
Maximum gas pressure: 25bar(2.5MPa)

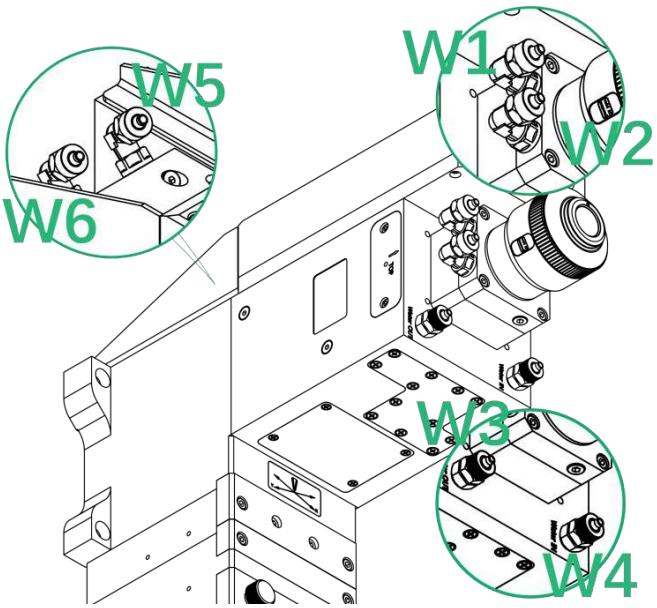
The impurity in cutting gas such as hydrocarbon and steam will damage the lens and cause cutting power fluctuation as well as inconsistencies between the sections of the work piece. The table below is the recommended cutting gas specification. The higher the purity of the gas, the better the quality of the cutting section.

Cutting Gas	Purity	Maximum Content of Water Vapor （ppm）	Maximum Content of Hydrocarbon （ppm）
Oxygen	> 99.5%	<5 ppm	<1 ppm
Nitrogen	> 99.95%	<5 ppm	<1 ppm

- Connect the gas to the ⌀10 interface (G).

CAUTION: Gas interface cannot be replaced arbitrarily especially do not use PTFE TAPE. Otherwise the gas path will be blocked and cannot do normal cutting which will damage cutting head at the same time.

2.5.2 Connection of Cooling Water



The recommended cooling water connection is shown in the above figure.

- Connect the cooling water to the □6 interface.
- Cooling pipeline of the fiber interface: W1, W2
- Cooling pipeline of the collimation module: W3, W4
- Cooling pipeline of the reflector: W5, W6

The cooling water shall meet the following technical requirements.

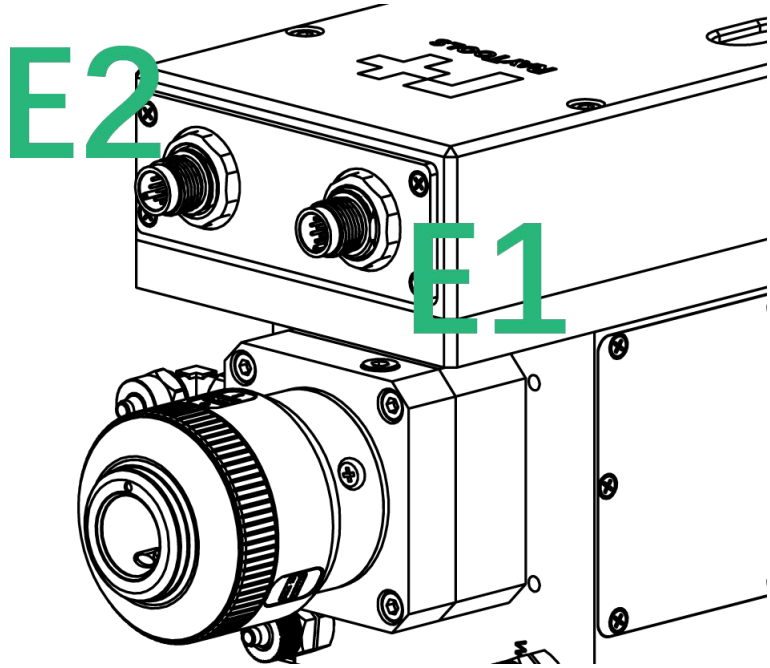
Minimum flow speed	1.5 l/min
Entry pressure	170-520kPa
Entry temperature	≥room temperature /＞dew point
Hardness（relative to CaCO3）	＜250mg/L
PH range	6 to 8
Particle size allowed	Diameter less than 200 microns

To avoid corrosion, it is a must to comply with the related instructions and maintenance interval of the equipment, manufacturer and the cooling water device.

Note: When the laser power is greater than 500W, it is recommended to use water cooling.

3 Connection and Commissioning

3.1 Cable Connection



Connect the encoder cable to the interface E1(12-pin) and the control cable to the interface E2(8-pin). Reserve a proper length to fix the cable into the cable groove inside the machine.
Connect the 8-pin control cable and 12-pin encoder cable to the drive interfaces according to instructions on the cable sleeves.

The limit sensor is NPN-NC (only output NPN signals when not actuated). Please install a relay if necessary.

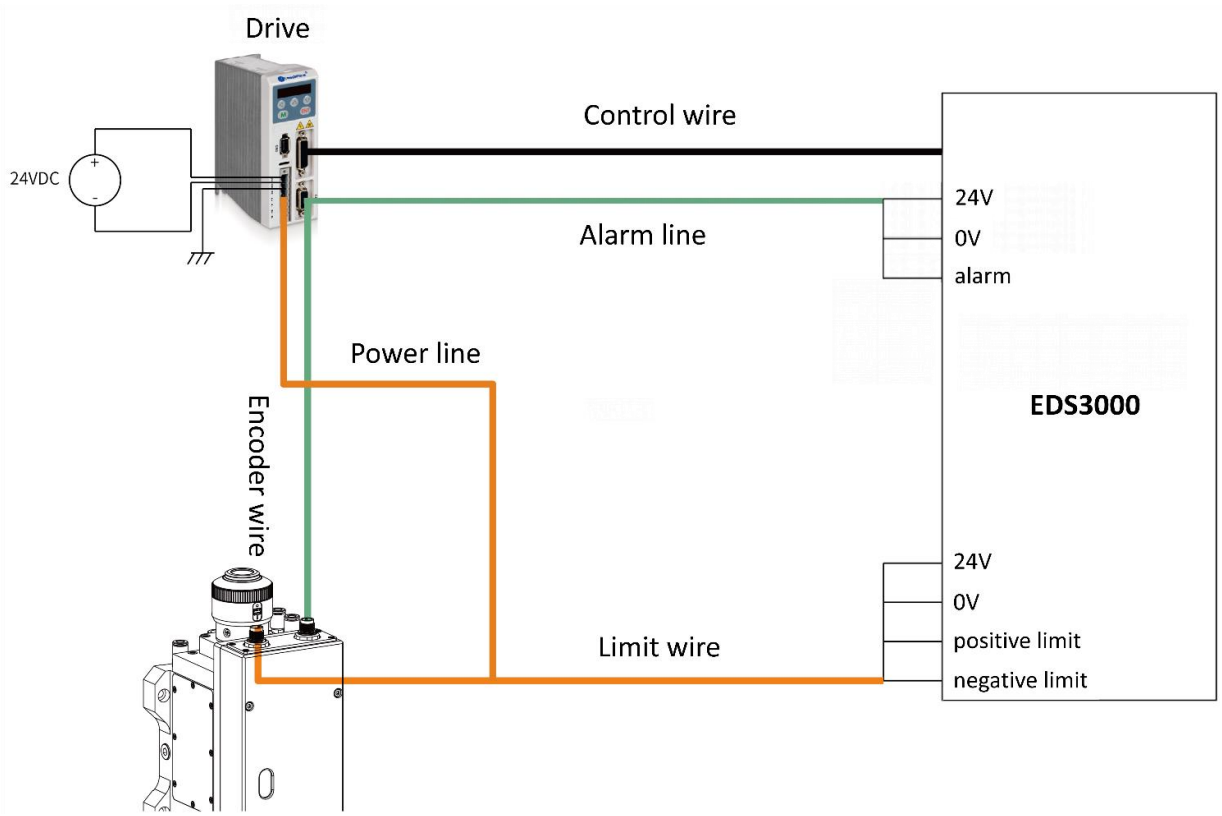
Caution: The wiring must be done when the power is off. Operate the power-on testing after the wiring is checked.

3.2 System Commissioning

Take *Raytools* system as an example below.

3.2.1 Wiring

Vdc, GND, and PE on the drive shall be respectively connected with 24V, 0V, and ground wires. A+, A-, B+, and B- are the power lines of the stepper motor. Please complete the wiring according to the schematic diagram. (24V power supply is needed to be self-provided.)



Limit signal:

White	Red	Pink	Blue
+24V	0V	Positive limit	Negative limit

The limit sensor is NPN-NC, and continuously outputs 0V signals in the resting state.

Alarm signal:

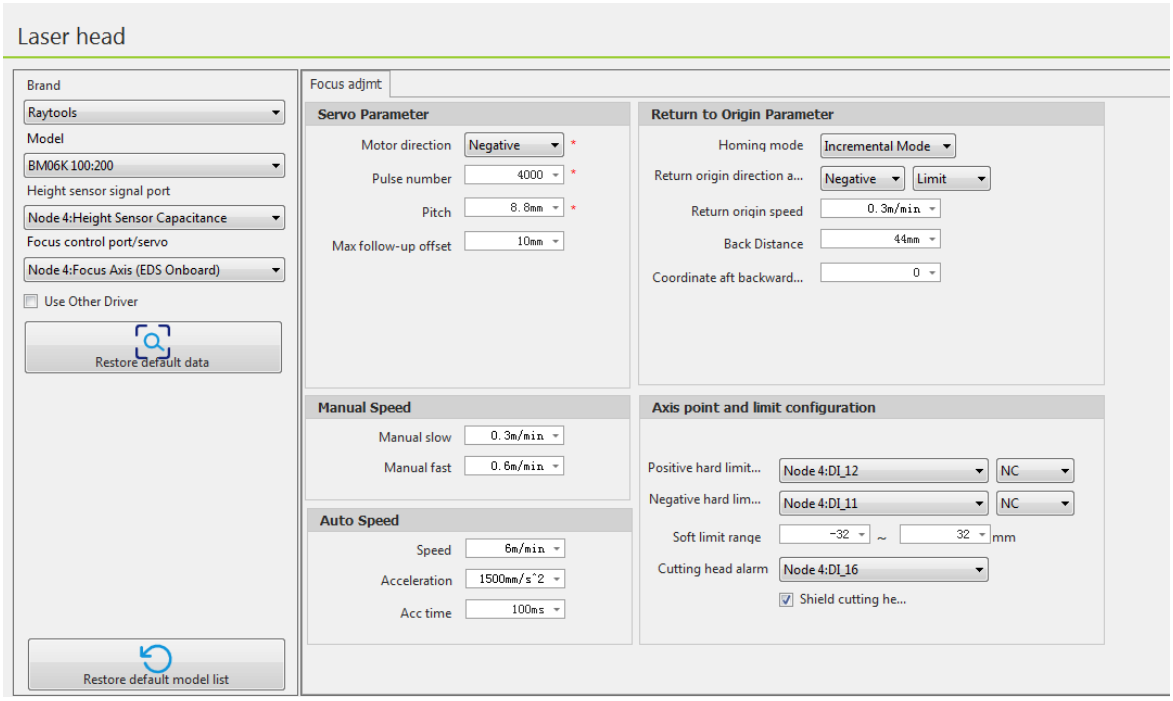
Red	Black	Brown
+24V	0V	Alarm output

The alarm signal is NPN-NC, and continuously outputs 0V signals in the resting state.

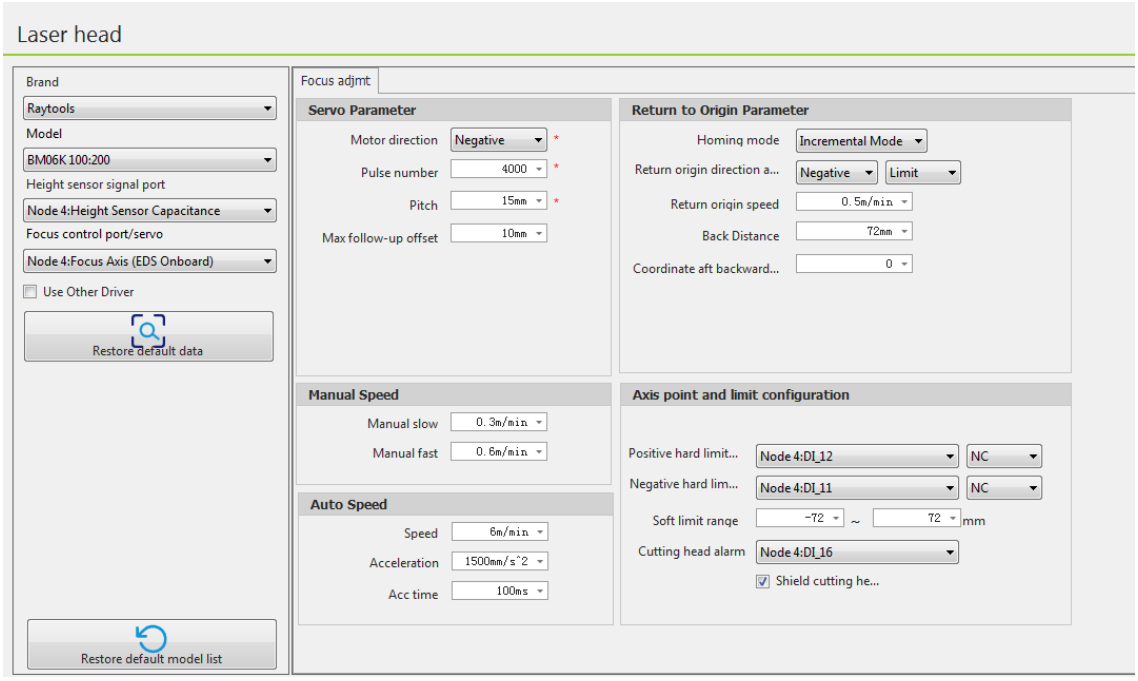
3.2.2 System Setting (*Raytools*)

Open the setting interface and set the parameters according actual needs as shown in below figures.

Optical configuration: 100:200



Optical configuration: 100:300

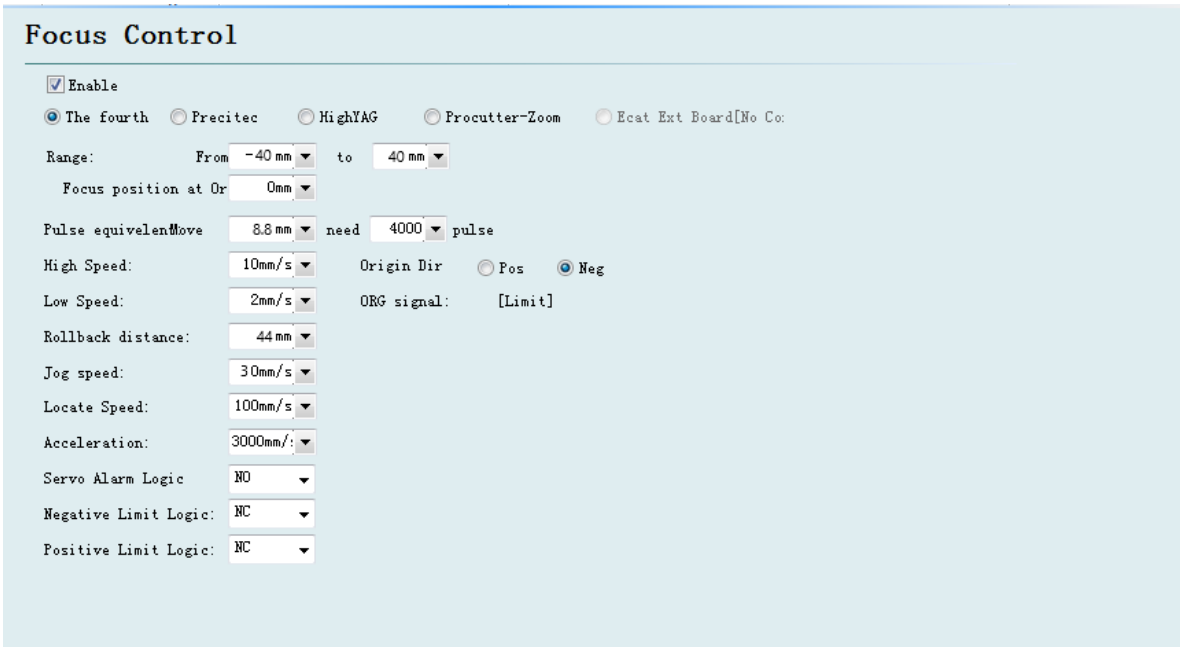


(Optical configuration: 100:300 is not optional in the Model, but the above parameters can be reference.)

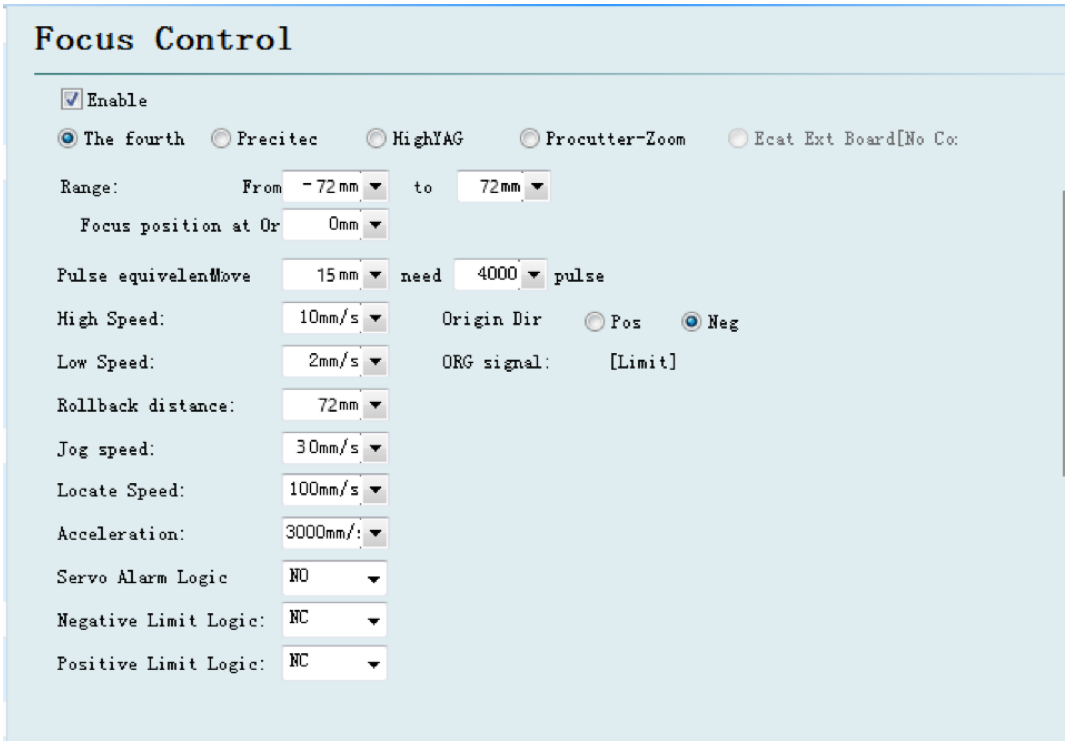
Please set pulse number as 10000 when applying EtherCAT driver.

3.2.3 System Setting (*FSCUT*)

Optical configuration: **100:200**



Optical configuration: **100:300**



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.

3.3 Mobile APP

· Start the app and complete the connection according to the instruction.

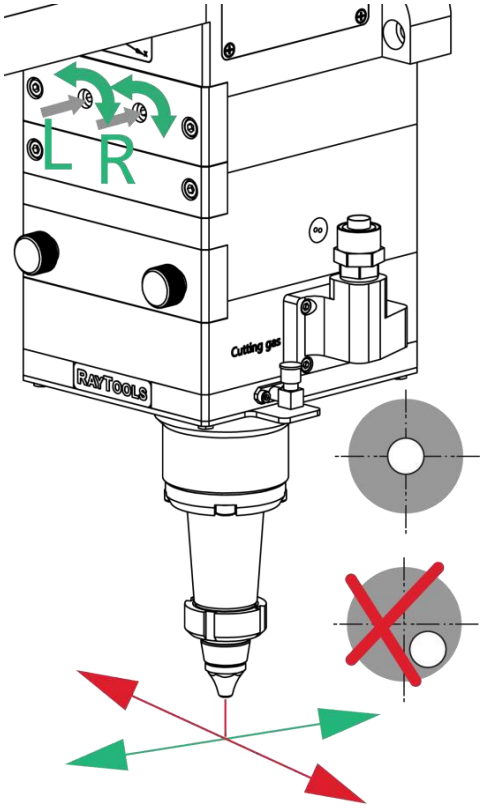
· Complete setting manually bases on actual needs.

Example:

Smart inspection data setting	Remark	Setting value
Bottom cover glass-Temp	Alarm threshold 45℃	45℃

4 Beam Alignment and Zero Focus Correction

4.1 Beam Alignment



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

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

4.2 Zero Focus Correction

Laser cutting head is equipped with automated focusing system. But it is required to dot manually to redefine the zero focus position when it is initially set or lenses and lasers are replaced. For details about operating system parameters, please refer to the system instructions. Manual dot can refer to the following steps:

- Attach one textured tape on nozzle tip. Set laser power to 80-100W.
- While moving each 0.5mm focus (as small as possible), shot a hole on the textured tape.
- Dotting several times to find out the focus corresponding to the smallest hole which is supposed to be real zero focus. The zero focus is just at the tip of the nozzle.

5 Maintenance

5.1 Cleaning Lens

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:

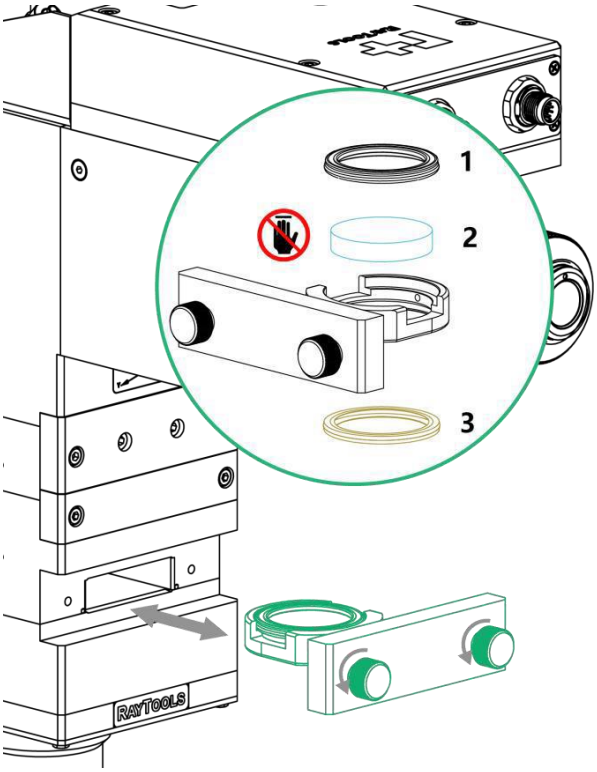
- To put fingertip onto left thumb and index finger.
- Spray absolute ethanol onto the polyester swab.
- Hold the edge of the lens with left thumb and index finger gently. (note: avoid touching the surface of the lens by fingertip in case of trace)
- Hold the lens to face eyes by left hand and hold the 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.

5.2 Removal and Installation of Lenses

The whole process needs to be completed in a dust free room. Wear dust-proof gloves or fingertips when removing or installing the lenses.

5.2.1 Removal and Installation of Bottom Cover Glass/Protection Glass

The cover glass is wearing part which needs to be replaced once it is damaged.

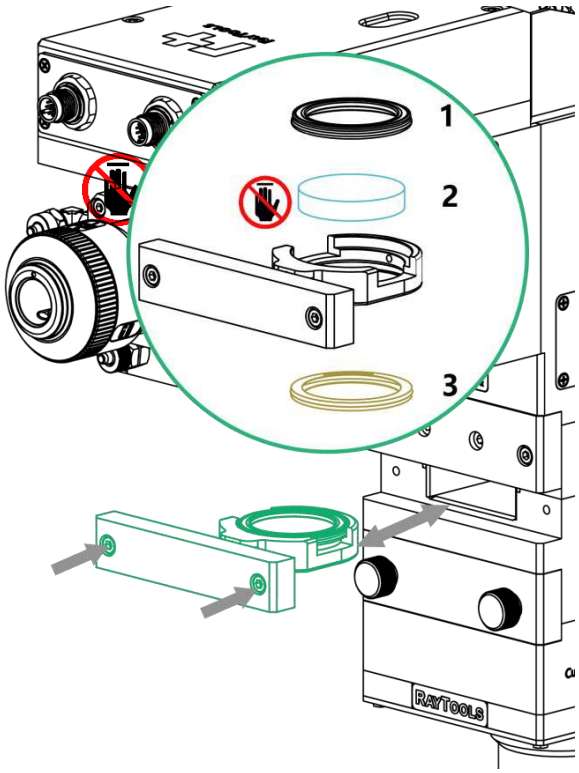


1. As shown above, loose the 2 bolts to pull out the cover glass holder by pinching 2 edges of drawer type holder.
2. Seal the mounting openings with textured tape immediately.
3. Remove the pressing ring (1) and cover glass (2) after wearing finger-cots.
4. Clean the cover glass holder and seal ring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

It is not allowed to pull out the edge of seal ring directly as it is very easy to be damaged.
Please wear the clean gloves or fingertips.

5.2.2 Maintenance of Middle Cover Glass/Protection Glass

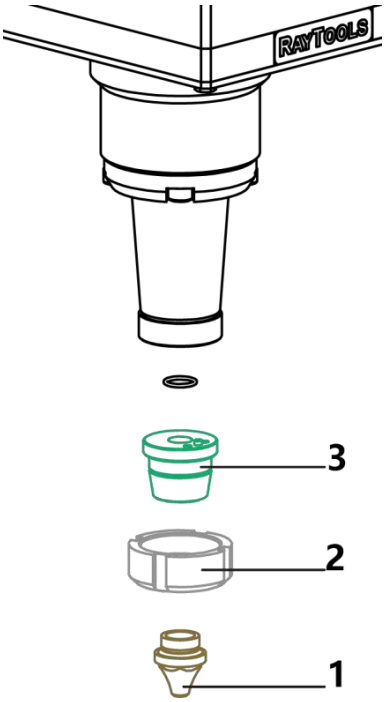
The cover glass is wearing part which needs to be replaced once it is damaged.



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

It is not allowed to pull out the edge of seal ring directly as it is very easy to be damaged.
Please wear the clean gloves or fingertips.

5.3 Replace Ceramic Body and Nozzle



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

- 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 retaining ring by hand (without tools) otherwise it could damage the ceramic body.

Keep the contact surface of all parts and clean.

Consumables

Name	Technical Data	Material Code
Fiber Interface	QBH	211FIA3003
Lens 100:200	Meniscus spherical lens F100B-D37	3250010323
	Biconvex spherical lens F100A-D37	3250010322
	Biconvex spherical lens F220A-D37	3250010433
	Meniscus spherical lens F190.5B-D37	3250010420
Lens 100:300	Biconvex spherical lens F100A-D37	3250010322
	Meniscus spherical lens F100B-D37	3250010323
	Plano-convex spherical lens F300-D37	3250010477
Cover Glass	D24.9x1.5	211LCG0086
	D37x7	211LCG0078
Nozzle	3D Single layer M11-ø1.2	120GJT1112
	3D Single layer M11-ø1.3	120GJT1113
	3D Single layer M11-ø1.4	120GJT1114
	3D Single layer M11-ø1.6	120GJT1116
	3D Single layer M11-ø1.8	120GJT1118
	3D Single layer M11-ø2.0	120GJT1120
	3D Single layer M11-ø3.0	120GJT1130
	3D Single layer M11-ø4.0	120GJT1140
	3D Single layer M11-ø5.0	120GJT1150
	3D Double layer M11-ø1.2	120GJT1412
	3D Double layer M11-ø1.3	120GJT1413
	3D Double layer M11-ø1.4	120GJT1414
	3D Double layer M11-ø1.6	120GJT1416
	3D Double layer M11-ø1.8	120GJT1418
	3D Single layer M8-ø1.2	120GJT0112
	3D Single layer M8-ø1.3	120GJT0113
	3D Single layer M8-ø1.4	120GJT0114
	3D Single layer M8-ø1.5	120GJT0115
	3D Single layer M8-ø1.8	120GJT0118
	3D Single layer M8-ø2.0	120GJT0120
	3D Single layer M8-ø3.0	120GJT0130
	3D Single layer M8-ø4.0	120GJT0140
	3D Single layer M8-ø5.0	120GJT0150
Ceramic Body	D21.4-M8	120515093A
	D21.4-M11	120515092A

Cable

Name	Technical Data	Material Code
Encoder Cable	20m	3570040059
	30m	3570040070
Power Cable	15m	3570030145
	20m	3570030146
	30m	3570030147
FSCUT Position Loop-Leadshine Control Cable	2m	ELNAB102M00045