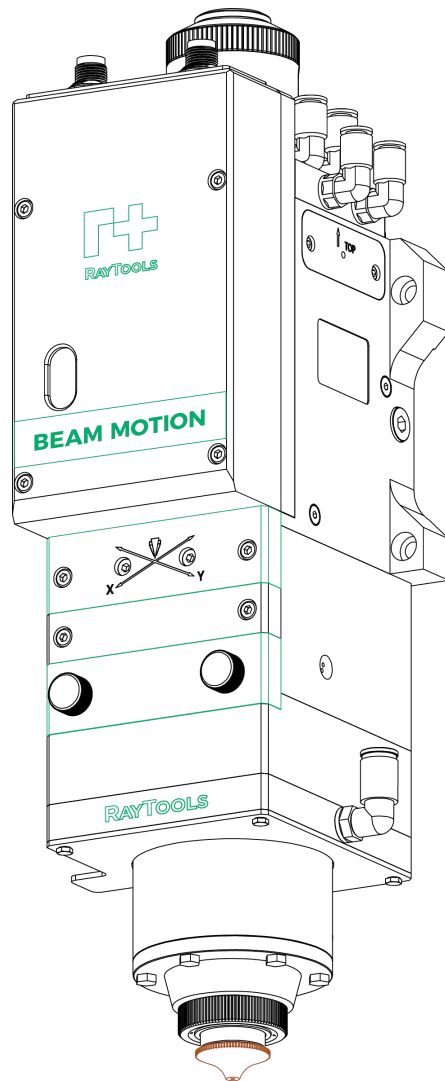


RAYTOOLS

BM06K

6kW Auto Focus Cutting Head - User Manual



Email: sales@raytools.com

Website: www.raytools.ch

Thank you for choosing our product!

This manual describes the installation and commissioning of the laser cutting head in detail 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.

We reserve all rights in this document including the issued patents and other registered commercial ownership related to this document. It is strictly prohibited to use this document in improperly, especially to copy and disseminate it to third parties.

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 to improve the quality or expand the application or comply with manufacturing workmanship.
- We will not bear any responsibility for losses or accidents caused by wrong operation or improper handling of our products.
- Dismantling of the 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 our 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 and accident prevention, having received equipment operation guidance.
- Read and understand basic safety instructions and operations.
- 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 the 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 parts under the laser head.
- Repair and maintenance 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 Water Circuit Corrosion

- 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 to prevent personnel from being harmed by noise when the cutting air pressure is high.

Storage and Transportation

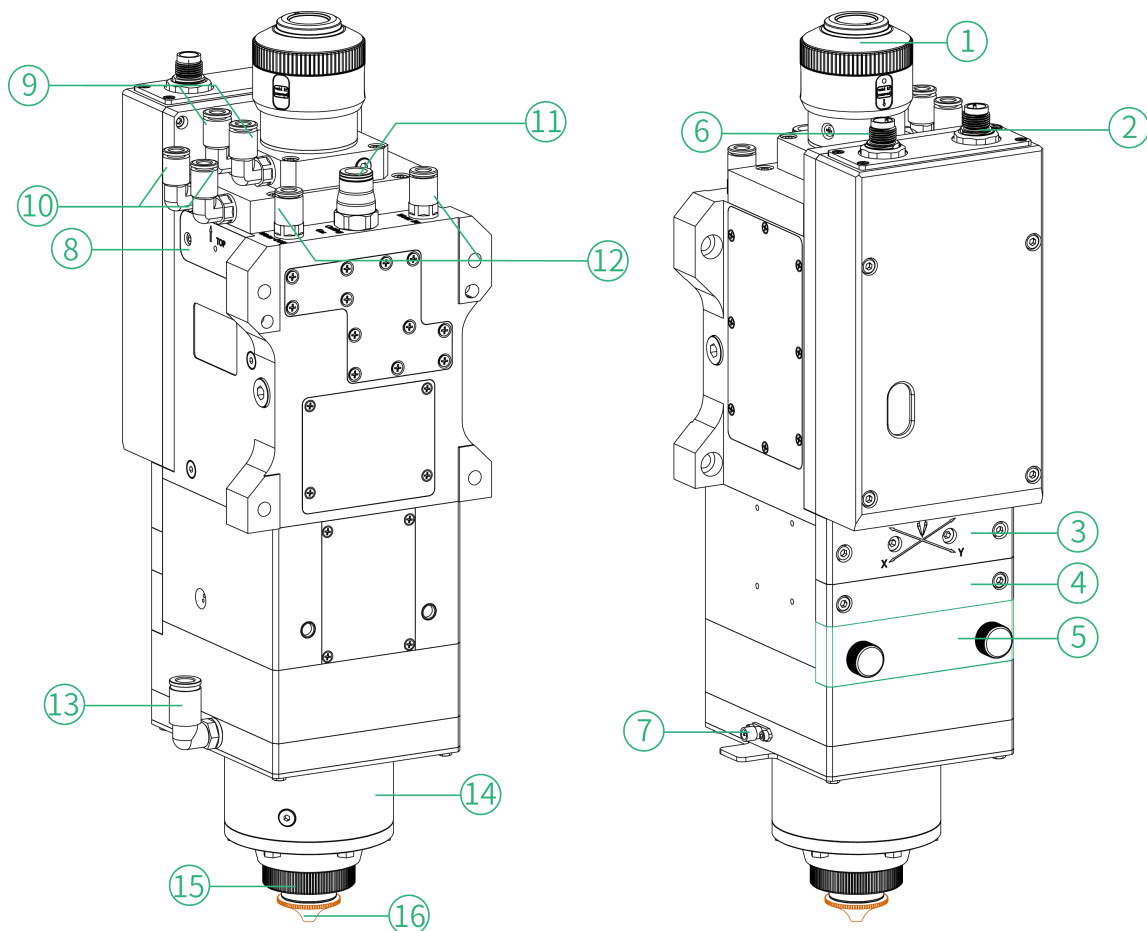
- Observe the storage temperature range allowed by the technical data.
- Take reasonable measures to prevent fire, vibration, or impact.
- Do not store in or near the magnetic field.

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1 Product Summary

1.1 View and Structure (with QBH Interface)



01 Fiber Interface

04 Middle Cover Glass Assembly

07 Preamplifier Interface

10 Water Cooling Interface (Φ6)

13 Water Cooling Interface (Φ8)

16 Ceramic Body & Nozzle

02 Control Interface (12-pin)

05 Bottom Cover Glass Assembly

08 Top Cover Glass (Dual Cover Glass)

11 Cutting Gas Interface (Φ10)

14 TRA (Nozzle Assembly)

03 Focus Module / XY Alignment

06 Encoder Wiring Interface (8-pin)

09 Water Cooling Interface (Φ6)

12 Water Cooling Interface (Φ6)

15 Retainer Ring

1.2 Functions

1.2.1 Protection and Monitoring

- Fool-proofing test to bottom cover glass
- Temperature monitoring to bottom cover glass
- Dual cover glass of collimation lens

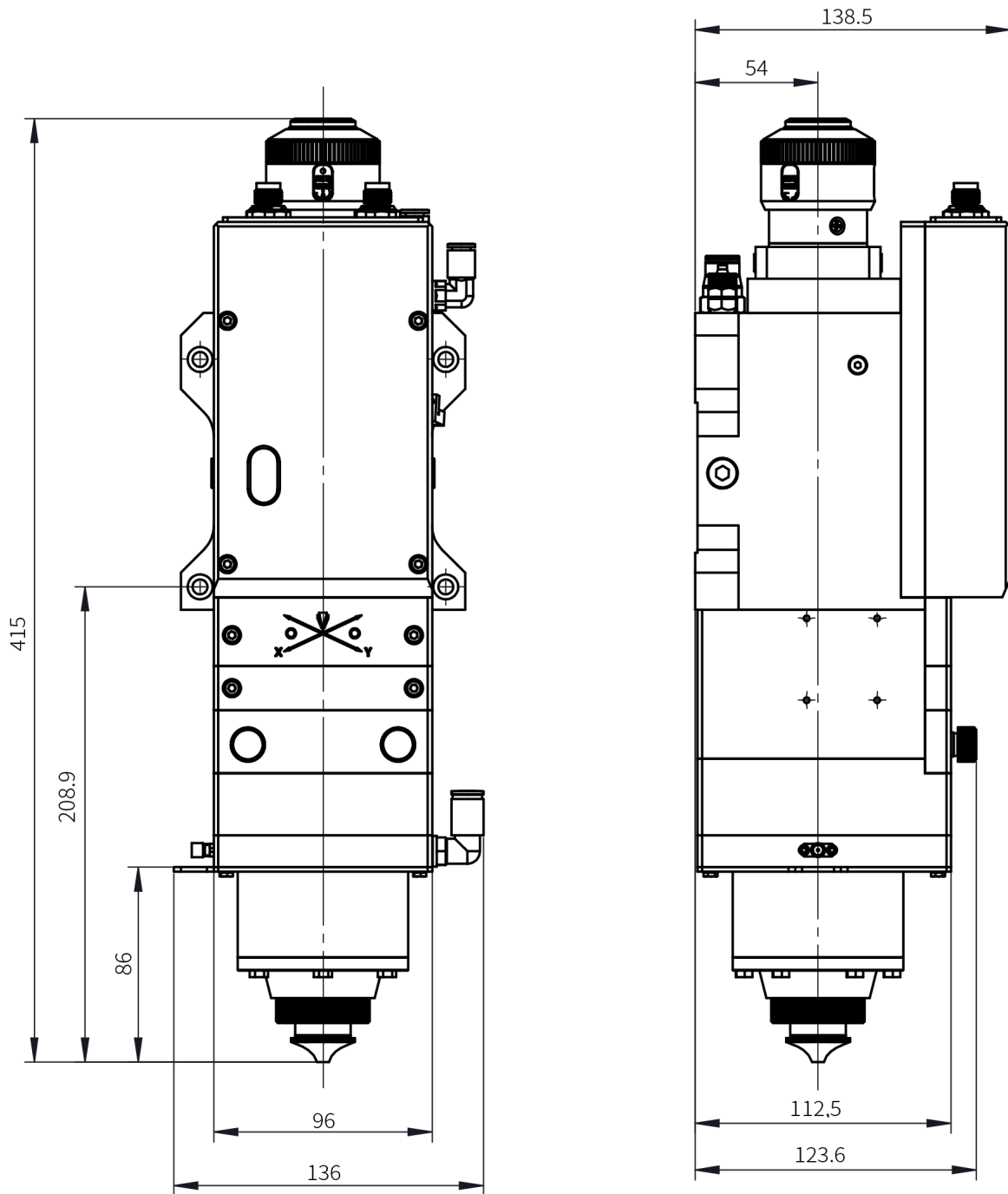
1.2.2 Smart Monitoring

- Compatible with PC
- Compatible with Android

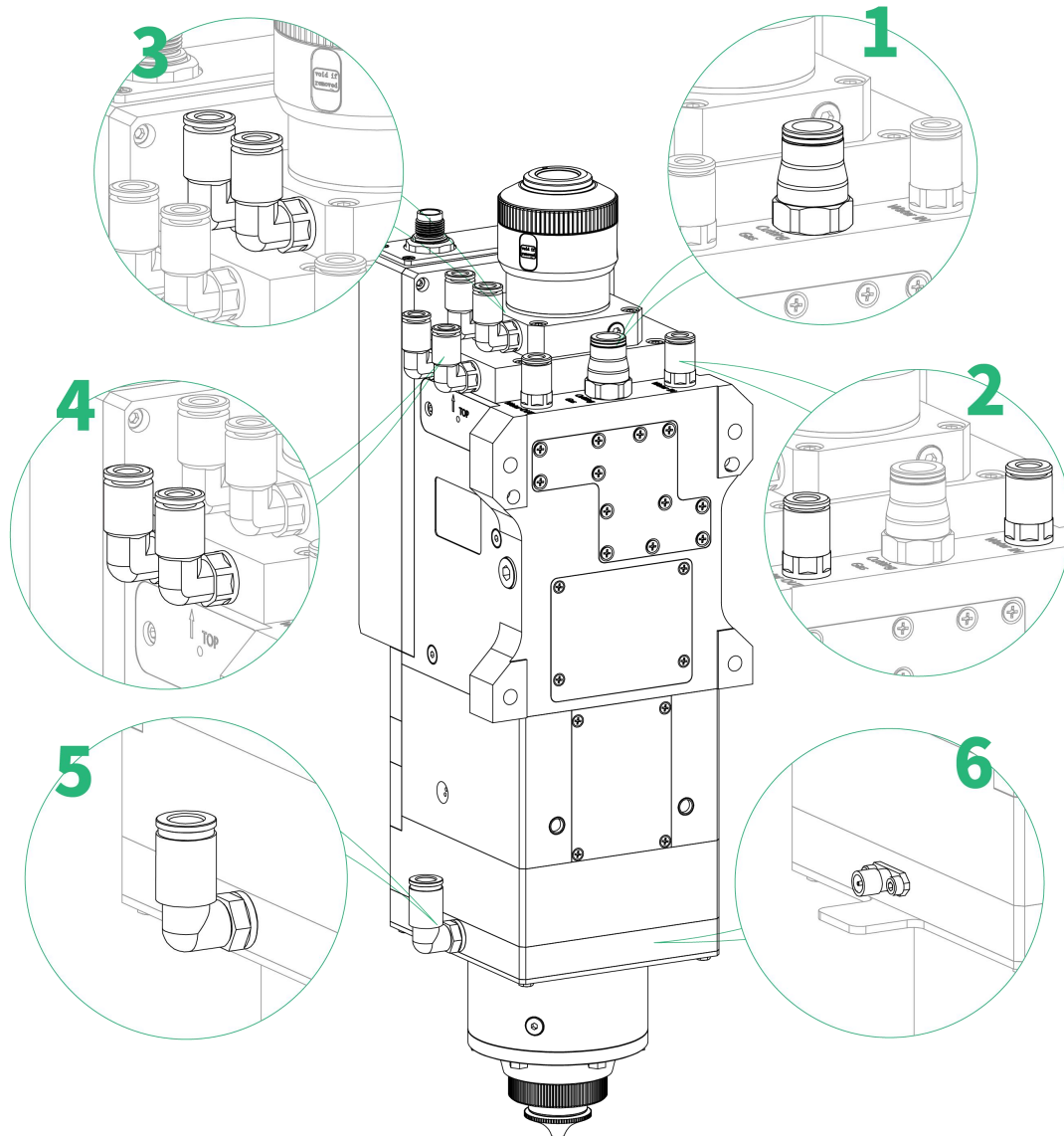
1.3 Technical Datasheet

Fiber Interface	QBH, G5
Wavelength	1080nm
Power Rating	6kW
NA	0.14
Optical Configuration	
-Collimation Length (fC)	100
-Focusing Length (fF)	150, 200
Auto Focus Range	
-Horizontal	-1.5~+1.5mm
-Vertical	-17~+17mm (F150mm), -32~+32mm (F200mm)
Installation - Screw QTY and Size	
Mounting Plate	4×M6.6
Preamplifier	4×M3
Gas Circuit Interface	
-Cutting Gas	Φ10 connector, max. 25bar
-Nozzle Cooling Gas	Φ8 connector, max. 5bar
-Water Cooling (downstream and upstream)	Φ6 connector, 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°C~55°C
Humidity	30%~95%, without condensing
Weight	6.5kg~7.0kg

1.4 Mechanical Size (Optical Configuration 100:200)



1.5 Interface Instruction



No. 1	Cutting gas (Φ10)	No. 4	Cooling water (Φ6)
No. 2	Cooling water (Φ6)	No. 5	Nozzle cooling gas (Φ8)
No. 3	Cooling water (Φ6)	No. 6	Preamplifier interface (SMA)



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

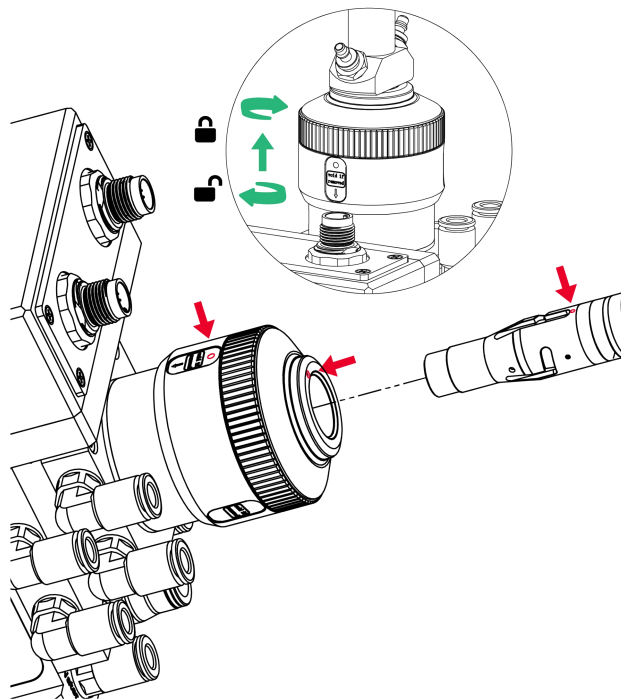
2 Mechanical Installation

2.1 Fiber Insertion



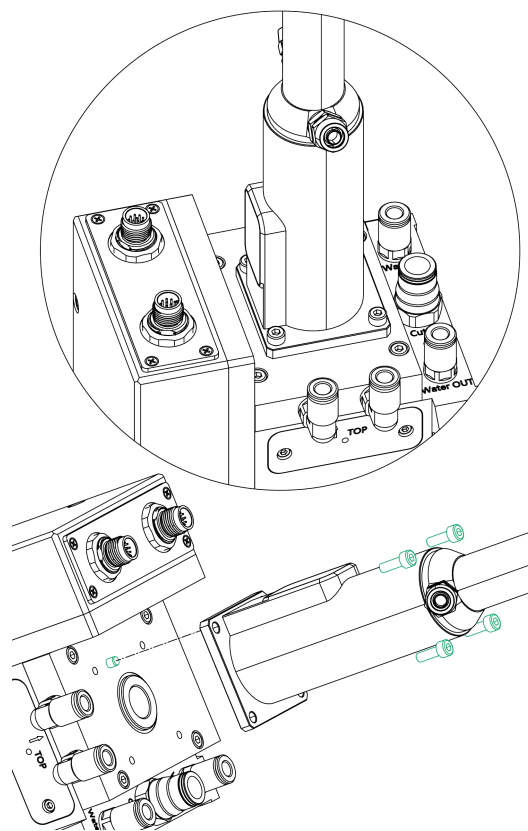
WARNING: The optical components must be dust free and all dust must be cleaned before use. The fiber shall be horizontally inserted into the fiber interface to prevent dust from entering the interface and falling on the surface of the lens. Upper limit in the fiber before fixing the laser head.

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

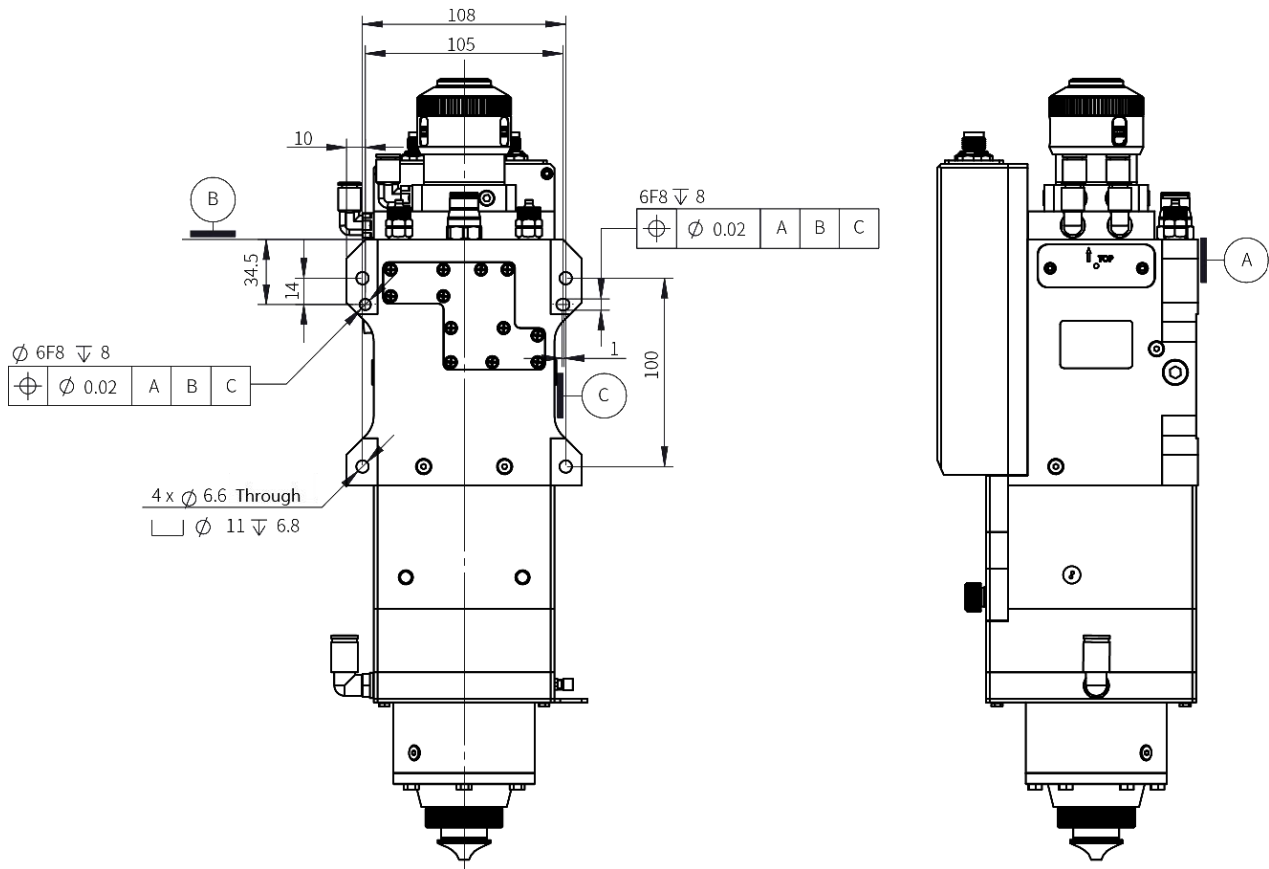


- Remove the dust cover of G5 adaptor.
- Align the locating pin holes of the fiber end and the laser head.
- Lock the fiber end and the laser head with locking screws tightened to the corresponding screw holes.
- Shake the fiber gently after locked, to confirm it is tightened prior to use.



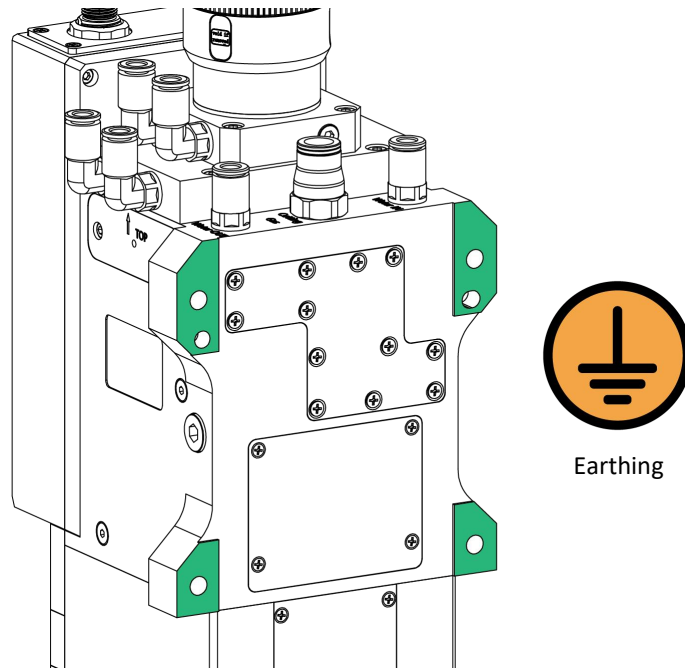
It is recommended to use insulating tape to seal the connection of female and male fiber interface after the installation is finished in order to prevent from dust as much as possible in critical dusty environment.

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

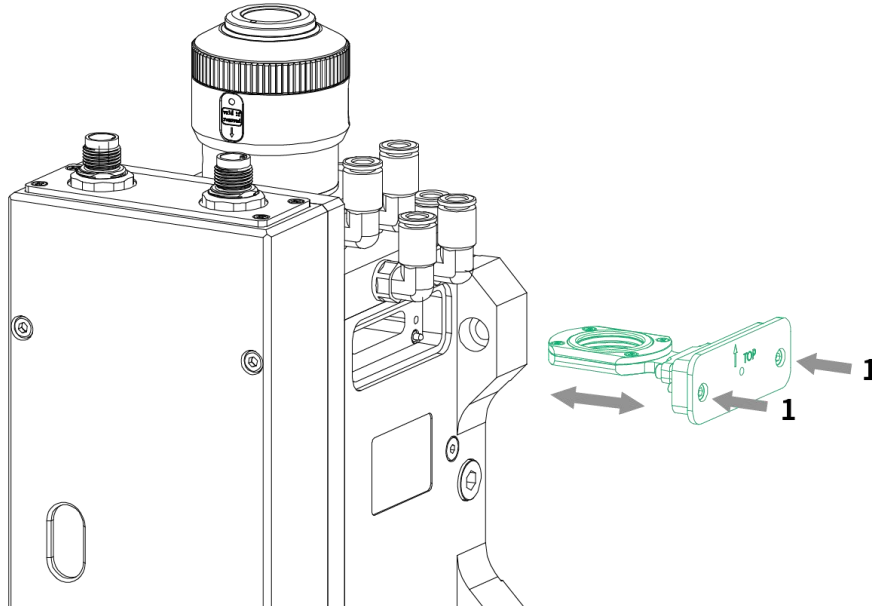


The shaking or vibration of cutting head due to incorrect earthing will cause damage to sensor mechanism and machine.

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



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



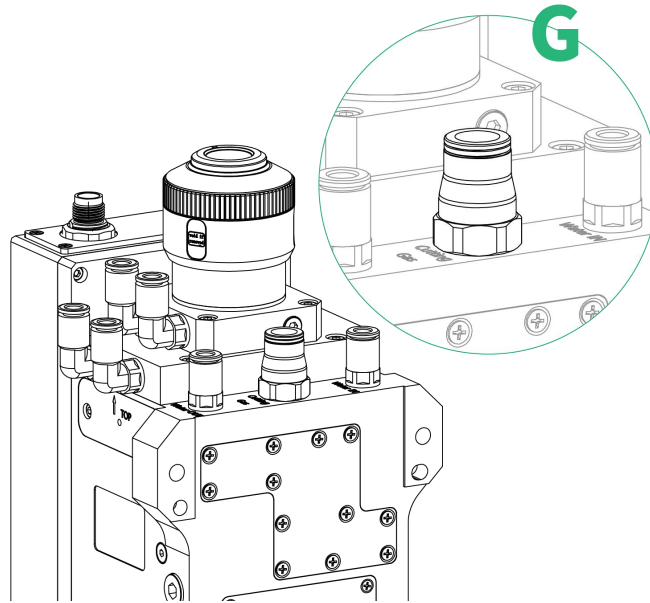
- Loose bolts (item 1), and the drawer of glass holder will pop up automatically. Pull out the glass holder until the glass can be seen completely.
- Check if there is any contamination on the glass and blow off the dust on cover glass with clean air if it's needed till the glass surface is clean.



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.

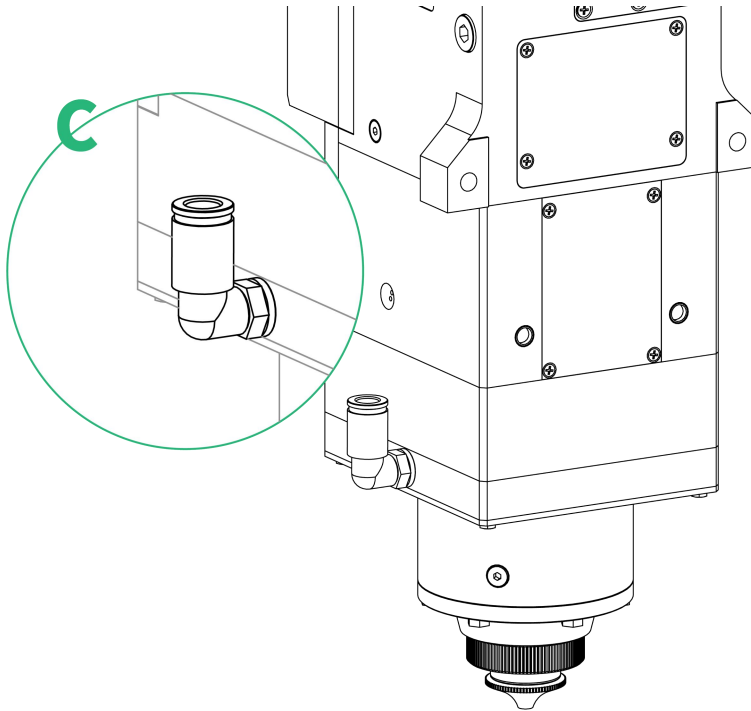
Cutting Gas	Purity	Maximum Content of Water Vapor (ppm)	Maximum Content of Hydrocarbon (ppm)
Oxygen	> 99.5%	<5 ppm	<1 ppm
Nitrogen	>99.9995%	<5 ppm	<1 ppm

- Connect the gas to the $\Phi 10$ 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 Gas (Nozzle)



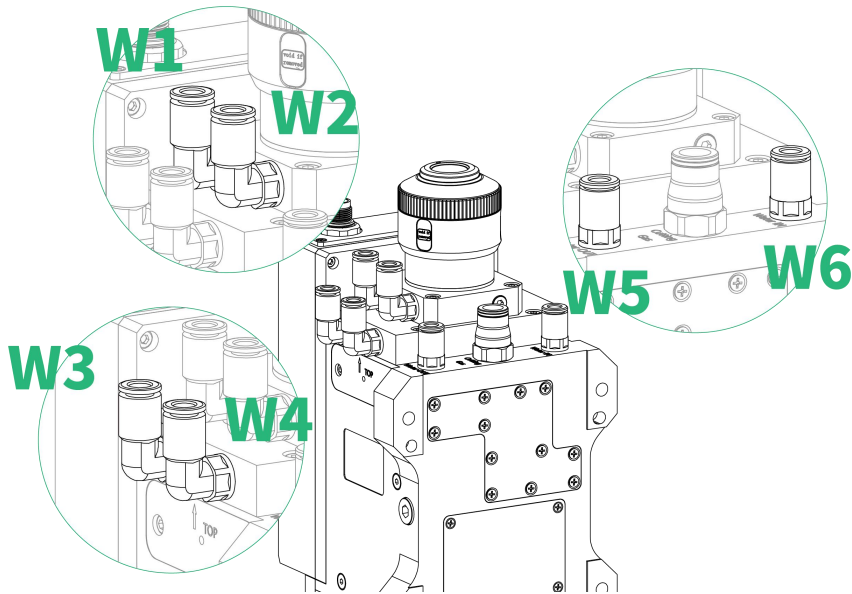
Dried nitrogen or fine filtered air is recommended but oxygen is prohibited for nozzle cooling.
Maximum gas pressure: 5bar(0.5MPa)

- Connect the gas to the $\Phi 8$ interface (C).



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.

2.5.3 Connection of Cooling Water



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

- Connect the cooling water to the $\Phi 6$ interface.
- Cooling pipeline of the fiber interface: W1, W2
- Cooling pipeline of the collimation module: W3, W4
- Cooling pipeline of the machine: W5, W6

The cooling water shall meet the following technical requirements.

Minimum flow speed	1.5 l/min
Entry pressure	170-520kPa
Entry temperature	\geq room temperature / $>$ dew point
Hardness (relative to CaCO ₃)	$<$ 250mg/L
PH range	6 to 8
Particle size allowed	Diameter less than 200 microns



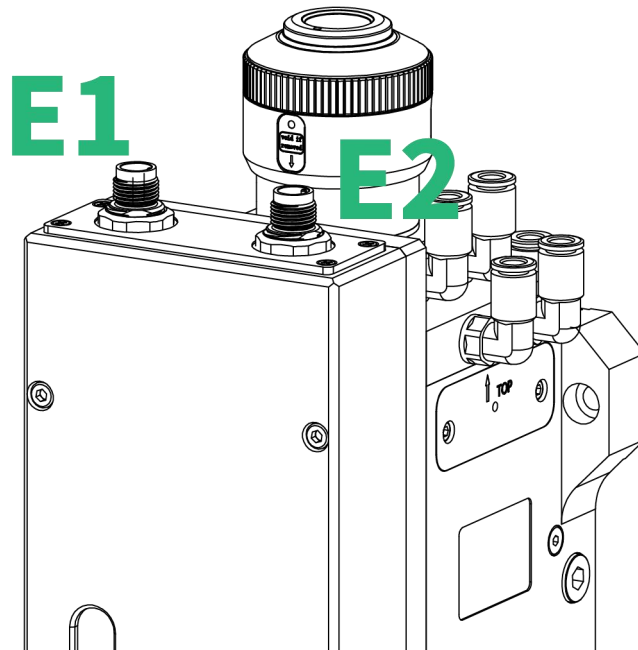
To avoid corrosion, it is a must to comply with the related instructions and maintenance interval of the equipment, manufacturer and the cooling water device. CAUTION: The wiring must be done when the power is off. Operate the power-on test after the wiring is checked.



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 in a low-level and normally closed mode and only outputs low-level signals when not actuated. Please install a relay if necessary.



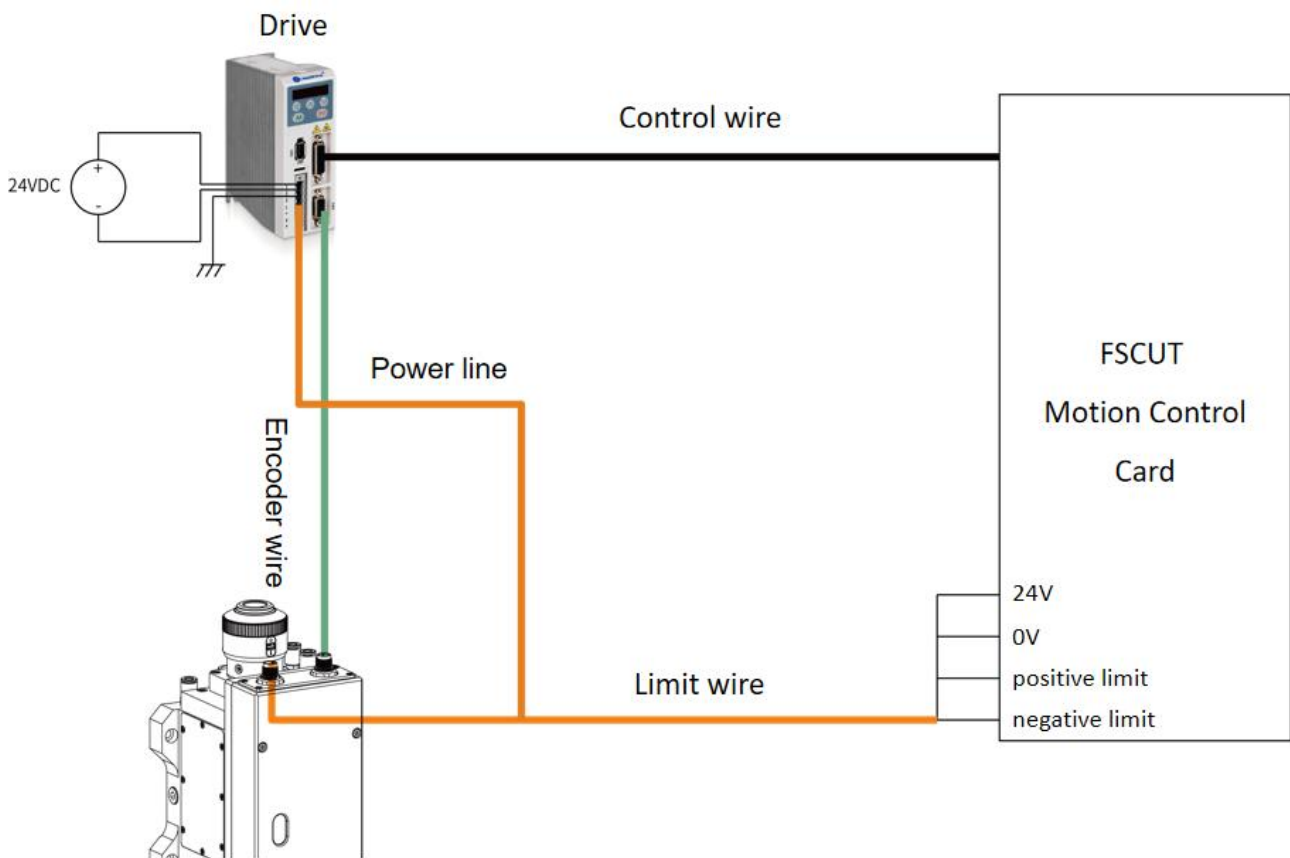
Caution: The wiring must be done when the power is off. Operate the power-on testing after the wiring is checked.

3.2 System Commissioning

Take FSCUT 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.)



Electrical signal:

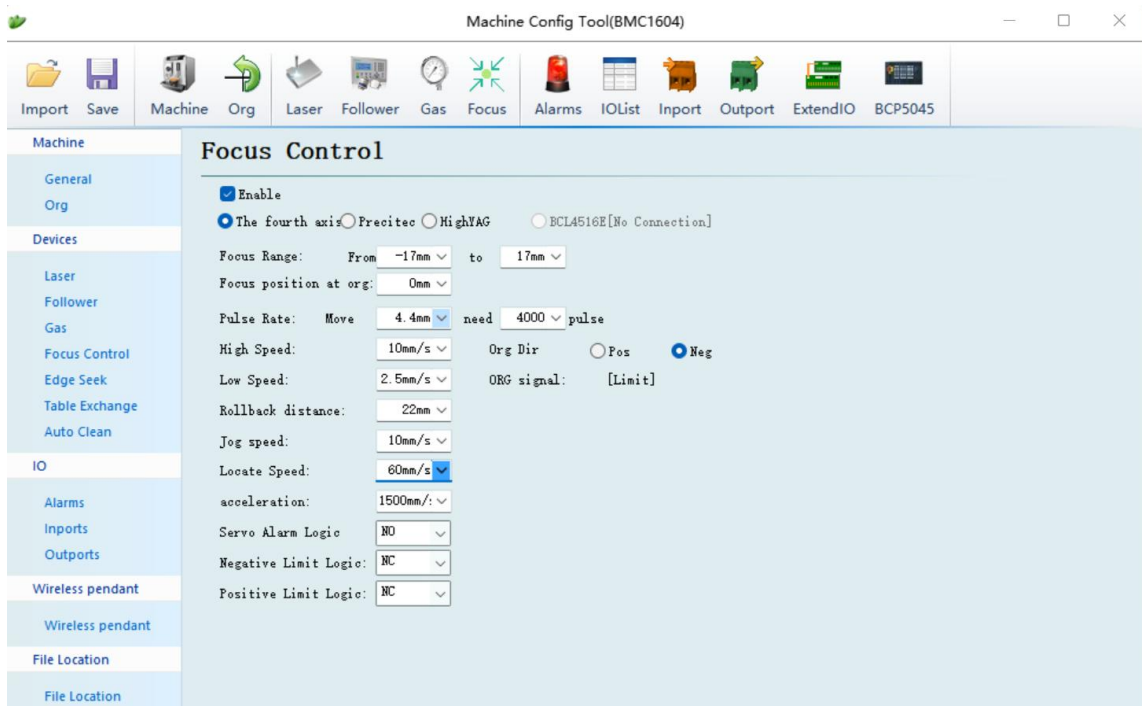
White	Red	Pink	Blue
+24V	0V	Positive limit	Negative limit



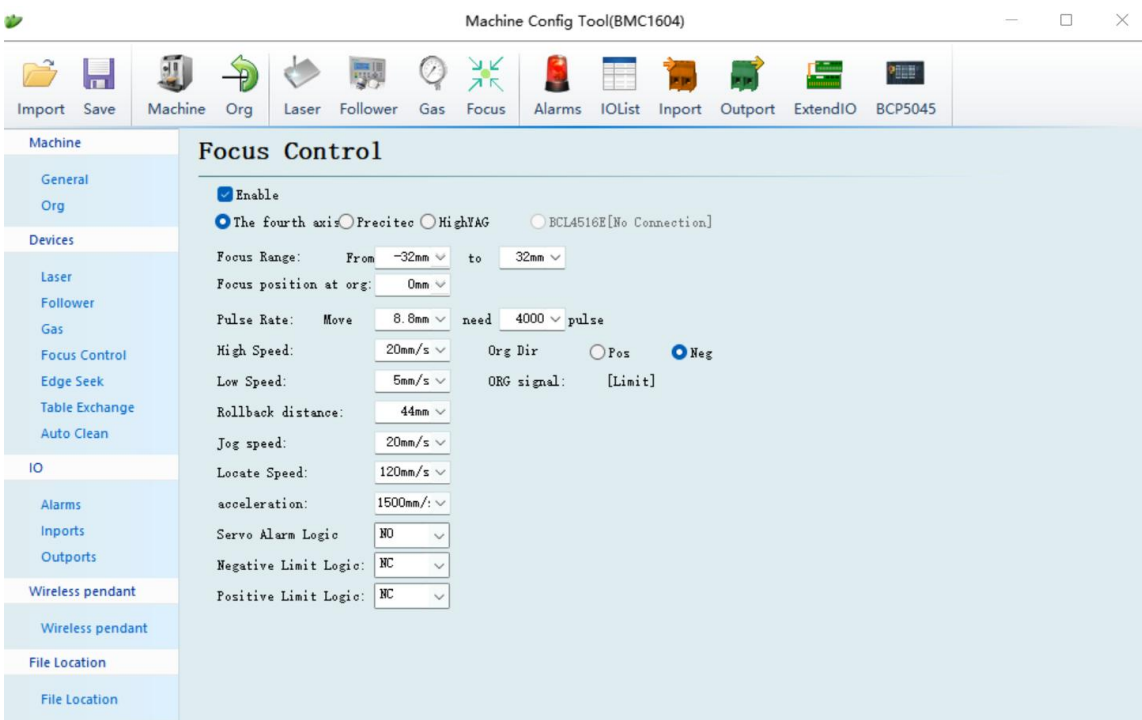
The limit sensor is effective with low-level voltage, normally closed, and continuously outputs 0V signals in the resting state.

3.2.2 System Setting

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

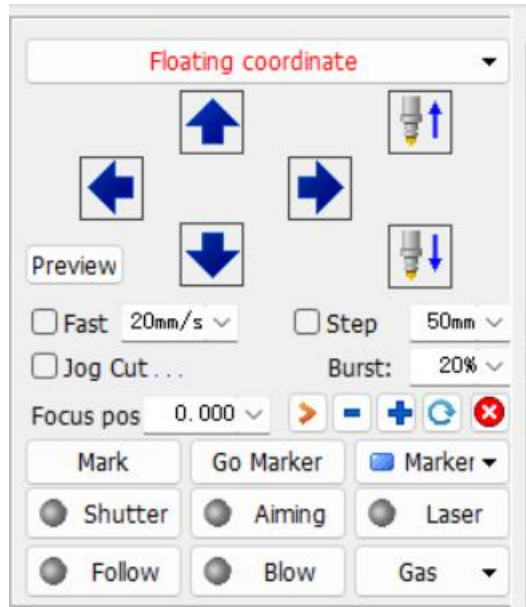


Optical configuration: 100:150



Optical configuration: 100:200

3.2.3 Commissioning



1. Make the J-axis inching and check the normal moving condition, with the distance of the screw pitch and the direction. The zero mark on the scale moves upward to the J+.
2. Move the J-axis slowly to reach the position limits. Check the direction and limit signal are in normal condition.
3. Click the Homing icon. J-axis moves to the minus direction and returns to the zero point again when reaches the limit position. That makes the zero point coincides with the position of zero focus. Homing complete.



- Click “+” to move the lens barrel upwards to the positive limit. Click “-” to move the lens barrel downwards and reach the negative limit.
- Back to the zero point till the negative limit and take the negative limit as a sampled signal.
- 8.8mm screw pitch, 4000ppr.
- Suggested positioning speed 100~120mm/s.

3.3 Mobile APP

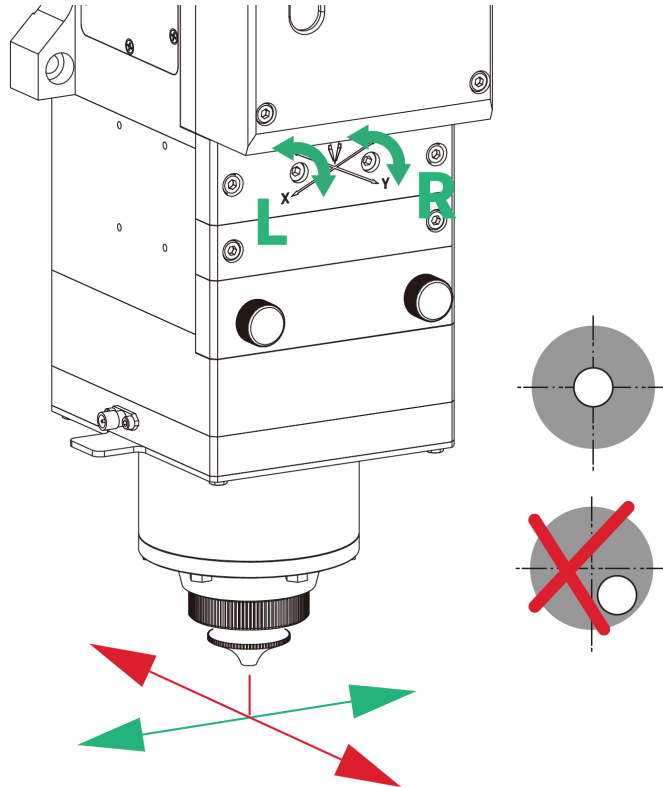
- Start the app and complete the connection according to the instruction.
- Complete setting manually bases on actual needs.

Example:

Smart inspection data setting	Remark	Setting value
Temperature of bottom cover glass	Alarm threshold 45°C	45°C

3.4 Beam Alignment and Zero Focus Correction

3.4.1 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.**

3.4.2 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.

Manually dotting please refer to the following steps:

1. Attach one textured tape on nozzle tip. Set laser power to 80-100W.
2. While moving each 0.5mm focus (as small as possible), shot a hole on the textured tape.
3. 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.

4 Maintenance

4.1 Overview

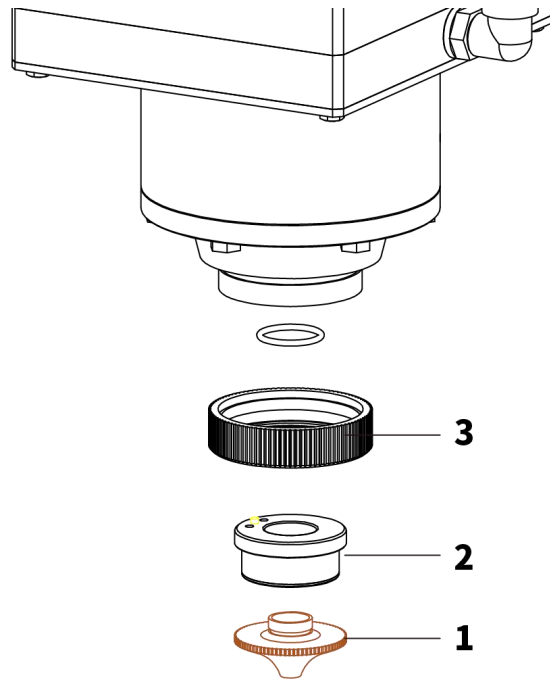
- Regular maintenance and cleaning:
 1. Checking the pipeline, cable connection, fastening of the laser head, the fixing of seamless cover glass holder and nozzle
 2. Cleaning dirt

- The following parts need to be maintained, and replaced if worn:
 1. Nozzle and ceramic body
 2. Cover glass and axial sealing parts (cover glass holder)

- To ensure the effective operation of the follow system, must keep the clean electric contact of these fittings:
 1. Nozzle and ceramic body
 2. Interface of sensor(TRA) and amplifier

- To avoid corrosion, must comply with the related instructions and maintenance interval from the manufacturer.

4.2 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.

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



Tighten the nozzle and lock the nut only by hand (without tools). Otherwise, the ceramic body might be damaged.



Keep the contact surface of all parts and clean.

4.3 Maintenance of Cover Glass

Due to processing techniques of laser cutting, the cover glass needs to be maintained regularly. It is suggested to clean the cover glass once a week.

Tools needed: dustproof gloves or finger-cots, polyester cotton swabs, absolute ethanol alcohol, and rubber air pump cleaner for compressing and cleaning air, etc.

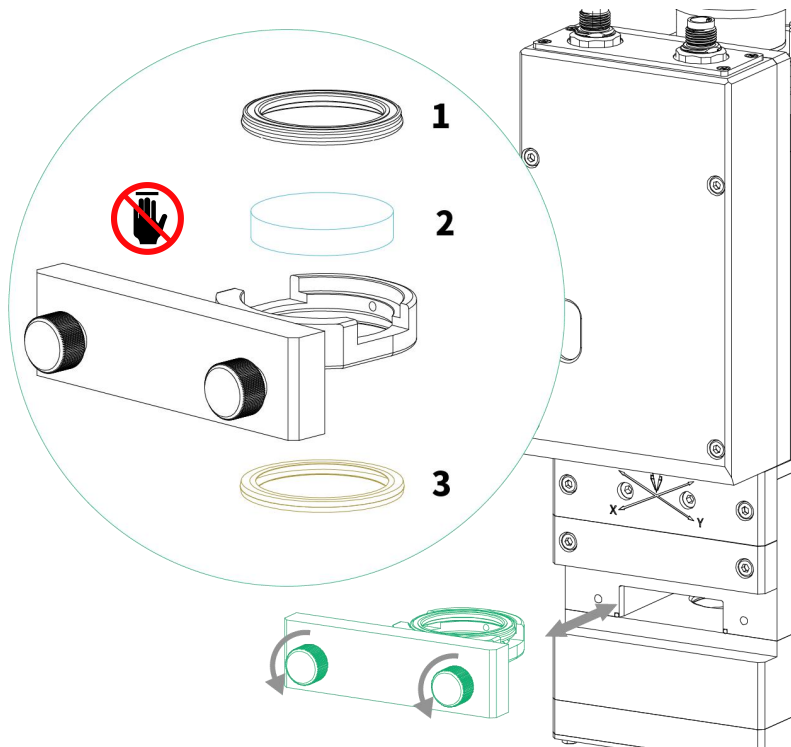
Cleaning method:

- Spray the ethanol on the cotton swab;
- Pinch the side edge with the left thumb and forefinger. Pay attention not to touch the glass surface in case of any traces are left.
- Place the glass in front of eyes and hold the polyester swab in the right hand. Gently wipe the glass from one direction with a left-to-right or top-down approach. Please note that do not wipe back and forth to avoid secondary pollution to the glass. And then, blow the glass surface by the rubber air pump cleaner.



Clean both sides of glasses. Afterward make sure there is no residue on the glass.

4.3.1 Maintenance of Cover Glass Holder (Bottom Cover Glass)

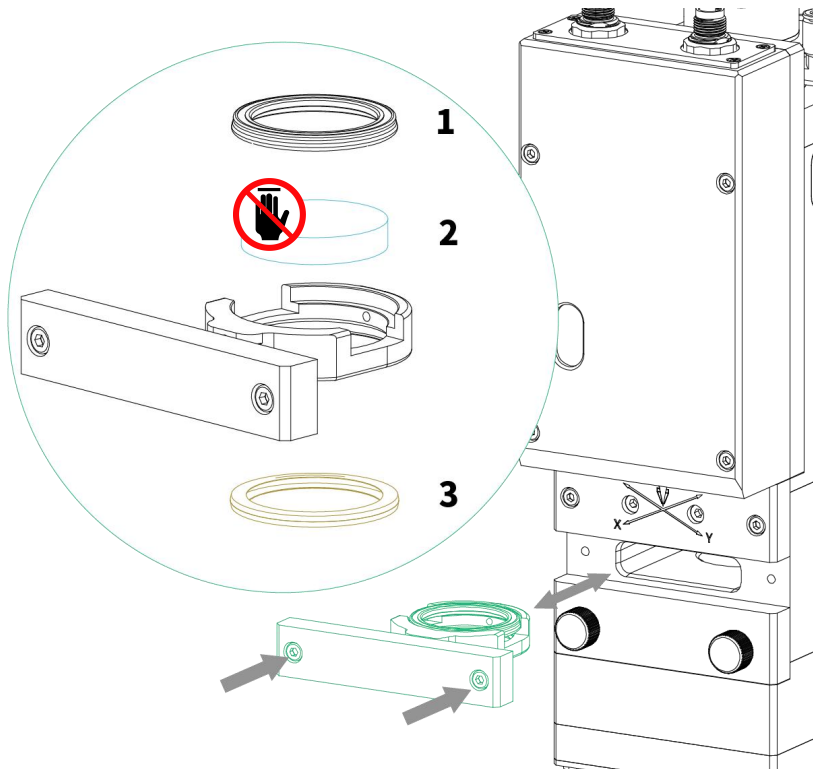


1. As shown above, loose the 2 bolts to pull out the cover glass holder by pinching 2 edges of drawer type holder.
2. Seal the mounting openings with textured tape immediately.
3. Remove the pressing ring (1) and cover glass (2) after wearing finger-cots.
4. Clean the cover glass holder and seal ring (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. Insert the cover glass holder back into the laser head and tighten the bolts.



The whole process shall be done in a clean place. Must wear the clean gloves or finger-cots to remove and install the lens. **It is not allowed to pull out the edge of seal ring directly as it is very easy to be damaged.**

4.3.2 Maintenance of Cover Glass Holder (Middle Cover Glass/Protection Glass)



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. Insert the cover glass holder back into the laser head and tighten the bolts.



The whole process shall be done in a clean place. Must wear the clean gloves or finger-cots to remove and install the lens. **It is not allowed to pull out the edge of seal ring directly as it is very easy to be damaged.**

Appendix

Available Accessories

Name	Technical Data	Material Code
Fiber Interface	QBH	211FIA3003
Lens	Biconvex spherical lens F100-D37	3250010280
	Diverging meniscus lens F100-D37	3250010281
	Biconvex spherical lens F190.5-D37	3250010419
	Diverging meniscus lens F190.5-D37	3250010420
Cover Glass	D24.9x1.5	211LCG0086
	D37x7	211LCG0078
Nozzle	Single layer Φ 1.2	120GJT7212
	Single layer Φ 1.3	120GJT7213
	Single layer Φ 1.4	120GJT7214
	Single layer Φ 1.5	120GJT7215
	Single layer Φ 1.6	120GJT7216
	Single layer Φ 1.7	120GJT7217
	Single layer Φ 1.8	120GJT7218
	Single layer Φ 2.0	120GJT4520
	Single layer Φ 2.5	120GJT4525
	Single layer Φ 3.0	120GJT4530
	Single layer Φ 3.5	120GJT4535
	Single layer Φ 4.0	120GJT4540
	Single layer Φ 4.5	120GJT4545
	Double layer Φ 5.0	120GJT4550
	Double layer Φ 1.2	120GJT7212
	Double layer Φ 1.3	120GJT7213
	Double layer Φ 1.4	120GJT7214
	Double layer Φ 1.5	120GJT7215
	Double layer Φ 1.6	120GJT7216
	Double layer Φ 1.7	120GJT7217
Double layer Φ 1.8	120GJT7218	
Ceramic Body	D28-M11	120515099A