



# BM109 SERIES

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1500W Auto-Focusing Laser Cutting Heads User Manual

**Empower** 嘉强

Hotline: 400-670-1510

Email: sales@empower.cn

Add: No.72, Lane 1500, Xinfei Road, Songjiang District, Shanghai



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Thank you for your choosing our product!

This manual makes a detail introduction about the use of BM109 laser cutting head, including installation, setup, operation and service etc. Please directly contact us if you have other things to know.

Please read these instructions carefully before use the series cutting head and relative equipments. This will help you to use it better.

Because the product keeps renewing, please note the product you receive may differ slightly from the illustrations in this manual in some aspects. We apologize for your inconvenience here.

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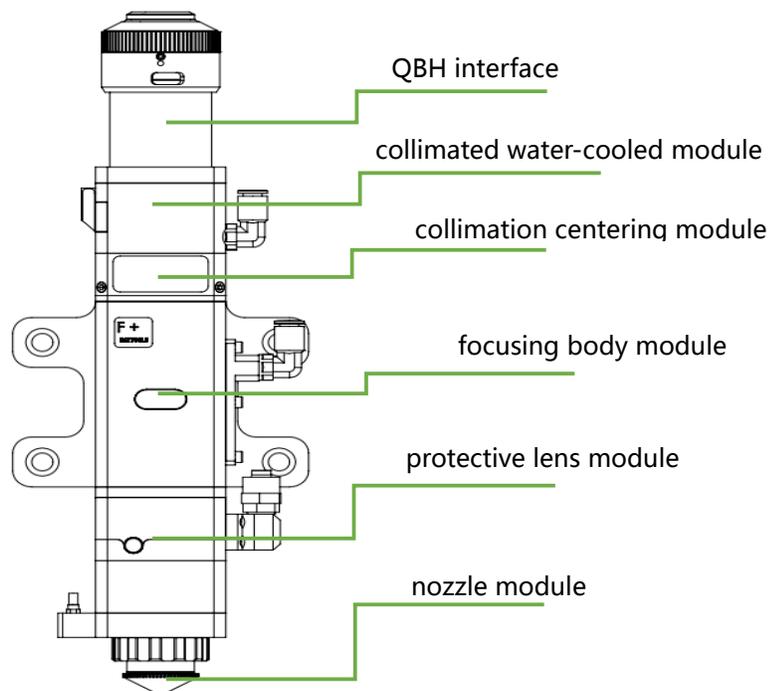
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## 1 Summary

This manual covers the general description of BM109 series products, including the basic installation, factory settings, operation, use and maintenance services and other aspects. The specific optical mechanical customization configurations are too much, so only the main unit parts will be introduced in this manual.

The BM109 series is an automatic focusing fiber cutting head released by Swiss RAYTOOLS AG in 2017. The product is equipped with external servo motor and internal driver units, which can drive the focus lamp to change position automatically in the range of about 17mm by linear mechanism. Users can continuously focus through setting program to finish the rapid perforation of thick plates and the automatic cutting of plates of various thickness and materials. The product can be equipped with D28 composite lens group to integrate the beam, and equipped with QBH interface with fiber laser; optimized optical and water-cooled design allows the laser head to work under low and medium power steadily for a long time.



### 1.1 Product Advantages

- Optimized optical configuration and smooth and efficient airflow design;
- Automatic focusing range +8~-9mm, adjustment accuracy 0.05mm;
- Equipped with D28 composite lens, the maximum fiber input power can carry 1.5KW;

- Maximum acceleration of focus lens driver  $10\text{m} / \text{s}^2$ , maximum speed  $6\text{m} / \text{min}$ ;
- The drawer type lens holder makes the replacement of protective lens more quickly and easier
- The composite lenses were used for collimation and focusing to obtain the best optical quality and cutting effect;
- With QBH interface, can be adapted with various fiber lasers.

## 1.2 Structure & Function

As shown in Figure 1, the laser head consists of five basic units, such as collimated water-cooled module, collimation centering module, focus drive module, protective lens module, nozzle module.

- Collimated water-cooled module: complete the function of cooled collimating module, water-cool the collimation centering module;
- collimation centering module: complete the function of fiber collimation, collimate incident laser into parallel beams with centering function;
- Focus drive module: focus the collimated beam to a high power density convergent beam and realize automatic adjustment of the focus position by the driving device;
- Protective lens module: protecting lens can protect focusing lens from the damage of return slags and extend the life of focusing lens;
- Nozzle module: guide beams to the processing workpiece and produce high-speed air jet joint-cutting to achieve high-quality cutting.

## 2 Machinery Installation

### 2.1 Hole Site installation

BM109 laser machining head and the fixed mounting hole size and position of the machine tool are shown in Figure 3.1. Customers are 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 follow up stable cutting effect.



**CAUTION:** the Z-axis sliding base for fixing laser processing head should be connected with machine tools and keep a good grounded.

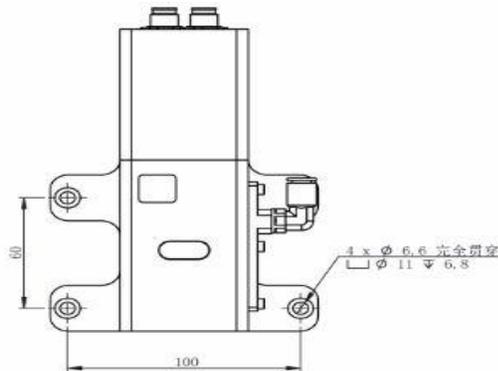


Figure 3.1 - Hole site installation

### 2.2 Connection of Water Pipe and Gas Pipe

#### 2.2.1 Water-cooled Interface

BM109 laser processing head has 2 sets of water-cooled channels which direction of water entry and exit can be arranged arbitrarily. It is important to note that when the laser power is greater than 500 watt hours, it is recommended to use water-cooling. As you can see from Figure 3.2, the position and amount of the water-cooled interface, and the right table details the recommended flow velocity.

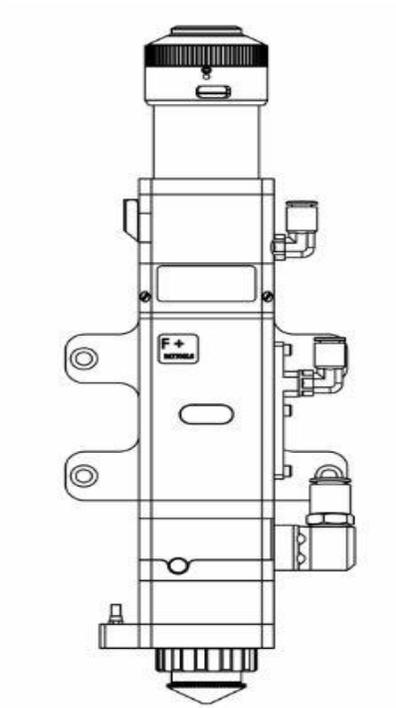


Figure 3.2 - Positions of the joints of water pipe and gas pipe

<b>Outer diameter of water pipe caliber</b>	6mm
<b>Minimum flow speed</b>	1.8L/min (0.48gpm)
<b>Entry pressure</b>	170-520kPa (30-60 psi)
<b>Entry temperature</b>	≥room temperature / > dew point
<b>Hardness (relative to CaCO<sub>3</sub>)</b>	< 250mg/liter
<b>PH range</b>	6 to 8
<b>Particles size available</b>	Diameter less than 200 microns

This water-cooled interface is designed as a closed-loop water-cooled system that can also be used in conjunction with external free water supply and must meet the requirements in the above list.

### 2.2.2 Assist Gas Interface

The impurity in auxiliary 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 form below is the recommended auxiliary gas specification. The higher the purity of the gas, the

better the quality of the cutting section.

Gas	Purity	Maximum content of water vapor (ppm)	Maximum content of hydrocarbon (ppm)
oxygen	99.95%	<5 ppm	<1 ppm
nitrogen	99.99%	<5 ppm	<1 ppm
argon	99.998%	<5 ppm	<1 ppm
helium	99.998%	<5 ppm	<1 ppm
Diameter of cooled gas pipe (Outer diameter)		10mm	

Impurity can be filtered out in gas supply tube, but oxygen and water vapor can permeate the light path system through nonmetal materials, which is the source of the appearance of dust and hydrocarbon. Stainless steel fittings are recommended, at the same time, operators must use filters which can remove a minimum of 0.01 micron particle to purify.

A pressure gauge with a stainless steel diaphragm is recommended. Industrial pressure gauges suck in air. Rubber diaphragm produce hydrocarbon by aging or other factors.



**CAUTION: gas interface can not be replaced arbitrarily, especially do not use PTFE TAPE, Otherwise, the gas path will be blocked, the normal cutting will not be possible and the laser head parts will be damaged at the same time.**

## 2.3 Connection of Cutting Head Cable

This paper mainly introduces the connection between the cable and the cutting head. The connection of control sections such as the driver refers to the wiring diagram of each series of system.

### 2.3.1 Connection of Cutting Head and Cable

Connect the corresponding connector of cutting head with eight-core power limit cable, twelve-core encoder cable respectively (as shown in Figure 3.3). After the proper length is reserved, insert and fix the cable into the track groove of the machine tool.

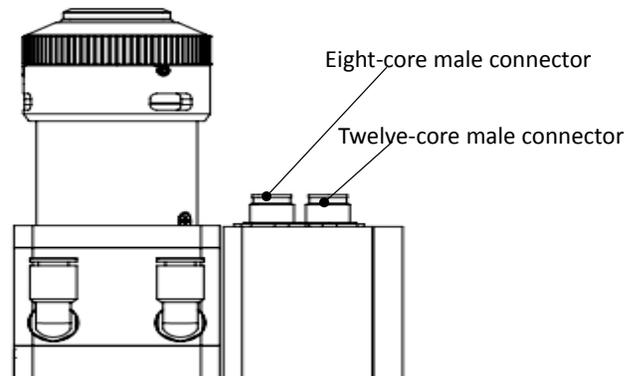


Figure 3.3 - Cable interface of laser cutting head

### 2.3.2 Connection Cable and Driver Connection

Connect the eight-core power limit cable and the twelve-core encoder cable to the corresponding interfaces on the drive as defined on the cable sleeve. For the wiring of the driver and limit sensor cables, see the appendix for each series of system components - wiring diagram. **Caution: the limiting sensor is low-level normally closed output mode, and the two are normally closed output mode (low level signal is output by the sensor when not triggered); if necessary, the user should install relays for conversion in person.**



**CAUTION: All wiring is in the state of power failure, and the power can be debugged after inspection without errors.**

## 2.4 Fiber Input Interface

BM109 is suitable for most industrial laser generators. It is equipped with collimating mirror assembly.

The connection between the end of the fiber and the cutting head is called fiber interface. The commonly used fiber connector is QBH, and every fiber interface has its unique fixation method. Please refer to the corresponding instruction of fibre-optical splice. Figure 3.4 shows the installation interface of QBH connector.



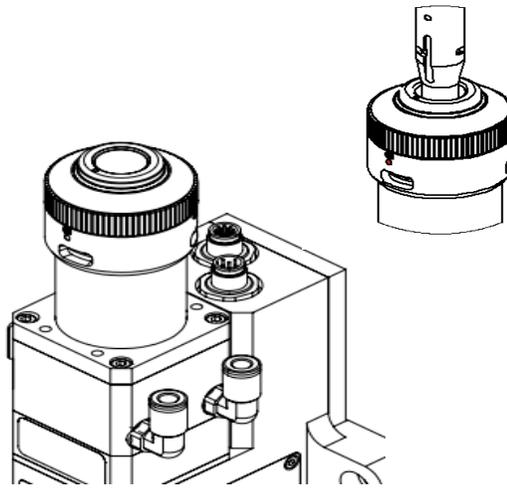
**WARNING: The optical devices must be kept clean and all dust must be removed before use. If the laser head is vertically inserted in the optical fiber, the laser head must be rotated 90 degrees to the horizontal level and then inserted into the optical fiber to prevent dust from falling on the surface of the lens. Fix the laser head after inserting the optical fiber.**

## 2.5 Fiber Insertion and Interface Direction Adjustment

In this paper, an optical fiber insertion method is described in conjunction with a QBH joint.

First, align the red point at the end of the QBH interface with the red point of the handwheel; then remove QBH dust proof cover and align the red mark of fiber output end with QBH red mark and insert straight lines to bottom; then turn the QBH handwheel clockwise. It is in place when you hear the "Da" sound, then pull the handwheel up and turn clockwise again. (see Figure 3.4)

When the fiber connector is inserted into the interface, the red dot on fiber is too far away from the red dot on laser head interface, causing alignment insertion impossible, and at this time, the user can refer to steps below to adjust the position of fiber interface on laser head for solving the problem. As shown in Figure 3.4, unscrew the 4 locking screws of the graphical position of the part with a wrench, rotate the QBH interface and screw the locking screws after the red mark is in place.



**Figure 3.4 - Diagram of inserting fiber into QBH interface**

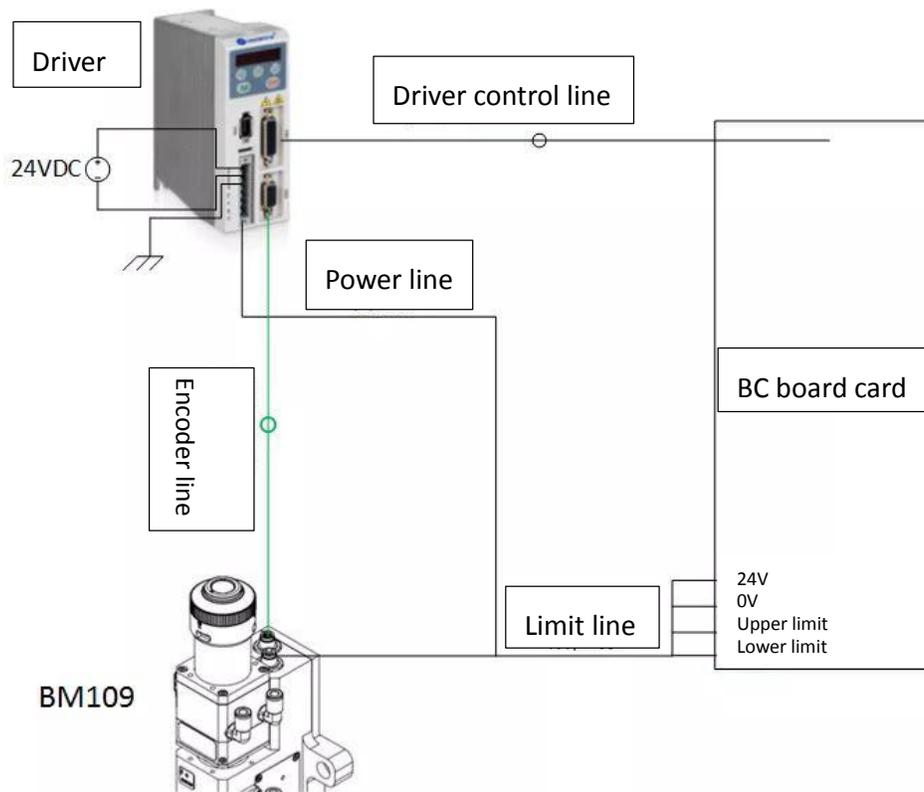
### 3 System Installation Commissioning

#### 3.1 Non-bus Position Loop-BC

##### 3.1.1 Distribution

- Driver + stepping motor:

The motor is mixed stepping motor, which needs to connect 24V, 0V and earth to the Vdc, GND and PE of the driver respectively. A+, A-, B+, B- are the power lines of the stepping motor. Please follow the line label connection (24V power supply is customer-owned)



- Limit signal:

Black	Red	Pink	Blue
+24V	0V	Upper limit	Lower limit

**Note:** the limit sensor is active low, and the signal is often closed, and it continuously outputs 0V signal when it is not triggered. The limit diagram is shown in Figure 4-1.

### 3.1.2 Software Settings

Open the platform configuration tool, enter the value shown in Figure 4.6

1. Set parameter as the figure.
2. Enter the interface and set parameters

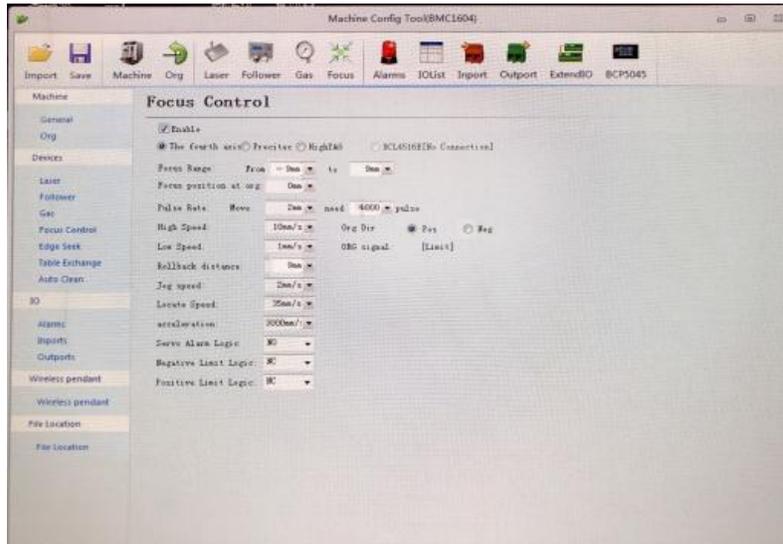


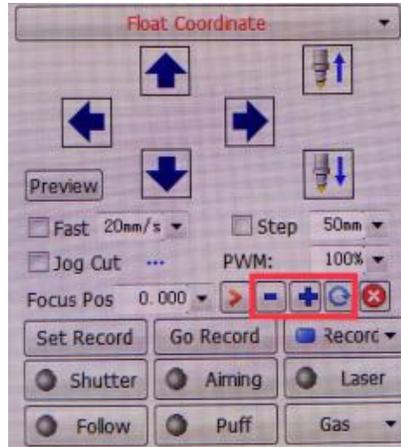
Figure 4.6 -Platform configuration tools

### 3.1.3 Interface Operation

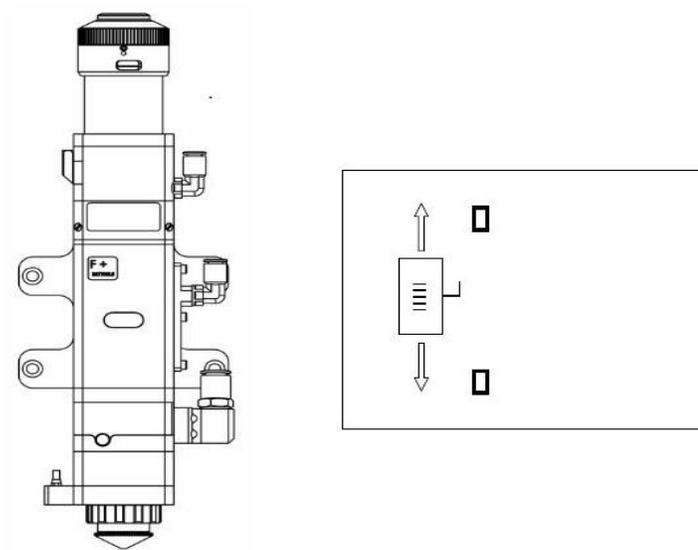
1. Inch J axis, check up if the action is normal (distance to “pitch” and direction), 0 scale moves up to J+.
2. Slowly moving the J axis so that it meets the positive and negative limit, check whether the direction, the limit signal is normal or not.
3. Click zero returning icon, the J axis moves in the negative direction and return zero again when touches negative limit, at the same time, the position of zero point coincides with zero point position and the zero returning is finished.

**Note:**

1. Click+, the barrel moves upward. When it touches positive limit, click -, then the barrel moves downward to the negative limit.
2. The direction of back to the origin is negative, and take lower limit as a sampling signal.
3. Pitch 2mm, 40000 pulses one turn
4. Recommended positioning speed 50-100mm/s.



**Figure 4.7 - operation interface**



**Figure 4.1 - Limit diagram**

## 4 Beam Adjustments and Focusing

### 4.1 Beam Adjustments (QBH Interface)

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

Lens centering of BM109 laser cutting head can be finished by adjusting collimating mirror, X-Y direction. The adjusting screw is located on the top of the cutting head as shown in Figure 5.1. Using inner hexagon spanner can loosen or screw the adjusting screw until the beam is located in the middle of the nozzle. Make sure the laser beam output from the center of nozzle. A method commonly used tape dotting method:

Take a piece of transparent tape flattened directly below the end face of the nozzle center hole;

Open the inner guiding red light of the laser, find and observe the position of nozzle center that the red light in the scotch tape relative to. Adjust the red light spot to the relative center of the nozzle by adjusting the screw;

Next, open and adjust the laser generator at the range of 80W-100W and dot manually;

Tear off the tape and check whether the hole in the center of the nozzle;

Repeat the above steps to find the optimum relative nozzle center position of the beam;

This centering operation requires a series of adjustments, which is the basic operation of general laser centering.

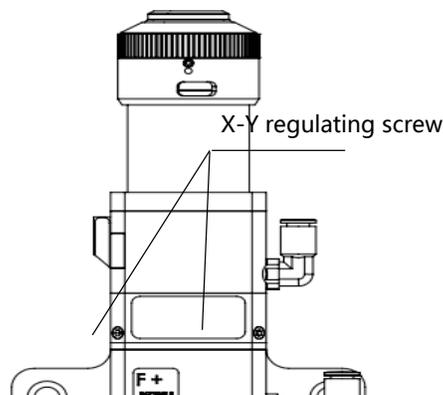


Figure 5.1 - beam centering

## 4.2 The Focus Position Adjustment

BM109 is equipped with automated focusing system. But it still needs to dot manually to redecide the focus position when it initially resets or replaces lenses, lasers, etc. For details about operating system parameters, please refer to the system instructions.

Manual focus can refer to the following steps:

1. The laser head scale is displayed to the maximum, and the laser power range is set to 80-100w;
2. Then, within each moving 0.5mm (as small as possible), open a laser hole on the textured paper;
3. Punching for several times, finally compare and find out zero focus, namely the scale corresponding to the hole with the smallest aperture, that is, the focus is just at the end of the nozzle section.

## 5 Maintenance

### 5.1 Cleaning Lens

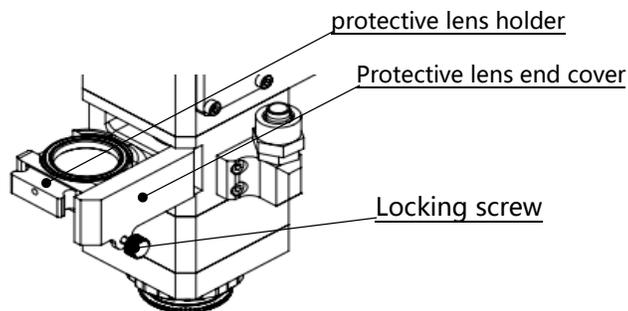
It's necessary to maintain lenses regularly because of the characteristic of laser cutting process, it is recommended to clean the protective lenses once a week. In order to facilitate the maintenance of the protective lens, the protective lens holder adopts a drawer type structure. (Figure 6.1)

#### Lens cleaning

a. Tools: dust-proof gloves or finger stall, long fiber cotton stick, ethanol, rubber blowing.

b. Cleaning instruction:

1. The left thumb and index finger wear fingertips;
2. Spray ethanol onto the absorbent cotton stick
3. Hold the slide edge of the lens with left thumb and index finger gently.(note: avoid the fingertip touching the surface of the lens)
4. Put the lens facing to eyes, and hold the absorbent cotton stick with the right hand. Wipe the lens gently in single direction, from bottom to top or from left to right, (not wipe back and forth so as to avoid secondary pollution of the lens) and use rubber blowing to sway the surface of the lens and both sides should be cleaned. After cleaning, make sure that there is no residual: detergent, absorbent cotton, foreign matter and impurities.



**Figure 6.1 - Take out protective lens**

## 5.2 Removal and Installation of Lenses

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

### 5.2.1 Removal and Installation of Protective Lenses

The protective lens are a fragile part and need to be replaced after damage.

- As shown in Figure 6.2, open the buckle, open the cover of protective lens, pinch the two sides of the drawer-type lens holder and pull out the base of protective lens;
- Remove the pressing ring of the protective lens , remove the lens after wearing fingertips;
- Clean the lens, lens holder and seal ring. The elastic seal ring should be replaced if damaged;
- Install the new cleaned lens (regardless of the positive or negative sides) into the drawer type lens holder.
- Put the pressing ring of the protective lens back.
- Insert the protective lens holder back to the laser processing head, cover the lid of the protective lens and fasten the buckle.

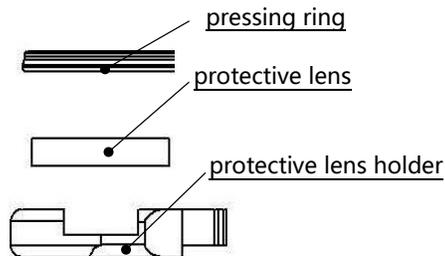


Figure 6.2 - structure of protective lens

### 5.2.2 Removal and Installation of Collimating Protective Glasses

The collimating protective lenses are a fragile part and need to be replaced after damage.

Use a 3 mm inner hexagon spanner to unscrew the screw of collimating protective lens (as shown in Figure 6.3);

Remove the gland of collimating protective lens, pinch the two sides of the drawer-type lens holder and pull out the base of protective lens; seal the part connected with the components of collimating protective lens with textured paper so as to prevent the entry of dust;

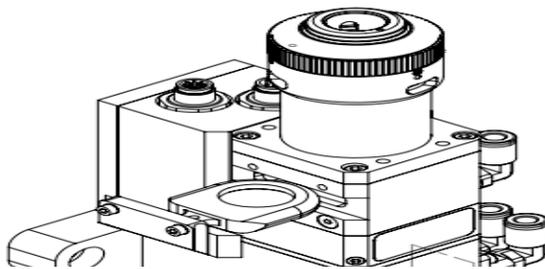
Wear the fingerstall and take out the lens;

Clean the lenses, lens holder and seal rings, and replace a new one for the damaged elastic seal ring;

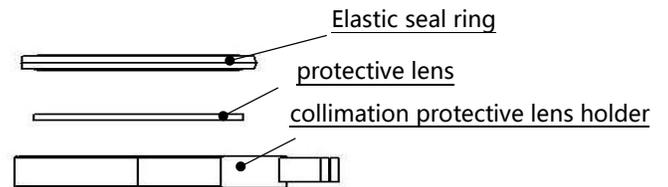
Install the new lens (regardless of the front and back sides) wiped clean into the drawer-type lens holder;

Re-install it back to the seal ring;

Re-insert the collimating protective lens holder to the laser processing head, cover the lid of collimating protective lens and tighten the locking screw.



**Figure 6.3 - Take out collimation protective lens**



**Figure 6.4 - collimation structure of protective lens**

**Note:** It is not allowed to directly pull out of the edge of the elastic seal ring, which will damage the elastic seal ring very easily.



### 5.2.3 Removal and Installation of Collimating Lenses

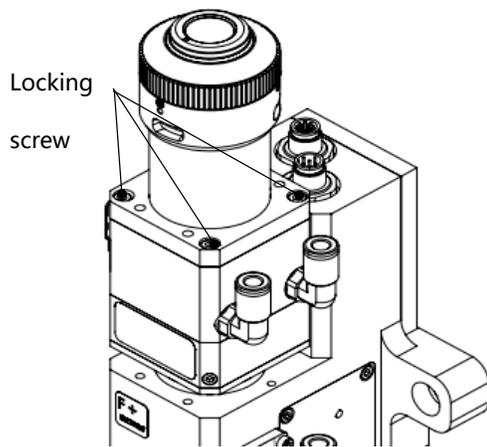
- Removal and installation of collimating lenses refer to the following steps:
- Remove the laser head, move it to a clean place, and clean all dust on the laser head surface;
- Use a 3mm internal hexagonal wrench to unscrew the locking screws of the collimating components (as shown in Figure 6.5), seal the part connected with the components of collimating components with textured paper so as to prevent the entry of dust;
- Screw out the collimating lens holder, and remove the spring compression ring and collimator lens with the lens-removing tools;
- Replace or clean the collimating lenses.
- As shown in Figure 6.6, reassemble the components of collimating lens in order, pay attention to

screw the spring compression ring appropriately with force, and re-screw it into the collimating components;

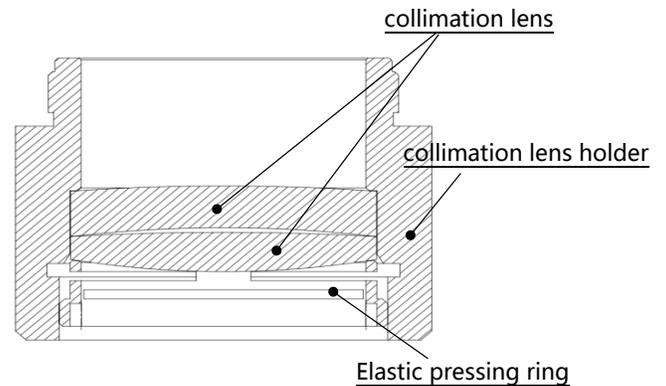
- Lock the screws of the collimating components;
- Check whether the focus position is in the center of the nozzle hole before use, if it is not in the center, it is necessary to carry out center-regulating operation again.

### 5.2.4 Removal and Installation of Focus Lenses

- Removal and installation of focus lenses refer to the following steps.

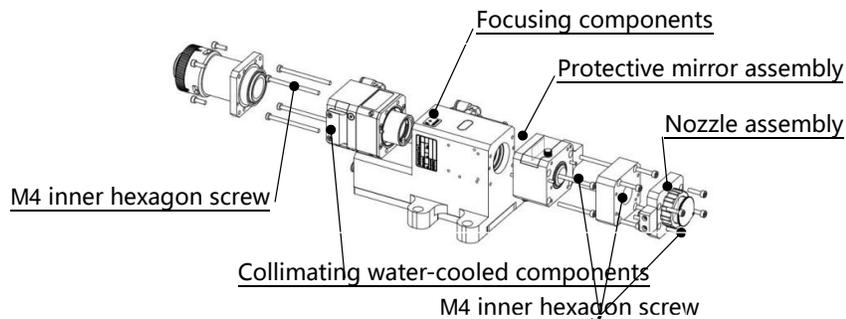


**Figure 6.5 - Disassemble collimation components**



**Figure 6.6 - Diagram of installing collimation lens**

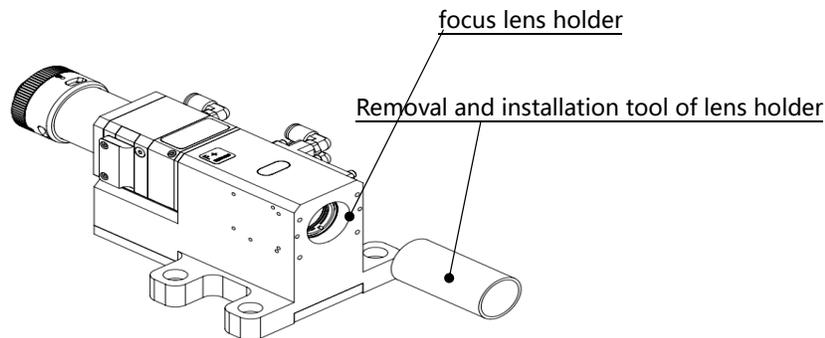
- Remove the laser head, move it to a clean place, and clean all dust on the laser head surface;
- Place the laser head horizontally. As shown in Figure 6.7, remove the locking screws from bottom



**Figure 6.7 - Lens taking**

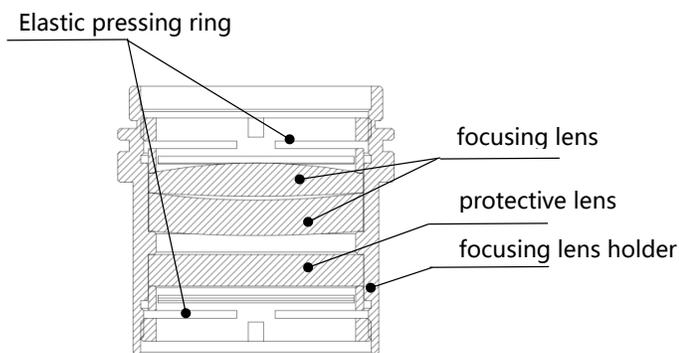
to top;

- As shown in figure 6.8, use a lens-taking tool to remove the focus lens holder;



**Figure 6.8 - Removal and installation tool of focus lens holder**

- Remove the spring pressure washer and lens with a lens taking tool;
- Replace or clean the focus lens;
- As the direction shown in figure 6.9, put the focusing lens and the spring pressing ring in the lens holder carefully and tighten the pressing ring properly;



**Figure 6.9 - Installation diagram of focusing lens**

- Spin the focus lens holder back to focus lens barrel and tighten it;
- As the sequence shown in Figure 6.7, reassemble and lock the screw.
- Check if the focus position is at the center of nozzle hole. If not, refer to the 3.1 step to reset the centering operation.

## 5.3 Replace Nozzle Connector

In the laser cutting process, the laser head will inevitably be hit, so it is necessary to replace the nozzle connectors.

### 5.3.1 Replace Ceramic Body

- Unscrew the nozzle;
- Press the ceramic body with hands, make it fixed and not oblique, and then screw off the pressing sleeve;
- Align the pin hole of the new ceramic body with 2 locating pins, press the ceramic body with the hand and screw on the pressuring sleeve;
- Screw on the nozzle and tighten it with appropriate strength.

### 5.3.2 Replace Nozzle

- Unscrew the nozzle
- Replace with a new nozzle, and re-tighten it with appropriate force.
- Do the capacitance calibration once again after replacing the nozzle or ceramic body.

## 5.4 Common Fault and Diagnosis of Driver

### 5.4.1 Fault Analysis of Driver

The server initially displays the interface when the motor is powered on

Displaying L \_\_\_\_0 indicates that the difference between the given pulse and the feedback pulse is 0.

LED Display	Implication	Note
	low parts of data	
	high parts of data	
	position error	The difference of given pulse and feedback pulse

LED display	Meaning	Remarks
	data-low	

	data-high	
	position error	difference between the given pulse and the feedback pulse

When the driver controls the motor movement;

1. If the motor moves normally, this value will change in real time according to the position of the motor. After the motor is stable, the value is 0. It means that the connection is normal and the servo works normally.

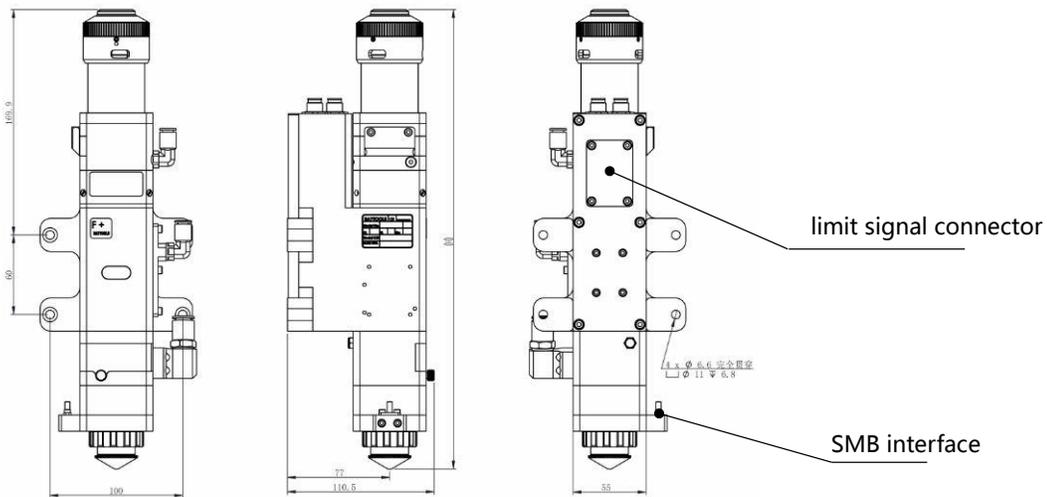
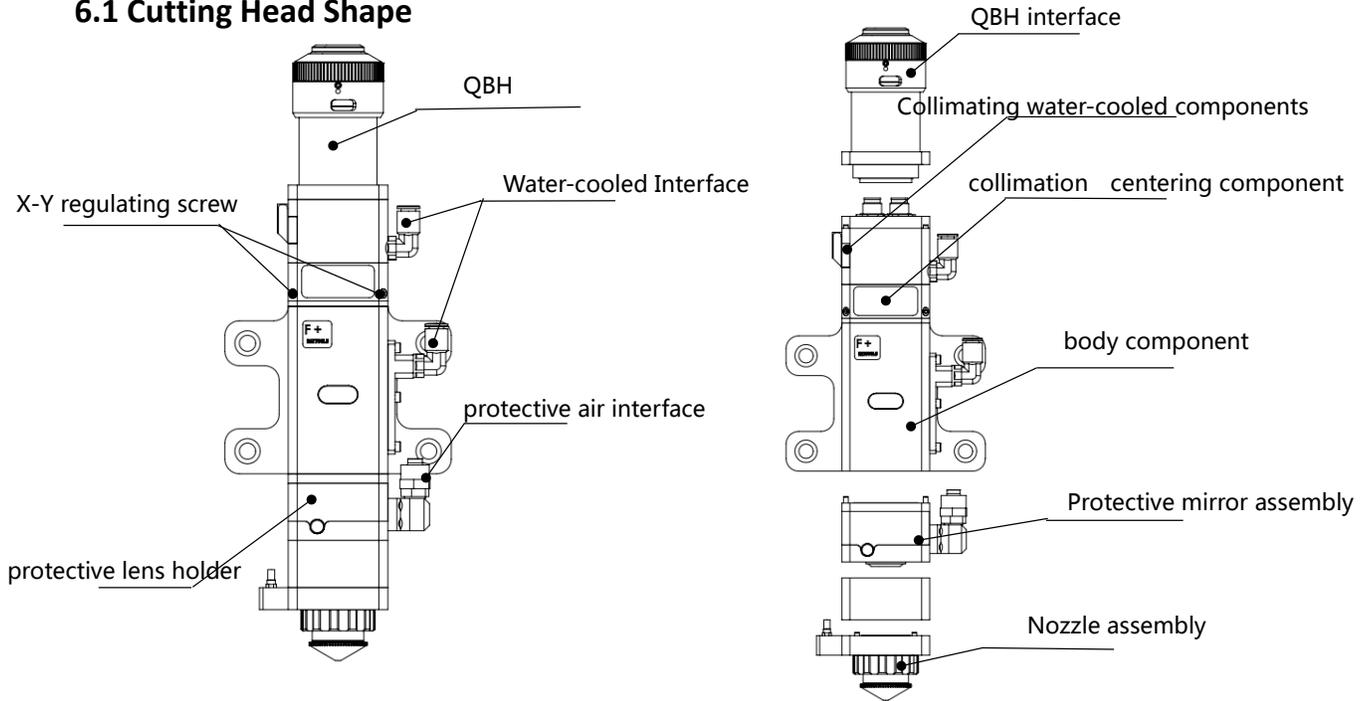
2. If this value remains 0 and the motor does not move, it means that the server does not receive a given pulse and it needs to check if the control line contact is good;

3. If the number has always been increasing or decreasing and the motor does not move, it means that the server receives the given pulse, but does not receive the feedback pulse (from the motor), and it needs to check if the power line and the encoder is in good contact, or whether the motor touches the upper and lower bounds, causing the motor unable to move;

4. When this value increases to 6000 or decreases to -6,000, the server will produce an overproof protection failure, and the interface will show Er020. When the driver fails, the driver will go down and prompt the corresponding fault code. The fault can only be cleared when the user powers off and powers on again.

## 6 Mechanical and Optical Configurations Diagram

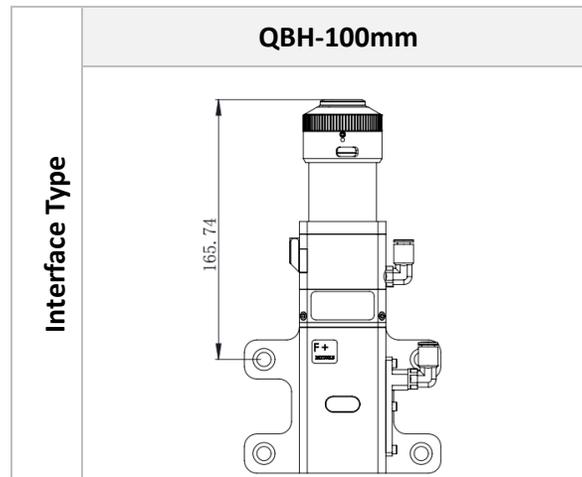
### 6.1 Cutting Head Shape



CL/mm		100	
FL/mm		125	150
H/mm	QBH	346.23	371.13

## 6.2 Cutting Head Configuration Diagram

### 6.2.1 Interface Type



### 6.2.2 Focus Length

