



BM115 SERIES

6-12KW Auto-Focusing Laser Cutting Head- User Manual

RAYTOOLS
Brighten your machine tools

Email: sales@raytools.ch

Add: EMMENTALSTRASSE 96 CH-3414 OBERBURG, SWITZERLAND



Version	V1.0
Date:	2017/12/14

Historical Version:

History version	Date	Change the profile	Editors	Reviewers	Review date
V1.0	2018/8/22	Establish			

Thank you for choosing our product!

This manual makes a detail introduction about the use of BM115 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.

Index

1	Summary.....	4
1.1	Structure.....	4
2	Mechanical Installation.....	4
2.1	Mounting.....	4
2.2	Connection of Water Pipe and Gas Pipe	5
	2.2.1 Water cooling interface	5
	2.2.2 Assist gas interface	6
2.3	Connection of Cutting Head Cable	7
	2.3.1 Connection of Cutting Head and Cable	7
	2.3.2 Cable connection to drive	7
2.4	Fiber Input Interface.....	7
2.5	Fiber Insertion and Interface Direction Adjustment	8
3	System Installation and Commissioning	9
3.1	ETC_F100 Installation (Auto focus by 0-10V analog)	9
	3.1.1 Interface & Signal	10
	3.1.2 Wiring	11
	3.1.3 Dimension of ETC_F100.....	13
	3.1.4 Dimension of Drive	14
3.2	FSCUT (Cypcut) with position mode.....	14
	3.2.1 Wiring	14
4	Beam Adjustments and Focusing.....	17
4.1	Beam Adjustments (QBH interface)	17
4.2	The Focus Position Adjustment	18
5	Maintenance.....	18
5.1	Cleaning Lens.....	18
5.2	Removal and Installation of Lenses	19
	5.2.1 Removal and Installation of Cover Glass	19
	5.2.2 Removal and Installation of Top Cover Glass	20
	5.2.3 Removal and Installation of Collimating Lenses.....	21
	5.2.4 Removal and Installation of Focus Lenses	22
5.3	Replace Nozzle Connector	22
	5.3.1 Replace Ceramic Body	23
	5.3.2 Replace Nozzle.....	23
5.4	Troubleshooting of Drive	23
	5.4.1 Alarm information	23
5.5	Common Problem Analysis.....	24
	5.5.1 Servo calibration process terminated abnormally	24
	5.5.2 The screen is abnormally displayed	25

5.5.3 Z-axis coordinate drift.....	25
5.5.4 Input signal jitter or invalid	25

1 Summary

1.1 Structure

BM115 laser cutting head includes fiber interface, collimation module, focus & beam alignment module, cover glass module and nozzle module which is shown in figure 1.1.

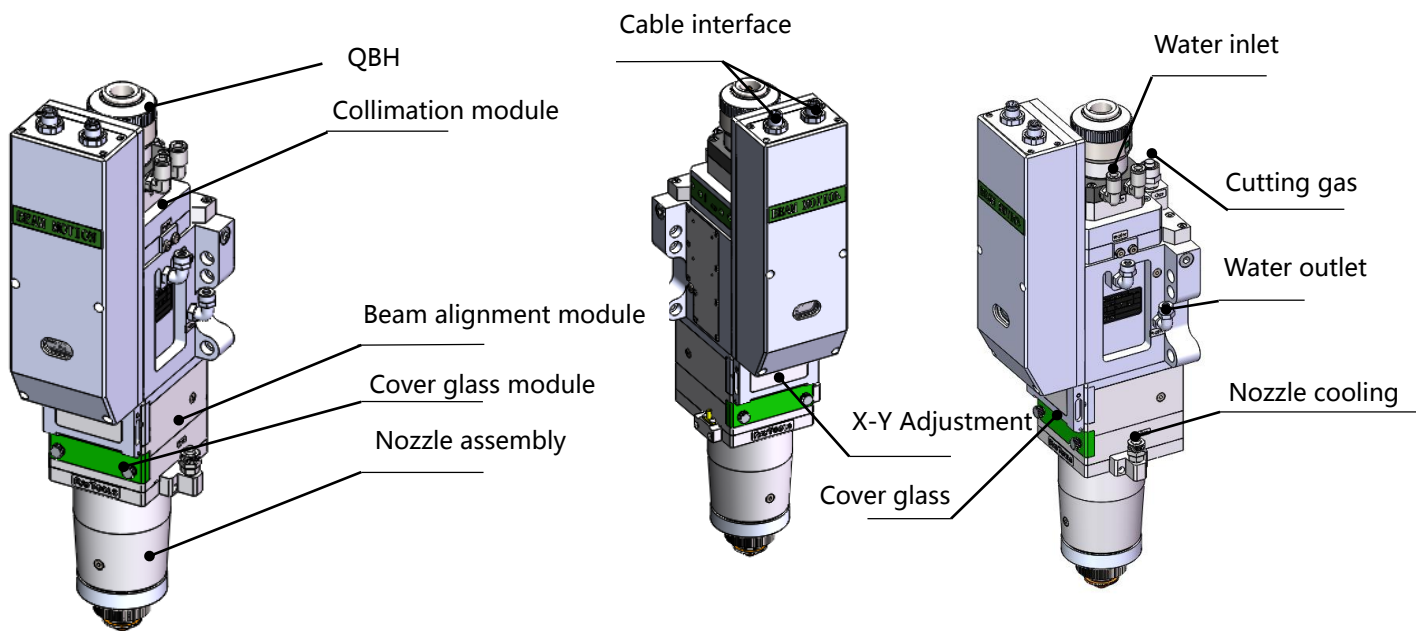


Figure 1.1 — Function module and interface

2 Mechanical Installation

2.1 Mounting

The mounting of BM115 to machine tool is shown in Figure 2.1. Customers are advised to install the laser head perpendicular to the bed surface as requested and make sure the laser head is locked, which is one of the premises to ensure the stable cutting.



CAUTION: The Z-axis sliding base for fixing laser cutting head should be conductive to machine tools and keep a good grounding.

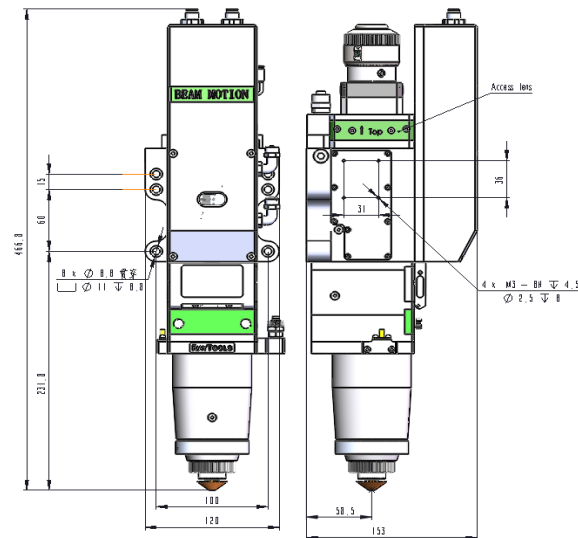


Figure 2.1 — Mounting hole

2.2 Connection of Water Pipe and Gas Pipe

2.2.1 Water cooling interface

BM115 laser cutting head is equipped with water cooling circuit for fiber interface, collimator and focus module which could be found in figure 2.2. It is important to note that when the laser power is greater than 500 watt, it is recommended to use water cooling. The recommended water flow is as below.

The design of this water cooling interface is a closed loop.

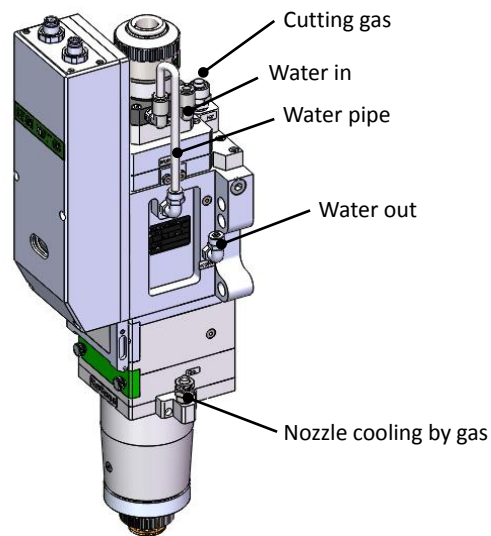


Figure 2.2 — Water pipe and gas pipe

Outer diameter of water pipe caliber	6mm
Minimum flow speed	1.8 l/min(0.48 gpm)
Entry pressure	170-520kPa (30-60 psi)
Entry temperature	≥room temperature / >dew point
Hardness (relative to CaCO3)	<250mg/liter
PH range	6 to 8
Particle size allowed	Diameter less than 200 microns

2.2.2 Assist gas interface

The impurity in assist 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 auxiliary gas specification. The higher the purity of the gas, the better the quality of the cutting section.

Impurity can be filtered out in gas supply tube, but Oxygen and water vapor can permeate light path through nonmetal materials, which is the source of the appearance of dust and hydrocarbon. Stainless steel fittings are recommended, at the same time 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.

N2 or fine filtered air with pressure less than 1 bar is recommended for nozzle cooling. The O2 is prohibited for nozzle cooling.

Gas	Purity	Maximum content of water vapor	Maximum content of hydrocarbon
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 auxiliary gas pipe (Outer diameter)	10mm		
Diameter of cooled gas pipe (Outer diameter)	8mm		



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.

2.3 Connection of Cutting Head Cable

2.3.1 Connection of Cutting Head and Cable

Connect the corresponding interface of cutting head to power cable and encoder cable as shown in figure 2.3. To fix the cables into cable tray of machine tool after cable with proper length is preserved.

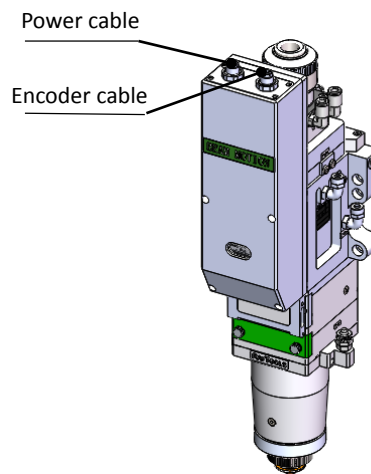


Figure 2.3 — Cable connection

2.3.2 Cable connection to drive

Connect power cable and encoder cable to the corresponding interfaces of drive according to the definition on cable sleeve. The wiring of drive is to be as per the system installation and commissioning.

CAUTION: The output signal of limiting sensor is NPN-NC;

CAUTION: All wiring shall be done when the power is disconnected and commissioning could be commenced after inspection on wiring.



2.4 Fiber Input Interface

BM115 is applicable to most of industrial laser in market. It is equipped with collimator. The connection between the end of the fiber and the cutting head is called fiber interface. Commonly used fiber connectors include QBH, QD, etc, and every fiber interface has its unique

fixation method. Please refer to corresponding instruction of fiber interface.



WARNING: The optical components must be dust free and all dusts must be cleaned before use. The fiber shall be horizontally inserted into 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.

2.5 Fiber Insertion and Interface Direction Adjustment

The fiber insertion way is described as below by example of QBH.

Firstly, to align the red point at the end of the QBH interface to the red point of the handwheel; Then remove QBH dustproof cover and ensure the red mark of fiber end aligned to red mark on QBH of cutting head when you insert the fiber end straightly to bottom of QBH interface of cutting head. Then 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. (see Figure 2.4)

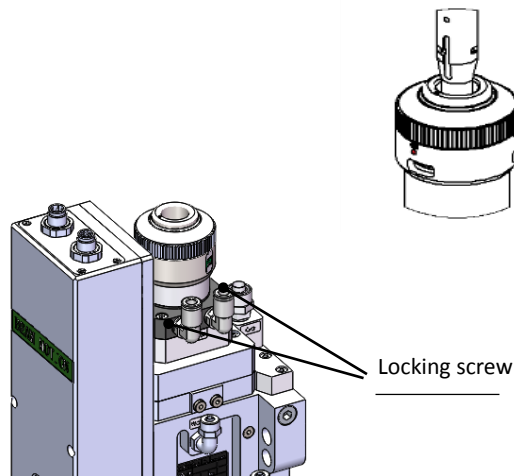


Figure 2.4— Fiber insertion to QBH

If the red mark on fiber is too far away from the red dot on laser head interface when the fiber connector is inserted into the interface causing an out of alignment insertion, you can refer to steps below to adjust the position of fiber interface on laser head for solving the problem. As shown in Fig. 2.4, unscrew the 4 locking screws of the position of the part icon with a wrench, rotate the QBH interface and screw the locking screws after the red mark is in place.

The fiber insertion way is described as below by example of QD (LLK-D).

Firstly, to remove the dustproof cover and align the location pin of fiber end to U type slot of QD interface. To pull the external edge downward and insert fiber straightly to bottom then release. Check if there is any loose by slightly rotating fiber. (see figure 2.5)

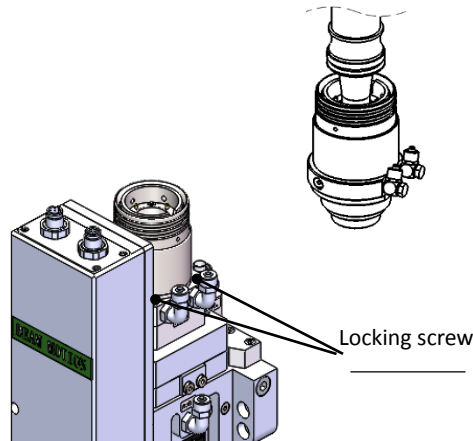


Figure 2.5— Fiber insertion to QD

The fiber insertion way is described as below by example of Q+.

Firstly, to remove the dustproof cover and align the location pin of fiber end to U type slot of Q+ interface. To pull the external edge downward and rotate in anti-clockwise direction until the mechanical part is locked. Then insert fiber straightly to bottom and rotate external edge of Q+ interface in clockwise direction then release. Check if there is any loose by slightly rotating fiber. (see figure 2.6)

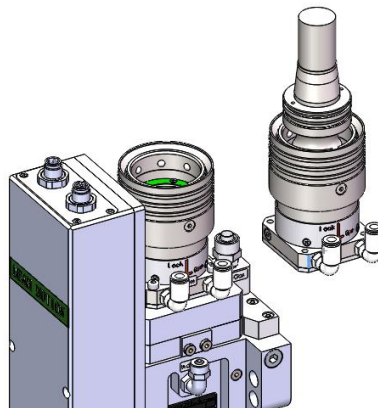


Figure 2.6— Fiber insertion to Q+

3 System Installation and Commissioning

3.1 ETC_F100 Installation (Auto focus by 0-10V analog)

3.1.1 Interface & Signal

Interface	Descriptions
CON1	DB15 female connector, interface to servo driver.
CON2	Interface for connecting external IO devices.
CON3	Interface to 24V DC power supply.
CON4	Interface for connecting external IO devices.

Pins of CON1 :

Pin	Descriptions
1	OUT_Servo_DA (Drive speed command)
2	Servo_TGON (Drive brake signal)
3	Servo_CLR (Drive alarm clear signal)
4	Servo_OS (Drive zero speed clamp, used to control motor lock shaft)
5	PGND (Power ground)
6	E1_A_N (Encoder A negative)
7	E1_B_N (Encoder B negative)
8	E1_C_N (Encoder C negative)
9	AGND (Analog ground)
10	Servo_ALM (Drive alarm signal)
11	Servo_SON (Drive enable signal)
12	VDD_24V (Power supply)
13	E1_A_P (Encoder A positive)
14	E1_B_P (Encoder B positive)
15	E1_C_P (Encoder C positive)

Pins of CON2 :

Pin	Descriptions
N/A	/
N/A	/
Alarm out	When alarm occurs, a high level signal is output, normally is high impedance state.
Home	Homing input signal, active high.
AGND	Common ground of analog signals, analog signals include: focus set input, focus feedback output.
Focus set	The input signal of focus setting, is analog.

Focus Feedback	Output the position of current focus, is analog.
Brake+	This signal is not connected (motor without brake)

Note : N / A is an undefined interface, please leave it blank.

Pins of CON4 :

Pin	Descriptions
Emergency Stop	When the accident occurs, press the emergency stop button to achieve emergency stop, 24V effective.
N/A	/
Focus IN Pos.	Output 24V when focus in position.
N/A	/
N/A	/
Focus Enable	High-level control focus on, low-level control focus off.
Down limit	The input signal of down limit, NPN.
Up limit	The input signal of up limit, NPN.

Note: N / A is an undefined interface, please leave it blank.

The above table shows only for factory default settings for the ETC-F100 controller.

BM115 achieves the auto focus by movement of collimation lens group and the focus adjustment range is based on movement of collimation lens. When the collimation lens moves 1mm, it conducts the movement of focus point by 2.25mm or 4mm.

Optical configuration	Scale range	Auto focus range
CL100mm/FL150mm	-10 to +10mm	-22.5 to +22.5mm
CL100mm/FL200mm	-10 to +10mm	-40 to +40mm

3.1.2 Wiring

The motor is an AC servo motor, which is connected to 220V AC L and N at the drive terminals L1, L2, L1C and L2C. Details of connection method is shown in figure 3.1.

Limit signal: the limit diagram is shown in figure 3.2.

Brown	White & Brown	Green	White & Green
+24V	0V	Up limit	Low limit

Note: the limit sensor is NPN-NC and it continuously outputs 0V signal when it is not triggered.

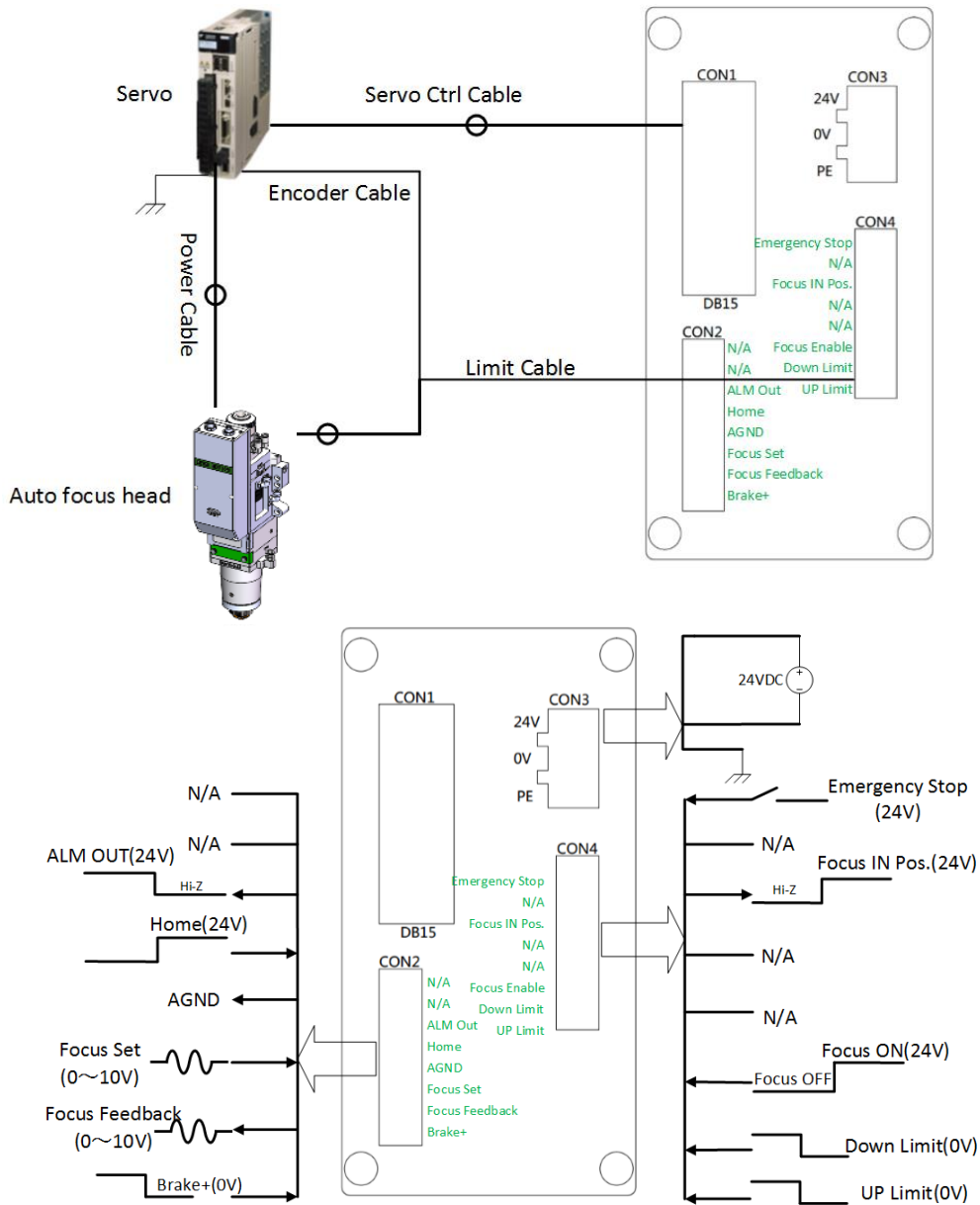


Figure 3.1—ETC_F100 Wiring instruction

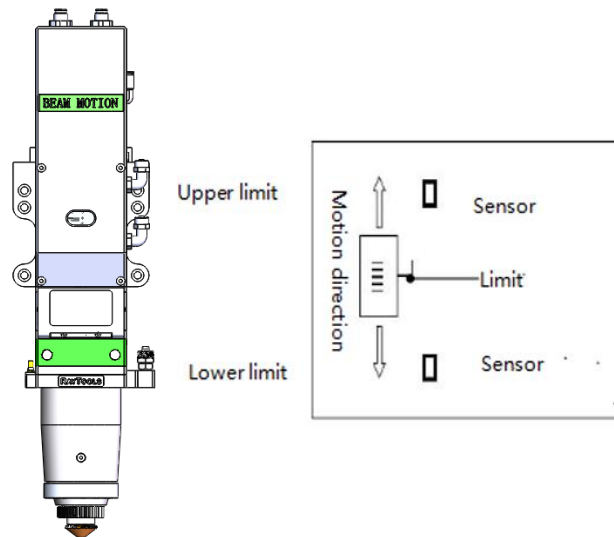


Figure 3.2—limit diagram

Note: Limit sensor is NPN-NC and outputs 0V continuously when it is not triggered.

3.1.3 Dimension of ETC_F100

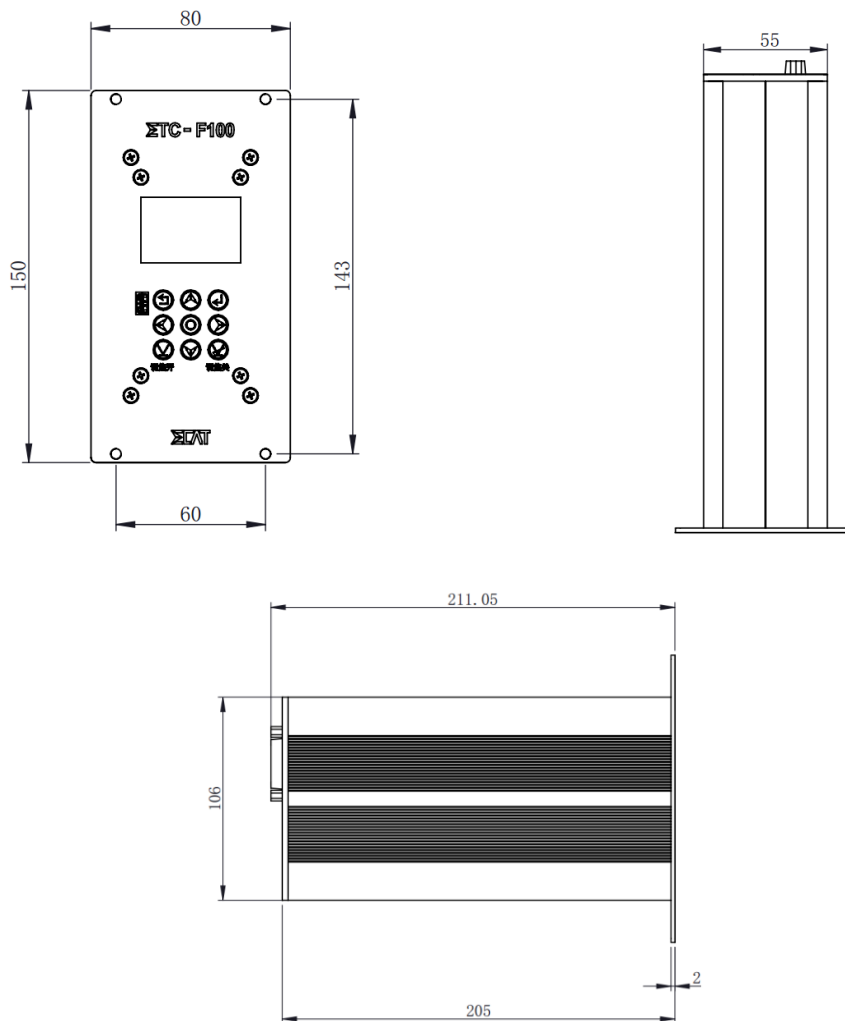


Figure 3.3 —Overall size of ETC-F100 controller (unit: mm)

3.1.4 Dimension of Drive

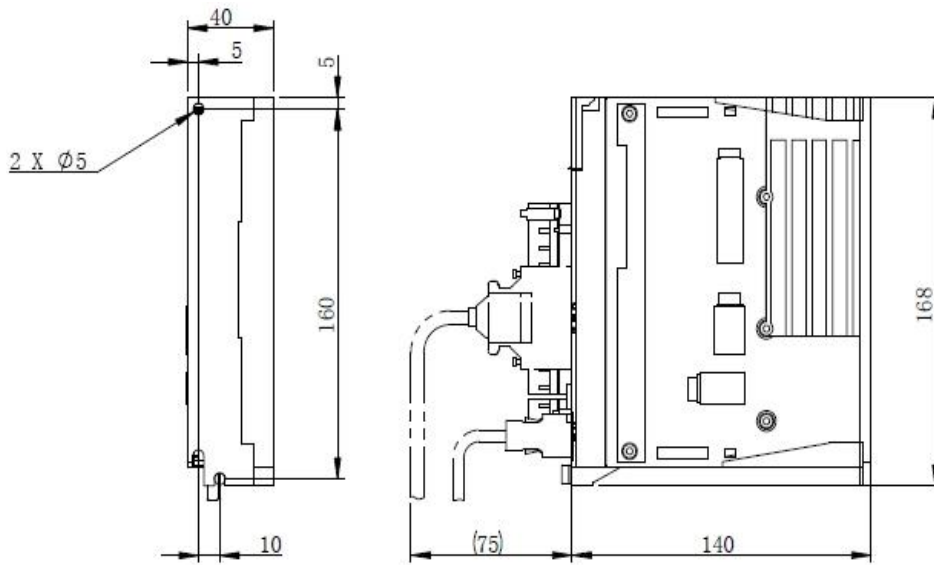


Figure3.4 —Overall size of drive (unit: mm)

3.2 FSCUT (Cypcut) with position mode

3.2.1 Wiring

The motor is AC servo motor, which should connect the end of the drive L1, L2 , L1C and L2C to AC 220V L and N. Please refer to figure 3.5 for the wiring diagram and figure 3.4 for the drive installation size

Limit signal: As shown in figure 3.2

Brown	White & Brown	Green	White & Green
+24V	0V	Up limit	Low limit

Note: The limit sensor is NPN-NC and it continuously outputs 0V signal when it is not triggered.

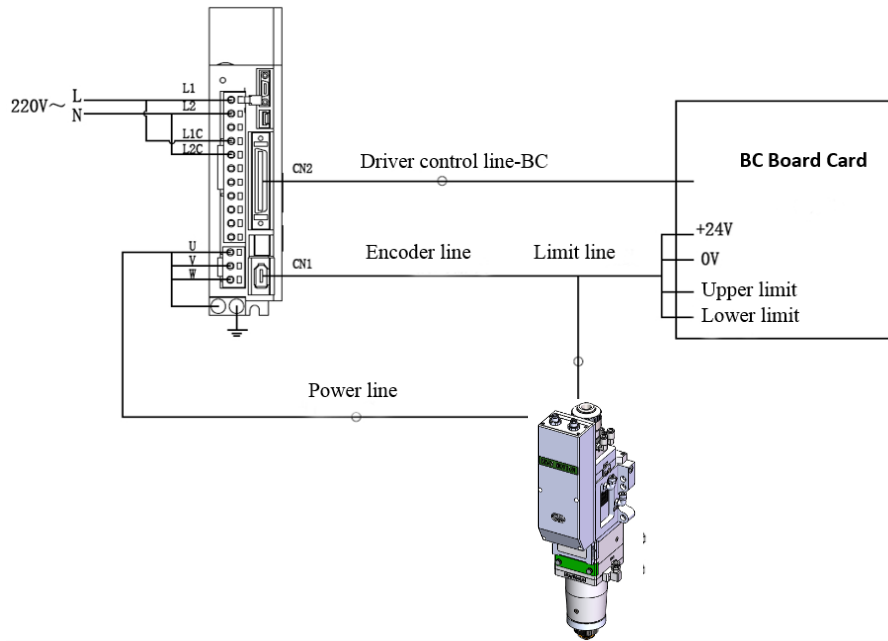


Figure3.5 — Position loop FSCUT wiring diagram

BM115 achieves the auto focus by movement of collimation lens group and the focus adjustment range & pulse rate are based on movement of collimation lens. When the collimation lens moves 1mm, it conducts the movement of focus point by 2.25mm or 4mm.

Optical configuration	Scale range	Auto focus range
CL100mm/FL150mm	-10 to +10mm	-22.5 to +22.5mm
CL100mm/FL200mm	-10 to +10mm	-40 to +40mm

Open the platform configuration tool to enter the reference value as shown in Figure 3.6 and Figure 3.7. (Just for reference)



Figure 3.6 — Platform configuration tools (BM115, CL100:FL150)



Figure 3.7 — Platform configuration tools (BM115, CL100:FL200)

4 Beam Adjustments and Focusing

4.1 Beam Adjustments (QBH interface)

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 centering operation should be considered when nozzle is replaced or the cutting quality declines.

Lens centering of laser cutting head can be finished by adjusting focus lens, X-Y direction. The adjusting screw is located on the top of the cutting head as shown in Figure 4.1. By using inner hexagon spanner can loosen or screw the adjusting screw 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 tape dotting method:

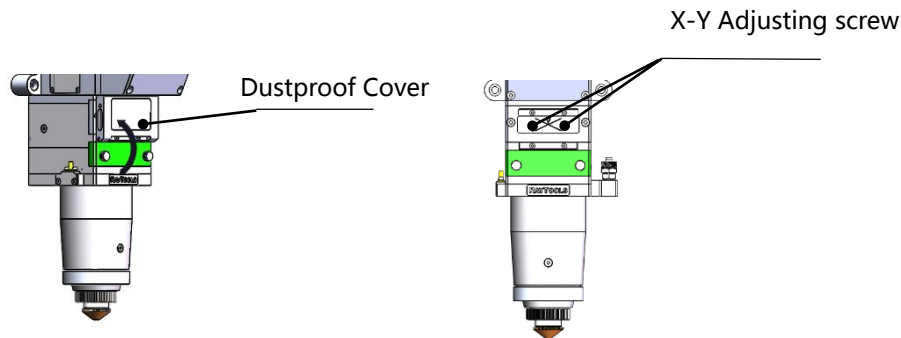


Figure 4.1— Beam adjustment

Pick a scotch tape, flatten it, and attach it to the nozzle tip;
 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;
 Next open and adjust laser generator at the range of 80W-100W and dot manually.
 Tear off the tape and check the hole in the center of the nozzle;
 Repeat the above steps to find the optimum relative nozzle center position of the beam;
 This adjustment requires a series of adjustments, which is the basic operation of general laser beam adjustment.

4.2 The Focus Position Adjustment

BM115 is equipped with automated focusing system. But it still needs dot manually to redefine the focus position when it initially sets 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:

1. To attach one textured tape on nozzle tip and adjust the scale to biggest value, and set laser power to 80-100w;
2. While moving each 0.5mm (as small as possible), shot a hole on the textured tape;
3. Dotting several times, finally compare and find out the scale corresponding to the smallest hole is zero focus. The 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. (Figure 5.1)

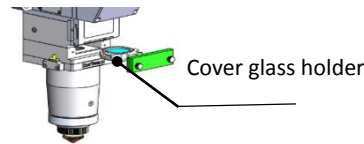


Figure 5.1 — Replacement of cover glass

Lens cleaning

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

b. Cleaning instruction:

1. To put fingertip onto left thumb and index finger.
2. Spray absolute ethanol onto the polyester swab.
3. 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)
4. 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 Cover Glass

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

- As shown in Figure 5.2, open the buckle to pull out cover glass holder by pinching 2 edges of drawer type holder.
- Remove the pressing ring of the cover glass and cover glass after wearing fingertips
- Clean the cover glass, cover glass holder and seal ring. The elastic seal ring should be replaced if it is damaged.
- Install the cleaned 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 processing head and fasten the buckle.

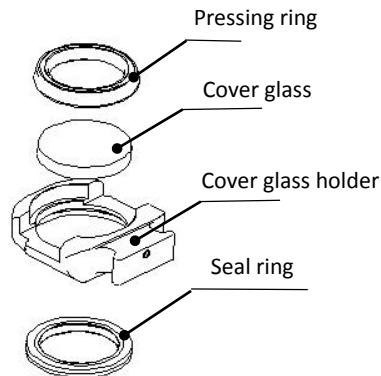


Figure 5.2 — Structure of cover glass holder



Attention: It is not allowed to pull out the edge of seal ring directly as it is very easy to damage the elastic seal ring.

5.2.2 Removal and Installation of Top Cover Glass

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

- Use an inner hexagon spanner to unscrew the screw of top cover glass (as shown in figure 5.3);

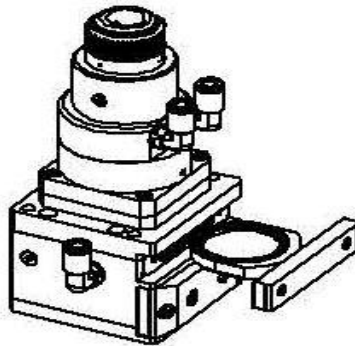


Figure 5.3 — Removal of top cover glass

- Pull out the cover glass holder by pinching the two edges;
- Seal the opening by textured tape so as to prevent the entry of dust;
- Wear the fingerstall and take out the cover glass;
- Clean the cover glass, cover glass holder and seal rings. replace a new one if the seal ring is damaged;
- Install the cleaned cover glass (regardless of the front or back surface) into the holder;
- Re-install the seal ring;

- Re-insert the cover glass holder to the laser processing head and tighten the locking screw.



Note: It is not allowed to pull out the edge of seal ring directly as it is very easy to damage the elastic seal ring.

5.2.3 Removal and Installation of Collimating Lenses

- Removal and installation of collimating lenses refers to the following steps:
- Remove the laser head and move to a dust free room. Clean all dusts on the laser head surface;
- Use a 3mm internal hexagonal wrench to unscrew the locking screws of the collimator (as shown in Figure 5.4), seal the opening with textured tape so as to prevent the entry of dust;
- Screw out the collimating lens holder, and remove the pressing ring and collimation lens by lens tool;
- Replace or clean the collimating lenses.
- As shown in Figure 5.5, reassemble the collimation lens assembly, pay attention to screw the pressing ring properly, and re-screw it into the collimator;
- Lock the bolts of the collimator;
- Check whether the focus point is in the center of the nozzle hole before use. If not, it is necessary to do beam centering.

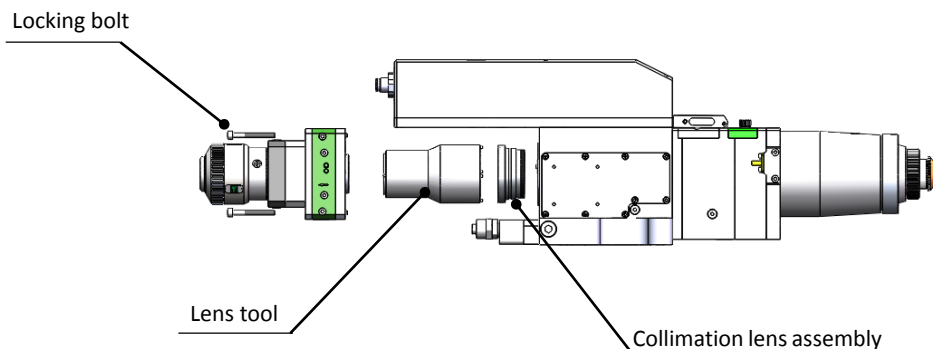


Figure 5.4 — Removal of collimation lens assembly

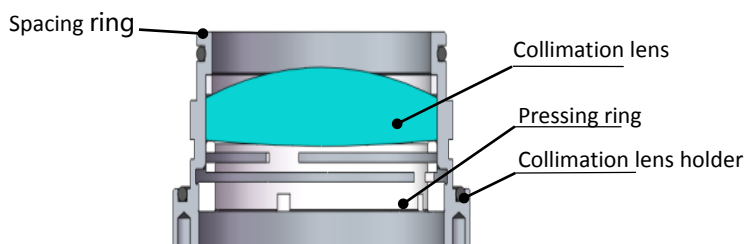


Figure 5.5 — Installation of collimation lens

5.2.4 Removal and Installation of Focus Lenses

- Removal and installation of focus lenses refer to the following steps:
- Remove the laser head and move to a dust free room. Clean all dusts on the laser head surface;
- Open the dustproof cover and unscrew the locking screw as figure 5.6;

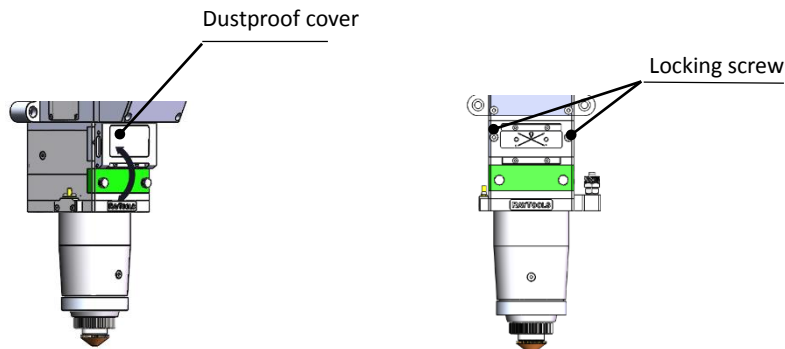
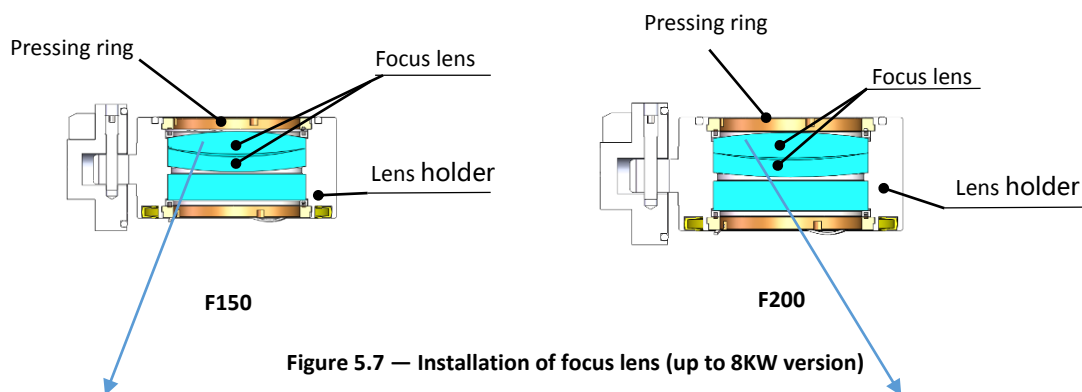


Figure 5.6— Removal of focus lens assembly

- Take out focus lens assembly and seal opening by textured tape;
- Remove the pressing ring and focus lens by lens tool;
- Replace or clean the focus lens.
- As shown in figure 5.7, put the focusing lens and pressing ring into the lens holder carefully and tighten the pressing ring properly;
- Install the focus lens assembly into cutting head and tighten screw.
- Check if the focus point is at the center of nozzle. If not, you need to repeat beam adjustment procedure.



Attention: the biconvex lens gets 1 big curve face and 1 small curve face. The small curve face shall be next to concave face of meniscus lens.

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 connector.

5.3.1 Replace Ceramic Body

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

5.3.2 Replace Nozzle

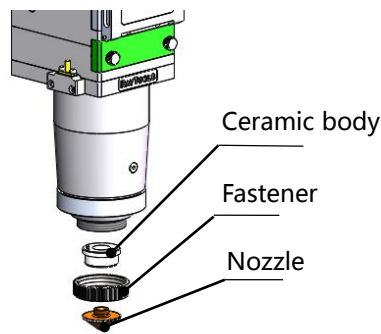


Figure 5.8 — Replacement of nozzle connector

- 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 Troubleshooting of Drive

5.4.1 Alarm information

These following alarm information may happen on ETC_F100 :

Up or Down Limit Alarm

This alarm is generated when the system detects a sensor signal of the Z-axis up limit or down limit. If not meet the requirements, please reset the sensor position. If the alarm is always displayed, please check:

1. Limit signal is not connected to the ETC-F100;

2. Whether the sensor is obscured by unknown objects; ;
3. Limit sensor installed improperly (this possibility is minimal);
4. The limit signal is disturbed. At this time, the corresponding limit signal may flicker in the function test, especially after the machine tool is enabled. The ETC-F100 and the 24VDC limit signal can be independently powered. Add a filter for 220V AC power supply of the Servo drive, and ensure good grounding.

Home first

After the system is powered on, the controller needs to home to establish a coordinate system. If do not home, the screen will display "Home First" Can be solved by the following methods: :

1. Control by keyboard of the ETC_F100 .
2. Select "Yes" and save in the "Auto Homing" menu.
3. By the interface of "Home".

Exceed Z-axis Travel

This alarm is generated when the actual Z-axis coordinate exceeds Z-axis travel distance or less than 0. When this alarm occurs, please note:

1. Whether Z-axis travel settings are appropriate;
2. Whether the position of dial over travelled.

Servo Alarm

Under normal circumstances, when the servo alarms, "servo alarm will be displayed. If the drive is normal, an alarm is displayed, it may be caused by the following conditions:

1. Incorrect wiring of servo drive ;
2. External interference.

5.5 Common Problem Analysis

5.5.1 Servo calibration process terminated abnormally

- 1 Up limit triggered by dial

This error occurs when servo calibration is executed when the up limit triggered by dial.

- 2 The dial position is near the up limit.

The dial position near the up limit (about 1mm), this situation will occur when servo calibrating. In the event of the above problems, please jog the focus to the middle of the stroke (more than 1mm), and then execute servo calibration.

5.5.2 The screen is abnormally displayed

External interference may cause the screen to display abnormally. Please reboot the ETC-F100 when this abnormality occurs.

5.5.3 Z-axis coordinate drift

In the static state, the Z-axis coordinate changes continuously and slowly, at this moment, the servo calibration should be carried out.

5.5.4 Input signal jitter or invalid

If the input signal is invalid or jittered, enter the I / O port detection interface of the function test, directly connect 24V (PNP) or 0V (NPN) of the 24V DC power supply to the corresponding input port, and observe whether the corresponding number is inverted:

For active-high input signal, 24V can be directly connected to the corresponding input port, if the corresponding number is inverted, then the hardware is normal.

For active-low input signal, 0V can be directly connected to the corresponding input port, if the corresponding number is inverted, then the hardware is normal.

After ensuring the hardware is normal, access the input signal. If the number is jittering, the input signal may be unstable. Please make sure that the 24V power of the input signal is common with the ETC-F100 power supply. Please exclude the external interference and test again. If the number is not inverted, please check whether the input signal is valid.