NC150 high power auto-focus fiber laser cutting head

Intelligent Monitoring System

Structure and function introduction

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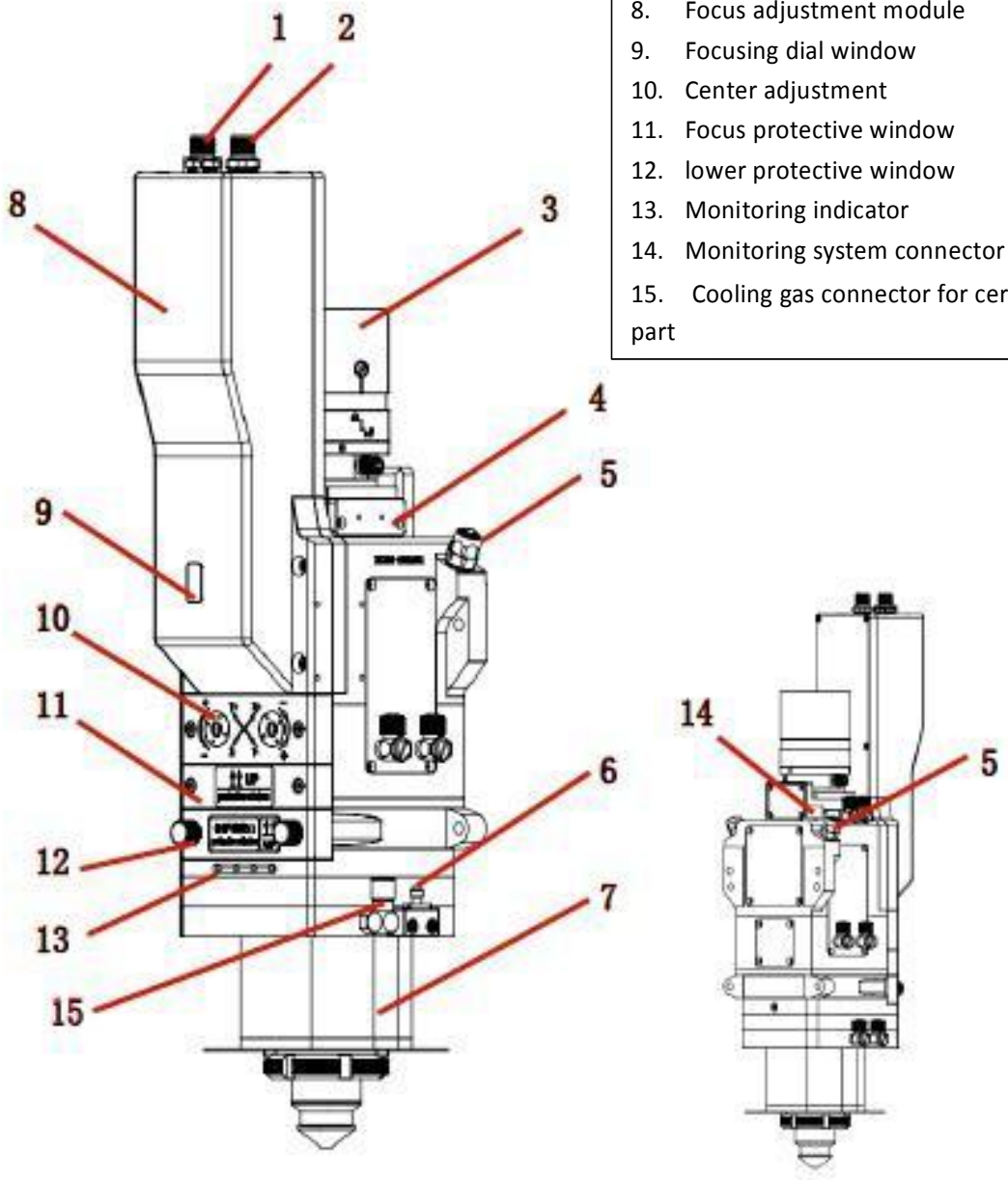
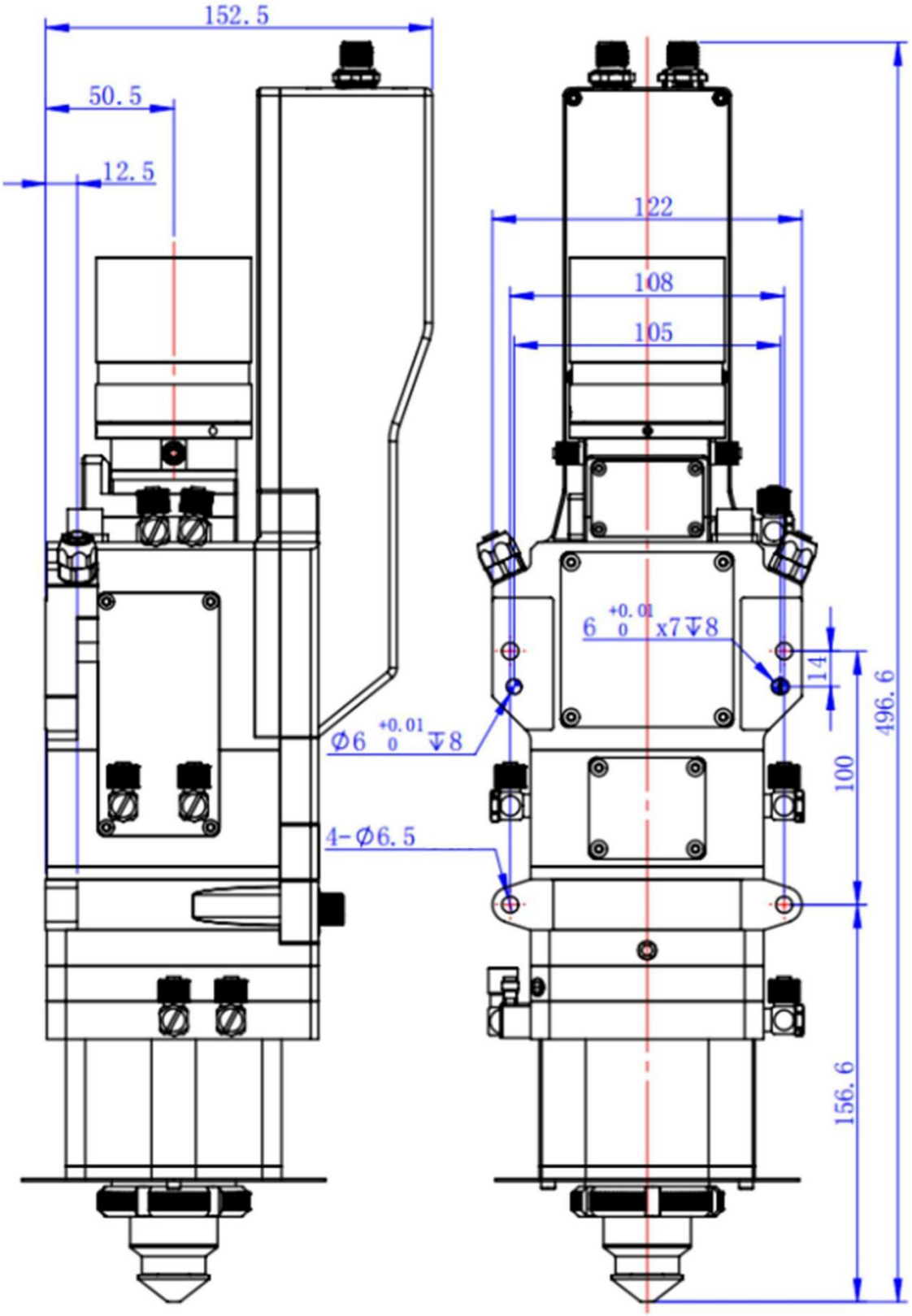
1. Product structure

1.1 Structure diagram

1. Encoder & Limit Signal
2. Triphase power wire
3. Fiber Access
4. Upper protective window
5. Cutting gas connector
6. Height signal connector
7. Height adjustment module
8. Focus adjustment module
9. Focusing dial window
10. Center adjustment
11. Focus protective window
12. lower protective window
13. Monitoring indicator
14. Monitoring system connector
15. Cooling gas connector for ceramic part



1.2 Installation size



1.3 Basic parameters

Model: NC150

Max working power:15kw

Collimation focal length:100mm

Focusing focal length:200mm

Focusing adjustment range:±30mm

Centering adjustment range:±1.5mm

Cutting gas pressure:≤2.5Mpa

Fiber types:QBH, QD, Q+, LOE

Weight:≤8.5kg

Gas pipe connector: Cutting gas connector:ϕ12, Max pressure 25 Bar （2.5Mpa）;

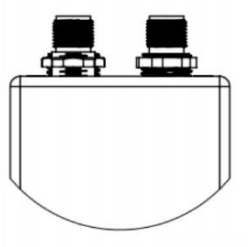
Nozzle cooling gas connector:ϕ6, Max pressure 5 Bar (0.5Mpa)

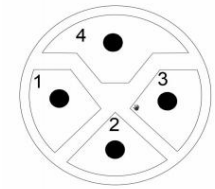
Cooling water connector: ϕ8, Max pressure 5 Bar (0.5Mpa), water flow: minimum 2.0L/min

Working temperature: -25℃ ~ +55℃

Note: To avoid damage during storage and transport: 1. The cutting head should be stored in the proper temperature and humidity; 2. Avoid vibration and shock; 3. Do not put the cutting head in or near magnetic fields (such as permanent magnets or strong alternating fields).

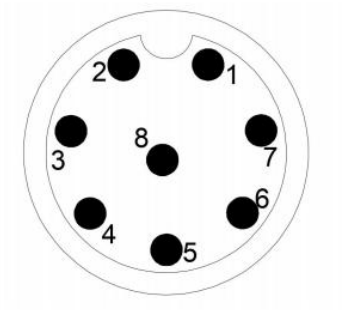
1.4 Electrical interface and definition





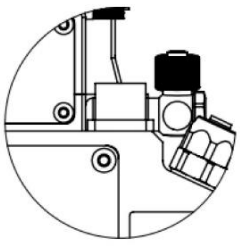
1	W
2	U
3	V
4	FG (ground)

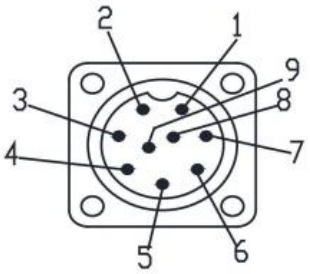
Servo motor power interface (red)



Pin	Definition
Shell	Shielded wire
1	-D (encoder signal data-)
2	+D (encoder signal data+)
3	SG (signal ground)
4	VCC (encoder power +5V)
5	+24V (Approach switch power)
6	0V (Approach switch power)
7	W+ (Approach switch signal)
8	W- (Approach switch signal)

Servo motor encoder & approach switch interface (green)





Lens monitoring signal interface (red)

Pin	Definition
1	24- or 0V power ground
2	24+ power
3	232 ground
4	Alarm reset
5	ALM - OUT
6	232 TX
7	232 RS
8	NULL
9	NULL

1.5 Monitoring function introduction

The different monitoring devices in the laser head realize the monitoring of the operation status of the laser head by the customer's control system. The different parameters can be queried via the device interface (DO) and their limit values monitored by the control system of the device (CNC/PLC).

A group error (/ERROR) is generated when a limit value or measuring range limit is violated, and the corresponding error status can be recognized by means of a special current value on the device interface (DO). Error status is additionally displayed to the user via the LED display on the laser head.

Since the error limit for a specific parameter is highly process dependent, the shutdown must be done by the customer control system.

If multiple errors occur at the same time, the corresponding error codes will be output according to the current value. (Measuring range limitations do not represent the maximum permissible operating range!)

Cutting head monitoring instructions:

Cutting head temperature monitoring	The laser head is monitored by a temperature sensor. A group error is generated when the threshold of approx. 55° C is exceeded.
Optical component temperature monitoring	The lenses inside the laser head are monitored by a temperature sensor. Group errors are generated when the collimating lens or focusing lens exceeds a threshold of approximately 80° C.
Cutting gas pressure monitoring	The cutting gas pressure inside the laser head is measured by a precision pressure sensor and can be interrogated by the control unit via the device interface (DO). A group error is generated when the cutting gas pressure is >25Bar (2.5MPa).
Gas leakage monitoring	A group error is generated when the pressure exceeds 3 Bar (0.3 MPa).
Protection lens temperature monitoring	Dirty protection lenses are identified by the temperature of the glass cargo scattered light monitoring device. The current temperature can be checked on the control system. User actions can be requested through the process proprietary limit values at the control system. A group error is generated when the temperature exceeds 80° C or when the scattered light exposure exceeds 80%.

(The limit can also be adjusted to a lower value if necessary.)

2. Installation and debugging

2.1 Fiber connection

2.1.1 Preparation

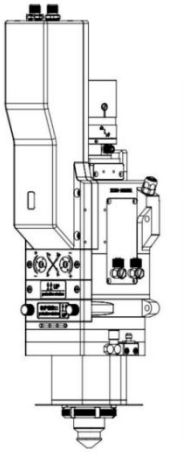
To prevent dust or dirt from entering the cutting head, refer to the following way to install the cutting head:

Preparation:

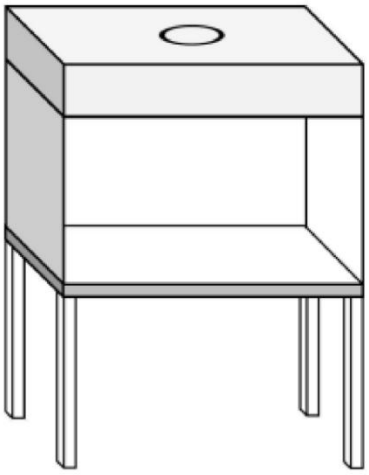
A. Cutting head;

B. Clean bench (clean bench type: vertical purification; clean class: ISO 5, 100; average wind speed: ≥ 0.4m/s);

C. Cleaning kit: strong flashlight, anhydrous ethanol (or IPA), dust-free cleaning swab, dust-free cloth, compressed air dusting can



Cutting head



Clean bench

Cleaning kit:

Prepare the clean bench:

A. Check the cleanliness of the equipment (dust particle counter to check the cleanliness) and make sure the FFU purification unit is within the validity period (measure the average wind speed in the working area, when the wind speed cannot reach 0.3m/s, the FFU purification unit must be replaced);

B. Checking that the switches are operating properly and that the fans are operating properly;

C. It is strictly forbidden to place unnecessary items in the clean bench to ensure that the clean air flow is not disturbed;

D. For the newly installed or long-term unused clean bench, please use a clean cloth with anhydrous ethanol to wipe clean before use.

Power on and use:

A. Turn on the power and pull the clean bench glass sliding door to the bottom position (leaving a gap of about 10 cm);

B. Turn on the fan, it is recommended to purify and clean about 30 minutes in advance;

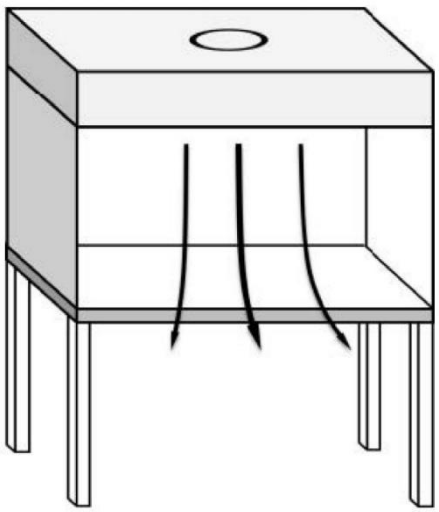
C. After normal operation, turn on the clean bench lighting power.

Note:

Only trained professionals are allowed to operate it.

Operators who do not follow safe work practices may pose a risk to personnel or finances.

To ensure the proper operation of the laser unit in the working environment and the safety of the operator, the relevant operating instructions must be followed and implemented.



2.2 Connection of cutting head and fiber

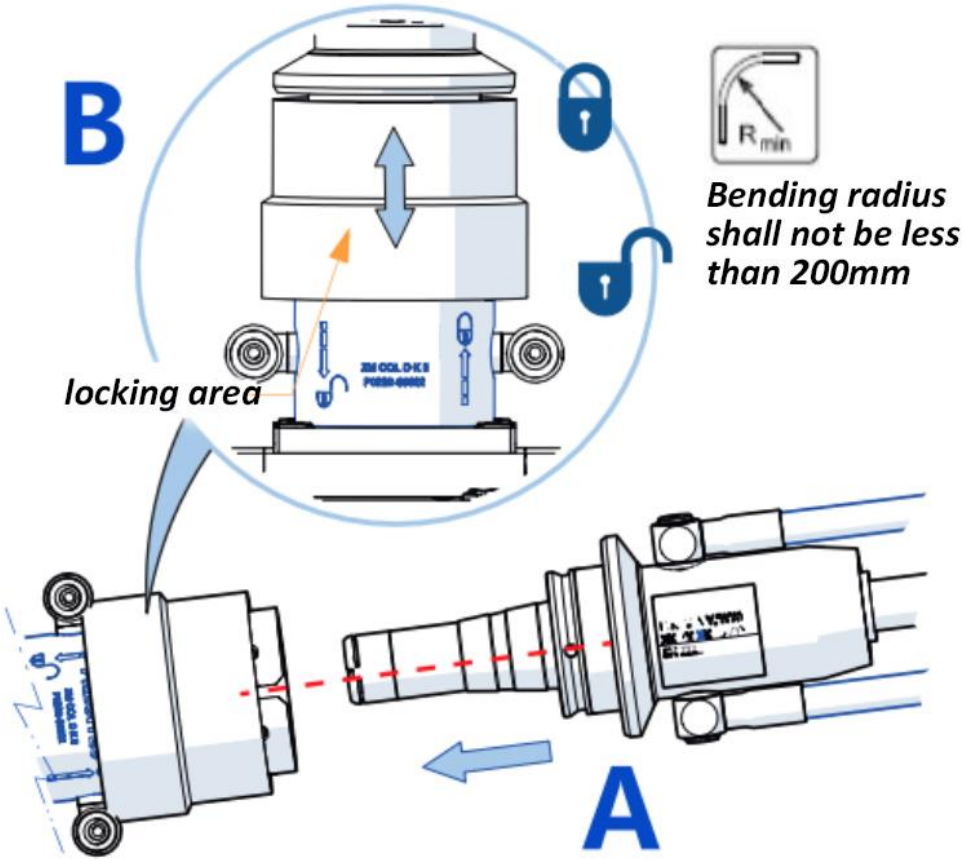
A. QD fiber socket installation

Note： · Fiber insertion and removal should be on a clean work bench;

· Before inserting the optical fiber, it is necessary to check whether the fiber end face and QD interface are polluted;

· Horizontal insertion;

· After inserting the fiber, wrap white tape around the gap between the fiber and the cutting head interface.



1. Remove the protective film/cover from the fiber optic socket.

2. Insert the fiber optic plug (aligned) into the unlocked fiber optic socket (sealing cap in the lowest position) until it stops. NOTE: Before inserting the plug, the dowel pin of the plug sealing cap must be aligned with the socket slot (see Detail A).

3. Release the sealing cap, which closes and locks in the direction of the fiber (see Detail B).

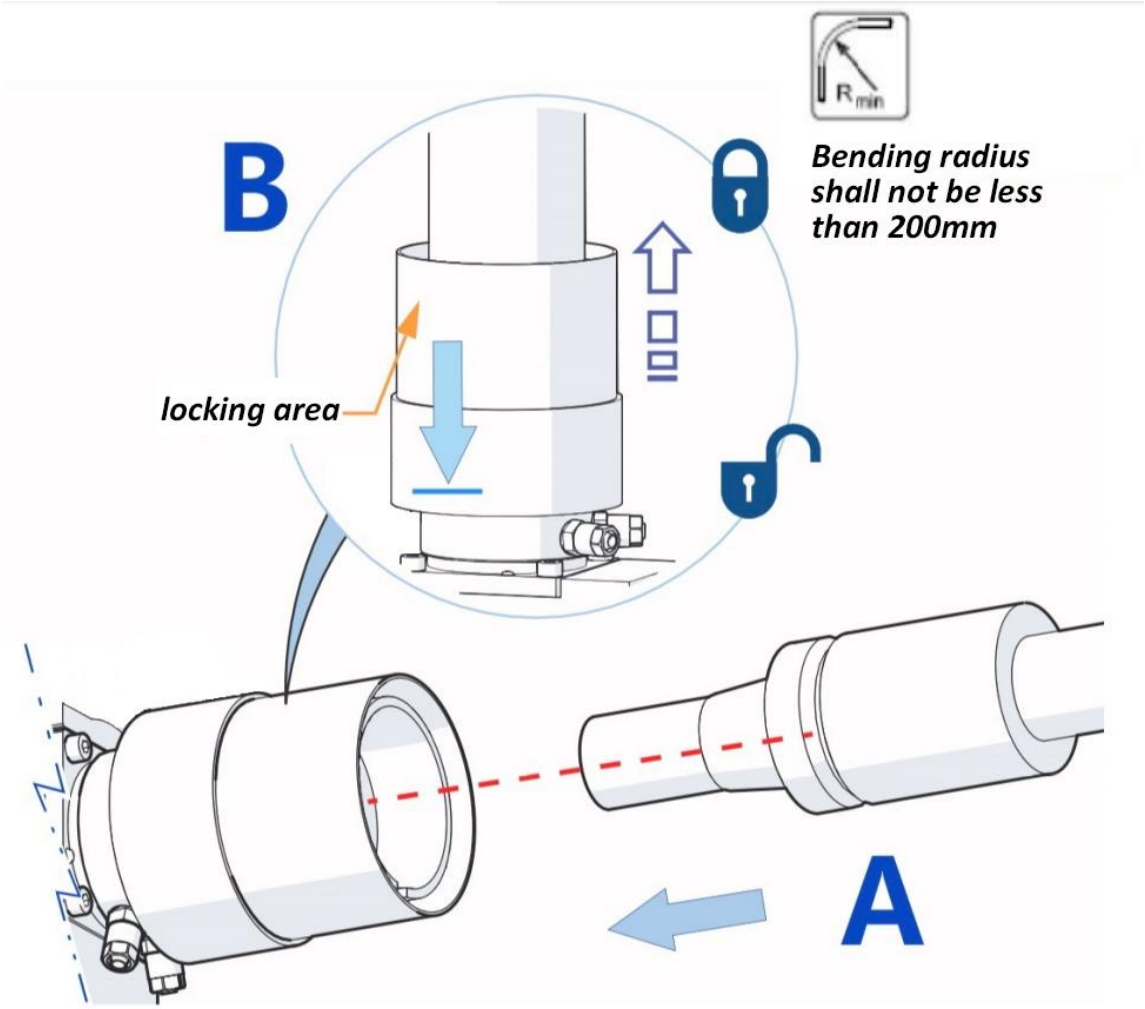
B. Q+ fiber socket installation

Note： · Fiber insertion and removal should be on a clean work bench;

· Before inserting the optical fiber, it is necessary to check whether the fiber end face and Q+ interface are polluted;

· Horizontal insertion;

· After inserting the fiber, wrap white tape around the gap between the fiber and the cutting head interface.



1. Remove the protective film/cover from the fiber optic socket.

2. Insert the fiber optic plug (aligned) into the unlocked fiber optic socket (sealing cap in the lowest position) until it stops. The sealing cap closes and locks in the direction of the fiber (see Detail B). NOTE: Before inserting the plug, the dowel pin of the plug sealing cap must be aligned with the socket slot (see Detail A)

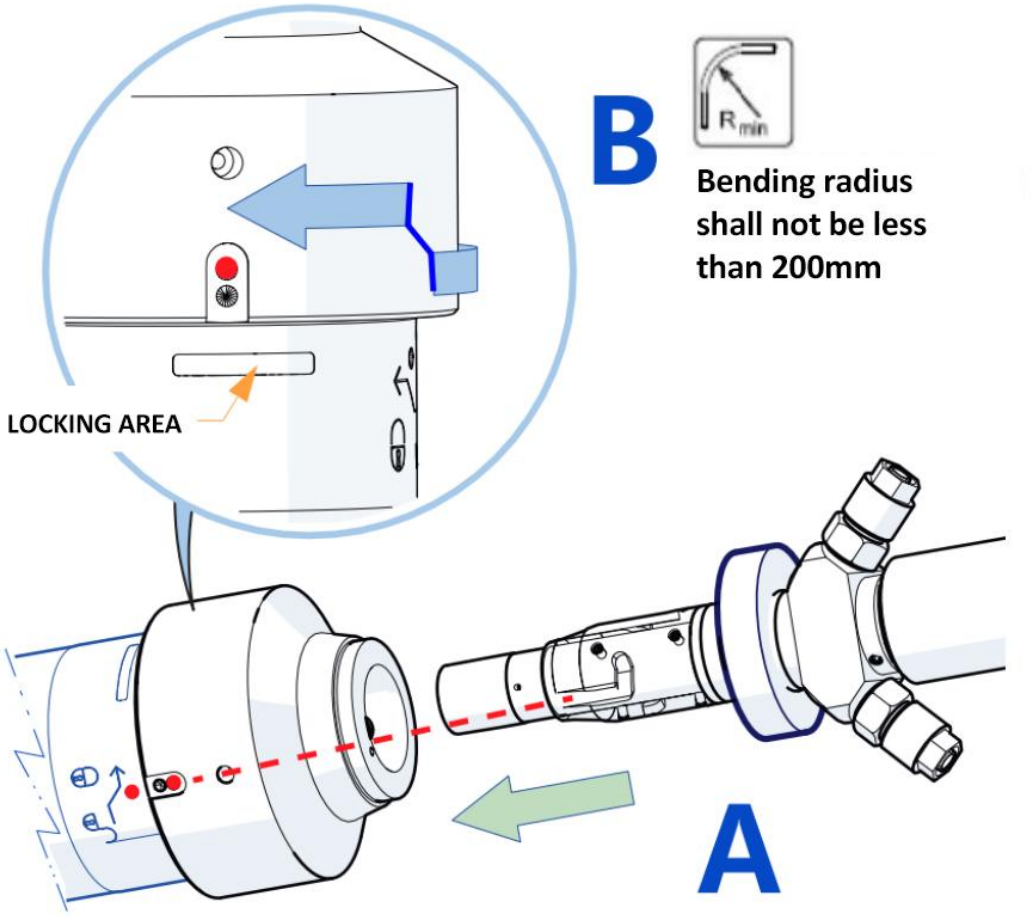
C. QBH fiber socket installation

Note： · Fiber insertion and removal should be on a clean work bench;

· Before inserting the optical fiber, it is necessary to check whether the fiber end face and QBH interface are polluted;

· Horizontal insertion;

· After inserting the fiber, wrap white tape around the gap between the fiber and the cutting head interface.



1.Remove the protective film/cover from the fiber optic socket.

2.Insert the fiber optic plug (aligned) into the unlocked fiber optic socket (sealing cap in the lowest position) until it stops. The sealing cap closes and locks in the direction of the fiber (see Detail B). NOTE: Before inserting the plug, the dowel pin of the plug sealing cap must be aligned with the socket slot (see Detail A)

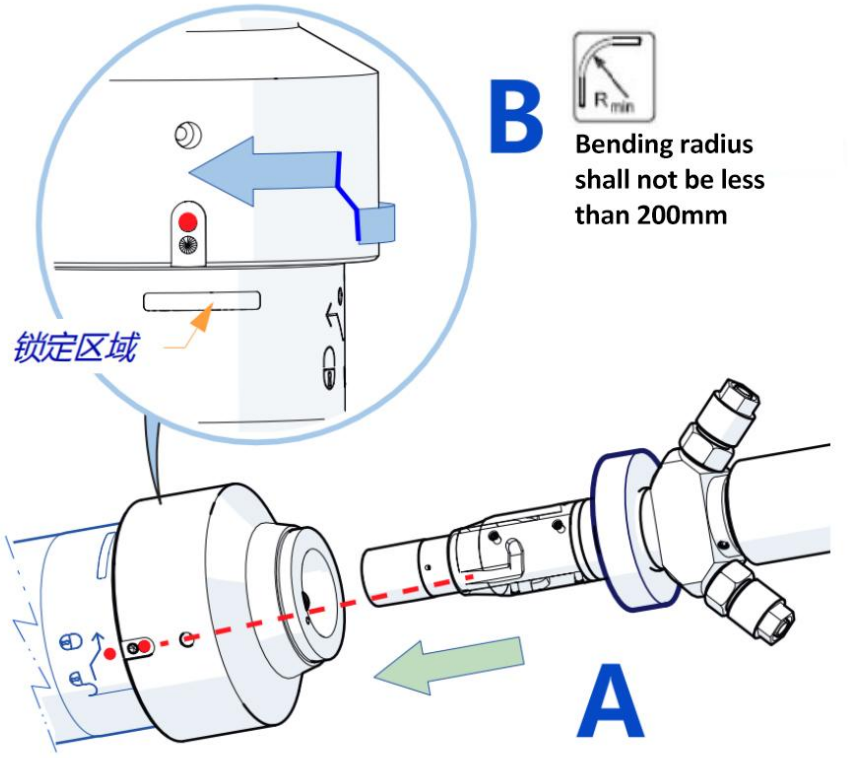
D. LOE fiber socket installation

Note： · Fiber insertion and removal should be on a clean work bench;

· Before inserting the optical fiber, it is necessary to check whether the fiber end face and LOE interface are polluted;

· Horizontal insertion;

· After inserting the fiber, wrap white tape around the gap between the fiber and the cutting head interface.



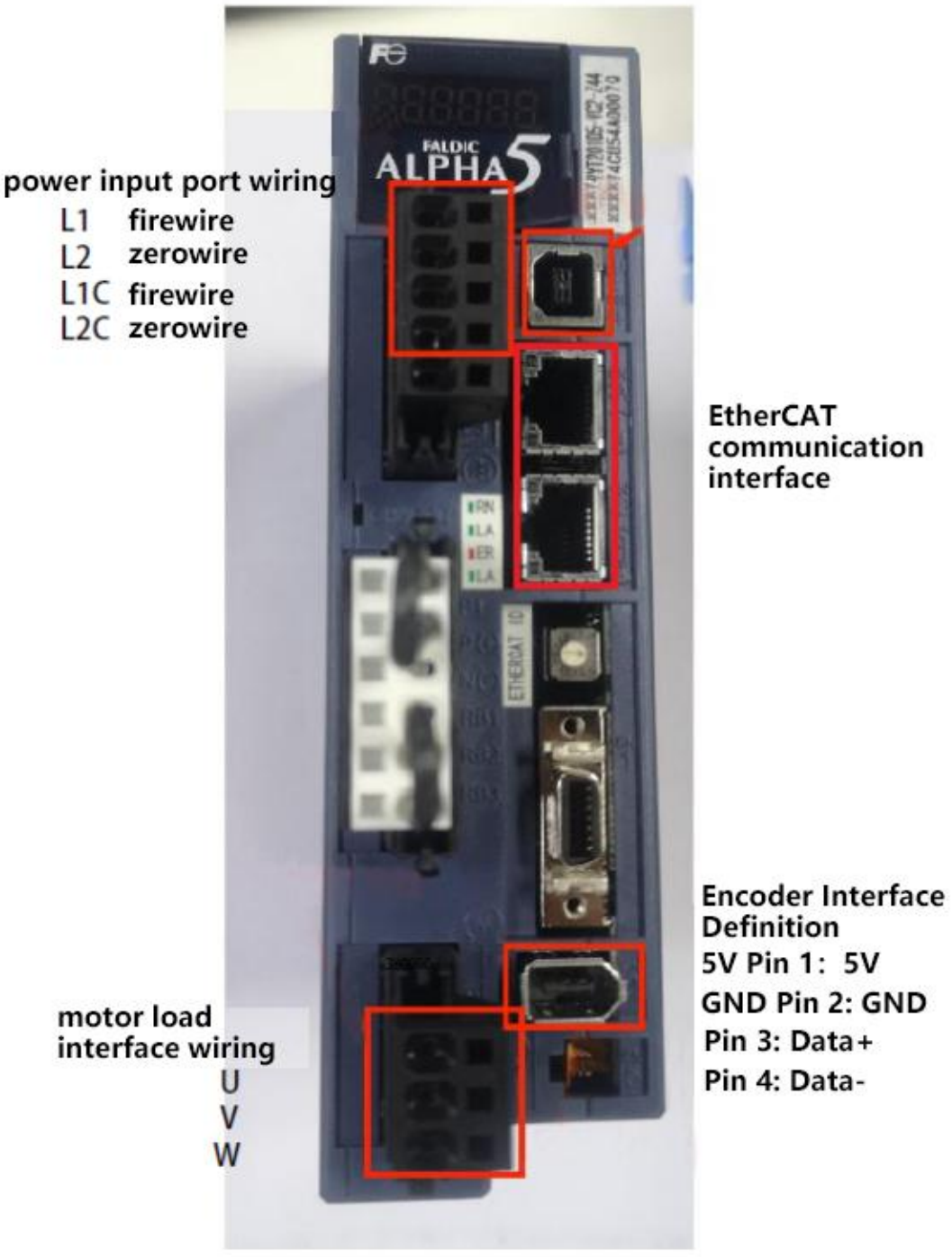
1. Remove the protective film/cover from the fiber optic socket.

2. Install the fiber optic plug on the fiber optic interface (see Detail B). NOTE: Before installation, the sockets of the fiber optic plugs must be aligned with the alignment pins of the sockets (see Detail A)

3. Use M4*12 cylindrical head socket head cap screws and spring washers to lock them (see details B).

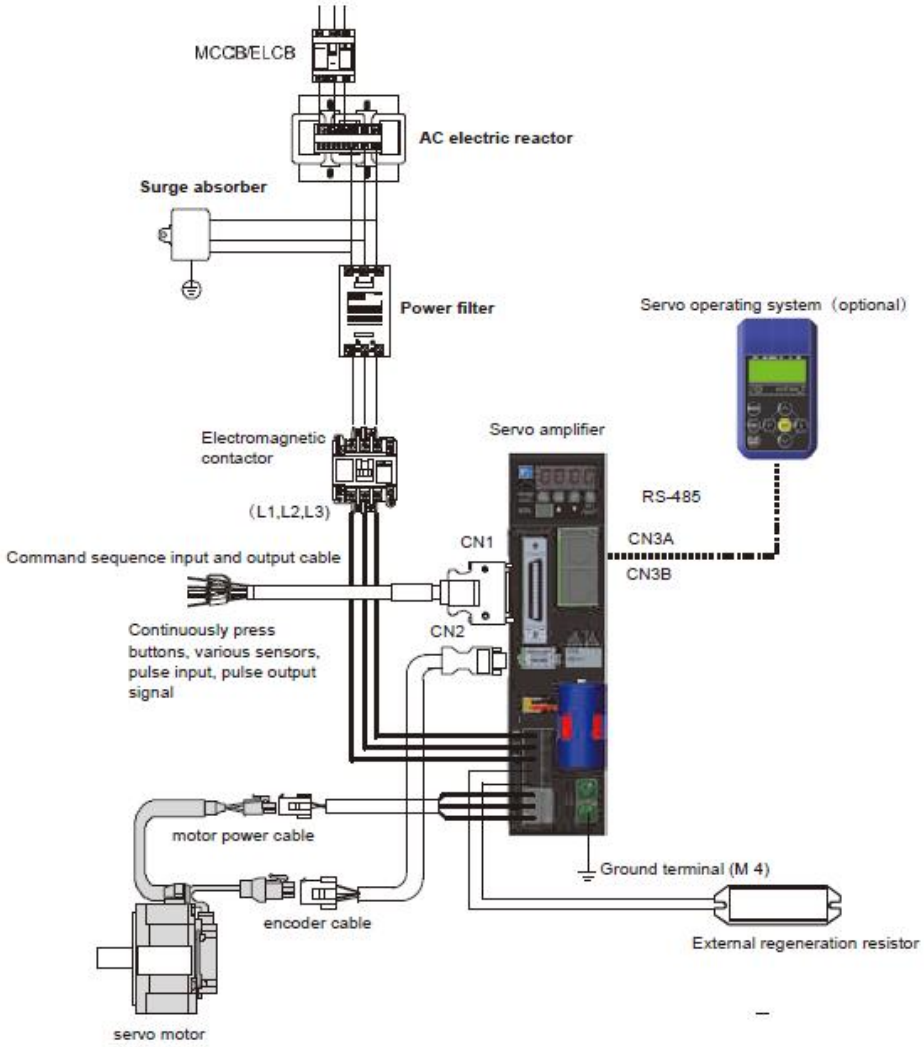
2.3 FUJI servo port definition

Pulse drive wiring diagram



Bus drive wiring diagram

2.4 Drive wiring diagram



Checking of wiring between laser head and driver

(1) Check the mark of the UVW cable, which should correspond one-to-one with the UVW on the plug.

(2) The UVW cannot be connected to the ground wire and the casing, and the resistance between the UVW and the casing is greater than 5MΩ. Test conditions: one end of the cutting head is connected, and one end of the driver is not connected.

(3) The resistance between UVW electrodes is about 20Ω. If the resistance is 0 (short circuit) or the multimeter shows infinity (open circuit), it is regarded as abnormal. Test conditions: one end of the cutting head is connected, and one end of the driver is not connected.

(4) Ground (very important).

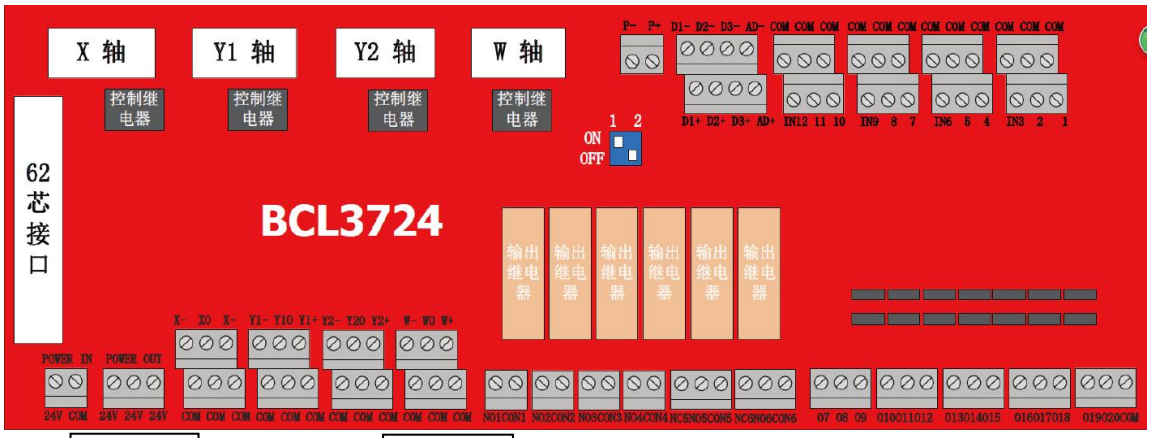
(5) When connecting the aviation plug, be sure to follow the steps below:

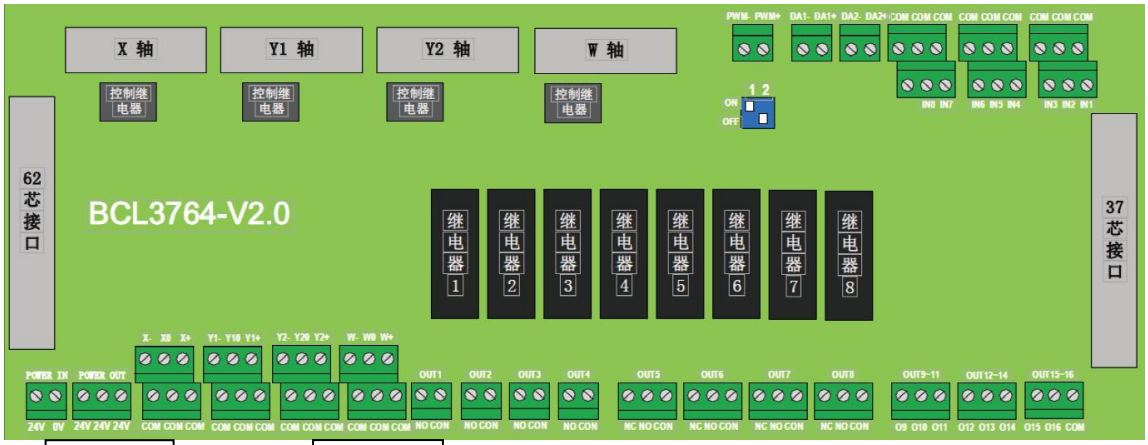
Step 1: Use an air gun to blow off the water, oil, dust and other debris in the air port.

Step 2: Tighten the male and female headers of the aerial plug.

Step 3: Use masking tape or electrical tape to wrap the air plug to prevent moisture, oil and dust from entering the air plug.

FSCUT closed loop expansion card

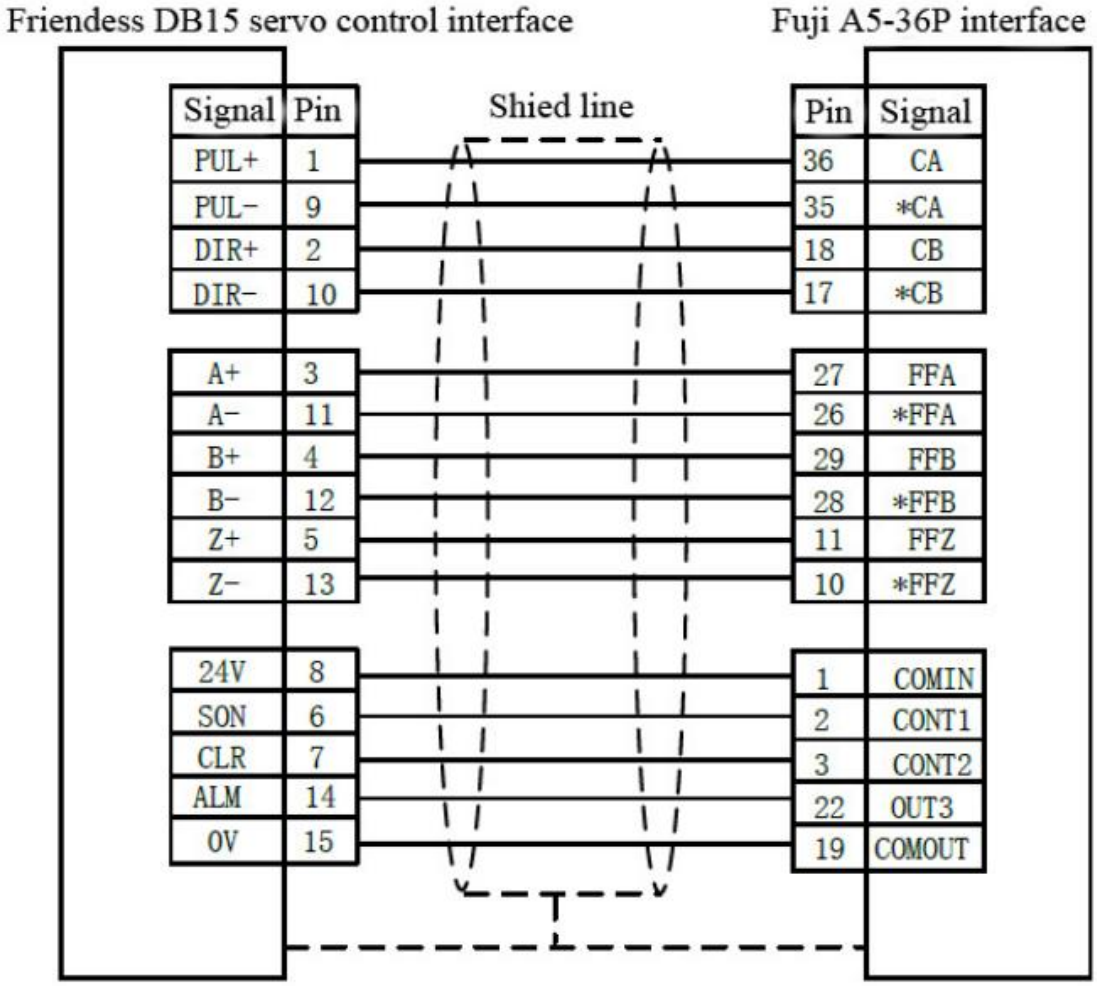




2.5 Servo connection(FSCUT open loop)

Friendess FSCUT2000A laser cutting control system BCL3764 terminal plate W axis DB15

servo control interface connect with Fuji servo driver 36P interface definition



NC30 parameter

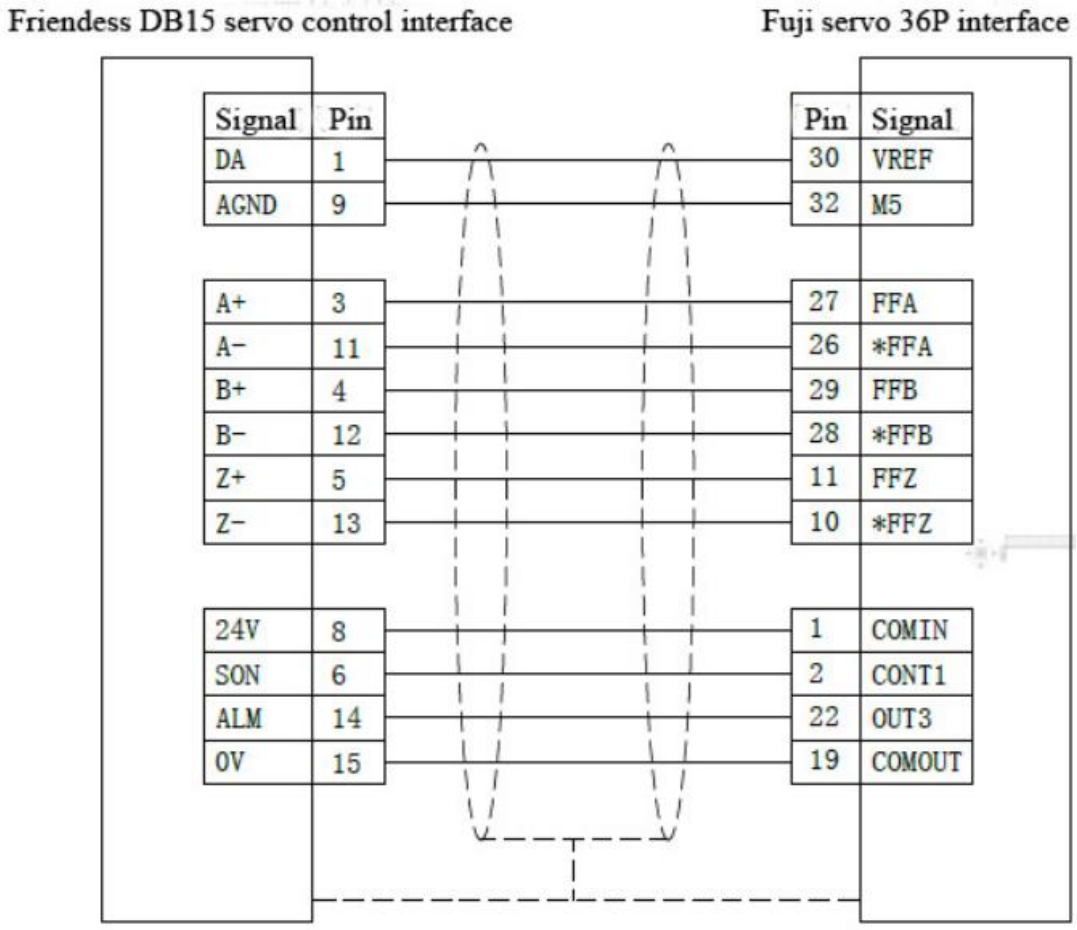
parameter	value	parameter	value	parameter	value
PA1-01	0	PA1-05	10000	PA1-27	50
PA1-03	30	PA1-08	2500	PA1-28	50
PA1-04	1	PA1-15	28		

Note: 1.Definitions of servo driver and servo motor connector shown in Fuji servo driver instruction;

2.Please use uniphase power, L connects to L1; N connects to L2.

2.6 Servo connection(FSCUT closed loop)

Friendess FSCUT4000A laser cutting control system BCL3724 terminal plate W axis DB15 servo control interface connect with Fuji smartplus servo driver 36P interface definition



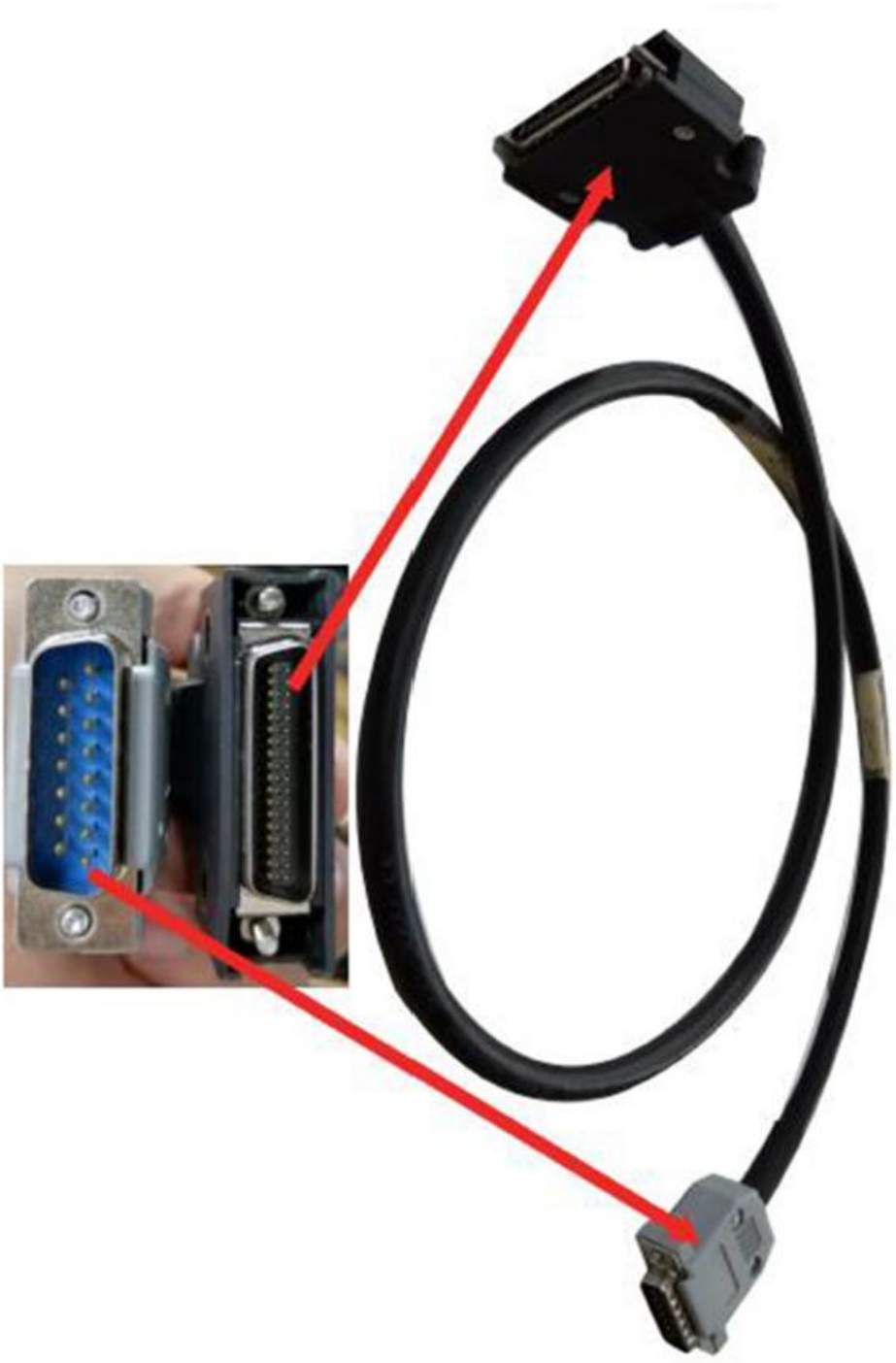
NC30 parameter

parameter	value	parameter	value	parameter	value
PA1-01	1	PA3-26	2	PA1-56	39
PA1-04	1	PA3-31	6.0	PA1-57	17
PA1-08	2500	PA1-15	28	PA1-59	0.53

Note: 1.Definitions of servo driver and servo motor connector shown in Fuji servo driver instruction;
2.Please use uniphase power, L connects to L1; N connects to L2.

2.7 FSCUT control system & servo drive communication wire

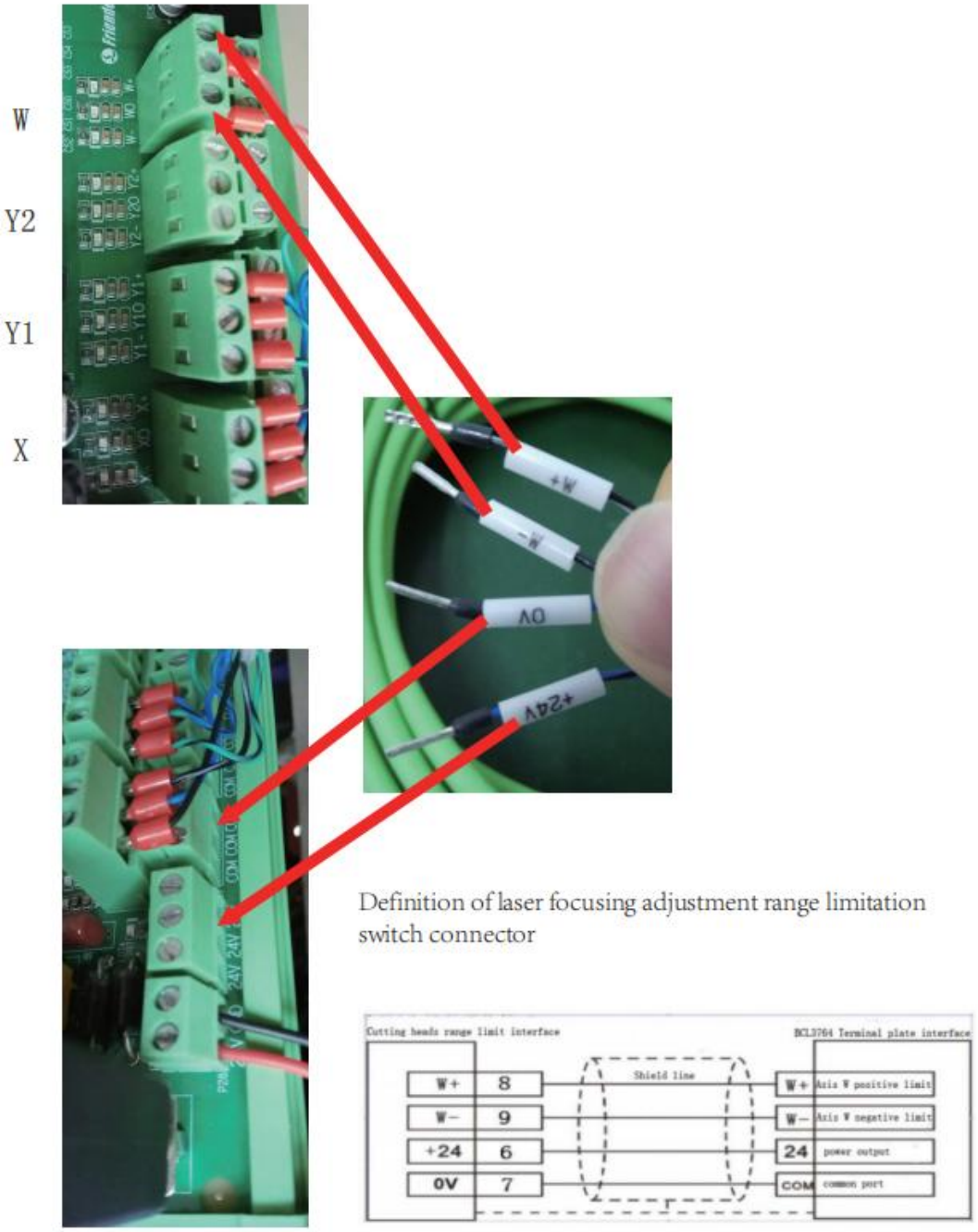
36 pin connects to
drive CN1



15 pin connects to W axis

2.8 Connection of FSCUT expansion card and drive

FUSCUT W axis limit connection



Definition of laser focusing adjustment range limitation switch connector

2.9 Limit signal inspection method:

Test condition

(1)Connect the DC24 power supply.

(2)Do not connect W+ W- first.

(3)The laser head scale 0 is in the middle of the window.

Steps

(1) Select the "DC voltage" gear for the multimeter, 200V or above.

(2) The red test lead is connected to the DC24V end, and the black test lead is connected to the W+ end (the side of the laser head line).

(3) If the displayed voltage value is greater than 18V, it is normal (theoretical value is 24V), and if it is less than 14V, it is abnormal (theoretical value is 0V).

(4) Jog in the positive direction, observe that the voltage changes, and the voltage difference is more than 12V, which is normal.

(5) The red test lead is connected to the DC24V end, and the black test lead is connected to the W- end (the side of the laser head line).

(6) If the displayed voltage value is greater than 18V, it is normal (theoretical value is 24V), and if it is less than 14V, it is abnormal (theoretical value is 0V).

(7) Jog in the positive and negative directions in turn, observe that the voltage has changed, and the voltage difference is greater than 12V, which is normal.

(8) Connect W+ W- to the corresponding port of the system expansion card.

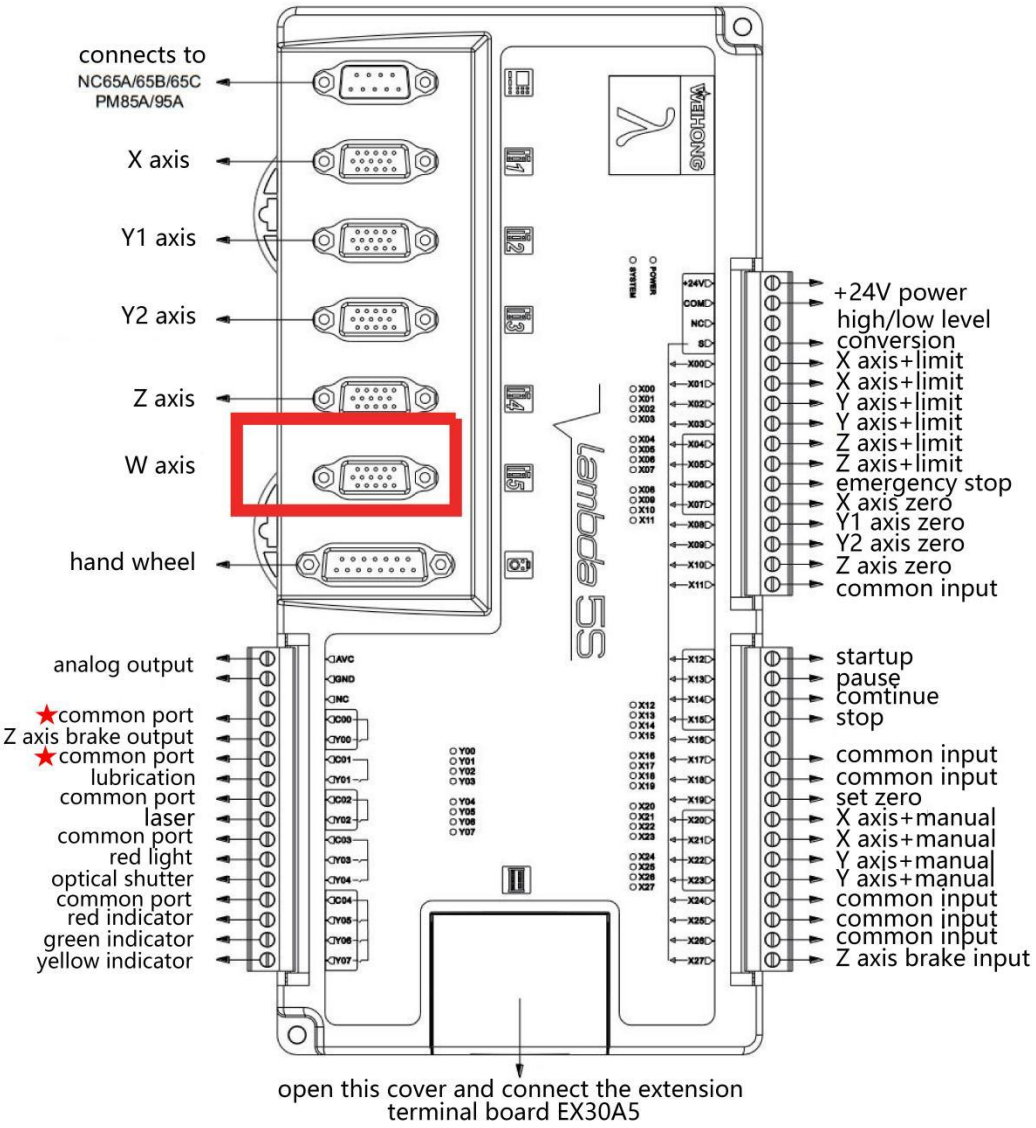
(9) Open the control software, the limit logic high is normally closed. Jog the movement to the positive and negative limit and observe whether the system can detect the limit.

(10) The above is the detection method of the normally closed limit switch, and the opposite is true for the normally open type.

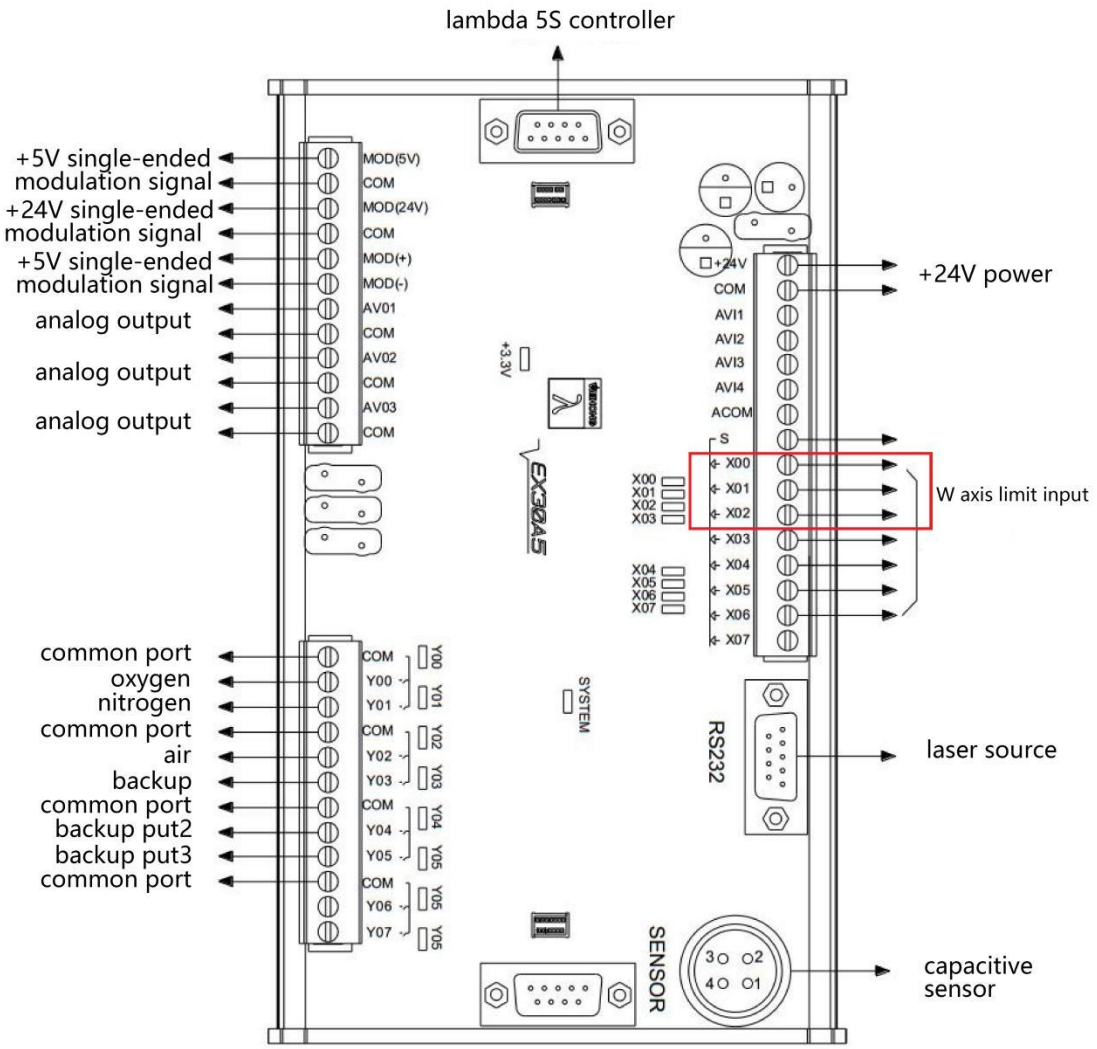
Note： Before use, jog the servo motor to confirm that the positive and negative limits are valid, and then enable the automatic mode. Before enabling automatic mode, let the servo motor home.

Weihong expansion card 1

Terminal board wiring diagram

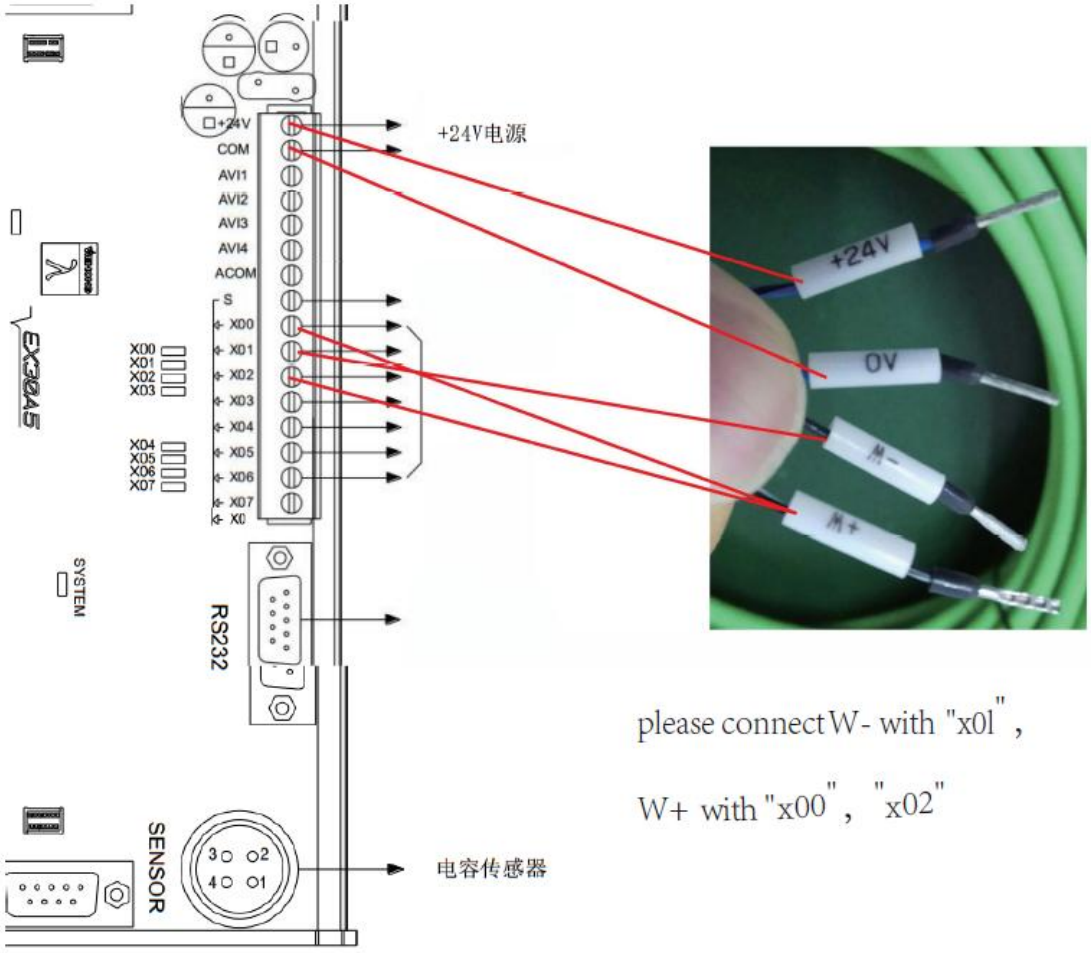


Weihong expansion card 2



Wiring diagram of extended terminal board EX30A5 in laser cuttiong system

Connection of limit line and Weihong



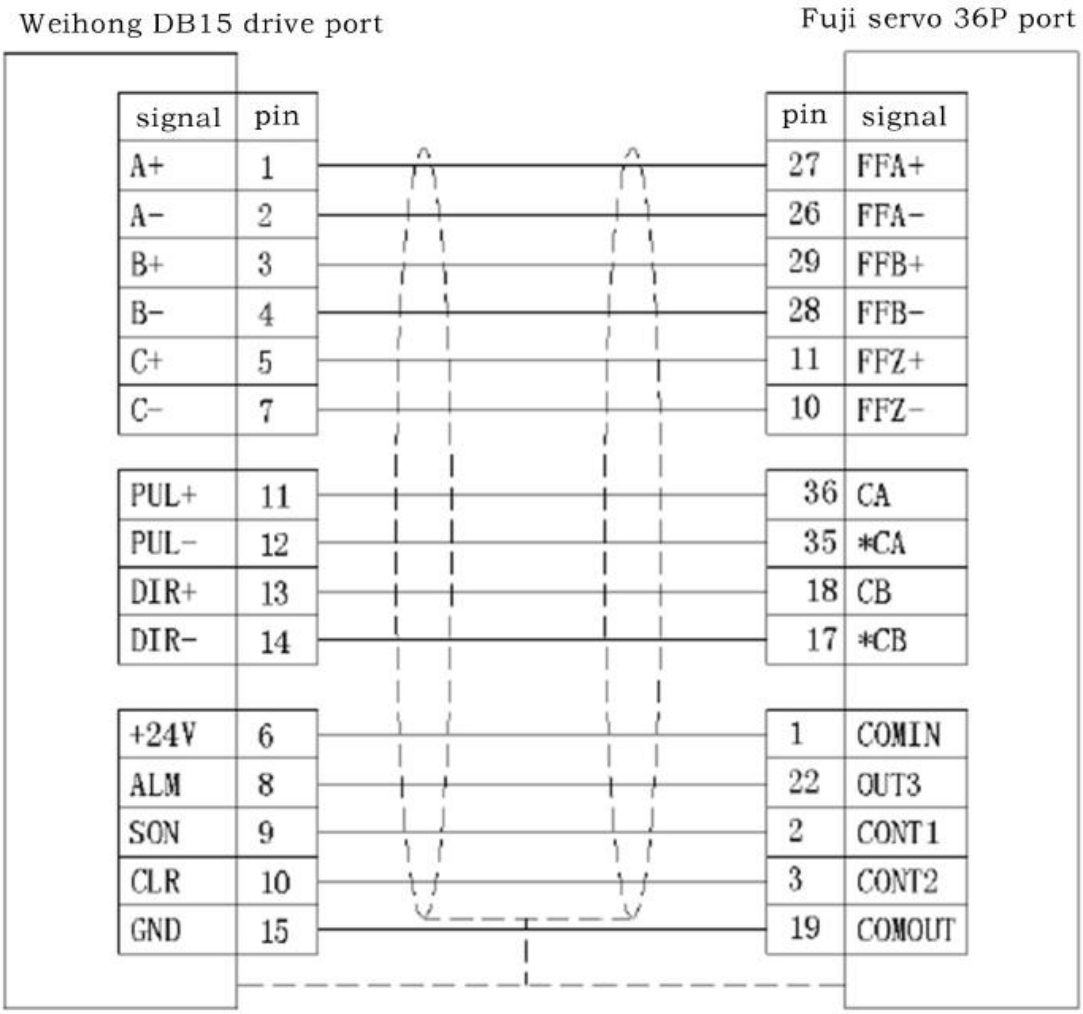
please connect W- with "x01",

W+ with "x00", "x02"

Limit logic parameter configuration

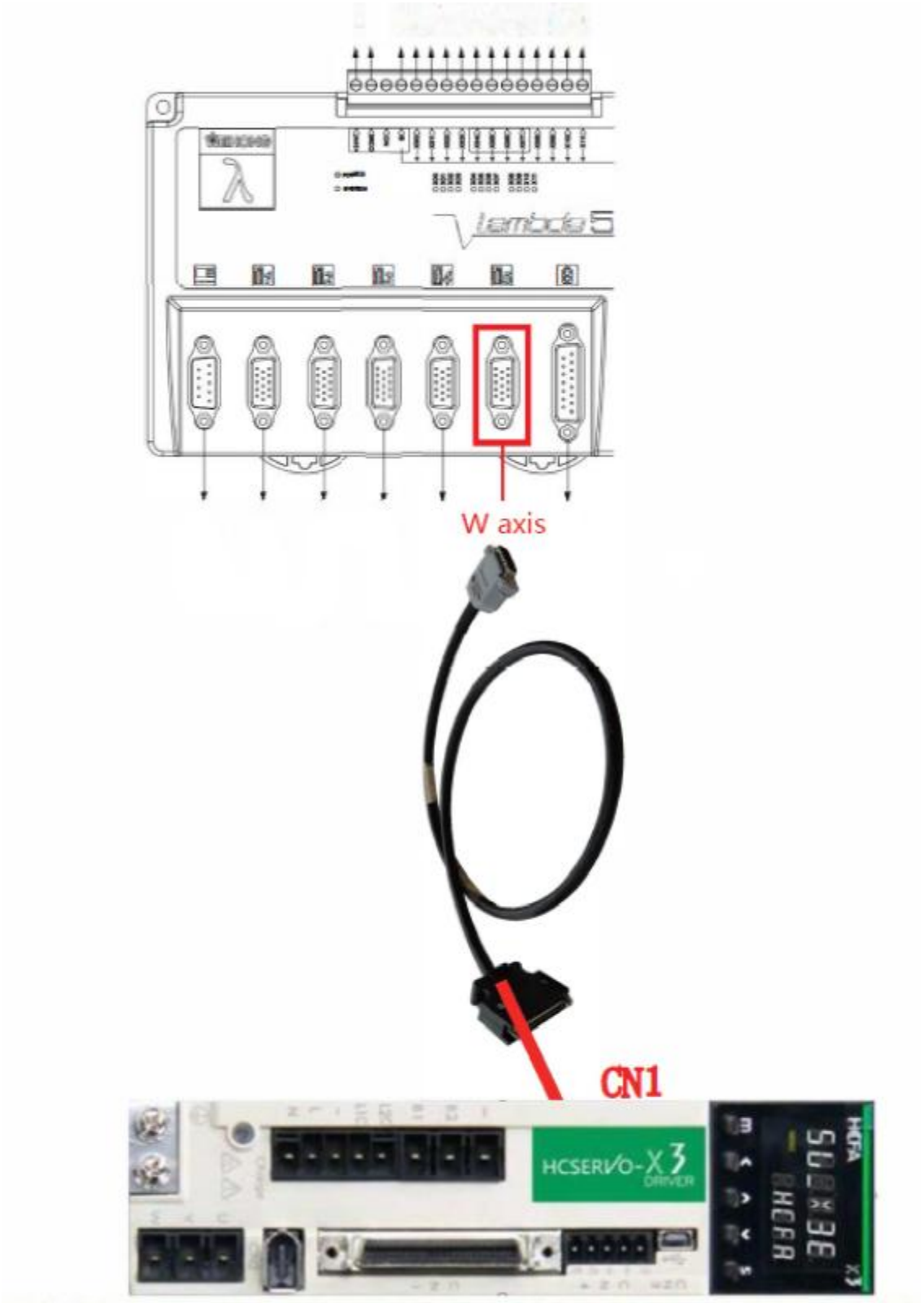
EX00	P	00072	E,F:16ms S:4ms	W axis+limit
EX01	P	00073	E,F:16ms S:4ms	W axis-limit
EX02	P	00074	E,F:16ms S:4ms	W axis zero

Fuji & Weihong communication line wiring (NC63A)



paramet	value	paramet	value	paramet	value
PA1-01	0	PA1-05	10000	PA1-27	50
PA1-03	30	PA1-08	2500	PA1-28	50
PA1-04	1	PA1-15	28		

Connection of Fuji and Weihong communication line



Weihong parameter configuration

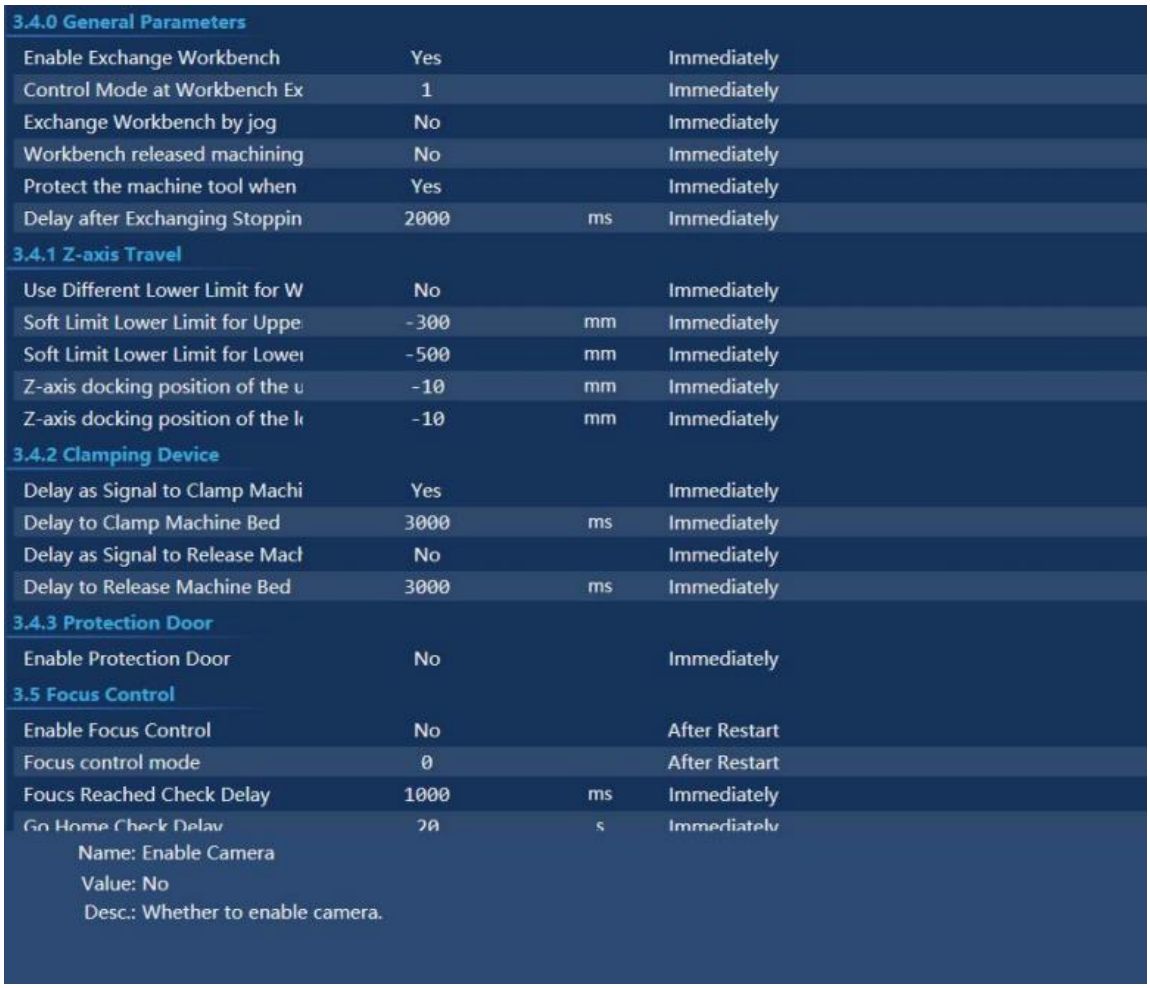
Name	Value	Unit	Effective
1.0.3 W-axis			
Encoder Direction(W)	1		Immediately
Axis Direction(W)	1		Immediately
Pulse Equivalent(W)	0.001	mm/p	Immediately
Command Pulse Count Per Rev	10000		Immediately
Feedback Pulse Count Per Revo	65536		Immediately
Upper Limit of Soft Limit (W)	100	mm	Immediately
Lower Limit of Soft Limit (W)	-100	mm	Immediately
Enable Soft Limit Protection (W	Yes		Immediately
Max Speed of Axis (W)	48000	mm/min	Immediately
Check Axis Encoder Error(W)	No		Immediately
Encoder Static Tolerance(W)	0.1	mm	Immediately
Encoder Dynamic Tolerance(W)	40	mm	Immediately

Limit logic parameter configuration

EX00	P	00072	E,F:16ms S:4ms	W axis + limit
EX01	P	00073	E,F:16ms S:4ms	W axis - limit
EX02	P	00074	E,F:16ms S:4ms	W axis zero

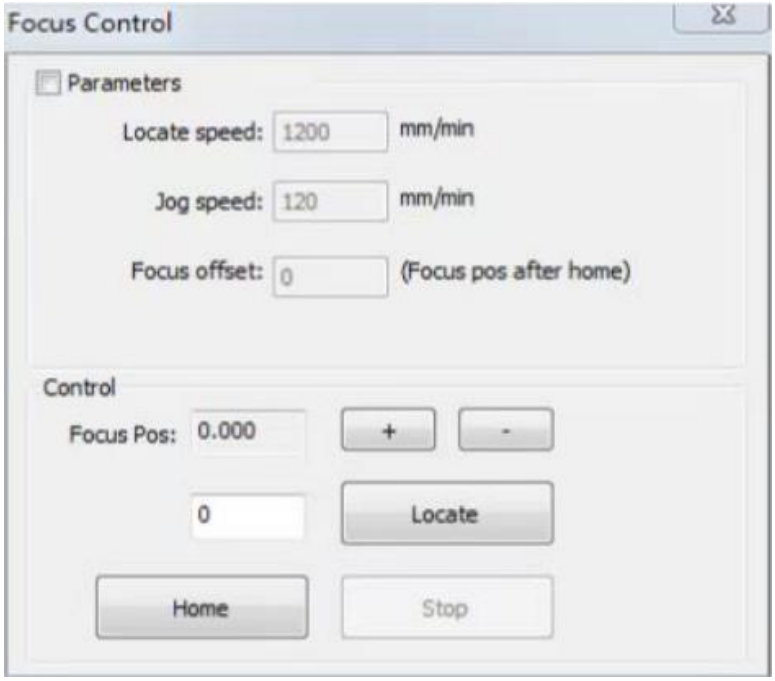
1.1.4 Origin Setting(W)			
Use Z Phase Signal(W)	No		Immediately
Coarse Positioning Direction(W	1		Immediately
Coarse Positioning Speed(W)	600	mm/min	Immediately
Fine Positioning Speed(W)	60	mm/min	Immediately
Retract Distance(W)	2	mm	Immediately
Retract Speed(W)	200	mm/min	Immediately
Min Distance between Coarse a	0.5	mm	Immediately
Enable Latch(W)	Yes		Immediately

Weihong parameter configuration



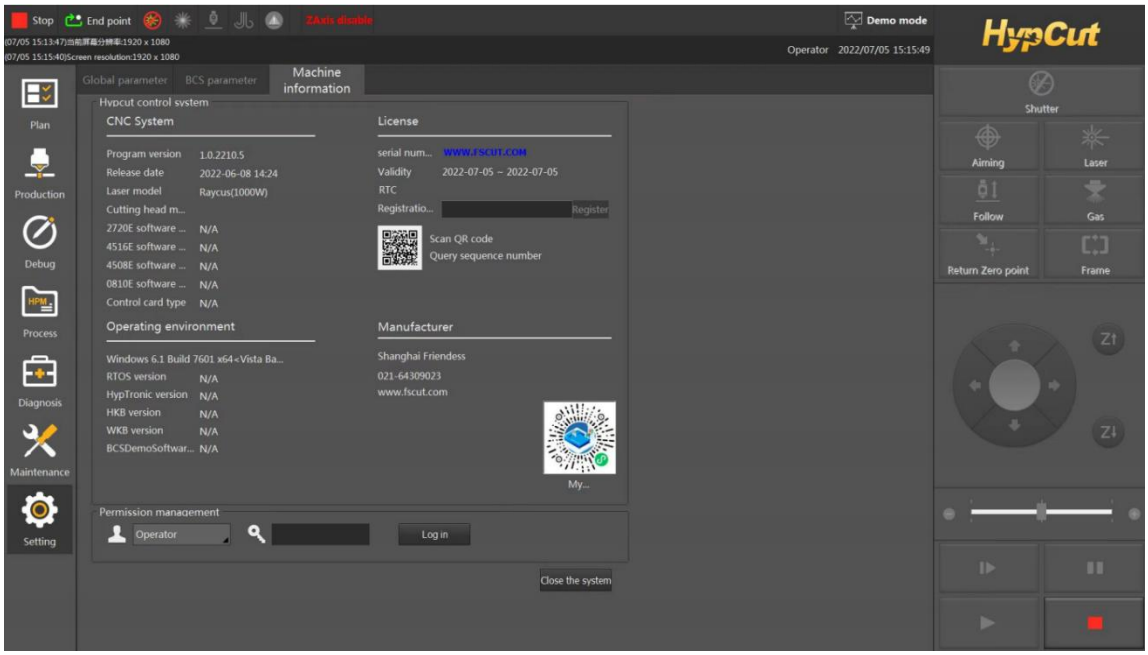
3.4.0 General Parameters			
Enable Exchange Workbench	Yes		Immediately
Control Mode at Workbench Ex	1		Immediately
Exchange Workbench by jog	No		Immediately
Workbench released machining	No		Immediately
Protect the machine tool when	Yes		Immediately
Delay after Exchanging Stoppin	2000	ms	Immediately
3.4.1 Z-axis Travel			
Use Different Lower Limit for W	No		Immediately
Soft Limit Lower Limit for Uppe	-300	mm	Immediately
Soft Limit Lower Limit for Lowe	-500	mm	Immediately
Z-axis docking position of the u	-10	mm	Immediately
Z-axis docking position of the l	-10	mm	Immediately
3.4.2 Clamping Device			
Delay as Signal to Clamp Machi	Yes		Immediately
Delay to Clamp Machine Bed	3000	ms	Immediately
Delay as Signal to Release Mac	No		Immediately
Delay to Release Machine Bed	3000	ms	Immediately
3.4.3 Protection Door			
Enable Protection Door	No		Immediately
3.5 Focus Control			
Enable Focus Control	No		After Restart
Focus control mode	0		After Restart
Foucs Reached Check Delay	1000	ms	Immediately
Go Home Check Delay	20	s	Immediately

Name: Enable Camera
Value: No
Desc.: Whether to enable camera.

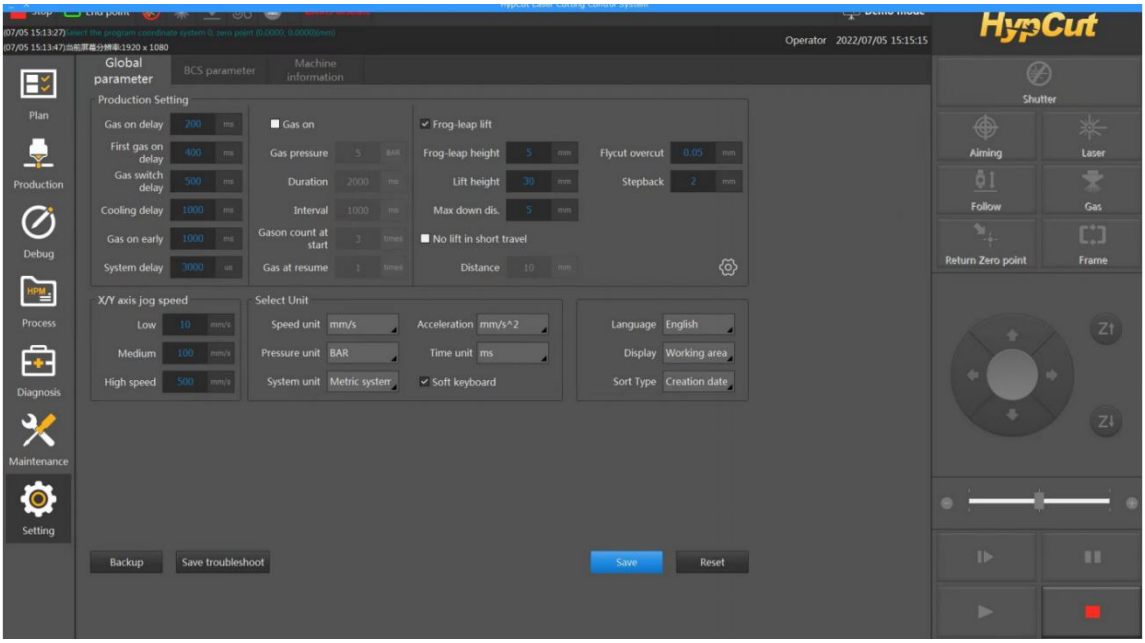


HypCut bus system operation and setting

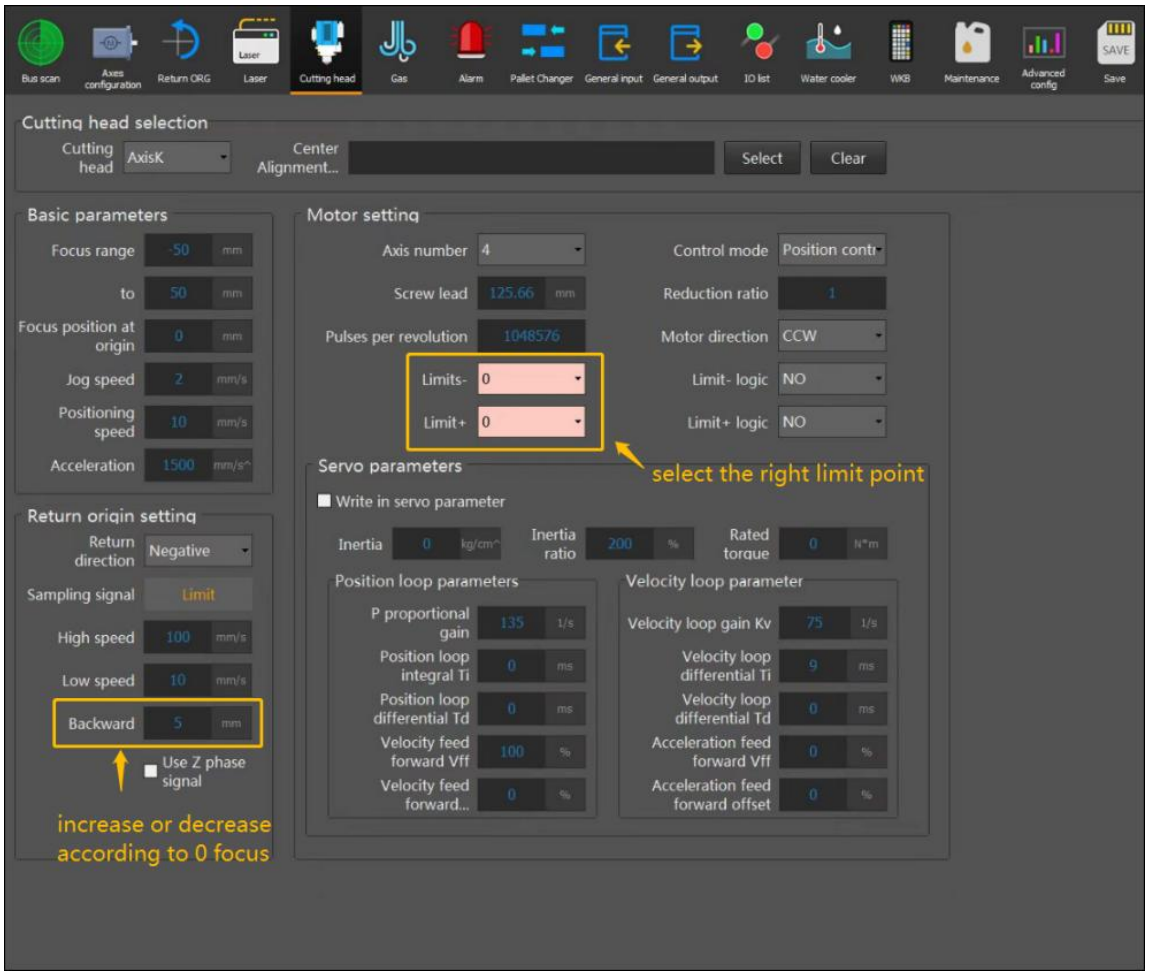
1. Settings > Device Information Interface > Enter Password 64309023 > Enter Expert Mode



2. Settings>Overall Parameters>Click Platform Configuration>



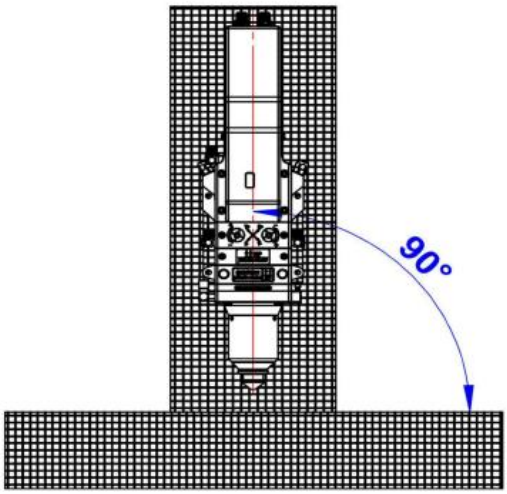
Axis configuration

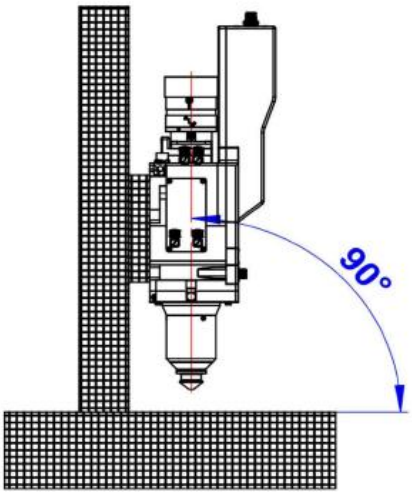


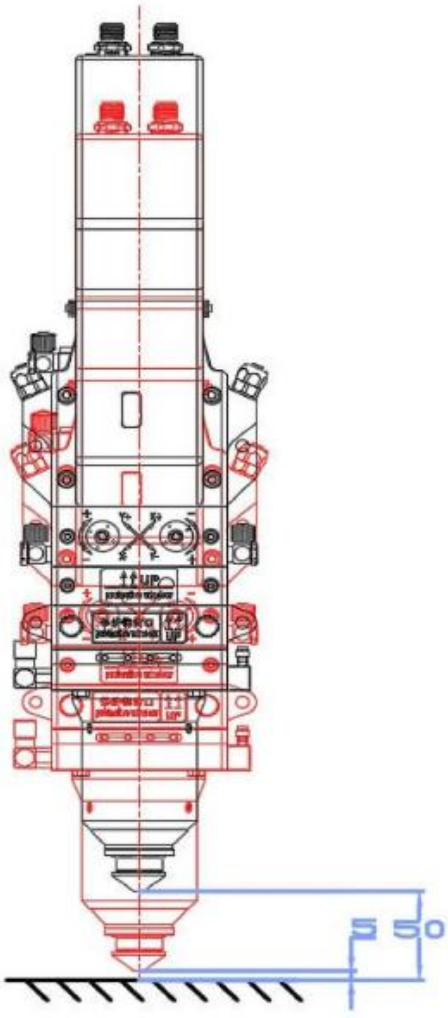
Common problems and failures

1	oc1	Overcurrent 1	tH	Regenerative transistor overheating
2	oc2	Overcurrent 2	Ec	Encoder communication abnormal
3	oS	Overspeeding	ctE	CONT repeat
4	Hu	Encoding	oL1	Overload 1
5	Et1	Encoder abnormal 1	oL2	Overload 2
6	Et2	Encoder abnormal 2	rH4	Inrush current suppression circuit abnormal
7	ct	Control circuit abnormal	LuP	Insufficient voltage in main circuit
8	dE	Memory abnormal	rH1	Internal regenerative resistor overheating
9	Fb	Fuse broken	rH2	External regenerative resistor overheating
10	cE	Motor combination abnormal	rH3	Regenerative transistor abnormal

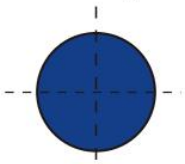
2.10 Verticality Inspection



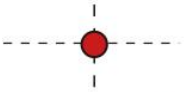




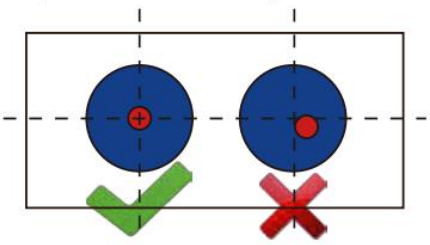
Step 1: set the laser power to 500W, make a short burst at the height of 5cm from the plate, burn around scorch on the plate;



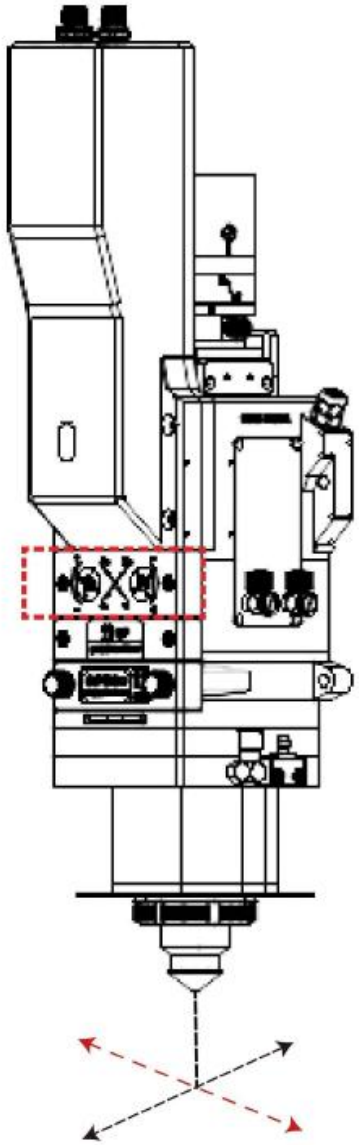
Step 2: set the laser power to 100W, make a short burst at the height of 1~5 cm from the plate, burn a round scorched spot on the plate;



Step 3: compare the concentricity;



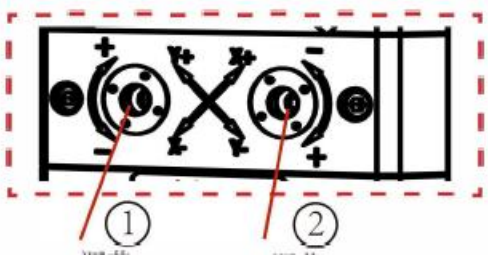
2.11 Coaxiality adjustment



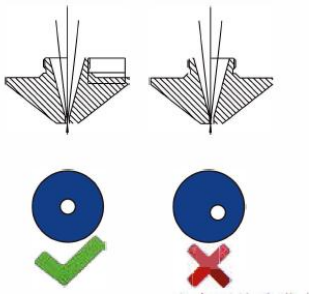
1. adjust the X/Y horizontal adjustment screws of 1 and 2 with an Allen wrench so that the beam passes through the center of the nozzle.
2. when the beam passes through the center of the nozzle, the cutting effect is best.
3. If the beam does not pass through the center of the nozzle, it may cause no light and poor cutting effect.

Method for detecting whether the beam passes through the center of the nozzle:

1. using transparent tape on the nozzle (the nozzle should preferably be new or not deformed).
2. adjust the power of the laser to about 50W; (500W for example, adjust the spot power to 10 %)
3. after 1 to 2 seconds out of the light, remove the transparent tape.
4. the transparent tape facing the lighting source, observe the nozzle printed on the tape and the laser printed on the round burn spot through the tape is concentric.
5. if concentric, then the debugging results qualified; if not, then continue to debug until qualified.



X/Y adjusting

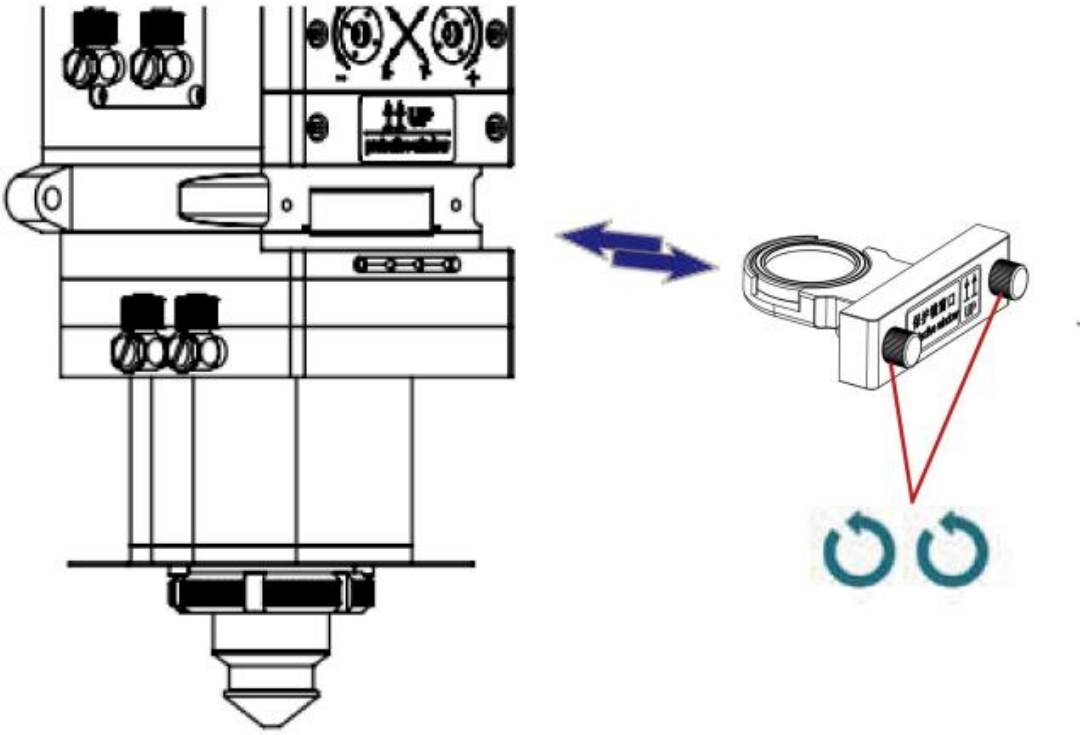


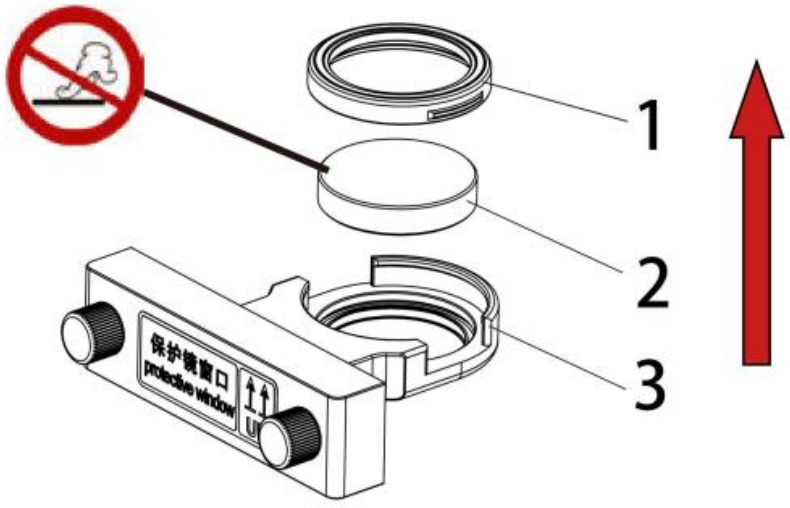
Concentric checking

3. Replacement of protection lens

Attention to dustproofing: wear dustproof gloves or finger covers when disassembling and assembling lenses, which needs to be done in a clean place. (When replacing lenses, user can seal the opening with a tape sticker to prevent dust from entering inside the cutting head). Do not use wrenches, pliers or other tools to prevent damage to parts.

3.1 Replacement of bottom protection lens

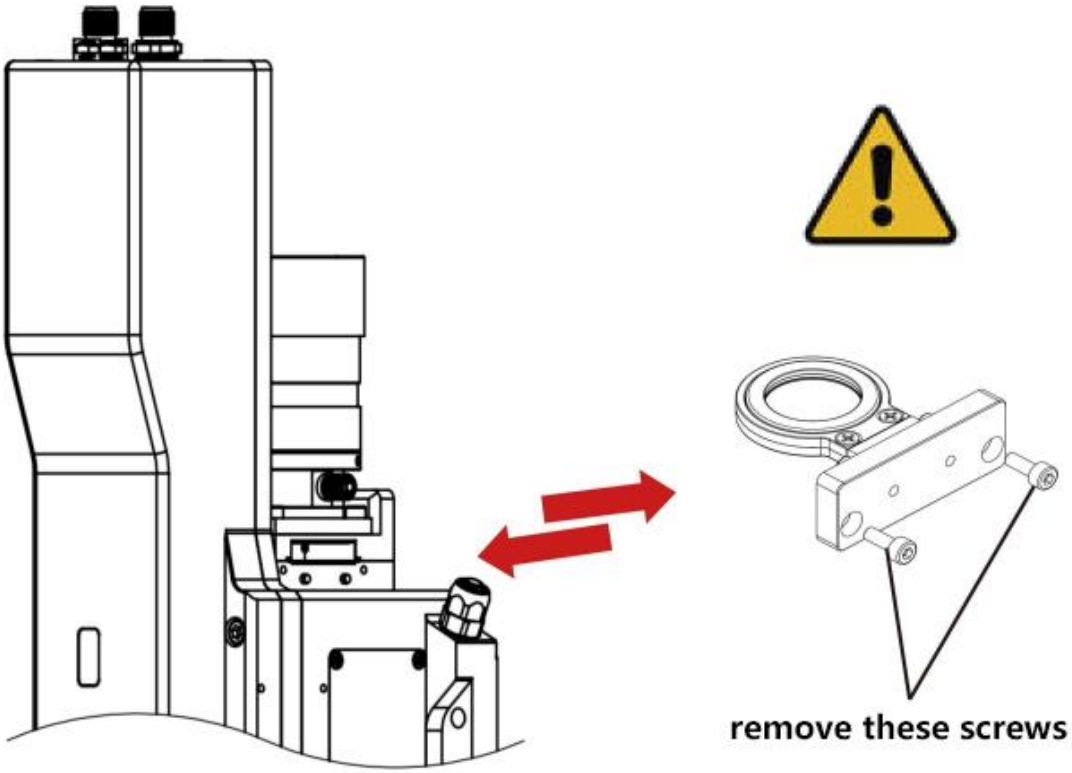


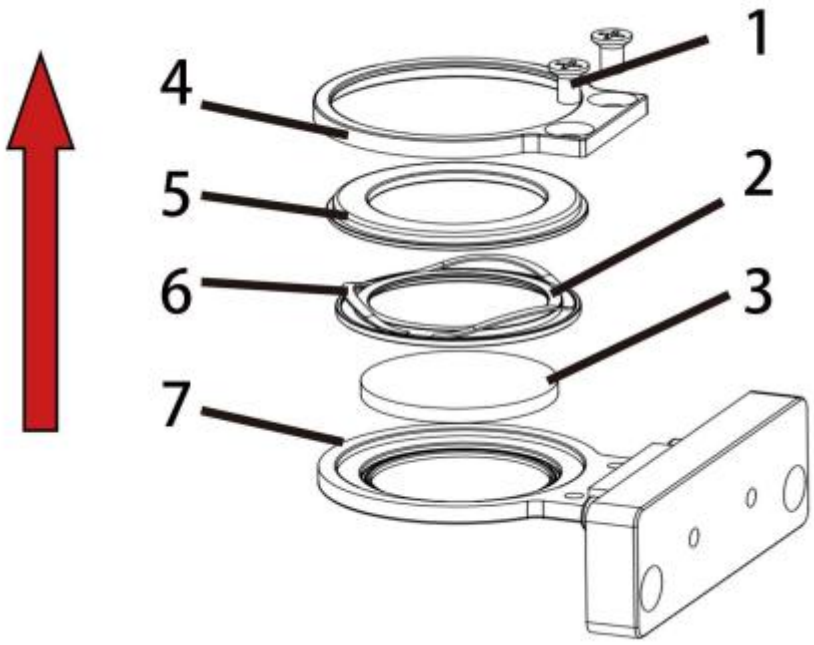


1. Pressing ring 2. Protection lens 3. lens base

Rotate the pressing ring and pull out upwards

3.2 Replacement of top protection lens

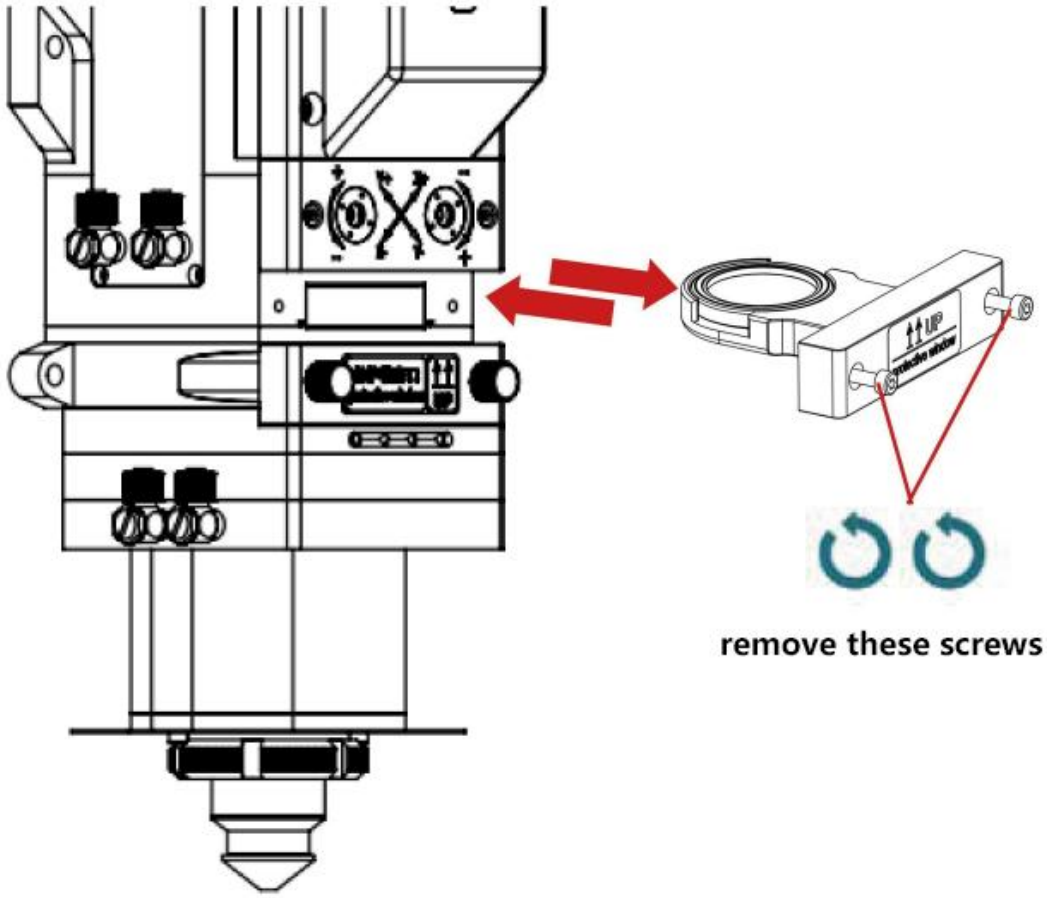


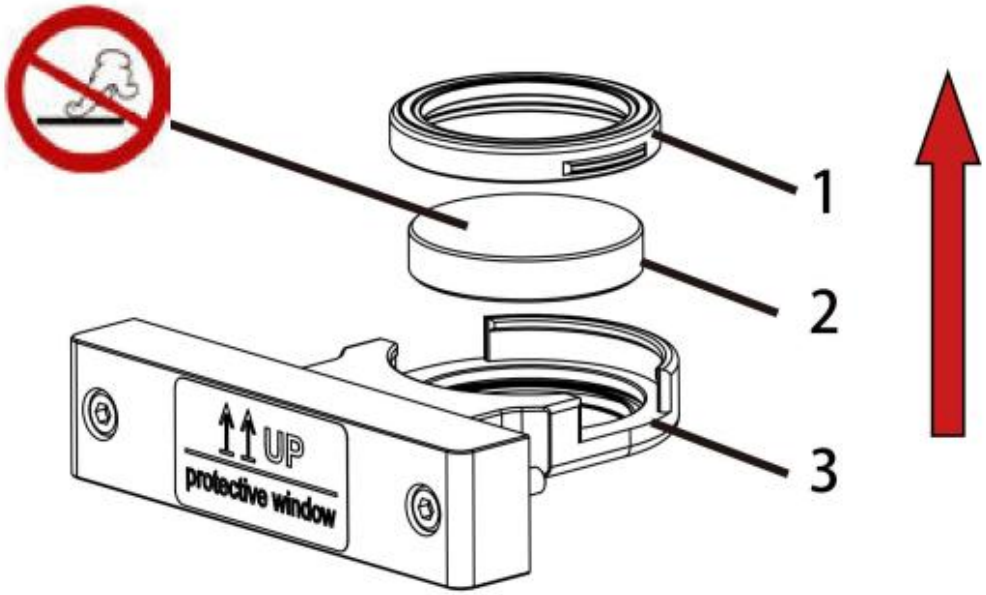


1. Screws 2. Pressing ring 3. Protection lens 4. Locking ring 5. Spring ring 6. Spring 7. Lens base

Loosen the screws then remove the rings and replace the lens.

3.3 Replacement of focus protection lens

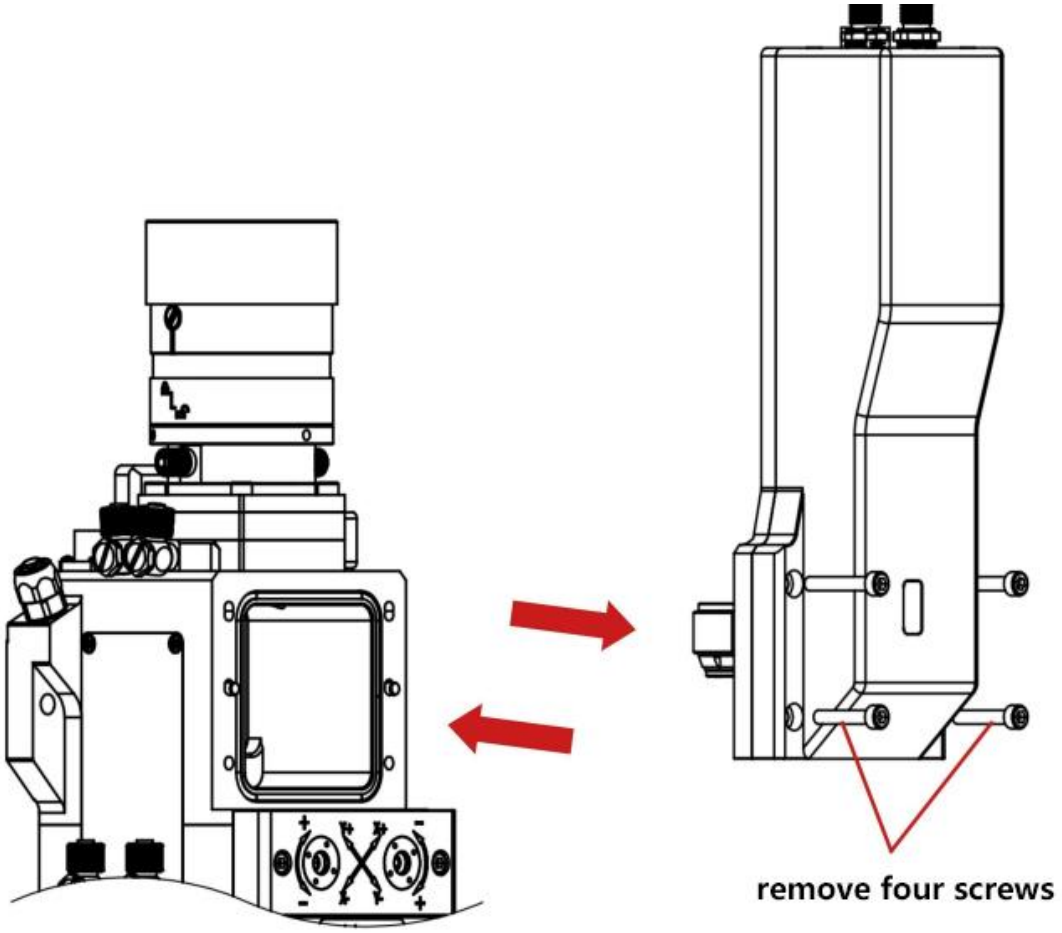


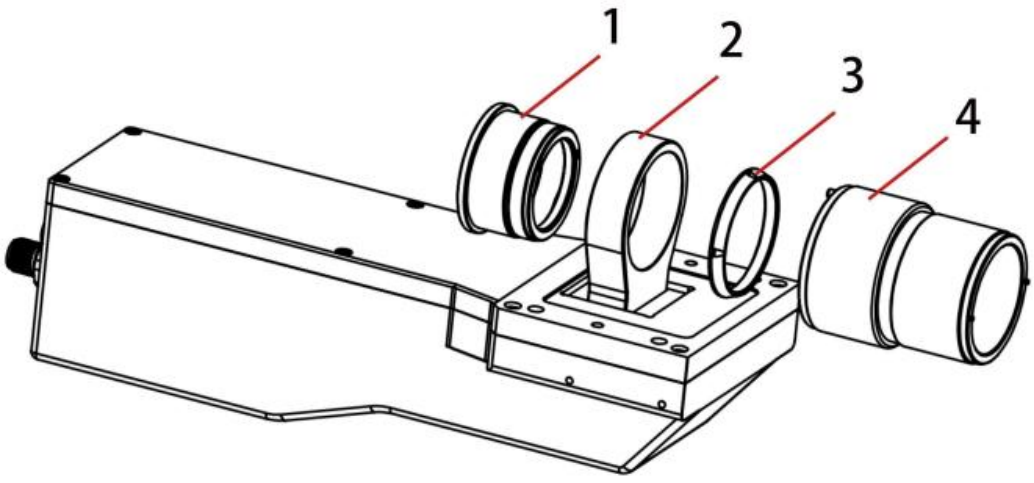


1. Pressing ring 2. Protection lens 3. Lens base

Rotate the pressing ring and pull out upwards

3.4 Replacement of collimation lens

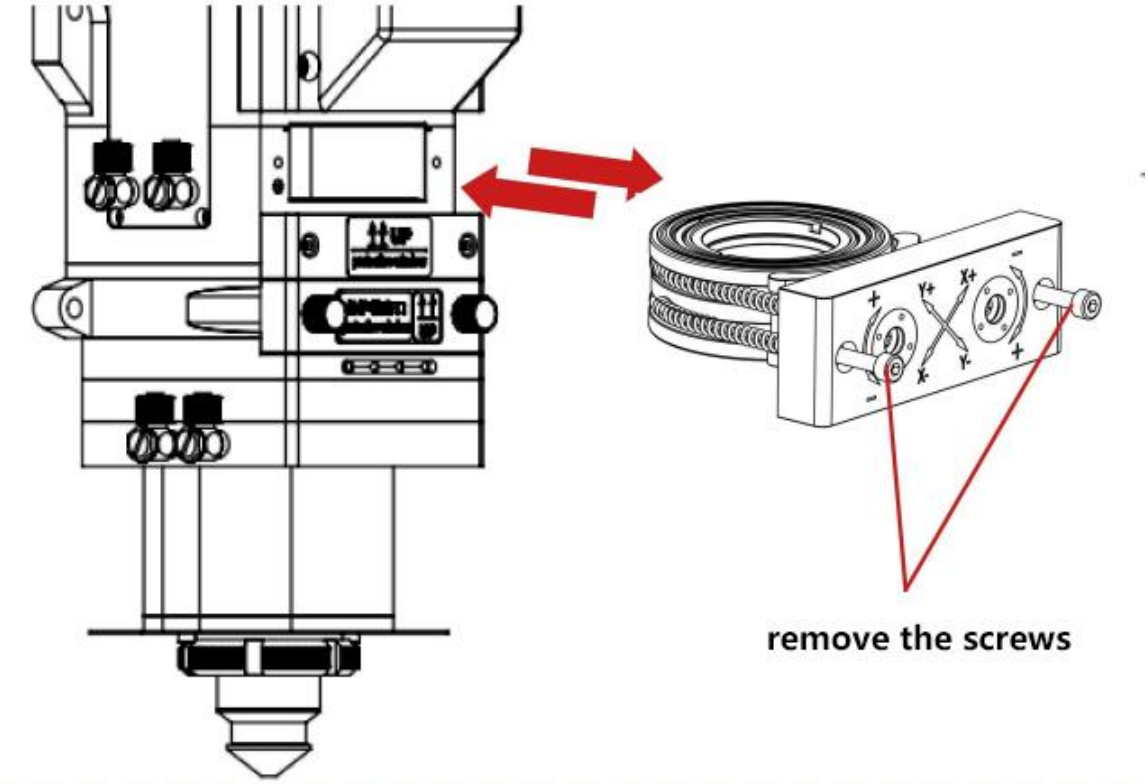


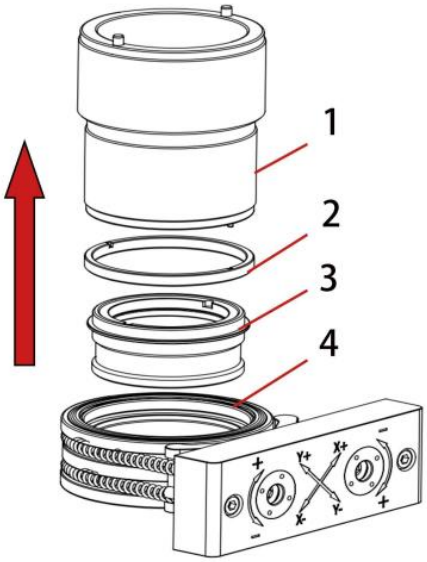


1. Lens barrel 2. Fixing base 3. Locking ring 4. Fixture tool

After loosening the locking ring with the fixture tool, the lens barrel can be withdrawn.

3.5 Replacement of focus lens



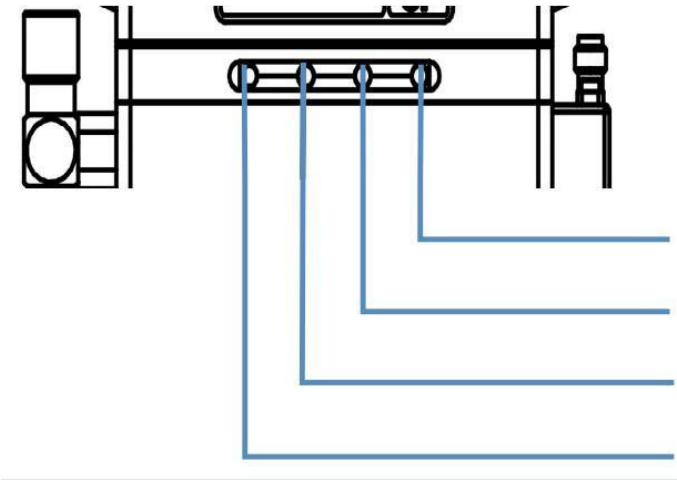


1. Fixture tool 2. Locking ring 3. Lens barrel 4. Lens base

After loosening the locking ring with the fixture tool, the lens barrel can be withdrawn.

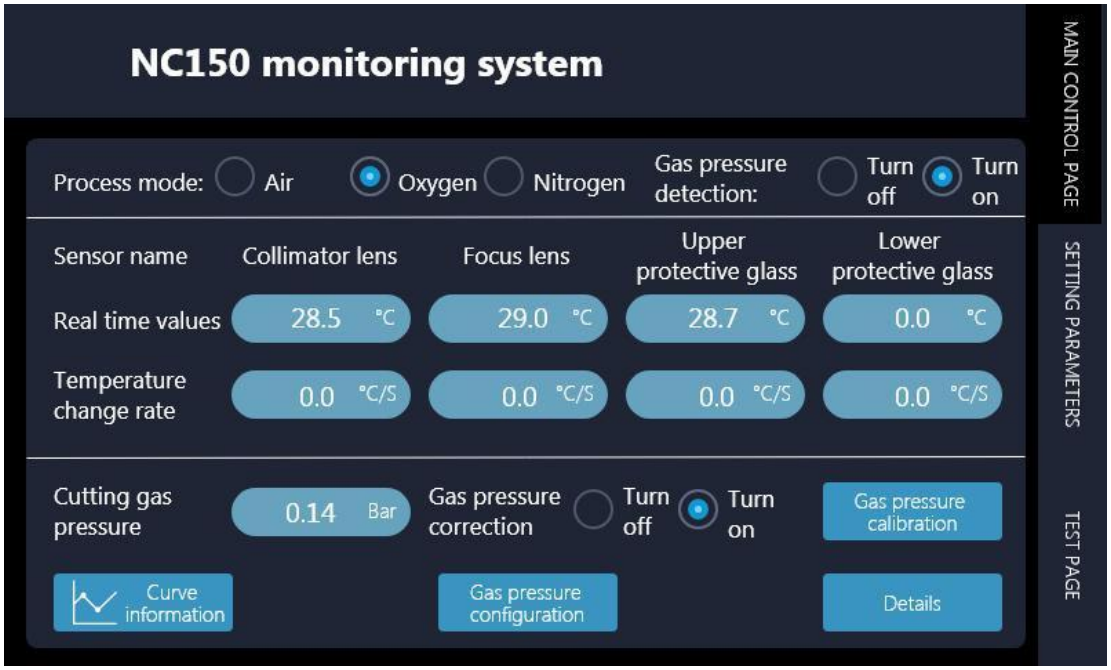
4. Monitoring system

Status display light description



Light 4: Upper and lower protective glass temperature/cutting gas pressure
Light 3: Collimation/focusing lens temperature
Light 2: The connection status of the host computer
Light 1: Running status

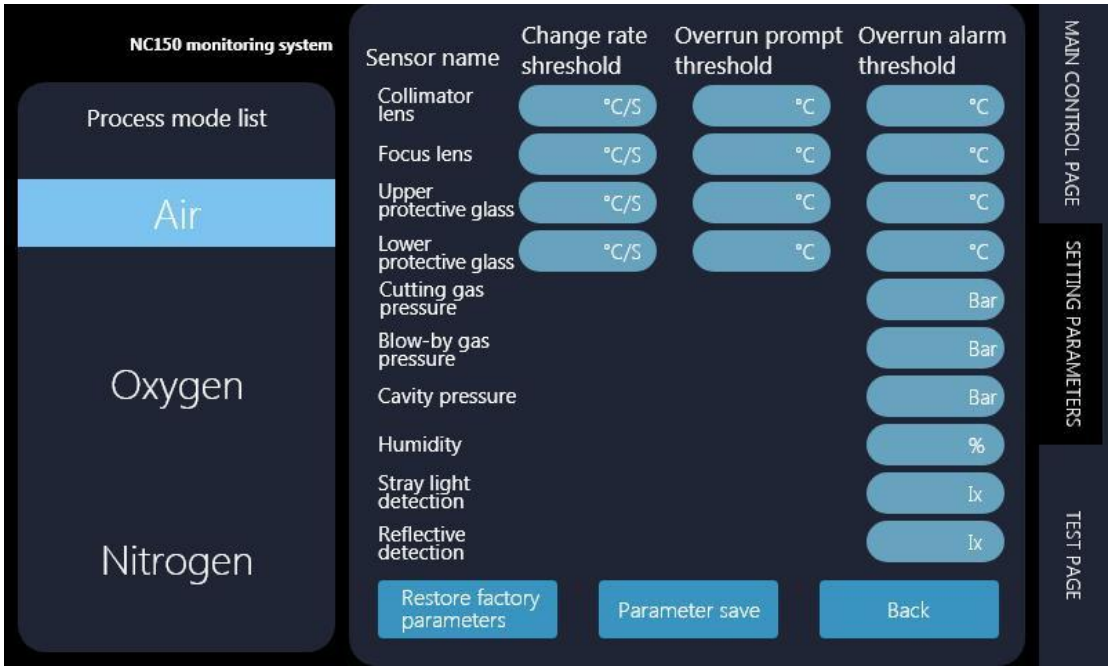
Real-time status interface



1. Monitor value column: cutting head real-time monitoring status.

2. Alarm value setting column: the default alarm value has been given (to change the alarm value, user needs to click the "Set Parameters" button and enter the permission password to confirm the change.)

4.1 Monitoring system process mode alarm threshold setting interface



In this interface user can set the process mode related over temperature alarm thresholds and over limit alarm thresholds for the corresponding gases. There are three buttons at the bottom of the function page, which are:

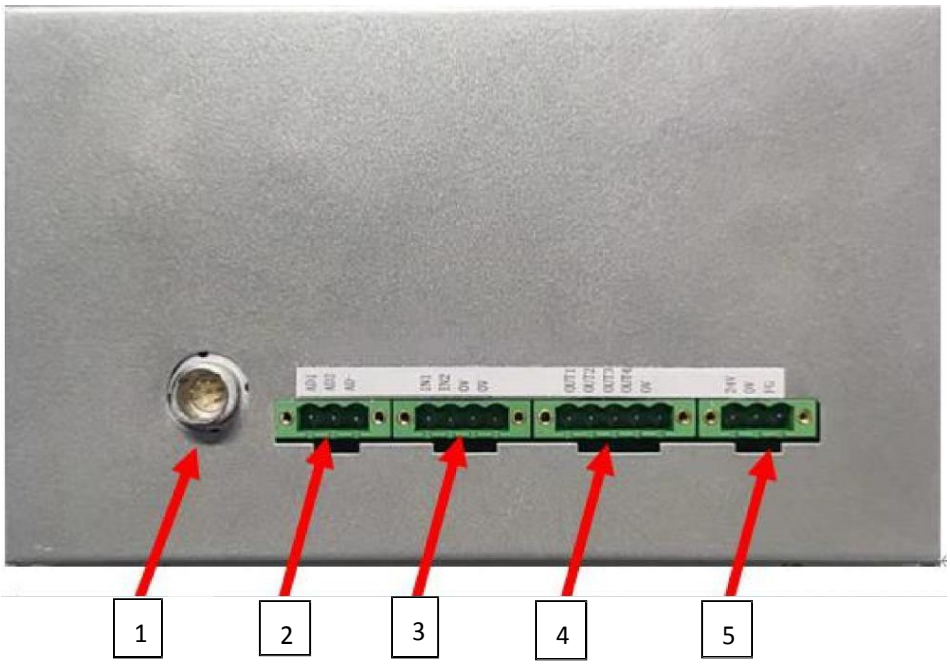
Restore factory parameters - Click this button to restore the factory default alarm threshold setting parameters. Note that to use the factory parameters, user needs to click on the parameter save;

Parameter Save - Clicking Parameter Save saves the data to the cache, and the power-down data page will not be cleared

Back-Return to home page

Note: The monitoring parameters can be generally defaulted, and then changed if there are special needs.

4.2 Electrical wiring



1. Cutting head communication interface: used to connect the cutting head and get the cutting head signal parameters;

2. Analog input: The air pressure alarm comparison interface, AD1 and AD- are connected to the analog output port of the board together with A+ and A- of the proportional valve. So that the board outputs 1V to the proportional valve and the monitoring screen page can get the 1V voltage signal for comparison;

3. Reserved signals: two input IO ports, only as reserved;

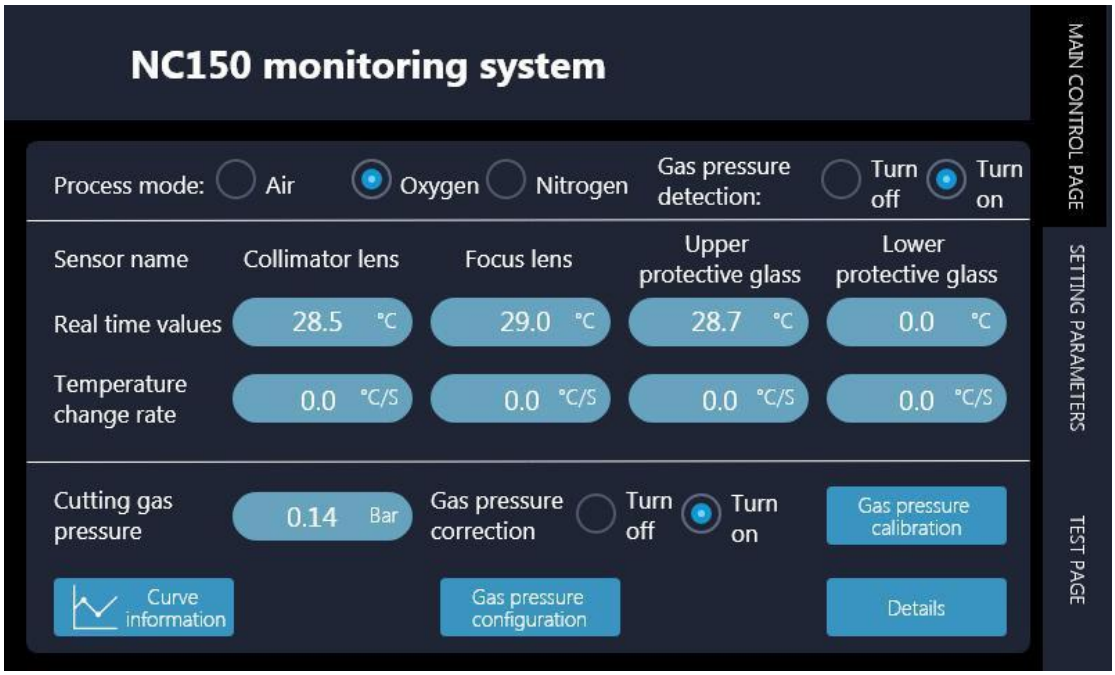
4. Alarm output: OUT1 and 0V are a set of alarm signals, OUT1 outputs 24V when the cutting head is alarmed, and 3.3V when it is not (the alarm signal is relayed to the board for use);

5. Power supply interface: the 24V3A DC switch power supply is recommended for power supply.

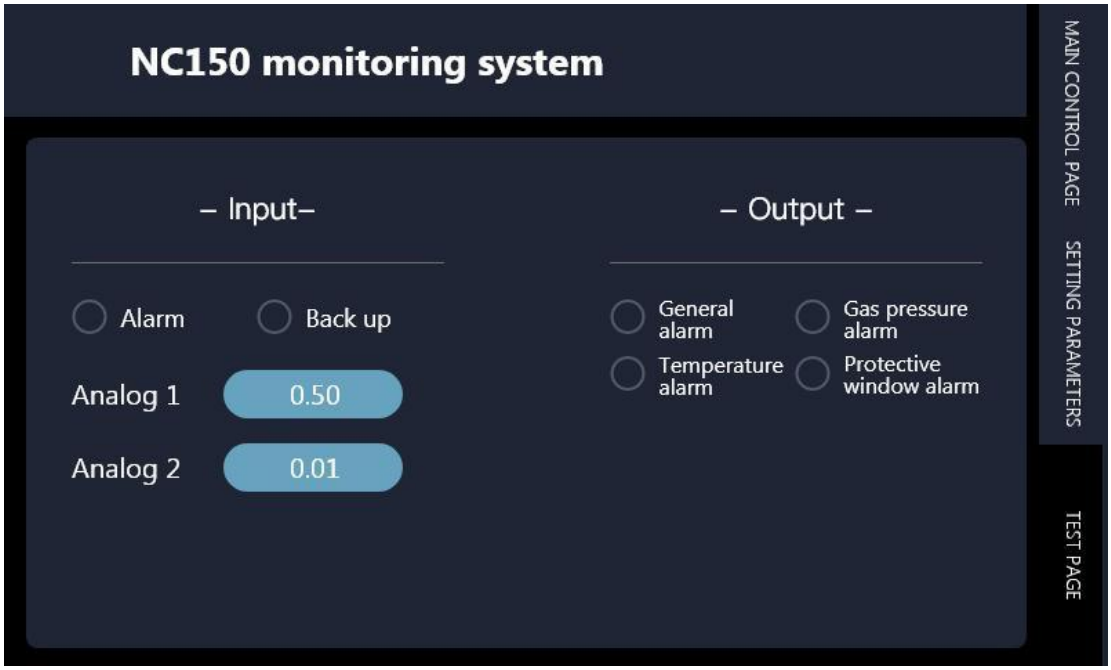
4.3 Air pressure correction

Steps：

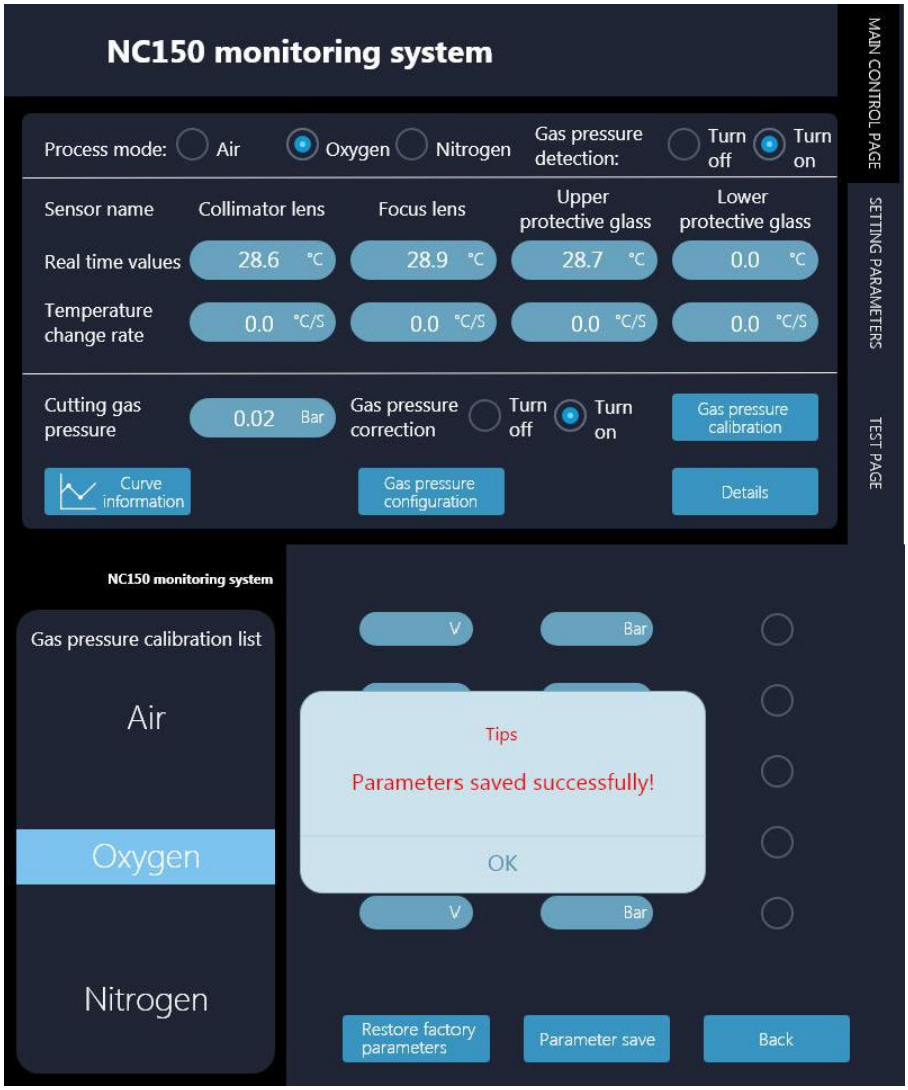
1. Set open gas pressure to 0.5 on the upper PC and then open;
2. Observe the cutting air pressure at the main interface of the monitoring screen, and record the air pressure of 0.14BAR



3. Open the test page-analog volume 1 , and record the voltage of 0.5V



4. Return to the home page, click the air pressure correction, fill in the new set of parameters to the first set, and check the enable, click the parameter to save



5. Set the open gas pressure to 1BAR in the upper PC, and then open the gas

6. Repeat steps 2-4 to record the parameters to the second set

7. Continue to increase the air pressure on the upper PC and record five sets of data (the air pressure is set to 0.5BAR -1BAR -1.5BAR-2BAR -2.5BAR)