

Microstep

SH-HC30

Flame / Plasma Cutting Torch

Height Controller

System Manual

Manual Content

-
1. Foreword

 2. Overview

 3. Installation

 4. Fast Operation

 5. Debugging

 6. Operating guide

 7. Control Panel

 8. Troubleshooting

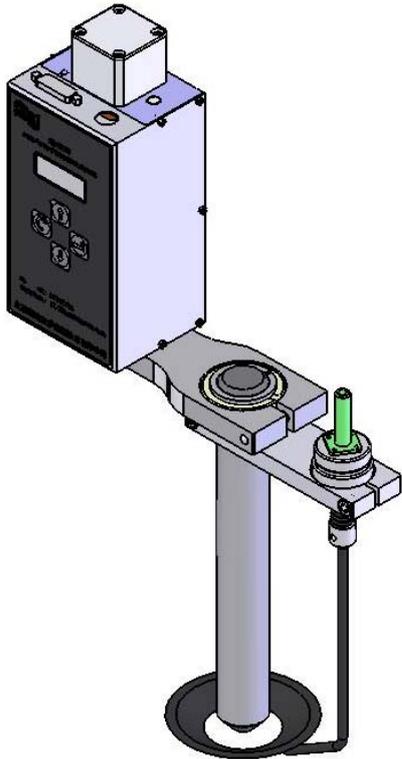
 9. Initial positioning

 10. NC and commands related with height adjustment device

 11. Height adjustment remote controller



北京斯达微步控制技术有限公司
Micro Step Control Technology co., Ltd.



Graphic model of height controller



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Contents

1. Preface	1
1.1 Purpose.....	1
1.2 Important statement:.....	1
1.3 Warning	2
1.4 Terms.....	2
1.5 Company Information	3
2. Overview.....	3
2.1 Technical Features	3
2.2 Main Technical Parameters	4
3. Installation	5
3.1 Mechanical Installation	5
3.2 Electrical Installation Connection	8
3.2.1 External Switch Control Mode	8
3.3 Description of functions of voltage divider board	14
3.4 Dimensional drawing of voltage divider board.....	16
4. Quick Operation Guide for Capacitance and Arc Voltage height Controller.....	17
4.1 The control operation of electrical operation panel: (external switch mode).....	17
4.2 SH-2002AH/SH-2200H CNC system output interface operation (I / O control mode) ...	18
4.3 The communication interface of the CNC system is used to complete the operation (RS232 communication mode)	19
4.4 Operation Flow	19
4.5 Operation Flow of Daily Work.....	20
Figure 4-2 Operation Flow of Daily Work	20
5 Operating Guide.....	21
5.1 Parameter Setting	21
5.2 Manual Operation	21
5.3 Automatic Operation	21
6. Debugging.....	21

6.1 Initial debugging of capacitive detection.....	21
6.2 Debugging steps of a key height calibration	22
7 Controller Panel	22
7.1 Control Parameters	22
7.2 Operation Panel.....	23
7.3 Description of Display.....	24
8 Troubleshooting.....	25
9 Description of initial positioning function.....	26
9.1 Positioning mode.....	26
9.2 Positioning height setting	26
9.3 Process	26
10 Command Functions Related To M of CNC System and Height Controller.....	27
10.1 Function M of Direct Control Output Port of CNC System	27
10.2 Fixed Cycle of Function M.....	27
11 Height Adjustment Remote Controller	28
11.1 Function Introduction	29
11.2 Operation Guide	29
11.3 Wiring Instructions	30
11.4 Installation Dimensions	31

1. Preface

Either flame cutting or plasma cutting mode the stability of the distance (height) between the cutting torch and the cutting board in cutting is essential, which will directly affect the cutting speed and cutting quality.

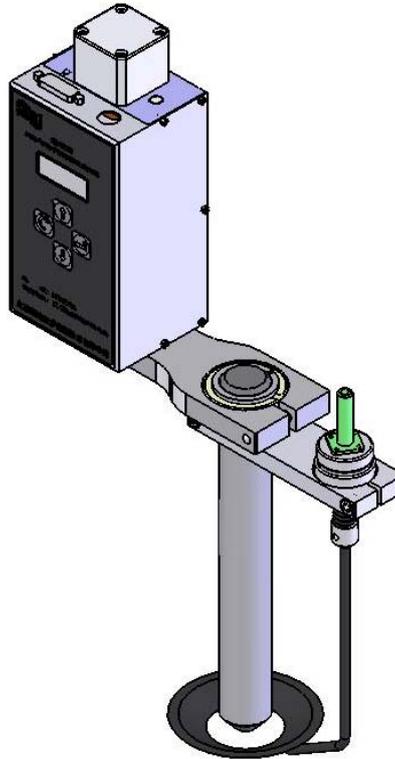


Figure1-1 SH-HC30 flame / plasma cutting torch height controller

1.1 Purpose

SH-HC30 flame / plasma cutting torch height controller is the automatic control module for cutting torch height with the integration of mechanical increase and electric control specially designed for portable flame and plasma cutting machine, and another new product in the aspect of industrial automation control of Beijing Start Microstep Control Technology Co., Ltd.

SH-HC30 flame / plasma cutting torch height controller is easy to use; debugging is convenient; and the price is low; it inherits the characteristics of Microstep products: "The performance of imported product; Domestic price." It is the ideal accessory product for welding and cutting equipment manufacturers.

1.2 Important statement:

- Please comply with the actual instrument if there is any discrepancy between the SH-HC30 flame / plasma cutting torch height controller and the content of the manual. We won't inform you particularly if some amendments about the product and its accessories are made. If you want to know more updated content, please go to our website <http://www.startsh.com>, or call Beijing Start Microstep Control Technology Co., Ltd.

- Please read the safety warning and attentions to avoid any accidents due to incorrect operations.
- Please operate the machines strictly following the manual and its detailed instructions before you install and use this machine.
- All the responsibilities will be undertaken by the users if any particular illegal utilization of SH-HC30 flame / plasma cutting torch height controller or manual is made for it doesn't represent our position and we refuse to admit the legal responsibility.
- The safety warning is to avoid any accidents to the human body or properties.
- For any quality problems during the utilization of the SH-HC30 flame / plasma cutting torch height controller, the customers can call the service center of our company or authorized agents, distributors to get service and help.
- It's not allowed to copy, transmit or utilize any content of this manual without the specific permission. Any offenders will undertake all the responsibilities for the loss.

1.3 Warning

Please read and strictly comply with the following instructions before operating the product to reach the design control accuracy of product and avoid any damage and accident.

- Installation must be carried out by technical personnel of related industry or having relevant experiences.
- Please thoroughly read the instructions before installation.
- Confirm that the selected power supply complies with the required specifications.
- Installation, inserting and pulling of plugs are prohibited when the current is switched on.
- Keep away from heat for the installation position.
- The controller shell must be grounded well to avoid electric shock or affecting the controller.
- The cutting board must be grounded well, and maintain a good grounding with the controller shell in order to ensure the accuracy of height control.



Note: If the controller shell and the cutting board are not grounded well, the height controller will not work normally.

- Take care when transporting and never make some fierce collision or tremble for damage may occur.
- Please don't disconnect the SH-HC30 flame / plasma cutting torch height controller or change its internal construction for any accidents or fault may occur.

1.4 Terms

- **One key height calibration:** when the capacitance height measurement is adopted, the specific inductive capacity between the capacitance detection ring and the cutting board may affect the accuracy of height measurement due to temperature, pressure, humidity, gas composition and many other factors on site. In addition, the serious non-linear relationship exists between capacitance value and height value. Our company has developed the intelligent program of "a key height calibration". You only need to press a key on site, you can set various factors of change automatically. And within 3-30mm, the display and control of high accuracy, high precision and high linearity are realized.
- **High speed zone:** When the difference between the actual height and the set height is bigger, in order to reach the set value at the fastest speed, the cutting head advances for the set value at the highest speed; this zone is called high speed zone.
- **Speed Regulating Zone:** When the cutting head reaches the set value at high speed, severe oscillation may be caused so that the height control is unstable. In order to achieve a smooth transition, the speed regulating zone is set. This zone is located between the high-speed zone and dead zone. In this zone, when it is farther away from the set value, the cutting head moves at higher speed; if not, at a lower speed. The range value in this zone may be set. When it is too big, the transition is smooth, but the track time is too long; when it is too small, the tracking is conducted in time, but oscillation may be caused easily.
- **Dead zone:** When the cutting head is within certain height value, the height of the cutting head will not be adjusted any more. The range is called dead zone. When the dead-zone value is too large, the control precision is too low; when it is too small, the cutting head may oscillate up and down easily. The appropriate value of dead zone not only can guarantee the control precision but also do not generate oscillation.

1.5 Company Information

Beijing Start Microstep Control Technology Co.,Ltd.

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2. Overview

2.1 Technical Features

- **Stepper motor instead of the traditional DC motor**
SH-HC30 flame / plasma cutting torch height controller uses the unique stepper motor control technology of Start Microstep Company. It subverts the traditional DC motor height control mode and makes it become fast and smooth, and the life of the product is increased greatly.
- **The height of cutting nozzle is displayed directly in the mode of capacitance height control**
- The advanced height linear calibration technology makes the cutting nozzle and cutting board be within 3 ~ 30mm in the automatic height controlling in the capacitance mode; the absolute height display and control are realized; the unit is mm. The display accuracy is $\pm 0.1\text{mm}$.
- **Integration of mechanical lifting device and height controller**
The integrated design of detector, controller and drive makes the products reach a high degree of integration; adjusting the stroke: 10Cm.
- **All Digital Technology**
Circuit uses SMD technology without any adjustable devices; all digital control technology ensures that the product has a high degree of reliability.
- **Simple and convenient linearization calibration**
The function of "One key for height calibration" guarantees that in any circumstances, the user only needs to press a key, he can calibrate the absolute height measurement and achieve a linear height measurement.
- **It can be used in tough environment**
The shell uses the sealed, tamper-proof, waterproof and moisture-proof aluminum box design, particularly applicable to the severe environment of high temperature and high electromagnetic interference from flame cutting and plasma cutting.
- **There are various interfaces that are easy to use.**
- The interface is simple and easy to control, suitable for all flame cutting and plasma cutting numerical control system, and they can also be used alone.
- **RS232 communication interface**
Asynchronous communication function can be connected with the numerical control system, convenient for parameter setting, automatic / manual control, taper angle transition control and data exchange.

2.2 Main Technical Parameters

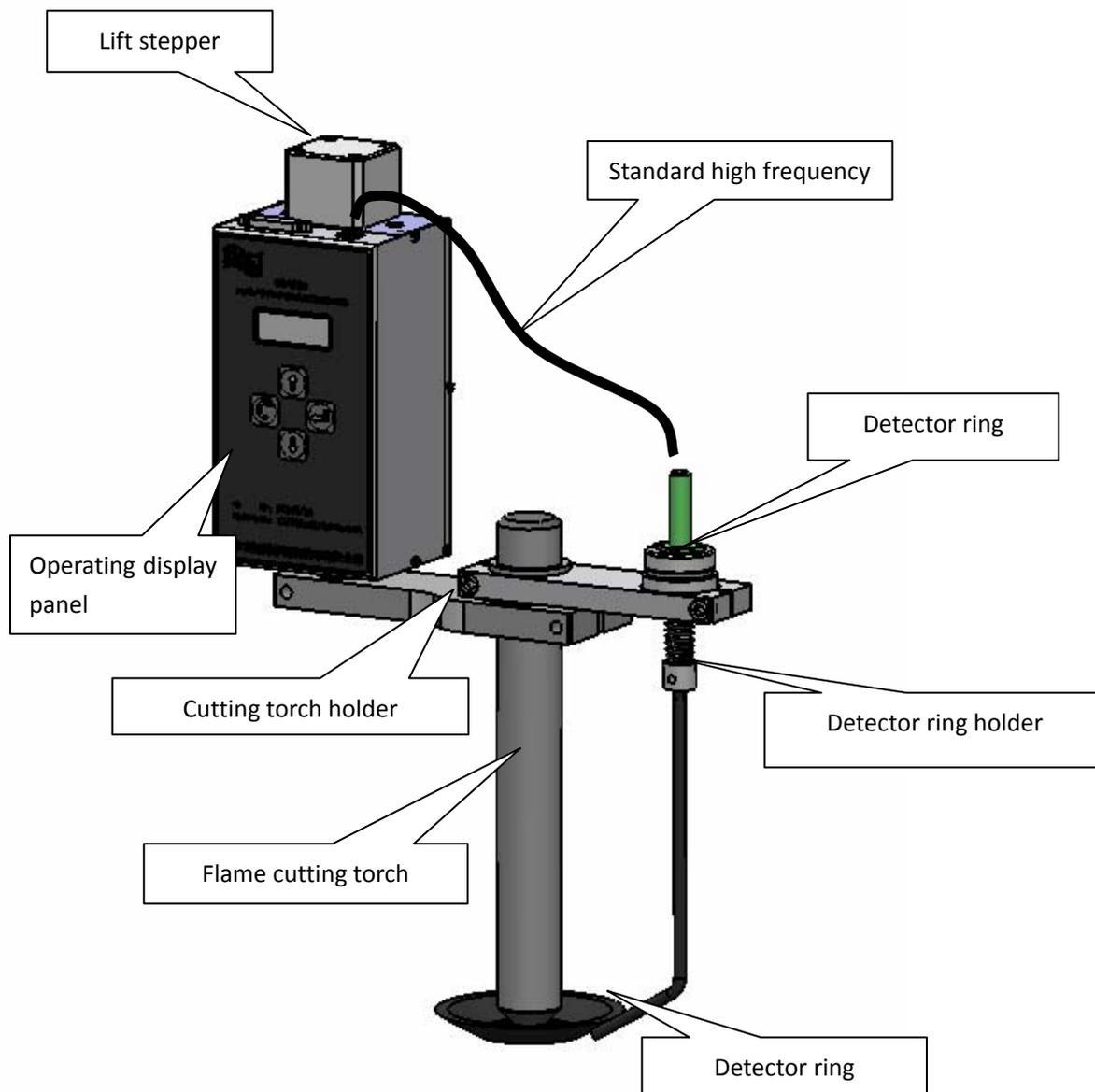
- Power Requirements: DC 24V \pm 2 V 3 A
- Applicable motor: 17 / 23 hs series of stepper motors
- Manual adjustment range: 0 ~ 100 mm
- Automatic increase of control range: 3 ~ 30 mm \cup
- Automatic increase of control speed: 3000 mm / min (30 ° slope)
- Control precision: ± 0.5 mm
- Dimensions of box body: (155 \times 87 \times 71) mm \cup
- Operating temperature: -10 °C ~ 50 °C
- Weight: total weight of capacitance height control: 1.990kg

- Total weight of Arc Voltage height: 1.645kg
- Detection system: capacitance-type detector, arc voltage height detector

3. Installation

3.1 Mechanical Installation

- The name and position of relevant components of the height controller are shown in Figure 3-1.
- Among them, capacitive sensor connecting components are only added in flame .



■ **Figure 3-1 The position, name and function of various components of controller**

- 6 screw holes M6 on the back of the height controller are used to fix the box body to the support. Their position and size are shown in Figure 3-2.

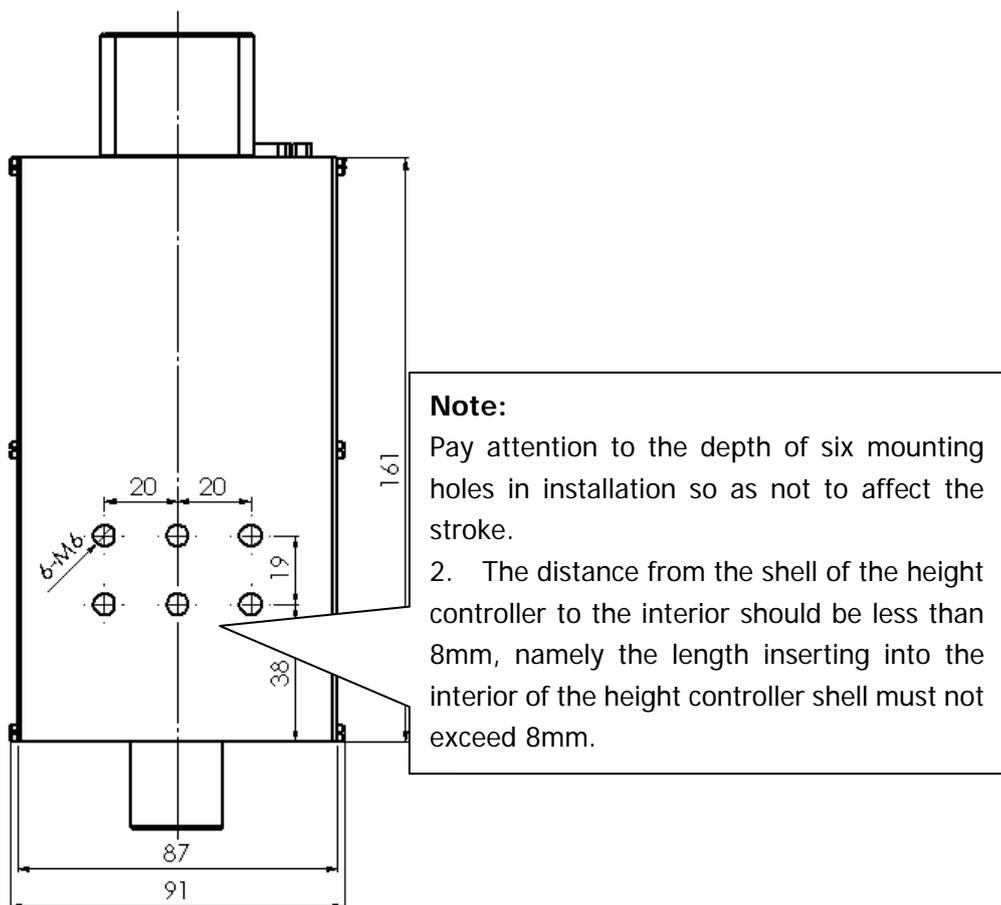


Figure 3-2 Position for installation of screw holes on the back of the controller

- Left view installation drawing of the height controller and related dimensions, as shown in Figure 3-3.
- Back view installation drawing of the height controller and related dimensions, as shown in Figure 3-4.

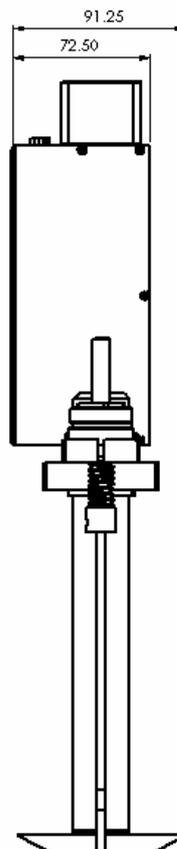


Figure 3-3 The right view of the controller

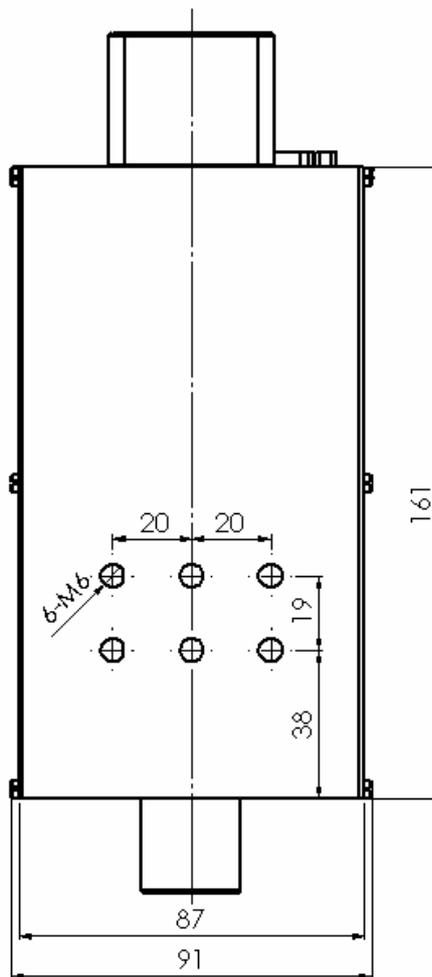


Figure 3-4 Back view of height controller

Installation diagram of the connecting components of the height controller is shown in Figure 3-5

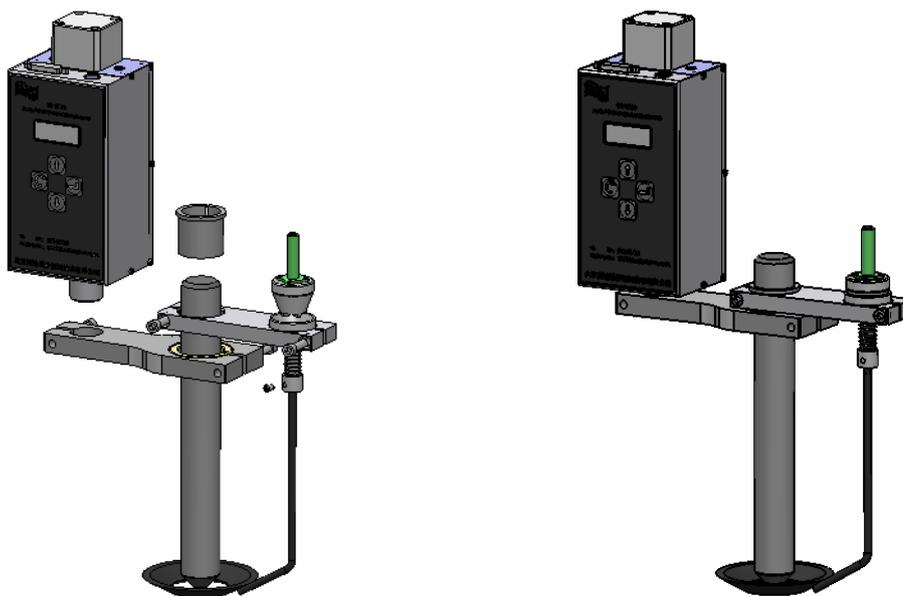
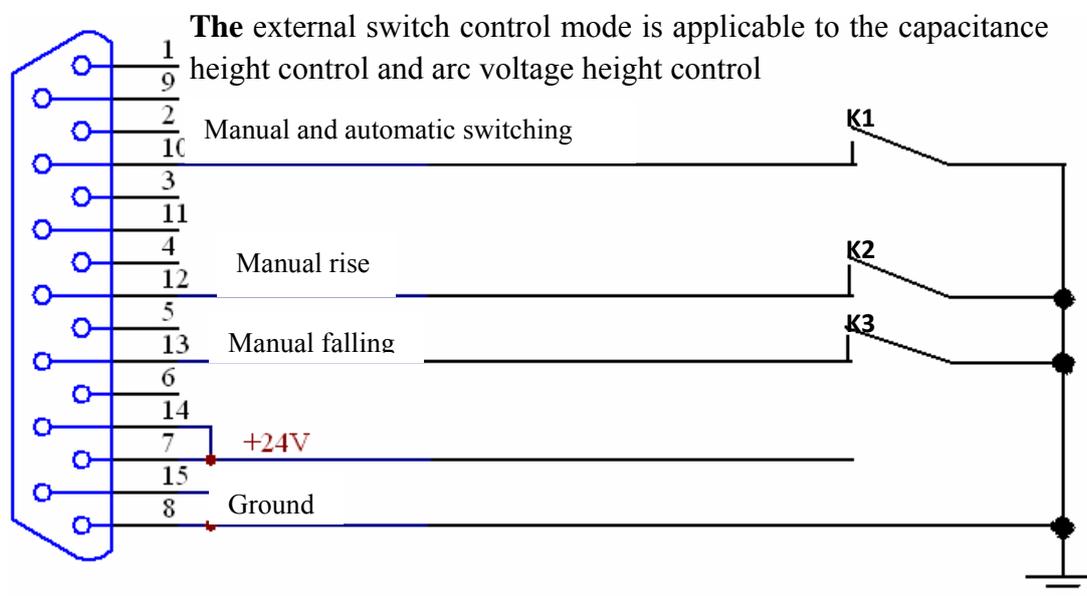


Figure 3-5 Installation diagram of the connecting components of the height controller

3.2 Electrical Installation Connection

3.2.1 External Switch Control Mode



Electrical diagram of external switch control

When K1 is turned off, the height controller is in manual state;

When K1 is closed, the height controller enters the automatic state.

When K1 is turned off, closure of K2 and K3 is valid.

When K1 is closed, closure of K2 and K3 is invalid.

3.2.2 CNC system input / output control mode (I / O control)

Electrical installation of capacitive detection height controller

- ◆ The electrical installation of capacitive detection height controller is shown in Figure 3-6.
- ◆ The high-frequency cables and plugs are special parts. The high-frequency cables of 1000mm can be configured according to different demands.
- ◆ The connection to height control (15-pin connector) and the numerical control system (25-pin connector) may be made by the user. The connection mode is shown in Figure 3-7. For the detailed pin definition of 15-pin and 25-pin see Table 3-1 and Table 3-2.

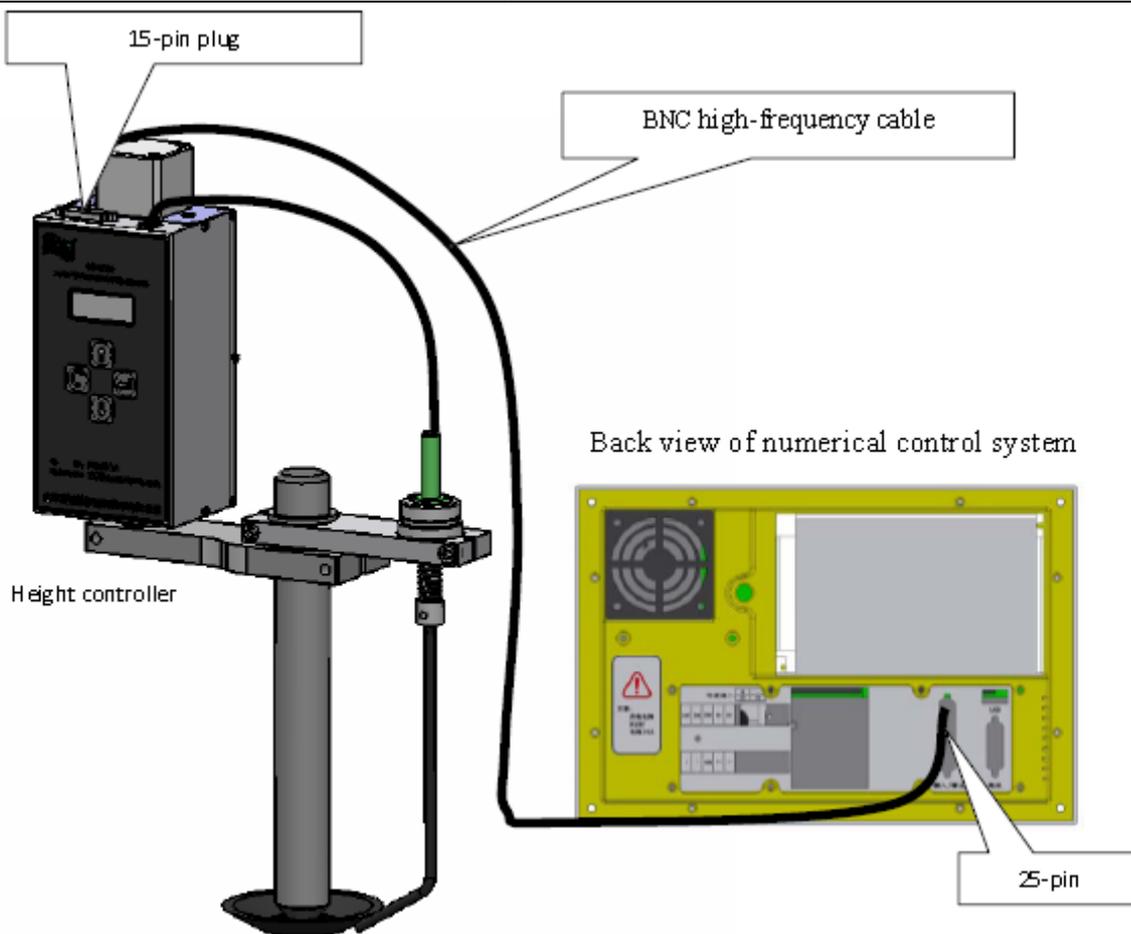


Figure 3-6 capacitive controller electrical installation diagram

Note: The diameter of 24 V power wire and ground wire should be larger than 0.75 mm²

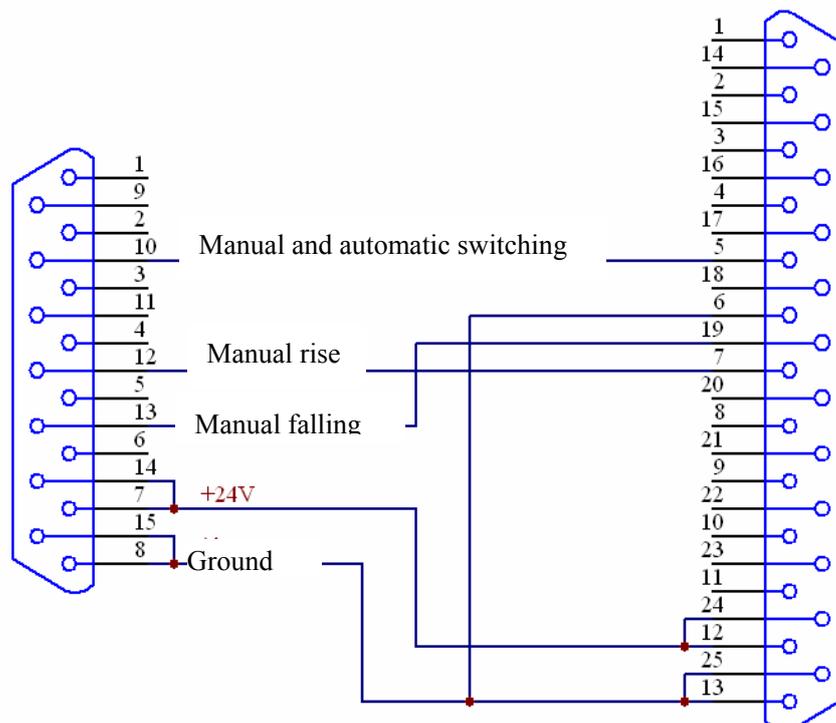


Table 3-1 25-pin connector of numerical control system for the pin definition of the height control system

No.	Property	Description
5	Output	Manual / automatic selective signal
6	Power Supply	Power supply 24V ground, height controller power supply
7	Output	Manual rise signal, drive cutting gun to rise
12, 13	Power Supply	Power supply 24 V positive, height controller power supply
19	Output	Manual falling signal, drive cutting gun to fall
24, 25	Power Supply	Power supply 24 V positive, height controller power supply

Note: 25-pin plugs of the numerical control system that do not list the pin serial number will not be used.

Table 3-2 Pin definition of 15-pin connector of height Controller

No.	Property	Description	Remarks
1	Serial port public	232-COM	
2	Serial port Receiving	232-RXD	
3	Serial port sending	232-TXD	
4	Input Signal	Arc voltage (height of cutting head) signal	
5	Signal ground	Arc voltage signal ground	
7, 14	Power supply	Power supply 24 V positive, height controller power supply	
8, 15	Power supply	Power supply 24 V ground, height controller power supply	
10	Input	manual / automatic selection signal	
12	Input	Manual rise signal, drive the cutting gun to rise	
13	Input	Manual falling signal, drive the cutting gun to fall	

Note: 15-pin plugs of the numerical control system that do not list the pin serial number will not be used.

Electrical installation of arc voltage detection-type height controller

- The electrical installation of arc voltage detection-type height controller is shown in Figure 3-8.
- The cables connecting to height control (15-pin connector), numerical control system (25-pin connector) and voltage divider board (9-pin connector) are made by the user. For the pin definition of 15-pin,

25-pin connector and 9-pin connector see Table 3-1, Table 3-2 and Table 3-3

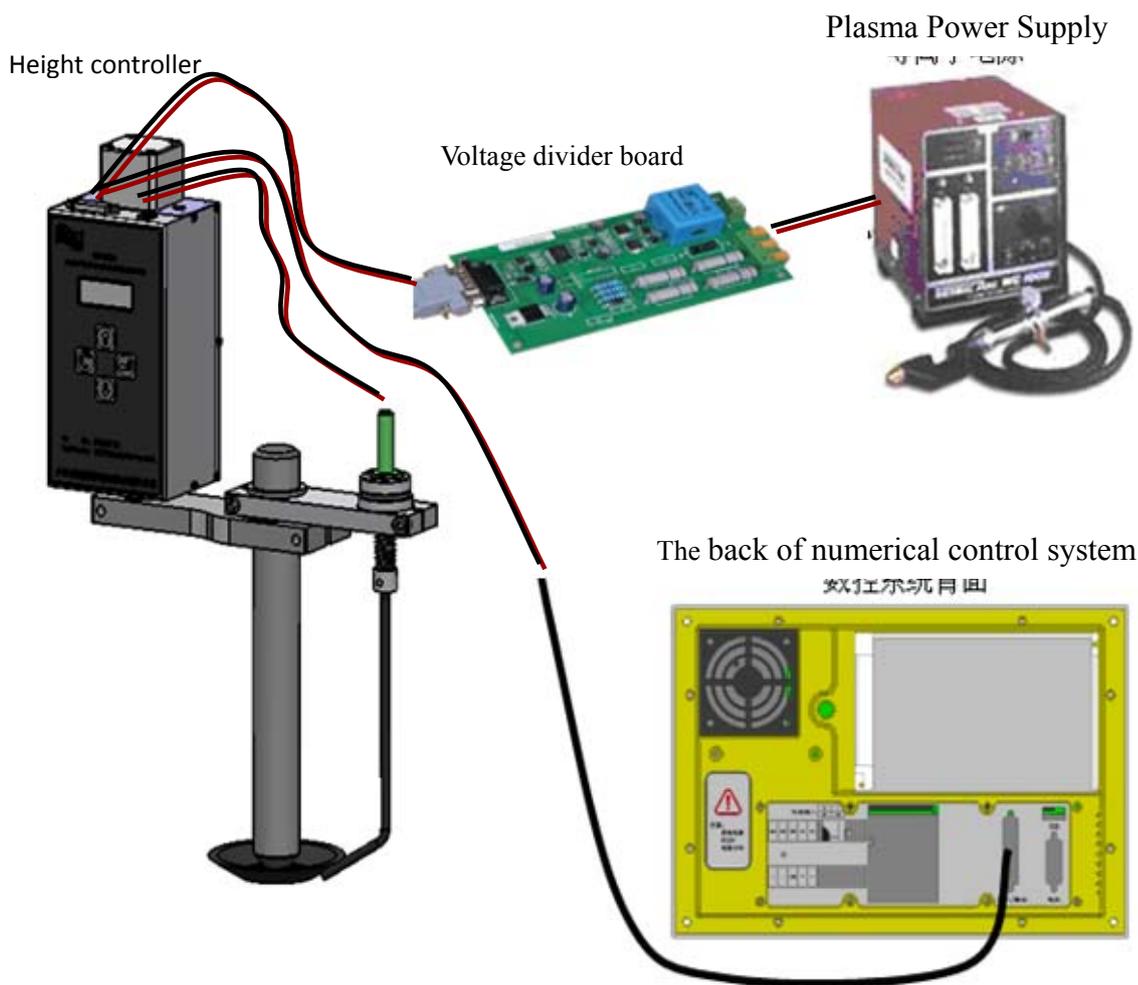


Figure 3-8 Electrical installation diagram of arc voltage controller

Table 3-3 The pin definition of 9-pin connector of voltage divider board

No.	Property	Description
2	Power supply	V ground, height controller power supply
5	Power supply	V ground, height controller power supply
6	Output	Arc voltage signal, height signal of the plasma cutting nozzle
9	Output	Power supply 24 V positive, height controller power supply

Note: Those that do not list the pin serial number will not be used.

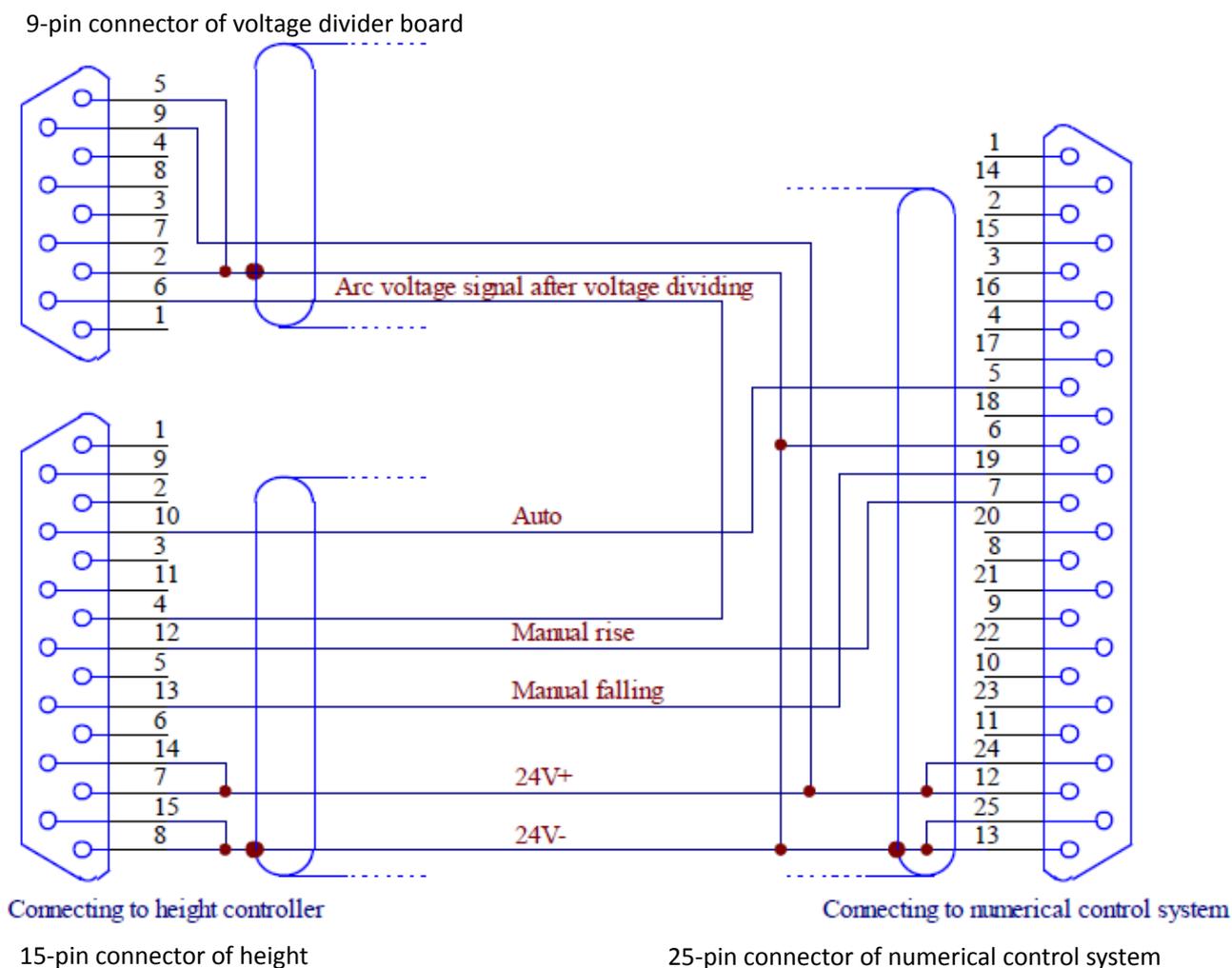
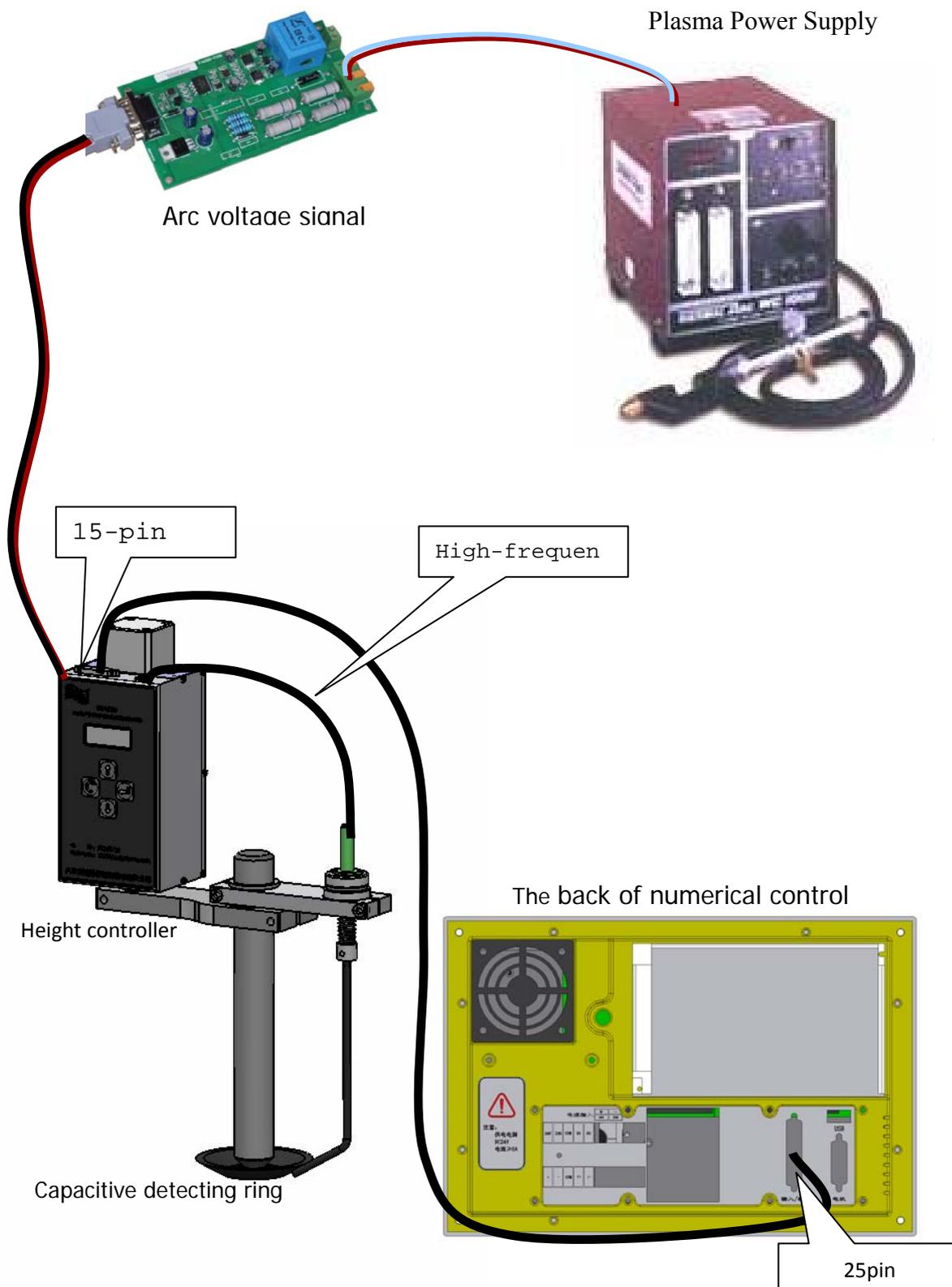
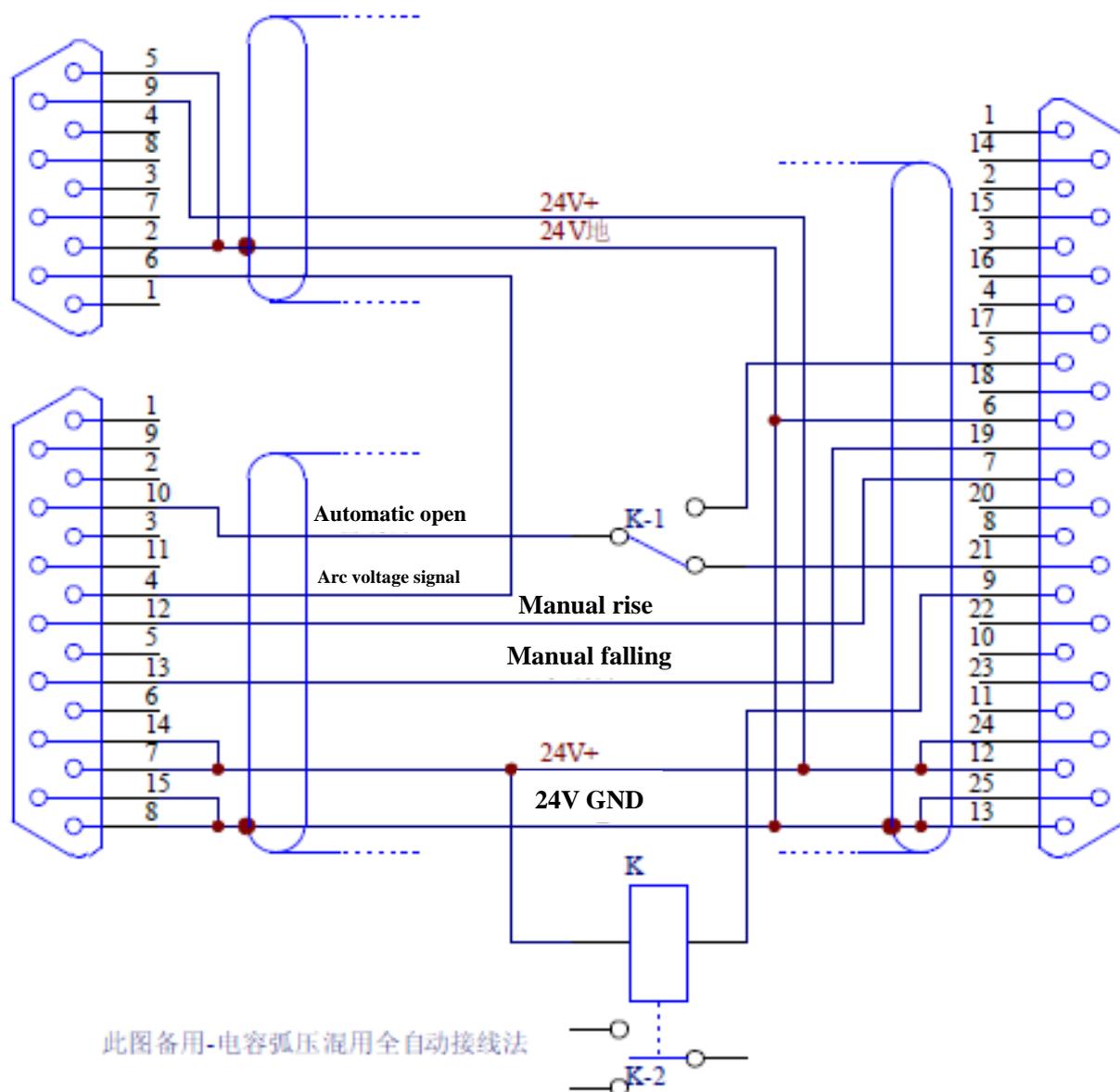


Figure 3-9 Wiring diagrams of arc-type height controller, voltage divider board and numerical control system

Note: The wire diameter of 24V power cord and ground wire should be greater than 0.5 square millimeter.

The electrical installation diagram of height controller when the arc voltage detection and the capacitive detection are used together.





This figure is kept on standby – automatic connecting method by using arc voltage and capacitance

3.2.3 The control mode of communication interface of CNC system

(RS232 control)

The control mode of communication interface of CNC system is conducting the software debugging

3.3 Description of functions of voltage divider board

- The voltage divider board is to reduce the voltage after arc starting of plasma cutting torch in a certain proportion, and is separated and converted to the functional module reflecting the low-voltage signal of cutting nozzle and cutting board. It is the indispensable accessory in the height monitoring and control of plasma cutting. The voltage dividing ratio of the voltage divider board of standard configuration is 50:1.
- The description of various interfaces of the voltage divider board is shown in Figure 3-10.

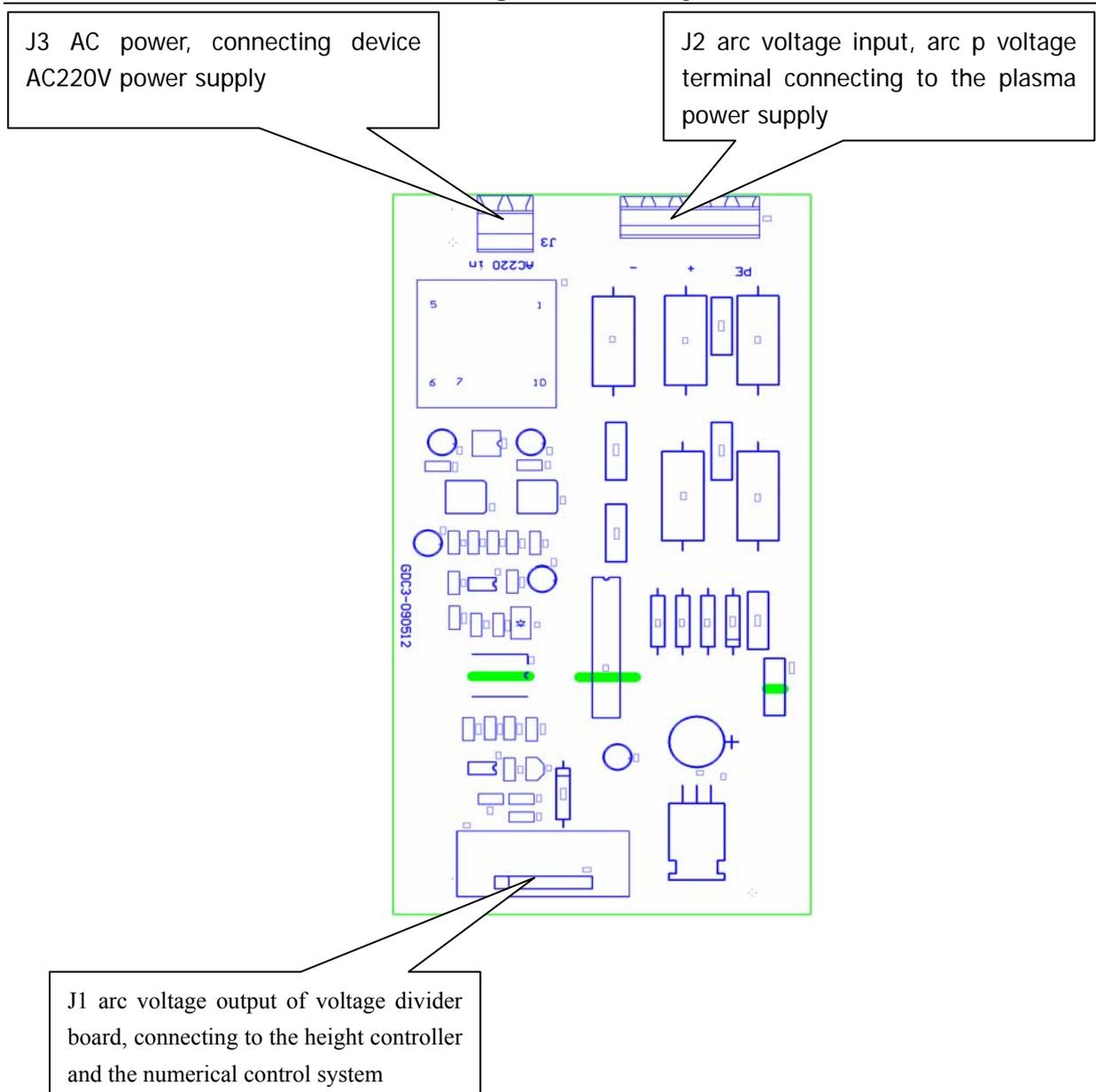


Figure 3-10 The interface description of voltage divider board
 The interface pin definition is shown in Table 3-4, Table 3-5 and Table 3-6.

■ Table 3-4 The pin definition of J1 connector

No.	Property	Description
2	Power supply	Power supply 24V ground, height controller power supply
5	Power supply	Power supply 24V ground, height controller power supply
6	Output	Arc voltage signal, the height signal of plasma cutting nozzle
9	Power supply	Power supply 24V positive, height controller power supply

Note: Those without pin number will not be used.

■ Table 3-5 The pin definition of J2 connector

No.	Property	Description
1	Power supply	Ground
2	Input	Plasma arc voltage positive terminal (clip for connecting with steel plate)
3	Input	Plasma arc voltage negative terminal (arc voltage output)

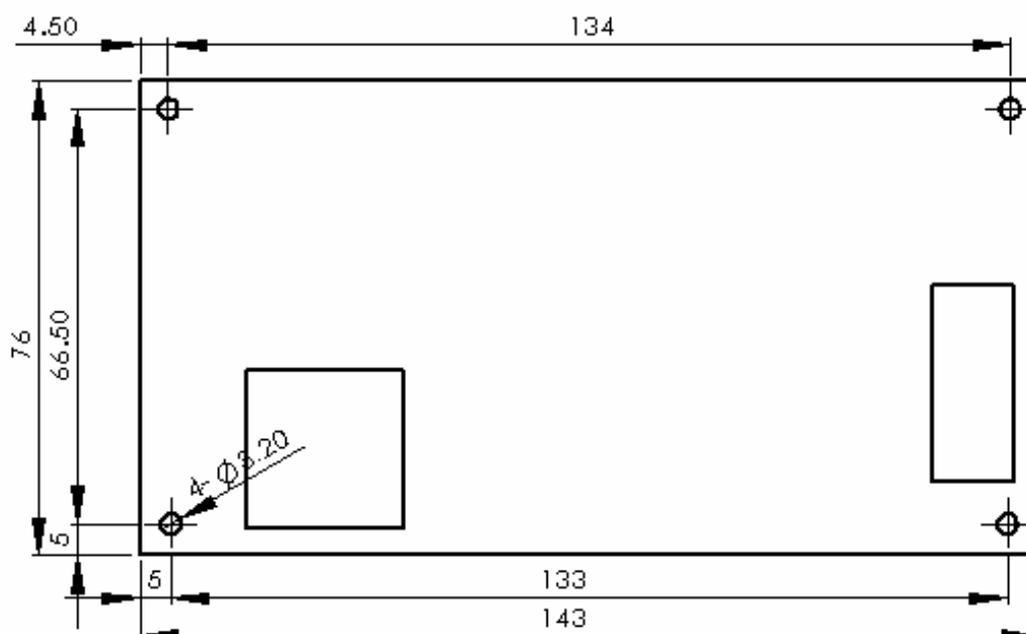
Note: push the orange button inside and insert the stripped cable into the wiring hole and then release.

■ Table 3-6 The pin definition of J3 connector

No.	Property	Description
1	Power supply	~220V±10%
2	Power supply	~220V±10%

- The voltage divider board may choose the installation position as required, but note: J1 interface is low-voltage signal; J2 is the high-voltage signal. In order to prevent the interference of high-pressure and high-frequency signals on the low-voltage signal and improve the stability of the system, the wire laying of J1 and J2 should be carried out independently.

3.4 Dimensional drawing of voltage divider board



4. Quick Operation Guide for Capacitance and Arc Voltage height Controller

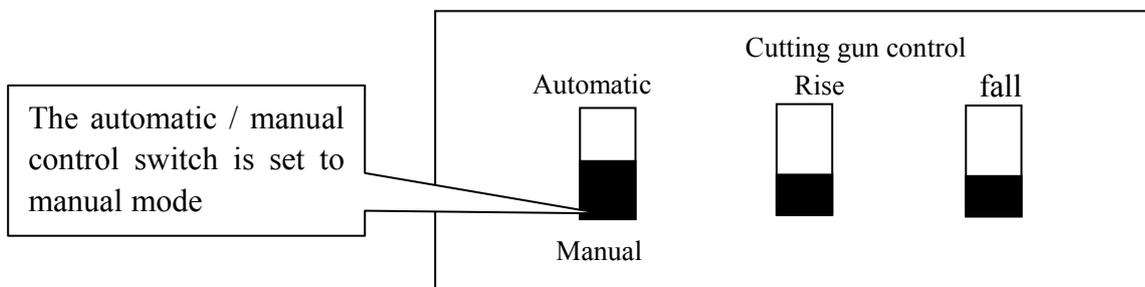
4.1 The control operation of electrical operation panel: (external switch mode)

For the wiring of electrical connection of capacitance height control see the "Electrical Connection" of section 3.2

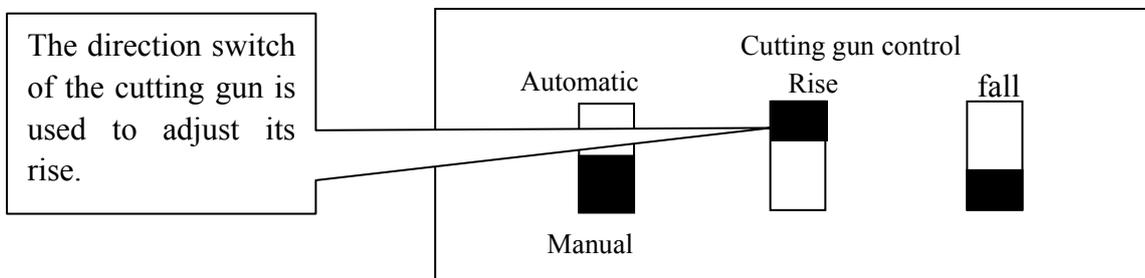
For the wiring of electrical connection of arc voltage height control see the "Electrical Connection" of section 3.3

Operation steps are as follows:

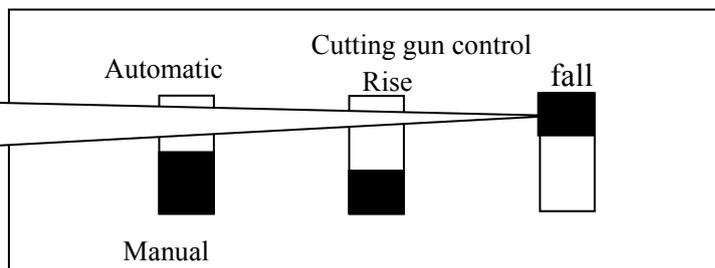
1. The automatic / manual control switch is set to manual mode.



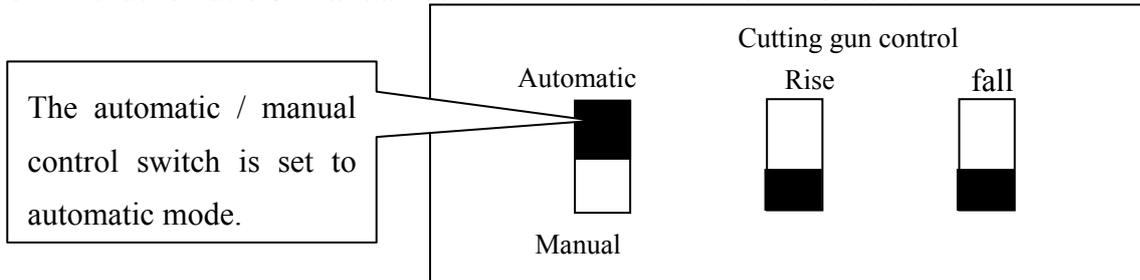
2. The direction switch of the cutting gun is used to adjust its rise and fall .



The direction switch of the cutting gun is used to adjust its fall.



3. The automatic / manual control switch is set to automatic



Now the mechanical lift device of the height controller realizes the automatic height control. If the height of the cutting gun is inappropriate, repeat the above steps 1-3. In automatic mode, the up / down switch of the cutting gun does not work.

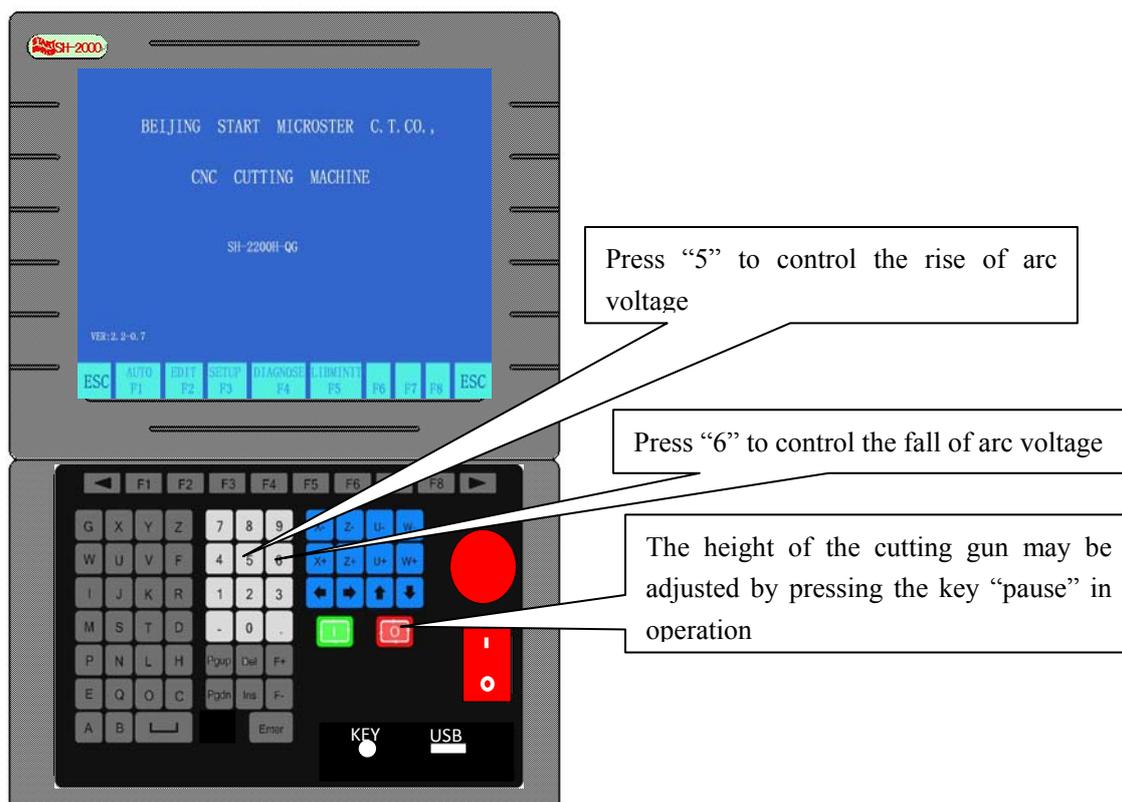
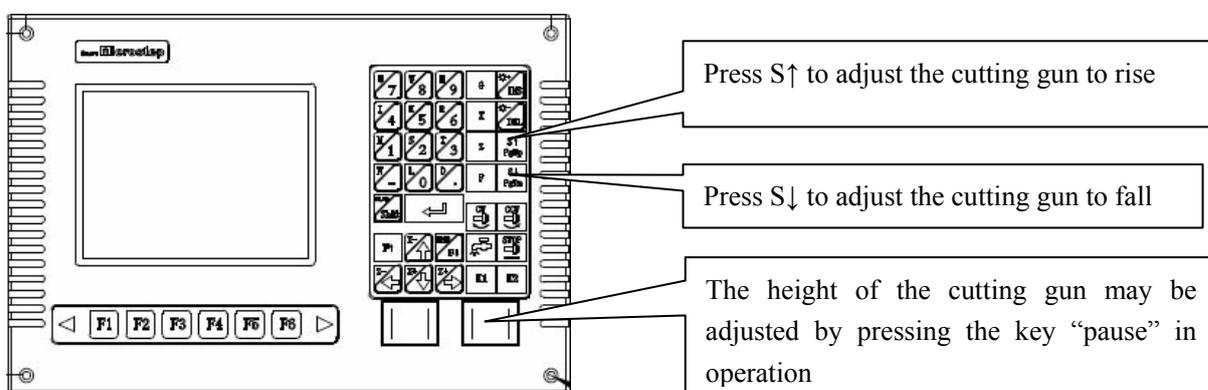
4.2 SH-2002AH/SH-2200H CNC system output interface operation (I / O control mode)

For the wiring of electrical connection of capacitance height control see the "Electrical Connection" of section 3.2

For the wiring of electrical connection of arc voltage height control see the "Electrical Connection" of section 3.3.

The operation steps are as follows

1. Adjust the rise and fall of cutting gun to a suitable height directly by pressing the keys for rise and fall of the cutting gun on CNC panel.



Usually, I / O of the numerical control system is in the manual control mode of the height controller. When the processing starts, I / O of the numerical control system converts to the automatic control mode of the height controller. Now the mechanical lifting device of the height controller realizes the automatic height control.

4.3 The communication interface of the CNC system is used to complete the operation (RS232 communication mode)

The function is being developed. For the final functions see the additional remarks after the functions are completed.

4.4 Operation Flow

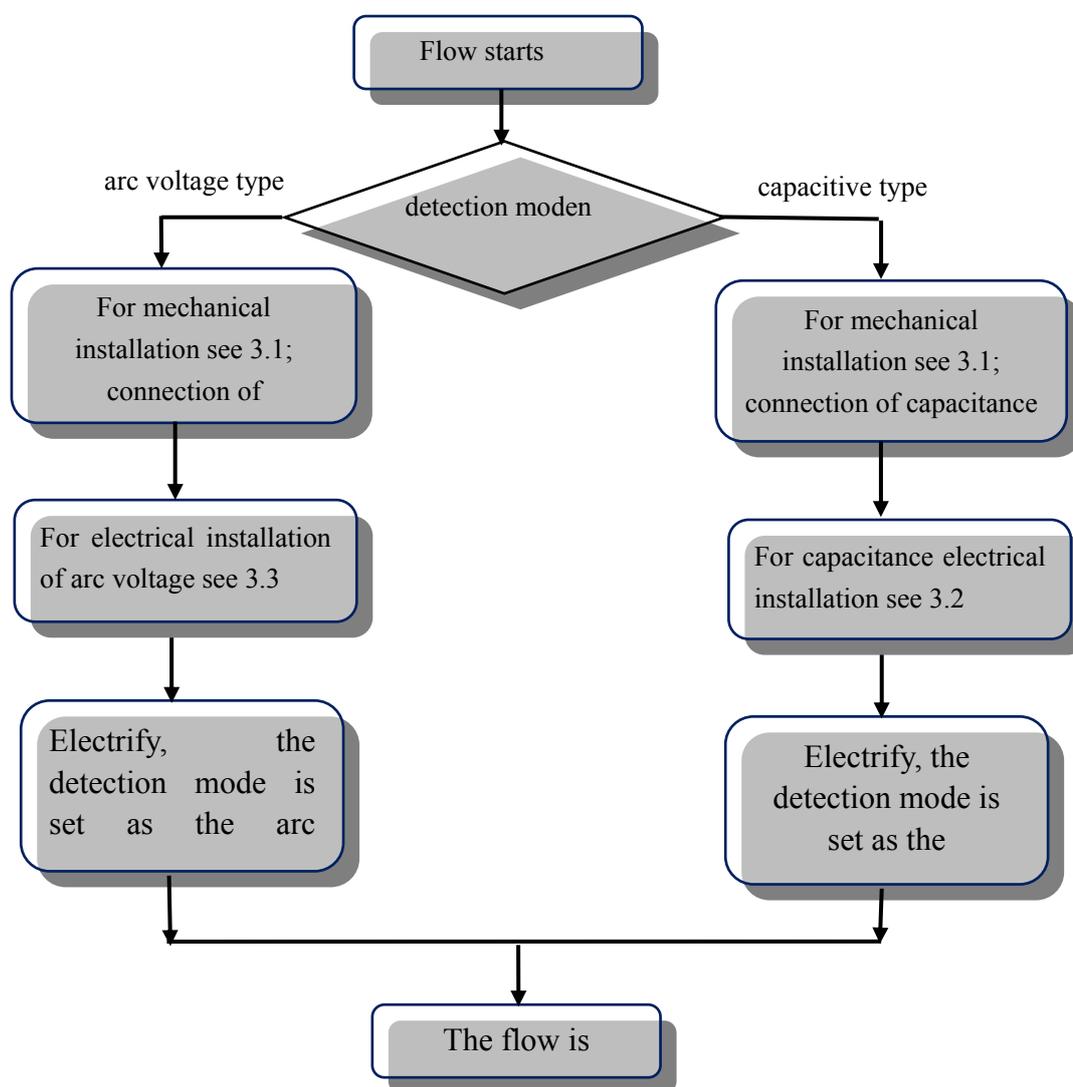


Figure 4-1 The operation flow using or needing the replacement of detection mode for the first time

4.5 Operation Flow of Daily Work

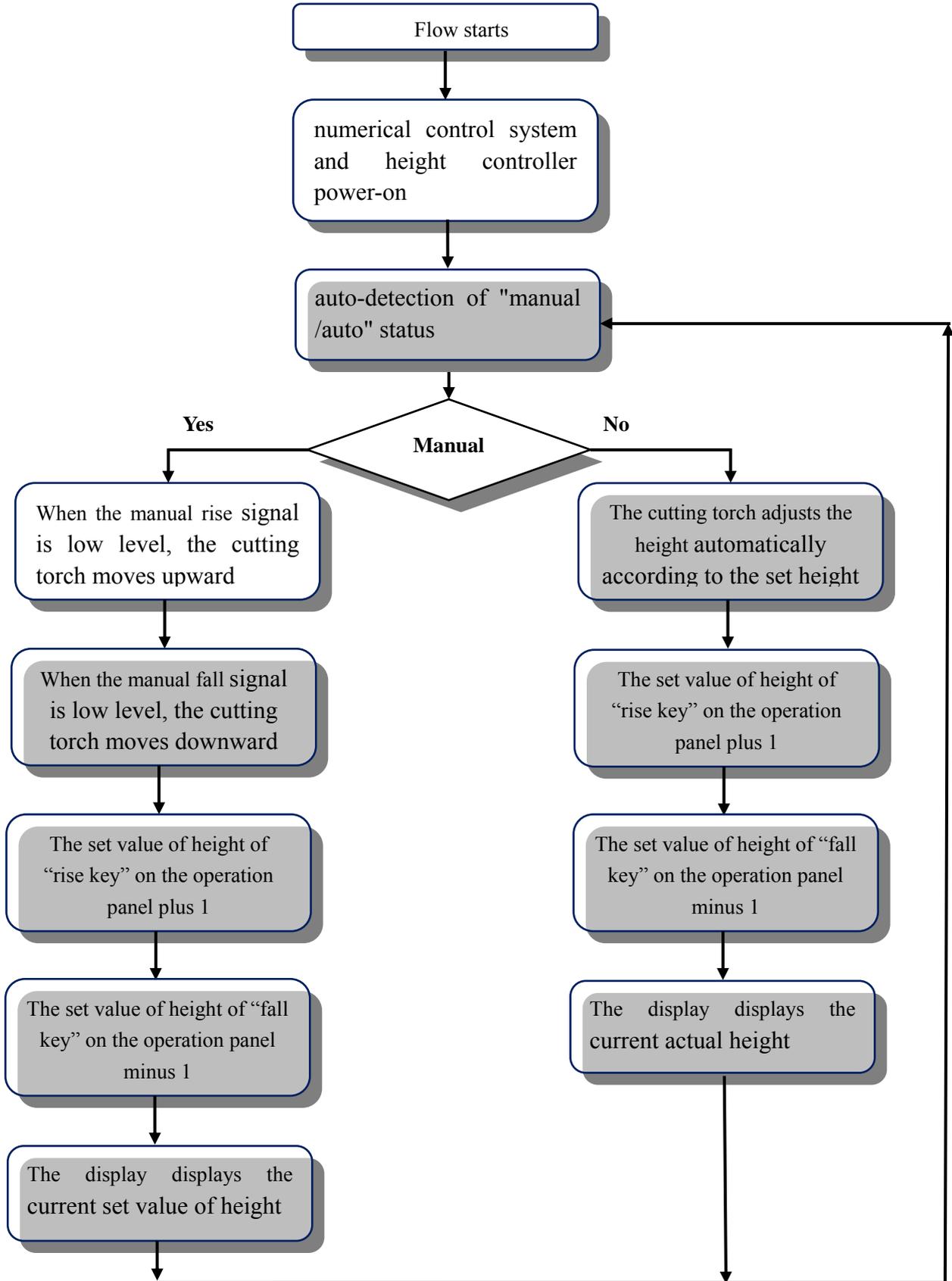


Figure 4-2 Operation Flow of Daily Work

5. Operating Guide

After turn-on, the height controller has three states: manual, automatic and parameter editing states.

5.1 Parameter Setting

- In the manual or automatic mode, press the key "Enter" for a long time, enter the parameter editing state. Click the key "Enter" in the editing state, you can exit to the manual or automatic state. The exited state depends on the state before entering.
- In the editing state, press the function key, switch the edited parameters circularly. The switching sequence is: H (upper limit value) → L (lower limit value) → A (set value of height) → E (dead-zone value) → d (speed regulating zone value) → C (detector mode selection) → b (non-board reduction parameters) → H (upper limit value). (See 7.3)
- Click the up arrow, the selected parameter value plus 1 (for the selective range of parameter values see 7.1).
- Click the down arrow, the selected parameter value minus 1 (for the selective range of parameter values see 7.1).

5.2 Manual Operation

- Manual / automatic signals: at high level, the controller is in manual state.
- Manual rise signal: at high level, invalid; at low level, the cutting head rises.
- Manual fall signal: at high level, invalid; at low level, the cutting head falls.
- Press the key " ↑ " on the operation panel, the cutting head rises.
- Press the key " ↓ " on the operation panel, the cutting head falls.
- When the manual rising and falling is implemented, the set value of height is modified.

5.3 Automatic Operation

- Manual / automatic signal: at low level, the controller is in the automatic state.
- In the automatic state, the controller controls the cutting head automatically according to the set height by the user.
- Press the key " ↑ " on the operation panel; the set value of height plus 1; hold it, plus 1 continuously.
- Press the key " ↓ " on the operation panel; the set value of height minus 1; hold it, minus 1 continuously.

6. Debugging

6.1 Initial debugging of capacitive detection

The capacitance height measurement is to detect the distance through the capacitance between the capacitance detection ring and the cutting board, namely, the height measurement mode, thereby to achieve the height control.

When the capacitive height measurement is adopted, the specific inductive capacity (SIC) between the capacitance detection ring and the cutting board may affect the height measurement accuracy due to the temperature, pressure, humidity, gas composition and many other factors on site. In addition, the serious non-linear relationship exists between the capacitance value and the height value. Our company has developed the intelligent program of "a key height calibration ". On site you only need to press a key, you can set various change factors automatically on site and realize the display and control of high accuracy, high precision and high linearity within 3-30mm.

In the following situations, the height calibration is needed.

1. When the equipment is used for the first time;
2. When the use environment of equipment changes;
3. When you find that the actual height of capacitance detection ring is not consistent with its display height.

Because "a key height calibration" is very simple, you only need to press a key, the users may calibrate at any time.

6.2 Debugging steps of a key height calibration

- Check: the circular ring at the bottom of capacitance detection ring must be parallel to the cutting board.
- Turn on the cutting torch height controller.
- Set the detector mode as the capacitance detector mode (for the method see 7.3).
- In manual mode, the cutting nozzle is adjusted to be connected with the cutting board.
- Press the key "down arrow" on the height control panel for about two seconds "; a key height calibration" starts automatically, as follows:
 1. Rise to about 30mm high in five steps;
 2. And then fall to about 10mm from the cutting board and stop;
 3. All the calibration is completed.The initialv debugging is finished.
- For the height control operation see 5.2 and 5.3.

7. Controller Panel

There are display and keys on the height controller panel. Through the panel operation, you can modify relevant parameters and monitor operation status.

7.1 Control Parameters

- Set value (A: Accuracy Height): the expectation value of the space (height) between the cutting nozzle and the cutting board, set by the user. For the set range and factory value see Table 7-1.
- Dead zone value (E: Errorv Area): When the actual height is $A \pm E$, the cutting torch height is not adjusted any more (see 1.4). For the set range and factory value see Table 7-1
- Speed regulating zone (d: Down Speed Area): the speed regulating zone is between $A - E - d$ and $A + E + d$ (see 1.4). For the set range and factory value see Table 7-1.
- High limit place (H: High Limit): When the cutting torch position is higher than the set value, display alarm, and moving-up stops. For the set range and factory value see Table 7-1.
- Low limit place (L: Low Limit): When the cutting torch is lower than the set value, display alarm, and moving-down stops. For the set range and factory value see Table 7-1.

- Selection of detector (C: capacitance): 0 is the arc voltage detection; 1 is capacitive detection. For the set range and factory value see Table 7-1.
- No board drop parameter (b):v
 In the capacitive detection mode, when the detected height is higher than value b, the cutting torch stops; when the height returns to the value below it, the automatic height control continues;
 In the arc voltage detection mode, when it falls manually, it encounters the zero signal, the cutting torch rises to b mm in the opposite direction. For the set range and factory value see Table 7-1.

Table 7-1 Setting range (V)

		H	L	A	E	d	C	b
Arc voltage	Set range (V)	100~300	10~40	20~200V	0~20	0~100	0~1	0~50
	Factory value (V)	280	10	80	3	5	1	5
Capacitance	Set range (mm)	20.0~30.0	3.0~10.0	6.0~25.0	0.0~4.0	0.0~4.0	0~1	2.0~30.0
	Factory value (mm)	25.0	4.0	10.0	0.3	2.0	1	25.0

7.2 Operation Panel

The operation panel is shown in Figure 7-1.

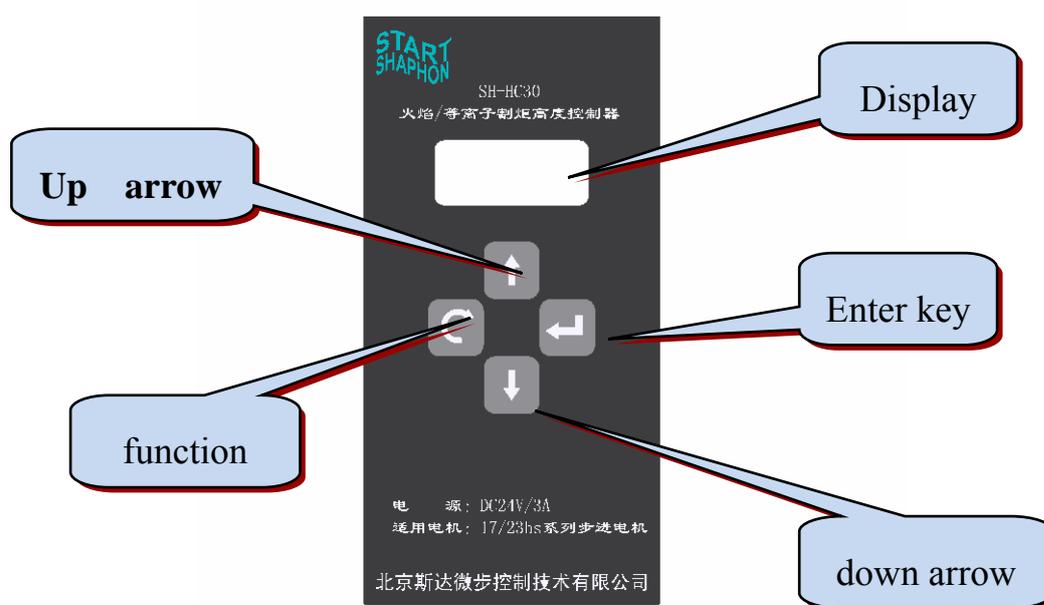


Figure 7-1 Operation Panel

- ◆ Enter key: enter or exit the editing state.
- ◆ Function key: in the manual state, implement the function of “a key height calibration”; in the editing state, switch the current editing parameters.
- ◆ Up arrow: in manual and automatic state, the set height value plus 1; in the editing state, the current parameter plus one.
- Down arrow: in manual andv automatic state, the set height value minus 1; in the editing state, the current parameter minus 1.
- Display: the display functions are as follows:v
 1. Manual operation status: Display detector mode, operation status, set value of height.
 2. Automatic operational state: display detector mode, running state, the current height value.
 3. Editing parameter status: Display the editing parameter names and the corresponding editing parameter values.

7.3 Description of Display

- Manual operation state: The first one displays the detection mode; the second one displays the operation state; the last 3 digits display the set value of height.
 - The first one: C: the capacitance detector mode, U: the arc voltage detector mode.
 - The second one: no operation, flash between  and  ; manual rising:  ; manual falling: 
 - The last 3 digits: in the capacitance mode, a decimal; unit: of mm; in arc voltage mode, there is no decimal place; unit: V.
- Automatic operation state: The first one displays the detection mode (as shown above); the second one displays the operation state; the last 3 digits display the set value of height (as shown above). The second one is described as follows:
 - When  is the fixed display, the cutting torch is adjusted up at high speed.
 - When  is the flashing display, the regulating speed of the cutting torch is increased.
 - When  is the fixed display, the cutting torch is adjusted down at high speed.
 - When  is the flashing display, the regulating speed of the cutting torch is reduced.
 - When  is the flashing display, the cutting torch is adjusted to the place.
 - When the last 3 digits are  and the height value flashes, it is the high alarm
 - When the last 3 digits are  and the height value flashes, it is the low alarm
 - When the last 4 digits are  and display, it is the upper limit position.
 - When the last 4 digits are  and display, it is the lower limit position.
- Editing parameter status: The first one displays the parameter name; the second one displays the equal sign  ; the last 3 digits display the parameter value in the flashing mode. In the capacitance mode, there is a digit after decimal; unit: mm; in

arc voltage mode, there is no decimal point position; unit: V. The first one is described as follows:

- H: the upper limit value. When the height is larger than this value, it is the high alarm. The cutting torch can only move down and cannot move up.
- L: lower limit value. When the height is lower than this value, it is the low alarm. The cutting torch can only move up and cannot move down.
- A: the set value of height; in the automatic mode, this value is used as the given value to adjust height automatically.
- E: Dead zone value (see 7.1).
- D: Speed regulating zone value (see 7.1).
- C: selection of detector mode (see 7.1).
- b: No board falling parameter value (see 7.1)

8. Troubleshooting

For the common faults, inspection methods and corrective measures see Table 8-1.

Table 8-1

Fault	Inspection items	Corrective measures
The motor does not work	Whether it is powered on	Power on
	Whether the power supply voltage is normal	Check the power supply
	Whether it is locked-rotor motor	Load reduction
No display	Check the power supply	Power on
Upper limit alarm	The running exceeds the upper limit value of machinery	Check the limit switch in high position
Lower limit alarm	The running exceeds the lower limit value of machinery	Check the limit switch in low position
Instable signal	Whether the cutting board is grounded reliably	Grounded firmly
Inaccurate height	Operating environment changes	Implement "a key height calibration"
Vibrate wildly	Speed reduction zone value is too small	Increase the speed reduction zone value d
Too slow tracking	Speed reduction zone value is too big	Reduce the speed reduction zone value d
Slight vibration	Dead zone value is too small	Increase the dead zone value E
Too low accuracy	Dead zone value is too big	Reduce the dead zone value E

9. Description of initial positioning function

9.1 Positioning mode

The impact position switch is set in the height controller. When the cutting gun moves down and collides with the cut workpiece, the internal switch is turned on without the need of special cutting gun and "protection cap". Electrical loop must not be formed between the "protection cap" and the workpiece. This approach applies to any plasma cutting gun.

How to use the positioning function: in the plasma mode, the signal of "manual down" of the external control interface is valid. When the cutting gun moves down and collides with the steel plate, the internal switch is turned on. It returns up to a certain height by automatic control of the height controller, and then positioning is completed.

9.2 Positioning height setting

Parameter value B is the positioning height, unit: mm; note when detection collision occurs, overmuch walking and certain deformation of workpieces and cantilever occur, so value B is generally set within 5-12mm.

9.3 Process

This function does not require additional relevant processes and instructions by the numerical control system. It only needs to extend the time for falling of the cutting gun. Generally, the time for the falling of the cutting gun is longer than its rise; 2-6 seconds are OK.

Before NC implements the perforating process, the cutting gun will rise or fall. Because the falling time will be longer than that of rise, and then the cutting nozzle may collide with the workpiece, at this time, the height controller can detect the collided workpiece and will return up to a certain distance immediately, thus the initial positioning is realized. Note even if the falling signal for the cutting gun has not been removed by NC system, the cutting torch will not continue to fall, waiting for falling delay of the cutting gun of NC to end.

- Why special attention should be paid to the collection of arc voltage? Because even the plasma power of different manufacturers cuts in the same environment, the arc column voltage is not necessarily the same. Fill in parameters A with the test results (see control parameters 7.1). If the value A is not tested, the current value is smaller than the current actual voltage for plasma power cutting, then the plasma cutting gun will fall rapidly until it collides with the workpiece in automatic cutting, if not, it will always rise until the arc breaks.
- For the new plasma power that is newly used and is not familiar, when it is equipped with the height controller for the first time, the actual starting arc testing must be made for the actual arc voltage of the plasma power supply. The normative power supply may be based on the "cutting speed chart" provided by the supporting instruction book by plasma power supply.
- Simple test method: adjust the distance of the cutting torch and steel plate to the appropriate value manually (according to the power process requirements). In the

manual mode of plasma, the height controller carries out the manual starting arc perforation, after perforation, the cutting gun moves (through the numerical control system) for actual cutting, at this time, the value on the nixie tube display of the height controller is the actual arc voltage of the plasma power supply in the current environment.

10. Command Functions Related To M of CNC System and Height Controller

10.1 Function M of Direct Control Output Port of CNC System

M14/M15 switch for rising of cutting gun, M14 (on), M15 (off)

M16/M17 switch for falling of cutting gun, M16 (on), M17 (off)

M38/M39 automatic / manual switch of the height controller M38 (auto) M39 (manual)

10.2 Fixed Cycle of Function M

M07 perforation fixed cycle

The flame cutting operation sequence is as follows:

M07

1. If the gas (acetylene) valve is not opened, then open gas (acetylene) for ignition;
2. The cutting gun falls (cutting gun fall delays, see M71);
3. Open the preheating oxygen valve, the preheating delay starts. If the preheating time is not enough, you can press the key **【pause】**, the preheating time is extended to 150 seconds automatically. If the preheating has been completed, press the key **【start】** to end the preheating delay, and the preheating time is saved automatically in the preheating delay parameter;
4. The cutting gun rises(perforation cutting gun rise delay, M72);
5. Open the cutting oxygen valve (M12), perforation delay time is delayed, after that the cutting gun falls (perforation cutting gun falling delay M73);
6. Turn on the height controller (M38); the following procedures start.

The plasma cutting operation sequence is as follows:

M07

1. The cutting gun falls (the falling of cutting gun delays, see M71);
2. If the selected perforation positioning is valid, then the cutting gun falls until it collides with the lower limit position switch, thus the falling stops; the cutting gun rises, after perforation positioning delay is delayed, the cutting gun stops;
3. Turn on the starting arc switch;
4. Detect the signal of "arc voltage success", if the arc voltage detection selects 0 in the setting of parameters (not detected), the arc voltage is not detected. After starting arc succeeds, the perforation delay is delayed (seconds)
5. Turn on the height controller (M38); the following procedures start.

M08 Close the fixed cycle of cutting

The flame cutting operation sequence is as follows:

M08

1. Close the cutting oxygen (M13);
2. Turn off the height controller (M39);
3. The cutting gun rises (M70);

The plasma cutting operation sequence is as follows:

M08

1. Turn off the arc voltage switch;
2. Turn off the height controller (M39);
3. The cutting gun rises (M70).

M50 perforation action:

1. The cutting gun rises (M72); when the plasma operation is carried out, there is no such action;
2. Open the cutting oxygen (M12); or plasma starting arc starts and the signal of "arc voltage success" is detected.
3. The cutting gun falls (M73), when the plasma operation is carried out, there is no such action;
4. Turn on the height controller (M38)

M70 Fixed cycle of the cutting gun rise:

It is used when the procedure starts and the cutting procedure of a stage ends, the cutting gun is lifted so that it can move to the next cutting position quickly. Operation sequence: turn on the cutting gun rise switch (M14), cutting gun rise delay is delayed; turn off the switch for the cutting gun rise (M15).

M71 Fixed cycle of cutting gun fall:

It is used before perforation. Its action is contrary to M70, but the value is smaller, because of the action of gravity, falling is faster than rising. Operation sequence: turn on the switch of cutting gun fall (M16), cutting gun fall delay is delayed, turn off the switch of the cutting gun fall (M17).

M72 Perforation cutting gun rise cycle:

It is used after preheating. The cutting gun is lifted to a certain extent. Avoid that sprayed steel slag blocks the muzzle of the cutting gun when the cutting oxygen is opened. Operation sequence: turn on the switch of the cutting gun rise (M14); perforation cutting gun rise delay is delayed; turn off the switch of cutting gun rise (M15).

M73 Falling cycle of perforation cutting gun:

It is used after the preheating. After the implementation of M72, open the cutting oxygen, the cutting gun is placed in the cutting position, the reverse action of M72, but the value is smaller. Because of the action of gravity, falling is faster than rising.

Operation sequence: turn on the switch of the cutting gun (M16); the perforation cutting gun delay is delayed; turn off the switch of the cutting gun (M17).

M75 Cutting gun positioning delay:

When the plasma gun is positioned, first the cutting gun falls (M16), when it comes to the lower limit place (see the input port XXW 8), the falling of the cutting gun stops (M17). Then, the cutting gun rise is started (M14); after the cutting gun positioning delay, the rising of the cutting gun stops (M15);

11. Height Adjustment Remote Controller

In order to make the users be far away from the cutting site in operation, and make them use it easily, simply and intuitively, our company provides the users with the dedicated remote controller, as shown in Figure X-1.

Graphic model of remote controller

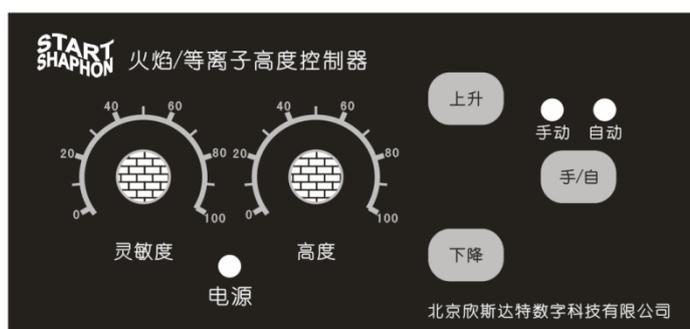


Figure X-1 Outside view of the height adjustment remote controller

The remote controller uses the computer core design and can implement the information communication RS232 with the master controller. The adjustment of the height and the sensitivity adopts the simple knob design so that it has the operation conveniences of analog circuit and accuracy and reliability of digital circuit.

11.1 Function Introduction

- ◆ 3 indicator lights.
 - Power: when the light is on, it is in the electrifying state.
- ◆ Manual: when the light is on, it is in the manual operation state, at this time the automatic indicator light is off.
- ◆ Automatic: when the light is on, it is in the automatic operation state, at this time the manual indicator light is off.
- 3 buttons.
 - Manual/ automatic: switching between the manual and automatic state.
 - Rise: the cutting torch rises manually.
 - Fall: the cutting torch falls manually.
- 2 knobs, as shown in Figure X-2.
 - Height: in automatic state, the height of cutting torch is adjusted.
 - Sensitivity: in automatic state, the control sensitivity of the cutting torch is adjusted.



11.2 Operation Guide

- When it is powered on, the controller is in manual operation state, the indicator light "Manual" is on, while the indicator light "automatic" is off. At this time, if the height of the cutting torch needs to be adjusted, the button of "up" or "down" may be pressed. When you press the key "up", the cutting torch rises; when you stop pressing, rising stops. In the same way, press the button of "down", the falling of the cutting torch may be completed.
- When the automatic height control is needed, click the button of "manual /automatic", the light of "Manual" is off; the light of "Automatic" is on, which makes the height controller enter the automatic control mode. In this mode, the height of the cutting torch is adjusted according to the set height automatically.
Note: This control system adopts two external control methods for the height controller, namely, direct external switch control mode and the remote controller control mode. In this system, if two external control modes exist simultaneously, only when the two modes are in the automatic control state, the height controller may enter the automatic control state, otherwise, they are manual control states.
- If the height does not meet the requirements, regulate the knob of "height" to set. 0% is low, 100% is high.
- If you think the regulation accuracy is not enough, you can adjust the knob of "sensitivity" to the low position (direction 0%), thereby the sensitivity is improved, but it should not be too low, otherwise it may cause the cutting torch oscillate up and down; When oscillation is found, the knob of "sensitivity" can be adjusted to a high position (direction 100%) till the oscillation is eliminated, which is the best.

11.3 Wiring Instructions

- Wiring diagram is shown in Figure X-3.

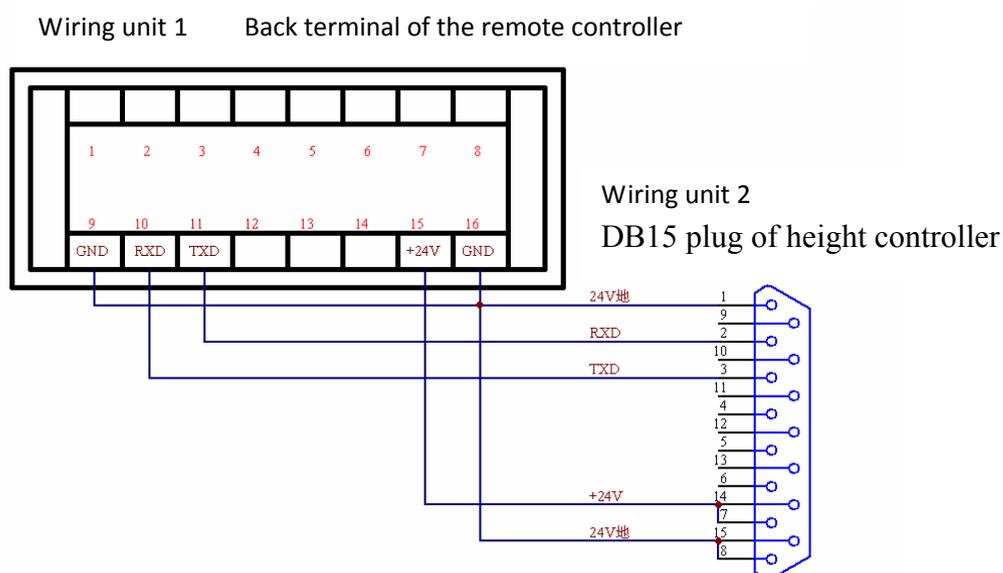


Figure X-3 Wiring diagram of height remote controller

The functions of the back terminal of the height remote controller are shown in Table X-1.

Table X-1 Function definition of the back terminal of the controller

No.	Property	Description
9	Power supply	Power supply 24V ground, height controller power supply
10	Input	RS232 communication receiving terminal
11	Input	RS232 communication receiving terminal
15	Power supply	Power supply 24V positive, height controller power supply
16	Power supply	Power supply 24V ground, height controller power supply
1~8,12,13,14		No functional definition

11.4 Installation Dimensions

96X48mm

