FLG-200HD/300/400HD

FINE PLASMA CUTTING MACHINE

SQK-A1/SQK-B1

MANUAL GAS CONSOLE

MANUAL

INSTRUCTION

(PLEASE READ CAREFULLY BEFORE OPERATION)

Safety Depends on You

Huayuan arc welding and plasma cutting equipments are designed and built with safety in mind. However, your overall safety can be increased by proper installation.

DO NOT INSTALL, OPERATE OR REPAIR THIS EQUIPMENT WITHOUT READING THIS MANUAL AND THE SAFETY PRECAUTIONS CONTAINED THROUGHOUT. And, most importantly, think before you act and be careful.

Special Attention (Very Important):

1. **AVOID FALLING DOWN WHEN THE WELDING/CUTTING MACHINE IS PLACED ON THE INCLINED SURFACE.**
2. **IT CAN NOT BE USED FOR UNFREEZING PIPELINES.**
3. **THE INGRESS PROTECTION CLASS OF THIS SERIES MACHINE IS IP21S, AND IT IS NOT SUTABLE FOR WORKING IN THE RAIN.**
4. **THIS MACHINE WITH SHARP DROP STATIC EXTERNAL CHARACTERISTIC, THE RATED DUTY CYCLE IS 100%, MEANS IT CAN CONTIGUOUSLY WORK IN NORMAL CONDITION.**
5. **THE EMC CLASFICATION OF THIS MACHINE IS A.**

Purchase date:_____

Serial number:_____

Machine model:_____

Content

Ⅰ. Safety instructions....1

Ⅱ. Product Summary....3

1. System composition....3

Model description....3

2. System connection diagram....4

3. Features....6

4. Usage....6

5. Symbol instruction....6

6. Working condition....7

Ⅲ. Technical parameters....8

1. Plasma power source FLG-200HD....8

2. Plasma power source FLG-300HD....9

3. Plasma power source FLG-400HD....11

3. Manual gas console SQK-A1....12

4. Manual gas console SQK-B1....13

5. HF Box QFK-D1....13

6. System gas supply requirements....14

7. Requirements of torch coolant....15

Ⅳ. Installation....18

1. Acceptance of delivery....18

2. Product defect solution....18

3. Installation requirement....18

4. Noise level....19

5. System installation Figures....19

6. Grounding connection and shield installation operation....21

7. Plasma power source installation (Part A in“Figure 4-2 system installation Figure”:Plasma cutting power source)....23

8. Manual gas console installation (Part B in“Figure 4-2 system installation Figure”: Manual gas console)....24

9. HF box installation （“Part C in“Figure 4-2 system installation Figure”: HF Box） 25
10. Other cables and connecting pipes 26
11. Plasma power source output signal diagram 31
12. Plasma power source input signal diagram 32
13. Plasma torch installation 33
14.Fulfil the coolant of plasma power source 34
14. Gas supply system installation 35

Ⅴ. Operation 36

1. Inspection before start 36
2. Plasma power source (machine) operation 36
3. Manual gas console operation 38
4. How to optimize cutting quality 43

Ⅵ. Maintenance 47

1. Operation process 47
2. Gas blowing process 48
3. Gas console solenoid valve operation 48
4. Trouble shooting and error code 52
5. Control board indicators instruction 60
6. System status 61
7. Initial inspection 62
8. The maintenance of air filter 62
9. The maintenance of cooling system 63
10. Gas leakage testing 64
11.Preventive maintenance 66

Ⅶ. Appendix 68

1. Some parts of the plasma power source 68
2. Some parts of the gas console 69
3. Some parts of HF box 69
4. System wiring diagram 70
5. Figure Multi-plasma power source working wiring diagram 71
6. Figure Complete plasma power source (machine) wiring diagram 72

I. Safety instructions

Cautions	**Arc and arc rays can hurt.**

All performing welding workers ought to have health qualification from the authority organization to prevent you and others from arc radiation and burn. It should be prevented for children to enter into dangerous area as well.

Carefully read the following important items and the welder safety bye-law from the authority organization. Be sure that qualified professionals perform all installation, maintenance and repair procedures.



1, Electric shock: The welding circuits are not insulated when welding. If you touch the two output electrodes of the machine with your bare skin at the same time, it will lead to electric shock, sometimes even fatal dangers. Users need to follow the items below to avoid electric shocks:

- If possible, lay some insulating materials, which are dry and large enough, in your working field. Otherwise, use the automatic or semiautomatic welding machine, DC welding machine as possible as you can.
- Components in the automatic and semiautomatic welding machine such as the welding wire reel, feed wheel, contact tip and welding head are all electric components. .
- Always be sure the machine has been connected perfectly to the work piece with the work cables and should be as close as possible to the working area.
- The work piece should be grounded perfectly.
- Make sure that the insulating material of the electrode holder, the grounding clamp, the welding cable and the welding head are not affected by damp, mildewed or spoil, and be replaced momentarily.
- Never dip the electrode in water for cooling.
- Never touch electric components of two welding machines at the same time, because this voltage is supposed to be two times of welding voltage while the grounding mode is not clear.
- While working high above the ground or other places having the risk of falling, please be sure to wear safety belt to avoid losing balance caused by electric shock.



2, Arc: Use an arc welding mask to protect your eyes and skin from sparks and the rays of the arc, pay special attention to the filter glass, which must be conformable to the national standard.

- Use clothing made from durable flame-resistant material or sailcloth to protect your skin from hurting by the arc rays.
- Remind other nearby personnel before working lest arc rays hurt them by accident.



3, Fumes and Gases: Welding may produce fumes and gases hazardous to health. Avoid breathing these fumes and gases. While working in limited room, use enough ventilation and/or exhaust to keep fumes and gases away from the breathing zone, or use the respirator. Do not weld at the same time when using of greasing, cleaning or spraying operations. The heat and rays of the arc can react with these gases to form phosgene, a highly toxic gas,

- Some protective gases used in welding might displace the O2gen in the air, and can lead to hurt or even death.
- Read and understand the manufacturer's instructions for this equipment, and validate the health certification of consumptive materials, make sure they are innocuous.



4, Spatter: Spatter can cause fire or explosion.

- Remove fire hazards from the welding area. Remember that spatter from welding can easily go through small cracks and touch fire hazards. Protect all kinds of lines going though welding area, including hydraulic lines in the wild.
- Where compressed gases are to be used in the field, special precautions should be used to prevent explosion.
- When welding stops, make certain that no live part is touching the work piece or the work stage. Accidental contact can

create a fire hazard.

- Do not weld containers or lines, which are not proved to be innocuous.
- It is very dangerous to heat, cut or weld tanks or containers at entry holes. Does not start work until the proper steps have been taken to insure that there is no flammable or toxic gas.
- Spatter might cause burn. Wear leather gloves, heavy shirt, cuff-less trousers, high shoes and a cap over your hair to prevent from burning by spatter. Wear the ear shield when performing sideways or face up welding. Always wear safety glasses with side shields when being in a welding area.
- The welding cables should be as close to the welding area as possible, and the short, the better. Avoid welding cables going through the building framework, lifting chains, AC or DC cables of other welding machines and appliances. The welding current is strong enough to damage them while having short circuit with them.



5, Cylinder: Damage of it might cause explosion.

- Make sure that the gas in the storage cylinder is qualified for welding, and the decompression flow-meter, the adapter and the pipe are all in good condition.
- Make sure that the installation of cylinder is by the wall and bundled tightly by a chain.
- Be sure to put the cylinder in the working space with no crash or shake, and far from welding area.
- It is forbidden to touch cylinder with the welding clamp or the work cables.
- Avoid facing the cylinder while installing the decompression flow-meter or the gasometer.
- When not working, please tighten the valve.



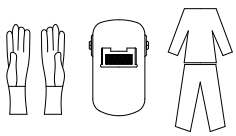
6, Power: (For electrically powered welding and cutting equipment) Turn off input power before installation, maintenance and repair, so that avoid accident.

- HUAYUAN welding equipment is I class safeguard equipment; please install the equipment in accordance with the manufacturer's recommendations by specific persons.
- Ground the equipment perfectly in accordance with the manufacturer's recommendations.



7, Power: (For engine driven welding and cutting equipment)

- Work in ventilated place or outdoors.
- Do not add fuel near to fire or during engine starting or welding. When not working, add fuel after engine is cooling down; otherwise, the evaporation of hot fuel would result in dangers. Do not splash fuel out of the fuel tank, and do not start the engine until complete evaporation of the outside fuel.



- Make sure that all the safeguard equipment, machine cover and devices are all in a good condition. Be sure that arms, clothes and all the tools do not touch all the moving and rotating components including V belt, gear and fan etc.
- Sometimes having to dismantle some parts of the device during maintenance, but must keep safety awareness strongly every time.
- Do not put your hand close to fans and do not move the brake handle while operating.
- Please remove the connection between the engine and the welding equipment to avoid sudden starting during maintenance.
- When engine is hot, it is forbidden to open the airtight cover of the radiator water tank to avoid hurt by the hot vapor.



8, Electromagnetic: Welding current going though any area can generate electromagnetic, as well as the welding equipment itself.

- Electromagnetic would affect cardiac pacemaker, the cardiac pacemaker users should consult one's doctor first.
- The effect of electromagnetic to one's health is not confirmed, so it might have some negative effect to one's health.
- Welders may use following method to reduce the hazardous of electromagnetic:

a. Bundle the cable connected to the work piece and the welding cable together.

b. Do not en-wind partially or entirely your body with the cable.

c. Do not place yourself between the welding cable and the ground (work piece) cable, if the welding cable is by your left side, then the ground cable should be by your left side too.

d. The Welding cable and the ground cable are as short as possible.

e. Do not work near to the welding power source.



9, Lift Equipment: carton or wooden boxes package the welding machines supplied by HUAYUAN. There is no lifting equipment in its wrapper. Users can move it to the prospective area by a fork-lift truck, and then open the box.



- If having rings, the machine can be transited using rings. While HUAYUAN Welding Machine Manufacture reminds users, there is possible risk to damage the welding machine. It is better to push the welding machine moving in use of its rollers unless special situations.
- Be sure that the appurtenances are all removed off when lifting.
- When lifting, make sure that there is no person below the welding machine, and remind people passing by at any moment.

Do not move the hoist too fast.



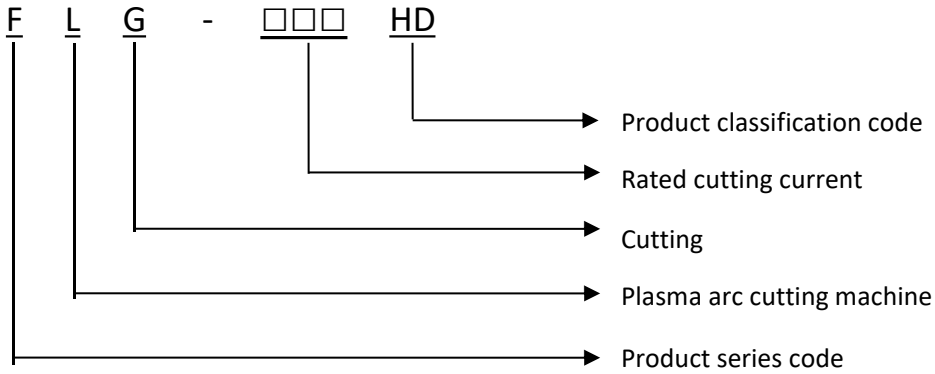
10, Noise: HUAYUAN Welding Machine Manufacture reminds users: Noise beyond the limit (over 80 db) can cause injury to vision, heart and audition depending on oneself. Please consult local medical institution. Use the equipment with doctor's permission would help to keeping healthy.

II. Product Summary

1. System composition

1) Plasma power source

Model description



Inverter fine plasma cutting power source include FLG-200HD, FLG-300HD, and FLG-400HD, they are generally called cutting power source. It is a constant current power source. The external cable interface of the cutting power source is exactly the same. The power source can communicate with CNC (Computer digital controller) through RS-422 serial communication protocol or discrete communication protocol. The working power supply of the whole cutting system is controlled by the switch on the cutting power source panel. When the switch on the panel is turned on, the green power indicator is on, and the cutting system is on power for working.

2） Manual gas console

There are two models of manual gas console： SQK-A1 and SQK-B1.The external cable interfaces of the two manual Gas consoles are exactly the same， It matches cutting power supply of FLG-200HD、FLG-300HD、FLG-400HD.

SQK-A1 has 4 gas input interfaces,when changing cutting technology and switch gas,the manual gas console automatically distributes the required gas type and gas flow.

SQK-B1 has 2 gas input interfaces,when changing cutting technology and switch gas,need to connect the required gas to gas input interfaces manually. And gas console automatically distributes the required gas flow.

3) HF box

QFK-D1 High frequency box mainly used to generate high frequency pulse, to generate pilot arc. When the pilot arc approaches the work-piece, the main arc is generated, then pilot arc close. Another function is to receive commands from the manual gas console, switch preflow gas and cutflow gas. The high frequency box can be used with both manual gas console SQK-A1,SQK-B1.

4） Plasma torch

Fine plasma cutting torch HYC-400H transmit control current to work-piece by arc, to realize metal cutting.

2. System connection diagram

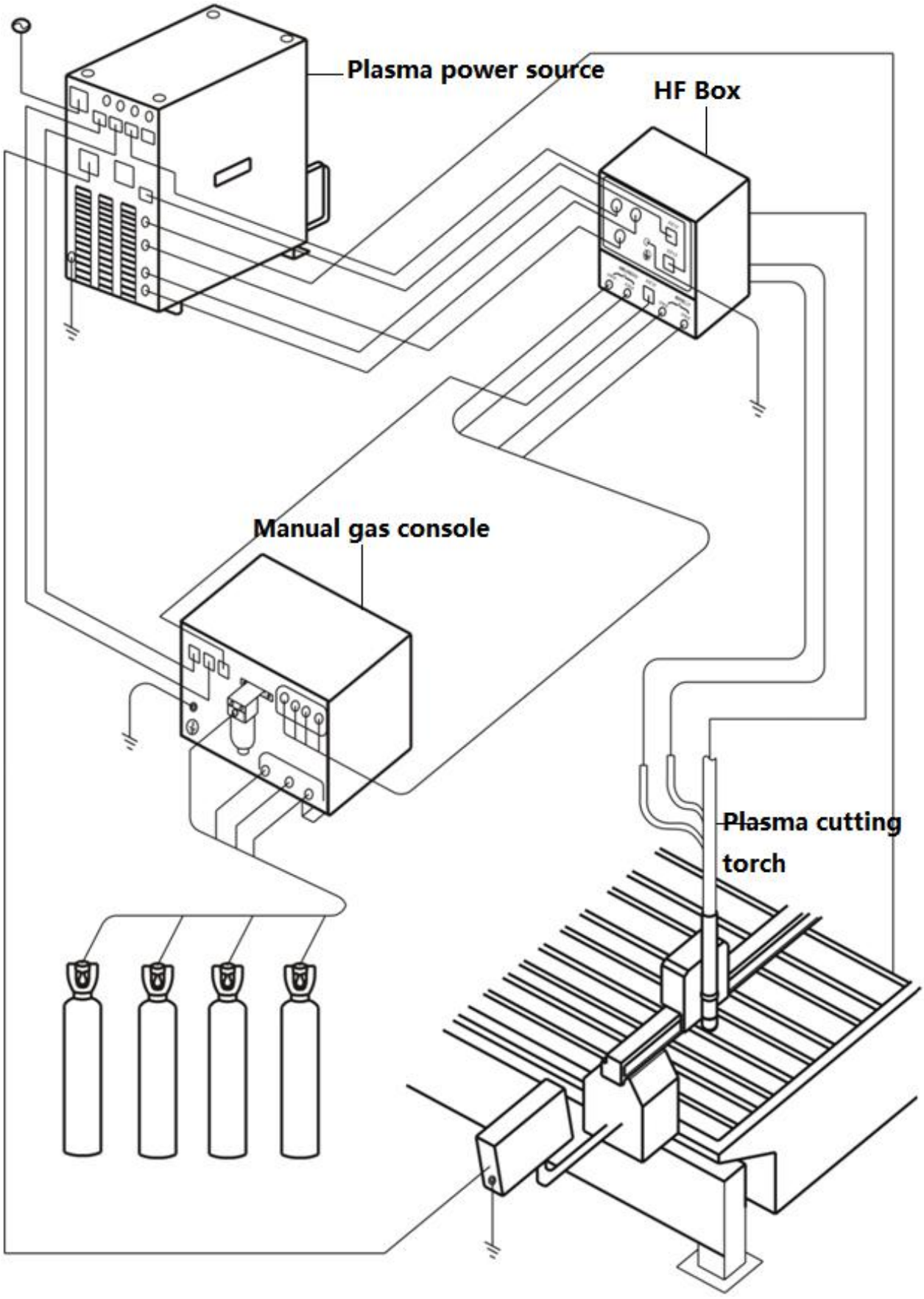


Figure 2-1 System connection diagram

3. Features

1) The CRCTech is used on this machine, the ripple of the output current is small, which makes reliable cutting quality and glossy cut;
2) A specially adjusted torch cooling system with high- power & high lift pump and high-power heat radiation structure, which highly lengthen the consumables working life;
3) With separate gas input connectors for different gas cutting process, get the best cutting condition for different metal materials;
4) Excellent high frequency arc ignition controlling technology, separate design of high frequency box and plasma power source, which highly reduces the high frequency disturb and get 100% arc starting success rate ;
5) Various of communication control connector, can easily work with different type of CNC control systems.

4. Usage

1) It's suitable for CNC cutting of carbon steel, stainless steel and aluminum, etc.
2) It's widely used in manufacturing of boiler,chemical pressure vessels, shipyard, construction engineering and so on.

5. Symbol instruction

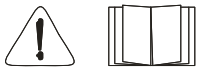
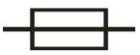
	Input voltage		Output current
	Coolant level		Coolant flow
	Cutting		Over heat
	Dangerous Voltage		Warning! Please read instruction
	Button "press in" to turn off the power		Button "pop up" to connect power
	Fuse		Pilot arc
	Working cable		Plasma gas
	Coolant input		Shield gas



Figure 2-2 Symbol instruction

6. Working condition

	**Note: Under any of following situations, the cutting machine may cannot meet the technology require or cannot working normally.** **Under any circumstance, the ambient temperature should higher than the coolant freezing point, as the freezing coolant will cause cooling system damage, make the copper tube\pump and torch crack.** **The coolant in the water tank must be clean up if the machine not use or stock for a long time**

1) Please use the machine in a clear place without any of dust, corrosive gas and flammables and explosives. Do not use it in open air and in rain.

2) Environment temperature range is -10℃～40℃; and -20℃～+55℃ when delivery and storage.

3) Required air relative humidity should ≤90％(at 20℃); ≤50％(at 40℃)；

4) The dust, acid, corrosive gas or substances around shall not exceed the normal content,except those produced in the cutting process.

5) Use it under altitude lower than 1000m.

6) The gradient of cutting power shall not exceed 10°.

7) Avoid using it under direct sunlight ,in rain or snow.

8) Do not cover the ventilation hole during the working, use and stored in a well ventilated environment.

9) Prevent metallic foreign matters from entering the cutting power supply.

10) Keep the machine away from the wall of some other closure things at least 50cm, two machines distance at least 50cm.

III. Technical parameters

1. Plasma power source FLG-200HD

1) Basic parameters

Table 3-1 FLG-200HD technical parameters

Item	Unit	Parameter
Input power	V/Hz	3～380±15% 50/60
Rated input current	A	71
Rated input capacity	kVA	48.6
Rated open circuit voltage	V	360
Power factor	-	0.92
Efficiency	-	93%
Rated duty cycle	-	100%（40℃）
Rated output current/voltage	A/V	200/200
Rated output current range	A	15～200
Arc striking mode	-	Non-contact
Quality cutting thickness (Carbon steel)	mm	25 (*1)
Piercing cutting thickness (Carbon steel)	mm	25 (*2)
Max cutting thickness	mm	50 (*3)
Insulation grade	-	F
Cooling mode	-	Air cooling
Protection grade	-	IP21S

Note: above(*1/*2/*3) cutting thickness is working with the parts listed in this instruction manual, even though can cut thicker material, but recommend cutting higher 80% materials thickness within 25mm,and start cutting from edge. Piercing cutting should not exceed 25mm.

2)Dimension and weight

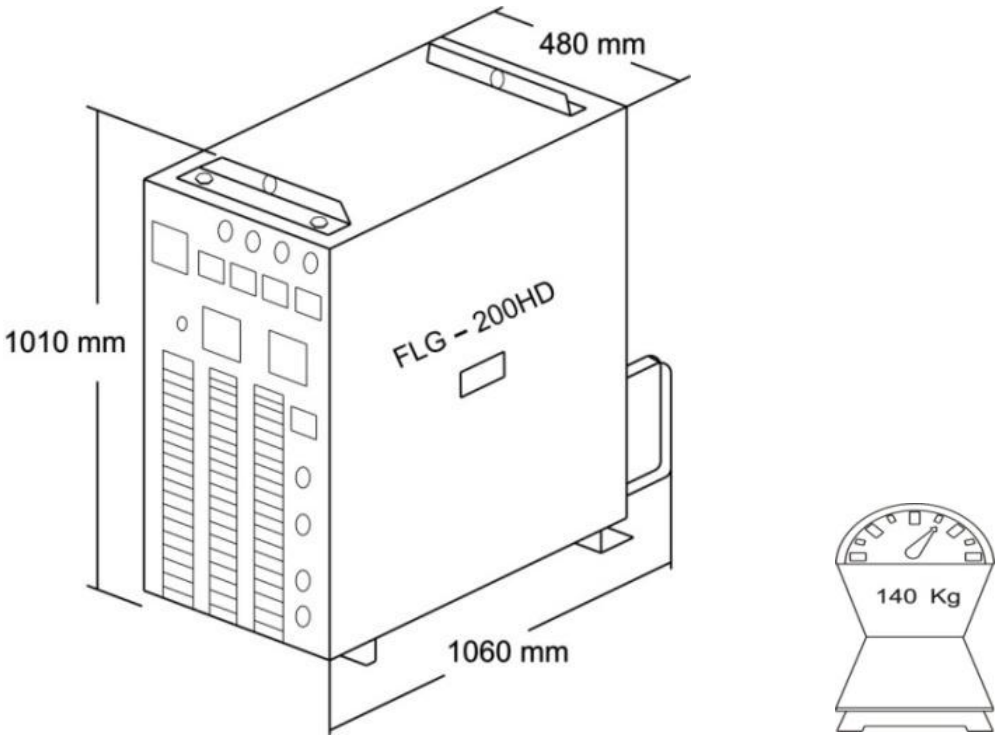


Figure 3-1 FLG-200HD Dimension and weight

3) Static external characteristic

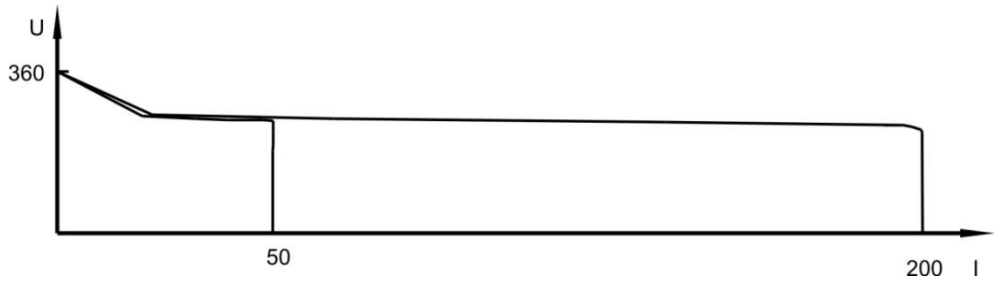


Figure 3-2 FLG-200HD Static external characteristic

2. Plasma power source FLG-300HD

1) Basic parameters

Table 3-2 FLG-300HD technical parameters

Item	Unit	Parameter
Input power	V/Hz	3～380±15% 50/60
Rated input current	A	110
Rated input capacity	kVA	72.4
Rated open circuit voltage	V	370
Power factor	-	0.92
Efficiency	-	93%

Rated duty cycle	-	100%（40℃）
Rated output current/voltage	A/V	300/210
Rated output current range	A	15～300
Arc striking mode	-	Non-contact
Quality cutting thickness (Carbon steel)	mm	38 (*1)
Piercing cutting thickness (Carbon steel)	mm	38 (*2)
Max cutting thickness	mm	64 (*3)
Insulation grade	-	F
Cooling mode	-	Air cooling
Protection grade	-	IP21S

Note: above(*1/*2/*3) cutting thickness is working with the parts listed in this instruction manual, even though can cut thicker material, but recommend cutting higher 80% materials thickness within 38mm,and start cutting from edge. Piercing cutting should not exceed 38mm.

1) Dimension and weight

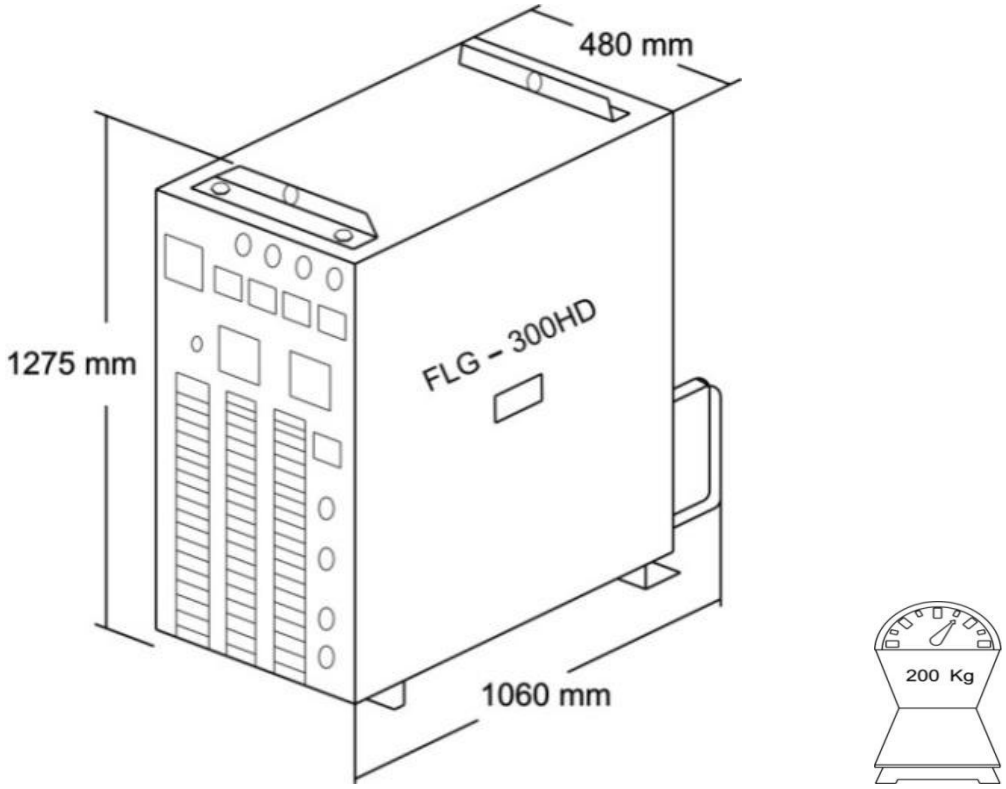


Figure 3-3 FLG-300HD dimension and weight

2) Static external characteristic

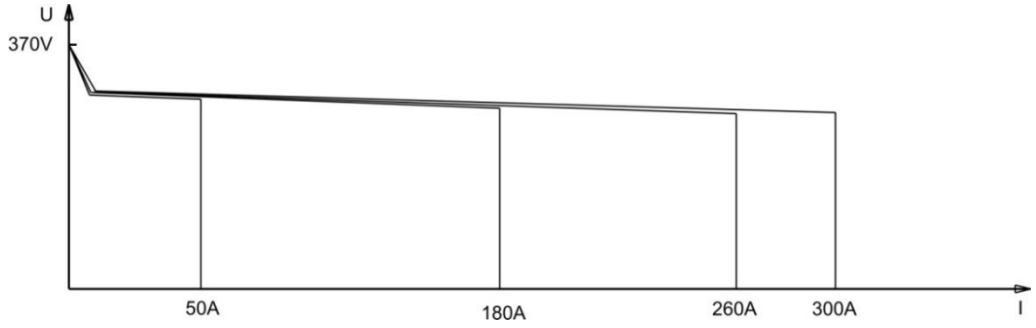


Figure 3-4 FLG-300HD Static external characteristic

3. Plasma power source FLG-400HD

1) Basic parameters

Table 3-3 FLG-400HD technical parameters

Item	Unit	Parameter
Input power	V/Hz	3～380±15% 50/60
Rated input current	A	140
Rated input capacity	kVA	93
Rated open circuit voltage	V	370
Power factor	-	0.91
Efficiency	-	94%
Rated duty cycle	-	100%（40℃）
Rated output current/voltage	A/V	400/200
Rated output current range	A	15～400
Arc striking mode	-	Non-contact
Quality cutting thickness (Carbon steel)	mm	50 (*1)
Piercing cutting thickness (Carbon steel)	mm	50 (*2)
Max cutting thickness	mm	80 (*3)
Insulation grade	-	F
Cooling mode	-	Air cooling
Protection grade	-	IP21S

Note: above(*1/*2/*3) cutting thickness is working with the parts listed in this instruction manual, even though can cut thicker material, but recommend cutting higher 80% materials thickness within 50mm,and start cutting from edge. Piercing cutting should not exceed 50mm.

2) Dimension and weight

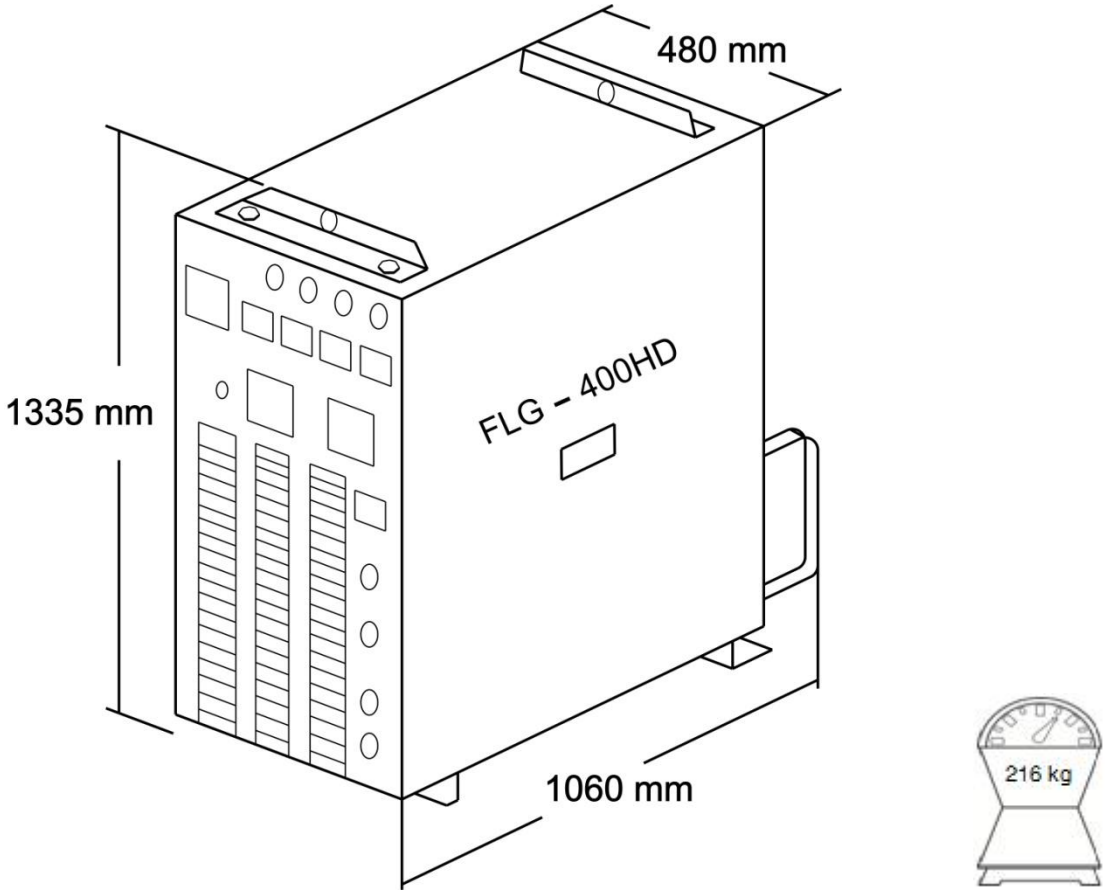


Figure 3-5 FLG-400HD dimension and weight

3) Static external characteristic

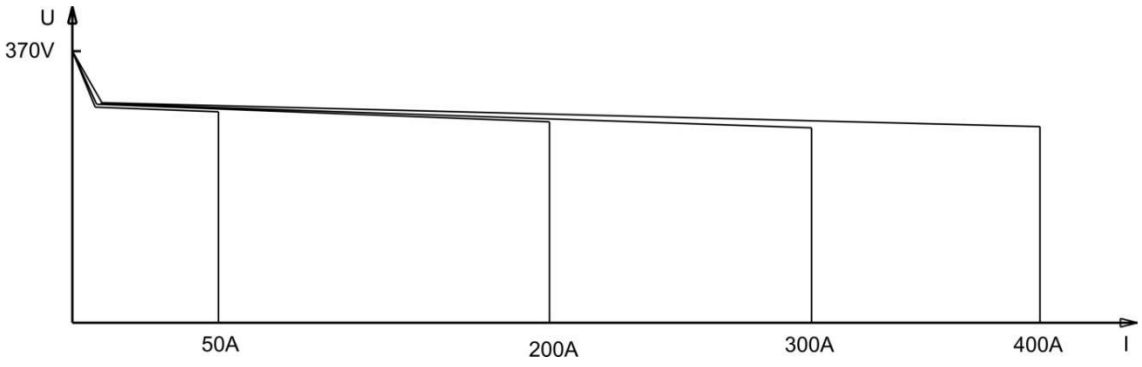


Figure 3-6 FLG-400HD Static external characteristic

3. Manual gas console SQK-A1

1) Manual gas console SQK-A1 has 4 gas input interfaces, they are Air, N2(or Ar), O2, H35(or F5);

2) Max. input gas pressure is 132 PSI/0.9 MPa;

3) Dimension and weight as Figure 3-7.

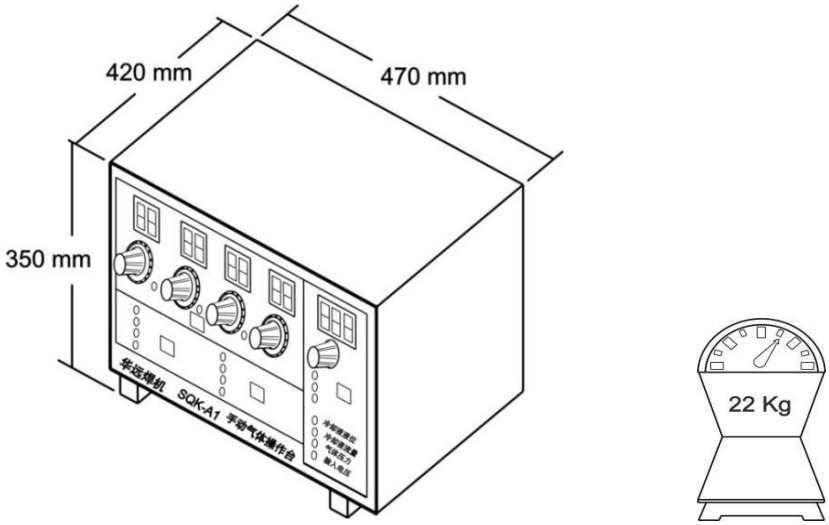


Figure 3-7 SQK-A1 dimension and weight

4. Manual gas console SQK-B1

1) Manual gas console SQK-B1has 2 gas input interfaces,they are Air and O_2 / N_2 / Ar;
2) Max. input gas pressure is 132 PSI/0.9 MPa;
3) Dimension and weight as Figure 3-8.

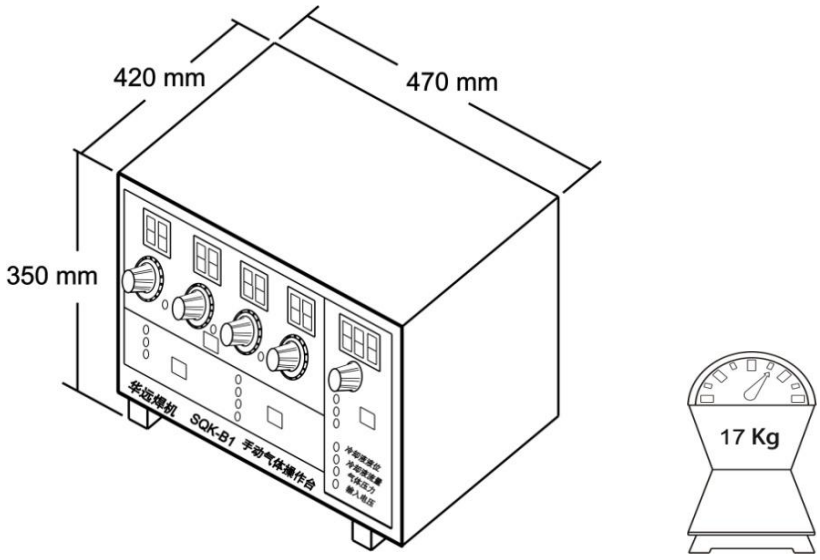


Figure 3-8 SQK-B1 Dimension and weight

5. HF Box QFK-D1

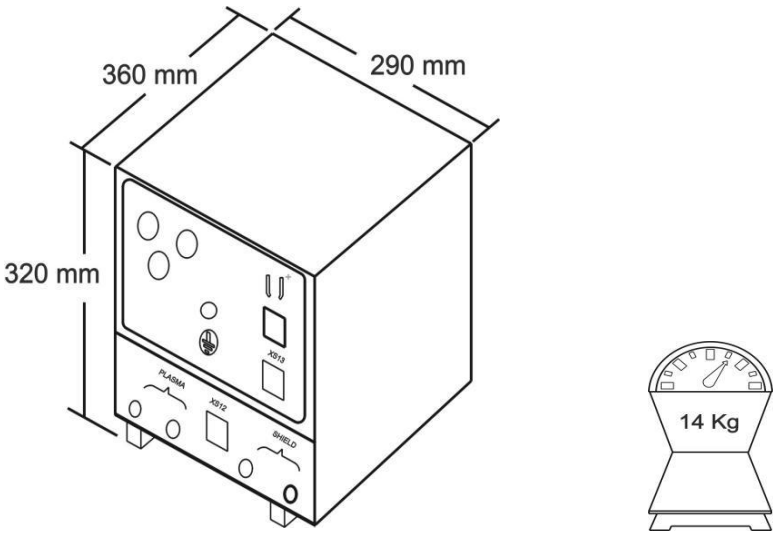


Figure 3-9 Dimension and weight

6. System gas supply requirements

Table 3-4 System gas supply requirements

Requirements of gas quality, pressure and flow			
Gas	Quality	Pressure±10%	Flow
O_2（Oxygen）	Purity≥99.5% Clean, dry and oil free	0.8MPa / 8bar / 115PSI	70 L/min
N_2（Nitrogen）	Purity≥99.99% Clean, dry and oil free	0.8MPa / 8bar / 115PSI	195 L/min
AIR（Air）	Clean, dry and oil free	0.8MPa / 8bar / 115 PSI	190 L/min
H35(Argon-hydrogen)	Purity≥99.995% （H35=65% Ar,35% H2）	0.8MPa / 8bar / 115 PSI	70 L/min
F5(Nitrogen-hydrogen)	Purity≥99.98% （F5=95% N2,5% H2）	0.8MPa / 8bar / 115 PSI	70 L/min
Ar（Argon）	Purity≥99.99% Clean, dry and oil free	0.8MPa / 8bar / 115 PSI	70 L/min

Note:

The Air in above table should accordance with the ISO standard 8573.1 grade, as following.

① Solid particle grade: Grade 1,0.1~0.5μm particle not exceed 100pc,0.5 ～ 5.0μm particle not exceed 1pc per 1CBM air;

② Temperature: Grade 4, humidity pressure must be less or equal to 3℃;

③ Oil: Grade 2, the density of the oil in air can not exceed 0.1mg/m3.

Table 3-5 SQK-A1 gas type

Gas type	**Low carbon steel**	**STAINLESS STEEL**	**ALUMINUM**

	 Plasma gas	 Shield gas	 Plasma gas	 Shield gas	 Plasma gas	 Shield gas
30~50A	O2	O2	N2	N2	Air	Air
			F5	N2		
80A	O2	Air	F5	N2	-	-
130A	O2	Air	N2	N2	Air	Air
			H35	N2	H35	N2
200A	O2	Air	N2	N2	N2	N2
			H35	N2	H35	N2
260A	O2	Air	N2	Air	N2	Air
			H35	N2	H35	N2
300A	O2	Air	N2	Air	N2	Air
			H35	N2	H35	N2
400A	O2	Air	N2	Air	N2	Air
			H35	N2	H35	N2

Table 3-6 SQK-B1 gas type

GAS TYPE	**Low carbon steel**		**STAINLESS STEEL**		**ALUMINUM**	
	 **Plasma gas**	 **Shield gas**	 **Plasma gas**	 **Shield gas**	 **Plasma gas**	 **Shield gas**
30~50A	O2	O2	N2	N2	Air	Air
80A	O2	Air	-	-	-	-
130A	O2	Air	N2	N2	Air	Air
200A	O2	Air	N2	N2	N2	N2
260A	O2	Air	N2	Air	N2	Air
300A	O2	Air	N2	Air	N2	Air
400A	O2	Air	N2	Air	N2	Air

7. Requirements of torch coolant

When delivery the plasma cutting power source, make sure there is no coolant in the coolant tank.

Before fulfil coolant, check which coolant is suitable for the current working environment.

Following warnings and precautions.

	**Warning!** **Coolant is irritating to skin and eyes, drink may cause mortal dangerous.**
Ethylene propylene glycol and phenylpropanetriazole are irritating to skin and eyes, drink may cause mortal dangerous. Use lots of water to wash if coolant contact skin or eye. If ingested, seek medical attention immediately.	
	**Always use ethylene propylene glycol in the coolant compound, do not use the vehicle antifreeze to instead, the antifreeze corrosion inhibitor will damage coolant system .** **Use pure water in the coolant compound to prevent corrosion of the cutting torch cooling system.**

1） The Huayuan standard coolant liquid is suitable to work in temperature between -12℃ and +40℃ (10℉~104℉);

The Huayuan standard coolant liquid of this cutting system is composed by 69.9% water, 30% ethylene propylene glycol and 0.1% benzotriazole.

If temperature is beyond of the range, please refer to the suggestion of homemade compound coolant in this manual;

2） Self-make mixed coolant for low temperature (Under -12℃).

	**When the temperature is lower than the following table notes, must increase ethylene propylene glycol , or it may cause torch head crack, tube crack or torch system damages.**

Please refere to the below table for suitable percentage composition of propylene glycol

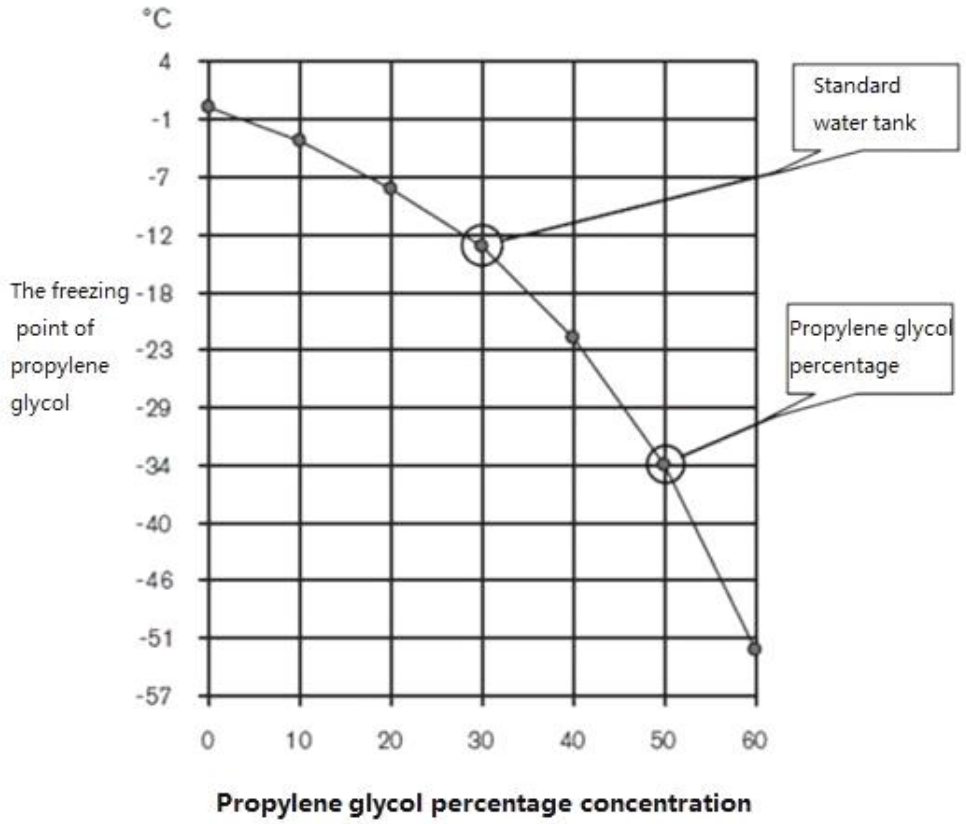


Figure 3-10 The percentage of ethylene propylene glycol and freezing point

Note: the percentage composition of ethylene propylene glycol should not exceed 50%.

3) The selfmade compound coolant is suitable to use in high temperature (over 38℃/100℉) .

The treated water works better when used in warm environment.

The treated water is a mixed water of pure water(which meet the below purity standard) and benzotriazole with percentage of 300:1. As a corrosion inhibitor, benzotriazole is suitable for copper cooling system included in plasma system.

4) Water purity

Table 3-7 Specification of water purity

Specification of water purity				
	Conductivity μS/cm (25℃ hour)	Electrical resistivity mΩ•cm (25℃ hour)	NaCl content （Unit ppm）	CaCO3 content （Unit ppm）
Pure water (Just for reference)	0.055	18.3	0	0
Max. purity	0.5	2	0.206	0.171
Min. purity	18	0.054	8.5	7.35
Max. purity of drinking water	1000	0.001	495	428

(Just for reference)				

It is vital to keep CaCO3 content at a low level, to maintain good performance of the cutting torch or cooling system.

If use selfmade compound coolant, please make sure the water always comply with the above standards. Including the lowest and highest index.

If use water used can not meet above lowest purity index, It will lead to excessive sediment at the electrode, which affects the water flow and lead to the instability of the arc.

If the water used does not meet the maximum purity index listed in the above table, it will also cause problems. Too high purity deionized water will lead to leakage of cooling system pipes.

Ⅳ. Installation

1. Acceptance of delivery

Please confirm all the items in your order are received in good condition, if any parts or accessories lost, please contact the supplier.

Please check whether any accessories are damaged during transportation. If and damages, refer to the "product defect handling" section.

2. Product defect solution

Treatment of defects such as appearance damages during transportation, or other damages that affect the use of product: If the product is broken on the way, it is necessary to reject the goods and inform transportation company.

If you need additional assistance, please call our service number or contact our authorized agent. About product accessory defects, please call our service number or contact our authorized agent.

3. Installation requirement

All the electrical and pipe system installation must be operated by qualified staff. If you have any technical questions, please contact our company or the technical department of our authorized agent.

		**Danger** **Electric shock kills**
Please cut off the power before installation, maintenance and repair. **All works need to remove the plasma power source cover must be carried out by qualified technicians.** **For more safety precautions, see Chapter 1 of the manual.**		

4. Noise level

This machine noise maybe exceed the acceptable noise level specified by the state or local government, please wear the protection devices. Please also refer to the chapter "noise hurts hearing" in the "safety" section of this manual.

5. System installation Figures

Note:

① Check all the parts before connect the cables and hoses,components can be placed according to the system installation diagram shown in this section.

② Ground all system components.For the grounding method, please refer to the section "grounding and shield installation operation" in this chapter.

③ To avoid any gas or coolant leakage,tighten all the gas and water hose according to the operation in the figure below.

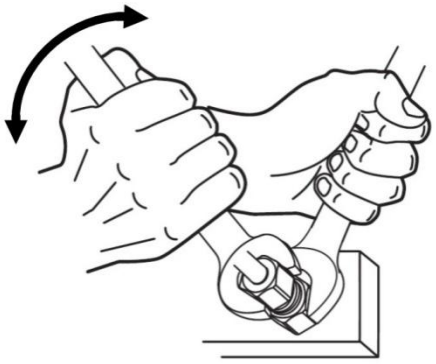


Figure 4-1 Correctly tighten all connectors

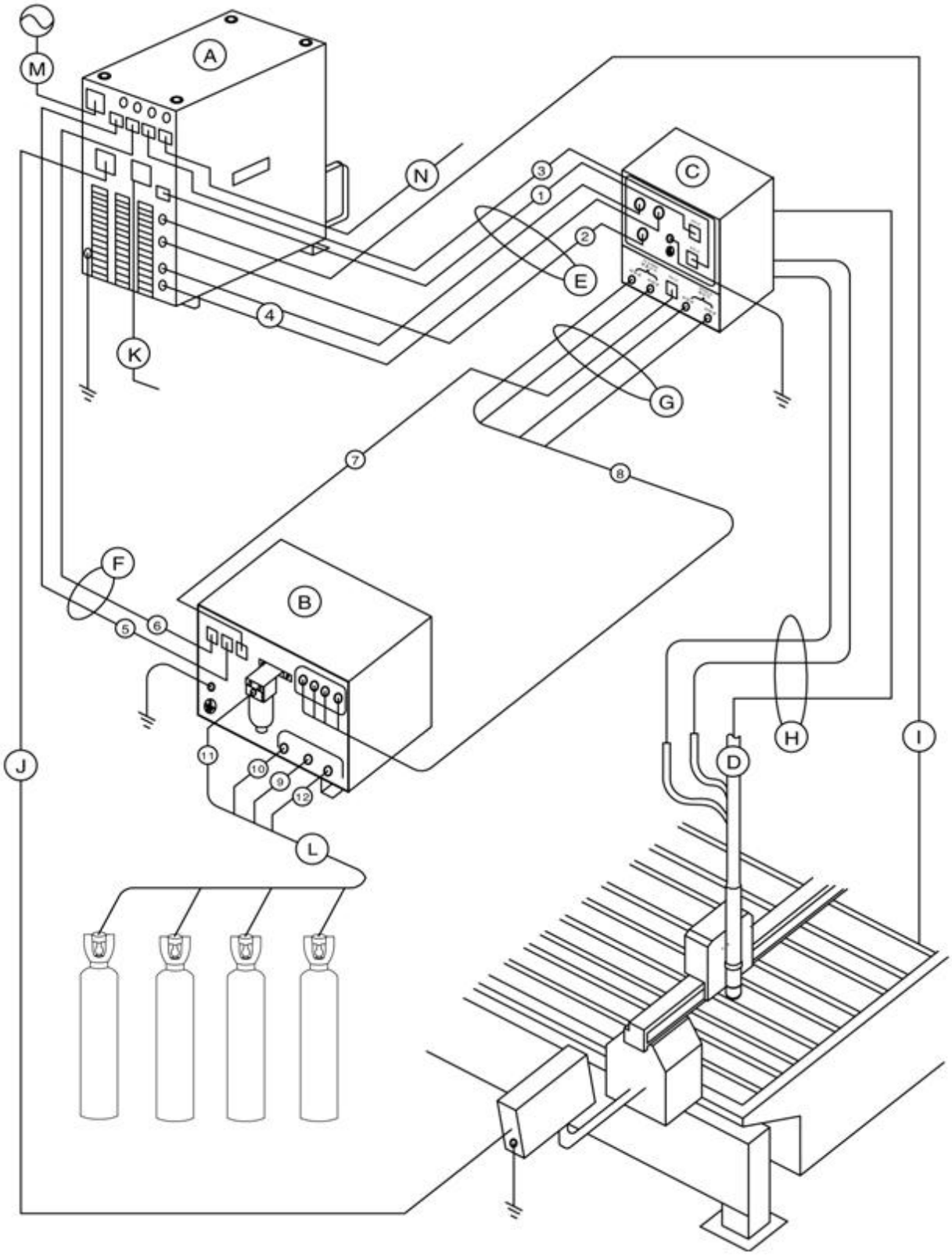


Figure 4-2 System installation diagram

1) System components:

Ⓐ Plasma cutting power source / Inverter fine plasma cutting machine FLG-200,300,400HD

Ⓑ Manual gas console SQK-A1,B1

Ⓒ HF box QFK-D1

Ⓓ Plasma torch HYC-400H

2) Cable and connection hose

Ⓔ Composite cable from plasma power source to HF box

① Pilot arc cable
② Negative pole wire
③ HF box power cable
④ Coolant hose

Ⓕ Composite cable from plasma power source to manual gas console

⑤ Control cable of manual gas console
⑥ Power cable of manual gas console

Ⓖ Composite cable from manual gas console to HF box

⑦ Control cable HF box solenoid valve
⑧ Connecting hose of working gas

Ⓗ Plasma torch cable

Ⓘ Work-piece cable (Called as cutting ground cable)

Ⓙ Control cable from plasma power source to CNC

Ⓚ Control cable of multi plasma power source

Ⓛ Gas supply hose (Figure 4-2 is manual gas console SQK-A1)

⑨ O2 hose
⑩ N2 or Ar hose
⑪ Air hose
⑫ Argon-hydrogen (H35) hose or nitrogen-hydrogen hose (F5)

Ⓜ Power cable of plasma power source

Ⓝ Arc voltage output cable

6. Grounding connection and shield installation operation

1) Grounding type

① Safety (PE) or protective grounding.The type is applied to grounding system of lead-in voltage, to avoid electrical shock by equipment of CNC table. It includes grounding that connect to plasma cutting machine system and others system (CNC controller, motor driver), also auxiliary ground rod connect to CNC cutting table.

② Cutting current grounding. It's a grounding system to finish the cutting current from plasma torch back to plasma power source route. Use a suitable cable connect the positive pole lead (lead out from plasma power source) to cutting table ground cable reliably.It is also necessary to install laths on the work-piece frame to make the cutting machine in good contact with the work-piece.

2) Installation measurements

① The cutting table use COM connection or Star Wired tree connection. Weld the stud with copper bus bar to the cutting table. If there driving motor on every rack tail, install a separate bus bar on the bench and close to drive motors. Lead a separate EMI grounding cable from the drive motor to the bench bus bar. the cutting torch lifting body and the manual gas console both need to connect the EMI grounding cable to the cutting machine grounding bus separately.

② The grounding rod should be installed within 6 meters of the cutting table, to comply with national and local electrical regulations.The PE grounding cable needs to be connected to the grounding bus or equivalent potential cable located on the cutting table. All PE grounding cables are yellow and green wires.

③ For better shielding,well connect the cutting machine CNC cable, serial communication signal cable ,multi branch connecting cable and other parts of CNC system, to shield the possible interference signals to the greatest extent.

④ All hardware used for grounding system must be made of brass or copper. Except the studs welded on the cutting table which used to install the grounding bus can be made of steel. No any aluminum products is allowed to use.

⑤ If distance is long, the positive, negative wire and pilot arc wire must be bound together. The power and signal cables shall be installed in separate wireways if available.

⑥ Try to install the high-frequency box as close as to the cutting torch. And a separate grounding cable on the HF box should be connected to the bus bar of the cutting table.

⑦ Each parts, and other CNC or motor driver should have a separate earthing cable on the cover, to connect COM port on cutting table(Star Wired tree connection).

⑧ Connect the shield of torch conductive wire to the HF box and torch well. It must insulate

from metal, ground or any building.

⑨ If a voltage divider is installed to generates arc voltage and use in arc voltage controller, try to install the voltage divider panel close to the arc voltage sampling position.

⑩ All other signals (analogy, digital, parallel communication, encoder) should operate in double glue shielded cables. The connectors of these cables must have metal shell or shielding layer, and link it to the metal shell of the connector at each end of the cable.

7. Plasma power source installation (Part A in“Figure 4-2 system installation Figure”:Plasma cutting power source)

1） Cutting power supply machine positioning

The cutting power source machine can be handled by forklift, but the length of the fork must be able to extend into the whole cutting power base. Carefully use forklift ,to avoid any damages.Pay attention to the fork balance, and move slowly especially when turning.

① Place the plasma cutting power at dry and clean place,with good ventilation. For ventilation and maintenance ,leave one meter space at each side of the cutting power supply machine.

② The cooling fan draws cold air from the front panel , and discharge at the rear. Do not put any filter equipment at the air inlet, it will affect cooling efficiency.

③ Do not put the cutting machine at tilting slop more than 10 degree, to avoid dumping.

2） Power supply installation requirements of plasma cutting power source

The power supply part to the machine must contain following parts on the power distribution box: power switch, slow fuse, and power supply cable and protective earthing conductor with suitable length. It shall be installed by licensed electricians and comply with national and local electrical regulations.

Power lead of plasma cutting power source:

Copper cable is required, and recommended length not exceed 15m. See table 4-1 for the cross-sectional area of copper conductor.

Power switch of distribution box

The power switch is used to cut off (isolate) the input voltage. Install the switch close to the plasma cutting power to facilitate the operation. This power switch should has following functions:

① When turned OFF, it isolates the electric and cut the connection between conductor and

plasma power source.

② With OFF and ON sign, “O” indicates close and” I”indicates open.

③ Equipped with a external handle, can be locked at the OFF position.

④ The switch is equipped with an electric operating device for emergency stop.

⑤ Equipped with slow melting fuse or air breaker for protection.

Table 4-1 Power lead requirements for plasma power source

Item	FLG-200HD	FLG-300HD	FLG-400HD
Input copper power lead sectional area	≥16 mm^2	≥35 mm^2	≥50 mm^2
Grounding copper cable sectional area	≥16 mm^2	≥16 mm^2	≥25 mm^2
Air breaker capacity	125A	160A	250A
FUSE capacity	125A	150A	200A

3) Install the power cable of plasma power source

<table>
<tr><td></td><td></td><td>Danger
Electric kills</td></tr>
<tr><td colspan="3">When install the cable, the switch must be cut OFF.
Obey the regional or national safety requirements.</td></tr>
</table>

① Remove the power junction box on the plasma power rear panel and connect the power cable to the input terminals.

② Connect the grounding conductor (PE) to the grounding terminal marked ⏚ on the plasma power rear panel.

③ Make sure the switch is OFF during the whole installing process.

④ Connect all cable and hose according to the regional or national requirements. During the installing,make sure input cable is disconnected before protective earthing cable.

8. Manual gas console installation (Part B in“Figure 4-2 system installation Figure”: Manual gas console)

The gas console should be installed close to the plasma power cutting machine for easy operation, for example : on the CNC crossbeam or next to the CNC system operation

interface. Reserve a certain space for maintenance.The installing hole positions of manual gas console SQK-A1 and SQK-B1 are same. See Figure 4-3.

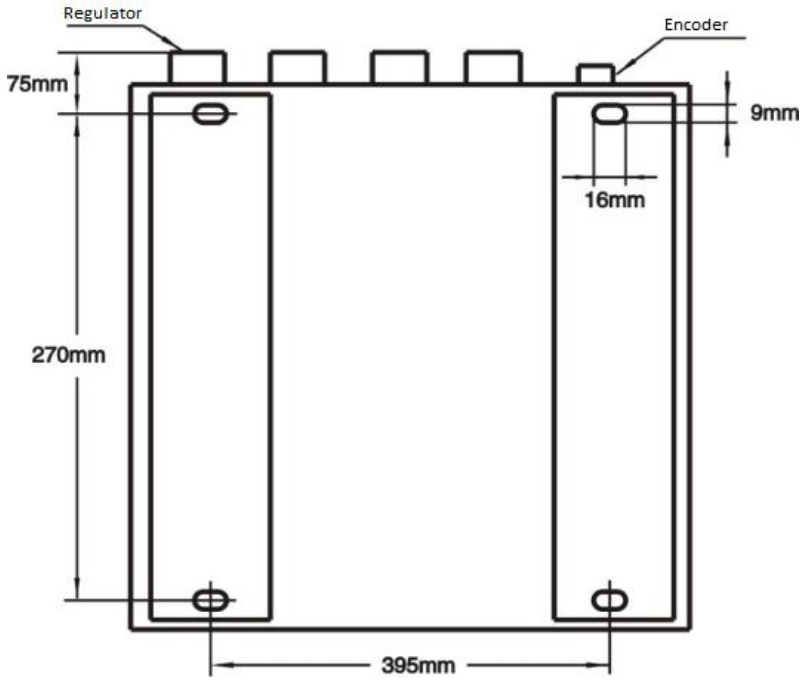


Figure 4-3 Top view of gas console

9. HF box installation （“Part C in“Figure 4-2 system installation Figure”: HF Box）

1) HF box should installed on the CNC torch moving body, close to the cutting torch,to ensure that the length of the plasma gas pipe and protective gas pipe connected with the plasma cutting torch is not more than 1.8m.

2) Reserve a certain space for maintenance. Check Figure 4-4 for the location of the installing holes.

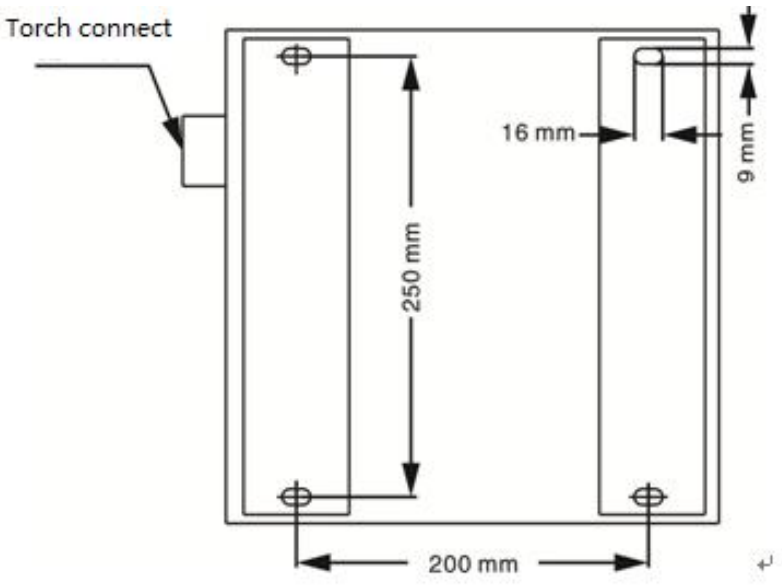


Figure 4-4 Top view of HF box

3) HF box and plasma torch connection

Make sure to connect the torch cable connect with the same color copper plug, as the coolant supply and coolant return connector screws same.

To avoid the HF cable affect other external equipment, the metal braided tube must connect stably with the HF torch cable, and fix well, see below Figure 4-5.

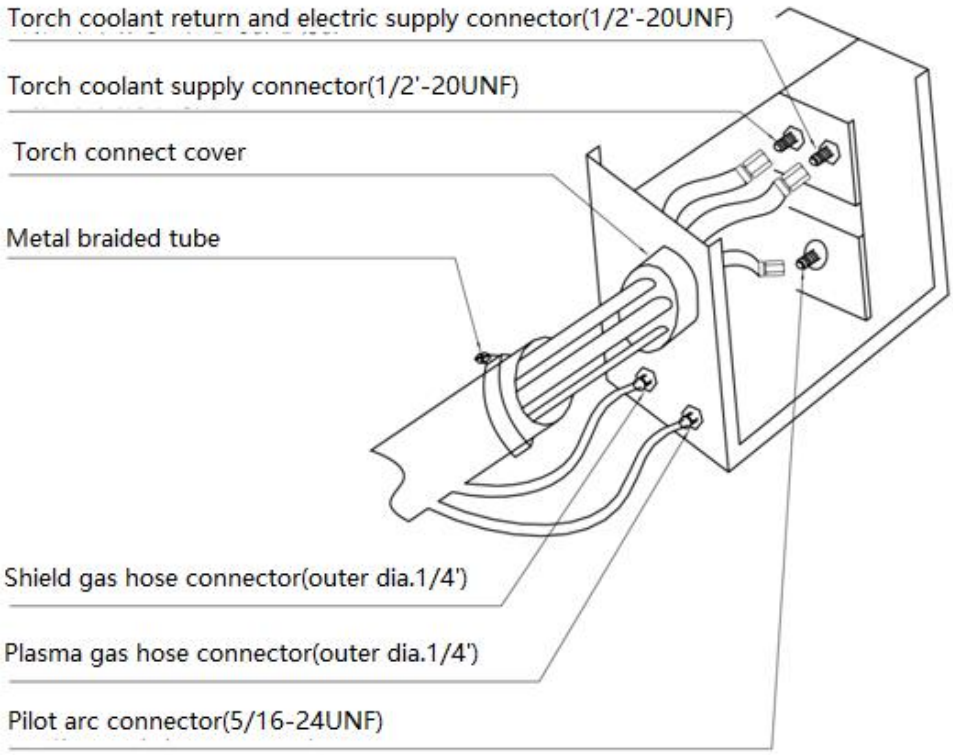


Figure 4-5 HF box and plasma torch connection

10. Other cables and connecting pipes

1） Composite cable between plasma power source to HF box (**“Part E in“Figure 4-2 system installation Figure”: Other cables and connecting pipes**)

Power cable of HF box（Cable ③ in“Figure **4**-2 system installation Figure”）

The power cable of HF box should connect with socket X3 in plasma power source machine and socket XS13 in HF box, the cable plug is 3 pins aviation socket, detail as following Table 4-1.

Table 4-1 Power cable pin signals of HF box

POWER CABLE PIN SIGNALS OF HF BOX	
Plug Pin	Signal
1	AC 120V fire

2	AC 120V back
3	Ground cable

2） Composite cable between plasma power source to manual gas console（**“Part F in“Figure 4-2 system installation Figure”**）

Control cable of manual gas console（Cable ⑤ in“Figure **4**-2 system installation Figure”）

The control cable of manual gas console should connect with socket X1 in plasma power source machine and socket XS10 in manual gas console, the cable plug is 9 pins aviation socket, detail as following Table 4-2.

Table 4-2 Power cable pin signals of manual gas console

Power cable pin signals of manual gas console	
Plug Pin	Signal
1	Ground cable
2	CAN L
3	CAN reference
4	Not use
5	Not use
6	Not use
7	CAN H
8	Not use
9	Not use

Manual gas console power cable （Cable ⑥ in“Figure **4**-2 system installation Figure”）

The power cable of manual gas console should connect with socket X2 in plasma power source machine and socket XS9 in manual gas console, the cable plug is 7 pins aviation socket, detail as following Table 4-3.

Table 4-3 Power cable pin signals of manual gas console

POWER CABLE PIN SIGNALS OF MANUAL GAS CONSOLE	
Plug Pin	Signal
1	AC 120V fire
2	AC 120V back
3	Ground cable
4	Not use
5	Not use

6	Not use
7	Not use

3) Composite cable between HF box to manual gas console （"Part G in"Figure 4-2 system installation Figure"）

HF box control cable （Cable ⑦ in"Figure **4**-2 system installation Figure"）

The control cable of HF box should connect with socket X11 in manual gas console and socket X12 in HF box, the cable plug is 12 pins aviation socket, detail as following Table 4-4.

Table 4-4 Power cable pin signals of manual gas console

HF box control cable	
Plug Pin	Signal
1	AC 120V fire -Shield gas preflow
2	AC 120V back-Shield gas preflow
3	AC 120V fire -Shield gas cutflow
4	AC 120V back-Shield gas cutflow
5	AC 120V fire -Plasma gas preflow
6	AC 120V back-Plasma gas preflow
7	AC 120V fire -Plasma gas cut flow
8	AC 120V back-Plasma gas cut flow
9	AC 120V fire -Plasma gas pressure relief
10	AC 120V back-Plasma gas pressure relief
11	Ground cable
12	Not use

Working gas connection pipe （Cable ⑧ in"Figure **4**-2 system installation Figure"）

The working gas connection pipe between manual gas console and HF box include 4 working gas hoses: Plasma gas preflow,Plasma gas cutflow,Shield gas preflow and Shield gas cutflow.

4) Control cable between plasma cutting power source to CNC （"Part J in"Figure 4-2 system installation Figure"）

The CNC control cable should connect with socket X5 or X6 of plasma power source and CNC control connector, the cable plug is on plasma power source terminal is 42 pins aviation socket, detail as following Table 4-5.

Note: the cable must be with 360°shield to ensure the two terminals of the shield connect with the machine cover, to get best shield.

Table 4-5 Control cable pin signals of plasma power source to CNC

Plasma power source		Signal name	Function	CNC
Plug Pin	Input/ Output			Input/ Output
1		Grounding	Cable shield ground connect	
2 3	Input	RX- RX+	RS-422 receiver RS-422 receiver	Output
4 5	Output	TX- TX+	RS-422 transmitter RS-422 transmitter	Input
6 7		RS-422 reference Not use	RS-422 ground cable No	
8 9	Output	Action 1E(-) Action 1C(+)	Inform CNC arc transferred already, default action 1 signal	Input
10 11	Output	Error E(-) Error C(+)	Inform CNC some errors	Input
12 13		Not use Not use		
14 15	Output	Not ready E(-) Not ready C(+)	Inform CNC plasma cutting system not ready	Input
16 17	Output	Move 2E(-) Move 2C(+)	Inform CNC arc transferred already, default action 1 signal	Input
18		+24VDC reference		
19 20	Output	Move 3E(-) Move 3C(+)	Inform CNC arc transferred already, default action 1 signal	Input
21 22	Output	Move 4E(-) Move 4C(+)	Inform CNC arc transferred already, default action 1 signal	Input
23 24	Input	Corner (-) Corner (+)	CNC inform plasma power source approach the corner,to decrease current(Default reduce 50% of the cutting current)	Output
25 26	Input	Piercing finish(-) Piercing finish(+)	CNC inform plasma power source keep the shield gas preflow, until CNC send out signal again. This function use for cutting shield gas cutflow less than preflow, need to keep big preflow shield gas for piercing; it's also used for shield gas control under other special situations.	Output

27 28	Input	Pause(-) Pause(+)	CNC inform plasma power source keep the shield gas preflow, until CNC send out signal again. It can be used for multi plasma work, arc strike after torch positioning well; it also can be use for underwater cutting.	Output
29 30	Input	Start(-) Start(+)	CNC start the plasma power source	Output
31		+24V_CNC	Voltage +24VDC from outside of the plasma power source	
32,33 34,35 36		Not use		
37		+24V_POWER	Voltage +24VDC from outside of the plasma power source(Max.200mA output capacity)	
38,39 40,41 42		Not use		

Note:

① The outside signal input terminal of the plasma cutting power source is light and electricity isolation. The circuit control and connection please refer to the “input circuit figure”of this chapter, the outside input to cutting machine max. Voltage no more than +24VDC.

② The output terminals of the plasma cutting power source is light and electricity isolation, rated output voltage is +24VDC, output current less than 15mA. The circuit control and connection please refer to the “input circuit figure”of this chapter.

③ Action signal is for option, for multi plasma power source use.

④ Choose the power of cutting machine input and output from machine or from outside according to the CNC system. The plasma power source provide voltage is +24VDC, max.output 200mA. When outside CNC system offer input and output power require the max.output current no less than 200mA.

5) Control cable of Multi plasma power source（“Part K in“Figure 4-2 system installation” Figure）

When one CNC cutting table work with multi plasma power sources, the multi plasma power source control cable connect socket X6 of the first power source and socket X5 of the second power source, the X6 of the second power source with the X5 of the third power source, same way to the following power source connection. The multi source control cable signal is same as the power source control cable to CNC.

Note: the cable must be with 360°shield to ensure the two terminals of the shield connect with the machine cover, to get best shield.

6) Arc voltage output cable（“Part N in“Figure 4-2 system installation” Figure）

Plasma power source arc voltage output socket X4 connect with the outside THC, the X4 plug output signal is 1:1 non-isolated arc voltage.Check the below Table 4-6 for details.

Table 4-6 Arc voltage output cable plug signal

Arc voltage output cable plug signal	
Plug pin	Signal
1	Arc voltage signal +
2	Arc voltage signal -

11. Plasma power source output signal diagram

Figure 4-6,4-7,4-8 is the connection and process diagram of plasma output signal in Table 4-5.

1) Logic connector, high electrical level

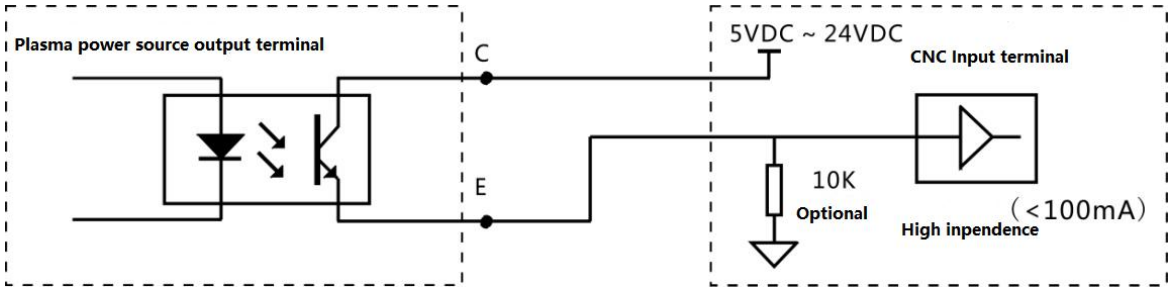


Figure 4-6 Logic connector, high electrical level

2) Logic connector, low electrical level

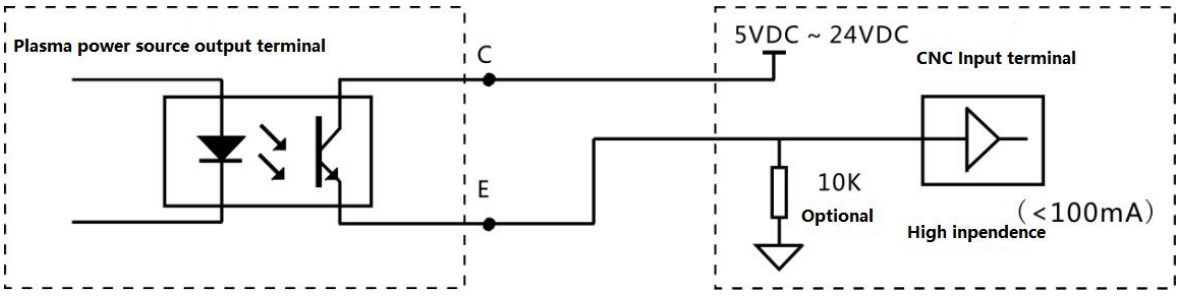


Figure 4-7 Logic connector, low electrical level

3) Potentiometer connector

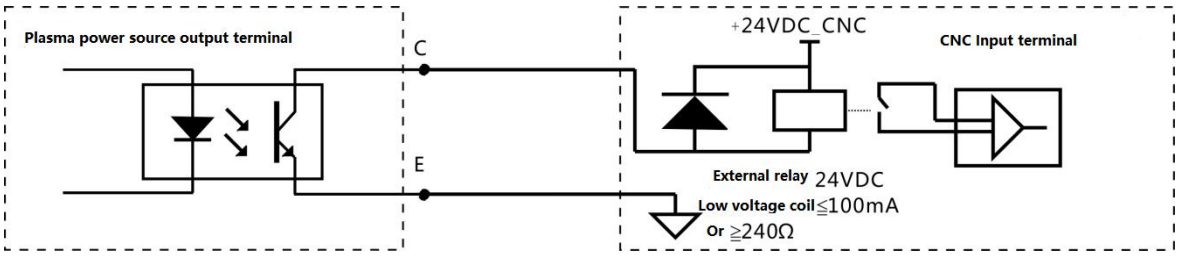


Figure 4-8 Potentiometer connector

12. Plasma power source input signal diagram

Figure 4-9,4-10,4-11,4-12 is the connection and process diagram of plasma input signal in Table 4-5.

1) Potentiometer interface

① Use plasma power source inside +24VDC power (Default)

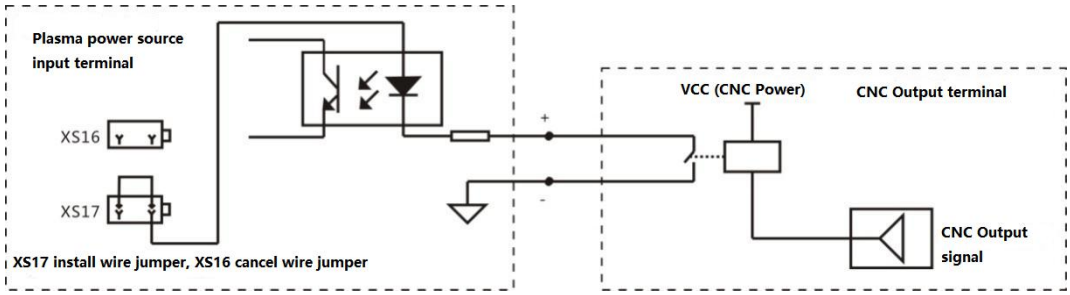


Figure 4-9 Plasma power source inside +24V potentiometer interface

② Use CNC power +24VDC (Pay attention to the XS16,XS17 short connect position of control cable PL01)

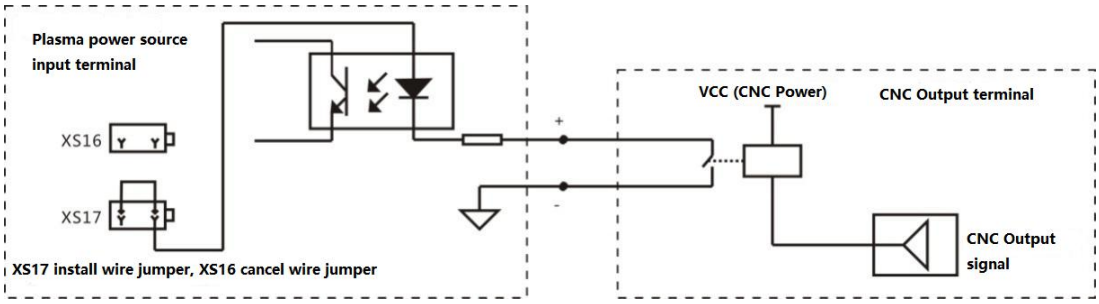


Figure 4-10 Outside supply +24V potentiometer interface

2) Optocoupler interface

① Use plasma power source inside +24VDC power (Default)

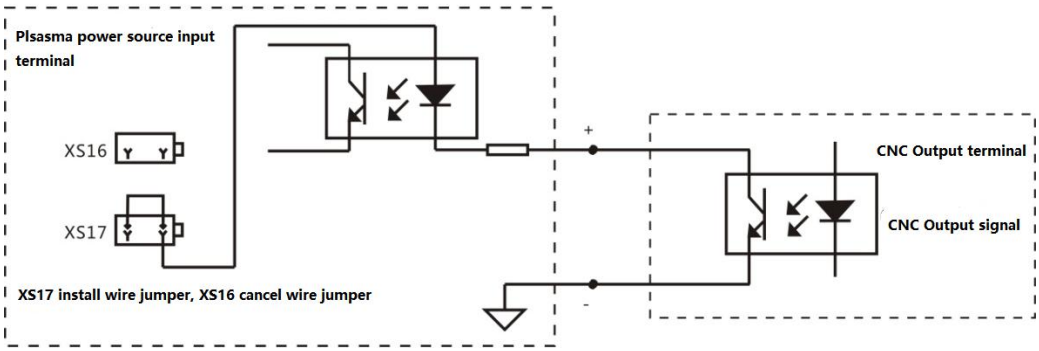


Figure 4-11 Plasma power source inside +24V optocoupler interface

② Use CNC power +24VDC (Pay attention to the XS16,XS17 short connect position of control cable PL01)

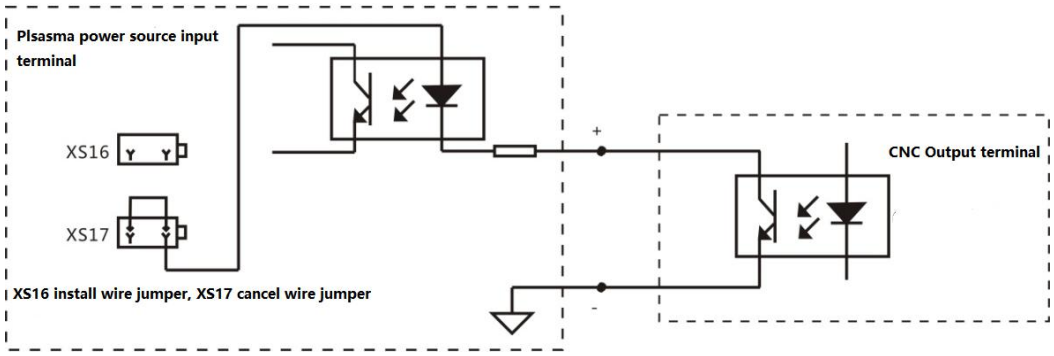


Figure 4-12 Outside supply +24V optocoupler interface

13. Plasma torch installation

1) Plasma torch installation

The cutting machine can work with different brand of plasma cutting torch, details refer to the torch manual.

2) Torch cable and HF box connection

Make sure the gas hose length from plasma gas and shield gas output connector of HF box to torch head less than 1.8m.

3) Install the plasma torch on CNC cutting table.

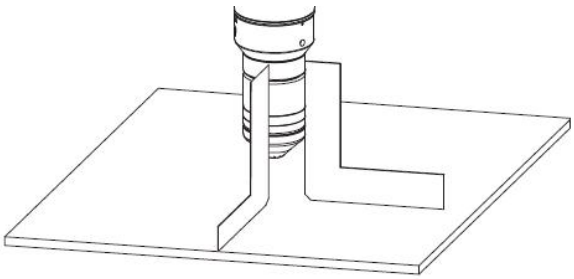


Figure 4-13 Install plasma torch

① Install the torch (already connected with torch cable) onto the torch holder.

② Hold the lower part of torch sleeve with holder, but don't contact the quick removal connector. The tray should be as lower as possible to reduce the torch shake.

③ Fix the screw.

④ Test the vertical of the torch and work-piece, like Figure 4-13.

4) Requirements for the torch lifting body

The cutting system requires a good quality electric torch lifting device, which should have 203mm stroke and max.5080mm/min constant speed with good brake function.

14.Fulfil the coolant of plasma power source

	**Improper coolant use may cause damage of the machine, detail refer to the "torch coolant requirement"chapter.** **Don't fill too much coolant.**

For different torch cable length and the HF box installation distance, the coolant require capacity is 20-35L, the coolant tank capacity is 20L, fulfil the coolant as following steps when first use:

Step 1: Full fill the tank with coolant.

Step 2: Power on the plasma power source, Error code "060" (Coolant not enough) maybe appear on manual gas console. Then press Knob "8" on manual gas console, after 5s, enter "Manual pump" status, pump start working. The digital meter will display the coolant flow value. After coolant flow back to normal (higher than 2.3L/min), release Knob "8".

Note: if the cooling pipelines in composite cable is too long, Error code "110" maybe appear during "manual pump" process, and pump stop working. Cut off the plasma source power and do step 1 and 2 again, until back to normal.

Step 3: Turn off the plasma power source, fulfil the coolant tan.

14. Gas supply system installation

	**If the gas supply pressure not in the required range which indicate in chapter 2, the cutting quality and torch consumables life may be affected.** **If the gas not pure, or the gas leak:** ● **cutting speed will be reduced** ● **cutting quality will get bad** ● **cutting capacity will be reduced** ● **consumables life will get shorter**

1) Set the gas regulator pressure

All the gas and gas regulator need prepared by user, please use good quality 2 section gas regulator install within 3m away from the gas console. Gas and gas flow please refer to the "System gas supply requirement".

① Make sure the plasma power source is powered off, set all the gas regulator pressure to 0.83MPa.

② Turn on the plasma power source power.

③ After blowing and clean the gas console, press knob "7", select preflow (indicator on), system start to blow.

④ During blow process, adjust the gas regulator to make Shield gas pressure to 0.83MPa.

⑤ Press the knob "7"on manual gas console, select the cutflow (indicator on), system start to blow.

⑥ Adjust the gas regulator to make plasma gas pressure to 0.83MPa.

⑦ Press the knob "7"to select "RUN" (indicator on).

2) Gas regulator requirements

Bad quality gas regulator is not able to supply stable gas pressure, which will cause bad cutting performance and system error. If use low temperature liquid gas or cylinder gas, please use good quality sectional gas regulator, if use high pressure cylinder gas, please use good quality 2 section gas regulator.

3) Gas supply pipelines setting

	**Make sure all the gas hose, connectors and parts suitable for O2 and "Argon Hydrogen" (H2).**

Note: when use O2 as the plasma shield gas, have to connect air into the manual gas console, to get suitable mix gas.

① Copper pipe or suitable soft hose can be used in gas supply system, but don't use steel pipe or aluminium pipe.

② After gas hose installation, test the system with high pressure to check if gas leakage.

③ The suggested hose inner diameter that connect with manual gas console is 9.5～10mm.

④ For hose system, please use special inert gas hose for Air, Ne and Ar.

Ⅴ. Operation

1. Inspection before start

Before start the machine everyday,make sure cutting surrounding environment and protective suit meet requirements according to "safety" of this manual,and have to check again as follow steps.

Plasma torch checking

		**WARNING**
Before operation,please read carefully "safety" chapter. **Turn off power before operate the following.**		

1) Turn off the power of contribution box,and cut the power switch of the plasma power source.

2) Take down consumables from plasma torch and check if there is some wearing or damage. **Please put all consumables on clean,dry and non-oil place. Dirty consumables hurt the plasma torch.**

3) If any consumables damage,replace it.

4) After installing consumables,make sure torch and work-piece keep vertical.

2. Plasma power source (machine) operation

1) Power switch of plasma power source (machine)

Plasma cutting machine power, manual gas console and HF box power supply are all controlled by the emergency stop switch on cutting machine panel, turn it clockwise is ON, press is OFF.

2） Power indicator light of plasma power source (machine)

When whole system is on power, this indicator lights, when whole system is off power, this indicator off.

3） Inner setting of plasma power source (machine)

Connect the machine according to “Figure 7-2 multi plasma power working wiring diagram”, the hardware of plasma power source supports one CNC maximally can control 4 sets of plasma cutting power source (machine) at the same time. When multi plasma power sources need to be equipped, open machine cover and set the N27/N25 on control board of PL01. (See Figure 5-1) The default setting is one CNC control one cutting machine.

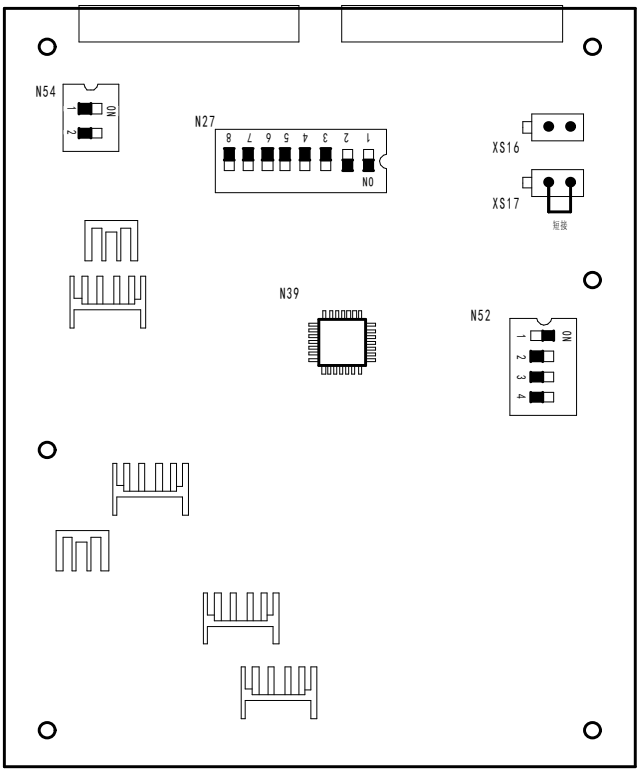


Figure 5-1 PL01 Hardware Default Settings

In Figure 5-1, the default setting of N27 toggle switch means this plasma power source (machine) use “MOVE 1” as running signal output, all other move signal has no any of functions on this machine.The default setting of N52 toggle switch means the ID number of this plasma power source (machine) is 1.

Connect the machine according to “Figure 7-2 multi plasma power working wiring diagram”, when one CNC control multi plasma power source (machine), need to open the machine cover and as below steps:

① Plasma power source (machine) ID set: the cutting machine ID number correspond the

N52 toggle switch pin 1.2.3. and 4 on PL01 control board. If No.1 cutting machine, then pull the N52 toggle switch pin“1”to “ON” position, pull other 3 toggle switch pin to opposite of “ON” position. If no.2 cutting machine, then pull the N52 toggle switch pin “2”to “ON”position, pull other 3 toggle switch pin to opposite of “ON”position.The rest can be done in the same way.

② “MOVE” signal set: “MOVE”signal is correspondent with the plasma power source (machine) ID set. If the plasma power source (machine) ID set is 1, then the “MOVE”signal should be 1, if plasma power source (machine) ID set is 4, then the “MOVE”signal should be 4. ”MOVE”1 signal setting is to pull the N27 toggle switch pin 1 & 2 to “ON” position, other 6 toggle switch pin to opposite of “ON” position.”MOVE”2 signal is to pull the N27 toggle switch pin 3 & 4 to “ON” position, and other 6 pin to opposite of “ON” position.The rest can be done in the same way.

③ RS422 communication matching resistor(RX) set: this setting is not for all users, but based on users’ system installation environment, and decide if it’s necessary to add two 120Ω resistors on control cable terminals. When users’CNC control cable length more than 35m or the environment electromagnetic interference is serious, we suggest to add two 120Ω/0.24W resistors on both terminal of the CNC control cable. To add the communication matching resistor(RX), pull both the N54 toggle switch pin 1 & 2 to “ON” position, if no need this, then turn to opposite “ON” position.

3. Manual gas console operation

1） Front panel function

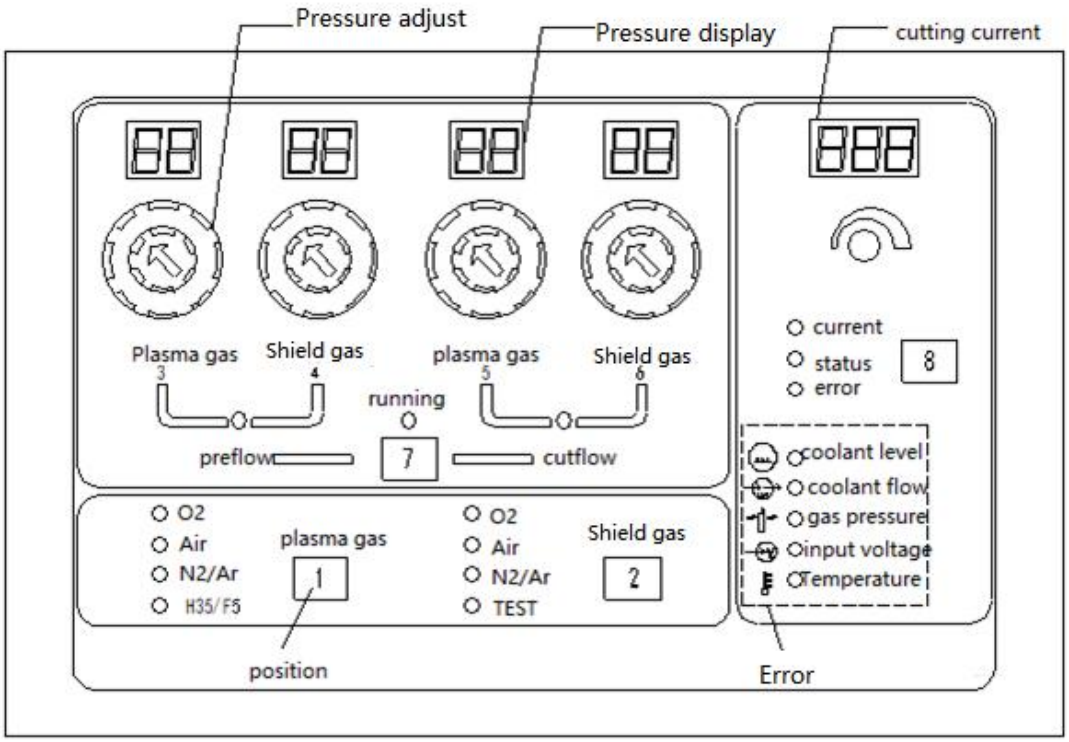


Figure 5-2 SQK-A1 front panel function

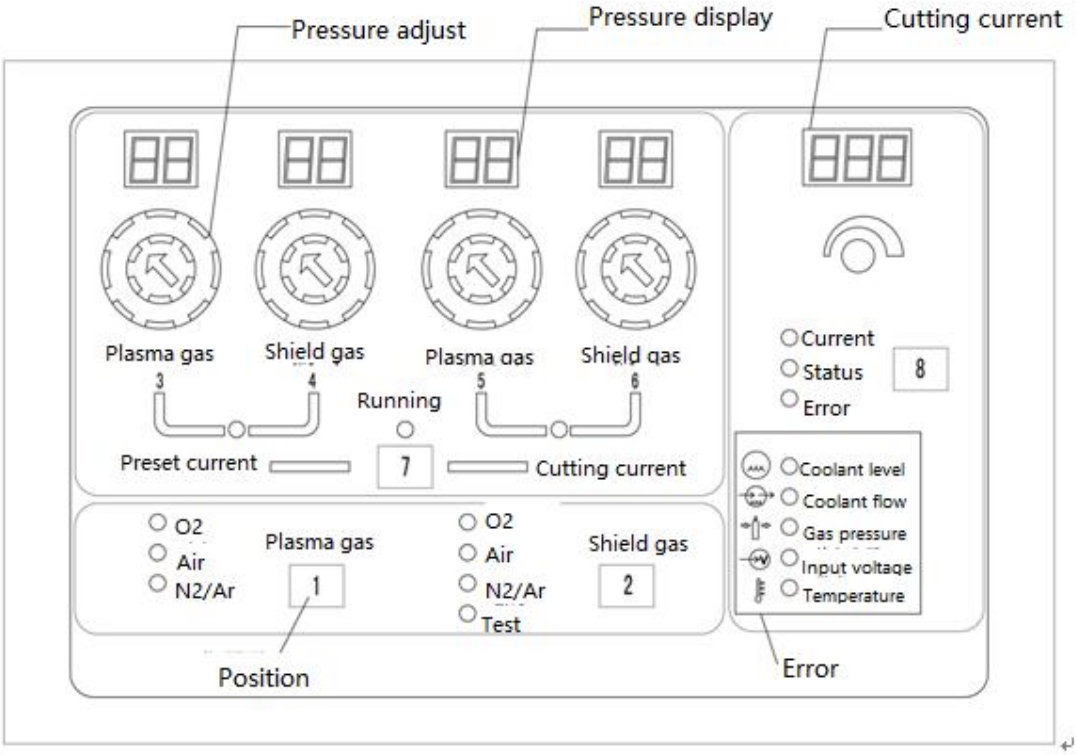


Figure 5-3 SQK-B1 front panel function

For the panel function of manual gas console SQK-A1and SQK-B1, except for SQK-B1 don't work for plasma gas H35/F5, all other functions are totally same.

SQK-A1 works with cutting gas: O2/O2,O2/Air, Air/Air, N2/Air, N2/N2, H35/N2, F5/N2,SQK-B1 works with cutting gas: O2/O2,O2/Air, Air/Air, N2/Air, N2/N2.

2) Rear panel function

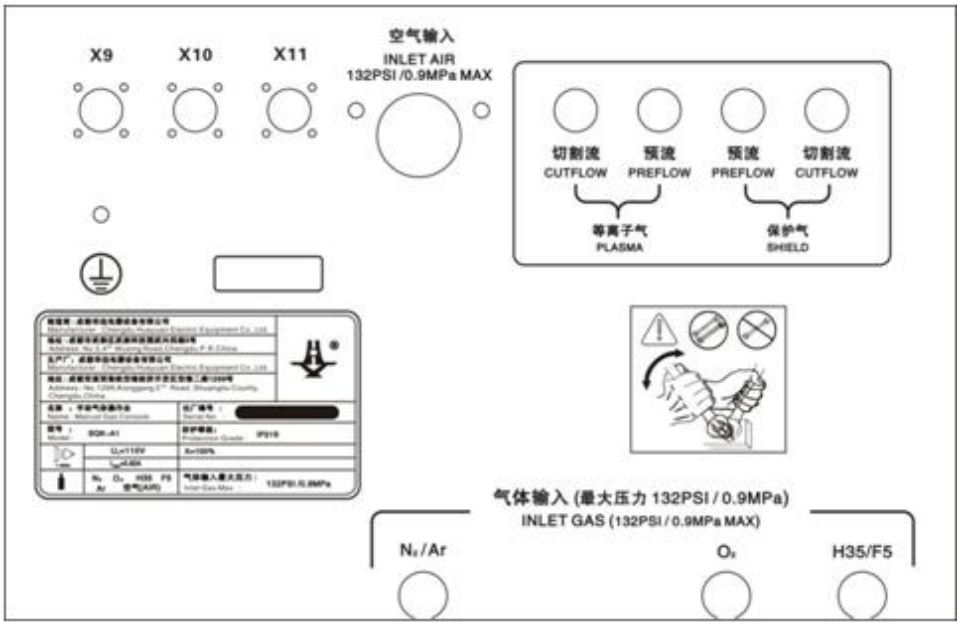


Figure 5-4 SQK-A1 back rear function

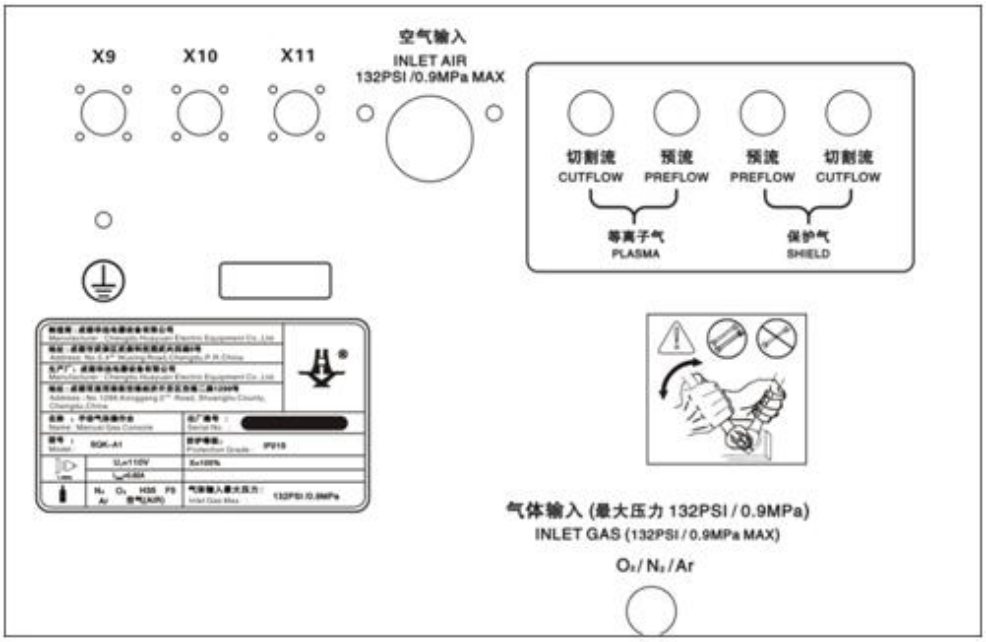


Figure 5-5 SQK-B1 rear panel function

3) Front panel function instruction

Table 5-1 Front panel function instruction

No.	Function instruction
1	Plasma gas select knob
2	Shield gas select knob
3	“3”related valve is to adjust the plasma gas preflow pressure “3”related 2 digital tube is to display plasma gas preflow pressure,unit is Psi;
4	“4”related valve is to adjust the shield gas preflow pressure; “4”related 2 digital tube is display shield gas preflow pressure,unit is Psi;
5	“5”related valve is to adjust plasma gas cutflow pressure ; “5”related 2 digital tube is to display plasma gas cutflow pressure, unit is Psi；
6	“6”related valve is to adjust shield gas cutflow pressure; “6”related 2 digital tube is to display shield gas cutflow pressure, unit is Psi；
7	Manual gas console status select knob. ⑴ Knob 7, select “RUN”indicator on, means the gas console is under working the machine is ready for work; ⑵ Knob 7, select “RUN”indicator on, means setting the preflow gas pressure, the machine can’t work; ⑶ Knob 7, select “CUTFLOW”indicator on, means setting the cutflow pressure, the machine can’t work.
8	Select 3 digital tube display knob ⑴ Knob 8, select “AMPS” indicator on, means the digital tube display the current value. In standby mode, it displays the set current value. Rotate the encoder to adjust the set current value. When cutting, it displays the actual cutting current value.This value is for reference, the actual output current maybe ±3A difference with the set current. ⑵ Knob 8, select”STATUS”indicator on, the 3 digital tube display the information such as: the cutting system status, plasma gas, shield gas,coolant flow, coolant temperature etc. ⑶ Knob 8, select “ERROR”indicator on, the 3 digital tube display show the alarm information.

4) Operate instruction

① Knob 1, 2 and 7, when press, the related indicator will on, but the manual gas console related action will be 3-5S delay. DO NOT press these 3 knobs during cutting.

② Knob 3.4.5.and 6 related four 2 digital tube display pressure range from 0-99, but the gas pressure regulating adjust range from 0~110, when the regulating adjust pressure higher than 99, the digital tube will show “ ”mark.



③ Plasma gas and shield gas preflow pressure/cutflow pressure should be manually set by the cutting procedure data, the setting steps as below:

Step 1: Select the plasma gas and shield gas by press knob 1 & 2, wait after gas blow finish, and no gas blowing from torch head;

Step 2: Press knob 7, select preflow (preflow indicator on), adjust the plasma gas and shield gas pressure according to the value in the cutting table, let the digital tube display the required pressure values.

Step 3:Press knob 7, select the cutflow (cutflow indicator on), adjust the plasma gas and shield gas pressure according to the value in the cutting table, let the digital tube display the required pressure values.

Step 4: Press knob 7, select “RUN”, pressure setting finish.

Note: When the set current higher than 30A, the plasma cutflow pressure has to higher than 50, or error code will appear: “044, plasma gas pressure too low”.

④ Knob 8, when“STATUS”indicator on, the 3 digital tubes display the status, plasma gas, shield gas, coolant flow and coolant temperature, one by one, same order as every time operation.

⑤ Plasma gas/shield gas selection: choose the required gas technology by setting Knob 1 and knob 2. SQK-A1and SQK-B1 manual gas console system has fixed the optional gas technology, choose other gas mix mode is invalid. When customer choose invalid gas sets, after 5s, the gas console will automatically select the gas sets same with last time use.

⑥ When user select the shield gas as”TEST”, the 3 digital tube will display alarm”062”，error indicator on, and then the gas console enter gas leak testing process. For detailed information of gas leakage please refer to “Maintenance” chapter.

5） Error warning

There are 3 classes error warnings in the entire system: self eliminating error, low priority error and high priority error.

① Self eliminating error

When self eliminating error appear, the machine changes the work process to wait or stop status. Knob 8 run to “ERROR” automatically,and error indicator flicker(light on 0.3s and light off 0.3s).Error code will be displayed on digital tube, the corresponding ERROR type indicator under Knob 8 will flicker(light on 0.3s and light off 0.3s). After some errors eliminated, Knob 8 run to “AMPS”automatically, the digital tube displays the set current, the corresponding ERROR type indicator under Knob 8 will off, the complete machine will work as normal process. After other errors eliminated, the complete machine enter stand by status, ERROR indicator flickers(light on 1s and light off 1s), the error code will be displayed on digital tube, the error type indicator flicker(light on 1s and light off 1s), this status will keep 300s.After

300s,Knob 8 run to “AMPS”automatically, the digital tube displays the set current,the corresponding ERROR type indicator under Knob 8 will off.

② Low priority error

When low priority error appear, the complete machine changes the work process and enter stand by status, there will be no any display changes on panel, press knob 8 and select “ERROR”, we can see the error code display on the digital tube.

③ High priority error

When high priority error appear, the complete machine changes the work process and enter stop status, user can only restart the machine. Knob 8 will automatically run to“ERROR”and error indicator flicker (light on 0.3s and light off 0.3s). Error code will be displayed on the digital tube, the corresponding ERROR type indicator under Knob 8 will flicker(light on 0.3s and light off 0.3s).

4. How to optimize cutting quality

Following points and steps help to get more vertical, smooth and slag-free cutting kerf,to improve cutting quality.

1） Matters need attention when use cutting table and plasma torch

① Use I-square check the vertical of the torch and work-piece, make sure it’s vertical.

② Clean and check the rail and transmit device on cutting table, test it to get more smooth torch moving. Unstable moving causes cutting roughness.

③ When cutting, plasma torch can not contact with work-piece, or it damages the shield cap and nozzle, cause bad cutting surface.

2） Gas pressure setting

Operate it as the steps in the chapter “inspection before start”process.

Blow the gas pipelines before cutting.

3） Lengthen the wearing parts working life

① Don’t strike arc without contacting work-piece

Can strike arc on edge of work-piece, but don’t strike without contacting work-piece.

If piercing at the beginning, please set piercing height 1.5-2 times distance (between torch to work-piece)than normal cutting.

② Make sure the cutting arc still on the work-piece after every cutting finish, to avoid arc extinguish.

③ If cutting arc extinguish suddenly, try the following.

Reduce the cutting speed when the cutting is going to finish.

Stop the cutting before work-piece been totally cut down,the gradual decline of current and gas flow can finish the cutting process.

Edit the routine for torch run into the garbage area, to use the gradual decline process of current and gas flow.

Note: if possible, use the “chain cutting” method, then the torch can continuously cut along with the cutting route without stop and restart.But if cutting route leave work-piece and return,it’s not allowed. And too long time chain cut will increase electrode consumption.

4) Other factors affect cutting quality

① Cutting angle

If the four side cutting tilt angle less the 4 degree, that is acceptable.

Note:

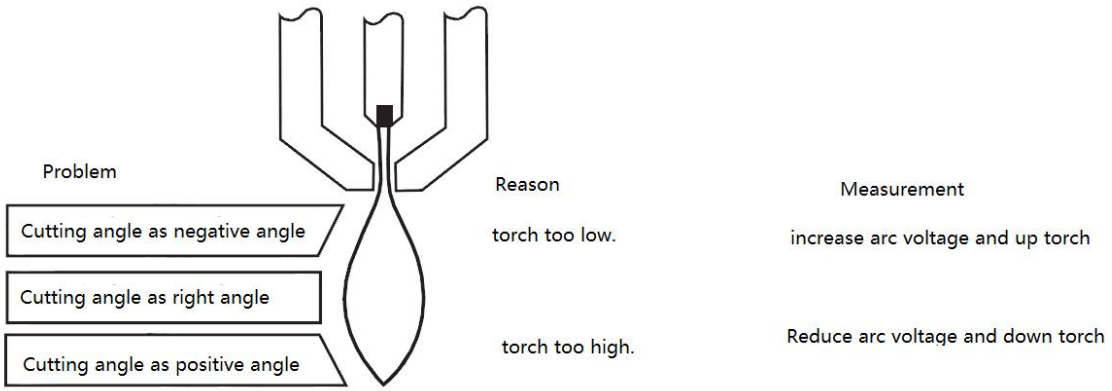
When torch move forward, the cutting angle will be at the right side of the torch.

If need to confirm the cutting angle problems are caused by the cutting power source (machine) or CNC system, can make a cutting test and check each side angle. Then 90°rotate the torch on support, and repeat the complete testing process. If the cutting angle is the same in the two cutting test, then the problem should be caused by the CNC system.

If the cutting angle problem still exist after solving the “mechanical problem”, then check the distance from torch to work-piece, especially when the cutting angle both is negative or positive.

When the cutting kerf upper side cut material more than bottom side, we call it positive angle.

When the cutting kerf upper side cut material less than bottom side, we call it negative angle.



② Slag

When the cutting speed too slow, plasma arc spray forward, then there will be low speed

slag. This slag collect at the bottom of the cutting kerf, easy to remove. Increase the cutting speed can reduce this slag.

When cutting speed too fast, plasma arc delay, then there will be fast speed slag. This slag look like a thin and long metal bead line, not easy to remove. To remove this kind of slag, please check below:

Slow down the cutting speed.

Decrease the arc voltage, to shorten the distance between torch to work-piece

Increase the O2 concentration in shield gas, to increase the range of cutting speed without slag.(The manual gas console not work with mix shield gas, but can increase the O2 concentration of shield gas in advance, then connect the mixed gas to the manual gas console input).

Note:Compare with cold metal, the hot metal is easier to arise slag. For example, in a period of cutting,there is least slag in the first cutting. Then with work-piece temperature rise,there will be more and more slag. Compare with stainless steel or aluminum, there is more slag on low carbon steel.

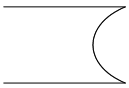
Worn and burned consumables may cause noncontinuous slag.

5) Cutting surface straightness



Typical plasma cutting surface is a little bit concave.

If the cutting height is not right, the cutting surface getting more concave or convex, so a suitable torch height is required.



If the distance from torch to work-piece is too short, there will be sharp concave on the cutting surface. Increase the arc voltage may increase the distance from torch to work-piece to get better cutting surface.



When the distance from torch to work-piece too big or cutting current too high, there will be convex on the cutting surface. Then need to firstly reduce the arc voltage, and then reduce cutting current. If there are different torch consumables which suit for the same work-piece thickness, please firstly use smaller current consumables.

6) Other improvement

Piercing

The piercing delay time should be long enough to pierce the material, but cannot be too long, if delay time too long the arc can't find the edge of the hole. The piercing time can be little lengthen along with the consumables consume. The piercing delay time in the cutting chart is based on the average piercing delay time in consumables working life.

Use"piercing finish signal" can keep high shield gas preflow pressure to protect the consumables.

For some special process, when piercing work-piece close to the max. Piercing thickness capacity of plasma, need consider the following important factors:

① The leading distance should be same with the material thickness, means 20mm material need 20mm leading distance;

② To avoid the slag damage the shield cap, need to clean the slag molten pool before put down the torch to cutting height;

③ Different material may affect the piercing capacity, especially the high strength steel, and steels with high Mn or Gi element, the max.piercing capacity should be reduced accordingly;

④ If it's difficult to pierce some material or some thickness, increase the shield gas preflow pressure can help (need to use piercing finish signal). But the disadvantage is that the arc strike success rate will be lower;

⑤ Adopt "fly piercing" (without leading) may increase the piercing capacity under some situation. But this process may cause damages of the torch or other parts, so stable cutting or edge cutting is more suggested;

VI. Maintenance

		**WARNING** **ELECTRIC SHOCK DANGEROUS**
Be carefully working around the inverter module. There is lot if electric power stored on the big capacitors on IGBT connections wires,even cut off power,capacitor connection terminal,IGBT,diode still exist dangerous voltage.Never use screwdriver or other tools to discharge capacitor,otherwise it will explode and damage equipment. Wait 5mins at least after cut power to release IGBT or capacitor.		

Only qualified technicians who hold qualification certificate are allowed to repair this machine, if you got any questions on repairing and maintenance, please do not hesitate to contact Huayuan engineer to get professional repairing advises. Meanwhile,please refer to "SAFETY" and study the operational precaution and warning before operation.

1. Operation process

1) **Power on:**Make sure all the following items are turned off before power input.

Cooling flow sensor

Output current

No arc transfer signal

No default phase signal

No radiator overheat protection signal

No liquid overheat protection signal

No plasma arc striking signal

2) **Blow:** Use Air or N2 to blow into torch,continue 24s

Turn on cooling system power

Check air pressure

No current sensor signal

3) **Standby**

Check air pressure

Check input voltage

No current sensor signal

4) **Preflow:** Open preflow gas,continue 1.2s

5) **Pilot Arc :** A stable current created between electrode and nozzle

Output open circuit voltage

Make high frequency

The checked current of sensors TA102 and TA202, is equal to pilot arc current

6) **Transferred arc :**The checked current on work-piece cable

7) **Current up : cut flow.Current on work-piece cable rise to setting point, gas switch to cutting flow.**

8) **Stable cutting: cut the work-piece with normal cutting parameter**

Cooling liquid flow normal

Air pressure normal

Input voltage normal

No radiator temperature protection

No liquid overheat protection

9) **Current down: After turn off the arc striking signal, current on work-piece cable down to setting point, gas pressure down**

10) **Automatic cut off : After 10s**

2. Gas blowing process

The system start blowing process automatically after power on or when operator switch the gas process. Blow time is 24s, divided into 2 steps: Preflow gas blowing (12s) and Cutflow gas blowing (12s).

There are two special situation on blow process: When operator switch gas process, switch nonflammable gas (O2/Air,Air/Air,N2/Air) to flammable gas (H35/N2,F5/N2) or opposite, blow process shall be divided to 3steps. Firstly blow gas supply system by N2 for 12s, secondly blow by preflow gas and cutflow gas.

3. Gas console solenoid valve operation

If the gas pressure abnormal and gas console warning, if air supply pressure is normal, shall check the solenoid valve of Gas console and HF box to see if it's damaged. Or check if the PL11 control board of gas console is damaged. LED indicator for solenoid valve and related PL11 control board, under different cutting process, please check the below table.

LED indicator working list for SQK-A1solenoid valve and related PL11 control board:

1) LED indicator list under N2 plasma gas/O2 shield gas cutting

Table 6-1 SQK-A1 O2/O2 Solenoid valve and related LED indicator list

Working Solenoid valve and related LED indicator											
Preflow status	Solenoid valve	YV5	YV6	YV13	YV14	YV15	YV16	YV23	YV24	YV25	YV26
	LED indicator	LED5		LED13		LED15		LED23		LED25	
Cutflow status	Solenoid valve	YV5	YV6	YV13	YV14	YV15	YV16	YV21	YV22	YV27	YV28
	LED indicator	LED5		LED13		LED15		LED21		LED27	

2) LED indicator list under O2 plasma gas/Air shield gas cutting

Table 6-2 SQK-A1 O2/Air Solenoid valve and related LED indicator list

Working Solenoid valve and related LED indicator											
Preflow status	Solenoid valve	YV1	YV2	YV5	YV6	YV15	YV16	YV23	YV24	YV25	YV26
	LED indicator	LED1		LED5		LED15		LED23		LED25	
Cutflow status	Solenoid valve	YV1	YV2	YV5	YV6	YV15	YV16	YV21	YV22	YV27	YV28
	LED indicator	LED1		LED5		LED15		LED21		LED27	

3) LED indicator list under Air plasma gas/Air shield gas cutting

Table 6-3 SQK-A1 Air/Air Solenoid valve and related LED indicator list

Working Solenoid valve and related LED indicator											
Preflow status	Solenoid valve	YV1	YV2	YV5	YV6	YV11	YV12	YV23	YV24	YV25	YV26
	LED indicator	LED1		LED5		LED11		LED23		LED25	
Cutflow status	Solenoid valve	YV1	YV2	YV5	YV6	YV11	YV12	YV21	YV22	YV27	YV28
	LED indicator	LED1		LED5		LED11		LED23		LED25	

4) LED indicator list under N2 plasma gas/N2 shield gas cutting

Table 6-4 SQK-A1 N2/N2 Solenoid valve and related LED indicator list

Working Solenoid valve and related LED indicator											
Preflow status	Solenoid valve	YV3	YV4	YV7	YV8	YV9	YV10	YV23	YV24	YV25	YV26
	LED indicator	LED3		LED7		LED9		LED23		LED25	

Cutflow status	Solenoid valve	YV3	YV4	YV7	YV8	YV9	YV10	YV21	YV22	YV27	YV28
	LED indicator	LED3		LED7		LED9		LED21		LED27	

5) LED indicator list under N2 plasma gas/Air shield gas cutting

Table 6-5 SQK-A1 N2/Air Solenoid valve and related LED indicator list

Working Solenoid valve and related LED indicator											
Preflow status	Solenoid valve	YV1	YV2	YV7	YV8	YV9	YV10	YV23	YV24	YV25	YV26
	LED indicator	LED1		LED7		LED9		LED23		LED25	
Cutflow status	Solenoid valve	YV1	YV2	YV7	YV8	YV9	YV10	YV21	YV22	YV27	YV28
	LED indicator	LED1		LED7		LED9		LED21		LED27	

6) LED indicator list under H35 or F5 plasma gas/N2 shield gas cutting

Table 6-6 SQK-A1 H35(F5)/N2 Solenoid valve and related LED indicator list

Working Solenoid valve and related LED indicator											
Preflow status	Solenoid valve	YV3	YV4	YV7	YV8	YV17	YV18	YV23	YV24	YV25	YV26
	LED indicator	LED3		LED7		LED17		LED23		LED25	
Cutflow status	Solenoid valve	YV3	YV4	YV7	YV8	YV17	YV18	YV21	YV22	YV27	YV28
	LED indicator	LED3		LED7		LED17		LED21		LED27	

Solenoid valve working list for SQK-B1 manual gas console:

1) LED indicator list under O2 plasma gas/O2 shield gas cutting

Table 6-7 SQK-B1 O2/O2 Solenoid valve and related LED indicator list

Working Solenoid valve and related LED indicator										
Preflow status	Solenoid valve	YV3	YV7	YV8	YV9	YV10	YV23	YV24	YV25	YV26
	LED indicator	LED3	LED7		LED9		LED23		LED25	
Cutflow status	Solenoid valve	YV3	YV7	YV8	YV9	YV10	YV21	YV22	YV27	YV28
	LED indicator	LED3	LED7		LED9		LED21		LED27	

2) LED indicator list under O2 plasma gas/Air shield gas cutting

Table 6-8 SQK-B1 O2/Air Solenoid valve and related LED indicator list

Working Solenoid valve and related LED indicator

Preflow status	Solenoid valve	YV1	YV2	YV3	YV9	YV10	YV23	YV24	YV25	YV26
	LED indicator	LED1		LED3	LED9		LED23		LED25	
Cutflow status	Solenoid valve	YV1	YV2	YV3	YV9	YV10	YV21	YV22	YV27	YV28
	LED indicator	LED1		LED3	LED9		LED23		LED27	

3) LED indicator list under Air plasma gas/Air shield gas cutting

Table 6-9 SQK-B1 Air/Air Solenoid valve and related LED indicator list

Working Solenoid valve and related LED indicator										
Preflow status	Solenoid valve	YV1	YV2	YV3	YV5	YV6	YV23	YV24	YV25	YV26
	LED indicator	LED1		LED3	LED5		LED23		LED25	
Cutflow status	Solenoid valve	YV1	YV2	YV3	YV5	YV6	YV21	YV22	YV27	YV28
	LED indicator	LED1		LED3	LED5		LED21		LED27	

4) LED indicator list under N2 plasma gas/N2 shield gas cutting

Table 6-10 SQK-B1 N2/N2 Solenoid valve and related LED indicator list

Working Solenoid valve and related LED indicator										
Preflow status	Solenoid valve	YV3	YV7	YV8	YV9	YV10	YV23	YV24	YV25	YV26
	LED indicator	LED3	LED7		LED9		LED23		LED25	
Cutflow status	Solenoid valve	YV3	YV7	YV8	YV9	YV10	YV21	YV22	YV27	YV28
	LED indicator	LED3	LED7		LED9		LED21		LED27	

5) LED indicator list under N2 plasma gas/Air shield gas cutting

Table 6-11 SQK-B1 N2/Air Solenoid valve and related LED indicator list

Working Solenoid valve and related LED indicator										
Preflow status	Solenoid valve	YV1	YV2	YV3	YV9	YV10	YV23	YV24	YV25	YV26
	LED indicator	LED1		LED3	LED9		LED23		LED25	
Cutflow status	Solenoid valve	YV1	YV2	YV3	YV9	YV10	YV21	YV22	YV27	YV28
	LED indicator	LED1		LED3	LED9		LED21		LED27	

4. Trouble shooting and error code

1) Error code and repairing

Table 6-12 Error code and repairing

Code	Item	Details	Measurement
000	No error warning	System got no error warning	No need to do anything
009	Flow switch testing	After pump time-out (No start signal 30 Mins),and restart the pump, cooling system start working, if cooling liquid flow lower than 2.3L/min, error warning appears,if cooling liquid flow higher than 2.3L/min, this error disappear automatically. During this error warning, keep the cutting system under preflow status, to make sure the cooling liquid is normal before cutting. If after cutting power source receive start signal for 10s, the liquid flow still lower than 2.3L/min, error code will be replaced by “060”.	No need to do anything under this code. And this code lasts no more than 10s, if error still exist after 10s, error code will be replaced by “060”.
014	Gas leakage testing Error 1	Gas leakage on solenoid valve of manual gas console	Check the solenoid valve of manual gas console and confirm the connection is good and there is clean inside the valve.
015	Gas leakage testing Error 2	Gas pressure between gas console solenoid valve HF box solenoid valve get down, gas leakage in gas circuit, and the displaying of gas console pressure meter get down	1, Check the 4 gas hose between gas console and HF box, to see if there is some damage or connectors loosen; 2, Check the 4 copper tubes between gas console gas input solenoid valve and rear panel, to see if loosen or drop. If the pressure sensor is well connected, if leakage between gas connectors and pressure adjusting valve, if leakage between gas connectors and solenoid valve joint. Check the installation directions. 3, Check the gas hose between 4 copper tubes in HF box and solenoid valve,to see if loosen or drop,if leakage between gas connectors and solenoid valve joint.Check the installation directions.

Code	Item	Details	Measurement
020	No pilot arc current	Press HF,no pilot arc current signal tested, means the pilot arc current lower than 16A.	1,Check the torch consumables and make sure nor burned; 2,Check gas preflow and gas cutflow pressure, set right parameters by cutting chart; 3,Check and test gas leakage; 4,Check the striking head of HF box, make sure it's not over corrosion; 5,Check the HF box power lead between socket X3 and X13,make sure it's not damaged or bad connections; 6,Check the pilot arc cable between HF box and plasma power, make sure it's not damaged or bad connections; 7,Check the pilot arc cable which connect HF box and plasma torch, make sure it's not damaged or bad connections; 8,Check the pilot arc cable in plasma cable, make sure it's not damaged or bad connections; 9,Check if the IGBT of arc pilot is working normal; 10,After connecting start signal, check if there is open circuit voltage output.
021	No transferred arc	After making pilot arc current over 500ms,there is still no current on work-piece lead. (Means the current lower than 10A)	1.Check if the initial position height is suitable; 2.Check preflow gas and cutflow gas pressure value in correct setting; 3.Check the work-piece cable whether damaged or not good connection;
024	No main machine current	After arc transferred, main machine lost the current signal	1.Check the torch consumables; 2.Check cutting gas pressure value in correct setting; 3.Check arc and work-piece in good connection during cutting;
025	No deputy machine current	After arc transferred, main machine lost the current signal.(No error code on FLG-200HD)	1.Check the torch consumables; 2.Check cutting gas pressure value in correct setting; 3.Check arc and work-piece in good connection during cutting;

Code	Item	Details	Measurement
026	No transferred arc	After arc transferred, lost the current signal.	1.Check the torch consumables; 2.Check cutting gas pressure value in correct setting; 3.Check arc and work-piece in good connection during cutting; 4, Check if the piercing time is suitable; 5, Check if the work-piece cable connected well;
027	Power default phase	3 phase power supply not stable.	1.Check the voltage of power supply phase to phase; 2.Turn off power,check if contactor tip damaged; 3.Check if the connection of power cable and contactor cable connected well;
031	Lost start signal	Start signal lost before cutting arc create	Check the control cable from CNC to power source, make sure it's in good connection
032	Pause overtime	The pause signal valid time over 60s	1.Check XS5,XS6 cable on rear panel of plasma power source, make sure it's not damaged; 2.CNC is holding this signal, maybe waiting for another torch initial location finish signal;
042	N2 pressure too low	When blow pipelines with N2, the N2 pressure lower than lower limiting value. 1,When cutting current lower than 30A,the lower limiting value is 5psi; 2,When cutting current higher than 30A,the lower limiting value is 30psi;	1,Check the gas supply, make sure the gas pressure enough; 2,Check the gas console setting of pressure regulating valve according to the cutting chart; 3,Run the gas leakage testing procedure;
044	Plasma gas pressure too low	Plasma gs pressure lower than lower limiting value: 1,Plasma preflow pressure lower than 5PSI; 2,Plasma cutting flow pressure lower than 50PSI;	1,Check the gas supply, make sure the gas pressure enough; 2,Check the gas console setting of pressure regulating valve according to the cutting chart; 3,Run the gas leakage testing procedure;
045	Plasma gas pressure too high	Plasma gas pressure higher than upper limit 110PSI	1,Check if the gas supply valve adjust is right, if gas supply pressure is in normal range; 2,Check the gas console setting of pressure regulating valve according to the cutting chart; 3,Check if the solenoid valve on switch valve is on. Check the power of solenoid valve;

Code	Item	Details	Measurement
046	Power Lack voltage	Actual power supply of cutting power source less -15% of rated input voltage	1.Check if the power input lead voltage in range of rated input voltage -15%; 2.The IGBT driving board of +15VDC power got problems; 3, If both input voltage and IGBT driving board is normal, then the main control board got problems, have to change;
047	Power over voltage	Actual power supply of cutting power source higher +15% of rated input voltage	1. Check if the power input lead voltage in range of rated input voltage +15%; 2. If input voltage is normal, then the main control board got problems, have to change;
050	Power input signal error	During power on,CNC signals output to plasma power source is valid.(Signals such as corner signal,piercing signal,pause signal and start signal)	1.Stop or clear cutting program.When finish cutting,the start signal still not disconnected; 2.Check if the cable from CNC to power source is damaged;
053	Shield gas pressure too low	Shield gas pressure lower than the lower limited value 2psi	1,Check the gas supply, make sure the gas pressure enough; 2,Check the gas console setting of pressure regulating valve according to the cutting chart; 3,Run the gas leakage testing procedure;
054	Shield gas pressure too high	Shield gas pressure higher than upper limit 110PSI	1,Check if the gas supply valve adjust is right, if gas supply pressure is in normal range; 2,Check the gas console setting of pressure regulating valve according to the cutting chart; 3,Check if the solenoid valve on switch valve is on. Check the power of solenoid valve;
060	Coolant flow too low	Coolant flow is lower than 2.3L/min	1.Check the flow sensor in the front panel of power source whether is working; 2.Check if the torch consumables are well installed; 3.Test it,details please refer to “Maintenance”chapter,the coolant flow test process.

Code	Item	Details	Measurement
062	No shield gas type	System not able to recognize shield gas type.If press Knob“2”select “test”and indicator light on,then the error code only tell function.	1.If press Knob “2”and select to “TEST” indicator on,just tell user that select “7”got no actions,means not able to do any test process,must select “preflow” or “cutflow”; 2.If “test” indicator not light on, means the PCB board of power source got problem,shall replace it;
065	Main machine radiator overheat	Main machine radiator temperature higher than 75℃	1.Check the radiator fan of plasma power source whether working normal; 2.Open the machine,use compressed air to blow away dust,specially the dust on radiator and fan; 3. If radiator temperature not high,but appear warning on main machine,shall check the temperature relay whether damage;
066	Deputy machine radiator overheat	Deputy machine radiator temperature higher than 75℃ (No error code on FLG-200HD)	1.Check the radiator fan of plasma power source whether working normal; 2.Open the machine,use compressed air to blow away dust,specially the dust on radiator and fan; 3. If radiator temperature not high,but appear warning on deputy machine,shall check the temperature relay whether damage;
071	Coolant over heat	Coolant temperature higher than 70℃	1.Check the coolant flow level; 2.Check condenser fan whether working normal; 3.If cooling system still running,keep it running and let cooling system cool the coolant; 4.If system often appear this error warning,shall clean condenser and dust inside the fan;
093	No coolant flow after cooling system power on	At the beginning of cool system turn on, the coolant flow not reach 2.3L/min. After error code “093” last 10s, the liquid flow still lower than 2.3L/min, error code will be replaced by “060”.	If it’s a new plasma cutting system and first time power on, carry out manual pump operation and refer to “add plasma power source coolant” chapter;

Code	Item	Details	Measurement
108	When not cutting, there is current on main machine hall sensor T102 and cutting current sensor TA1	There is signal output from current sensor when plasma power source not outputting current	The current hall sensor or control board PL01 is broken, have to replace it;
109	There is coolant flow after cooling system power on	When cooling system not working, but plasma power source can detect coolant flow signal	1,Check if there is abnormal power supply on flow sensor when the cooling system not working; 2,Check if the control cable which connected with flow sensor is well connected; 3,Check if some circuit damage on PL01 control board;
110	Coolant flow not enough	Coolant in the coolant box not enough	1,Check if the coolant capacity in require range; 2,Check the liquid level sensor of the coolant box; 3,Check if the liquid level sensor wires connected well;
116	CAN communication error	Cutting machine cannot communicate with manual gas console after power on	1.Check the control cable connection between plasma power source socket X1 and gas console socket X10, make sure it's connected well and not damaged; 2.The CAN communication circuit of control board PL01 for plasma power source and control board PL09 for manual gas console is broken, contact manufacture for help;
133	Gas console type not identified	After power on, plasma power source not receive exact signal from gas console	1.Check the control cable connection between plasma power source socket X1 and gas console socket X10, make sure it's connected well and not damaged; 2.The flash memory of control board is broken, contact manufacture for help;
139	Blowing overtime	After power on, the gas pressure not normal more than 3 minutes	Check if there are error alarms, and take measurements accordingly
144	The flash memory of manual gas console got problem	The chips on flash memory of manual gas console broken	Chips damaged by the external HF interference,contact manufacture for help;
145	Gas console EEPROM got problems	Gas console EEPROM got problem	Chips damaged by the external HF interference,contact manufacture for help;

Code	Item	Details	Measurement
156	There is current on deputy machine have current after power on	There is current output signal on the sensor of TA202 of the deputy machine when power on. (No error code on FLG-200HD)	Current hall sensor or control board PL01 damaged,contact manufacture for help;
163	Plasma gas cutflow pressure ±25% over the set value	Plasma gas cutflow pressure ±25% over the set value	1.Check shield gas supply pressure value whether in range of 0.8MPa±10%; 2.Check if the voltage valve regulator setting value of shield gas is correct, or reset the pressure according to cutting chart;
164	Shield gas cutflow pressure ±25% over the set value	Shield gas cutflow pressure ±25% over the set value	1.Check shield gas supply pressure value whether in range of 0.8MPa±10%; 2.Check if the voltage valve regulator setting value of shield gas is correct, or reset the pressure according to cutting chart;
180	CAN communication overtime during working	No communication is set up between plasma machine and manual gas console	1.Communication cable is interfered,restart the system; 2.Check if the control cable from power source to gas console is damaged or well connected.

2) Trouble shooting without displaying error code

Table 6-13 Trouble shooting without displaying error code

Item	Details	Measurement
. Turn on the plasma power source,all indicators of power source not light on,gas console panel no displaying.	1,Default phase; 2,Power supply switch damaged; 3,Control transformer of plasma power source no output;	1,Check three phase power supply; 2,Replace power source switch; 3,Replace 8A fuse on power source rear panel, or change a new transformer;
Power indicator of power source light on,but gas console panel no displaying.	Gas console power supply is abnormal	1,Check if there is 110VAC voltage on gas console rear panel XS2 connector; 2,Check if the output voltage of PCB PL10 of gas console is correct; 3,Check the input voltage of gas console control board PL09 is correct;

Item	Details	Measurement
Gas console no any error alarms,CNC give start signal to plasma power source source,but no actions on plasma power source;	1,The control cable from CNC to plasma power source got damaged or bad connection; 2,Control board PL01 of power source is damaged;	1,Check LED22 on control board PL01,if have start signal,the light should be on,disconnect the signal,the light should be off.Otherwise there is problem on start signal circuit of external plasma power source; 2,If LED22 on PL01 is working,then PL01 control board is damaged,replace PL01;
Work-piece is not completely piercing,there are sparks on the work-piece surface.	1,Cutting current too low 2,Cutting speed too fast 3,Torch consumables burned; 4,Work-piece is too thick;	1,Check and reset current according to cutting chart; 2,Check and reset cutting speed according to cutting chart; 3,Replace the consumables accordingly; 4,Select the cutting procedure according to the cutting chart;
Bad cutting quality	1,Big difference between actual gas pressure and theory gas pressure; 2,Work-piece too thick; 3,Nozzle and electrode badly burned; 4,Plasma arc is not vertical with work-piece; 5,Cutting speed too slow or too fast;	1,Adjust the air pressure according to cutting chart. And check pressure sensor and PL09: check the voltage of the 4 pressure sensors in gas console one by one,adjust the corresponding pressure adjusting valve,when displaying 50 on digital tube, the output voltage of pressure sensor should be 2.38±0.2VDC; 2,Check the cutting chart and make sure work-piece under quality cutting thickness; 3,Replace the consumables accordingly; 4,Adjust the torch angle; 5,Adjust the cutting speed according to cutting chart;
Short working life of nozzle&electrode	1,Big difference between actual gas pressure and theory gas pressure; 2,Nozzle is too close to work-piece(＜2mm); 3,Nozzle size not matching cutting current; 4,Work-piece too thick; 5,Bad quality of nozzle&electrode; 6,Bad quality of cutting torch;	1,Set suitable gas pressure according to cutting chart. Or check the PL01 board and gas pressure sensor as above methods; 2,Increase the distance between torch and work-piece; 3,Choose the suitable diameter nozzle according to cutting current; 4,Cut work-piece under machine cutting capacity; 5,Use original electrode and nozzle; 6,Use original torch;
Power distribution box switch trip	1,3 phase rectifier bridge is broken; 2,IGBT broken; 3,Other parts in main circuit broken;	1,Replace same model rectifier bridge; 2,Replace same model IGBT module; 3,Check and replace the damaged parts.

Note:Please record the troubles which are not able to repair,please contact our local agent or contact Huayuan manufacture directly. Also provide the model and series number of the power source(refer to nameplate).

5. Control board indicators instruction

FLG-200HD,FLG-300HD and FLG-400HD plasma power source use same PCB，SQK-A1,SQK-B1 gas console use same PCB. There are different indicators on board,which helps find out problems easily.

1） Plasma power source FLG-200HD,FLG-300HD,FLG-400HD

Main control board AP1（PL01）

Table 6-14 Plasma power source main control board AP1（PL01）indicators

Code	Instruction
LED1	Digital communication +5V_T power indicator.
LED2	-15V1 power indicator.
LED3	Coolant high level point testing normal, this LED light on.
LED4	Coolant low level point testing normal, this LED light on.
LED5	+24VDC power indicator.
LED6	Three phase power supply of plasma power source lower -15% of rated input voltage, this LED light on.
LED7	Three phase power supply of plasma power source higher +15% of rated input voltage, this LED light on.
LED8	+5V power indicator.
LED9	+15V1 power indicator.
LED10	When pilot arc start, this LED light on.
LED11	+15V power indicator.
LED13	It is moving signal indicator,after arc transferred, this LED light on.
LED14	It is plasma power source error indicator, when some errors appear, this LED light on.
LED15	When plasma power source not ready, this indicator light on. When this indicator is on,start signal is invalid.
LED16	When turn on high frequency, this LED flickers.
LED17	When radiator fan of main circuit work, this LED light on.
LED18	When coolant system work, this LED light on.
LED19	IGBT driving board power supply voltage is abnormal.

Control power distribute board AP2（PL02）

Table 6-15　Control power distribute board AP2（PL02）indicator

Code	Instruction
D1	When coolant system work, this LED light on.
D2	When radiator fan of main circuit work, this LED light on.
D3	When turn on high frequency, this LED flickers.

2）Manual gas console SQK-A1,SQK-B1

Control power distribute board AP2（PL10）

Table 6-16　Manual gas console control power distribute board AP2（PL10）indicator

Code	Instruction
LED1	+5V1 power indicator.
LED2	+15V power indicator.
LED3	+5V power indicator.

Solenoid valve driving board AP3（PL11）

Table 6-17 Manual gas console Solenoid valve driving board AP3（PL11）indicator

Code	Working Solenoid valve	Code	Working Solenoid valve
LED1	YV1,YV2	LED17	YV17,YV18
LED3	YV3,YV4	LED19	YV19
LED5	YV5,YV6	LED20	YV20
LED7	YV7,YV8	LED21	YV21,YV22
LED9	YV9,YV10	LED23	YV23,YV24
LED11	YV11,YV12	LED25	YV25,YV26
LED13	YV13,YV14	LED27	YV27,YV28
LED15	YV15,YV16		

6. System status

When the system fails or can not receive the arc striking signal, can estimate the possible problems by system status. Select the Knob“8”on gas console, and let the status indicator light on, digital tube can display the current system status ID.

Table 6-18　System status

Status ID	Instruction
000	System on power
002	Blowing status
003	Standby status
004	Preflow
005	Pilot arc
006	Transferred arc
007	Gradually up
008	Stable cutting
009	Gradually down
010	Cut automatically
012	Cutflow testing
014	Machine shut down
016	Debug
020	Preflow testing
024	Gas leakage testing

7. Initial inspection

Before repairing, make a appearance inspection first, check the fuse on real panel, IGBT module,diode module and PCB parts.

1) Turn off the power switch of distribution box, cut the power of plasma power source.

2) Check if the 4 fuses on rear panel of machine are fused.

3) Connect power again, measure any two phase of the three phase inlet interface voltage, any two phase voltage shall as same as power supply voltage. If find problem here, cut the main power and check the inlet wire circuit.

4) Remove the top cover and two sides covers of the plasma power source.

5) Check inside of the plasma power source, for example, if the PCB have color changes as burned, or whether any parts have been explored. If yes, these broken parts have to be replaced first, then go to next testing procedure.

8. The maintenance of air filter

Regularly change air filter elements is highly suggested.

Regularly change air filter bowl is highly suggested.

The maintenance steps as below:

1) Cut off all power supply and disconnect the air tube which is connected to air filter.

2) Rotate the filter bowl and take it down, clear it.

3) Take out the old filter elements and install a new one.

Note: please don't rotate the filter elements when loosen bolts.

4) Re-install the filter bowl carefully, in case of gas leakage.

9. The maintenance of cooling system

1) Coolant discharge

① Turn off the power switch of plasma power source,put the coolant back pipe (with red tape) from rear panel of plasma power source,and put it into a 20L container.

② Press know "8" and wait 5 seconds, then the pump start working.

③ Let the pump working until there is no coolant discharge, then release Know "8".

④ Connect the coolant back pipe (with red tape) back to machine panel, and screw up.

Note: Water pump may be damaged if long time running without load.

2) Coolant filer

	**Note: when remove coolant filter shell,there maybe coolant flow out.So,before maintenance coolant filter,discharge coolant first.**

Check the coolant filter regularly.

Every 1 month or 50 arc hours,when coolant system is working but cutting system not working, open the drain valve of filter to discharge impurities (NOTE: use a hose to lead the coolant or load it with a tank).After discharge coolant,ful up with clean coolant again.

Every 6 month or 300 arc hours,please remove the filter cylinder and take out the filter mesh,clear it carefully.

Note:Do not use strong acid or alkali cleaning it, the filter mesh cannot be damaged.If necessary,please replace filter mesh,replace step as follows:

① Cut the plasma power;

② Remove the filter shell;

③ Take out the filter mesh;

④ Install a new filter mesh;

⑤ Install back the filter shell;

⑥ Put enough new coolant.

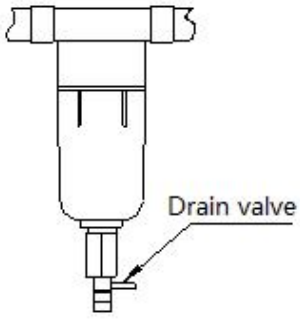


Figure 6-1 Coolant filter

3) Coolant flow sensor

Regularly check and maintenance coolant flow sensor,clear up the impurities accumulated inside coolant flow sensor,otherwise it affect the actual value of coolant flow,causing false alarm.

4) Water pump

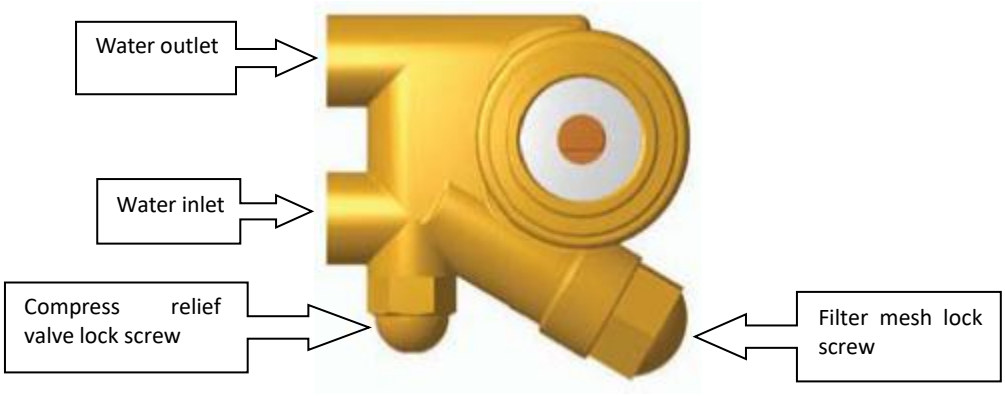


Figure 6-2 Pump elements name

Check the filter mesh in pump regularly. Firstly cut the machine power, turn the filter knob anticlockwise, then take out the filter, use laundry powder and brush to clean the filter, then install back to the pump, fix the knob till no water drain out.

Note:Do not use strong acid or alkali cleaning it, the filter mesh cannot be damaged.No need to remove the pump from machine to do the above.

5) Coolant flow testing

If plasma power source alarm and display “060”code (Low level if coolant flow), please firstly check if there is leakage on coolant pipes, if no leakage, start “manual pump function” to check the actual working coolant flow. If coolant flow lower than 2.3L/Min, please refer to coolant filter maintenance chapter to make the first maintenance. If still display code “060”after maintenance, then check pump and motor. If no problems on motor, than make maintenance on pump. After pump maintenance, if still display code “060”, then have to do further to find out the reasons.

10. Gas leakage testing

Manual gas console have two modes of gas leakage testing.Select shield gas from knob“2” to “test”,system enter gas leakage test mode,then select knob“7” to preflow indicator on,or cutflow indicator on,to start the gas leakage testing procedure.

Gas leakage test mode 1: Press Knob“7” and select preflow indicator light on.Gas console

inlet gas valve will be cut automatically,and switch valve in HF box will be opened,to discharge all gas in gas circuit.Then all switch valve in HF box will be cut after about 20s.Now there shall be no gas pressure between the gas console and HF box,digital tube displays 0.The purpose of this test is to check whether the inlet gas valve is totally closed. If no,the gas console may display gas pressure.This mode can also check leakage on gas supply pipelines.

Operation and working of Gas leakage test mode 1

① Power on the plasma power source;

② After gas blowing,select shield gas knob “2” to “TEST” indicator on;

③ Select knob “7”switch to preflow indicator on. Gas circuit system may automatically cut the gas inlet valve,and turn on switch valve in HF box, to discharge the gas between gas console and HF box;

④ Close switch valve after 20s;

⑤ Close gas inlet valve manually;

⑥ Observe the gas pressure display and gas pressure on gas console.Count for 20mins,gas pressure display should be 0 or closed to 0, the gas supply pressure should keep same.

⑦ If digital tube pressure display increase,then one or more inlet gas valve of gas console are not completely closed;

⑧ If gas supply valve pressure down,but gas console digital tube display 0 or close to 0, then the gas supply pipelines between gas supply valve and gas console;

Gas leakage test mode 2: Press Knob“7”and select cutflow indicator light on.Gas console inlet gas valve will be opened automatically,now there is gas pressure between HF box and gas console. After 20s, cut the gas inlet valve of gas console. The pressure value displaying on digital tube should keep same. The purpose of this test is to check whether there is gas leakage inside gas console or between gas console and HF box.

Operation and working of Gas leakage test mode 2

① After run gas leakage testing 1, open the gas supply valve, select Know “7”to cutflow indicator on. Gas circuit system will automatically open the gas inlet valve in gas console, and close it after 20s. The switch valve in HF box keep “close” status,let some gas pressure exist between gas console and switch valve.

② Close the gas supply valve manually;

③ Observe the gas pressure display and gas pressure on gas console.Count for 20mins,gas pressure display and the gas supply pressure should keep same;

④ If digital tube pressure display decrease,then there is gas leakage inside gas console or between gas console and switch valve;

⑤ If gas supply pressure down, then there is gas leakage between the gas supply valve and gas console.

11.Preventive maintenance

Wearing parts working life become shorter is one of a early signs when the plasma system got problems. It increases cost by two aspects: firstly, operator have to use more consumables for same qty work-piece cutting, secondly operator has to stop more times to replace the consumables.

Suitable maintenance can reduce the production cost obviously.

1) Plasma power source

① Remove the side and top covers once a month, use dry compressed air to flow away dust;

② Check the cutting machine cable regularly to check if any damages or wearings. If the cable color fade,and caused by overheat, please replace it;

③ Check the contactor regularly, check the connection is corrosive or not, if the surface is black and hard, please replace it.

2) Cooling system

① Replace the coolant and clean the coolant pipelines regularly (6 month or 300 arc hours).The maintenance time based on actual working strength and environment.

How to clean the coolant pipelines:

Step 1:Refer to coolant discharge method and drain out all coolant in the pipelines.

Step 2:Fulfil pure water and let cooling system work 10 mins.

Step 3:Drain out the pure water and fulfil again with coolant.

② Check the coolant level, if short of coolant, add more;

③ Regularly check the coolant filter mesh under cutting machine front panel, clean and replace if need;

④ Regularly check the pump filter mesh, clean and replace if need;

⑤ Power on the machine and keep it on standby status, check if any coolant leakage: the inlet and outlet connectors on rear side of cutting machine, HF box torch connection parts, water tube connection parts, and plasma torch;

⑥ After long time working, normal wear and tear appear on the water pump in cooling system, replace it if need.

3) Gas supply system

Check every pipeline in gas supply system as below steps:

① Remove the assembly parts on gas inlets of gas console, and block off the gas inlets with plug;

② Increase the gas pressure of gas pipelines to 0.8MPa;

③ Shut off the gas supply valve, check the gas pressure to see if decrease, if decrease, need to find out the gas leakage point;

④ Check every pipeline as above method in ③;

⑤ Make a gas leakage testing as gas leakage testing procedure;

⑥ Check all hoses, make sure there is no twist,damage and serious wearings.

Note: if use the flammable gas, the gas system maintenance must do everyday .

4) HF box

① Open the HF box cover, use compressed air to flow away the dust,if any water, clean it with cloth, and find out the water source;

② Check the HF ignition head to see if any corrosion.

Note: Over corrosion may reduce the arc striking success rate.

5) System ground

① Make sure all parts of the system connected with ground safely, refer to ground part of this manual.

② Make sure the work-piece ground connect well, especially the work-piece cable and CNC table connect well, it must be clean and connect well.

VII. Appendix

1. Some parts of the plasma power source

Table 7-1 Some parts of the plasma power source

No.	Part name		Code	Model
1	Control transformer		TC1	TL04
2	Circuit control board		AP1	PL01
			AP2	PL02
			AP3	PL03
3	AC contactor		KM1	CJ20-160/AC380V
4	Hall current sensor		TA102,TA202	HAS200-S/SP50
5	Hall current sensor		TA1	HAS300-S/SP50
6	Diode module		V104～TA107, V204～V207,V8	DBA200UA60
7	IGBT module		V102,V103,V202,V203	FF150R12RT4
8	IGBT module		V9	GD75CUL120C1S
9	3 phase bridge rectifier		V101 ,V201	MDS100-12
10	Temperature replay		KT101 ,KT201	KSD305A 常闭 75℃
11	Liquid level switch		BP1	F2HY-K-1304075
12	Flow sensor		BP2	RFO (155421)
13	Temperature sensor		RT1	RX-WD-03 (MF58 型热敏电阻)
14	Power indicator		HL1	AD16-22E/g32
15	Solenoid valve		YV1	2WT05010AT
16	Water pump	Pump head	MA1	101B070R12BA (200PSI 带滤网)
		Motor		YKD-370-4(1218E)
17	Condenser fan		EV3	TG28080HA2BL-C
18	Main circuit fan		EV1 ,EV2	200FZY6-SP/220V
19	Emergency stop		SA1	LA39-A1-R02Z/r (AC-15 慢动型)
20	Arc striking resister		R15	600W1R5J(ASZ6038)

2. Some parts of the gas console

1) Manual gas console SQK-A1

Table 7-2 Some parts of the gas console SQK-A1

No.	Part name	Code	Model
1	Pressure sensor	SP1,SP2,SP3,SP4	PSE530-M5
2	Solenoid valve	YV1,YV2,YV5,YV6	VX2C0ACH
3	Solenoid valve	YV3,YV4,YV7,YV8,YV9,YV10,YV11,YV12,YV13,YV14,YV15,YV16,YV17,YV18,YV19	VX2A0ACH
4	Relief valve	RP1,RP2,RP3,RP4	80-AR20-N02H-NZ-B
5	Main control board	AP1	PL09
6	Control power divide board	AP2	PL10
7	Solenoid valve driving board	AP3	PL11

2) Manual gas console SQK-B1

Table 7-3 Some parts of the gas console SQK-B1

No.	Name	Code	Model
1	Pressure sensor	SP1,SP2,SP3,SP4	PSE530-M5
2	Solenoid valve	YV1,YV2,YV3	VX2C0ACH
3	Solenoid valve	YV5,YV6,YV7,YV8,YV9,YV10	VX2A0ACH
4	Relief valve	RP1,RP2,RP3,RP4	80-AR20-N02H-NZ-B
5	Main control board	AP1	PL09
6	Control power divide board	AP2	PL10
7	Solenoid valve driving board	AP3	PL11

3. Some parts of HF box

Table 7-4 Some parts of HF box

No.	Name	Code	Model
1	Solenoid valve	YV20,YV21,YV22,YV23,YV24,YV25,YV26,YV27,YV28	VX2A0ACH
2	High frequency coupling transformer	THF1	
3	Boosting transformer	TC4	TL03
4	Main control board	AP1	PK03

4. System wiring diagram

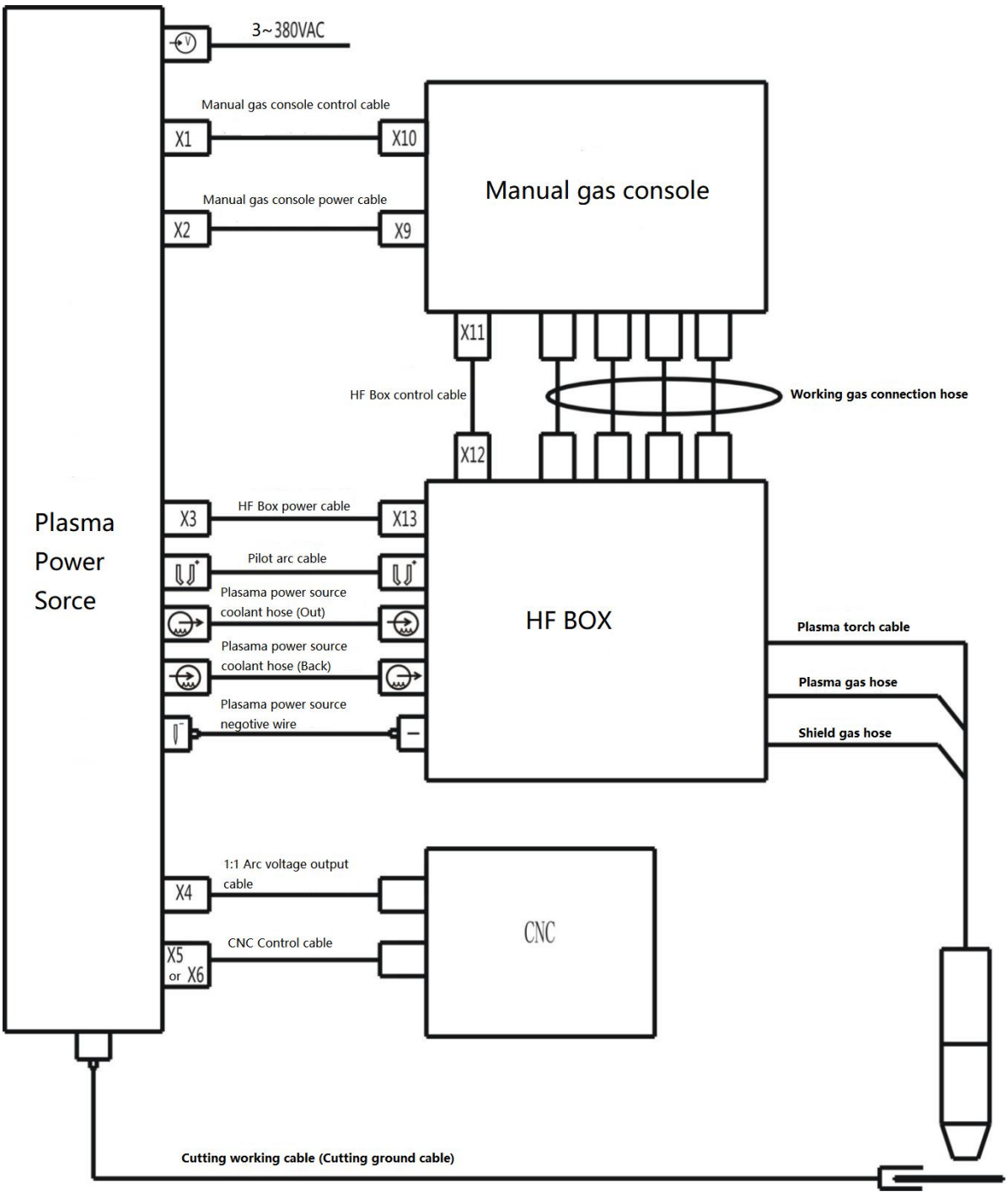


Figure 7-1 System wiring diagram

5. Figure Multi-plasma power source working wiring diagram

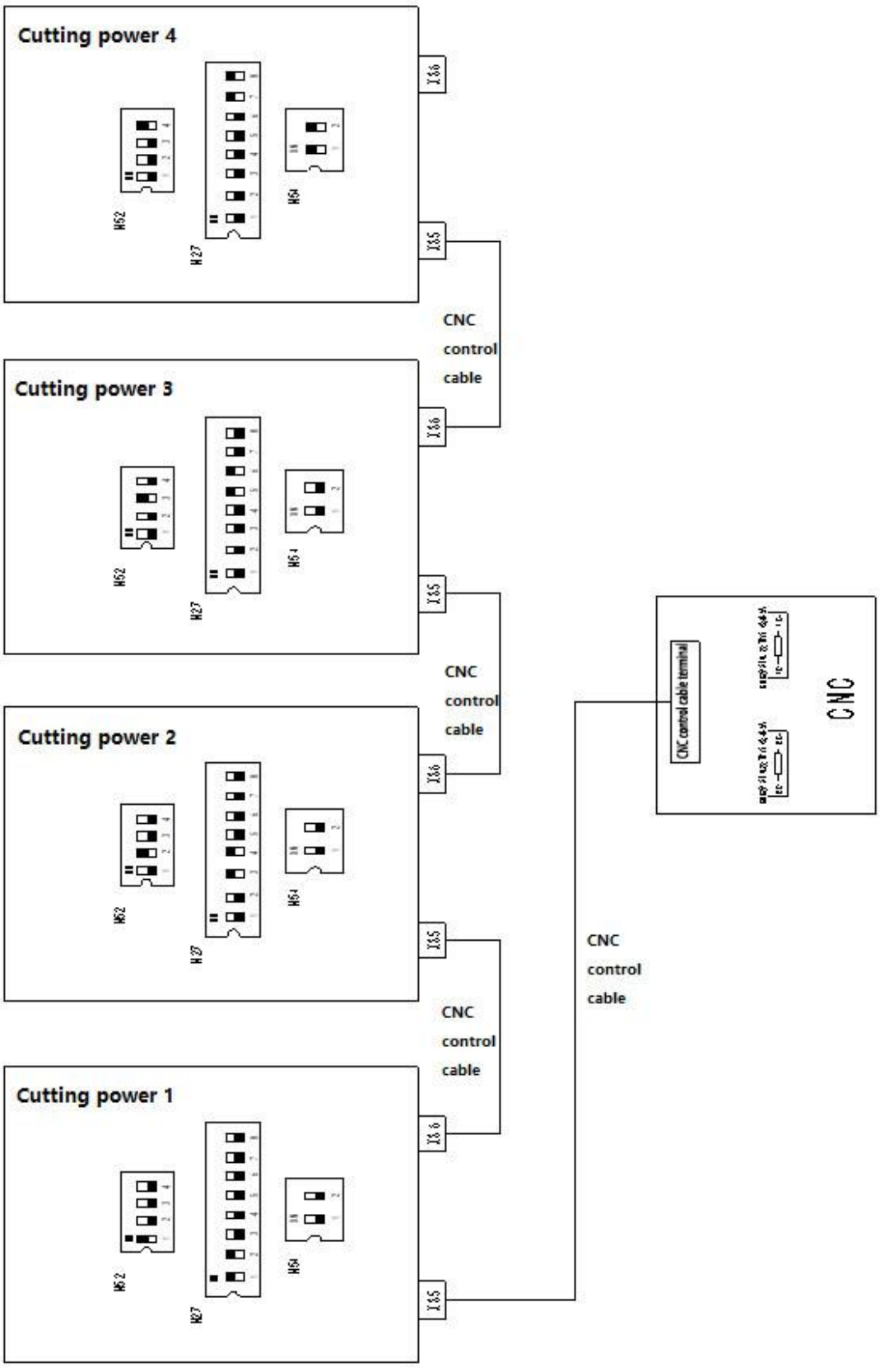


Figure 7-2 Multi-plasma power source working wiring diagram

6. Figure Complete plasma power source (machine) wiring diagram

FLG-200HD wiring diagram

1） Main circuit wiring diagram 1

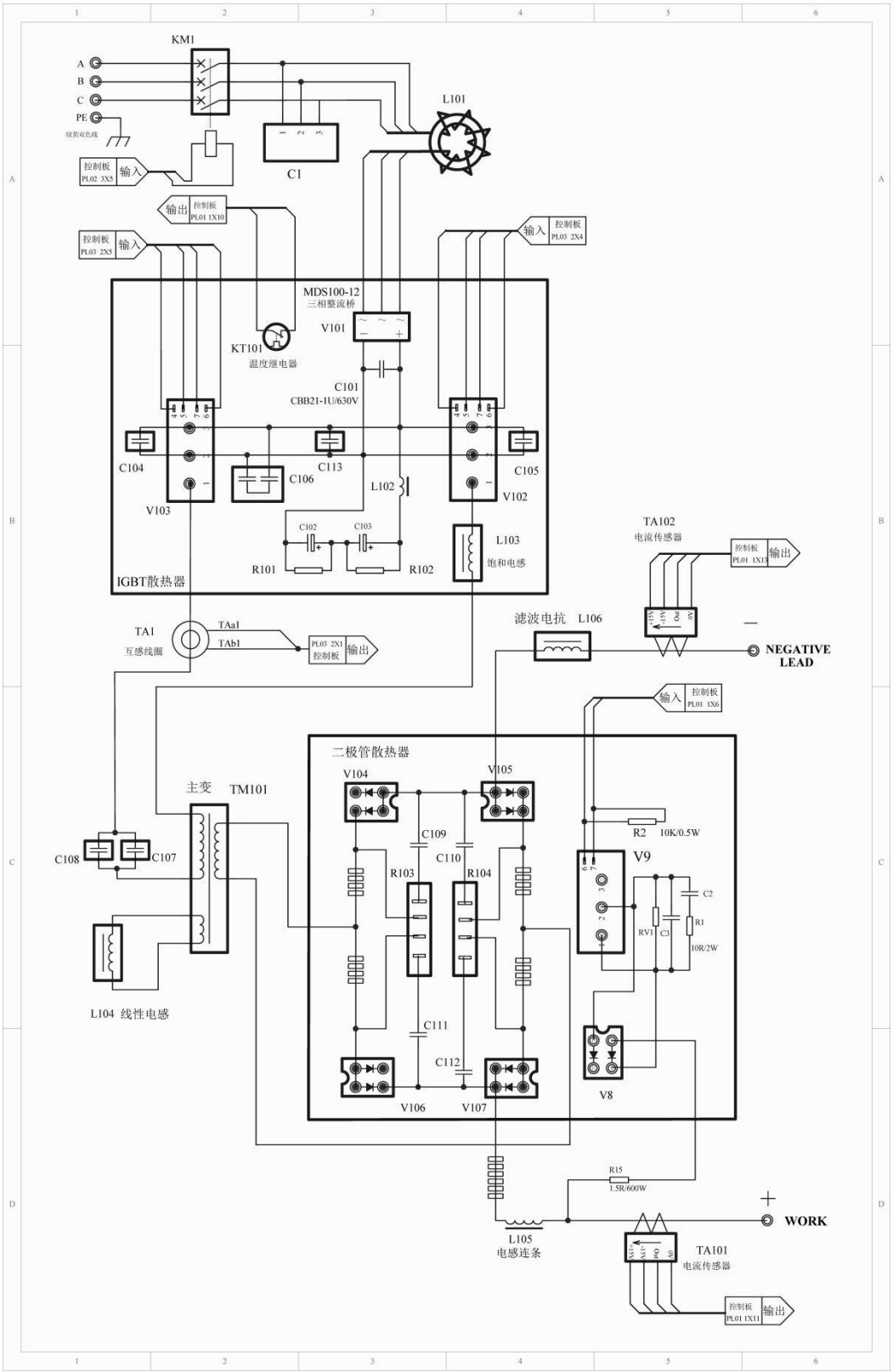


Figure 7-3 FLG-200HD Main circuit wiring diagram 1

2) Main circuit wiring diagram 2

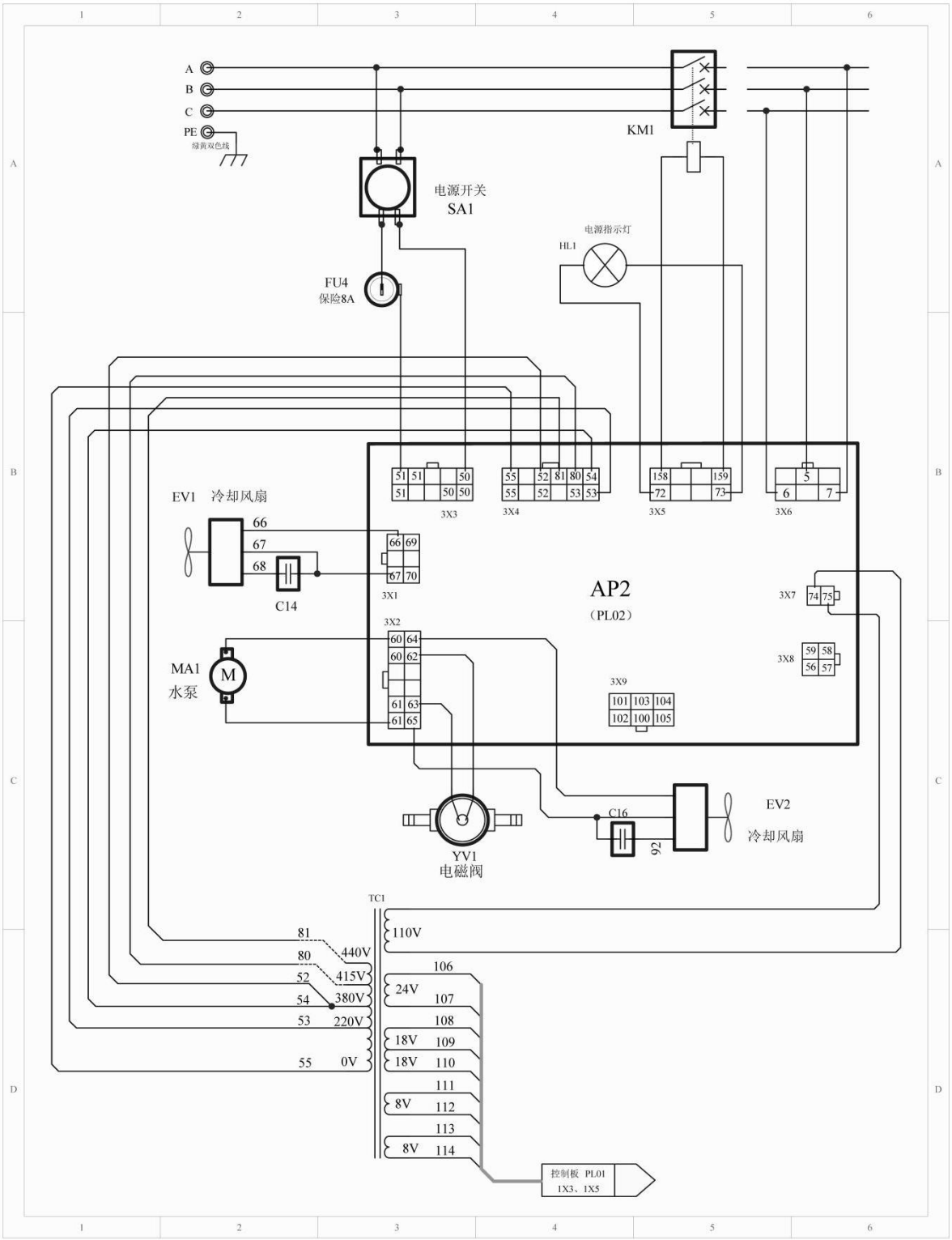


Figure 7-4 FLG-200HD Main circuit wiring diagram 2

FLG-300HD,FLG-400HD wiring diagram

3) Main circuit wiring diagram 1

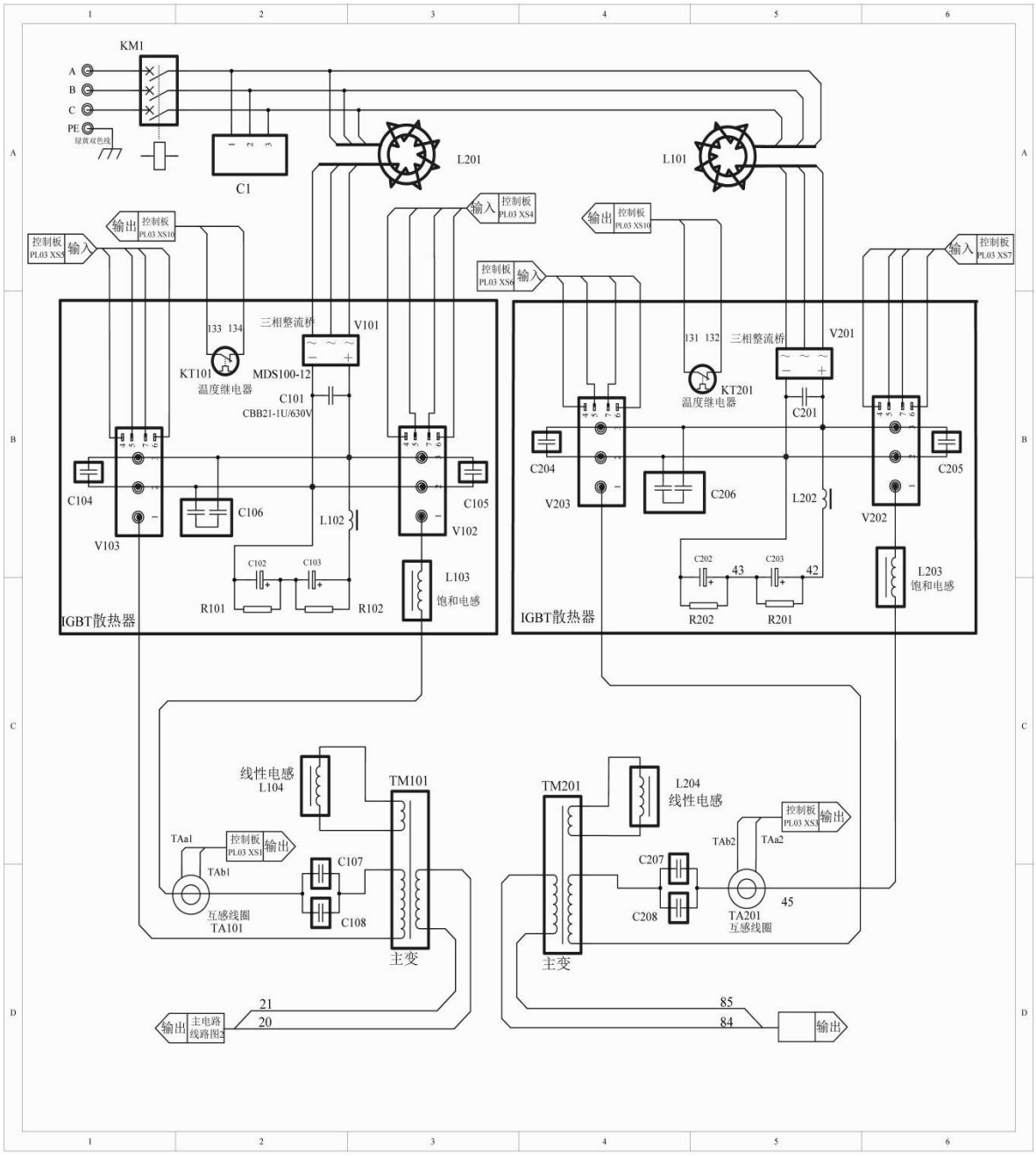


Figure 7-5 FLG-300HD,FLG-400HD Main circuit wiring diagram 1

4) Main circuit wiring diagram 2

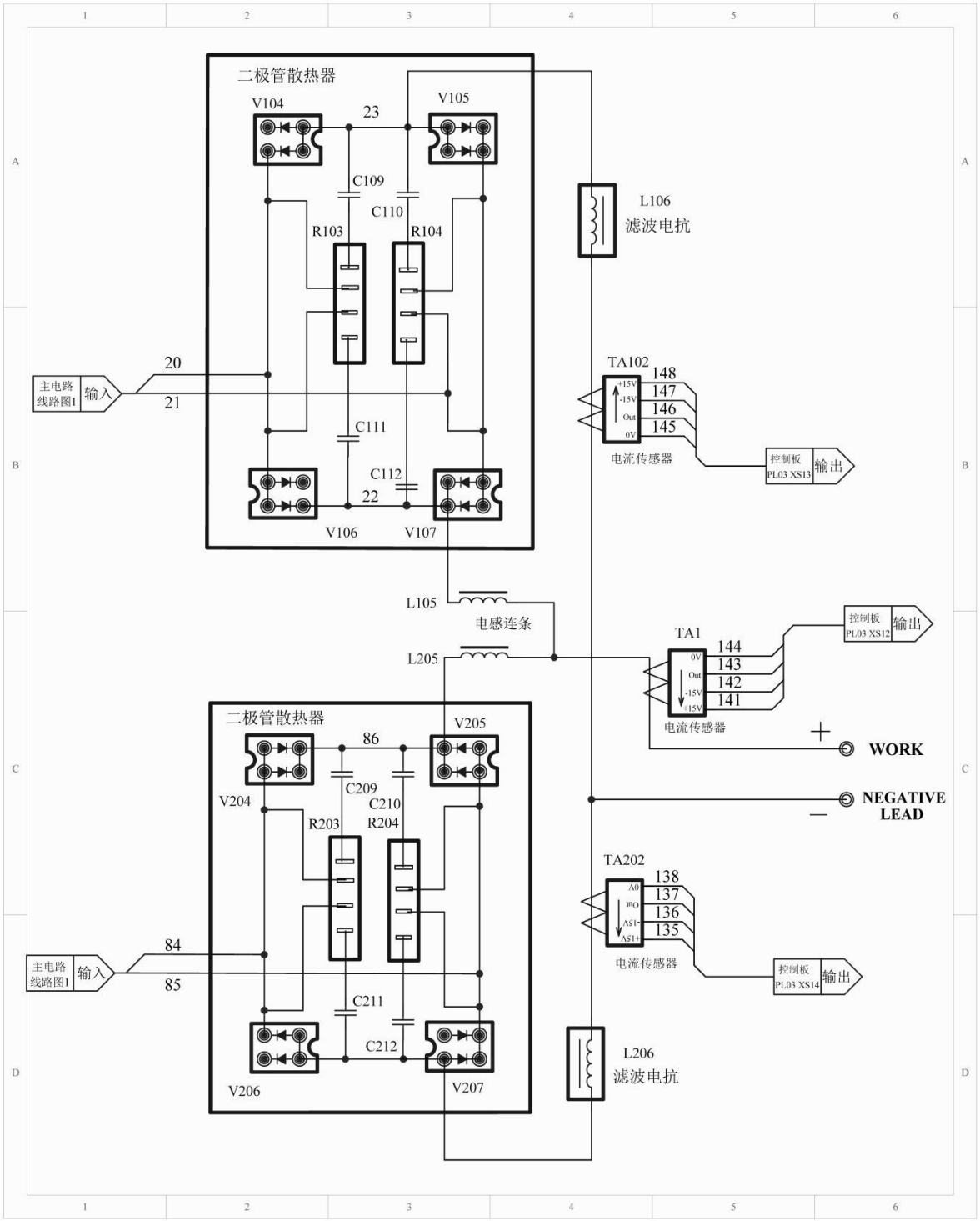


Figure 7-6 FLG-300HD,FLG-400HD Main circuit wiring diagram 2

5) Main circuit wiring diagram 3

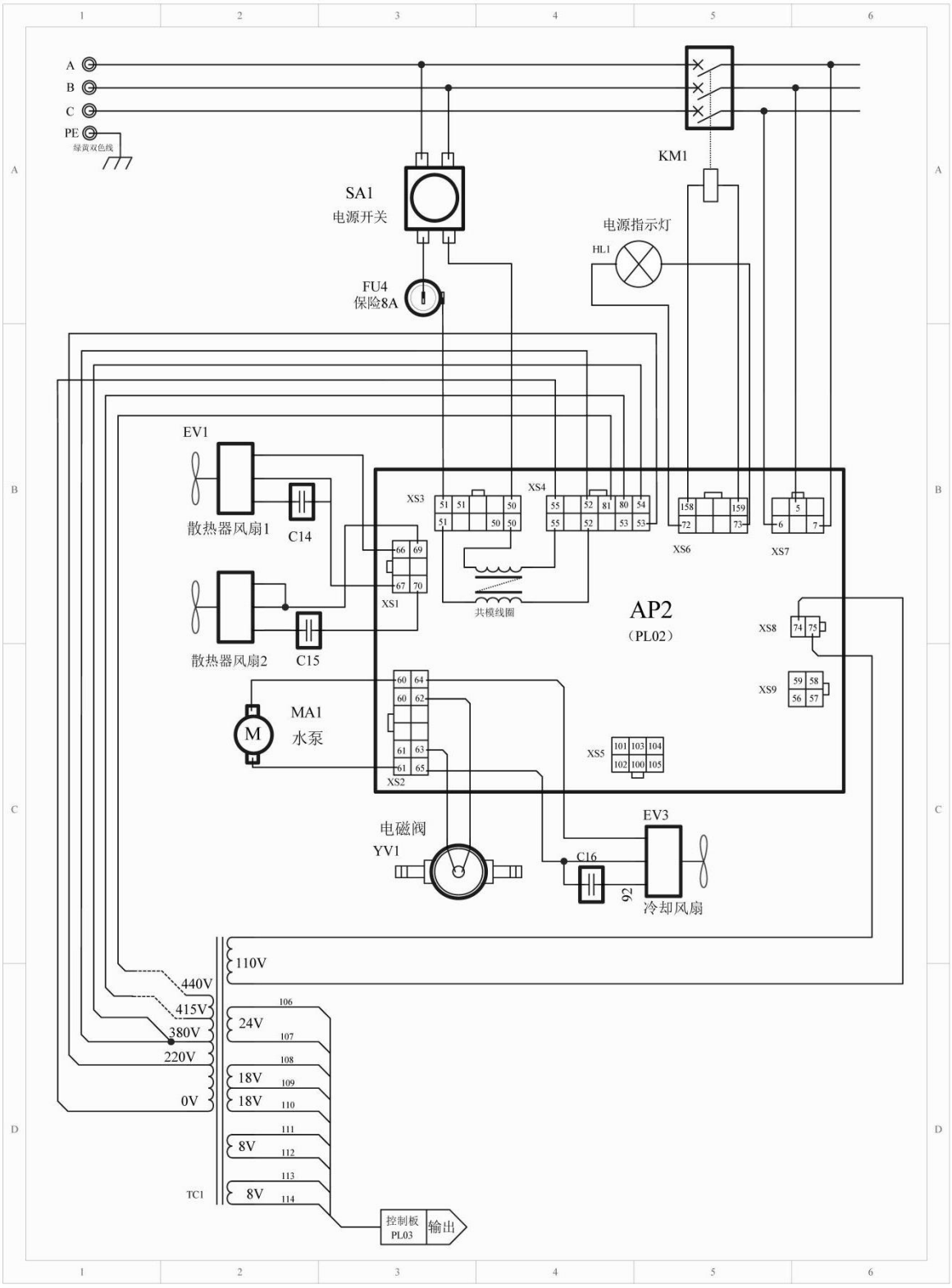
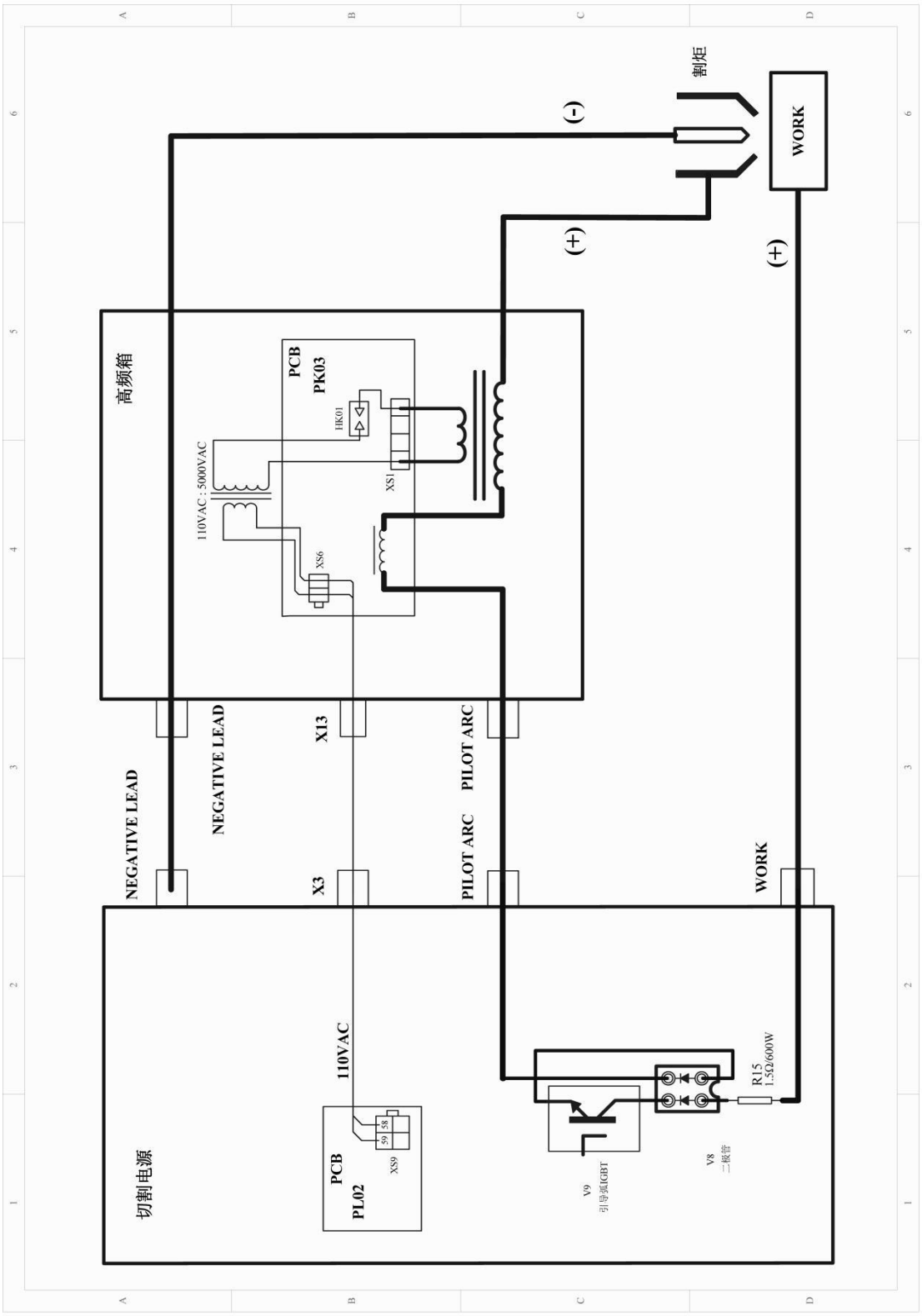


Figure 7-7 FLG-300HD,FLG-400HD Main circuit wiring diagram 3

6) HF striking diagram



The final explanation rights reserved to Westweld/Huayuan Company!

If there is any changes in the user's manual, forgive not to inform separately!

Westweld Ltd

4-23-4, No.51, Xuefu Avenue, Nanan, Chongqing, China

E-mail: info@westweld.com sales@westweld.com

www.westweld.com