

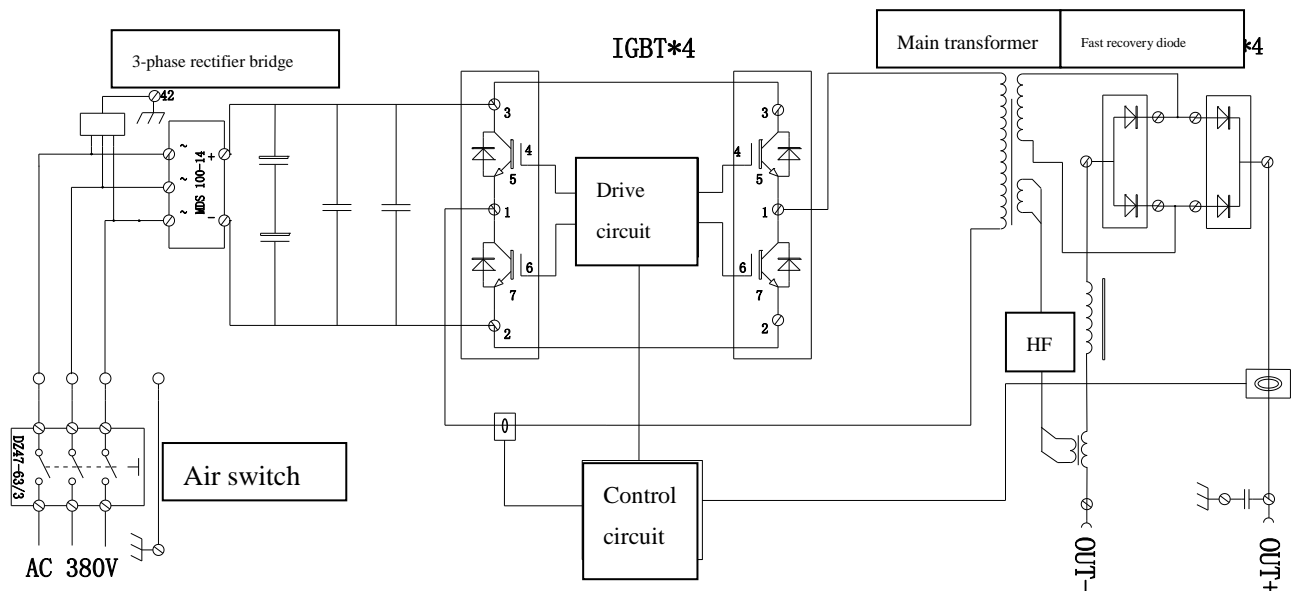
LGK-160 (L307) Service Manual

PLASMA CUT 165

1. Function description.

LGK-160(L307) plasma cutting machine adopts power cutting system of current mode control principle and mainstream inverter technology. This system applies improved HF arc ignition technology with high successful rate of arc ignition and little interferences to CNC and ambient. Gradual increasing function of working current can reduce arcing shock and accidental damages to cutting torch. It is widely applied in ship building, pipeline industry, aerospace industry, machine manufacturing, field operation, etc. Key components of the system are from world-class brands which are of high reliability. LGK-160(L307) system can cut conductive metal such as low carbon steel, stainless steel or aluminum by means of air. The cutting thickness of carbon steel can be up to 60mm.

2. Schematic Block Diagram



Main circuit is composed of EMC, rectifier bridge, filter circuit, bridge inverter circuit, main transformer, secondary rectifier and output reactor. The three-phase AC380V (50Hz) current is rectified and filtered and to be provided for IGBT inverter to invert and obtain 20KHz AC current; then the 20KHz AC is isolated and stepped down by the MF transformer. And finally, DC is obtained from fast recovery diode rectification.

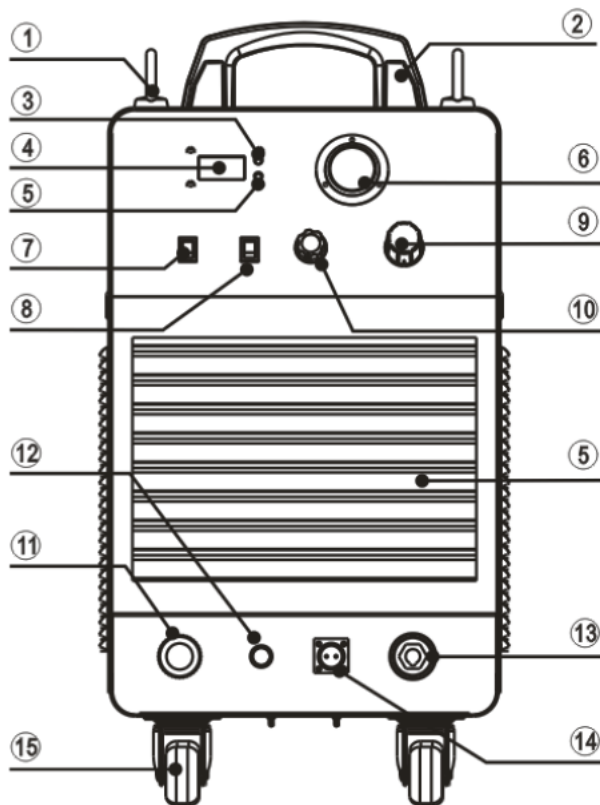
3、Panel Description

3.1Front panel

LGK-160 (L307) main functions:

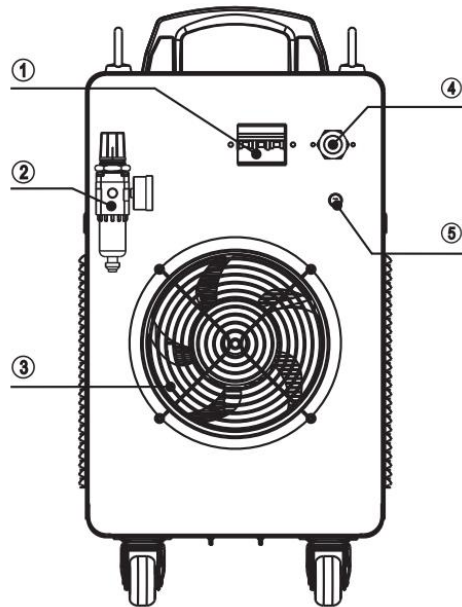
- ①current adjustment and display
current over heat, over/under voltage alarm
④gas deficiency alarm ⑤ 2T/4T

- ② voltage adjustment and display ③over
⑥gas detection



No.	Name	Description
1	Hanging ring	Rings for hanging the machine
2	handle	For convenient machine moving
3	Abnormity indicators	If indicator is on it means over-current or over-heat
4	Digital meter display	To display current
5	Gas lack indicator	If indicator is on, it means gas pressure is not enough(<0.3 MPa)
6	Gas pressure indicator	To display gas pressure during working
7	Gas detection	
8	2T/4T	Change to 2T/4T functions
9	Gas pressure adjustment	Adjust gas pressure during work
10	Current adjustment	Adjust cutting current
11	Cutting torch connector	To connect cutting torch
12	Pilot arc binding post	To connect torch pilot arc terminal
13	Quick socket	To connect earth clamp
14	2 pin aviation socket	To connect 2 pin aviation socket and control machine on/off.
15	Omni-directional wheel	supporting the machine and convenient for moving

3.2 Back panel

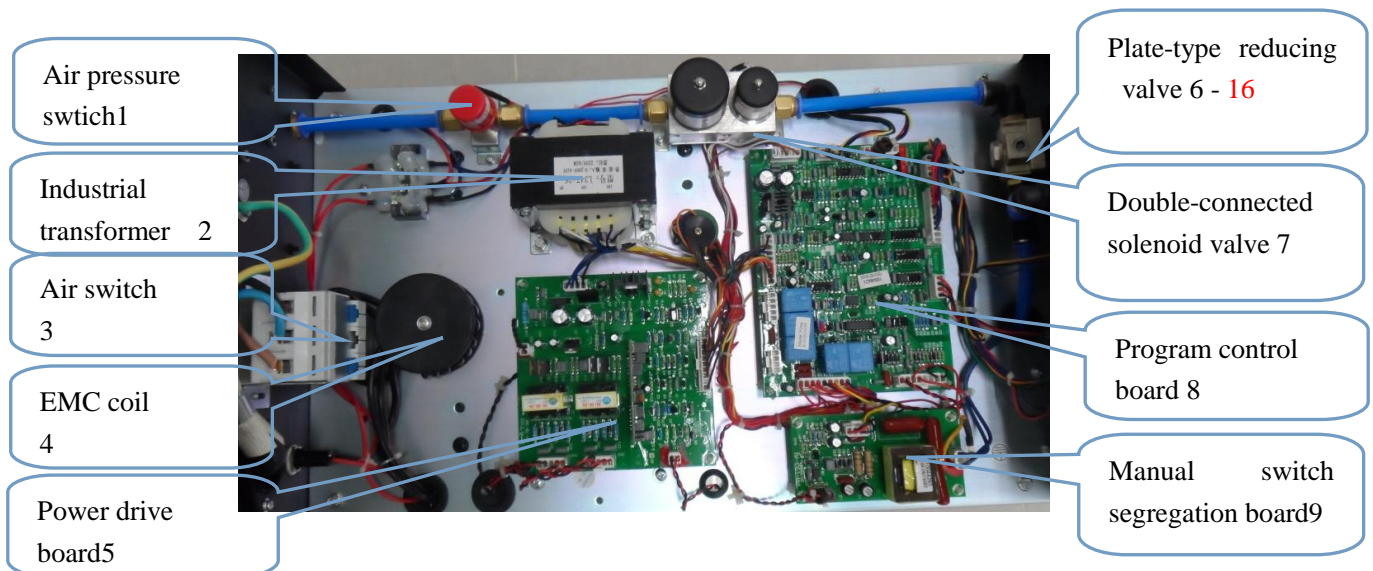


No.	Name	Description
1	Power switch	To control power on/off
2	Air reducing valve	To adjust pressure of inlet gas
3	fan	Forced dissipation
4	cable	Power input
5	fuse	To protect industrial transformer from being burnt

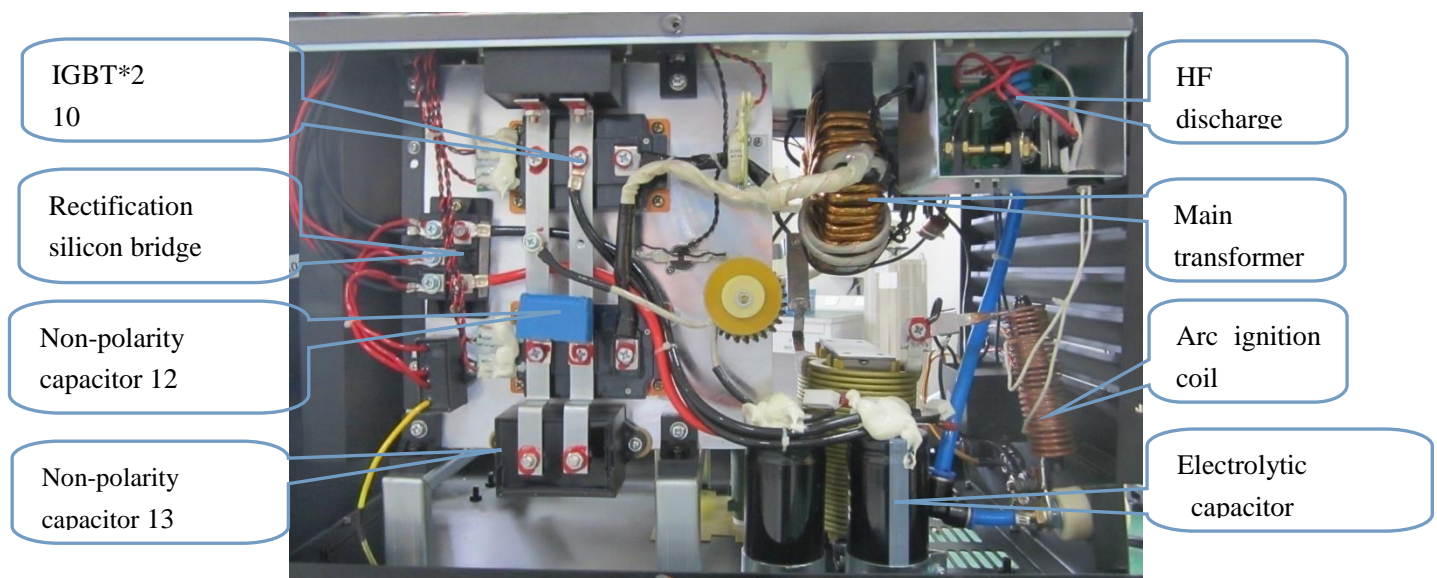
5A/400V 6*30mm ceramics fuse.

Components and parts

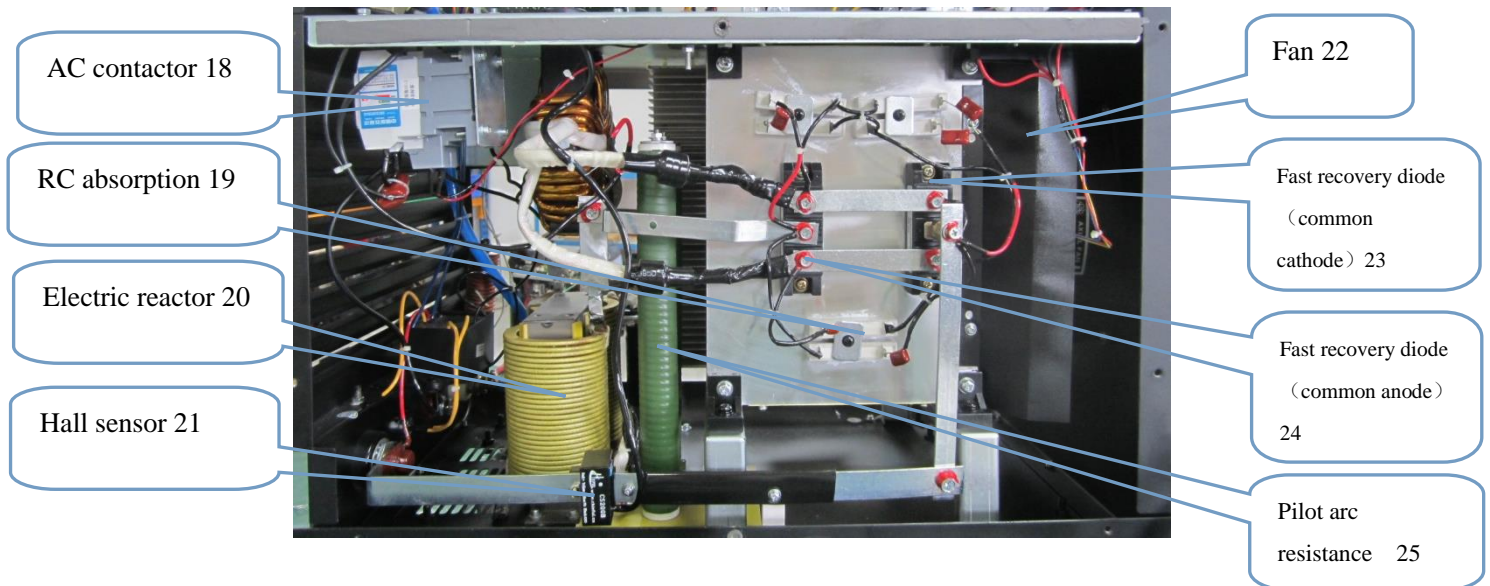
4.1 medium plate top view



4.2 left view



4.3 Right view



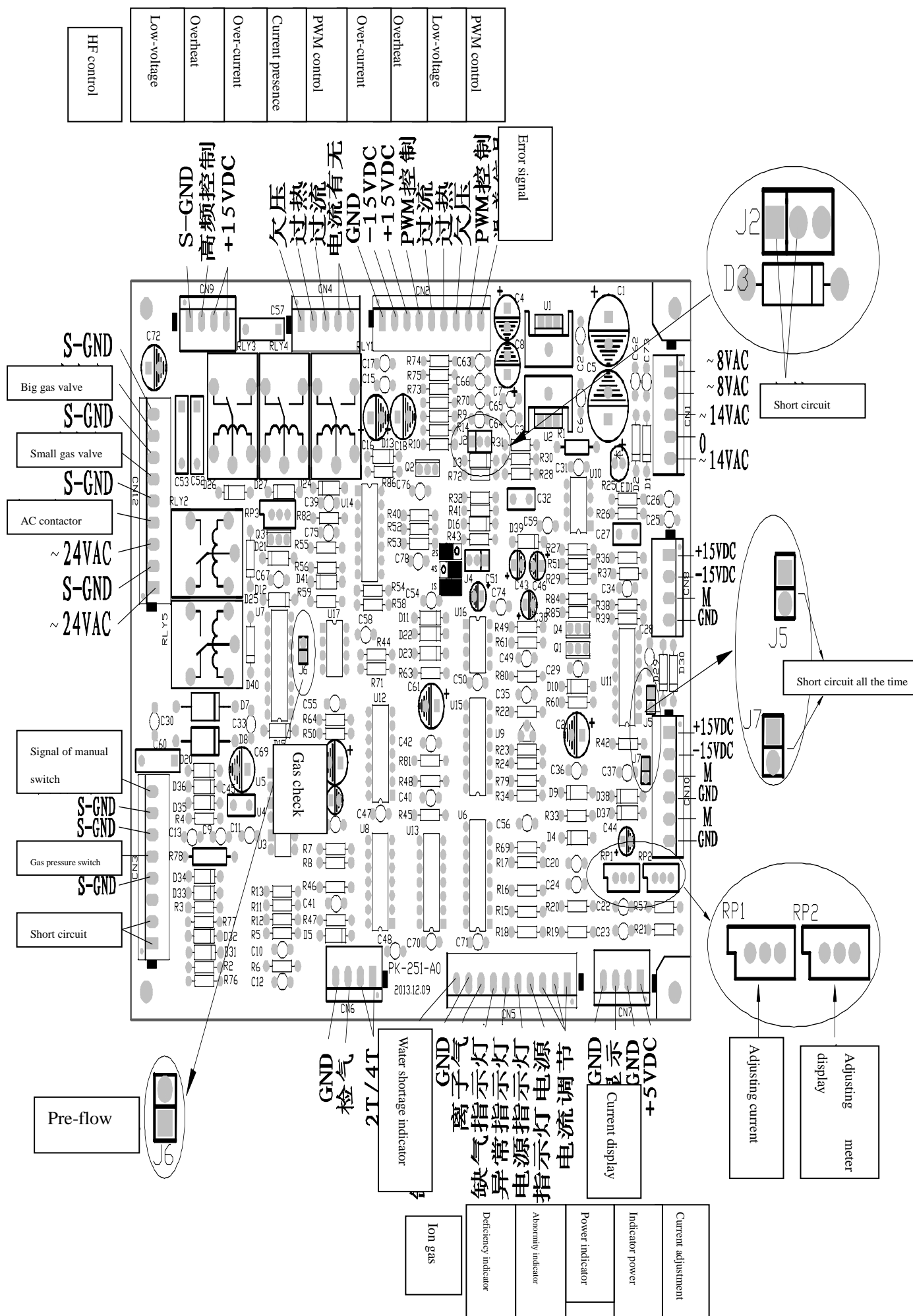
4.4 Main components and parts specification

no	Material code	description
1	10004928	Air pressure switch: 3KGf/cm ²
2	10044738	CPS transformer: L347-26/A0
3	10004925	Air switch: DZ47-3P-63A
4	10046597	EMC coil
5	10000778	Power drive board: J47-22(PK-81-A3)
6	10007275	Pressure reducing valve: STNC TR2000-02
7	10046227	Environmental double-connected aluminum valve: ZTC-2/ZCT-5 DC24V
8	10046423	Program power control board: L307-21(PK-251-A0)
9	10044293	Manual switching segregation board: J47-27(PH-193-A1)
10	10007252	IGBT: CM100DC1-24NM
11	10006623	3 phase rectifier bridge: MDS100A/1400V(without cooper ring)
12	10005912	Non-inductive capacitor: MKPH-S-1200VDC-0.47uF
13	10005913	Non-inductive capacitor : MKP-LS-1250V.DC-40uF-J(black pin distance 28mm)

14	10046424	HF discharge board: L307-29(PH-196-A0)
15	10001074	Main transformer (23: 13)
16	10046436	LGK-160 arc striking coil: L307-35/A1(25 比 12)
17	10005825	Aluminum electrolytic capacitor: CD-2200uF-400V(with base Φ51*105)
18	10006523	contactor: GMC-12(AC24V 50Hz)
19	10046604	RC absorption
20	10046462	LGK-160 electric reactor: L307-33/A0
21	10006803	Hall sensor: 200A/4V
22	10027895	Fan: G21070HA2(220V black) with capacitance
23	10046809	Fast recovery diode module : MPKB2CA100U60 (common cathode)
24	10046810	Fast recovery diode module : MPKB2CB100U60 (common anode)
25	10005326	Pilot arc resistance: RX-250W-12R-J

5、PCB socket description

5.1 program control board (PK-251-A0)



Function:

- ① To control cutting torch working timing sequence.
- ② To handle protection signals sent through PK-81
- ③ To check working gas pressure.
- ④ Control panel display
- ⑤ Control panel function switch
- ⑥ Control gas valve, pilot arc.
- ⑦ Control cutting current

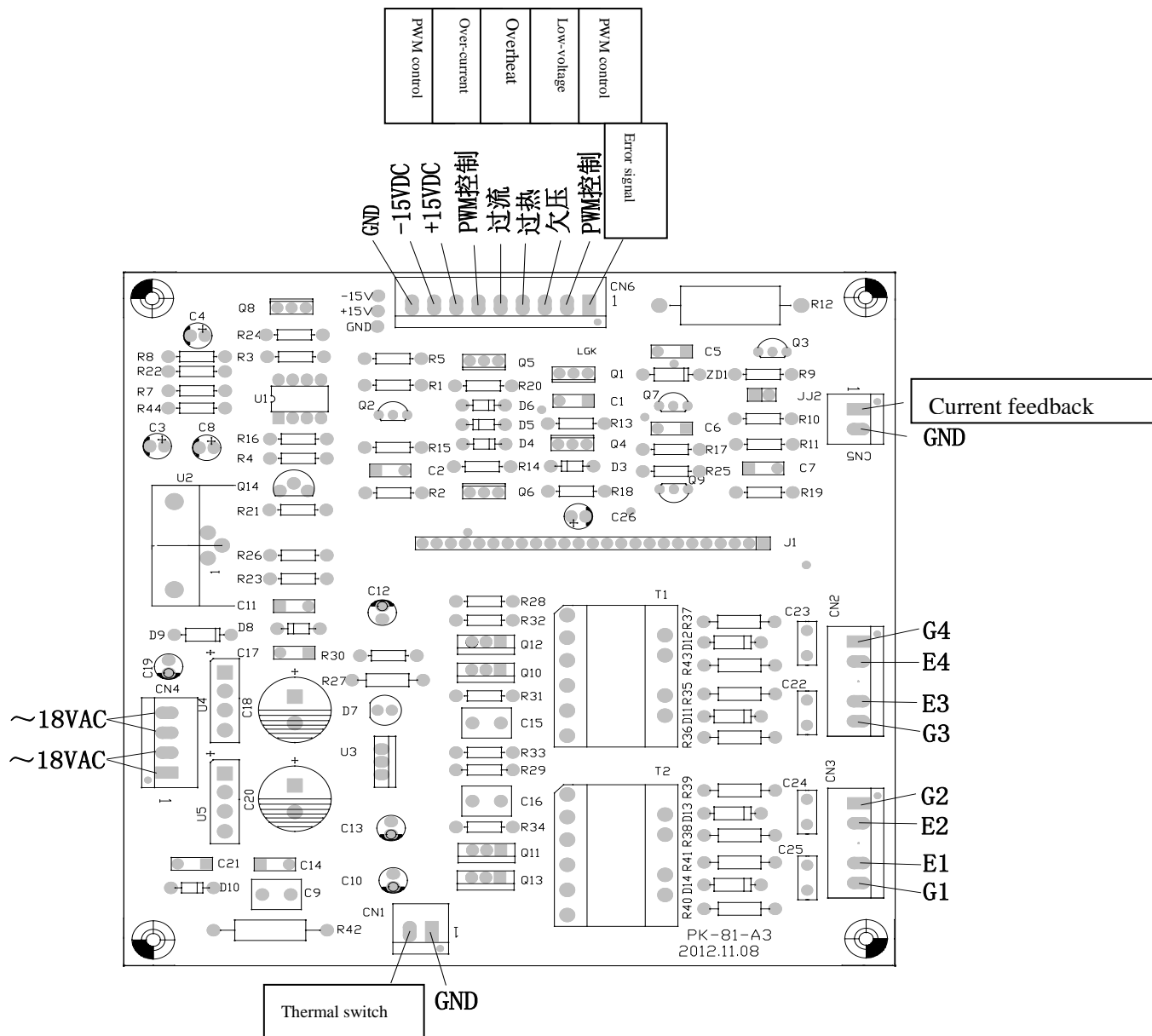
Description:

- ① RP1 trimming resistor: adjustment of given signals of the machine, to guarantee Pin1 of CN5 is +3.20V.
- ② RP2 trimming resistor: adjustment of RP2 and make sure digital meter of machine displays 160 (to adjust the panel potentiometer to the maximum)
- ③ J2 factory defaulted connection is to make the left two short-circuited; the right one is for commission before delivery.
- ④ J5、J7 are signal transmission calibrating terminal and are required to be short-circuited all the time.
- ⑤ J6 is pre-flow; after having short circuit, there is post flow, then normally there is no pre flow. We recommend not to making short circuit for most of the circumstances.

Port description:

- CN1: Power supply terminal to connect industrial transformer, AC8V and AC dual 14V;
- CN2: The terminal is to communicate with PK-81 power drive board. And over heat, over current, over/under voltage, PWM torch trigger control signals are transmitted through this terminal.
- CN3: Torch trigger control signal terminal; torch trigger short circuit signal is transmitted to other logic control blocks of this board to complete all logic control action.
- CN4: Successful current signal provided to CNN and make sure CNN has a short circuit start signal. Use a multi-meter to test Pin4 and Pin5 of CN4. Under normal condition, these two pins will turn from open circuited to short circuited after arc ignition.
- CN5: Power indicator, abnormality indicators signals, and current adjustment signal input.
- CN6: Gas detection and 2T/4T selection
- CN7: Panel current meter display connecting terminal; Pin1 is +5V; meter can display 30-160A.
- CN8、CN10: Hall signals input terminal. Hall sensor tests machine actual current and feedback according to signals on control board. The signals changes from 0-3.2V based on machine actual output.
- CN12: Big/small gas valve and AC contactor control terminal; big/small gas valve are both controlled by DC+24V; AC contactor is controlled by AC 24V.

5.2 Power drive board (PK-81-A3)



Function:

- ① To provide DC±15V to PK-80 program control board
- ② Detect thermal switch signal
- ③ detect primary current feedback signal
- ④ Detect network voltage signal
- ⑤ Drive IGBT

Port description:

CN1: Connect thermal switch control signal; when it is under normal operation, the voltage of this terminal is 0V; when machine is over-heated, Pin2 of this terminal is +15V and front panel abnormality indicator is on, machine stops output. When machine stops operation for a certain time, temperature will be back to allowable standard, and machine can resume work.

CN2、CN3: PWM signal output, there is about 30V AC voltage among each of four sets of signals;

CN4: To connect industrial transformer AC18V output and provide DC±15V to control board;

CN5: Main transformer current sampling board sampling of primary sample signal input terminal; when machine is under over-current, the signal tested by current sampling board will make machine stop working through this terminal and abnormality indicator on front panel will be on. Operation can be resumed only after restarting the machine;

CN6: It is program control board communication signal. Over heat, over current, under/over voltage and PWM control signals are all transmitted through this terminal.

6. Troubleshooting

6.1 Alarm Analysis and Solutions

Type	Alarm	Machine Self-proce ssing	Cause Analysis	Solution
Over-curr ent	Over current indicator is on.	Permanen t shut-dow n of the main circuit	Load current is too big or over-current protection for main power components.	1. Restart the machine 2. If over-current protection still exists, please turn off the machine and contact qualified maintenance personnel.
Over-volt age	Abnormity indicator is on	Temporar y shut-dow n of the main circuit	Network voltage is too low. (>437VAC)	Wait till power supply is back to normal and alarm will disappear by itself and machine can resume to normal operation. If network voltage is continuously high, please check 3 phase voltage and resume cutting until network voltage is back to normal. If the voltage is normal and there is still alarm sound, please contact qualified maintenance personnel.
Under-vo ltage		Temporar y shut-dow n of the main circuit	Network voltage is too low. (<280VAC) or phase loss	Wait till power supply is back to normal and alarm will disappear by itself and machine can resume to normal operation. If network voltage is continuously high, please check 3 phase voltage and resume cutting until network voltage is back to normal. If the voltage is normal and there is still alarm sound, please contact qualified maintenance personnel.
Over-hea t	Abnormity indicator is on	Temporar y shut-dow n of the main circuit	1. Long time operation triggered over-heat protection. 2. Fan doesn' t work. 3. The environment temperature is too high.	1. Wait for a while to see if the machine will be back to normal operation. 2. Check if there is AC220V for fan wires connection; if not, check if wires are short circuited. If yes, it means fan is failed. 3. Make sure there is enough ventilation and temperature is lower than 40℃ in the working environment

Abnormal gas-cooling	Gas lack indicator is on.	Temporary shut-down of the main circuit	Lack of gas or abnormal gas circuit.	Make sure machine inlet pressure reach 2.5kg/cm ² ; if yes, check gas pressure switch and make gas pressure switch' s two control wires short-circuited at the PCB terminal position. Examine if the indicator is still on or not; if operation still can' t resumed, please contact qualified maintenance personnel.
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6.2 Small Malfunction Analysis and Solution

Malfunction	Cause analysis	Solution
Air switch cannot be closed/trips	<ol style="list-style-type: none"> 1. 380V power cable is short circuited. 2. Short circuit inside the machine. 3. Air switch is failed. 	<ol style="list-style-type: none"> 1. Make sure the power cable is not short-circuited. 2. Make sure IGBT or 3 phase rectifier bridge is not failed. 3. Replace the failed air switch.
No response when power on the machine	<ol style="list-style-type: none"> 1. Abnormal power input. 2. Air switch is failed. 	<ol style="list-style-type: none"> 1. Check the power input. 2. Replace the failed air switch.
The fan does not work.	<ol style="list-style-type: none"> 1. The three phase power cord is not well connected; 2. Open phase 3. Network voltage is too low 	<ol style="list-style-type: none"> 1. Make sure the three phase power cable is well connected. 2. Please make sure there is no default phase 3. Operate when network voltage is back to normal.
Interrupted cutting and easy broken arc	Check if there is suitable working gas flow.	<ol style="list-style-type: none"> 1. Adjust back panel gas lent filter and increase gas inlet flow; or adjust front panel reducing valve, only can obtain normal cutting. 2. Check cutting torch electrode and nozzle; interrupted arc or double arc, etc might be caused by over consumption of electrode and nozzle
Interrupted pilot arc sound	The interrupted pilot arc sound may be resulted from too big gas flow, leading to unstable arc.	Open the enclosure and adjust ion gas adjusting knob of solenoid valve until pilot arc is continuous.
Pilot arc flame is green	<ol style="list-style-type: none"> 1. Ion gas flow is too small, which leads to burnt electrode nozzle by arc and generate green pilot flame. 2. Stuck cutting gas circuit. 	<ol style="list-style-type: none"> 1. Open the enclosure and adjust ion gas adjusting knob of solenoid valve to increase ion gas until white ion arc occurs 2. Make sure there is no stuck inside the torch or gas horse.

6、3 Common malfunction analysis and solution

Malfunction Phenomena	Cause Analysis	Solution
No response when pull the torch trigger	1. Cutting torch is failed.	1. Check torch control circuit or plug off torch aviation plug; use a metal to make machine's aviation socket short-circuited and check if there is any response; if yes, it might be the torch trigger is failed and need to repair or replace
	2. Torch trigger segregation board is failed.	2. Use a multi-meter and take torch segregation board CN2's Pin② as the reference and test voltage of CN2's ①; pull torch trigger, if voltage of Pin① changes from +35V to 0V, it means PCB is not failed and vice versa.
	3. The circuit controls torch trigger is burned down by HF.	3. If segregation board is not failed, use a multi-meter to check control board's R78 resistance is normal or not; if yes, please contact qualified maintenance personnel.
No pilot arc gas or working gas	1. Relay on program control board is failed.	1. First make sure there is no pilot arc gas or working gas; then use multi-meter and take CN12's Pin ⑨ as the reference GND and test the voltage between CN12's Pin ⑥ and ⑧; if there is no +24V when pull the torch trigger, it means relay is failed.
	2. The according gas valve is failed.	2. If there is +24V, the gas valve is abnormal. Check whether it's caused by gas valve wire connection or failed gas valve by itself.
Non-adjustable current	1. Hall sensor is failed.	1. Make sure all Hall terminals are tightly connected; then test Hall signal terminal (Blue). When there is no current, take CN8's Pin4 as the reference GNC, AND check if the voltage for Pin3 is 0V. If not, it means, Hall sensor is failed.
	2. Current adjusting potentiometer is failed.	3. If Hall is not failed, use a multi-meter to check potentiometer resistance; if the resistance doesn't change according to the adjustment of potentiometer, it means potentiometer is failed.
	2 Control board is failed.	4. If potentiometer is normal. Take CN5's Pin9 as the reference GND, and test if control board CN5's Pin2's voltage changes according to potentiometer adjustment; if no change, it means control board is failed. Check if the resistance for R19 and R20 is normal or not; if yes, contact qualified

		maintenance personnel.
Press torch and activate gas valve and there is OCV, but no HF	1 AC contactor is failed.	<p>1. If the AC contactor doesn't absorb when pull the torch trigger, use a multi-meter to check if there is 2s 24V AC control signal between CN12's Pin 4 and Pin5 when pull the torch trigger; if yes, but no contactor absorbs, it means contact control wires are not tightly connected or contactor is failed.</p> <p>2 If contact absorbs when pull the torch trigger, press AC contactor's yellow trigger device and check if HF wire is close-circuited. If not, it means contactor touch point is failed and need to replace it with a new one.,</p>
	2 HF discharge board is failed.	2 Pull torch trigger and use a multi-meter to test the two wires (winded from main transformer and connected on HF board CN1) voltage is around AC70V; if yes, it means HF board is failed. Examine if there are burnt components on HF board or remove the board and check if the capacitor resistance value is in accordance with the component specification. If no obvious damage, contact qualified maintenance personnel to deal with.
Press torch gas valve and there is neither OCV nor HF	1. Program control board is failed.	1. Use multi-meter and take CN2's Pin1 as GND to test if the voltage of CN2's Pin4 changes from +13V to 0V when pull the torch trigger; if no change, it means the program control board is failed.
	2. Power drive board is failed.	3. Unplug IGBT drive wire and test if there are AC 30V voltage among each of the four groups of G4、E4, E3、G3, G2、E2, E1、G1 on power drive board; If no, it means power drive board is failed.
	4. Three-phase rectifier bridge is failed.	5. Check if there is about 540V DC voltage between positive and negative of 3-phase rectifier bridge. If no, it means the rectifier bridge is failed.

	6. Rectifier diode and AC contactor are all failed.	4. Remove the fast recovery diode from the machine, and use diode mode of a multi-meter to test two fast recovery diode modules. If there is diode having short circuit, it means diode is failed; then check the condition of AC contactor according to above described methods.
	5. Rectifier diode and HF board are all failed.	5. Check the condition of diode and HF board respectively according to above described methods.
There is HF but no pilot arc when pull the torch trigger.	1. Pilot arc resistance is burned out.	2. Measure with resistance mode of multi-meter to check if the pilot arc resistance is normal.
	2. AC contactor is failed.	2. Press the movable yellow trigger device in the middle of AC contactor and measure with diode mode of multi-meter to check if the pilot arc circuit which is connected to AC contactor is close-circuited. If not, it means wires are not well connected or contact of AC contactor is failed.
	3. Fast recovery diode is failed.	3. If the fast recovery diode is failed and short circuited, there might be no machine output. Please check the condition of diode according to above methods.
Pilot arc current is normal but cannot cut normally.	1. Fast recovery diode is failed.	1. If the OCV tested is $\leq 280V$, it is possible that the diode is broken and there is short circuit. Please remove the diode and measure with diode mode of a multi-meter for confirmation.
	2. 3-phase voltage phase loss.	2. If there is a phase loss, it would be hard to establish a stable main arc when adjusting the machine to the maximum output. Please check if the 3-phase power supply is well connected.
	3. IGBT is failed.	3. Remove the 4 sets of drive wires of IGBT from the power driving board. Use diode mode of a multi-meter to check the 4 sets of drive wires of IGBT. If testing results of all sets display 1.95, it means IGBT is not failed.
	4. 3-phase rectifier bridge is damaged.	4. Remove the rectifier bridge from the machine. Use diode mode of a multi-meter to measure if every diode has open circuit. If yes, it means the rectifier bridge is failed.
Pilot arc current is low; no load is normal, but can't cut normally.	1. Weak HF.	1. Inappropriate adjustment for discharging nozzle distance. Please adjust the distance to 1.2mm; or the HF board is damaged. For instance, if the capacitor on the board is damaged, HF may be weak.

	2. Fast recovery diode is damaged.	2. Remove the fast recovery diode from the machine. Use diode mode of a multi-meter to measure if every diode has open circuit; if yes, it means diode is damaged.
Low carbon steel air plasma cutting		

7. Annexed table

7.1 Recommend process specification

Thickn ess (mm)	Contact tube diameter (mm)	Cutting current (A)	Distance between cutting torch and workpie ce	Gas flow (L/min)	Working air pressure (Kg/cm2)	Cutting performance	Recommen d cutting speed(m m/min)
10	Φ1.7	160	3mm	150	5	Smooth cutting surface and no adhering slag	690
20	Φ1.7	160	3mm	150		Smooth cutting surface and no adhering slag	440
30	Φ1.7	160	5mm	150		Smooth cutting surface and no adhering slag	330
40	Φ1.7	160	5mm	150		Smooth cutting surface and no adhering slag	150
50	Φ1.7	160	7mm	150		Smooth cutting surface and no adhering slag	100
60	Φ1.7	160	7mm	150		Smooth cutting surface and no adhering slag	80
Stainless steel air plasma cutting							
Thickn ess (mm)	Contact tube diameter (mm)	Cutting current (A)	Distance between cutting torch to workpie ce	Gas flow (L/min)	Working air pressure (Kg/cm2)	Cutting performance	Recommen d cutting speed (mm/min)
40	Φ1.7	160	5mm	150	5	Rough cutting surface and no adhering slag	210
Aluminum and aluminum alloy air plasma cutting							
Thickn ess (mm)	Contact tube diameter	Cutting current (A)	Distance between cutting	Gas flow (L/min)	Working air pressure	Cutting performance	Recommen d cutting speed

)	(mm)		torch to workpie ce		(Kg/cm2)		(mm/min)
20	Φ1.7	160	3mm	150	5	Rough cutting surface and no adhering slag	560

7.2 Time sequential routine description (2T/4T)

Sequential control (2T)

1. Press torch trigger; after small gas valve works for 1-2s, make the control circuit emit wave and the main circuit work; meanwhile, HF pilot arc control switch starts to work; there are no-load voltage and transferred arc; if main circuit doesn't detect any current, the control circuit will stop emitting wave after 2s, and HF control, pilot arc control switch will stop working; big gas valve starts to work without no-load voltage; working gas will be turned off after working for 12s.
2. The control circuit starts emitting wave and main circuit starts to work after torch trigger is pressed (1-2s); meanwhile HF pilot arc control switch starts to work; also there are no-load voltage and transferred arc; if transferred arc transfers to workpiece, and main circuit detects current, the controlling switch of HF and pilot arc will be turned off. Main arc is ignited and big gas valve is working (working gas is operated);
3. Press the torch trigger and after ion gas is working (1-2s), main circuit starts to work; also, HF pilot arc switch starts to work; transferred arc succeeds in breaking arc and cutting. If suddenly main arc is broken when transferred arc successfully transfers to the workpiece, AC contactor will work instantly to generate HF and pilot arc; they will contact with the workpiece until the main arc is ignited again.

The difference between 4T and 2T is that the flame of main arc of 4T will not stop and the normal cutting will continue when the torch trigger is pressed and then released when the cutting is normal.

7.3 Technical parameters

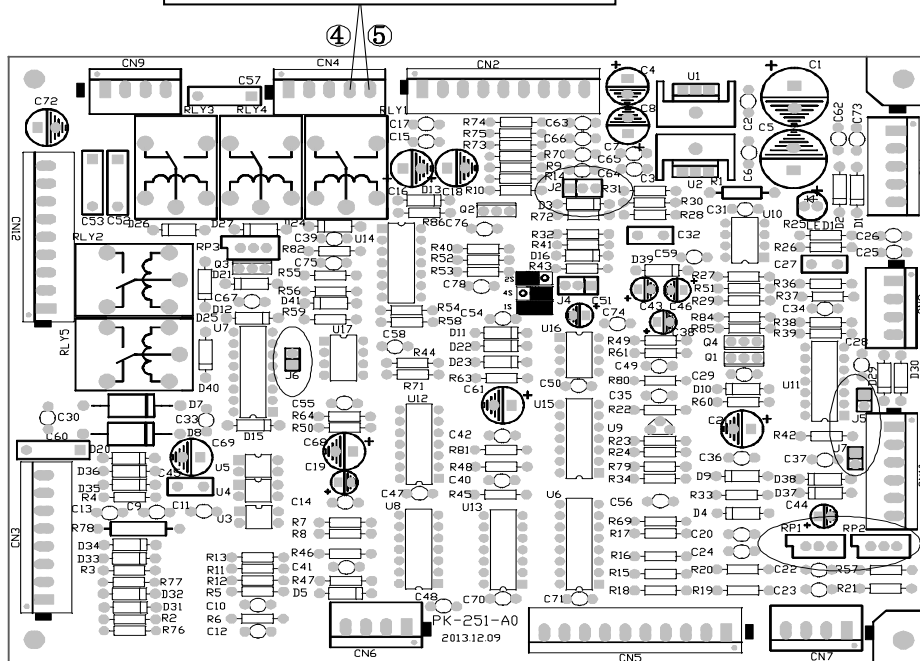
Item		Model
		LGK—160(L307)
Input	Input voltage	3 Phase AC380V±15% 50Hz
	Rated input capacity (KVA)	29.2
	Power factor	0.78

Output	Rated OCV(V)	320
	Rated max output(A/V)	160/144
	Cutting current range (A)	30~160
	Output characteristics	CC(constant current)
	Arc start type	Contactless arcing
	Quality cutting thickness (mm)	40(carbon steel)
	Max cutting thickness (mm)	60(carbon steel)
	Recommend compressor gas displacement(L/min)	170
	Recommend cutting air pressure (Kg/cm ²)	4~6
Environment	Working temperature range (°C)	-10~+40
	Storage temperature range (°C)	-25~+55
	Humidity (%)	≦90 no water drop condensation
Structure	Enclosure protection class	IP21S
	Cooling type	Forced air cooling
Rated duty circle (%)		60
Efficiency (%)		85
Insulation grade		F

7.4 LGK-160 (J47) CNC connection

1. Pin4 and Pin 5 of CN4 on programmed control PCB (as shown in below diagram) are equivalent to a switch contact (without polarity differentiation). Under normal cutting, Pin4 and Pin5 are automatically short-circuited (note: Pin4 and Pin5 are disconnected under pilot arc status), so that they provide successful arcing signal for CNC machine and control CNC on and off.

Successful signal of arcing



2. Cutting machine provides arc voltage signal for arc voltage regulator. Arc voltage regulator will automatically adjust the height of cutting torch according to arc voltage signal. Arc voltage can be divided into “arc voltage+” and “arc voltage-” .

