GGPX00-0.X-H型

# 固态高频一体焊机

# Solid state high frequency integrated welder

安装与使用

Installation and use

说

明

书

# 中国·河北·保定
# 保定同泽电气科技有限公司
# China Baoding Tongze Electric Technology Co., Ltd.

## 一、前 言

尊敬的用户，感谢您选用我公司产品。我们将尽最大努力，并与您真诚的合作，将我们的设备和售后服务做好，使之发挥最佳效能，为您创造出最大效益。

为此，现将该设备安装和使用的要求以及应注意的问题做较为详细说明，以免造成不必要的损失。

本装置是我公司科研人员在充分吸收国内外同类产品的先进技术并总结了他们多年在国内调试、维修经验的基础上精心研制的高技术产品。主要应用于直缝焊管（感应焊、接触焊）、淬火、钎焊等领域。自 2016 年研制成功后，经过多次改进，现已非常成熟可靠。其主电路与传统的可控硅中频电源基本相似（后附图），而控制电路采用微型计算机为核心，并配以其它外围器件，全部控制元件集成在两块线路板上（整流、逆变各一块）。在充分发挥计算机软硬件的强大功能基础上，实现了对整流和逆变的最佳调节，与原电子管高频设备相比，具有以下几个优点：

1、 焊管质量好：经对比表明，焊缝的宽度、火候均匀、焊接毛刺少。
2、 节能：经测试表明，本设备比同规格的电子管设备节电 30%以上。
3、 节水：由于自身损耗小，不需要太多冷却水，因此用水量比同规格电子管设备少 50%以上。
4、 体积小、重量轻：由于主要功率器件（MOSFET、电容等）均很小，也没有诸如灯丝稳压器、匹配线圈、栅极回路、焊接变压器等器件，工作电压低，安装紧凑，整体体积比同规格的电子管设备小 50%以上 。
5、 操作方便：即开即用，说停就停。既无须电子管式预热，也不必停机后继续冷却。
6、 使用安全：电子管属于高压器件，工作时有上万伏高压，而 MOSFET 为低压器件并工作在并联谐振状态（不同于某些厂家的串联谐振），最高电压不过几百伏，一般不会造成人身伤害。

Dear users, thank you for choosing our products. We will do our best and cooperate with you sincerely to make our equipment and after-sales service well, so as to make it play the best role and create the maximum benefit for you.

For this reason, the installation and use requirements of the equipment as well as the problems to be noted are described in detail to avoid unnecessary losses.

The device is a high-tech product developed by our company's scientific researchers on the basis of fully absorbing the advanced technology of similar products at home and abroad and summarizing their years of experience in domestic debugging and maintenance. It is

mainly used in straight welded pipe (induction welding, contact welding), quenching, brazing and other fields. Since its successful development in 2016, it has been very mature and reliable after many improvements. Its main circuit is basically similar to the traditional silicon controlled medium frequency power supply (see the attached figure), while the control circuit uses a microcomputer as the core, and is equipped with other peripheral devices. All the control elements are integrated on two circuit boards (one for rectifier and one for inverter). On the basis of giving full play to the powerful functions of computer software and hardware, the optimal regulation of rectifier and inverter is realized. Compared with the original electronic tube high-frequency equipment, it has the following advantages:

1. The quality of welded pipe is good: the comparison shows that the width of weld joint, uniform fire and less welding burr.
2. Energy saving: according to the test, this equipment saves more than 30% of the electricity compared with the electronic tube equipment of the same specification.
3. Water saving: due to its small loss, it does not need too much cooling water, so the water consumption is more than 50% less than that of electronic tube equipment of the same specification.
4. Small size and light weight: because the main power devices (MOSFET, capacitor, etc.) are very small, and there are no such devices as filament voltage regulator, matching coil, grid circuit, welding transformer, etc., the working voltage is low, the installation is compact, and the overall volume is more than 50% smaller than the electronic tube equipment of the same specification.
5. Convenient operation: open and use, stop and stop. It doesn't need electric tube preheating or cooling after shutdown.
6. Use safety: the electronic tube is a high-voltage device, with tens of thousands of volts of high voltage when it works, while the MOSFET is a low-voltage device and works in a parallel resonance state (different from the series resonance of some manufacturers), with the highest voltage of only a few hundred volts, which generally will not cause personal injury.

## 二、设备概述

1、型号说明：

GGP150-0.35-H

以上代表额定功率150KW、频率350KHZ、用于焊管的固态高频。

2、输入电源：三相四线380V±5%，频率50Hz±1Hz（根据要求可特殊定做），容量大于120KVA

3、额定输出：功率150千瓦，频率250到400千赫。

4、设备组成：

柜体： 长1750×宽800×高1100 一台

水冷系统（选配）：长1900×宽1100×高2000 一台

1. Model Description:
Ggp150-0.35-h
The above represents the rated power of 150KW, the frequency of 350khz, and the solid-state high frequency used for welded pipe.
2. Input power supply: three-phase four wire 380V ± 5%, frequency 50Hz ± 1Hz (can be customized according to requirements), capacity greater than 120kVA
3. Rated output: power 150 kW, frequency 250-400 kHz.
4. Equipment composition:
Cabinet body: 1750 × 800 × 1100 long, one set
Water cooling system (optional): length 1900 × width 1100 × height 2000, one set

## 三、设备安装

本设备运到用户现场后，应用叉车小心水平卸车及安装，若没有叉车可用吊车及绳索托底起吊，本设备不允许过分倾斜，更不许倒置。

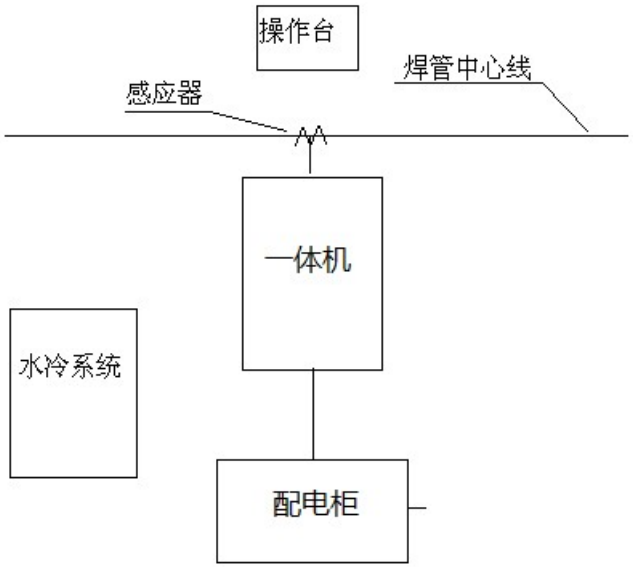
设备安装前请仔细查看下图并阅读后面文字说明，施工时尽量按要求作好相应工作，以便能长期稳定运行，若有疑问，可来电话询问。

为了使本设备能尽快投入使用，缩短调试时间，将设备安放好后，应将水、电管线接入设备。然后我公司调试人员才能进厂，以便迅速开展调试工作。调试步骤在《调试与维修》中有详细说明

After the equipment is transported to the user's site, the forklift shall be used for careful horizontal unloading and installation. If there is no forklift that can be lifted by crane and rope bottom, the equipment shall not be tilted excessively or inverted.

Please carefully check the figure below and read the following text instructions before the equipment installation. During the construction, try to do the corresponding work as required, so as to be able to operate stably for a long time. If you have any questions, you can ask by phone.

In order to put the equipment into use as soon as possible and shorten the commissioning time, after the equipment is placed, the water and electricity lines shall be connected to the equipment. Then the debugging personnel of our company can enter the factory, so as to carry out the debugging work quickly. Commissioning steps are detailed in commissioning and maintenance




焊管固态高频布局参考

## 3.1使用环境要求：

本设备设计为室内安装，避免雨淋、霜雪、阳光曝晒。同时还应满足以下条件：

a）：海拔高度不超过1000米，海拔过高会因气压降低而冷却效果变差，

b）：环境温度-5℃---- +40℃，(低于0℃时停机后应注意防止结冰冻坏冷却水管路)

c）：空气相对湿度不超过85％，

d）：无导电爆炸尘埃，没有腐蚀金属和破坏绝缘的气体及蒸汽，

e）：无剧烈振动和冲击，

f）：额定负荷以下运行。

不满足以上要求，订货时应重点说明，设备应降规格使用，否则故障率会有所上升，使用寿命会相应缩短。

The equipment is designed for indoor installation to avoid rain, frost and snow, sunlight exposure. The following conditions shall also be met:

A): the altitude is not more than 1000m. If the altitude is too high, the cooling effect will be poor due to the decrease of air pressure.

B): the ambient temperature is - 5 ℃ - + 40 ℃, (when the temperature is lower than 0 ℃, attention shall be paid to prevent the cooling water pipeline from being damaged by freezing)

C): the relative humidity of air shall not exceed 85%.

D): no conductive explosive dust, no gas or steam that corrodes metal and destroys insulation,

E): no violent vibration and impact,

F): operation under rated load.

If the above requirements are not met, it should be emphasized when ordering that the equipment should be used with reduced specifications, otherwise the failure rate will rise and the service life will be shortened accordingly.

## 3.2场地的要求

a） 安装设备的工房或场地要求基本符合上述设备的使用环境要求，用户可根据本车间的具体情况自行布置，为了工房的整洁和工作方便，要设置专用的水、电地槽，上面盖上木板（或水泥砖）与地面相平，以便于安装水电管线。

b） 安放设备的地面面积略大于设备面积即可，不影响日常检修和维修操作。设备安装垂直倾斜度不大于5度、以免日久变形

A) the workshop or site where the equipment is installed shall basically meet the requirements of the use environment of the above-mentioned equipment. The user can arrange by himself according to the specific conditions of the workshop. In order to keep the workshop clean and convenient for work, special water and electricity trenches shall be set up, and the wooden board (or cement brick) shall be covered on it to be level with the ground, so as to facilitate the installation of water and electricity pipelines.

B) the ground area of the equipment is slightly larger than the area of the equipment, which will not affect the daily maintenance and repair operation. The vertical inclination of equipment installation shall be no more than 5 degrees to avoid long-term deformation.

## 3.3供电要求

a)用户供电容量应满足实际使用功率的1.2倍，如实际输出150KW的设备，供电容量应为180KVA。

b) 进入设备的电缆应接到空气开关上口，截面应不小于95 ㎜²以上塑铜线（若采用铝线截面积加倍）。

c)电源中线（零线）应从供电变压器零线接出，不允许用大地代替零线，截面积大于150 ㎜²。但设备机箱应与大地可靠连接。

A) The user's power supply capacity should be 1.2 times of the actual power used. If the actual output of 150 KW equipment, the power supply capacity should be 180 KVA.

B) The cables entering the equipment shall be connected to the upper outlet of the air switch, and the cross-section shall be no less than 95 m_of the plastic copper wire (if the cross-section area of the aluminum wire is doubled).

C) the central line (zero line) of the power supply shall be connected from the zero line of the power supply transformer. It is not allowed to replace the zero line with the earth, with a sectional area greater than 150 m ㎡. But the equipment case shall be reliably connected with the earth.

## 3.4供水要求

本设备的整流部分、MOSFET 模块、槽路电容、线圈等都要求水冷却，且对水温、水质等有严格要求。一般情况下用户应选配我公司水冷系统。与固态高频配套的水冷系统有两种：1）风水冷却系统，该系统自成体系，内含水箱、水泵、散热片、风机、喷淋装置、电控元件等部件。水箱内装纯净水，由水泵通到高频设备上，将发热器件冷却。而纯净水回到水冷系统后通过散热片被风机吹冷。当天气炎热无法由风冷却到要求温度时，由喷淋系统靠蒸发散热。2）水水冷却系统，主要由水泵、水箱、热交换器等组成，该系统分内水和外水，外水通过热交换器将内水冷却。内水采用纯净水，避免设备内部结垢而损坏。但应定期清理热交换器。

若用户想自备水冷却系统，须满足以下要求：

a）进水压力：0.15—0.25Mpa,过高容易漏水，过低不利散热。

b）冷却水水温5—35℃，过低容易结露，过高不利散热。进出水温差小于2℃。

c）水流量：大于10吨/小时

d）冷却水应为软化中性水、纯净水或蒸馏水，无杂质。

The rectifier part, MOSFET module, channel capacitor and coil of the equipment require water cooling, and have strict requirements on water temperature and water quality. In general, users should choose our company's water cooling system. There are two kinds of water-cooling system matching with solid-state high-frequency: 1) air water cooling system, which is a self-contained system, including water tank, water pump, radiator, fan, spray device, electronic control elements and other components. The water tank is filled with pure water, which is passed from the pump to the high frequency equipment, and the heating device is cooled. After the purified water returns to the water cooling system, it is cooled by the fan through the heat sink. When the weather is hot and cannot be cooled by the wind to the required temperature, the spray system uses evaporation to dissipate heat. 2) water cooling system is mainly composed of water pump, water tank, heat exchanger, etc. the system is divided into internal water and external water, and the external water cools the internal water through the heat exchanger. Pure water is used for internal water to avoid internal scaling and damage of equipment. However, the heat exchanger should be cleaned regularly.

If users want to provide their own water cooling system, they must meet the following requirements:

A) water inlet pressure: 0.15-0.25mpa, too high, easy to leak, too low, adverse to heat dissipation.

B) the temperature of cooling water is 5-35 ℃, which is easy to condense when it is too low and disadvantageous for heat dissipation when it is too high. The difference between the inlet and outlet water temperature is less than 2 ℃.

C) water flow: more than 10 tons / hour

D) the cooling water shall be softened neutral water, purified water or distilled water, free of impurities.

## 四、操作规程

开机前应先检查设备旁边是否有能引起危险的人或物品。设备是否有异常情况。若一切正常应先开启水冷系统。并检查供水是否正常，设备内是否有漏水、阻塞现象。若一切正常方可通电开机。

### 4.1 开机顺序：

a)转动控制电源开关，整流柜和逆变柜控制电源（微机板用电源）上电，按加热停按钮可使逆变柜复位,触摸屏显示设备正常。若不能则可能有问题。

b) 按主通按钮，给电容充电后主回路上电，显示由‘1’最后变为‘A’（逆变正常）或‘y’（逆变故障），若显示‘y’再按‘加热停’可使逆变柜控制复位,显示变为‘A’。

c)按加热启按钮，显示变为“C”（正在启动），随后变为‘d’（低功率运行），这表示正常，若停在‘C’上不动表明无法启动。

d)顺时针调节功率调节电位器，直流电压，直流电流会逐渐升起，直流电压升到某一值后显示变为‘H’(正常工作)，若电流过大，还未显示‘H’时就升到较大值，则会停机并显示‘L’,这表明设备可能有问题。

注：在正常工作时，可将功率给定电位器事先调到某一固定位不再动，直接按加热启迅速起动）。

4.2 停机顺序：

a) 逆时针调节功率调节电位器，直流电压，直流电流会逐渐下降至某一较小值，显示变为‘d’。注：正常工作时可不进行本操作。

b) 按加热停按钮，直流电压，直流电流变为0，显示变为‘A’，

c) 按主断按钮断开主接触器。注：短时停机并且不接触有电部位时可以不断此开关及下一步的控制电源，再开机时直接从“开机顺序”中的第c步开始即可。

d) 断开控制电源开关。

A) adjust the power regulating potentiometer anticlockwise, DC voltage, DC current will gradually drop to a smaller value, and the display will change to "d". Note: this operation is not required in normal operation.

B) press the heating stop button, DC voltage, DC current will change to 0, display will change to 'a',

C) press the main disconnect button to disconnect the main contactor. Note: when the machine is shut down for a short time and does not touch the electrified part, the switch and the next control power supply can be kept. When the machine is restarted, it can be started directly from step C in "startup sequence".

D) disconnect the control power switch.

4．3匹配调节：

更换感应圈后、正式生产之前，应进行电感匹配，应制作合适的感应圈，否则感应圈电感相差过大会使设备输出频率、功率偏离正常范围，造成逆变柜不正常。

不同应用和不同规格设备对频率和功率要求不同，应根据工艺要求和调试状态调节。

After the replacement of induction coil and before the formal production, inductance matching shall be carried out, and appropriate induction coil shall be made, otherwise, if the inductance difference of induction coil is too large, the output frequency and power of the equipment will deviate from the normal range, resulting in abnormal inverter cabinet.

Different applications and different specifications of equipment have different requirements for frequency and power, which should be adjusted according to process requirements and commissioning status.

# 五、日常维护

5.1 人员和规定：

本设备是一部大功率、高电压的电子设备，也是电子、电力、电控紧密结合的整机产品，其操作和维护要配备适当人员，一般的内外线电工是不够的。这就要求使用单位选调、培训相应的人员。操作人员和维修人员可以兼任，也可以分别设置，重要的是必须定岗定位，要保持相对稳定和连续性，不可经常更换，不然对设备的使用、维护、技术的提高、熟练都不利。事在人为，人的要素是最重要的、不可忽视的。

人员固定后，要制定相应的岗位责任制度，使工作有章可循。例如操作规程、班前准备的要求、班后维护的要求、阶段性的保养规定等等。这些可根据单位的具体情况制定。

This equipment is a high-power, high-voltage electronic equipment, but also electronic, power, electronic control close integration of the whole product, its operation and maintenance should be equipped with appropriate personnel, general internal and external electricians is not enough. This requires the user to select and train the corresponding personnel. The operators and maintenance personnel can be appointed at the same time or set up separately. It is important to fix their posts and positions, keep relative stability and continuity, and do not replace them frequently, otherwise it will be unfavorable to the use, maintenance, technical improvement and proficiency of the equipment. Human factors are the most important and cannot be ignored.

After the personnel are fixed, the corresponding post responsibility system shall be formulated to make the work have rules to follow. For example, operation regulations, requirements for preparation before shift, requirements for post shift maintenance, phased maintenance regulations, etc. These can be formulated according to the specific situation of the unit.

## 5.2 设备的日常维护

1） 定期对设备内外裸露器件除尘，因为工厂车间内的灰尘大多含有金属粉末成分，这样积尘到一定程度就会引起高压放电，势必将损坏设备。

2） 定期检查各接头螺丝是否松动，是否有发热烧糊的地方，是否有严重锈蚀、接触不良的地方，若有，应立即处理。

3） 定期对水冷故障保护器件进行检测，以免保护失灵而损坏设备。

4） 采用水水冷却系统的用户，应定期对热交换器进行清洗。

5） 未采用闭路水冷系统而直接水池冷却的用户，应时刻注意观察各水管流水是否通畅，水温是否过热。

6） 严冬季节，特别是北方，停机时间过长，车间气温低于零下时，一定要把设备内的存水排净，防止冻裂管路和线圈。

**处理机内问题时应切断内部电源，以免触电。**

1) regularly dust the exposed parts inside and outside the equipment, because most of the dust in the workshop contains metal powder composition, so the dust accumulation to a certain extent will cause high-voltage discharge, which is bound to damage the equipment.

2) regularly check whether the joint screws are loose, whether there are hot and burnt places, whether there are serious rust and poor contact places, and if there are, handle them immediately.

3) regularly inspect the water-cooling fault protection device to avoid damage to the equipment due to the protection failure.

4) users using water cooling system shall clean the heat exchanger regularly.

5) users who do not use the closed-circuit water cooling system but directly cool the pool should always pay attention to observe whether the water flow of each water pipe is smooth and whether the water temperature is overheated.

6) in the severe winter season, especially in the north, when the shutdown time is too long and the workshop temperature is lower than zero, the water in the equipment must be drained to prevent the pipeline and coil from frost cracking.

When there is a problem in the processor, the internal power should be cut off to avoid electric shock.

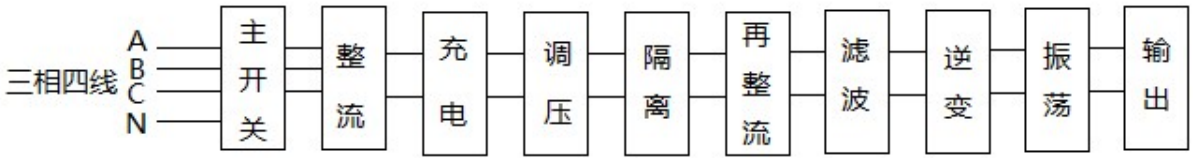
# 六、主回路说明

本装置的主回路与可控硅中频电源基本相同(见附图) 。三相380V交流电进入三相全控桥整流后变成脉动直流，平波电抗器及滤波装置将此直流滤波变成平直的直流，再经单相逆变桥变成高频率的交流电供给槽路（电容和感应器组成槽路）作为振荡电源。

以下为本设备电气原理图：

The main circuit of the device is basically the same as the SCR IF power supply (see attached figure). After three-phase 380V AC enters into three-phase full control bridge for rectification, it becomes pulsating DC. The smoothing reactor and filter device will transform this DC filter into straight DC, and then through single-phase inverter bridge, it becomes high-frequency AC supply channel (the channel composed of capacitance and inductor) as the oscillating power source.

The following is the electrical schematic diagram of the equipment:




## 6.1 整流部分主要由以下组成：

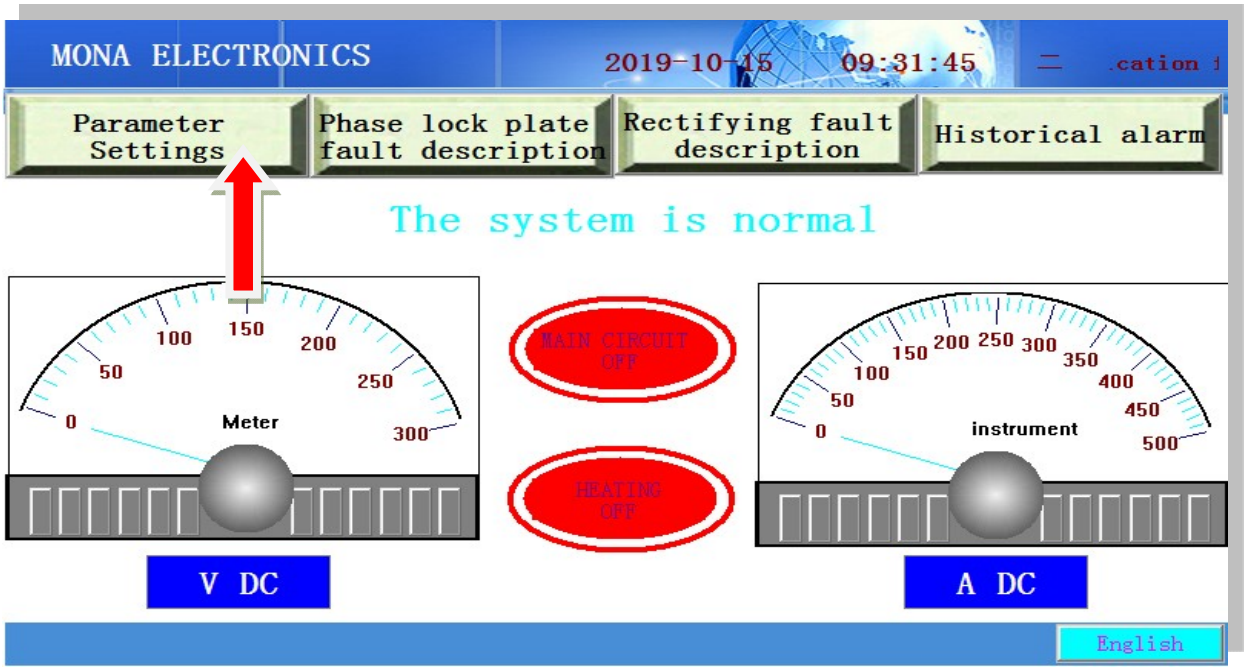
1：二极管整流桥：,.
2：充电电抗器：
3：充电电容：
4： IGBT
5：隔离降压变压器
6：二次整流二极管
7：平波电抗器
8：控制电路：数控板、电源板、操作板、电压反馈板、继电器等
9：电流互感器

1: diode rectifier bridge:.
2: charging reactor:
3: charging capacitance:
4:IGBT
5: isolated step-down transformer
6: secondary rectifier diode
7: smoothing reactor
8: control circuit: CNC board, power board, operation board, voltage feedback board, relay, etc.
9: current transformer

## 6.2 数控整流控制板说明：

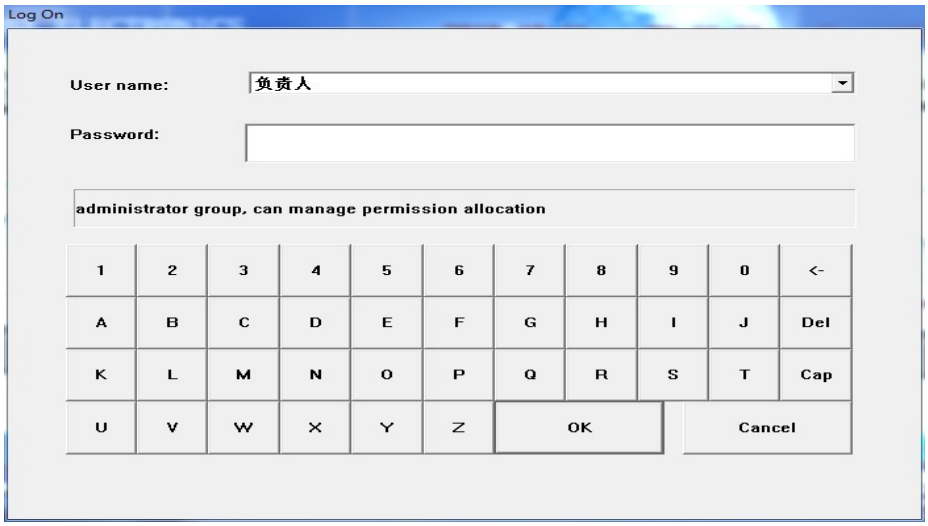
通过触摸屏调整设备的各种工作状态.

Adjust various working states of the device through the touch screen



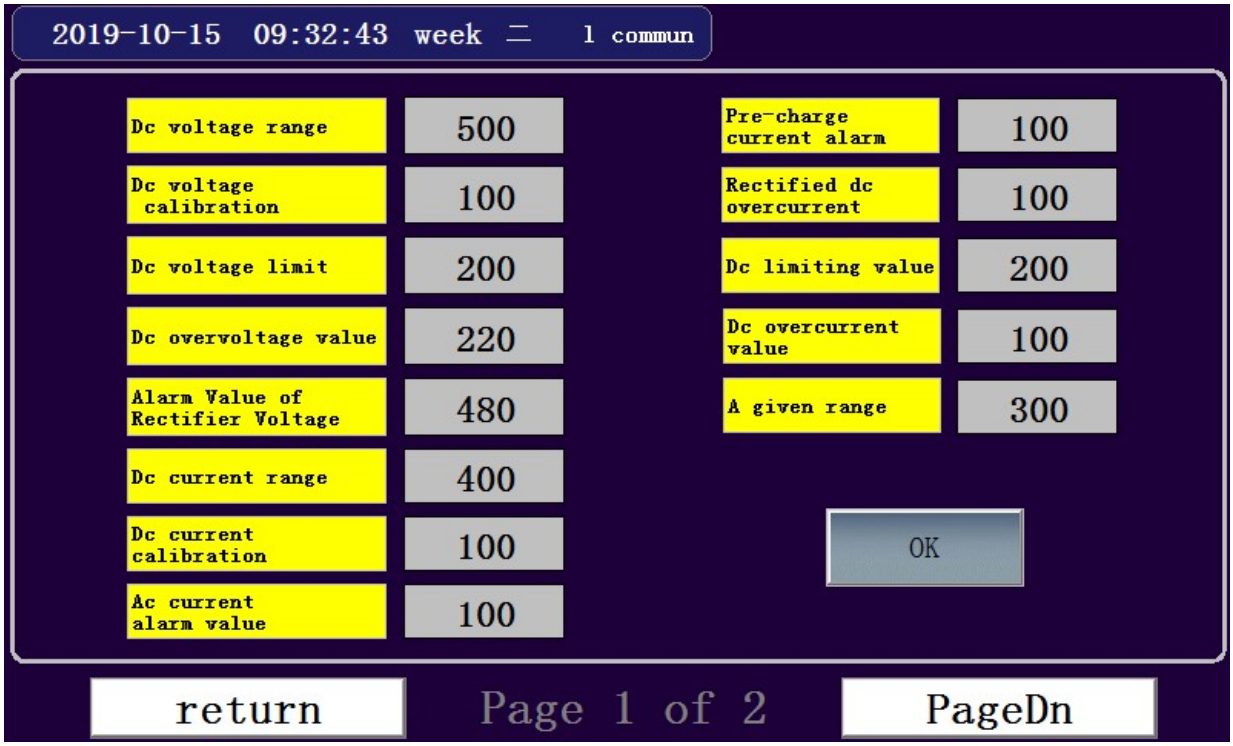

点击红色箭头指示的按钮，进入密码输入界面

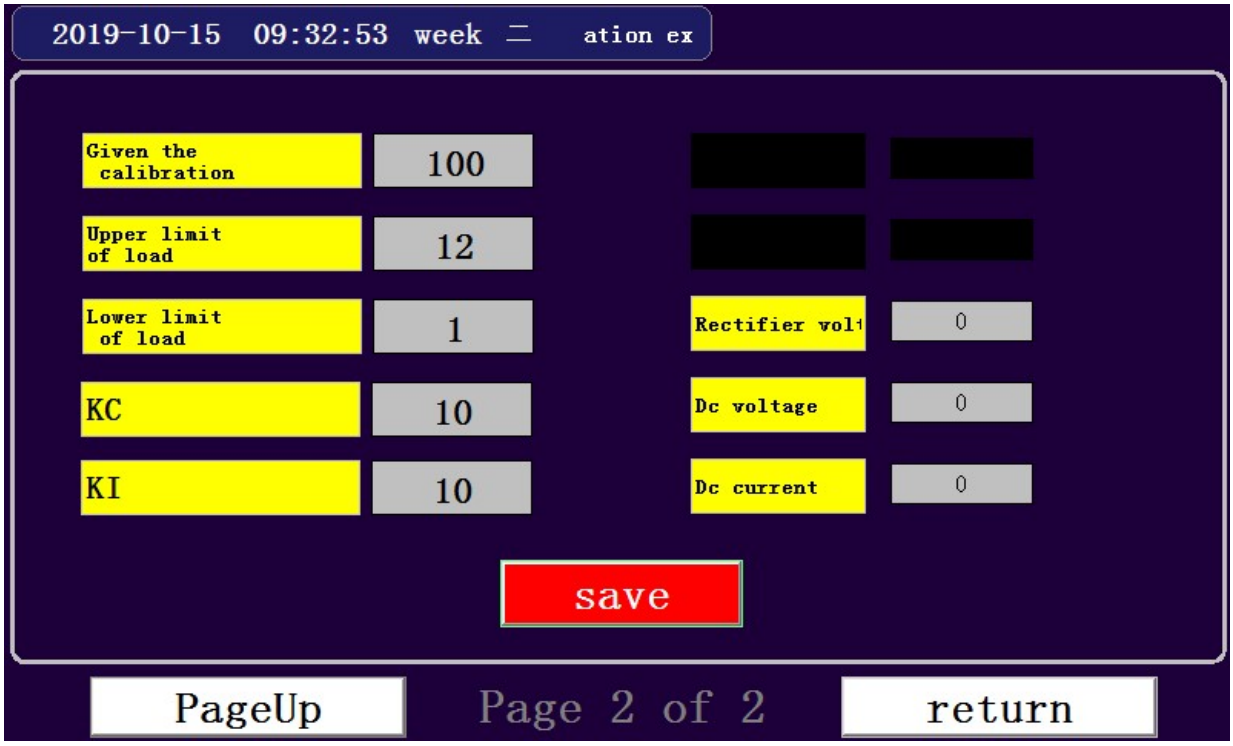
Click the button indicated by the red arrow to enter the password input interface.




输入密码：123456，进入参数设置页面

Enter the password: 123456, enter the parameter setting page




参数设置完成后点击保存按钮，进行数据保存。

After the parameter setting, click Save to save the data.

1. 直流电压量程：用于修改直流电压反馈值范围。
2. 直流电压校准：用于微调直流电压范围 50-100
3. 直流限压值：限制直流输出最大电压。

4. 直流过压值：直流电压超过此值将报警。
5. 整流直压报警值：三相进线整流直流电压值超过此值报警。
6. 直流电流量程：用于修改直流电流反馈值范围。
7. 直流电流校准：用于微调直流电流范围 50-100
8. 交流电流报警值：交流进线大于此值报警。
9. 预充电电流报警值：电解电容充电电流大于此值报警。
10. 整流直流过流：IGBT进线电流大于此值报警。
11. 直流限流值：限制直流输出最大电流。
12. 直流过流值：直流电流超过此值将报警。
13. 给定量程：电位器给定值。
14. 给定校准：电位器给定值微调。

1. DC voltage range: used to modify the DC voltage feedback value range.
2. DC voltage calibration: used to fine tune DC voltage range 50-100
3. DC voltage limit: limit the maximum DC output voltage.
4. DC overvoltage value: if the DC voltage exceeds this value, an alarm will be given.
5. Rectified direct voltage alarm value: the three-phase incoming line rectified direct voltage value exceeds this value to alarm.
6. DC current range: used to modify the DC current feedback value range.
7. DC Current Calibration: Used for fine-tuning DC Current Range 50-100
8. AC current alarm value: alarm when the AC incoming line is greater than this value.
9. Alarm value of precharge current: alarm when the charging current of electrolytic capacitor is greater than this value.
10. Rectifier DC over-current: alarm when IGBT incoming current is greater than this value.
11. DC current limit value: limit the maximum DC output current.
12. DC overcurrent value: if the DC current exceeds this value, an alarm will be given.
13. Given range: given value of potentiometer.
14. Given calibration: adjust the given value of potentiometer.

6.3 逆变部分由以下组成：

1：功率单元：共4块，2正2负，
2：槽路电容：分为四组（与感应器大小有关），
3：调节电感：并联电感1个。
4：泄流电抗：一个，电感量。
5：控制电路：逆变控制板、反馈板、电源分配板、冷却检测板、开关电源。
6：传感器：电接点压力表。
7：冷却风机：2个。
8：频率表及状态显示块。
逆变柜输入：直流电0到230V，输出：高频交流电，频率300到450KHZ。
保护：整流柜故障（1）、冷却故障（2）、逆变控制板15V电源故障（3）、频率越限（4）、调节失锁（5、6）、过压（7）、功率板故障（9）。

1: power unit: 4 pieces in total, 2 positive and 2 negative.
2: channel capacitance: divided into four groups (related to the size of inductor).
3: regulating inductance: one in parallel.
4: discharge reactance: one, inductance.
5: control circuit: inverter control board, feedback board, power distribution board, cooling detection board, switching power supply.
6: sensor: electric contact pressure gauge.
7: cooling fan: 2.
8: frequency meter and status display block.
Inverter cabinet input: DC 0 to 230V, output: high frequency AC, frequency 300 to 450kHZ.
Protection: rectifier cabinet fault (1), cooling fault (2), inverter control board 15V power supply fault (3), frequency out of limit (4), regulation loss of lock (5, 6), overvoltage (7), power board fault (9).

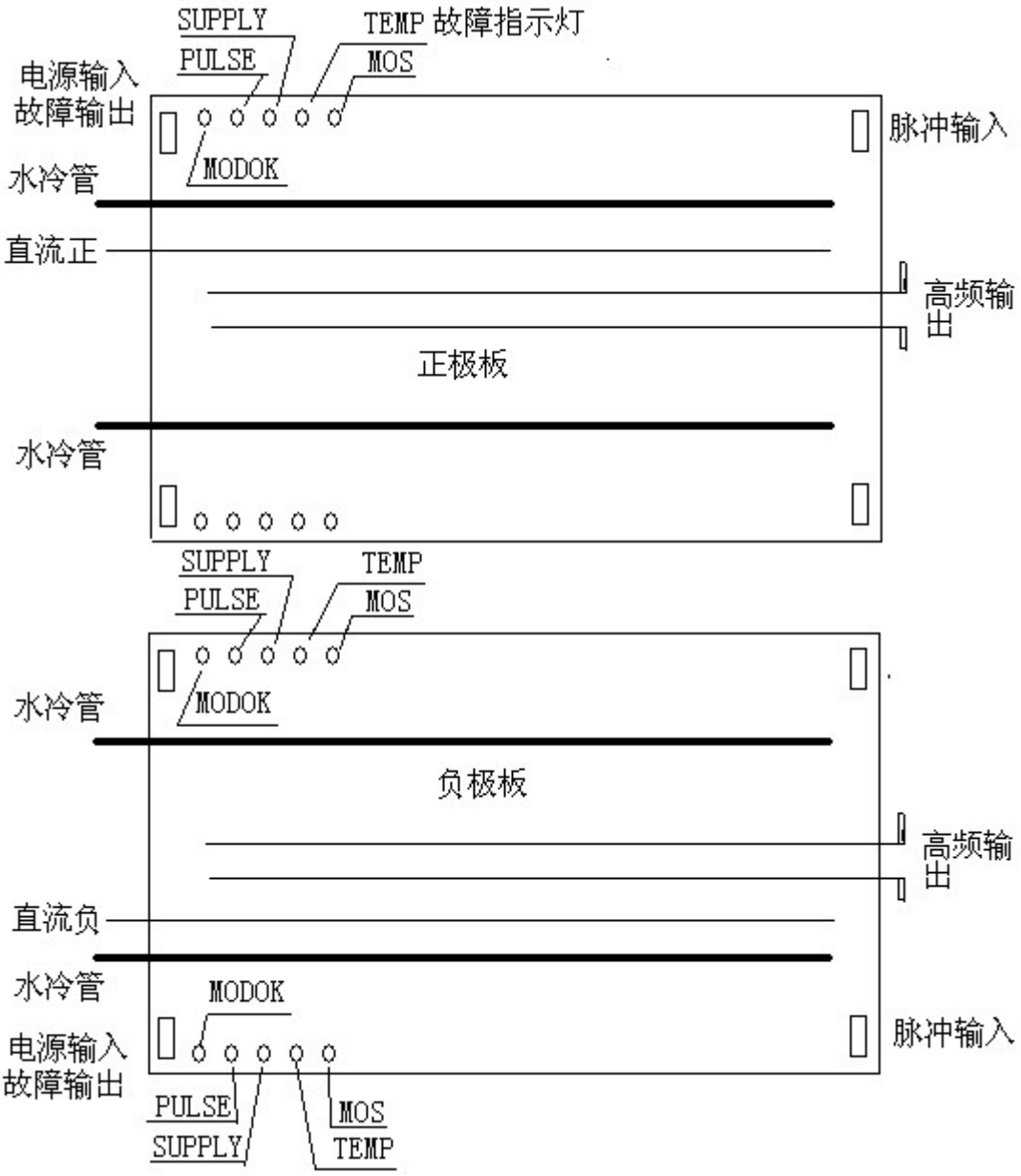
## 6.4 MOSFET功率单元说明：

逆变柜内装有2对4块功率单元板，接直流正极的为正极板，接直流负极的为负极板，正负极板组成完全一样，但内部连接方式不同而用处不同。一正一负为一对，组成一个逆变桥，可输出50KW。

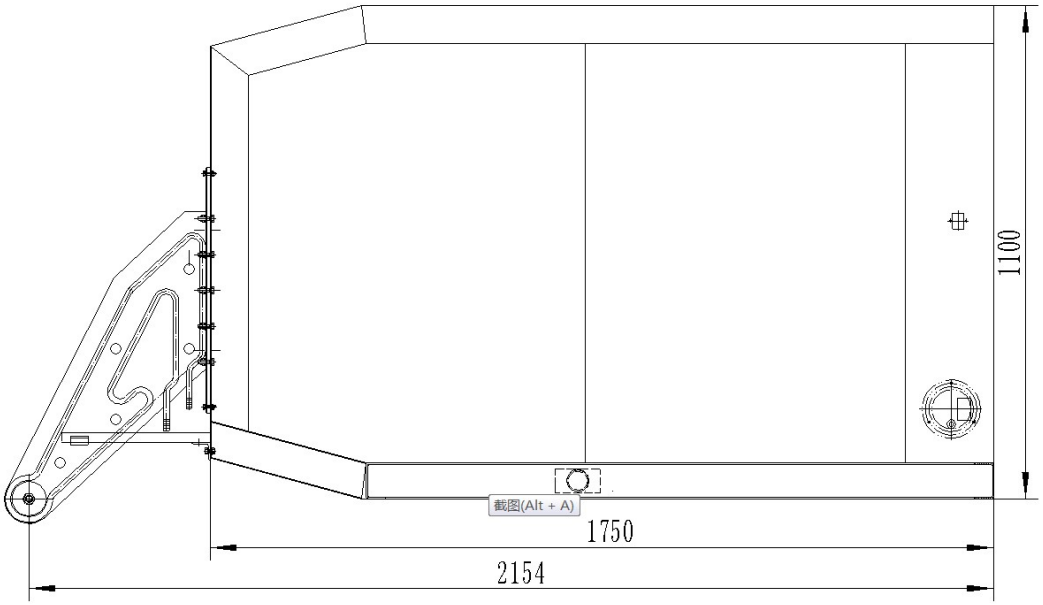
每块功率板上器件又分成基本对称的两部分，每部分为一个桥臂。每个桥臂由24只大功率场效应管IR460(MOSFET)、12只大功率二极管和相应控制、保护器件组成。控制电路包括：脉冲变压器、驱动脉冲整形及功率放大、反压形成等功能。保护电路包括：阻容吸收、温度（TEMP）、脉冲丢失(PULSE)、功率管坏（MOS）、驱动电源过低（SUPPLY）等，每个故障均有一个红灯指示，没有故障时绿灯亮（MODOK）,各指示灯位置见图示。

Two pairs of four power unit boards are installed in the inverter cabinet. The positive board is connected to the DC positive pole, and the negative board is connected to the DC negative pole. The positive and negative pole boards have the same composition, but different internal connection methods lead to different uses. One positive and one negative is a pair, forming an inverter bridge, which can output 50KW.

Each power board device is divided into two parts which are basically symmetrical, each part is a bridge arm. Each bridge arm consists of 24 high power MOSFETs (ir460), 12 high power diodes and corresponding control and protection devices. The control circuit includes: pulse transformer, driving pulse shaping, power amplification, back pressure forming and other functions. The protection circuit includes: resistance capacitance absorption, temperature (Temp), pulse loss (pulse), power tube failure (MOS), drive power supply too low (supply), etc. each fault has a red light indicator, and if there is no fault, the green light will be on (modok), and the location of each indicator is shown in the figure.


SUPPLY
PULSE
TEMP 故障指示灯
MOS
电源输入
故障输出
MODOK
脉冲输入
水冷管
直流正
高频输出
正极板
水冷管
SUPPLY
PULSE
TEMP
MOS
水冷管
MODOK
负极板
高频输出
直流负
水冷管
MODOK
电源输入
故障输出
脉冲输入
PULSE
SUPPLY
MOS
TEMP

下面附有机箱外形图和电气原理图




机箱外形尺寸图