SINEPOWER

ST35 Digital

Forward and Reverse Control Three Phase Full Control Rectifier Trigger Board

（Constant Voltage and Constant Current Control）

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Content in this user manual is just for your reference, we will update the user experiences, like to modify the parameters for better functions. Pls follow our updates on our website, and download the electronic edition freely.

Content

The components of our products:

* The power transformer adopts industrial grade transformer, epoxy resin potting, high quality products tempered by high temperature aging;

* The main control chip adopts NXP 32-bit LPC17 series industrial-grade high-performance processor, which has superior computing processing capability and reliable anti-interference ability;

* Passive components are basically our national giant brand Yageo, high temperature resistance, low drift, device working life can achieve more than 10 years;

* The key passive components adopt Murata and Infineon brand to ensure that the key parts of the control panel cannot be easily damaged;

* Control relay is Omron brand, the number of actions is more than 10 times that of domestic brands;

* The terminal block is made of Machiya's DINKLE brand and made of internal copper alloy. Unlike most of the control panel on the market which usually uses iron terminals.

* Control board with intrinsically safe design, uses self-recovery fuse at the power supply to limit current output, and to prevent accidental short circuit of external terminal block and damage control board;

* Associate with our core control algorithms and SMD placement technology, we assure you with reliable and stable control panels.

- **Safety regulations and notes before operation：**

>> Safety regulations:

- The wrong use may cause permanent damage to the product or serious personal accidents. Therefore, the operating procedures on must be strictly follow the user manual, National and industry standards and safety regulations.

- The installation, maintenance or guidance installation, maintenance control devices should be charged by professional and technical person with relevant experience.

- Under no circumstances should you plug out the wiring or try to touch the contacts in the socket while it is still on power to prevent electric shock and accidents.

- This machine is designed to be used in a cool and dry environment. It needs to maintain a good ventilation and heat dissipation environment. Please do not soaking in water or exposing under the sun.

- To work outside the temperature range required by electrical characteristics, pls clean the control panel regularly.

- Under no circumstances should the control panel be operated beyond the design limit.

- Please strictly follow the instructions for use. For any equipment or personal injury caused by failure to follow these operating instructions, we do not does not assume any civil and criminal responsibility.

- Trying to repair the damaged control board (regulator) may cause permanent damage to the equipment. If the unit malfunctions, please contact us, we will provide technical support as soon as possible. Please do not attempt to repair the unit all by yourselves.

- This manual can only be applied to its supporting equipment. We will be continuously upgrade and improve our products and to modify the versions of user manual as well. Pls follow our latest updates on website, we won't contact you directly for the latest update technical data.

>> Note:

1. When ordering, pls indicate the exact model and requirement of your required product in PO. Or we may supply with default parameters, namely: voltage level at AC380V, rated frequency at 50Hz, current and voltage feedback signal at DC0-5V and given signal at DC0-5V and potentiometer, non-special design type; Regular products are available in stock, for special design product, pls contact us to determine the specific delivery period when ordering.

2. At the thyristor trigger interface, please note that K1-K6 and G1-G6 are three-phase full-control trigger control ports. If there is a wrong connection, the risk of damage to the device will occur; the thyristor on the main circuit should be settled with proper capacitance absorption and VDR to protect the circuit. RC resistance-capacitance absorption protection device in wiring diagram is convenient for users. We have related RC absorption board STP10 and STP11. Please contact us if you need to order.

3. Before power-on, pls check if the control board is connected according to its actual requirements, then disconnect the control line of the thyristor trigger terminal first, do not connect to the load, power-on after correct operation. And then enter the menu to set and modify the relevant parameters of the control panel according to your own needs. Connect the thyristor trigger regulator to the load after finishing the parameter settings, and the actual operation can be performed.

4. Refer to the wiring diagram of the user manual of this control board for proper wiring. To prevent interference, given the control line and the thyristor trigger line, the main circuit power line is better wired separately. If the wires are not separated, use a twisted shielded wire for the given control line; strictly follow the corresponding relationship between the control board and the thyristor connection at the same time.

5. Before powering on, please check the wiring carefully, disconnect the load, and connect to a small power resistive dummy load test. It is recommended to connect the 1KW bulb for the experimental load. When using the incandescent lamp as the load for debugging, please press the start button to observe the brightness changes of the incandescent lamp. If the incandescent lamp can continuously and smoothly change according to different set values, the control panel wiring is normal; if it is out of control, then is abnormal, please turn off the power and check if there is a wiring errors to avoid burning the device. After the control board is debugged normally, you can access the real load for running.

6. The external control terminal has a corresponding power supply configuration. Do not send active signals to the port. Otherwise, the product may be irreparable.

7. If the thyristor device needs to be tested for insulation, please remove the control board from the device, otherwise the control board may be permanently damaged.

8. We do not responsible for the damages of other components outside the thyristor regulator board.

9. Our Service Commitment: Provide one-year free warranty service and lifetime maintenance within the normal operation of the users. After the expiration of the warranty period, we can continue to provide technical support and assistance, and during this time, the replacement parts are available at our lowest cost price.

>> Circuit wiring control:

If the electromagnetic interference of the control panel is serious, pls follow the measures as below while controlling the circuit wiring in order to prevent the equipment from working abnormally due to electromagnetic interference.

1. When the control cable is long, it is recommended to use a shielded cable. The shield of the cable should be grounded at one end.

2. The analog and digital signal cables should be routed separately;

3. All signal cables should be placed in the steel pipe or cable trough when necessary;

4. The signal cable and the strong electrical equipment should have as much isolation distance as possible;

5. Provide a separate grounding loop for the system;

6. All shielding layers are grounded at the transmitter port;

7. Do not connect wires of different metals to each other;

8. Minimize or eliminate intermediate terminals or connection points;

9. The pipe and cable trough should be grounded reliably and ensure continuous grounding over the entire length.

Before operating this control panel, please read the user manual carefully to avoid incorrect operation and accidents!

I. Introductions:

ST35 three-phase rectifier thyristor trigger board adopts 32-bit industrial grade high-performance microprocessor, specially used for the forward and reverse voltage regulation of loads in inverters. High digital precision quality design, support network remote control and on-site control mode. The fuzzy-PID parameter is open-ended, which integrates open-loop voltage regulation, closed-loop constant voltage and constant current into one board, to control the thyristor to achieve constant voltage current limiting or constant current voltage limiting. The fault alarm and interface parameters are displayed on the LCD screen or touch screen menu in Chinese, and parameters are automatically stored after setting. The control board has the functions such as phase loss protection, soft start, soft stop, constant current output, constant voltage output, overvoltage protection, overcurrent protection, short circuit protection, and working status indication. It has three-phase full-control bridge rectification, double anti-star rectification and thyristor anti-parallel AC triggering mode, which can trigger thyristor below 5000A, suitable for resistive load and, inductive load, capacitive load, transformer primary side and other types of loads which adjust by voltage and current regulation in various fields of industry. It has been widely used in electroplating/electrolytic and plating devices, battery charge and discharge devices, three-phase thyristor power supply devices, electric heating temperature control devices, arc discharge control and other equipment.

This trigger board adopts industrial-grade high-performance microprocessor, which continues to lead the innovation of core control algorithms and software technology in the industry. The structure of the control software package and the processing speed of the single-chip microcomputer ensures all the adjustment of the control loops to be finished during transform (conversion) time of the six thyristor bridges in the main circuit, so that the voltage and current loop sampling time can be less than 3.33mS (50HZ power supply) or 2.77mS (60HZ power supply) for superior performance.

ST35 three-phase digital rectification thyristor trigger regulator has a variety selections of given control signal, and supports analogue input automatic control modes such as 0-5Vdc, 0-10Vdc, 0-10mA, 4-20mA, etc., and can also controlled by potentiometers (10K 2W) manually. Flexible and convenient, with reliable and stable performance, strong anti-interference ability, unique anti-interference measures, normal operation in harsh interference environment, complete control panel self-diagnosis and load operation protection. It is also with power failure protection, over-voltage protection, overload protection, phase failure protection, etc. Therefore, regardless of the external or internal interference types and fault signals, the performance of the control board is safer and more reliable due to the above-mentioned protection functions. The outputs are completely isolated and has a wide application range. It has complete fault detection and alarm indication and protection function. All parameters of ST35 are digital, no temperature drift changes which improves the adjustment accuracy and power utilization efficiency.

II. Technical Specifications

Working power supply	220/380Vac ±15%, 50/60HZ
Main circuit working voltage	380V660Vac ±15%, 50/60HZ
Voltage adjustment range:	0 ~ 100%
Current adjustment range:	0 ~ 100%
Phase shift range	0~178°
Adjust output resolution	1/4000
Stability accuracy	better than ±1% or ±1 Vac
Trigger current:	≥ 750mA
Trigger capacity	≤ 5000A one-way thyristor
PID dynamic response time:	≤ 50mS
Overshoot:	≤ 10%
Input signal:	DC0-5V, DC0-10V, 0-10mA, 4-20mA, 10K potentiometer adjustment
Three-phase trigger imbalance	≤ 0.3°
Applicable load:	Resistive, inductive, capacitive, transformer load and other loads
Alarm relay contact capacity:	250Vac/10A

Dielectric strength:	3500 VRMS
Ambient (working) temperature:	-20°C~ 60°C
Working Relative humidity:	≤ 90% RH (no frost)
Indoor installation requirements	no flammable, no explosive, no corrosive gas, no conductive dust, and vibration should be less than 0.5G
Dimensions:	240X160X50mm
Dimensions between install holes:	225X145mm
Weight:	1.2KG
Altitude should be under 3000m, otherwise need to reduce the capacity level.	

ST35 meets the standard:

IEC60947-4-2: Low-voltage switchgear and controlgear. Part 4-2: Contactors and motor-starters. AC semiconductor motor Controllers and starters.

GB14048.6-1998: Low-voltage switchgear and controlgear Part 4-2: Contactors and motor starters AC semiconductor motor controllers and starters.

GB3797-89: Electronic Control Equipment Part II - Electronic Control Equipment with Electronic Devices.

IEC61000-4: Electromagnetic compatibility, test and measurement technology.

IEC65: Safety of household and similar general purpose electronic and related equipment powered by grid power.

III. Features

1. Using 32-bit industrial high-speed microprocessor, LCD screen or touch menu in Chinese, fully automatic SMD process manufacturing, stable and reliable performance.

2. With digital constant current, constant voltage function, current limiting and voltage limiting function, it can control the loads precisely, and has overcurrent and overvoltage abnormal protection function.

3. Complete fault detection and alarm function, real-time detection of load status, load current, control signal, feedback signal loss and other parameters.

4. Intelligent PID control solution, parameter opening, can be set to any physical quantity flexibly. Great dynamic characteristics, adapts to different loads.

5. Phase loss protection: When the main circuit power supply is out of phase, the alarm prompts, and the load stops in real time to stop output

6. Interface compatibility: support 0-5Vdc, 0-10Vdc, 0-10mA, 4-20mA and other automatic input signals, direct interface with various instruments and PLC, can be manually controlled by potentiometer.

7. Overload protection: After starting, it will judge whether the load is overloaded. When it continuous overload the settled protection time, it stops running and the alarm relay outputs;

8. Soft start: At startup, the output voltage will gradually increase from zero to 100% to eliminate the impact on the grid and itself during load operation. The parameter of the soft start time can be set.

9. Soft stop: When stopped, the output voltage will gradually decrease from 100% to zero to eliminate the impact on the grid and itself when the load stops. The parameter of the soft shutdown time can be set.

10. It has the function of automatic phase sequence identification, no phase sequence requirement for the power supply of the control board, no debugging, very convenient wiring;

11. Current loop (voltage loop) feedback input signal supports various analog input signals such as transformer, Hall current (voltage) sensor, 0-75mV shunt, 0-5V, etc.

12. Can be remote controlled by PLC or other equipment, with MODBUS field bus communication function, full isolated control by RS485 (optional);

13. It also has a running time query function to record the current running time and accumulate all the running times;

14. Adopts intrinsically safe design, the control board (regulator) is designed with the function of preventing thyristor trigger

interface from burnout protection, and supports input and output multi-function expansion board;

15. The thyristor drive interface has double-row LED indicator, the green light indicates whether the trigger board is faulty, and the red light indicates whether the external control line is correct. The error position can be quickly checked;

16. All output ports and digital switch input interface are electronic isolated, it is with better anti-electromagnetic interference protection.

IV. LCD panel operating instructions (i.e. the handheld device)：(Optional, purchase additionally)
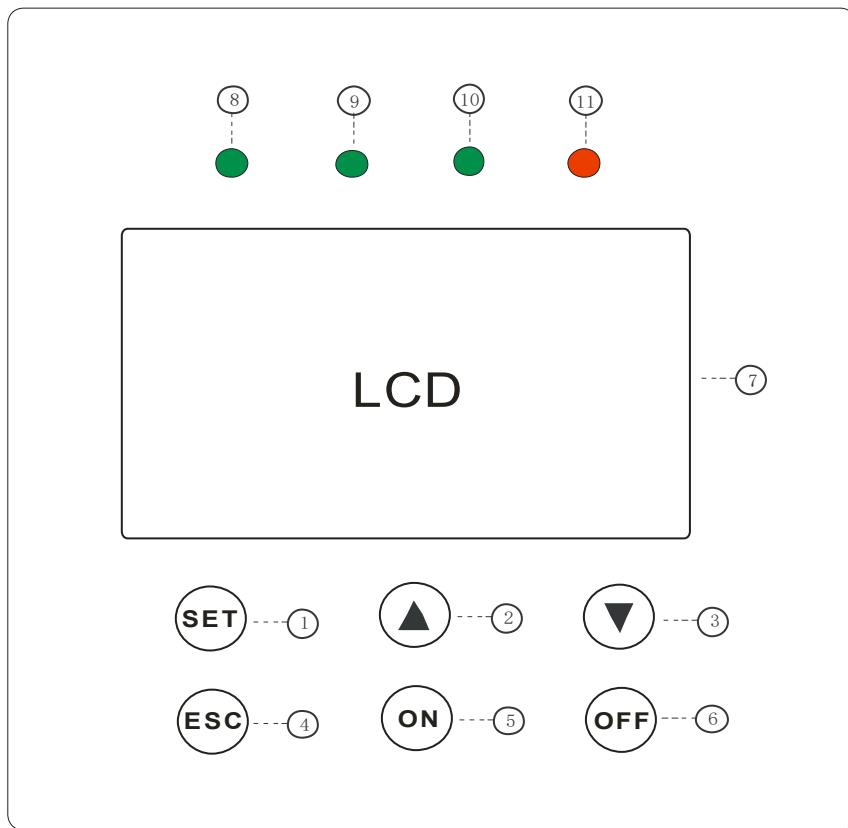
Parts	Function
SET	Setting button, used as parameter confirm button under the setting mode
▲	To increase the parameter value when modify.
▼	To decrease the parameter value when modify.
ESC	Return button
ON	The start button on the panel
OFF	The stop button on the panel
LCD Display Screen	To display the load mode and parameters.
A Mode indicator (Green)	When it lights, means the control board is in constant voltage adjustment mode; When both A & B are not in lit, then the control board is in open loop voltage adjustment mode.
B Mode Indicator (Green)	When it lights, means the control board is in constant current adjustment mode.
C Mode indicator (Red)	Running indicator
D Mode indicator (Red)	Alarm indicator

V. Control board terminal definition：
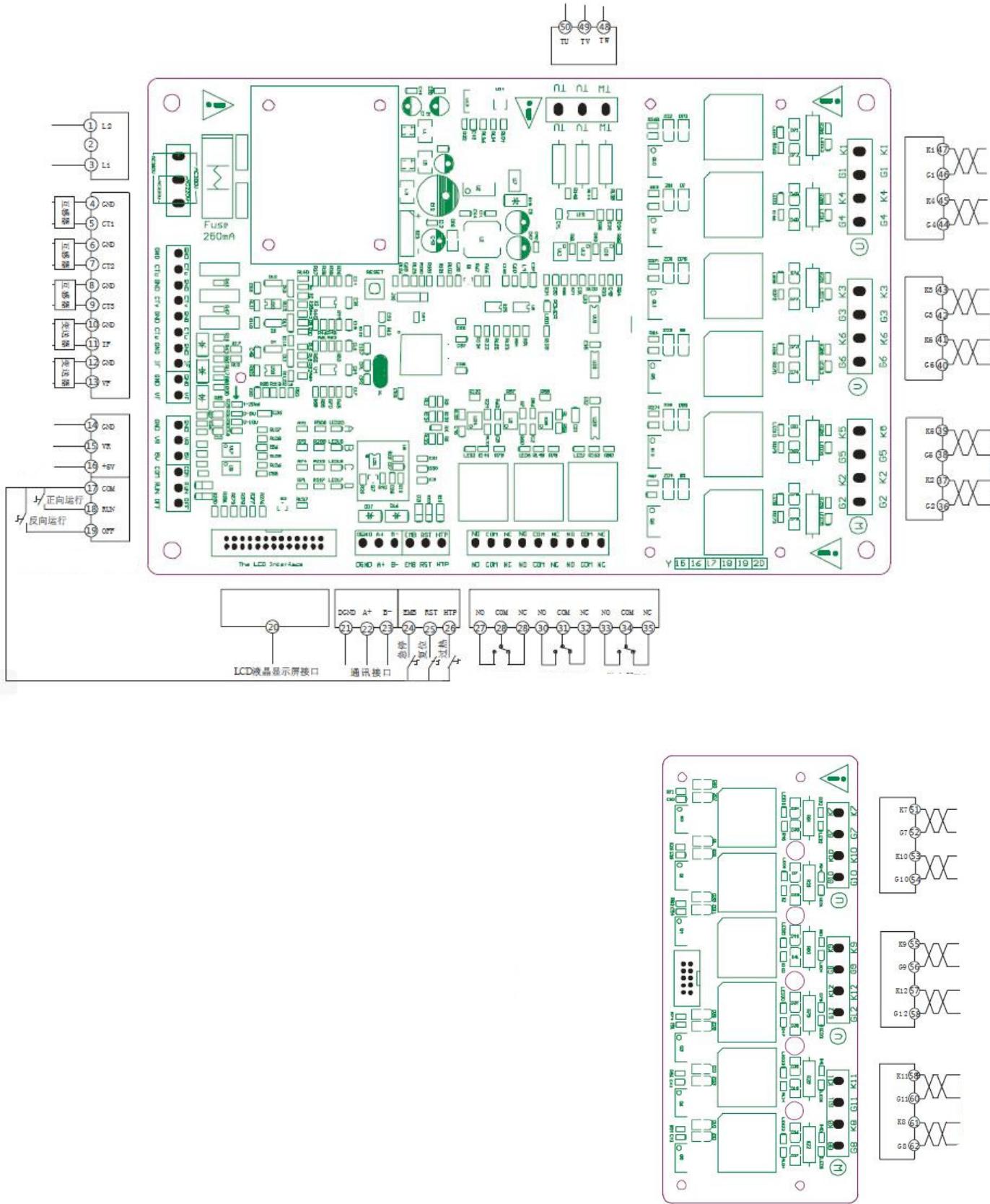
- 1, 2, 3: Working power input terminal of the control board. Pin 1 with 3 for 380V AC power supply, Pin 2 with 3 for 220V AC power supply, only one of the power supply can be connected, it is recommended to use 380V AC power supply.
- 4, 5: Connection terminal CT1 of the current transformer is corresponding to U phase current display, with overcurrent protection and phase failure protection identification function at the same time. Leave it if don't need to use.
- 6, 7: Connection terminal CT2 of the current transformer is corresponding to V phase current display, with overcurrent protection and phase failure protection identification function at the same time. Leave it if don't need to use.

- 8, 9: Connection terminal CT3 of the current transformer is corresponding to W phase current display, with overcurrent protection and open-phase protection identification function at the same time. Leave it if don't need to use.

(Pls note that pin 4 ~ 9   don't have be connected if you are just for rectification use.)

- 10, 11: Signal terminal of constant current feedback input, factory default is DC0-5V, GND (-), IF (+), if you need other signals, please express in advance.

- 12, 13: Signal terminal of constant voltage feedback input, factory default is DC0-5V, GND (-), VF (+), if you need other signals, please express in advance.

- 14, 15, 16: Potentiometer adjustment input, using 10K 2W potentiometer, this input terminal can also input other automatic control signals (0-5V, 0-10V, 4 -20 mA) through GND (-) and VR (+) port to controlled, i.e. given signal input terminal.

- 17, 18, 19: Common COM, forward and reverse control. Startup mode is "self-locking", connect 17 and 18 for forward working; connect 17 and 19 for reverse working; when 17, 18, 19 are not connected, means to stop working, and the start/stop button on the hand-held device is valid.

- 20: LCD display interface, i.e. the handheld device **(optional, no a standard equipment of the control board, need to purchase additionally).**

- 21, 22, 23: RS485 communication connection interface **(optional, no a standard equipment of the control board, need to purchase additionally, and the version with the function is called ST35C)**.

- 24: The emergency stop button input terminal, the other terminal corresponds to the 17-pin COM connection, to short circuit 17 and 24, is to operate emergency stop.

- 25: The reset button terminal, the other terminal corresponds to the 17-pin COM connection. When in the fault condition, short circuit 17 and 25 to rest the system.

- 26: The thyristor overheat input terminal, and the other terminal corresponds to the COM connection of 17-pin. It adopts the normal open temperature control switch and automatically stops when overheat.

- 27, 28, 29: Running relay output, 27 is normally open terminal, 28 is common terminal, and 29 is normally closed terminal.

- 30, 31, 32: Fault relay output, 30 is normally open terminal, 31 is common terminal, and 32 is normally closed terminal.

- 33, 34, 35: Function reserved.

- 36, 37, 38, 39: W-phase thyristor control trigger interface (Forward voltage output control).

- 40, 41, 42, 43: V-phase thyristor control trigger interface (Forward voltage output control).

- 44, 45, 46, 47: U-phase thyristor control trigger interface (Forward voltage output control).

- 48, 49, 50: Main circuit power supply sync signal input terminal, 48 corresponds to W phase, 49 corresponds to V phase, and 50 corresponds to U phase. (Synchronous transformer is recommended for serious interference occasions)

- 51, 52, 53, 54: The second group U phase thyristor control trigger interface (Reverse voltage output control)

- 55, 56, 57, 58: The second group V phase thyristor control trigger interface (Reverse voltage output control)

- 59, 60, 61, 62: The second group W phase thyristor control trigger interface (Reverse voltage output control)

VI.   LCD panel Chinese Menu display and parameter operation instructions：

6.1. In the standby mode, the LCD display interface is as below. The first three lines on the display screen is the feedback display value of the current adjusted signal, the voltage and current when the is in running mode, and the last line shows the running mode of the load: **(Warm reminder: the voltage and current feedback display value has a certain mini mistake measurements, this value is for your reference only, please refer to the multimeter measurement.)**

Input Si:
Output V:
Output I:
CV Mode: OFF

Input Signal: xxxx%
Output Voltage: xxxxV
Output Current: xxxxA
(CV/CC/OL) mode: OFF/ON

6.2. Key operation and display function:

Through the LCD screen and four function keys, SET, ▲ (up), ▼ (down) and ESC (Return) button, to achieve man-machine dialogue, it is easy to modify the required parameters and it can also display the operation status of the Load in real-time.

The screen display part displays the current working state of the load, users can modify and set the parameters according to their own needs. If there is no abnormality after the self-test on the control panel, it will enter the standby mode and wait for the user to input the operation command. If there is an error in the control panel, the fault will be displayed in the running status (in Chinese). If you need to query the fault, press the ESC key to enter the query mode, and then press the ESC again to return to the standby mode.

6.3. In the standby mode, when there is no fault, press the ESC (return) to switch to the AC side current value query mode. Press ESC again or without button operation within 10 seconds it will return to the standby mode. The display format is as below:

U phase C:
V phase C
W phase C
CV mode: OFF

U Phase Current: xxxxA
V Phase current: xxxxA
W Phase current: xxxxA
(CV/CC/OL) mode: OFF

6.4.Menu setting operation. After short pressing the SET button in standby mode, it will remind you to enter the password: ------ (factory password: ▲▲▲▼▼▼). Press the SET again after entering the correct password to enter the first level menu, the interface is as below.

1. Basic data set
2. Protection set:
3. Comm data set:
4. Reset default:

1. Basic parameter setting
2. Protection parameter setting
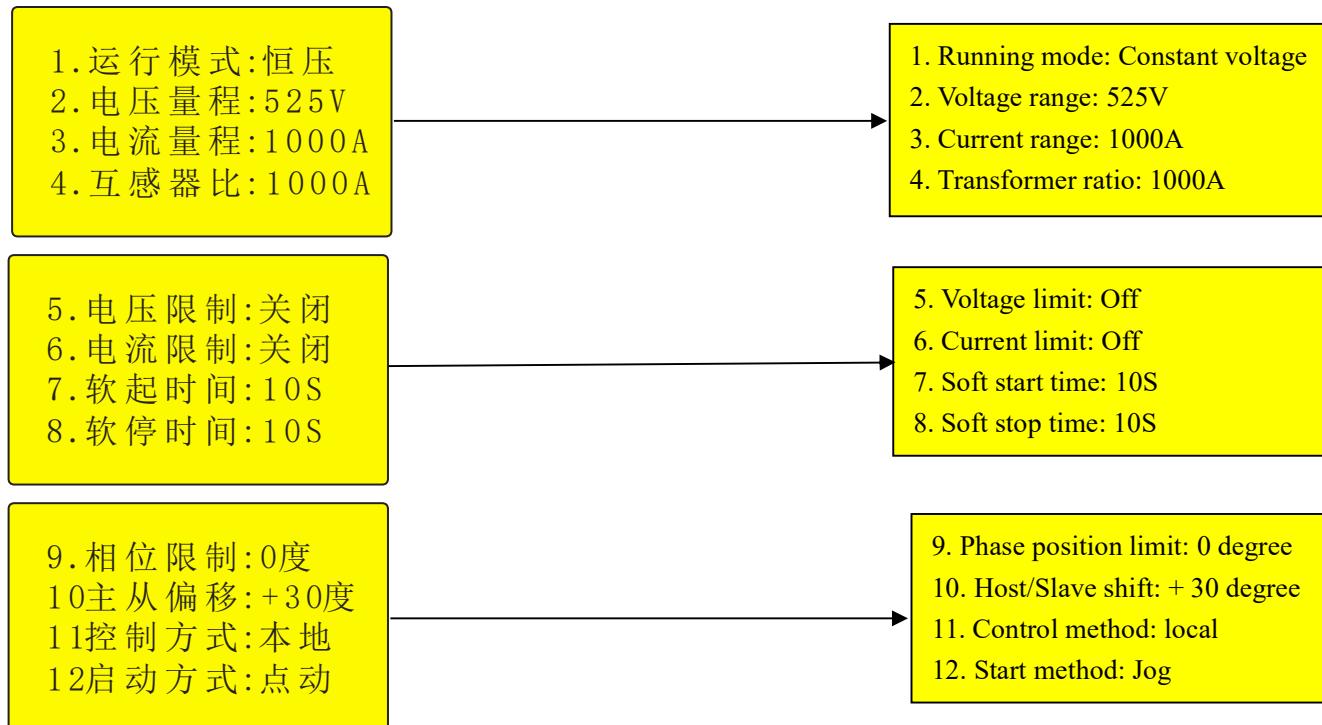3. Communication parameter setting
4. Reset to default value

5. PID data set:
6. Calibrat Phase:
7. Running time:
8. Product info

5. PID parameter setting
6. Phase parameter calibration
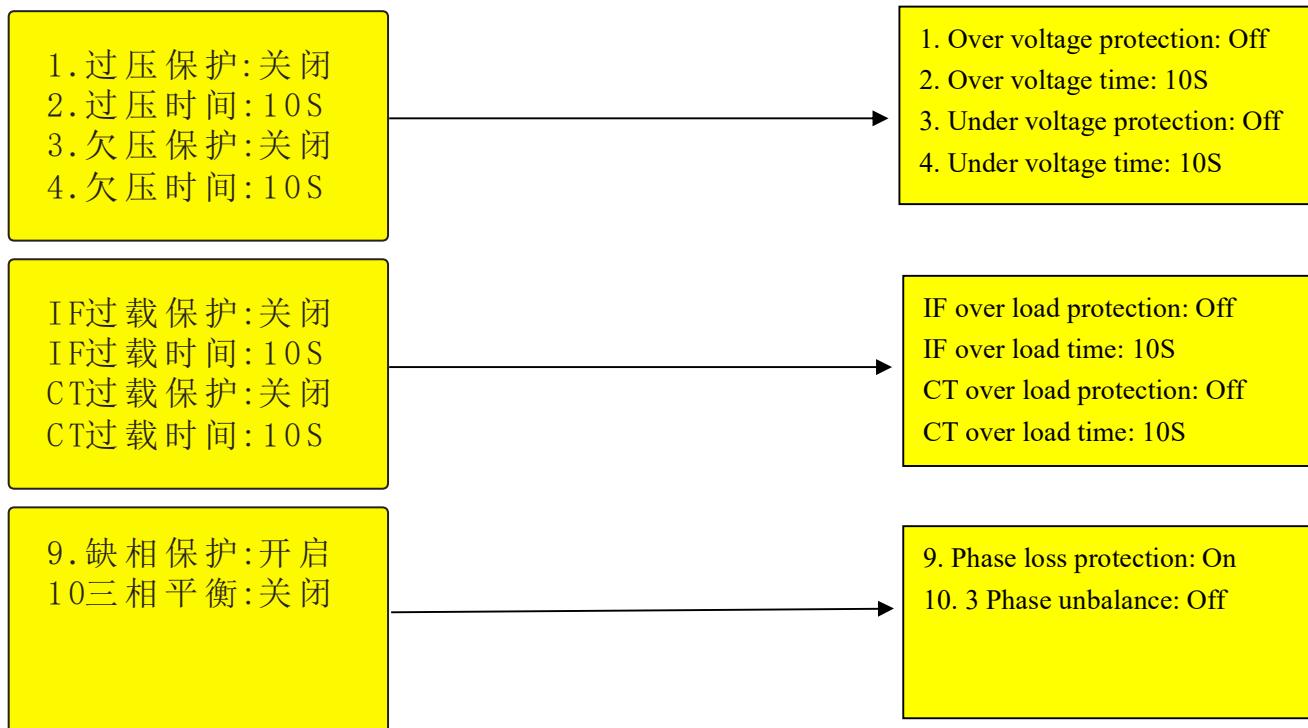7. Running time query
8. Product version information

In first grade menu, by press ▲ or ▼ to choose different function parameters. And then press SET again enter the second grade. In the parameter modification of each level, we can use the ▲ (up) or ▼ (down) key to set the value, the reverse line is the present chosen line, short press the SET button, the parameter will flash, and enter the current parameter value modification mode, we can use the ▲ (up) or ▼ (down) to set different parameters. Press SET to confirm after setting. Since the LCD screen displays has the limitation of the subtitle width, it displays four consecutive items each time, if we want to select the following options, we can press ▲ (up) or ▼ (down) to select. In the setting mode operation, if the button is not pressed again within ten seconds, it will

automatically return to the standby main screen.

6.4.1、Secondary menu under basic parameter setting options：

1.运行模式:恒压 2.电压量程:525V 3.电流量程:1000A 4.互感器比:1000A	⟶	1. Running mode: Constant voltage 2. Voltage range: 525V 3. Current range: 1000A 4. Transformer ratio: 1000A
5.电压限制:关闭 6.电流限制:关闭 7.软起时间:10S 8.软停时间:10S	⟶	5. Voltage limit: Off 6. Current limit: Off 7. Soft start time: 10S 8. Soft stop time: 10S
9.相位限制:0度 10主从偏移:+30度 11控制方式:本地 12启动方式:点动	⟶	9. Phase position limit: 0 degree 10. Host/Slave shift: + 30 degree 11. Control method: local 12. Start method: Jog

6.4.2、Secondary menu under the protection parameter setting options：

1.过压保护:关闭 2.过压时间:10S 3.欠压保护:关闭 4.欠压时间:10S	⟶	1. Over voltage protection: Off 2. Over voltage time: 10S 3. Under voltage protection: Off 4. Under voltage time: 10S
IF过载保护:关闭 IF过载时间:10S CT过载保护:关闭 CT过载时间:10S	⟶	IF over load protection: Off IF over load time: 10S CT over load protection: Off CT over load time: 10S
9.缺相保护:开启 10三相平衡:关闭	⟶	9. Phase loss protection: On 10. 3 Phase unbalance: Off

6.4.3、Secondary menu under the communication parameter setting options：

```
1.通讯地址：   1
2.波 特 率： 9600
3.校 验 位:无 校 验
4.通讯检测:关 闭
```

```
1. Communication address: 1
2. Baud rate: 9600
3. Parity: No check
4. Communication test: Off
```

6.4.4. Restore factory parameters setting options:

Remind users to enter the password (factory password: ▲ ▲ ▲ ▲ ▲ ▲). After the password verification is passed, the factory recovery operation will be automatically performed, and the control system will be restarted after completion.

6.4.5. Under PID parameter setting options:

```
1.PID参数:中速
2.P参数：   80
3.I参数：   60
4.D参数：  自 动
```

```
1. PID parameter: Medium speed
2. P parameter: 80
3. I parameter: 60
4. D parameter: Auto
```

When users use different loads, different dynamic parameters can be adjusted according to the load characteristics to achieve the optimal or stable operation adjustment mode. At this time, users need to enter the PID parameter setting mode.

Function Parameter	Parameter Value	Default	Remark
PID parameter setting	Refer to the Remark	Medium Speed	PID setting has fast speed (Suitable for resistive load, constant voltage and constant current), medium speed, slow speed (Suitable for inductive and conductive load, constant voltage and constant current) and user-defined PID regulation. Under the user-defined mode, users can regulate the P and I parameters all by themselves, but parameters under other three kind of mode are not regulable.
P parameter setting	1~128	--	
I parameter setting	1~128	--	
D parameter setting	Not adjustable	--	

6.4.6、Under the phase parameter calibration setting option: (i.e. adjusting the number of time)

```
   相 位 校 准
  输 出 电 压50%
  参 数：xxx
运 行 状 态: 停 机
```

```
Phase position calibration
Output voltage 50%
Parameter: x x x
Running mode: Shut down
```

When users change the main circuit voltage or the pre-stage access transformer or connect a synchronous transformer to the synchronous signal terminal, then users need to enter the phase parameter calibration at this time.

In the phase calibration mode, it is recommended that users access the resistive dummy load of 1~10KW to test. The default output

voltage of the system is 50% of the voltage on the main circuit. Press the start key for running, at this time, press ▲ or ▼ to adjust the output voltage to the half of the main circuit voltage, and then, the calibration is completed. The default is calibrated by AC380V, so users don't need to be calibrated anymore if they are using AC380V on the main circuit.

* When the main circuit is in AC380V, the corresponding output is about DC256V, corresponding of AC220V is about DC150V.

* Phase calibration value is 0 when AC380V is not connected with a synchronous transformer.

* Phase calibration value is -250 when AC380V, 660V, 1140V are added with a synchronous transformer:

6.4.7、Running time query option：（ *(In standby mode, press button▲ and ▼ at the same time for three seconds can also enter the running time query interface)*

When entering the running time query mode, the present running time is the time recorded after start or power off, the maximum is 99999 hours. The calculated time is the total running time of the device, maximum is 99999 hours, if users want to delete the calculated time, press the ▲and ▼ button at the same time, then it will return to 0, the record form is as below
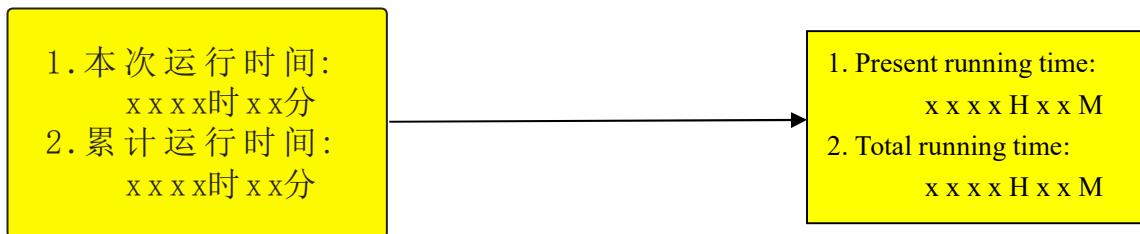
6.4.8、Product version information option：

Under this option, the system will display the related item number, version of the software, manufacture and contact information, so that users can check if the related software has been update and the technical support number, it cannot be modified.

6.4.9、Constant current constant voltage external switch method(If users need external switch, pls express in advance, the default is internal menu setting switch）

⚠ **Tips in menu setting：**

　　1、Press ESC return to the last menu。

　　2、It will back to standby mode if no operation in ten seconds under the setting mode.

　　3、The menu setting can only entered in standby or fault mode, can't enter after start.

　　4、It cannot be start in the setting menu, only out of the menu can it be start.。

6.5、Overview of User menu：

6.5.1、Basic parameter option

Parameter	Setting range	Default
1、Running mode	Constant current, Constant current, open loop	Constant voltage
2、Voltage range	10~6000V	525V
3、Current range	10~6000A	1000A
4、Transformer ratio	10~6000A	1000A
5、Voltage limitation	10~6000V, setting value is "CLOSE" when over 6000V	CLOSE

6、Current limitation	10~6000A, setting value is "CLOSE" when over 6000A	CLOSE
7、Soft start time	1~200S	10S
8、Soft stop time	0~200S	10S
9、Phase position limitation	20~100%	100
10、Master-slave Offset	-60~60 degree	0
11、Control method	Local、communication	Local
12、Start method	Jog、Self-locking	Jog

※ Running mode setting

　　The running mode has three kinds, they are constant voltage, constant current and open loop.

※ Voltage range setting

　　It is set according to the thyristor rectifier direct current, the actual max voltage or voltage sensor full scale of the load is related to the voltage feedback terminal VF5V, the constant voltage value, over voltage value and under voltage value are set according to this parameter.。

※ Current range setting

　　It can be set according to the DC current after rectification. The actual max load current or the current sensor full range is related to the current feedback terminal IF5V, the constant current value, over load value and over current value are all set by referring to this parameter.

※　Transformer ratio setting

　　It is set according to the current transformer ratio sampled by the pre-level AC current terminal. CT-3 connect to the transformer with 1A secondary side current, with the function of pre-level AC side over current protection or three phase imbalance protection, leave it alone if don't need it.

※ Voltage limit setting (Valid in constant current mode)

　　To prevent the load from damaging of over high output voltage, it has the highest running voltage limitation, to limit the actual output voltage.

※ Current limit setting (Valid in constant voltage mode)

　　To prevent the load and power supply system from impacting from big current, it has the running current limitation, to limit the actual running current.

※ Soft start time setting

　　The soft start time adjust range is 1~200 seconds.

※ Soft off time setting

　　The soft off time is form 0 to 200 seconds, if the soft time is set to "0", then the soft off function is close.

※ Phase position limitation setting

　　To limit the thyristor output phase angle shift, the setting is set according to the percentage of 178 degree.

※ Master-slave offset setting

　　In normal circumstance, the setting range is -30°~ +30. When there is a transformer in the main circuit, such as△/Y transformer, there would be a phase difference between the primary and secondary of the transformer, then the parameter need to be adjusted. △/Y transformer set as +30, Y/△ transformer set as -30.

※ Control method setting

The control methods setting has "local" and "communication" modes, users can select according to their own needs, the out of factory default is "local". "Local" mode is controlled by the external signal of the potentiometer, "Communication" mode is remote controlled by the host computer (to remote control the on and off and analog quantity), the external control signal will be invalid.

※ Start methods selection

The start methods setting has jog and self-locking two modes, for the specific usage please refer to part V, users can select according to their own needs, the out factory default is jog.

6.5.2、Protection parameter setting.

Parameter	Setting range	Default
1. Over voltage protection range	Close, 1～6000V	Close
2. Over voltage protection time	0～200 seconds	10 seconds
3. Under voltage protection range	Close, 1～6000V	Close
4. Under voltage protection time	0～200 seconds	10 seconds
5. IF over load protection option	Close, 1～6000A	Close
6. IF over load protection time	0~200 seconds	10 Seconds
7. CT over load protection option	Close, 1～6000A	Close
8. CT over load protection time	0~200 seconds	10 Seconds
9. Phase missing protection option	Close, open	Open
10. Three phase imbalance protection	Close, 10～60%	Close

※ Overvoltage protection selection (less than the settled maximum voltage range)

VF voltage signal feedback terminal. It will generates an overvoltage protection fault after the overvoltage time delay when the output voltage is too high. The overvoltage protection of the factory preset is close.

※ Overvoltage protection time

The delay time for overvoltage protection, can be adjust from 0 to 200 seconds and the factory default is 10 seconds.

※ Undervoltage protection selection (less than the settled maximum voltage range)

VF voltage signal feedback terminal, when the output voltage is too low, an undervoltage protection fault occurs after the undervoltage time delay. The factory default of the long-time protection is close.

※　Undervoltage protection time

The delay time for undervoltage protection, can be adjust from 0 to 200 seconds, and the factory default is 10 seconds.

※ IF overload protection option

The IF current signal feedback terminal. It will generates an overload protection fault after the overload time delay when the load current is too large. The factory preset of the overload protection is close.

※ IF overload protection time

The delay time of the IF over load protection, can be adjusted from 0 to 200 seconds and the factory default is 10 seconds.

※ CT overload protection option

The transformer signal input detection protection. It will generates an overcurrent protection fault after the overload time delay when the load current is too large. The factory preset of the overload protection is close.

※ CT overload protection time

The delay time of the transformer overload protection, can be adjusted from 0 to 200 seconds, and the factory default is 10 seconds.

※ Phase loss protection option

When a phase current disappears, it enters phase loss protection. The phase loss protection function can be close or open by choice.

※ Three-phase balance protection setting

This function is used to detect the balance state of the three-phase current during the running, representing the percentage between the two-phase current difference and the maximum value. The adjustable range is 10%~60%. When users choose close, the current unbalance protection is canceled.

6.5.3. Communication parameter (For specific communication protocol please ask for communication protocol attachment instruction)

Parameter	Setting range	Default
1.Communication address	1~247	1
2.Baud rate	2400, 4800, 9600, 14400, 19200, 38400, 57600, 115200	9600
3.Parity bit	None, odd, even	None
4.Communication detection	Close, open	Close

※ Communication address selection

Adopt RS485 communication mode, comply with MODBUS RTU bus protocol, communication address parameters is 1~247.

※ Baud rate selection

Baud rate has 2400, 4800, 9600, 14400, 19200, 38400, 57600, 115200.

※ Parity bit selection

The parity bits has three ways, no parity, odd parity, and even parity.

※ Communication detection setting

The communication detection function is to judge whether the communication between the control computer and the control board is normal. When the function is open, the control board detects if the upper computer has send a command every 1 minute, and automatically close the output if no command received after timeout, and prompts "communication error".

VII. Output feedback control connection instruction:

7.1. Constant voltage and constant current feedback terminal refers to the following diagram.
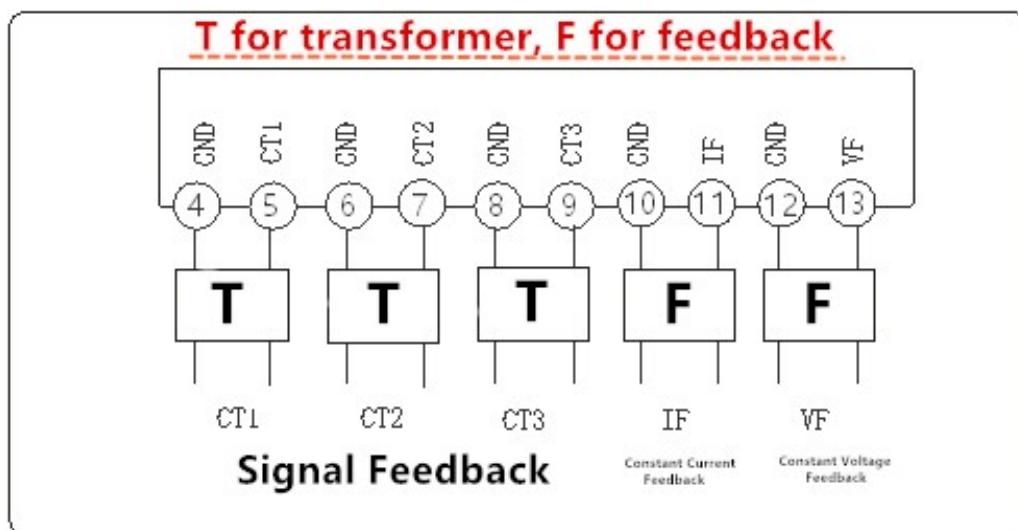
During constant voltage feedback, the feedback voltage signal is DC0-5V (factory default). If the load is added with transformer isolation control, the load terminal can take the feedback voltage by adding two resistors to divide the voltage and obtain the signal. Connect the resistors to VF and GND, please refer to the connection diagram below; Or using the rated output voltage of 0-5V Hall voltage sensor, we also have the constant voltage acquisition module used with this trigger board, please consult our sales for details.

In the voltage divider circuit of the diagram below, generally, R2 takes 1K and the power is no less than 2W. The calculation formula of the resistance value (unit KΩ) and power P (unit W) of the voltage dividing resistor R1:
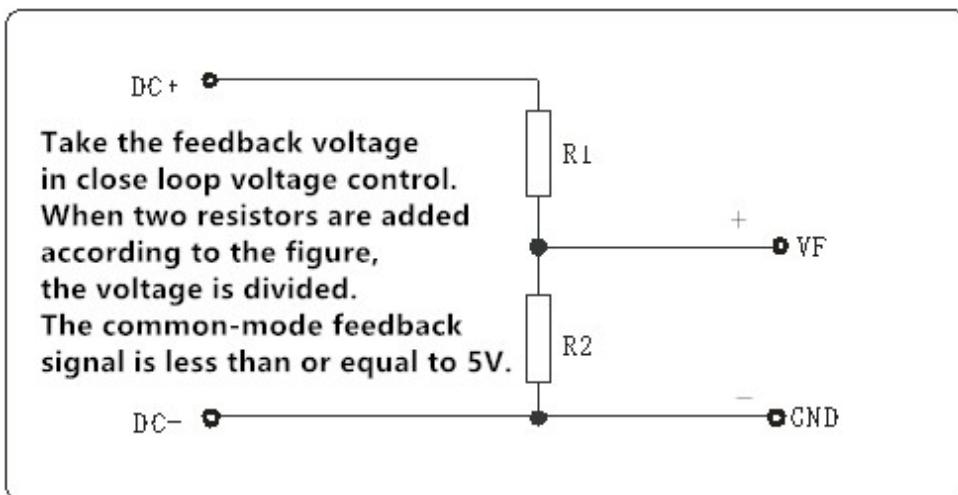
$$R1=V0/5-1(KΩ) \quad P=0.2×R1(W)$$

V0 in this formula is the rated rectified output voltage, unit is Vdc

E.G. Rated rectified output voltage V0=500V, to calculate the resistance value and power of the divider resistor R1.

$$R1=500/5-1＝99(KΩ) \quad P=0.2×99＝19.8(W)$$

Select divider resistor R1 with 100K resistance value and 20W power.

For constant current feedback, please use Hall current sensor, and connect to IF and GND constant current feedback interface, the feedback voltage signal is DC0-5V (factory default); if using 0-75mV divider to sampling current signal and connect to port, please explain in advance. For other transformer signals, please directly connect the transformer with the secondary 1A at the CT port.

7.2. Option current transformer ：

When the main circuit is380V/660V/1140V, the current transformer of the load can be selected according to the recommend value in the form below.

Rated current	660V load power	1140V load power	Transformer
More than 480A	More than 425KW	More than 720KW	2000:1
120A< rated current ≤480A	110KW< load power ≤425KW	185KW＜ load power ≤720KW	1000:1
15A< rated current ≤120A	11KW< load power ≤110KW	22KW＜ load power ≤185KW	200:1
15A and lower	11KW and lower	22KW and lower	100:1

7.3. Notes on three-phase synchronous signals:

Since the controller has a phase sequence self-applying function, the connection of the rectifying device to the incoming power source does not have to distinguish the phase sequence. However, the connection relationship inside the device must strictly follow the correspondence. It is necessary to ensure that the wiring of the TU terminal corresponds to the wiring of the SCR1 and SCR4 thyristors; the wiring of the TV terminal corresponds to the wiring of the SCR3 and SCR6 thyristors; the wiring of the TW terminal corresponds to the wiring of the SCR5 and SCR2 thyristors. When there is a transformer in the main circuit, the primary/secondary of the transformer adopts Δ/Y connection or Y/Δ connection. It is necessary to pay attention to the correspondence between the secondary winding of the transformer and each thyristor, corresponding to the TU. , TV, TW signal.

VIII.   The related principles schematic in rectification control process

8.1. Closed loop constant voltage mode: When the load current is less than the current limit parameter, the microprocessor will compares the voltage feedback signal with the given signal. When the voltage feedback signal is less than the given signal, the microprocessor will increase the output till the voltage feedback signal and the given signal are equal. When the voltage feedback signal is greater than the given signal, the microprocessor will reduce the output till the voltage feedback signal is equal to the given signal. In this adjustment method, if the input signal stay unchanged, even if the power supply voltage changes or the load impedance changes, the load voltage remains unchanged (excluding the sudden change of the grid and load impedance), and it has a current limiting function, and the current limit has priority. The schematic is as follows:
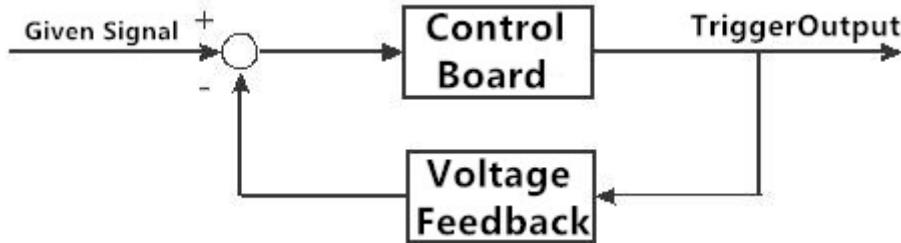

8.2. Closed-loop constant current mode: When the load voltage is less than the voltage limit parameter, the microprocessor of the control board compares the current feedback signal with the given signal. When the current feedback signal is less than the given signal, the microprocessor will increase the output till the current feedback signal equal to the given signal, when the current feedback signal is greater than the given signal, the microprocessor will reduce the output till the current feedback signal is equal to the given signal. In this adjustment, if he input signal stay unchanged, even if the power supply voltage changes or the load impedance changes, the load current remains unchanged (excluding the sudden change of the grid and load impedance). It is with voltage limiting function, the voltage limit has priority. The schematic is as follows:
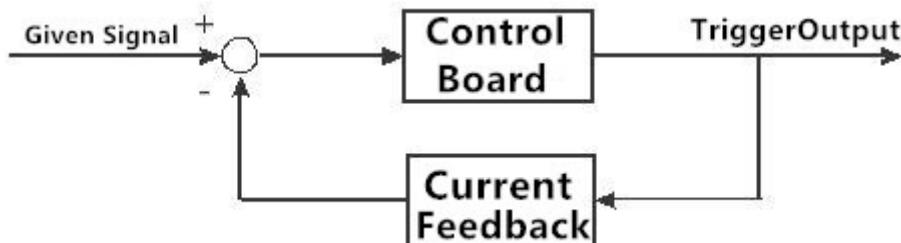
8.3. Adjustment open loop control mode: that is, the open-loop control mode, the microprocessor of the control board linearly converts the input signal into a thyristor conduction angle trigger output, in this adjustment mode, the output of the control board changes with the power or power supply voltage. It is with overvoltage and overcurrent protection. The schematic is as follows:
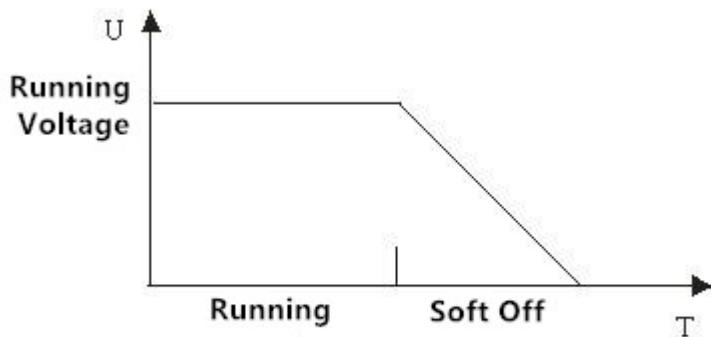

8.4. Soft start: At start-up, it is starts from the zero voltage, and gradually rises into the settled operating voltage during the starting time.
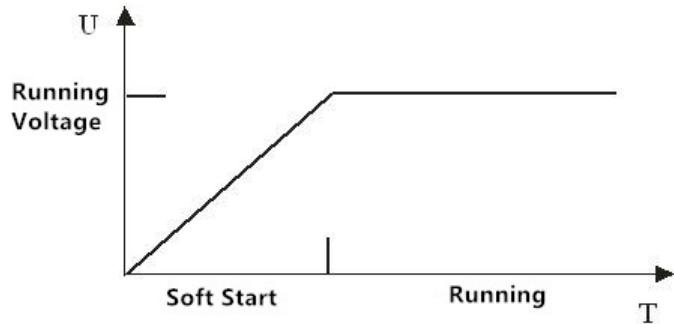
Soft Start Process Diagram

8.5. Soft off: At the stop time, the operating voltage will gradually reduce into the ending voltage of 0V.

Soft Off Process Diagram

IX. Fault display and dealing methods

When the fault occurs during operation, the display screen will display the cause of the fault in real time. The figure below shows the cause of the fault during the query operation.

When a fault occurs, the fault relay output a signal, the running relay and the load output are disconnected, and the text on the lower right of the LCD screen is the fault display. If you need to query the fault, press the ESC key to enter the fault display mode. At this time the fault is displayed in the middle of the screen. We provide the following troubleshooting methods for the possible failures:
※ Overvoltage fault: Check the voltage protection level and overvoltage protection selection setting. If the parameters are normal, then check if the power supply voltage exceeds the set value.
※ Undervoltage fault: Check the voltage protection level and undervoltage protection selection setting. If the parameters are normal, then check if the power supply voltage is lower than the set value.
※ Phase loss protection: The protection circuit operates when any phase of the main circuit power supply is disconnected. Maintenance method: Check if the main circuit input is disconnected or the load is too light. If the load current is too small, then the

transformer needs to be replaced.

※ Overcurrent protection: The protection circuit operates instantaneously when any phase current exceeds 8 times the rated current.

Maintenance method: Check if there is a short circuit in the main circuit or the overload protection parameter setting is too low.

※ Overload protection: Uses overload reverse time protection.

Maintenance method: Reduce the load.

※ Three-phase unbalance protection: When two of the phase current values   differ bigger than the set value, the protection take action after three seconds.

Maintenance method: Check if there is any abnormality in the power supply or in the load.

※ Overheat protection: Protection acts when the thyristor is over temperature.

Maintenance method: Check if the radiator is too small or the load current is too large.

※ Feedback fault: There is no signal input to the VF or IF feedback terminal from voltage sensor or current sensor during the constant voltage or constant current.

Maintenance method: Check if the voltage sensor or current sensor didn't output feedback signal, or if it is damaged or the line is disconnected.

X.   Analysis and elimination of common problems：

Number	Fault	Possible Reason	Solution
1	No display on the display screen	1.No connection of AC power	1.Check if the power is on, or the fuse is fused
		2.AC power voltage is too low	2.Check input voltage of the control power
		3.Display screen interface is broken	3.Return to factory for replacement
2	No output on from the control board	1.Control wire on the trigger port is connected wrong	1.Follow the wiring diagram, check the wiring of the control wire
		2.The thyristor is damaged	2.Replace the thyristor
		3.There is an indicator light (six red lights) not lit on the trigger port	3.The related indictor of certain road is not lit, check if the thyristor on this road is connected right
		4.There is an indicator light (six green lights) not lit on the trigger port	4.Return to factory for replacement
3	The output voltage is unstable	1.Open load	1.Check if the load is wired
		2.Power of the load is low	2.Change for a high power load, please take >1000W for experiment
		3.One of the thyristor is not conductive	3.Replace the thyristor
		4.PID parameter is wrong	4.Reset the PID parameters according to the feature of the load
4	The differ ratio between the input signal value and the actual output voltage is too big.	1.Constant current or constant voltage does not match with feedback signal	1.Check if the feedback signal is DC0-5V
5	Output voltage can't adjust to	1. Feedback signal of constant	1.Check if the feedback signal is DC0-5V

the rated value.	current or constant voltage does not match.	
	2.The settled value of limit voltage or limit current is too low	2.Reset the value of limit voltage or limit current
	3.The main circuit is not with 380V or synchronous transformer	3.Re-phase calibration, adjust parameters

XI.   Main circuit and control circuit wiring diagram

The wiring diagram below is a schematic diagram of the main circuit, the trigger terminal of the control board and the thyristor when the three-phase full-controlled rectifier control board is combined with other components. In the process of wiring the control panel trigger terminal and the thyristor, it should be noted that the correspondence   of the position between the cathode (K) and the gate (G) as the diagram below, users should avoid the misconnection and reverse connection, otherwise a short-circuit will occur to burnout the device or damage the control board; The main circuit must be added with the necessary protection components, such as using fast-melting for over-current protection and piezoresistor for over-voltage protection, and both side of thyristor connected to the RC to absorption circuit and so on.

Note: 1. Transformers, circuit breakers, contactors, fast-melting and thyristors, etc., needs to be purchased by users.

2. Hall voltage sensor, Hall current sensor, transformer and shunt needs to be purchased by the user.

3. Thyristor RC absorption components are optional accessories, need to be purchased by user.

Three Phase Rectifier Reversible Control Wiring (With transformer to reduce the voltage)