

TGRJ High-pressure Motor Solid State Soft Starter

3KV~10KV/200kW -15000kW

Instruction Book

Hubei Xiangyang Tenghui Electric Manufacture CO., LTD.

Safety Warning:

Soft starter is high-tension apparatus with potential voltage to harm people, so it must be operated and maintained by authorized and trained personnel.

After high-pressure power off, due to the induction high-pressure of motor, it is safe once after being discharged.

Interlock of high-tension switch cabinet and soft starter cabinet or interlock in the soft starter cabinet is indispensable, and it is the important measure to ensure safety.

Soft starter has high-pressure power supply and control power. When disconnecting high-pressure power supply, also note that control supply is disconnected. DO NOT operate without careful consideration.

Application of Compensating Capacitor:

Compensating capacitor is reactive power compensation capacitor used to increase power factor. It can only be connected to the input end of the soft starter but the output end, or it will damage thyristor power devices in the soft starter.

Megohmmeter Insulation Detection:

DO NOT use megohmmeter to measure insulation resistance between input and output of soft starter, or it will damage silicon controlled rectifier and control panel of soft starter because of overvoltage.

Megohmmeter can be used to measure insulation between phases and relatively insulation of soft starter, but in advance put three short-circuit wires respectively to short the input and output, and pull all the plugs on the control panel.

The above principles should be followed when measure the electrical insulation.

Content

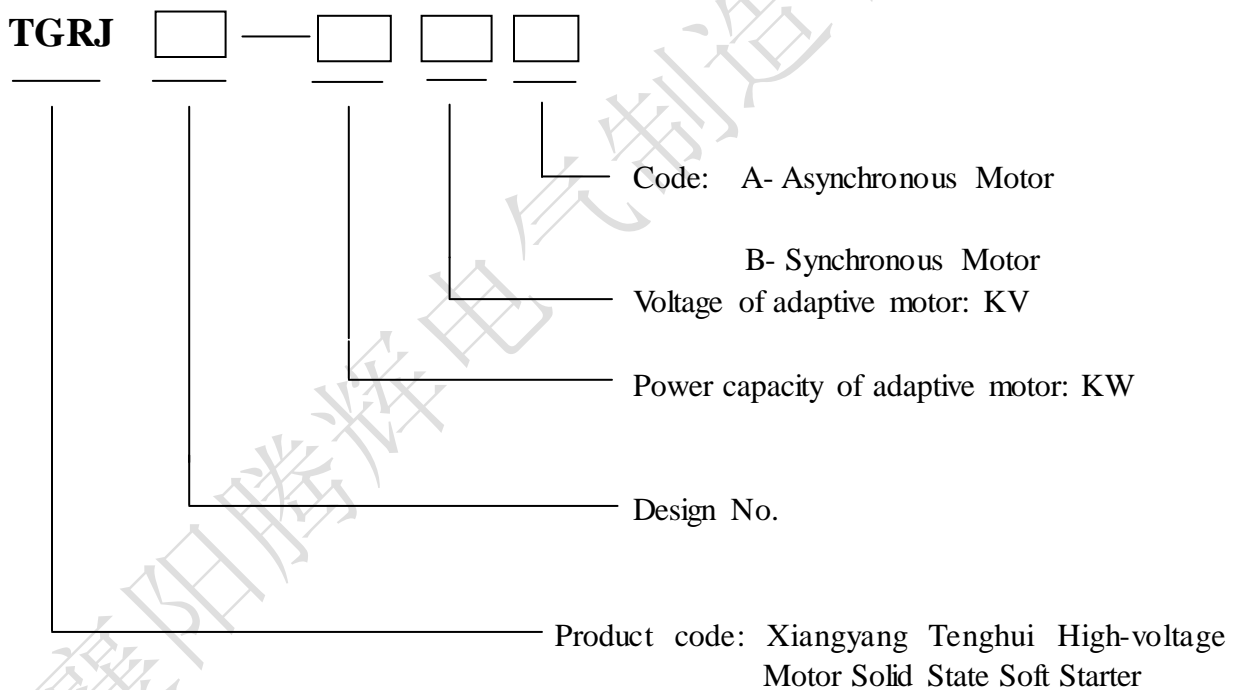
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襄阳腾辉电气制造有限公司

I. Instruction

TGRJ High-voltage Motor Solid State Soft Starter is used to start and protect motor (3000V~10000V) high-voltage AC asynchronous or synchronous motor soft start device. It applies high quality thyristor in series and electrodeless control to output voltage, so that it starts and stops motor smoothly. It protects motor from overload, default phase and peak over-current, and makes the motor effectively avoid harmful impact because of excessive current. With TGRJ High-voltage Motor Solid State Soft Starter, high-power motor can work under limited grid capacity and prolong service life.

1.1 Type specification



1.2 Service conditions

Power supply: three phase current 3KV~10KV (+10%~ -15%) 60Hz

Adaptive motor: three-phase asynchronous motor (squirrel-cage induction motor) and synchronous motor etc.

Starting frequency: frequently start

Cooling method: natural cooling or force cooled

Way of inlet and outlet: according to users' option

Level of protection: IP 20 (natural cooling), IP00 (air-cooled) tailor-make for special orders.

Environmental conditions: altitude is not more than 1000 meters, more than 1000 meters need to reduce conditions to use.

Environmental temperature: -25°C — $+45^{\circ}\text{C}$

The maximum relative temperature: 95% non-condensing

No corrosive gas, no conductive dust and no violent vibration (less than 0.5G), well-ventilated

If you have special environment requirements for the product, please inform us when place an order.

II. Technical Performance and Indicators

Project	Function and Index
Product standard and certificate	ISO9001
Power range	200kW~15000KW
Rated operational voltage	1KV~15KV
Soft starter voltage drop	With the bypass contactor, less than 3V
Thyristor triggering technology	Fiber-trigger or CT trigger
Rated short-circuit bearing capacity	Greater than or equal to 20KA
Overload capacity	500%, 30S 120% for a long time
Current-limiting starting current	100%~500%, user can adjust it according to overload
Starting time of ramp voltage	0~120S
Maximum adjustable current	100~500%
Control method of stopping brake	Free stopping, soft stopping and brake stopping
Protecting and monitoring	Over-current protection, thermal overload protection, phase current unbalance protection, phase break

	protection and overheat protection
Communication function	Standard RS485 interface

III. Operating principle

Thyristor high-voltage soft starter device actually is concatenated between three-phase AC voltage and three-phase AC asynchronous motor. It accesses to three opposite parallel thyristor components and electronic control equipment between the high voltage motor stator winding and power source. When the motor starting, it controls the conduction angle of thyristor according to certain rules (such as constant current or the voltage ramp), and changes the input voltage of motor stator winding continuously to the total pressure, when starting ended, the bypass contactor will pull in. In addition, the TGRJ high-voltage motor solid state soft starter also has the function of “soft stop”, when it stops softly, the motor stator winding voltage will be reduced smoothly, thus it can avoid driving stall suddenly, and it is quite helpful to the water pump drive (can avoid water hammer effect) or conveyor belt.

After starting the motor, three-phase bypass contactor J automatic suction, motor begins to operate in the grid (See figure 1) Input or output voltage waveform and current change waveform (See figure 2).

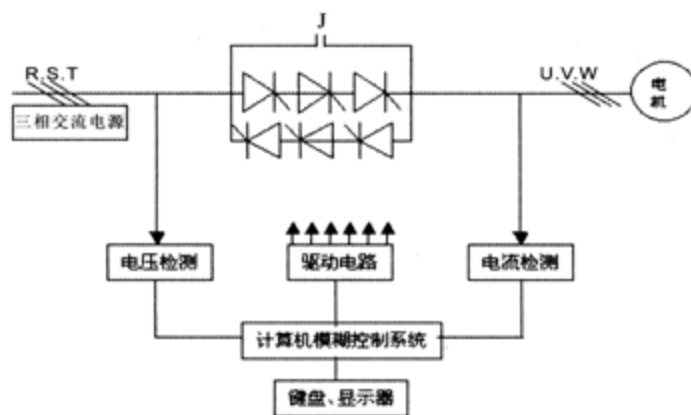


图1

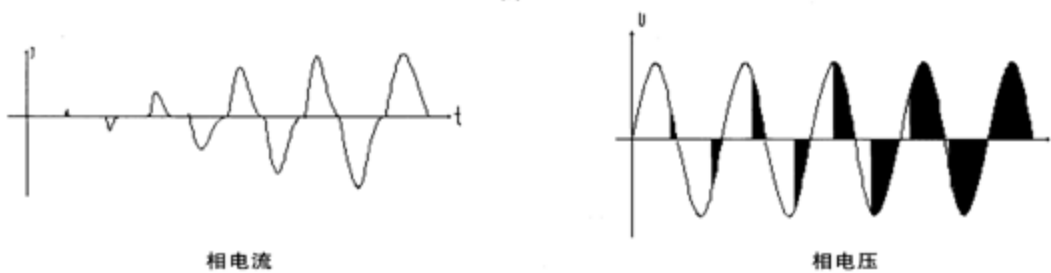


图2 每相晶闸管电流和电压变化趋势 (示意)

English translation about Chinese in the above figure 1 and 2

Chinese	English
三相交流电源	Three-phase alternating-current supply
电机	Motor
电压检测	Voltage detection
驱动电路	Drive circuit
电流检测	Current detection
计算机模糊控制系统	Computer fuzzy control system
键盘、显示器	Keyboard and display
相电流	Phase current
相电压	Phase voltage

IV. Features of Device

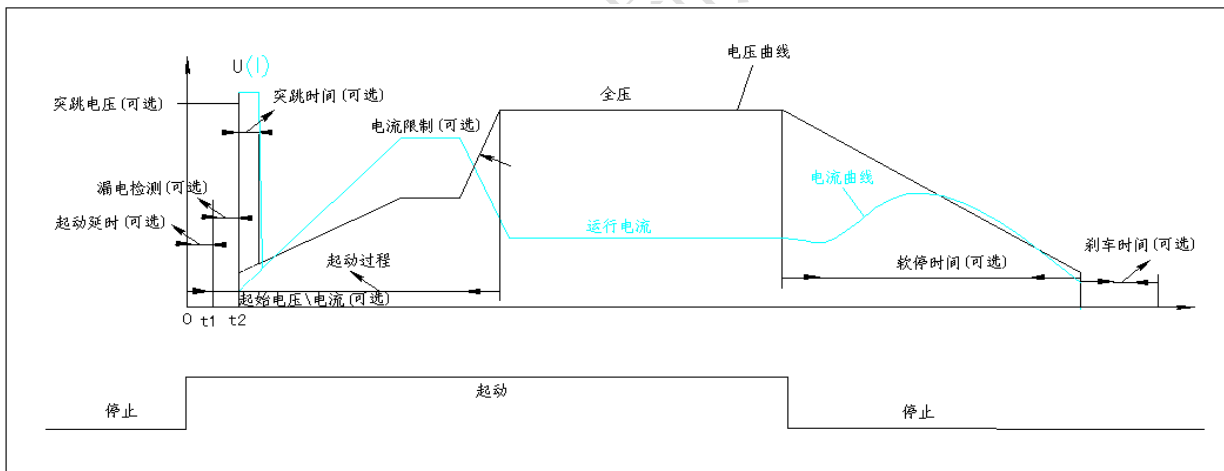
The device adopts component-based structure and modularization way of install. It has multiple surge absorb and protection technology.

Transient state dv/dt , in the transient state process of lightning impulse voltage and switching wave overvoltage, the device will be clamped by multiple amplitude limiting.

Adopt anti-interference digital trigger and CT isolated transfer trigger pulse to make safe high-voltage device as the low-voltage.

V. Operating Instruction

5.1 Control mode of soft starter



English translation about Chinese in the above figure

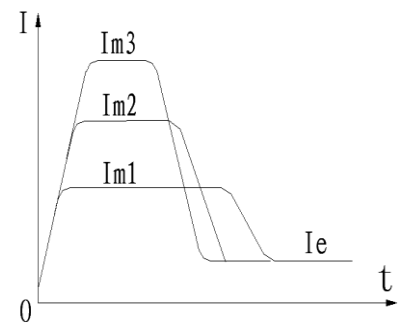
Chinese	English
突跳电压 (可选)	Jump voltage (optional)
漏电检测 (可选)	Electric leakage detection (optional)
启动延时 (可选)	Start delay (optional)
突跳时间 (可选)	Jump time (optional)
电流限制 (可选)	Current limiting (optional)

全压	Total head
电压曲线	Voltage curve
刹车时间（可选）	Brake time (optional)
软停时间（可选）	Soft start time (optional)
起动过程	Start process
起始电压\电流（可选）	Starting voltage or current (optional)
运行电流	Running current
电流曲线	Current curve
停止	Stop
起动	Start
停止	Stop

TGRJ Soft Starter has various start-up mode: current-limiting soft start, voltage linearity curve start, voltage exponential curve start, current linearity curve start, current exponential curve start; many kinds of stop ways: free stop, soft stop, brake stop, soft stop and brake stop, and the device also has inching function. Users can choose different start-up mode and stop ways according to different load and specific working conditions.

5.1.1 Current-limiting soft starter

When adopting current-limiting soft start mode, start time should be set to 0. After the soft starter receives starting order, the output voltage increases fast until it reaches amplitude limiting value I_m of setting current. Then the output current stops increasing, and after the motor continues to accelerate the operation for a period of time, the current begins to fall. Finally the output voltage increases fast until total voltage output and starting process is completed.



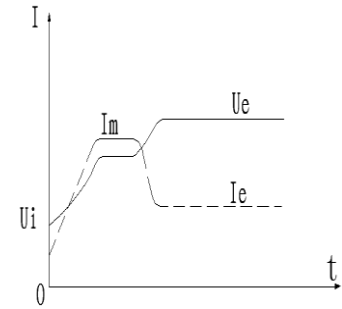
Parameters	Name	Range	Setting value	Setting value in factory
1M04	Starting Time	0 ~ 120S	0	10

1M05	Current-limiting multiples	100 ~ 500%Ie	—	300
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Note: “—” refers to users can set this value according to their demand.

5.1.2 Voltage index curve

According to index property, the output voltage increases by setting starting time, meanwhile, the output current also increases with a certain rate. When starting current increases to amplitude limiting value I_m , the current keeps constant until the start is finished.

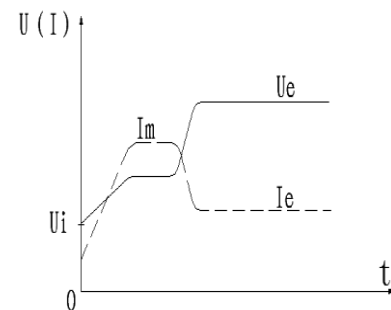


When adopting this mode, starting time and current-limiting multiples should be set simultaneously.

Parameters	Name	Range	Setting value	Setting value in factory
1M00	Start-up Mode	0~3	0	0
1M03	Starting Voltage	20~100%Ue	—	30%
1M04	Starting Time	0~120S	—	10
1M05	Current-limiting Multiples	100~500%Ie	—	300

5.1.3 Voltage linearity curve

According to linear characteristic, the output voltage increases by setting starting time, meanwhile, the output current also increases with a certain rate. When starting current increases to amplitude limiting value I_m , the current keeps constant until the start is finished.

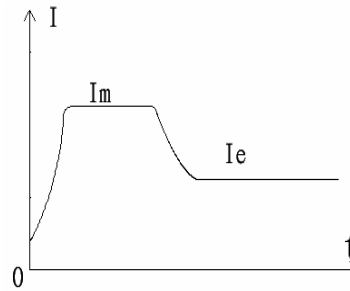


When adopting this mode, starting time and current-limiting multiples should be set simultaneously.

Parameters	Name	Range	Setting value	Setting value in factory
1M00	Start-up Mode	0~3	1	0
1M03	Starting Voltage	20~100%Ue	—	30%
1M04	Starting Time	0~120S	—	10
1M05	Current-limiting Multiples	100~500%Ie	—	300

5.1.4 Current index curve

According to index property, the output current increases by setting starting time. When starting current increases to amplitude limiting value I_m , the current keeps constant until the start is finished.

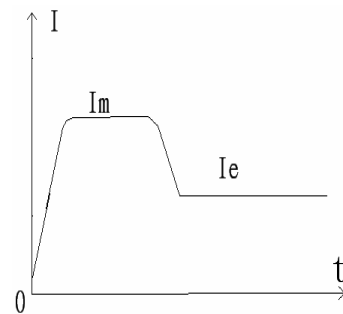


When adopting this mode, starting time and current-limiting multiples should be set simultaneously.

Parameters	Name	Range	Setting value	Setting value in factory
1M00	Start-up Mode	0~3	2	0
1M03	Starting Current	20~100%Ue	—	30%
1M04	Starting Time	0~120S	—	10
1M05	Current-limiting Multiples	100~500%Ie	—	300

5.1.5 Current linearity curve

According to linear characteristic, the output current increases by setting starting time. When starting current increases to amplitude limiting value I_m , the current keeps constant until the start is finished.



When adopting this mode, starting time and current-limiting multiples should be set simultaneously.

Parameters	Name	Range	Setting value	Setting value in factory
1M00	Start-up Mode	0~3	3	0
1M03	Starting Current	20~100%Ue	—	30%
1M04	Starting Time	0~120S	—	10
1M05	Current-limiting Multiples	100~500%Ie	—	300

5.1.6 Jump torque soft starter

Jump torque soft starter is applied to load motor with lager stiction, by applying an instantaneous large starting torque to overcome large static friction torque. In this mode, the output voltage quickly increases to setting step voltage and setting step time, and then it

reduces to starting voltage. Finally the motor completes soft start according to starting voltage or current and starting time.

Parameters	Name	Range	Setting value	Setting value in factory
1M03	Starting Voltage or Current	(20-100%)Ue\ (20-100%)Ie	—	30
1M01	Step Voltage	20~100%Ue	—	20
1M02	Step Time	0~2000mS	—	0



Jump torque starting mode must be applied cooperatively with other soft start ways, and also users should set step voltage and time.

5.1.7 Free stop

Free stop is the time when soft stop time and brake time set to zero simultaneously. After soft starter receives stop order, firstly the pilot relay of bypass contactor will be closed, and then close thyristor of main circuit, the motor will freely stop by inertia load.

Parameters	Name	Range	Setting value	Setting value in factory
1M07	Soft Stop Time	0~120S	0	0
1M01	Brake Time	0~250S	0	0

5.1.8 Soft stop

When soft stop time setting is not 0, it is soft stop in the condition of total pressure. Stop the motor in this mode, the bypass contactor of soft starter will be firstly disconnected. Then output voltage of soft starter gradually drops to setting ceased voltage in setting soft stop time. After finishing soft stop process, soft starter will be changed to brake state (brake time is not 0) or soft starter will stop freely.

Parameters	Name	Range	Setting value	Setting value in factory
1M07	Soft Stop Time	0~120S	—	0
1M08	Step Stop Voltage	20~60%Ue	—	20
1M09	Brake Time	0~250S	0	0

5.1.9 Brake stop

When soft starter sets brake time (1M09) and chooses output of brake time relay, after soft starter stops freely, output signal of brake time relay keeps effective in the brake time. The output signal of time relay can be used to control the outer brake units or electric control units

of mechanical brake.

5.1.10 Soft stop and brake stop

When soft starter sets soft stop time and brake time, the bypass contactor will be disconnected firstly. Then output voltage of soft starter gradually drops to setting ceased voltage in setting soft stop time. After finishing soft stop process, soft starter will be braked in the brake time.

5.2 Control, setting and operation

5.2.1 Buttons function description

Note: data will be kept to next modification once read in, not be effected by power down.

VI. Installation Instruction

NOTE: Soft starter is high-tension apparatus with potential voltage to harm people, so it must be operated and maintained by authorized and trained personnel. After high-pressure power off, due to the induction high-pressure of motor, it is safe once after being discharged.

6.1 Open and check

(1) Open the box carefully and check the equipment is damaged or not in the course of

Signal	Name	Function Description
—	Enter Key	Enter the parameters menu, confirm parameters needed to modify
∧	Increasing Key	Progressive increasing of parameters or data
∨	Decreasing Key	Progressive decreasing of parameters or data
C	Exit Key	Confirm modified parameter data and exit from parameters menu
RUN	Run Key	When key operation is effective, it is applied to run operation, short circuit 3 or 5 X1 terminal row
STOP	Stop Key	When key operation is effective, it is used to stop operation. In fault condition, press STOP key for 4 seconds to reset the current fault.

transportation. If it is damaged, please inform us in 15 days.

(2) Check mechanical components loose or wire loose or not in the course of transportation and carriage, once occurs this problem please inform us to deal with.

6.2 Installation

(1) Installation should comply with the installation rules of high-voltage electrical apparatus, keep installation distance and lay out horizontally. For convenient operation and maintenance, keep certain space before and behind the cabinet.

(2) Connect ground cable to ground terminal under the soft starter, use ohm gauge to check all resistance value between ground cables and confirm reliable grounding.

6.3 Insulating strength and protection

(1) Under normal circumstances, users had better not have insulating strength test on soft starter.

(2) Purpose of protection function test is to check reliable protection. The test should be carried out in 380V system because of various simulative faults.

VII. The Common Failures and Processing Method

When abnormal situations occur, immediately stop soft starter and operation keyboard will show error code. Users can analyze the cause of accident according to error code. After trouble removal, soft starter can be reset by reset key (details follow).

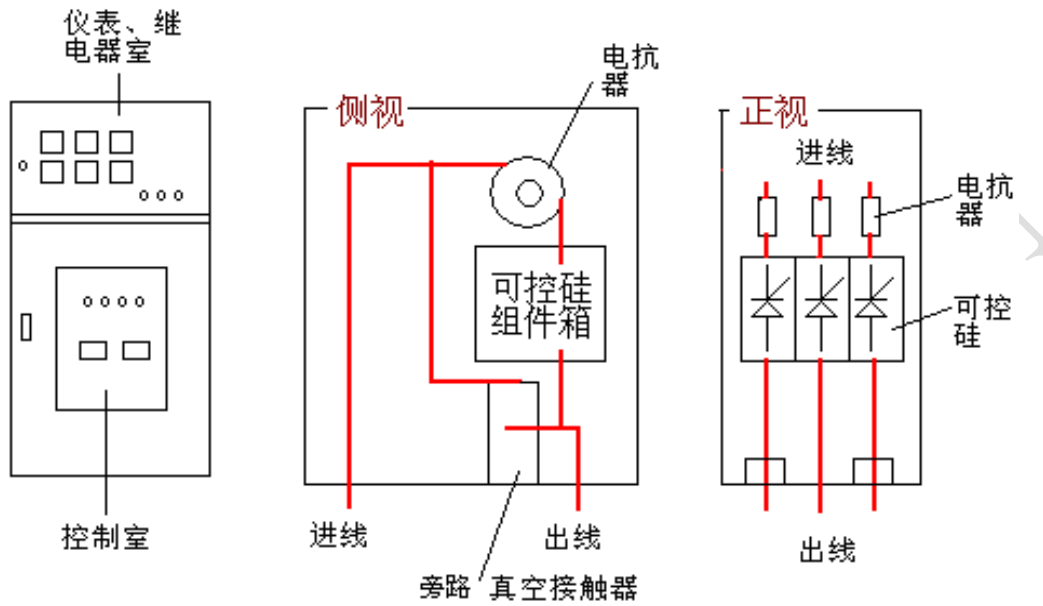
Error Code Table

Soft starter has 11 protection functions, when functions operate, soft starter stops immediately and LCD display shows the current failure. Users can analyze the cause of accident according to the fault content.

Error Code	Fault Name	Fault Cause	Handling Method
01	Main Power Failure	Default phase in starting or operation?	Check three-phase power is reliable or not?
02	Phase Sequence Failure	Phase sequence in incorrect way	Adjust phase sequence or set no detect

03	Parameters missing	Set parameters loss	Check various settings and reset
05	Operating Over-current	Sudden increase in load? Too much fluctuation of load?	Adjust the load operation condition Adjust M13 setting
07	Phase Current Unbalance	Default phase or phase voltage unbalance	Adjust M12 setting
08	SCR Overheating	Internal radiator overheating Machine unventilation	Check draught fan can work or not Reduce the starting frequency Check whether the supply voltage is too low
09	Internal Forbidden	Violate operating regulation	Confirm the operation procedures
10	Starting Time Overtime	Under the heavy load startup time is too short? Current limiting amplitude is too small?	Adjust starting time M04 Adjust current limiting value M05
12	Earth-fault lock-out Protection	A leakage is detected Electrical and insulation impedance is too small	Adjust setting can be set as do not test leakage or not?
13	Electronic Thermal Overload	Large current duration is too long whether the overload operation?	Check the current setting is wrong or not? Overload or not?
14	SCR Abnormal	SCR can work or not? Default phase in the output of soft starter?	Check SCR is damaged or not? Check the input and output of soft starter lack of phase or not?

VIII. Size of Soft Starter Cabinet



外形与主回路

English translation about Chinese in the above figure

Chinese	English
仪表、继电器室	Instrument and relay room
控制室	Control room
侧视	Side-looking
电抗器	Electric reactor
可控硅组件箱	Thyristor components box
进线	Incoming line
出线	Outgoing line
旁路真空接触器	Bypass vacuum contactor
正视	Front view
进线	Incoming line
电抗器	Electric reactor
可控硅	Silicon controlled
出线	Outgoing line

外形和主回路	Size and major loop
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Cabinet size (H*D*W): 2300mm*1500mm*1000mm

Installation of hole site as illustrated in figure: 770mm*1420mm

