

Selectric

ENERGY OF INNOVATION

USER MANUAL
SOFT STARTER

Selectric – SSE6

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Chapter I General information

1. Briefly on the product

For the SSE6 series high-voltage solid-state soft starter, smart digital control is provided, using a 32-bit microcontroller as the control core and an SCR valve block as the execution unit, to implement fully automatic control of motor starting and stopping.

It is suitable for controlling high-voltage squirrel-cage induction motors and high-voltage synchronous motors with various loads.

The SCR valve block in the SSE6 series high-voltage solid-state soft starter consists of multiple thyristors connected in series and parallel. The voltage at the motor terminals is varied by controlling the actuating angle during the motor starting process, so that the soft starter can smoothly accelerate the motor according to the preset starting curve, and when the motor reaches normal speed, the bypass contactor or circuit breaker closes, completing the motor starting. The soft starter provides motor operation monitoring, measures voltage, current, and motor status in real-time, and provides a complete protection function during motor operation.

2. Operation characteristics

Items	Description
AC voltage	AC3KV/6KV/10KV, $\pm 10\%$ -15% ;
Load type	Three-phase high-voltage AC induction motor/synchronous motor
Frequency	50 Hz $\pm$ 2 Hz or 60 Hz $\pm$ 2 Hz
Main circuit composition	3KV,12SCRS ; 6KV,18SCRS ; 10KV, 30SCRS ;
Instantaneous overvoltage protection	Voltage-equalizing protective device and resistive absorption network
Cooling method	Natural cooling
Bypass contactor	Direct start contactor
Control method	Two-wire or three-wire
Environmental conditions	Ambient temperature: -10 to 40°C, altitude above sea level: not more than 1000 m, relative humidity: not more than 90%.

3. Operating principle

Continuous stepless voltage ramp-up is provided for the SSE6 series high-voltage solid-state soft starter, so that the stator voltage gradually rises to full voltage from a specific initial value during motor starting, and the current increase is limited during the voltage ramp-up process. At the same time, the RC resistor-absorption unit absorbs the peak voltage when the SCR turns off in the reverse direction; the equalizing resistor blocks the SCR voltage so that the voltage of all SCR groups in the series circuit is the same; the fiber-optic trigger provides electrical isolation between the controller and the high-voltage SCR and ensures that the firing signals are not subjected to electromagnetic interference.

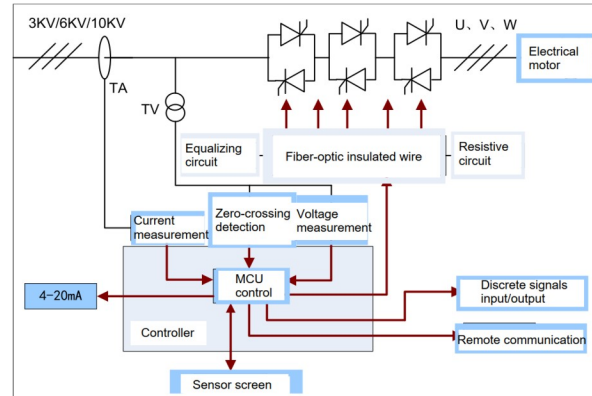


Fig. 1.1 Block diagram of high-voltage soft starter

In the three-phase voltage regulation circuit of the soft starter (Fig. 1.2), a back-to-back parallel thyristor is connected between the power supply and the motor. Phase control is provided for the thyristor, i.e., the thyristor connects the load and the power supply at a selected time during each cycle of the supply voltage, and the purpose of voltage regulation can be achieved by changing the selected time.

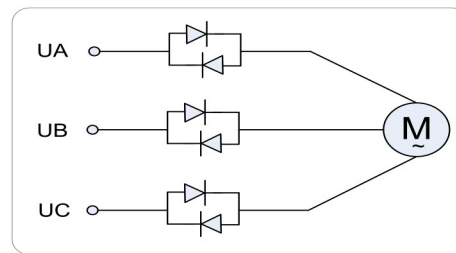


Fig. 1.2 Three-phase AC voltage regulation circuit

The thyristor connected in series into the main circuit of the motor can be considered as a non-linear resistor, with low resistance in the on-state and high resistance in the off-state. The motor has a three-phase three-wire wiring. Let's take phase A as an example: it conducts only when AB forms a circuit, AC forms a circuit, or AB and AC form a circuit simultaneously.

4. Control system

The control system of the SSE6 high-voltage solid-state soft starter consists of three parts: the soft starter controller, the pulse card, and the trigger card.

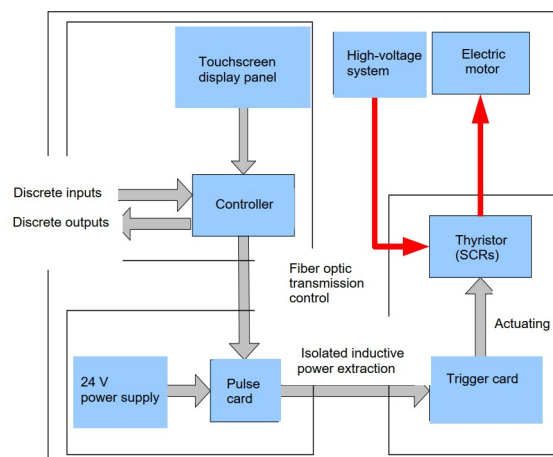


Fig. 1.3 Control system block diagram

1) Soft starter controller

1) The soft starter controller consists of a CPU card, a fiber-optic trigger card, a power supply and relay card, a sampling card, and a touchscreen. The CPU card is the core of the controller and implements control functions including photoelectrically isolated discrete signal input/output, voltage and current signal acquisition, voltage zero-crossing detection, 4-20 mA output, touchscreen communication, remote communication and protection.

The touchscreen is connected to the controller via RS232, and features a Chinese-English menu, allowing for convenient parameter settings.

2) Pulse card

The trigger card converts the fiber-optic triggering signals transmitted from the soft starter controller into electrical firing signals, and then modulates the electrical firing signals into high-frequency pulse current signals. The soft starter controller and the pulse card are electrically isolated from each other thanks to the fiber-optic transmission and control.

3) Trigger board

When the high-frequency pulse current passes through the high-frequency pulse transformer, the transformer can sense the electrical signal and convert it into an SCR triggering signal, allowing the SCR actuation to be implemented. There is no direct electrical connection between the pulse card and the trigger card; the trigger card is electrically isolated, receiving energy through electromagnetic induction.

5. Design

The SSE6 series high-voltage solid-state soft starter is designed as a cabinet, which can be divided into separated and integrated types according to the product code. The high-voltage solid-state soft starter cabinet is modified based on the KYN28-12 cabinet and is made of aluminum-zinc coated steel sheets processed with multiple CNC bending and bolted connections. The cabinet features a high degree of protection against debris and pests.

1) Separated type

The separated-type high-voltage solid-state soft starter belongs to the SSE6 type, and the components inside the cabinet include: an AC contactor, an SCR valve block, a surge arrester, a current transformer, a voltage transformer, a soft starter control system, etc. The internal structure of the device is simple, and all parts have a modular design, which ensures easy and convenient maintenance and repair. The layout of components in the cabinet is shown in Fig. 1.4.

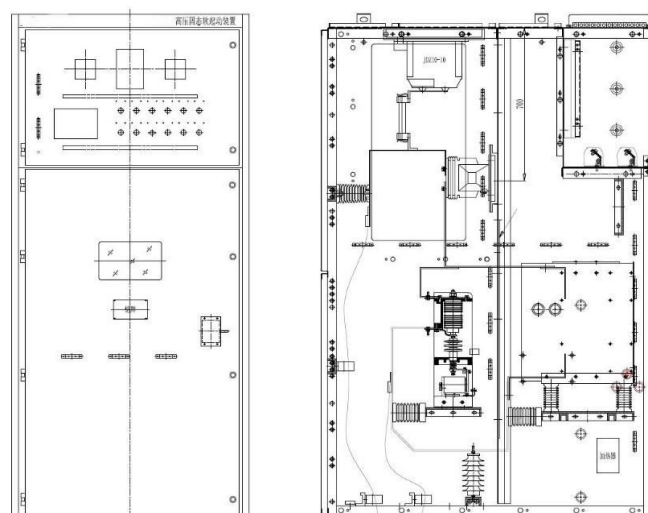


Fig. 1.4 Component layout diagram in the cabinet of the separated-type high-voltage solid-state soft starter.

2) Integrated type

The integrated-type high-voltage solid-state soft starter belongs to the SSE6 type. The handcart circuit breaker is installed in the circuit breaker compartment; the controller and secondary components are located in the low-voltage compartment; the voltage transformer is installed in the busbar compartment; the bypass contactor and current transformer are installed in the cable compartment.

The components inside the cabinet of the integrated solid-state soft starter include: a vacuum circuit breaker, an AC contactor, an SCR valve block, a surge arrester, a current transformer, a voltage transformer, a soft starter control system, a microcomputer protection device, etc. The layout of components in the cabinet is shown in Fig. 1.5.

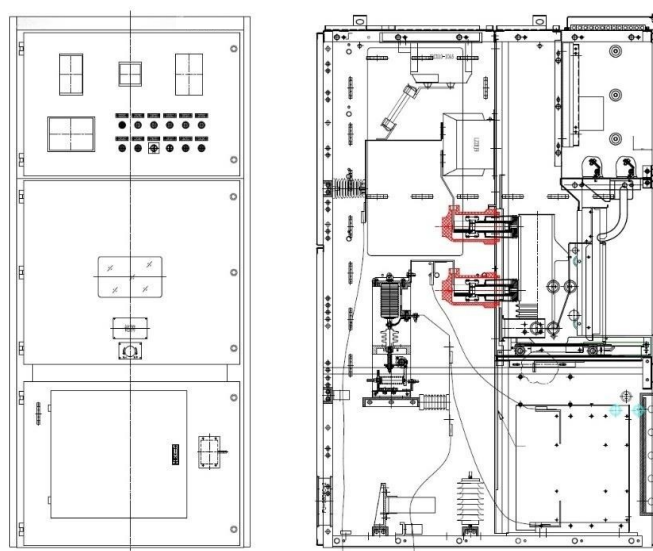


Fig. 1.5 Component layout diagram in the cabinet of the integrated type high-voltage solid-state soft starter.

Chapter II Functions and selection

1. Products selection

Model	Voltage Class	Rated current	Cabinet size		
	(kV)	(A)	Height, mm	Width, mm	Depth, mm
SSE613-500/30	3	113	2300	1000	1500
SSE613-900/30	3	204	2300	1000	1500
SSE613-1250/30	3	283	2300	1200	1500
SSE613-1800/30	3	408	2300	1500	1500
SSE613-2000/30	3	453	2300	1500	1500
SSE613-xxxx/30	3	> 450	On request		
SSE613-500/60	6	57	2300	1000	1500
SSE613-1000/60	6	113	2300	1000	1500
SSE613-1500/60	6	170	2300	1000	1500
SSE613-2000/60	6	226	2300	1000	1500
SSE613-2500/60	6	283	2300	1200	1500
SSE613-3000/60	6	340	2300	1200	1500
SSE613-3500/60	6	396	2300	1500	1500
SSE613-4000/60	6	453	2300	1500	1500
SSE613-xxxx/60	6	> 450	On request		
SSE613-500/10	10	34	2300	1000	1500
SSE613-1000/10	10	68	2300	1000	1500
SSE613-1500/10	10	102	2300	1000	1500
SSE613-2000/10	10	136	2300	1000	1500
SSE613-2500/10	10	170	2300	1000	1500
SSE613-3000/10	10	204	2300	1200	1500
SSE613-3500/10	10	238	2300	1200	1500
SSE613-4000/10	10	272	2300	1200	1500
SSE613-5000/10	10	340	2300	1500	1500
SSE613-6000/10	10	408	2300	1500	1500
SSE613-xxxx/10	10	> 450	On request		

Notes:

- 1) The rated current of the matching motor cannot exceed the rated current of the soft starter.
- 2) If the rated current of the motor exceeds 450 A, the cabinet needs to be redesigned; please contact the manufacturer.
- 3) A bypass contactor is provided in the high-voltage soft starter cabinet; if you have other special requirements, please inform us.

2. Functional description

2.1 Protection function

Starting timeout

Section 1 overcurrent protection

Section 2 overcurrent protection

Section 1 negative sequence overcurrent protection

Section 2 negative sequence overcurrent protection

Underload protection

Overvoltage protection

Undervoltage protection

Negative sequence overvoltage protection

2.2 Measurement function

System frequency: displays the system frequency value.

Voltage measurement: three-phase voltages U_{ab} , U_{bc} , U_{ca} , and negative sequence voltage.

Current measurement: motor three-phase currents I_a , I_b , I_c , and negative sequence current.

2.3 Communication interface

Communication 1: RS232 communication, connected to the touchscreen for data display, parameter settings, etc.

Communication 2: RS485 communication, communication with the background monitoring system, standard MODBUS protocol, can be used for reading and writing parameters and controlling the controller.

2.4 Discrete signal input and output

8 input quantities, DC24V relay isolation, photoelectric isolation.

9 output quantities, contact capacity 6A/250VAC, passive discrete signal output.

2.5 Cabinet door layout

- 1) Touchscreen for human-machine interaction.
- 2) Control switches and buttons: 2 switches for direct/soft start and local/remote control, 3 buttons for start, stop, and emergency stop.
- 3) Status indicators: 6 pcs - power supply, ready, start/soft stop, shunting/run, fault, spare.

Notes: The above is the standard configuration; special conditions can be adjusted according to user requirements.

Chapter III Installation and commissioning

1. Transportation, storage, and unpacking inspection

1.1 Lifting and transportation guidelines

The equipment is packed in simple packaging; if the user has additional requirements, they must be agreed upon separately.

During transportation, the equipment and its packaging case must be securely fastened to transport vehicles using ropes or other fasteners and must not tilt freely. The equipment fastening during transportation must be carried out in accordance with the diagrams on the packaging. During transportation, sufficient and appropriate waterproofing measures must be taken to ensure the safety of the equipment.

For lifting the equipment, a lifting mechanism is generally used; during lifting, attention must be paid to the center of gravity of the equipment. Four-point lifting is required, and two-point lifting is prohibited. It must be ensured that the equipment remains stable, without tilting or shaking, during lifting for transportation and installation. If the equipment needs to be moved using a forklift, it must be operated in accordance with the forklift slots on the packaging. The equipment must be placed on a flat and solid surface, and soft ground must be reinforced with wooden blocks.

1.2 Storage

Preserve the original packaging.

The storage location must be flat and solid, protected from the effects of sun, rain, and water. When placed outdoors, it must be protected from the effects of sun and rain.

Do not place the device in a confined space with other objects.

The storage period must not exceed 1 year, unless otherwise specified.

1.3 Unpacking and inspection

Verify that the ordered model and the received product match.

Carefully unpack and check if the product was damaged during transportation; contact the manufacturer if any damage is found.

Check the completeness of the delivered equipment: certificate of conformity, user manual, factory test report, drawings, spare parts, etc.

Check for any loose mechanical parts, broken wires, or loose wiring during transportation and handling; loose wiring will affect the product operation.

Verify the correctness of the rated voltage and current before starting.

2. Cabinet installation and hook-up

(1) Determine the equipment location in accordance with the site layout; the surface of the cable trench under the cabinet is treated with cement to ensure reliability and durability.

2) Install the required embedded parts.

3) Before installation, clean the equipment space and ensure that it is dry.

4) The equipment is lifted into position and secured or welded to the fixed channel steel using anchor bolts.

5) Routing and connection of primary and control cables.

3. Insulation test

Insulation resistance test: Before the test, short-circuit the three-phase input and output of the bypass contactor, remove the primary wiring of the voltage transformer, short-circuit both ends of the SCR (all heatsinks are connected together) or remove the input and output busbars of the SCR assembly, and short-circuit the triggering terminals on the trigger card.

Measure the insulation resistance of the circuit to ground using a 2500 V megohmmeter for 1 min; the measured insulation resistance values are given in the table below:

Ambient temperature, °C	10	20	30	40
Insulation resistance, MOhm	900	450	220	110

Power-frequency withstand voltage test: remove the surge arrester based on the insulation resistance test, and use a power-frequency withstand voltage tester to conduct an AC 32 kV (6 kV - AC 25 kV) withstand voltage test for 1 min.

After completing the test, reinstall the surge arrester and remove the short circuit.

Attention! The soft starter has undergone a withstand voltage test at the factory, therefore a site test is not required; however, withstand voltage tests must be conducted on the external connection cable and the motor. It is recommended to contact the manufacturer if a site withstand voltage test inside the cabinet is necessary, in order to avoid damage to the valve block.

4. Low-voltage lamp test

The test procedure is given below:

- 1) Disconnect the input and output of the high-voltage soft starter;
- 2) Connect a three-phase three-wire AC 380 V power supply to the input and three incandescent lamps to the output; the neutral connection of the lamps is Y-shaped.
- 3) The control power supply of the soft starter cabinet is AC 220 V/DC 220 V; after power-on, the controller and the touchscreen operate normally.
- 4) Using a multimeter, determine the resistance of each GK terminal on the trigger card—this is the resistance of the SCR gate electrode and cathode, which is about 15 Ohms. If the measured resistance deviates from the normal value by 50%, there may be a problem with the SCR crimping or with the SCR itself. Next, measure the resistance of the left and right K terminals on the trigger card using a multimeter. The resistance value corresponds to the resistance at both ends of the two back-to-back parallel SCRs and is similar to the equalizing resistance, which is about 150K. If the resistance is low, either the SCR is not installed in the back-to-back parallel mode, or the SCR has been broken down.
- 5) After checking the SCR, press the touchscreen to enter the hardware test, input the commissioning password, and check the discrete signal input/output and the pulse output. If the results are positive, it means that there are no problems with the soft starter control system and secondary wiring, and the start conditions are met.
- 6) Set the control mode to 2, test mode. In this mode, the equipment actions during a soft start can be simulated. If the switch operates normally, change the control mode to 1 (official star with remote control) or 0 (official start without remote control).
- 7) Turn the switch to local mode and soft start, set the parameters on the touchscreen, and press the start button; the lamp will gradually brighten until the bypass switch closes, completing the start.
- 8) The high-voltage solid-state soft starter can be tested under high voltage if the commissioning process through steps 1–5 continues normally.
- 9) Restore all wiring after completing the tests.

Attention! After each soft start, the device will count down the time until the next start, and starting is prohibited until the countdown finishes. Once the countdown time expires, the start interlock is automatically released, allowing the device to start the next time.

5. High-voltage wiring and start

- 1) After completing the lamp tests, remove the test power supply and test equipment, and connect the input and output high-voltage cables of the high-voltage solid-state soft starter, paying attention to the phase sequence.
- 2) After connection, turn on the primary power supply; the touchscreen should display the correct frequency, the three-phase voltage values should be correct, the negative sequence voltage should be very low, and the motor phase sequence should be positive. Then, set the start/stop parameters and protection parameters according to the operating conditions. Press the "Stop" button to reset the fault signal when the fault indicator is lit; the reset will not occur if the fault is still present.
- 3) During the first start, set to jogging mode for a duration of 3–5 seconds.
- 4) Turn the switch to local mode and soft start mode, press the start button, and the motor will start; the current value displayed by the ammeter or touchscreen can be continuously observed, and the motor will automatically stop after running for 3–5 seconds.

In the jogging mode, the rotation direction of the motor can be observed; if the direction is correct, you can proceed to the next start; if the direction is incorrect, isolate the high-voltage power supply and adjust the motor connection sequence.

- 5) If there really is confidence, steps 3–4 can be skipped; set to the voltage ramp mode or current-limiting start mode, then press the start button, the motor will start, the current will begin to decrease after the motor reaches full speed, and then the bypass contactor will close, completing the start. Trip protection is activated if a fault occurs during start. If the current fluctuates not normally during start, press the stop button or the emergency button to stop the device; restarting is permitted only after the fault is eliminated.

Chapter IV Menu and settings

A 7-inch high-performance industrial touchscreen with a 65,536-color display and a high resolution of 800*480 is used as the display interface of the SSE6 series high-voltage solid-state soft starter, making the image finer and more realistic.

1. Main interface description

The main interface displays the date, time, system frequency, three-phase voltage, negative sequence voltage, three-phase current, negative sequence current, average current, load factor, phase difference angle between voltage and current, power factor, starting time, remaining interlock time, starting mode, stopping mode, control mode, operating status, interlock status, company information, etc. as well as buttons for system settings, event logging, starting curve, hardware settings, other settings, and operating instructions.

System frequency: system power frequency; this setting supports 50 Hz and 60 Hz power systems.

Three-phase voltage: effective value of the three-phase line voltage U_{ab} , U_{bc} , and U_{ca} ;

Negative sequence voltage: effective value of the negative sequence voltage;

Phase difference angle: phase difference between voltage and current of three phases A, B, and C;

Power factor: real-time power factor value;

Three-phase current: RMS value of the three-phase currents I_a , I_b , I_c ;

Average current: average value of the three-phase currents I_a , I_b , I_c ;

Negative sequence current: RMS value of the negative sequence current;

Load factor: ratio of the average three-phase current to the rated current;

Transmit current: real-time output value of the transmitted current;

Actuation angle: real-time actuation angle of the soft starter during start and soft stop;

Starting time: duration of the current soft start, the time resets to zero before the next start.

Circuit breaker: status of the main circuit breaker of the soft starter, turns red when closed and green when open. The circuit breaker in the integrated soft starter is a vacuum circuit breaker inside the cabinet.

Bypass contactor: status of the bypass contactor in the soft starter, turns red when the contactor closes and green when it opens.

Start lockout: after the soft starter starts, the lockout time does not expire until the next start, the lockout status is red and starting is prohibited; after the interlock time expires, the lockout status turns green and starting is allowed.

Starting mode: current starting mode of the soft starter, for example, voltage ramp, current-limiting ramp, kickstart ramp, jogging start, two-stage voltage ramp;

Stopping mode: current stopping mode of the soft starter, for example, coast stop, soft stop;

Operating status: current operating status of the soft starter, for example, communication failure, ready, start, running, soft stop, fault, test, emergency stop, standby;

Motor phase sequence: current phase sequence of the power supply connected to the three phases ABC of the soft starter; an unknown phase sequence is displayed when there is no voltage, positive phase sequence is displayed for positive sequence, and reverse phase sequence is displayed for negative sequence.

Remaining time: countdown time until the next start after the soft starter completes its start.

Running time: the countdown begins after the soft starter completes its start, and the running time resets to zero before the next start.

Device number: the soft starter number on site, which can be set by the signal itself.

You can switch between Chinese and English by pressing the Chinese/English button in the upper left corner.

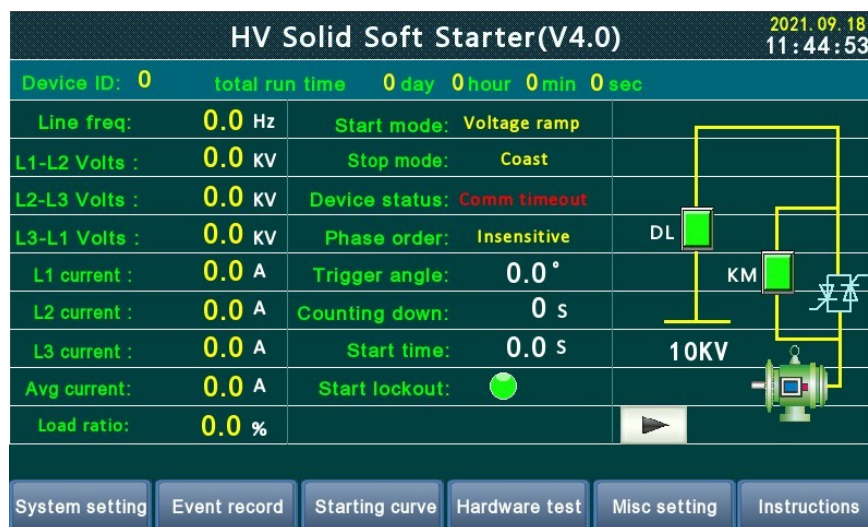


Fig.4.2 Main interface in English

2. System settings

Press the System Settings button on the main interface to enter the system parameter settings interface.

Status description: 1) Reset button – after pressing the reset button, the system exits the commissioning mode and the indicator turns green. 2) Indicator – when the system is in the commissioning mode, the indicator turns red and flashes. 3) If the text color of the button is yellow, it indicates the page corresponding to the current button. 4) If the corresponding page contains configuration instructions, you can access the parameter configuration instructions.

Commissioning password: system commissioning password is 102, after entering the correct password, the display will show the value 9999, the indicator in the lower left corner will start flashing, and the interface will enter commissioning mode, allowing parameters to be modified.

Notes: Access to the commissioning mode is only possible in standby, ready, and fault states; access is not possible in other states.

After modifying the parameters, press the button in the lower left corner to exit the commissioning mode and enter the normal operating mode.

Set value set number: 4 sets of set values can be configured for the device; typically, the first set of set values is used by default. Do not change the set value set number after use, otherwise, it may lead to incorrect engine parameters.

Rated current: parameter setting range is 1-800, default value is 100. The set value is the rated motor current; the rated current is rounded up if it is a decimal.

Voltage transformer transformation ratio: parameter setting range is 1-200, default value is 100. The set value is the ratio of the primary and secondary voltages of the voltage transformer, for example, $10000\text{V}/100\text{V}=100$.

Current transformer transformation ratio: parameter setting range is 1-800, default value is 100. The set value is the ratio of the primary and secondary currents of the current transformer, for example, $200\text{A}/5\text{A}=40$. The set value is the ratio of the primary and secondary currents of the current transformer, for example, $200\text{A}/5\text{A}=40$.

Starting mode: parameter setting range is 0-1, default value is 0. 0 - button start, 1 - feedback start (feedback start means that simultaneous start and stop will occur after closing the switch, no need to press the start/stop button again).

Control mode: parameter setting range is 0-2, default value is 1. 0 - local control, 1 - local control + remote control, 2 - analog control (analog control can only be tested in standby mode).

Switch configuration: parameter setting range is 0-3, default value is 0. 0 - bypass contactor only, 1 - bypass contactor + main circuit main contactor, 2 - bypass contactor + main circuit disconnecter, 3 - bypass contactor + isolation contactor.

Frequency setting: parameter setting range is 50 Hz/60 Hz; for a 50 Hz system, it is set to 50, and for a 60 Hz system, it is set to 60; if set to other values, the 50 Hz system is used by default.

Start interval: parameter setting range is 0-60 min, usually set to 15 min, i.e., a 15 min interval is required to restart the soft starter; the user can modify it according to actual needs.

Start delay time: parameter setting range is 0-15 s, usually set to 1, which is the waiting time before the start action begins after the start signal is given.

Pulse width: parameter setting range is 0-15, default value is 10° . 1° represents the cycle time $t/360^\circ$, $1^\circ = 55.5 \mu\text{s}$ in a 50 Hz system, $1^\circ = 46.3 \mu\text{s}$ in a 60 Hz system.

Acceleration time: parameter setting range is 100-2000 ms, usually set to 500 ms. After the motor starts at full speed, the motor current begins to drop; at this time, the voltage at the motor terminals has not reached full voltage, and it is necessary to quickly increase the voltage to full voltage and then bypass it to avoid motor fluctuations when it is not bypassed at full speed.

Cut-off angle: parameter setting range is 15° - 60° , usually set to 35° . The cut-off angle is the smallest actuation angle achieved during soft start.

"One controls many" setting: parameter setting range is 0-1, default value is 1. 0 - one controls many, 1 - one controls one.

Phase sequence interlocking: parameter setting range is 0-2, usually set to 1. 0 - no interlocking, 1 - interlocked in positive sequence, the system detects an alarm in negative sequence, 2 - locked in negative sequence, the system detects an alarm in positive sequence.

Communication address: parameter setting range is 1-63, default value is 1. RS485 address, for background communication.

Baud rate: parameter setting range is 1-5, default value is 1. 1 - 9600, 2 - 19200, 3 - 38400, 4 - 57600, 5 - 115200.

Motor synchronization factor: parameter setting range is 100-300, default value is 100. The synchronous motor starts asynchronously; if excitation is not switched on after starting, the current is relatively large and bypass conditions are not met. The synchronous motor can meet the bypass conditions by setting the electrical synchronization factor.

The motor synchronization factor is set to 100 for asynchronous motors.

The motor synchronization factor is set to 150-200 for synchronous motors.

Signal inverting: parameter setting range is 0-1, default value is 1. 0 - not inverted, 1 - inverted. Some stop signals and equipment fault signals are negative signals, which must be used after signal inversion.

4-20 mA output: parameter setting range is 0-1, default value is 1. 0 - output is not enabled, 1 - output is enabled.

4-20 mA offset: parameter setting range is ± 1000 , default value is +640. This parameter is used to correct the constant offset value within the 4 to 20 mA range.

4-20 mA factor: parameter setting range is 200-5000, default value is 1000.

This parameter is used to correct the constant linear deviation within the 4 to 20 mA range.

Direct start time: parameter setting range is 1-15 s, default value is 10 s. During direct motor start, the soft start process is skipped; the stage 1 overcurrent protection, stage 2 overcurrent protection, stage 1 negative sequence current protection, and stage 2 negative sequence current protection may yield malfunction. After setting the direct start time, the overload protection values for the stage 1 overcurrent protection and stage 1 negative sequence current protection are increased during the direct start time, while the functions of the stage 2 overcurrent protection and stage 2 negative sequence current protection are interlocked.

Voltage correction factor: the soft starter is delivered with a calibrated voltage factor. Modifying the voltage factor is generally not allowed.

Current correction factor: the soft starter is delivered with a calibrated current factor. Modifying the current factors is generally not allowed.

The voltage and current correction factors can be modified after entering the safety password; if you really need to modify the factors, please contact the manufacturer to obtain the password. The user is responsible for the consequences of modifying the factors.

Digital input fault: parameter setting range is 0-1, default value is 1. 0 - invalid, 1 - valid. The digital input fault must be set to 1 unless specified otherwise.

3. Start and stop settings

Starting mode: 0 - voltage ramp, 1 - current limit, 2 - kickstart, 3 - jogging mode, 4 - dual-stage voltage ramp.

3.1 Voltage ramp starting

When starting in voltage ramp mode, the voltage begins to rise according to the set rate based on the initial voltage, and the current begins to drop when the motor speed reaches full speed; at this time, the soft starter quickly increases the voltage to full voltage and then returns to bypass mode.

The voltage ramp includes two parameters: initial voltage and ramp-up time; **Initial voltage:** parameter setting range is 30-80%, default value is 30, which is a percentage of the system voltage;

Ramp-up time: parameter setting range is 5-60 s, default value is 30. The ramp-up time is the time to increase from the initial voltage to full voltage under ideal conditions.

Regarding the actual motor start time, if the initial voltage is set to 30% and the ramp-up time is 35 s, the voltage ramp-up rate is $(100\%-30\%) \div 35 = 2\%/s$, i.e., the voltage increases by 2% per second. If the motor can start at 70% voltage, the actual start time will be $(70\%-30\%) \div 2\% = 20$ s. General-purpose motors start before reaching full voltage, so the actual start time is much shorter than the ramp-up time; the start time can be automatically adjusted depending on the load.

t_1 - t_2 on the left side of Fig. 4.6 is the section of rapid voltage increase, the time of which corresponds to the acceleration time parameter.

t_1 - t_2 on the right side of Fig. 4.6 is the difference in start time at different ramp-up time settings. With the same initial voltage, the longer the ramp-up time, the longer the start time, but the smaller the maximum starting current.

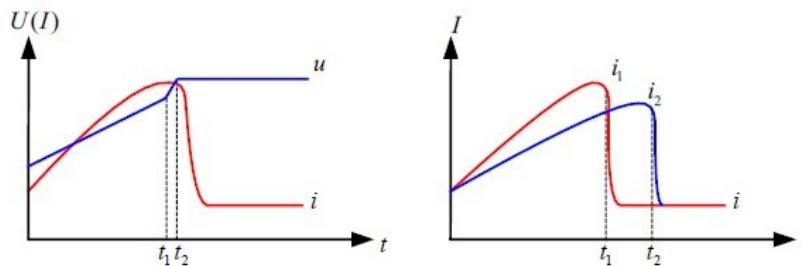


Fig. 4.6 Voltage and current curves in voltage ramp mode

3.2 Current limit starting

The initial start is carried out according to the voltage ramp mode during current limit starting; when the current reaches the set current limit multiple, the current enters the regulation stage to maintain the current at the limit value. When the motor reaches full speed, the current begins to drop; at this time, the soft starter quickly increases the voltage to full voltage and then returns to bypass mode.

Current limit starting includes two parameters: current limit multiple and regulation factor.

Current limit class: parameter setting range is 150-400%, default value is 350%, which is a percentage of the rated motor current;

Regulation factor: parameter setting range is 1-100, default value is 10; after the starting current reaches the current limit value, the current is maintained near the current limit value through PI regulation. The regulation factor represents the current regulation amplitude; if this value is set too large, the sensitivity increases, but the current regulation amplitude is too large; if this value is set too small, the sensitivity decreases, but the current regulation amplitude fluctuates too little. It is generally recommended to set it to 5-10.

On the left diagram of Fig. 4.7, the section 0- t_1 is the voltage ramp start time section, and t_1 - t_2 is the current regulation section.

On the right diagram of Fig. 4.7, the section t_1 - t_2 is the difference in start time at different current limit classes; the smaller the current limit value, the longer the start time.

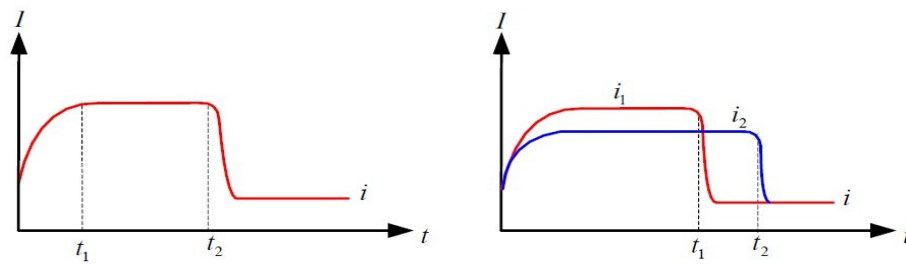


Figure 4.7 Current curve during current limit starting

3.3 Kickstart

Kickstart is used in cases where the initial static friction is relatively large; at the beginning of the start, a step voltage is applied for a period of time to make the motor rotate, and then the start is completed in voltage ramp mode.

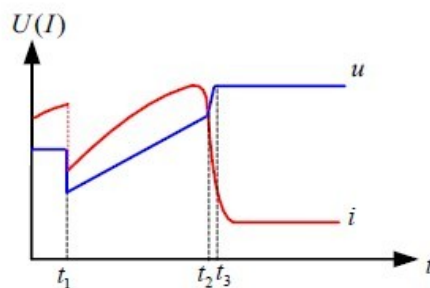


Figure 4.8 Voltage and current curves during jogging start

Voltage ramp starting includes two parameters: step voltage and duration;

Step voltage: parameter setting range is 50-80%, default value is 60, as a percentage of the rated voltage;

Duration: parameter setting range is 300-5000 ms, default value is 1000.

As shown in Fig. 4.8, during the time interval 0-t₁, a higher voltage is applied to generate a larger torque to make the motor start rotating, but this is accompanied by a large inrush current. During the time interval t₁-t₃, the starting process is carried out in the voltage ramp mode; when the motor reaches full speed, the current begins to drop, while the soft starter quickly increases the voltage to full voltage and is then shunted. During the time interval t₂-t₃, the voltage increases rapidly.

3.4. Jogging start

Jogging is carried out in the voltage ramp mode, but the duration is short; the main purpose is to start the motor for a few seconds to observe its rotation direction. This starting method is only suitable for initial adjustment.

Duration: parameter setting range is 1-10 s, default value is 5, which is the continuous motor starting time.

Jogging is a soft start in the voltage ramp mode, rather than a full-voltage start.

3.5 Dual-stage voltage ramp start

Dual-stage voltage ramp start is a starting process in which the voltage ramp mode is divided into two different ramps. The voltage begins to rise according to the set rate based on the

initial voltage, and the current begins to drop when the motor speed reaches full speed; at this time, the soft starter quickly increases the voltage to full voltage and then returns to bypass mode.

Stage 2 voltage: parameter setting range is 10-80%, default value is 50, the stage 2 voltage must be higher than the initial voltage;

Stage 2 time: parameter setting range is 5-60 s, default value is 15.

When calculating a dual-stage ramp, if the initial voltage is set to 30% and the ramp-up time is 20 s, and the stage 2 voltage is set to 50% with a ramp-up time of 20 s, then the stage 1 voltage ramp-up rate is $(50\%-30\%) \div 20 = 1\%/s$, and the stage 2 voltage ramp-up rate is $(100\%-50\%) \div 20 = 2.5\%/s$. The stage 2 voltage ramp-up rate is much faster than that of stage 1, so we can set this parameter in such a way that during the starting process, the motor creates a situation such as fast-then-slow or slow-then-fast.

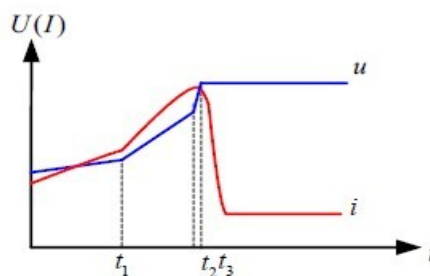


Figure 4.10 Starting voltage and current curves in dual-stage voltage ramp mode

3.6 Stop mode

Stop mode: parameter setting range is 0-1, default value is set to 0. 0 - coast stop, 1 - soft stop.

Coast stop means stopping by directly opening the switch.

Soft stop is controlled by a thyristor to gradually reduce the voltage on the motor side during the stopping process, thereby ensuring a reduction in output torque during the stopping process. This allows for an increase in stopping time and a reduction in mechanical shock when stopping under load.

When directly turning off a pump, the water above the pump will fall freely, and the backflow of water will generate a strong water hammer that will have a destructive effect on pipelines, valves, and other associated equipment. When using the soft stop method, the water does not generate vibration waves during the stopping process, and the water hammer phenomenon basically disappears.

Note: soft stop is suitable for pump loads with a certain lift height; in other cases, the soft stop function must be used with caution.

Cut-off voltage: parameter setting range is 30-70%, default value is 50, as a percentage of the rated voltage;

Soft stop time: parameter setting range is 5-30 s, default value is 10. The time from the start of the soft stop output to the final soft stop should not be set too long.

4. Protection setting

Starting timeout: parameter setting range is 20-60 s, recommended value is 50. The protective link is activated, when the motor starting time exceeds the set starting time, the protection trips and issues signals.

If the motor does not complete the start within the set time, the soft starter reports an emergency stop. The electrical motor starting time under normal load is much shorter than the protection starting timeout, but during current limit starting, if the current limit value is too small, resulting in insufficient motor output torque, the motor cannot reach full speed later, which leads to the activation of the starting timeout protection.

Stage 1 overcurrent: parameter setting range is 300%-500%, recommended value is 450. The protection link is activated, the stage 1 overcurrent protection operates in standby, ready, starting, running, and soft stop states. If the current value in any phase of the three-phase current exceeds the set value, the protection trips instantaneously and issues a signal.

For soft start, the stage 1 overcurrent during starting is the setpoint. During direct start, the set value of the stage 1 overcurrent is increased up to 2 times the setpoint during the starting process, and the stage 1 overcurrent value returns to its original value after the starting time ends.

Stage 2 overcurrent: parameter setting range is 80%-300%, default value is 120. The protection link is activated; the stage 2 overcurrent protection operates in standby, ready, and running states. If the current value in any phase of the three-phase current exceeds the set value, the protection trips with a delay and issues a signal.

Delay setpoint: parameter setting range is 0-60 s, recommended value is 3. If the set current value in any phase of the three-phase current is exceeded, the protection trips with a delay and issues signals. If the current value drops within the delay time, the protection is cleared.

Stage 1 negative sequence current: parameter setting range is 5%-80%, recommended value is 50. The protection link is activated, the stage 1 negative sequence current protection operates in standby, ready, starting, running, and soft stop states. Three-phase current in the negative sequence phase, incorrect connection of the current input and output in any phase or two-phase current, and three-phase current imbalance generate negative sequence current, the negative sequence current will also increase as the three-phase current increases. Stage 1 negative sequence current is generally used for negative phase sequence protection, incorrect current input and output connection, and phase loss. The negative sequence current value exceeds the protection setpoint, and the protection trips with a delay and issues a signal.

During soft start, soft stop, or direct start, the stage 1 negative sequence current value increases up to 4 times the setpoint, and during running, the stage 1 negative sequence current value returns to its original value.

Delay setpoint: parameter setting range is 0-60 s, recommended value is 1. When the negative sequence current value exceeds the protection setpoint, the protection trips with a delay and issues a signal; if the negative sequence current value decreases within the delay time, the protection is cleared.

Stage 2 negative sequence current: parameter setting range is 0-80%, default value is 15. The protection link is activated; the stage 2 negative sequence current protection is in standby and operates in ready and running states. Stage 2 negative sequence current is commonly used as three-phase current imbalance protection. The negative sequence current value exceeds the protection setpoint, and the protection trips with a delay and issues a signal.

The stage 2 negative sequence overcurrent protection function is blocked during soft start, soft stop, or direct start, and the protection is enabled in the running state.

Delay setpoint: parameter setting range is 0-60 s, recommended value is 5. When the negative sequence current value exceeds the protection setpoint, the protection trips with a

delay and issues a signal; if the negative sequence current value decreases within the delay time, the protection is cleared.

Underload protection: parameter setting range is 0-100%, default value is 10. The protection link is activated, this is a below-normal load protection, commonly used for belt conveyors. During motor operation, when the average value of the three-phase current is less than the set current value, the protection trips with a delay and issues a signal.

Delay setpoint: parameter setting range is 0-60 s, recommended value is 3. When the current value is below the protection setpoint, the protection trips with a delay and issues a signal; if the current value increases within the delay time, the protection is cleared.

Overvoltage protection: parameter setting range is 100%-200%, recommended value is 120. The protection link is activated, the overvoltage protection operates in standby, ready, starting, running, and soft stop states. If the voltage value in any phase of the three-phase voltage exceeds the set value, the protection trips with a delay and issues a signal.

Delay setpoint: parameter setting range is 0-60 s, recommended value is 3. When the voltage value exceeds the protection setpoint, the protection trips with a delay and issues a signal; if the voltage decreases within the delay time, the protection is cleared.

Undervoltage protection: parameter setting range is 30-100%, default value is 70. The protection link is activated, the undervoltage protection operates in starting, running, and soft stop states. If the voltage value in any phase of the three-phase voltage is below the set value, the protection trips with a delay and issues a signal.

Delay setpoint: parameter setting range is 0-60 s, default value is 3. The voltage is below the protection setpoint, and the protection trips with a delay and issues a signal; if the voltage rises within the delay time, the protection is cleared.

5. Event logging

Each fault includes: serial number, date, fault time, reset time, and fault information; if there are many fault records, you can view the history using the green navigation bar on the right and the up and down triangle buttons.

Reset: After a fault occurs, it can be reset by pressing the reset button.

6. Starting curve

Press the "Starting curve" button on the main interface to enter the Starting curve page. The starting curve records the average current for 50 s after starting and automatically stops after 50 s. Before the next start, the previous current record data is cleared, and then the current starting current is recorded.

7. Hardware testing

Press the "Hardware testing" button on the main interface to enter the digital input and output testing page. To enter the commissioning mode during the digital input and output testing, a password must be entered, and the commissioning status indicator will flash in the commissioning mode.

Turn-on and turn-off tests are carried out in standby and ready modes.

Digital input testing: apply a digital input signal externally or to the terminals, and the corresponding digital input status indicator changes from green to red.

Digital output testing: press the corresponding digital output button, and the corresponding digital output status indicator changes from green to red, and the external relay operates.

Press the corresponding digital output button again, the state resets, the corresponding status indicator changes from red to green, and the external relay returns to its original position.

Pulse testing: Before the pulse testing, press the digital output button 2 to turn on the power of the pulse trigger. First, press the phase A pulse start button, the phase A pulse status indicator changes from green to red, and the indicator on the corresponding phase A trigger card lights up. Press the phase A pulse start button again, the phase pulse state resets, the corresponding digital input status indicator changes from red to green, and the indicator on the corresponding phase A trigger board goes out. Perform the same actions for phase B and phase C pulse testing.

After the pulse testing, press the corresponding digital output button 2 again to reset the state.

After completing all digital input and output tests, press the return button to exit the commissioning mode.

Notes: Factor calibration is used for factory calibration of voltage and current factors and is not available for user operation.

8. Other settings

Press the "Other settings" button on the main interface to enter the version information page.

Firmware version: software version number of the controller's internal processor.

Operating voltage: input operating voltage supported by the controller.

PT/CT configuration: secondary PT/CT parameters corresponding to the controller; there are two operating modes: PT:100V, CT:5A and PT:100V, CT:1A.

Product serial number: consists of the year, month, day, and a sequential number.

Time setting: setting the time on the touchscreen; if time calibration on the touchscreen is required, it should be modified through the time setting.

Sound signal: 0 - disabled, 1 - enabled. When the sound signal is enabled, a warning beep sounds during touch control, as well as an alarm beep.

Language setting: the touchscreen operates in both Chinese and English; selecting Chinese displays the Chinese interface, and selecting English displays the English interface.

9. Operating instructions

Press the "Operating instructions" button on the main interface to enter the "Operating instructions" page.

The operating instructions include:

1. Description of start and stop parameters
2. Description of protection parameters
3. Power-on process
4. Commissioning and maintenance instructions

Chapter V Soft Starter Controller

The soft starter controller is a domestically advanced level controller specifically developed for the HSD2000 series high-voltage solid-state soft starter, featuring advanced technology, good versatility, easy expansion, etc.

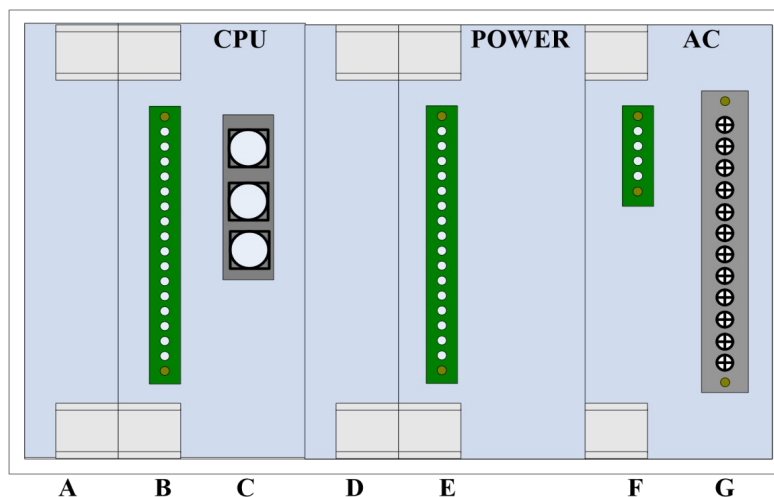


Figure 5.1 Terminal diagram of the soft starter controller

The terminals of the soft starter controller are described below:

1. Signal input and communication

For external control signal input, the input terminals are: B1-B8.

B1: start signal; soft start begins after the signal is input, and the jog input signal is supplied.

B2: Stop, soft stop, or reset signal. When the device is configured for coast stop, a stop-open will coast to stop; when the soft starter controller is configured for soft stop, a stop-open will soft stop; when the device is in a fault state, a stop-open has a fault reset function.

B3: External fault signal; after the external fault signal is input to the controller, an emergency stop is reported directly.

B4: Bypass input signal, used to determine the position of the bypass contactor.

B5: Switch input signal, used to determine the position of the circuit breaker.

B6: Contactor No. 2 input signal, used to determine the position of the auxiliary contactor.

B7: Emergency stop / multi-motor control, opening-type emergency stop signal when the device is set to standalone mode.

B8: Direct start / multi-motor control; direct start is activated by a signal when the device is set to standalone mode.

If the device is set to multi-machine mode, B7/B8 together form the device selection for multi-level mode.

B7=0, B8=0 selected as machine #1, corresponding to the fixed value set under number 1;

B7=1, B8=0 selected as machine #2, corresponding to the setpoint number 2;

B7=0, B8=1 selected as machine #3, corresponding to the setpoint number 3;

B7=1, B8=1 selected as machine #4, corresponding to the setpoint number 4;

B9: Common terminal input, connect to 24V-.

B10-B12: RS232RX/232TX/GND, connecting the controller and the touchscreen.

B13-B14: RS485A/RS485B, connecting the controller and the internal unit.

B15-B16: 4-20 mA output terminals, no positive or negative polarity identification required.

2. Fiber-optic trigger

C1: TXA, phase A trigger control signal.

C2: TXB, phase B trigger control signal.

C3: TXC, phase C trigger control signal.

3. Power and output

E1: AC220V/DC220V, L.

E2: AC220V/DC220V, N.

E3: Reserve

E4: Ready signal, out in the ready state.

E5: Start/Soft stop, out during starting or soft stop.

E6: bypass/start, out in the starting state.

E7: Fault, out in case of a fault.

E8: Circuit breaker trip, out upon circuit breaker trip.

E9: Bypass contactor closure output, out upon bypass closure.

E10: Bypass contactor electrical trip, normally closed output point, normally closed becomes normally open when the bypass contactor trips

E11: Bypass contactor trip, out upon bypass contactor trip.

E12: contactor 2# closure output, out upon contactor 2# closure.

E13: contactor 2# electrical trip, normally closed output point, normally closed becomes normally open when contactor 2# trips.

E14: contactor 2# trip, out upon contactor 2# trip.

E15: common output, 24 VDC.

E16: common output, 24 VDC.

4. AC voltage sampling

F1: Ua, Ua voltage signal on the secondary side of the voltage transformer for voltage measurement and synchronization detection.

F2: Ub, Ub voltage signal on the secondary side of the voltage transformer for voltage measurement and synchronization detection.

F3: Uc, Uc voltage signal on the secondary side of the voltage transformer for synchronization detection.

F4: Un, Un voltage signal on the secondary side of the voltage transformer; V-V connection must not be connected.

G1-G2: IA-IA' current signals, Ia on the secondary side of the current transformer, for Phase A current measurement.

G3-G4: IB-IB', Ib current signal on the secondary side of the current transformer, for Phase B current measurement.

G5-G6: IC-IC', Ic current signal on the secondary side of the current transformer, for Phase C current measurement.

G7-G12: reserve

Chapter VI Communication Protocol

To adapt to the diverse communication needs of users, the SSE6 series high-voltage solid-state soft starter is equipped with an RS485 communication interface for communication with background equipment.

The standard MODBUS protocol is used for communication, which defines in detail the checksums, data sequences, etc., required for specific data exchange. The MODBUS protocol uses a master-slave query-response connection (half-duplex) on a single communication line; the terminal device sends a response signal to the host computer when the computer addresses the unique number of the terminal device.

The MODBUS protocol only enables communication between the host computer and the terminal device, and does not allow data exchange between terminal devices.

1. Transmission Mode

Information transmission in the MODBUS protocol is asynchronous and measured in bytes. The data transmitted between the host and the slave contains 1 start bit, 8 data bits, a parity bit, and 1 stop bit.

2. Parameter Setting

Set communication parameters on the touch screen, the parameters are shown below:

Communication address: setting range 1-63, it is recommended to set the address sequentially, starting from 1.

Baud rate: setting range 1-5, where 1 is 9600, 2 is 19200, 3 is 38400, 4 is 57600, 5 is 115200. For long distances and in the absence of communication speed requirements, it is recommended to set the baud rate to 9600.

3. Information Frame Format

Address Code	Function Code	Data Field	CRC Check Code
1 byte	1 byte	N bytes	2 bytes

Address code: consists of 1 byte, this device uses addresses 1-63. When connecting multiple devices to a single host, the address number of each device must be unique.

Data field:

01H, Read Coil Command

02H, Read Input Coil Command

03H, Read Register

04H, Read Input Register

05H, Write Single Coil

06H, Write Single Register

CRC check code: used to verify the correctness of the received data.

4. Data Point Table

For external communication, the specific data and addresses are listed below:

4.1 01H/05H.

Function Code	Modbus Address	Data Name
Read 01H/Write 05H	0X0000	Write Setpoint Enabled
Read 01H/Write 05H	0X0001	Ready State
Read 01H/Write 05H	0X0002	Soft Start/Stop Coil Status
Read 01H/Write 05H	0X0003	Operating Status
Read 01H/Write 05H	0X0004	Failure State
Read 01H/Write 05H	0X0005	Bypass Close Coil Status
Read 01H/Write 05H	0X0006	Bypass Open Coil Status
Read 01H/Write 05H	0X0007	Contact No. 2 Close Coil Status
Read 01H/Write 05H	0X0008	Contact No. 2 Open Coil Status
Read 01H/Write 05H	0X0009	Circuit Breaker Open Coil Status
Read 01H/Write 05H	0X000A	Phase A Actuating Pulse Open Coil Status
Read 01H/Write 05H	0X000B	Phase B Actuating Pulse Open Coil Status
Read 01H/Write 05H	0X000C	Phase C Actuating Pulse Open Coil Status
Read 01H/Write 05H	0X000D	Status Return Coil Status
Read 01H/Write 05H	0X000E	Spare Point Coil Status
Read 01H/Write 05H	0X000F	Operation within setpoint No. 1 register area
Read 01H/Write 05H	0X0010	Operation within setpoint No. 2 register area
Read 01H/Write 05H	0X0011	Operation within setpoint No. 3 register area
Read 01H/Write 05H	0X0012	Operation within setpoint No. 4 register area
Read 01H/Write 05H	0X0013	Operation with setpoint No. 1 bundle
Read 01H/Write 05H	0X0014	Operation within bundle No. 2
Read 01H/Write 05H	0X0015	Operation within setpoint No. 3 bundle
Read 01H/Write 05H	0X0016	Operation within setpoint No. 4 bundle
Read 01H/Write 05H	0X0017	Operation within setpoint No. 5 bundle
Read 01H/Write 05H	0X0018	Reserve
Read 01H/Write 05H	0X0019	Reserve
Read 01H/Write 05H	0X001A	Reserve
Read 01H/Write 05H	0X001B	Calibration of three-phase voltage coefficients
Read 01H/Write 05H	0X001C	Calibration of three-phase current coefficients
Read 01H/Write 05H	0X001D	Phase A voltage coefficient calibration
Read 01H/Write 05H	0X001E	Phase B voltage coefficient calibration
Read 01H/Write 05H	0X001F	Phase C voltage coefficient calibration
Read 01H/Write 05H	0X0020	Phase A current coefficient calibration

Read 01H/Write 05H	0X0021	Phase B current coefficient calibration
Read 01H/Write 05H	0X0022	Phase C current coefficient calibration
Read 01H/Write 05H	0X0023	Restoring default value of the shared area setpoint
Read 01H/Write 05H	0X0024	Restoring default value of the current device setpoint
Read 01H/Write 05H	0X0025	Setpoint is undefined
Read 01H/Write 05H	0X0026	Coefficient 1

4.2 02H

Function Code	Modbus Address	Data Name
02H	0X0000	Device message
02H	0X0001	Start signal input
02H	0X0002	Stop signal input
02H	0X0003	External failure input
02H	0X0004	Bypass position input
02H	0X0005	Circuit breaker position input
02H	0X0006	Contactor No. 2 input
02H	0X0007	Emergency stop input / Multi-source option
02H	0X0008	Direct start input / Multi-source option
02H	0X0009	Start timeout
02H	0X000A	Overcurrent section No. 1
02H	0X000B	Overcurrent section No. 2
02H	0X000C	Negative sequence overcurrent section No. 1
02H	0X000D	Negative sequence overcurrent section No. 2
02H	0X000E	Underload during operation
02H	0X000F	Overvoltage
02H	0X0010	Undervoltage
02H	0X0011	Negative sequence overvoltage
02H	0X0012	External fault
02H	0X0013	Emergency stop
02H	0X0014	Starting current does not decrease
02H	0X0015	Bypass conditions mismatch

02H	0X0016	Stop during start due to fault
02H	0X0017	Unknown fault
02H	0X0018	Phase A synchronization signal loss
02H	0X0019	Phase B synchronization signal loss
02H	0X001A	Phase C synchronization signal loss
02H	0X001B	Start prohibited, lockout time not expired
02H	0X001C	Start prohibited, circuit breaker not connected
02H	0X001D	Start prohibited, bypass not in OFF position
02H	0X001E	Start prohibited, invalid position of contactor No. 2
02H	0X001F	Start prohibited, fault not cleared
02H	0X0020	Start prohibited, not in ready state
02H	0X0021	Start prohibited, no voltage signal
02H	0X0022	Bypass close fault
02H	0X0023	Bypass open fault
02H	0X0024	Start prohibited, overcurrent
02H	0X0025	Contactor No. 2 close fault №2
02H	0X0026	Contactor open fault №2
02H	0X0027	Trial operation prohibited in ready state
02H	0X0028	Circuit breaker open fault
02H	0X0029	Soft stop timeout
02H	0X002A	Spare point
02H	0X002B	Start prohibited, phase sequence undefined
02H	0X002C	Start prohibited, positive sequence alarm not sent
02H	0X002D	Start prohibited, negative sequence alarm not sent
02H	0X002E	Reserve
02H	0X002F	Common protection signal
02H	0X0030	Start prohibited, phase sequence alarm
02H	0X0031	Start prohibited, frequency error

02H	0X0032	Direct start permitted
02H	0X0033	Main FLASH area table damaged
02H	0X0034	Backup FLASH area table damaged
02H	0X0035	Stop command during soft start
02H	0X0036	Unexpected circuit breaker trip during soft start
02H	0X0037	Unexpected bypass contactor trip during soft start
02H	0X0038	Unexpected contactor No. 2 trip during soft start
02H	0X0039	Unexpected circuit breaker trip during operation
02H	0X003A	Unexpected bypass contactor trip during operation
02H	0X003B	Unexpected contactor No. 2 trip during operation
02H	0X003C	Unexpected circuit breaker trip during soft stop
02H	0X003D	Unexpected bypass contactor trip during soft stop
02H	0X003E	Unexpected contactor No. 2 trip during soft stop
02H	0X003F	Bypass faulty connection in ready state
02H	0X0040	Contactor No. 2 faulty connection in ready state
02H	0X0041	Record waveform
02H	0X0042	Clear waveform

4.3 03H/06H.

Function Code	Modbus Address	Data type	Multiplier	Data name
Read 03H/Write 06H	0X0000	ushort	x1	Message counter
Read 03H/Write 06H	0X0001	ushort	x1	RS485 communication address
Read 03H/Write 06H	0X0002	ushort	x1	RS485 baud rate
Read 03H/Write 06H	0X0003	ushort	x1	Commissioning password mode
Read 03H/Write 06H	0X0004	ushort	x100	Calibration reference values
Read 03H/Write 06H	0X0005	ushort	x1	System frequency setting
Read 03H/Write 06H	0X0006	ushort	x1	System phase sequence

				setting
Read 03H/Write 06H	0X0007	ushort	x1	Output pulse width
Read 03H/Write 06H	0X0008	short	x1	4-20 mA output enable
Read 03H/Write 06H	0X0009	ushort	×1000	4-20 mA output offset
Read 03H/Write 06H	0X000A	ushort	×1000	4-20 mA output coefficient
Read 03H/Write 06H	0X000B	ushort	×1	Start interval
Read 03H/Write 06H	0X000C	ushort	×1	Start delay
Read 03H/Write 06H	0X000D	ushort	×1	Shared enable
Read 03H/Write 06H	0X000E	ushort	×1	Bitwise inversion of the stop signal
Read 03H/Write 06H	0X000F	ushort	×1	Bitwise inversion of the failure signal
Read 03H/Write 06H	0X0010	ushort	×1	Standalone / Multi-computer mode
Read 03H/Write 06H	0X0011	ushort	×1	Selected setpoint group number
Read 03H/Write 06H	0X0012	ushort	×1	Selected setpoint bundle number
Read 03H/Write 06H	0X0013	ushort	×1	Starting current oscillography
03H	0X0014	ushort	×1	Equipment type
03H	0X0015	ushort	×1	Firmware version
Read 03H/Write 06H	0X0016	ushort	×1	Year of manufacture
Read 03H/Write 06H	0X0017	ushort	×1	Date of manufacture
Read 03H/Write 06H	0X0018	ushort	×1	Serial No.
Read 03H/Write 06H	0X0019	ushort	×10000	Phase A voltage coefficient
Read 03H/Write 06H	0X001A	ushort	×10000	Phase B voltage coefficient
Read 03H/Write 06H	0X001B	ushort	×10000	Phase C voltage coefficient
Read 03H/Write 06H	0X001C	ushort	×10000	Phase A current coefficient
Read 03H/Write 06H	0X001D	ushort	×10000	Phase B current coefficient
Read 03H/Write 06H	0X001E	ushort	×10000	Phase C current coefficient
03H	0X001F	ushort	×1	Setpoint group number
03H	0X0020	ushort	×1	Setpoint bundle number
Read 03H/Write 06H	0X0021	ushort	×1	Rated current
Read 03H/Write 06H	0X0022	ushort	×1	PT ratio

Read 03H/Write 06H	0X0023	ushort	×1	CT ratio
Read 03H/Write 06H	0X0024	ushort	×1	Contact No. 2 configuration method
Read 03H/Write 06H	0X0025	ushort	×1	Bypass acceleration time
Read 03H/Write 06H	0X0026	ushort	×1	Start cutoff angle
Read 03H/Write 06H	0X0027	ushort	×1	Synchronous motor coefficient
Read 03H/Write 06H	0X0028	ushort	×1	Start method
Read 03H/Write 06H	0X0029	ushort	×1	Initial voltage
Read 03H/Write 06H	0X002A	ushort	×1	Ramp-up time
Read 03H/Write 06H	0X002B	ushort	×1	Current limit class
Read 03H/Write 06H	0X002C	ushort	×1	Current regulation coefficient
Read 03H/Write 06H	0X002D	ushort	×1	Step voltage
Read 03H/Write 06H	0X002E	ushort	×1	Kickstart duration
Read 03H/Write 06H	0X002F	ushort	×1	Operation start time
Read 03H/Write 06H	0X0030	ushort	×1	Dual-stage voltage
Read 03H/Write 06H	0X0031	ushort	×1	Dual-stage time
Read 03H/Write 06H	0X0032	ushort	×1	Stop mode
Read 03H/Write 06H	0X0033	ushort	×1	Soft stop voltage limit
Read 03H/Write 06H	0X0034	ushort	×1	Soft stop time
Read 03H/Write 06H	0X0035	ushort	×1	Startup timeout setpoint
Read 03H/Write 06H	0X0036	ushort	×1	Overcurrent stage 1 setpoint
Read 03H/Write 06H	0X0037	ushort	×1	Overcurrent stage 2 setpoint
Read 03H/Write 06H	0X0038	ushort	×1	Overcurrent stage 2 delay
Read 03H/Write 06H	0X0039	ushort	×1	Negative sequence overcurrent stage 1 setpoint
Read 03H/Write 06H	0X003A	ushort	×1	Negative sequence overcurrent stage 1 delay
Read 03H/Write 06H	0X003B	ushort	×1	Negative sequence overcurrent stage 2 setpoint
Read 03H/Write 06H	0X003C	ushort	×1	Negative sequence overcurrent stage 2 delay
Read 03H/Write 06H	0X003D	ushort	×1	Underload rated value
Read 03H/Write 06H	0X003E	ushort	×1	Underload delay time
Read 03H/Write 06H	0X003F	ushort	×1	Overvoltage setpoint
Read 03H/Write 06H	0X0040	ushort	×1	Overvoltage time delay

Read 03H/Write 06H	0X0041	ushort	×1	Undervoltage setpoint
Read 03H/Write 06H	0X0042	ushort	×1	Undervoltage delay
Read 03H/Write 06H	0X0043	ushort	×1	Negative sequence overvoltage setpoint
Read 03H/Write 06H	0X0044	ushort	×1	Negative sequence overvoltage delay
Read 03H/Write 06H	0X0045	ushort	×1	Startup timeout protection enable
Read 03H/Write 06H	0X0046	ushort	×1	Overcurrent protection Section 1 enable
Read 03H/Write 06H	0X0047	ushort	×1	Overcurrent protection Section 2 enable
Read 03H/Write 06H	0X0048	ushort	×1	Negative sequence overcurrent protection Section 1 enable
Read 03H/Write 06H	0X0049	ushort	×1	Negative sequence overcurrent protection Section 2 enable
Read 03H/Write 06H	0X004A	ushort	×1	Underload protection enable
Read 03H/Write 06H	0X004B	ushort	×1	Overvoltage protection enable
Read 03H/Write 06H	0X004C	ushort	×1	Undervoltage protection enable.
Read 03H/Write 06H	0X004D	ushort	×1	Negative sequence voltage protection Section 1 enable
Read 03H/Write 06H	0X004E	ushort	×1	Input failure protection enable
Read 03H/Write 06H	0X004F	ushort	×1	Direct start time
Read 03H/Write 06H	0X0050	ushort	×1	Control mode
03H	0X0051	ushort	×1	Group 1 setting sector number
03H	0X0052	ushort	×1	Group 2 setting sector number
03H	0X0053	ushort	×1	Group 3 setting sector number
03H	0X0054	ushort	×1	Group 4 setting sector

				number
03H	0X0055	ushort	×1	Setting error counter

4.3 04H

Function Code	Modbus Address	Data type	Multiplier	Data name
04H	0X0000	float	×1	Uab coefficient
04H	0X0002	float	×1	Ubc coefficient
04H	0X0004	float	×1	Uca coefficient
04H	0X0006	float	×1	Ia coefficient
04H	0X0008	float	×1	Ib coefficient
04H	0X000a	float	×1	Ic coefficient
04H	0X000c	float	×1	Uab voltage
04H	0X000e	float	×1	Ubc voltage
04H	0X0010	float	×1	Uca voltage
04H	0X0012	float	×1	Ia current
04H	0X0014	float	×1	Ib Current
04H	0X0016	float	×1	Ic Current
04H	0X0018	float	×1	Three-phase average current
04H	0X001a	float	×1	Load factor
04H	0X001c	float	×1	System frequency
04H	0X001e	float	×1	Actuating angle
04H	0X0020	float	×1	Power factor
04H	0X0022	float	×1	UaIa phase difference angle
04H	0X0024	float	×1	Ublb phase difference angle
04H	0X0026	float	×1	UcIc phase difference angle
04H	0X0028	float	×1	Negative sequence current
04H	0X002a	float	×1	Negative sequence voltage
04H	0X002c	ulong	×1	Device power-on time
04H	0X002e	uint16	×1	Device reset counter
04H	0X002f	uint16	×1	Device operating state

04H	0X0030	uint16	×10	Uab voltage
04H	0X0031	uint16	×10	Ubc voltage
04H	0X0032	uint16	×10	Uca voltage
04H	0X0033	uint16	×10	Ia current
04H	0X0034	uint16	×10	Ib Current
04H	0X0035	uint16	×10	Ic Current
04H	0X0036	uint16	×10	Three-phase average current
04H	0X0037	uint16	×10	Load factor
04H	0X0038	uint16	×100	System frequency
04H	0X0039	uint16	×10	Actuating angle
04H	0X003a	int16	×1000	Power factor
04H	0X003b	int16	×10	UaIa phase difference angle
04H	0X003c	int16	×10	UbIb phase difference angle
04H	0X003d	int16	×10	UcIc phase difference angle
04H	0X003e	int16	×10	Negative sequence current
04H	0X003f	int16	×10	Negative sequence voltage
04H	0X0040	uint16	×10	Start time
04H	0X0041	uint16	×1	Countdown timer
04H	0X0042	uint16	×1	Operating time, days
04H	0X0043	uint16	×1	Operating time, hours
04H	0X0044	uint16	×1	Operating time, minutes
04H	0X0045	uint16	×1	Operating time, seconds
04H	0X0046	uint16	×1	20mA full range
04H	0X0047	uint16	×100	20mA output value
04H	0X0048	uint16	×100	20mA pulse width modulation
04H	0X0049	uint16	×1	Current phase sequence

04H	0X004a	uint16	×1	Phase sequence alarm
04H	0X004b	uint16	×1	Reserved for commissioning
04H	0X004c	uint16	×1	Reserved for commissioning
04H	0X004d	uint16	×1	Reserved for commissioning
04H	0X004e	uint16	×1	Reserved for commissioning

Notes: working state 0 Disconnected 1 Ready 2 Starting 3 Running 4 Soft stop 5 Fault 6 Test 7 Emergency stop 8 Standby

5. Communication application

Data reading message example:

Command 01H

Address code	Function code	Starting address	Number of registers	CRC check code
01	01	00 00	00 27	7C10

Return message example:

Address code	Function code	Data length	Value	CRC check code
01	01	05	Data1-data5	HSD2000

Command 02H

Address code	Function code	Starting address	Number of registers	CRC check code
01	02	00 00	00 43	39FB

Return message example:

Address code	Function code	Data length	Value	CRC check code
01	02	09	Data1-data9	HSD2000

Command 03H

Address code	Function code	Starting address	Number of registers	CRC check code
01	03	00 00	00 56	C5F4

Return message example:

Address code	Function code	Data length	Value	CRC check code
01	03	AC	Data1-data86	HSD2000

Command 04H

Address code	Function code	Starting address	Number of registers	CRC check code
01	04	00 00	00 4F	B1FE

Return message example:

Address code	Function	Data length	Value	CRC check
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	code			code
01	04	9E	Data1-data79	HSD2000

Command 05H

Address code	Function code	Register address	Written value	CRC check code
01	05	00 1D	FF00	1C3C

Setting coil state to ON or OFF is written to 0xFF00.

Command 06H

Address code	Function code	Register address	Written value	CRC check code
01	06	00 1D	0064	1827

Chapter VII Maintenance and Troubleshooting

1. Routine Maintenance

The SSE6 series high-voltage solid-state soft starter is designed as a maintenance-free product. Like other electronic equipment, it must be regularly inspected for air pollution, humidity, and industrial contamination. Product contamination can cause high-voltage discharges or affect equipment heat dissipation. Check annually for loose bolts and tighten them to the appropriate torque. Ensure that the vacuum contactor air gaps comply with the manufacturer's technical manual requirements.

During extended shutdown, clean the surfaces of the cabinet, sensors, and indicators; check the cable grounding; clean the insulation spacers and the inside of the cabinet. Check grounding, clean and inspect surge arresters, measure grounding resistance, clean and inspect cable sheaths and post insulators.

2. System self-test

The SSE6 series high-voltage solid-state soft starter must undergo periodic self-testing to ensure the equipment remains in good condition.

2.1 Communication check

The device is powered on, data on the touch screen is displayed normally, and there is no communication alarm, which indicates normal communication.

2.2 SCR check

Using a multimeter, determine the resistance of each GK terminal on the trigger card—this is the resistance of the SCR gate electrode and cathode, which is about 15 Ohms. If the measured resistance deviates from the normal value by 50%, there may be a problem with the SCR crimping or with the SCR itself. Then use a multimeter to determine the resistance between the left and right K terminals on the trigger card, the resistance value should be about 190kΩ, if the resistance value is very low, an SCR breakdown is possible.

2.3. Discrete signal input and output test

After checking the SCR, press the touchscreen to enter the equipment test and enter the commissioning password. In accordance with the description in Chapter 4, Section 7 of the manual, perform the discrete signal input and output test. If the test is normal, then the soft starter control system and the electrical secondary wiring are normal.

3. Fault Analysis

When a fault occurs, the corresponding indication appears on the display and indicator lamps. Before restarting the engine, all occurred faults must be eliminated. In the event of a fault that cannot be handled, contact the Manufacturer for assistance in resolving the problems.

Fault phenomenon	Fault cause	Corrective action
Thyristor failure	Thyristor breakdown or damage	Disconnect the front high-voltage power supply, connect the grounding wire, use a multimeter to measure the resistance around terminal K on the trigger board. The normal value is 190K; if it is too small, the SCR is broken down and must be replaced.

Unable to start and stop correctly	1) Fault exists 2) Not in ready state 3) Start interval lockout	1) Eliminate the cause of the fault 2) Check controller status 3) Time between two starts has not elapsed, please wait
Motor does not complete startup	Starting current limit is too low, insufficient starting torque	Adjust the corresponding current limit multiplier
Motor bypass fault	1) Incorrect parameter settings 2) Starting current does not decrease	1) Note whether the contactor is mechanically or electrically held 2) Increase in starting current
Start timeout	Unreasonable setting of startup parameters	Current limit value is too low
Negative sequence current	1) Startup with phase loss 2) Fault in CT secondary connection 3) Phase sequence error 4) Motor failure 5) PT connection error	1) One phase or a half-phase of SCR is not connected 2) CT wiring loose or reversed 3) Current phase sequence error 4) Motor repair 5) An error in VT wiring causes a sync signal error, starting signal mismatch, and starting current disruption.
Inaccurate current and voltage measurements	1) Incorrect setting of VT/CT transformation ratio 2) Incorrect current channel coefficients 3) Hardware failure	1) Change to the correct transformation ratio 2) Change to the correct coefficients 3) Replace the circuit board of the corresponding hardware

Chapter VIII After-sale service

1. Warranty period

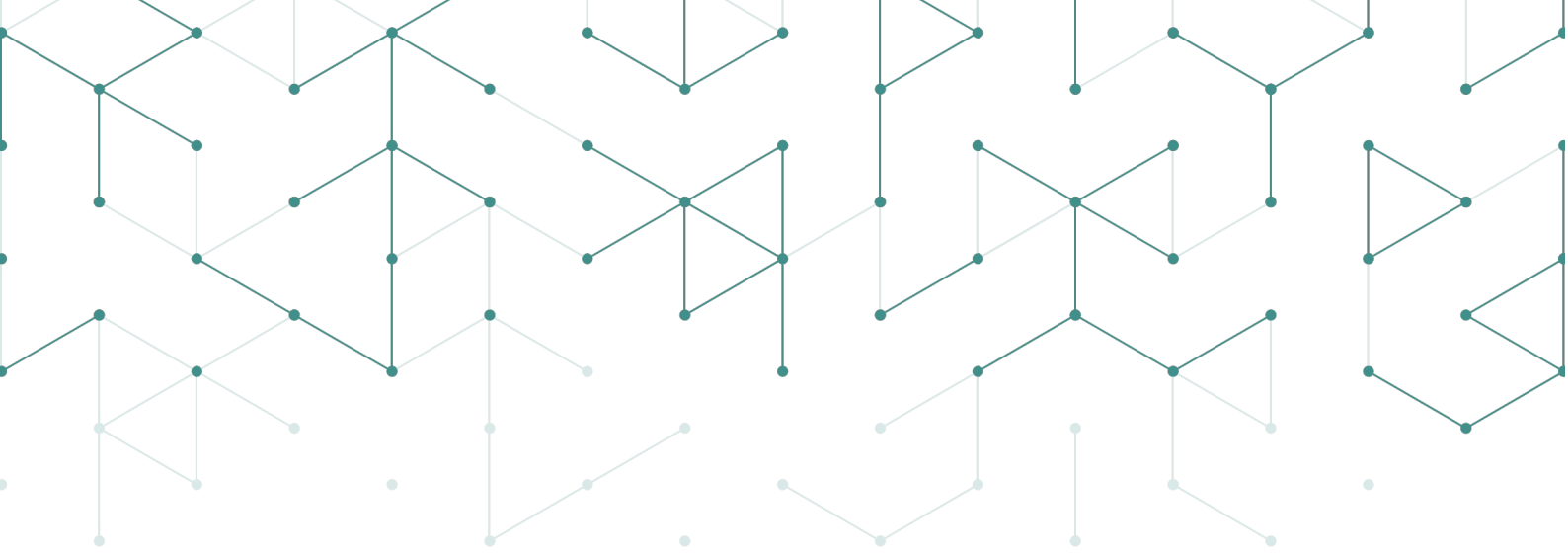
The warranty period for the SSE6 series high-voltage solid-state soft starter is 12 months from the date of commissioning completion, or 18 months from the date of shipment, whichever comes first. Within the warranty period, if equipment damage or inability to operate normally occurs due to equipment quality issues, the manufacturer is responsible for timely and free repair or replacement of parts.

2. Warranty rules

- 1) Our products are serviced free of charge within the warranty period; however, losses caused by human error, natural disasters (such as fire, flood, earthquake, typhoon, etc.), and the like are excluded from this coverage.
- 2) Beyond the warranty period, our company provides lifelong free technical consultations and paid maintenance services.

3. Maintenance manual

- 1) Troubleshoot and eliminate faults in accordance with the product user manual.
- 2) If the causes cannot be determined, promptly contact our technical support department to report the fault phenomenon, or perform an on-site inspection following the methods guided by our technicians to accurately identify the fault causes and resolve the issues in a timely manner.
- 3) If the guidance still cannot resolve the problem, our company will provide a solution based on the user's description or the received situational information, and dispatch personnel to the site as soon as possible. For on-site maintenance outside the warranty period, the user shall pay for the services in advance.



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DESIGNED FOR MAXIMUM RELIABILITY

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