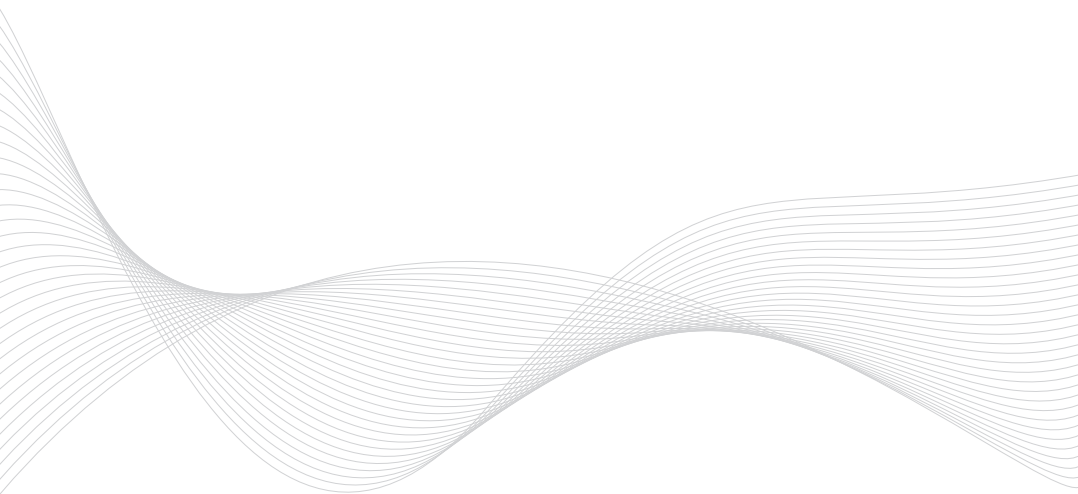# AC Motor Smart Soft Starter
Built-in Bypass Motor soft starter

Instruction manual

Preface

Thank you for choosing FST-3000 series soft starter! FST-3000 series soft starter has following features:

- Built-in bypass contactor to simplify customer external wiring.
- Six starting modes are selected to maximize the best starting effect of the motor.
- The original swing starting mode has good starting effect for eccentric load.
- It can realize the forward and reverse stepwise frequency conversion inching function, and realize the forward and reverse inching operation of the motor.
- Three parking modes can be selected: free parking, soft parking and DC braking parking.
- Two driving modes can be selected: torque mode and smooth mode.
- Two independent programmable output relays: it can easily realize interlocking control with other equipment, and has delay action function with adjustable delay time.
- Three phase current value can be displayed at the same time, and the current value can be calibrated independently.
- Large screen LCD man-machine interface, Chinese (Chinese display) and English display modes, easy to operate.
- Multiple protection and monitoring functions. The thermal overload protection can be adjusted according to the load requirements. Multiple protection functions can be opened and closed independently.
- The last 12 fault records can be queried to provide fault analysis basis.
- A group of 4 ~ 20mA (0 ~ 20mA) analog output.
- Modbus RTU communication (RS485) can enter parameter setting, operation and monitoring through the upper computer to realize high intelligent control.
  Actual power setting: when the power of the soft starter is greater than the actual load power, the rated current of the soft starter can be set according to the actual load to match the actual power of the soft starter with the load, so as to ensure the accuracy of starting, operation, protection and other parameters.

Safety precautions

This manual provides the user with relevant precautions for installation, commissioning, parameter setting, fault diagnosis and operation. Please keep it properly. Before using this product, please read this manual carefully to avoid equipment or even personal safety loss due to misoperation.

▲ Install, operate, maintain or inspect the product after carefully reading the manual and ensuring normal use.

▲ The power supply must be disconnected during wiring. Do not touch the power terminal with hands or conductive objects. Do not put or drop foreign matters into the soft starter.

▲ Do not use a megger to measure the insulation resistance between the input and output of the soft starter, otherwise the thyristor and control board of the soft starter may be damaged due to overvoltage. Megger can be used to measure the phase to phase and phase to ground insulation of soft starter. However, three short circuits shall be used in advance to short circuit the input and output terminals of the three phases respectively, and all plugs on the control board shall be unplugged.

▲ Input terminals are R, S and T, connected to 380V mains supply, output terminals are U, V and W, and connected to motor.

▲ The shell of soft starter shall be reliably grounded (the grounding impedance shall not be greater than 4 Ω).

▲ After the input terminals R, S and T are connected to the AC 380V power supply, if the output terminals U, V and W are open circuit (i.e. the output is not connected to the motor), then the measured terminals U, V and W have AC 380V or nearly 380V voltage output, which is a normal phenomenon. This phenomenon is mainly caused by the virtual voltage generated by the leakage current of the module (thyristor). This phenomenon will disappear when U V and W are connected to the motor.

▲ When the soft starter and the frequency converter are used in parallel, with one for use and one for standby output, please add a contactor at the output end of the soft starter and the frequency converter and interlock them to prevent damage caused by mutual interference between the output of the frequency converter and the soft starter.

▲ The output end of the soft starter cannot be connected with a capacitor to improve the power factor. If it needs to be connected, it can be connected with the input end.

Preparation before installation:

Please prepare the following tools for installing the soft starter:
screwdriver, wire stripping pliers, plate pliers, etc.

Warning！Be sure to read "safety precautions" before installation.

Catalogue

I.Product introduction

This manual briefly introduces the installation wiring, parameter setting, operation and use of FST-3000 series soft starter. Please keep it properly. If any fault occurs during use, please contact the manufacturer or dealer.

1.1 Product Nameplate

Take FST-3000 series three-phase AC 380V input 15kw soft starter as an example,and its nameplate is shown in the figure.

Specification: 3Ph refers to three-phase input; 380V and 50/60hz indicate input voltage and rated frequency.

soft starter				GB 14048.6	
model	FST-3015		use category	AC-53b	
specifications	3PH	AC	380V		50Hz
ratedcurrent	30A	adapter motor	15kW	trigger level	10

2022030100350022

Figure 1-1 Nampeplate label

1.2Product model description

Take the three-phase 380V input 15kw soft starter as an example, and its model description is shown in the figure below.

FST   3   015   T4

T4:AC380V T6:AC660V T10:AC1140V

Rated power (15kw)

3000 internal bypass P external bypass Z online operation

F series soft starter
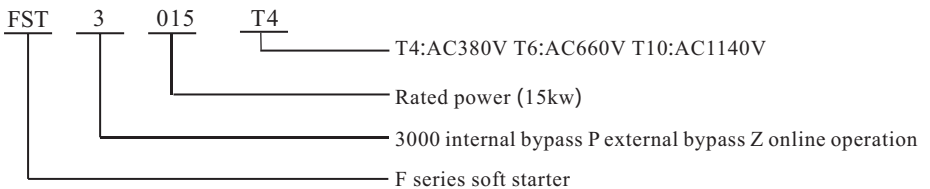
1.3 Product appearance

The main structure of FST-3000

series soft starter shell is a metal shell wall mounting structure.

The upper panel and control keyboard are made of plastic shell, and the metal

shell adopts advanced surface powder spraying and plastic spraying technology, with exquisite color and beautiful appearance.1

1.4 Technical specifications

FST-3000 series soft starter Technical specifications

Control power supply	AC 380V（－10% ～ 15%），50hz/60hz（provided internally, users do not need to connect externally）	
Input power supply	AC 380V（－10%～15%），50Hz/60Hz	
Applicable motor	General squirrel cage AC asynchronous motor	
Starting mode	Current limiting starting; Voltage ramp start; Sudden tripping current limiting start; Jump voltage ramp start; Inching start; Swing start	
Stop mode	Free shutdown; Soft shutdown; DC brake stop	
Relay output	Two way programmable output relay	
Starting frequency	Not more than 15 times in an hour	
Protection function	Input phase loss, startup overload, operation overload, overcurrent, current imbalance, overvoltage, undervoltage, overheating, output phase loss, etc	
Display	Large screen LCD, Chinese and English display modes. Display current three-phase output current, grid voltage, fault type, system parameters and operating parameters	
Degree of protection	IP20（55kW and below）/IP00（75kW and above）	
Cooling mode	Forced air cooling / natural cooling	
Installation method	Wall mounted	
Environment condition	Equipment site	Indoor, no direct sunlight, no dust, corrosive gas, flammable gas, oil mist, water vapor, dripping water or salt, etc
	ambient temperature	$-25℃ ～ +40℃$
	ambient humidity	Below 90%（no condensation）
	Vibration intensity	Below 0.5g（acceleration）
	Altitude	Below 1000m（derating is required if the altitude exceeds 1000m）
Adapter motor	15～320KW	

1.5 Executive Standards for product design

● GB14048.6-2016 low voltage switchgear and control gear Part 4-2: Contactors and motor starters semiconductor controllers and starters (including soft starters) for AC motors.

1.6 Safety matters

● Before installation, please carefully confirm the model and rated value of the nameplate of the soft starter. Check whether the machine is damaged during transportation. If the soft starter is damaged or missing, please do not use it to avoid potential safety hazards.

● The installation and use environment shall be free from rain, water drops, steam, dust and oily dust; No corrosive or flammable gas or liquid; No metal particles or metal powder, etc. Ambient temperature within $-25\ ℃~+40\ ℃$.

● Please install it on the metal and other flame retardant materials and keep away from combustibles.

● Do not drop foreign matters such as wire head or screw into the soft starter.

● The reliability of soft starter depends on temperature to a great extent. Due to the wrong installation or improper fixing of the soft starter, the temperature of the soft starter will rise or the ambient temperature will rise, which may lead to accidents such as failure or damage.

● The soft starter shall be installed in the control cabinet to ensure smooth ventilation between the control cabinet and the outside. Please install the soft starter vertically, so that the heat can be emitted upward, not upsidedown; If there are multiple soft starters in the cabinet, ensure the heat dissipation space of the soft starter. It is better to install side by side; When it is necessary to install it up and down, please install the heat insulation deflector.

1.7 Matters needing attention

1.7.1 Instructions for use

● Do not touch internal devices within 5 minutes after power failure. It is not safe until it is completely discharged.

● Three phase input terminals R, S and T are connected to 380V mains supply, and output terminals U, V and W are connected to motor.

● The grounding shall be reliable, and the grounding resistance shall not exceed 4 Ω ; The motor and soft starter shall be grounded respectively, and shall not be connected in series.

- Do not switch the load at the output end during the operation of the soft starter.
- The rated output current of the soft starter shall be greater than or equal to the rated current of the motor.
- Control circuit wiring shall be separated from power circuit wiring to avoid possible.
- The signal line should not be too long, otherwise common mode interference will increase.
- Comply with the surrounding environmental requirements of "FST-3000 series soft starter technical specifications".

1.7.2 Special warning

- Do not touch the power terminal and radiator in the soft starter to prevent electric shock.
- Before the soft starter is powered on, all protective covers shall be reinstalled to prevent electric shock.
- Only professionals are allowed to carry out maintenance, check or replace parts.
- Live working is strictly prohibited.

1.8 Daily inspection and maintenance

1.8.1 Periodic inspection

Clean the cooling fan and air duct regularly and check whether they are normal; Regularly clean the dust accumulated in the machine.

- Periodic inspection Check whether the input and output wiring of the soft starter. and the wiring terminal have arc traces, and whether the wires are aging.
- Check whether the terminal connecting screws are fastened.
- Check the soft starter for corrosion.

1.8.2 Replacement of wearing parts

The cooling fan is a vulnerable part of the soft starter, and its service life is generally 2 ~ 3 years. Possible damage causes of cooling fan: bearing wear and aging of blades. Check whether the fan blades have cracks and whether there is abnormal vibration sound when starting up, so as to judge whether they need to be replaced.

1.8.3 Storage

●   When storing, try to put it in the packing box of the company as it is.

●   In order to prevent deterioration of electrolytic capacitor caused by long−term storage, it is guaranteed to charge once within half a year, and the power on time shall be at least 5 hours.

1.8.4 Daily maintenance

Due to the influence of ambient temperature,humidity, dust and vibration, the internal components of the soft starter will be aged, potential faults will occur and the service life of the soft starter will be reduced. Therefore, daily maintenance of the soft starter is very necessary.

Daily inspection：

●   Whether there is abnormal sound change during motor starting.

●   Whether vibration occurs during motor starting.

●   Whether the installation environment of the soft starter has changed.

●   Whether the soft starter fan operates normally and whether the soft starter is overheated.

Daily cleaning：

The soft starter shall be kept clean all the time; The dust on the surface of the soft starter shall be removed in time to prevent dust, metal dust, oil stain, water, etc. from entering the soft starter.

II. Control panel

2.1 Panel description

The panel is divided into three parts: data display area, status indication area and control panel operation area, as shown in figure below.

LED indicates working status. Standby flashes, and operation is always on.

standby/operation   communication   fault

LCD display area, displaying standby/ operation parameters, function codes, parameter values or faults.

programming/ confirmation   ▲   startup

◄   ►

return   ▼   stop

in the panel operation area, set the function code parameters, and operate the operation and shutdown panels

Figure 2-1 Control panel Figure

III. Principle and curve diagram of soft starter

3.1 Principle box Figure

J

R.S.T

Three phase AC power supply 380V

U.V.W

Motor

Voltage detection   Drive circuit   Current detection

Computer fuzzy control system

Keyboard and display
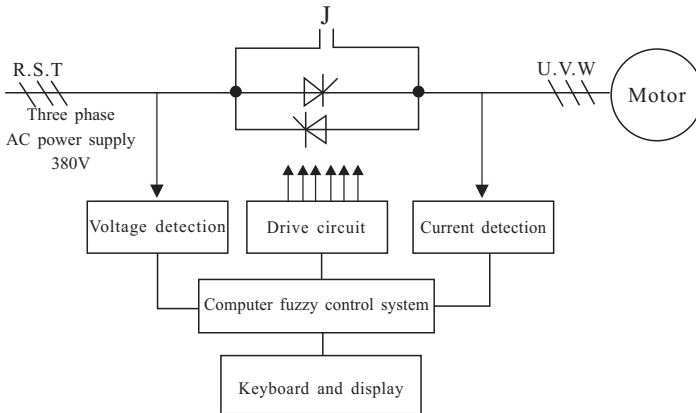
Three groups of anti parallel thyristor modules are used as power devices. The synchronous signal is obtained by sampling the input voltage. The output current is sampled for feedback fuzzy control. The phase is automatically tracked and the phase shift angle is controlled to gradually increase the voltage, so as to control the starting current. After starting, the built−in bypass contactor will short−circuit the thyristor, and the motor will be put into power grid operation.

IV. Installation wiring

4.1 Power loop matching table

Model of soft starter	Adapter motor	Rated current	Sectional area （mm2）
F-3015	15	30	10
F-3022	22	45	16
F-3030	30	60	25
F-3037	37	75	25
F-3045	45	90	35
F-3055	55	110	35
F-3075	75	150	50
F-3090	90	180	70
F-3110	110	230	70
F-3132	132	260	95
F-3160	160	320	120
F-3185	185	370	120
F-3200	200	400	150
F-3250	250	500	240
F-3280	280	560	240
F-3320	320	630	150*2

4.2 FST-3000 **recommended wiring**
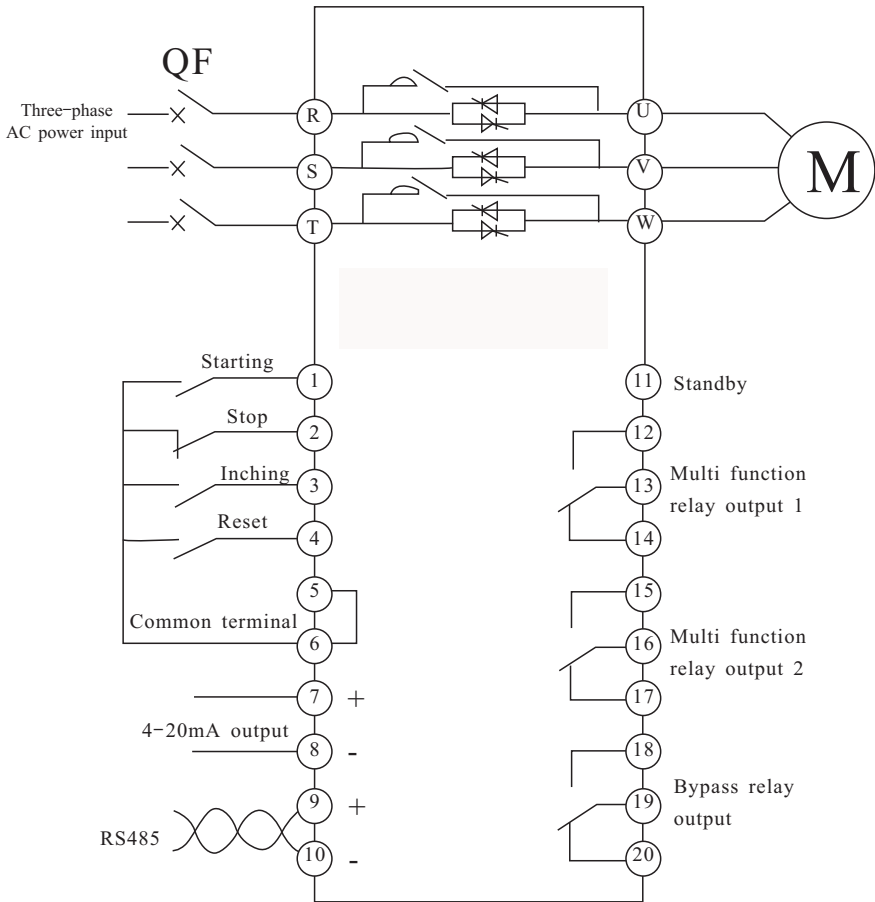
Terminals R, S and T of soft starter are input terminals; U. V and W are output terminals; Qf- automatic air circuit breaker.

4.3 Terminal function description
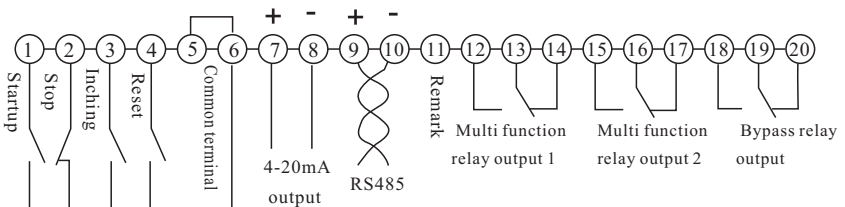
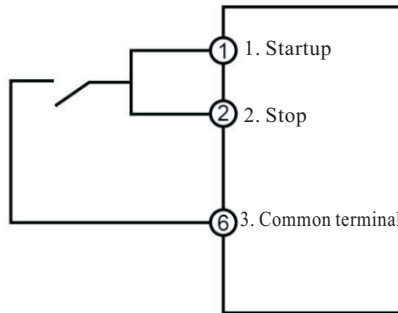| Terminal type		No	Terminal name	Explain
Main circuit		R,S,T	Power input	Soft starter three-phase AC power input, located on the upper part of the soft starter
		U,V,W	Soft starter output	Connected to three-phase asynchronous motor, located at the lower part of soft starter
control loop	Digital input	1	External control start	Short circuit with common terminal (5, 6) to start soft starter
		2	External control stop	Disconnect from the common terminal (5, 6) to stop the soft starter
		3	External control inching	Short circuit with common terminal (5, 6) to start soft starter
		4	External control fault reset	In case of fault, the fault status can be cleared by short circuiting with the common terminal (5, 6)
		5	Digital input common terminal	Common terminal of digital input terminal
		6		
	Analog output	7	4-20mA output positive pole	4-20mA output, 20mA corresponding current can pass through parameter C26, C27, C28 adjustment
		8	4-20mA output negative pole	
	communication	9	RS485+	For ModbusRTU communication
		10	RS485-	
	Spare	11	Spare	No function, reserved
	Program relay 1	12	Programming relay 1 normally open	Programmable output, selectable from the following functions: 0. no action 1. power on action 2. soft starting action 3. bypass action 4. soft stop action 5. inching action
		13	Programming relay 1 common	
		14	Programming relay 1 normally closed	
	Program relay 2	15	Programming relay 2 normally open	
		16	Programming relay 2 common	

control loop	Program Relay2	17	Programming relay 2 normally closed	6. action during operation 7. standby action 8. fault action 9. thyristor breakdown action 10. the current is greater than the reached value 1 11. the current is greater than the reached value 2 12. the current is less than the reached value 1 13. the current is less than the reached value 2
	Bypass relay	18	Bypass relay normally open	Pull in during bypass operation (YW60 meaningless)
		19	Bypass relay common	
		20	Bypass relay normally closed	

4.4 Two wire control mode wiring

Two wire type

The switch is closed for starting and disconnected for stopping.

V Function parameter table

5.1 Parameter list

Main item	Subordinate item	Parameter range	Default	Remarks	Change
A Basic parameters	A00. control mode	0: start stop prohibited 1: Keyboard independent control 2: External control independent control 3: Keyboard + external control 4: Communication independent control 5: Keyboard + communication 6: External control + communication 7: Keyboard + external control+ communication	3 ： Keyboard + external control		×
	A01.Starting mode	0: current limiting start 1: Voltage ramp start 2: Jump current limiting start 3: Jump voltage ramp 4: Inching start 5: Swing start	0 ： Current limiting starting		×
	A02. starting current limit percentage	50% ~600	300		×
	A03. percentage of starting voltage	10% ~80	35		×
	A04. voltage ramp starting time	1s~120s	15s		×
	A05. jump voltage	10 %~95	80		×
	A06. jump time	10ms~2000ms	500ms		×
	A07.Jog mode	0: step down mode 1: Down frequency forward rotation 1 (4 division) 2: Down frequency forward rotation 2 (7 division) 3: Down frequency forward rotation 3 4: Down frequency inversion 1 (5 division)	0 ： Buck mode		×

		5: Down frequency inversion 2 (8 division) 6: Down frequency inversion 3			
	A08. inching voltage	10% ~80	40		×
	A09. low frequency point power	10% ~100	50		×
	A10.Stop mode	0: free parking 1: Soft stop 2: DC brake stop	0 ： Free parking		×
	A11. soft stop time	1s~60s	5s		×
	A12. soft starter type	0: Online type 1: Bypass type	1: Bypass type		×
B Protection parameters	B00. starting overload level	0~30	10	0 ： close	×
	B01. operation overload level	0~30	10	0 ： close	×
	B02. operation overcurrent multiple	0% -600	0	0 ： close	×
	B03. operation overcurrent protection time	0s-6000s	5s		×
	B04. overvoltage protection value	100% ~140	120	100 ： close	×
	B05. overvoltage protection time	1s~60s	5s		×
	B06. undervoltage protection value	60% -100	80	100 ： close	×
	B07. undervoltage protection time	1s~60s	5s		×
	B08. three phase current unbalance	20% ~100	40	100 ： close	×
	B09. three phase current unbalance time	0.1s~60.0s	10.0s		×
	B10. starting timeout	0s~150s	60s	0 ： close	×
	B11. jog timeout	0s~150s	0s	0 ： close	×
	B12. under load protection value	0% ~100	0	0 ： close	×
	B13. under load protection time	1s~60s	10s		×

C senior function	C00.Programmable relay 1	Function: 0: no action 1: Power on action 2: Soft starting action 3: Bypass action 4: Soft stop action 5: Inching action 6: Runtime action 7: Standby action 8: Fault action 9: Thyristor breakdown action 10: Action 1 when the current is greater than the reached value 11: Action 2 when the current is greater than the reached value 12: Action 1 when the current is less than the reached value 13: Action 2 when the current is less than the reached value Delay: 0-600s	8: Fault action		×
	C01.Programmable output delay 1		0s		×
	C02.Programmable relay 2		6:Runtime action		×
	C03.Programmable output delay 2		0s		×
	C04. DC braking force	10%~100	40		×
	C05. DC braking time	2s~120s	10s		×
	C06. current reaches 1	1%~600	100		×
	C07. current reaches return difference 1	1 %~100	20		×
	C08. current reaches 2	1%~600	70		×
	C09. current reaches return difference 2	1 %~100	20		×
	C10.Driving mode	0：Torque mode 1：Smoothing mode	0：Torque mode		×
	C11. number of swings	1-4	1		×
	C12. one swing starting time	1-120s	5s		×
	C13. primary swing stop time	1-120s	5s		×
	C14. secondary swing starting time	1-120s	5s		×
	C15. secondary swing stop time	1-120s	5s		×
	C16. three swing starting time	1-120s	5s		×

C senior Function	C17. three swing stop time	1-120s	5s		×
	C18. four swing starting time	1-120s	5s		×
	C19. four swing stop time	1-120s	5s		×
	C20. mailing address	1-127	1		×
	C21.Baud rate	0:2400 1:4800 2:9600 3:19200	2:9600		×
	C22.a phase current calibration value	10%~1000	100		√
	C23.b phase current calibration value	10%~1000	100		√
	C24.c phase current calibration value	10%~1000	100		√
	C25. input voltage calibration value	10%~1000	100		√
	C26.4-20mA lower limit calibration	0 %~150.0	20.0		×
	C27.4-20mA upper limit calibration	0%~150.0	100.0		×
	C28.4-20mA upper limit current	50%~500	200		×
D status information	D00. rated current of soft starter				△
	D01. rated voltage of soft starter				△
	D02. motor rated current				×
	D03. times of soft start				△
	D04. accumulated operating hours				△
	D05. master control software version				△
E Display	E00.Standby display mode	0：model 0 1：model 1	0：model 0		√
	E01.Operation display mode	0：model 0 1：model 1	0：model 0		√

para meters	E02.Operation language selection	0：English 1：Chinese		1：Chinese	√
	E03.Screen saver time	0s~1800s	120s	0：Unprotected	√
	E04.Keyboard software version				△
	E05.Screen contrast				√

√：Indicates that the parameter value can be modified when the soft starter is in the stop and running states.

×：Indicates that the parameter value cannot be modified when the soft starter is in operation.

△：Indicates that the parameter value is read-only and cannot be modified.

5.2   Function parameter description

5.2.1 Starting mode

The intelligent AC motor soft starter has the following 6 starting modes, which can be selected by users according to their own load conditions.

    0: current limiting start
    1: Voltage ramp start
    2: Jump current limiting start
    3: Jump voltage ramp start
    4: Inching start
    5: Swing start

Except for inching start, all start models are subject to B10 Start timeout time limit: when the start time exceeds the start timeout time limit value, the soft starter will alarm the start timeout fault and shut down. When B10 is set to 0, close the start timeout protection.

5．2．1．1   Current limiting starting

After starting, the motor current quickly rises to the set current limit value IM, and keeps the output current not greater than this value, so that the motor gradually accelerates and the voltage gradually increases. When the motor approaches the rated speed, the motor current rapidly drops to the rated current Ie, and the starting process is completed, as shown in Figure 5-1.

The current limiting starting mode is generally used in occasions with strict requirements on starting current, especially when the power grid capacity is too small. To limit the starting capacity, the current limiting multiple can be set according to the requirements, which is generally between 2.5 and 3 times. If the setting is too small, the normal starting will not be possible. When current limiting starting is adopted, the starting time is related to the current limiting multiple. The larger the current limiting multiple is, the shorter the starting time is, and vice versa. Parameters related to "current limiting starting".
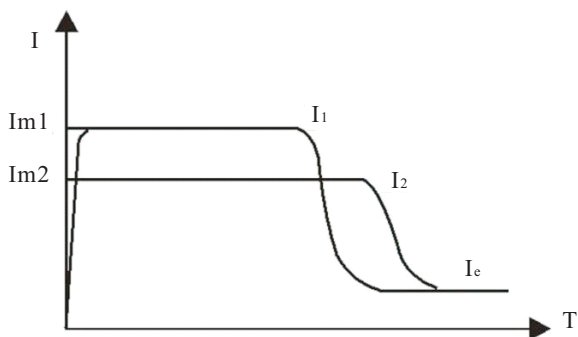
A01.Starting mode，A02.Starting current limit percentage

Figure 5-1 Current limiting starting

5.2.1.2 Voltage ramp start

After starting, the output voltage of the soft starter quickly rises to the "starting voltage" value U1, and then gradually increases the output voltage according to the "voltage ramp starting time" until the starting is completed, as shown in Figure 5-2.

The voltage ramp starting mode is applicable to large inertia loads, or occasions where the starting current is not strict and the starting stability is high. This starting mode can greatly reduce the starting impact and mechanical stress. The larger the initial voltage U1 is, the larger the initial starting torque is, but the larger the starting instant impact is. The voltage ramp starting is also controlled by the current limit starting multiple, that is, the starting current will not exceed the starting current limit during the voltage ramp starting process. This measure is to prevent damage to the system caused by improper parameter settings. Therefore, the starting current limit should be appropriately increased when using the voltage ramp model. Length of the starting process is related to setting value of the starting time and weight of the load.

Parameters related to "voltage ramp start":

A01.Starting mode；
A02. starting current limit percentage;
A03. percentage of starting voltage;
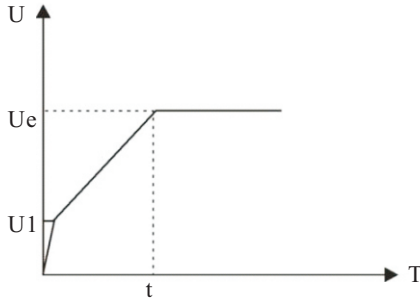A04. voltage ramp start time.

Figure 5-2 Voltage

5.2.1.3 Jump current limiting start

For some loads with large static resistance, a large torque is required at the moment of starting. In order to ensure normal starting, sudden tripping and current limiting starting can be selected. When starting, the soft starter instantly outputs a higher voltage (the time can be set) to make the motor rotate, and then start it according to the current limiting starting mode until the starting is completed, as shown in Figure 5-3.

Parameters related to "jump current limiting start":

A01. Starting mode；
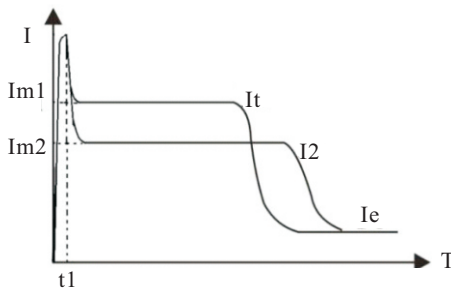A02. starting current limit percentage;
A05. jump voltage;
A06. jump time.

Figure 5-3 Sudden tripping current limiting startup

17

5.2.1.4 Jump voltage ramp start

For some loads with large static resistance, a large torque is required at the moment of starting. In order to ensure normal starting, sudden jump voltage ramp starting can be selected. When starting, the soft starter instantly outputs a higher voltage (the time can be set) to make the motor rotate, and then starts according to the voltage ramp starting mode until the starting is completed, as shown in Figure 5-4.

Parameters related to "jump voltage ramp start":

A01.Starting mode；

A02. starting current limit percentage;

A03. percentage of starting voltage;

A04. voltage ramp starting time;

A05. jump voltage;

A06. jump time.
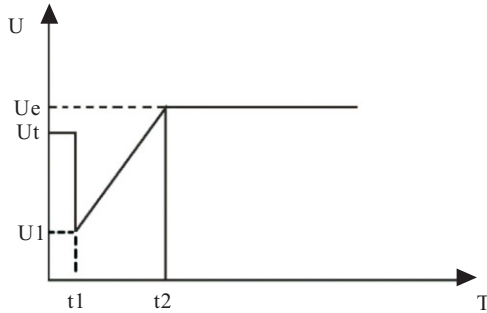
Figure5-4 Jump voltage ramp start

5.2.1.5 Inching start

Inching start is mainly used for some load positioning or commissioning functions; Jog model is selected by A07. It can be divided into step-down model inching and down-requency model inching. The step-down model jog includes three kinds of frequency reduction forward rotation and three kinds of frequency reduction reverse rotation. In the down frequency forward rotation model, the speed of down frequency forward rotation 1 is the fastest, and the speed of down frequency forward rotation 3 is the slowest; In the frequency reduction inversion model, the speed of frequency reduction inversion 1 is the fastest, and the speed of frequency reduction inversion 3 is the slowest.

During step-down inching, the output voltage of the soft starter rapidly increases to the inching voltage up (A08) and remains unchanged. Changing the set value of the inching voltage up can change the output torque of the motor during inching.

In the reduced frequency jog model, the output torque of the motor is adjusted by the power degree of A09 low frequency point. The larger the value, the greater the output torque and the output current.

Inching time is affected by B11 Limit of inching timeout time. When the inching time exceeds the value of inching timeout time, the soft starter will alarm the inching timeout fault and stop the machine. B11=0 means close inching timeout protection.

5.2.1.6 Swing start

To solve the problem that it is difficult to start the ball mill with large inertia and eccentric center of gravity, this series of soft starters provide swing starting function, which can make the load start smoothly by swinging back and forth for several times.

The basic starting model and current limiting model used for swing starting can be set to 1~4 times, and the starting time and stopping time can be set independently each time. The soft starter will be subject to the actual start-up, but will not be started rigidly according to the set swing times. For example, if it is set to start 4 times of swing, but actually only 2 times of swing are required to complete the start-up, the soft starter will enter the running state after starting twice without executing the remaining swing times. The swing start model is shown in Figure 5-5. The parameters related to swing starting are as follows:

A01.Starting mode， A02. Starting current limit percentage,

C11 Number of swings.

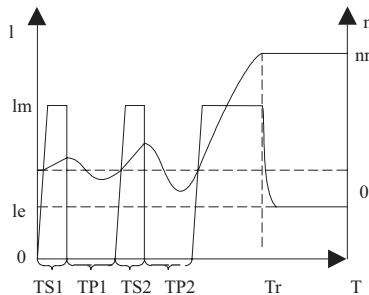C12～C19. Swing start time and swing stop time.

Figure 5-5 Swing start

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In Figure: I represents motor current, Ie represents motor rated current, Im represents starting current limit, n represents motor speed, nr represents motor rated speed, T represents starting time,

TS1 and TS2 represent the first and second swing start time, TP1 and TP2 represent the first swing, and the second swing stop time Tr represents the start completion time.

This figure is an example where the number of swings is set to 2.

5.2.2 Stop mode

The soft starter has the following three stop modes:

A10=0: free stop

A10=1: soft parking a10=2:

DC braking parking

5.2.2.1 Free parking

After receiving the shutdown command, the soft starter controls the bypass contactor to disconnect. At the same time, the output voltage of the main circuit thyristor is blocked, and the motor stops gradually according to inertia.

5.2.2.2 Soft stop

Under this shutdown model, the motor power supply is switched from the bypass contactor to the main circuit thyristor, and the control output voltage is gradually reduced until the motor stops smoothly. The model is generally used to prevent the water hammer phenomenon of the equipment in the vertical water supply pipeline at the moment of horizontal stop, so as to prolong the service life of the pipeline valve.

Parameters related to soft parking are:
A10.Stop mode ; A11. soft stop time.

5.2.2.3 DC braking parking

Under this shutdown model, the power supply of the motor is switched from the bypass contactor to the main circuit thyristor, and the soft starter controls the output DC voltage for the motor braking and shutdown, so as to shorten the operation time of the motor from the rotating state to the static state. The model is generally used in the occasions where the motor shutdown time is required, which can make the large inertia load stop completely to the static state in a short time.

C04. the DC braking force is used to control the DC braking torque. The greater the parameter value, the greater the braking torque and braking current, and the shorter the braking time. C05. DC braking time is used to adjust the time for applying braking current. The longer the time, the lower the remaining speed of the motor after braking.

Parameters related to DC braking parking are:

A10.Stop mode；C04. DC braking force; C05. DC braking time.

5.2.3 Soft starter type selection

Parameter A12.Soft starter Type This parameter is used to select the soft starter type, which can be selected between the online type and the bypass type. The on-line soft starter is used for the on-line operation of the soft starter because the thyristor always keeps the trigger state in the running state. The bypass type (including built-in bypass and external bypass) stops triggering when the thyristor is in operation state, and the motor operates at full pressure when the bypass contactor is responsible for connecting the main circuit.

YW60 series soft starter is a built-in bypass soft starter, A12=1.

5.2.4 Overload protection

Overload protection adopts inverse time limit to control

Protection time: $t = \dfrac{35 * T_P}{(I/I_P)^2 - 1}$

Where: T represents the action time, TP represents the protection level, I represents the operating current, IP represents the rated current of the motor.

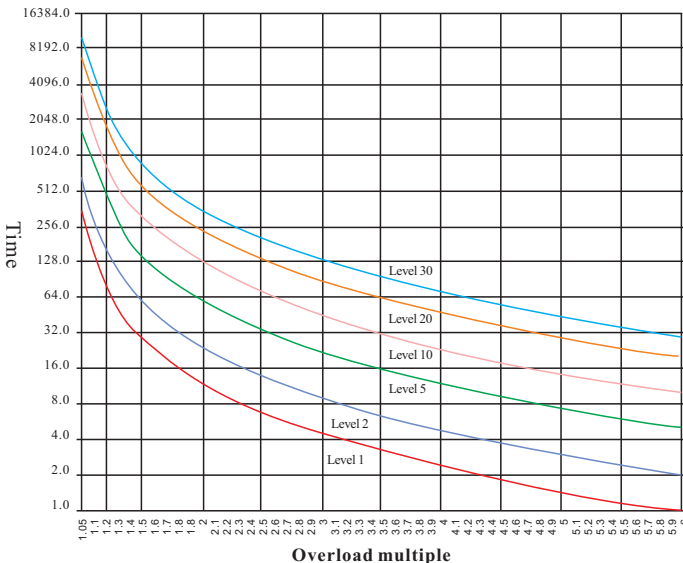Motor overload protection characteristic curve: figure 5-6

Figure5-6 Overload protection characteristic curve

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Table 5-1 Motor overload protection characteristics

Overload Overload level	1.05Ie	1.2Ie	1.5Ie	2Ie	3Ie	4Ie	5Ie	6Ie
1	∞	79.5s	28s	11.7s	4.4s	2.3s	1.5s	1s
2	∞	159s	56s	23.3s	8.8s	4.7s	2.9s	2s
5	∞	398s	140s	58.3s	22s	11.7s	7.3s	5s
10	∞	795.5s	280s	117s	43.8s	23.3s	14.6s	10s
20	∞	1591s	560s	233s	87.5s	46.7s	29.2s	20s
30	∞	2386s	840s	350s	131s	70s	43.8s	30s

∞ : Indicates no action
Parameters related to overload protection are:
B00. starting overload level; B01. operation overload level.

5.2.5 Current arrival function

Current arrival function It is used together with two multi-functional relays and is divided
into two models: current greater than the arrival value and current less than the arrival
value.

In the current greater than the reached value action model, when the operating current
is greater than the current reaching the set value, the relay acts. When the operating current
is less than (current reaching value - current reaching return difference), the relay recovers,
as shown in Figure 5-7.

In the current less than the reached value action model, when the operating current is less
than the current reaching the set value, the relay acts. When the operating current is
greater than (current reaching value + current reaching return difference), the relay
recovers, as shown in Figure 5-8.

The parameters related to the current arrival function are:

C00. programmable relay 1;   C01. programmable output delay 1;

C02. programmable relay 2;   C03.programmable output delay 2;

C06. current reaches 1;   C07. current reaches return difference 1;

C08. current reaches 2;   C09. current reaches return difference 2.

Action when the current is greater than the reached value
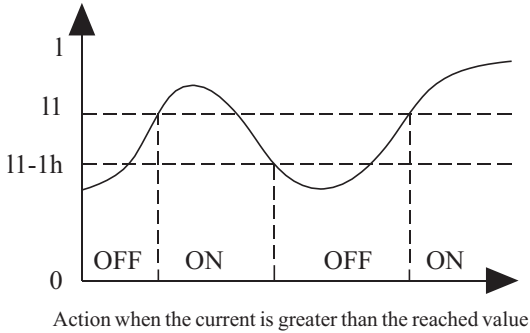
Figure 5-7 Function of current greater than reach value

Action when the current is less than the reached value
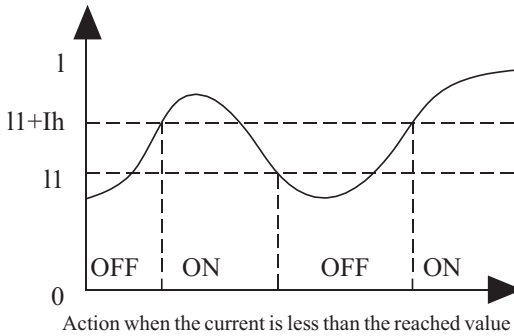
Figure 5-8 Function of current less than reach value

In Figure: I1 represents current reaching value, IH represents return differential current, on represents relay action, and off represents relay recovery.

5.2.6 Driving mode

Parameter C10. Driving mode is used to select the driving mode of the soft starter, C10=0 torque model; C10=1 smooth model. The starting torque of torque model motor is large, but there may be large current fluctuation during the starting process, which is mainly used in the occasions where starting is difficult and large starting torque is required; The smooth model motor has stable starting current, more accurate control, and less impact on mechanical load and power grid during the starting process. It is suitable for most occasions.

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5.2.7 Analog current output function

Analog current output function can realize analog 4-20mA, 0-20mA and other current output functions.

C28.4-20mA upper limit current: used to set the soft starter current corresponding to the upper limit of analog current output.

C27.4-20mA upper limit calibration: used to set the upper limit value of analog current output. 100 means 20mA.

C26.4-20mA lower limit calibration: used to set the upper limit value of analog current output. 20 means 4mA.

Example of analog current output parameter setting:

Example 1: 20mA corresponds to twice the rated current of the motor,
4mA corresponds to 0A C28=200%, C26=20%, C27=100%

Example 2: 20mA corresponds to one time of the rated current of the motor,
0mA corresponds to 0A C28=100%, C26=0%, C27=100%

Note: if the analog current output has deviation, the parameters C26 and C27 can also be used for fine adjustment.

5.2.8 Screen saver time

Screen saver time is used to set the screen backlight lighting time, which passes E03 after the last keyboard operation After screen saver time, the screen backlight close is used to save energy and prolong the service life of the screen backlight. Set E03 The screen saver time is set to 0 to close this function, and the screen remains lit all.

VI. Product outline dimension and installation dimension

Table 6-1 Structure type list of FST-3000 **series products**

Soft starter model	Overall dimension(A×B×H×H1)	Mounting dimensions (W×L)	Mounting screws	Structure code	Remarks
FST-3015	185×210×348×325	140×305	M6	RR1	Plastic shell wall hang
FST-3022	185×210×348×325	140×305	M6	RR1	
FST-3030	185×210×348×325	140×305	M6	RR1	
FST-3037	185×210×348×325	140×305	M6	RR1	
FST-3045	185×210×348×325	140×305	M6	RR1	
FST-3055	185×210×348×325	140×305	M6	RR1	
FST-3075	300×250×605×560	215×536	M8	RR2	Metal wall hanging
FST-3090	300×250×605×560	215×536	M8	RR2	
FST-3110	300×250×605×560	215×536	M8	RR2	
FST-3132	300×250×605×560	215×536	M8	RR2	
FST-3160	300×250×605×560	215×536	M8	RR2	
FST-3185	300×250×605×560	215×536	M8	RR2	
FST-3200	340×260×661×615	265×590	M8	RR3	
FST-3250	340×260×661×615	265×590	M8	RR3	
FST-3320	340×260×661×615	265×590	M8	RR3	

Table 6-2 Installation dimension of copper bar

Structure code	L1×L2×L3	S	D
RR1	20×322×52	103	M8
RR2	30×570×96	115	M10
RR3	40×627×106	118	M10

Outline structure Figure：
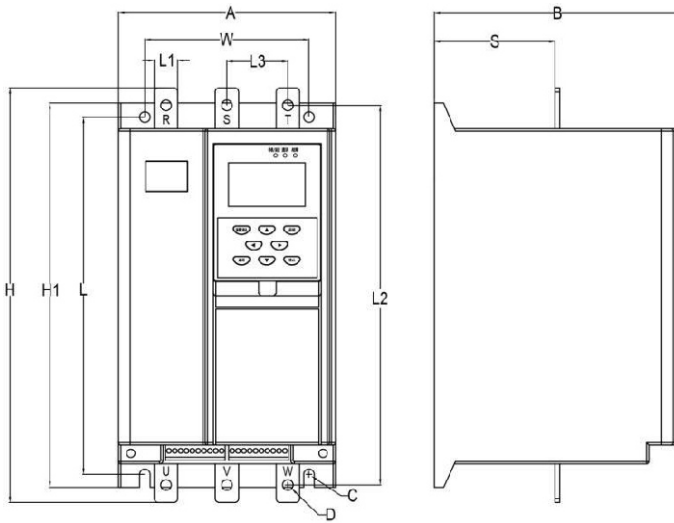
RR1 Outline and copper bar structure diagram
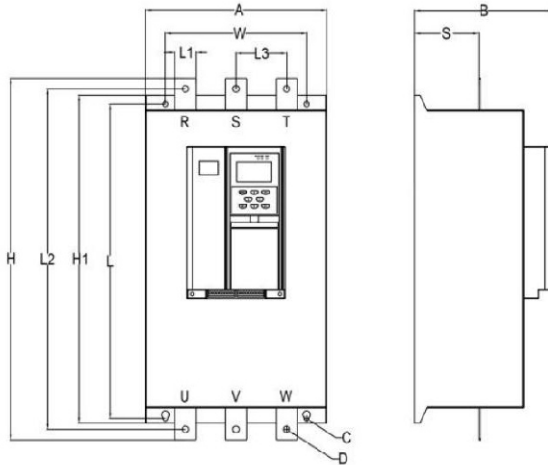
RR2-RR3 Outline and copper bar structure diagram

Appendix 1 fault protection function and Solutions

No.	Fault name	Possible fault causes	Terms of settlement
1	Input phase loss	Phase failure of incoming power supply	Check whether the three-phase power supply at the upper inlet is lack of phase, whether the upper power inlet is connected properly, and whether the upper circuit breaker is in good condition
2	Output phase loss	Output phase loss	Check whether the motor wiring at the lower outlet is in good condition and whether the motor has fault
3	Operation overload	1. Motor overload operation 2. Incorrect setting of motor rated current 3. Improper selection of operation overload level 4. Inaccurate current display	1. Check the load condition, and check whether the load is too heavy 2. Check whether parameter D02 is set correctly 3. Check whether the parameter B01 setting is appropriate 4. Adjust parameters C22, C23 and C24 to make the three-phase displayed current of the soft starter equal to the actual current
4	Starting overload	1. Motor overload starting 2. Incorrect setting of motor rated current 3. Improper selection of operation overload level 4. Inaccurate current display	1. Check the load condition, and check whether the load is too heavy 2. Check whether parameter D02 is set correctly 3. Check whether the parameter B00 setting is appropriate 4. Adjust parameters C22, C23 and C24 to make the three-phase displayed current of the soft starter equal to the actual current
5	Soft start underload	1. Incorrect setting of motor underload parameters 2. Inaccurate current display	1. Adjust parameters B12 and B13 to appropriate values 2. Adjust parameters C22, C23 and C24 to make the three-phase displayed current of the soft starter equal to the actual current
6	Current unbalance	1. There is a problem with the motor coil 2. Poor contact of main wiring terminal 3. Inaccurate current display	1. Replace or repair the motor 2. Retighten each terminal block 3. Adjust parameters C22, C23 and C24 to make the three-phase displayed current of the soft starter equal to the actual current
7	Soft start overheat	1. Soft starter starts too frequently 2. External ambient temperature of soft starter is too high	1. Increase the starting interval, wait for the soft starter to cool before the next start, or add a cooling device to make the soft starter cool down faster 2. Improve the external environment of the soft starter or reduce the capacity

		3. There are large heating devices around the soft starter and the installation is too compact	3. Improve the layout or strengthen the cooling intensity in the cabinet
8	Overvoltage fault	1. Supply voltage too high 2. Inaccurate voltage display	1. Adjust transformer supply voltage 2. Adjust parameter C25 so that the displayed voltage of the soft starter is consistent with the actual voltage
9	Undervoltage fault	1. Supply voltage too low 2. Inaccurate voltage display	1. Adjust the power supply voltage of the transformer; Check whether the incoming cable is too small and whether the transformer power margin is too small 2. Adjust parameter C25 so that the displayed voltage of the soft starter is consistent with the actual voltage
10	Thyristor breakdown	The two-phase thyristor breaks down, and the soft starter has current flowing under the shutdown state	The fault will be reported when there is current in the shutdown state. Cut off the power and check whether there is breakdown of two-phase thyristors
11	Start timeout	Starting time exceeds B10 setting value	1. Check whether the parameter B10 setting is appropriate 2. Check whether the starting time is too long due to heavy load 3. Properly adjust the starting parameters to shorten the starting time
12	Jog timeout	Jog time exceeds B11 setting value	1. Check whether the parameter B11 setting is appropriate 2. Shorten jog operation time
13	Operation overcurrent	1. Excessive operating current 2. Incorrect setting of motor rated current 3. Incorrect setting of operating overcurrent value 4. Inaccurate current display	1. Check the load condition, and check whether the load is too heavy 2. Check whether parameter D02 is set correctly 3. Check whether the settings of parameters B02 and B03 are appropriate 4. Adjust parameters C22, C23 and C24 to make the three-phase displayed current of the soft starter equal to the actual current
14	internal fault	Soft starter sends internal hardware fault	Try to power on again to see if it is resolved. If it is not resolved, please contact the manufacturer

Appendix 2 communication manual

I、 Modbus overview

Modbus is a serial asynchronous communication protocol. Modbus protocol is a common language for application with PLC or other controllers. This protocol defines the message structures that a controller can recognize, regardless of the network they are transmitted through.

Modbus protocol does not require a special interface. The typical physical interface is RS485. For details about modbus, please refer to relevant books.

II、 Modbus communication protocol

2.1 Transmission mode：

2.1.1 Packet format

2.1.2

Start flag	Address field	Functional domain	Data field	CRC verification		End flag
T1-T2-T3-T4	Soft starter address	Function code	N data	CRC Low byte	CRC High byte	T1-T2-T3-T4

2.1.3 RTU model data format

The characters sent are expressed in hexadecimal numbers. For example, send 31H. Then the 31H can be directly sent to the data packet.

2.2 Baud rate setting range

Setting range:C21=0 2400；C21=1 4800；C21=2 9600；C21=3 19200

2.3 Frame structure

RTU model only supports 8-bit data bits, no verification, and the format of 1 stop bit (N-8-1).

2.4 Error detection

2.4.1 RTU model

CRC-16 (cyclic redundancy error check)

The CRC-16 error check procedure is as follows:

The message (only data bits are involved here, not start bits, stop bits and optional parity bits) is regarded as a continuous binary, and its most significant

bit (MSB) is preferred to be sent. The message is multiplied by 216 (shifted by 16 bits to the left) and then divided by 216+215+22+1. 216+215+22+1 can be expressed as binary number 11000000000000101. If the integer quotient bit is ignored, the 16 bit remainder is added to the message (MSB sends it first) and becomes two CRC check bytes. All 1 in the remainder are initialized to prevent all zeros from becoming a message to be received. If there is no error in the message containing CRC bytes after the above processing, it will be divided by the polynomial 216+215+22+1 after arriving at the receiving equipment to obtain a zero remainder. The receiving equipment will verify this CRC byte and compare it with the transmitted CRC.

Devices used to sending data in series will prefer the rightmost bit (LSB least significant bit) of the sent character. In the case of CRC generation, the first place of transmission should be the most significant MSB of the dividend. Since there is no carry in the operation, MSB is set in the rightmost bit during CRC calculation for the convenience of operation. The bit order of the generated polynomial must also be reversed to maintain consistency. The MSB of polynomials is omitted because it is only for quotient.

Have influence but not influence the remainder.

The steps to generate CRC-16 check bytes are as follows:

a: load a 16 bit register, and all digits are 1.

b: The low byte of the 16 bit register is XOR with the start 8-bit byte. The result of the operation is placed in this 16 bit register.

c: Shift this 16 register one bit to the right.

d: If the digit shifted to the right (mark bit) is 1, generate the polynomial 1010000000000001 and this register for "XOR" operation; If the digit moved to the right is 0, C is returned.

e: Repeat C and d until 8 bits are removed.

f: The next 8-bit byte performs an XOR operation with the 16 bit register.

g: Repeat C ~ F until all bytes of the message are XORed with 16 bit registers and shifted for 8 times.

h: The contents of this 16 bit register are exchanged between high and low bytes, that is, 2-byte CRC error check, which is added to the most significant bit of the message.

2.5 Command type and format

2.5.1 The supported command types are as follows：

Command type	Name	Describe
03	Read the contents of the holding register	Get the current value in one or more registers, no more than 10 at most
06	Preset single register	Load the specific value into the holding register

2.5.2 Communication address and command meaning

This part is the content of communication, which is used to control the operation of the soft starter, the status of the soft starter and the setting of relevant parameters. For details, refer to the table of communication function parameters.

Be careful：

At most one function code can be written at a time.

2.5.2.1 Abnormal response when reading and writing parameters

Command description	Function code area	Data area
Slave parameter response	The highest bit of the function code area changes to 1.	Meaning of command content 0001: illegal function code (within the interval) 0002: illegal data address 0003: illegal data 0004: slave equipment fault Note 2

III Communication function parameters

MODBUS address	Function name	set range	Default	Remarks
0x0000	control mode	0: start stop prohibited 1: Keyboard independent control 2: External control independent control 3: Keyboard + external control 4: Communication independent control 5: Keyboard+communication 6: External control + communication 7: Keyboard + external control + communication	3: Keyboard + external control	
0x0001	Startup mode	0: current limiting start 1: Voltage ramp start 2: Sudden tripping current limiting startup 3: Jump voltage ramp start 4: Stepwise variable frequency starting 5: Inching start 6: Swing start	0: current limiting start	
0x0002	Starting current limit percentage	50%~600	300	
0x0003	Starting voltage percentage	10%~80	35	
0x0004	Voltage ramp start time	1s~120s	15s	
0x0005	Jump voltage	10%~95	80	
0x0006	Jump time	10ms~2000ms	500ms	
0x0007	Jog model	0: Buck model 1: Down frequency forward rotation 1 (4df) 2: Down frequency forward rotation 2 (7df) 3: Down frequency forward rotation 3 4: Down frequency inversion 1 (5df) 5: Down frequency inversion 2 (8df) 6: Down frequency inversion 3	0: Buck model	
0x0008	Inching voltage	10%~80	40	

0x0009	Low frequency point power	10%~100	50	
0x000A	Swing times	1~4	1	
0x000B	One swing start time	1~120s	5s	
0x000C	One swing stop time	1~120s	5s	
0x000D	Secondary swing start time	1~120s	5s	
0x000E	Secondary swing stop time	1~120s	5s	
0x000F	Three swing start time	1~120s	5s	
0x0010	Three swing stop time	1~120s	5s	
0x0011	Start time of four swings	1~120s	5s	
0x0012	Four swing stop time	1~120s	5s	
0x0013	Stop mode	0：Free parking 1：Soft stop	0：Free parking	
0x0014	Soft stop time	1s~60s	5s	
0x0015	DC braking force	10%~100	40	
0x0016	DC braking time	2s~120s	10s	
0x0017	Current reaches 1	1%~600	100	
0x0018	Current reaches return difference 1	1%~100	20	
0x0019	Current reaches 2	1%~600	70	
0x001A	Current reaches return difference 2	1%~100	20	
0x001B	Soft starter type	0: Online 1: Bypass type	1: Bypass type	
0x001C	Programmable relay 1	0: no action 1: Power on action 2: Soft starting action 3: Bypass action 4: Soft stop action 5: Inching action 6: Runtime action 7: Standby action 8: Fault action 9: Thyristor breakdown action 10: Action 1 when the current is greater than the reached value 11: Action 2 when the current is greater than the reached value 12: Action 1 when the current is less than the reached value 13: Action 2 when the current is less than the reached value	8：Fault action	
0x001D	Programmable output delay 1	0~600s	0s	

0x001E	Programmable relay 2	0: no action 1: Power on action 2: Soft starting action 3: Bypass action 4: Soft stop action 5: Inching action 6: Runtime action 7: Standby action 8: Fault action 9: Thyristor breakdown action 10: Action 1 when the current is greater than the reached value 11: Action 2 when the current is greater than the reached value 12: Action 1 when the current is less than the reached value 13: Action 2 when the current is less than the reached value	6:Run time action	
0x001F	Programmable output delay 2	0~600s	0s	
0x0020	spare			
0x0021	spare			
0x0022	spare			
0x0023	Calibration value of phase a current	10%~1000	100	
0x0024	Phase B current calibration value	10%~1000	100	
0x0025	C-phase current calibration value	10%~1000	100	
0x0026	AB phase voltage calibration value	10 %~1000	100	
0x0027	spare			
0x0028	spare			
0x0029	4-20mA Lower limit calibration	0 %~150.0	20.0	
0x002A	4-20mA upper limit calibration	0% ~150.0	100.0	
0x002B	4-20mA upper limit current	50%~500	200	
0x002C	Fast overcurrent protection value	0 ~800	500	0 Indicates no protection

0x002D	Starting overload level	0~30	10	0 Indicates no protection
0x002E	Operating overload level	0~30	10	0 Indicates no protection
0x002F	spare			
0x0030	spare			
0x0031	Operating overcurrent multiple	0% -600	0	0 Indicates no protection
0x0032	Operation overcurrent protection time	0s-6000s	5s	
0x0033	Overvoltage protection value	100% ~140	120	100 Indicates no protection
0x0034	Overvoltage protection time	1s~60s	5s	
0x0035	Undervoltage protection value	60% -100	80	100 Indicates no protection
0x0036	Undervoltage protection time	1s~60s	5s	
0x0037	Three phase unbalance	20% ~100	40	100% Indicates no protection
0x0038	Three phase unbalance time	0.1s~60.0s	10.0s	
0x0039	Startup timeout	0s~150s	60s	0 Indicates no protection
0x003A	Jog timeout	0s~150s	0s	0 Indicates no protection
0x003B	Under load protection value	0% ~100	0	0 Indicates no protection
0x003C	Underload protection time	1s~60s	10s	
0x003D	postal address	1~127	1	
0x003E	Baud rate	0：2400 1：4800 2：9600 3：19200	2：9600	
0x003F	Communication model	n, 8, 1		
0x0040	Down frequency starting time			
0x0041	Frequency reduction starting force			
0x0042	Reduced frequency starting frequency			

0x0043 ~ 0x0063	Spare			
0x0064	Soft start rated current			read-only
0x0065	Soft start rated voltage			read-only
0x0066	Motor rated current			
0x0067	Start times of Soft start			read-only
0x0068	Cumulative operating hours			read-only
0x0069	Current running seconds			read-only
0x006A	Master control software version			read-only
0x006B ~ 0x00FF	Spare			
0x0100	Soft starter status			read-only
0x0101	Current fault			read-only
0x0102	Average voltage			read-only
0x0103	average current			read-only
0x0104	Percentage of output voltage			read-only
0x0105	Average current percentage			read-only
0x0106	Apparent power value			read-only
0x0107	Three phase current unbalance			read-only
0x0108	Phase A current value			read-only
0x0109	Phase B current value			read-only
0x010A	Phase C current value			read-only
0x010B	Phase AB voltage value			read-only
0x010C	BC phase voltage value			read-only
0x010D	CA phase voltage value			read-only

0x010E	Current running time (minutes)			read-only
0x010F ~ 0x011F	spare			
0x0120	Fault record 1			read-only
0x0121	Fault record 2			read-only
0x0122	Fault record 3			read-only
0x0123	Fault record 4			read-only
0x0124	Fault record 5			read-only
0x0125	Fault record 6			read-only
0x0126	Fault record 7			read-only
0x0127	Fault record 8			read-only
0x0128	Fault Record 9			read-only
0x0129	Fault record 10			read-only
0x012A	Fault record 11			read-only
0x012B	Fault record 12			read-only
0x012C ~ 0x012F	spare			
0x0130	Control command register	0x0001 Start 0x0003 stop it 0x0004 Clear fault		Write only

Upgrade record

Instruction version number	Change content
2022030201	Create instructions

Inform users

Thank you for choosing the soft starter product. In order to ensure you get the best after-sales service, please carefully read the following terms and do a good job in related matters.

1. Product warranty scope

The fault generated under normal use according to the use requirements.

2. Product warranty period

The warranty period of the product is within 24 months from the date of delivery. Implement long-term technical service after the warranty period.

3. Non warranty coverage

Any damage caused by man-made accidents, natural disasters and other reasons in violation of the use requirements, as well as the disassembly, modification and repair of the frequency converter without permission, shall be deemed as the automatic waiver of the warranty service.

4. Purchase products from middlemen

Any user who purchases products from the distributor should contact the distributor and agent in case of product failure.

5. Disclaimer:

Product failures caused by the following reasons are not covered by the manufacturer's 24-month free warranty service:

(1) The manufacturer does not operate correctly according to the procedures listed in the product manual;

(2) The user repairs the product without communicating with the manufacturer or modifies the product without authorization;

(3) Abnormal aging or failure of product components due to poor user environment;

(4) Users use the product beyond the standard range of the product;

(5) Product damage caused by force majeure such as earthquake, fire, wind and water disasters, lightning strike, abnormal voltage or other natural disasters;

(6) Hardware damage caused by man-made falling and transportation after purchase.

6．Responsibility:

No matter from the perspective of contract, warranty period, negligence, civil tort, strict liability, or any other point of view, the company and its suppliers and distributors shall not be

liable for the following special, indirect and secondary losses caused by the use of equipment. This includes but is not limited to the loss of profits and revenues, the loss of the use of supplied equipment and related equipment, the cost of capital, the cost of substitute equipment, tool fees and service fees, the cost of downtime, delays, and the loss of the buyer's customers or any third party. In addition, unless the user can provide strong evidence, the company and its suppliers will not be responsible for some allegations, such as problems caused by the use of unqualified raw materials, wrong design, or non-standard production.

The company reserves the right to interpret

If you have any questions about soft start, please contact the company or its office. The technical data, information and specifications are the latest materials at the time of publication, and the company reserves the right to change them without prior notice, and will not bear any responsibility for the losses caused thereby. The company reserves the right to interpret.