C-Lin
欣灵电气股份有限公司
XINLING ELECTRIC CO.,LTD

**Address**: No. 328, Weishi 19th Road, Yueqing Economic Development Zone, Zhejiang Province
**Website**: Http://www.c-lin.cn
**Technical Consultation**: 0577-57151561, 57151563, 13353303966
**Publication Date**: December 2019

RECYCLABLE

National High-Tech Enterprise Zhejiang Province Famous Trade Name

C-Lin 欣灵

使用手册
Products Instructions

# XLR5000
## Intelligent Soft Starter

Thank you very much for using the Xinling brand intelligent soft starter. Please read the user manual before use!

18B002E2

# Contents

# I.Overview

The XLR5000 series intelligent motor soft starter is suitable for three-phase AC squirrel-cage asynchronous motors with AC 380V 50 (60) Hz and rated current of 998A or below.The XLR5000 series intelligent motor soft starter is suitable for three-phase AC squirrel-cage asynchronous motors with AC 380V 50 (60) Hz and rated current of 998A or below.

This soft starter is a device type. It requires installing a circuit breaker (for short-circuit protection) and an AC contactor (for bypass operation) in the cabinet, and works with switches to form a complete motor control circuit.This soft starter is a device type. It requires installing a circuit breaker (for short-circuit protection) and an AC contactor (for bypass operation) in the cabinet, and works with switches to form a complete motor control circuit.

The XLR5000 series integrates the latest motor control theory, proprietary motor protection technology, and advanced software. It eliminates the need for an external thermal relay, providing comprehensive motor protection during both starting and operation. Closed-loop control ensures balanced and reliable soft start/stop performance. A bypass contactor is used during operation, resulting in near-zero power consumption—this enhances reliability while reducing the device size.It is an ideal replacement for legacy motor starting equipment such as star/delta starters, autotransformer starters, and magnetic soft starters. Its performance far exceeds that of conventional soft starters on the market that lack intelligent start control technology.

# II.Model Nomenclature

XLR 5000 — □ □ □

- Z: Indicates device type
- 055: Indicates 55kW
- 4: Indicates 380V
- Design series number
- Xinling Soft Starter

This product complies with the standard GB/T14048.6-2016.





# III. Operating and Environmental Conditions

1.Rated operating voltage: AC 380V (±10%), 50/60 Hz.
Applicable motor: Squirrel-cage three-phase asynchronous motor.Starting frequency: No fixed requirement; the actual number of starts depends on the load condition.
Cooling method: Natural air cooling.
Altitude: Max. 1000 m. If operating above 1000 m, the device capacity must be derated.
Ambient air temperature: 0 °C to +40 °C, with the 24-hour average temperature not exceeding +35 °C.
Humidity: At +40 °C, relative humidity ≤ 50%. Higher humidity is allowed at lower temperatures (e.g., up to 90% at 10 °C). Special measures must be taken to prevent condensation caused by temperature fluctuations.
Protection class: IP20.

# IV.Installation Requirements

1.Installation orientation and spacing:To ensure good ventilation and heat dissipation, the soft starter must be installed vertically. Sufficient clearance must be maintained around the unit for heat dissipation (see Figure 1). Figure 2 specifies the minimum allowable distances. (All dimensions in the figures are in millimeters.)

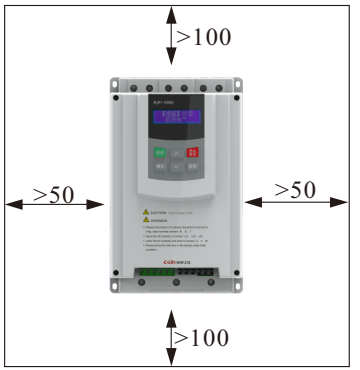



Figure 1

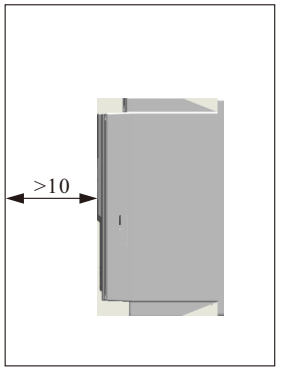



Figure 2

2. Basic Wiring Diagram of the Soft Starter (See Figure 3)

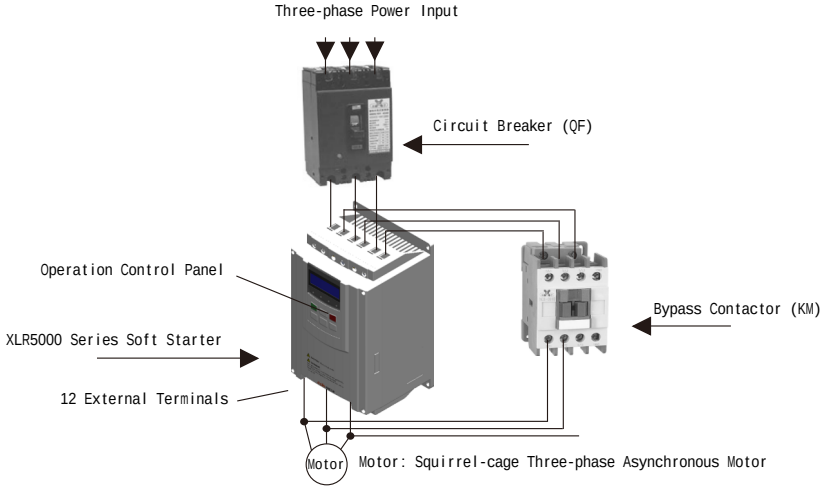



Figure 3

Notes: a) For models rated 5.5～55kW: 6 incoming terminals (the upper row R, S, T connect to three-phase power L21, L22, L23 and to the bypass AC contactor), with 3 outgoing terminals.

b) For models rated 75～500kW: 6 incoming terminals (the top three copper bars R, S, T connect to the circuit breaker; the bottom three copper bars L21, L22, L23 connect to the bypass AC contactor), with 3 outgoing terminals.

3. Description of Soft Starter External Control Terminals

a) The external control terminals are shown in Figure 4:

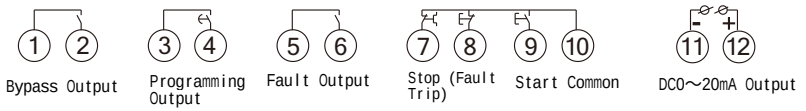



Figure 4

b) Terminals ① and ② are Bypass Output: Used to control the bypass contactor. These are normally open (NO) passive contacts, which close after the start-up process is complete. Contact rating: AC250V/5A.

c) Terminals ③ and ④ are Programmable Relay Output: The output mode and function are set via parameter FE. These are normally open (NO) passive contacts. For details, refer to the Programmable Relay Output Function Description on Page 8. Contact rating: AC250V/5A.

d) Terminals ⑤ and ⑥ are Fault Output: These contacts close when the soft starter experiences a fault or power loss, and remain open during normal operation. Contact rating: AC250V/5A.





e)Terminal ⑦ is Emergency Stop Input: This terminal must be shorted to Terminal ⑩ during normal operation of the soft starter. If this terminal is open-circuited from Terminal ⑩, the soft starter will stop and enter fault protection mode. This terminal can be controlled by the normally closed (NC) output of an external protection device. When parameter FA is set to 0 (Primary Protection), this terminal function is disabled.

f)Terminals ⑧, ⑨, and ⑩ are External Control Start/Stop Button Input Terminals. There are two connection methods: 3-wire mode and 2-wire mode, as shown in Figure 5.

g)Terminals ⑪ and ⑫ are 0～20mA DC Analog Output: Used for real-time monitoring of motor current. A full-scale 20mA output indicates 4 times the motor's nominal rated current. A 0～20mA DC ammeter can be connected externally for observation. The maximum load resistance for this output is 300Ω.Terminals ⑪ and ⑫ are 0～20mA DC Analog Output: Used for real-time monitoring of motor current. A full-scale 20mA output indicates 4 times the motor's nominal rated current. A 0～20mA DC ammeter can be connected externally for observation. The maximum load resistance for this output is 300Ω.

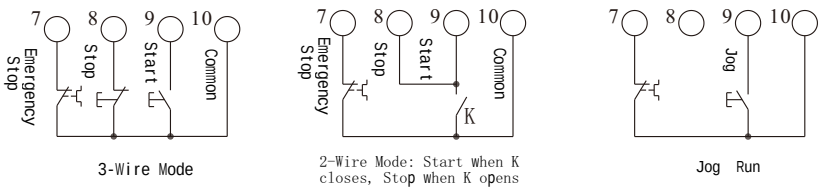



Figure 5

4. Simplified Wiring Diagram of Soft Starter (See Figure 6):

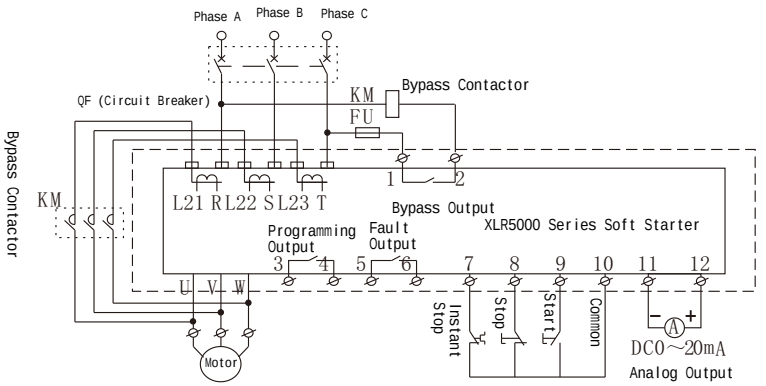



Figure 6

5.Communication Interface and Description:

a) The XLR5000 series soft starter is equipped with a terminal block on its left side. For detailed wiring, refer to Figure 7.

b) Standard Modbus RTU communication protocol.

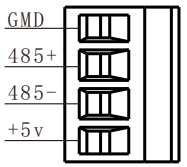



Figure 7

# V.Control Keyboard Operation Instructions

1. Operation Keyboard and Function Buttons:

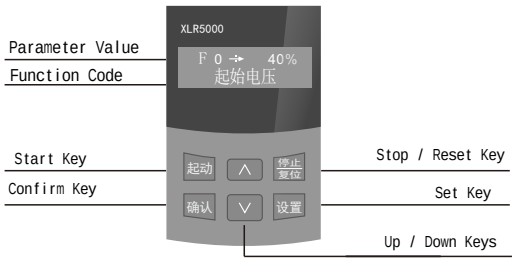



Figure 8

LCD Display: The first line shows the parameter value, and the second line shows the function code.

Power-On State: After the system is powered on, a "beep" will sound (indicating standby mode). The motor can only be started by pressing the Start key when "C-Lin Electrical" is displayed on the LCD.

2. Key Functions and Operation Methods:

a) Start Key: Press to display "Soft Start State Motor Current: 25.0A", which indicates the starting current (the displayed value is for example only). Only the Stop key is active during this phase.

b) Stop Key: When the motor is running, press the Stop key; the display will show the status during the soft stop process.





"Soft Stop State Motor Current: 50.0A" indicates the motor current value. The Stop key also has a reset function. After the soft starter clears a fault or is in the setting state, press the Stop key to reset and return to the ready state.

Note: Press and hold the Stop key while powering on to clear stored fault information.

c) Set Key: In standby or running state, press the Set key to enter the setting menu. "F0:30% Starting Voltage" will be displayed first. Press the Set key again to display "F030% Starting Voltage". The colon and arrow on the LCD will flash, indicating that parameters can be modified.

Notes:① The colon ":" indicates that the Up ∧ and Down ∨ keys can be used to scroll through parameter values.
② A flashing arrow " → " indicates that the parameter can be edited.

When the arrow is flashing, press the Confirm key. If data has been modified, " GOOD Data Write Successful" will be displayed, accompanied by two "beep" sounds, indicating the new data has been saved, then exit. If you do not want to save the new data, press the Set key — the arrow will stop flashing and the original data will be restored — then press Confirm to exit, or press Stop to exit directly.

d) Confirm Key:In the setting state, if data has been modified, press the Confirm key to save the data and exit the setting state.In the non-setting state, press Confirm to enter the help menu (see page 9 for help information), then press Confirm again to exit.
Note: Press and hold the Confirm key while powering on to restore the factory default parameters.

e) ∧ / ∨ Keys:
In the setting menu, you can view the F0-F1 setting values. When the arrow is flashing, press the ∧ or ∨ keys to change the parameter value. Press and hold either key for more than 1 second to increase or decrease the parameter value rapidly and continuously. In the help menu, press the ∧ or ∨ keys to change the function code and the corresponding prompt information.

A beep will sound when a key operation is valid; otherwise, the key is inactive in the current state.When the soft starter starts successfully and runs in bypass mode, the LCD will display "Running State Motor Current: 55.0A".

3. Function Parameter Settings and Descriptions (As shown in the table below):

| Setting Code Descriptions | | | | |
|---|---|---|---|---|
| Code | Name | Setting Range | Factory Default | Description |
| F0 | Starting Voltage | 30-80% | 40% | Voltage ramp mode is active; starting voltage is 40% in current mode. |
| F1 | Soft Start Time | 2-60s | 16s | Current limiting mode is inactive. |
| F2 | Soft Stop Time | 0-60s | 0s | Free stop when set to 0; set to 0 for one-to-two wiring configuration. |
| F3 | Start Interval Delay | 0-999s | 0s | Delays in countdown direction; no delay and starts immediately when set to 0. |
| F4 | Programming Delay | 0-999s | 0s | Used for programmable relay output. |
| F5 | Starting Current Limit | 50-500% | 400% | Current limit mode is active; maximum current limit in voltage ramp mode is 400%. |
| F6 | Maximum Operating Current | 50-200% | 100% | Motor rated current × (setting value) triggers inverse time overload protection. |
| F7 | Undervoltage Protection | 40-90% | 70% | Triggers protection when voltage is below the setting. |
| F8 | Overvoltage Protection | 100-140% | 120% | Triggers protection when voltage is above the setting. |
| F9 | Start Mode | 0-5 | 1 | 0: Current Limit; 1: Voltage Ramp; 2: Jump Start + Current Limit; 3: Jump Start + Voltage; 4: Current Ramp ; 5: Dual Closed Loop; 6: Monitoring |
| FA | Output Protection Enable | 0-4 | 2 | 0: Primary; 1: Light Load; 2: Standard; 3: Heavy Load; 4 : Advanced |
| FB | Operation Control Mode | 0-6 | 4 | Disables external start/stop control via keypad when set to 6; see page 8 for details. |
| FC | Parameter Modification Enable | 0-2 | 1 | See page 9 for details. |
| FD | Communication Address | 0-64 | 0 | Used for multi-machine communication between multiple soft starters and the host computer. |
| FE | Programmable Output | 0-19 | 6 | See page 8 for details. |
| FF | Soft Stop Current Limit | 20-100% | 80% | See page 16 for details. |
| FP | Motor Rated Current | | Rated Value | Used to input the motor's nominal rated current. |
| FU | Bypass Delay | 1-40S | 3 | When the motor reaches rated current during start-up, it delays for the time set in FU before switching to power frequency operation. |
| FL | Phase Loss Protection | 0-3 | 3 | 0: Unbalance & Loss (Correlated); 01: Unbalance & Loss (Uncorrelated);<br>02: Unbalance & Open Phase (Correlated); 03: Unbalance & Open Phase (Uncorrelated) |

Remarks：1.F6 refers to the maximum sustainable operating current calculated based on the value set in FP. Exceeding this value will trigger inverse-time thermal protection.
2. If no key operation is performed for more than 2 minutes in the setting state, it will automatically exit the setting mode.
3. Parameters cannot be modified during soft start or soft stop, but can be modified in other states.
4. Pressing and holding the Confirm key to power on the motor will restore all parameters to factory defaults.





4. Programmable Relay Output Function

a) The programmable relay output function has two operating modes: Programmable Timing Output Mode and Programmable Status Output Mode.

b) When the setting item FE is set to 0～4 (10～14), the programmable output operates in Timing Output Mode. The start timing of the output is shown in the table below:

| Value of FE Setting | 0 (10) | 1 (11) | 2 (12) | 3 (13) | 4 (14) |
|---|---|---|---|---|---|
| Programmable Output Timing | Reserved | At Start | During Bypass Operation | When Stop Command is Issued | After Stop Completion |

c) This operating mode includes a 999-second timer, set by the parameter F4. If F4 ≠ 0, timing starts at the moment set by FE, and the output state changes when the timer expires. If F4 = 0, the output state changes immediately. The output resets after the delay time set by F4 has expired and the unit remains in the ready state for an additional 1 second.

d) The Programmable Timing Output Mode uses one start cycle as the control period. If the motor is started again, the previous programmed output will be automatically interrupted and the process will restart.

e) When the setting item FE is set to 5～9 (15～19), the programmable output operates in Status Output Mode. The set operating state outputs are shown in the following table:

| Value of FE Setting | 5 (15) | 6 (16) | 7 (17) | 8 (18) | 9 (19) |
|---|---|---|---|---|---|
| Programmable Output Timing | Reserved | At Start | During Bypass Operation | When Stop Command is Issued | After Stop Completion |

f)The Programmable Status Output Mode is used to indicate the operating status of the soft starter. In this mode, the time set by parameter F4 is invalid. The factory default value of FE is 6, which indicates the running status of the soft starter. The running status refers to the non-ready state, which includes three processes: start, bypass, and soft stop.

g)When FE > 9, the reset state of the programmable output (external terminals ③ and ④) changes from Normally Open (NO) to Normally Closed (NC), i.e., inverted output. Flexible use of the programmable relay output function can effectively simplify the peripheral control logic circuit.

5. Other Parameter Settings

a)Parameter FB is used to select the motor start control mode, as shown in the table below:

| Control Mode \ Value | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|---|
| Keypad | 1 | 1 | 0 | 0 | 1 | 1 | 0 |
| External Control | 0 | 1 | 1 | 1 | 1 | 0 | 0 |
| Communication | 0 | 0 | 0 | 1 | 1 | 1 | 1 |

b)In the table, 1 = Enabled and 0 = Disabled. For example: when an unexpected stop after starting, or an unexpected start during maintenance, is not allowed.

c)When External Control is enabled, a normally closed (NC) pushbutton switch must be connected between external control terminals ⑧ and ⑩, or the terminals must be shorted. Otherwise, the motor cannot be started.

d)Parameter FC is the Parameter Modification Enable option, with three choices:

① When FC is set to 0: Modification of all parameters is prohibited, except for FC itself.

② When FC is set to 1: Modification of parameters F4, F6, FD, FE, FF, FU, and FL is prohibited.

③ When FC is set to 2: Modification of all parameters is allowed.

6. Help Information and Instructions

a) The help information prompts are shown in the following table:

| Display | Description |
|---|---|
| AC:038OV<br>Power Voltage | 4-digit digital voltmeter for monitoring three-phase AC power voltage. |
| 060A-380V<br>Soft Starter Specification | Indicates the soft starter specification is 60A 380V. |
| H1:Error 04<br>Input Phase Loss Fault | Indicates the most recent fault was an output phase loss. |
| H2:Error 06<br>Three-Phase Unbalance | Indicates a previous fault was three-phase unbalance. |
| H3:Error 09<br>Power Overvoltage | Indicates a previous fault was power overvoltage. |
| H4<br>⋮<br>H9 | H4<br>⋮<br>H9 |
| H1:Error 00<br>Fault Cleared | Indicates no active fault information. |
| Ver 4.3<br>Software Version | Indicates the product software version is VER4.3. |
| L0003<br>Start Count | Total count of successful starts. |
| T-run 40s<br>Last Soft Start Time | Time taken for the last successful start (in seconds). |
| Note: H1-H9 store the 9 most recent faults on a rolling basis. | |

b)When the soft starter is not in soft start/soft stop mode and not in setting mode, press the Confirm key to enter the help menu. Then use the ∧ and ∨ keys to select the prompt information.

c)While in help mode, press the Confirm key or Stop key to exit help mode.





# VI.Protection Function Description

The XLR5000 series soft starter is equipped with comprehensive protection functions to ensure the safe operation of both the soft starter and the motor. During use, the protection level and parameters should be set according to different working conditions.

1. Protection Functions and Parameters

a) SCR Protection: Excessively long or frequent starting will cause overheating of the SCR. The protection will activate when the temperature rises to 80℃±5℃, and the overheat protection will reset when the temperature drops to 55℃ (minimum).

b) Input Phase Loss Protection Delay Time: <3 seconds.

c) Output Phase Loss Protection Delay Time: <3 seconds.

d) Overlong Starting Time Protection: When the starting current is ⩾ the F5 set value and fails to reach the rated current within 60 seconds, the product will trigger protection.

e) Running Overload Protection Time: Anti-thermal protection is based on the maximum operating current set in F6. The trip protection time curve is shown in Figure 9.

f) Undervoltage Protection Delay Time:
1) When the power supply voltage is lower than 40% of the limit value, the protection activation time is <0.5 seconds.
Otherwise, when the voltage is lower than the set value, the protection activation time is <3 seconds.

g) Overvoltage Protection Delay Time:
1) When the power supply voltage is higher than 140% of the limit value, the protection activation time is <0.5 seconds.
Otherwise, when the voltage is higher than the set value, the protection activation time is <3 seconds.

h) Load Short-Circuit Protection Delay Time:
<0.1 seconds, When the current exceeds 10 times the nominal rated current of the soft starter. This protection cannot replace fuse-type short-circuit protection devices.

i)The above time parameters are measured from the detection of a valid signal to the issuance of a trip protection command, and are for reference only. All protection functions listed for the XLR5000 series soft starter can be verified through actual or simulated methods.

2. Protection Level Description

a) To adapt to different application scenarios, the XLR5000 series soft starter is equipped with five protection levels:
0: Primary, 1: Light Load, 2: Standard, 3: Heavy Load, 4: Advanced. These levels are configured via setting parameter FA.
Among them:

① Primary Protection (Level 0) disables the external emergency stop terminal function and only retains overheat, short-circuit, and main circuit fault protection. It is suitable for scenarios requiring unconditional emergency starting, such as fire protection systems.

② The Light Load, Standard, and Heavy Load protection levels provide full protection functions, with the only difference being the motor overload thermal protection time curves. The motor thermal protection time parameters are shown in the table below and Figure 9.

③ The Advanced protection level features stricter protection criteria during startup, while other protection function parameters are identical to those of the Standard protection setting.

b) The different protection levels and thermal protection times configured via setting parameter FA are shown in the table below:

| FA Setting | 0 (Primary) | 1 (Light Load) | | | 2 (Standard) | | | 3 (Heavy Load) | | | 4 (Advanced) | | | Description |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Overload Protection Level | None | Level 2 | | | Level 10 | | | Level 20 | | | Level 10 | | | Complies with IEC60947-4-2 standard |
| Overload Protection Time | None | 3s | | | 15s | | | 30s | | | 15s | | | Calculated when starting current exceeds 5 times the F6 setting |
| | | | | | | | | | | | | | | |
| Overload Trip Time List | Current Multiple (I/Ie) | 3 | 4 | 5 | 3 | 4 | 5 | 3 | 4 | 5 | 3 | 4 | 5 | Values in the table are typical values |
| | Trip Time (seconds) | 4.5 | 2.3 | 1.5 | 23 | 12 | 7.5 | 46 | 23 | 15 | 23 | 12 | 7.5 | |

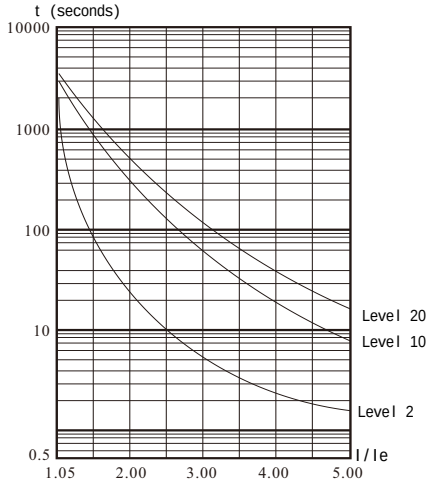
c) The value of setting parameter FP shall be entered based on the rated current indicated on the motor nameplate. Otherwise, if the input mode of setting parameters F5 and F6 is percentage-based, there will be significant deviations in the starting current and protection current.

d) The motor current set by parameter FP shall not be less than 20% of the soft starter's nominal current. When the motor current set by FP is relatively small, the sensitivity error of the protection tripping action will increase.

e) The motor thermal protection tripping time curve in accordance with the IEC60947-4-2 standard is shown in Figure 9 below:








Motor Thermal Protection Trip Time Curve (Hot State)

Figure 9

# VII.Power-On Operation and Application

Before power-on operation, carefully inspect the following items:
① Verify that the rated power of the soft starter matches that of the motor.
② Check that the motor insulation performance meets the requirements.
③ Ensure the input and output main circuit wiring is correct.
④ Confirm that all terminal screws are securely tightened.

1. Power-On Test Run

a) When powered on, the display shows "Ready C-Lin Electrical". Press the Start key to start the motor at this time.

b) Enter the rated current value from the motor nameplate into setting parameter FP.

c) After starting, check that the motor rotation direction is correct and operation is normal. If abnormal, press the Stop key to shut down the motor or cut off the power supply if necessary.

d) If the motor starting performance is unsatisfactory, refer to Soft Starter Starting Modes and Applications on page 14 to select an appropriate starting mode.

e) If the motor starting torque is insufficient, adjust the starting voltage (voltage mode) or current limit value (current mode) to increase the motor starting torque.

f) After the soft starter is powered on, do not open the top cover to avoid electric shock.
g) During the power-on test run, if any abnormal phenomena (such as unusual noise, smoke, or peculiar smell) are observed, cut off the power supply immediately and identify the root cause.
h) If a fault "ErrOR XX" is displayed after power-on or during starting, refer to the Fault Table on page 13 according to the displayed fault code to find the cause.
i) Press the Stop key or external stop button to reset the fault state to the ready state.
j) Note: When the ambient temperature is below -10℃, preheat the soft starter by applying power for more than 30 minutes before starting.
k) Fault codes and troubleshooting methods are shown in the table below:

| Display | Description | Issue and Troubleshooting |
|---|---|---|
| Err00 | Fault Cleared | Faults such as undervoltage, overvoltage, overheating, or emergency stop terminal open circuit have just occurred and are now resolved. The ready indicator is on, and the motor can be started after reset. |
| Err01 | External Emergency Stop Terminal Open Circuit | Short the external emergency stop terminal ⑦ to common terminal ⑩, or connect it to the normally closed contact of another protection device. |
| Err02 | Soft Starter Overheating | Excessively frequent starting or mismatch between motor power and soft starter rating. |
| Err03 | Starting Time Exceeds 60 Seconds | Inappropriate starting parameter settings, excessive load, or insufficient power supply capacity. |
| Err04 | Input Phase Loss | Check for input/main circuit faults, bypass contactor stuck in closed position, or SCR open circuit. |
| Err05 | Output Phase Loss | Check for output/main circuit faults, bypass contactor stuck in closed position, or SCR short circuit. |
| Err06 | Reserved | |
| Err07 | Starting Overcurrent | Check for excessive load or mismatch between motor power and soft starter rating. |
| Err08 | Running Overload Protection | Check for excessive load or incorrect settings of parameters F6 and FP. |
| Err09 | Power Undervoltage | Check input power voltage or incorrect setting of parameter F7. |
| Err10 | Power Overvoltage | Check input power voltage or incorrect setting of parameter F8. |
| Err11 | Setting Parameter Error | Modify the settings or restore factory defaults by powering on while pressing the Confirm key. |
| Err12 | Load Short Circuit | Check for load/SCR short circuit or excessive load. |
| Err13 | Auto-Restart Wiring Error | Check if the external start/stop terminals are not wired in 2-wire mode. |





| Display | Description | Issue and Troubleshooting |
|---|---|---|
| Note: Some fault phenomena are interrelated. For example, a reported "Error 02 (Soft Starter Overheating)" may be associated with starting overcurrent or load short circuit. Therefore, when troubleshooting, a comprehensive analysis should be conducted to accurately identify the fault point. | | |

Caution: After the soft starter starts normally and displays the Running state, it indicates the unit is in bypass operation. If the bypass contactor fails to close and causes the motor to stop, inspect the bypass contactor and related wiring for errors or poor contact.

# VIII.Soft Starter Starting Modes and Applications

The soft starter offers six starting modes to accommodate various complex motor and load conditions, allowing users to select the appropriate mode based on specific application requirements.

1. Current-Limit Starting Mode
a) The current-limit starting mode is activated when setting parameter F9 is set to 0.
b) Figure 10 illustrates the motor current waveform in current-limit starting mode, where I1 is the set starting current limit. When the motor starts, the output voltage increases rapidly until the motor current reaches the set limit I1 and is held at or below this value. The motor then accelerates as the output voltage rises gradually. When the motor reaches rated speed, the bypass contactor closes, and the output current drops rapidly to the motor's rated current Ie or below, completing the starting process.
c) It is normal for the maximum starting current to not reach the set limit if the motor load is light or the set current limit is relatively high.
d) The current-limit starting mode is generally used in scenarios where strict starting current limitations are required.

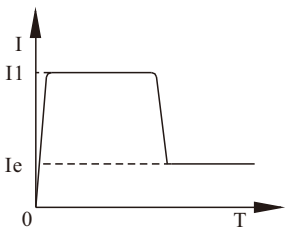


Figure 10

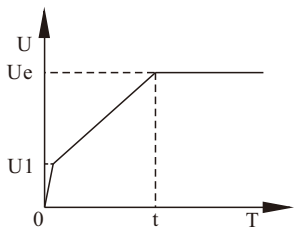


Figure 11

2. Voltage Ramp Starting Mode
a) The voltage ramp starting mode is activated when setting parameter F9 is set to 1.
b) Figure 11 shows the output voltage waveform of this mode, where U1 is the initial starting voltage. When the motor starts, the soft starter's output voltage rises rapidly, ensuring the motor current does not exceed 400% of its rated value. The motor accelerates smoothly as the voltage increases. When the voltage reaches the rated voltage Ue, the motor achieves rated speed, the bypass contactor closes, and the starting process is complete.
c) The starting time t is a control parameter derived from standard test conditions with a standard load. The XLR5000 series soft starter uses this parameter as a reference to control the output voltage for smooth acceleration, rather than rigidly enforcing the time t regardless of motor stability. Thus, it is normal for the actual starting time to be shorter than the set value when the load is light, as long as the motor starts successfully.
d) Generally, the voltage ramp starting mode is suitable for scenarios where strict starting current limits are not required, but high starting smoothness is a priority.

3. Jump Starting Mode
a) The jump starting mode is activated when setting parameter F9 is set to 2 or 3.
b) Figures 12 and 13 show the output waveform of this mode. It is used in heavy-load applications where the motor cannot start due to high mechanical static friction. At startup, a high fixed voltage is applied to the motor for a short period to overcome static friction and initiate rotation, followed by current-limit (Figure 12) or voltage ramp (Figure 13) starting.
c) Before using this mode, first attempt to start the motor in a non-jump mode. Only select this mode if the motor fails to rotate due to excessive static friction; otherwise, avoid it to reduce unnecessary high-current shocks.

4. Current Ramp Starting Mode
a) The current ramp starting mode is activated when setting parameter F9 is set to 4.
b) Figure 14 shows the output current waveform of the current ramp starting mode, where I1 is the current limit value set by F6, and T1 is the time value set by F1.
c) The current ramp starting mode offers strong acceleration capability, making it suitable for two-pole motors and capable of shortening the starting time within a certain range.





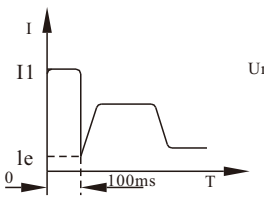



Figure 12

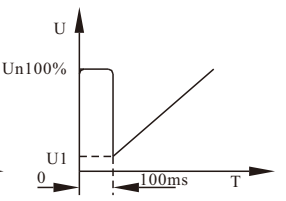



Figure 13

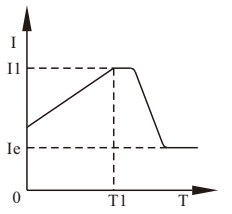



Figure 14

5. Voltage-Limited Current Double Closed-Loop Starting Mode
a) The voltage-limited current double closed-loop starting mode is activated when setting parameter F9 is set to 5.
b) This mode uses voltage ramp and current-limiting double closed-loop control, combining the requirements for smooth starting and strict current limitation. It employs a prediction algorithm to estimate the motor's operating state.
c) The output voltage waveform of this starting mode varies according to the motor and load conditions.

6. Monitor Starting Mode
a) The monitor starting mode is activated when setting parameter F9 is set to 6.
b) This mode directly starts the motor: when the start key is pressed, the bypass contactor closes immediately, and the motor operates at line frequency. (This mode is designed to facilitate debugging and cabinet testing with a 1.5kW motor.)
**Caution: Do not use this mode for actual on-site loads.**

# IX. Soft Starter Stop Modes and Applications

The soft starter provides two stop modes: soft stop mode and free stop mode.
1. Soft Stop Mode (See Figure 15)
a) The soft stop mode is activated when setting parameter F2 is set to a non-zero value.
b) In this mode, the motor's power supply is switched from the bypass contactor to the soft starter's SCR output. The output voltage decreases gradually from full voltage, allowing the motor speed to drop smoothly and avoid mechanical shock until the motor stops. The output cut-off voltage during soft stop is equal to the initial starting voltage.
c) The soft stop mode can reduce and eliminate water hammer in pump-type loads.
d) The soft stop current limit can be set via parameter FP to reduce high-current shocks during stopping. Note that this soft current limit is a percentage calculated based on the starting current limit value.

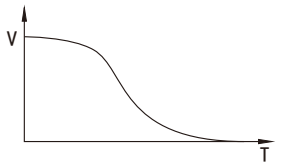



Figure 15

2. Free Stop Mode:

a) Free stop mode is activated when setting item F2 is set to 0.

b) In this stop mode, upon receiving a stop command, the soft starter immediately disconnects the bypass contactor and disables the voltage output of the soft starter's thyristors. The motor then decelerates to a stop due to load inertia. For one-to-two (multi-motor) wiring configurations, this stop mode must be selected to prevent phase loss fault reports during output switching.

c) In most cases, free stop mode is recommended when soft stopping is not required, as it helps extend the service life of the soft starter.

d) Free stop mode completely disables instantaneous output, which prevents large transient current surges in special applications.

3. Special Applications

a) Starting of Parallel Motors:

Motors can be connected in parallel if the total rated power does not exceed the soft starter's power limit (the sum of the motor currents must not exceed the rated current of the soft starter selected based on the application type). However, separate thermal protection devices must be provided for each motor.

b) Starting of Two-Speed Motors:

The soft starter can be used with two-speed motors. A demagnetization delay period must be observed before switching from low speed to high speed, to avoid extremely large reverse-phase currents between the circuit and the motor.

c) Long Cables:

The resistance of long cables between the supply line and the motor will cause a voltage drop. If the voltage drop is significant, it will affect current consumption and starting torque, which must be taken into account when selecting the motor and soft starter.

d) Soft Starters Connected in Parallel on the Same Power Line:

If multiple soft starters are installed on the same power line, input line reactors must be installed between the transformer and the soft starters. The reactors should be placed between each incoming line circuit breaker and the soft starter.





e) Use of Surge Protectors:

Surge protectors should be installed in locations where lightning strikes or other factors may cause overvoltage, overcurrent, or surge interference in the application system. For detailed application methods, please refer to C-Lin's Surge Protector product manual or other relevant documents.

# X. Application Examples

1.Parameter setting examples for different load conditions are shown in the table below. The data is for reference only and should be adjusted according to actual operating conditions.

| Load Type | Starting Time (s) | Initial Voltage (Ue) | Maximum Starting (Max Current Limit Ie) | Current-Limited Starting (Ue) |
|---|---|---|---|---|
| Ball Mill | 30 | 60% | 4x | 4.5x |
| Fan | 26 | 30% | 4x | 3.5x |
| Centrifugal Pump | 16 | 40% | 4x | 2.5x |
| Reciprocating Compressor | 16 | 40% | 4x | 3x |
| Hoist | 16 | 60% | 4x | 3.5x |
| Mixer | 16 | 50% | 4x | 3x |
| Crusher | 16 | 50% | 4x | 3.5x |
| Screw Compressor | 16 | 40% | 4x | 3x |
| Screw Conveyor | 20 | 40% | 4x | 2x |
| Light-Load Motor | 16 | 30% | 4x | 3x |
| Belt Conveyor | 20 | 40% | 4x | 2.5x |
| Heat Pump | 16 | 40% | 4x | 3x |

# XI.Communication Protocol

1. Overview of Modbus RTU Communication Protocol

Modbus is a serial asynchronous communication protocol with a physical interface of RS485. It was originally designed for Modicon PLCs and features the structural characteristics of PLCs. In network control, the XLR5000 soft starter can be treated as a PLC for read/write operations. The XLR5000 maps start/stop control, status information (current, faults, etc.), and functional parameters to the holding register area (4XXX). When in use, it communicates via the P1 master...

The slave station allows read/write control from the master station.
a) Communication Parameters
Baud rate: 9600; 8 data bits; No parity; 1 stop bit.
b) Communication Data Format

Data Format：

| Address Code | Function Code | Data Area | CRC Check |
|---|---|---|---|
| 1 Byte | 1 Byte | N Bytes | 2 Bytes |

2. Soft Starter Related Settings

a) Register Addresses

| Register Address | Operation Code | Register Function Description |
|---|---|---|
| 40001 | 06 | Control Word |
| 40002 | 03 | Status Word |
| 40003 | 03 | Current Average Value × 10 |
| 40004 | 03 | Fault Code |
| 40256-40274 | 03&06 | Soft Starter Function Code |

(1) The registers listed above are illegal and cannot be read or written. If accessed, the slave station will report an exception code to the controller.
(2) All data addresses are referenced to 40000. For example:
The address of coil relay 40001 is 0001
The address of 40256 is 0100 (hexadecimal)

b) Supported Codes
The soft starter only supports the specified codes. Using any other code will result in an exception code 01 being returned.

| Code | 03 | 06 |
|---|---|---|
| Function Description | Read Register | Write Single Register |

Code 03 only reads in single-word (WORD) format.

c) Register Description

● 40001 Command Register

| Bit | Value | Description |
|---|---|---|
| 0 | 1 | Starter Start |
| | 0 | Hold State |





| Bit | Value | Description |
|---|---|---|
| 1 | 1 | Starter Stop |
| | 0 | Hold State |
| 2 | 0-1 | Reset the Starter |
| 3-15 | 0 | Unused |

Example:
To start the soft starter at slave address 02, send the command 02 06 00 01 00 01. If the command executes successfully, the return code is 02 06 00 01 00 01. To stop the starter, send 02 06 00 01 00 02 — the return code will be 02 06 00 01 00 02.
Whether the soft starter can restart normally depends on the status register. If a fault exists, send the reset command 02 06 00 01 00 04.

●Status Register (Register Address 40002)

The status register reflects the state of the soft starter and is represented by one 16-bit word.

| Bit | Value | Description |
|---|---|---|
| 0 | 1 | Starting state |
| | 0 | Stopping state |
| 1 | 1 | Running state |
| | 0 | Stopping state |
| 2 | 1 | Soft stop state |
| | 0 | Stopping state |
| 3 | 1 | Fault state |
| | 0 | Normal state |
| 4-15 | | Unused |

Example: Reading the status register
Command code: 02 03 00 02 00 01
If the starter is in the starting process, it returns: 02 03 02 00 01
If the starter has a fault, it returns: 02 03 02 00 08
(The fault type can be determined by checking the value of Bit 4.)

● 40003 Current average value (Hexadecimal)
This value represents the average of the motor's three-phase actual current × 10 (including one decimal place).
Example: Reading the current value
Send command: 02 03 00 02 00 01
If the actual current is 235A, it returns: 02 03 02 09 2E
(Actual current = Returned value ÷ 10)

● 40004 Fault Code (Hexadecimal)
When Bit 3 of the status register 40002 is 1, it indicates the soft starter is in a fault state. The fault codes are consistent with those listed in the Fault Code Table (Page 13).
Example:
Send command code: 02 03 00 04 00 01
If it returns 02 03 02 00 04, this indicates an input phase loss (Fault Code 04).

● Function Parameter Registers 40XXX of the Soft Starter
Registers 40256 – 40274 are function registers, corresponding to addresses 0X0100 – 0X0112.
The high-byte address is 01
The low-byte address is 0X00 – 0X12
These map to function codes F0 – FL, which are consistent with the Function Code Table (Page 7).
For example, address 0X109 corresponds to Function Code F9 (Starting Mode).
These codes support read/write operations. Examples of usage are provided below:
Example 1: Read the value of Function Code F5 (Current Limit Value)
Send command: 02 03 01 05 00 01
The returned value 02 03 02 01 5E for Function Code F5 indicates a current limit of 35%.
Example 2: Read the value of Function Code FA (Protection Level)
Send command: 02 03 01 0A 00 01
The returned value 02 03 02 00 03 for Function Code FA indicates a protection level of 3.
Example 3: Rewrite Function Code F5 (Starting Current) to 250%
The host sends command: 02 06 01 05 00 FA
The soft starter returns: 02 06 01 05 00 FA
If it returns 02 86 03, writing is not allowed (this usually occurs because the starter is running).

## 3. Exception Responses

| Code | Name | Description |
|---|---|---|
| 01 | Illegal Function | The function code cannot be executed; not supported by the soft starter. |
| 02 | Illegal Data Address | The received data address cannot be executed; address overflow has occurred. |
| 03 | Illegal Data Value | The received data cannot be executed. |
| | | 1. Parameter exceeds the allowable range |
| | | 2. Parameter cannot be modified |
| | | 3.Parameters cannot be modified during operation |

a) Illegal Function Code 01
Master Station Query Message Format:





| Slave Address | Function Code | Starting Address High Byte | Starting Address Low Byte | Register Count High Byte | Register Count Low Byte | CRC Check |
|---|---|---|---|---|---|---|
| 0x01 | 0x08 | 0x00 | 0x80 | 0x00 | 0x0D | |

This protocol does not use the 0x08 function code, so the slave returns an exception response:

| Slave Address | Function Code | Exception Code | CRC Check |
|---|---|---|---|
| 0x01 | 0x88 | 0x01 | |

b) Illegal Function Code 02

Master Station Query Message Format

| Slave Address | Function Code | Starting Address High Byte | Starting Address Low Byte | Register Count High Byte | Register Count Low Byte | CRC Check |
|---|---|---|---|---|---|---|
| 0x01 | 0x04 | 0x01 | 0x80 | 0x00 | 0x07 | |

The register address for function code 0x04 is invalid, so the slave responds:

| Slave Address | Function Code | Exception Code | CRC Check |
|---|---|---|---|
| 0x01 | 0x84 | 0x02 | |

c) Illegal Data Value (Exception Code 03)
Master Station Query Message Format

| Slave Address | Function Code | Starting Address High Byte | Starting Address Low Byte | Register Count High Byte | Register Count Low Byte | CRC Check |
|---|---|---|---|---|---|---|
| 0x01 | 0x04 | 0x00 | 0x80 | 0x01 | 0x80 | |

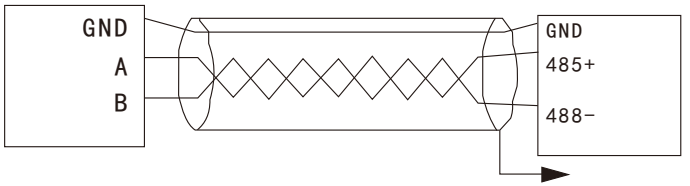
The register count for function code 0x04 is invalid, so the slave responds:

| Slave Address | Function Code | Exception Code | CRC Check |
|---|---|---|---|
| 0x01 | 0x84 | 0x03 | |

## 4.Usage Precautions

a) The communication address, baud rate, and parity mode of the soft starter must be consistent with the communication settings of the controller.
b) If no response data is received, check the above parameter settings, the correctness of the wiring to the 485 terminals, and the validity of the CRC check.
c) When multiple TGS5 units are communicating, a 120Ω resistor should be connected across terminals A and B of the last unit in the communication chain.

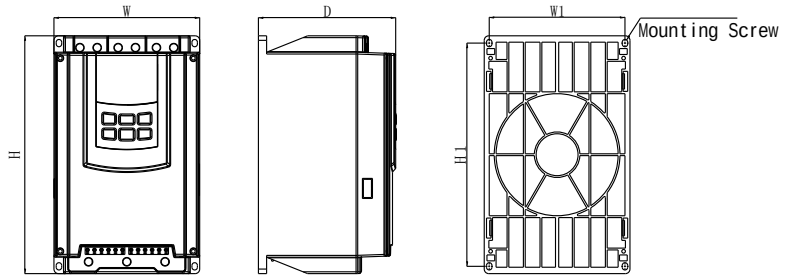
d) When connecting to other Modbus devices, follow the diagram below:




Shield connected to enclosure

# XII. Installation and Dimensions

The external appearance and installation dimensions of the XLR5000 series 5.5kW－55kW soft starters are shown in the table below. The factory standard configuration is six inputs and three outputs.




| Model | Rated Power (kW) | Rated Current (A) | External Dimension | | | Installation Dimensions | | | Net Weight (kg) |
|---|---|---|---|---|---|---|---|---|---|
| | | | H | W | D | H1 | W1 | d | |
| XLR5000-4005Z | 5.5 | 11 | 261 | 160 | 153 | 245 | 149 | M5 | ＜3.8 |
| XLR5000-4007Z | 7.5 | 15 | 261 | 160 | 153 | 245 | 149 | M5 | ＜3.8 |
| XLR5000-4011Z | 11 | 23 | 261 | 160 | 153 | 245 | 149 | M5 | ＜3.8 |
| XLR5000-4015Z | 15 | 30 | 261 | 160 | 153 | 245 | 149 | M5 | ＜3.8 |
| XLR5000-4018Z | 18.5 | 37 | 261 | 160 | 153 | 245 | 149 | M5 | ＜3.8 |
| XLR5000-4022Z | 22 | 45 | 261 | 160 | 153 | 245 | 149 | M5 | ＜3.8 |
| XLR5000-4030Z | 30 | 60 | 261 | 160 | 153 | 245 | 149 | M5 | ＜3.8 |
| XLR5000-4037Z | 37 | 75 | 261 | 160 | 153 | 245 | 149 | M5 | ＜5.0 |
| XLR5000-4045Z | 45 | 90 | 261 | 160 | 153 | 245 | 149 | M5 | ＜5.0 |
| XLR5000-4055Z | 55 | 110 | 261 | 160 | 153 | 245 | 149 | M5 | ＜5.0 |

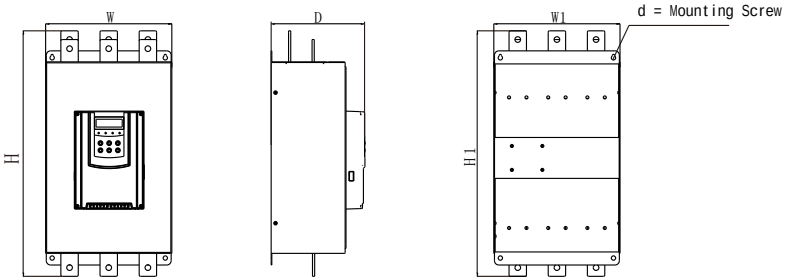




Note：Rated power and rated current refer to the maximum rated values of the soft starter. In general, the corresponding parameters of the motor being matched shall not exceed these values.

2. Installation and Dimensions

The external appearance and installation dimensions of the XLR5000 series 75kW－500kW soft starters are shown in the table below. The factory standard configuration is six inputs and three outputs.




| Model | Rated Power (kW) | Rated Current (A) | External Dimension | | | Installation Dimensions | | | Net Weight (kg) |
|---|---|---|---|---|---|---|---|---|---|
| | | | H | W | D | H1 | W1 | d | |
| XLR5000-4075Z | 75 | 150 | 363 | 210 | 185 | 298 | 156 | M8 | ＜10 |
| XLR5000-4090Z | 90 | 180 | 530 | 260 | 210 | 380 | 196 | M8 | ＜22 |
| XLR5000-4115Z | 115 | 230 | 530 | 260 | 210 | 380 | 196 | M8 | ＜22 |
| XLR5000-4132Z | 132 | 260 | 530 | 260 | 210 | 380 | 196 | M8 | ＜22 |
| XLR5000-4160Z | 160 | 320 | 530 | 260 | 210 | 380 | 196 | M8 | ＜22 |
| XLR5000-4185Z | 185 | 370 | 530 | 260 | 210 | 380 | 196 | M8 | ＜22 |
| XLR5000-4200Z | 200 | 400 | 530 | 260 | 210 | 380 | 196 | M8 | ＜22 |
| XLR5000-4250Z | 250 | 500 | 564 | 290 | 214 | 460 | 260 | M8 | ＜32 |
| XLR5000-4280Z | 280 | 560 | 564 | 290 | 214 | 460 | 260 | M8 | ＜32 |
| XLR5000-4320Z | 320 | 630 | 564 | 290 | 214 | 460 | 260 | M8 | ＜32 |
| XLR5000-4400Z | 400 | 800 | 594 | 330 | 217 | 500 | 300 | M8 | ＜36 |
| XLR5000-4450Z | 450 | 900 | 594 | 330 | 217 | 500 | 300 | M8 | ＜36 |
| XLR5000-4500Z | 500 | 998 | 664 | 411 | 214 | 550 | 370 | M8 | ＜45 |

# XIII.Precautions

1.Electric Shock Prevention

When the input terminals of the soft starter are powered on, if the load is open-circuited or phase-loss occurs, the output terminals will still carry a relatively high induced voltage even in the stopped state. Do not touch the output terminals of the soft starter, otherwise there is a risk of electric shock.

2.Induced Voltage

The induced voltage at the output terminals of the soft starter is a normal phenomenon and does not affect operation. It is generated by the leakage current of thyristors (solid-state semiconductor devices such as thyristors, GTRs, and IGBTs all have varying degrees of leakage) and the AC path of the dv/dt RC filter circuit. When measured against ground with a voltmeter, it is approximately 100~220V (related to the internal resistance of the voltmeter). This induced voltage has very low load capacity and will disappear once a load is connected to the output.

3.Compensation Capacitors

Reactive power compensation capacitors used to improve power factor must be connected to the input terminals of the soft starter, and must not be connected to the output terminals. Otherwise, the thyristor power devices in the soft starter will be damaged.

4.Megohmmeter

Do not use a megohmmeter to measure the insulation resistance between the input and output of the soft starter, otherwise the thyristors and control board of the soft starter may be damaged due to overvoltage.

5.Input and Output

Do not reverse the input and output terminals of the main circuit of the XLR soft starter, otherwise both the soft starter and the motor will be damaged.

6.Bypass Phase Sequence

When using the bypass contactor, the phase sequence of the starting circuit must be consistent with that of the bypass circuit. Otherwise, an interphase short circuit will occur during bypass switching, causing the air circuit breaker to trip or even damage the equipment.

7.Low Voltage Level

Terminals 7, 8, 9, 10, 11, and 12 operate on the internal working voltage. Do not connect any external power sources to these terminals, otherwise the internal circuit of the soft starter will be damaged.

# XIV. Daily Maintenance of the Soft Starter

1. Dust

Excessive dust will reduce the insulation level of the soft starter and may cause it to malfunction, leading to the following issues:

Primary circuit: Tracking and arcing, which endangers the equipment

Secondary circuit: Leakage and short circuits, resulting in control failure





The thermal resistance of the heat sink increases, leading to a rise in thyristor temperature.

Treatment methods:

Gently brush away dust with a clean, dry brush

Blow away dust with compressed air

2. Condensation

If condensation occurs, it will reduce the insulation level of the soft starter and may cause it to malfunction, leading to the following issues:

Primary circuit: Tracking and arcing, which endangers the equipment

Secondary circuit: Leakage and short circuits, resulting in control failure

Accelerated corrosion of metal components

Treatment methods:

Dry with a hair dryer

Dehumidify the electrical distribution room

# XV. Ordering Instructions

1.When selecting a soft starter, please specify the model specification, quantity, power supply voltage, and structure type (unit type or integrated type).

2.Example: XLR5000-4075-3 × 5 units indicates:

Model: XLR5000

Rated power: 75kW

Structure type: Unit type

Power supply voltage: AC 380V

Quantity: 5 units

# XVI. Appendix

Specification parameter list of peripheral accessories for XLR5000 series soft starters (5.5kW～55kW) (for reference):

| Soft Starter Model | Rated Power (kW) | Rated Current (A) | Matching Circuit Breaker Model (QF) | Matching Bypass Contactor Model (KM) | Matching Fuse Model (FU) | Primary Cable Specification (Cable) |
|---|---|---|---|---|---|---|
| XLR5000-405.5Z | 5.5 | 11 | CM1-63L/16 | CJ20-16 | RT16-0/12A | 2.5mm² |
| XLR5000-407.5Z | 7.5 | 15 | CM1-63L/25 | CJ20-16 | RT16-0/16A | 4mm² |
| XLR5000-4011Z | 11 | 23 | CM1-63L/32 | CJ20-25 | RT16-0/25A | 6mm² |
| XLR5000-4015Z | 15 | 30 | CM1-63L/40 | CJ20-40 | RT16-0/32A | 10mm² |
| XLR5000-4018Z | 18.5 | 37 | CM1-63L/50 | CJ20-40 | RT16-0/40A | 10mm² |
| XLR5000-4022Z | 22 | 45 | CM1-63L/63 | CJ20-63 | RT16-0/63A | 16mm² |
| XLR5000-4030Z | 30 | 60 | CM1-100L/80 | CJ20-63 | RT16-0/63A | 25mm² |
| XLR5000-4037Z | 37 | 75 | CM1-100L/100 | CJ20-100 | RT16-1/100A | 35mm² |
| XLR5000-4045Z | 45 | 90 | CM1-160L/125 | CJ20-100 | RT16-1/100A | 35mm² |
| XLR5000-4055Z | 55 | 110 | CM1-160L/160 | CJ20-160 | RT16-1/160A | 35mm² |

Notes：Rated power and rated current refer to the maximum rated values of the soft starter. The specifications of the matching circuit breaker, bypass contactor, and fuse shall be matched with the motor specifications.





2. Specification parameter list of peripheral accessories for XLR5000 series soft starters (75kW～500kW) (for reference):

| Soft Starter Model | Rated Power (kW) | Rated Current (A) | Matching Circuit Breaker Model (QF) | Matching Bypass Contactor Model (KM) | Matching Fuse Model (FU) | Primary Conductor Specification (Copper Busbar) |
|---|---|---|---|---|---|---|
| XLR5000-4075Z | 75 | 150 | CM1-255L/180 | CJ20-160 | RT16-2/160A | 30×3mm² |
| XLR5000-4090Z | 90 | 180 | CM1-225L/225 | CJ20-250 | RT16-2/200A | 30×3mm² |
| XLR5000-4115Z | 115 | 230 | CM1-400L/315 | CJ20-250 | RT16-2/250A | 30×3mm² |
| XLR5000-4132Z | 132 | 260 | CM1-400L/315 | CJ20-400 | RT16-2/315A | 30×4mm² |
| XLR5000-4160Z | 160 | 320 | CM1-400L/350 | CJ20-400 | RT16-2/400A | 30×4mm² |
| XLR5000-4185Z | 185 | 370 | CM1-400L/400 | CJ20-400 | RT16-2/400A | 40×4mm² |
| XLR5000-4200Z | 200 | 400 | CM1-630L/500 | CJ20-400 | RT16-2/400A | 40×4mm² |
| XLR5000-4250Z | 250 | 500 | CM1-630L/630 | CJ20-630 | RT16-3/500A | 40×4mm² |
| XLR5000-4280Z | 280 | 560 | CM1-630L/630 | CJ20-630 | RT16-3/630A | 40×5mm² |
| XLR5000-4320Z | 320 | 630 | CM1-800H/700 | CJ20-630 | RT16-3/630A | 40×5mm² |
| XLR5000-4400Z | 400 | 800 | CM1-1250L/1000 | CJ40-1000 | RT16-4/800A | 50×5mm² |
| XLR5000-4450Z | 450 | 900 | CM1-1250L/1000 | CJ20-630 2 pcs | RT16-4/1000A | 50×5mm² |
| XLR5000-4500Z | 500 | 998 | CM1-1250L/1200 | CJ20-630 2 pcs | RT16-4/1250A | 50×8mm² |