

Foreword

Thanks for your selection of CDRA Series Soft Starter manufactured by Delixi Hangzhou Inverter Co., Ltd.

Before using it, please read this manual carefully so as to guarantee correct operation. Erroneous operation might result in malfunction, faults or shortened life span of the equipment, or even personal injury. Therefore, users are advised to read carefully this manual and abide by it during operation. The manual is a standard attached document. Please keep it for maintenance and repair in the future.

Aside from operation instructions, this manual also presents some wiring diagrams for your reference. If you have any difficulty or special demands for using the soft starter, please contact our offices or distributors. You may also contact the customer service centre of our head office for our quality service.

The manual noted that its content might be changed without further notice.

Please confirm following content during unpacking:

1. If the product is damaged during process of transportation, if parts are damaged and dropped, or if main body is bruised.
2. If rated value marked on nameplate is consistent with your order requirement, or if there are ordered unit, acceptance certificate, operation manual and guarantee shed in package.

The Company strictly complies with quality system during production and packaging, for any inspection miss, please contact our Company or supplier for settlement.



Warning

People should not reprint, transmit, and use the manual or content relating to it without written permission of the Company, who will assume legal responsibility for damage caused in violation of the item.

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Chapter 1 Safe Operation and Precautions

CDRA Series All-digital Intelligent Soft Starter for AC Electric Machine is an advanced new-type starter where power electronics technology, micro-processor technology and modern control theory are applied. The product can effectively limit the start current of asynchronous machine. Therefore it is widely used on air blowers, water pumps, and heavy-load equipments like conveyors and compressors, and it is an ideal substitute for reduced-voltage start equipments such as star-delta switch and self-coupling buck transformer. Besides, it is equipped with multiple control modes such as keyboard control, external terminal control and host computer control, and several output methods like fault relay output, multi-functional relay output, and analogue signal output. All this makes it more flexible and convenient for the product to be integrated into the system.

Please read this manual carefully before the installation, run, maintenance and inspection of CDRA Series Soft Starter.

To protect yourself, the equipment, and the property from any possible harm, please read this chapter before using our E Series Soft starters. Precautions relevant to operation safety are categorized as “Warning” and “Attention”.



Warning

: Potential dangerous indication, which may cause severe equipment damage, body injuries or dead if relevant operation requirement is ignored.



Attention

: Potential dangerous indication, which may cause middle, light injuries or device damage if relevant operation requirement is ignored. It also applies to unsafe operation




1.1 Examination and Acceptance

Please examine the following items after unpacking:

Items	Note
1. Does the model conform to your order?	Check the Model indicated on the nameplate on one side of the soft starter.
2. Is there any damage to the components?	Conduct visual check on the external appearance of the soft starter and make sure that no damage has occurred during transportation.
3. Are the components properly fastened?	Check all visible components with appropriate tools.
4. Do you have the user's manual, the quality certificate and the warranty claims form?	Check for the user's manual, the quality certificate and the warranty claims form.

As we have strict quality control system in terms of manufacture, packing and transportation, you can contact us or our local agent if there is anything missing.

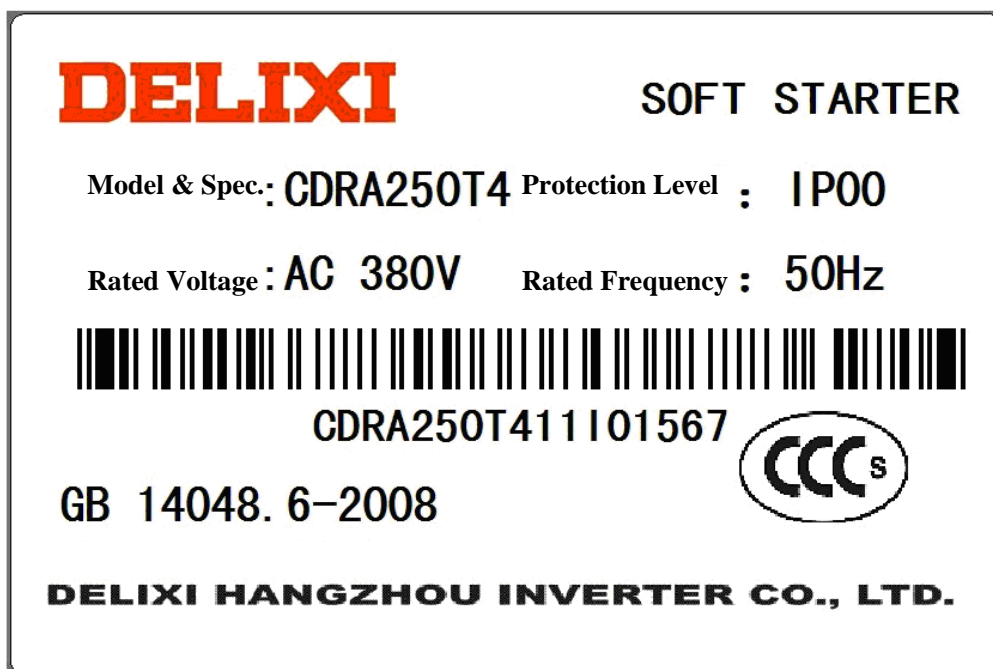
1.2 Precautions for Safe Operation

 Warning	1. Please install the starter on incombustibles such as metal, or there will be risk of fire; Do not put combustibles nearby, or there will be risk of fire; Do not install the starter in an environment with explosive gas, or there will be risk of explosion.
	2. Installation and maintenance should be performed by professional only.
	3. Verify soft starter's rated voltage which should conform with voltage level of AC power supply.
	4. Do not connect the input and output terminals in a reverse way, or it will lead to unexpected actions of the soft starter, which may possibly result in damages to the starter and the electric machine.
	5. When a bypass contactor is used, the phase sequence of the start circuit shall be consistent with that of the bypass circuit, or there will be phase fault when switching the bypass circuit, which will result in damage to the equipment or even fire.
	6. Only connect it to input power supply after the panel is well installed. Do not remove the external lid when it is powered; otherwise it may cause electric shock and explosion.
	7. Forbid touching high voltage terminal inside the soft starter when it is powered on; otherwise, there is danger of electric shock.
	8. Do not turn on or off line and connector when the circuit is powered on; otherwise it can cause electric shock.
	9. Do not operate the soft starter with wet hand; otherwise, there is danger of electric shock.
	10. All parts should be replaced by professional only. It is strictly prohibitive to remain stub or metal object in machine, to prevent from fire.
	11. Electric elements can be easily damaged by static electricity. Do not touch electric elements.
	12. You must not carry out withstand voltage test for the soft starter, for it will lead to damages to semi-conductor components in the starter.
 Electrostatic Discharge	
 Attention	1. The reactive power compensation capacitor to increase the power factor must be connected to the input terminal and must not be connected to the output one, or there will be damages to the silicon controlled power devices in the soft starter.
	2. The terminal of main loop should connect with terminal of lead firmly, otherwise may cause damage risk to the property.
	3. In regions at an altitude of 1000 meters plus, the de-rated operation will be necessary. In such cases, please contact us for technical advice.
	4. Do not start or stop the soft starter with contactors. Otherwise, it may occur damage to the equipment.
	5. Please treat it as industrial garbage when it is scrapped, for the electrolytic capacitor on the PCB can explode and the plastic parts can generate poisonous gas when they are burnt.

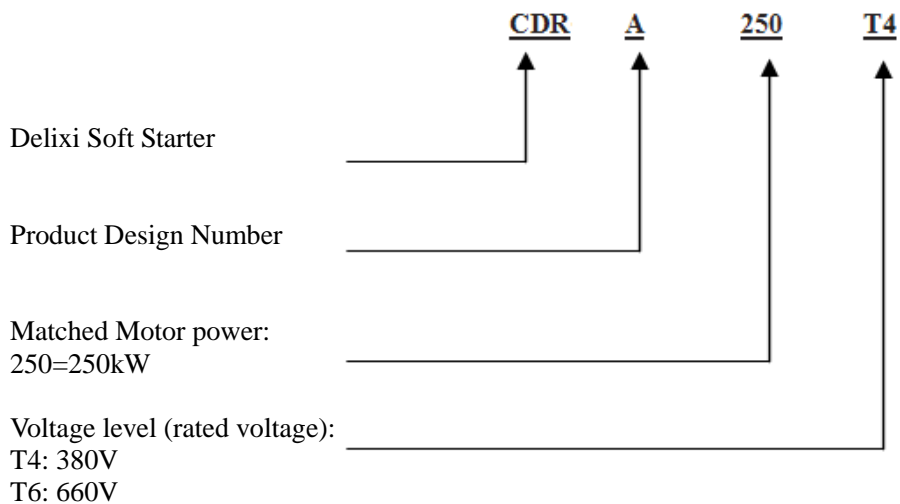
Chapter 2 Product Information

2.1 Nameplate data and designation

Nameplate data: for example CDRA250T4:



Nameplate Data Model Description:



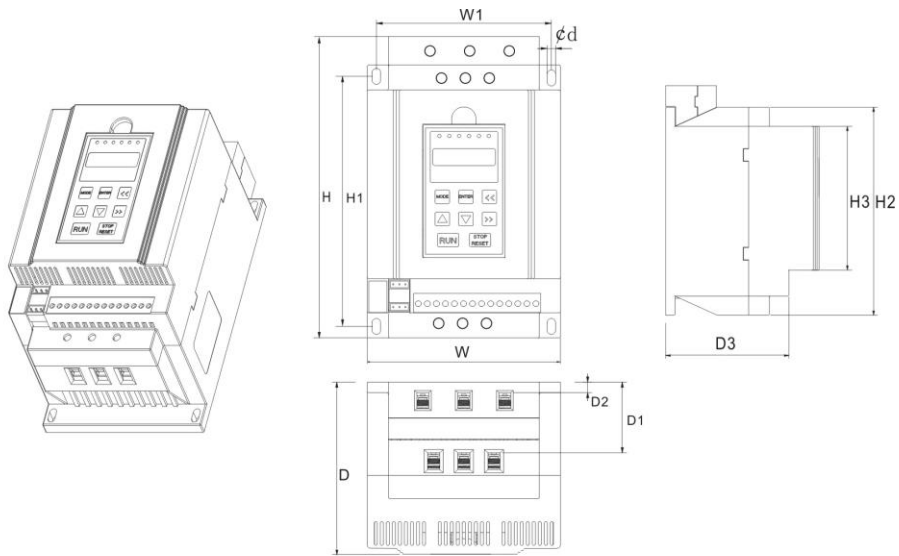
2.2 Technical Specification

Run	Run control methods		Keyboard / External Terminal / RS485 Communication	
	Start Mode		Current Limiting / Voltage / Heavy-load	
	Start & Stop Time		Can be digitally set.	
	Start Delay Time		Can be digitally set.	
	Emergency Stop		Output of the soft starter is interrupted.	
	Current Limit		The start current is below this value when the starter is run in the current limiting and heavy-load modes.	
	Initial Voltage		The initial voltage can be digitally set in the voltage mode.	
	Light-load Control		Can be used to check for accidents such as released belt buckle.	
	Restartability		Can be automatically restarted after it stops due to fault.	
	Fault Output		Contact Output — AC 250V 5A, DC 30V 5A	
	Multi-functional Relay Output		Start Delay, Start, Run, Stop, Complete Stop and Restart	
Analogue Output		0~20mA / 4~20mA Optional		
Protection	Soft Starter Protection		Over-current, Over-load, Over-heat, Three Phases Imbalance, Open Phase, Light-load, External Fault	
	Soft Starter Alarm		Emergency Stop, Light-load, Restart	
Display	Keyboard	Operation Information	Ready, Start Delay, Start Process, Run, Stop, Fault Alarm	
		Parameter Protection	Parameters set as protected can not be modified.	
Working Conditions	Usage Type		AC-53b	
	Rated Insulation Voltage	660V	Rated Impact Withstand Voltage	4kV
	Operation Frequency		≤ 12/hour	
	Protection Grade		CDRA011T4~CDRA055T4: IP20 CDRA075T4~CDRA600T4: IP00	
	Rated Conditional Short-circuit Current		CDRA055T4: 6kA; CDRA160T4: 12kA CDRA320T4: 20kA; CDRA600T4: 48kA	
Environment	Ambient temperature		-10°C ~ 40°C	
	Storage temperature		-20°C ~ 65°C	
	Ambient humidity		90% RH in Max. (no dewing)	
	Height/vibration		Below 1,000 m, below 5.9m/sec ² (=0.6g)	
	Application position		No corrosive gas, inflammable gas, oil mist, dust and others	
Cooling		Natural air cooling		

2.3 CDRA Series Soft Starter Model

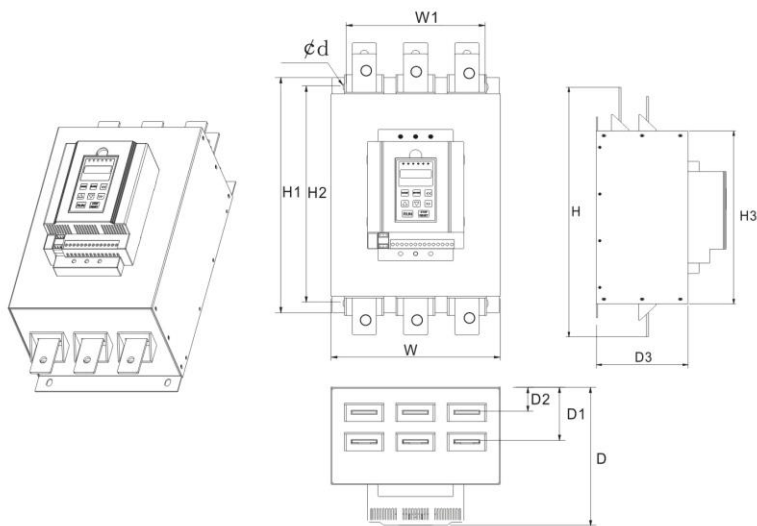
Soft Starter Model	Rated Frequency (kW)	Rated Current (A)	Auxiliary Circuit Breaker Model (QF)	Auxiliary Bypass Contactor Model (KM)	Primary Line Specifications
CDRA011T4	11	25	CDM1-63L/32	CJ20-25	6mm ² cable
CDRA015T4	15	32	CDM1-63L/40	CJ20-40	10mm ² cable
CDRA018T4	18.5	37	CDM1-63L/50	CJ20-40	10mm ² cable
CDRA022T4	22	45	CDM1-63L/63	CJ20-63	16mm ² cable
CDRA030T4	30	60	CDM1-100L/80	CJ20-63	25mm ² cable
CDRA037T4	37	75	CDM1-100L/100	CJ20-100	35mm ² cable
CDRA045T4	45	90	CDM1-225L/125	CJ20-100	35mm ² cable
CDRA055T4	55	110	CDM1-225L/160	CJ20-160	35mm ² cable
CDRA075T4	75	152	CDM1-225L/180	CJ20-160	35mm ² cable
CDRA093T4	93	176	CDM1-225L/200	CJ20-250	30*3mm ² copper busbar
CDRA110T4	110	210	CDM1-400L/250	CJ20-250	30*3mm ² copper busbar
CDRA132T4	132	253	CDM1-400L/315	CJ20-400	30*4mm ² copper busbar
CDRA160T4	160	300	CDM1-400L/350	CJ20-400	30*4mm ² copper busbar
CDRA200T4	200	380	CDM1-400L/400	CJ20-400	40*4mm ² copper busbar
CDRA250T4	250	480	CDM1-630L/630	CJ20-630	40*5mm ² copper busbar
CDRA320T4	320	600	CDM1-800H/700	CJ40-800	40*5mm ² copper busbar
CDRA400T4	400	750	CDM1-800H/800	CJ40-1000	50*5mm ² copper busbar
CDRA450T4	450	892	CDM1-1250/1000	CJ40-1000	50*5mm ² copper busbar
CDRA500T4	500	930	CDM1-1250/1250	CJ40-1000	50*5mm ² copper busbar
CDRA600T4	600	1100	CDM1-1250/1250	CJ40-1000	50*5mm ² copper busbar

2.4 Outline and installation size



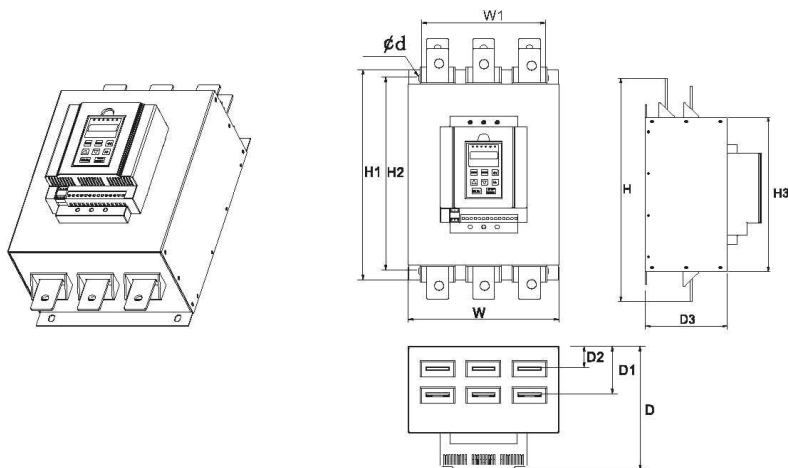
Type	W	W1	H	H1	H2	H3	D	D1	D2	D3	ϕd
CDRA011T4											
CDRA015T4											
CDRA018T4											
CDRA022T4	160	145	265	220	240	166	164	67	10	111	8
CDRA030T4											
CDRA037T4											
CDRA045T4											
CDRA055T4											

Dimension unit Millimeter



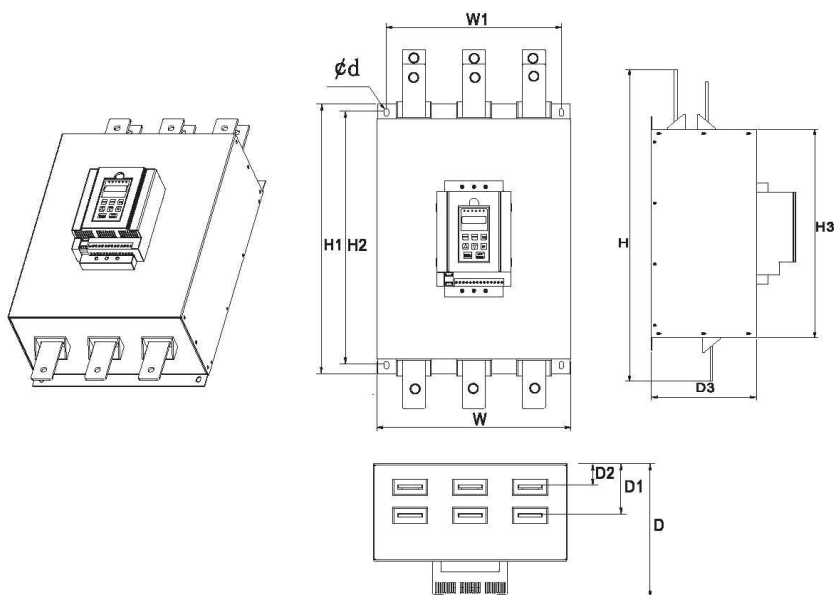
Type	W	W1	H	H1	H2	H3	D	D1	D2	D3	ϕd
CDRA075T4											
CDRA093T4											
CDRA110T4	280	230	534	430	395	370	255	98	44	180	10
CDRA132T4											
CDRA160T4											

Dimension unit Millimeter



Type	W	W1	H	H1	H2	H3	D	D1	D2	D3	ϕd
CDRA200T4	310	265	594	475	440	415	255	98	44	180	10
CDRA250T4											
CDRA320T4											

Dimension unit Millimeter



Type	W	W1	H	H1	H2	H3	D	D1	D2	D3	ϕd
CDRA400T4	416	375	740	555	520	495	275	106	44	200	10
CDRA450T4											
CDRA500T4											
CDRA600T4											

Dimension unit Millimeter

2.5 Routine maintenance

(1) Routine maintenance

Under the influence of temperature, humidity, dust and vibration, they may cause insulation level of soft starter decreasing, creepage distance reducing, as well as electric arc or short circuit, failure to control loop and soft starter, which all result the soft starter can't work properly or service life of soft starter is reduced. Therefore, it is significant to perform routine maintenance and regular inspection with the soft starter.

Routine maintenance item:

- A. If starting, running or stopping sound of motor is abnormal.
- B. If vibration is created during operation of motor.
- C. If installing condition of soft start is changed.
- D. If soft start is in state of overheat.

Daily cleanness:

- A. Keep cleanness of soft starter.
- B. Remove dust from surface of soft starter effectively, to prevent soft starter from incursion of dust, or metal dust.
- C. Prevent aqueous vapor or water dropping into soft starter effectively.

(2) Regular inspection

Please inspect the following for the corner pockets of soft starter regularly.

- A. Inspect air flue, and clean it regularly.
- B. Inspect if screw is loosened.
- C. Inspect if soft starter is corrosive.
- D. Inspect if there is arc on surface connecting terminal.
- E. Insulated test of major loop

Note: Please disconnect major loop and soft starter while testing insulation resistance by using megohmmeter (500V DC megohmmeter). Do not measure insulation of control loop with megohmmeter. And high voltage test is needless (finished in ex works).

(3) Warranty

Free Warranty is limited to the soft starter only.

For fault or damage occurs during normal application (refer to User Manual) of device sold in home, and the Warranty period of the product should be effective within 18 months after the bar code date.

For the products sold out of China (exclude those sold in domestic), the Warranty period of the product should be effective within 6 months after shipment at purchasing place.

For products manufactured by the Company, we will provide paid service for full service life anytime or anywhere applies it.

All sales companies and agents of our Company should provide after-sale services to the products, and the service terms include:

- A. Provide 3 levels inspection service at site of the unit. (Include fault elimination)
- B. Refer to after sell service contract concluded between the Company and agents.
- C. Request for compensated after-sale service from agent of the Company (without reference to Warranty).

Our Company should take responsibility of Warranty, guaranteed exchange, and guaranteed return for quality and accident responsibility relating to the product, but user could affect insurance for further responsibility compensation guarantee from insurance agent.

Warranty period of the product should be effective within 18 months after the bar code date.

For fault caused in following reason, user could obtain compensated maintenance only even guarantee term is effective:

- A. Problem caused in incorrect operation (based on user's manual) or repair, modification without authorization.
- B. Problem caused in violation of critical requirement.

- C. Damage caused in undeserved transportation after purchased.
- D. Aging or fault caused in bad environment.
- E. Damage caused in earthquake, fire, disaster, lightning strike, abnormal voltage or other natural disaster and incidental disaster.
- F. Damage occurs in transportation. (Note: transportation mode should be appointed by user of themselves, the Company should assist agent to conduct transfer of goods).
- G. Brand, trade mark, SN, nameplate marked by manufacturer is damaged or unjustifiable.
- H. Failure to pay off fund according to purchase contract.
- I. Failure to describe actual conditions relating to installation, distribution, operation, maintenance, or other condition to the Company.

The Company should carry out responsibility of “Three guarantee” abovementioned only after received the returned goods, and confirmed responsibility attribution.


Should it involve an unpaid or untimely settlement due to the buyer, the ownership hereof still belongs to the supplier. In addition, the latter will assume no liability hereinabove, and the buyer shall have no disagreement.

All relevant service fees shall be calculated in accordance with the identical standards of the factory. In the event that there is an agreement or a contract, such agreement or contract shall prevail.

Chapter 3 Installation and Connection of Soft starter

3.1 Selection of the Site and Space for Installation

Selection of installing position:

 Warning	1. Prevent from sunniness; Don't use in the open air directly.
	2. Don't use in the corrosive gas and liquid environment.
	3. Don't use in the oil fog and splash environment.
	4. Don't use in the salt spray environment.
	5. Don't use in the moist and rain environment.
	6. Please equip the unit with filters device if metal dust or fiber wadding existing in air.
	7. Do not use the unit in mechanical shock or vibration condition.
	8. It is necessary to adopt cooling measure if ambient temperature is higher than 40°C.
	9. It is recommended to use the unit in temperature range of -10°C~+40°C because fault maybe occur in overcool or overheat condition.
	10. Keep the unit away from power supply noise, high-power application, such as electric welder should impact application of the unit.
	11. Emissive material should impact application of the unit.
	12. Keep the unit away from combustibile material, attenuant and solvent.

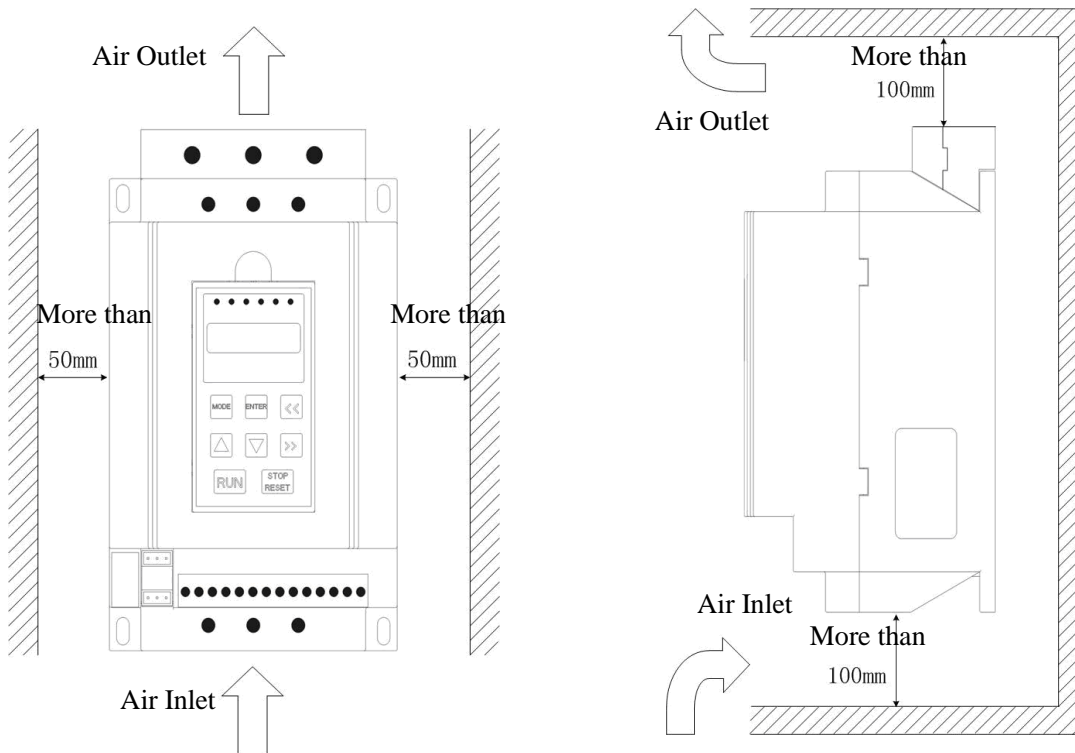
For ensuring perfect performance and long-term service life, please comply with above mentioned advices while installing CDRA series soft starter to prevent the unit from damage.

Installation Direction: Please make sure that the soft starter is installed in a vertical way for the sake of cooling.

Selection of the installation space:

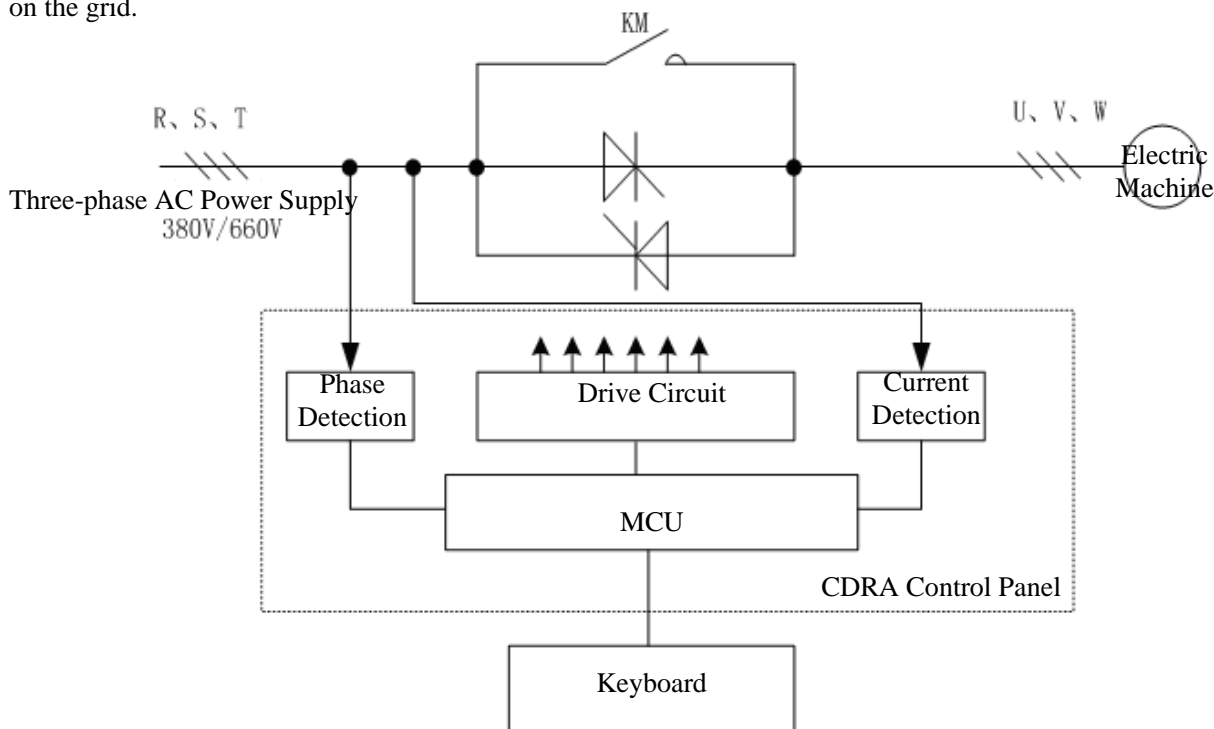
For vertical installation of CDRA series soft starter, adequate cooling room should be left, so as to ensure effective cooling, see following drawing for details.

Please do not drop foreign objects inside the soft starter when installing it to avoid reduced insulation grade or even short-circuit.



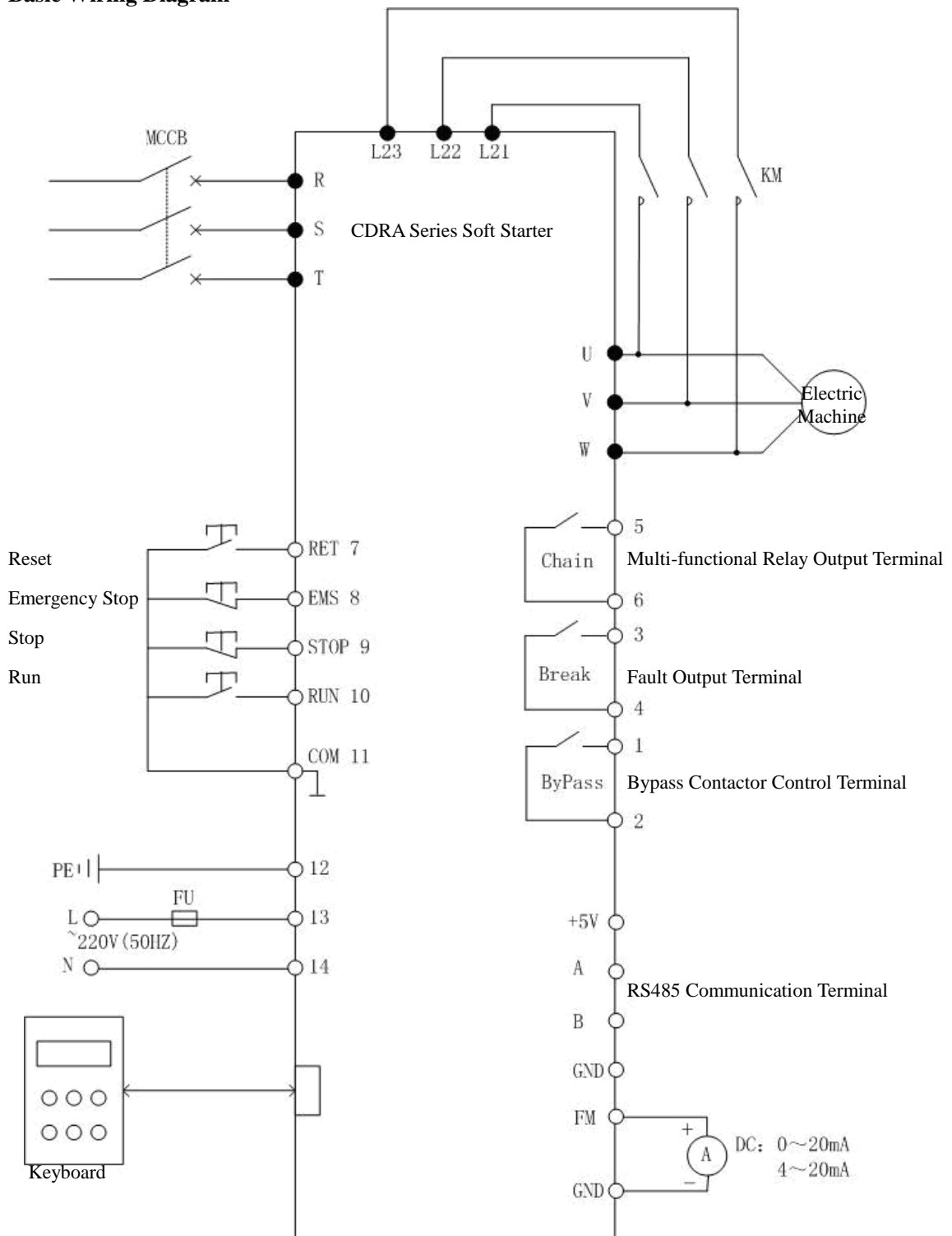
3.2 Working Principles of Soft Starter

The main circuit of CDRA Series Soft Starter for Electric Machine consists of six antiparallel SCRs connected in series with the stator of the AC electric machine. The trigger angle of the electronic switch of SCR is controlled by a micro-processor to change the conduction angle of SCR, and thus to change the input voltage of the electric machine so that the soft start of electric machine is controlled. After the start, the output voltage of the soft starter reaches rated value while KM, the three-phase bypass contactor, is pulled in to put the electric machine into use on the grid.




3.3 Wiring

3.3.1 Basic Wiring Diagram



Wiring Precautions

 Warning	1. Please connect unit only after shut down the power supply.
	2. Verify soft starter's rated voltage which should conform with voltage level of AC power supply.
	3. Do not connect the input and output terminals in a reverse way, or it will lead to unexpected actions of the soft starter, which may possibly result in damages to the starter and the electric machine.
	4. When a bypass contactor is used, the phase sequence of the start circuit shall be consistent with that of the bypass circuit, or there will be phase fault when switching the bypass circuit, which will result in damages to the equipment or even fire.
	5. Electric elements can be easily damaged by static electricity. Do not touch electric elements.
	6. You must not carry out withstand voltage test for the soft starter, for it will lead to damages to semi-conductor components in the starter.

3.3.2 External Terminals Description:

Type	Terminal Symbol	Terminal Name	Description	
Main Circuit	R.S.T	AC Main Circuit Power Input	Connected with three-phase AC Power Supply through circuit breaker	
	U.V.W	Soft Starter Output Terminal	Connected with three-phase asynchronous electric machine	
	L21.L22.L23	External Bypass Contactor Terminal	Connected with bypass contactor	
Control Circuit	13	Control Power Input Terminal	Connected with AC 220V, 50Hz	
	14			
	12	Grounding Terminal	Grounding	
Control Circuit	Relay Output	1	Bypass Contactor Control Terminal: Bypass	Close after start Capacity: AC 220V 5A
		2		
		3	Fault Relay Output Terminal: Break	Act when there is fault (method can be set) Capacity: AC 220V 5A
		4		
		5	Multi-functional Relay Output Terminal: Chain	Programmable action method Capacity: AC 220V 5A
		6		
	Digital Input	7	External Reset Terminal: RET	Reset signal of external terminal when there is fault
		8	Emergency Stop Control Terminal: EMS	Emergency stop control signal of external terminal
		9	External Stop Terminal: STOP	STOP & COM are closed in external control mode. Run is effective if STOP & COM are closed, or stop is effective if they are open.
		10	External Run Terminal: RUN	
		11	Common Signal Terminal for External Terminals: COM	Common terminal for digital input
	RS485 Communication	A	485 Communication Positive Signal	RS485 Communication Terminal
		B	485 Communication Negative Signal	
	Power Interface	+5V	+5V Power Supply	Power Supply
		GND	GND Terminal	Power Grounding
Analogue Output	GND	Current Signal Output Terminal		0-20mA, 4-20mA Analogue Output Signal, optional through programming
	FM			

3.3.3 Control Terminal Connection and Instructions for Use

1. Terminal Wiring Precautions:

Please connect the control terminals with multi-core shielding cable or strand wire. In the case of shielding cable, the end near the shielding layer (the end near the soft starter) shall be connected with the grounding terminal PE of the soft starter. The control cable shall be kept over 20cm far from the main circuit and the strong current circuit (including the power cable, electric machine cable, the relay cable and the contactor cable), and shall not be put in parallel with them. Vertical wiring is recommended in order to prevent malfunction of the soft starter resulting from interference.

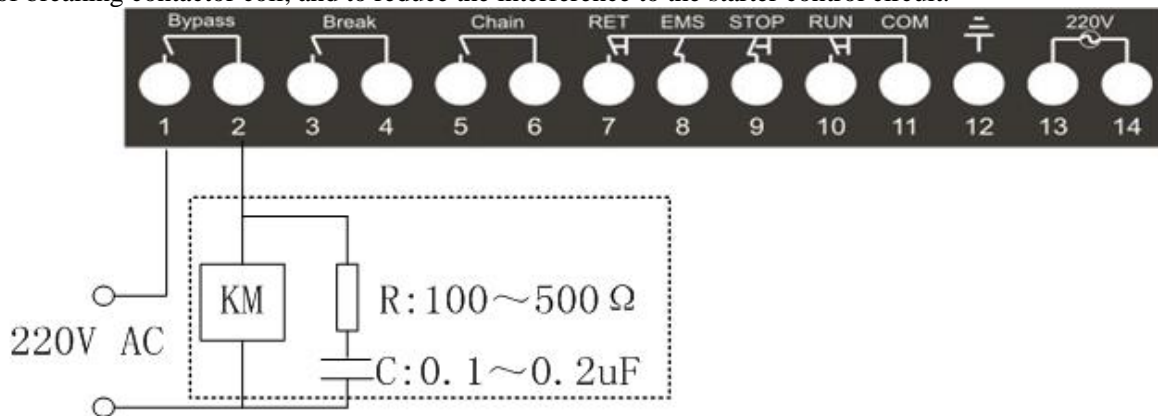
2. External Control Terminal Wiring

Turn off power before connecting or removing the cables to keep away from possible dangerous voltage.

(1) Bypass Contactor Control: Bypass Terminal 1, 2

After the start is completed, the internal contact is closed to make the bypass contactor KM pulled-in; when the stop order is send out, the internal contact will open.

Suggestion: Install an RC absorbing circuit near the ends of the coil of the contactor to absorb the surge voltage in case of breaking contactor coil, and to reduce the interference to the starter control circuit.



(2) Fault Output Relay: Break Terminal 3, 4

The action of the relay when there is fault with the soft starter can be set as normal open or normal close through parameter setting with the contact capacity of AC 250V 5A.

(3) Multi-functional Relay Output: Chain Terminal 5, 6

The contact can be used to connect with other control equipments, and its action method can be optional through parameter settings with the contact capacity of AC 250V 5A.

(4) Reset Input: RET Terminal 7, 11

Fault state may be released when the external reset terminal RET is connected with the common terminal COM.

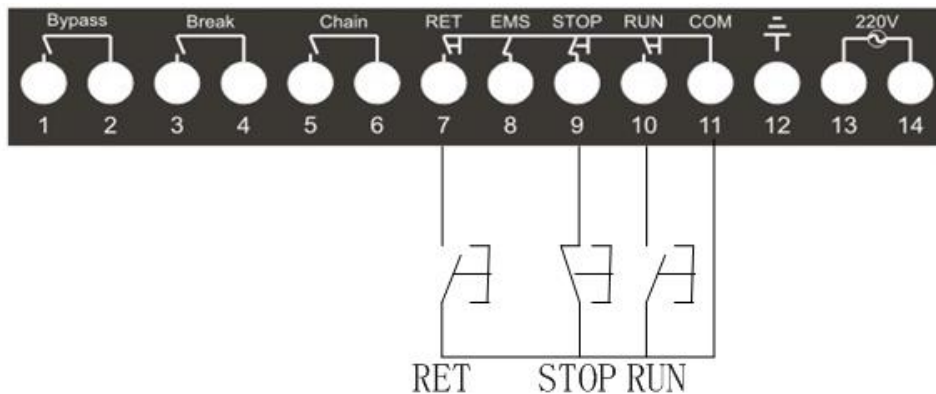
(5) Emergency Stop Input: EMS Terminal 8, 11

The terminals can be used for external signal input of emergency stop. They can be connected externally with emergency stop buttons or a thermal relay, and can protect the normally closed contact in the circuit. The soft starter can operate only when EMS and COM is connected, and stops within 2 seconds after they are disconnected. You can shield this function through parameter settings.

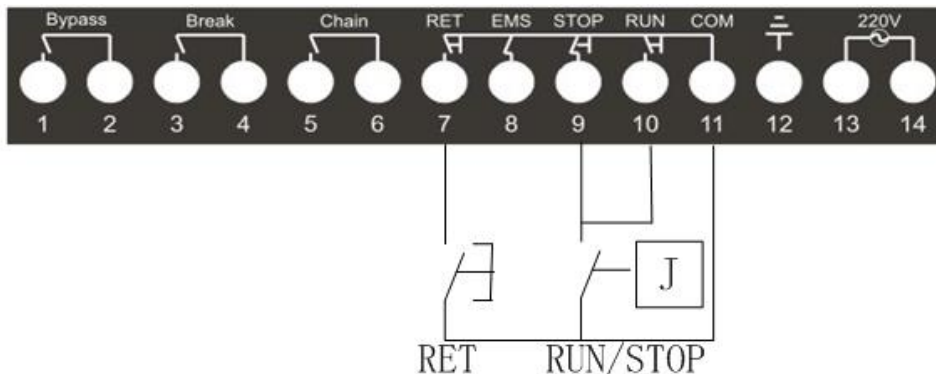
(6) Run Control: STOP, RUN, COM Terminal 9, 10, 11

The three terminals are used to input run and stop signals in case of external control. Set the control method as external control before use. In the external control mode, the soft starter is running when the STOP-COM and RUN-COM is closed and otherwise it stops.

The common three-wire connection of external buttons is as follows:



The two-wire connection is as follows:

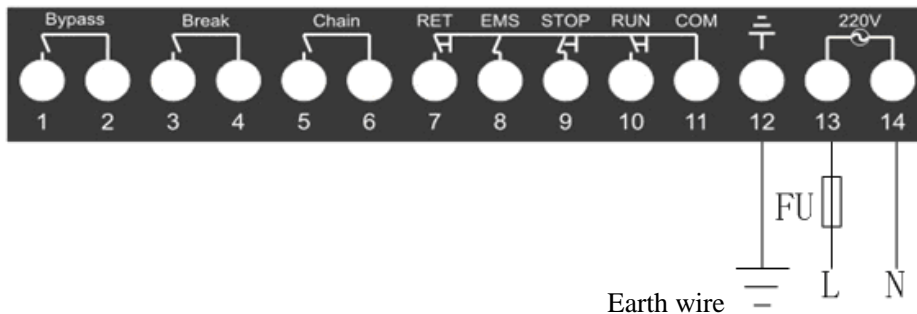


(7) Grounding Terminal 12

Please connect an effective grounding cable with this terminal, and use multi-core cable for connection.

(8) Control Power Terminal 13, 14

Connect externally with the control power of AC 220V to supply the control panel with power.



(9) Analogue Current Output Terminal FM, GND

They can be used to output the current signal with a range of 4-20mA or 0-20mA, which indicates the main circuit current. The output method can be set through parameter settings.

(10) RS485 Communication Terminal A, B

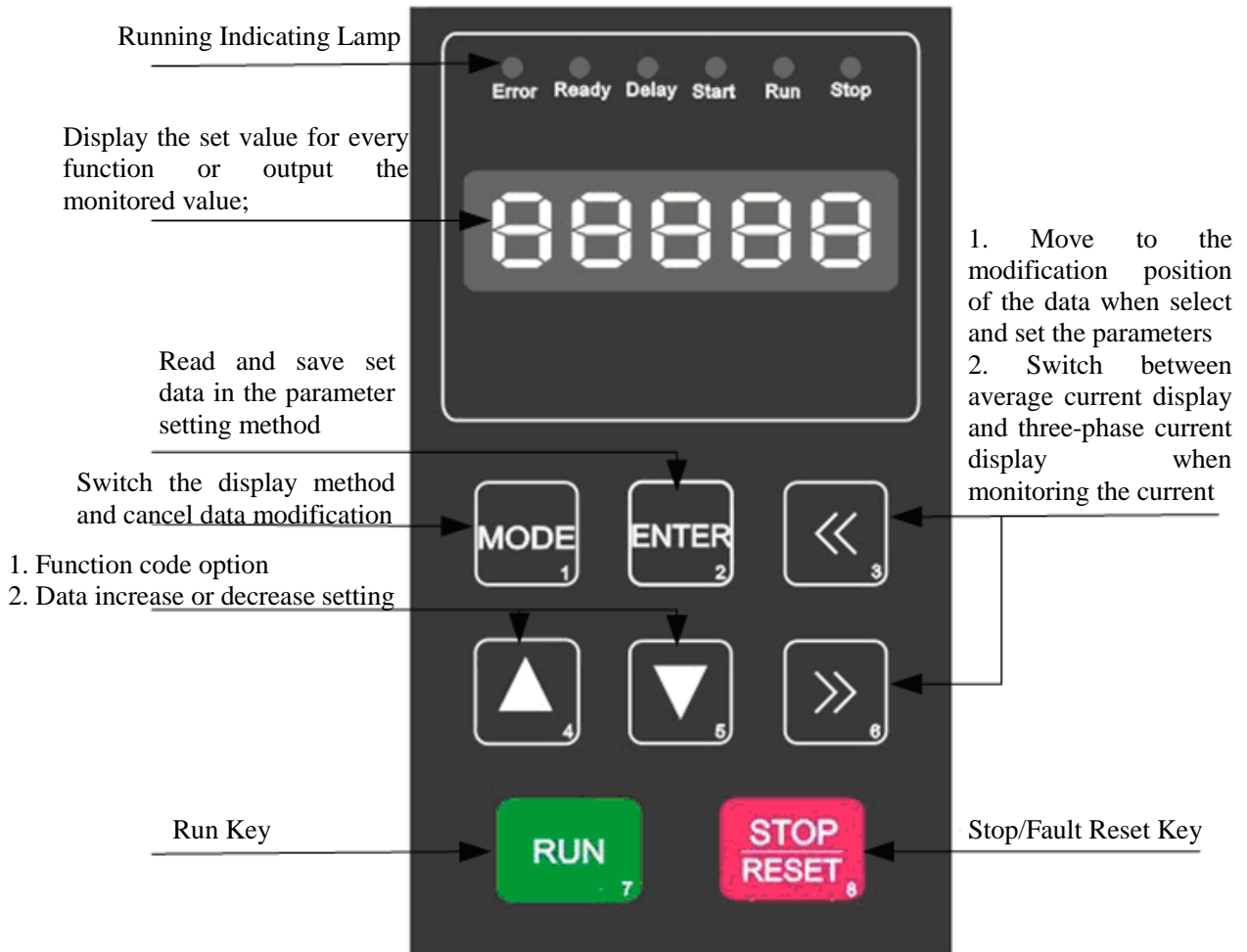
A: 485 Positive Signal; B: 485 Negative Signal

+5V	A	B
GND	GND	FM

Chapter 4 Keyboard Operation and Run

4.1 Keyboard Operation

4.1.1 Keyboard Display, Keys and Function Description



The function description of indicating lamps are as follows:

No.	Error name	Error name in Chinese	Description of Function
1	Error	Fault	It lights when soft starter is under state of failure.
2	Ready	Ready	It lights when soft starter is under state of ready.
3	Delay	Time delay	It lights when soft starter is under state of time delay.
4	Start	Start	It lights when soft starter is under state of starting.
5	Run	Run	It lights when soft starter is under state of running.
6	Stop	Stop	It lights when soft starter is under state of stopping.

4.1.2 Display and Operation

1. Display:

The soft starter keyboard has two display modes: Monitoring Mode and Function Code Mode:

a) The display in the monitoring mode includes:

- “READY”: ready to run;
- “DELAY”: in the start delay;
- “START”: in the start process;
- “RUN”: in the bypass run process;
- “STOP”: in the stop process;
- “ERR-X”: fault display;
- “Average Current Display”;
- “Phase A Current Display”;
- “Phase B Current Display”;
- “Phase C Current Display”;

b) Function Code Mode:

- “P0XX”: Function Code Number;
- “XXXX”: Function Code Parameter Value;

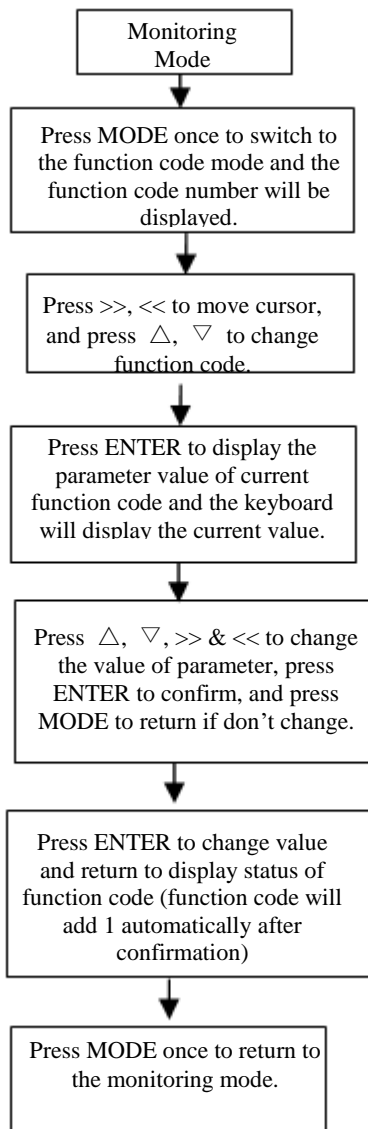
The monitoring mode and function code mode can be switched by pressing “MODE” at any time.

2. Operation in the Monitoring Mode:

- a) Turn on the soft starter. When the start detection is normal, the digital tube will display “READY”, and the indicating lamp “Ready” will be on, indicating the starter is ready.
- b) Make sure the wiring and phase sequence are right. Press “RUN”. If delay function is set, “DELAY” will be displayed, and the indicating lamp “Delay” will be on. If delay function is not set or the delay time is over, “START” will be displayed, and the indicating lamp “Start” will be on, indicating the soft starter is in the start process.
- c) When the start is completed, “RUN” will be displayed and the indicating lamp “Run” will be on, indicating the bypass is running. After this is displayed for about 1 second, the starter will be automatically switched to display the average current.
- d) Press “>>”, and “Phase A Current Display”, “Phase B Current Display” and “Phase C Current Display” can be displayed in sequence.
- e) Press “STOP”, “STOP” will be displayed and the indicating lamp “Stop” will be on, indicating the soft starter is carrying out the stop process.
- f) When the stop process is over, “READY” will be displayed.
- g) If there is any fault or warning when the soft starter is carrying out the processes, “ERR-X” will be displayed blinkingly with “X” representing the number of the fault, and the indicating lamp “Error” will be on. You can reset the soft starter by pressing “STOP” or closing the “RET” terminal.

3. Operation in the Function Code Mode

In the monitoring mode, press “MODE” to enter the function code mode. The function code number “P0XX” is firstly displayed. Press “ENTER” to call out the current function code parameter value. Press “>>” & “<<” to move to the digit you want to modify. Press “△” & “▽” to increase or decrease the value of the current digit. After all the settings are over, if you want to save the result, press “ENTER”, or otherwise press “MODE”.



Example: the following is an example of stop time parameter P002 changing from 2 sec. to 5 sec.:

1	READY	It indicates the starter is ready. Press MODE to enter the function code mode.
2	P000	It indicates the function code number is P000. Press Δ twice.
3	P002	Press ENTER to call out the function code parameter value.
4	02	Check whether the current value of the parameter is 02; at the same time the pointer points to the last digital bit "2".
5	05	Press Δ for three times to change the display value to 05, and press ENTER.
6	P003	Save the data 05 into P002, and return to the function code number display. The number will be increased by 1 and P003 will be displayed.
7	P002	If directly press MODE instead of ENTER in Step 5, the keyboard shall return to display P002, and the data is changed but not saved, i.e. remain 02.
8	READY	Press MODE again, and the starter will return to the monitoring mode.

Note: the parameters can not be modified if the parameter protection function of P029 (Parameter Protection) is turned on.

4.2 Power-on Run

4.2.1 Test Run

The test run is mainly for the user to confirm whether the rotating direction and transmission of the electric machine is normal.

- (1) Please make sure all the cables are reliably connected and the phase sequence of the main electric cable is right.
- (2) Turn on the control power supply, and "READY" is displayed on the keyboard.
- (3) Adjust the function code parameters of the soft starter in a reasonable range according to the load of the electric machine on the site so that the machine can get the optimal starting torque.
- (4) Press RUN to start the soft starter. Watch the rotating direction of the electric machine to see if it meets the requirements, and if there is anything abnormal, press STOP to stop. If the electric machine does not work, increase the initial voltage value to increase the starting torque.

4.2.2 Run

- (1) Adjust the function code parameters of the soft starter in a reasonable range according to the load of the electric machine on the site.
- (2) Press RUN on the panel to start the soft starter. If the electric machine speeds up steadily without sudden current change, the parameter settings are proper. You may press STOP to stop.
- (3) If there is any fault in the run, please check for the cause according to Chapter 6.
- (4) If two machines are started by one soft starter, the stop time must be set as 0.
- (5) After the soft starter begins to run, you may press“<>”to switch among the displays of “Average Current”, “Phase A Current”, “Phase B Current” and “Phase C Current”.

Chapter 5 Function Code Parameters

5.1 Function Code Table

Function code	Name	Setting range	Min. Unit	Factory Value	Notes
P000	Initial Voltage	30%~70%	1%	30%	Effective in voltage mode.
P001	Start Time	2~100S	1S	12S	Effective in all modes.
P002	Stop Time	0~50S	1S	2S	0 means free stop.
P003	Start Mode	0: Voltage 1: Current Limiting 2: Heavy-load	1	0	Select according to the load of the electric machine, and you may refer to Attached Table 1.
P004	Load Type	0: No Designated Load 1: Centrifugal pump 2: Air Blower 3: Compressor(Piston) 4: Compressor(Centrifugal) 5: Transportation Machine 6: Mixer 7: Ball Mill 8: Compressor 9: Water Pump	1	0	Set this parameter according to the load
P005	Control Method	0: Keyboard 1: External Control 2: Keyboard +External Control 3: PC 4: Keyboard+PC 5: External Control+PC 6: Three Methods All Work 7: Lockout	1	0	Select according to actual working conditions.
P006	Start Hold Time	0~20S	1S	0S	Effective in all modes Impulse voltage time in heavy-load mode
P007	Intermediate Voltage	P000~70%	1%	50%	Effective in all modes
P008	Intermediate Time	0~P001-2	1S	0S	Effective in all modes
P009	Impulse Voltage	50%~80%	1%	50%	Effective in heavy-load mode
P010	Start Delay	0~999.9S	0.1S	0	The delay time from when the RUN signal is effective to when the start begins.
P011	Emergency Stop Control	0: Ineffective Control 1: Effective Control	1	0	Set the effectiveness of the EMS terminal.

P012	Fault Relay Control	0: Normal Open 1: Normal Closed	1	0	Set the contact state.
P013	Time when the multi-functional relay is closed	0: Effective Run Signal 1: Start Process 2: Bypass Run 3: Stop Process	1	0	Configure the set of parameters according to external use.
P014	Time when the Multi-functional relay is open	4: Stop Completed 5: Fault 6: Restart Completed	1	0	
P015	Multi-functional relay closure delay	0.0~999.9S	0.1S	0	
P016	Multi-functional relay open delay	0.0~999.9S	0.1S	0	
P017	Current Limiting	150%~500%	1%	250%	Effective in heavy-load mode and current limiting mode.
P018	Over-load Protection of the Electric Machine	50%~150%	1%	100%	Over-load Curve Options
P019	Imbalance	0~100%	1%	0	0: Closed
P020	Full Scale Value of Analogue Output	20~5000A	1A	Machine Model	Set the corresponding current value to the max. analogue output value (20mA)
P021	Analogue Output Options	0: 4~20mA 1: 0~20mA	1	0	Analogue Output Current Range Options
P022	Light-load Control	0: Close 1: Alarm 2: Stop	1	0	The action method of soft starter after light-load is detected
P023	Light-load Rate	10~100%	1%	100%	The light-load level detected
P024	Light-load Detection Delay	0.0~99.9S	0.1S	0	Delay after the light-load is detected
P025	Possible Restart Times	0~3	1	0	The possible restart times after the starter stops due to fault
P026	Baud Rate Options	0: 2400bps 1: 4800bps 2: 9600bps 3: 19200bps	1	2	Set the communication parameters
P027	Data Format	0: ASCII N 8 1 (No Check) 1: ASCII E 8 1 (Even Parity Check) 2: ASCII O 8 1 (Odd Parity Check) 3: RTU N 8 1 (No Check) 4: RTU E 8 1 (Even Parity Check) 5: RTU O 8 1 (Odd Parity Check)	1	0	

P028	Number of This Starter	0~31	1	1	
P029	Parameter Write-protection	0: No 1: Yes	1	0	Protect the parameters from re-write
P030	Parameter Initialization	0: No Action 1: Restore Ex-works Settings	1	0	Restore Ex-works Settings
PASS	Factory Password	****			

5.2 Function Code Description

5.2.1 P000: Initial Voltage

P001: Start Time

They are the parameters to control start in voltage mode. The initial voltage increase can help to overcome the static friction when start with load. The greater the inertia of the load, the longer it takes to start.

When the soft starter starts, the output voltage increases from the initial voltage with the start time going. When a rated voltage is reached, the bypass contactor pulls in and the start process is completed. The start time is the base for the time parameter concerning the output voltage increase of the soft starter, and is intended to control the output voltage so as to speed up the electric machine steadily and complete the start process. Therefore, when the load is light, the start time will be shorter than the set one, but it is normal as long as it can be started smoothly.

5.2.2 P002: Stop Time

It is time for soft start. When it is set as 0, free stop is effective.

In soft stop mode, the power supply of electric machine is switched to the SCR output of the soft starter by the bypass contactor. The output voltage of the soft starter decrease gradually from full voltage to make the rotation of electric machine speed down steadily so as to prevent mechanical vibration. However, stop time too long will make the system less stable.

In the free stop mode, the bypass contactor is disconnected immediately and the voltage output of SCR of the soft starter is prohibited when the starter receives the order to stop. The electric machine stops gradually based on its load inertia. When n machines are started by one soft starter, free stop mode shall be applied in order to prevent phase failure when the output is switched.

5.2.3 P003: Start Mode

0: Voltage Mode

1: Current Limiting Mode

2: Heavy-load Mode

Voltage Start Mode: refer to 5.2.1 for the description of the start parameters in voltage mode. The voltage mode is applicable to occasions where high-level of start steadiness is required while start current is not so demanding.

Current Limiting Start Mode: refer to 5.2.13 for the description of current limiting parameters. The current limiting mode is generally applicable in occasions where limited start current is required.

Heavy-load Start Mode: it is applicable in occasions with heavy load.

5.2.4 P004: Load Type

Set the parameter properly according to the load. If the start effect is not ideal in actual use, you may adjust the parameters concerning the start properly.

5.2.5 P005: Control Method

0: Keyboard: Start or stop only by pressing RUN or STOP on the panel.

1: External Control: Only three-wire or two-wire start method by Terminal RUN/STOP/COM

2: Keyboard +External Control (Applicable to three-wire control method)

It can be operated through both methods, but the external control terminals of STOP-COM must be connected through when start by keyboard.

3: PC: Monitor and control its run by the bus.

4: Keyboard + PC: Control by keyboard and the bus simultaneously.

5: External Control+PC: Control by the terminals of RUN & STOP and the bus simultaneously.

6: Keyboard +External Control+PC: Control by keyboard, external control terminals and the bus simultaneously.

7: Lockout: None of the three methods including keyboard, external control and PC works.

5.2.6 P006: Start Hold Time

In voltage and current limiting modes, this parameter indicates the start voltage hold time. In heavy-load mode, this parameter is impulse voltage hold time.

5.2.7 P007: Intermediate Voltage

P008: Intermediate Time

Effective in all modes;

Intermediate Voltage is the percentage of rated voltage of the electric machine.

Intermediate Time is the time when the initial voltage changes into the intermediate voltage.

5.2.8 P009: Impulse Voltage

Effective in heavy-load mode. It is used to overcome the static friction when start with heavy-load, and shall be used with P006.

5.2.9 P010: Start Delay

The delay time from when the RUN signal is effective to when the start begins.

5.2.10 P011: Emergency Stop Control

The externally controlled emergency stop input function of EMS can be turned on or off.

0: Ineffective Control;

1: Effective Control.

5.2.11 P012: Fault Relay Control

The user can set the output of fault relay as Normal Open(0) or Normal Closed(1) according to his own needs.

5.2.12 P013: Time when the Multi-functional relay is closed

P014: Time when the Multi-functional relay is open

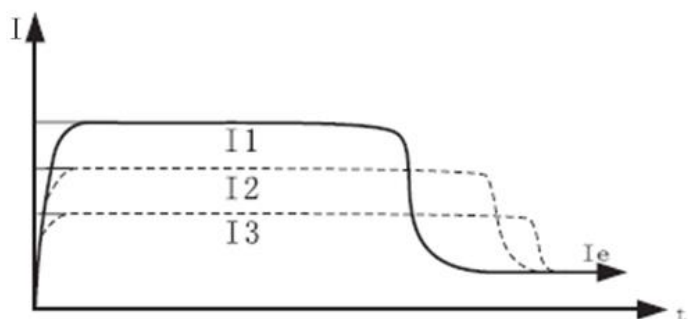
P015: Multi-functional relay closure delay

P016: Multi-functional relay open delay

The time when the multi-functional relay is closed/open as well as its delays can be set flexibly by the user according to his own needs.

5.2.13 P017: Current Limiting

It is used to set the current limit in the current limiting start mode. When the electric machine is started, the output voltage increases until the current of the electric machine reaches this set value, and the start current is made no more than this value. After the pull-in of the bypass contactor, the output current drops under the rated current of the electric machine. The greater this set value, the shorter the start time.

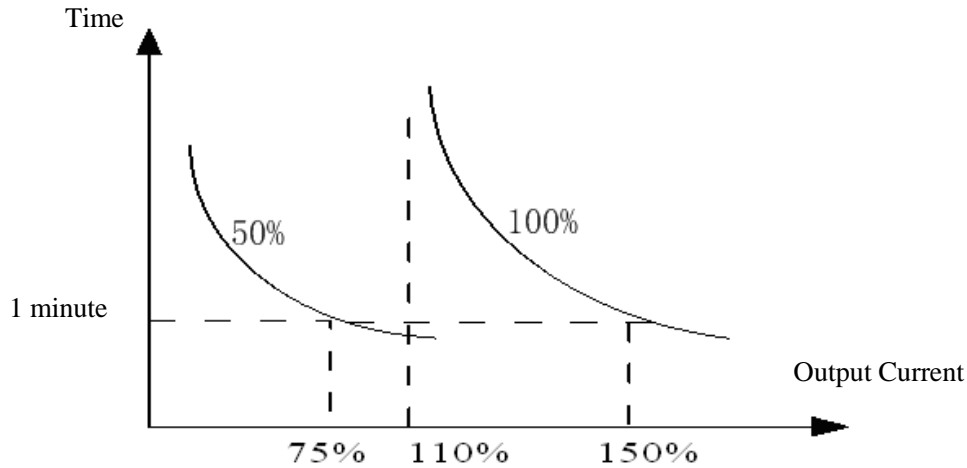


5.2.14 P018: Electric Machine Over-load Protection Factor

The set value of over-load protection factor is 100% in case the electric machine matches the soft starter.

Inverse time over-load protection characteristic curve is as follows (P018=100% & P018=50%)

The over-load of this series soft starter is: When P018=100%, the starter runs continuously with 150% of the rated current for 1 minute or with 120% of the rated current for 500 seconds.



Inverse time over-load protection characteristic curve

5.2.15 P019: Imbalance

0: Imbalance Protection is closed;

1%~100%: Imbalance protection threshold;

When the imbalance of the actual current detected is over this set value, the soft starter protection starts.

The imbalance K is defined as: $K = I_s / I_d * 100\%$

I_s is the max. of $|I_a - I_b|$, $|I_a - I_c|$, $|I_b - I_c|$, and I_d is the average value of the three-phase current I_a , I_b , I_c .

5.2.16 P020: Full Scale Value of Analogue Output

P021: Analogue Output Options

Terminal FM-GND is analogue output with a range of P021=0: 4~20mA, P021=1: 0~20mA. The analogue output current has a linear relation with the actual output current of the soft starter. The corresponding output current value of the soft starter to the max. analogue output value 20mA is decided by P020. The initial value of P020 is the rated current value of the soft starter itself.

5.2.17 P022: Light-load Control

P023: Light-load Rate

Light-load control can be used to check for accidents like released belt buckle.

P022=0: The light-load detection is off;

1: Alarm only by the fault relay when the set value of light-load rate (P023) is exceeded.

2: The starter is stopped and the fault relay acts when the set value is exceeded.

P023 Light-load rate K_s is defined as follows: $K_s = I_s / I_e * 100\%$ (I_e is the rated current value, I_s is the average value of three-phase current).

5.2.18 P024: Light-load Detection Delay

When light-load fault is detected, the soft starter will alarm or stop according to the method set by P022 after the time delayed as set by P024.

5.2.19 P025P: Possible Restart Times

This function code is only effective in external control mode.

If P025 is set as a value other than 0, when the soft starter stops due to fault, it will automatically reset and run after 6 seconds are delayed, and the restart times is reduced by 1. If the restart times is reduced to 0, you can only reset the starter manually.

If the function code is set as 0, restart is only allowed after the starter is reset manually.

5.2.20 P026: Baud Rate Options

P027: Data Format

P028: Number of This Machine

They can be used to set the communication parameters.

Refer to Appendix 1 for details of communication protocol.

5.2.21 P029: Parameter Protection

When the function code of P029 is set as 1, you can not modify the other parameters until the value is set as 0. This is intended to prevent the personnel other than the debugger from setting the parameters at their option.

5.2.22 P030: Parameter Initialization

0: No Action

The read and write of the parameters of the soft starter is normal.

1: Restore Ex-works Settings

When the function code is set as 1 and confirmed, the soft starter restores the parameter values of P000~P029 to the defaulting ex-works values. In this process the keyboard display is “————”.

5.2.23 PASS: Factory Password

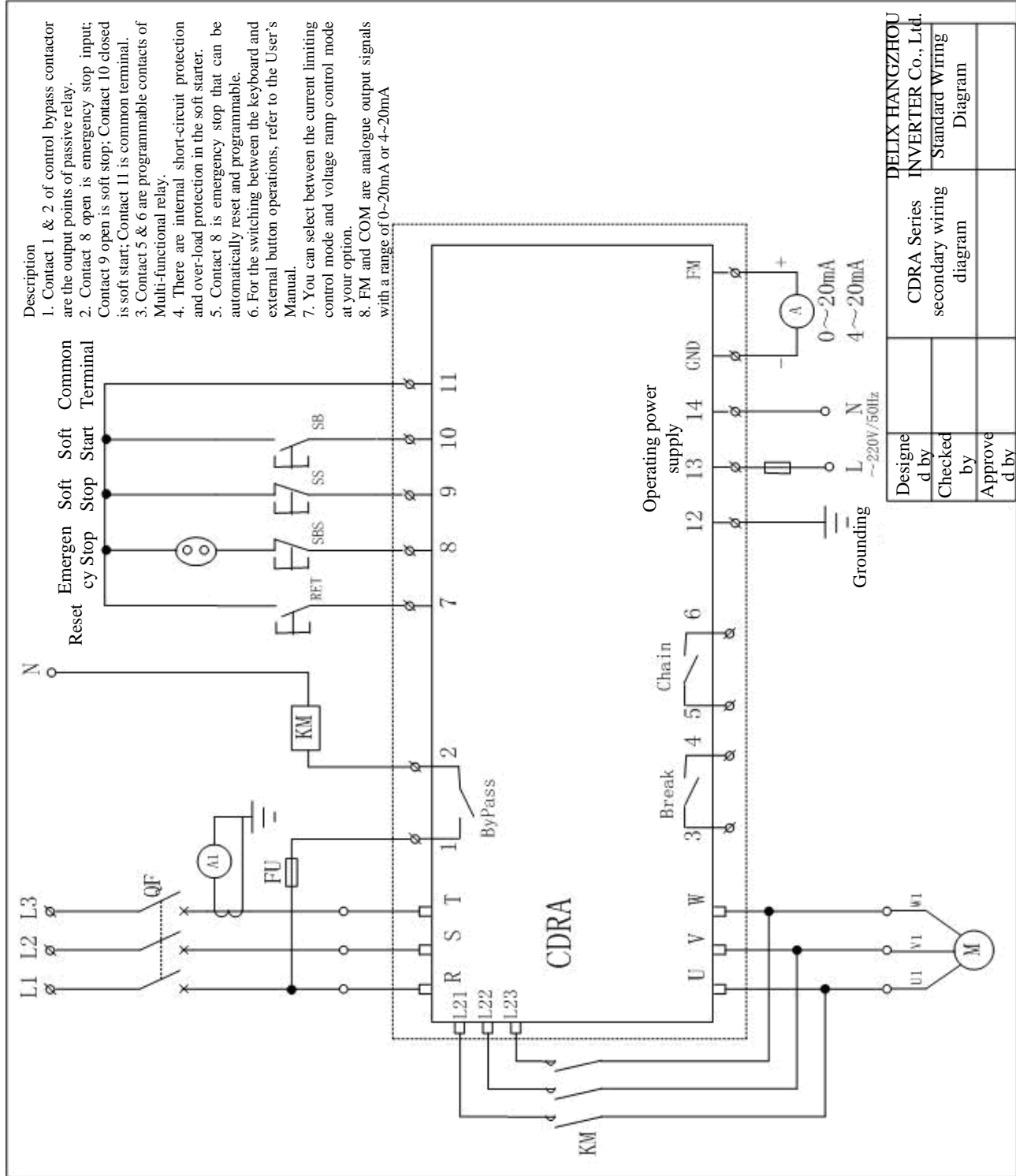
The code is used for factory password input, indicating exclusive function codes of the factory.

Chapter 6 Troubleshooting

CDRA series soft starter is equipped with a whole range of protection functions and can stop and display the fault code in case of any fault. You can only restart the starter after the fault state is released by pressing STOP or the external control terminal of RET (when restart function is set, the starter can automatically start).

Fault Display	Description	Causes and Measures
Err-0	Input phase failure	Check the input cable power supply and the SCRs
Err-1	Over-heat	Start too frequently or start time too long
Err-2	Over-load	Change the over-load protection factor or reduce the load
Err-3	Light-load	Load too light. Set P022 as 0. If there are accidents including released belt buckle, please check the device.
Err-4	Three-phase Imbalance	Check the load or whether the cable connection is loose.
Err-5	Emergency Stop	If the circuit of emergency stop terminal EMS- COM is open, please check the testing devices. If this terminal is not used, please set P011 as 0.
Err-6	Over-current	In case of over-current when starting, reduce the initial voltage or turn to current limiting mode. In case of over-current when running, reduce the load.
Err-7	Control Panel Fault	Current sampling circuit fault
Err-8	Start Time Too Long	The parameters are not properly set or the load is too heavy
d.Err	Parameter Error	Change P029 to 0, restart or restore the ex-works value.

CDRA Series Soft Starter Secondary Wiring Diagram



Attached Table I

Application Occasions

Machine Type	Load Type	Start Mode			Value Setting		Start Time
		Voltage	Current	Heavy-load	Voltage (%)	Current (%)	
Centrifugal pump	Standard		O			250	5
Air Blower	A Little Heavy		O	O		400	40
Compressor (Piston)	Standard		O			300	10
Compressor (Centrifugal)	Standard	O			30		20
Transportation Machine	Standard		O			250	10
Mixer	Standard		O	O		350	5
Ball Mill	Heavy		O	O	70	400	50
Crusher	Heavy	O			60		45

Appendix 1: MODBUS Communication Protocol

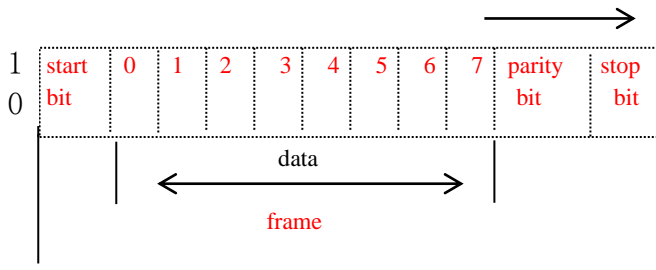
CDRA Series Soft Starter is equipped with RS-485 Communication Interface

1. MODBUS Communication Code Meaning:

AASCII Model: Every 8-Bit data consists of two ASCII Characters. For example, a 1-Bit data of 64H (hexadecimal) is represented by “64”of ASCII, including 6 (36H) and 4(34H).

Character Symbol	0	1	2	3	4	5	6	7
ASCII Code	30H	31H	32H	33H	34H	35H	36H	37H
Character Symbol	8	9	A	B	C	D	E	F
ASCII Code	38H	39H	41H	42H	43H	44H	45H	46H

- 2. Asynchronous transmission is adopted. Several slave machines (soft starters) receive information from one host computer and can not send information by themselves without the request from the host computer.
- 3. **Baud Rate**
- 4. **Numeric Character Format**



1-bit Start Bit

8-bit Data

Odd and Even Parity Check: based on function code

1-bit Stop Bit

Standard MODBUS ASCII Communication Format:

STX “:” (3AH)	A	K	DATA _(n-1) ...DATA ₀	LRC	END CR (0DH) LF (0AH)
------------------	---	---	--	-----	-----------------------------

- 1) STX: Start Unit“:”3ah
- 2) A: Slave Machine (Soft Starter) Address
- 3) K: Data Packet
03H: Read one or more data from the register
06H: Write one data into the register
- 4) DATA_(n-1)...DATA₀: Data.

- 5) LRC: Add the data from A to the last data and divide the sum by 256 to get the remainder (hexadecimal) (e.g. get 5AH if the sum is 15AH). Calculate the radix-minus-one complement and the complement number of the remainder, and the result obtained is the LRC error detection value.
- 6) END: Ending Character “CR” 0DH, “LF” 0AH

Standard MODBUS RTU Communication Format:

STX	A	K	DATA _(n-1) ... DATA ₀	CRC	END
-----	---	---	---	-----	-----

- 1) STX: Start Unit, the rest time over 10ms
- 2) A: Slave Machine (Soft Starter) Address
- 3) K: Data Packet
03H: Read one or more data from the register
06H: Write one data into the register
- 4) DATA_(n-1) ... DATA₀: Data
- 5) CRC: CRC Error Detection Value:
16-bit error detection value consists of two 8-bit characters.
- 6) END: the rest time over 10ms

5. Error Correcting

ASCII Model:

LRC (Longitudinal Redundancy Check) error detection value is adopted in ASCII model. Add the data from A to the last data and divide the sum by 256 to get the remainder (hexadecimal). Calculate the radix-minus-one complement and the complement number of the remainder, and the result obtained is the LRC error detection value.

LRC Computational Method

Start Bit	3AH
Soft Starter Address	30H
	31H
CMD	30H
	36H
Data Address	30H
	30H
	31H
	32H
Data	30H
	30H
	36H
	45H
LRC	37H
	39H
End	0DH
	0AH

The LRC computation in this example is as follows

$01H+06H+00H+12H+00H+6EH=82H$. The result through calculating the radix-minus-one complement and the complement number is 79H.

RTU Model:

CRC Computational Method:

1. Preset a 16-bit register as FFFF (hexadecimal) (i.e. all the bits are 1), and such a register is called CRC register.
2. Put the XOR result of the first 8-bit binary data (i.e. the first byte of the communication information frame) and the low 8 bits of the 16-bit CRC register into the CRC register.
3. Move the data of CRC register one bit rightwards (to the low bits), and fill up the highest bit with 0. Check the shift-out bit.
4. If the shift-out bit is 0: repeat step 3 (move one bit rightwards once more);
If the shift-out bit is 1: get the XOR result of CRC register and the polynomial A001 (1010 0000 0000 0001).
5. Repeat step 3 and step 4 until 8 rightwards movements are made. Thus the whole 8-bit data has been processed.
6. Repeat step 2 to step 5 to process the next byte of the communication information frame.
7. Exchange the high byte and the low byte of the 16-bit result of the CRC register from the computation of all the bits of the communication information frame.

Standard MODBUS Communication Protocol Parameter Address Definition:

Definition	Parameter Address	Function Description	
Internally Set Parameter of the Driver	00nnH	nn represents the number of the parameter, e.g. 14H represents P020.	
Order to the Driver	2000H	Bit0~1	00B: None
			01B: Stop
			10B: Start
			11B: None
		Bit2~15	Reserve
	2001H	Reserve	
2002H	Bit0	1: EF.ON	
	Bit1	1: Reset	
	Bit2~15	Reserve	
Monitoring of the Driver	2100H	0001	Ready
		0002	Normal Run
		0004	Phase Failure Err-0
		0008	Over-heat Err-1

		0010	Over-load Err-2
		0020	Light-load Err-3
		0040	Three-phase Imbalance Err-4
		0080	Emergency Stop Err-5
		0100	Over-current Err-6
		0200	Current Sampling Hardware Fault Err-7
		0400	Start Time Too Long Err-8
	2101H	****	Current Display

Parameter Function Description:

CMD: Function Order

03H: Read one data from the register

For example: Read Current Limiting Parameter P017

Command Information:

RTU Model:

Soft Starter Address	01H
CMD	03H
Data Address	00H
	11H
Data Number	00H
	01H
CRC	D4H
	0FH

Reply:

Soft Starter Address	01H
CMD	03H
Data Number	02H
Data	00H
	FAH
CRC	38H
	07H

ASCII Model:

Start Bit	3AH
Soft Starter Address	30H
	31H
CMD	30H
	33H
Data Address	30H
	30H
	31H
	31H
Data Number	30H
	30H
	30H
	31H
LRC	45H
	41H
End	0DH
	0AH

Reply:

Start Bit	3AH
Soft Starter Address	30H
	31H
CMD	30H
	33H
Data Number	30H
	32H
Data	30H
	30H
	46H
	41H
LRC	30H
	30H
End	0DH
	0AH

06H: Write a Parameter

For Example: Write Electric Machine Over-load Protection Parameter P018

Command Information:

RTU Model:

Soft Starter Address	01H
CMD	06H
Data Address	00H
	12H
Data	00H
	6EH
CRC	A8H
	23H

Reply:

Soft Starter Address	01H
CMD	06H
Data Address	00H
	12H
Data	00H
	6EH
CRC	A8H
	23H

ASCII Model:

Start Bit	3AH
Soft Starter Address	30H
	31H
CMD	30H
	36H
Data Address	30H
	30H
	31H
	32H
Data	30H
	30H
	36H
	45H
LRC	37H
	39H
End	0DH
	0AH

Reply:

Start Bit	3AH
Soft Starter Address	30H
	31H
CMD	30H
	36H
Data Address	30H
	30H
	31H
	32H
Data	30H
	30H
	36H
	45H
LRC	37H
	39H
End	0DH
	0AH