

HDRA / K 3 Series Soft Starter User Manual

(11kW~600kW)



(1.3)

Preface

Thank you for choosing the HDRA/K3 series soft starter manufactured by GUANGZHOU HEDY INTELLIGENT EQUIPMENT CO.,LTD

As a standard appendix, the Manual should be read carefully and followed strictly before and during use of HDRA/K3 series soft starter, in order to avoid operation errors, faults, shortened service life or even personal injuries. Please keep the Manual properly for further inspection & maintenance of soft starter.

The Manual contains operation steps and wiring diagrams for your reference. For any query or special requirements of soft starter, please kindly contact our local offices or dealers, or directly call our customer service center in the Headquarters for receiving wholehearted services.

The Manual is subject to a change without a prior notice.

Do unpacking inspection carefully as follows:

1. Check if there's product damage, part damage and falling and collision of main body during transport.
2. Check if rated values in nameplate are consistent with your order requirements; the packaging box contains the quality certificate, user manual and warranty card you need.

The soft starter is manufactured and packaged by the Company in strict accordance with the quality guarantee system. For any omission of inspection, please contact us or supplier for solution.



Warning

Do not print, spread or use the Manual unless otherwise permitted in writing. Violators will be investigated for the legal liabilities.

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Chapter 1 Safe Running and Notice

As a new and highly advanced starting device developed based on power electronic technique, microprocessor technique and modern control theory technique, the HDRA/K3 series all-digital intelligent AC motor soft starter (hereinafter referred to as "the Product") can restrict the startup current of asynchronous motor effectively, be widely applied in heavy-load equipment such as fans, water pumps, conveyors and compressors, making it the ideal alternative product for reduced-voltage starting product, such as star/triangle conversion and self-coupling voltage reduction. Moreover, the Product supports multiple control modes such as keyboard, external terminal and upper computer, supports outputs of fault relay, multi-function relay and analog signals, in order to be integrated into the system easily and flexibly.

Please read the Manual carefully before installation, running, maintenance and inspection of the Product.

Please read the chapter carefully before using the Product to keep safety of personnel equipment and properties. The Manual's precautions of safe running are divided into "warning" and "attention".



Warning

: Potential hazards which, if violated, may lead to major damage of equipment and major personal casualties.



Attention

: Potential hazards which, if being violated, may lead to moderate damages of equipment and personal injuries. This also applies to warning of unsafe operation.

1.1 Acceptance

Unpacking inspection items:

Items	Introduction
1. Check if the Product's model is consistent with that of order.	Check the model on the Product's lateral nameplate.
2. Check if parts are damaged.	Visually inspect the surface and check if there's damage during transport.
3. Check if parts are fastened safely.	Check all visible parts by using appropriate tools.
4. Check if instructions are attached. Check if quality certificate and warranty card are received.	Instructions, quality certificate and warranty card of the Product

The Product is manufactured and packaged by the Company in strict accordance with the quality guarantee system. For any omission of inspection, please contact us or supplier for solution.

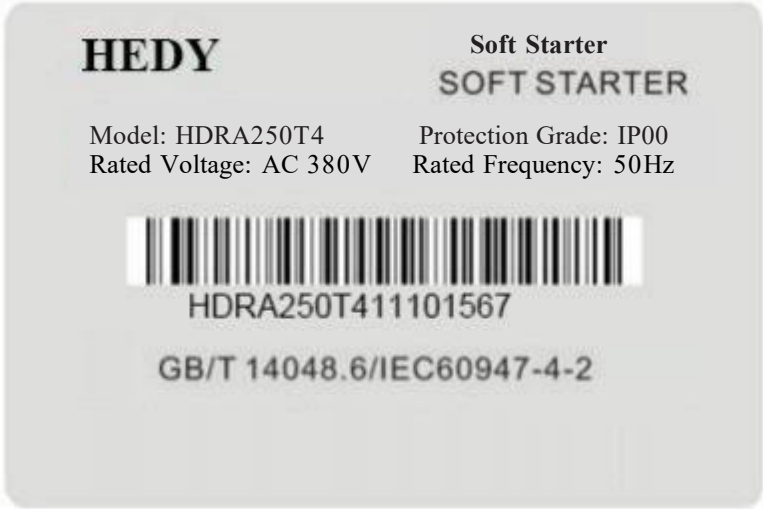
1.2 Safety Information

 Warning	1. Please install the Product on non combustibles such as metal to avoid fire; Keep the Product far away from combustibles to avoid fire; Do not install the Product in places with explosive gas to avoid explosion.
	2. The Product should be installed and maintained by professional personnel only.
	3. The Product's rated voltage must be consistent with the grade of AC power grade.
	4. Do not connect the Product's input/output end reversely to avoid unexpected action, or damage of the Product and its motor.
	5. Make sure starting circuit has the same phase sequence with that of bypass circuit before starting the bypass contactor; otherwise, inter-phase short circuit, damage or even fire may occur when switching bypass circuit.
	6. Make sure to install the cover plate before connecting input power. Do not remove the cover when power is on; otherwise, electric shock and explosion will occur.
	7. Do not touch the Product's terminals if the Product is power-on to avoid electric shock.
	8. Do not connect or disconnect the conductor and connector if circuit is power-on to avoid electric shock.
	9. Do not handle the Product with wet hands to avoid electric shock.
	10. Spare parts should be replaced by professional technicians only. Do not leave thread residue or metal in the Product to avoid fire.
	11. Do not touch the electronic components that can be easily damaged by static electricity.
	12. User should not apply withstand voltage test to the Product to avoid damage of internal components.
 Anti-static	
 Attention	1. The reactive power compensation capacitor designed for improving power factor must be connected to the Product's input end instead of output end; otherwise, the SCR power device can be damaged.
	2. Main loop terminal must be connected to conductor nose firmly to avoid damage of properties.
	3. The Product must be derated at places over 1,000 m. For more information, please consult our Technical Department.
	4. Do not modify the Product's default parameters at will to avoid damage.
	5. Once scrapped, the Product should be disposed as industrial waste, for electrolytic capacitor on printed board may explode when being burnt, or plastic parts, such as cover plate, will generate toxic gas when being burnt.

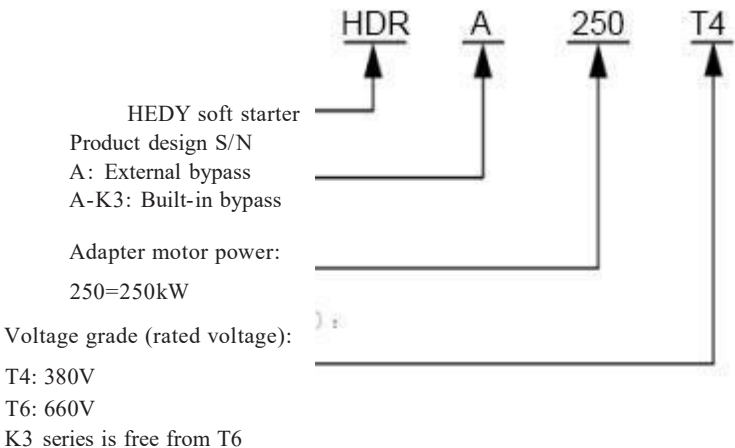
Chapter 2 Product Information

2.1 Data and Coding Rules of Nameplate

Data in nameplate: Take Type HDRA250T4 soft starter as example:

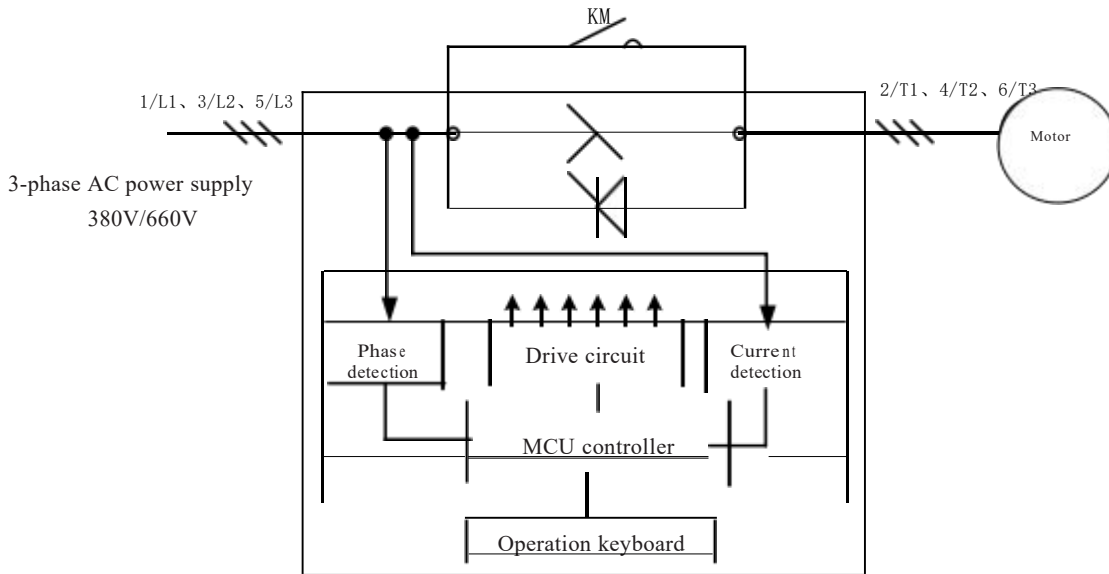


Data and model introduction of nameplate:

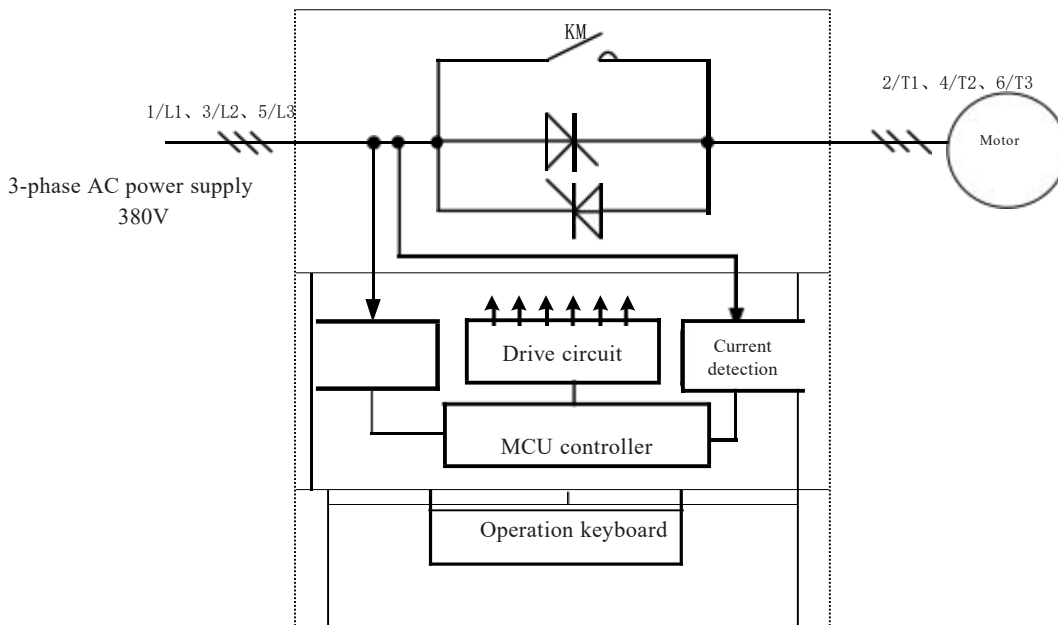


2.2 How it Works

(1) The main circuit of HDRA series motor soft starter is given inverse parallel connection via 6 thyristors before being given tandem connection to the stator loop on the AC motor. The soft start of motor is controlled by using the electronic switching of thyristor, changing the conduction angle of thyristor by controlling the variation of trigger angle through microprocessor, in order to change the input voltage of motor. Once started, the Product will output rated voltage, external 3-phase bypass contactor KM will be connected and the motor will be connected to power grid for connection.



(2) The main circuit of K3 series motor soft starter is given inverse parallel connection via 6 thyristors before being given tandem connection to the stator loop on the AC motor. The soft start of motor is controlled by using the electronic switching of thyristor, changing the conduction angle of thyristor by controlling the variation of trigger angle through microprocessor, in order to change the input voltage of motor. Once started, the Product will output rated voltage, external 3-phase bypass contactor KM will be connected and the motor will be connected to power grid for connection.



2.3 Technical Specification

Operation	Operation control mode		Keyboard/external terminal/RS485 communication		
	Start mode		Current limiting/voltage/heavy load		
	Start/stop period		Digital setting supported		
	Start delay		Digital setting supported		
	Emergency stop		Interrupt output of soft starter		
	Limiting current		Starting current is lower than this value under current limiting and heavy-load mode		
	Initial voltage		Initial voltage supports digital setting under voltage mode		
	Light-load control		Detect accidents such as belt tripping		
	Restart		Support restart in case of shutdown due to a fault		
	Fault output		Contact output - AC 250V 5A, DC 30V 5A		
	Multifunction relay output		Start delay, start, running, stop, complete stop, restart		
	Analog output		0~20mA / 4~20mA, optional		
Protection Function	Soft starter protection		Overcurrent, overload, overheat, three-phase imbalance, default phase, light load, external fault		
	Soft starter alarm		Emergency shutdown, light load and restart		
Display	Keyboard	Running information	Ready condition, start delay, starting process, operation, stop, fault alarm		
		Parameter protection	Set parameters are protected against modification		
Working Conditions	Category of use		AC-53b		
	Rated insulation voltage		660V	Rated impulse withstand voltage	4kV
	Operation frequency		≤ 12 times/h		
	Protection grade	IP20	HDRA011T4~HDRA055T4		
		IP00	HDRA075T4~HDRA600T4, K3G055T4~K3G600T4		
	Rated limit short-circuit current		HDRA055T4: 6kA ; HDRA160T4: 12kA		
			HDRA320T4: 20kA; HDRA600T4: 48kA		
			K3G075T4: 9.1kA ; K3G160T4: 12kA		
			K3G320T4: 20kA; K3G600T4: 48kA		
Environment	Ambient temperature		- 10 C ~ 40 C		
	Storage temperature		-20 C ~ 65 C		
	Ambient humidity		Max. 90 % RH. (no condensation)		
	Height/vibration		Below 1,000 m; below 5.9m/s ² (=0.6g)		
	Application scenario		No corrosive gas, inflammable gas, oil mist, dust or others		
Cooling Method	Natural air cooling		HDRA011T4~HDRA600T4, K3G055T4~ K3G075T4		
	Forced air cooling		K3G093T4~K3G600T4		

2.4 Model

2.4.1 Model of HDRA Series Soft Starter

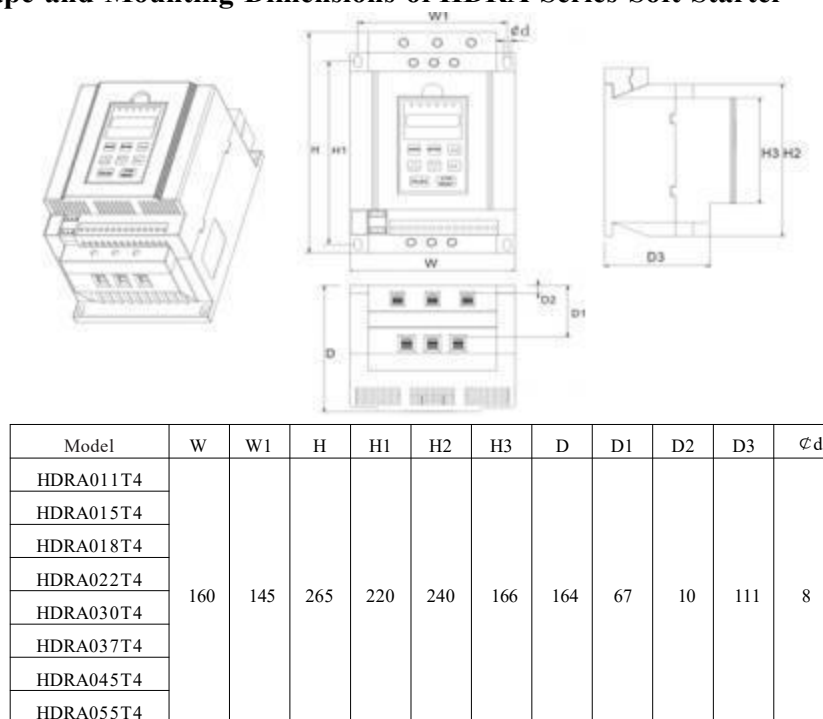
Model of Soft Starter	Rated Power (kW)	Rated Current (A)	Model of Circuit Breaker (QF)	Model of Bypass Contactor (KM)	Specification of Primary Wire
HDRA011T4	11	25	HDM1-63L/32	HJ20-25	6mm ² cable
HDRA015T4	15	32	HDM1-63L/40	HJ20-40	10mm ² cable
HDRA018T4	18.5	37	HDM1-63L/50	HJ20-40	10mm ² cable
HDRA022T4	22	45	HDM1-63L/63	HJ20-63	16mm ² cable
HDRA030T4	30	60	HDM1- 100L/80	HJ20-63	25mm ² cable
HDRA037T4	37	75	HDM1- 100L/ 100	HJ20- 100	35mm ² cable
HDRA045T4	45	90	HDM1-225L/ 125	HJ20- 100	35mm ² cable
HDRA055T4	55	110	HDM1-225L/ 160	HJ20- 160	35mm ² cable
HDRA075T4	75	152	HDM1-225L/ 180	HJ20- 160	35mm ² cable
HDRA093T4	93	176	HDM1-225L/200	HJ20-250	30*3mm ² copper bar
HDRA110T4	110	210	HDM1-400L/250	HJ20-250	30*3mm ² copper bar
HDRA132T4	132	253	HDM1-400L/315	HJ20-400	30*4mm ² copper bar
HDRA160T4	160	300	HDM1-400L/350	HJ20-400	30*4mm ² copper bar
HDRA200T4	200	380	HDM1-400L/400	HJ20-400	40*4mm ² copper bar
HDRA250T4	250	480	HDM1-630L/630	HJ20-630	40*5mm ² copper bar
HDRA320T4	320	600	HDM1-800H/700	HJ40-800	40*5mm ² copper bar
HDRA400T4	400	750	HDM1-800H/800	HJ40- 1000	50*5mm ² copper bar
HDRA450T4	450	892	HDM1- 1250/1000	HJ40- 1000	50*5mm ² copper bar
HDRA500T4	500	930	HDM1- 1250/1250	HJ40- 1000	50*5mm ² copper bar
HDRA600T4	600	1100	HDM1- 1250/1250	HJ40- 1000	50*5mm ² copper bar

2.4.2 Model of K3 Series Soft Starter

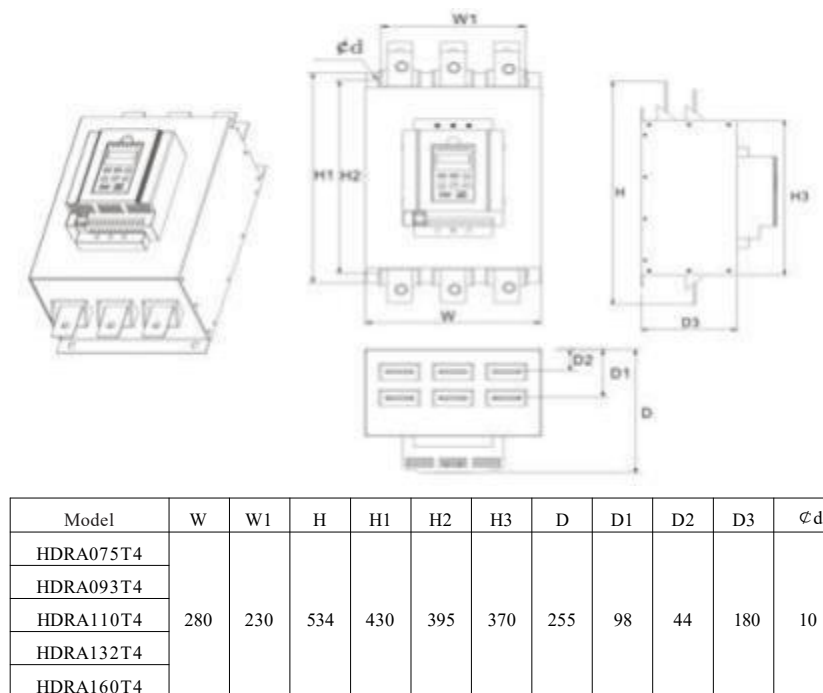
Model of Soft Starter	Rated Power (kW)	Rated Current (A)	Model of Circuit Breaker (QF)	Specification of Primary Wire
K3G055T4	55	110	HDM1-225L/160	35mm ² cable
K3G075T4	75	152	HDM1-225L/180	35mm ² cable
K3G093T4	93	176	HDM1-225L/200	30*3mm ² copper bar
K3G110T4	110	210	HDM1-400L/250	30*3mm ² copper bar
K3G132T4	132	253	HDM1-400L/315	30*4mm ² copper bar
K3G160T4	160	300	HDM1-400L/350	30*4mm ² copper bar
K3G200T4	200	380	HDM1-400L/400	40*4mm ² copper bar
K3G250T4	250	480	HDM1-630L/630	40*5mm ² copper bar
K3G320T4	320	600	HDM1-800H/700	40*5mm ² copper bar
K3G400T4	400	750	HDM1-800H/800	50*5mm ² copper bar
K3G450T4	450	892	HDM1- 1250/1000	50*5mm ² copper bar
K3G500T4	500	930	HDM1- 1250/1250	50*5mm ² copper bar
K3G600T4	600	1100	HDM1- 1250/1250	50*5mm ² copper bar

2.5 Shape and Mounting Dimensions

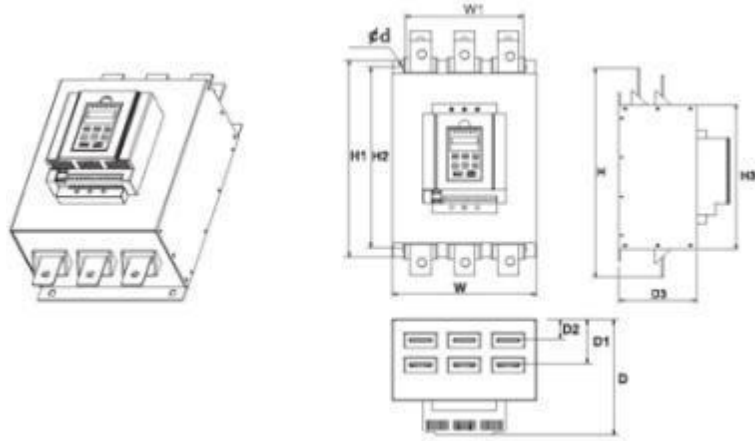
2.5.1 Shape and Mounting Dimensions of HDRA Series Soft Starter



Dimension unit Millimeter

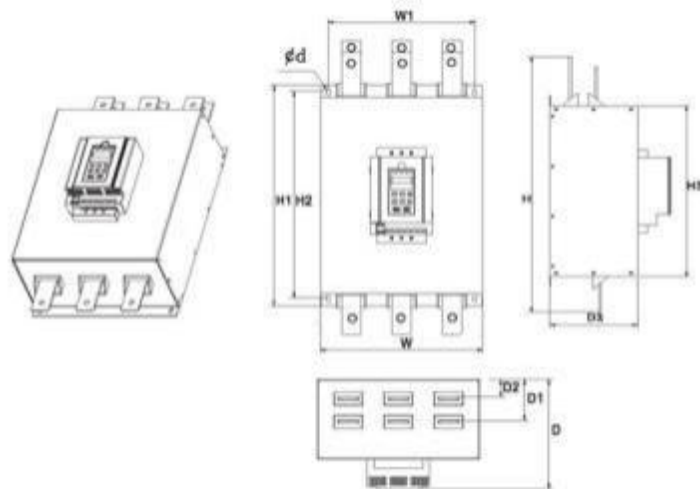


Dimension unit Millimeter



Model	W	W1	H	H1	H2	H3	D	D1	D2	D3	ϕd
HDRA200T4	310	265	594	475	440	415	255	98	44	180	10
HDRA250T4											
HDRA320T4											

Dimension unit Millimeter



Model	W	W1	H	H1	H2	H3	D	D1	D2	D3	ϕd
HDRA400T4	416	375	740	555	520	495	275	106	44	200	10
HDRA450T4											
HDRA500T4											
HDRA600T4											

Dimension unit Millimeter

2.5.2 Shape and Mounting Dimensions of K3 Series Soft Starter (unit: mm)

Model	H	H1	H2	W	W1	D	D1	D2	∅d
K3G055T4	384	345	360	200	165	226	137.5	137.5	7
K3G075T4									
K3G093T4	579	520	545	255	180	230	160	151	9
K3G110T4									
K3G132T4									
K3G160T4									
K3G200T4	684	620	650	300	235	235	159	154	9
K3G250T4									
K3G320T4									
K3G400T4	810	715	740	520	400	240	166	163	9
K3G450T4									
K3G500T4									
K3G600T4									

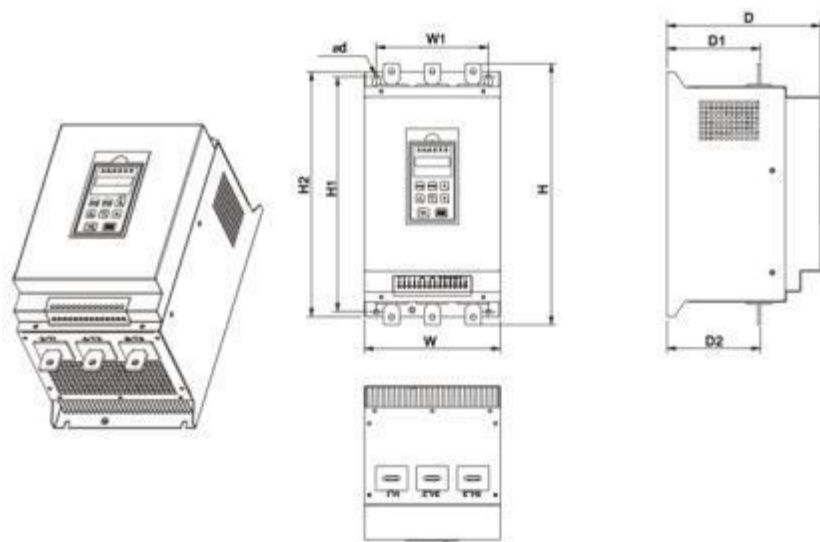


Fig. 1 Applicable to K3G055-075kW

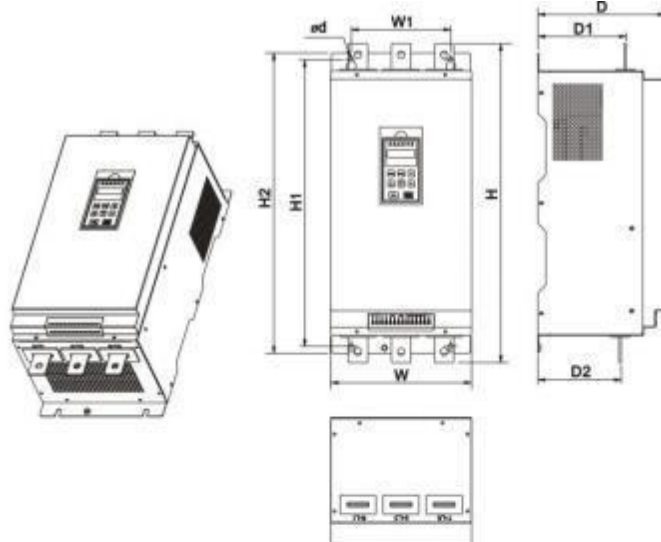


Fig. 2 Applicable to K3G093-320kW

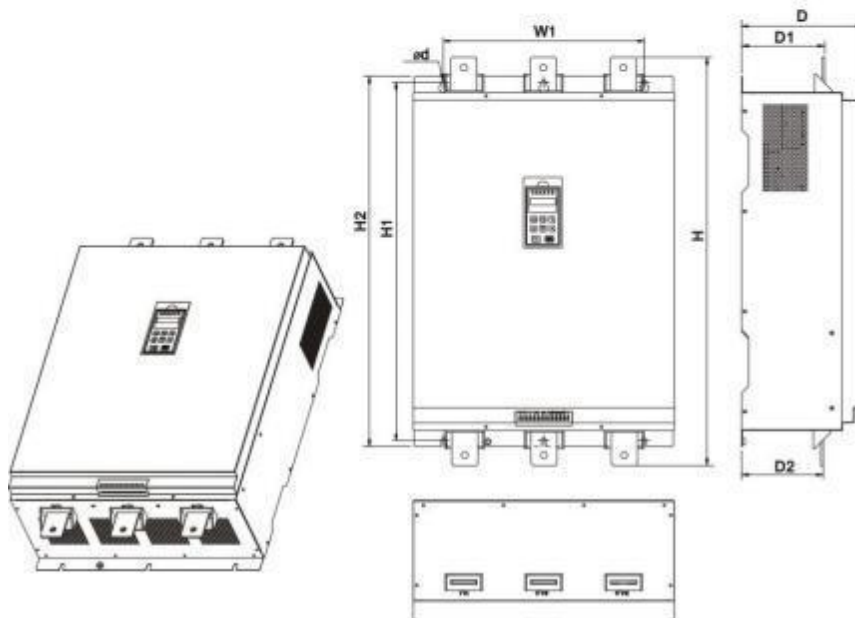


Fig. 3 Applicable to K3G400-600kW

2.6 Daily Maintenance

(1) Daily Maintenance

The Product should be given daily and regular maintenance against the adverse influences from ambient temperature, humidity, dust and vibration, to avoid reduced insulation grade and creepage distance, arc discharge or short circuit, control circuit failure, accidents, working failure or reduced service life.

Daily inspection items:

- A. Whether motor has abnormal sounds at startup, shutdown and running period.
- B. Whether motor has vibration in running period.
- C. Whether the Product's installation environment is changed.
- D. Whether the Product is overheated.

Daily cleaning:

- A. Keep the Product clean.
- B. Remove the dust on the Product's surface, and prevent dust from entering the Product, especially the metal dust.
- C. Prevent moisture or water drop from entering the Product.

(2) Regular Inspection

Please do regular inspection to the inaccessible parts.

- A. Check and clean the air duct on a regular basis.
- B. Check if screws are loose.
- C. Check if the Product is corroded.
- D. Check if terminal block has traces of arc discharge.
- E. Do insulation test of main circuit.

Prompt: Disconnect the main circuit from the Product before measuring the insulation resistance by using a megger (DC 500V megger). Do not measure the insulation of control circuit by using insulation resistance meter. No high-voltage test is required (for it is conducted before delivery).

(3) Warranty

Free warranty applies to the Product itself.

For any fault or damage of the Product in normal use domestically (subject to the Manual), the Product may enjoy 18-month free warranty as of the date on bar code.

The Product enjoys 6-month free warranty as of the date of delivery if being sold overseas (excluding domestic market).

The Company's products enjoy life-long services regardless of time and location.

The Product may enjoy after-sales services from the Company's national sales institutes and agents on basis of the following service conditions:

- A. "3-level" inspection services (except for troubleshooting) are conducted in the place of this institute.
- B. Be subject to the standards of after-sales responsibility in contract signed by and between the Company and sales agent.
- C. Request for paid after-sales services (whether within warranty period or not) can be sent to the Company's sales agents.

The user should firstly purchase property insurance from the insurance company for acquiring more guarantees on compensation, for the Company bears the sole responsibility of repairing, replacement and return of product if it has quality problem or accident.

The Product may enjoy 18-month free warranty as of the date on bar code.

For any fault due to the following causes, paid maintenance services will be provided even if the Product is within the warranty period:

- A. The fault is caused by improper operation (subject to the operation instructions) or unauthorized self-repairing and modification.
- B. The fault is caused due to violation of standards.
- C. The Product is damaged due to falling or improper handling after purchase.
- D. The parts become aged or faulty due to improper ambient environment.

- E. The Product is damaged due to earthquake, fire, wind and fire disaster, abnormal voltage, other natural hazards or disaster-related factors.
- F. The Product is damaged in transport process (Note: The transport mode is designated by customer; the Company assists in handling the procedure of cargo transfer).
- G. The manufacturer's brands, trademark, S/N and nameplates are damaged or fail to be identified.
- H. The payment of goods is not made as agreed.
- I. Fail to introduce the information of installation wiring, operation, maintenance or other cases to the Company in an objective and real way.

Products enjoying services of repairing, replacement and return must be firstly returned to the Company to determine the attribution of liability before start of return or repairing.

If buyer fails to pay off in time, the Company still owns the Product without bearing the responsibility above and the buyer should have no objection on this.

The service fees should be calculated according to the unified standards of manufacturer. The contract (if any) should prevail.

Chapter 3 Installation and Wiring of Soft Starter

3.1 Selection of Installation Location and Space

Selection of installation location:

 Warning	1. Avoid direct sunlight and outdoor use.
	2. Do not use the Product in places with corrosive gas and liquid.
	3. Do not use the Product in places with oil mist and splashed water.
	4. Do not use the Product in places with salt mist.
	5. Do not use the Product in places with rainfall and moisture.
	6. Install a filter if air has metal powder, silk, optical fiber or flying fabric.
	7. Do not use it in places with mechanical impact and vibration.
	8. Cooling measures must be adopted if ambient temperature exceeds 40C.
	9. Use the Product in the recommended temperature range of - 10C~+40C to avoid faults due to overcooling or overheat.
	10. Keep distance with power supply noise; for example, the Product can be affected by electric welder and high-power equipment.
	11. The Product's running will be affected by the radioactive materials.
	12. Keep the Product away from flammable materials, diluents and solvents.

It is recommended to install the Product in the places as recommended above to safeguard its performance, long life and avoid damages.

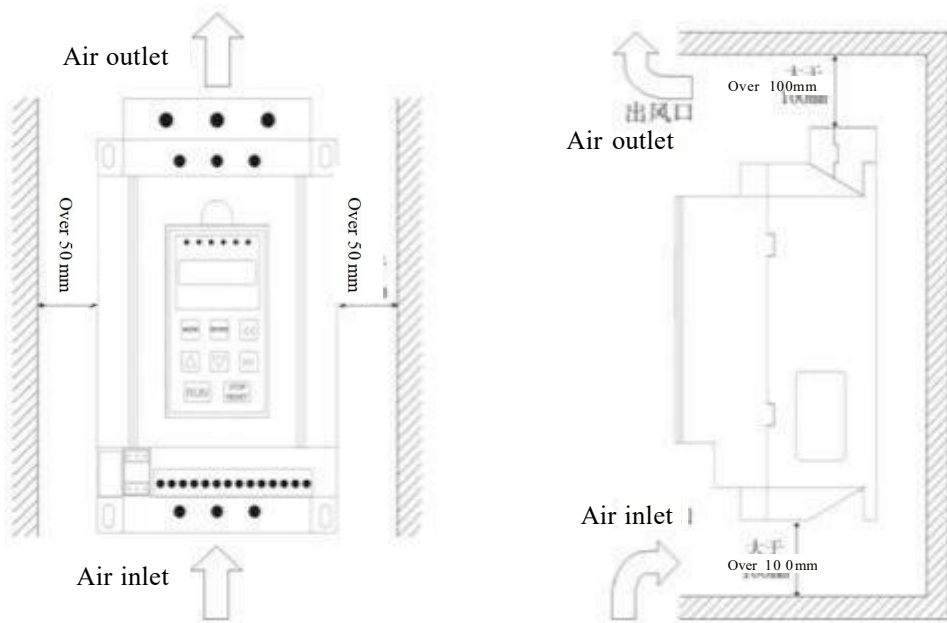
Installation direction: The Product must be installed vertically to ensure good cooling.

Selection of installation space:

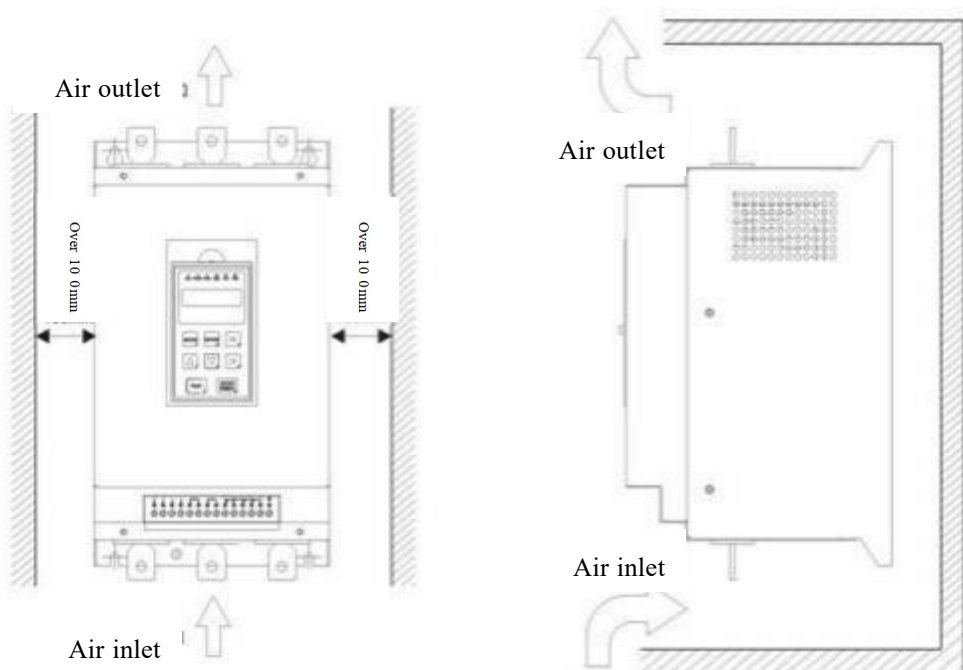
The HDRA series soft starter should be reserved with sufficient cooling space when installed vertically to guarantee effective cooling; see diagram below:

Do not drop any foreign matter into the Product during installation, to avoid reduced insulation grade or even short circuit.

Schematic diagram for installation of HDRA series soft starter

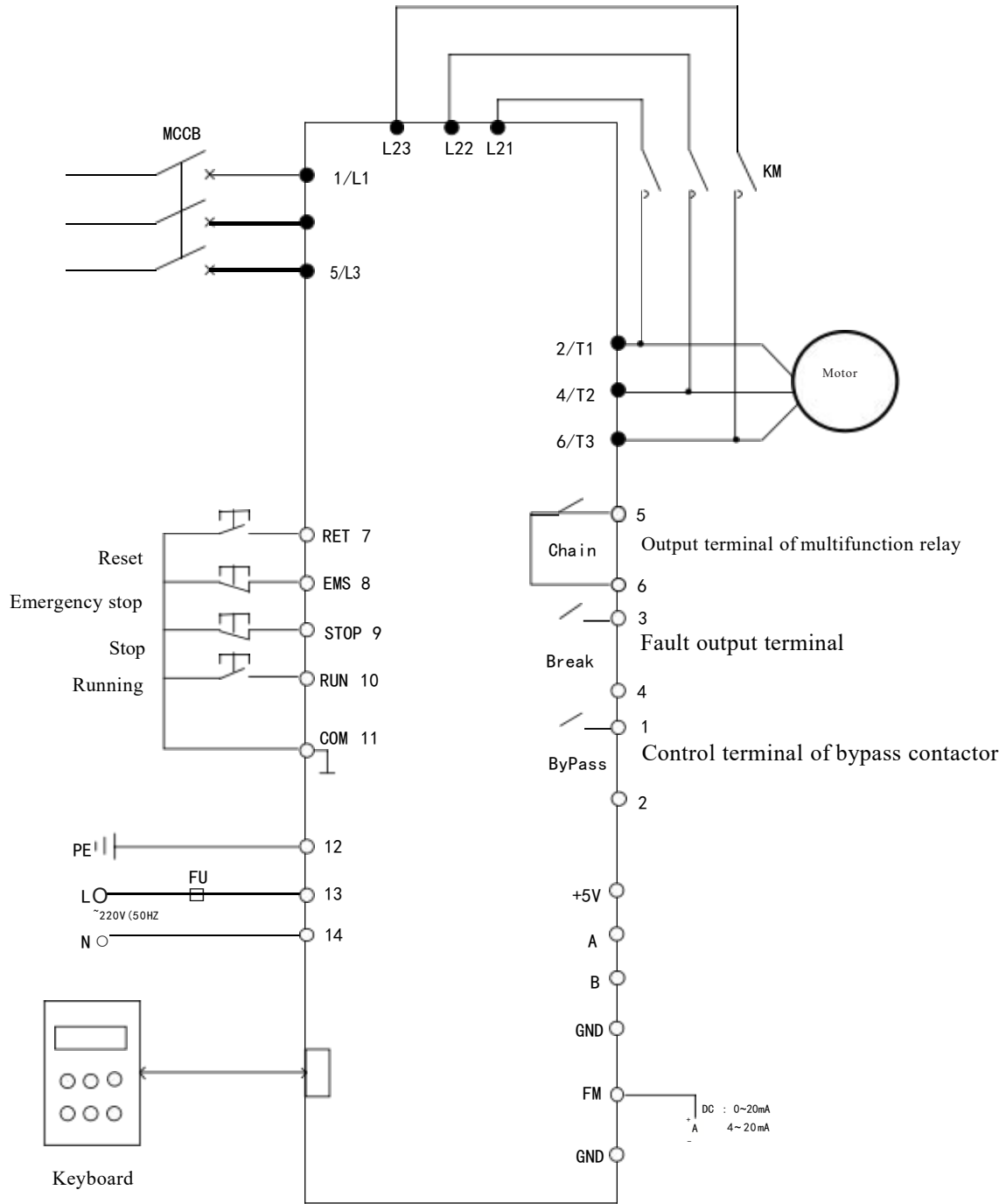


Schematic diagram for installation of K3 series soft starter



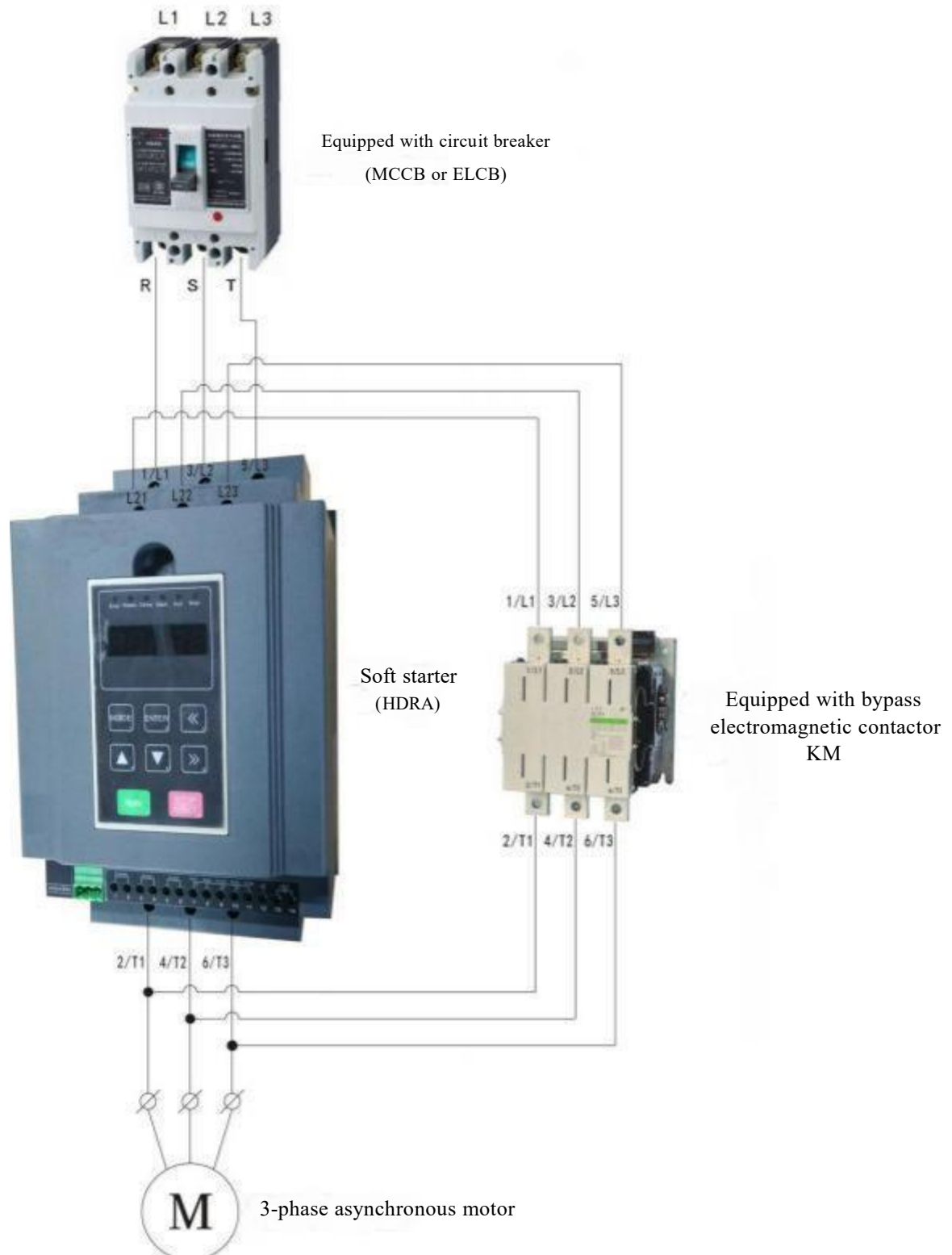
3.2 Wiring

3.2.1 Schematic Diagram for Basic Wiring of HDRA

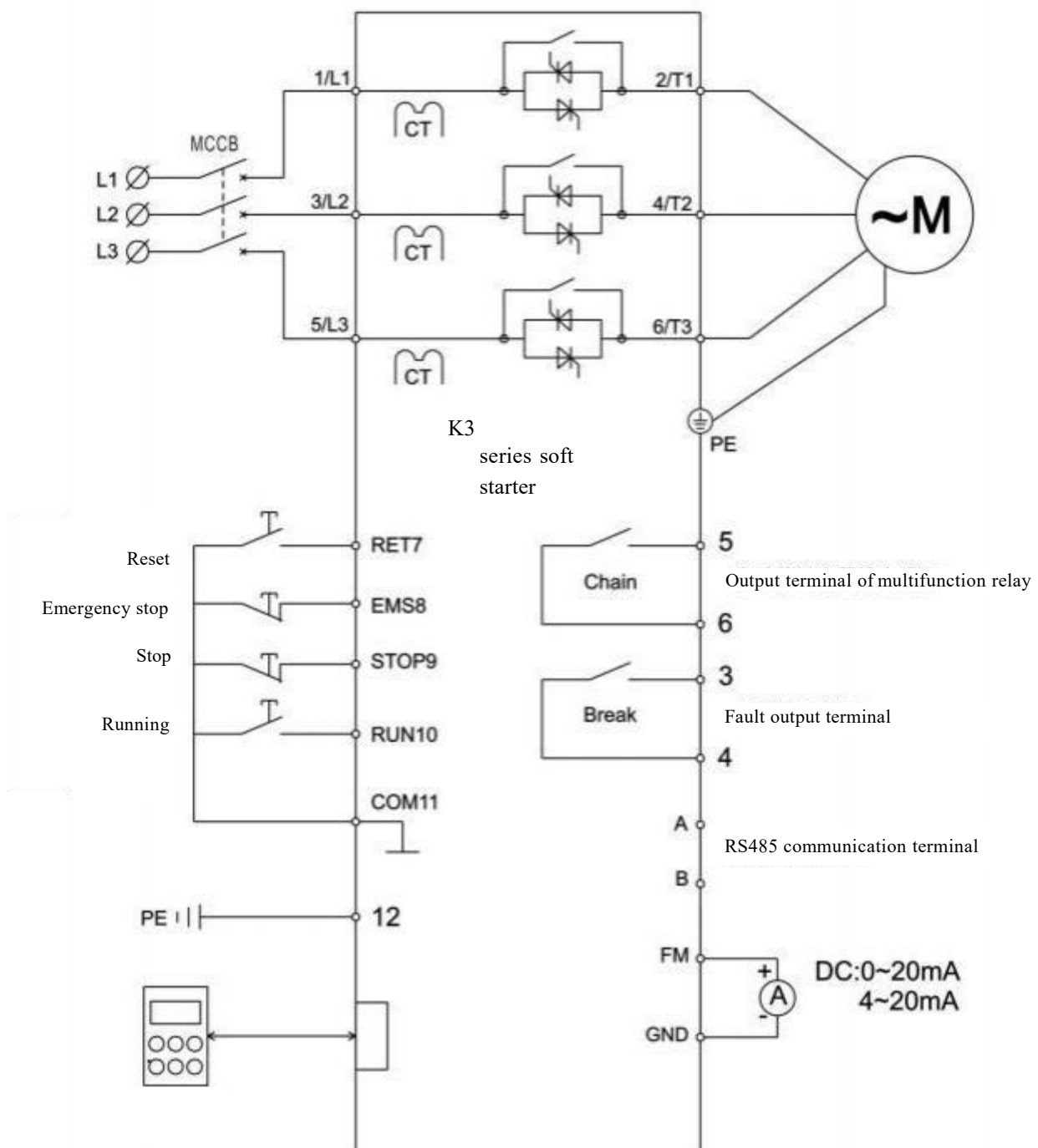


3.2.2 Basic Wiring Diagram of HDRA

Power 3-phase 380V-50Hz



3.2.3 Schematic Diagram for Basic Wiring of K3



3.2.4 Basic Wiring Diagram of K3



Precautions of Wiring:

 Warning	1. Make sure to power off before wiring.
	2. Check if the Product's rated voltage is consistent with voltage grade of AC power supply.
	3. Do not connect the Product's input/output end reversely to avoid unexpected action, or damage of the Product and its motor.
	4. Make sure starting circuit has the same phase sequence with that of bypass circuit before starting the bypass contactor; otherwise, inter-phase short circuit, damage or even fire may occur when switching bypass circuit.
	5. Do not touch the electronic components that can be easily damaged by static electricity.
	6. User should not apply withstand voltage test to the Product to avoid damage of internal components.

3.2.5 Introduction to HDRA and K3 External Terminals

Classification		Terminal Symbol	Terminal Name	Introduction
Main circuit		1/L1.3/L2.5/L3	Power input of AC main circuit	Connect 3-phase AC power supply via circuit breaker
		2/T1.4/T2.6/T3	Output terminal of soft starter	Connect 3-phase asynchronous motor
		L21.L22.L23	Specific terminal of external bypass contactor	Connect bypass contactor (A-K3 series is free from this terminal)
Control power supply		13	Input terminal of control power supply	Connect to AC 220V, 50Hz
		14		(A-K3 series is free from this terminal)
		12	Ground terminal	Grounding
Control Circuit	Relay output	1	Bypass Control terminal of bypass contactor	Closed after startup Capacity: AC 220V 5 (A-K3 series is free from this terminal)
		2	Bypass	
		3	Break	
		4	Output terminal of fault relay	Action in case of fault (method is settable) Capacity: AC 220V 5A
		5	Chain	
		6	Output terminal of multifunction relay	Action mode is programmable Capacity: AC 220V 5A
	Digital input	7	External reset terminal RET	External terminal sends reset signal in case of fault
		8	Emergency stop control terminal EMS	Emergency control signal is controlled by external signal
		9	External and stop terminal STOP	Under external control mode, STOP and COM are closed, RUN and COM are closed to realize effective running; otherwise, shutdown is enabled.
		10	External running terminal RUN	
		11	Common port of external signal terminal COM	Public terminal of digital input
	RS45 communication	A	Positive signal of 485 communication	RS485 communication terminal
		B	Negative signal of 485 communication	
	Power interface	+5V	+5V power supply	Power supply
		GND	GND terminal	Power ground
	Analog output	GND		0-20mA, 4-20mA output signal of analog quantity can be selected via programming
		FM	Output terminal of current signal	

3.2.6 Connection and Use of HDRA and K3 Control Terminal

1. Precautions of terminal wiring

Please connect the control terminal using multi-core shielded cable or stranded wire. If shielded cable is used, the near end (the end closer to the Product) should be connected to the Product's ground terminal PE. In process of wiring, the control cable should be over 20 cm away from the main circuit and high-voltage line (including power wire, motor wire, relay wire and contactor wire), avoid parallel arrangement and be provided with vertical wiring as recommended, in order to avoid malfunction of the Product due to interference.

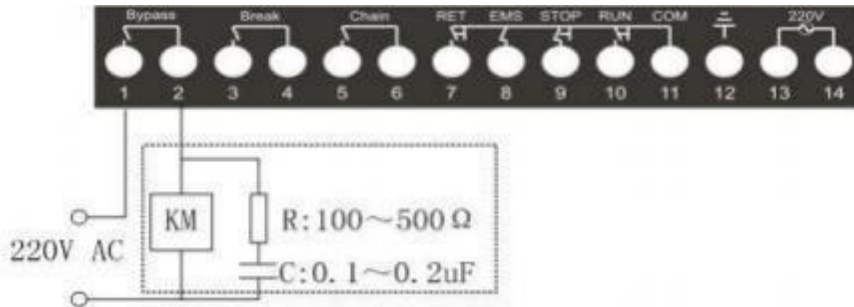
2. Wiring of external control terminals

Make sure to cut off power supply before wiring to avoid hazardous voltage.

(1) Bypass terminal 1 and 2 are controlled by bypass contactor (**A-K3 series is free from this terminal**)

Upon finishing startup, close the internal contacts and connect the bypass contactor KM; the internal contacts will be opened when stop commands are given out.

Suggestion: Install a RC absorption circuit near the both ends of contactor coil to absorb the surge voltage generated by the disconnection of contactor coil and reduce the interference of starter on the control circuit.



(2) Break terminal 3 and 4 of fault output relay

The relay, which will act if the Product becomes faulty, can be set to be normally open or closed through parameter setting. The contactor capacity is AC 250V 5A.

(3) Output Chain terminal 5, 6 of multifunction relay

This contactor can be connected to other control equipment, with its action mode being selected via parameter setting. Contactor capacity: AC 250V 5A.

(4) Reset input RET terminal 7, 11

The fault status can be relieved when external reset terminal RET is connected to public terminal COM.

(5) Emergency stop input EMS terminal 8, 11

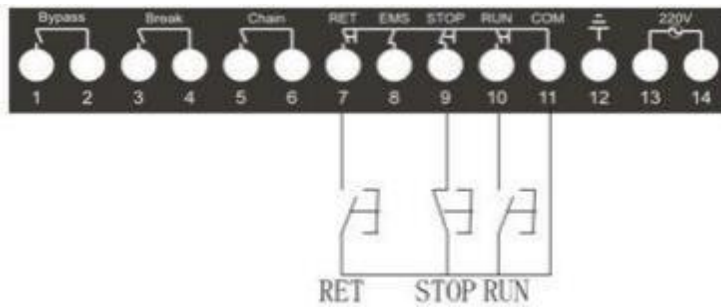
Designed for inputting the external signal of emergency stop, the terminal can be connected to external emergency stop button and thermal relay, in order to protect the normally closed contacts of circuit. The Product will not work until both of EMS and COM are connected and, if they are disconnected, the Product will shut down within 2s. This function can be disabled by user via parameter setting.

(6) Operation control STOP, RUN, COM terminal 9, 10, 11

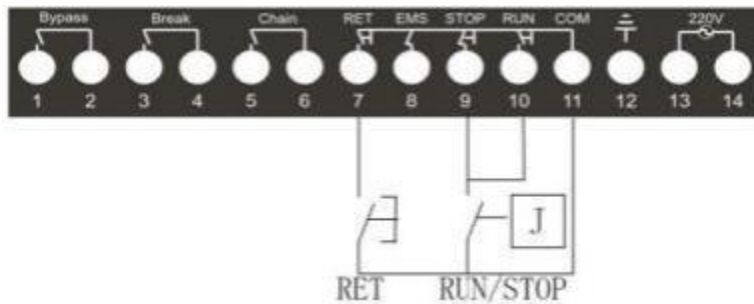
Designed for inputting running and stop signals during external control, these three terminals are not enabled until the external control mode is entered. Under external control mode, the Product will enter running status if STOP-COM and RUN-COM are closed, or enter shutdown status under other control signal modes.

Chapter 3 Installation and Wiring of Soft Starter

Common 3-wire wiring method of external buttons is as follows:



2-wire wiring method as shown in diagram below:

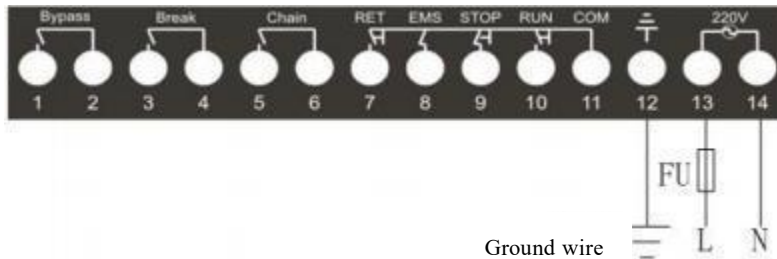


(7) Ground terminal 12

Please connect effective ground wire to this terminal and use multi-core cable.

(8) Control power terminal 13, 14 (**A-K3 series is free from this terminal**)

Connect to external control power supply, AC 200v for supplying power to the control board.



(9) Analog current output terminal FM, GND

Output the 4-20mA or 0-20mA current signals of reaction main circuit and output modes can be set via parameters.

(10) RS485 communication terminal A, B

A: 485 positive signal; B: 485 negative signal



Chapter 4 Keyboard Operation and Running

4.1 Keyboard Operation

4.1.1 Keyboard Display, Button and Function Introduction



Functional introduction to indicator lamps:

No.	Name (English)	Name (Chinese)	Function Description
1	Error	故障	The lamp is on when the Product becomes faulty
2	Ready	准备	The Lamp is on when the Product is ready for start
3	Delay	延时	The lamp is on when the Product is under delay mode
4	Start	起动	The lamp is on when the Product is under startup status
5	Run	运行	The lamp is on when the Product is running
6	Stop	停止	The lamp is on when the Product is shut down

4.1.2 Display Method and Operation Method

1. Display contents

The Product's keyboard display has two modes: Monitoring mode and function code mode.

a) Display contents at monitoring mode:

“READY”: Ready for start;

“DELAY”: Delayed start;

“START”: In start process;

“RUN”: In bypass running;

“STOP”: In stop process;

“ERR-X”: Fault display;

"Display mean current";

"Display Phase-A current"

"Display Phase-B current";

"Display Phase-C current"

b) Function code mode

“P0XX”: Function code No.;

“XXXX”: Parameter value of function code;

Monitoring mode and function code mode can be switched via "MODE" key.

2. Operation method at monitoring mode

a) Power on the Product normally, pass power-on self-test and nixie tube will show "READY" and indicator "Ready" is on, which means the Product is ready for start;

b) If wiring and phase sequence are correct and delay function is enabled, press "RUN" key and it will show "DELAY" and indicator "Delay" is on; if delay function is disabled or delay period is finished, it will show "START" and indicator "Start" is on; "START" will be displayed for about 1 s in startup process of the Product before it is automatically switched to display of mean current.

c) Once started, the Product will show "RUN" and indicator "Run" is on, which mean bypass is running. "RUN" will be displayed for about 1 s before it is automatically switched to display of mean current.

d) Press ">>" key to display the "Phase A current", "Phase B current" and "Phase C current" in turns.

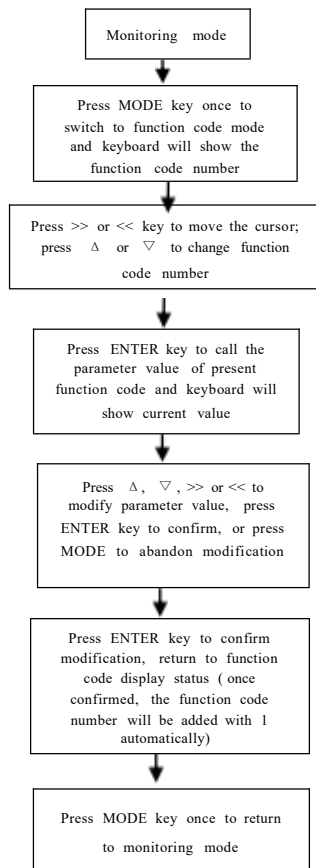
e) Press "STOP" key to display "STOP", indicator "Stop" is on and the Product will be stopped.

f) "Ready" will be displayed at the completion of stop process.

g) For any fault or alarm in execution process of the Product, it will show flickering “ERR-X”; X means fault code and indicator "Error" is on. Press "STOP" key or close "RET" terminal to reset the Product.

3. Operation method at function code mode

Press "MODE" key at monitoring mode to enter the function code mode. Firstly, it shows the function code No. "P0XX", press "ENTER" key to call the parameter value of present function code, press ">>" or "<<" key to move to the to-be-modified digit; press “△” or “▽” key to increase or decrease the value at the current digit. Once setting is done, save the parameters, press "ENTER" key; or press "MODE" key to abandon the setting.



For example: Modify stop time parameter
P002 from 2s to 5s

1	READY	Display ready status, press MODE key to enter function code mode
2	P000	Display function code number P0 0 0 and press Δ key twice
3	P002	Press ENTER key to call the parameter value of function code
4	02	Check if current parameter value is 02 and the point stays at the final data bit 2
5	05	Press Δ key for third times, modify display value as 05 and then press ENTER key
6	P003	Save Data 05 and write it into P002, return to display of function code number, add 1 and display P003
7	P002	If MODE, instead of ENTER, is pressed in the 5th step, the keyword will return to function code display P0 0 2, data will be kept as 02 and data are not modified
8	READY	Press MODE key to return to monitoring mode

Note: Do not modify the parameters once parameter protection function is enabled in P029 (parameter protection).

4.2 Running

4.2.1 Trial Run

Do trial run to see if revolving direction and transmission of motor are normal

- (1) Make sure all wires are connected reliably and phase of main electric wiring is correct;
- (2) Power on and keyboard displays "READY";
- (3) Adjust the Product's function parameters reasonably according to motor load at site, in order to reach the optimal starting torque of motor;
- (4) Press RUN to start the Product, check if motor revolving direction is correct and if not, press STOP to stop it. For any rotation failure of motor, increase the starting voltage and torque.

4.2.2 Operation

- (1) Adjust the Product's function parameters reasonably according to motor load at site, in order to reach the optimal starting torque of motor;
- (2) Press RUN key on panel to start the Product. If motor is running stably and free from acceleration or sudden current change, the parameters are proper and press STOP key to stop it;
- (3) For any fault in running, find out the fault as per Chapter 6;
- (4) Stop time must be set as 0 if the Product is used for driving two motors.
- (5) Once the Product is started, press ">>" to switch the display of "Mean current", "Phase A current", "Phase B current" and "Phase C current";

Chapter 5 Function Code Parameter

5.1 List of Function Codes

Function Code	Name	Range	Min. Unit	Default Setting	Introduction
P000	Initial voltage	30%~70%	1%	30	Voltage mode is effective
P001	Starting time	2~100S	1S	12	All modes are effective
P002	Parking time	0~50S	1S	0	0 means free stop
P003	Starting mode	0: Voltage 1: Current limiting 2: Jump and current limiting (heavy load) 3: Torque slope 4: Current limiting of torque 5: Jump and current limiting of torque	1	0	Be selected depending on motor load; see Attached Table 1
P004	Load type	0: No specific load 1: Centrifugal pump 2: Fan 3: Compressor (piston) 4: Compressor (centrifugal) 5: Conveyor 6: Blender 7: Ball mill 8: Crusher 9: Water pump	1	0	Set this parameter depending on load
P005	Control mode	0: Keyboard 1: External control 2: Keyboard + External control 3: PC 4: Keyboard + PC 5: External control + PC 6: All of three control modes are enabled 7: Locked running	1	4	Select control mode depending on working conditions
P006	Start and maintaining period	0~20S	0.1S	0.0	All modes are effective Impulse voltage time under heavy load mode
P007	Intermediate voltage	P000~70%	1%	50	All modes are effective
P008	Intermediate time	0~P001-2	1S	0	All modes are effective
P009	Impulse voltage	50%~80%	1%	50	Effective under heavy load mode
P010	Start delay	0~999.9S	0.1S	0	The delay period from enabling of startup signal to actual startup
P011	Emergency stop control	0: Emergency stop control is invalid 1: Emergency stop control is valid	1	0	Set effectiveness of EMS terminal

Chapter 5 Function Code Parameter

P012	Fault relay control	0: Normally open 1: Normally closed	1	0	Set contact status
P013	Closing moment of multi-function relay	0: Running signal is effective 1: Start process 2: Bypass running 3: Stop process 4: Stop completes 5: Fault 6: Heavy-load start completes	1	0	This set of parameter should be set reasonably considering the external control device
P014	Opening moment of multi-function relay		1	0	
P015	Closing delay of multi-function relay	0.0~999.9S	0.1S	0	
P016	Opening delay of multi-function relay	0.0~999.9S	0.1S	0	
P017	Limiting current	150%~500%	1%	250	Effective under heavy load and current limiting mode
P018	Motor overload protection	50%~200%	1%	100	Select overload curve
P019	Degree of unbalance	0~100%	1%	50	0: Closing
P020	Analog output of full-scale value	20~5000A	1A	Model	Set the current value of the maximum analog output value (20mA)
P021	Select analog quantity output	0: 4~20mA 1: 0~20mA	1	0	Select current range of analog quantity output
P022	Light-load control	0: Closing 1: Alarm 2: Shutdown	1	0	Action mode of soft start once light load is detected
P023	Light-load rate	10~100%	1%	100	Light load detection level
P024	Light-load detection delay	0.0~99.9S	0.1S	0	Action delay after detection of light load
P025	Restart times supported	0~3	1	0	Restart times supported after faulty shutdown
P026	Select baud rate	0: 2400bps 1: 4800bps 2: 9600bps 3: 19200bps	1	2	Set 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	3	
P028	Machine No.	0~31	1	1	

P029	Parameter writing protection	0: No protection 1: Protection provided	1	0	Protect parameters against modification
P030	Parameter initialization	0: No action 1: Recovery default setting	1	0	Recover default parameters
P031	Fault record 1				The latest fault record
P032	Fault record 2				
P033	Fault record 3				
P034	Fault record 4				
P035	Select power-on running	0: Response to running 1: No response to running	1	1	Mode of response to terminal running instruction when powering on
PASS	Manufacturer password	****			

5.2 Introduction to Function Code

5.2.1 P000: Initial Voltage

P001: Starting time

As the start control parameters under voltage mode, the initial voltage can be increase to overcome the static friction force at startup; the start time will be longer if load inertia is increased.

When started, the Product will increase its output voltage gradually from the initial voltage by start time; when rated voltage is reached, the bypass contact will be closed to finish the start process. In which, the start time is the time parameter baseline for the Product's output voltage rise, in order to control the output voltage, accelerate the motor stably to finish the start process. So, the start time is lower than the set value in case of light load and it is normal phenomenon only if the Product can be started normally.

5.2.2 P002: Stop Time

The Product can stop freely if soft stop time and stop time is 0.

Under mode of soft stop, the motor's power supply will be switched by bypass contactor to the thyristor output of the Product; the Product's output voltage will be reduced slowly from full voltage, in order to reduce the motor's revolving speed stably, avoid mechanical vibration; however, the system may become unstable if stop time is too long.

Upon receiving the stop command under free stop mode, the Product will cut off the bypass contactor immediately and prohibit the voltage output of the Product's thyristor and the motor will be stopped gradually due to the load inertia. Set free stop mode if n wirings are driven by the Product, in order to avoid open phase during output switching.

5.2.3 P003: Start Mode

0: Voltage mode

1: Current limiting mode

2: Jump and current limiting (heavy load) mode

3: Torque slope mode

4: Torque current limiting mode

5: Jump and current limiting mode

Jump: A high impact torque is applied at startup and lasts for a certain period before start. It mainly applies to the loads with high inertia.

Torque mode: The output voltage is controlled according to the law of linear increase of motor start torque. Merit: Smooth and flexible start; favorable for driving system; reduce the impacts on power grid. Demerit: Long startup period. In theory, the starting current at torque mode is relatively lower.

Voltage start mode: Please refer to the introduction to start parameters at voltage mode in 5.2.1. Voltage mode applies to the scenarios with low requirements for starting current but high requirements for start stability

Chapter 5 Function Code Parameter

Current-limiting start mode: Please refer to the introduction to current-limiting parameters of 5.2.13.

Current-limiting mode applies to the scenarios with limitation on starting current.

Jump and current limiting (heavy load) mode: Applies to scenarios with heavy load.

Torque slope mode: Current is not limited when started at torque mode.

Torque current limiting mode: Current is limited when started at torque mode.

Jump torque current limiting mode: Current is limited when started at jump torque mode.

5.2.4 P004: Load Type

Set this parameter properly depending on the load. Adjust the startup parameters properly if startup effects are not ideal.

5.2.5 P005: Control Mode

0: Keyboard: Start/stop is solely controlled by RUN and STOP key on panel

1: External control: Startup is solely supported by RUN/STOP/COM two-wire or three-wire startup mode of terminal

2: Keyboard + external control (applicable to 3-wire control mode)

Both of keyboard and external control are available for operation. However, the external control terminal STOP-COM must be connected when started via keyboard

3: PC: Operation is controlled and monitored via busbar

4: Jointly controlled by keyboard + PC keyboard and busbar

5: Jointly controlled by external control + PC terminal RUN, STOP and busbar terminal

6: Jointly controlled by keyboard + external control + PC keyboard, external control terminal and busbar

7: Locked running: Neither of keyboard, external control and PC is enabled

Remark: If external control is included in combined control mode, the 3-wire control mode should be adopted as external control

5.2.6 P006: Start Maintaining Period

This parameter is regarded as maintaining period of original voltage under current and current limiting mode, or regarded as lasting period of impulse voltage under heavy-load mode.

5.2.7 P007: Intermediate Voltage

P008: Intermediate time

Valid in all modes;

Intermediate voltage: The proportion of a motor's rated voltage;

Intermediate time: The period from initial voltage to the intermediate voltage.

5.2.8 P009: Impulse Voltage

Valid under heavy-load mode: To overcome the static friction force at startup under heavy load and be used together with P006.

5.2.9 P010: Start Delay

Set the delay time from enabling of start signal to the start of the Product.

5.2.10 P011: Emergency Stop Control

Enable or disable the emergency stop function of external control to enter EMS function

0: Emergency stop control is disabled;

1: Emergency stop control is enabled.

5.2.1.1 P012: Control over Faulty Relay

User may set output of faulty relay as normally open (0) or normally closed (1) as required.

5.2.12 P013: Closing moment of multi-function relay

P014: Disconnection moment of multi-function relay

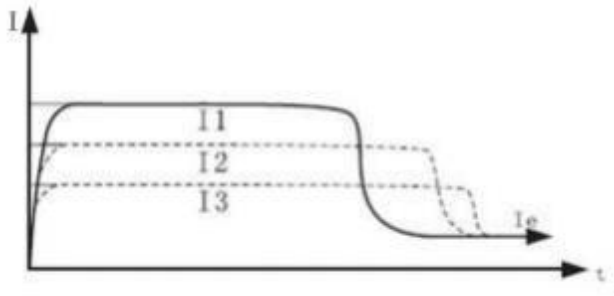
P015: Closing delay of multi-function relay

P016: Disconnection delay of multi-function relay

Disconnection/closing moment and action delay of multi-function relay can be set flexibly by user as required.

5.2.13 P017: Current Limiting Current

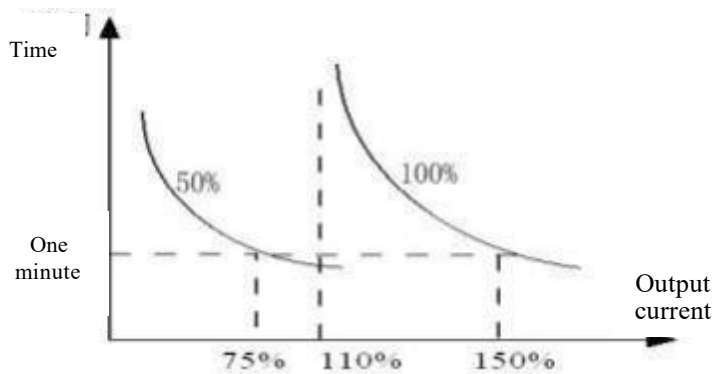
Set the current limit under current-limiting start mode; increase output voltage at the start of motor until motor current reaches the set value, and keep the starting current value not higher than the this value. Once bypass contactor is connected, the output current will be reduced to be lower than the rated current. The start period will be shortened along with the increase of this set value.



5.2.14 P018: Motor Overload Protection Factor

The set value of overload protection coefficient is 100% when motor is matched with the Product.

Inverse-time characteristic curve of overload protection is shown in diagram below (P018= 100% and P018=50%).
Overload of soft starter of this series: When P018= 100%, run continuously for 1 min at 150% of rated current, or run 500 s continuously at 120 % of rated current



Inverse-time Characteristic Curve of Overload Protection

5.2.15 P019: Degree of Unbalance

0: Unbalance protection is disabled;

1%~ 100%: Threshold for unbalance protection;

The Product is protected if detected current unbalance is higher than this value.

Definition of unbalance K: $K = I_s / I_d * 100\%$

I_s : The maximum value of $|I_a - I_b|$, $|I_a - I_c|$ and $|I_b - I_c|$; I_d : The mean value of 3-phase current I_a , I_b and I_c .

5.2.16 P020: Full-scale Value of Analog Output

P021: Select analog output

Port FM-GND means output of analog quantity with output range of P021=0: 4~20mA, P021=1: 0~20mA. The analog output current is in linear relationship with the actual output current of the Product. The Product's output current corresponding to analog output 20mA is determined by P020. Initial value of P020 means the rated current of the Product.

5.2.17 P022: Light Load Control

P023: Light load rate

Light load control applies to detection of belt tripping accidents.

P022=0: Disable light load detection function;

1: Alarm signal is solely sent by faulty relay when set value of light-load value (P023) is exceeded;

2: The Product is stopped and faulty relay acts when set value is exceeded.

Definition of P023 light-load rate Ks: $Ks = I_s / I_e * 100\%$ (Ie: Rated current; Is: Mean value of 3-phase current)

5.2.18 P024: Light Load Detection Delay

Once light-load fault is detected, the Product will give out alarm or be stopped according to set method of P022 after a delay period of P024.

5.2.19 P025: Restart Times

This function code is valid under external control mode only.

Once P025 is set as other parameters other than 0, the Product, if stops due to a fault, will be reset and enter running after a delay of 6 s and times of available restart is reduced by 1. If the times of available start are reduced to 0, the Product can be reset manually only.

If this parameter is set as 0, the Product needs to be reset manually before restart.

5.2.20 P026: Select Baud Rate

P027: Data format

P028: Machine No.

Set communication parameters.

See Appendix 1 for communication protocol.

5.2.21 P029: Parameter Protection

Once function code P029 is set as 1, the remaining parameters are unmodifiable to prevent the Product's parameters from being changed by other personnel other than debugging staffs. This value should be set as 0 before user is allowed to modify the parameter.

5.2.22 P030: Parameter Initialization

0: No action

The Product is under normal parameter reading/writing status.

1: Recover default setting

Set the parameter as 1 and the Product will recover the parameter of P000~P029 as the default value before delivery. In this process, the keyboard displays “———”.

5.2.23 Select P035 Power-on and Running

0: Make response and run.

1: Make no response to running. The running command must be removed and enabled again before running.

5.2.24 PASS: Manufacturer's Password

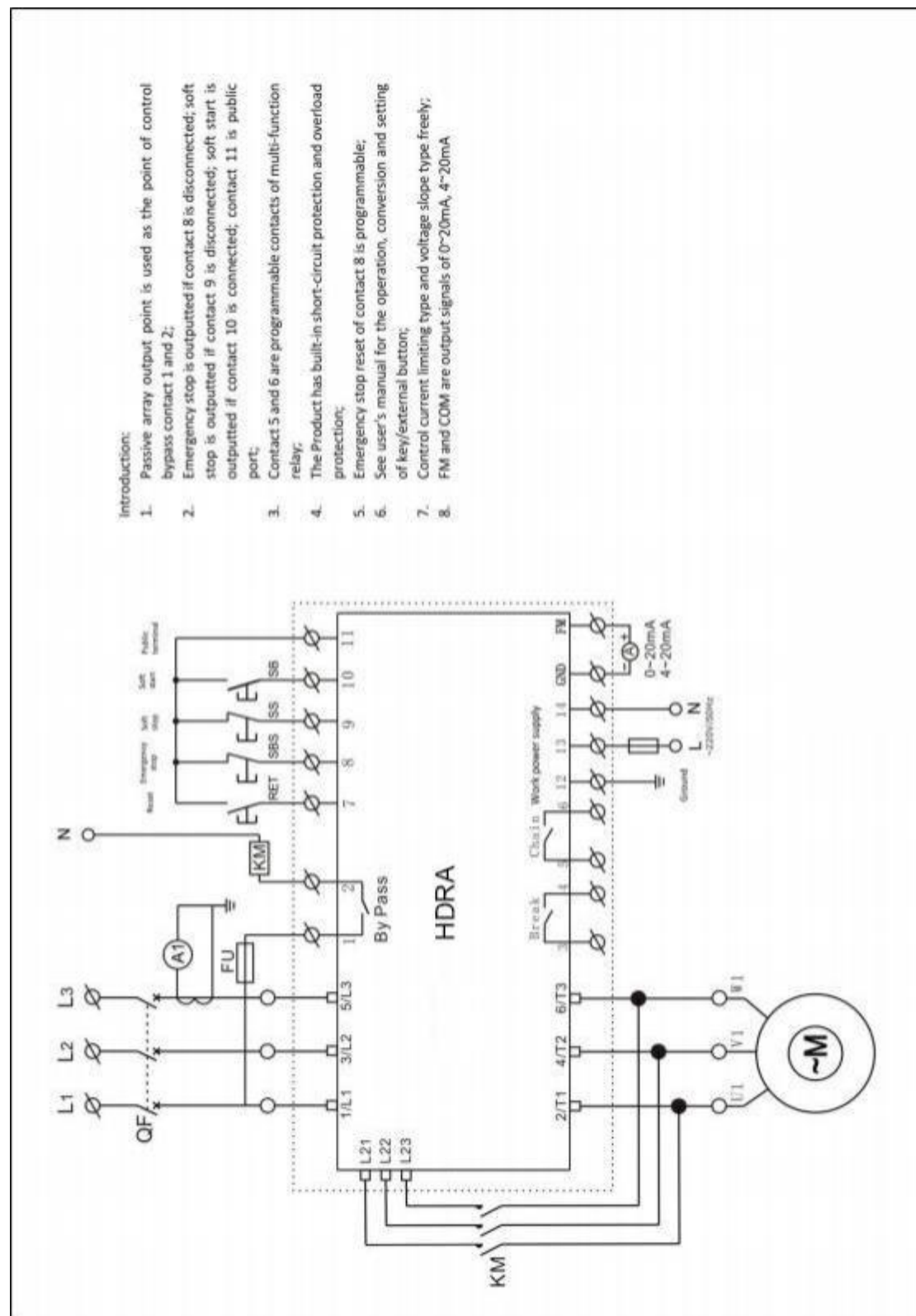
Enter manufacturer's password and display the specific function code of manufacturer.

Chapter 6 Troubleshooting

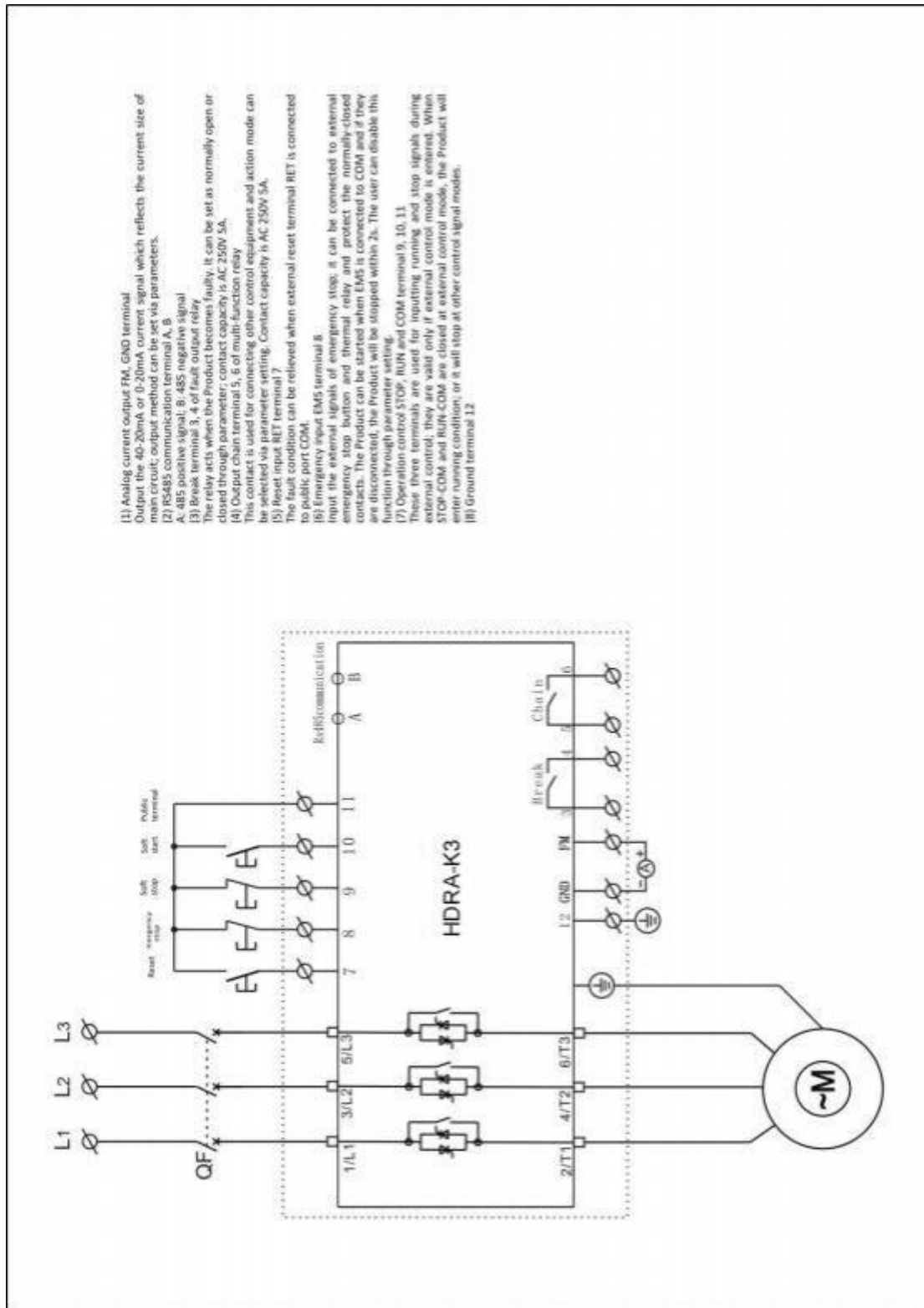
With complete protection functions, the Product will shut down and display the fault codes if meeting any fault, and it will not be restarted (auto start is supported if restart function is enabled) unless the fault status is relieved via STOP key or external control RET.

Fault Display	Fault Introduction	Cause and Troubleshooting
Err-0	Open phase	Check if incoming wire power supply and SCR are damaged and moor is wired reliably
Err- 1	Overheat	Start is frequent or start period is too long
Err-2	Overload	Change the overload protection coefficient or reduce the load
Err-3	Light load	Load is light, set P022 as 0 Accidents occur, such as belt tripping; please check the device.
Err-4	3-phase imbalance	Check the load and whether wiring is loose
Err-5	Emergency stop	Emergency stop terminal EMS has open circuit to COM; please check the test device If this terminal is unused, please set P011 as 0
Err-6	Overcurrent	Overcurrent occurs at startup, reduce the initial voltage or change it as current-limiting mode Overcurrent occurs in running; reduce the load
Err-7	Control board is faulty	Current sampling circuit is faulty
Err-8	Start period is too long	Parameter is improper or load is too heavy
d.Err	Parameter error	Set P029 as 0, restart or recover to the default value

Secondary Connection Diagram for HDRA Series Soft Starter



Secondary Wiring Diagram for K3 Series Soft Starter



Attached Table 1

Application scenarios

Machine Type	Load Type	Start Mode			Value Setting		Start Time
		Voltage	Current	Heavy Load	Voltage (%)	Current (%)	
Centrifugal pump	Standard load		O	0		250	5
Fan	Heavy load		O			400	40
Compressor (pistol)	Standard load		O			300	10
Compressor (centrifugal)	Standard load	O			30		20
Conveyor	Standard load		O	0		250	10
Mixer	Standard load		O	O		350	5
Ball mill	Heavy load		O		70	400	50
Crusher	Heavy load	O			60		45

Appendix 1: MODBUS Communication Protocol

The HDRA series soft starter is equipped with RS-485 communication interfaces

1. Definition of MODBUS communication code:

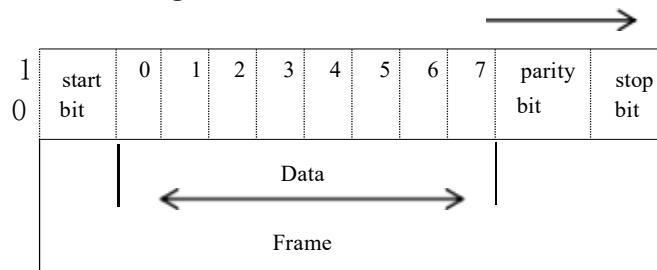
ASCII mode: 8-Bit data consist of two ASCII character sets; for example, one 16-bit data 64H (hexadecimal) are expressed by ASCII“64”, including 6 (36H) and 4 “34H” .

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. On basis of asynchronous transmission, the data can be sent by one host and received by multiple slaves (soft starter). Information cannot be sent by slave unless otherwise a request from host is received.

3. Baud rate: Be set via function code P026; the default baud rate is 9600bps.

4. Format of digital element



1-bit start bit

8-bit data bit

Odd-even check: Determined by function code

1-bit stop bit

Format of standard MODBUS ASCII communication:

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

1) STX: Start unit “:” 3ah

2) A: Address of slave (soft starter).

3) K: Function of data packet.

03H: Read the contents from one or more registers.

06H: Write data to one register.

4) DATA_(n-1) ...DATA₀ : Data contents

5) LRC: LRC detection error value: Calculate the contents from A to the final data, divide the results with 256, remove the excessive parts (for example: Take 5AH if result is 15AH) and then calculate the results after secondary supplementation as the LRC detection error value.

Attached Table 1

6) END: END character is “CR”0DH, “LF”0AH

Format of standard MODBUS RTU communication:

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

- 1) STX: Start unit, the static period over 10MS.
- 2) A: Address of slave (soft starter).
- 3) K: Function of data packet.
 03H: Read the contents from one or more registers.
 06H: Write data to one register.
- 4) DATA_(n-1) ...DATA₀ : Data contents
- 5) CRC: CRC detection error value:
 16-bit detection error value consists of 2 8-bit characters
- 6) END: Static period over 10ms

5. Correction Method:

ASCII mode:

LRC (Longitudinal Redundancy Check) detection error value is adopted in ASCII mode. LRC: LRC detection error value: Calculate the contents from A to the final data, divide the results with 256, remove the excessive parts and then calculate the results after secondary supplementation as the LRC detection error value.

Calculation method of LRC calibration:

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

LRC calibration of this case:

Secondary supplementation of $01\text{H}+06\text{H}+00\text{H}+12\text{H}+00\text{H}+6\text{EH}=82\text{H}$ is **79H**

RTU mode:

CRC calculation method

1. Preset one 16-bit register as hexadecimal FFFF (all of them is 1); this register is called CRC register;
2. Apply exclusive OR to the lower 8 bits of one 8-bit binary data (the first byte of communication frame) and 16-bit CRC register and put the result into CRC register;
3. Move the contents of CRC register to the right for 1 bit (lower bit) and fill the highest bit with 0; inspect the shift-out bit after rightward movement;
4. If shift-out bit is 0: Repeat the Step 3 (move it to the right bit again);
If shift-out bit is 1: Apply exclusive OR to the CRC register and polynomial A001 (1010 0000 0000 0001);
5. Repeat Step 3 and 4 until it is shifted to the right for 8 times; so, all of 8-bit data are handled;
6. Repeat Step 2 to 5 and handle the next byte of communication information frame;
7. Calculate all bytes of communication information frame according to steps above and exchange the high and low bytes of 16-bit CRC register;

Definition of parameter address of standard MODBUS communication protocol:

Definition	Parameter Address	Function Introduction	
Internal parameter of drive	00nnH	nn: Parameter No.; for example, P020 is expressed by 14H	
Command of drive	2000H	Bit0~1	00B: No function
			01B: Stop
			10B: Enable
			11B: No function
		Bit2~15	Reserved
	2001H	Reserved	
	2002H	Bit0	1:EF.ON
		Bit1	1: Reset
		Bit2~15	Reserved
Monitor drive status	2100H	0001	Preparation status
		0002	Normal running status
		0004	Open phase Err-0
		0008	Overheat Err- 1
		0010	Overload Err-2
		0020	Light load Err-3
		0040	3-phase imbalance Err-4
		0080	Emergency stop Err-5
		0100	Overcurrent Err-6
		0200	Fault of current sampling hardware Err-7
		0400	Err-8 Start time is too long Err-8
	2101H	****	Current display

Attached Table 1

Introduction to parameter function:

CMD: Function command

03H: Read the contents of one register

For example: Read current-limiting current P017

Command information:

RTU mode:

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

Response:

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

ASCII mode:

Start Bit	3AH
Address of Soft Starter	30H
	31H
CMD	30H
	33H
Data Address	30H
	30H
	31H
	31H
Data Number	30H
	30H
	30H
	31H
LRC Calibration	45H
	41H
Ending Character	0DH
	0AH

Response:

Start Bit	3AH
Address of Soft Starter	30H
	31H
CMD	30H
	33H
Data Number	30H
	32H
Data Contents	30H
	30H
	46H
	41H
LRC Calibration	30H
	30H
Ending Character	0DH
	0AH

Attached Table 1

06H: Write one character

For example: Write motor overload protection parameter P018

Command information:

RTU mode:

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

Response:

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

ASCII mode:

Start Bit	3AH
Address of Soft Starter	30H
	31H
CMD	30H
	36H
Data Address	30H
	30H
	31H
	32H
Data Contents	30H
	30H
	36H
	45H
LRC Calibration	37H
	39H
Ending Character	0DH
	0AH

Response:

Start Bit	3AH
Address of Soft Starter	30H
	31H
CMD	30H
	36H
Data Address	30H
	30H
	31H
	32H
Data Contents	30H
	30H
	36H
	45H
LRC Calibration	37H
	39H
Ending Character	0DH
	0AH

