EMHEATER

User Manual

EM-GW Series Online Soft Starter

China EM Technology Limited

Preface

Thanks for your using EMHEATER EM-GW series motor soft starter, this product is used for three-phase squirrel cage induction motor soft starting and soft stopping control. Before using, please carefully read and understand the contents of this manual.

In the process of using the soft starter, please note the following Safety Clauses:

 Please check this user manual carefully before using the product.

 Only the technical person is allowed to install the product.

 To be sure that the motor is correctly matched with the soft starter.

 It is forbidden to connect capacitors to the output terminals (U V W).

 Please seal the terminal switch insulation glue after finishing connect them.

 The soft starter and its enclosures must be fixedly earthed.

 During the maintenance and repair, the input must be off-power.

 **PRODUCT UNPACKING INSPECTION**
Please check up the products before using, if in some problems; please do not hesitate to contact us with any request for additional information.
● Check-up the type of product whether it is the right one you order. ● Check any damage to the product because of the transport, such as the spare parts are apart from the main body or the shell be damage etc. ● Check others, including the user's manual.

This user manual content may be changed due to technical reasons or modified. We reserve the updating right.

Version 3.0.0

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1. Products Information

1.1 Motor Soft Starter

Intelligent motor soft starter, the use of intelligent digital control; With the single chip processor as the intelligence center, thyristor module for actuators for full automatic control motor. It applies various squirrel-cage asynchronous motor control of load, the motor can smooth starting under any working conditions, protect the drag system, reduce the starting current impact on power grid, ensure reliable motor starting. Smoothly soft stopping function can effectively solve the inertial system surge problem, eliminate the drag system of inertial impact, that is traditional equipment cannot be achieved. Intelligent digital motor soft start equipment system with the complete protection function, extend the service life of the system, reduce the cost of system cost, improve the reliability of system and compatible with all the functions of starting equipment; It is a new ideal alternative for traditional star triangle starter and self-coupling decompression starter.

1.2 Main Function

- Effectively reduce the starting current of the motor; Can reduce the distribution capacity, avoid grid expansion investment.
- Reduce the starting stress of motor and load equipment; Prolong the service life of the motor and related equipment.
- Soft stopping function can effectively solve the parking surge problem of inertial systems; That is a traditional starting equipment cannot be achieved.
- With six unique starting mode; To adapt to the complex motor and load, achieve perfect priming effect.
- With complete and reliable protection function; effectively protect the safety of motor and related production equipment.
- Intelligent motor soft starter, the application of network technology used motor control technology to adapt to the rapid development of electric power automation technology in the higher requirements.

Reliable quality

- The computer simulation design.
- SMT production process.
- Good EMC performance.
- The machine before delivery on the high temperature aging, vibration test.

Perfect and reliable system protection function

- Protection of no voltage, less voltage and over voltage.
- Protection of overheating and starting time too long.
- Protection of Input phase lost, output phase lost and 3phase unbalance.
- Protection of starting over current, running overload, and load short circuit protection.

Maintenance function

- Fault self-diagnosis (short circuit, over voltage, less voltage, one phase grounded, motor overload, one phase lost, motor blocked, and intelligent software can inspect drag system working state).
- Combination of modular design, according to the fault display content, quick troubleshooting.

Independent intellectual property products

- Independently software copyright.
- Motor starting and protection proprietary technology.

- Unique way to detect debug equipment and process.

Quick and thoughtful after-sales service

- Reliable performances lay the foundation of qualified service and quality.
- Provide perfect system solution.
- The timely and thoughtful Consulting Services.
- Constantly improve the product performance according to user's opinion.

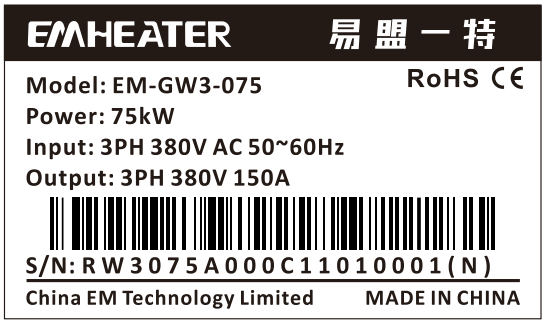
1.3 Technical Specification

Item		Description
Input Power Supply	Input Voltage	Three-phase 380V/480V/660 AC
	Frequency	50/60Hz
Adaptive Motor		Squirrel-cage three-phase asynchronous motor
Starting Times		It is recommended not to exceed 10 times per hour.
Control Mode		(1) Operation panel control. (2) Operation panel + external control. (3) External control. (4) External control + COM control. (5) Operation panel + external + COM control. (6) Operation panel + COM control. (7) COM control. (8) No start or stop operation.
Start Mode		(1) Current-limiting to start. (2) Voltage ramp to start. (3) Torque control + current-limiting to start. (4) Torque control + voltage ramp to start. (5) Current ramp to start. (6) Voltage current-limiting double closed-loop start.
Stop Mode		(1) Soft stop. (2) Free stop.
Protective Function		(1) Open loop protection for external instantaneous stop terminals. (2) Over-heat protection for soft starter. (3) Protection for too long starting time. (4) Input open phase protection. (5) Output open phase protection. (6) Unbalanced three-phase protection. (7) starting over current protection. (8) Running overload protection. (9) Under voltage protection for power voltage. (10) Overvoltage protection for power voltage. (11) Protection for fault parameter setting. (12) Load short circuit protection. (13) Auto restart or incorrect wiring protection. (14) Incorrect wiring protection of external control stop terminals.
Ambient	Place to be used	Indoor location with good ventilation free from corrosive gas and conductive dust.
	Altitude	Below 1000M. It has to rise the rate power when the altitude is more than 1000M.
	Temperature	-20 +45 ºC
	Humidity	90%RH without dew condensation.
	Vibration	<0.5G
Structure	Protection Class	IP20
	Cooling Pattern	Fans cooling.

2. Products Explanation and Installation

2.1 Model Explanation

EM - GW 3 - 075
❶ ❷ ❸ ❹



❶	EMHEATER
❷	GW Series online soft starter
❸	Rated voltage: 2: Three phase 220V 3: Three phase 380V 4: Three phase480V 6: Three phase 660V
❹	Matched motor: 075:75kW; 160:160kW

Diagram 2.1 Products model explanation

2.2 Installation Environment

- **Power Supply:** City grid power, self-provided power, diesel oil dynamotor, 3-phase alternating current 380V/480V/660V±15%, 50Hz or 60Hz. The power capacity of the soft start must meet the motor starting requirement.
- **Matched Motor:** Motor should be three phase squirrel asynchronous motor, and its power capacity must be matched with soft starters.
- **Starting Frequency:** The starting time is according to the loading equipment.
- **Cooling Mode:** Naturally wind cooling.
- **Protective Grade: IP20**
- **Environment Conditions:** when altitude is less than 1000m, the temperature of the environment should be between -20ºC ~ 45 ºC, relative humidity should be less than 90% RH, no vapor, no flammable, volatile, corrosive gas. No electric dirt, indoor installation, ventilated, vibration is less 0.5G.

2.3 Installation requirement

The direction and distance of installation: In order to make sure that the soft starter be in good ventilation and heat dissipation, please install the product in vertical direction, and be sure the space around the product is enough. If the soft starter is installed in a box, please note that the ventilation is very good, as well as the above notes. (See the following diagram 2.2)

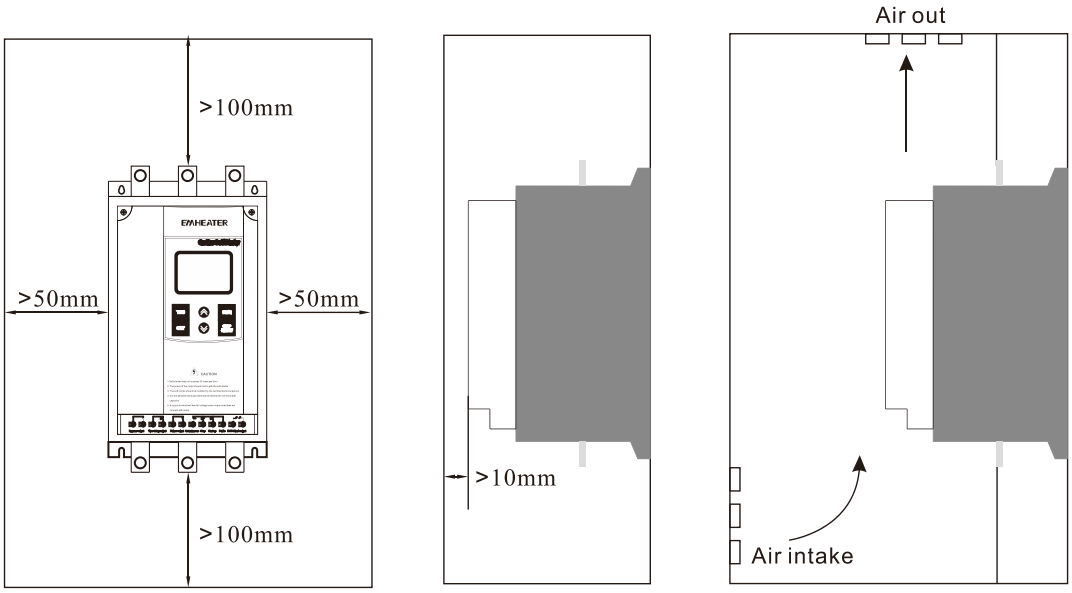


Diagram 2.2 Ventilating duct installation dimension diagram of soft starter

2.4 Products Appearance and Installation Dimension

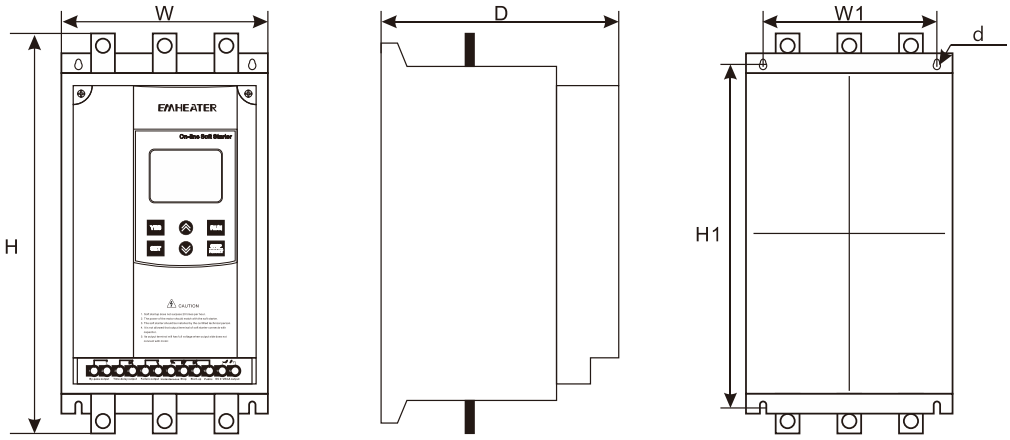


Diagram 2.3 11KW~45KW installation dimension and mounting holes

Model	Power	Current	External Dimensions (mm)			Installation Dimensions (mm)		
	(KW)	(A)	H	W	D	H1	W1	d
EM-GW3-011	11	23	315	145	221	298	85	M6
EM-GW3-015	15	30						
EM-GW3-018	18.5	37						
EM-GW3-022	22	45						
EM-GW3-030	30	60						
EM-GW3-037	37	75						
EM-GW3-045	45	90						
EM-GW3-055	55	110						
EM-GW3-075	75	150	360	210	261	343	150	M8
EM-GW3-090	90	180						
EM-GW3-115	115	230						

Model	Power	Current	External Dimensions (mm)			Installation Dimensions (mm)		
	(KW)	(A)	H	W	D	H1	W1	d
EM-GW3-132	132	260	465	330	261	440	260	M8
EM-GW3-160	160	320						
EM-GW3-200	200	400	562	490	301	535	335	M8
EM-GW3-250	250	500						
EM-GW3-280	280	560						
EM-GW3-315	315	630						
EM-GW3-355	355	710						
EM-GW3-400	400	800	840	680	426	780	350	M10
EM-GW3-450	450	900						
EM-GW3-500	500	1000						
EM-GW3-600	600	1200						

Note: The rated power of motor in the above form is the maximum rated value. Generally, the values of matched motor power capacity should not be more than this value.

2.5 Peripheral Devices Connection Diagram

Main circuit connection: It contains the wiring of 3-phase source input, the output to motor.

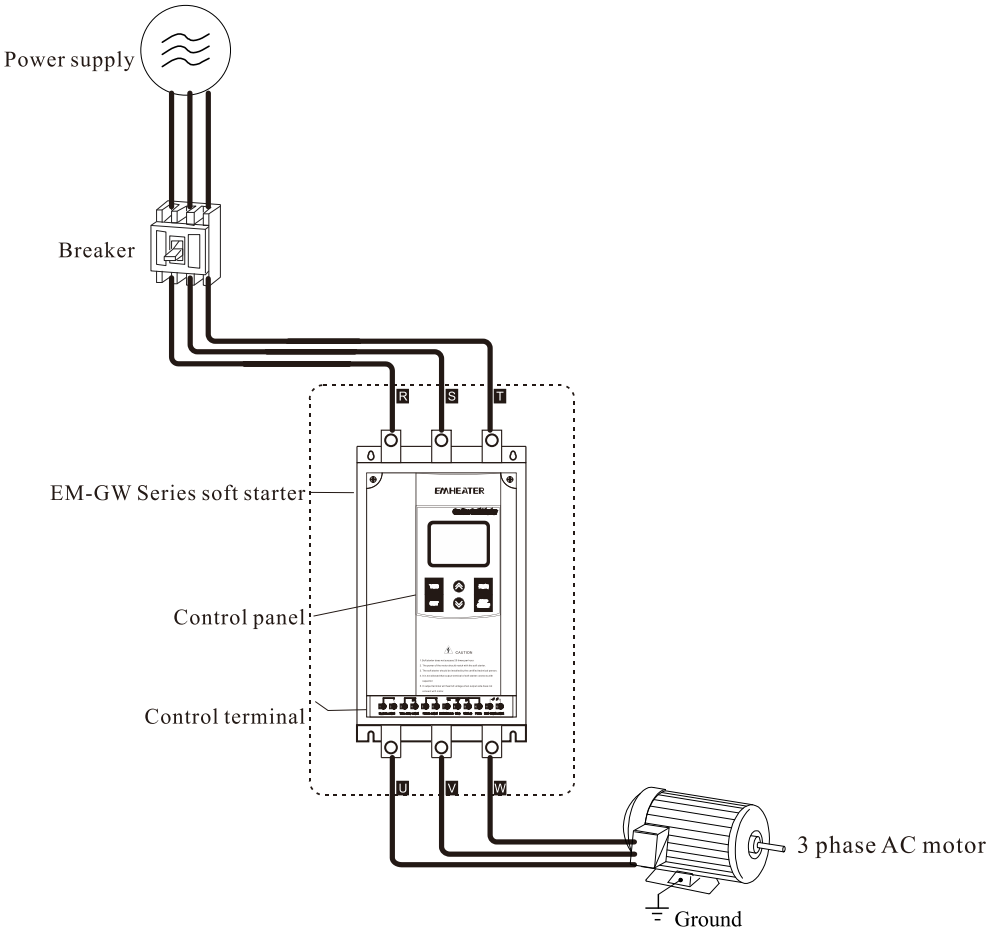


Diagram 2.5 GW soft starter peripheral devices connection

2.6 Control Circuit Terminal Description

Control terminal connection: That is the wire comes from 12 external terminals which including input and output control signal and analogue output or RS485 communication signal.

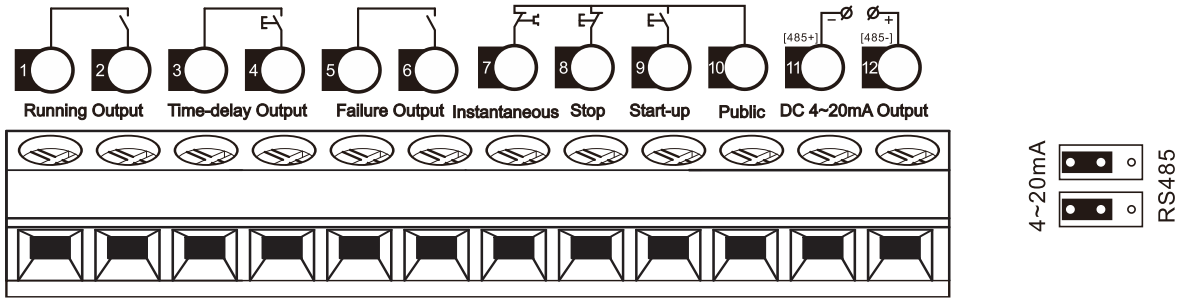
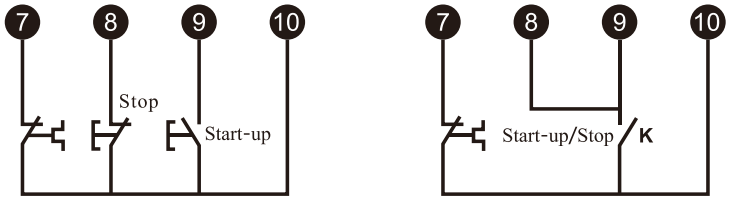


Diagram 2.6 Control circuit terminal

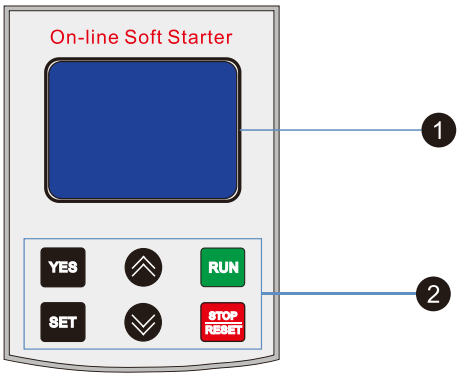
No.	Terminal Name	Description
❶ ❷	Running output	They are normal open contacts and are closed when finishing starting. The terminal contact capacity is AC 250V/5A.
❸ ❹	Programmable relay output	The delay time is set by **FE** code. The output command type is set by **FE** code. They are normal open no-power terminals, being close when output valid. Please see the detailed information in item 3.2.1. This terminal contact capacity is AC250V/5A.
❺ ❻	Fault output	They will be closed when there are any fault matters happened to the soft starter or electricity lost, while at normal case they are open. This terminal contact Capacity is AC250V/0.5A.
❼	Instantaneous stop input	This terminal must be connected with terminal ⑩ when the starter works normally. But if these two terminals are open, the soft starter will stop, and at this time the starter is at the state of fault protection. This terminal ⑦ can be controlled by the normally closed output terminals of external protection device. Note: it is useless when the FA code is set to 0 (Primary protection).
❽ ❾ ❿	External start up or Stop input	There are two ways of connections for your selection; Three line connection and two line connection, as below:  Three line connection Two line connection
⓫ ⓬	DC 4~20mA analog output / 485 communication output	This terminal can switch the output function through the control board jumper, as following table: **DC 4~20mA output** — They indicate the current value of motor at real-time working. The 20mA is full-scale value and that is four times than rated current of nominal power of soft starter, while, we can connect a 4 ~ 20mA DC current meter to check. The max value of output load resistance is 300Ω. **(Jumper to 485) 485 communication** — 485+/485-communication interface terminal, input and output signal terminal for MODBUS-RTU communication protocol. Note: 4~20mA and 485 communication can not exist at the same time, only one of them can be used.

Note： Please make sure that external terminals are in right connection; otherwise, the product may be damaged.

3. Operation and Display

The motor soft starter has five kinds of working state; Ready, Run, Error, Starting and Stopping, the showing parameter is easy to understand and modify.

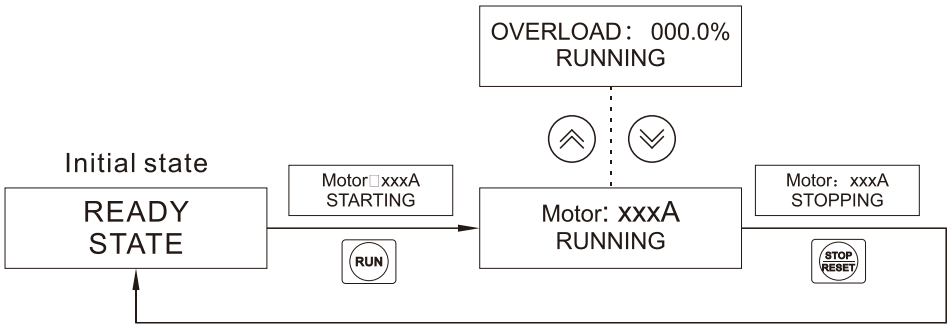
3.1 Key Panel and Operation



No.	Name	Description	
1	LCD display area	LCD display can display the parameter, monitoring data and Error codes.	
2	Operation key area	RUN	Running key: Start the soft starter in the keypad control mode.
		STOP RESET	STOP/RESET key: Stop operation when it is in the running state and perform the reset operation when it is in the error state.
		SET	SET key: Parameter enter and return.
		YES	Confirmation key: confirm the parameter setting.
		^	UP key: Increase data or function code.
		v	DOWN key: Decrease data or function code.

Start and stop operation:

The soft starter shows “READY STATE” after power on, press RUN running key to start motor. In the process of starting, the key panel shows “Motor: xxxA STARTING”; When the starting is completed, the key panel shows “Motor: xxxA RUNNING”, at this time, can be press ^ UP key, v DOWN key to select the prompt information. And press STOP RESET STOP/RESET key to stop motor.

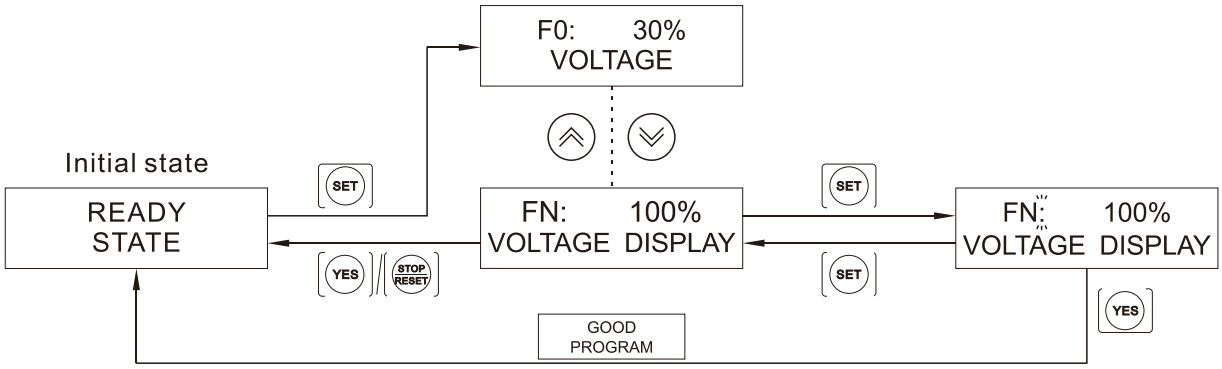


Prompt:

- Only when the "READY STATE" is displayed, the motor can be started by pressing the RUN running key.
- During the start and stop process, you can not enter the Set Menu or Help Menu.
- When the value of overload is more than 100%, the screen shows Error 08, that means soft starter is at state of over-load protection.

Parameter modification operation:

Under non-Set State, press the SET set key to enter Set Menu" and shows "F0: 30% VOLTAGE". You can press UP key or DOWN key to select the function code. And press SET set key again to enter the parameter that needs to be modified. At this time, the colon is flashing, press YES confirmation key, If the screen shows "GOOD PROGRAM" and beeps twice, it means that the new data has been saved, then exit and return to "READY STATE". If you do not want to save, please press the SET set key until the colon stops flashing, then the parameters recover. Having finished the above operation, please press the YES confirmation key to exit or press STOP RESET key to exit directly.

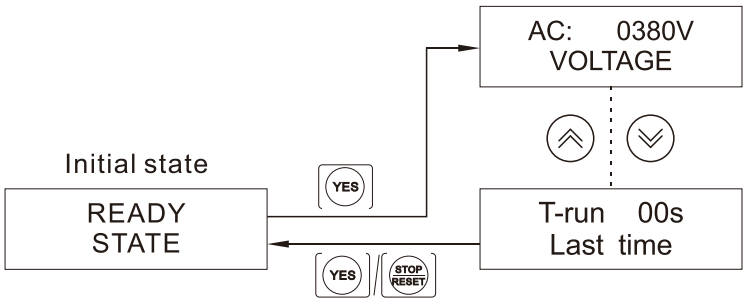


Prompt:

- There will be a sound prompt when the key operation is valid, otherwise the key is not valid.

Checking help information:

When the product is not starting or stopping state, and not at the "set" state, you can press YES confirmation key and come into helping menu, then press the or key to choose the help message. Please press YES or STOP RESET key to return.



Message displayed	Explanation
AC: xxxxV VOLTAGE	XXXX is 3 phase power voltage,
030A-380V SPEC	That is the specification is AC 30A-380V/50Hz.
H1: Error 01 7-10 OPEN	The fault message Err01 that happened at the last time.
.....	.....
H9: Error 00 NO ALARM	It means no fault happened.
Ver 3.0 Version Number	It means the software of the products is Ver3.0.
L XXXX Number of starts	XXXX is number of times of successful starting.
T-run xxS Last time	XX is last soft starting time.
Note: The message H1 ~ H9 displayed means 9 faults records that happened lately.	

3.2 Description of Function Codes

The explanation for function codes as below:

F0 Initial Voltage	**Setting range**	30-70%	**Default**	30%
	This code can be used when the starting mode is set as "Voltage ramp to start", and if the motor load is heavy, please set F0=40%, or higher a little. Under "Limit-current" mode, the F0 value will be fixed as 40%.			
F1 Start Time	**Setting range**	2-60s	**Default**	16s
	It is used to set longest soft starting process time, and soft starting time maybe shorter for different load. It is invalid under "Limit-Current" starting mode.			
F2 Stop Time	**Setting range**	0-60s	**Default**	0s
	If the code set as "0", the motor will free stop. One soft starter for 2 motor, this code should set "0".			
F3 Interval Time	**Setting range**	0-999s	**Default**	0s
	Delay is with countdown mode; If set as "0", the starter will start up the motor immediately.			
***F4** Program Delay	**Setting range**	0-999s	**Default**	0s
	This code is used to set delay time of ③&④ terminals output. Set "0" immediately close. (Please refer to FE for details)			
F5 Current Limit	**Setting range**	50~500%	**Default**	400%
	It is used when the staring mode is "current limit", and the value will be fixed as 400% when the starting mode is "Voltage ramp to start"			
***F6** Maximum Current	**Setting range**	50~200%	**Default**	100%
	The "50 ~ 200%" is basic on the nominal current of motor. If the set value of this code over 200%, the soft starter will reverse to overheat protection.			
F7 Low Voltage	**Setting range**	40~90%	**Default**	80%
	When the working voltage is under the voltage range (80%), the soft starter will be low voltage protection			
F8 Over Voltage	**Setting range**	100~130%	**Default**	120%
	When the working voltage is over the voltage range (120%), the soft starter will be over voltage protection			

F9 Start Mode	**Setting range**	0~5	**Default**	1
	0: Current limit 1: Voltage ramp 2: Torque control + Current limit 3: Torque control + Voltage ramp 4: Current ramp 5: Closed loop			
FA Protection Level	**Setting range**	0~4	**Default**	1
	0. Primary 1. Light-load 2. Standard 3. Heavy-load 4. Top Grade			
FB Control Mode	**Setting range**	0~7	**Default**	1
	0: Keypad 1: Keypad + Terminal 2: Terminal 3: Terminal + Communication 4: Keypad + Terminal + Communication 5: Keypad + Communication 6: Communication			
FC Parameter Selection	**Setting range**	0~2	**Default**	1
	0: Read Only; (It is prohibited to revise the parameter except FC) 1: Read &Partial Write; (It is prohibited to revise the parameter with "*") 2: Read &All Write.			
***FD** Communication address	**Setting range**	0~63	**Default**	0
	Many soft starters connect with upper computer.			
***FE** Program Output	**Setting range**	0~19	**Default**	6
	Setting the detailed in Item 5.3			
***FF** Stop Current Limit	**Setting range**	20~100%	**Default**	80%
	Setting the detailed in Item 7.3			
FP Motor Rated Current	**Setting range**	---	**Default**	Rated value
	"The rated current of motor" is the same as the motor nominal current. If your motor rated power is much lower than soft starter, please revise the FP same as motor rated current. And then soft starter can protect small KW motor. If you meet Error 05, please change FA=2.			
***FU** Bypass Time	**Setting range**	0~99s	**Default**	5s
	This parameter can delay soft starter switching to bypass contactor time. If soft starter starts very heavy fan or pump, please set the parameter to 10 or 15 seconds.			
***FL** Current Unbalance	**Setting range**	0~1	**Default**	1
	0: Prohibited 1: Allowed			
***FM** Current Calibration	**Setting range**	50~150%	**Default**	100%
	Showing current slants high, to set coefficient down; Lower conversely			
***FN** Voltage Calibration	**Setting range**	50~150%	**Default**	100%
	Showing voltage slants high, to set coefficient down; lower conversely			
FO Language	**Setting range**	0-2	**Default**	1
	0: Chinese 1: English			

	2: Russian

Prompt:

- F6 the " Max Current ", is basic on the value of FP (Motor Rated Current).
- If you have no any operation for 2 minutes after you come into the "set" state, soft starter will exit from "set" state.
- You can not set any parameters in the process of starting or stopping.
- If you press the YES conformation key to power on soft starter, all parameters will recover to default setting except FE code.

3.2.1 Programmable Relay Output Function

The programmable relay output function has two working modes: programmable timing output and programmable state output.

When the FE is setting to 0~4(10~14), the terminal ③&④ work in programmable timing output, as the following form :

FE setting value	Programmable timing output
0(10)	When sending the order of starting, the program output
1(11)	When beginning to start, the program output
2(12)	When at the start of bypass operation, the program output
3(13)	When sending the order of stopping, the program output
4(14)	When finishing the operation of stopping, the program output

- This working mode includes a 999 second timer, which is set by the parameter F4.
  If F4 setting is not 0, it will be starting timing according to the value of parameter FE, the output state will change when the time is up.
  If F4 setting is 0, it will change state immediately.
- When **FE** setting is 10~14, the programmable output will be “reverse phase output”, (Normal open will reverse to normal close).

When the FE is setting to 5~9(15-19), the terminal ③&④ work in programmable state output, as the following form :

FE setting value	Programmable state output
5(15)	Fault state
6(16)	Working state
7(17)	Ready state
8(18)	Starting state
9(19)	By-pass operation state

- When the **FE** setting is 5, the terminal ③&④ can output error such as: Error05, Error06, Error07, Error08, Error12, Error14, this will not affect the function of ⑤⑥ error output terminals.
- When FE=5~9(15~19), under this way, the F4 setting delay time is invalid.
- When **FE** setting is 15~19, the programmable output will be “reverse phase output”, (Normal open will reverse to normal close).

3.2.2 Other Parameter Description

The parameter FB is used to set the control ways of soft starter; as the following form:

Numerical value	0	1	2	3	4	5	6	7

Keypad	1	1	0	0	1	1	0	0
External terminal control	0	1	1	1	1	0	0	0
RS485 Communication	0	0	0	1	1	1	1	0

- In the above form,"1" is allowing,"0" is forbidding. For example.
- If the "External terminal Control" is allowing, you must contact a normally closed switch button between the terminal ⑦⑧ and ⑩, otherwise the soft starter can't start-up the motor and show "Error 01/ Error 16".

3.3 Fault Diagnosis and Solution

The fault codes and handling methods are as follows:

Fault Type	Description	Possible causes and solutions
Error00	No Errror	Any faults are removed, such as low-voltage, over-voltage, over-heat. Now the Ready-lamp is lighting and you can start the motor.
Error01	7,10 Term. Open	Please connect the external instantaneous stop terminal (terminal ⑦) and stop terminal 8 with the public terminal (terminal ⑩) together.
Error02	Over Heat	The soft starter is started too frequently, or the soft starter rated current is smaller than motor, or motor is heavy over load.
Error03	Excess Start Time	The starter parameter is set wrong; or the motor load is heavy, or voltage transformer capacity is not enough; or power supply cable is too long. If soft starter capacity is enough and load is heavy fan or pump, please set FU to 10 or 15 second.
Error04	Input phase loss	Please check whether the input circuit connections, bypass contactor and the controlled silicon is open or whether the thyristor wire is not connected.
Error05	Output phase loss	Please check whether the output circuit connection, bypass contactor and the controlled silicon are short circuit, or whether the thyristor wire is connected well; The power supply should connect to R,S,T, and bypass contactor should connect with L1,L2,L3; If motor KW is much smaller than soft starter, please set parameter FA=2.
Error06	Current Unbalance	Please check the input three-phase power voltage is balance or not, and check the motor 3phase is abnormal. Or set parameter FC=2 and E1=0.
Error07	Over Current	Overload, or the motor is not matched with the soft starter.
Error08	Over Load	Overload or the F6, FP code is set wrong.
Error09	Low Voltage	Please check the voltage of input power or the F7 item is set wrong.
Error10	Over Voltage	Please check the voltage of input power or the F8 item is set wrong.
Error11	Paramter Error	Please change the parameter correctly, or you can press the Confirmation key to power on the starter again to recovery the default setting.
Error12	Load short circuit	Check load and the controlled silicon is short circuit or overload.
Error13	Line Fault	The external terminals are not connected according the 2-wire way.
Error14	8,10 Term. Open	Please check and connect⑧,⑩.
Error15	Motor Underload	Please match the appropriate motor.
Note: When the motor starts successfully, ① and ② will close to suck by pass contactor running. At this time, if the contactor is not closed, the motor will stop running, so you can check whether the wiring of the bypass contactor is right.		

4. Protection Functions and Directions

We make our soft starters have all kinds of protection functions to protect the safety of soft starter and the motor. Please choose the correct protection Class and parameters according to your application conditions!

4.1 Protection Function

- Over-heat protection: When soft starter inside temperature is up to 80°C ± 5°C, the starter will turn to over-heat protection, when be down to 55 °C, this protection removes.
- Input phase loss protection: The delayed time < 3s
- Output phase loss protection: The delayed time < 3s
- Current unbalance protection: The delayed time < 3s, when the difference of current among three phrases is more than 50% ± 10%, the protection be valid.
- Over current protection time: The diagram of over current 5 times of F6 set rated working current is just as diagram 4.1.
- Over load protection time: The starter will be in inverse time thermal protection on. Base of the Max current of motor (Set by F6), (The diagram 4.1 show)
- Low voltage protection: When power voltage is less than 40%, the protection delayed time < 0.5s; When power voltage is less than 80%, the protection delayed time < 3S.
- Over voltage protection: When power voltage is more than 140%, the protection delayed time < 0.5S; When power voltage is more than 120%, the protection delayed time < 3S.
- Load short circuit protection delay time: The protection delayed time < 0.1S.

4.2 Protection Classes and Explanation

According different usage conditions, EM-GW series Soft Starter has five protection classes, as following:

0. Primary
1. Light load
2. Standard
3. Heavy load
4. Top grade

- Primary protection includes the protection functions of overheat, short circuit, and input default phase protection and prohibit external instantaneous stop terminal. Which are proper urgently startup conditions, such as fire pump.
- Light load, standard and heavy load protection have the overall protection function of soft starter. The difference among them is protection level of overload and over current. See the diagram of 4.1.
- The protection classes and the time of heat protection as (diagram 4.1)

FA	0:Primary	1:Light Load			2:Standard			3:Heavy load			4:Top Grade			Note
The grade of overload protection	No	2 grades			10 grades			20 grades			10 grades			Standard of IEC60947-4-2
The grade of over-current protection	No	3s			15s			30s			15s			The 5 times of F6 current
Overload drop-away time	The multiple to the current	3	4	5	3	4	5	3	4	5	3	4	5	They are the typical values
	Drop-away time (S)	4.5	2.2	1.5	23	12	7.5	46	23	15	23	12	7.5	

Remark: FP set value should be same as motor nameplate rated current. The **FP** set value should not be less than 20% of soft starter rated current, otherwise the overheat protection will be useless because of big tolerance.

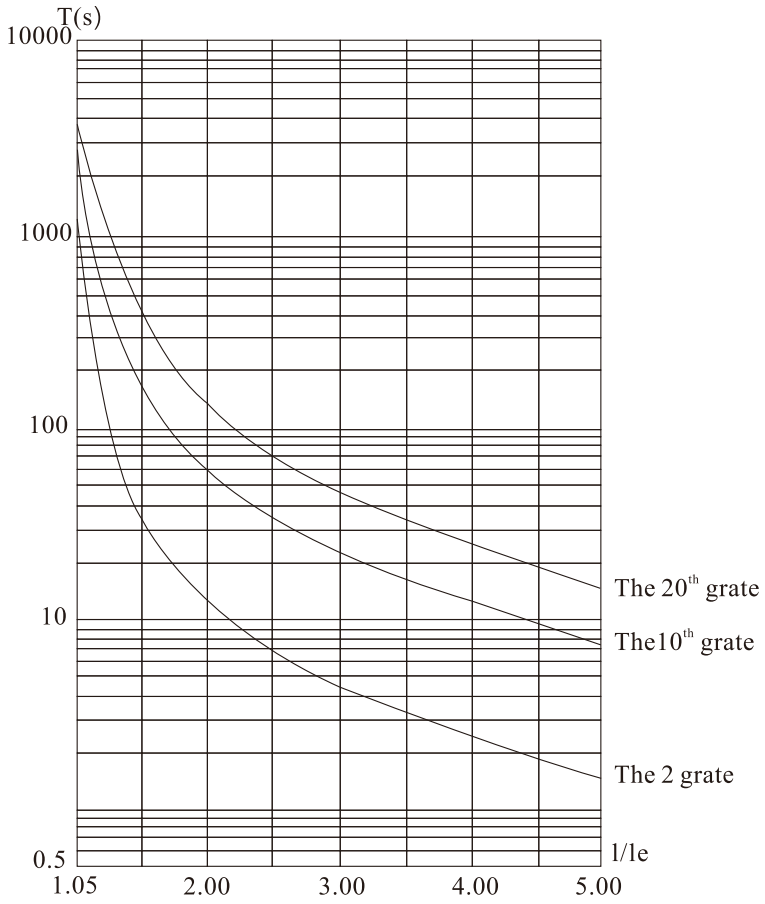


Diagram 4.1(IEC60947-4-2 standard) Motor heat protection curve (overload drop-away time)

5. Test Run and Application

Please do some examinations before test running as following:

- Whether the rated power of soft starter is matched with the Motor.
- Whether the insulation of motor meets requirement.
- Whether the main circuit connection of input and output is correct.
- Whether all the screws of terminals are twisted tightly.

5.1 Power on to Test Running

- After Power on, please do not disassemble the soft starter cover that is dangerous!
- Power on, soft starter displays “READY”, and the Ready is light, then you can press RUN running key to start.
- Set **FP** be same as motor nameplate rated current.
- After started the motor, you should examine whether the motor running direction is correct, or whether runs normally. If not, you can press STOP RESET key or cut off the power to stop running.
- If the soft starter starting state is not satisfied. Please see the detailed explanation at chapter 5.5: the starting mode and application
- If the start torque is not enough, you can change the starting voltage (when the starting mode is voltage control) or the certain current value (when the mode is current control) to improve start torque.
- Do not open the face cover in case of electric shock.
- If there is any abnormal voice, smoke or taste, please cut off power as soon as fast, and check the reason.
- When the starter power on or be in starting, the error lamp is lighting and screen displays "Error xx", at this time, you can check chapter 3.5 to find out reason.
- Press STOP RESET key or external stop button can reset the error state.

Note: When ambient temperature is less than -10°C, the starter should be power on to preheat for 30 minutes, and then to start.

5.2 Starting Mode and Application

The EM-GW series soft starter has six starting modes for the user to select according the motor and load equipment.

5.2.1 Current limit

(**F9=0)** Diagram 5.1 shows the waveform of motor current. I1 is the starting limit-current preset value. When starting, the output voltage rises quickly till the motor current up to I1 value and not beyond this value. The motor runs steadily in pace with the rising of output voltage, and when the motor runs to be the rated speed, the output current will have a quick-drop and down to the motor rated current (Ie value),then the bypass contactor is working, the stating process finished.

Note: When motor load is too light or I1 preset value is too high, the max current of starting may can not reach I1 value. This starting mode fits for the conditions which requires strict current limit of starting.

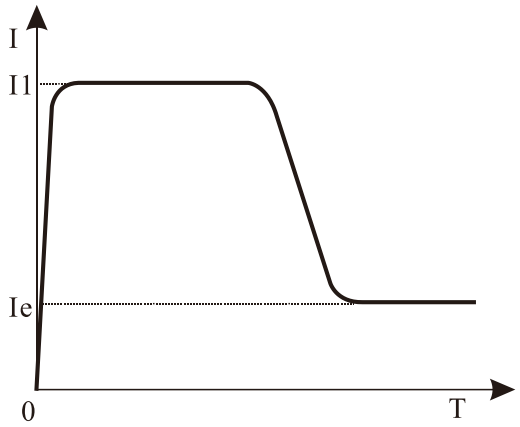


Diagram 5.1

5.2.2 Voltage Ramp

(**F9=1**) Diagram 5.2 shows the output voltage waveform. In the diagram, the U1 is the initial voltage value of starting. When starting, if the motor current is not more 400% than the rated current, the output voltage of soft starter will rapidly rise to U1, and the output voltage rises gradually to the rated voltage (Ue), and the motor gradually increase and until running at rated voltage and speed, and then the bypass contactor closed, the starting process finished.

Starting time "T" is obtained in the standard experiment under the condition of soft starter with standard load. And soft starter takes this control parameters as a benchmark, smooth acceleration by controlling the output voltage to motor starting process to complete, not mechanically controlled time "T" and regardless smooth of whether the motor speed. In view of this, when the load is lighter, starting time are often less than the set starting time, as long as can smooth starter is normal

In general, the voltage ramp is generally used mode; it is suitable for requiring higher starting stability without strictly current limitation case.

Note:"T" is the automatic detecting starting time according to load. It will be less than set time when the load equipment is light; this starting mode fits for the common occasions where the motor needs to be started smoothly.

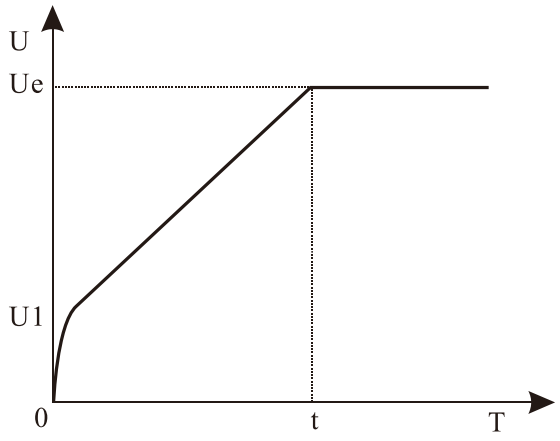


Diagram 5.2

5.2.3 Torque control + Current limit/Voltage ramp

(**F9=2 or 3**) Diagram 5.3 and 5.4 shows the output changing waveform of torque control starting mode. When the static friction force of heavy load is too stronger to start the motor, user can use this starting mode. At first state of

starting, the motor needs a higher voltage to conquer the static friction force of heavy load, and then starts with current-limit or voltage ramp mode to start the heavy motor.

Note: This mode will cause big-current shock to the motor, so if the voltage ramp or current limit starting mode can startup the motor, it is better not to use this torque control mode to start.

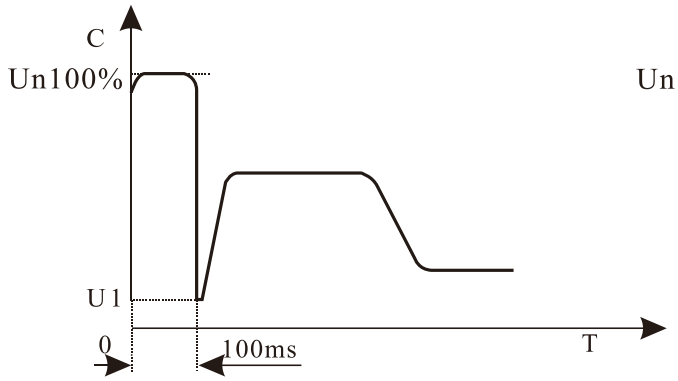


Diagram 5.3

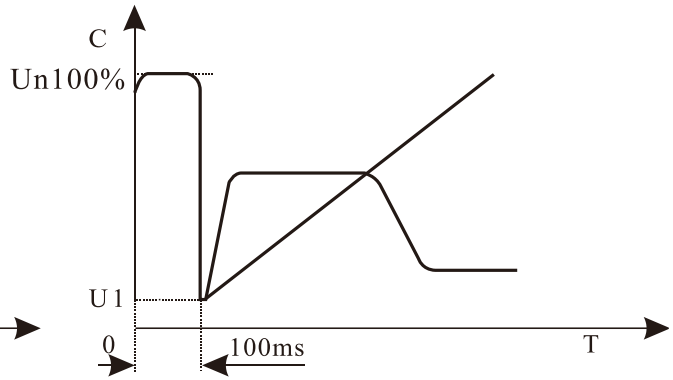


Diagram 5.4

5.2.4 Current ramp

(**F9=4**) Diagram 5.5 shows the output current waveform. The I1 in the diagram is current value preset by F5 code, and T1 is time value present by F1 code. This starting mode has very stronger speed-up ability and is suit for the bipolar motors, and it can reduce the starting time.

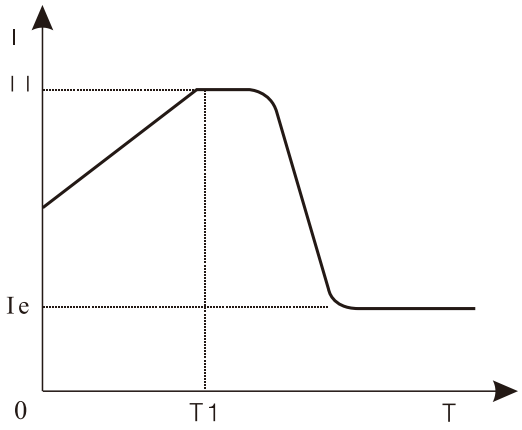


Diagram 5.5

5.2.5 Closed loop

(Both voltage ramp and current limit) to start (**F9=5**). This starting mode uses voltage ramp and current limit double closed loop circuit; it is a composite starting mode. The output voltage waveform is changed as different motor and the load equipment. This mode fits for smooth starting and strictly current limit occasions.

5.3 Stopping mode and Application

The soft starter has two stopping modes; those are Soft-stopping mode and Free-stopping mode.

5.3.1 Soft-stopping Mode

(The F2 item is not set as"0") When using this mode to stop the motor, the power supply of motor will be transferred from the bypass contactor to the controlled silicon of soft starter, and the output voltage of starter will be reduced gradually so that the running speed of motor can be cut down smoothly avoid mechanical shock. The

output ending voltage is the same as the starting initial voltage. Soft-stopping mode can reduce or remove the surge of the loading equipment such as the water pump.

You can set the soft-stopping current limit value through the FF code to reduce the high current shock to the motor when stopping. This current limit value is percentage of **F5**.

5.3.2 Free-stopping Mode

(The **F2** code is set as"0") When using this mode to stop the motor, the soft starter will cut off the connection to the bypass contactor and forbid the controlled silicon output voltage after receiving stopping command. The motor stops gradually with its inertia. One soft start connecting with two motors must use this free stopping mode. Generally, if the soft stopping mode is not necessary, please choose the free stopping mode to prolong the service life of soft starter. This mode completely forbids the instantaneous output; avoid instantaneous high current shock to the motor of specially applying.

5.4 Special Application

- **In parallel the starting of the motors:** If the motors total power is less than 80% of soft starter, the motors can be parallel connection. But at this time should be also provides for each motor thermal protection device.
- **Double speed motor:** Motor soft starter can cooperate with double speed motor starting, must go through demagnetization delay period before change from low speed to high speed, to avoid anti-phase current generated between the lines and motor.
- **Too long cable:** f the cable is too long, the cable voltage drop will be high, and that will increase current loss and reduce starting torque, so please use big KW soft starter and motor.
- **Soft starter parallel connected with one power-line:** If several soft starters parallel installed in the one power line, the input line reactor should be installed in the middle of the transformer and the soft starter circuit. Reactor should be installed at each line input side between circuit breaker and soft starter.
- **The application of surge protection device (SPD):** The surge protection device should be considered to installed in the application case, where is easily caused trouble by lightning or other reasons, such as over voltage, over-current, surge interference. Please refer to SPD related documents for details.

5.5 Application Examples

The parameters of the different loads are different, please refer to form as below:

The loading	Start time(s)	Stop time(s)	Initial voltage	Voltage ramp (Current limit)	Current limit to start
Ball mill machine	20	6	60%	400%	350%
Fan	26	4	30%	400%	350%
Centrifugal	16	20	40%	400%	250%
Piston compressor	16	4	40%	400%	300%
hoister	16	10	60%	400%	350%
Stirring machine	16	2	50%	400%	300%
Breaker	16	10	50%	400%	350%
Screw compressor	16	2	40%	400%	300%
Rotating conveyor	20	10	40%	400%	200%
Light load	16	2	30%	400%	300%
Convey belt	20	10	40%	400%	250%
Heat pump	16	20	40%	400%	300%

6. Online Soft Starter Cabinet

EM-GS32 series online soft starter cabinet is suitable for squirrel cage asynchronous motor control with various loads to ensure reliable start of motor. It has a complete system protection function, extend the service life of the system, reduces the cost of the system, improves the reliability of the system and compatible with various functions of all devices. It is a new ideal alternative for traditional star triangle starter and self-coupling decompression starter.

6.1 Product Function

- Effectively reduce the starting current of the motor; Can reduce the distribution capacity, avoid grid expansion investment.
- Reduce the starting stress of motor and load equipment; Prolong the service life of the motor and related equipment.
- Soft stopping function can effectively solve the parking surge problem of inertial systems; That is a traditional starting equipment cannot be achieved.
- With six unique starting mode; To adapt to the complex motor and load, achieve perfect priming effect.
- With complete and reliable protection function; effectively protect the safety of motor and related production equipment.
- Intelligent motor soft starter, the application of network technology used motor control technology to adapt to the rapid development of electric power automation technology in the higher requirements.

Conditions of Use:

- **Power Supply:** City grid power, self-provided power, diesel oil dynamotor, 3-phase alternating current 380V/480V/660V±15%, 50Hz or 60Hz.
- The power capacity of the soft start must meet the motor starting requirement.
- **Matched Motor:** Motor should be three phase squirrel asynchronous motor, and its power capacity must be matched with soft starters.
- **Starting Frequency:** The starting time is according to the loading equipment.
- **Cooling Mode:** Naturally wind cooling.
- **Protective Grade: IP20**
- **Environment Conditions:** when altitude is less than 1000m, the temperature of the environment should be between -20ºC ~ 45 ºC, relative humidity should be less than 90% RH, no vapor, no flammable, volatile, corrosive gas. No electric dirt, indoor installation, ventilated, vibration is less 0.5G.

6.2 Products Structure and Installation

Installation:

The installation adopts floor vertical installation, which can be installed on the trench slot, the cabinet body is exposed, and the power cable and control cable are introduced into the control cabinet by the trench. The cabinet body is made of angle steel frame and painted, and the door is opened from the front of the control cabinet

Model	Rate Power	Rated Current	External Dimension(mm)		
	(KW)	(A)	W	D	H
EM-GS32-030	30	60	420	380	1000
EM-GS32-045	45	90	420	380	1000
EM-GS32-055	55	110	420	380	1000
EM-GS32-075	75	150	420	380	1000
EM-GS32-090	90	180	420	380	1000
EM-GS32-115	115	230	420	380	1000
EM-GS32-132	132	260	600	450	1200
EM-GS32-160	160	320	600	450	1200
EM-GS32-185	185	370	600	450	1200
EM-GS32-200	200	400	600	450	1200
EM-GS32-220	220	450	700	500	1450
EM-GS32-250	250	500	700	500	1450
EM-GS32-280	280	560	700	500	1450
EM-GS32-320	320	630	700	500	1450
EM-GS32-355	355	710	700	500	1450
EM-GS32-400	400	800	700	500	1450
EM-GS32-450	450	900	700	500	1700
EM-GS32-500	500	1000	700	500	1700
EM-GS32-600	600	1200	700	500	1700

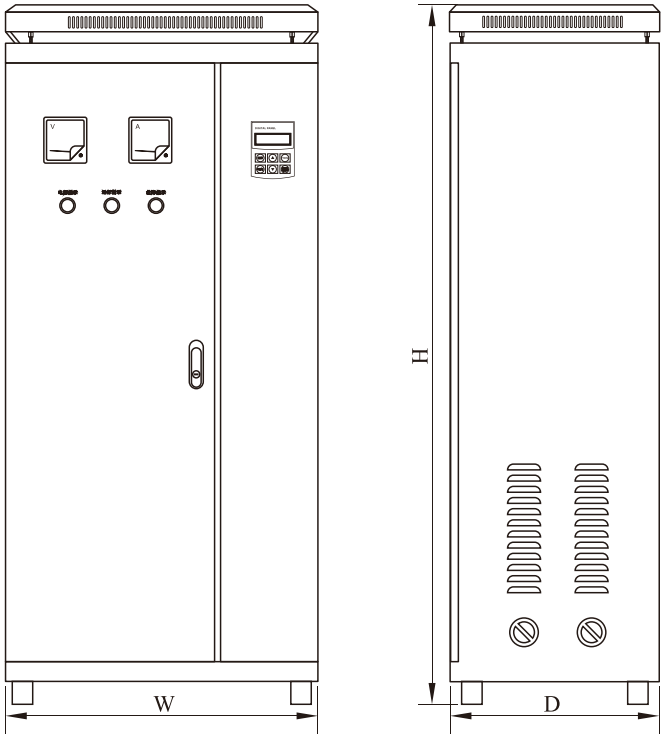


图 6.1

6.3 Operation and Notice

Operation:

- Please read the manual, operation and notice carefully before using
- When power is on, you need open the front door of the cabinet, close the circuit breaker, and the power indicator of the online soft starter cabinet (red light) is on, indicates that the cabinet is powered on. The soft starter is in a state to be started controlled by the control terminal.
- Check the wiring and motor before starting the motor.
- After confirmation, press the RUN running key, the running indicator light (Green light) is on, and the motor starts to run.
- When the STOP RESET stop / reset key is pressed, the motor will stop freely (If the soft stop time is set, then soft stop) and the running indicator (Green light) is off.

Parameters setting:

The parameter settings are consistent with the online soft starter parameters, please refer to chapter 3.2.

Note:

- The main power circuit breaker must be closed before the online soft starting cabinet works.
- When the online soft starter cabinet is power on or operation, the fault indicator light (yellow light) is on, it indicates that the online soft starter cabinet or load has a fault, it should stop and check, and restart after troubleshooting by the professionals.

7. Modbus Communication Protocol

7.1 About Protocol

EM-GW series soft start provides RS485 communication interface and supports Modbus-RTU slave communication protocol, users can achieve centralized control through the computer or PLC.

Electrical interface: RS485 Half-Duplex Mode

Terminal: 11(485+), 12(485-)

Communication parameter: Baud rate:9600, 8 bits, No parity bit, 1 stop bit.

7.2 Bus Structure

7.2.1 Support code

Soft starter only supports following code, if other codes were used, there will feedback messy code 01.

Code	03	06
Function description	Read register	Write in one register

Code 03 only can read single word.

7.2.3 Register address

Register Address	Operation Code	Register Function
0001	06	Control word
0002	03	Status word
0003	03	Current average value
0004	03	Fault code
0100-0111	03&06	Soft starter function parameters

Commander register:

Register Address	Operation Code
0001	0001: Running 0002: Stop 0004: Fault reset

Communication data format:

Data format	Address	Function Code	Register address	Command	CRC Verify
Length of the Data	1 byte	1 byte	2 bytes	2 bytes	2 bytes

For example: to startup the soft starter with address 02, the upper controller sent command 02 06 00 01 00 01. If command is correct，there will feedback 02 06 00 01 00 01, if the register status is normal, soft starter will startup. If the register has fault, there should firstly sent command 02 06 00 01 00 04 to reset fault.

Status register:

Register Address	Operation Code
0002	0000: Ready 0001: Starting state 0002: Running state 0004: Stopping state 0008: Fault state

Communication data format:

Data format	Address	Function Code	Register address	Number of read registers	CRC Verify
Length of the Data	1 byte	1 byte	2 bytes	2 bytes	2 bytes

For example:

Reading state code of register 02 03 00 02 **00 01**.

If soft starter is during starting process, it will feedback code 02 03 00 02 **00 01**.

If soft starter is fault, it will feedback code:02 03 00 02 **00 08**.

0003 Average value of current (hexadecimal) Display with current percentage or represents current actual value:

Communication data format:

Data format	Address	Function Code	Register address	Number of read registers	CRC Verify
Length of the Data	1 byte	1 byte	2 bytes	2 bytes	2 bytes

For example: Read present current

Send code: 02 03 00 03 00 01

If the present current is 235A，and then feedback: 02 03 02 00 EB

0004 Fault code (hexadecimal)

Communication data format:

Data format	Address	Function Code	Register address	Number of read registers	CRC Verify
Length of the Data	1 byte	1 byte	2 bytes	2 bytes	2 bytes

For example: Read fault code

Send code: 02 03 00 04 00 01

If feedback: 02 03 02 00 04 means present is input phase loss (Error 04).

Function register:

Function register(256-274) , the corresponding address is 0x100 ~ 0x111, high level byte is 0x01,address of low level byte is 0x00 ~ 0x11, corresponding function code is F0~FU, For example, address : 0x109 is corresponding to 09 (start mode).Through these address can read and re-write function codes, for example:

Example 1: Read function code F5 (starting current limit),

Send code: 02 03 01 05 00 01

Feedback code: 02 03 02 01 5E means “05” current limit value is 350%.

Example 2: Read function code FA (protection class)

Send code: 02 03 01 0A 00 01

Feedback code: 02 03 02 00 03 means “0A” protection class value is 3.

Example 3: change code 05 value (F5 starting current limit) to 250%

Send code: 02 06 01 05 00 FA，feedback code : 02 06 01 05 00 FA

If feedback: 02 86 03 means write fail，probably soft starter is during running.

7.3 Abnormal Feedback

Code	Name	Explanation
01	Illegal function	Soft starter does not support this function code
02	Illegal data address	Illegal address, can not implement
03	Illegal data value	Can not implement received value 1. Parameter out of range 2. Parameter can not revise

		3. Parameter can not revise during running

Illegal function code 01

Master inquire message format:

Slave address	Function code	Initial address (High byte)	Initial address (Low byte)	Register number high level	Register number low level	CRC check
0x01	0x08	0x00	0x80	0x00	0x0D	

For example: this protocol does not use code 0x08, so slave feedback:

Slave address	Function code	Abnormal code	CRC check
0x01	0x88	0x01	

Illegal data address 02

Master inquire message format:

Slave address	Function code	Initial address (High byte)	Initial address (Low byte)	Register number high level	Register number low level	CRC check
0x01	0x04	0x01	0x80	0x00	0x07	

04 is register fault address, so slave feedback:

Slave address	Function code	Abnormal code	CRC check
0x01	0x84	0x02	

Illegal data value 03

Master inquire message format:

Slave address	Function code	Initial address (High byte)	Initial address (Low byte)	Register number high level	Register number low level	CRC check
0x01	0x04	0x00	0x80	0x01	0x80	

04 is register fault address, so slave feedback:

Slave address	Function code	Abnormal code	CRC check
0x01	0x84	0x03	

Remarks

- Soft starter address, communication rate, calibration model must be the same with the controller communication Settings.
- Cannot receive feedback data, please check the above parameters, terminal connections are correct.
- Communicate many pieces soft starters, a 120Ω resistor should be connected to terminal 485+ and 485- of last soft starter.

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