Manual File Number: B-V2.2-14
Version Number: V2.2-380V
Revision Number: 2014
Issuance Date: 2014-07-10

1. Overview

This manual is applicable to RQ100-B serial products.

This manual is intended to guide qualified personnel in the installation and operation of this product.

In the case of a registered trademark and business ownership, final interpretation right to this manual is belonged to Any unreasonable application, especially in reproduction by third parties and release, is not allowed

Although the information in this manual is checked carefully, but there may be some mistakes. If you find them, please phone us as soon as possible.

Because this product is improved continuously, so user should regard this manual as the reference.

The parameters in the manual is only used to describe the product, In order to meet the needs of the customers, we will improving our products continuously to fulfill the latest technical criteria.

2. Safty 

Pay attention to the Note, warning and tips mentioned in this manual.

Only professional technician can be permitted to install or guide the installation of this product.

Ensuring the power and specification of the motor is matched to those of this product;

The capacitor is prohibited strictly to be connected with the output terminal (U.V.W) of this production

The cables connecting to the input and output terminals of this product should be packed well by insulating tape;

The shell of this product must be connected to the ground reliably;

Make sure the power of this product must be cut off before it is maintained.

This manual is packed with the product. Operator must take it as the guide of this product. Please read it carefully before using this product.

3. Safe Mark

Warning、Tips and Note

◆ Attention Something can lead to personal injury or death
◆ Warning Something can lead to damage of the device or software.
◆ Note Remind user something related.

1.Function and feature

RQ100-L/B Series digital AC motor soft starter is new type starting equipment with advanced international level. This equipment designed and manufactured by the technique of power electronics microprocessor and modern control theory. This equipment can limit the start current efficiently when the

asynchronous motor starts. It is widely applied in the field such as winding machine, pump, transition and compressor etc. It is the ideal product to replace the traditional voltage dropping start equipment such as star/triangle conversion, self-coupling voltage dropping, magnetic control dropping voltage etc.

Function

◆ Reduce the starting current of motor; reduce capacity of power distribution; reduce the investment cost;

◆ Reduce the start stress; prolong the operation lifetime of the motor and correspond equipments;

◆ Smooth and steady starting and soft stopping; The Water hammer and surge can be avoid;

◆ Several sorts of starting mode, wide range setting of the current and voltage. It can be used in a lot of load conditions, so the technic can be improved;

◆ Perfect and reliable protection; The safeguard of the motor and relative equipment can be achieved effectively;

◆ It can be used in the state in which motor should star and stop frequently。

Feature

◆ Starting Mode： Based on the load characteristics, different starting mode can the related parameters can be selected. So the best starting effect can be gained;

◆ Technical Performance： The higher performance microprocessor and software are used, so the control circuit is simplified. The best perform speed can gained without the adjustment of the circuit parameters;

◆ Reliability： All the electronic components of this product are selected strictly. Additionally, the main control board is tested in high temperature environment above seventy-two hours. The reliability of this product can be guaranteed

◆ Configuration： The modularization configuration and up-in-down-out wiring mode are adopted. It is easy to used and integrated;

◆ Multi-Protection：The motor protection circuit is not be added if the single product is in used. Because this product have multiple protection function such as Overload; Line fault; Over current; the starting time and so on. So the cost can be reduced and the circuit can be simplified。

◆ Keyboard：Operation of the keyboard is easy. User can set and modify the parameters (for example, starting, stopping running protection) by this keyboard based on the different load condition

◆ Analog signal：4-20mA output analog signal is provided;

◆ Actual power setting：When the rate power of Soft Starter is higher than the power of actual load, soft starter can be matched to the actual load by modifying the actual current parameter. So the parameters about starting、running and protection are correct

2.Product Type and Inspection

Each RQ100-B series soft starter is tested. Only the starter that passes the function and running test can leave the factory. After receiving the equipment, the user should inspect it according the steps described below. Please notify the supplier immediately if you find any problem

◆ Check the nameplate：Check the item(s) nameplate catalog number against the purchase order. Make sure that the equipment you received is matched with the product you ordered。

FRECON

Type: RQ100-075B-3-H
Batch Number:
Voltage:AC380V(-10%~+15%)　50HZ
Type of use:AC-53b
Moter Power:　75KW　Rated Current：　150A
Executive Standard:GB14048.6-2008

FRECON ELECTRIC (SHENZHEN) CO.,LTD.

◆ Inspect whether or not the product is damaged through the delivery, for example: Inner parts falls off, She11 is deformed or depressed, the wires is loose etc

◆ Quality certificate and user manual: the package of each soft start includes quality certificate and user manual

3. Environment and Installation

3.1 Environment

The environment is important to the equipment life. So please install the soft starter on the site described below

◆ **Operation Condition for the regular products**

Power Supply: AC: 380V (-10%, +15%), 50Hz.
(note：voltage level should be matched to the rate voltage of the actually motor, user should explain the voltage level in the purchase order if it is special.)
Motor: Squirrel cage asynchronous motor. (Please explain in the purchase order if it is special)
Start frequency: less than 20 times per hour for Standard products (Please explain in the purchase order if the motor should be start more frequent)
Cooling: Natural air-cooled or Fan air cooling
IP Code: IP20
Environment condition: If the altitude is above 2000 M, user should select the higher power equipment

Environment Temperature: -25℃ to +40℃.

Relative humidity: ≤95% (20℃± 5℃) non-condensing, no inflammable，explosive gases, no conducive dust.

Install in an enclosure with good ventilation. The vibration is less than 0.5G

Structure Form: For the RQ100-B series product, there is not inner bypass contactor

◆ **Special conditions**

If unconventional products using in the special conditions is needed, please explain in the purchase order

3.2 Installation

◆ **Direction and Distance**

The product must be vertically installed. There should be enough space to dissipate the heat, as shown in figure 3-1. For the cabinet product, there should be a certain distance between back door of the product and wall. Therefore it is easy to maintain.

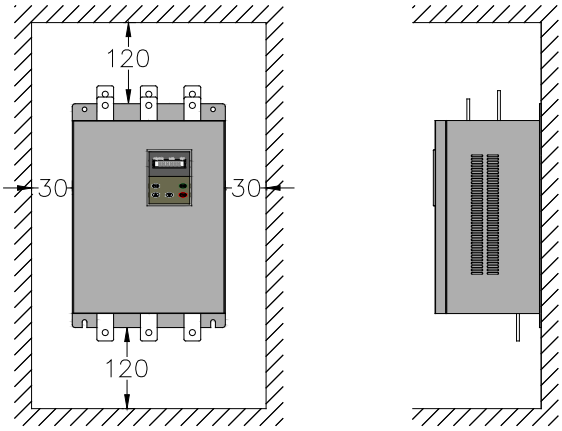


Figure3-1

◆ **Cabinet installation**

If the product is installed in the cabinet, make sure there are good ventilation in the cabinet. The products can be installed vertically or horizontally. Horizontal layout shows in Figure 3-2. Vertical layout shows in Figure 3-3. User can adopt any of them.

Note: If the vertical layout is adopted (especial in fan air cooling mode), clapboard should be installed between them to avoid that the upper starter is affected by heat generated by the lower starter.

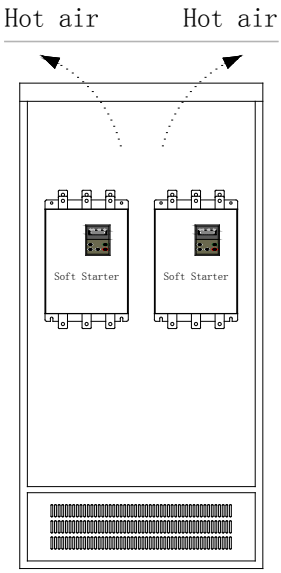


Figure3-2
Horizontal layout

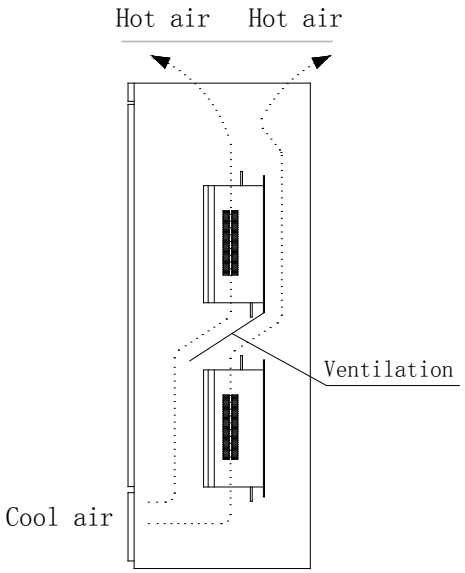


Figure3-3
Vertical layout

4. Operating principle

There are three pairs of anti-parallel thyristors connected to the stator of motor. Using the electric switch feature of the thyristors, the voltage of the motor can be controlled by changing the triggering angel of the thyristors. The triggering angel of the thyristors is controlled by microprocessor. So the motor can be started softer and smooth. After the equipment is up to full voltage, it outputs a bypass signal. User can use this signal to control the bypass contactor to supply the motor. See figure4-1.

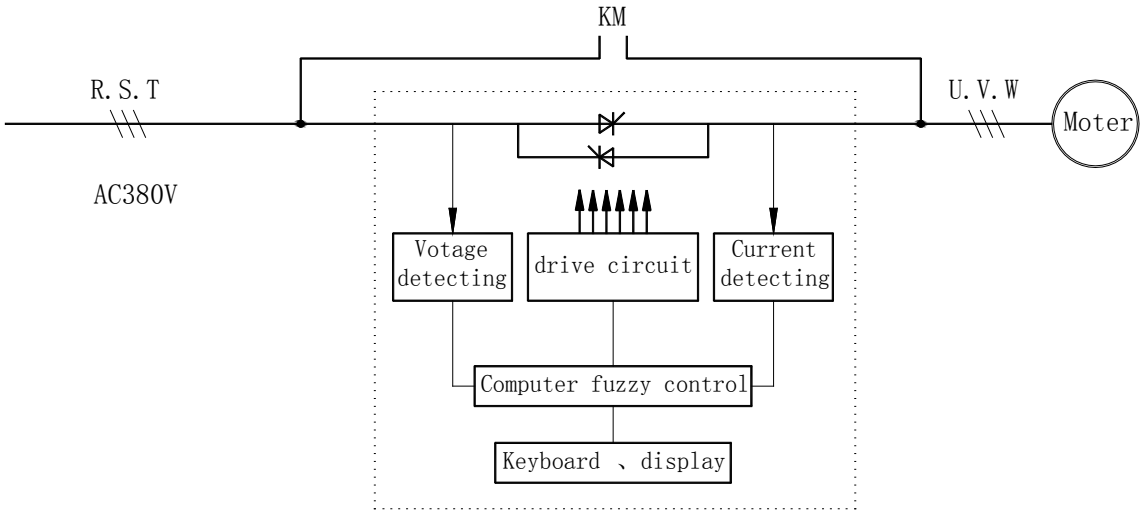
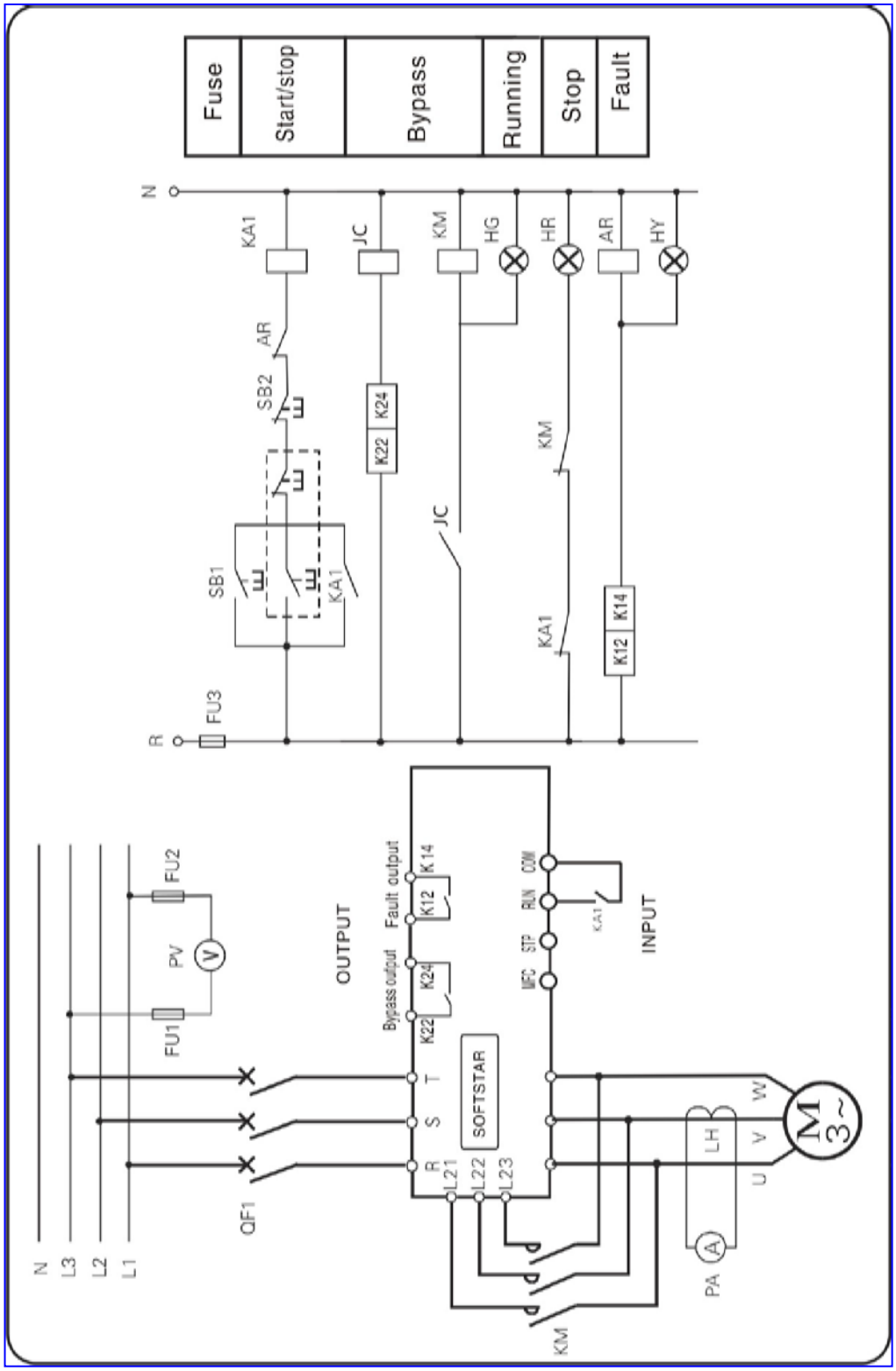


Figure 4-1

5. General wiring and external terminal

5.1 Wiring schematic



5.2 External terminals explain

table5-1

<table>
<tr><th colspan="3">Terminal Name</th><th colspan="3">Terminal function</th><th>Explanation</th></tr>
<tr><td colspan="2" rowspan="3">Main circuit</td><td>R.S.T</td><td colspan="3">Input</td><td>Connect to three-phase power source through breaker (QF)</td></tr>
<tr><td>U.V.W</td><td colspan="3">Output</td><td>Connect to three-phase asynchronous motor</td></tr>
<tr><td>L21.L22.L23</td><td colspan="3">Bypass</td><td>Connect to the up of bypass contactor</td></tr>
<tr><td rowspan="9"></td><td rowspan="4"></td><td>MFC</td><td colspan="3">Program input</td><td>Program input</td></tr>
<tr><td>RUN</td><td colspan="3">Start</td><td>Connect RUN and COM directly</td></tr>
<tr><td>STP</td><td colspan="3">stop</td><td>Connect STOP and COM directly</td></tr>
<tr><td>COM</td><td colspan="3">common</td><td>Logic Ground</td></tr>
<tr><td rowspan="2">analog output</td><td>I+</td><td colspan="3">4-20Ma output
Load input resistance≤400Ω</td><td rowspan="2">Im=Ie(I-4)/8
Im：motor output current (A)
Ie: motor rate current (A)
I：4-20mA output current(mA)</td></tr>
<tr><td>I-</td><td colspan="3">4～20mA output reference</td></tr>
<tr><td rowspan="4">Relay output</td><td>K14</td><td>NO</td><td rowspan="2">Fault output terminals</td><td rowspan="2">In Fault:
K14-K12 close
Contacts capacity
AC:10A/250V 或 5A/380V　DC:10A/30V</td></tr>
<tr><td>K12</td><td>COM</td></tr>
<tr><td>K24</td><td>NO</td><td rowspan="2">Bypass terminals</td><td rowspan="2">Starting end：K24-K22 close；K21-K22open
Contacts capacity:
AC:10A/250V 或 5A/380V　DC:10A/30V</td></tr>
<tr><td>K22</td><td>COM</td></tr>
</table>

Note：Fault, bypass and starting end output terminals are all dry contact。

5.3 Main circuit wiring

There are nine power terminals for RQ100-B series product. R, S, T (Power line),L21,L22,L23 (Bypass line)and U, V, W (Motor line).

5.4 Control circuit terminals

There are control circuit terminals on the main control board. This control circuit terminal provides convenience for the user to realize remote control and external signal control. User can connect the corresponding terminals according to the actual state. By setting the parameter, user can select keyboard mode or terminal mode by to control product to start and stop.

6. Control mode

This product has three start modes: Current Limit and Voltage Ramp and jogging. These start modes is independent. Only one of them can be chosen. Text below introduce that the different of them and which mode should be selected.

6.1 Voltage Ramp

The waveform of the voltage shows in Figure 6-1. U1 in figure is initial output voltage. When starting, the output voltage is up to U1 immediately, and then ramps up gradually according to the parameter Start Time “t” setting in advance. Then the motor accelerates continuously. When the output voltage reaches the rate value Ue, the motor reaches the rate speed. Starting process is finished. The Initial Voltage U1 and the Start Time t can be set according to the load. The range of U1 is 0~80%Ue, and the range of t is 1~120s.

This mode is used in the state with large inertia load, or in the state in which the current is not the important parameter but the stability is important. Using the mode, the mechanical stress and starting striking may decreased greatly. The bigger the initial voltage is, the more the initial torque and starting striking is. The time of starting is related to the parameter of “starting time” and load. It is unconcerned with current limited.

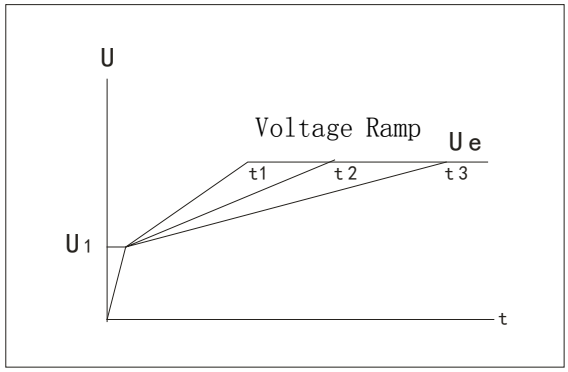


Figure 6-1

6.2 Current Limit

At the Current Limiting mode, the output voltage increases quickly until the output current reaches the limited current value Im. See figure 6-2. And then the output current maintains below this limited value. Then the output voltage is increased gradually, and the motor accelerate gradually; when the motor's speed is close to the rated，the output current decreases quickly to the rated value Ie, the starting is over. The limited current value can be set according to the load instance. The range of this parameter is 0.5-5Ie.

This mode is used in the state in which the current is very important parameter. Special in the state in which the grid capacity is small. The parameter of the current limit multiples should be set 2.5-3. If this value is small, the starting will be abnormal. At this mode, the time of starting is concerned to the parameter of the current limit multiples. The more this value is, the shorter the time of starting is, vice versa.

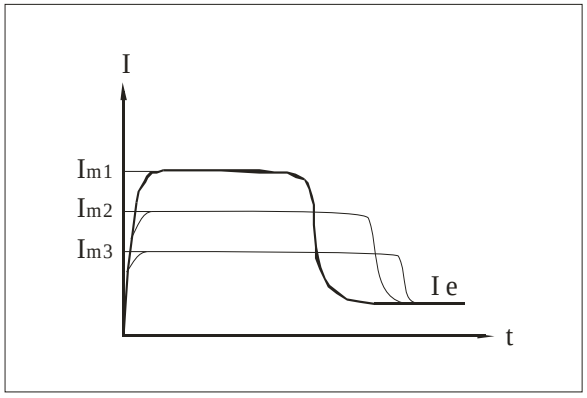


Figure 6-2

6.3 Jogging

At this start mode, the output voltage reaches the initial voltage U1 quickly, and remains unchanged. Changing the U1, the output voltage and torque of the motor will change corresponding. (See figure 6-3). It is convenient to judge the director of the motor.

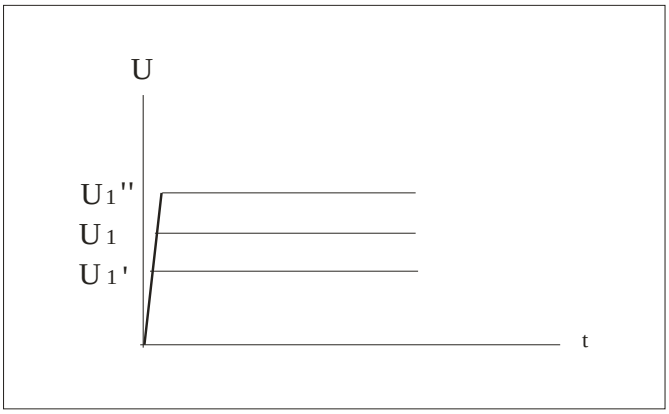


Figure 6-3

6.4 Stop Mode

There are two stop modes. user can set this parameter according to load and working condition.

● Free stop

When receiving the stop signal, the terminals K22, K24 is open, the bypass contactor is disconnected. The trigger signal of the SCR module is close at the same time. Motor inertia stop according the load.

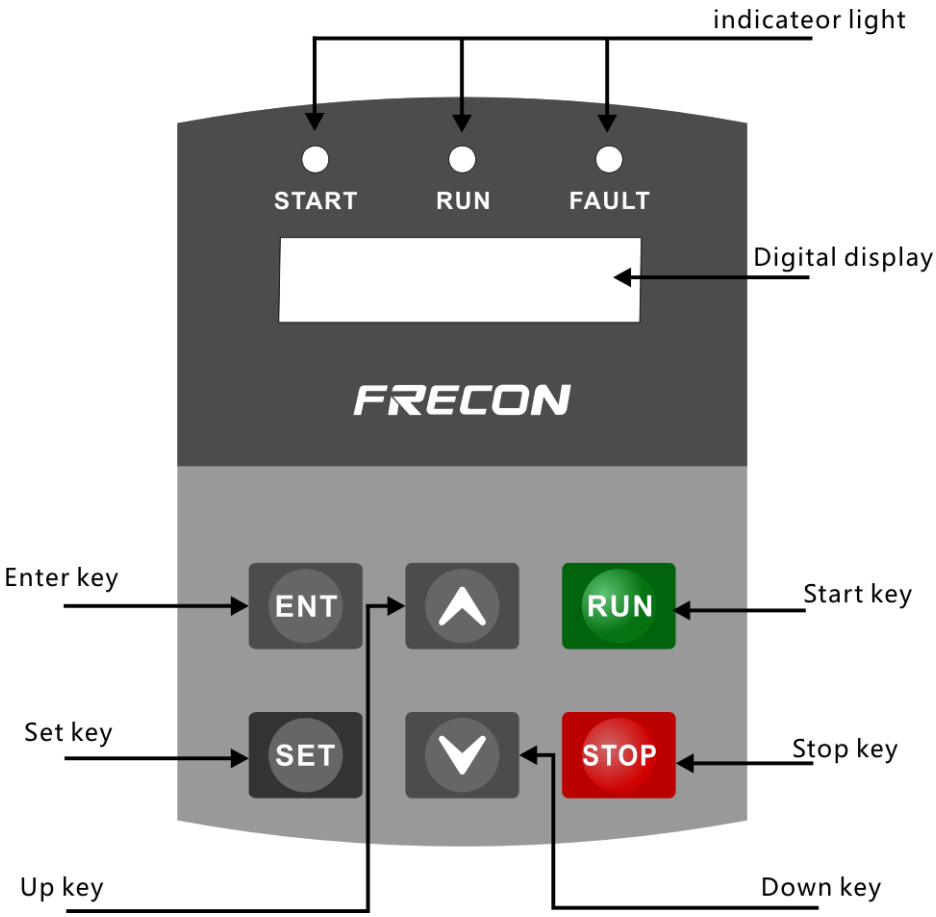
● soft stop

At this stop mode, when receiving the stop signal, the bypass contactor is disconnected. At the same time, motor is controlled through SCR. The output voltage decreases gradually. At last motor stop completely. The stop time is related to the parameter of load and factor of soft stop time. To gain the smooth stop effect, the “soft stop time” should be set carefully.

7. Keyboard

7.1 Keyboard Description

There is a Keyboard on the front of the soft starter. User can operate it to display data, save data, check data, display fault, reset fault, start or stop the motor etc.



7.2 Key Function

There are five key on the keyboard: RUN (start), STOP (stop), SET (set) ▲ (increase), ▼ (decrease)

● RUN (start)：When the system is on ready state rdy-12, press this key, the motor start according the start mode user set.

● STOP（stop）：When the system is on starting or running state, press this key, the motor stops, then the system enter ready state rdy-12. When the system is on setting state, press this key, system enter ready state rdy-12, and the parameter user modified is saved at the same time. When the system is on fault state, the fault code shows on the keyboard. Press this key, release it 5 minutes later, system enter ready state rdy-12 if the fault is deal with.

● SET(set）: On ready state, press this key, system enter setting state. On setting state, user can switch

between different parameter groups

● ENT: On setting state, press this key, system enter ready state.

● ▲（increase）: On SETTING state, user can increase the parameter value by press this key。

● ▼（decrease）: On SETTING state, user can decrease the parameter value by press this key。

Note: 1. If user selects external control, the keyboard can be taken off after all the parameters set.

8.Parameter function table

Table 8-1

NO.	DISPLAY	Name	Range and mean	The default value
1	FUN-01	Control Mode	1：keyboard control 2：external control 3：keyboard and external	3
2	FUN-02	Starting mode	1：Ramp▲ 2：limit★ 3:jog■	1
3	FUN-03	Stop mode select	1：free stop 2：soft stop(ramp)	1
4	FUN-04	rated current of soft starter	rated current of soft starter	
5	FUN-05	rated current of motor	According to the power of motor	
6	FUN-06	Jog voltage	0%~80% of Supply Voltage	30
7	FUN-07	Curr. Limit Level	50%~500% of rated current	300
8	FUN-08	Initial voltage	0%~80% of Supply Voltage	30
9	FUN-09	Ramp time	（1-120）S	30
10	FUN-10	Soft stop time factor	1-60	1
11	FUN-11	OverCurr.protect	400%~600% of rated current	400
12	FUN-12		50%~100%	100
13	FUN-13	Over running current protect	20%~400% of rated current	200
14	FUN-14	Start overload level	1-8	4
15	FUN-15	Run overload level	1-8	2
16	FUN-16	Current unbalance protect	5%~85%	60%
17	FUN-17	Over time of start	0-200	100
18	FUN-18	Function of Input	0：invalid 1：Emergency stop 2：reset 3：jogging 4：softstop	0

9.Parameter setting

9.1Working State

● Ready

When the soft Starter is power on, self-inspection is performed. The self-inspection includes: test the parameters that the user changed (fault protection of parameters setting), check if the phase of voltage is not right (protection of missing supply phase) and check if the system temperature is too high (protection of overheating) etc. Any fault is detected, the system immediately enter FAULT mode. If no fault is detected, the system enters the READY state, and the rdy sign displays on the keyboard panel. At the same time, the lamp on the left of the keyboard is light, it shows which start mode is.

● Setting

On READY state, press “SET” key , system enter the group select mode FUN-01, Then press▲ or ▼ key，can select different parameter to edit. Then press ▲or▼ key to modify the parameter. In editing state, press EXIT key, system will enter READY state after the parameter be saved.

● Starting

When soft starter is in the READY state, and it is allowed to start the motor, then user can press RUN button to start the motor according to the starting mode user set. At the same time, current value shows on the keyboard. At the process of Starting or running, user can press the STOP button at any time to stop the motor, and then the system enter READY state rdy。

In this state, the system detects the parameter voltage phase, high current suddenly, the time of starting and the system temperature etc. So during the motor is running, soft starter can protect motor.

● Bypass

After the starting process completed, the terminals K22,K24 is close automatically. User can control bypass conductor KM by this terminals, then the motor is powered by electric net through the bypass conductor KM.

● Fault

When soft starter is on the process of STARTING, OPERATING and READY state, system monitor all the protect parameter. If the value of measured is over the limited value user set, the trigger signal of the SCR module is cut off, system enters the FAULT state. Fault code shows on the keyboard. The explain of the fault code introduce in the chapter 10.1“fault display explanation and solutions”

10.Fault Protection and Display

When the fault is detected, soft starter stop immediately, the fault code displays on the keyboard. User can find the solution by check the explanations to this fault code. After the fault is solved, pres the ENT key to reset and return ready state。For detail see table 10-1

10.1 Fault displaying and Solution

Table 10-1

Code	explanation	Fault reason	Solution
Er801	Phase loss of power on	Power Line is unconnected A phase output open	Check the power line and output line
Er802	Phase loss of running	Power Line is unconnected A phase output open	Check the power line and output line
Er803	Over current at starting	Current at starting is over the limit	Adjust the limit and protect value
Er804	Over current at running	Load increase suddenly Fluctuate of the load is too big.	Adjust the load
Er805	Overload of starting	Is it overload	If the load current exceed the limit
Er806	Overload of running	Is it overload	If the load current exceed the limit
Er807	Current unbalance	Motor have fault The parameter of unbalance factor is too small	Check the motor Reset the parameter of unbalance factor
Er809	Start over time	Motor have fault The parameter of over time is too small	Check the motor set the parameter of over time
Er810	MFC terminal disconnect	MFC terminal disconnect The parameter of FUN-18	Check the MFC terminal set the parameter of FUN-18e

10.2 Overload

Overload protection function is in used during the process of starting and running

● There are 8 protection levels. The default is 4(same as 15 in IEC60974-4-2 standard). User can set this parameter according to de load situation, the smaller this parameter is, and the shorter the starting time of protection is, vice verse.

● The level 2 can’t be selected(same as 10A in IEC60974-4-2 standard).For detail see the table 10-2. Standard curve graph of IEC60974-4-2

IEC60974-4-2 Thermal protection curve of motor

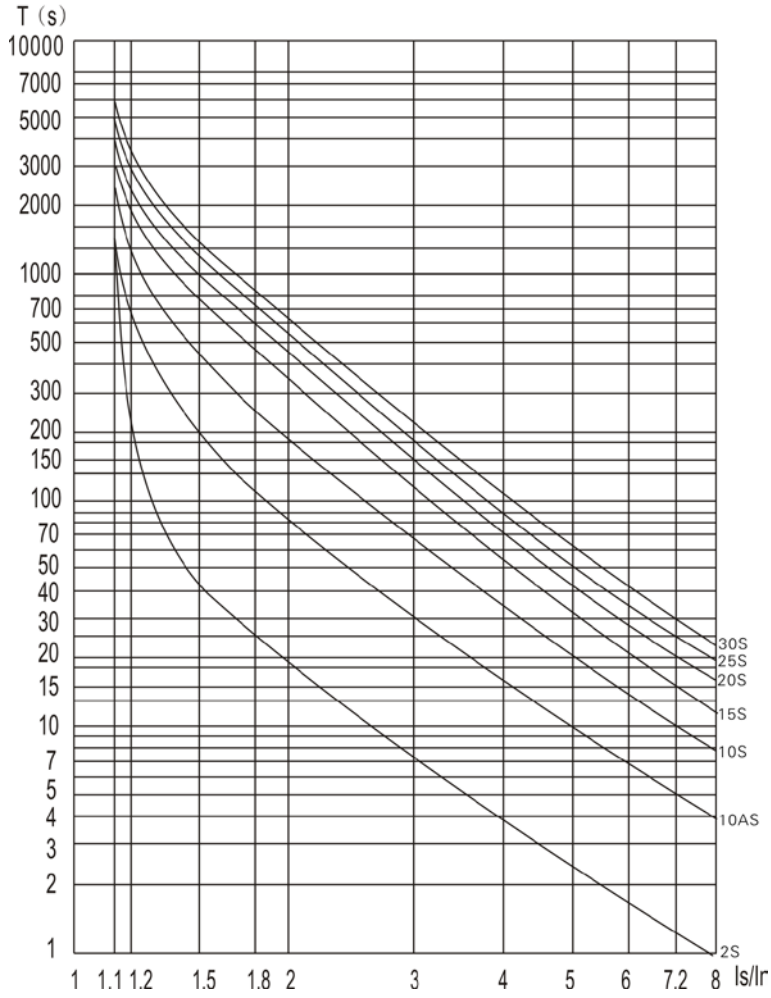


Table 10-2

Overload protection levels	IEC60947-4-2	5Ie	4Ie	3Ie	2Ie	1.5Ie	1.2Ie	1.05Ie
1	Class 2	1.5s	2.5s	4.5S	13S	35S	180S	—
2	Class 10A	4s	6S	12S	30S	80S	460S	—
3	Class 10	8s	13S	23S	60S	180S	800S	—
4	Class 15	12s	18S	32S	90S	230S	1200S	—
5	Class 20	16s	25S	46S	130S	320S	1650S	—
6	Class 25	18s	30S	58S	170S	520S	2200S	—
7	Class 30	23s	36S	68S	190S	650S	2800S	—
8	Class Special	28s	45S	82S	224S	—	—	—

11.Test running

● Inspection before running

For safe running, user should inspection the items show as following items before power on.

→ Is the power of the soft starter match to that of the motor?

→ Does the insulation of the motor meet the requirement?

→ Is the wiring of power and motor line right?

→ Do all the nut screw tightly

→ Measure the input power (R\S\T) using multimeter, Check whether there is short circuit.

Note: 1. There is linear power transformer between any two phases of power side. Static resistance is about 300Ω.

2. There are fans between any two phases of load side. Static resistance is about 2KΩ.

● Power on and trial running

→ When power is on, system enter READY state, rdy shows on the keyboard means everything is right. There are two lamp on the left of the keyboard to indicate the starting mode(voltage ramp or current limit)。User can select it according to the load.

- → If the keyboard display correctly, press RUN key to start the motor, then the actual current displays on the keyboard.

At running state, press STOP key to stop the motor, return to ready state rdy.

→ If the motor is not connected to the output load terminal U、V、W of the soft starter, step above can also be executed. It is used to check wiring of operate system, bypass contactor, all the lamp etc.

● Attention and Safe

→ If any fault is detected, responded fault code will show on the keyboard. See Table 10-1, Please deal with them according to the corresponding tips

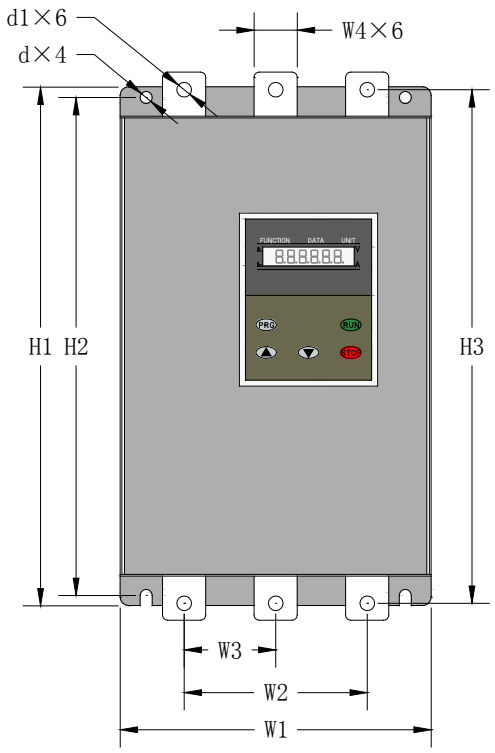
→ Warning: If the soft starter is power, don't open the shell cover to avoid electric shock。

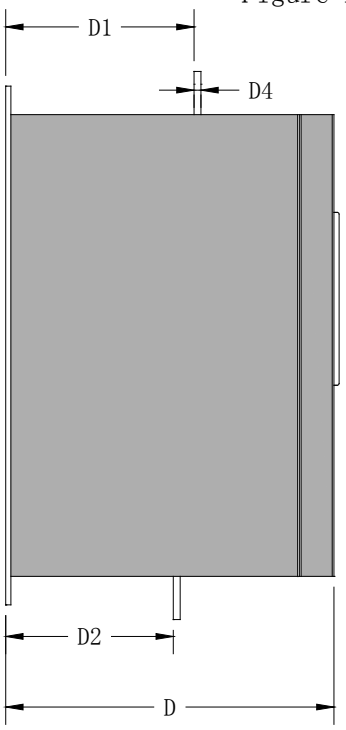
→ Warning: At the course of trial running, any abnormal phenomenon is fond, such as: Abnormal sound, Smoking or abnormal smell, user should cut off the power immediately。

→ If the motor is not connected to the output load terminal, power on, voltage can be measured at the output power connections. This is inductive voltage. This is normal phenomenon. This inductive voltage disappears immediately after the motor is connected。

→ During trial running, if the starting effect is not ideal, user can modify the parameter such as starting mode, current, voltage and time etc。

Figure F-2





AC380V(-10%,+15%)

Power rating (KW)	Rated current (A)	Appearance dimension (mm)			Installation dimension(mm)		
		W1	H1	D	W2	H2	d
15	30	170	320	219	144	263	Ø7
22	45	170	320	219	144	263	Ø7
30	60	170	320	219	144	263	Ø7
37	75	170	320	219	144	263	Ø7
45	90	170	320	219	144	263	Ø7
55	110	170	320	219	144	263	Ø7
75	150	170	320	219	144	263	Ø7
90	180	265	470	196	195	383	Ø11
115	230	265	470	196	195	383	Ø11
132	265	265	470	196	195	383	Ø11
160	320	265	470	196	195	383	Ø11
185	370	265	470	196	195	383	Ø11
200	400	265	470	196	195	383	Ø11
220	440	265	470	196	195	383	Ø11
250	500	295	560	205	260	469	Ø13
280	560	295	560	205	260	469	Ø13
320	640	295	560	205	260	469	Ø13
355	710	295	560	205	260	469	Ø13
400	800	295	560	205	260	469	Ø13