Safety Clauses

Thank you for using ATO intelligent 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 forbid 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.

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

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1. ATO GS Series Soft Starter

1.1 Motor soft starter profile

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 The 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 equipments.
- 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.

1.3 The main feature of soft starter

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 3 phase 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.

1.4 Technical specification

Item		Description
Input Power Supply	Input Voltage	Three-phase 220V/380V/480V/660 AC
	Frequency	50/60Hz
Adaptive Motor		Squirrel-cage three-phase asynchronous motor
Starting Times		It is recommended not to exceed 20 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.

Item		Description
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	-30 +55 ^{o}C
	Humidity	90%RH without dew condensation.
	Vibration	<0.5G
Structure	Protection Class	IP20
	Cooling Pattern	Natural wind cooling.

2. Nameplate Explanation and 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.

Nameplate explanation:

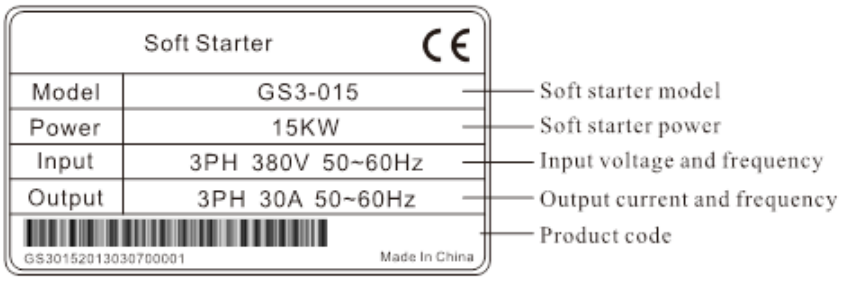


Diagram 2.1

Model explanation:

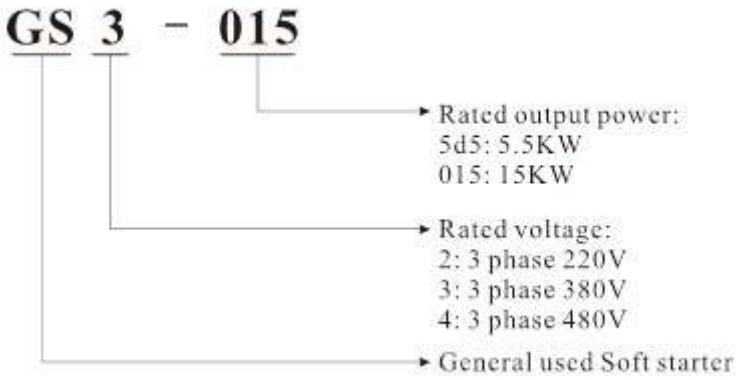


Diagram 2.2

- 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.

3. Usage Condition and Installation

It is strict rule for the users to use or install the soft starter according to the requirement; otherwise, it will be in bad result.

3.1 The usage condition

- **Power Supply:** City grid power, self-provided power, diesel oil dynamotor, 3-phase alternating current 220V/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 equipments.
- **Cooling Mode:** Naturally wind cooling.
- **Protective Grade: IP20**
- **Environment Conditions:** when altitude is less than 1000m, the temperature of the environment should be between -25°C ~ 40 °C, 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.

3.2 The 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. (See the following diagram 3.1)
- 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 3.1)

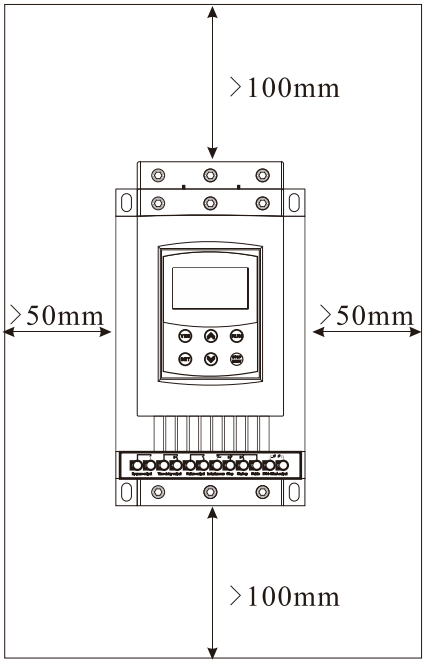


Diagram 3.1

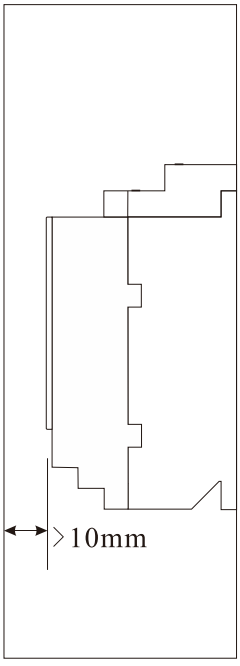


Diagram 3.2

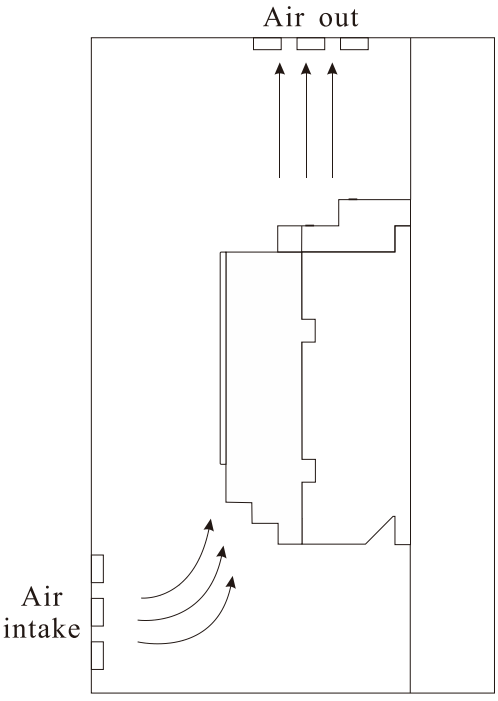
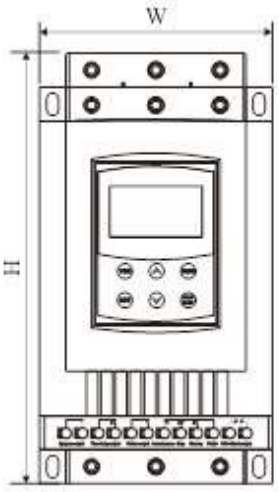
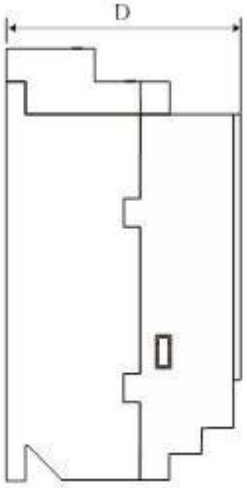


Diagram 3.3

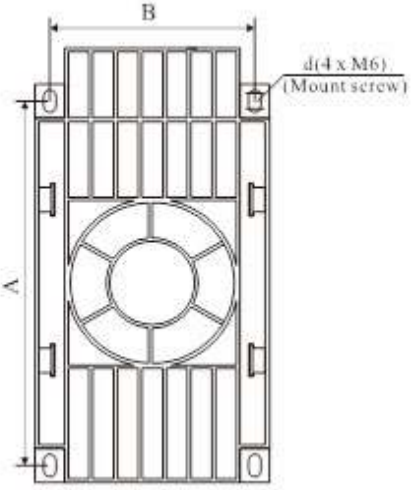
3.3 The installation dimensions

The external shape and installation dimensions of 5.5KW ~ 75KW (Diagram 3.4).





Dimensional drawing

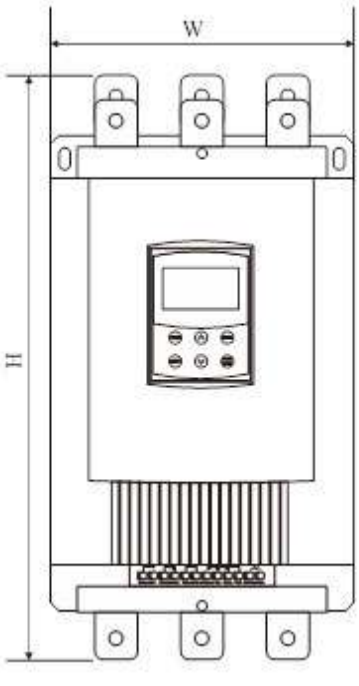


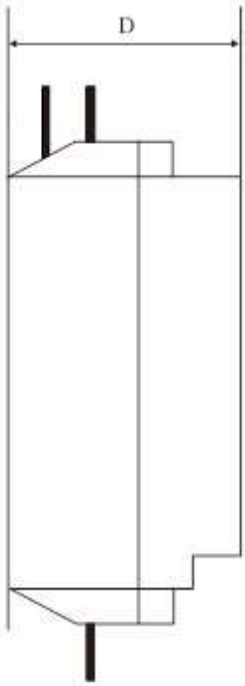
Mounting holes schematic

Model			Power	Current	External Dimensions (mm)			Installation Dimensions (mm)			N.W
220V	380V	480V	(KW)	(A)	H	W	D	A	B	d	(K.G)
---	GS3-5d5	GS4-5d5	5.5	11	146	270	160	131	247	M6	<5
---	GS3-7d5	GS4-7d5	7.5	15	146	270	160	131	247	M6	<5
GS2-5d5	GS3-011	GS4-011	11	23	146	270	160	131	247	M6	<5
GS2-7d5	GS3-015	GS4-015	15	30	146	270	160	131	247	M6	<5
---	GS3-018	GS4-018	18.5	37	146	270	160	131	247	M6	<5
GS2-011	GS3-022	GS4-022	22	43	146	270	160	131	247	M6	<5
GS2-015	GS3-030	GS4-030	30	60	146	270	160	131	247	M6	<5
GS2-018	GS3-037	GS4-037	37	75	146	270	160	131	247	M6	<5
GS2-022	GS3-045	GS4-045	45	90	146	270	160	131	247	M6	<5
GS2-030	GS3-055	GS4-055	55	110	146	270	160	131	247	M6	<5
GS2-037	GS3-075	GS4-075	75	150	146	270	160	131	247	M6	<5

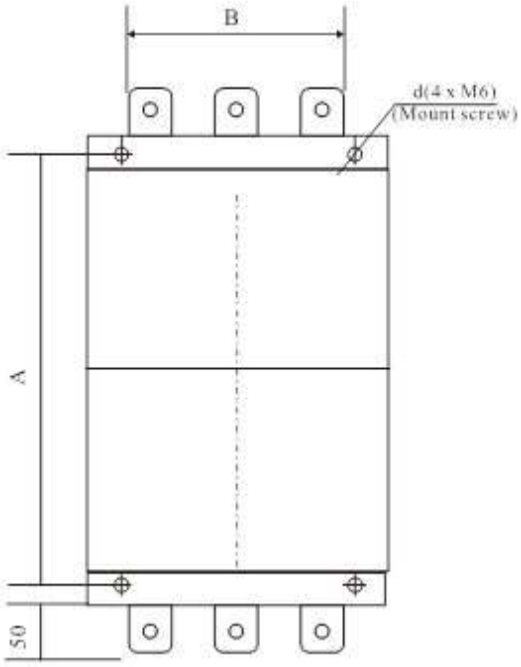
: The rated power of motor in the above form is the maximum rated value. Generally, the values of matched motor power capacity should not be more than this value.

The external shape and installation dimensions of 90KW ~ 600KW(Diagram 3.5).





Dimensional drawing



Mounting holes schematic

Model			Power	Current	External Dimensions (mm)			Installation Dimensions (mm)			N.W
220V	380V	480V	(KW)	(A)	H	W	D	A	B	d	(K.G)
GS2-045	GS3-090	GS4-090	90	180	257	525	194	195	377	M8	<21
GS2-055	GS3-115	GS4-115	115	230	257	525	194	195	377	M8	<21
---	GS3-132	GS4-132	132	264	257	525	194	195	377	M8	<21
GS2-075	GS3-160	GS4-160	160	320	257	525	194	195	377	M8	<21
GS2-090	GS3-185	GS4-185	185	370	257	525	194	195	377	M8	<21
GS2-100	GS3-200	GS4-200	200	400	257	525	194	195	377	M8	<21
GS2-132	GS3-250	GS4-250	250	500	290	560	245	260	465	M8	<25
GS2-160	GS3-280	GS4-280	280	560	290	560	245	260	465	M8	<25
GS2-185	GS3-320	GS4-320	320	640	290	560	245	260	465	M8	<25
GS2-200	GS3-400	GS4-400	400	800	330	590	245	300	490	M8	<32
GS2-220	GS3-450	GS4-450	450	900	330	590	245	300	490	M8	<32
GS2-250	GS3-500	GS4-500	500	1000	450	740	300	400	575	M10	<40
GS2-315	GS3-600	GS4-600	600	1200	450	740	300	400	575	M10	<40

3.4 Installation diagram

GS series soft starter has three types of connection as following:

- **Main circuit connection:** It contains the wiring of 3-phase source input, the output to motor, and the pass -by contactor connection.
- **External terminal connection:** That is the wire comes from twelve external terminals which including control signal and analogue output signal.
- **Communication connection:** One standard RJ-45 network cable socket and one DB9 socket can be used to connect computer or network.

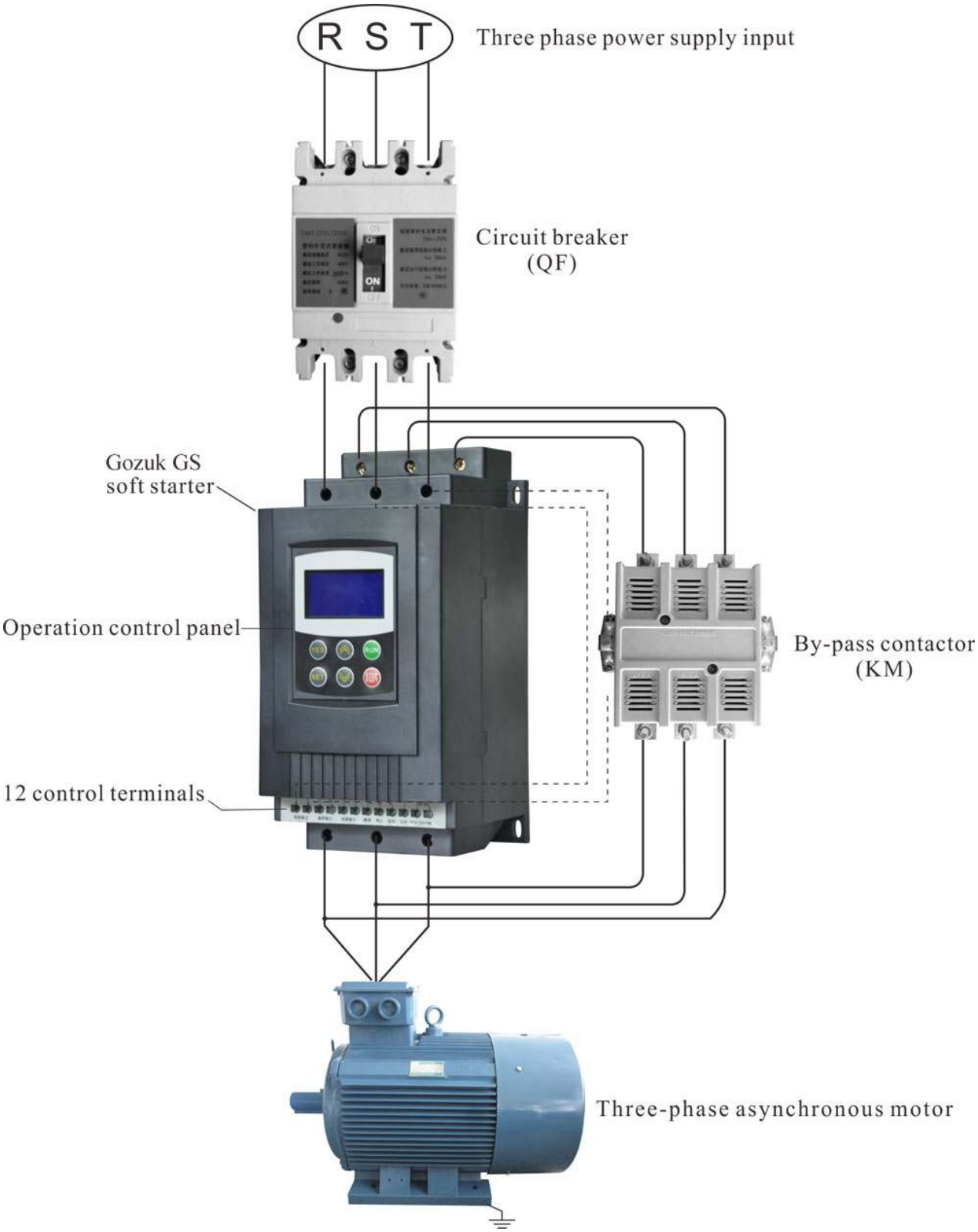

R S T
Three phase power supply input
Circuit breaker
(QF)
Gozuk GS
soft starter
Operation control panel
12 control terminals
By-pass contactor
(KM)
Three-phase asynchronous motor

Diagram 3.6

4. Connection and External Terminal

4.1 The external terminal

Please see the diagram diagram 4.1:

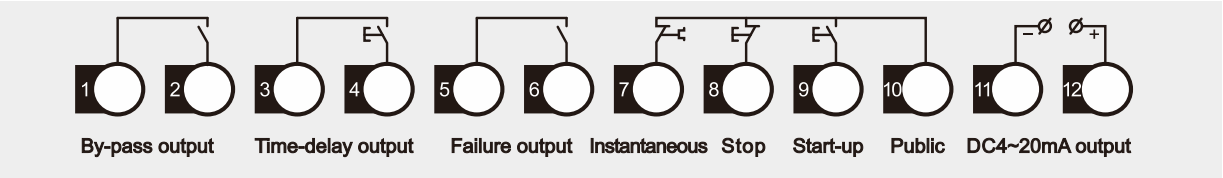


Diagram 4.1

- Terminal ① ② are by-pass output, are used to control the by-pass contactor. They are normal open contacts and are closed when finishing starting. The terminal contact capacity is AC 250V/5A.
- Terminal ③ ④ are programmable relay output: The delay time is set by **F4** 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 5.3. This terminal contact capacity is AC250V/5A.
- Terminal ⑤ ⑥ are 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.
- Terminal ⑦ are 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, and it is useless when the **FA** code is set to 0(Primary protection).
- Terminal ⑧ ⑨ ⑩ are startup or stop input .There are two ways of connections for your selection; those are 3-wire connection and 2-wire connection. Please see the diagram 4.2

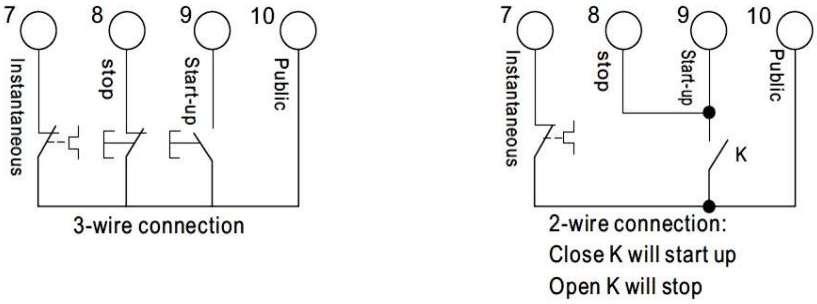


Diagram 4.2

- Terminal ⑪ ⑫ are DC 4 ~ 20mA analogue 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 ~ 20mADC current meter to check. The max value of output load resistance is 300Ω.

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

4.2 The communication interfaces

RJ-45 is the standard web line socket.

DB9 socket has RS485 and RS232 interfaces inside.

Please see the diagram 4.3

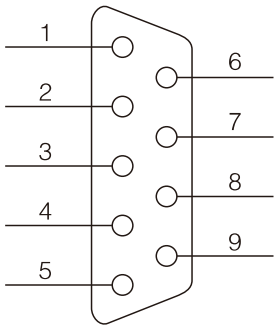


Diagram 4.3

① is RS485+

⑥ is RS485-

② is RS232 output.

③ is RS232 input.

④ is +5V output (limit-current is 50mA)

⑤ is earthed GND.

⑦⑧⑨ are empty.

The user can choose the following software:

- Computer collector distribution control communication software.
- Device Net interface card and communication.
- Device Net/Mod-bus/Profi-bus gateways.
- Others.

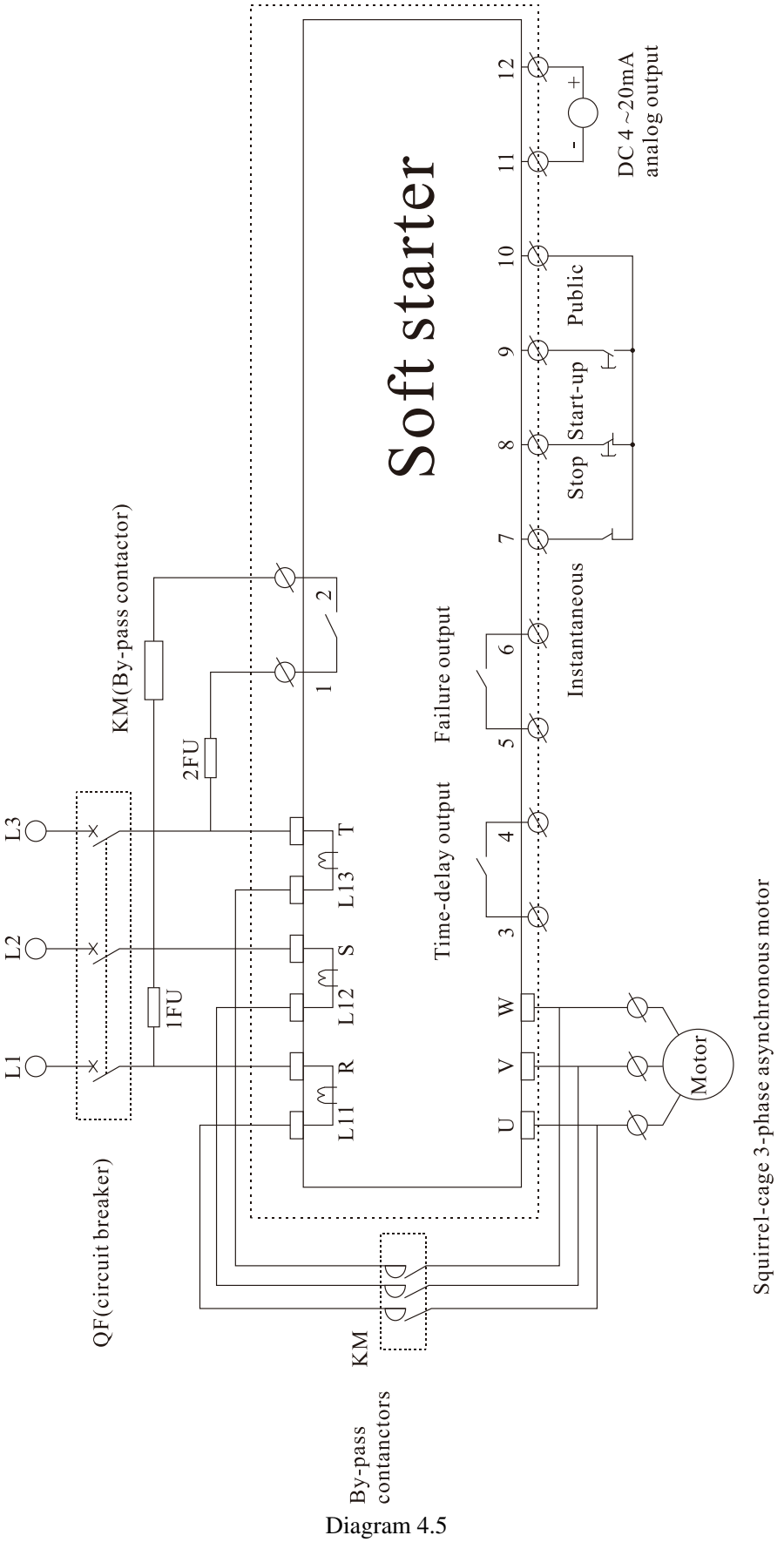

Soft starter
L1
L2
L3
QF(circuit breaker)
KM(By-pass contactor)
1FU
2FU
L11
L12
L13
R
S
T
U
V
W
1
2
3
4
5
6
7
8
9
10
11
12
Time-delay output
Failure output
Instantaneous
Stop
Start-up
Public
DC 4~20mA
analog output
Motor
Squirrel-cage 3-phase asynchronous motor
KM
By-pass
contanctors

Diagram 4.5

5. Control Panel and Operation

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.

5.1 The operation of control panel

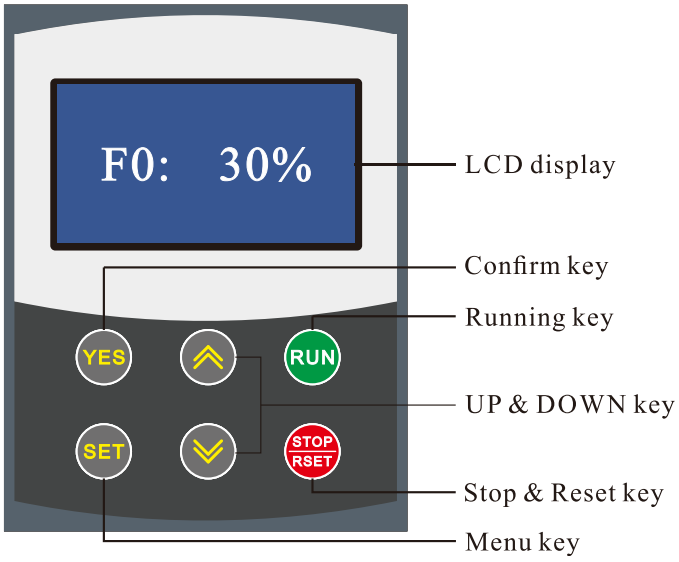


Diagram 5.1

- Power on: Will show "READY", press **RUN** key can soft start motor。The state "READY" means soft starter is ready for starting.

The keypad key specification:

- **RUN** key and **STOP&RSET** key: In the soft starting process，keypad will show "A:***" displaying motor current, at this moment, only **STOP&RSET** key is valid, and cannot enter menu of parameter setting and helping. In the soft stopping process, the keypad will show "A:***", displaying motor current, at this moment, only **RUN** key is valid，and cannot enter menu of parameter setting and helping, **STOP&RSET** key also has function of fault reset.
- **SET** key: under non-helping state, to press **SET** key enter setting menu, displaying initial voltage F0:30%, and press **SET** key again, the colon behind F0 flashing, means the parameter behind colon is revisable, and press **UP** key or **DOWN** key to change parameter. And then press **YES** key to save, the screen will show "GOOD" and ring two, means parameter saved, and then quit. If you do not want to save new parameter, to press **SET** key, the colon stop flashing and recover old parameter, and to press **YES** key to quit, also can directly go back to main menu by pressing **STOP&RSET** key.
- **YES** key: Under non-setting state, press **YES** key to enter helping menu， displaying power voltage "AC:XXXXV" , and press **YES** key to quit，and also can press **STOP&RSET** key quit. Under setting state, to press **YES** key to save new parameter and quit setting state.
- **UP** key and **DOWN** key: Under setting menu, when the colon no-flashing to press **UP** key or **DOWN** key can change parameter code, when colon flashing: **UP** key or **DOWN** key to change this parameter value; pressing **UP** key or **DOWN** key over 1 second, the parameter value will rapidly change. Under helping menu to press **UP** key or **DOWN** key can change function code and helping information. When the soft starter is starting, and do not enter setting and helping menu, the keypad will display motor current :"A:*** " ，at this tmei to press **UP** key or **DOWN** key, can check apparent power "XXX.XKW" or over load ratio "XXX.X%"， when the overload

ratio over 100%, starter will stop and alarm over load, the keypad displaying "Error 8".

- There will be a sound when pressing key is valid， no sound means this key is invalid under this state.
- when external control way use 3 wiring, the terminal start button and stop button is same function as keypad **RUN** key and **STOP&RSET**.
- Control keypad adopts super-strong anti-interference design, allowing the extending cable distance longer than 3 meters.

5.2 Parameters set and explanation

The explanation for "Parameter-set" codes.

Code	Explanation for codes	The range of value	Default value	Special explanation
F0	Initial voltage	30~70%	30%	This code can be used when the starting mode is set as "Voltage ramp to start", and if is "Limit-current" mode ,the value will be fixed as 40%
F1	Soft starting time	2~60S	16S	It is invalid in "Limit-Current" starting mode.
F2	Soft stopping time	0~60S	0S	If the code set as "0", the motor will free stop. One soft starter for 2 motor, this code should set "0".
F3	Start-up time delay	0~999S	0S	Delay is with countdown mode; If set as "0", the starter will start up the motor immediately.
F4*	Programming time-delay	0~999S	0S	This code is used to set delay time of ③&④terminals output. Set "0" immediately close.
F5	Start-up current limited value	50~500%	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 of soft starter	50~200%	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	Lower voltage protection	40~90%	80%	When the working voltage is under the voltage range(80%),the soft starter will be low voltage protection
F8	Over voltage protection	100~130%	120%	When the working voltage is over the voltage range(120%),the soft starter will be over voltage protection
F9	Modes of starting	0~6	1	0: Limit-current to start 1: Voltage ramp start 2: Torque control + limit current 3: Torque control + voltage ramp 4: Current ramp start 5: Double closed loop 6: Monitoring

Code	Explanation for codes	The range of value	Default value	Special explanation
FA	Protection Level	0~4	4	0. Primary protection 1. Light-load protection 2. Standard protection 3. Heavy-load protection 4. The superior level protection
FB	Operation control mode	0 ~6	1	0: Run by keypad 1: Run by keypad and terminal 2: Run by terminal 3: Run by terminal and RS485 4: Run by keypad, terminal and RS485 5: Run by keypad and RS485 6: Run by RS485
FC	Parameter revise	0~2	1	0: Parameter revise prohibit; 1: Partial parameter revise prohibit; 2: All parameter allow revising.
FD*	Communication address	0~63	0	Many soft starters connect with upper computer.
FE*	Programming output	0~19	6	Setting the detailed in Item 5.3
FF*	Soft-stopping limited current	20~100%	80%	Setting the detailed in Item 7.3
FP	Motor rated current	---	Rated value	"The rated current of motor" is the same as the motor nominal current.
FU	Motor less load protection	0~99	Prohibit	Setting the detailed in Item 5.3
FL	3 phase balance valid	0~1	1	0: Invalid 1: Valid
FM	Current coefficient	50~150%	100%	Showing current slants high, to set coefficient down; Lower conversely
FN	Voltage coefficient	50~150%	100%	Showing voltage slants high, to set coefficient down; lower conversely

Note:

- F6 the "Max working current", is basic on the nominal current of motor.
- 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** key to power on soft starter, all parameters will recover to default setting except FE code.
- When FC=1, these parameters with "*" is prohibited to revise.

5.3 Parameters code function explanation

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

Note: In the above form,"1" is allowing,"0" is forbidding. For example, If you press keypad "RUN", and meet **"Error 14"**, please set "**Fb**=0". And then soft starter can be run by keypad.

If the "External Control" is allowing, you must contact a normally closed switch button between the terminal ⑦⑧ and terminal ⑩, otherwise the soft starter can't start-up the motor and show "**Error1/Error 16**".

The parameter **"FE"** is use to setting the way of ③&④ programmable relay output, As the following form:

Numerical Value of FE	The moment of programmable relay 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

If users need programmable relay output time delay, the time can be setting by parameter **"F4"**.

- When the **"FE"** is setting as 5~9(or 15~19), the terminal ③&④ will display the state of programmable relay output, As the following form:

The number setting by FE	The state of programmable relay output
5(15)	Error state
6(16)	Working state
7(17)	Ready state
8(18)	Starting state
9(19)	By-pass operation state

- The state of programmable relay output is used to show the working state of soft starter, and under this way, the **"F4"** setting delay time is invalid;
- The default setting of **"FE"** code is "7" showing the ready state of soft starter and at this state the motor can be started up;
- When the **"FE"** code is "5" outputting error state of motor, Terminal ③ ④ can output fault such as: (Err05, Err06, Err07, Err08, Err12, and Err15). This will not affect the function of ⑤⑥ error output terminals.
- When **"FE"** >9, the programmable output will be "reverse phase output", (Normal open will reverse to normal close).
- When **"FC"**=0, all parameters cannot be revised. And when **"FC"**=1, (F4; F6; Fd; FE; FF; FU) cannot be revised. When **"FC"**=2, all parameters can be revised.
- **"FU"** is motor less load protection, when **"FU"** < 10, the motor less load protection is invalid. The **"FU"** less load protection current range is 10%~90%. And delay time is 5~90 seconds. The ten bits*10% is protection current percentage, the Bits*10 is delay time; the bits=0, the delay time is 5seconds.
  For example: **"FU"**=42, the less load current is 40%, and delay time is 20 seconds.

5.4 Helping message and explanation

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

Helping message Form

Message displayed	Explanation
AC: XXXXV	That is the 3-phase power voltage is AC 380V.
030A-380V	That is the specification is AC 380V, 50Hz, 30A.
H1: Error 5	The fault message Err05 that happened at the last time.
:	:
H9: Error 0	It says no fault happened.
VEr3.0	It says the software of the products is Ver3.0.
Lxxxx	Xxxxx is times of successful soft starting
T-run xxS	"xx" is last soft starting time
Note: The message H1 ~ H9 displayed means 9 faults records that happened lately.	

- Not in state of soft starting and stopping, and not in setting state, to press YES key to enter helping menu, and press UP or DOWN key to choose helping information.
- Under state of helping, to press YES key or stop key to quit helping menu.

5.5 The complete solution of default setting and user debugging

The system integrator or final user do not have proper motor for testing, but you can use star wiring by 3 piece 100W or 200W electric lamps or small KW motor for testing. At this moment, because the output current is very small, so the soft starter will alarm Error05 "output phase lost" and stop, so user needs to change parameter FA to 0 (Primary protection) , and soft starter will not alarm, and after starting, the 3 lamps will be light and gradually brighter, lastly bypass contacted and lamps be full bright.

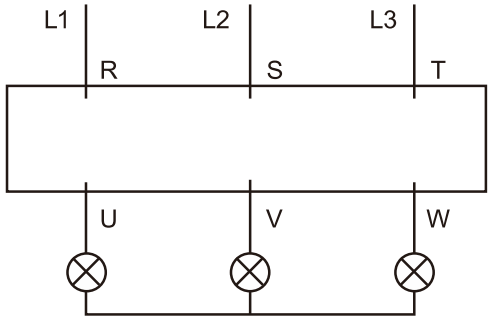


Diagram 5.2

6. 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!

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 less-phase protection: The delayed time < 3s
- Output less-phase protection: The delayed time < 3s
- Three-phase unbalance protection: The delayed time < 3s, when the difference of current among three phrases is more than 50% ± 10%, the protection be valid.
- Starting over-current protection time: The diagram of over current 5 times of **F6** set rated working current is just as diagram 6.1.
- Working over-load protection time: The starter will be in inverse time thermal protection on. Base of the Max working current of motor (Set by **F6**), (The diagram 6.1 show)
- Low voltage protection delay time: 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 delay time: 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.
- Loads short-circuit protection delay time: The protection delayed time < 0.1S.
- Motor less load protection delay time: The protection range (10% ~ 90%) is set by **FU**; the delayed time is 5~90 seconds. When **FU** < 10, the protection is invalid.

6.1 Protection classes and explanation

According different usage conditions, GS series Soft Starter has five protection classes, as following:

0. Primary protection
1. Light-load protection
2. Standard protection
3. Heavy-load protection
4. The superior protection

- Primary protection includes the protection functions of overheat, short circuit, and input default phase protection and prohibit external instantaneous stop terminal. Which is proper urgently startup conditions, such as fire pump.
- The protections of light load, standard and heavy-load have the overall protection function of soft starter. The difference among them is protection level of overload and over current. See the diagram of 6.1.
- Under the superior protection, the soft starter has a higher protection level.
- The protection classes and the time of heat protection as (diagram 6.1)

FA code	0:Basic protection	1:Light-load protection			2:Standard protection			3:Heavy-load protection			4:Superior protection			Note
The grade of overload protection	No	2 grade			10 grade			20 grade			10 grade			Standard of IEC60947-4-2
The grade of over-current protection	No	3 Second			15 Second			30 Second			15 Second			The 5 times of **F6** current
Overload drop-away time	The multiple to the rated 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	

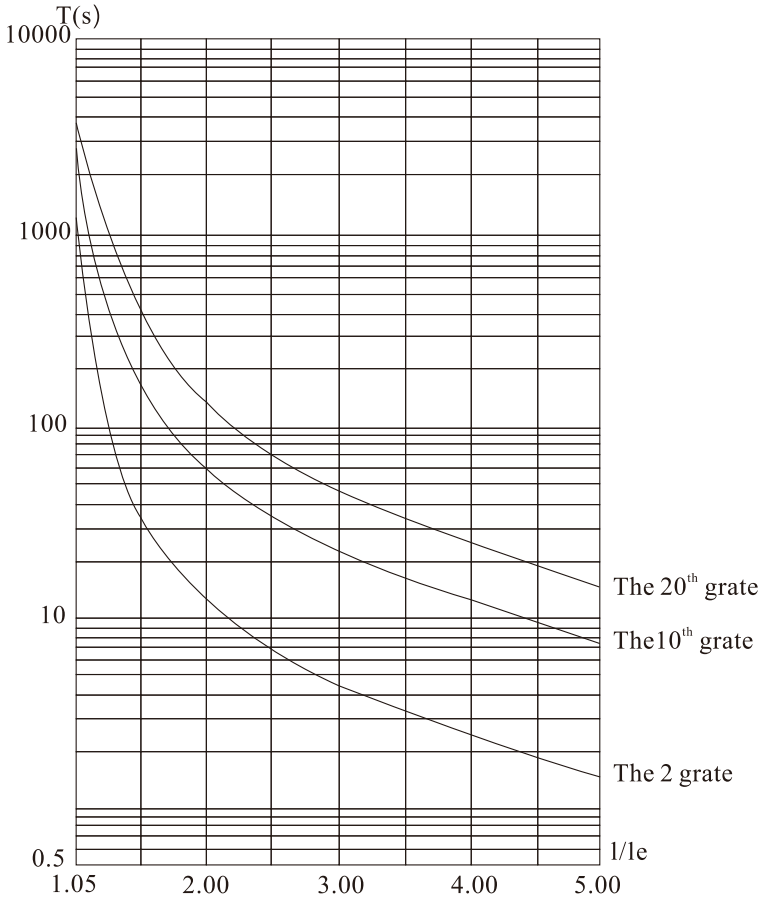


Diagram 6.1 (IEC60947-4-2 standard) Motor heat protection curve (overload drop-away time)

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.

7. 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.

7.1 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" 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" key or cut off the power to stop running.
- If the soft starter starting state is not satisfied. Please see the detailed explanation at 7.2: 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 "Err??", at this time, you can check diagram 7.1 to find out reason .
- Press "STOP" key or external stop button can reset the error state.

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

Error Code	Explanation	Reason and the solution way
Error 0	The fault is removed	Any faults are removed, such as low-voltage, over-voltage, over-heat. Now the Ready-lamp is lighting and you can start the motor.
Error 1	The external instantaneous stop terminal is open	Please connect the external instantaneous stop terminal (terminal ⑦) with the public terminal (terminal ⑩).
Error 2	The soft starter is over heat	The starter is started too frequently, or the starter power is not matched with the motor.
Error 3	The starting time is over long, which is longer than 60s.	The starting parameter is set wrong, or the load is over and the power capacity is not enough.
Error 4	Input phase failure	Please check whether the input circuit connections, bypass contactor and the controlled silicon is open or whether the thyristor wire is not connected..
Error 5	Output phase-failure	Please check whether the output circuit connection, bypass contactor and the controlled silicon are short circuit, or whether the thyristor wire is connected well.
Error 6	Three-phase unbalance	Please check the input three-phase power or the motor is abnormal.
Error 7	Starting over current	Overload, or the motor is not matched with the soft starter.

Error Code	Explanation	Reason and the solution way
Error 8	Running over load	Overload or the **F6** code is set wrong.
Error 9	Low voltage	Please check the voltage of input power or the **F7** item is set wrong.
Error 10	Over voltage	Please check the voltage of input power or the **F8** item is set wrong.
Error 11	The parameters are set wrong	Please change the parameter correctly, or you can press the "YES" key to power on the starter again to recovery the default setting.
Error 12	Load short circuit	Check load and the controlled silicon is short circuit or overload.
Error 13	The wiring of automatic Re-start is wrong	The external terminals is not connected according the 2-wire way.
Error 14	The wiring of external terminal is wrong	change **Fb**=0,When external control mode is allowing, the external stop terminal is open, and soft starter cannot start.
Error15	Motor less load	Please match the appropriate motor.
Error16	⑧,⑩ terminal open circuit	Please check and connect⑧,⑩.
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.		

7.2 The starting mode and application

ATO GS series soft starter has six starting modes for the user to select according the motor and load equipments.

7.2.1 Current-limit to start

(The **F9** code is set as"0") Diagram 7.1 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.

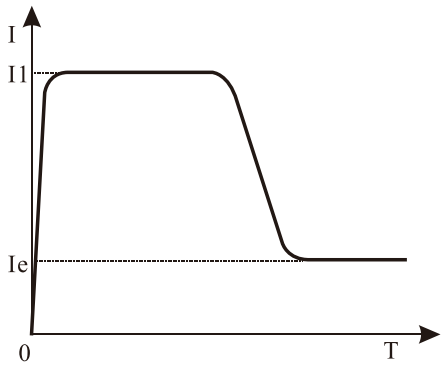


Diagram 7.1

7.2.2 Voltage ramp to start

(The **F9** code is set as"1") Diagram 7.2 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 equipments are light; this starting mode fits for the common occasions where the motor need to be started smoothly.

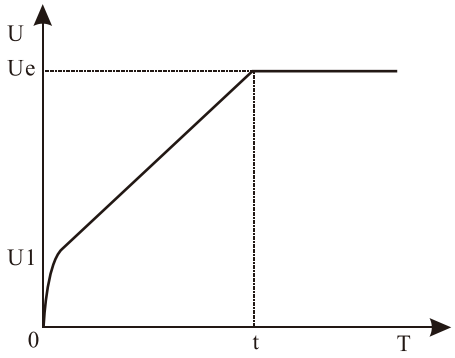


Diagram 7.2

7.2.3 Torque control + current limit or + voltage ramp to start

(The **F9** code is set as "2" or "3") Diagram 7.3 and 7.4 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.

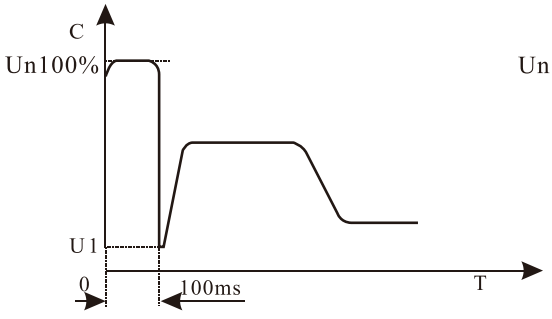


Diagram 7.3

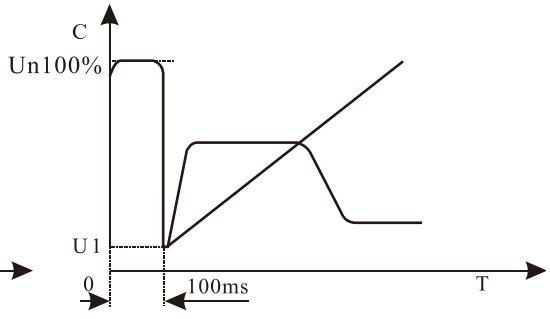


Diagram 7.4

7.2.4 Current ramp to start

(The **F9** code is set as"4") Diagram 7.5 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.

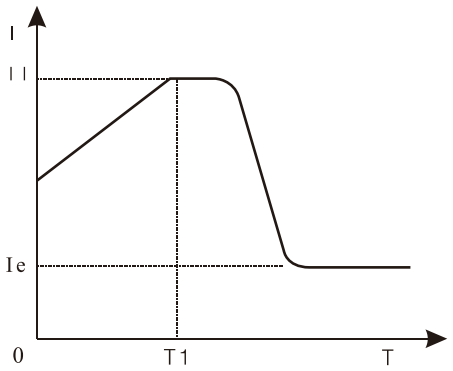


Diagram 7.5

7.2.5 Voltage current-limiting double closed-loop start

(Both voltage ramp and current limit) to start (The **F9** items set as"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 equipments. This mode fits for smooth starting and strictly current limit occasions.

7.3 The stopping mode and application

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

7.3.1 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 equipments 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**.

7.3.2 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.

7.4 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 starter 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 install 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.

7.5 Application examples

The parameters of the different loads are different, please refer to diagram 7.2.

The loading	Voltage ramp starting time(s)	Voltage ramp stopping 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%

Appendix I

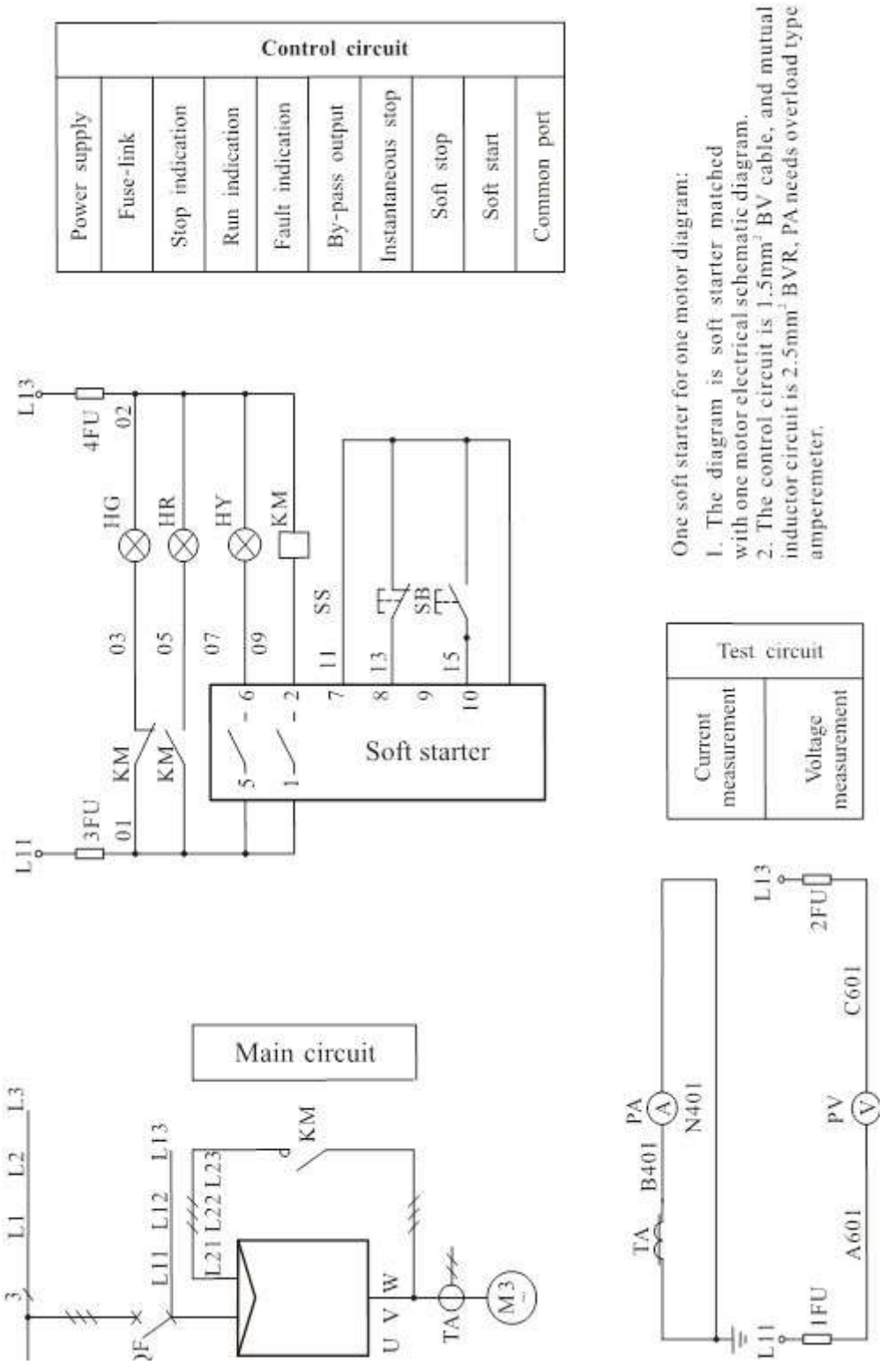
The soft start (5.5KW~600KW) selection list of peripheral appliances are as follows:

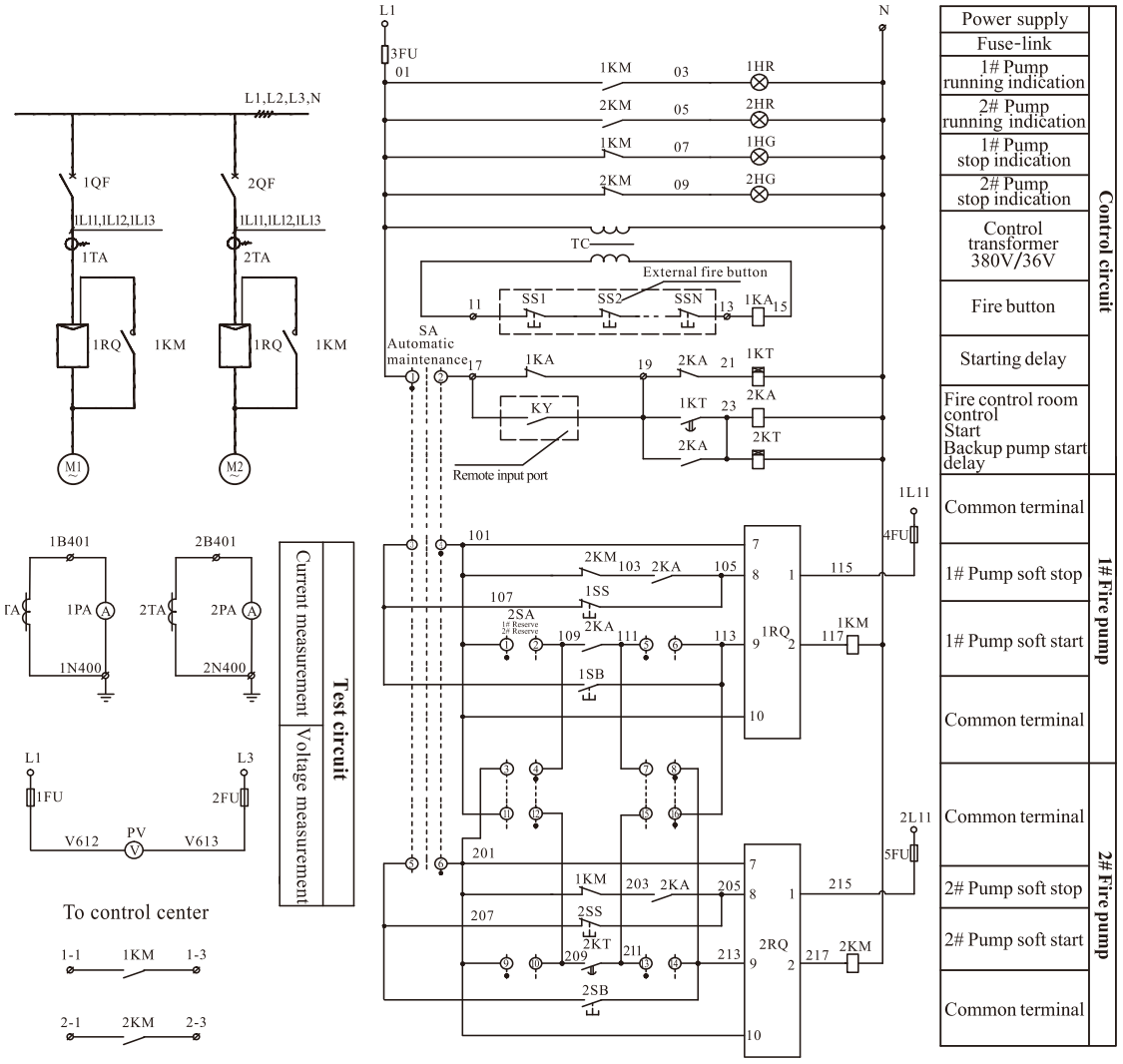
Model	Rated power (KW)	Rated current (A)	Breaker (A)	By-pass contactor(A)	Cable size (mm^2)
GS3-5d5	5.5	11	16	16	4 mm^2
GS3-7d5	7.5	15	20	16	4 mm^2
GS3-011	11	23	32	25	6 mm^2
GS3-015	15	30	40	40	10 mm^2
GS3-018	18	37	50	40	10 mm^2
GS3-022	22	43	63	63	16 mm^2
GS3-030	30	60	80	63	25 mm^2
GS3-037	37	75	100	100	35 mm^2
GS3-045	45	90	125	100	35 mm^2
GS3-055	55	110	160	160	35 mm^2
GS3-075	75	150	180	160	30×3 mm^2
GS3-090	90	180	225	250	30×3 mm^2
GS3-115	115	230	315	250	30×3 mm^2
GS3-132	132	264	315	400	30×4 mm^2
GS3-160	160	320	350	400	30×4 mm^2
GS3-185	185	370	400	400	30×4 mm^2
GS3-200	200	400	400	400	50×5 mm^2
GS3-250	250	500	630	630	50×5 mm^2
GS3-280	280	560	630	630	50×5 mm^2
GS3-320	320	640	630	630	50×5 mm^2
GS3-355	355	710	1000	1000	60×6 mm^2
GS3-400	400	800	1000	1000	60×6 mm^2
GS3-450	450	900	1000	1000	60×6 mm^2
GS3-500	500	1000	1250	1000	80×6 mm^2
GS3-600	600	1200	1600	1600	80×6 mm^2

Note:

- The rated power and rated current indicate the maximum rated value of the soft start. The matching specification of breakers and bypass contactors should match with the motor.
- Soft starter is for six terminal inputs and three terminal outputs, it is still with the online protection function at the state of bypass contactor sucking, do not need to add additional motor protection device.

Appendix II


Control circuit
Power supply
Fuse-link
Stop indication
Run indication
Fault indication
By-pass output
Instantaneous stop
Soft stop
Soft start
Common port
One soft starter for one motor diagram:
1. The diagram is soft starter matched with one motor electrical schematic diagram.
2. The control circuit is 1.5mm² BV cable, and mutual inductor circuit is 2.5mm² BVR, PA needs overload type amperemeter.
Test circuit
Current measurement
Voltage measurement
L13
4FU
02
HG
HR
HY
KM
SS
SB
03
05
07
09
11
13
15
Soft starter
L11
3FU
01
KM
KM
Main circuit
L1 L2 L3
L11 L12 L13
L21 L22 L23
KM
U V W
TA
M3
PA
A
N401
B401
TA
PV
V
C601
A601
2FU
1FU



One fire pump is working and another is as backup fire pump control diagram:

1. The control circuit is 1.5mm2BV cable, and mutual inductor circuit is 2.5mm2BVR,
2. The SA switches to automatically when two fire pumps one is working and one backup, two pump mutually backup. When one pump is fault, the backup pump automatically put into immediately. SA switches to manually, both pumps manual and separate operation;
3. fault automatic reset;
4. KY is for fire control room control contact point;
5. SS1~SSn are for external fire buttons;

The soft starter control terminal description:

1, 2 - the bypass relay terminal.

5, 6 - fault output terminals.

7 - instantaneous stop input terminal.

8 - soft stop input terminal.

9 - soft start input terminal.

10 - common contact input terminal.

JX			
1TA-1	1	1B401	
1PA-2		1N400	
1TA-1		2N401	
1PA-2		2N400	
TC	5	11	SS1
1KA		13	SSn
SA-2		17	KY
2KA		19	KY
1KM		1-1	
1KM	10	1-3	
2KM		2-1	
2KM		2-3	
	15		

To control room

To fire control box

Quality Warranty

The warranty of soft starter is as follows:

(1) Warranty period under normal conditions.

We provide guarantees for repair and replacement in 1 month from the date of use.

We provide guarantee for repair in 12 months from the date of use or 18 months from the date of ex-factory.

(2) The purchaser enjoys life-long paid service whenever and wherever he uses a motor soft starter made in our company.

(3) Service in the following cases, even within the warranty period, shall be charged to the purchaser:

Problems caused by mal-operation in violation of this manual, or caused by unauthorized repair or renovation.

Problems caused by improper use of soft starter that is off standard and requirement;

Malfunction or damage caused by improper transit or storage after purchase;

Induced failure or aging of the device due to poor ambient;

Malfunction or damage caused by fire, flood, thunder, earthquake, abnormal voltage or other natural disasters;

Unidentifiable nameplate, mark and ORD number due to intentional spoilage;

Delayed or unsatisfied payment in violation of purchase appointment;

Fail to give an objective description on the use of installation, wiring, operation, maintenance or else;

(4) Defective products should be sent to us for repair, replacement and return, which can be proceeded only after verifying the burden of liability.

(5) In case there is any quality problem or accident, we merely promise to bear the above-mentioned responsibilities. If a user needs more guarantees for liabilities, please assure on the insurance company voluntarily.

Warranty Bill

User company name:			
Website:			
Address:			
Tel:		Purchase date:	
Fax:		Product model:	
Contact person:		Products' code:	
Equipment:		Matched Motor	
Remark:			