SENLAN INVERTER

USER'S Manual

SB61Z+ Series

Wall-mount Inverter for Injection Molding Machines

Hope Senlan Science and Technology Holding Corp.ltd

Preface

Thank you for choosing our SenLan SB61Z^{+} series inverter, which is dedicated to injection molding machines. It has most of the functions of SB60^{+}/SB61^{+} series and some functions specially designed for injection molding machines. SB61Z^{+} adopts high-performance DSP and is rich in function and easy to operate. It is developed in accordance with the national standard GB/T 12668.2-2002.

Although the installation and operation of SB61Z^{+} are simple, errors in operation may cause accidents, shorten the inverter's life and degrade its performance. The operators therefore must read and understand this manual before using the inverter.

This series inverter employs the V/F control and speed sensorless vector control technology. If you have any problems in operation, refer to the manual for help or contact us.

Content

1 General

1.1 Check upon delivery

Please check the following items after unpacking SB61Z$^+$ inverter to see:

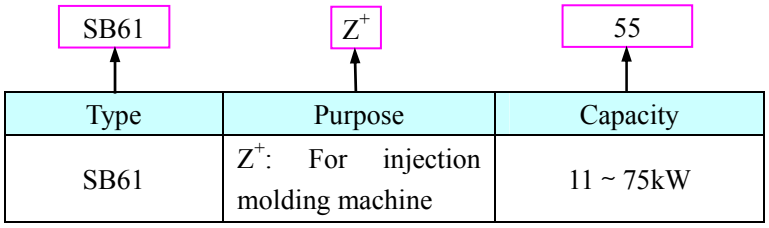
- If the product has got any damage during shipping.
- If the data on the nameplate conform to those on your order.
- If the accessories shipped together with the inverter are complete.

If you find anything missing, contact our local agents or distributors please.

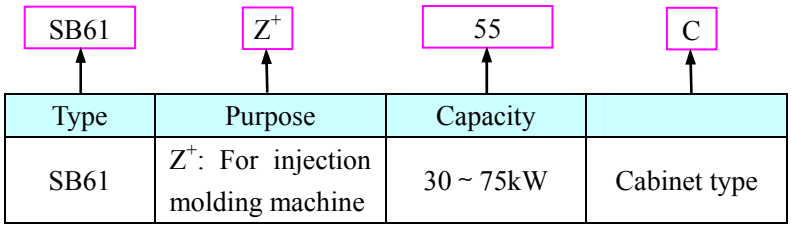
1.2 Type description

SB61Z$^+$ falls into two types: wall mount and unitary cabinet. The latter type has a “C” at the end of its type number.

- Wall-mount type

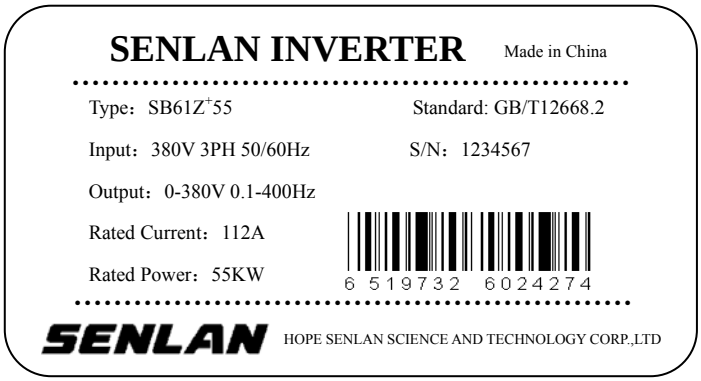


■ Unitary cabinet type



Type	Purpose	Capacity	
SB61	Z^+: For injection molding machine	30 ~ 75kW	Cabinet type

1.3 Nameplate description



1.4 Product warranty

This product is guaranteed against defects in workmanship for one year from the purchase date. However, for the following failures or damages, the repair cost should be borne by the customer even within the warranty period.

■ Failure or damage caused by misoperation or by unauthorized repairs or modifications.

- Failure or damage due to using the inverter beyond the range specified on the nameplate.
- Failure or damage caused by the inverter falling or an accident during transportation after the purchase.

1.5 Safety precautions

Read the following items before installing, wiring, running and maintaining the product, and always bear them in your mind.

Precautions in this manual fall into two types:


Danger : indicates that errors in operation may destroy the inverter or lead to death or heavy injury to people.


Caution: indicates that errors in operation may lead to damage to the inverter.

(1) Installation

 **Danger**
• **Install the inverter on a nonflammable object(such as metals). Otherwise, there may be a risk of fire.** • **Do not install the inverter in an environment with explosive gas. That may cause explosion.** • **Do not install or run the inverter if it is damaged or any component is missing. Otherwise, accident may occur.**

Caution
• **Install the inverter firmly on an object capable of bearing its weight. Otherwise, the falling of the inverter may cause injury or damage.** • **Do not drop any metal materials in the inverter. Otherwise, accident may occur.**

(2) Wiring

Danger
• **Connect a proper circuit-breaker on the input power side of the inverter. Otherwise, accident may occur.** • **The PE terminal of the inverter must be grounded securely. Otherwise, electric shock or fire may occur.** • **The wiring must be done by a qualified electrician after the power is cut off and the high-voltage indicator extinguishes.** • **Never connect the output terminals(U, V, W) to the input power. That will destroy the inverter.**

Caution
• **The input power must conform to the specifications on the nameplate. Otherwise, the inverter may be damage.**

(3) Operation

Danger
• **Only when the wiring has been completed and the cover board been attached, can the power be switched on. Otherwise, there may be a risk of electric shock.** • **Do not touch inverter terminals when electrical power is going to the inverter even if the inverter is in stop state. Otherwise, there may be a risk of electric shock.** • **Do not approach the load if the function of 'Restart after momentary power failure' has been set. The sudden restart of the inverter may cause electric shock or injury.**

(4) Maintenance

Danger
• **10 minutes after switching off power, measure the voltage of the DC filter capacitor. Only when the voltage is less than 36V, can the inverter be inspected and repaired. Otherwise, there may be a risk of electric shock or injury.** • **Only professional person can maintain the inverter. Otherwise, electric shock or injury may occur.** • **Do not leave any conductor such as metals in the inverter after repairing it. Otherwise, the inverter may be damaged.**
Caution
• **While charging an inverter which has not been used for a long period, use a voltage regulator to raise the input voltage**

gradually until it reaches the rated value, and wait for a while to confirm it is safe. Otherwise, accident may occur.

(5) Disposal

Caution

- **When the product is no longer useful, dispose it as an industrial waste. Otherwise, accident may occur.**

2 Installation and Wiring

2.1 Installation

2.1.1 Ambient condition

–10~40℃, with humidity less than 90%. If the ambient temperature is over 40℃, derate the inverter by 5% for every 1℃ increment.

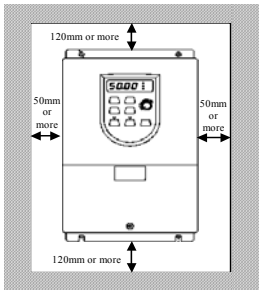
2.1.2 Installation site

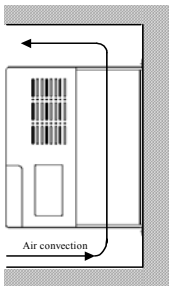
- No corrosive, flammable or explosive gases or liquids.
- No dust, floating fibers or metallic particles.
- The support is firm and without vibration.
- No direct sunlight.
- No electromagnetic interference.

2.1.3 Installation space and heat dissipation

To ensure good cooling effect, the inverter must be installed vertically and adequate space must be maintained around it.

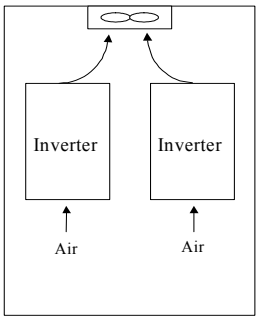
- Installation of wall-mount inverters



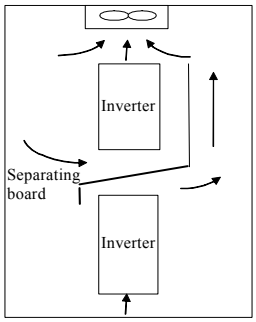


When two or more inverters are installed in one cabinet, horizontal arrangement is recommended to minimize the mutual thermal influence. If the inverters have to be installed in a vertical row, a separating board should be provided to prevent the heat from the

lower inverter affecting the upper one, as shown below:



(a) Horizontal arrangement

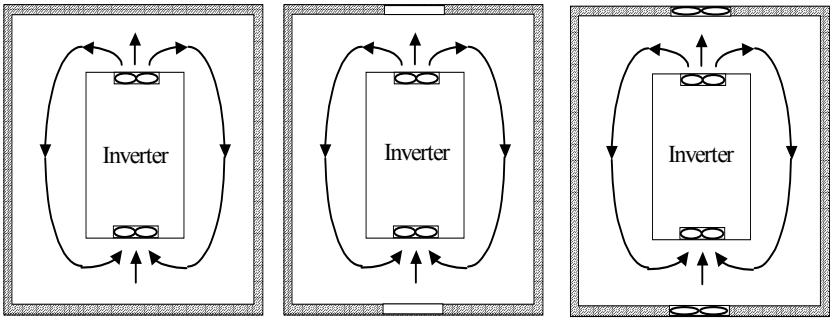


(b) Vertical arrangement

If the cabinet has exhaust fans on its top, the air flow of the fans must be greater than the total out flow of all inverters. For cabinets without exhaust fans, the top should be left open if possible, if not possible, the area of the air vents(inlets & outlets) on the top and bottom of the cabinet must be greater than the total area of the up & down surfaces of individual inverters, and the wind resistance at air vents should be kept as small as possible.

If the inverter is installed on the wall of a control room, the room should have good ventilation.

Several typical incorrect installation methods are shown as follows:



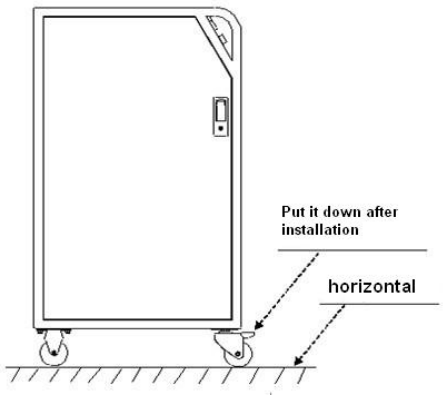
A Enclosed cabinet

B Air vents too small

C Exhaust fan too small

■ Installation of cabinet-type inverters

SB61Z+C series inverter is of cabinet construction. Its installation is relatively simple: put the inverter at the right place, and lock the roller wheels to prevent the inverter from moving. In the mean time, keep sufficient space around the inverter. See the following figure.



2-4 Installation of cabinet-type inverters

Since the cooling fan is vulnerable to damage, a temperature switch is used to control it. If F415 is set to 0, then when the temperature inside the inverter is higher than the set value, the cooling fan will run, otherwise the cooling fan will stop.

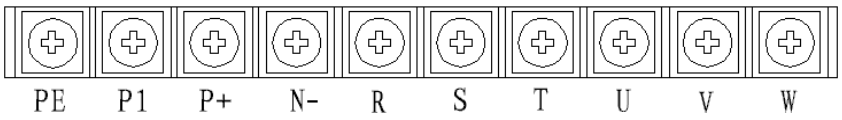
Refer to the following table for the air out flow and outlet size of various inverters.

Type	Out flow (m^3/min)	Outlet size (m^2)
SB61Z+ 11~15kW	4	0.051
SB61Z+ 18.5~22kW	5	0.073
SB61Z+ 30kW	10	0.076

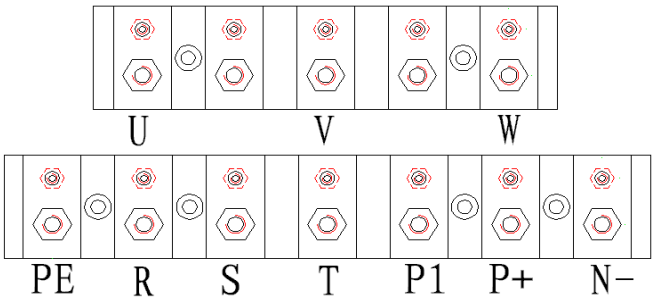
SB61Z+ 37~45kW	10	0.117
SB61Z+ 55~75kW	12	0.145

2.2 Wiring of inverter

2.2.1 Main circuit terminals



11-30kW



37-75kW or more

Table 2-1 Functions of main circuit terminals

Terminal	Function
R, S, T	3-phase AC power input
U, V, W	3-phase AC power output
PE	Grounding terminal
P+, P1	Connect an external DC reactor
P+, N-	Connect an external braking unit

（1）Main power supply terminals [R, S, T]

- The input power is connected to the R, S & T terminals via a circuit breaker or a leakage breaker(MCCB), the rated current of which is 1.5~2 times that of the inverter. There is no need to match the phase when connecting.
- It is recommended that the input power is fed to the inverter

through a magnetic contactor to prevent further problems or damage to the inverter in the event of a failure.

（2）Inverter output terminals [U, V, W]

- Connect a 3-phase motor to the inverter output terminals U, V & W in correct phase order. If the running direction of the motor does not match the rotary direction required, interchange any two of the U, V, W connections.
- Do not connect a power factor correction capacitor or a surge absorber to the output side of the inverter.
- If the wiring between the inverter and motor is long, the large distribution capacitance between wires may lead to abnormal operation of the inverter or even trip. To avoid this problem, connect a filter or a magnetic ring on the output side and lower the carrier frequency appropriately. Refer to the following table for the relationship between wiring length and carrier frequency.

Wiring length	<50m	<100m	⩾100m
F407	⩽7	⩽5	⩽2

- To suppress the interference generated by the inverter with other devices, it is recommended to connect a special noise filter on the output side or place the output cables (U, V, W) in a grounded metal conduit, and separate them from the control signal lines.

（3）DC reactor terminals [P1, P+]

- These terminals are used to connect a DC reactor which is configured according to the inverter capacity.
- The two terminals are connected by a shorting-bar when shipped from the factory. Remove it before connecting the DC reactor.
- If DC reactor is not used, P1 and P+ must be shorted.

（4）External braking unit terminals[P+, N-]

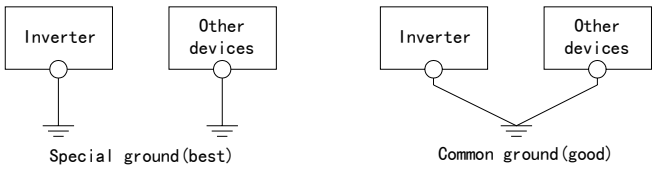
- These terminals are used to connect an external braking unit(option).While configure an external braking resistor, the wiring should be of twisted pair type and its length be less than 5

meters. We don't provide built-in braking units for SB61Z+ inverters, if you need, you'll have to purchase from us.

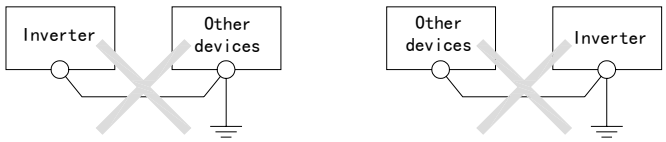
（5）Grounding terminal [PE]

- For safety purpose and to reduce noise, prevent electric shock and fire, this terminal must be securely grounded with the grounding resistance less than 10Ω.
- When connecting two or more inverters to the ground, be careful not to make the grounding wires form a closed loop.

Grounding methods recommended:



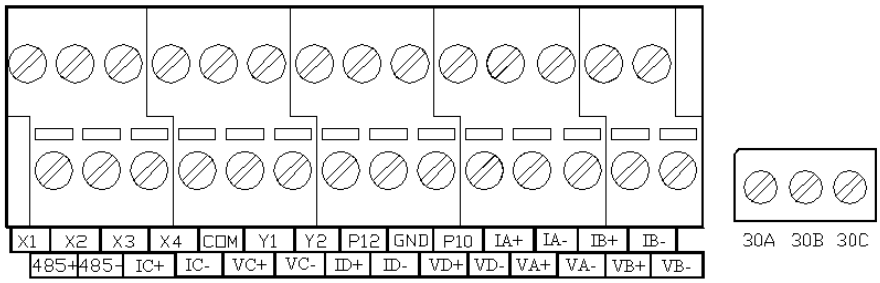
Grounding methods prohibited:



2-6 Grounding methods

2.2.2 Control circuit terminals

Control terminals is as follows:



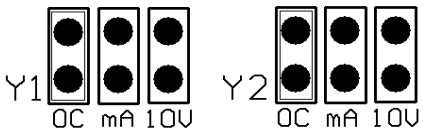
2-7 Control terminal

（1）Multi-function relay output terminals [30A, 30B, 30C]

30A is a normally-open contact, 30C is a normally-closed contact, and 30B is a switching contact. When the relay acts, 30A and 30B are closed, while 30B and 30C are open. These terminals can withstand AC 220V/1A or DC 24V/3A. Refer to function F507.

（2）Multi-function output terminals [Y1, Y2]

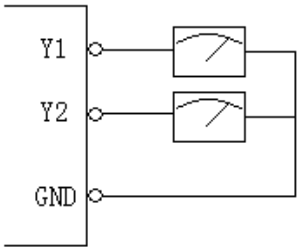
The two terminals can be set as open collector output terminals or 0-20mA analog current/0-10V analog voltage output terminals. They can withstand DC 24V/50mA. Refer to F508, F509.



2-8 Y1、Y2 function Choose of Terminal

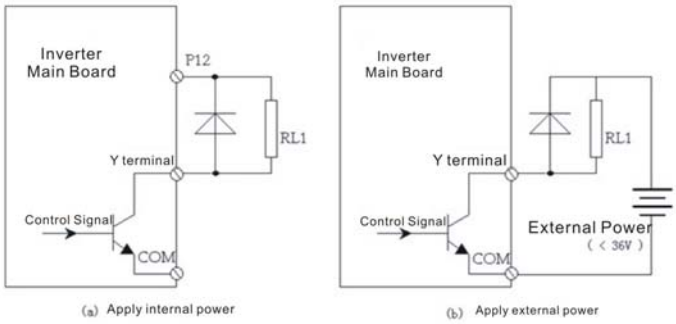
The function of Y1/Y2 is determined by the jumper on the main board, see Fig.2-8. The jumper is at the position of “OC” while shipped from the factory.

Please note that, when Y1/Y2 is set as analog output, its earth is GND(as shown



2-9 Analog output of Y terminal

in Fig.2-9); when Y1/Y2 is set as OC digital output, its common terminal is COM(as shown in Fig.2-10).



2-10 Y terminal OC output

（3）Multi-function input terminals [X1~X4]

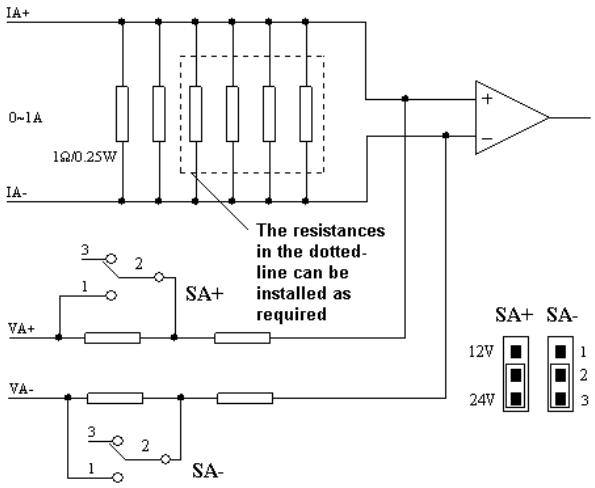
Refer to F500 ~ F503.

（4）External analog signal input terminals [IA/VA, IB/VB, IC/VC, ID/VD]

SB61Z^{+} offers four pairs of fully-isolated differential analog input terminals. Each pair is isolated by an optical coupler in order to improve the interference immunity. Current (I+, I-) and voltage(V+, V-) interfaces are also provided for users to input analog current or voltage signals. Each channel can not be used for both current and voltage input at the same time. For example, if IA+ and IA- are used as the current input terminals for channel A, VA+ and VA- can not be used as voltage input terminals and should be kept idle. The other three channels have the same functions.

IA+ and IA- are current signal input terminals for channel A. They accept 0-3A input current. The default setting: input current 0-1A, input impedance 0.5Ω. If the input current exceeds 1A, the user can regulate the welding point of the built-in sampling resistor to increase the resistance connected, refer to Fig.10-5.

VA+ and VA- are 0-24V/0-12V voltage signal input terminals for channel A with the input impedance being 40kΩ. Internally, IA+/IA- and VA+/VA- share the same signal input channel, therefore, the input signal can not be connected to IA+/IA- and VA+/VA- at the same time. As the input is a differential signal, there is a voltage-selecting jumper on both positive and negative polarity. The two jumpers are named SA+ and SA-. They are placed at the 0-24V position while shipped from the factory. If the input is a 12V signal, both jumpers should be placed at the 12V position. Refer to the following figure.



2.11 Current and voltage input of Channel A

Channel B has the same structure and function as channel A. Its voltage-selecting jumpers are SB+ and SB-. Channel A and B are generally used for setting the pressure and flow signals for injection molding machines.

Channel C and D are input channels for 0-10V/0-20mA analog input signals. The two channels are similar to channel A and B

except that channel C and D have different input values from channel A and B, and the range of input voltage for Channel C and D is fixed at 0-10V.

For details of analog input, refer to Function Group F3, Chapter 6.

（5）External power supply terminals [P10, GND, P12, COM]

External potentiometer power supply: P10, GND(10V, 24mA)

External control power supply: P12, COM(12V).

COM is the common terminal of external terminals.

（6）Attention points on connection of control circuit terminals

As the analog input signals are weak electric signals and susceptive to the external interference, shielded cables must be used for the wiring and securely connected to the ground or to the common terminal.

The control cable must be separated from the main circuit cable, power supply cable or other power cables. Do not run them in parallel. They must cross each other, preferably at right angles. If they are arranged in parallel, severe interference will be created and affect the normal operation of the inverter.

2.2.3 Communication terminals[485+, 485-]

The inverter is connected to the master device via a built-in RS485 port. If the master device is a PC, an RS485-RS232 converter must be used to connect the inverter to the master device.

If you need the PC to control multiple inverters simultaneously, please assign a unique address(F901) to each inverter in order that the PC can identify them.

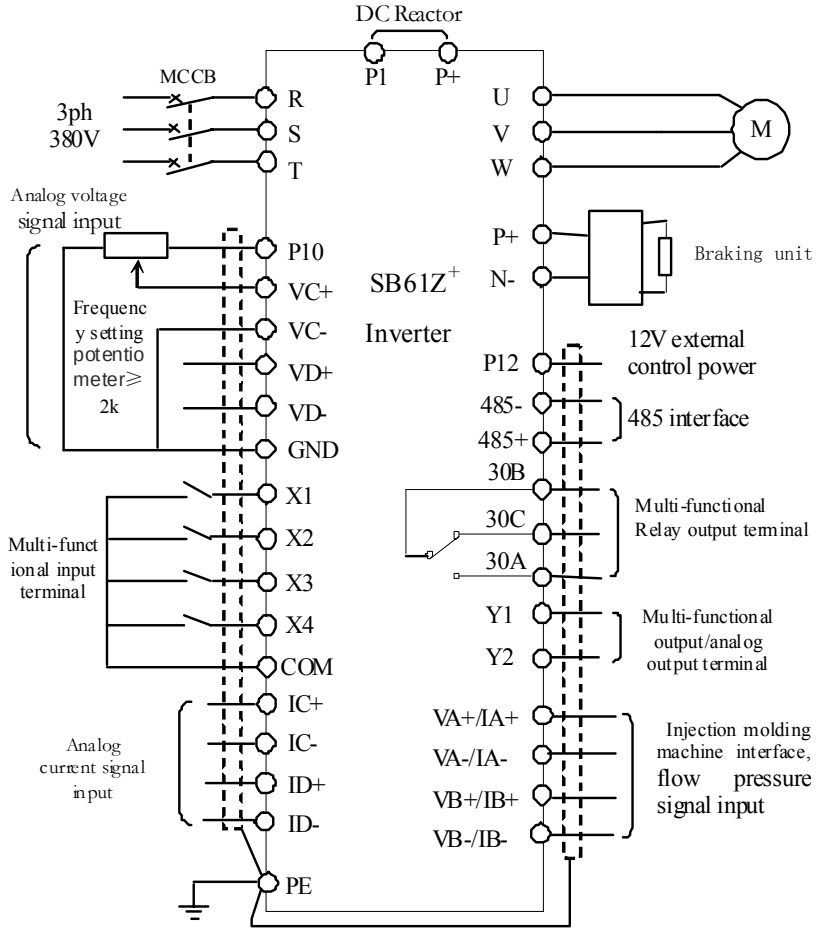
Refer to Chapter 10 for details of the communication protocol.

2.2.4 Terminal wiring specifications

Inverter type	Main circuit wiring（mm²）	Control circuit wiring（mm²）
SB61Z+11	10	⩾0.5
SB61Z+15	10	⩾0.5
SB61Z+18.5	16	⩾0.5
SB61Z+22	16	⩾0.5
SB61Z+30／SB61Z+30C	25	⩾0.5
SB61Z+37／SB61Z+37C	25	⩾0.5
SB61Z+45／SB61Z+45C	35	⩾0.5
SB61Z+55／SB61Z+55C	35	⩾0.5
SB61Z+75／SB61Z+75C	60	⩾0.5

2.3 Wiring diagram

1 SB61Z+ Wiring

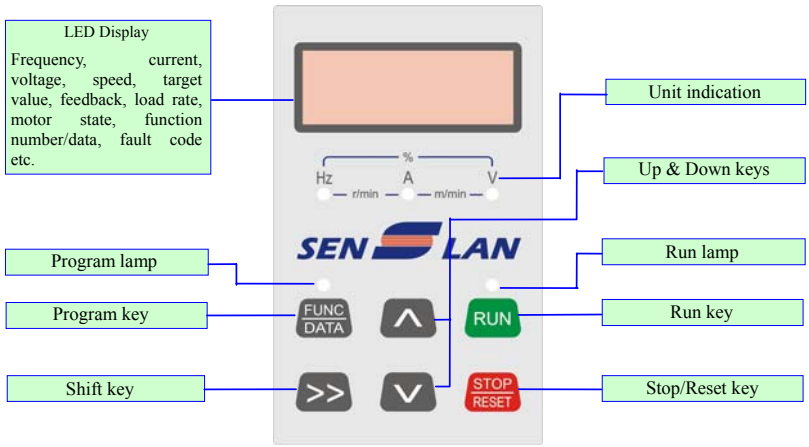


Note:

1. **The P1-P+ terminals are shorted by a bar when shipped from the factory. Before installing the DC reactor, remove the bar.**
2. **R, S, T, U, V, W, P1, P+, N- & PE are main circuit terminals, while the rest are control circuit terminals.**

3 Operation Description

3.1 Appearance of operation panel



The operation panel is applicable to SB60G$^+$/P$^+$, SB61G$^+$/P$^+$ and SB61Z$^+$.

3.2 Key definitions

Key	Function
FUNC DATA	Reading out function No. & data; Writing in data
>>	Switching display status; Switching between function group and function No.; Selecting the data digit to be changed
^	Increasing function number or data
v	Decreasing function number or data
RUN	Run command
STOP RESET	Stop command; Fault reset command; Err5 reset command

3.3 Display of alarm information

Error code	Description	Error code	Description
corr	No fault record	**Err4**	Illegal operation
dbr	Braking resistor overheating	**Err5**	Save failed
dd	DC braking	**oH**	Overheating
PLo	Output phase failure	**oL**	Overload
PLI	Input phase failure	**oLP**	Overload pre-alarm
FL	Short circuit	**oLE**	External alarm
Lu	Undervoltage	**LLL1**	Error in current sensor
oc	Overcurrent	**LLL2**	Error in temperature sensor
ou	Overvoltage		

3.4 Control mode

SB61Z^{+} inverter has two motor control modes: V/F open-loop control and speed sensor-less vector control, refer to F013.

3.5 Frequency setting mode

- F001=0: Frequency is given by F000 which is set by the operation panel.
- F001=1: Frequency is given by the external analog signal.
- F001= 3: Frequency is given by the master device via RS485 port.

3.6 LED display status

3.6.1 Stop status

When the inverter stops, the LED monitor displays the stop parameters and the run lamp is off.

3.6.2 Run status

Upon receiving correct run command, the inverter runs, the LED monitor displays the run parameters and the forward or reverse run lamp is on.

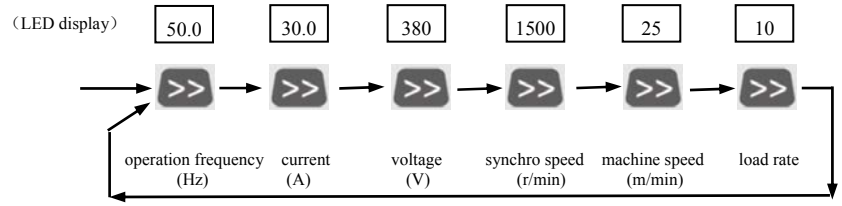
3.6.3 Fault status

With the inverter in stop state, if there is any fault, the LED monitor will display the corresponding fault code(see 3.3). After the fault is eliminated, reset the inverter with STOP/RESET key.

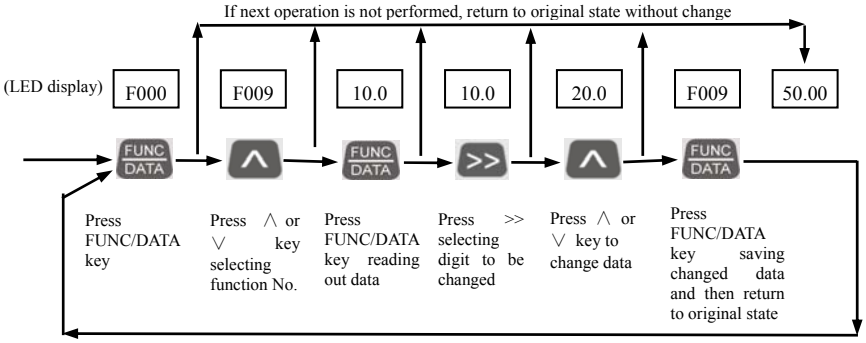
With the inverter in run state, if there is any fault, the inverter immediately stops, the run lamp is off and the LED monitor will display the corresponding fault code(see 3.3). After the fault is eliminated, reset the inverter with STOP/RESET key.

3.7 Operation of operation panel

3.7.1 Switching display information in running

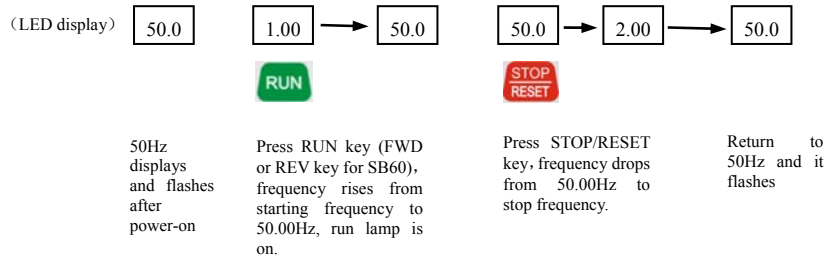


3.7.2 Parameter setting（Set F009 = 20S）



Continue

3.7.3 Run operation



SB61Z+ doesn't provide the forward-reverse switching function; the motor can only run in a direction. If the motor runs reversely after wiring, exchange any two of the 3-phase output lines(U, V, W)

3.8 Operation of external terminals

Set any of the four external terminals(F500-F503) as run command input and set F004=1: short the terminal and COM, the inverter will run; open the terminal and COM, the inverter will stop.

3.9 User password function

To prevent illegal change of the parameters, SB61Z^{+} inverter allows the user to set a password.

3.9.1 Setting user password

Enter Fb00, input your password, save it and restart the inverter.

If a password has been set, you can change the parameters only after you input the right password in Fb00.

It is recommended to reset the user password following the adjustment of the inverter.

Do not lose your password. If you do, contact the supplier.

3.9.2 Canceling user password

Enter Fb00, input the right password; reenter Fb00, set Fb00=0, save

it and restart the inverter.

3.10 Factory special function

Functions Fb02~Fb06 are used by the factory only. After inputting the right factory password, one can have access to specific information about the product, such as inverter type, run time, software version and rated current etc.

4 Specifications

4.1 Common specifications

Input	Rated voltage/frequency	3 phase 380V, 50/60Hz
	Range	320~420V, 47~63Hz
Output	Voltage	3 phase 0~380V, error<5%
	Frequency	0.1~400Hz
Control	Modulation mode	Sinusoidal PWM
	Control mode	V/F open-loop control and speed sensor-less vector control
	V/F curve	Linear or random V/F curve, up to six step V/F curves can be set by users
	Frequency setting mode	Panel; analog; master device(via RS485 port)
	Acceleration/ deceleration control	Linear, 0 ~ 3600s
	Additional functions	Upper-limit frequency, lower-limit frequency, jump frequency, current limit, stall control, auto reset, auto energy-saving operation, auto voltage regulation, auto-restart after momentary power failure
Run	Command channel	Panel; multi-function external terminal; master device (via RS485 port)
	Input signal	Multi-function digital terminal (X1-X4), 4 channel of differential analog inputs(with isolation)
	Output signal	Multi-function digital OC output (Y1-Y2, DC 24V/50mA); multi-function relay output(30A, 30B & 30C, AC 220V/1A or DC 24V/3A); analog output(Y1-Y2, 0-20mA/0-10V)
	Carrier frequency	Regulated Automatically according to the load characteristics and ambient temperature.
	AVR	Output voltage is kept constant automatically when the grid voltage fluctuates.
Braking function		External braking resistor and external braking unit
Protection function		Overcurrent, short circuit, grounding fault, overvoltage, undervoltage, overload, overheating, phase failure, external alarm
Ambient	Service site	Indoor and below 1000m altitude
	Temperature/ humidity	-10-+40℃/20-90% RH, no condensation
	Vibration	Less than 5.9m/s² (0.6G)
	Storage temperature	-20-+60℃
Cooling method		Forced air cooling
Protection degree		IP20

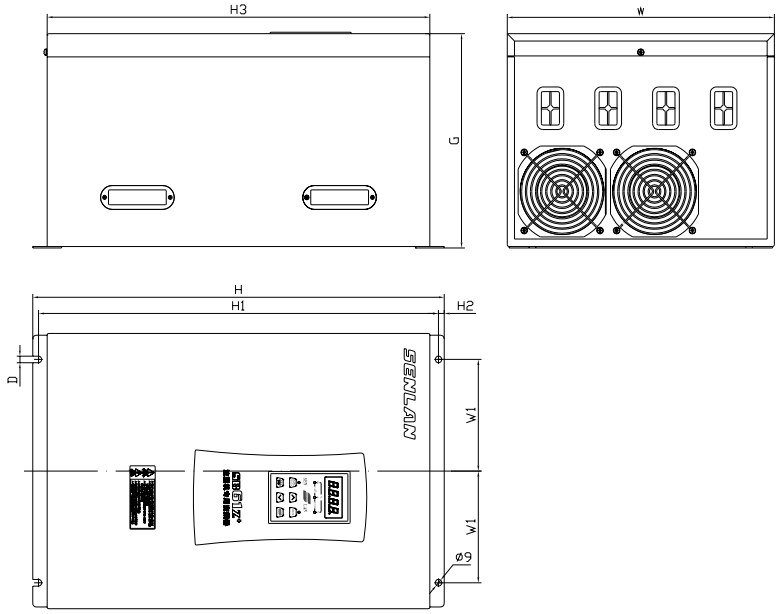
4.2 Type specifications

SB61Z+		11	15	18.5	22	30	37	45	55	75
Motor capacity (kW)		11	15	18.5	22	30	37	45	55	75
Output	Rated capacity (kVA)	16	20	25	30	40	49	60	74	99
	Rated current (A)	24	30	38	45	60	75	91	112	150
	Voltage (V)	0 ~ 380V 0.1 ~ 400 Hz								
	Overload capacity	150% 1 minute								
Input power		3-phase 380V 50/60Hz								

Note: Wall-mount type (11-75kW), cabinet type (30-75kW)

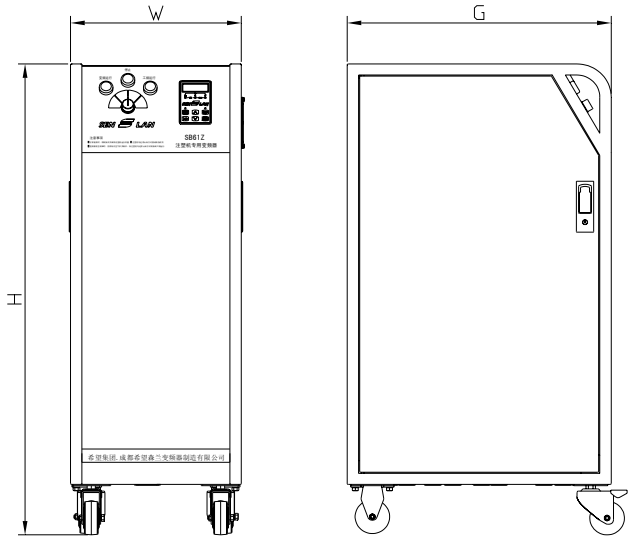
4.3 Outline dimensions

- Wall-mount type



	D	G	H	H1	H2	H3	W	W1
11~15kW	7	215	426	414	6	401	270	90
18.5~22kW	7	265	460	448	6	430	290	100
30kW	9	265	514	500	6.5	480	310	123
37~45kW	9	288	570	540	8	530	370	150
55kW	10	300	610	590	8	560	380	125
75kW	10	320	686	670	6	650	446	150

- Unitary cabinet type



	G	H	W
30~75kW	580	1064	375

5 Table of Functions

5.1 Description

5.1.1 In the "**Change**" column of the table:

"○" indicates the function is changeable in both running and stop.

"×" indicates the function is changeable in stop only.

"△" indicates the function is unchangeable in both running and stop.

5.1.2 In the "**Default**" column of the table

"*" indicates the function is not controlled by Data Protection(F400).

5.1.3 How to change parameters

SB61Z$^+$ series inverter has more than 200 functions, which are organized in eleven function groups. After entering the function number display screen, you can change the data of a function as follows:

(1) Press >> key to switch between function group or number;

(2) Press ∧ or ∨ key to select the desired function group or function number;

(3) Press **FUNC/DATA** key to display the data;

(4) Press ∧ or ∨ key to change the data;

(5) Press **FUNC/DATA** key to save the changed data.

SB61Z$^+$ is developed based on SB61$^+$, with some special functions for injection molding machines being added and some unnecessary functions deleted. To facilitate those users who has been familiar with our SB61$^+$ product, we retain the function number of SB61$^+$ for a same function of SB61Z$^+$. Therefore, the numbering system for SB61Z$^+$'s functions is not continuous.

5.1.4 Step and display of parameter values

SB61Z^{+} inverter adopts 4-digit LED display, therefore the decimal digits of the minimum step of a parameter may not consistent with that of the displayed value of the same parameter. For example, the step of the parameter F000(range 0.10~400.0) is 0.01, if the parameter value exceeds 100, only one decimal digit of the value will be displayed. However, the parameter remains varying according to the real step, i.e. 0.01.

5.2 F0 (Basic function parameters)

No.	Name	Setting range	Min. step	Default	Unit	Change
F000	Digital reference frequency	0.10-400.0	0.01	50.00*	Hz	○
F001	Frequency setting mode	0. F000 (panel) 1. External analog signal 2. Communication port	1	0	-	×
F004	RUN/STOP command channel selection	0.Panel 1.External terminal 2.Communication port	1	0	-	×
F005	STOP/RESET key function selection	0. Stop invalid, fault reset 1 1. Stop invalid, fault reset 2 2. Stop valid, fault reset 1 3. Stop valid, fault reset 2 4. Emergency stop valid, fault reset 1 5. Emergency stop valid, fault reset 2	1	0	-	○
F007	Motor stop mode	0. Ramp 1. Coast 2. Ramp + DC braking	1	0	-	○
F008	Maximum frequency	50.00-400.0	0.01	50.00	Hz	×
F009	Accel time 1	0.1-3600	0.1	20.0	s	○
F010	Decel time 1	0.1-3600	0.1	20.0	s	○
F011	Electronic thermal protection and overload pre-alarm	0.Both inactive 1.Electronic thermal protection inactive, overload pre-alarm active 2.Both active	1	0	-	○
F012	Electronic thermal protection level	25-105	1	100	%	○
F013	Motor control mode	0.V/F control 1.Vector control	1	0	-	×

5.3 F1 (V/F control parameters)

No.	Name	Setting range	Min. step	Default	Unit	Change
F100	V/F curve	0. Linear V/F 1. Assigned V/F	1	0	-	×
F101	Base frequency	10.00-400	0.01	50.00	Hz	×

F102	Maximum output voltage	150-380	1	380	V	×
F103	Torque boost	0-50	1	10	V	×
F104	VF1 frequency	0.00-400.0	0.01	8.00	Hz	×
F105	VF1 voltage	0-380	1	9	V	×
F106	VF2 frequency	0.00-400.0	0.01	16.00	Hz	×
F107	VF2 voltage	0-380	1	37	V	×
F108	VF3 frequency	0.00-400.0	0.01	24.00	Hz	×
F109	VF3 voltage	0-380	1	84	V	×
F110	VF4 frequency	0.00-400.0	0.01	32.00	Hz	×
F111	VF4 voltage	0-380	1	151	V	×
F112	VF5 frequency	0.00-400.0	0.01	40.00	Hz	×
F113	VF5 voltage	0-380	1	246	V	×
F114	Slip compensation	0.00-10.00	0.01	0.00	Hz	○
F115	Auto energy-saving mode	0. Disabled 1. Enabled	1	0	-	×
F116	Auto-restart after momentary power failure	0.Inactive 1.Restart from 0Hz 2.Restart from searched speed	1	0	-	×
F117	Speed search waiting time	0.1-20.0	0.1	0.2	s	○
F118	Overvoltage stall prevention	0.Stall prevention and discharge are invalid 1.Stall prevention valid, discharge invalid 2.Stall prevention and discharge are valid 3.Stall prevention invalid, discharge valid	1	1	-	○
F119	Overcurrent stall prevention	0. Invalid 1. Valid	1	1	-	×
F120	Overcurrent stall level	20-150	1	120	%	×
F126	Allowable time for momentary power failure	0.1-10.0	0.1	1.0	s	○
F127	Speed search decel time	0.1-30.0	0.1	2.0	s	○
F128	Speed search voltage recovery time	0.1-30.0	0.1	1.0	s	○

F129	Anti-oscillation coefficient	0.00-10.00	0.01	0.00	-	○

5.4 F2 (Vector control parameters)

No.	Name	Setting range	Min. step	Default	Unit	Change
F200	Motor parameter test	0. Manual test 1. Auto test	1	0	-	×
F201	Motor rated frequency	20.00-400.0	0.01	50.00	Hz	×
F202	Motor rated speed	10.0-2400（×10）	0.1	144.0	-	×
F203	Motor rated voltage	150-380	1	380	V	×
F204	Motor rated current	Depends on power	0.1	Ie	A	×
F205	Motor no-load current	Percentage of rated current	1	In	%	×
F206	Motor constant R	1-5000	1	2000	-	×
F207	Motor constant X	1-5000	1	1000	-	×
F208	Driving torque	20-200	1	150	%	×
F209	Braking torque	0-150	1	100	%	×
F210	ASR proportional coefficient	0.00-2.00	0.01	1.00	-	○
F211	ASR integral coefficient	0.00-2.00	0.01	1.00	-	○
F212	Pre-excitation time	0.00-3.00	0.01	0.10	s	○

5.5 F3 (Analog setting parameters)

No.	Name	Setting range	Min. step	Default	Unit	Change
F300	Analog signal channel selection	0. Channel A 1. Channel B 2. Channel C 3. Channel D 4. A+B+C+D 5. MAX(A,B) 6. MIN(A,B)	1	0	-	○
F301	Channel A min. analog input 1	0.0-100.00	0. 1	0.0	%	○

F302	Frequency 1 corresponding to F301	0.00-400.0	0.01	0.00	Hz	○
F303	Channel A max. analog input 1	0.0-100.00	0. 1	100.0	%	○
F304	Frequency 1 corresponding to F303	0.00-400.0	0.01	50.00	Hz	○
F305	Channel A gain 1	-1.00-1.00	0.01	1.00	-	○
F306	Channel B min. analog input 1	0.0-100.00	0. 1	0.0	%	○
F307	Frequency 1 corresponding to F306	0.00-400.0	0.01	0.00	Hz	○
F308	Channel B max. analog input 1	0.0-100.00	0. 1	100.0	%	○
F309	Frequency 1 corresponding to F308	0.00-400.0	0.01	40.00	Hz	○
F310	Channel B gain 1	-1.00-1.00	0.01	1.00	-	○
F311	Inflection point 1	0. Invalid 1. Valid	1	0	-	○
F312	Analog 1 corresponding to channel A middle inflection point 1	0.0-100.0	0.1	0.0	%	○
F313	Frequency 1 corresponding to channel A middle inflection point 1	0.0-400.0	0.01	0.00	Hz	○
F314	Analog 1 corresponding to channel A middle inflection point 2	0.0-100.0	0.1	0.0	%	○
F315	Frequency 1 corresponding to channel A middle inflection point 2	0.0-400.0	0.01	0.00	Hz	○
F316	Analog 1 corresponding to channel B middle inflection point 1	0.0-100.0	0.1	0.0	%	○
F317	Frequency 1 corresponding to channel B middle inflection point 1	0.0-400.0	0.01	0.00	Hz	○
F318	Analog 1 corresponding to channel B middle inflection point 2	0.0-100.0	0.1	0.0	%	○

F319	Frequency 1 corresponding to channel B middle inflection point 2	0.0-400.0	0.01	0.00	Hz	○
F320	Channel A min. analog input 2	0.0-100.00	0. 1	0.0	%	○
F321	Frequency 2 corresponding to F320	0.00-400.0	0.01	0.00	Hz	○
F322	Channel A max. analog input 2	0.0-100.00	0. 1	100.0	%	○
F323	Frequency 2 corresponding to F322	0.00-400.0	0.01	50.00	Hz	○
F324	Channel A gain 2	-1.00-1.00	0.01	0.50	-	○
F325	Channel B min. analog input 2	0.0-100.00	0. 1	0.0	%	○
F326	Frequency 2 corresponding to F325	0.00-400.0	0.01	0.00	Hz	○
F327	Channel B max. analog input 2	0.0-100.00	0. 1	100.0	%	○
F328	Frequency 2 corresponding to F327	0.00-400.0	0.01	40.00	Hz	○
F329	Channel B gain 2	-1.00-1.00	0.01	0.50	-	○
F330	Inflection point 2	0. Invalid 1. Valid	1	0	-	○
F331	Analog 2 corresponding to channel A middle inflection point 1	0.0-100.0	0.1	0.0	%	○
F332	Frequency 2 corresponding to channel A middle inflection point 1	0.0-400.0	0.01	0.00	Hz	○
F333	Analog 2 corresponding to channel A middle inflection point 2	0.0-100.0	0.1	0.0	%	○
F334	Frequency 2 corresponding to channel A middle inflection point 2	0.0-400.0	0.01	0.00	Hz	○
F335	Analog 2 corresponding to channel B middle inflection point 1	0.0-100.0	0.1	0.0	%	○
F336	Frequency 2 corresponding to channel B middle inflection point 1	0.0-400.0	0.01	0.00	Hz	○

F337	Analog 2 corresponding to channel B middle inflection point 2	0.0-100.0	0.1	0.0	%	○
F338	Frequency 2 corresponding to channel B middle inflection point 2	0.0-400.0	0.01	0.00	Hz	○
F339	Channel C min. analog input	0.0-100.0	0.1	0.0	%	○
F340	Frequency corresponding to F339	0.00-400.0	0.01	0.00	Hz	○
F341	Channel C max. analog input	0.0-100.0	0.1	100.0	%	○
F342	Frequency corresponding to F341	0.00-400.0	0.01	50.00	Hz	
F343	Channel C gain KC	-1.00-1.00	0.01	1.00	-	○
F344	Channel D min. analog input	0.0-100.0	0.1	0.0	%	○
F345	Frequency corresponding to F344	0.00-400.0	0.01	0.00	Hz	○
F346	Channel D max. analog input	0.0-100.0	0.1	100.0	%	○
F347	Frequency corresponding to F346	0.00-400.0	0.01	50.00	Hz	○
F348	Channel D gain KD	-1.00-1.00	0.01	1.00	-	○
F349	Channel A filtering time constant	0.00-10.00	0.01	0.10	s	○
F350	Channel B filtering time constant	0.00-10.00	0.01	0.10	s	○
F351	Channel C filtering time constant	0.00-10.00	0.01	0.10	s	○
F352	Channel D filtering time constant	0.00-10.00	0.01	0.10	s	○

5.6 F4 (Auxiliary control parameters)

No.	Name	Setting range	Min. step	Default	Unit	Change
F400	Data protection	0. Disabled 1. Enabled	1	0*	-	○
F401	Data initialization	0. Disabled 1. Enabled	1	0	-	×
F403	DC braking starting frequency	0.00-60.00	0.01	5.00	Hz	○

F404	DC braking amount	0-100	1	25	%	○
F405	DC braking time	0.1-20.0	0.1	5.0	s	○
F406	Braking resistor overheating	0. Invalid 1. Overheating pre-alarm	1	0	-	○
F407	Carrier frequency	0-7	1	2	-	○
F408	Auto-reset times	0-7	1	0	-	○
F409	Auto-reset interval	1.0-20.0	0.1	5.0	s	○
F410	Undervoltage protection level	350-450	1	400	V	○
F411	Phase failure protection	0. Inactive 1. Output phase failure protection active 2. Input phase failure protection active 3. Both I/O phase failure protection active	1	0	-	×
F412	AVR	0. Disabled 1. Enabled	1	1	-	×
F415	Cooling fan control	0. Auto run 1. Always run	1	0	-	○
F419	Braking unit working voltage threshold	620-720	1	680	V	○
F420	Starting delay time	0.0-10.0	0.1	0.0	s	○

5.7 F5 (Terminal function parameters)

No.	Name	Setting range	Min. step	Default	Unit	Change
F500	X1 function	0. Analog channel 1 1. Analog channel 2 2. Analog parameter switching input 3. Run command input 4. External fault normally-open input 5. External fault normally-closed input 6. External reset input	1	3	-	×
F501	X2 function		1	2	-	×
F502	X3 function		1	4	-	×
F503	X4 function		1	6	-	×
F507	Relay output terminal (0-8)	0. Running 1. Stop 2. Frequency reach 3. Frequency reach	1	8	-	×

F508	Y1 output terminal (0-11)	detection signal 4. Overload pre-alarm 5. External alarm 6. Panel operation 7. Undervoltage stop 8. Fault alarm 9. Y1, Y2 operation frequency analog output 10. Y1, Y2 output current analog output 11. Y1, Y2 frequency reference analog output	1	0	-	×
F509	Y2 output terminal (0-11)		1	1	-	×
F515	Y1 gain	50-200	1	100	%	○
F516	Y2 gain	50-200	1	100	%	○
F518	Y1 bias	0-100	1	0	%	○
F519	Y2 bias	0-100	1	0	%	○
F520	Relay closing delay	0.0-100.0	0.1	0.0	s	○
F521	Relay opening delay	0.0-100.0	0.1	0.0	s	○
F522	Y1 terminal closing delay	0.0-100.0	0.1	0.0	s	○
F523	Y1 terminal opening delay	0.0-100.0	0.1	0.0	s	○
F524	Y2 terminal closing delay	0.0-100.0	0.1	0.0	s	○
F525	Y2 terminal opening delay	0.0-100.0	0.1	0.0	s	○
F528	X terminal jitter-eliminating time	10-2000	1	10	ms	○

5.8 F6 (Auxiliary frequency parameters)

No.	Name	Setting range	Min. step	Default	Unit	Change
F600	Starting frequency	0.10-50.00	0.01	1.00	Hz	○
F601	Starting frequency duration	0.0-20.0	0.1	0.5	s	○
F602	Stop frequency	0.00-50.00	0.01	0.00	Hz	○
F607	Upper-limit frequency	0.50-400.0	0.01	50.00	Hz	○
F608	Lower-limit frequency	0.10-400.0	0.01	0.50	Hz	○
F609	Jump frequency 1	0.00-400.0	0.01	0.00	Hz	○

F610	Jump frequency 2	0.00-400.0	0.01	0.00	Hz	○
F611	Jump frequency 3	0.00-400.0	0.01	0.00	Hz	○
F612	Jumping width	0.00-10.00	0.01	0.00	Hz	○
F613	Frequency reach detection band	0.00-10.00	0.01	1.00	Hz	○
F614	Specified detection frequency	0.10-400.0	0.01	40.00	Hz	○
F615	Specified detection frequency width	0 .00-30.00	0.01	1.00	Hz	○

5.9 F9 (Communication function)

No.	Name	Setting range	Min. step	Default	Unit	Change
F900	communication protocol selection	0. Factory protocol(Modbus) 1.Compatible USS commands	1	0	-	○
F901	Local address	0-247 Modbus: 1-247; USS: 0-31	1	1	-	○
F902	Baud rate	0. 1200bps 1. 2400bps 2. 4800bps 3. 9600bps 4. 19200bps	1	3	-	○
F903	Communication data format	0. 8,N,1(1 start bit, 8 data bits, no parity check, 1 stop bit) 1. 8,O,1(1 start bit, 8 data bits, odd check, 1 stop bit) 2. 8,E,1(1 start bit, 8 data bits, even check, 1 stop bit) 4. 8,N,2(1 start bit, 8 data bits, no parity check, 2 stop bits)	1	0	-	○

5.10 FA (Display parameters)

No.	Name	Setting range	Min. step	Default	Unit	Change
FA00	LED display	0-5	1	0*	-	○
FA01	Speed coefficient	0.01-45.00	0.01	1.00	-	○
FA02	DC voltage correction coefficient	1000-1050	1	1024	-	○
FA03	Module temperature	0.0-100.0	1	-	℃	△

FA05	Cumulated run time	0.0-6553	0.1	-	h	△
FA07	Cumulated run time clear	0. Disabled 1. Enabled	1	0	-	○
FA08	Fault record 1	1. FL(main elements protection) 2. oc(overcurrent) 3. PLo(output phase failure) 4. oU(overvoltage) 5. oH(overheating) 6. oL(overload) 7. oLE(external alarm)				△
FA09	Fault record 2					△
FA10	Fault record 3					△
FA11	DC voltage at the last fault		1	-	V	△
FA12	Output current at the last fault		0.1	-	A	△
FA13	Output frequency at the last fault		0.01	-	Hz	△
FA14	Heat-sink temperature at the last fault		1	-	℃	△
FA15	Fault record clear	0. Disabled 1. Enabled	1	0	-	○

5.11 Fb (Password parameters)

No.	Name	Setting range	Min. step	Default	Unit	Change
Fb00	User password	0-9999	1	0*	-	○
Fb01	Factory password		1	*	-	○

5.12 Fc (Running information display)

No.	Name	Description	Min. step	Default	Unit	Change
Fc00	Set frequency		0.01		Hz	△
Fc01	Output frequency		0.01		Hz	△
Fc02	Output current		0.1		A	△
Fc03	Output voltage		1		V	△

Fc04	Set synchro speed		1		r/min	△
Fc05	Output synchro speed		1		r/min	△
Fc06	Set line speed		1		m/s	△
Fc07	Output line speed		1		m/s	△
Fc08	Load rate	Take inverter's rated current as 100%	1		%	△
Fc11	DC voltage	DC bus voltage	1		V	△

6 Function Details

6.1 Function Group F0: Basic Function

F000	**Digital reference frequency**	Default: 50.00Hz
	Setting range 0.10-400.0Hz	Change: ○

F000 sets the output frequency, which is limited by the maximum, upper- and lower-limit frequencies.

F001	**Frequency setting mode**	Default: 0
	Setting range 0. F000 (panel) 1. External analog signal 2. Communication port	Change: ×

This function decides how the frequency is set. When F001=1, ∧/∨ keys on the panel can change the value of F000 directly.

F004	**RUN/STOP command channel selection**	Default: 0
	Setting range 0. Panel 1. External terminal 2. Communication port	Change: ×

This function sets the operation command channel.

F004=0: The inverter is controlled by the RUN and STOP keys on the panel.

F004=1: The inverter is controlled by external terminals (refer to F500-F503).

F004=2: The inverter is controlled by the master device via the RS485 communication port.

F005	**STOP/RESET key function selection**	Default: 0
	Setting range	Change: ○

	0. Stop invalid, fault reset 1 1. Stop invalid, fault reset 2 2. Stop valid, fault reset 1 3. Stop valid, fault reset 2 4. Emergency stop valid, fault reset 1 5. Emergency stop valid, fault reset 2

F005 sets the function of the panel STOP/RESET key when the inverter is controlled by external terminals.

'Fault reset 1' means that following the fault reset, the run command must be canceled before the inverter is run again.

'Fault reset 2' means that following the fault reset, the inverter restores running if the run command is valid.

F005=0 or 1: STOP/RESET key cannot be used to stop the inverter.

F005=4 or 5: STOP/RESET key is used for the emergency stop of the inverter. In this case, the inverter will coast to a stop.

F007	**Motor stop mode**	Default: 0
	Setting range 0. Ramp (Fig.6-1A) 1. Coast (Fig.6-1B) 2. Ramp + DC braking (Fig.6-1C)	Change: ○

F007=0: The motor slows down to the stop frequency(F602) according to the deceleration time, and then stops.

F007=1: The motor coasts to a stop.

F007=2: The motor first decelerates to the DC braking starting frequency(F403) according to the deceleration time, then stops in the DC braking mode.

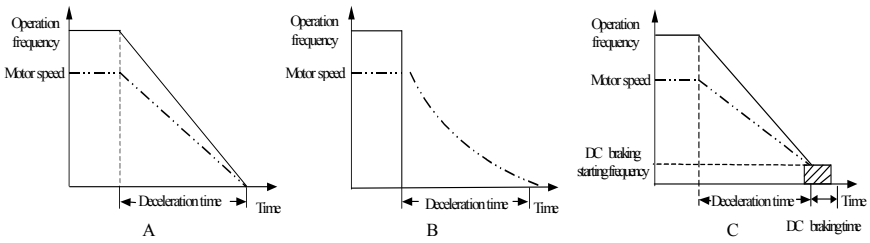


Fig. 6-1

F008	**Maximum frequency**	Default: 50.00Hz
	Setting range 50.00-400.0Hz	Change: ×

The function sets the allowable maximum output frequency of the inverter.

F009	**Accel time 1**	Default: 20s
	Setting range 0.1-3600s	Change: ○
F010	**Decel time 1**	Default: 20s
	Setting range 0.1-3600s	Change: ○

Accel/decel time is the time period over which frequency rises/drops by 50Hz. Refer to Fig.6-2, where t1 is the accel time, t2 the decel time.

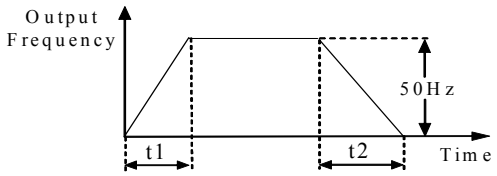


Fig. 6-2

F011	**Electronic thermal protection and overload pre-alarm**	Default: 0
	Setting range 0.Both inactive 1.Electronic thermal protection inactive, overload pre-alarm active 2.Both active	Change: ○

F012	**Electronic thermal protection level**	Default: 100%
	Setting range 25-105%	Change: ○

F011 provides overload protection for the motor when the rated current of the motor does not match that of the inverter (see Fig. 6-3).

F012 sets the overload protection level.

SB61Z$^+$ overload capacity: 150% of rated current for 1 minute

$$F012 = \frac{\text{Allowable max. load current}}{\text{Inverter rated output current}} \times 100\%$$

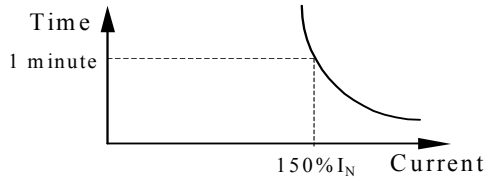


Fig. 6-3

F013	**Motor control mode**	Default: 0
	Setting range 0.V/F control 1.Vector control	Change: ×

This function selects how the inverter controls the motor.

F013=0: V/F open-loop control. Function group F1 need to be correctly set. Function group F2 is invalid.

F013=1: Sensorless vector control. In this mode, please set F200=1 to test the motor parameters automatically before you operate the inverter for the first time. Function group F2 needs to be correctly set. Function group F1 is invalid.

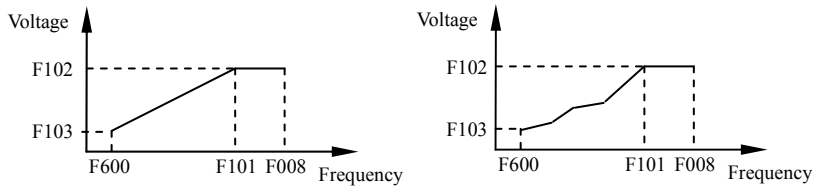
SB61Z$^+$ provides no interface for encoder and doesn't support pulse encoder input.

6.2 Function Group F1: V/F Control

Functions F100 ~ F125 are valid when F013=0.

F100	**V/F curve**	Default: 0
	Setting range 0. Linear V/F(Fig.6-4A) 1. Assigned V/F(Fig.6-4B), see F104-F113	Change: ×

This function sets the pattern of the V/F curve.



A. Linear V/F curve　　B. Assigned V/F curve

Fig. 6-4

F101	**Base frequency**	Default: 50.00Hz
	Setting range 10.00-400.0Hz	Change: ×

Base frequency is the rated frequency of the motor(indicated on the motor nameplate). It is also the frequency that corresponds to the maximum output voltage of the inverter. The base frequency must match the motor rated frequency, otherwise the motor may be damaged.

F102	**Maximum output voltage**	Default: 380V
	Setting range 150-380V	Change: ×

Maximum output voltage is set as the rated operation voltage indicated on the motor nameplate.

F103	**Torque boost**	Default: 10V
	Setting range 0-50V	Change: ×

This function increases the output voltage at the low frequency range so as to boost the torque.

If F103 = 0, torque boost is performed automatically.

If the torque too low to start the motor, increase F103 gradually until the motor is started(see Fig. 6-5).

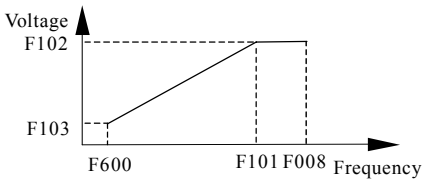
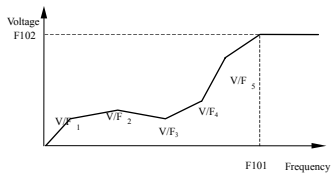


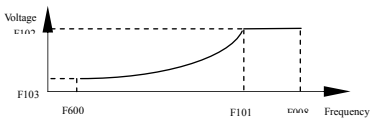
Fig. 6-5

F104	**VF1 frequency**	Default: 8.00Hz
	Setting range 0.00-400.0Hz	Change: ×
F105	**VF1 voltage**	Default: 9V
	Setting range 0-380V	Change: ×
F106	**VF2 frequency**	Default: 16.00Hz
	Setting range 0.00-400.0Hz	Change: ×
F107	**VF2 voltage**	Default: 37V
	Setting range 0-380V	Change: ×
F108	**VF3 frequency**	Default: 24.00Hz
	Setting range 0.00-400.0Hz	Change: ×
F109	**VF3 voltage**	Default: 81V
	Setting range 0-380V	Change: ×
F110	**VF4 frequency**	Default: 32.00Hz
	Setting range 0.00-400.0Hz	Change: ×
F111	**VF4 voltage**	Default: 151V
	Setting range 0-380V	Change: ×
F112	**VF5 frequency**	Default: 40.00Hz
	Setting range 0.00-400.0Hz	Change: ×
F113	**VF5 voltage**	Default: 246V
	Setting range 0-380V	Change: ×

These functions are used to set an assigned V/F curves(Fig. 6-6A). If $F_{n+1} < F_n$, F_{n+1} is invalid. The factory default curve is a squared-torque

curve(Fig.6-6B).





A B

Fig. 6-6

F114	**Slip compensation**	Default: 0.00Hz
	Setting range 0.00-10.00Hz	Change: ○

When the load of the asynchronous motor increases, the slip will increase. F114 is used to compensate the slip, ensuring the motor speed is approximately equal to the synchronous speed.

$$\text{F114=Base frequency} \times \frac{\text{Synchronous speed} - \text{Rated speed}}{\text{Synchronous speed}}$$

F115	**Auto energy-saving mode**	Default: 0
	Setting range 0. Disabled 1. Enabled	Change: ×

When F115=1, with the decrease of the load(i.e. light-load run), the inverter will adjust the output voltage according to the measured load current, thus achieving the energy-saving operation.

This function is especially suitable for fans, pumps and squared-torque loads, but not to loads that change frequently or to motors that run at near full-load.

Refer to Fig.6-7, where ① V/F constant，② Energy-saving operation.

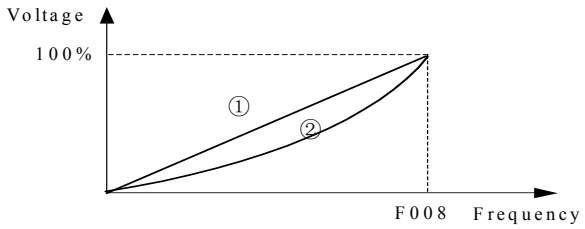


Fig. 6-7

F116	**Auto-restart after momentary power failure**	Default: 0
	Setting range 0.Inactive 1.Restart from 0Hz 2.Restart from searched speed	Change: ×
F117	**Speed search waiting time**	Default: 0.2s
	Setting range 0.1-20.0s	Change: ○
F126	**Allowable time for momentary power failure**	Default: 1.0s
	Setting range 0.1-10.0s	Change: ○
F127	**Speed search decel time**	Default: 2.0s
	Setting range 0.1-30.0s	Change: ○
F128	**Speed search voltage recovery time**	Default: 1.0s
	Setting range 0.1-30.0s	Change: ○

F116 sets the restart mode of the inverter after momentary power failure and recovery. F117 sets the waiting time from the power recovery to the restart of the inverter.

F116=0: After power recovery, the LED displays the fault code Lu, inverter does not start(Fig.6-8A).

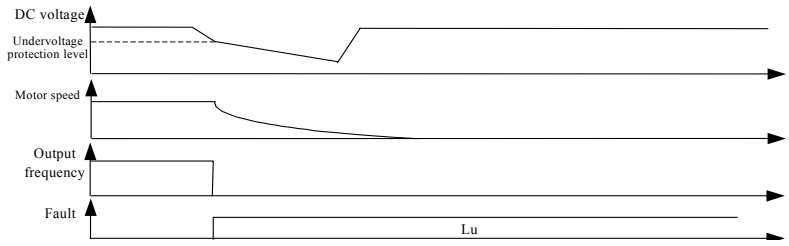


Fig. 6-8A

F116=1: After power recovery, when the inverter detects that the DC voltage is greater than the undervoltage protection level(F410), it restarts from 0Hz after the period of F117(Fig.6-8B).

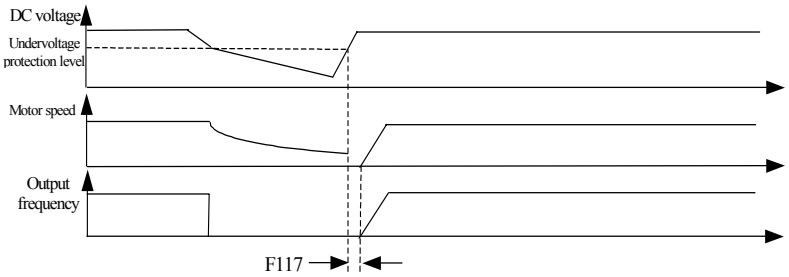


Fig. 6-8B

F116=2: After power recovery, when the DC voltage is greater than the undervoltage protection level(F410), then after the period of F117, the inverter will search the motor speed based on its output frequency before power failure, and restart from the frequency corresponding to the searched speed (Fig.6-8C).

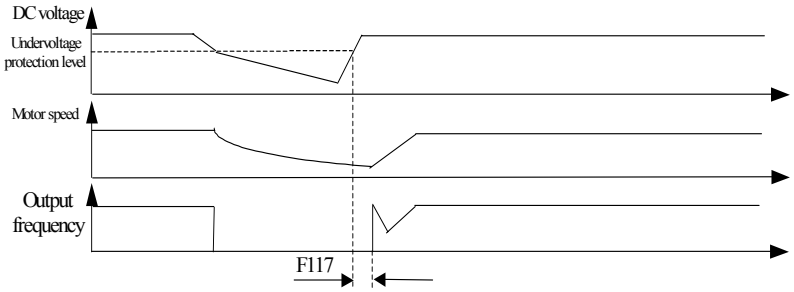


Fig. 6-8C

F126 sets the allowable time period for momentary power failure. If the time of power failure exceeds F126, the inverter won't start the motor automatically after the power recovery even if F116=1(or 2) and the DC voltage is greater than the undervoltage protection level(F410). The inverter will start the motor after receiving the start command.

The system searches the speed with "decreasing frequency" method. F127 sets the speed search deceleration time. It's the time period over which the frequency decreases by 50Hz. It reflects how fast the frequency decreases. Too short F127 may cause overvoltage. F127 is generally set to a bigger value for motors with large capacities.

F128 sets the time for the search voltage to recover to the normal voltage. Too short F128 may lead to overcurrent. F128 is generally set to a bigger value for motors with large capacities.

The function of "speed search" is only used for V/F control without PG. There is no need of "speed search" for vector control.

F118	**Overvoltage stall prevention**	Default: 1
	Setting range	Change: ○
	0.Stall prevention and discharge are invalid	
	1.Stall prevention valid, discharge invalid	
	2.Stall prevention and discharge are valid	
	3.Stall prevention invalid, discharge valid	

This function is used to prevent the overvoltage stall.

During the inverter deceleration, the regenerative energy produced by the motor will lead to the increase of the DC voltage. If this voltage reaches the overvoltage stall level, the inverter stops decelerating(i.e. output frequency remains constant). When this voltage drops to a certain value below the stall level, the inverter continues decelerating. Refer to Fig.6-9.

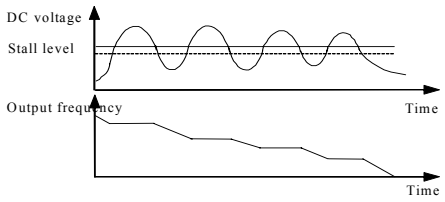


Fig. 6-9

If the DC voltage exceeds the action voltage of the braking resistor, and F118=2 and a braking resistor is connected between P+ and N-, the inverter will be braked. The discharging voltage is set by F419.

F119	**Overcurrent stall prevention**	Default: 1
	Setting range 0. Invalid 1. Valid	Change: ×
F120	**Overcurrent stall level**	Default: 120%
	Setting range 20-150%	Change: ×

During inverter steady-state operation, if the output current exceeds the overcurrent stall level, the inverter will lower its output frequency. When the output current drops to a certain value below the stall level, the inverter reaccelerates to the set frequency. See Fig. 6-10.

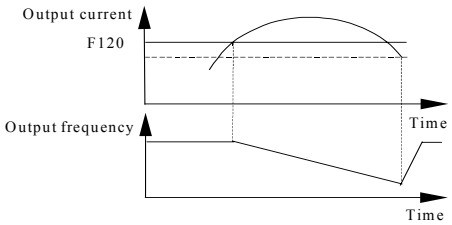


Fig. 6-10 Overcurrent stall control during steady-state operation

During inverter acceleration, too fast acceleration or too large load will lead to sharp rise of the output current which may exceeds the stall level. In this case, the inverter will extend the acceleration time or stop accelerating. And when the current drops to a certain value below the stall level, the inverter continues accelerating. See Fig. 6-11.

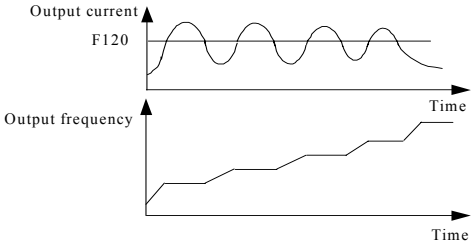


Fig. 6-11 Overcurrent stall control during acceleration

Overvoltage and overcurrent stall prevention are also valid to vector control.

F129	**Motor anti-oscillation coefficient**	Default: 0.00
	Setting range 0.00-10.00	Change: ○

The function suppresses or reduces the motor's mechanical oscillation during no-load or slight-load operation. Since different motors have different oscillation property, F129 should be set according to the actual operation condition. Increase F129 gradually until the oscillation is eliminated.

6.3 Function Group F2: Vector Control

Functions F200 ~ F211 are valid when F013=1.

F200	**Motor parameter test**	Default: 0
	Setting range 0. Manual test 1. Auto test	Change: ×

This function decides whether test the motor parameters automatically or not..

F200=1: The inverter automatically tests the motor parameters and saves them in corresponding functions(F206~207).

In following cases, auto test is needed:

- The actual motor parameters are different from F206 ~ F207.
- The impedance on the output side of the inverter cannot be ignored, for example, a very long cable or a reactor between the inverter and motor.
- A nonstandard motor or a special motor is used.

F201	**Motor rated frequency**	Default: 50.00Hz
	Setting range 20.00-400.0Hz	Change: ×
F202	**Motor rated speed**	Default: 144.0
	Setting range 10.0-2400 (×10)	Change: ×
F203	**Motor rated voltage**	Default: 380V
	Setting range 220-380V	Change: ×
F204	**Motor rated current**	Default: Ie
	Setting range Depends on power	Change: ×
F205	**Motor no-load current**	Default: In
	Setting range 20-70%	Change: ×
F206	**Motor constant R**	Default: 2000
	Setting range 1-5000	Change: ×
F207	**Motor constant X**	Default: 1000
	Setting range 1-5000	Change: ×

F201, F202 and F203 are set to the rated frequency, speed and voltage

indicated on the nameplate respectively.

The default settings of F204 and F205 depend on the motor rated current(I_e) and no-load current(I_n) respectively.

If customer need to calculate the motor parameters manually, refer to the following formulas for R and X and the asynchronous motor steady-state circuit(Fig.6-12). It is recommended to use the parameters tested by the inverter instead of inputting parameters manually.

R=100(Rn*I)/U

X=100(I*Ls*Fs)/U

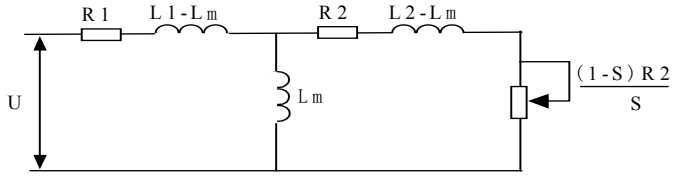


Fig. 6-12

In Fig.6-12, R1, R2, L1, L2, Lm and S represent stator resistance, rotator resistance, stator inductance, rotator inductance, mutual inductance and slip respectively.

In the formulas above:

Rn=motor stator resistance(R1)+cable resistance(mΩ)

U=motor rated voltage(V)

I=motor rated current(A)

Fs=motor rated frequency(Hz)

Ls=motor stator leak inductance(mH)=L1-Lm

Lm=motor mutual inductance(mH)

L1=motor stator self-inductance(mH)

F208	**Driving torque**	Default: 150%
	Setting range 20-200%	Change: ×

This function sets the torque current(in percentage) output by the

speed regulator(ASR) while ASR is working. If F208=100, the torque current will be the rated current of the inverter.

F209	**Braking torque**	Default: 100%
	Setting range 0-150%	Change: ×

This function sets the torque current(in percentage) output by the speed regulator(ASR) while ASR is braking. If F209=100, the torque current will be the rated current of the inverter.

F210	**ASR proportional coefficient**	Default: 1.00
	Setting range 0.01-2.00	Change: ○
F211	**ASR integral coefficient**	Default: 1.00
	Setting range 0.01-2.00	Change: ○

These functions set the proportional cofficient(P) and integral cofficient(I) of the speed PID regulator(ASR) to regulate the dynamic response property of vector control.

Either increasing P or I can increase the system response speed，however, excessive large P or I easily causes oscillation.

While regulating the two parameters, please regulate P first and then I.

F212	**Pre-excitation time**	Default: 0.1s
	Setting range 0.00-3.00s	Change: ○

Pre-excitation can boost the starting torque and shorten the starting time. It usually increases with the motor capacity.

6.4 Function Group F3: Analog Setting

SB61Z+ offers rich analog input ports. Function group F3 is designed for injection molding machines and used to set analog signals like flow and pressure.

To facilitate customer use, SB61Z+ is designed to have an identical set of parameters for channel A and channel B. Functions F301-F319 form the parameter set 1, while F320-F338 constitute the parameter set 2. Whether you select the parameter set 1 or set 2 is determined by the terminal X(refer to F500-F503). The design of two sets of parameters is very useful for an injection molding machines, for example, during injection molding, you can use the parameter set 1 for larger work pieces and the parameter set 2 for smaller work pieces.

F300	**Analog signal channel selection**	Default: 0
	Setting range	Change: ○
	0. Channel A 1. Channel B 2. Channel C 3. Channel D 4. A+B+C+D 5. MAX(A,B) 6. MIN(A,B)	

F300 sets the source of the analog signal.

F300=0-3: Frequency is given by channel A(or B, C, D).

F300=4: Frequency is given by the combination of channel A, B, C and D. as SB61Z+ doesn't support reverse run, the output frequency is considered to be zero if the combination is a negative value.

F300=5: Frequency is the larger one of channel A and B.

F300=6: Frequency is the smaller one of channel A and B.

Channel A(B,C,D) here refers to the final reference frequency of the channel A(B,C,C). The final reference frequency of a certain channel equals the analog setting multiplied by the gain of the same channel. Each

channel has a gain which ranges from -1.00~1.00.

The following F301-F319 are the parameter set 1 for channel A and B.

F301	**Channel A min. analog input 1**	Default: 0.0%
	Setting range 0.0-100.0%	Change: ○
F302	**Frequency 1 corresponding to F301**	Default: 0.00Hz
	Setting range 0.00-400.0Hz	Change: ○
F303	**Channel A max. analog input 1**	Default: 100.0%
	Setting range 0.0-100.0%	Change: ○
F304	**Frequency 1 corresponding to F303**	Default: 50.00Hz
	Setting range 0.00-400.0Hz	Change: ○
F305	**Channel A gain 1**	Default: 1.00
	Setting range -1.00-1.00	Change: ○

F301-F305 set the relationship between the reference frequency and analog input of channel A. Channel A supports 0-24V/0-12V(determined by jumpers SA+ and SA-, see Fig.2-11) voltage input or 0-1A current input. 100% analog input corresponds to 24V, 12V or 1A.

When F311 is set to 0(i.e. inflection point invalid), the reference frequency of channel A is completely determined by F301-F305, as shown in Fig.6-13A.

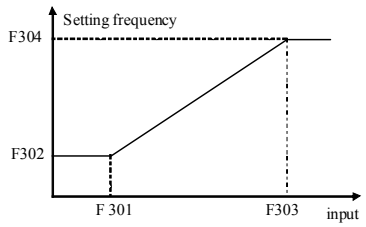


Fig. 6-13A

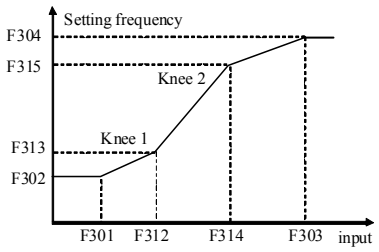


Fig. 6-13B

Example of setting: Suppose the input of channel A is a 0-10V voltage signal, 10V corresponds to 40Hz frequency and 0V corresponds to 20Hz, you can place SA+ and SA- at the position of 12V, and set F301=0.0%, F302=20.00, F303=10/12=83.33% and F304=40Hz.

F305 is used to set the proportion of channel A when the reference frequency is set by the combination of multiple channels.

F306	**Channel B min. analog input 1**	Default: 0.0%
	Setting range 0.0-100.0%	Change: ○
F307	**Frequency 1 corresponding to F306**	Default: 0.00Hz
	Setting range 0.00-400.0Hz	Change: ○
F308	**Channel B max. analog input 1**	Default: 100.0%
	Setting range 0.0-100.0%	Change: ○
F309	**Frequency 1 corresponding to F308**	Default: 50.00Hz
	Setting range 0.00-400.0Hz	Change: ○
F310	**Channel B gain 1**	Default: 1.00
	Setting range -1.00-1.00	Change: ○

Channel B is same as Channel A in structure and function. Refer to F301-F305.

F311	**Inflection point 1**	Default: 0
	Setting range 0.Invalid 1.Valid	Change: ○
F312	**Analog 1 corresponding to channel A middle inflection point 1**	Default: 0.0%
	Setting range 0.0-100.0%	Change: ○
F313	**Frequency 1 corresponding to channel A middle inflection point 1**	Default: 0.00Hz
	Setting range 0.00-400.0Hz	Change: ○

F314	**Analog 1 corresponding to channel A middle inflection point 2**	Default: 0.0%
	Setting range 0.0-100.0%	Change: ◦
F315	**Frequency 1 corresponding to channel A middle inflection point 2**	Default: 0.00Hz
	Setting range 0.00-400.0Hz	Change: ◦

These functions set the analog and frequency corresponding to the inflection point 1 of channel A. Rfer to Fig.6-13B

F316	**Analog 1 corresponding to channel B middle inflection point 1**	Default: 0.0%
	Setting range 0.0-100.0%	Change: ◦
F317	**Frequency 1 corresponding to channel B middle inflection point 1**	Default: 0.00Hz
	Setting range 0.00-400.0Hz	Change: ◦
F318	**Analog 1 corresponding to channel B middle inflection point 2**	Default: 0.0%
	Setting range 0.0-100.0%	Change: ◦
F319	**Frequency 1 corresponding to channel B middle inflection point 2**	Default: 0.00Hz
	Setting range 0.00-400.0Hz	Change: ◦

Infection point of channel B is similar to that of channel A. Refer to F312-F315.

Functions F320-F338 are the parameter set 2 for channel A and B. They have the same meaning with those functions in the parameter set 1. Refer to F301-F319.

F339	**Channel C min. analog input 1**	Default: 0.0%
	Setting range 0.0-100.0%	Change: ◦
F340	**Frequency corresponding to F339**	Default: 0.00Hz
	Setting range 0.00-400.0Hz	Change: ◦

F341	**Channel C max. analog input 1**	Default: 100.0%
	Setting range 0.0-100.0%	Change: ◦
F342	**Frequency corresponding to F341**	Default: 50.00Hz
	Setting range 0.00-400.0Hz	Change: ◦
F343	**Channel C gain KC**	Default: 1.00
	Setting range -1.00-1.00	Change: ◦
F344	**Channel D min. analog input 1**	Default: 0.0%
	Setting range 0.0-100.0%	Change: ◦
F345	**Frequency corresponding to F344**	Default: 0.00Hz
	Setting range 0.00-400.0Hz	Change: ◦
F346	**Channel D max. analog input 1**	Default: 100.0%
	Setting range 0.0-100.0%	Change: ◦
F347	**Frequency 1 corresponding to F346**	Default: 50.00Hz
	Setting range 0.00-400.0Hz	Change: ◦
F348	**Channel D gain KD**	Default: 1.00
	Setting range -1.00-1.00	Change: ◦

F339-F343 set the relationship between the reference frequency and analog input of channel C, and F344-F348 set the relationship between the reference frequency and analog input of channel D. Channel C and D are same in structure and function. They both support 0-10V voltage input or 0-20mA current input. 100% analog input corresponds to 10V or 1A. Refer to Fig.6-13A for the relationship between the reference frequency and analog input.

F349	**Channel A filtering time constant**	Default: 0.10s
	Setting range 0.0-10.00s	Change: ◦
F350	**Channel B filtering time constant**	Default: 0.10s
	Setting range 0.0-10.00s	Change: ◦
F351	**Channel C filtering time constant**	Default: 0.10s
	Setting range 0.0-10.00s	Change: ◦

F352	**Channel D filtering time constant**	Default: 0.10s
	Setting range 0.0-10.00s	Change: ○

These functions are used to reduce the outside interference with the voltage or current input signals. Increasing the filtering time will lower the response, but strengthen the immunity to the interference. On the contrary, decreasing the filtering time will speed up the response, but damage the immunity.

6.5 Function Group F4: Auxiliary Function

F400	**Data protection**	Default: 0
	Setting range	Change: ○
	0. Disabled 1. Enabled	

Setting F400=1 can lock the data preventing illegal change.

Note that F000, FA00, Fb00 and Fb01 are not controlled by this function.

F401	**Data initialization**	Default: 0
	Setting range	Change: ×
	0. Disabled 1. Enabled	

This function is used for restoring all parameters to default values, but it is controlled by F400. Note that function group F9 is not controlled by this function.

F403	**DC braking starting frequency**	Default: 5.00Hz
	Setting range 0.00-60.00Hz	Change: ○
F404	**DC braking amount**	Default: 25%
	Setting range 0-100%	Change: ○
F405	**DC braking time**	Default: 5.0s
	Setting range 0.1-20.0s	Change: ○

These functions are used to stop the motor quickly and prevent the creep of the motor.

F403 sets the DC braking starting frequency.

F404 sets the DC braking torque. It is recommended to increase it gradually until braking is achieved.

F405 sets the DC braking time.

F406	**Braking resistor overheating**	Default: 0

	Setting range	Change: ○
	0. Invalid 1. Overheating pre-alarm	

The braking resistor may be damaged by overheating if its capacity is not properly selected. Setting F406=1 can pre-alarm the overheating condition.

F407	**Carrier frequency**	Default: 2
	Setting range 0-7	Change: ○

SB61Z$^+$ uses IGBT as the power switch. The carrier frequency's range is 1.75~ 7.5KHz.

When a higher carrier frequency is adopted, the motor will generate smaller noise, harmonic current and amount of heat, but the inverter will lead to stronger interference, bigger common-mode current and larger amount of heat, thus the motor is easier to develop no-load oscillation. A lower carrier frequency will cause the reverse result.

Refer to the following table for carrier frequencies corresponding to the different setting values.

Setting	0	1	2	3	4	5	6	7
SB61Z$^+$	1.75k	2.5k	3.25k	4k	4.5k	5.25k	6k	7.5k

If the carrier frequency is set higher than the default, the inverter should be derated by 5% for every 1 increment of F407. This series inverter has the function of auto carrier frequency regulation, which can automatically lower the carrier frequency if the inverter temperature is too high.

F408	**Auto-reset times**	Default: 0
	Setting range 0-7	Change: ○
F409	**Auto-reset interval**	Default: 5.0s
	Setting range 1.0-20.0s	Change: ○

These functions set the maximum number of retries and the reset interval when a trip occurs. Auto-reset is only valid when F004=1. The

oH(overheating) fault can't be auto-reset.

In following cases, auto-reset function is invalid.

- STOP/RESET key is pressed or external terminals are reset.
- Inverter power is turned off.

F410	**Undervoltage protection level**	Default: 400V
	Setting range 350-450V	Change: ○

This function sets the threshold value of the DC voltage when undervoltage fault occurs. When the DC voltage is lower than this value, the inverter will stop generating pulses, report undervoltage fault and break the charging contactor.

F411	**Phase failure protection**	Default: 0
	Setting range 0. Inactive 1. Output phase failure protection active 2. Input phase failure protection active 3. Both I/O phase failure protection active	Change: ×
F412	**AVR**	Default: 0
	Setting range 0. Disabled 1. Enabled	Change: ×

These functions set the phase failure protection function and the AVR function.

If F412=1，when the power input voltage deviates from the rated value, the inverter will automatically regulate the PWM width, making the output voltage approach the set value.

AVR function is recommended to be open. But if in some cases AVR may worsen the mechanical oscillation of the motor, close it.

F415	**Cooling fan control**	Default: 0
	Setting range 0. Auto run 1. Always run	Change: ○

This function sets the operation mode of the cooling fan.

When the power goes on, the cooling fan first conducts self-test, then runs according to the control mode.

F415=0: If the temperature inside the inverter is higher than the set temperature(factory default), the cooling fan begins to run; and when the temperature is below the set temperature, the cooling fan will stop.

F415=1: The cooling fan always runs at any temperature.

F419	**Braking unit working voltage threshold**	Default: 680V
	Setting range 620-720V	Change: ○

When the DC voltage is greater than F419, the braking unit begins to work, preventing the DC voltage from rising further.

F420	**Starting delay**	Default: 0.0s
	Setting range 0.0-10.0s	Change: ○

After receiving the start command, the inverter will start the motor after a period of time set by F420.

6.6 Function Group F5: Terminal Function

F500	**X1 function**	Default: 3
	Setting range 0-6	Change: ×
F501	**X2 function**	Default: 2
	Setting range 0-6	Change: ×
F502	**X3 function**	Default: 4
	Setting range 0-6	Change: ×
F503	**X4 function**	Default: 6
	Setting range 0-6	Change: ×

SB61Z+ provides four multi-function digital input terminals X1~X4. Each X terminal can be set as one of the six functions as shown in the following table.

Table 6-1 Input terminal functions 0 ~ 6

0	Analog channel 1
1	Analog channel 2
2	Analog parameter switching input
3	Run command input
4	External fault normally-open input
5	External fault normally-closed input
6	External reset input

Function 0 and function 1, plus the combination of any two of the four X terminals(one set to 0, the other set to 1), are used to select the analog channel. Refer to Table 6-2(X1 & X2 as example).

Table 6-2 Analog channel selection by X1 & X2

X1	X2	Channel selection
OFF	OFF	Selected by F300
OFF	ON	Channel B

ON	OFF	Channel C
ON	ON	Channel D

Note: Function F300 is also used to select the analog channel, but terminal selection is prior to F300.

Function 2 is used to switch parameters between channel A and channel B. F301-F319 form the parameter set 1 and F320-F338 constitute the parameter set 2. If any X terminal is set to 2, disconnecting it from COM will select the parameter set 1, while connecting it to COM will select the parameter set 2.

Function 3 is used to control the start and stop of the inverter. If F004=1 and any of the four X terminals is set to 3, connecting the X terminal to COM will start the inverter, while disconnecting the X terminal from COM will stop the inverter.

Function 4 and function 5 are used to input an external fault signal into the inverter through an X terminal. The external fault signal has two input modes: normally-open and normally-closed.

Function 6 is used to reset the inverter. If any X terminal is set to 6, connecting this terminal and COM after a fault occurs and is fixed will reset the inverter. It has the same function as the STOP/RESET key on the operation panel.

F507	**Relay output terminal**	Default: 8
	Setting range 0-8	Change: ×
F508	**Y1 output terminal**	Default: 0
	Setting range 0-11	Change: ×
F509	**Y2 output terminal**	Default: 1
	Setting range 0-11	Change: ×

These functions set the output signals from the relay output terminals (30A, 30B & 30C) and open collector output(OC output) terminals(Y1 &

Y2). Refer to Table 6-6 for functions of output terminal and Fig.2-10 for OC output circuit connection .

Table 6-6 Output terminal functions 0 ~ 8

0	Running
1	Stop
2	Frequency reach
3	Frequency reach detection signal
4	Overload pre-alarm
5	External alarm
6	Panel operation
7	Undervoltage stop
8	Fault alarm

Detailed description of Table 6-6:

0: Running
A signal is output when the inverter is running.

1: Stop
A signal is output when the inverter has stopped.

2: Frequency reach
A signal is output when the output frequency reaches the reference frequency.

3: Frequency detection signal
A signal is output when the output frequency reaches the detection frequency.

4: Overload pre-alarm
A signal is output when the output current exceeds F012 and F011=1 or 2.

5: External alarm
When this terminal is disconnected from COM, a signal is output.

6: Panel operation
When F004=0， a signal is output.

7: Undervoltage stop

When undervoltage causes the inverter to stop，a signal is output.

8: Fault alarm

When any fault occurs, this terminal is used to give alarm or control peripheral devices.

When F507=8, contacts 30A & 30B close，while contacts 30B & 30C open.

When F508=8 and F509=8, a signal is output from the corresponding terminal(Y1 or Y2).

Y1 and Y2 can be set as analog output terminals by the jumpers(Fig.2-8). In this case, their functions are as shown in Table 6-7.

Table 6-7 Analog output functions of Y1 & Y2

F508=9, F509=9	Y1, Y2: Operation frequency analog output
F508=10, F509=10	Y2, Y2: Output current analog output
F508=11, F509=11	Y2, Y2: Frequency reference analog output

F515	**Y1 gain**	Default: 100%
	Setting range 50-200%	Change: ○
F516	**Y2 gain**	Default: 100%
	Setting range 50-200%	Change: ○
F518	**Y1 bias**	Default: 0
	Setting range 0-100%	Change: ○
F519	**Y2 bias**	Default: 0
	Setting range 0-100%	Change: ○

F515 & F516 set the gain of the analog output from Y1 & Y2. The maximum analog output of Y1/Y2 is 20mA or 10V.

F518 & F519 set the minimum value of the analog output from Y1 & Y2.

These four functions are valid when Y1 & Y2 are used as analog outputs, but invalid when Y1 & Y2 are used as OC outputs.

Example of setting: Suppose Y1 is used as the output current analog output. If F515=100, F518=20 and the analog output signal is 4-20mA, then 4mA corresponds to 0Hz and 20mA corresponds to the maximum output frequency 50Hz. If F515=200, F518=20 and the analog output signal is 4-20mA, then 4mA corresponds to 0Hz and 20mA corresponds to 25Hz.

The default setting for Y1/Y2 analog output signal is 0-20mA.

F520	**Relay closing delay**	Default: 0.0
	Setting range 0.0-100.0s	Change: ◦
F521	**Relay opening delay**	Default: 0.0
	Setting range 0.0-100.0s	Change: ◦
F522	**Y1 terminal closing delay**	Default: 0.0
	Setting range 0.0-100.0s	Change: ◦
F523	**Y1 terminal opening delay**	Default: 0.0
	Setting range 0.0-100.0s	Change: ◦
F524	**Y2 terminal closing delay**	Default: 0.0
	Setting range 0.0-100.0s	Change: ◦
F525	**Y2 terminal opening delay**	Default: 0.0
	Setting range 0.0-100.0s	Change: ◦
F528	**X terminal jitter-eliminating time**	Default: 10ms
	Setting range 10-2000ms	Change: ◦

F520-F525 set a delay time for the signal output from the relay or terminal Y. Refer to Fig.6-14. These functions can eliminate jitter of the output signal. Any signal whose duration is less than the delay time will be ignored.

F528 is used to eliminate jitter of the signal input from the terminal X; any signal whose duration is less than the jitter-eliminating time will be ignored.

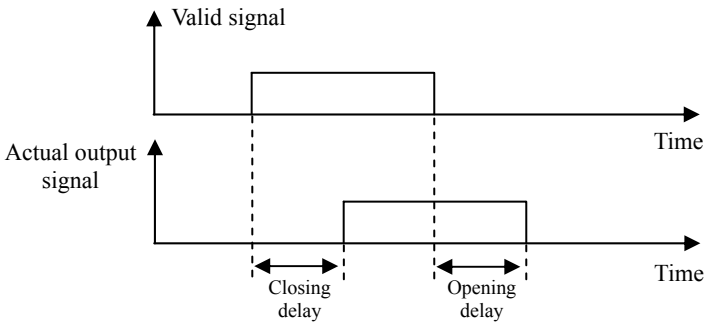


Fig.6-14 Delay function for terminal output signal

6.7 Function Group F6: Auxiliary Frequency Function

F600	**Starting frequency**	Default: 1.00Hz
	Setting range 0.10-50.00Hz	Change: ○
F601	**Starting frequency duration**	Default: 0.5s
	Setting range 0.0-20.0s	Change: ○
F602	**Stop frequency**	Default: 0.00Hz
	Setting range 0.00-50.00Hz	Change: ○

"Starting frequency" is the frequency at the moment when the inverter begins to have voltage output. "Starting frequency duration" is the time period from the moment the inverter begins to have voltage output to the moment the inverter begins to accelerate.

F607	**Upper-limit frequency**	Default: 50.00Hz
	Setting range 0.50-400.0Hz	Change: ○
F608	**Lower-limit frequency**	Default: 0.50Hz
	Setting range 0.1-400.0Hz	Change: ○

Upper-limit(lower-limit) frequency is the max (min) frequency which is set according to the load requirement. F608 is always less than F607.

F609	**Jump frequency 1**	Default: 0.00Hz
	Setting range 0.00-400.0Hz	Change: ○
F610	**Jump frequency 2**	Default: 0.00Hz
	Setting range 0.00-400.0Hz	Change: ○
F611	**Jump frequency 3**	Default: 0.00Hz
	Setting range 0.00-400.0Hz	Change: ○
F612	**Jumping width**	Default: 0.00Hz
	Setting range 0.00-10.00Hz	Change: ○

These functions enable the inverter output frequency to avoid the mechanical resonant points. See Fig.6-15.

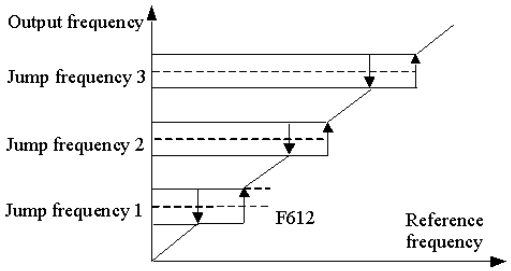


Fig. 6-15

F613	**Frequency reach detection band**	Default: 1.00Hz
	Setting range 0.00-10.0Hz	Change: ○

When the output frequency falls in the range of reference frequency ± F613, If F507=2, F508=2 or F509=2, a signal will be output from the relay or terminal Y1 or Y2. See Fig. 6-16.

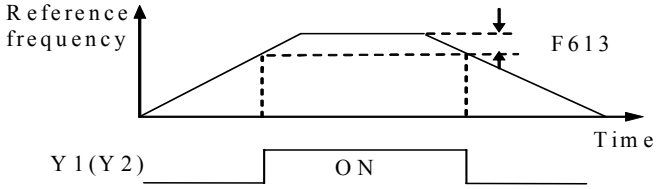


Fig 6-16

F614	**Specified detection frequency**	Default: 40.00Hz
	Setting range 0.10-400.0Hz	Change: ○
F615	**Specified detection frequency width**	Default: 1.00Hz
	Setting range 0.00-30.00Hz	Change: ○

When the output frequency reaches the specified detection frequency, the internal contact of the output terminal closes; when the output frequency drops to F614 - F615, the internal contact opens. See fig. 6-17.

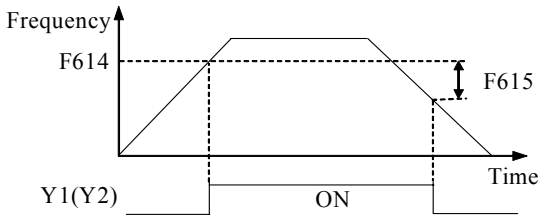


Fig.6-17

6.8 Function Group F9: Communication Function

F900	**Communication protocol selection**	Default: 0
	Setting range 0. Factory protocol(Modbus) 1. Compatible USS commands	Change: ○
F901	**Local address**	Default: 1
	Setting range 0-247 Modbus: 1-247 USS: 0-31	Change: ○
F902	**Baud rate**	Default: 3
	Setting range 0. 1200bps 1. 2400bps 2. 4800bps 3. 9600bps 4. 19200bps	Change: ○
F903	**Communication data format**	Default: 0
	Setting range 0. 8,N,1(1 start bit, 8 data bits, no parity check, 1 stop bit) 1. 8,O,1(1 start bit, 8 data bits, odd check, 1 stop bit) 2. 8,E,1(1 start bit, 8 data bits, Even check, 1 stop bit) 4. 8,N,2(1 start bit, 8 data bits, no parity check, 2 stop bits)	Change: ○

SB61Z$^+$ provides the RS485 port, enabling the customer to realize the centralized monitor of the inverter through PC/PLC.

SB61Z$^+$ supports the Modbus protocol and part of USS commands. Up to 32 inverters can operate simultaneous. For the communication protocols, refer to Chapter 10.

6.9 Function Group FA: Display Parameters

FA00	**LED display**	Default: 0
	Setting range 0-5	Change: ○

This function selects which information is displayed on the LED monitor when the power of the inverter is turned on.

Setting	Display in running	Display in stop
FA00=0	Output frequency	Reference frequency
FA00=1	Output current	Reference frequency
FA00=2	Output voltage	Reference frequency
FA00=3	Synchronous speed	Synchronous speed
FA00=4	Line speed	Reference line speed
FA00=5	Overload rate	Reference frequency

FA01	**Speed coefficient**	Default: 1.00
	Setting range 0.01-45.00	Change: ○

This function sets the speed coefficient when the line speed or load speed is required to display on the LED monitor.

Displayed line speed or load speed = Frequency × Speed coefficient

FA02	**DC voltage correction coefficient**	Default: 1024
	Setting range 1000-1050	Change: ○

When the display value of DC voltage does not conform to the actual DC voltage value, this function is used to regulate the display value. 1024 corresponds to 100%.

FA03	**Module temperature**	Default:
	Setting range 0.0-100.0℃	Change: △

This function is used to display the temperature of the IGBT module in the inverter. It can not be changed.

FA05	**Cumulated run time**	Default:
	Setting range 0.0-6553h	Change: △
FA07	**Cumulated run time clear**	Default:
	Setting range 0. Disabled 1. Enabled	Change: ○

FA05 can not be changed in both running and stop. It can only be cleared by setting FA07=1.

FA08	**Fault record 1**	Default: 0
FA09	**Fault record 2**	Default: 0
FA10	**Fault record 3**	Default: 0
	Display see Paragraph 3.3	Change: △
FA11	**DC voltage at the last fault**	Default:
	Display	Change: △
FA12	**Output current at the last fault**	Default:
	Display	Change: △
FA13	**Output frequency at the last fault**	Default:
	Display	Change: △
FA14	**Heat-sink temperature at the last fault**	Default:
	Display	Change: △
FA15	**Fault record clear**	Default:
	Setting range 0. Disabled 1. Enabled	Change: ○

FA08 ~ FA10 record the last three faults respectively. After faults have been eliminated, setting FA15=1 will clear the fault records of FA08 ~ FA10. “corr” represents no error.

6.10 Function Group Fb: Password parameters

Fb00	**User password**	Default: 0
	Setting range 0-9999	Change: ○
Fb01	**Factory password**	Default: *
	Setting range -	Change: ○

Function Fb00 enable the user to set a password (1~9999) preventing illegal data change by unauthorized persons. If you forget the user password, contact the supplier to get the factory password. Input the factory password in Fb01, and then set a new user password in Fb00.

6.11 Function Group Fc: Running information display

This function group includes some common display parameters. They are read only.

Fc00	**Reference frequency**	Default: 50.00Hz
	Setting range	Change: △
Fc01	**Output frequency**	Default: 0.00Hz
	Setting range	Change: △
Fc02	**Output current**	Default: 0.0A
	Setting range	Change: △
Fc03	**Output voltage**	Default: 0V
	Setting range	Change: △
Fc04	**Reference synchronous speed**	Default: 1500r/min
	Setting range	Change: △
Fc05	**Output synchronous speed**	Default: 0
	Setting range	Change: △
Fc06	**Reference line speed**	Default: 50m/s
	Setting range	Change: △
Fc07	**Output line speed**	Default: 0
	Setting range	Change: △
Fc08	**Load rate**	Default: 0
	Setting range	Change: △
Fc09	**Reference value**	Default: 0
	Setting range	Change: △
Fc10	**Feedback value**	Default: 0
	Setting range	Change: △
Fc11	**DC voltage**	Default: 537
	Setting range	Change: △

7 Maintenance

DANGER

- **Only professionally trained persons can disassemble and repair the inverter and replace its parts.**
- **Don't leave any electricity conductor like metals in the inverter after repair. That may destroy the inverter.**

CAUTION

Before repairing the inverter, check and verify the following items. Otherwise, electric shock may occur.

- **The power supply of the inverter has been cut off.**
- **The high-voltage lamp on the main board has extinguished.**
- **The DC voltage has fallen to the safety level(below DC 36V).**

CAUTION

- **The insulation test has been performed at factory. Try not to test the insulation with a megger. That may destroy the product. If you have to use a megger, follow the steps described hereinafter(7.3).**
- **When conducting an insulation test on control terminals, use only a tester(high resistance range). Otherwise, parts on the control circuit will be destroyed.**

7.1 Daily inspection & maintenance

In order that the inverter may work reliably for a long period, you must install and operate it strictly in accordance with this manual and conduct the daily inspection and maintenance as follows:

■ Check that if the operation environment of the inverter meets the

requirements.

- Check that if inverter operation parameters are set within the specified ranges.
- Check that if the inverter or motor has signs of unusual noise, vibration or overheating.

7.2 Periodical maintenance

Periodical maintenance should be performed once every 3 or 6 months depending on the service conditions.

Check items:

- Check to see if the three phase output voltages (U, V, W) are balanced when the inverter operates without any load.
- Check to see if the screws of the control circuit terminals are loose. If so, tighten them.
- Check the input(R, S, T) and output(U, V, W) terminals for damage.
- Check that if the connections between terminals(R, S, T, U, V, W) and copperplates are firm.
- Check the terminals and copperplates for overheating, discoloration and deformation.
- Check to see if the insulation of the main circuit & control circuit terminals meets the requirements.
- Check the power cables and control cables for damage, aging and discoloration.
- Remove dirt with cloth immersed with neutral chemicals and dust with a vacuum cleaner, especially from the vents and printed circuit boards.
- When leaving the inverter unused for a long time, check it for functioning at least once every year by supplying it with electricity for at least two hours with the motor disconnected. While supplying the power, the input voltage should be increased gradually with a transformer to the rated value.

7.3 Insulation test

7.3.1 Main circuit test

- Prepare a DC 500V megger.
- Disconnect all inverter terminals.
- Connect the main circuit terminals (R、S、T、P1、P+、DB、U、V、W) with a common wire.
- Perform the insulation test only between the common wire and ground(PE terminal).
- If the megger's indication is greater than 5MΩ, that means normal.

7.3.2 Control circuit test

- Disconnect all control circuit terminals.
- Perform the insulation test between the control circuit terminal and ground. If the megger's indication is greater than 1MΩ, that means normal.

7.4 Replacement of parts

The lives of parts vary with their types, installation environments and service conditions. It is recommended to replace a part before it is damaged. Refer to the following table for replacement cycles of various parts.

Table 7-1. Replacement cycles of parts

Part name	Standard replacement cycle
Cooling fan	3 years
DC filter capacitor	5 years
Electrolytic capacitor on PCB	7 years
Other parts	Determined after inspection

8 Troubleshooting

8.1 Troubleshooting

When faults occur, diagnose the inverter according to the following table and make a detailed record. If your problem can't be resolved by the aid of the table or you need technical support, please contact our distributors.

Table 8-1 Faults and remedies

Code	Fault type	Possible causes	Remedies
ou	Overvoltage	(1) Supply voltage abnormal (2) Decel time too short (3) Braking resistor improper	(1) Check input power (2) Reset decel time (3) Reselect braking resistor
Lu	Undervoltage	(1) Input voltage abnormal (2) Failure inside inverter	(1) Check input power (2) Call us
oL	Overload	(1) Setting of electronic thermal protection parameter improper (2) Load too large	(1) Reset electronic thermal protection parameter (2) Use an inverter with higher capacity
PLo	Output phase failure	(1) Inverter output phase failure	(1) Eliminate the failure (2) Call us
PLI	Input phase failure	(1) Input phase failure	(1) Eliminate the failure (2) Call us
FL	Module failure	(1) Input voltage too low (2) Load too large (3) Shorting or grounding fault (4) Failure inside inverter	(1) Check input power (2) Use an inverter with higher capacity (3) Eliminate the fault (4) Call us
oLE	External alarm	(1) External circuit failure	(1) Eliminate the failure
oH	Overheating	(1) Fan damaged (2) Air vent blocked (3) Failure inside inverter	(1) Replace the fan (2) Clear air vent (3) Call us
oc	Overcurrent	(1) Accel/decel time too short (2) V/F curve setting improper (3) Inverter capacity too low	(1) Reset accel/decel time (2) Reset V/F curve (3) Use an inverter with higher capacity
LLL1	Current sensor error	Failure in current sensor	(1) Replace current sensor (2) call us

Code	Fault type	Possible causes	Remedies
LLL2	temperature sensor error	Failure in temperature sensor	Call us
Err5	Save failed	Failure inside inverter	Call us
	No display on the panel	(1) Input voltage abnormal (2) Connector, cable or display abnormal (3) Failure inside inverter	(1) Check input power (2) Replace connector, cable, or display (3) Call us
	Motor malfunction	(1) Motor failure (2) V/F curve improper (3)External terminal connection incorrect (4) Failure inside inverter	(1) Replace the motor (2) Reset V/F curve (3) Reconnect external terminal (4) Call us

8.2 EMI Reducing

8.2.1 Preventing external noise

- Separate the control cable(shielded wire preferred) and the power cable(input R、S、T and output U、V、W), and connect the shielded wire firmly to the inverter PE terminal or the common terminal.
- If the control cable is long , run it through and wrap 2-3 circles on the magnetic ring before connecting it to the inverter.

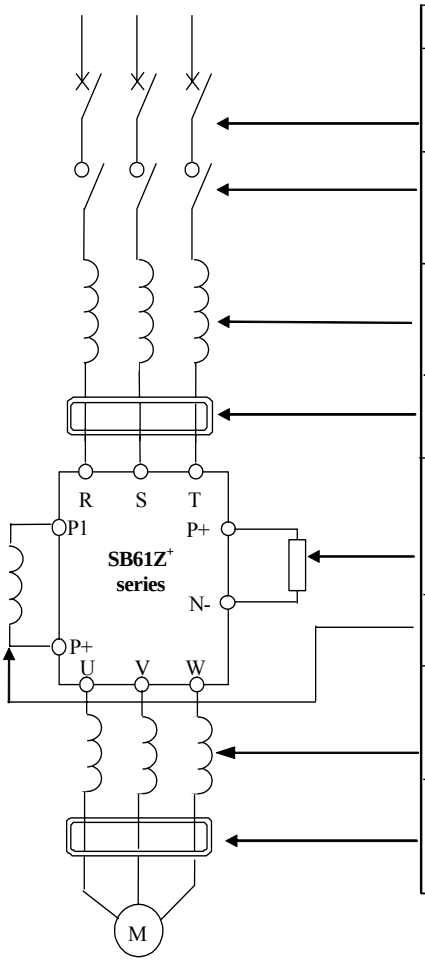
8.2.2 Preventing radio interference

Connect an AC reactor on both input and output side of the inverter, and put the inverter and the power cable in the grounded metal cabinet and conduit respectively.

Also you can connect a filter on both the input side and output side of the inverter. If the filter is not available, an equivalent magnetic ring can be used as the substitute: run the wires(R, S, T, U, V, W) through it and wrap them 3-4 rounds in the same direction.

9 Peripheral Devices

9.1 Connecting diagram of peripheral devices



Peripheral devices and options	Function
Air switch (non-fuse breaker)	Shuts off the inverter to prevent the failure of inverter and circuits from leading to power failure
Magnetic contactor	Shuts off the main power when inverter fails and prevents restart after power-off and failure
AC reactor	Improves the power factor, reduces higher harmonics and suppresses surge voltage
Filter	Reduces radio interference generated by inverter
Braking resistor	Used when the braking torque is insufficient. Applicable to large-inertia loads and the cases where frequent braking or quick stop is required
DC reactor	Improves power factor and suppresses current peak
Output AC reactor	Suppresses inverter radiated and inducted interference and the motor vibration
Filter	Reduces radio interference generated by inverter

9.2 Description of Accessories

9.2.1 AC reactor

The input AC reactor can suppress the higher harmonic of the inverter input current and obviously improve the power factor. It is recommended to adopt it in following cases:

- The ratio of the power supply capacity to inverter capacity is greater than 10:1.
- Thyristor loads or power factor compensators are connected to the power supply.
- The voltage unbalance of the 3-phase power is great(⩾ 3%).
- The power factor on the input side is required to improve. It may be increased to 0.75~0.85.
- The inverter power is greater than 30kW.

9.2.2 Filter

The filter suppresses not only the inverter generated radio interference, but also the external radio interference, and the transient shock & surge interference with the inverter.

The radio noise filter should be adopted in following cases:

- The requirement of anti-radio interference is highly emphasized.
- Meeting CE, UL and CSA standards is required.
- There are devices with poor anti-interference ability around the inverter.

The filter should be located as close as possible to the inverter, with the wiring as short as possible.

9.2.3 Braking resistor and braking unit

When a quick braking is needed, connect an external braking unit

between terminals P+ and N-.

The table below lists the resistances and capacities of common types of braking resistors (braking torque 100%).

SB61Z+ Series

Voltage(V)	Motor capacity(kW)	Resistance(Ω)/ quantity	Resistor capacity(kW)
380 V	11~22	40	4
	30	20	5
	37~45	15	9
	55	20/2	12
	75	20/3	18

9.2.4 DC reactor

When the power grid capacity is far more than the inverter capacity, or improving the power factor is very important, a DC reactor should be connected between P1 and P+.

The DC reactor can be used together with the AC reactor. It also effectively decreases the higher harmonics and can raise the power factor up to 0.95.

9.2.5 Remote panel

If you want to control the inverter from a remote location, you can choose our remote panel(see Chapter 3) and special cables.

9.2.6 Current-leak protector

Since the static capacitance to the ground exists in the inverter, motor and wire leads, and the carrier frequency used by the inverter is high, therefore, the leakage current of the inverter to the ground is very high,

sometimes even leads to error action of the protection circuit.

To avoid above problem, reduce the carrier frequency, shorten the wire leads, and install a current-leak protector.

While using the current-leak protector, pay attention to the following points:

- The current-leak protector should be connected on the input side of the inverter, and behind the air switch.
- The action current of the current-leak protector should be ten times the leakage current of the same circuit(this circuit should be supplied by the commercial power without the inverter connected).

10 Communication Protocols

The communication protocols for SB60$^+$/61$^+$ are a kind of serial master-slave protocols. There in only one device(known as the master) on the network which can establish the protocol(called “request/command”). Other devices(known as the slaves) respond to the request from the master. Here the PC or PLC is the master and the inverter is the slave. The master is able to access to a certain slave device or send broadcasts to all slave devices. In the former case, the slave will send back a message(called “response”) to the master, but needn’t in the latter case.

SB60$^+$/61$^+$ supports both the Modbus protocol and part of USS commands. It adopts the point-to-point communication method and sets the communication parameters of the inverter’s serial ports through the keypad of the inverter, such as communication protocol, local address, baud rate and data format. **The master must has the same baud rate and data format as the inverter.**

1 Factory Modbus protocol

The factory Modbus protocol for SB60+/61+ includes three layers: Physical layer, Data Link layer and Application layer. The former two layers employ the RS485-based Modbus protocol. The Application layer controls the run/stop of the inverter and the reading/writing of the inverter’s parameters and so on.

Modbus is a master-slave protocol. The communication between the master and slave falls into two types: master requests, slave responds; master broadcasts, slave doesn’t respond. The master polls the slaves.

Any slave can't send messages without receiving the command from the master. The master may resend the command when the communication is not correct. If the master doesn't get a response within given time, the slave polled is considered to be lost. The slave will send error information to the master if it can not implement a message. A slave can't communicate directly with other slaves. Communication between slaves must be performed by means of the master's software, which reads out data from a salve and send the data to another salve.

SB60$^+$/61$^+$ supports the Modbus/RTU mode and the following Modbus functions: function 3(multi-read, max word 32), function 16(multi-write, max word 10), function 22(mask write), and function 8(read-back test). Among them, function 16 and 22 support broadcast.

Method of addressing the inverter parameters: among the 16 bits of the Modbus parameter address, the upper 8 bits represent the group number of the parameter, while the lower 8 bits represent the serial number in the group. For example, the address of the parameter F5-17 is 0511H. The group number 50(32H) is for communication dedicated variables(control word, status word, etc.)

Communication variables include the inverter parameters, communication dedicated commands and communication dedicated status variables.

1.1 Inverter parameters

Name	Modbus address	Change	Remarks
Inverter parameter	Upper 8 bits：group number Lower 8 bits：serial number in group	Refer to Chapter 5	Refer to SB60+/SB61+ Operation Manual for parameter details

The group numbers of the parameters correspond to the menu codes as shown in the following table:

Menu code	Group number	Menu code	Group number	Menu code	Group number
F0	0（00H）	F1	1（01H）	F2	2（02H）
F3	3（03H）	F4	4（04H）	F5	5（05H）
F6	6（06H）	F7	7（07H）	F8	8（08H）
F9	9（09H）	FA	10（0AH）	Fb	11（0BH）
Fc	12（0CH）			Communication variables	50（32H）

Description:

The data transmitted in communication is integer. For the minimum step of the data, refer to the Operation Manual. For example, the min step of F0-00(frequency setting) is 0.01Hz, therefore, the transmitted data 5000 represents 50Hz.

Note: parameters changed by the host computer through communication as well as those changed by means of the operation panel, will be stored in EEPROM automatically.

1.2 Communication dedicated commands

Name	Modbus address	Change	Description
Main control word	3200H	○	Bit0：ON/OFF1（run on the leading edge. 0: stop according to the setting of F007） Bit1：OFF2（1：status remains unchanged；0：coast stop. This bit acts as the emergency stop key）

Name	Modbus address	Change	Description
			Bit2：not used Bit3：not used Bit4：not used Bit5：not used Bit6：not used Bit7：fault reset(on the leading edge) Bit8：jog(forward) Bit9：not used Bit10：not used Bit11：frequency direction (0: forward; 1: reverse) Bit12：not used Bit13：not used Bit14：not used Bit15：not used
Communication set frequency	3201H	○	Non-negatives(unit: 0.01Hz)
Reserved	3202H	○	
Reserved	3203H	○	
Extended control word 1	3204H	○	Bit0～Bit15 correspond to digital inputs 1~16 respectively
Extended control word 2 (reserved)	3205H	○	Bit0～Bit15 correspond to digital inputs 17~32. Not used.
Extended control word 3 (reserved)	3206H	○	Bit0～Bit15 correspond to digital inputs 33~48. Not used.
Reserved	3207H	○	
Reserved	3208H	○	

Name	Modbus address	Change	Description
Reserved	3209H	○	

Definitions of extended control word bits: (For meanings of the digital inputs, refer to Chapter 6 of the Operation Manual)

Extended control word 1			
Bit	Digital input	Bit	Digital input
0	0：not used	8	8：not used
1	1：not used	9	9：not used
2	2：not used	10	10：not used
3	3：not used	11	11：not used
4	4：not used	12	12：coast stop command
5	5：not used	13	13：not used
6	6：external fault input	14	14：not used
7	7：fault reset command	15	15：not used

1.3 Communication dedicated status variables

Name	Modbus address	Change	Description
Main status word	3210H	△	Bit0：reserved Bit1：ready for run Bit2：running Bit3：fault Bit4：reserved Bit5：reserved Bit6：charging contactor breaks Bit7：reserved Bit8：reserved Bit9：reserved Bit10：frequency detection signal 1 (FDT1) Bit11：reserved Bit12：reserved

Name	Modbus address	Change	Description
			Bit13：reserved Bit14：forward run Bit15：reserved
Operating frequency	3211H	△	Non-negatives(unit: 0.01Hz)
Reserved	3212H	△	
Reserved	3213H	△	
Set frequency	3214H	△	Non-negatives(unit: 0.01Hz)
Output current	3215H	△	Unit: 0.1A
Reserved	3216H	△	
Output voltage	3217H	△	Unit: 0.1V
But voltage	3218H	△	Unit: 0.1V
Fault code	3219H	△	Detailed as below
Reserved	321AH	△	
Reserved	321BH	△	
Extended status word 1	321CH	△	
Reserved	321DH	△	
Reserved	321EH	△	
Reserved	321FH	△	
Reserved	3220H	△	

Definitions of extended status word bits:

Extended status word			
Bit	Digital input	Bit	Digital input
0	0：ready for run	8	8：not used
1	1：running	9	9：not used
2	2：frequency reach（FAR）	10	10：not used
3	3：frequency detection signal 1 (FDT1)	11	11：not used
4	4：frequency detection signal 2 (FDT2)	12	12：not used
5	5：not used	13	13：not used
6	6：not used	14	14：reverse running
7	7：not used	15	15：stopping

Definition of fault word(3219H):

bit3 ~ 0 define the fault type:

bit3 ~ 0=1：	FL	module protection
bit3 ~ 0=2：	oc	overcurrent protection
bit3 ~ 0=3：	PLo	output phase failure protection
bit3 ~ 0=4：	oL	overload protection
bit3 ~ 0=5：	oU	overvoltage protection
bit3 ~ 0=6：	oH	overheating protection
bit3 ~ 0=7：	oLE	external alarm
bit3 ~ 0=8：	PLI	input phase failure
bit3 ~ 0=9：	LLL1	current sensor error
bit3 ~ 0=10：	LLL2	temp sensor error
bit3 ~ 0=11	reserved	
bit3 ~ 0=12	reserved	
bit3 ~ 0=13	reserved	
bit3 ~ 0=14：	Err5	save failed
bit3 ~ 0=15：	LU	undervoltage protection
bit14～4：	reserved	
bit15：	main protection flag，bit15＝1(error)，bit15＝0(no error)	

1.4 Modbus functions supported by SB60^{+}/61^{+}

SB60+/61+ supports the communication on a Modbus network using RTU(Remote Terminal Unit) mode. In RTU mode, both the starting and ending of the message frame are marked by an interval of at least 3.5 character times(but 2ms for baud rates 19200bit/s and 38400bit/s). A typical RTU message frame is shown below.

Slave address （1 byte）	Modbus function code （1 byte）	Data （multiple bytes）	CRC16 （2 bytes）

The bit sequence of a byte is: 1 start bit, 8 data bits, 1 odd/even parity bit(or no parity bit), 1(or 2) stop bit(s).

Range of slave address: 1~247. 0 is for the broadcast address.

CRC(Cyclical Redundancy Check): CRC16 mode in which the LSB is appended first, followed by the MSB.

SB60+/61+ supports the following Modbus functions:

- Function 3: read multiple parameters. Word number 1~32. Refer to the following example for the message format.

Example: read three words(main control word, operating frequency and one reserved word) from the #1 slave, with the start address being 3210H.

Query from master:

Slave address	01H
Modbus function code	03H
Start address (MSB)	32H
Start address (LSB)	10H
Word number (MSB)	00H
Word number (LSB)	03H
CRC (LSB)	0AH
CRC (MSB)	B6H

Response from slave:

Slave address	01H
Modbus function code	03H
Byte number returned	06H
MSB of 3210H	44H
LSB of 3210H	37H
MSB of 3211H	13H
LSB of 3211H	88H
MSB of 3212H	00H
LSB of 3212H	00H
CRC (LSB)	5FH
CRC (MSB)	5BH

■ Function 16: write multiple parameters. Word number 1~10. Refer to the following example for the message format.

Example: rewrite two words from the #1 slave into 0035H and 1388H(forward run and set frequency 50Hz) respectively, with the start address being 3200H.

Query from master:

Slave address	01H
Modbus function code	10H
Start address (MSB)	32H
Start address (LSB)	00H
Word number (MSB)	00H
Word number (LSB)	02H
Byte number	04H
MSB of 1st data	00H
LSB of 1st data	37H
MSB of 2nd data	13H
LSB of 2nd data	88H
CRC (LSB)	02H
CRC(MSB)	56H

Response from slave:

Slave address	01H
Modbus function code	10H
Start address (MSB)	32H
Start address (LSB)	00H
Word number (MSB)	00H
Word number (LSB)	02H
CRC (LSB)	4FH
CRC (MSB)	70H

■ Function 22: mask write.

This function provides an easy way to modify certain bit(s) of the control word, compared to the time-consuming “read-change-write” method. It is only valid with the control word(including the main control word and extended control word). The operation is as follows:

Result=(operand & AndMask)|（OrMask & (~ AndMask)）, i.e.,

When all bits of OrMask are “0”: clear certain bit(s);

When all bits of OrMask are “1”: set certain bit(s) to “0”;

When all bits of AndMask are “0”: the result is OrMask;

When all bits of AndMask are “1”: the result remain unchanged.

Example: set bit7 of the address 3205H(extended control word 2) of the #1 slave to 1.

The query from the master and the response from the slave are as follows(the slave echoes the original function code):

Slave address	01H
Modbus function code	16H
MSB of operand address	32H
LSB of operand address	05H
MSB of AndMask	FFH
LSB of AndMask	7FH
MSB of OrMask	FFH
LSB of OrMask	FFH
CRC (LSB)	3EH
CRC (MSB)	68H

Example: clear bit7 of the address 3205H(extended control word 2) of the #1 slave(the slave echoes the original function code).

Slave address	01H
Modbus function code	16H
MSB of operand address	32H
LSB of operand address	05H
MSB of AndMask	FFH
LSB of AndMask	7FH
MSB of OrMask	00H
LSB of OrMask	00H
CRC (LSB)	3FH
CRC (MSB)	D8H

- Function 8: read-back test. The test code is 0000H. The original frame is required to return. The query from the master and the response from the slave are as follows:

Slave address	01H
Modbus function code	08H
MSB of test function code	00H
LSB of test function code	00H
MSB of test data	37H
LSB of test data	DAH
CRC（LSB）	77H
CRC（MSB）	A0H

Exception response: if the slave fails to implement the request from the master, it will return an exception response message, the format of which is as follows:

Slave address	1 byte
Response code	1 byte（Modbus function code＋80H）
Error code	1 byte，meaning: 1: Modbus function codes that can't be handled 2: illegal data address 3: data value beyond the range 4: operation failed（such as attempting to write a

	read-only parameter, modify an unchangeable parameter during running, etc.）
CRC（LSB）	—
CRC（MSB）	—

CRC16 source code(C language):

```
unsigned short GetCrc(unsigned char* data, unsigned short length)
{
    unsigned short j;
    unsigned short crc = 0xffff;
    while(length--){
        crc ^= *data++;
        for(j=0;j<8;j++){
            if(crc&0x01){
                crc = (crc>>1) ^ 0xa001;
            }else{
                crc = crc>>1;
            }
        }
    }
    return crc;
}
```

Program description: input the start address and the length of the character string of the data which is to be checked, and return the CRC result. The constant "0xa001" in the program is verifying characteristic code of CRC algorithm.

2. USS commands

SB60$^+$/61$^+$ also supports USS commands. Through the host computer(including PC, PLC, etc.) software which support USS protocol, you can control the operation of the inverter, set the frequency for the inverter, and read the operation parameters of the inverter.

Frequency base value:

The frequency base value for SB60^{+}/61^{+} is F0-08(motor max frequency). This protocol takes 4000H=100% as the frequency base value.

The way to set the frequency for the inverter by means of the host computer software is shown below:

If F0-08 is set to 50.00Hz, then 2000H represents 50% of the frequency base value, that is 25.00Hz, and 4000H represents 100% of the frequency base value, that is 50.00Hz.

Description of the control message

Message construction:

STX	LGE	ADR	PKW field	PZD field	BCC

STX field: the start of the message. Its length is 1 byte and content is 02H.

LGE field: defines the byte number following LGE. The actual length of the message is two bytes longer than LGE, as the bytes of STX and LGE are not included in LGE.

ADR field: defines the inverter address. Its length is 1 byte. The bit order is shown below.

7	6	5	4	3	2	1	0

Bits 0~4 are the address bits, so the range of the inverter address is 0~31.

Bit 5 is the broadcast bit. If this bit is set to logic 1, the message is a broadcast message which is valid with all inverters on the network. In broadcast mode, the inverters don't need to respond to the master.

Bit 6 denotes echoing the message. The addressed inverter will return the original message to the host computer.

Bit 7 must be set to 0.

PKW field: its length is fixed at 6 bytes and its function is not defined yet now.

PZD field: its length is fixed at 2 words(or 4 bytes). The first word(it is control word in query message and status word in response message) in this field is used to control the operation of the inverter, with the response being the operation status of the inverter. The second word is for setting the set frequency, with the response being the operating frequency of the inverter.

Note: the reference frequency set through communication can't be a negative, therefore reverse run can't be realized by setting a negative frequency. This can be achieved by setting the 11th bit(reversing the set value) of the first word(control word) in the PZD field to logic 1.

BCC field: it's the result of the "exclusive OR" operation of all bytes prior to the BBC field. Its length is 1 byte. The inverter will make the BBC calculation after receiving the message. If the result is not equal to the BBC value in the message, the message is invalid and will be discarded by the inverter. And the inverter will not give a response.

Here is an example of a communication message(all data in the message are hexadecimal). Suppose the inverter address is 0 and operating frequency is 50% of the frequency reference.

Forward： 02 0C 00 00 00 00 00 00 00 04 7F 20 00 55

Reverse： 02 0C 00 00 00 00 00 00 00 0C 7F 20 00 5D

Forward OFF1stop：02 0C 00 00 00 00 00 00 00 04 7E 20 00 54

Forward run (broadcast mode)：02 0C 20 00 00 00 00 00 00 04 7F 20 00 75

Mirror： 02 0C 40 00 00 00 00 00 00 04 7F 20 00 15

Message received by PZD field:

First word in PZD field: main control word	○	Bit0：ON/OFF1（run on leading edge. 0: stop） Bit1：OFF2（0: coast stop） Bit2：not used Bit3：not used Bit4：not used Bit5：not used Bit6：not used Bit7：fault reset（reset on leading edge） Bit8：forward jog Bit9：not used Bit10：not used Bit11：frequency direction（0: forward，1: reverse） Bit12：not used Bit13：not used Bit14：not used Bit15：not used
Second word in PZD field: Frequency setting through communication	○	Non-negatives(unit: 0.01Hz)

Message returned by PZD field:

First word in PZD field: main state word	△	Bit0：reserved Bit1：ready for run Bit2：running Bit3：fault Bit4：reserved Bit5：reserved Bit6：charging contactor breaks Bit7：reserved Bit8：reserved Bit9：reserved Bit10：frequency detection signal 1(FDT1) Bit11：reserved Bit12：reserved Bit13：reserved Bit14：forward run Bit15：reserved
Second word in PZD field: operating frequency	△	Non-negatives(unit: 0.01Hz)

Appendix: Application Example

1. Main circuit wiring

Before inverters are used on injection molding machines with constant delivery pumps, most of the oil pump motors have a capacity range from 11kW~75kW. In order to reduce the impact current generated when the motor starts, the motor is usually designed to start in the Y-Δ mode, as shown in Fig.10-1.

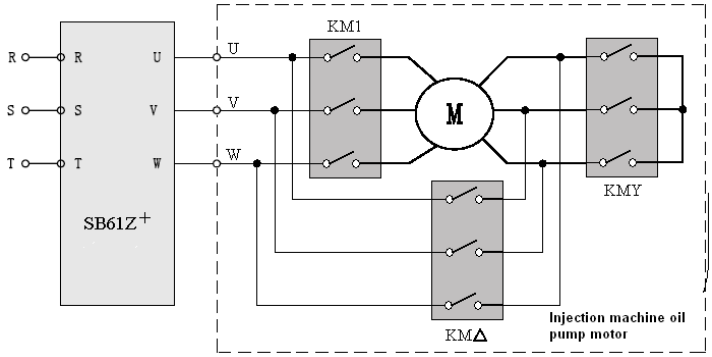


Fig10-1 Y-Δ switching of Injection Molding Machine Oil Pump Motor

Y-Δ starting process is as follows: (1) Open KMΔ first, then close switches KM1 and KMY, making the stator windings form a Y-type connection; (2) When the motor starts after a delay, open KMY and close switches KM1 and KMΔ, making the stator windings form a Δ-type connection.

The motor starts with Y-type connection. After the start is finished, the Y-type connection is switched to Δ-type connection. The Y-Δ switching is generally controlled by a time relay. KM and KMY are interlocked and can not be connected concurrently.

If you want to use an inverter on the injection molding machine, you may retain the original control circuit and connect the inverter output terminals to the oil pump motor input terminals, without changing the motor's original wiring and Y-Δ control mode(see Fig.10-1). When the inverter is connected, the motor can be started directly by the inverter; there is no need to use Y-Δ start. However, the inverter should be started after the KMY-KMΔ switching under no electricity is finished, or the Y-Δ switching may impact the inverter. The auxiliary contact of KMΔ can be used to control the start/stop of the inverter (refer to the following section).

2. Start/stop control mode of the inverter

The inverter used on an injection molding machine is usually controlled by the terminals. Set one of the four X terminals (F500-F503) to 3(run command input). Hereinafter suppose X1 is set to 3. And set F004=1.

2.1 Mode 1: KMΔ auxiliary contact control

As mentioned above, for oil pump motors needing Y-Δ start, to avoid the impact to the inverter, the inverter should be started after the Y-Δ switching under no electricity is finished. In this case, the auxiliary contact of KMΔ can be used to control the start and stop of the inverter. The wiring is as shown in Fig.10-2.

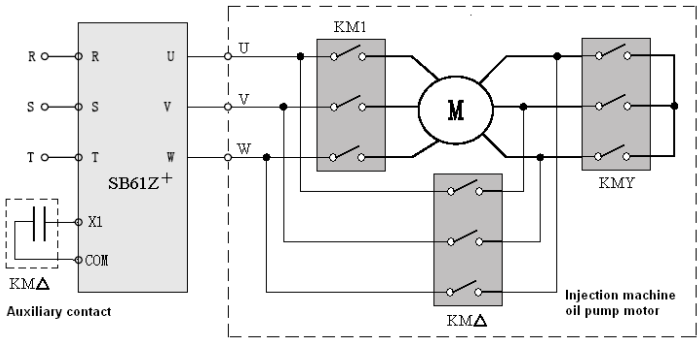


Fig10-2 Utilize the auxiliary contacts of KMΔ to control the start-stop o inverters

This control mode is applicable to oil pumps which need Y-Δ start. The main problem is finding the exact position of the contact KMΔ; this needs you to be well familiar with the electrical circuitry of the injection molding machine.

2.2 Mode 2: Starting delay

SB61Z$^+$ has a special starting delay function (F420) for the Y-Δ start. When the inverter receives the start command, it will start the motor after a period of time (set by F420). The purpose of doing so is to start the motor after the Y-Δ switching under no electricity is finished, thus avoiding the impact during the switching.

If you want to start the inverter in this mode, you can short X1 and COM directly, as shown in Fig.10-3.

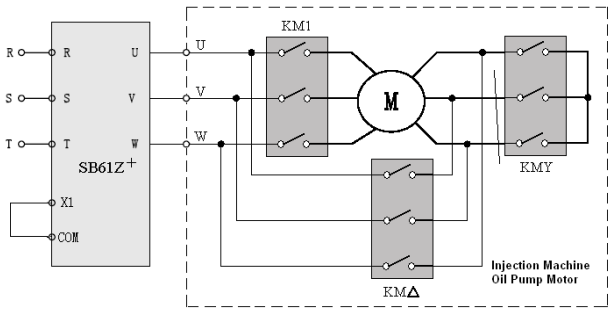


Fig. 10-3 Shortcut X1 and COM terminal，utilize start delay function of inverter

Chengdu Hope Senlan Inverter Co., Ltd.
181 Airport Road, Chengdu, P.R.China
Tel: 86-28-85964751 85968792
Fax: 86-28-85962488
http://www.slanvert.com