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Frekvenčný menič SB70

Uživateľská príručka

Anglická verzia



vysokovýkonné univerzálne frekvenčné meniče so zdokonaleným vektorovým riadením dosahujúce krútiaci moment až 290% nadštandardné hardvérové a softvérové vybavenie výkony od 0,4kWdo 1100kW



USER'S MANUAL

SB70 Series Inverter

High-performance Sensorless vector control

Input: 3-phase 400V class Capacity: 0.4~1100kW

Hope SenLan Science & Technology Holding Corp., Ltd

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Preface

Thank you for purchasing our SenLan SB70G series vector control inverters.

SB70G is a new-generation inverter developed independently by the SenLan Science & Technology Holding Corp.,Ltd., featuring low noise, hight performance and multiple functions. It adopts the rotor field-oriented vector control strategy to realize high-accuracy, wide-range speed and torque control of the motor. SB70G is extensively applicable to equipment in various industries, such as drawbenches, mixers, extruders, winding machines, compressors, fans, pumps, grinding machines, belt conveyors, hoists and centrifuges.

SB70G's wide application is attributed to its modular design and various options, which offer the customers the integrated solutions, lower the system cost and improve the system reliability remarkably. And the users can carry out the secondary development according to their own needs.

Please carefully read and understand this manual before installing, setting, runing and maintaining the product and keep it at a safe place. The technical specifications for the product may alter and the contents of this manual are subject to change without notice.

Check after unpacking

Please check the following items after unpacking SB70 inverter. If there is anything missing, contact us or our distributors.

Check items	Check method
If the product is exactly what you have ordered?	Check to see if the data on the nampelate of the inverter is consistent with thoes in your order form.
If there is any damage on the product?	Observe the external apperance of the product. Check to see if it has got andy damage during transportation.

Description of inverter type



We also provide inverters of 400~1000kW as required.



Description of inverter nameplate(SB70G15)

Safety signs

The safety signs in this manual fall into two categories:

DYGER : indicates that errors in operation may destroy the inverter or lead to death or

heavy injury to people.

CALLION: indicates that errors in operation may lead to damage to the inverter or other

devices.

Terms and abbreviations:

Name	Description
AI	Analog Input(see F6-00~F6-13)
AO	Analog Output(see F6-14~F6-21)
ASR	Automatic Speed Regulator(see F3-00~F3-05)
AVR	Automatic Voltage Regulation(see F2-10)
EMC	Electric Magnetic Compatibility
EMI	Electric Magnetic Interference
LED	Light Emitting Diode
PFI	Pulse Frequency Input(see F6-22~F6-24)
PFO	Pulse Frequency Output(see F6-25~F6-30)
PID	Proportaion, integration and differentiation(see Section 6.8)
PG	Pulse Generator(see Fd-01~Fd-08)

PWM	Pulse Width Modulation
UP/DOWN value	A percentage value that can be adjusted by terminals and keypad \bigcirc/\bigcirc keys. It can be used as the frequency reference(max. frequency=100%) or PID reference. See F4-12~F4-16.
Programmable unit	A software module inside the inverter that implements the arithmetic operation, logic operation, comparison and the like. See Section 6.15.
n(digital input)	The nth digital signal listed in the "Table of digital input functions" in Section 6.5. It can be used as the input of the X, FWD and REV terminals, as well as the output of the logic unit, timer and comparator.
n(digital output)	The nth digital signal listed in the "Table of digital outputput functions" in Section 6.6. It can be used as the output of the Y terminals and relays, as well as the input of the logic unit, timer, analog multi-switch, counter and meter-counter.
n(analog output)	The nth analog signal listed in the "Table of analog output functions" in Section 6.7. It can be used as the output of the AO1, AO2 and PFO terminals, as well as the input of the comparator, analog multi-switch and low-pass filter.

1 Precautions

1.1 Safety precautions

1.1.1 Installation

- Do not install the inverter at a place with or near inflammable objects, otherwise there may be a risk of fire.
- Do not install the inverter in an environment with inflammable gases. That may cause explosion.

1.1.2 Wiring

- Make sure the high-voltage indicator is off and the DC link voltage is less than 36V, otherwise there may be a risk of electric shock.
- Make sure the input power is completely disconnected before the wiring is conducted, otherwise there may be a risk of electric shock.
- Do not connect a braking resistor between the DC terminals P+ and N-. That may cause fire.
- The voltage of the input power terminals should not beyond the rated voltage range. That may damage the inverter.
- The grounding terminal(PE) of the inverter must be securely connected to earth(resistance to earth≤10Ω), otherwise there may be a risk of electric fire.

1.1.3 Check before switching on the power

- Close the cover board of the inverter before turning on the power, otherwise there may be a risk of electric shock or explosion.
- Before trying to run the motor at a frequency over the rated motor frequency, conform that the motor and the mechanical devices can endure such a high speed.

1.1.4 Precautions on power and operation

- Check to see if parameters are set appropriately before commissioning.
- Do not open the front cover while the input power is switched on, for the high voltage inside may cause electric shock.
- Do not handle the inverter with wet hands. That may lead to electric shock.
- "Power-on auto start" is enabled before shipment from the factory. When the terminal control and the run signal are valid, the inverter will start automatically once the power is turned on.
- Do not control the run and stop of the inverter by switching on and off the input power.
- Related parameters should be reset after parameter initialization.
- If the function of restart has been set(such as auto-reset or restart after momentary power failure), do not approach the motor or mechanical load while the inverter is waiting to restart.

1.1.5 Precautions on transport and package

Do not place more inverters than specified in the packaging box.

- Do not put any heavy object on the inverter.
- Do not open the cover board during transport.
- Do not apply any force on the keypad and the cover board while handling the inverter, otherwise there may be a risk of injury to people or damage to equipment.

1.1.6 Disposal

- Dispose the inverter as industrial waste.
- The electrolytic capacitors inside the inverter may explose while burned.
- Plastic components of the inverter will generates toxic gases while burned.

1.2 Other precautions

1.2.1 About motor and mechanical load

Comparison with commercial power operation

SB70G inverter is a voltage-type PWM motor drive. Its output voltage contains some harmonics. Compared with the commercial power, it creates more loss and noise and leads to higher temperature rise of the motor.

The insulation withstand voltage of the cables and motor should be taken into account when the input voltage is high or the motor cables are long.

Constant-torque, low-speed operation

When a common motor runs at low speed for a long time, the motor temperature will rise due to the weakening cooling effect. So if a motor is required to operate at low speed and constant torque for a long term, an inverter or the forced air cooling method must be used.

Overload protection

If the rated capacity of the motor does not match that of the inveter, regulate the overload protection level or adopt other protective measures so that the motor can operate safely.

Running above 50Hz

If you plan to run the motor over 50Hz, be aware that the vibration and noise will increase and make sure that the motor bearings and mechanical devices can withstand such a high speed.

Lubrication of mechanical devices

While runing at low speed for a long period, such mechanical deveices as gearbox and gears may be damaged due to worsening lubricating effect. Before you run them, check the lubrication conditions.

Load of regerative torque

Regerative torque often occurs while a load is hoisted, and the inverter often stops due to overvoltage protection. In this case, an appropriate braking unit should be selected and installed.

Mechanical resonant point

Certain output frequencies of the inverter may be the mechanical resonant points. To avoid these points, place anti-vibration rubber under the base of the motor or setting the jump frequencies.

Motor insulation check before connected to the inverter

When the motor is used for the first time or reused after it has not been used for a long period, the motor insulation must be inspected to prevent the damage to the inverter cause by the failed insulation of the motor windings. Use a 500V voltage-type megaohm meter to measure the insulation resistance, which should not be less than $5M\Omega$.

1.2.2 About inverter

Capacitor or voltage-dependent resistor for improving power factor

As the inverter output is of PWM voltage type, the capactor or voltage-dependent resistor(for improving the power factor) installed on the output side of the inverter will lead to inverter trip or damage to components. Do remove the capacitor or the voltage-dependent resistor before using the inverter.

Installation of switching devices(e.g. contactor) on inverter output side

If a switching device like contactor is required to be installed between the inverter and the motor, make sure the on/off operation is performed while the inverter has no output, otherwise the inverter may be destroyed.

Frequent start and stop

For applications where frequent start and stop are needed, terminals are recommended for the control of the start/stop of the inverter. Using the switching device(such as contactor) on the inverter input side to start or stop the inverter frequently is prohibted. That may destroy the inverter.

Using the inverter beyond the rated value

It is not remommended to operate the inverter beyond the range of the allowable input voltage. If the inverter has to be used beyond the range, increase or decrease the voltage via a voltage regulator.

Changing 3-phase input to single-phase input

If the 3-phase input is changed to the single-phase input, the bus voltage and current ripple will increase, which not only shortens the life of the capacitors, but also damages the performance of the inverter.

It is not recommed to turn the 3-phase into the single-phase. If single-phase is needed, the function of input phase loss protection must be disabled, and the inverter must be detated with its max. value not greater than 60% of the rated value. For models of 18.5kw or above, the single-phase input must be connected to the terminals R and S, or the inverter can't work.

Lightning protection

With the built-in protection of overvoltage from lightning, the inverter has certain self-protection ability againt the lightning strike.

Leakage protector

The high-speed switching operation during the running of the inver will generate high-frequency current which sometimes causes the mis-operation of the leakage protection circuit. To address this issue, moderately lower the carrier frequency, shorten the wires or install a leakage protector.

Observe the following points while installing the leakage protector.

1) The leakage protector should be installed on the inverter input side, preferably behind the air switch(non-fuse circuit breaker).

2) The leakage protector should be one that is insensitive to higher harmonics or specially designed for the inverter(sensitivity above 30mA). If a common leakage protector is selected, its sensitivity and action time should be greater than 200mA and 0.2s, respectively.

Derating of inverter

 If the ambient temperature exceeds 40°C, the inverter should be derated by 5% for every 1°C increase, and external forced cooling should be provided.

2) If the altitude is above 1000 meters, the inverter should be derated by 1% for every 100m rise.

 If the carrier frequency is greater than the factory setting, the ivnerter should be derated by 5% for every 1kHz increase.

2 Specifications

2.1 Common specifications for SB70G series

	Item	Description					
Input	Rated voltage and frequency	3-phase: 380V, 50/60Hz					
1	Allowable range	Voltage: 320 ~ 420V; voltage imbalance < 3%; frequency:47 ~ 63 Hz					
	Output voltage	3-phase, $0V \sim$ input voltage, with the error less than 5%.					
output	Output frequency	V/F control: 0.00 ~ 650.00Hz					
	range	Vector control: 0.00 ~ 200.00Hz					
	Motor control mode	V/F control without PG, V/F control with PG, vector control without PG, vector control with PG, V/F separate control					
	Steady-state speed	Vector control without PG: $\leq 1 \%$					
	precision	Vector control with PG: $\leq 0.02\%$					
	Starting torque	Not less than 150% of rated torque at 0.50Hz					
	Overload capacity	150% of rated current for 1 minute					
	Frequency resolution	Digital reference: 0.01Hz Analog reference: 0.1% of max. frequency					
	Output frequency	Analog reference: :±0.2% of max. frequency ($25{\pm}10{\square}$)					
	precision	Digital reference: 0.01Hz ($-10 \sim +40$)					
_	Command source	Keypad, terminal and communication. They can be switched over by terminals					
	Frequency	Keypad, communication, UP/DOWN value, AI1, AI2, PFI and					
	Auxiliary	Achieves flevible frequency setting					
	frequency reference	Achieves nextole nequency setting					
	Torque boost	Auto or manual torque boost					
Basic	V/F curve	User defined V/F, linear V/F and 5 reduced-torque curves					
specifications	Accel/decel	Linear or S-curve acceleration/deceleartion					
	Jog	Jog freuqnecy: 0.10 ~ 50.00Hz					
		Jog accel/decel time: $0.1 \sim 60.0s$					
	Auto energy saving	V/F curve is optimized automatically based on the load condition, achieving auto energy-saving run					
	AVR	Keeps the output voltage constant automatically when the voltage of power arid fluctuates					
	Auto carrier	Carrier frequency is regulated automatically based on the load					
	regulation	characteristic and ambient temperature					
	Random PWM	Regulates the tone of the motor noise					
	Droop control	Applicable to cases where multiple inverters drive the same load					
	Momentary power failure	Ensures uninterrupted operation by controlling the DC link voltage					
	Dynamic braking	Built-in braking unit and external braking resistor for models of 15kW or less					
	DC hashing	Braking time: 0.0 ~ 60.0s					
	DC braking	Braking current: 0.0 ~ 100.0% of rated current					
	PFI	Highest input frequency: 50kHz					

	PFO	Open-collector pulse(square wave) output of $0 \sim 50$ kHz, programmable				
	Analog input	2 channels of analog input, voltage or current type, positive or negative				
	Analog output	2 channels of analog output, $0/4 \sim 20$ mA or $0/2 \sim 10$ V, programmable				
	Digital input	8 channels of optional multi-function digital input(leakage/source type)				
	Digital output	2 channels of optional multi-function digital output(leakage/source type); 2 channels of multi-function relay output				
	Communication	Bulti-in RS485 port, supporting Modbus protocol and USS commands				
	Process PID	Two sets of PID parameters; multiple correction modes; free PID function				
	Multiple PLC modes	User can set 8 PLC run modes, with each having up to 48 stages. The mode can be selected by terminals. PLC status can be saved at power failure.				
	Multi-speed select mode	4 selection modes. Refer to F4-17				
	User defined menu	30 user parameters can be defined				
Charactoristia	Parameter display change	Can display parameters different from the default ones				
functions	Toreque control	Torque/speed control can be switched by terminals. Multiple torque setting modes.				
	Zero-servo	Zero-speed position can be locked				
	High-speed UP/DOWN counter	Synchronous control, counting in production, stop contol by count and precise position control can be realized				
	High-speed meter counter	Stop control by length and length indication can be achieved				
	Wobble	Ensures even winding of textiles				
	Programmable unit	Comparator, logic unit, trigger, arithmetic unit, filter, multiple-way switch, timer				
	kWh meter timer	For adjustment of optimal energy saving strategy				
Prote	ction functions	Overcurrent, overvoltage, undervoltage, input/output phase loss, output short-circuit, overheating, motor overload, external fault, analog input disconnection, stall prevention, etc.				
Options		Braking unit, remote control box, digital I/O expansion board, encoder interface board, analog input expansion board, keypad with copying function or potentiometer, keypad mounting box, keypad extension line,I/O reactor, EMI filter, Profibus-DP module, etc.				
	Service site	Altitude less than 1000 meters; indoor; no direct sunlight; free of dust, corrosive gases, inflammable gases, oil mist, water vapor, water drops, salt mist, etc.				
Ambient	Temperature/humid	$-10 \sim + 40^{\circ}C/20 \sim 90$ %RH, no condensation				
	Storage temperature	$-20 \sim + 60^{\circ}C$				
	Vibration	Less than 5.9m/s^2 (0.6g)				
Structure	Protection degree	IP20				
Suuciare	Cooling method	Forced air cooling, with fan control				

2.2 SB 70 Product series

200V class:

Model	Rated capacity (kVA)	Rated output current(A)	Applicable motor (kW)
SB70G0.55D2	1.1	3	0.55
SB70G0.75D2	1.9	5	0.75
SB70G1.5D2	3.1	8	1.5
SB70G2.2D2	4.2	11	2.2
SB70G4T2	6.9	18	4
SB70G5.5T2	9.9	26	5.5

400V class

Model	Rated capacity (kVA)	Rated output current (A)	Applicable motor (kW)	model	Rated capacity (kVA)	Rated output current (A)	Applicable motor (kW)
SB70G0.4	1.1	1.5	0.4	SB70G45	60	91	45
SB70G0.75	1.6	2.5	0.75	SB70G55	74	112	55
SB70G1.5	2.4	3.7	1.5	SB70G75	99	150	75
SB70G2.2	3.6	5.5	2.2	SB70G90	116	176	90
SB70G4	6.4	9.7	4	SB70G110	138	210	110
SB70G5.5	8.5	13	5.5	SB70G280	342	520	280
SB70G7.5	12	18	7.5	SB70G315	389	590	315
SB70G11	16	24	11	SB70G375	460	705	375
SB70G15	20	30	15	SB70G400	490	760	400
SB70G18.5	25	38	18.5	SB70G450	550	855	450
SB70G22	30	45	22	SB70G500	610	950	500
SB70G30	40	60	30	SB70G560	680	1040	560
SB70G37	49	75	37	SB70G630	765	1180	630
SB70G132	167	253	132	SB70G700	850	1320	700
SB70G160	200	304	160	SB70G800	970	1520	800
SB70G200	248	377	200	SB70G900	1090	1710	900
SB70G220	273	415	220	SB70G1000	1210	1900	1000
SB70G250	310	475	250	SB70G1100	1330	2080	1100

Outline drawings of model type less than SB70G2.2D2 and SB70G4T4 (can be DIN rail mounted):



Outline drawings of SB70G4T2, SB70G5.5T2, SB70G5.5T4 ~ SB70G15T4 walling single models:



2 SPECIFICATIONS



Outline drawing of SB70G18.5(or more) models:

Outline drawing of SB70G400(or more) cabinet single models:



Outline drawing of SB70G800(or more) cabinet in paralling models:





Outline dimensions and weights of SB70G series inverters:

200V Class

Model	W (mm)	H (mm)	H1 (mm)	D (mm)	A (mm)	B (mm)	d (mm)	Construction	Weight (kg)
SB70G0.55D2	100	190	105	157	075	170	6 45		2
SB70G0.75D2	100	160	105	137	07.5	170	Ψ4.5		2
SB70G1.5D2	125	240	140	170	125	220	6 45	Walling	2
SB70G2.2D2	155	240	140	170	125	230	Ψ4.5	single	5
SB70G4T2	150	300		105	128	266	6 55		7
SB70G5.5T2	150	500	-	195	138	200	Ψ5.5		/

400V Class

Model	W (mm)	H (mm)	H1 (mm)	D (mm)	A1 (mm)	A (mm)	B (mm)	d (mm)	Construction	Weight (kg)
SB70G0.4										
SB70G0.75	100	180	105	157	-	87.5	170	Ф4.5		2
SB70G1.5										
SB70G2.2	125	240	140	170		125	220	Φ 1.5		3
SB70G4	155	240	140	170	-	125	250	Ψ4.5		3
SB70G5.5	150	200		105		128	288	م ر د		7
SB70G7.5	150	300	-	195	-	158	200	Ψ3.5		/
SB70G11	200	380		225		185	367	ሰ 7		10
SB70G15	200	580	_	223	_	105	507	Ŷ	_	10
SB70G18.5	290	460	430	265		200	448	መ7		23
SB70G22	270	400	450	205	-	200	Ψ/	Ψ	_	25
SB70G30	310	514	480	265	-	246	500	Φ7		33
SB70G37	270	570	520	200		200	551	4 0	Walling	40
SB70G45	370	570	330	200	-	300	554	Ψ9	single	48
SB70G55	380	610	560	300	-	250	590	Φ10		58
SB70G75	440	686	650	320	-	300	670	Φ10		82
SB70G90	490	700	720	245		250	7(0	4 10		112
SB70G110	480	/80	/30	345	-	350	/60	Ψ10		113
SB70G132	520	810	760	360	-	350	788	Ф12		130
SB70G160	500	080	020	270		250	055		1	200
SB70G200	590	980	920	370	-	330	955	Ψ^{14}		200
SB70G220	640	1020	060	280		430	005	መ 14		220
SB70G250	040	1020	900	300	-	430	993	Ψ^{14}		230
SB70G280	720	1100	1030	405		450	1068	ሰ 17		268
SB70G315	/20	1100	1050	403	-	450	1008	Ψ^{1}		200

2 SPECIFICATIONS

Model	W (mm)	H (mm)	H1 (mm)	D (mm)	A1 (mm)	A (mm)	B (mm)	d (mm)	Construction	Weight (kg)
SB70G375	820	1250	1180	405	-	500	1218	Φ17		300
SB70G400										600
SB70G450	1000	2200	-	600	-	840	507	Φ14	Cabinet Singal	630
SB70G500										650
SB70G560	Customer defined									
SB70G630	720	1100	1030	405	-	450	1068	Φ17	Walling in	536
SB70G700	820	1250	1180	405	-	500	1218	Φ17	parallel	600
SB70G800										1210
SB70G900	2000	2200	-	600	160	840	507	507 Φ14	cabinet in parallel	1270
SB70G1000										1320
SB70G1100	0 Customer defined									
Note	: Walling	g in paral	lel mode	l can be no	oted one l	box dimen	sion			

3 Installation and wiring

3.1 Installation

	 The installation of the inverter can be performed only by qualified professionals. Do not install and run the inverter if there is any damage on the
A DANGER	 inverter or any part is missing, otherwise there may be a risk of fire and injury. 3. Install the inverter on a firm support that can bear its weight, otherwise the inverter may fall and cause damage or injury. 4. Do not apply force on the keypad or cover board while handling the inverter, otherwise the falling of keypad or cover board may cause damage or injury.

The inverter should be installed in a room with good ventilation. The installing environment should meet the following requirements:

- Ambient temperature: -10 ~ 40°C. If the temperature exceeds 40°C, derate the inverter by 5% for every one-degree increase in temperature and apply external forced cooling.
- 2. Altitude: not greater than 1000m. If the altitude exceeds 1000m, derate the inverter by 1% for every 100-meter increase in altitude.
- 3. Humidity: less than 90% RH, no condensation.
- 4. Vibration: less than 5.9m/s^2 (0.6 g)
- 5. Avoid installing it at a place with direct sunlight
- 6. Avoid installing it at a place with much dust and metal powder
- 7. Never intall it at a place with corrosive and inflammable gases
- 8. The inverter should be installed vertically instead of upside down, slantways or horizontally, and fixed to a firm structure with screws. To ensure cooling effect, sufficient space should be maintained around the inverter, as shown below(a partition board should be provided in between if two inverters are installed in a vertical row).



3.2 Removal and installation of parts

3.2.1 Removal and installation of keypad

Removal: press the spring piece on top of the keypad and pull out.

Installation: push the keypad in with the slot on its bottom aligning with the stopper on the mounting box.



3.2.2 Installation of keypad on cabinet front cover

The keypad of an SB70G inverter can be taken off from the inverter and installed on the front cover of the cabinet, with the keypad and inverter connected by the extension line. You can choose any one of the following two installing methods.

Method 1: direct installation

- □ Make an opening on the front cover of the cabinet according to the following drawing.
- □ Take off the keypad and the two screws on the diagonal of the keypad. Fix the keypad to the front cover with the two M3×14 screws shipped with the product.
- □ Insert one end of the extension line into the keypad and fix it with the fastener shipped with the product. Insert the other end of the extension line into the corresponding slot on the inverter circuit board and lock it. Close the cover board of the cabinet.

Holes for installing keypad



• Method 2: installation via the mounting box

- □ Make an opening on the front cover of the cabinet according to the following drawing.
- □ Install the mounting box(option) onto the front cover.
- □ Install the keypad into the mounting box.
- □ Insert one end of the extension line into the keypad and the other end into the corresponding slot on the inverter circuit board, and lock the line. Close the cover board of the cabinet.



3.3 Wiring

A DANGER

- 1. Wiring of the inverter can be performed only by qualified professionals.
- 2. Before opening the cover board of the inverter, cut the power supply and wait for at least five minutes after all indicators on the keypad go out.
- 3. The wiring inside the inverter can only begin after the internal high-voltage indicator of the inverter goes out or the voltage between terminals P+ and N-(measured with voltmeter) is less than 36V.
- 4. The inverter must be earthed reliably, otherwise there may be a risk of electric shock or fire.
- 5. Shorting P+ and N- is prohibited. That may cause fire or damage to properties.
- 6. Connecting the power line with U, V or W is prohibited.
- 7. The inverter has passed the voltage resistance test before it is shipped from the factory; the users need not do this test again.
- 8. Before turning on the power verify the rated input voltage of the inverter is consistent with the voltage of the AC power supply, otherwise injury to people or damage to equipment may occur.
- 9. All terminals must be securely connected.

10. The output terminals U, V and W must be connected in strict phase order. Connecting surge absorbing capacitors or voltage-dependent resistors on the output side of the inverter is prohibited.

3.3.1 Wiring and configuration of main circuit terminals

The inverter and its peripherals are connected as follows:



We recommend you to choose the following air switches and main circuit wirings(copper-core insulation wires):

T	Aire	Main circuit	Terrer de la constant	Aire	Main circuit
Inverter model	switch(A) wiring (mm ²)		Inverter model	switch(A)	wiring(mm ²)
SB70G0.4 ~ 1.5	16	2.5	SB70G75 ~ 90	315	60
SB70G2.2 ~ 4	20	4	SB70G110~132	400	90
SB70G5.5 ~ 7.5	40	6	SB70G160	500	120
SB70G11 ~ 15	63	8	SB70G200	630	180
SB70G18.5 ~ 22	100	10	SB70G220	630	210
SB70G30	125	16	SB70G250 ~ 280	850	240

3 INSTALLATION AND WIRING

		1			
SB70G37	160	25	SB70G315	1000	270
SB70G45 ~ 55	200	35	SB70G375	1200	400

Basic wiring diagram is shown as below:



Symbol	Terminal name	Description
R, S, T	Power input terminal	To 3-phase 380V power supply
U, V, W	Inverter output terminal	To 3-phase motor
P1, P +	DC reactor terminal	Connect an external DC reactor(shorted by a bar if reactor is not used)
P + , N-	DC bus terminal	Connect a braking unit, common DC bus or external rectifying unit. Contact us for the usage of the common DC bus.
DB	Braking output terminal	Braking resistor is connected between P + and DB
PE	Grounding terminal	Connect the inverter case to earth.

Description of main circuit terminals:

Arrangement of main circuit terminals:

SB70G0.4 ~ 1.5: (PE is located at the bottom right corner of the bottom board)



SB70G2.2 ~ 15:

N-	P+	DB	R	S	Т	U	V	W	PE
----	----	----	---	---	---	---	---	---	----

SB70G18.5 or more:

Cabinet top Cabin						net bottom	n		
PE	R	S	Т	P1	P+	N-	U	V	W

To prevent the mutual coupling generating disturbance, the control cables, power cables and motor cables must be laid apart as far as possible, especially when the cables are run in parallel to a long distance. If the control cables must cross the power ones, run them at right angles.



The longer the motor cables or the larger the section area of motor cables, the larger the ground capacitance, and the stronger the mutual coupling and disturbance. Therefore, the cables with specified section area and minimum length should be used.

Recommended grounding methods:



Incorrect grounding methods:



Control board terminals, jumpers and wirings 3.3.2

Functions of control board jumpers:

Symbol	Name	Function and setting				
CJ1	AI2	AI2 input type selection V: voltage type mA: current type	V			
CJ2	AI1	All input type selection V: voltage type mA: current type	V			
CJ3	AO2	AO2 output type selection V: 0~10V voltage signal mA: 0/4~20mA current signal	V			
CJ4	AO1	AO1 output type selection V: 0~10V voltage signal mA: 0/4~20mA current signal	V			

Arrangement of control board terminals(1mm² copper wires recommended as the terminals wirings):

	$\begin{array}{c} \begin{array}{c} \begin{array}{c} \end{array} \\ \end{array} \\ \end{array} \\ \end{array} \\ \end{array} \\ \begin{array}{c} \end{array} \\ \end{array} \\ \end{array} \\ \begin{array}{c} \end{array} \\ \end{array} \\ \end{array} \\ \end{array} \\ \begin{array}{c} \end{array} \\ \end{array} \\ \end{array} \\ \end{array} \\ \begin{array}{c} \end{array} \\ \end{array} \\ \end{array} \\ \end{array} \\ \begin{array}{c} \end{array} \\ \end{array} \\ \end{array} \\ \end{array} \\ \begin{array}{c} \end{array} \\ \end{array} \\ \end{array} \\ \end{array} \\ \begin{array}{c} \end{array} \\ \end{array} $
	$ \begin{array}{cccccccccccccccccccccccccccccccccccc$
2TA 2TC 2TB 1TA 1TC 1TB	Y1 COM X1 X2 X3 X4 X5 X6 PFO GND A01 A12 GND +10V Y2 COM OVY P12 OVK COM REV FV0 24V PFI A02 A11 485-485+

Functions of control board terminals:

Symbol	Name	Function and description	Specification	
485+	485 differential signal (positive)485 differential signal	RS485 communication port	Connect 1~32 RS485 station(s) Input impedance: > $10k\Omega$	
485-	(negative)		r ···· r ···· ·	
GND	Ground	Grounding terminal for analog I/O, PFI, PFO, communication, +10V or 24V power	Its inside is isolated from COM, CMX and CMY	
+10V	+10V reference power supply	+10V power supply offered to user	Max. output current is 15mA, with the voltage accuracy better than 2%	
PFO	Pulse frequency output	Refer to F6-25	0~50 kHz, open collector output Specification: 24V/50mA	
			$0{\sim}50$ kHz, with input impedance of 1.5 k Ω	
PFI	Pulse frequency input	Refer to F6-22 ~ 24	Hight level: >6V	
			Low level: $< 3V$	
			Max. input voltage: 30V	
AO1	Multi-function analog output 1	Refer to F6-14 and F6-18 Jumpers CJ4 and CJ3 are used to	Current type: $0 \sim 20 \text{mA}$, load $\leq 500\Omega$ Voltage type: $0 \sim 10 \text{V}$, output $\leq 10 \text{mA}$	
AO2	Multi-function analog output 2	select the output type(voltage or current type)		
24V	24V power terminal	24V power supply offered to user	Max. output current: 80mA	
AI1	Analog input 1	Refer to F6-00 and F6-07 Jumpers CJ1 and CJ2 are used to	Input voltage: - 10~+10V Input current: - 20~+20mA	
AI2	Analog input 2	select the output type(voltage or current type)	Input impedance: $110k\Omega$ for voltage input, 250Ω for current input	
X1	X1 digital input terminal			
X2	X2 digital input terminal		Onto isolation	
X3	X3 digital input terminal		Bi-directional input available Input impedance: $\ge 3k\Omega$	
X4	X4 digital input terminal	Defer to E4	Input voltage: < 30V Sampling period: 1ms	
X5	X5 digital input terminal	Kelei 10 F4	High level: voltage difference (relative to CMX) greater than	
X6	X6 digital input terminal		10V Low level: voltage difference	
REV	REV digital input terminal		(relative to CIVIA) less than 3 V	
FWD	FWD digital input terminal			

3 INSTALLATION AND WIRING

CMX	Digital input common terminal	Common terminal for X1~X6, FWD and REV	Its inside is isolated from COM and P12. CMX and its adjacent P12 are shorted before shipment from the factory.	
P12	12W nower terminal	12V power supply offered to user	Max output ourrant: 80m A	
COM	12 v power terminar	Ground of 12V power	Max. output current. soniA	
Y1	Y1 digital output terminal	Defer to F5	Opto-isolated, bi-directional, open collector output	
Y2	Y2 digital output terminal		Specification: 24V DC/50mA Action frequency: < 500Hz	
СМҮ	Common terminal of Y1 and Y2	Common terminal of Y1 and Y2 digital output	Start-up voltage: < 2.5V(relative to CMY) CMY and COM are shorted before shipment from the factory.	
1TA				
ITB	Relay I output		TA TP: normally on on	
ITC	terminur	Defer to E5	TB-TC: normally closed	
2TA		Kelei to F5	Contacts: 250V AC/3A	
2TB	Relay 2 output		24V DC/5A	
2TC	terminar			

1) Wiring of analog input terminals

When analog signals are used for remote control, the control wires between the controller and inverter should be less than 30 meters in length. And since the analog signal is vulnerable to interference, the analog control wires should be laid apart from strong-electricity, relay or contactor circuit. The wiring should be shielded twisted pair cable and be as short as possible, with one of its end connected to the terminal GND of the inverter.

2) Wiring of multi-function input(X1~X6, FWD, REV) and output(Y1, Y2) terminals

SB70G has two types of logic for its multi-function input and output terminals: leakage and source. Therefore, the interfacing is easy and flexible.

The typical connections for multi-fucntion input and output terminals are shown below:

	Leakage-type logic	Sour ce-t ype I ogi c
Use internal power	Peripherals	Peripherals Perip
Use external power(remove shorting bar)	Peripherals	Peripherals

Connection of multi-function input terminals to peripherals

Connection of multi-function output terminals to peripherals



3) Wiring of relay output terminals(TA, TB, TC)

If an inductive load, such as electromagnetic relay, contactor and electromagnetic brake, is driven, a surge voltage absorbing circuit, voltage-dependent resistor or continuous current diode(used in DC electromagnetic

circuit. Be careful of the polarity during installation) should be installed. The components of the absorbing circuit should be installed near the sides of the winding of the relay or contactor, as shown below.



3.4 Methods of suppressing electromagnetic interference

1	Countermeasures	against	electromagnetic	interference
1.	Countermeasures	agamsi	electromagnetic	interference

Interference source	Countermeasure			
Leakage current Ground loop	When peripheral devices form a closed circuit through the wiring of the inverter, the leakage current from the earthing line of the inverter will cause false action of devices. To reduce false action, you may leave devices unearthed.			
Power cables	When peripheral devices share the same power supply with the inverter, the interference generated by the inverter will transmit along the power line, causing false action of other devices in the same system. Follwing measures can be taken: (1) Install an EMI filter or ferrite common-mode filter(magnetic ring) on the input side of the inverter. (2) Isolate noise of other devices with an isolation transformer or power supply filter.			
Motor cable radiation Power cable radiation Inverter radiation	 As measuring meters, radios, sensors or signal lines are installed in the same cabinet with the inverter, they are easy to be interfered with and act falsely. Follwing measures can be taken: (1) Install devices and signal lines which are easily affected as far as possible away from the inverter. The signal lines should be shielded wires and be earthed. They should be run in metal conduits, and be as far as possible away from the inverter and its input/output lines. If the signal lines have to cross the power cables, keep them at right angles. (2) Install an EMI filter or ferrite common-mode filter(magnetic ring) on both input and output side of the inverter. (3) Motor cables should be laid in a thick shield, such as conduits(over 2mm) or cement tubes. The power cables should be run in metal conduits and be shielded and earthed(the motor cable is a 4-core cable, one end of which is connected to earth one the inverter side, while the other end is connected to the motor case). 			

	(1) Avoid running signal lines in parallel with or in the same bundle with the			
	power cables.			
Static induction	(2) Try to keep devices and signal lines subject to disturbance as far as possible			
Electromagnetic induction	n away from the inverter and its input and output lines.			
	(3) Use shield wires as the signal lines and power cables and lay them in separate			
	metal conduits, with the space between the two conduits being at least 20cm.			

2. Countermeasures against leakage current

Leakage current is generated due to the existence of capacitance between inverter input/output cables and earth, between lines and between the motor and earth. The size of the leakage curren, including earth leakage current and inter-line leakage current, is determined by the size of the distributed capacitance and carrier frequency.

Sources of leakage current:



Earth leakage current

The leakage current may flows into not only the inverter system, but also other devices via the earth line, causing false action of the leakage circuit breaker, relay or other devices. The higher the carrier frequency and the longer the motor cables, the larger the leakage current.

Suppression measures: (1) Lower the carrier frequency, but that will increase the motor noise; (2) Minimize the length of the motor cables; (3) Use a leakage circuit breaker specially designed for higher harmonics and surge leakage current.

Inter-line leakage current

The higher harmonics of the leakage current from the inter-line distributed capacitance on the inverter output side may lead to false action of the external thermal relay, especially when the inverter has a small capacity and the wiring is very long(over 50m). Therefore we recommend you to use a temperature sensor to monitor the motor temperature directly or use the inverter's motor overload protection function to replace the external thermal relay.

Suppression measures: (1) Lower the carrier frequency; (2) Install a reactor on the output side.

4 Operation and commissioning

4.1 Operation and display

4.1.1 Functions of keypad

The keypad is used to set or browse parameters, control operations, display error information and so on. It has a standard configuration SB-PU70 and two optional configurations SB-PU03(with potentiometer) and SB-PU70E(with copying function). The appearance of the keypad is as follows.



Description of keys on the keypad:

Key	Name	Function		
	Menu/Exit	Return to previous menu; enter/exit monitoring status		
	Enter	Enter next menu; save parameter; clear alarm information		
	UP	Increasing number or data		
	DOWN	Decrease number or data		
	Shift	Select the data digit to be modified; switch between monitored parameters		
	Direction	Set run direction. This key is invalid if the hundreds digit of FC-01 is set to 0.		
	Run	Run command		
\bigcirc	Stop/Reset	Stop, fault reset		

Indicators	Unit	Description
●-kw-○-r/min-○-m/s-○ A V Hz %	Α	Ampere
$O-kW - \mathbf{O}-r/min - O-m/s - O$ A V Hz %	v	Volt
$\bigcirc -kW - \bigcirc -r/minm/s - \bigcirc Hz$	Hz	Hertz
⊖−kw−⊖−r/min−⊖−m/s− A V Hz %	%	Percent
$ A^{-kW} - \bullet^{-r/min} - \bigcirc^{-m/s} - \bigcirc^{-m/s} + V^{-kW} + Iz $	kW	Kilowatt (indicators A and V are on)
$O-kW - \mathbf{O} - r/min - \mathbf{O} - m/s - O$ A V Hz %	r/min	Revolution/minute (indicators V and Hz are on)
A V Hz $%$	m/s	Meter/second (indicators Hz and % are on)
A - kW - \bullet - r/min- \bullet - m/s- \bigcirc Hz %	Length	Meter or millimeter (indicators A, V and Hz are on)
⊖−kw−●−r/min−●−m/s−● A V Hz %	Time	Hour, minute, second or millisecond (indicators V, Hz and % are on) $% \left({{{\rm{A}}_{{\rm{A}}}}_{{\rm{A}}}} \right)$

Meanings of unit indicators:

Meanings of status indicators RUN, REV and EXT:

Indicator	Status	Inverter state
	Off	Standby state
RUN indicator	On	Stable run state
	Blinking	Accelerating or decelerating state
REV indicator	Off	Both preset and current direction are forward
	ON	Both preset and current direction are reverse
	Blinking	Preset direction is inconsistent with current direction
EXT indicator	Off	Keypad control
	ON	Terminal control
	Blinking	Communication control
Potentiometer indicator	ON	Indicator is on when F0-01=10

4.1.2 Display status and operation of keypad

The keypad of SB70G has the following display status: monitoring status(including in standby state and in run state), parameter editing status, fault display status, alarm display status, etc.



Monitoring status in standby state

Pressing (<<) in this status cyclically displays the standby-state parameters(defined by FC-02 ~ FC-08).

Monitoring status in run state

Pressing () in this status cyclically displays the run-state parameters(defined by FC-02 ~ FC-12).

Parameter editing status

In monitoring status, pressing () enters the editing status, which contains three level menus: parameter group number—serial number in parameter group—parameter value. Pressing () enters the next menu and pressing () returns to the previous menu(returns to monitoring status if at the first level menu). Pressing () and () change the parameter group numbers, serial numbers in parameter group or parameter values. Under the third level menu, the digit which can be edited blinks. Pressing ()switches the digit to be edited to another digit, and pressing () saves the modified data and returns to the second level menu, and the next parameter is displayed.

When FC-00=1(only user parameters are displayed) or 2(only parameters different from default values are displayed), the first level menu doesn't appear, so that the user operation can be faster.

Password check status

If there is a user password(F0-15 not equal to zero), before you can edit any parameter you enter the password check status and "-----" is displayed. Input the password with $(\)$, $(\)$ and (<<)

("-----" is displayed during input) and press ((MIX). If the password is not correct, "Err" blinks.
At this moment, press **(*)** returning to the password check status and press **(*)** again exiting the password check status.

In the monitoring status following the right password is input, if () + () are pressed or

there is no any keystroke within two minutes, the password protection will take effect automatically.

When FC-00=1, the user parameters are not under the password protection, but modifying FC-00 needs the user password.

Fault display status

Once the inverter detects a fault signal, the keypad enters the fault display status, and the error code

blinks.The fault can be reset by inputting reset command(((O)) key, control terminal or communication

command). If the fault still exists, the error code continues to blink, during this period you can modify related parameters to eliminate the fault.

Alarm display status

When the inverter detects the alarm information, the alarm code blinks. If there are multiple alarm signals, the alarm codes display alternately. The alarm information can be temporarily hidden by pressing Pressing

(**X**) or (. The alarm signal is automatically removed if normal state is recovered. The inverter does not stop in alarm display status.

Other display status

Display information	Description
UP	Parameters are being uploaded
dn	Parameters are being downloaded
СР	Parameters are being compared
Ld	Default values are being recovered
yES	Parameters compared are consistent

4.2 Switching on the power for the first time

Connect the wires in accordance with the technical requirements specified in section 3.3.

After checking the wiring and power supply, close the air switch of the AC power on the inverter input side. "8.8.8.8." will fist be displayed on the keypad of the inverter. When the contactor inside the inverter is closed normally, the display becomes the reference frequency. This shows the inveter initialization has been completed. If anything unusual occurs when the power is turned on, disconnect the air switch and check and remove the error.

4.3 Quick commissioning

4.3.1 Setting of common parameters

1. Control mode: select the control mode according to the application conditions and requirements. Refer to F0-12.

2、 Frequency setting channel and reference frequency: refer to F0-01.

3、 Command source: refer to F0-02.

4. Maximum frequency, upper-limit frequency and lower-limit frequency: refer to F0-06, F0-07 and F0-08.

5、 Motor run direction: refer to F0-09.

6, Accel/decel time: the accel/decel time should be as long as possible. Too short time will cause overcurrent or overlarge torque which damages the load.

7. Start and stop mode: refer to F1-19 and F1-25.

8. Motor nameplate parameters: rated power, motor pole number, rated current, rated frequency, rated speed and rated voltage. Refer to section 6.11.

9. Motor overload protection: refer to Fb-00, Fb-01 and Fb-02.

4.3.2 Quick commissioning for V/F control

The method of quick commissioning for V/F control without PG is described below. For V/F control with PG, the encoder-related parameters need to be set, too, refer to to section 6.14.

1、 V/F curve setting: refer to F2-00.

2, Torque boost selection: refer to F2-01~F2-04.

Motor auto tuning: refer to FA-00. For V/F control, just set FA-00 to 11(standstill auto-tuning).
 Optimization of V/F control:

1, F2-09 is used to eliminate the vibration when the motor drives a light load. If vibration occurs, increase the value of F2-09 gradually until the vibration disappears.

2. If the current at the start is too large, reduce the value of F2-02.

3. It is recommended to boost the torque automatically(F2-01=2) in order to increase the inverter's starting torque and its output torque at low speeds. To use the function of "auto torque boost", the motor nameplate parameters need to be set appropriately and the motor standstill auto-tuning be performed.

4. Slip compensation can ease the speed drop caused by the load. It is only valid when "auto torque boost" is valid. Parameters of F2-05 and F2-06 need to be set. And F2-07 and F2-08 can be set, too.

4.3.3 Quick commissioning for vector control

The method of quick commissioning for vector control without PG is as follows. For vector control with PG, the encoder-related parameters need to be set, too, refer to to section 6.14.

1. Adjust the parameter F3-22, making the motor no-load current at low speeds(non flux-weakening region)under vector control approximately equal the motor no-load current.

2. The motor auto-tuning(without load) needs to be performed for vector control. If it is impossible to perform it, the motor parameters must be manually input, including FA-08, FA-09, FA-10 and FA-11. ;

3. Setting of the speed regulator: refer to section 6.4.

5 Parameter table

Note: In the "Change" column of the table below, "O" indicates the parameter can be changed in any state, "×" indicates the parameter is only changeable in running state, while "□" indicates the parameter is read only.

F0: Basic Parameters

No.	Name	Setting range	Default	Change
F0-00	Digital reference frequency	0.00Hz ~ F0-06	50.00Hz	0
F0-01	Main reference channel	0: F0-001: Communication2: UP/DOWN value3: AI14: AI25:PFI7: Arithmetic unit 28: Arithmetic unit 39: Arithmetic unit 410: Keypad POT	0	0
F0-02	Command source	0: Keypad 1: Terminal 2: Communication	0	×
F0-03	Frequency holding	 Units digit: selects the frequency saving mode after power failure. 0: Frequency changed via , or or communication is stored in F0-00. 1: Frequency changed via , or or communication is not stored. Tens digit: selects the frequency holding mode in stop state. 0: Frequency changed via , or or communication is retained. 1: Frequency changed via , or or communication is retained. 1: Frequency changed via , or or communication is retained. 	00	0
F0-04	Auxiliary reference channel	0: None1: F0-002: UP/DOWN value3: AI14: AI25: PFI6: Arithmetic unit 17: Arithmetic unit 28: Arithmetic unit 39: Arithmetic unit 4	0	0
F0-05	Auxiliary reference gain	-1.000 ~ 1.000	1.000	0
F0-06	Max. frequency	F0-07 ~ 650.00Hz(V/F control) F0-07 ~ 200.00Hz(vector control)	50.00Hz	×
F0-07	Upper-limit frequency	F0-08 ~ F0-06	50.00Hz	×
F0-08	Lower-limit frequency	0.00Hz ~ F0-07	0.00 Hz	×
F0-09	Direction lock	0: Forward or reverse 1: Forward only 2: Reverse only	0	0

F0-10	Parameter protection	 0: All parameters can be changed except read-only ones 1: All parameters can't be changed except F0-00, F7-04 and F0-10 2: All parameters can't be changed except F0-10 	0	0
F0-11	Parameter initialization	11: Enabled 22: Enabled(except communication parameters)	00	×
F0-12	Motor control mode	0: V/F control without PG 1: V/F control with PG 2: Vector control without PG 3: Vector control with PG 4: V/F separate control	0	×
F0-13	Inverter rated capacity	Minimum unit: 0.01kW	Depends on model	
F0-14	Software version	0.00 ~ 99.99	-	
F0-15	User password	0000 ~ 9999(0000 means no password)	0000	0

F1: Accel/decel, start, stop and jog parameters

No.	Name	Setting range	Default	Change
F1-00	Accel time 1	0.01 ~ 3600.0s		
F1-01	Decel time 1			
F1-02	Accel time 2	Acceleration time: time period over which the		
F1-03	Decel time 2	frequency rises by 50Hz.		
F1-04	Accel time 3	Deceleration time: time period over which the		
F1-05	Decel time 3	frequency drops by 50Hz.		
F1-06	Accel time 4	Note:		
F1-07	Decel time 4	1. Factory setting is 6.0s for models of 22kW	Depends on model	0
F1-08	Accel time 5	or less, and 20.0s for 30kW or more.		
F1-09	Decel time 5	2. The minimum unit of accel/decar time is determined by F1-16.		
F1-10	Accel time 6			
F1-11	Decel time 6			
F1-12	Accel time 7			
F1-13	Decel time 7			
F1-14	Accel time 8			
F1-15	Decel time 8			
F1-16	Accel/decel time minimum unit	0: 0.01s 1: 0.1s	1	0
F1-17	Accel/decel time auto switching point	0.00 ~ 650.00Hz(switched to accel/decel time 8 below this point)	0.00Hz	×
F1-18	Decel time for emergency stop	0.01 ~ 3600.0s. Minimum unit is determined by F1-16.	10.0s	0

F1-19	Starting mode	 0: Start from starting frequency 1: Start from starting frequency after DC braking 2: Start from searched speed 	0	×
F1-20	Starting frequency	0.00 ~ 60.00Hz	0.50Hz	0
F1-21	Starting frequency duration	0.0 ~ 60.0s	0.0s	0
F1-22	Voltage soft start	0: Disable 1: Enabled	1	×
F1-23	DC braking time(at start)	0.0 ~ 60.0s	0.0s	0
F1-24	DC braking current(at start)	0.0 ~ 100.0%(inverter rated current=100%)	0.0%	0
F1-25	Stop mode	0: Slowdown stop 1: Coast stop 2: Slowdown+DC braking 3: Slowdown+holding brake delay	0	0
F1-26	DC braking frequency (at stop)	0.00 ~ 60.00Hz	0.50Hz	0
F1-27	DC braking waiting time (at stop)	0.00 ~ 10.00s	0.00s	0
F1-28	DC braking time(at stop)	$0.0 \sim 60.0$ s(also as the holding brake delay time)	0.0s	0
F1-29	DC braking current(at stop)	$0.0 \sim 100.0$ %(inverter rated current=100%)	0.0%	0
F1-30	Zero-speed delay time	0.0 ~ 60.0s	0.0s	0
F1-31	Accel/decel mode	0: Linear 1: S-curve	0	×
F1-32 F1-33	S-curve accel start-stage time S-curve accel end-stage time	0.01 ~ 10.00s	0.20s	×
F1-34 F1-35	S-curve decel start-stage time S-curve decel end-stage time	0.01 ~ 10.00s	0.20s	×
F1-36	Deadband time	0.0 ~ 3600.0s	0.0s	×
F1-37	Jog frequency	0.10 ~ 50.00Hz	5.00Hz	0
F1-38	Jog accel time	0.1 ~ 60.0s	Depends on model	0
F1-39	Jog decel time	0.1 ~ 60.0s	Depends on model	0

F2: V/F control parameters

No.	Name	Setting range	Default	Change
F2-00	V/F curve	0: Self-defined 1: Linear 2: Reduced-torque V/F curve 1 3: Reduced-torque V/F curve 2 4: Reduced-torque V/F curve 3 5: Reduced-torque V/F curve 4 6: Reduced-torque V/F curve 5	1	×
F2-01	Torque boost	0: No boost1: Manual2: Auto3: Maunal+auto	1	×

F2-02	Manual torque boost level	0.0% ~ maximum value(depends on model). Minimum unit is 0.1%	Depends on model	0
F2-03	Manual torque boost cut-off point	$0.0 \sim 100.0\%$ (F2-12=100%)	10.0%	O
F2-04	Auto torque boost level	0.0 ~ 100.0 %	100.0%	×
F2-05	Slip compensation gain	0.0 ~ 300.0 %	0.0%	0
F2-06	Slip compensation filtering time	0.1 ~ 25.0s	1.0s	×
F2-07	Electromotive slip compensation limit	0 ~ 250%(motor rated slip frequency=100%)	200%	×
F2-08	Regenerative slip compensation limit	$0 \sim 250\%$ (motor rated slip frequency=100%)	200%	×
F2-09	Vibration damping	0~200	Depends on model	0
F2-10	AVR	0: Inactive 1: Active 2: Active except during decel	1	×
F2-11	Auto energy-saving operation	0: Inactive 1: Active	0	0
F2-12	Base frequency	1.00 ~ 650.00Hz	50.00Hz	×
F2-13	Max. output voltage	150 ~ 500V	380V	×
F2-14	V/F frequency F4	F2-16 ~ F2-12	0.00Hz	×
F2-15	V/F voltage V4	$F2-17 \sim 100.0\%(F2-13=100\%)$	0.0%	×
F2-16	V/F frequency F3	F2-18 ~ F2-14	0.00Hz	×
F2-17	V/F voltage V3	F2-19 ~ F2-15(F2-13=100%)	0.0%	×
F2-18	V/F frequency F2	F2-20 ~ F2-16	0.00Hz	×
F2-19	V/F voltage V2	F2-21 ~ F2-17(F2-13=100%)	0.0%	×
F2-20	V/F frequency F1	0.00Hz~F2-18	0.00Hz	×
F2-21	V/F voltage V1	$0.0\% \sim F2-19(F2-13=100\%)$	0.0%	×
F2-22	V/F separate voltage input	0:F2-23 1: AI1 2: AI2 3: UP/DOWN value 4: PFI 5: Arithmetic unit 1 6: Arithmetic unit 2 7: Arithmetic unit 3 8: Arithmetic unit 4	0	×
F2-23	V/F separate voltage digital setting	0.0 ~ 100.0 %	100.0%	0
F2-24	V/F voltage factor	0:100.0% 1: AI1 2: AI2 3: UP/DOWN value 4: PFI 5: Arithmetic unit 1 6: Arithmetic unit 2 7: Arithmetic unit 3 8: Arithmetic unit 4	0	×

No.	Name	Setting range	Default	Change			
F3-00	High-speed ASR proportional gain	0.00 ~ 200.00	5.00	×			
F3-01	High-speed ASR integral time	0.010 ~ 30.000s	1.000s	×			
F3-02	Low-speed ASR proportional gain	0.00 ~ 200.00	10.00	×			
F3-03	Low-speed ASR integral time	0.010 ~ 30.000s	0.500s	×			
F3-04	ASR parameter swithing point	0.00 ~ 650.00Hz	0.00Hz	×			
F3-05	ASR filtering time	0.000 ~ 2.000s	0.010s	×			
F3-06	Accel compensation differential time	0.000 ~ 20.000s	0.000s	×			
F3-07	Torque limit select	0: Determined by F3-08 and F3-09 1: AI1 ×2.5 2: AI2 ×2.5 3: Arithmetic unit 1 ×2.5 4: Arithmetic unit 2 ×2.5 5: Arithmetic unit 3 ×2.5 6: Arithmetic unit 4 ×2.5	0	×			
F3-08	Electromotive torque limit	0.0 ~ 290.0% (motor rated torque=100%)	180.0%	×			
F3-09	Regenerative torque limit	Note: used for vector control only	180.0%	×			
F3-10	ASR output frequency limit	$0.0{\color{black}{\sim}}20.0{\color{black}{\%}}$. Used for PG V/F control only.	10.0%	×			
F3-11	Droop level	0.00 ~ 50.00Hz	0.00Hz	0			
F3-12	Droop starting torque	tarting torque $0.0 \sim 100.0\%$ (motor rated torque=100%)		0			
F3-13	Torque control select	0: Conditionally active(selected by digital input 45) 1: Active	0	×			
F3-14	Torque reference select	0: F3-15 1: AI1×2.5 2: AI2×2.5 3: PFI×2.5 4: UP/DOWN value×2.5 5: Arithmetic unit 1×2.5 6: Arithmetic unit 2×2.5 7: Arithmetic unit 3×2.5 8: Arithmetic unit 4×2.5	0	×			
F3-15	Digital torque reference	-290.0 ~ 290.0% (motor rated torque=100%)	0.0%	0			
F3-16	Torque control speed limit input select	0: Determined by reference frequency 1: Determined by F3-17 and F3-18	0	0			
F3-17	Torque control speed forward limit	/ard 0.00Hz ~ F0-07		0			
F3-18	Torque control speed reverse limit	0.00Hz ~ F0-07	5.00 Hz	0			
F3-19	Torque reference UP/DOWN	0.000 ~ 10.000s	0.020s	×			

F3: Speed, torque and flux control parameters

time

F3-20	Speed/torque control swithing delay time	0.001 ~ 1.000s	0.050s	×
F3-21	Pre-excitation time	0.01 ~ 5.00s	Depends on model	×
F3-22	Flux density	50.0 ~ 150.0%	100.0%	×
F3-23	Low-speed flux boost	0~50%	0%	×
F3-24	Flux-weakening regulator integral time	0.010 ~ 3.000s	0.150s	×
F3-25	Electromotive power limit	0.0 ~ 250.0%(inverter rated power=100%)	120.0%	×
F3-26	Regenerative power limit	0.0 ~ 250.0%(inverter rated power=100%)	120.0%	×

F4: Digital input terminals and multistep speed

No.	Name	Setting 1	Default	Change	
F4-00	X1 terminal	0: No signal 1: Multistep frequency 1 2: Multistep frequency 2 3: Multistep frequency 3	29: PLC mode select 5 30: PLC mode select 6 31: PLC mode select 7 32: Auxiliary reference	1	
F4-01	X2 terminal	4: Multistep frequency 4 5: Multistep frequency 5 6: Multistep frequency 6 7: Multistep frequency 7 8: Multistep frequency 8	disabled 33: Operation interrupted 34: DC braking(at stop) 35: Process PID disabled 36: PID 2	2	
F4-02	X3 terminal	9: Accel/decel time select 1 10: Accel/decel time select 2 11: Accel/decel time select 3 12: External fault input	 37: 3-wire stop command 38: Internal virtual FWD terminal 39: Internal virtual REV 	3	
F4-03	X4 terminal	13: Fault reset 14: Jog forward 15: Jog reverse 16: Emergency stop	terminal 40: Analog reference frequency hold 41: Accel/decel disabled 42: Burn conversed	4	
F4-04	X5 terminal	17: Inverter full disabled 18: Coast stop 19: UP/DOWN increase 20: UP/DOWN decrease 21: UP/DOWN clear	42. Run command switched to terminal/keypad43: Reference frequency switched to AI1	12	×
F4-05	X6 terminal	22: PLC control disabled 23: PLC operation pause 24: PLC standby state reset 25: PLC mode select 1	44: Reference frequency switched to arithmetic unit 145: Speed/torque control	13	
F4-06	FWD terminal	20: PLC mode select 2 27: PLC mode select 3 28: PLC mode select 4	46: Multi-PID select 1 47: Multi-PID select 2 48: Multi-PID select 3 49: Zero-servo command	38	
F4-07	REV terminal		 50: Counter preset 51: Counter clear 52: Meter-counter clear 53: Wobble frequency injection 54: Wobble state reset 	39	
F4-08	FWD/REV mode	0: 1-wire mode(start/stop) 1: 2-wire mode 1(FWD, REV) 2: 2-wire mode 2(start/stop, di 3: 2-wire mode 3(start, stop) 4: 3-wire mode 1(FWD, REV, 5: 3-wore mode 2(run, direction) rection) stop) on, stop)	1	×

F4-09	Input terminal logic 1(positive & negative)	Ten thoudands digit: X5 Thoudands digit: X4 Hundreds digit: X3 Tens digit: X2 Units digit: X1	00000	×
F4-10	Input terminal logic 2(positive & negative)	Hundreds digit: REV Tens digit: FWD Units digit: X6	000	×
F4-11	Digital input terminal anti-jittering time	0 ~ 2000ms	10ms	0
F4-12	UP/DOWN regulation mode	0: Level type(terminal)1: Pulse type(terminal)2: Level type(keypad)3: Pulse type(keypad)	0	0
F4-13	UP/DOWN speed/step	0.01 ~ 100.00(unit is %/s or %)	1.00	0
F4-14	UP/DOWN memory select	0: Stored on power loss 1: Cleared on power loss 2: Cleared at stop and on power loss	0	0
F4-15	UP/DOWN upper limit	0.0 ~ 100.0 %	100.0%	0
F4-16	UP/DOWN lower limit	-100.0 ~ 0.0 %	0.0%	0
F4-17	Multi-speed select mode	0: Binary code1: Direct select2: Sum3: Number	0	×
F4-18 ~ F4-65	Multistep frequenci 1 ~ 48	0.00 ~ 650.00Hz Note: The default values of multistep frequencies 1~48 are their respective frequency code numbers, for example, the default value of the multistep frequency 3 is 3.00Hz.	n.00Hz (n=1 ~ 48)	0

Multistep frequencies 1~48 corresponds to F4-18~F4-65 respectively, as shown below:

n	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Multi-step frequency n	F4-18	F4-19	F4-20	F4-21	F4-22	F4-23	F4-24	F4-25	F4-26	F4-27	F4-28	F4-29	F4-30	F4-31	F4-32	F4-33
n	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
Multi-step frequency n	F4-34	F4-35	F4-36	F4-37	F4-38	F4-39	F4-40	F4-41	F4-42	F4-43	F4-44	F4-45	F4-46	F4-47	F4-48	F4-49
n	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
Multi-step frequency n	F4-50	F4-51	F4-52	F4-53	F4-54	F4-55	F4-56	F4-57	F4-58	F4-59	F4-60	F4-61	F4-62	F4-63	F4-64	F4-65

F5: Digital and relay outputs

No.	Name	Setting range	Default	Change
F5-00	Y1 terminal	0: Inverter ready 36: X3(after positive & negative logic) 1: Inverter running 37: X4(after positive & negative logic) 2: Frequency reach 37: X4(after positive & negative logic) 3: Frequency reach 38: X5(after positive & negative logic) 4: Frequency reach negative logic) 4: Frequency reach negative logic) 5: Fault output 39: X6(after positive & negative logic)	1	×

F5-01	Y2 terminal	6: Holding brake signal 7: Motor load overweight 8: Motor overload 9: Undervoltage lockout 10: External fault trip 11: Fault auto-reset 12: Restart after momentary power failure 13: A larm output	40: X7 (expansion terminal) 41: X8 (expansion terminal) 42: X9 (expansion terminal) 43: X10 (expansion terminal) 44: X11 (expansion terminal)	2	
F5-02	T1 relay output	 Atarm output Reverse runing Stopping Run interruption Keypad control Torque limit Frequency upper limit Frequency lower limit Frequency lower limit 	 ATT (expansion terminal) FWD(after positive & negative logic) REV(after positive & negative logic) Comparator I output Comparator 2 output Logic unit 1 output 	5	
F5-03	T2 relay output	state 22: Running at zero speed 23: Zero servo finished 24:PLC operation 25:PLC operation pause 26:PLC stage finished 27:PLC cycle finished 28: PC digital 1 29: PC digital 2 30: Wobble frequency upper/lower limit 31: Setpoint count reach 32: Designated count reach 33: Meter-counter setpoint lengh reach 34: X1(after positive & negative logic) 35: X2(after positive & negative logic)	50: Logic unit 2 output 51: Logic unit 3 output 52: Logic unit 4 output 53: Timer 1 output 54: Timer 2 output 55: Timer 3 output 56: Timer 4 output 57: Timer 5 output 56: Timer 4 output 57: Encoder A channel 58: Encoder B channel 59: PFI terminal status 60: Virtual revolution-counting pulse 61: PLC mode 1 indication 62: PLC mode 1 indication 63: PLC mode 2 indication 65: PLC mode 3 indication 65: PLC mode 4 indication 66: PLC mode 5 indication 67: PLC mode 6 indication 68: PLC mode 7 indication 68: PLC mode 7 indication 69: Designated count 2 reach 70: Logic unit 5 output 71: Logic unit 6 output	13	
F5-04	Y output logic(positive & negative)	Tens digit: Y2 Units digit: Y1		00	×
F5-05	Frequency reach detection band	0.00 ~ 650.00Hz		2.50Hz	0
F5-06	Frequency reach detection level 1	0.00 ~ 650.00Hz		50.00Hz	0
F5-07	Frequency reach detection hysteresis 1	0.00 ~ 650.00Hz		1.00Hz	0
F5-08	Frequency reach detection level 2	0.00 ~ 650.00Hz		25.00Hz	0
F5-09	Frequency reach detection hysteresis 2	0.00 ~ 650.00Hz		1.00Hz	0

F5-10	Y1 terminal closing delay	0.00 ~ 650.00s	0.00s	
F5-11	Y1 terminal opening delay		0.00s	
F5-12	Y2 terminal closing delay		0.00s	0
F5-13	Y2 terminal opening delay		0.00s	
F5-14	T1 terminal closing delay	0.00 ~ 650.00s	0.00s	
F5-15	T1 terminal opening delay		0.00s	
F5-16	T2 terminal closing delay		0.00s	0
F5-17	T2 terminal opening delay		0.00s	

F6: Analog and pulse frequency terminals

No.	Name	Setting range	Default	Change
F6-00	AI1 input type	 0: 0~10V or 0~20mA(corresponding to 0~100%) 1: 10~0V or 20~0mA(corresponding to 0~100%) 2: 2~10V or 4~20mA(corresponding to 0~100%) 3: 10~2V or 20~4mA(corresponding to 0~100%) 4: -10~10V or -20~20mA(corresponding to -100~100%) 5: 10~-10V or 20~-20mA(corresponding to -100~100%) 6: 0~10V or 0~20mA(corresponding to -100~100%) 7: 10~0V or 20~0mA(corresponding to -100~100%) 	0	0
F6-01	AI1 gain	0.0~1000.0%	100.0%	0
F6-02	AI1 bias	-99.99 ~ 99.99%(10V or 20mA=100%)	0.00%	0
F6-03	AI1 filtering time	0.000 ~ 10.000s	0.100s	0
F6-04	AI1 zero-point threshold	0.0 ~ 50.0 %	0.0%	0
F6-05	AI1 zero-point hysteresis error	0.0 ~ 50.0 %	0.0%	0

F6-06	AI1 disconnection threshold	$0.0 \sim 20.0\%(10V \text{ or } 20\text{mA}=100\%)$ Note: For $2 \sim 10V/4 \sim 20\text{mA}$ or $10 \sim 2V/20 \sim 4\text{mA}$, the internal disconnection threshold is fixed at 10%; for $-10 \sim 10V$ or $-20 \sim 20\text{mA}$, the disconnection test is not performed.	0.0%	0
F6-07	AI2 input type	Same as F6-00	0	0
F6-08	AI2 gain	0.0 ~ 1000.0 %	100.0%	0
F6-09	AI2 bias	- 99.99 ~ 99.99%(10V or 20mA=100%)	0.00%	0
F6-10	AI2 filtering time	0.000 ~ 10.000s	0.100s	0
F6-11	AI2 zero-point threshold	0.0 ~ 50.0 %	0.0%	0
F6-12	AI2 zero-point hysteresis error	0.0 ~ 50.0 %	0.0%	0
F6-13	AI2 disconnection threshold	Same as F6-06	0.0%	0
F6-14	AO1 function	0:Operating frequency24: Arithmetic unit 6 output1: Reference frequency24: Arithmetic unit 6 output2: Output current25: Low-pass filter 1 output3: Output voltageoutput4: Output voltageoutput6: Reference torque26: Low-pass filter 2 	0	Ο

F6-15	AO1 type	0: 0 ~ 10V or 0 ~ 20mA 1: 2 ~ 10V or 4 ~ 20mA 2: 5V or 10mA at the center	0	0
F6-16	AO1 gain	0.0 ~ 1000.0%	100.0%	0
F6-17	AO1 bias	-99.99 ~ 99.99%(10V or 20mA=100%)	0.00%	0
F6-18	AO2 function	Same as F6-14	2	0
F6-19	AO2 type	Same as F6-15	0	0
F6-20	AO2 gain	0.0 ~ 1000.0%	100.0%	0
F6-21	AO2 bias	-99.99 ~ 99.99%(10V or 20mA=100%)	0.00%	0
F6-22	PFI frequency corresponding to 100%	0~50000Hz	10000Hz	0
F6-23	PFI frequency corresponding to 0%	0~50000Hz	0Hz	0
F6-24	PFI filtering time	0.000 ~ 10.000s	0.100s	0
F6-25	PFO function	Same as F6-14	0	0
F6-26	PFO output pulse modulation method	0: Frequency modulation 1: Duty-ratio modulation	0	0
F6-27	PFO frequency corresponding to 100%	0 ~ 50000Hz (also as the duty-ratio modulationfrequency)	10000Hz	0
F6-28	PFO frequency corresponding to 0%	0~50000Hz	0Hz	0
F6-29	PFO duty ratio corresponding to 100%	0.0 ~ 100.0 %	100.0%	0
F6-30	PFO duty ratio corresponding to 0%	0.0 ~ 100.0 %	0.0%	0

F7: Process PID parameters

No.	Name	Setting range	Default	Change
F7-00	PID control select	 0: PID control disabled 1: PID control enabled 2: PID corrects reference frequency prior to accel/decel 3: PID corrects reference frequency after accel/decel 4: PID corrects torque 5: Free PID function 	0	×
F7-01	PID reference channel	0: F7-041: AI12: AI23: PFI4: UP/DOWN value5: Arithmetic unit 16: Arithmetic unit 27: Arithmetic unit 38: Arithmetic unit 4	0	×

F7-02	PID feedback channel	0: AI1 1: AI2 2: PFI 3: AI1 - AI2 4: AI1 + AI2 5: $\sqrt{ AII }$ 6: $\sqrt{ AI2 }$ 7: $\sqrt{ AI1 - AI2 }$ 8: $\sqrt{ AI1 } + \sqrt{ AI2 }$ 9: Arithmetic unit 1 10: Arithmetic unit 2 11: Arithmetic unit 3 12: Arithmetic unit 4	0	×
F7-03	PID display coefficient	0.010 ~ 10.000(only affects FU-13 and FU-14)	1.000	0
F7-04	PID digital reference	-100.0 ~ 100.0%	0.0%	0
F7-05	Proportional gain 1	0.00 ~ 100.00	0.20	0
F7-06	Integral time 1	0.01 ~ 100.00s	20.00s	0
F7-07	Differential time 1	0.00 ~ 10.00s	0.00s	0
F7-08	Proportional gain 2	0.00 ~ 100.00	0.20	0
F7-09	Integral time 2	0.01 ~ 100.00s	20.00s	0
F7-10	Differential time 2	0.00 ~ 10.00s	0.00s	0
F7-11	PID parameter switching	0: By digital input 36 1: According to operating frequency 2: [Arithmetic unit 1] 3: [Arithmetic unit 2] 4: [Arithmetic unit 3] 5: [Arithmetic unit 4]	0	×
F7-12	Sampling period	0.001 ~ 10.000s	0.010s	0
F7-13	Error limit	0.0 ~ 20.0%(PID setpoint=100%)	0.0%	0
F7-14	Setpoint up/down time	0.00 ~ 20.00s	0.00s	0
F7-15	PID regulation characteristic	0: Positive 1: Negative	0	×
F7-16	Integral regulation	0: Disabled 1: Enabled	1	×
F7-17	PID upper limit	F7-18 ~ 100.0%	100.0%	0
F7-18	PID lower limit	-100.0% ~ F7-17	0.0%	0
F7-19	PID differential limit	0.0 ~ 100.0%(limits the max. and min. value of differential component)	5.0%	0
F7-20	PID preset	F7-18 ~ F7-17	0.0%	0
F7-21	PID preset holding time	0.0 ~ 3600.0s	0.0s	×
F7-22	Multi-PID setpoint 1	-100.0 ~ 100.0 %	1.0%	
F7-23	Multi-PID setpoint 2		2.0%	
F7-24	Multi-PID setpoint 3		3.0%	_
F7-25	Multi-PID setpoint 4		4.0%	0
F7-26	Multi-PID setpoint 5		5.0%	
F7-27	Multi-PID setpoint 6		6.0%	

F7-28 Multi-PID setpoint 7

F8: Simple PLC

No.	Name	Setting range	Default	Change
F8-00	PLC operation setting	 Units digit: PLC cycle mode PLC operation disabled N cycles(cycle number decided by F8-02)+stop N cycles+final stage speed (cycle number decided by F8-02) Continuous cycle Tens digit: PLC restart mode Restart from the first stage Restart from the frequency of the interrupted stage Restart from the operating frequency at the moment of interruption Hundreds digit: Whether to save PLC status parameters after power-off Not store Store Thousands digit: Unit of time for each stage Munte 	0000	×
F8-01	PLC mode	Units digit: PLC mode/stage number 0: 1×48, 1 mode, 48 stages 1: 2×24, 2 modes, 24 stages for each mode 2: 3×16, 3 modes, 16 stages for each mode 3: 4×12, 4 modes, 12 stages for each mode 4: 6×8, 6 modes, 8 stages for each mode 5: 8×6, 8 modes, 6 stages for each mode Tens digit: PLC mode select 0: Binary code select 1: Direct select 2~9: Mode 0~7	00	×
F8-02	PLC cycle number	1 ~ 65535	1	×
F8-03 ~ F8-97	Stage(1~48) setting	Units digit: Direction 0: Forward 1: Reverse Tens digit: Accel/decel time select 0: Accel/decel time 1 1: Accel/decel time 2 2: Accel/decel time 3 3: Accel/decel time 4 4: Accel/decel time 5 5: Accel/decel time 6 6: Accel/decel time 7 7: Accel/decel time 8	00	0
F8-04 ~ F8-98	Stage(1~48) time	$0.0 \sim 6500.0$ (second or minute) The time unit is determined by the thousands digit of F8-00	0.0	0

n	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Stage n setting	F8-03	F8-05	F8-07	F8-09	F8-11	F8-13	F8-15	F8-17	F8-19	F8-21	F8-23	F8-25	F8-27	F8-29	F8-31	F8-33
Stage n time	F8-04	F8-06	F8-08	F8-10	F8-12	F8-14	F8-16	F8-18	F8-20	F8-22	F8-24	F8-26	F8-28	F8-30	F8-32	F8-34
Multistep frequency n	F4-18	F4-19	F4-20	F4-21	F4-22	F4-23	F4-24	F4-25	F4-26	F4-27	F4-28	F4-29	F4-30	F4-31	F4-32	F4-33

n	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
Stage n setting	F8-35	F8-37	F8-39	F8-41	F8-43	F8-45	F8-47	F8-49	F8-51	F8-53	F8-55	F8-57	F8-59	F8-61	F8-63	F8-65
Stage n time	F8-36	F8-38	F8-40	F8-42	F8-44	F8-46	F8-48	F8-50	F8-52	F8-54	F8-56	F8-58	F8-60	F8-62	F8-64	F8-66
Multistep frequency n	F4-34	F4-35	F4-36	F4-37	F4-38	F4-39	F4-40	F4-41	F4-42	F4-43	F4-44	F4-45	F4-46	F4-47	F4-48	F4-49
n	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
Stage n setting	F8-67	F8-69	F8-71	F8-73	F8-75	F8-77	F8-79	F8-81	F8-83	F8-85	F8-87	F8-89	F8-91	F8-93	F8-95	F8-97
Stage n time	F8-68	F8-70	F8-72	F8-74	F8-76	F8-78	F8-80	F8-82	F8-84	F8-86	F8-88	F8-90	F8-92	F8-94	F8-96	F8-98
Multistep frequency n	F4-50	F4-51	F4-52	F4-53	F4-54	F4-55	F4-56	F4-57	F4-58	F4-59	F4-60	F4-61	F4-62	F4-63	F4-64	F4-65

F9: Wobble frequency, counter, meter-counter and zero-servo

No.	Name	Setting range	Default	Change				
F9-00	Wobble frequency injection mode	0: Disabled 1: Auto injection 2: Manual injection	0	×				
F9-01	Wobble amplitude control	0: Center frequency=100% 1: Max. frequency=100%	0	×				
F9-02	Preset wobble frequency	F0-08 ~ F0-07	0.00Hz	0				
F9-03	Prese wobble frequency waiting time	0.0 ~ 3600.0s	0.0s	0				
F9-04	Wobble frequency amplitude	$0.0 \sim 50.0$ % (relative to center frequency or Max. frequency)	0.0%	0				
F9-05	Sudden jump frequency	0.0 ~ 50.0 % (actual wobble frequency amplitude=100%)	0.0%	0				
F9-06	Sudden jump time	0 ~ 50ms	0ms	0				
F9-07	Wobble period	0.1 ~ 1000.0s	10.0s	0				
F9-08	Rising time	0.0 ~ 100.0%(F9-07=100%)	50.0%	0				
F9-09	Wobble randomness	0.0~50.0%(F9-07=100%)	0.0%	0				
F9-10	Wobble restart and power-off setting	Units digit: Wobble restart mode afte stop 0: Smooth restart 1: Restart from zero Tens digit: Whether to save the wobble frequency status after power-off 0: Save 1: Not save	00	×				
F9-11	Counter UP command select	Same as F5-00. Selecting digital outputs	57	0				
F9-12	Counter DOWN command select	57~59 can achieve high-speed counting.	58	0				
F9-13	Counter preset value	set value $0 \sim 65535$						
F9-14	Setpoint count	F9-15 ~ 65535	10000	0				

F9-15	Designated count	0 ~ F9-14	0	0
F9-16	Counter frequency-deviding coefficient	1~65535	1	0
F9-17	Meter-counter input command select	Same as F5-00 Selecting digital outputs 57~59 can realize high-speed meter counting.	0	0
F9-18	Meter-counter setpoint length	0 ~ 65535m	1000m	0
F9-19	Meter-counter pulse number per meter	0.1 ~ 6553.5	100.0	0
F9-20	Zero-servo control	0: Invalid 1: Always valid 2: Conditionally valid(selected by digital input 49)	0	×
F9-21	Zero-speed level	0 ~ 120r/min	30r/min	×
F9-22	Zero-servo ending level	1 ~ 10000 pulse(s)	10	0
F9-23	Zero-servo control gain	0.00 ~ 50.00	1.00	×
F9-24 ~ F9-34	Reserved			

FA: Motor parameters

No.	Name	Setting range	Default	Change
FA-00	Auto-tuning	11: Standstill auto-tuning 22: No-load auto-tuning	00	×
FA-01	Motor rated capacity	0.40 ~ 500.00kW	Depends on model	×
FA-02	Pole number	2~48	4	×
FA-03	Motor rated current	0.5~1200.0A	Depends on model	×
FA-04	Motor rated frequency	1.00 ~ 650.00Hz	50.00Hz	×
FA-05	Motor rated speed	125 ~ 40000r/min	Depends on model	×
FA-06	Motor rated voltage	150~500V	380V	×
FA-07	Motor no-load current	0.1A ~ FA-03	Depends on model	×
FA-08	Motor stator resistance	0.00 ~ 50.00%	Depends on model	0
FA-09	Motor leakage reactance	0.00 ~ 50.00%	Depends on model	0
FA-10	Motor rotor resistance	0.00 ~ 50.00%	Depends on model	0
FA-11	Motor mutual reactance	0.0 ~ 2000.0%	Depends on model	0

FA-12	Motor core saturation coefficient 1	1.000 ~ 1.500	1.300	×
FA-13	Motor core saturation coefficient 2	1.000 ~ FA-12	1.100	×
FA-14	Motor core saturation coefficient 3	FA-15 ~ 1.000	0.900	×
FA-15	Motor core saturation coefficient 4	0.500 ~ 1.000	0.700	×

Fb: Protection functions and advanced settings

No.	Name	Setting range	Default	Change
Fb-00	Motor cooling condition	0: Common motor 1: Inverter-controlled motor or motor with separate cooling fan	0	0
Fb-01	Motor overload protection level	50.0 ~ 150.0%(motor rated current=100%)	100.0%	0
Fb-02	Motor overload action	0: No action 1: Contintue running with an alarm 2: Coast to a stop due to fault	2	×
Fb-03	Motor load overweight protection	Units digit: inverter input phase loss protection 0: No action 1: Continue runing with an alarm 2: Coast to a stop due to fault Tens digit: Action to overweight 0: No action 1: Continue running with an alarm 2: Coast to a stop due to fault	00	×
Fb-04	Motor load overweight detection level	20.0 ~ 200.0%(motor rated current=100%)	130.0%	×
Fb-05	Motor load overweight detection time	0.0 ~ 30.0s	5.0s	×
Fb-06	Inverter underload protection	0: No action 1: Contintue running with an alarm 2: Coast to a stop due to fault	0	×
Fb-07	Inverter underload protection level	$0.0 \sim 100.0\%$ (inverter rated current=100%)	30.0%	×
Fb-08	underload protection detection time	0.0 ~ 100.0s	1.0s	×
Fb-09	Analog input disconnection action	 0: No action 1: Run at the average frequency within 10s before disconnection, with an AL.Aco alarm 2: Run at the frequency set by Fb-10, with an AL.Aco alarm 3: Coast to a stop, with an Er.Aco alarm 	0	×
Fb-10	Frequency after analog input disconnection	0.00Hz ~ F0-06	0.00Hz	0
Fb-11	Other protection actions	Units digit: inverter input phase loss protection 0: No action 1: Continue runing with an alarm 2: Coast to a stop due to fault	0022	×

		Tens digit: inverter output phase loss protection 0: No action 1: Continue runing with an alarm 2: Coast to a stop due to fault Hundreds digit: keypad disconnection protection 0: No action 1: Continue runing with an alarm 2: Coast to a stop due to fault Thousands digit: parameter store failure protection 0: Continue runing with an alarm 1: Coast to a stop due to fault		
Fb-12	Accel overcurrent stall prevention	0: Invalid 1: Valid	1	×
Fb-13	Accel overcurrent stall point	10.0 ~ 150.0%(inverter rated current=100%)	150.0%	×
Fb-14	Constant-speed overcurrent stall prevention	0: Invalid 1: Valid	1	×
Fb-15	Constant-speed overcurrent stall point	10.0 ~ 150.0%(inverter rated current=100%)	150.0%	×
Fb-16	Overvoltage stall prevention	0: Invalid 1: Valid	1	×
Fb-17	Overvoltage stall point	650 ~ 750V	700V	×
Fb-18	DC link undervoltage action	0: Coast to a stop and report the undervoltage fault(Er.dcL) 1: Coast to a stop, and restart if the voltage resumes within the time set by Fb-20 or report the undervoltage fault(Er.dcL) if undervoltage time exceeds the time set by Fb-20 2: Coast to a stop, and restart if CPU is still working and detects that the voltage resumes, without reporting the undervoltage fault 3: Decelerate, and accelerate to the reference frequency if CPU is still working and detects that the voltage resumes, without reporting the undervoltage fault.	0	x
Fb-19	DC link undervoltage point	370~480V	400V	×
Fb-20	Allowable time for momentary power failure	0.0 ~ 30.0s	0.1s	×
Fb-21	Momentary power failure decel time	$0.0 \sim 200.0$ s(if Fb-21=0.0, the current decel time is used)	0.0s	×
Fb-22	Auto reset times	0~10	0	×
Fb-23	Auto reset interval	1.0 ~ 30.0s	5.0s	×
Fb-24	Fault output during auto reset	0: No output 1: Output	0	×
Fb-25	Restart after momentary stop, auto reset or pause	0: Restart according to the preset starting mode 1: Restart smoothly	1	×
Fb-26	Power-on auto reset	0: Disabled 1: Enabled	1	0
Fb-27	Built-in braking unit working threshold	620 ~ 720V	680V	0

Fb-28	Modulation mode	0: Auto	1: Continuous	0	0
Fb-29	Carrier frequency	15kW or less:1.1k 18.5~30kW:1.1k~ 37~160 kW: 1.1k~ 200kW or more:1.	~12.0kHz(default: 4.0kHz) 10.0 kHz(default: 3.0kHz -8.0 kHz(default: 2.5kHz) 1k~5.0 kHz(default: 2.0kHz)	Depends on model	0
Fb-30	Random PWM setting	0~30%		0%	0
Fb-31	Carrier frequency auto adjustment	0: Disabled	1: Enabled	1	0
Fb-32	Deadband compensation	0: Disabled	1: Enabled	1	×
Fb-33	Space vector angle stop save	0: Not save	1: Save	0	×
Fb-34	Overmodulation	0: Disabled	1: Enabled	1	×
Fb-35	Cooling fan control	0: Stop after stand 1: Keep running	by state lasts 3 minutes	0	0
Fb-36	Jump frequency 1	0.00 ~ 625.00Hz		0.00Hz	0
Fb-37	Jumping width 1	0.00 ~ 20.00Hz		0.00Hz	0
Fb-38	Jump frequency 2	0.00 ~ 625.00Hz		0.00Hz	0
Fb-39	Jumping width 2	0.00 ~ 20.00Hz		0.00Hz	0
Fb-40	Jump frequency 3	0.00 ~ 625.00Hz		0.00Hz	0
Fb-41	Jumping width 3	0.00 ~ 20.00Hz		0.00Hz	0

FC: Keypad operation and display settings

No.	Name	Setting range	Default	Change
FC-00	Display parameter select	0: All menus 1: User selected parameters 2: Parameters different from factory settings	0	0

FC-01	Key function and auto lockup	 Units digit: determines which keys are locked. 0: None locked 1: All locked 2: All locked but ③ 3: All locked but ④ 4: All locked but ④ and ④ 5: All locked but ① and ⑥ Tens digit: determines the function of ⑥ 0: Valid only when keypad is the command source 1: Valid when keypad, terminal or communication is the command source. Stops motor according to preset stop mode. 2: Stops motor according to preset stop mode. 2: Stops motor according to preset stop mode. 2: Stops motor according to and ⑤ (only when keypad is the command source. When other channels are the command cource, makes the motor coast to a stop and gives an Er.Abb alarm. Hundreds digit: determines the function of ⑥ (only when keypad is command source) 0: Invalid 1: Valid only in standby state 2: Valid Thousands digit: determines the function of ① (only when keypad is command source) 0: Normal run 1: Jog 	0000	×
FC-02	Monitored parameter 1 (in run and standby)	-1 ~ 59 Select monitored parameters which are		0
FC-03	Monitored parameter 2 (in run and standby)	displayed in both running and standby states. Note: -1 indicates null and 0~59 represent	-1	0
FC-04	Monitored parameter 3 (in run and standby)	FU-00~FU-59. The minimum value of FC-02 is 0.	-1	0
FC-05	Monitored parameter 4 (in run and standby)		-1	0
FC-06	Monitored parameter 5 (in run and standby)		-1	0
FC-07	Monitored parameter 6 (in run and standby)		-1	0
FC-08	Monitored parameter 7 (in run and standby)		-1	0
FC-09	Monitored parameter 1 (in run)	-1 ~ 59	0	0
FC-10	Monitored parameter 2 (in run)	Select monitored parameters which are only	2	0
FC-11	Monitored parameter 3 (in run)	displayed in running state.	4	0
FC-12	Monitored parameter 4 (in run)	Note: -1 indicates null and 0~59 represent FU-00~FU-59.	- 1	0
FC-13	Speed display coefficient	0.001 ~ 10.000	1.000	0
FC-14	Line speed display coefficient	0.01 ~ 100.00	0.01	0

FC-15 ~ FC-44	User parameters 1~30	-00.01 ~ FU.59(excluding factory parameters Fn) Note: -00.01 indicates null and others represent parameter numbers. For example, F0.01 represents F0-01.	-00.01	0
FC-45	User parameter 31	Fixed as FC-00	FC.00	
FC-46	User parameter 32	Fixed as F0-10	F0.10	

User parameters 1~32 corresponds to FC15~FC46 respectively, as shown below.

n	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
User parameter n	FC-15	FC-16	FC-17	FC-18	FC-19	FC-20	FC-21	FC-22	FC-23	FC-24	FC-25	FC-26	FC-27	FC-28	FC-29	FC-30
n	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
User parameter n	FC-31	FC-32	FC-33	FC-34	FC-35	FC-36	FC-37	FC-38	FC-39	FC-40	FC-41	FC-42	FC-43	FC-44	FC-45	FC-46

Fd: Expansion options and functions

No.	Name	Setting range	Default	Change
Fd-00	Parameter copying	 Upload parameters from inverter to keypad Download parameters from keypad to inverter Confirm the consistency of keypad parameters with inverter parameters Clear parameters stored in keypad 	00	×
Fd-01	PG pulse number per revolution	1 ~ 8192	1024	×
Fd-02	PG type	0: Quadrature encoder 1: Single-channel encoder	0	×
Fd-03	PG direction	0: Positive 1: Negative	0	×
Fd-04	PG disconnection reaction	0: No action1: Alarm (AL.PGo displayed)2: Coast to a stop due to fault(Er.PGo displayed)	2	×
Fd-05	PG disconnection detection time	0.1 ~ 10.0s	1.0s	×
Fd-06	PG speed ratio denominator	1 ~ 1000	1	×
Fd-07	PG speed ratio numerator	1 ~ 1000	1	×
Fd-08	PG speed test filtering time	0.000 ~ 2.000s	0.005s	0
Fd-09	Expansion digital input terminal X7	Refer to the table of digital input functions in Section 6.5.		
Fd-10	Expansion digital input terminal X8		0	×
Fd-11	Expansion digital input terminal X9			

Fd-12	Expansion digital input terminal X10			
Fd-13	Expansion digitla input terminal X11			
Fd-14	Expansion digital output terminal Y3	Refer to the table of digital output functions in Section 6.6.		
Fd-15	Expansion digital output terminal Y4			
Fd-16	Expansion digital output terminal Y5			
Fd-17	Expansion digital output terminal Y6			
Fd-18	Expansion digital output terminal Y7			
Fd-19	Counting method	0: Common counting 1: Quadrature counting	0	×
Fd-20	Designated count 2	0 ~ F9-14	0	0
Fd-21	Logic unit 5 input 1	Same as F5-00	0	0
Fd-22	Logic unit 5 input 2		0	0
Fd-23	Logit unit 5 config	Same as FE-14	9	0
Fd-24	Logic unit 5 output	Same as F4-00	0	0
Fd-25	Logic unit 6 input 1	Same as F5-00	0	0
Fd-26	Logic unit 6 input 2		0	0
Fd-27	Logic unit 6 config	Same as FE-14	9	0
Fd-28	Logic unit 6 output	Same as F4-00	0	0
Fd-29 ~ Fd-60	Reserved			

FE: Programmable unit

No.	Name	Setting range	Default	Change
FE-00	Comparator 1 in-phase input	Same as F6-14		0
FE-01	Comparator 1 opposite-phase input	Same as F6-14	0	0
FE-02	Comparator 1 config	Units digit: selects the functions 0:> 1: 2:= 3:≠ 4: Output always 1 5: Output always 0 Tens digit: whether to take absolute value 0: No 1: Yes Hundreds digit: selects the protection function for comparator output 0: No action 1: The motor continues running with an alarm 1: The motor continues running with an alarm 2: The inverter coasts to a stop due to fault(Er.Col or Er.Co2 displayed)	005	0

No.	Name	Setting range	Default	Change
FE-03	Comparator 1 digital setting	-100.0 ~ 100.0%(corresponding to analog output 28)	50.0%	0
FE-04	Comparator 1 error band	0.0 ~ 100.0 %	5.0%	0
FE-05	Comparator 1 output select	Same as F4-00	0	0
FE-06	Comparator 2 in-phase input select	Same as F6-14	0	0
FE-07	Comparator 2 opposite-phase input select	Same as F6-14	0	0
FE-08	Comparator 2 config	Same as FE-02	005	0
FE-09	Comparator 2 digital setting	-100.0 ~ 100.0%(corresponding to analog output 29)	50.0%	0
FE-10	Comparator 2 error band	0.0 ~ 100.0 %	5.0%	0
FE-11	Comparator 2 output select	Same as F4-00	0	0
FE-12	Logic unit 1 input 1 select	Same as F5-00	0	0
FE-13	Logic unit 1 input 2 select		0	0
FE-14	Logic unit 1 config	0: AND 1: OR 2: NAND 3: NOR 4: XOR (≠) 5:XNOR (=) 6: Output=input 1 7: Output= ~ input 1 8: Output=1 9: Output=0 10: R-S trigger	9	0
FE-15	Logic unit 1 output select	Same as F4-00	0	0
FE-16	Logic unit 2 input 1 select	Same as F5-00	0	0
FE-17	Logic unit 2 input 2 select		0	0
FE-18	Logic unit 2 config	Same as FE-14	9	0
FE-19	Logic unit 2 output select	Same as F4-00	0	0
FE-20	Logic unit 3 input 1 select	Same as F5-00	0	0
FE-21	Logic unit 3 input 2 select		0	0
FE-22	Logic unit 3 config	Saem as FE-14	9	0
FE-23	Logic unit 3 output select	Same as F4-00	0	0
FE-24	Logic unit 4 input 1 select	Same as F5-00	0	0
FE-25	Logic unit 4 input 2 select		0	0
FE-26	Logic unit 4 config	Same as FE-14	9	0
FE-27	Logic unit 4 output select	Same as F4-00	0	0
FE-28	Timer 1 input select	Same as F5-00	0	0

No.	Name	Setting range	Default	Change
FE-29	Timer 1 config	Units digit: type of timer 0: Rising edge delay 1: Falling edge delay 2: Rising and Falling edge delay 3: Pulse function Tens digit: magnification of set time 0: 1 1: 10 2: 100 3: 1000 4: 10000 Hundreds digit: output signal setting 0: Output=input 1: Output=~input 2: Output≡1 3: Output≡0 4: AND 5: NAND 6: OR	300	0
FE-30	Timer 1 set time	0~40000ms. Delay time=set time×magnification	0ms	0
FE-31	Timer 1 output select	Same as F4-00	0	0
FE-32	Timer 2 input select	Same as F5-00	0	0
FE-33	Timer 2 config	Same as FE-29	300	0
FE-34	Timer 2 set time	0~40000ms. Delay time=set time×magnification	0ms	0
FE-35	Timer 2 output select	Same as F4-00	0	0
FE-36	Timer 3 input select	Same as F5-00	0	0
FE-37	Timer 3 config	Same as FE-29	300	0
FE-38	Timer 3 set time	0~40000ms. Delay time=set time×magnification	0ms	0
FE-39	Timer 3 output select	Same as F4-00	0	0
FE-40	Timer 4 input select	Same as F5-00	0	0
FE-41	Timer 4 config	Same as FE-29	300	0
FE-42	Timer 4 set time	0~40000ms. Delay time=set time×magnification	0ms	0
FE-43	Timer 4 output select	Same as F4-00	0	0
FE-44	Arithmetic unit 1 input 1 select	Same as F6-14	0	0
FE-45	Arithmetic unit 1 input 2 select		0	0
FE-46	Arithmetic unit 1 config	0: Input 1+input 2 1: Input 1-input 2 2: Input 1×input 2 3: Input 1÷input 2 4: Take the smaller one of the two 5: Take the larger one of the two 6: [Input 1 ×input 2 7: [Input 1 ÷input 2 8: Input 1 is output directly(functions as a connection)	0	0
FE-47	Arithmetic unit 1 digital setting	-100.0 ~ 100.0% (corresponding to analog output 30)	0.0%	0
FE-48	Arithmetic unit 2 input 1 select	Same as F6-14	0	0
FE-49	Arithmetic unit 2 input 2 select		0	0
FE-50	Arithmetic unit 2 config	Same as FE-46	0	0
FE-51	Arithmetic unit 2 digital setting	-100.0 ~ 100.0%(corresponding to analog output 31)	0.0%	0
FE-52	Arithmetic unit 3 input 1 select	Same as F6-14	0	0
FE-53	Arithmetic unit 3 input 2 select		0	0
FE-54	Arithmetic unit 3 config	Same as FE-46	0	0

No.	Name	Setting range	Default	Change
FE-55	Arithmetic unit 3 digital setting	-100.0 ~ 100.0% (corresponding to analog output 32)	0.0%	0
FE-56	Arithmetic unit 4 input 1 select	Same as F6-14	0	0
FE-57	Arithmetic unit 4 input 2 select		0	0
FE-58	Arithmetic unit 4 config	Same as FE-46	0	0
FE-59	Arithmetic unit 4 digital setting	-100.0 ~ 100.0% (corresponding to analog output 33)	0.0%	0
FE-60	Arithmetic unit 5 input 1 select	Same as F6-14	0	0
FE-61	Arithmetic unit 5 input 2 select		0	0
FE-62	Arithmetic unit 5 config	Same as FE-46	0	0
FE-63	Arithmetic unit 5 digital setting	-100.0 ~ 100.0% (corresponding to analog output 34)	0.0%	0
FE-64	Arithmetic unit 6 input 1 select	Same as F6-14	0	0
FE-65	Arithmetic unit 6 input 2 select		0	0
FE-66	Arithmetic unit 6 config	Same as FE-46	0	0
FE-67	Arithmetic unit 6 digital setting	-100.0 ~ 100.0% (corresponding to analog output 35)	0.0%	0
FE-68	Low-pass filter 1 input select	Same as F6-14	0	0
FE-69	Low-pass filter 1 filtering time	0.000 ~ 10.000s	0.010s	0
FE-70	Low-pass filter 2 input select	Same as F6-14	0	0
FE-71	Low-pass filter 2 filtering time	0.000 ~ 10.000s	0.010s	0
FE-72	Analog multi-switch input 1	Same as F6-14	0	0
FE-73	Analog multi-switch input 2	Same as F6-14	0	0
FE-74	Analog multi-switch control singal	Same as F5-00	0	0

FF: Communication parameters

No.	Name	Setting range	Default	Change
FF-00	Communication protocol	0:Modbus 1:USS commands 2:CAN	0	×
FF-01	Data format	0:8,N,1 1:8,E,1 2:8,O,1 3:8,N,2	0	×
FF-02	Baud rate	0:1200bps 1:2400bps 2:4800bps 3:9600bps 4:19200bps 5:38400bps 6:57600bps 7:115200bps 8:250000bps 9:500000bps	3	×
FF-03	Local address	0~247	1	×
FF-04	Overtime detection time	0.1 ~ 600.0s	10.0s	0
FF-05	Response delay	0 ~ 1000ms	5ms	0
FF-06	Overtime reaction	0: No action 1: Alarm 2: Alarm and coast to a stop 3: Alarm and run acocording to F0-00 4: Alarm and run at upper-limit frequency	0	×

No.	Name	Setting range	Default	Change
		5: Alarm and run at lower-limit frequency		
FF-07	USS message PZD word number	0~4	2	×
FF-08	Communication reference magnification	0.001 ~ 30.000	1.000	0

Fn: Factory parameter

No.	Name	Description	Default	change
-	-	-	-	-

FP: Fault history

No.	Name	Descr	ription
FP-00	Last fault type	0: No fault 1. ocb: Momentary overcurrent at start 2. ocA: Overcurrent in accel 3. ocd: Overcurrent in decel 4. ocn: Overcurrent in constant-speed run 5. ouA: Overvoltage in accel 6. oud: Overvoltage in decel 7. oun: Overvoltage in in constant-speed run 8. ouE: Overvoltage in standby state 9. dcL: Undervoltage in run 10. PLI: Input phase loss 11. PLo: Output phase loss 12. FoP: Power device protection 13. oHI: Inverter overhead 14. oLI: Motor overload	 EEF: External fault CEF: External fault OtP: Motor load overweight ULd: Inverter underload Col: Comparator 1 output protection signal Co2: Comparator 2 output protection signal EEP: Parameter saving failed CFE: Communication error CFE: Communication error CFC: Current check error ArF: Poor auto-tuning Co: Analog input disconnection PGO: PG disconnection PGO: PG disconnection Arbb: Abnormal stop Io1: Reserved Io2: Reserved IPAL: Keypad disconnection
FP-01	Cumulated run time at last fault	Min. unit:1h	
FP-02	Operating frequency at last fault	Min. unit:0.01Hz	
FP-03	Reference frequency at last fault	Min. unit:0.01Hz	
FP-04	Output current at last fault	Min. unit:0.1A	
FP-05	Output voltage at last fault	Min. unit:0.1V	
FP-06	Output capacity at last fault	Min. unit:0.1kW	
FP-07	DC link voltage at last fault	Min. unit:0.1V	
FP-08	Bridge temperature at last fault	Min. unit:0.1°C	
FP-09	Terminal input status 1 at last fault	Ten thousands digit: X5 Thous Hundreds digit: X3 Tens digit	sands digit: X4 : X2 Units digit: X1
FP-10	Terminal input status 2 at last fault	Hundreds digit: REV Tens dig	it:FWD Units digit:X6
FP-11	2nd last fault type	Same as FP-00	
FP-12	Cumulated run time at 2nd last fault	Min. unit:1h	
FP-13	3rd last fault type	Same as FP-00	
FP-14	Cumulated run time at 3rd last fault	Min. unit:1h	

No.	Name	Description
FP-15	4th last fault type	Same as FP-00
FP-16	Cumulated run time at 4th last fault	Min. unit:1h
FP-17	5th last fault type	Same as FP-00
FP-18	Cumulated run time at 5th last fault	Min. unit:1h
FP-19	Single-time run time at fault	Min. unit:0.1h
FP-20	Fault history clear	11: Clear FP-00~FP-20.

FU: Data monitoring

No.	Name	Description
FU-00	Operating frequency	Min. unit: 0.01Hz
FU-01	Reference frequency	Unit indicator blinks. Min. unit: 0.01Hz
FU-02	Output current	Min. unit:0.1A
FU-03	Load current percentage	Inverter rated current=100%. Min. unit: 0.1%
FU-04	Output voltage	Min. unit:0.1V
FU-05	Operating speed	Min. unit:1r/min
FU-06	Reference speed	Unit indicator blinks. Min. unit: 0.01Hz
FU-07	DC link voltage	Min. unit:0.1V
FU-08	Output capacity	Min. unit:0.1kW
FU-09	Output torque	Rated torque=100%. Min. unit:0.1%
FU-10	Reference torque	Rated torque=100%. Unit indicator blinks. Min. unit:0.1%
FU-11	Operating line speed	Min. unit:1m/s
FU-12	Referenc line speed	Unit indicator blinks. Min. unit:1m/s
FU-13	PID feedback	Min. unit:0.1%
FU-14	PID reference	Unit indicator blinks. Min. unit:0.1%
FU-15	Counter count	Min. unit:1
FU-16	Meter-counter actual length	Min. unit:1m
FU-17	AI1	Min. unit:0.1%
FU-18	AI2	Min. unit:0.1%
FU-19	PFI	Min. unit:0.1%
FU-20	UP/DOWN value	Unit indicator blinks. Min. unit: 0.1%
FU-21	PLC current mode and stage	Example: 2.03 indicates the 3rd stage of mode 2.
FU-22	PLC cycled number	Min. unit:1
FU-23	Remaining time of PLC current stage	Min. unit:0.1s or 0.1min, decided by the thousands digit of F8-00
FU-24	Arithmetic unit 1 output	Min. unit:0.1%
FU-25	Arithmetic unit 2 output	Min. unit:0.1%

No.	Name	Description
FU-26	Arithmetic unit 3 output	Min. unit:0.1%
FU-27	Arithmetic unit 4 output	Min. unit:0.1%
FU-28	Arithmetic unit 5 output	Min. unit:0.1%
FU-29	Arithmetic unit 6 output	Min. unit:0.1%
FU-30	Low-pass filter 1 output	Min. unit:0.1%
FU-31	Low-pass filter 2 output	Min. unit:0.1%
FU-32	Analog multi-switch output	Min. unit:0.1%
FU-33	PID output	Min. unit:0.1%
FU-34	Counter error	F9-14=100%. Min. unit:0.01%
FU-35	PG detection frequency	Min. unit:0.1Hz
FU-36	Heat sink temperature	Min. unit:0.1°C
FU-37	Output power factor	Min. unit:0.01
FU-38	Watt-hour meter kWh	$0.0 \sim 6553.5$ kWh. Pressing (a) and (c) concurrently clears this parameter itself and the watt-hour meter timer.
FU-39	Watt-hour meter timer	$0.00 \sim 655.35$ h. Pressing (a) and (c) concurrently clears this parameter itself and the watt-hour meter kWh.
FU-40	Digital input terminal status 1	Ten thousands digit: X5 Thousands digit: X4 Hundreds digit: X3 Tens digit: X2 Units digit:X1 (0: Open 1: Closed)
FU-41	Digital input terminal status 2	Hundreds digit: REV Tens digit: FWD Units digit:X6 (0: Open 1: Closed)
FU-42	Digital output terminal status	Thousands digit: T2 Hundreds digit: T1 Tens digit: Y2 Units digit: Y1 (0: Open 1: Closed)
FU-43	Expansion digital input terminal status	Ten thousands digit: X11 Thousands digit: X10 Hundreds digit: X9 Tens digit: X8 Units digit:X7 (0: Open 1: Closed)
FU-44	Expansion digital output terminal status	Ten thousands digit: Y7 Thousands digit: Y6 Hundreds digit: Y5 Tens digit: Y4 Units digit: Y3 (0: Open 1: Closed)
FU-45	Communication error times	0 ~ 60000
FU-46	Reference frequency after accel/decel	Min. unit:0.01Hz
FU-47	Output frequency	Freuqney output by the inverter (used by factory). Min. unit: 0.01Hz
FU-52	Communication poll cycle	Min. unit:0.001s
FU-55	Max. current holding	It is cleared by pressing (and (concurrently. Min. unit:0.1A)
Others	Reserved	-

6 Parameter Description

6.1 F0: Basic Parameters

F0-00	Digital reference frequency	Default	50.00Hz	Change	0
Setting range	0.00Hz ~ F0-06				
F0-01	Main reference channel	Default	0	Change	0
Setting range	0: F0-00(adjusted via &	1: Commu 5: PFI 9: Arithme	nication(F0-00 6: Arith tic unit 4 10:	as initial va hmetic unit Keypad PO	lue) 1 T

The reference frequency channels are shown in the following diagram:



- The inverter has 5 operation modes and their priorities are: jog>process PID>PLC>multi-speed>common operation. For example, if multi-speed operation is valid when the inverter is in common operation, the main reference frequency will be determined by the multistep frequency.
- In common operation, the main reference frequency can be selected by F0-01, and the frequency setting channel can be compulsively switched to AI1 and Arithmetic unit 1 by digital input 43 and 44 respectively (for functions of digital input, refer to Section 6.5).
- Auxiliary reference channel is selected by F0-04 and it can be disabled by digital input 32.
- Setting F7-00 = 2 can correct the reference frequency before acceleration/deceleration.
- Jog command is valid in following cases: 1) In kepad control mode, the thousands digit of FC-01 equals 1; or 2) In terminal control mode, digital input 14 or 15 is valid.
- The reference frequency is restricted by F0-07 and F0-08.

F0-02	Command	l source	Default	0	Change	×
Setting range	0: Keypad(EXT off)	1: Terminal(EXT on) 2: Co	ommunication(EXT blinks))

Digital input 42 can compulsively switch the command source.

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F0-03	Frequency holding	Default	00	Change	0	
Setting range	Units digit: selects the frequency saving mode after power failure. 0: Frequency changed via (A), (T) or communication is stored in F0-00. 1: Frequency changed via (A), (T) or communication is not stored.					
	Tens digit: selects the frequency holding mode in s 0: Frequency changed via (), or or commu 1: Frequency changed via (), or or commu	top state. nication is re nication is re	tained. stored to F0-00).		

This parameter is valid only when F0-01=0 or 1.

F0-04	Auxiliary refe	erence channel	Default	0	Change	0
Seting range	0: None 1: F0-00 6: Arithmetic unit 1	2: UP/DOWN value 7: Arithmetic unit 2	3: AI1 8: Arithmetic	4: AI2 c unit 3	5: PFI 9: Arithmetic	unit 4
F0-05	Auxiliary reference gain		Default	1.000	Change	0
Setting range	-1.000 ~ 1.000					

Refer to F0-00 and F0-01.

F0-06	Max. frequency	Default	50.00Hz	Change	×
Setting range	V/F control: F0-07 ~ 650.00Hz Vector control: F0-07 ~ 200.00Hz				
F0-07	Upper-limit frequency	Default	50.00Hz	Change	×
Setting range	F0-08 ~ F0-06				
F0-08	Lower-limit frequency	Default	0.00Hz	Change	×
Setting range	0.00Hz ~ F0-07				

F0-06 is the frequency corresponding to 100% of the frequency setting.

Generation F0-07 and F0-08 limit the size of the reference frequency.

F0-09	Direction lo	ck	Default	0	Change	0
Setting range	0: Forward or reverse	1: Forward only	2	: Reverse only		

It is recommended to set F0-09 to 1 or 2 when only a single direction is required.

If you want to change the direction via the key (2), you should set the hundreds digit of FC-01 to 1 or 2.

F0-10	Parameter protection	Default	0	Change	0
Setting range	0: All parameters can be changed except read-onl 1: All parameters can't be changed except F0-00, 2: All parameters can't be changed except F0-10	y ones F7-04 and F	0-10		

F0-10 is used to prevent parameters from being modified unexpectedly.

F0-11	Parameter initialization	Default	00	Change	×			
Setting range	11: Enabled 22: Enabled(except communication parameters) Note: this parameter is automatically set to 00 after initialization.							
F0-11 restores parameters to the factory settings(except the fault history, which can be cleared by FP-20).								
F0-12	Motor control mode	Default	0	Change	×			

Setting	0: V/F control without PG	1: V/F control with PG	2: Vector control without PG
range	3: Vector control with PG	4: V/F separate control	

Motor control mode:

F0-12 = 0: open-loop V/F control. The torque output capacity can be improved by torque boost, and the mechanical characteristics and speed control accuracy can be improved by slip compensation.

F0-12 = 1: closed-loop V/F control. This mode has a high steady-state speed accuracy, and is especially suited for applications where the encoder is not directly installed on the motor shaft and the accurate speed control is needed.

F0-12=2: speed sensor-less vector control. This mode has good mechanical characteristics. It can be used for applications where there is a high demand for driving performance and it is not convenient to install an encoder. Torque control can be achieved under this mode.

F0-12 = 3: speed sensor vector control. This mode has the highest dynamic performance and steady-state accuracy. It is mainly used for high-performance control such as high-accuracy speed control and simple servo control. Torque control can be achieved under this mode, with high control accuracy both at low speeds and in generating state.

F0-12 = 4: voltage and frequency can be regulated separately.

- Attentions for vector control
 - Vector control is usually used in cases where one inverter controls one motor. It also can be used to ontrol
 multiple motors that have the same model and parameters and are connected by a same shaft, however,
 you should perform the parameter auto-tuning when these motors are connected together, or you can
 manually input the equivalent parameters when these motors are connected in parallel.
 - Motor parameter auto-tuning or accurate motor parameter input is needed for motor dynamic modeling and field-oriented control algorithm.
 - 3. The capacity of the motor and inverter must match each other. The motor rated current should not less than 1/4 of the inverter rated current; too low value would harm the control performance.
 - ASR parameters must be properly set to ensure the steady-state performance and dynamic performance of speed control.
 - It is recommended that the motor pole number not be greater than eight, and vector control not be used for double-cage motors, current-displacement motors or torque motors.
- V/F control is required in following cases:
 - One inverter drives multiple motors simultaneously(the motors have uneven loads or different parameters or capacities).
 - 2. Load curren is less than 1/4 of the inverter rated current.
 - 3. No load is connected to the inverter(e.g. during test).
 - 4. Inverter output is connected to the transformer.
- Danger: in the control mode with PG, the PG paremetters must be set correctly(refer to Section 6.14), otherwise injury to people or damage to equipment may occur. The direction setting of the encoder must be rechecked after the rewiring of the motor cables.

6 PARAMETER DESCRIPTION

F0-13	Inverter rated capacity	Default	Depends on model	Change	
The min	imum unit is 0.01kW.				
F0-14	Software version	Default	Version No.	Change	
The sett	ing range is between 0.00 and 99.99.				
F0-15	User password	Default	0000	Change	0
Setting range	0000 ~ 9999(0000 means no password)				

□ The password takes effect if no key is pressed within two minutes after the password is set. In monitoring status, pressing () + (<<) validates the password immediately.

6.2 F1: Accel/decel, start, stop and jog parameters

F1-00	Accel time 1	Default	Depends on model	Change	0
F1-01	Decel time 1	Default	Depends on model	Change	0
F1-02	Accel time 2	Default	Depends on model	Change	0
F1-03	Decel time 2	Default	Depends on model	Change	0
F1-04	Accel time 3	Default	Depends on model	Change	0
F1-05	Decel time 3	Default	Depends on model	Change	0
F1-06	Accel time 4	Default	Depends on model	Change	0
F1-07	Decel time 4	Default	Depends on model	Change	0
F1-08	Accel time 5	Default	Depends on model	Change	0
F1-09	Decel time 5	Default	Depends on model	Change	0
F1-10	Accel time 6	Default	Depends on model	Change	0
F1-11	Decel time 6	Default	Depends on model	Change	0
F1-12	Accel time 7	Default	Depends on model	Change	0
F1-13	Decel time 7	Default	Depends on model	Change	0
F1-14	Accel time 8	Default	Depends on model	Change	0
F1-15	Decel time 8	Default	Depends on model	Change	0

Setting range	0.01 ~ 3600.0s. The minimum unit is determined by F1-16. Acceleration time is the time period over which the frequency rises by 50Hz. Deceleration time is the time period over which the frequency drops by 50Hz. Note: the factory setting is 6.0s for models of 22kW or less, and 20.0s for 30kW or more.					
F1-16	Accel/decel time minimum unit	Default	1	Change	0	
Setting range	0: 0.01s 1: 0.1s					
F1-17	Accel/decel time auto switching point	Default	0.00Hz	Change	×	
Setting range	0.00 ~ 650.00Hz. Accel/decel time is compulsivel and F1-15) when the frequency drops below this p	ly switched t oint.	to accel/decel t	ime 8(i.e. F	1-14	
F1-18	Decel time for emergency stop	Default	10.0s	Change	0	
Setting range	0.01 ~ 3600.0s. Minimum unit is determined by F1-16.					

F1-00 ~ F1-15 offer eight accel/decel times, which can be selected by digital inputs 9, 10 and 11(refer to Section 6.5).

III F1-17 is illustrated as below. It is invalid in jog operation, emergency stop and stall prevention.



Upon receiving the emergency stop command(digital input 16 or communication command), the inverter will stop according to the time set by F1-18.

F1-19	Starting mode	Default	0	Change	×
Setting range	0: Start from starting frequency 1: Start from starting frequency after DC braking 2: Start from searched speed				
F1-20	Starting frequency	Default	0.50Hz	Change	0
Setting range	0.00 ~ 60.00Hz				
F1-21	Starting frequency duration	Default	0.0s	Change	0
Setting range	$0.1 \sim 60.0$ s(only valid for V/F control without PC	i)			
F1-22	Voltage soft start	Default	1	Change	×
Setting range	0: Disabled. Start from the voltage corresponding 1: Enabled. The voltage rises smoothly within the	to the starting to the starting time period	ng frequency. set by F1-21.		
F1-23	DC braking time(at start)	Default	0.0s	Change	0
Setting range	0.0 ~ 60.0s				

6 PARAMETER DESCRIPTION

F1-24	DC braking current(at start)	Default	0.0%	Change	0
Setting range	0.0 ~ 100.0% (inverter rated current=100%)				

The inverter has the following starting modes:

F1-19 = 0: The motor first runs at the starting frequency(F1-20) for a period of time(F1-21) and then begins accelerating. This mode can reduce the current impact at the start.

F1-19 = 1: The motor sometimes is in rotation before it starts(for example, the fan motor may run reverse because of the wind). In such a case, the motor can be stopped by DC braking and then restarts, thus preventing the overcurrent impact at the start. Refer to F1-23 and F1-24.

F1-19=2: The speed and the direction of the motor is searched automatically before the motor starts, then the motor starts smoothly from the searched speed. This starting mode shortens the starting time and reduces the impact at the start.

- For restarts following the momentary stop, auto reset or operation interruption, parameter Fb-25 can make the motor start from the searched speed compulsively. If V/F control with PG or Vector control with PG is selected, restart from the searched speed is not needed.
- DC braking at start and stop is illustrated as below.



- **Caution:** For high-speed or large-inertia loads, it is recommended to adopt "starts from searched speed" instead of "starts from starting frequency after DC braking".
- **Caution:** Starting from the starting frequency immediately after a coast stop will cause overcurrent. Therefore if an immediate start is needed when the motor doesn't stop turning after the coast stop, it is recommended to adopt "starts from searched speed".
- If F1-22=1 when the starting mode is "starts from starting frequency" and F1-21 is not equal to zero, the output voltage will rise gradually from zero to the value which corresponds to the starting frequency within the time period set by F1-21. This helps reduce the impact at the start and prevent undirectional rotation due to voltage surge. The function is only valid for V/F control without PG.

F1-25	Stop mode	Default	0	Change	0	
Setting range	0: Slowdown stop 1: Coast stop 2: Slowdown+DC braking 3: Slowdown+holding brake delay					
F1-26	DC braking frequency(at stop)	Default	0.50Hz	Change	0	
Setting range	0.00 ~ 60.00Hz					
F1-27	DC braking waiting time(at stop)	Default	0.00s	Change	0	
Setting range	0.00 ~ 10.00s					
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F1-28	DC braking time(at stop)	Default	0.0s	Change	0	
Setting range	$0.0 \sim 60.0$ s. It's also used as the holding bake delay time.					
F1-29	DC braking current(at stop)	Default	0.0%	Change	0	
Setting range	0.0 ~ 100.0% (inverter rated current=100%)					
F1-30	Zero-speed delay time	Default	0.0s	Change	0	
Setting reange	0.0 ~ 60.0s					

The inverter has the following stop modes:

F1-25=0: The inverter decelerates until its operating frequency drops to F1-26 and then enters the standby state.

F1-25 = 1: The inverter blocks the output and the motor coasts to a stop. But for jog stop or emergency stop, the stop mode remains to be slowdown stop(F1-25=0). Coast stop is not recommended for a water pump, for the water pump has a short stop time ant its sudden stop may result in water hammer.

F1-25 = 2: The inverter slows down and blocks the output when its operating frequency drops to F1-26. After a period of time(F1-27), the inverter applies the DC current(F1-29) to the motor, which stops following another period of time(F1-28)(refer to F1-19). The DC braking state can be remained by the digital input 34(refer to Section 6.5).

Caution: DC braking mode is only recommended for low speed(less than 10Hz) operation or small motors.

Caution: Long-time or frequent DC braking is easy to cause motor overheating, for the load mechanical energy is consumed in the motor rotor.

F1-25 = 3: The inverter slows down until its operating frequency drops to F1-26, then after a period of time(F1-28) the inverter enters the standby state. The digital input 6 can be used to control the electromagnetic holding brake, as shown in the diagram below.

F1-30: In the slowdown stop mode(F1-25=0), when the frequency drops to F1-26, the motor continues decelerating to zero within the time period(F1-30) and keeps running at the zero frequency(refer to the following diagram). The motor remains excited so that it can start quickly at any time without pre-excitation. F1-30 is invalid when its value is set to zero.



No matter what the command source is(except the communication control), pressing () and double-clicking () can cause the inverter to coast to a stop, provided the keypad is unlocked.

F1-31	Accel/decel mode	Default	0	Change	×

Setting range	0: Linear 1: S-curve					
F1-32	S-curve accel start-stage time	Default	0.20s	Change	×	
F1-33	S-curve accel end-stage time	Default	0.20s	Change	×	
F1-34	S-curve decel start-stage time	Default	0.20s	Change	×	
F1-35	S-curve decel end-stage time	Default	0.20s	Change	×	
Setting range	0.01 ~ 10.00s					

In S-curve accel/decel mode, the acceleration and speed change gradually and smoothly, which is helpful to raise the comfort degree in elevators, prevent the falling of objects on conveyors, or reduce the impact to equipment at the start/stop.

The total accel/decel time is extended after the S-curve accel/decel time is set, as shown below.



The calculation formula for the total accel/decel time is:

Total accel/decel time=accel/decel time for non S-curve+

(accel/decel start-stage time + accel/decel end-stage time)÷2

If the total accel/decel time obtained from the above formula is less than the sum of accel/decel start-stage time and accel/decel end-stage time, then:

Total accel/decel time= accel/decel start-stage time+accel/decel end-stage time

 $\hfill\square$ The S-curve function becomes invalid if F1-17 doesn't equal zero.

F1-36	Deadband time	Default	0.0s	Change	×
Setting range	0.0 ~ 3600.0s				

Deadband time is the waiting time during which the motor switches from forward run to reverse run or vice virsa. It is used to reduce the impact to equipment during the forward-reverse switching.

F1-37	Jog frequency	Default	5.00Hz	Change	0
Setting range	0.10 ~ 50.00Hz				
F1-38	Jog accel time	Default	Depends on model	Change	0
F1-39	Jog decel time	Default	Depends on model	Change	0

Setting range	0.1 ~ 60.0s Note: The factory setting of jog accel/decel time is 6.0s for models of 22 kW or less, and 20.0s for 30kW or above
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- In keypad control mode, if the thousands digit of FC-01 is set to 1, then pressing the key () will activate the jog operation, while in terminal control mode the digital input 14 or 15 may activate the jog operation. If both digital inputs are valid or invalid, jog operation will become invalid.
- In jog operation, the functions of "auxiliary reference" and "PID frequency correction" are invalid.
- The start/stop mode for jog operation is fixted to "starts from starting frequency" and "slowdown stop".

6.3 F2: V/F control parameters

F2-00	V/F curve	Default	1	Change	×
Setting range	0: Self-defined(see F2-14~F2-21) 1: Linear V/F curve(1st power) 2: Reduced-torque V/F curve 1(1.2th power) 3: Reduced-torque V/F curv 2(1.5th power) 4: Reduced-torque V/F curv 3(1.7th power) 5: Reduced-torque V/F curv 4(2.0th power) 6: Reduced-torque V/F curv 5(3.0th power)				

- V/F curve can be a self-defined multi-segment line, linear line or reduced-torque curve. For the latter two, refer to the diagram below.
- A reduced-torque V/F curve can improve the efficiency of the motor of a reduced-torque load(such as a fan or pump) in light-load operation. The auto energy-saving operation(see F2-11) also improve the motor efficiency.
- Apart from improving the motor efficiency, the reduced-torque V/F curve and auto energy-saving operation can decrease the noise.



F2-01	Torque boost		Default	1	Change	×
Setting range	0: No boost 2: Auto	1: Manual 3: Manual+auto				
F2-02	Manual torque boost level		Default	Depends on model	Change	0

Setting range	15kW or less: 0.0 ~ 15.0% 18.5kW or more: 0.0 ~ 10.0% (F2-13=100%)				
F2-03	Auto torque boost cut-off point	Default	10.0%	Change	0
Setting range	0.0 ~ 100.0%(F2-12=100%)				
F2-04	Auto torque boost level	Default	100.0%	Change	×
Setting range	0.0~100.0%				

Manual torque boost increases the motor's torque at the start or at low speeds. The value of F2-02 should be adjusted gradually until the torque meets the requirement for start. Note that too large F2-02 value will lead to motor overheating or overcurrent.

The relastionship between F2-02, F2-03, F2-12 and F2-13 are shown in the following diagram.



- Auto torque boost can alter the voltage according to the load current, compensating for the voltage loss of the stator impedance and adapting to various load conditions automatically. It ensures a large output torque under heavy load and a small output current under no load.
- In V/F control mode, the functions of "starts from searched speed", "auto torque boost" and "slip compensation" use some motor parameters, therefore we recommend you to conduct the auto-tuning of the motor at a standstill before using them in order to gain a better control.

F2-05	Slip compensation gain	Default	0.0%	Change	0
Setting range	0.0 ~ 300.0 %				
F2-06	Slip compensation filtering time	Default	1.0s	Change	×
Setting range	0.1 ~ 25.0s				
F2-07	Electromotive slip compensation limit	Default	200%	Change	×
F2-08	Regenerative slip compensation limit	Default	200%	Change	×
Setting range	0 ~ 250%(motor rated slip frequency=100%)				

If the output frequency remains constant, the change of the load will cause the change of the slip, thus leading to the drop of the speed. The slip compensation function can regulate the inverter output

frequency online according to the load torque, reducing the speed change with the torque and improving the speed control accuracy.

- Slip compensation is valid when F2-01=2 or 3.
- □ The size of slip compensation can be adjusted by F2-05. It's better to perform the adjustment when the temperature of the motor running with the load is basically stable. F2-05=100% means the compensation value corresponding to the rated torque is the rated slip frequency, which is calculated from the following formula:

Rated slip frequency=rated frequency-(rated speed×pole number÷120)

If the motor vibrates when the slip compensation is performed, increase the value of F2-06 moderately.

F2-09	Vibration damping	Default	Depends on mode	Change	0
Setting range	0~200				

Increasing this parameter can suppress the motor vibration under the no-load or light-load condition.

F2-10		AVR		Default	1	Change	×
Setting range	0: Inactive	1: Active	2: Activ	ve except dur	ing decel		

AVR is automatic voltage regulation. It keeps the output voltage unaffected when the input voltage or DC link voltage alters, thus stabilizing the production process and product quality.

When the input voltage is higher than the rating, the AVR function should be enabled so that the motor would not run under an overhigh voltage.

Setting F2-10 to 2 allows a quicker deceleration and generates a higher current compared with setting it to 1, because deceleration would raise the DC link voltage and then the output voltage if AVR is inactive, which leads to a greater motor loss and less mechanical energy feedback, therefore the deceleration time can be shorter.

Caution: If the load has a very large moment of inertia, F2-10 should be set to 1 to prevent the overhigh voltage causing motor overheating during deceleration.

F2-11	Auto energy-saving operation	Default	0	Change	0
Setting range	0: Inactive	: Active			

□ This function automatically regulates the output voltage, ensuring a minimum load current when the motor speed remains unchanged, thus reducing the motor loss. It's particularly suitable for reduced-torque loads such as fans and pumps. Refer to the diagram below.



- Auto energy-saving operation is only valid for V/F control and only applicable to applications with a stable load.
- In the auto energy-saving operation under V/F control, the functions of auto torque boost and slip compensation need to be used together.

F2-12	Base frequency	Default	50.00Hz	Change	×
Setting range	1.00 ~ 650.00Hz				
F2-13	Max. output voltage	Default	380V	Change	×
Setting range	150 ~ 500V				
F2-14	V/F frequency F4	Default	0.00Hz	Change	×
Setting range	F2-16 ~ F2-12				
F2-15	V/F voltage V4	Default	0.0%	Change	×
Setting range	F2-17 ~ 100.0%(F2-13=100%)				
F2-16	V/F frequency F3	Default	0.00Hz	Change	×
Setting range	F2-18 ~ F2-14				
F2-17	V/F voltage V3	Default	0.0%	Change	×
Setting range	F2-19 ~ F2-15(F2-13=100%)				
F2-18	V/F frequency F2	Default	0.00Hz	Change	×
Setting range	F2-20 ~ F2-16				
F2-19	V/F voltage V2	Default	0.0%	Change	×
Setting range	F2-21 ~ F2-17(F2-13=100%)				
F2-20	V/F frequency F1	Default	0.00Hz	Change	×
Setting range	0.00Hz ~ F2-18				
F2-21	V/F voltage V1	Default	0.0%	Change	×
Setting range	0.0% ~ F2-19(F2-13=100%)				

Description The self-defined V/F curve is shown as the following diagram.



F2-22	V/F separate voltage input	Default	0	Change	×
Setting range	0: F2-23 1: AI1 2: AI2 5: Arithmetic unit 1 6: Arithmetic unit 2	3: UP/DOWN 7: Arithmetio	N value c unit 3 8: A	4: PFI rithmetic un	it 4
F2-23	V/F separate voltage digital setting	Default	100.0%	Change	0
Setting range	0.0 ~ 100.0%(F2-13=100%)				
F2-24	V/F voltage factor	Default	0	Change	×
Setting range	0:100.0% 1: AI1 2: AI2 3 5: Arithmetic unit 1 6: Arithmetic unit 2	3: UP/DOWN 7: Arithmetic	N value c unit 3 8: A	4: PFI rithmetic un	it 4

V/F separate control allows the independent regulation of the invter output voltage or frequency. It can be used for torque motors or linear motors, and used as a programmable power supply.

- In V/F separate control mode, functions of "torque boost", "slip compensation" and "vibration damping" become invalid.
- F2-24 corrects the maximum output voltage in many ways. It's used for motor testing equipment and generally doesn't need setting by users. It's only valid in V/F control.

6.4 F3: Speed, torque and flux control parameters

F3-00	High-speed ASR proportional gain	Default	5.00	Change	×
Setting range	0.00 ~ 200.00				
F3-01	High-speed ASR integral time	Default	1.000s	Change	×
Setting range	0.010 ~ 30.000s				
F3-02	Low-speed ASR proportional gain	Default	10.00	Change	×
Setting range	0.00 ~ 200.00				
F3-03	Low-speed ASR integral time	Default	0.500s	Change	×
Setting range	0.010 ~ 30.000s				
F3-04	ASR parameter switching point	Default	0.00Hz	Change	×
Setting range	0.00 ~ 650.00Hz				

F3-05	ASR filtering time	Default	0.010s	Change	×
Setting range	0.000 ~ 2.000s				
F3-06	Accel compensation differential time	Default	0.000s	Change	×
Setting range	0.000 ~ 20.000s				
F3-07	Torque limit select	Default	0	Change	×
Setting range	0: Determined by F3-08 and F3-09 2: AI2 ×2.5 3: Arithmetic unit 1 ×2.5 5: Arithmetic unit 3 ×2.5 6: Arithmetic unit 4 ×2.5		1: AI1 ×2.5 4: Arithmetic unit 2 ×2.5		2 ×2.5
F3-08	Electromotive torque limit	Default	180.0%	Change	×
F3-09	Regenerative torque limit	Default	180.0%	Change	×
Setting range	0.0 ~ 290.0%(motor rated toqure=100%). Used for vector control only.				
F3-10	ASR output frequency limit	ASR output frequency limit Default 10.0% Change ×			
Setting range	0.0 ~ 20.0%(Max. frequency=100%). Used for PG V/F control only.				

ASR is automatic speed regulator. In vector control ASR outputs the reference torque which is limited by F3-07 ~ F3-09, while in PG V/F control it outputs the frequency correction value which is limited by F3-10.

ASR structure(for vector control) is shown below:



ASR structure(for PG V/F control) is as follows:



Note: In PG V/F control, if F3-07 = 0, ASR is limited by F3-10; if F3-07≠0, ASR limit= F3-10×F3-07÷2.5.

F3-04 can be used if different ASR parameters are needed at high-speed and low-speed operation. Low-speed ASR parameters F3-02 and F3-03 are used at zero speed. High-speed ASR parameters F3-00 and F3-01 are used when the operating frequency is higer than F3-04. When the frequency is between zero and F3-04, the ASR parameters are smoothly switched from the low-speed ones to high-speed ones or vice versa, as shown in the following diagram. If only one set of ASR parameters is needed, you can set F3-04 to 0, i.e. only the high-speed ASR parameters are used.



- F3-06 performs the differential operation on the reference frequency which has been accel/decel treated to obtain a feedforward torque reference, which in turn is added to the reference torque, thus helping the operating frequency better track the reference frequency during accel/decel and reduce the overshoot.
- ASR regulation principle: first increase the proportional gain as much as possible(but should not cause system oscillation), then adjust the integral time so that the system has a quick sponse and a slight overshoot.
- If improper parameter settings lead to an excessive speed overhoot, overvoltage may occur due to regenerative energy generated during speed restoring(a deceleration process).

F3-11	Droop level	Default	0.00Hz	Change	0
Setting range	0.00 ~ 50.00Hz				
F3-12	Droop starting torque	Default	0.0%	Change	0
Setting range	0.0 ~ 100.0% (motor rated torque=100%)				

- When multiple motors drive the same mechanical load and each motor is controlled by an inverter, each motor and inverter will bear different load because of the disparity in rated speed or mechanical characteristics among different motors. The droop function can balance the load among motors by regulating the hardness or softness of motors' mechanical characteristics.
- F3-11 set the changing value of the operating frequency when the motor torque equals F3-12 plus rated torque.
- If motor torque is greater than F3-12,

Frequency after droop=initial reference frequency-(current torque-F3-12) ×droop level

Definition The droop mechanical characteristic is shown as the folloing diagram.



F3-13	Torque control select	Default	0	Change	×
Setting range	0: Conditionally active(selected by digital in	0: Conditionally active(selected by digital input 45) 1: Always active			
F3-14	Torque reference select	Default	0	Change	×
Setting range	0: F3-15 1: AI1×2.5 3: PFI×2.5 4: UP/DOWN 6: Arithmetic unit 2×2.5 7: Arithmetic Note: In all cases above, motor rated torque= Motor rated torque=motor rated capacit	Value×2.5 unit 3×2.5 is equivalent ty÷(2π×moto	2: AI2× 5: Arith 8: Arith to 100%. r rated speed÷6	2.5 metic unit 1 metic unit 4 0)	×2.5 ×2.5
F3-15	Digital torque reference	Default	0.0%	Change	0
Setting range	-290.0 ~ 290.0% (motor rated torque=100%))			
F3-16	Torque control speed limit input select	Default	0	Change	0
Setting range	0: Determined by reference frequency	1: Determin	ned by F3-17 ar	nd F3-18	
F3-17	Torque control speed forward limit	Default	5.00Hz	Change	0
Setting range	0.00Hz ~ F0-07				
F3-18	Torque control speed reverse limit	Default	5.00Hz	Change	0
Setting range	0.00Hz ~ F0-07				
F3-19	Torque reference UP/DOWN time	Default	0.020s	Change	×
Setting range	0.000 ~ 10.000s. This time is the time over motor rated torque.	which the tor	rque rises from	zero to 250	% of
F3-20	Speed/torque control switching delay time	Default	0.050s	Change	×
Setting range	0.001 ~ 1.000s				

The torque control function can control the motor torque directly. It can be used for open-loop tension control, load balancing control, etc.. Upon receiving the stop command in torque control mode, the inverter will switch to the speed control mode and stop.

Torque control is only applicable to vector control, and PG vector control is recommended for torque control at low speeds or in generating state.

F3-13=0 means that the digital input 45 can switch from speed control to torque control. Refer to Section

6.5.

- F3-16 selects the source for limiting the speed for torque control.
- F3-19 is used to reduce the sudden change of the torque command. If the motor vibrates in torque control mode, increasing F3-19 can be considered.
- In torque control mode, the REV indicator on the keypad shows the direction of the oprating frequency.

F3-21	Pre-excitation time	Default	Depends on mode	Change	×
Setting range	$0.01 \sim 5.00$ s(only valid for vector control)				
F3-22	Flux density	Default	100.0%	Change	×
Setting range	$50.0 \sim 150.0\%$ (only valid for vector control)				
F3-23	Low-speed flux boost	Default	0%	Change	×
Setting range	$0 \sim 50\%$ (only valid for vector control)				
F3-24	Flux-weakening regulator integral time	Default	0.150s	Change	×
Setting range	0.010 ~ 3.000s(only valid for vector control)				

F3-21 ensures that the motor has a full pre-excitation and enough starting torque. The pre-excitation time is normally 0.1~2.0s, and the larger the motor capacity, the longer the time.

- □ F3-22: Its value is better to be below the flux-weakening point. Eithter overhigh or overlow setting would reduce the torque output capacity and efficiency.
- F3-23 boosts the flux density when the frequency is below 10% of the base frequency, increasing the torque ouptut capacity at low speeds in the vector control mode.
- F3-24 automatically applies the flux weakening control to the motor when the latter runs over the base frequency or the DC link voltage is low. It decides the speed of the flux weakening response. Its value needs reducing if there is a high requirement for dynamic performance.

F3-25	Electromotive capacity limit	Default	120.0%	Change	×
F3-26	Regenerative capacity limit	Default	120.0%	Change	×
Setting range	$0.0 \sim 250.0\%$ (inverter rated capacity=100%). Ovector control.	Only used to	restrict the ou	itput capacit	ty in

6.5 F4: Digital input terminals and multistep speed

F4-00	X1 terminal	Default	1	Change	×
F4-01	X2 terminal	Default	2	Change	×
F4-02	X3 terminal	Default	3	Change	×
F4-03	X4 terminal	Default	4	Change	×
F4-04	X5 terminal	Default	12	Change	×
F4-05	X6 terminal	Default	13	Change	×
F4-06	FWD terminal	Default	38	Change	×

F4-07	REV terminal	Default	39	Change	×
Setting range	Refer to the following table.				

Table of digital input functions(any two digital input terminals can't select the same digital input function simultaneously).

0: No signal	19: UP/DOWN increase	38: Internal virtual FWD terminal
1: Multistep frequency 1	20: UP/DOWN decrease	39: Internal virtual REV terminal
2: Multistep frequency 2	21: UP/DOWN clear	40: Analog reference frequency hold
3: Multistep frequency 3	22: PLC control disabled	41: Accel/decel disabled
4: Multistep frequency 4	23: PLC operation pause	42: Run command source switched to
5: Multistep frequency 5	24: PLC standby state reset	terminal/keypad
6: Multistep frequency 6	25: PLC mode select 1	43: Reference frequency switched to
7: Multistep frequency 7	26: PLC mode select 2	AI1(top priority)
8: Multistep frequency 8	27: PLC mode select 3	44: Reference frequency switched to
9: Accel/decel time select 1	28: PLC mode select 4	arithmetic unit 1(2nd top priority)
10: Accel/decel time select 2	29: PLC mode select 5	45: Speed/torque control select
11: Accel/decel time select 3	30: PLC mode select 6	46: Multi-PID select 1
12: External fault input	31: PLC mode select 7	47: Multi-PID select 2
13: Fault reset	32: Auxiliary reference	48: Multi-PID select 3
14: Jog forward	disabled	49: Zero-servo command
15: Jog reverse	33: Operation interrupted	50: Counter preset
16: Emergency stop	34: DC braking(at stop)	51: Counter clear
17: Inverter run disabled	35: Process PID disabled	52: Meter-counter clear
18: Coast stop	36: PID 2	53: Wobble frequency injection
-	37: 3-wire stop command	54: Wobble state reset

SB70 has eight built-in multi-function programmable digital input terminals(X1~X6, FWD and REV) and offers five expansion input terminals.

- Each digital input function listed in the table above can also be used as the output of the comparator, logic unit or timer. Refer to Section FE.
- Related monitored parameters: FU-40 and FU-41.

Description of digital input functions:

1 ~ 8: Multistep frequency 1~8. Refer to F4-17.

9~11: Accel/decel time select 1~3. The combination of accel/decel time 1, 2 and 3 determines which

accel/decel time is selected. Refer to the following table, where "0" indicates invalid, while "1" indicates valid.

Accel/decel time select 3	Accel/decel time select 2	Accel/decel time select 1	Accel/decel time
0	0	Accel/decel time 1 (F1-00, F1-01)	
0	0	1	Accel/decel time 2 (F1-02, F1-03)
0	1	0	Accel/decel time 3 (F1-04, F1-05)
0	1	1	Accel/decel time 4 (F1-06, F1-07)

1	0	0	Accel/decel time 5 (F1-08, F1-09)
1	0	1	Accel/decel time 6(F1-10, F1-11)
1	1	0	Accel/decel time 7 (F1-12, F1-13)
1	1	1	Accel/decel time 8 (F1-14, F1-15)
1			

Note: the function of accel/decel time select is invalid in simple PLC operation, jog operation or emergy stop.

12: External fault input. This signal sends the error or fault information about the peripherals into the inverter, causing the inverter to stop and giving the external fault alarm. This fault can not be reset automatically; it must be reset manually. If you need a normally-closed input, you can negate the digital input terminal by means of F4-09 or F4-10. The external fault can be indicated by the digital output 10(refer to Section 6.6).

13: Fault reset. The rising edge of this signal resets the fault. It has the same function as the key (2) on the keypad.

14 ~ 15: Jog forward/reverse. Refer to F1-37~F1-39.

16: Emergency stop. When this signal is valid, the inverter will stop according to the time set by F1-18.

17: Inverter run disabled. When this signal is valid, the inverter is prohibited to run or coasts to a stop if it is running.

18: Coast stop. If this signal is valid when the inverter is running, the inverter will block the output and the motor will coast to a stop.

19 ~ 21: UP/DOWN increase, decrease and clear. Refer to F4-12~F4-16.

22 ~ 24: PLC control disable, operation pause and standby state reset. Refer to Section 6.9.

25 ~ 31: PLC mode select 1~7. Refer to Section 6.9.

32: Auxiliary reference disabled. When this signal is valid, the auxiliary reference is invalid.

33: Operation interrupted. If this signal is valid when the inverter is running, the inverter will block the output; after this signal is canceled, the inverter will restart according to the mode set by Fb-25. This signal can be indicated by the digital input 16.

34: DC braking(at stop). During stop, if this signal is valid when the operating frequency is less than F1-26 and F1-25=2, the DC braking is introduced until the braking time exceeds F1-28 and this signal is canceled.

35: Process PID disabled. This signal invalidates the PID operation. Only when it is invalid and there is no operation mode with a higher priority than PID, can the PID operation begin.

36: PID parameter 2. If this signal is valid when F7-11=0, the second set of PID parameters(F7-08 ~ F7-10) will be selected, otherwise the first set be selected(F7-05 ~ F7-07).

37 ~ 39: 3-wire stop command, internal virtual FWD and REV terminals. Refer to F4-08.

40: Analog reference frequency hold. If this signal is valid when the reference frequency comes from the analog input, the reference frequency will not change with the analog input, otherwise it will. This function is quite useful in applications where the analog input is vulnerable to the electromagnetic disturbance. Refer to the diagram below.



41: Accel/decel disabled. When this signal is valid, the accel/decel process will stop, otherwise the accel/decel process will resume.

42: Run command source switched to terminal/keypad. This signal, in conjuction with F0-02, can switch the command source from one to another, as shown in the following table.

F0-02	State of digital input 42	Command source selected
0: Kaunad	Invalid	Keypad
0. Keypad	Valid	Terminal
1. Torminal	Invalid	Terminal
1. Terminar	Valid	Keypad
2: Communication	Invalid	Communication
2. Communication	Valid	Keypad

43: Reference frequency switched to AI1. When this signal is valid, the frequency setting channel will be forcibly switched to AI1, otherwise the frequency setting channel will be restored. If the priority is higher than digital input 44, the frequency setting channel will be switched to arithmetic unit 1.

44: Reference frequency switched to arithmetic unit 1. When this signal is valid, the frequency setting channel will be forcibly switched to arithmetic unit 1, otherwise the frequency setting channel will be restored. If the priority is lower than digital input 43, the frequency setting channel will be switched to A11.

45: Speed/torque control select. This signal switches the control mode between torque control and speed control. If it is valid, the control mode is speed control, otherwise the torque control.

46~48: Multi-PID select 1~3. The combination of multi-PID select 1, 2 and 3 determines which PID reference is selected, as shown in the table below.

Multi-PID select 3	Multi-PID select 2	Multi-PID select 1	PID reference selected
0	0	0	F7-01
0	0	1	F7-22
0	1	0	F7-23
0	1	1	F7-24
1	0	0	F7-25
1	0	1	F7-26

1	1	0	F7-27
1	1	1	F7-28

49: Zero-servo command. Refer to F9-20~F9-23.

50, 51: Counter preset and clear. Refer to F9-11~F9-16.

52: Meter-counter clear. Refer to F9-17~F9-19.

53, 54: Wobble frequency injection and wobble state reset. Refer to F9-00~F910.

F4-08	FWD/REV run mode	Default	1	Change	×
Setting range	0: 1-wire mode(start/stop) 2: 2-wire mode 2(start/stop, direction) 4: 3-wire mode 1(FWD, REV, stop)	1: 2-wire mo 3: 2-wire mo 5: 3-wire mo	de 1(FWD, RE de 3(start, stop de 2(run, direct	V)) tion, stop)	

Related digital inputs include 37, 38 and 39.

The logic and illustration for each mode are listed in the following table, where S indicats "level is valid", while B indicates "edge is valid".

F4-08	Mode		Logic	Diagram	
0	l-wire mode (start/stop)	S: Run switc runs. Note: The run direction of the	ch. When it is van direction is det e reference frequ	P12 OMX S Internal virtual P00 terminal COM	
		S2(REV)	S1(FWD)	Result	
		Invalid	Invalid	Stop	
1	2-wire mode 1	Invalid	Valid	FWD	S1 FWD terminal
	(FWD, KEV)	Valid	Invalid	REV	S2Internal virtual REV terminal
		Valid	Valid	Stop	└──
		S2(direction)	S1(start/stop)	Result	
	2-wire mode 2 (start/stop, direction)	Invalid	Invalid	Stop	
2		Invalid	Valid	FWD	S1Internal virtual FV10 terminal
		Valid	Invalid	Stop	S2Internal virtual REV terminal
		Valid	Valid	REV	<u> </u>
3	2-wire mode 3 (start, stop)	B1: Run butto B2: Stop butto Note: The run direction of th	n(normally-oper on(normally-clos direction is det e reference frequ	P12 OUK BIT Internal virtual PWD terninal Rev terninal COM	
4	3-wire mode 1 (FWD, REV, stop) Digital input 37 needed	B1: Stop button(normally-closed) B2: FWD button(normally-open) B3: REV button(normally-open)			PI2 OVK BI Coverence BE Coverence Hoterminal BC Coverence Hoterminal

5	3-wire mode 2 (Run, direction, stop) Digital input 37 needed	B1: Stop button(normally-closed)B2: Run button(normally-open)S: Direction switch. When it is valid, the motor runs reverse.	P12 OUK BIT BIT Sociation BIT Sociation BIT For an and BIT Sociation BIT
---	--	---	---

In 1-wire mode or 2-wire mode 1 and 2 under the terminal control mode, if the stop command comes from other sources and causes the inverter to stop, then the stop command must be given before the run command in oder to restart the inverter.

- In 3-wire mode 3 and 3-wire mode, the run button is invalid if the normally-closed stop button is open.
- Even if the run direction has been determined, it is still restricted by F0-09(direction lock)
- If the terminal command doesn't contain the direction informantion, the run direction will be determined by the polarity of the reference frequency channel.

Danger: When the run signal exists and Fb-26=1(default value), the inverter will self start.

F4-09	Input terminal logic 1(positive & negative)	Default	00000	Change	×
Setting range	Ten thoudands digit: X5 Thoudands digit: X4 Hundreds digit: X3 Tens digit: X2 Units digit: X1 0: Positive logic, valid when circuit is closed and invalid when circuit is open. 1: Negative logic, invalid when circuit is closed and valid when circuit is open.				
F4-10	Input terminal logic 2(positive & negative)	Default	000	Change	×
Setting range	Hundreds digit: REV Tens digit: FWD Units digit: X6 0: Positive logic, valid when circuit is closed and invalid when circuit is open. 1: Negative logic, invalid when circuit is closed and valid when circuit is open.				
F4-11	Digital input terminal anti-jittering time	Default	10ms	Change	0
Setting range	0 ~ 2000ms				

□ This parameter determines the anti-jittering time for the digital input signal. Those signals with their duration less than the anti-jittering time will be ignored.

F4-12	UP/DOWN regulation mode	Default	0	Change	0
Setting range	0: Level type(terminal)1: Pulse type(termina2: Level type(keypad)3: Pulse type(keypad)	l)			
F4-13	UP/DOWN speed/step	Default	1.00	Change	0
Setting range	0.01 ~ 100.00. Minimum unit: 0.01%/s(level type	e), 0.01%(pu	lse type)		
F4-14	UP/DOWN memory select	Default	0	Change	0
Setting range	0: Stored on power loss 1: Cleared on power loss 2: Cleared at stop or on power loss				
F4-15	UP/DOWN upper limit	Default	100.0%	Change	0
Setting range	0.0 ~ 100.0%				
F4-16	UP/DOWN lower limit	Default	0.0%	Change	0
Setting range	-100.0 ~ 0.0 %				

- The UP/DOWN function allows the continuous regulation in the switching mode. The regulated value can be used as the frequency reference or PID reference.
- □ **F4-12 = 0:** When the digital input 19 or 20 is valid, FU-20(UP/DOWN value) increases or decreases at the speed set by F4-13; when the digital inputs 19 and 20 are valid or invalid at the same time, FU-20 remains unchanged.

F4-12 = 1: When the digital input 19 or 20 is valid, FU-20 increases or decreases a step set by F4-13.

F4-12 = 2 or 3: Similar to F4-12=0 or 1 respectively, except that the digital inputs 19 and 20 are replaced by keys and on the keypad. and can be used for regulation only when the the value of FU-20 is displayed.

The two types of UP/DOWN regulation mode are shown as the following diagrams:



The rising edge of the digital input 21 clears FU-20.

F4-17	Multi-speed select mode	Default	0	Change	×		
Setting range	0: Binary code1: Direct select2: Sum3: Number						
F4-18 ~ F4-65	Multistep frequency 1 ~ 48	Default	n.00Hz (n=1 ~ 48)	Change	0		
Setting range	0.00 ~ 650.00Hz Note: Multistep frequencies 32~48 are only used for the simple PLC operation. Each multistep frequency's default setting is its respective serial number, for example, the default setting of the multistep frequency 3 is 3.00 Hz.						

F4-17=0: The multistep frequency is selected by the combination of the binary codes for the multistep frequency selects $1\sim5$ (see Section 6.5), for example, if X1~X5 are set to multistep frequency selects $1\sim5$ respectively, the frequency selecting table will be as follows, where "0" means invalid and "1" means valid.

X5	X4	X3	X2	X1	Result of selection	X5	X4	X3	X2	X1	Result of selection
0	0	0	0	0	Reference frequency for common operation	1	0	0	0	0	Multistep frequency 16 (F4-33)
0	0	0	0	1	Multistep frequency 1 (F4-18)	1	0	0	0	1	Multistep frequency 17 (F4-34)
0	0	0	1	0	Multistep frequency 2 (F4-19)	1	0	0	1	0	Multistep frequency 18 (F4-35)
0	0	0	1	1	Multistep frequency 3 (F4-20)	1	0	0	1	1	Multistep frequency 19 (F4-36)
0	0	1	0	0	Multistep frequency 4 (F4-21)	1	0	1	0	0	Multistep frequency 20 (F4-37)

0	0	1	0	1	Multistep frequency 5 (F4-22)	1	0	1	0	1	Multistep frequency 21 (F4-38)
0	0	1	1	0	Multistep frequency 6 (F4-23)	1	0	1	1	0	Multistep frequency 22 (F4-39)
0	0	1	1	1	Multistep frequency 7 (F4-24)	1	0	1	1	1	Multistep frequency 23 (F4-40)
0	1	0	0	0	Multistep frequency 8 (F4-25)	1	1	0	0	0	Multistep frequency 24 (F4-41)
0	1	0	0	1	Multistep frequency 9 (F4-26)	1	1	0	0	1	Multistep frequency 25 (F4-42)
0	1	0	1	0	Multistep frequency 10 (F4-27)	1	1	0	1	0	Multistep frequency 26 (F4-43)
0	1	0	1	1	Multistep frequency 11 (F4-28)	1	1	0	1	1	Multistep frequency 27 (F4-44)
0	1	1	0	0	Multistep frequency 12 (F4-29)	1	1	1	0	0	Multistep frequency 28 (F4-45)
0	1	1	0	1	Multistep frequency 13 (F4-30)	1	1	1	0	1	Multistep frequency 29 (F4-46)
0	1	1	1	0	Multistep frequency 14 (F4-31)	1	1	1	1	0	Multistep frequency 30 (F4-47)
0	1	1	1	1	Multistep frequency 15 (F4-32)	1	1	1	1	1	Multistep frequency 31 (F4-48)

F4-17=1: The multistep frequency selects $1 \sim 8$ (see Section 6.5) directly correspond to the multistep frequencies $1 \sim 8$ respectively, for example, if X1 \sim X8 are set to multistep frequency selects $1 \sim 8$, the frequency selecting table will be as follows, where "0" indicates invalid, "1" indicates valid and "—" indicates any state.

X8	X7	X6	X5	X4	X3	X2	X1	Result of selection
0	0	0	0	0	0	0	0	Reference frequency for common operation
-	-	-	-	-	-	-	1	Multistep frequency 1 (F4-18)
-	-	-	-	-	-	1	0	Multistep frequency 2 (F4-19)
-	-	-	-	-	1	0	0	Multistep frequency 3 (F4-20)
-	-	-	-	1	0	0	0	Multistep frequency 4 (F4-21)
-	-	-	1	0	0	0	0	Multistep frequency 5 (F4-22)
-	-	1	0	0	0	0	0	Multistep frequency 6 (F4-23)
-	1	0	0	0	0	0	0	Multistep frequency 7 (F4-24)
1	0	0	0	0	0	0	0	Multistep frequency 8 (F4-25)

F4-17 = 2: The reference frequency equals the sum of all the multistep frequencies selected, but it is still

restricted by the upper- and lower-limit frequencies.

Example: if only "multistep frequency select 1", "multistep frequency select 2" and "multistep frequency select 4" are valid, then

Reference frequency= multistep frequency 1+ multistep frequency 3+multistep frequency 4

F4-17=3: The number of the valid signal(s) among multistep frequency selects $1 \sim 8$ determines which multistep frequency is used as the reference, for example, if any three of them are valid, then reference frequency=multistep frequency 3.

6.6 F5: Digital output and relay outputs

F5-00	Y1 terminal	Default	1	Change	×
F5-01	Y2 terminal	Default	2	Change	×
F5-02	T1 relay output	Default	5	Change	×
F5-03	T2 relay output	Default	13	Change	×
Setting range	$0 \sim 68$. Refer to the table of digital output function	ons below.			

Related monitored parameter: FU-42.

Table of digital output functions

 0: Inverter ready 1: Inverter running 2: Frequency reach 3: Frequency reach detection signal 1 4: Frequency reach detection signal 2 5: Fault output 6: Holding brake signal 7: Motor load overweight 8: Motor overload 9: Undervoltage lockout 10: External fault trip 11: Fault auto-reset 12: Restart after momentary power failure 13: Alarm output 14: Reverse running 15: Stopping 16: Run interruption 17: Keypad control 18: Torque limit 19: Frequency upper limit 20: Frequency lower limit 21: Running in generating state 22: Running at zero speed 23: Zero-servo finished 	 24: PLC operation 25: PLC operation pause 26: PLC stage finished 27: PLC cycle finished 28: PC digital 1 29: PC digital 2 30: Wobble frequency upper/lower limit 31: Setpoint count reach 32: Designated count reach 33: Meter-counter setpoint length reach 34: X1(after positive & negative logic) 35: X2(after positive & negative logic) 36: X3(after positive & negative logic) 37: X4(after positive & negative logic) 38: X5(after positive & negative logic) 39: X6(after positive & negative logic) 39: X6(after positive & negative logic) 39: X6(after positive & negative logic) 31: St(after positive & negative logic) 32: X5(after positive & negative logic) 33: X1(expansion terminal) 41: X8(expansion terminal) 42: X9(expansion terminal) 43: X11(expansion terminal) 44: K11(expansion terminal) 45: FWD(after positive & negative logic) 46: REV(after positive & negative logic) 	 48: Comparator 2 output 49: Logic unit 1 output 50: Logic unit 2 output 51: Logic unit 3 output 52: Logic unit 4 output 53: Timer 1 output 54: Timer 2 output 55: Timer 3 output 56: Timer 4 output 57: Encoder A channel 59: PFI terminal status 60: Virtual revolution-counting pulse 61: PLC mode 0 indication 63: PLC mode 1 indication 64: PLC mode 2 indication 65: PLC mode 4 indication 66: PLC mode 5 indication 67: PLC mode 6 indication 68: PLC mode 6 indication 69: Designated count 2 reach 70: Logic unit 6 output
	logic) 46: REV(after positive & negative logic)	

47: Comparator 1 output

Detailed description of digital output functions:

0: Inverter ready. The inverter is ready to run.

1: Inverter running. The inverter is in operation.

2: Frequency reach. This signal is valid when the inverter operating frequency falls in the range between reference frequency minus F5-05 and reference frequency plus F5-05. Refer to F5-05.

3 ~ 4: Frequency reach detection signals 1 & 2. Refer to F5-06 ~ F5-09.

5: Fault output. It's valid if any failure occurs.

6: Holding brake signal. Refer to F1-25.

7: Motor load overweight. Refer to Fb-03~Fb-05.

8: Motor overload. Refer to Fb-01~Fb-02.

9: Undervoltage lockout. This signal is valid when DC bus undervoltage causes trip.

10: External fault trip. This signal is valid when an external fault causes trip and becomes invalid after fault reset.

11: Fault auto-reset. This signal is valid when fault auto-reset is in process.Refer to Fb-22~Fb-24

12: Restart after momentary power failure. Refer to Fb-25.

13: Alarm output. This signal is valid when the inverter gives an alarm.

14: Reverse running. This signal is valid when the inverter is running reverse.

15: Stopping. This signal is valid when the inverter is in the process of slowdown stop.

16: Run interruption. This signal is valid when the inverter's running is interrupted.

17: Keypad control. This signal is valid when the keypad is used as the command source.

18: Torque limit. This signal is valid when the torque reached the limit value.

19: Frquency upper limit. This signal is valid when reference frequency apper-limit frequency and the operating frequency rises to the upper-limit frequency.

20: Frequency lower limit. This signal is valid when reference frequency ≤ lower-limit frequency and the operating frequency falls to the lower-limit frequency.

21: Running in generating state. This signal is valid when the inverter is running in the generating state.

22: Running at zero speed. This signal is valid when the motor speed is lower than F9-21.

23: Zero-servo finished. This signal is valid when the zero-servo position error is less than the zero-servo ending value.

24: PLC operation. This signal is valid when the inverter is in the simple PLC operation mode.

25: PLC operation pause. This signal is valid when the digital input 23 is valid.

26: PLC stage finished. A 500ms pulse is sent out each time a stage of PLC operation is completed.

27: PLC cycle finished. A 500ms pulse is sent out each time a cycle of PLC operation is completed.

28 ~ 29: PC digitals 1 & 2. Can be used by the programmable unit. Refer to Section 6.16.

30: Wobble frequency upper/lower limit. Refer to Secton 6.10.

31, 32, 69: Setpoint count reach, designated count 1 & 2 reach. Refer to section 6.10.

33: Meter-counter setpoint length reach. Refer to section 6.10.

34 ~ 39: X1 ~ X6(after positive & negative logic). These are digital input signals which have undergone positive & negative logic operation and anti-jittering treatment. They can be used by the programmable unit.

40 ~ 44: X7 ~ X11(expansion terminals). These are expansion digital input signals which have undergone anti-jittering treatment and can be used by the programmable unit.

45, 46: FWD and REV(after positive & negative logic). These are digital input signals which have undergone positive & negative logic operation and anti-jittering treatment. They can be used by the programmable unit.

47, 48: Comparator 1 & 2 outputs. Can be used by the programmable unit.

49 ~ 52, 70, 71: Logic unit 1~6 outputs. Can be used by the programmable unit.

53 ~ 56: Timer 1~4 outputs. Can be used by the programmable unit.

57, 58: Encoder A & B channels. Can be used as the high-speed input of the counter and meter-counter.

59: PFI terminal status. Can be used as the high-speed input of the counter and meter-counter.

60: Virtual revolution-counting pulse. It is a pulse signal with a duty ratio of 50%. It can be connected to the counter for the calculation of the winding diameter in winding control.

61 ~ 68: PLC mode 0~7 indication. Used to indicate the serial number of current PLC mode

F5-04	Y output logic(positive & negative)	Default	00	Change	×
Setting range	Tens digit: Y2 Units digit: Y1 0: Positive logic, valid when closed and invalid w 1: Negative logic, valid when open and invalid w	hen open nen closed			

This parameter can negate the Y1 and Y2 signals and output them.

F5-05	Frequency reach detection band	Default	2.50Hz	Change	0
Setting range	0.00 ~ 650.00Hz				

The frequency reach signal is sent out when the inverter operating frequency is in the range between reference frequency minus F5-05 and reference frequency plus F5-05, as shown below.



F5-06	Frequency reach detection level 1	Default	50.00Hz	Change	0
F5-07	Frequency reach detection hysteresis 1	Default	1.00Hz	Change	0
F5-08	Frequency reach detection level 2	Default	25.00Hz	Change	0

F5-09	Frequency reach detection hysteresis 2	Default	1.00Hz	Change	0
Setting range	0.00 ~ 650.00Hz				

□ The digital output 3 or 4(frequency reach detection signal) is valid when the operating frequency is greater than the F5-06 or F5-08. It becomes invalid when the operating frequency is less than "frequency reach detection level-frequency reach detection hysteresis". Refer to the diagram below.



F5-10	Y1 terminal closing delay	Default	0.00s	Change	0
F5-11	Y1 terminal opening delay	Default	0.00s	Change	0
F5-12	Y2 terminal closing delay	Default	0.00s	Change	0
F5-13	Y2 terminal opening delay	Default	0.00s	Change	0
F5-14	T1 terminal closing delay	Default	0.00s	Change	0
F5-15	T1 terminal opening delay	Default	0.00s	Change	0
F5-16	T2 terminal closing delay	Default	0.00s	Change	0
F5-17	T2 terminal opening delay	Default	0.00s	Change	0
Setting range	0.00 ~ 650.00s				

The digital output delay is illustrated as follows.



6.7 F6: Analog and pulse frequency terminals

F6-00	AI1 input type	Default	0	Change	0

Setting range	0: 0 ~ 10V or 0 ~ 20mA(corresponding to 0 ~ 100%) 1: 10 ~ 0V or 20 ~ 0mA(corresponding to 0 ~ 100%) 2: 2 ~ 10V or 4 ~ 20mA(corresponding to 0 ~ 100%) 3: 10 ~ 2V or 20 ~ 4mA(corresponding to 0 ~ 100%) 4: -10 ~ 10V or -20 ~ 20mA(corresponding to -100 ~ 100%) 5: 10 ~ -10V or 20 ~ -20mA(corresponding to -100 ~ 100%) 6: 0 ~ 10V or 0 ~ 20mA(corresponding to -100 ~ 100%, with 5V or 10mA at the center) 7: 10 ~ 0V or 20 ~ 0mA(corresponding to -100 ~ 100%, with 5V or 10mA at the center) Note: The jumper on the control board chooses whether the input is a voltage-type or current-type input.					
F6-01	AI1 gain	Default	100.0%	Change	0	
Setting range	0.0 ~ 1000.0%					
F6-02	AI1 bias	Default	0.00%	Change	0	
Setting range	-99.99 ~ 99.99%(10V or 20mA=100%)					
F6-03	AI1 filtering time	Default	0.100s	Change	0	
Setting range	0.000 ~ 10.000s					
F6-04	AI1 zero-point threshold Default 0.0% Change o					
Setting range	0.0 ~ 50.0 %					
F6-05	AI1 zero-point hysteresis error	Default	0.0%	Change	0	
Setting range	0.0 ~ 50.0 %					
F6-06	AI1 disconnection threshold	Default	0.0%	Change	0	
Setting range	0.0 ~ 20.0%(10V or 20mA=100%) Note: For 2 ~ 10V/ 4 ~ 20mA or 10 ~ 2V/20 ~ 4 fixed at 10%; for -10 ~ 10V/-20 ~ 20mA or 10 ~ not performed.	4mA, the int -10V/20 ~ -	eral disconnect 20mA, the disc	tion thresho onnection te	ld is est is	
F6-07	AI2 input type	Default	0	Change	0	
F6-08	AI2 gain	Default	100.0%	Change	0	
F6-09	AI2 bias	Default	0.00%	Change	0	
F6-10	AI2 filtering time	Default	0.100s	Change	0	
F6-11	AI2 zero-point threshold	Default	0.0%	Change	0	
F6-12	Al2 zero-point hysteresis errorDefault0.0%Changeo					
F6-13	AI2 disconnection threshold	Default	0.0%	Change	0	
Setting range	All settings for AI2 are the same as those for AI1					

The table below lists the calculation formulas, characteristic curves and regulation diagrams for analog inputs(dotted lines represent factory settings while the solid ones represent regulated settings).

Input	Calculation formula for output	Basic curve	Bias = 10.00%	Gain = 200.0%
0~10V or 0~20mA (corresponding to 0~100%)	Output=gain×(input-bias) (result confined to 0~100%)	0 101/20mA	0 100%	0 100%
10~0V or 20~0mA (corresponding to 0~100%)	Output=gain×[-(input-bias) + 100%] (result confined to 0~100%)	0 100%	0 100%	0 100%
0~10V (corresponding to -100~100%, with 5V at the center)	Output=gain×2× [(input-bias) -50%] (result confined to -100~100%)	▲100% 	▲100% 7 100 - 100%	▲100% // I 10V - 100%
10~0V (corresponding to -100~100%, with 5V at the center)	Output=gain×(-2)× [(input-bias)-50%] (result confined to -100~100%)			▲100 % 10V - 100%
-10~10V or -20~20mA (corresponding to -100~100%)	Output=gain×(input-bias) (result confined to -100~100%)			
10~-10V or 20~-20mA (corresponding to -100~100%)	Output=gain×[-(input-bias)] (result confined to -100~100%)	- 100% 10V -10V -100%		100% 10V -10V -10V -100%
2~10V or 4 ~ 20mA (corresponding to 0~100%)	Output=gain×[5/4× (input-bias) -25%] (result confined to 0~100%)	100%	100% 1 1 1 1 2V/4nA 10V/20nA	100%
10~2V or 20 ~ 4mA (corresponding to 0~100%)	Output=gain×[-5/4× (input-bias)+125%] (result confined to 0~100%)	2V/ 4mA 10V/ 20mA	2V/4mA 10V/20mA	2V/ 4mA 10V/ 20mA

□ "Zero-point threshold" and "zero-point hysteresis error" prevent the analog input signal fluctuating around the zero point. For example, setting the former to 10.0% and the latter to 5.0% can bring the hysteresis effect shown in the following diagram.



- Increasing the filtering time slows down the response, but strengthens the immunity to the disturbance. Reducing the filtering time speed up the response, but weakens the immunity.
- Analog input is considered to be disconnected if it is lower than the disconnection threshold. The action after the disconnection is determined by Fb-09.

F6-14	AO1 function	Default	0	Change	0	
Setting range	See the table of analog output functions below.					
F6-15	AO1 type	Default	0	Change	0	
Setting range	0: 0 ~ 10V or 0 ~ 20mA 1: 2 ~ 10V or 4 ~ 20mA 2: 5V c			at the center	er	
F6-16	AO1 gain	Default	100.0%	Change	0	
Setting range	0.0 ~ 1000.0 %					
F6-17	AO1 bias	Default	0.00%	Change	0	
Setting range	-99.99 ~ 99.99%(10V or 20mA=100%)					
F6-18	AO2 function	Default	2	Change	0	
F6-19	AO2 type	Default	0	Change	0	
F6-20	AO2 gain	Default	100.0%	Change	0	
F6-21	AO2 bias	Default	0.00%	Change	0	
Setting range	All settings for AO2 are the same as those for AO	All settings for AO2 are the same as those for AO1.				

Table of analog output functions:

0: Operating frequency (Max.	12: PFI	26: Low-pass filter 2 output	
frequency= full-scale value)	13: UP/DOWN value	27: Analog multiple switching	
1: Reference frequency (Max.	14: DC link voltage	output	
frequency =full-scale value)	(1000V=full-scale value)	28: Comparator 1 digital setting	
2: Output current (2 times inverter	15: Reference frequency after	29: Comparator 2 digital setting	
rated current=full-scale value)	accel/decel (Max.	30: Arithmetic unit 1digital setting	
3: Output voltage (1.5 times inverter	frequency=full-scale value)	31: Arithmetic unit 2digital setting	
rated voltage=full-scale value)	16: PG detection frequency (Max.	32: Arithmetic unit 3digital setting	
4: Output capacity (2 times motor	frequency=full-scale value)	33: Arithmetic unit 4digital setting	
rated capacity=full-scale value)	17: Counter error (setpoint	34: Arithmetic unit 5digital setting	
5: Output torque (2.5 times motor	count=full-scale value)	35: Arithmetic unit 6digital setting	
rated torque=full-scale value)	18: Count percentage (setpoint	36: PC analog 1	
6: Reference torque (2.5 times motor	count=full-scale value)	37: PC analog 2	
rated torque=full-scale value)	19: Arithmetic unit 1 output	38: Factory output 1	
7: PID feedback value	20: Arithmetic unit 2 output	39: Factory output 2	
8: PID reference value	21: Arithmetic unit 3 output	40: Output frequency(for factory	
9: PID output value	22: Arithmetic unit 4 output	use)	
10: AI1	23: Arithmetic unit 5 output	41: Keypad POT value(POT:	
11: AI2	24: Arithmetic unit 6 output	potentiometer)	
	25: Low-pass filter 1 output	^	

Analog output has the following three types:



Adjusting the gain and bias can change the measuring range and correct the zero point. The calculation formula is: Y=X×gain+bias(X is any item in the table of analog output functions).

F6-22	PFI frequency corresponding to 100%	Default	10000Hz	Change	0
F6-23	PFI frequency corresponding to 0%	Default	0Hz	Change	0
Settting range	0~50000Hz				
F6-24	PFI filtering time	Default	0.100s	Change	0
Setting range	0.000 ~ 10.000s				

The PFI function converts the input pulse frequency to a percentage value and filters it, as shown below. PFI can be used as the frequency reference for cascade synchronous control, or as the PID feedback for constant line speed control.



E6 25	DEO function	Default	0	Change	0	
F0-25	PFO luncuon	Delault	0	Change	0	
Setting	See the table of analog output functions.					
range						
F6-26	PFO output pulse modulation method	Default	0	Change	0	
Setting range	0: Frequency modulation	1: Duty-ratio	o modulation			
F6-27	PFO frequency corresponding to 100%	Default	10000Hz	Change	0	
Setting range	0 ~ 50000Hz(also used as the duty-ratio modulation frequency)					
F6-28	PFO frequency corresponding to 0%	Default	0Hz	Change	0	
Setting range	0~50000Hz	1				
F6-29	PFO duty ratio corresponding to 100%	Default	100.0%	Change	0	
F6-30	PFO duty ratio corresponding to 0%	Default	0.0%	Change	0	
Setting range	0.0~100.0%					

PFO function outputs the internal percentage signal in the format of pulse frequency or duty ratio, as shown below.



□ In frequency modulation, the duty ratio is fixed at 50%. In duty-ratio modulation, the pulse frequency is fixed at F6-27.

6.8 F7: Process PID parameters

F7-00	PID control select	Default	0	Change	×
Setting range	0: PID control disabled 1: PID control enabled(PID output: max. frequence 2: PID corrects reference frequency prior to accell 3: PID corrects reference frequency after accel/de 4: PID corrects torque(PID output: 2.5 times motors) 5: Free PID function	cy=100%) /decel(PID o cel(PID outp or rated torqu	utput: max. free out: max. freque ue=100%)	quency=100 ncy=100%)	%)

Process PID can be used for the control of process variables such as tension, pressure, flowrate, liquid level and temperature. The proportional(P) element can reduce the error. The integral(I) element can eliminate the static error. The longer the integral time, the weaker the integral action; the shorter the integral time, the stronger the integral action. The differential(D) element can increase the response speed of the control. The structure of process PID is as follows.



Process PID has three types of correction mode: reference frequency correction prior to accel/decel, reference frequency correction after accel/decel, and torque correction. These correction modes make it convenient to use the inverter in master-slave synchronous control and tension control.

Reference frequency correction prior to accel/decel: PID output is added to the reference frequency prior to accel/decel.



Reference frequency correction after accel/decel: PID output is added to the reference frequency after accel/decel. Unlike the previous correction mode, this mode can also perform the correction during accel/decel.

Torque correction: PID output is added to the reference torque. This correction mode is only valid for torque control. As this correction mode has the fastest response, it can be used for synchronous control of a rigidly-connected system.



Free PID function: PID acts as a programmable module. Its input and output can be defined separately. PID output can be connected to the analog output.

F7-01	PID reference channel	Default	0	Change	×

Setting range	0: F7-04 3: PFI 6: Arithmetic unit 2	1: AI1 4: UP/DOWN 7: Arithmetic	l val unit	lue t 3	2: AI2 5: Arithmetic 8: Arithmetic	unit 1 unit 4	
F7-02	PID feed	back channel		Default	0	Change	×
Setting range	0: AI1 1: AI2 5: $\sqrt{ AI1 }$ 9: Arithmetic unit 1	2: PFI 6:√[AI2] 10: Arithmetic unit 2	3: 7:- 11	AI1-AI2 $\sqrt{ AI1 - AI2 }$: Arithmetic	4: AI1 8: √ AI unit 3 12: Ar	+AI2 $\overline{I} + \sqrt{ AI2 }$ ithmetic unit	t 4
F7-03	PID disp	lay coefficient		Default	1.000	Change	0
Setting range	0.010 ~ 10.000(only	affects FU-13 and FU-1	4)				
F7-04	PID dig	ital reference		Default	0.0%	Change	0
Setting range	-100.0 ~ 100.0%						

PID process adopts normalized input and output, that is, both the input and output range are between -100%~+100%. The input scaling is related to feedback channel, sensor characteristics and analog input setting. The output scaling takes the maximum frequency as 100% for frequency control.

There is a filtering section for the PID reference channel and feedback channel, for example, the filtering time for AI1 is F6-03. These filtering sections have influence on the control performance and can be set according to the actual needs.

In some machines(such as centrifuges), the square root of the inlet pressure has a linear relationship with the flowrate, therefore, the square root feedback can be used to control the flowrate.

F7-03 is used to scale FU-13 and FU-14, making them match the real physical units. It has no influence on the control.

F7-05	Proportional gain 1	Default	0.20	Change	0
Setting range	0.00 ~ 100.00				
F7-06	Integral time 1	Default	20.00s	Change	0
Setting range	0.01 ~ 100.00s				
F7-07	Differential time 1	Default	0.00s	Change	0
Setting range	0.01 ~ 10.00s				
F7-08	Proportional gain 2	Default	0.20	Change	0
Setting range	0.00 ~ 100.00				
F7-09	Integral time 2	Default	20.00s	Change	0
Setting range	0.01 ~ 100.00s				
F7-10	Differential time 2	Default	0.00s	Change	0
Setting range	0.01 ~ 10.00s				
F7-11	PID parameter switching	Default	0	Change	×
Setting range	0: By digital input 361: According3: Arithmetic unit 2 4: Arithmetic	to operating unit 3	frequency 2: A 5: A	Arithmetic un Arithmetic un	nit 1 nit 4

SB70 has two sets of PID parameters: PID parameter 1(F7-05, F7-06, F7-07) and PID parameter 2(F7-08, F7-09, F7-10). They can be switched mutually by the digital input 36. They can also be smoothly switched according to the operating frequency or the arithmetic unit output, particularly suitable for the winding control where the winding diameter changes greatly.



Principle of PID parameter regulation: first raise the proportional gain from a smaller value(e.g. 0.20) until the feedback signal starts oscillating, then lower it by 40~60% to stabilize the feedback signal; reduce the integral time from a larger value(e.g. 20.00s) until the feedback signal starts oscillating, then raise it by 10~50% to stabilize the feedback signal. Differential action can be introduced if there is a high requirement for overshoot and dynamic error.

F7-12	Sampling period	Default	0.010s	Change	0
Setting range	0.001 ~ 10.000s				

It should be generally set to a value five to ten times smaller than the response time of the controlled object.

F7-13	Error limit	Default	0.0%	Change	0
Setting range	0.0 ~ 20.0 %(PID setpoint=100%)				

When the error of the setpoint and feedback is less than the error limit, PID stops its regulation and the output remains constant. This function eliminates frequent actions during the control. See the following diagram.



F7-14	Setpoint up/down time	Default	0.00s	Change	0
Setting range	0.00 ~ 20.00s				

This parameter enables the setpoint to increase and decrease smoothly, thus reducing the impact generated at the moment PID is introduced.

F7-15	PID regulation characteri	stic	Default	0	Change	×
Setting range	0: Positive	1:1	Negative			

Positive" means when the setpoint is increased the speed is required to be increase, for example, in heating control; while "negative" means when the setpoint is increased the speed is required to be lowered, for example, in cooling control.

F7-16	Integral regulation	Default	1	Change	×
Setting range	0: Didabled 1: E	nabled			
F7-17	PID upper limit	Default	100.0%	Change	0
Setting range	F7-18 ~ 100.0 %				
F7-18	PID lower limit	Default	0.0%	Change	0
Setting range	-100.0% ~ F7-17				·
F7-19	PID differential limit	Default	5.0%	Change	0
Setting range	$0.0 \sim 100.0\%$ (limits the max. and min. value of	of differential co	omponent)		

Moderate limitation of PID can reduce overshoot. Excessive limitation should be avoided.

F7-20	PID preset	Default	0.0%	Change	0
Setting range	F7-18 ~ F7-17				
F7-21	PID preset holding time	Default	0.0s	Change	×
Setting range	0.0 ~ 3600.0s				

PID preset: the PID output remains as the preset value within the preset holding time; this is equivalent to an open-loop control. At the end of the preset, the initial value of the PID integrator is assigned the preset value and the PID close-loop control begins. See the diagram below.



If F7-21=0, PID control is performed with the preset value being the integrator initial value. This can speed up the response at the start.

F7-22	Multi-PID setpoint 1	Default	1.0%	Change	0
F7-23	Multi-PID setpoint 2	Default	2.0%	Change	0
F7-24	Multi-PID setpoint 3	Default	3.0%	Change	0
F7-25	Multi-PID setpoint 4	Default	4.0%	Change	0
F7-26	Multi-PID setpoint 5	Default	5.0%	Change	0

F7-27	Multi-PID setpoint 6	Default	6.0%	Change	0
F7-28	Multi-PID setpoint 7	Default	7.0%	Change	0
Setting range	-100.0 ~ 100.0%				

Used for multi-PID control. Refer to digital inputs 46~48 in Section 6.5.

6.9 F8: Simple PLC

F8-00	PLC operation setting	Default	0000	Change	×						
	Units digit: PLC cycle mode 0: PLC operation disabled 1: N cycles(cycle number decided by F8-02)+stop 2: N cycles+final stage speed (cycle number decided by F8-02) 3: Continuous cycle										
Setting range	Tens digit: PLC restart mode 0: Restart from the first stage 1: Restart from the frequency of the interrupted stage 2: Restart from the operating frequency at the moment of interruption										
	Hundreds digit: Whether to save PLC status para 0: Not store 1: Store	meters after p	ower-off								
	Thousands digit: Unit of time for each stage 0: Second 1: Minute			1							
F8-01	PLC mode	Default	00	Change	×						
Setting range	Units digit: PLC mode/stage number 0: 1×48, 1 mode(mode 0), 48 stages 1: 2×24, 2 modes(mode 0~1), 24 stages for each mode 2: 3×16, 3 modes(mode 0~2), 16 stages for each mode 3: 4×12, 4 modes(mode 0~3), 12 stages for each mode 4: 6×8, 6 modes(mode 0~5), 8 stages for each mode 5: 8×6, 8 modes(mode 0~7), 6 stages for each mode Tens digit: PLC mode select 0: Binary code select 1: Direct select 2: Mode 0 3: Mode 1 4: Mode 2										
F8-02	PLC cycle number	Default	1	Change	×						
Setting range	1 ~ 65535			1							
F8-03	Stage 1 setting	Default	00	Change	0						
G	Units digit: Direction 0: Forward 1: Reverse										
range	Tens digit: Accel/decel time select										
Tunge	0: Accel/decel 1 1: Accel/decel 2 2 4: Accel/decel 5 5: Accel/decel 6 6	: Accel/decel : Accel/decel	3 3: Ac 7 7: Ac	ccel/decel 4 ccel/decel 8							
F8-04	Stage 1 time	Default	0.0	Change	0						
Setting range	$0.0 \sim 6500.0$ (second or minute). The time unit is	determined b	y the thousand	s digit of F8	-00.						

The settings for stages 2~48 are similar to that for stage 1. The default value of the multistep frequency n equals its respective stage number. Refer to the following table.

n	1	2	3	4	5	6	7	8
Stage n setting	F8-03	F8-05	F8-07	F8-09	F8-11	F8-13	F8-15	F8-17
Stage n time	F8-04	F8-06	F8-08	F8-10	F8-12	F8-14	F8-16	F8-18
Multistep frequency n	F4-18	F4-19	F4-20	F4-21	F4-22	F4-23	F4-24	F4-25
n	9	10	11	12	13	14	15	16
Stage n setting	F8-19	F8-21	F8-23	F8-25	F8-27	F8-29	F8-31	F8-33
Stage n time	F8-20	F8-22	F8-24	F8-26	F8-28	F8-30	F8-32	F8-34
Multistep frequency n	F4-26	F4-27	F4-28	F4-29	F4-30	F4-31	F4-32	F4-33
n	17	18	19	20	21	22	23	24
Stage n setting	F8-35	F8-37	F8-39	F8-41	F8-43	F8-45	F8-47	F8-49
Stage n time	F8-36	F8-38	F8-40	F8-42	F8-44	F8-46	F8-48	F8-50
Multistep frequency n	F4-34	F4-35	F4-36	F4-37	F4-38	F4-39	F4-40	F4-41
n	25	26	27	20	20	20	21	22
11	25	20	21	20	29	30	51	32
Stage n setting	F8-51	F8-53	F8-55	F8-57	F8-59	F8-61	51 F8-63	52 F8-65
Stage n setting Stage n time	F8-51 F8-52	F8-53 F8-54	F8-55 F8-56	F8-57 F8-58	F8-59 F8-60	F8-61 F8-62	F8-63 F8-64	52 F8-65 F8-66
Stage n setting Stage n time Multistep frequency n	23 F8-51 F8-52 F4-42	20 F8-53 F8-54 F4-43	F8-55 F8-56 F4-44	F8-57 F8-58 F4-45	F8-59 F8-60 F4-46	50 F8-61 F8-62 F4-47	51 F8-63 F8-64 F4-48	32 F8-65 F8-66 F4-49
Stage n setting Stage n time Multistep frequency n n	23 F8-51 F8-52 F4-42 33	20 F8-53 F8-54 F4-43 34	F8-55 F8-56 F4-44 35	26 F8-57 F8-58 F4-45 36	29 F8-59 F8-60 F4-46 37	50 F8-61 F8-62 F4-47 38	51 F8-63 F8-64 F4-48 39	52 F8-65 F8-66 F4-49 40
Stage n setting Stage n time Multistep frequency n n Stage n setting	23 F8-51 F8-52 F4-42 33 F8-67	20 F8-53 F8-54 F4-43 34 F8-69	27 F8-55 F8-56 F4-44 35 F8-71	26 F8-57 F8-58 F4-45 36 F8-73	29 F8-59 F8-60 F4-46 37 F8-75	30 F8-61 F8-62 F4-47 38 F8-77	S1 F8-63 F8-64 F4-48 39 F8-79	52 F8-65 F8-66 F4-49 40 F8-81
Stage n setting Stage n time Multistep frequency n n Stage n setting Stage n time	23 F8-51 F8-52 F4-42 33 F8-67 F8-68	26 F8-53 F8-54 F4-43 34 F8-69 F8-70	27 F8-55 F8-56 F4-44 35 F8-71 F8-72	26 F8-57 F8-58 F4-45 36 F8-73 F8-74	29 F8-59 F8-60 F4-46 37 F8-75 F8-76	30 F8-61 F8-62 F4-47 38 F8-77 F8-78	31 F8-63 F8-64 F4-48 39 F8-79 F8-80	32 F8-65 F8-66 F4-49 40 F8-81 F8-82
Image: Stage n setting Stage n time Multistep frequency n n Stage n setting Stage n time Multistep frequency n	25 F8-51 F8-52 F4-42 33 F8-67 F8-68 F4-50	26 F8-53 F8-54 F4-43 34 F8-69 F8-70 F4-51	27 F8-55 F8-56 F4-44 35 F8-71 F8-72 F4-52	26 F8-57 F8-58 F4-45 36 F8-73 F8-74 F4-53	23 F8-59 F8-60 F4-46 37 F8-75 F8-76 F4-54	50 F8-61 F8-62 F4-47 38 F8-77 F8-78 F4-55	31 F8-63 F8-64 F4-48 39 F8-79 F8-80 F4-56	32 F8-65 F8-66 F4-49 40 F8-81 F8-82 F4-57
Stage n setting Stage n time Multistep frequency n n Stage n setting Stage n time Multistep frequency n n	25 F8-51 F8-52 F4-42 33 F8-67 F8-68 F4-50 41	26 F8-53 F8-54 F4-43 34 F8-69 F8-70 F4-51 42	27 F8-55 F8-56 F4-44 35 F8-71 F8-72 F4-52 43	26 F8-57 F8-58 F4-45 36 F8-73 F8-74 F4-53 44	23 F8-59 F8-60 F4-46 37 F8-75 F8-76 F4-54 45	30 F8-61 F8-62 F4-47 38 F8-77 F8-78 F4-55 46	31 F8-63 F8-64 F4-48 39 F8-79 F8-80 F4-56 47	32 F8-65 F8-66 F4-49 40 F8-81 F8-82 F4-57 48
Image: Non-Stage n setting Stage n time Multistep frequency n n Stage n setting Stage n time Multistep frequency n n Stage n setting	25 F8-51 F8-52 F4-42 33 F8-67 F8-68 F4-50 41 F8-83	26 F8-53 F8-54 F4-43 34 F8-69 F8-70 F4-51 42 F8-85	27 F8-55 F8-56 F4-44 35 F8-71 F8-72 F4-52 43 F8-87	26 F8-57 F8-58 F4-45 36 F8-73 F8-74 F4-53 44 F8-89	23 F8-59 F8-60 F4-46 37 F8-75 F8-76 F4-54 45 F8-91	30 F8-61 F8-62 F4-47 38 F8-77 F8-78 F4-55 46 F8-93	31 F8-63 F8-64 F4-48 39 F8-79 F8-80 F4-56 47 F8-95	32 F8-65 F8-66 F4-49 40 F8-81 F8-82 F4-57 48 F8-97
Image: Image of the setting Stage n setting Multistep frequency n Image: Image of the setting Stage n setting Stage n time Multistep frequency n Image: Image of the setting Stage n time	23 F8-51 F8-52 F4-42 33 F8-67 F8-68 F4-50 41 F8-83 F8-84	26 F8-53 F8-54 F4-43 34 F8-69 F8-70 F4-51 42 F8-85 F8-86	27 F8-55 F8-56 F4-44 35 F8-71 F8-72 F4-52 43 F8-87 F8-88	26 F8-57 F8-58 F4-45 36 F8-73 F8-74 F4-53 44 F8-89 F8-90	23 F8-59 F8-60 F4-46 37 F8-75 F8-76 F4-54 45 F8-91 F8-92	30 F8-61 F8-62 F4-47 38 F8-77 F8-78 F4-55 46 F8-93 F8-94	31 F8-63 F8-64 F4-48 39 F8-79 F8-80 F4-56 47 F8-95 F8-96	32 F8-65 F8-66 F4-49 40 F8-81 F8-82 F4-57 48 F8-97 F8-98

The simple PLC function allows the automatic switching of reference frequencies according to the preset run time, thus realizing the automation of the production process.

PLC restart mode is determined by the tens digit of F8-00. When PLC operation is interrupted(failure or stop), it can restart from the first stage, from the frequency of the interrupted stage, or from the operating frequency at the moment of interruption. Refer to the following diagrams. The start mode is determined by F1-19.

In all diagrams in this section, fn represents stage n's multistep frequency n, an and dn represent stage n's accel and decel time respectively, and Tn stands for stage n's time. n=1~48.





- PLC status can be stored when power is off, so that it can continue running from the stop status. For example, the unfinished operation of the previous day can be continued when you turn on the power the next day.
- PLC status will be automatically reset when F8-00, F8-01 or F8-02 is modified.
- SB70's multiple PLC modes can be used to control the manufacture of different product models. For example, if a cement plant manufactures cement columns of six sizes, and each size needs an eight-stage of PLC operation, then the units digit of F8-01 can be set to 4(6 modes, 8 stages for each mode).
- Switching PLC modes during running will takes effect after the stop. The maximum mode number available is determined by the units digit of F8-01.

1 mode×48 stages		Mode 0										
Stages contained in each mode		Stage 1 ~ 48										
2 modes×24 stages			Mo	de 0			Mode 1					
Stages contained in each mode		1~24						25 -	- 48			
3 modes×16 stages	Mode 0					Mo	de 1			Moo	le 2	2
Stages contained in each mode	1~16				17 ~ 32				33~48			
4 modes×12 stages	Mo	de ()	1	Mode 1 Mode 2		de 2	2 Mode			le 3	
Stages contained in each mode	1~	1~12 13~24 25~3			- 36)	3	57~	- 48			
6 modes×8 stages	Mode ()	Mo	de 1		Mode 2	Mode	3	Mo	de 4	N	Aode 5
Stages contained in each mode	1~8		9~	16		17~24	25 ~ 32	2	33 -	- 40	4	11 ~ 4 8
8 modes×6 stages	Mode 0	M	ode 1	Mode	e 2	Mode 3	Mode 4	Μ	ode 5	Mode	6	Mode 7
Stages contained in each mode	1~6	7	~12	13~	18	19~24	25 ~ 30	31	~ 36	37 ~ 4	2	43 ~ 48

The PLC modes and the stage number for each mode are listed in the table below.

Select PLC mode by binary codes according to the following table:

Digital input 27 (PLC mode select 3)	Digital input 26 (PLC mode select 2)	Digital input 25 (PLC mode select 2)	PLC mode selected
0	0	0	Mode 0
0	0	1	Mode 1

0	1	0	Mode 2
0	1	1	Mode 3
1	0	0	Mode 4
1	0	1	Mode 5
1	1	0	Mode 6
1	1	1	Mode 7

Select PLC mode directly according to the following table, where X1~X7 are set to PLC mode select 1~7(see digital input 25~31) respectively.

X7	X6	X5	X4	X3	X2	X1	PLC mode selected
0	0	0	0	0	0	0	Mode 0
-	-	-	-	-	-	1	Mode 1
-	-	-	-	-	1	0	Mode 2
-	-	-	-	1	0	0	Mode 3
-	-	-	1	0	0	0	Mode 4
-	-	1	0	0	0	0	Mode 5
-	1	0	0	0	0	0	Mode 6
1	0	0	0	0	0	0	Mode 7

Each stage of PLC operation has its own multistep frequency(acting as the reference), run time, run direction and accel/decel time. If you don't want a certain stage, set the run time of that stage to zero.

□ The following diagram illustrates the operation process of mode 0 (units digit of F8-01 equals zero).



When the digital input 23 is valid, PLC operation pauses; when it is invalid, PLC operation restarts from the stage before the pause(start mode is determined by F1-19), as shown below.



- When digital input 22 is valid, the inverter enters the runs mode with a lower priority(refer to F0-01); when it is invalid, PLC operation resumes.
- If digital input 24 is valid in the standby state, then parameters concerning the PLC run stage, cycled number and run timing are reset.
- Related digital outputs: digital output 24, 25, 26, 27, and 61~68.
- Related monitored parameters: FU-21~FU23.

6.10 F9: Wobble frequency, counter, meter-counter and zero-servo

F9-00	Wobble frequency injection mode	Default	0	Change	×
Setting range	0: Disabled 1: Auto injection	2: Manual i	njection		
F9-01	Wobble amplitude control	Default	0	Change	×
Setting range	0: Center frequency=100% 1:	Max. frequer	ncy=100%		
F9-02	Preset wobble frequency	Default	0.00Hz	Change	0
Setting range	F0-08 ~ F0-07				
F9-03	Preset wobble frequency waiting time	Default	0.0s	Change	0
Setting range	0.0 ~ 3600.0s				
F9-04	Wobble frequency amplitude	Default	0.0%	Change	0
Setting range	0.0 ~ 50.0%(center or Max. frequency=100%)				
F9-05	Sudden jump frequency	Default	0.0%	Change	0
Setting range	$0.0 \sim 50.0\%$ (actual wobble frequency amplitude	=100%)			
F9-06	Sudden jump time	Default	0ms	Change	0
Setting range	0 ~ 50ms				
F9-07	Wobble period	Default	10.0s	Change	0
------------------	--	----------------	-----------	--------	---
Setting range	0.1 ~ 1000.0s				
F9-08	Rising time	Default	50.0%	Change	0
Setting range	0.0 ~ 100.0%(F9-07=100%)				
F9-09	Wobble randomness	Default	0.0%	Change	0
Setting range	0.0 ~ 50.0%(F9-07=100%)				
F9-10	Wobble restart and power-off setting	Default	00	Change	×
Setting range	Units digit: Wobble restart mode afte stop 0: Smooth restart 1: Restart from zero				
	Tens digit: Whether to save the wobble frequency 0: Save 1: Not save	y status after	power-off		

Wobble function is specially designed for winding yarns; it ensures that the yarns are wound around the spindle smoothly and evenly.

- Wobble function is only valid for V/F control. It becomes invalid automatically in vector control, jog and PID closed-loop operation.
- The typical wobble operation is shown in the diagram below.



- When F9-00=1, the inverter first accelerates to F9-02, waits for a period of time(F9-03)(or waits until the digital input 53 becomes valid if F9-00=2), and then reaches the center frequency. After that, it begins the wobble operation according to the settings of F9-04~F9-08 and keeps running until receiving the stop command.
- The source of the center frequency is the reference frequency for common operation, multi-speed operation and PLC operation.
- F9-04 should not set too high. That will cause motor overheating. F9-04 is normally set to 0.5~2Hz.
- F9-05 is use to to overcome the actual speed lag caused by the inertia. It is only used when there is an relatively large inertia of the grooved drum.

- F9-06 sets the time the sudden jump frequency spends.
- F9-07 sets the time for a complete wobble cycle.
- □ F9-08 sets the time for the rising edge. Actual rising time=wobble peroid×rising time. Actual falling time=wobble period×(1 rising time).
- When F9-09 is not equal to zero, the actual rising time will vary randomly within a certain range, while the wobble period remain unchanged. The function of random wobble can prevent the stacking of some high-elasticity fibres when they are wound.
- F9-10 selects the wobble restart mode.
- Digital input 54: If F9-00=1, the inverter runs at the preset frequency; if F9-00=2, the wobble freqency is disabled and the inverter runs at the center frequency.
- Digital output 30: If the center frequency or wobble amplitude is set too high and the wobble frequency goes beyond the upper- or lower-limit frequency, the wobble amplitude will be reduced automatically to make the wobble frequency fall within the range between upper- and lower-limit frequency, as shown below.



The wobble frequency is only valid in stable operation. If the center frequency changed during the wobble operation, the wobble frequency becomes invalid automatically until the stable operation resumes.

F9-11	Counter UP command select	Default	57	Change	0		
Setting range	Refer to the table of digital output functions in Section 6.6.						
F9-12	Counter DOWN command select	Default	58	Change	0		
Setting range	Refer to the table of digital output functions in Section 6.6.						
F9-13	Counter preset value	Default	0	Change	0		
Setting range	0~65535						
F9-14	Setpoint count	Default	10000	Change	0		

Setting range	F9-15 ~ 65535				
F9-15	Designated count	Default	0	Change	0
Setting range	0 ~ F9-14				
F9-16	Counter frequency-deviding coefficient	Default	1	Change	0
Setting range	1 ~ 65535				

SB70's counter can conduct high-speed UP/DOWN counting, with the highest frequency reaching 300kH if an encoder interface is adopted, 50kHz if a PFI terminal is adopted and 500Hz if a common terminal is used.

- The value in the counter can be stored after power-off and is used as the initial value for the next counting.
- Digital inputs 50 and 51 can preset or clear the counter. For the function of the counter, see the following diagram.



Note: In quadrature counting mode(Fd-19=1), encoder channels A and B are fixed as the UP and DOWN command channels.

F9-11, F9-12:

- When digital outputs 34~36 are selected, the input signal is affected by F4-11;
- Selecting the digital outputs 57 and 58 can realize high-speed counting, with the highest input frequency reaching 300kHz;
- Selecting the digital output 59 can also realize high-speed counting, with the highest input frequency reaching 50kHz;
- When other digital outputs are selected, the samping time is 1ms.
- F9-13 is used for calculation of FU-34 and for presetting the counter when the digital input 50 is valid.
- When the count reaches F9-14, the digital output 31 becomes valid, and when the next UP count pulse arrives, the digital output 31 becomes invalid.
- When the count reaches F9-15, the digital output 32 becomes valid, and when the pulse number reaches F9-14+1, the digital output 32 becomes invalid.

Example: If F9-11=34(X1), F9-14=9, F9-15=4, and Fd-20=6, then the digital outputs 32, 69 and 31

become valid when the input pulse number of X1 reaches 4, 6 and 9 respectively. When the next pulse arrives, digital output 31, 32 and 69 becomes invalid simultaneously. Refer to the following diagram.

X1 Count er UP command 1 2 3	4_5_	6_7_8_	9	1011
32 Designated count reach		 		
69 Designated count 2 reach				
31 Set point count reach				

- □ F9-16"计数器分频系数":对输入的脉冲合并后进行计数,由 F9-16 个脉冲合并为1 个计数脉冲。
- Related monitored parameters include FU-15, FU-34 and related analog outputs include 17 and 18. They can be connected to the analog output, arithmetic unit and PID feedback. Their functions are shown as below.



F9-17	Meter-counter input command select	Default	0	Change	0
Setting range	Refer to the tabel of digital output functions in Section 6.6.				
F9-18	Meter-counter setpoint length	Default	1000m	Change	0
Setting range	0~65535m				
F9-19	Meter-counter pulse number per meter	Default	100.0	Change	0
Setting range	0.1 ~ 6553.5				

🖾 F9-17:

- When digital outputs 34~46 are selected, the input signal is affected by F4-11.
- Selecting digital outputs 57 and 58 can realize high-speed meter counting, with the highest input frequency reaching 300kHz.
- Selecting the digital output 59 can also realize high-speed meter counting, with the highest input frequency reaching 50kHz.
- The samping time is 1ms when other digital outputs are selected.
- When FU-16 reaches F9-18, the digital output 33 becomes valid.
- When the digital input 52 is valid, FU-16 is cleared.

F9-20		Zero-servo control	Default	0	Change	×	
Setting range	0: Invalid	0: Invalid 1: Always valid 2: Conditionally valid(selected by digital input 49)					
F9-21		Zero-speed level	Default	30r/min	Change	×	
Setting range	0 ~ 120r/min	l					
F9-22	2	Zero-servo ending level	Default	10	Change	0	
Setting range	1 ~ 10000 pt	ılse(s)					
F9-23	Z	Zero-servo control gain	Default	1.00	Change	×	
Setting range	0.00 ~ 50.00						

Zero-servo is only valid for PG vector control.

Zero-servo is enabled when F9-20=1 or 2 and the digital input 49 is valid.

With zero-servo being enabled, when the reference frequency equals zero and the motor decelerates to F9-21, zero-servo position control begins.

When the zero-servo position error is less than F9-22, the digital output 23 is valid, otherwise it's invalid. Refer to the following diagram for zero-servo control sequence.



- Zero-servo can only adopt the quadrature encoder. The pulse number set by F9-22 refers to the total number of edges(both rising and falling) of the quadrature encoder's A and B signals.
- The response characteristic of zero-servo control can be adjusted by F9-23. Note: adjust the performance of the ASR speed loop first and then the zero-servo control gain.

6.11 FA: Motor parameters

FA-00	Auto-tuning	Default	00	Change	×
Setting range	11: Standstill auto-tuning 22:	No-load auto	-tuning		

FA-01	Motor rated capacity	Default	Depends on model	Change	×
Setting range	0.40 ~ 500.00kW				
FA-02	Pole number	Default	4	Change	×
Setting range	2~48				
FA-03	Motor rated current	Default	Depends on model	Change	×
Setting range	0.5 ~ 1200.0A				
FA-04	Motor rated frequency	Default	50.00Hz	Change	×
Setting range	1.00 ~ 650.00Hz				
FA-05	Motor rated speed	Default	Depends on model	Change	×
Setting range	125 ~ 40000r/min				
FA-06	Motor rated voltage	Default	380V	Change	×
Setting range	10~500V				

Be sure to input the motor nameplate parameters FA-01~FA-06 befor running the inverter.

FA-00=11: The stator resistance, leakage inductance and rotor resistance are measured. It is recommended to input the no-load current before auto-tuning.

FA-00=22: Besides the parameter measured in standtill auto-tuning, mutual inductance, no-load current and iron core saturation coefficient are measured. The beginning of the no-load auto-tuning process comprises the standstill auto-tuning process.

- Attentions on auto-tuning:
 - 1. The motor nameplate parameters must be set before auto-tuning, or the motor may be damaged.
 - 2. The capacity level of the motor should match that of the inverter, and the rated current of the motor should not be less than 1/4 of that of the inverter.
 - When the motor rated capacity is changed, the motor parameters determined by the model will restore to the factory settings.
 - 4. Auto-tuning must be conducted again when the motor or output cable is replaced.
 - 5. To perform the auto-tuning, the keypad needs to be set as the command source.
 - 6. Verify the following items before the no-load auto-tuning: the motor is disconnected from its mechanical load; the motor can accelerate to 80% of the base frequency; the mechanical braking device is released; and in the case where an elevator is used, the mechanical load is disconnected from the motor.
- Tips on auto-tuning operation:
 - The motor nameplate parameters(FA-01~FA-06) must be input correctly, particularly when vector control is adopted, or the control performance of the inverter will be affected.

- 2. Before the no-load auto-tuning, set F2-12 and F2-13 correctly and choose the appropriate accel/decel time so that no overcurrent/overvoltage occurs during acceleration and deceleration.
- 3. Confirm the motor is in standstill, set FA-00 correctly, and press () to run the motor.
- 4. The motor stops after the auto-tuning is completed. The results of the measurement are recorded in corresponding motor parameters and the value of FA-00 becomes 00 automatically.
- The motor may turn slightly during the standstill auto-tuning.

FA-07	Motor no-load current	Default	Depends on model	Change	×					
Setting range	0.1A ~ FA-03									
FA-08	Motor stator resistance	Default	Depends on model	Change	0					
Setting range	0.00 ~ 50.00 %		-							
FA-09	Motor leakage reactance	Default	Depends on model	Change	0					
Setting range	0.00 ~ 50.00 %									
FA-10	Motor rotor resistance	Default	Depends on model	Change	0					
Setting range	0.00 ~ 50.00 %									
FA-11	Motor mutual reactance	Default	Depends on model	Change	0					
Setting range	0.0 ~ 2000.0 %									
FA-12	Motor core saturation coefficient 1	Default	1.300	Change	×					
Setting range	1.000 ~ 1.500(saturation coefficient correspondin	g to 50% of	flux)							
FA-13	Motor core seturation coefficient 2	Default	1 100	Change	×					
1.1.10	whotor core saturation coefficient 2	Delaun	1.100	1.000 ~ FA-12(saturation coefficient corresponding to 75% of flux)						
Setting range	1.000 ~ FA-12(saturation coefficient corresponding	ng to 75% o	f flux)							
Setting range FA-14	1.000 ~ FA-12(saturation coefficient corresponding Motor core saturation coefficient 3	ng to 75% o Default	f flux)	Change	×					
Setting range FA-14 Setting range	1.000 ~ FA-12(saturation coefficient corresponding Motor core saturation coefficient 3 FA-15 ~ 1.000(saturation coefficient corresponding	ng to 75% o Default ng to 125%	f flux) 0.900 of flux)	Change	×					
Setting range FA-14 Setting range FA-15	1.000 ~ FA-12(saturation coefficient corresponding Motor core saturation coefficient 3 FA-15 ~ 1.000(saturation coefficient corresponding Motor core saturation coefficient 4	ng to 75% o Default ng to 125% Default	f flux) 0.900 of flux) 0.700	Change	×					

If the motor auto-tuning can not be conducted or the precise motor parameters are known, the motor parameters can be calculated and input manually. The calculation formula for the percentage values of motor parameters are as follows:

Resistan ceorinduc tan ce(percentagevalue) = $\frac{resis \tan ceorinduc \tan ce(\Omega)}{ratedvoltage (V)/r} \times 100\%$

 $(\sqrt{3} \times ratedcurrent (A))$

Note: The reactance refers to the reactance at the motor rated frequency. It is calculated based on:

reactance= $2\pi \times$ frequency \times inductance.

The parameters adopted by SB70 are parameters of induction motor's T-I-type equivalent circuit(see the follwing diagram). The conversion relation between the common T-type and T-I-type equivalent circuit is as follows:

Stator resistance (T - I - type circuit) = R_s Rotor resistance (T - I - type circuit) = $(L_m/L_r)^2 R_r$ Leakage inductance (T - I - type circuit) = $(L_m/L_r)^2 L_\sigma$ Mutual inductance (T - I - type circuit) = L_{mm}^2/L_r



6.12 Fb: Protection functions and advanced settings

Fb-00	Motor cooling condition	Default	0	Change	0
Setting range	0: Common motor 1: Inverter-controlled motor or common motor w	ith separate c	ooling fan		
Fb-01	Motor overload protection level	Default	100.0%	Change	0
Setting range	50.0 ~ 150.0%(motor rated current=100%)				
Fb-02	Motor overload action	Default	2	Change	×
Setting range	0: No action 1: Contintue runni 2: Coast to a stop due to fault	ng with an al	arm		

Fb-00: The motor cooling condition depends on the type of the motor connected to the inverter. When a common motor runs at low speeds, the cooling effect of the self-cooling fan becomes poorer and the inverter overload protection level becomes lower accordingly. See the diagram below.

Fb-01 is used to adjust the motor overload protection curve. Suppose the motor is running at the rated speed and Fb-01=100%, if the motor suddenly runs at 150% of its rated current, then the overload protection function will take effect one minute later, as shown in the following diagrams.



When the motor overload protection takes effect, the motor can continue to run only after it is cooled. Caution: The motor overload protection function is only applicable to applications where one inverter drives one motor. For applications where one inverter controls more than one motor, please install a thermal protector on each motor.

Fb-03	Motor load overweight protection	Default	00	Change	×
-					

Setting range	Units digit: Overweight detection mode 0: Always detect 1: Detect only in consta	Units digit: Overweight detection mode 0: Always detect 1: Detect only in constant-speed operation					
	Tens digit: Action to overweight 0: No action 1: Continue running with an alarm 2: Coast to a stop due to fault						
Fb-04	Motor load overweight detection level	Default	130.0%	Change	×		
Setting range	20.0 ~ 200.0%(motor rated current=100%)						
Fb-05	Motor load overweight detection time	Default	5.0s	Change	×		
Setting range	0.0 ~ 30.0s						

□ When the motor current exceeds Fb-04 and lasts for a period of time longer than Fb-05, the motor acts according to the setting of Fb-03. This function is used to detect whether the mechanical load is abnormal and causes an excessively large current.

Fb-06	Inverter underload protection	Default	0	Change	×
Setting range	0: No action 1: Contintue running with an al	arm	2: Coast to a st	op due to fa	ult
Fb-07	Inverter underload protection level	Default	30.0%	Change	×
Setting range	0.0 ~ 100.0%(inverter rated current=100%)				
Fb-08	underload protection detection time	Default	1.0s	Change	×
Setting range	0.0 ~ 100.0s				

□ When the output current is lower than Fb-07 and lasts for a period of time longer than Fb-08, the inverter acts accroding to the setting of Fb-06. This function can timely detect such faults as no-load turning or water pump, breaking of conveying belt and opening of contactor on the motor side.

Do not enable this protection function during the inverter no-load test.

Fb-09	Analog input disconnection action	Default	0	Change	×
Setting range	0: No action 1: Run at the average frequency within 10s before 2: Run at the frequency set by Fb-10, with an AL 3: Coast to a stop, with an Er.Aco alarm	disconnectio Aco alarm	n, with an AL.	Aco alarm	
Fb-10	Frequency after analog input disconnection	Default	0.00Hz	Change	0
Setting range	0.00Hz ~ F0-06				

The analog input is considered to be disconnected when the inverter detects that the analog input signal is lower than the disconnection threshold.

Related parameters: F6-06 and F6-13.

Fb-11	Other protection actions	Default	0022	Change	×
Setting range	Units digit: inverter input phase loss protection 0: No action 1: Continue runing with an alarm 2: Coast to a stop due to fault				

Tens digit: inverter output phase loss protection 0: No action 1: Continue runing with an alarm 2: Coast to a stop due to fault
Hundreds digit: keypad disconnection protection 0: No action 1: Continue runing with an alarm 2: Coast to a stop due to fault
Thousands digit: parameter store failure protection 0: Continue runing with an alarm 1: Coast to a stop due to fault

Inverter input phase loss is judged by the DC link voltage ripples it causes. In no-load or slight-load operation, the input phase loss may not be able to be detected. When there is great imbalance among the three input phases or great oscillation with the output, input phase loss will also be detected.

- When the inverter has the fault of output phase loss, the motor will run in single phase, which will lead to both a greater current and torque pulsation. Output phase loss protection prevents the motor and its mechanical load being damaged.
- I When the output frequency or current is very low, the output phase loss protection will be invalid.

Fb-12	Accel overcurrent stall prevention	Default	1	Change	×
Setting range	0: Invalid	1: Valid			
Fb-13	Accel overcurrent stall point	Default	150.0%	Change	×
Setting range	10.0 ~ 150.0% (inverter rated current=100%)				
Fb-14	Constant-speed overcurrent stall prevention	Default	1	Change	×
Setting range	0: Invalid	1: Valid			
Fb-15	Constant-speed overcurrent stall point	Default	150.0%	Change	×
Setting range	10.0 ~ 150.0%(inverter rated current=100%)				
Fb-16	Overvoltage stall prevention	Default	1	Change	×
Setting range	0: Invalid	1: Valid			
Fb-17	Overvoltage stall point	Default	700V	Change	×
Setting range	650 ~ 750V				

During acceleration, when Fb-12 is valid and the output current is greater than Fb-13, the acceleration stops temporarily. After the current drops the motor continues to accelerate. See diagram (a) below.

- During constant-speed running, when Fb-14 is valid and the output current is greater than Fb-15, the motor decelerates. Afther the current drops the motor reaccelerates to the original operating frequency. See diagram(b) below.
- During deceleration, when Fb-16 is valid and the DC link voltage is greater than Fb-17, the deceleration stops temporarily. After the DC link voltage drops to the normal level the motor continues to decelerate.



See diagram (c) below.

	(-) (-)			(-)	
Fb-18	DC link undervoltage action	Default	0	Change	×
Setting range	 0: Coast to a stop and report the undervoltage faul 1: Coast to a stop, and restart if the voltage resum undervoltage fault(Er.dcL) if undervoltage time 2: Coast to a stop, and restart if CPU is still worki without reporting the undervoltage fault 3: Decelerate, and accelerate to the reference freq the voltage resumes, without reporting the under 	tt(Er.dcL) es within the e exceeds the ng and detec uency if CPU ervoltage faul	time set by Fb time set by Fb ts that the volta U is still workin It.	-20 or report -20 uge resumes, ug and detect	t the
Fb-19	DC link undervoltage point	Default	400V	Change	×
Setting range	370~480V				
Fb-20	Allowable time for momentary power failure	Default	0.1s	Change	×
Setting range	0.0 ~ 30.0s				
Fb-21	Momentary power failure decel time	Default	0.0s	Change	×
Setting range	$0.0 \sim 200.0$ s(if Fb-21=0.0, the current decel time	is used)			

The detection of momentary power failure is completed by detecting the DC link voltage. When DC link voltage is less than Fb-19,

if Fb-18 = 0: The motor coasts to a stop, and the fault of DC link undervoltage is reported;

if Fb-18 = 1: The motor restarts if the voltage resumes within the time set by Fb-20(refer to Fb-25 for start mode), or the undervoltage fault is reported if undervoltage time exceeds the time set by Fb-20;

if Fb-18 = 2: The motor restarts(refer to Fb-25 for start mode) if CPU is still working and detects that the voltage resumes;

if Fb-18 = 3: The motor first decelerates according to the Fb-21 time or current decel time, then accelerates to the reference frequency if the voltage resumes.

- Fb-18 = 1 or 2 or 3 can prevent undervoltage stop caused by momentary power failure for large-inertia loads like fans and centrifuges.
- Fb-20 is used only when Fb-18 = 1.
- If undervoltage occurs during running, the motors coasts to a stop and the undervoltage fault(Er.dcL) is reported. If undervoltage occurs in standby state, only the alarm of AL.dcL is given.

Fb-22	Auto reset times	Default	0	Change	×

Setting range	0~10				
Fb-23	Auto reset interval	Default	5.0s	Change	×
Setting range	1.0 ~ 30.0s				
Fb-24	Fault output during auto reset	Default	0	Change	×
Setting range	0: No output	1: Output			
Fb-25	Restart after momentary stop, auto reset or pause	Default	1	Change	×
Setting range	0: Restart according to the preset starting mode 1: Restart smoothly				

Auto reset function: when a fault occurs during running, the fault is reset automatically according to the settings of Fb-22 and Fb-23, thus avoiding trip due to misoperation, instantaneous power supply overvoltage and external non-repeated impact.

□ Auto reset process: when a fault occurs during running, it is reset automatically after a period of time(Fb-23). If the fault disappears, the motor restarts according to the mode set by Fb-25; if the fault still exists and the reset times is less than Fb-22, auto reset is continued being retried, otherwise an alarm is reported and the motor stops.

- Fb-22 is cleared in any of the following cases: no fault occurs for continuous ten minutes after the fault reset; fault is manually reset after it is detected; power supply resumes after the momentary power failure.
- Fb-24 selects whether the digital output 5 is valid during auto reset.
- Faults of "power device protection" (Er.FoP) and "external fault" (Er.EEF) are not reset automatically.

Danger: Be extremely careful while using the auto reset function, for it may cause injury to people or damage to equipment.

Fb-26	Power-on auto restart	Default	1	Change	0
Setting range	0: Disabled	1: Enabled			

□ When terminal is the command source and F4-08=0, 1 or 2, if the run command is valid after power-on, then Fb-26 can be used to select whether to start the system immediately.

Fb-27	Built-in braking unit working threshold	Default	680V	Change	0
Setting range	620 ~ 720V				

Using the braking unit can consume the energy on the braking resister and make the motor stop quickly. When the DC link voltage exceeds Fb-27, the braking unit will begin working automatically.

This function is only valid for models of 15kW or less.

Modulation mode	Default	0	Change	0
Auto(automatically switching between continu	ous and disco	ontinuous mod	ulation)	
	Auto(automatically switching between continu Continuous	Auto(automatically switching between continuous and disco	Auto(automatically switching between continuous and discontinuous mode Continuous	Auto(automatically switching between continuous and discontinuous modulation) Continuous

I The discontinuous modulation in the auto mode has a lower switching loss but greater harmonics

Fb-29	Carrier frequency	Default	Depends on model	Change	0
Setting range	15kW or less: 1.1k~12.0kHz(default: 4.0kHz) 18.5~30kW: 1.1k~10.0 kHz(default: 3.0kHz) 37~160 kW: 1.1k~8.0 kHz(default: 2.5kHz) 200kW or more: 1.1k~5.0 kHz(default: 2.0kHz)				
Fb-30	Random PWM setting	Default	0%	Change	0
Fb-30 Setting range	Random PWM setting	Default	0%	Change	0
Fb-30 Setting range Fb-31	Random PWM setting 0 ~ 30% Carrier frequency auto adjustment	Default	0%	Change	0

compared with the continuous one.

Increasing the carrier frequency can lower the motor noise, harmonic current and the heat generated by the motor, but raise the common-mode current, disturbance and the heat generated by the inverter, and decreasing the carrier frequency will lead to the opposite. Therefore, when a silent run is required, you can moderately raise the carrier frequency. If the carrier frequency is higher than the factory setting, the inverter should be derated by 5% for every increment of 1kHz.

- □ Fb-30 disperses the spectrum of the carrier frequency and improves the acoustic quality. Lowering this parameter can make the noise less harsh. Fb-30=0% means the carrier frequency is fixed.
- Fb-31 can automatically regulate the carrier frequency according to the heat sink temperature, output current and output frequency, preventing the inverter from failing due to overheating. The carrier frequency falls automatically if the heat sink temperature and the low-frequency current are too high.

Fb-32	Deadband compensation	Default	1	Change	×
Setting range	0: Disabled	1: Enabled			

Deadband compensation can reduce output harmonics and torque ripples; however, it must be disabled when the inverter is used as a power supply.

Fb-33	Space vector angle stop save	Default	0	Change	×
Setting range	0: Not save	1: Save			

It is used to maintain synchronization after the synchronous motor stops and restarts, only valid for V/F control.

Fb-34	Overmodulation	Default	1	Change	×
Setting range	0: Disabled	1: Enabled			

Overmodulation enables the inverter to have a high output voltage which can be near or greater than the power supply voltage, but also causes high torque ripples of the motor. Disabling overmodulation can eliminate the torque ripples and improve the control of such load as grinding machines.

Fb-35	Cooling fan control	Default	0	Change	0

Setting	0: Stop after standby state lasts 3 minutes
range	1: Keep running

In applications where the motor starts/stops frequently, setting Fb-35 to 1 can prevent frequent start/stop of the cooling fan.

Fb-36	Jump frequency 1	Default	0.00Hz	Change	0
Setting range	0.00 ~ 625.00Hz				
Fb-37	Jumping width 1	Default	0.00Hz	Change	0
Setting range	0.00 ~ 20.00Hz				
Fb-38	Jump frequency 2	Default	0.00Hz	Change	0
Setting range	0.00 ~ 625.00Hz				
Fb-39	Jumping width 2	Default	0.00Hz	Change	0
Setting range	0.00 ~ 20.00Hz				
Fb-40	Jump frequency 3	Default	0.00Hz	Change	0
Setting range	0.00 ~ 625.00Hz				
Fb-41	Jumping width 3	Default	0.00Hz	Change	0
Setting range	0.00 ~ 20.00Hz				

Jump frequency prevents the inverter running at the mechanical resonant points.

During acceleration or deceleration, the inverter can run through the jump frequency smoothly(i.e. jump frequency becomes invalid), but can not keep steady-state operation within the jumping width.



6.13 FC: Keypad operation and display settings

FC-00	Display parameter select	Default	0	Change	0
Setting	0: All menus 1:User-selected paramerte	ers			
range	2: Parameters different from factory settings				

FC-00 = 1: Only parameters selected by FC-15~FC-46 are displayed. User password is invalid for these parameters. But changing FC-00 needs the user password.

FC-00 = 2: Only parameters that have different settings from the factory settings are displayed. This facilitates the test and maintenance.

FC-01	Key function and auto lockup	Default	0000	Change	×
Setting range	 Units digit: determines which keys are locked. 0: None locked 1: All locked 2: All locked but ③ 3: All locked but ④ 4: All locked but ④ and ④ 5: All locked but ④ and ④ 7: All locked but ④ and ④ 1: Valid only when keypad is the command sourt 1: Valid only when keypad, is the command sourt 1: Valid when keypad, terminal or communicat according to preset stop mode. 2: Stops the motor according to preset stop mode the motor coast to a stop and give an Er.Ab selected. Hundreds digit: determines the function of ④ (o 0: Invalid 1: Valid only in standby state 2: Valid Thousands digit: determines the function of ① (o 0: Common run 1: Jog 	ce tion is the co e when keypa ob alarm whe nly when key	ommand source ad is the comm on any other co vpad is comma ypad is comma	e. Stops the and source; ommand sou nd source) and source)	motor makes irce is

Keys are locked up automatically if no key is pressed within one minute. In monitoring state, pressing
 + () will lock the keys , and pressing () + () and holding for three seconds will unlock them.

FC-02	Monitored parameter 1 (in run and standby)	Default	1	Change	0
FC-03	Monitored parameter 2 (in run and standby)	Default	-1	Change	0
FC-04	Monitored parameter 3 (in run and standby)	Default	-1	Change	0
FC-05	Monitored parameter 4 (in run and standby)	Default	-1	Change	0
FC-06	Monitored parameter 5 (in run and standby)	Default	-1	Change	0
FC-07	Monitored parameter 6 (in run and standby)	Default	-1	Change	0
FC-08	Monitored parameter 7 (in run and standby)	Default	-1	Change	0
FC-09	Monitored parameter 1 (in run)	Default	0	Change	0
FC-10	Monitored parameter 2 (in run)	Default	2	Change	0
FC-11	Monitored parameter 3 (in run)	Default	4	Change	0
FC-12	Monitored parameter 4 (in run)	Default	-1	Change	0
Setting range	Setting range -1 ~ 59 Note: -1 indicates null and 0~59 represent FU-00~FU-59 respectively. The minimum value of FC-02 is 0.			alue	

FC-02~FC-08 select(from the FU menu) the parameters to be monitored in both running and standby states.

General FC-09~FC-12 select(from the FU menu) the parameters to be monitored only in running state.

FC-13	Speed display coefficient	Default	1.000	Change	0
Setting range	0.001 ~ 10.000 FU-05=120×operating frequency÷pole number×F FU-06=120×reference frequency÷pole number×F	C-13 C-13			
Only us	ed for speed conversion and has no influence on act	ual speed and	d motor control	l.	

	FC-14	Line speed display coefficient	Default	0.01	Change	0
--	-------	--------------------------------	---------	------	--------	---

Setting range	0.01 ~ 100.00
	FU-11=operating frequency×FC-14 FU-12=reference frequency×FC-14

Only used for line speed conversion and has no influence on actual line speed and motor control.

FC-15 ~ FC-44	User parameters 1~30	Default	-00.01	Change	0	
Setting range	-00.01~FU.59(excluding factory parameters Fn) Note: -00.01 indicates null and others represent parameter numbers respectively, for example, F0.01 represents F0-01.					
FC-45	User parameter 31	Default	FC.00	Change		
FC-46	User parameter 32	Default	F0.10	Change		

User parameters 1~30 select the parameters the user uses often or concerns about. When FC-00=1, these parameters are displayed.

User parameters 31 and 32 are fixed to be FC-00 and F0-10 respectively; they can not be modified.

6.14 Fd: Expansion options and functions

Fd-00	Parameter copying	Default	00	Change	×
Setting range	 11: Upload parameters from inverter to keypad 22: Download parameters from keypad to inverter 33: Confirm the consistency of keypad parameters 44: Clear parameters stored in keypad The value of this parameter becomes 00 after the of 	with inverte	er parameters		

This function is very useful in applications where multiple inverters have the same settings.

It is not recommended to use the download function between inverters with different capacity classes.

This function is only valid for keypads(SB-PU70E) with parameter copying function.

Fd-01	PG pulse number per revolution	Default	1024	Change	×			
Setting range	1~8192							
Fd-02	PG type	Default	0	Change	×			
Setting range	0: Quadrature encoder 1: Single-	0: Quadrature encoder 1: Single-channel encoder						
Fd-03	PG direction	Default	0	Change	×			
Setting range	0: Positive(direction is positive if phase A of quad 1: Negative(direction is positive if phase B of qua	lrature encod drature encod	er leads phase der leads phase	B) : A)				
Fd-04	PG disconnection action	Default	2	Change	×			
Setting range	0: No action 1: Alarm (AL.PGo displayed) 2: Coast to a stop due to fault(Er.PGo displayed)							
Fd-05	PG disconnection detection time	Default	1.0s	Change	×			
Setting range	0.1 ~ 10.0s							
Fd-06	PG speed ratio denominator	Default	1	Change	×			

Fd-07	PG speed ratio numerator	Default	1	Change	×
Setting range	1~1000				
Fd-08	PG speed test filtering time	Default	0.005s	Change	0

To use the encoder a encoder interface card(such as SL-PG0) is needed. The wiring of the card is described in detail in Chapter 9.

- General Fd-02: If single-channel encoder is selected, the signal must enter from channel A. Single-channel encoder is not applicable to low-speed operations and operations with both forward and reverse directions.
- Fd-03: For a single-channel encoder, if positive direction is selected, then FU-35 is always positive, otherwise always negative.
- PG disconnection: PG is regarded to be disconnected if the reference frequency of the speed regulator is greater than 0.5Hz and the encoder fails to generate a pulse within the time set by Fd-05. The motor act according to the setting of Fd-04. PG disconnection detection is performed only for PG V/F control and PG vector control.
- In application where the encoder is connected to the motor shaft via speed changing devices such as gears, Fd-06 and Fd-07 must be correctly set. The relationship between the encoder speed and motor speed is: Motor speed=encoder speed×Fd-07÷Fd-06.
- General Fd-08 should not be too large if a high dynamic performance is required.
- Related monitored parameter: FU-35.
- Method of verifying the encoder setting: Adopt PG V/F control mode and run the motor in the direction and at the frequency which are allowed by the load, check to see if the direction of FU-35 is consistent with the direction displayed on the keypad, and if the value of FU-35 is close to the reference frequency.

Danger: PG p	rameters must	be set correc	tly in control	modes with P	'G, otherwise in	jury to people	e and
damaş	e to equipment	may occur.	The setting of	the encoder of	direction must	be rechecked	after
the mo	tor cables are re	ewired.					

Fd-09	Expansion digital input terminal X7	Default	0	Change	×
Fd-10	Expansion digital input terminal X8	Default	0	Change	×
Fd-11	Expansion digital input terminal X9	Default	0	Change	×
Fd-12	Expansion digital input terminal X10	Default	0	Change	×
Fd-13	Expansion digital input terminal X11	Default	0	Change	×
Setting range	Refer to the table of digital input functions in Sec	tion 6.5.			

The expansion digital input terminals X7~X11 are located on the expansion board. See Section 9.5.

The expansion digital input terminal signals are processed by F4-11, too.

Related monitored parameter: FU-43.

Fd-14	Expansion digital output terminal Y3	Default	0	Change	×
Fd-15	Expansion digital output terminal Y4	Default	0	Change	×
Fd-16	Expansion digital output terminal Y5	Default	0	Change	×

Fd-17	Expansion digital output terminal Y6	Default	0	Change	×
Fd-18	Expansion digital output terminal Y7	Default	0	Change	×
Setting range	Refer to the table of digital output functions in Se	ection 6.6.			

The expansion digital output terminals Y3~Y7 are located on the expansion board. See Section 9.5.

Related monitored parameter: FU-44

Fd-19	Counting method		Default	0	Change	×
Setting range	0: Common counting	1: Quadrature	counting			

Using the quadrature counting method can make the UP/DOWN count for quadrature encoder's channels

A and B (count up if A leads B and count down if B leads A). Fd-03 can swap channel A with B.

Fd-20	Designated count 2	Default	0	Change	0
Setting range	0 ~ F9-14				

The function of Fd-20 is the same as that of F9-15.

Digital output 69 is identical to digital out 32 in function.

Fd-21	Logic unit 5 input 1	Default	0	Change	0
Fd-22	Logic unit 5 input 2	Default	0	Change	0
Fd-23	Logic unit 5 config	Default	9	Change	0
Fd-24	Logic unit 5 output	Default	0	Change	0
Fd-25	Logic unit 6 input 1	Default	0	Change	0
Fd-26	Logic unit 6 input 2	Default	0	Change	0
Fd-27	Logic unit 6 config	Default	9	Change	0
Fd-28	Logic unit 6 output	Default	0	Change	0
Setting range	All settings for logic units 5 and 6 are the same as	that for logic	c unit 1		

Related digital outputs: 70 and 71.

6.15 FE: Programmable unit

FE-00	Comparator 1 in-phase input select	Default	0	Change	0	
Setting range	see the table of analog output functions in Section 6.7.					
FE-01	Comparator 1 opposite-phase input select	Default	0	Change	0	
Setting range	See the table of analog output functions in Section 6.7.					
FE-02	Comparator 1 config	Default	005	Change	0	

Setting range	 0: If in-phase input>opposite-phase input, the comparator outputs 1, otherwise outputs 0 1: If in-phase input<opposite-phase 0<="" 1,="" comparator="" input,="" li="" otherwise="" outputs="" the=""> 2: If in-phase input=opposite-phase input(in-phase input - opposite-phase input ≤error band/2), the comparator outputs 1, otherwise outputs 0 3: If in-phase input≠opposite-phase input(in-phase input - opposite-phase input ≤error band/2), the comparator outputs 1, otherwise outputs 0 3: If in-phase input≠opposite-phase input(in-phase input - opposite-phase input ≤error band/2), the comparator outputs 1, otherwise outputs 0 4: Comparison is invalid, and the output is constant 1 5: Comparison is invalid, and the output is constant 0 </opposite-phase> Tens digit: determines whether to take the absolute value 0: No 1: Yes Hundreds digit: selects the protection function for comparator output 0: No action 1: The motor continues running with an alarm 2: The inverter coasts to a stop due to fault(Er.Col or Er.Co2 displayed) 							
FE-03	Comparator 1 digital setting	Comparator 1 digital settingDefault50.0%Changeo						
Setting range	-100.0~100.0%(corresponding to analog output 28)							
FE-04	Comparator 1 error band	Default	5.0%	Change	0			
Setting range	0.0 ~ 100.0 %		L					
FE-05	Comparator 1 output select	Default	0	Change	0			
Setting range	Refer to the table of digital input functions in Sec	tion 6.5						
FE-06	Comparator 2 in-phase input select	Default	0	Change	0			
FE-07	Comparator 2 opposite-phase input select	Default	0	Change	0			
FE-08	Comparator 2 config	Default	005	Change	0			
FE-09	Comparator 2 digital setting(corresponding to analog output 29)	Default	50.0%	Change	0			
FE-10	Comparator 2 error band	Default	5.0%	Change	0			
FE-11	Comparator 2 output select	Default	0	Change	0			
Setting range	All settings for comparator 2 are identical to that for comparator 1							

Description: The structure of the comparator is as the following diagram.



The functions of the comparator are shown in the following diagrams.



FE-12	Logic unit 1 input 1 select	Default	0	Change	0
Setting range	Refer to the table of digital output functions in Se	ection 6.6.			
FE-13	Logic unit 1 input 2 select	Default	0	Change	0
Setting range	Refer to the table of digital output functions in Se	ection 6.6.	-	-	
FE-14	Logic unit 1 config	Default	9	Change	0
Setting	0: AND 1: OR 2: NAND 3: N	OR 4: У	KOR (≠)	5:XNOR (=)
range	6: Output=input 1 7: Output= ~ input 1 8: Out	tput≡1 9: 0	Output≡0 1	0: R-S trigge	r
FE-15	Logic unit 1 output select	Default	0	Change	0
Setting range	Refer to the table of digital input functions in Sec	tion 6.5.			
FE-16	Logic unit 2 input 1 select	Default	0	Change	0
FE-17	Logic unit 2 input 2 select	Default	0	Change	0
FE-18	Logic unit 2 config	Default	9	Change	0
FE-19	Logic unit 2 output select	Default	0	Change	0
FE-20	Logic unit 3 input 1 select	Default	0	Change	0
FE-21	Logic unit 3 input 2 select	Default	0	Change	0
FE-22	Logic unit 3 config	Default	9	Change	0
FE-23	Logic unit 3 output select	Default	0	Change	0
FE-24	Logic unit 4 input 1 select	Default	0	Change	0
FE-25	Logic unit 4 input 2 select	Default	0	Change	0
FE-26	Logic unit 4 config	Default	9	Change	0
FE-27	Logic unit 4 output select	Default	0	Change	0
Setting range	All settings for logic units 2~4 are identical to that	at for logic un	it 1		

 \square The structure of the logic unit is as the following diagram.



FE-28	Timer 1 input select		Default	0	Change	0
Setting range	Same as F5-00					
FE-29	Timer 1 config		Default	300	Change	0
	Units digit: type of timer 0: Rising edge delay 1: 2: Rising and Falling edge delay 3:	Fallin Pulse	lling edge delay lse function			
Setting range	Tens digit: magnification of set time 0: 1 1: 10 2: 100 3: 100		00 4: 10000 5: 100000			
_	Hundreds digit: output signal setting					
	0: Output=input 1: Output=~input 2 4: AND 5: NAND	2: Outj 6: OR	put≡1	3: Output≡0 7: NOR)	
FE-30	Timer 1 set time		Default	0ms	Change	0
Setting range	0 ~ 40000ms					
FE-31	Timer 1 output select		Default	0	Change	0
Setting range	Refer to the table of digital input functions in S	Sectior	n 6.5.			
FE-32	Timer 2 input select		Default	0	Change	0
FE-33	Timers 2 config		Default	300	Change	0
FE-34	Timer 2 set time	Í	Default	0ms	Change	0
FE-35	Timer 2 output select		Default	0	Change	0
FE-36	Timer 3 input select		Default	0	Change	0
FE-37	Timer 3 config		Default	300	Change	0
FE-38	Timer 3 set time		Default	0ms	Change	0
FE-39	Timer 3 output select		Default	0	Change	0
FE-40	Timer 4 input select		Default	0	Change	0
FE-41	Timer 4 config		Default	300	Change	0
FE-42	Timer 4 set time		Default	0ms	Change	0
FE-43	Timer 4 output select		Default	0	Change	0
Setting range	All settings for timers $2 \sim 4$ are identical to that	t for ti	imer 1.			

Define the timer is as the following diagram.



The functions of the timer are shown in the diagrams below.



Using the timer can eliminate the signal jitter. Take the function of "rising edge delay" as an example, if the input pulse is shorter than the delay time, no signal will be output.

FE-44	Arithmetic unit 1 input 1 select	Default	0	Change	0	
Setting range	Refer to the table of analog output functions in Se	ction 6.7.				
FE-45	Arithmetic unit 1 input 2 select	Default	0	Change	0	
Setting range	Refer to the table of analog output functions in Se	Refer to the table of analog output functions in Section 6.7.				
FE-46	Arithmetic unit 1 config	Default	0	Change	0	
Setting range	0: Input 1+input 2 1: Input 1-input 2 2: Input 1×input 2 3: Input 1÷input 2 4: Take the smaller one of the two inputs 5: Take the larger one of the two inputs 6: Input 1 ×input 2 7: Input 1 ÷input 2 8: Input 1 is output directly(functions as a connection)					
FE-47	Arithmetic unit 1 digital setting	Default	0.0%	Change	0	
Setting range	-100.0 ~ 100.0%(corresponding to analog output	30)				
FE-48	Arithmetic unit 2 input 1 select	Default	0	Change	0	
FE-49	Arithmetic unit 2 input 2 select	Default	0	Change	0	
FE-50	Arithmetic unit 2 config	Default	0	Change	0	
FE-51	Arithmetic unit 2 digital setting (corresponding to analog output 31)	Default	0.0%	Change	0	
		•			• • • • • • • • • • • • • • • • • • •	

FE-53	Arithmetic unit 3 input 2 select	Default	0	Change	0	
FE-54	Arithmetic unit 3 config	Default	0	Change	0	
FE-55	Arithmetic unit 3 digital setting(corresponding to analog output 32)	Default	0.0%	Change	0	
FE-56	Arithmetic unit 4 input 1 select	Default	0	Change	0	
FE-57	Arithmetic unit 4 input 2 select	Default	0	Change	0	
FE-58	Arithmetic unit 4 config	Default	0	Change	0	
FE-59	Arithmetic unit 4 digital setting(corresponding to analog output 33)	Default	0.0%	Change	0	
FE-60	Arithmetic unit 5 input 1 select	Default	0	Change	0	
FE-61	Arithmetic unit 5 input 2 select	Default	0	Change	0	
FE-62	Arithmetic unit 5 config	Default	0	Change	0	
FE-63	Arithmetic unit 5 digital setting (corresponding to analog output 34)	Default	0.0%	Change	0	
FE-64	Arithmetic unit 6 input 1 select	Default	0	Change	0	
FE-65	Arithmetic unit 6 input 2 select	Default	0	Change	0	
FE-66	Arithmetic unit 6 config	Default	0	Change	0	
FE-67	Arithmetic unit 6 digital setting(corresponding to analog output 35)	Default	0.0%	Change	0	
Setting range	All settings for arithmetic units $2 \sim 6$ are identical to that for arithmetic unit 1					

Description: The structure of the arithmetic uint is as the following diagram.



FE-68	Low-pass filter 1 input select	Default	0	Change	0
Setting range	Refer to the table of analog output functions in Se	ction 6.7.			
FE-69	Low-pass filter 1 filtering time	Default	0.010s	Change	0
Setting range	0.000 ~ 10.000s				
FE-70	Low-pass filter 2 input select	Default	0	Change	0

Setting range	Refer to the table of analog output functions in Se	ction 6.7.			
FE-71	Low-pass filter 2 filtering time Default 0.010s Change				
Setting range	0.000 ~ 10.000s				

Dear The structure of the low-pass filter is as the following diagram.



Low-pass filter filtering time

FE-72	Analog multi-switch input 1	Default	0	Change	0		
Setting range	Refer to the table of analog output functions in Se	er to the table of analog output functions in Section 6.7.					
FE-73	Analog multi-switch input 2	0	Change	0			
Setting range	Refer to the table of analog output functions in Se	er to the table of analog output functions in Section 6.7.					
FE-74	Analog multi-switch control signal	Analog multi-switch control signal Default 0 Change					
Setting range	Refer to the table of digital output functions in Section 6.6.						

The structure of the analog multi-switch is as the following diagram.



6.16 FF: Communication parameters

FF-00	Communication protocol	Default	0	Change	×
Setting range	0: Modbus protocol 1: Compatible USS c	commands	2: CAN	bus	
FF-01	Data format	0	Change	×	
Setting range	 0:8,N,1 (1 start bit, 8 data bits, no parity check, 1 stop bit) 1:8,E,1 (1 start bit, 8 data bits, even check, 1 stop bit) 2:8,O,1 (1 start bit, 8 data bits, odd check, 1 stop bit) 3:8,N,2 (1 start bit, 8 data bits, no parity check, 2 stop bits) 				
FF-02	Baud rate	Default	3	Change	×
Setting range	0:1200bps 1:2400bps 2:4800bps 5:38400bps 6:57600bps 7:115200bps Note: 0~5 for Modbus and USS, while 0~9 for C.	3:9600bj 8:250000 AN	os 4:1920 Obps 9:5000	00bps 000bps	
FF-03	Local address	Default	1	Change	×

Setting range	0~247 Note: 1~247 for Modbus, 0~31 for USS, and 0~1	~ 247 Jote: 1~247 for Modbus, 0~31 for USS, and 0~127 for CAN						
FF-04	Overtime detection time	Default	10.0s	Change	0			
Setting range	0.1 ~ 600.0s							
FF-05	Response delay	Response delay Default 5ms Change						
Setting range	0 ~ 1000ms							
FF-06	Overtime action	Default	0	Change	×			
Setting range	0: No action 1: Alarm 2: Alarm and coast to a stop 3: Alarm and run acocording to F0-00 4: Alarm and run at upper-limit frequency 5: Alarm and run at lower-limit frequency							
FF-07	USS message PZD word number	Default	2	Change	×			
Setting range	0~4							
FF-08	Communication reference magnification	Default	1.000	Change	0			
Setting range	0.001 ~ 30.000. Frequency reference=FF-80×con	amunication 1	reference frequ	iency				

BB70 inverter's RS485 Modbus protocol comprises 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 parameter reading and writing 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 sends a piece of error information to the master if it can not implement a message.
- Communication only changes RAM values. If a parameter in RAM is to be written into EEPROM, the communication variable "EEP write command" (Modbus address is 3209H) needs to be changed to 1 by communication.
- Method of addressing the inverter parameters: among the 16 bits of the Modbus parameter address, the upper 8 bits represent the group number of a parameter, and the lower 8 bits represent the serial number of the same parameter in the group. For example, the address of the parameter F4-17 is 0511H. The group number is 50(32H) for communication variables(control word, status word, etc.).

Note: Communication variables include inverter parameters which can be accessed to by communication, as well as communication dedicated command variables and status variables. The menu codes correspond to the group numbers of parameters according to the following table.

Menu	Parameter	Menu	Parameter	Menu	Parameter	Menu	Parameter
code	group No.	code	group No.	code	group No.	code	group No.
F0	0 (00H)	F5	5 (05H)	FA	10 (0AH)	FF	15 (OFH)

1								
	F1	1 (01H)	F6	6 (06H)	Fb	11 (0BH)	Fn	16 (10H)
	F2	2 (02H)	F7	7 (07H)	FC	12 (0CH)	FP	17 (11H)
	F3	3 (03H)	F8	8 (08H)	Fd	13 (0DH)	FU	18 (12H)
	F4	4 (04H)	F9	9 (09H)	FE	14 (0EH)	-	-

□ The data transmitted in communication are 16-bit integers. The minimum unit can be seen from the position of the radix point of the parameter. For example, the minimum unit of F0-00 is 0.01Hz, therefore, the data 5000 transmitted in communication represents 50.00Hz.

Table of communication command variables

Name	Modbus address	Change	Description
Mian control word	3200Н	o	Bit 0: ON/OFF1(run on rising edge. 0: stop) Bit 1: OFF2(0: coast stop) Bit 2: OFF3(0: emergency stop) Bit 3: Driving lockout(0: driving lockout) Bit 4: Accel/decel enabled(0: accel/decel disabled) Bit 5: Reserved Bit 6: Reserved Bit 7: Fault reset(on rising edge) Bit 8: Jog forward Bit 9: Jog reverse Bit 10: Reserved Bit 11: Reference reversion(1: reference frequency reversed, 0: not reversed) Bit 12: PC digital 1(used for programmable unit) Bit 13: UP Bit 14: DOWN Bit 15: PC digital 2(used for programmable unit)
Communication reference frequency	3201H	0	Non-negatives(unit: 0.01Hz). Used as the frequency reference after multiplied by FF-08.
PC analog 1	3202H	0	Range: -100.00~100.00%
PC analog 2	3203H	0	Range: -100.00~100.00%
Extended control word 1	3204H	0	Bits $0 \sim 15$ correspond to digital inputs $1 \sim 16$
Extended control word 2	3205H	0	Bits 0 ~ 15 correspond to digital inputs 17 ~ 32
Extended control word 3	3206H	0	Bits 0 ~ 15 correspond to digital inputs 33 ~ 48
Extended control word 4	3207H	0	Bits $0 \sim 5$ correspond to digital inputs $49 \sim 54$, other bits are reserved.
Extended control word 5	3208H	0	Reserved
EEPROM write-in	3209Н	0	When "1" is written to this address, the parameters in the inverter RAM will be written in EEPROM.

Note: Digital inputs 37, 38 and 39 are only used for terminal control. They are invalid in communication control.

Table of communication status variables

Name	Modbus address	Change	Description
Main status word	3210Н		Bit 0: Ready(constant 1)Bit 8: ReservedBit 1: Ready for runBit 9: ReservedBit 2: RunningBit 10: Frequency reachBit 3: FaultBit 11: ReservedBit 4: OFF2 valid(0: valid)Bit 11: ReservedBit 5: OFF3 stopping(0: valid)Bit 13: ReservedBit 6: Charging contactor openBit 14: Running forwardBit 7: AlarmBit 15: Reserved
Operating frequency	3211H		Non-negatives(unit: 0.01Hz)
Arithmetic unit 1 output	3212H		Unit: 0.01%
Arithmetic unit 2 output	3213H		Unit: 0.01%
Reference frequency	3214H		Non-negatives(unit: 0.01Hz)
Output current	3215H		Unit: 0.1A
Output torque	3216H		Rated torque with a unit of 0.1%
Output voltage	3217H		Unit: 0.1V
DC link voltage	3218H		Unit: 0.1V
Fault code	3219H		See section 7.1
Alarm word 1	321AH		See section 7.2
Alarm word 2	321BH		See section 7.2
Extended status word 1	321CH		Bits $0 \sim 15$ correspond to digital outputs $0 \sim 15$
Extended status word 2	321DH		Bits 0 ~ 15 correspond to digital outputs 16 ~ 31
Extended status word 3	321EH		Bits 0 ~ 15 correspond to digital outputs 32 ~ 47
Extended status word 4	321FH		Bits 0 ~ 12 correspond to digital outputs 48 ~ 60
Extended status word 5	3220Н		Reserved

SB70 inverter supports the communication on a Modbus network using RTU(Remote Terminal Unit) mode. The functions it supports include: Function 3(read multiple parameters, with max. word number of 50), Function 16(write multiple parameters, with max. word number of 10), Function 22(mask write) and Function 8(read-back test). Among them, Functions 16 and 22 support broadcast(broadcast message address is 0). 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 of 19200bit/s and 38400bit/s). A typical RTU message frame is shown below.

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

Function 3: read multiple parameters. Word number read ranges from 1 to 50. Refer to the following example for its message format.

Example: read the main status word, operating frequency and arithmetic unit 1 output(three words with their addresses beginning with 3210H) from the #1 slave.

Query from master:

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

response nom 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

Response from slave:

Function 16: write multiple parameters. Word number written ranges from 1 to 10. Refer to the following example for its message format.

Example: to make the #1 slave runs forward at 50.00Hz, you can rewrite the two words with their addresses beginning with 3200H into 003FH and 1388H.

Query from master:	
Slave address	01H
Modbus function code	10H
Start address(MSB)	32H
Start address(LSB)	00H
Word number written(MSB)	00H
Word number written(LSB)	02H
Byte number written	04H
MSB of 1st data	00H
LSB of 1st data	3FH
MSB of 2nd data	13H
LSB of 2nd data	88H
CRC(LSB)	83H
CRC(MSB)	94H

Response from slave:

Slave address	01H
Modbus function code	10H
Start address(MSB)	32H
Start address(LSB)	00H
Word number	0011
written(MSB)	001
Word number	02H
written(LSB)	0211
CRC(LSB)	4FH
CRC(MSB)	70H

Example: to make the #1 slave stop(forward run at 50.00Hz), you can rewrite the two words with their addresses beginning with 3200H into 003EH and 1388H.

Response from slave:

Slave address	01H
Modbus function code	10H
Start address(MSB)	32H
Start address(LSB)	00H
Word number written(MSB)	00H
Word number written(LSB)	02H
Byte number written	04H
MSB of 1st data	00H
LSB of 1st data	3EH
MSB of 2nd data	13H
LSB of 2nd data	88H

Ouerv from master:

Slave address	01H
Modbus function code	10H
Start address(MSB)	32H
Start address(LSB)	00H
Word number	0011
written(MSB)	0011
Word number	0211
written(LSB)	02П

CRC(LSB)	D2H	CRC(LSB)	4FH
CRC(MSB)	54H	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 complicated and time-consuming "read-change-write" method. It is only valid for 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 "1";

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

When all bits of AndMask are "1": the result remains unchanged

Example: set bit 7(digital input 24: process PID disabled) of the address 3205H(extended control word 2) of the #1 slave to 1 and then clear it. The query from the master and the response from the slave are as follows(the slave echoes the original function code)

Set	bit	7	to	1

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

Clear bit 1	
Slave address	01H
Modbus function code	16H
MSB of oprand address	32H
LSB of oprand address	05H
AndMask MSB	FFH
AndMask LSB	7FH
OrMask MSB	00H
OrMask LSB	00H
CRC(LSB)	3FH
CRC(MSB)	D8H

Function 8: read-back test. The test code is 0000H. The original frame is required to return.

Exception response: if the slave fails to implement the request from the master, it will return an exception response message.

Example of read-back test:

Example	of exception	response:
---------	--------------	-----------

		Slave address	1 byte
		Response code	1 byte(Modbus function code + 80H)
01H		Exception code	1 byte, with following measings:
08H			1: Modbus function codes that can't
00H			be handled
00H			2: illegal data address
37H			3: data value beyond the range
DAH			4: operation failed(such as attempting
			to write a read-only parameter, modify an unchangeable parameter
			during running, etc.)
77H		CRC(LSB)	-
	01H 08H 00H 37H DAH 77H	01H 08H 00H 37H DAH 77H	Slave address Response code 01H 08H 00H 00H 37H DAH 77H CRC(LSB)

CRC(MSB)

3)

A0H

CRC(MSB)

_

Compatibility of USS commands

SB70 inverter also supports USS commands. By using the host computer(including PC, PLC, etc.) software that supports the USS protocol, one can control the operation of the inverter, set its reference frequency and read its operation status parameters such as operating frequency, output current, output voltage and DC link voltage. Please contact us if you have such requirement.

6.17 FP: Fault history

FP-00	Last fault type	Min. unit	1	Change		
Description	See the fault table below.					
FP-01	Cumulated run time at last fault	Min. unit	1h	Change		
FP-02	Operating frequency at last fault	Min. unit	0.01Hz	Change		
FP-03	Reference frequency at last fault	Min. unit	0.01Hz	Change		
FP-04	Output current at last fault	Min. unit	0.1A	Change		
FP-05	Output voltage at last fault	Min. unit	0.1V	Change		
FP-06	Output capacity at last fault	Min. unit	0.1kW	Change		
FP-07	DC link voltage at last fault	Min. unit	0.1V	Change		
FP-08	Bridge temperature at last fault	Min. unit	0.1°C	Change		
FP-09	Terminal input status 1 at last fault	Min. unit	1	Change		
Description	Ten thousands digit: X5 Thousands digit: X4	Hundreds of	digit: X3			
Description	Tens digit: X2 Units digit: X1 (0: Invalid 1: Valid)					
FP-10	Terminal input status 2 at last fault	Min. unit	1	Change		
Description	Hundreds digit: REV Tens digit:FWD Unit	ts digit:X6 (0: Invalid	1: Valid)		
FP-11	2nd last fault type	Min. unit	1	Change		
FP-12	Cumulated run time at 2nd last fault	Min. unit	1h	Change		
FP-13	3rd last fault type	Min. unit	1	Change		
FP-14	Cumulated run time at 3rd last fault	Min. unit	1h	Change		
FP-15	4th last fault type	Min. unit	1	Change		
FP-16	Cumulated run time at 4th last fault	Min. unit	1h	Change		
FP-17	5th last fault type	Min. unit	1	Change		
FP-18	Cumulated run time at 5th last fault	Min. unit	1h	Change		
FP-19	Single-time run time at fault	Min. unit	0.1h	Change		
FP-20	Fault history clear	Min. unit	1	Change	0	
Setting range	11: Clear FP-00~FP-20.					

The following is the inverter fault table.

0: No fault		
1.ocb: Momentary overcurrent at start	11.PLo: Output phase loss	
2.ocA: Overcurrent in accel	12. FoP: Power device protection	22 CEE: Communication error
3.ocd: Overcurrent in decel	13.0HI: Inverter overlead	23.ccF: Current check error
4.och: Overcurrent in constant-speed run	15.0LL: Motor overload	24.ArF: Poor auto-tuning
5.ouA: Overvoltage in accel	16.EEF: External fault	25.Aco: Analog input disconnection
6.oud: Overvoltage in decel	17.0LP: Motor load overweight	26.PGo:PG disconnection
7.oun: Overvoltage in constant-speed run	18.ULd: Inverter underload	28.Abb: Abnormal stop
8.ouE: Overvoltage in standby	signal	29.Io1: Reserved
state	20.Co2: Comparator 2 output protection	30.Io2: Reserved
9.dcL: Undervoltage in run	signal	31.PnL: Keypad disconnection
10.PLI: Input phase loss	21.EEP: Parameter saving failed	

6.18 FU: Data monitoring

FU-00	Operating frequency	Min. unit	0.01Hz	Change 🛛	
Description	Frequency of the motor speed				
FU-01	Reference frequency Min. unit 0.01Hz Change				
Description	The unit indicator blinks				
FU-02	Output current	Min. unit	0.1A	Change 🛛	
FU-03	Load current percentage	Min. unit	0.1%	Change 🗆	
Description	Inverter rated current=100%				
FU-04	Output voltage	Min. unit	0.1V	Change 🛛	
FU-05	Operating speed	Min. unit	1r/min	Change 🛛	
Description	$FU-05 = 120 \times operating frequency \div pole number$	r×FC-13			
FU-06	Reference speed	Min. unit	1r/min	Change 🛛	
Description	1 FU-06 = 120×reference frequency÷pole number×FC-13. The unit indicator blinks.				
FU-07	DC link voltage	Min. unit	0.1V	Change 🛛	
FU-08	Output capacity	Min. unit	0.1kW	Change 🛛	
FU-09	Output torque	Min. unit	0.1%	Change 🗆	
FU-10	Reference torque	Min. unit	0.1%	Change 🗆	
Description	The unit indicator blinks				
FU-11	Operating line speed	Min. unit	1 m/s	Change 🛛	
description	FU-11=operating frequency×FC-14				
FU-12	Reference line speed	Min. unit	1 m/s	Change 🛛	
Description	FU-12=reference frequency×FC-14. The unit in	dicator blinks.			
FU-13	PID feedback	Min. unit	0.1%	Change 🗆	
Description	FU-13=PID feedback channel×F7-03				
FU-14	PID reference	Min. unit	0.1%	Change 🗆	
Description	FU-14=PID reference channel×F7-03. The unit	indicator blinks.			
FU-15	Counter count	Min. unit	1	Change 🗆	

FU-16	Meter-counter actual length	Min. unit	1m	Change	
FU-17	AI1	Min. unit	0.1%	Change	
FU-18	AI2	Min. unit	0.1%	Change	
FU-19	PFI	Min. unit	0.1%	Change	
FU-20	UP/DOWN value	Min. unit	0.1%	Change	
Description	The unit indicator blinks				
FU-21	PLC current mode and stage	Min. unit	1	Change	
Description	Example: 2.03 indicates the 3ird stage of mode 2	2.			
FU-22	PLC cycled number	Min. unit	1	Change	
FU-23	Remaining time of PLC current stage	Min. unit	0.1s/min	Change	
FU-24	Arithmetic unit 1 output	Min. unit	0.1%	Change	
FU-25	Arithmetic unit 2 output	Min. unit	0.1%	Change	
FU-26	Arithmetic unit 3 output	Min. unit	0.1%	Change	
FU-27	Arithmetic unit 4 output	Min. unit	0.1%	Change	
FU-28	Arithmetic unit 5 output	Min. unit	0.1%	Change	
FU-29	Arithmetic unit 6 output	Min. unit	0.1%	Change	
FU-30	Low-pass filter 1 output	Min. unit	0.1%	Change	
FU-31	Low-pass filter 2 output	Min. unit	0.1%	Change	
FU-32	Analog multi-switch output	Min. unit	0.1%	Chage	
FU-33	PID output	Min. unit	0.1%	Change	
FU-34	Counter error	Min. unit	0.01%	Change	
Description	FU-34= (FU-15—F9-13)÷F9-14×100%				
FU-35	PG detection frequency	Min. unit	0.1Hz	Change	
Description	It is a numerical value with signs and can repres	ent forward or revo	erse run		
FU-36	Heat sink temperature	Min. unit	0.1°C	Change	
FU-37	Output power factor	Min. unit	0.01	Change	
FU-38	Watt-hour meter kWh	Min. unit	0.1kWh	Change	
Description	$0.0 \sim 6553.5$ kWh. Pressing (\triangle) and \bigcirc co watt-hour meter timer.	oncurrently clears	this parameter	itself and	d the
FU-39	Watt-hour meter timer	Min. unit	0.01h	Change	
Setting range	$0.00 \sim 655.35$ h. Pressing (\checkmark) and (\bigcirc) conwatt-hour meter kWh.	ncurrently clears	this parameter	itself and	d the
FU-40	Digital input terminal status 1	Min. unit	1	Change	
Description	Ten thousands digit: X5 Thousands digit: X Hundreds digit: X3 Tens digit: X2 (0: Open 1: Closed)	Units digit:X1			

FU-41	Digital input terminal status 2	Min. unit	1	Change	
Description	Hundreds digit: REV Tens digit: FWD	Units digit:X6 (0	: Open 1: C	losed)	
FU-42	Digital output terminal status	Min. unit	1	Change	
Description	Thousands digit: T2 Hundreds digit: T1 (0: Open 1: Closed)	Tens digit: Y2	Units digit: Y	1	
FU-43	Expansion digital input terminal status	Min. unit	1	Change	
Description	Ten thousands digit: X11 Thousands digit: X Hundreds digit: X9 Tens digit: X8 Un	10 its digit:X7 (0: 0	Open 1: Clos	ed)	
FU-44	Expansion digital output terminal status	Min. unit	1	Change	
Description	Ten thousands digit: Y7 Thousands digit: Y6 Hundreds digit: Y5 Tens digit: Y4 Un (0: Open 1: Closed)	its digit: Y3			
FU-45	Communication error times	Min. unit	1	Change	
FU-45 Description	Communication error times 0 ~ 60000	Min. unit	1	Change	
FU-45 Description FU-46	Communication error times 0 ~ 60000 Reference frequency after accel/decel	Min. unit Min. unit	1 0.01Hz	Change Change	
FU-45 Description FU-46 Description	Communication error times 0 ~ 60000 Reference frequency after accel/decel Frequency created after acceleration/deceleratio	Min. unit Min. unit n	1 0.01Hz	Change	
FU-45 Description FU-46 Description FU-47	Communication error times 0 ~ 60000 Reference frequency after accel/decel Frequency created after acceleration/deceleration Output frequency	Min. unit Min. unit n Min. unit	1 0.01Hz 0.01Hz	Change Change	
FU-45 Description FU-46 Description FU-47 Description	Communication error times 0 ~ 60000 Reference frequency after accel/decel Frequency created after acceleration/deceleratio Output frequency Frequency output by the inverter (used by factor)	Min. unit Min. unit n Min. unit ry)	1 0.01Hz 0.01Hz	Change Change Change	
FU-45 Description FU-46 Description FU-47 Description FU-52	Communication error times 0 ~ 60000 Reference frequency after accel/decel Frequency created after acceleration/deceleration Output frequency Frequency output by the inverter (used by factor Communication poll cycle	Min. unit Min. unit n Min. unit ry) Min. unit	1 0.01Hz 0.01Hz 0.001s	Change Change Change Change	
FU-45 Description FU-46 Description FU-47 Description FU-52 FU-55	Communication error times 0 ~ 60000 Reference frequency after accel/decel Frequency created after acceleration/deceleration Output frequency Frequency output by the inverter (used by factor Communication poll cycle Max. current holding	Min. unit Min. unit n Min. unit ry) Min. unit Min. unit	1 0.01Hz 0.001Hz 0.001s 0.1A	Change Change Change Change Change	
FU-45 Description FU-46 Description FU-47 Description FU-52 FU-55 Description	Communication error times 0 ~ 60000 Reference frequency after accel/decel Frequency created after acceleration/deceleration Output frequency Frequency output by the inverter (used by factor Communication poll cycle Max. current holding It is cleared by pressing () and () concurrent	Min. unit Min. unit n Min. unit ry) Min. unit Min. unit ntly.	1 0.01Hz 0.01Hz 0.001s 0.1A	Change Change Change Change Change	

7 Troubleshooting

7.1 Faults and remedies

Fault code	Fault type	Possible causes	Remedies
Er.ocb	Overcurrent at start	Inter-phase or grounding short-circuit inside the motor or between wirings	Check the motor and wiring
Er.ocb (1)		Inverting module failed	Call us
		Voltage overhigh at start	Check the setting of "torque boost"
		Accel time too short	Increase the accel time
		V/F curve improper	Regulate V/F curve or the setting of "torque boost"
Er.ocA	Overcurrent during acceleration	Running motor restarts	Set the start mode as "smooth start" Restart the motor after it stops completely
		Low prower grid voltage	Check the input power
		Inverter capacity too small	Use an inverter with larger capacity
		Auto-tuning not performed for vector control	Perform the parameter auto-tuning
		Decel time too short	Increase the decel time
Er.ocd	Overcurrent during	There is potential energy load or inertial torque of the load is large	Install an external dynamic braking unit
Er.ocd (3)	deceleration	Inverter capacity too small	Use an inverter with larger capacity
		Auto-tuning not performed for vector control	Perform the parameter auto-tuning
		Sudden change of load	Reduce the sudden change of the load
C	Overcurrent during	load error	Check the load
	constant-speed	Low power grid voltage	Check the input power
Er.ocn (4)	operation	Inverter capacity too small	Use an inverter with larger capacity
		Auto-tuning not performed for vector control	Perform the parameter auto-tuning
		Input voltage abnormal	Check the input power
Е г. 🖬 и Н Er.ouA (5)	Overvoltage during acceleration	Running motor restarts	Set the start mode as "smooth start" Restart the motor after it stops completely
		Decel time too short	Increase the decel time
		There is potential energy load or inertial torque of the load is large	Install an external dynamic braking unit
Eroud	Overvoltage during	Input voltage abnormal	Check the input power
Er.oud (6)	deceleration	Accel time too short	Increase the accel time
		Large load inertia	Employ a dynamic braking unit
		Improper ASR setting	Adjust ASR parameter reducing overshoot
Feene	Overvoltage during	Input voltage abnormal	Check the input power

Er.oun (7)	constant-speed	Accel/decel time too short	Increase the accel/decel time
. ,	operation	Input voltage changes irregularily	Install an input reactor
		Large load inertia	Employ a dynamic braking unit
ECOVE	Overvoltage in	Input voltage overhigh	Check the input power
Er.ouE (8)	standby state	Error of DC bus voltage test circuit	Call us
<i></i> .		Input voltage abnormal or power loss during runing	Check input power and wiring
tr.dcl	Undervoltage during	There is heavy-load impact	Check the load
Er.dcL (9)	running	Charging contactor failed	Check and replace it
		Input phase loss	Input the input power and wiring
_		R, S or T phase loss	Check the wiring
Er.PLI	Input phase loss	Three input phases imbalanced	Check input voltage
Er.PLI (10)	input phuse 1655	Serious oscillation of output	Adjust parameters to eliminate the oscillation
Er.PL @ Er.PLo (11)	Output phase loss	Loss of output (U, V or W)	Check the output wiring Check the motor and cables
		Output has interphase short-circuit or grounding short-circuit	Rewire
5-5-0		Wiring of or components on the control board loose	Check and rewire
Er.FoP (12)	Power device protection	Wiring of the motor or inverter too long	Add output reactor or filter
		Overcurrent of braking unit of 15kW inverter or below	Check the external braking resistance and wiring
		Serious interference or failure of inverter	Call us
		Ambient temperature overhigh	Lower the ambient temperature
Er.oHI	Inverter	Air path blocked or the fan failed	Clean air path or replance the fan
Er.oHI (13)	overheating	Load too heavy	Check the load or select an high-capacity inverter
		Load too heavy	Check the load or select an high-capacity inverter
		Inverter temperature too high	Check the fan, air path and ambient temperature
		Accel time too short	Increase the accel time
Er.oli (14)	Inverter overload	Carrier frequency too high	Lower the carrier frequency or select an inverter with a higher capacity
		V/F curve improper	Regulate V/F curve and torque boost level
		Running motor restarted	Set the restart mode as "smooth restart" or "restart after motor stops"

		Input voltage too low	Check the input voltage
	Motor overload	V/F curve improper	Correctly set the V/F curve and torque boost level
Eroll		The common motor runs with heavy load at low speed for a long time	Install a separate cooling fan or select a motor designed for inverter
Er.oLL (15)		Improper setting of nameplate parameters or overload protection	Set FA-03, Fb-00 and Fb-01 correctly
		Motor stalls or load changes suddenly and greatly	Check the load
E - E E F Er.EEF(16)	External fault	External fault terminal closed	Deal with the external fault
Er.olp(17)	Motor load overweight	Motor current exceeds the load overweight detection level, and the detection time is exceeded	Check the load Check the setting of load overweight protection
Er.ULd Er.ULd (18)	Inverter underload	Inverter output current is less than the underload protection level, and the detection time is exceeded	Check the load Check the setting of underload protection
Е <i>г.Е о I</i> Er.Col (19)	Comparator 1 output protection signal	Generated by comparator 1	Check the definition of comparator 1 output
Е <i>г.Е о 2</i> Er.Co2 (20)	Comparator 2 output protection signal	Generated by comparator 2	Check the definition of comparator 2 output
E r. E E P Er.EEP (21)	Parameter saving failed	Failure in writing parameters	Retry after reset. Call us if problem still existes.
e_ree		Improper settting of communication parameters	Check the settings of FF menu
E F.L F E Er.CFE (22)	error	Seriour communication interference	Check the wiring and grounding of the communication circuit
		PC does not work	Check PC and wiring
Er.ccF	Current test error	Loose wiring or components inside the inverter	Check and rewire
Er.ccF (23)	Current test entor	failed current sensor or circuit error	Call us
		Incorrect setting of motor nameplate parameters	Set the parameters according to the motor nameplate
Er.ArF	Poor auto-tunning	Motor not connected or motor phase lost	Check the motor wiring
Er.ArF (24)		Motor not in no-load state during rotary auto-tuning	Disconnect the motor from the mechanical load
		Oscillation of auto-tuning	Adjust F2-09
Er.Aco	Analog input disconnection	Wires broken or peripheral devices failed	Check external wires and peripheral devices
Er.Aco (25)		Disconnection threshold not set properly	Check the settings of F6-06 and F6-13
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		Error of connecting wires for encoder interface board	Check the wires
Er.PGo Er.PGo (26)	PG disconnected	Encoder interface board jumper not set properly	Check the jumper(refer to paragraph 9.6)
EI.1 G0 (20)		Fd-05 too short	Increase it moderately
		Encoder failed	Check and replace it
Е г. г. Н 🗖 Er.rHo (27)	Thermal resistor open	Thermal resistor disconnected	Check the connection of thermal resistor or call us
		Statll state lasts one minute	Set the operating parameters correctly
E ー.日とし Er.Abb (28)	Abnormal stop	Try to use () to stop the inverter while keypad is disabled	-
2111100 (20)		Overspeed due to reverse connection of PG	Check the connection of PG
E - 1 - 1 Er.Io1 (29)	Reserved	-	-
Er.Io2(30)	Reserved	-	-
Er.PnL (31)	Keypad disconnection	Keypad lost or disconnected	-

7.2 Alarms and remedies

Alarm code	Alarm name	Description	Remedies	Alarm word Bit
AL.OLL	Motor overload	Motor thermal model detects the motor temperature rise is overhigh	Refer to above table	Word 1 Bit 0
AL.oLP	Motor load overweigth	Motor current exceeds the load overweight detection level, and the detection time is exceeded	Refer to above table	Word 1 Bit 1
ALUL d	Inverter underload	Inverter output current is less than the underload protection level, and the detection time is exceeded	Refer to above table	Word 1 Bit 2
RLPnL AL.PnL	Keypad disconnection	Keypad lost or disconected(alarm signal is output via the terminal)	Refer to above table	Word 1 Bit 4
AL.Aco	Analog input drop	Analog input signal is lower than the drop threshold	Refer to above table	Word 1 Bit 5
ALPLI	Input phase loss	Lack of input phase or imbalance among three phases	Refer to above table	Word 1 Bit 6

AL.PLO	Output phase loss	Lack of output phase	Refer to above table	Word 1 Bit 7
AL.CFE	Communication error	Communication timeout	Refer to above table	Word 1 Bit 8
ALEEP	Parameter saving failed	Failure in writing parameters	Refer to above table Press () to clear	Word 1 Bit 9
	DC link undervoltage	DC link voltage is lowter than the threshold	It is normal for this alarm information to be displayed when the power is off	Word 1 Bit 11
AL.Col	Comparator 1 output protection	Generated by comparator 1	Check the definition of comparator 1 output	Word 1 Bit 12
	Comparator 2 output protection	Generated by comparator 2	Check the definition of comparator 2 output	Word 1 Bit 13
AL.PGo	PG disconnected	No PG signal	Refer to above table	Word 1 Bit 14
AL.PEE	Parameter check error	Improper parameter setting	Correct parameter setting or restore factory setting. Press () to clear	Word 2 Bit 1
AL.Pdd	Keypad data inconsistent	Parameters stored in keypad differs from those in the inverter	Press () to clear	Word 2 Bit 2
AL.UPF	Parameter upload failed	Keypad EEP error during parameter uploading	Check to see: 1. If the keypad is of SB-PU70E type:	Word 2 Bit 3
ALPDE	Keypad data error	Keypad data check error during paramter downloading and comparing	 If the connecting wire is too long; If the interference is toogreat. And retry. Press to clear 	Word 2 Bit 4

7.3 Operation faults and remedies

Fault	Description	Possible causes	Remedies
No key-press	One key or all keys have no	The key(s) is(are) automatically locked	Unlock it(them) by pressing () + () for three seconds
response	response to key pressing	Poor contact of the keypad connecting wire	Check the connecting wire or call us

		Key(s) damaged	Replace the keypad
	Parameters connot	F0-10 is set to 1 or 2	Set F0-10 to 0
Parameter correction failed	be modified	The parameters are read-only ones	Read-only parameters are unchangeable
	Parameters cannot be modified in runing state	Some parameters are unchangeable during running	Modify them in standby state
	Inverter stops	There is fault	Troubleshoot and reset it
	automatically	PLC cycle completed	Check the PLC paramter setting
	without receiving stop command	Run command channel switches over	Check the operation and run command channel status
	and the run LED is	Fb-18=3 and the power cut time is too long	Check the DC link undervoltage setting and input voltage
stop during		Waiting for the fault auto reset	Check auto reset setting
running	Inverter stops automatically	In PLC pause state	Check PLC parameter setting
. 0		Run interruption	Check run interruption setting
	without receiving	Reference frequency is zero	Check reference frequency
	stop command, and the run LED is on	PID positive, feedback > reference PID negative, feedback < reference	Check PID reference and feedback
		Digital input 18 is valid	Check terminal "coast stop"
	After receiving start command, inverter fails to	Digital input 17 is valid	Check terminal "inverter run disabled"
Inverter start failed		The stop key is not closed under 3-wire 1, 3-wire 2 or 2-wire 3 control mode	Chek the stop key and its connection
	start, and the run	Run command channel error	Change the run command channel
	10 10 011	Inverter error	Troubleshoot
		Input terminal logic error	Check the setting of F4-09 and F4-10

8 Maintenance and after-sale service

Danger

- 1. Only professionally trained persons can disassemble and repair the inverter and replace its parts.
- 2. Make sure the power supply of the inverter is cut off, the high-voltage indicator goes out and the voltage between P+ and N- is less than 36V before checking and repairing the inverter, otherwise there may be a risk of electric shock.
- **3.** Do not leave any metal pieces such as screws and washers in the inverter. That many destroy the inverter or cause fire.
- 4. Reset related parameters after replacing the control board, otherwise the inverter may be destroyed.

8.1 Daily maintenance

Due to factors of dust, humidity, vibration, aging, etc., faults would occur over time. It is necessary to check the inverter and its working environment regularly in order to extend the lifespan of the inverter.

Check points:

- 1. If the working environment of the inverter meets the requirement.
- 2. If the operating parameters of the inverter are set within the specified ranges.
- 3. If there is any unusual vibration or noise.
- 4. If there is any unusual odor.
- 5. If the fans run normally.
- 6. If the input voltage is within the specified range and voltages of various phases are balanced.

8.2 Periodical maintenance

The periodical maintenance should be performed once every three or six months according to the service conditions. Check points:

1. If the screws of control terminals are loose.

2. If the main circuit terminals have a poor contact and the copperplate connections have traces of overheating.

3. If the power and control cables are damaged.

- 4. If the insulated binding band for the cold-pressed terminals of the power cables comes off.
- 5. Remove dust on PCBs and wind path thoroughly. It's better to use a vacuum cleaner.
- 6. When leaving the inverter unused for a long term, check it for functioning once every two years by supplying it with electricity for at least five hours with the motor disconnected. Wihle supplying th epower, use a voltage regulator to raise the voltage gradually to the rated value.

Danger: Motor insulation test must be performed with the inverter disconnected, otherwise the inverter may be destroyed.

Danger: Do not perform the voltage resistance test or insulation test on the control circuit. That may destroy the circuit components on it.

8.3 Replacement of parts

Cooling fan

Causes of damage: wear of bearings; aging of blades(average life is 30 to 40 thousand hours).

Judging criterion: crack in blades, etc.; unusual vibration at the start.

Caution:

1. While replacing the fan, use the fan model designated by the factory(with identical rated voltage, current, speed and air volume).

2. While installing the fan, be careful that the direction marked on the fan must conform to direction in which the fan supplies wind.

3. Do not forget to install the fan guard.

Electrolytic capacitor

Causes of damage: high ambient temperature; frequent and sudden load change which leads to high pulsating current; aging of electrolyte.

Judging criterion: protrusion of safety valve; measurement of static capacitance; measurement of insulation resistance.

It is recommended to replace the bus electrolytic capacitor once every four or five years.

8.4 Storage of the inverter

- Avoid storing the inverter in a place with high-temperature, humidity, dust and metal powder.
- Leaving the inverter unused for a long period would lead to aging of the electrolytic capacitors. So the inverter must be supplied with electricity once every two years for at least five hours, and the input voltage raised gradually through a regulator to the rated value.

8.5 After-sale service

The warranty period is one year from the purchase date. However, the repair cost should be born by the user for the following damages even within this term.

- 1. Damage caused by operation not in accordance with the user's manual.
- 2. Damage caused by unauthorized repairs or modifications.
- 3. Damage caused by using the inverter beyond the standard specifications.
- 4. Damage caused by falling or an accident during transportation after the purchase.
- 5. Damage cause by fire, flood, abnormal voltage, lightning strike, etc.

9 **Options**

We offer the following options which you can purchase from us as you require.

9.1 Braking unit

It is all right to configure an appropriate braking resistor for an inverter with a built-in braking unit. But for an inverter without a built-in braking unit, the SZ series braking unit and braking resistor are needed. The resistance of the braking resistor should not be less than the recommended value, or the inverter may be damaged. The capacity of the braking resistor must be decided based on the power generation condition(power generation capacity, frequency of power generation, etc.) of the actual load.

Inverter model	Resistance(Ω)	Inverter model	Resistance(Ω)
SB70G0.4	≥500	SB70G5.5	≥90
SB70G0.75	≥300	SB70G7.5	≥65
SB70G1.5	≥150	SB70G11	≥65
SB70G2.2	≥130	SB70G15	≥32
SB70G4	≥100	-	-

Braking resistors for the built-in braking unit are recommended as follows:

The SZ series braking units are as follow:

Braking unit model	Resistance(Ω)	Braking unit model	Resistance(Ω)
SZ10G11/22	≥ 20	SZ10G160/200	≥2.2
SZ10G30/45	≥10	SZ10G220/375	≥1.2
SZ10G55/90	≥5.1	SZ10G400/440	≥ 0.8
SZ10G110/132	≥3.3	-	-

9.2 Communication component

Keypad extension line

There are two types of extension line: ≥ 18.5 kW and ≤ 15 kW. The length of the line can be determined by the user.

■ Background monitoring software SENLANWin

It is applicable to an RS485-based network composed of SenLan inverters. It can realize the real-time monitoring of the inveters and the centrallized management.

Profibus-DP module

9.3 AC reactor

The AC reactor on the input side can suppress the higher harmonics of the input current and improve theinput-side power factor. We suggest you use it in following cases:

- The power grid capacity is far greater that that of the inverter and the inverter's power is larger than 30kW.
- A load of thyristor or power factor compensator(with switch control) shares the same power supply with the inveter.
- The voltage imbalance of the 3-phase power is greater than 3%.
- The input-side power factor needs improving.

The reactor can:

- Reduce the inverter output harmonics.
- Prevent the motor insulation being damaged.
- Lower the output-side common-mode interference and the motor shaft current.

9.4 EMI filter and ferrite chip common-mode filter

The EMI filter is used to suppress the inverter-generated radio interference, external radio interference as well as the interference of transient shock and surge with the inverter, and the ferrite chip common-mode filter(magnetic ring) is employed to restrain the inverter-generated radio interference.

Filters should be used in applications where there is a high anti-radio disturbance requirement, CE/UL/CSA standards must be met, or devices with poor interference immunity are around the inverter. While installing them, try to minimize the wiring and locate them as close as possible to the inverter.

9.5 Digital I/O expansion board

The digital I/O expansion board is used to expand the digital input and output terminals.

Installation method: (1) confirm the power of the inverter is turned off; (2) insert the plastic poles shipped with the expansion board into the holes on the main control board; (3) align the connector on the expansion board with the connector on the main control board(J1) and align the two mounting holes on the expansion board with the plastic poles, and then press down.

Basic wiring diagram:



The digital I/O expansion board provides multi-channel inputs and outputs. The number of the channels can be decided by the user, for example, 5 channels of digital input(SL-5X), 5 channels of digital output(SL-5Y) and 3 channels of digital input plus 2 channels of digital output(SL-3X2Y).

Symbal	Terminal	Function	Specfication		
X7	X7 expansion digital input	Multiple functions, refer	Input voltage: < 25V		
X8	X8 expansion digital input	to Section 6.14. Monitored parameter:	Input impedance: $\geq 3.9 \text{k}\Omega$ Hige level: > 10V Sampling period: 2ms		
X9	X9 expansion digital input	FU-43	Low level: < 3V		
P12	12V power	12V power offered to the user	Max. output current for 12V power: 80mA		
COM		12V power ground			
Y3	Y3 expansion digital output	Multiple functions, refer	Optocoupler isolation		
Y4	Y4 expansion digital output	to Section 6.14. Monitored parameter: FU-44	Open collector output Output action frequency: < 250Hz Start-up voltage: < 1.0V 24V DC/50mA		

The functions and specificaions of the terminals are as follows(take SL-3X2Y as an example)

9.6 Encoder interface board(SL-PG0)

The encoder interface board is used to receive signals from the encoder, so that the inverter can implement PG V/F control or PG vector control. It is also used in the high-speed counting of numbers or meters. Moreover, it can be connected to the reference frequency via the analog input 16.

Installation method: (1) confirm the power of the inverter is disconnected; (2) insert the plastic poles shipped with the interface board into the holes on the main control board; (3) align the connector on the interface board with the connector on the main control board(J1) and align the two mounting holes on the expansion board with the plastic poles, and then press down.

The encoder interface board is nearly compatible with all encoders with different types of output: open collector type(NPN and PNP), voltage type, complementary push-pull type and differential output type. It offers isolated power supplies of 12V and 5V.

Caution: the input type of the encoder and the power supply must be selected by the jumper. The default jumper setting is 12V and NPN encoder.

Basic wiring diagram(for 12V, differential output type encoder):



The functions and specificaions of the terminals on the encoder inface board are as follows.

Symbol	Terminal	Function	Specification
A +	Encoder A+ input terminal	A+ signal input	Max input frequency: 300kHz
A -	Encoder A- input terminal	A- signal input	Only channel A is connected for single-channel encoder.
в+	Encoder B+ input terminal	B+ signal input	Non differential input type must be connected from A+ or B+,
В -	Encoder B- input terminal	B- signal input	while A- and B- are left floating.
СОМ	Power ground	Ground of P12 and P5 power supplies and signals Isolated from GND of main control board	-
P12	12V power terminal	12V power offered to user	Max. output current: 80mA

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Symbol	Terminal	Function	Specification	
P5	5V power terminal	5V power offered to user	Max. output current: 200mA	

Power jumpers of the encoder interface board:

Power supply	12V	5V
Jumper position	+12 +5	+12 +5

Jumpers for encoder output type:

Туре	NPN type	Voltage type	Complementary push-pull type	Differential output type	PNP type
Output structure	• Power Out put Ground	• Power Qut put • Gr ound	Power Cut put Ground	A'B A'B A'B	• Ground
Jumper position	PNP V/L NPN	PNP V/L NPN		PNP V/L NPN	

Attention	 The coaxial degree of the mechanial shaft and encoder should meet the requirement, or torque fluctuation and mechanical vibration would occur. It is recommended to use shielded twisted pair to connect the eencoder and the encoder interface board. The shielded layer of the twisted pair(near the inverter) must be connected to COM on the encoder interface board. The encoder signal lines must be separated from the power lines, otherwise the electromagnetic interference would affect the output signals of the encoder.
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9.7 keypad options

SB-PU70E has the function of parameter copying, which is quite useful to set the same parameters on multiple inverters.

SB-PU03 is a keypad with a potentiometer, which facilitates the adjustment of the setting.

9.8 keypad mounting box

It is used to install the keypad on the cabinet. Refer to section 3.2.2 for the mounting size.

9.9 Analog input expansion board

Call us if you need it